

# DSO Shell DIY Kit

## User Manual

Rev. 03

Applicable models: 15001K, 15002K, and 15003K

See page 2 for  
tools needed

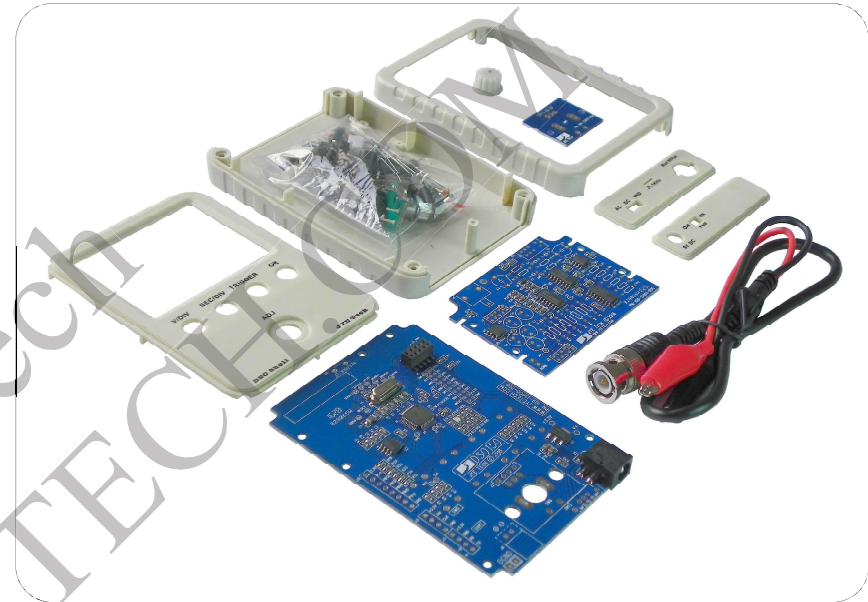
### Before you start

- ① Check kit contents and part quantities/values by the photo at right and part list in page2 and page 3. Report missing or wrong parts to your vendor.
- ② Resistor values are easy to mis-read. It is strongly suggested to check their values before soldering them to board.
- ③ Make sure you understand the polarities and orientations of all parts.
- ④ 15003K does not include enclosure. Some instructions are not applicable.

### Important !!!

If your have purchased 15002K kit (SMD not pre-soldered) you must install all SMD parts before mounting the through-hole parts. Please refer to the instructions below for SMD part installation. Otherwise, proceed to page2 to start through-hole part assembly.

SMD parts are only installed to the analog board (PCB PN# 109-15001-xxx).



### How to Solder SMD Parts

1. Before soldering check components against the part list to make sure you have correct parts.
2. Identify IC orientation and diode polarity (see photos).
3. Do not put iron on one pad for too long time. Otherwise, traces may peel off and get damaged.

#### SMD Part List

Loc/Ref	Qty	Descriptions
U1	1	TL082, SO8
U2	1	74HC4053, SO16
U3	1	74HC4051, SO16
U4	1	TL084, SO14
U5	1	ICL7660, SO8
R17	1	100,1%, 0805
R18, R23, R28	3	1K,1%, 0805
R19, R20, R21	3	100K,1%, 0805
R22	1	300K,1%, 0805
R24, R25	3	10K,1%, 0805
C8, C9, C15, C16, C17, C18, C19, C20, C21, C22	10	0.1uF, 50V, 0805
D1	1	Zener, 3.0V, 0805

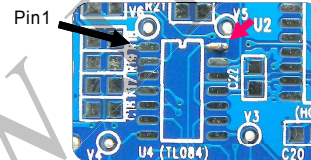
#### Identify IC orientation



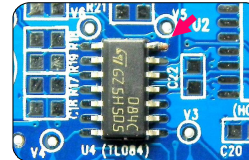
PIN 1

Place IC in front of you so that its marking read from left to right. The first pin at lower-left corner is pin 1.

