

SDS1000X-E Series Digital Oscilloscope

Service Manual

SM0101E-E01A



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Contact Us

If you have any problem or requirement when using our products, please contact
SIGLENTTECHNOLOGIES CO., LTD

Add: 3//F, Bldg No.4, Antongda Industrial Zone, 3rd Liuxian Road, Bao'an District,
Shenzhen, 518101,P.R.China

Tel: 400-878-0807

E-mail: sales@siglent.com

<http://www.siglent.com>

General Safety Summary

Review the following safety precautions to avoid personal injuries and prevent damages to this product or any products connected to it. To avoid potential hazards, use this product only as specified.

Only qualified personnel should perform service procedures.

To Avoid Fire or Personal Injuries

Use Proper Power Cord. Use only the power cord specified for this product and approved by your local governing agencies.

Avoid Electric Shock. To avoid injuries or potential loss of life, do not connect or disconnect probes or test leads while they are connected to a voltage source.

Ground the Product. This product is grounded through the protective ground conductor of the power line. To avoid electric shock, the grounding conductor must be connected to the earth ground. Make sure the instrument is grounded correctly before connecting its input or output terminals.

Connect the Probe Properly. Do not connect the probe ground lead to a high voltage since it has the isobaric electric potential as ground.

Observe All Terminal Ratings. To avoid fire or shock hazard, observe all ratings and markings on the instrument and check your manual for more information about ratings before connecting.

Use Proper Fuse. Use only the specified fuse.

Do Not Operate Without Covers. Do not operate this instrument with covers or panels removed.

Avoid Circuit or Wire Exposed. Do not touch exposed junctions and components when the unit is powered.

Do Not Operate With Suspected Problems. If you suspect damage has occurred to this instrument, have it inspected by qualified service personnel before further operation. Any maintenance, adjustment or replacement, especially to the circuits or accessories should be performed by SIGLENT authorized personnel.

Keep Product Surfaces Clean and Dry.

Do Not Operate in Wet/Damp Conditions. To avoid electric shock, do not operate the instrument in wet or damp conditions.

Do Not Operate in an Explosive Atmosphere. To avoid injuries or fire hazards, do not operate in an explosive atmosphere.

Safety Terms and Symbols

Terms on the Product. These terms may appear on the product:

DANGER: Indicates an injury or hazard that may immediately happen.

WARNING: Indicates an injury or hazard may be potentially accessible.

CAUTION: Indicates damage to the instrument or other property may occur.

Symbols on the Product. These symbols may appear on the product:



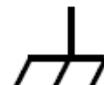
**Hazardous
Voltage**



**Refer to
Instructions**



**Protective
Earth
Terminal**



**Chassis
Ground**



**Test
Ground**

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General Features

SIGLENT's new SDS1000X-E Super Phosphor Oscilloscopes feature two channel and four channel models. The two channel model is available with a 200 MHz analog bandwidth (model SDS1202X-E), a single ADC with a 1 GSa/s maximum sample rate, and a single memory module with 14Mpts of sample memory. The four channel scope is available in 100 and 200 MHz models and incorporates two 1 GSa/s ADCs and two 14Mpts memory modules. When all channels are enabled, each channel has sample rate of 500MSa/s and a standard record length of 7Mpts. When only a single channel per ADC is active, the maximum sample rate is 1GSa/s and the maximum record length is 14Mpts. For ease-of-use, the most commonly used functions can be accessed with its user- friendly front panel design.

The SDS1000X -E series employs a new generation of SPO (Super -Phosphor Oscilloscope) technology that provides excellent signal fidelity and performance. The system noise is also lower than similar products in the industry. It comes with a minimum vertical input range of 500 uV/div, an innovative digital trigger system with high sensitivity and low jitter, and a waveform capture rate of 400,000 frames/sec (sequence mode). The SDS1000X -E also employs a 256 -level intensity grading display function and a color temperature display mode not found in other models in this class. SIGLENT's latest oscilloscope offering supports multiple powerful triggering modes including serial bus triggering. Serial bus decoding for IIC,SPI,UART,CAN,LIN bus types is included. The X-E models also include History waveform recording, and sequential triggering that enable extended waveform recording and analysis. Another powerful addition is the new 1million point FFT math function that gives the SDS1000X-E very high

frequency resolution when observing signal spectra. The new digital design also includes a hardware co-processor that delivers measurements quickly and accurately without slowing acquisition and front-panel response. The features and performance of SIGLENT's new SDS1000X -E cannot be matched anywhere else in this price class.

The four channel series includes even more functions, including: searching and navigating, on-screen Bode plot, 16 digital channels(Option), an external USB powered 25 MHz AWG module(Option), a USB WIFI adapter(Option), and an embedded application that allows remote control via web browser.

Table 1 General features

Model	SDS1104X-E	SDS1204X -E SDS1202X -E
Bandwidth	100 MHz	200 MHz
SamplingRate(Max.)	Two channel series have a single 1GSa/s ADC, four channel series have two 1GSa/s ADCs. When all channels are enabled, each channel has a maximum sample rate of 500 MSa/s. When a single channel per pair is active, , that channel has sample rate of 1 GSa/s	
Channels	4 (four channel series) 2+EXT (two channel series)	
Memory Depth(Max.)	7Mpts/CH(not interleave mode); 14Mpts/CH(interleave mode)	

- 100MHz, 200MHz bandwidth models
- Two channel series have one 1GSa/s ADC, four channel series have two 1GSa/s ADCs. When all channels are enabled, each channel has a maximum sample rate of 500 MSa/s. When a single channel per ADC is active, it has sample rate of 1 GSa/s
- The newest generation of SPO technology
- Waveform capture rate up to 100,000 wfm/s (normal mode), and 400,000 wfm/s (sequence mode)
- Supports 256-level intensity grading and color display modes
- Record length up to 14 Mpts
- Digital trigger system
- Intelligent trigger: Edge, Slope, Pulse Width, Window, Runt, Interval, Time

out (Dropout), Pattern

- Serial bus triggering and decoding (Standard), supports protocols IIC, SPI, UART, RS232,CAN,LIN
- Video trigger, supports HDTV
- Low noise floor with voltage scales from 500 μ V/div to 10V/div
- 10 types of one-button shortcuts, supports Auto Setup, Default, Cursors, Measure, Roll, History, Display/Persist, Clear Sweep, Zoom and Print
- Segmented acquisition (Sequence) mode, divides the maximum record length into multiple segments(up to 80,000), according to trigger conditions set by the user, with a very small dead time segment to capture the qualifying event.
- History waveform record (History) function(maximum recorded waveform length is 80,000 frames)
- Automatic measurement function for 38 parameters as well as Measurement Statistics, Zoom, Gating, Math, History and Reference functions
- 1Mpts FFT
- Math and measurement functions use all sampled data points (up to 14Mpts)
- Math functions (FFT, addition, subtraction, multiplication,division, integration, differential, square root)
- Preset key can be customized for user settings or factory “defaults”
- Security Erase mode
- High Speed hardware based Pass/ Fail function
- 16 Digital channels (MSO) (four channel series only, option)
- Bode plot(four channel series only)
- Search and navigate(four channel series only)
- USB AWG module(four channel series only, option)
- USB WIFI adapter(four channel series only, option)
- Web Browser based control(four channel series only)
- Large 7 inch TFT -LCD display with 800 * 480 resolution
- Multiple interface types: USB Host, USB Device (USB -TMC), LAN Pass / Fail, Trigger Out
- Supports SCPI remote control commands
- Supports Multi-language display and embedded online help

Prepare Information

Before initiating performance verification or any adjustments, it is recommended the user follow these procedures. The following topics are discussed in this chapter.

- How to perform functional checks
- How to operate four standard interface tests
- How to use self-calibration routine
- How to recall factory Default settings

For more detailed information about oscilloscope operation, please refer to the Quick Start Guide.

Functional checking

The functional checking details four types of checks used to determine if the oscilloscope is operating properly.

Power-on Inspection

The power requirements of the oscilloscope are 100-240 V, 50/60Hz or 100-120 V, 400Hz. Please use the power cord supplied with the accessories to connect the oscilloscope to the power source.

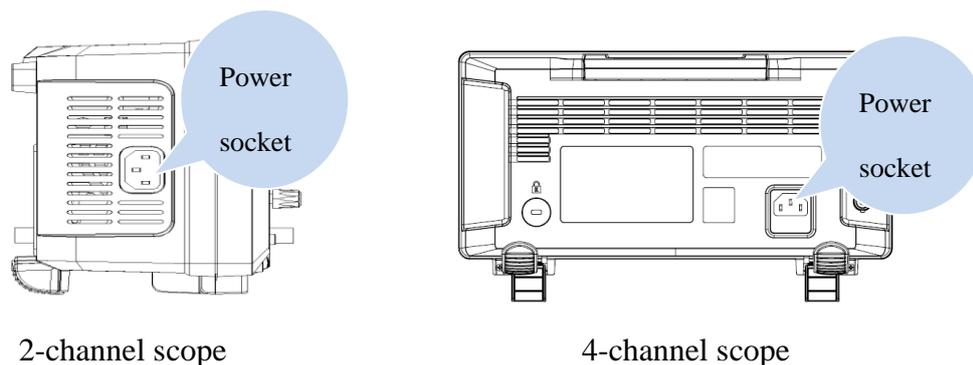


Figure 1 Connect power cord

Note: To avoid electric shock, make sure that the instrument is correctly grounded to the earth before connecting AC power.

Press the **power-on** button located at the lower left corner of the front panel and note that several oscilloscope keys will be lighted for about 6 seconds simultaneously, until the boot screen appears. The oscilloscope will then begin to perform its power-on tests automatically, after which the **Default** button can be pressed in order to recall the factory default settings.

Probe Compensation

It is necessary to compensate the probe at first use so as to properly match the probe to the oscilloscope's input channel. Non-compensated or poorly compensated probes may cause measurement inaccuracies or errors. The probe compensation steps are as follows:

1. Set the attenuation switch on the probe to 10X.

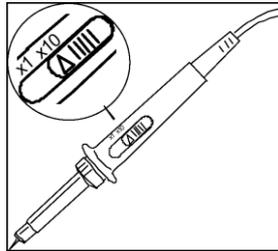


Figure 2 Set the attenuation switch

2. Connect the alligator clip of the probe to the Ground Terminal on the front panel, and then use the probe to connect CH1 BNC input connector to the Compensation Signal Output Terminal.



Compensation Signal Output Terminal

Ground Terminal

2-channel scope



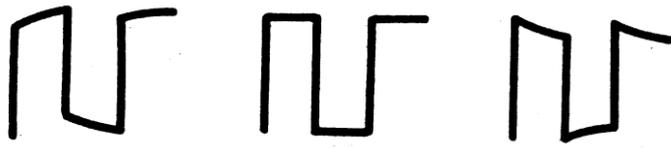
Ground Terminal

Compensation Signal Output Terminal

4-channel scope

3. Press **Auto Setup**.

4. Observe waveform on the screen. The displaying should be a square waveform as shown in the figure below:



Under
Compensated

Compensated
Correctly

Over
Compensated

5. If the waveform does not show as “compensated correctly”, use a nonmetallic screwdriver to adjust the low-frequency compensation adjustment hole on the probe until the waveform displays correctly.

Auto Setup

Press the **Auto Setup** key to enable the waveform auto setting function. The oscilloscope will automatically adjust the horizontal time base, vertical scale and trigger mode according to the input signal to obtain an optimum waveform display.

- The input signal frequency must be higher than 20 Hz, with the amplitude greater than 8 mV.
- Select the channel with the lowest frequency when several channels are connected to signals.

Self Calibration

The self-calibration program can quickly make the oscilloscope reach the best working state to get the most precise measurement values. You can perform self-calibration at any time especially when the change of the environment temperature is up to or more than 5 °C. Make sure that the oscilloscope has been warmed up or operated for more than 30 minutes before the self-calibration.

Do the following steps to do self calibration:

1. Disconnect all the input channels.
2. Press the **Utility** button on the front panel, and then press the **Do Self Cal** softkey, and the oscilloscope will pop-out the message box shown as below:

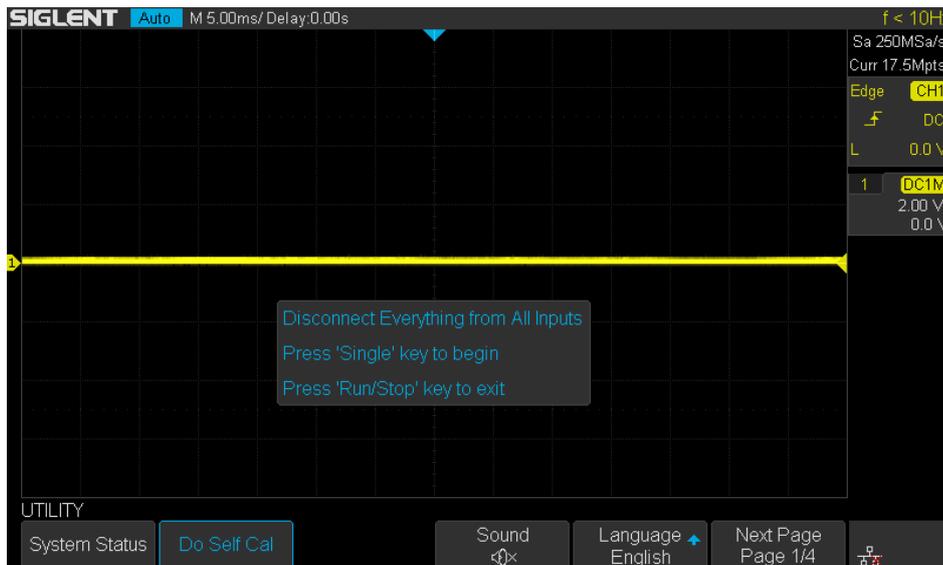


Figure 3 Calibration Interface

3. Press the **Single** button on the front panel to perform the self calibration program. During the calibration, most of the oscilloscope's keys are disabled.
4. When the self calibration process is completed, the following message will appear: "**Press Run/Stop key to exit**". Press the **Run/Stop** button on the front panel to exit the calibration interface.

Interface Test

The SDS1000X-E series oscilloscope is designed with four standard interfaces: USB Host, USB Device, LAN and Pass/Fail. Connecting to other instruments via these interfaces enables the oscilloscope to achieve additional capabilities. In order to ensure the oscilloscope is operating properly it is recommended that the user first test the interfaces.

USB Host Test

To test whether the USB Host interface is operating correctly.

Tools:

- A U disk

Steps:

1. Insert a U disk (flash drive) into the USB Host interface on the front panel of the oscilloscope.
2. A message prompt “USB Flash Drive Detected.” appears on the screen, and an icon will be shown in the lower right corner of the screen which confirms the U disk has been successfully recognized.



Figure 4 USB drive in interface

USB Device Test

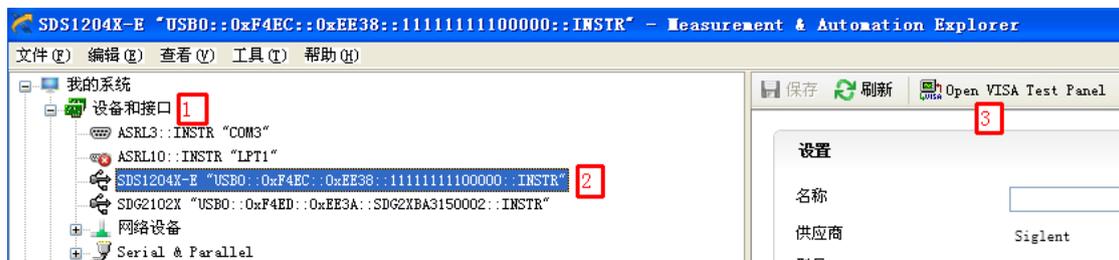
To test if the USB Device interface operating correctly.

Tools:

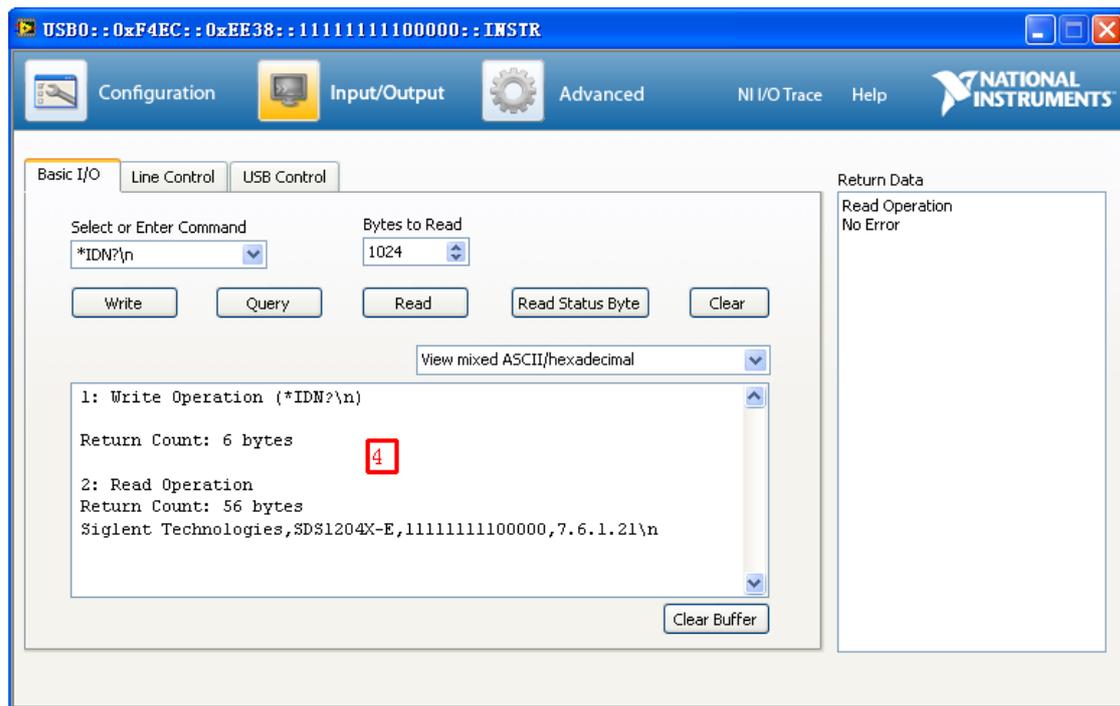
- A computer with USB interface
- A standard USB cable (Type AB)
- NI Max software

Steps:

1. Set up NI Max software in a computer and Install the driver step by step following the instructions.
2. Connect the oscilloscope to the computer using an USB cable.
3. Run NI Max software. Click “Device and Interface” at the upper left corner of the NI software interface and immediately the “USBTMC” device symbol is displayed.



