ITECH Solar Array Simulation SAS1000M Software User Manual

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Manual Part Number

SAS1000M Ver:2.1.0

Revision

2nd Edition: Jan. 10, 2022

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NOTE

A NOTE sign denotes important hint. It calls attention to tips or supplementary information that is essential for users to refer to.

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Chapter1 Brief Introduction

1.1 Software Introduction

SAS1000M solar array simulation software equipped with multiple IT6500C series power supplies, IT6000C/IT6000B series power supplies or IT-M3600 series power supplies can accurately simulate the multi-channel solar array I-V curve, P-V curve. Every channel software have a built-in EN50530 / Sandia / NB/T32004 / CGC/GF004 / CGC/GF035's SAS model that can easily program test regulations, materials, Vmp, Pmp parameters, so as to simulate I-V curve characteristic output and generate reports, and can be applied in test the static & dynamic maximum power tracking performance of photovoltaic inverters. Also provides the shadow and table mode, the user can enter the maximum 4096 points array, and also can store maximum 100 I-V curves under different irradiation and temperature to test the long-term maximum power tracking performance of photovoltaic inverters under different climatic conditions.

1.2 Preparation before operation

- Connect to Device

  This software can be connected to several devices of different models or series for multi-channel test and multi-channel synchronous test. This software need equipped with appropriate frame version, otherwise, an error occurred while connecting the instrument.

  IT6000 00.006.082 and above

  IT6500C 0.40P-0.46P and above

  IT-M3600 1.63-1.18-0.62-1.37 and above

  This software supports interfaces like USB, RS232, GPIB and Ethernet. Before using the software, the user needs to connect the device to computer by communication interface first, and enter the communication interface parameter to software interface. Please refer to 1.4 Configuring Interface of Device for the detailed information.

- Insert the Encryption Lock

  Insert the encryption lock provided by ITECH into the computer and the official software will be available to you.

1.3 SAS1000M Initial Interface

Double-click the desktop icon to run SAS1000M software. The software will initialize in about 2 seconds, and then the below interface will appear.

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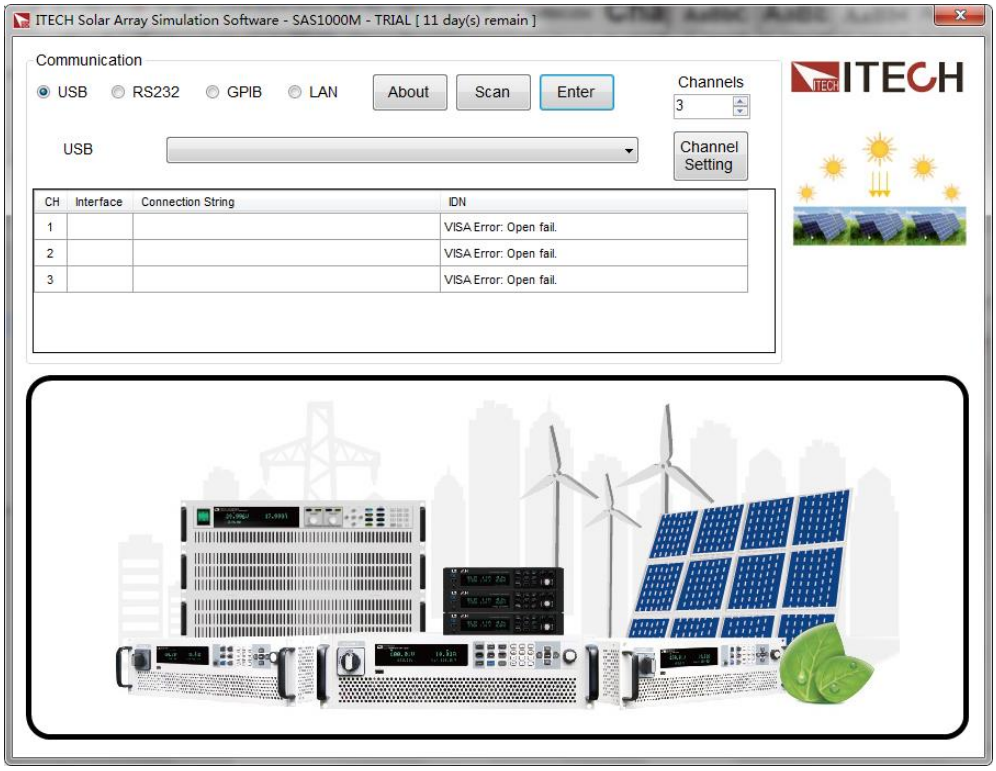


The interface is described as follows:

- Communication

  Select the communication interface between the software and the device.
- About

  Check SAS1000M information, such as name and version number.
- Scan

  Scan communication interfaces for the device.
- Enter

  Enter to the main operation interface of the software.
- Channels

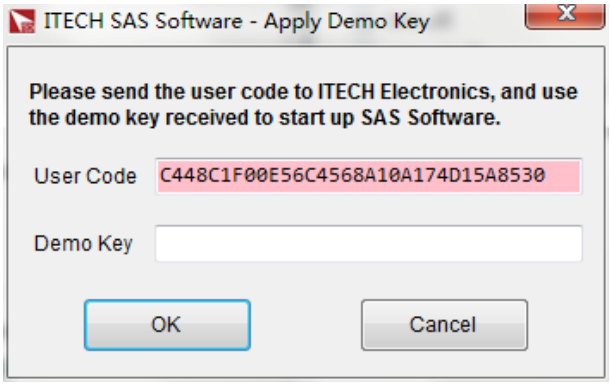
  Set the present channel number according to connect instrument.
- Channel Setting

  Confirm the communication information setting of the present channel. If the communication is normal, the IDN in the channel information list will display the real-time instrument information.
- Quick Enter

  After the software and the instrument are successfully connected once, the connection information is recorded. When you re-enter the main operation interface of the software, you can directly click **[Enter]**.

Troubleshooting

If the interface below appears during the operation, you need to check the device connection.



The reasons for the above interface:

- Error in the communication connection

  In this instance, you need to check the communication connection between the SAS software and the device, and the device model.
- Loss of the encryption lock

  The interface will also appear without inserting the encryption lock. Please check the encryption lock delivered with box has insert to PC.
  If encryption is missed, the user can contact ITECH and convey the user code to us. Then you will receive the demo key offered by ITECH. Input it, click **[OK]** and if the demo key matches, the demo software will be available to you for 14 days.

NOTE

When using the demo software, if you connect the device to PC, the software will enter the TRIAL mode. The software function in TRIAL mode is the same as that of the official software; if you do not connect the device to PC, the software will enter the DEMO mode. In DEMO mode, all functions can de simulated.

1.4 Configuring Interface of Device

SAS1000M software is installed in PC and interacts with matching hardware devices via different communication interfaces. This software supports interfaces like USB, RS232, GPIB and Ethernet. (At the time of start-up scan, in default, RS232 scans at Baud rate of 9,600). The user needs to connect the device to the computer. During hardware setting, select a hardware interface that is compatible with the one connected to the device, and set interface parameters based on different interface types.

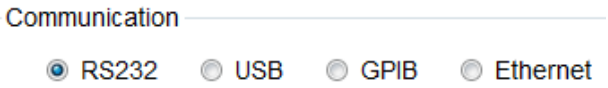
Precondition

1. Before configuring hardware, you need to check whether the device communication method is consistent with the realistic application or not.

   The detailed steps refer to corresponding User Manual of device.
2. Connect the power supply and PC by communication cable.

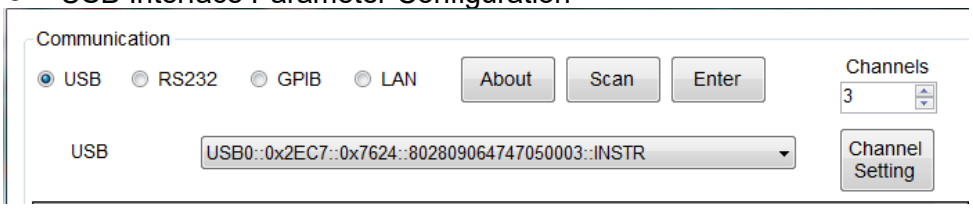
Operation steps

1. Select the required hardware interface type on the initial interface.

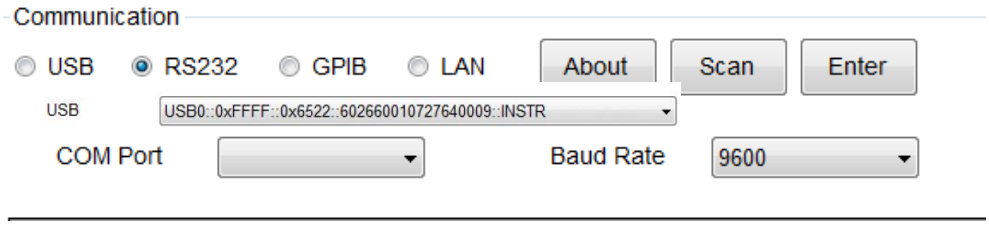


2. After selecting the device interface, configure interface parameters at bottom. Click **[Scan]**.

- USB Interface Parameter Configuration

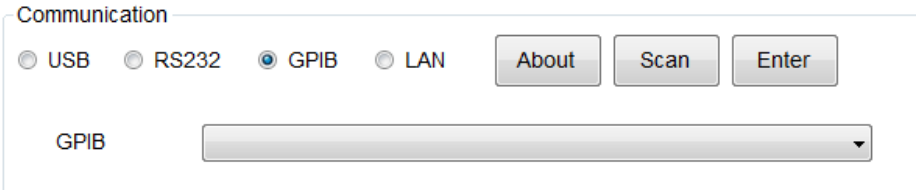


- RS232 Interface Parameter Configuration



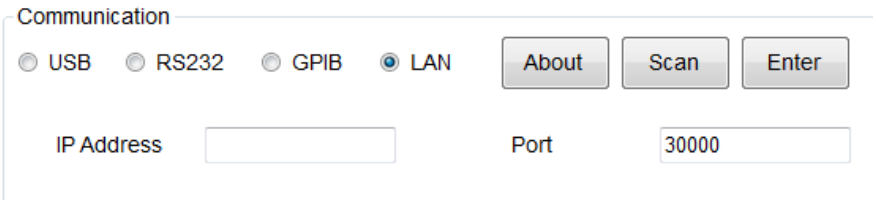
COM Port: to select serial interface, i.e., the serial interface number occupied by RS232 communication cable interface.
Baud Rate: Baud rate must be configured consistently with those in menu setup.

- GPIB Interface Parameter Configuration



GPIB Address: Set GPIB address of device.

- Ethernet Interface Parameter Configuration



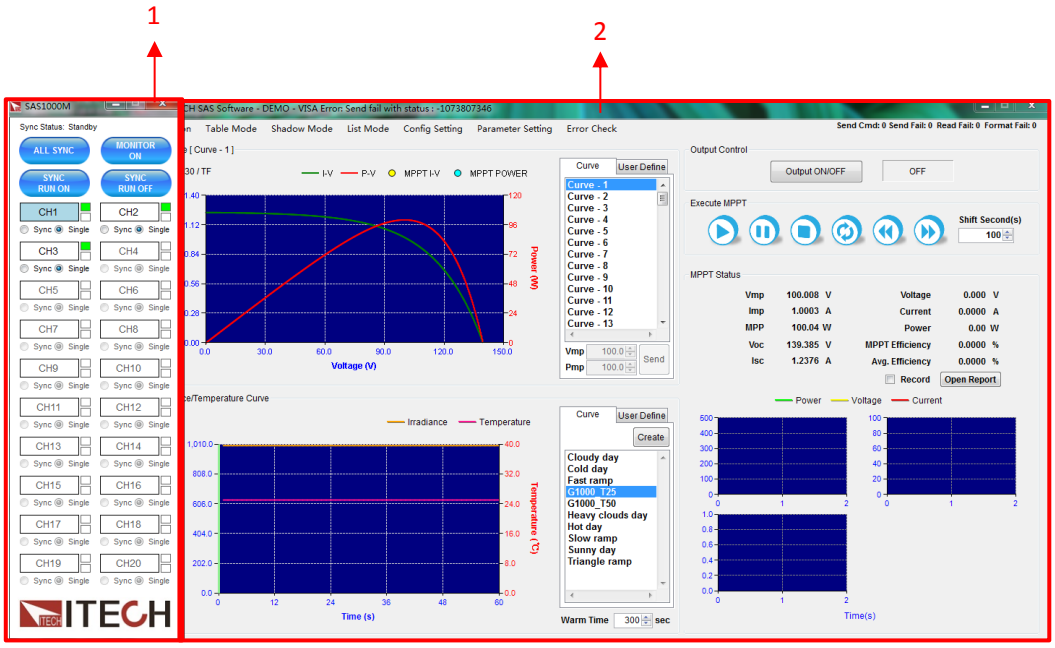
IP Address: Set Ethernet IP address of device.
Port: Set Socket port of device, the default value is 30000.

