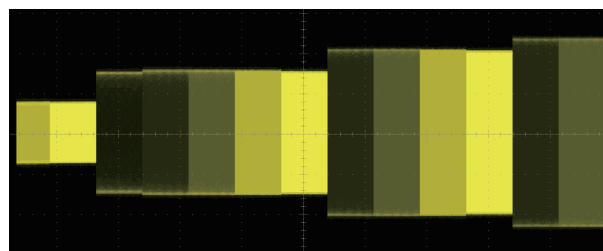
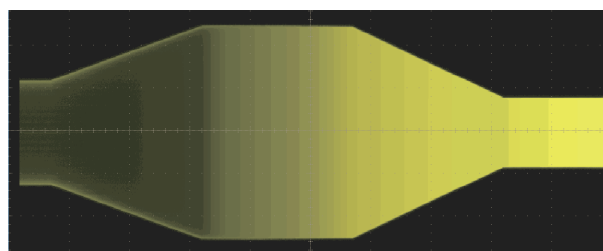
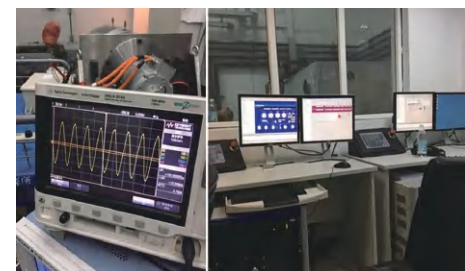


# HY-RCSU Series Ripple Coupling Device

Hangyu Power System (Shanghai) Co., Ltd.



# HY-RCSU Series Ripple Coupling Device



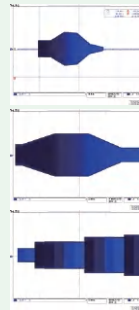
Ripple superposition testing has always been a challenge, as there is a lack of coupling devices that meet the requirements of high frequency, high voltage, and large current to simulate the actual working condition of the automotive high-voltage system in high-frequency operation, which continuously generates high voltage ripple superposition. This makes it difficult to ensure the stability of the functional state of high-voltage components in electric vehicles.

HY-RCSU series ripple coupling device, coupled with high voltage up to 1500V, coupled with high current up to 1000A, coupled with high-frequency ripple of 10-150kHz, convenient operation, efficient assistance in high-voltage component ripple superposition testing, ensuring long-term stable operation of the high-voltage system.

## Product Features

- Applicable standards: LV123、VW80303、VW80300、ISO21498-2
- Coupling voltage: 0-1500V
- Coupling current: 0-1000A
- Coupled ripple frequency: 200-150kHz/200kHz/300kHz (10-200Hz Completed by DC power supply)
- Supports front panel programming without the need for upper computer software control.

## Application Area



- EHV-08 Generated HV voltage ripple
- EHV-09 System HV voltage ripple
- EHV-13 HV service life (addenda)

## Electrical Characteristic Testing Plan

HY-PMSU Programmable multifunctional DC power supply



HY-RCSU Ripple Coupling Device



High voltage module

# HY-RCSU Product Selection And Purchase

## Product Selection Notice

Product series	Output voltage	Output current	Output broadband
HY-RCSU	300	500	100k

Selection Example:  
 Product model: HY-RCSU 300-500-100k  
 Coupling voltage 0-300V, Coupling current 0-500A,  
 Coupled ripple frequency 100kHz

## Standard Communication Interface

- LAN Ethernet communication interface
- GPIB GPIB communication interface
- IA Analog programming and monitoring interface  
(isolated type)

\*All technical indicators can only be guaranteed when the equipment runs continuously for more than 30 minutes at the specified operating temperature.

## HY-RC Product selection and parameters

### Output power 2.5kW series power supply selection

Product model	Output voltage	Output current	Output broadband
HY-RCSU 300-8.4	300V	8.4A	2.5kW
HY-RCSU 400-6.3	400V	6.3A	2.5kW
HY-RCSU 500-5	500V	5A	2.5kW
HY-RCSU 600-4.2	600V	4.2A	2.5kW

Product model	Output voltage	Output current	Output broadband
HY-RCSU 750-3.4	750V	3.4A	2.5kW
HY-RCSU 800-3.2	800V	3.2A	2.5kW
HY-RCSU 1000-2.5	1000V	2.5A	2.5kW
HY-RCSU 1500-1.7	1500V	1.7A	2.5kW

### Output power 5kW series power supply selection

Product model	Output voltage	Output current	Output broadband
HY-RCSU 300-16.7	300V	16.7A	5kW
HY-RCSU 400-12.5	400V	12.5A	5kW
HY-RCSU 500-10	500V	10A	5kW
HY-RCSU 600-8.4	600V	8.4A	5kW
HY-RCSU 750-6.7	750V	6.7A	5kW
HY-RCSU 800-6.3	800V	6.3A	5kW
HY-RCSU 1000-5	1000V	5A	5kW
HY-RCSU 1500-3.4	1500V	3.4A	5kW

### Output power 10kW series power supply selection

Product model	Output voltage	Output current	Output broadband
HY-RCSU 300-33.4	300V	33.4A	10kW
HY-RCSU 400-25	400V	25A	10kW
HY-RCSU 500-20	500V	20A	10kW
HY-RCSU 600-16.7	600V	16.7A	10kW
HY-RCSU 750-13.4	750V	13.4A	10kW
HY-RCSU 800-12.5	800V	12.5A	10kW
HY-RCSU 1000-10	1000V	10A	10kW
HY-RCSU 1500-6.7	1500V	6.7A	10kW