4. Click “Open VISA Test Panel” option button, and then the following Interface will appear. Next, click the “Input/Output” option button and click the “Query” option button in order to view the Read operation information.



LAN Port Test

Use to test if the LAN interface operates correctly when connected with NI Visa software.

Tools:

- A computer with LAN interface
- A standard LAN cable
- NI Max software

Steps:

1. Set up NI Max software in a computer and install the driver using the following instructions.
2. Press **Utility** → **NextPage2/4** → **I/O** → **LAN** → **IP Set**, input usable IP Address and Subnet Mask.

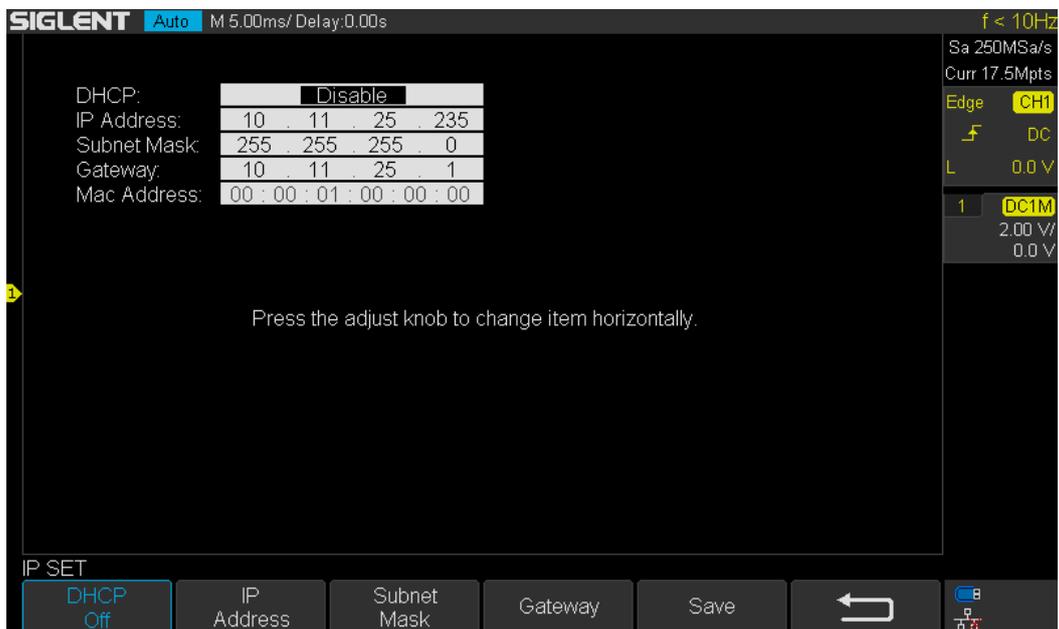
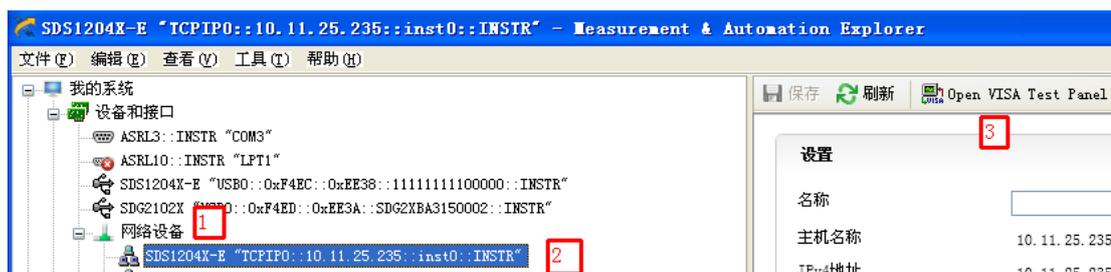
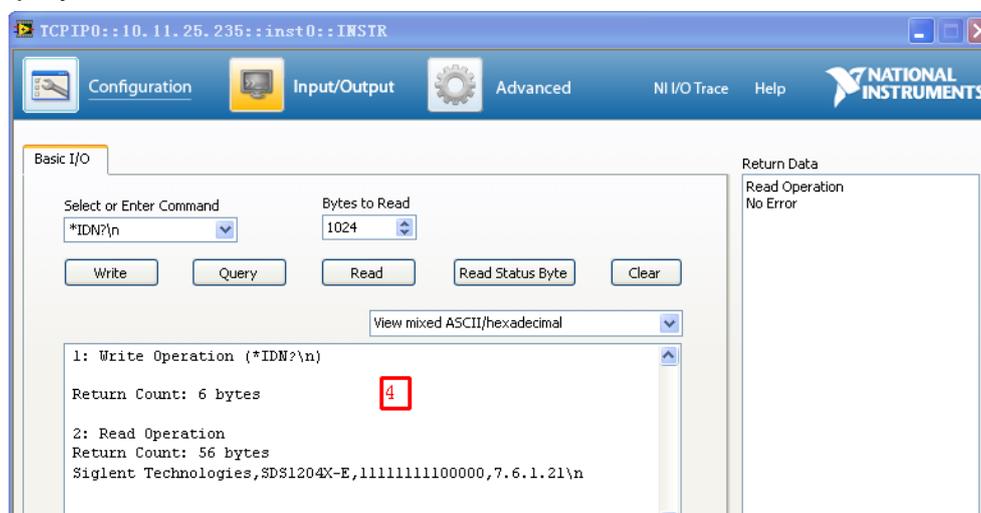


Figure 5 IP Setting interface

3. Connect the oscilloscope to the computer using a LAN cable via the LAN interface ports.
4. Run NI Max software. Click “Device and Interface” at the upper left corner of the NI software interface and select the “LAN” device symbol.



5. Click “Open VISA Test Panel” option button, which then displays the following interface (below). Then click the “Input/Output” option button and click the “Query” option button. The Read operation information will be displayed.



Pass/Fail out Test

To test the Pass/Fail function and signal output by viewing on a second oscilloscope.

Tools:

- A second oscilloscope
- Two BNC cables

Steps:

1. Turn on the SDS1000X-E oscilloscope.
2. Enable Channel 1.
3. Press **Utility** → **Next Page2/4** → **Pass/Fail**, set the submenu items under Pass/Fail menu as below:

Table 2 Pass/Fail submenu items

Submenu	Setting
Enable Test	On
Source	CH1
Msg Display	On
Mask setting	
X Mask	0.32div
Y Mask	0.32div

Note: Remember to press “Create Mask” to complete Mask setting, after x mask setting and y mask setting.

After selecting the corresponding items as shown in the table above, the SDS1000X-E screen will appear as in Figure 6:



Figure 6 Pass/Fail Waveform

If the waveform is within the range that was set under Mask menu setting, the waveform displayed on the screen will Pass. If any part of the trace falls outside the Mask area then it will Fail.

4. Connect the Pass/Fail output signal (on the rear panel) to the input terminal of another oscilloscope.
5. Move the waveform on the screen up, down, or sideways so that any portion of it falls outside of the Pass/Fail mask. If the interface is operating normally then a pulse will appear on the second oscilloscope (Figure 7). Adjust the second oscilloscope's time base and voltage scale as needed. If there is no viewable pulse on the second oscilloscope then there may be a problem with this function.

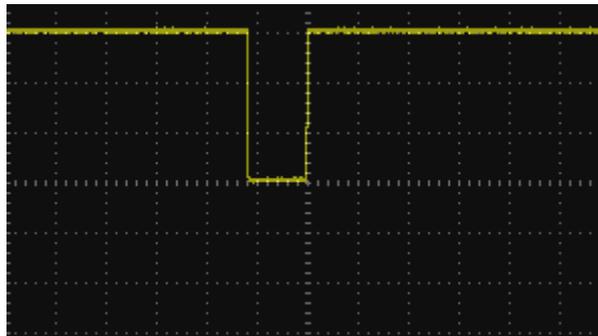


Figure 7 Pulse Waveform

Performance Test

This chapter explains testing the oscilloscope in order to verify performance specifications. For accurate test results, please let the test instruments and the oscilloscope warm up 30 minutes before testing.

Below is the required equipment for the test:

Table 3 Test equipment

Equipment	Description	Test item
Fluke 9500B + Active Heads	High Performance Oscilloscope Calibrator	DCG\Offset\Clock accuracy\Trigger delay \BW\BWL\trigger sensitivity\ Input impedance\ Ext Trigger delay\Ext Trigger level
GPIB Card and Cable	For communication between the computer and the 9500B	
USB Cable	For communication between the computer and the SDS1000X-E	
BNC Cables	BNC(m) to BNC(m), Approx.1m long	
BNC T Connectors	For signal distribution	DCG\Offset\Ext Trigger level
Terminal Load	50 ohm	Ext Trigger delay\ BW\BWL\trigger sensitivity
Computer		

The figures below show the interconnections between the test equipment and PC to the oscilloscope under test (Table 3):

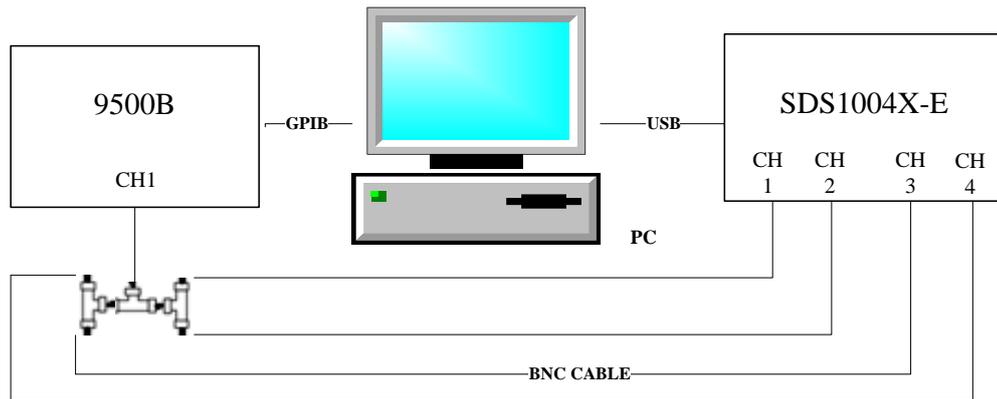


Figure 8 Connecting test instruments for DCG\Offset

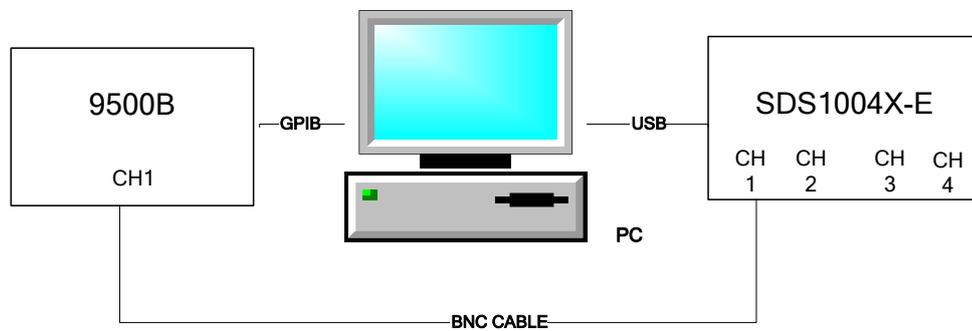


Figure 9 Connecting test instruments for Clock\Trigger Delay

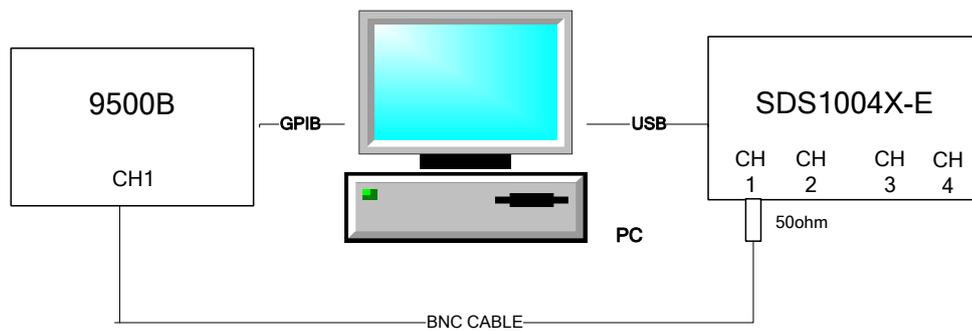


Figure 10 Connecting test instruments for BW\BWL\Trigger Sensitivity

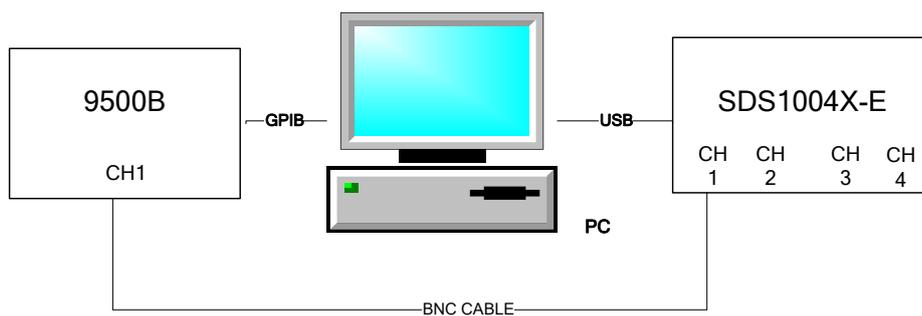


Figure 11 Connecting test instruments for Input impedance

The figures below show the interconnections between the test equipment and PC to the SDS1002X-E for Ext Trigger test:

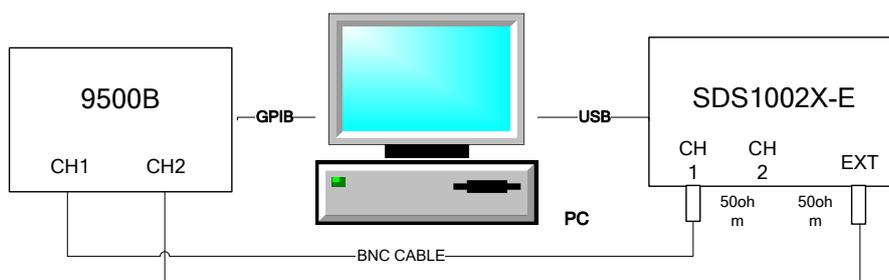


Figure 12 Connecting test instruments for Ext Trigger Delay

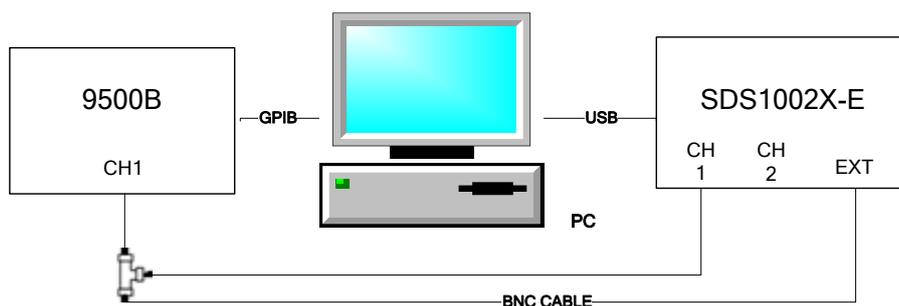


Figure 13 Connecting test instruments for Ext Trigger Level

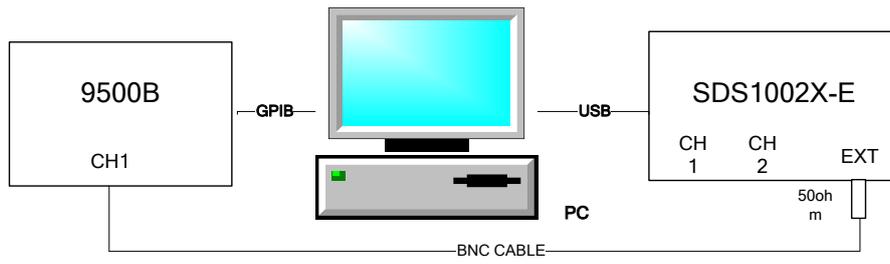


Figure 14 Connecting test instruments for Ext Trigger Sensitivity

Verify Test Results

To verify whether or not a test passes (i.e. whether the readings are within the appropriate limits), it is necessary to record the readings in the Performance Test located in the Test Record.

