Chipsmall Limited consists of a professional team with an average of over 10 year of expertise in the distribution of electronic components. Based in Hongkong, we have already established firm and mutual-benefit business relationships with customers from,Europe,America and south Asia,supplying obsolete and hard-to-find components to meet their specific needs.

With the principle of “Quality Parts,Customers Priority,Honest Operation,and Considerate Service”,our business mainly focus on the distribution of electronic components. Line cards we deal with include Microchip,ALPS,ROHM,Xilinx,Pulse,ON,Everlight and Freescale. Main products comprise IC,Modules,Potentiometer,IC Socket,Relay,Connector.Our parts cover such applications as commercial,industrial, and automotives areas.

We are looking forward to setting up business relationship with you and hope to provide you with the best service and solution. Let us make a better world for our industry!


## Contact us

Tel: +86-755-8981 8866 Fax: +86-755-8427 6832
Email & Skype: info@chipsmall.com Web: www.chipsmall.com
Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China

# Switch-Mode Single Cell Li-Ion Charger with USB-OTG

## General Description

The RT9469 is a switch-mode single cell Li-Ion/Li-Polymer battery charger for portable applications. It integrates a synchronous PWM controller, power MOSFETs, input current sensing and regulation, and high accuracy voltage regulation and charge termination circuits. Besides, the charging current is regulated through the integrated sensing resistors. The RT9469 also features USB On-The-Go (OTG) support.

The RT9469 optimizes the charging task by using a control algorithm to vary the charge rate via different modes, including pre-charge mode, fast charge mode, and constant voltage mode. The key charge parameters are programmable via the $I^2C$ interface. The RT9469 resumes the charge cycle whenever the battery voltage falls below an internal recharge threshold, and automatically enters sleep mode when the input power supply is removed.

Other features include under-voltage protection, over-voltage protection, thermal regulation and reverse leakage protection.

The RT9469 is available in the small WL-CSP-25B 2.52x2.52 packages.

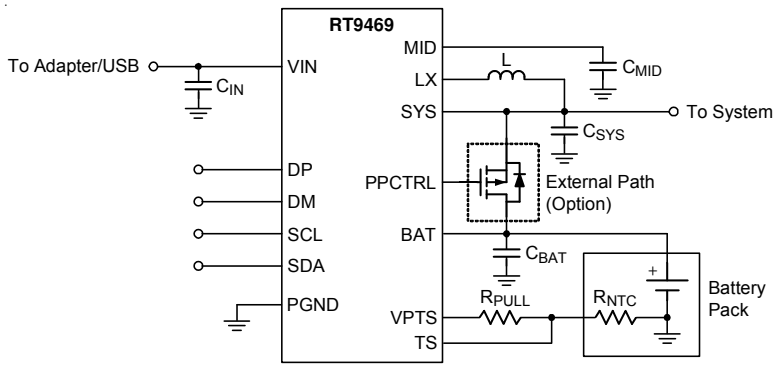
## Features

- **High Accuracy Voltage/Current Regulation**
- **Average Input Current Regulation (AICR) : 0.1/0.15/ 0.5/ to 3A per 0.1A**
- **Minimum Input Voltage Regulation**
  - **For 5V Adapter : 4V/4.25V/4.5V/4.75V**
  - **For 9V Adapter : 7V/7.5V/8V/8.5V**
- **Charge Current Regulation Accuracy : ±5%**
- **Charge Voltage Regulation Accuracy : ±1% (0 to 85°C)**
- **Integrated Power MOSFETS for up to 2.275A Charge Rate**
- **Support USB Charging Detection**
- **Battery Temperature Sensing**
- **Synchronous 0.75/1.5MHz Fixed Frequency PWM Controller with Up to 95% Duty Cycle**
- **Reverse Leakage Protection to Prevent Battery Drainage**
- **Thermal Regulation and Protection**
- **Over-Temperature Protection**
- **Input Over-Voltage Protection**
- **IRQ Output for Communication with $I^2C$**
- **Automatic Charging**
- **RoHS Compliant and Halogen Free**

## Applications

- Cellular Telephones
- Personal Information Appliances
- Tablet PC, Power Bank
- Portable Instruments

## Simplified Application Circuit



## Ordering Information

RT9469□

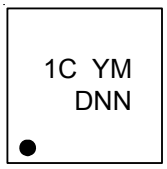
└Package Type
WSC : WL-CSP-25B 2.52x2.52 (BSC)

Note :

Richtek products are :

- RoHS compliant and compatible with the current requirements of IPC/JEDEC J-STD-020.
- Suitable for use in SnPb or Pb-free soldering processes.

## Marking Information

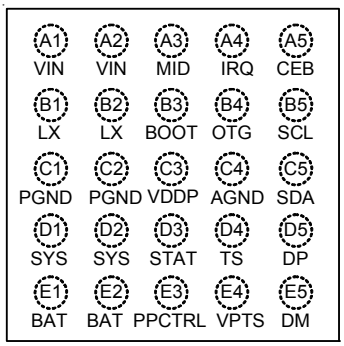



1C : Product Code

YMDNN : Date Code

## Pin Configuration

(TOP VIEW)

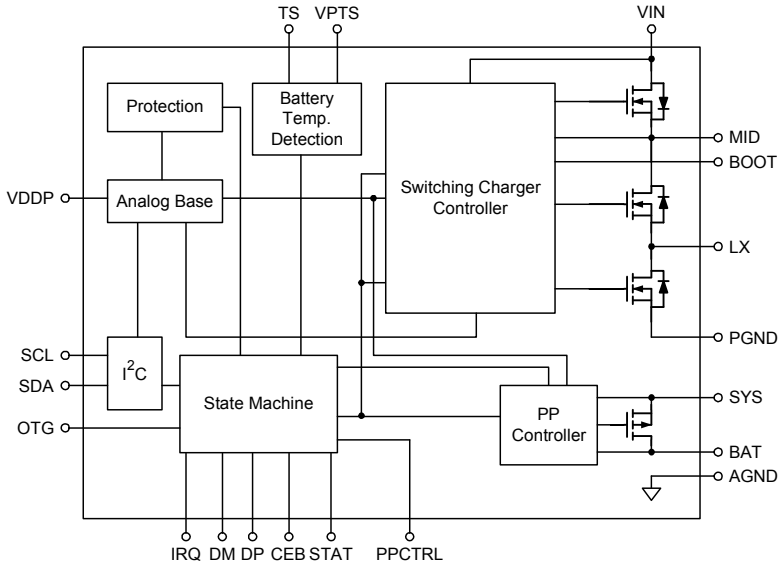



WL-CSP-25B 2.52x2.52 (BSC)

## Functional Pin Description

| Pin No. | Pin Name | Pin Description |
|---|---|---|
| A1, A2 | VIN | Power input. |
| A3 | MID | Connection point between reverse blocking MOSFET and high-side switching MOSFET. |
| A4 | IRQ | IRQ output node. |
| A5 | CEB | Enable control input. Low active. With internal 102kΩ pull low resistor. |
| B1, B2 | LX | Switch node. Connect to an external inductor. |
| B3 | BOOT | Bootstrap supply for high-side MOSFET. Connect a capacitor between BOOT and LX. |
| B4 | OTG | Setting input pin OTG boost mode. With internal 102kΩ pull low resistor. |
| B5 | SCL | Clock input for $I^2C$. Open-drain output. Connect a pull-up resistor. |
| C1, C2 | PGND | Power ground for switching charger. |
| C3 | VDDP | Internal power for power stage. |
| C4 | AGND | Analog ground. |
| C5 | SDA | Data input for $I^2C$. Open drain output. Connect a pull-up Resistor. |
| D1, D2 | SYS | System voltage regulator node. |
| D3 | STAT | Charge status indicator (Open drain). |
| D4 | TS | Battery temperature detection pin. |
| D5 | DP | USB charger type detection pin. |
| E1, E2 | BAT | Charging current output node. Battery charging voltage regulation feedback pin with power Path. |
| E3 | PPCTRL | Power path control pin (Connect to external P-MOSFET gate). |
| E4 | VPTS | Supply voltage for battery temperature detection. |
| E5 | DM | USB charger type detection pin. |

## Functional Block Diagram




## Operation

The RT9469 is an integrated single cell Li-ion battery switching charger with power path controller.

### Base Circuits

Base circuits provide the internal power, VDDP and reference voltage and bias current.

### Protection Circuits

The protection circuits include the VINOVP, VINUVLO, BATOVP and OTP circuits. The protection circuits turn off the charging when the input power or die temperature is in abnormal level.

### Buck Regulator for charging and Boost Regulator as OTG

The multi-loop controller controls the operation of charging process and current supply to the system. It also controls the circuits as a Boost converter for OTG applications.

### Battery Detection

The RT9469 is capable of doing the battery absence detection. The detection protects the charger when battery is removed accidentally.