# HY-RCSU Product Selection And Purchase

## Output power 20kW series power supply selection

Product model	Output voltage	Output current	Output broadband
HY-RCSU 300-67	300V	67A	20kW
HY-RCSU 400-50	400V	50A	20kW
HY-RCSU 500-40	500V	40A	20kW
HY-RCSU 600-34	600V	34A	20kW
HY-RCSU 750-27	750V	27A	20kW
HY-RCSU 800-25	800V	25A	20kW
HY-RCSU 1000-20	1000V	20A	20kW
HY-RCSU 1500-13.5	1500V	13.5A	20kW

## Output power 30kW series power supply selection

Product model	Output voltage	Output current	Output broadband
HY-RCSU 300-100	300V	100A	30kW
HY-RCSU 400-75	400V	75A	30kW
HY-RCSU 500-60	500V	60A	30kW
HY-RCSU 600-50	600V	50A	30kW
HY-RCSU 750-40	750V	40A	30kW
HY-RCSU 800-38	800V	38A	30kW
HY-RCSU 1000-30	1000V	30A	30kW
HY-RCSU 1500-20	1500V	20A	30kW

## Output power 40kW series power supply selection

Product model	Output voltage	Output current	Output broadband
HY-RCSU 300-134	300V	134A	40kW
HY-RCSU 400-100	400V	100A	40kW
HY-RCSU 500-80	500V	80A	40kW
HY-RCSU 600-67	600V	67A	40kW
HY-RCSU 750-54	750V	54A	40kW
HY-RCSU 800-50	800V	50A	40kW
HY-RCSU 1000-40	1000V	40A	40kW
HY-RCSU 1500-27	1500V	27A	40kW

## Output power 50kW series power supply selection

Product model	Output voltage	Output current	Output broadband
HY-RCSU 300-167	300V	167A	50kW
HY-RCSU 400-125	400V	125A	50kW
HY-RCSU 500-100	500V	100A	50kW
HY-RCSU 600-84	600V	84A	50kW
HY-RCSU 750-67	750V	67A	50kW
HY-RCSU 800-63	800V	63A	50kW
HY-RCSU 1000-50	1000V	50A	50kW
HY-RCSU 1500-33.5	1500V	33.5A	50kW

## Output power 60kW series power supply selection

Product model	Output voltage	Output current	Output broadband
HY-RCSU 300-200	300V	200A	60kW
HY-RCSU 400-150	400V	150A	60kW
HY-RCSU 500-120	500V	120A	60kW
HY-RCSU 600-100	600V	100A	60kW
HY-RCSU 750-80	750V	80A	60kW
HY-RCSU 800-75	800V	75A	60kW
HY-RCSU 1000-60	1000V	60A	60kW
HY-RCSU 1500-40	1500V	40A	60kW

## Output power 75kW series power supply selection

Product model	Output voltage	Output current	Output broadband
HY-RCSU 300-250	300V	250A	75kW
HY-RCSU 400-188	400V	188A	75kW
HY-RCSU 500-150	500V	150A	75kW
HY-RCSU 600-125	600V	125A	75kW
HY-RCSU 750-100	750V	100A	75kW
HY-RCSU 800-94	800V	94A	75kW
HY-RCSU 1000-75	1000V	75A	75kW
HY-RCSU 1500-50	1500V	50A	75kW

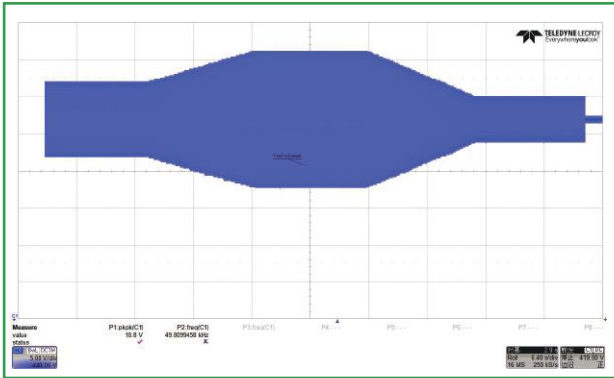
## Output power 100kW series power supply selection

Product model	Output voltage	Output current	Output broadband
HY-RCSU 300-334	300V	334A	100kW
HY-RCSU 400-250	400V	250A	100kW
HY-RCSU 500-200	500V	200A	100kW
HY-RCSU 600-167	600V	167A	100kW
HY-RCSU 750-134	750V	134A	100kW
HY-RCSU 800-125	800V	125A	100kW
HY-RCSU 1000-100	1000V	100A	100kW
HY-RCSU 1500-67	1500V	67A	100kW

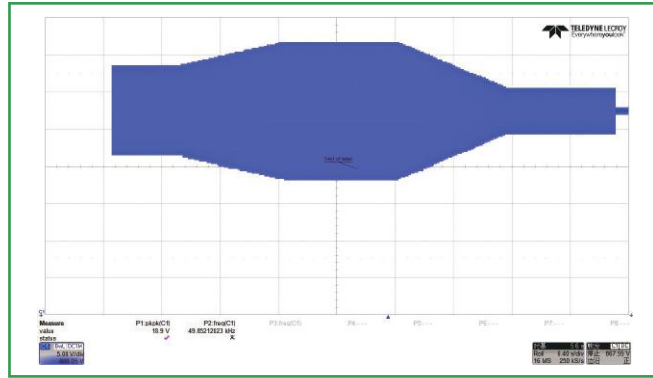
## Output power 150kW series power supply selection

Product model	Output voltage	Output current	Output broadband
HY-RCSU 300-500	300V	500A	150kW
HY-RCSU 400-375	400V	375A	150kW
HY-RCSU 500-300	500V	300A	150kW
HY-RCSU 600-250	600V	250A	150kW
HY-RCSU 750-200	750V	200A	150kW
HY-RCSU 800-188	800V	188A	150kW
HY-RCSU 1000-150	1000V	150A	150kW
HY-RCSU 1500-100	1500V	100A	150kW

## 1.6 EHV-08 Generated HV voltage ripple



450-VDC vehicle electrical system



900-VDC vehicle electrical system

**Purpose:** ■ The purpose of this test is to verify that the generated HV voltage ripple of an HV component falls within the specified limits and that its HV functional state will not change as a result of this self-generated HV ripple.

