DSO Quad v2.6 Manual 0.92b

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INTRO

DSO Quad 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

Display	Full Color 3" TFT LCD 400×240
Input channel	Analog: CH(A)\CH(B)
	Digital: CH(C)\CH(D)
Analog bandwidth	>5M
Max sample rate	72MS/s, 8bit
Sample memory depth	4096 Points for each channel
Vertical Scale	20mV-10V/div(x1 probe)
Vertical resolution	8 bit
Horizontal sensitivity	0.1uS/Div-1S/Div
Horizontal position	Adjustable
Input coupling	AC/DC
Input impedance	>800K Ω
Max input voltage	80Vpp(x1 probe)
Trigger type	Auto, Normal, Single, SCAN, None
Trigger source	CH1/CH2/EXT
Signal generator	Sine/Triangle/Saw/Square,10Hz~20KHz
Storage	Internal 2MB USB disk, BMP, DAT file
Auto measure	Max, Min, Vbt, FPS, Vpp, Vdc, RMS
Sampling mode	Real time
Dimension	98 * 60 * 14.5 (mm)
Weight	80g (without battery)
Accesorier within Pack	2 mcx oscilloscope probe/battery

Probe Calibration

Probe Calibration is required before using the Quad.

When and Why the probe calibration needed

Power up the DSO Quad, connect the Signal generator to CH_A (or CH_B). You can first plug a probe to Signal generator , and another probe to CH_A(or CH_B), and then connect the probe together .
Set the signal generator as Square, 10kHz, Set the tigger mode as auto , T/div as 20us. Check the waveform on the screen.

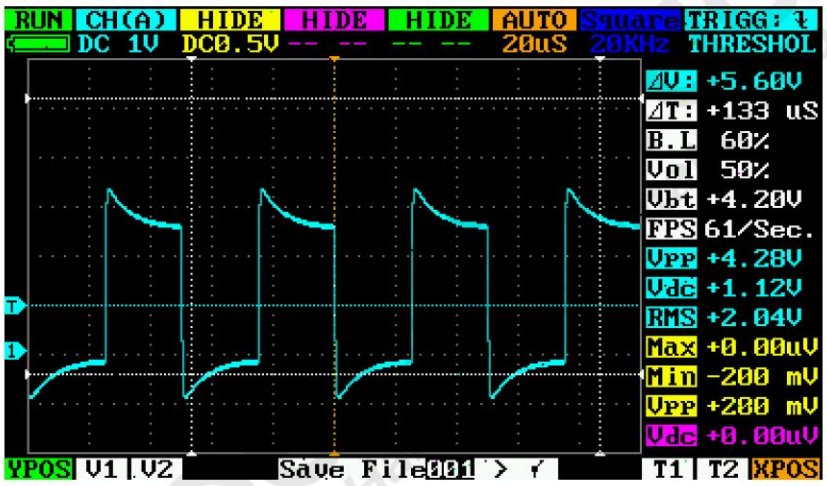

Figure1. Waveform when calibration is needed

If the waveform is like that of above figure 1, with obvious overshoot, then the probe calibration is essential.

How to calibration the probe

Step 1. Open the back cover of Quad, You would find 6 adjustable capacitors:

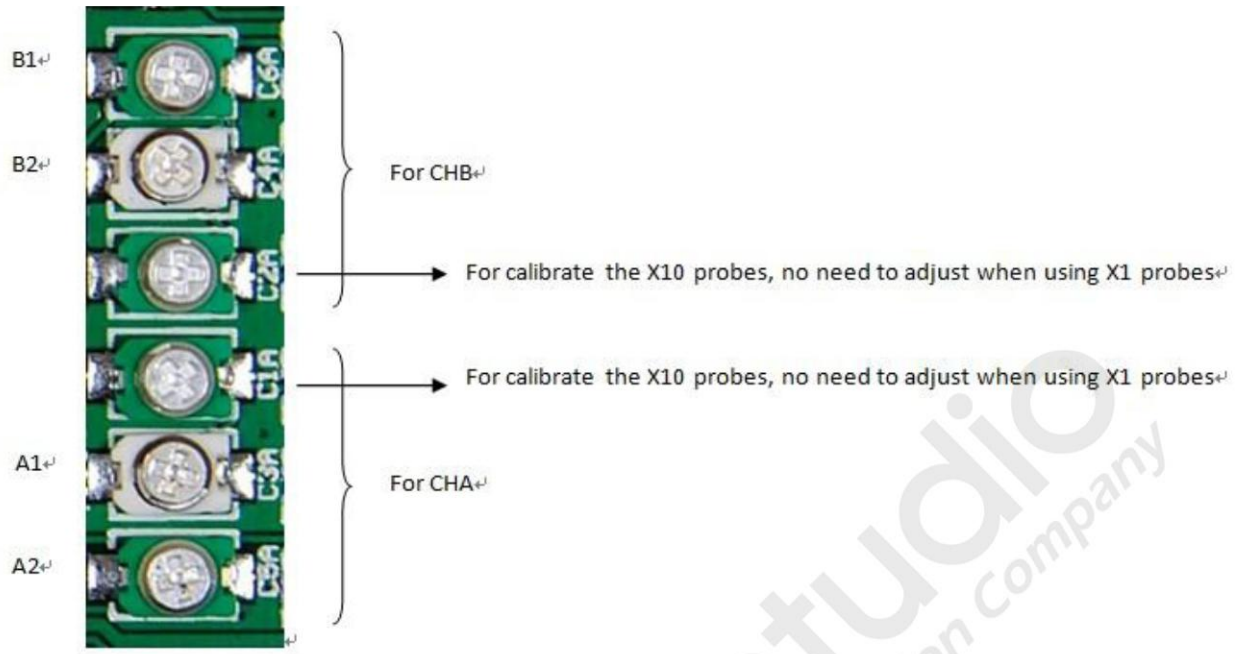

Figure2. probe calibration cap

Step2: Connect the wave out to CHA(CHB) , set the wave output :square 10Khz , and the CHA (CHB) DC couple , trigger mode :auto ,and T/div 20us

Step3: Adjust the A1 and A2, to calibrate the CHA, B1 and B2 to calibrate CHB. Please note that the adjustment of 0.5v/div and 1v/div will interact each other so that you should compare both of them and then make sure the waveform is smooth in 0.5v/div and 1v/div. Doing this maybe take you a while, please be patient. Finally, after your careful adjustment of these 2 capacitors, you could achieve waveform as shown below:

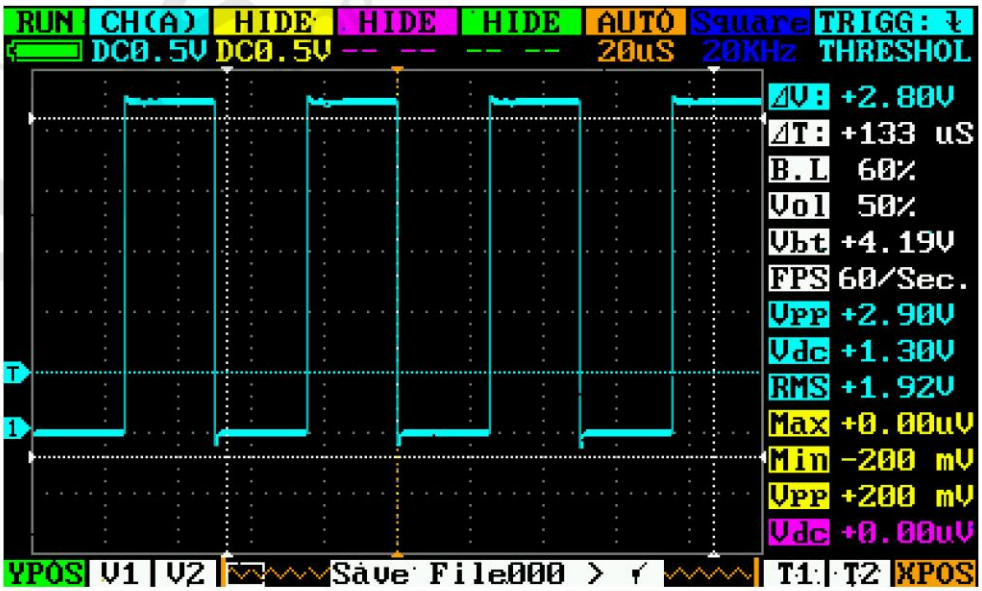

Figure3. waveform in 0.5v/div after probe calibratio

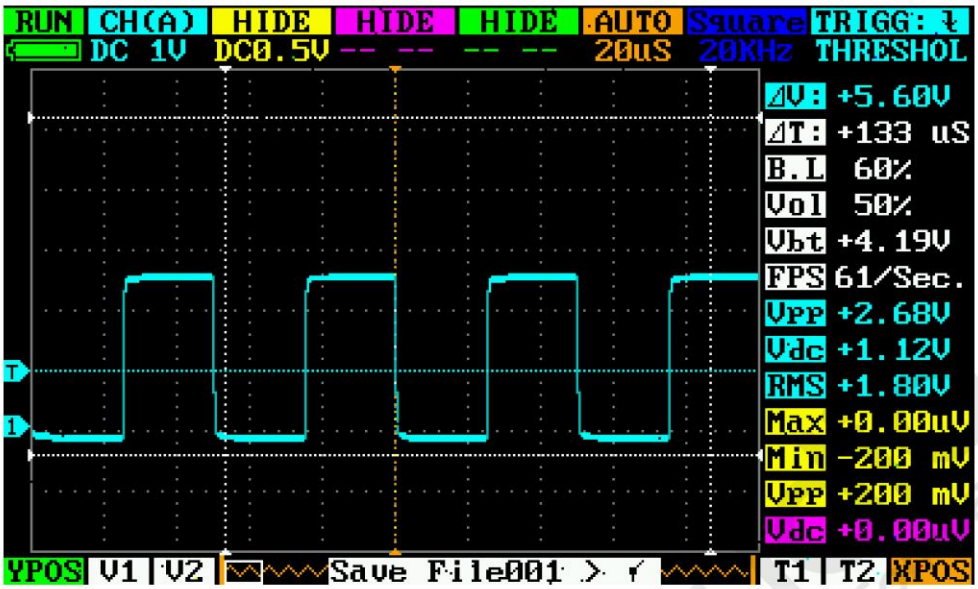

Figure4. waveform in 1v/div after probe calibration

OK, You did a fantastic work if the waveform on your Quad looks like the waveform above!

BASIC OPERATION

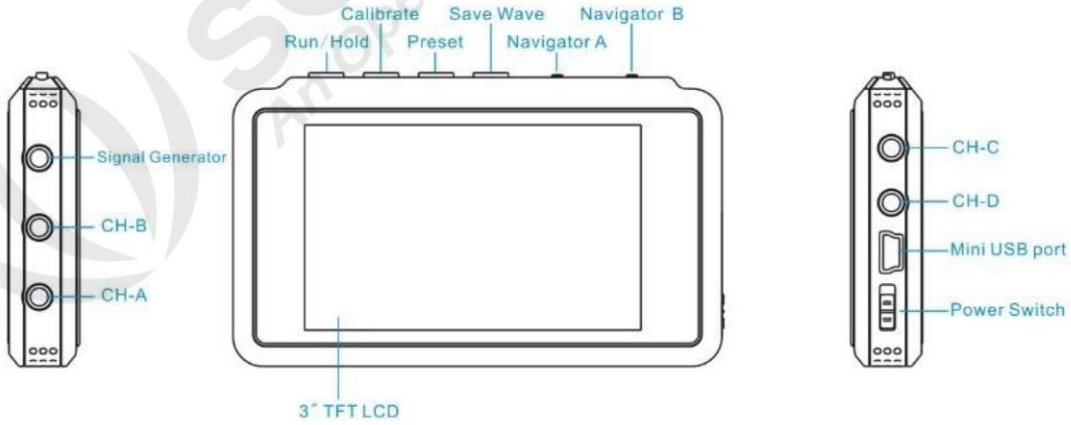

Figure5. Button and Interface

Button

There are 2 navigators and 4 buttons in DSO Quad.

NavigatorA

The NavigatorA is used to select/change the submenu of menu. Action "Press" Navigate in the submenus , While Action "Pull/ Push" changes the setting of a submenu(*ref.* ***menu***).
For example, When selecting the menu: CHA Control, with NavigatorB(*Ref.* ***NavigatorB***), Action "Pull/ Push" of NavigatorA changes the setting of submenu1 ,from "CH(A)"to "HIDE". while action "Press" changes selected submenu, making the blink area jump to next item: DC(or AC), Still, Action "Pull/ Push" changes the setting of this submenu.
Action "Press" of NavigatorA 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.

NavigatorB

NavigatorB is used to navigate in the main menus(*ref. table 1*), Action "Press" of NavigatorB changes menus from menu Group 1 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 Quad: Working or Pause

Calibrate

First , make sure you app is V2.35 or above, if not, please download the latest firmware at:
http://www.seeedstudio.com/forum/viewtopic.php?f=22&t=1929
A standard voltmeter and a adjustable voltage source are needed for calibrating the Quad.
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	---	1.20v
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 Quad shows "Save the calibration data" means you have done the calibration successfully.

