096 LCD Digital Storage Oscilloscope

Manual of Operation

Applicable Models: 09601, 09602

1. Packing List

Contents	09601	09602
096 Digital Storage Oscilloscope	1	1
BNC Probe, 20MHz, 1X/10X	1	1
Battery, 3.7V, 1200mAh		1
Quick Use Guide	1	1

2. Precautions

Do not attempt to directly measure mains power supply without using a step-down transformer. DO NOT EXCEED 50Vpk MAX

3. Panel Description

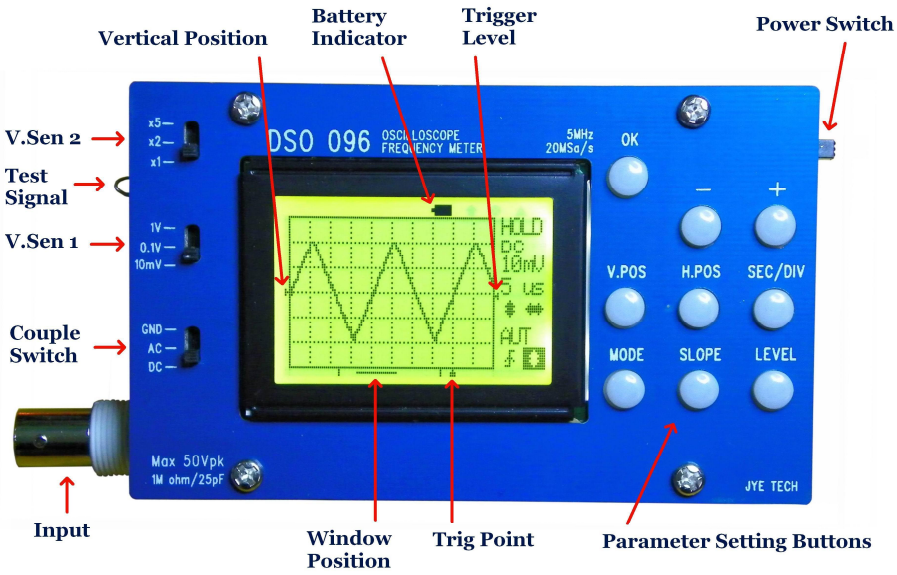


Fig 1

The photo above shows the screen and various front panel controls. They are explained respectively below.

Screen

1) **Vertical position indicator** – the small triangle on the left border of the grid– indicates the 0V input level. It can be adjusted up and down by first pressing [VPOS] and following with [+] or [-].
2) **Trigger level indicator** – the small triangle on the right border of the grid – indicates the threshold voltage of trigger. Signal capture is triggered when the input signal level crosses the threshold voltage level. Trigger level can be adjusted by first pressing [LEVEL] and following with [+] or [-].
3) **Window position indicator** – indicates the displayed portion of sampled memory. The distance between the two short vertical bars at the bottom represents the whole size of sample memory, which is usually longer than the screen can display. So at any given moment the screen can only display a portion of the sampled data. The window position indicator shows approximately what portion is being displayed. By pressing [HPOS] and following with [+] or [-] you can pan the display window through the waveform buffer.
4) **Trigger point indicator** – indicates the point where trigger occurs. Depending on the trigger position

setting the trigger point can be set to 1/8, 1/4, 1/2, 3/4, or 7/8 of the sample memory. With the trigger point indicator users can visually identify the spot where trigger occurs. When the trigger point is outside of the display window it will be indicated by a small triangle, pointing either left or right.

5) "**HOLD**" is displayed when the oscilloscope is in HOLD state, which means capture action is halted until HOLD state is released.

6) **Parameter setting indicators** – their functions are described below in Fig. 2.

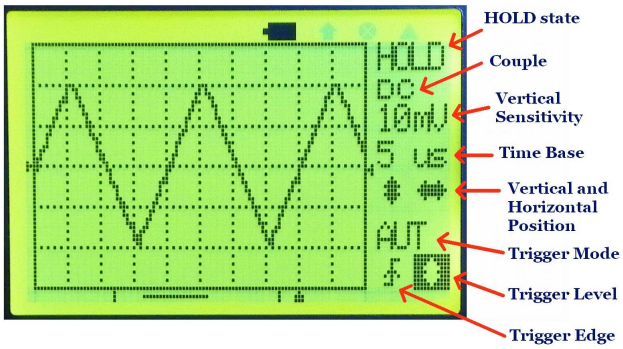


Fig 2

Couple Select Switch

This switch selects couple method. "**DC**" means input signal is directly applied to the oscilloscope. "**AC**" means input signal is connected to the oscilloscope via a capacitor, which blocks the DC component of input signal. When this switch is set to "**GND**" oscilloscope input is connected to ground and input signal is disconnected.