**Test:** ■ The ripple contents superimposed on the DC HV supply voltage and the DC HV supply current must be tested.

Test setup type 2 in section 4.9.2 must be used.

■ All measurement signals must be fed to a spectrum analyzer, data logger, or oscilloscope with a fast Fourier transform (FFT) function and must be evaluated.

■ In order to take different circuit topologies and power classes into account, this test must be evaluated in the time domain and in the frequency domain. The component must meet all of the requirements individually.

■ Before the test, the worst-case scenario out of the possible operating and load scenarios must be determined for each HV operating voltage. The test must then be carried out using this scenario.

■ The contractor must agree upon the worst-case scenario test with the purchaser and add it to the test plan.

■ Worst-case scenarios include, for example:

- Voltage ripple caused by hunting oscillation at low load, e.g., at 5% to 10% of the rated load
- Voltage ripple when fast control algorithms are activated, e.g., in order to damp jerking caused by mechanical vibrations in the powertrain
- Voltage ripple at maximum acceleration from stop or from a low speed
- Low-temperature operation of a duty cycle/PWM-controlled heater

■ The test must be carried out at the following HV component power levels:

- The worst-case scenario determined previously
- Idling with powertrains at 5% to 10% of the rated speed
- 25%
- 50%
- 75%
- 100%

■ For each measurement run, a spectral amplitude distribution of the HV voltage and current ripples must be generated in the form of a diagram. In this diagram, the maximum amplitude and at least the following 10 maxima, with the corresponding frequency and amplitude, must be marked as characteristic frequencies. These characteristic frequencies must be listed in a table that also specifies all relevant parameters.

■ If operation without an HV energy storage device is intended for the DUT, the entire test must additionally be run for this operating case, with the parameters adjusted accordingly.

# HY-RCSU Product Selection And Purchase

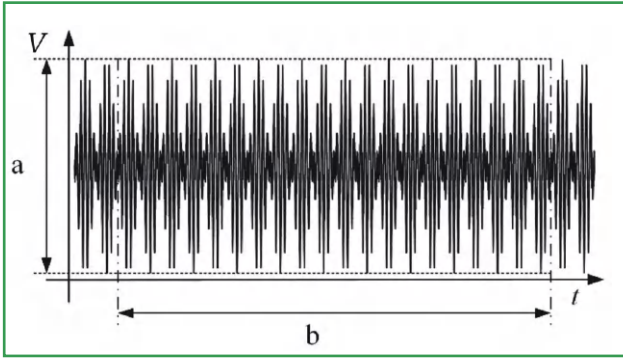


Figure 27 – Example of the measured voltage (VHV) in the time domain

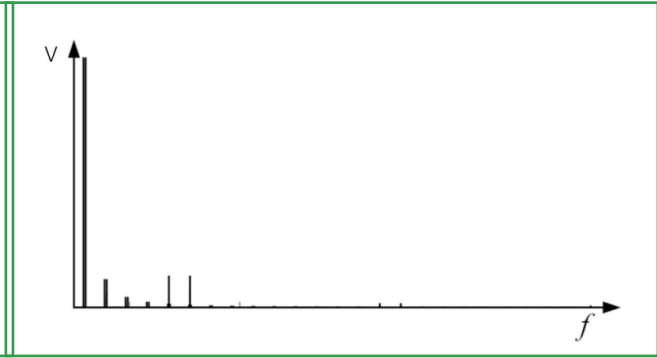


Figure 28 – Example of the measured voltage (VHV) in the frequency domain

Table 31 – Test parameters for EHV-08 Generated HV voltage ripple

DUT operating mode	Operation <sub>min</sub> and Operation <sub>max</sub>	
HV voltages	$V_{opmin,HV}, V_{N,HV}, V_{opmax,HV}$	
LV voltages	$V_{op}$	
Internal resistance of HV source	$R_{i,HV} = 100m\Omega$	
Measuring frequency range f	10Hz~150kHz	
Maximum voltage ripple up to and including the constant power output specified in the Component Performance Specification in the time domain, unless otherwise specified in the Component Performance Specification	450-VDC vehicle electrical system: 16V <sub>pp</sub> 900-VDC vehicle electrical system: 16V <sub>pp</sub>	
Short-term, maximum voltage ripple in the time domain above the constant power output (static and dynamic), unless otherwise specified in the Component Performance Specification. The permissible duration must be derived from the peak load scenarios.	450-VDC vehicle electrical system: 32V <sub>pp</sub> 900-VDC vehicle electrical system: 32V <sub>pp</sub>	
In the frequency domain, unless otherwise specified in the Component Performance Specification	450-VDC vehicle electrical system	10Hz~2kHz 10V <sub>pp</sub> 2kHz~5kHz 10V <sub>pp</sub> ~19V <sub>pp</sub> (frequency log scale) 5kHz~40kHz 19V <sub>pp</sub> 40kHz~50kHz 19V <sub>pp</sub> ~6V <sub>pp</sub> (frequency log scale) >50kHz 6V <sub>pp</sub>
	900-VDC vehicle electrical system	10Hz~2kHz 12V <sub>pp</sub> 2kHz~5kHz 12V <sub>pp</sub> ~19V <sub>pp</sub> (frequency log scale) 5kHz~40kHz 19V <sub>pp</sub> 40kHz~50kHz 19V <sub>pp</sub> ~6V <sub>pp</sub> (frequency log scale) >50kHz 6V <sub>pp</sub>
Maximum voltage ripple without HV energy storage device	The test must be carried out in generator mode with CS = 700 μF with the same maximum voltage ripple values.	
Temperatures	$T_{max}$ 与 $T_{cool,max}$ , $T_{RT}$ 与 $T_{cool}$ , $T_{mix}$ 与 $T_{cool,mix}$	
Number of cycles	3	
Number of DUTs	3	

## 1.7、 EHV-09 System HV voltage ripple

Purpose: ■ The robustness of HV components when subjected to the HV voltage ripple produced in the HV system must be verified.

