爱科赛博
ACTIONPOWER

HGS

HGS Grid Simulator Technical Specifications

西安爱科赛博电气股份有限公司
XI'AN ACTIONPOWER ELECTRIC CO.,LTD.

1.Product Overview

In 2020, ActionPower launched the first generation HGS grid simulator, aiming to simulate the various characteristic of grid on-site, specifically for 10kV/35kV voltage level grid accreditation for field power plant.

In 2022, ActionPower launched the second generation HGS grid simulator product, with stronger environmental adaptability, 10kV full power output and other characteristics, and launched series products according to the power of the local power station. It mainly carries out grid adaptability tests and fault ride through tests for green energy power stations connected to 35kV/10kV grid. The tests includes voltage adaptability test, frequency adaptability test, three-phase voltage unbalance adaptability test, flicker adaptability test, harmonic/inter-harmonic adaptability test, high/low voltage fault ride through test, etc.

The equipment is of container structure, it meets the requirements of domestic highway transportation and it can be arranged at various power stations for field tests. Through the specific design of the heat dissipation air tube, rainwater and sandstones can be prevented from entering the equipment, so that the equipment can still operate normally in harsh environments such as sandstorm, rain and snow.

The HGS MV grid simulator still has parallel function, and the maximum capacity can reach 15MW.

Test regulation

Tests of HGS series MV grid simulation sources meet the following standards:

Technical Specification for Connecting Wind Farm to Power System - Part 1: On Shore Wind Power (GB/T 19963.1-2021)

Wind Turbines - Test Procedure of Voltage Fault Ride Through Capability (GB/T 36995-2018)

Wind Turbines - Test Procedure of Grid Adaptability (GB/T 36994-2018)

Test Procedure of Wind Turbine High Voltage Ride Through Capability (NB/T 31111-2017)

Technical Requirements for Connecting Photovoltaic Power Station to Power System (GB/T 19964-2012)

Testing Code for Photovoltaic Power Station Connected to Power Grid (GB/T 31365-2015)

Technical Rule for Electrochemical Energy Storage System Connected to Power Grid (GBT 36547-2018)

Test Specification for Electrochemical Energy Storage System Connected to Power Grid (GBT 36548-2018)

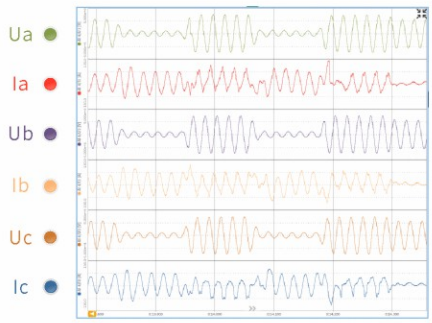
Selection

Model	Power (kVA)	VoltageU_{L-L} (kV)	Nominal voltageU_{L-L} (kV)	Max current (A)	Output frequency
HGS-20-3512	2000	0-46/0-13	0-35/0-10	33A@35kV/115A@10kV	45~65Hz
HGS-30-3518	3000	0-46/0-13	0-35/0-10	38A@35kV/173A@10kV	45~65Hz
HGS-40-3523	4000	0-46/0-13	0-35/0-10	66A@35kV/231A@10kV	45~65Hz
HGS-60-3535	6000	0-46/0-13	0-35/0-10	100A@35kV/346A@10kV	45~65Hz
HGS-75-3543	7500	0-46/0-13	0-35/0-10	124A@35kV/433A@10kV	45~65Hz

Product Advantages

- **High dynamic and strong impact resistance**

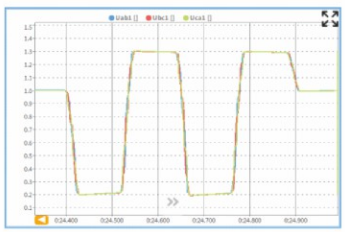
The power supply can be subject to continuous high & low voltage ride through tests, the voltage sag or swell time is less than 10ms. The components have derated criteria and have strong impact resistance. During the continuous high & low voltage ride through tests, the test equipment can withstand the exciting surge current of the transformer during transient process, meeting the test requirements of the wind power plant.



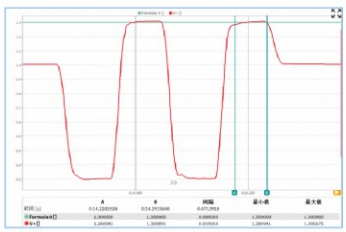
Two continuous on-load high & low voltage ride through tests

- **Stable-state voltage accuracy of on-load HVRT test ⩽2%Un**

The power supply adopts a closed loop control algorithm or a special control algorithm while simulating the behavior of grid. It has strong load adaptability and is not easy to resonance. At the same time, it reduces the overstrike in the high voltage ride through process, and the stable-state voltage accuracy of on-load high voltage ride through test is ⩽2%Un, which accurately simulates the high voltage ride through waveform.