Vertical Sensitivity Select Switches

There are two switches for vertical sensitivity selection: The first one selects base value. The second selects multiplier. The combination of the two determines actual vertical sensitivity. For example, when switch V. SEN. 1 is at the "0.1V" position and switch V SEN 2 is at the "X2" position, the actual vertical sensitivity is (0.1 x 2 = 0.2) which means 0.2V per division.

SEC/DIV

Select time-base. Press this button so as time-base display is highlighted. Change Time-base settings by [+] and [-] buttons.

V.POS

Select vertical position. Press this button so as vertical position indicator is highlighted. Adjust vertical position by [+] and [-] buttons.

H.POS

Select horizontal position. Press this button so as horizontal position indicator is highlighted. Adjust horizontal position by [+] and [-] buttons.

MODE

Selects trigger modes. Press this button so as trigger mode display is highlighted. Adjust trigger mode with [+] and [-] buttons.

SLOPE

Selects trigger polarity. Pressing this button will toggle trigger slope between rising (positive) and falling (negative).

LEVEL

Selects trigger level. Press this button so as trigger level indicator is highlighted. Adjust trigger level by [+] and [-] buttons.

OK

This button toggles the oscilloscope between HOLD and RUN states.

4. Connectors, Terminal, and Power Switch

Power Switch

Power switch locates at the upper-right of the panel. This switch selects the power source used for the

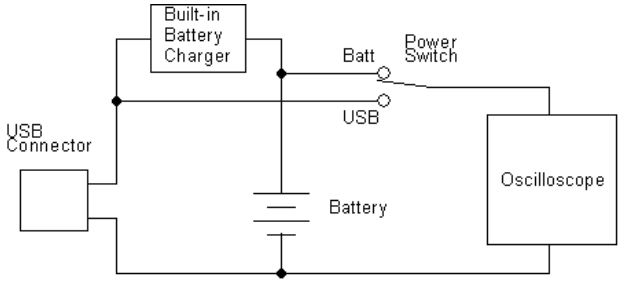


Fig 3

oscilloscope. When USB is not connected it acts as a power on/off switch for battery. Please see Fig. 3 below for switch connections.

Signal Input Connector

This connector locates at lower-left of the panel. This is a standard BNC connector for oscilloscope probe. Please note that with a 1X probe the maximum peak-to-peak voltage applied to this input should not be greater than 50Vpk. If measurement for larger voltage is required appropriate divider (use 10X probe, for example) should be used.

USB Connector

This connector locates at the right side of oscilloscope. This is a 5-pin mini USB B type connector. It is for firmware upgrading and data transferring to/from PC.

Test Signal Terminal

The Test Signal terminal is a small metal ring locating at the left side of oscilloscope. It is the output of 1KH/5Vpp test signal.

5. Basic Operations

Power On and Off

To turn on the device place the Power Switch to "BATT" position. Placing the switch at "USB" position will turn the device off if USB is not connected. If USB is connected this will make the device powered from USB. Please see drawing of Fig. 3 for details.

Set Parameters

The basic and most frequently used oscilloscope parameters include:

1) Vertical related – sensitivity (V/DIV), vertical position [VPOS], and AC/DC coupling.
2) Horizontal related – Time-base [SEC/DIV] and horizontal position [HPOS].
3) Trigger – trigger modes [MODE], edges [SLOPE], and level [LEVEL].

Please refer to the descriptions in Section 3 above for how to use various controls to change these parameters.

Example 1 Observe the test signal (Practice basic operations)

1) Place the tip of the probe on the Test Signal terminal ring. This is the output of built-in 1KHz/5Vpp test signal. **The attenuation switch at probe handle should be set to 1X position.**
2) Set vertical sensitivity to 2V (V.Sen 1 switch in position "1V" And V. Sen 2 switch in position "X2").
3) Set the couple switch to the "DC" position.
4) Press the [V.POS] button, and adjust 0V indicator to the position shown in Fig. 4.

