SDG3000X Series

Arbitrary Waveform Generator

User Manual

EN01A

SIGLENT TECHNOLOGIES CO.,LTD

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1 Introduction

This user manual includes important safety and installation information related to the SDG3000X series of Arbitrary Waveform Generator and includes simple tutorials for basic operation of the instrument.

The series includes the following models:

Model	Analogy Bandwidth	Maximum Sampling Rate	Analog Channel
SDG3202X	200 MHz	1.2 GSa/s (2X Interpolation)	2
SDG3162X	160 MHz	1.2 GSa/s (2X Interpolation)	2
SDG3082X	80 MHz	1.2 GSa/s (2X Interpolation)	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 personal injury and prevent damage to the instrument and any products connected to it. To avoid potential hazards, please use the instrument as specified.

To Avoid Fire or Personal Injury.

Use Proper Power Line.

Only use a local/state approved power cord for connecting the instrument to mains power sources.

Ground the Instrument.

The instrument grounds through the protective ground 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, so do not connect the signal wire to a high voltage. Do not touch the exposed contacts or components.

Review All Terminals' Ratings.

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

Equipment Maintenance and Service.

When the equipment fails, please do not dismantle the machine for maintenance.
The equipment contains capacitors, power supply, transformers, and other energy storage devices, which may cause high voltage damage.
The internal devices of the equipment are sensitive to static electricity, and direct contact is easy to cause irreparable damage to the equipment.
It is necessary to return to the factory or the company's designated maintenance organization for maintenance.
Be sure to pull out the power supply when repairing the equipment.
Live line operation is strictly prohibited.
The equipment can only be powered on when the maintenance is completed and the maintenance is confirmed to be successful.

Identification of Normal State of Equipment.

After the equipment is powered on, there will be no alarm information and error information at the interface under normal conditions.
You need to view the specific prompt information.
You can try to restart the setting. If the fault information is still in place, do not use it for testing.
Contact the manufacturer or the maintenance department designated by the manufacturer to carry out maintenance to avoid the wrong test data caused by the use of the fault or endanger the personal safety.

Not Operate with Suspected Failures.

If you suspect that there is damage to the instrument, please let qualified service personnel check it.

Avoid Circuit or Wire Exposed 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.

Not to use the equipment for measurements on mains circuits, not to use the equipment for measurements on voltage exceed the voltage range describe in the manual. The maximum additional transient voltage cannot exceed 1300V.

The responsible body or operator should refer to the instruction manual to preserve the protection afforded by the equipment. If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Any parts of the device and its accessories are not allowed to be changed or replaced, other than authorized by the manufacturer or agent.

2.2 Safety Terms and Symbols

When the following symbols or terms appear on the front or rear panel of the instrument or in this manual, they indicate special care in terms of safety.

	This symbol is used where caution is required. Refer to the accompanying information or documents to protect against personal injury or damage to the instrument.
	This symbol warns of a potential risk of shock hazard.
	This symbol is used to denote the measurement ground connection.
	This symbol is used to denote a safety ground connection.
	This symbol shows that the switch is an On/Standby switch. When it is pressed, the scope's state switches between Operation and Standby. This switch does not disconnect the device's power supply. To completely power off the scope, the power cord must be unplugged from the AC socket after the instrument is in the standby state.
	This symbol is used to represent alternating current, or "AC".
CAUTION	The "CAUTION" symbol indicates a potential hazard. It calls attention to a procedure, practice, or condition which may be dangerous if not followed. Do not proceed until its conditions are fully understood and met.
WARNING	The "WARNING" symbol indicates a potential hazard. It calls attention to a procedure, practice, or condition which, if not followed, could cause bodily injury or death. If a WARNING is indicated, do not proceed until the safety conditions are fully understood and met.

2.3 Working Environment

The design of the instrument has been verified to conform to EN 61010-1 safety standard per the following limits:

Environment

The instrument is used indoors and should be operated in a clean and dry environment with an ambient temperature range.

Note: Direct sunlight, electric heaters, and other heat sources should be considered when evaluating the ambient temperature.

	**WARNING:** Do not operate the instrument in explosive, dusty, or humid environments.

Ambient Temperature

Operating: 0 ℃ to +40 ℃

Non-operation: -20 ℃ to +60 ℃

Note: Direct sunlight, radiators, and other heat sources should be taken into account when assessing the ambient temperature.

Humidity

Operating: 5% ~ 90 %RH, 30 ℃, derate to 50 %RH at 40 ℃

Non-operating: 5% ~ 95% RH

Mains supply voltage fluctuations

Refer to 2.5 Power and Ground Requirements

Altitude

Operating: ≤ 3,048 m, 30 ℃

Non-operating: ≤ 15,000 m

Installation (overvoltage) category: Category II (mains connector) and Category I (measuring terminal)

Note: Installation (overvoltage) category I refers to the signal level, which is suitable for connecting to the equipment measuring terminal in the source circuit, in which measures have been taken to limit the instantaneous voltage to a corresponding low level.

Installation (overvoltage) category II refers to the local distribution level, which is suitable for devices connected to the mains (AC power supply).

Pollution degree: Class 2

Note: Pollution degree 2 refers to the working environment where only dry and non-conductive pollution occurs. Sometimes it is necessary to predict the temporary conductivity caused by concentration.

IP Rating

IP20 (as defined in IEC 60529).

2.4 Cooling Requirements

This instrument relies on the forced air cooling with internal fans and ventilation openings. Care must be taken to avoid restricting the airflow around the apertures (fan holes) at each side of the scope. To ensure adequate ventilation it is required to leave a 15 cm (6 inch) minimum gap around the sides of the instrument.

	**CAUTION:** Do not block the ventilation holes located on both sides of the scope.

	**CAUTION:** Do not allow any foreign matter to enter the scope through the ventilation holes, etc.

2.5 Power and Grounding Requirements

The instrument operates with a single-phase, 100 to 240 Vrms (±10%) AC power at 50/60 Hz (±5%), or single-phase 100 to 120 Vrms (±10%) AC power at 400 Hz (±5%).

No manual voltage selection is required because the instrument automatically adapts to line voltage. Depending on the type and number of options and accessories (probes, PC port plug-in, etc.), the instrument can consume up to 50 W of power.

Note: The instrument automatically adapts to the AC line input within the following ranges:

Voltage Range:	90 - 264 Vrms	90 - 132 Vrms
Frequency Range:	47 - 63 Hz	380 - 420 Hz

The instrument includes a grounded cord set containing a molded three-terminal polarized plug and a standard IEC320 (Type C13) connector for making line voltage and safety ground connection. The AC inlet ground terminal is connected directly to the frame of the instrument. For adequate protection against electrical shock hazards, the power cord plug must be inserted into a mating AC outlet containing a safety ground contact. Use only the power cord specified for this instrument and certified for the country of use.

WARNING:

Electrical Shock Hazard!

Any interruption of the protective conductor inside or outside of the scope, or disconnection of the safety ground terminal creates a hazardous situation.

Intentional interruption is prohibited.

The position of the instrument should allow easy access to the socket. To make the instrument completely power off, unplug the instrument power cord from the AC socket.

The power cord should be unplugged from the AC outlet if the scope is not to be used for an extended period.

CAUTION:

Each terminal housing of the front/rear panel is connected to the equipment casing, and then connected to the safety ground.

2.6 Cleaning

Clean only the exterior of the instrument, using a damp, soft cloth. Do not use chemicals or abrasive elements. Under no circumstances allow moisture to penetrate the instrument. To avoid electrical shock, unplug the power cord from the AC outlet before cleaning.

	**WARNING:** Electrical Shock Hazard! No operator serviceable parts inside. Do not remove covers. Refer servicing to qualified personnel

2.7 Abnormal Conditions

Use this equipment only for the purposes specified by the manufacturer.

Do not operate the scope if there is any visible sign of damage or has been subjected to severe transport stresses.

If you suspect the scope's protection has been impaired, disconnect the power cord and secure the instrument against any unintended operation.

Proper use of the instrument depends on careful reading of all instructions and labels.

	**WARNING:** Using the equipment in a way not specified by the manufacturer may damage the safety protection of the equipment.This equipment and related accessories should not be directly connected to the human body or used for patient monitoring.

2.8 Safety Compliance

This section lists the safety standards with which the product complies.

U.S. nationally recognized testing laboratory listing

- UL 61010-1:2012/R: 2024-11. Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 1: General Requirements.

Canadian certification

- CAN/CSA-C22.2 No. 61010-1:2012/U4:2024-11. Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 1: General Requirements.

Informations

essentielles sur la sécurité

Ce manuel contient des informations et des avertissements que les utilisateurs doivent suivre pour assurer la sécurité des opérations et maintenir les produits en sécurité.

Exigence de Sécurité

Lisez attentivement les précautions de sécurité ci - après afin d 'éviter les dommages corporels et de prévenir les dommages aux instruments et aux produits associés. Pour éviter les risques potentiels, utilisez les instruments prescrits.

Éviter l 'incendie ou les lésions corporelles.

Utilisez un cordon d'alimentation approprié.

N'utilisez que des cordons d'alimentation spécifiques aux instruments approuvés par les autorités locales.

Mettez l'instrument au sol.

L'instrument est mis à la Terre par un conducteur de mise à la terre de protection du cordon d'alimentation.Pour éviter un choc électrique, le conducteur de mise à la terre doit être mis à la terre.Assurez - vous que l'instrument est correctement mis à la terre avant de connecter les bornes d'entrée ou de sortie de l'instrument.

Connectez correctement le fil de signalisation.

Le potentiel de la ligne de signal est égal au potentiel au sol, donc ne connectez pas la ligne de signal à haute tension.Ne touchez pas les contacts ou les composants exposés.

Voir les cotes de tous les terminaux.

Pour éviter un incendie ou un choc électrique, vérifiez toutes les cotes et signez les instructions de l'instrument.Avant de brancher l'instrument, lisez attentivement ce manuel pour obtenir de plus amples renseignements sur les cotes.

Entretien du matériel.

En cas de défaillance de l'équipement, ne pas démonter et entretenir l'équipement sans autorisation. L'équipement contient des condensateurs, de l'alimentation électrique, des transformateurs et d'autres dispositifs de stockage d'énergie, ce qui peut causer des blessures à haute tension. Les dispositifs internes de l'équipement sont sensibles à l'électricité statique. Le contact direct peut

facilement causer des blessures irrécupérables à l'équipement. L'équipement doit être retourné à l'usine ou à l'organisme de maintenance désigné par l'entreprise pour l'entretien. L'alimentation électrique doit être retirée pendant l'entretienLa ligne ne doit pas être mise sous tension tant que l'entretien de l'équipement n'est pas terminé et que l'entretien n'est pas confirmé.

Identification de l'état normal de l'équipement.

Après le démarrage de l'équipement, dans des conditions normales, il n'y aura pas d'information d'alarme et d'erreur au bas de l'interface, et la courbe de l'interface sera balayée librement de gauche à droite; si un blocage se produit pendant le processus de numérisation, ou si l'information d'alarme ou d'erreur apparaît au bas de l'interface, l'équipement peut être dans un état anormal. Pour voir l'information d'alarme spécifique, vous pouvez d'abord essayer de redémarrerSi l'information sur la d éfaillance est toujours présente, ne l'utilisez pas pour l'essai. Contactez le fabricant ou le Service de réparation désigné par le fabricant pour effectuer l'entretien afin d'éviter d'apporter des données d'essai erronées ou de mettre en danger la sécurité personnelle en raison de l'utilisation de la défaillance.

Ne pas fonctionner en cas de suspicion de défaillance.

Si vous soupçonnez des dommages à l'instrument, demandez à un technicien qualifié de vérifier.

L 'exposition du circuit ou de l' élément d 'exposition du fil est évitée.

Lorsque l 'alimentation est connectée, aucun contact ou élément nu n' est mis en contact.

Ne pas fonctionner dans des conditions humides / humides.

Pas dans un environnement explosif.

Maintenez la surface de l 'instrument propre et sec.

Le Circuit d 'alimentation électrique ne peut pas être mesuré à l' aide du dispositif, ni la tension qui dépasse la plage de tension décrite dans le présent manuel.

L'organisme ou l'opérateur responsable doit se référer au cahier des charges pour protéger la protection offerte par le matériel.La protection offerte par le matériel peut être compromise si celui - ci est utilisé de manière non spécifiée par le fabricant.

Aucune pièce du matériel et de ses annexes ne peut être remplacée ou remplacée sans l'autorisation de son fabricant.

Termes et symboles de sécurité

Lorsque les symboles ou termes suivants apparaissent sur le panneau avant ou arrière de l'instrument ou dans ce manuel, ils indiquent un soin particulier en termes de sécurité.

	Ce symbole est utilisé lorsque la prudence est requise. Reportez-vous aux informations ou documents joints afin de vous protéger contre les blessures ou les dommages à l'instrument.
	Ce symbole avertit d'un risque potentiel de choc électrique.
	Ce symbole est utilisé pour désigner la connexion de terre de mesure.
	Ce symbole est utilisé pour indiquer une connexion à la terre de sécurité.
	Ce symbole indique que l'interrupteur est un interrupteur marche / veille. Lorsqu'il est enfoncé, l'état de l'instruments bascule entre Fonctionnement et Veille. Ce commutateur ne déconnecte pas l'alimentation de l'appareil. Pour éteindre complètement l'instruments, le cordon d'alimentation doit être débranché de la prise secteur une fois l'instruments en état de veille.
	Ce symbole est utilisé pour représenter un courant alternatif, ou "AC".
CAUTION	Le symbole " CAUTION" indique un danger potentiel. Il attire l'attention sur une procédure, une pratique ou une condition qui peut être dangereuse si elle n'est pas suivie. Ne continuez pas tant que ses conditions n'ont pas été entièrement comprises et remplies.
WARNING	Le symbole " WARNING" indique un danger potentiel. Il attire l'attention sur une procédure, une pratique ou une condition qui, si elle n'est pas suivie, pourrait entraîner des blessures corporelles ou la mort. Si un AVERTISSEMENT est indiqué, ne continuez pas tant que les conditions de sécurité ne sont pas entièrement comprises et remplies.

Environnement de travail

La conception de l'instrument a été certifiée conforme à la norme EN 61010-1, sur la base des valeurs limites suivantes:

Environnement

L'instrument doit être utilisé à l'intérieur dans un environnement propre et sec dans la plage de température ambiante.

Note: la lumière directe du soleil, les réchauffeurs électriques et d'autres sources de chaleur doivent être pris en considération lors de l'évaluation de la température ambiante.

	**ATTENTION:** ne pas utiliser l'instrument dans l'air explosif, poussiéreux ou humide.

Température ambiante

En fonctionnement: 0 ℃ à +40 ℃

Hors fonctionnement: -20 ℃ à +60 ℃

Note: pour évaluer la température de l'environnement, il convient de tenir compte des rayonnements solaires directs, des radiateurs thermiques et d'autres sources de chaleur.

Humidité

Fonctionnement: 5% ~ 90% HR, 30 °C, 40 °C réduit à 50% HRHors fonctionnement: 5% ~ 95%, 65 ℃, 24 heures

Fluctuation de la tension d'alimentation

Voir connexions d'alimentation et au sol

Altitude

Fonctionnement: ≤ 3048 m

À l'arrêt: ≤ 15,000 m

Catégorie d 'installation (surtension)

Ce produit est alimenté par une alimentation électrique conforme à l 'installation (surtension) Catégorie ll.

Installation (overvoltage) Category Definitions Définition de catégorie d 'installation (surtension)

La catégorie II d'installation (surtension) est un niveau de signal applicable aux terminaux de mesure d' équipement reliés au circuit source.Dans ces bornes, des mesures préventives sont prises pour limiter la tension transitoire à un niveau inférieur correspondant.

La catégorie II d'installation (surtension) désigne le niveau local de distribution d 'énergie d' un équipement conçu pour accéder à un circuit alternatif (alimentation alternative).

Degré de pollution

Un instruments peut être utilisé dans un environnement Pollution Degree II.

Note: Pollution Degree II signifie que le milieu de travail est sec et qu'il y a une pollution non conductrice.Parfois, la condensation produit une conductivité temporaire.

IP Rating

IP20 (as defined in IEC 60529).

Exigences de refroidissement

Cet instrument repose sur un refroidissement à air forcé avec des ventilateurs internes et des ouvertures de ventilation. Des précautions doivent être prises pour éviter de restreindre le flux d'air autour des ouvertures (trous de ventilateur) de chaque côté de la lunette. Pour assurer une ventilation adéquate, il est nécessaire de laisser un espace minimum de 15 cm (6 pouces) sur les côtés de l'instrument.

	ATTENTION: Ne bloquez pas les trous de ventilation situés des deux côtés de la lunette.

	ATTENTION: Ne laissez aucun corps étranger pénétrer dans la lunette par les trous de ventilation, etc.

Connexions d'alimentation et de terre

L'instrument fonctionne avec une alimentation CA monophasée de 100 à 240 Vrms (+/- 10%) à 50/60 Hz (+/- 5%), ou monophasée 100 - 120 Vrms (+/-10 %) Alimentation CA à 400 Hz (+/-5%).
Aucune sélection manuelle de la tension n'est requise car l'instrument s'adapte automatiquement à la tension de ligne.
Selon le type et le nombre d'options et d'accessoires (sondes, plug-in de port PC, etc.), l'instrument peut consommer jusqu'à 50 W d'énergie.

Remarque: l'instrument s'adapte automatiquement à l'entrée de ligne CA dans les plages suivantes:

Plage de tension:	90 - 264 Vrms	90 - 132 Vrms
Gamme de fréquences:	47 - 63 Hz	380 - 420 Hz

L'instrument comprend un jeu de cordons mis à la terre contenant une fiche polarisée à trois bornes moulée et un connecteur standard IEC320 (Type C13) pour établir la tension de ligne et la connexion de mise à la terre de sécurité. La borne de mise à la terre de l'entrée CA est directement connectée au châssis de l'instrument. Pour une protection adéquate contre les risques d'électrocution, la fiche du cordon d'alimentation doit être insérée dans une prise secteur correspondante contenant un contact de sécurité avec la terre. Utilisez uniquement le cordon d'alimentation spécifié pour cet instrument et certifié pour le pays d'utilisation.

	**Avertissement:** risque de choc électrique! Toute interruption du conducteur de terre de protection à l'intérieur ou à l'extérieur de la portée ou la déconnexion de la borne de terre de sécurité crée une situation dangereuse. L'interruption intentionnelle est interdite.

La position de l'instruments doit permettre un accès facile à la prise. Pour éteindre complètement l'instruments, débranchez le cordon d'alimentation de l'instrument de la prise secteur.

Le cordon d'alimentation doit être débranché de la prise secteur si la lunette ne doit pas être utilisée pendant une période prolongée.

	**ATTENTION:** les enveloppes extérieures des bornes du panneau avant (CH1, CH2) sont connectées au châssis de l'instrument et donc à la terre de sécurité.

Nettoyage

Nettoyez uniquement l'extérieur de l'instrument à l'aide d'un chiffon doux et humide. N'utilisez pas de produits chimiques ou d'éléments abrasifs. Ne laissez en aucun cas l'humidité pénétrer dans l'instrument. Pour éviter les chocs électriques, débranchez le cordon d'alimentation de la prise secteur avant de le nettoyer.

	**Avertissement:** risque de choc électrique! Aucune pièce réparable par l'opérateur à l'intérieur. Ne retirez pas les capots. Confiez l'entretien à un personnel qualifié

Conditions anormales

Utilisez l'instrument uniquement aux fins spécifiées par le fabricant.
N'utilisez pas la lunette s'il y a des signes visibles de dommages ou si elle a été soumise à de fortes contraintes de transport.

Si vous pensez que la protection de l'instruments a été altérée, débranchez le cordon d'alimentation et sécurisez l'instrument contre toute opération involontaire.

Une bonne utilisation de l'instrument nécessite la lecture et la compréhension de toutes les instructions et étiquettes.

	**Avertissement:** Toute utilisation de l'instruments d'une manière non spécifiée par le fabricant peut compromettre la protection de sécurité de l'instrument. Cet instrument ne doit pas être directement connecté à des sujets humains ni utilisé pour la surveillance des patients.

Conformité en matière de sécurité

La présente section présente les normes de sécurité applicables aux produits.

U.S. nationally recognized testing laboratory listing

- UL 61010-1:2012/R:2024-11. Prescriptions en matière de sécurité pour les appareils électriques utilisés en laboratoire et de mesure - partie 1: prescriptions générales.

Canadian certification

- CAN/CSA-C22.2 No. 61010-1:2012/U4:2024-11. Prescriptions en matière de sécurité pour les appareils électriques utilisés en laboratoire et de mesure - partie 1: prescriptions générales.

3 Delivery instrument

3.1 Delivery Checklist

First, verify that all items listed on the packing list have been delivered. If you note any omissions or damage, please contact your nearest **SIGLENT** customer service center or distributor as soon as possible. If you fail to contact us immediately in case of omission or damage, we will not be responsible for replacement.

3.2 Quality Assurance

The signal source has a 3-year warranty (1-year warranty for accessories) from the date of shipment, during normal use and operation. **SIGLENT** can repair or replace any product that is returned to the authorized service center during the warranty period. We must first examine the product to make sure that the defect is caused by the process or material, not by abuse, negligence, accident, abnormal conditions, or operation.

SIGLENT shall not be responsible for any defect, damage, or failure caused by any of the following:

a) Attempted repairs or installations by personnel other than **SIGLENT**.

b) Connection to incompatible devices/incorrect connection.

c) For any damage or malfunction caused by the use of non-**SIGLENT** supplies. Furthermore, **SIGLENT** shall not be obligated to service a product that has been modified. Spare, replacement parts and repairs have a 90-day warranty.

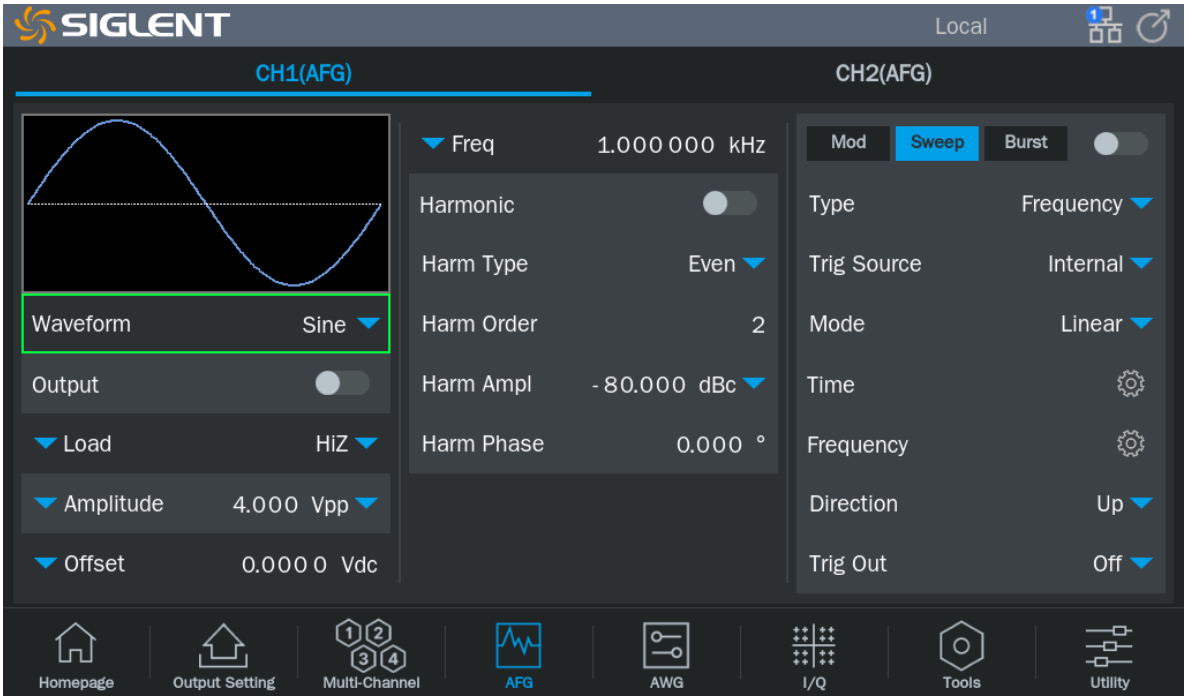
The signal source firmware has been thoroughly tested and is presumed to be functional. Nevertheless, it is supplied without a warranty of any kind covering detailed performance. Products not made by **SIGLENT** are covered solely by the warranty of the original equipment manufacturer.

3.3 Maintenance Agreement

We provide various services based on maintenance agreements. We offer extended warranties as well as installation, training, enhancement and on-site maintenance, and other services through specialized supplementary support agreements. For details, please consult your local **SIGLENT** customer service center or distributor.

4 Document Conventions

For convenience, text surrounded by a box border is used to represent the button of the front panel. For example, Utility represents the "Utility" button on the front panel. Use italicized text with character shading to represent clickable menus, options, and virtual buttons on the display screen. For example, *Frequency* represents the "Frequency" menu on the screen:



For the operations that contain multiple steps, the description is in the form of "Step 1 > Step 2 >...". As an example, follow each step in the sequence to enter the system information interface:

Utility > *System Info*

Press the Utility button on the front panel as step 1, click the *System Info* option on the screen as step 2, You can enter the system information interface.

5 Introduction to SDG3000X Series Arbitrary Waveform Generator

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.

Below are its performance characteristics, which will help you gain a deeper understanding of the technical specifications of SDG3000X.

- 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-AM, 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.

6 Quick start

6.1 Front panel

A. **Power button** Used to turn on or off the signal generator. When the power button is turned off, the signal generator is in a power-off state.

B. **USB Host** Used to connect USB storage devices, it can read waveforms or status files from the USB flash drive, or store the current instrument status to the USB flash drive.

C. **Display area** Display the menu and parameter settings, system status, and prompt information of the current function.

D. **Numeral key** Used to input parameter values.

E. **Knob** When setting parameters, rotate the knob to increase (clockwise) or decrease the parameter value; When storing or reading files, rotate the knob to select the file.

F. **Direction keys** Used to change the position of the cursor.

G. **CH1/CH2 output control** Output Button used to turn channel output on or off,Signal output from BNC port.

H. **Channel switch key** Used to switch CH1 or CH2 to the currently selected channel.

I. **Mode/Auxiliary function keys** Function menu shortcut key, can quickly enter the modulation/scanning/pulse train function menu, parameter settings, file manager, and view system information.

J. **Waveform selection** Used to select output waveform.

K. **Trig/Sync IN/Out** Input/output port of trigger signal and input/output port of synchronization signal.

6.2 Rear panel

A. **10MHz IN** External 10MHz reference clock input port.

B. **10MHz Out** Internal 10MHz reference clock output port.

C. **MODULATION IN** Input port of external modulation signal.

D. **Counter IN** Frequency meter measured signal input port.

E. **LAN port** Used to connect the signal generator to the computer or the network where the computer is located for remote control.

F. **USB Device** Through this interface, a PC can be connected, and the signal generator can be controlled by the upper computer software EasyWaveX or user-defined programming.

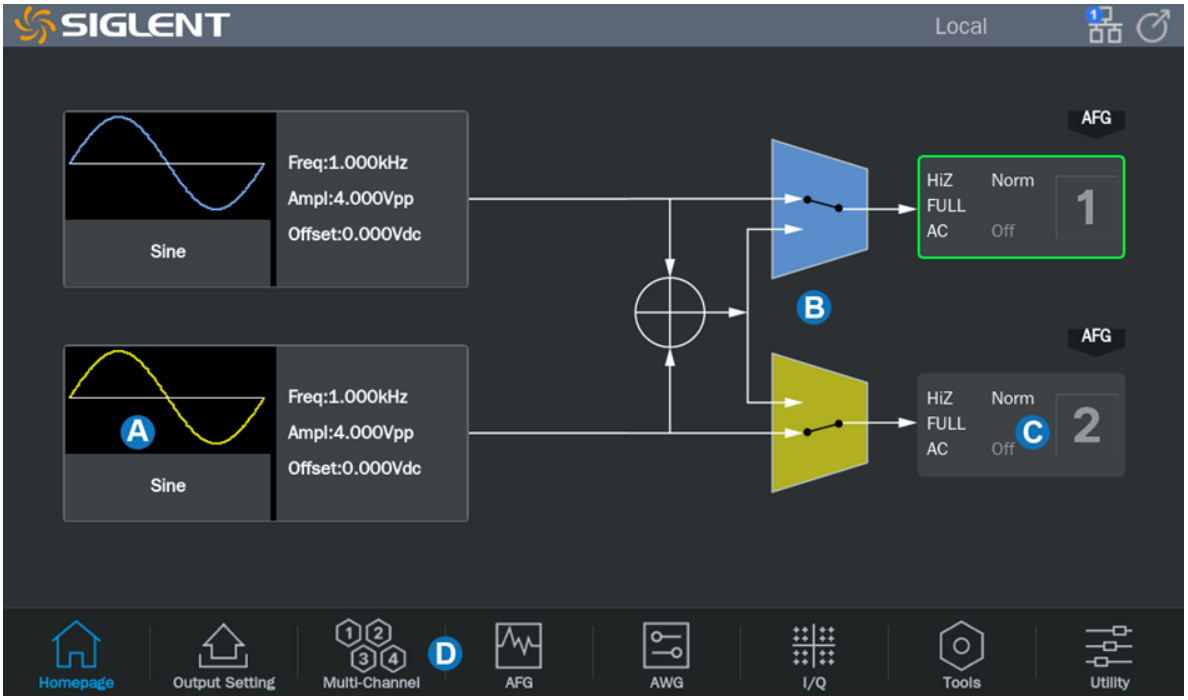
G. **USB Host** Used to connect USB storage devices, which can read the waveform or status file in the U disk or store the current instrument status in the U disk.

H. **AC power input** Power input port of signal generator.

7 Touch screen display area

The whole screen of this device is a touch screen. You can touch with your fingers or operate with your mouse. All display and control can be realized through the touch screen.

7.1 Home page



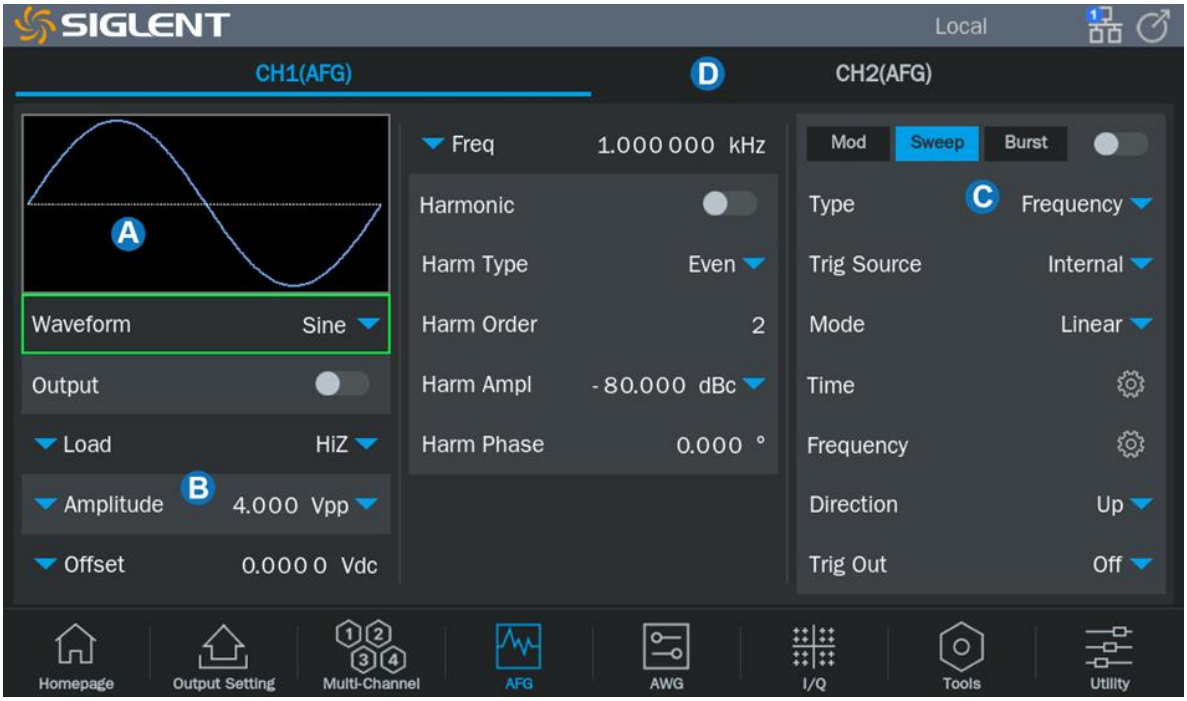
A. Carrier setting module

B. Dual-channel merging settings

C. Channel output setting module

D. Toolbar

7.2 Parameter setting page



A. Waveform preview

B. Parameter setting box

C. Mod/Sweep/Burst setting box

D. Channel selection bar

7.3 Gesture control

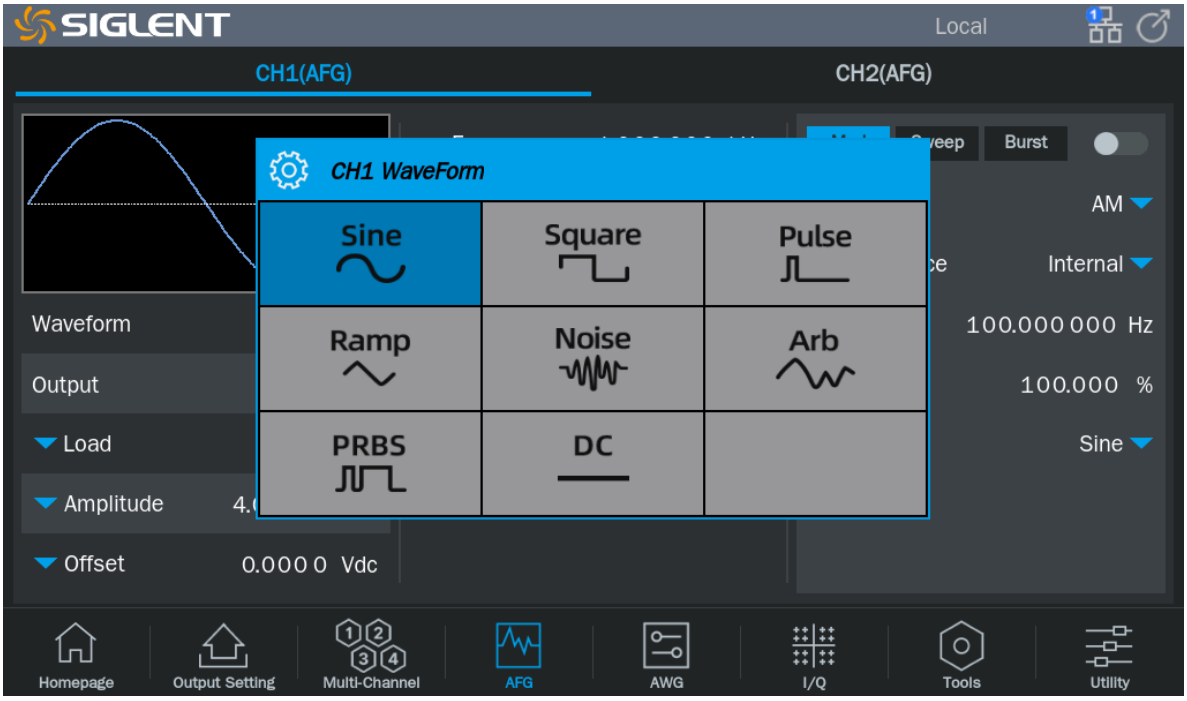
The touch screen of this device is a capacitive touch screen, which is mainly operated by touching/clicking.

7.4 Mouse operation

The operation of the touch screen display area is not limited to touching. If the device is connected with a mouse, you can also use the mouse to operate.

8 Front Panel Control

8.1 Shortcut waveform selection

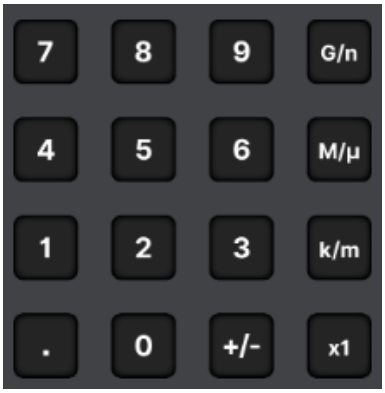


There are waveform selection menus under the *AFG* operation interface, including sine wave, square wave, triangular wave, pulse wave, Gaussian white noise, DC, arbitrary wave and PRBS.

8.2 Mod/Sweep/Burst settings

Press the Burst / Mod / Sweep button to quickly turn on/off the pulse train/modulation/sweep function and jump to the corresponding parameter settings page. When the function is turned on, the corresponding button light will light up.

8.3 Number keyboard and knob



Use the numeric keypad to directly input the numerical value and magnitude of the selected parameter. For example, to set the frequency to 1 MHz, press button [1] and [M/μ] in sequence.

In addition to using the numeric keypad to directly input parameter values, knobs can also be used to achieve continuous adjustment of parameters. Press the knob on the selected parameter box, and press the button below the knob [◄] And [►] Select the digit to be adjusted with the key, then turn the knob clockwise to increase the value, or counterclockwise to decrease the value.

8.4 Common function buttons

Use the [Output] button to turn on/off the signal output of the output interface on the front panel. Select the corresponding channel, press the [Output] button, the button light will be on, and at the same time, turn on the output switch to output a signal; Press the [Output] button again to turn off the output.

Press the [Home] button to quickly return to the home page.

Press the [Utility] button to quickly enter the system setting interface.

Press the [Save/Recall] button to quickly open the file management window.

Press the [Touch] button to turn on/off the touch screen function of the screen. The key light is lit, indicating that the touch screen function is turned on, and the key light is turned off, indicating that the touch screen function is turned off.