NOTE 4: The test results flow into the System Performance Specification as feedback.

Test ■ An alternating voltage with a variable amplitude and frequency is superimposed on the DUT's DC HV supply voltage.

Test setup type 2 in section 4.9.2 must be used and expanded as per the diagram in figure 29.

An oscilloscope must be used to monitor the injected alternating voltage. The test parameters are specified in table 32. If the DUT is powered from the HV vehicle electrical system via a DC-DC converter, the curve for the system ripple must be agreed upon between the purchaser and the contractor on a project-specific basis.

Test case 1

■ In test case 1, the amplitude of the ripple voltage on the DUT must be set to the values specified in table 32 and readjusted, if necessary.

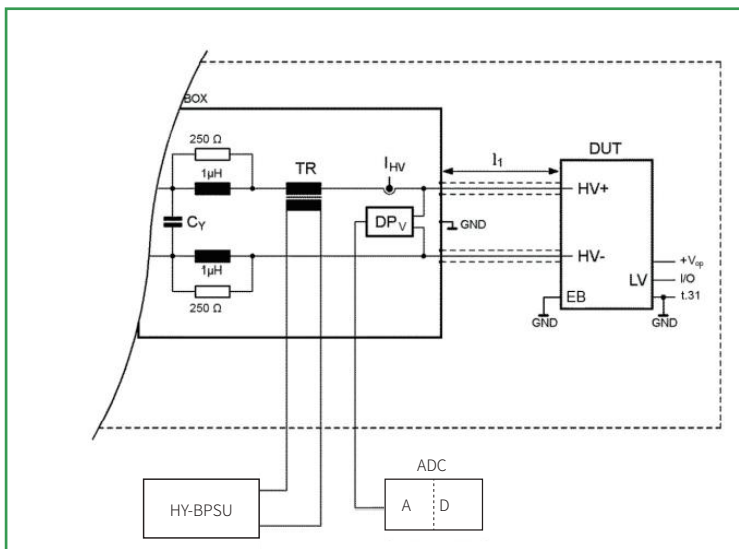
During the test, it is necessary to look out for resonance phenomena between the test setup and the DUT. All peaks and sags in the ripple content of the HV voltage and HV current in the DUT must be documented together with the corresponding frequency.

Test case 2

■ In test case 2, the amplitude of the ripple voltage on the DUT must be set to the value specified in table 32 at 1 kHz. After this, the required frequency range must be run through without any change to the injected amplitude. During this process, the amplifier is only used to correct the amplitude-frequency response of the transformer used for coupling purposes.

During the test, it is necessary to look out for resonance phenomena between the test setup and the DUT. All peaks and sags in the ripple content of the HV voltage in the DUT must be documented together with the corresponding frequency.

NOTE 5: If test case 1 showed that there is a resonance point at 1 kHz, the amplitude must be set at a frequency between 500 Hz and 1 kHz at which there is no resonance point.

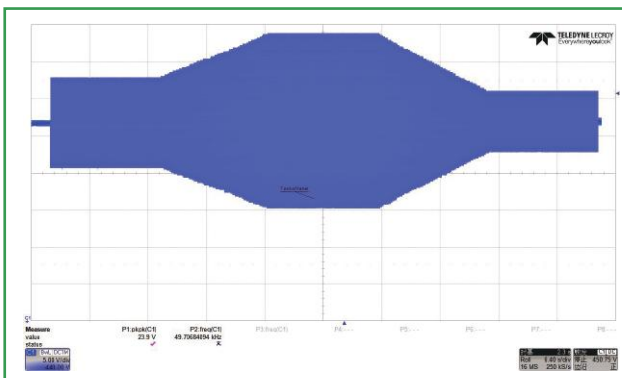


DPV : Differential probe for HV voltage measurement  
 ADC : Oscilloscope  
 TR : Transformer with wide bandwidth and high DC current-carrying capacity  
 HY-BPSU : High speed power supply for automotive electronic testing

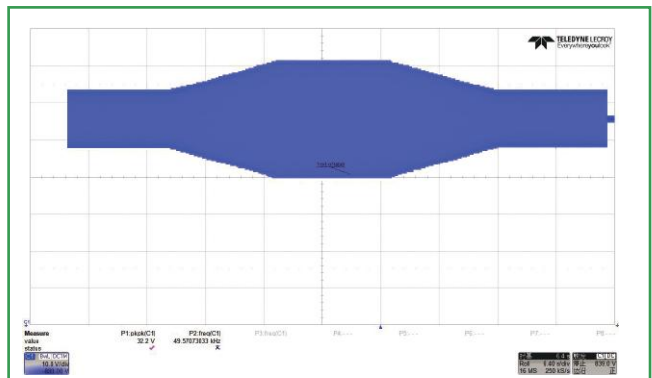
# HY-RCSU Product Selection And Purchase

