SY24561 Quick Start Guide

1. Overview

SY24561 is a simple gas gauge IC for single cell lithium-ion (Li+) batteries in handheld and portable equipment. SY24561 senses battery terminal voltage and use the proprietary algorithm to calculate the corresponding State of Charge (SOC). Comparing with conventional voltage-based gauge which translates terminal voltage directly to SOC, the advanced algorithm in SY24561 shows great advantage in SOC accuracy. SY24561 can be classified as advanced voltage-based gauge without current sensor and the SOC accuracy will not degrade with time. Temperature of the battery pack is measured by the host microcontroller and feed to SY24561 through the I2C interface. SY24561 can automatically compensate temperature, load variation and battery age.

2. Hardware

SY24561 is available in DFN2×2-8 package. The chip has 8 pins, the top view is shown in Figure 1:
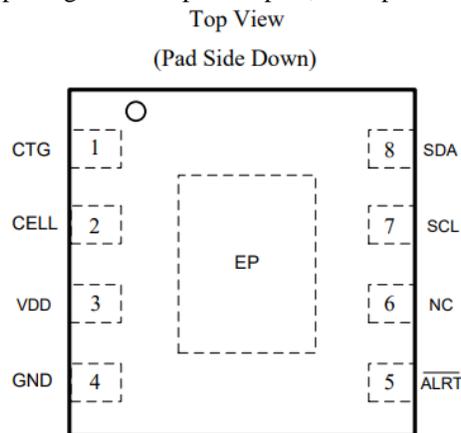
Figure 1 Top view

The application circuit of SY24561 is shown in Figure 2:
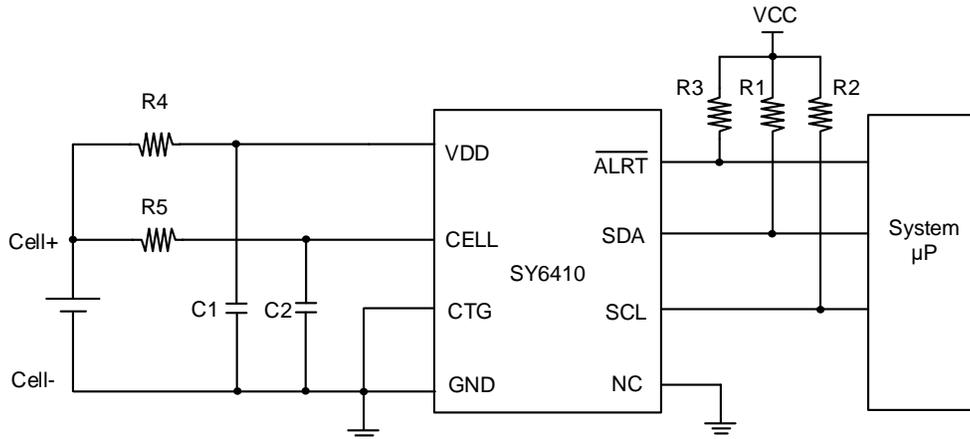

Figure 2 Basic Architecture Information

The functions of the pins are as table1:

Table 1 The functions of the pins

Pin Name	Description
CTG	Connect to GND.
CELL	Battery voltage monitors I/O. Bypass with a 1μF capacitor to the GND. Connect to battery's positive terminal through R5
VDD	Power supply input. Bypass with a 1μF capacitor to GND. Connect to battery's positive terminal through R4
GND	Ground. Connect to battery's negative terminal.
ALRT	Open-drain output. Low SOC alarm signal. When SOC is below the threshold, this pin will be pulled down.
NC	No connection. NC is recommended to connect to GND.
SCL	I2C clock input. SCL has an internal pull-down resistance.
SDA	I2C data input/output. SDA has an internal pull-down resistance.

The steps to connect the hardware are as follows:

a. The top view of SY24561 demo board is shown in Figure 3:
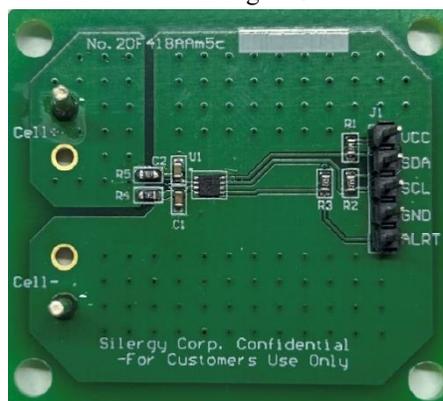
Figure 3 SY24561 Demo Board Top View

b. Typically, the SY24561 is always battery powered, even when the system is down. When power up

SY24561, the power supply must meet the following requirements: VDD=4 to 5.5V and no working current.

c. Connect the corresponding ports of I2C and SY24561 demo (VCC, GND, SDA, SCL).

