

Utilize power supplies with the Test Script function to realize IEC 61215, IEC61646 or UL1703-35 Temperature cycling test



PSB-1000 series



PSW series



PSU series

PSU 6-200	PSW 30-36	PSW 250-4.5	PSB-1400L
PSU 12.5-120	PSW 30-72	PSW 250-9	PSB-1400M
PSU 20-76	PSW 30-108	PSW 250-13.5	PSB-1800L
PSU 30-50	PSW 80-13.5	PSW 800-1.44	PSB-1800M
PSU 40-38	PSW 80-27	PSW 800-2.88	
PSU 60-25	PSW 80-40.5	PSW 800-4.32	
PSU 80-19	PSW 160-7.2		
PSU 100-15	PSW 160-14.4		
PSU 150-10	PSW 160-21.6		
PSU 300-5			
PSU 600-2.6			

Solar power has been regarded as the trend of renewable energy sources technology ever since the pressing energy saving demands. A sound solar cell design can effectively absorb light emitting by the Sun and then produces voltage and current. ; An important assessment factor of solar cells is the capabilities, including operational life cycle and outdoor tolerance to expose the module to the normal environment. IEC61215, IEC61646 and UL1703 are test regulations for the characteristics of solar cell modules to ensure the materials can sustain the severe outdoor environment in a long run and to reduce the chances of damage. UL1703-35 Temperature cycling test and the thermal cycling TC200 of IEC61215 or IEC61646 are to test solar cell under 200 temperature cycles to monitor the continuity of the electric circuit; and to identify problems of malfunction, leakage of electricity, open circuit and insulation occurred at internal or welding spots that are caused by different coefficient of thermal expansion of various packing materials.

Temperature cycling test:

Temperature cycling test requires temperature control and working voltage to ensure the electric flow among modules. A constant temperature and constant humidity chamber (CT/CH chamber) and a programmable power supply are to control solar panel' s temperature variation and to supply power to solar modules so as to verify whether solar modules meet the regulations under temperature cycling. Solar modules require different test voltage due to different connection method of modules. Therefore, the output conditions of the power supply must be set according to the actual specifications of solar modules.

Test procedures:

Objective:

To verify whether the continuity of electric circuit of solar cells is normal after 200 temperature cycles.

Qualifications:

1. According to IEC61215-10.11 test procedures, each module should not have internal open circuit or leakage of electricity.
2. According to IEC61215, there is no serious defect on appearance.

3. According to IEC61215, under the standard test conditions, the attenuation of the maximum output power should not exceed 5% of the maximum power output measured before the test.
4. According to IEC61215, insulation resistors should satisfy the requirement before the preliminary test.

Test conditions:

According to IEC61215-10.11 temperature variation from $-40^{\circ}\text{C}\pm 2^{\circ}\text{C}$ (at least 10 minutes) to $+85^{\circ}\text{C}\pm 2^{\circ}\text{C}$ (at least 10 minutes) 50 or 200 cycles

Test equipment:

power supply (PSW-series) · constant temperature/constant humidity (CT/CH) chamber (EC-385MHP)

Operations:

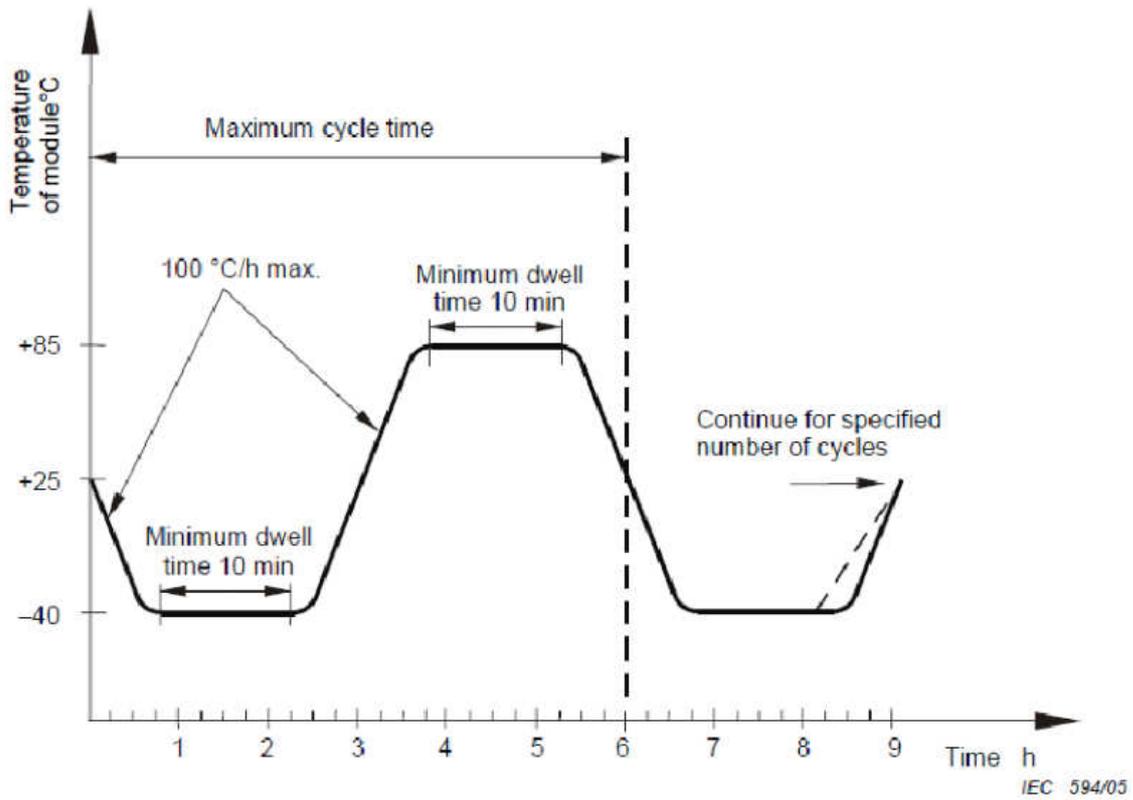
Step 1 Power down DUT and place it at -40°C environment for at least 10 minutes