Table 32 – Test parameters for EHV-09 System HV voltage ripple

DUT operating mode		Operation <sub>min</sub> and Operation <sub>max</sub>
HV voltages	Test case 1	$V_{opmin}, V_{N.HV}, V_{opmax.HV}$
	Test case 2	$V_{N.HV}$
LV voltages		$V_{op}$
Internal resistance of HV source		$R_{i.HV}=100m\Omega$
Power limiting		AC current limiting: The applied current must be limited to a maximum of 100 A, unless otherwise defined in the Component Performance Specification.
Voltage waveform		Sinusoidal
Increment		10Hz (80Hz~1kHz) 100Hz (1kHz~10kHz) 1kHz (10kHz~150kHz)
Test duration per frequency increment		> 2s- but at least as long as required for all measured values to be recorded
Test case 1 Voltage ripple	450-VDC vehicle electrical system	80Hz~1kHz 12V <sub>pp</sub> 1kHz~5kHz 12V <sub>pp</sub> ~24V <sub>pp</sub> (frequency log scale) 5kHz~40kHz 24V <sub>pp</sub> 40kHz~50kHz 24V <sub>pp</sub> ~8V <sub>pp</sub> (frequency log scale) >50kHz 8V <sub>pp</sub>
	900-VDC vehicle electrical system	80Hz~1kHz 15V <sub>pp</sub> 1kHz~5kHz 15V <sub>pp</sub> ~32V <sub>pp</sub> (frequency log scale) 5kHz~40kHz 32V <sub>pp</sub> 40kHz~50kHz 32V <sub>pp</sub> ~15V <sub>pp</sub> (frequency log scale) >50kHz 15V <sub>pp</sub>
Test case 1 Resonance test		Voltage ripple amplitude :4 V <sub>pp</sub> at 1 kHz Frequency range :80 Hz to 150 kHz
Temperatures	Test case 1	$T_{max}$ 与 $T_{cool,max}$ , $T_{RT}$ 与 $T_{cool}$ , $T_{mix}$ 与 $T_{cool,mix}$ ‘
	Test case 2	$T_{RT}$ 与 $T_{cool}$
Number of cycles		3
Number of DUTs	Test case 1	3
	Test case 2	1



450-VDC vehicle electrical system



900-VDC vehicle electrical system



# HY-RCSU Product Selection And Purchase

## 1.10 EHV-13 HV service life (additional)

Purpose: ■ As a result of existing HV voltage ripples and HV voltage dynamics, HV components are subject to a load that has an influence on the required service life. This test uses accelerated loading on the components that represents the load during the entire vehicle service life.

Test: ■ In addition to test L-02 "High-temperature durability service life test" in VW 80000, the following applies: Test setup type 2 in section 4.9.2 must be used and expanded as per diagram figure 29.

1 cycle = computed total test time / 50

The test must be carried out as per the parameters in table 37.

In each cycle, the HV voltage ripple to which the DUT must be subjected must be set as per table 38.

For each HV voltage ripple, the frequencies must be distributed evenly as per figure 35.

Table 37 – Test parameters for EHV-13 HV service life (additional)

DUT operating mode	Operation <sub>max</sub>
V <sub>S,HV</sub> HV voltages	$V_{N,HV} + V_{VPP,HV}$
HV voltages	$V_{op}$
Internal resistance of HV source	100mΩ
Voltage waveform	Sinusoidal
Number of cycles	50次

Proportion	450-VDC	900-VDC	Frequencies
85%	3V <sub>pp</sub>	5V <sub>pp</sub>	200Hz/5kHz/10kHz/20kHz/40kHz
12%	6V <sub>pp</sub>	9V <sub>pp</sub>	200Hz/5kHz/10kHz/20kHz/40kHz
2%	8V <sub>pp</sub>	12V <sub>pp</sub>	5kHz/10kHz/20kHz/40kHz
1%	9V <sub>pp</sub>	14V <sub>pp</sub>	5kHz/10kHz/20kHz