3. GUI

After Battery learning is completed (refer to section 4 (1) for details on battery learning), the gauge configuration file will be sent to customer using following folder structure: (1) Battery test report and memory burn instructions;(2) Silergy I2C Burn Tool. As shown in Figure 4:
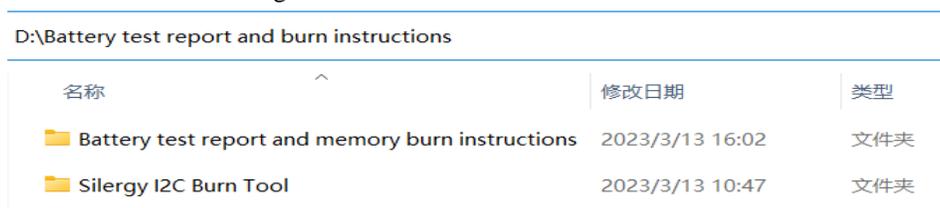
D:\Battery test report and burn instructions		
名称 ^	修改日期	类型
📁 Battery test report and memory burn instructions	2023/3/13 16:02	文件夹
📁 Silergy I2C Burn Tool	2023/3/13 10:47	文件夹

Figure 4 Folder description

(1) Configuration File Structure

Battery test report and memory (MTP) program instructions contain three types of files. Battery Memory Data(word/pdf) file records MTP data, and Battery Test Report (word/pdf) file records test cases and test results. The Process of Writing and Reading the MTP of SY24561 file records the steps of writing and reading the MTP of SY24561.

In the Silergy I2C Burn Tool folder, CH341PAR (.exe) is the I2C driver, SY24561 (.exe) is the operating interface of the SY24561 chip, and Tab is the MTP Data.

(2) Install Software

a. To install the I2C driver, double-click CH341PAR.exe in path "…\Battery test report and burn instructions\Silergy I2C Burn Tool". Click Install.

b. After connecting I2C, double-click SY24561.exe in path "…\Battery test report and burn instructions\Silergy I2C Burn Tool" to open the SY24561 operation interface.

4. Configure SY24561

(1) Generate the Battery Model

The battery model is obtained through the actual test of the target battery. The items to be tested are: charge curve, discharge curve and discharge OCV curve. It should be noted that the test item must be a complete charge and discharge process, including current, voltage, relax process, time stamp that captured every two seconds. In addition, when temperature compensation is required, it is also necessary to test the charge and discharge curve at multiple temperatures.

A set of MTP parameters will be generated by modeling the data captured, including SOC-OCV table, charge and discharge parameters, temperature compensation parameters and other information. Specific information is shown in Table 2:

Table 2 MTP parameters

ADDRESS	DESCRIPTION
7'h00-7'h12	19 SOC values
7'h13-7'h17	5 NTC voltage values
7'h18-7'h1C	5 null values
7'h1D-7'h2F	19 charging information values
7'h30-7'h44	21 discharging information values
7'h45-7'h70	44 OCV values
7'h71-7'h77	7 trim values
7'h78-7'h7F	8 temperature information values

(2) Load the Battery Model

a. Click **MTP Function** to write MTP parameters. As shown in Figure 5:
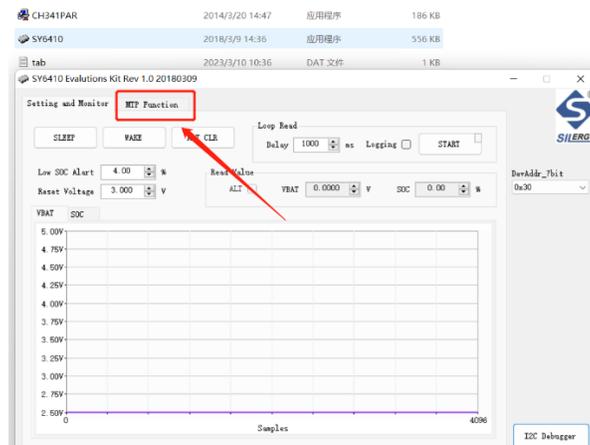