### Adapter Detection

If the poor input power source is connected to the RT9469, the operation is shut down by the adapter detection.

### Power Path Management and Control

Once the battery voltage increase to a defined system minimum regulation voltage, the internal path between SYS and BAT will be fully turned on (Cool PPM operation). That is, a better charging efficiency can be derived. When end of charge occurs, the charing stops and the internal path will be off.

### USB Charger Detection

The RT9469 detects and distinguishes SONY, APPLE NIKON and USB Charger (Standard Charger Port, Charging Downstream Port and Dedicated Charger Port) via DP and DM pins.

### TS Detection

The RT9469 detects the temperature of the battery pack via TS and VPTS pins. The VPTS pin provides a constant voltage source used to drive the voltage divider composed of a pulled-high resister and a NTC resister. The RT9469 reports the sensing results via IRQ and status bits for COLD, COOL, WARM and HOT.

### $I^2C$ Controller

The key parameters of charging and OTG are programmable through $I^2C$ commands.

## Absolute Maximum Ratings (Note 1)

- Supply Input Voltage, VIN ---------- –0.3V to 28V
- MID, BOOT ---------- –0.3V to 28V
- LX ---------- –0.3V to 20V
- MID – VIN, BOOT – LX ---------- –0.3V to 6V
- Other Pins ---------- –0.3V to 6V
- Power Dissipation, $P_D$ @ $T_A$ = 25°C
  WL-CSP-25B 2.52x2.52 (BSC) ---------- 3.11W
- Package Thermal Resistance (Note 2)
  WL-CSP-25B 2.52x2.52 (BSC), $\theta_{JA}$ ---------- 32.1°C/W
- Lead Temperature (Soldering, 10 sec.) ---------- 260°C
- Junction Temperature ---------- 150°C
- Storage Temperature Range ---------- –65°C to 150°C
- ESD Susceptibility (Note 3)
  HBM (Human Body Model) ---------- 2kV

## Recommended Operating Conditions (Note 4)

- Supply Input Voltage, VIN ---------- 4.3V to 9V
- Junction Temperature Range ---------- –40°C to 125°C
- Ambient Temperature Range ---------- –40°C to 85°C

## Electrical Characteristics

($V_{IN}$ = 5V, $V_{BAT}$ = 4.2V, L = 2.2µH, $C_{IN}$ = 2.2µF, $C_{BATS}$ = 10µF, $T_A$ = 25°C, unless otherwise specified)

| Parameter | Symbol | Test Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **Protection** | | | | | | |
| $V_{IN}$ OVP Threshold Voltage | | | 10 | 11 | 12 | V |
| $V_{IN}$ OVP Hysteresis | | | -- | 200 | -- | mV |
| Battery OVP | | | 110 | 117 | 124 | % |
| Battery OVP Hysteresis | | | -- | 10 | -- | % |
| Over-Temperature Protection | OTP | | -- | 165 | -- | °C |
| OTP Hysteresis | | | -- | 10 | -- | °C |
| Thermal Regulation Threshold | | Charge current begins to reduce | -- | 120 | -- | °C |
| System UVP Threshold Voltage | $V_{SYS\_UVP}$ | | -- | 2.4 | -- | V |
| **Sleep Mode Comparator** | | | | | | |
| Sleep Mode Entry Threshold $V_{IN}$ – $V_{BATS}$ | $V_{SLP}$ | 2.5V < $V_{BATx}$ < $V_{BATREG}$, $V_{IN}$ falling | 0 | 0.04 | 0.1 | V |
| Sleep Mode Exit Hysteresis $V_{IN}$ – $V_{BATS}$ | $V_{SLPEXIT}$ | 2.5V < $V_{BATx}$ < $V_{BATREG}$ | 40 | 100 | 200 | mV |
| Sleep Mode Deglitch Time | $t_{SLP}$ | $V_{IN}$ rising above $V_{SLP}$ + $V_{SLPEXIT}$ | -- | 128 | -- | ms |

| Parameter | Symbol | Test Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **Under-Voltage Lockout Threshold** | | | | | | |
| IC Active Threshold Voltage | $V_{UVLO}$ | $V_{IN}$ rising | 3.05 | 3.3 | 3.55 | V |
| IC Active Hysteresis | $\Delta V_{UVLO}$ | $V_{IN}$ falling from UVLO | -- | 150 | -- | mV |
| **Input Currents** | | | | | | |
| VIN Supply Current | $I_Q$ | PWM switching, $I_{CHG}$ = $I_{BAT}$ = 0mA | -- | 10 | -- | mA |
| | | PWM is not switching. $I_{CHG}$ = $I_{BAT}$ = 0mA | -- | -- | 5 | mA |
| | | High impendence mode | -- | -- | 150 | μA |
| Leakage Current from Battery | $I_{BAT}$ | $V_{IN}$ = 0V, charger off. | -- | -- | 25 | μA |
| **Input Power Regulation** | | | | | | |
| Input Voltage Regulation | $V_{MIVR}$ | $I^2C$ Programmable refer to Reg0x21[3:0] | 4 | -- | 8.5 | V |
| VMIVR Accuracy | | VMIVR = 4.5V | –5 | -- | 5 | % |
| Average Input Current Regulation Accuracy | $I_{AICR}$ | USB charge mode, $I_{AICR}$ = 100mA | 80 | -- | 100 | mA |
| | | USB charge mode, $I_{AICR}$ = 500mA | 400 | -- | 500 | |
| | | USB charge mode, $I_{AICR}$ = 1A | 800 | -- | 1000 | |
| **Battery Voltage Regulation** | | | | | | |
| Battery Voltage Regulation | $V_{OREG}$ | $I^2C$ programmable per 20mV. | 3.5 | -- | 4.62 | V |
| VBATREG Accuracy | | 0 to 85°C | –1 | -- | 1 | % |
| Re-Charge Threshold | $V_{RECH}$ | $V_{BATx}$ falling, below $V_{BATREG}$ | -- | 125 | -- | mV |
| Re-Charge Deglitch | $t_{RECH}$ | | -- | 128 | -- | ms |
| **System Minimum Regulation Voltage** | | | | | | |
| System Minimum Regulation Voltage | $V_{SYS}$ | $I^2C$ programmable per 0.1V | 3.5 | -- | 3.8 | V |
| **Charging Current Regulation** | | | | | | |
| Output Charging Current | $I_{CHG}$ | $I^2C$ programmable per 0.125A | 0.4 | -- | 2.275 | A |
| ICHG Accuracy | | AICR is disabled | –5 | -- | 5 | % |
| Pre-Charge Threshold | $V_{PREC}$ | $I^2C$ programmable per 0.2V | 2 | -- | 3 | V |
| VPREC Accuracy | | | –5 | -- | 5 | % |
| Pre-Charge Current | $I_{PREC}$ | $I^2C$ programmable per 50mA | 100 | -- | 850 | mA |
| IPREC Accuracy | | | –30 | -- | 30 | % |

| Parameter | | Symbol | Test Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| **Charge Termination Detection** | | | | | | | |
| End of Charge Current | | $I_{EOC}$ | $I^2C$ programmable per 50mA | 100 | -- | 450 | mA |
| Fixed IEOC | | | As $I_{AICR}$ = 100mA | -- | 50 | -- | mA |
| IEOC Accuracy | | | | –100 | -- | 100 | mA |
| Deglitch Time for EOC | | $t_{EOC}$ | $I_{CHG} < I_{EOC}$, $V_{BAT} > V_{REC}$ | -- | 2 | -- | ms |
| **PWM** | | | | | | | |
| High-Side On-Resistance | | | From VIN to LX, exclude $I_{AICR}$ = 100mA | -- | 90 | 150 | mΩ |
| Low-Side On-Resistance | | | From LX to PGND | -- | 60 | 100 | mΩ |
| Charging Efficiency | | | $V_{BATx}$ = 4V, and $I_{CHG}$ = 2.025A | -- | 85 | -- | % |
| Oscillator Frequency | | OSC | $I^2C$ programmable 0.75/1.5 MHz | -- | 1.5 | -- | MHz |
| Frequency Accuracy | | | | –10 | -- | 10 | % |
| Maximum Duty Cycle | | | At minimum voltage input | -- | 95 | -- | % |
| Minimum Duty Cycle | | | | 0 | -- | -- | % |
| Peak OCP as Charger Mode | | $I_{CHGOCP}$ | | -- | 4.5 | -- | A |
| Power Path On-Resistance | | | From SYS to VBAT | -- | 35 | 60 | mΩ |
| **Boost Mode Operation** | | | | | | | |
| Output Voltage Level | | $V_{OTG}$ | To VIN | -- | 5.05 | -- | V |
| Output Voltage Accuracy | | | | –3 | -- | 3 | % |
| Efficiency | | | $V_{BATx}$ = 4V, and $I_{IN}$ = 0.8A, | -- | 85 | -- | % |
| Maximum Output Current | | | $I^2C$ programmable, 0.5A/1A | 1 | -- | -- | A |
| Peak Over-Current Protection | | | | -- | 4.5 | -- | A |
| VIN OVP as OTG Boost | | | | -- | 6 | -- | V |
| VIN OVP Hysteresis | | | | -- | 250 | -- | mV |
| Minimum Battery Voltage for Boost | | $V_{BATMIN}$ | As boost start-up | -- | 2.9 | -- | V |
| Minimum Battery Voltage Hysteresis | | | | -- | 400 | -- | mV |
| **$I^2C$ Characteristics** | | | | | | | |
| Output Low Voltage | | $V_{OL}$ | $I_{DS}$ = 10mA | -- | -- | 0.4 | V |
| SCL, SDA Input Threshold Voltage | Logic-High | $V_{IH}$ | | 1.3 | -- | -- | V |
| | Logic-Low | $V_{IL}$ | | -- | -- | 0.4 | |
| SCL Clock | | | | -- | -- | 400 | kHz |