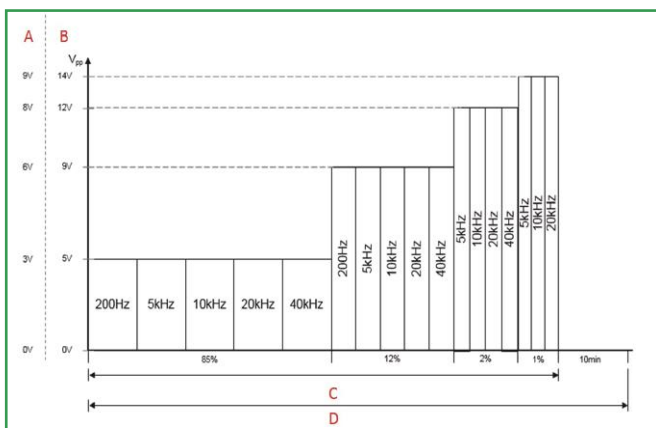


Figure 35 – Cycle description with frequency distribution

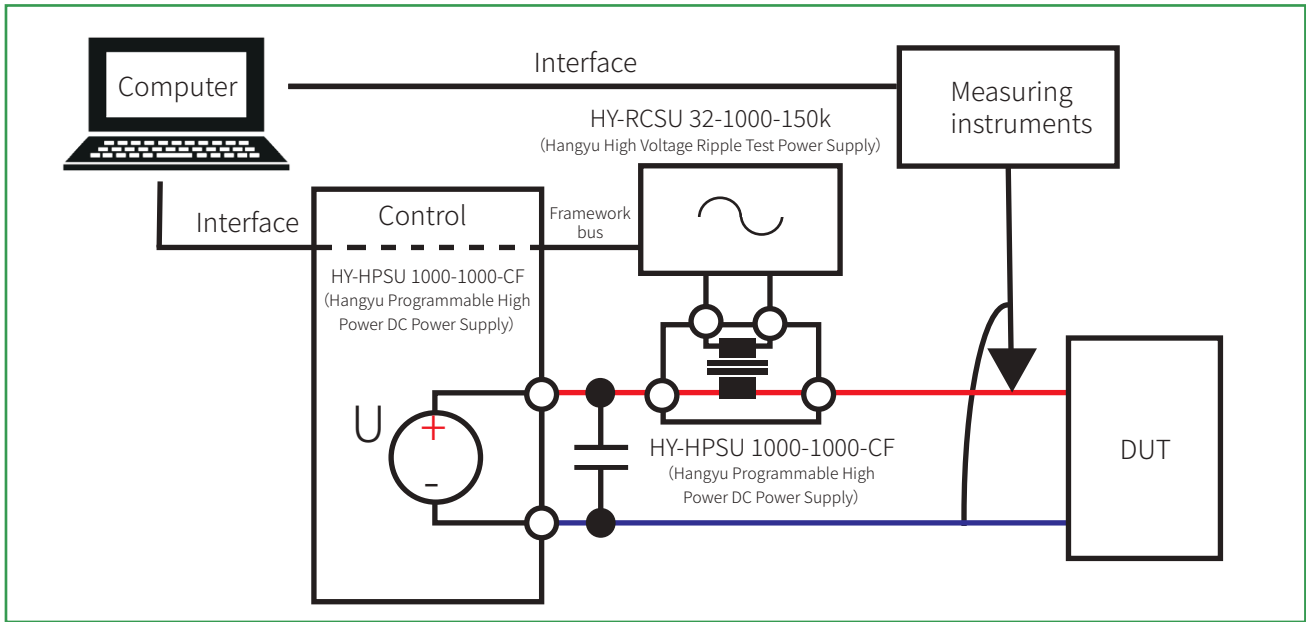
A 450-V DC vehicle electrical system

B 900-VDC vehicle electrical system

C 1/50 (-10 min) of total test duration (Arrhenius model)

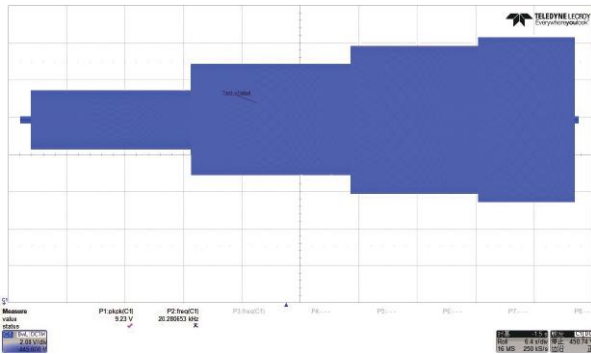
D 1 cycle

# HY-RCSU Product Selection And Purchase

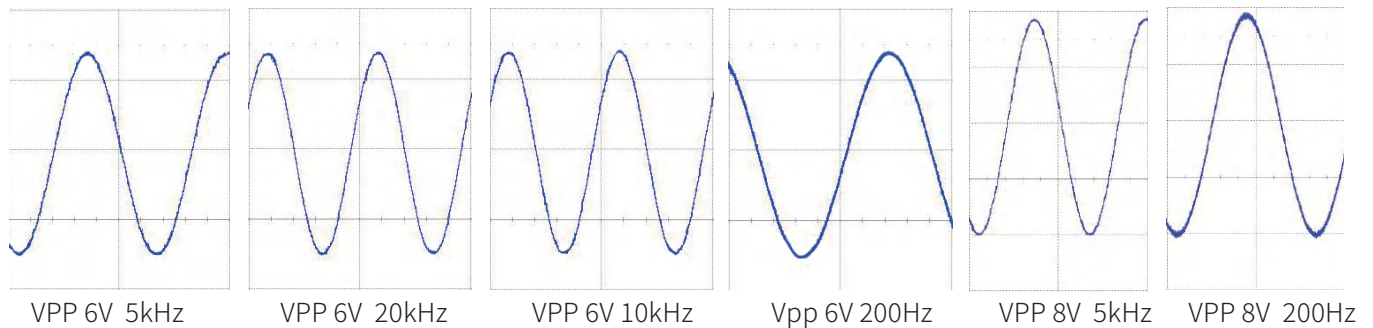
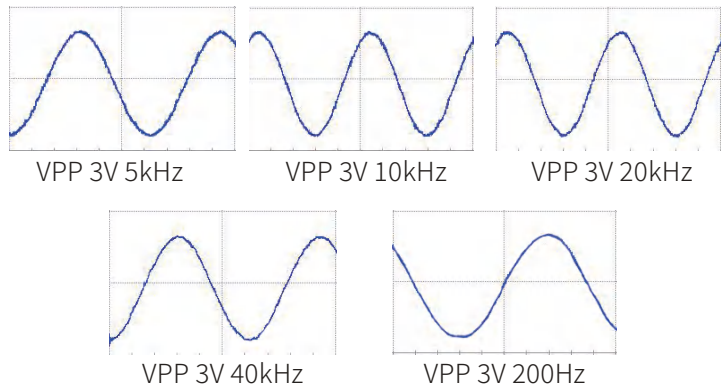


Implementation testing schematic diagram

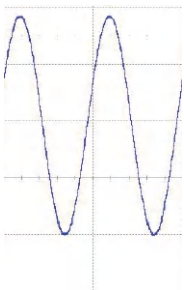
VW 80000, L-02 “High temperature durability service life test” actual waveform measurement.



