

PORTABLE BATTERY ANALYZER

Model No. IT27-20

USER MANUAL



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1. ABOUT THE PBA

Portable Battery Analyzer (PBA) is developed for Insight series batteries and is used to acquire information and status of both individual batteries and battery bank (multiple batteries connected in parallel). By connecting the PBA to the CAN bus port of the battery, Battery's SOC, cycle count, cell voltages and other useful information in real time can be retrieved. PBA also capable to update battery's software, record battery performance for subsequent analysis.

2. PRODUCT PERFORMANCE

2.1 TECHNICAL SPECIFICATION

| | | |
|--------------------|--------------|---|
| Battery | Type | 18650 Cylindrical Lithium-ion Battery |
| | Capacity | 11.7Wh/ 3.67V 3200mAh |
| Dimensions (LWH) | | 170.7 *76.5 *32 mm / 6.72*3.0*1.26inch |
| Weight | | About 0.28KG/0.62lb |
| Input Recharging | | DC 5V - 2A |
| Fully Charge Time | | > 3hr |
| Charge Port | | USB Type C |
| LCD Display | Color | 16.7M colors |
| | Display size | 56.16mm (W) ×93.6mm (H) |
| | Resolution | 480x800 Pixel Matrix |
| | Backlight | LED |
| | Brightness | 250nit |
| Communication Port | CAN | Compatible with the CANBus cable of Insight's batteries |

| | | |
|------------------|------------|---|
| | USB TYPE-C | Access TF memory card & Re-charge the PBA |
| External Storage | | micro SD (TF) card with more than 4GB available space in FAT32 format. |
| Temperature | Operating | -20°C - 50°C |
| | Storage | -20°C - 40°C |
| | Charging | 10°C - 45°C |
| Humidity | Operating | 10 - 90%RH, non condensing |
| | Storage | 25 - 85%RH, non condensing |
| Package Include | | 1x IT27-20 Portable Battery Analyzer 1x LG INR18650-MH1 Lithium-ion cell |

2.2 Power LED Indicator

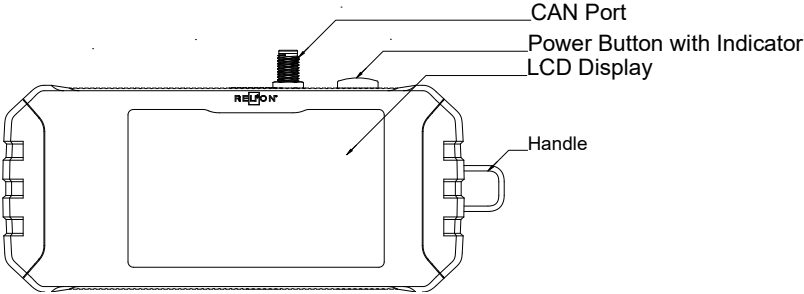
| Status | Description |
|--|---------------------------|
| Communicating with external device | Green LED blinking at 1Hz |
| PBA on charging | Blue LED Blinking at 1Hz |
| PBA is fully charged or the PBA is powered by the external power | Blue LED remains ON |

2.3 Buzzer

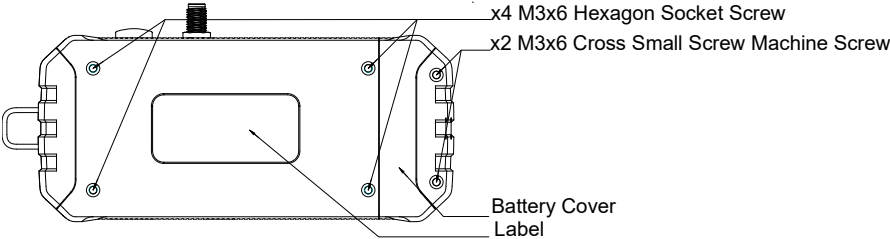
- When a battery symbol turns RED, a continuous "beep..." sound will generate too, indicates that the battery is about to run out.
- When a temperature symbol come out, a continuous "beep..." sound will generate, indicates that internal temperature of PBA is out of the range.