Chapter2 Channel Control

The SAS1000M matrix simulation software of multi-channel solar battery can support the test of 20 channels at maximum. In the channel control menu, you can control multiple channels for synchronous test; and can also conduct an independent test for single channel.

2.1 Introduction of Main Interface

After successful connection of instrument communication, click Enter and enter the main interface, as shown below.



1:Channel control area. In this area, the user can realize the following functions:

Note

The channel control area is always displayed on the top of the desk top. You can click the Minimize button at the right top corner to hide the window.

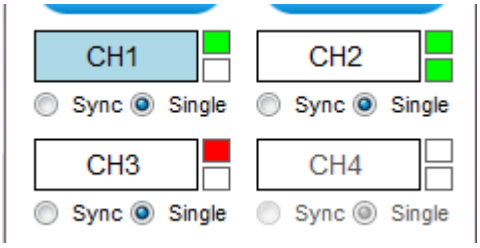
- Switch Channels
- Set whether to synchronize the channels
- Set to turn on or turn off outputs of all channels
- Check the MPPT execution information of all channels

2: Main interface of channel test: execute the MPPT test

2.2 Channel Control

This software can be connected to 20 channels at maximum. The connection state of each channel is displayed in the channel control menu.

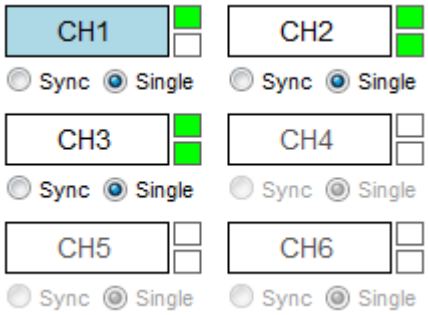
The channel state description:



- If the channel is connected normally, the box at the top right of the channel ID displays green, for example, CH1
- If the Output status of the channel is ON, the box at the lower right of the channel ID displays green, for example, CH2
- If the main test interface of the channel is closed, the box at the top right of the channel ID displays red, for example, CH3
- If the channel is connected abnormal, the channel ID displays gray, The user cannot set and operation the channel.

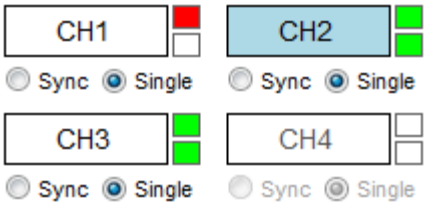
Switch Channels

The user can click the normally-connected channel number to switch the present channel test interface. As shown below. At present, only CH1, CH2 and CH3 channels are connected, and the real-time test main interface is switched to CH1.



Close the Channels

The user can close the main interface of present channel test and off line the channel, and the cahnnel director light will be change to RED when the channel is off line. Click the channel control button repeatedly to connect the channel again, and the channel director light returns to GREEN. The CH1 is closed is shown as below.

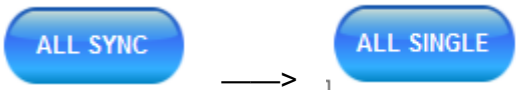


Set Channel Synchronization

There are Sync and Single option boxes under each channel. The user can select Sync to set the channel for synchronous operation. Select Single, and set that the channel is not to involve in the synchronous operation.

The user can uniformly switch all channels to the Sync mode, and the button turns to ALL SINGLE. Click the button again, and all channels are switched to

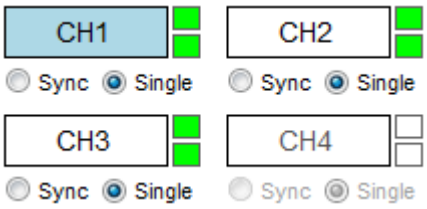
the Single mode.



Turn On/Off Channel Output

The user can directly control the output of all channels in the channel control menu, as shown below. When the SYCN RUN ON button is pressed, the outputs of all channels are turned on simultaneously, and the right bottom box displays green. Or, click SYNC RUN OFF to turn off the outputs of all channels simultaneously.

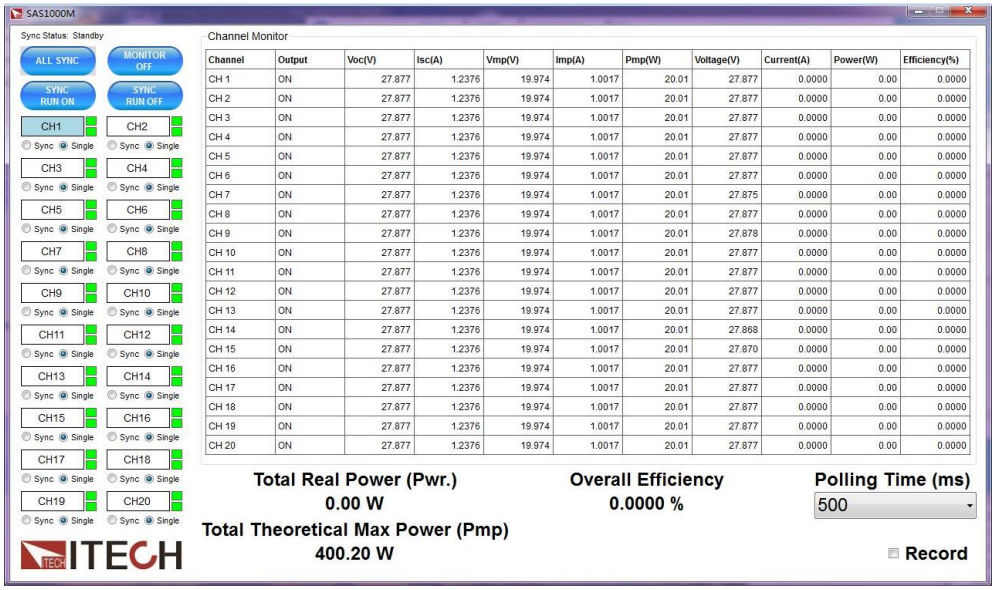
When the channel output is turned on, the bottom indicator light near the channel number is lighted on.



Check MPPT Information

Press

in the channel control menu. The user can check the output state and MPPT running information of all channels.



Channel	Output	Voc(V)	Isc(A)	Vmp(V)	Imp(A)	Pmp(W)	Voltage(V)	Current(A)	Power(W)	Efficiency(%)
CH 1	ON	27.877	1.2376	19.974	1.0017	20.01	27.877	0.0000	0.00	0.0000
CH 2	ON	27.877	1.2376	19.974	1.0017	20.01	27.877	0.0000	0.00	0.0000
CH 3	ON	27.877	1.2376	19.974	1.0017	20.01	27.877	0.0000	0.00	0.0000
CH 4	ON	27.877	1.2376	19.974	1.0017	20.01	27.877	0.0000	0.00	0.0000
CH 5	ON	27.877	1.2376	19.974	1.0017	20.01	27.877	0.0000	0.00	0.0000
CH 6	ON	27.877	1.2376	19.974	1.0017	20.01	27.877	0.0000	0.00	0.0000
CH 7	ON	27.877	1.2376	19.974	1.0017	20.01	27.875	0.0000	0.00	0.0000
CH 8	ON	27.877	1.2376	19.974	1.0017	20.01	27.877	0.0000	0.00	0.0000
CH 9	ON	27.877	1.2376	19.974	1.0017	20.01	27.878	0.0000	0.00	0.0000
CH 10	ON	27.877	1.2376	19.974	1.0017	20.01	27.877	0.0000	0.00	0.0000
CH 11	ON	27.877	1.2376	19.974	1.0017	20.01	27.877	0.0000	0.00	0.0000
CH 12	ON	27.877	1.2376	19.974	1.0017	20.01	27.877	0.0000	0.00	0.0000
CH 13	ON	27.877	1.2376	19.974	1.0017	20.01	27.877	0.0000	0.00	0.0000
CH 14	ON	27.877	1.2376	19.974	1.0017	20.01	27.868	0.0000	0.00	0.0000
CH 15	ON	27.877	1.2376	19.974	1.0017	20.01	27.870	0.0000	0.00	0.0000
CH 16	ON	27.877	1.2376	19.974	1.0017	20.01	27.877	0.0000	0.00	0.0000
CH 17	ON	27.877	1.2376	19.974	1.0017	20.01	27.877	0.0000	0.00	0.0000
CH 18	ON	27.877	1.2376	19.974	1.0017	20.01	27.877	0.0000	0.00	0.0000
CH 19	ON	27.877	1.2376	19.974	1.0017	20.01	27.877	0.0000	0.00	0.0000
CH 20	ON	27.877	1.2376	19.974	1.0017	20.01	27.877	0.0000	0.00	0.0000

total real power: The total real power for all of output channels.

total theoretical max power: total theoretical max power for all of output channels.

over efficiency: total efficiency value

over efficiency = total real power/ total theoretical max power

Polling Time (ms): MPPT running data refresh time of all channels.

Check Channel Synchronization State

The synchronization state of the present channel is displayed at the right top of the channel control menu. When several channels run tests synchronously, the user needs to check whether the real-time operation is completed synchronously, and whether Sync Status is Standby. If the synchronization is executing (for example Sync Status: Executing is displayed), please wait until the real-time synchronization is completed.

Note

If you continue to operate when the system is executing, the software may crash.

Chapter3 MPPT Test

SAS1000M software built-in EN50530 / Sandia and other five kinds of regulatory testing procedures, it is convenient for users to test the static and dynamic MPPT performance of PV inverters and generate reports, so as to compare with competitors' results. Solar simulation power supply also provides the shadow and table mode, the user can enter the 128 ~ 4096 points array to edit any shielded IV curve to achieve dynamic shadow effect and also can store 100 I-V curves (IT-M series just supports 10 curves) under different irradiation and temperature to test the long-term maximum power tracking performance of photovoltaic inverters under different climatic conditions.

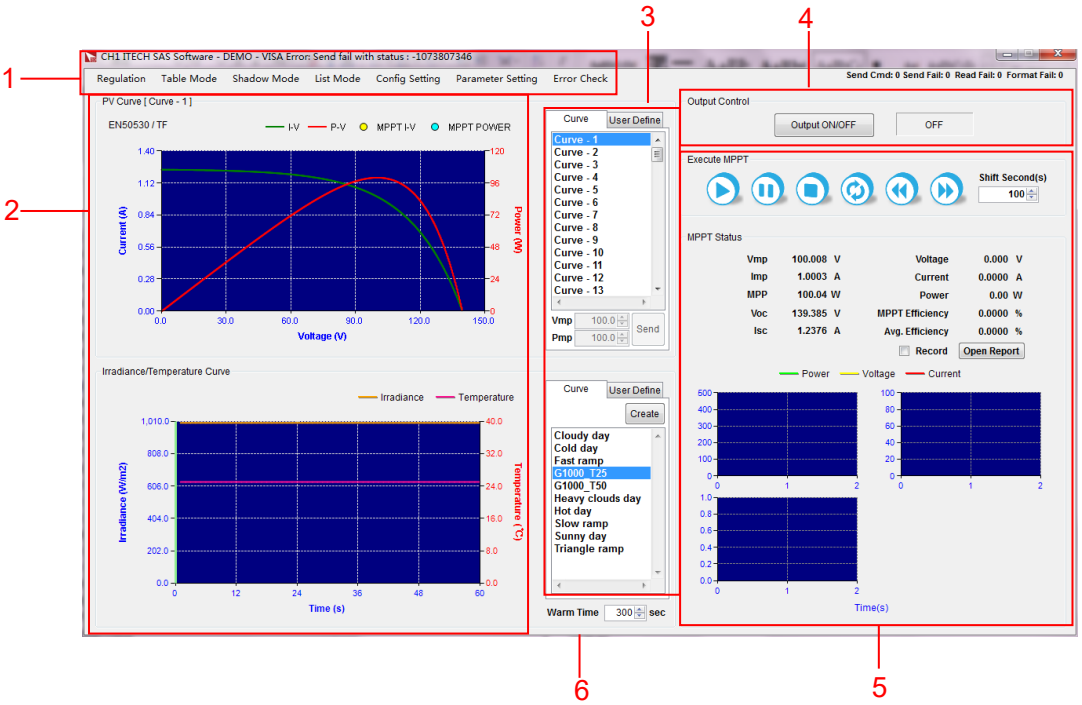
3.1 Basic Test Function

SAS1000M software provides basic test function on the main interface. It is configured with two common regulation items (EN50530 and SANDIA) for direct and convenient operation. The user can configure related voltage power curve parameter; select or create irradiance and temperature curve based on actual weather parameters; analog PV curve and measure MPP under this circumstance.

If other regulatory testing procedures, table mode and shadow mode to be execute, please select the corresponding function menu.

Introduction of Main Interface

SAS1000M main interface is shown below.



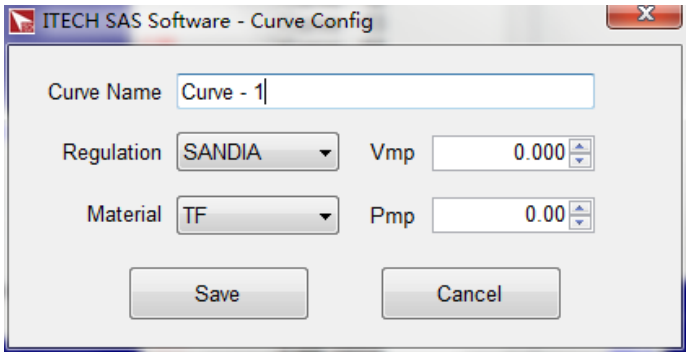
1. Function Bar
   - Regulation
   - Table Mode
   - Shadow Mode
   - List Mode
   - Config Setting
   - Parameter setting
   - Error Check
2. PV Curve and Irradiance/Temperature Curve, right click to save or copy curve picture in Curve area.
3. Editing of PV Curve, selection and creation of Irradiance/Temperature Curve.
4. Output ON/OFF.
5. MPPT test and display of real-time parameter curve.
6. MPPT test warm time

3.1.1 Edit Curve

SAS1000M software provides the following two methods for the user to edit PV curves.

- The SAS1000M main interface has 100 PV curves (Curve-1 to Curve-100) for selection (only 10 curves are provided when equipment with IT-M series instruments). The user can set parameters as needed for MPP test. Detailed operation steps are as below:

1. Select one Curve from the list and double click the curve name to set curve parameters. Editing interface of curve parameter is shown as below:



Parameter editing description:

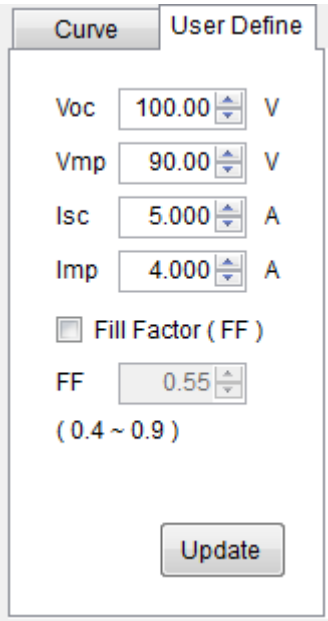
Parameter	Description
Regulation	There are two regulation items for setting: ● EN50530 ● SANDIA
Material	Set solar panel material. Materials are different under different regulation item. EN50530

Parameter	Description
	● TF: Thin-Film ● CSi SANDIA ● TF: Thin-Film ● SCMC: Standard Crystalline or Multi-crystalline ● HEC: High-efficiency Crystalline
Vmp	Voltage of maximum power
Pmp	Maximum power

2. After parameter setting, click **[Save]**. Newly edited PV curve will be displayed at the left PV Curve.

- The user can select **[User Define]** to edit the associated parameters of PV curve. Detailed operation steps are as below:

1. Click **[User Define]** to enter to the user-defined PV curve page, shown as follow.



Parameter editing description:

Parameter	Description
Voc	Open-circuit voltage value
Vmp	Voltage of maximum power
Isc	Short-circuit current value
Imp	Current of maximum power
Fill Factor (FF)	The fill factor (FF) can be represented as the ratio of the maximum output power Pmax of the solar battery and the product of Voc and Isc, i.e., FF = Pmax / (Voc* Isc).

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	If you check this box and set this parameter, then there's no need to set Voc and Isc.

2. After parameter setting, click **[Update]**. Newly edited PV curve will be displayed at the left PV Curve.

3.1.2 Configure Irradiance/Temperature Curve

After setting PV curve, the user needs to configure the Irradiance/Temperature Curve to simulate working conditions of the solar panel under actual climate. SAS1000M software is built in with ten Irradiance/Temperature Curves for selection. Click corresponding Curve name for usage.

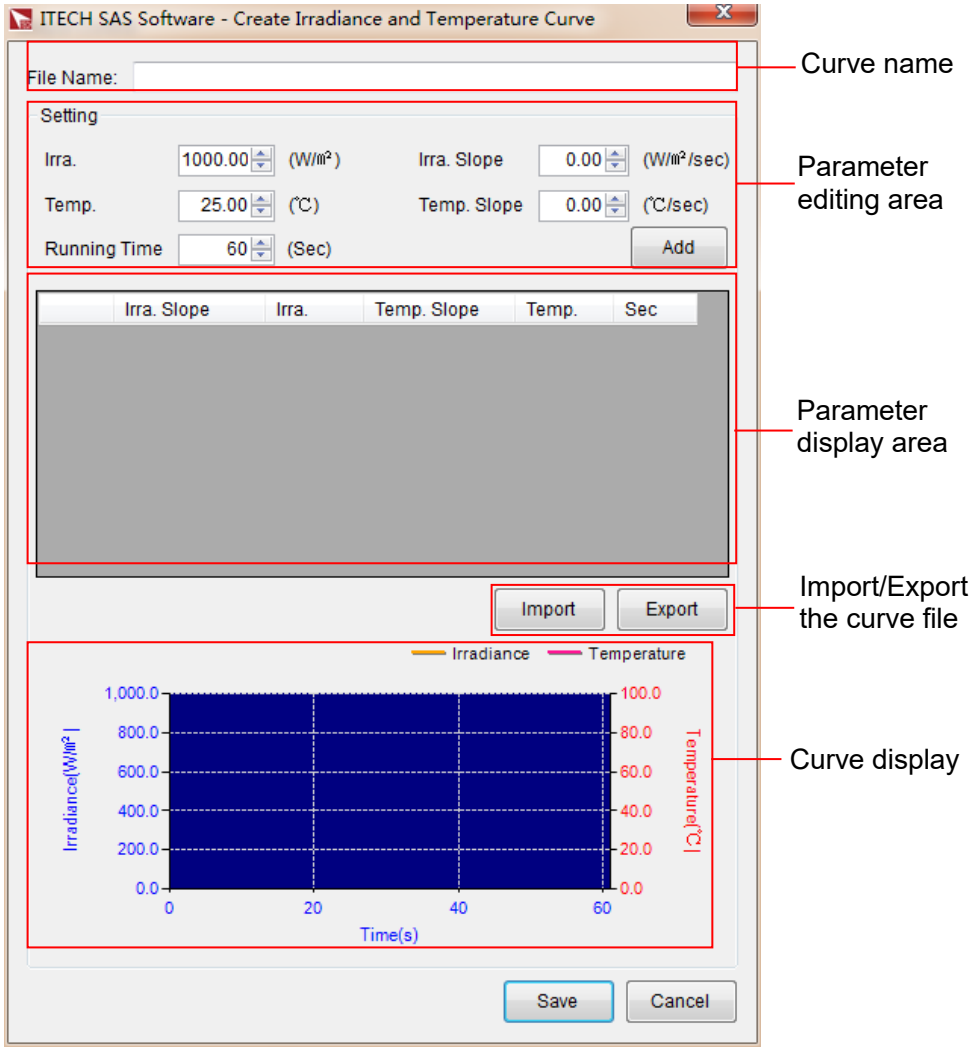
Description of ten Irradiance/Temperature Curves:

Irradiance/Temperature Curve	Description
Cloudy day	Cloudy day
Cold day	Cold day
Fast ramp	Irradiance rises and falls rapidly and temperature keeps unchanged.
G1000_T25	Confirm with Regulation EN50530 test.
G1000_T50	Confirm with Regulation SANDIA test.
Heavy clouds day	Heavy cloudy day
Hot day	Hot day
Slow ramp	Temperature and irradiance rise and fall evenly.
Sunny day	Sunny day
Triangle ramp	Irradiance rises and falls in triangle and temperature keeps unchanged

In addition, the user can create a new Irradiance/Temperature Curve as needed.

Create Irradiance/Temperature Curve

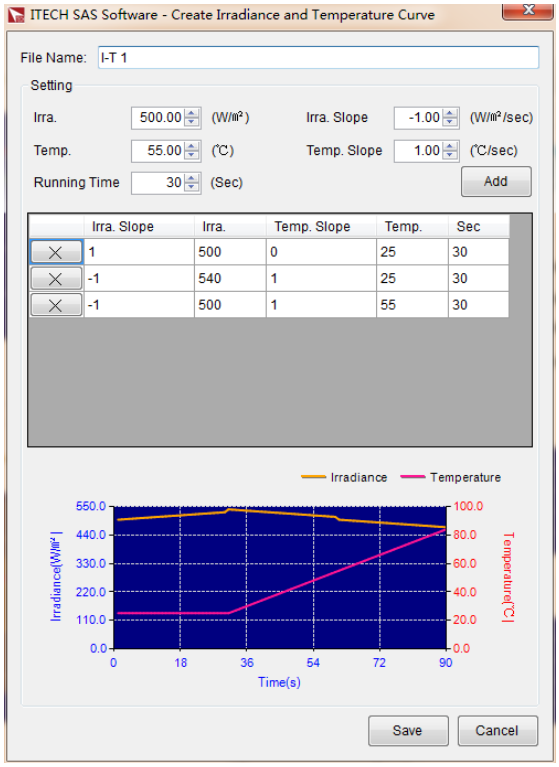
1. Click **[Create]** button at right top of the Irradiance/Temperature Curve list to enter the parameter setting interface, as shown below.



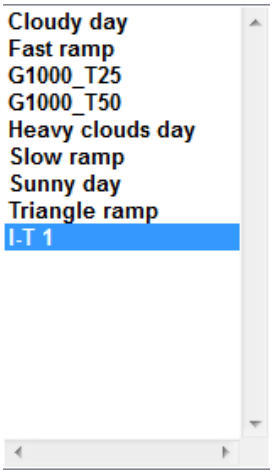
Parameter editing description:

Parameter	Description
Irra	Set irradiance with range of 0 to 3,000W/m^2
Temp	Set temperature with range of -40 to 85°C
Running Time	Set wave running time. Total running time of wave shall be within one day.
Irra Slope	Irradiance curve slope
Temp Slope	Temperature curve slope

2. Input curve name and set curve parameter. Click **[Add]**. The curve will automatically appear in the parameter display list and display on the Curve graph. After configuration, the effect is as shown below.



3. After curve editing, click **[Save]**. The new wave name will be automatically listed in the list of irradiance and temperature curves of the main interface for usage. As shown below.



In addition to direct creating the irradiance and temperature curve on the software operation interface, the user can edit curve files and save them in the software through Import. This function simplifies the Curve operation process and is easy-to-use.

- Import curve
  1. Create a new Excel document on the local PC and name it I-T 1.
  2. Open the Excel document and save it as in “other formats” in “(*.csv)”.
  3. Open the I-T 1 csv file and set the relevant parameters of the curve. The arrangement format is shown as below.

	A	B	C	D	E	F
1	Index	IrraSlope	Irra	TempSlope	Temp	Sec
2	1	1	500	0	25	30
3	2	-1	540	1	25	30
4	3	-1	500	1	55	30
5						

4. Select the number of curve to be saved. Click **[Import]** and select the newly-created csv file. The curve data will be displayed in the table and curve diagram of the Program interface.
5. Input curve name and click **[Save]**. The new wave name will be automatically listed in the list of irradiance and temperature curves of the main interface for usage.

- Export curve

  The user can also export the curve which is edited in the software to the computer. Click **[Export]** and select save location.

- Delete curve

  To delete an irradiance curve, select the curve to be deleted and press Delete on the keyboard or right click and select delete. The curves are built in software cannot delete, user can delete the user defined curves.

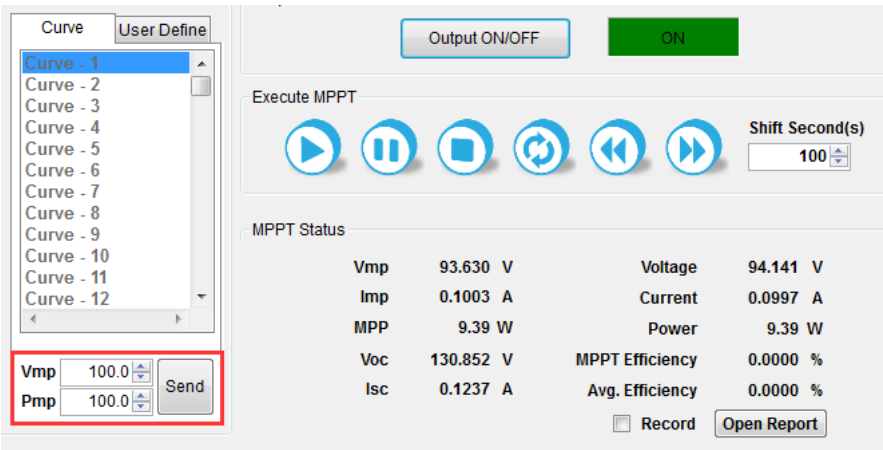
- Edit curve

  The user can double click the user created curve and edit the curve. The edit curve interface and operation methods are the same as create.

Run the Photovoltaic Curve

After editing the PV curve and irradiance curve, click **[Output ON/OFF]** to turn on curve output under this setting. When execute the test in the main interface, the curve parameter can be adjust when Output is ON state.

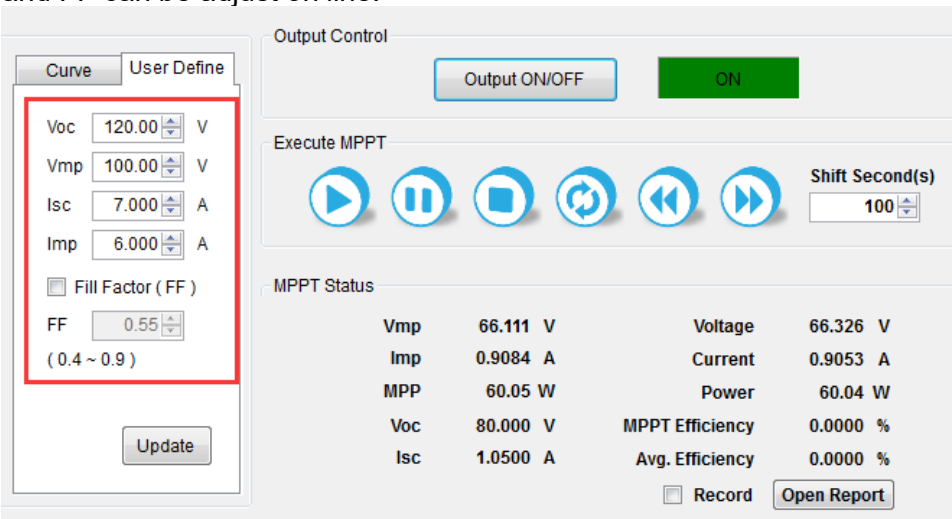
- When select curve such as Curve-1, user can adjust the Vmp and Pmp on line.



User can adjust the values of Vmp and Pmp, click the **[Send]**, the curve will update according to the new parameters.

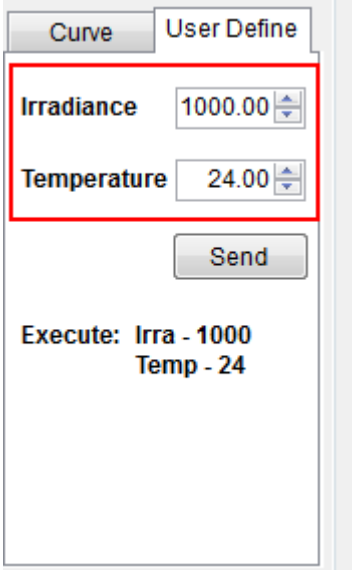
- When select User Define curve, the parameters such as Voc, Vmp, Isc, Imp

and FF can be adjust on line.



User can adjust the values such as Voc, Vmp, Isc, Imp and FF parameter, and click [Update], the curve will update according to new parameters.

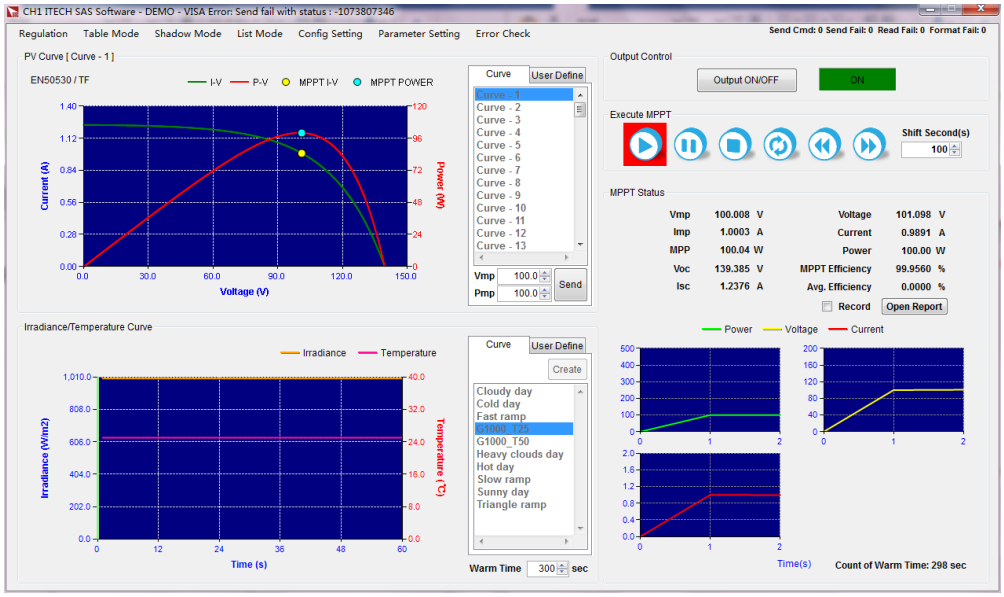
- The Irradiance/Temperature Curve can be select and adjust on line.



When select the built-in curve, the Irradiance/Temperature Curve changed directly. And when select User Define, adjust the parameter and click [Send].

Turn on MPPT

Before executing MPPT test, you can set Warm Time. After clicking start button, the count-down of Warm Time displays in the bottom right corner of the interface. The MPPT test isn't executed until the warm time runs out. And the MPPT display area will display real-time parameters of MPPT efficiency. Actual operation interface is as shown below.



Record: To save related test parameters as .csv file to Report folder of software installation on the computer.

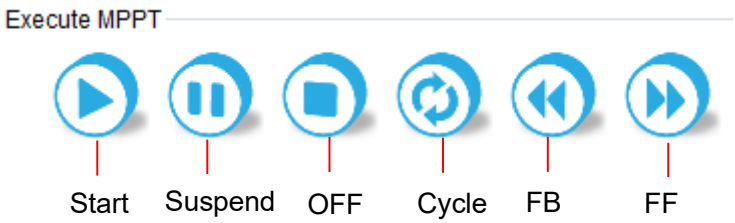
Open Report: click Open Report button to open the report file path directly.

Note

The data file is writing state during test, it can not be open as excel in this state. If user need to view the record data during test, you can open the data file as .txt format.

Shift Second: To set time for MPPT Fast Forward/Fast Backward.

Description of Execute MPPT:



MPPT parameter description:

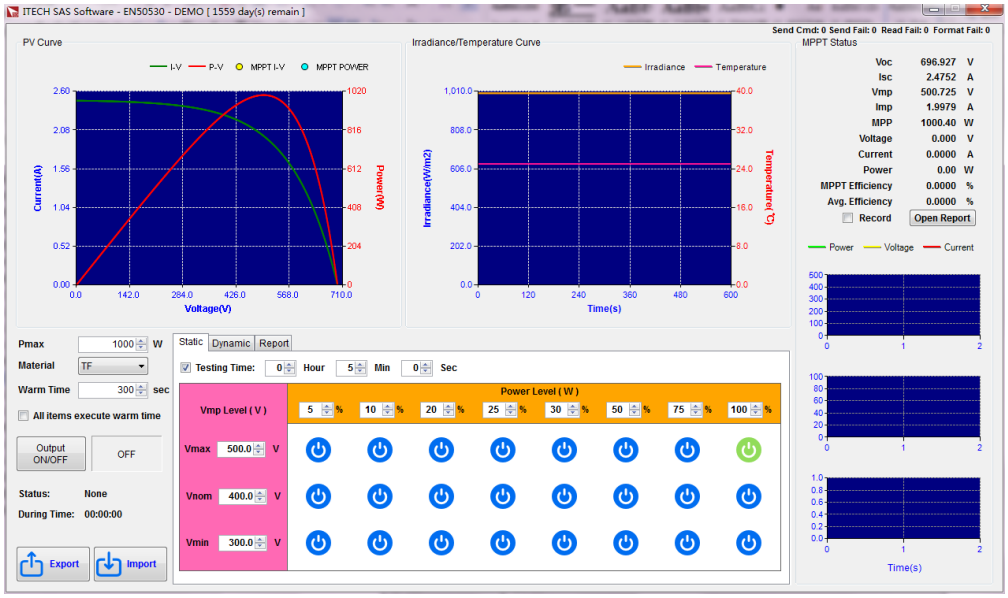
Parameter	Description	Parameter	Description
Vmp	Voltage of maximum power	Voltage	Real-time voltage value
Imp	Current of maximum power	Current	Real-time current value
MPP	Maximum power value	Power	Real-time power value
MPPT Efficiency	Maximum power point efficiency	Avg. Efficiency	Average efficiency
Voc	Open-circuit voltage value	Isc	Short-circuit current value

3.2 Regulation Test

In addition to two common regulation items configured in the main interface, SAS1000M software also provides special regulation test. It is built in with five MPPT test programs (EN50530, SANDIA, NB/T32004, CGC/GF004 and CGC/GF035) to meet regulation test requirements. Every regulation item is set with static test, dynamic test and report output functions. Under static/dynamic test functions of different regulations, irradiance and temperature curves are also different. The user shall define related parameters of PV curve. Take regulation NB/T32004 as an example for illustration.

3.2.1 Static Test

Regulation test provides test environment under static conditions. Under static test environment, temperature and irradiance values are constant and depend on regulation requirements. During test, set parameters related to PV curve and execution time.



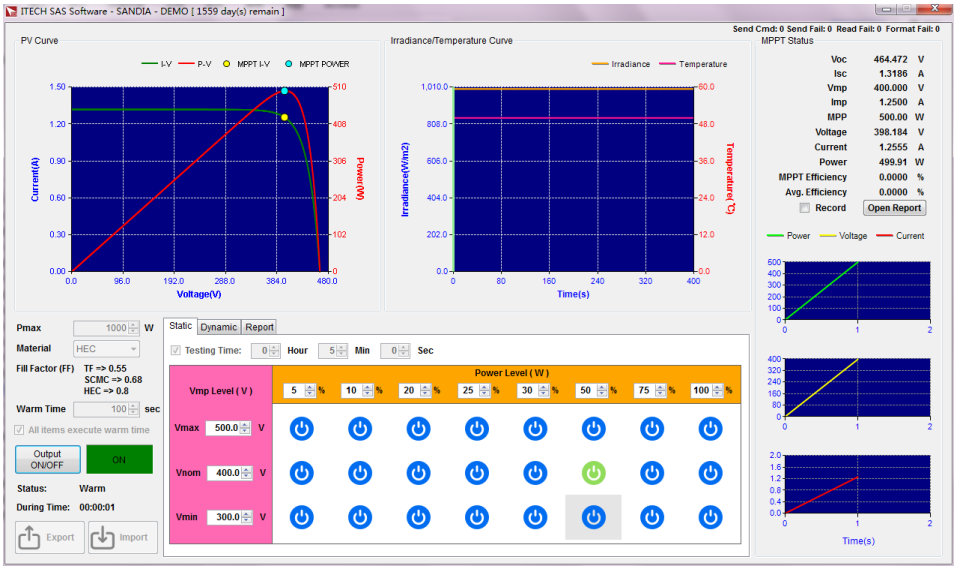
Parameter description for static test:

Parameter	Description
Pmax	Set maximum power value. Setting range depends on the setting range of the device. The user can set Pmax as needed during test.
Material	Set solar panel material. Materials are different under different regulation item, which can be selected by the user as needed.
Warm Time	Set warm time with range of 1 to 999s and initial value of 300s.
All Items execute warm time	Select whether to execute warm time for each power level change. Tick it off in the box, indicates that after the power level changes, the warm time will be executed every time. Do not tick it: just execute warm time for once at first.

Parameter	Description
Status	Display running status: ● None: none ● Warm: warm status ● Test: running status
During Time	Display real-time running time. The time is recounted when the test condition is changed.
Testing Time	Set static test time. ● Tick it off in the box, the test running according to the set time. The test is stopped when the running time is met. ● Do not tick it, the test will loop running until select to stop.
Vmp Level	Set Vmp level: ● Vmax: Maximum value of Vmp. The user can set Vmax as needed during test. ● Vnom: Normal value of Vmp. The user can set Vmax as needed during test. ● Vmin: Minimum value of Vmp. The user can set Vmax as needed during test. Setting ranges of Vmax, Vnom and Vmin depend on the setting range of the device.
Power Level	Set power level. Under static test, the user can set percentage of eight power parameters.

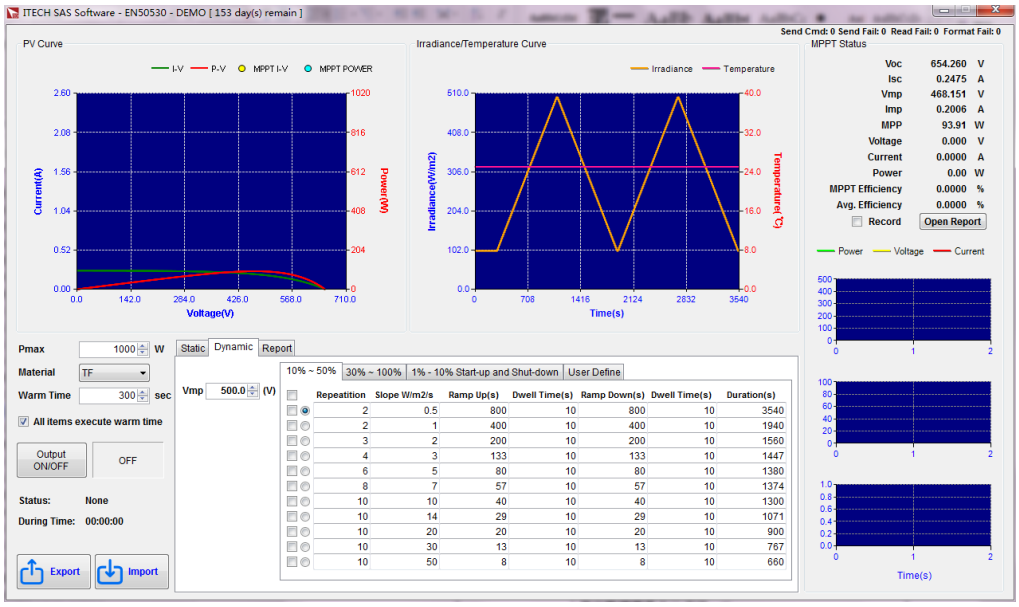
Operation steps

1. Set Pmax, Material and Warm Time as needed.
2. Set Vmax and Vmin of Vmp Level and adjust Power Level.
3. Set Testing Time for static test time.
4. Click the blue button to select the Vmp and Pmp to be executed.
5. Click **[Output ON/OFF]** to start static test. As shown below. During static test, you can change percentages of Power, and click the blue button to select other test parameters.



3.2.2 Dynamic Test

Under dynamic test environment, different regulation items have temperature and irradiance curves of different specifications. The user can run MPPT dynamic test by selecting the temperature and radiance curve as needed.



Parameter description for dynamic test:

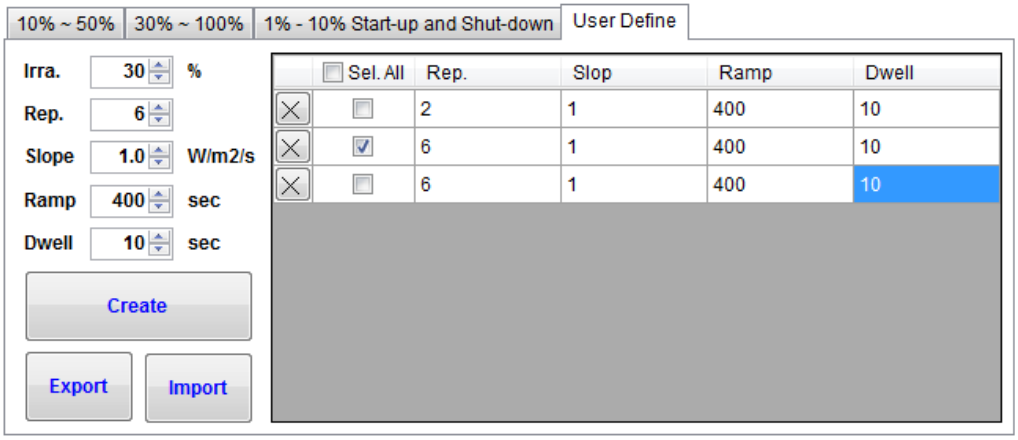
Parameter	Description
Pmax	Set maximum power value. Setting range depends on the setting range of the device. The user can set Pmax as needed during test.
Material	Set solar panel material. Materials are different under different regulation item, which can be selected by the user as needed.
Warm Time	Set warm time with range of 1 to 999s and initial value of 300s.

Parameter	Description
All Items execute warm time	Select whether to execute warm time for each power level change. Tick it off in the box, indicates that after the power level or Vmp level changes, the warm time will be executed every time. Do not tick it: just execute warm time for once at first.
Status	Display running status: ● None: none ● Warm: warm status ● Test: running status
During Time	Display current running time. The time is recounted when the test condition is changed.
Vmp	Voltage of maximum power. Setting range depends on the setting range of the device.
Repeatition	Repeatition of irradiance and temperature curves
Slope W/m2/s	Speed of irradiance and temperature up or down
Ramp Up(s)	Rise time
Dwell Time(s)	Dwell time on top
Ramp Down(s)	Fall time
Dwell Time(s)	Dwell time at the bottom
Duration(s)	Total Rise time, Fall time, Dwell time and warm time.

Operation steps

1. Click **[Dynamic]** to enter the dynamic test interface.
2. Set Pmax, Material and Warm Time as needed.
3. Set Vmp as needed.
4. Select the dynamic item to be tested, and user can select multi condition under the 10%-50% tab and 30%-100% tab.

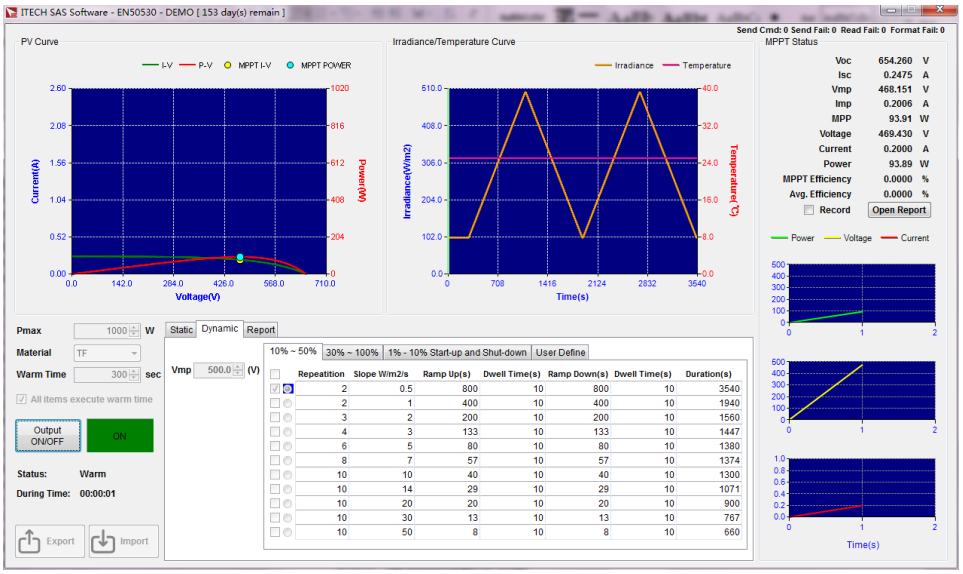
- 10%-50%: The status of solar irradiance is 10%-50%.
- 30%-100%: The status of solar irradiance is 30%-100%。
- 1%-10% W/m2 start-up and shut-down：The status of solar irradiance is 2-100 W/m2, test the DUT start up and shut down.
- User Define: user self-defined the solar irradiance curve.



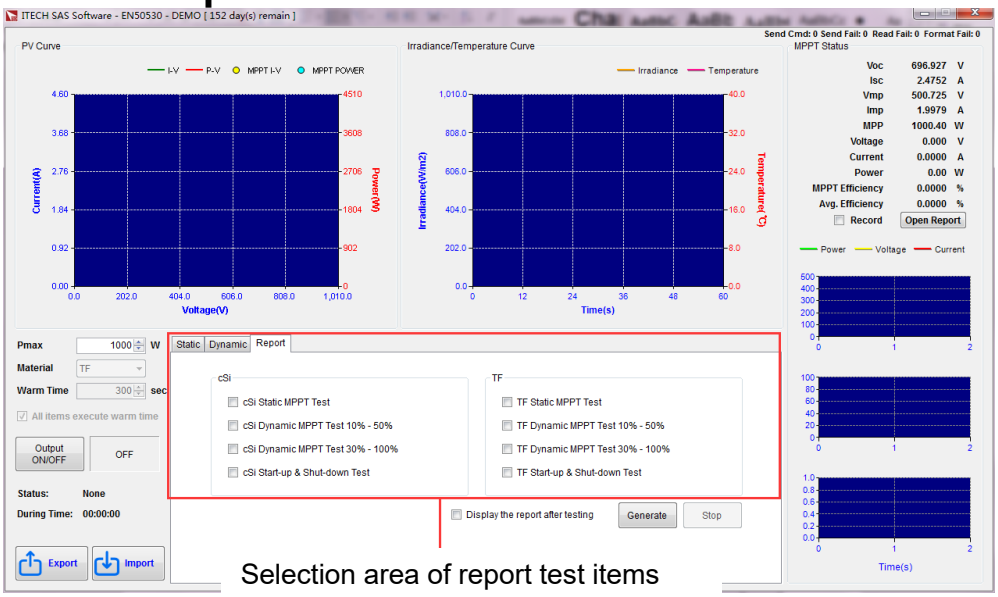
Irra.	The status of solar irradiance
Rep.	Repeatition of irradiance and temperature curves
Slope W/m2/s	Speed of irradiance and temperature up or down
Ramp(s)	Ramp time
Dwell(s)	Dwell time

- Create: create a new irradiance and temperature curve.
- Export: export the curve to pc.
- Import: Import the curve from pc.

5. Click **[Output ON/OFF]** to start dynamic test. As shown below. During test, you cannot change screen parameters. The screen will give irradiance and temperature parameters based on Irradiance Curve data.



3.2.3 Report Test Output



Selection area of report test items

Operation steps

1. Click **[Report]** to enter the report test interface.
2. Set Pmax as needed. The Material setting is invalid here and the actual Material is subject to the report test items. The Warm Time defaults to 300 seconds and cannot be set by the user.
3. Select test item as needed.
4. Check **[Display the report after testing]**. After test, output report will be automatically displayed. If the button is not checked, after test, the software will automatically prompt the storage path in the computer.
5. Click **[Generate]** to execute report test item. After test, the table will be displayed in excel. Table forms vary a lot based on different test items. Examples are given as below.

Test specifications for the static MPPT efficiency									
MPP Voltage of the simulated I/V characteristic of the PV generator	Simulated I/V characteristic	MPP power of the simulated I/V characteristic normalised to rated DC power, Pmpp / Pdc							
		0.05	0.10	0.20	0.25	0.30	0.50	0.75	1.00
Vmppmax =	c-Si								
Vdc =	c-Si								
Vmppmin =	c-Si								

European MPPT Efficiency (0.03 * 5% + 0.06 * 10% + 0.13 * 20% + 0.10 * 30% + 0.48 * 50% + 0.2 * 100%)	
c-Si Vmppmax	0.00
c-Si Vdc	0.00
c-Si Vmppmin	0.00

CEC MPPT Efficiency (0.04 * 10% + 0.05 * 20% + 0.12 * 30% + 0.21 * 50% + 0.53 * 75% + 0.05 * 100%)	
c-Si Vmppmax	0.00
c-Si Vdc	0.00
c-Si Vmppmin	0.00

Parameter Import/Export

Click **[Export]**. Related parameters on the test interface will be exported in txt.

The user can edit txt files in the same format and import the files to the computer by clicking **[Import]**.

3.3 Table Mode

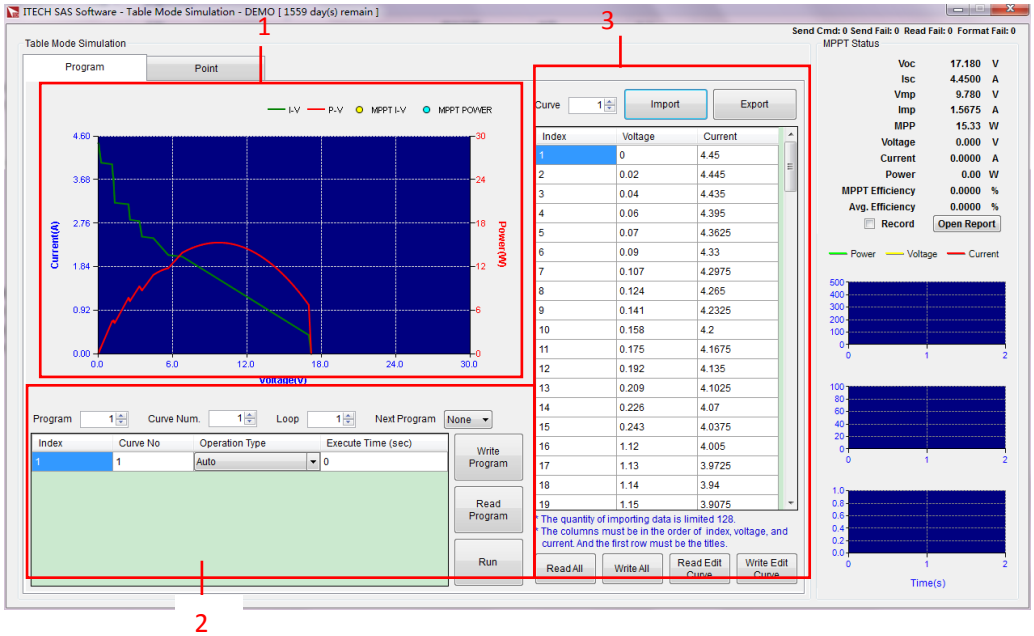
SAS1000M provides table drawing. The user can edit multi-point voltage and current values in table. The software will automatically draw a PV curve for convenient test under given conditions.

Note

In the table mode, the imported voltage value and the edited voltage value cannot be the same.

3.3.1 Program

Under SAS1000M Program, the user can define 10 Program files. Each Program file contains 10 curves at maximum. The user can select one curve from self-defined 100 curves (IT-M series instrument supports 10 curves) and each curve contains 128 points, and combine curves into a Program file based on required sequence. In addition, the user can set cycle count and final status of Program file.



1: Curve display

2: Program edit area, select and edit the sequence or execute time of curves, and execute the program.

3: Curve edit area, can edit 100 I-V curves (IT-M series instrument supports 10 curves) which include 128 points.

Edit Curve

Before creation of Program file, the user needs to define Curve for selection. Directly select a Curve number on the Operation Interface and continuously set voltage and current value of each point as needed. After setting, corresponding PV curve will be displayed at the left graph area.

- Import/Export Curve in Computer

In addition to direct editing of voltage and current parameters on the software

operation interface, the user can edit curve files and save them in the software through Import. This function simplifies the Curve operation process and is easy-to-use.

1. Create a new Excel document on the local PC and name it Curve1.
2. Open the Excel document and save it as in “other formats” in “(*.csv)”.
3. Open the Curve1 csv file and set voltage and current value of each point of the curve. The arrangement format is index value, voltage and current. The first line is title. Quantity of import points is limited to 128.

	A	B	C
1	Index	Voltage	Current
2	1	0	28.0374
3	2	0.31	28.0374
4	3	0.63	28.0374
5	4	0.94	28.0374
6	5	1.25	28.0374
7	6	1.57	28.0374
8	7	1.88	28.0374
9	8	2.2	28.0374
10	9	2.51	28.0374
11	10	2.82	28.0374

4. Select the number of curve to be saved. Click **[Import]** and select the newly-created csv file. The curve data will be displayed in the table and curve diagram of the Program interface.

The user can also export PV curve parameters in the software to the computer. Select the number of curve to be exported. Click **[Export]** and select save location.

- Write/Read Curve from Device

  Apart from the above two methods to define a Curve, the user can save PV curve parameter values of the device to the software for internal usage via Import, and edit the parameter for a single curve.

- Read All Curves

  Click **[Read All]** to read out data of all 100 curves inside the device and save them in the software.

- Write All Curves

  Click **[Write All]** to write data of all 100 curves of the software in the device. The Read/Write process may take about three minutes and the number of the executed Curve will display in this process.

- Read Edit Curve Parameter

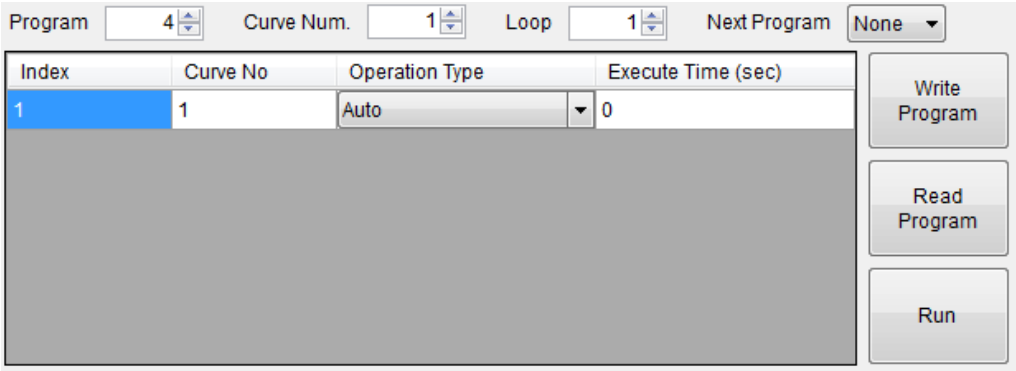
  Select the number of curve to be updated on the software interface. Click **[Read Edit Curve]**. The data of selected curve will be updated as internal data of the device and stored in the software.

- Write Edit Curve Parameter

  Select the number of updated curve on the software interface. Click **[Write Edit Curve]**. The data of selected curve will be written into the device.

Create Program

By creating Program files, the user can output PV curves in various forms to facilitate complex MPPT.



Description of parameters in Program editing area:

Parameter	Description
Program	Set Program number, with range of 1 to 10.
Curve Num	Set Curve Num. in the Program file, with range of 1 to 10.
Loop	Set Execute count of current Program, with range of 1 to 15,000.
Next Program	Set next Execute status when this Program is over. ● None: Stop execution when current execution is over. ● 1 to 10: Execute next selected Program when current execution is over.
Curve No	Select a Curve number for this step from 1 to 100 curves.
Operation Type	Set Trigger mode. ● Auto: Auto trigger ● Manual: Manual trigger
Execute Time	Set execution time for each step under Auto Trigger mode, with range of 0 to 86400. When the Operation Type set to Manual, the Execute Time can not be set. The running time of curve is according to the trigger manually.

Detailed operation steps are as below:

1. Select Program Num.
2. Select Curve Num. The list of curves in program table varies according to the number of curves selected.
3. Set number, trigger type and execution time for each Curve.
4. Set Program cycle count.
5. Set final status of execution.

Write the Program

Before running Program, you need to write the established program file in the

software to the device.

Click **[Write Program]**, the data of programs 1 to 10 in software will all be write to the device.

Click **[Read Program]**, the data of programs 1 to 10 in the device will all be read and updated to the software. New data are displayed in a list.

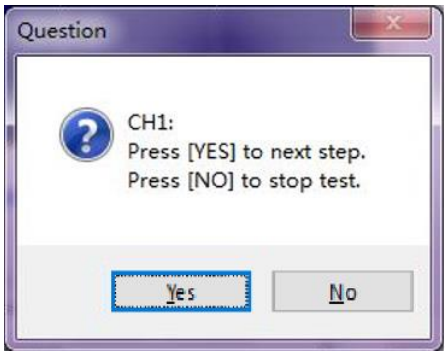
Run Program

Click **[Run]** to execute and output selected Program. Meanwhile, MPPT display area will display real-time voltage/current values and curve graph to test MPP.

During test, curves in program file execute according to trigger condition.

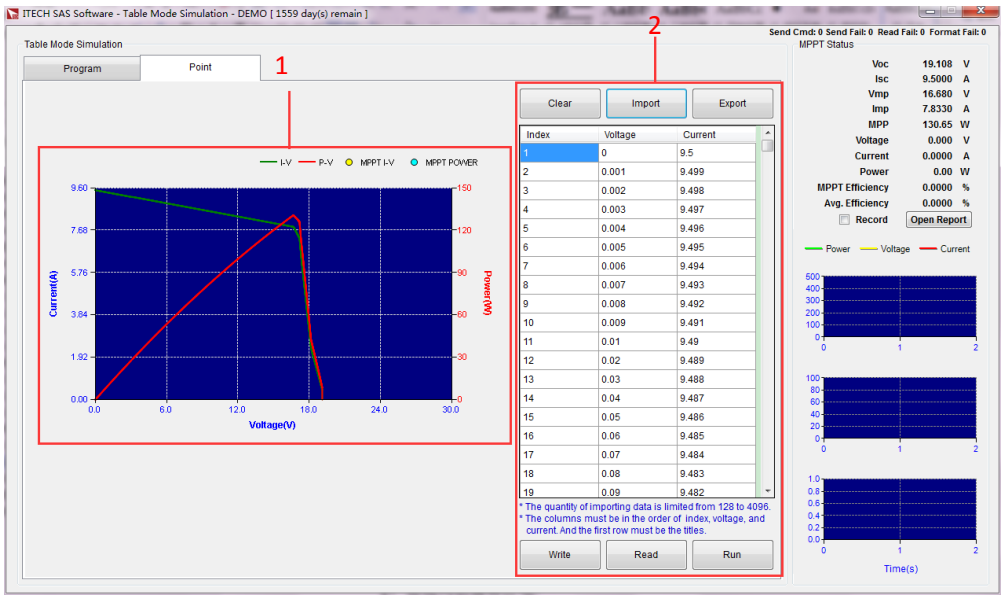
When the Operation Type set to Auto, the next step executed automatically when the running time meets the Execute Time setting.

When the Operation Type set to Manual, the next step need to be trigger manually, the prompt interface as shown below.



3.3.2 Point

SAS1000M provides Point Definition function. The user can set voltage and current values for each point of the curve with range of 128 to 4096. (The curve points range is 128-1024 for IT-M series)



1: Curve display area

2: Curve table edit area

Import/Export Curve

The user can edit curve files in the computer and save them in the software through Import/Export.

- Import curve

  Detailed operation steps are as below:

  1. Create a new Excel document on local PC and name it Curve.
  2. Open the Excel document and save it as in “other formats” in “(*.csv)”.
  3. Open the Curve csv file and set voltage and current value of each point of the curve. The arrangement format is index value, voltage and current. The first line is title. Quantity of import points is limited to 128-4,096. (The curve points range is 128-1024 for IT-M series instrument)
  4. Click **[Import]** and select newly-created csv file. The curve data will be displayed in Point list.

- Export curve

  Click **[Export]** and select save location.

Write/Read Curve

The user can also read the curve data stored in the device to the software, or write the software data to the device. Before running the curve, the data of curve in software need write to device.

Click **[Read]**. The software will read device data and display data in the list and Curve graph.

Click **[Write]**. The software will write all list data in the device.

Edit Curve

The user can edit directly curve voltage and current values on the table with data through keyboard.

Run Curve

After setting of curve, click **[Write]** and write the data to device. And then click **[Run]**. The software will perform PV test based on data. Meanwhile, MPPT display area will display real-time voltage/current values and curve graph to test MPP.

Clear Data

To clear data, click **[Clear]**. All listed data will be cleared. The user can re-define a curve.

3.4 Shadow Moving Simulation

With dynamic Shadow Moving Simulation provided by SAS1000M, the user can change related parameters in the PV Curve graph by selecting number of serial or parallel solar panels. Meanwhile, the user can also select from seven shadow statuses to simulate various irradiance and temperature environments, thus tracking MPPs under different circumstances. Test requirements under this mode are subject to Regulation SANDIA.

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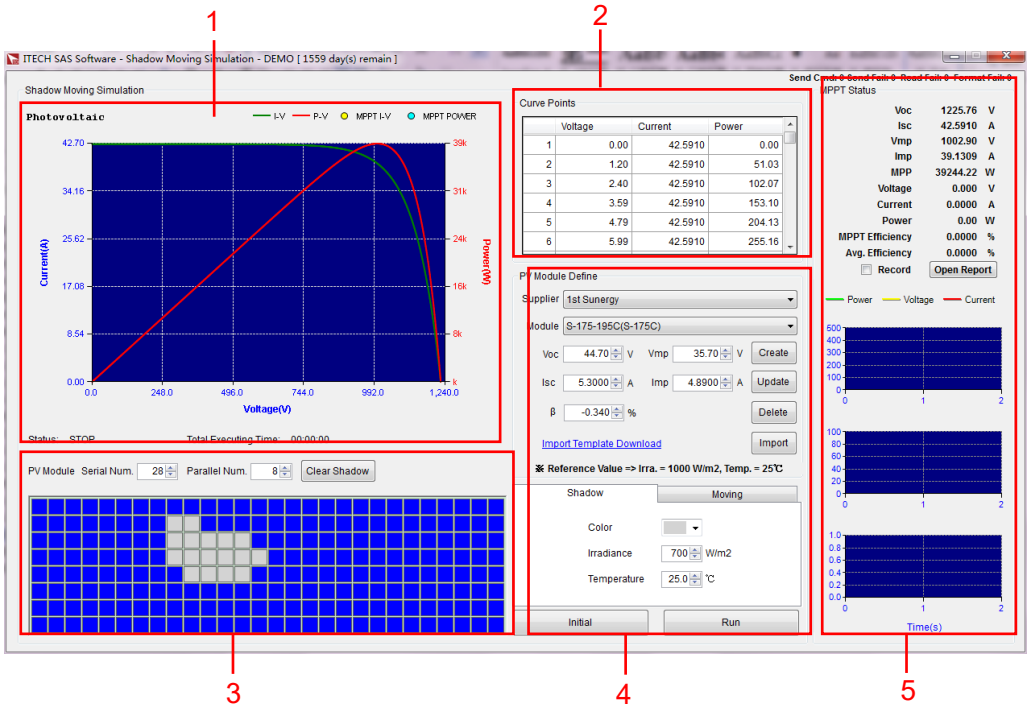
Interface Introduction



1. PV Curve graph
2. List of 1,024 sampled voltage/current/power values for PV Curve graph
3. Draw shadow area with PV Module
4. PV Module setting area and Shadow status selection area
5. Display area of MPPT real-time parameter curves

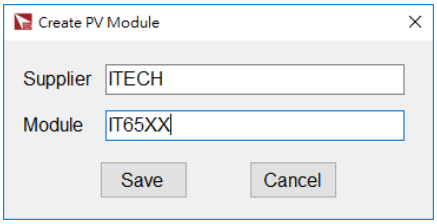
Create Module

During Shadow Moving Simulation operation, the user should select solar panel supplier at setting and selection area of PV Module, and then select different solar panel models based on selected supplier. SAS1000M has several mainstream solar panel suppliers and models for selection.

Apart from built-in models, the user can use the following two methods to create new modules.

- Edit the module on the software interface. Detailed operation steps are as below:

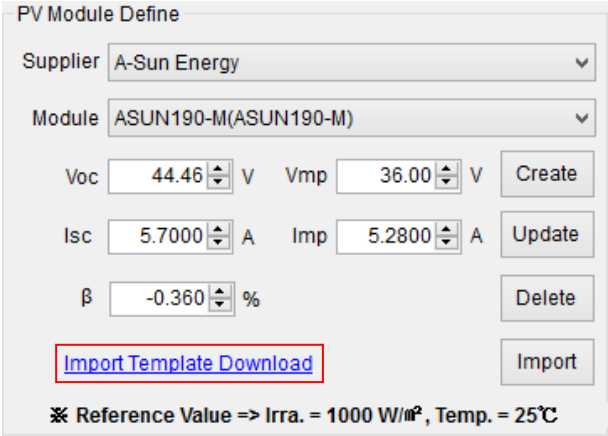
  1. In PV Module Define area, edit a series of parameters like voltage and current. After editing, click **[Create]**. As shown below.



  2. Edit supplier name and model name. After editing, click **[Save]**. The created module will automatically appear in the list of suppliers and models for selection.

- Edit the document in the computer and import it to software. Detailed operation steps are as below:

  1. Click “import template download” to download the import template.



  2. Open the downloaded template “PVModuleImportTemplate.xlsx” as follows. Edit the desired parameters. Up to 65535 Module data can be saved in one downloaded template and imported into software. Close the downloaded template after finishing editing.

	A	B	C	D	E	F	G
1	Supplier	Module	Voc(V)	Isc(A)	Vmp(V)	Imp(A)	Beta(%)
2	ITECH	Module1	10	1	9	0.9	-0.384

  3. Click **[Import]** and select the edited downloaded template to import it to software. The imported modules will automatically appear in the list of suppliers and models for selection.

- Edit Module

  The user can re-edit parameters for new module. Select the module to be edited, and modify parameters as needed. After editing, click **[Update]** to complete operation.

- Delete Module

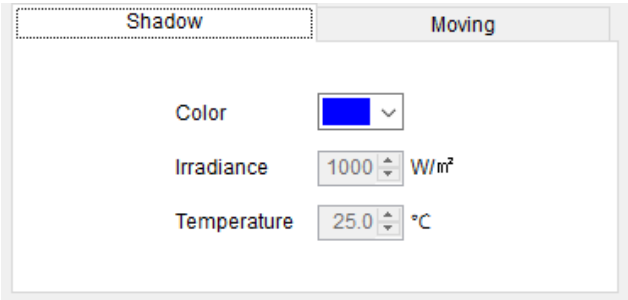
  The user can delete newly-created Module. To delete a Module, click **[Delete]**.

Edit Shadow Status

After setting of solar panel mode, the user can select shadow status. SAS1000M provides seven shadow statuses for selection. Apart from blue, which indicates no shadow (standard irradiance 1,000W/m^2 and temperature 25°C), the user can define other six shadow statuses. Detailed operation steps are as below:

1. Click the drop-down list at right side of Color and select one as needed.

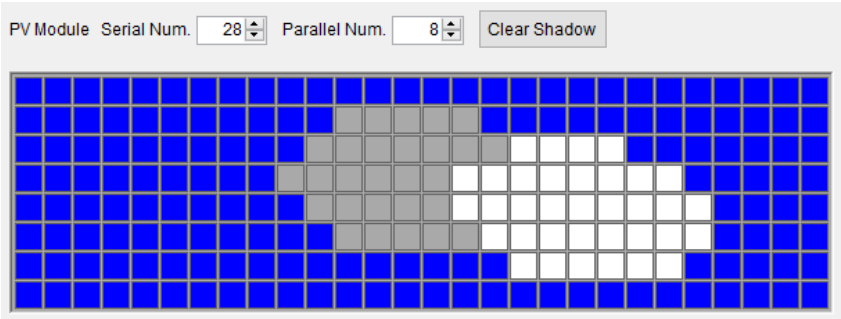
2. After selecting, to change temperature or irradiance value, input required value in the editing box at bottom.



Draw Shadow

After defining temperature and irradiance values of the shadow, the user can draw shadow shape and size in the solar panel simulation area to simulate shadow status under actual climate. During drawing, the user can change shadow status and continue drawing. Detailed operation steps are as below:

1. Set number of serial and parallel PV Modules. (For example, 28 pieces per series, and 8 series in total)
2. Select the color of cloud to be drawn.
3. In the Module blockage, hold the left mouse button and slip the mouse to draw the selected shadow area and click any block to select single area.



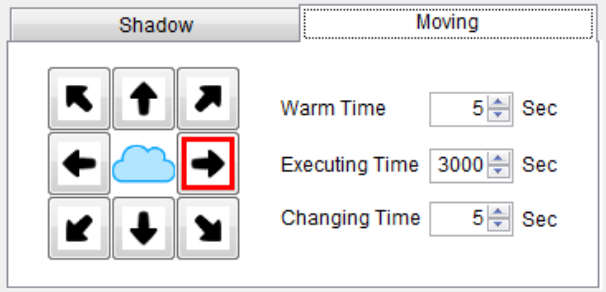
4. After drawing, click **[Initial]** to make the PV Curve into effect.

Edit Shadow Moving Parameters

After drawing shadow size and shape, the user can set moving direction, warm time, executing time and changing time of moving during shadow moving simulation process to better fit actual climate.

Note

The software will automatically adjust the running time to make the shadow movement completed.



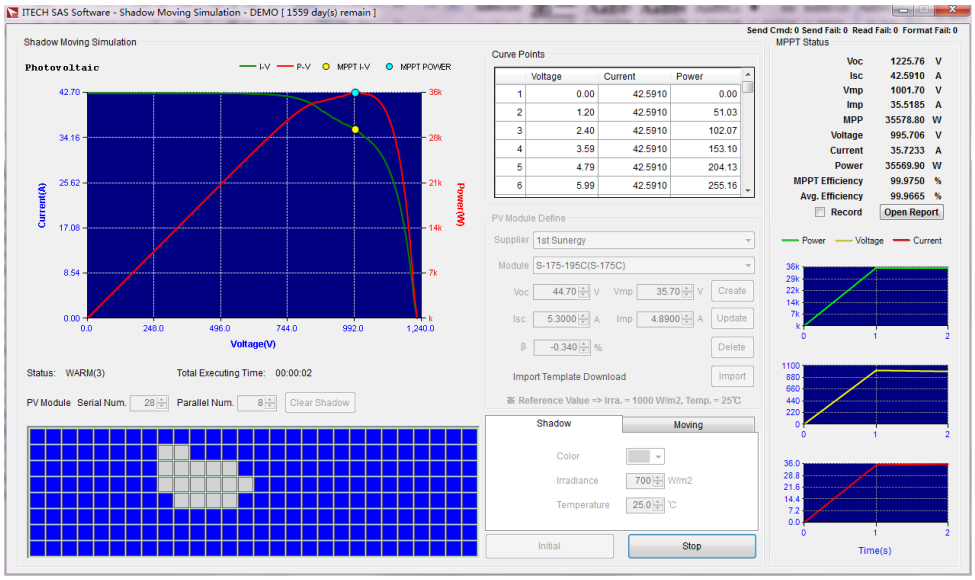
Warm Time: instrument warm time

Executing Time: the curve running time

Changing Time: interval of cloud shadow moving, take the above figure for an example, the cloud shadow moving every 5s.

Run Shadow Simulation

After setting all parameters, click **[Run]** to run shadow moving simulation. Meanwhile, MPPT display area will display real-time voltage/current values and curve graph to test MPP. Actual running interface is as shown below.



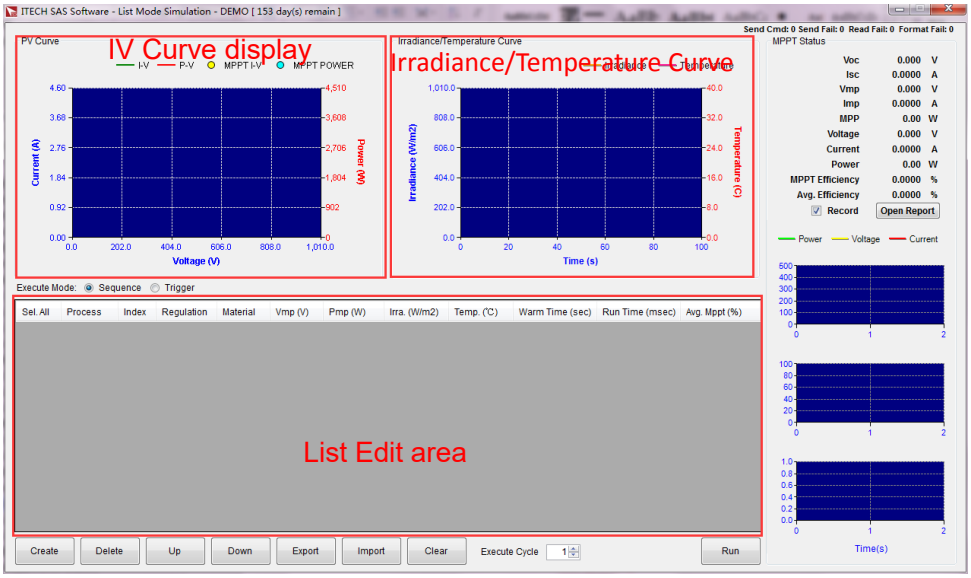
3.5 List Mode

SAS1000M provides a List mode, the user can define multiple waveform curves, and then combine different waveform and run in sequence or according to the trigger signal.

List Mode has two modes: Curve or Userdefine, which are different from Curve and Userdefine in the main interface. Curve is the Curve simulation Mode under regulations, while Userdefine is the user-set Voc, Vmp, Isc and Imp simulation Curve. Other execution methods and temperature illumination conditions are the same.

3.5.1 Introduction of Main Interface

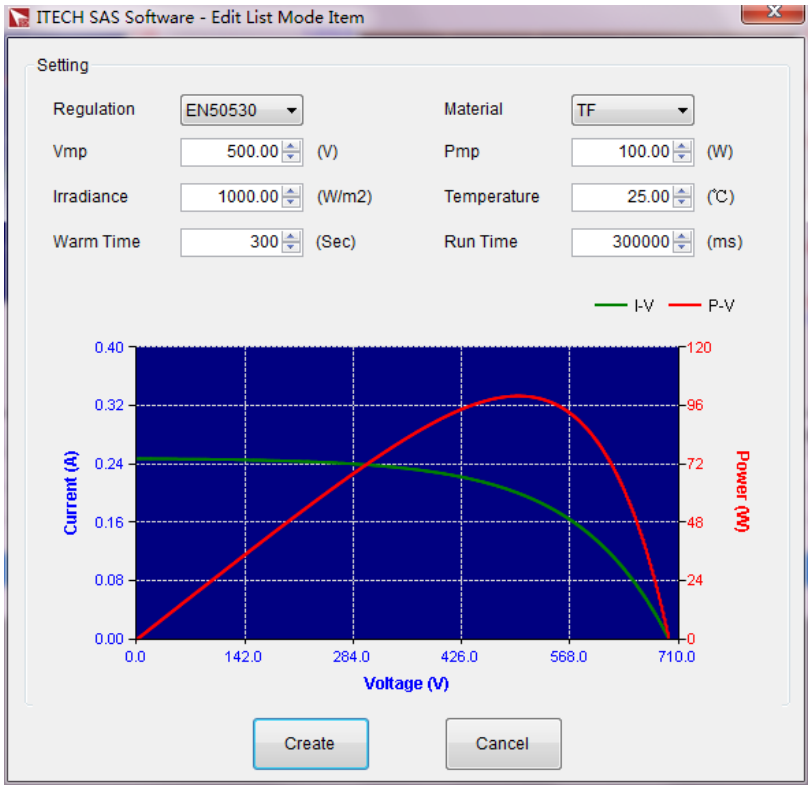
Take the Curve interface as an example, except for different parameters of curves in the interface, other areas are consistent with Curve interface.



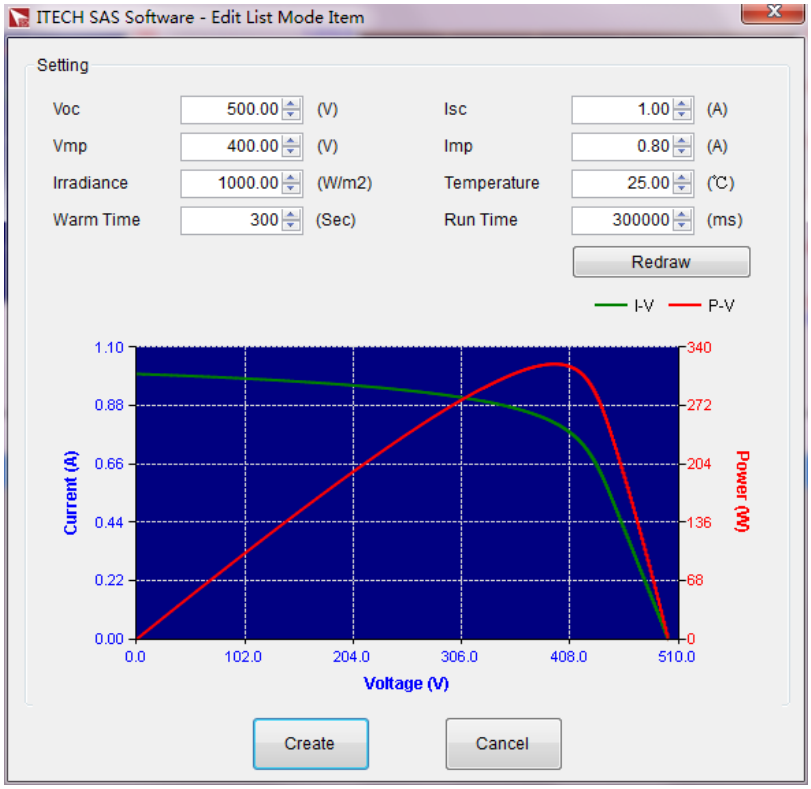
3.5.2 Edit List Curve

1. Click **[Create]** button to edit a new list curve at list edit area, as shown below.

- Curve mode



- UserDefine mode



2. Set the curve parameters and Irradiance/ temperature parameters in Setting area, then click Create button to create a new list curve. Repeat this operation to create multiple List curves.

3.5.3 Run List

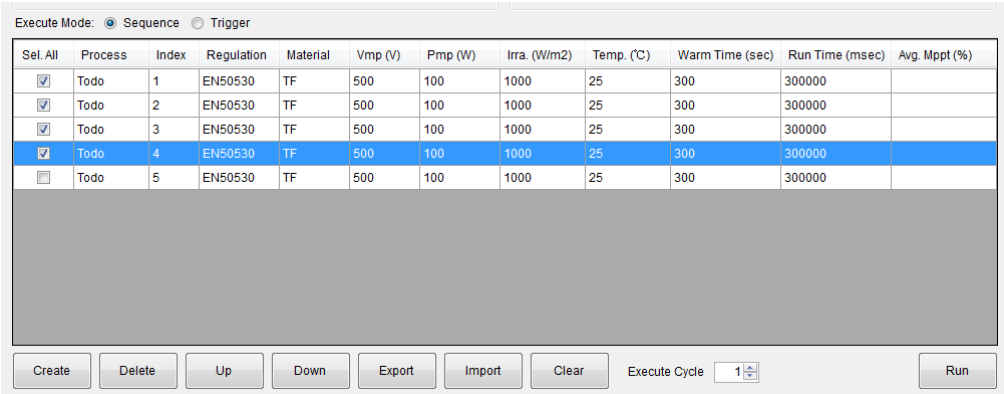
There are two modes of list running.

- Sequence: All the selected curves are executed in sequence.
- Trigger: The curve in the List is executed according to the trigger signal. If no trigger is performed, one of the curves is always executed.

Running in Sequence Mode

1. Select “Sequence” on the List area.
2. Select the curves to perform in the edit area below.
3. Click [Run] to perform the list curves in sequence.

Take the Sequence mode as an example. The parameters of the Curve in Userdefine mode are not exactly the same.



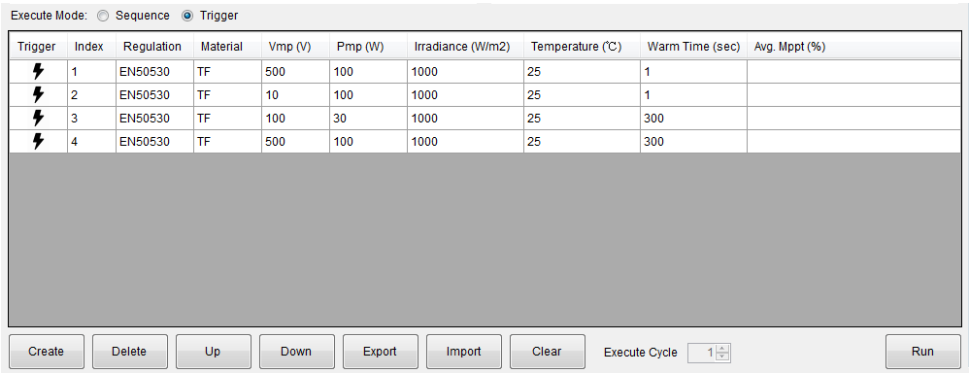
- Create: New a List curve step
- Delete: Delete a List curve step
- Up: Move the selected List up in step order
- Down: Move the selected List down in step order
- Export: Export the List file to an Excel table
- Import: Import the List file data from excel
- Clear: Clear all List curves
- Execute Cycle: repeat execute.

Double-click the List step to modify the step curve data.

Running in Trigger Mode

1. Select “Trigger” on the List area
2. Select a curve to perform in the edit area below.
3. Click [Run] to perform the selected list curve.
4. If you need to run other curve, click the lightning icon in front to trigger the curve.

Take the Sequence mode as an example. The parameters of the Curve in Userdefine mode are not exactly the same.



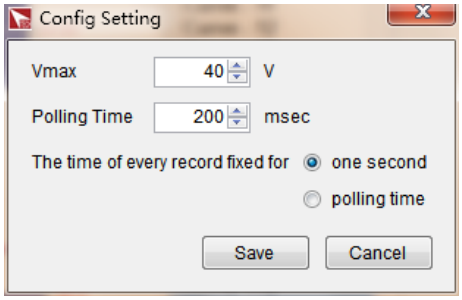
- Create: New a List curve step
- Delete: Delete a List curve step
- Up: Move the selected List up in step order
- Down: Move the selected List down in step order

- Export: Export the List file to an Excel table
- Import: Import the List file data from excel
- Clear: Clear all List curves
- Execute Cycle: repeat execute.

Double-click the List step to modify the step curve data.

3.6 Config Setting

Click **[Config Setting]** in the main interface and enter the configuration function interface shown as follows.



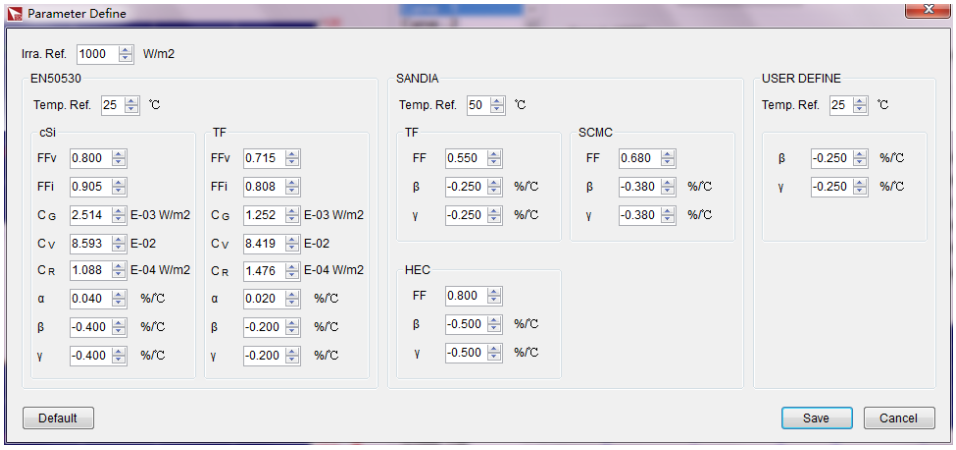
Parameter description:

- Vmax: the maximum output voltage value of the power supply in PV mode.
- Polling Time: the data polling cycle between software and power supply, with the range of 50ms to 1000ms.

  Under shadow moving simulation mode, the polling time range is 100ms-1000ms.
- The time of every record fixed for: the method for the software to record the data, there're the following two options.
  - one second: record the data every second.
  - polling time: record the data every polling time.

3.7 Parameter Setting

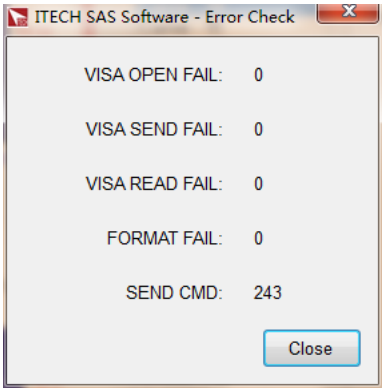
User can define the parameters of regulation and PV module under the Parameter Define interface.



3.8 Error Check

In the upper right corner of the software interface, the user can intuitively see the number of the sending command (Send Cmd), sending fail command (Send Fail), read fail command (Read Fail), and format errors (Format Fail) for each function during the operation. As shown below.

The user can also click **[Error Check]** in the main interface to entry the error check page.



- VISA OPEN FAIL: determine whether there is an error when opening the communication interface.
- VISA SEND FAIL: sending fail commands.
- VISA READ FAIL: read fail commands.
- FORMAT FAIL: format errors.
- SEND CMD: sending commands.

  The sending commands here is different from that in the upper right corner of the software interface. One is the total number of the sending commands during the operation, and the other is the number of the sending commands under the specific function.

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