| Parameter | | Symbol | Test Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| **DP DM Detection** | | | | | | | |
| D+ Voltage Source | | $V_{DP\_SCR}$ | | 0.5 | 0.6 | 0.7 | V |
| D+ Voltage Source Output Current | | | | 200 | -- | -- | μA |
| D- Current Sink | | $I_{DM\_SINK}$ | | 50 | 100 | 150 | μA |
| Input Capacitance | | $C_I$ | DM pin, switch open | -- | 4.5 | 5 | pF |
| | | | DP pin, switch open | -- | 4.5 | 5 | |
| Input leakage | | $I_I$ | DM pin, switch open | −1 | -- | 1 | μA |
| | | | DP pin, switch open | −1 | -- | 1 | |
| DP Low Comparator Threshold | | $V_{DP\_LOW}$ | | 0.8 | -- | -- | V |
| DM High Comparator Threshold | | $V_{DM\_HIGH}$ | | 0.8 | -- | -- | V |
| DM Low Comparator Threshold | | $V_{DM\_LOW}$ | | -- | -- | 475 | mV |
| **NTC Monitor** | | | | | | | |
| HOT Threshold | | $V_{VTS\_HOT}$ | VTS falling, the ratio of VPTS, VIN > $V_{IN(MIN)}$ | 29 | 30 | 31 | %VPTS |
| WARM Threshold | | $V_{VTS\_WARM}$ | VTS falling, the ratio of VPTS, VIN > $V_{IN(MIN)}$ | 37 | 38 | 39 | %VPTS |
| COOL Threshold | | $V_{VTS\_COOL}$ | VTS rising, the ratio of VPTS, VIN > $V_{IN(MIN)}$ | 55 | 56 | 57 | %VPTS |
| COLD Threshold | | $V_{VTS\_COLD}$ | VTS rising, the ratio of VPTS, VIN > $V_{IN(MIN)}$ | 59 | 60 | 61 | %VPTS |
| Low Temperature Hysteresis | | $\Delta V_{VTS}$ | | -- | 1 | -- | %VPTS |
| Disable Threshold | | $V_{VTS\_OFF}$ | TS function disable | 2 | 3 | 4 | %VPTS |
| **Control I/O Pin** | | | | | | | |
| Output Low Voltage for STAT | | $V_{OL}$ | $I_{DS}$ = 10mA | -- | -- | 0.4 | V |
| CE Input Threshold Voltage | Logic-High | $V_{IH}$ | | 1.3 | -- | -- | V |
| | Logic-Low | $V_{IL}$ | | -- | -- | 0.4 | |

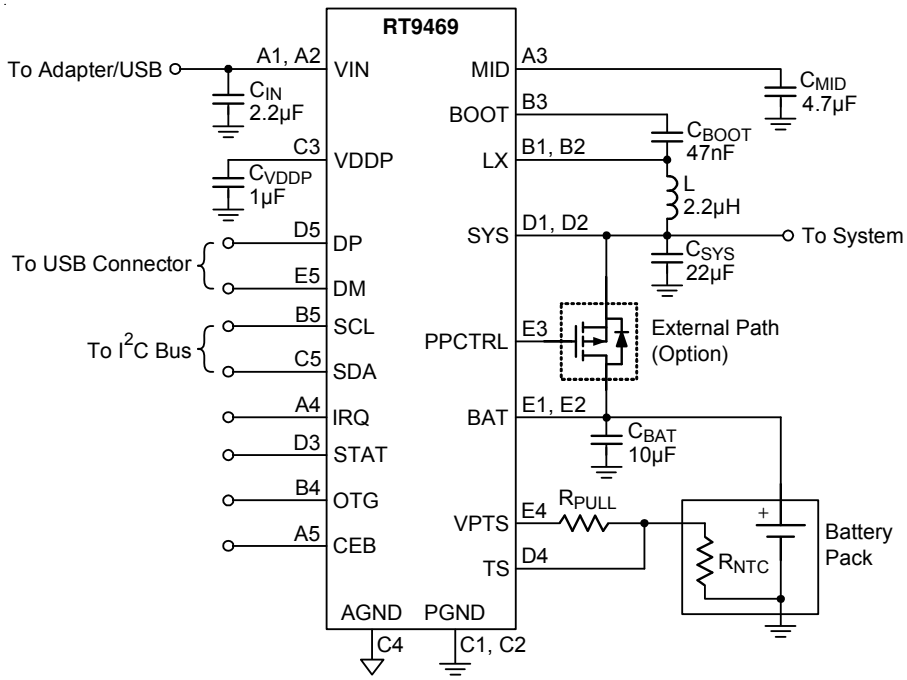
**Note 1.** Stresses beyond those listed "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions may affect device reliability.

**Note 2.** $\theta_{JA}$ is measured under natural convection (still air) at $T_A$ = 25°C with the component mounted on a high effective-thermal-conductivity four-layer test board on a JEDEC 51-7 thermal measurement standard.

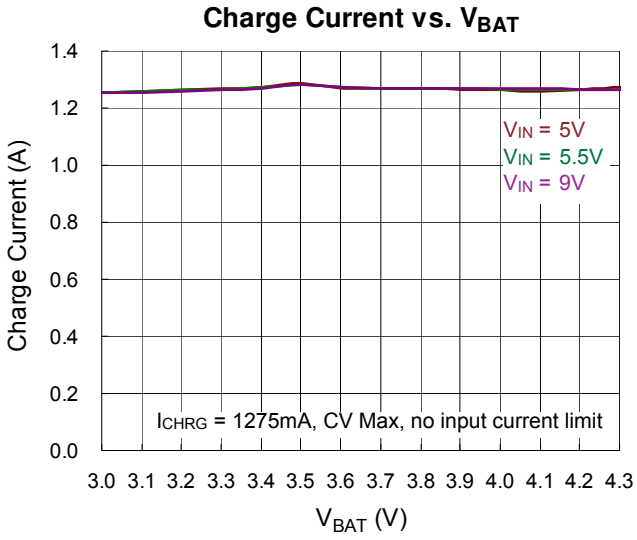
**Note 3.** Devices are ESD sensitive. Handling precaution is recommended.

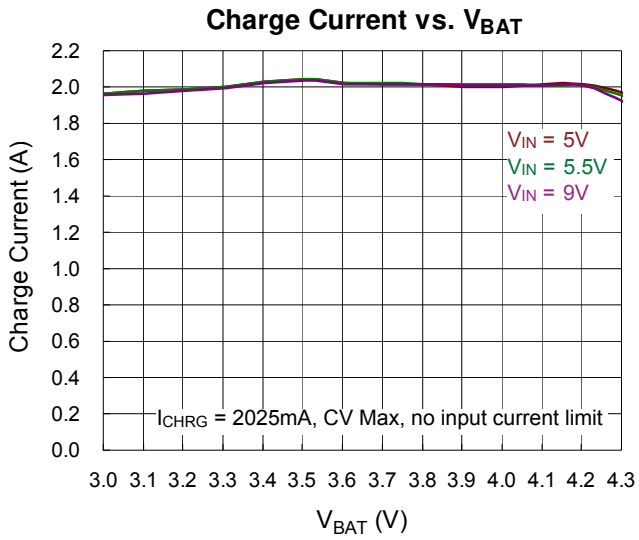
**Note 4.** The device is not guaranteed to function outside its operating conditions.