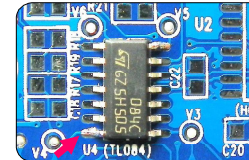
#### Solder ICs



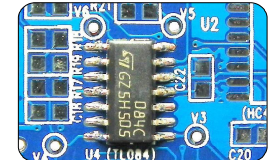
Apply solder to a corner pad



Solder IC to the pad. Make sure pins are aligned to pads

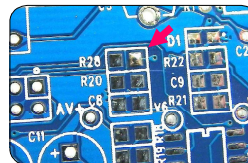


Solder the pin at the opposite corner so as chip is fixed

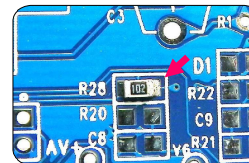


Solder all the rest pins one by one

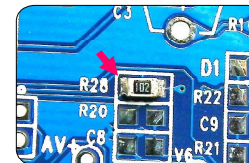
#### Solder two-terminal parts



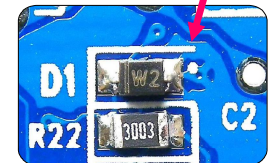
Apply solder to one pad



Solder part to the pad



Solder the other pad



Diode D1 polarity

Positive pole

## Important

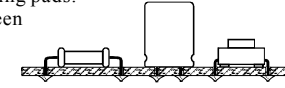
If your kit does not have SMD device pre-soldered you are strongly suggested to install all SMD parts before mounting through-hole parts. Please see instructions at Page 1.

## Tools you need

- ① 20 - 25W iron for most of parts. For the BNC connector higher power iron (50 - 100W) is recommended if available.
- ② Rosin solder wire (0.8 - 1mm dia.)
- ③ Digital multimeter
- ④ Screw driver (phillips, size# 0)
- ⑤ Flush cutter
- ⑥ Tweezers
- ⑦ DC 9V power supply with 200mA (or higher) current capacity and 5.5 x 2.1 mm plug.
- ⑧ Needle-nose pliers
- ⑨ Small slotted screwdriver (2mm width, for cap trimmer adjustment)

## Soldering Hints

- ① Put leads through mounting holes from the side with part outline. Ensure component evenly touch PCB.
- ② Solder leads at the other side. Solder should fully fill and cover soldering pads. Avoid bridges between neighboring pads.
- ③ Cut unused leads flush with cutter.

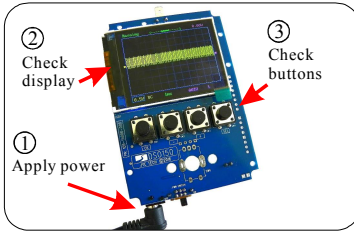


## Step 1

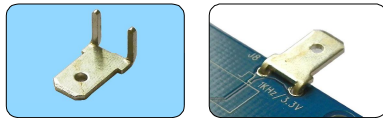
Assembly the Main Board (follow the order as numbered)

### 1. Check the main board

- ① Connect 9V power supply (center positive) to J7 on the mainboard.
- ② You should see the scope boots up to a screen similar to the photo below. D1 (LED) blinks twice.
- ③ Test the four buttons. You should see responses on screen. (Do this after buttons have been installed)



### 2. Test Signal Terminal



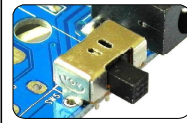
- ☐ J8 : 4.8 x 0.8mm terminal
- Note: Before soldering bend the terminal to the shape as shown in the left photo above.

### 3. Power Connector (optional)



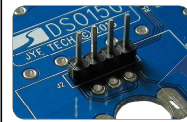
- ☐ J6: 0.1" pitch, rightangle

### 4. Slide Switch



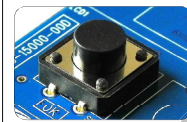
- ☐ SW5 : DPDT

### 5. Pin-header (male)



- ☐ J2 : 1X4 pin, 0.1" pitch

### 6. Tact Switches



- ☐ SW1, SW2, SW3, SW4 : 12x12x7mm

### 7. Remove Resistor R30



#### How to:

Let iron stay on one pad of the resistor until solder on the other pad melt and then remove the part.

#### Note:

R30 is used to bypass SW5 so as the mainboard can be tested without the switch. It must be removed for correct functioning of the power switch.

## Step 2

Assembly the Analog Board (follow the order as numbered)

### 1. Resistors



Note: Always meter resistor values before soldering

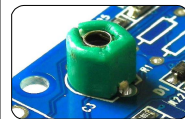
- |  |  |
|--|--|
| <input type="checkbox"/> R1 : 510K $\Omega$        | <input type="checkbox"/> R7 : 300 $\Omega$           |
| <input type="checkbox"/> R2 : 5.1M $\Omega$        | <input type="checkbox"/> R8, R13, R16 : 150 $\Omega$ |
| <input type="checkbox"/> R3 : 1.2M $\Omega$        | <input type="checkbox"/> R9 : 91 $\Omega$            |
| <input type="checkbox"/> R4 : 11K $\Omega$         | <input type="checkbox"/> R10 : 30 $\Omega$           |
| <input type="checkbox"/> R5, R6, R14 : 1K $\Omega$ | <input type="checkbox"/> R11, R12 : 15 $\Omega$      |
|  | <input type="checkbox"/> R15 : 680 $\Omega$          |
|  | <input type="checkbox"/> R26, R27 : 120 $\Omega$     |

### 2. Ceramic Capacitors



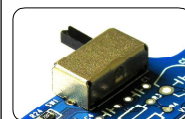
- |   |
|---|
| <input type="checkbox"/> C1 : 0.1 $\mu$ F |
| <input type="checkbox"/> C2 : 330pF       |
| <input type="checkbox"/> C4 : 1pF         |
| <input type="checkbox"/> C6, C7 : 120pF   |

### 3. Capacitor Trimmers



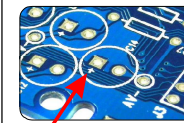
- ☐ C3, C5 : 5 - 30pF

### 4. Slide switch

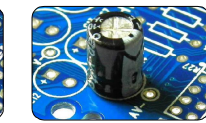


- ☐ SW1 : 2P3T

### 5. Electrolytic capacitors

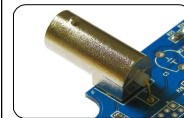


Solder positive pole (the longer lead) to the square pad



- ☐ C10, C11 : 100  $\mu$ F / 16V  
C12, C13, C14

### 6. BNC connector

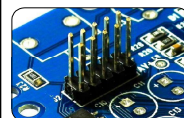


- ☐ J1 : BNC

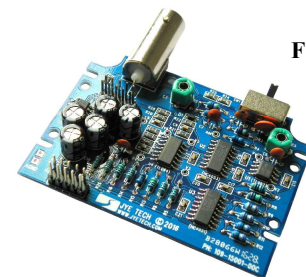
#### Note:

The thicker pins need to heat up longer to get good soldering result.

### 7. Pin-header (male)



- ☐ J2, J3 : 2 X 5 pin



Finished



## Step 3 Assembly Front Module

### 1. Solder Rotary Encoder

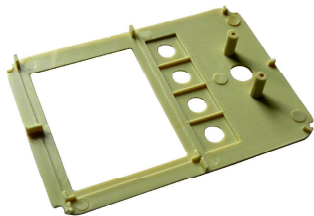


For 15001K & 15003K:  
Mount to the small PCB  
(PN: 109-15002-00A)

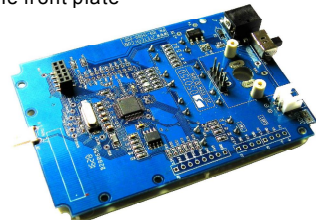
For 15002K:  
Mount to the main board  
and proceed to Step 4.

### 2. Assemble Front Module

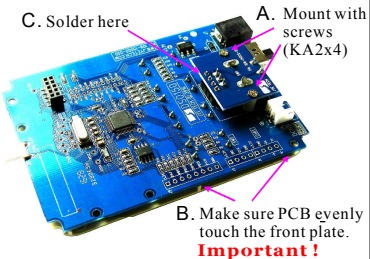
#### ① Get the front plate



#### ② Attach the mainboard to the front plate



#### ③ Mount rotary encoder board to the front plate with screws and solder the board to J2 of the main board.



## Step 4 Check Voltages

**Important!**  
Always remove power before  
connecting or disconnecting  
the analog board.

### Verify voltages on the analog board

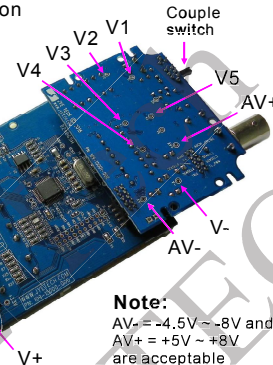
- ① Attach the analog board to the main board by mating J3 on the analog board to J4 on the main board (see photo).
- ② Apply 9V DC power supply to J7 (or J6) on the main board.
- ③ Set couple switch to GND position.
- ④ Check voltages at the points as shown in the photo.

References  
(\*) Input dependent

Input	+9.20V
V+	+8.25V
AV+	+6.87V
V-	-7.14V
AV-	-5.55V
V1	0V
V2	0V
V3	0V
V4	+1.61V
V5	-0.98V

Place negative pen at DGND

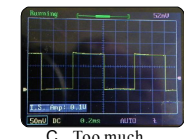
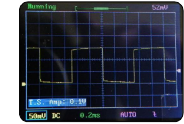
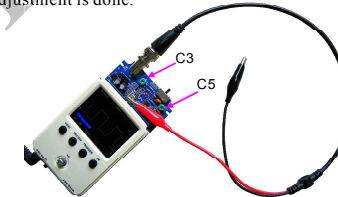
Apply power here



## Step 5 Probe Calibration

### Adjust trimmers C3 and C5

- ① Connect the red clip to the test signal terminal and leave the black clip un-connected (see photo at bottom).
- ② Apply power and boot. Hold down ADJ dial for 3 seconds to bring up Test Signal amplitude display at lower-left corner. Push ADJ to set the amplitude to 0.1V.
- ③ Set sensitivity to 50mV and adjust trigger level so that waveform stable (see "How to Use" at page 4).
- ④ Tuning C3 so that sharp rectangle (photo B at left) is obtained. The adjustment for C3 is done.
- ⑤ Push ADJ to set the amplitude to 3.3V. Change sensitivity to 1V. Tuning C5 so that sharp rectangle waveform is obtained. The adjustment is done.



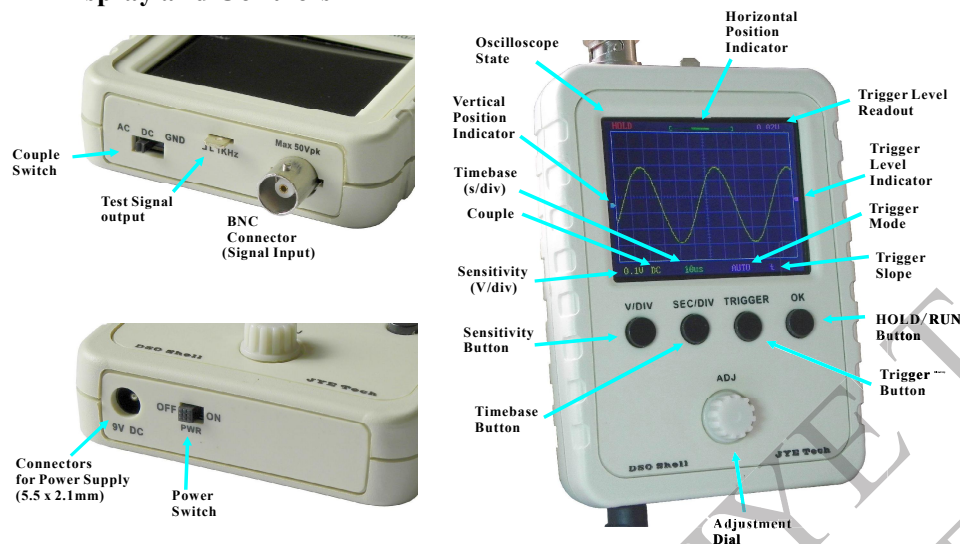
## Step 6 Put all parts together (For 15001K & 15002K. For 15003K see photo at the end of page 4)

### Final assembly (for 15001K and 15002K only)

- ① Screw the analog board to back cover with the top bracket attached  
Screws KA2x4 (4 positions)
- ② Combine the front module and the back cover  
Put test signal terminal through the small slot
- ③ Make sure receptacle (J4) mate with pin-header (J2)
- ④ Attach bottom bracket before holding the two modules together
- ⑤ Attach the front frame
- ⑥ Firmly press the frame in
- ⑦ Screw up at the back  
Screws PA2.3x8 (4 positions)
- ⑧ Attach knob cap and done!

## How to Use

### Display and Controls



### Connections

**Power Supply:** Connect 9V DC power supply to the 5.5x2.1mm jack at bottom (center positive). Power supply voltage must be in the range of 8 - 10V.

**Probe:** Connect probe to the BNC connector at top.

### Operations

#### Basic Button Functions

- [V/DIV]: Select sensitivity or vertical position. The selected parameter indicator will be highlighted.
- [SEC/DIV]: Select timebase or horizontal position. The selected parameter indicator will be highlighted.
- [TRIGGER]: Select trigger mode, trigger level, and trigger edge. The selected parameter indicator will be highlighted.
- [OK]: Enter HOLD state (freeze waveform). Press it again will de-freeze.
- [ADJ]: Adjust the parameter selected (highlighted).
- Couple switch:** Set couple to DC, AC, or GND. When GND is selected the scope input is isolated from input signal and connected to ground (0V input).

#### Specifications

Max realtime sample rate	1MSa/s	Timebase range	500s/Div -- 10us/Div
Analog bandwidth	0 -- 200KHz	Trigger modes	Auto, Normal, and Single
Sensitivity range	5mV/div - 20V/div	Trigger position	Center of buffer
Max input voltage	50Vpk (1X probe)	Power supply	9V DC (8 - 10V)
Input impedance	1M ohm/20pF	Current consumption	~120mA @ 9V
Resolution	12 bits	Dimension	105 x 75 x 22mm
Record length	1024 points	Weight	100 gram (without probe and PS)

### More Functions

Functions	Operations
<b>VPos Alignment</b>	Set Couple Switch to GND position. Hold down [V/DIV] button for about 3 seconds.
<b>Measurements ON/OFF</b>	Hold down [OK] button for about 3 seconds. This will turn ON or OFF on-screen display of measurements including Vmax, Vmin, Vavr, Vpp, Vrms, Freq., Cycle, Pulse width, and Duty cycle.
<b>Save Waveform</b>	Press [OK] & [Trigger] buttons simultaneously. The currently displayed waveform is saved to EEPROM. The existing data in EEPROM will be over-written.
<b>Recall Waveform</b>	Press [OK] & [SEC/DIV] buttons simultaneously. Recalled waveform is always displayed in Hold state.
<b>Default Restore</b>	Hold down [SEC/DIV] and [TRIGGER] buttons simultaneously for about 3 seconds.
<b>Center HPos</b>	Hold down [SEC/DIV] button for about 3 seconds. This will make the data at the center of capture buffer displayed.
<b>Center Trigger Level</b>	Hold down [TRIGGER] button for about 3 seconds. This will set the trigger level to the medium value of signal amplitude.

### Troubleshooting

Problems	Possible Causes
<b>Bad V+</b>	① Connector J7 defective. ② Diode D2 open or damaged.
<b>Bad V-</b>	① Bad C12 and/or C13. ② U5 (7660) bad soldering or defective. Hint: Check with R27 disconnected would let you know the issue is caused by load or source.
<b>Bad AV-</b>	① R27 bad soldering or wrong value. ② Shorts between AV- and ground.
<b>Bad AV+</b>	① R26 bad soldering or wrong value. ② Shorts between AV+ and ground.
<b>V1 does not close to 0V</b>	① SW1 not set to GND position. ② Bad soldering on R1 and/or R2. ③ Bad soldering on U1.
<b>V2 does not close to 0V</b>	① SW1 not set to GND position. ② Bad soldering on R3 and/or R4. ③ Bad soldering on U1.
<b>V3 does not close to 0V</b>	① Bad soldering on U2. ② Bad soldering on R5 and/or R6. ③ Bad soldering on U4.
<b>Bad V4</b>	① Incorrect V5. ② Bad soldering on R13, R14, and R15.
<b>Bad V5</b>	① Bad soldering on R21, R22, R28, C9, and D1. ② Bad soldering on U4.
<b>No Trace</b>	① Incorrect V4. If V4 is correct perform factory default restore as described in ②. ② Make sure trigger mode is AUTO and timebase is 1ms. Hold down [SEC/DIV] and [TRIGGER] buttons simultaneously for 3 seconds.

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