Self Calibration

The Self Calibration procedure is described in Chapter "Self Calibration". If the environmental temperature changes by more than 5°C, the Self Calibration operation must be performed in order to achieve the specifications.

To Verify DC Gain Accuracy

DC Gain Accuracy Slope = $\text{LINEST}(V_{\text{error}1}:V_{\text{error}5}, V_{\text{Setting}1}:V_{\text{Setting}5})$

Note: “ V_{Setting} ” represents DC voltage output level setting;
 “ V_{error} ” represents the difference between the output setting and the measurement.

This test verifies DC Gain Accuracy of all channels.

Steps:

1. Set the 9500B output to on.
2. Connect all channels of the oscilloscope to the 9500B as shown in Figure 8.
3. Set Volts/Div of the oscilloscope to 2 mV/div. Press the **Measure** button on the front panel of the oscilloscope to display Mean measurement.
4. Set DC voltage output level of the 9500B according to Table 4, and record mean value of the oscilloscope as V_{mean} .
5. Calculate $V_{\text{error}}(V_{\text{error}}=V_{\text{Setting}} - V_{\text{mean}})$, and set the next output level as step 4.
6. Make a linear regression with these 5 data points: $V_{\text{Setting}1} \sim V_{\text{Setting}5}$, $V_{\text{error}1} \sim V_{\text{error}5}$. Check if the slope falls within the range shown in Table 4.
7. Set the oscilloscope Volts/Div to the other settings in Table 4, and repeat steps 4 to 6.
8. Turn the 9500B output off.
9. Disconnect the connection to all the channels.

Table 4 DC Gain Accuracy

Volt/Div	DC voltage output levels	DC Gain Accuracy
10 V/div	30 V, 15V ,0, -15 V, -30 V	±3%
5 V/div	15 V, 7.5 V, 0, -7.5 V, -15 V	±3%
2 V/div	6 V, 3 V, 0, -3 V, -6 V	±3%
1 V/div	3 V, 1.5 V, 0, -1.5 V, -3 V	±3%
500 mV/div	1.5 V, 0.75 V, 0, -0.75 V, -1.5 V	±3%
200 mV/div	600 mV, 300 mV, 0, -300 mV, -600 mV	±3%

100 mV/div	300 mV, 150 mV, 0, -150 mV, -300 mV	±3%
50 mV/div	150 mV, 75 mV, 0, -75 mV, -150 mV	±3%
20 mV/div	60 mV, 30 mV, 0, -30 mV, -60 mV	±3%
10 mV/div	30 mV, 150 mV, 0, -150 mV, -30 mV	±3%
5 mV/div	15 mV, 7.5 mV, 0, -7.5 mV, -15 mV	±3%
2 mV/div	6 mV, 3 mV, 0, -3 mV, -6 mV	±4%

$$\text{DC Gain Accuracy} = (|V_{\text{mea1}}| + |V_{\text{mea2}}| - (|V_{\text{set1}}| + |V_{\text{set2}}|)) / (|V_{\text{set1}}| + |V_{\text{set2}}|) * 100\%$$

Note: “V_{set}” represents DC voltage output level setting;
 “V_{mea}” represents the measurement.

This test verifies DC Gain Accuracy in Different Sampling Rate.

Steps:

1. Set the 9500B output to on.
2. Connect channel 1 of the oscilloscope to the 9500B.
3. Set the oscilloscope Sec/Div to 200 us/div. Only turn on channel 1 and the sample rate will be automatically set to 1 GSa/s.
4. Set Volts/Div of channel 1 to 500 mV/div. Press the **Measure** button on the front panel of the oscilloscope to display Mean measurement.
5. Set DC voltage output level V_{set} of the 9500B according to Table 5, and record mean value of the oscilloscope as V_{mea}.
6. Calculate the DC Gain Accuracy and check if it falls within the range shown in Table 5.
7. Set the Memory Depth to 1.4 Mpts and turn on channel 2, then the sample rate will be automatically set to 250 MSa/s.
8. Repeat steps 5 to 6.
9. Turn the 9500B output off.
10. Disconnect the connection to the channel.

Table 5 DC Gain Accuracy in Different Sampling Rate

Volt/Div	Sampling Rate	DC voltage output	DC Gain Accuracy error
500 mV/div	1 GSa/s	1.5 V,-1.5 V	±3%
500 mV/div	250 MSa/s	1.5 V,-1.5 V	±3%

To Verify Offset Accuracy

Offset Accuracy Slope = LINEST(Offset_{error1}:Offset_{error5}, Offset_{out1}:Offset_{out5})

Note:“Offset_{out}” represents DC voltage output level setting;

“Offset_{error}” represents the difference between the output setting and the measurement.

This test verifies Offset Accuracy of all the channels.

Steps:

1. Set the 9500B output to on.
2. Connect all channels of the oscilloscope to 9500B as shown in Figure 8.
3. Set the Volts/Div of channel to 2 mV/div. Press **Measure** button on the front panel of the oscilloscope to display Mean measurement.
4. According to Table 6, set offset of the channel to -Offset, and set the 9500B output level to equal the offset, then record the mean value of the oscilloscope as V_{mean} . When the offset is 0, set the 9500B output to off and record the mean value of the oscilloscope as V_{zero} .
5. Calculate Offset_{error} (Offset_{error}= V_{mean} - Offset), and adjust the 9500B to the output level as step 4.
6. Make a linear regression with these 5 data points: Offset_{error1}~Offset_{error5}, Offset_{out1}~Offset_{out5}. Check to verify that the slope is within the limits specified in Table 6.
7. Check to verify that $\text{abs}(V_{\text{zero}})$ in step 4 is within the limits specified in Table 6.
8. Set the oscilloscope Volts/Div to the other settings in Table 6, and repeat the steps 4 to 6.
9. Turn the 9500B output off.
10. Disconnect the connection to all the channels.

Table 6 Offset Accuracy

Volt/Div	Offset	Slope error	Zero input(V)
10 V/div	35 V,30 V,0,-3 0V,-35 V	±1.5%	±1.202

5 V/div	30 V,25 V,0,-25 V,-30 V	±1.5%	±0.602
2 V/div	20 V,10 V,0,-10 V,-20 V	±1.5%	±0.242
1 V/div	10 V,5 V,0,-5 V,-10 V	±1.5%	±0.122
500 mV/div	5 V,2.5 V,0,-2.5 V,-5 V	±1.5%	±0.062
200 mV/div	2 V,1 V,0,-1 V,-2 V	±1.5%	±0.026
100 mV/div	1 V,0.5 V,0,-0.5 V,-1 V	±1.5%	±0.014
50 mV/div	500 mV,250 mV,0,-250 mV,-500 mV	±1.5%	±0.008
20 mV/div	200 mV,100 mV,0,-100 mV,-200 mV	±1.5%	±0.0044
10 mV/div	100 mV, 50 mV,0,- 50 mV,-100	±1.5%	±0.0032
5 mV/div	50 mV,25 mV,0,-25 mV,-50 mV	±1.5%	±0.0026
2 mV/div	20 mV, 10 mV,0,-10 mV, -20 mV	±1.5%	±0.00224

To Verify Time Base Accuracy

This test verifies the time base accuracy of the oscilloscope. In the test, the impedance of both the 9500B and the oscilloscope should be set to 1 M Ω .

Time Base Accuracy: Frequency Error < 500 Hz

Steps:

1. Connect selected channel of the oscilloscope to the 9500B.
2. Set the oscilloscope Volts/Div to 100 mV/div.
3. Set the oscilloscope Sec/Div to 50 ms/div.
4. Set the Memory Depth to 14 Mpts, and the sample rate will be automatically set to 20 MSa/s.
5. Disable the Roll mode if it is enabled.
6. Set waveform of the 9500B to sine, amplitude to 600 mV, and frequency to the value (20 MHz) which is equal to the sample rate of the oscilloscope.
7. Press **Measure** button on the front panel of the oscilloscope to display Freq measurement.
8. Check if the Freq measurement is less than 500 Hz.
9. Disconnect the test connection.

To Verify Trigger Delay

This test checks the trigger delay of the analog channels. In this test, the impedance of both the 9500B and the oscilloscope should be set to 1 M Ω .

Channel Trigger Delay Limit: $\text{abs}(T@L) \leq 100 \text{ ps}$

Steps:

1. Connect selected channel of the oscilloscope to the 9500B.
2. Set impedance of the 9500B to 1 M Ω , frequency to 50 MHz, amplitude to 800 mV, and waveform to Sine.
3. Set the oscilloscope Volts/Div to 100 mV/div.
4. Set the oscilloscope Sec/Div to 2 ns/div.
5. Press **Measure** button on the front panel of the oscilloscope to display Time@Level measurement.
6. Check if the result is in the limited range above.
7. Disconnect the test connection.
8. Check other channels in the same way as steps 1 to 7.

To Verify Ext Trigger Delay

This test checks the delay between ext trigger channel and analog channels. In the test, the impedance of the 9500B should be set to 50 Ω and the 50 Ω feedthrough terminations need to be connected with the ext trigger channel selected analog channel.

CH-Ext Trigger Delay Limit: $\text{abs}(\text{Delay}) \leq 1 \text{ ns}$

Steps:

1. Connect selected analog channel and ext trigger channel of the oscilloscope to the 9500B with active heads (CH1/CH2).
2. Press the 'Aux' key at the right of the 'OSCILLOSCOPE CALIBRATOR' panel of the 9500B and select the Zero Skew function.
3. Set impedance of the 9500B to 50 Ω , frequency to 1 KHz, and amplitude to 0.6 V.
4. Set the oscilloscope Volts/Div to 100 mV/div.
5. Set the oscilloscope Sec/Div to 2 ns/div.
6. Set the oscilloscope trigger source to EXT, the trigger slope to Rising, and the trigger level to 0.
7. Press **Measure** button on the front panel of the oscilloscope to display Delay measurement.
8. Check if the delay is within the limited range above ($\leq 1 \text{ ns}$).
9. Disconnect the test connection.
10. Check the other analog channel in the same way as steps 1 to 9.

To Verify Ext Trigger Level

This test checks the trigger level accuracy of the ext trigger. In this test, the impedance of both the 9500B and the oscilloscope should be set to 1 MΩ.

Table 7 EXT Trigger Level data

Trigger Channel	Volt/div	Trigger Level Limited Range
EXT	200 mV	300 mV~500 mV
		-500 mV~-300 mV
EXT/5	1V	1.5 V~2.5 V
		-2.5 V~-1.5 V

Steps:

1. Connect channel 1 and ext trigger channel of the oscilloscope to the 9500B with a BNC T connector, as shown in Figure 13.
2. Set impedance of the 9500B to 1 MΩ, frequency to 1 kHz, amplitude to 800 mV, and waveform to sine.
3. Set the oscilloscope Sec/Div to 500 us/div.
4. Set the oscilloscope Volts/Div to 200 mV/div, trigger source to EXT, and coupling mode to DC.
5. Set the trigger level to find the level that can not trigger the waveform.
6. Check if the trigger level is in the limited range above.
7. Set amplitude of the 9500B to 4V, set trigger source of the oscilloscope to EXT/5, and the Volts/div to 1 V.
8. Repeat step 5 to step 6.
9. Disconnect the test connection.

To Verify Noise Floor

This test checks the noise floor of the analog channels, and varies from models. In this test, do not connect any testing devices to the oscilloscope.

For 2-Channel models:

Table 8 Noise Floor Limited Range for 2-Channel

Volt/Div	Stdev Limited Range	Volt/Div	Stdev Limited Range
500 μ V	$\leq 250 \mu$ V	100 mV	≤ 10 mV
1 mV	≤ 0.2 mV	200 mV	≤ 20 mV
2 mV	≤ 0.2 mV	500 mV	≤ 50 mV
5 mV	≤ 0.5 mV	1 V	≤ 100 mV
10 mV	≤ 1 mV	2 V	≤ 200 mV
20 mV	≤ 2 mV	5 V	≤ 500 mV
50 mV	≤ 5 mV	10 V	≤ 1 V

Steps:

1. Set the oscilloscope Sec/Div to 1 ms/div.
2. Set the oscilloscope Volts/Div to 500 μ V/div.
3. Press **Measure** button on the front panel of the oscilloscope to display Stdev measurement.
4. Check if the Stdev is in the limited range shown in Table 8.
5. Check the other analog channel in the same way as steps 1 to 4.
6. Set the oscilloscope Volts/Div to the others in Table 8, and repeat the steps 3 to 5.

For 4-Channel models:

Table 9 Noise Floor Limited Range for 4-Channel

Volt/Div	pkpk/stdev Limited Range	SNR Limited Range	Volt/Div	pkpk/stdev Limited Range	SNR Limited Range
500 μ V	[0,12]	[19,55]	100 mV	[0,12]	[36,55]
1 mV	[0,12]	[25,55]	200 mV	[0,12]	[36,55]
2 mV	[0,12]	[27,55]	500 mV	[0,12]	[36,55]

5 mV	[0,12]	[31,55]	1 V	[0,12]	[36,55]
10 mV	[0,12]	[35,55]	2 V	[0,12]	[36,55]
20 mV	[0,12]	[36,55]	5 V	[0,12]	[36,55]
50 mV	[0,12]	[36,55]	10 V	[0,12]	[36,55]

Steps:

7. Set the oscilloscope Sec/Div to 1 ms/div.
8. Set the oscilloscope Volts/Div to 500 uV/div.
9. Press **Measure** button on the front panel of the oscilloscope to display Stdev and Peak-Peak measurement.
10. Calculate SNR ($SNR = 20 * \log_{10} \frac{8 * v_{div}}{2 * \sqrt{2} * stdev}$), pkpk/stdev.
11. Check if the SNR and pkpk/stdev are in the limited range shown in Table 9.
12. Check the other analog channels in the same way as steps 1 to 5.
13. Set the oscilloscope Volts/Div to the others in the table above, and repeat the steps 3 to 5.

To Verify Bandwidth

This test checks the bandwidth of all analog channels. In the test, the impedance of 9500B should be set to 50 Ω, and a 50Ω feedthrough termination need to be connected with the channel of oscilloscope.

The bandwidth should be verified at 2 V/div、200 mV/div and 100 mV/div.

Steps:

1. Connect channel 1 of the oscilloscope to the 9500B via the active head, as shown in Figure 10.
2. Set the oscilloscope Volts/Div to 2 V/div, the Sec/Div to 50 ms/div.
3. Press the **Measure** button on the front panel of the oscilloscope to display Peak-Peak measurement.
4. Set waveform of the 9500B to sine, amplitude to 5.5 V, and impedance to 50 Ω.
5. Set frequency of the 9500B to the frequency in Table 10. When testing at 200 mV/div or 100 mV/div, set start frequency at 100 kHz. Set frequency start frequency at 1 MHz when testing at 2 V/div.

Table 10 Frequency points in the test

Scope Model	Frequency Point (Hz)
SDS1204X-E	100k,500k,1M,5M,10M,50M,100M,140M,180M,20
/SDS1202X-E	0M,220M,250M

6. Every time the frequency is changed, it is recommended to adjust the Sec/Div to a proper value in order to display a complete waveform.
7. Record the Peak-Peak measurement of the waveform.
8. Set the oscilloscope Volts/Div to the setting choices, and repeat the steps 2 to 7. Set amplitude of the 9500B to 600 mV when testing at 100 mV/div, and set to 1.2 V when testing at 200 mV/div.
9. Check other channels in the same way as steps 1 to 8.
10. Disconnect the test connection.

After the test, calculate the dB value at every frequent point. Check if the value is in limited range in Table 11.

Table 11 Limited Range

Scope Model	Frequency Point (Hz)	Range
SDS1204X-E/ SDS1202X-E	$\leq 20\text{M}$	(-1,1) dB
	$\leq 100\text{M}$	(-2,2) dB
	$100\text{M} < \leq 200\text{M}$	(-3,2) dB
	$> 200\text{M}$	(-4,2) dB
	250M	(-6,2) dB

To Verify Bandwidth Limit

This test checks the bandwidth limit of all the analog channels. The test is similar to the bandwidth test except that the bandwidth limit is turned on.

In the test, the impedance of 9500B should be set to 50 Ω , and a 50 Ω feedthrough termination need to be connected with the channel of oscilloscope.

Test the bandwidth at 2 V/div, 200 mV/div and 100 mV/div

Steps:

1. Connect channel 1 of the oscilloscope to the 9500B via the active head, as shown in Figure 10.
2. Set the oscilloscope Volts/Div to 2 V/div, the Sec/Div to 50 ms/div, and set BW Limit button to 20 MHz.
3. Press the **Measure** button on the front panel of the oscilloscope to display Peak-Peak measurement.
4. Set amplitude of the 9500B to 5.5 V, and impedance to 50 Ω .
5. Set frequency of the 9500B to the frequency in Table 12. When testing at 200 mV/div or 100 mV/div set the start frequency to 100 kHz. When testing at 2 V/div set start frequency to 1 MHz.

Table 12 Frequency points in the test

Frequency Point (Hz)
100k,500k,1M,5M,10M,11M,12M,13M,14M,15M,16M,17M,18M,19M,20M,21M,22M,23M,24M,25M,26M,27M,28M,29M

6. Every time the frequency is changed, it is recommended to adjust the Sec/Div to a proper value thus to display a complete waveform.
7. Record the Peak-Peak measurement value of the waveform.
8. Calculate the dB value at frequency point. If the value isn't in the range of (-3, 2) but the frequency is in the range of (12MHz, 28MHz), the Bandwidth Limit of the oscilloscope pass. Else, test at next frequency point. When the test finished, if none of the frequency points satisfy the requirement above, the Bandwidth Limit of the oscilloscope fail.
9. Set the oscilloscope Volts/Div to the other settings and repeat the steps

from 2 to 8. Set amplitude of the 9500B to 600 mV when testing at 100 mV/div, and set to 1.2 V when at 200 mV/div.

