

3S Gauge GUI introduce

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1. Introduction

3S Gauge Graphical User Interface (GUI), with 3S Gauge Evaluation Module (EVM) hardware. Provides users with 3S li-battery product development tool.

GUI characteristic :

- Support adjust the parameters , Includes V/I/T battery information
- Built-in calibration provides quick li-battery calibration
- Product Monitoring Functions , display SOC/SOH et.
- Built-in Battery Abnormal Record Condition , read history data for analysis

2.Platform interface

2.1 Pages

When you click the executable file installed on the desktop, the first page as shown in Figure 2-1 will appear. This page consists of two main parts, the system field (labeled 1 below) and the operation page (labeled 2 below).

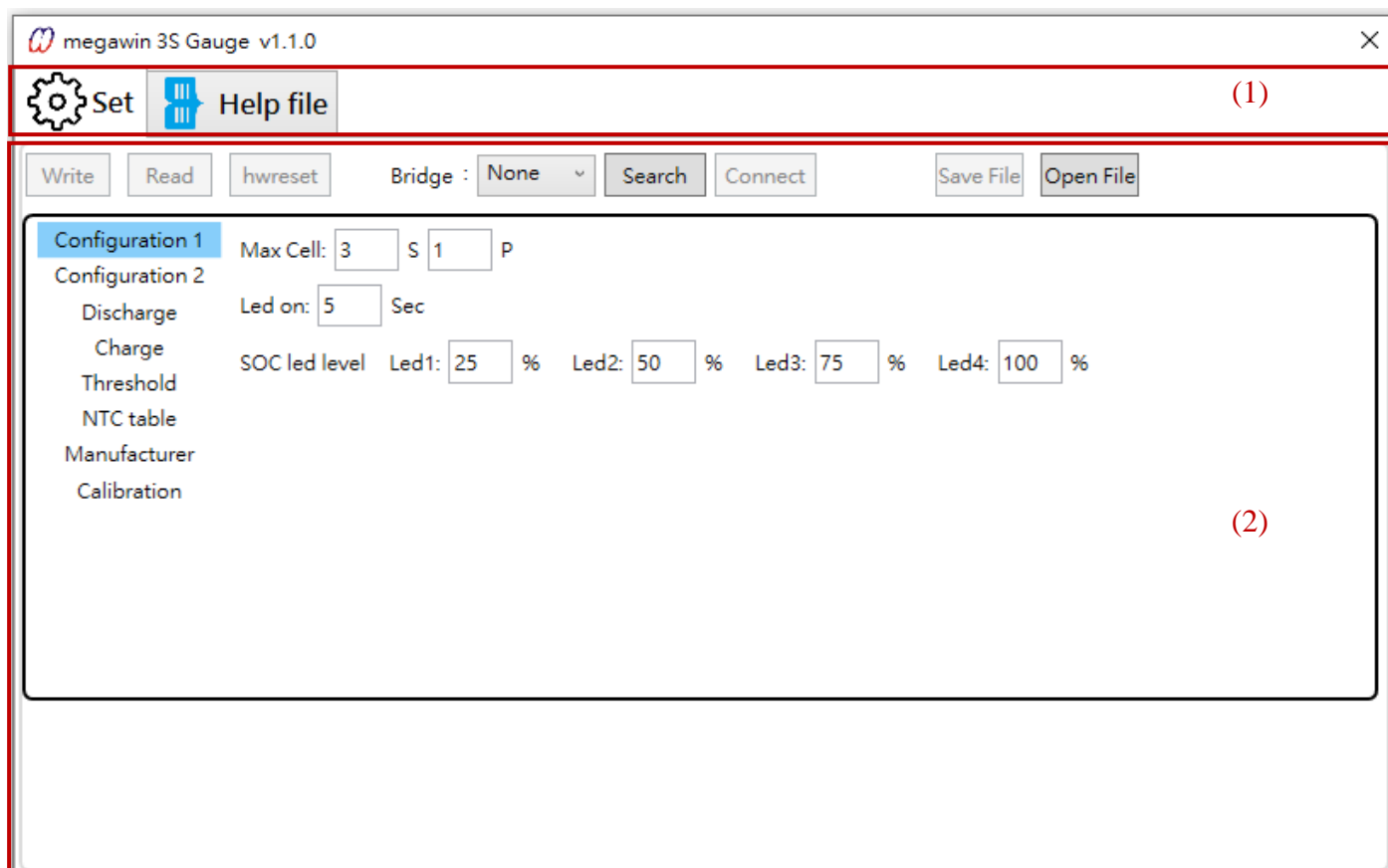


Figure 2-1 Page

- (1) System field: It mainly provides different options and displays different operation page contents synchronously, which is convenient for users to operate. There are four functions: parameter setting, help file, real-time monitoring of operation status, and viewing of battery history, etc. The two functions of monitoring and recording can only be appeared after successfully connecting with EVM through I2C interface.
- (2) Operation Page: Provides different display contents according to different system field options.

2.2 Setting Fields

After selecting the Setup field, the operation page will be as shown in Figure 2-2. This page is mainly responsible for the setting of the relevant parameters of the product system, and the parameters are written into the MCU, and the parameter setting is divided into seven parts.

Note: After adjusting the parameters, please do not re-adjust the parameters unless necessary to avoid resetting and resetting to zero, which may result in undesirable or unanticipated results in the use of the product.

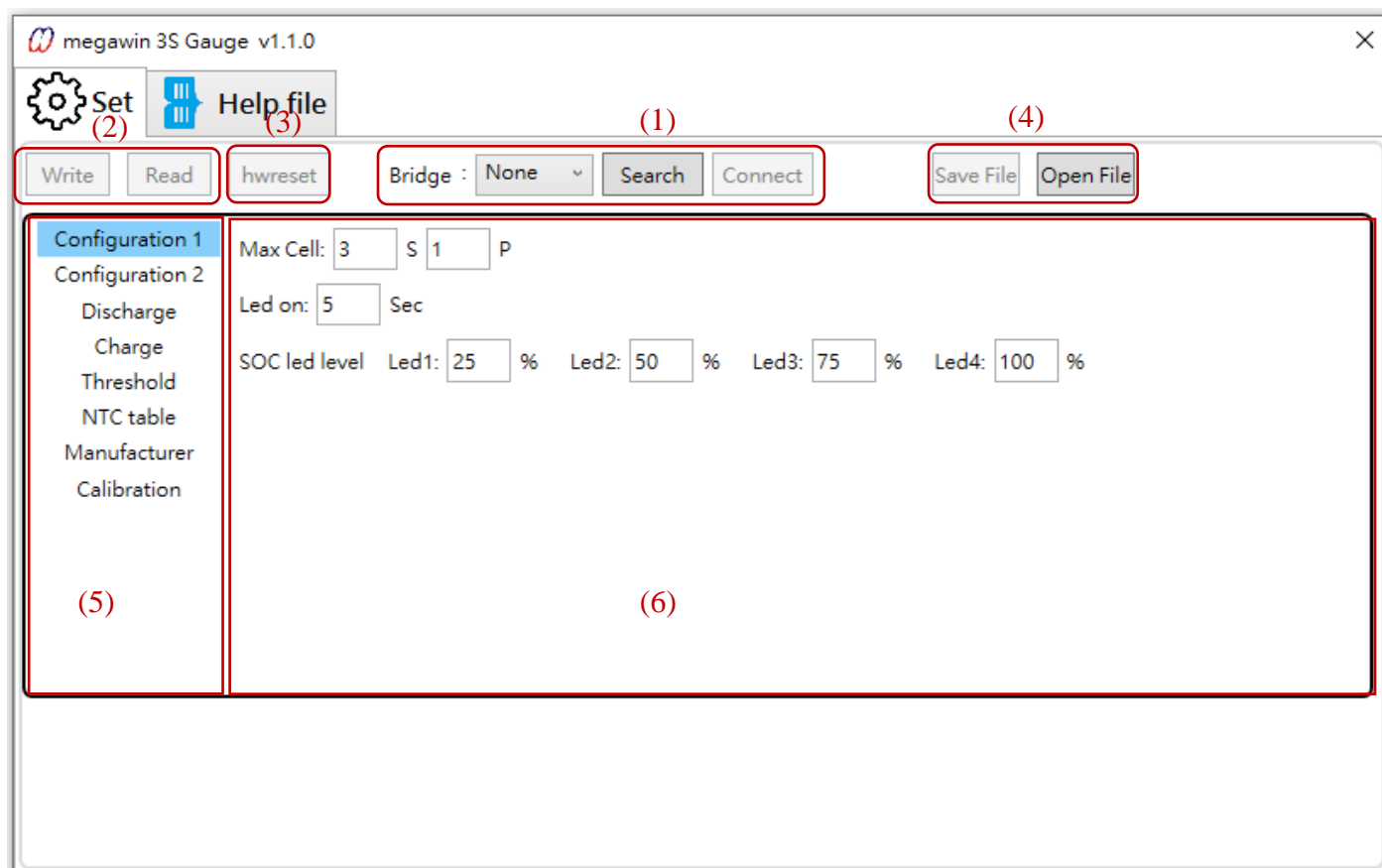


Figure 2-2 Setting up the page classification of a field

- (1) Communication link block: It is responsible for establishing the communication link with EVM hardware, if the link is not successful, it will not be able to know the internal parameter and operation status of MCU.
- (2) Access Block: It is responsible for writing setting parameters into MCU parameter space or reading out relevant setting parameters from MCU parameter space and displaying them in GUI.
- (3) Reset Block: After clicking this button, the GUI will send a reset command to the MCU to reset and re-run .
- (4) File Block: Responsible for saving system parameters to an external file, or reading system parameters from an external file and displaying them in the GUI.
- (5) Selection Block: Contains eight categories: Configuration 1, Configuration 2, Calibration, Discharge, Charge, Threshold, Thermal Resistance, and Manufacturing Information, which are the parameters required to set up the operation of the MCU, and one of them is indispensable.

- (6) Display Block: Displays different setup parameters for modification according to the options of the selected block.

2.2.1 Communication link block

As shown in Figure 2-3, click the Search button (labeled 1 below) to start searching for all the ports of the computer system and store them in its drop-down menu.

After pulling down its menu (labeled 2 below), select the communication port of the real connected device, and then click the Connect button (labeled 3 below) to start the connection, when the connection is successful, as shown in Figure 2-4, the I2C communication block and the MCU parameter logging block can be operated normally, and the monitoring and logging field options are added on the system field (on the left and right side of the setting).

If the connection fails, an error message will be displayed, and the I2C communication block and MCU parameter logging block will remain inoperative.