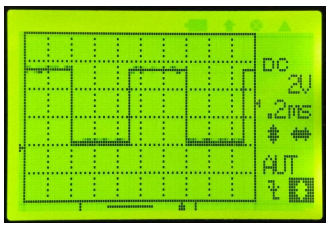


Fig 4

5) Press the [SEC/DIV] button, and set the Time-base to 0.2ms. Waveform shown in Fig. 3 should be seen. (If you find the display is unstable, you can press [LEVEL] and change Trigger Level so that a stable display is obtained.)
6) Changing the position of V. Sen 2 switch you should see that the displayed amplitude changes accordingly. Read amplitude based on sensitivity and divisions. Compare results of different settings.
7) Changing the Time-base setting to 0.1ms, for instance, you should see the signal waveform widens accordingly. Compare of displays of different time-base settings.
8) Now, change couple selection switch to "AC" position you should see that the waveform is shifted down to a position where the VPos indicator is at its midway point. This is because the DC component

of the signal was blocked.

Example 2 Observe saw signal (Learn how to use trigger modes)

The schematic of Fig. 5 is a simple sawtooth signal generator. We are going to use the scope to observe its output. Build the circuit according to the schematic. Connect power and oscilloscope as indicated.

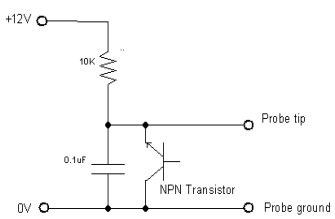


Fig. 5

1) Set couple switch to DC. Set V. Sen. 1 switch to the "1V" position and V. Sen. 2 switch to the "X2" position. (i.e. sensitivity is set to 2V/Div). Adjust the 0V to the second last linet on the vertical scale. (See Fig 6)
2) Power the circuit with voltage +12V or higher. Set Time-base to 0.5ms (or other depending on the type of transistor used).
3) Set the switch on probe handle to X1 position and connect probe tip to the test signal output ring. You should see a waveform similar to that shown in Fig 6.
4) Select AUTO trigger mode and change the trigger level. You should be able to observe that the waveform stabilizes itself when it intersects with trigger level. Otherwise, the waveform will keep moving and you won't be able to get a clear view of it.
5) Change the trigger mode to NORM, and vary the trigger level. Notice that the waveforms only update when they intersect with the trigger level. Otherwise, it will stall.

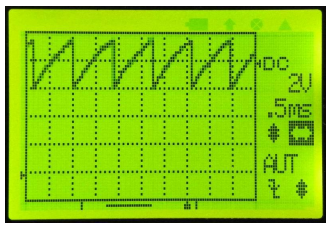


Fig. 6

6) Press the [OK] button to put the oscilloscope into the HOLD state. "HOLD" is displayed. Now you can shift the waveform back/forth or up/down to view the un-displayed waveform. Pressing [OK] again will release the HOLD state and put oscilloscope back into capture state.

Calibrate 10X Probe

10X probe offers the advantage of higher input voltage range, higher impedance, and less interference to the circuits being measured. In order to effectively use 10X probe the compensation cap trimmer (see Fig 7) must be calibrated. This can be done by using the built-in 1KHz/5V test signal.

Set the probe attenuation to 1/10 by placing the attenuation switch on probe handle to the "10X" position. Place the tip of the probe on the Test Signal terminal ring. Set oscilloscope Time-base to 0.2ms/Div and adjust trigger level so that a stable waveform display is obtained. Tune the cap trimmer carefully (see Fig 7) so that right compensation figure is reached (refer to Fig 8).

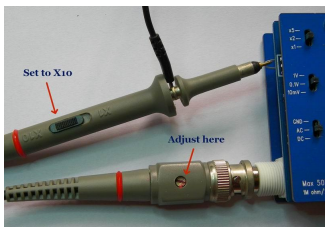
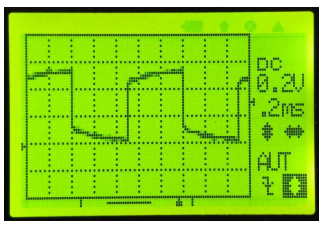
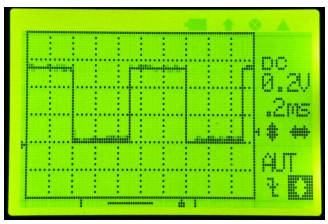


Fig. 7

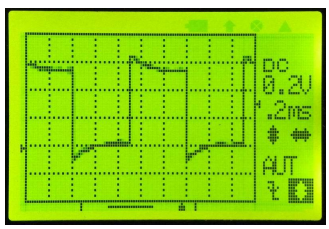
For 10X probe remember to multiply vertical reading by 10 to get true results. If, for example, the displayed signal amplitude is 2.5V the real signal amplitude is actually 25V.



(a) Under compensation



(b) Right compensation



(c) Over compensation

Fig 8

Vertical Position Alignment

Sometimes you may find the vertical position indicator is not aligned to 0V level trace. The difference can be removed by:

1) Set couple switch to "GND" position.
2) Press [VPOS] and hold it down for about 3 seconds.

When the button is released you will see 0V line is aligned to the vertical indicator.

Do the alignment by placing V.Sen.2 switch at X1, X2, and X5 respectively.

About Rolling Display Mode

When Time-base is set to 0.1s/Div or slower DSO 096 uses a display mode called "Rolling". In this mode the trace shifts from right to left, simulating time passing.

About Equivalent-Time Sampling (ETS)

When time-base is set to 2us/DIV or faster Equivalent-Time Sampling (ETS) technique is used. ETS is different from real-time sampling. By ETS the displayed waveforms are actually re-constructed from samples taken at multiple cycles. For ETS to work the following conditions must be met.

1) The signal to be measured must be periodical.
2) Trig must be generated. This is because the trig points serve as the reference for re-constructing waveforms.

So if time-base is set to 2us/DIV or faster and you don't see waveform updates try adjusting trigger level so that waveform display updates (trig happens).

Please note under ETS the trigger point indicator does not have meaning.

LCD Backlight ON/OFF

Under oscilloscope mode hold [SLOPE] 3 – 4 seconds will toggle the LCD backlight on/off. This is useful for saving power when the oscilloscope is running on battery.

6. Advanced Operations

Change Trigger Position

1) Under normal oscilloscope running mode hold down the [LEVEL] button for about 3 seconds to enter Setting Select Menu (Fig. 9).
2) Scroll the highlight bar to "TRIG POSITION" using [+] or [-] button and [OK]. This will bring up trig position adjustment screen (Fig. 10).
3) Use [+] and [-] change trig position and press [OK] to complete.
4) Press [LEVEL] to exit Setting Select Menu and return to normal running mode.

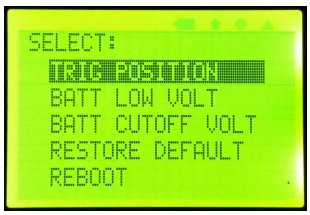


Fig 9

Why We Need to Change Trig Position

The Trigger position can be set to 1/8, 1/4, 1/2, 3/4, or 7/8 of the sample buffer. If the trigger position is set to 1/8 that means the first 1/8 of the buffer keeps samples taken before trigger point, and the rest of 7/8 buffer keeps samples taken after trigger point. If the trigger position is set to 1/2 that means buffer size used to keep samples before and after trigger point is half to half. Apparently, if you are more interested in waveforms after the trigger point you should set the trigger position to a smaller value. Otherwise, you should set trig position to a larger value.

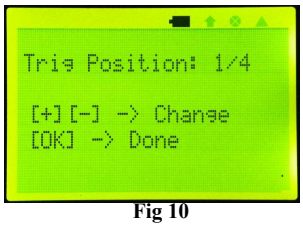


Fig 10

USB Connection

The USB connection in DSO 096 is a virtual Uart port. It is based on the dedicated Uart-USB convert chip CP2102 from Silicon Lab. To use the connection, you need to install PC driver for the chip. Drivers for Windows and Linux can be downloaded from Silicon Lab's web site.

Download link: http://www.silabs.com/products/mcu/pages/usbtouartbridgevcpdrivers.aspx

Save captured signal samples

Captured waveforms can be stored in the on-chip EEPROM for later use. Up to 6 waveforms can be stored. To do this:

1) Freeze the waveform you intend to save by pressing [OK] key (enter HOLD state).
2) Press [SEC/DIV] and use [+] or [-] to select one of the 6 buffers (Fig. 11).
3) Press [OK] to save the frozen waveform to the buffer selected.

Fig 11

Recall captured signal samples

To recall saved waveforms:

1) Enter HOLD state by pressing [OK].
2) Press [SLOPE] and use [+] or [-] to select the buffer to be recalled (Fig. 12).
3) Press [OK] to display the waveform in the buffer selected.

Fig 12

Send Screen as Bitmap File

The oscilloscope screen can be transferred to PC as a bitmap file via the USB. The transfer protocol used here is Xmodem. Communication format is **38400bps, 8 data bits, 1 stop bit, no**

parity, no flow control. To do so please follow the steps below:

1) Install Virtual Com Port driver if you have not already done so.
2) Connect the scope to PC via a mini USB cable.
3) Launch Windows HyperTerminal (or any other communication tool that can handle the Xmodem protocol) and make it ready for file receiving. Select file extension name to be ".bmp" so as it can be open by photo viewers. If you failed to do so in this step you can always rename the file to ".bmp" after transfer is done.

Fig 13

4) Put scope into HOLD state and make the interested portion of waveform displayed on screen.
5) Press the [LEVEL] button. You should see screen as Fig.13. Press [OK] to start transfer.

Vertical Position Alignment

If you see the 0V line does not match to the VPOS indicator you can follow the steps below to align them.

1) Set couple switch to "GND" position.
2) Hold down [VPOS] for about 3 seconds and release. You should see the 0V line aligned to the VPOS indicator.
3) Do this with V.Sen.2 switch at X1, X2, and X5 position, respectively.

Change Battery-Low Alert Level

This feature is not support in current version of firmware. There is no Battery-Low alert for the time being.

Change Battery Cut-off Level

This feature is not supported in current version of firmware. Battery cut-off level is fixed to 2.5V.

Restore Factory Default

To restore factory default settings:

1) Hold down [LEVEL] for about 3 seconds to bring up Setting Select menu (Fig. 17).
2) Scroll highlight bar to "RESTORE DEFAULT" and press [OK].

Battery Recharging

Please follow these steps to do battery recharging:

1) Place power switch at "USB" position.
2) Connect USB cable. You should see the red LED on the charger board lit up.
3) If you want to turn the oscilloscope off during charging hold down [OK] button for about 3 seconds.
4) Do not move power switch during charging to avoid un-intentionally terminate the charge process.

For a fully discharged battery the recharge time is about 12 hours.

7. Frequency Meter

Enter Frequency Meter Mode

Hold down the [MODE] button when the device is at Oscilloscope Mode. The Select Function menu will be displayed (Fig. 14). Scroll highlight bar to "Freq. Meter" and press [OK].

Fig 14

Attenuation and Coupling

Under Frequency Meter mode input signal can be attenuated by operating switches V.Sen1 and V. Sen2. Attenuation is displayed in fraction and decibel (see Fig. 15).

AC couple is recommended for frequency measurement.

Exit Frequency Meter Mode

To exit Frequency Meter mode press [MODE] button. This will bring up Select Function menu again. Choose "DSO" or "FFT" and press [OK] to enter the mode selected.

Fig 15

8. FFT (Signal Spectrum Analysis)

Enter FFT Mode

Hold down the [MODE] button when the device is at Oscilloscope Mode. The Select Function menu will be brought up (Fig. 14). Scroll highlight bar to "FFT" and press [OK].

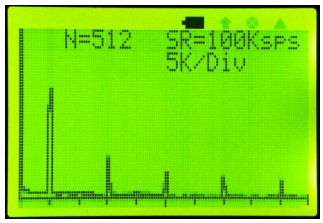


Fig 16

Change Sampling Rate and FFT Size

- Use [+] and [-] to change FFT sampling rate.
- Press [HPOS] to toggle FFT size between 256-point and 512-point.

Attenuation

Input signal can be attenuated by operating switches V.Sen1 and V. Sen2.

Exit FFT Mode

To exit FFT mode press [MODE] button. This will bring up Select Function menu again. Choose "DSO" or "Freq. Meter" and press [OK] to enter the mode selected.

9. Firmware Upgrade

The main firmware is run by MCU ATmega64. There are two ways to upgrade this firmware.

- By pre-programmed bootloader.
- By hardware programmer.

Upgrade by Bootloader

To use the bootloader you only need a miniUSB cable and an application running on PC. This is the easiest and saftest way so it is strongly recommended. For Windows users, the PC application is called "**avrubd.exe**" from Shao Ziyang (http://blog.ednchina.com/shaoziyang/). Please download this program from JYE Tech web site (http://www.jyetech.com/Support/avrubd.rar) and copy it to your computer (no installation required). Refer to the document "How to Upgrade Firmware by Bootloader" (http://www.jyetech.com/Support/HowToUpgradefirmwareByBootloader.pdf) for more detailed instructions.

Entering Bootloader

To enter bootloader:

3) Hold down [LEVEL] for about 3 seconds to bring up Setting Select menu (Fig. 17).
4) Scroll highlight bar to "REBOOT" and press [OK].

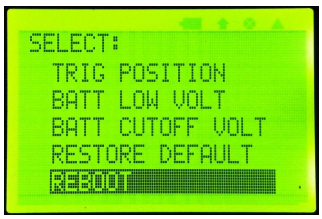


Fig 17

Upgrade by Hardware Programmer

If hardware programmer is used, it is important to make sure the programmer has a compatible pin-out. If they are different you need to re-route the signals to match the pinouts. The programming header for ATmega64 (U7) is J4. Its pin-out is shown Fig 18 and is also indicated on the PCB.

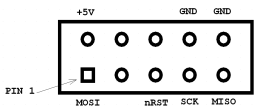


Fig 18 J4 pin-out

If JYE Tech's USB AVR Programmer (PN: 07302) is used to program the oscilloscope remember to connect programming ribbon cable to header J5 on 07302 board. Do not connect to J8, This is for the older 062 models only. The first conductor of the ribbon cable (usually marked with red stripe along one edge) should be aligned to PIN 1 of headers on both boards. Follow the instructions of the programmer used to complete.

10. Specifications

Vertical	
Number of Channels	One
Analog Bandwidth	0 – 5MHz
Sensitivity	10mV/Div – 5V/Div
Resolution	8 bits
Input Impedance	1M Ohm, 25pF
Max Input Voltage	50Vpk (for 1X probe)
Couple	DC, AC, GND
Horizontal	
Max Real-time Sampling Rate	2MSPS
Max Equivalent-Time Sampling Rate	20MSPS
Time-base Range	0.5us/Div – 10minute/Div
Record Length	256 points
RUN/HOLD Modes	One button switchable
Trigger	
Trigger Modes	Auto, Normal, and Single
Trigger Polarity	Rising/Falling
Trigger Source	Internal only
Trigger position	1/8, 1/4, 1/2, 3/4, or 7/8 of sample buffer user adjustable
Trigger Point Indicator	Yes
Other Features	
Save/recall up to 6 captures (256 points each)	
Screen image hardcopy	
Built-in battery charger	
Firmware upgradeable via bootloader. No programmer needed	
USB connection for data transfer and firmware upgrade	
Battery over-discharge protection	
Frequency Meter	
Bandwidth	20MHz
Sensitivity	< 0.2Vpp @ 20MHz
FFT	
FFT Size	256 or 512 points selectable
FFT Sampling Rate	1KSps – 2MSps adjustable
Window	Hamming
Display	
Screen	2-inch 128 X 64 dot-matrix black/white LCD
Backlight	Yes (ON/OFF controllable)
Contrast	Adjustable
Power Supply	
Power Supply	3.7V Li-ion battery (1200mAh) or USB
Power Supply Current	LCD backlight on : 210mA @ 3.7V (Typical) LCD backlight off: 150mA @ 3.7V (Typical)
Physical	
Dimension	140mm X 65mm X 25mm
Weight	120 grams (not including probe and battery)

9 Technical Support

Please contact JYE Tech at **support@jyetech.com** for any technical assistance. You can also seek assistance by posting your questions to JYE Tech Forum at **http://forum.jyetech.com/index.php**.

10 Revision History

Version	Date	Summary
v01	2011.12.29	First draft