SDG1000X Plus

Arbitrary Waveform Generator

Service Manual

EN01A



SIGLENT TECHNOLOGIES CO., LTD.

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1 Introduction

Overview of this Document

This document is for the SDG1000X Plus 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 SDG1000X Plus Series Generator at a Glance

This section introduces the main technology characteristics for the SDG1000X Plus 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 SDG1000X Plus Models Addressed by this Manual

All the description for function and performance in this document are according to the SDG1062X Plus series generator, and apply to all generators in this series. The SDG1000X Plus series contains the following types:

Type	Analog Bandwidth	Channels
SDG1022X Plus	25 MHz	2
SDG1032X Plus	30 MHz	2
SDG1062X Plus	60 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 SDG1000X Plus Series Generator at a Glance

The SDG1000X Plus series dual channel function/arbitrary waveform generator has a maximum bandwidth of 60 MHz and excellent sampling system indicators of 1 GSa/s sampling rate and 16 bit 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, SDG1000X Plus 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 60 MHz, maximum output amplitude of 20 Vpp.
- 1 GSa/s analog-to-digital converter sampling rate, 16 bit vertical resolution.
- Using TrueArb technology, outputting any wave point by point, while ensuring no loss of waveform details, can achieve 1μ Low jitter waveform output with variable sampling rate of 1μSa/s~250MSa/s.
- Supporting sequence wave playback function, with a maximum storage depth of 8 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.
- Can output PRBS code types up to 40 Mbps.
- Rich analog and digital modulation functions: AM, DSB-AM, FM, PM, FSK, ASK, PSK, and PWM.
- Scanning and Burst functions.
- 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.
- 4.3 inch display screen.

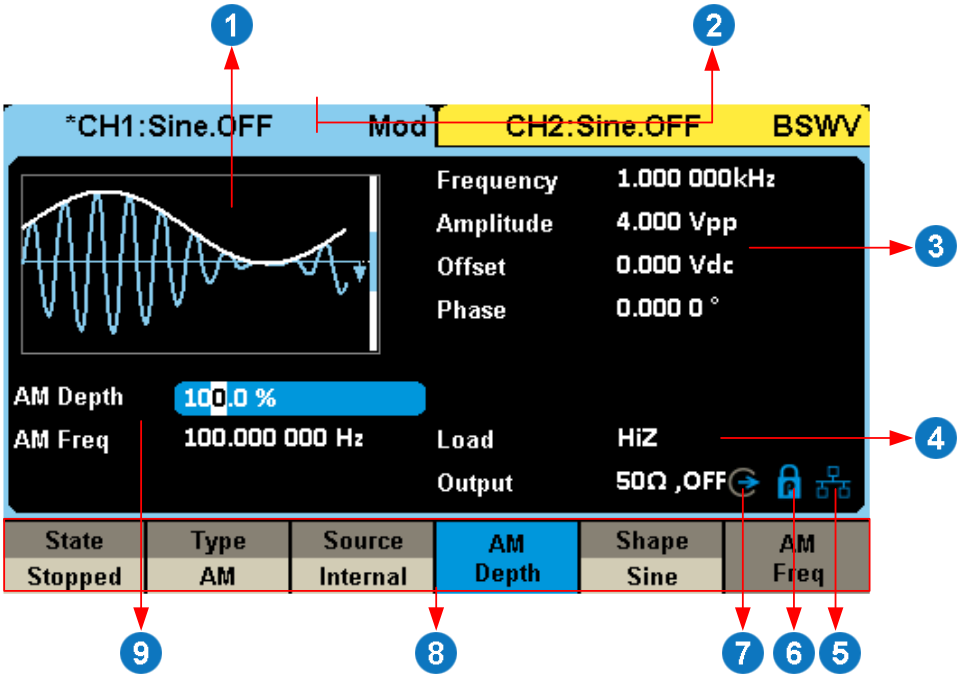
Note: All the specifications described in this manual refer to the SDG1062X Plus.

3.2 The Front Panel at a Glance



3.2.1 The User Interface at a Glance

The SDG1000X Plus 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. Basic Waveform Parameters Area

Shows the current waveform parameters of each channel.

4. Channel Parameters Area

Displays the load and output settings of the currently selected channel.

Load ---- Value of the output load, as selected by the user.

High Impedance: Displays HiZ, and assumes a load impedance of 1 MΩ.

Load: Displays the set impedance value. The default is 50 Ω and the range is from 50 Ω to 100 kΩ.

Note: This setting does not actually change the instrument's output impedance of 50 Ω but rather is used to maintain amplitude accuracy when fed into different load values.

Output ---- Channel output state.

Pressing corresponding channel output control button, the current channel can be turned on/off.

5. LAN Status Icon

SDG1000X Plus 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.

6. 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.

7. 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.