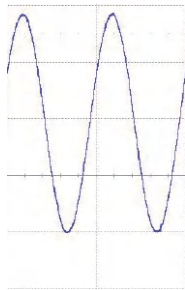
DC450V envelope line



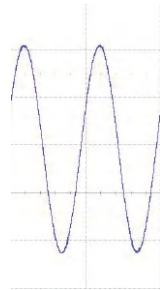
# HY-RCSU Product Selection And Purchase



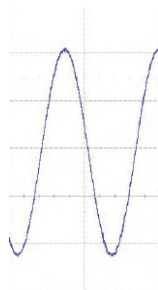
VPP 8V 10kHz



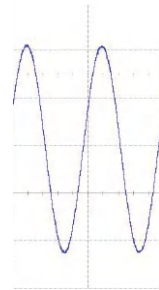
VPP 8V 20kHz



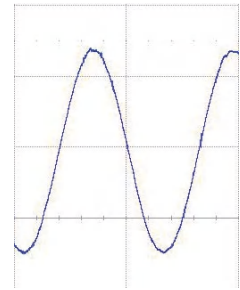
VPP 9V 20kHz



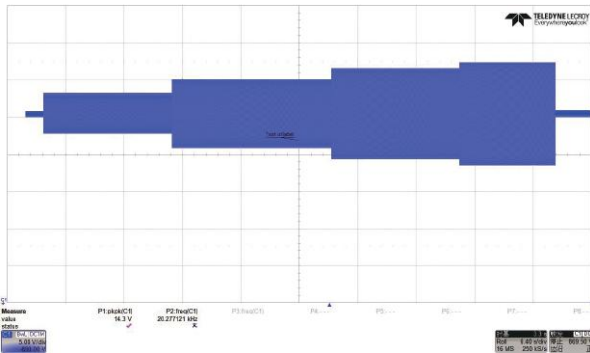
VPP 9V 5kHz



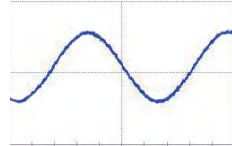
VPP 9V 10kHz



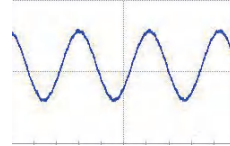
Vpp6V 40kHz



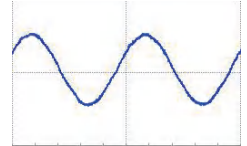
DC900V envelope line



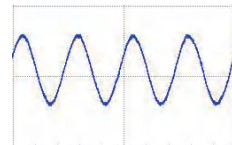
VPP 5V 5kHz



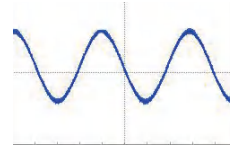
VPP 5V 10kHz



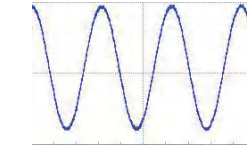
VPP 5V 20kHz



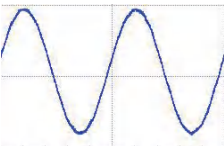
VPP 5V 40kHz



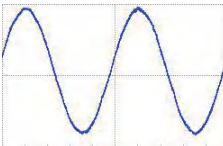
VPP 5V 200Hz



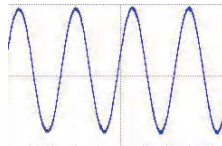
VPP 9V 5kHz



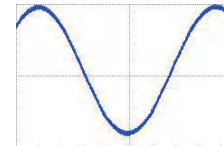
VPP 9V 10kHz



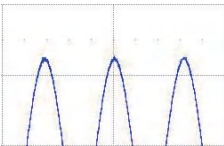
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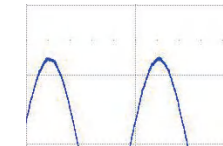
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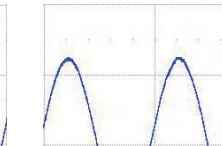
VPP 9V 200Hz



