SDG3000X

Arbitrary Waveform Generator

Service Manual

EN01A



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1 Introduction

Overview of this Document

This document is for the SDG3000X series arbitrary waveform generator, which will be mostly referred to as “the generator” for short in the following text. The main contents described in this manual are:

The SDG3000X Series Generator at a Glance

This section introduces the main technology characteristics for the SDG3000X generator.

The Front Panel at a Glance

This section introduces briefly all of the buttons and the knob on the front panel.

The Rear Panel at a Glance

This section introduces the ports for easy communication on the rear panel.

Calibration

Chapter 4 provides calibration, verification and adjustment procedures for the generator.

Assembly Procedures

Chapter 5 provides disassembly procedures to help in gaining an understanding of the structure of the generator in preparing to install or replace any needed modules or troubleshoot faults that might be encountered during operation.

Troubleshooting

Chapter 6 provides troubleshooting procedures for the internal circuit boards, as well a quick guide for solving general problems. Before any operation, please read the ESD Precautions to avoid personal injuries or damage to the generator.

Maintenance

Chapter 7 provides information on maintenance, daily care and inspection of the instrument. The contact information is included at the end of the chapter in case of some unsolvable problems that might be encountered.

The Different SDG3000X Models Addressed by this Manual

All the description for function and performance in this document are according to the SDG3202X Plus series generator, and apply to all generators in this series. The SDG3000X series contains the following types:

Type	Analog Bandwidth	Channels
SDG3082X	80 MHz	2
SDG3162X	160 MHz	2
SDG3202X	200 MHz	2

2 Important Safety Information

This manual contains information and warnings that must be followed by the user for safe operation and to keep the product in a safe condition.

2.1 General Safety Summary

Carefully read the following safety precautions to avoid person injury and prevent damage to the instrument or any products connected to it. To avoid potential hazards, please use the instrument as specified.

Only qualified technician should perform service procedures

Use Proper Power Line

Use only the special power line of the instrument that approved by local state.

Ground the Instrument

The instrument grounds through the protective earth conductor of the power line. To avoid electric shock, the ground conductor must be connected to the earth. Make sure the instrument is grounded correctly before connect its input or output terminals.

Connect the Signal Wire correctly

The potential of the signal wire is equal to the earth, do not connect the signal wire to a high voltage. Do not touch the exposed contacts or components.

Look Over All Terminals' Ratings

To avoid fire or electric shock, please observe all ratings and sign instructions of the instrument. Before connecting the instrument, please read the manual carefully to gain more information about the ratings.

Not Operate with Suspected Failures

If you suspect that there is a damage of the instrument, please have a qualified service personnel check it.

Avoid Circuit or Components Exposed

Do not touch exposed contacts or components when the power is on.

Do not Operate in Wet/Damp conditions

Do not Operate in an Explosive Atmosphere

Keep the Surface of the Instrument Clean and Dry

2.2 Safety Terms and Symbols

Terms in this manual. Terms may appear in this manual:

WARNING Warning statements indicate the conditions and behaviors that could result in injury or loss of life.

CAUTION Caution statements indicate the conditions and behaviors that could result in damage to this product or other properties.

Terms used in this product. These terms may appear in the product:

DANGER Indicates direct injury or hazards that may happen.

WARNING Indicates potential injury or hazards that may happen.

CAUTION Indicates potential damage to the instrument or other property that may happen.

Symbols used in this product. These symbols may appear on the product:



Hazardous Voltage



Warning



Protective Earth Ground



Terminal Ground



Power Switch

3 The SDG3000X Series Generator at a Glance

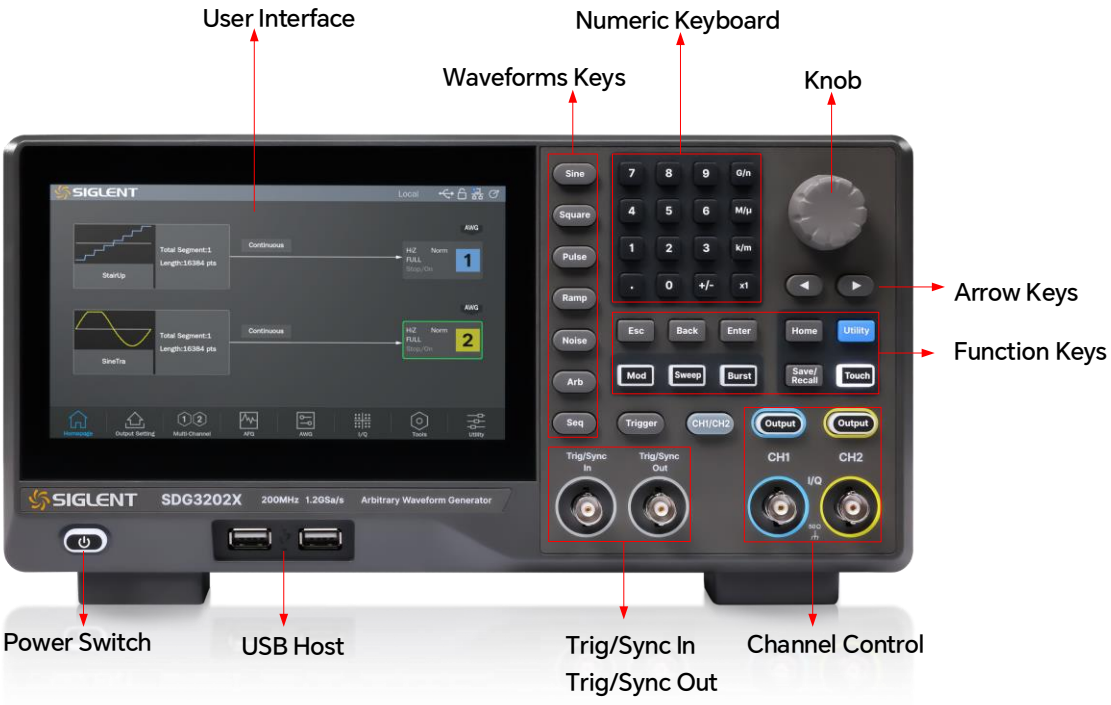
The SDG3000X series dual channel function/arbitrary waveform generator has a maximum bandwidth of 200MHz and excellent sampling system indicators of 1.2GSa/s sampling rate and 16bit vertical resolution. Based on traditional DDS technology, it adopts innovative TrueArb and EasyPulse technologies to overcome the inherent defects of DDS technology in outputting arbitrary waves and square waves/pulses, and can provide users with high fidelity and low jitter signals. In addition, SDG3000X also provides PRBS code generation, sequence wave output, and dual pulse output functions to meet a wider range of application needs.

3.1 Characteristics

- Dual channel, maximum output frequency of 200 MHz, maximum output amplitude of 20 Vpp.
- 1.2 GSa/s analog-to-digital converter sampling rate, 16 bit vertical resolution.
- With the technology of TrueArb, arbitrary wave is output point by point, and low jitter waveform can be output at a variable sampling rate of 10mSa/s~600MSa/s without losing waveform details.
- Supporting sequence wave playback function, with a maximum storage depth of 40 Mpts per channel.
- Adopting EasyPulse technology, it can output low jitter square waves/pulses, and the pulse wave can achieve fine adjustable pulse width and rising/falling edges, with extremely high adjustment resolution and range.
- Support multi pulse output function, which can be used to measure the switch parameters of power equipment and evaluate its dynamic characteristics.
- Support IQ vector signal output.
- Can output PRBS code types up to 120 Mbps.
- Rich analog and digital modulation functions: AM, DSB-SC, FM, PM, FSK, ASK, PSK, and PWM.
- Scanning and Burst functions.
- Harmonic transmission function.
- Channel merging function.
- Hardware frequency meter function.
- 196 built-in arbitrary waves.
- Rich communication interfaces: standard USB Host, USB Device (USBTMC), LAN (VXI-11), optional GPIB.
- Built in WebServer supports controlling instruments through a web browser.
- 7-inch touch screen.