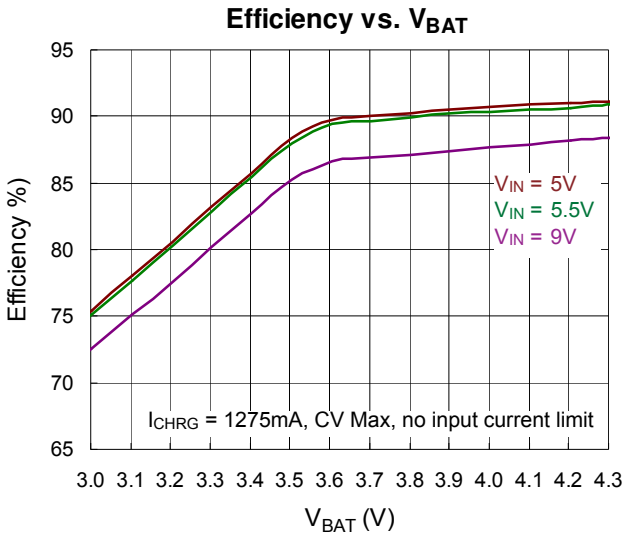
## Typical Application Circuit

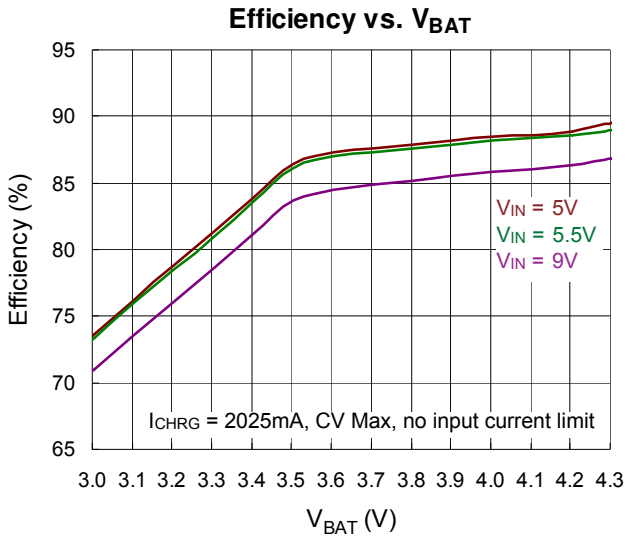


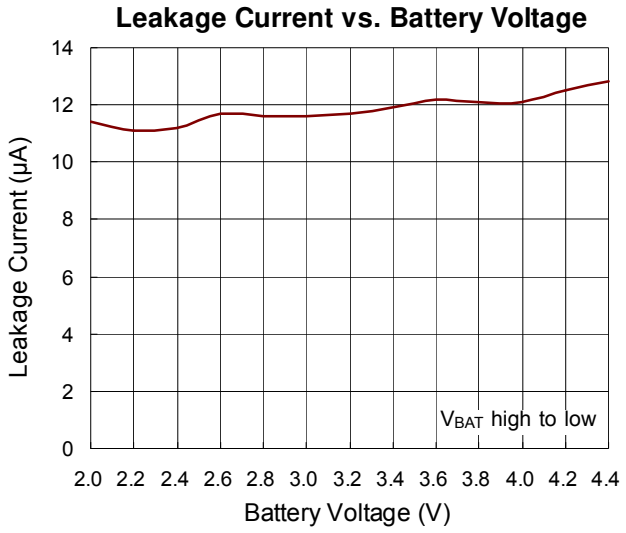
## Typical Operating Characteristics

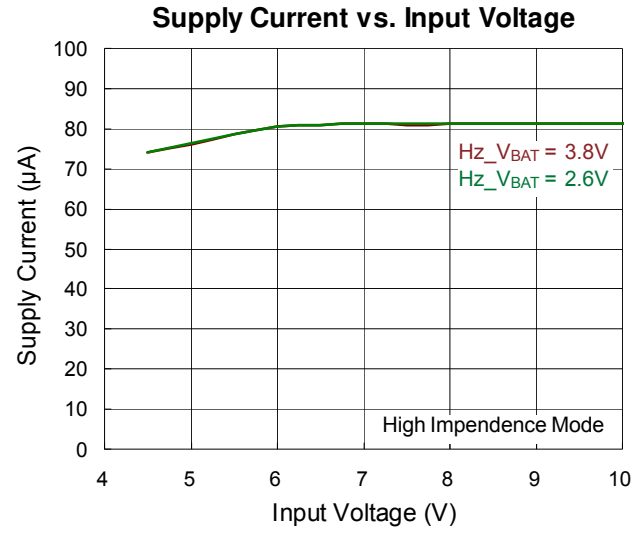


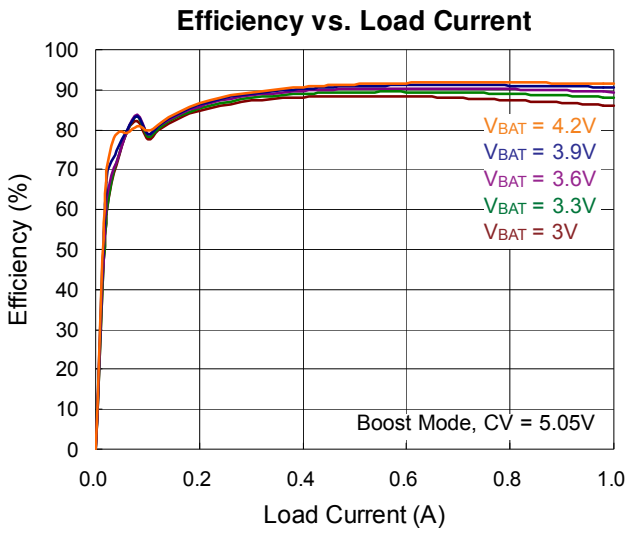



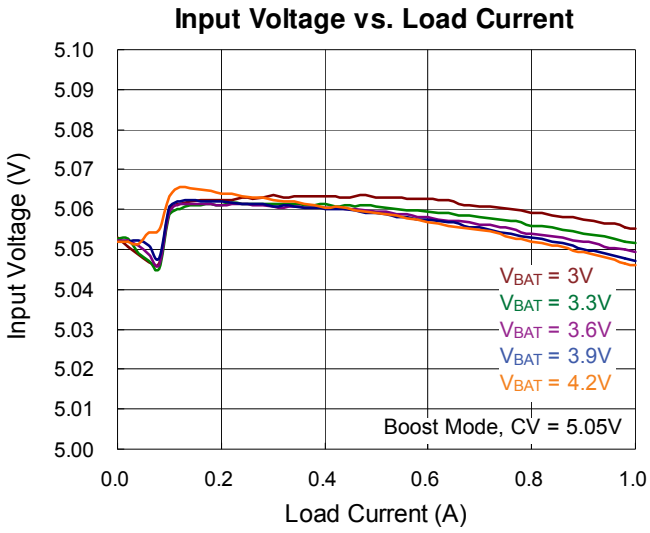





## Applications Information

The RT9469 switching charger integrates a synchronous PWM controller with power MOSFETs to provide input voltage MIVR (Minimum Input Voltage Regulation), input current AICR (Active Input Current Regulation), high accuracy current and voltage regulation, and charge termination. The charger also features USB OTG (On-The-Go).

The RT9469 has three operation modes : charge mode, boost mode (USB OTG), and high impedance mode. In charge mode, the RT9469 supports a precision charging system for single cell. In boost mode, the RT9469 works as the boost converter and boosts the voltage from battery to VIN pin for sourcing the OTG devices. In high impedance mode, the RT9469 stops charging or boosting and operates in a mode with low current from VIN or battery to reduce the power consumption when the portable device is in standby mode.

Notice that the RT9469 integrate input power source (AC adapter or USB input) detection. Thus, the RT9469 can automatically set the charge current by option. The charge current needs to be set via $I^2C$ interface by the host. The RT9469 application mechanism and $I^2C$ compatible interface are introduced in later sections.

### Charge Mode Operation

#### Minimum Input Voltage Regulation (MIVR)

The RT9469 features input voltage MIVR function to prevent input voltage drop due to insufficient current provided by the adapter or USB input. If MIVR function is enabled, the input voltage decreases when the over-current of the input power source occurs. VIN is regulated at a predetermined voltage level which can be set as 4V to 8.5V by $I^2C$ interface. At this time, the current drawn by the RT9469 equals to the maximum current value that the input power can provide at the predetermined voltage level, instead of the set value.

#### Charge Profile

The RT9469 provides a precision Li-ion or Li-polymer charging solution for single-cell applications. Input current limit, charge current, termination current, charge voltage and input voltage MIVR are all programmable via the $I^2C$ interface. In charge mode, the RT9469 has five control loops to regulate input current (AICR), charge current, charge voltage, input voltage (MIVR) and device junction temperature. During the charging process, all five loops (if MIVR is enabled) are enabled and the dominant one will take over the control.

For normal charging process, the Li-ion or Li-polymer battery is charged in three charging modes depending on the battery voltage. At the beginning of the charging process, the RT9469 is in pre-charge mode. When the battery voltage rises above pre-charge threshold voltage ($V_{PREC}$), the RT9469 enters fast-charge mode. Once the battery voltage is close to the regulation voltage ($V_{OREG}$), the RT9469 enters constant voltage mode.

