SMM3000X Series
Digital Source Meter

User Manual

EN01A

SIGLENT TECHNOLOGIES CO.,LTD

Contents

1 Introductory

This user manual contains to important safety and installation information related the SMM3000X Series Digital Source Meter and includes a simple tutorial on the basic operational use of the source meter.

2 Safety Requirement

This section contains information and warnings that must be observed to keep the instrument operating under the appropriate safety conditions. In addition to the safety precautions indicated in this section, you must follow recognized safety procedures.

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.

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.

Do not operate the product if you suspect a malfunction.

If you suspect that the product is malfunctioning, please contact SIGLENT's authorized service personnel for testing.

Any maintenance, adjustment or replacement of parts must be by the carried out relevant person in charge of SIGLENT.

Do not operate in a flammable or explosive atmosphere.

To avoid injury to the instrument or to persons, do not operate the instrument in a flammable or explosive atmosphere.

Do not operate in humid environments.

Keep the surface of the instrument clean and dry.

Protection against static electricity Static electricity can cause damage to the instrument and tests should be carried out in an antistatic area whenever possible. Before connecting cables to the instrument, the inner and outer conductors should be briefly grounded to discharge static electricity.

Do not place heavy objects on the SMM3000X.

To avoid damage from severe impact or improper placement the source meter, do not place heavy objects on the source meter.

2.2 Safety Terms and Symbols

When the following symbols or terms appear on the front or rear panels 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.
	Indicates measurement grounding.
	This symbol is used to denote a safety ground connection.
	This is a start/standby switch.
	Indicates “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 Operating 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 direct heat sources, should be considered when evaluating the ambient temperature.

	**WARNING:** Do not operate the SMM3000X in an explosive, dusty or humid environment.

Ambient Temperature

Operating: 0 ℃ to +50 ℃

Non-operation: -30 ℃ to +70 ℃

Humidity

Operating: 30%RH to 80 %RH

Non-operating: 10%RH to 90%RH

Altitude

Operating: 0 m ≤ altitude ≤ 2,000 m

Non-operating: 0 m ≤ altitude ≤ 4,600 m

This instrument meets the EN 61010-1 standard, and has the following restrictions:

Installation (overvoltage) category: Class II (electric supply connector) and Class I (measure terminal)

Pollution level: Class II

Protection level: Class I

IP Rating: IP20 (as defined in IEC 60529)

Note:

Installation (overvoltage) category Class II indicates the local supply level is suitable for equipment connected to the AC power supply.

Installation (overvoltage) category Class I indicates the signal level suitable for the input terminals connected to the Source Meter.

Pollution level Class II indicates it only occurs in a dry and non-conductive environment, sometimes we should consider the temporary conductivity caused by concentration.

Protection level Class I indicates grounding equipment, it prevents electric shock by connecting the equipment to the ground wire.

	**CAUTION:** Do not apply excessive pressure or strike the surface of the touch screen.

	**CAUTION:** Do not exceed the maximum voltage marked on the front panel connectors.

2.4 Cooling Requirements

This instrument relies on forced ventilation for cooling and has a built-in fan and vent.

To keep adequate ventilation, a gap of at least 15 cm should be left on both sides, as well as the front and rear panels of the instrument.

Poor ventilation can cause the temperature of the instrument to rise, which in turn can cause damage to the instrument, so please maintain good ventilation when using the instrument and check the vent and fan regularly.

	**CAUTION:** Do not block the vents located along the side and rear panel of the instrument.

	**CAUTION:** Do not let any external objects enter the instrument through the vents.

2.5 AC power supply

The instrument accepts 100-240V, 50/60Hz AC power. The maximum power consumption is 160W with complete options.

Note: The instrument can operate within the following input ranges:

Voltage range: 90 - 264 Vrms

Frequency range: 47 - 63 Hz

	**Warning:** High voltage shock hazard The SMM3000X series digital source meters can be forced to generate a hazardous voltage on the High Force, High Sense, and Guard terminals. In order to prevent the risk of high-voltage electric shock, the following safety precautions must be followed when using the SMM3000X in application scenarios above ± 42V.

- Before connecting the instrument using the High Force, High Sense, or Guard terminals, turn off the source outputs and confirm that ON/OFF is turned off. if not, press ON/OFF button to turn off the source output and make sure the HV (High Voltage) status indicator is not lit.
- If any capacitor is connected to the instrument, discharge that capacitor before connecting it.

- Warn workers in the vicinity of the instrument of possible hazardous conditions such as high voltage electric shock.

Power-on Check

Use the power cord provided with the accessory and connect the instrument to an AC power source, then perform a power-on check according to the following procedure:

1. Turn on the instrument power

	**WARNING:** To avoid electric shock, make sure the instrument is properly grounded.

2. Turn on the power switch

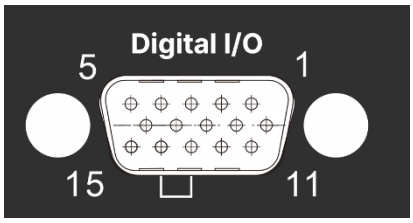
Pressing the button on the front panel, the instrument starts and enters the power-on interface, and later opens the default setting state.

2.6 Installation of High-voltage Interlocks

In order to prevent electric shock in the event voltage that greater than ±42 V may be output, the instrument is by a ±42 V protected high-voltage output interlock that limits the output voltage. When the interlock terminal is open, the output voltage is limited to -42 V to 42 V. When the interlock terminal is shorted, an output of voltage is possibly ±210 V.

	**Warning:** High voltage shock hazard Dangerous voltages may be generated at the High Force, High Sense, and Guard terminals when the interlock terminals are shorted. Do not touch the measurement terminals during high voltage measurement.

1. If the interlock terminals are opened in the high voltage state (HV), the output will be turned off and the voltage will be set to 42 V.
2. By default the interlock terminal is open. To short the interlock terminal, please connect pin.13 and pin.14 in the rear panel Digital I/O interface, refer to 10.4.5 DIO Setting, the connection is as follows:



2.7 Calibration

The recommended calibration cycle is one year. Calibration should only be performed by qualified personnel.

2.8 Cleaning

Only a soft damp cloth without any chemical/corrosive substances can be used to clean the instrument.

Do not clean or use the product in wet environments.

To avoid electric shock, unplug the power cord from the AC socket before cleaning.

⚠	**WARNING:** Danger of electric shock! Do not disassemble the instrument. Maintenance must be carried out by qualified personnel only.

2.9 Exceptional conditions

Use the instrument only for the purpose specified by the manufacturer.

Do not use if the instrument has visible damage or has endured severe transportation vibration.

If the device is suspected to be damaged, please disconnect the power cord and contact your local SIGLENT office.

To operate the instrument correctly, all instructions and marks should be read carefully.

⚠	**WARNING:** Use of the instrument for purposes unspecified by the manufacturer may damage the instrument.

2.10 Safety Compliance

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

CE-LVD certification

1. EN 61010-1:2010/A1:2019. Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 1: General Requirements.
2. EN IEC 61010-2-030:2021/A11:2021. Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part2-030: Particular requirements for testing and measuring circuits.

U.S. nationally recognized testing laboratory listing

1. UL 61010-1:2012/R: 2019-07. Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 1: General Requirements.
2. UL 61010-2-030:2018. Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part2-030: Particular requirements for testing and measuring circuits.

Canadian certification

1. CAN/CSA-C22.2 No. 61010-1:2012/A1:2018-11. Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 1: General Requirements.
2. CAN/CSA-C22.2 No. 61010-2-030:2018. Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 2-030: Particular requirements for testing and measuring circuits.

Informations de sécurité importantes

Ce manuel contient des informations et des avertissements que l'utilisateur doit suivre pour assurer un fonctionnement sûr et maintenir le produit dans un état sûr.

Résumé général de la sécurité

Veuillez examiner attentivement les précautions de sécurité ci - dessous pour éviter des blessures ou des dommages corporels à ce produit ou à tout produit qui y est associé. Pour prévenir les dangers potentiels, utilisez l'instrument comme indiqué.

Évitez les incendies ou les blessures corporelles.

Utilisez le cordon d'alimentation approprié.

Vous ne pouvez connecter l'instrument à l'alimentation principale qu'à l'aide d'un cordon d'alimentation approuvé localement / par l'État. Vendu en Amérique du Nord et dans d'autres pays, il sera équipé d'un cordon d'alimentation conforme aux exigences locales.

Mettre l'instrument à la terre.

L'instrument est mis à la Terre par le conducteur de terre de protection du cordon d'alimentation. Pour éviter les chocs électriques, le fil de 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.

Voir les cotes de tous les terminaux.

Pour éviter un incendie ou une électrocution, consultez toutes les notes et instructions signées de l'instrument. Lisez attentivement le Manuel pour obtenir plus d'informations sur les valeurs nominales avant de connecter l'instrument.

Si vous soupçonnez un défaut, n'utilisez pas le produit.

Si vous soupçonnez un dysfonctionnement du produit, veuillez contacter le personnel de service autorisé de siglent pour effectuer le test.

La maintenance, le réglage ou le remplacement de toute pièce doit être effectué par le responsable concerné de siglent.

Ne pas utiliser dans un environnement inflammable et explosif.

Pour éviter de blesser l'instrument ou le personnel, n'utilisez pas l'instrument dans un environnement inflammable et explosif.

Ne pas utiliser dans un environnement humide.

Gardez la surface de l'instrument propre et sèche.

Antistatique l'électricité statique peut endommager l'instrument et doit être testée dans la zone antistatique autant que possible. Avant de connecter le câble à l'instrument, les conducteurs internes et externes doivent être brièvement mis à la terre pour libérer l'électricité statique.

Ne placez pas d'objets lourds sur le SMM3000X.

Évitez les impacts graves ou les placements inappropriés qui pourraient endommager l'instrument. Ne placez pas d'objets lourds sur l'instrument.

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.
	Représente la mesure de la terre.
	Ce symbole est utilisé pour indiquer une connexion à la terre de sécurité.
	Il s'agit d'un commutateur de démarrage / 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 WARNING est indiqué, ne continuez pas tant que les conditions de sécurité ne sont pas entièrement comprises et remplies

Environnement opérationnel

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

Remarque: la lumière directe du soleil, les appareils de chauffage électriques et d'autres sources de chaleur directe doivent être pris en compte lors de l'évaluation de la température ambiante.

	**WARNING:** N'utilisez pas le smm3000x dans un environnement explosif, poussiéreux ou humide.

Température ambiante

Température de fonctionnement: 0℃ à + 50℃

Ne fonctionne pas: - 30 ℃ à + 70 ℃

Humidité

Fonctionnement: 30% RH à 80% RH

Non opérationnel: 10% RH à 90% RH

Altitude

Fonctionnement: 0 m ≤ altitude ≤ 2000 m

Non opérationnel: 0 m ≤ altitude ≤ 4600 m

Cet instrument est conforme à la norme en 61010 - 1 et présente les limitations suivantes:

Catégorie d'installation (surtension): classe II (connecteurs d'alimentation) et classe I (bornes de mesure)

Niveau de pollution: classe II

Niveau de protection: classe I

Degré de protection: IP20 (tel que défini dans IEC 60529)

Remarque:

La catégorie d'installation (surtension) II indique que le niveau d'alimentation local est approprié pour les appareils connectés à une source d'alimentation en courant alternatif.

La catégorie d'installation (surtension) i représente le niveau de signal applicable aux bornes d'entrée connectées à la table source.

Le niveau de pollution II indique qu'il ne se produit que dans des environnements secs et non conducteurs, et parfois nous devrions considérer la conductivité temporaire causée par la concentration.

Le niveau de protection I indique l'équipement de mise à la terre, qui est protégé contre les chocs électriques en connectant l'équipement au fil de terre.

	**CAUTION:** Ne pas trop presser ou frapper sur la surface de l'écran tactile.

	**CAUTION:** Ne pas dépasser la tension maximale indiquée sur le connecteur du panneau avant.

Exigences de refroidissement

L'instrument repose sur la ventilation forcée pour le refroidissement et est équipé d'un ventilateur et d'un évent intégrés.

Pour maintenir une ventilation adéquate, un espace d'au moins 15 cm doit être laissé de part et d'autre de l'instrument, ainsi que sur les panneaux avant et arrière.

Une mauvaise ventilation peut provoquer une augmentation de la température de l'instrument, ce qui peut endommager l'instrument, alors gardez une bonne ventilation lorsque vous utilisez l'instrument et vérifiez régulièrement les évents et les ventilateurs.

	**CAUTION:** Ne pas obstruer les évents sur les côtés et le panneau arrière du compteur.

	**CAUTION:** Ne laissez aucun objet extérieur entrer dans l'instrument par les évents.

Alimentation secteur

L'instrument peut accepter une alimentation secteur de 100 – 240V, 50 / 60HZ. La consommation maximale est de 160W et les options sont complètes.

Remarque: l'instrument peut fonctionner dans les plages d'entrée suivantes:

Gamme de tension: 90 – 264vrms

Gamme de fréquences: 47 – 63hz

	**WARNING:** Danger de choc à haute tension Le SMM3000X peut forcer une tension dangereuse de ±210 V sur les bornes haute Force, haute Sense et Guard. Pour éviter le risque de choc à haute tension, veuillez respecter les précautions de sécurité suivantes pendant l'utilisation de l'instrument.

Éteignez la sortie source avant d'utiliser les bornes haute Force, haute Sense ou Guard pour connecter l'instrument, confirmer si le bouton ON/OFF est éteint. S'il n'est pas éteint, appuyez sur le bouton ON/OFF pour éteindre la sortie source. Vérifiez que le voyant d'état HV (haute tension) ne s'allume pas.

Si un condensateur est connecté à l'instrument, déchargez le condensateur avant de le connecter.

Avertir les travailleurs à proximité de l'instrument des conditions dangereuses telles que les chocs électriques à haute tension qui peuvent exister.

Inspection électrique

Veuillez utiliser le cordon d'alimentation fourni en tant qu'accessoire et connecter l'instrument à une alimentation secteur. Suivez les étapes ci – dessous pour vérifier l'alimentation.

1. Connecter l'alimentation

⚠	**WARNING:** Pour éviter les chocs électriques, assurez - vous que l'instrument est correctement mis à la terre.

2. Allumer l'interrupteur d'alimentation

Appuyez sur le bouton Power Switch, entrez dans l'interface de démarrage et après un certain temps, le système revient aux paramètres par défaut.

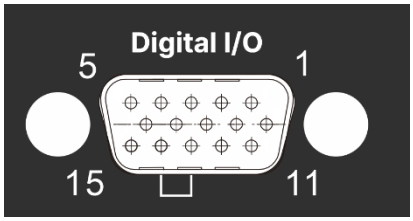
Installation de circuits de protection haute tension

Pour éviter le choc lorsque la sortie possible est supérieure à ±42V, l'instrument limite la tension de sortie par une fonction de protection haute tension. Lorsque les bornes de protection sont ouvertes, la tension de sortie est limitée entre -42 V et 42 V; Lorsque les bornes de protection sont connectées en court-circuit, la tension de sortie peut être de ±210 V.

⚠	**WARNING:** Danger de choc à haute tension Lorsque les bornes de protection sont connectées en court-circuit, des tensions dangereuses peuvent se produire sur les bornes haute Force, haute Sense et Guard. Ne touchez pas les bornes de mesure pendant les mesures à haute tension.

Si, à haute tension (HV), les bornes de protection sont ouvertes, la sortie est éteinte et la tension est réglée à 42 V.

Par défaut, les bornes de protection sont ouvertes. Pour court-circuitez les bornes de protection, connectez les pin.13 et pin.14 dans l'interface Digital I/O sur le panneau arrière. Connectez comme suit:



Calibration

La période d'étalonnage recommandée est d'un an. L'étalonnage ne peut être effectué que par du personnel qualifié.

Nettoyage

Utilisez uniquement un chiffon doux et humide qui ne contient aucune substance chimique / corrosive pour nettoyer l'instrument.

Ne pas nettoyer ou utiliser ce produit dans un environnement humide.

Pour éviter les chocs électriques, débranchez le cordon d'alimentation de la prise secteur avant le nettoyage.

	**WARNING:** Risque d'électrocution! Ne démontez pas l'instrument. La maintenance doit être effectuée par du personnel qualifié.

Cas particuliers

N'utilisez l'instrument qu'aux fins spécifiées par le fabricant.

Ne pas utiliser l'instrument s'il présente des dommages importants ou s'il a subi de graves vibrations de transport.

Si vous soupçonnez que l'appareil est endommagé, débranchez le cordon d'alimentation et contactez votre bureau siglent local.

Pour le bon fonctionnement de l'instrument, toutes les instructions et les marques doivent être lues attentivement.

	**WARNING:** L'utilisation de l'instrument à des fins non spécifiées par le fabricant peut l'endommager.

Conformité en matière de sécurité

Cette section énumère les normes de sécurité auxquelles le produit est conforme.

Certifié ce - lvd

1. EN 61010-1:2010/A1:2019. Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 1: General Requirements.
2. EN IEC 61010-2-030:2021/A11:2021. Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part2-030: Particular requirements for testing and measuring circuits.

Liste des laboratoires d'essai reconnus au niveau national aux États – Unis

1. UL 61010-1:2012/R: 2019-07. Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 1: General Requirements.
2. UL 61010-2-030:2018. Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part2-030: Particular requirements for testing and measuring circuits.

Certifié au Canada

1. CAN/CSA-C22.2 No. 61010-1:2012/A1:2018-11. Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 1: General Requirements.
2. CAN/CSA-C22.2 No. 61010-2-030:2018. Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 2-030: Particular requirements for testing and measuring circuits.

3 Delivery of the Source Meter

3.1 General Inspection

When you get a new instrument, it is recommended that you check it step-by-step as follows.

- **Look for damage due to transportation issues**

If you find the box or foam protective padding badly damaged, keep it until the complete unit and accessories have passed the electrical and mechanical tests.

- **Check the whole instrument**

If external damage to the instrument is found, please contact the SIGLENT distributor or local office responsible for this business, and SIGLENT will arrange for repair or replacement with a new unit.

- **Check the accessories**

The details of the supplied accessories are described in detail in the "Packing List", which you can refer to in order to check whether the accessories are complete. If you find any missing or damaged accessories, please contact your SIGLENT distributor or local office.

3.2 Quality Assurance

The source meter 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 source meter 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 the convenience of description, the user manual use text with character border to represent the keys on the front panel, such as HOME on behalf of the "HOME" button of the front panel; the use of underlined characters to represent the menu, options and virtual keys clicked on the display screen, such as Config for the "Config" option on the display.

For the operation which contains multiple steps, it is described in the form of “Step 1> Step 2> Step 3 .....". For example, the operation steps of LAN: MENU > I/O > LAN means that the first step is to press MENU on the front panel. In the second step, press the menu button corresponding to I/O on the display screen. In the third step, press the menu button corresponding to LAN on the display screen to enter the LAN settings interface.

5 Introduction of SMM3000X Series

5.1 Brief Introduction

The SMM3000X series are accurate source/measurement unit (SMU) instruments that simultaneously output and measure voltage and current, integrating current source, voltage source, voltmeter, and ammeter functions in an instrument where each function can be switched at will. Its use of a graphical user interface (GUI) and advanced capacitive touch screen technology allows intuitive use.

The SMM3000X series is a versatile instrument especially suited for testing modern scale semiconductors, nanoscale devices, materials, organic semiconductors, printed electronics, other small geometry and low-power devices. They are widely used in R&D, educational applications, industrial development, test and manufacturing.

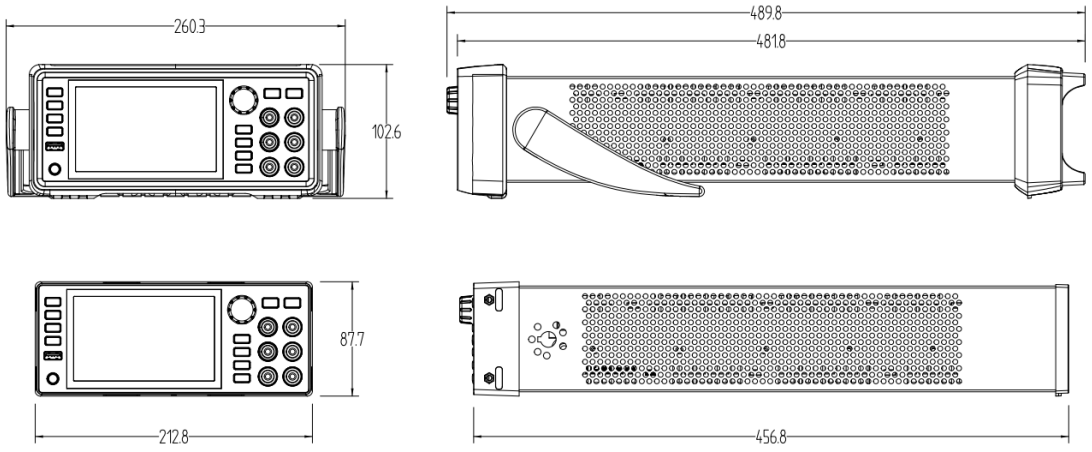
The main parameters of each model of SMM3000X series digital source meter are shown in the table below:

Basic parameters		SMM3311X	SMM3312X
Channel		1	2
Source Output (DC)	Voltage	±210 V	±210 V
	Current	±3.03 A	±3.03 A
Pulse		±10.5 A	±10.5 A
Digits	Source	6.5 digits	6.5 digits
	Measure	6.5 digits	6.5 digits
Current Resolution	Source	10 fA	10 fA
	Measure	10 fA	10 fA
Current range (DC)		10 nA-3 A	10 nA-3 A
Voltage Resolution	Source	100 nV	100 nV
	Measure	100 nV	100 nV
Voltage range		200 mV-200 V	200 mV-200 V
Minimum time interval		10 µs	10 µs

5.2 Performance and Features

- 5-inch true color TFT-LCD large screen display with resolution 800*480, touch screen, new UI, user-friendly front panel interaction, color LCD support graphic and digital view modes
- 10 fA / 100 nV minimum output and measurement resolution 6½ (2,100,000 count)
- Read rate up to 4M rdgs/s, supports up to 100 PLC, minimum 0.0005 PLC sample interval, minimum sample interval 10 μs
- Up to 2 M points of internal storage and timestamp support
- Four-quadrant precision source meter single/dual channel outputs and measurements
- Up to ±210 V DC voltage, ±3 A DC current/ ±10.5 A pulse
- Five basic modes: voltage source, current source, voltmeter, ammeter and resistance meter
- Supports DC, Pulse, Sweep and List output
- Pulse width of the pulse output can be as low as 50 μs
- Arbitrary waveform generation and list sweep function (minimum 10 μs interval)
- Delta low resistance test method, effectively compensates for measurement errors caused by thermal electromotive force
- 2-wire measurement / 4-wire measurement
- Supports standard SCPI remote control commands, host computer software
- Output filter time constant (or cut-off frequency) can be freely set to realize arbitrary frequency response output
- Configuration interfaces: USB Device (optional USB-GPIB adapter), USB Host, LAN

5.3 Mechanical Dimension



Dimensions (unit: mm)

6 Quick Start

6.1 Front Panel

The front panel of the dual-channel model of the SMM3000X series is shown below:

1. Shortcut panel buttons
2. Display screen
3. Setting interface
4. Knob
5. On/Off keys for channel 1 and channel 2
6. Sense terminal for channel 1
7. Force terminal for channel 1
8. Ground and Guard terminals for channel 1
9. Quick function buttons
10. USB-A interface
11. Power switch

Front Panel Description:

Number	Function	Description
1	Shortcut panel buttons	HOME : One button to return to the main interface. MENU : Enter the menu interface, including system functions and settings. FUNCTION : Access to the Math Function and Limit Test screen, which contains parameters for setting up math expressions, setting up composite limit test, and setting up limit tests as part of a composite limit test. HELP : Enter the help screen.
2	Display screen	Equipped with a large 5-inch true-color TFT-LCD screen, it displays the channel's source output and measurement status, system parameters, menu options, and prompt messages.
3	Setting interface	Sets the source output and measurement parameters for the channel.
4	Knob	When setting parameters, rotate the knob to move the position quickly, and press the knob to adjust input value.
5	On/Off keys for channel 1 and channel 2	ON/OFF : Turns on/off the current corresponding single channel, when this key is lit, it means the output is on.
6	Sense terminal for channel 1	When setting up the four-wire mode, it is necessary to connect the Sense terminal and the Force terminal to both ends of the device to be tested at the same time. This method of connection reduces measurement errors caused by resistance on the test cable.
7	Force terminal for channel 1	When the 2-wire mode is set, the Sense terminal can be disconnected and only the Force terminal can be used to connect to the test device, output DC voltage or current, and measure voltage, current, and resistance.
8	Ground and Guard terminals for channel 1	The ground terminal is used to connect to chassis ground.The Guard terminal generally has the same potential as the Force and Sense terminals.
9	Quick function buttons	AUTO : Starts continuous measurement. If continuous measurement is in progress, you can press again to stop it. TRIGGER : Starts a single output/measurement or starts a trigger system. EXIT : Exit the current interface or dialog box and return to the previous interface. ENTER : Input confirmation.