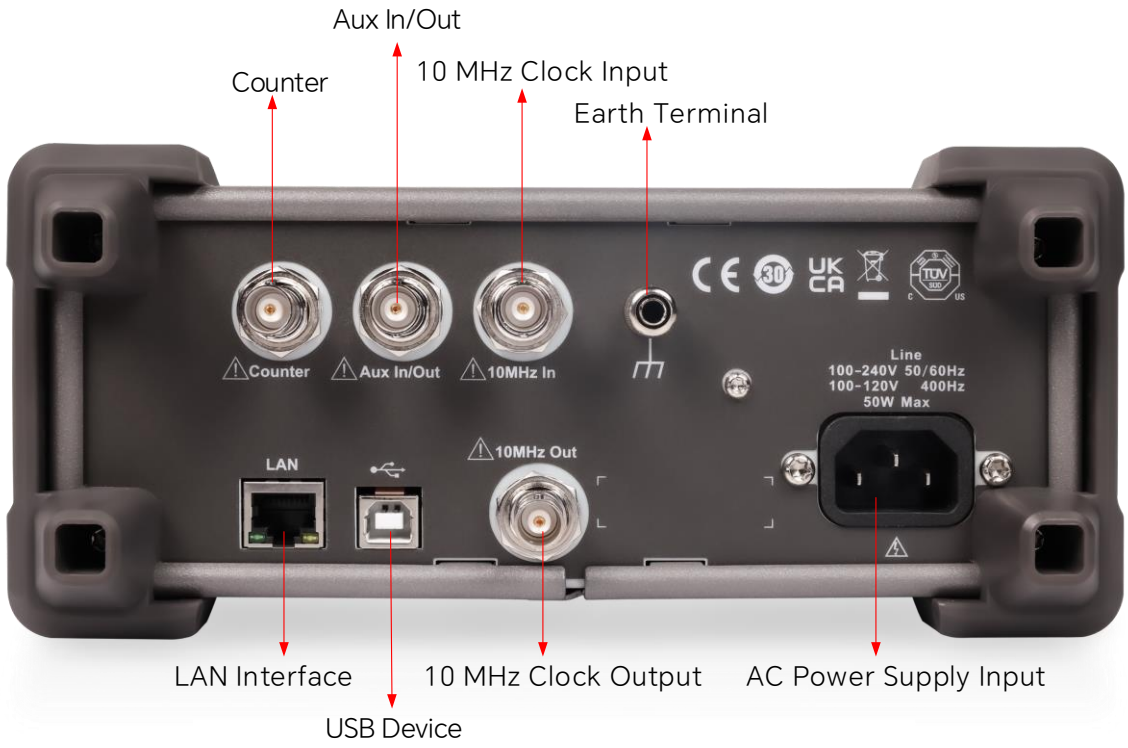
8. Menu

Shows the menu corresponding to the selected function.

9. Modulation Parameters Area

Shows the parameters of the current modulation function.

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

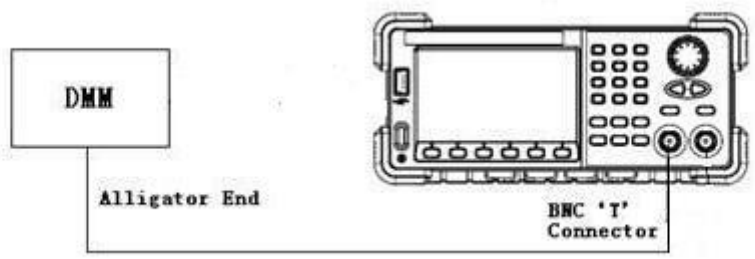
The performance verification tests are recommended as acceptance tests upon receipt of the instrument. The acceptance test results should be compared against the specifications given in chapter 1. After acceptance, repeat the performance verification tests at every calibration interval.

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 are 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

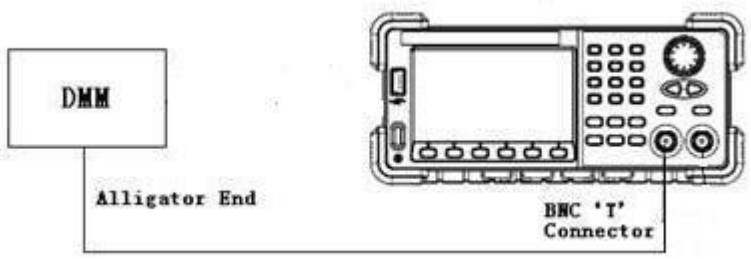
-1 V			-1.012 V ~ -0.988 V
-3 V			-3.032 V ~ -2.968 V
-10 V			10.102 V ~ -9.898 V

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. Set the Load to 50 Ω.
2. Connect the DMM and generator as shown below.



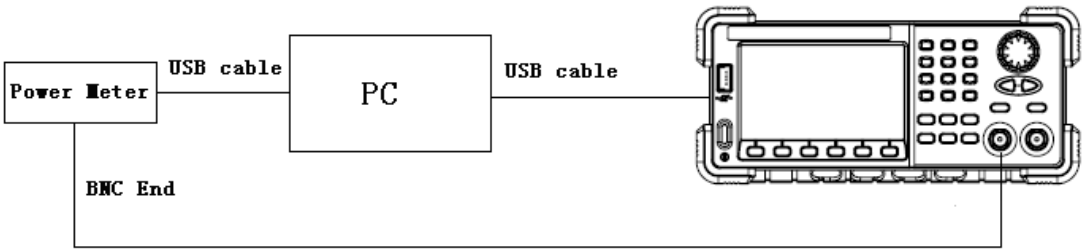
3. Select Sine waveform of the generator and set the amplitude to the values listed below in sequence.