#### Pre-Charge Mode

For life-cycle consideration, the battery can not be charged with large current under low battery condition. When the BATS pin voltage is below pre-charge threshold voltage ($V_{PREC}$), the charger is in pre-charge mode with a weak charge current witch equals to the pre-charge current ($I_{PREC}$). There are two control loops in Pre-charge mode. One is the ICC and the other is the MIN_SYS. If the battery voltage is lower than the SYS voltage, the MOSFET won't fully turn-on to prevent the battery voltage to influence the SYS voltage. It features that the charger can also provide the current to the load from SYS even the battery voltage is too low. In pre-charge mode, the charger basically works as an LDO. The pre-charge current also acts as the current limit when the BATS pin is shorted. The Pre-Charge current levels are 100mA - 850mA programmed by $I^2C$.

#### Fast-Charge Mode and Settings

As the BAT pin rises above VPREC, the charger enters fast-charge mode and starts charging. Notice that the MUIC integrates input power source (AC adapter or USB input) detection. Thus, the switching charger can set the charge current by option automatically. Unlike the linear charger (LDO), the switching charger (Buck converter) is a current amplifier. The current drawn by the switching

charger is different from the current into the battery.

The user can set the Average Input Current Regulation (AICR) and output charge current ($I_{CHRG}$) respectively.

### Cycle-by-Cycle Current Limit

The charger of the RT9469 has an embedded cycle-by-cycle current limit for inductor. Once the inductor current touches the threshold (4.5A typ.), the charger stops charging immediately to prevent over-current from damaging the device. Notice that, the mechanism can not be disabled by any way.

### Average Input Current Regulation (AICR)

The AICR setting is controlled by $I^2C$. The AICR100 mode limits the input current to 100mA. The AICR500 mode limits the input current to 500mA. If the application does not need input current limit, it can be disabled also. The AICR levels programmed by $I^2C$ and suitable for USB port and several TA types

### Charge Current ($I_{CHG}$)

The charge current into the battery is determined by the power path sensing RON and ICC setting by $I^2C$. The voltage between the SYS and BAT pins is regulated to the voltage control by ICC setting. ($I_{CC}$ x $R_{ON}$, $R_{ON}$ : power path $R_{ON}$)

At the RT9469, the $R_{ON}$ is 35mΩ and the Fast-Charge currents is set by the $I^2C$ interface from 0.4A to 2.275A per 125mA.

### Constant Voltage Mode and Settings

The RT9469 enters constant voltage mode when the BATS voltage is close to the output-charge voltage ($V_{OREG}$). In this mode, the charge current begins to decrease. For default settings (charge current termination is disabled), the RT9469 does not turn off and always regulates the battery voltage at VOREG. However, once the charge current termination is enabled, the charger terminates if the charge current is below termination current ($I_{EOC}$) in constant-voltage mode. The charge current termination function is controlled by the I2C interface.

After termination, a new charge cycle restarts when one of the following conditions is detected :

- The BATS pin voltage falls below the $V_{OREG}$ - $V_{RECH}$ threshold.
- VIN Power On Reset (POR).
- CHG_EN bit toggle or RST bit is set (via $I^2C$ interface).

### Output Charge Voltage ($V_{OREG}$)

The output-charge voltage is set by the $I^2C$ interface from 3.5V to 4.62V per 25mV. The default value is 4V (011001).

### Termination Current ($I_{EOC}$)

If the charger current termination is enabled (TE bit = " 1" of REG0x01[3]), the end-of-charge current is determined by both termination current sense voltage ($V_{EOC}$) and power path sense resistor ($R_{ON}$). General $R_{ON}$ is 35mΩ, IEOC is set by the $I^2C$ interface from 100mA to 450mA per 50mA.

### Input Voltage Protection in Charge Mode

During charge mode, there are two protection mechanisms against if input power source capability is less than the charging current setting. One is AICR and the other is minimum input voltage regulation. A suitable level of AICR can prevent VBUS drop by the insufficient capability. As the AICR setting is not suitable, MIVR will regulate the VBUS in the setting level and sink the maximum current of power source.

### Sleep Mode ($V_{IN}$ - $V_{BATS}$ < $V_{SLP}$)

The RT9469 enters sleep mode if the voltage drop between the VIN and BATS pins falls below $V_{SLP}$. In sleep mode, the reverse blocking switch and PWM are all turned off. This function prevents battery drain during poor or no input power source.

### Input Over-Voltage Protection

When VBUS rises above the input over-voltage threshold, the switching charger stops charging and sets the fault status bits. The condition is released when VBUS falls below OVP threshold. The switching charger then resumes charging operation.

### Boost Mode Operation (OTG)

### Trigger and Operation

The RT9469 features USB OTG support. When OTG function is enabled, the synchronous boost control loop takes over the power MOSFETs and reverses the power flow from the battery to the VIN pin. In normal boost mode, the VIN pin is regulated to the level controlled by VOREG[5:0] from 4.425V to 5.825 per 25mV. The boost provides up to 1A current to support other OTG devices connected to the USB connector.

### Output Over-Voltage Protection

In boost mode, the output over-voltage protection is triggered when the VIN voltage is above the output OVP threshold. When OVP occurs, the boost converter stops switching and turns off immediately.

### Output Overload Protection

The RT9469 provides an overload protection to prevent the device and battery from damage when VIN is overload. Once overload condition is detected, the reverse blocking switch operates in linear region to limit the output current while the MID voltage remains in voltage regulation. If the overload condition lasts for more than 32ms, the RT9469 will recognize the overload fault condition and resets registers to the default settings.

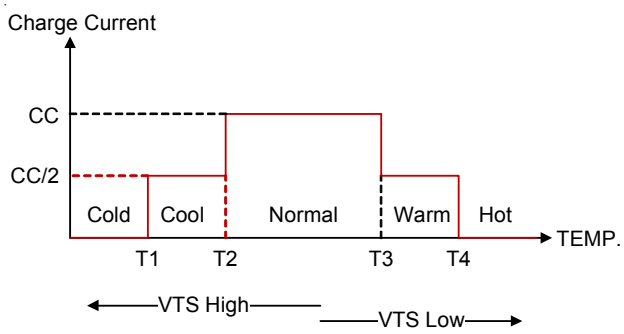
### Battery Detection During Normal Charging

The RT9469 provides a battery absent detection scheme to detect insertion or removal of the battery pack. The battery detection scheme is valid only when both TE = 1 and BATD_EN = 1.

During normal charging process, once the charge done condition is satisfied ($V_{BATS}$ > $V_{OREG}$ - $V_{RECH}$ and termination current is detected), the RT9469 turns off the PWM converter and initiates a discharge current (detection current) for a detection time period. After that, the RT9469 checks the BATS voltage. If it is still above the recharge threshold, the battery is present and charge done is detected. If the BATS voltage is below the recharge threshold, the battery is absent. Thus, the RT9469 stops charging and the charge parameters are reset to the default values. The charge resumes after a period of tDET (2sec. typ.).

### JEITA Protection

To enhance thermal protection of battery, JEITA function is implemented in the RT9469. JEITA guideline was released in 2007. It includes Warm and cool protection (cool section is between T1 and T2; warm section is between T3 and T4, see the figure as below). When battery's temperature is in warm or cool section, the RT9469 will reduce charging current (by a half of CC mode current). RT9469 stop charging if temperature is lower than T1 or is higher than T4.

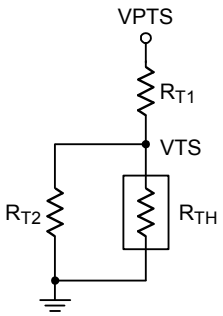



Thermal of battery can be monitored by TS PIN. There are 4 sections should be implemented in JEITA function. Base on $R_{hot}$ and $R_{cold}$, RT1 and RT2 can be determined by equation (1) and equation (2).

($R_{hot}$ mean that system trigger battery OTP, $R_{cold}$ mean that system trigger battery low temperature protection.)

$$R_{T1} = VPTS \times [ (1/ V_{T1} - 1/ V_{T4})/(1 / R_{Cold} - 1 / R_{Hot})] \quad (1)$$

$$R_{T2} = R_{T1} \times [ 1 / (VPTS / V_{T1} - R_{T1} / R_{Cold} - 1)] \quad (2)$$



### Thermal Considerations

The junction temperature should never exceed the absolute maximum junction temperature $T_{J(MAX)}$, listed under Absolute Maximum Ratings, to avoid permanent damage to the device. The maximum allowable power dissipation depends on the thermal resistance of the IC package, the PCB layout, the rate of surrounding airflow, and the difference between the junction and ambient temperatures. The maximum power dissipation can be calculated using the following formula :

$P_{D(MAX)} = (T_{J(MAX)} - T_A) / \theta_{JA}$

where $T_{J(MAX)}$ is the maximum junction temperature, $T_A$ is the ambient temperature, and $\theta_{JA}$ is the junction-to-ambient thermal resistance.