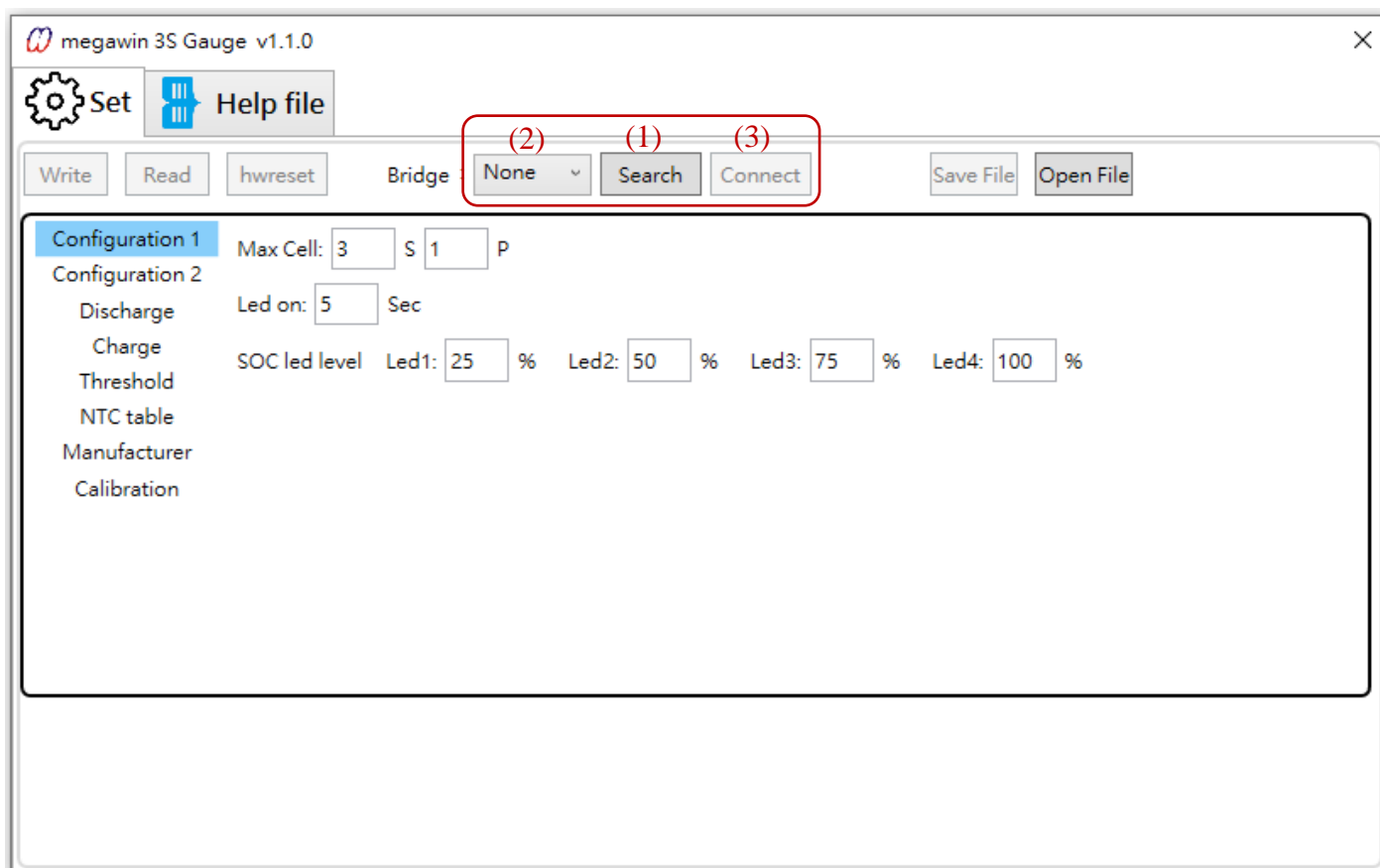


Figure 2-3 Communication Connection

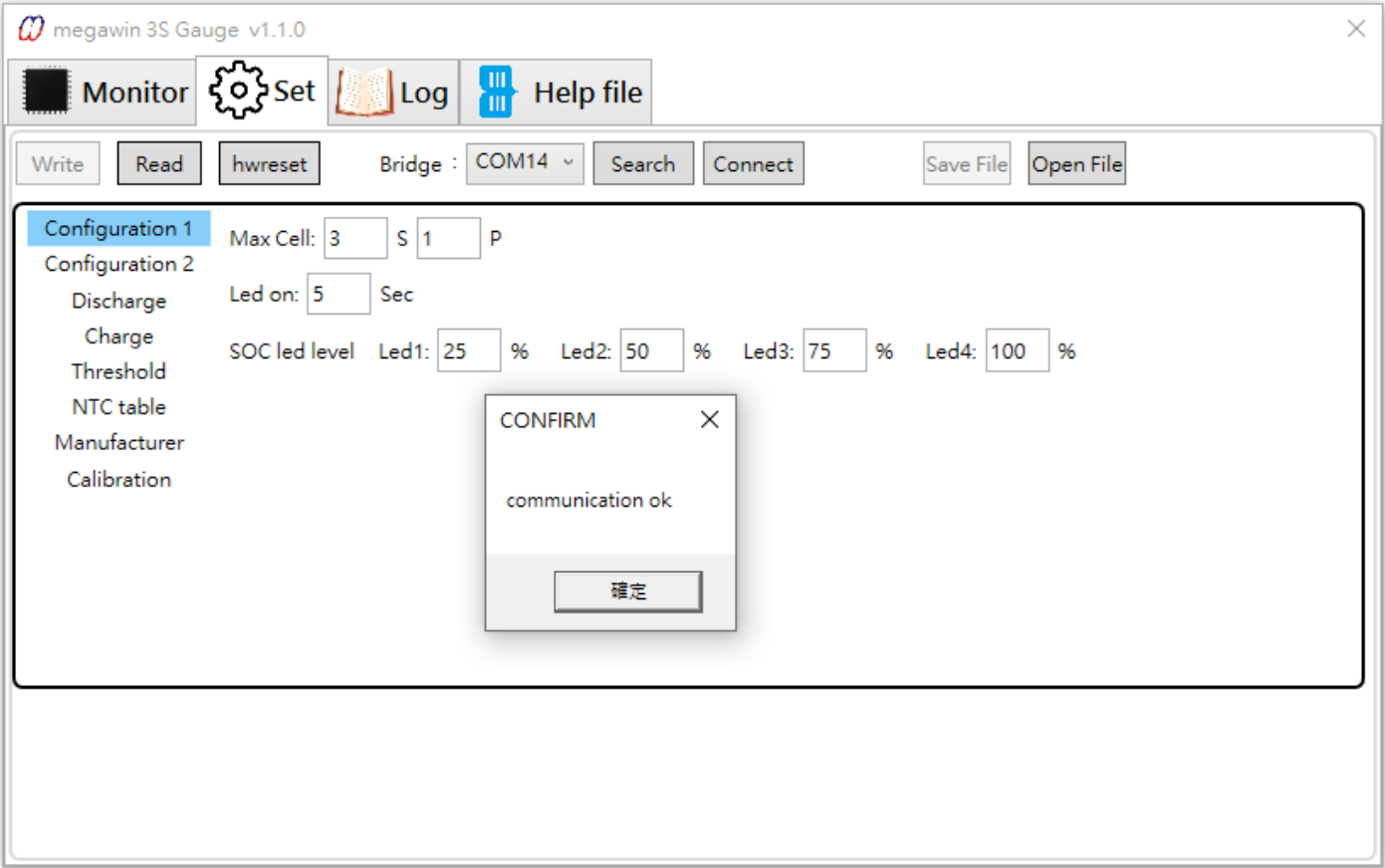


Figure 2-4 Communication Connection Success Page

2.2.2 Access Block

As shown in Figure 2-5 (1), this block is responsible for writing and reading system parameters inside the MCU. When the Read button is selected, all system parameters will be read from the MCU to the GUI (selecting the options in the block will display the read contents), and until the message box of "Read Complete" appears, which means that the data has been read.

When selecting the Write button, you must first confirm that the system is not charging or discharging before proceeding, otherwise, it will cause the internal data error. At this time, all the system parameters of the GUI will be written into the MCU, and the data will be written into the MCU until the data comparison success message box appears, which means that the data is written into the MCU, and the data has been confirmed to be correct.

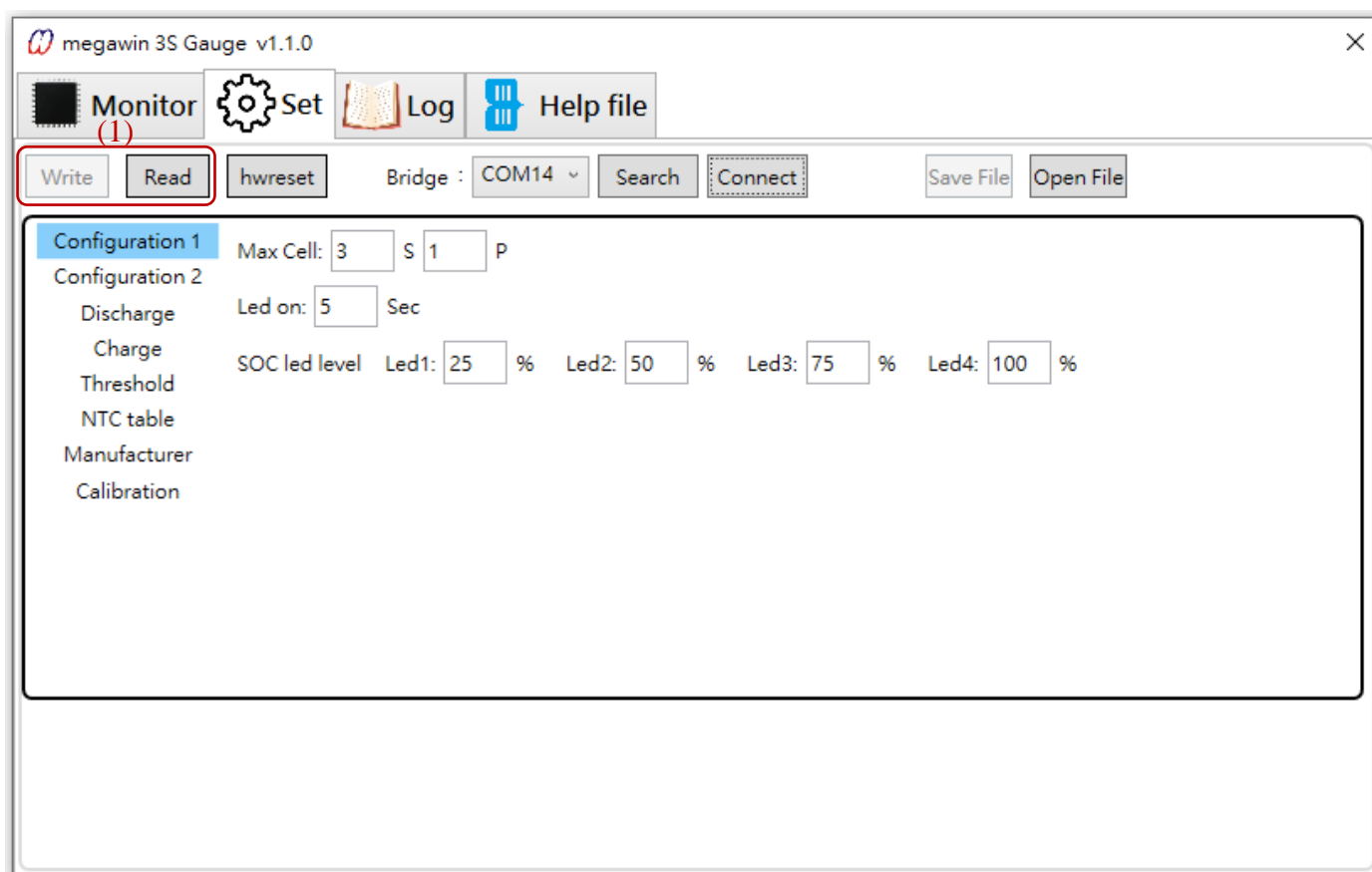


Figure 2-5 Access Block

2.2.3 Reset Block

As the area shown in Figure 2-6 (1), this is used for MCU reset, which is mainly applied when the GUI has correctly written all the system parameters to the MCU, use this button to allow the MCU to reset and run again.