Amplitude (V)	CH1 (V)	CH2 (V)	Spec Range (V) ± (1%+1 mV)
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

1. This test checks if the amplitude flatness is within the spec range using a Power Meter.
2. Turn on the generator and choose CH1 as the operating channel. Set the Load to 50 Ω.
3. Connect the Power Meter, PC and generator as shown below.



4. Select Sine waveform of the generator and set the amplitude to 1 V and 2.5 V, frequency to the values listed below in sequence.

Output Voltage	1 V			2.5 V		
Frequency	CH1	CH2	Spec Range (dBm)	CH1	CH2	Spec Range (dBm)
1 MHz			3.6794 ~ 4.2794			11.64 ~12.24
5 MHz			3.6794 ~ 4.2794			11.64 ~12.24
10 MHz			3.6794 ~ 4.2794			11.64 ~12.24
15 MHz			3.6794 ~ 4.2794			11.64 ~12.24
20 MHz			3.6794 ~ 4.2794			11.64 ~12.24
25 MHz			3.6794 ~ 4.2794			11.64 ~12.24
30 MHz			3.6794 ~ 4.2794			11.64 ~12.24
35 MHz			3.6794 ~ 4.2794			11.64 ~12.24
40 MHz			3.6794 ~ 4.2794			11.64 ~12.24
45 MHz			3.6794 ~ 4.2794			11.64 ~12.24
50 MHz			3.5794 ~ 4.3794			11.54 ~12.34
55 MHz			3.5794 ~ 4.3794			11.54 ~12.34
60 MHz			3.5794 ~ 4.3794			11.54 ~12.34

5. Remove the BNC cable to CH2 output and perform the same verification as CH1.
6. 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 the major modules from the SDG1000X Plus series generator. To install the removed modules or replace new modules, please follow corresponding operating steps in reverse order.

The following subjects are addressed in this chapter:

- **Security Consideration** which describes security information needed to consider while operating.
- **List of Modules** in which the modules to remove are listed.
- **Required Tools** which describes the tools needed to perform the procedures.
- **Disassembly Procedures** which describes in detail how to remove and install the modules.

5.1 Security Consideration

Only qualified personnel should perform the disassembly procedures. Whenever possible, disconnect the power supply before removing or replacing modules. Otherwise, personal injuries or damages to the components may occur.

Avoid Electric Shock Hazardous voltages exist on the LCD module and power supply module. To avoid electrical shock, disconnect the power cord from the generator, and then wait at least three minutes for the capacitors in the generator to discharge before beginning the disassembly.

Preventing ESD Almost all electrical components can be damaged by electrostatic discharge (ESD) during handling. Component damages can occur at electrostatic discharge voltages as low as 50 volts. The following guidelines will help preventing ESD damage when servicing the instrument or any electronic device.

- Disassemble instruments only in a static-free work area.
- Use a conductive work area to reduce static charges.
- Use a conductive wrist strap to reduce static charge accumulation.
- Minimize handling.
- Keep replacement parts in original static-free packaging.
- Remove all plastic, foam, vinyl, paper and other static-generating materials from the immediate work area.
- Use only anti-static solder suckers.

5.2 List of Modules

The following removable modules are listed in the order of performing disassembly procedures.

Number of Module	Module
1	Handle
2	Metal Shell and Rear Cabinet
3	Front Cabinet
4	Display Module
5	Main Body

5.3 Required Tools

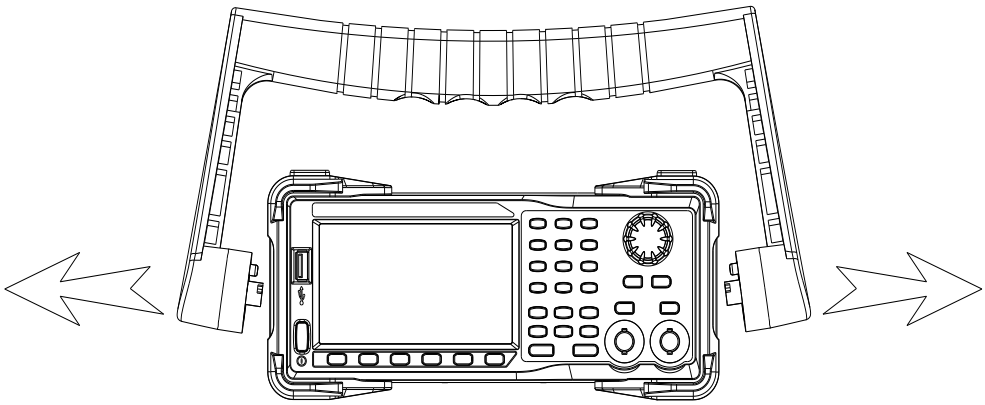
Use these tools to remove or replace the modules in the generator:

- T10 and T15 Torx screwdriver

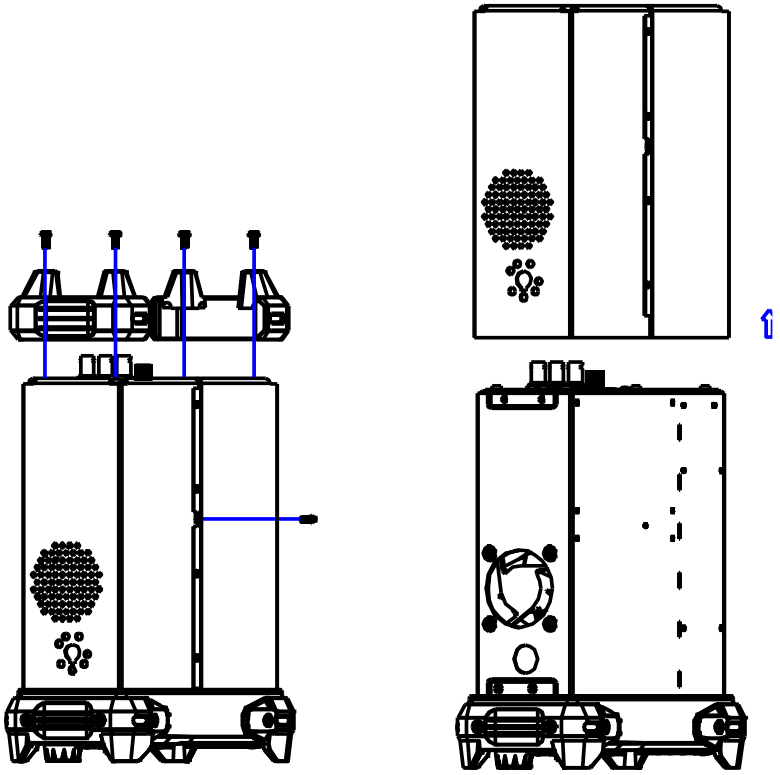
5.4 Disassembly Procedures

This section describes how to remove and install the generator's modules listed above in detail. Complete disassembly will be best achieved through the following operating steps.

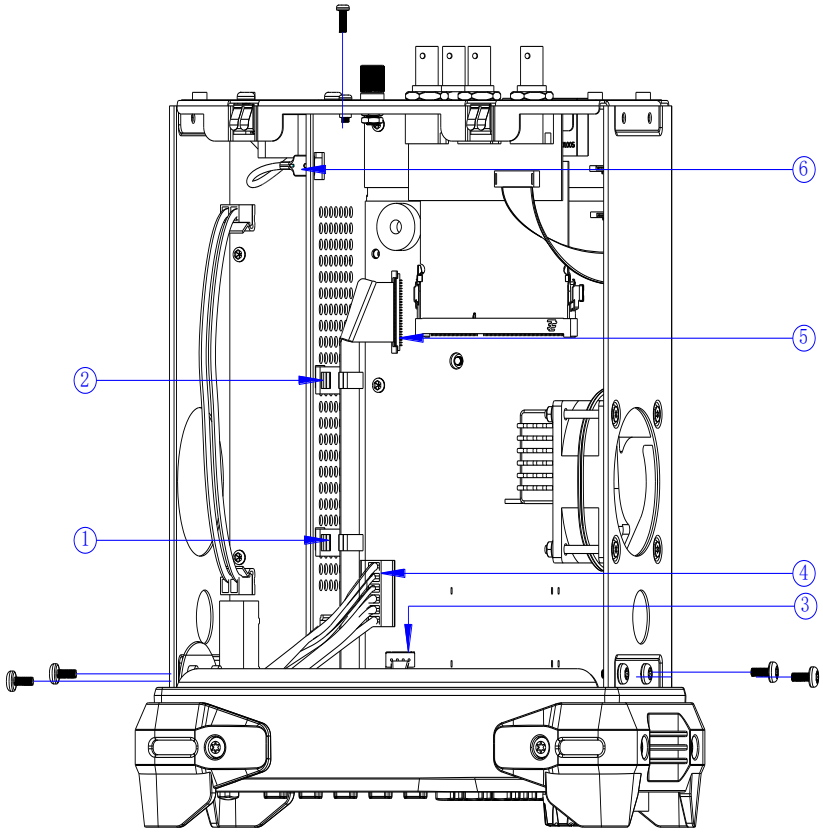
1. Pull out the handle firmly from the two sides of the generator.