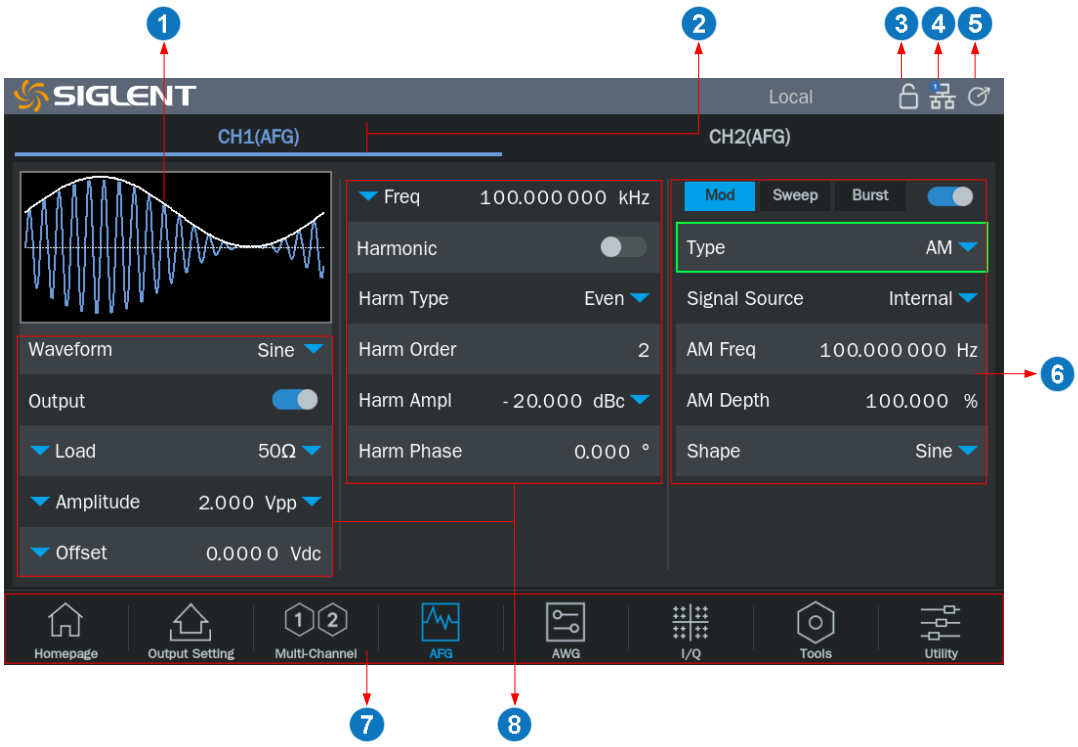
Note: All the specifications described in this manual refer to the SDG3202X.

3.2 The Front Panel at a Glance



3.2.1 The User Interface at a Glance

The SDG3000X displays parameter and waveform information of one channel at a time. The picture below shows the interface when CH1 is selected. In this example, the waveform is an AM modulated sine wave. The information displayed may vary depending on the function selected.



1. Waveform Display Area

Displays the currently selected waveform of each channel.

2. Channel Status Bar

Indicates the selected status and output configuration of the channels.

3. Mode Icon

The display will show different prompt messages based on the current phase mode.

 This icon indicates current phase mode is Phase-locked.

 This icon indicates current phase mode is Independent.

4. LAN Status Icon

SDG3000X will show different prompt messages based on the current network status.

 This mark indicates LAN connection is successful.

 This mark indicates there is no LAN connection or LAN connection is unsuccessful.

5. Clock Source Icon

The display will show different prompt messages based on the current clock source.

 This mark indicates the current clock source is from the internal TCXO.

 This mark indicates the current clock source is from an external clock source.

6. Modulation Parameters Area

Shows the parameters of the current modulation function.

7. Menu

Shows the menu corresponding to the selected function.

8. Basic Waveform Parameters Area

Shows the current waveform parameters of each channel.

3.3 The Rear Panel at a Glance



WARNING

For protection from electric shock, the grounding power cord must not be defeated. If only a two-contact electrical outlet is available, connect the instrument's chassis ground screw (see above) to a good earth ground.

4 Performance Verification

The performance verification tests are recommended as acceptance tests upon receipt of the instrument. The acceptance test results should be compared to the specifications given in chapter 1. After acceptance, repeat the performance verification tests within every calibration interval.

If the instrument fails performance verification, adjustment or repair is required.

4.1 DC Output Verification

This test checks if the DC offset listed in the table below is within the spec range using a DMM.

1. Set the DMM to measure DC voltage. Connect the DMM to the CH1 output of the generator as shown below.



2. Turn on CH1 and select the DC waveform.
3. Set the instrument to each output value described in the table below and measure the output voltage with the DMM. Be sure the generator output load is set to High-Z and the output is enabled.