Preset

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

Save Wave

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

http://www.seeedstudio.com/forum/viewtopic.php?f=22&t=1912

Navigate to storage menu with navigatorB, select the action you want to do (load file/save file), the file number and file format(.DAT or .bmp), then ,press the "Save Wave" button, the wave in Quad will be stored in the format you set.

Menu

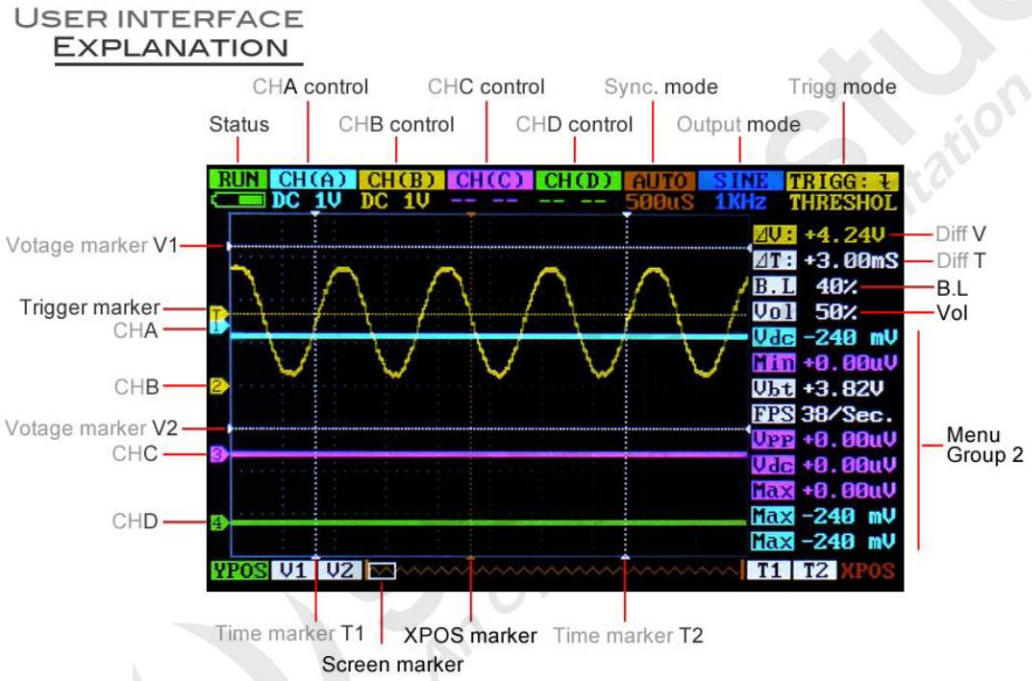

Figure6. Menu of Quad

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

Group1: Menus to define user's action. Include:

Table 1. Menu Group1

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) / (C|D) / (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	Δ V
Storage Manu	(Note 2)
Diff between ref T1 &T2	Δ T
Back Light Control	B.L
Voice Control	Vol

Note 1: The color in DSO Quad v2.6 represents each channel(blue for CH(A), yellow for CH(B), purple for CH(C) and cyan for CH(D)).

Note 2: Storage Menu is at the bottom of Quad. It shows only when selected.

Group2: Menus to show user the measure result:

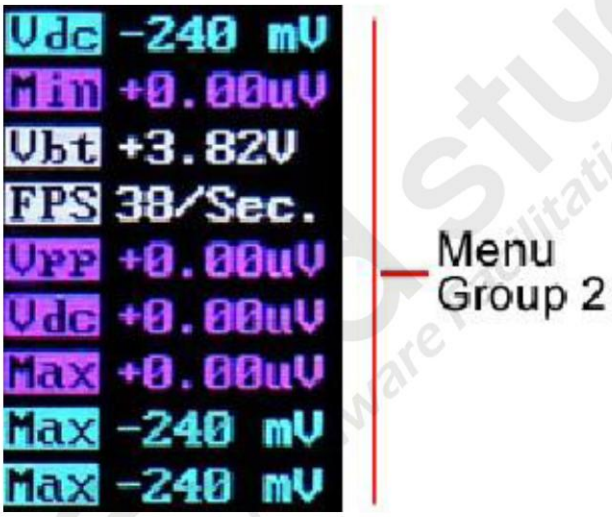

Figure7. Menu Group2

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

Menu Operation

CHA/CHB/CHC/CHD Control

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

Select CHA or CHB with NavigatorB , Both CHA and CHB have submenus of :

Table 2. Submenus of CH_X (X=A/B)Control

Submenu	Function
Show mode	Show or hide related input channel

Couple mode	AC couple or DC couple
Vol sensitivity	Vol sensitivity adjust(50mv-10v)
YPOS adjust mode	YPos adjust

Navigate the submenus with action “press” of NavigatorA, 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 input channel CHD has something different. It can be set to math inputs (Table 2). It has submenus of :

Table 3. Submenus of CHD Control

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

Table 4. Synchronize Mode

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

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 NavigatorA.