Two consecutive
no-load high and low voltage ride-through tests
(longitudinal axis: 35kV per-unit value)



Voltage accuracy of two consecutive
on-load high and low voltage ride-through tests
(longitudinal axis: 35kV per-unit value) ⩽2%Un

- **Environmental adaptability**

The air inlet of the power supply is equipped with rainproof louvers, which can effectively prevent rainwater and dust from entering the equipment at the test site, and the overall protection grade meets the requirement of IP54. The internal components of the equipment are strictly selected to adapt to various low-temperature and high-temperature environments. The power supply can operate normally in rainy and snowy weather, sandstorm, high temperature difference and other severe environments.

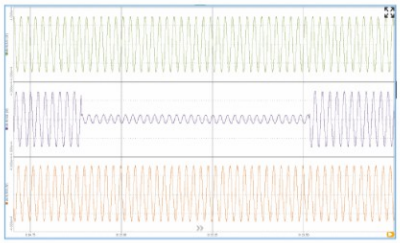
- **High seismic resistance**

The power supply is designed and arranged with high-strength containers as the carrier, and the internal structural parts are designed according to military-grade design standards, with high toughness. The whole power supply can move frequently to meet the long-term highway transportation needs, adapt to the on-site non-paved pavement and other transportation environments, and meet the outdoor field test requirements, including the use requirements in many occasions such as the coastal region and the western sandstorm region.

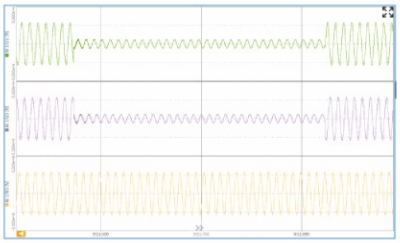
Product Function

- **Low voltage ride through (LVRT) test**

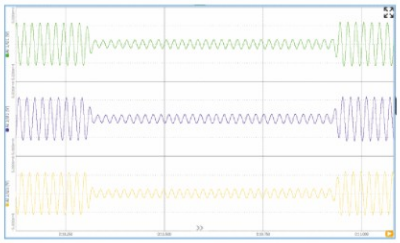
The three-phase voltage of the power output is independently settable. The initial value, target value, change time and hold time of the output voltage can be programmed to simulate the single-phase grounding short-circuit fault, two-phase short-circuit fault and three-phase short-circuit fault of the 35kV/10kV grid.



20% drop of phase B,
time: 0.625s



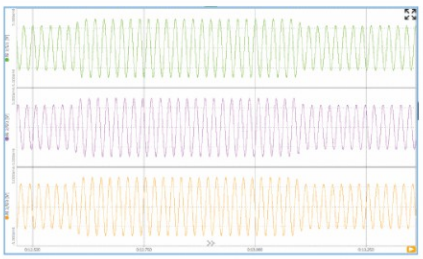
20% drop of phase A and phase B,
time: 0.625s



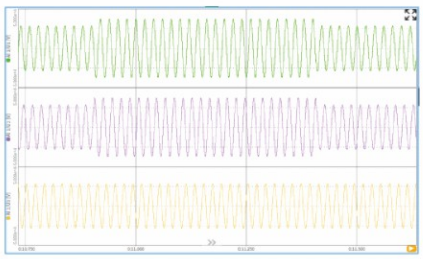
20% drop of three phases,
time: 0.625s

- **High voltage ride through (HVRT) test**

The max output voltage of the power supply reaches 45kV, and the initial value, target value, change time and hold time of the output voltage can be programmed to meet the requirement of 1.3 times high voltage ride through test of 35kV system.



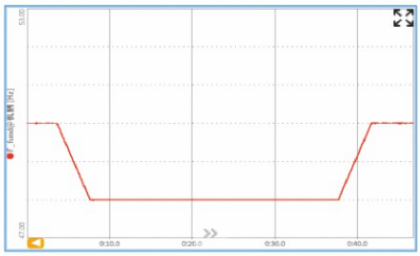
130% HV ride-through test of three phases,
time: 0.5s



130% HV ride-through test of phase A and phase B,
time: 0.5s

- **Frequency adaptability test**

The power output frequency is continuously settable from 45Hz to 65Hz, and the initial value, target value, change time and hold time of the output frequency can be programmed to meet the frequency deviation adaptability test requirements of power generation equipment and power plant.