DC Offset	CH1	CH2	Spec Range ± (1%+2 mV)
0 mV			-2 mV ~ 2 mV
10 mV			7.9 mV ~ 12.1 mV
100 mV			97 mV ~ 103 mV

1 V			0.988 V ~ 1.012 V
3 V			2.968 V ~ 3.032 V
10 V			9.898 V ~ 10.102 V
-10 mV			-12.1 mV ~ - 7.9 mV
-100 mV			-103 mV ~ -97 mV
-1 V			-1.012 V ~ -0.988 V
-3 V			-3.032 V ~ -2.968 V
-10 V			10.102 V ~ -9.898 V

4. Remove the BNC cable to CH2 output and perform the same verification as CH1.
5. Compare the measured voltage to the spec range shown in the table above.

4.2 AC Amplitude Verification

This test checks the ac amplitude output accuracy at the frequency of 10 kHz using a DMM.

1. Turn on the generator and choose CH1 as the operating channel.
2. Connect the DMM and generator as shown below.



3. Select a 10 kHz Sine waveform of the generator and set the amplitude to the values listed below in sequence.

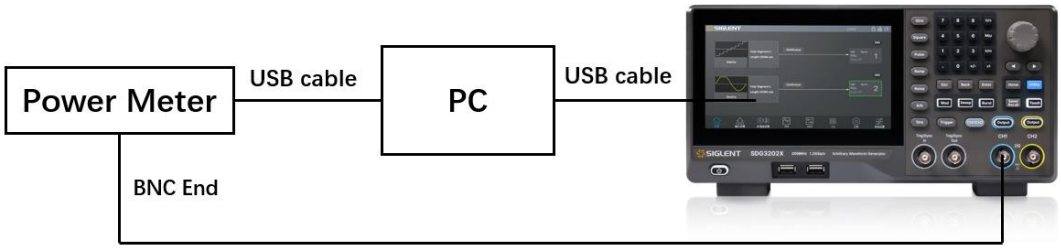
Amplitude (Vpp)	CH1 (Vpp)	CH2 (Vpp)	Spec Range ± (1% +1 mVpp)
10			9.899~10.101
5.6			5.543~5.657
2			1.979~2.021
0.9			0.89~0.91
0.4			0.395~0.405
0.142			0.13958~0.14442
0.064			0.06236~0.06564
0.022			0.02078~0.02322
0.01			0.0089~0.0111
0.004			0.00296~0.00504

4. Remove the BNC cable to CH2 output and perform the same verification as CH1.
5. Compare the value measured from the DMM to the spec range shown in the table above.

4.3 Frequency Response Verification

This test checks if the amplitude flatness is within the spec range using a Power Meter.

1. Turn on the generator and choose CH1 as the operating channel. Set the Load to 50 Ω.
2. Connect the Power Meter, PC and generator as shown below.



3. Select Sine waveform of the generator and set the amplitude to 0.5 Vpp and frequency to the values listed below in sequence.

Frequency	CH1 (dBm)	CH2 (dBm)	Spec Range (dBm)
1 MHz			-2.3412~-1.7412
20 MHz			-2.3412~-1.7412
40 MHz			-2.3412~-1.7412
60 MHz			-2.3412~-1.7412
80 MHz			-2.3412~-1.7412
100 MHz			-2.3412~-1.7412
120 MHz			-2.3412~-1.7412
140 MHz			-2.3412~-1.7412
160 MHz			-2.3412~-1.7412
180 MHz			-2.3412~-1.7412
200 MHz			-2.3412~-1.7412

4. Remove the BNC cable to CH2 output and perform the same verification as CH1.
5. Compare the value measured from Power Meter to the spec range shown in the table above.

5 Assembly Procedures

This chapter describes how to remove major parts from the SDG3000X series Arbitrary Waveform Generator.

5.1 Safety Consideration and Cautions

WARNING 	HAZARDOUS VOLTAGES Maintenance is performed with the power supply on and without protective covers. Only qualified personnel with proper tools and protection should perform maintenance. Perform maintenance with the power cord disconnected whenever possible.
WARNING 	AVOID ELECTRICAL SHOCK Hazardous voltages exist on the power supply and LCD modules. 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. At 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 the power on. Damage to the components may occur.