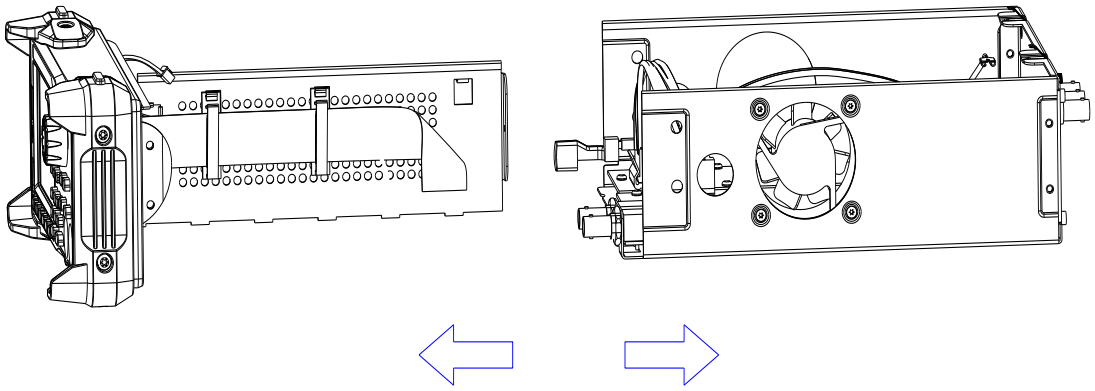
2. After removing 4PCS screws of the pad and 1PCS screw at the bottom of the generator's case, remove the metal shell carefully from the main body to avoid being scratched.



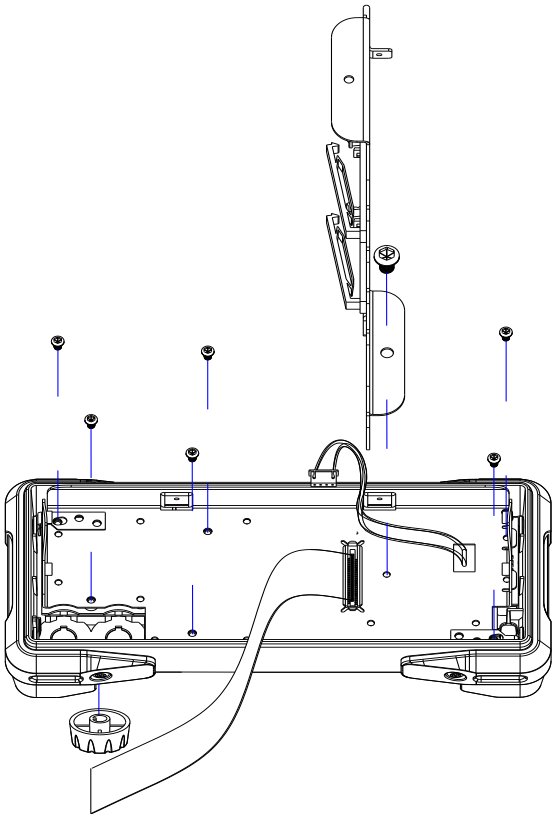
3. Open the cable clamp as ①② shows and pull out the cable as ③④⑤⑥ shows, and then remove the 5PCS screws as shown in the following figure.



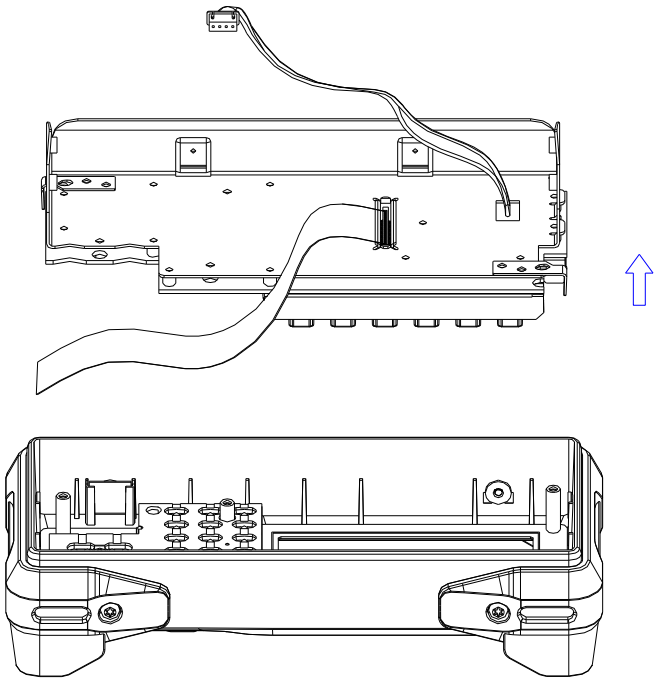
4. Separate the front panel from the main body of the generator.