10. Check the other channels in the same way as in steps 1 to 9.

11. Disconnect the test connection.

To Verify Trigger Sensitivity

This test checks trigger sensitivity at the frequency of 10 MHz and also at the bandwidth frequency.

In the test, the impedance of 9500B should be set to 50 Ω , and a 50 Ω feedthrough termination need to be connected with the channel of oscilloscope.

Table 13 Trigger sensitivity data

Volts/Div	Frequency	Trigger Range
100 mV/div	10 MHz	9.9~10.1 MHz
100 mV/div	bandwidth	bandwidth \pm 1%

Steps:

1. Connect the selected channel of the oscilloscope to the 9500B, as shown in Figure 10.
2. Set the oscilloscope Volts/Div to 100 mV/div, Sec/Div to 50 ns/div, coupling mode to AC.
3. Set impedance of the 9500B to 50 Ω , frequency to 10 MHz, and amplitude to 60 mV.
4. Set trigger slope of the oscilloscope to Positive.
5. Press Trigger Level knob to set the level to the center of the waveform.
6. Adjust the trigger level within the waveform range to achieve a stable trigger.
7. Record the (hardware-measured) frequency which is on the top right of the screen, and check that it is in the specified trigger range listed in Table 13.
8. Set the oscilloscope trigger slope to Negative, repeat steps 5 to 7.
9. Set frequency of the 9500B to the bandwidth frequency of the oscilloscope. Set Sec/Div to 2 ns/div if you are testing SDS1204X-E/SDS1202X-E. Then repeat steps 4 to 8.
10. Check the other channels in the same way as steps 1 to 9.
11. Disconnect the test connection.

The steps above are for testing the trigger level when using internal trigger

using the analog input channels. The following steps are used to test the EXT trigger sensitivity.

Steps:

1. Connect the ext trigger channel of the oscilloscope to the 9500B, as shown in Figure 14.
2. Set impedance of the 9500B to 50 Ω , amplitude to 200 mV, frequency to 10 MHz.
3. Set trigger source of the oscilloscope to EXT, trigger slope to Positive.
4. Press Trigger Level knob to set the level to the center of the waveform.
5. Adjust the trigger level within the range of [-100 mV, 100 mV] in order to achieve a stable waveform and then record the (hardware-measured) frequency, located at the top right of area of the screen.
6. Check if the frequency is within the specified trigger range listed in Table 13.
7. Set trigger slope to Negative, repeat steps 4 to 6.
8. Set frequency of the 9500B to the oscilloscope's bandwidth frequency, amplitude to 300 mV. Repeat steps 3 to 7. In step 5, the range changes to [-150 mV, 150 mV].
9. Set frequency of the 9500B to 10 MHz, amplitude to 1 V.
10. Set the trigger source of the oscilloscope to EXT/5, trigger slope to Positive.
11. Press Trigger Level knob to set the level to the center of the waveform.
12. Adjust the trigger level within the range of [-500mV, 500mV] to achieve a stable waveform and then record the hardware-measured value which is on the top right of screen.
13. Check if the frequency is within the specified range listed in Table 13.
14. Set the trigger slope to Negative, repeat steps 11 to 13.
15. Set the frequency of the 9500B to the oscilloscope's bandwidth frequency, amplitude to 1.5 V. Repeat steps 11 to 14. In step 6, the range changes to [-750 mV, 750 mV].
16. Disconnect the test connection.

To Verify Input Impedance

This test checks the input impedance of all analog channels and ext trigger channel with different coupling modes and vertical scales (100 mV/div, 200 mV/div and 2 V/div).

Table 14 Input Impedance data

Channel	Coupling and impedance type	Impedance Range	
		0.1V/div	1176000~1224000 Ω
CH	AC/1 M Ω	0.2V/div, 2V/div	980000~1020000 Ω
		980000~1020000 Ω	
DC/1 M Ω	980000~1020000 Ω		
Ext	1 M Ω	980000~1020000 Ω	

Steps:

1. Connect the selected channel of the oscilloscope to the 9500B, as shown in Figure 11.
2. Set the oscilloscope Volts/Div to 100 mV/div, coupling mode of the channel to AC.
3. Press the 'Aux' key at the right of the 'OSCILLOSCOPE CALIBRATOR' panel of the 9500B and select the Load Resistance Measurement Function. Record the reading displays on the screen of the 9500B.
4. Set coupling mode of the channel to DC. Record the reading displays on the screen of the 9500B.
5. Check if the impedance is within the specified range in Table 14.
6. Test at 2 V/div and 200 mV/div, using the same procedure as steps 2 to 5.
7. Check the other analog channels in the same way as steps 1 to 6.
8. Disconnect the test connection

When checking the EXT trigger channel, it is the same as checking analog channel. Record the reading displays on the screen of the 9500B, and check to verify it is within the specified range in Table 14.

Disassembly Procedures

This chapter describes how to remove major parts from the SDS1000X-E series oscilloscope.

Safety Consideration and Cautions

Only qualified personnel should perform the disassembly procedures. Disconnect the power before you begin to remove or replace the parts. Otherwise, potential personal injuries or damages to the components may occur.

WARNING**HAZARDOUS VOLTAGES**

Maintenance is performed with power supply on and without protective covers. Only qualified personnel with proper tools and protection should perform the maintenance. Perform the maintenance with power cord disconnected whenever possible.

WARNING**AVOID ELECTRICAL SHOCK**

Hazardous voltages exist on the power supply module and LCD module. To avoid electrical shock, disconnect the power cord and wait at least three minutes for the capacitors to discharge before you begin disassembly.

CAUTION**ESD CAUTION**

Electrostatic discharge (ESD) sensitive devices inside. Electronic components may be damaged without detection. Proper ESD precautions should be taken to avoid performance degeneration or loss of functionality. As a minimum, place the oscilloscope on a properly grounded ESD mat and wear a properly grounded ESD strap.

CAUTION**REMOVE POWER TO AVOID DAMAGE**

Remove power before you start to disassemble or replace parts. DO NOT disassemble or replace parts with power on is not allowed, or damage to the components may occur.

Tools Lists

Use these tools to remove or replace the modules in the oscilloscope:

- Multifunction screwdriver
- Antistatic gloves
- Custom screw hexagonal nut tool or long nose pliers

Disassembly Procedures

This section describes how to remove the modules in the oscilloscope in detail. To install the removed parts or replace a new part, follow the instructions in reverse order.

2-Channel Module

Removing the Front-Panel Knobs

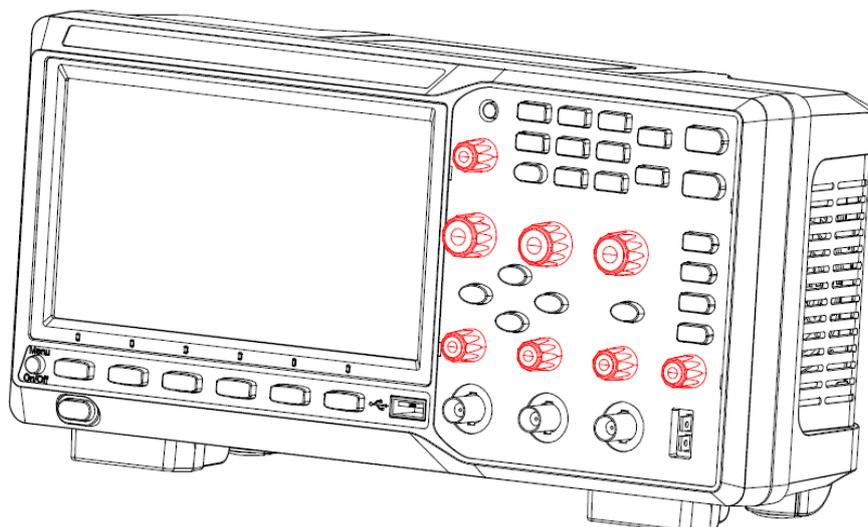


Figure 15 Removing the front panel knobs

Removing steps:

Removing each front-panel knobs by firmly grasping the knob (with pliers protected by a soft cloth to prevent scratches, if necessary) and pulling it away from the front panel.

Removing the Rear Cover

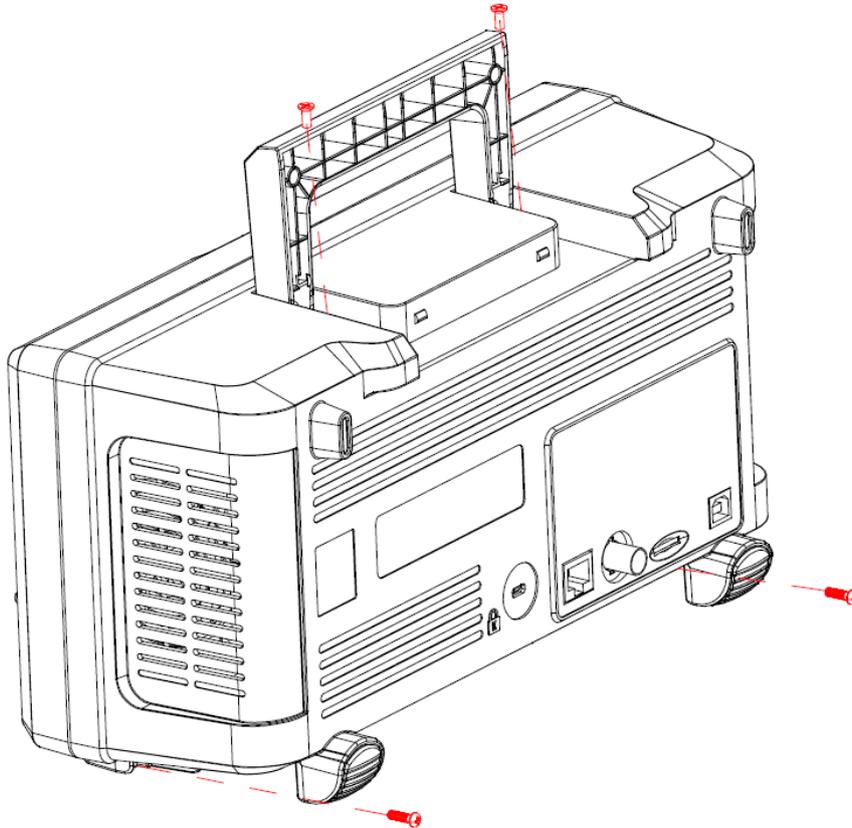


Figure 16 Removing the rear cover

Removing steps:

1. Placing the oscilloscope face down on a soft surface such as an anti-static mat.
2. Removing the two PM3*10 screws on the rear panel. Removing the two KM3*6 screws under the tilt-legs in this same position.
3. Lifting the rear cover up and off carefully.

Removing the Metal Shield

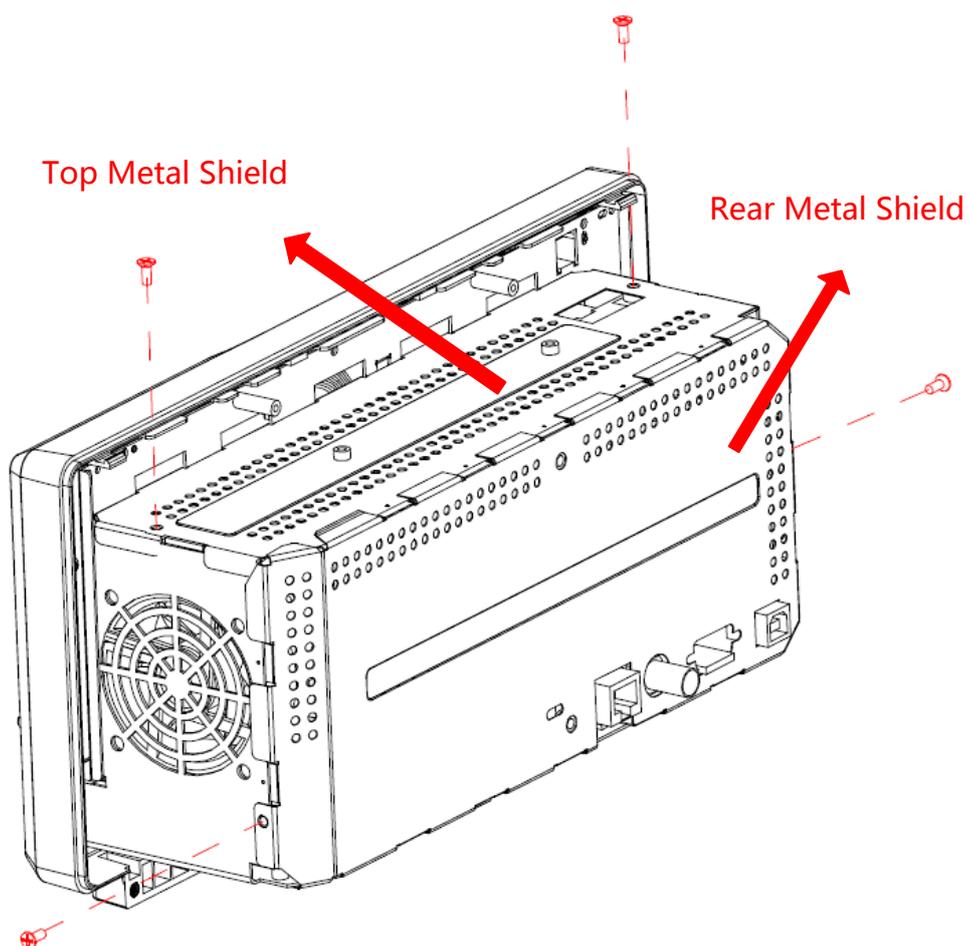


Figure 17 Removing the top and rear metal cover

Removing steps:

1. Placing the oscilloscope face down on a soft surface such as an anti-static mat.
2. Removing the two KM3*6 screws on the inside of the rear metal shield.
3. Removing the rear metal shield.
4. Removing the two KM3*6 screws on top of the metal shield.
5. Removing the top metal shield.

Removing the Power Supply Module and (Optionally) the Fan

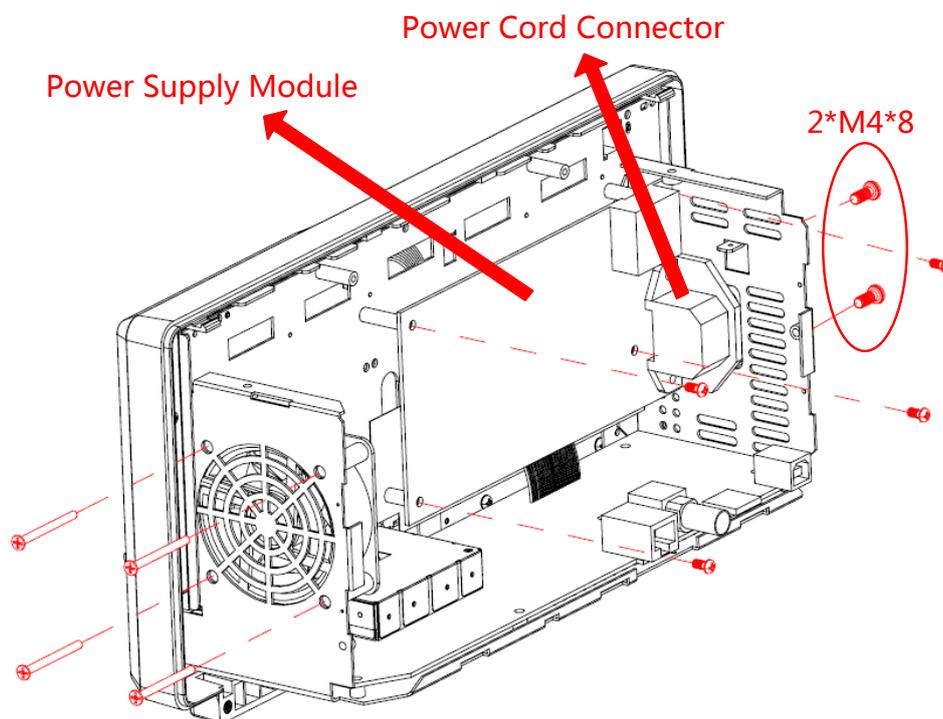


Figure 18 Removing the power supply module

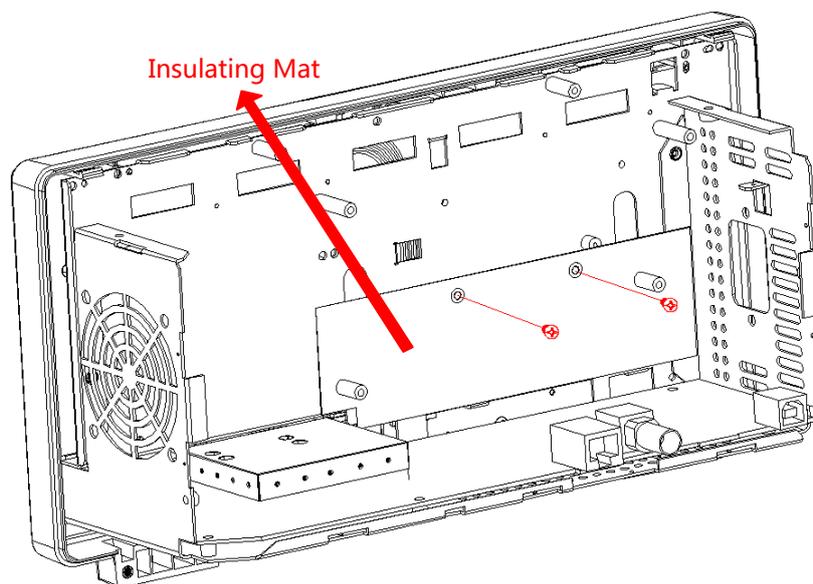


Figure 19 Removing the insulating mat

Removing steps:

1. Removing the two M4*8 screws on the power cord connector.

2. Disconnecting the power cable on the main board and the earth connecting cable on the metal frame.
3. Removing the four PWM3*8 screws on the power supply module.
4. Removing the power supply module.
5. Removing the two PM3*6 on the insulating mat.
6. Disconnecting the cable of the fan on the main board.
7. Optionally removing the four KM3*32 screws and nuts on the fan and removing the fan.