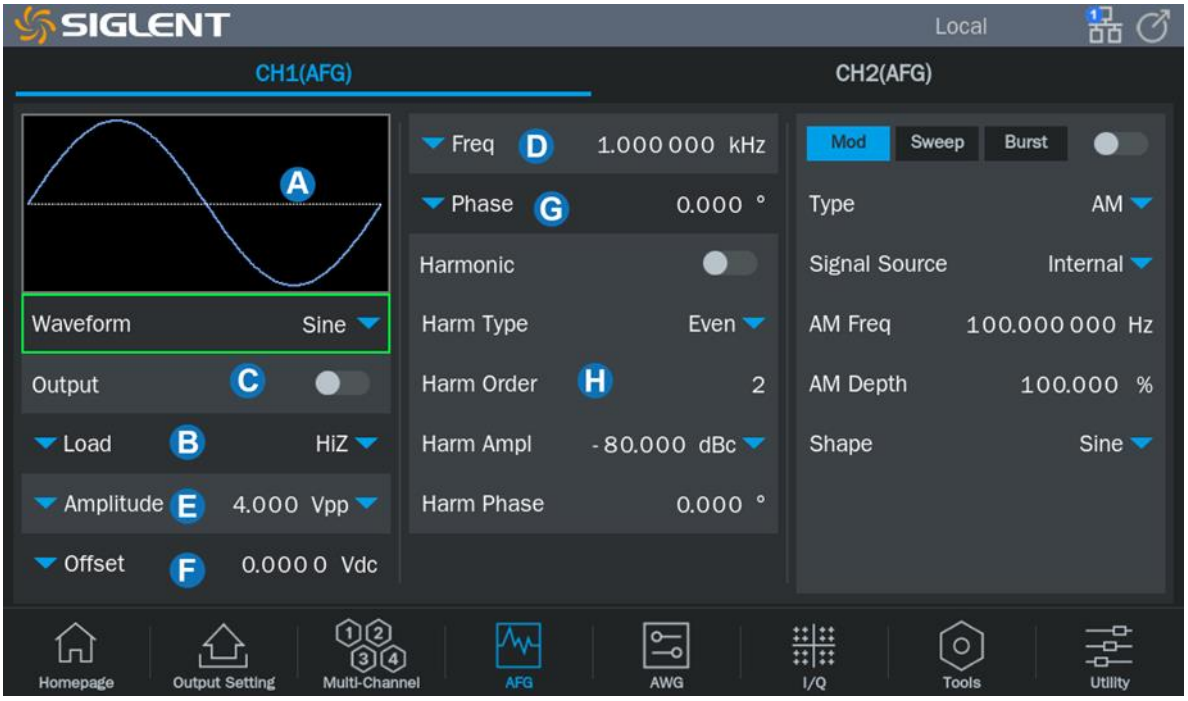
Press CH1/CH2 to quickly switch the parameter setting pages of two channels.

Pressing the Trigger button can be used to trigger when the waveform manually triggers the output.

9 Basic waveform settings

9.1 Standard waveform settings

This section applies to sine waves, square waves, pulses, triangular waves, and direct currents. Taking setting a sine wave as an example, the following will explain some basic parameters of the standard waveform.



A. Waveform preview image

B. Load parameter display

C. Output status display

D. Freq/Period parameter setting menu

E. Amplitude/High Level Parameter Setting Menu

F. Offset/Low Level Parameter Setting Menu

G. Phase/Delay Parameter Setting Menu

H. Harmonic parameter setting menu (only applicable to sine wave)

Load

To understand the setting of the load, it is first necessary to understand that due to the voltage division effect of the load and the internal resistance of the signal source (Figure 9.1), the voltage Vo observed by the user is a variable related to the load RL:

$$V_o = V_s \cdot \frac{R_L}{R_L + R_s}$$

Among them, Vs is the output voltage of the signal source before the internal resistance, and Rs is the internal resistance of the signal source. Due to the inability of the signal source to automatically recognize the size of RL, users need to inform the signal source of this value by inputting the "load" value, and then the signal source calculates the expected Vs based on the RL and Vo set by the user, so that under any load situation, the voltage value obtained by the user is consistent with the expected value.

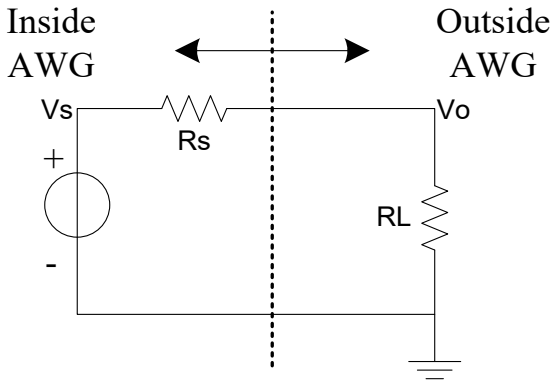


Figure 9.1

Waveform parameters

The parameters that can be set for each standard wave are different, as shown in the table below:

Table 9.1 Explanation of Standard Waveform Parameters

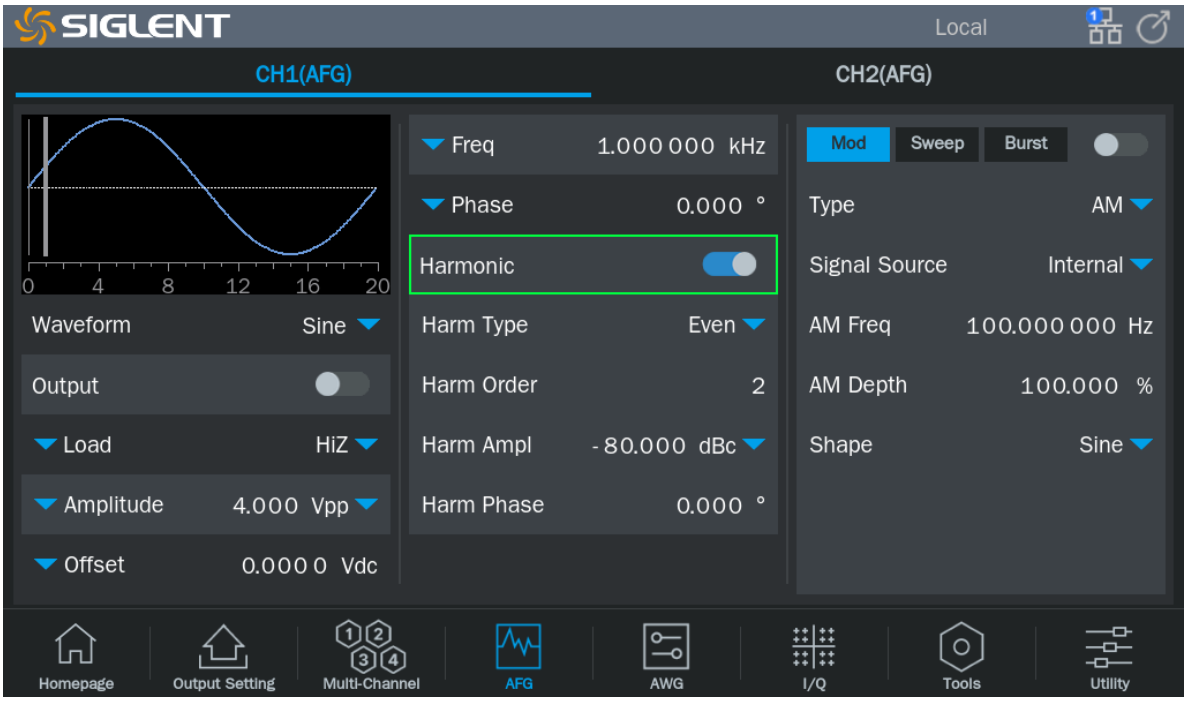
Sine	
Frequency/Period	The frequency/period of the signal. The unit of frequency is Hz, and the unit of period is s. The relationship between the two is: *Frequency = 1 / Period*
Amplitude/HighLevel Offset/LowLevel	The amplitude/offset of the signal is linked with the high level/low level. Amplitude value refers to the difference between the highest point (high level, unit V) and the lowest point (low level, unit V) of the signal. Supported units include Vpp, Vrms and dBm (available when the load is ≠HiZ). Offset refers to the DC component superimposed on the signal waveform, in V; The relationship between several parameters is:

	Amplitude value (Vpp) =HighLevel - LowLevel *Offset* =(HighLevel +LowLevel) */ 2*
Phase/Delay	The phase/delay of the signal is only meaningful when the dual channel phase mode is phase locked, used to set the phase relationship between two channels. The unit of phase is °, and the unit of delay is s. The relationship between the two is: *Delay = - (period x phase / 360 °)*
Square	
Frequency/Period	Same as sine wave.
Amplitude/HighLevel Offset/LowLevel	Same as sine wave.
Phase/Delay	Same as sine wave.
DutyCycle	The ratio of the positive pulse width to the period of a square wave, in %
Pulse	
Frequency/Period	Same as sine wave.
Amplitude/HighLevel Offset/LowLevel	Same as sine wave.
Width/DutyCycle	Pulse width refers to the positive pulse width of a pulse, measured in seconds; Duty cycle refers to the ratio of positive pulse width to cycle, measured in %. The relationship between the two is: *Pulse width = period x duty cycle*
Rise/Fall	The rising edge refers to a rising time of 10% to 90%, and the falling edge refers to a falling time of 90% to 10%, both of which are measured in seconds. The rising and falling edges are independent of each other and can be set separately
Delay	Same as sine wave.
Ramp	
Frequency/Period	Same as sine wave.
Amplitude/HighLevel Offset/LowLevel	Same as sine wave.
Phase/Delay	Same as sine wave.
Symmetry	The ratio of the time and period during which a triangular wave is rising, the unit is%
DC	
Offset	Same as sine wave.

9.2 Harmonic settings

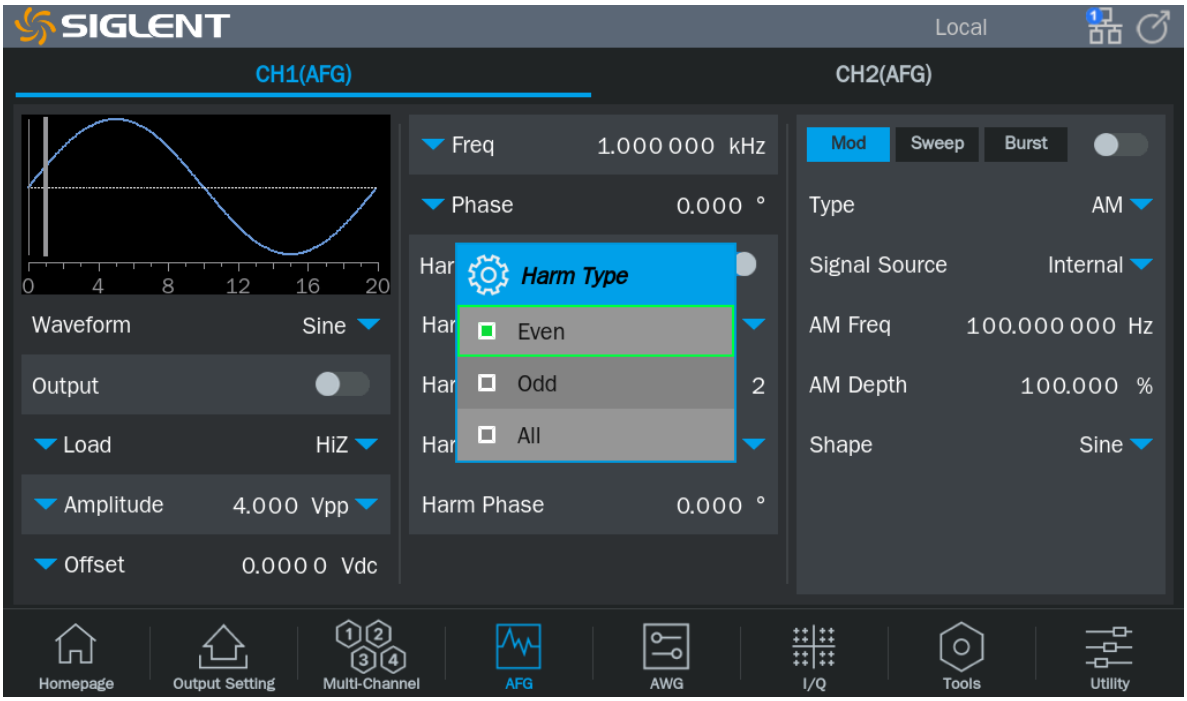
Harmonics are a sub function of the sine wave generation function, Can output harmonics with specified number, amplitude, and phase, Used to simulate sine waves with poor linearity.

Under the parameter setting page of carrier = sine wave, turn on the harmonic switch to set the harmonic parameters.



Set harmonic type

Click on the parameter value area of the harmonic type in the "Harm Type" parameter setting box, and select the harmonic type in the pop-up parameter selection dialog box. If only odd harmonics are set, select "Odd"; If only even harmonics are set, select "Even "; If both odd and even harmonics need to be set, select "All".



Set harmonic order

Click the "Harm Order" parameter setting menu, and then type the harmonic order to be set through the numeric keypad or through the knob. If type = odd, only odd values can be entered; If Type = Even, only even values can be entered; If Type = All, you can type any integer in the range of 2~ the maximum harmonic number.

Set harmonic amplitude

Click the "Harm Ampl" setting menu, set the required amplitude through the numeric keypad or knob, and then select the unit as "Vpp" or "dBc". The unit "Vpp" is suitable for setting the absolute amplitude of harmonics, and the unit "dBc" is suitable for setting the relative amplitude of harmonics relative to the fundamental frequency signal.The relative minimum amplitude of harmonics is -80 dBc. If it is less than -80 dBc, it means no harmonics.

Set harmonic phase

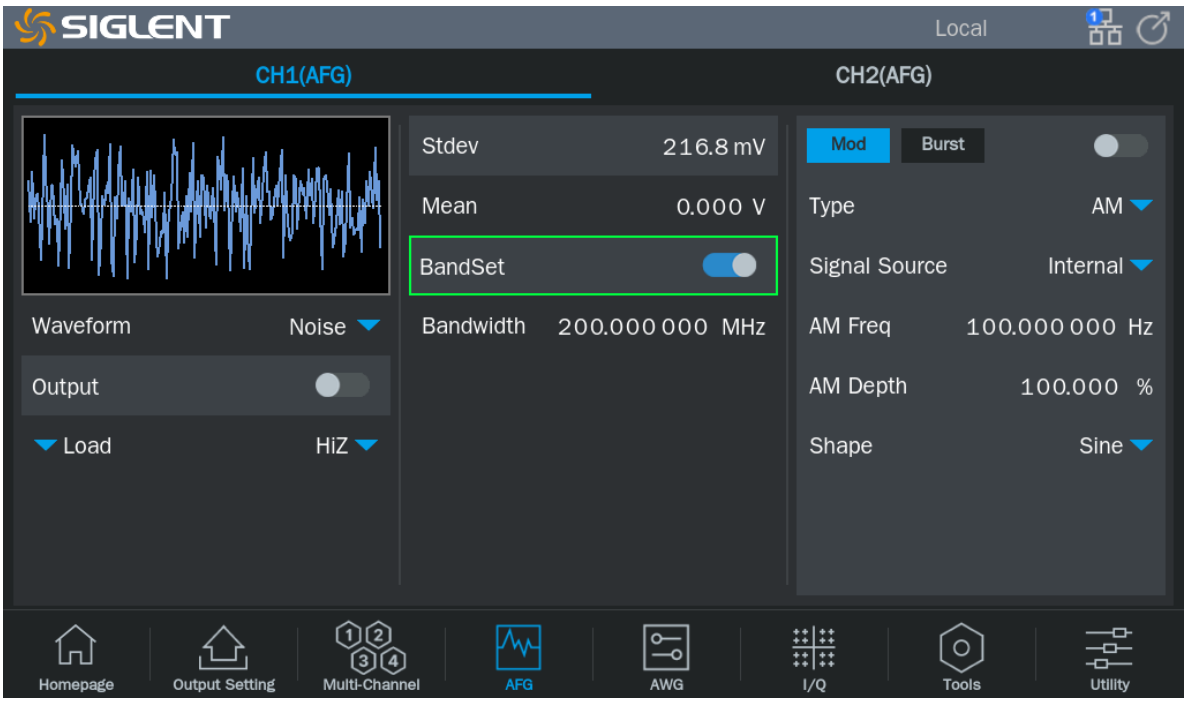
Click on the "Harm Phase" setting menu, then type the desired value through the knob or numeric keypad. The unit of phase is °.

Enable harmonic function

After all harmonic parameters are set, the time domain waveform can be previewed through the waveform preview diagram, and the set harmonics and their approximate amplitudes can be browsed through the harmonic schematic diagram. After confirmation, turn on the output of the channel to output the harmonic waveform.

9.3 Noise settings

The noise generation function can provide Gaussian noise with adjustable bandwidth.



Set waveform parameters

The waveform parameters of noise include "stdev" and "mean". Due to the noise following a Gaussian distribution (normal distribution), using mean (m) and standard deviation （σ） It can characterize its distribution characteristics. The setting method refers to the waveform parameter settings of sine waves.

Table 9.2 Explanation of Noise Waveform Parameters

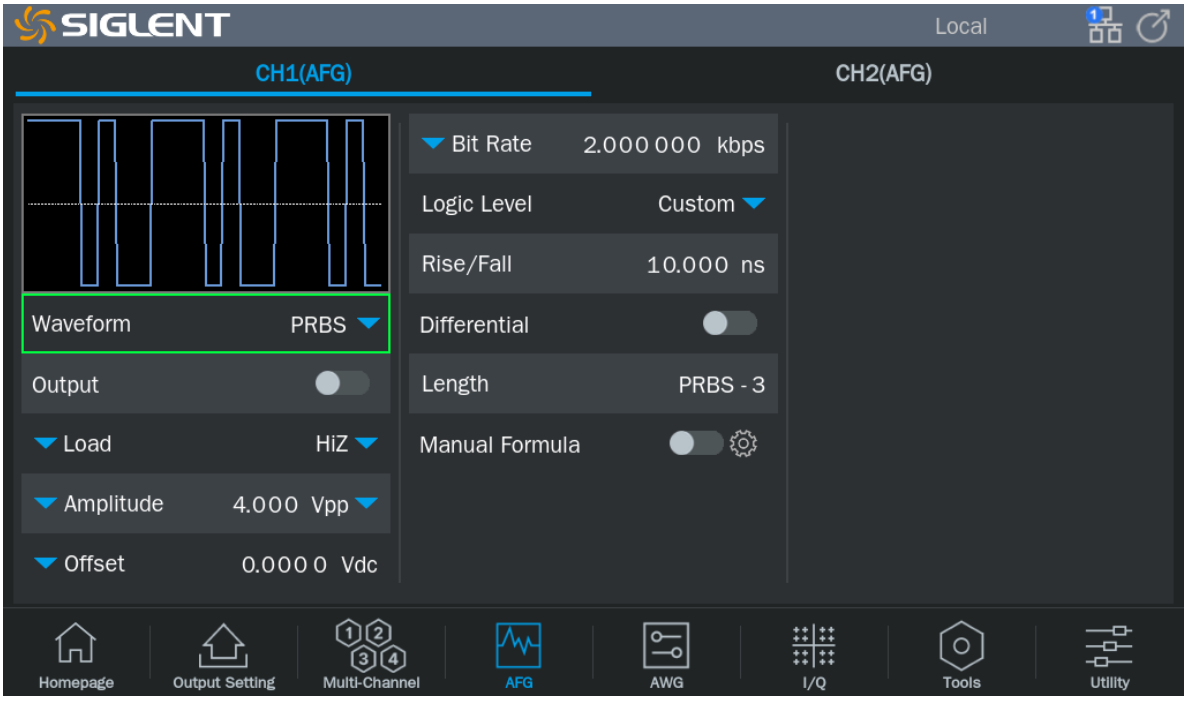
Noise	
Stdev	Standard deviation of noise sequence.
Mean	Mean value of noise sequence (mathematical expectation).

Set bandwidth

To set the bandwidth for noise, first click on the switch area in the bandwidth switch settings box, open the bandwidth settings, and then type in the desired value and unit.

9.4 PRBS settings

The PRBS generation function can generate a maximum bit rate of 120 Mbps, along with a configurable pseudo-random sequence.



Set waveform parameters

The waveform parameters of PRBS are shown in the table below. The setting method refers to the waveform parameter settings of sine waves.

Table 9.3 Description of PRBS waveform parameters

PRBS	
BitRate/Period	The bit rate/period of PRBS sequence, with the unit of bit rate being bps and the unit of period being s. The relationship between the two is: *Bit rate= 1 / Period*
Amplitude/HighLevel Offset/LowLevel	Same as sine wave.
Logic Level	Used to quickly set the amplitude to some standard levels. See Table 9.4 for details.
Length	PRBS-3~32 can be set, corresponding to lengths (2^3-1) ~ $(2^{32}-1)$.
Rise/Fall	Refers to a rise time of 10% to 90% and a decrease time of 90% to 10%, in seconds. Setting both rising and falling edges simultaneously.

Table 9.4 Logic Levels Supported by PRBS

Logic level	Amplitude（Vpp）	Offset（V）
TTL/CMOS	5.00	2.50
LVTTL/LVCMOS	3.30	1.65
ECL	0.80	-1.30
LVPECL	0.80	2.00
LVDS	0.35	1.25

The preset logic levels in the table are only valid when the output mode is single ended.

Manual Formula

The generation of PRBS depends on specific polynomials, These polynomials define how the linear feedback shift register (LFSR) operates. Commonly used PRBS polynomials are:

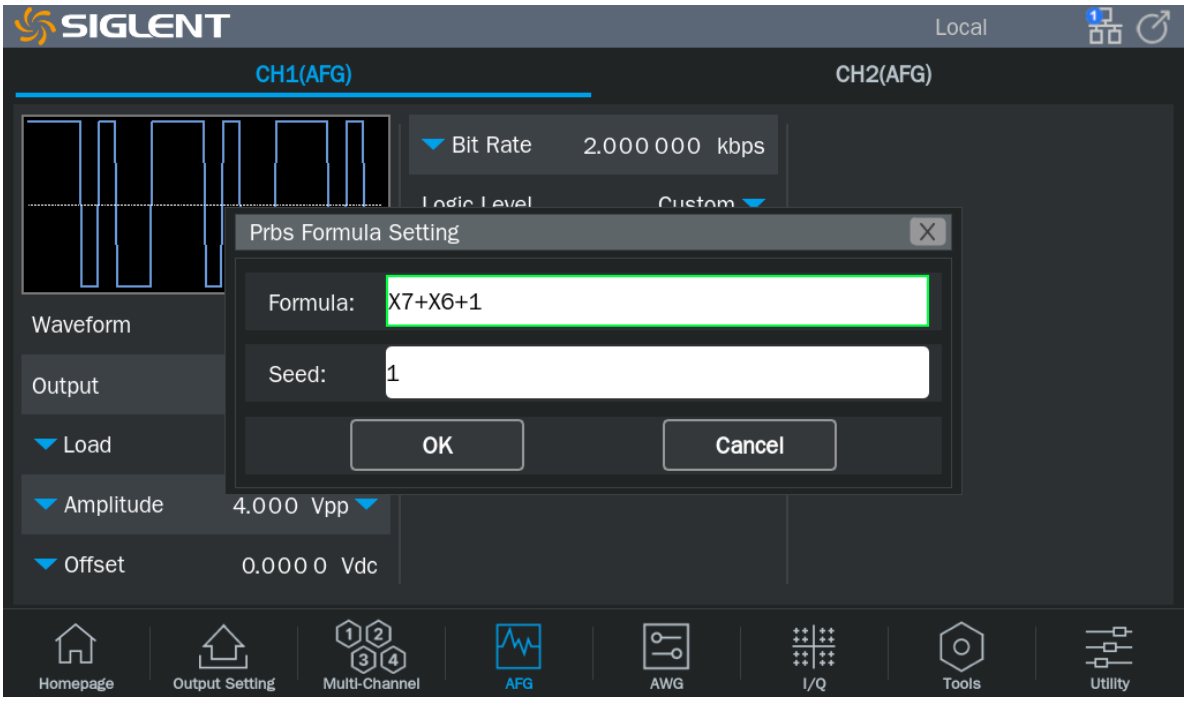
PRBS7 (x^7 + x^6 + 1): The example formula is x^7 + x^6 + 1,The corresponding LFSR has 7 bits,Feedback comes from No.7 and No.6.

PRBS15 (x^15 + x^14 + 1): The example formula is x^15 + x^14 + 1,The corresponding LFSR has 15 bits,Feedback comes from No.15 and No.14.

PRBS23 (x^23 + x^18 + 1): The example formula is x^23 + x^18 + 1,The corresponding LFSR has 23 bits,Feedback comes from No.23 and No.18.

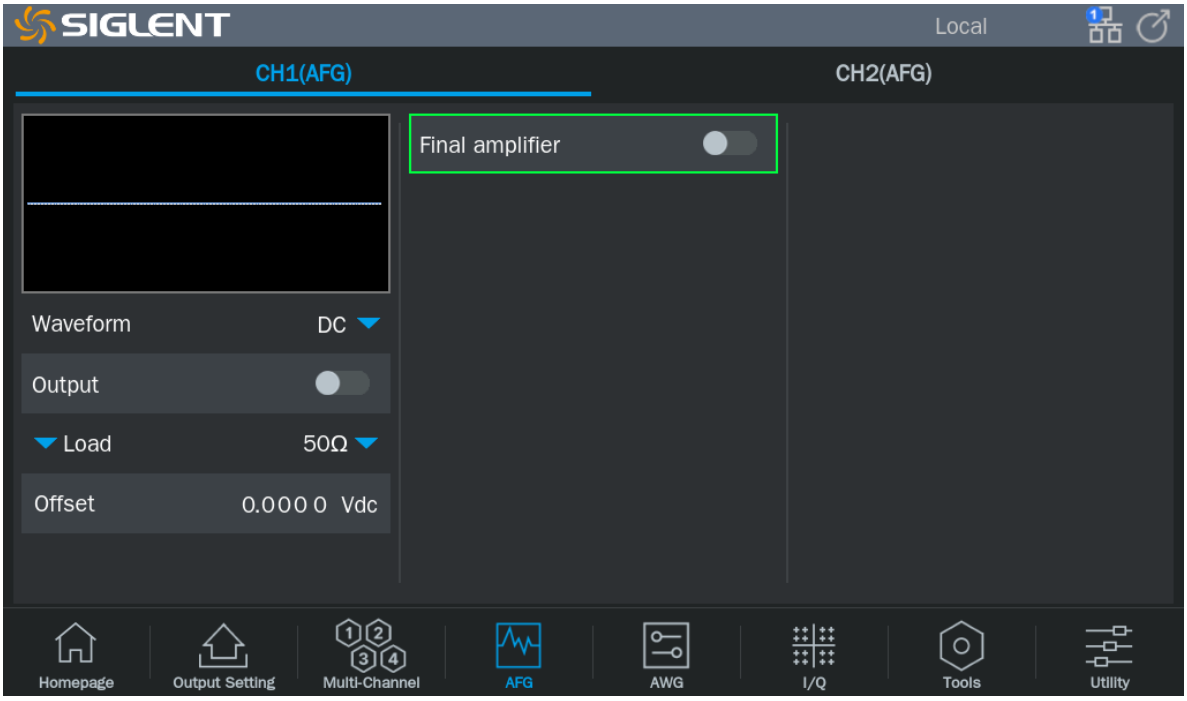
PRBS31 (x^31 + x^28 + 1): The example formula is x^31 + x^28 + 1,The corresponding LFSR has 31 bits,Feedback comes from No.31 and No.28.

Taking PRBS7 as an example, The polynomial X7+X6+1 can be input via the keyboard to customize the polynomial output:

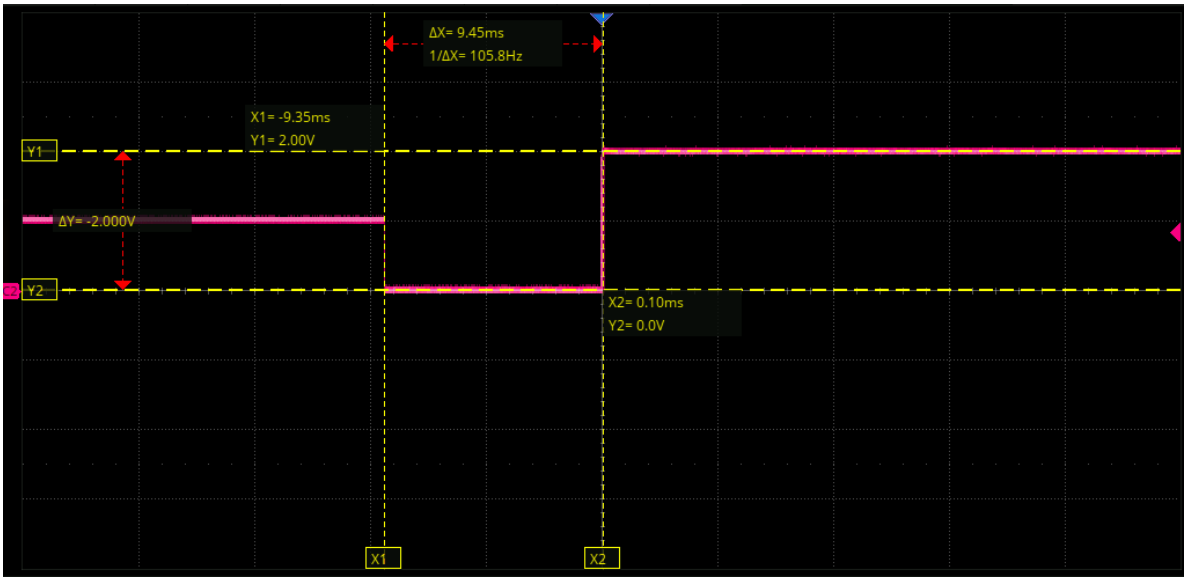

SIGLENT
Local
CH1(AFG)
CH2(AFG)
Bit Rate
2.000 000 kbps
Logic Level
Custom
Prbs Formula Setting
Formula:
X7+X6+1
Seed:
1
OK
Cancel
Waveform
Output
Load
Amplitude
4.000 Vpp
Offset
0.000 0 Vdc
Homepage
Output Setting
Multi-Channel
AFG
AWG
I/Q
Tools
Utility

9.5 DC final amplifier

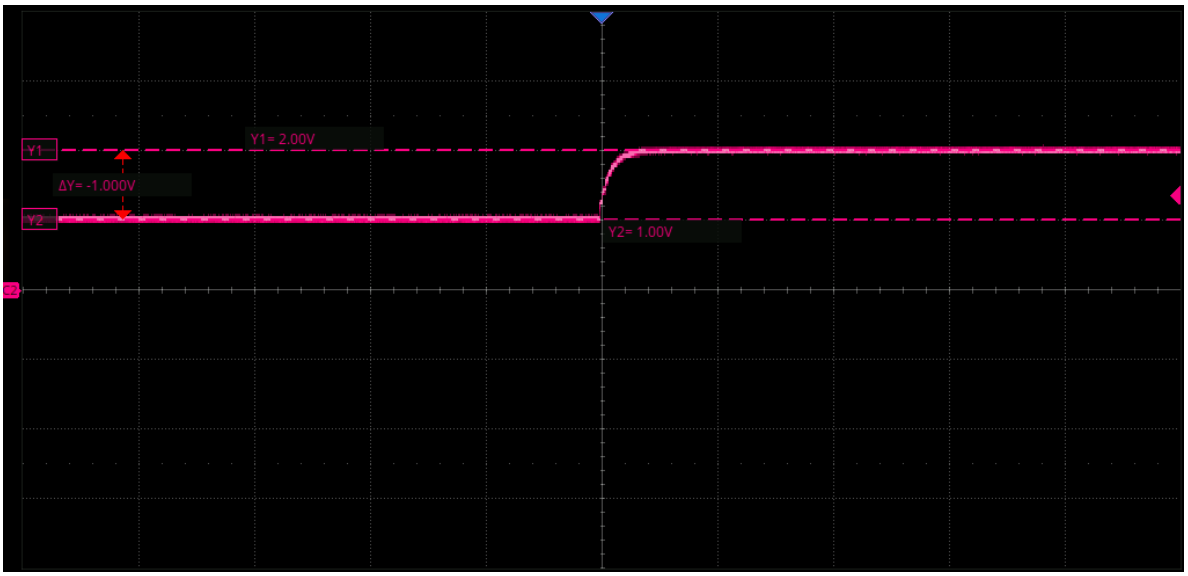
DC provides the final amplifier function, users can turn the final amplifier on or off as needed. When the final amplifier is turned on, the DC accuracy of the output in small gears will be reduced.



When the final amplifier is turned off, switching the DC level will first drop from the previous level to 0Vdc. Then it is pulled up to the next set level, and there will be a period of zero level in the middle. The figure below shows the DC signal measured by an oscilloscope. The signal source is set to 50Ω load, set the offset to switch from 1Vdc level to 2Vdc level, It is measured that there is a zero-level transition in the middle:



When the final amplifier is turned on, switching the DC gear will directly increase the level from the previous level to the next level without dropping to 0Vdc; The figure below shows the DC signal measured by an oscilloscope. Set the signal source to a 50Ω load, and set the offset to switch from the 1Vdc level to the 2Vdc level. The intermediate level will rise directly from 1Vdc to 2Vdc, and the transition level will not drop:



9.6 Arbitrary Waveform settings

9.6.1 AFG mode

In AFG mode, the signal generator outputs the specified arbitrary waveform in the traditional DDS method. The basic waveform parameter settings at this time are the same as the sine wave. Please refer to the "Standard Waveform Settings" section.

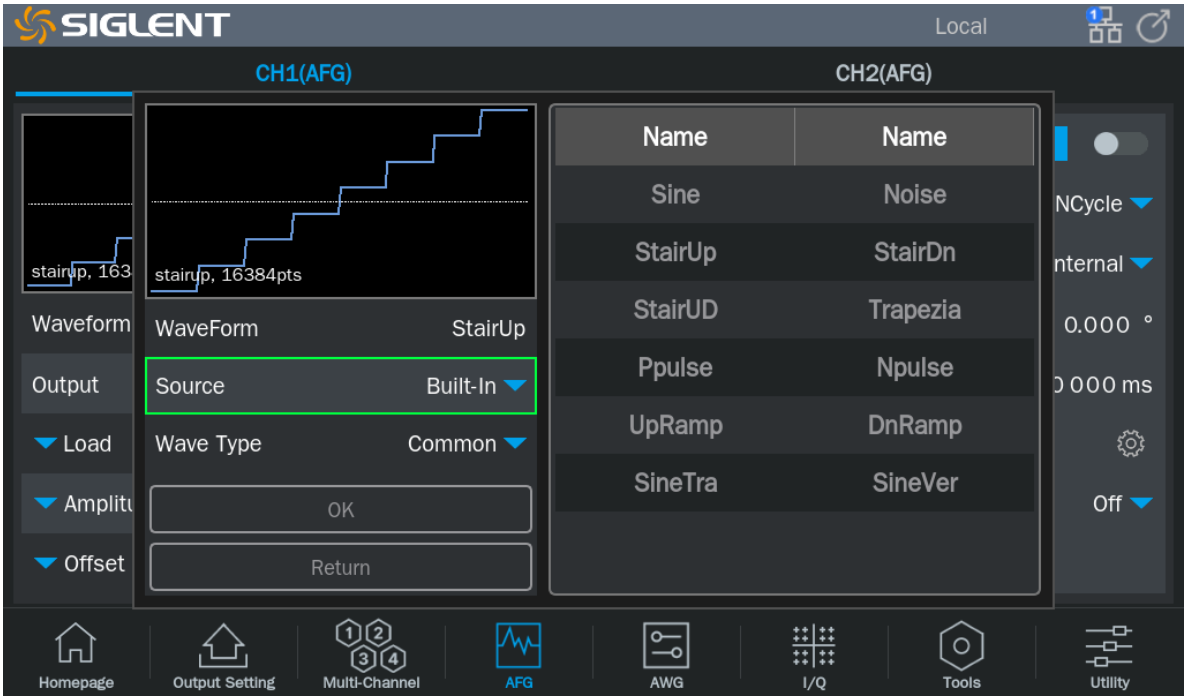
For the selection and editing of data sources for any wave, refer to the "Data Sources" section.

9.6.2 Data source

Click the "Data source" parameter setting menu to enter the data source selection interface. Data sources include Built-In, From File.

Built-In

Built-In waveforms are pre configured waveforms within a signal generator, which can be divided into several types: common, math, engineering, window, trigo, square, medical, mod, filter, and demo. There are multiple waveforms available for selection under each type.



From File

The From File is a waveform file saved by the user in a local directory, external USB drive, or sent to the device through the upper computer software (EasyWaveX) and saved locally. When selecting the

data source as "From File", the file manager window will be automatically called. Select the waveform file that needs to be called in this window, and then click "Recall" to proceed.

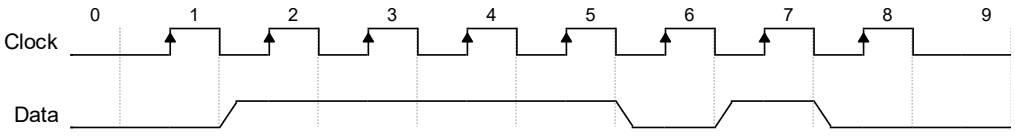
For the operation method of the file management window, please refer to the "Store/Recall" chapter.

EasyWaveX

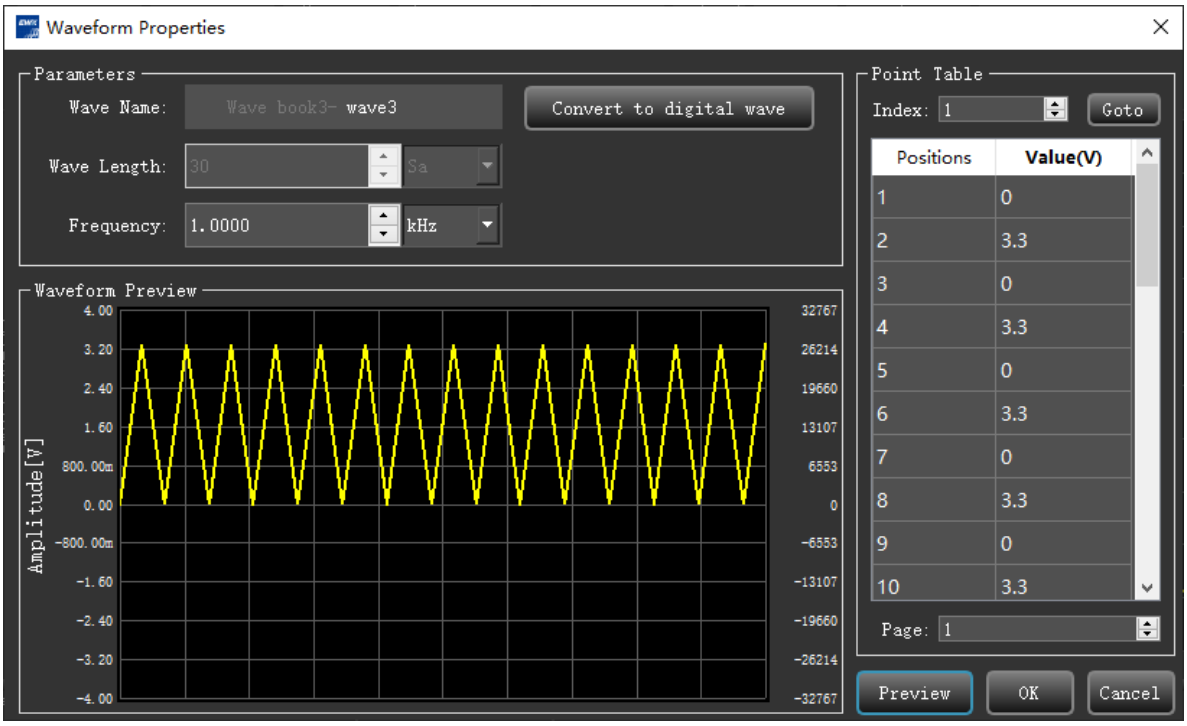
EasyWaveX, an arbitrary wave editing software, provides 12 standard waveforms including Sine, Square, Ramp, Pulse, Noise, and DC, which can meet the most basic needs; At the same time, it also provides users with manual drawing, line drawing (including horizontal lines, vertical lines, and two-point lines), coordinate drawing (coordinates can be entered through the mouse or table, and there are two ways to connect and smooth), and equation drawing, making creating complex waveforms light and easy.