10	USB-A interface	For connecting to USB memory.
11	Power switch	Used to turn power on or off.

6.2 Rear Panel

The rear panel of the dual-channel model of the SMM3000X is shown below:

1. Certification mark
2. Source/measurement terminals for Channel 2, including Sense, Force, Ground, and Guard terminals
3. USB-A interface
4. Digital I/O interface
5. Fan Vent
6. AC power interface and description of power connector
7. LAN interface
8. USB-B interface

The rear of the single-channel model of the SMM3000X panel is shown below:

1. Certification mark
2. USB-A interface
3. Digital I/O interface
4. Fan Vent
5. AC power interface and description of power connector
6. LAN interface
7. USB-B interface

7 Switch On/Off

7.1 Connect the Power

The instrument can be input AC power supply specification: AC 100-240 V, 47-63 Hz. Please use the power cord provided with the accessory to connect this product to the power supply, and make sure the fuse is working properly before powering up the instrument.

7.2 Power On

SMM3000X startup mode is manual startup, after the source meter is connected to the AC power supply through the power cord, manually press the power switch to start the instrument, the user interface lights up, and the default setting state is turned on after a while, and the power is powered on successfully.

When the power switch is pressed, the display illuminates to indicate that the switch is on.

Note: The power supply generates an inrush current during power-up. Please make sure that the power supply is sufficient at the moment of power-on, especially when turning on more than one source meter at the same time.

7.3 Power Off

When the source meter switch is pressed long, it indicates that the switch is closed.

	**Warning:** It takes about 1 minute for the source meter to fully open and close, so do not open and close the source meter quickly. Please wait until it is completely closed.

Note: Continuously and quickly closing and opening the source meter while it is powered on may damage the source meter.

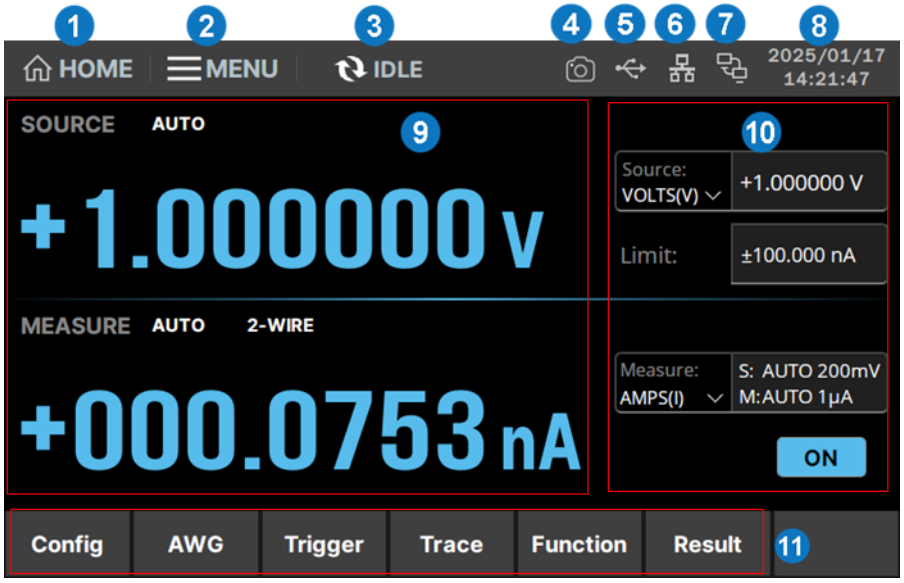
8 Interface Introduction

8.1 User Interface

The user interface for the dual-channel model of the SMM3000X is shown below:

1. HOME Return to the main interface
2. MENU Access to the menu screen, including system functions and settings
3. Trigger system Displays AUTO / ARM / IDLE status, sets trigger parameters and controls the trigger system
4. Take a screenshot and save it locally
5. Peripheral USB access status
6. LAN port means the LAN cable is connected, means it is not connected; click it to enter LAN setting
7. Remote status indicates remote status
8. Date and time Displays the current date and time, which can be set by clicking on it
9. Measurement display Displays the measured value, as well as source and measurement status information, ON/OFF setting channel switches
10. Channel Setup Set the source output mode, output value and Limit value, as well as the measurement mode, measurement speed and measurement range; click on the at the top CH1 / CH2 box to enter the CH single-channel setup interface

The user interface for the single-channel model of the SMM3000X is shown below:



1. HOME Return to the main interface
2. MENU Access to the menu screen, including system functions and settings
3. Trigger system Displays AUTO / ARM / IDLE status, sets trigger parameters and controls the trigger system
4. Take a screenshot and save it locally
5. Peripheral USB access status
6. LAN port means LAN cable is connected, means not connected; click to enter LAN settings
7. Remote status indicates remote status
8. Date and time Displays the current date and time, which can be set by clicking on it
9. Measurement display Displays the measured value, as well as source and measurement status information
10. Channel Setup Sets source output mode, output value and Limit value, as well as measurement mode, measurement speed and measurement range; ON/OFF is the channel switch
11. Menu bar Allows you to make detailed settings for channel functions, including Config to set up detailed configuration of source and measurement functions; AWG to set up sweep source and list sweep; Trigger to set up trigger parameters and trigger system control; Trace to check Graph view, Roll view and trace statistics; Function to set math operation function and limit test function; Result to check measurement result, limit test result and trace result.

8.2 Menu Functions

System settings:

Category	Description	
System	PLC: Sets the power line frequency, selectable 50/60 Hz Sound: Buzzer Switch Power-on State: Sets power-on state, optional RST (factory default)/Last (last power-on state)/Config #1-5 (pre-saved power-on state) Power-on Mode: Sets the power-on mode, selectable Auto/Manual Timestamp Auto CLR: Sets up timestamp auto clearing function Timestamp: Clears timestamp. Reset Config: Restores factory settings	
Display	Display digits: Sets the digital resolution of the display data, optional 3.5/4.5/5.5/6.5 Digits Language: Sets the language of the user interface, selectable Simplified Chinese/English BackLight Brightness: Sets the backlight brightness of the screen, adjustable from 0 to 100 Screen Saver: Sets the screen saver time, optional Disable/1/2/5/15/30 min Immediate V/I Update by Knob: Uses knob to set the voltage and current, and makes the settings take effect immediately	
About	Product Name: Instrument model name Serial Number BKF Ver: BKF version number Software Ver: Software version number FPGA Ver: FPGA version number Hardware Ver: Hardware version number Start_Up Times Running Time: Running time since power-on	
	Copyrights	Introduction Products list Software packages: Software packages with name, version and license Verbatim license texts: License texts Copyrights
I/O	Format	SENSE: Sets the measurement data of the output, multi-selectable voltage/current/resistance/source/time/status

		Math/Limit: Sets the output math operation and limit test result data, multi-selectable result/time/status Data Type: Sets the output data format, optional ASCII / REAL32 / REAL64 Data Swap: Sets byte swap, enable ON to byte reverse order
	LAN	DHCP: ☑ : Obtains IP automatically; ☐: Sets IP manually IP Address: Internet Protocol Address Net Mask: Subnet mask Gateway MAC: Media Access Control Address Auto DNS: ☑: Obtains DNS automatically; ☐: Sets DNS manually; Auto DNS is optional only when DHCP is on DNS1/DNS2: Domain names Apply: Applys the above LAN settings Refresh: Updates LAN settings
	LXI	IP Address Configuration(DHCP and AutoIP): Allows DHCP and IP address auto-acquisition ICMP Ping Responder: Allows ICMP messages to be answered Web password for configuration: Web password factory default mDNS and DNS-SD: Allows multicast DNS as well as DNS-SD Lan Reset: Initializes LAN settings
	VNC	Port: Port number, optional 5900-5999 Password: Sets password
	USB	Displays USB resource information when USB is connected
	GPIB	Address: GPIB address, optional 0-30
	DIO	Direction: Selects Digital I/O interface for setting, optional INPUT/OUTPUT Pin#: Digital I/O pin number, pin.1-6 is for output, pin.7-12 is for input Function: DIGITAL digital signal input/output and TRIGGER trigger input/output of the specified pins Output Trigger timing: timing of output trigger, selectable AFTER / BEFORE / BOTH; only output pins can be set Output Pulse Width: Output trigger pulse width, min. 10 μs, max. 10 ms Polar: Polarity of input/output functions, POSITIVE / NEGATIVE

		Output trigger type: Type of output trigger, EDGE/LEVEL; only output pins display Format: Sets the format of the values to the Mask field and Value field, optional BIN (binary)/DEC (decimal)/HEX (hexadecimal) Mask: Sets the mask value for the Digital I/O interface Value: Sets the value for the Digital I/O interface Read: Reads the current mask value/value set to the Digital I/O interface Write: Writes the specified mask value /value to the Digital I/O interface
Test&Cali	Screen Test: Screen self-test, displaying red, green, blue, black and white colors in turn Key Test: Key board test, pressing key to make the block corresponding to the key lit up in response LED Test: LED light test, block corresponding to the button with LED light responds and lights up Self Test: Self-test function, the instrument can use it to check if there is any abnormality Temperature Monitor: View ambient, calibration, positive and negative terminal and power supply temperatures Hardware Unit Test	
Help	Go to the help screen	
Save	Measure Result: Saves measurement data Math Result: Saves math result data Limit Test Result: Saves limit test result data Trace buffer: Saves trace buffer data Config: Saves system settings	
Load	Config: Imports system settings file	
File	New: New folder Copy: Copies the selected file for the next step of paste or move Paste: Pastes the file to the current location Move: Moves the file to the current location Rename: Renames the selected file Delete: Deletes the selected file Multi: Enters the multi-select file mode, you can batch file operations	
Upgrade	Select Firmware: Browse for local and USB flash drive files and select the .ads	

	upgrade file Upgrade: After selecting the firmware (upgrade file), click to upgrade the software version	
Event Log	Log Setting	Popups: Sets the type of message to be popped up Reset Popups: Restores default settings for popups (error and warning messages) Show Warning: Shows the warning messages in the current screen Show Information: Displays information messages in the current screen Log Warning: Logs warning messages, which will not log or display pop-up windows after closing Log Information: Logs information type messages Log Command: Records commands sent to the instrument, Log Information is required to be turned on
	Save to USB: Saves the log as a .csv file to local or USB flash drive Clear Log: Clears the event log	
Shut Down	Turns off the instrument	

Channel settings:

Category	Description		
Config	Source	Limit for Each Polarity: Sets both positive and negative Limit values when enabled AutoOutput-ON: Channel output can be turned on automatically before triggering the system startup when enabled AutoOutput-OFF: Channel output can be turned off automatically when trigger system turns to IDLE when enabled OVP/OCP: Overvoltage/current protection switch High Capacitance: Sets high capacitance mode Low Terminal State: Sets the Low Force terminal connection state, selectable GROUND / FLOAT Output Off: Sets the output off state, selectable HIGH-Z / NORMAL / ZERO	
		Output Filter	ON/OFF: Enables output filter Automatic Filter: Sets to automatic filter

			Time Constant: Sets the time constant, minimum 5μs, maximum 5ms
		Wait Control	The calculation of the waiting time is described in the chapter "Wait Time Control" below. ON/OFF: Source output wait function, when enabled, the source will wait for a period of time before changing the output value Automatic: Gain can be used to set the wait time when enabled Gain: Coefficient of initial waiting time, value 0-100 Offset: Offset of waiting time, value is 0-1s
	Measure	Display Digits: Sets the digital resolution of the displayed data R Compen: Sets resistance compensation, acts on resistance measurements Sensing Type: Sets 2-WIRE / 4-WIRE	
		Wait Control:	The calculation of the waiting time is described in the chapter "Wait Time Control" below. ON/OFF: Measurement wait function, when enabled, the measurement will be taken after the wait time Automatic: Gain can be used to set the wait time when enabled Gain: Coefficient of initial waiting time, value 0-100 Offset: Offset of waiting time, value is 0-1s
	Save	Saves the above source and measurement settings for all channels, optional groups Config #1-5	
	Recall	Reads the settings saved by group Config #1-5 and acts on all channels	
AWG	Pulse	Sweep State: Sweep source state, shows the status of AWG > Sweep List State: List sweep source state, shows the state of the AWG > List Pulse: Sets to ON to apply all pulse parameters Peak: Peak pulse, not applicable to sweep source and list	

		sweep source Delay: Pulse delay, selectable 0 – 99.9999 ks Width: Pulse width, min. 50 μs, max. 100 ks Basic: Base current, the maximum current value allowed to be continuously output when pulse output is not triggered in pulse mode, non-configurable
	Sweep	Sweep: Enables sweep source Sweep Type: Sets the shape of the sweep source, optional LINEAR SINGLE / LINEAR DOUBLE / LOG SINGLE / LOG DOUBLE; LINEAR / LOG means linear / logarithmic step, SINGLE / DOUBLE means unidirectional/bidirectional (back and forth) Start: Start value of the sweep source Stop: End value of the sweep source Points: Number of sweep points (steps), maximum 100,000 Step: Sweep step value, not applicable to LOG SINGLE / LOG DOUBLE
	List	List: Enables list sweep source Type: Displays voltage source/current source Points: Number of list sweep source steps (number of list data) Max: Maximum value of the Value of the list Min: Minimum value of the Value of the list No.: List data number Value: List value, click to set the list value for each step Append: Adds a line of list data below the currently selected line Insert: Inserts a row of list data above the currently selected row Delete: Deletes the list data of the currently selected row Save: Saves the list data as a .csv file to local storage or USB flash drive Recall: Reads .csv / .list files from local or USB flash drive, and applys to list
	Sweep Setting	Sweep Direction: Sweep direction, optional UP (step from initial value to end value)/DOWN (step from end value to initial value) Sweep/List Ranging: Sweep range mode, selectable BEST / FIXED / AUTO Output After Sweep/List: End of Sweep output hold value,

		optional START VALUE (the DC output value before applying the sweep source) / END VALUE (the last value of the sweep source output)
Trigger	Trigger	Trigger: Sets the trigger type, optional AUTO (automatic trigger) / SYNC (synchronized trigger) / TIMER (timer trigger) / MANUAL (manual trigger) Different parameters can be set for different types of triggers, see the chapter "Trigger System Settings and Control" below. Count: Number of trigger for source and measurement, 1-100,000 or Inf. (countless) Delay: Trigger delay, optional 0-100 ks Period: Trigger period, minimum 10 μs, maximum 100 ks Trigger: Trigger source, selectable AUTO (automatic selection)/BUS (remote interface)/TIMER (timer internal generation)/INT1-2 (internal signals 1 and 2)/LAN (LXI trigger)/EXT7-12 (DIO pin.7-12)
	Config	When setting up the trigger system, you need to select the Action and Layer, and then set the parameters to be applied to the corresponding layer and action. Action: Selects the device operation, optional TRANS.(transient)/ ACQ.(acquisition) Layer: Selects the trigger layer, optional ARM/ TRIGGER/ ACTION Count: Trigger count number Bypass: Bypass switch Trigger Source Period: Trigger period Trigger Delay Trigger Output: Trigger Output switch, enable it to trigger the output at the port Trigger Output Signal: Trigger output port, INT1-2 / LAN / EXT1-6 can be set
	Initiate Abort	Initiate ALL: Initiate for all device operations (go to the ARM layer of the trigger system) Initiate Trans.: Initiate for transient device operation Initiate Acq.: Initiate for acquisition device operation Abort ALL: Abort all device operations(return to IDLE of the trigger system) Abort Trans.: Abort operation of the transient device

		Abort Acq.: Abort operation of the acquisition device
	Immediate	Trigger ALL: Sends an immediate trigger commands to all operations in the selected trigger layer Trigger Trans.: Sends an immediate trigger commands to transient operations in the selected trigger layer Trigger Acq.: Sends an immediate trigger commands to acquisition operations in the selected trigger layer Arm ALL: Sends an immediate trigger commands to all operations in the selected ARM layer Arm Trans.: Sends an immediate trigger commands to transient operations in the selected ARM layer Arm Acq.: Sends an immediate trigger commands to acquisition operations in the selected ARM layer
Trace	Graph	Auto Scale: Changes the graphic scale to automatically fit the traces in the graphic Dump Screen: Takes screenshot, saves screen dump to JPEG file, and saves to local internal storage Cursors: Hides/shows the position and distance of the X and Y cursors 1 and 2 Show/Hide Source: Shows/hides the limit value of channel 1 and 2 Y-X Axis: Sets the data type and calibration of the X and Y axes to LINEAR / LOG CH1/CH2 ON: Displays drawing traces for channel 1/2
	Roll	Auto Scale: Changes the graphic scale to automatically fit the traces in the graphic Dump Screen: Takes screenshot, saves screen dump to JPEG file, and saves to local internal storage Cursors: Hides/shows the position and distance of the X and Y cursors 1 and 2 Show/Hide Source: Shows/hides the limit value of channel 1 and 2 Line1/Line2: Sets trace for the corresponding channel 1/2 (1/2/OFF) and the type of measurement data (voltage/current/resistance/power)
	Statistics	Feed: Displays data type, optional SENSE/ MATH/ LIMIT Element: Displays when Feed is SENSE, selectable current/voltage/resistance Length: Length of the data

		Mean: Average value of the data Std.Dev: Standard deviation of the data Min: Minimum value of the data Max: Maximum value of the data Clear Buffer: Clear the current buffer
	Buffer	Feed Data: Selects the data type, optional SENSE/ MATH/ LIMIT Buffer Control: Trace buffer write mode, optional NEVER (disable writes)/NEXT (enable writes until the cache is full) Buffer Size: Changes the trace buffer size Data: Chooses to return the statistics of the trace data, with options for MEAN/MAX/STD.DEV/PK-PK/MIN Timestamp: Selects the timestamp data format, optional ABSOLUTE/DELTA (differential)
Function	Math Expression	The math operation function supports the calculation of mathematical expressions for the measured source/voltage/current/resistance/time data, and outputs the calculation results, please edit and select the mathematical expressions in the function area below. Status: Enables math operations Unit String: Edits the unit of the result of a mathematical expression Edit: Edits the selected customized mathematical expression Add: Adds customized mathematical expressions Delete: Deletes the selected customized mathematical expression
	Composite	Composite limit test can include up to 12 limit tests and compliance checks to adjudicate measurement data. Limit Test: Enables composite limit test Mode: Sets GRADING mode/SORTING mode Auto Clear: Enables automatic clearing of composite limit test results Update: Selects the IMMEDIATE / END field to set the timing of the GRADING mode output fail/pass pattern Offset Cancel: Enables test data offset Offset: Sets the offset value of the test data Pass Pattern: Sets the pass bit pattern of the output when the composite limit test passes in GRADING mode Fail Pattern: Sets the failure bit pattern output when the

		composite limit test fails in SORTING mode GPIO Pins: Displays the used DIO pins for bit patterns output, to set this field, you need the remote command ":CALCulate[c]:DIGital:BIT *pin*" /BUSY: Sets the used DIO pin in the busy signal /SOT: Sets the used DIO pin for the start-of-test signal /EOT: Sets the used DIO pin for the end-of-test signal
	Limits	The following parameters are used to set up the individual limit tests/compliance checks that make up the composite limit test. Feed Data: Selects the type of data for limit test/compliance check Test Index: Selects the index for limit test/compliance check Limit Test: Enables the current limit test/compliance check Function: Sets LIMIT(limit test)/ COMPLIANCE(compliance check) Pass Pattern: Sets the bit pattern of the output of the single limit test passed in SORTING mode Up Pattern: Sets the bit pattern of the output of a single limit test that fails due to exceeding the upper limit in GRADING mode Low Pattern: Sets the bit pattern of the output of a single limit test that fails due to falling below the lower limit in GRADING mode Up Limit: Sets the upper limit value for single limit test Low Limit: Sets the lower limit value of single limit test Fail on: Available when Function is COMPLIANCE (compliance check), sets to IN (judged to be a failure if it enters the compliance state)/OUT (judged to be a failure if it is not in the compliance state) Fail Pattern: Available when Function is COMPLIANCE, sets the bit pattern when the compliance check fails
Result	Measure	Type: Selects the type of measurement data to be viewed, selectable current/voltage/resistance/power/ math result/time Points: Shows the number of recorded data points Max: Maximum value of the displayed data Min: Minimum value of the displayed data
	Limit Test	Displays the results of the composite limit test

	Trace	Feed: Displays data type, SENSE (measurement)/MATH (mathematical calculation result)/LIMIT (limit test data) Element: Selects the type of SENSE (measurement) data to be viewed , optional Current / Voltage / Resistance Length: Displays data length Mean: Displays the average value of the data Std.Dev: Shows the standard deviation of the data Min: Displays the minimum value of data Max: Displays the maximum value of the data Clear Buffer: Clears the data in the trace buffer

9 Basic Operation

9.1 Source/Measurement Settings

9.1.1 CH Single Channel Settings

SMM3000X can be used as a DC voltage source or current source. In the user interface, source output mode, output value, limit value, measurement mode and range can be set.

Source parameter settings:

1. Click on the HOME key on the display screen or press the shortcut panel button HOME to enter the main screen.
2. For dual-channel model, you need to select the channel (1 or 2) to be set.
3. Set the Source Output Mode. Use the knob to move the pointer to the Source mode setting area with the selected field bordered in white; then press the knob or ENTER button to enter the Source mode setting, rotate the knob to select VOLTS(V) (Voltage Output) or AMPS(I) (Current Output), press the knob or ENTER button to fix the setting.
4. Set the Source value (output value). Use the knob to move the pointer to the right of the Source value setting area, and use the knob, ENTER button or numeric keypad to complete the setting of the output value.
5. Set the limit value. Use the knob to move the pointer to the limit value on the right of the "Limit" area, and fix the value by using keyscreen numeric keypad, knob or ENTER button.

Measurement parameter settings:

1. Tap the display screen HOME key or the shortcut panel button HOME to enter the main screen.
2. For dual-channel model, you need to select the channel (1 or 2) to be set.
3. Set the Measurement Mode. Use the knob to move the pointer to the Measure mode setting area and press the knob or ENTER button to enter the Measurement Mode setting. rotate the knob to select the measurement VOLTS(V) / OHMS(R) / AMPS(I) / WATTS(P), and press the knob or the ENTER button to fix the setting.
4. Set the range (taking measurement current as an example, please refer to chapter "Apply Measurement Settings" for other parameter measurements). After selecting AMPS(I) in

Measure mode, enter into the range setting interface, select AUTO (automatic range) or FIXED (fixed range) in Measure Amps field, and set the range in the right field.

9.1.2 Function of Positive and Negative Limit Values

1. From the HOME screen, press the Config menu key to select the Source settings screen;
2. Select the channel to be set (1 or 2) to enter the single channel setting interface;
3. In the Limit for Each Polarity area, set the function of positive and negative limit values to ON (enabled) or OFF (disabled);
4. When the function of positive and negative limit values is on, positive and negative limit values can be set both. Limit values are entered by using the numeric keypad/knob, and press Enter button to complete the limit setting.

9.1.3 High Capacitance Mode

The high capacitance mode allows efficient measurement of capacitive loads greater than 0.01 μF. In high capacitance mode, the maximum allowable load capacitance is 50 μF.

The high capacitance mode applies to the following mode/range conditions:

- V/I mode: Only voltage source mode.
- Range: Current measurement ranges are limited to manual range mode, and high capacitance mode is not supported for 10 nA and 100 nA ranges.

To set the high capacitance mode, proceed as follows:

1. From the HOME screen, press the Config menu key to select the Source settings screen;
2. Select the channel to be set (1 or 2) to enter the single channel setting interface;
3. In the High Capacitance area, set the high capacitance mode to ON (enabled) or OFF (disabled).

9.1.4 Automatic Output-On/Off

The Auto Output ON/OFF function defines the state (ON/OFF) of the channel output when the trigger state changes in trigger system.