Removing the Front Cover

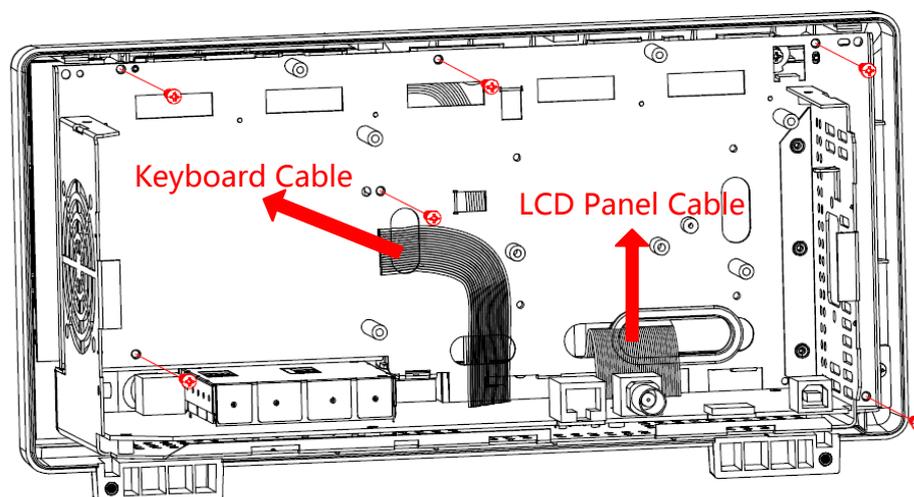


Figure 20 Removing the front cover

Removing steps:

1. Placing the oscilloscope back-side down on a soft surface such as an anti-static mat.
2. Disconnecting the keyboard cable and the LCD panel cable on the main board.
3. Removing the six PC3*8 screws on the metal frame.
4. Removing the front cover.

Removing the Main board

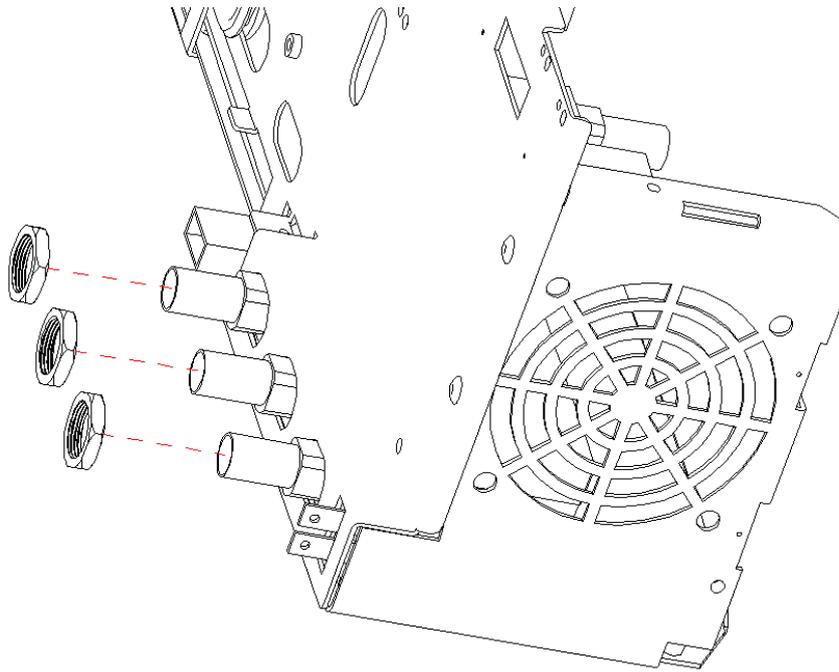


Figure 21 Removing the BNC nuts and gaskets

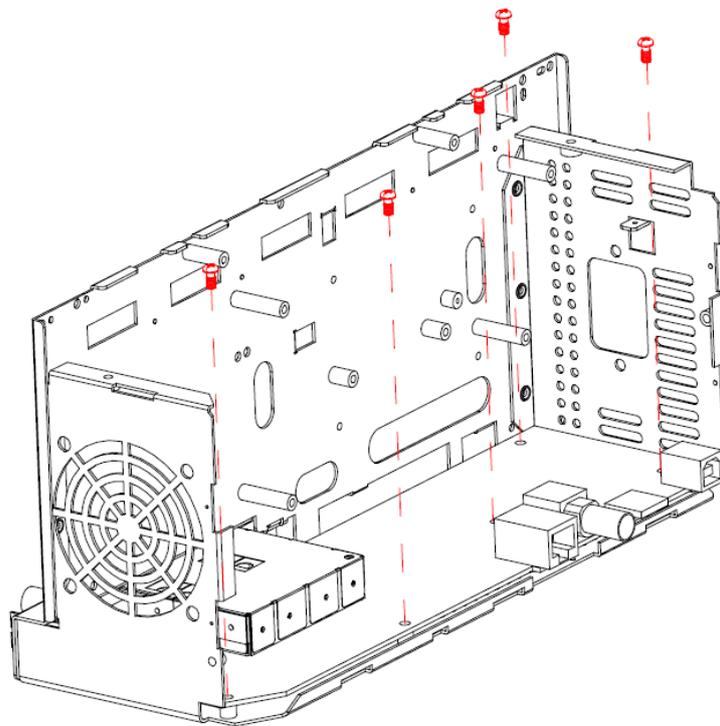


Figure 22 Removing the main board

Removing steps:

1. Removing the three BNC nuts and gaskets on the front side of the metal frame.
2. Removing the five PM3*6 screws on the main board.
3. Removing the main board.

Removing the LCD and Keyboard

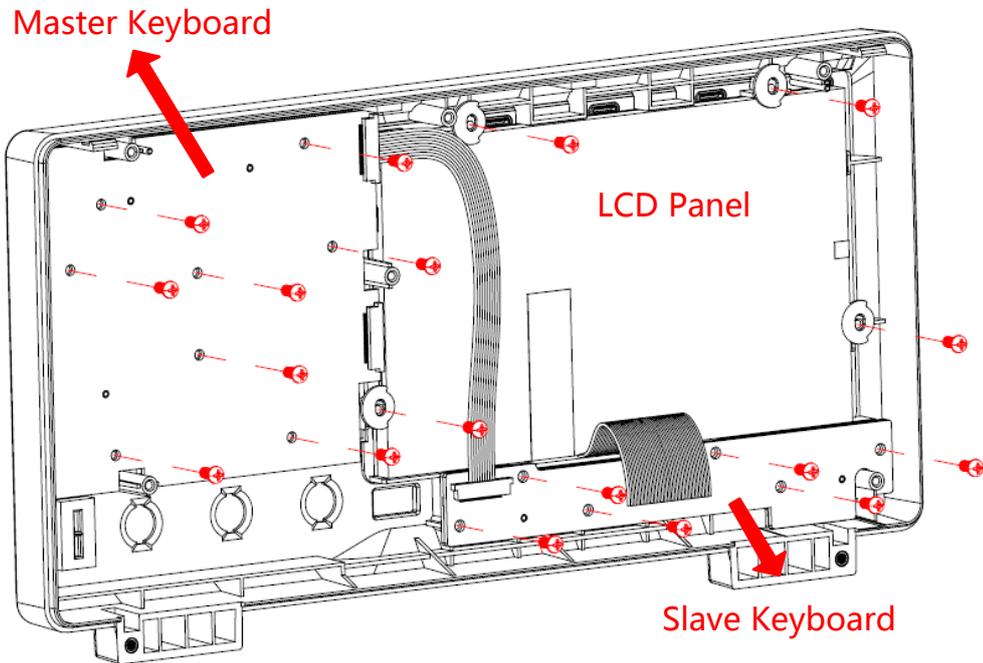


Figure 23 Removing the LCD panel and keyboard

Removing steps:

1. Disconnecting the cable between the master keyboard and slave keyboard.
2. Removing the seven PC3*8 screws on the master keyboard.
3. Removing the master keyboard.
4. Removing the six PC3*8 screws on the slave keyboard.
5. Removing the slave keyboard.
6. Removing the four screws and gaskets on the LCD panel.
7. Removing the LCD panel and the antiglare glass panel.

4-Channel Module

Removing the Front-Panel Knobs

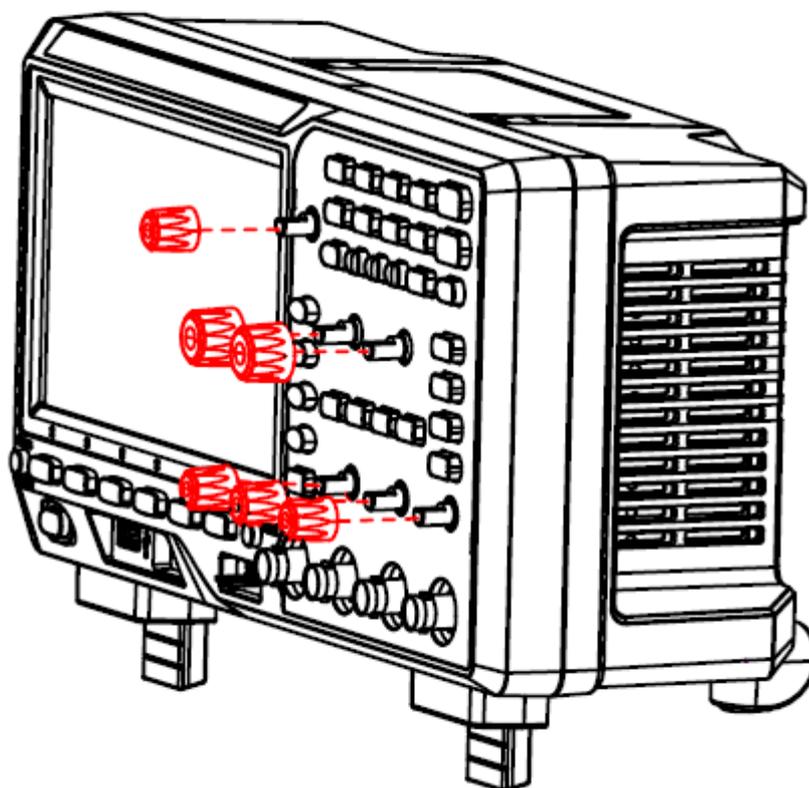


Figure 24 Removing the front panel knobs

Removing steps:

Removing each front-panel knob by firmly grasping the knob (with pliers protected by a soft cloth to prevent scratches, if necessary) and pulling it away from the front panel.

Removing the Rear Cover

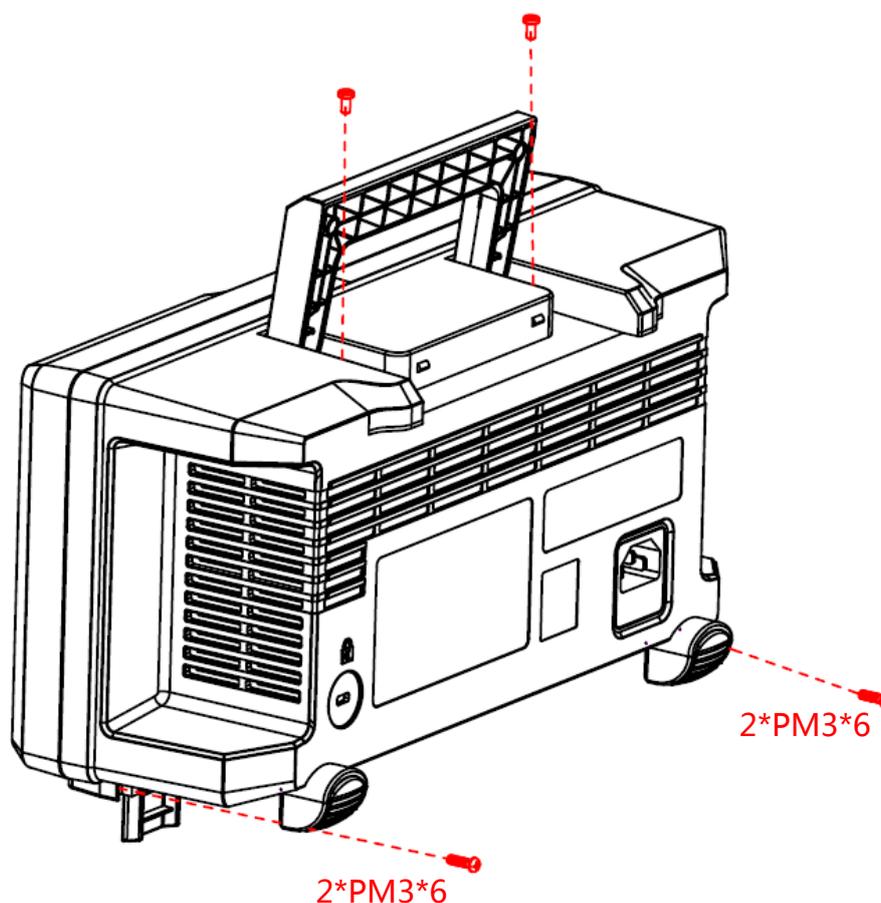


Figure 25 Removing the rear cover

Removing steps:

1. Placing the oscilloscope face down on a soft surface such as an anti-static mat.
2. Removing the four PM3*6 screws located on the rear panel. Removing the two PM3*6 screws under the tilt-legs in this same position.
3. Lifting the rear cover up and off carefully.

Removing the Rear Metal Shield

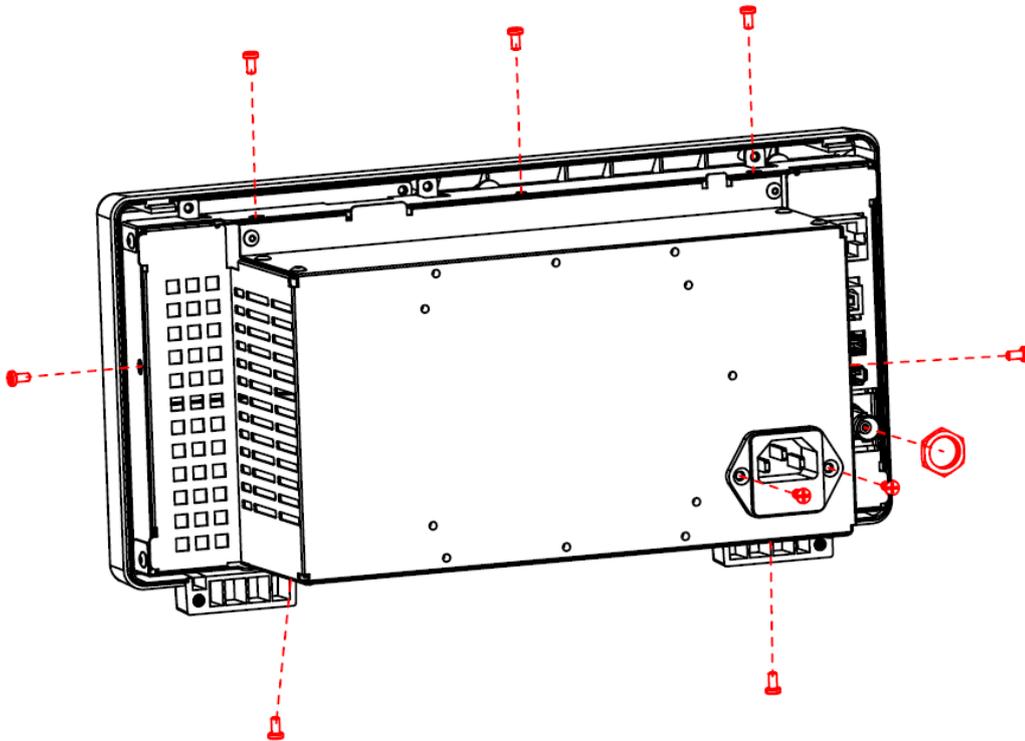


Figure 26 Removing the rear metal shield

Removing steps:

1. Placing the oscilloscope face down on a soft surface such as an anti-static mat.
2. Removing the BNC nut and gasket on the BNC connector.
3. Removing the seven PM 3*6 screws on side of the rear metal shield.
4. Optionally removing the two KM3*6 screws on the main power cord connector if removing the connector is required.
5. Lifting the rear metal shield a little bit to have the access to disconnect the power cable and fan cable on the main board. Be caution about the latching type power cable connector.
6. Removing the rear metal shield completely.