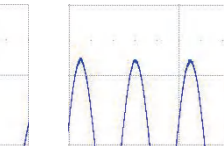
VPP 12V 5kHz



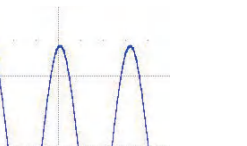
VPP 12V 10kHz



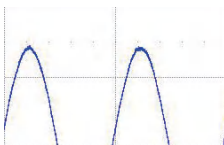
VPP 12V 20kHz



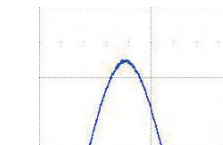
VPP 12V 40kHz



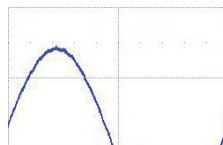
VPP 14V 5kHz



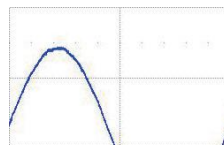
VPP 14V 20kHz



VPP 12V 5kHz



VPP 14V 5kHz



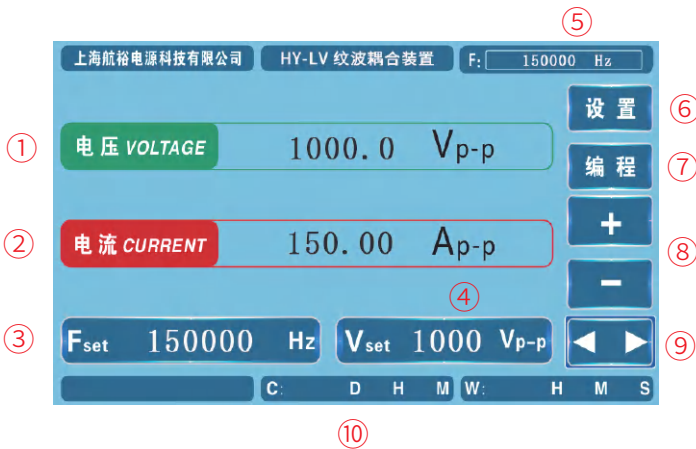
VPP 14V 10kHz

## Appearance and Display



## Control Panel Description

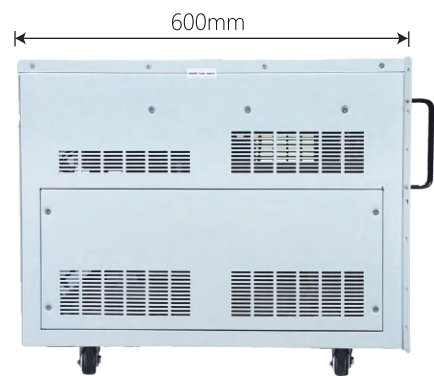
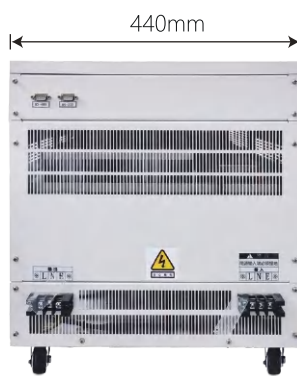
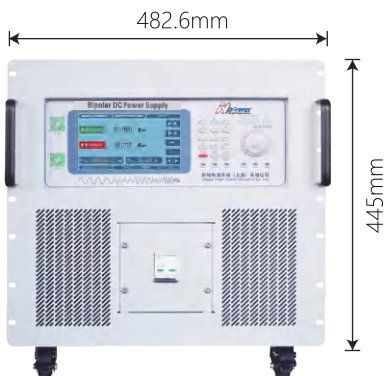
- 1、 Power input circuit breaker;
- 2、 7-inch LCD display window display:  
Set value of coupling voltage and current, measured value of coupling voltage and current Function Settings Menu;
- 3、 Function keys:  
Used for required numerical input and parameter settings;
- 4、 Coupling voltage/current setting key
- 5、 Shift Function reuse key
- 6、 Status
- 7、 Chassis handle
- 8、 Multistage shuttle adjustment knob, inner circle adjusts one word at a time, outer circle The circle is divided into  $\pm 8$  adjustable segments;
- 9、 Lock, Enter to confirm, Esc to exit Local Reset restart/Alarm, Output ON/OFF switch
- 10、 19 inch standard rack mounting holes



## Display Description

- 1、 Coupling voltage measurement value display;
- 2、 Display of coupling current measurement value;
- 3、 Display of coupling ripple frequency setting value;
- 4、 Display of coupling voltage setting value;
- 5、 Coupling ripple frequency measurement value display;
- 6、 Set menu button for setting system parameters;
- 7、 Programming button, used to set parameters during programming, click to enter step Programming interfaces such as steps, gradients, etc;
- 8、 Quickly increase or decrease voltage and current values during editing;
- 9、 When entering numerical values, you can shift them left and right, select the option that needs to be modified Number of;
- 10、 Current time and working time display.

10U 440(W)\*600(D)\*445(H)mm



# HY-RCSU Series Model And Size

18U 600(W)\*800(D)\*920(H)mm



24U 600(W)\*800(D)\*1190(H)mm  
30U 600(W)\*800(D)\*1453(H)mm  
36U 600(W)\*800(D)\*1718(H)mm



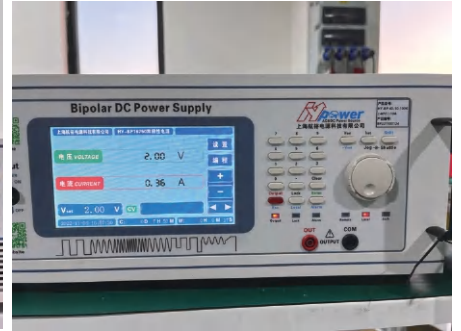
Customer Cases (Partial)



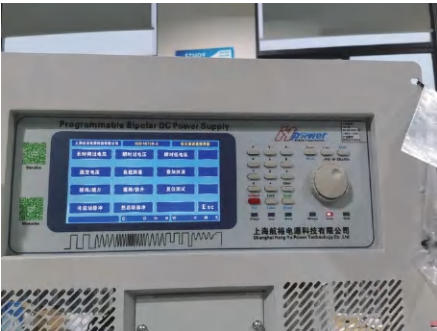
China FAW



Valeo



BYD



Zhejiang Tiancheng



Shanghai Zhefu Intelligent



Beijing Minmo Zhixing



BMW



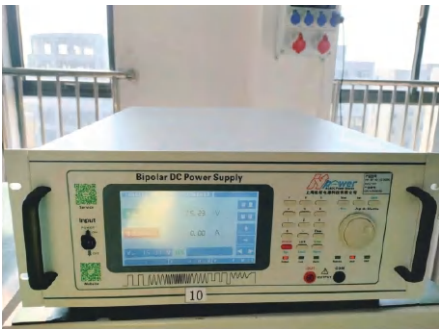
NIO



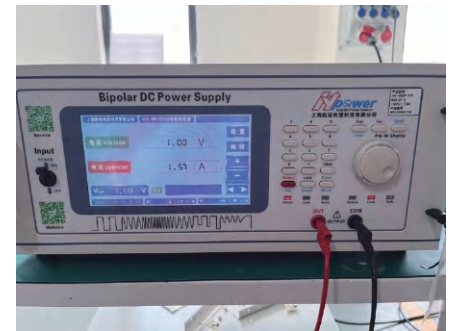
Xiaomi Motors



Tianhua Lighting



Rothwell



Inovance



Official WeChat:hypower-cn



## Contact us

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Hangyu Power Automotive Electronic Testing Solution Manual, Version 05.00, February 2024

All technical data and instructions are based on the actual product

If there are any changes, Hangyu Power has the final interpretation right

Authorized dealer:

