

# Mini DS203 OSC Manual

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## Intro

DS203 V2.6 is a pocket size 4 channel digital Oscilloscope for common electronic engineering tasks. It's based on ARM cortex M3 (STM32F103VCT6) 32 bits platform, providing 72MS/s sampling rate with integrated FPGA and high speed ADC. Internal 2MB USB disk could be used to store waveform, user application and upgrade firmware. Due to the palm size and handy performance, it fits in-field diagnosis, quick measurement, hobbyist projects and wherever convenience matters. Scheme and source files are also open for re-innovating.

## Features

- Portable and lightweight
- Color display
- Waveform storage and playback
- Two 72MS/s analog channels, plus two digital channels
- Firmware upgradable
- 4 programmable space for user application program
- Open Source

## Specification

|                               |   |
|-------------------------------|---|
| <b>Display</b>                | <b>Full Color 3" TFT LCD 400 X 240</b>      |
| <b>Input channel</b>          | Analog: CH(A)\CH(B)<br>Digital: CH(C)\CH(D) |
| <b>Max sample rate</b>        | 72MS/s, 8bit                                |
| <b>Sample memory depth</b>    | 4096 Points for each channel                |
| <b>Vertical Scale</b>         | 20mV-10V/div(x1 probe)                      |
| <b>Vertical resolution</b>    | 8 bit                                       |
| <b>Horizontal sensitivity</b> | 0.1uS/Div ~ 1S/Div                          |
| <b>Horizontal position</b>    | Adjustable                                  |
| <b>Input coupling</b>         | AC/DC                                       |
| <b>Input impedance</b>        | >800K $\Omega$                              |
| <b>Max input voltage</b>      | 80Vpp(x1 probe)                             |
| <b>Trigger type</b>           | Auto, Normal, Single, SCAN, None            |
| <b>Trigger source</b>         | CH1/CH2/EXT                                 |
| <b>Signal generator</b>       | Sine/Triangle/Saw/Square,10Hz-20K Hz        |

|                                |                                       |
|--------------------------------|---------------------------------------|
| <b>Storage</b>                 | Internal 2MB USB disk, BM P, DAT file |
| <b>Auto measure</b>            | Max, Min, Vbt, FPS, Vpp, Vdc, RMS     |
| <b>Sampling mode</b>           | Real time                             |
| <b>Dimension</b>               | 98 * 60 * 14.5 (mm)                   |
| <b>Weight</b>                  | 80g (without battery)                 |
| <b>Accessories within Pack</b> | 2 mcx oscilloscope probe/battery      |

## Basic Operation

### Install the battery

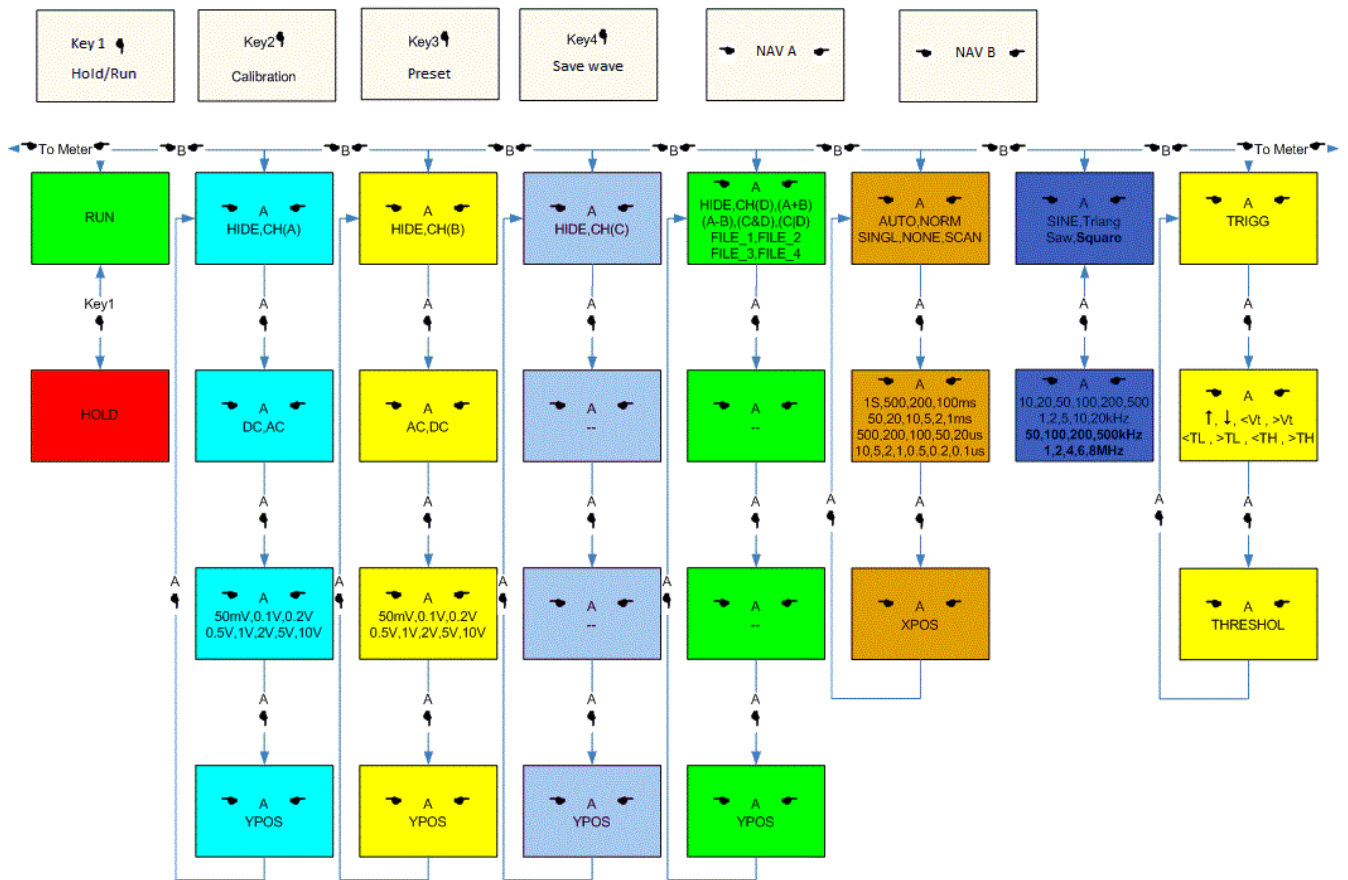




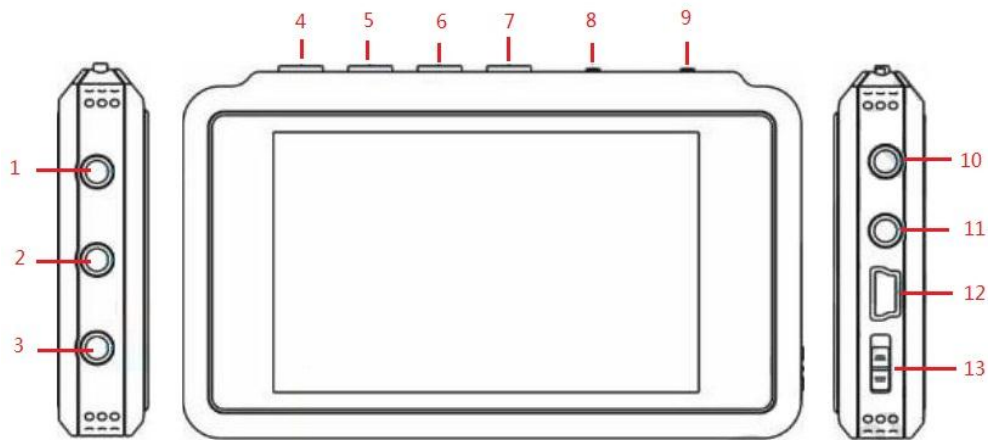
1. Push the back cover toward the Mini USB port direction.
2. Lift the back cover
3. Install the battery

#### Operation Overview





## Buttons



- |                     |           |              |                   |
|---------------------|-----------|--------------|-------------------|
| 1. Signal generator | 2. CH-A   | 3. CH-B      | 4. Run/Hold       |
| 5. Calibrate        | 6. Preset | 7. Save Wave | 8. Navigator A    |
| 9. Navigator B      | 10. CH-C  | 11. CH-D     | 12. Mini USB port |
| 13. Power Switch    |           |              |                   |