5.2 Tools Lists

- use these tools to remove or replace the modules in the Arbitrary Waveform Generator.
- Multifunction screwdriver
- Antistatic gloves
- Custom screw hexagonal nut tool or long nose pliers

5.3 Disassembly Procedures

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

5.3.1 To Remove the Rear Cover

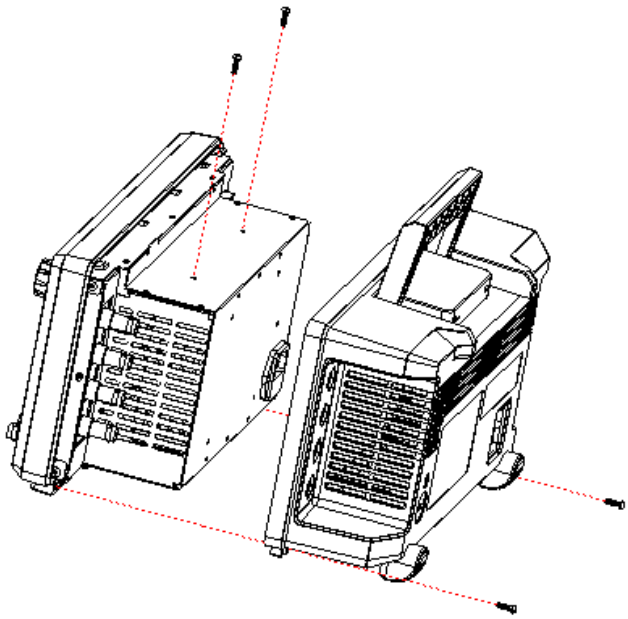


Figure 1 To remove the Rear Cover

Steps:

1. Lift the handle and remove the two PM3*8 screws on the rear-cover.
2. Remove the two PM3*8 screws near the bottom of each foot.
3. lift the Rear cover carefully and then Remove the Rear cover

5.3.2 To Remove the Rear Metal Cover

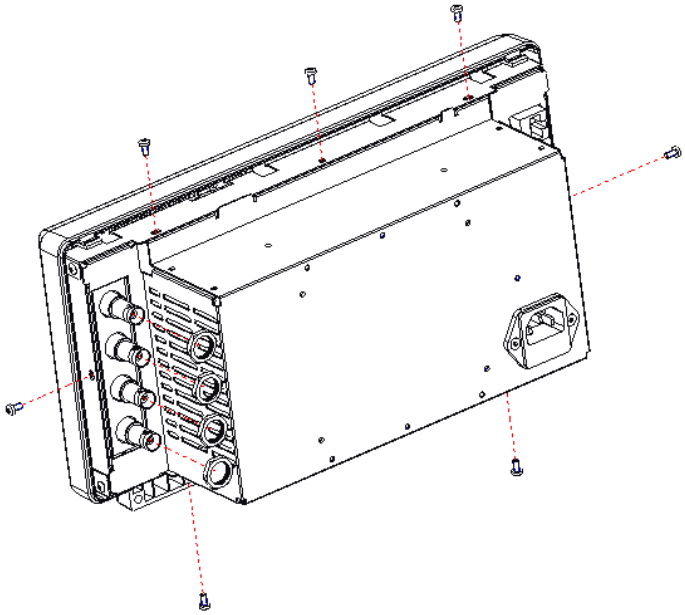


Figure 2 To remove the Rear Metal Cover

Steps:

1. Remove the four BNC nuts on the rear metal cover.
2. Remove the seven screws from the outside of the rear metal cover.
3. Lift the rear metal cover carefully and then Unplug the cables connected to the main board.
4. Remove the rear metal cover.

5.3.3 To Remove the Front Metal

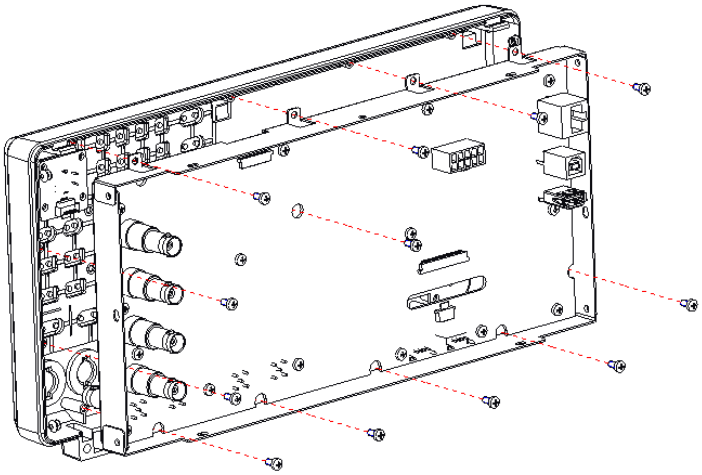


Figure 3 To remove the Front Metal

Steps:

1. Remove the twelve PC3*6 screws on the Front Metal.
2. Unplug the cables connected to the main board.
3. Remove the front Metal with the main board.