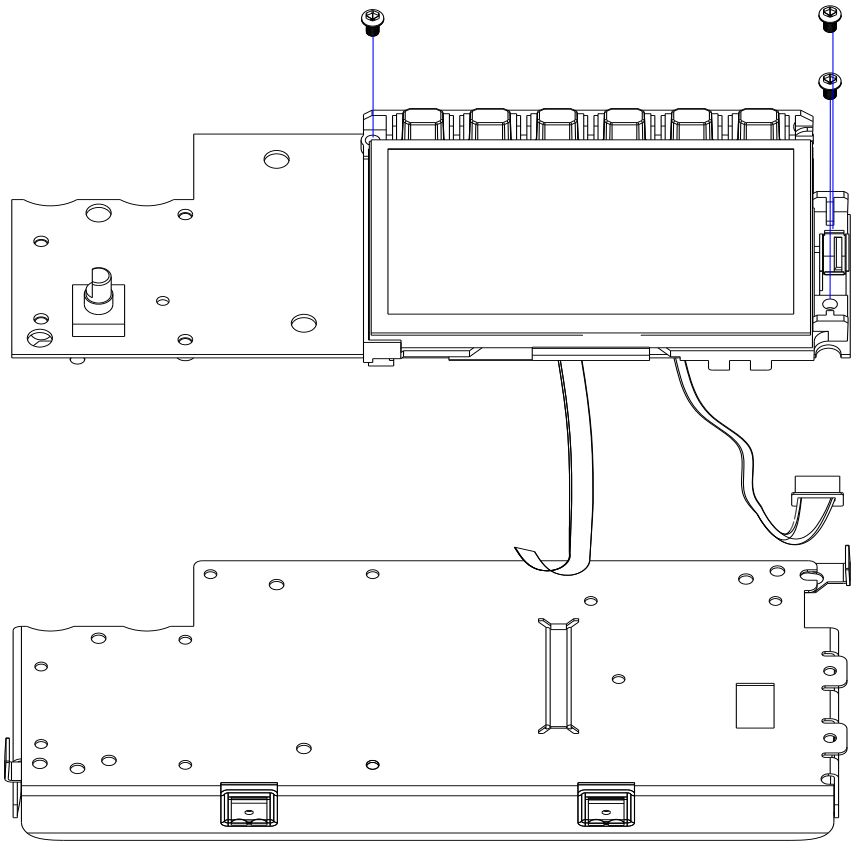
5. Pull out the knob and then remove the screws attaching the hardware partition plate and the front cabinet screws.



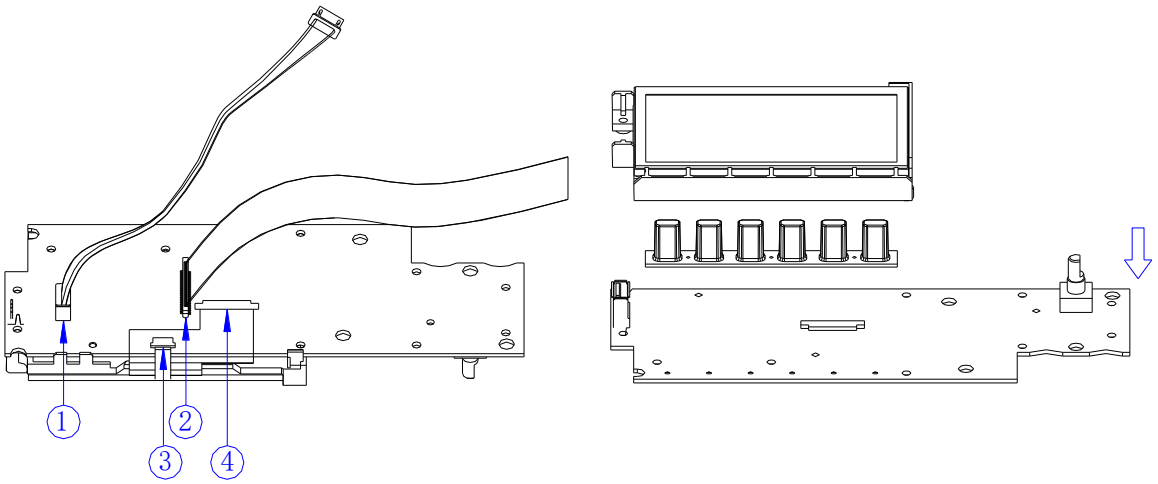
6. Remove the keypad circuit board assembly.



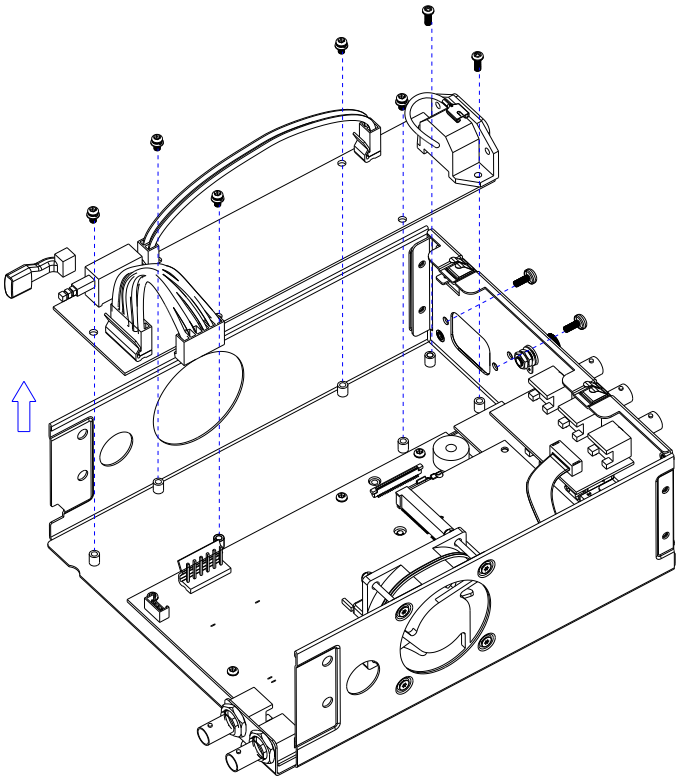
7. Remove the 3PCS screws holding the screen bracket and remove the metal front panel.