*There are 2 navigators and 4 buttons on DS203*

### **Navigator A**

*The Navigator A is used to select/change the submenu of menu. Action "Press" Navigate in the sub-menus, While Action "Pull/ Push" changes the setting of a sub-menu (ref. menu).*

*For example, when selecting the menu: CHA Control, with Navigator B (ref. Navigator B), Action "Pull/ Push" of Navigator A changes the setting of sub-menu1, from "CH (A)"to "HIDE". While action "Press" changes selected sub-menu, making the blink area jump to next item: DC (or AC), Still, Action "Pull/ Push" changes the setting of this sub-menu.*

*Action "Press" of Navigator A changes the submenu of CHA Control menu as follows:*

*Show mode (CH (A)/HIDE) -> Couple mode (AC/DC-) -> Vol sensitivity (50mV-10V) -> YPOS Select mode.*

### **Navigator B**

*Navigator B is used to navigate in the main menu (ref. table 1), Action "Press" of Navigator B changes menus from menu Group1 to Group2 (ref. menu) and vice versa; While action "Pull/Push" changes the main menu within a Group.*

### **Run/Hold**

*The Run/Hold is used to control working state of DS203: Working or Pause*

### **Calibrate**

*A standard voltmeter and an adjustable voltage source is needed for calibrating the Quad.*

*In working state, when the menu CHA Control or CHB Control is selected, pressing the Calibrate button making the Quad enter the calibration status:*

- 1. Connect the standard voltmeter and DS203 in parallel. Input the voltage from the adjustable voltage source to both voltmeter and DS203.*
- 2. There will some prompt in the first column, eg. "Please connect CH\_A input to GND". Input voltage to DS203 as the prompt. Adjust the value to make it the same as the standard voltmeter, with Navigator A. And select different range and calibrate item with action "Press" and "Pull/Push" of Navigator B.*

- When cursor is at the bottom, select the exit mode with Navigator A, and press the calibrate button to exit the calibration status.

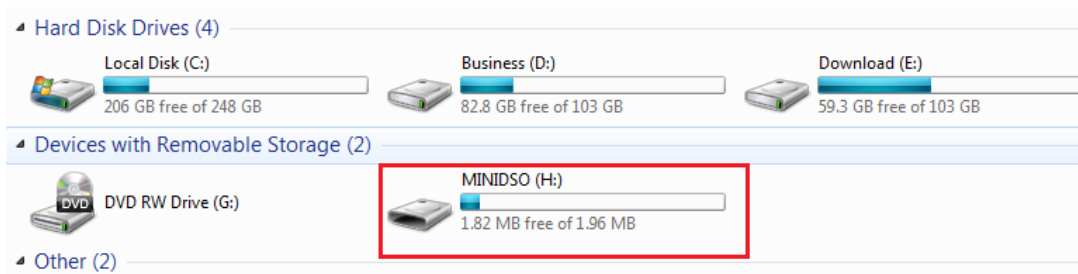
More calibration information will be supplied in latter pages.

### Preset

This button is used to save your setting when using the DS203. With this function, you don't need to configure your DS203 every time you power it. For example, configure the signal generator as Square, 10kHz, and then press the Preset Button. You would find the signal generator the same as your last configuration.

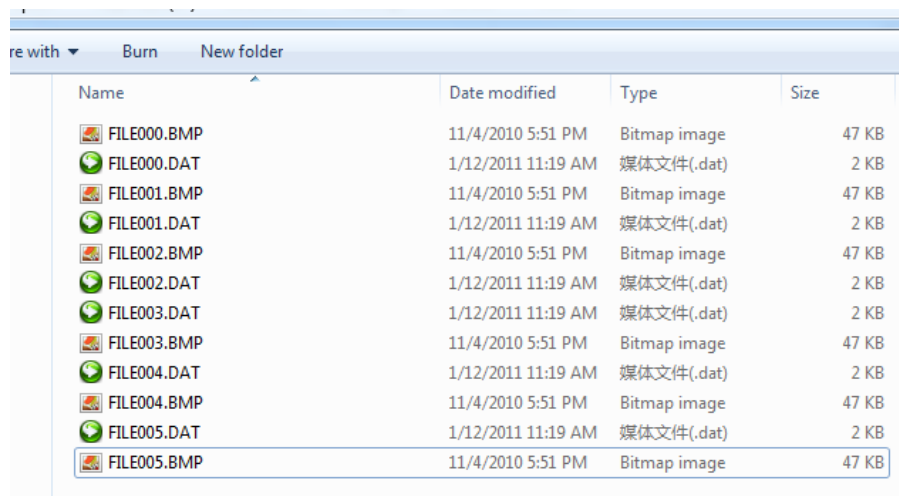
### Save Wave

Connect DS203 to PC via USB cable. Switch on the device, and then you will find it in your PC.



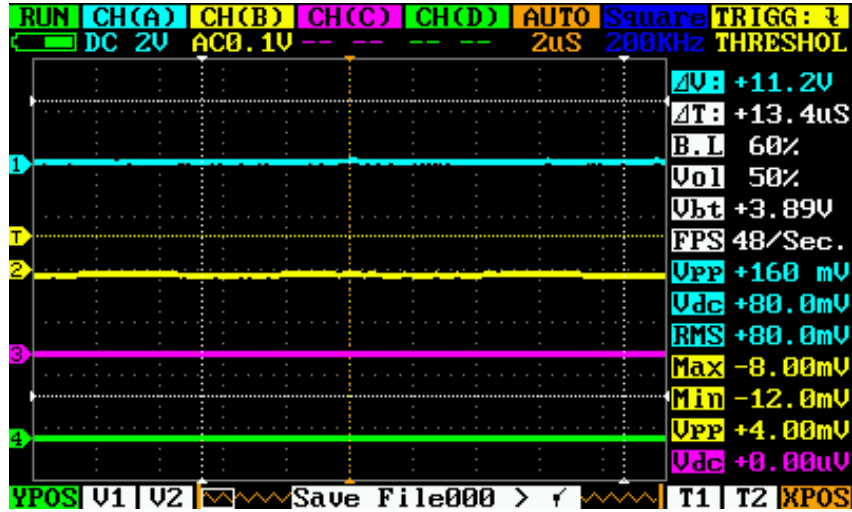
In order to save the wave in DS203, Template of .bmp files or .dat files must be stored into DS203 first. You can download the template:

[http://www.elechouse.com/elechouse/images/product/DS203/save\\_wave\\_tem.rar](http://www.elechouse.com/elechouse/images/product/DS203/save_wave_tem.rar)

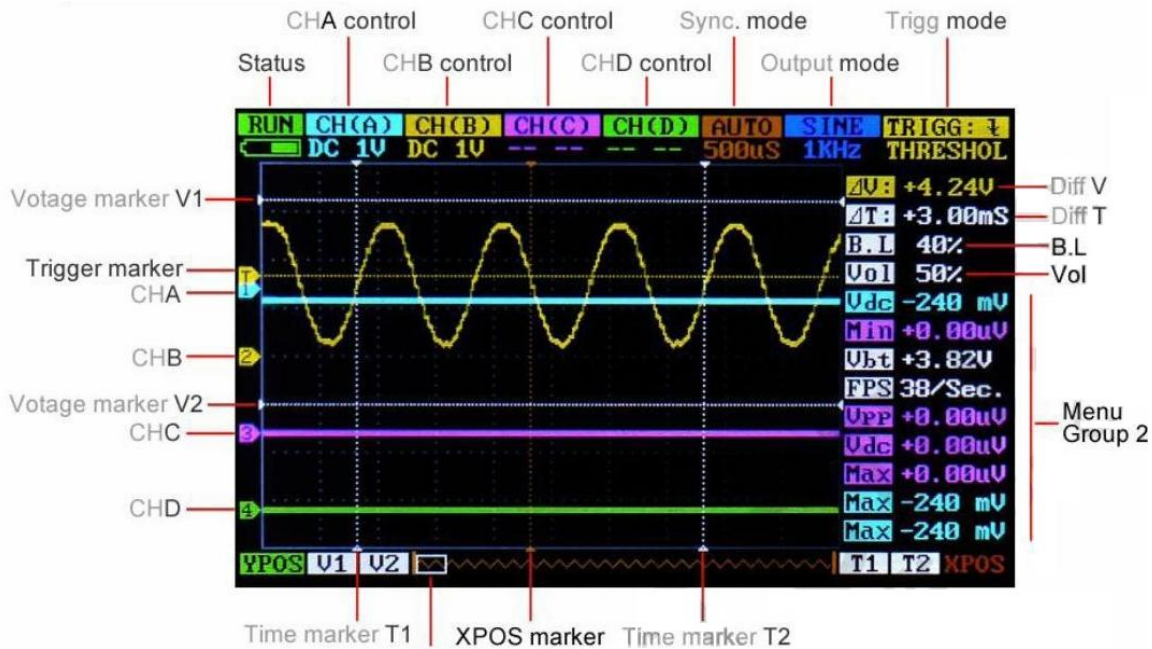




Navigate to storage menu with Navigator B. While you get **Save File** option, you can select the action (**Save File/Load File**) you want to do via Navigator A. Press Navigator A to select the file name and file format (.dat or .bmp), then press the "Save Wave" button, the wave in DS203 will be stored as the format you set.