For continuous operation, the maximum operating junction temperature indicated under Recommended Operating Conditions is 125°C. The junction-to-ambient thermal resistance, $\theta_{JA}$, is highly package dependent. For a WL-CSP-25B 2.52x2.52 package, the thermal resistance, $\theta_{JA}$, is 32.1°C/W on a standard JEDEC 51-7 high effective-thermal-conductivity four-layer test board. The maximum power dissipation at $T_A$ = 25°C can be calculated as below :

$P_{D(MAX)}$ = (125°C – 25°C) / (32.1°C/W) = 3.11W for a WL-CSP-25B 2.52x2.52 package.

The maximum power dissipation depends on the operating ambient temperature for the fixed $T_{J(MAX)}$ and the thermal resistance, $\theta_{JA}$. The derating curves in Figure 1 allows the designer to see the effect of rising ambient temperature on the maximum power dissipation.

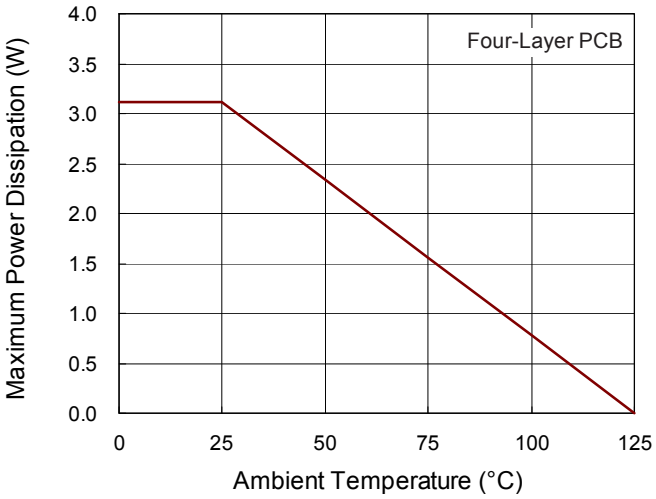



Figure 1. Derating Curve of Maximum Power Dissipation

### Layout Considerations

- For AGND noise reduction, PGND and AGND should connect directly at top layer.
- For AGND noise reduction, PGND and AGND should be connected by ground plane at inner layer1. And this ground plane should be connected to system ground plane by via.
- VBUS and VMID (capacitor GND) should be connected to IC PGND directly at top layer.
- The output inductor and bootstrap capacitor should be placed close to the RT9469 and LX pins.

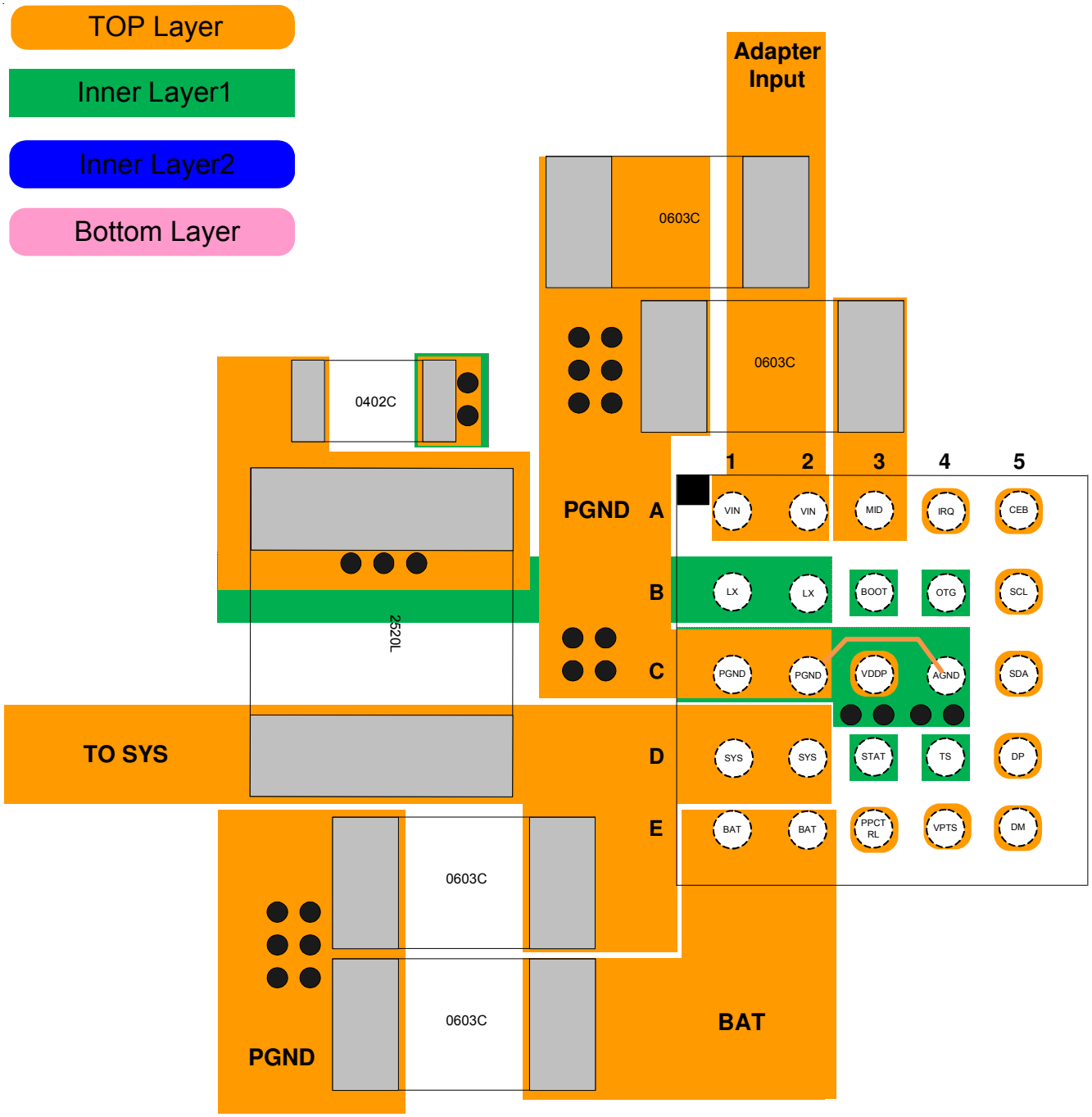



Figure 2. PCB Layout Guide

## Control Register (Control)

**I²C Slave Address : 0100101**

| Address | Name | Bit7 | Bit6 | Bit5 | Bit4 | Bit3 | Bit2 | Bit1 | Bit0 |
|---|---|---|---|---|---|---|---|---|---|
| 0x03 | Device ID | VENDOR_ID | | | | CHIP_REV | | | |
| | Reset Value | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Read/Write | R | R | R | R | R | R | R | R |
| 0x00 | Control1 | Sel_ SWFreq | EN_ STAT | STAT | | BOOST | PWR_ Rdy | OTG_ PinP | MIVR |
| | Reset Value | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Read/Write | R/W | R/W | R | R | R | R | R | R |
| 0x01 | Control2 | IEOC[2:0] | | | Higher_ OCP | TE | IIN_INT | HZ | OPA_ MODE |
| | Reset Value | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| 0x02 | Control3 | VOREG[5:0] | | | | | | OTG_PL | OTG_EN |
| | Reset Value | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 |
| | Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| 0x04 | Control4 | RST | Reserved | Reserved | Reserved | Reserved | Reserved | Reserved | Reserved |
| | Reset Value | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| 0x05 | Control5 | SYSUVP_ HW_SEL | OTG_OC | SYS_Min[1:0] | | IPREC[3:0] | | | |
| | Reset Value | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 1 |
| | Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| 0x06 | Control6 | ICHRG[3:0] | | | | EN_OSCSS | VPREC[2:0] | | |
| | Reset Value | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| | Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| 0x07 | Control7 | CC_JEITA | BATD_EN | Chip_EN | CHG_EN | TS_HOT | TS_ WARM | TS_COOL | TS_COLD |
| | Reset Value | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| | Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| 0x1C | Control8 | Reserved | Reserved | Reserved | Reserved | Reserved | PPSenseNode [2:0] | | |
| | Reset Value | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 |
| | Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| 0x08 | IRQ1 | TSDI | VINOVPI | WakeUpI | WatchDogI | Reserved | CHTERM_ TMRI | SYSUVP | BATAB |
| | Reset Value | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Read/Write | R | R | R | R | R | R | R | R |
| 0x09 | IRQ2 | CHRVPI | CHBADI | CHBATOVI | CHTERMI | CHRCHGI | CHTMRI | CHTREGI | SYSWAKEUPI |
| | Reset Value | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Read/Write | R | R | R | R | R | R | R | R |