- When AutoOutput-On function is enabled, the channel output is automatically turned on before the trigger system starts when triggered by Initiate .
- When AutoOutput-Off function is enabled, the channel output is automatically shut down when trigger system state changes to IDLE (idle)

To set AutoOutput-ON/OFF, proceed as follows:

1. From the HOME screen, press the Config menu key to select the Source settings screen;
2. Select the channel to be set (1 or 2) to enter the single channel setting interface;
3. In the AutoOutput-ON area, set the AutoOutput-ON function to ON (enabled) or OFF (disabled);
4. In the AutoOutput-OFF area, set the AutoOutput-Off function to ON (enabled) or OFF (disabled).

9.1.5 Low Terminal Status

To set the low terminal status, proceed as follows:

1. From the HOME screen, press the Config menu key to select the Source settings screen;
2. Select the channel to be set (1 or 2) to enter the single channel setting interface;
3. In the Low Terminal State area, set the low terminal state, optional GROUND/ FLOAT.
   GROUND: Ground. Low level terminal connected to chassis ground wire
   FLOAT: Floating ground. Internally disconnects the low level terminal from the ground wire

	**Warning:** To prevent electric shock, do not touch any of the measurement circuits at any time while performing a floating ground measurement. Measurement terminals and wires need to be isolated by using insulating caps, insulating sleeves, etc.

9.1.6 Output Off State

To set the output off state, proceed as follows:

1. From the HOME screen, press the Config menu key to select the Source settings screen;
2. Select the channel to be set (1 or 2) to enter the single channel setting interface;
3. In the Output Off area, set the output off state, optional HIGH-Z / NORMAL / ZERO.

HIGH-Z: Disconnect the output relay when the output is turned off.
When the output is off, the voltage setting value≤ 40 V.
The current setting value≤ 100 mA.

NORMAL: Disconnect the output relay when the output is turned off.
When the output is turned off, it is in voltage source mode with a voltage setting value of 0 V and a current Limit of 100 uA.

ZERO: The output relay is not disconnected after the output is turned off.
When the output is turned off, it is in voltage source mode with a voltage setting value of 0 V and a current Limit of 100 uA.

9.1.7 Overvoltage/Overcurrent Protection

Enabling the OVP (Over Voltage Protection) / OCP (Over Current Protection) function effectively prevents damage to the test instrument due to over current or over voltage. To avoid damage to the equipment, avoid loading voltage/current more than the limited value on the output port.

To set overvoltage/overcurrent protection, proceed as follows:

1. From the HOME screen, press the Config menu key to select the Source settings screen;
2. Select the channel to be set (1 or 2) to enter the single channel setting interface;
3. In the OVP/OCP area, set the overvoltage/overcurrent protection function to ON (enabled) or OFF (disabled).

9.1.8 Output Filter

Enable the output filter function to obtain a source output that is free of peak, noise, and overshoot. However, enabling the filter may increase the stabilization time.

To set the output filter, proceed as follows:

1. From the HOME screen, press the Config menu key to select the Source settings screen;
2. Select the channel to be set (1 or 2) to enter the single channel setting interface;
3. Click the  icon on the right of Output Filter area to set the filter parameters:
   a) In the Automatic Filter area set the automatic filter function to ON (enabled) or OFF (disabled). When this function is enabled, the output filter will be set automatically, providing the best filter characteristics and cutoff frequency.
   b) In the Time Constant area, set the time constant of the output filter, optional 5 μs ~ 5 ms.

4. In the Output Filter area, set output filter to ON (enabled) or OFF (disabled).

9.1.9 Wait Time Control

SMM3000X allows you to set source and measurement wait time, where:

- The source wait time is defined as the amount of time that the source channel cannot change the output value when starting a DC output or after the trailing edge of the pulse.
- The measurement wait time is defined as the amount of time that the measurement channel is unable to start a measurement when starting a DC output or after the trailing edge of the pulse.

The wait time control requires the following parameters to be set:

- Wait Control: Set the source output wait function to ON (enabled) or OFF (disabled). When enabled, the source channel will wait for a period of time before changing the output value.
- Automatic: Automatic wait time, optional ON (enable) or OFF (disable). When enabled, the wait time can be automatically set.
- Gain: Coefficient of the initial wait time, used to calculate the wait time, 0~ 100 can be set.
- Offset: Offset of wait time, used to calculate wait time, 0~ 1s can be set.

The wait time is calculated as follows:

- If Wait Control = OFF, Wait time = 0
- If Wait Control = ON, Wait time = Gain x initial wait time x Automatic + Offset, and Automatic = 1(ON)/0(OFF)

The initial wait time is set automatically by the instrument and cannot be changed.

To set the wait time, proceed as follows:

1. In the HOME screen, press the Config menu key to select the Source or Measure setting screen to set the source or measurement wait time;
2. Select the channel (1 or 2) to be set;
3. Click the icon to set the parameters of wait time control on the right side of the Wait Control area:
   a) In the Automatic area, set to ON (enabled) or OFF (disabled).
   b) In the Gain area, set the coefficient of the initial wait time.
   c) In the Offset area, set the offset of the wait time.

4. Set Wait Control to ON (enabled) or OFF (disabled).

9.1.10 Measurement Speed

Select the channel to be set (1 or 2) to enter the single channel setting interface;

In the right field of the Measure: range setting, click to open Measure area and set Speed measurement speed mode, which allows you to select different PLC factors; or select the MANUAL mode and set the desired measurement time.

9.1.11 Resistance Compensation

Resistance compensation allows resistance measurements to acquire more accurate measurements. When the resistance compensation function is enabled for a channel, two measurements are performed and the compensated measurement specified by the following formula is returned. Designed to effectively reduce the thermal potential.

$Rcompen = (V_2 - V_1) / (I_2 - I_1)$

where V_1 is the measurement result in the 0 A current source state and I_1 is the measurement result in the 0 V voltage source state.

To set the resistance compensation, proceed as follows:

1. In the HOME screen, press the Config menu key to select the Measure setting screen;
2. Select the channel to be set (1 or 2) to enter the single channel setting interface;
3. In the R Compen area, set the resistance compensation function to ON (enabled) or OFF (disabled).

9.1.12 Sensing Type(4-Wire/2-Wire)

When connecting the DUT, you can choose to use either the 2-wire connection type or the 4-wire connection type.

2-Wire Connection: Use a 2-wire connection by connecting only the Force terminal and opening the Sense terminal. DC voltage or current can be applied and measured using the Force terminal.

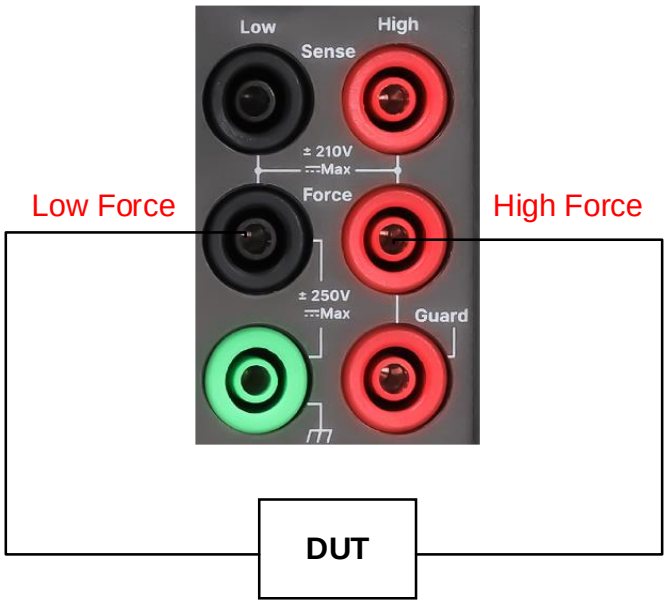


Figure 9-1 2-Wire Connection Diagram

Four-wire connection: Simultaneous use of Force and Sense terminals. Connecting both the Force and Sense wires to the terminals of the DUT minimizes measurement errors caused by contact resistance of the test leads or cables. This connection is effective for low resistance measurements and high current measurements.

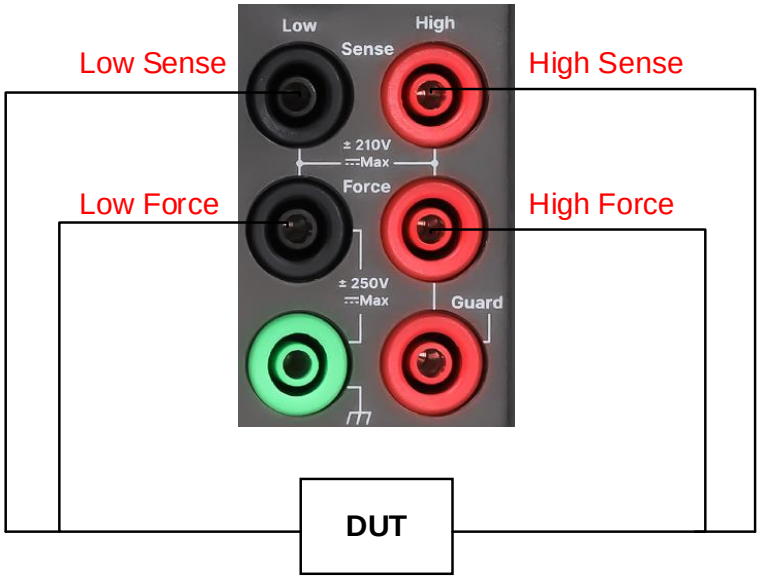


Figure 9-2 4-Wire Connection Diagram

To set the sensing type, proceed as follows:

1. In the HOME screen, press the Config menu key to select the Measure setting screen;

2. Select the channel to be set (1 or 2) to enter the single channel setting interface;
3. In the Sensing Type area, set the sensing type as 2-Wire or 4-Wire, after successful setup, the measurement display area of the main interface will show 2-WIRE or 4-WIRE icon.

9.1.13 Save and Recall Source/Measurement Settings

Parameters set in the Config > Source 和 Config > Measure screens can be saved;
Press Config > Save to save the parameters in step 1 to Config #1-5;
Press Config > Recall to read Config #1-5 settings to apply the parameters to all channels.
If Config #1-5 are unsaved settings, the default settings are applied when recalling.

9.2 Apply Source Output/Measurement Operation

9.2.1 Constant Voltage/Current Mode

The source output of SMM3000X series digital source meter supports constant voltage and constant current mode. When the source output (Source) is the voltage source setting value, the current (Limit) is the current setting value. If the output load impedance is greater than the value obtained by dividing the voltage set value by the current set value, the power supply will operate in constant voltage mode (CV). If the output load impedance is less than the value obtained by dividing the voltage setting by the current setting, the power supply will operate in constant current mode (CC).
In constant voltage mode, the output current is less than the set value and the output voltage is controlled through the front panel. The voltage value is kept at the set value and when the output current value reaches the set value, it switches to the constant current mode.
In constant current mode, the output current is a set value, the current is maintained at the set value, at this time the voltage value is lower than the set value, when the output current is lower than the set value, it switches to constant voltage mode.

9.2.2 Apply DC Source Output

Dual-channel models CH1 and CH2 outputs are in independent control states, while both CH1 and CH2 each have a set of source/measurement terminals containing Force, Sense, Guard and ground terminals, and the source/measurement terminals for CH1 and CH2 are on the front and rear panels, respectively.

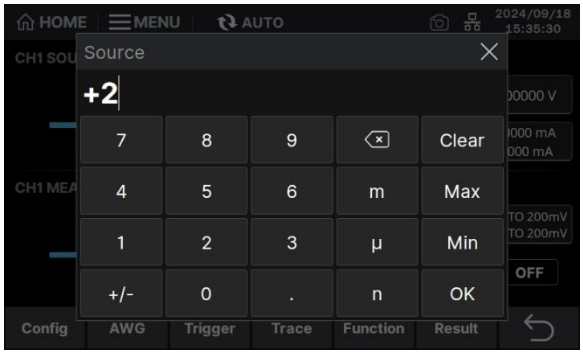
Operational Steps:

1. Use the knob to move the pointer to Source mode, check that the field border is white, then press the knob or ENTER button to enter the Source mode setting, turn the knob to select VOLTS(V) and press the knob or ENTER button to fix the setting;

2. Use the knob to move the pointer to the right side of the Source value, and then press the knob, you can see the Source value field border from white to yellow, that is setting the field; at the same time, the selected position in the field is blue, that is called the moving mode, in the moving mode, rotate the knob can be moved to any number of the location; then press the knob, the current selected position becomes green, that is called the editing mode, In the editing mode, rotating the knob can change the size of the number, if the selected is a decimal point, rotating the knob can change its position; Finally, when the Source value is set, press the knob, when the field border changes from yellow back to white, that is, the Source value is confirmed and applied.

In addition, by opening MENU > Display > Immediate V/I Update by Knob , turn on the knob real-time source output update function, which allows you to apply the output before finalizing the Source value.

3. If you do not want to use the knob input in step 2, you can also tap the screen or press ENTER button at the Source value to open the numeric keypad and set the Source value via the knob or touch screen. For example, to input +2 V, first click to select the number and press Clear , then click +/- to select the input positive sign, then click the number 2 , and finally click OK to confirm; if the input value is with unit (m / μ / n), the last step is changed to click m / μ / n . The above operation is based on the touch screen input for example, the same setting can also be done by moving the pointer with the knob and pressing the knob to confirm.



4. Use the knob to move the pointer to the Limit value of the field on the right of Limit: and then use the touch screen, or use the knob, ENTER button to set and fix the value;

5. Press the CH1 switch ON / OFF to enable channel 1 and the indicator lights. Channel 1 output;
6. Press the CH1 switch ON / OFF when in output state to turn off the output and the indicator goes out.

9.2.3 Apply Measurement Settings

Operational Steps:

1. Use the knob to move the pointer to Measure mode, then press the knob or the ENTER button, to enter the Measurement Mode setting, rotate the knob to select Measurement VOLTS(V) / OHMS(R) / AMPS(I) / WATTS(P) , press the knob or the ENTER button to fix the setting;

2. Use the knob to move the pointer to the range setting in the Measure: right field, then press the knob or ENTER button to enter the setting. When the source output is voltage, rotate the knob to Source Volts and press the knob to select AUTO (Automatic Range Adjustment) or FIXED (Fixed Range); if AUTO is selected, you can set the minimum range value in the right field for range operation; if FIXED is selected, you can set the fixed range value in the right field for range operation;
3. If measuring current, select AMPS(I) in Measure mode, then go to the range setup screen, select AUTO or FIXED in the Measure Amps field and set the range in the right field;
4. If measuring resistance, select OHMS(R) in Measure mode, then go to the range setting screen, change Measure ohms from OFF to AUTO , V / I or FIXED , the right field is used to set the resistance measurement range value for the FIXED operation, or set the minimum and maximum ranges for the AUTO operation. For V / I mode, the channel uses the value calculated according to the current source/measurement conditions to perform the resistance measurement and the resistance value is calculated based on V/I;

Taking the application of DC voltage source output to measure current as an example: S: indicates the range used for constant voltage output and voltage measurement of voltage source, and M: indicates the range used for current measurement of voltage source.

5. With the channel enabled, press TRIGGER button to make a single measurement of the DC source bias output, sweep output, pulse bias output, or pulse-sweep output; press AUTO button to make a repeated (continuous) measurement of the DC source bias output for the Source value.

9.3 Trigger System Settings and Control

This section describes the parameter settings of the trigger system, please refer to "Trigger System Diagram" for detailed illustration.

9.3.1 Introduction to Trigger System and Parameters

SMM3000X series digital source meters allow you to set detailed trigger parameters and control the trigger system. This trigger mode is applied independently to two device operations, transient (source output) and acquisition (measurement). These two operations can be started simultaneously or separately. For dual-channel models, both channels can also perform synchronous or asynchronous operations.

Selecting Device Operation

ALL: Indicates selection of both transient and acquisition device operations.

Trans.: Indicates that only transient (source output) device operation is selected.

Acq.: Indicates that only the acquisition (measurement) device operation is selected.

Trigger Source

AUTO: Automatically selects the trigger source that best suits the current operating mode.

BUS: Trigger commands using the remote interface, including *TRG, etc.

TIMER: Uses internally generated signals at each interval set by the Period parameter.

INT1/INT2: Uses signals from internal bus 1 or 2, respectively.

LAN: Triggered using LXI.

EXTn: Uses the signal from the DIO pin, which is the output port of the Digital I/O D-sub connector on the rear panel.

Trigger Command

Trigger denotes the trigger layer, Arm denotes the arm layer, IDLE denotes the idle layer, and Action denotes the device operation.

Initiate: Initiate (to go to the arm layer of the trigger system)

Abort: Abort (to return to the idle layer of the trigger system)

Immediate Trigger: Select the trigger layer to send an immediate trigger command.

Immediate Arm: Select the arm layer to send an immediate trigger command.

Trigger Type

AUTO: Automatic Trigger

SYNC: Synchronized Trigger

TIMER: Timer Trigger

MANUAL: Manually Trigger

Trigger Parameter

Count: Number of triggers for source and measurement, optional 1-100,000 or Inf. (countless)

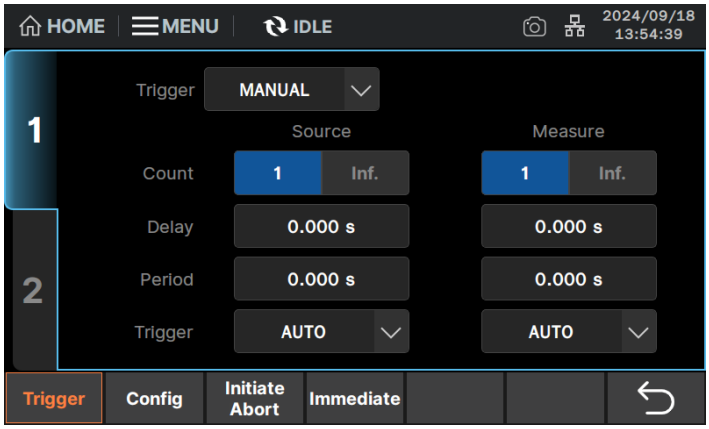
Delay: Trigger delay, optional 0-100 ks

Period: Trigger period, only for TIMER, minimum 20μs, maximum 100ks

Trigger: Trigger source, selectable AUTO (automatic selection)/BUS (remote interface)/TIMER (timer internal generation)/INT1-2 (internal signals 1 and 2)/LAN (LXI trigger)/EXT7-12 (DIO pin pin.7-12)

9.3.2 TRIGGER Layer Quick Setup

1. In the HOME interface, press the corresponding menu key of Trigger and select Trigger to enter the TRIGGER layer quick setting interface;



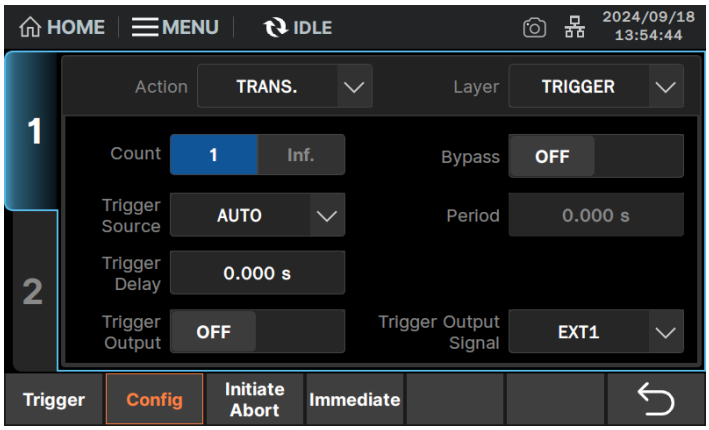
2. Select the channel to be set (1 or 2) to enter the single channel setting interface;
3. In the Trigger area, set the trigger type to AUTO / SYNC / TIMER / MANUAL;
4. Set the trigger parameters for source output and measurement:
   - Count: Trigger count. This value is automatically set when the trigger type is AUTO. For other trigger types, set the number of triggers required for each source output and measurement correctly. 1 ~ 100,000 can be set.
   - Delay: Trigger delay time. When the trigger type is AUTO, this value is 0. For other trigger types, the input value can be set as the trigger delay. 0 μs ~ 100,000 s can be set.
   - Period: Trigger period, interval of TIMER event, only applicable to TIMER event, can be set when the trigger type is TIMER and MANUAL. 10 μs ~ 100,000 s can be set.
   - Trigger: When the trigger type is AUTO and SYNC, the value is AUTO. when the trigger type is TIMER, the value is TIMER. when the trigger type is MANUAL, the value is optional AUTO, BUS, TIMER, INT1, INT2, LAN, EXT7-12.

Table 9.1 Trigger Type and Trigger Parameter Setting Table

Trigger Type	Count	Delay	Period	Trigger
AUTO	automatic setting	0	automatic setting	AUTO
SYNC	input value	input value	inapplicable	AUTO
TIMER	input value	input value	input value	TIMER
MANUAL	input value	input value	input value	selected value

9.3.3 ARM Layer, TRIGGER Layer and ACTION Detailed Settings

1. In the HOME screen, press the corresponding menu key of Trigger and select Config to enter the detailed trigger parameter setting interface;



2. Select the channel to be set (1 or 2) to enter the single channel setting interface;
3. In the Action area, select the type of source output or measurement device operation, optional TRANS.(transient)/ ACQ.(acquisition);
4. In the Layer area, set the selection layer, optional ARM/ TRIGGER/ ACTION;
5. In the Count area, set the count for the specified operation, 1~ 100,000 or Inf. (infinite);
6. In the Bypass area, set the bypass switch to ON (enabled) or OFF (disabled);
7. In the Trigger Source area, set the trigger source;
8. In the Period area, set the trigger period, only applicable when the trigger source is TIMER;
9. In the Trigger Delay area, set the trigger delay;
10. In the Trigger Output area, set the Trigger Output switch to ON (enabled) or OFF (disabled) to enable triggering of output at the I/O port;
11. In the Trigger Output Signal area, set the trigger output port, and you can set INT1-2 / LAN / EXT1-6.

9.3.4 Trigger System Control

1. From the HOME screen, go to the Trigger menu bar, which has four sub-screens: Trigger, Config, Initiate Abort, and Immediate;
2. Select the channel to be set (1 or 2) to enter the single channel setting interface;
3. In the Trigger interface, first select the trigger type (Trigger), and then depending on the trigger type, you can set the Source column to set the the following setup parameters of source output trigger (transient operation), and use the Measure column to set the following setup parameters of measurement trigger (acquisition operation), including Count, Delay, Period, and Trigger;
4. In the Config screen, first specify the type of device operation (Action) and the layer or device operation (Layer) to be set, and then set the following parameters specified by

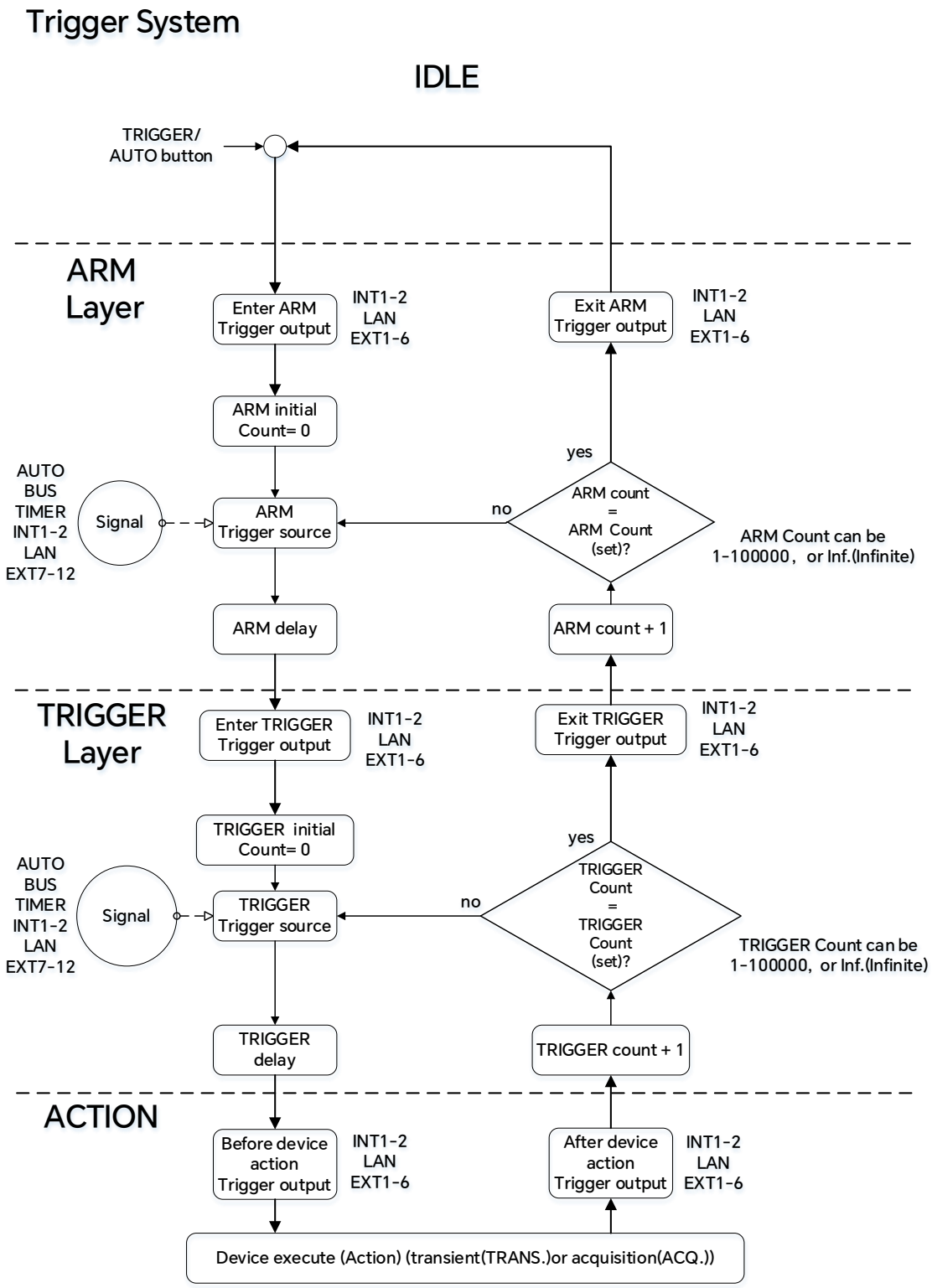
Action and Layer. Some of the settings such as Count, Trigger Delay, Period and Trigger Source are synchronized with the Trigger screen;

5. In the Initiate Abort screen, you can execute Initiate and Abort for the specified device operation of the current channel;
6. In the Immediate screen, you can execute Immediate Trigger and Immediate Arm for the specified device operation of the current channel.

