



## PW466i

# Protective Relay Test Set

PONOVO POWER CO., LTD.  
[www.ponovo.net](http://www.ponovo.net)





## PW466i Protective Relay Test Set



PW466i protective relay test set is an economic model with 6 current channels and 6 voltage channels, capable of automatic testing different kinds of protection relays, such as distance, overcurrent, frequency, directional, time inversed, line-differential, differential relay easily without changing cable connection. It's the ideal test device

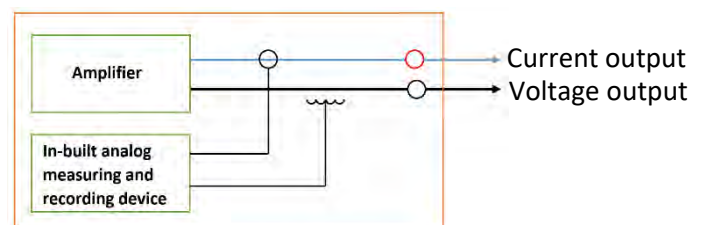
for all power utilities, power plants, relay manufacturers, panel manufacturers, research institutes, universities, testing companies, etc.

### Product Features

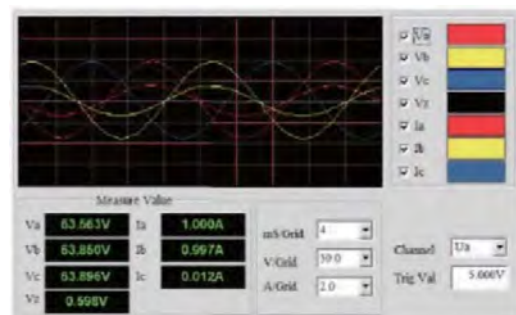
- 6×20A, 6×150V
- Auxiliary DC Power Supply (0-300V)
- 8 binary inputs, 4 binary outputs
- Adjustable threshold (0-400V) for binary inputs or potential free
- In-built analog monitoring and recording function
- Can support the test of IEC61850 complied relay with GOOSE
- More than 500 relay templates offered freely to do automatic testings
- Support importing setting value of relays via CSV, RIO, XRIO, and PONOVO's Powertest default set files automatically into relay templates

#### ➤ In-Built Analog Monitoring & Recording Unit

- ❖ This in-built analog monitoring and recording unit samples the actual current/voltage outputs and real-time output waveform can be displayed in the software.
- ❖ This makes it easy to check the correctness of wiring before the test and observe the output during the test process.



Principle



#### ➤ Real-Time Outputs Display

- ❖ Real-time output waveform display helps the fast troubleshooting of wiring and test circuitry before test actual started.
- ❖ User can also use this provision to analyze the external signals, such as phase angle, power, harmonic, etc.

#### ➤ IEC 61850 Function

- ❖ PW466i provides analog voltage/current signal to relay and the GOOSE message from relay is received and analyzed by relay test equipment.

#### Protection relay



## Application

### Relay test

- Distance protection relay
- Differential protection relay
- Directional relay
- Current relay
- Voltage relay and frequency relay, etc.



### Measuring and control device

- Synchronizer
- Auto-reclosing, etc.



### System simulation

- Transient, permanent fault simulation
- Playback of COMTRADE format file

### Calibration

- 0.5 Class energy meter
- Disturbance recorder
- Indicating meters, etc.

## Test functions according to IEEE relay code

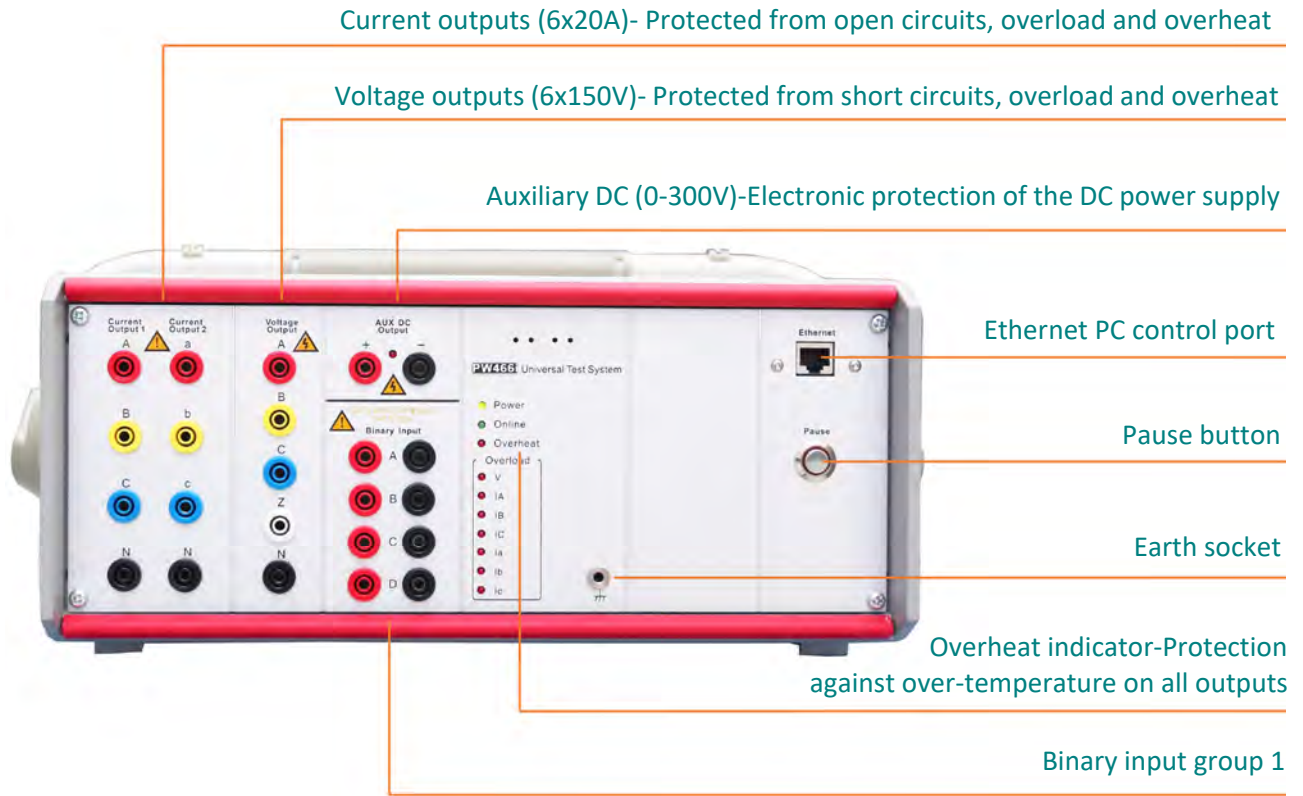
### IEEE. NO. DEVICE

2	Time Delay Starting or Closing Relay
21	Distance Relay
24	Volts per Hertz Relay
25	Synchronizing or Synchronism-Check Device
27/27N	Undervoltage Relay
30	Annunciator Relay
32	Directional Power Relay
36	Polarity or Polarizing Voltage Devices
37	Undercurrent or Underpower Relay
40	Field (over/under excitation) Relay
46	Reverse phase or Phase-Balance Current Relay
47	Phase-sequence or phase-balance voltage relay
50/50N	Instantaneous Overcurrent
51/51N	AC Time Overcurrent Relay
52	AC Circuit Breaker
53	Field Excitation Relay
55	Power Factor Relay
56	Field Application Relay
58	Rectification failure relay
59/59N	Overvoltage Relay
60	Voltage or Current Balance Relay

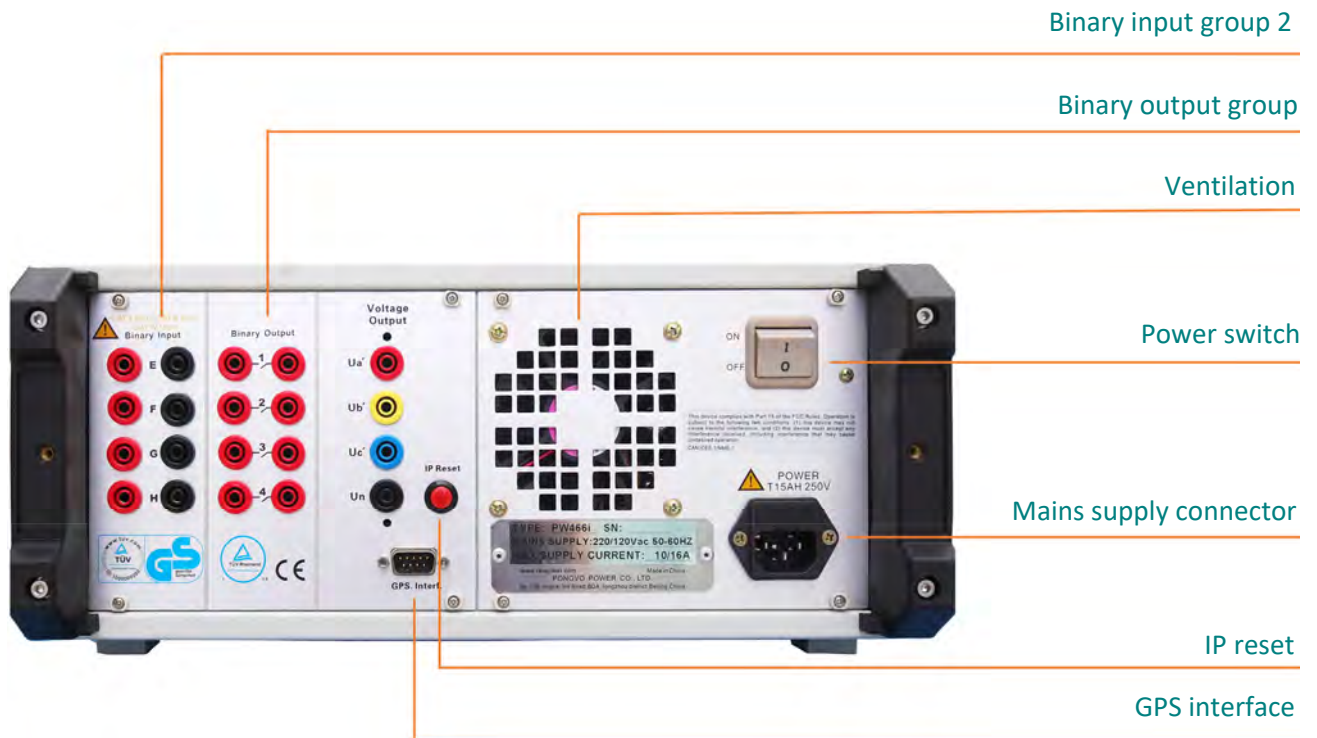
### IEEE. NO. DEVICE

61	Density switch or sensor
62	Time-Delay Stopping or Opening Relay
64	Ground Detector Relay
67/67N	AC Directional Overcurrent Relay
68	Blocking or "out of step" Relay
74	Alarm Relay
76	DC Overcurrent Relay
78	Phase-Angle Measuring Relay
79	AC-Reclosing Relay
81/81U/O/R	Frequency Relay
82	DC load-measuring reclosing relay
85	Carrier or pilot-receiver relay
86	Lock-out relay
87	Differential Protective Relay
91	Voltage Directional Relay
92	Voltage and Power Directional Relay
94	Trip Relay
Other Functions (Optional)	IEC61850 Energy meter

