# RT4805A 2.5MHz, Synchronous Boost Regulator with Bypass Mode

## Purpose

The RT4805A is a Boost converter with the input voltage range from 1.8V to 5V and provides 2A output current. This document explains the function and use of the RT4805A evaluation board (EVB), and provides information to enable operation, output voltage setting of the evaluation board.

## Table of Contents

## Introduction

### General Product Information

The RT4805A allows systems to take advantage of new battery chemistries that can supply significant energy when the battery voltage is lower than the required voltage for system power ICs. By combining built-in power transistors, synchronous rectification, and low supply current; this IC provides a compact solution for systems using advanced Li-Ion battery chemistries.

The RT4805A is a boost regulator designed to provide a minimum output voltage from a single-cell Li-Ion battery, even when the battery voltage is below system minimum. In boost mode, output voltage regulation is guaranteed to a maximum load current of 2A. Quiescent current in Shutdown Mode is less than 1µA, which maximizes battery life. The regulator transitions smoothly between Bypass and normal Boost Mode. The device can be forced into Bypass Mode to reduce quiescent current. The RT4805A is available in the WL-CSP-16B 1.67x1.67 (BSC) package.
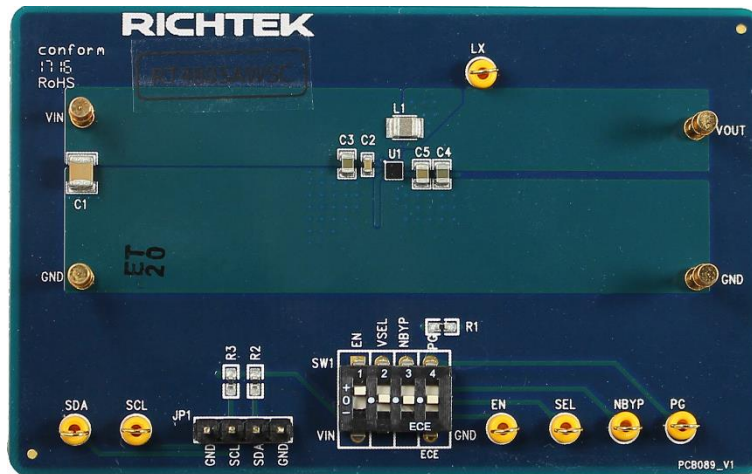
### Product Feature

- **4 Few External Components : 0.47µH Inductor and 0603 Case Size Input and Output Capacitors**
- **Input Voltage Range : 1.8V to 5V**
- **Output Range from 2.85V to 4.4V**
    - **VSEL = L 3.6V**
    - **VSEL = H 3.7V**
- **Maximum Continuous Load Current : 2A at $V_{IN}$ > 2.65V Boosting $V_{OUT}$ to 3.35V**
- **Up to 96% Efficient**
- **True Bypass Operation when $V_{IN}$ > Target $V_{OUT}$**
- **Internal Synchronous Rectifier**
- **True Load Disconnectwhen Shut Down**
- **Forced Bypass Mode**
- **$V_{SEL}$ Control to Optimize Target $V_{OUT}$**
- **Short-Circuit Protection**
- **I²C Controlled Interface**
- **Ultra low Operating Quiescent Current**
- **Small WL-CSP 16B Package**

### Key Performance Summary Table

| Key Features | Evaluation Board Number : PCB089_V1 |
| --- | --- |
| **Default Input Voltage** | 3.0V |
| **Max Output Current** | 2A |
| **Default Output Voltage** | Vout_H = 3.7V, Vout_L = 3.6V |
| **Default Marking & Package Type** | WL-CSP-16B 1.67x1.67 (BSC) |

## Bench Test Setup Conditions

### Headers Description and Placement



Carefully inspect all the components used in the EVB according to the following Bill of Materials table, and then make sure all the components are undamaged and correctly installed. If there is any missing or damaged component, which may occur during transportation, please contact our distributors or e-mail us at evb_service@richtek.com.

### Test Points

The EVB is provided with the test points and pin names listed in the table below.

| Test point/ Pin name | Signal | Comment (expected waveforms or voltage levels on test points) |
|---|---|---|
| **VIN** | Input voltage | Input voltage with range 1.8V to 5V. |
| **EN** | $V_{OUT}$ Enable | Enable control pin for VOUT. |
| **LX** | Switching Node | Switching Node. |
| **PGND/AGND** | Ground | Ground. |
| **SDA/SCL** | I2C Control | Pins to set functions such as VOUT, ILIM. |
| **VOUT** | Output Voltage | Default voltage : 5V ± 2%. |
| **PGOOD** | Power Good | Power Good. It is a open-drain output. PGOOD pin pulls low automatically if the overload or OTP event occurs. |
| **VSEL** | $V_{OUT}$ Select GPIO | Output Voltage Select. When boost is running, this pin can be used to select output voltage. |
| **nBYP** | Inverse Bypass Signal | Bypass. This pin can be used to activate Forced Bypass Mode. When this pin is LOW, the bypass switches are turned on and the IC is otherwise inactive. |

### Power-up & Measurement Procedure

1. Connect input voltage (1.8V < $V_{IN}$ < 5.0V).

2. To use a switch at "H" option to tie EN pin to input voltage VIN via SW1 or external voltage for enabling the device. Inversely, to use a jumper at "L" option to tie EN pin to ground GND for disabling the device.

3. To verify the output voltage $V_{OUT}$ via the I2C interface.

4. To connect an external load up to 1A and verify the output voltage and current.

## I2C Register Setting

The register as the table shown can be programmed by a MCU through the dedicated I2C interface. The device slave address is 0x39.

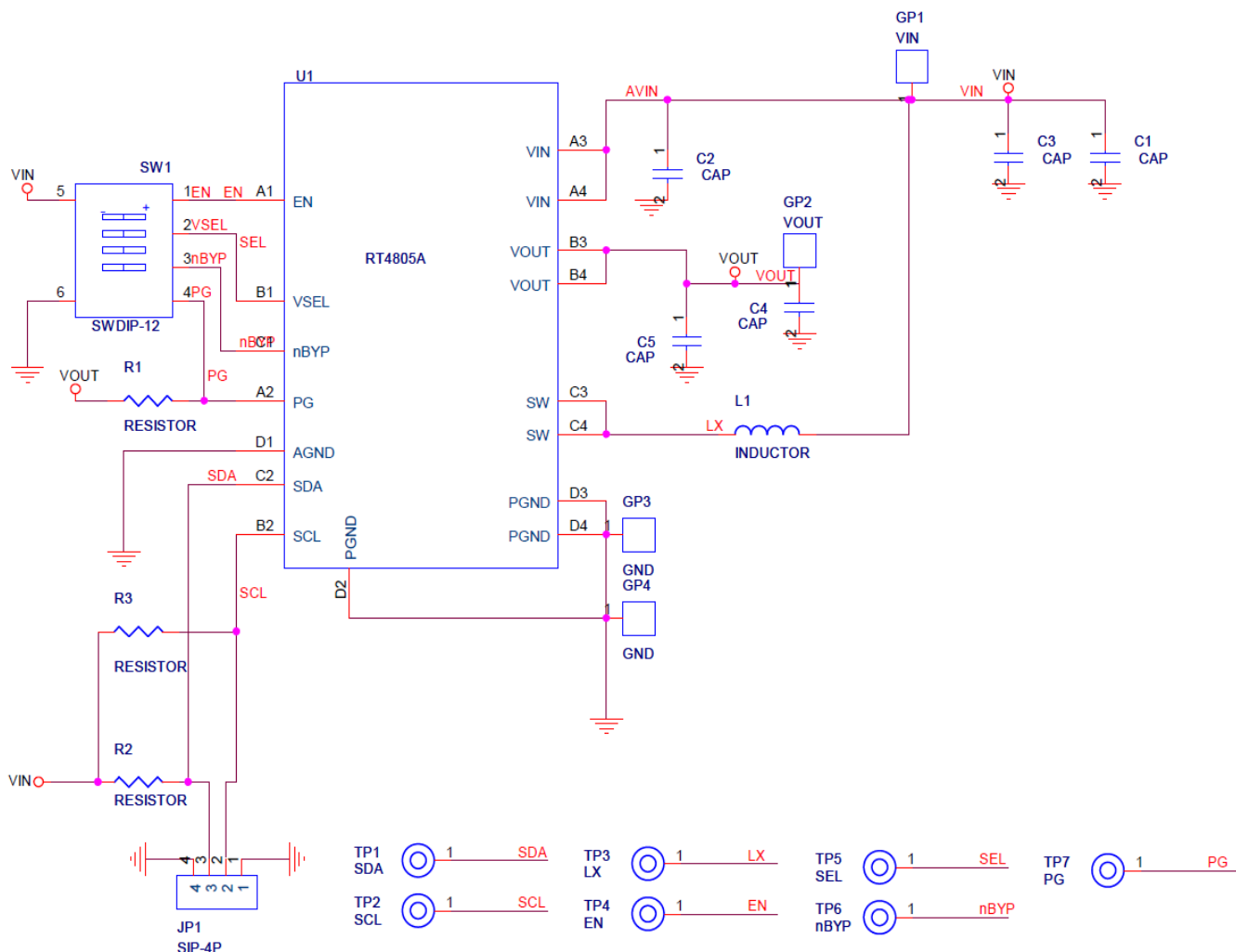| Name | Function | Addr | |
|---|---|---|---|
| CONFIG | MODE control & Spread modulation control | 0x01 | |
| **Bit** | **Mode** | **name** | **Reset** | **Description** |
| 7 | R/W | RESET | 0 | 0 : Disable ID detection function<br>1 : Enable ID detection function |
| [6 : 5] | R/W | ENABLE[1 : 0] | 0 | 00 : Device operation follows hardware control signal (refer to table 1)<br>01 : Device operation in auto transition mode (boost/bypass) regardless of the nBYP control signal (EN = 1)<br>10 : Device is forced in pass-through mode regardless of the nBYP control signal (EN = 1)<br>11 : Device is in shutdown mode. The output voltage is reduced to a minimum value ($V_{IN} - V_{OUT} \leq 3.6V$) regardless of the nBYP control signal (EN = 1) |
| 4 | R/W | Reserved | 0 | |
| 3 | R/W | PG Config. | 1 | 0 : PG pin = H, it is not allowed.<br>  PG pin = L, it is shut down.<br>1 : PG pin is for power good indication. |
| 2 | R/W | SSFM | 0 | 0 : Spread spectrum modulation is disabled.<br>1 : Spread spectrum modulation is enabled in PWM mode. |
| [1 : 0] | R/W | MODE_CTRL[1 : 0] | 01 | 00 : Device operation follows hardware control signal.<br>01 : PFM with automatic transition into PWM operation.<br>10 : Forced PWM operation.<br>11 : PFM with automatic transition into PWM operation (VSEL = L), forced PWM operation (VSEL = H). |

| Name | Function | Addr | |
|---|---|---|---|
| VOUTFLOOR | Output Voltage Selection | 0x02 | |
| **Bit** | **Mode** | **name** | **Reset** | **Description** |
| [7 : 5] | R/W | Reserved | 000 | |
| [4 : 0] | R/W | VOUT[4 : 0] | 01111 | 00000 : $V_{OUT}$ = 2.85V<br>00001 : $V_{OUT}$ = 2.9V<br>00010 : $V_{OUT}$ = 2.95V<br>00011 : $V_{OUT}$ = 3V<br>00100 : $V_{OUT}$ = 3.05V<br>…<br>01111 : $V_{OUT}$ = 3.6V (default)<br>…<br>11111 : $V_{OUT}$ = 4.4V |

| Name | | Function | Addr | |
|---|---|---|---|---|
| VOUTROOF | | Output Voltage Selection | 0x03 | |
| Bit | Mode | name | Reset | Description |
| [7 : 5] | R/W | Reserved | 000 | |
| [4 : 0] | R/W | VOUT[4 : 0] | 10001 | 00000 : V$_{OUT}$ = 2.85V<br>00001 : V$_{OUT}$ = 2.9V<br>00010 : V$_{OUT}$ = 2.95V<br>00011 : V$_{OUT}$ = 3V<br>00100 : V$_{OUT}$ = 3.05V<br>…<br>10001 : V$_{OUT}$ = 3.7V (default)<br>…<br>11111 : V$_{OUT}$ = 4.4V |