**Menu**



The main menu of DS203 can be defined as 2 groups:

**Group 1: Menus to define user's action. Include:**



| Menu Name:               | Optional State:                                  |
|--------------------------|--|
| CHA Control              | CH(A)/HIDE                                       |
| CHB Control              | CH(B)/HIDE                                       |
| CHC Control              | CH(C)/HIDE                                       |
| CHD Control              | CH(D) / (A+B) / (A-B) / (C&D) / (CID) / (FILE_X) |
| Sync. Mode               | AUTO/NORM/SINGL/NONE/SCAN                        |
| Output Mode              | SINE /Triang/ Saw / Square                       |
| Trigg Mode               | Trigg (Note 1)                                   |
| Diff between ref v1 & v2 | $\Delta V$                                       |
| Storage Manu             | (Note 2)   |
| Diff between ref T2 &T2  | $\Delta T$                                       |
| Back Light Control       | B.L  |
| Voice Control            | Vol  |

Note:

1. The color in DSO Quod v2.6 represents each channel (blue for CH(A). yellow for CH(B). purple for CH(C) and cyan for CH(D))
2. Storage Menu is at the bottom of DS203. It shows only when selected

**Group2: Menus to show user the measure result**



These menus could be a quick tool to check the signal characteristics and can be changed with Navigator A as users want (Ref. Navigator A). These characteristics include: Max, Min, Vbt, FPS, Vpp, Vdc, RMS.

### Menu Operation

#### CHA/CHB/CHC/CHD Control

There are 4 input channels in DS203. CHA and CHB are analog inputs while the CHC and CHD are digital inputs (Table 2).

Select CHA or CHB with Navigator B, Both CHA and CHB have submenus as

| <b>Submenu</b>          | <b>Function</b>                    |
|-------------------------|------------------------------------|
| <b>Show mode</b>        | Show or hide related input channel |
| <b>Couple mode</b>      | AC couple or DC couple             |
| <b>Vol sensitivity</b>  | Vol sensitivity adjust(50mV-10V)   |
| <b>YPOS adjust mode</b> | YPOS adjust                        |

Navigate the submenus with action "press" of Navigator A, and adjust the setting with action "Pull/Push".

Digital input channel CHC is a digital input channel, it only has two submenus: Show mode and YPOS adjust Mode.Digital

Digital input channel CHD has something different. It can be set to math inputs (Table2). It has sub-menus as

| <b>Submenu</b>          | <b>Function</b>  |
|-------------------------|--|
| <b>Show mode</b>        | HIDE / CH(D) / (A+B) / (A-B) / (C&D) / (C D) / ( FILE_X) |
| <b>YPOS adjust mode</b> | YPos adjust  |

The results of A+B, A-B, C&D and C|D, can be set as the inputs of channel D. With this function, it is convenient for the user to observe and analyze the signal of each channel. Besides, the FILE\_X can be used as the input when recalling data from .DAT file (Ref. store and Recall).

### **Syn. Mode**

**AUTO:** Always refresh display, synchronize when triggered.

**Norm:** Display synchronized waveform when triggered, blank if not triggering

**Single:** Display triggered waveform and hold, blank before triggering.

**Scan:** Repeatedly sweep waveform from screen left to right.

**None:** Refresh unsynchronized waveform ignoring triggering.

| <b>Mode</b> | <b>Trigger</b> | <b>Display</b> | <b>Synchronization</b> | <b>Application</b> |
|-------------|----------------|----------------|------------------------|--------------------|
| <b>AUTO</b> | Yes            | Always         | Yes                    | General use        |
| <b>Norm</b> | Yes            | Triggered      | Yes                    | Periodic signals   |
| <b>SING</b> | Yes            | Triggered      | Auto-hold              | Random pulse       |
| <b>Scan</b> | No             | Always         | No                     | Monitoring         |
| <b>None</b> | No             | Always         | No                     | Unsynchronized     |

This menu also has a submenu of Horizontal sensitivity, From 0.1s/div to 1s/div. And a submenu of XPOS, Each "div" means a grid unit of the screen. You can view the full sampling buffer of a channel with the action "Push/Pull" of Navigator A.

### Output Mode

There are two signal generator sources in the DS203, Digital source and analog source. The digital source outputs duty ratio is adjustable from 1% to 99% square wave, and frequency from 10HZ to 8MHZ. The analog outputs wave forms include: Sine wave, Triangle wave, Saw wave.

Frequency form 10HZ to 20KHZ.

This menu has a sub-menu as

| Sub-menu    | Function                    |
|-------------|-----------------------------|
| Output wave | Output wave select          |
| Frequency   | Set the frequency of output |

### Trigger Mode

There are 8 trigger modes

| Trigger Mode | Trigger Condition   |
|--------------|---|
| I            | Falling edge of threshold   |
| F            | Rising edge of threshold  |
| <vt          | Voltage higher than threshold                                     |
| >vt          | Voltage lower than threshold                                      |
| <TL          | Low level pulse width shorter than $\Delta T$ (Ref. Time Measure) |
| >TL          | Low level pulse width longer than $\Delta T$                      |
| <TH          | High level pulse width shorter than $\Delta T$                    |
| >TH          | High level pulse width longer than $\Delta T$                     |

Navigate to the THRESHOL to adjust the Trigger threshold. Also, the different color of this menu represents which channel is the current trigger source, Please refer to Note 1.

### Voltage Measure

The  $\Delta V$  menu shows user the D-value of V1 and V2. It have submenu of V1 and V2. Adjust V1 line and V2 line, with Navigator A, and the  $\Delta V$  will show you the D-value between them.

### Store and Recall

Waveform could be saved to the internal 2MB USB disk, with .bmp or .dat files, and then recalled as the user want.

Save waveform as .bmp:

1. Copy the Filexxx.BM P to the 2M USB disk, rename the xxx as 000, 001, 002\_
2. Navigate to the save menu, select "Save file", "xxx (the one you select to use)" and ".BMP"
3. Push button "Save wave" (The forth button on DS203)
4. Reset the DS203, you will see the saved BMP in your USB disk.

Save and recall .DAT

1. Copy the Filexxx. DAT to the 2M USB disk, rename the xxx as 000, 001, 002....
2. Navigate to the save menu, select "Save file", "xxx(the one you select to use)" and ".dat"
3. Press button "Save wave" to store the data into .dat file.
4. In order to recall the data you stored in the USB disk, first navigate to the save menu, select the "load file""xxx(the one you want to recall)"and ".dat", and then press the button "Save Wave".
5. Navigate to the CHD, select the show mode as File\_x(the data in which channel you stored ), and, you can get the recalled waveform.

### Time Measure

The  $\Delta T$  menu shows user the D-value of T1 and T2. It have submenu of T1 and T2. Adjust T1 line and T2 line, with Navigator A and the  $\Delta T$  will show you the D-value between them.

### B.L& Vol

B.L (backlight) and Vol can also be adjusted by Navigator A, Reducing the B.L and Vol make benefits to your battery duration.

### Measurement

These menus in menu group 2 are for auto-measurement. There are 9 menus in this group (ref.Figure1. Menu Group2). Users can set these 9 menus as they need.