Figure 5 Open MTP Function

b. When writing MTP parameter, first check whether the address is *0x30* and then perform four steps: (1) **Read form File**; (2) **Write Tab**; (3) **Read Tab**; (4) **Check**. Note When writing MTP data, do not have working current. The steps for writing MTP parameters are shown in Figure 6:
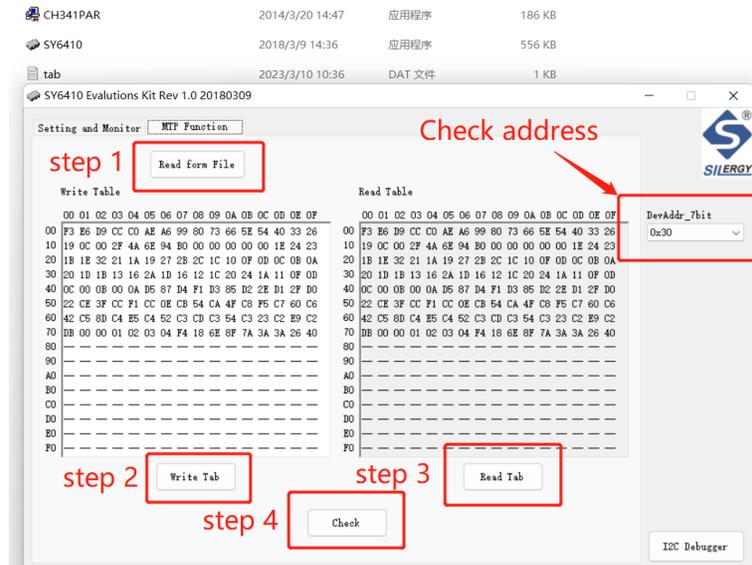
Figure 6 Steps for writing MTP

(3) Set up the Register

After writing MTP parameters, you need to exit sleep mode if you want SY24561 to work properly.

Click **I2C Debugger** in the lower right corner of the SY24561 operation interface to enter the General Debugger interface.

First click **Scan** and the address is 30; then click **REGISTER MODE**. As shown in Figure 7:
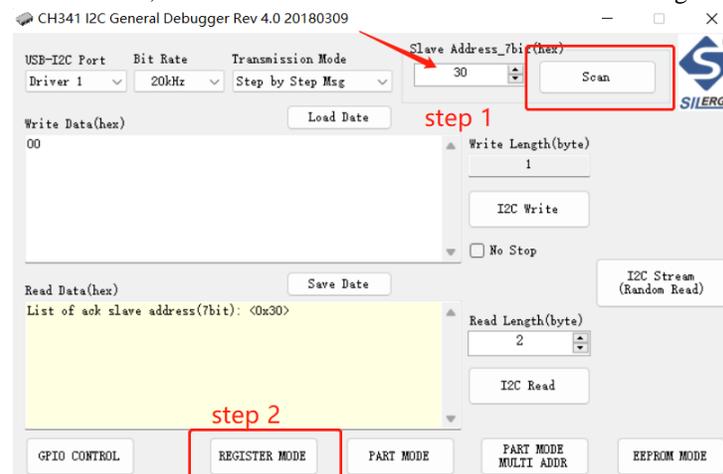
Figure 7 REGISTER MODE

Enter the **REGISTER MODE** screen, and write the address of *0x06* to 20 and the address of *0x0d* to 9C. The operation to write the address of *0x0d* is the same as that of *0x06*.

The operation is as follows: (1) Click **Scan** and the address is 30; (2) Input 6 in **Register Address_start** ; (3) Input 20 in **Register Data** ; (4) Click **Write Register**; (5) Input 6 in **Register Address_start**; (6) Click **Read Register**; (7) check. The operation method of entering and exiting Sleep Mode is shown in Figure 8:
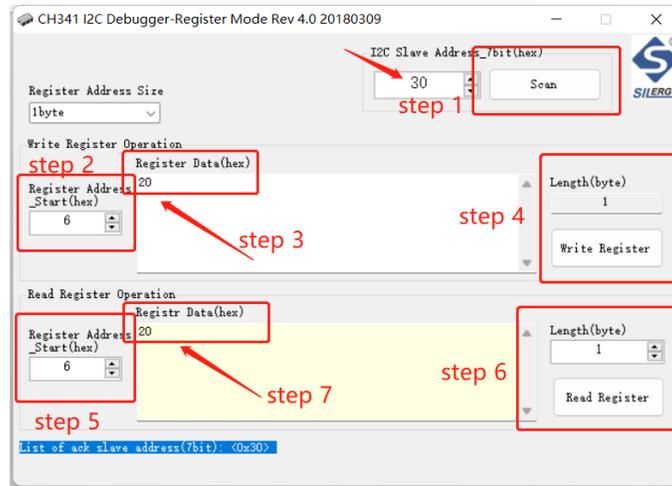
Figure8 Operation Method of Sleep Mode

Because the SY24561 does not sample the temperature, it needs to be written externally. TEMP is the value of battery's temperature, which can be written by I2C interface. The address of the TEMP register is *0x0C*. The 0x0C address information is shown in Figure 9:

MSB —ADDRESS 0x0C							
x	x	x	TEMP4	TEMP3	TEMP2	TEMP1	TEMP0
Msb							Lsb

Figure9 *0x0C* address information

The default value of TEMP is *0x3C*(20℃). The following formula is the calculation of TEMP.

$$TEMP = DEC2HEX(INT(temperature(℃) + 40))$$

(4) Data Monitoring and Preservation

Monitor battery VBAT and SOC data. First click **Setting Monitor** and then Click **Start** to display the VBAT and SOC data. During this process, the chip is working properly and the battery can have working current. Operation is shown in Figure 10:
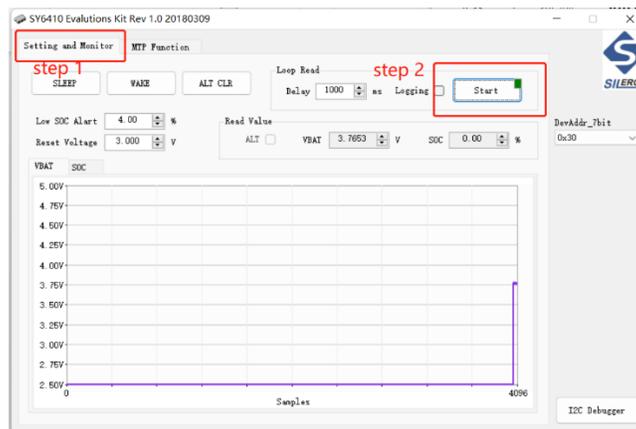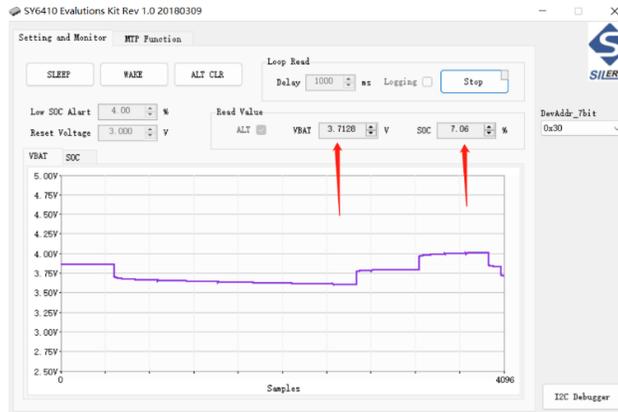
Figure 10 Monitor VBAT and SOC Data

If you want to save the data read by the SY24561, please check Logging and then click **Start**, Logging will produce a text document containing Time, Voltage, SOC and other information. As shown in Figure 11:
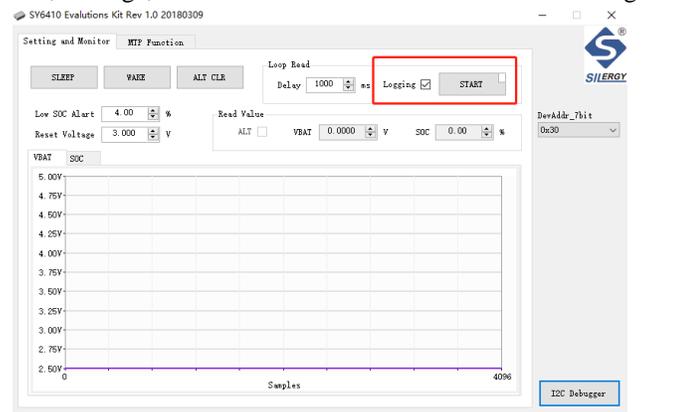
Date	Time	Alart	Voltage(V)		SOC(%)
23/06/09	08:47:32	FALSE	4.3127	98.13	
23/06/09	08:47:33	FALSE	4.3134	98.13	
23/06/09	08:47:34	FALSE	4.3127	98.13	
23/06/09	08:47:35	FALSE	4.3134	98.13	
23/06/09	08:47:36	FALSE	4.3127	98.13	
23/06/09	08:47:37	FALSE	4.3127	98.13	
23/06/09	08:47:38	FALSE	4.3127	98.13	
23/06/09	08:47:39	FALSE	4.3127	98.13	
23/06/09	08:47:40	FALSE	4.3134	98.13	
23/06/09	08:47:41	FALSE	4.3134	98.13	
23/06/09	08:47:42	FALSE	4.3127	98.13	
23/06/09	08:47:43	FALSE	4.3134	98.13	

Figure 11 Logging Date

5. Tips

a. When reading or writing MTP data, ensure that power supply is not providing power for other use (such as charging or discharging batteries) to ensure supply voltage and current are stable.

b. The SY24561 chip is powered off. When reconnecting the power supply, ensure that the power supply has no working current.

c. When entering and exiting the Sleep Mode, ensure that the power supply has no working current.