Step 2 Set power supply to 80V/15A as the maximum output to power DUT and set the environment temperature of CT/CH chamber at $+85^{\circ}\text{C}$

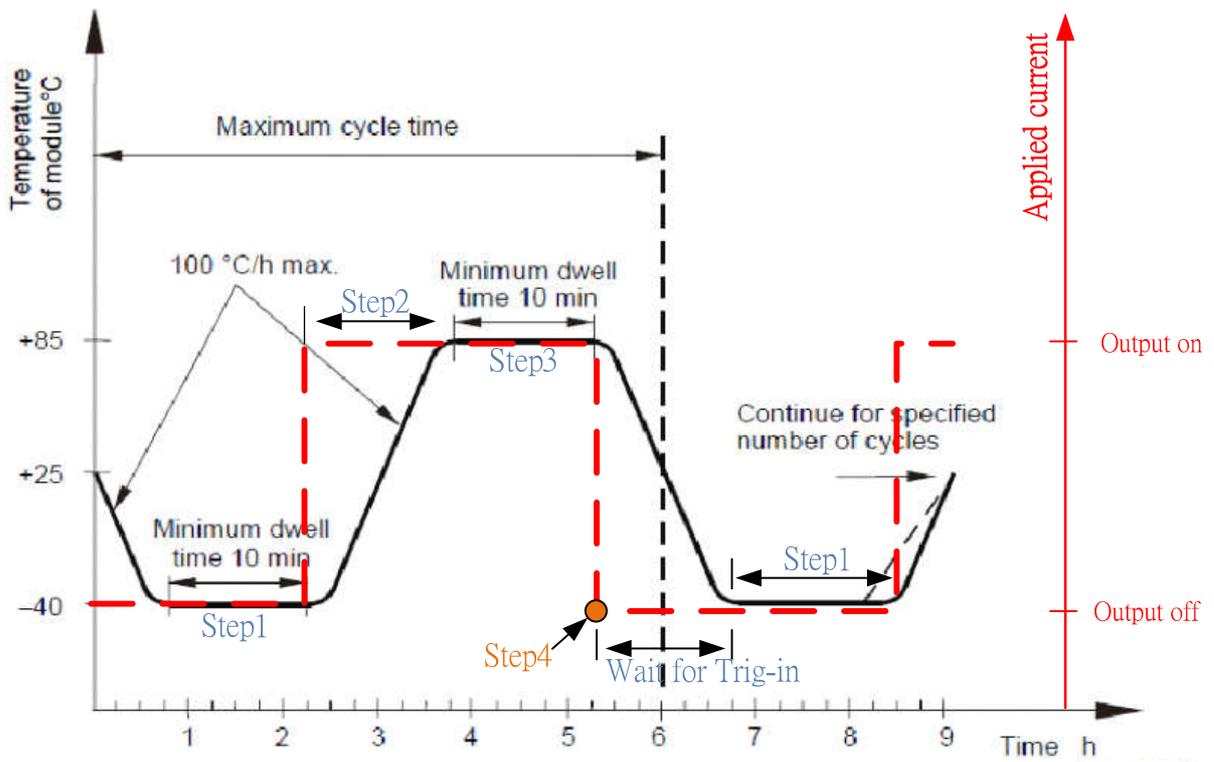
Step 3 Place DUT at $+85^{\circ}\text{C}$ environment for at least 10 minutes

Step 4 Power down DUT and set the temperature of CT/CH chamber at -40°C . Repeat step1~4 based on the number of temperature cycles