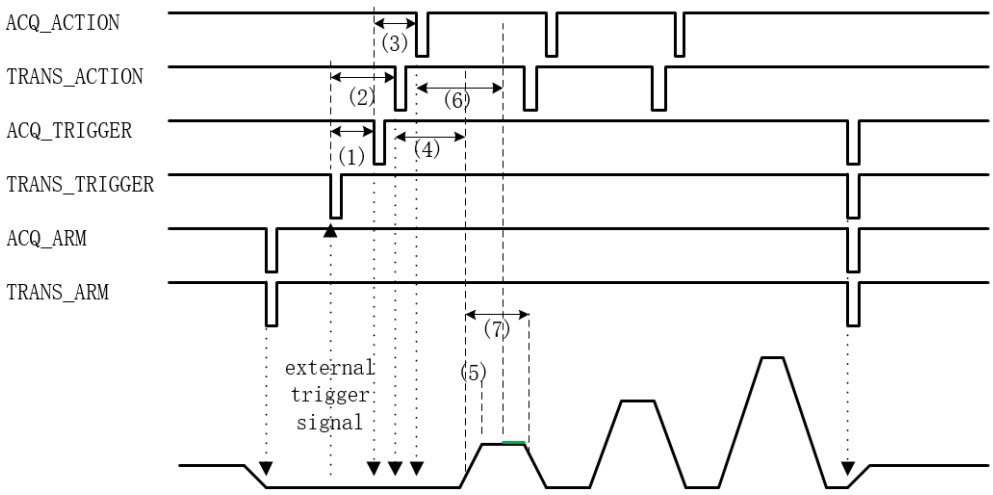
Shortcut Key

The field AUTO or IDLE or ARM at the top of the user interface, use the knob to move the pointer there, and then press the knob to execute Auto, Trigger, Initiate, Abort, Immediate Trigger, or Immediate ARM for the specified device operation of the specified channel; in addition, by pressing AUTO button or TRIGGER button of the front panel, you can execute repeat(continuous) measurement or single output/measurement.

9.3.5 Trigger System Diagram



Example for setting up the trigger system for sweep output:



1. Immediate Arm ALL or click the trigger TRIGGER button;
2. Output ARM Before signals (TRANS & ACQ), waiting for external trigger signal;
3. Receives external trigger signal, waits for ARM layer delay time (1), enters TRIGGER layer, and outputs TRIGGER Before signal (ARM layer responds immediately to the signal when it receives the signal without setting the delay time);
4. When the TRIGGER layer is triggered for the internal TIMER, the Action layer cycles according to the set cycle time;
5. TRANS_TRIGGER delays(2), enters the TRANS_ACTION layer, outputs the ACTION_Before signal, and the output changes; ACQ_TRIGGER delays(3), enters the ACQ_ACTION layer, outputs the ACTION_Before signal, and performs the data measurement;
6. After the ACTION layer operation is completed, the ACTION_After signal is output(when in TIMER trigger, the ACTION_Before and ACTION_After signal waveforms overlap), and the next ACTION operation is entered;
7. Completes all operations of the current ACTION layer, exits the ACTION layer, exits the TRIGGER layer, and outputs the TRIGGER_After signal;
8. Completes all operations of the current TRIGGER layer, exits the TRIGGER layer, exits the ARM layer, and outputs the ARM_After signal;
9. Completes all ARM layer operations, exits the sweep output function, and maintains the DC output as configured.

where parameters (1)-(7) are described as follows:

(1) ACQ_ARM delay. Affects ACQ_TRIGGER response time.

(2) TRANS_TRIGGER delay. Affects the TRANS_ACTION response time.

(3) ACQ_TRIGGER delay. Affects ACQ_ACTION response time.

(4) Pulse delay. After the ACTION layer responds, the pulse is generated with a delayed setup time.

(5) System source wait time. Effective only in AUTO trigger mode, the system will change output after a response to TRANS_ACTION and a range switch.

(6) System measurement wait time. Effective only in AUTO trigger mode, the system will execute measurement after a response to ACQ_ACTION and the waveform to stabilize. It is typically greater than the system source wait time.

(7) Pulse width.

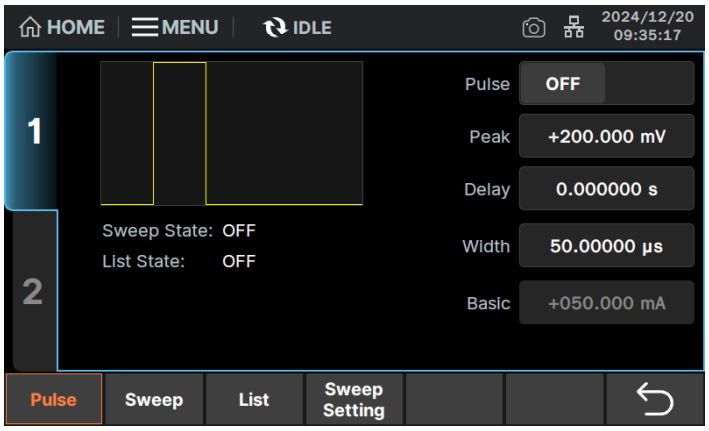
9.4 Sweep Output/Measurement

This section describes the parameter settings for Pulse, Sweep Source, and List Sweep, see Appendix A for examples.

9.4.1 Pulse Parameters and Sweep Settings

To set the pulse parameters, proceed as follows:

1. In the HOME interface, press the corresponding menu key of AWG and select Pluse to enter the pulse parameter setting interface;

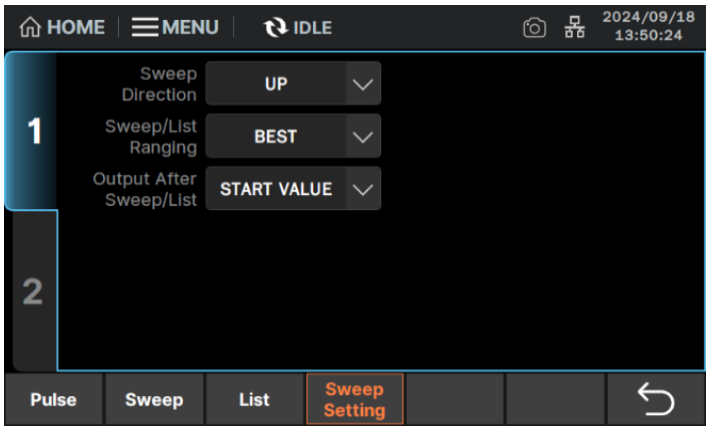


2. Select the channel to be set (1 or 2) to enter the single channel setting interface;
3. In the Pluse area, set to ON (enabled) or OFF (disabled). Set to ON to apply all pulse parameters; set to OFF to apply only Peak;
4. In the Peak area, set the pulse peak value;

5. In the Delay area, set the pulse delay time, selectable 0-99.9999 ks;
6. In the Width area, set the width of the pulse from 50 μs to 100 ks;
7. In the Basic area, displays the maximum value of current allowed to be continuously output in pulse mode when the pulse output is not triggered.

The sweep setting procedure is as follows:

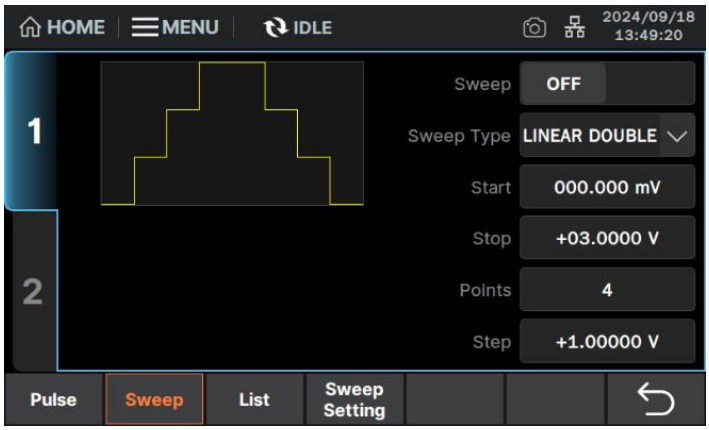
1. In the HOME interface, press the menu key AWG and select Sweep Setting to enter the sweep setting parameter interface;



2. Select the channel to be set (1 or 2) to enter the single channel setting interface;
3. In the Sweep Drection area, set the sweep direction, optionally UP / DOWN;
   UP: step from the initial value to the end value
   DOWN: step from end value to initial value
4. In the Sweep / List Ranging area, set the range adjustment mode for sweep source operation, selectable BEST / FIXED / AUTO;
   BEST: In linear sweep mode, the sweep source channel automatically uses the minimum range that covers the entire sweep output; in logarithmic sweep mode, the sweep source channel automatically uses the range that provides the best resolution for each sweep step output.
   FIXED: Fixed range
   AUTO: The sweep source channel automatically changes and sets the range, which provides the optimal resolution for applying the source output for each sweep step.
5. In the Output After Sweep / List area, set the value applied after the source channel has completed sweep output, optionally START VALUE/ END VALUE.
   START VALUE: Change to the DC output value before applying sweep output
   END VALUE: Hold the last value of the sweep output

9.4.2 Sweep Source

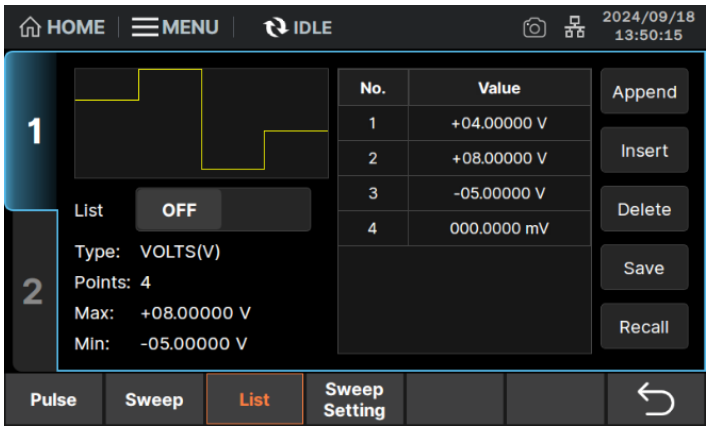
1. In the HOME interface, press the menu key AWG and select Sweep to enter the sweep source interface;



2. Select the channel to be set (1 or 2) to enter the single channel setting interface;
3. In the Sweep area, set sweep source switch to ON (enabled) or OFF (disabled);
4. In the Sweep Type area, set the sweep mode, optional LINEAR SINGLE / LINEAR DOUBLE / LOG SINGLE / LOG DOUBLE;where LINEAR / LOG means linear/logarithmic step, and SINGLE / DOUBLE means unidirectional/bidirectional (back and forth);
5. In the Start area, set the start value for the sweep source;
6. In the Stop area, set the end value for the sweep source;
7. In the Points area, set the number of points of sweep source, up to a maximum of 100000;
8. In the Step area, set the sweep step value. It is not required When in LOG SINGLE / LOG DOUBLE sweep mode.

9.4.3 List Sweep

1. In the HOME interface, press the menu key AWG and select List to enter the list sweep interface;



2. Select the channel to be set (1 or 2) to enter the single channel setting interface;
3. In the List area, set list sweep switch to ON (enabled) or OFF (disabled);
4. Below the List area, the current list statistics are displayed:

   Type: Display voltage source/current source

   Points: Number of list sweep steps (number of list data)

   Max: The maximum value of the value of the list

   Min: The minimum value of the value of the list
5. Click Append to add a row of list data below the currently selected row of the list;
6. Click Insert to insert a row of list data above the currently selected row of the list;
7. Click Delete to delete the list data of the currently selected row of the list;
8. Click Save to save the list data as a .csv file to local storage or USB flash drive;
9. Click Recall to read the .csv / .list file from local or USB flash drive and apply it to the current list.

9.4.4 Apply Sweep Source and Measurement

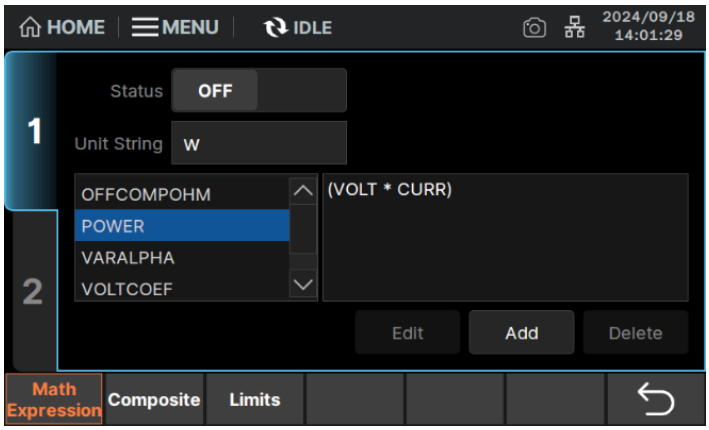
1. Set the source output mode to voltage VOLTS(V) or current AMPS(I);
2. Set the measurement mode to current AMPS (I), voltage VOLTS (V), resistance OHMS (R) or power WATTS (P);
3. To set the sweep source (output), first set the pulse parameters, In the AWG > Pulse interface, set Pulse to ON, and set the Delay and Width; then set the Sweep parameters, in the AWG > Sweep interface, set Sweep to ON, and set the Sweep Type, the sweep output displayed on the left will change accordingly, then set the sweep start value (Start), sweep stop value (Stop), the number of sweep steps (Points) or the sweep step value (Step), the number of sweep steps and the step value will interact with each other;

4. Go to the Graph view and in the Trace > Graph interface, set the appropriate Y-X Axis;
5. Press the ON / OFF switch to turn on the channel with the sweep output set, then press TRIGGER button to trigger a sweep source output and measurement;
6. The measurement will be displayed on the Graph view. Press Auto Scale to adapt the trace to the graph scale.

9.5 Math Function

The math operation function supports calculating mathematical expressions for measured source/voltage/current/resistance/time data and outputting calculation results. The setup procedure for the math function is as follows:

1. Press Function menu key in the HOME interface or FUNCTION button on the front panel to enter the math function setting interface;
2. Open the Math Expression settings screen:



3. Select the channel to be set (1 or 2) to enter the single channel setting interface;
4. In the Status area, set Math Functions to ON (enabled) or OFF (disabled);
5. In the Unit String area, enter the unit for the calculation result data;
6. Click to select the math expression to use; the selected blue border is highlighted; you can also click Add to customize the math expression;
7. Apply the settings.

The following math expressions have been defined for SMM3000X. Predefined math expressions are not cleared by closing or opening the source meter.

POWER

POWER = VOLT[c] * CURR[c]

Offset Compensation Ohms (OFFCOMPOHM)

OFFCOMPOHM = (VOLT[c][1]-VOLT[c][0]) / (CURR[c][1]-CURR[c][0])

Where VOLT[c][0] and CURR[c][0] are measured using the current output level, VOLT[c][1] and CURR[c][1] are measured using a different current output level or zero output.

This function effectively minimizes measurement errors in low resistance measurements.

Varistor Alpha (VARALPHA)

VARALPHA = log(CURR[c][1] / CURR[c][0]) / log(VOLT[c][1] / VOLT[c][0])

where CURR[c][0] and VOLT[c][0] are measurements at one point on the nonlinear I-V characteristic curve of the varistor, and CURR[c][1] and VOLT[c][1] are data at the other point.

Voltage Coefficient (VOLTCOEF)

VOLTCOEF = (RES[c][1]-RES[c][0]) / (RES[c][1] * (VOLT[c][1]-VOLT[c][0])) * 100 %

Where RES[c][0] and RES[c][1] are the resistance measurement data of the first and second measurement points respectively, and VOLT[c][0] and VOLT[c][1] are the voltage measurement data of the first and second measurement points, respectively.

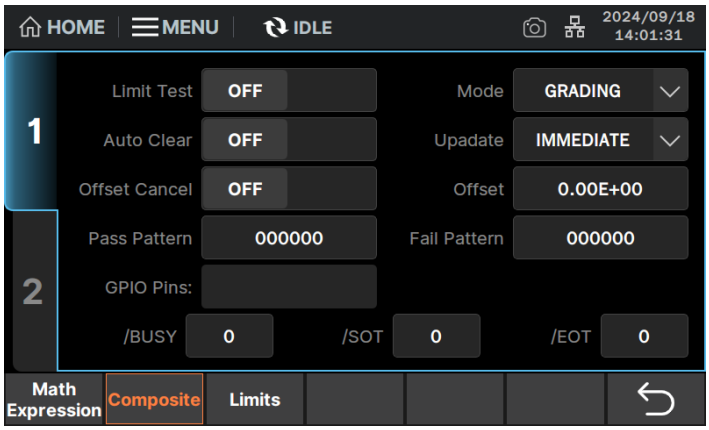
The voltage coefficient is the ratio of the fractional change in resistance as the voltage changes in the resistor.

9.6 Limit Test

This section describes the setup method and parameters of the Limit Test, for flowchart examples and operation examples, see Appendix B.

9.6.1 Composite Limit Test

1. Press the Function menu key in the HOME interface or FUNCTION button on the front panel and select Composite to enter the interface of composite limit test setting:



2. Select the channel to be set (1 or 2) to enter the single channel setting interface;
3. In the Limit Test area, set Composite Limit Test switch to ON (enabled) or OFF (disabled);
4. In the Mode area, set the operation mode, either GRADING or SORTING;

   GRADING: Grading mode, see Appendix B for details

   SORTING: Sorting mode, see Appendix B for details
5. In the Auto Clear area, set Auto Clear Composite Limit Test Results to ON (enabled) or OFF (disabled);
6. When the operation mode is GRADING, in the Update area, set the test result output timing mode.

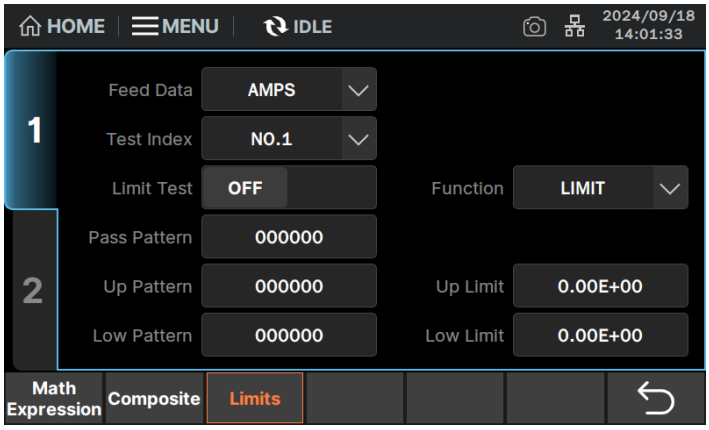
   IMMEDIATE or END can be set;

   IMMEDIATE: After each test

   END: After the last test
7. In the Offset Cancel area, set the offset cancel switch to ON (enabled) or OFF (disabled);
8. In the Offset area, set the offset value used for offset canceling if it is on;
9. When the operation mode is GRADING, in the Pass Pattern area, set the bit pattern indicating the pass state of composite limit test;
10. When the operation mode is SORTING, in the Fail Pattern area set the bit pattern indicating the fail state of composite limit test;
11. In the /BUSY area, set the DIO pin number used for BUSY signal output;
12. In the /SOT area, set the DIO pin number used for the Start-of-Test (SOT) signal output;
13. In the /EOT area, set the DIO pin number used for the End-of-Test (EOT) signal output.

9.6.2 Limit Tests

1. Press the Function menu key in the HOME interface or FUNCTION button on the front panel and select Limits to enter Limit Tests Setting interface:



2. Select the channel to be set (1 or 2) to enter the single channel setting interface;
3. In the Feed Data area, set the type of data used to determine the pass/fail of the limit test, selectable MATH, VOLTS, AMPS, or OHMS;

   MATH: Calculated resulting data for mathematical expressions

   VOLTS: Voltage measurement data (Vmeas)

   AMPS: Current measurement data (Imeas)

   OHMS: Resistance data (=Vmeas/Imeas)
4. In the Test Index area, set the index of the limit test;
5. In the Limit Test area, set Limit Test switch to ON (enabled) or OFF (disabled);
6. In the Function area, set the test mode of a limit test, either LIMIT or COMPLIANCE;

   LIMIT: Limit Test

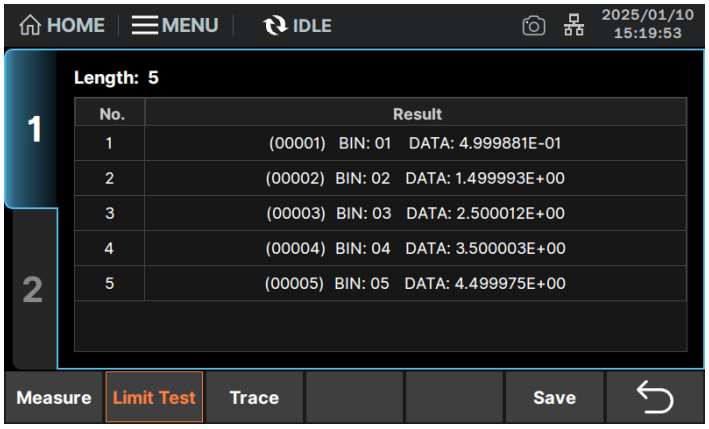
   COMPLIANCE: Compliance Check
7. When the operation mode is SORTING, in the Pass Pattern area, set the bit pattern indicating the pass state of the limit test;
8. When the operation mode is GRADING, in the Up Pattern area, set the bit pattern indicating the fail status of exceeding the upper limit, in the Up Limit area, set the upper limit for pass/fail judgment; in the Low Pattern area, set the bit pattern indicating the fail status that test data is lower than the lower limit, in the Low Limit area, set the lower limit for pass/fail judgment;
9. When the test function is COMPLIANCE, in the Fail on area, set the failure judgment method to IN or OUT.