5.3.4 To Remove the Main Board

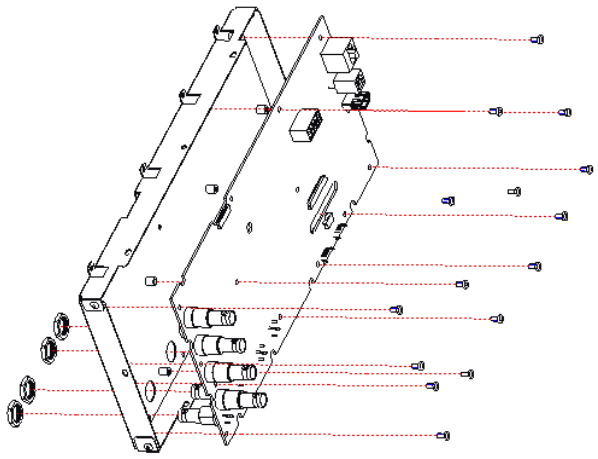


Figure 4 To remove the Main Board

Steps:

1. Remove the four BNC nuts on the Front Metal.
2. Remove the fifteen PM3*6 screws on the Main Board.
3. Remove the Main board.

5.3.5 To Remove the Front Panel

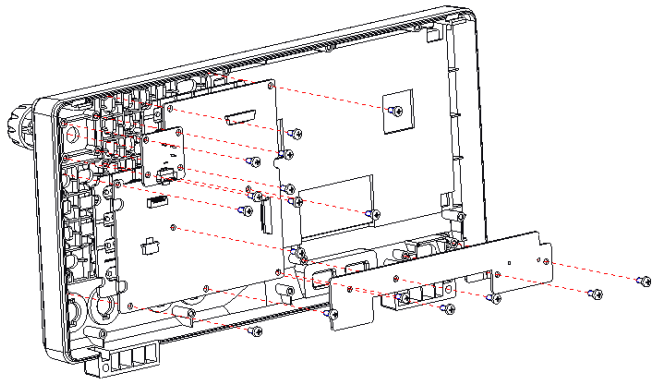


Figure 5 To remove the Front Panel

Steps:

1. Remove the front-panel knob by firmly grasping the knob (with pliers protected by a soft cloth to prevent scratches, if necessary) and pull it away from the front panel.
2. Remove the nine PC3*6 screws on the keyboard and four PC3*6 screws on the knob board and four PC3*6 screws on the power key board.
3. Remove the keyboard and the knob board and the power key board.
4. Remove the rubber keypad.

6 Troubleshooting

The internal structure of the generator consists of the main board, channel board, power supply board, key and LCD board, and two interface boards. They are linked through cables or connectors. This chapter explains the main troubleshooting procedures for these boards (mainly main board and channel board) by measuring the corresponding test points and checking the signals of connectors on them, thus to help in determining the cause of the failure that has been encountered while operating the SDG3000X.

6.1 ESD Precautions

While performing any internal test of the generator, please refer to the following precautions to avoid damages to its internal modules or components resulting from ESD.

- Handle circuit boards by their edges as much as possible.
- Avoid handling of static-sensitive modules if not necessary.
- Wear a grounded antistatic wrist strap to drain the static voltage from your body while touching these modules.
- Operate static-sensitive modules only in static-free areas. Avoid handling modules in areas that allow anything capable of generating or holding a static charge.

6.2 Required Equipments

The equipment listed in the table below is required to troubleshoot the generator.