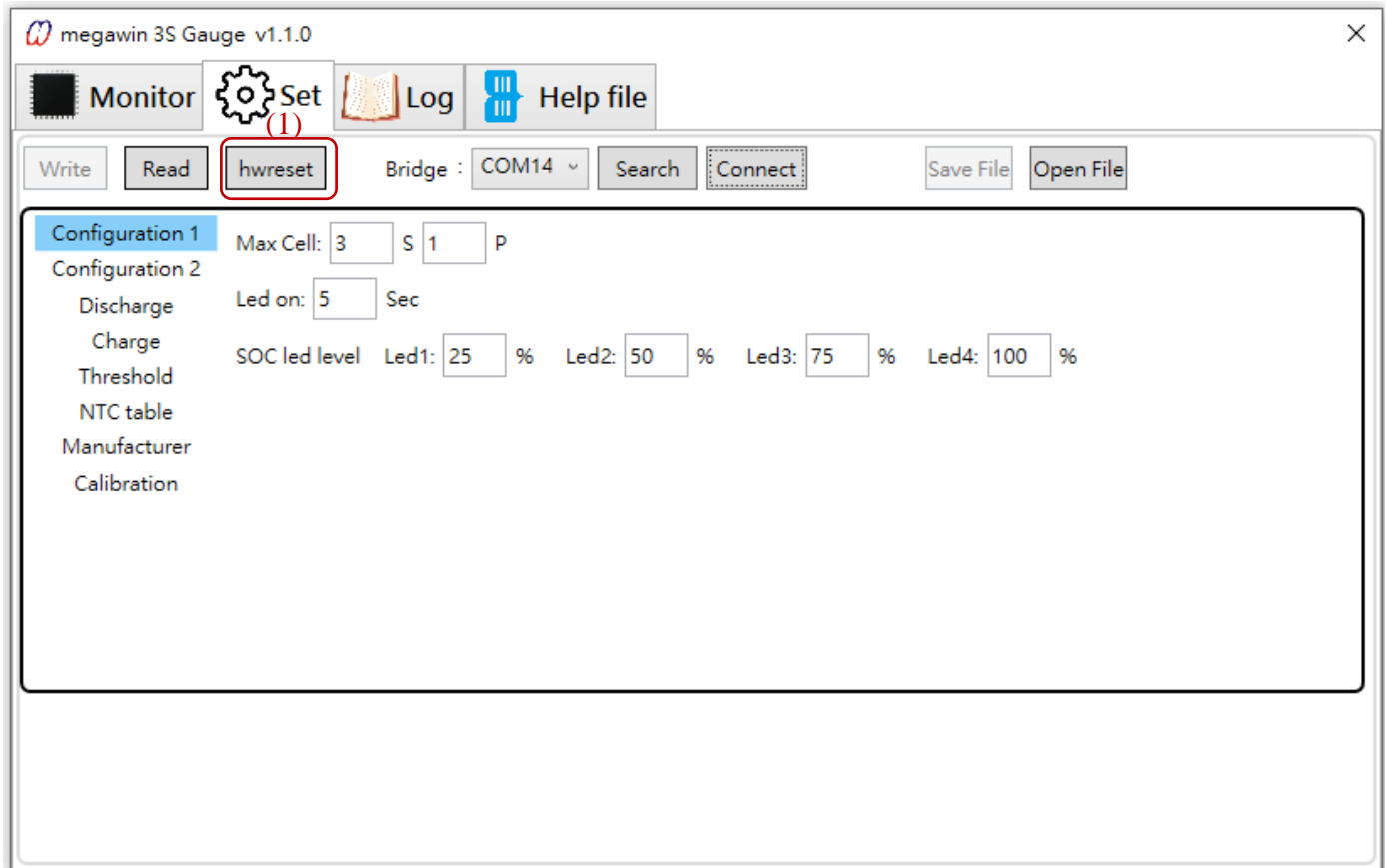


Figure 2-6 Reset Block

2.2.4 File Block

As the area shown in Figure 2-7 (1), all system parameters of the GUI can be saved to an external file or read back from an external file into the GUI.

After clicking Save File button, the Save As dialog box will appear. After selecting the location and name of the file to be saved, the save action will be initiated until the message indicating that the file has been written appears.

After clicking the Open File button, the Open dialog box will appear, please select the file you want to use (must have previously saved the file using the Save File button), and when all the data has been loaded into the GUI, a file reading completion message will be displayed, indicating that reading is complete.

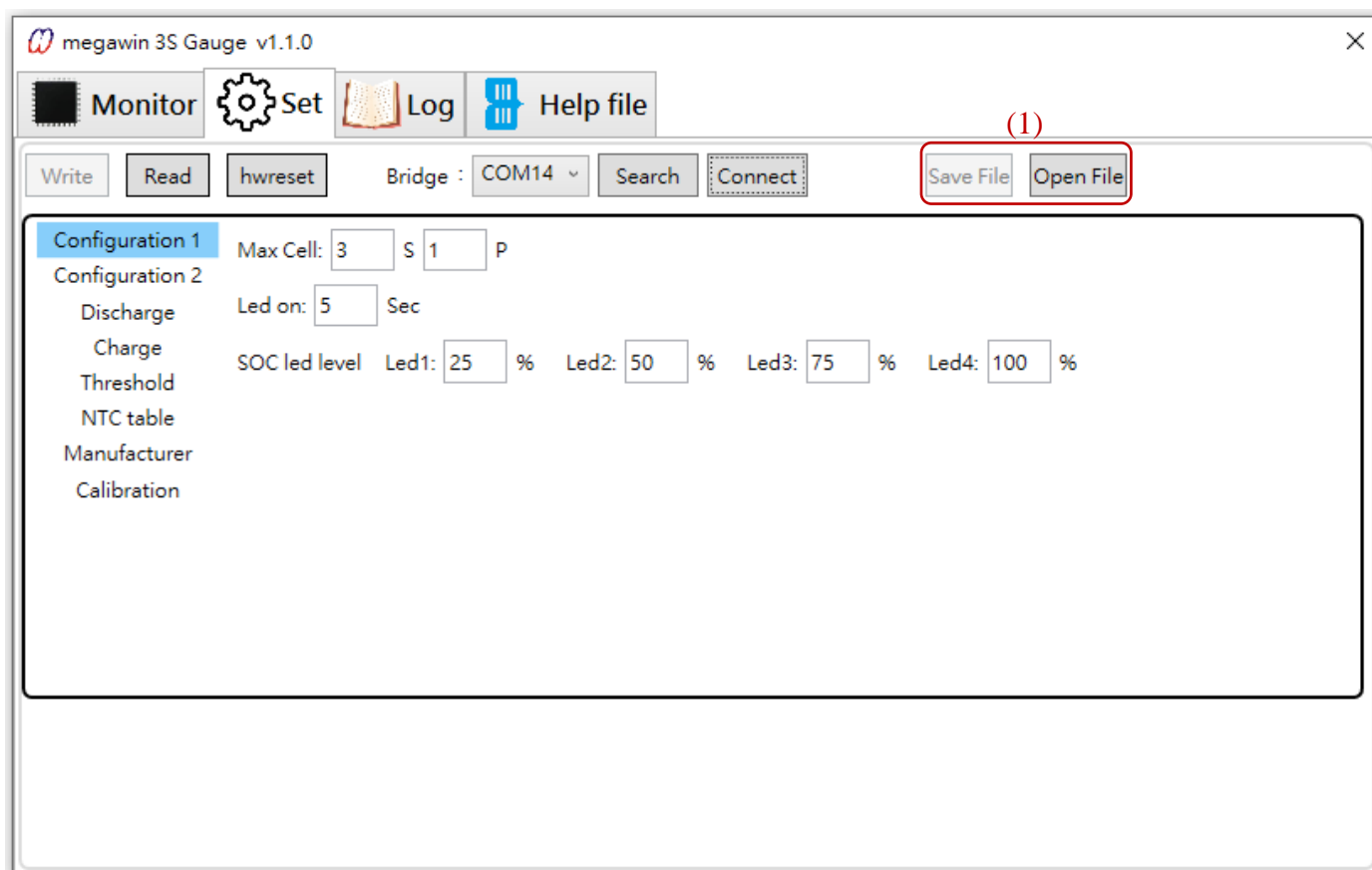


Figure 2-7 File Block

2.2.5 Selection Block

As shown in Figure 2-8 (1), there are eight categories of options, which are mainly for setting the system parameters required for MCU operation. When the options of the selected block are changed, the contents on the display block (labeled 2 below) will also be changed synchronously.