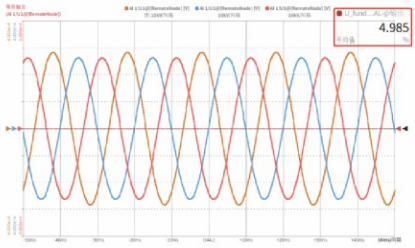


The output frequency is reduced from 50Hz to 48Hz and recovered after 30s

▪ Three-phase voltage unbalance test

The unbalanced voltage, phase information etc. are available to set on the power supply to make the output in an unbalanced state, and automatically display the unbalance factor. Additionally, It can also directly set the unbalance factor, automatically calculate and output the voltage, phase and other information with the unbalance factor to simulate the grid unbalance characteristics and according with the requirements of the three-phase voltage unbalance adaptability tests of power generation equipment and power stations.

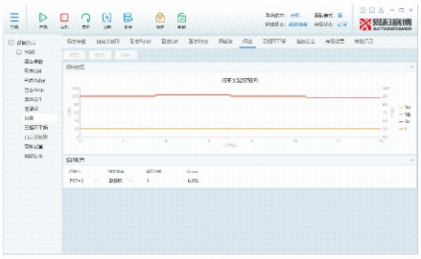
Three-phase unbalance setting interface



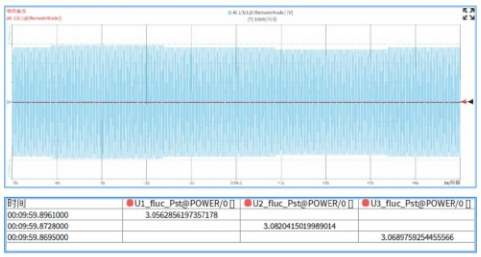
Three-phase unbalanced voltage waveform
(degree of unbalance in the upper right red box)

▪ Flicker test

The power supply can directly set the flicker level, simulate the flicker characteristics of the power grid and according with the flicker adaptability test requirements of power generation equipment and power plants.



Flicker setting interface

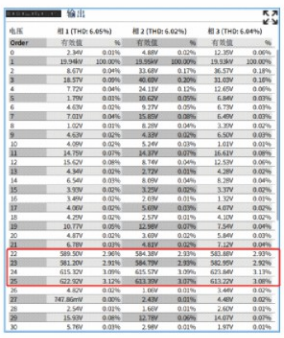


时间	U1_fluc_Pst@POWER/0	U2_fluc_Pst@POWER/0	U3_fluc_Pst@POWER/0
00:09:59.8961000	3.056285619735717 8		
00:09:59.8728000		3.082041501998901 4	
00:09:59.8695000			3.068759254455566

Flicker simulation

▪ Harmonic/inter-harmonic voltage test

The power supply allows 2-50 harmonics at the fundamental frequency of 50Hz, or synthesis 45Hz~2500Hz inter-harmonics, which can be applied to regulation IEC61000-3-2/3-12, so as to meet the harmonic/inter-harmonic voltage adaptability test requirements of power generation equipment and power plants.



电压	相 1 (THD: 6.05%)		相 2 (THD: 6.02%)		相 3 (THD: 6.04%)	
Order	有效值	%	有效值	%	有效值	%
0	1.34V	0.01%	4.88V	0.02%	12.35V	0.06%
1	19.94kV	100.00%	19.59kV	100.00%	19.53kV	100.00%
2	8.67V	0.04%	33.68V	0.17%	36.57V	0.18%
3	18.37V	0.09%	40.46V	0.20%	31.03V	0.16%
4	7.72V	0.04%	24.12V	0.12%	12.65V	0.06%
5	1.79V	0.01%	16.62V	0.09%	6.84V	0.03%
6	4.63V	0.02%	9.27V	0.05%	6.75V	0.03%
7	7.03V	0.04%	15.65V	0.08%	6.49V	0.03%
8	1.02V	0.01%	8.28V	0.04%	3.35V	0.02%
9	4.62V	0.02%	4.39V	0.02%	6.50V	0.03%
10	4.09V	0.02%	5.24V	0.03%	1.01V	0.01%
11	14.75V	0.07%	14.37V	0.07%	16.61V	0.08%
12	15.62V	0.08%	8.74V	0.04%	12.53V	0.06%
13	4.34V	0.02%	2.72V	0.01%	4.28V	0.02%
14	6.54V	0.03%	8.05V	0.04%	8.38V	0.04%
15	3.93V	0.02%	3.25V	0.02%	3.37V	0.02%
16	3.49V	0.02%	2.65V	0.01%	1.32V	0.01%
17	4.06V	0.02%	5.63V	0.03%	4.07V	0.02%
18	4.29V	0.02%	2.57V	0.01%	4.32V	0.02%
19	10.77V	0.05%	12.98V	0.07%	7.54V	0.04%
20	4.87V	0.02%	3.69V	0.02%	5.84V	0.03%
21	5.78V	0.03%	4.61V	0.02%	7.12V	0.04%
22	580.50V	2.96%	584.38V	2.93%	583.88V	2.93%
23	581.20V	2.91%	584.75V	2.93%	582.95V	2.92%
24	615.32V	3.09%	615.57V	3.09%	623.84V	3.13%
25	622.92V	3.12%	613.35V	3.07%	613.22V	3.08%
26	8.82V	0.02%	1.06V	0.01%	3.44V	0.02%
27	747.86mV	0.00%	2.42V	0.01%	4.48V	0.02%
28	2.54V	0.01%	1.66V	0.01%	2.60V	0.01%
29	15.93V	0.08%	12.79V	0.06%	14.07V	0.07%
30	5.78V	0.03%	2.98V	0.01%	1.97V	0.01%