There are 7 parameters can be observed for channel A/B/C:

**Parameter to measure**

**meaning**

Max

Max value of input (CHA/B/C)

|            |                                   |
|------------|-----------------------------------|
| <b>Min</b> | Min value of input (CHA/B/C)      |
| <b>Vbt</b> | Voltage of battry(common)         |
| <b>FPS</b> | Frames per second(common)         |
| <b>Vpp</b> | Vpp of input (CHA/B/C)            |
| <b>Vdc</b> | Mean value of input(CHA/B/C)      |
| <b>RMS</b> | Effective value of input(CHA/B/C) |

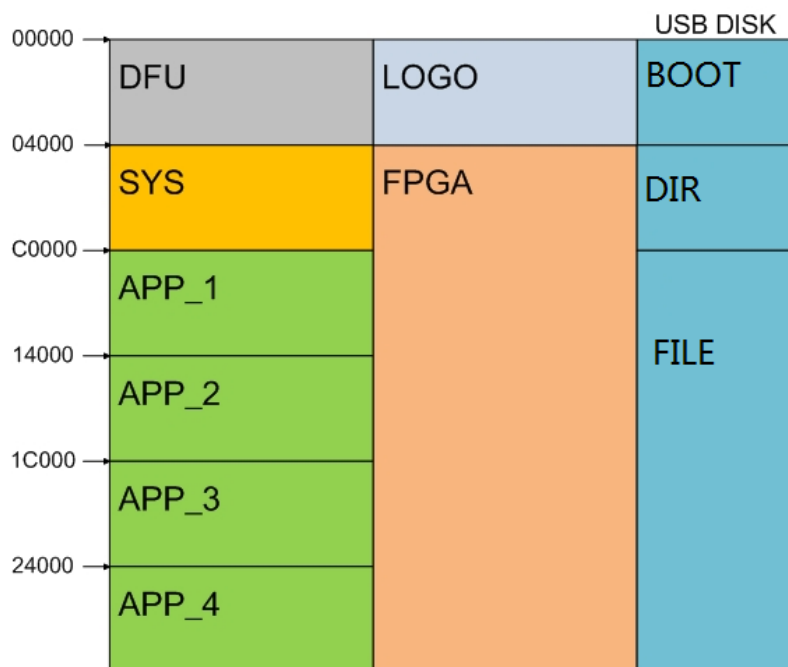
Also, different color represents different channel. And, because the Vbt and FPS is common for all the channels, the back color of them is white.

### Firmware Upgrade

Firmware can be downloaded via this link: [http://www.elehouse.com/elehouse/images/product/DS203/DS203\\_firmware.rar](http://www.elehouse.com/elehouse/images/product/DS203/DS203_firmware.rar)

Installation into the DS203 are shown as follows:

1. CFG\_FPGA.ADR + VxxxFPGA.bin. The two files for FPGA logic, you need to install the .ADR file and then the .bin file.
2. logo\_00B.ADR + logo\_001.bin. The logo files, you need to install the .ADR file and then the .bin file.
3. APP\_Bxxx.hex, the app firmware.
4. SYS\_Bxxx.hex, the sys firmware.



|      |   |
|------|---|
| DFU  | Bootloader, can not be modified                                       |
| LOGO | LOGO file, imported via USB disk                                      |
| FPGA | FPGA bin file, imported via USB disk, modification is not recommended |
| SYS  | System files, modification is not recommended                         |
| APP  | Application files, open source, imported via USB disk                 |

*The firmware of DS203 is upgradable via USB as following steps:*

- 1. Connecting DS203 via mini USB cable to PC, Power up the DS203 while pressing ">|", you will see a virtue USB disk added on your PC and the screen of DS203 will display words "Device Firmware Upgrade Vx.xx", "Please Copy .Hex/.Bin file to DFU virtual USB disk."*
- 2. If you want to update App or Sys, copy APP\_xxx.hex or SYS\_xxx.hex into the USB disk. Note that only one file can be copied each time. The USB disk will auto-reset, the disk window will automatically be closed, and the file name will be changed to APP\_xxx.rdy or SYS\_xxx.rdy.*
- 3. If you want to update the logo or logic in FPGA, You should first copy the logo/FPGA.ADR file into the USB disk. After the Auto-reset, the file name changes to logo/FPGA.SET. Then, copy the logo/FPGA.bin into the disk, After the Auto-reset, the file name changes to logo/FPGA.rdy.*
- 4. Reset the DS203, the upgrade process is finished*

*For example, you want to update the APP firmware to v2.35 to correct the calibration error, you just need to update the app to 2.35, as there is no update in the sys firmware.*

*You should do as follows:*

- 1. Download the APP2.35 zip from web.*
- 2. Unzip it, you would see APP\_B235.hex.*
- 3. Connect the Quad to PC via USB, and power it with the ">|" been pressed. The screen of DS203 will display words "Device Firmware Upgrade Vx.xx", "Please Copy .Hex/.Bin file to DFU virtual USB disk." And you can see a virtual disk added on your PC.*
- 4. Copy the App\_B235 to the virtual disk. The virtual disk window will automatically close and change the file name to: APP\_B235.RDY, it means the upgrade is successful.*
- 5. Reset (Restart) DS203 and the upgrade is done. Calibrate the Quad as shown in the Calibrate catalogue below in this document.*



The issue right now in your DS203 can be seen on the screen when you power it on.

### *Design your own logo*

Logo files are included in the firmware package. You can download via the link above.

When you want to change the logo displayed on the screen, you may do it as follows:

1. Design your logo. The logo you designed should be a picture saved as "xxx\_logo.bmp" (note the formate should be bmp and the name of the logo should be 8 characters including the "\_"), and the picture should be 16 colors and in size of 64x256. The logo picture should be 8.11kB.
2. Then change the document style of the picture (namely the suffix) from ".bmp" into ".bin".
3. Connect the Quad to PC via USB, and power it with the ">|" been pressed. The screen of DS203 will display words "Device Firmware Upgrade Vx.xx", "Please Copy .Hex/.Bin file to DFU virtual USB disk." And you can see a virtual disk added on your PC.
4. Copy the LOGO\_00B.ADR that you downloaded into the Virtual disk. It will reset automatically and change the name into LOGO\_00B.SET which means that you can put in logo file now.
5. Copy the "xxx\_logo.bin" into the Virtual disk. It again will reset automatically and change the logo name into "xxx\_logo.rdy" and the "LOGO\_00B.ADR" into "LOGO\_00B.USE" which means the logo is loaded successfully.
6. Reset (restart) DS203, you can see your logo on it, as picture below shows.