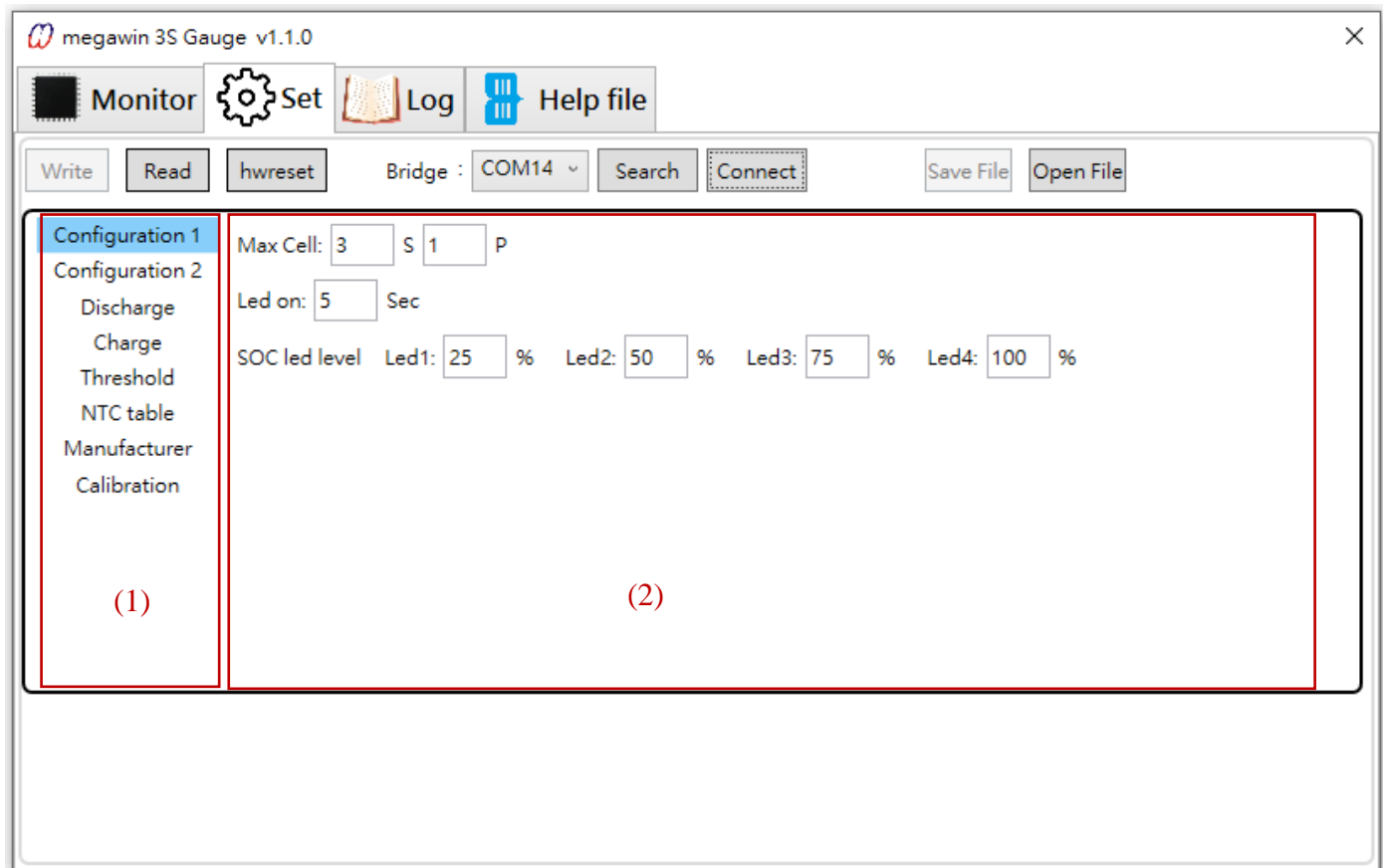


Figure 2-8 Selection Block and Display Block

Configuration 1: When this item is selected, the contents as shown in Figure 2-9.

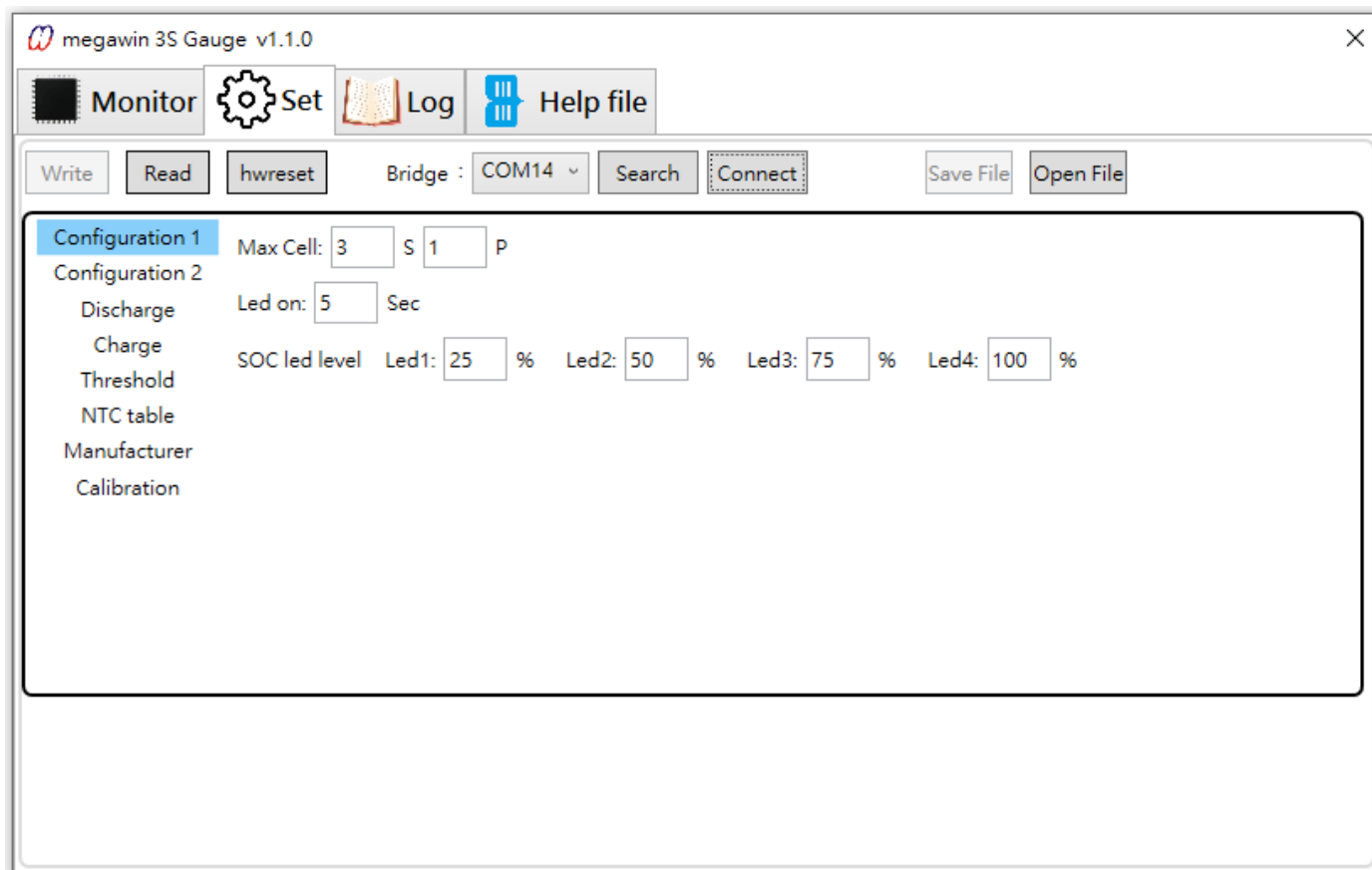


Figure 2-9 Configuration 1 Parameter Setting

1. Module Serial and Parallel : The number of series and parallel columns of the system module, as the figure shows that this module is a 3-series and 1-parallel system.
2. Led Lighting times : When the user presses the power display button, the duration of the power is displayed.
3. SOC level indicator : Set the percentage of capacity (SOC) level for triggering the Led light. As shown in Figure, the Led 2 level is 50%, which means that when the SOC level is greater than or equal to 50%, the Led 2 LED is ON, otherwise the Led 2 LED is OFF.

Configuration 2 : When this item is selected, the contents as shown in Figure 2-10.

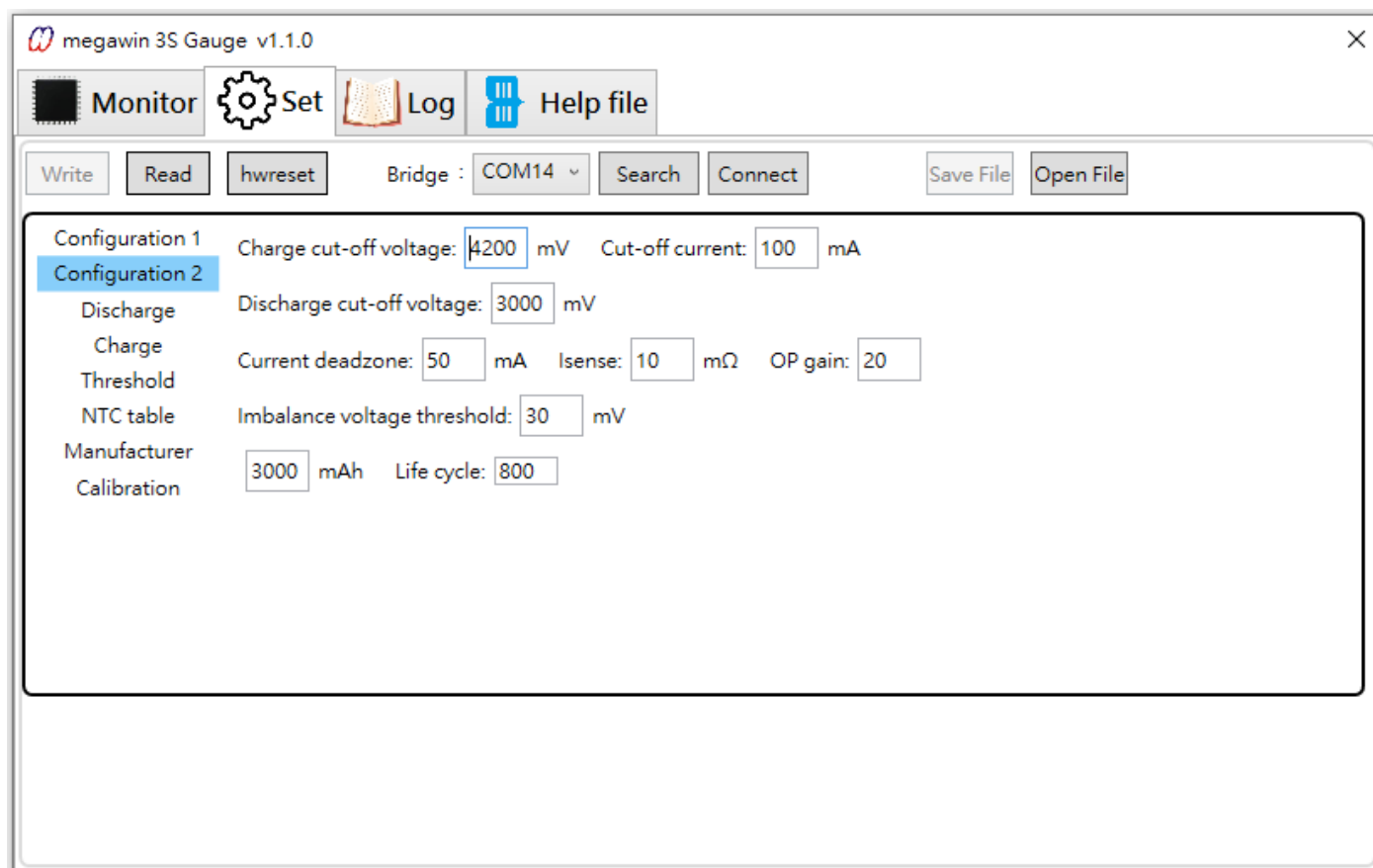


Figure 2-10 Configuration 2 Parameter Setting

1. Charge cut-off voltage: Set the voltage condition for charge and saturation.
2. Cut-off current: Setting the current condition for charging and saturating.
In the charging state, the MCU detects the individual voltages and currents of the series-connected batteries, and if the voltage of one of the batteries is greater than the saturation cutoff voltage and the charging current is less than the cutoff current, then the system is considered to be saturated.
3. Discharge cut-off voltage: Set the discharge to empty condition.
In the discharging state, the MCU detects the individual voltages of the serial batteries, and if the voltage of one of the batteries is less than the discharging cutoff voltage, it is considered that the system power has been exhausted.
4. Current deadzone: The minimum current under system operation.
When the MCU detects that the system current is less than this setting (regarded as no current state), the system will enter the sleep state to achieve a more energy-saving mode.
5. Isense: The value of the resistor connected to the MCU to measure the current.
6. OP gain : The current amplifier gain value designed by the MCU to measure the current.
7. Imbalance voltage threshold: Set the unbalance voltage warning.
In use, the MCU detects the individual voltages of the serial batteries and calculates the voltage difference between the highest voltage battery and the lowest voltage battery, and triggers the

relevant warning settings when the difference is larger than the set value.