## Front Panel



## Rear Panel



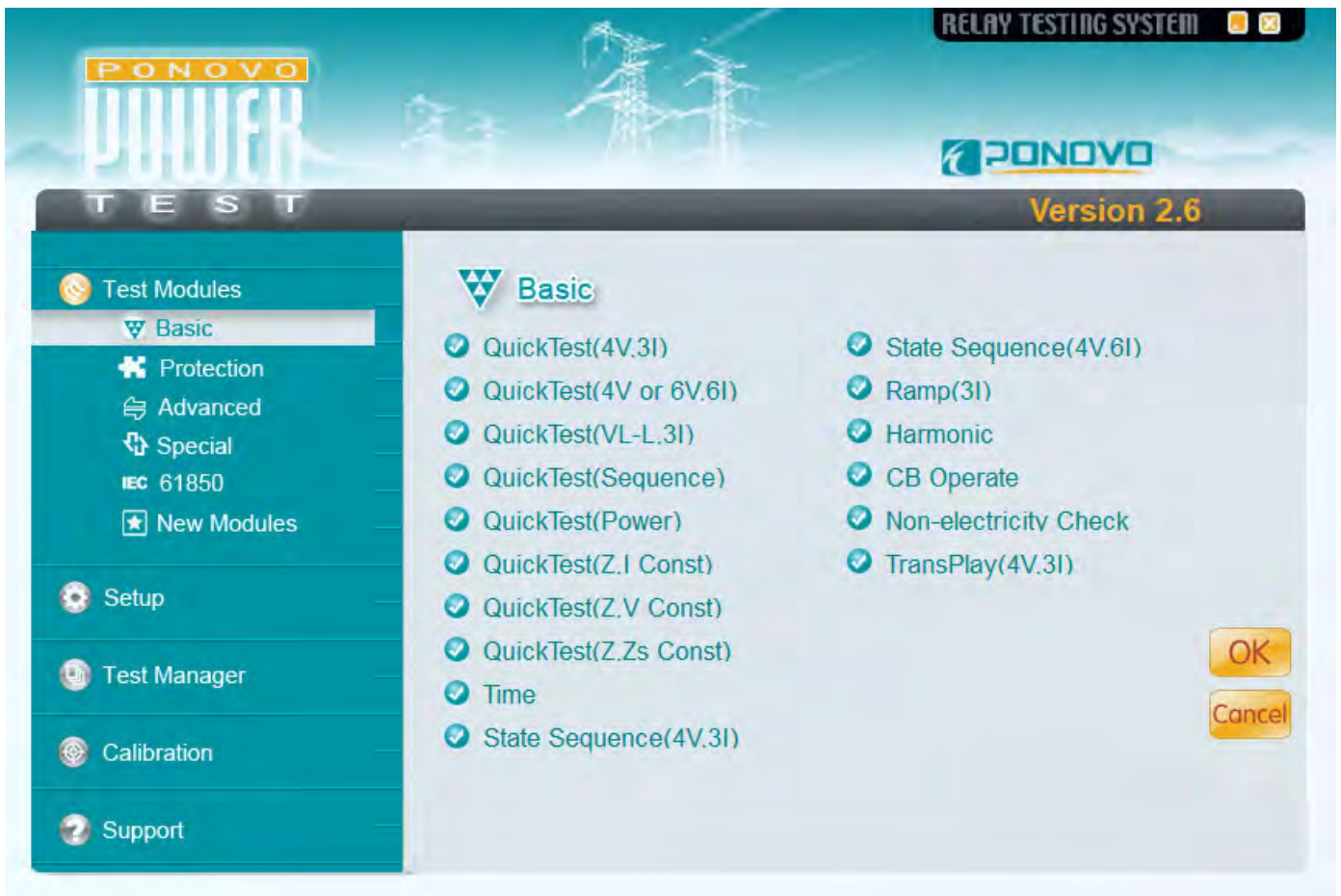


## PowerTest - Relay Test Set Software

For all the three phase or six phase relay testers of PONOVO, one universal software can be used, the name is **PowerTest** software. PowerTest is a relay test software that includes different test packages, the **Basic** package, **Protection** package, **Advanced** package, **Special** package, **New Modules**, which packages includes different testing module, that can be used for all kinds of relay testing, and it also has the special package for more testing application, such as energy meter, etc.

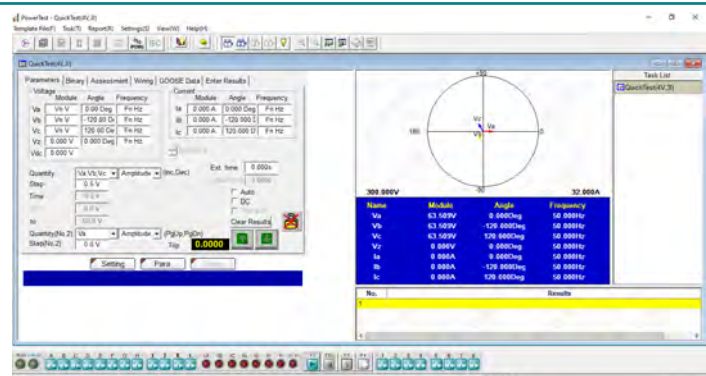
### ➤ Basic Package

In the **Basic** package, there are different Quick Test modules, Time module, State Sequence, Ramp, Harmonic, CB Operation, Non-electricity Check, and TransPlay for playing back the comtrade file.



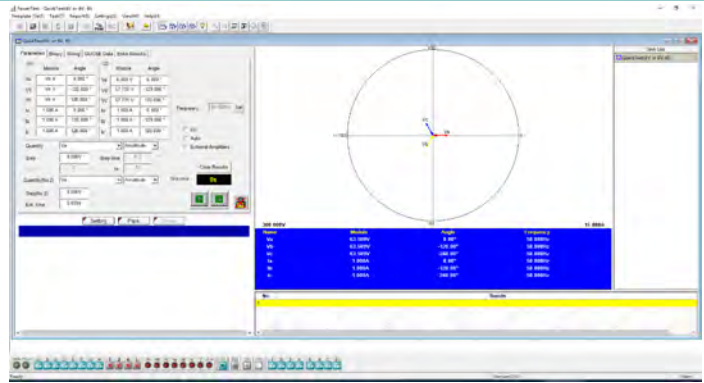
### QuickTest (4V. 3I)

- ❖ 4 voltage and 3 current sources available for test relay
- ❖ Amplitude, phase angle and frequency of voltage and current sources can be controlled independently
- ❖ Test can be in manual or auto mode



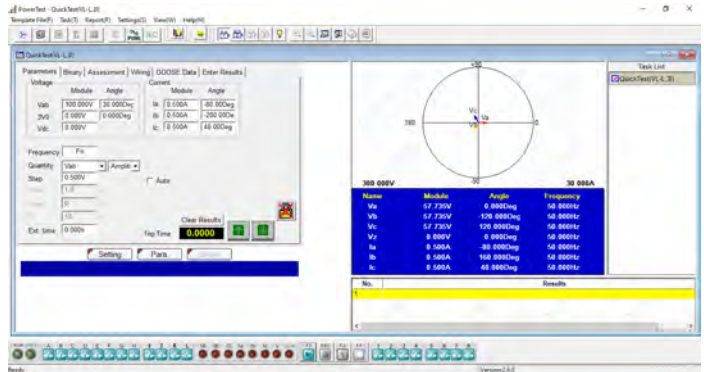
## QuickTest (4V or 6V, 6I)

- ❖ 4 voltage or 6 voltages and 6 current sources available for test relay
- ❖ Amplitude, phase angle and frequency of voltage and current sources can be controlled independently
- ❖ Test can be in manual or auto mode



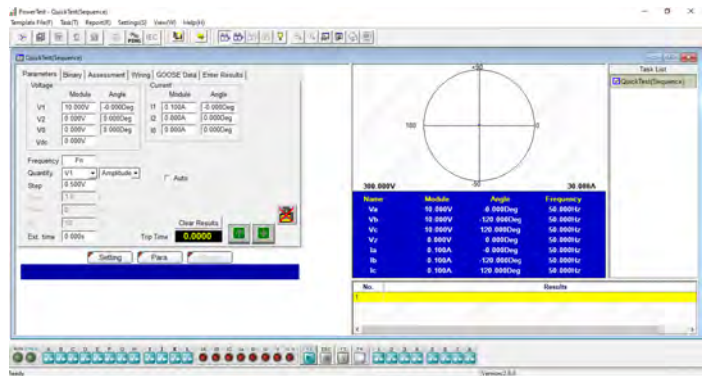
## QuickTest (VL-L, 3I)