Regarding the use of EasyWaveX, please refer to the software's user manual.

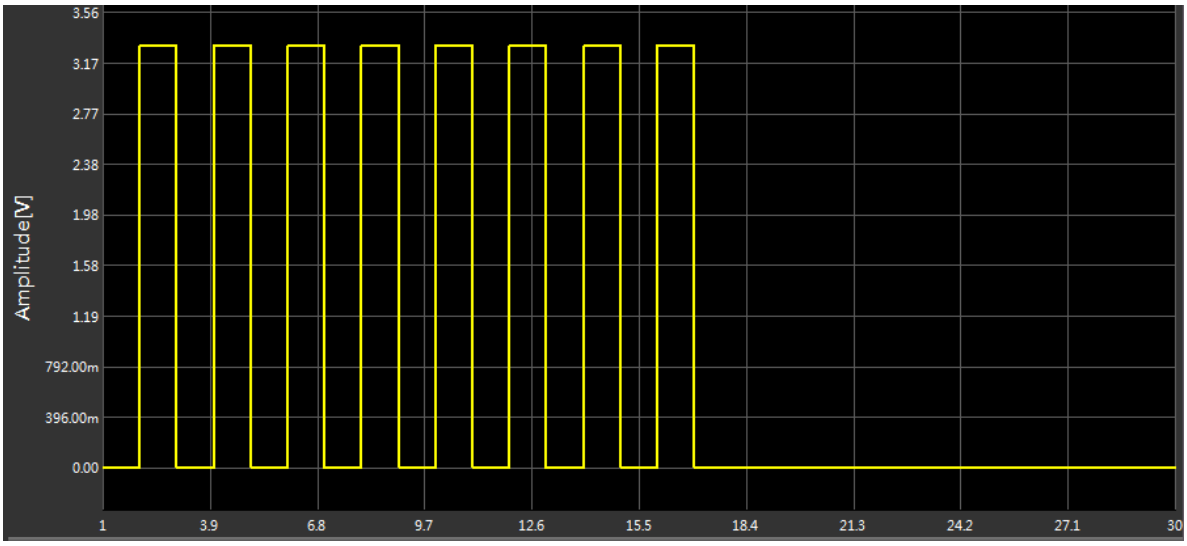
Application example: Using the upper computer software EasyWaveX to generate digital clock and data waveforms that simulate the following timing relationships, and downloading them to the CH1 and CH2 outputs of any waveform generator, with adjustable rates.



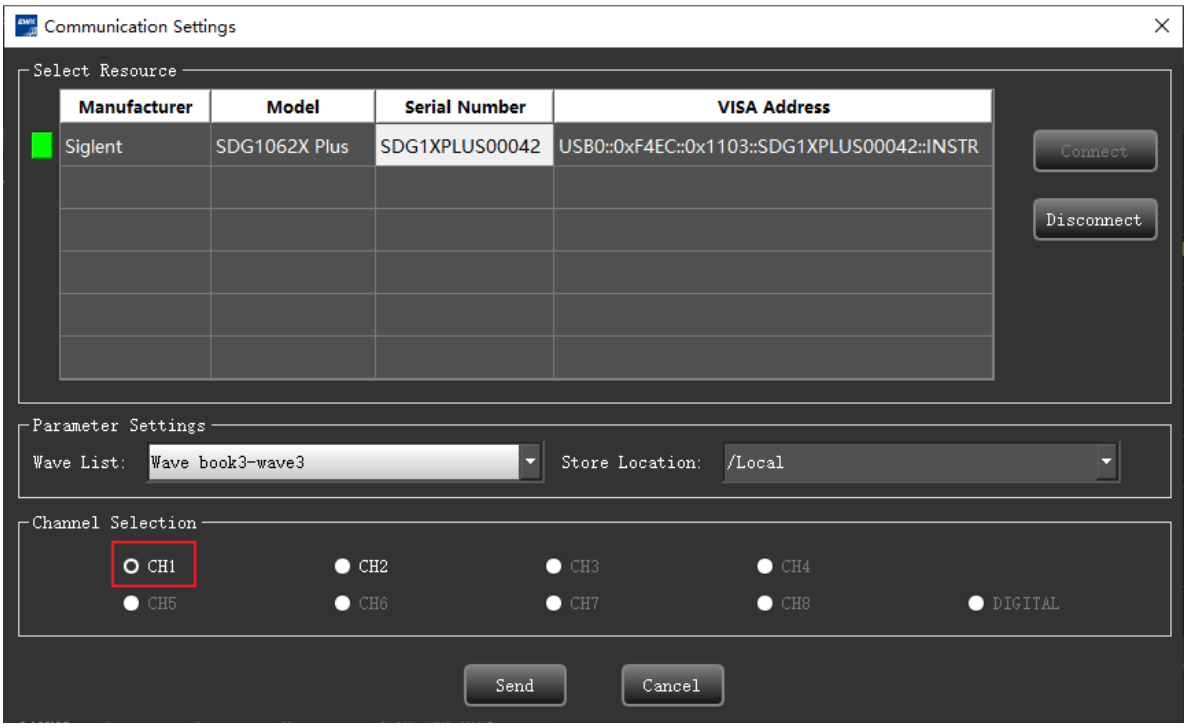
1. Connect devices and computers with EasyWaveX upper computer software installed via USB or LAN.
2. Open EasyWaveX and create any wave at 30 points.
3. In the "Properties" section of the toolbar, select "Waveform Properties" , Input the voltage levels of each point in the "Draw Point Table" point by point according to the clock's "0" and "1" jump pattern, as shown in the following figure:



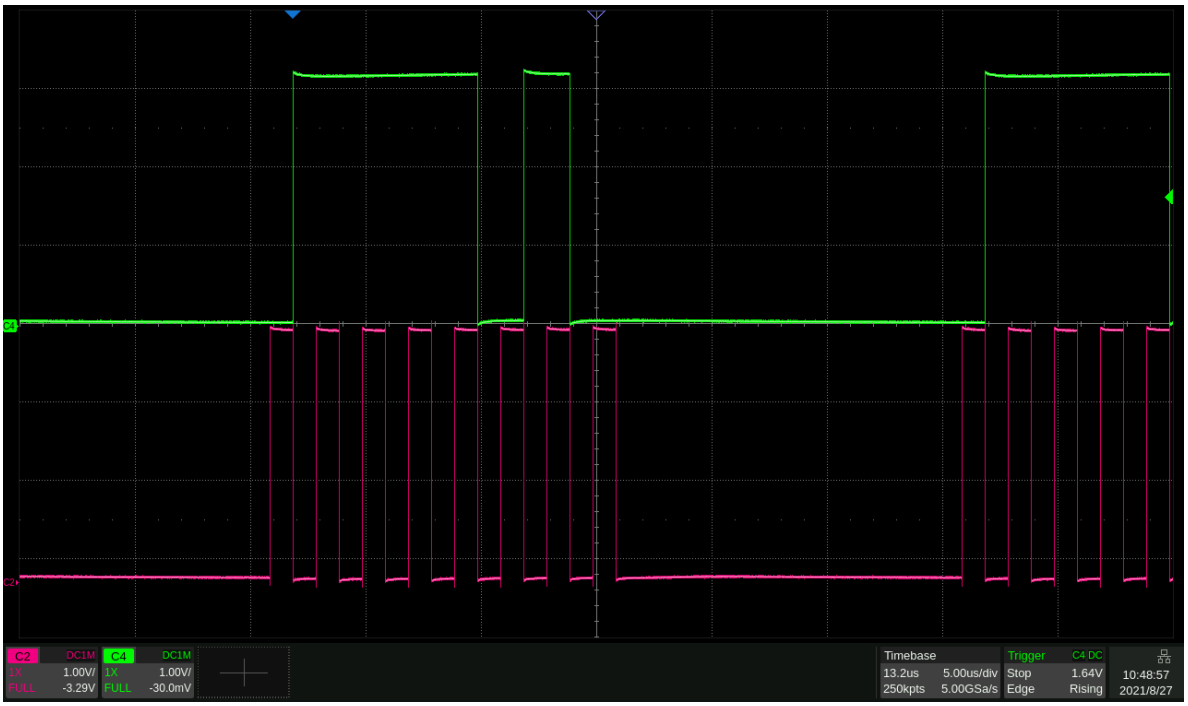
4. After entering, view the waveform in the waveform preview window of the main program. In the "Properties" area of the toolbar, select "View Properties"  , Change the "interpolation method" to "zero order preservation" to obtain the correct waveform preview of the digital clock:



5. Execute *communication* > *Send waveform to signal source* , select the device to perform waveform output in the pop-up dialog box, click *connect* , and select the download target channel as CH1:



6. Generate data files using the same method and download them to the device's CH2.
7. Set the "interpolation method" of two channels to "0-order hold" on the device.
8. Set the amplitude and rate of clock and data output on the device as needed. For example, to set the clock frequency to 1 MHz, set the sampling rate of the clock channel to 2 MSA/s. Due to the synchronization of clock and data, CH1 and CH2 can be set to frequency coupling with a ratio of 1, In this way, you only need to set the speed of one channel, and the speed of the other channel can be updated synchronously. The final clock and data signals output by the device are as follows:



	The waveform generated by EasyWaveX can be saved as a CSV file for further editing. After the editing is completed, it can be imported into EasyWaveX and distributed to the device through EasyWaveX. CSV files can also be stored on a USB drive, and the device can directly call them from the USB drive.

10 AWG settings

In AWG mode, the signal generator uses TrueArb technology (Figure 10.1). Outputs the specified waveform sequence point by point at the specified sampling rate. TrueArb overcomes the serious shortcomings of traditional DDS technology that may increase jitter and distortion when generating arbitrary waves. At the same time, it retains its advantages of low cost, simplicity and flexibility.

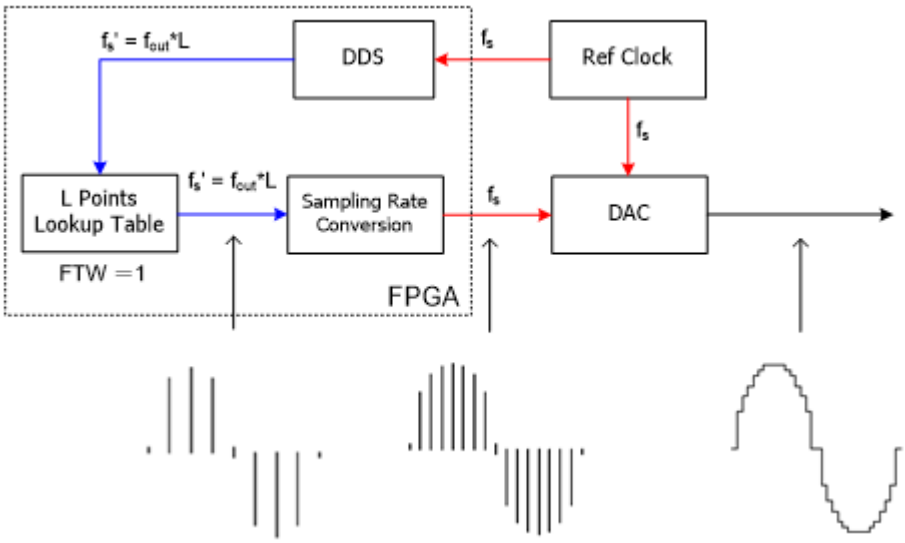
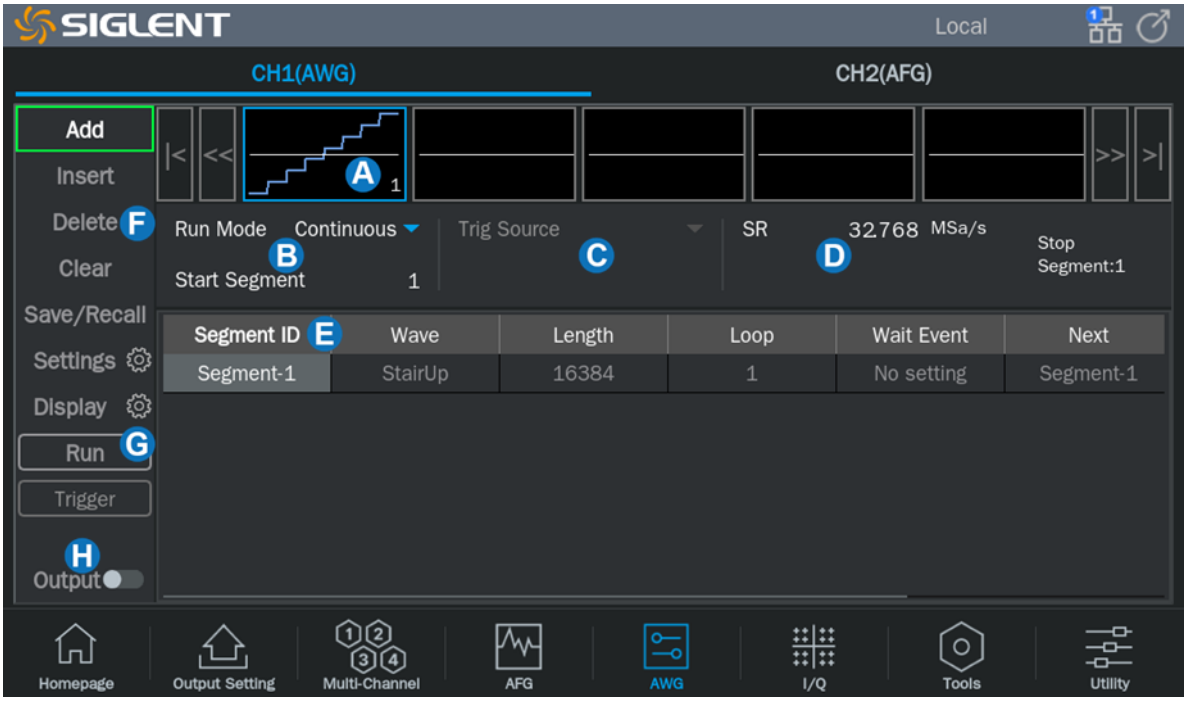


Figure 10.1 TrueArb Technology Schematic Block Diagram



A. Waveform preview image

B. Run mode setting box

C. Trig Source setting box

D. Sample rate setting

E. Segment Parameter Setting

F. Segment operation setting box and AWG parameter setting box

G. AWG wave operation switch

H. AWG wave output switch

10.1 Waveform parameter settings

The waveform parameter setting method of AWG refers to the waveform parameter setting of sine wave.

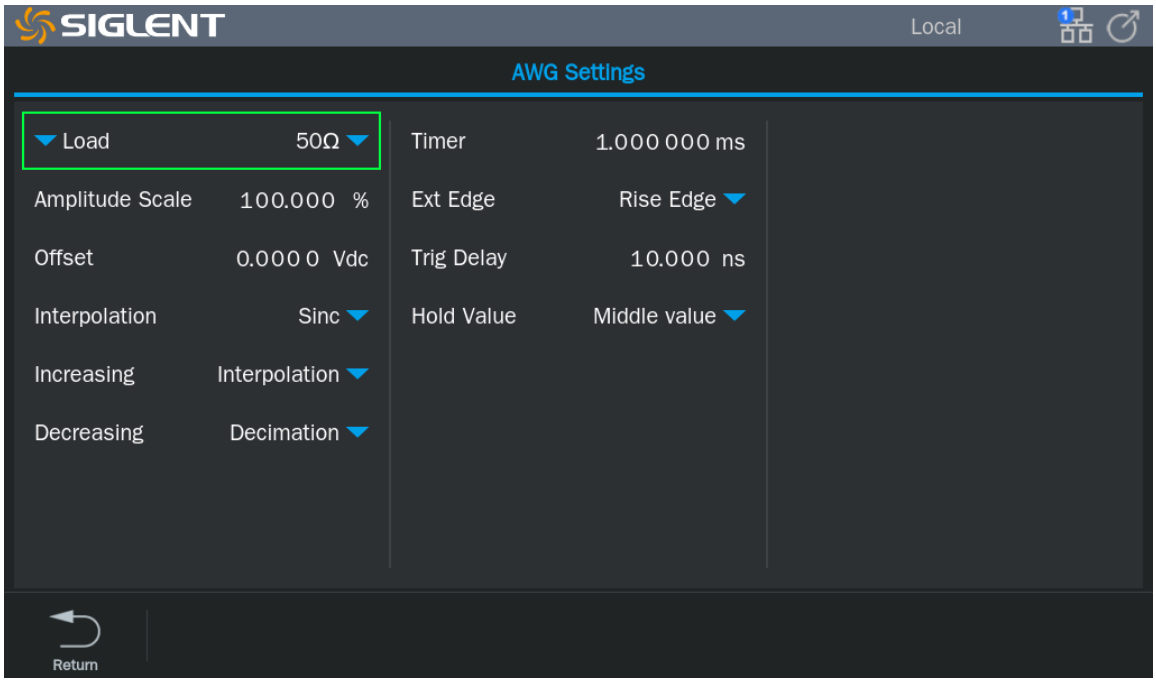


Table 10.1 AWG waveform parameter description

AWG Settings	Description
Load	AWG output load can be selected from 50 Ω, Hiz and custom.
SR	The sampling rate unit is Sa/s,the setting range is 10mSa/s ~ 600MSa/s.
Amplitude Scale	Setting the amplitude scale can output the Segment amplitude according to the set ratio, the unit is %.

Offset	Offset is the DC component superimposed on the AWG waveform, the unit is V.
Interpolation	Waveform interpolation type, see Table 10-2 for details.
Increasing	Waveform Increasing type, see Table 10-3 for details.
Decreasing	Waveform Decreasing type, see Table 10-4 for details.
Timer	This parameter is used to set the interval time of AWG wave output.
Ext Edge	Set when external triggering, including Rise edge, Fall edge, Both.
Trig Delay	This parameter is used to set the delay time of the trigger signal. The minimum value of the trigger delay represents the minimum delay that can be achieved on the hardware.
Hold Value	The output level after the AWG waveform output ends.

Table 10.2 Interpolation types supported by AWG

Interpolation	**Description**
0-order hold	Zero order hold.
Linear	Linear interpolation.
Sinc	Sinc/x interpolation.
Sinc13	Sinx/x interpolation combined with low-pass filtering, bandwidth = 0.13x sample rate.
Sinc27	Sinx/x interpolation combined with low-pass filtering, bandwidth = 0.27x sample rate.

Table 10.3 Interpolation methods supported by AWG

Increasing	**Description**
Interpolation	Increase the segment length,the output waveform will linearly add increasing length to a cycle.
Zero	Increase the segment length,the output waveform will output the original length of the waveform in one cycle,then output a period of 0 level,the length of the 0 level is equal to the increased Segment length.
Hold Last	Increase the segment length, the output waveform will output the original length of the waveform in one cycle,then output a termination level,the length of the termination level is equal to the increased Segment length.
Duplication	Increase the segment length, the output waveform will output the original length of the waveform in one cycle,then output the waveform,this waveform starts to be output according to one cycle,the length is equal to the increased Segment length.

Table 10.4 Decreasing methods supported by AWG

Decreasing	Description
Decimation	Decreasing the segment length,the output waveform will linearly reduce the corresponding length in one cycle.
Cut Tail	Decreasing the segment length,the output waveform will decrease in length starting from the tail in one cycle.
Cut Head	Decreasing the segment length,the output waveform will decrease in length from the head in one cycle.

10.2 Segment settings

AWG can set multi-segment waveform output through Add, Insert, Delete and Clear in the left menu bar.

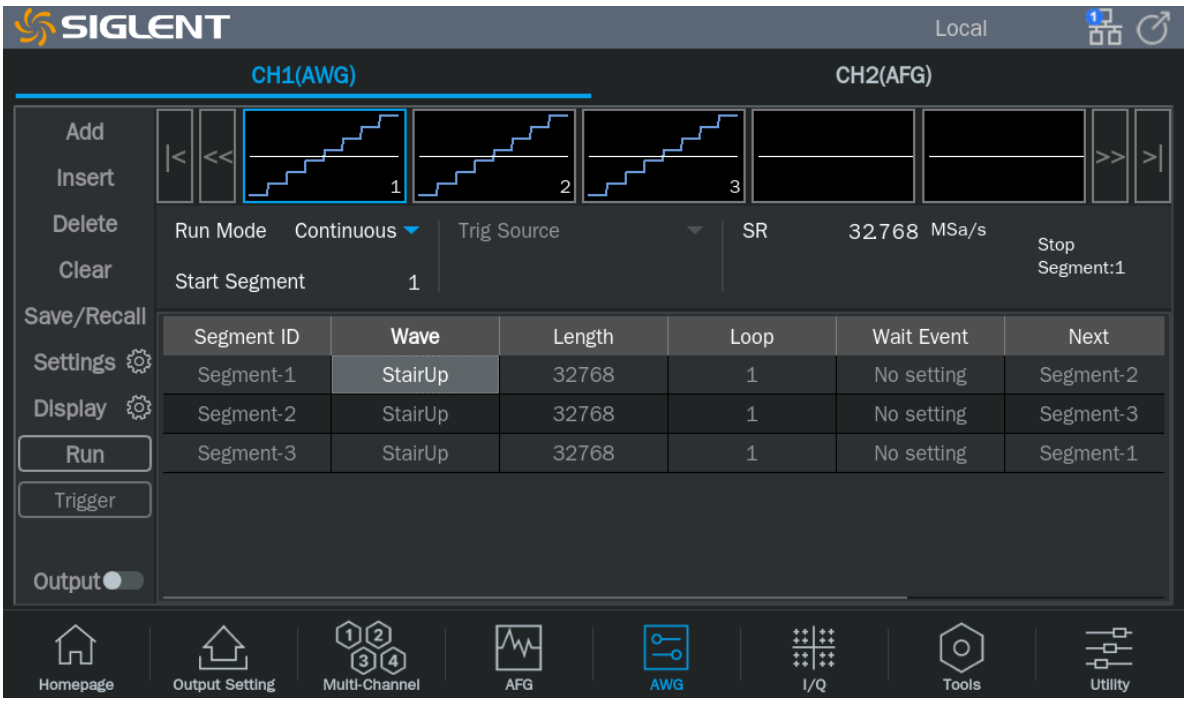


Table 10.5 Segment settings

Segment setting	Description
Add	Add a new waveform after the last Segment.
Insert	Insert a waveform in front the currently selected Segment.
Delete	Delete the currently selected Segment.
Clear	Clear all Segments,only keep a default Segment-1.

10.2.1 Segment Display Items Settings

Segment display item settings can display the parameters that need to be displayed in the Segment serial number,it is convenient for users to modify segment parameters.

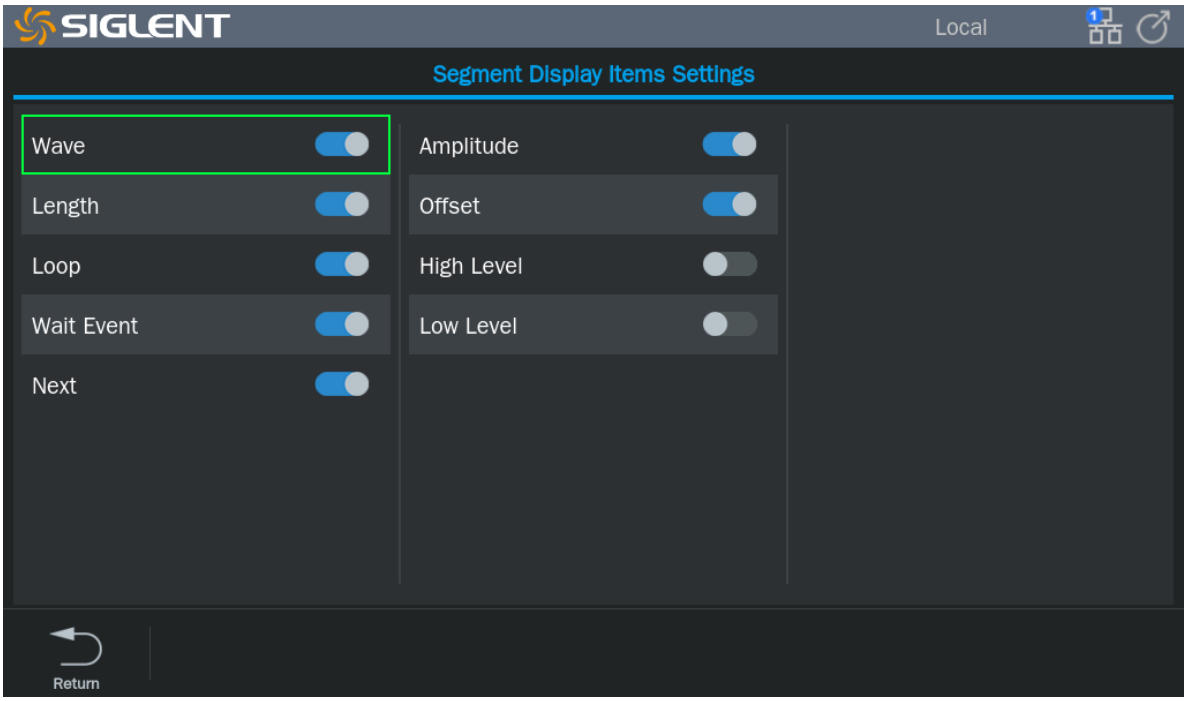


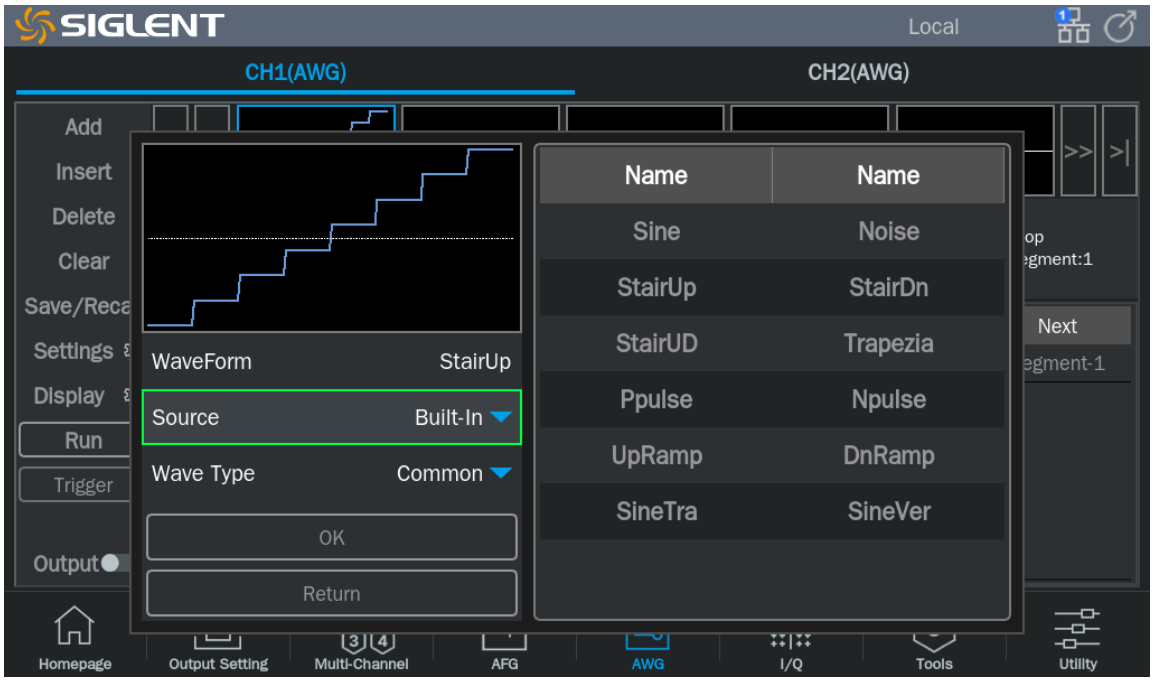
Table 10.6 Segment display item settings

Display Items	Description
Wave	Display the waveform name in Segment,click this item to select the waveform data source,displayed by default.
Length	Represents the length of the Segment,users can modify the output waveform length according to their needs,displayed by default.
Loop	Indicates the number of times the current Segment is continuously output in a cycle,displayed by default.
Wait Event	Indicates that the current Segment needs to wait for certain trigger conditions before it can be output,valid when the run mode is advanced,displayed by default.
Next	Used to set the next waveform to be output after the current Segment is played,displayed by default.
Amplitude	Used to set the amplitude of the current Segment output waveform,displayed by default.
Offset	Used to set the offset of the current Segment segment output waveform,displayed by default.
High Level	Used to set the high level of the current Segment segment output waveform,not shown by default.

Low Level	Used to set the low level of the current Segment segment output waveform,not shown by default.

10.2.2 Data source

Click on the waveform preview or waveform name to enter the data source selection interface. Data sources include built-in waveforms and from file waveforms.



Built-In

Built-In waveforms are pre configured waveforms within a signal generator, which can be divided into several types: common, math, engineering, window, trigo, square, medical, mod, filter, and demo. There are multiple waveforms available for selection under each type.

From File

The From File is a waveform file saved by the user in a local directory, external USB drive, or sent to the device through the upper computer software (EasyWaveX) and saved locally. When selecting the data source as "From File", the file manager window will be automatically called. Select the waveform file that needs to be called in this window, and then click "Recall" to proceed.

For the operation method of the file management window, please refer to the "Store/Recall" chapter.

10.2.3 Run Mode

The run modes of AWG include continuous, triggered, Burst, step and advanced.The run mode of Segment can be modified according to needs.

Table 10.7 Segment run mode settings

Run mode	Description
Continuous	Waveform sequence continuous loop output.
Triggered	After the trigger condition is met,waveform sequence continuous loop output.
Burst	After the trigger condition is met,output a specified number of waveform sequences.
Step	Each time it is triggered, each waveform is output in sequence according to the set output sequence.
Advanced	Each Segment can independently set different waiting events and triggering methods. Different playback orders can be set between multiple segments.

10.2.4 Trig Source

The triggering methods of AWG include manual triggering, timer triggering, and external triggering. The triggering method of Segment can be modified according to needs.

Table 10.8 Segment trig source settings

Trig source	Description
Manual	Click the *Trigger* button on the menu bar to trigger.
Timer	Trigger using internal timer.
Ext Trig	Trigger using external source.

10.3 Save/Recall

AWG save and load function can save the currently configured waveform parameters and waveform data into files with the suffix '.awgx'.This function can save both AWG files and AWG files containing waveform files.

Table 10.9 Save/Recall Type

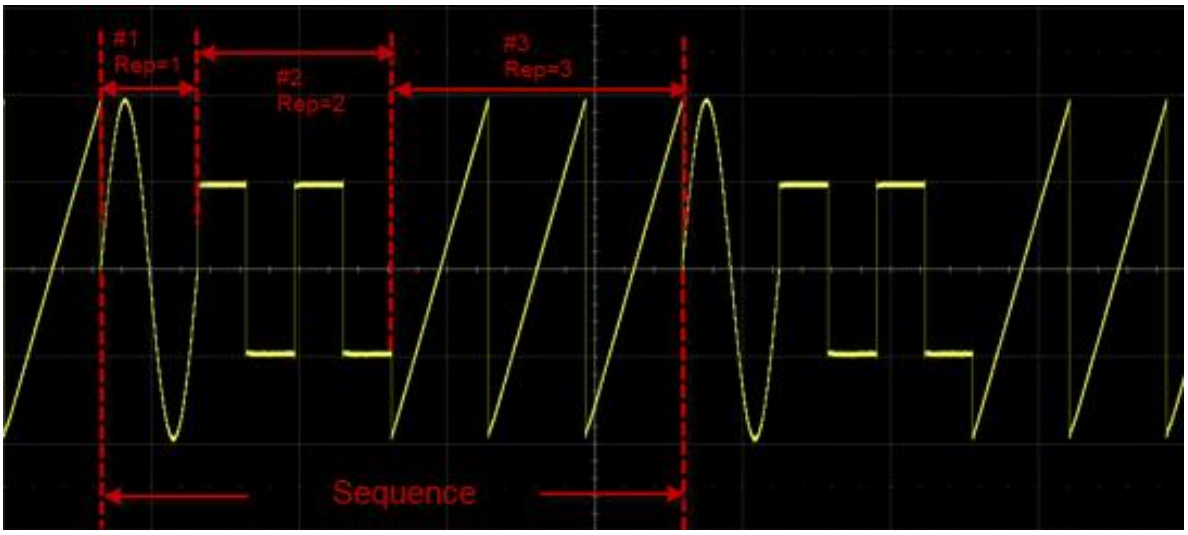
Type	Description
AWG	This item only saves the data of the built-in wave of the machine,do not save user-defined waveform data (such as wave1.bin and other waveform files),if the Segment waveform has a user-defined wave1 waveform,then the saved file will not generate wave1 waves when used on other machines. If there is a wave1.bin file with the same waveform name and path on other machines, Wave1 waves can also be generated.
AWG(with wavefile)	This item can save built-in wave data and user wave data,the saved files can be copied to other machines and used normally.

Application example:Output a waveform sequence, outputting the following segments in sequence:

- Wave1=Sine，Length=32768，Amplitude=2Vpp, Loop=1
- Wave2=Square_Duty50，Length=32768，Amplitude=1Vpp, Loop=2
- Wave3=UpRamp，Length=32768，Amplitude=2Vpp, Loop=3

1. Execute the Seq button to turn on the AWG mode;
2. Click Add in the sidebar to *Add* two segments;
3. Click on the waveform of Segment-1, select the Sine wave in the built-in waveform and confirm;
4. Then click on Segment-1 and set the length to 32768, the amplitude to 2 Vpp, and the loop to 1;
5. The settings of Segment-2 and Segment-3 are the same as steps 3 and 4;
6. Click the Run button to start sequence playback and turn on the output.

The following figure shows the actual output waveform:



	In the case of AWG, the actual output amplitude is also affected by the amplitude ratio of the setting interface. For example, the amplitude set under the AWG page is 2 Vpp, If the amplitude ratio on the setting page is 50%, the actual output amplitude is 1 Vpp.

11 IQ settings

SDG3000X can be used as an I/Q signal generator,provides I/Q vector signals in various debugging methods such as ASK, PSK, QAM, FSK, MSK and Multitone. I/Q signal source data can be generated with the help of the host computer software EasyIQ. EasyIQ and the device are connected through USB or LAN.

In the I/Q function mode, CH1 serves as the I output and CH2 serves as the Q output,the two outputs share a set of parameter settings, as shown below:

A. Waveform spectrum preview
B. Parameter setting box
C. Output switch
D. IQ Adjustment setting

Set waveform parameters

The basic waveform parameters of I/Q include "Carrier", "Amplitude" and "Fs/Fsymb". The setting method refers to the waveform parameter setting of sine wave.

Table 11.1 IQ waveform parameter description

IQ	
Carrier	The frequency of the carrier wave, when the Carrier = 0,the output is a baseband I/Q signal.When the Carrier ≠ 0, the output is a quadrature modulated intermediate frequency signal.The difference between the two is detailed in the "Working Mode" section.

Amplitude	When the center frequency = 0, the amplitude value is the modulus $\sqrt{I^2+Q^2}$ of the I/Q signal. When the center frequency ≠ 0, the signal is only output from channel I, and the amplitude value is the root mean square value I_{rms} of the output of channel I.
Fs/Fsymb	The symbol rate (Fsymb) and sampling rate (Fs) are converted according to the parameter oversampling point (Pts/Symbol), The conversion relationship Fs=Fsymb*Pts/Symbol. Information about waveform oversampling points can be read in "Waveform Information".

Waveform Information

The waveform information contains the modulation parameters of the waveform, including modulation, symbol length, oversampling, filter type and filter alpha, etc., and is read-only.

Trig Source

Trigger sources include internal, external, manual and timer triggers.

Table 11.2 IQ waveform trigger source description

Trig source	Description
Internal	When triggered internally, internal triggering is the default IQ baseband signal playback mode, and the IQ waveform is always output.
External	When externally triggered, the signal generator receives the trigger signal input from the front panel of the instrument. When receiving the rising edge of a CMOS pulse, it will always output a periodic IQ waveform.
Manual	When triggering manually, a *Trig Button* will appear on the parameter page. Pressing this button once will always output a periodic IQ signal.
Timer	When the timer is triggered, the parameter page will have the time setting. After waiting for the set time, the periodic IQ signal will always be output.

Data Source

Click the settings icon in the "Data Source" parameter setting box to enter the data source selection interface. You can choose to load built-in or from file.

Table 11.3 IQ waveform data source description

Data source	Description
Built-In	The built-in waveform is a preset waveform inside the signal generator, including a variety of ASK, PSK, QAM and other modulation

	waveforms.The selection method of built-in waveform is the same as the built-in waveform of arbitrary waveform.
From File	From File waveforms are waveform files saved by users in local directories or external USB drives.Or the waveform file sent by the host computer to the device and saved locally.The selection method of the saved waveform is the same as that of the arbitrary waveform.

11.1 Working mode

The I/Q signals of SDG3000X can be output in two working modes. When the center frequency = 0, the operating mode is baseband I/Q mode. At this time, CH1 is used as the I output, and CH2 is used as the Q output. When the center frequency ≠ 0, the working mode is the intermediate frequency signal mode. At this time, both I and Q channels have signal output.

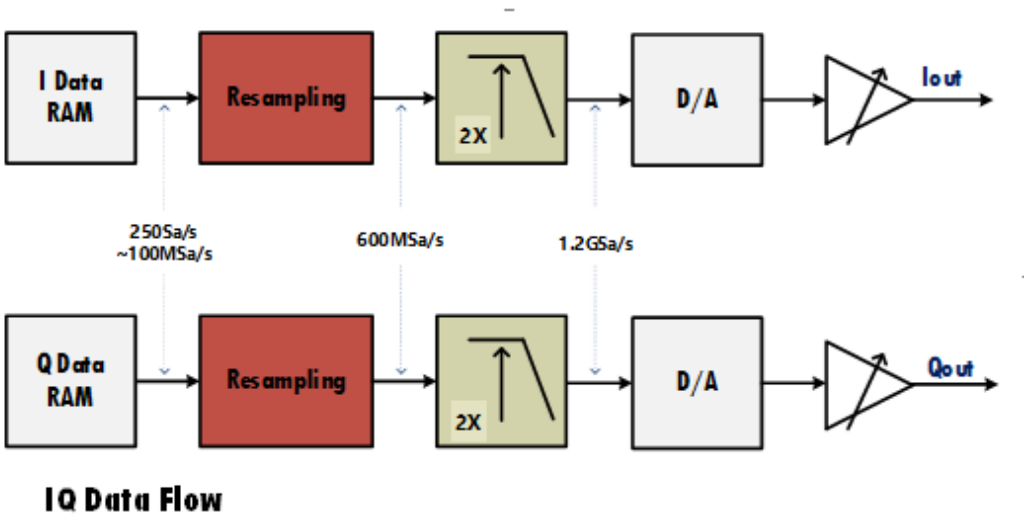


Figure11.1 Baseband IQ mode

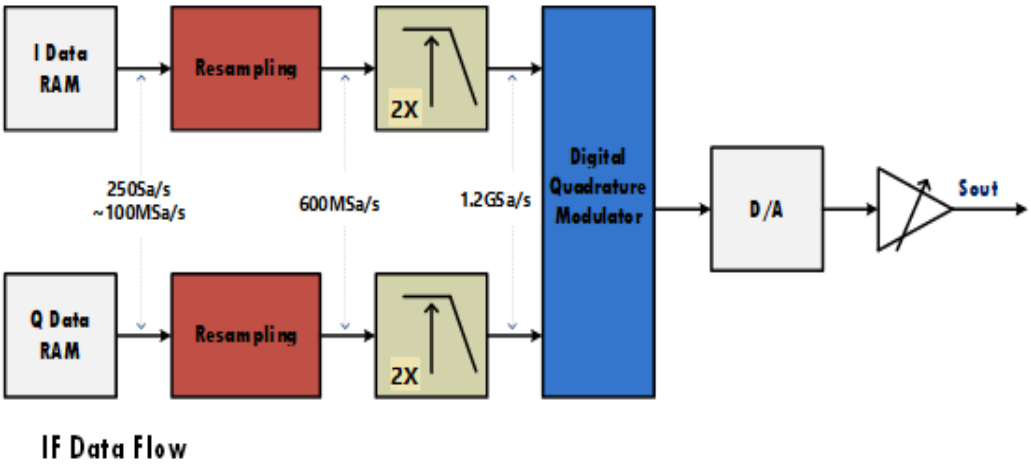


Figure11.2 IF signal mode

The schematic block diagram of the quadrature modulator is as follows:

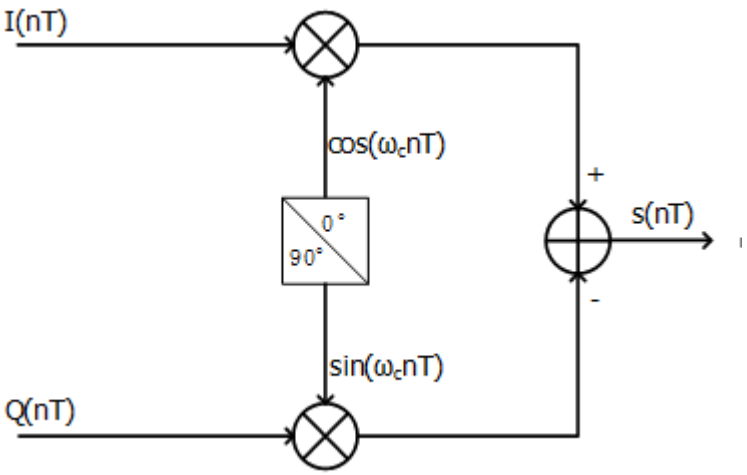


Figure11.3 Schematic block diagram of quadrature modulator

11.2 IQ Adjustment

In baseband I/Q operating mode, SDG3000X provides I/Q compensation options. It is used to suppress the image caused by the imbalance of the two I/Q channels to the greatest extent.

Table 11.4 IQ waveform data source description

IQ adjustment items	Description
Gain Balance	Amplitude gain balance, adjusts the amplitude difference between I/Q channels, the unit is dB.

Path I Offset	DC bias of path I,combined with the Q DC bias adjustment to compensate for the bias imbalance of the I/Q channels.
Path Q Offset	DC bias of path Q.
Angle Q Adjustment	Phase angle adjustment of Q path,to compensate for the phase imbalance of the I/Q channels.

11.3 EasyIQ

I/Q waveform editing software EasyIQ supports 2ASK, 4ASK, 8ASK, BPSK, QPSK, 8PSK, DBPSK, DQPSK, D8PSK, 8QAM, 16QAM, 32QAM, 64QAM, 128QAM, 256QAM, 2FSK, 4FSK, 8FSK, 16FSK, MSK, MultiTone, etc. I/Q for multiple modulation types data generation, and download the generated data directly to the device output.

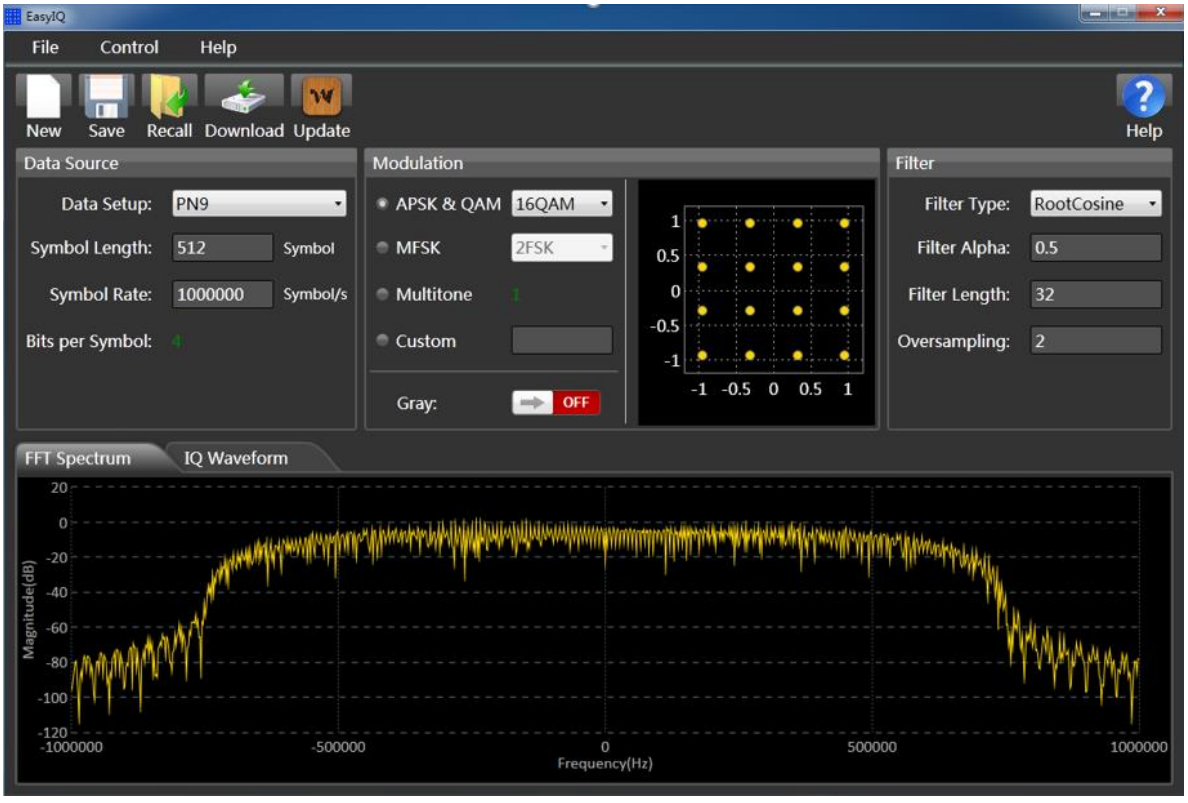


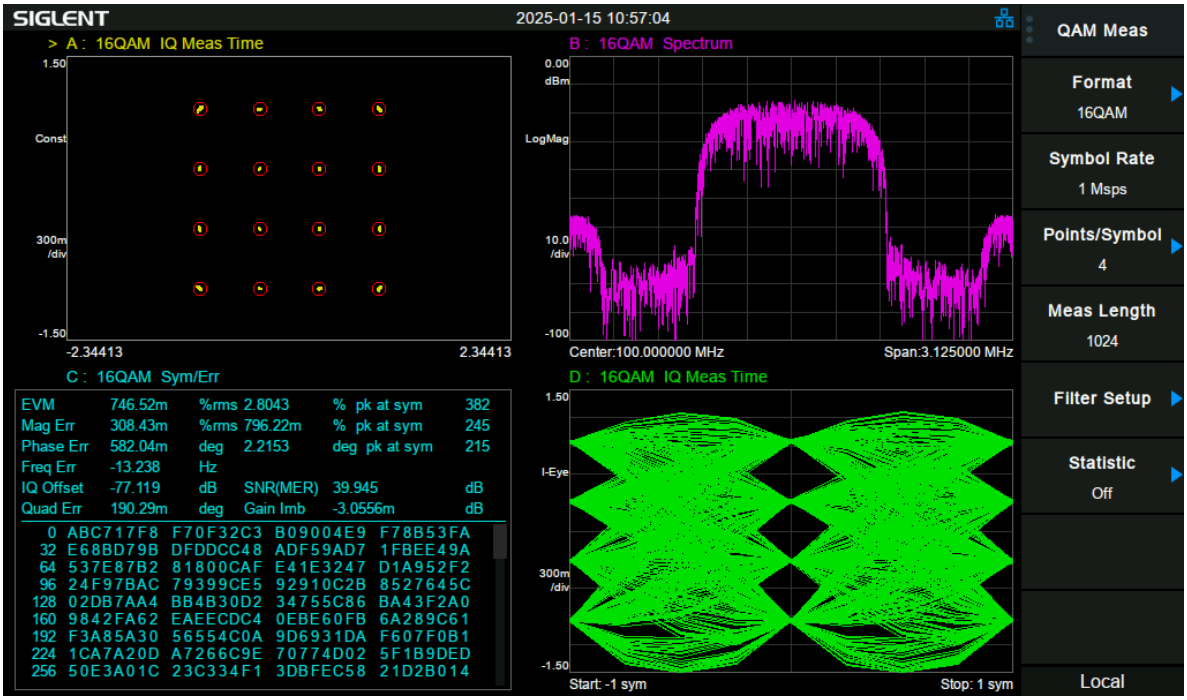
Figure11.4 EasyIQ operation interface

For detailed instructions on using EasyIQ, please refer to the help of the software itself.

Application example: Output an I/Q signal,modulate the I/Q signal to 100 MHz IF and output it, and observe the output result. The parameters of the I/Q signal are as follows:

- Modulation = 16QAM
- Symbol Length = 1024
- Symbol Rate = 1MSymbol/s
- Oversampling = 4
- Filter Alpha = 0.35

1. Open I/Q and execute *I/Q* in the bottom menu bar;
2. Click *Data Source* , select 16 QAM in the built-in waveform and confirm;
3. Click *Fs/Fsymb* and set the symbol rate to 1 MS/s;
4. Click *Carrier* and set it to 100 MHz;
5. Turn on the output switch and connect to the signal analyzer for demodulation. The results are as follows:



12 Modulation/Sweep/Burst settings

12.1 Overview

Modulation / Sweep / Burst can all be seen as modulation of the carrier wave. In addition to conventional modulation, sweep frequency is a special type of frequency modulation, while burst is a type of pulse modulation.

SDG3000X provides rich modulation functions, including AM, DSB-AM, FM, PM, FSK, ASK, PSK, and PWM.

Different modulation parameters need to be set according to different modulation types.

When amplitude modulation, the modulation frequency, modulation depth, modulation waveform, and signal source type can be set.

During frequency modulation, the frequency modulation frequency, frequency deviation, modulation waveform, and signal source type can be set.

During phase modulation, the modulation frequency, phase deviation, modulation waveform, and signal source type can be set.

When using frequency shift keying modulation, the keying frequency, hopping frequency, and signal source type can be set.

When amplitude shift keying modulation is used, the keying frequency, carrier frequency, and source type can be set.

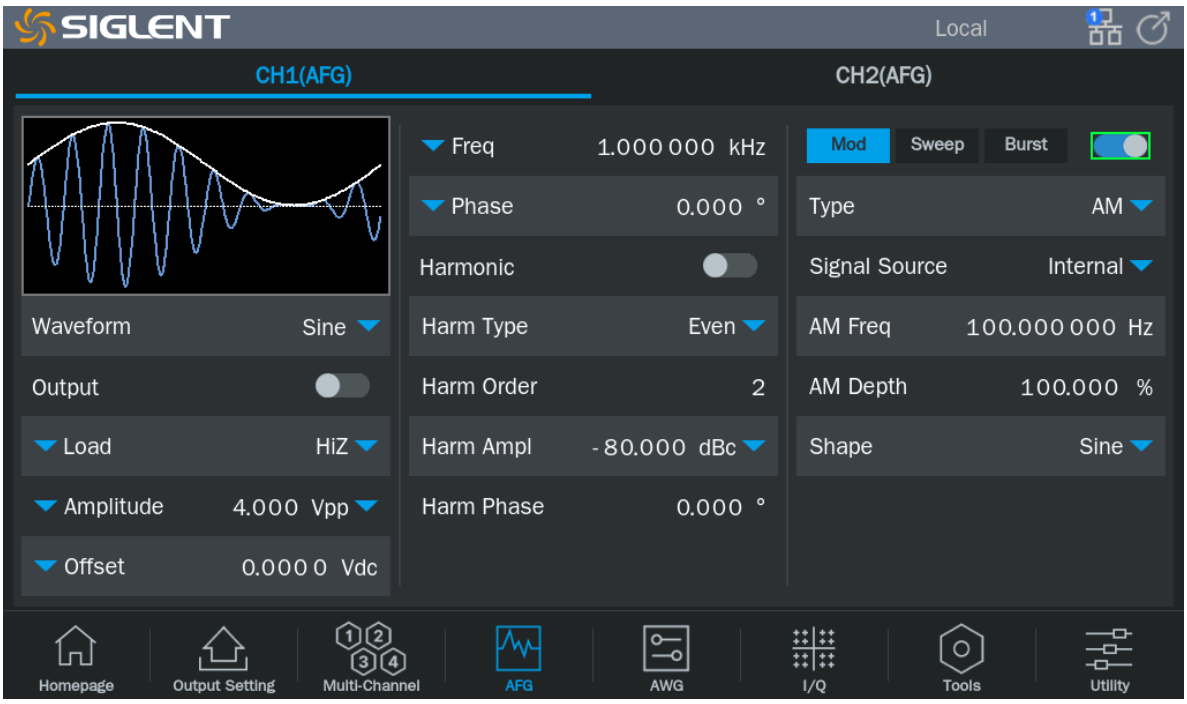
When using phase shift keying modulation, the modulation rate, polarity, and source type can be set.

When pulse width modulation is used, the modulation frequency, pulse width/duty cycle deviation, modulation waveform, and signal source type can be set.

Below, different modulation types will be introduced one by one, with a focus on their parameter settings.

12.2 Modulation

SDG3000X supports commonly used analog modulation (AM/DSB-SC/FM/PM/PWM, etc.) and digital keying (ASK/FSK/PSK, etc.). The modulated source can be selected from internal, external and channel.



12.2.1 Signal Source

There are three sources of modulated waves: internal, external and channel. See the table below for details:

Table 12.1 Modulation Wave Source and Description

Source	Description
Internal	The modulation signal is generated internally from the DDS module, and corresponding modulation waves are generated based on the user's configuration (modulation frequency, modulation waveform), etc.
External	The modulation signal is input externally. When the modulation type is analog modulation (AM/DSB-SC/FM/PM/PWM, etc.), the external source is input from the external modulation interface. The amplitude of the input analog signal determines the modulation coefficient (modulation depth/frequency offset/phase offset/pulse width deviation, etc.), and the requirements for external modulation amplitude are detailed in the parameter

	"amplitude corresponding to 100% modulation" in the data manual. For instructions on 100% modulation, please refer to Table 12.2. When the modulation type is digital keying (ASK/FSK/PSK, etc.),external sources are input through the MODULATION IN interface on the rear panel. The input digital sequence must meet the electrical requirements of the external trigger interface (see the data sheet for details).
Channel	When the modulated carrier is in CH1, CH2 can be directly used as the modulation wave. At this time, the equipment directly uses CH2 as the modulation wave to modulate the carrier of CH1 internally, without introducing the waveform of CH2 to the external interface through an external cable. or vice versa.

Table 12.2 Explanation of 100% modulation

	Description
AM	Corresponding modulation depth=100%.
FM	Corresponding frequency offset=the situation where frequency offset is set. For example, if the amplitude of the external modulation input is 50% of the amplitude corresponding to 100% modulation, the resulting frequency offset is 50% of the set frequency offset.
PM	Corresponding phase offset=setting phase offset. For example, if the amplitude of the external modulation input is 50% of the amplitude corresponding to 100% modulation, the resulting phase offset is 50% of the set phase offset.

12.2.2 Modulation type

The following table reflects the various modulation types supported by SDG3000X and their compatibility with carriers:

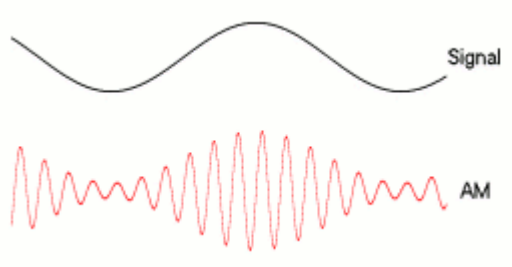
Table 12.3 Compatibility Relationship between Modulation Type and wave

waveform / modulate	Sine	Square	Pulse	Ramp	Noise	Arb
AM	●	●	●	●	●	●
DSB-SC	●	●	●	●	●	●
FM	●	●		●		●
PM	●	●		●		●
PWM			●			

FSK	●	●		●		●
ASK	●	●	●	●	●	●
PSK	●	●		●		●

AM

AM is amplitude modulation, which is a modulation method that uses the amplitude of the modulated wave to control the amplitude of the carrier wave.

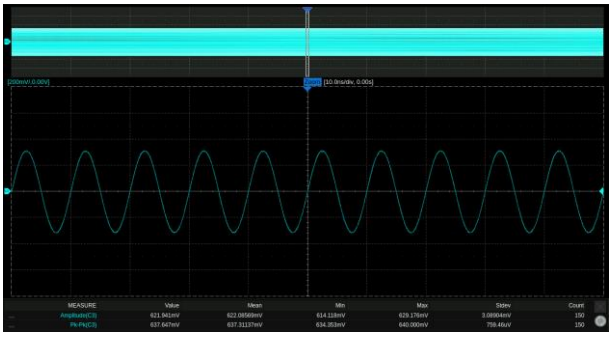


The configurable parameters of AM are shown in the table below:

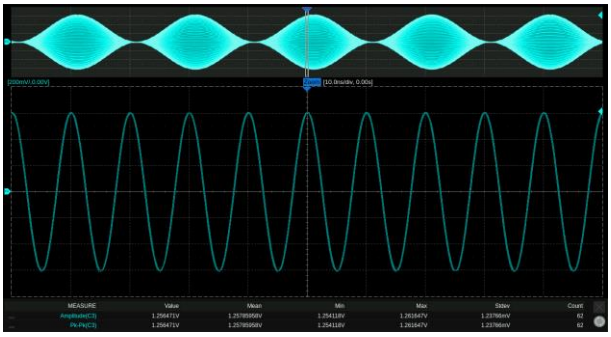
Table 12.4 Explanation of AM modulation parameters

AM	
AM Depth	Also known as amplitude modulation coefficient (m), Determined by the maximum value $U_{cm,max}$ and minimum value $U_{cm,min}$ of the amplitude modulation wave envelope: $m=\frac{U_{cm,max}-U_{cm,min}}{U_{cm,max}+U_{cm,min}}$ When the source is internal or channel, this value can be directly set; When the signal source is external, it is determined by the amplitude of the external modulation input.
AM Freq	The frequency of the modulated wave. When the source is internal, this value can be directly set; When the signal source is external, it is determined by the frequency of the external modulation input or another channel.
AM Shape	The shape of the modulated wave. When the source is internal, this value can be directly set. When the signal source is external, it is determined by the waveform of the external modulation input or another channel.

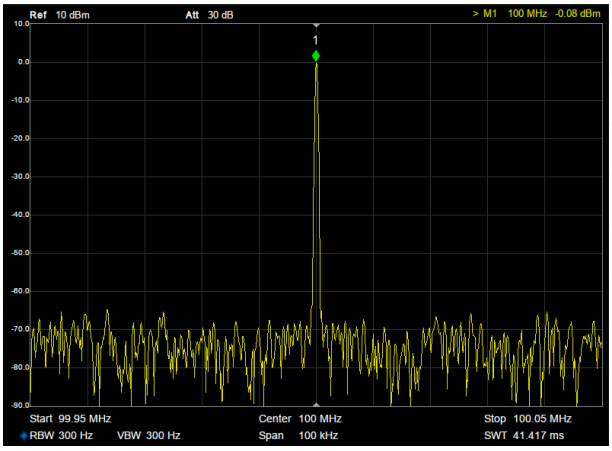
The amplitude strategy of AM is to maintain the power of the carrier consistent with the unmodulated state, that is, the power of the carrier is independent of the modulation depth. This is a normal phenomenon where the peak to peak value of the AM waveform exceeds the set value. The following figure shows the amplitude comparison of a 60MHz, 0dBm carrier at no modulation and 100% modulation depth. It can be seen that after modulation is turned on, the peak to peak value in the time domain increases, but the power of the carrier in the frequency domain remains unchanged.



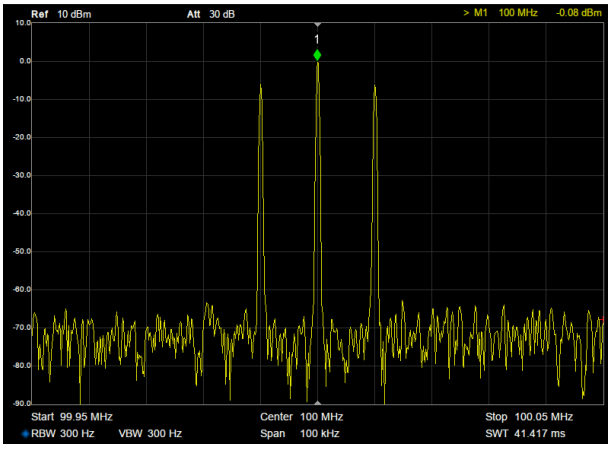
Unmodulated time-domain diagram



100% modulation depth time-domain diagram



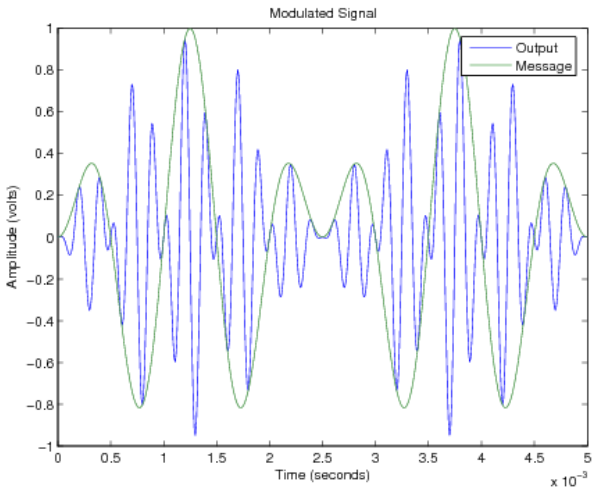
Unmodulated spectrogram



100% modulation depth spectrogram

DSB-SC

DSB-SC is a dual sideband amplitude modulation that suppresses the carrier wave.



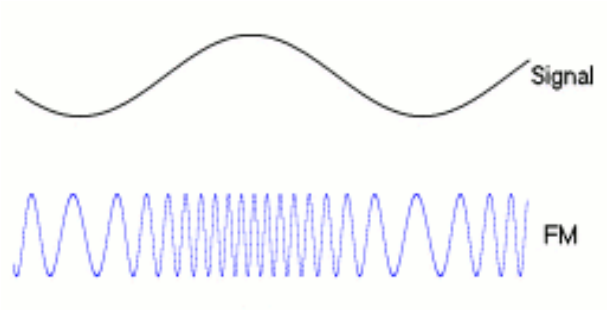
The configurable parameters of DSB-SC are shown in the table below:

Table 12.5 Description of DSB-SC modulation parameters

DSB-SC	
DSB Freq	Same as AM.
DSB Shape	Same as AM.

FM

FM is a frequency modulation method that uses the amplitude of the modulated wave to control the frequency of the carrier wave.



The configurable parameters of FM are shown in the table below:

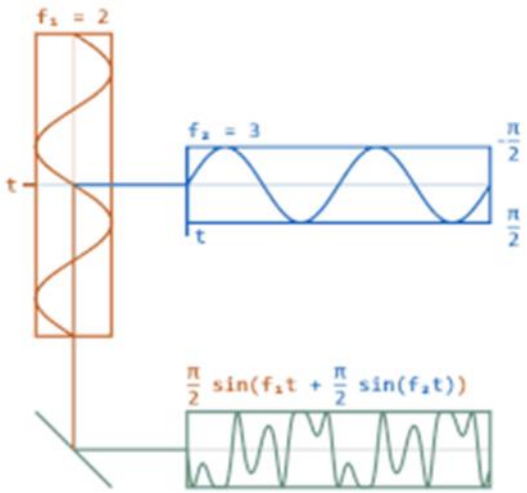
Table 12.6 FM Modulation Parameter Description

FM	
FM Freq	Same as AM.
FM Shape	Same as AM.

FM Dev	The maximum value Δf of instantaneous frequency deviation from carrier frequency f_c, when the frequency deviation reaches, it corresponds to the maximum or minimum amplitude of the modulated wave. The modulated carrier frequency varies within the range of $f_c \pm \Delta f$. When the source is internal or channel, this value can be directly set; When the signal source is external, it is determined by the amplitude of the external modulation input, and the full amplitude of the external modulation corresponds to the set frequency deviation.

PM

PM is a phase modulation method that uses the amplitude of the modulated wave to control the instantaneous phase of the carrier wave.



The PM configurable parameters are shown in the table below:

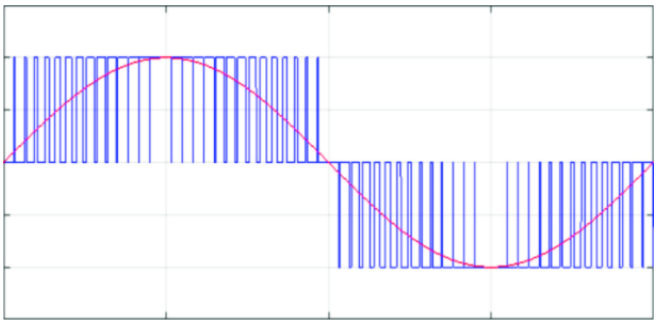
Table 12.7 Description of PM modulation parameters

PM	
PM Freq	Same as AM.
PM Shape	Same as AM.
Phase Dev	The maximum value $\Delta\varphi$ of the instantaneous phase $\varphi_c(t)$ when the instantaneous phase deviates from the carrier without modulation, when the phase deviation reaches, it corresponds to the maximum or minimum amplitude of the modulated wave. The modulated carrier phase varies within the range of $\varphi_c(t) \pm \Delta\varphi$.

	When the source is internal or channel, this value can be directly set; When the signal source is external, it is determined by the amplitude of the external modulation input, and the full amplitude of the external modulation corresponds to the set phase deviation.

PWM

PWM, also known as pulse width modulation, is only applicable to the case where the carrier wave equals Pulse. It refers to a modulation method that uses the amplitude of the modulated wave to control the positive pulse width of the carrier wave.



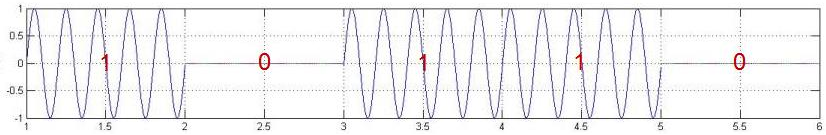
The adjustable parameters of PWM are shown in the table below:

Table 12.8 Description of PWM modulation parameters

PWM	
PWM Freq	Same as AM.
PWM Shape	Same as AM.
Width Dev	The deviation of positive pulse width from the maximum value of positive pulse width without modulation, and when the deviation of pulse width reaches, it corresponds to the maximum or minimum value of modulation wave amplitude. When the source is internal or channel, this value can be directly set; When the signal source is external, it is determined by the amplitude of the external modulation input, and the full amplitude of the external modulation corresponds to the set pulse width deviation.

ASK

ASK stands for amplitude keying, specifically referring to binary amplitude keying. The amplitude of the modulated carrier varies with the 1/0 state of the binary sequence, that is, the presence or absence of the carrier amplitude is used to represent 1 or 0.



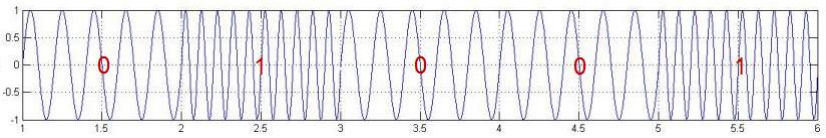
The configurable parameters of ASK are shown in the table below:

Table 12.9 ASK parameter description

ASK	
Key Freq	The bit rate of a binary sequence. When the signal source is internal, this value can be directly set, and the internal source is a clock sequence with a specified frequency; When the signal source is external, it is determined by the 0/1 state of the external trigger port input.

FSK

FSK stands for frequency keying, specifically binary frequency keying here.The amplitude of the modulated carrier changes with the 1/0 state of the binary sequence,that is, when the carrier frequency is f0, it means 0 is transmitted, and when the carrier frequency is f1, it means 1 is transmitted.



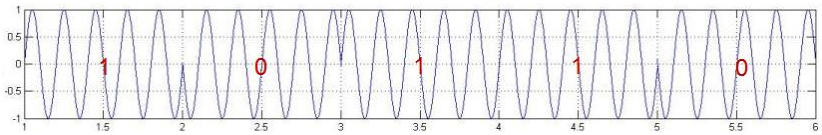
The configurable parameters of FSK are shown in the table below:

Table 12.10 FSK parameter description

FSK	
Key Freq	Same as ASK.
Hop Freq	Represents the frequency of 1, i.e.f1. The frequency representing 0 (i.e.f0) is the currently set carrier frequency.

PSK

PSK stands for phase keying, specifically referring to binary phase keying. The instantaneous phase of the modulated carrier varies with the 1/0 state of the binary sequence.



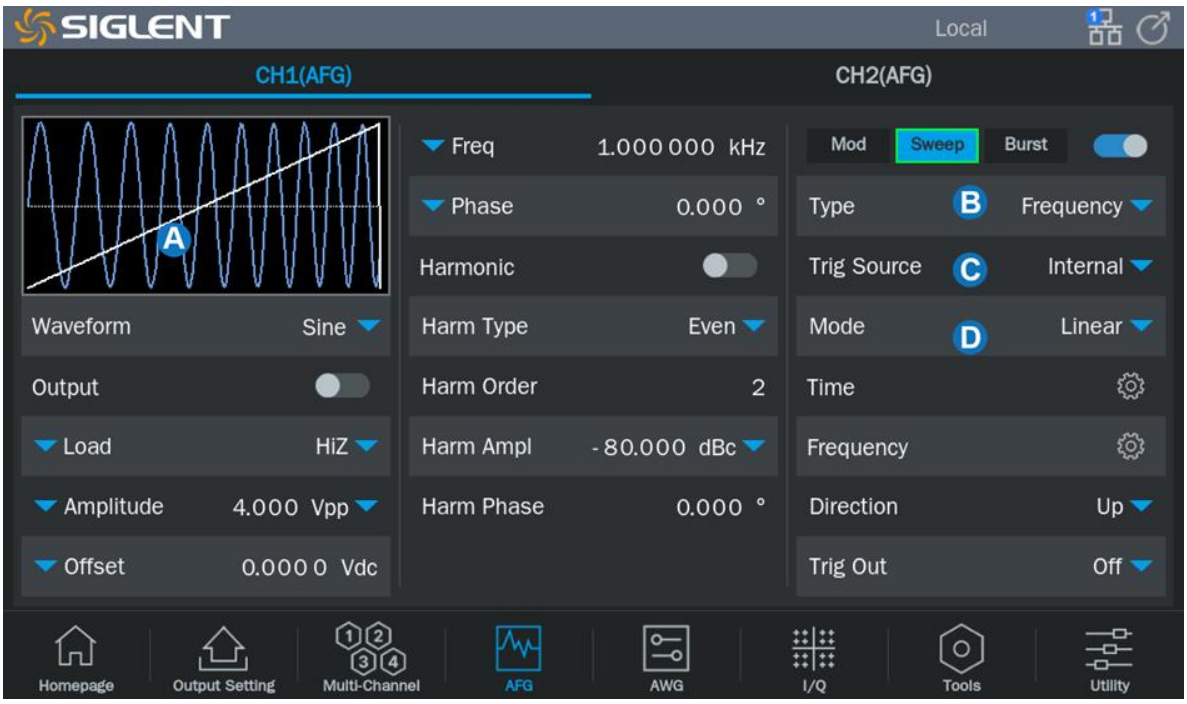
The configurable parameters of PSK are shown in the table below:

Table 12.11 PSK parameter description

PSK	
PSK Rate	Same as ASK.
Polarity	Positive/Negative. When in positive phase, the phase is 0 ° when changing from 0 to 1; When changing from 1 to 0, the phase is 180 °; When reversed, it is opposite.

12.3 Sweep

Sweep belongs to special frequency modulation (FM) or amplitude modulation (AM). When the frequency sweep is turned on, the carrier output frequency or amplitude can vary according to the set pattern (linear/log/step) and can be controlled by the trigger signal.



A. Waveform preview

B. Sweep type setting box

C. Trigger source setting box

D. Sweep parameter setting box

12.3.1 Sweep type

There are three scanning types:Frequency, Amplitude and Freq&Ampl.See the table below for details:

Table 12.12 Type of Sweep

Sweep type	Description
Frequency	A special frequency modulation (FM).
Amplitude	A special amplitude modulation (AM).
Freq&Ampl	Frequency sweep and amplitude sweep.

12.3.2 Sweep mode

There are three scanning modes: linear, log and step. See the table below for details:

Table 12.13 Sweep Mode

Sweep mode	Description
Linear	FM/AM with sawtooth modulation wave. Its frequency/amplitude changes linearly from the starting frequency/amplitude to the ending frequency/ amplitude during the scanning cycle.
log	The frequency variation follows a 10^x rule and is commonly used for frequency response testing in some channels. The frequency response is generally plotted in logarithmic coordinates (10 octaves), so in order to see a uniform distribution of samples on the logarithmic coordinate plot, logarithmic scanning (only supports frequency scanning) is needed.
Step	Frequency or amplitude divides the scanning range into equal steps according to the number of steps.

12.3.3 Trigger Source

There are three types of trigger sources used for sweep: internal, external, and manual. Please refer to the table below for detailed instructions:

Table 12.14 Trigger Sources for Sweep

Trigger Source	Description
Internal	Controlled by an internal timer for frequency sweep loop output.
External	The signal generator receives the trigger signal input from the rear panel of the instrument, and outputs a frequency sweep every time it receives a rising edge of a CMOS pulse. After the frequency sweep is completed, the carrier frequency will return to the starting frequency and remain unchanged until the next trigger arrives.
Manual	When manually triggered, a *Trig Button* button will appear on the parameter page. Press this button once to output a frequency sweep. After the frequency sweep is completed, the carrier frequency will return to the starting frequency and remain unchanged until the next trigger arrives.

12.3.4 Sweep parameter settings

The sweep parameters and their detailed explanations are shown in the table below:

Table 12.15 Sweep Parameters and Explanation

Sweep parameters	Description
Sweep Time	The time spent on a single frequency sweep.
Start Hold-time	Wait time to stay at the starting frequency or starting amplitude before starting the sweep.
End Hold-time	Waiting time to stay at the stop frequency or stop amplitude after the sweep is completed.
Back Time	Waiting time to stay at zero level after sweep.
StartFreq/CenterFreq StopFreq/FreqSpan	Sweep frequency parameters. The relationship is as follows: CenterFreq = (StartFreq + StopFreq) / 2 FreqSpan = | StopFreq - StartFreq | (The same applies to amplitude parameters during amplitude sweep)
Direction	There are three modes: up, down, and up and down. Up represents scanning frequency from low to high; Downward represents scanning frequency from high to low; The up and down mode is only applicable to linear scanning, which scans from the starting frequency to the ending frequency within the scanning time, and then scans back to the starting frequency. This method is equivalent to using a triangular wave for frequency modulation, and the symmetry of the triangular wave can be set, corresponding to different up scanning times and down scanning times. (The same applies to amplitude parameters during amplitude sweep)
Trig Out	When the trigger source is internal or manual,the trigger signal can be output from the trigger output interface on the front panel. The rising edge of the trigger signal corresponds to the start of sweep.