   IN: If the channel enters the compliance state, the test result is to be a judged failure

OUT: If the channel exits the compliance state, the test result is to be a judged failure

9.6.3 Limit Test Result

1. Press the Result menu key and select Limit Test to enter the limit test result display interface;



2. Select the channel to be set (1 or 2) to enter the single channel setting interface;
3. View the limit test results for the selected channel containing the following:

   Length: Length of the data

   No.: Data index

   BIN: 2-digit number (00, 01 to 12, and 15)

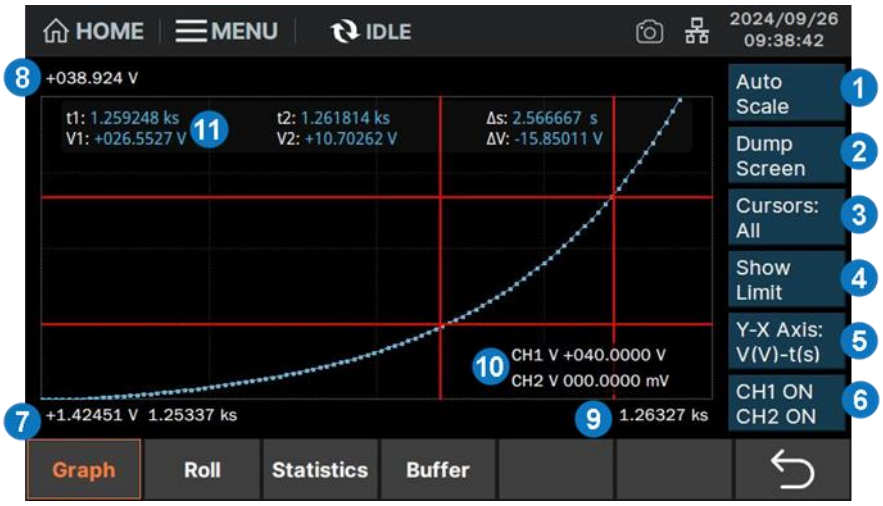
   DATA: Limit test data

9.7 View Display

SMM3000X can not only display the measurement or mathematical operation results of channel 1/2 in Graph view, but also show the time domain chart in Roll view through curve drawing, which is used to draw the measurement data of channel 1/2.

9.7.1 Graph View

Press the Trace menu key in the HOME screen and select Graph to enter the Graph view:



1. Auto Scale: Change the graphic scale to automatically fit the traces in the graphic.
2. Dump Screen: Save screen dump to JPEG file, and save to local internal.
3. Cursors Hide / Hori / Vert / All: Hide all/show the position and distance of the X cursor 1 and 2/show the position and distance of the Y cursor 1 and 2/show the X and Y cursors at the same time
4. Hide / Show Source / Limit: Hide all/show source setting values/limits for channels 1 and 2
5. Y-X Axis: Selection of the data type for the X- and Y-axis and the calibration (LINEAR/LOG), see Table 9 -2 for the data type
6. CH1/2 ON / OFF: Graph display status, ON or OFF
7. Minimum data of the graph (X-axis or Y-axis)
8. Maximum data of the graph (Y-axis)
9. Maximum data of the graph (X-axis)
10. Channel source output setting value
11. Cursor data

    First line: Position and distance of Y cursors 1 and 2 (e.g. t1, t2, Δs)

    Second line: Position and distance of X cursors 1 and 2 (e.g. V1, V2, ΔV)

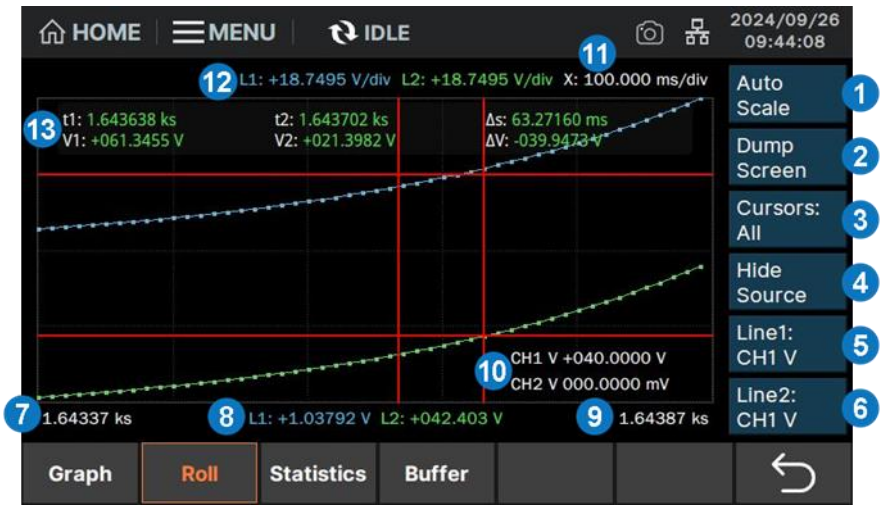
Table 9-1 Graph view X/Y axis data types

Data type	Description
I(A)	Current measurement
V(V)	Voltage measurement
R(Ω)	Resistance measurement
P(W)	Power measurement

MATH	Mathematical operation result value
t(s)	Time data. Only for X-axis values
V1	Voltage data for channel 1 or 2. X-axis values for dual-channel models only.
V2	

9.7.2 Roll View

Press the Trace menu key in the HOME screen and select Roll to enter the Roll view:



1. Auto Scale: Change the graphic scale to automatically fit the traces in the graphic.
2. Dump Screen: Save screen dump to JPEG file, and save to local internal.
3. Cursors Hide / Hori / Vert / All: Hide all/show the position and distance of the X cursor 1 and 2/show the position and distance of the Y cursor 1 and 2/show the X and Y cursors at the same time
4. Hide / Show Source / Limit: Hide all/show source setting values/limits for channels 1 and 2
5. Line 1: Set the channel and measurement data type displayed on trace 1, for data types see Table 9 -3
6. Line 2: Set the channel and measurement data type displayed on trace 2, for data types see Table 9 -3
7. X-axis minimum (minimum time stamp)
8. Y-axis offset values for Line1 and Line2
9. X-axis maximum value (maximum time stamp)
10. Channel source output setting value
11. X-scale
12. Y-scale

13. Cursor data

    First line: Position and distance of Y cursors 1 and 2 (e.g. t1, t2, Δs)

    Second line: Position and distance of X cursors 1 and 2 (e.g. V1, V2, ΔV)

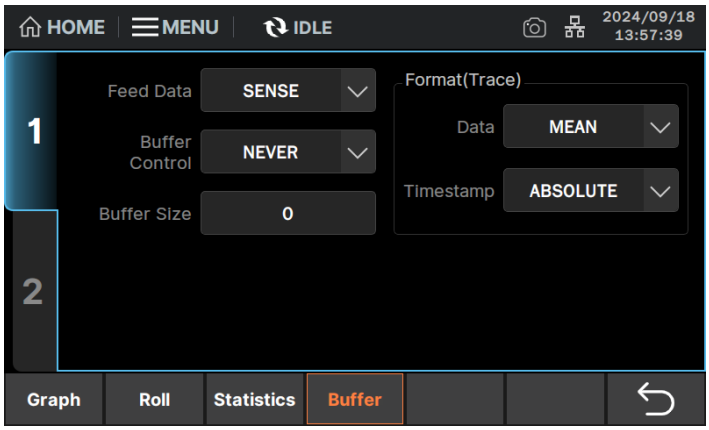
Table 9-2 Roll view Y-axis data types

Data type	Description
I	Current measurement
V	Voltage measurement
R	Resistance measurement
P	Power measurement

9.8 Data/results Show

9.8.1 Trace Statistics Settings

1. Press the Trace menu key in the HOME interface and select Buffer to enter the trace buffer setting interface;



2. Select the channel to be set (1 or 2) to enter the single channel setting interface;
3. In the Feed Data area, specify the type of data placed in the trace buffer, optionally SENSE / MATH / LIMIT;

   SENSE: Acquisition of measurement result data

   MATH: Calculation result data

   LIMIT: Acquisition of limit value result data
4. In the Buffer Control area, set the trace buffer write mode, optionally NEVER/NEXT;

   NEVER: Writing is disabled , data cannot be written to the buffer at this time.

NEXT: Enables writing, writes data to the buffer until the trace buffer is full, then changes to NEVER mode.

5. In the Buffer Size area, set the size of the trace buffer, 0~ 100,000 can be set;
6. Set the format of trace statistics. In the Data area, select the statistics to be returned for trace data, selectable MEAN/ MAX / STD.DEV / PK-PK /MIN; in the Timestamp area, select the timestamp data format, selectable ABSOLUTE / DELTA.

   MEAN: Mean of the trace buffer data

   MAX: Maximum of the trace buffer data

   STD.DEV: Standard deviation of the trace buffer data

   PK-PK: Peak to peak value of the trace buffer data

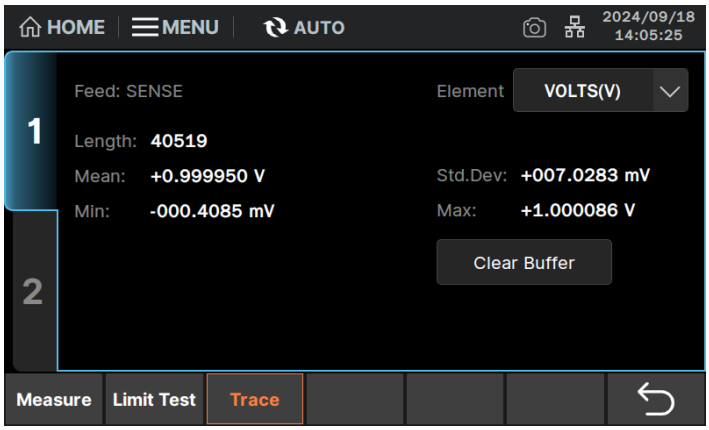
   MIN: Minimum of the trace buffer data

   ABSOLUTE: Absolute value of the trace buffer data

   DELTA: Differential value of the trace buffer data

9.8.2 Trace Statistics Result

1. Press the Result menu key in the HOME interface and select Trace to enter the trace statistics screen;



2. Select the channel to be set (1 or 2) to enter the single channel setting interface;
3. View the trace statistics results for the selected channel, containing the following:

   Feed: Type of data displayed

   Element: Displayed when Feed is SENSE, sets the type of data for statistical calculations, optionally AMPS (current) / VOLTS (voltage) / OHMS (resistance)

   Length: Length of the data

   Mean: Mean of the data

Std.Dev: Standard deviation of the data

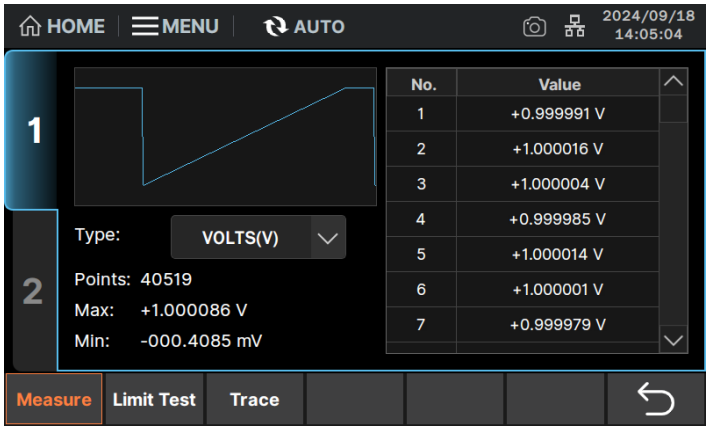
Min: Minimum of the data

Max: Maximum of the data

4. To clear the currently buffered data, click Clear Buffer and press Enter button to confirm the clear operation.

9.8.3 Measurement Result

1. Press the Result menu key in the HOME interface and select Measure to enter the measurement result display interface;



2. Select the channel to be set (1 or 2) to enter the single channel setting interface;
3. View the measurement result for the selected channel, containing the following:

Type: Specifies the type of measurement data results to be displayed, optionally AMPS (current) / VOLTS (voltage) / OHMS (resistance) / WATTS (power) / MATH (math calculation results) / TIME (time)

Points: Points of data

Max: Maximum value of the data

Min: Minimum value of the data

10 Menu Function Operation

10.1 System Settings

10.1.1 PLC Setting

1. Press the MENU button on the front panel or MENU key to enter the menu selection interface;
2. Select the System menu key to enter the system setting interface;
3. Select PLC to set the power line frequency, selectable 50/60Hz.

10.1.2 Beeper Setup

1. Press the MENU button on the front panel or MENU key to enter the menu selection interface;
2. Select the System menu key to enter the system setting interface;
3. Select Sound to set the buzzer on or off.

10.1.3 Power-on setting

1. Press the MENU button on the front panel or MENU key to enter the menu selection interface;
2. Select the System menu key to enter the system setting interface;
3. Select Power-on State to set the power-on state, optionally RST (default)/Last (last power-on state)/Config #1-5 (pre-saved power-on state);
4. Select Power-on Mode to set the power-on mode, selectable Auto/Manual.

10.1.4 Timestamp

Setting the Timestamp Automatic Clearing

1. Press the MENU button on the front panel or MENU key to enter the menu selection interface;
2. Select the System menu key to enter the system setting interface;

3. In the Timestamp Auto CLR area, set Timestamp Auto Clear to ON (enabled) or OFF (disabled);
4. The timestamp will be automatically cleared after each initiation of the trigger system.

Clearing Timestamp

1. Press the MENU button on the front panel or MENU key to enter the menu selection interface;
2. Select the System menu key to enter the system setting interface;
3. In the Timestamp area, click Clear and press Enter button to clear the timestamp.

10.1.5 Default Setting Operation

Refer to Appendix C of the detailed setting items.

1. Press the MENU button on the front panel or MENU key to enter the menu selection interface;
2. Select the System menu key to enter the system setting interface;
3. Click Reset Config , and then click Yes to restore the default settings. To cancel this operation, press No .

10.1.6 SCPI

1. Press the MENU button on the front panel or MENU key to enter the menu selection interface;
2. Select the System menu key to enter the system setting interface;
3. In the SCPI area, you can select Default mode or 2400 mode, which is compatible with the SCPI instruction of the Keithley 2400 series source meter.

10.2 Display Settings

1. Press the MENU button on the front panel or MENU key to enter the menu selection interface;
2. Select the Display menu key to enter the display setting interface, where you can set the parameters related to the display:

Display digits: Set the digital resolution of the displayed data, selectable 3.5 / 4.5 / 5.5 / 6.5 Digits.

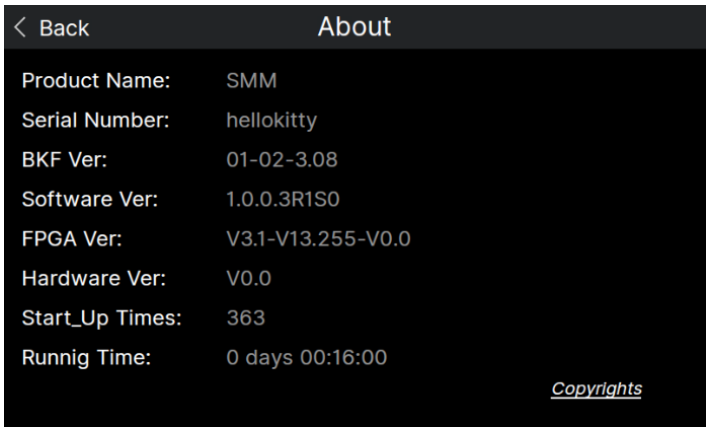
Language: Set the user interface language, selectable Simplified Chinese/English.

BackLight Brightness: Set the backlight brightness of the screen, adjustable from 0 to 100.

Screen Saver: Set the screen saver time, optionally Disable / 1 / 2 / 5 / 15 / 30 min.

10.3 View Version Information

1. Press the MENU button on the front panel or MENU key to enter the menu selection interface;
2. Select the About menu key to enter the following version information display screen:



Version information content includes:

Product Name: Instrument model name

Serial Number

BKF Ver: BKF version number

Software Ver: Software version number

FPGA Ver: FPGA version number

Hardware Ver: Hardware version number

Start_Up Times

Running Time: Running time since power-on

Click the “Copyrights” on the lower right corner of the version information display screen to view the copyright notice document, which contains the following contents:

Introduction

Products list

Software packages: Software packages with name, version and license

Verbatim license texts: License texts

Copyrights

10.4 I/O Communication Interface Settings

SMM3000X series digital source meters support and can be set up with LAN, VNC, USB, GPIB and DIO interface information for connecting and controlling the instrument, and support LXI control.

10.4.1 Interface Data Format

1. Press the MENU button on the front panel or MENU key to enter the menu selection interface, then press the I/O menu key to enter the network setting interface;
2. Press the knob to select the field to turn yellow box, use the knob to move the pointer to Format , and then press the knob again to enter the interface data format setting to set the data format of the interface:

   SENSE: Set the measurement data of the output, multi-selectable voltage/ current/ resistance/ source/ time/status.

   Math/Limit: Set the output math operation and limit test result data, multi-selectable result/time/status.

   Data Type: Set the output data format, optional ASCII / REAL32 / REAL64.

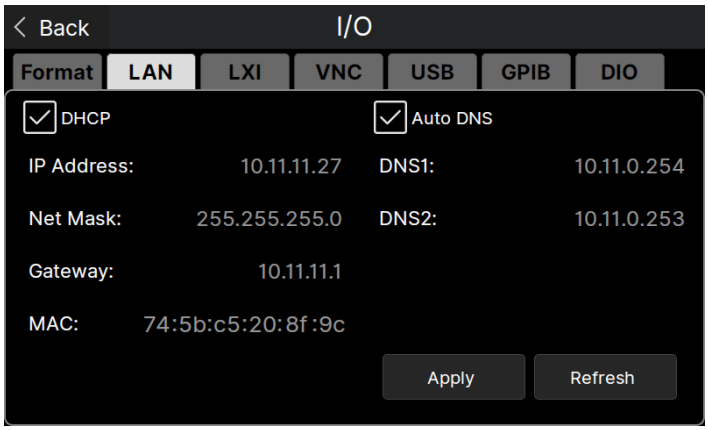
   Data Swap: Set up byte swap, enable ON to reverse byte order.

10.4.2 LAN Setting

1. Connect the LAN port to the local network on the rear panel of the SMM3000X using a network cable;
2. Press the MENU button on the front panel or MENU key to enter the menu selection interface, then press the I/O menu key to enter the network setting interface;
3. Press the knob, check the field to turn yellow box, use the knob to move the pointer to LAN , then press the knob again to enter into the LAN setting interface, set DHCP to ☑ or ☐ . Among them:

   ☑: Automatically obtained IP address, subnet mask and gateway according to the current access network.

: Users can manually set the IP address, subnet mask, and gateway by moving the knob to the address field, pressing the knob, and using the numeric keypad to complete the address setting.



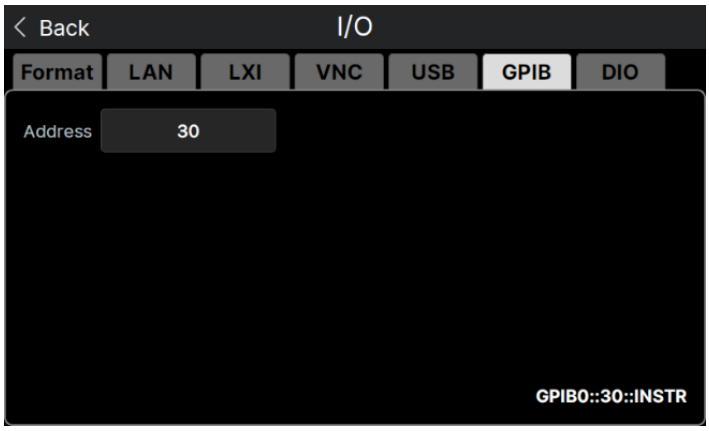
4. Set up DHCP, IP address, subnet mask, and gateway;
5. When the settings are completed, click Apply to apply the settings; click Refresh to refresh the current state if the access network changes.

10.4.3 VNC Setting

1. Press the MENU button on the front panel or MENU key to enter the menu selection interface, then press the I/O menu key to enter the network setting interface;
2. Press the knob, check the field to turn yellow box, use the knob to move the pointer to VNC , then press the knob again to enter into the VNC setting interface;
3. Set the port number (Port), the port number can be selected from 5900-5999. You can use the numeric keyboard or knob to set the value;
4. Set the password (Password). The value can be set using the numeric keypad or the knob.

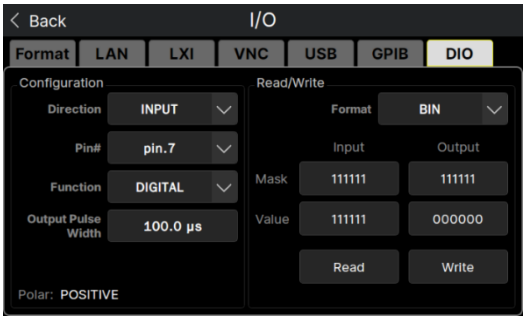
10.4.4 GPIB Setting

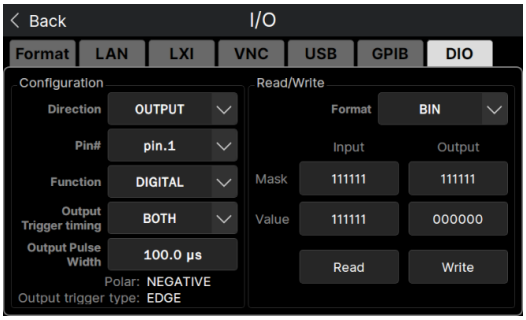
1. Press the MENU button on the front panel or MENU key to enter the menu selection interface, then press the I/O menu key to enter the network setting interface;
2. Press the knob, check the field to turn yellow box, use the knob to move the pointer to GPIB , then press the knob again to enter into the GPIB setting interface;
3. Set the GPIB address, the address can be selected from 0-30. you can use the numeric keypad or knob to set the value.



10.4.5 DIO Setting

1. Press the MENU button on the front panel or MENU key to enter the menu selection interface, then press the I/O menu key to enter the network setting interface;
2. Press the knob, check the field to turn yellow box, use the knob to move the pointer to DIO , then press the knob again to enter into the DIO setting interface:
   - Direction: Select Digital I/O interface to set up, the left figure below is input (INPUT), the right figure is output (OUTPUT).

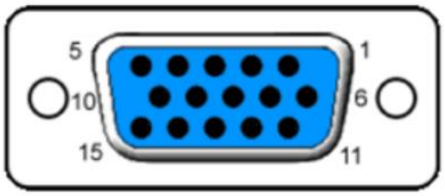




   - Pin#: Digital I/O pin number, pin.1-6 is output, pin.7-12 is input.
   - Function: The function of the specified pin, selectable digital signal input/output (DIGITAL) and trigger input/output (TRIGGER).
   - Output Trigger timing: Timing of the output trigger, selectable output after operation (arm, trigger and action) (AFTER), before operation (BEFORE) or both (BOTH).
   - Output Pulse Width: Output trigger pulse width, from 10 µs to 10 ms.
   - Polar: Polarity of the input/output function. POSITIVE / NEGATIVE.
   - Output trigger type: Type of output trigger. EDGE.
   - Format: Set the format of the values to the Mask and Value fields in binary (BIN), decimal (DEC), or hexadecimal (HEX).

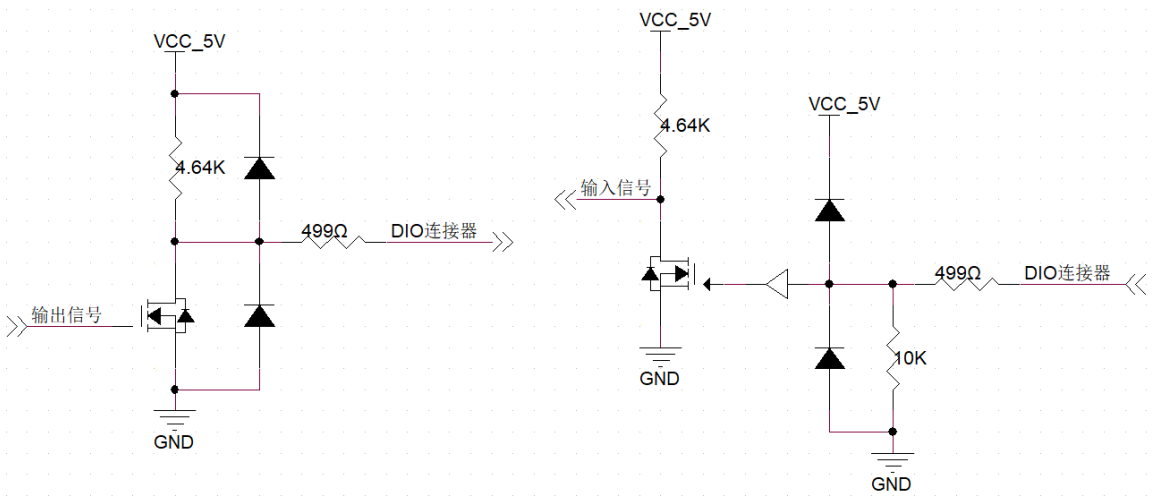
- Mask: Mask value, indicating the code type of the unused bits of the Digital I/O interface.
- Value: The value set to the Digital I/O interface.
- Read: Read the mask value/values currently set to the Digital I/O interface.
- Write: Write the specified mask value/values to the Digital I/O interface.