| Name | | Function | Addr | |
|---|---|---|---|---|
| ILIMSET | | Set current limit & Softstart current limit | 0x04 | |
| Bit | Mode | name | Reset | Description |
| [7 : 6] | R/W | Reserved | 00 | |
| 5 | R/W | ILIM_OFF | 0 | 0 : Current Limit Enabled<br>1 : Current Limit Disabled |
| 4 | R/W | Soft-Start | 1 | 0 : Boost soft-start current is limited per ILIM bit settings<br>1 : Boost soft-start current is limited to ca. 1250mA inductor valley current |
| [3 : 0] | R/W | ILIM[3 : 0] | 1101 | 1000 : 1500mA<br>1001 : 2000mA<br>1010 : 2500mA<br>1011 : 3000mA<br>1100 : 3500mA<br>1101 : 4000mA (default)<br>1110 : 4500mA<br>1111 : 5000mA |

| Name | | Function | Addr | |
|---|---|---|---|---|
| STATUS | | Read IC status | 0x05 | |
| Bit | Mode | name | Reset | Description |
| 7 | R | TSD | 0 | 0 : Normal operation.<br>1 : Thermal shutdown tripped. The flag is reset after readout. |
| 6 | R | HOTDIE | 0 | 0 : $T_J < 115°C$.<br>1 : $T_J > 115°C$. |
| 5 | R | DCDCMODE | 0 | 0 : Device operates in PFM mode.<br>1 : Device operates in PWM mode. |
| 4 | R | OPMODE | 0 | 0 : Device operates in pass-through mode.<br>1 : Device operates in dc/dc mode. |
| 3 | R | ILIMPT | 0 | 0 : Normal operation.<br>1 : Indicates that the bypass FET current limit has triggered. This flag is reset after readout. |
| 2 | R | ILIMBST | 0 | 0 : Normal operation.<br>1 : Indicates that the average input current limit has triggered for 1.5ms in dc/dc boost mode. This flag is reset after readout. |
| 1 | R | FAULT | 0 | 0 : Normal operation.<br>1 : Indicates that a fault condition has occurred. This flag is reset after readout. |
| 0 | R | PGOOD | 0 | 0 : Indicates the output voltage is out of regulation.<br>1 : Indicates the output voltage is within its nominal range. This bit is set if the converter is forced in pass-through mode. |

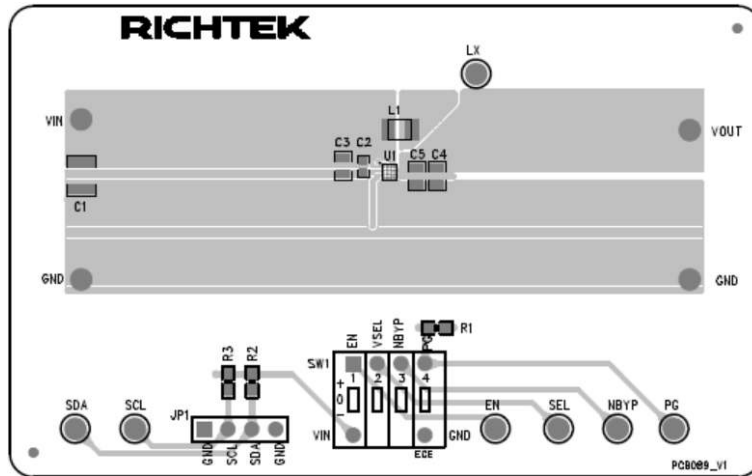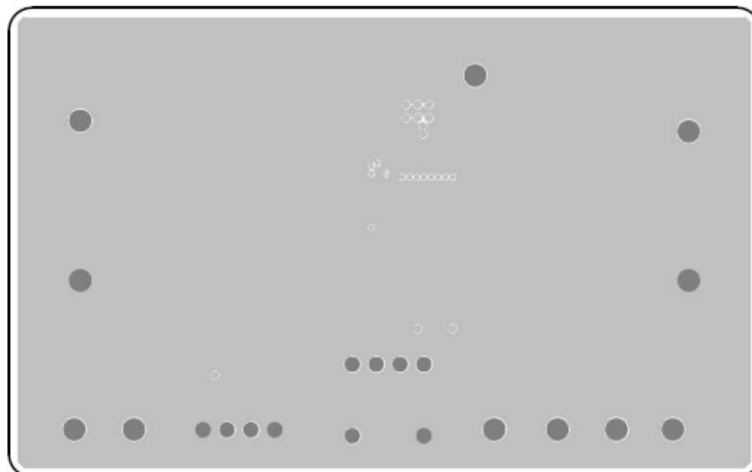## Schematic, Bill of Materials & Board Layout