| Address | Name | Bit7 | Bit6 | Bit5 | Bit4 | Bit3 | Bit2 | Bit1 | Bit0 |
|---|---|---|---|---|---|---|---|---|---|
| 0x0A | IRQ3 | BSTVINOVI | BSTOLI | BSTLOWVI | Reserved | Reserved | Reserved | Reserved | Reserved |
| | Reset Value | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Read/Write | R | R | R | R | R | R | R | R |
| 0x0B | Mask 1 | TSDIM | VINOVPIM | WakeUpIM | WatchDog IM | Reserved | CHTERM_ TMRIM | SYSUVP IM | BATABM |
| | Reset Value | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| 0x0C | Mask 2 | CHRVPIM | CHBADIM | CHBATOV IM | CHTERMIM | CHRCHGIM | CHTMRIM | CHTREGI M | SYSWAKE UPIM |
| | Reset Value | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| 0x0D | Mask 3 | BSTVINOV IM | BSTOLIM | BSTLOW VIM | Reserved | Reserved | Reserved | Reserved | Reserved |
| | Reset Value | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| 0x0E | Control-DP DM | CHG_TYP[2:0] | | | IINLMTSEL[1:0] | | CHG_ 2DET | CHG_ 1DET | CHGRUN |
| | Reset Value | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 |
| | Read/Write | R | R | R | R/W | R/W | R/W | R/W | R |
| 0x21 | Control 9 | Reserved | PPC_ CTRL_SEL | EN_ PPCTRL | MIVR_ ENB | MIVR_LVL[3:0] | | | |
| | Reset Value | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| 0x22 | Control 10 | CLR_DP | DP_STAT | WT_FC[2:0] | | | WT_PRC[1:0] | | TMR_ Pause |
| | Reset Value | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Read/Write | R/W | R | R/W | R/W | R/W | R/W | R/W | R/W |
| 0x23 | Control 11 | AICR[4:0] | | | | | Reserved | | |
| | Reset Value | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 |
| | Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| 0x24 | Control 12 | EOC_Timer[1:0] | | WakeUp_Timer[2:0] | | | WK_ Timer_EN | IRQ_ Pulse | IRQ_REZ |
| | Reset Value | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| 0x25 | Control 13 | WDT_EN | Reserved | Reserved | TWDTRST | Reserved | Reserved | TWDT[1:0] | |
| | Reset Value | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 |
| | Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |

| Address | Name | Bit7 | Bit6 | Bit5 | Bit4 | Bit3 | Bit2 | Bit1 | Bit0 |
|---|---|---|---|---|---|---|---|---|---|
| 0x26 | STAT IRQ | TSHOTI | TSWARMI | TSCOOLI | TSCOLDI | PWR_RdyI | MIVRI | Reserved | Reserved |
| | Reset Value | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| 0x27 | STAT IRQ Mask | TSHOTIM | TSWARMIM | TSCOOLIM | TSCOLDIM | PWR_RdyIM | MIVRIM | Reserved | Reserved |
| | Reset Value | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |

| Address | Name | Bit7 | Bit6 | Bit5 | Bit4 | Bit3 | Bit2 | Bit1 | Bit0 |
|---|---|---|---|---|---|---|---|---|---|
| 0x00 | Control 1 | Sel_ SWFreq | EN_ STAT | STAT | | BOOST | PWR_ Rdy | OTG_ Pinp | MIVR |
| | Reset Value | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Read/Write | R/W | R/W | R | R | R | R | R | R |
| Sel_SWFreq | | The switching frequency selection bit (Charger/OTG)<br>0 : The switching frequency is 1.5MHz<br>1 : The switching frequency is 750kHz | | | | | | | |
| EN_STAT | | 0 : Disable STAT pin function<br>1 : Enable STAT pin function | | | | | | | |
| STAT | | Charger status bit<br>00 : Ready<br>01 : Charge in progress<br>10 : Charge done<br>11 : Fault | | | | | | | |
| BOOST | | 0 : Not in boost mode<br>1 : Boost mode | | | | | | | |
| PWR_Rdy | | Power status bit<br>0 : Input power is bad, VIN > VOVP or VIN < VUVLO or VIN < BATS + VSLP<br>1 : Input power is good, UVLO < VIN < VOVP & VIN > BATS + VSLP | | | | | | | |
| OTG_PinP | | OTG pin polarity<br>0 : OTG input pin is low<br>1 : OTG input pin is high | | | | | | | |
| MIVR | | MIVR status pin :<br>0 : MIVR regulation is inactive<br>1 : MIVR regulation is active | | | | | | | |
| 0x01 | Control 2 | IEOC[2:0] | | | Higher_ OCP | TE | IIN_INT | HZ | OPA_ MODE |
| | Reset Value | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| IEOC | | EOC current level setting<br>000 : 100mA<br>001 : 150mA<br>010 : 200mA<br>011 : 250mA<br>100 : 300mA<br>101 : 350mA<br>110 : 400mA<br>111 : 450mA | | | | | | | |
| Higher_OCP | | Charger/OTG OCP level selection<br>0 : OCP = 4.5A<br>1 : OCP = 6A | | | | | | | |
| TE | | Charge current termination detection and IRQ control<br>0 : Disable charge current termination<br>1 : Enable charge current termination | | | | | | | |

| Address | Name | Bit7 | Bit6 | Bit5 | Bit4 | Bit3 | Bit2 | Bit1 | Bit0 |
|---|---|---|---|---|---|---|---|---|---|
| IIN_INT | | IAICR setting bit<br>0 : Decided by external OTG pin, 500mA current limit when OTG pin is low and 1A current limit when OTG pin is high<br>1 : Decided by $I^2C$ IAICR[4:0] and DPDM results, refer to REG0x0E | | | | | | | |
| HZ | | 0 : Not high impedance mode<br>1 : High impedance mode | | | | | | | |
| OPA_MODE | | 0 : Charger mode<br>1 : Boost mode | | | | | | | |
| 0x02 | Control 3 | VOREG[5:0] | | | | | | OTG_PL | OTG_EN |
| | Reset Value | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 |
| | Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| VOREG[5:0] | | Battery regulation voltage / Boost output voltage.<br>00 0000 : 3.50V / 4.425V<br>00 0001 : 3.52V / 4.45V<br>00 0010 : 3.54V / 4.475V<br>.....<br>01 1000 : 3.98V / 5.025 V<br>01 1001 : 4.00V / 5.05V<br>01 1010 : 4.02 / 5.075V<br>.....<br>10 0111 : 4.28V / 5.4V<br>10 1000 : 4.30V / 5.425V<br>10 1001 : 4.32V / 5.45V<br>.....<br>10 1110 : 4.42V / 5.575V<br>10 1111 : 4.44V / 5.6V<br>.....<br>11 0110 : 4.58V / 5.775V<br>11 0111 : 4.60V / 5.8V<br>11 1000 : 4.62V / 5.825V<br>.....<br>11 1111 : 4.62V / 5.825V | | | | | | | |
| OTG_PL | | 0 : Active at low level<br>1 : Active at High level | | | | | | | |
| OTG_EN | | 0 : Disable OTG Pin<br>1 : Enable OTG Pin | | | | | | | |

| Address | Name | Bit7 | Bit6 | Bit5 | Bit4 | Bit3 | Bit2 | Bit1 | Bit0 |
|---|---|---|---|---|---|---|---|---|---|
| 0x03 | Device ID | VENDOR_ID | | | | CHIP_REV | | | |
| | Reset Value | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Read/Write | R | R | R | R | R | R | R | R |
| VENDOR_ID | | Vendor Identification : Richtek : 0100b | | | | | | | |
| CHIP_REV | | Chip Revision | | | | | | | |
| 0x04 | Control 4 | RST | Reserved | Reserved | Reserved | Reserved | Reserved | Reserved | Reserved |
| | Reset Value | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| RST | | Write : 1-Charger in reset mode, 0-No effect, Read : always get "0" | | | | | | | |
| 0x05 | Control 5 | SYSUVP_HW_SEL | OTG_OC | SYS_Min[1:0] | | IPREC[3:0] | | | |
| | Reset Value | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 1 |
| | Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| SYSUVP_HW_SEL | | System UV protection selection bit<br>0 : Switching is not turned off when System UVP<br>1 : Switching is turned off when System UVP | | | | | | | |
| OTG_OC | | Over-current protection threshold<br>0 : 0.5A<br>1 : 1A | | | | | | | |
| SYS_Min[1:0] | | System minimum regulation voltage<br>00 : 3.5V<br>01 : 3.6V<br>10 : 3.7V<br>11 : 3.8V | | | | | | | |
| IPREC[3:0] | | 0000 : 100mA<br>0001 : 150mA<br>0010 : 200mA<br>0011 : 250mA<br>0100 : 300mA<br>0101 : 350mA<br>0110 : 400mA<br>0111 : 450mA<br>1000 : 500mA<br>1001 : 550mA<br>1010 : 600mA<br>1011 : 650mA<br>1100 : 700mA<br>1101 : 750mA<br>1110 : 800mA<br>1111 : 850mA | | | | | | | |