Digital I/O Digital Interface:



Output: pin.1-6	Internal 4.7 kΩ resistor pull-up to 5 V, falling edge/low active
Input: pin.7-12	TTL COMS drive input, rising edge/high level active
pin.13	+5 V output, max. current 50 mA, uninsured
pin.14	Safety lockout pin: output voltage > 42 V after high level enable (connect 13 pin)
pin.15	GND
Maximum Input Voltage	5.25V
Minimum Input Voltage	-0.25 V
Minimum logic low level	0.25 V
Minimum logic high level	2 V
Maximum drive current of pin	1 mA @ Vout = 0 V
Maximum absorption current of pin	10 mA @ Vout = 5 V
Maximum simultaneous trigger (using digital I/O)	8

Digital I/O Internal Circuitry:



10.5 Board Test

10.5.1 Screen Test

The screen test is mainly conducted by observing the state the of source meter display screen under the red, green, blue, black and white, and checking the screen for any serious color deviation, bad dots or screen scratches. Please follow the steps below to perform the screen test:

1. Press the MENU button on the front panel or MENU key to enter the menu selection interface, then press the Test&Cali menu key to enter the self-test function interface;
2. Use the knob to move the pointer to Screen Test , then press the knob to enter the Screen Test screen, which appears solid red;
3. Observe the screen for problems such as severe color casts, smudges, or screen scratches;
4. Click on the screen to switch between different screen colors for viewing;
5. Repeat the previous step until you confirm that the screen display is normal;
6. Double-tap the screen to complete the screen test.

10.5.2 Keyboard Test

The keyboard test is mainly used to find problems such as unresponsive or untimely response of the source meter's front panel keys or knobs. Please follow the steps below to perform the key test:

1. Press the MENU button on the front panel or MENU key to enter the menu selection interface, then press the Test&Cali menu key to enter the self-test function interface;
2. Use the knob to move the pointer to Key Test , then press the knob to go to the Key Test screen;
3. Press the buttons on the front panel in the order from top to bottom and from left to right, and observe whether the corresponding keys on the keyboard test interface light up in real time;
4. Repeat the previous step until all buttons of the panel have been tested;
5. Press the knob, then release it, and observe whether the Knob down / Knob up button becomes bright in real time;
6. After completing all key and knob tests, exit the test.

10.5.3 LED Test

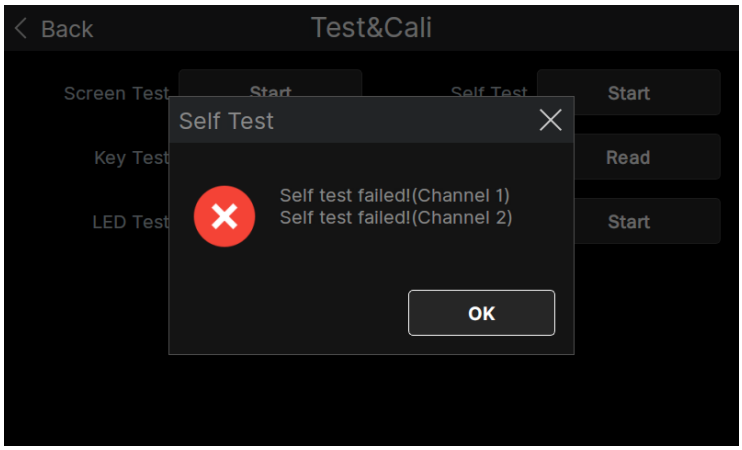
The LED test is mainly used to find the problems of the lights of the front panel button of the source meter such as not lighting up or poor brightness. Please follow the steps below to perform the LED test:

1. Press the MENU button on the front panel or MENU key to enter the menu selection interface, then press the Test&Cali menu key to enter the self-test function interface;
2. Use the knob to move the pointer to LED Test , then press the knob to go to the LED Test screen;
3. Light the key block in the on-screen test interface and observe whether the LED of the front panel keys corresponding to that key block is lit;
4. Repeat the previous step until all LED tests have been finished;
5. Exit LED test.

10.5.4 Self Test

The function self-test can be used to self-test the channel to check whether the channel can operate normally when an abnormality occurs in the source meter.

1. Press the MENU button on the front panel or MENU key to enter the menu selection interface, then press the Test&Cali menu key to enter the self-test function interface;
2. Use the knob to move the pointer to Self Test and press the knob. Then come out the test result. If it fails, the pop-up window appears as follows:



10.5.5 Temperature Monitor

1. Press the MENU button on the front panel or MENU key to enter the menu selection interface, then press the Test&Cali menu key to enter the self-test function interface;
2. Use the knob to move the pointer to Temperature Monitor , then press the knob again;
3. View the temperature of environment, calibration, positive terminals, negative terminals, and power supply, respectively.

10.6 File Browser and Save/Recall

SMM3000X supports storing the current settings on an internal or external USB flash drive, so that the user can recall the saved file to restore the settings. The File Browser allows you to browse and manage images (JPG), data (CSV), and other files that have been saved on the USB flash drive or locally.

Press the MENU button on the front panel or MENU key to enter the menu selection interface, then press the File menu key to enter the file browser interface to edit the file:

- New: New folder
- Copy: Copy the selected file for the next step of paste or move
- Paste: Paste the file to the current location
- Move: Move the file to the current location
- Rename: Rename the selected file
- Delete: Delete the selected file
- Multi: Enter the multi-select file mode, and you can batch file operations

The contents of the settings that can be saved and recalled include:

- Source Output and Measurement Settings
- List Sweep Settings
- Dump Screen
- Save / Load in Menu Screen

Source Output and Measurement Setting

Operational Steps:

1. In the Config -> Source and Config -> Measure interface, set the parameters needed;
2. Press Config -> Save to save the settings from step 1 to Config #1-5;
3. Press Config -> Recall to read Config #1-5 settings to apply to all channels.

If Config #1-5 are unsaved settings, the default settings are applied when reading.

List Sweep Setting

Operational Steps:

1. In the AWG -> List interface, there are Save and Recall function keys in the lower right;
2. Press Save to save the current list sweep as a CSV file, set the file name and store it to internal or external USB flash drive;
3. Press Recall to read a CSV or list file from an internal or external USB flash drive to apply to the current list sweep.

Screen Dump

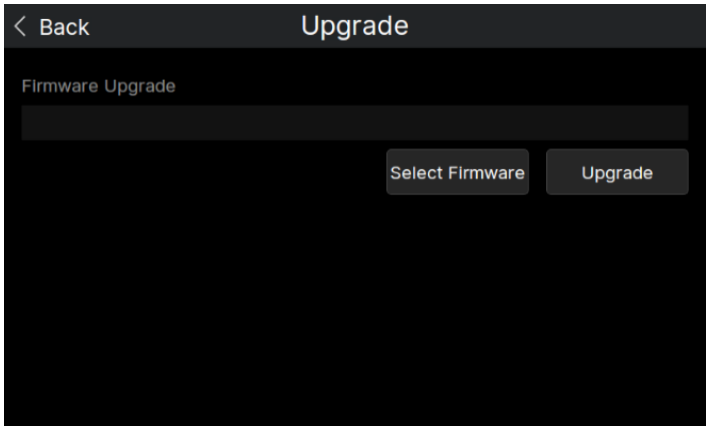
Operational Steps:

1. At the top of the user interface, there is the  icon, press it to dump the current screen to an internal file, which is automatically named after the current time;
2. In the Trace -> Graph and Trace -> Roll interface, it is also possible to dump the graph to an internal file by pressing Dump Screen .

10.7 System Upgrade

Please follow the steps below to upgrade the firmware:

1. Download the firmware upgrade package from the official website;
2. Copy the .ADS file from the upgrade package to the root directory of the USB flash drive;
3. Insert the USB flash drive into the USB-A port on the rear panel;
4. Press the MENU button on the front panel or MENU key to enter the menu selection interface, and press Upgrade menu key to enter the upgrade interface;
5. Press Select Firmware , to enter the external USB flash disk interface, select the upgrade file and press OK to confirm;
6. Press Upgrade key to confirm. The upgrade progress bar will pop up, and the instrument will restart after upgrading successfully. If failed, a prompt box will pop up.



Note: Any operation that interrupts the upgrade process may cause the upgrade to fail or even prevent the machine from restarting, so please keep the USB flash drive in a stable state and the machine's power supply during the upgrade process.

10.8 Event Log

1. Press the MENU button on the front panel or MENU key to enter the menu selection interface, then press the Event Log menu key to enter the event log interface;
2. Press Log Setting to enter the log setting interface and set the log parameters:

   Popups: Set the type of message to be popped up

   Reset Popups: Restore default settings for popups (error and warning messages)

   Show Warning: Show warning messages in the current screen

   Show Information: Display information messages in the current interface

   Log Warning: Log warning messages, pop-up windows will not be logged or shown after closing

   Log Information: Log information type messages

Log Command: Record commands sent to the instrument, Log Information is required to be turned on

3. Select Save to USB to save the log as a .csv file to a local or USB flash drive;
4. Select Clear Log to clear the log.

11 Remote Control

The SMM3000X supports communication with a computer via USB and LAN interfaces using a SCPI (Standard Commands for Programmable Instruments) compliant command set.

This chapter will introduce how to build a programming environment and explain the SCPI commands supported by the SMM3000X.

11.1 Way to Control

Using NI-VISA

Users can develop remote control programs for the instrument by using NI-VISA of NI (National Instrument Corporation). Regarding NI-VISA, there is a complete and real-time version (Run-Time Engine version). The complete version includes NI device drivers and a tool called NI MAX. NI MAX is a user interface used to control the device. The real-time version is much smaller than the full version, and it only includes NI device drivers.

After installing NI-VISA, use a USB cable to connect the SMM3000X (via the USB Device interface on the rear panel) to the computer, or use a network cable to connect the SMM3000X (via the LAN interface on the rear panel) to the local area network where the computer is located.

Based on NI-VISA, users can remotely control SMM3000X in two ways, one is through web service; the other is by developing custom programming combined with SCPI commands. For more information, please refer to the programming examples.

Using Sockets

Users can also use Sockets to communicate with SMM3000X based on the TCP/IP protocol through the network port. Socket communication is a basic communication technology of computer networks, which allows applications to communicate through network hardware and standard network protocol mechanisms built into the operating system. This method requires two-way communication between the instrument and the computer network through an IP address and a fixed port number.

The port of SMM3000X for Socket communication is 5025.

After connecting the SMM3000X (via the LAN interface on the rear panel) to the local area network where the computer is located with a network cable, the user can combine SCPI commands for custom programming to realize remote control of the SMM3000X. For more information, please refer to the programming examples.

11.2 Grammatical Conventions

SCPI commands are a tree-like hierarchical structure, including multiple subsystems. Each subsystem is composed of a root keyword and one or several hierarchical keywords. Command keywords are separated by colons ' : ', keywords are followed by optional parameter settings, commands and parameters are separated by ' spaces ', for multiple parameters, parameters are separated by commas ' , '. A question mark ' ? ' is added after the command line, which means to query this function.

Angle brackets (< >), Braces ({ }), vertical line (|) and square brackets ([ ]) are not in commands and are not sent with the command, but are often used to aid in describing the parameters in the SCPI command.

Most SCPI commands are a mixture of upper and lower case letters. Capital letters indicate the abbreviations of commands, namely short commands. If you want better program readability, you can use long commands. E.g:

[:SOURce]:VOLTage[:LEVel][:IMMediate][:AMPLitude]?

[:SOURce]:VOLTage[:LEVel][:IMMediate][:AMPLitude] {<value> | MINimum | MAXimum |DEFault}

SOURce is the root keyword of the command, and VOLTage is the second-level keyword. The command line starts with a colon ":", and also each level of keywords is separated by a colon ":" There are four parameters inside the Braces, <value>, MINimum, MAXimum and DEFault, indicating that this command must select a parameter from the four optional parameters, and <value> indicates that it must be replaced with a value within the set voltage range of this model.

- Braces ({ }) enclose the parameter selection. The braces are not sent with the command string.
- The vertical line (|) divides the parameter selection.
- Angle brackets (< >) indicate that a value must be assigned to the parameter inside the bracket. The angle brackets are not sent with the command string.
- Optional parameters are enclosed in square brackets ([ ]). If you do not specify a value for the optional parameter, the instrument will use the default value. E.g:

Sending the following commands all have the same effect of querying the voltage setting value:

:SOURce:VOLTage?
:SOUR:VOLT?
:VOLTage?
:VOLT?

Sending the following commands all have the same effect of setting the voltage to 2.82 V:

:SOURce:VOLTage 2.82
:SOUR:VOLT 2.82
:VOLTage 2.82
:VOLT 2.82

11.3 Web Service

11.3.1 Web Connection Method

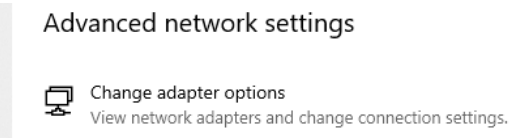
The SMM3000X can be remotely controlled through its embedded web control interface.

The first connection method:

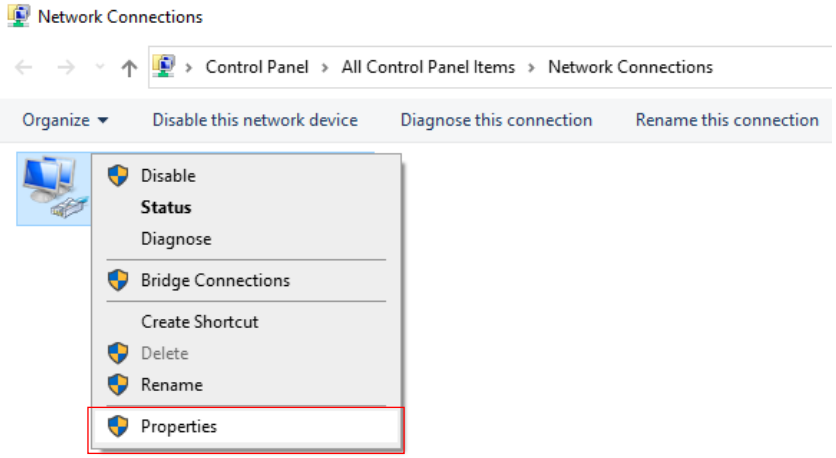
The computer is not connected to the network, and the SMM3000X and the PC computer are directly connected through a network cable (cross-over cable).

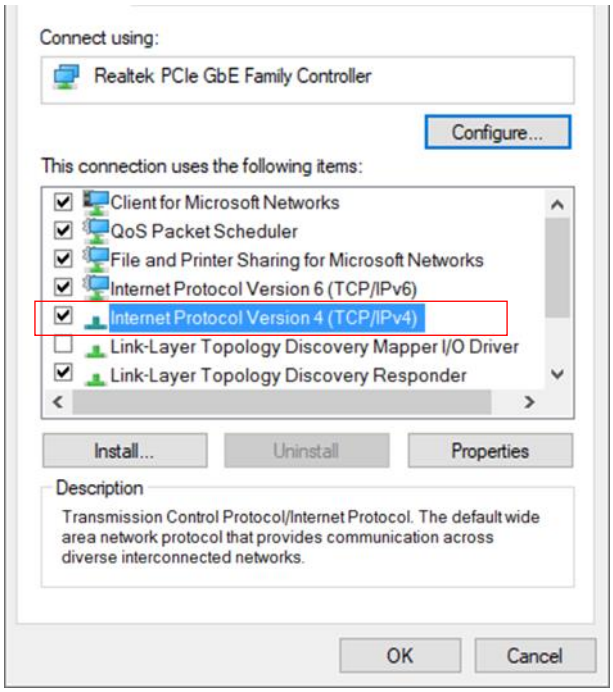
First, set up the computer. The following uses Windows 10 system as an example:

1. Select "Network and Internet" in Windows settings and click "Change adapter settings" in "Advanced network settings".

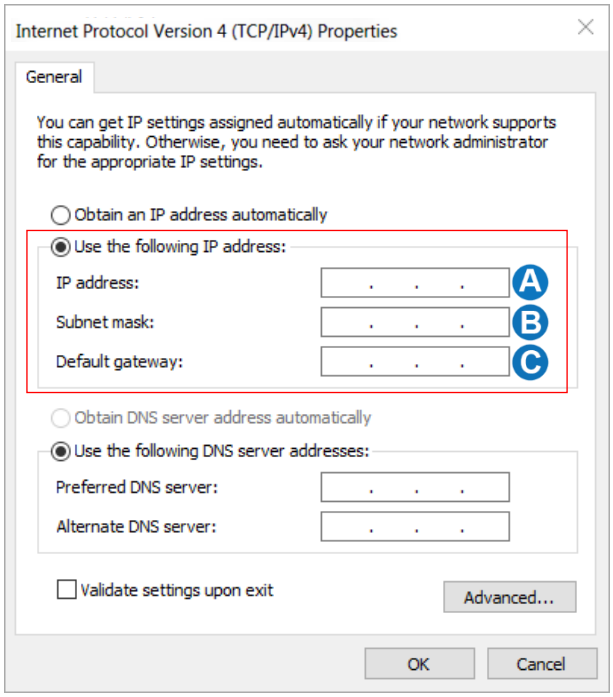


2. Right-click "Ethernet" and select "Properties", and double-click "Internet Protocol Version 4 (TCP/IPv4)" in the pop-up window.





3. Select "Use the following IP address" to set the IP address, subnet mask and default gateway, and click "OK" after setting.



A. Set an IP address different from SMM

B. Set the same subnet mask as SMM

C. Set the same gateway as SMM

4. The PC computer setting is completed.

Set the SMM3000X:

Refer to the previous chapter “LAN Setting”, manually set SMM3000X to be the same as the PC computer subnet mask and default gateway, and set a different IP address. At this point, the PC and SMM3000X settings are completed, and the web page can be opened for remote control.

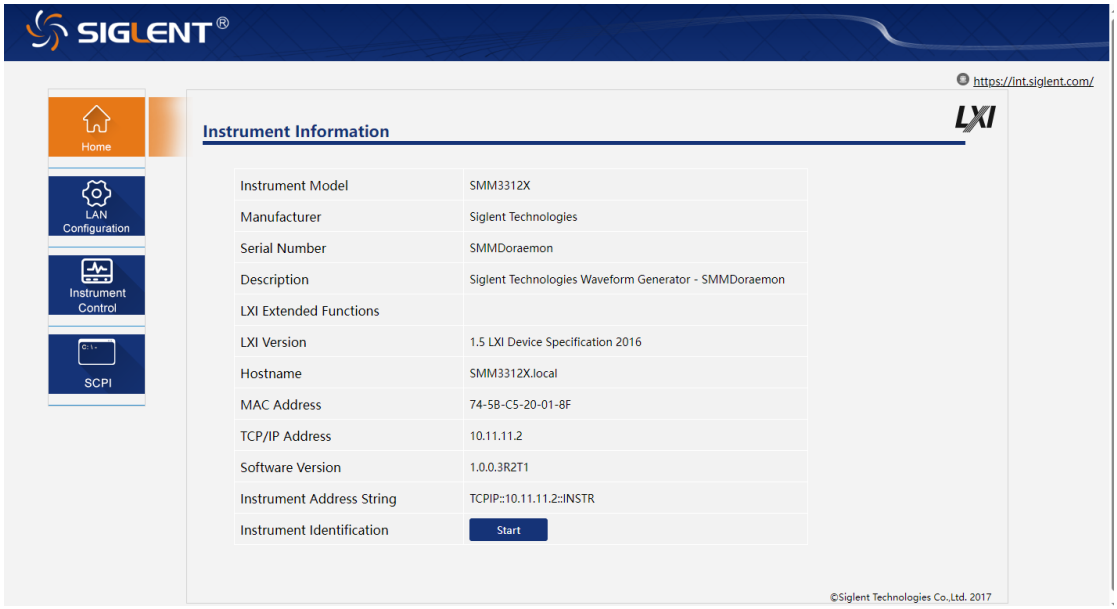
The second connection method:

SMM3000X and PC are connected to the same network. In the LAN setting interface, set DHCP to "ON", SMM3000X can automatically obtain IP or manually change the IP address to be connected.

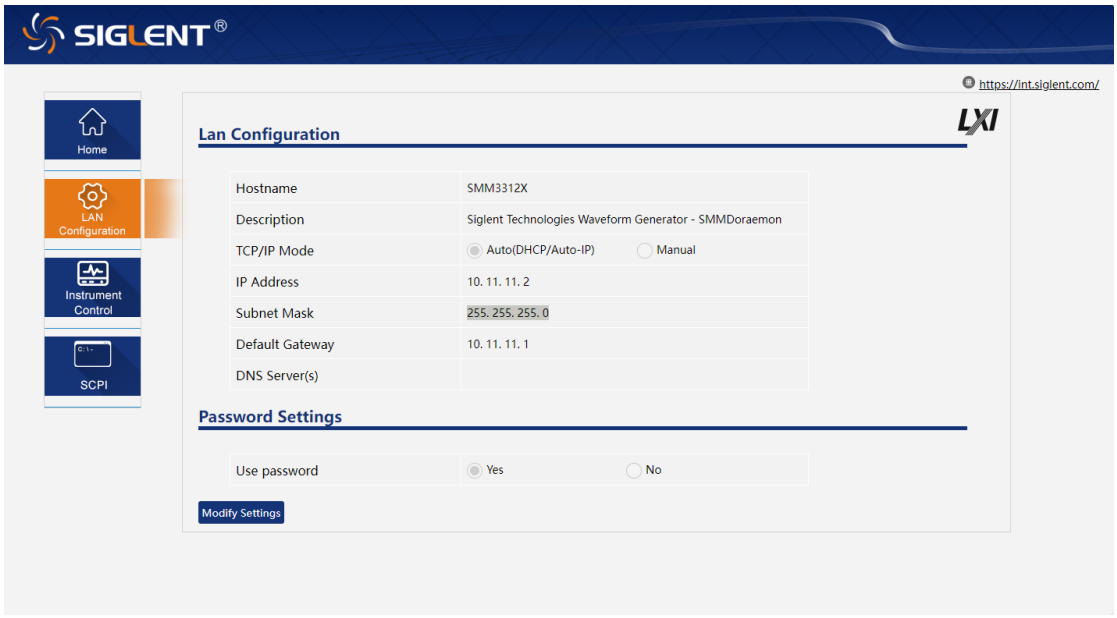
11.3.2 Web Interface

After obtaining the IP address of the SMM3000X by any of the above methods, open the Google browser on the PC and directly enter the IP address in the input field to enter.

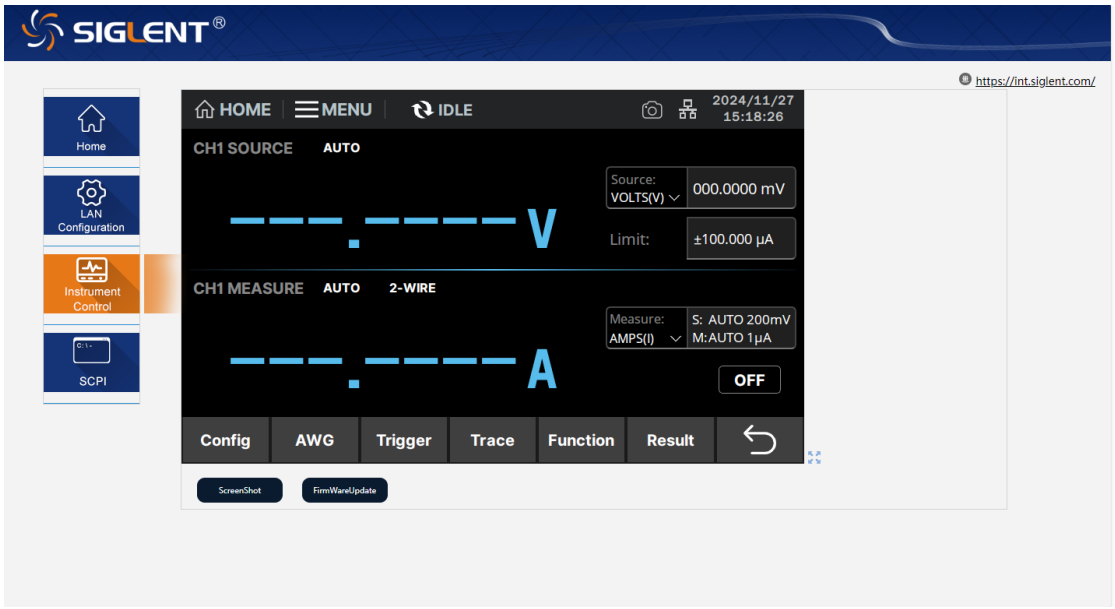
1. Click "Home" in the left column to view device information, including machine model, serial number, Mac address, IP address, software version and so on.