8. Designed Capacity: The designed capacity of the battery as documented in the battery specification.
9. Number of cycles: Limit the number of cycles as stated in the battery specifications.

Discharge: When this item is selected, the contents as shown in Figure 2-11.

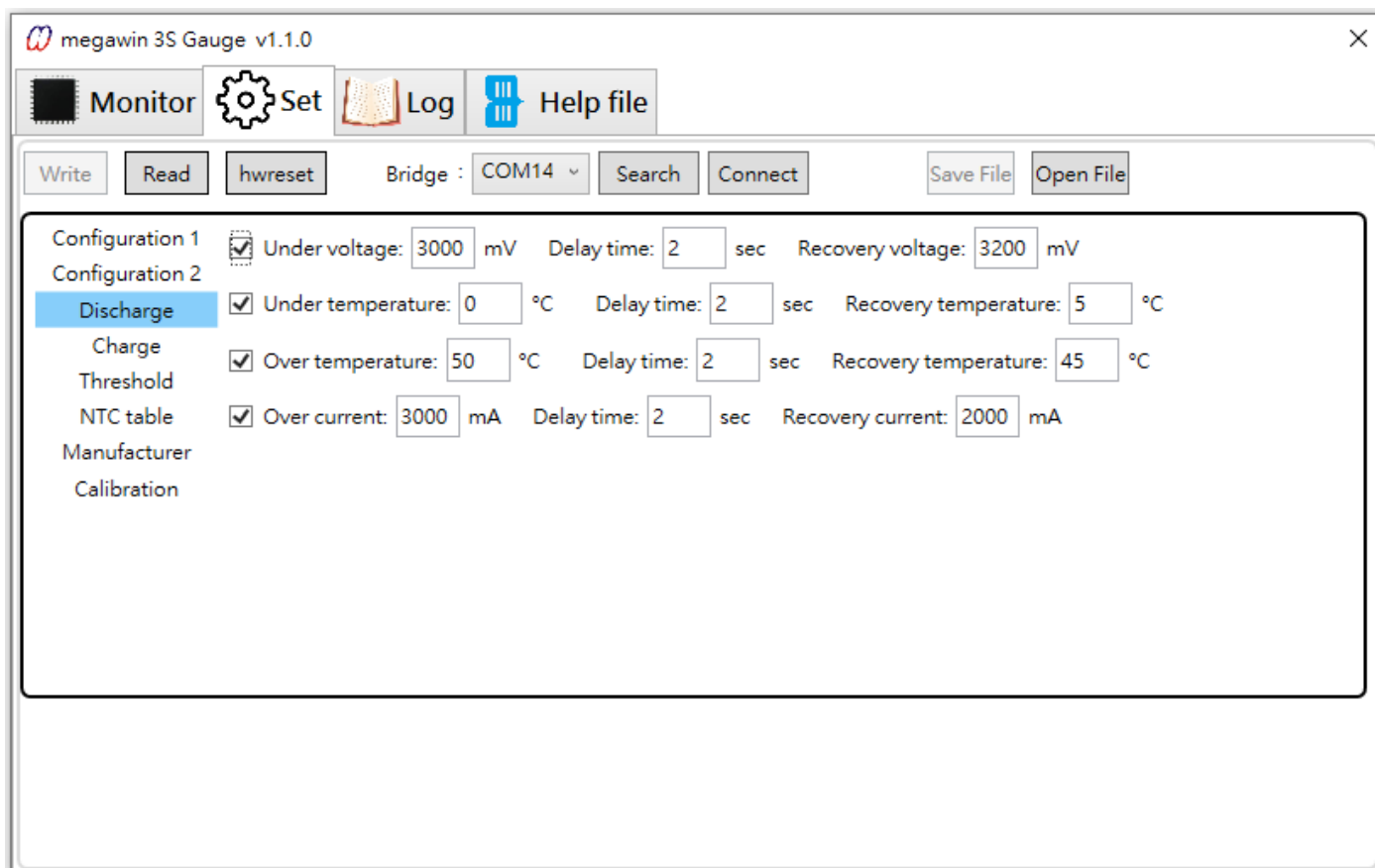


Figure 2-11 Discharge Parameter Setting

1. Under voltage: Discharge low voltage setting.
2. Delay Time: The duration of the discharge depression.
3. Recovery Voltage: Voltage setting for discharging low voltage warning elimination.

When in the discharged state, MCU detects the voltage of each battery in series, if the voltage of one of the batteries has been lower than the discharged under voltage setting, and the delay time has passed, then MCU will issue a warning (flag, IO output) reminder until the voltage of each battery detected by MCU exceeds the recovery voltage setting before eliminating the problem, and return to the normal state.

4. Under Temperature: Discharge low temperature setting.
5. Delay Time: The duration of the discharge low temperature.
6. Recovery Temperature: Temperature setting to eliminate the low temperature warning of discharging.

When the temperature detected by MCU is lower than the low temperature setting of discharging during discharging state, and the delay time is over, then MCU will issue a warning (flag, IO

output) reminder until the temperature detected by MCU exceeds the recovery temperature setting, then it will be canceled and return to normal state.

7. Over temperature: Discharge high temperature setting.
8. Delay Time: The duration of the discharge high temperature .
9. Recovery Temperature: Temperature setting to eliminate the high temperature warning of discharging.

When the temperature detected by the MCU is higher than the discharge over-temperature setting in the discharged state and the delay time has passed, the MCU will issue a warning (flag, IO output) reminder until the temperature detected by the MCU has fallen below the recovery temperature set point before eliminating it and returning to the normal state.

10. Overcurrent: Discharge overcurrent setting.
11. Delay Time: The duration during which the discharge overcurrent occurs.
12. Recovery current: Current setting for overcurrent discharge warning elimination.

When the current detected by the MCU is higher than the discharge overcurrent setting in the discharge state, and the delay time has passed, then the MCU will issue a warning (flag, IO output) reminder until the current detected by the MCU is lower than the recovery current setting before eliminating it and returning to the normal state.

Charge: When this item is selected, as shown in Figure 2-12.

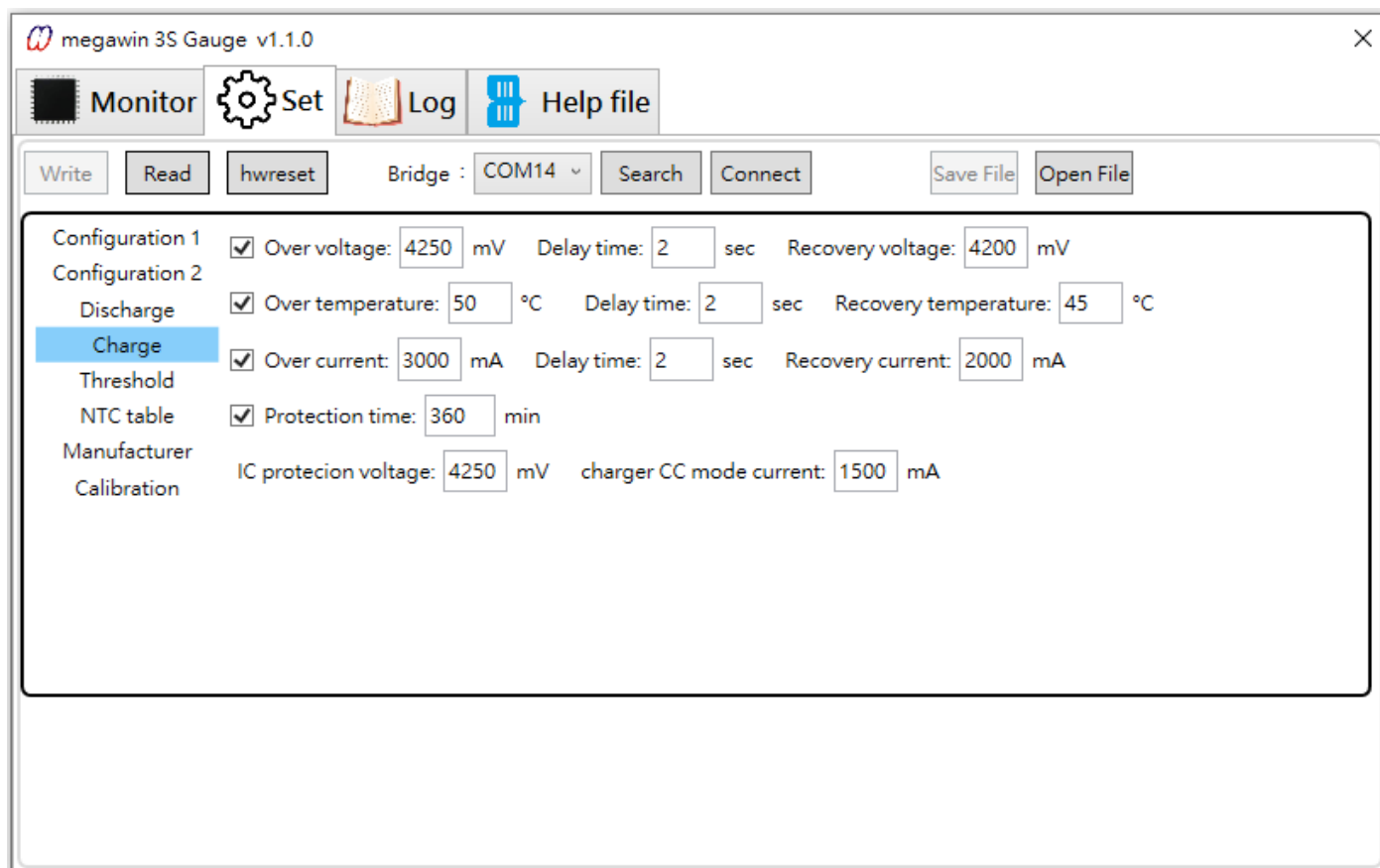
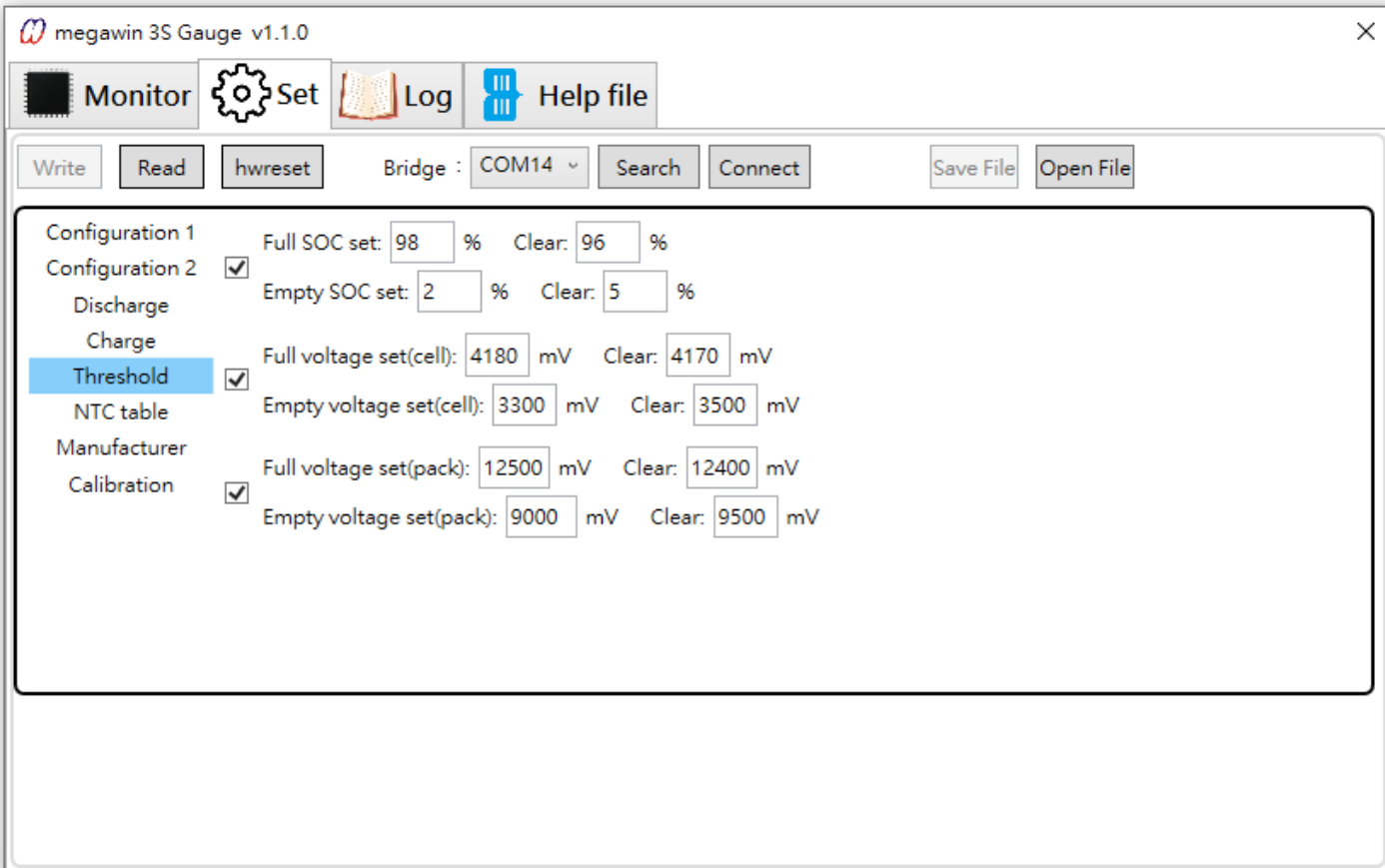