Step 5 Verify DUT according to qualifications



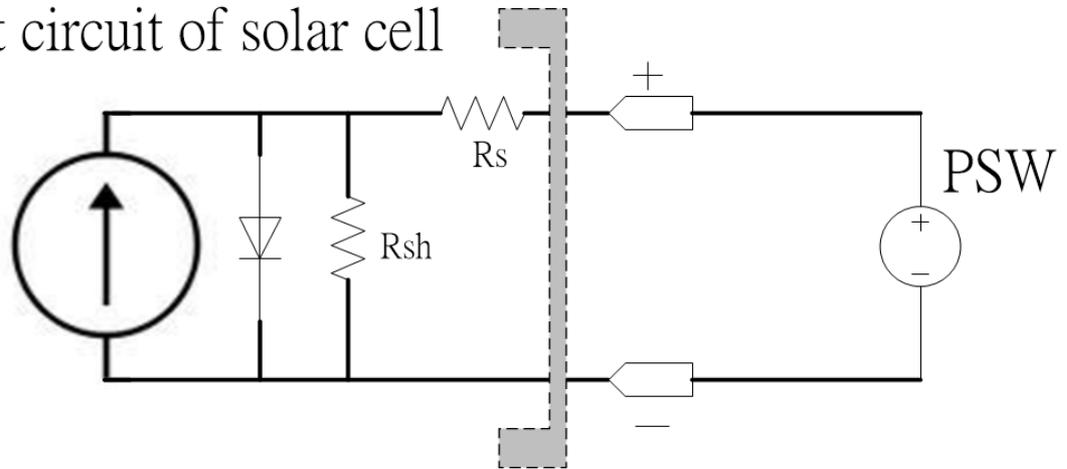
Cycling temperature limits of $-40^{\circ}\text{C} \pm 2^{\circ}\text{C}$ & $+85^{\circ}\text{C} \pm 2^{\circ}\text{C}$



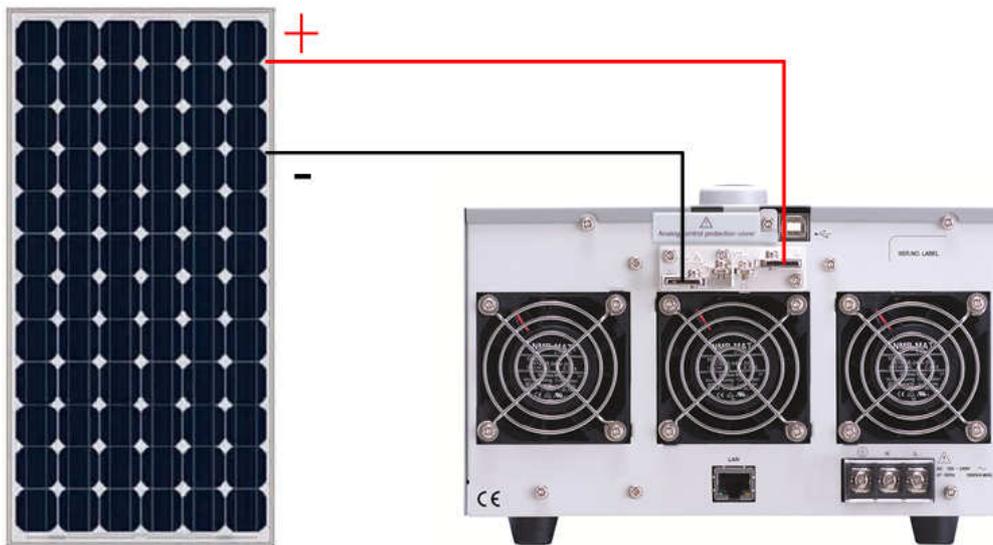
Power output VS. Variances of temperature

Schematic connection:

Equivalent circuit of solar cell



Schematic connection of PSW and Solar modules



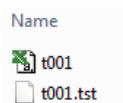
Physical connection chart

Utilize PSW Test Script Function:

GW Instek PSW series provides users with the Test Script function to directly set a series of different voltage and current combinations by using Microsoft Excel to plan a sequential power output. PSW executes the planned sequential power output according to the uploaded Excel file. Based on the test procedures, first of all, set the temperature of CT/CH chamber at -40°C and dwell for 10 minutes at -40 °C and then power up the power supply. Next, set the temperature of CT/CH chamber at +85°C and dwell for 10 minutes at +85°C and then power down the power supply. Wait for the trigger signal when the temperature of CT/CH chamber is to be dropped to -40°C. After receiving the trigger signal, dwell for 10 minutes at -40°C and then power up the power supply. Next, wait for the temperature of CT/CH chamber to be increased to +85°C. Repeat this process for 200 times.

Test Script Setting:

1. Confirm that there are .csv and .tst files and their file names are identical in your USB



2. Open t001.csv provided by GW Instek and edit output voltage, current, time, cycle, etc. for step1~ step4. Please refer to the following chart. For cycle setting, first of all, set the step numbers for Start and End. Start and End should be placed corresponding to the step positions.