Optionally Removing the Power Supply Module and the Fan

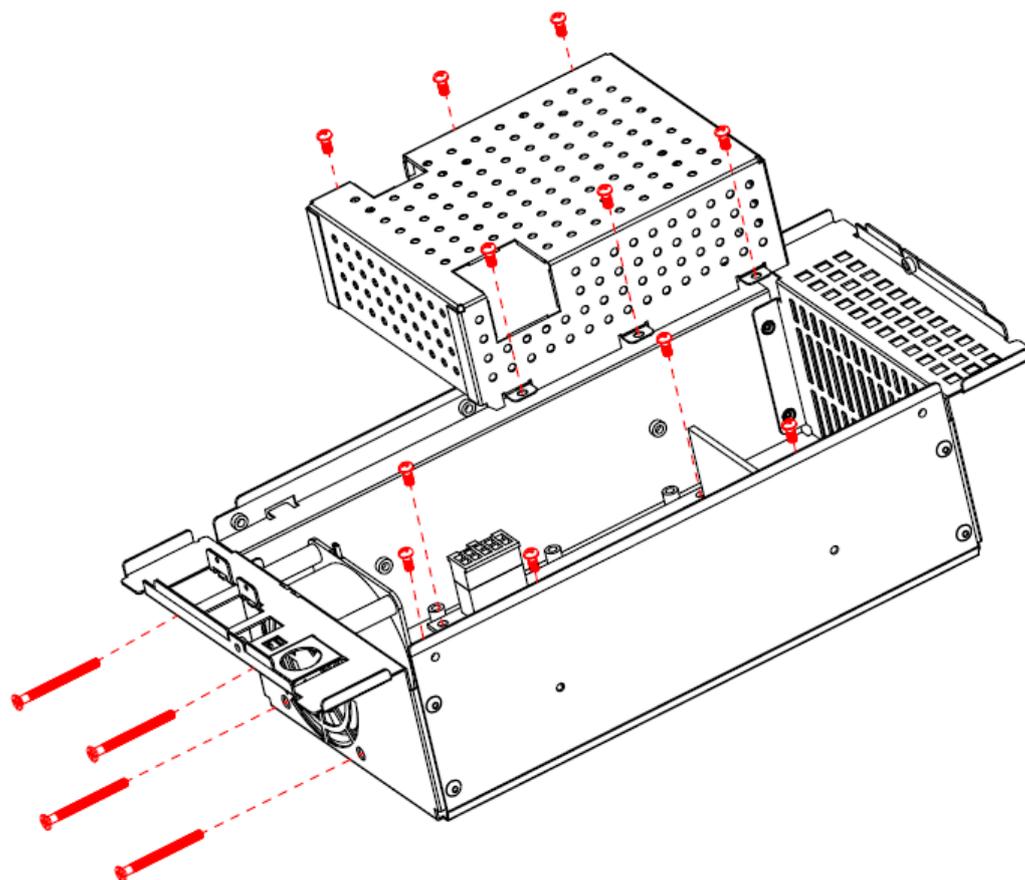


Figure 27 Removing the power supply module and the fan

Removing steps:

1. Disconnecting the main power cord cable on the power supply module.
2. Optionally removing the PWM3*8 screw and gasket of the earth connecting cable on the rear metal cover if removing the main power cord connector is required.
3. Removing the six PC3*6 screws on the power supply module shield.
4. Removing the power supply module shield (without disconnecting the power cable on the module since disconnecting the latching type connector is tricky under the shield).
5. Disconnecting the power cable on the power supply module.

6. Removing the four PC3*6 screws on the power supply module.
7. Removing the power supply module.
8. Optionally removing the four PM3*32 screws and nuts on the fan and then removing the fan.

Removing the Front Cover

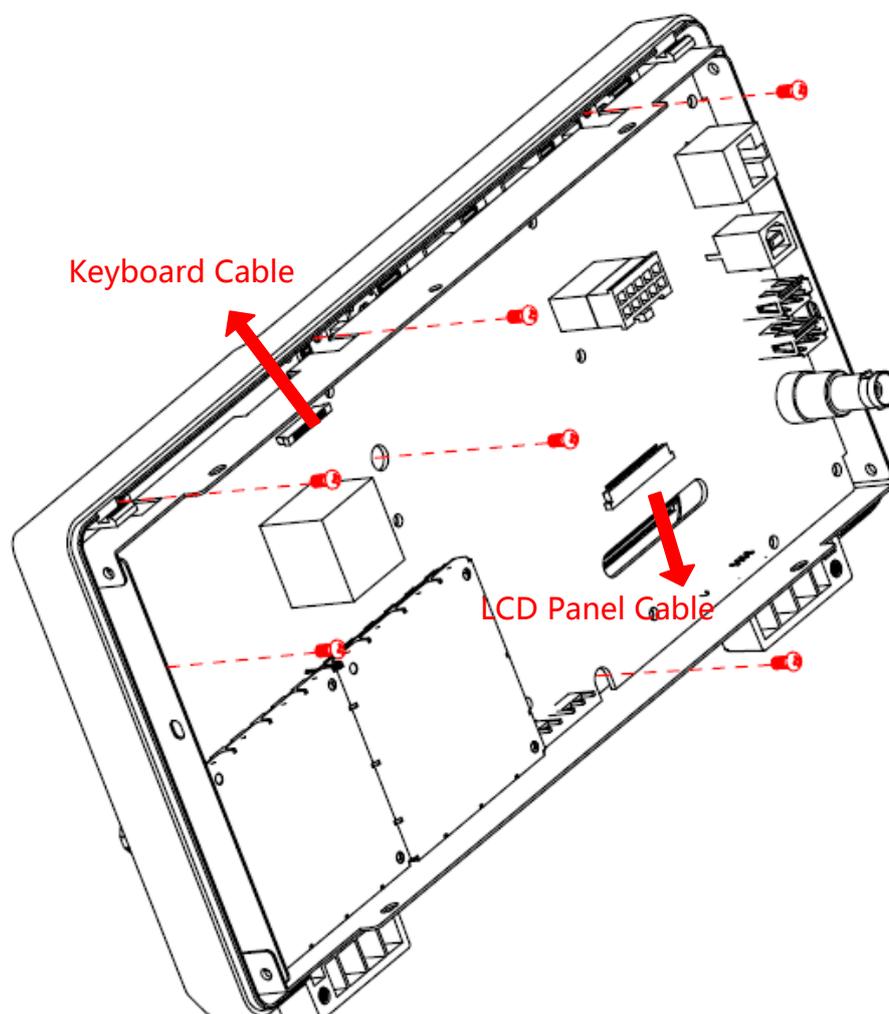


Figure 28 Removing the front cover

Removing steps:

1. Placing the oscilloscope back-side down on a soft surface such as an anti-static mat.
2. Disconnecting the keyboard cable and the LCD panel cable on the main board.
3. Removing the six PC3*6 screws on the metal frame.
4. Removing the front cover.

Removing the Main Board

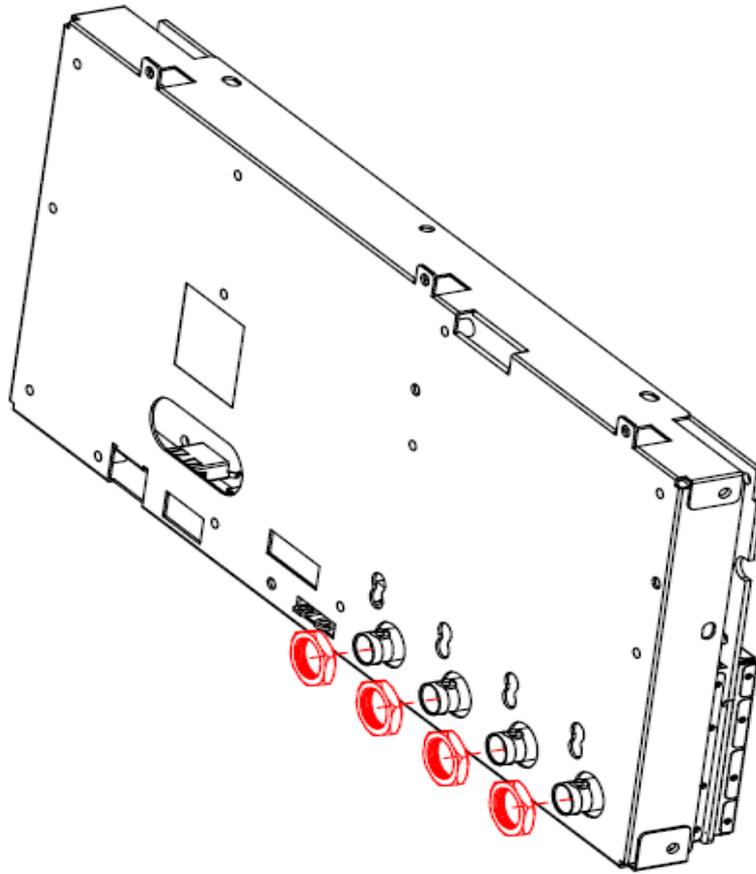


Figure 29 Removing the BNC nuts and gaskets

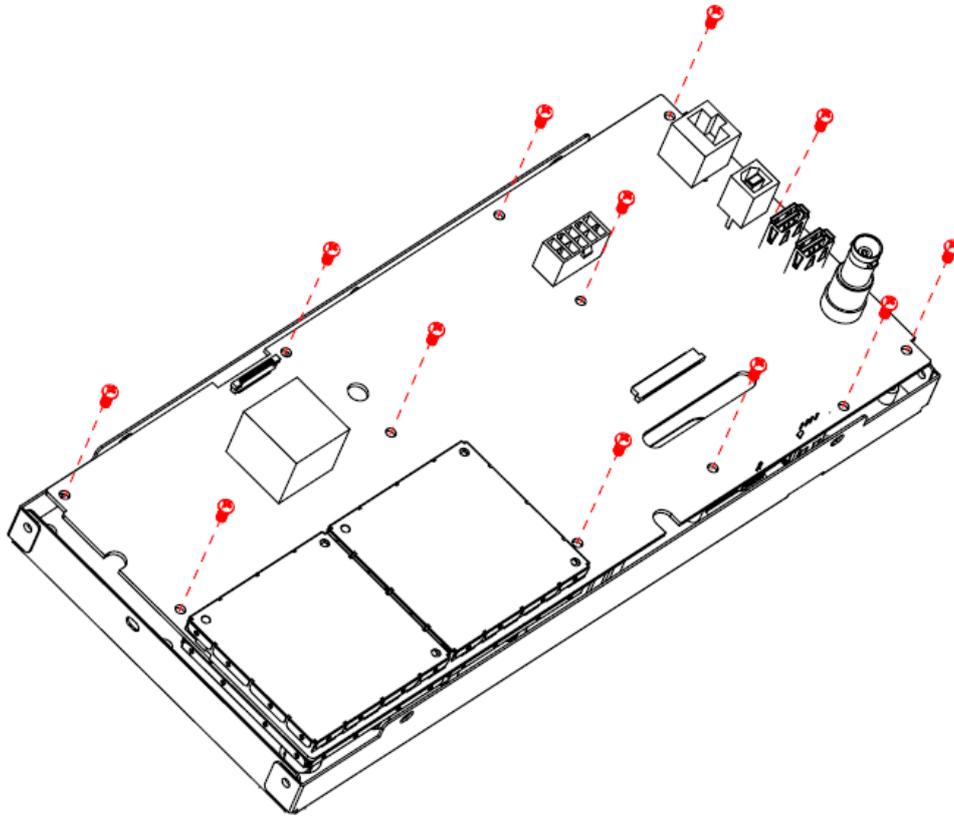


Figure 30 Removing the main board

Removing steps:

1. Removing the four BNC nuts and gaskets on the front side of the metal frame.
2. Removing the twelve PM3*6 screws on the main Board.
3. Removing the main board.

Removing the LCD and Keyboard

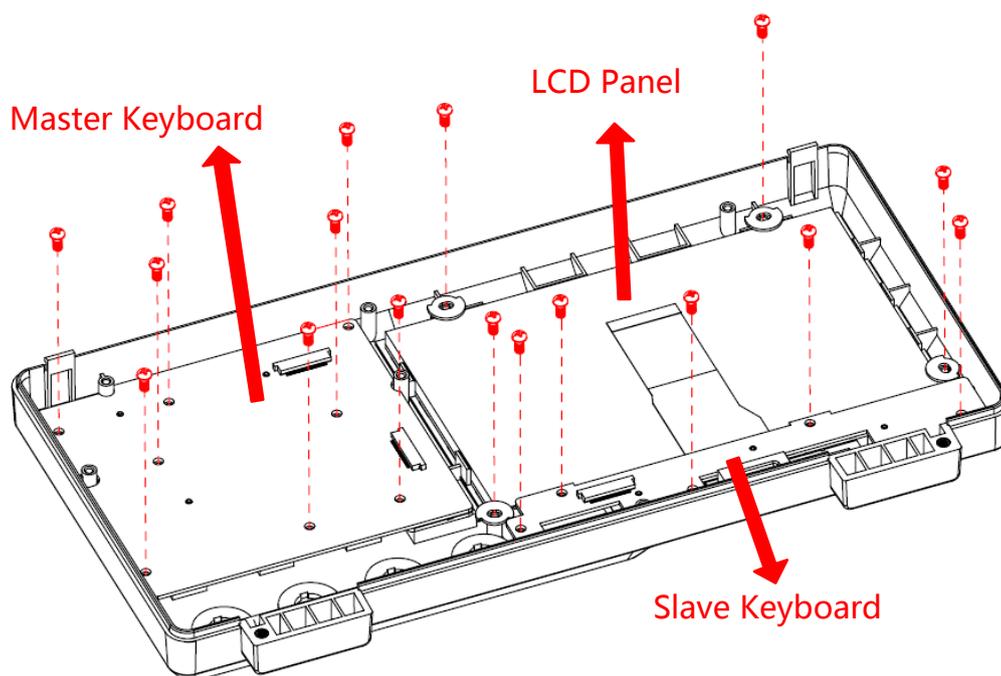


Figure 31 Removing the LCD panel and keyboard

Removing steps:

1. Disconnecting the cable between the master keyboard and slave keyboard.
2. Removing the eight PC3*8 screws on the master keyboard.
3. Removing the master keyboard.
4. Removing the five PC3*8 screws on the slave keyboard.
5. Removing the slave keyboard.
6. Removing the four screws and gaskets on the LCD panel.
7. Removing the LCD panel and the antiglare glass panel.

Solving General Problems

This chapter contents suggestions for solving general problems.

If there is no display

Is the light of the power button glowing?

If yes:

Go to the **Troubleshooting** chapter and check the power supply modules and main board.

If no:

Check that the power cord is secured in the power receptacle.

Check that the fuse in the power receptacle is not blew out.

Check that the power source is alive.

If there is still no light glowing, go to the **Troubleshooting** chapter and check the power supply modules and main board.

If the display stuck at logo graph

Remove all the USB FLASH drivers plugged into the oscilloscope and power cycle the oscilloscope to try again.

Wait ten minutes to see if the oscilloscope can boot successfully. If not, contact SIGLENT for further instructions. If is, try to upgrade to newest firmware to solve the problem.

If the display still stuck at logo graph, contact SIGLENT for further instructions.

If there is no trace display

Check the acquisition is running and trigger status is **Trig'd** or **Auto**.

Check the horizontal time/division setting is reasonable and the acquisition time is short enough for fast display.

Disconnect associated channel input and recall the default setup following the procedures in the **User Guide**.

Turn on the associated channel again and press **Auto Setup** key.

If there is still no trace displayed, contact SIGLENT for further instructions.

If the baseline trace drift out of specification

- Check that the fan is running.
- Check that the vertical position setting is working.
- Do a self-calibration following the procedures in the ***User Guide***.
- If self-calibration does not work, contact SIGLENT for further instructions.

If there is an unexpected trace when no input connected to channel input

- Power cycle the oscilloscope.
- Upgrade to newest firmware.
- Contact SIGLENT for further instructions.

Troubleshooting

This chapter content information and procedures to troubleshooting general hardware failures.

Safety Consideration and Cautions

Only qualified personnel should perform the troubleshooting procedures. Disconnect the power cord whenever possible. DO NOT try to troubleshoot if visible damage is detected on the power supply module and the main board, return it to SIGLENT for further repair.

WARNING**HAZARDOUS VOLTAGES**

Maintenance is performed with power supply on and without protective covers. Only qualified personnel with proper tools and protection should perform the maintenance. Always operate the oscilloscope with a three conductor power cable.

WARNING**AVOID ELECTRICAL SHOCK**

Hazardous voltages exist on the power supply module and LCD module. To avoid electrical shock, disconnect the power cord and wait at least three minutes for the capacitors to discharge before you begin disassembly.

CAUTION**ESD CAUTION**

Electrostatic discharge (ESD) sensitive devices inside. Electronic components may be damaged without detection. Proper ESD precautions should be taken to avoid performance degeneration or loss of functionality. As a minimum, place the oscilloscope on a properly grounded ESD mat and wear a properly grounded ESD strap.

CAUTION**REMOVE POWER TO AVOID DAMAGE**

Remove power before you start to disassemble or replace parts. Do not disassemble or replace parts with power on is not allowed, or damage to the components may occur.

CAUTION**USE AN EXTERNAL FAN**

When you remove the oscilloscope metal shield, always use an external fan to provide air flow over the heat sinks and the main board. The fan will be noneffective without the metal shield and over heat will occur on some components. The fan will work properly if the back cover is removed but the metal shield remains, and no external fan is required in this case.