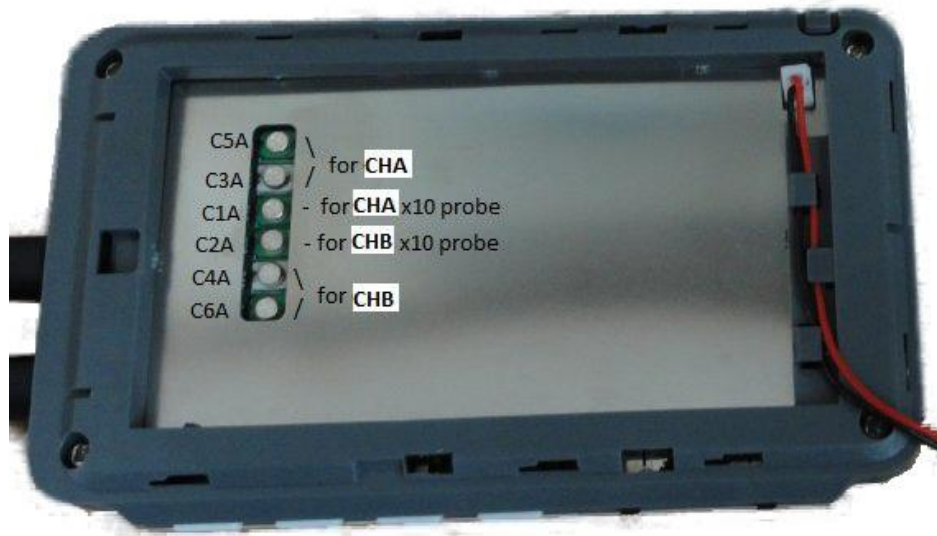


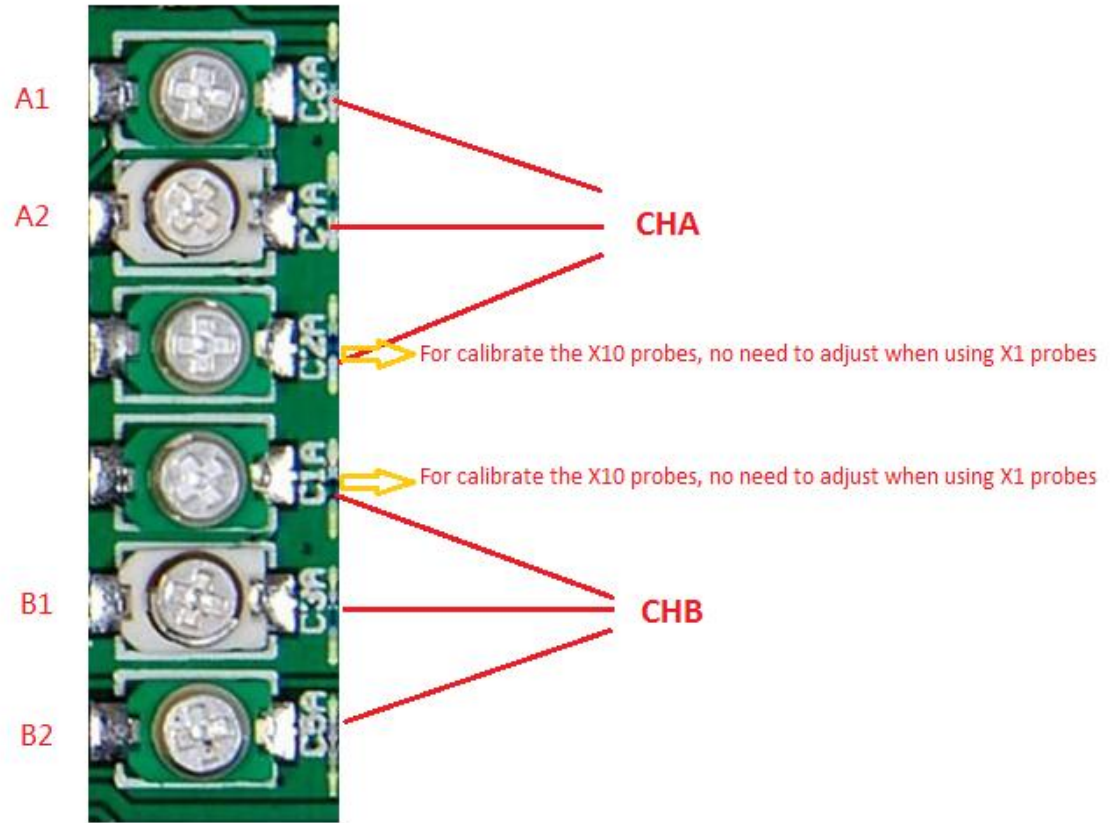
## Calibrate

Calibrate the probe

When you first receive your DS203 or after a long time using, you may need to calibrate your DS203.

**Step1:** Open the back cover, and you will see 6 adjustable capacitors.

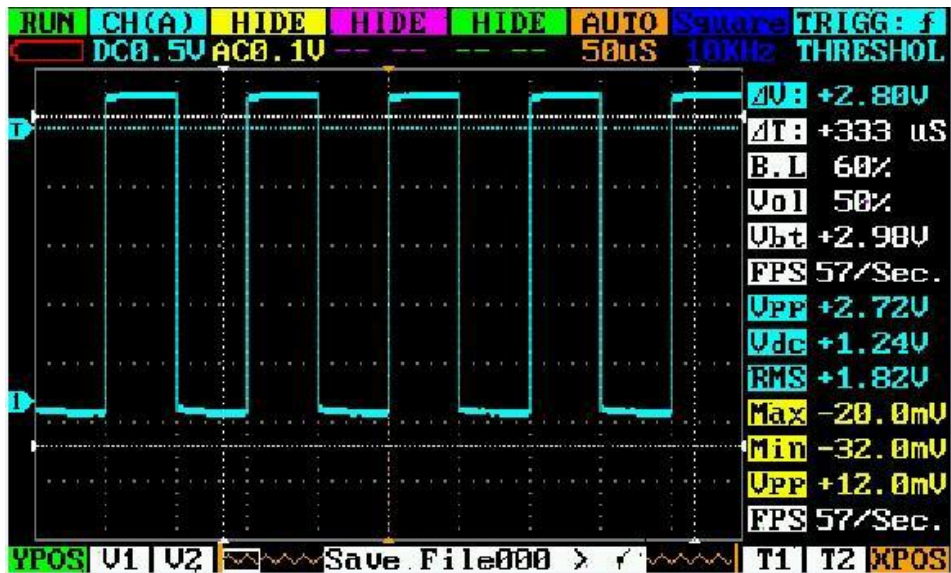




**Step2:** Connect the wave out to CHA or CHB, set the wave output: square 10Khz, and the CHA or CHB DC couple, 0.5V/div, trigger mode: auto, and 50us

**Step3:** adjust the A1 and A2, to calibrate the CHA, B1 and B2 to calibrate CHB. To make the wave as good as you can:

After calibration:



Calibrate the DS203 (for app2.35 or above)

If you update your App to app2.35, you might need to do this calibration. A standard voltmeter and an adjustable voltage source are needed for calibrating the DS203.

In working state, when the main menu CH (A) was selected, pressing the calibrate button about 2s to begin the calibration of CH (A). While main menu CH (B) was selected, pressing the calibrate button about 2s to begin the calibration of CH (B).

1. Connect the probe to ground. And, adjust the Cell “ZERO”—“50mv” to 0.00 with Navigator A. Then, press down the Navigator A to jump to the cell “DIFF”-“50mv”. Adjust this cell to 0.00(-1 or +1 can be acceptable too). Press down the Navigator A, the cursor jumps back to cell “ZERO”—“50mv”, make sure the 2 cells are 0.00(or +1 ,-1).
2. With the probe grounded. Jump to the 0.1v row with Navigator B. Adjust the cell “ZERO”-“0.1V” to 0.00. DO NOT adjust the “DIFF”-“0.1V” now, as it can not be adjusted.
3. Repeat the above operation. Now, the result should be (probe ground):

| CHA  | ZERO | DIFF           | Voltage |
|------|------|----------------|---------|
| 50mv | 0.00 | 0.00(or +1,-1) |         |
| 0.1v | 0.00 | ---            |         |
| 0.2v | 0.00 | ---            |         |
| 0.5v | 0.00 | ---            |         |
| 1v   | 0.00 | ---            |         |
| 2v   | 0.00 | ---            |         |
| 5v   | 0.00 | ---            |         |
| 10v  | 0.00 | ---            |         |

4. Press the Navigator B to jump to the “voltage” line, Set the voltage source to 250mv-300mv as the prompt (you can measure the voltage with a voltmeter to get the voltage precisely), connect it to the DSO channel you are calibrating, and adjust the “voltage” to the voltage you measured. For example, if your source was 290mv, adjust the cell”voltage”-“50mv” to 290mv. Push/pull the Navigator B to jump to the other row.
5. For the other row, repeat the operation as the prompt. For example, my voltage source for all the row was: 300mv, 600mv, 1.2v, 3v, 6v, 10v, 10v, 10v (I do not have a voltage source of 30v and 60v, so ,I use 10v for the row 5v and row 10v).

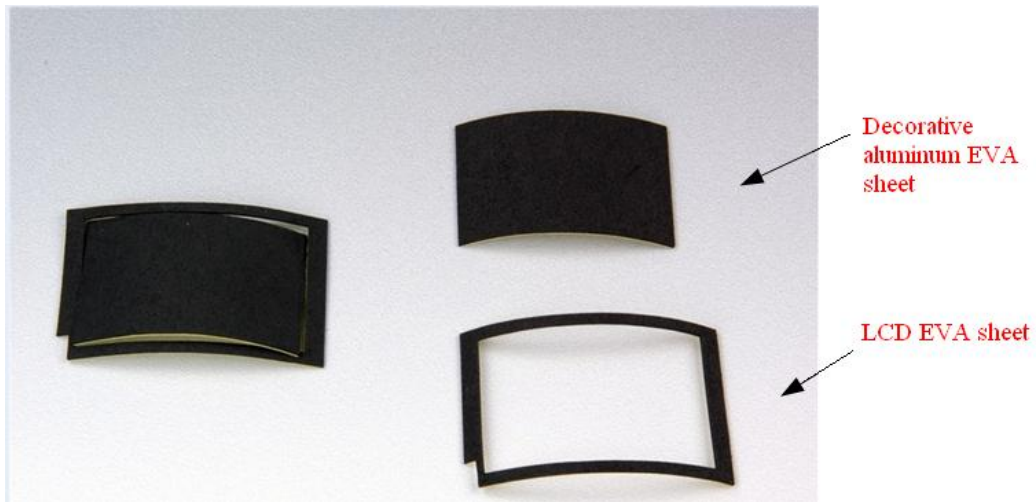
| CHA  | ZERO | DIFF           | Voltage |
|------|------|----------------|---------|
| 50mv | 0.00 | 0.00(or +1,-1) | 300mv   |
| 0.1v | 0.00 | ---            | 600mv   |
| 0.2v | 0.00 | ---            | 1.2v    |
| 0.5v | 0.00 | ---            | 3.00v   |
| 1v   | 0.00 | ---            | 6.00v   |
| 2v   | 0.00 | ---            | 10.00v  |
| 5v   | 0.00 | ---            | 10.00v  |
| 10v  | 0.00 | ---            | 10.00v  |

6. After all this have been done, push the Navigator B to the exit mode. There are 3 models: exit without calibration/exit with calibration/exit with restore defaults. Select the “exit with calibration” with Navigator A. And then press the calibrate button.
7. The DS203 shows “Save the calibration data” means you have done the calibration successfully.

## Assemble

### Step 1

Split the EVA sheet into two, stick one on the back of decorative aluminum board, and attach the other one to the surface of the shell to protect the LCD screen.



### Step 2

Note the direction when attaching it, a notch there for the square hole can help you. It is only when you finish the sticking that you can tear up the protection paper for the back-adhesive paper.



### Step 3

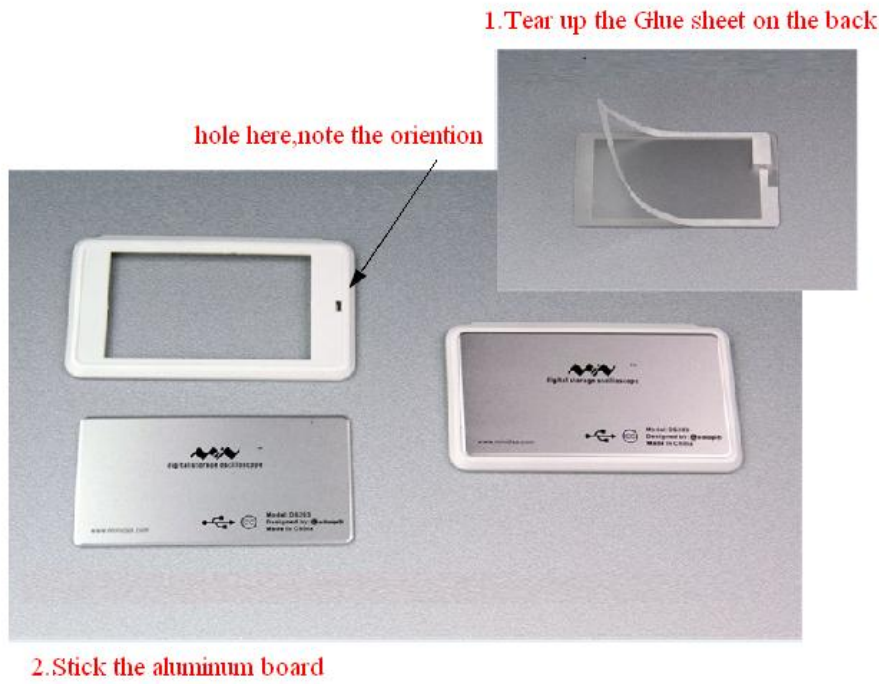
When approaching the glass to the top shell, do not tear up the protection film and prevent dust during the installation process.





**Step 4**

Stick the decorative aluminum board on the battery shell.



**Step 5**



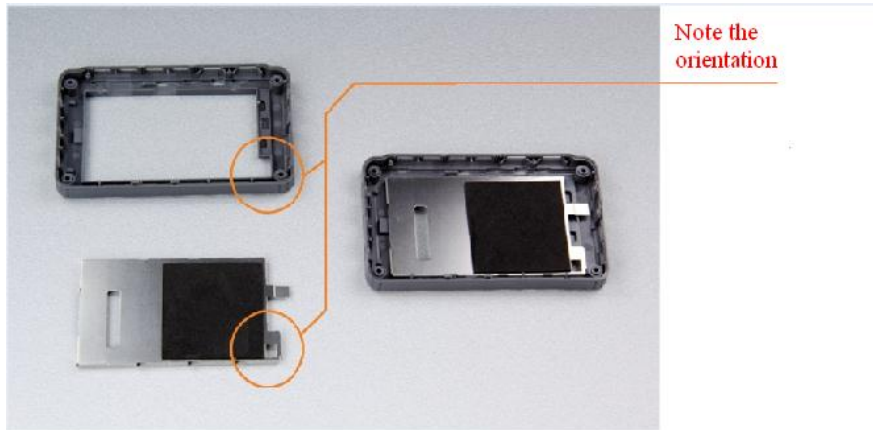
### Step 6

*Stick the EVA adhesive sheet on the battery shield.*



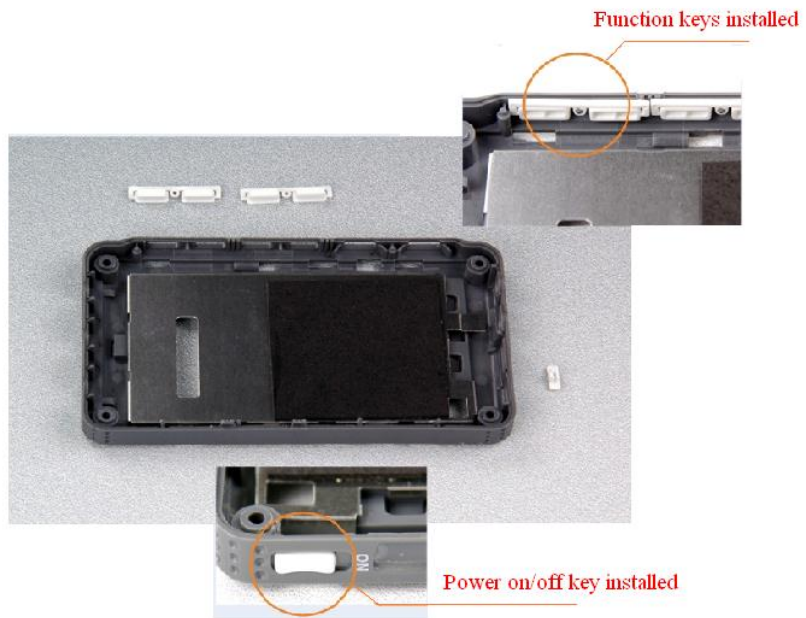
### Step 7

*Install the battery shield*



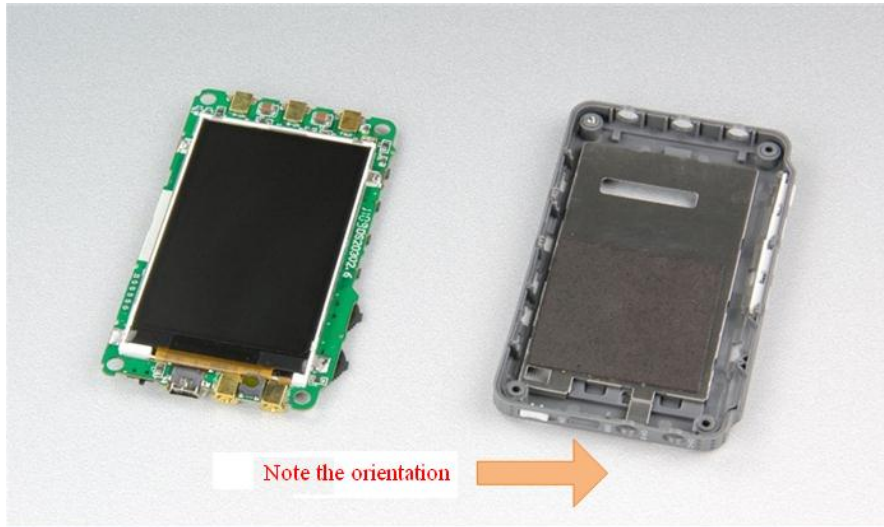
### Step 8

*Install the keys*



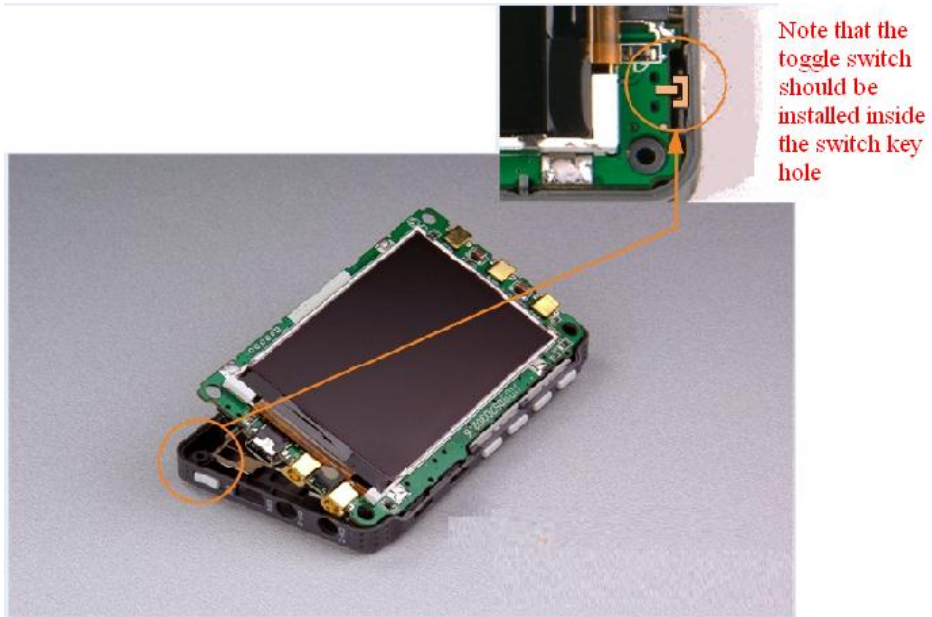
### Step 9

*Install the main board in the bottom shell*



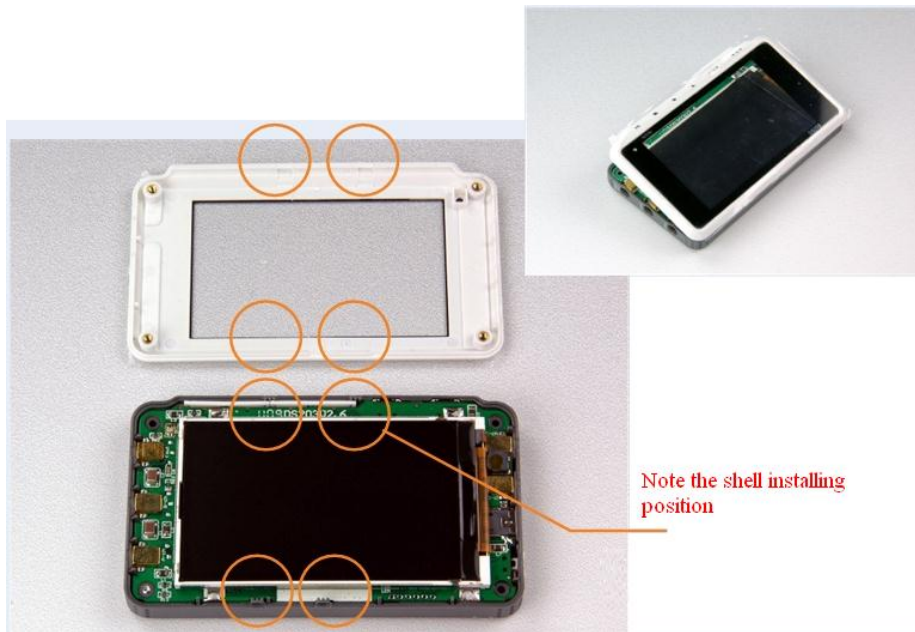
**Step 10**

*Install the main board in the bottom shell*



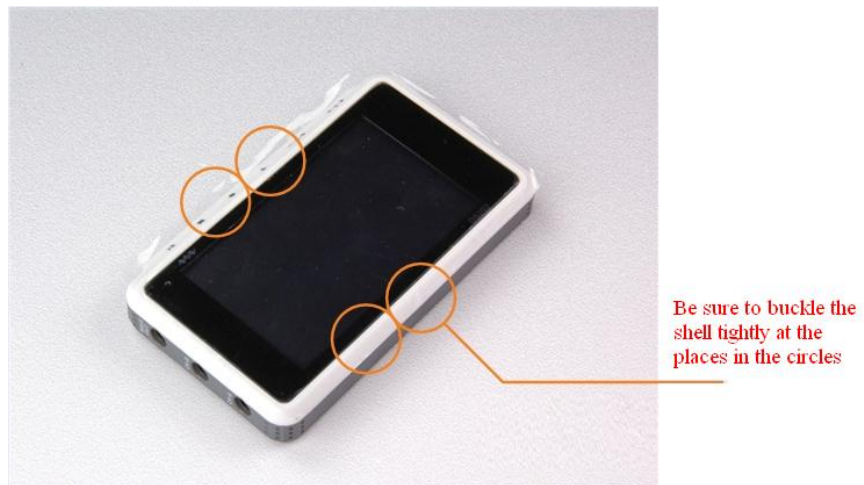
**Step 11**

*Install the surface shell*



### Step 12

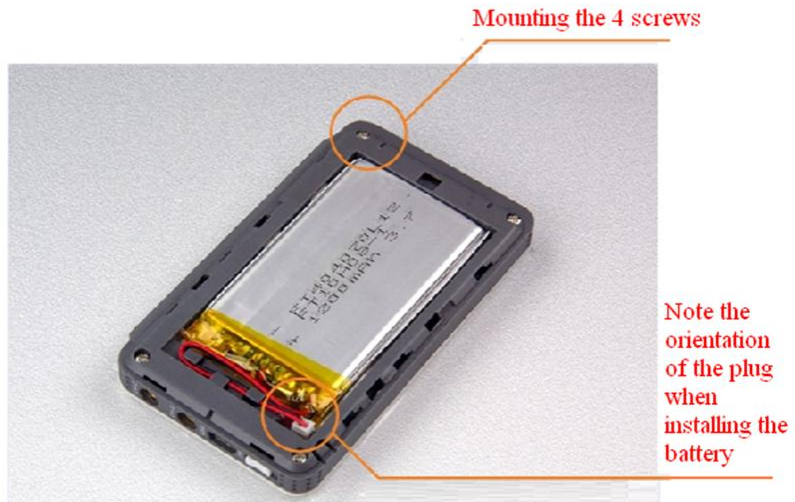
*Install the surface shell*