Figure 2-12 Charging Parameter Setting

1. Overvoltage: Charge overvoltage setting.
2. Delay Time: The duration of the charging overvoltage setting
3. Recovery Voltage: Setting the voltage to cancel the overvoltage warning.
When in charging state, MCU detects the voltage of each battery in series, if it finds that the voltage of one battery is higher than the charging over-voltage setting, and the delay time has passed, then MCU will issue a warning (flag, IO output) to remind until MCU detects the voltage of each battery in series, and all of them are lower than the recovery voltage setting point, then the warning will be canceled and return to the normal state.
4. Over Temperature: Charge over temperature setting
5. Delay Time: The duration of the charging over-temperature setting.
6. Recovery Temperature: Setting of recovery temperature when charging over-temperature warning is canceled.
When the MCU detects the temperature is higher than the charging over-temperature setting and the delay time is over, the MCU will issue a warning (flag, IO output) until the MCU detects the temperature is lower than the recovery temperature setting, then the warning will be canceled and the normal state will be restored.
7. Overcurrent: Charge overcurrent setting.
8. Delay Time: Setting of the duration of the charging overcurrent.
9. Recovery current: Setting of recovery current when charging overcurrent warning is canceled.
When the MCU detects the current is higher than the overcurrent setting and the delay time is over, the MCU will issue a warning (flag, IO output) until the MCU detects the current is lower than the recovery current setting, then the warning will be canceled and the normal state will be restored.
10. Protect Time: The maximum time allowed for charging is set. When the MCU detects the charging state, it will start counting the charging time (when it is in the discharging state or stop charging, the counting will be cleared), if the counting time exceeds the protection time setting (to maintain the process of charging, but not yet fully charged), then the MCU will send out a warning (register flags, IO outputs) reminder, and not until the charging state disappears, the warning will be eliminated, and the state will be back to normal.
11. IC Protection Voltage: Over-voltage setting of external protection IC.
12. Charger CC mode current: Maximum output current of the external charger (CC mode state).

Threshold: When this item is selected, the contents as shown in Figure 2-13.



The screenshot shows the 'megawin 3S Gauge v1.1.0' window. The 'Set' tab is active, and the 'Threshold' option is selected in the left sidebar. The main area displays configuration settings for Configuration 1 and Configuration 2. Configuration 2 is checked. The settings include SOC (State of Charge) and voltage thresholds for full and empty states, with checkboxes to enable or disable each.

| Configuration | Full SOC set (%) | Clear (%) | Empty SOC set (%) | Clear (%) | Full voltage set(cell) (mV) | Clear (mV) | Empty voltage set(cell) (mV) | Clear (mV) | Full voltage set(pack) (mV) | Clear (mV) | Empty voltage set(pack) (mV) | Clear (mV) |
|---|------------------|-----------|-------------------|-----------|-----------------------------|------------|------------------------------|------------|-----------------------------|------------|------------------------------|------------|
| Configuration 1 | 98 | 96 | 2 | 5 | 4180 | 4170 | 3300 | 3500 | 12500 | 12400 | 9000 | 9500 |
| Configuration 2 <input checked="" type="checkbox"/> | | | | | | | | | | | | |

Figure 2-13 Threshold Parameters

For charging to full and discharging to empty warning settings, the percentage of capacity (SOC), the total voltage of the series connected batteries (pack), and the individual cell voltages of the series connected batteries (cell) are provided for selection.

1. SOC charge full flag raise: When the calculated SOC value is greater than the charge flag raise setting, the charge flag will be raised.
2. Clear: When the SOC value is less than the clear setting, the full flag will be cleared.
When the MCU calculates the SOC is greater than the saturation flag setting, the saturation flag will be raised to notify the system that it has been fully charged until the calculated SOC is lower than the clear setting, then the saturation flag will be cleared and the normal state will be restored.
3. SOC empty flag raise: SOC is less than the SOC empty flag raise setting, the release flag will be raised.
4. Clear: The SOC is greater than the Clear setting, and the empty flag will be cleared.
When MCU calculates the SOC is lower than the deflate flag raise setting, the deflate flag will be raised to notify the system that it has been discharged to empty until the calculated SOC is higher than clear setting, the deflate flag will be cleared and return to normal state.
5. The battery voltage charge full flag raised: When the battery voltage is higher than the battery voltage charge full flag raised setting, the charge flag will be raised.
6. Clear: The battery voltage is below the clear setting, the full flag will be cleared.

When the MCU detects the voltage of each battery in series, if the voltage of a battery is higher than the battery voltage charging and saturating flag raising setting, the charging and saturating flag will be raised to notify the system that it has been fully charged, and the charging and saturating flag will be cleared only when the MCU detects that the voltage of each voltage in series is lower than the clearing setting, and then the charging and saturating flag will be cleared, and the system will be restored to normal state.

7. Battery pack voltage charge full flag raised: When the total voltage of the series connected batteries is higher than the battery pack voltage charge full flag raised setting, the charge flag will be raised.
8. Clear: When the pack voltage of the serial batteries is lower than the clear setting, the charging flag will be cleared.

When the MCU detects that pack voltage of the serial batteries is higher than the battery pack voltage charging and saturation flag raise setting, the charging and saturation flag will be raised to inform the system that it has been fully charged, and the charging and saturation flag will be cleared until the MCU detects that the total voltage of the serial batteries is lower than the clearing setting, and the charging and saturation flag will be cleared, and the system will be restored to normal state.

9. Battery voltage empty flag raised: The battery voltage is lower than the battery voltage empty flag raised setting and the empty flag will be raised.
10. Clear: The battery voltage is above the clear setting and the empty flag will be cleared.

When MCU detects the voltage of each battery in series, if the voltage of one battery is lower than the battery discharge flag setting, the discharge flag will be raised to notify the system that it has been discharged to empty until MCU detects that the voltage of each battery in series is higher than the clear setting, the discharge flag will be cleared and the system will be back to normal state.

11. Battery pack voltage empty flag raised: When the pack voltage is lower than the battery pack voltage empty flag raised setting, the empty flag will be raised.
12. Clear: When the pack voltage is higher than the clear setting, the empty flag will be cleared.

When the MCU detects the total voltage of the serial batteries, if it is lower than the battery pack voltage bleed flag setting, the bleed flag will be raised to notify the system that it has been discharged to empty until the MCU detects that the total voltage of the serial batteries is higher than the cleared setting, the bleed flag will be cleared and the system will be back to normal status.

Thermal Resistance Meter: After selecting this item, the contents are shown in Figure 2-14.

The EVM is connected to the thermistor with negative temperature coefficient, and the MCU measures the voltage on it. According to the table (temperature-voltage correspondence table) built in Figure 2-19, the Celsius temperature is converted to Celsius temperature by using the voltage, and the Celsius temperature is finally displayed in the GUI.