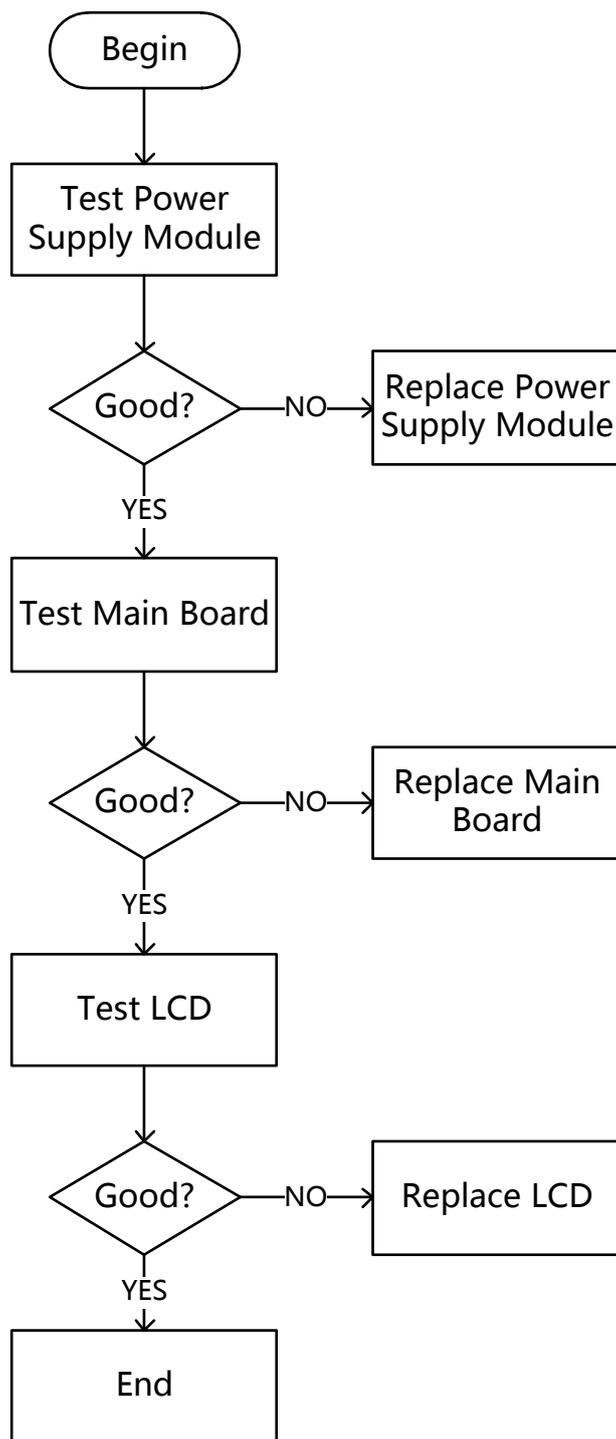
Required equipment

Table 15 Required Equipment

Equipment	Critical Specifications	Recommended Model
Digital Multi-meter	Accuracy $\pm 0.05\%$ 1 mV resolution	SIGLENT SDM3065X Agilent 34401A
Oscilloscope	200MHz BW 1M Ω impedance	SIGLENT SDS1204X-E

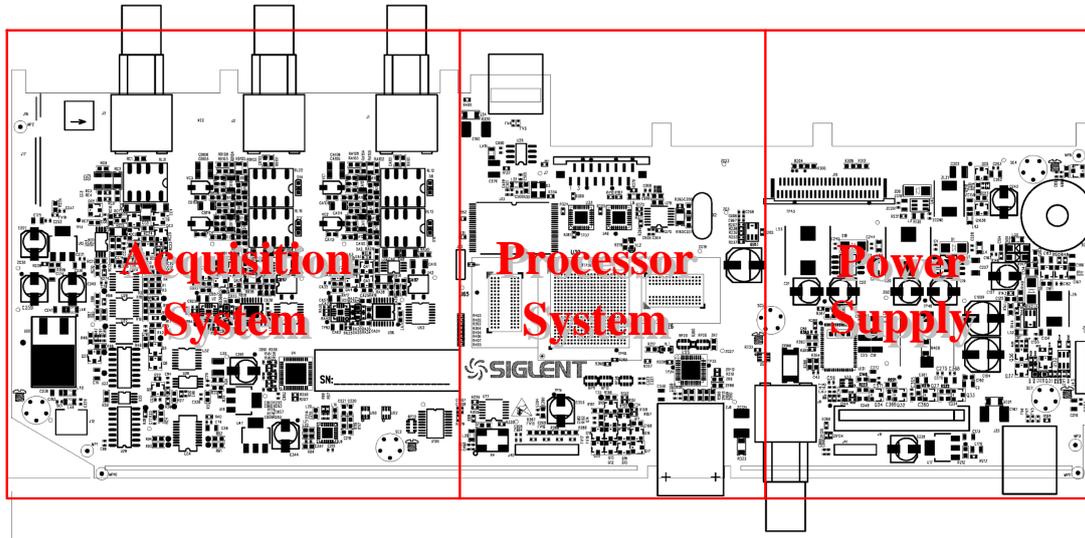
Troubleshooting Flowchart

The following flowchart describes how to troubleshoot the oscilloscope in general case. This does not guaranteed a 100% cover of all frequent hardware failures. Contact SIGLENT if you cannot solve the problem.



For 2-Channel Module

Main Board Drawing



To Check the Power Supply Module

- Disconnect all the external cables and devices from the front and back panel.
- Disconnect the power cord of the oscilloscope.
- Remove the rear cover and top and rear metal shield following the instructions in chapter **Disassembly Procedures**. Note that the power supply module is on the metal frame and you do not have to remove the power supply module to check it.
- Disconnect the power cable to the main board.
- Reconnect the power cord to the receptacle of the power supply module. Be caution about the power supply module without protective cover, high voltage may exist on the heat sink and other exposed conductor.
- Measure the voltage list below on the power cable plug using a multi-meter.

Table 16 Voltage parameters of the power supply module

Definition	Pin	Tolerance
GND	Pin 1, Pin 5, Pin 8, Pin 12	NULL
Primary Power	Pin3, Pin 4	+6.5 $V_{DC} \pm 10\%$
Positive Auxiliary	Pin 6, Pin 7	+3.4 $V_{DC} \pm 100mV_{DC}$

Power 1		
Positive Auxiliary Power 2	Pin 2	+15V _{DC} ± 10%
Negative Auxiliary Power	Pin9	-10V _{DC} ± 10%
AC Line Trigger	Pin10	2V _{PP} ± 20% This will only affect AC Line Trigger function.
Reserved	Pin 11	Don't care (not used in this oscilloscope).

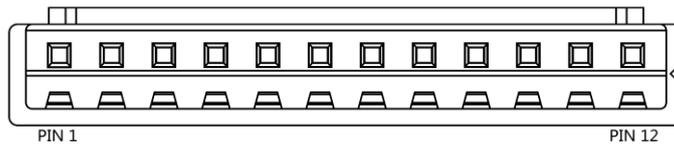
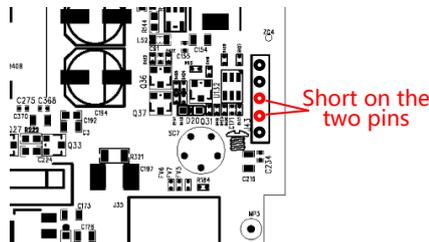


Figure 32 Pin definition of the power cable plug

To Check the Main Board

- It is recommended that to remove the main board from the metal frame and re-assemble the power supply module to the metal frame for easy accessing to the test points and safety considerations. Follow the instructions in chapter **Disassembly Procedures**.
- Reconnect the power cable to the main board after you have confirmed that the power supply module is in good condition.
- Power up the main board either by pushing the front panel power button or by causing a short duration short circuit on the pin 2 and pin 3 of the J43 near U132 if you have disconnected the keyboard cable on the main board.



- In most case, you can hear the relays click if the main board power up successfully. If you cannot hear the click or there is no sign that the main board is powering up, go to the **To Check Other Power Supplies** section first to check the stand-by power and the main power.
- If the power or the signal under test is abnormal, replace the main board.

To Check the Processor System

- Check the processor power supplies
 - Locate the Power Supply section. Find and measure those test points using a multi-meter.

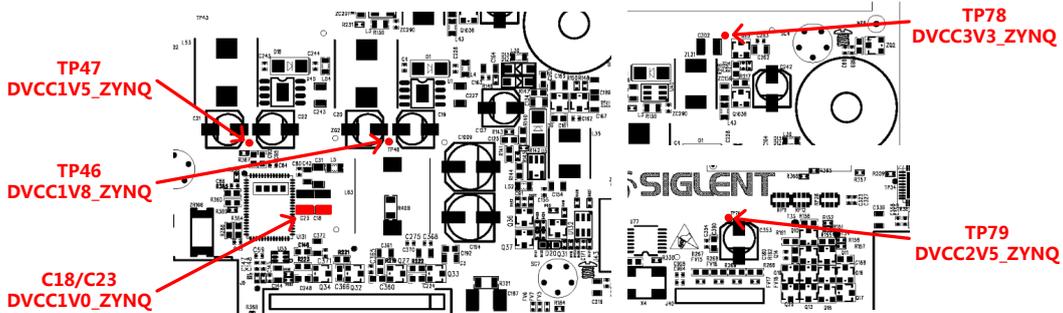


Figure 33 Test points for the processor power supplies

Table 17 Voltage parameters of the processor power supplies

Net Name	Test Point	Tolerance
DVCC1V0_ZYNQ	C18/C23	+1.0 $V_{DC} \pm 50mV_{DC}$
DVCC1V8_ZYNQ	TP46	+1.8 $V_{DC} \pm 50mV_{DC}$
DVCC1V5_ZYNQ	TP47	+1.5 $V_{DC} \pm 50mV_{DC}$
DVCC3V3_ZYNQ	TP78	+3.3 $V_{DC} \pm 100mV_{DC}$
DVCC2V5_ZYNQ	TP79	+2.5 $V_{DC} \pm 100mV_{DC}$

Check the clock

- Locate the three oscillators X1, X2 and X3, use an oscilloscope to measure the clock signal using the method below.

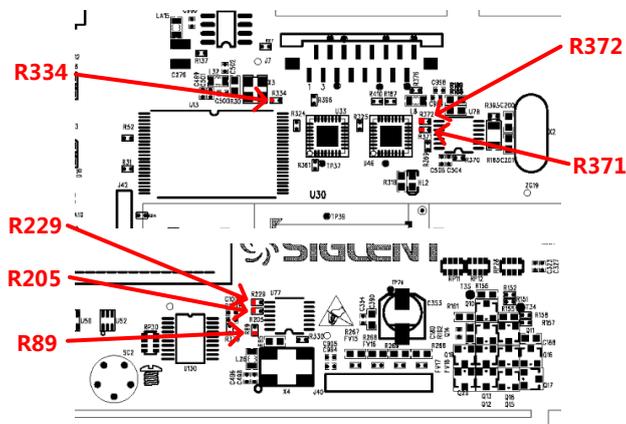


Figure 34 Test points for clock

Table 18 Clock parameters of the Processor System

Test Point	Clock Domain	Level	Frequency Tolerance
R334	Processor Reference	LVC MOS33	33.333333 MHz \pm 50PPM
R372	USB Host Reference	LVC MOS33	24.000000 MHz \pm 50PPM
R371	USB Device Reference	LVC MOS33	24.000000 MHz \pm 50PPM
R205	Ethernet Reference	LVC MOS33	25.000000 MHz \pm 50PPM
R229	Acquisition System Clock	LVC MOS33	25.000000 MHz \pm 25PPM
R89	PLL Reference Clock	LVC MOS33	25.000000 MHz \pm 25PPM

To Check the Acquisition System

Check the Acquisition System power supplies

- Locate the Acquisition System power supplies section. Find and measure those test points using a multi-meter.

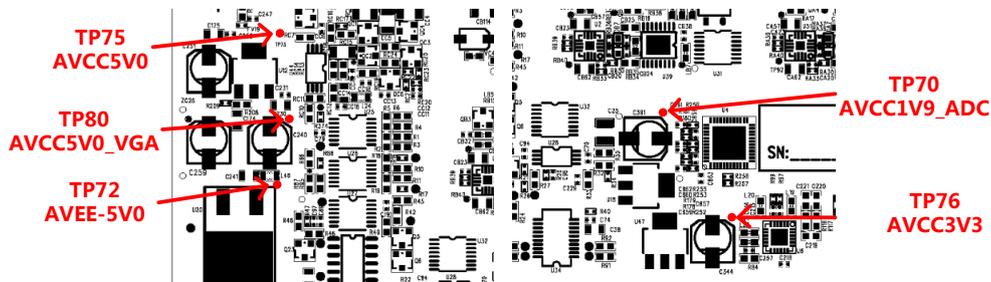


Figure 35 Test points for the Acquisition System power supplies section

Table 19 Voltage parameters of the Acquisition System power supplies

Net Name	Test Point	Tolerance
AVCC1V9_ADC	TP70	+1.9V _{DC} \pm 50mV _{DC}
AVCC3V3	TP76	+3.3 V _{DC} \pm 100mV _{DC}
AVCC5V0_VGA	TP80	+5.0 V _{DC} \pm 100mV _{DC}
AVCC5V0	TP75	+5.0 V _{DC} \pm 100mV _{DC}
AVEE-5V0	TP72	-5.0 V _{DC} \pm 200mV _{DC}

Check the clock

- Locate the oscillator X4, use an oscilloscope to measure the clock signal using the method below.

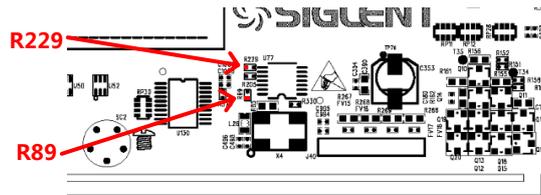


Figure 36 Test points for clock

Table 20 Clock parameters of the Acquisition System

Test Point	Clock Domain	Level	Frequency Tolerance
R229	Acquisition System Clock	LVC MOS33	25.000000 MHz \pm 25PPM
R89	PLL Reference Clock	LVC MOS33	25.000000 MHz \pm 25PPM

To Check Other Power Supplies

Check other power supplies

- Find and measure those test points using a multi-meter.

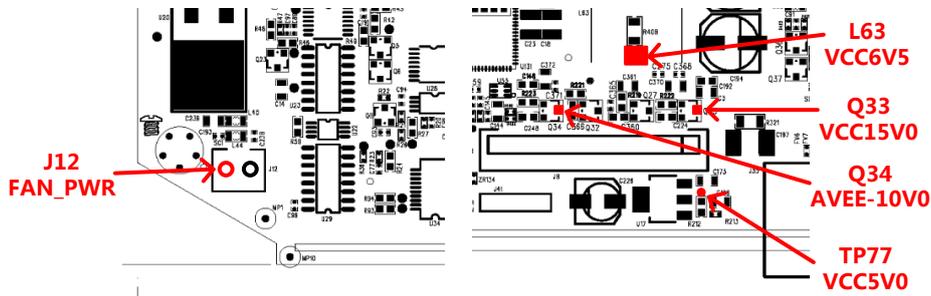


Figure 37 Test points for other power supplies

Table 21 Voltage parameters of other power supplies

Net Name	Test Point	Tolerance	Comments
VCC5V0	TP77	+5 V_{DC} \pm 100m V_{DC}	Stand-by power for power on circuits and power source for USB host VBUS
VCC6V5	L63	+6.5 V_{DC} \pm 10%	Main power
FAN_PWR	J12	-10 V_{DC} \pm 10%	Power supply for fan
VCC15V0	Q33	+15 V_{DC} \pm 10%	Positive power supply for TDC circuits

AVEE-10V0	Q34	-10 V _{DC} ± 10%	Negative power supply for analog circuits
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To Check the LCD

- Reconnect the power cable to the main board after you have confirmed that the power supply module is in good condition.
- Connect the LCD cable to the main board.
- Power up the main board either by pushing the front panel power button or by causing a short duration short circuit on the pin 2 and pin 3 of the J43 near U132 if you have disconnected the keyboard cable on the main board.

To Check the LCD Power Supply

- Find and measure those test points using a multi-meter.

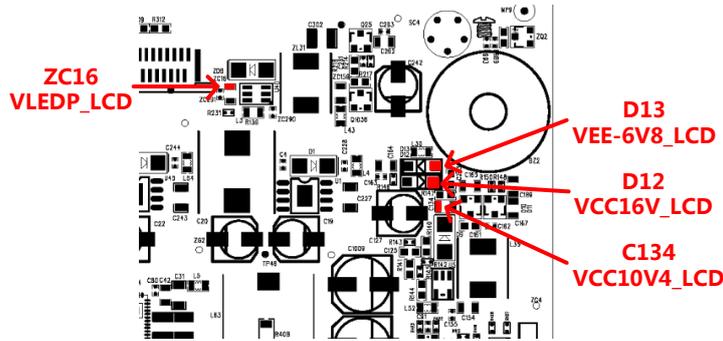


Figure 38 Test points for the LCD power supplies

Table 22 Voltage parameters of the LCD power supplies

Net Name	Test Point	Tolerance
VCC10V4_LCD	C134	+10.4 V _{DC} ± 10%
VCC16V_LCD	D12	+16 V _{DC} ± 10%
VEE-6V8_LCD	D13	-6.8 V _{DC} ± 10%
VLEDP_LCD	ZC16	+6.5V _{DC} ~ +20 V _{DC}

- If the power supply is abnormal, replace the main board.

To Check the LCD Signal

- Locate resistors array between U30 and U34, use an oscilloscope to measure the signal using the method below.