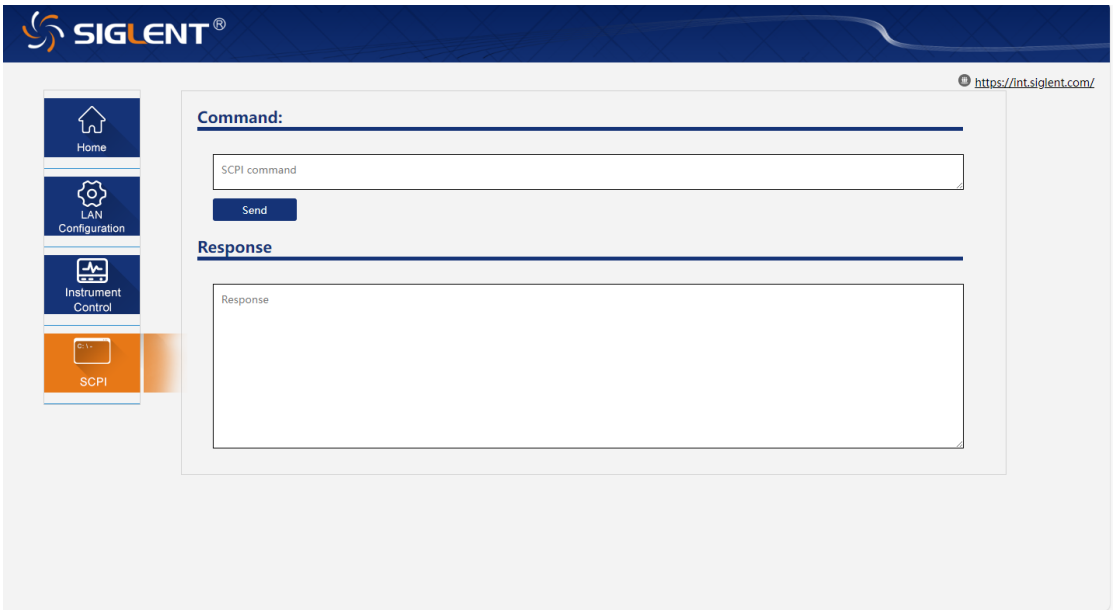
2. Click "LAN Configuration" in the left column to switch to the LAN configuration interface, and click Modify Settings to configure the LAN and set the password. After finishing the settings, click “Apply”/”Submit” to apply.



3. Click "Instrument Control" in the left column to control and operate the instrument directly, with ScreenShot and FirmWareUpdate functions below.



4. Click "SCPI" in the left column to enter the remote control status, and you can send SCPI commands.


SIGLENT®
https://int.siglent.com/
Home
LAN Configuration
Instrument Control
SCPI
Command:
SCPI command
Send
Response
Response

12 Troubleshooting

The following lists the source meter in the use of the process of possible failures and troubleshooting. When you encounter these faults, please follow the corresponding steps to deal with them. If you can't handle them, please contact **SIGLENT** in time.

1. If the power on key is pressed, the source meter is still black, and there is no display:

   1) Check whether the power connector is connected properly.
   2) After checking, please restart the source meter.
   3) If the source meter can not be started normally, please contact **SIGLENT**.

2. No voltage output by pressing ON :

   1) Check whether the voltage and current settings are correct.
   2) Use the Reset Config to reset the voltage and current output after restoring the factory settings.
   3) If the source meter still cannot be used normally, please contact **SIGLENT.**

3. U disk cannot be recognized:

   1) Check whether the U disk device can work normally.
   2) Check whether the source meter USB HOST interface is working properly.
   3) Make sure that the flash-type U disk is used, and that the source meter does not support hard disk-type U disk devices.
   4) Re-plug the U disk, or restart the power and insert the U disk again.
   5) If you still cannot use the U disk normally, please contact **SIGLENT**.

13 Contact Us

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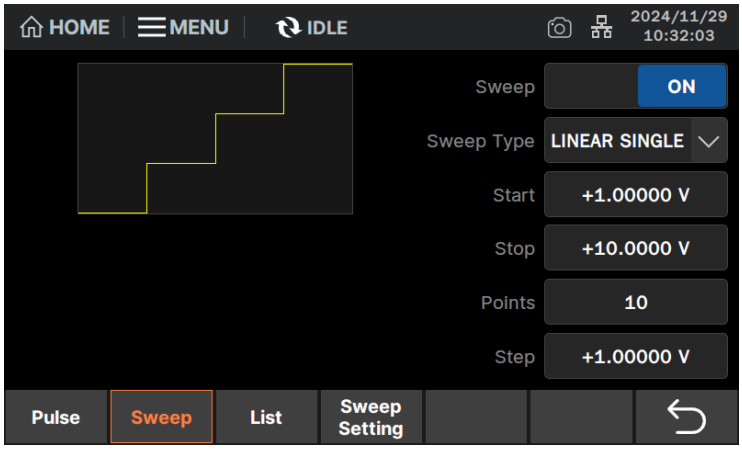
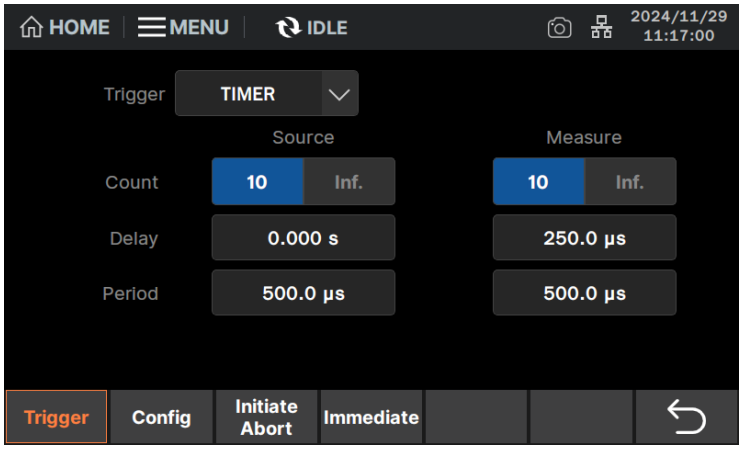
Appendix A

Apply Sweep Source Output

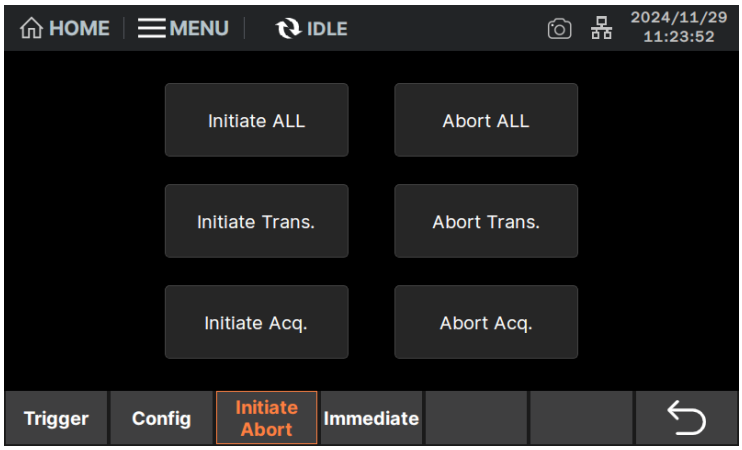
1. Refer to "Sweep Source" for an example of a sweep output 1-10 V, 10-point, and set it as follows:



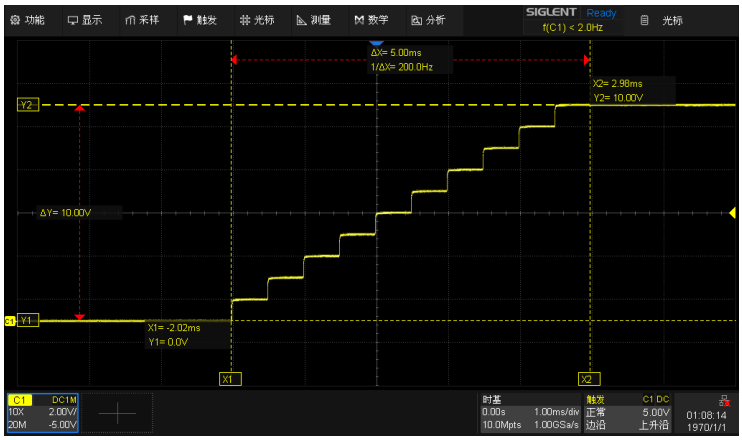
2. Refer to "TRIGGER Layer Quick Setup" and "ARM Layer, TRIGGER Layer and ACTION Detailed Settings", set the corresponding source output trigger in the trigger system settings. When setting up, you can choose the combination of ARM layer and TRIGGER layer as needed; by default, ARM layer and TRIGGER layer are both in AUTO mode. The trigger count of the TRIGGER layer will be automatically set to the number of sweep source points; in this case, ARM layer is set to AUTO mode and TRIGGER layer is set to TIMER mode, as follows:



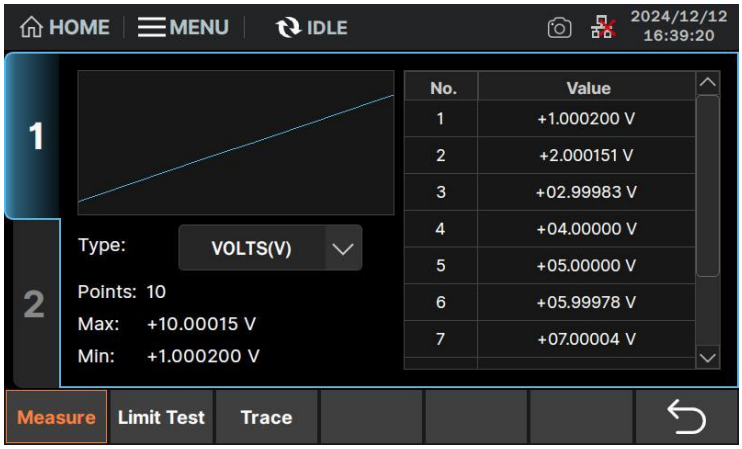
3. Refer to "Trigger System Control" to initiate the trigger system. Click Initiate ALL to start sweep output and measurement as follows:



4. The step of the sweep output can be observed through the oscilloscope as follows:

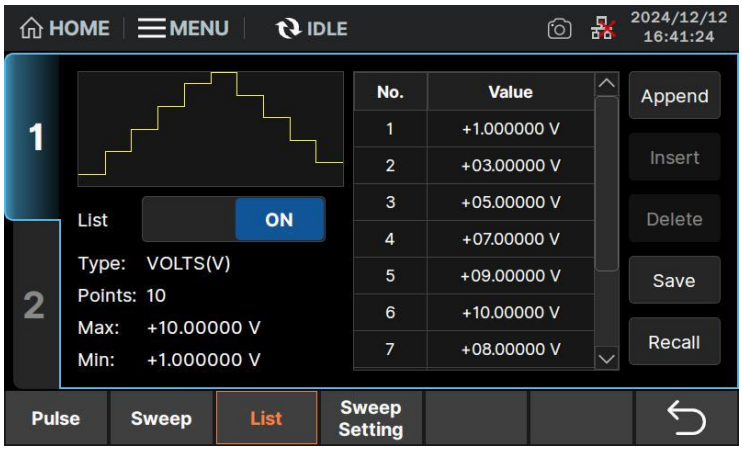


5. Refer to “Measurement Result”, in the Result > Measure interface, you can see the measurement results of 10 points as follows:



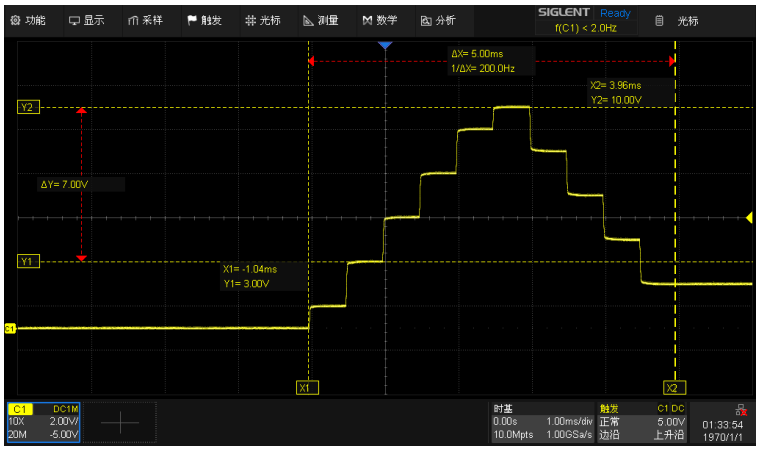
Apply List Sweep Output

1. Refer to "List Sweep" for an example of the following settings:

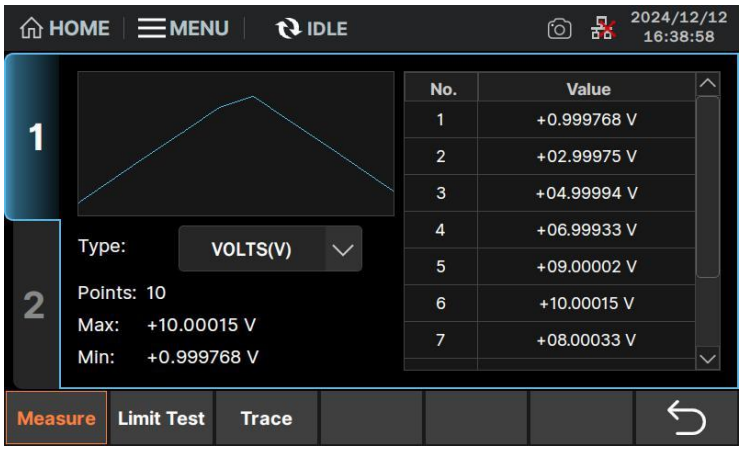


Note: List settings can be saved and read as .CSV files.

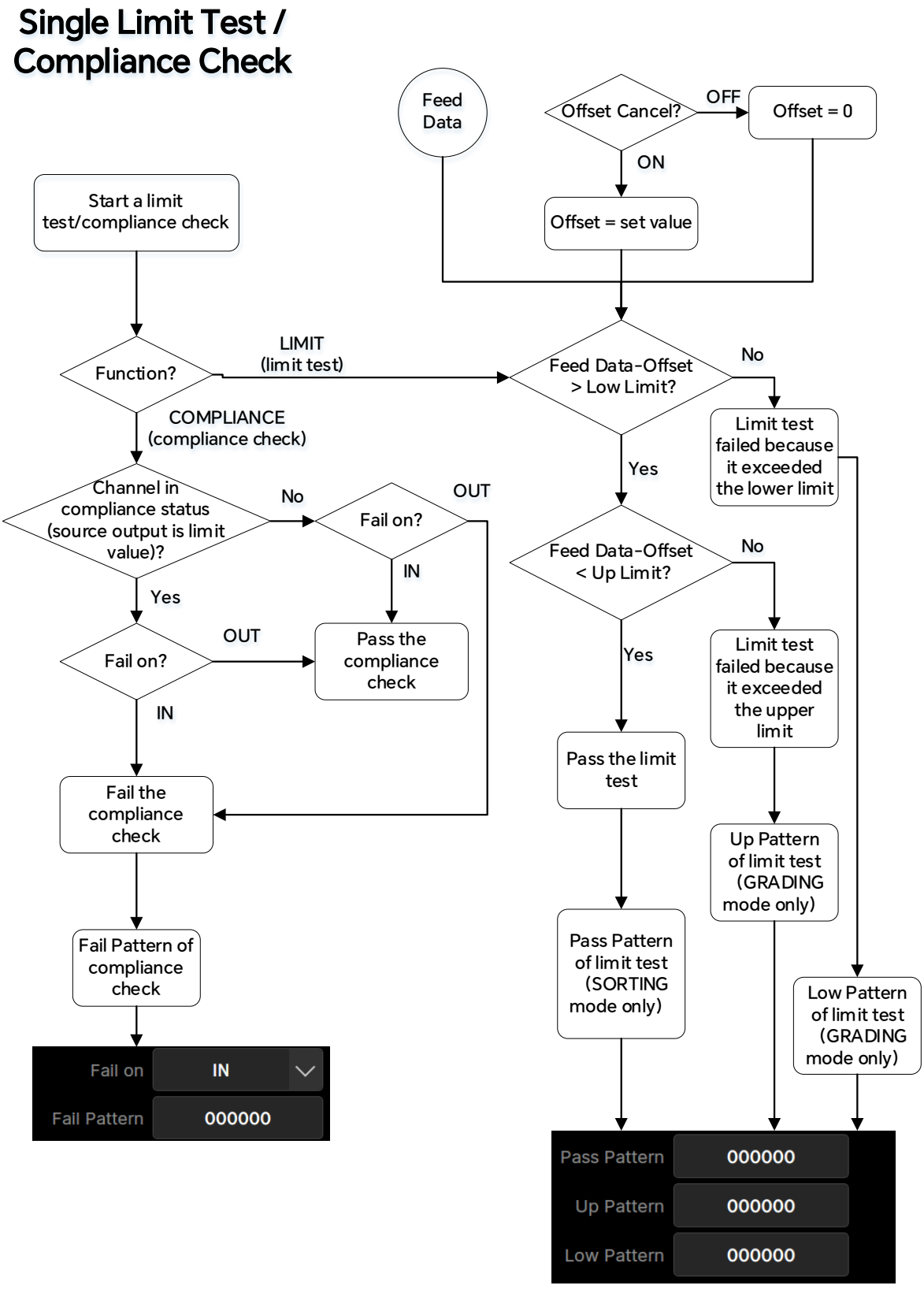
2. Setting the trigger system, the operation is the same as when applying the sweep source output.
3. Initiate the trigger system and the output can be observed by an oscilloscope as follows:



4. Refer to “Measurement Result”, in the Result > Measure interface, you can see the measurement results of 10 points as follows:



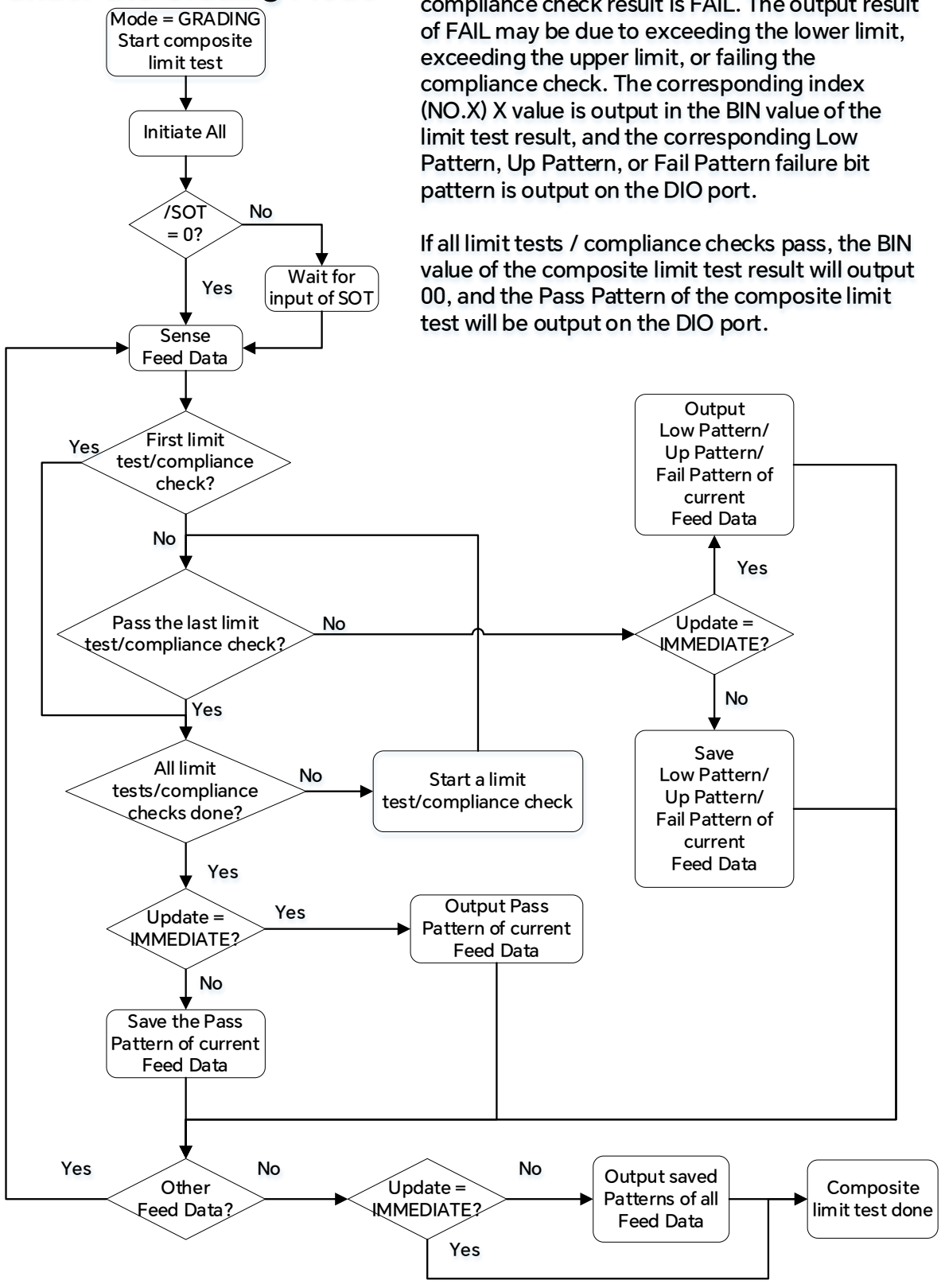
Appendix B


Single Limit Test / Compliance Check
Feed Data
Offset Cancel?
OFF
Offset = 0
ON
Offset = set value
Start a limit test/compliance check
Function?
LIMIT (limit test)
COMPLIANCE (compliance check)
Feed Data-Offset > Low Limit?
No
Yes
Limit test failed because it exceeded the lower limit
Channel in compliance status (source output is limit value)?
No
Fail on?
OUT
IN
Yes
Fail on?
OUT
IN
Pass the compliance check
Feed Data-Offset < Up Limit?
No
Yes
Limit test failed because it exceeded the upper limit
Pass the limit test
Fail the compliance check
Up Pattern of limit test (GRADING mode only)
Fail Pattern of compliance check
Pass Pattern of limit test (SORTING mode only)
Low Pattern of limit test (GRADING mode only)
Fail on
IN
Fail Pattern
000000
Pass Pattern
000000
Up Pattern
000000
Low Pattern
000000

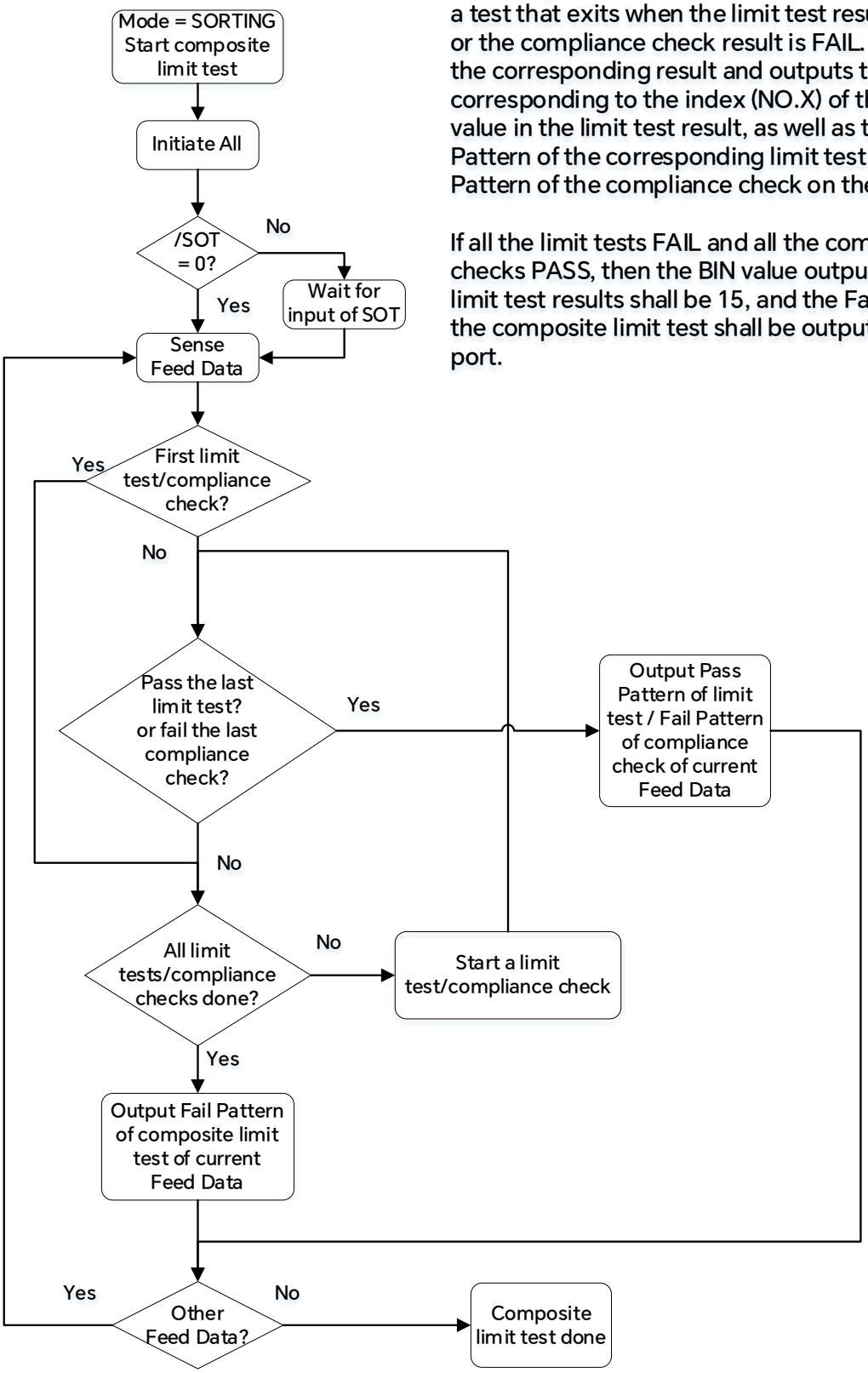
Flowchart of the Composite Limit Test under the Grading Mode

The composite limit test under the GRADING mode is a test that exits when a limit test/ compliance check result is FAIL. The output result of FAIL may be due to exceeding the lower limit, exceeding the upper limit, or failing the compliance check. The corresponding index (NO.X) X value is output in the BIN value of the limit test result, and the corresponding Low Pattern, Up Pattern, or Fail Pattern failure bit pattern is output on the DIO port.

If all limit tests / compliance checks pass, the BIN value of the composite limit test result will output 00, and the Pass Pattern of the composite limit test will be output on the DIO port.



Flowchart of the Composite Limit Test under the Sorting Mode

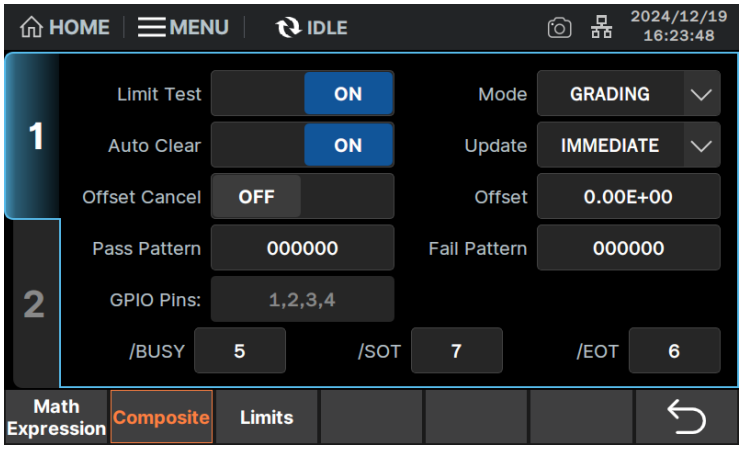


The composite limit test in the SORTING mode is a test that exits when the limit test result is PASS or the compliance check result is FAIL. It outputs the corresponding result and outputs the X value corresponding to the index (NO.X) of the BIN value in the limit test result, as well as the Pass Pattern of the corresponding limit test or the Fail Pattern of the compliance check on the DIO port.

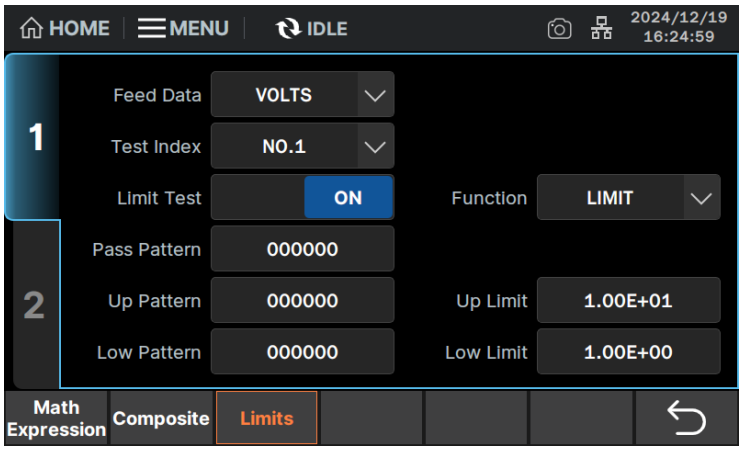
If all the limit tests FAIL and all the compliance checks PASS, then the BIN value output in the limit test results shall be 15, and the Fail Pattern of the composite limit test shall be output on the DIO port.

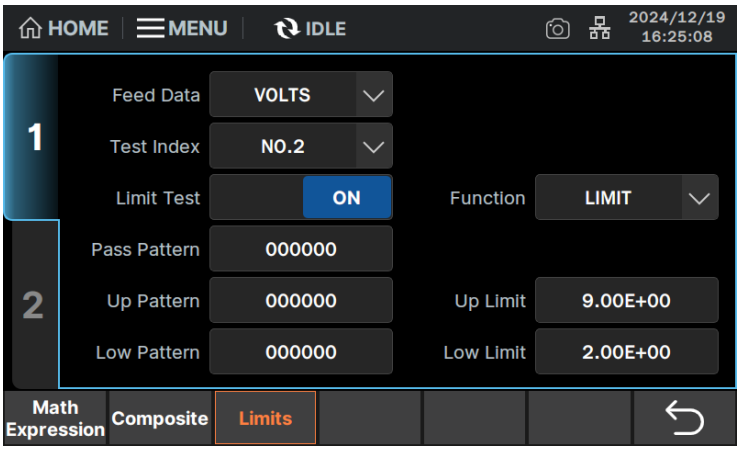
Apply Limit Test

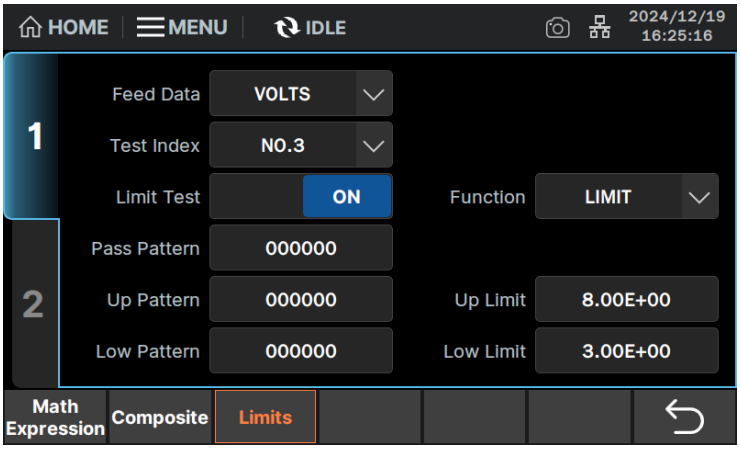
1. Refer to "Composite Limit Test", first in the Function > Composite interface, set the composite limit test parameters, GPIO Pins for 1,2,3,4 (can only be input by remote command, see Command ":CALCulate[c]:DIGital:BIT pin" for details), indicating that the output of Digital I/O pin 1,2,3,4 is the lower four bits of the bit pattern of limit test result. BUSY is pin.5, EOT is pin.6, and SOT is pin.7 for inputing the trigger signal. See settings as follows:

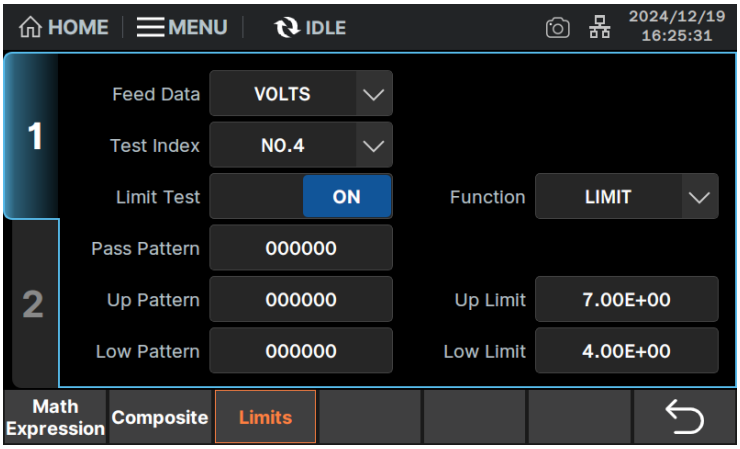


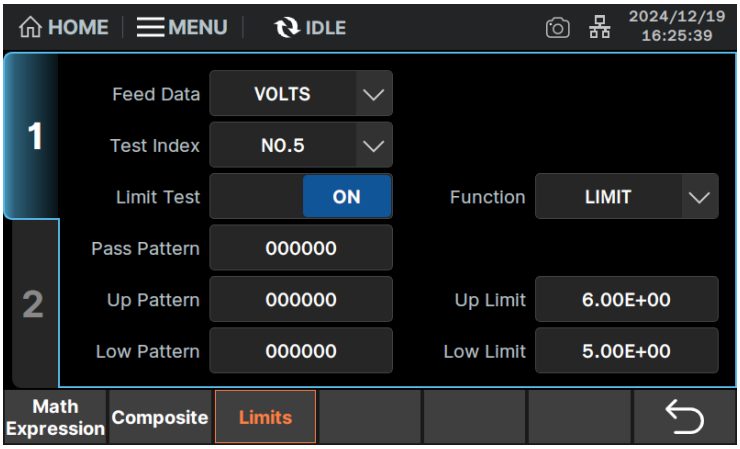
2. Refer to "Limit Tests", in the Function > Limits interface, set each limit test/compliance test of NO.1-12, and this example sets NO.1-5, which is expressed as five tests for each measurement data respectively in one round of composite limit test, and the upper and lower limits of the test ranges are [1,10], [2,9], [3,8], [4,7], [5,6], which need to be set sequentially as follows:



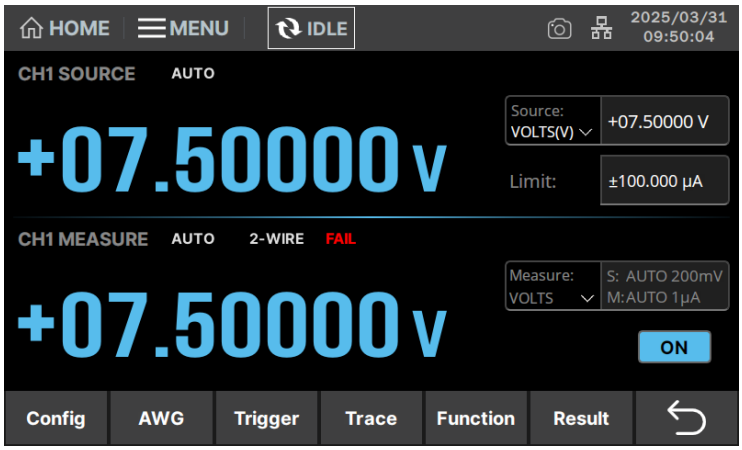

HOME
MENU
IDLE
2024/12/19
16:25:08
1
Feed Data
VOLTS
Test Index
NO.2
Limit Test
ON
Function
LIMIT
2
Pass Pattern
000000
Up Pattern
000000
Up Limit
9.00E+00
Low Pattern
000000
Low Limit
2.00E+00
Math Expression
Composite
Limits

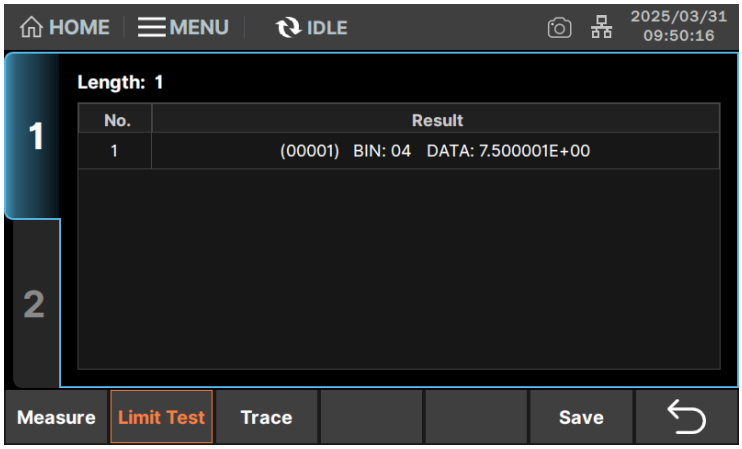

HOME
MENU
IDLE
2024/12/19
16:25:16
1
Feed Data
VOLTS
Test Index
NO.3
Limit Test
ON
Function
LIMIT
2
Pass Pattern
000000
Up Pattern
000000
Up Limit
8.00E+00
Low Pattern
000000
Low Limit
3.00E+00
Math Expression
Composite
Limits


HOME
MENU
IDLE
2024/12/19
16:25:31
1
Feed Data
VOLTS
Test Index
NO.4
Limit Test
ON
Function
LIMIT
2
Pass Pattern
000000
Up Pattern
000000
Up Limit
7.00E+00
Low Pattern
000000
Low Limit
4.00E+00
Math Expression
Composite
Limits


HOME
MENU
IDLE
2024/12/19
16:25:39
1
Feed Data
VOLTS
Test Index
NO.5
Limit Test
ON
Function
LIMIT
2
Pass Pattern
000000
Up Pattern
000000
Up Limit
6.00E+00
Low Pattern
000000
Low Limit
5.00E+00
Math Expression
Composite
Limits

3. Refer to "DIO Setting", configure the Digital I/O pins where the Function of Pin#1,2,3,4 is set to DIGITAL and Pin#5,6,7 is set to TRIGGER.
4. Refer to "Apply DC Source Output" to set the voltage source to 7.5V as an example.
5. Initiate the trigger system. Click Initiate ALL and wait for the SOT signal to be input from pin.7.
6. A pulse is input from pin.7 as a SOT signal to start the limit test.
7. After the limit test is completed, you can see the test result above the measurement data in the user interface with the words FAIL / PASS, or view the limit test result in the Result > Limit Test interface as follows:





As shown, (00001) indicates the first data, and BIN: 04 indicates that the composite limit test ends in the 4th limit test because the test data "DATA" is not in the 4th limit test set for the range [4,7].

8. Digital I/O pin 1,2,3,4 outputs the test result bit pattern which can viewed be by connecting the digital channel of the oscilloscope.

Appendix C

Default Settings

SMM3000X supports initializing the device to the initial setup state by MENU > System > Reset Config , power-on state MENU > System > Power-on State to RST and then powering down and restarting, and remote command *RST. The following describes the initial setting of the system.

System:

Function	Location	Default
Power line frequency	MENU > System > PLC	50Hz
Buzzers	MENU > System > Sound	ON
Display precision digits	MENU > Display > Display Digits	6.5 Digits
Screen backlight brightness	MENU > Display > BackLight Brightness	90
Screen saver	MENU > Display > Screen Saver	Disable
Measurement data type	MENU > I/O > Format > SENSE	Voltage, Current, Resistance, Time, Status, Source
Math/Limit tests data types	MENU > I/O > Format > Math/Limit	Data
Measurement data format	MENU > I/O > Format > Data Type	ASCII
Measurement data byte swap	MENU > I/O > Format > Data Swap	OFF
DIO function (pin.1-12)	MENU > I/O > DIO > Function	DIGITAL
DIO output pulse width (pin.1-12)	MENU > I/O > DIO > Output Pulse Width	100 μs
DIO polarity (pin.1-6)	MENU > I/O > DIO > Polar	NEGATIVE
DIO polarity (pin.7-12)	MENU > I/O > DIO > Polar	POSITIVE
DIO output trigger type (pin.1-6)	MENU > I/O > DIO > Output trigger type	EDGE

Source/Measure Configuration:

Function	Location	Default
Source output mode	Column of Source user interface	VOLTS(V)
Voltage source setting value	Right side of the column of Source user interface	0 V
Limit value at voltage source	Right side of the column of Limit user interface	±100 μA
Current source setting value	Right side of the column of Source user interface	100 μA
Limit value at current source	Right side of the column of Limit user interface	0 V
measurement mode	Column of Measure user interface	AMPS(I)
Voltage source range mode	Measure > Source Volts	AUTO
Voltage source range value	Measure > Source Volts	200 mV
Current source range mode	Measure > Source Amps	AUTO
Current source range value	Measure > Source Amps	1 μA
Measurement speed	Measure > Source Amps	AUTO (0.01 PLC/166.7 μs)
Voltage measurement mode	Measure > Measure Volts	AUTO
Voltage measurement range	Measure > Measure Volts	200 mV
Current measurement mode	Measure > Measure Amps	AUTO
Current measurement range	Measure > Measure Amps	1 μA
Resistance measurement mode	Measure > Measure ohms	OFF
Lower range limit of resistance measurement AUTO mode	Measure > Measure ohms > AUTO	2 Ω

Upper range limit of resistance measurement AUTO mode	Measure > Measure ohms > AUTO	200 MΩ
Range of resistance measurement FIXED mode	Measure > Measure ohms > FIXED	2 Ω
Positive and negative limit settings	Config > Source > Limit for Each Polarity	OFF
Automatic output on	Config > Source > AutoOutput-ON	ON
Automatic output off	Config > Source > AutoOutput-OFF	OFF
OVP/OCP	Config > Source > OVP/OCP	OFF
High capacitance mode	Config > Source > High Capacitance	OFF
Low level terminal status	Config > Source > Low Terminal State	GROUND
Output off state	Config > Source > Output Off	NORMAL
Output filter switch	Config > Source > Output Filter	OFF
Automatic Set Output Filter switch	Config > Source > Output Filter > Automatic Filter	OFF
Output filter time constant	Config > Source > Output Filter > Time Constant	0
Source wait control switch	Config > Source > Wait Control	OFF
Source wait control time automatic setting	Config > Source > Wait Control > Automatic	OFF
Source wait control time gain	Config > Source > Wait Control > Gain	0
Source wait control time offset	Config > Source > Wait Control > Offset	0
Resistance Compensation	Config > Measure > R Compen	OFF
Sensing type	Config > Measure > Sensing Type	2-WIRE
Display precision digits	Config > Measure > Display Digits	6.5 Digits

Measurement wait control switch	Config > Measure > Wait Control	OFF
Measurement wait control time automatic setting	Config > Measure > Wait Control > Automatic	OFF
Measurement wait control time gain	Config > Measure > Wait Control > Gain	0
Measurement wait control time offset	Config > Measure > Wait Control > Offset	0

Sweep:

Function	Location	Default
Pulse switch	AWG > Pulse > Pulse	OFF
Pulse peak value	AWG > Pulse > Peak	200 mV(voltage source)/ 50 mA(current source)
Pulse delay	AWG > Pulse > Delay	0 s
Pulse width	AWG > Pulse > Width	50 μs
Pulse base current	AWG > Pulse > Basic	100 μA
Sweep source switch	AWG > Sweep > Sweep	OFF
Sweep mode	AWG > Sweep > Sweep Type	LINEAR SINGLE
Sweep start value	AWG > Sweep > Start	0
Sweep end value	AWG > Sweep > Stop	0
Sweep points	AWG > Sweep > Points	1
List sweep switch	AWG > List > List	OFF
List value	AWG > List > No./ Value	No.1/ 0
Sweep direction	AWG > Sweep Setting > Sweep Direction	UP
Sweep range	AWG > Sweep Setting > Sweep/List Ranging	BEST
Output value after sweep	AWG > Sweep Setting > Output After Sweep/List	START VALUE

Trigger:

Function	Location	Default
Trigger mode	Trigger > Trigger > Trigger	AUTO
TRIGGER layer count	Trigger > Config > Layer select TRIGGER > Count	1
ARM layer count	Trigger > Config > Layer select ARM > Count	1
Bypass switch	Trigger > Config > Bypass	OFF
Trigger source	Trigger > Config > Trigger Source	AUTO
Trigger period	Trigger > Config > Period	10 μs
Trigger delay	Trigger > Config > Trigger Delay	0 s
Trigger output switch	Trigger > Config > Trigger Output	OFF
Trigger output signal	Trigger > Config > Trigger Output Signal	EXT1

Limit Test:

Function	Location	Default
Composite limit test switch	Function > Composite > Limit Test	ON
Composite limit test mode	Function > Composite > Mode	GRADING
Automatic clearing of composite limit test results	Function > Composite > Auto Clear	ON
Timing mode of composite limit test result output	Function > Composite > Update	IMMEDIATE
Test data offset switch	Function > Composite > Offset Cancel	OFF
Test data offset	Function > Composite > Offset	0
Pass bit pattern of GRADING mode	Function > Composite > Pass Pattern	000000

Fail bit pattern of SORTING mode	Function > Composite > Fail Pattern	000000
DIO port for bit pattern output	Function > Composite > GPIO Pins	None
DIO port for inputting SOT (start of test) signal	Function > Composite > /SOT	0(None)
DIO port for outputting BUSY (under test) signal	Function > Composite > /BUSY	0(None)
DIO port for outputting EOT (end of test) signal	Function > Composite > /EOT	0(None)
Limit test data type	Function > Limits > Feed Data	VOLTS
Limit test switch	Function > Limits > Limit Test	OFF
Limit test function	Function > Limits > Function	LIMIT
Limit test upper limit value	Function > Limits > Up Limit	1
Limit test lower limit value	Function > Limits > Low Limit	-1
Pass bit pattern of SORTING mode	Function > Limits > Pass Pattern	000000
Fail bit pattern of GRADING mode by exceeding the upper limit	Function > Limits > Up Pattern	000000
Fail bit pattern of GRADING mode by exceeding the lower limit	Function > Limits > Low Pattern	000000
Determination method for compliance check failure	Function > Limits > Function select COMPLIANCE > Fail on	IN
Fail bit pattern of compliance check	Function > Limits > Function select COMPLIANCE > Fail Pattern	000000

Mathematical Expression:

Function	Location	Default
Math operations switch	Function > Math Expression > Status	OFF
Units of results of mathematical operations	Function > Math Expression > Unit String	"W"
Selected mathematical expression	Function > Lower half of the column of Math Expression	"POWER" (VOLT * CURR)
Catalog of mathematical expressions	Function > Lower half of the column of Math Expression	"OFFCOMPOHM" "POWER" "VARALPHA" "VOLTCOEF"

Trace Statistics:

Function	Location	Default
Trace buffer acquisition data type	Trace > Buffer > Feed Data	SENSE
Trace buffer write mode	Trace > Buffer > Buffer Control	NEVER
Trace buffer size	Trace > Buffer > Buffer Size	100,000
Trace statistics data format	Trace > Buffer > Data	MEAN
Timestamp format	Trace > Buffer > Timestamp	ABSOLUTE

Settings that will not be changed by "Reset Config":

Function	Location	Factory setting
SCPI	MENU > System > SCPI	Default
DHCP	MENU > I/O > LAN > DHCP	OFF
IP address	MENU > I/O > LAN > IP Address	169.254.244.13
Subnet mask	MENU > I/O > LAN > Net Mask	255.255.0.0

Default gateway	MENU > I/O > LAN > Gateway	0.0.0.0
Auto DNS	MENU > I/O > LAN > Auto DNS	OFF
DNS1, DNS2	MENU > I/O > LAN > DNS	0.0.0.0
VNC port	MENU > I/O > VNC > Port	5900
GPIB address	MENU > I/O > GPIB > Address	30
Language	MENU > Display > Language	English

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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