### EVB Schematic Diagram



### Bill of Materials

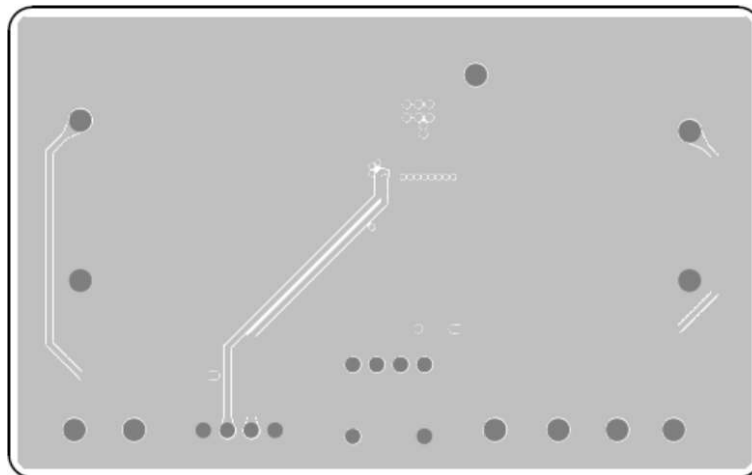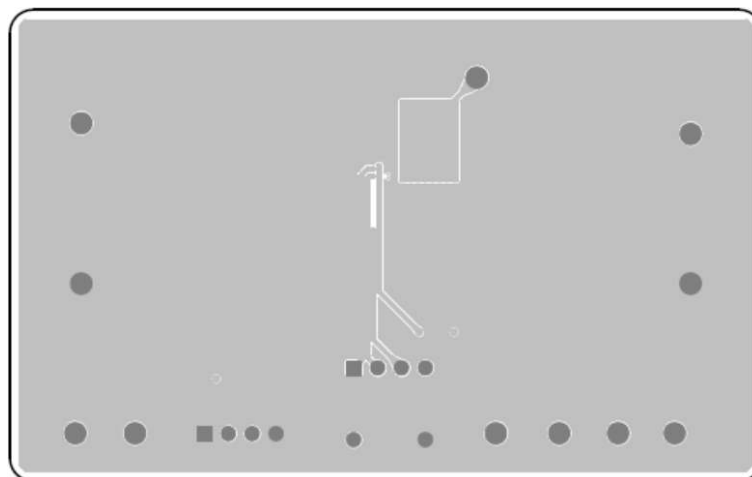| Reference | Qty | Part number | Description | Package | Manufacture |
|---|---|---|---|---|---|
| U1 | 1 | RT4805AWSC | Boost Converter | WL-CSP-16B 1.67x1.67 | Richtek |
| C1 | 1 | GRM32ER61A107ME20L | 100µF/10V/X5R/1210 | C-1210 | Murata |
| C2 | 1 | GRM188R61H105KAAL | 1.0µF/50V/X7R/0603 | C-0603 | Murata |
| C3 | 1 | EMK212ABJ106KG | 10µF/16V/X7R/0805 | C-0805 | Taiyo |
| C4, C5 | 2 | LMK212BBJ226MG | 22µF/6.3V/X7R/0805 | C-0805 | Taiyo |
| L1 | 1 | DFE2520F-R47M | 0.47µH | L-2520 | TOKO |
| R1 | 1 | PFR05105FNH | 1MΩ/0402/1% | R-0402 | 乾坤 |
| R2, R3 | 2 | PFR05102FNH | 1kΩ/0402/1% | R-0402 | 乾坤 |

## PCB Layout



Top View (1$^{st}$ layer)



PCB Layout—Inner Side (2$^{nd}$ Layer)

PCB Layout—Inner Side (3rd Layer)



Bottom View (4th Layer)

## More Information

For more information, please find the related datasheet or application notes from Richtek website http://www.richtek.com.

## Important Notice for Richtek Evaluation Board