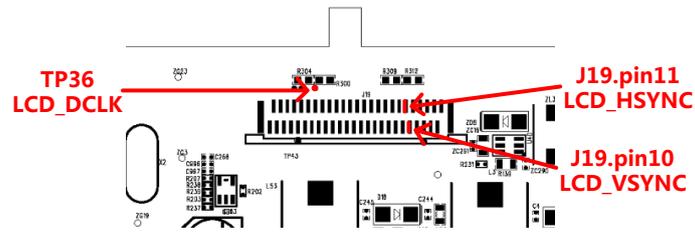


Figure 39 Test points for LCD signal

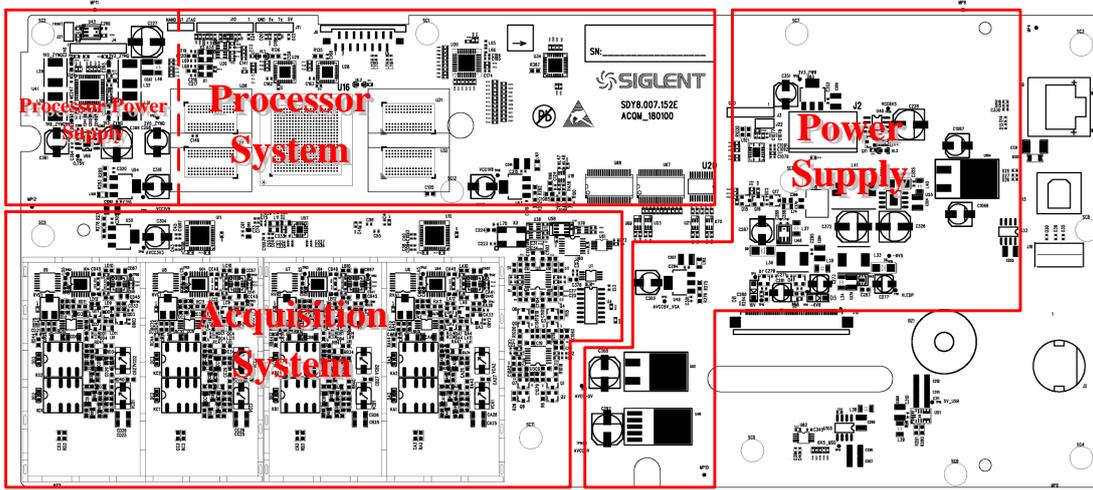
Table 23 Signal parameters of the LCD

Test Point	Signal	Level	Frequency Tolerance
R420	LCD_DCLK	LVCMOS33	27.5 MHz \pm 1%
R422	LCD_VSYNC	LVCMOS33	50 Hz \pm 1%
R423	LCD_HSYNC	LVCMOS33	26 kHz \pm 1%

- If the signal is good, replace the LCD panel.
- If the signal is dead, replace the main board.

For 4-Channel Module

Main Board Drawings



To Check the Power Supply Module

- Disconnect all the external cables and devices from the front and back panel.
- Disconnect the power cord of the oscilloscope.
- Remove the rear cover and rear metal shield following the instructions in chapter **Disassembly Procedures**. Note that the power supply module is on the rear metal shield and you do not have to remove the power supply module to check it.
- Disconnect the power cable and fan cable to the main board. Leave the power cable connected on the power supply module to have an easy access to the test points.
- Reconnect the power cord to the receptacle of the power supply module.
- Measure the voltage list below on the power cable plug using a multi-meter.

Table 24 Voltage parameters of the power supply module

Definition	Pin	Cable Color	Tolerance
GND	Pin 4, Pin5, Pin 6	Black	NULL
Primary Power	Pin 1, Pin 2	Red	+6.5 V _{DC} ± 10%
Positive Auxiliary	Pin 8	Blue	+15 V _{DC} ± 10%

Power			
AC Line Trigger	Pin 7	Brown	$2V_{PP} \pm 20\%$ This will only affect AC Line Trigger function.
Negative Auxiliary Power	Pin 3	Orange	$-9.5 V_{DC} \pm 10\%$ Don't care (not used in this oscilloscope).

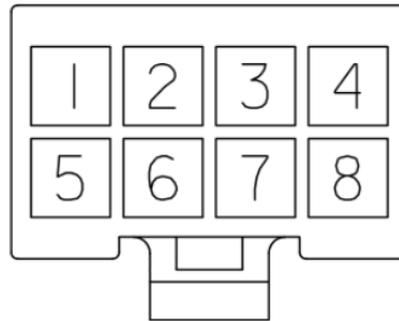
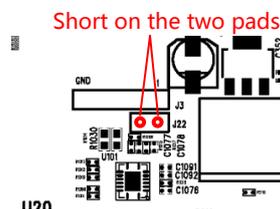


Figure 40 Pin definition of the power cable plug

To Check the Main Board

- Reconnect the power cable to the main board after you have confirmed that the power supply module is in good condition.
- There are no user accessible test points on the bottom side of the main board, so you do not have to remove the main board completely. Leave the main board on the main metal frame with front cover, keyboard and LCD.
- Power up the main board either by pushing the front panel power button or by causing a short duration short circuit on the two pads of J22 beside the power cable receptacle J2 if you have disconnected the keyboard cable on the main board.



- In most case, you can hear the relays click if the main board power up successfully. If you cannot hear the click or there is no sign that the main board is powering up, go to the **To Check Other Power Supplies** section first to check the stand-by power and the main power.
- If the power or the signal under test is abnormal, replace the main board.

To Check the Processor System

Check the processor power supplies

- Locate the Processor power supplies section. Find and measure those test points using a multi-meter.

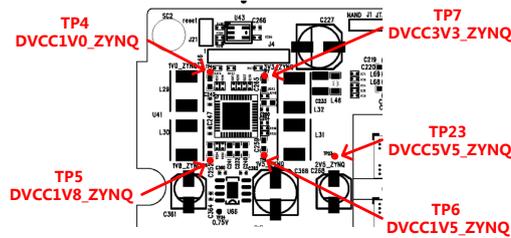


Figure 41 Test points for the processor power supplies

Table 25 Voltage parameters of the processor power supplies

Net Name	Test Point	Tolerance
DVCC1V0_ZYNQ	TP4	+1.0 $V_{DC} \pm 50mV_{DC}$
DVCC1V8_ZYNQ	TP5	+1.8 $V_{DC} \pm 50mV_{DC}$
DVCC1V5_ZYNQ	TP6	+1.5 $V_{DC} \pm 50mV_{DC}$
DVCC3V3_ZYNQ	TP7	+3.3 $V_{DC} \pm 100mV_{DC}$
DVCC2V5_ZYNQ	TP23	+2.5 $V_{DC} \pm 100mV_{DC}$

Check the clock

- Locate the three oscillators X1, X2 and X3, use an oscilloscope to measure the clock signal using the method below.

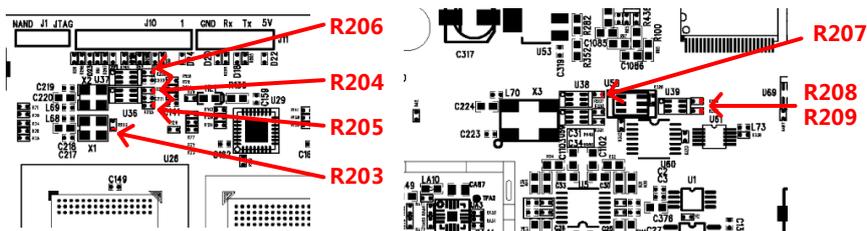


Figure 42 Test points for clock

Table 26 Clock parameters of the Processor System

Test Point	Clock Domain	Level	Frequency Tolerance
R203	Processor Reference	LVC MOS33	33.333333 MHz \pm 50PPM
R204	USB Host Reference	LVC MOS33	24.000000 MHz \pm

			50PPM
R205	USB Device Reference	LVC MOS33	24.000000 MHz \pm 50PPM
R206	USB Hub Reference	LVC MOS33	24.000000 MHz \pm 50PPM
R207	Ethernet Reference	LVC MOS33	25.000000 MHz \pm 50PPM
R208	Acquisition System Clock	LVC MOS33	25.000000 MHz \pm 25PPM
R209	PLL Reference Clock	LVC MOS33	25.000000 MHz \pm 25PPM

To Check the Acquisition System

Check the Acquisition System power supply

- Locate the Acquisition System power supplies section. Find and measure those test points using a multi-meter.

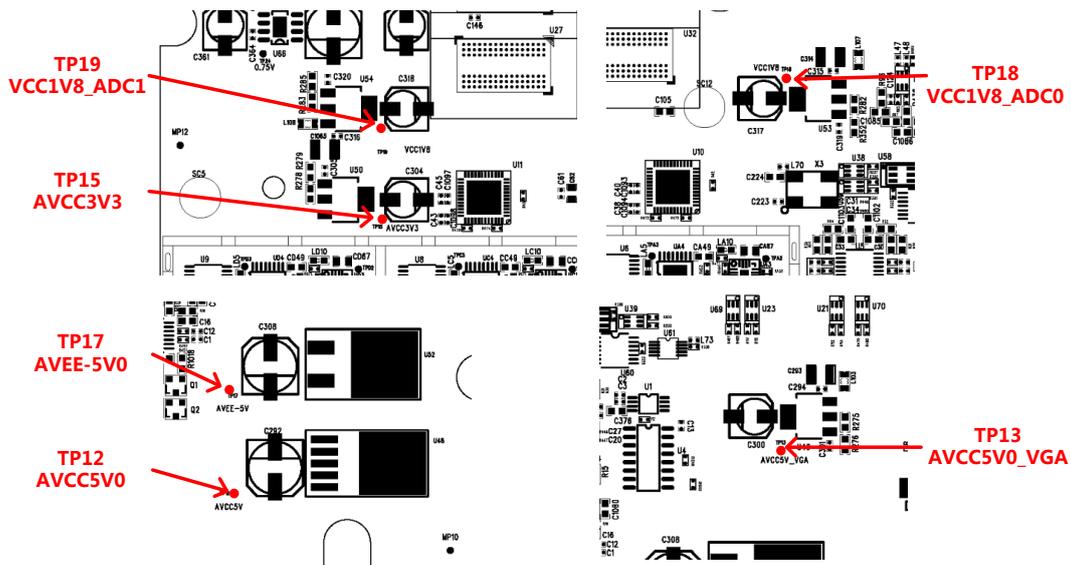


Figure 43 Test points for the Acquisition System power supplies section

Table 27 Voltage parameters of the Acquisition System power supplies

Net Name	Test Point	Tolerance
VCC1V8_ADC0	TP18	+1.8V _{DC} \pm 50mV _{DC}
VCC1V8_ADC1	TP19	+1.8 V _{DC} \pm 50mV _{DC}
AVCC3V3	TP15	+3.3V _{DC} \pm 100mV _{DC}
AVCC5V0_VGA	TP13	+5.0V _{DC} \pm 100mV _{DC}
AVCC5V0	TP12	+5.0V _{DC} \pm 100mV _{DC}

AVEE-5V0	TP17	$-5.0V_{DC} \pm 200mV_{DC}$
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Check the clock

- Locate the oscillatorX3, use an oscilloscope to measure the clock signal using the method below.

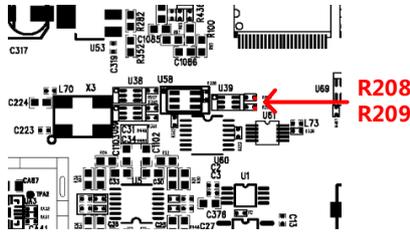


Figure 44 Test points for clock

Table 28 Clock parameters of the Acquisition System

Test Point	Clock Domain	Level	Frequency Tolerance
R208	Acquisition System Clock	LVC MOS33	25.000000 MHz \pm 25PPM
R209	PLL Reference Clock	LVC MOS33	25.000000 MHz \pm 25PPM

To Check Other Power Supplies

Check other power supplies

- Find and measure those test points using a multi-meter.

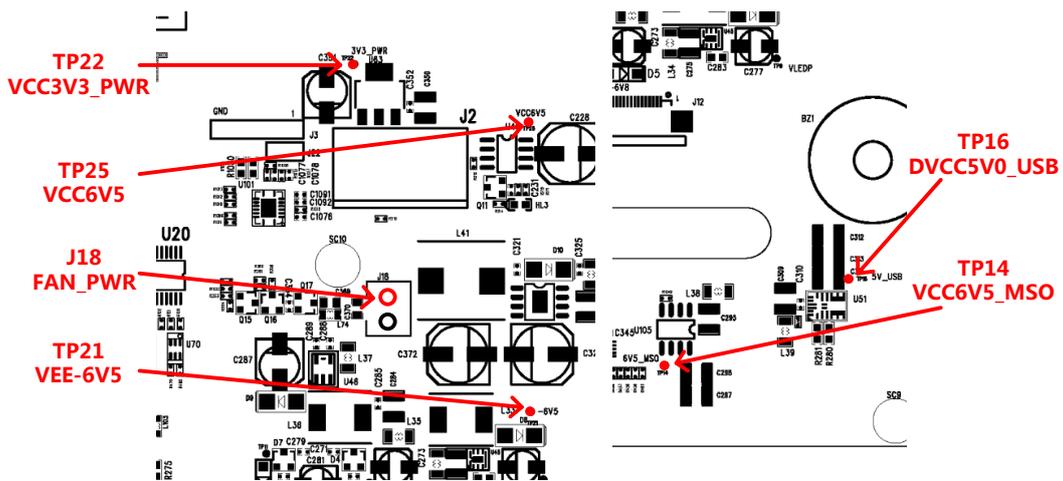


Figure 45 Test points for other power supplies

Table 29 Voltage parameters of other power supplies

Net Name	Test	Tolerance	Comments
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	Point		
VCC3V3_PWR	TP22	+3.3 V_{DC} \pm 100m V_{DC}	Stand-by power for power on circuits
VCC6V5	TP25	+6.5 V_{DC} \pm 10%	Main power
FAN_PWR	J18	+12 V_{DC} \pm 1 V_{DC}	Power supply for fan
VEE-6V5	TP21	-6.5 V_{DC} \pm 10%	Negative power supply for analog circuits
DVCC5V0_USB	TP12	+5.0 V_{DC} \pm 100m V_{DC}	Power source for USB host VBUS
VCC6V5_MSO	TP14	+6.5 V_{DC} \pm 10%	Power supply for SBUS, measuring near 0 V if no SBUS-Device is inserted

To Check the LCD

- Reconnect the power cable to the main board after you have confirmed that the power supply module is in good condition.
- Do not remove the main board completely. Leave the main board on the main metal frame with front cover, keyboard and LCD connected.
- Power up the main board either by pushing the front panel power button or by causing a short duration short circuit on the two pads of J22 beside the power cable receptacle J2 if you have disconnected the keyboard cable on the main board.

To Check the LCD Power Supply

- Find and measure those test points using a multi-meter.

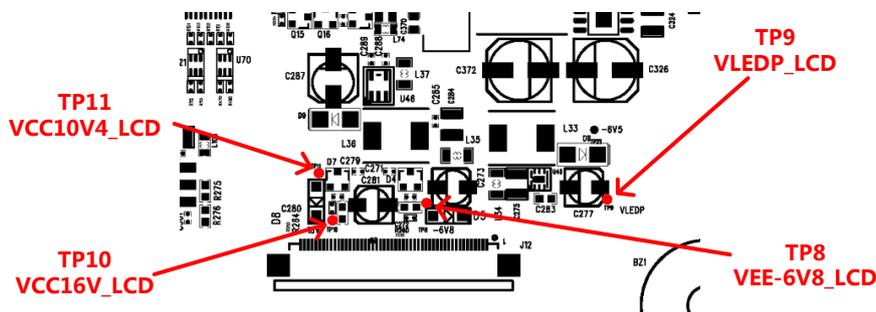


Figure 46 Test points for the LCD power supplies

Table 30 Voltage parameters of the LCD power supplies

Net Name	Test Point	Tolerance
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VCC10V4_LCD	TP11	+10.4 $V_{DC} \pm 10\%$
VCC16V_LCD	TP10	+16 $V_{DC} \pm 10\%$
VEE-6V8_LCD	TP8	-6.8 $V_{DC} \pm 10\%$
VLEDP_LCD	TP9	+6.5 $V_{DC} \sim +20 V_{DC}$

- If the power supply is abnormal, replace the main board.

To Check the LCD Signal

- Locate resistors array between U30 and U34, use an oscilloscope to measure the signal using the method below.

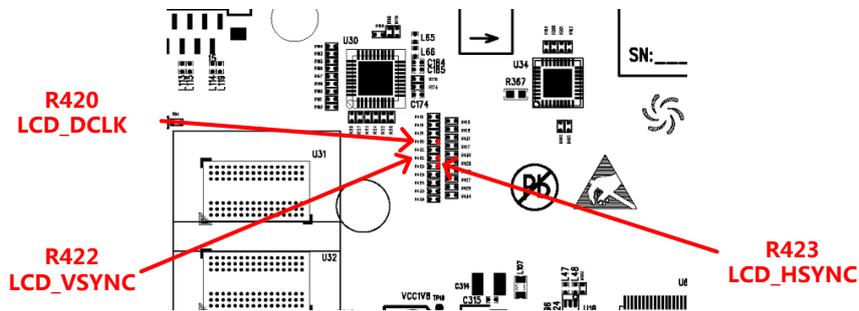


Figure 47 Test points for LCD signal

Table 31 Signal parameters of the LCD

Test Point	Signal	Level	Frequency Tolerance
R420	LCD_DCLK	LVC MOS33	27.5 MHz $\pm 1\%$
R422	LCD_VSYNC	LVC MOS33	50 Hz $\pm 1\%$
R423	LCD_HSYNC	LVC MOS33	26kHz $\pm 1\%$

- If the signal is good, replace the LCD panel.
- If the signal is dead, replace the main board.