Application example: Output a sweep frequency sine wave in linear and logarithmic patterns, with the following parameters:

- Direction = up，StartFreq = 100 Hz，StopFreq = 100 kHz
- Sweep Time = 3 ms
- Source = Internal, Trigger output on

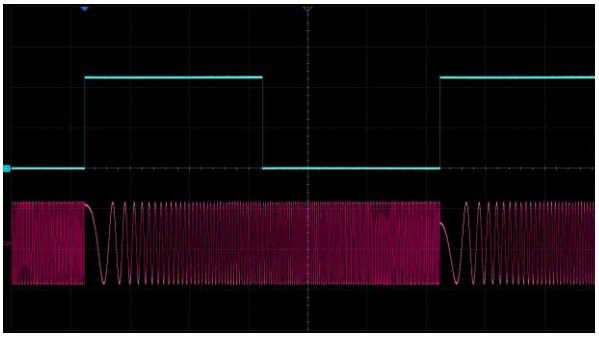
1. Set the "waveform" of the carrier wave to "Sine" on the parameter settings page of CH1 carrier

wave;

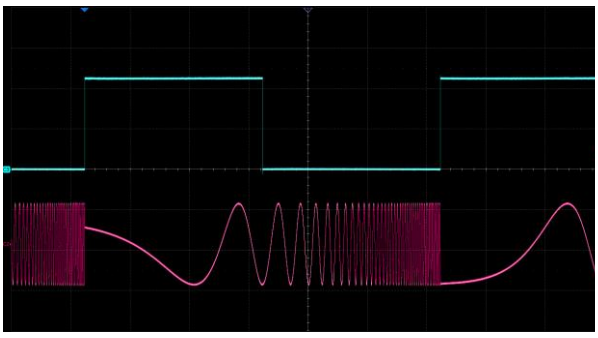
2. Enter the interface for frequency sweep settings;
3. Set "Sweep Type" to "Linear";
4. Set "Trigger Source" to "Internal";
5. Set the "sweep time" to 3 ms and the "sweep direction" to "Up";
6. Set the "start frequency" to 100 Hz and the stop frequency to 100 kHz;
7. Turn on trigger output. Using the characteristic of triggering the rising edge of the output to synchronize with the starting frequency, use it to trigger an oscilloscope to observe a stable sweep signal;
8. Open the output of CH1 and observe the results;
9. Change the "sweep type" to "Log" and observe the results.

By following the above steps, the expected sweep frequency signal can be output. After setting, the linear sweep parameter page is as follows. The parameters for logarithmic sweep frequency only differ at the "sweep type".

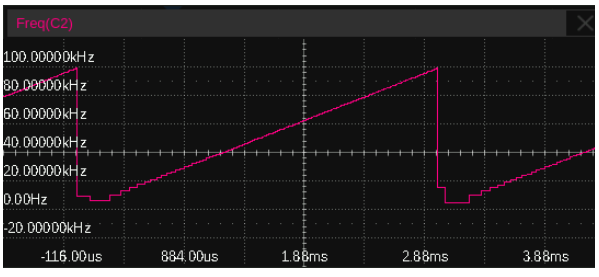
The result of frequency sweep output is as follows (the red trace in the figure represents the sweep signal, and the blue trace represents the trigger signal):



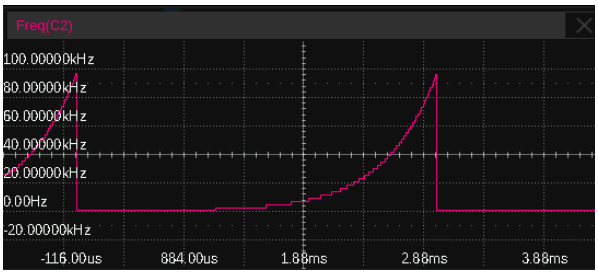
Linear sweep result



Log sweep result



Linear sweep frequency vs time



Log sweep frequency vs time

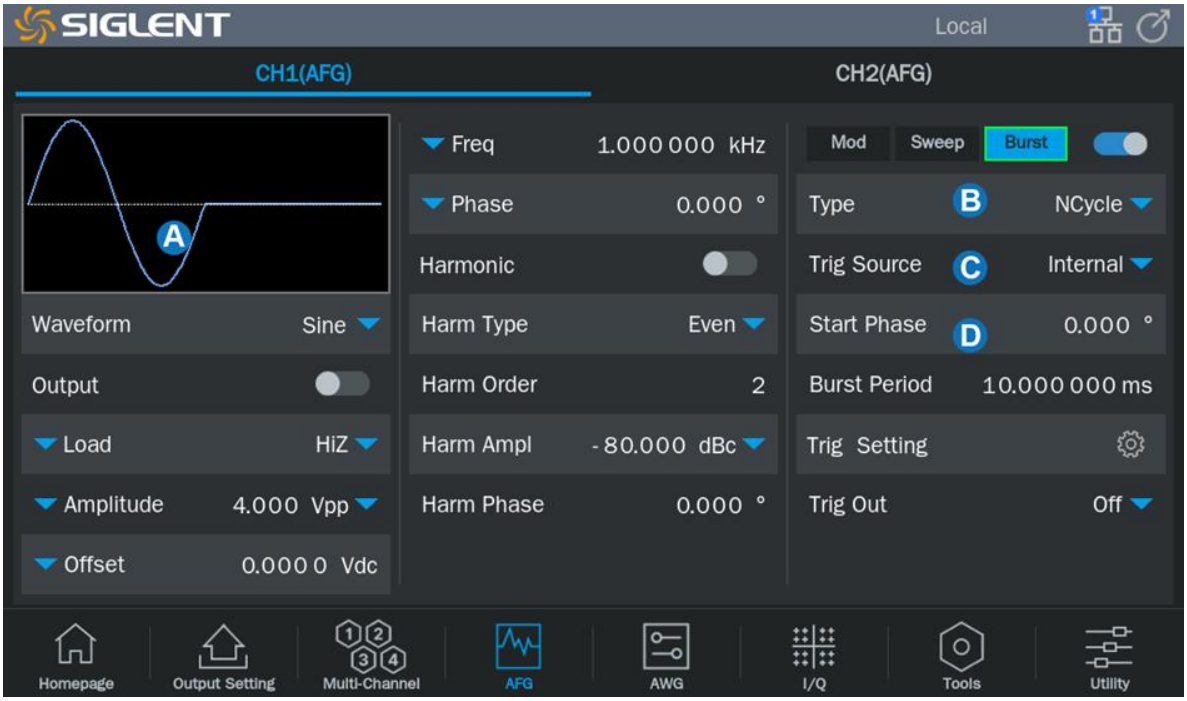
This example can help users gain a deeper understanding of the difference between linear scanning and logarithmic scanning: scanning from 100 Hz to 100 kHz, with a scanning time of 3 ms, the

frequency increases by 10^3 times, and logarithmic scanning increases by 10 times every 1 ms. The table below lists the frequency values corresponding to each time point in logarithmic and linear sweep modes.

Time（ms)	0	1	2	3
Frequency（Hz) -- Log sweep frequency	100	1000	10000	100000
Frequency（Hz) -- Linear sweep frequency	100	33400	66700	100000

12.4 Burst

Burst is a burst signal. Triggering the output of a certain number of carrier cycles through a certain control signal.



A. Waveform preview

B. Burst type setting box

C. Trigger source setting box

D. Burst parameter setting box

12.4.1 Burst type

Burst types are divided into NCycle and Gated control, and detailed explanations are shown in the table below:

Table 12.16 Types of Burst

Burst type	Description
NCycle	Each time triggered, output a specified number (N) of carrier cycles.
Gated	When the gate signal is valid, the carrier is output; otherwise, it is not output. The gate signal can be high or low effective.

12.4.2 Trigger Source

Burst uses three types of trigger sources: internal, external, and manual, similar to sweep. Detailed instructions can be found in the table below:

Table 12.17 Burst Trigger Sources

Trigger Source	Description
Internal	Controlled by an internal timer for pulse train loop output.
External	The signal generator receives the trigger signal/gating signal input from the front panel of the instrument. As a trigger signal, every time a CMOS pulse rising edge is received, a pulse train is output. When used as a gate control signal, the output of the carrier signal is determined by judging the height of the signal.
Manual	When manually triggered, a *Trig Button* button will appear in the parameter setting area, which outputs a pulse train every time it is pressed.

12.4.3 Burst parameter settings

The Burst parameter and its detailed description are shown in the table below:

Table 12.18 Burst parameters and explanations

Burst parameter	Description
Start Phase	Initial phase when starting to output pulse train.
Burst Period	This parameter is only available when the trigger source is internal and is used to set the cycle period of the internal timer.
Cycles	This parameter is only available when Burst type=N cycles, and is used to specify the number of cycles contained in each pulse string. Click on the parameter name area in the parameter settings box to set the number of cycles to "infinite", which means that continuous carriers will be output continuously after receiving the trigger, used to control the carrier to output after a specific event occurs.
Polarity	This parameter is only available when Burst type=gated, used to specify the polarity of the gating signal.When the polarity is positive, the carrier signal can be output only when the gate is active at a high level; when the polarity is negative, the carrier signal can be output only when the gate is at a low level.
Trig Delay	This parameter is only available when the trigger source is internal or

	manual, and is used to set the delay time of the trigger signal. The minimum value of trigger delay represents the minimum delay that can be achieved on hardware.
Trig Out	This parameter is only available when triggering source=internal or manual, and can be set to Up, Down, or off.
Edge	This parameter is only available when trigger source = external and can be set to Up or Down.
Hold Value	The output level after the pulse train output ends.

13 Hopping

SDG3000X supports frequency hopping function only when in AFG mode and the carrier is sine wave. When the frequency hopping function is turned on, only AM modulation is supported. Click *Hopping* in the toolbar on the home page to enter the frequency hopping setting page.

Turning on frequency hopping is divided into two steps: channel output and frequency hopping output. When the frequency hopping function is turned on, functions such as sweep and burst are forcibly turned off, and automatically switches the basic wave to sine (when the current channel carrier is not sine) and stops normal output.

After editing the frequency hopping parameters, turn on the frequency hopping output and output the frequency hopping signal.

There are three frequency hopping modes: Manual, Random Hop, and Random List. Different modes can be switched through the "Type" menu selection.

In Random Hop and Random List modes, you need to set the order n of the PRBS code (n=[7,32]) to output the frequency points of the frequency table.

The machine uses n-level shift registers and different feedback combinations to generate a pseudo-random sequence of length 2^n-1,the length of the pseudo-random sequence needs to be greater than or equal to the number of frequency points, and the value of the sequence is modulo calculated with the number of frequency points respectively,use the operation results to index the frequency hopping table to generate the final frequency hopping sequence.

Table 13.1 hopping type description

Hopping type	Description
Manual	Output the frequency points in the frequency list according to the customized order list.
Random Hop	Determine the frequency list output frequency point according to the set max frequency, min frequency and frequency step. The frequency avoid list can be set to filter out the frequency range that you do not want to output.
Random List	The frequency point in the output frequency list is determined by the PRBS code value.

13.1 Manual

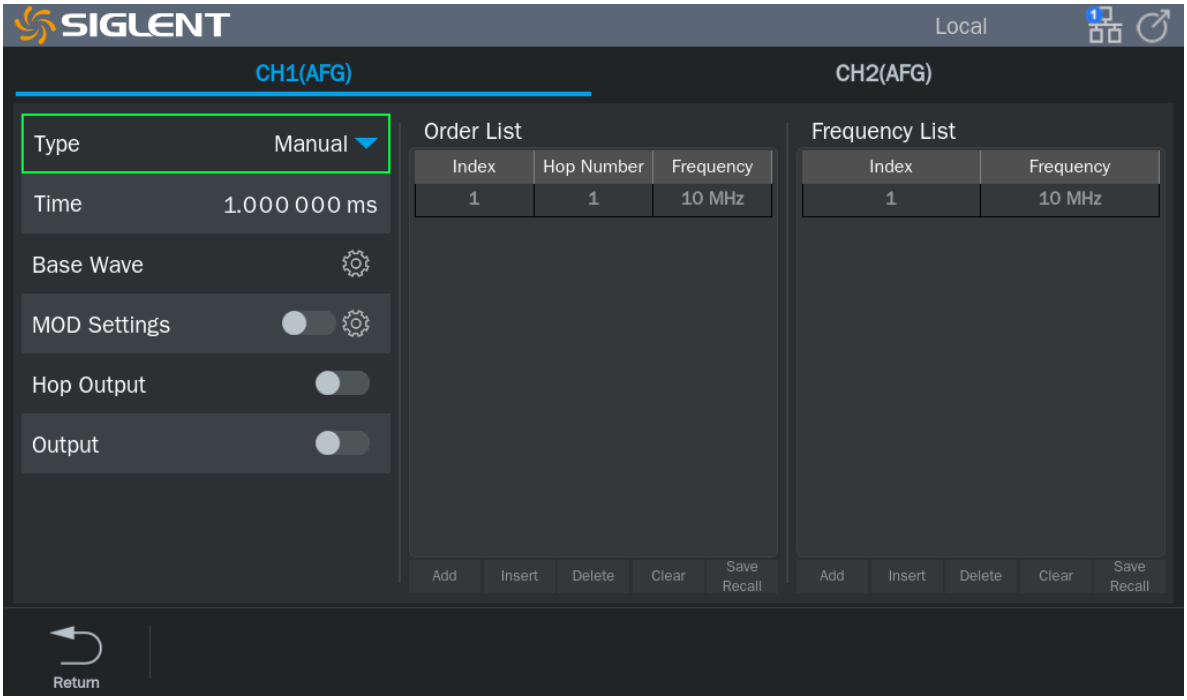


Table 13.2 Manual parameter description

Parameter	Description
Time	Frequency hopping time interval.
Base Wave	Set the load, amplitude, offset and other parameters of the Sine wave.
MOD Settings	Set signal source, am frequency, am depth, shape and other parameters.

Table 13.3 Order list description

Function	Description
Add	Add a frequency point at the end of the order list.
Insert	Insert a frequency point in front of the selected frequency point in the order list.
Delete	Delete the last frequency point or selected frequency point.
Clear	Clear all newly added frequencies and restore default items.
Save/Recall	Save the hop file of the current table configuration or call the saved hop file.

Table 13.4 Frequency list description

Function	Description
Add	Add a frequency point at the end of the frequency list.
Insert	Insert a frequency point in front of the selected frequency point in the frequency list.
Delete	Delete the last frequency point or selected frequency point.
Clear	Clear all newly added frequencies and restore default items.
Save/Recall	Save the hop file of the current table configuration or call the saved hop file.

13.2 Random Hop

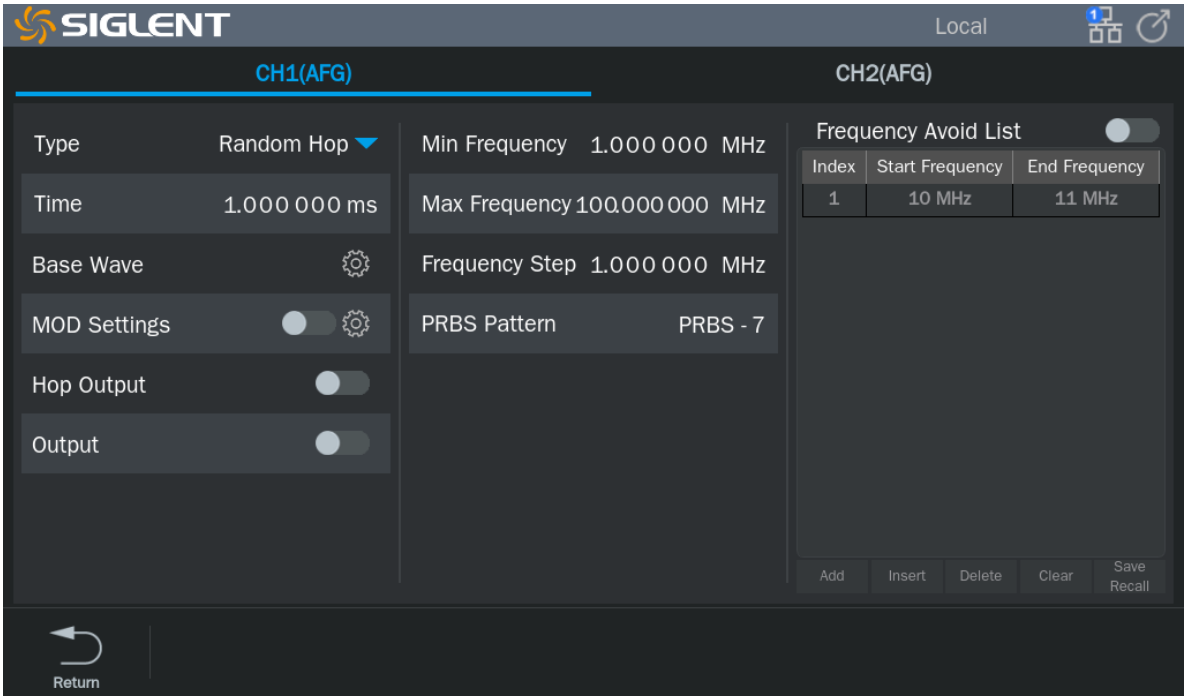


Table 13.5 Random Hop parameter description

Parameter	Description
Time	Frequency hopping time interval.
Base Wave	Set the load, amplitude, offset and other parameters of the Sine wave.
MOD Settings	Set signal source, am frequency, am depth, shape and other parameters.
Min Frequency	Set the minimum frequency for frequency hopping.
Max Frequency	Set the maximum frequency for frequency hopping.
Frequency Step	Set the frequency interval between frequency hopping frequencies.
PRBS Pattern	Set the PRBS pattern of frequency hopping output.

Table 13.6 Frequency avoid list description

Function	Description
Add	Add a frequency point at the end of the frequency avoid list.
Insert	Insert a frequency point in front of the selected frequency point in the frequency avoid list.
Delete	Delete the last filter range or select the filter range.
Clear	Clear all new filter ranges and restore default items.
Save/Recall	Save the hop file of the current table configuration or call the saved hop file.

13.3 Random List

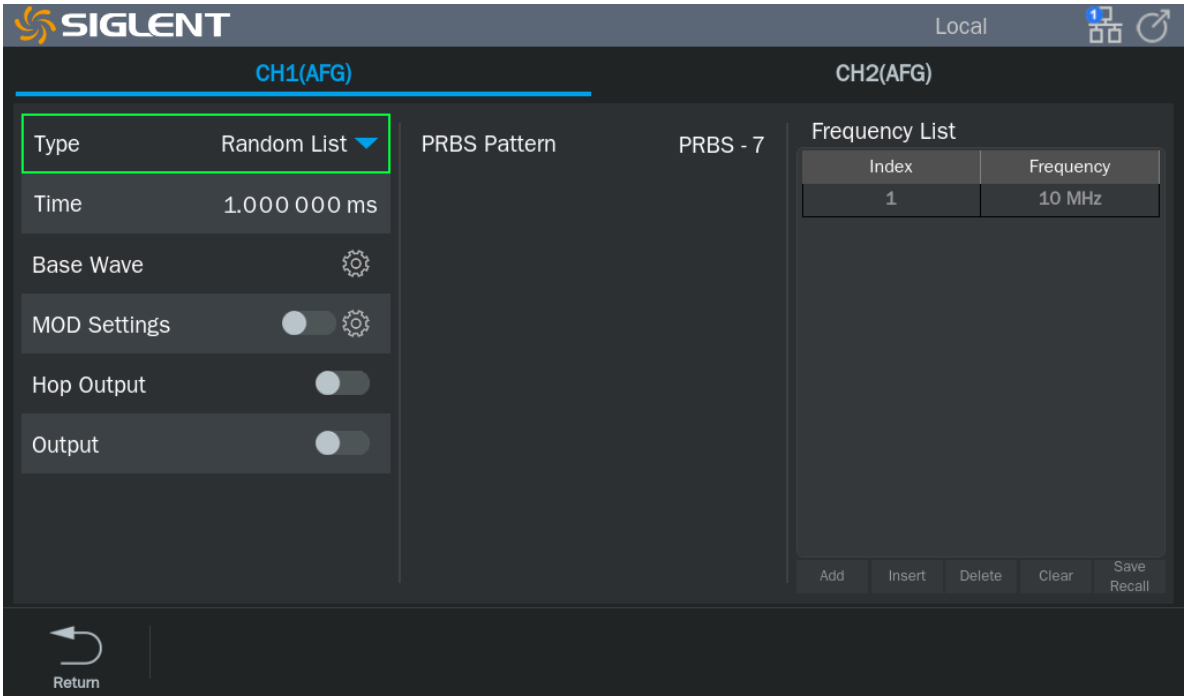


Table 13.7 Random list parameter description

Parameter	Description
Time	Frequency hopping time interval.
Base Wave	Set the load, amplitude, offset and other parameters of the Sine wave.
MOD Settings	Set signal source, am frequency, am depth, shape and other parameters.
PRBS Pattern	Set the PRBS pattern of frequency hopping output.

14 MultiTone

SDG3000X supports multi-tone function. Execute *Tools* > *Multitone* , You can enter the multi-tone parameter setting page.

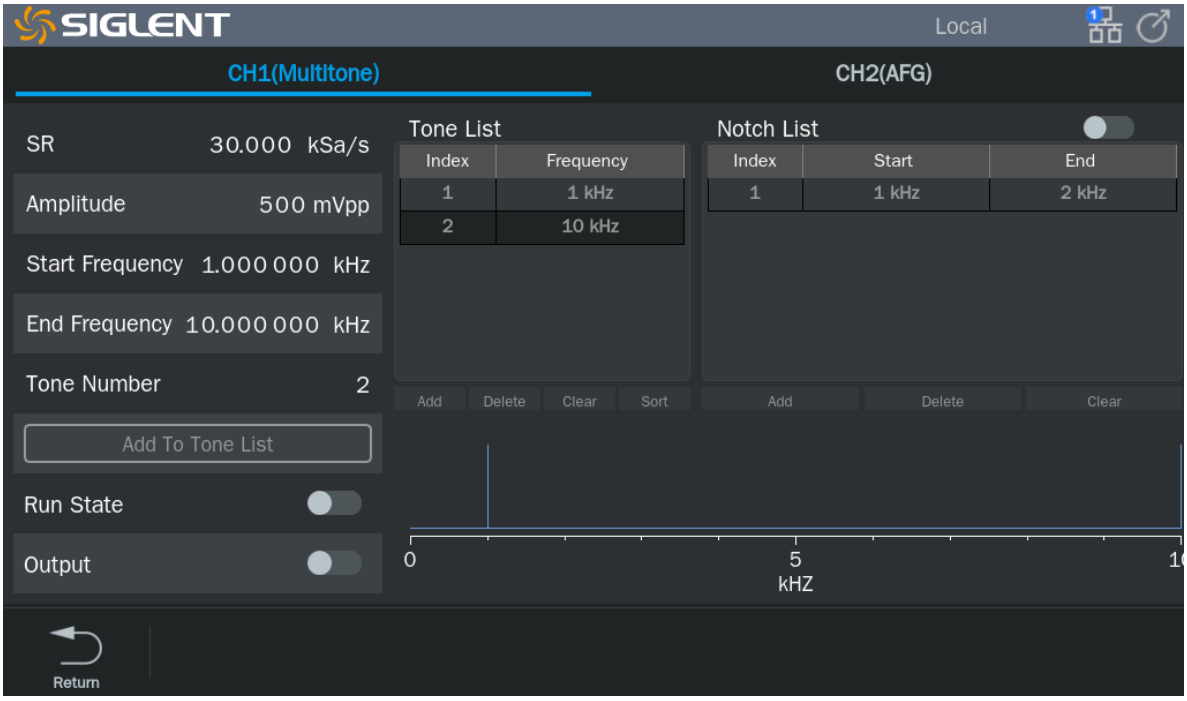


Table 14.1 Multitone parameter description

Parameter	Description
SR	The sampling rate unit is Sa/s, and the settable range is 10m Sa/s ~ 600M Sa/s. The set sampling rate should be greater than 2.5 times the multi-tone frequency.
Amplitude	The amplitude unit is Vpp, and the settable range is 2m Vpp ~ 20 Vpp.
Start Frequency	The minimum frequency point used to update the Tone List. It will take effect after clicking *Add to Tone List* .
End Frequency	The maximum frequency point used to update the Tone List. It will take effect after clicking *Add to Tone List* .
Tone Number	The number of frequency points used to update the Tone List. It will take effect after clicking *Add to Tone List* .
Notch List	Set the frequency range that needs to filter the Tone List. It will take effect after clicking *Add to Tone List* . See Table 14-2 for details.
Tone List	The frequency point to be output can be manually set. You can also click *Add to Tone List* to generate frequency points. See Table 14-3 for details.

Table 14.2 Notch List parameter description

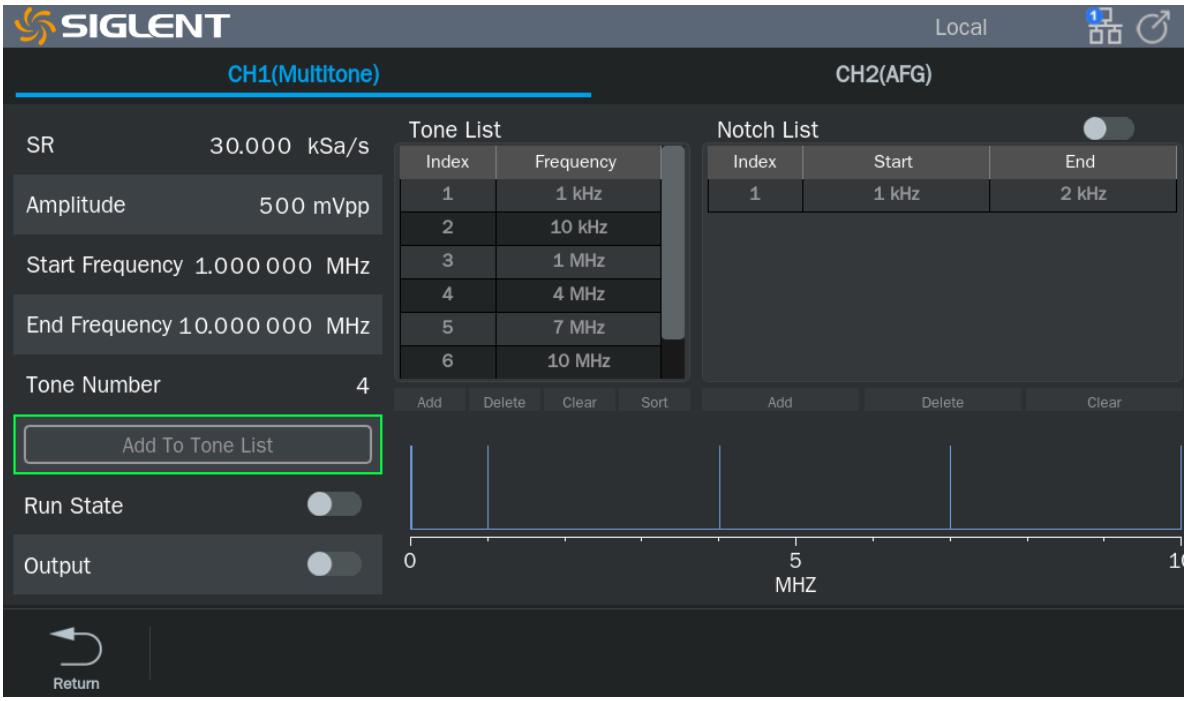
Parameter	Description
Add	Add a frequency range at the end of the Notch List.
Delete	Delete the last frequency range or selected frequency range.
Clear	Clear all frequency ranges and restore default items.

Table 14.3 Tone List parameter description

Parameter	Description
Add	Add a frequency range at the end of the Tone List.
Delete	Delete the last frequency range or selected frequency range.
Clear	Clear all frequency ranges and restore default items.
Sort	Sort all frequency points from small to large.

14.1 Add To Tone List

After clicking *Add To Tone List* , the frequency range will be divided into equal parts according to the Tone Number and added to the Tone List.

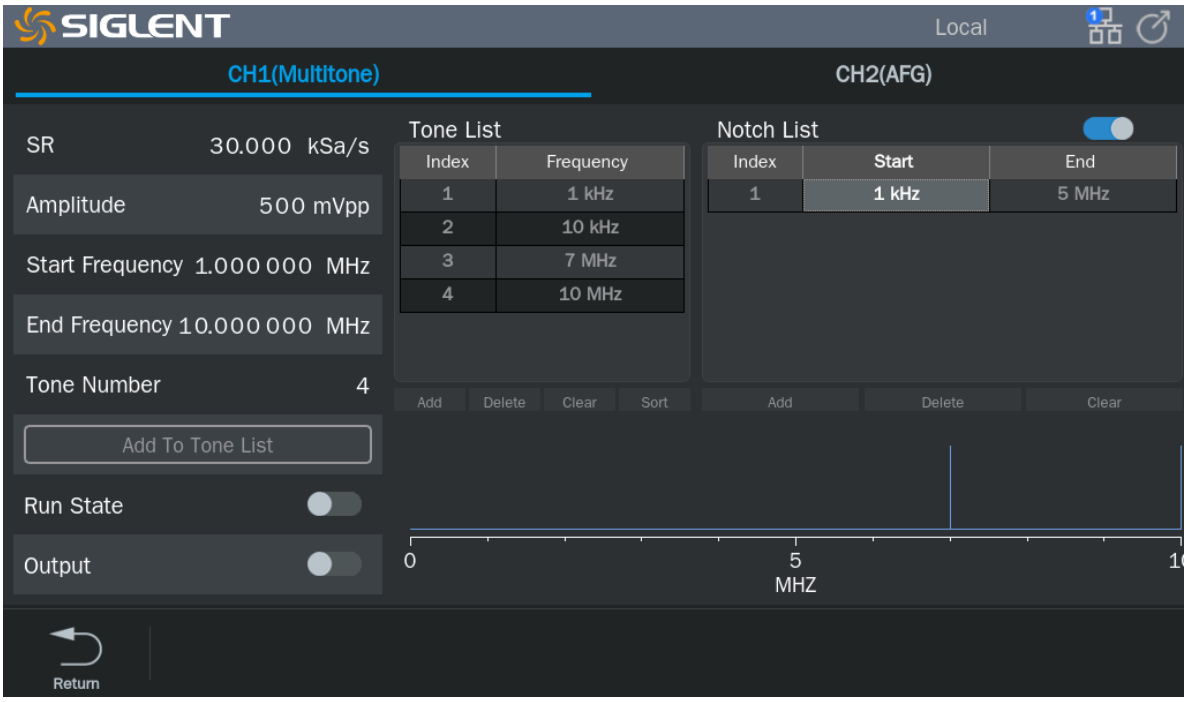


For example, set the Tone Number to 4, the starting frequency to 1 MHz, and the ending frequency

to 10 MHz, then there will be 4 frequency points equally dividing the frequency range, The interval frequency of each frequency point is (End frequency - Start frequency)/(Tone Number - 1), Then four frequency points of 1 MHz, 4 MHz, 7 MHz, and 10 MHz will be added to the Tone List according to the frequency interval of 3 MHz.

14.2 Notch Switch

Notch List can set a frequency range to filter out unwanted frequencies. Open Notch Switch, click *Add To Tone List* , frequency points falling within this frequency range in the Tone List will be cleared.



For example, if you set a frequency range in the Notch List, the starting value is 1 MHz and the ending value is 5 MHz. Turn on Notch Switch, click *Add To Tone List* , the 1 MHz and 4 MHz in the Tone List that fall within the [1 MHz, 5 MHz] range will be cleared. There are only two frequency points left, 7 MHz and 10 MHz.

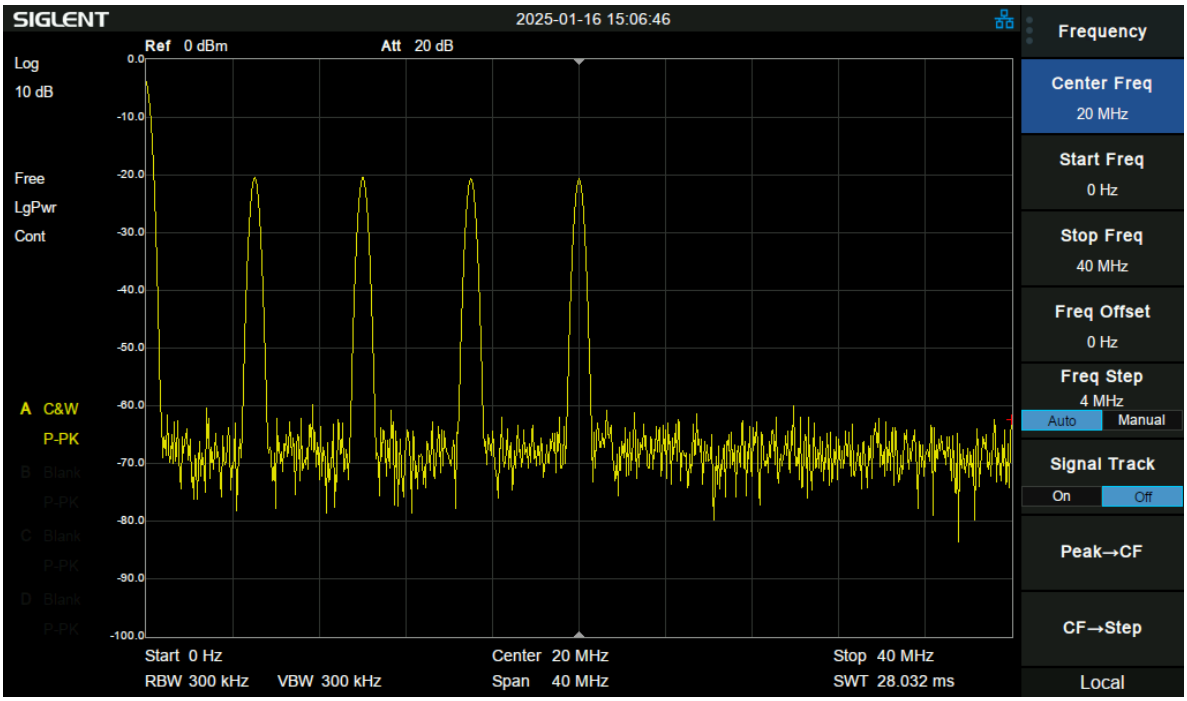
Application example: Output a multi-tone signal and observe the output result. The parameters of the multi-tone signal are as follows:

- SR = 60 MSa/s
- Amplitude = 500mVpp
- Start Frequency = 5MHz

- End Frequency = 20MHz
- Tone Number = 4

1. Click *Tools* in the bottom menu bar;
2. Click *Multitone* to enter the multitone parameter setting interface. Set the sampling rate to 60 MSa/s, the amplitude to 500 mVpp, the starting frequency to 5 MHz, the ending frequency to 20 MHz, and the Tone Number to 4;
3. Click *Clear* in the Tone List, then click *Add To Tone List* ;
4. Click the Run button to start multi-tone playback and turn on the output.

The measurement results of the signal analyzer are as follows. The multi-tone signal has signal output measured at four frequency points: 5M, 10M, 15M, and 20M.



15 Multi Pulse

SDG3000X supports multi-pulse function. Multi-pulse start is divided into channel output and multi-pulse operation. After editing the multi-pulse parameters, turn on the channel output and run to output the multi-pulse wave.

Execute *Tools* > *Multi Pulse* , You can enter the multi pulse parameter setting page.

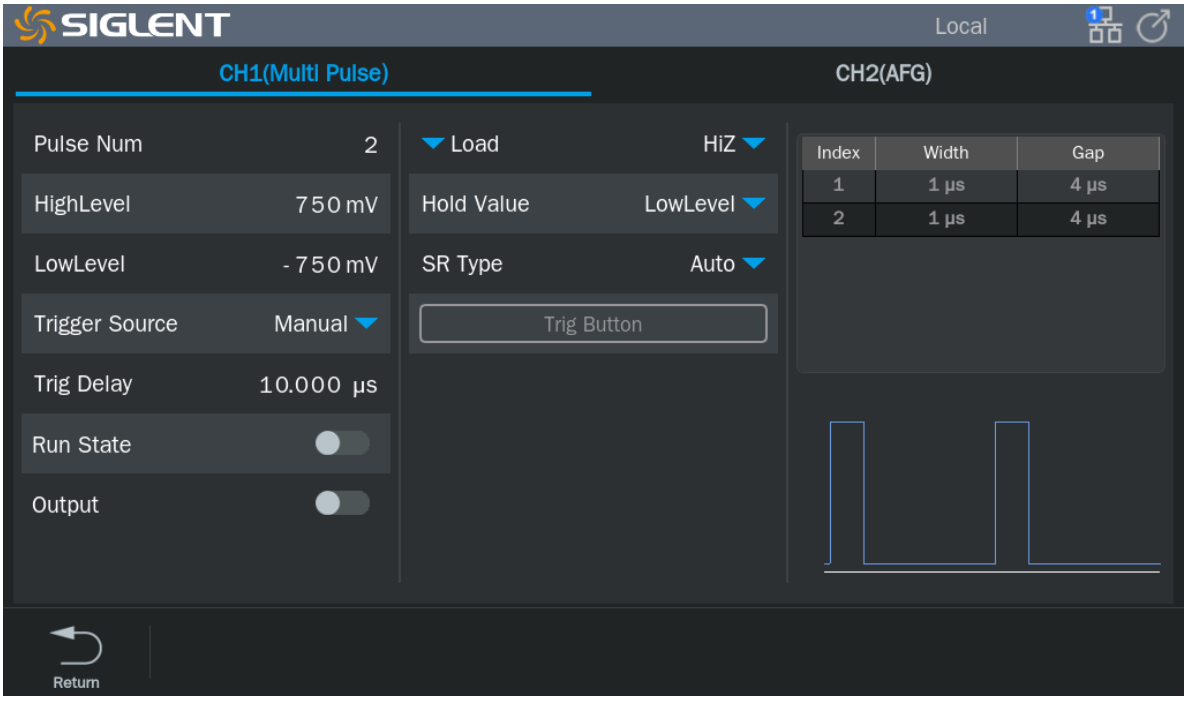


Table 15.1 Multi pulse parameter description

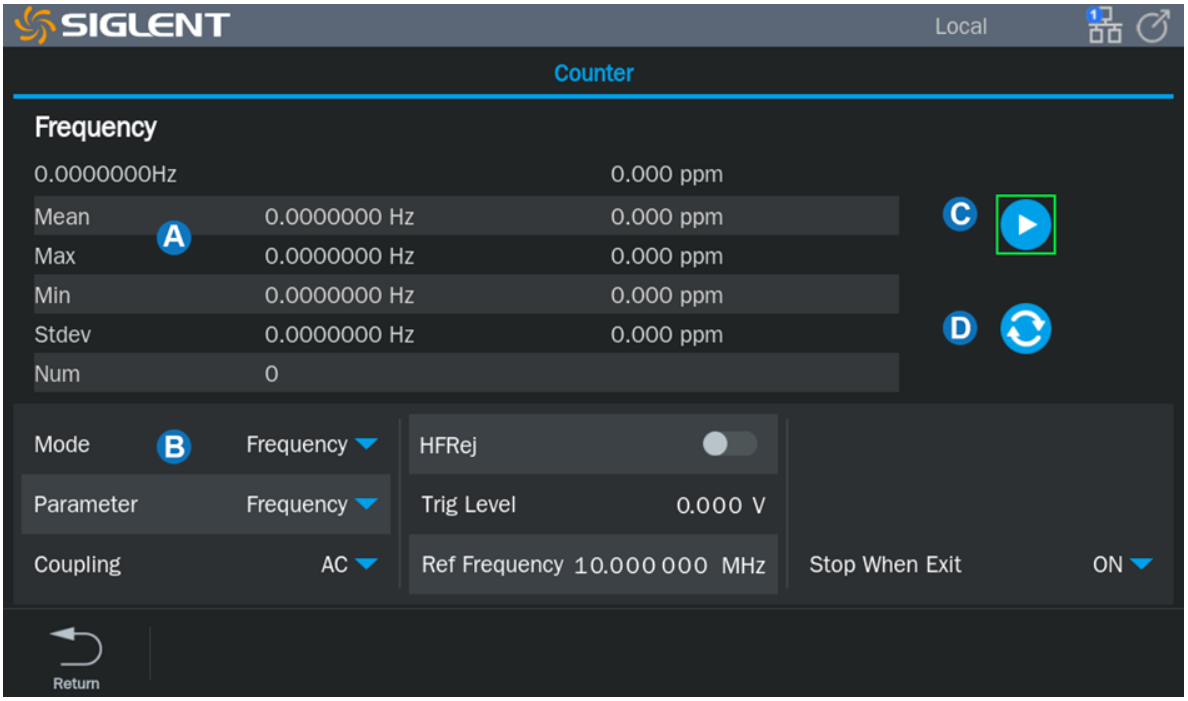
Parameter	Description
Pulse Num	Set the number of output pulse.
HighLevel	Set the high level of the output pulse.
LowLevel	Set the low level of the output pulse.
Trigger Source	Set multi-pulse triggering mode, you can set internal, manual, external, timer trigger.
Trig Delay	Used to set the delay time of multi-pulse output.
Load	Multi-pulse output load can be selected from 50 Ω, HiZ and Custom.
Hold Value	The output level after the pulse output ends. The default output is low level when multi-pulse is stopped.
SR Type	The type can be set to Auto or Custom. When customized, the sampling rate setting range is 10mSa/s ~ 600Msa/s.
Width	Set the positive pulse width of the output pulse.
Gap	Set the negative pulse width of the output pulse.

16 Counter

The counter is used to measure the frequency and period of the current signal, or to count the currently specified trigger event. Click *Counter* in the toolbar of the bottom menu to enter related settings. The counter has two working modes: Frequency and Totalizer.

16.1 Frequency Mode

The parameter setting page of frequency mode is as follows:



A. Measurement value display area

B. Parameter setting box

C. Pause counting

D. Clear statistics

The frequency meter will make statistics on historical measurement data and display the statistical results on the screen.

Table 16.1 Frequency meter statistical value description

Statistical value	Description
Mean	Mean -- the arithmetic mean of all measured values.
Max	Maximum -- the highest value among all measured values.
Min	Minimum value -- the smallest value among all measured values.

Stdev	Standard deviation -- the standard deviation of all measured values, used to determine the distribution of measured parameters.
Num	Number -- the statistical number of measurement values that have been measured.

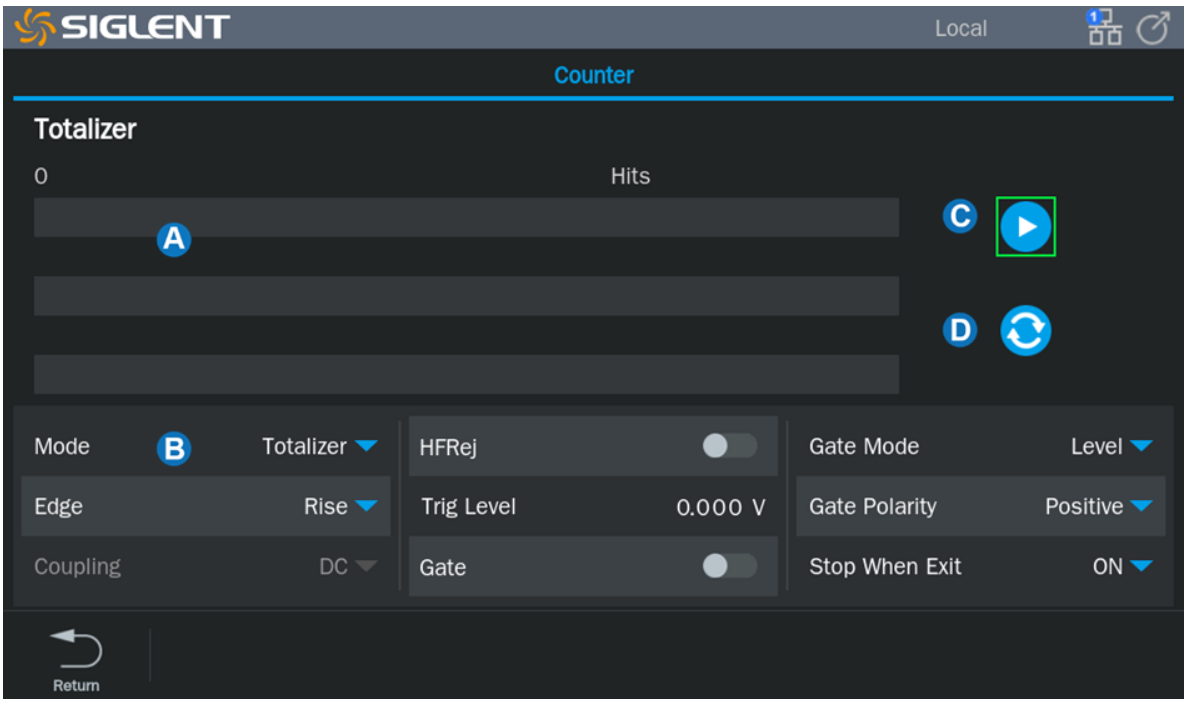
The parameters and descriptions that can be set by the frequency meter are shown in the table below:

Table 16.2 Frequency meter parameter description

Parameter	Description
Parameter	Display parameters can be selected such as frequency, period and duty cycle.
Coupling	AC/DC coupling mode optional. with DC coupling, all frequency components of the signal enter the channel. During AC coupling, the DC component of the signal is isolated, and only the AC component enters the channel.
HFRej	High frequency suppression. Suppress high-frequency components in the signal. Suitable for testing low-frequency signals, suppressing high-frequency noise without affecting useful signals to obtain more accurate test results.
Trig Level	The input signal is compared with the trigger level to generate a count pulse. It is generally recommended to set the trigger level at 50% of the signal swing.
Ref Frequency	The input signal can be compared with the reference frequency to determine its accuracy.
Stop When Exit	When set to on, the counter function will be automatically turned off when exiting the counter setting page. When set to off, the counter function will still run in the background when exiting the counter settings page.

16.2 Totalizer Mode

The parameter setting page of totalizer mode is as follows:



A. Measurement value display area

B. Parameter setting box

C. Pause counting

D. Clear statistics

Table 16.3 Totalizer parameter description

Parameter	Description
Edge	The counter can detect the number of rise/fall edges of the input signal.
HFRej	Suppress high-frequency components in the signal. Suitable for testing low-frequency signals, suppressing high-frequency noise without affecting useful signals to obtain more accurate test results.
Trig Level	The input signal is compared with the trigger level to generate a count pulse. It is generally recommended to set the trigger level at 50% of the signal swing.
Gate	When turning on the door control setting, you need to connect signals to the Trig/Sync IN interface on the front panel and the Counter IN interface on the rear panel at the same time for it to take effect.
Stop When Exit	When set to on, the counter function will be automatically turned off when exiting the counter setting page. When set to off, the counter function will still run in the background when exiting the counter settings page.

Table 16.4 Gate mode description

Parameter	Description
Level	Select the gate mode as level, and set the gate polarity to positive/negative polarity. The counter starts counting only when it detects a signal that meets the polarity conditions.
After Edge	After selecting the gate control mode as edge, you can set the gate control edge as rise/fall. The counter starts counting only when it detects a signal that meets the edge condition.

Table 16.5 Gate polarity description

Parameter	Description
Positive	The counter only starts counting when it detects the positive polarity level of the input gate signal.
Negtive	The counter only starts counting when it detects the negative polarity level of the input gate signal.

Table 16.6 Gate slope description

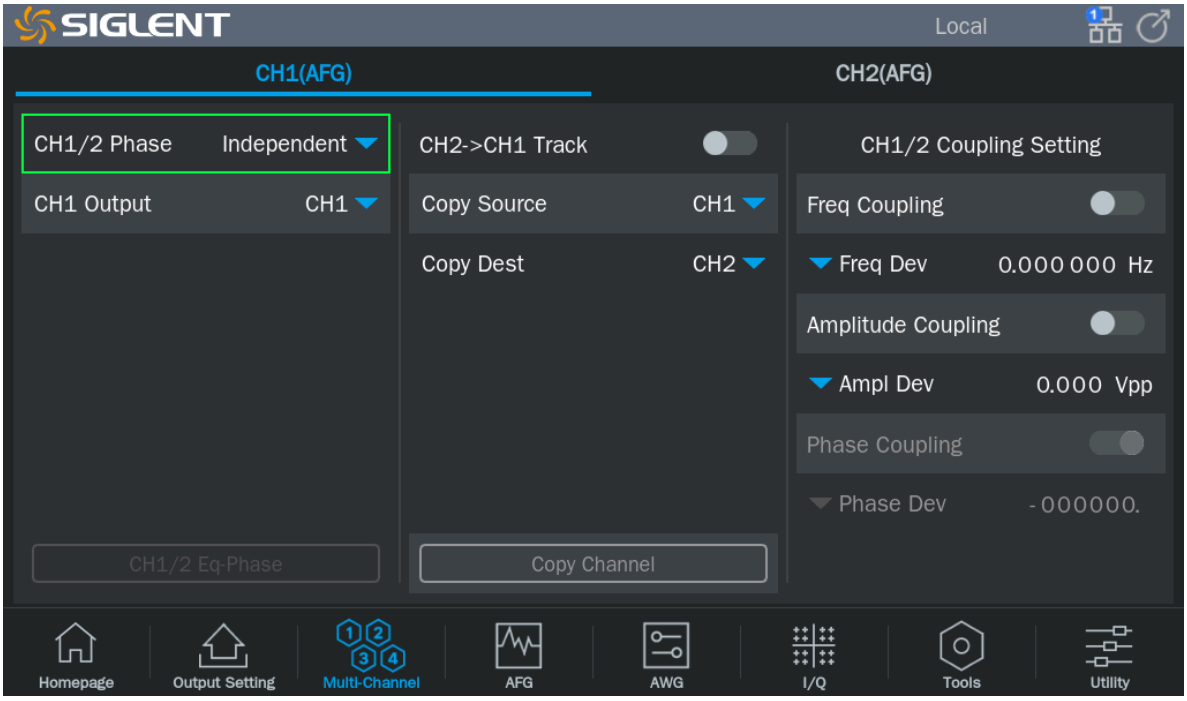
Parameter	Description
Rise	The counter starts counting when it detects the rising edge of the input gate signal.
Fall	The counter starts counting when it detects the falling edge of the input gate signal.

17 Multi Channel

17.1 Overview

SDG3000X has enhanced dual-channel functionality. It has two phase modes, the device can be used as two independent signal generators, and the two channels can be output simultaneously. With tracking, copying and coupling capabilities between two channels, ensure that the parameters of one channel are quickly passed to another channel as needed, greatly simplifies operation and meets the need for fast and synchronous switching of waveforms. Able to combine two channel waveforms and output, It has the advantages of good real-time performance, the ability to superimpose real noise, modulation signals, sweep signals, burst signals and Arb waveforms. Provides users with a new means of accurately generating complex waveforms.

Click *Multi-Channel* in the menu bar at the bottom of the UI to enter multi-channel related settings.



17.2 Phase Mode

SDG3000X supports phase independent mode and locked mode.

Independent mode: The two channels can be used as two independent signal generators, setting one

channel does not affect the output of the other channel.

Locked mode: Two channels are output synchronously, with initial phase alignment. And ensure that the two are phase-locked when the frequencies are integer multiples of each other and will not drift.

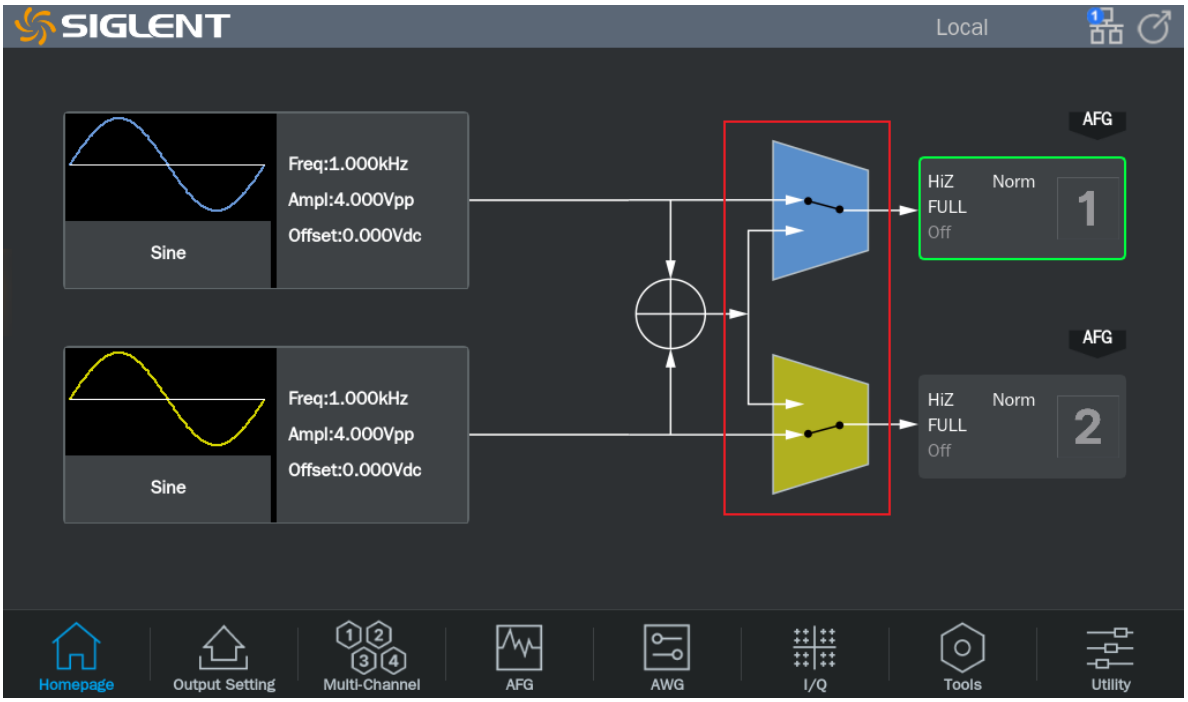
17.3 Channel Combine

Channel combine can combine the waveforms of two channels and output them. It has the advantages of good real-time performance, the ability to superimpose real noise, modulation signals, sweep signals, burst signals and Arb waveforms. Provides users with a new means of accurately generating complex waveforms.

Click *CH1 Output* under the CH1 multi-channel setting page, You can choose to output the waveform of CH1 or the waveform of CH1 + CH2.

Click *CH2 Output* under the CH2 multi-channel setting page, You can choose to output the waveform of CH2 or the waveform of CH2 + CH1.

You can also click the corresponding selector directly on the block diagram on the home page to set the output waveform of a single channel or the combined waveform:



17.4 Channel Track/Coupling/Copy

Table 17.1 Channel operation description

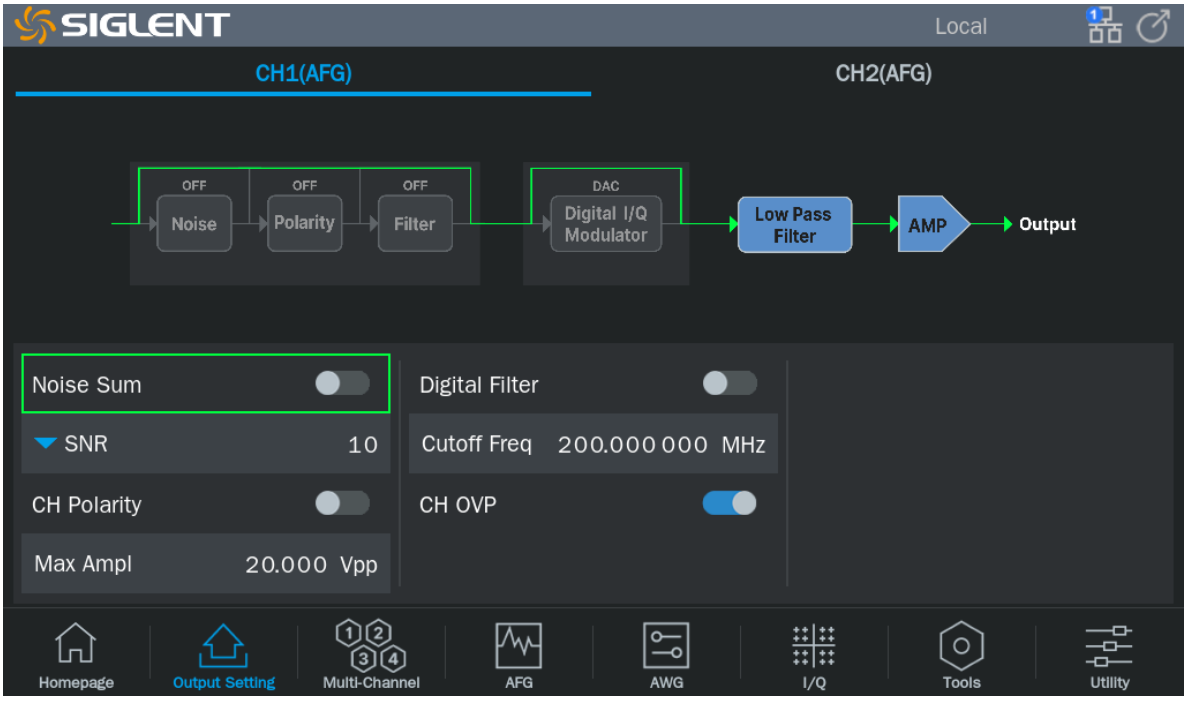
Operate	Description
Channel Track	The parameters of the two channels are completely synchronized. Setting the parameters of one channel will be automatically passed to the other channel. At this time, the two channels copy each other. In tracking mode, the device will force the phase mode to "Locked" mode and only allow the parameters of CH1 to be set.
Channel coupling	The parameters of the two channels are coupled according to a certain relationship with CH1 as the reference. The parameters set for one channel will be automatically converted according to the coupling relationship and then passed to the other channel. The settable coupling parameters include frequency, amplitude and phase, and the coupling relationship can be proportion or deviation.
Channel copy	Manually copy parameters from one channel to another. Changing the parameters of one channel afterwards will not cause the parameters of the other channel to change.

18 Output Settings

18.1 Overview

The waveform of each channel can undergo some processing before output, including polarity control, noise summing, digital filtering, amplitude limitation, etc.

Click *Output Setting* in the menu bar at the bottom of the UI to enter the relevant settings page.



18.2 Noise Sum

You can choose to add random noise to the signal and then output it to simulate a real scenario where the signal is contaminated by noise. You can set the "Noise Sum" switch and signal-to-noise ratio in the output settings page. The unit of signal-to-noise ratio is ratio (dimensionless) or dB.

Application example: Simulate a 1 MHz sine wave contaminated by Gaussian noise:

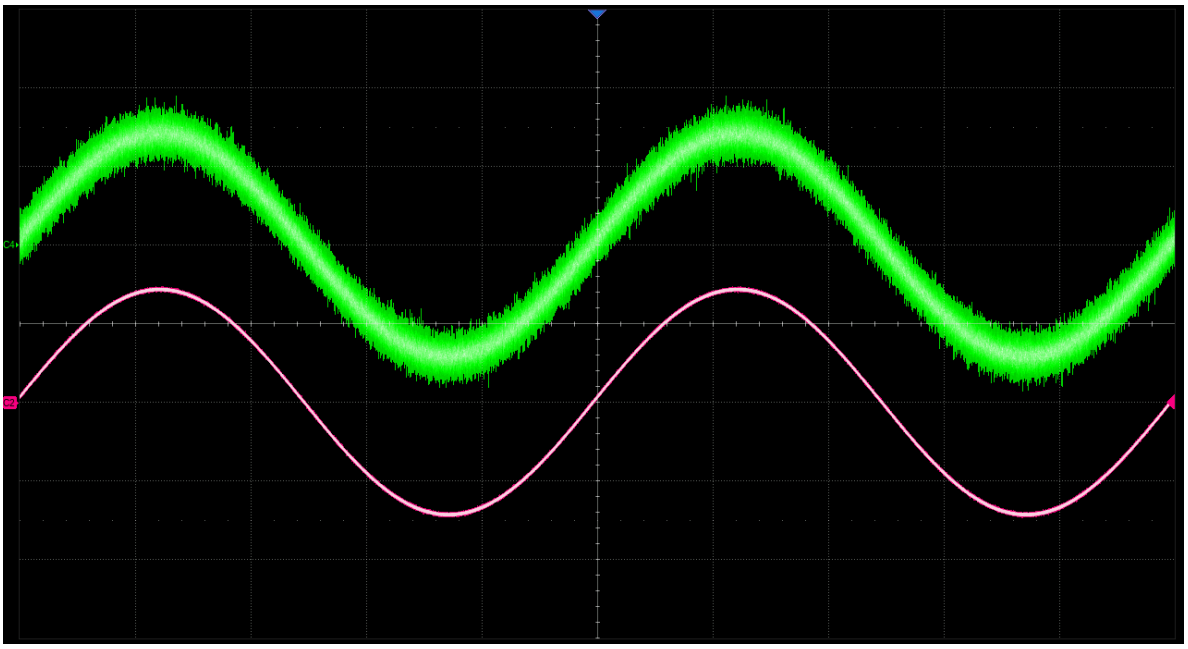
- Amplitude = 1 Vrms
- SNR(dB) = 20 dB

1. Set the carrier waveform of CH1 to SINE, frequency to 1MHz, and amplitude to 1 Vrms;
2. On the output settings page, turn on the noise superposition switch and set the signal-to-noise

ratio to 20 dB;

3. Turn on the channel output of CH1.

Follow the above steps to output the expected signal. The output results are as follows. The red trace in the figure is the signal before adding noise, and the green trace is the signal after adding noise.



18.3 CH Polarity

This function can set the positive polarity output or negative polarity output. When outputting with negative polarity, the device inverts the data before outputting it. At this time, a signal will be obtained that is inverse of the relative offset when outputting with positive polarity.

18.4 Max Ampl

In some application scenarios, users need to limit the amplitude of the channel output to ensure that amplitude-sensitive signal receiving equipment is not damaged. Click Amplitude Limit on the output setting page to set the maximum output amplitude. The default maximum amplitude is the maximum amplitude value that the device can provide. See the data sheet for details.

18.5 Digital Filter

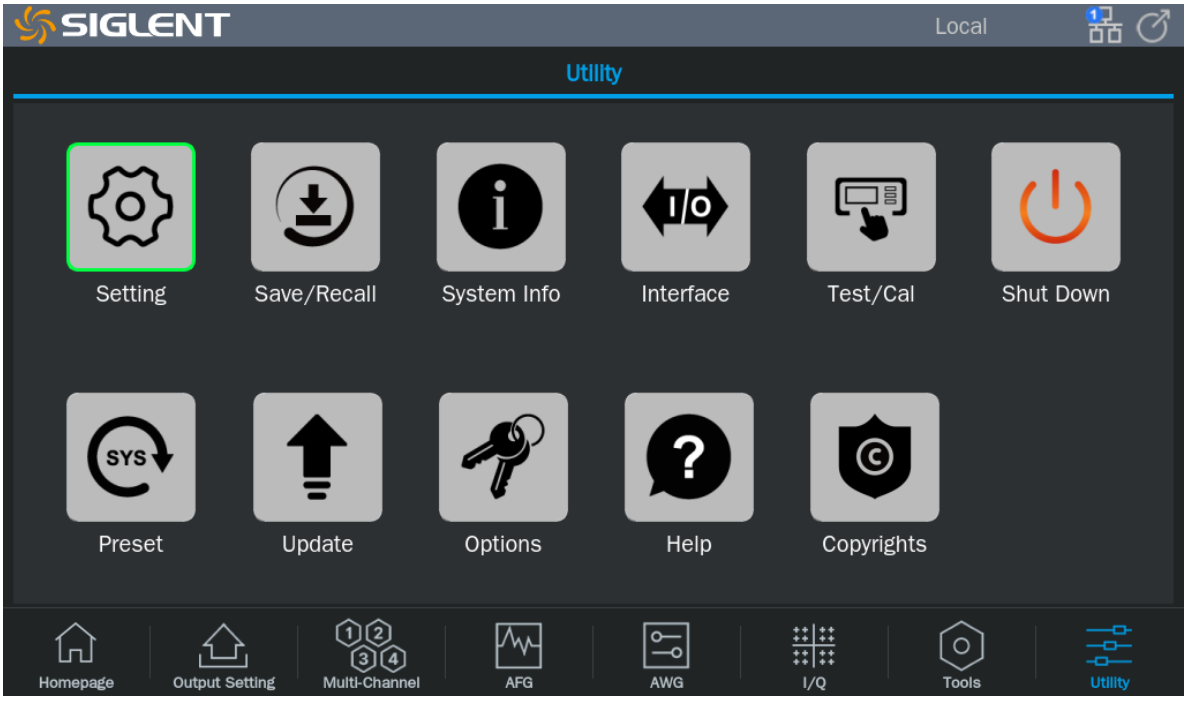
Each channel of the device integrates a digital filter to support low-pass filtering of output data. The cutoff frequency of the filter can be set, so that users can digitally filter the output signal according to their own needs.

18.6 CH OVP

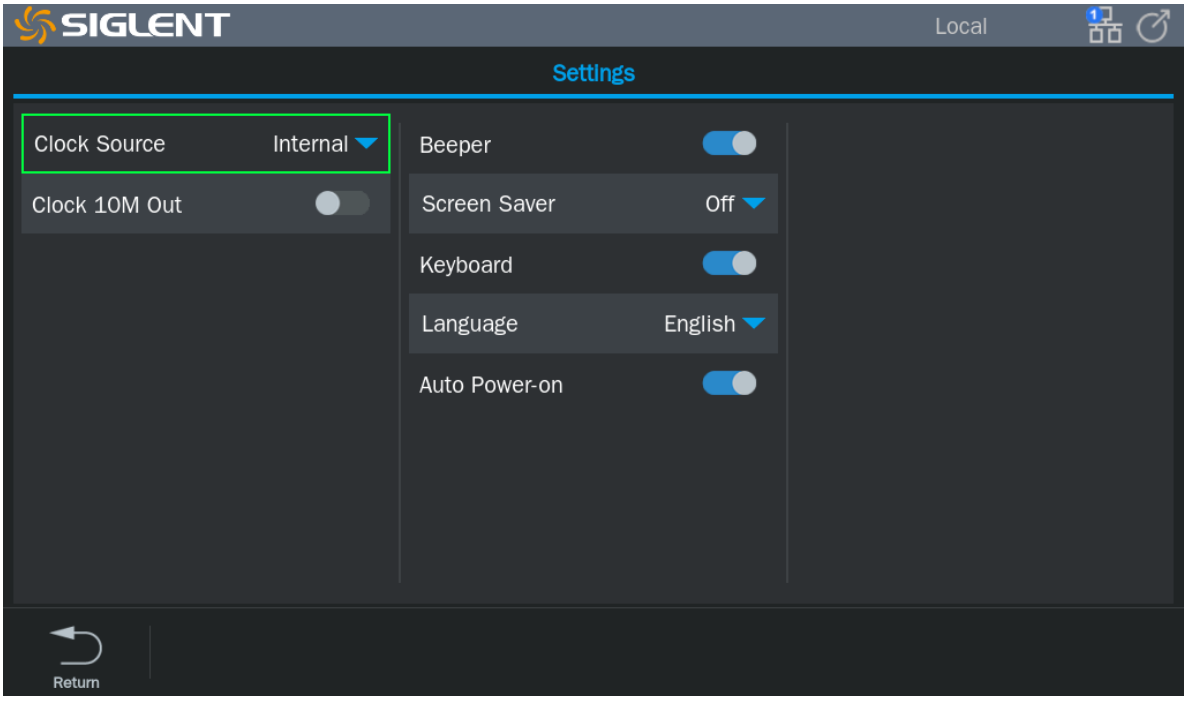
When overvoltage protection occurs, the device will prompt and turn off the channel output. Users can choose to turn on or off the overvoltage protection on the output setting page. If overvoltage protection is turned off, there will be no prompt when overvoltage occurs, and the channel output will not be turned off.

19 Utility settings

The utility function of SDG3000X can select and set system settings, interface, test/cal and preset functions.



19.1 Settings



19.1.1 Clock source settings

Execute Utility > *Setting* > *Clock Source* , Select the internal reference clock and external reference clock from the pop-up list.

19.1.2 Language settings

The operation interface of SDG3000X supports Simplified Chinese and English.

Execute Utility > *Setting* > *Language* , Select the language in the pop-up list.

19.1.3 Power on settings

Execute Utility > *Setting* > Auto *Power-on* , Just turn on or off the power-on switch..

19.1.4 Beeper settings

Execute Utility > *Setting* > *Beeper* , Set to turn on/off.

19.1.5 Keyboard settings

Execute Utility > *Setting* > *Keyboard* , Set to turn on/off.

19.1.6 Screen Saver settings

Execute Utility > *Setting* > *Screen Saver* , Just select the screen saver time in the pop-up list.

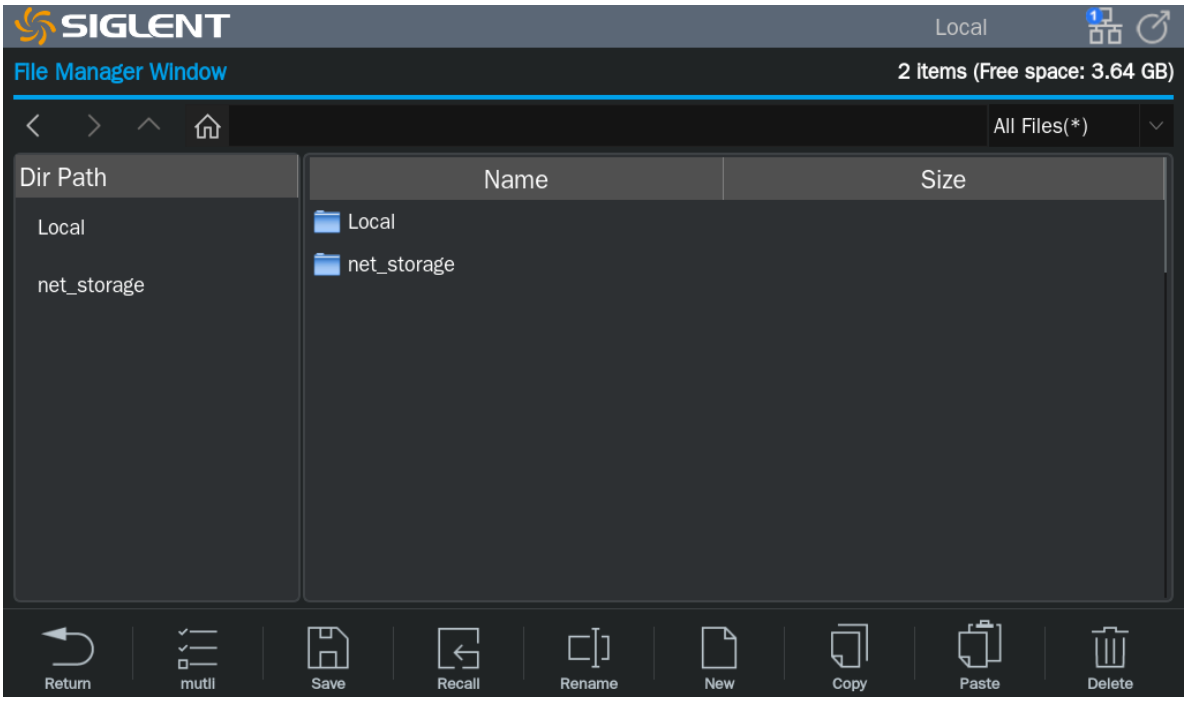
19.1.7 Clock 10M Out settings

Execute Utility > *Setting* > *Clock 10M Out* , Set to turn on/off.

After turning on the 10M clock output, the 10MHz Out on the rear panel will output a 10MHz reference clock signal.

19.2 Save/Recall

SDG3000X supports storing and calling setup files, waveform files and firmware upgrade files. The storage and calling locations include internal memory (Local) or external USB storage devices (such as U disk). The storage and calling operations are realized through the file manager, as shown in the following figure.



19.2.1 Storage system

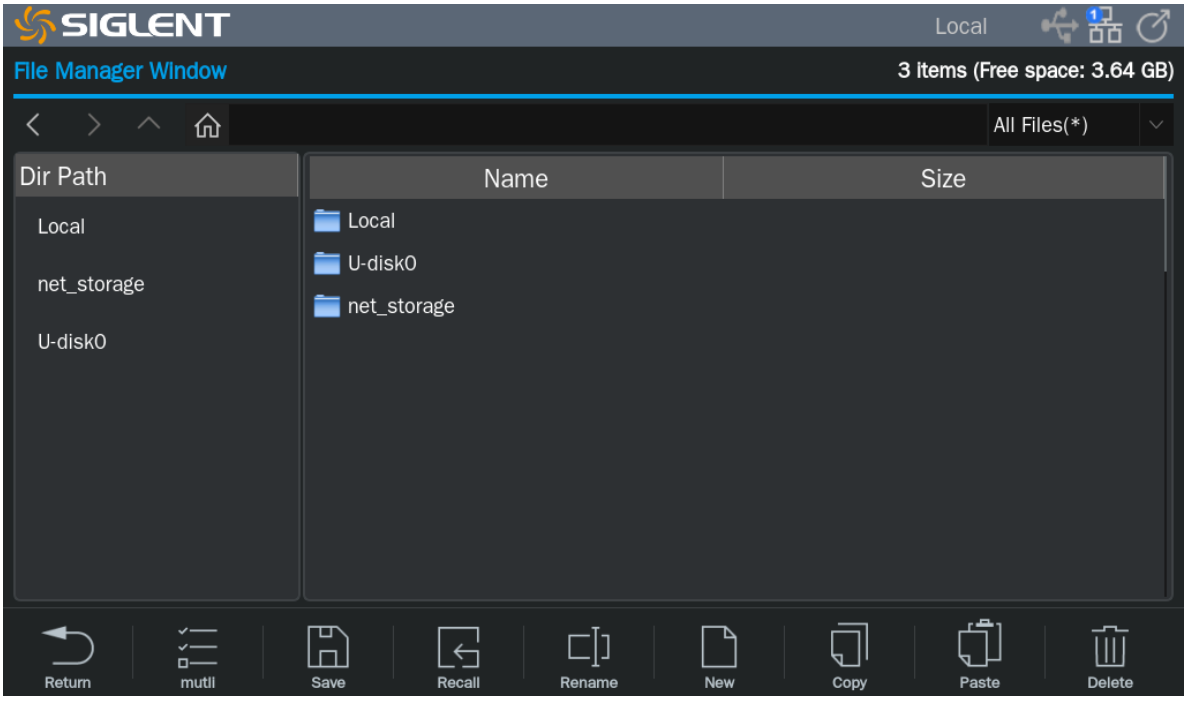
SDG3000X supports storing the current state of the instrument into internal or external memory, and supports users to call it when necessary. Users can download arbitrary wave files to the internal memory through the arbitrary wave editing software EasyWaveX, or read arbitrary wave files from the U disk and save them to the internal memory. SDG3000X provides an internal nonvolatile memory and an external memory interface.

Local

SDG3000X provides internal non-volatile memory, and users can save instrument status and arbitrary waveform files to local paths.

U-disk0

SDG3000X comes standard with USB Host, which is located at the lower left side of the instrument front panel, and supports U disk storage and firmware upgrade. When a mobile medium such as a USB flash drive is plugged into the USB Host interface, a "U-disk0" path will appear in the file management interface, and a prompt "The storage device is connected successfully" will appear. When the USB flash drive is unplugged from the USB Host interface, the system will prompt "The storage device is disconnected.", and the corresponding path disappears.



Note: SDG3000X can only recognize files with English characters, numbers and underscores. If you use other special characters to name files or folders, it may not be displayed normally in the file management interface.

19.2.2 File type

SDG3000X supports the saving and calling of waveform data files and status files. See the table below for specific instructions:

Table 19.1 File type description

File type	Description
*.xml	Status file. It includes parameters set by each functional module of the instrument and parameters set under the system setting menu.

*.bin	Binary arbitrary waveform data file can be directly called by the device. The data files downloaded to the device through the host computer EasyWaveX are also in this format.
*.csv	Arbitrary wave data files supported by the device can be called from external memory, at the same time, it is converted into a file in *.bin format and stored in the internal memory.
*.dat	Arbitrary wave data files supported by the device can be called from external memory, at the same time, it is converted into a file in *.bin format and stored in the internal memory.
*.mat	Arbitrary wave data files supported by the device can be called from external memory, at the same time, it is converted into a file in *.bin format and stored in the internal memory.
*.arb	IQ data file. Can be called by the IQ function.
*.awgx	AWG wave file. Can be called by AWG function.
*.hop	Frequency hopping frequency table, frequency hopping sequence list, frequency filter table configuration file. Can be called by HOP function.

19.2.3 File operation

Files can be saved, loaded, copied and pasted through the bottom menu bar. See the table below for specific instructions:

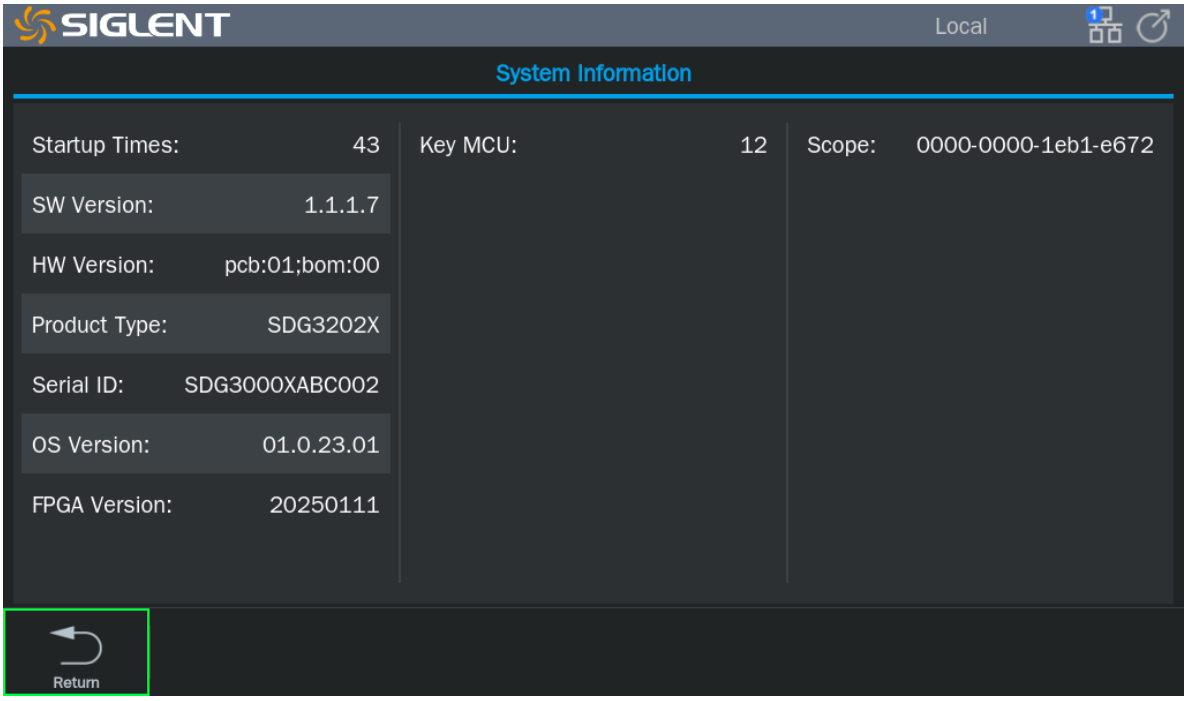
Table 19.2 File operation description

Menu	Description
Save	The status of the current machine can be saved to an xml file at the specified path.
Recall	Xml, bin, csv, awgx and other files on the specified path can be loaded and called.
Rename	Can modify the file name or folder name on the specified path.
New	You can create a new folder path on the specified path.
Copy	Select the file or folder you want to copy and click Copy to copy the file or folder.
Paste	Enter the specified path that needs to be copied and click Paste to copy the copied files or folders to the path.
Delete	Select the file or folder you want to delete and click Delete to delete the file or folder.

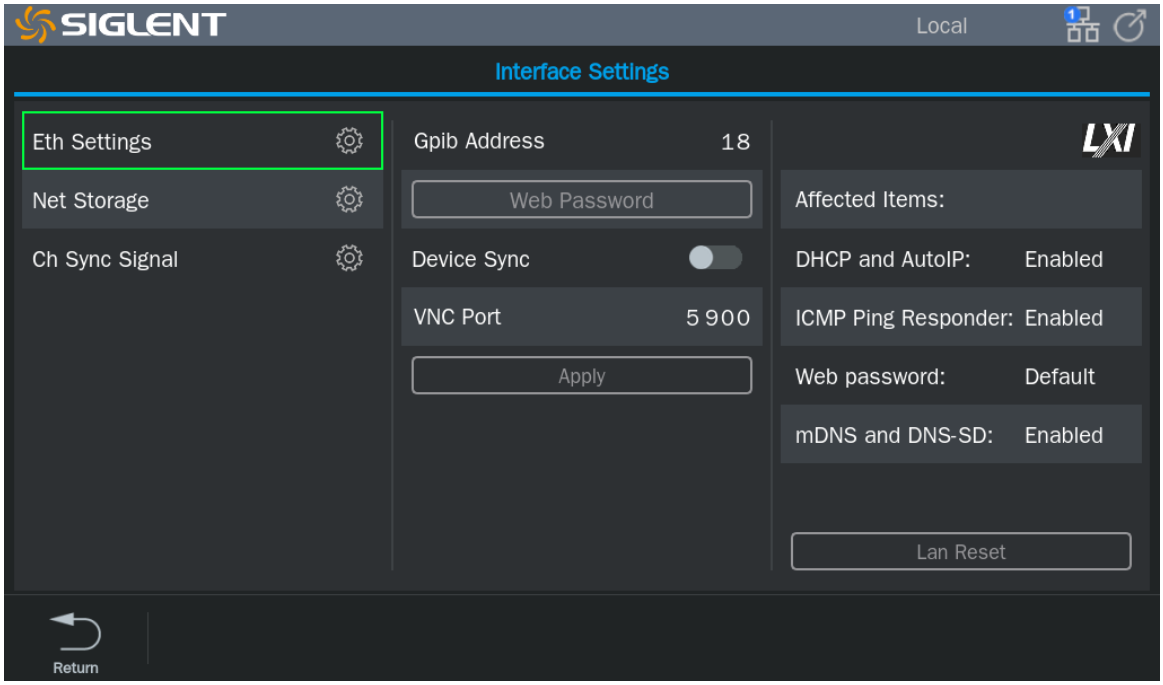
Multi	Click Multi-Select to select multiple different files or folders on the specified path.
All	This menu appears after clicking multi-select, and all files or folders on the specified path can be selected.
None	Click none to uncheck the selected files or folders on the specified path.
Invert	Click Invert Select to change the selected files or folders on the specified path to unselected, and the unselected files or folders to become selected.

19.3 System Information

Execute Utility > *System Info* , You can view the current version information of the device. System information includes the following contents:

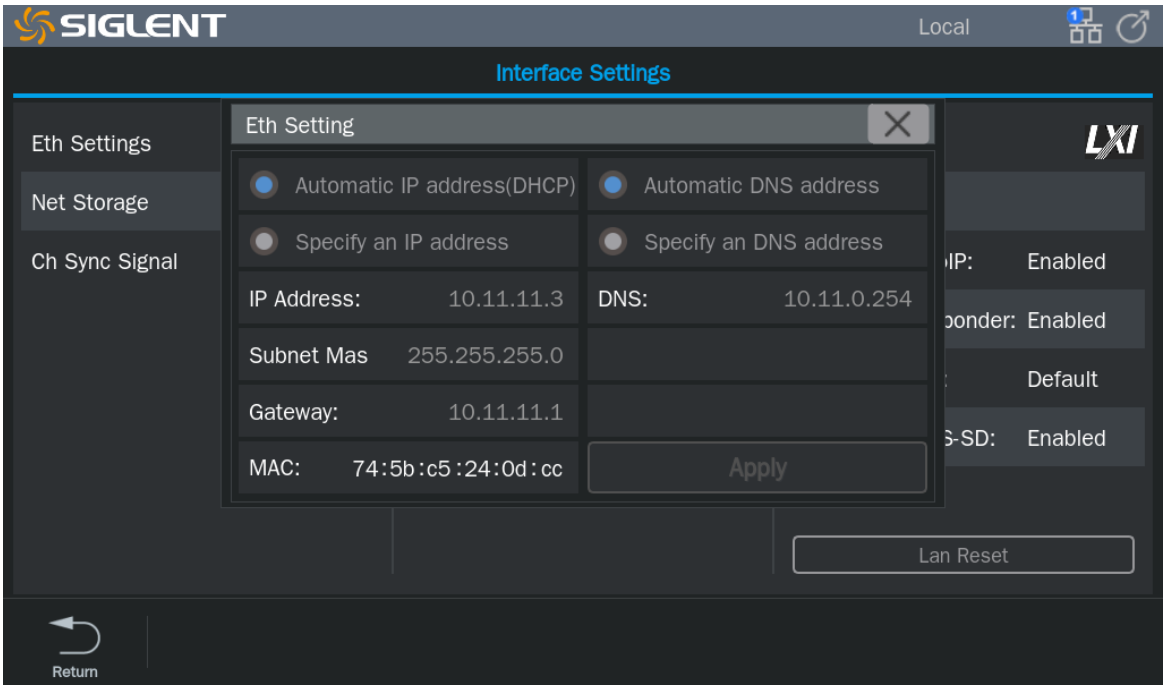


19.4 Interface Settings



19.4.1 Eth Settings

Execute Utility > *Interface* > *Eth Settings* , You can enter the web port setting page.



19.4.2 Net Storage

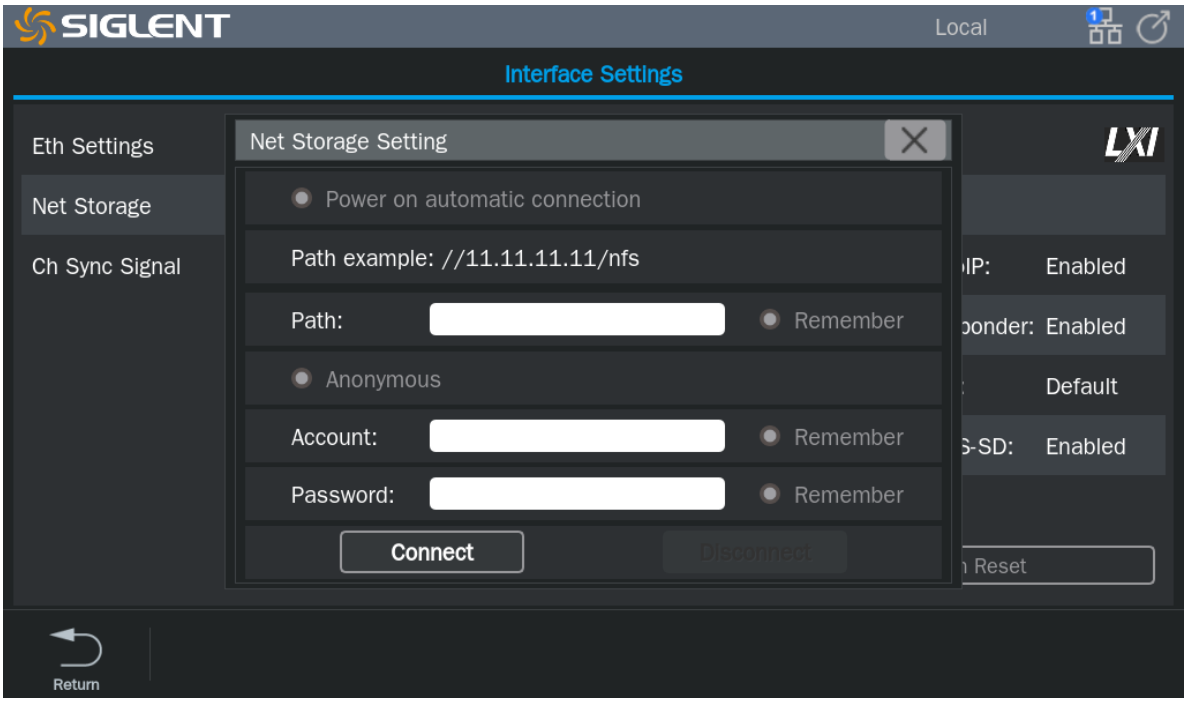
Execute Utility > *Interface* > *Net Storage* , You can enter the network storage settings page.

According to the example, enter the network path (//xx.xx.xx.xx/xxx) in the path and click Connect. If the connection is successful, the path net_storage will appear in the file management window, and you can access the computer's shared folder through the LAN.

After connecting to the network storage path, you can choose to connect automatically at startup. After setting this function, you need to set the power-on setting to the last time or user (see 19.6 Presets Setting). After restarting the machine, the network path can be automatically connected.

If the accessed shared folder is set with an account and password, you need to enter the account and password to connect and access. If anonymous access is checked, you can connect and access the shared folder without entering the account password (the computer needs to set the shared folder to a non-password-protected share).

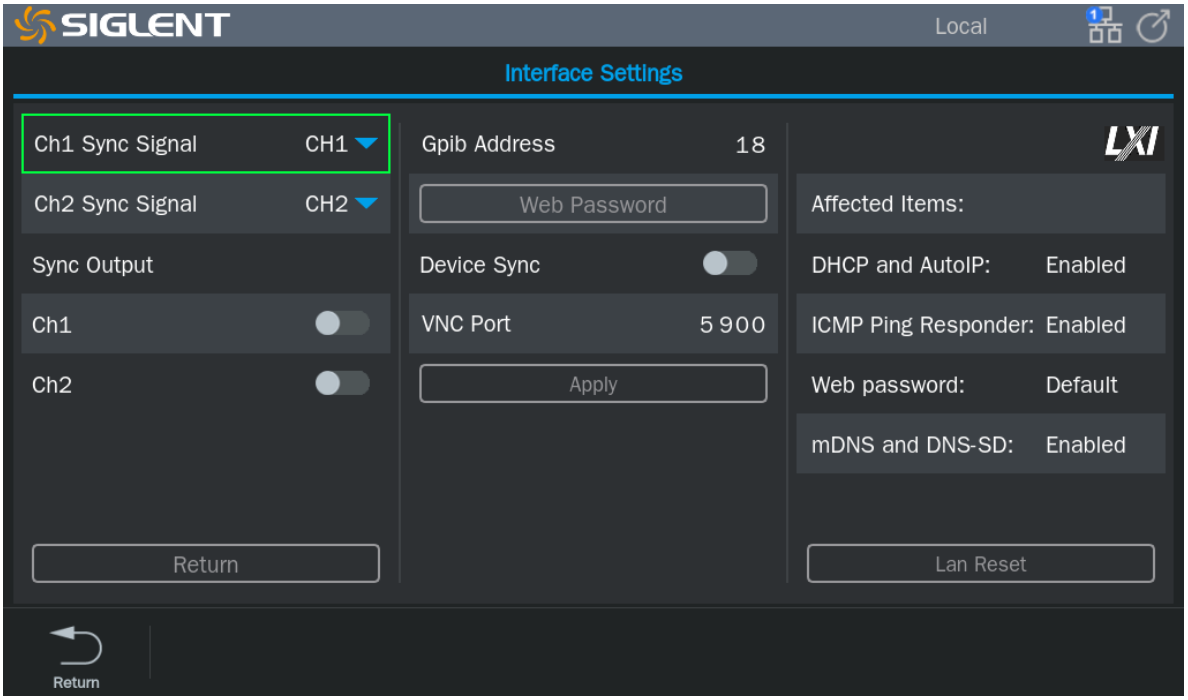
Each time the connection is disconnected, the entered path, account, password and other information will be cleared. You can save the input information by checking "Remember", so that you can connect without re-entering the path every time you disconnect.



19.4.3 Ch Sync Signal

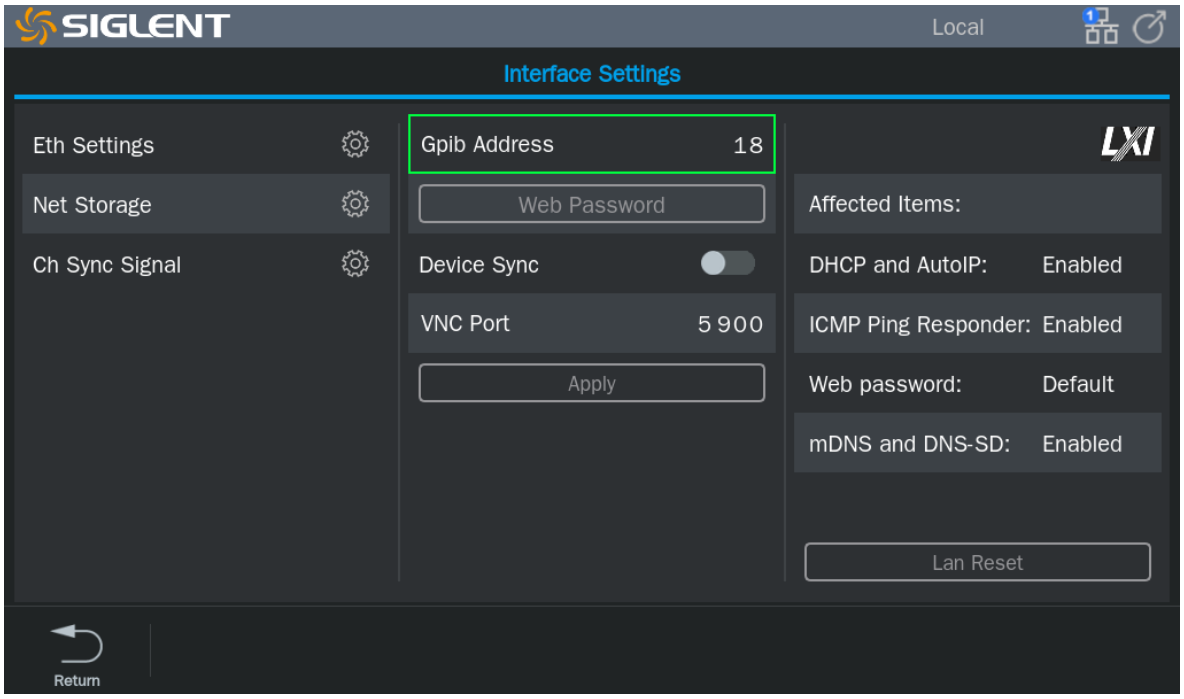
Execute Utility > *Interface* > *Ch Sync Signal* , You can enter the synchronization settings page.

By default, the synchronization signal types of channel 1 and channel 2 are only CH1 and CH2. Only when the MOD mode is turned on, the synchronization signal type can be selected as MOD-CH1 or MOD-CH2. The synchronous outputs of CH1 and CH2 are mutually exclusive. If the synchronous output of channel 1 is turned on, the synchronous output of channel 2 will be turned off, and vice versa.



19.4.4 Gpib Setting

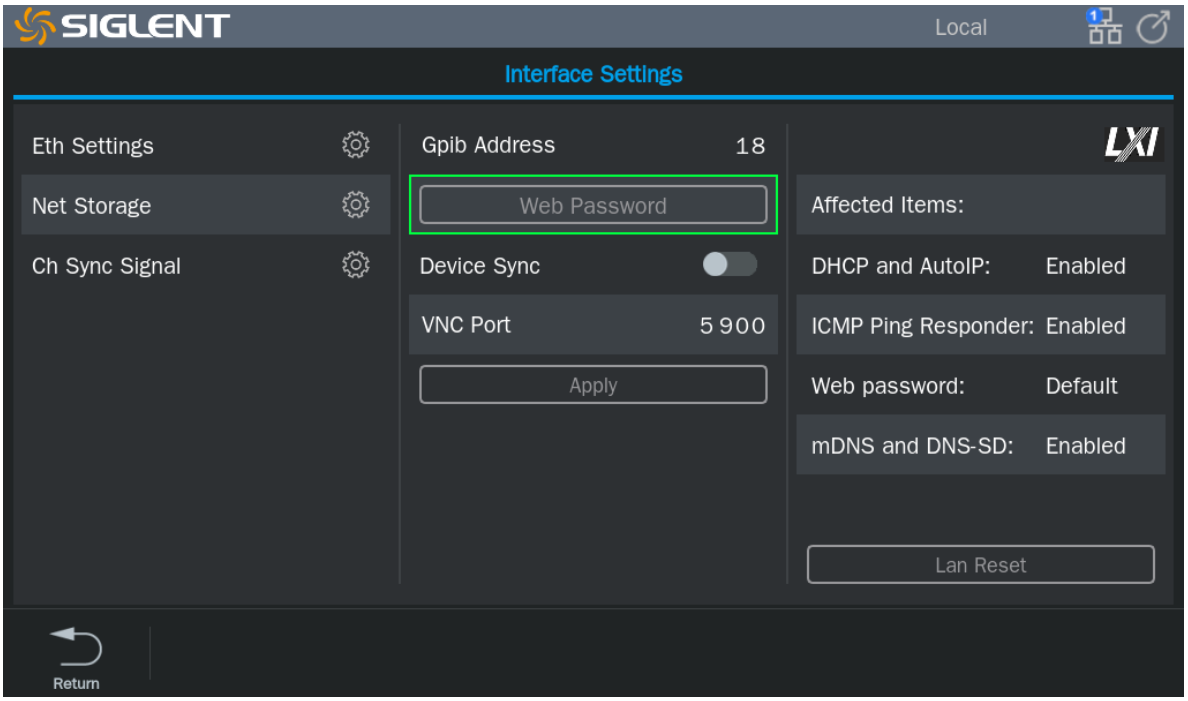
Execute Utility > *Interface* > *Gpib Address* , The equipment can communicate with computers or other upper computers through GPIB. Every device on the GPIB interface must have a unique address. GPIB setting range is 1-30.



19.4.5 Web Password Setting

Execute Utility > *Interface* > *Web Password* , You can set the password of the device Web remote control.

After setting the web page password, enter the device IP address in the browser. The remote control device needs to enter the password to enter. You need to enter the web page password every time you refresh the web page. If you do not need to enter a password, re-enter the web password setting, clear the password that has been set, and do not set another password.



19.4.6 Device Sync

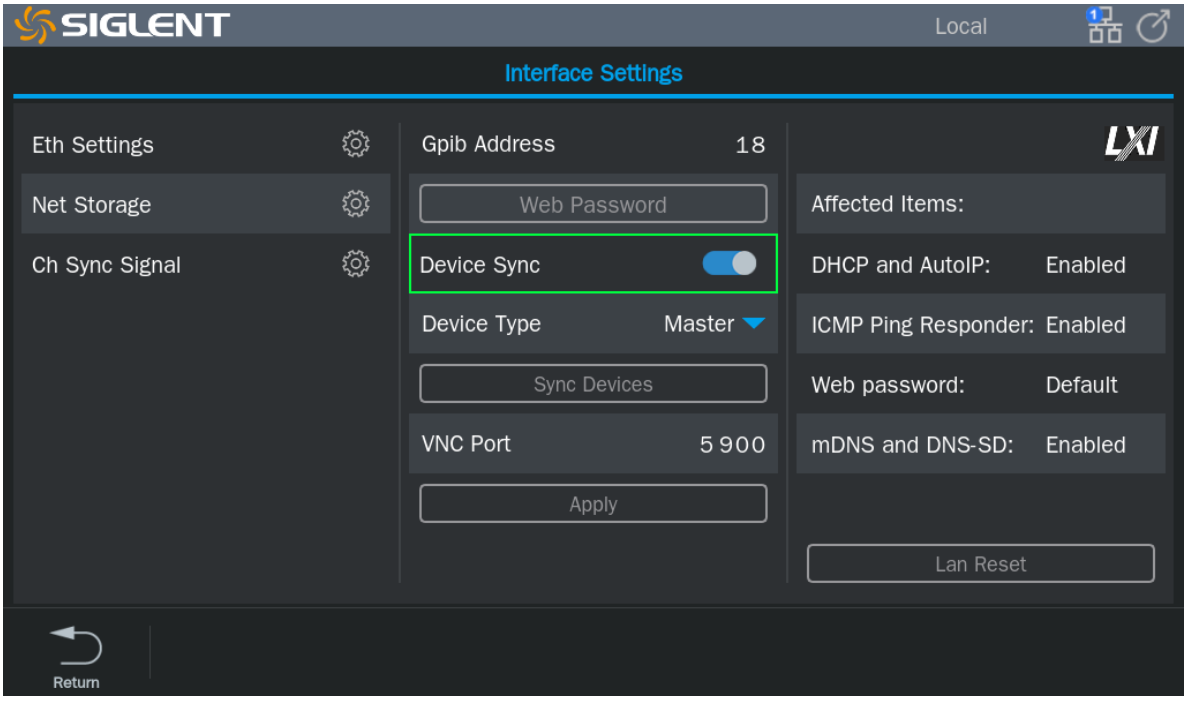
SDG3000X supports synchronization between two or more devices and can achieve in-phase output, which is used to expand multiple two-channel devices to four or more channels.

Execute Utility > *Interface* > *Device Sync* , You can open the device synchronization settings page. The specific steps are as follows:

1. After entering the multi-device synchronization setting interface, turn on the device synchronization switches of all instruments.
2. Set one of the machines as the master and the other machines as slaves.
3. Divide the [Trig/Sync Out] of the host machine into multiple channels, and then connect the [Trig/Sync In] of other slave machines respectively.
4. Connect the [10MHz Out] of the master to the [10MHz In] of the slave. If there are multiple slaves, connect the [10MHz Out] of the first slave to the [10MHz In] of the second slave. By analogy, connect the [10MHz Out] of the previous instrument to the [10MHz In] of the next instrument.
5. Set channel parameters for all machines and turn on channel output.
6. Press *Sync Devices* on the host computer to achieve synchronized and in-phase output of all instruments.

After pressing *Sync Devices* , the synchronization signal is transmitted to the slave device's

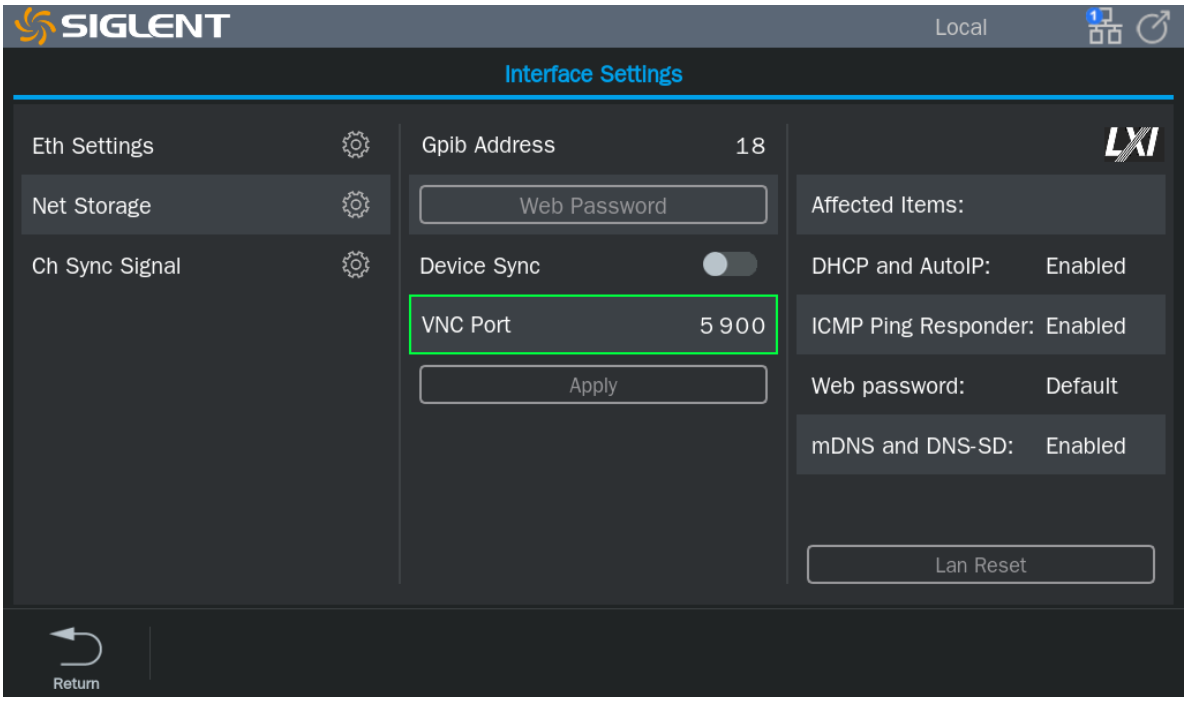
[Trig/Sync In] via the BNC cable through the host's [Trig/Sync Out]. The synchronization signal received by the slave will be delayed relative to the host, so there is actually a certain phase difference between the output waveforms of the slave and the host. The size of the phase difference is related to the BNC cable used. It is recommended to use the BNC cable that comes standard with the product. Fixed phase difference can be achieved by The *Slave Delay* to compensate.



19.4.7 VNC Port Setting

Execute Utility > *Interface* > *VNC Port* , The equipment can communicate with computers or other upper computers through VNC.

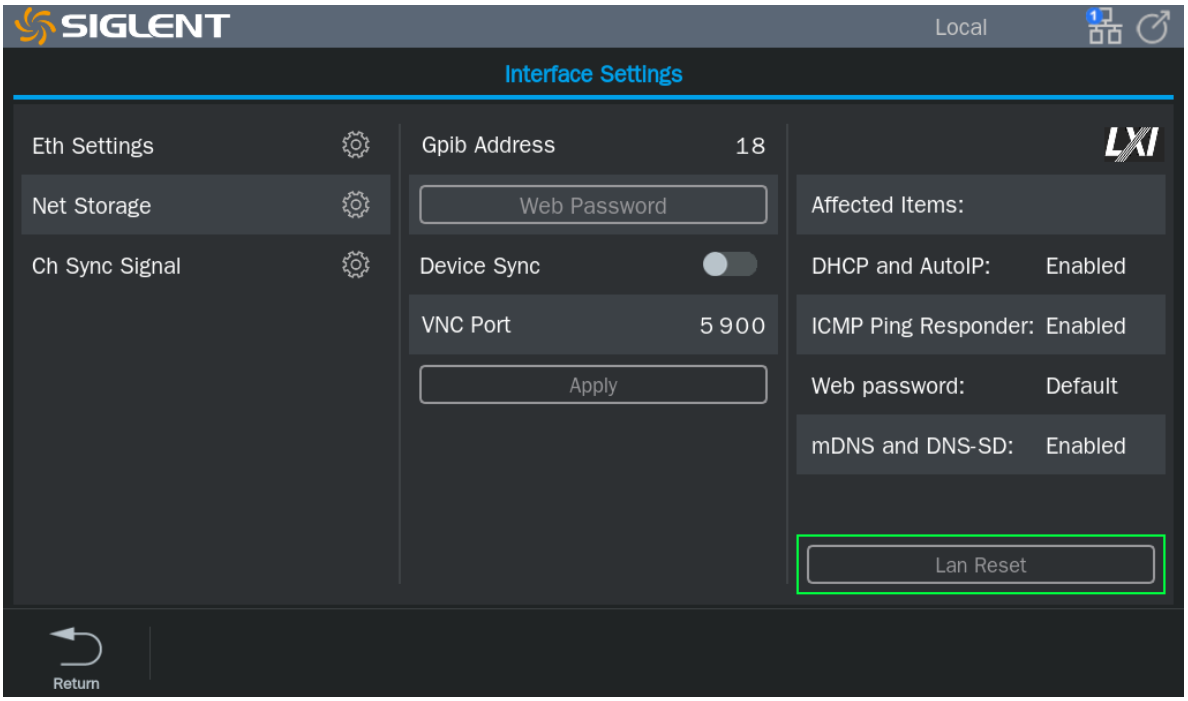
The use of VNC is similar to web connection. Enter the IP address and VNC port number of the device in the host computer software to connect to the device for remote control.



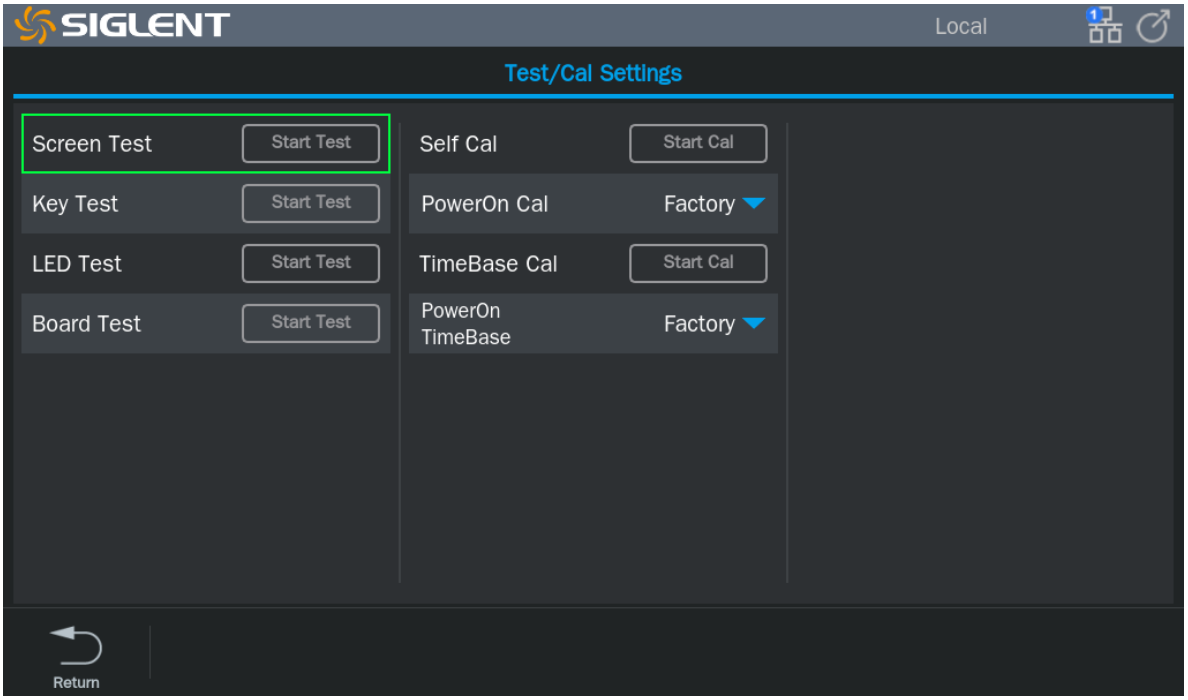
19.4.8 LXI Setting

The machine conforms to version 1.5 defined in LXI Equipment Specification 2016, and can be used to quickly build an automated test system.

Execute Utility > *Interface* , You can enter the LXI settings page.

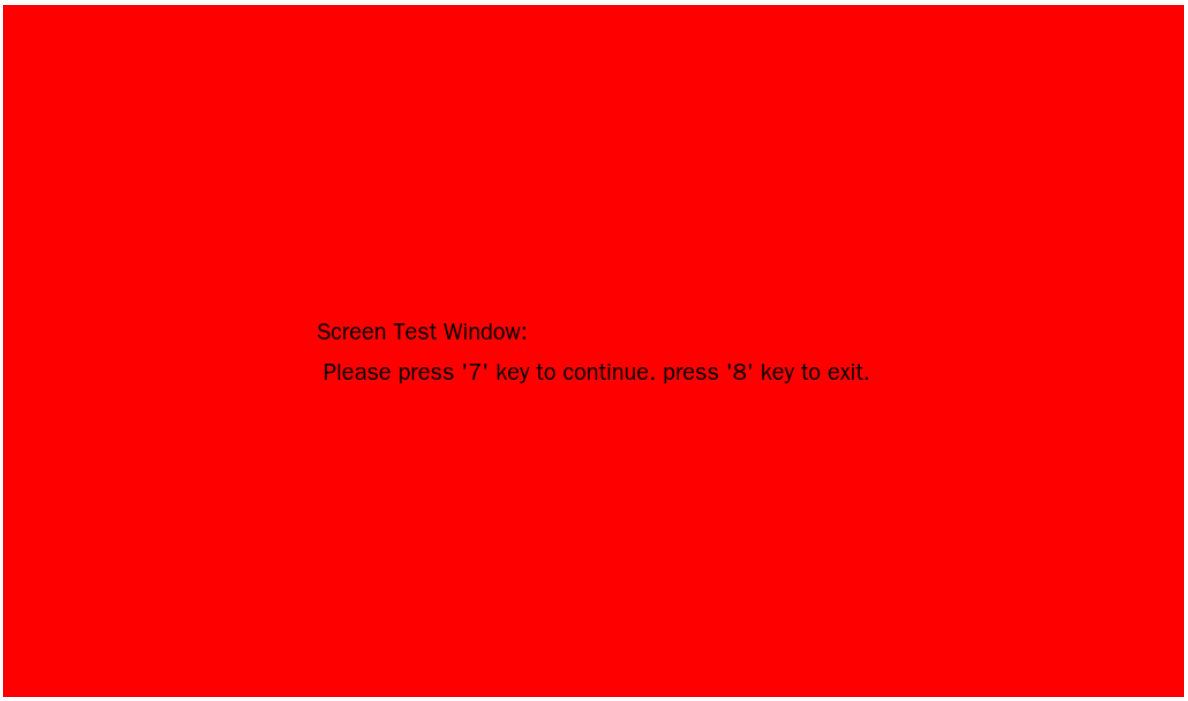


19.5 Test/Cal



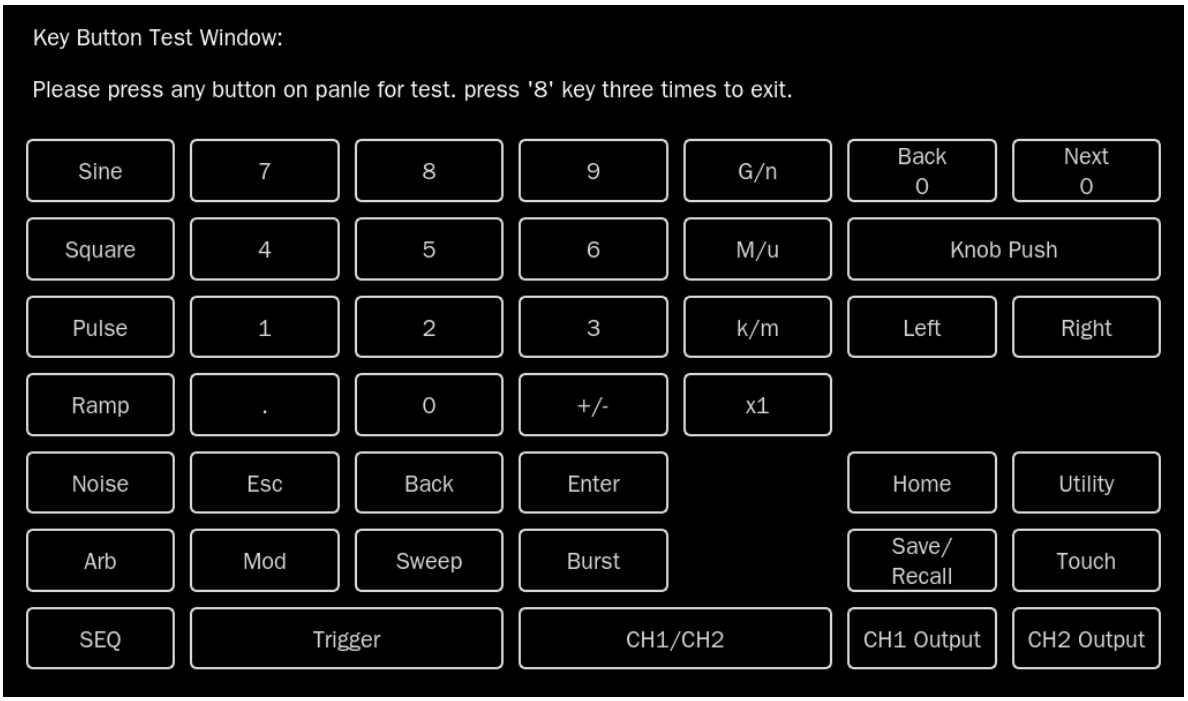
19.5.1 Screen Test

Execute Utility > *Test/Cal* > *Screen Test* , Can enter the screen test page. Just follow the UI prompts.



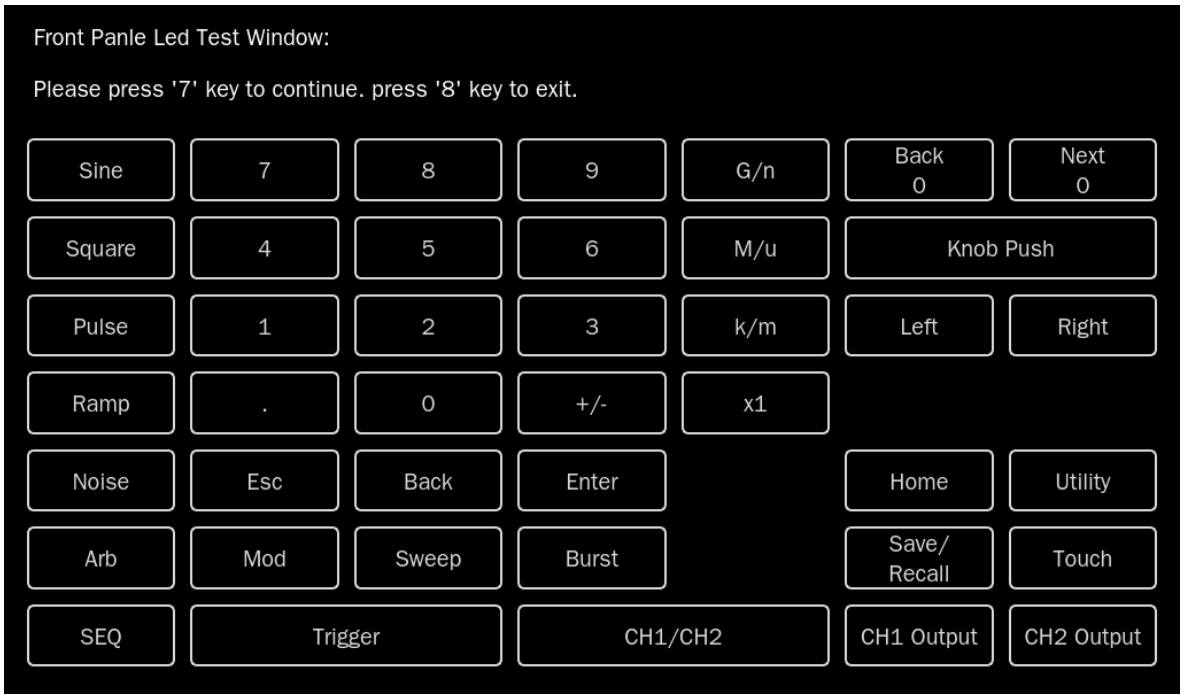
19.5.2 Key Test

Execute Utility > *Test/Cal* > *Key Test* , Can enter the key test page. Just follow the UI prompts.



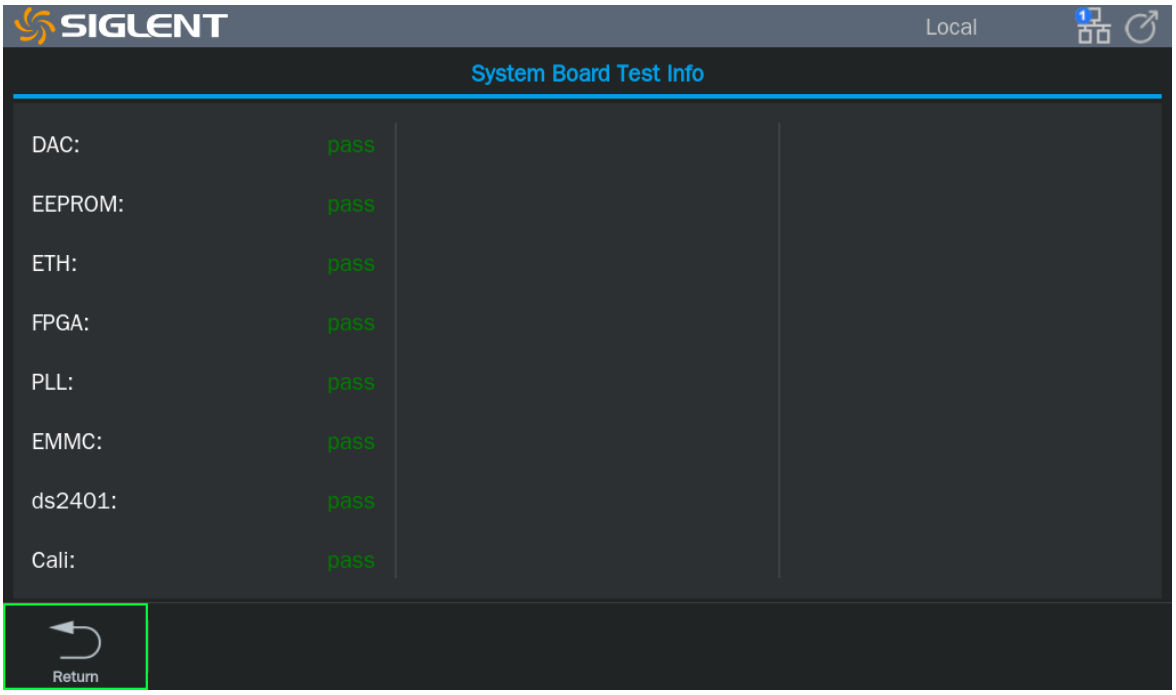
19.5.3 LED Test

Execute Utility > *Test/Cal* > *LED Test* , You can enter the LED test page. Just follow the UI prompts.



19.5.4 Board Test

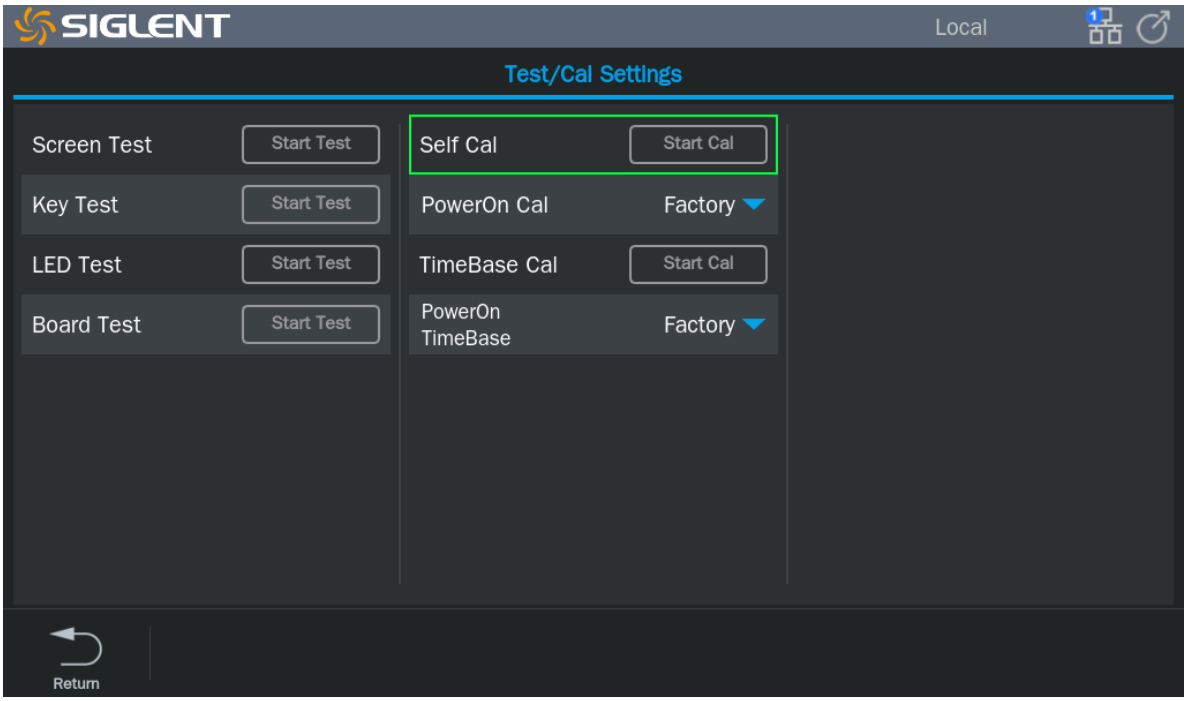
Execute Utility > *Test/Cal* > *Board Test* , You can enter the board-level test page. Every result of the board test of every factory-made instrument is pass.



19.5.5 Self Cal

Execute Utility > *Test/Cal* > *Self Cal* , Click Start Cal to perform self-calibration.

There will be a progress bar displayed during self-calibration. When the progress bar ends, it will automatically disappear, indicating that this self-calibration has been completed. After the calibration is completed, the device will save a copy of self-calibration data, and the user can select the calibration data to be loaded after power-on as needed.

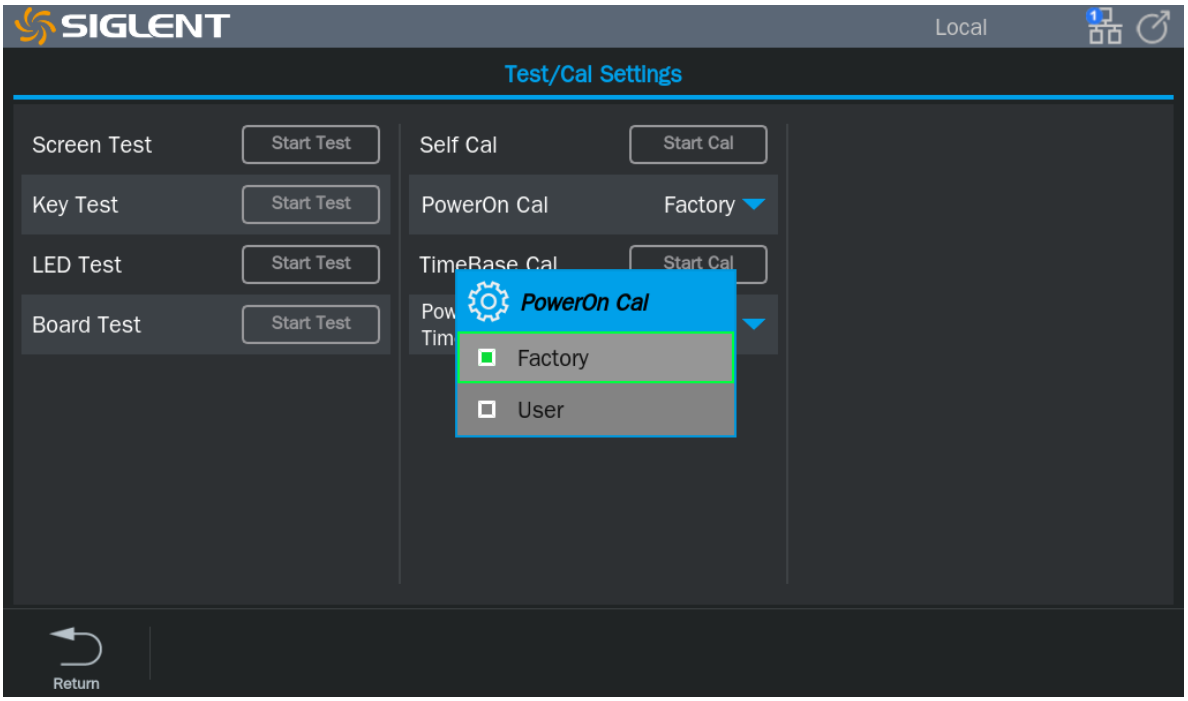


19.5.6 Power-on calibration data

Execute Utility > *Test/Cal* > *PowerOn Cal* , You can select Factory Data and User Data.

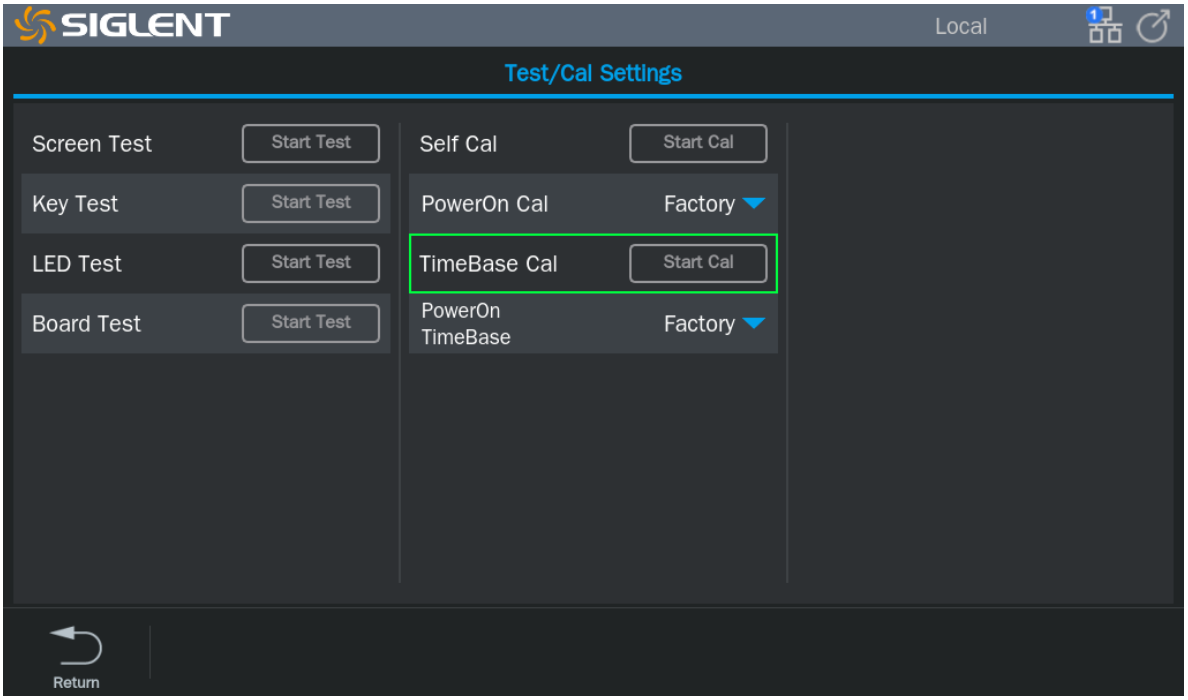
If you select factory data, the factory calibration data will be loaded when the machine is powered on.

If you select user data, the calibration data saved after you perform self-calibration will be loaded when the machine is powered on, instead of the factory calibration data.



19.5.7 TimeBase Cal

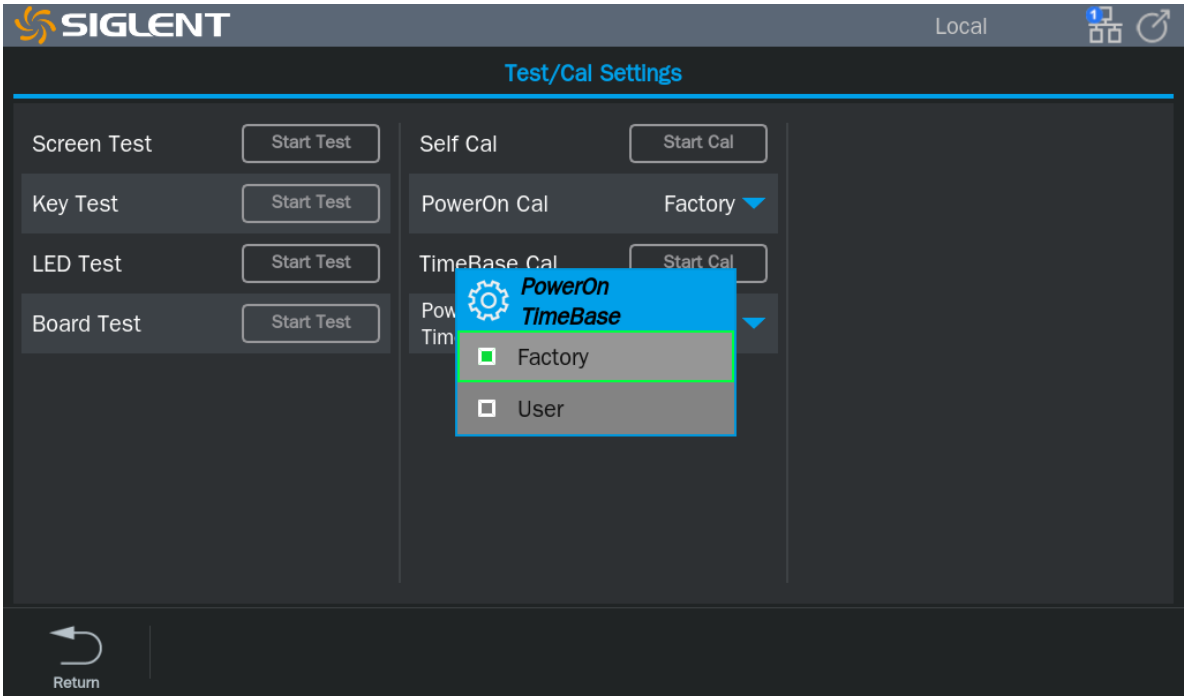
Execute Utility > *Test/Cal* > *TimeBase Cal* , Click Start Cal to perform time base calibration. When calibrating the time base, you need to connect the standard 10MHz clock source to the Counter IN interface on the rear panel. Then click *Auto Cal* , a progress bar will appear, and after the progress bar ends, the calibration result will be prompted. Calibration can also be performed by manually adjusting the time base code value.



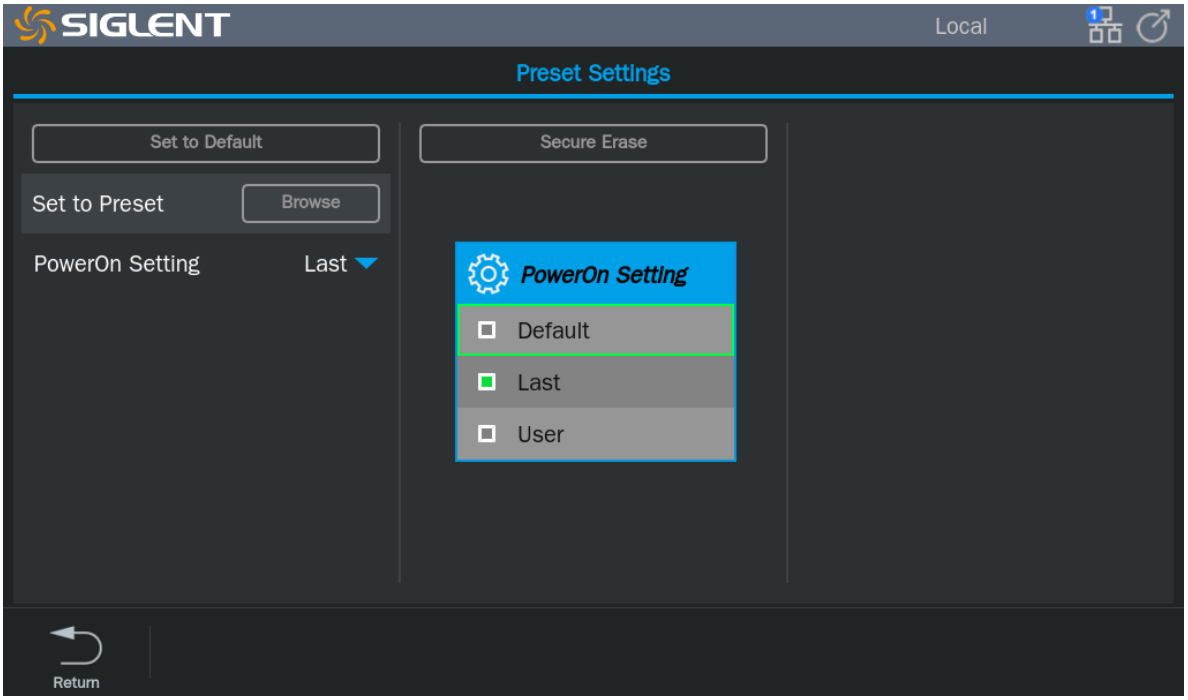
19.5.8 Power-on timebase calibration data

Execute Utility > *Test/Cal* > *PowerOn TimeBase* , You can select Factory Data and User Data.

If factory data is selected, the factory time base calibration code value will be loaded when the machine is powered on. If you select user data, the time base code value saved after you perform time base calibration will be loaded when the machine is powered on, instead of the factory time base code value. Click Time Base Calibration to check whether your time base code value is correct.



19.6 Preset Settings



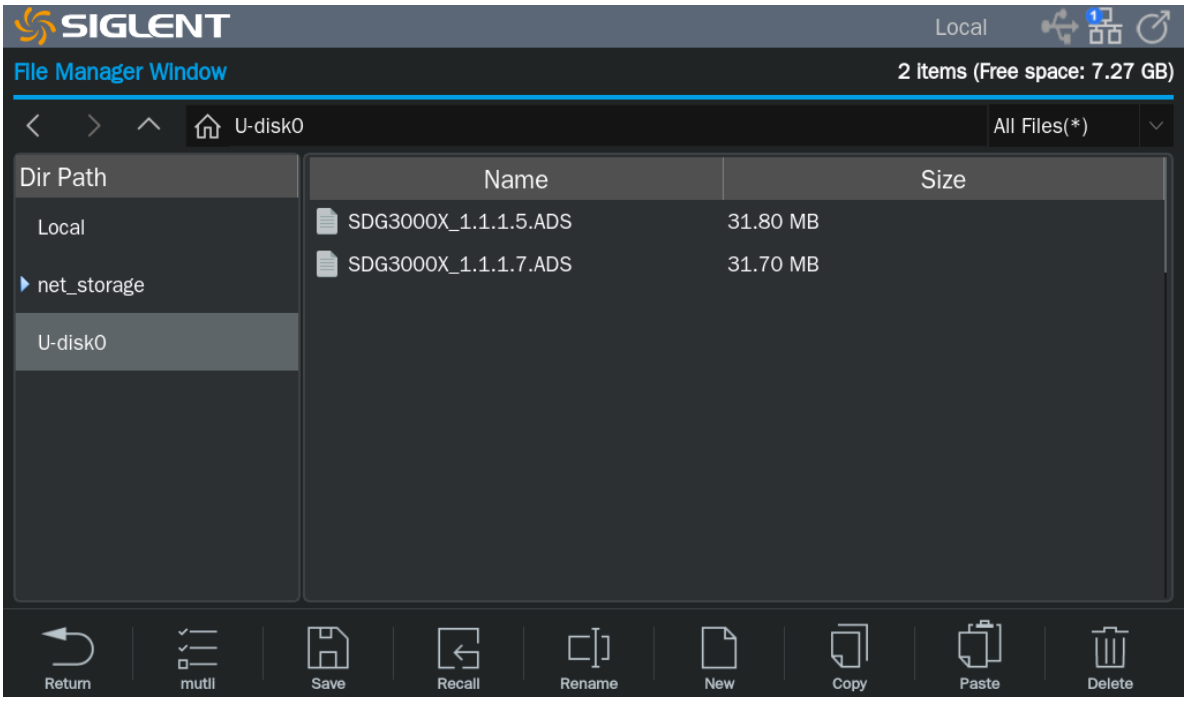
Preset type	Description
Set to Default	Restore the factory preset default configuration.
Set to Preset	Configure the device according to the saved configuration file.
Secure Erase	User-defined data can be deleted without deleting factory calibration data.
PowerOn Setting	Default: the default configuration preset by the factory is loaded at power-on.
	Last: the configuration before the last shutdown was loaded at power-on.
	User: the configuration in the configuration file specified by the user is loaded at power-on.

19.7 Update Software

SDG3000X can upgrade the software version through a USB flash drive or through WebServer. The version upgrade file is in *.ads format and can be obtained from the website or through technical support.

Upgrade via USB flash drive

Before performing the upgrade, please ensure that the USB flash drive containing the correct version of the upgrade file (*.ads) is connected to the device. Execute Utility > *Update* , Can bring up the file manager.



Select the correct ads file in the file manager and select *Recall* to start the upgrade operation. The device will automatically restart during the upgrade process. After the restart is complete, please check the system status to confirm whether the version upgrade is successful. See the "System Information" section for details.

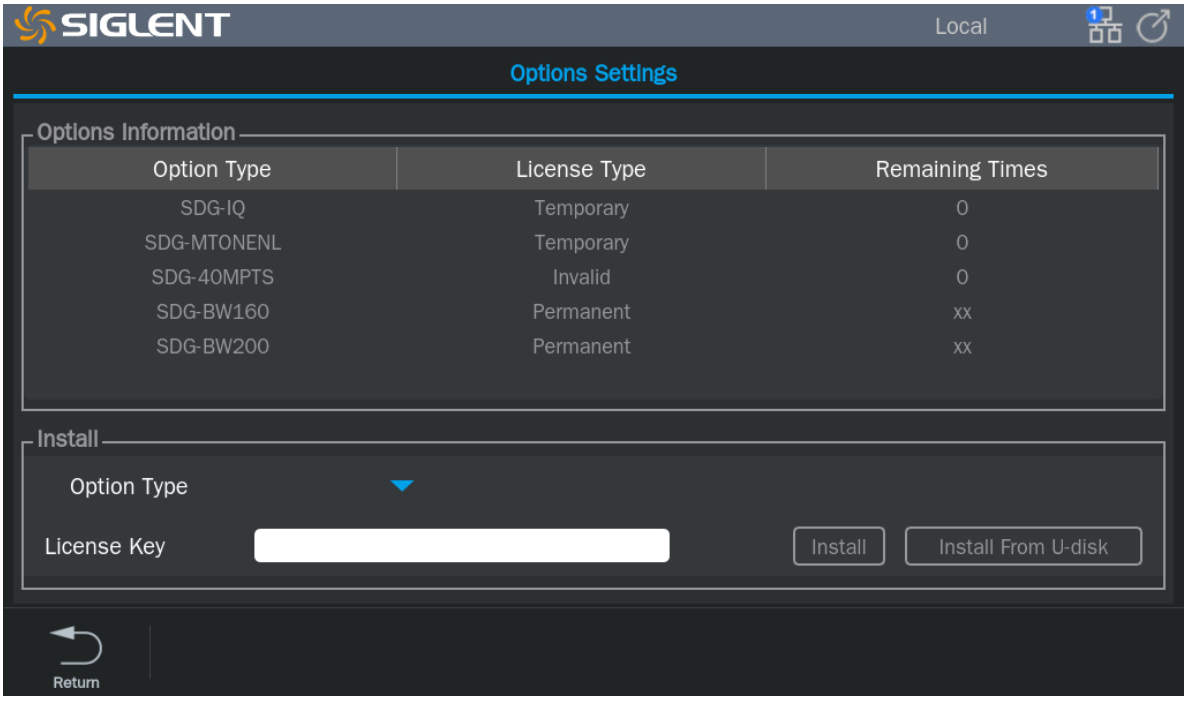
Upgrade via WebSever

Users can access the device by entering the device IP address in the browser address bar. Enter the device control page, click [Firmware Update] to load the ADS file and start the upgrade operation. The device will automatically restart during the upgrade process. After the restart is complete, please check the system status to confirm whether the version upgrade is successful.

19.8 Install Options

SDG3000X provides I/Q, bandwidth upgrade and other software options to meet users' measurement needs. Please contact Dingyang sales or technical support personnel to obtain the corresponding option license key. You can view option information or activate a newly purchased option license key on your device.

Execute Utility > *Options* , can perform option installation functions.



19.9 Help

Execute Utility > *Help* to invoke the help system. The content of the help document is equivalent to that of this user manual, and the browsing method is similar.

19.10 Copyrights

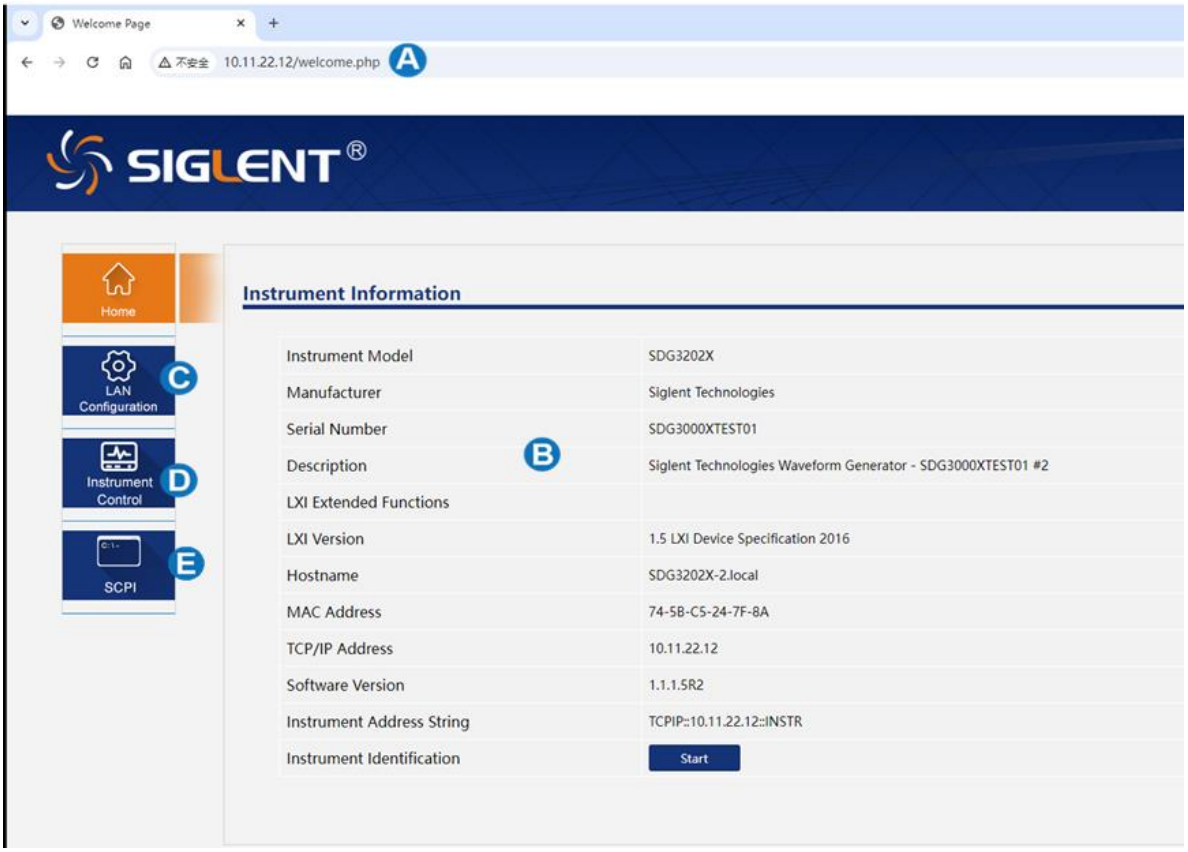
Execute Utility > *Copyrights* , you can view the copyright statement related to the device.

20 Remote Control

SDG3000X has a LAN port and a USB Device port. Based on these two ports, users can remotely control the device in a variety of ways.

20.1 Web link

SDG3000X series devices support users to access and control the device through a web browser. The access password can be set in the web service interface. Users can access the device by entering the device IP address in the browser address bar.



A. Enter the IP address of the device in the browser.

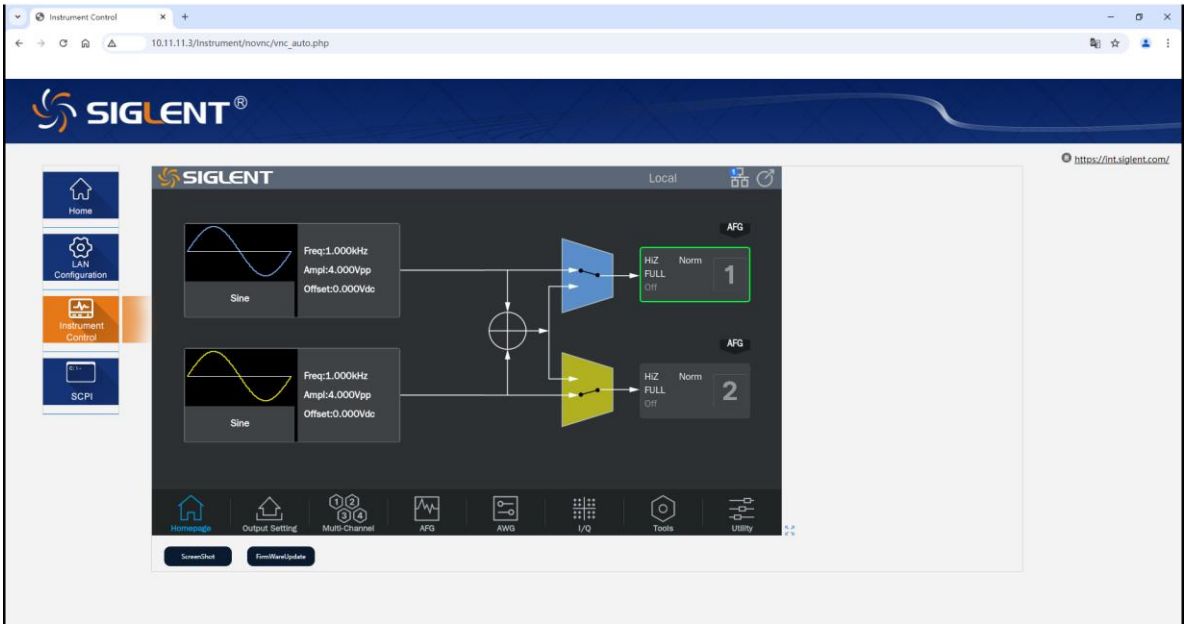
B. Device information displayed by default after entering the homepage.

C. Remotely modify device LAN parameters.

D. Device control page.

E. SCPI command interactive interface.

The device control interface is as shown below:



20.2 Other link

SDG3000X also supports remote control by sending SCPI commands to the device through NI-VISA, Telnet or Socket connection. See the programming guide for this product for details.

21 General inspection and troubleshooting

21.1 General inspection

When you receive a new SDG3000X series function/arbitrary waveform generator, it is recommended that you check it step by step as follows.

Check for any damage caused by transportation issues

If you find that the packaging box or foam plastic protective pad is seriously damaged, please keep it until the whole machine and accessories pass the electrical and mechanical tests.

Check attachments

Regarding the provided attachment details, there is a detailed explanation in Appendix A "SDG3000X Series Functions/Any Waveform Generator Attachment". You can refer to this to check if the attachments are complete. If any missing or damaged attachments are found, please contact the SIGLENT distributor or local office responsible for this business.

Inspect the entire machine

If external damage to the instrument is found and the corresponding test is not passed, please contact the SIGLENT dealer or local office responsible for this business. SIGLENT will arrange for repair or replacement of the new machine.

21.2 Troubleshooting

If the power switch is pressed, the SDG3000X series function/any waveform generator LCD screen still appears black. Please follow the following steps to handle it:

- Check if the power supply is powered on;
- Check if the power switch is properly connected;
- Restart the instrument;
- If you still cannot use this product normally, please contact SIGLENT and let us serve you.

If the setting is correct but there is no waveform output, please follow the following steps to handle it:

- Check if the signal connection wire is properly connected to the output port;
- Check if the BNC cable is properly connected;
- Check if the channel output is turned on;
- After completing the above checks, set the power on to the previous setting and restart the instrument.

22 Service and support

SIGLENT warrants that the products it manufactures and sells will be free from defects in materials and workmanship for three years from the date of shipment from an authorized **SIGLENT** distributor. If a product is proved to be defective within the warranty period, **SIGLENT** will provide repair or replace the unit 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 as provided in this summary or the applicable warranty statement, **SIGLENT** makes no warranty of any kind, express or implied, including but not limited to the implied warranties of merchantability and special applicability. In no event shall **SIGLENT** be liable for indirect, special or consequential damages.

APPENDIX A

SDG3000X Series Function/Arbitrary Waveform Generator Accessories:

Standard Accessories:

A power cord that meets the standards of the host country

One USB data cable

A set of arbitrary wave drawing software EasyWaveX (free download from the website)

A product qualification certificate

A product calibration report

A Quick Guide

One BNC coaxial cable

Purchase attachments:

USB-GPIB adapter

SPA1010 power amplifier

20dB attenuator

APPENDIX B

Default setting

The default settings for SDG3000X series functions/arbitrary waveform generators are as follows:

Item	Default state
Channel default state	Off
DC Output	
on/off	off
offset	0V
Basic waveform	
Frequency	1KHz
Amplitude	4V
Offset	0V
Phase	0°
Symmetry	50%
AM（default)	
Source selection	internal
modulated waveform	Sine
modulation frequency	100Hz
modulation depth	100%
FM	
Source selection	internal
modulated waveform	Sine
modulation frequency	100Hz
Frequency deviation	100Hz
PM	
Source selection	internal

Item	Default state
modulated waveform	Sine
modulation frequency	100Hz
phase deviation	100°
ASK	
Source selection	internal
Keying frequency	100Hz
FSK	
Source selection	internal
Keying frequency	100Hz
Frequency hopping	1MHz
PSK	
Source selection	internal
Modulation Rate	100Hz
polarity	positive
PWM	
Source selection	internal
modulated waveform	Sine
modulation frequency	100Hz
Pulse width deviation	100μs
Sweep	
Sweep Time	1 s
Start frequency	500Hz
Stop frequency	1.5KHz
Frequency span	1KHz
center frequency	1KHz
Trigger Source	internal
Trigger Output	Off
Scanning method	linear
Scanning direction	up

Item	Default state
Burst	
Burst Period	10ms
Starting phase	0.00°
Burst mode	NCycle
N cycles	1Cycle
Trigger Source	internal
Trigger Output	Off
delay	401ns

Note: The default startup parameters for channel 1 and channel 2 are the same.

APPENDIX C

Daily maintenance and cleaning

Daily maintenance

When storing or placing the instrument, do not expose the LCD monitor to direct sunlight for a long time.

Attention:

To avoid damaging the instrument or connecting wires, do not place them in mist, liquids, or solvents.

Cleaning

Regularly inspect the instruments and probes according to the operating conditions. Please clean the outer surface of the instrument according to the following steps:

1. Use a soft cloth to wipe off the floating dust on the outside of the instrument and connecting wires. When cleaning the LCD screen, be careful not to scratch the transparent plastic protective screen.
2. Use a soft cloth soaked in water to clean the instrument, please be careful to disconnect the power.

Attention:

- To avoid damaging the surface of the instrument or connecting wires, do not use any abrasive or chemical cleaning agents.
- Before re powering on for use, please confirm that the instrument has dried thoroughly to avoid electrical short circuits or even personal injury caused by moisture.

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, function/arbitrary waveform generators, RF/MW signal generators, spectrum analyzers, 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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