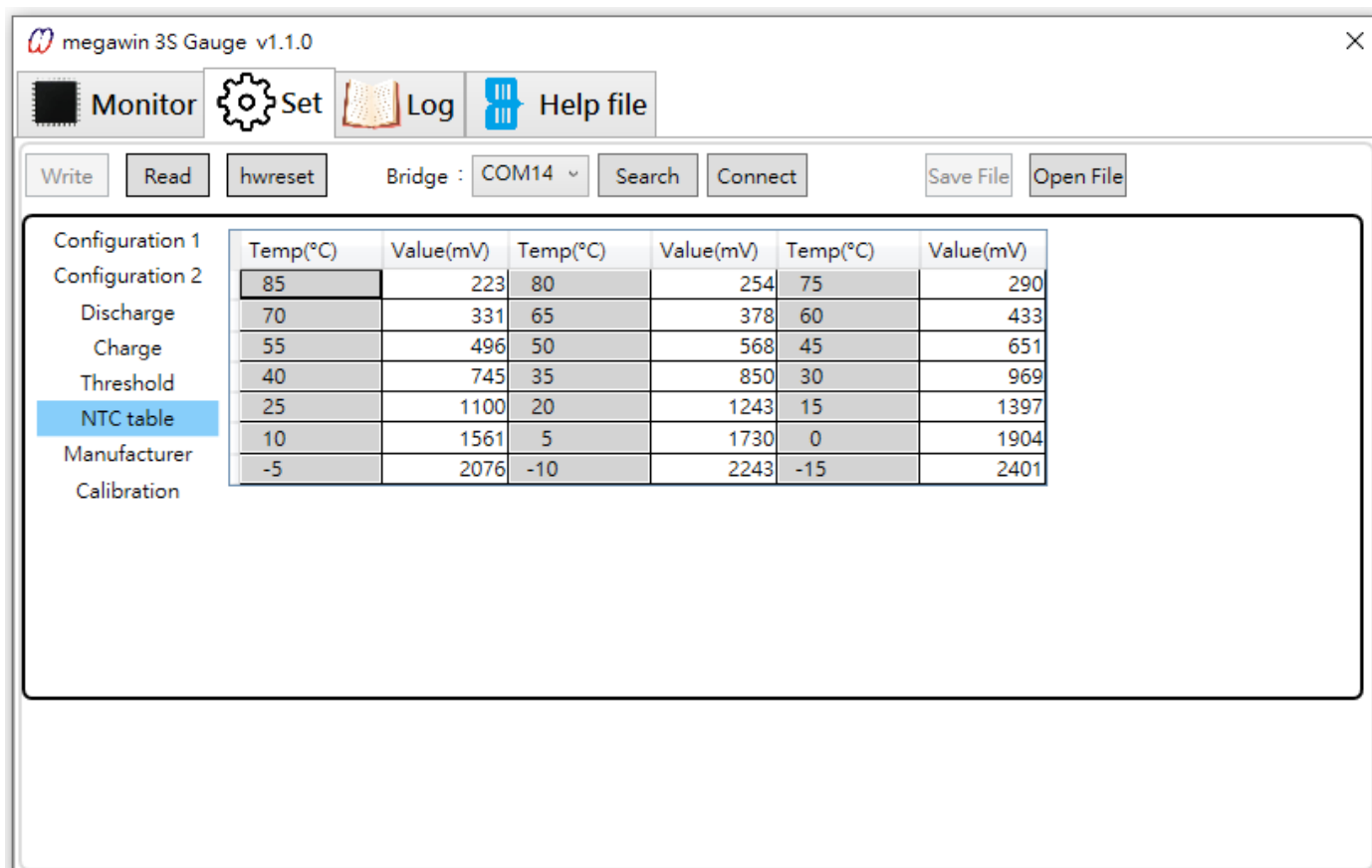


Figure 2-14 Thermal Resistance Parameter Page

Manufacturer Information: After selecting this item, the contents are shown in Figure 2-15.

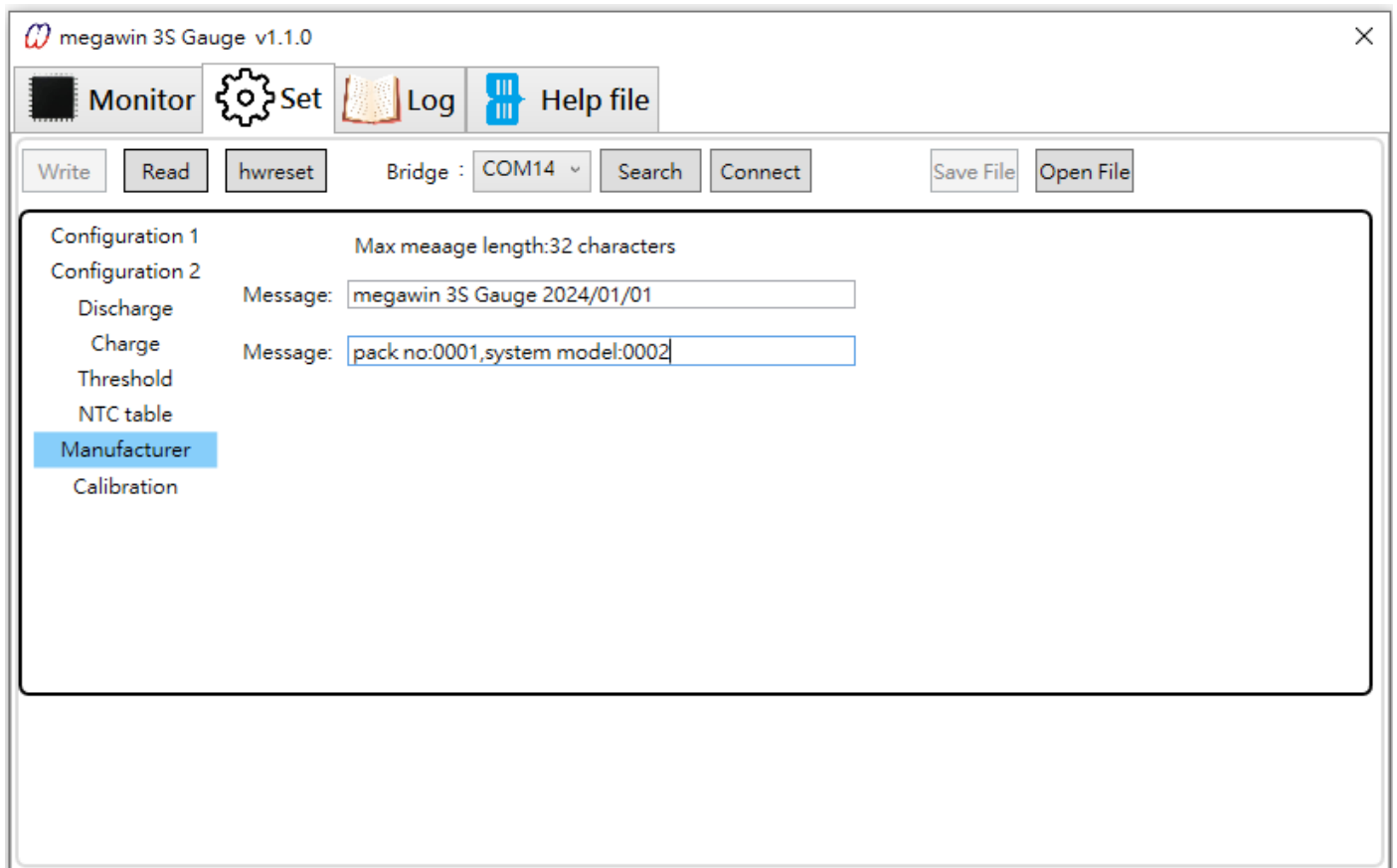


Figure 2-15 Manufacturer Information Parameter Setting

Provide 2 messages (max. 32 Byte) for user to write marking information (date of manufacture, battery lot number) etc.

2.3 Operation status monitoring

Dynamic monitoring of the battery's operating status allows the user to take appropriate action based on the reported information.

2.3.1 Page Description

Tap the Watch field in the function menu (labeled 1 below), and this menu will contain three main sections, namely the Start/Stop button (labeled 2 below), the battery message area (labeled 3 below), and the connection message display (labeled 4 below).

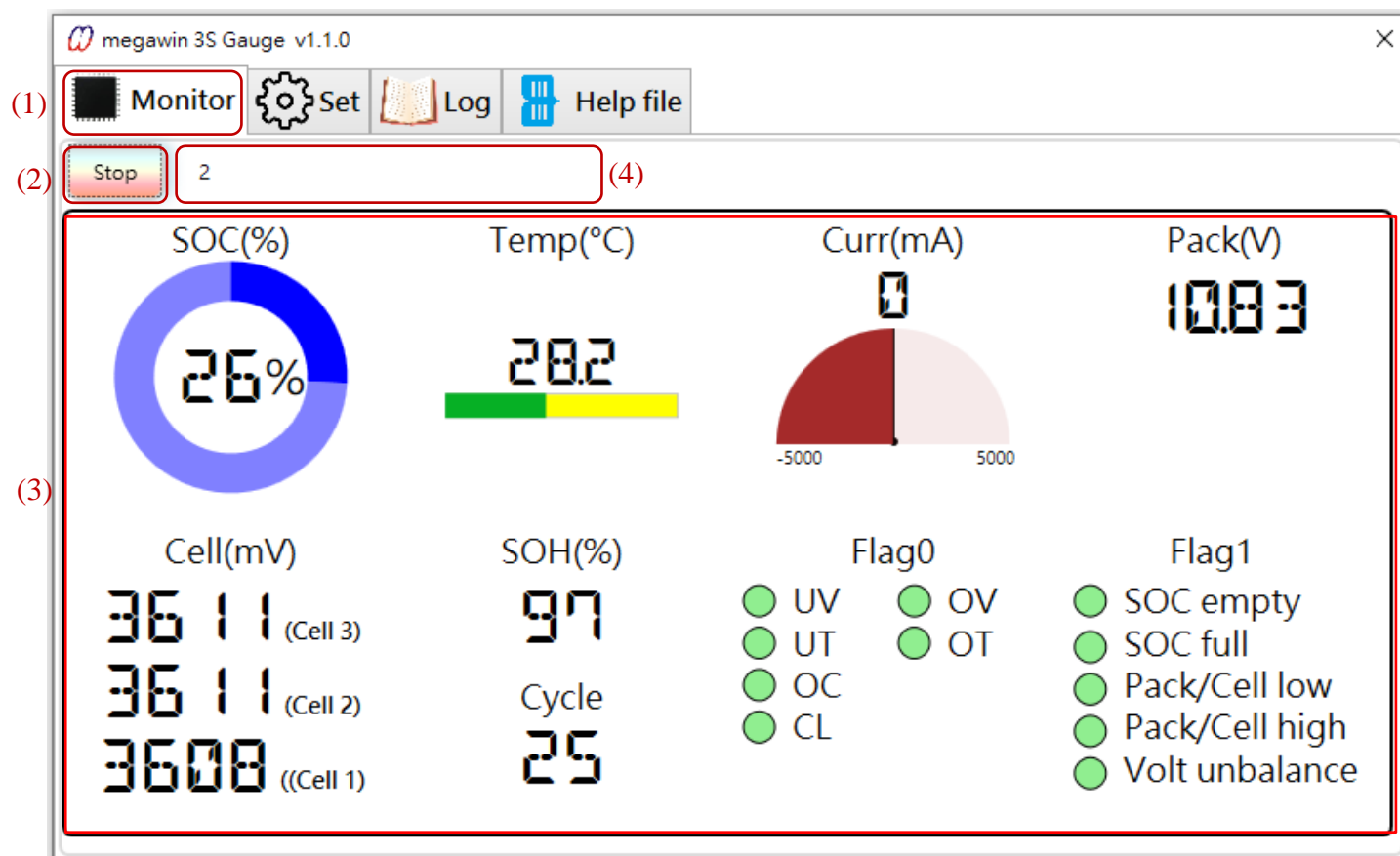


Figure 2-16 Battery Message Monitor Page

The connection message display area contains the following 9 major sections:

1. SOC display (labeled 1 below): Displays the remaining capacity of the battery, 100% means the battery is fully charged, 0% means the battery capacity has been discharged.
2. Temperature display (labeled 2 below): Displays the temperature detected by the external thermistor.
3. Current display (labeled 3 below): Displays the current through the battery pack, with a positive sign indicating that an external device is charging the series battery and a negative sign indicating that an external load is discharging the series battery.
4. Battery pack voltage display (labeled 4 below): Displays the total voltage of the series batteries.
5. Each battery voltage display (labeled 5 below): Displays the voltage of each battery.
6. SOC display (labeled 6 below) : Battery health level display. When it drops to 0%, it means the battery pack needs to be replaced.