| Address | Name | Bit7 | Bit6 | Bit5 | Bit4 | Bit3 | Bit2 | Bit1 | Bit0 |
|---|---|---|---|---|---|---|---|---|---|
| 0x06 | Control 6 | ICHRG[3:0] | | | | EN_OSCSS | VPREC[2:0] | | |
| | Reset Value | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| | Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| ICHRG[3:0] | | Charging current setting (Recommed to set REG0x1C [2:0] = 111)<br>0000 : 0.4A<br>0001 : 0.525A<br>0010 : 0.65A<br>……<br>0110 : 1.15A<br>……<br>1010 : 1.65A<br>……<br>1110 : 2.15A<br>1111 : 2.275A | | | | | | | |
| EN_OSCSS | | Enable signal of oscillator spread spectrum<br>0 : Disable spread spectrum<br>1 : Enable spread spectrum | | | | | | | |
| VPREC[2:0] | | Pre-Charge voltage threshold<br>000 : 2V<br>001 : 2.2V<br>010 : 2.4V<br>011 : 2.6V<br>100 : 2.8V<br>101 : 3.0V<br>…..<br>111 : 3.0V | | | | | | | |
| 0x07 | Control 7 | CC_JEITA | BATD_EN | CHIP_EN | CHG_EN | TS_HOT | TS_WARM | TS_COOL | TS_COLD |
| | Reset Value | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| | Read/Write | R/W | R/W | R/W | R/W | R | R | R | R |
| CC_JEITA | | Charging current setting bit<br>0 : ICHRG<br>1 : ICHRG/2 | | | | | | | |
| BATD_EN | | Battery detection when charge done<br>0 : Disable battery detection<br>1 : Enable battery detection | | | | | | | |
| CHIP_EN | | Chip enable bit<br>0 : Chip is disabled<br>1 : Chip is enabled | | | | | | | |
| CHG_EN | | Charger enable bit :<br>0 : Charger is disabled<br>1 : Charger is enabled | | | | | | | |
| TS_HOIT | | Temperature status read bit<br>0 : Normal temperature<br>1 : Temperature is hot | | | | | | | |

| Address | Name | Bit7 | Bit6 | Bit5 | Bit4 | Bit3 | Bit2 | Bit1 | Bit0 |
|---|---|---|---|---|---|---|---|---|---|
| TS_WARM | | Temperature status read bit<br>0 : Normal temperature<br>1 : Temperature is warm | | | | | | | |
| TS_COOL | | Temperature status read bit<br>0 : Normal temperature<br>1 : Temperature is cool | | | | | | | |
| TS_COLD | | Temperature status read bit<br>0 : Normal temperature<br>1 : Temperature is cold | | | | | | | |
| 0x1C | Control 8 | Reserved | Reserved | Reserved | Reserved | Reserved | PPSenseNode [2:0] | | |
| | Reset Value | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 |
| | Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| PPSenseNode [2:0] | | Power path current sensing adjustment<br>100 : default setting<br>……<br>111 : recommended setting | | | | | | | |
| 0x08 | IRQ 1 | TSDI | VINOVPI | WakeUpI | WatchDogI | Reserved | CHTERM_TMRI | SYSUVPI | BATABI |
| | Reset Value | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Read/Write | R | R | R | R | R | R | R | R |
| TSDI | | Thermal shutdown fault. Set if the die temperature exceeds the thermal shutdown threshold | | | | | | | |
| VINOVPI | | VIN over-voltage protection<br>0 : Normal<br>1 : VINOVP is detected | | | | | | | |
| WakeUpI | | WakeUp timer fault<br>0 : Normal<br>1 : WakeUp timer is expired | | | | | | | |
| WatchDogI | | WatchDog timer fault<br>0 : Normal<br>1 : WatchDog timer is expired | | | | | | | |
| CHTERM_TMRI | | EOC timer fault<br>0 : Normal<br>1 : EOC timer is expired | | | | | | | |
| SYSUVPI | | System UVP fault<br>0 : Normal<br>1 : SYSUVP is triggered | | | | | | | |
| BATABI | | Battery absence fault bit<br>0 : Normal<br>1 : Battery absence | | | | | | | |

| Address | Name | Bit7 | Bit6 | Bit5 | Bit4 | Bit3 | Bit2 | Bit1 | Bit0 |
|---|---|---|---|---|---|---|---|---|---|
| 0x09 | IRQ 2 | CHRVPI | CHBADI | CHBATOVI | CHTERMI | CHRCHGI | CHTMRI | CHTREGI | SYSWAKEUPI |
| | Reset Value | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Read/Write | R | R | R | R | R | R | R | R |
| CHRVPI | | Charger fault. Reverse protection (VIN < BATS + VSLP) | | | | | | | |
| CHBADI | | Charger fault. Bad adapter (Poor Input source or VIN < VUVLO) | | | | | | | |
| CHBATOVI | | Charger fault. Battery OVP | | | | | | | |
| CHTERMI | | Charge terminated | | | | | | | |
| CHRCHGI | | Recharge request (VBATS < VOREG – VRECH) | | | | | | | |
| CHTMRI | | Charger fault. Timer time-out | | | | | | | |
| CHTREGI | | Charger warning. Thermal regulation loop active | | | | | | | |
| SYSWAKEUPI | | Battery voltage is high enough to wakeup system | | | | | | | |
| 0x0A | IRQ 3 | BSTVINOVI | BSTOLI | BSTLOWVI | Reserved | Reserved | Reserved | Reserved | Reserved |
| | Reset Value | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Read/Write | R | R | R | R | R | R | R | R |
| BSTVINOVI | | Boost fault. VIN OVP (VIN > VIN_BOVP) | | | | | | | |
| BSTOLI | | Boost fault. Over load | | | | | | | |
| BSTLOWVI | | Boost fault. Battery voltage is too low | | | | | | | |
| 0x0B | Mask 1 | TSDIM | VINOVPIM | WakeUpIM | WatchDogIM | Reserved | CHTERM_TMRIM | SYSUVPIM | BATABIM |
| | Reset Value | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| TSDIM | | TSDI fault interrupt mask<br>0 : Interrupt is not masked<br>1 : Interrupt is masked | | | | | | | |
| VINOVPIM | | VIN OVP fault interrupt mask<br>0 : Interrupt is not masked<br>1 : Interrupt is masked | | | | | | | |
| WakeUpIM | | WakeUp timer interrupt mask<br>0 : Interrupt is not masked<br>1 : Interrupt is masked | | | | | | | |
| WatchDogIM | | WatchDog timer interrupt mask<br>0 : Interrupt is not masked<br>1 : Interrupt is masked | | | | | | | |
| CHTERM_TMRIM | | EOC timer interrupt mask<br>0 : Interrupt is not masked<br>1 : Interrupt is masked | | | | | | | |

| Address | Name | Bit7 | Bit6 | Bit5 | Bit4 | Bit3 | Bit2 | Bit1 | Bit0 |
|---|---|---|---|---|---|---|---|---|---|
| SYSUVPIM | | System UVP fault interrupt mask<br>0 : Interrupt is not masked<br>1 : Interrupt is masked | | | | | | | |
| BATABIM | | Battery absence fault interrupt mask<br>0 : Interrupt is not masked<br>1 : Interrupt is masked | | | | | | | |
| 0x0C | Mask 2 | CHRVPIM | CHBADIM | CHBATOVIM | CHTERMIM | CHRCHGIM | CHTMRIM | CHTREGIM | SYSWAKEUPIM |
| | Reset Value | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Read/Write | R | R | R | R | R | R | R | R |
| CHRVPIM | | Charger reverse protection interrupt mask<br>0 : Interrupt is not masked<br>1 : Interrupt is masked | | | | | | | |
| CHBADIM | | Charger Bad adapter interrupt mask<br>0 : Interrupt is not masked<br>1 : Interrupt is masked | | | | | | | |
| CHBATOVIM | | Charger battery over-voltage interrupt mask<br>0 : Interrupt is not masked,<br>1 : Interrupt is masked | | | | | | | |
| CHTERMIM | | Charge terminated interrupt mask<br>0 : Interrupt is not masked<br>1 : Interrupt is masked | | | | | | | |
| CHRCHGIM | | Charger recharge request interrupt mask<br>0 : Interrupt is not masked<br>1 : Interrupt is masked | | | | | | | |
| CHTMRIM | | Charger timer timeout interrupt mask<br>0 : Interrupt is not masked<br>1 : Interrupt is masked | | | | | | | |
| CHTREGIM | | Charger thermal regulation loop active interrupt mask<br>0 : Interrupt is not masked<br>1 : Interrupt is masked | | | | | | | |
| SYSWAKEUPIM | | System wakeup interrupt mask<br>0 : Interrupt is not masked<br>1 : Interrupt is masked | | | | | | | |