- ❖ Easy to control the phase-phase voltage, 3V0 (zero sequence voltage) and 3 currents
- ❖ Amplitude, phase angle and frequency of current sources and phase-phase voltage, zero sequence voltage can be controlled independently
- ❖ Test can be in manual or auto mode



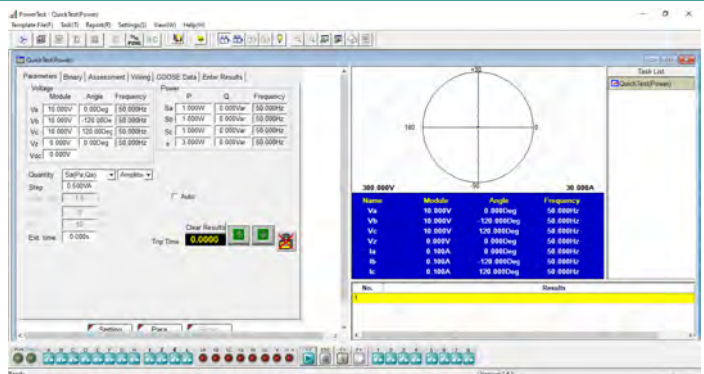
## QuickTest (Sequence)

- ❖ Easy to control the sequence components (positive sequence, negative sequence and zero sequence) for voltage and current
- ❖ Amplitude and phase angle of the sequence components of voltage and current can be controlled independently
- ❖ Test can be in manual or auto mode



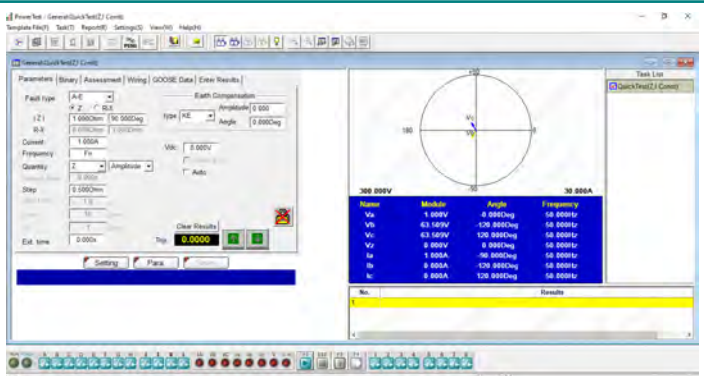
## QuickTest (Power)

- ❖ Easy to control the output of power, including active power, reactive power and apparent power
- ❖ Amplitude of active power, reactive power and apparent power can be controlled independently
- ❖ Test can be in manual or auto mode



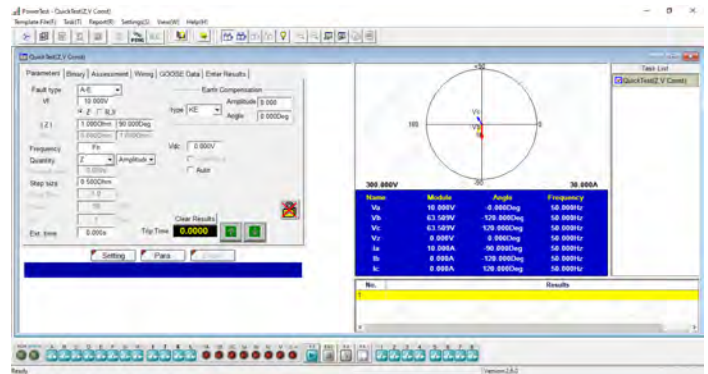
## QuickTest (Z, I Const)

- ❖ Easy to test impedance relay with constant current
- ❖ Set the fault impedance and fault current, obtain the amplitude and phase angle of each phase voltage and current according to the fault type
- ❖ Can manually or automatic search the relay operation value



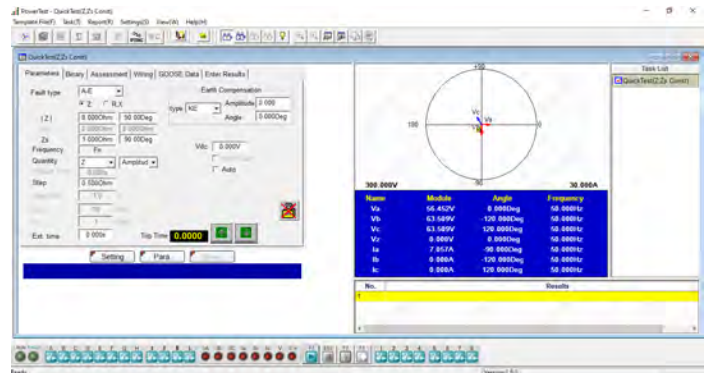
## QuickTest (Z, V Const)

- ❖ Easy to test impedance relay with constant voltage
- ❖ Set the fault impedance and fault voltage, obtain the amplitude and phase angle of each phase voltage and current according to the fault type
- ❖ Can manually or automatic search the relay operation value



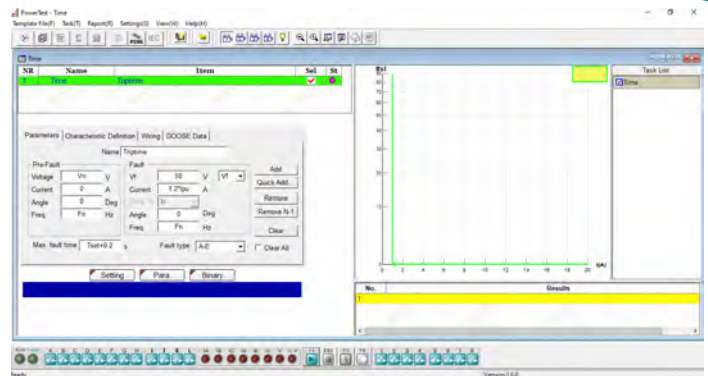
## QuickTest (Z, Zs Const)

- ❖ Easy to test impedance relay with constant system impedance
- ❖ Set the fault impedance and system impedance, obtain the amplitude and phase angle of each phase voltage and current according to the fault type
- ❖ Can manually or automatic search the relay operation value



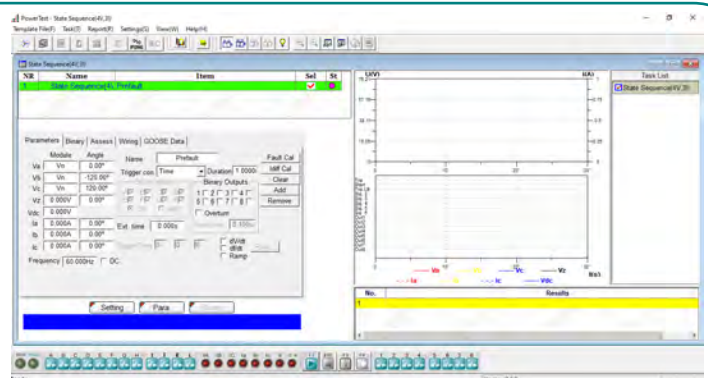
## Time

- ❖ Time module is used to test trip delay time of protection relay
- ❖ Various value can be set separately, such as pick up value, delay time, pre-fault time, post-fault time, binary input/output, the voltage and current at pre-fault and fault state, characteristic definition, etc.



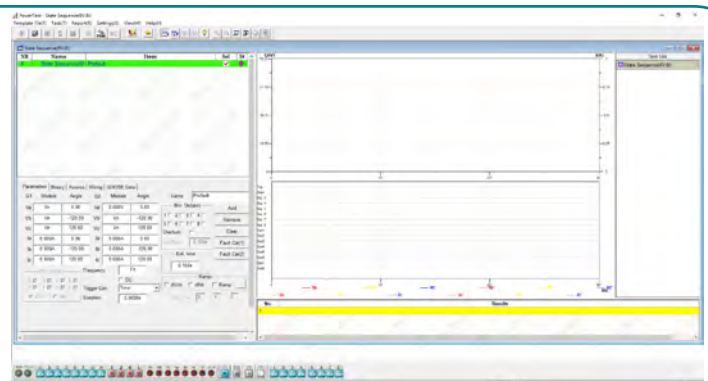
## State Sequence (4V, 3I)

- ❖ Used to define multiple continuous state sequences for special test applications, such as generate a series of states to test the tripping time and close time
- ❖ 4 voltage and 3 current sources available for each state
- ❖ Trigger condition in each state can be set separately



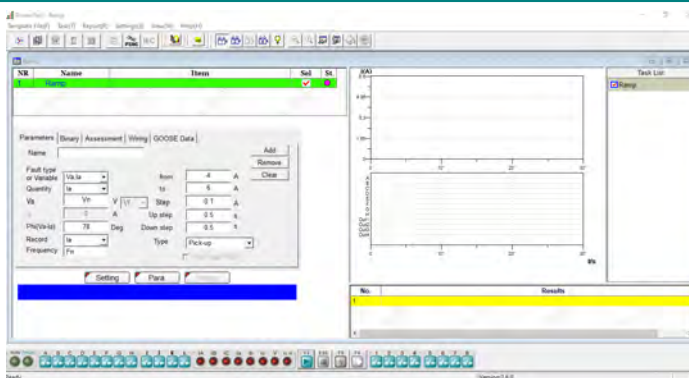
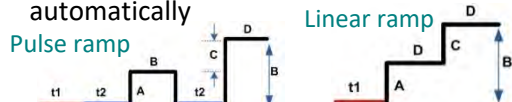
## State Sequence (4V, 6I)

- ❖ Used to define multiple continuous state sequences for special test applications, such as generate a series of states to test the tripping time and close time
- ❖ 4 voltage or 6 voltage and 6 current sources available for each state
- ❖ Trigger condition in each state can be set separately



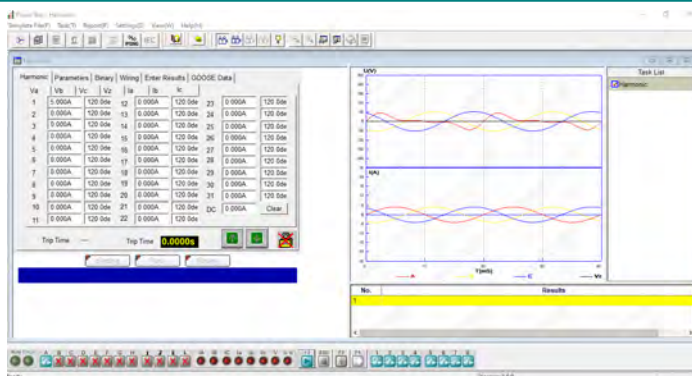
## Ramp (3I)

- ❖ Specially designed to realize RAMP for different test applications, such as pick up/drop off value checking, directional relay testing, maximum torque angle checking etc.
- ❖ Both pulse ramp and linear ramp available
- ❖ Can search the relay operation value automatically



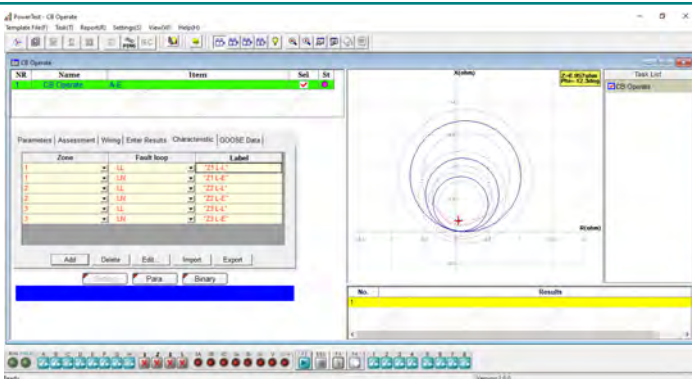
## Harmonic

- ❖ Can generate harmonics for all voltage and current outputs
- ❖ Can check the 2<sup>nd</sup> /3<sup>rd</sup> / 4<sup>th</sup> /5<sup>th</sup> harmonic restraint of current differential
- ❖ Can check the harmonic measurement of the relay up to 31<sup>st</sup> harmonic
- ❖ Can set the harmonic for each channel separately



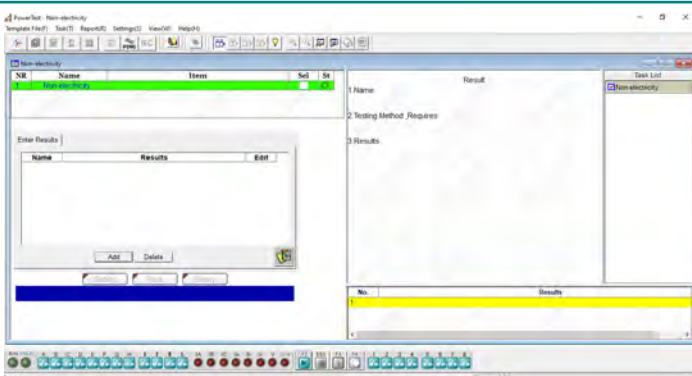
## CB Operate

- ❖ Can check different types of line protection system, including over current, distance, etc.
- ❖ Can check the whole relay system, including auto-reclosing and circuit breaker simulate
- ❖ Can set different fault type
- ❖ Can do end-to-end test with GPS control mode



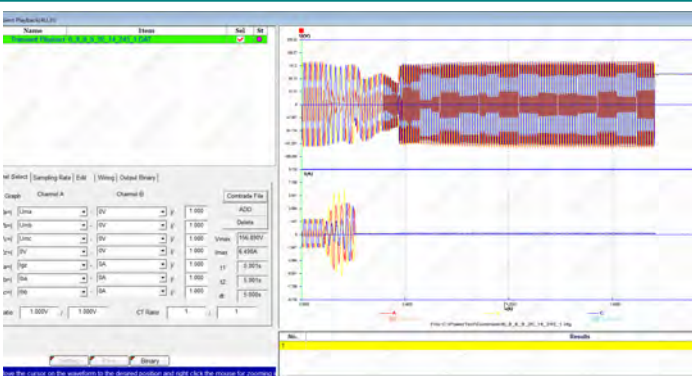
## Non-electricity

- ❖ Give tips before and after testings to have test scheme prepared well and finished well
- ❖ Neither has any output value nor judge the binary input. It only generates a complete report for project check from appearance and safety.



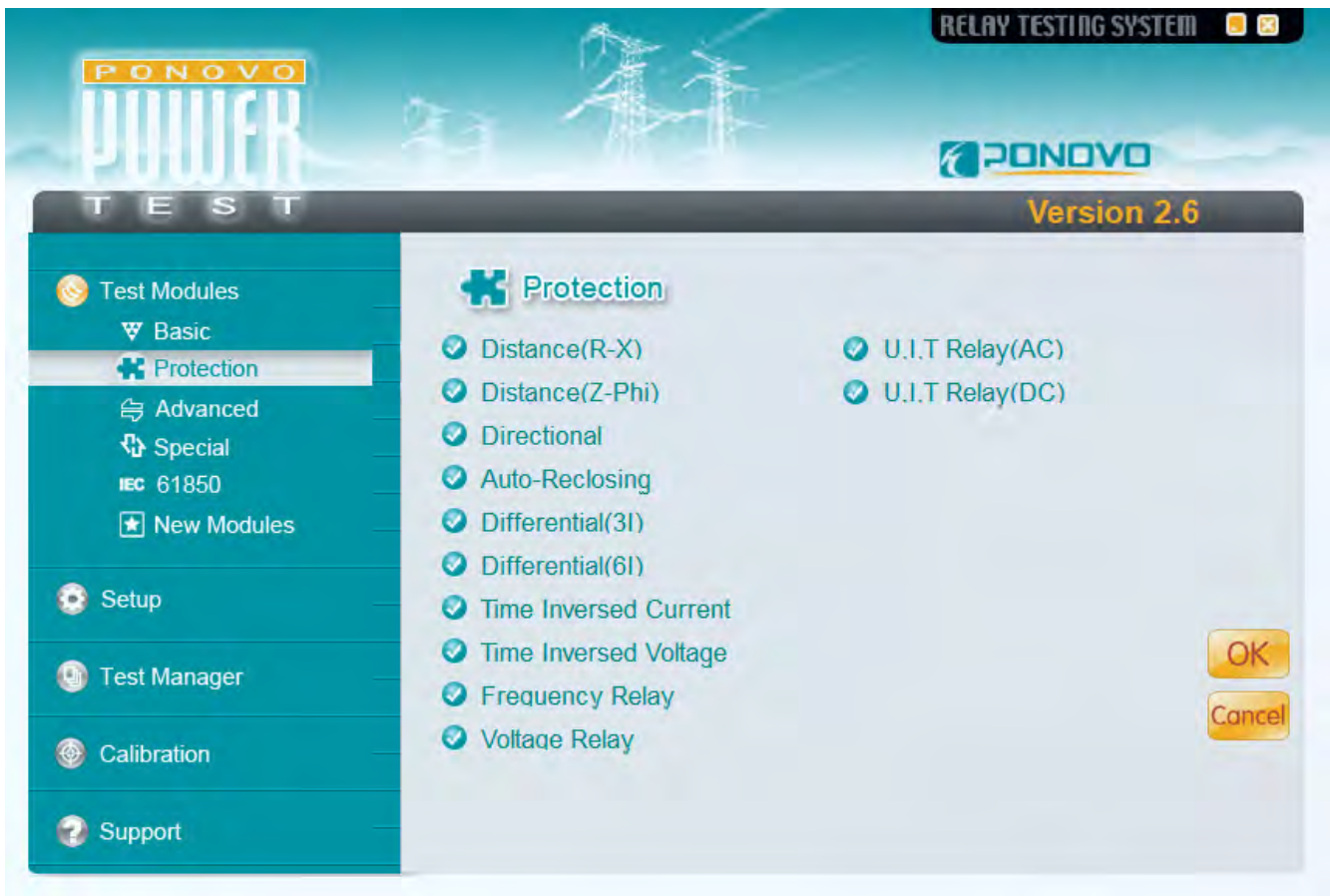
## Transient Playback (4V,3I)

- ❖ Can play back the COMTRADE format file which records 4 voltage channels and 3 current channels
- ❖ Display the waveform and data of the imported COMTRADE file



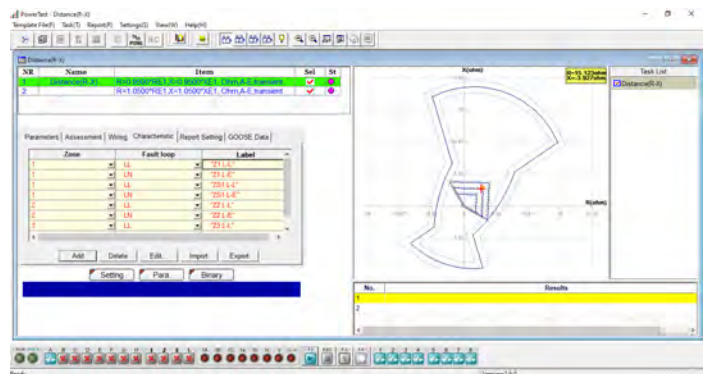
## ➤ Protection Package

In protection package, there are more testing modules for relay's characteristics testings, such as Distance, Differential, Directional, Time Inversed Current, Time Inversed Voltage, Frequency, Auto-Reclosing etc.



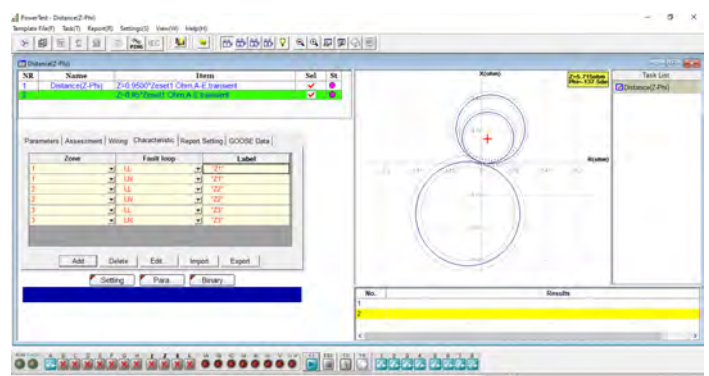
### Distance (R-X)

- ❖ Can test impedance relay with R-X setting in different ways
- ❖ Input impedance characteristic to Z plain
- ❖ Associate the characteristic with relay settings
- ❖ Select test point/ items directly on Z plain or in setting box
- ❖ Zone verification
- ❖ Z-T test
- ❖ Edit new characteristic



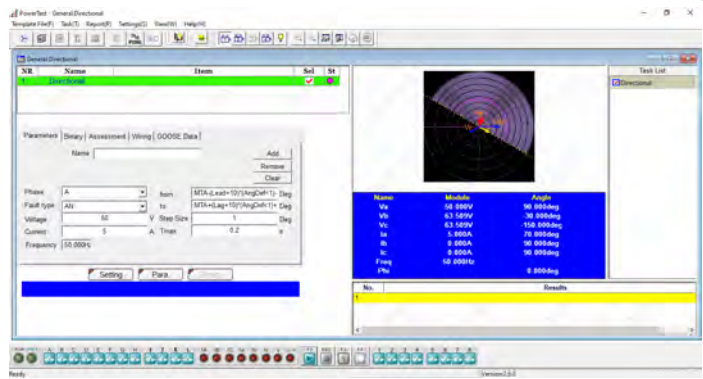
### Distance (Z-Phi)

- ❖ Can test impedance relay with Z-Phi setting in different ways
- ❖ Input impedance characteristic to Z plain
- ❖ Associate the characteristic with relay settings
- ❖ Select test point/ items directly on Z plain or in setting box
- ❖ Zone verification
- ❖ Z-T test
- ❖ Edit new characteristic



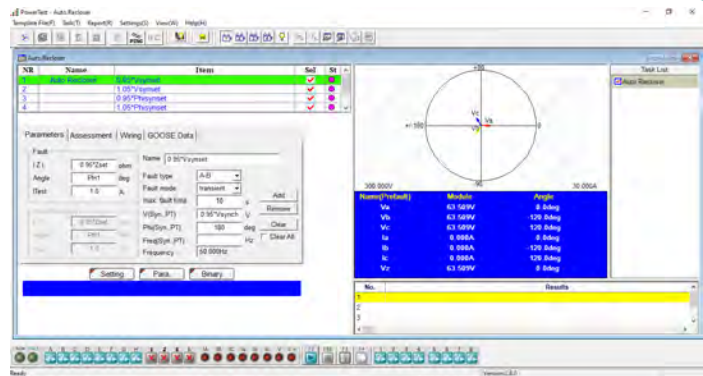
## Directional

- ❖ Can search maximum torque angle and two boundary angles (Lead and lag angles)
- ❖ Can set angle define, V lead I or I lead V
- ❖ Can set fault type, single phase, phase-phase or three phase fault



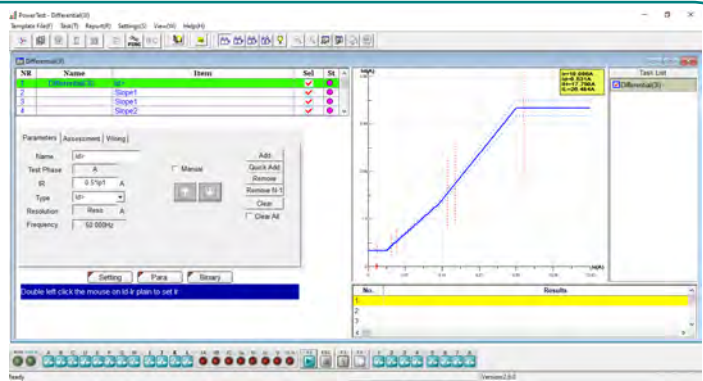
## Auto-Reclosing

- ❖ Can test the reclose function
- ❖ Realize relay automatic reclosing with checking the difference between two systems, checking the synchronization setting, reclose set time checking and automatic evaluating of testing results.



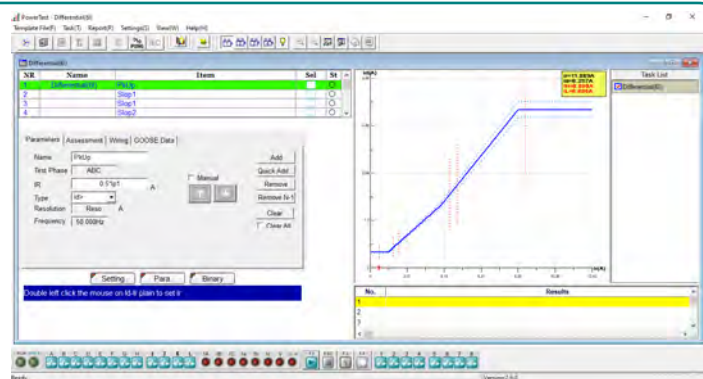
## Differential (3I)

- ❖ Can search out the percentage restraint curve, harmonic restraint, trip time for single phase fault
- ❖ Can search the percentage restraint curve
- ❖ Can check 2<sup>nd</sup> harmonic restraint
- ❖ Can check 3<sup>rd</sup> harmonic restraint
- ❖ Can check 5<sup>th</sup> harmonic restraint
- ❖ Can check tripping time of set points



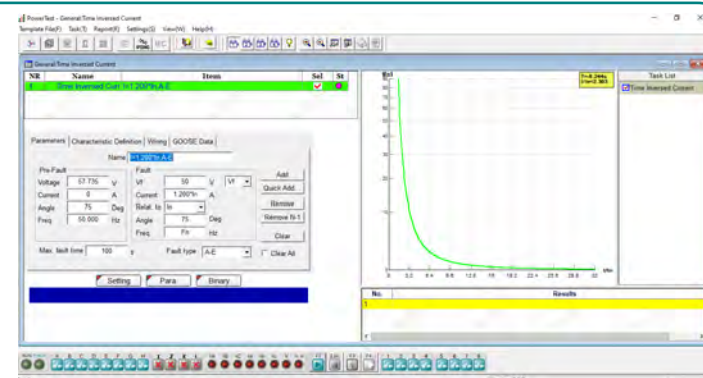
## Differential (6I)

- ❖ Suitable for 6 output current channels' relay tester, such as transformer, generator and bus bar etc. differential protection equipment test
- ❖ Realize the two sides 3 phase/phase-phase/single phase test between relay tester and relay equipment.
- ❖ Can search the percentage restraint curve, harmonic restraint, trip time



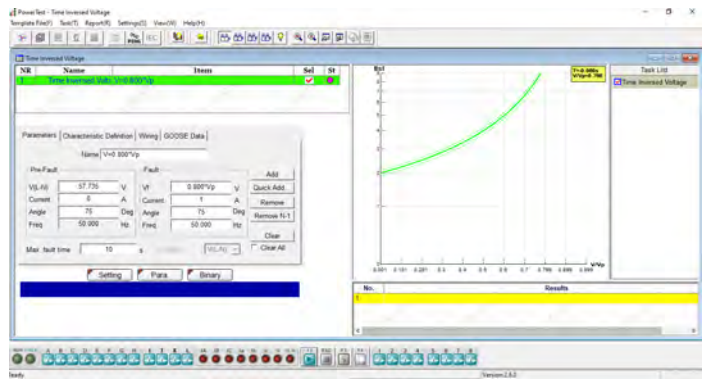
## Time Inversed Current

- ❖ Realize the directional over-current test and non-directional over-current test
- ❖ Include testing positive sequence, negative sequence and zero sequence inverse-time over-current, definite-time over-current, over-heat protection.
- ❖ Can import the IEC and IEEE standard curve or user defined curve



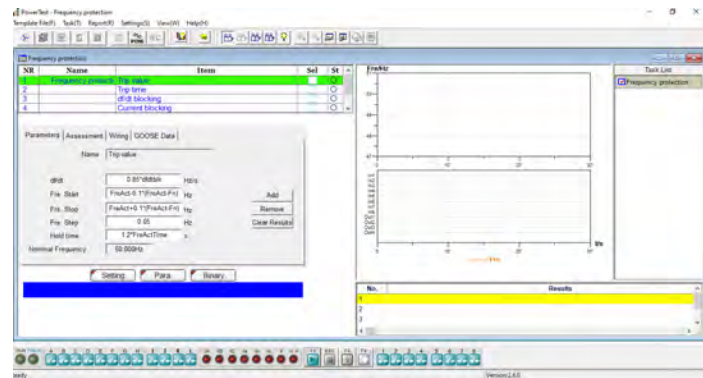
## Time Inversed Voltage

- ❖ Can test time inversed over voltage and time inverse under voltage relay
- ❖ Include testing directional, time definite and with time delay voltage relay
- ❖ Can simulate three phase, phase-earth fault, and phase-phase fault



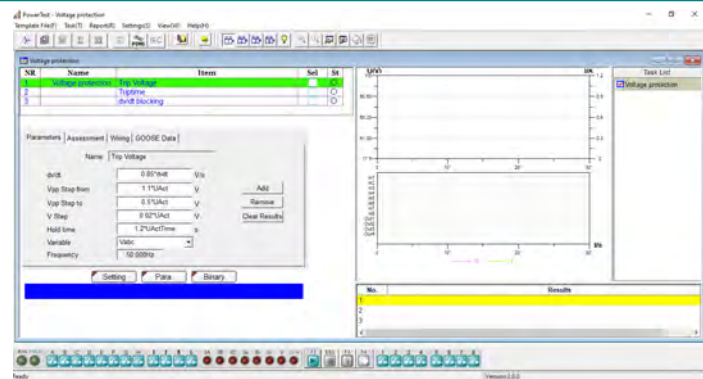
## Frequency Relay

- ❖ Can test frequency protection relay, such as over frequency, under frequency, df/dt trip, df/dt blocking
- ❖ Including pick up frequency, trip time, df/dt setting value, voltage blocking value and current blocking value test



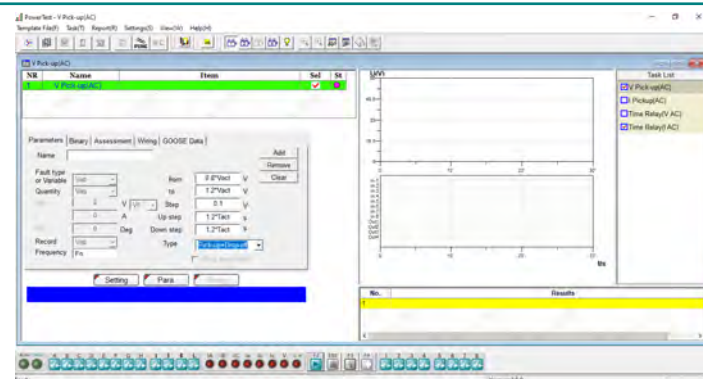
## Voltage Relay

- ❖ Can test voltage protection relay including under voltage and over voltage
- ❖ Can test pick up voltage, trip time and dv/dt setting value



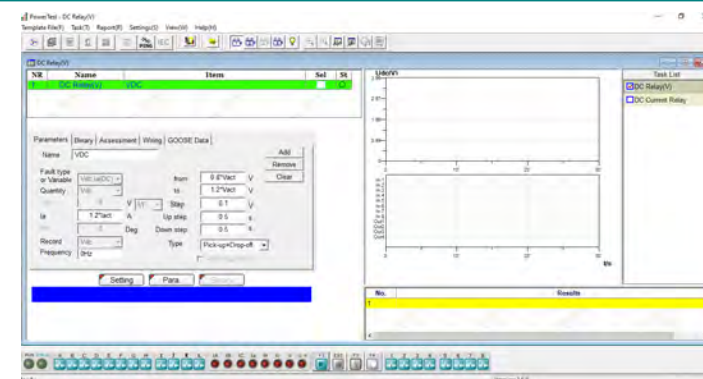
## U. I. T Relay (AC)

- ❖ Can test AC type auxiliary/intermediate relay and AC type time relay
- ❖ Can test AC voltage type electromagnetic relay
- ❖ Can test AC current type electromagnetic relay
- ❖ Can test electromagnetic time relay picked-up by AC voltage
- ❖ Can test electromagnetic time relay picked-up by AC current



## U. I. T Relay (DC)

- ❖ Can test DC type voltage relay. Auxiliary DC source Vdc is used for this test. Also DC current can be generated for some relays when it is required.
- ❖ Can test DC type current relay. Current source is used for this test. DC voltage can be generated for some relays when it is required.



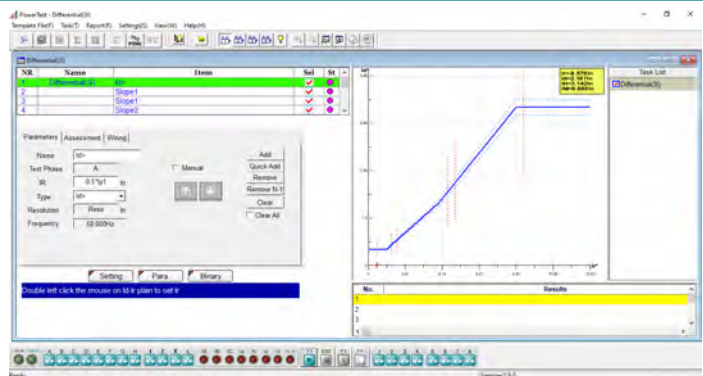
## ➤ Advanced Package

In the advanced package, the centralization testing the RX Characteristic Sweep, testing for distance relay, Advanced Differential, Advanced Transplay, Synchronization, etc.



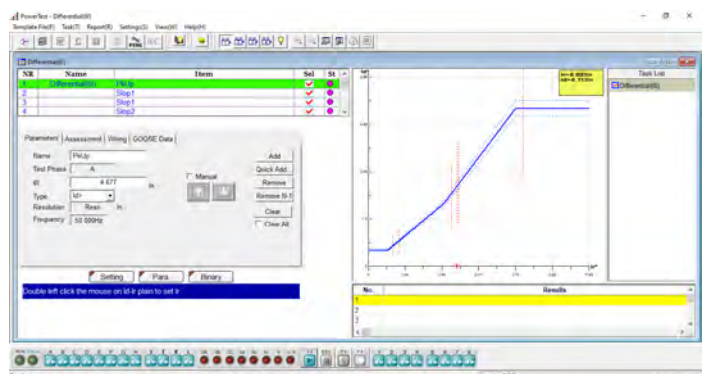
### Advanced Differential (3I)

- ❖ Can search the percentage restraint curve, harmonic restraint, trip time for single phase fault
- ❖ Can automatic to calculate the matching factor via the transformer parameter and CT/PT parameter
- ❖ Only check single phase fault



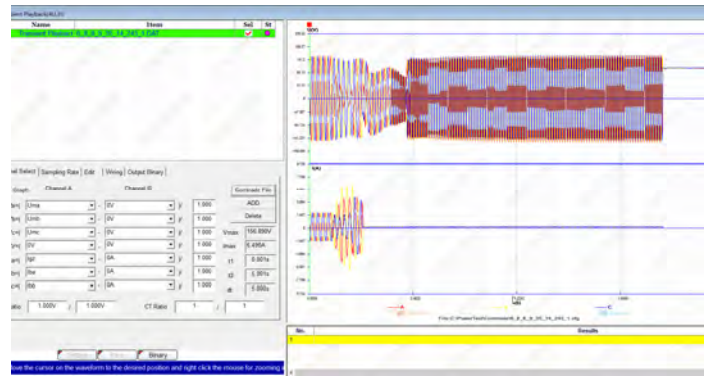
### Advanced Differential (6I)

- ❖ Can search the percentage restraint curve, harmonic restraint, trip time
- ❖ Can automatic to calculate the matching factor via the transformer parameter and CT/PT parameter
- ❖ Can test single phase, phase-phase, three-phase fault



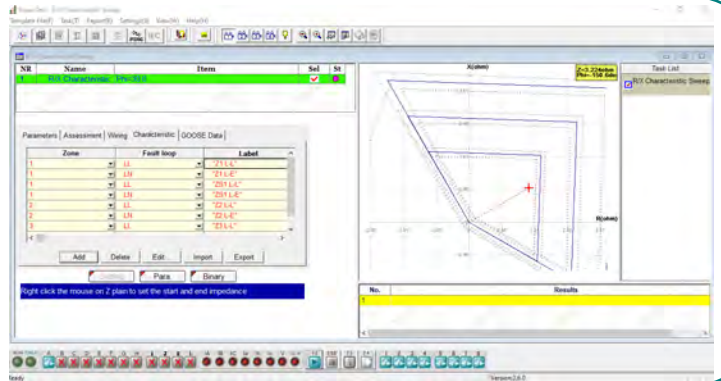
## Advanced TransPlay(4V,3I)

- ❖ Can play back the COMTRADE format file, including CFG, which describe signal names, sampling frequencies, etc. and DAT which contains the sampling values for each channel.
- ❖ Can edit the COMTRADE data



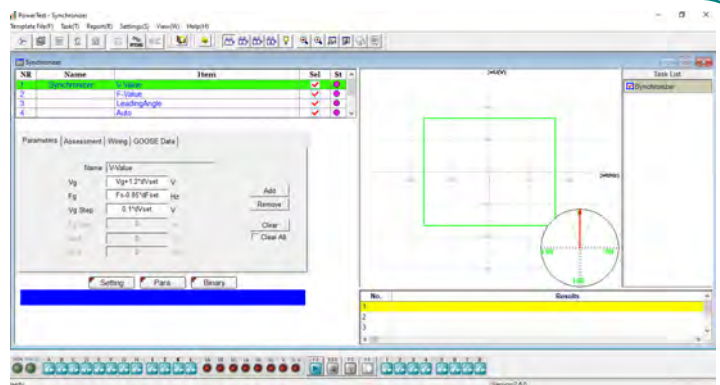
## RX Characteristic Sweep

- ❖ Can search the characteristic boundary of the impedance relay
- ❖ Can find the boundary at different angles



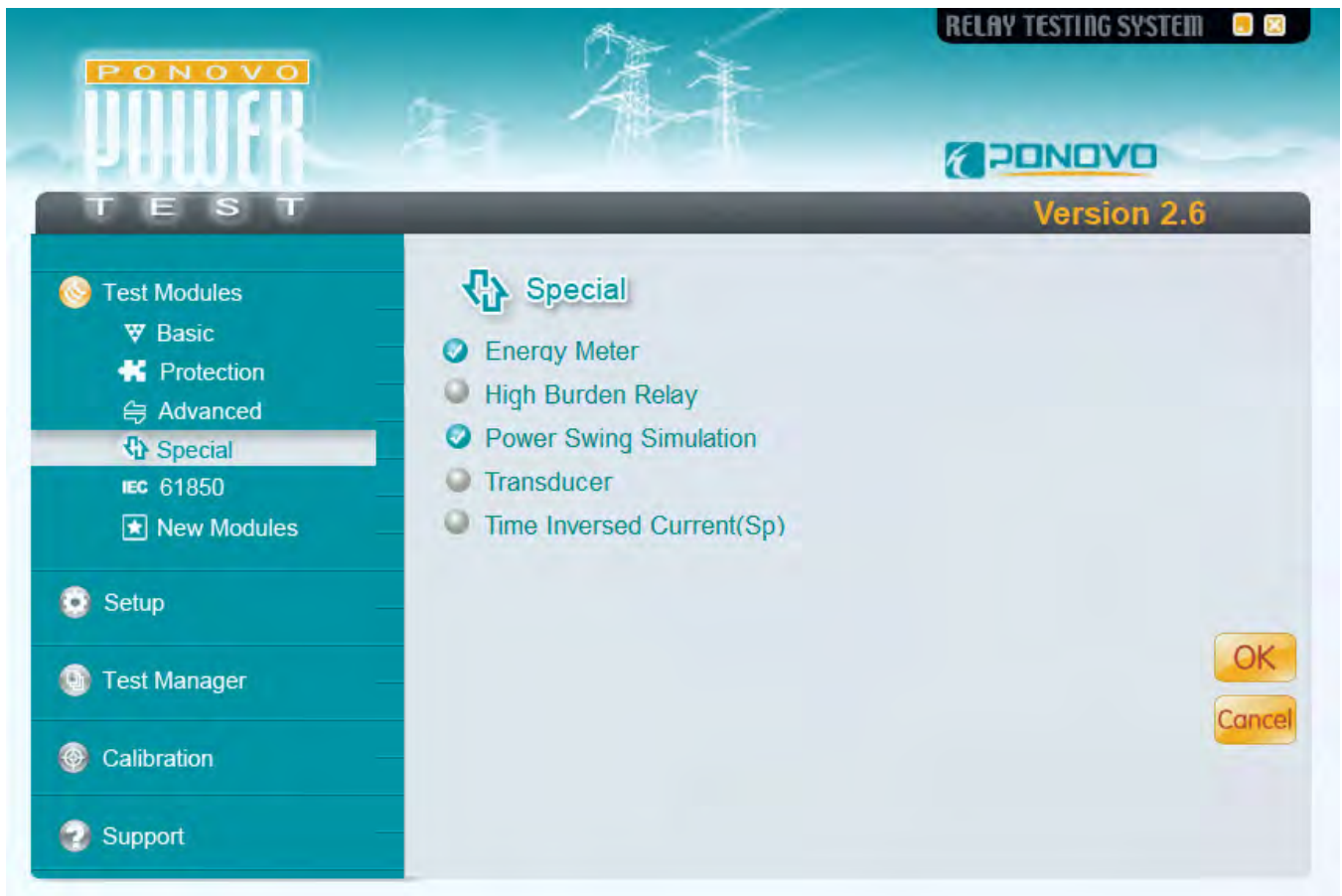
## Synchronizer

- ❖ Can check synchronizing relay
- ❖ Can check voltage difference
- ❖ Can check frequency difference
- ❖ Can check leading time and leading angle
- ❖ Can check pulse width for frequency adjustment
- ❖ Can check pulse width for voltage adjustment
- ❖ Can check auto-adjusting function with both voltage and frequency varying



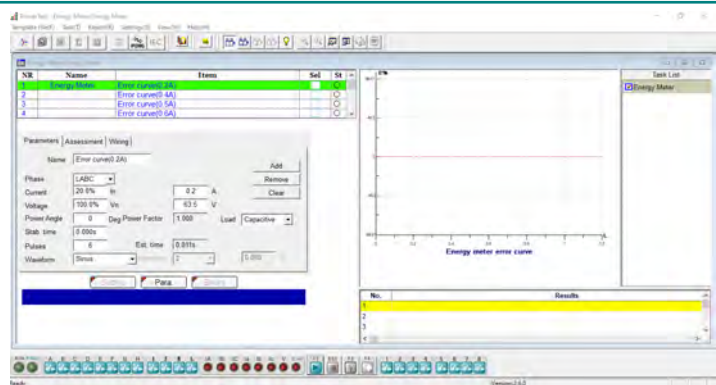
## ➤ Special Package

In the special package, there are energy meter module and power swing simulation module can be used by PW466i.



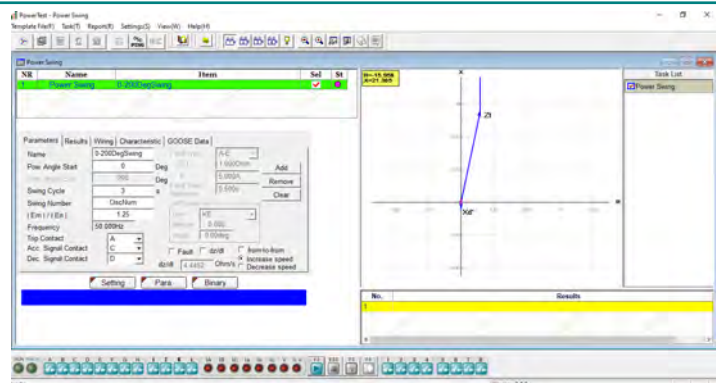
### Energy Meter

- ❖ Can check the functionality and accuracy of energy meter with or without optional accessory PACB108
- ❖ 1-phase or 3-phase energy meters can be checked
- ❖ Active power meter, reactive power meter, and apparent power meter can be checked



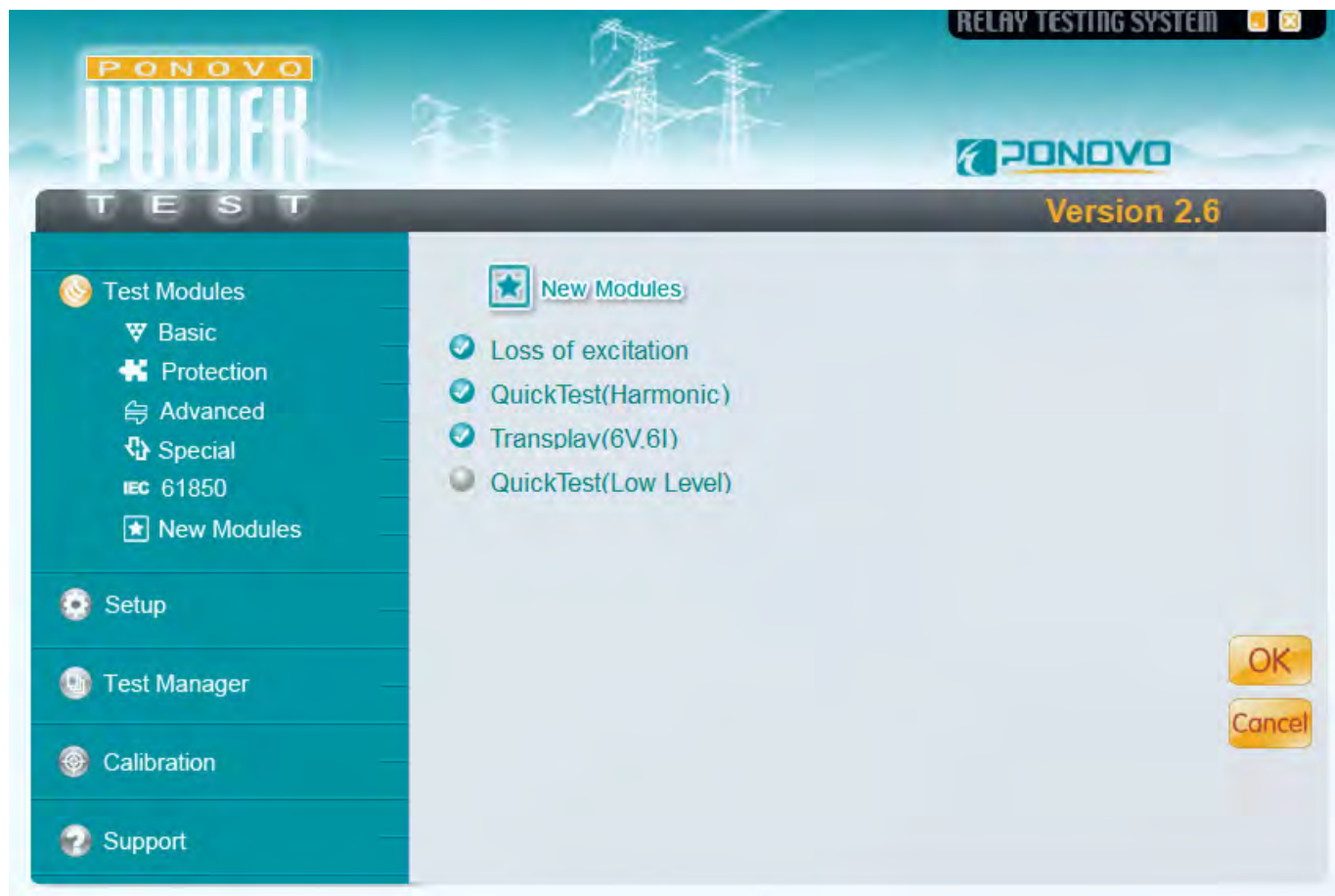
### Power Swing Simulation

- ❖ Can really simulate the oscillations in power flow reference the power parameter
- ❖ Can simulate Out-Of-Step and Stable swing
- ❖ Can simulate increase and decrease swing
- ❖ Can be a tool for relay test engineer to observe the relay behavior during dynamic power swing process.



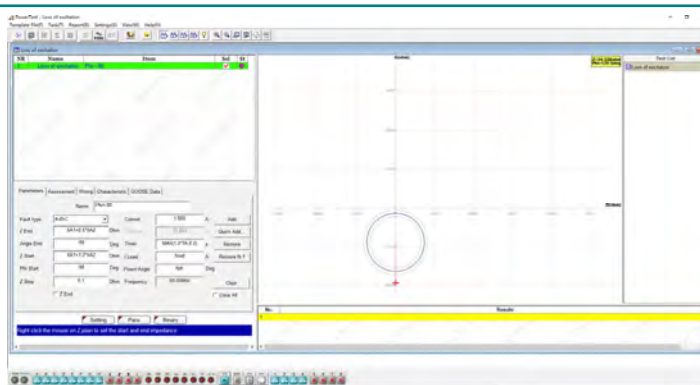
## ➤ New Modules Package

In the New Modules package, there are modules loss of excitation, QuickTest(harmonic) and Transply(6V, 6I) applied for PW466i.



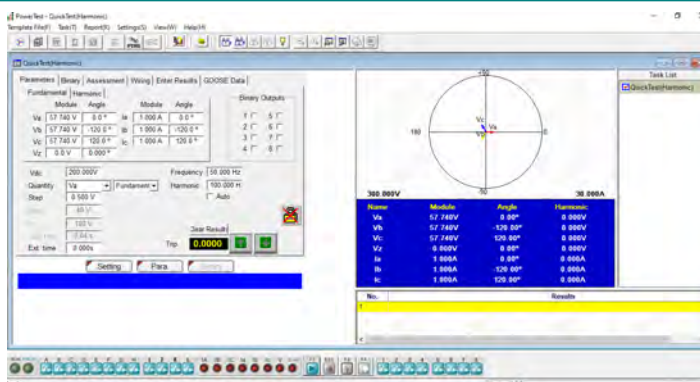
### Loss of excitation

- ❖ Can search for two different excitation loss characteristics
- ❖ During the test process a series of shots will be generated to search out the boundary along this shot line. Then next shot at a different angle will be generated. In this way we can then find out the boundary at different angles.



### QuickTest (Harmonic)

- ❖ Can automatically and manually superposition harmonics with user-defined frequency
- ❖ The fundamental and harmonic of voltage and current sources can be controlled independently





More Templates can be download from our website [www.ponovo.net](http://www.ponovo.net)



- CAG17
- CTIG
- CTIGM
- CTMFM
- CTMM
- CTNM
- CTT
- CTTM
- CTU
- DIFB
- MFVUM
- Micromho
- MVAPM
- MWTU
- Optimho
- P111
- P115
- P120
- P121
- P122
- P123
- P124
- P127
- P141
- P142
- P143
- P144
- P145
- P241
- P242
- P243
- P342
- P343
- P344
- P345
- P430
- P433
- P435
- P436
- P437
- P438
- P441
- P442
- P443
- P921
- P922
- P923
- P940
- P941
- P942
- P943
- PPX
- PVMM
- Quadromho
- SKE
- SKD
- VAGM22
- VAPM
- P632
- P633
- P634
- P642
- P643
- P645



- SEL300
- SEL351
- SEL587
- SEL311B
- SEL487B
- SEL487E
- SEL167
- SEL411
- SEL311C
- SEL311L
- SEL321
- SEL421
- SEL501
- SEL587



- 7RW600
- 7SA6XX
- 7SA511
- 7SA513
- 7SA518
- 7SA519
- 7SA522
- 7SD5
- 7SD52
- 7SD63
- 7SJ61
- 7SJ63
- 7SJ80
- 7SS52
- 7ST6
- 7UM61
- 7UM62
- 7UM512
- 7UM515



- LZ96
- REG100
- REL511
- REL531
- MSOC
- RAZFE
- REB670
- REC670
- REF542
- REG216
- REL300
- REL316
- REL350
- REL352
- REL356
- REL511
- REL512
- REL521
- REL531
- REL561
- REL650
- REL670



- PCS-902
- RCS-915
- RCS-931
- RCS-993
- RCS-902
- PCS-9611
- PCS-902H
- PCS-931D
- PCS-9611C



- SR489
- SR745
- F650
- SR750
- GT60
- D60
- DLPD
- G30
- L90
- GE345



- SEPAM 10
- SEPAM 80
- SEPAM 2000
- SEPAM S42
- T20



- MRA4
- MRDT4
- MRI4
- MRM
- MRN



- GRB100
- GRD110
- GRD140
- GRD150
- GRF100
- GRL100



- F\_PRO
- L\_PRO
- T\_PRO



- VAMP 255
- VAMP 265



- 326GD



- PCT210



## Optional Accessories

- PW-VP50 CT Polarity checker



2 units. Master machine injects pulse current to primary side of CT, slave machine receives and analysis the waveform of induced pulse current at the secondary side so as to judge the polarity is positive or negative automatically by the LED indicator on the kits.

- GPS synchronization (PGPS02/PGPS04i)

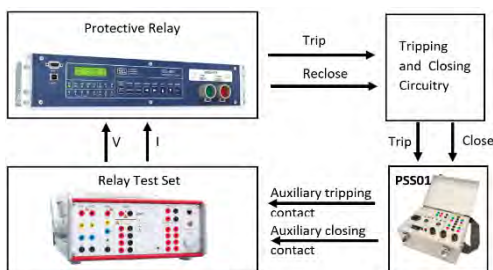


**PGPS02:** It provides GPS synchronization signal in PPS (pulse per second) or PPM (pulse per minute) for synchronized test. Trigger time can be set for end- to-end test application.



**PGPS04i:** The PGPS04i is a multi-functional time synchronization device that integrates with GPS time synchronization, IRIG-B (DC-TTL/DC-RS422/optical) outputs, IRIG-B (DC-TTL/DC-RS422/fiber) pulse input, 1PPS/1PPM (DC-TTL/DC-RS232 /fiber) pulse output, timing set of whole trigger points, real-time clock auto-generating and other relevant functions.

- Circuit breaker simulator (PSS01)



Working together with PONOVO relay testing device, PSS01 is to be used to simulate the circuit breaker operation for checking the relay scheme performance. Complicated software settings can be avoided by using this simple accessory.

- Scanning Head (PACB108)



The passive optical scanning head PACB108 detects the status of an LED, that is either an optical pulse output from an energy meter or the binary status of a protective relay or other similar optical source.



# PW466i

## Protective Relay Test Set



### Specifications

#### Voltage generators

##### Setting range

6-phase ac(L-N) 6×0~150V

1-phase ac(L-L) 1×0~300V

dc (L-N) 6×±0~150V

dc (L-L) 1×±0~300V

##### Power

6-phase ac(L-N) 6×30VA at 150V

3-phase ac(L-N) 3×60VA at 150V

1-phase ac(L-L) 1×100VA at 300V

dc (L-N) 6×40W at 150 V

**Accuracy** error < 0.08% rd.+0.02% rg. guar.  
error < 0.04% rd.+0.01% rg. typ.

**Ranges** 150V

**Resolution** 5mV for 150Vac

**Distortion** < 0.05% typ.  
(< 0.1% guar.)

#### Current generators

##### Setting range

6-phase ac(L-N) 6×0~20A

3-phase ac(2L-N) 3×0~40A

1-phase ac(6L-N) 1×0~120A

dc (L-N) 6×±0~20A

dc (6L-N) 1×±0~120A

##### Power

6-phase ac(L-N) 6×180VA typ., at 20A  
6×150VA guar., at 15A

3-phase ac(2L-N) 3×320VA typ., at 40A  
3×240VA guar., at 30A

1-phase ac(6L-N) 1×600VA typ., at 120A  
1×450VA guar., at 90A

1-phase ac(L-L) 1×450VA typ., at 30A

**Max compliance voltage(L-N)(L-L)**  
15Vpk/30Vpk

dc (L-N) 6×100W at 10A

dc (6L-N) 1×480W at 60A

**Accuracy** error < 0.15% rd.+0.05% rg. guar.  
error < 0.08% rd.+0.02% rg. typ.

**Ranges** 20A or 40A

**Resolution** 1mA

**Distortion** < 0.05% typ.  
(< 0.1% guar.)

#### General

##### Frequency

Sine signal DC, 0.001Hz~1000Hz

Transient signal DC~10.0kHz

**Accuracy** ±0.3ppm

**Resolution** 0.001Hz

##### Phase

**Angle range** -360°~+360°

**Accuracy** <0.05° typ.,  
<0.1° guar.  
at 50/60Hz

**Resolution** ±0.001°

#### Auxiliary dc supply

**Voltage range** 0~300V

**Power** 88W at 110V,  
176W at 220V,  
120W at 300V

**Accuracy** error < 0.1% rg. typ.  
(<0.5% rg. guar.)

## Binary inputs

Number	8
Input characteristics	0~400Vdc/ac peak threshold or potential free
Time resolution	100μs
Max. measuring time	Infinite
Debounce/Deglitch time	0~25ms
Counting function	< 3kHz at pulse width>150μs

## Binary outputs, relay

Number	4
Type	Potential free relay contacts, software controlled
Break capacity ac	Vmax: 300Vac /Imax: 8A /Pmax: 2000VA
Break capacity dc	Vmax: 300Vdc /Imax:8A /Pmax: 150W

## In-built monitoring and recording

Monitoring	currents and voltage outputs
Recording	analog outputs, binary inputs/outputs status
Mode	real time monitoring, no external wiring is required
Recording length	16s

## IEC61850 Goose function (Optional)

Interpretation hardware is in-built. Please contact the supplier for options to activate the IEC61850 software support Goose function

## Power supply

Nominal input voltage	110~240Vac
Permissible input voltage	90~260Vac
Nominal frequency	50/60Hz
Permissible frequency	45~65Hz

## Environmental conditions

Operation temperature	0~+50°C
Storage temperature	-25~+70°C
Relative humidity	5~95% non-condensing
EMC(E&I)	EN/IEC 61326-1 EN/IEC 61000-3-2/3 EN/IEC61000-4-2/3/4/5/6/8/11/18
Environment	EN/IEC 60068-2-1/2/3/6/27
Safety	EN/IEC 61010-1/1-12/2-030 EN/IEC 60255-25/27
Others	FCC Part 15:Sub B ECS-001:2006 LVD EU

## Others

PC connection	Ethernet,10M/100M
GPS interface	DB9/TTL
Ground Socket(earth)	4mm banana socket, front side
Weight	20kg
Dimensions (W x H x D)	360mm ×157mm×367mm

Specifications are subject to modification without notice

## PONOVO Activities in Worldwide



## Professional Solution Provider For The Power World

*Since 2001, Ponovo Power has been focusing on providing professional solutions to over 5000 clients in the fields of intelligent testing and power quality control in China and abroad*



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