7. Cycle display (labeled 7 below) : Discharge Count. When the CC THD value is exceeded (Setup Configuration 2 parameter), the number of discharging times will be increased by 1.
8. Battery operation warning display (labeled 8 below) : Monitor the battery operation status, determine whether the battery has abnormal operation (under/over-voltage, under/over-temperature, operation over-current, charging time abnormality), if the detection of abnormalities, the light will change from green to red until the abnormality disappears, the light will change to green again.
9. Battery operation warning display (labeled 9 below) : Battery voltage difference is too large for detecting the voltage of each battery in series, when the voltage difference between the batteries is found to be too large (battery inconsistency), a warning will be issued and it is recommended to replace the batteries. Capacity discharge and saturation, battery (group) voltage discharge and saturation prompt, according to the user settings, and debut off signal.

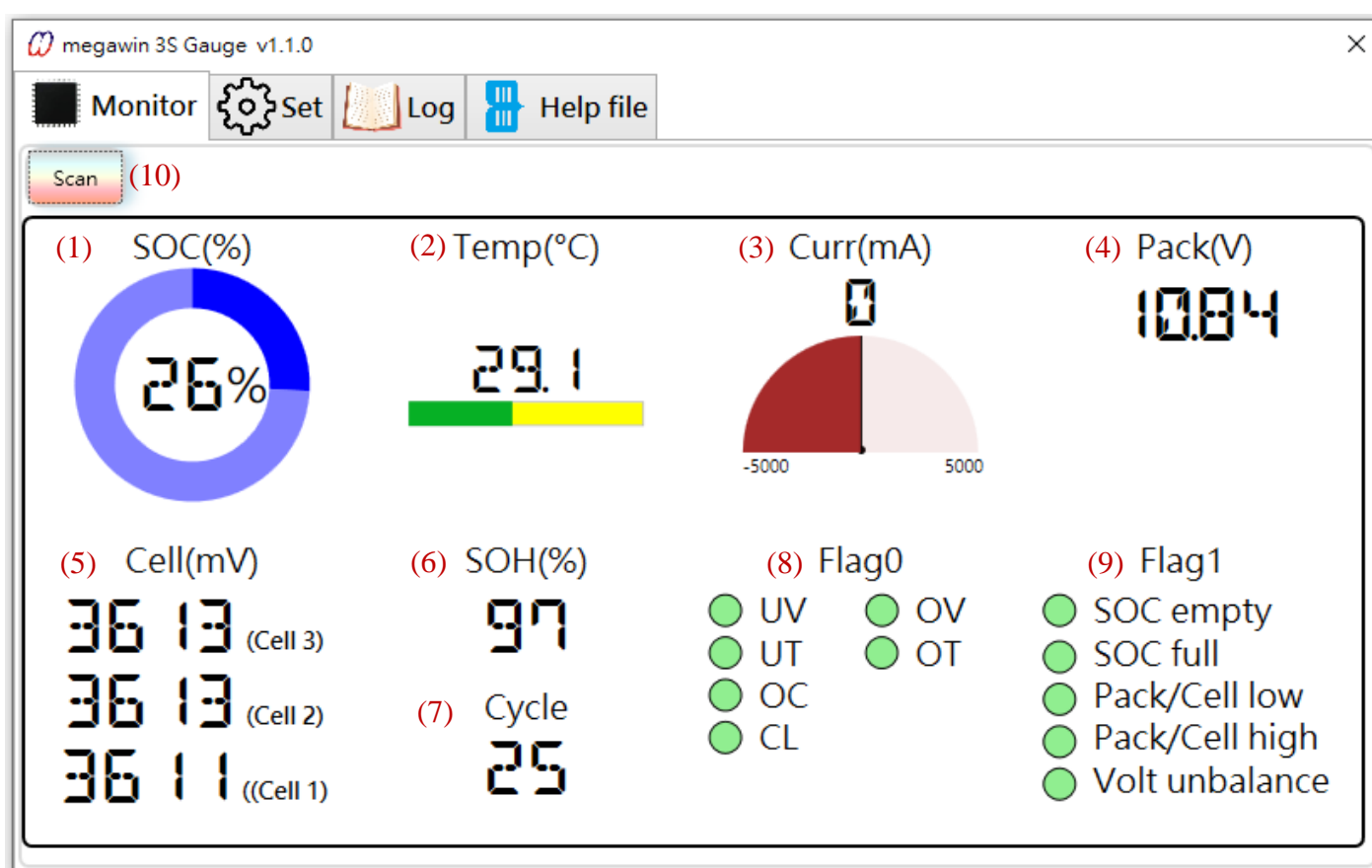


Figure 2-17 Battery Message Monitor - explanation

2.3.2 Operating Instruction

After user presses the scan button, the text of this button will change to stop (as Figure 2-16 labeled 2), and press the button again the text will return to scanning, and in the detection status, it will show the connection status of GUI and MCU (as Figure 2-16 labeled 4, the number indicates the number of times it has been scanned consecutively), and update the battery information regularly.

2.4 History Analysis

When the system has been running for a period of time, if you find that the frequency of battery voltage difference lights increases, or the health of the battery decreases too quickly, then you can read the battery history data to understand the battery's operating behavior on the system, and do a preliminary analysis.

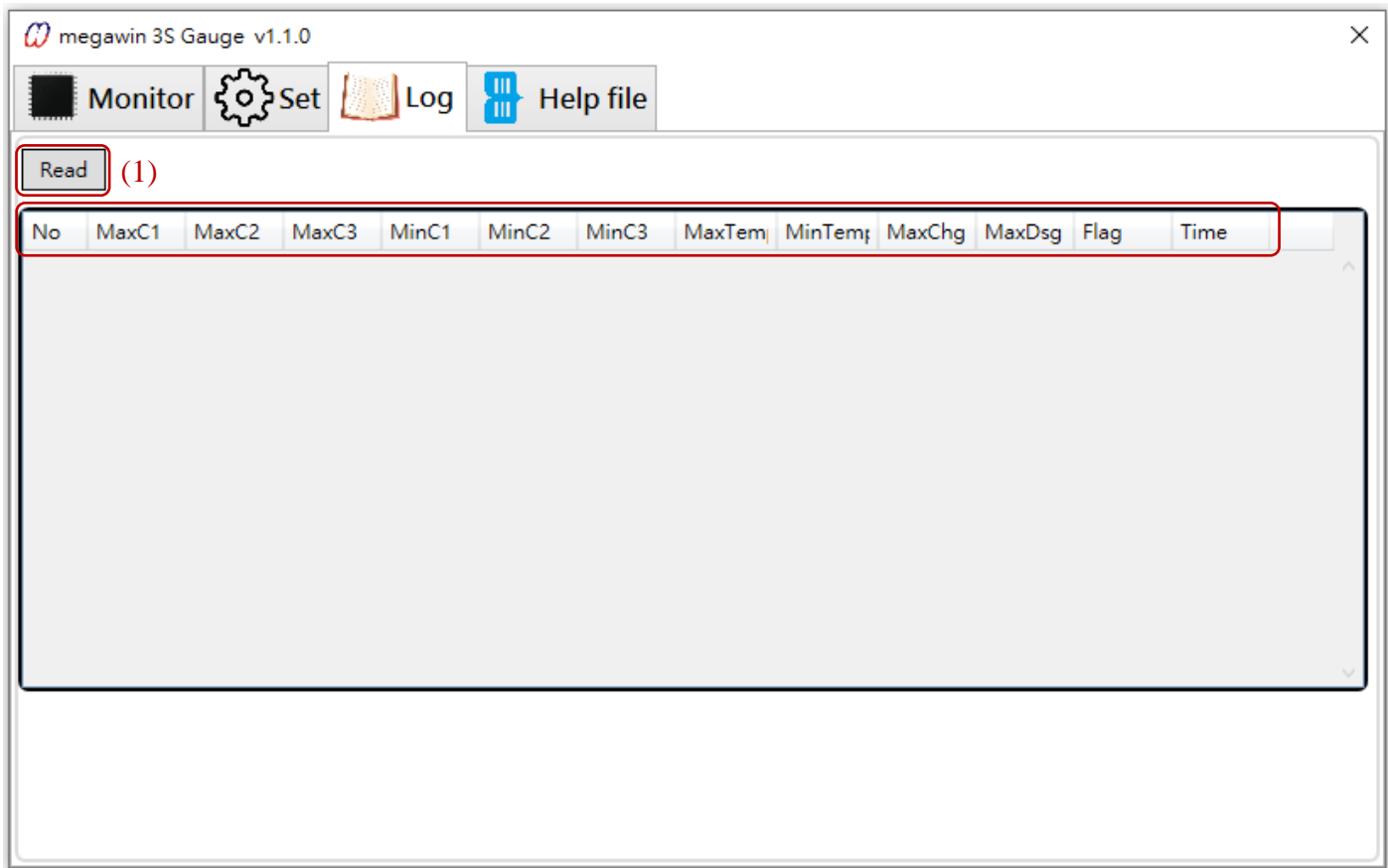


Figure 2-18 History Data Screen

2.4.1 Interface

The history for the battery in the operation process, every 32 Cycle number a record unit, record the use of the state in it, as shown in the above Figure, the contents of which contains the series connected to the battery of each battery in the operating state of the highest / lowest voltage, the maximum / minimum temperature, the maximum charging current, the maximum discharging current, the state of the warning occurs (Flag 0), the last cycle occurs in the time, so that analysts, from the data of the history of the battery in the system, to understand the behavior of the battery in the operation of this system.

Note: From the time column, you can understand whether the system is operated frequently, from the maximum discharge current, you can understand whether it is operated abnormally, and from the battery voltage, you can understand whether the imbalance occurs gradually.

2.4.2 Operating Instruction

When the button reads out (Figure 1 above), a warning message will pop up to tell you not to operate in the charging and discharging status, if you press OK, it will start to read until the confirmation box appears after reading.