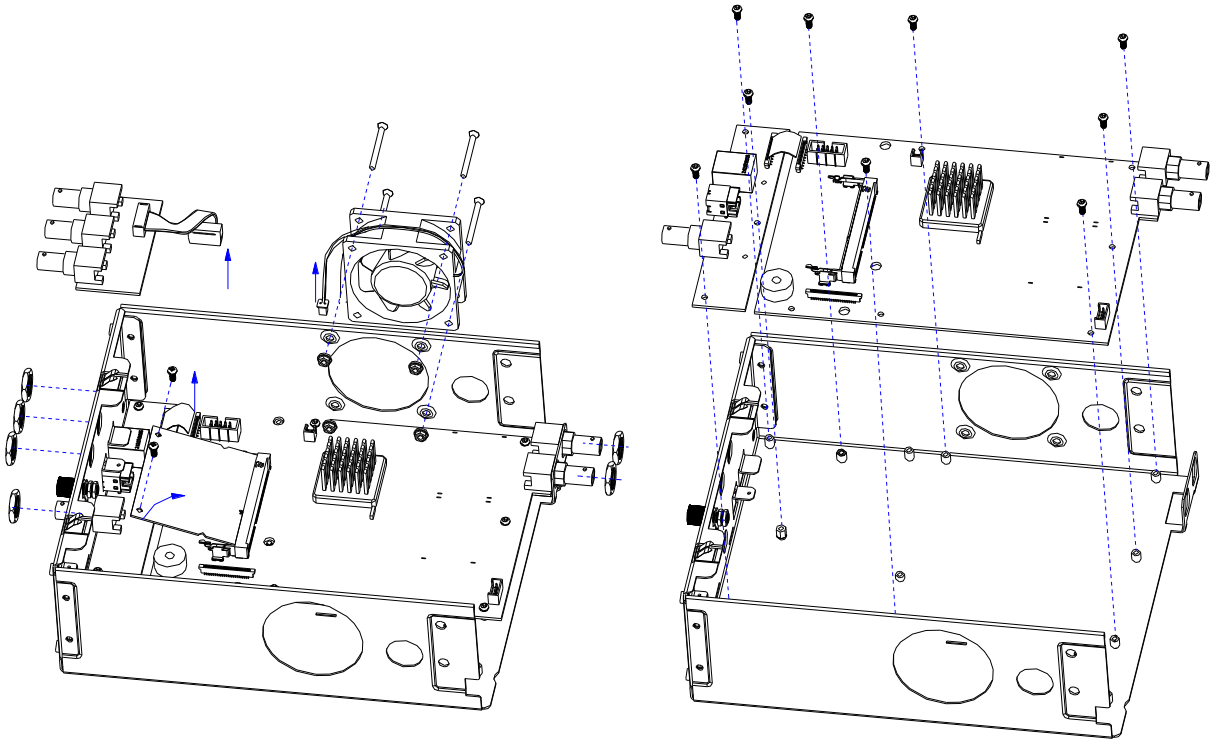
8. Pull out the connecting cable according to the index number as shown in the following figure and remove the keyboard.



9. Remove all the 9 screws affixed to the power supply board using the T10 Torx screwdriver. Separate the power supply board carefully from the main body of the generator in order to avoid being scratched by the sharp metal edge.



10. Pull out the connecting cable as shown in the following figure and then remove the fan, rear interface board, channel board and main board.



Note:

To assemble the generator, please follow these same steps in reverse order.

6 Troubleshooting

The internal structure of the generator consists of the main board, channel board, power supply board, key and LCD board, and interface board. 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 reason for the failure that has been encountered while operating the SDG1000X Plus series arbitrary waveform generator.

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.