3. PRODUCT STRUCTURE INTRODUCTION

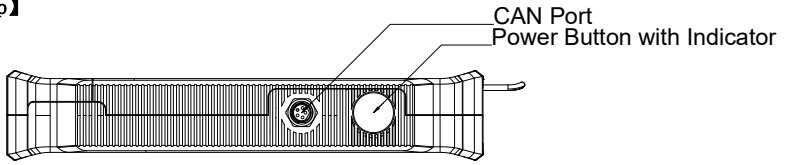
【Front】



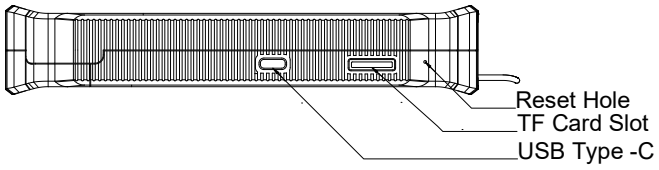
【Back】



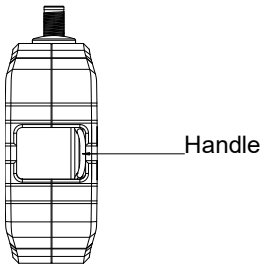
【Top】



【Bottom】



【Right】

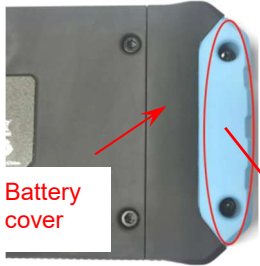


【Left】



4. PRODUCT DESCRIPTION

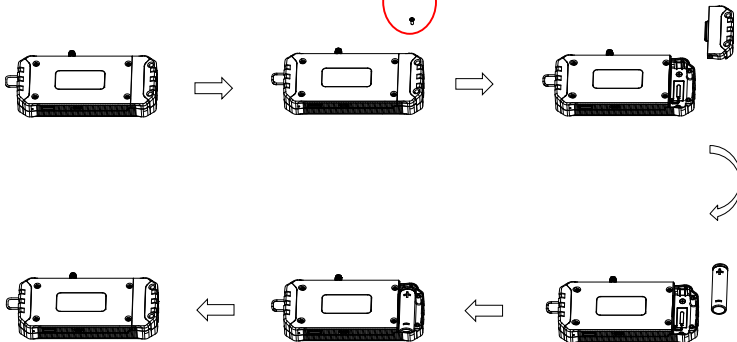
4.1 How to install or replace 18650 Lithium battery into PBA?



Use a cross slot screwdriver to remove 2pcs M3 cross machine screws (Red arrow), and open the battery cover. And then install a 18650 cylindrical cell into the battery compartment.

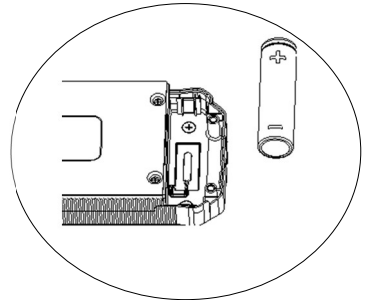
If one would like to take out the cell, please turn off the device first.

【Back】



❖ Note:

1. Pay attention to the positive and negative poles of cell when installing or replacing a 18650 cylindrical cell.
2. Please use 18650 lithium-ion cell, cell type like alkaline battery, nickel-metal hydride battery, manganese battery or hydrogen oxygen battery, etc are inappropriate.



4.2 How to charge the PBA?

When a battery symbol turns red and a continuous "beep..." sound come out, indicates that the battery is about to run out. "Battery Power Low device shutdown within 10s." will prompt out when the energy is too low.

In order to avoid the automatic shutdown due to insufficient power, please pay attention to the battery energy level and recharge regularly.

If there is nothing response in PBA even the power button is pressed, indicates that the battery power may be exhausted.

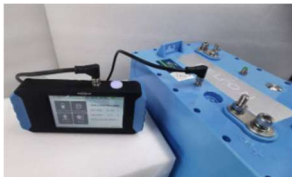
The PBA can be charged in the following way:



Charge the PBA through the USB-C:
Connect the PBA to any 5Vdc output supply.

The PBA is under charging when the blue LED indicator is blinking. Upon fully charge, the blue LED indicator stop blinking and remains on.

4.3 How to connect the PBA with Insight battery?



By using the Insight CANBus cable to connect between PBA and battery

4.4 How to Power on / off the PBA?



- Turn ON: Press and hold the white power button (red arrow) for 3Sec till the button LED is on, the PBA will be turned on and the LCD screen is ON
- Turn off: First disconnect external charging, then press and hold the power button for 3Sec, the PBA will be turned OFF.

4.5 Insert TF card to the PBA



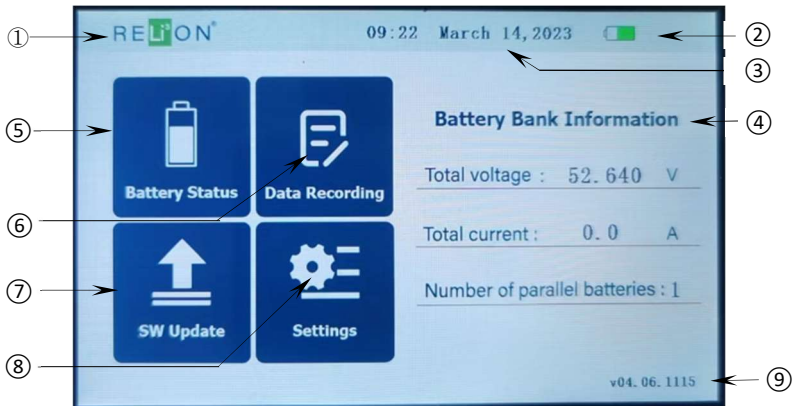
When recording battery pack data or upgrading battery pack software, please insert the TF memory card into the TF slot at the bottom of the PBA.

If you need to update the battery software, copy the updated files to the pre-established "UPDdatE" folder on the TF card.

4.6 How to operate the PBA?

4.6.1 Main Menu

The main menu which contains Battery Bank Information, Battery Status, Data Recording, SW Update



① **Logo**

② **Battery power level**

③ **Time, Date**

④ **Battery Bank Information**

- Total voltage
Display the bus terminal voltage value of the entire battery bank
- Total current
Display output current value of the entire battery bank
- Number of parallel batteries
Display the total number of parallel batteries

⑤ **Battery Status**

To retrieve battery information and status

⑥ **Data Recording**

To real time record the battery data, record files are generated and saved in an external memory card (TF card)

⑦ **SW Update**

To update the firmware (.HEX) and parameter (.SET) of battery.
Update is only valid for one battery at a time.

⑧ **Settings**

To set up the PBA

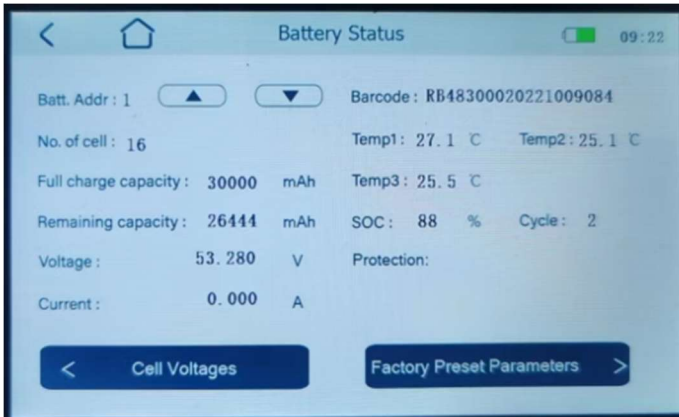
⑨ **PBA Interface Version**

4.6.2 Read the Battery Status from External Battery Packs



Click the icon “**Battery status**” of the main menu, then go to “Battery Status” page:

4.6.2.1 Battery Status



- **Batt. Addr**
Battery Address Selection
Press the ▲ or ▼ to change the battery address value to select corresponding battery connected to the PBA, default is 1 (the first battery connected to the PBA), value range: 0~255
- **No. of cell**
Number of the cell inside the selected battery
- **Barcode**
Barcode of the selected battery
- **Full charge capacity**
Full charge capacity of the selected battery
- **Remaining capacity**
Remaining capacity of the selected battery
- **Voltage**
Battery pack voltage of the selected battery
- **Current**
Battery pack current of the selected battery

➤ **Temp1, Temp2, Temp3**

Value of corresponding temperature sensors inside the selected battery

➤ **SOC**

State of Charge (SOC) in percentage of the selected battery

➤ **Cycle**

Cycle count of the selected battery



➤ **Protection**

When battery protection triggered, the corresponding types will be displayed, maximum two items will be displayed.

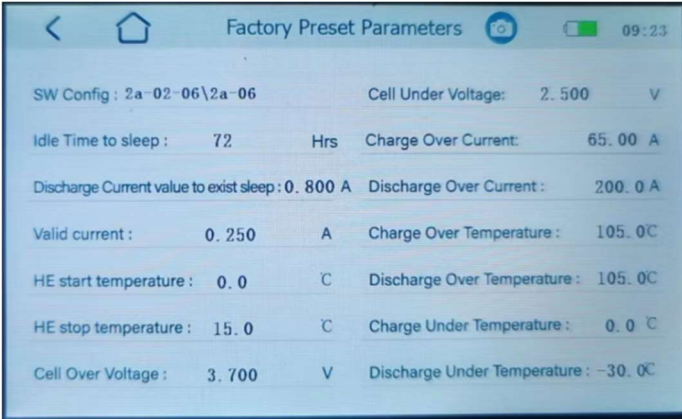
| | |
|------------|---|
| Protection | Over Temperature Protection in Charging |
| | Over Temperature Protection in Discharging |
| | Under Temperature Protection in Charging |
| | Under Temperature Protection in Discharging |
| | Over Voltage Protection |
| | Under Voltage Protection |
| | Over Current Protection in Charging |
| | Over Current Protection in Discharging |

4.6.2.2 Cell Voltage

| Cell | Voltage (mV) |
|--------|--------------|
| Cell1 | 3327 |
| Cell2 | 3327 |
| Cell3 | 3326 |
| Cell4 | 3308 |
| Cell5 | 3328 |
| Cell6 | 3329 |
| Cell7 | 3328 |
| Cell8 | 3328 |
| Cell9 | 3328 |
| Cell10 | 3329 |
| Cell11 | 3327 |
| Cell12 | 3329 |
| Cell13 | 3327 |
| Cell14 | 3328 |
| Cell15 | 3327 |
| Cell16 | 3373 |

- ◇ Display the voltage of each cell of the selected battery, number of cells depend on the battery configuration.
- ◇ Default is 0, indicates either no cell is occupied or open circuited.
- ◇ Click the icon  or swipe the screen to the left will return to **Battery Status** page
- ◇ Click the icon  will return to **Main Menu** page.

4.6.2.3 Factory Preset Parameters




| Factory Preset Parameters | | | |
|--|--------------------------|-------------------------------|---------|
| SW Config : 2a-02-06\2a-06 | Cell Under Voltage: | 2.500 | V |
| Idle Time to sleep : 72 | Hrs | Charge Over Current: | 65.00 A |
| Discharge Current value to exist sleep : 0.800 A | Discharge Over Current : | 200.0 A | |
| Valid current : 0.250 | A | Charge Over Temperature : | 105.0C |
| HE start temperature : 0.0 | C | Discharge Over Temperature : | 105.0C |
| HE stop temperature : 15.0 | C | Charge Under Temperature : | 0.0 C |
| Cell Over Voltage : 3.700 | V | Discharge Under Temperature : | -30.0C |



- **SW Config**
Configuration number of the selected battery.
- **Idle Time to sleep**
Default setting is 72 hours.
- **Valid Current**
- **HE Start temperature**
- **HE Stop temperature**
- **Cell Over Voltage**
- **Cell Under Voltage**
- **Charge Over Current**
- **Discharge Over Current**

- **Charge Over Temperature**
- **Discharge Over Temperature**
- **Charger Under Temperature**
- **Discharge Under Temperature**

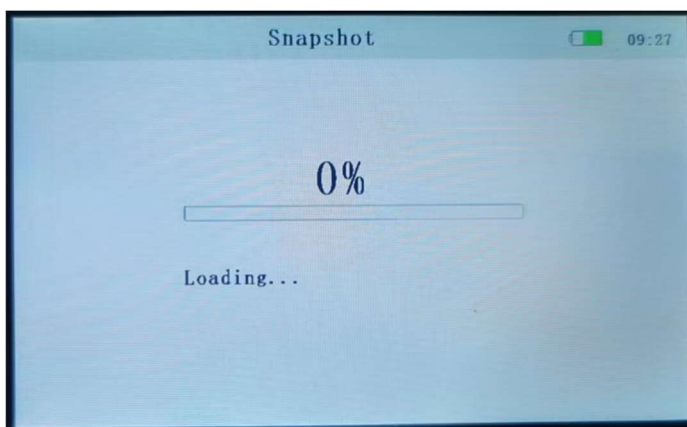
(*Refer to battery pack specification for detail of the above parameters*)

- ✧ Click the icon  on top of the screen will read the EEPROM data of the selected battery and save as EE file in TF card. After clicking this icon, the display will automatically jump to **Snapshot page** to display the data reading progress, and will automatically returned to **Factory Preset Parameters** 5 seconds after successfully download. If download is failed, the display will go to **Error page**.

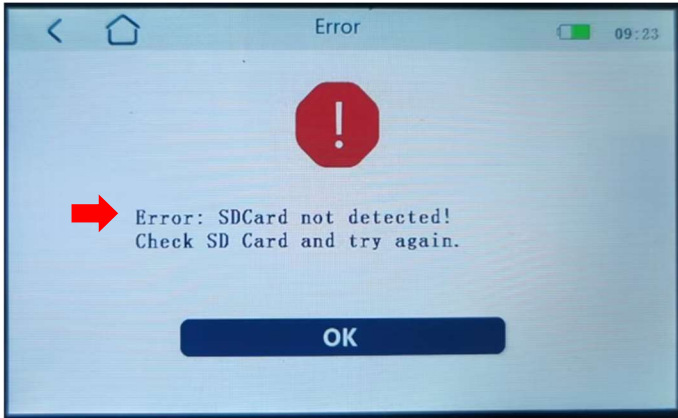
Note: this EE file is only for engineer to analysis

- ✧ Click the icon  will return to **Battery Status** page.
- ✧ Click the icon  will return to **Main Menu** page.



4.6.2.4 Snapshot Page



4.6.2.5 Error Page



- ❖ **Error description** displays the specific error messages as below:
 - ✓ **Snapshot Error:** Exception on Save File!
 - ✓ **Snapshot Error:** Exception on eject SD!
 - ✓ **Snapshot Error:** Read Data Failed! Battery %d might be not exist. Check connection and try again.

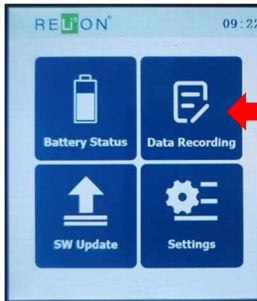
- ❖ Click the icon  or  will return to **Main Menu** page.

- ❖ Click **OK** will also return to **Main Menu** page.

4.6.3 Recording data from External Battery Pack

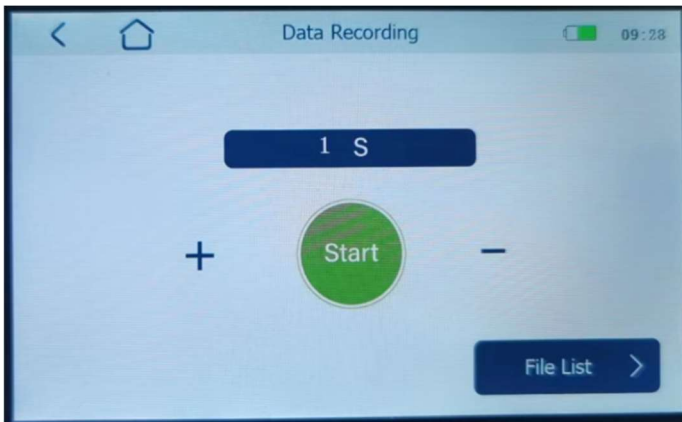
- ✧ Please insert the TF card before using this function.

Note: Must power off the PBA before insert or remove the memory card. Otherwise, the data may be damaged.






- ✧ Click the icon “Data Recording” of the main menu, then go to “Data Recording” page:

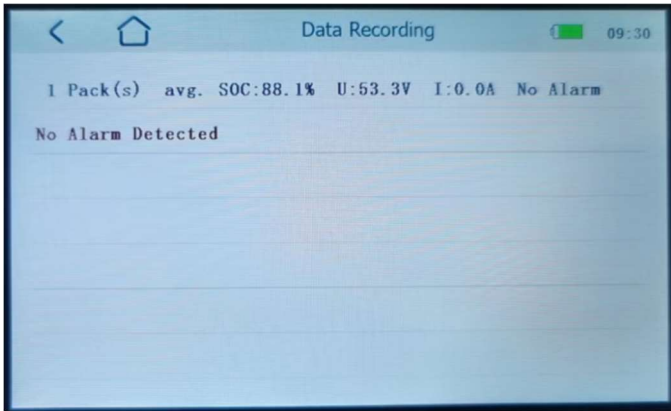
4.6.3.1 Data Record Interval Setting



- ✧ Data recording interval can be changed by clicking + or -, the range is 1~99 Second.

- ✧ Click the icon  will start data recording, and the screen will jump to **Data Recording** page
- ✧ Click **File List** will go to **File List** page
- ✧ Click the icon  or  will return to **Main Menu** page.

4.6.3.2 Data Recording



- ✧ **Battery Bank Information**
When the PBA is connected to the battery, the corresponding battery information will be displayed:

| No. of Pack | Ave. SOC | U (Voltage) | I (Current) | Alarm |
|-------------|----------|-------------|-------------|-------|
|-------------|----------|-------------|-------------|-------|

- ✧ **Error list**
When there is a battery abnormal alarm, the corresponding types will be displayed:

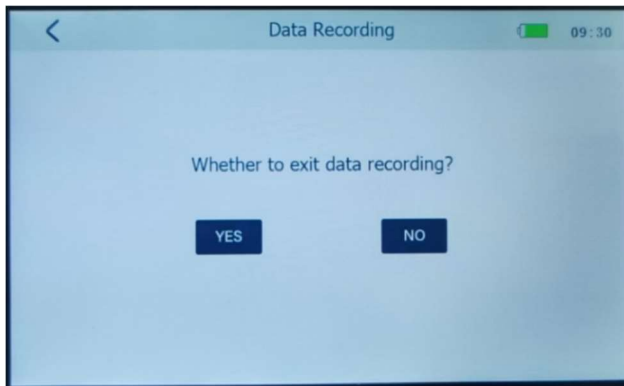
Display format:

| | |
|------------|----------------|
| Error code | Time: |
| S/N addr: | Recording Time |


Error table

| Alarm Status | Error Code |
|---|------------|
| Over Temperature Protection in Charging | OTP @C |
| Over Temperature Protection in Discharging | OTP @D |
| Under Temperature Protection in Charging | UTP@C |
| Under Temperature Protection in Discharging | UTP@D |
| Over Voltage Protection | OVP |
| Under Voltage Protection | UVP |
| Over Current Protection in Charging | OCP@C |
| Over Current Protection in Discharging | OCP@D |

✧ Click the icon  or  will go to exit page.

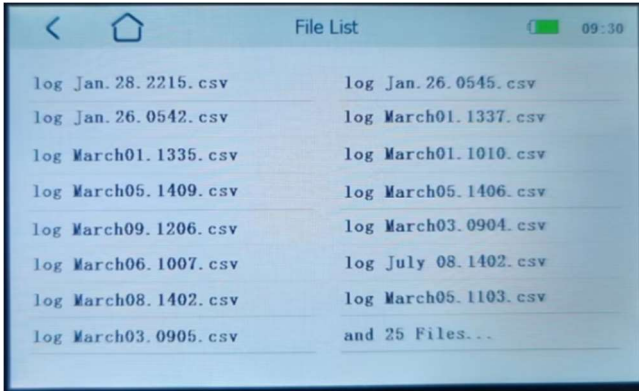


✧ Click Yes will return to Main Menu page, and then the PBA will exist data recording mode.


✧ Click No or  will return to previous page.


4.6.3.4 File List

Datalog files stored in TF card will be displayed here, up to 16 files can be displayed. If there are more than 16, 15 of them will be displayed and message “**and X Files**” will be displayed in lower right corner, **X** is the number of remaining files.



Note: The location File Name is display latest file

✧ Click the icon  will return to previous page.

✧ Click the icon  will return to Main Menu page.

4.6.4 Update the Software to the external Battery Pack

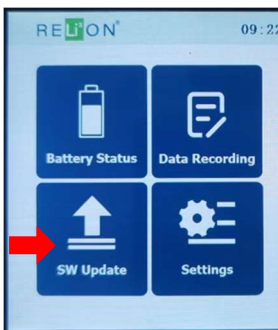
If you need to update the battery software, copy the updated files to the pre-established "UPDdatE" folder on the TF card. For example:

- ✓ **Main Pack hex:** IT24-xx-Mainpack-xxx-xx-xx-xx.hex
- ✓ **Comm. Controller Hex :** IT24-106C-xx-xxx-xx-xx.hex
- ✓ **EEPROM :** EEPROM-xxxxxxxx.set

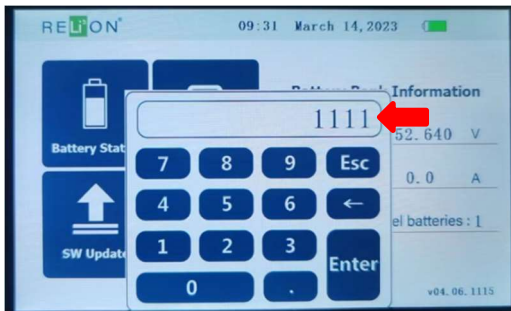
| 名称 | 修改日期 | 类型 | 大小 |
|-----------------------------------|-----------------|--------|-------|
| EEprom-20220413.set | 2022/4/13 14:38 | SET 文件 | 13 KB |
| IT24-4s-Mainpack-AMO-2A-02-06.hex | 2022/3/28 15:56 | HEX 文件 | 44 KB |
| IT24-4s-Mainpack-AMO-2A-02-07.hex | 2022/3/28 15:56 | HEX 文件 | 44 KB |
| IT24-106C-xx-AMO-2A-06.hex | 2022/3/28 15:57 | HEX 文件 | 20 KB |

✧ And then insert TF card to the PBA

✧ Click the icon “**SW Update**” of the main menu, then input password:

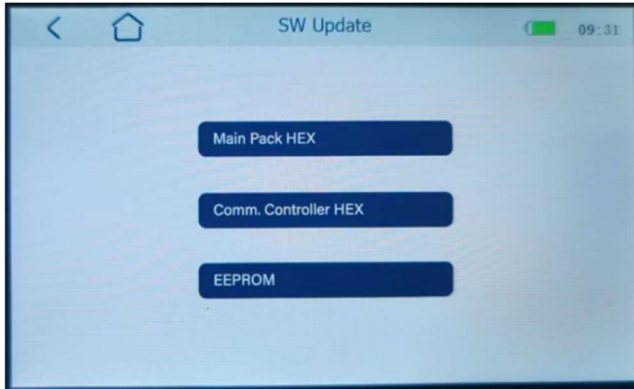


✧ An on-screen keyboard will appear when SW Update is selected, allowing you to input password. (default password is **1111**)



✧ after entering the correct password, the screen will go to SW Update page

4.6.4.1 SW Update operation



➤ **Main Pack Hex**

Update the battery pack firmware of the selected battery.
Click this icon will go to **Main Pack Hex** page.

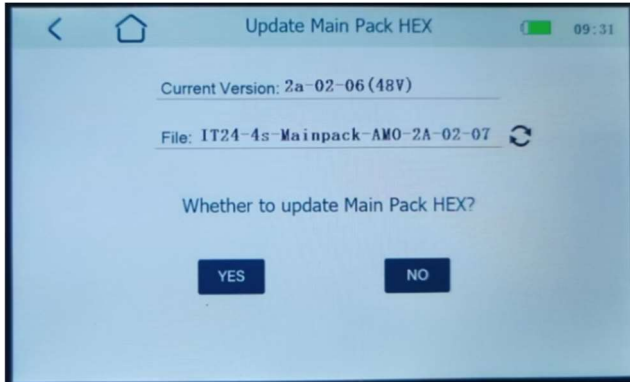
➤ **Comm. Controller Hex**


Update the communication controller firmware of the selected battery.
Click this icon will go to **Comm. Controller Hex** page.

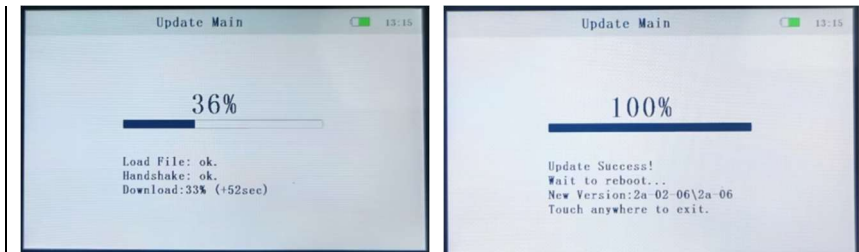
➤ **EEPROM (Only for Engineer)**

Update the EEPROM data of the selected external battery.
Click this icon will go to **EEPROM** page.

4.6.4.2 Update Main Pack Hex

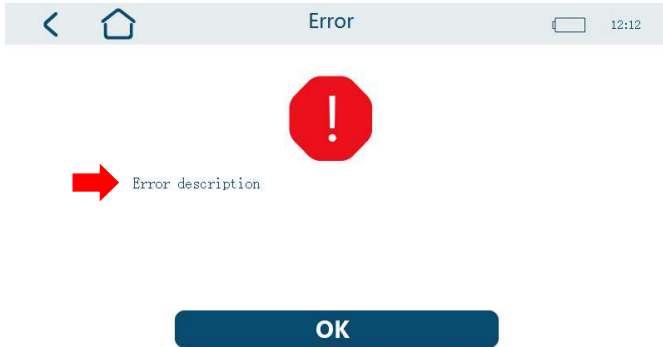






- ✧ Current Version
Battery existing main pack hex version
- ✧ File
PBA default to display the latest version main pack hex file stored in the folder "**UPDdate**". If lower version file is needed, please click the icon  to select file from the folder.
- ✧ Click **YES** will start update the main pack Hex.
 - ✓ The download progress bar is displayed on the **Update Main** page as follows:: When the update is completed, the battery will be reset after 5 seconds



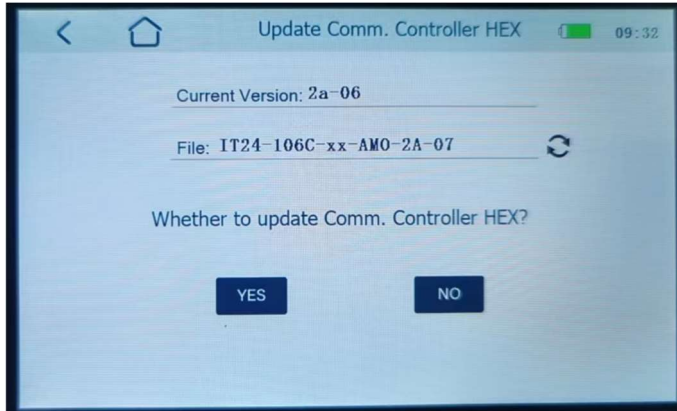
- ✓ And then touch the screen again will return to **SW Update** page.


- ✓ If the download is failed, below page will display with corresponding error message.

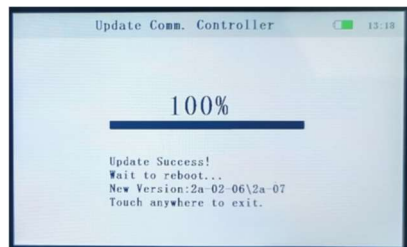
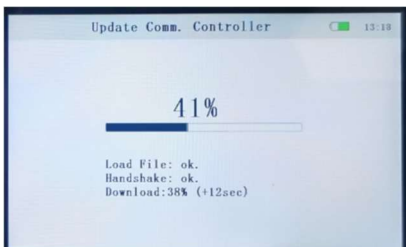


- ◇ **Error description** displays the specific error messages as below statuses:
 - ✓ **Error: File Length Error..**
 - ✓ **Error: Invalid File : XXX (file name)**
 - ✓ **Error: Device Low Power. Not support to download**
 - ✓ **Error: Make sure only ONE Battery on CAN bus.**
 - ✓ **Error on Handshake: Invalid ack: XXX**
 - ✓ **Error: XX No Acknowledge from Battery.**
 - ✓ **Error on write data.**
 - ✓ **Error: Idle mode. Please Exit Idle mode at First.**
 - ✓ **Error: Low Power. Cell Voltage(XXXmV) < 3000mV**
 - ✓ **Error: Low Power. SOC(X%) < 10%.**
- ◇ Click the icon  or the icon , then return to the **Main Menu** page;
- ◇ Or click the OK to return to the **Main Menu** page;
 - ✓ Click NO, then return to **SW Update** page
 - ✓ Click the icon  then return to previous page;
 - ✓ Click the icon , then return to the Main Menu page;

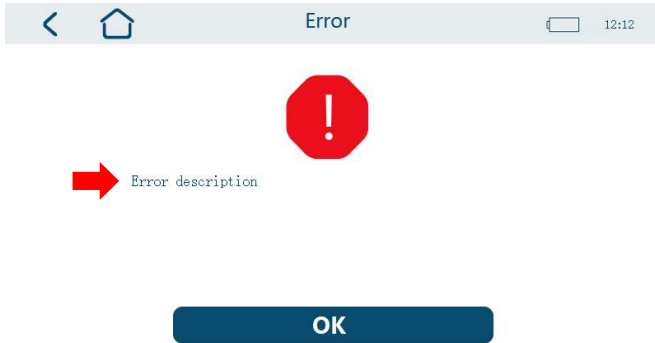
4.6.4.3 Update Comm. Controller Hex



- ✧ Current Version
Battery existing Comm. Controller hex version .
- ✧ File
- ✧ PBA default to display the latest version Comm. Controller hex file stored in the folder "**UPDdatE**". If lower version file is needed, please click the icon  to select file from the folder.
- ✧ Click the icon **YES** then start to update the 106Ccontroller Hex, as below page:
 - ✓ The download progress bar is displayed on the **Update Comm. Controller** page as follows: When the update is completed, the battery will be reset after 5 seconds



- ✓ And then touch the screen, then return to **SW Update** page;
- ✓ If the download is failed, below page will display with the corresponding error message.



✧ **Error description** displays the specific error messages as below statuses:

- ✓ **Error: File Length Error..**
- ✓ **Error: Invalid File : XXX (file name)**
- ✓ **Error: Device Low Power. Not support to download**
- ✓ **Error: Make sure only ONE Battery on CAN bus.**
- ✓ **Error on Handshake: Invalid ack: XXX**
- ✓ **Error: XX No Acknowledge from Battery.**
- ✓ **Error on write data.**
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- ✓ **Error: Low Power. Cell Voltage(XXXXmV) < 3000mV**
- ✓ **Error: Low Power. SOC(X%) < 10%.**

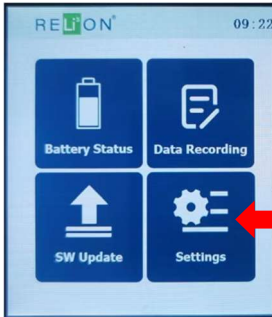
✧ Click the icon  or the icon , then return to the **Main Menu** page;

✧ Or click the **OK** to return to the **Main Menu** page;

4.6.5.4 Update EEPROM Data

Only for authorized personnel. Users are not allowed to update EEPROM without authorization

4.6.6 How to Setup the PBA?



- ✧ Click the icon "**Setting**" of the main menu, then go to "Setting" page:

4.6.6.1 Settings



- **Brightness Adjustment**
To adjust the brightness of PBA screen.
- **Date and Time Setting**
To adjust the date and time
- **Termination Setting**

To include 120Ω termination resistor in CAN communication.

➤ **CAN to USB & File Transfer**



- PBA can act as a battery reader, together with the specific PC interface, one can access the battery via PC
- One can direct access the TF card via PC under this mode

➤ **Update Analyzer FW (Only for authorized personnel)**

To update the PBA's firmware.

4.6.6.2 Brightness Adjustment



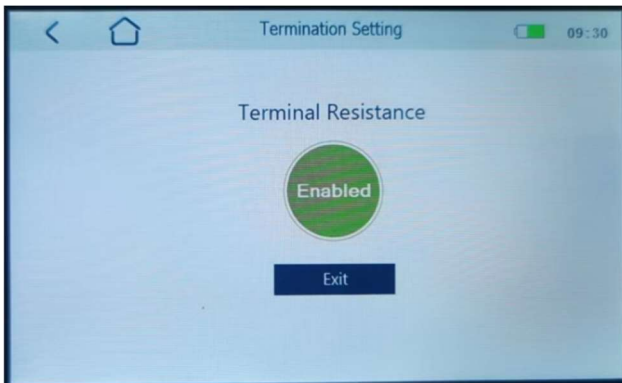
- ◇ swipe left and right to adjust the brightness of the screen;
- ◇ Click the icon  , then return to the previous **Settings** page;
- ◇ Click the icon  , then return to the **Main Menu** page;

4.6.6.3 Date and Time Setting








- ◇ Scroll up and down to select the correct time and date.
- ◇ Default setting is MM/DD/YYYY/HH/MM: 1/1/2000 01:01 (24-hour clock)
- ◇ After completed, then click the icon “OK”, the date and time will be updated and then return to **Settings** page

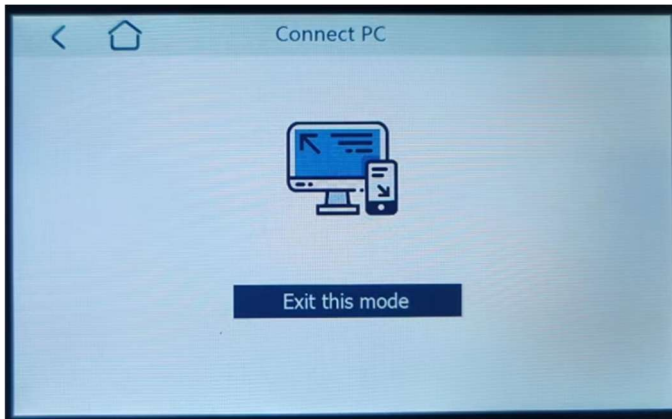
4.6.6.4 CAN Terminal Resistance (120Ω) Setting



If necessary, enable terminal resistance in the CAN communication

- ✧ Click the icon  (default setting is **disable**) to enable 120Ω terminal resistance of PBA.
- ✧ The icon will change to , press once again will disable the 120Ω termination function and the icon will change back to .
- ✧ And then click icon "Exit", return to the **Settings** page;
- ✧ Or click the icon , then return to the **Settings** page;
- ✧ Or click the icon , then return to the **Main Menu** page;

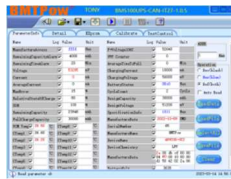
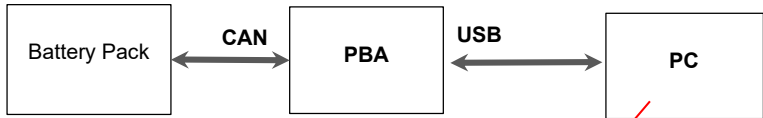
4.6.6.5 CAN to USB & File Transfer





- ✧ If select this mode, the PBA will act as a CAN to USB adaptor, user may use the PC to access the battery and TF card via a specific computer program running in PC

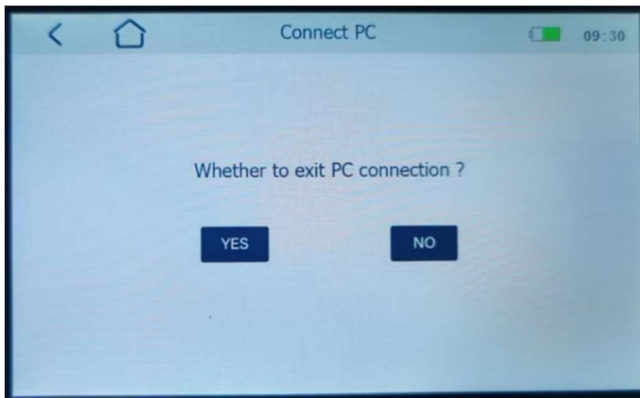
Or when the PBA is On, double click the power button within 1 sec will enter the **CAN to USB adaptor mode also**, in this mode, user can access the



battery information via PC directly. (Related software: BMS100UPS-CAN-xxxx-xxx.exe)



Run the specify interface software

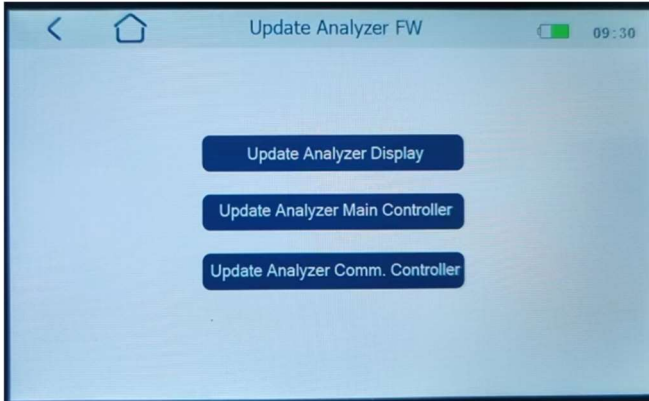
- ◇ To exit this mode, click the icon Exit or the icon  or  , they will all go to the page as below:



- ◇ Click YES, then return to the **Settings** page;
- ◇ Click NO, then return to the previous page;
- ◇ Click the icon  or  , return to the **Main Menu** page.

4.6.6.6 Update PBA FW

✧ **Please note: Only for authorized personnel.**



- **Update Analyzer Display**
Update the PBA's UI;
- **Update Analyzer Main Controller**
Update the main software of PBA;
- **Update Analyzer Comm. Controller**
Update the Communication software of PBA.

5. STORAGE

The product should be stored in a clean, dry and ventilated environment. Contact with corrosive substances should be avoided and away from fire and heat sources.

If the PBA is not used for a prolonged time (for example, more than 6 months), it should be charged up to 50%-70%, and remove the cell from the device, and stored in a dry and cool environment.

If rusts, leaks, bulges and other phenomena found in the Li-ion cell, it should be removed immediately and scrapped in accordance to the local regulation.

6. SAFETY INFORMATION WARNING AND CAUTION

A Warning identifies hazardous conditions and procedures that are dangerous to the user. A Caution identifies conditions and procedures that can cause damage to the Product or the equipment under test.

Warning

- ✓ To prevent possible electrical shock, fire, or personal injury and for safe operation of the Product:
- ✓ Read all safety information before you use the Product.
- ✓ Carefully read all instructions.
- ✓ Do not alter the Product and use only as specified, or the protection supplied by the Product can be compromised.
- ✓ Examine the case before you use the Product. Look for cracks or missing plastic. Carefully look at the insulation around the terminals.
- ✓ Do not use alkaline battery, nickel-metal hydride battery, manganese battery or hydrogen oxygen battery, etc
- ✓ Do not use the Product around explosive gas, vapor, or in damp or wet environments.
- ✓ Do not use the Product if it operates incorrectly.
- ✓ Disable the Product if it is damaged.
- ✓ Do not use the Product if it is altered or damaged.
- ✓ Do not use test leads if they are damaged. Examine the test leads for damaged insulation and measure a known voltage.
- ✓ Do not make connections on hazardous live conductors in damp or wet environments.
- ✓ Do not apply more than the rated voltage, between the terminals or between each terminal and earth ground.
- ✓ Do not operate the touch screen with sharp objects
- ✓ Do not use the Product if the protection film on the touch panel is damaged.
- ✓ Have an approved technician repair the Product.