Step	Point	Output	Time(sec)	Voltage (V)	Current (A)	OVP(V)	OCP(A)	Bleeder	IV Mode	Vst up(V/h)	Vst down(V/h)	Isr up(A/min)	Isr down(A/min)	RIR(ohm)	Beeper	Sense Ave	Jump to	Jump Cnt	Trig
1	Start	Off	600	0	0	MAX	MIN	ON	CVHS	MAX	MAX	MAX	MAX	MIN					
2	On	On	7200	80	15	MAX	MIN	ON	CVHS	MAX	MAX	MAX	MAX	MIN					
3	On	On	600	80	15	MAX	MIN	ON	CVHS	MAX	MAX	MAX	MAX	MIN					
4	Pause	Off	1	0	0	MAX	MIN	ON	CVHS	MAX	MAX	MAX	MAX	MIN					
5	End	Off	1	0	0	MAX	MIN	ON	CVHS	MAX	MAX	MAX	MAX	MIN					
6																			
7																			
8																			
9																			
10																			
11																			

Wait for Trig-Input

Fill the Excel chart with the parameters to quickly obtain a sequential power output as shown above. Execute step1~ step4 based on temperature cycling test requirements:

Step 1 Power down DUT and place it at -40°C environment for at least 10 minutes [Set Step 1 Output→Off, for 600 Sec]

Step 2 Set power supply to 80V/15A as the maximum output to power DUT and set the environment temperature of CT/CH chamber at +85°C

[① Set power supply at 80V/ 15A output. ② Set time required for CT/CH chamber to increase temperature from -40°C to +85°C]

Step 3 Place DUT at +85°C environment for at least 10 minutes[Set Step 3 Output On for 600 Sec]

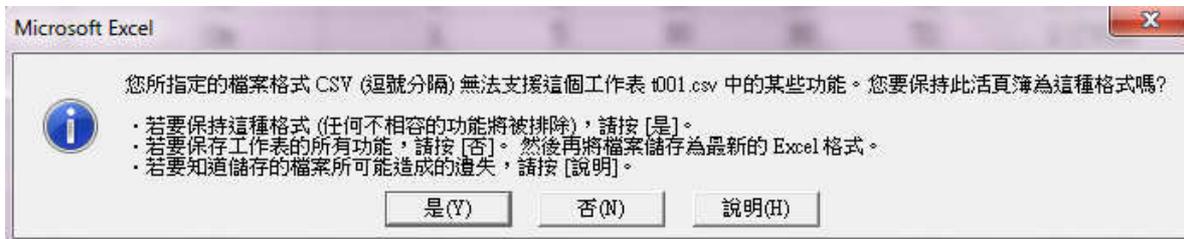
Step 4 Power down DUT and wait for external trigger signal. [①Power down power supply ②Wait for the temperature of CT/CH chamber to be dropped from +85°C to -40°C, and then receive trigger signal to restart cycle] Repeat step1~4 based on the trigger signal.

Step 5 Conclude temperature cycling test and verify DUT according to qualifications

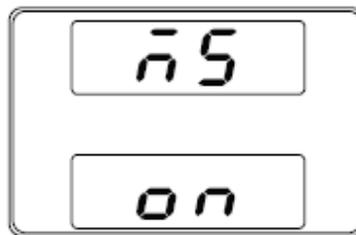
Test Script Parameter Definition:

- i. OVP: over voltage protection setting. MAX: Maximum value by default ;
MIN: Minimum value by default
- ii. OCP: over current protection setting. MAX: Maximum value by default ;
MIN: Minimum value by default
- iii. Set Bleeder to 1 to activate bleeder control ◦ (This function is to assist DUT to quickly discharge)
Set Bleeder to 0 to deactivate bleeder control
- iv. IV mode:
CVHS: Set PSW under CV priority mode, voltage rising and falling are at the fastest mode (slew rate setting for voltage and current is invalid)
CCHS: Set PSW under CC priority mode, current rising and falling are at the fastest mode (slew rate setting for voltage and current is invalid)
CVLS: Set PSW under CV slew rate control mode, voltage rising and falling are operated by settings ◦
CCLS: Set PSW under CC slew rate control mode, current rising and falling are operated by settings ◦
Cycle: Set the number of cycles (To execute infinite cycles please set the number of cycles to 0)

3. The following dialogue box will appear when you save or close the file. Please click “yes” to maintain this format.

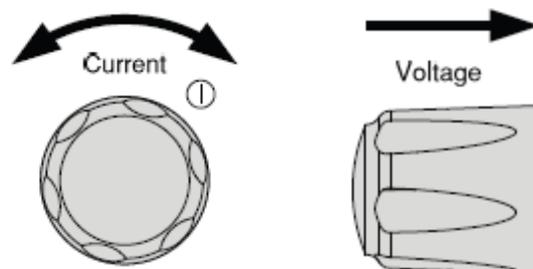


4. After saving the file, please insert USB to the USB port on the front panel of PSW and wait for 5 seconds. (MS appearing on the display represents USB has been read)



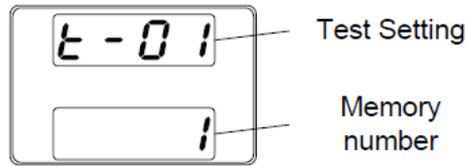
5. Press test key on the front panel of PSW  to enter Sequence function settings.

6. Use voltage knob to select T-02, then use current knob to select desired memory location (1~10) and finally press voltage knob to confirm setting.



Note: If .csv file name is t001 please select memory location 1. If .csv file name is t002 please select memory location 2 and so on. °

7. Use voltage knob to select T-01, then use current knob to select desired memory location (1~10) and finally press voltage knob to confirm setting. Next, press OUTPUT key. PSW will then output the previous edited settings.



8. Press voltage knob and then the following display will be shown to represent it is successfully entering the execution stand-by display. Press "output" to initiate operation. ◦



Note: If there is error messages as shown on the following displays please follow "Error Messages and Solutions" to amend t00x.csv file. ◦

(For example: Error 93→_SEQ_ERR_OCP_TOO_SMALL.) OCP setting is too small that is beyond the specifications. Settings should be within the specifications.)

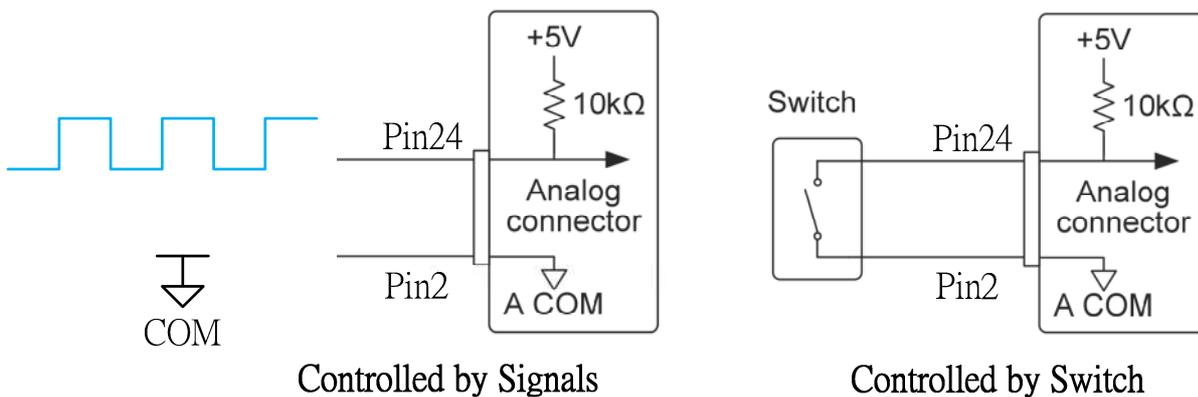


The Analog Control pins of PSW:

In order to synchronize the temperature variation of CT/CH chamber and activation of the Test script function of PSW. Utilize the analog control terminal of PSW for trigger waiting, which requires setting analog control conditions with panel function of F-94.

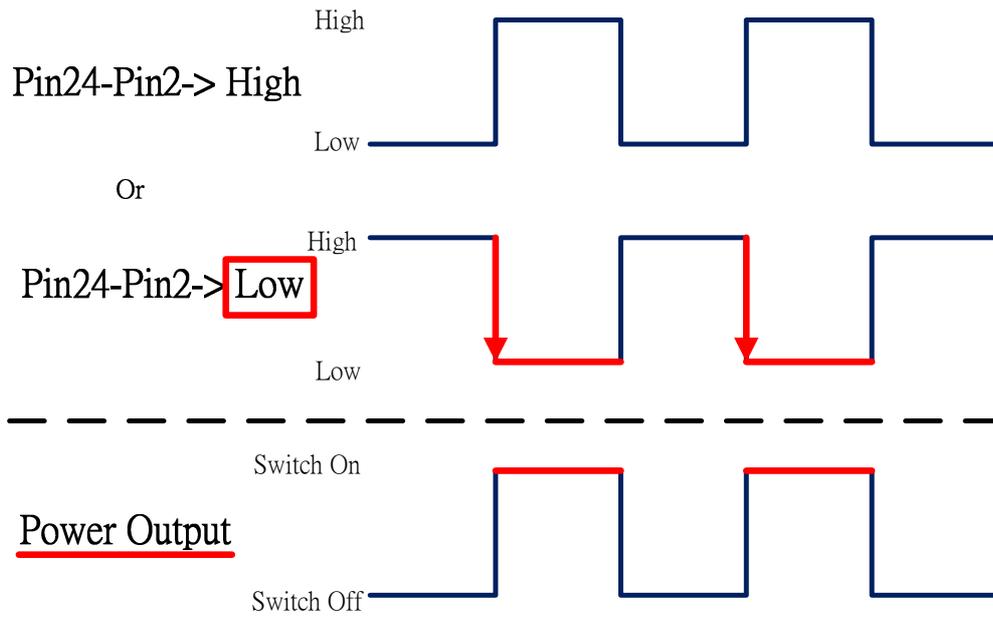
Panel Function Settings:

- i. Press and hold "Function" key to turn on PSW
- ii. Panel display shows F-90. Adjust voltage knob to F-94 and then press voltage knob.
- iii. Current column shows "ConF"
- iv. Adjust current knob F-94 to set logic HIGH or LOW (0 →HIGH, 1→LOW)
- v. Power down and turn back on the power. All setting will become valid.



Two methods to drive the analog control pins

When F-94 →1(LOW), Pin24-Pin2 port is negative-edge trigger and Low level maintains Test Script execution. Test Script will execute user-defined Step1 to Step4 and Trig in signal received by PSW will restart cycles.(i.e. when environment temperature is dropped from +85°Cto -40°C and stabilized) Since Pin24-Pin2 are not only the pin for Trigger in, they are also the pin for output activation. The Pause command of Test Script is to terminate Test Script execution and to wait for external trigger signals. Trigger input signals received by analog control pins will resume Test Script execution. The number of Test Script executions is determined by the number of received trigger input signals. The Pause command of Test Script to be triggered by external trigger signals allow PSW to synchronize with external CT/CH chamber.



Timing chart of F-94

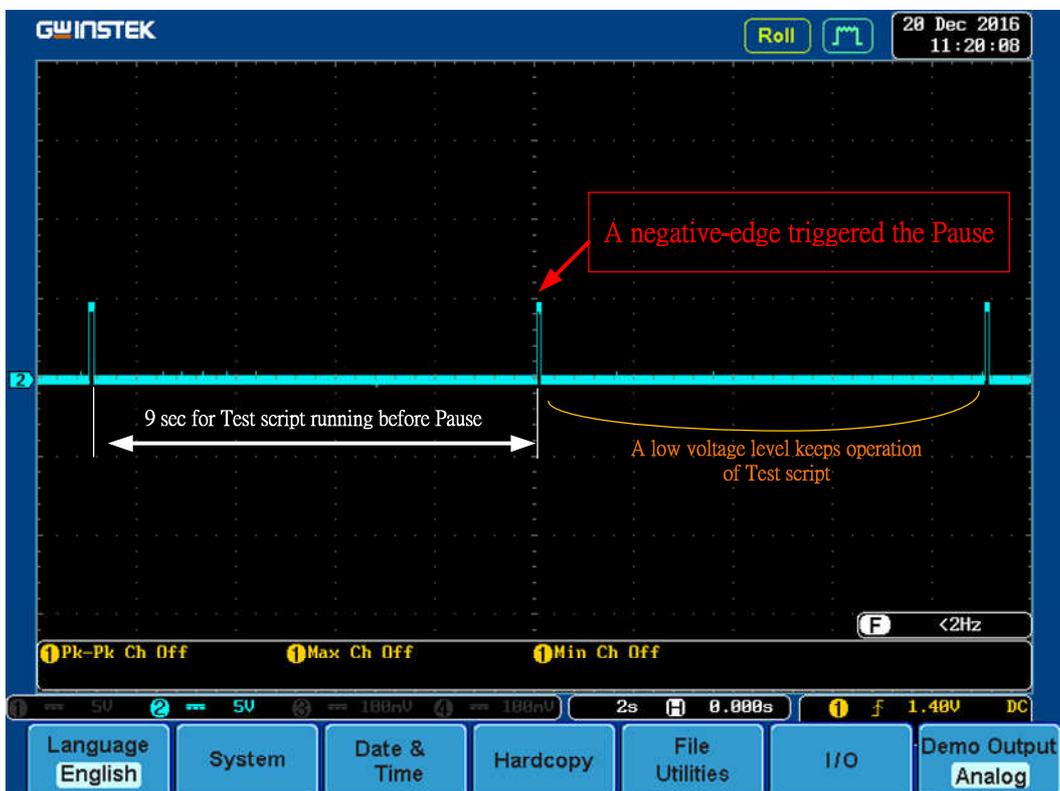
Utilize signal source to simulate signal control:

To shorten the simulation time, we shorten the Test Script execution time proportionally as follows:

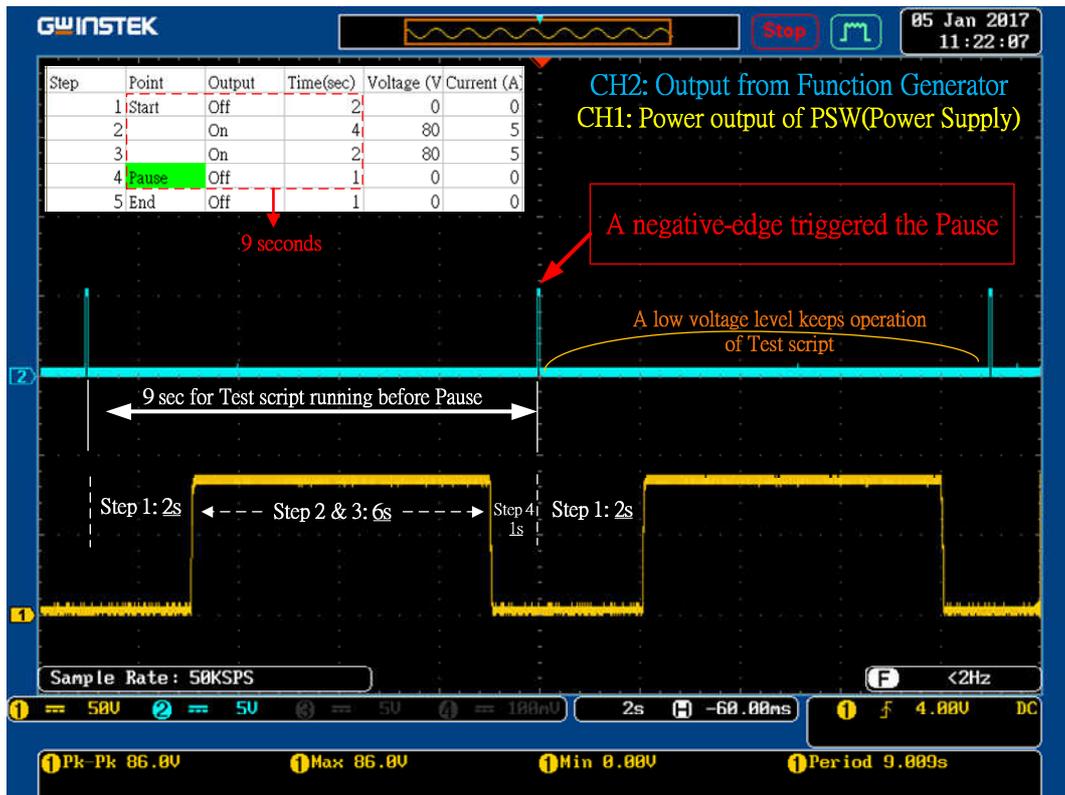
Step	Point	Output	Time(sec)	Voltage (V)	Current (A)	OVP(V)	OCP(A)	Bleeder	IV Mode	Vsr up(V/n)	Vsr down(V/n)	Isr up(A/m)	Isr down(A/m)	AIR(ohm)
1	Start	Off	2	0	0	MAX		17 ON	CVHS	MAX	MAX	MAX	MAX	MIN
2		On	4	80	5	MAX		17 ON	CVHS	MAX	MAX	MAX	MAX	MIN
3		On	2	80	5	MAX		17 ON	CVHS	MAX	MAX	MAX	MAX	MIN
4	Pause	Off	1	0	0	MAX		17 ON	CVHS	MAX	MAX	MAX	MAX	MIN
5	End	Off	1	0	0	MAX		17 ON	CVHS	MAX	MAX	MAX	MAX	MIN
6														
7														
8														
9														
10														

To shorten the total execution time to 9 Secs according to proportion.

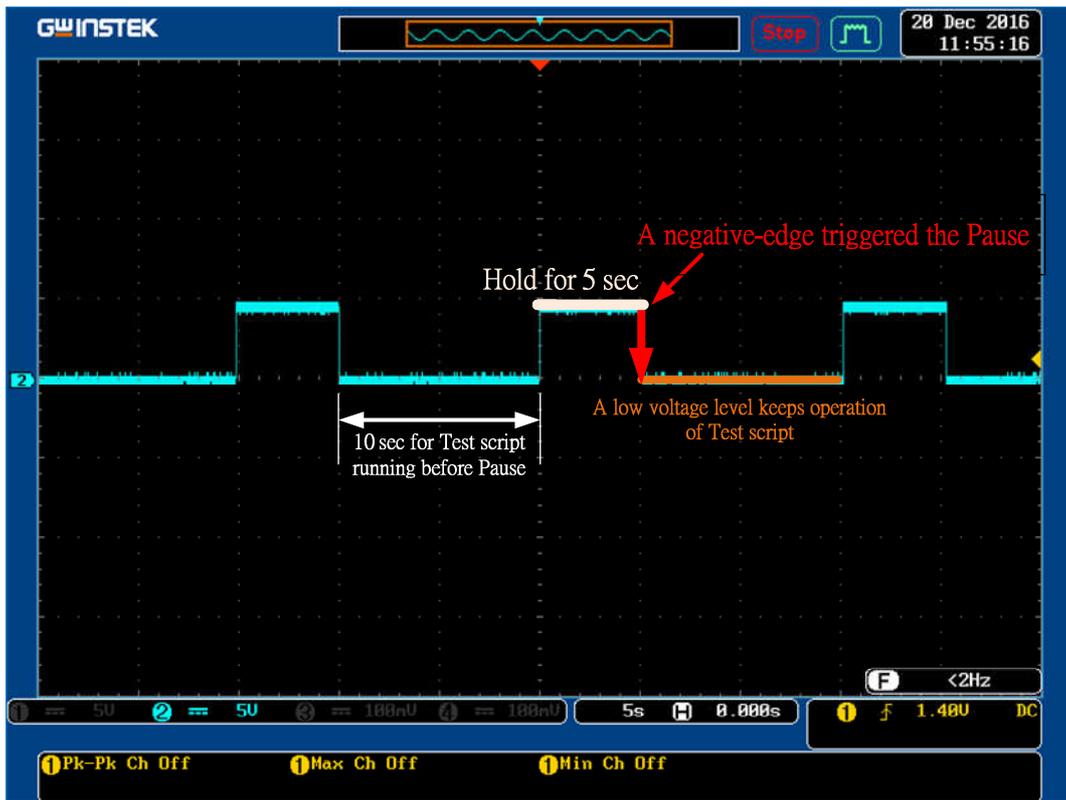
- I. Utilize a GW-MFG-2260MRA to output 5Vp-p/ 50ms consecutive pulse signals (as shown on CH2) as the trigger signal to restart Pause of Test Script, and execute Test Script based on the number of triggers.



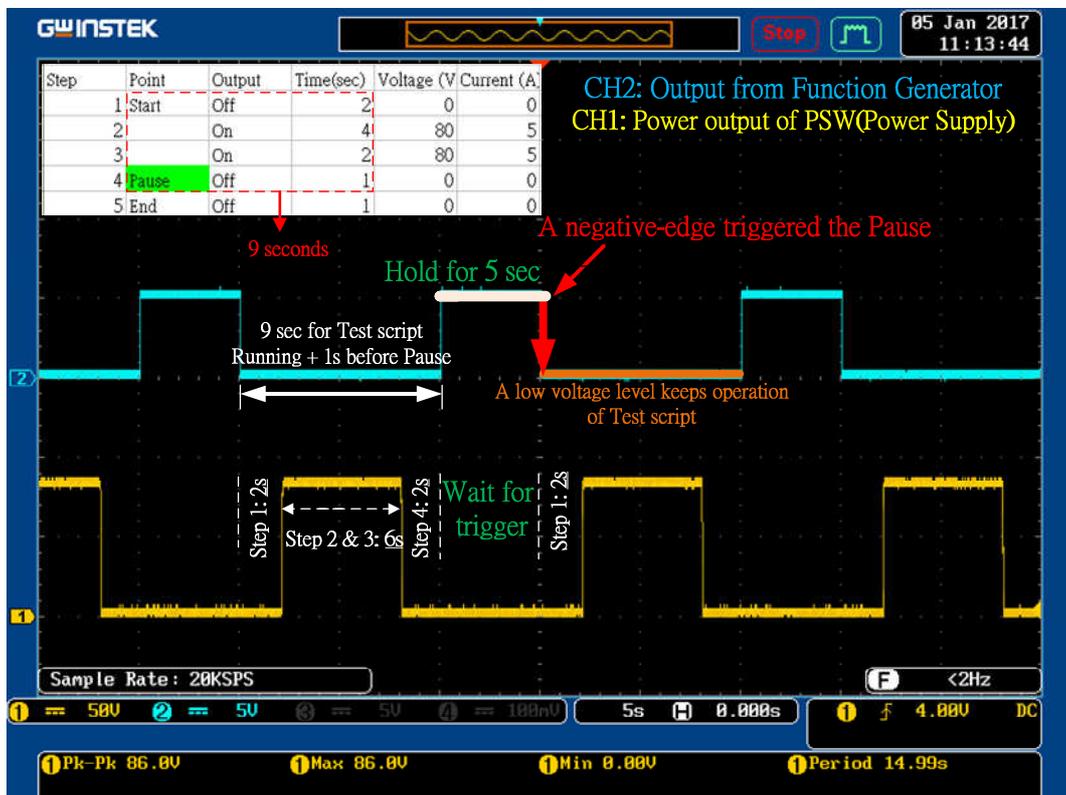
The following CH1 is that PSW repeatedly output and turned off power according the parameters of Test Script step1~ step4.



- II. Utilize a GW-MFG-2260MRA to output 5Vp-p/ 5s consecutive pulse signals (as shown on CH2) as the trigger signal to synchronize Test Script. One second after completing Test Script execution, a 5-second width pulse signal is produced to restart the Pause of Test Script and then execute Test Script based on the number of triggers.



The following CH1 is that PSW repeatedly output and turned off power according the parameters of Test Script step1~ step4.



Summary:

System designers can use a signal source simulated control signals as trigger signals of CT/CH chamber to verify whether the produced trigger signals can correctly restart Test Script execution. The produced trigger signals can also be used as the reference base of signal input source for system designers in planning and designing processes.

Note:

Acceptable trigger signal specifications for Test Script:

- 1 TTL signal level: 5V
- 2 Negative-edge trigger signal (Set F-94 →1(LOW))
- 3 Low level duration time must be greater than the total execution time of Test Script (Set F-94 →1(LOW))

Conclusion:

Thermal cycling TC200 of UL1703-35 or EC61215/IEC61646 can verify the stability of solar modules under different temperature variations by identifying temperature variations caused malfunctions such as reducing output power; open circuit or insulation problem. It is a tedious job to set temperature cycling variations and corresponding voltage outputs for the temperature cycling test. The Test Script of PSW saves the day by directly editing Excel file and uploading the edited file to PSW so as to quickly and easily run the test sequence. PSW can also collocate with CT/CH chamber to significantly simplify the complicated CT/CH chamber settings. Editing Test Script by Excel does not require any other software and it also allows PSW series to easily output complex sequential power outputs to satisfy the test requirements of aging test, automotive electronics, and electronic components, etc.

PS(Models supporting Test Script are as follows:)

PSU 6-200	PSW 30-36	PSW 250-4.5	PSB-1400L
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PSU 100-15	PSW 160-14.4		
PSU 150-10	PSW 160-21.6		
PSU 300-5			
PSU 600-2.6			