Superposition of 22~25 harmonics,
with each harmonic content of 3%

Technical specifications

Indicators		Technical parameters
AC Output		
Voltage	VoltageU$_{L-L}$(kV)	0-45kV&0-13kV, meeting the requirements of HV ride-through tests
	Resolution(kV)	0.01
	Accuracy	±0.5% F.S.
	Type of waveform	Sine
	Voltage distortion	<1%@50Hz, 35/10kV no-load & linear load
Current	Overcurrent protection	110%@Ie maximum 60s, 110%~140%@Ie inverse time limit, 140%@Ie immediate protection
	Accuracy	±1% F.S.
Frequency	Range(Hz)	45~65
	Resolution (Hz)	0.001
	Accuracy	0.01Hz
Phase	Scope	A = 0°, B = 240°, C = 120° (default); programmable range: 0°~359.9°, independently adjustable for three phases
	Accuracy	±0.3°
	Resolution	±0.1°
Harmonic	Times	50 times @ 50Hz total harmonic content less than 10%
	Content	For 2~10 times, single harmonic content not more than 5%, total harmonic content not more than 10%;
		For 11~25 times, single harmonic content not more than 3%, total harmonic content not more than 5%;
		For 26-50 times, single harmonic content not more than 2%, total harmonic content not more than 5%.
	Range of phase angle	0°~359.9°
Interharmonic	Frequency range	45Hz~2500Hz, content <2%
	Programming steps	100
	Programming parameters	Content, start frequency, end frequency, step length, execution time, and interval time
	Editing mode	Add, delete, store, and read
Flicker	Flicker level	Pst:1~10
	Adjustment step length	1
	Accuracy	±0.2
	Preview function	Able to preview of flicker trend chart

Technical specifications

Indicators		Technical parameters
Three-phase unbalance simulation	Adjustment mode	Independently adjustable voltage and phase for three phases; or through unbalance factor by one-key
	Unbalance factor adjustment range (%)	1~100, one-key calling
	Unbalance factor adjustment step length (%)	1
	Accuracy (%)	±0.5%
High & low voltage ride-through	Mode	Able to adjust the amplitude of output voltage and settable on the single-phase/two-phase/three-phase; able to simulate the drop and rise of three-phase voltage, line to line voltage and single-phase voltage (including 35kV and 10kV voltage levels)
	Configuration parameters	Voltage, phase, rise time, hold time, trigger phase angle, and trigger pulse output
	Minimum voltage of zero voltage ride-through test	⩽+5%UN (no load)
	Minimum voltage adjustment step length	⩽1%U_N
	Steady-state voltage accuracy of HV ride-through test	⩽2%U_N
	Dynamic time	＜10ms
Programmable	Programming steps	100 steps
	Programming parameters	Voltage, frequency, phase, rise time, hold time, trigger phase angle, and trigger pulse output
	Rise time range	100μs~999s
	Flat time range	100μs~999s
	Minimum programming time step size	100μs
	Editing mode	Add, delete, store, and read
	Relevant functions	List\Step\Pulse programming, with three-phase unbalance, flicker, sag, interruption, H&LVRT etc.
Operation	Operating mode	Operation, stop, cycling with adiustable
	Trigger mode	Automatic, manual, external
Input		
	Wiring mode	Three-phase four-wire ABC+PE
	Frequency (Hz)	50±5%
	Voltage range (kV)	AC35kV±10% / AC10kV±10%
	Protection	IGBT OC, inductive peak OC, output RMS OC, OP, OV, OT

ACTIONPOWER Xi'an

Address (Xi'an): *No.12,Xinxi Ave., Hi-tech Industries Development Zone, Xi'an City, Shaanxi Province*
Sales hotline: *029-88887953*
Sales email: *sales@cnaction.com*
Company switchboard: *029-85691870、85691871、85691872*
Fax: *029-85692080*
Website: *www.cnaction.com*

ACTIONPOWER Suzhou

Address (Suzhou): *No. 590, Songhuajiang Road, Hi-tech Industries Development Zone, Suzhou City, Jiangsu Province*
Tel: *0512-66806197 transfer 8060、8061、8062*
Fax: *0512-66806198*

ACTIONPOWER
Wechat Official Account

2022.07