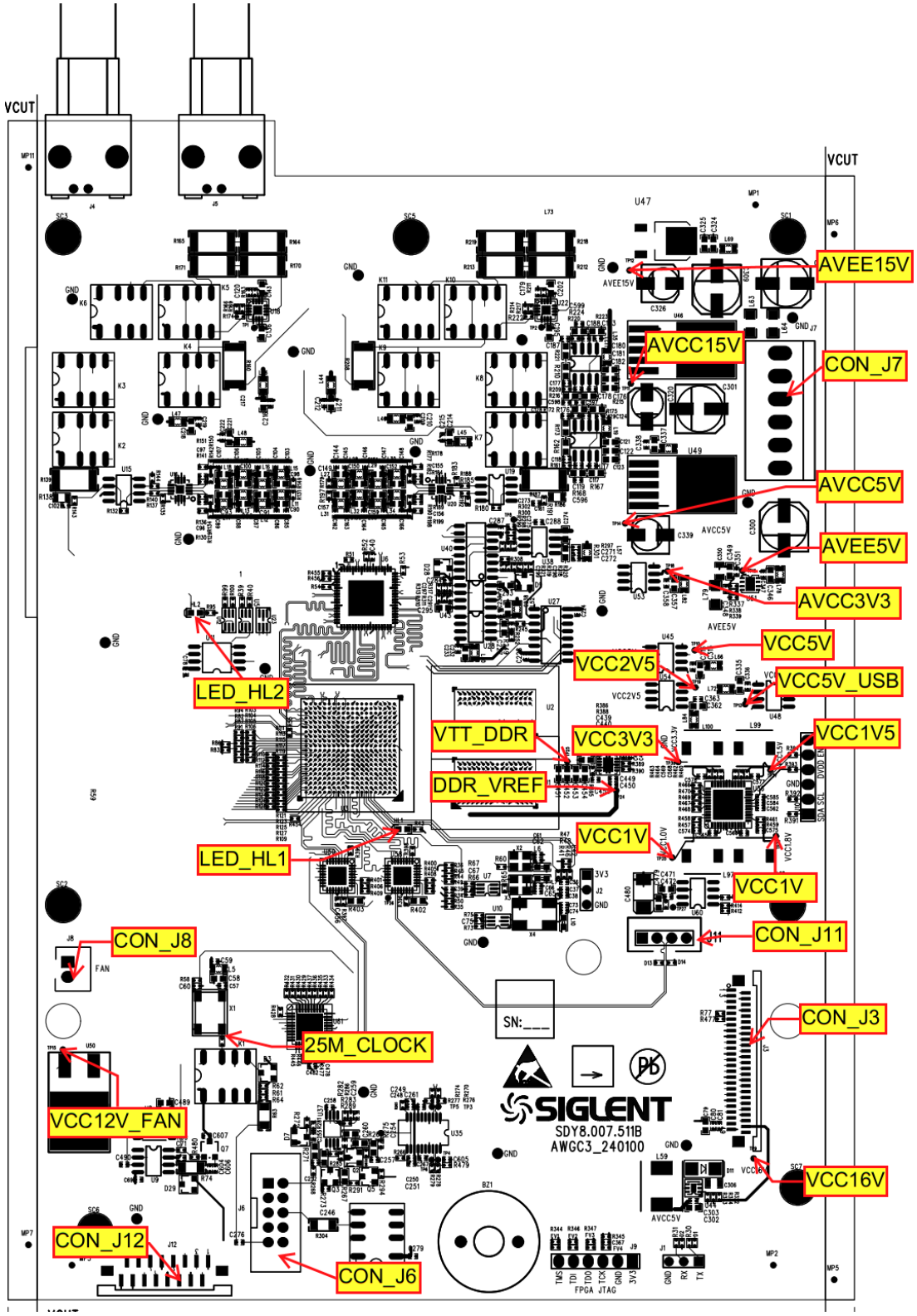
Table 6-1 Required Equipments

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

6.3 Board Drawing

SDG1000X Plus 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 (J7) on channel board, which contains 6 pins, from Pin 1 to Pin 6. Since two of the six pins are ground wires, test the other four pins that are marked respectively with blue, yellow, red and white, using a digital multimeter, to check whether the voltage value is within the corresponding specified range. The voltage parameters to be tested are listed in the table below:

Table 6-2 Test Voltages of Power Connector

Voltage value	Pins	Error limit
20 V	VH+(red)	±10%
-20 V	VH-(white)	±10%
6.5 V	VL+(yellow)	±10%
-6.5 V	VL-(blue)	±10%

3. If each tested voltage value is within the corresponding specified range listed in the table above, 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.

Table 6-3 Test Voltages of the Connector After Disconnected

Voltage value	Pins	Error limit
20 V	VH+(red)	±30%
-20 V	VH-(white)	±30%
6.5 V	VL+(yellow)	±30%
-6.5 V	VL-(blue)	±30%

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 the board:

1. Several types of connectors are used on the 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 6-4.

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 6-4, the channel board is defective. Please return it to the factory for repair or contact SIGLENT.

Table 6-4 Test Voltages of the Channel Board

Test point	Voltage value	Error limit
AVCC15V	15 V	±5%
AVEE15V	-15 V	±5%
AVCC5V	5V	±5%
AVEE5V	-5V	±5%
AVCC3V3	3.3V	±5%
VCC5V	5V	±5%
VCC5V_USB	5V	±5%

VCC12V_FAN	12V	±5%
VCC1V	1V	±5%
VCC1V8	1.8V	±5%
VCC1V5	1.5V	±5%
VCC3V3	3.3V	±5%
VCC2V5	2.5V	±5%

6.5.2 10 MHz Clock Source Checking

There is a Crystal oscillator 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 on the channel board drawing. The LED(HL1) light continuously and LED(HL2) may extinguish soon after powered in normal operation. If it cannot be lighted, then the FPGA may be fault.

6.5.4 Connector Checking

Table 6-5 Connectors of the Channel Board

Connector	Function
CON_J12	Communication between the channel board and the interface board.
CON_J7	Power supply of the channel board.
CON_J11	USB HOST
CON_J3	Communication between the channel board and the Key and LCD board.
CON_J8	Power supply of the fan.

Table 6-5 explains the function of all the connectors on the channel 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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