### Step 13

*Install the battery*





### Step 14

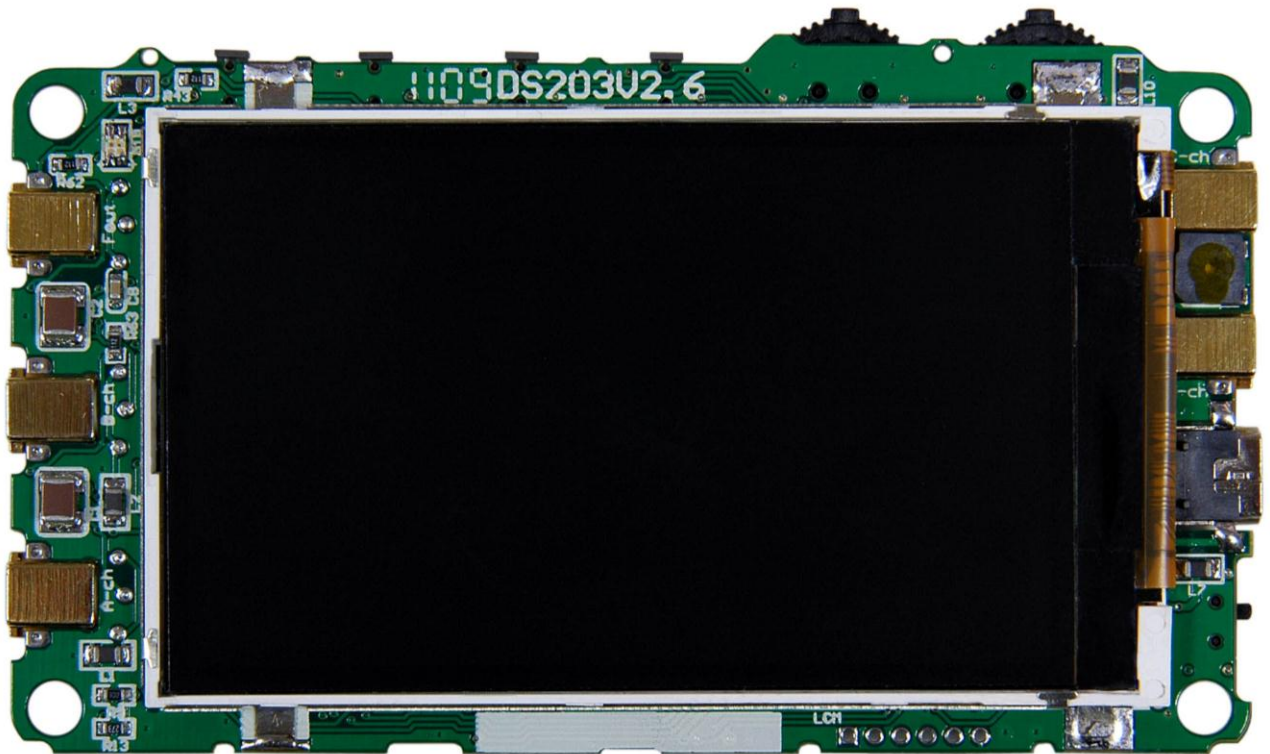
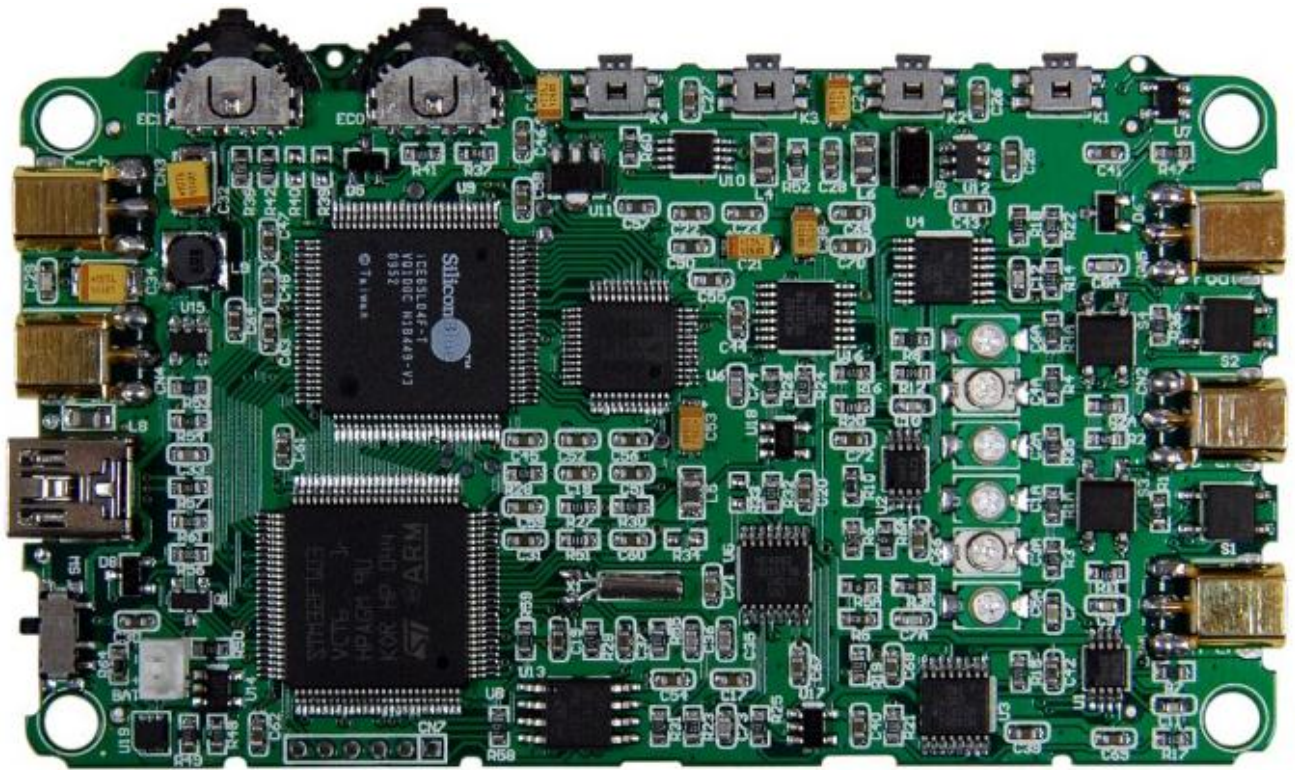
*Install the battery shield*



### Technique Information

*Please note: schematic diagram is attached on the page.*

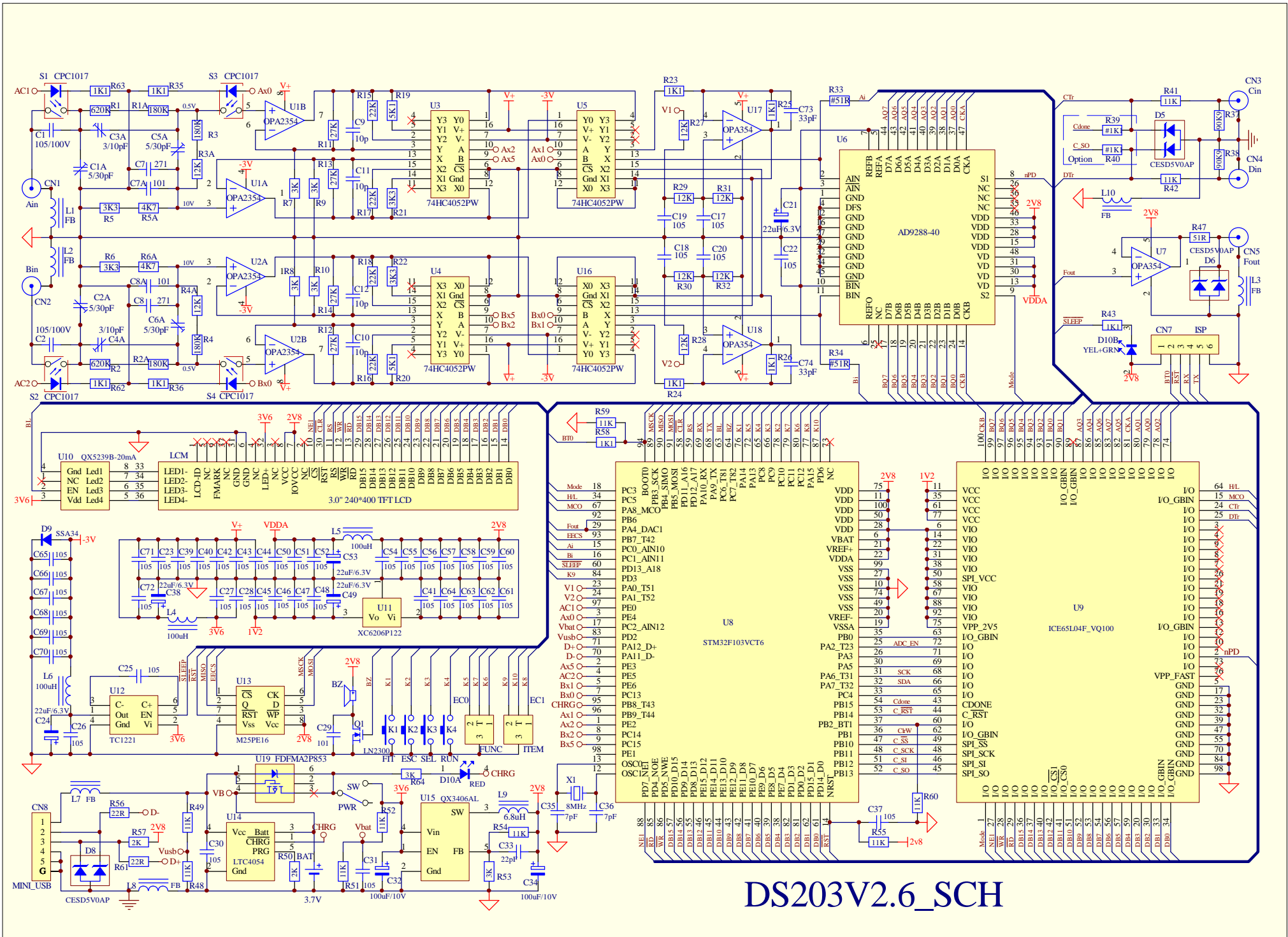




*The information in this document may change without notice.*

*Revision History*

| <b>Rev.</b> | <b>Date</b>                  | <b>Author</b> | <b>Description</b> |
|-------------|------------------------------|---------------|--------------------|
| A           | May. 22 <sup>nd</sup> , 2011 | Wilson Shen   | Initial version    |



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