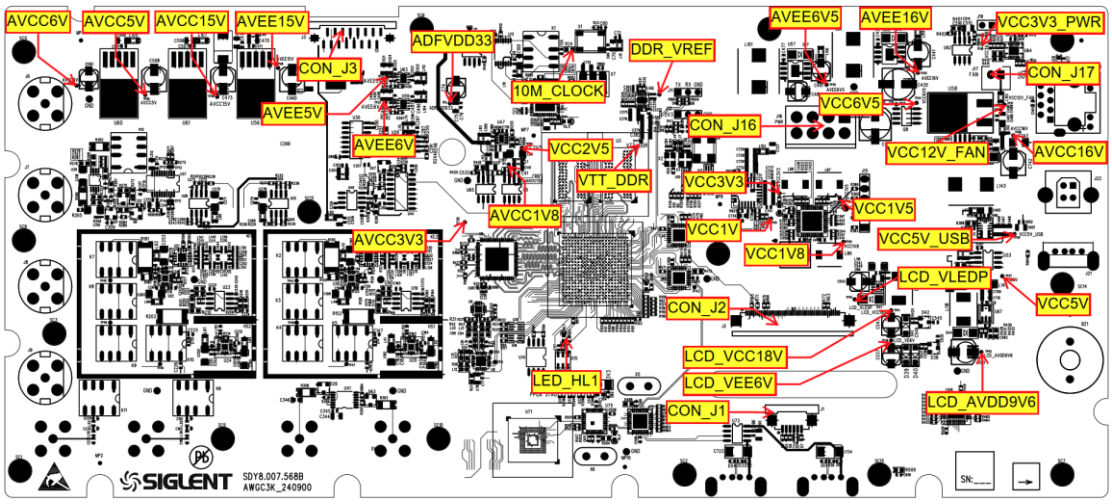
Table 6-1 Required Equipments

Equipment	Critical Specifications	Example
Digital Multimeter	DC Accuracy ±0.015%	SDM3055
Oscilloscope	300 MHz Bandwidth	SDS2304X

6.3 Main Board Drawing

SDG3000X is designed with the channels and main control system integrated onto a single board. Therefore, in the subsequent text, both the channel board and the main board refer to this board.

The main board is the control center of the generator that contains an ARM CPU system. It completes the GUI function, controlling and configuration function of the channel board as well as the user interface. Please refer to the following drawing to quickly locate the test points on the main board for easy resolution of any problems encountered.



6.4 Check the Power Supply

Before performing the power supply testing procedure, please make sure that the generator is grounded correctly through the protective lead of the power cord. Take care not to touch or even disassemble the power supply module without any safety precautions to avoid electric shock. Here are procedures for testing the power supply:

1. Disconnect the power cord of the generator and then check whether the fuse is good.
2. Connect the power cord and then turn on the generator. Focus on the Power Connector (J16) on main board, which contains 8 pins. Test the right-up one or TP23、24 to check whether the voltage value is 6.5V(error limit ±10%)。
3. If the tested voltage value is proper, then the power supply is working normally. Otherwise, please go to step 4.
4. Disconnect the power connector and redo step 3. Because of the removal of the load, each voltage value error limit increases by approximately 20 percent.

If each tested voltage value is within the specified range listed in the table above, then some abnormality of the load is most likely causing the power supply problem. Continuous checking or even replacing the channel/main board is required for further test.

If there is at least one voltage value that is out of the specified range, then the power supply module appears to be problematic and a replacement will be required. For safety, please use qualified

technical personnel to disassemble the power supply module.

Note: The main power supply provides an input fuse to protect against the danger of fire in the event of a failure of the power supply circuitry. However, this fuse will not fail ("open" or "blow") in normal power supply operation except when a significant overload occurs. Replace the entire main power supply if the input fuse fails.

6.5 Check the Board

If it is desired to remove the board from the metal shelf inside the generator, please place it on a clean, insulated mat. Here are the procedures for testing whole board:

1. Several types of connectors are used on the channel board. make certain that all of these connectors are connected properly.
2. After checking these connectors, then connect the generator to AC power and power it on. Check if the voltage values at all test points are within the specified range using a digital multimeter. The voltage parameters to be tested are listed in Table 6-2.

6.5.1 Voltage Checking

Test the voltage points on the channel board in the table below. To locate the test points, please refer to the drawing of the channel board. If each tested voltage value is not within the corresponding spec range referring to Table 6-2, the channel board is defective. Please return it to the factory for repair or contact SIGLENT.

Table 6-2 Test Voltages of the Channel Board

Test point	Voltage value	Error limit
VCC6V5	6.5 V	±10%
AVCC16V	16 V	±5%
AVEE16V	-16 V	±5%
AVCC15V	15 V	±5%
AVEE15V	-15 V	±5%
AVEE6V5	-6.5 V	±5%
AVEE6V	-6 V	±5%

AVCC6V	6 V	±5%
VCC5V	5 V	±5%
VCC5V_USB	5 V	±5%
VCC12V_FAN	12 V	±5%
VCC1V	1 V	±5%
VCC1V8	1.8 V	±5%
VCC1V5	1.5 V	±5%
VCC3V3	3.3 V	±5%
VCC2V5	2.5 V	±5%
VTT_DDR	0.75 V	±5%
DDR_VREF	0.75 V	±5%
AVCC5V	5 V	±5%
AVEE5V	-5 V	±5%
VCC3V3_PWR	3.3 V	±5%
AVCC3V3	3.3 V	±5%
LCD_VEE6V	-6 V	±5%
LCD_VCC18V	18 V	±5%
LCD_AVDD9V6	9.6 V	±5%

6.5.2 10 MHz Clock Source Checking

There is a TXCO generating a 10 MHz 3.3 V LVCOMS clock source to the entire channel board. Please check it referring to the marked point on the channel board drawing.

6.5.3 FPGA Checking

To check if the FPGA is working properly, please observe the test point marked with FPGA_LED(HL1) on the channel board drawing. The LED light blinks at a 2 Hz rate in normal operation. If it does not light cannot be lighted or blinks at an incorrect frequency, then the FPGA may be fault.

6.5.4 Connector Checking

Table 6-3 Connectors of the Channel Board

Connector	Function
CON_J1	Communication between the channel board and the touch screen.
CON_J2	Communication between the channel board and the LCD screen.
CON_J16	Power supply of the channel board.
CON_J3	Communication between the channel board and the Key board
CON_J17	Power supply of the fan.

Table 6-3 explains the function of all the connectors on the board. It is important to ensure that all the connections are tight.

6.6 Quick Guide for General Failures

The general hardware failures are described in the following. This information may help in determining the cause of some general hardware failures:

1. No start-up after pressing the power button:

(1) Check if the power cord is correctly connected.

(2) Check if the power button is operating correctly.

(3) Check whether the fuse has burned out. If the fuse is blown, please replace with a fuse of the same rating.

(4) Check if the connection between the power supply and the channel board is tight.

(5) If the instrument still does not work normally, please contact SIGLENT.

2. Starts up with a dark screen:

(1) Check the connection between the power supply and the channel board.

(2) Check the connection between the keypad circuit board and the channel board.

(3) If the instrument still does not work normally, please contact SIGLENT.

3. No response after pressing any button, or abnormal display of the screen:

(1) Check the connection between the keypad circuit board and the channel board.

(2) If the instrument still does not work normally, please contact SIGLENT.

4. The output voltage amplitude measured is higher or lower than expected:

(1) Check the connection between the generator and the load.

(2) Check if the impedance set in generator matches the input impedance of the load.

(3) If the instrument still does not work normally, please contact SIGLENT.

7 Maintenance

7.1 Maintain Summary

SIGLENT warrants that the products it manufactures and sells are free from defects in materials and workmanship for a period of three years from the date of shipment from an authorized **SIGLENT** distributor. If a product proves defective within the respective period, **SIGLENT** will provide repair or replacement as described in the complete warranty statement.

To arrange for service or obtain a copy of the complete warranty statement, please contact your nearest **SIGLENT** sales and service office.

Except that as provided in this summary or the applicable warranty Statement, **SIGLENT** makes no warranty of any kind, express or implied, including without limitation the implied warranties of merchantability and fitness for a particular purpose. In no case shall **SIGLENT** be liable for indirect, special or consequential damages.

7.2 Repackaging for Shipment

If the unit must be returned to **SIGLENT** for service or repair, be sure to:

1. Attach a tag to the unit identifying the owner and indicating the required service or repair.
2. Place the unit in its original container with appropriate packaging material for shipping.
3. Secure the container with strong tape or metal bands.

If the original shipping container is not available, place your unit in a container which will ensure at least 4 inches of compressible packaging material around all sides for the instrument. Use static-free packaging materials to avoid additional damage to your unit.

About SIGLENT

SIGLENT is an international high-tech company, concentrating on R&D, sales, production and services of electronic test & measurement instruments.

SIGLENT first began developing digital oscilloscopes independently in 2002. After more than a decade of continuous development, SIGLENT has extended its product line to include digital oscilloscopes, isolated handheld oscilloscopes, spectrum analyzers, function/arbitrary waveform generators, RF/MW signal generators, vector network analyzers, digital multimeters, DC power supplies, electronic loads and other general purpose test instrumentation. Since its first oscilloscope was launched in 2005, SIGLENT has become the fastest growing manufacturer of digital oscilloscopes. We firmly believe that today SIGLENT is the best value in electronic test & measurement.

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