Output Mode

There are two signal generator sources in the DSO Quad. Digital source and analog source. The digital source outputs duty ratio adjustable from 1% to 99% square wave, 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 submenu of :

Table 5. Submenus of Output mode

Submenu	Function
Output wave	Output waveform select
Frequency	Set the frequency of output

Trigger Mode

There are 8 trigger modes :

Table 6. Trigger modes

Trigger Mode	Trigger Condition
↓	Falling edge of threshold
↑	Rising edge of threshold
<Vt	Voltage higher than threshold
>Vt	Voltage lower than threshold
<TL	Low level pulse width shorter than Δ T(*Ref. Time Measure*)
>TL	Low level pulse width longer than Δ T
<TH	High level pulse width shorter than Δ T
>TH	High level pulse width longer than Δ 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 ref Note 1.

Voltage Measure

TheΔ 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 navigatorA, and the Δ 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.BMP 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 Quad)
4. Reset the Quad, 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. Push 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

TheΔ 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 navigatorA and the Δ T will show you the D-value between them .

B.L & Vol

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

Measurement

These menus in menu group2 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:

Table 7. parameter can be auto-observed

Parameter to measure	meaning
Max	Max value of input (CHA/B/C)
Min	Min value of input (CHA/B/C)
Vbt	Voltage of battry(common)
FPS	Frames per second(common)
Vpp	Vpp of input (CHA/B/C)
Vdc	Mean value of input(CHA/B/C)
RMS	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 are white.

Firmware update

The firmware of Quad is upgradable via USB as following steps:

1. Connecting DSO Quad via mini USB cable to PC, Power up the DSO Quad pressing ">||", You will see a USB disk added.
2. If you want to update App or Lib, Copy *XXX_app.hex* or *XXX_lib.hex* into the USB disk. Note that only one file can be copied each time. The USB disk will auto-reset, and the file name changes to *XXX_app.rdy* or *XXX_lib.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 Quad, the upgrade process finished.

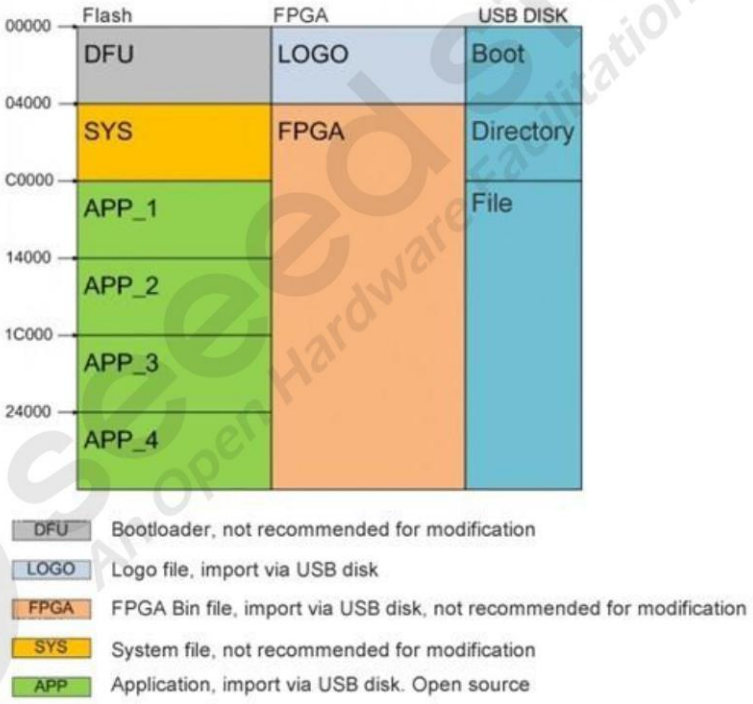

Figure8. Firmware of DSO Quad

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http://www.seeedstudio.com/forum/viewforum.php?f=22