Power Amplifier for Real Time Digital Simulation

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ISO 9001 QMS
ISO 14001 EMS
OHSAS 18001

PONOVO POWER CO., LTD.

About us

Throughout the last decade, PONOVO POWER CO., LTD (previously known as Power Advanced Co., LTD) has been focusing on providing professional solutions to over 5000 clients in the fields of intelligent testing and power quality control.

2001: Foundation of PONOVO POWER CO., LTD
2001: Launch of PWA, the relay test system with in-built output monitoring and recording function
2002: Launch of PW466A, the relay test system with 6 currents and 6 voltages
2003: Launch of PH01, the testing system for Traveling Wave Fault Locater
2004: Launch of PWS, the relay test system for subway used protective relays
2005: Launch of PWF, the relay test system for digital substation with IEC61850 protocol
2005: Launch of e40, the software for automatic test and management
2006: Launch of the relay test system for serial compensation system used relays
2007: Launch of PM605A, the universal calibrator and test system
2008: Launch of T200A, the single phase universal tester which can provide 120s output time at 250A
2008: Launch of MR1200, the portable disturbance recorder with in-built oscilloscope function
2008: Launch of PowerTest relay test software
2009: Launch of the relay test system for 500KV DC converting station test application
2009: Launch of L336i, the compact relay test system with 6 currents and 4 voltages and has a weight of 8.8kg
2009: Launch of PCT100i, the CT/PT tester with a weight of 11kg
2009: Launch of HB-6000, the online DGA (dissolved gas analyzer) system for transformer
2009: Launch of PF3000, the test system for automatic test of power filters
2009: Launch of T1000/T2000, the primary injection kit which can provide 120s output time at 1000A
2009: Launch of TD4000A, which can continuously supply 4000A DC current for testing DC type CT
2010: Launch of PCT200i, new generation of CT\PT Tester
2010: Launch of PNS series handheld digital signal analyzer for intelligent substation maintenance
2010: Launch of new generation PNF801 portable Fiber Digital relay tester with 8 fiber optical ports
2010: Launch of SSCS, the solid state composite switch for improving the performance of capacitor bank control
2010: Launch of LVRT (Low voltage ride through)
2011: Launch of APF (Active Power Filter)
2011: Launch of STATCOM (Static compensator)

Power Amplifier for Real Time Digital Simulator

PA series amplifiers are specially designed for power network real time simulation applications,which requires large power output,high accuracy even at high current output for all kinds of load.It can be used together with RTDS to compose a complete power network real time dynamic simulation system.

Specifications and typical configurations

Panel mount type

Model	Output	Type	Notes
PAC2000B	1×200A RMS, 2400VA/phase	4U	Requires PAP-01 power unit
PAC60Bi	3×60A RMS, 800VA/phase	4U	3 phase 380VAC±10%,47-63Hz
PAC60Ci	6×30A RMS, 450VA/phase	4U	3 phase 380VAC±10%,47-63Hz
PA30Bi	3×30A RMS, 450VA/phase ,4×120v RMS ,60VA/phase,	4U	3 phase 380VAC±10%,47-63Hz
PA30Bi-H	3×30A RMS 450VA/phase,4×250v RMS 75VA/phase	4U	3 phase 380VAC±10%,47-63Hz
PAV250Bi	6 x 250v RMS,75VA/phase	4U	3 phase 380VAC±10%,47-63Hz
PAV120Bi	6 x 120v RMS,60VA/phase	4U	3 phase 380VAC±10%,47-63Hz
PWF-2T	IEC61850 simulating device (3 fiber outputs, 12 analog signal sampling, ±10V input, 12 analog signal recording, GOOSE interpretation and publishing, support IEC61850-9-1, IEC61850-9-2)	2U	220V AC

Portable Type

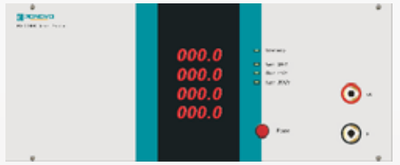
PAC60Cip	6×30A RMS,210VA/phase	4U	110V or 220V AC
PAC60Bip	3×60A RMS,400VA/phase	4U	110V or 220V AC
PA30Bip	3×30A RMS,210VA/phase ; 4×120v RMS,60VA/phase	4U	110V or 220V AC
PA30Bip-H	3×30A RMS,210VA/phase; 4×250v RMS,75VA/phase	4U	110V or 220V AC
PAV250Bip	6 x 250v RMS,75VA/phase	3U	110V or 220V AC
PAV120Bip	6 x 120v RMS,60VA/phase	3U	110V or 220V AC

Optional Accessories

PAD24	Binary input & output converter Number: 12; type: NC (300V,0.5A)	2U	220V AC
PAP01	Three phase main power supply for PAC2000	Cabinet	3 phase 380VAC±10%, 47-63Hz
PAP02	Three phase main power supply for PA series amplifiers	Cabinet	3 phase 380VAC±10%, 47-63Hz
PSS01B	Circuit Breaker Simulator(single tripping coil)	3U	220V AC
PSS02B	Circuit Breaker Simulator(two tripping coils, 2.5A)	3U	220V AC
PSS05B	Circuit Breaker Simulator(two tripping coils, 5A)	3U	220V AC
PAT01	Control unit(limit high current output, protect relay under test, reference base signal for calibrating amplifier source)	2U	220V AC

Panel mount type

PAC2000B



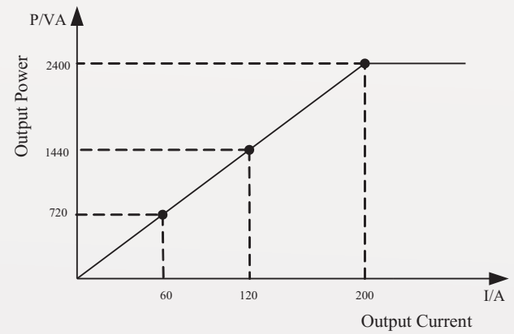
PAC2000B front view

PAC2000B rear view

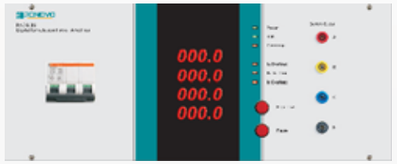
Technical Data

Single phase current amplifiers(200A)	
Model	**PAC2000B**
Current output	**0~200A RMS**
Max. output power	> 2400VA(200A output)
Input signal	0~7V RMS (±10Vp-p)
Current accuracy	0.2%(0.5A-200A)
Current typical accuracy	< 0.1%
Differential input impedance	20k
Gain	2A/V 4A/V 30A/V
Harmonic distortion ratio	≤0.2%
Linearity	≤0.2%
Phase accuracy	0.2°
Frequency range	DC-5kHz±1dB
Step response	< 20us
Input/output delay	< 20us
DC power supply	PAP01
Power supply	**3 phase** 380V AC 50/60 Hz
Chassis	4U 19 inches

Current amplifiers (200A) Power



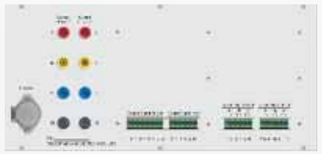
PAC60Bi, PAC60Ci



PAC60Bi front view

PAC60Ci front view

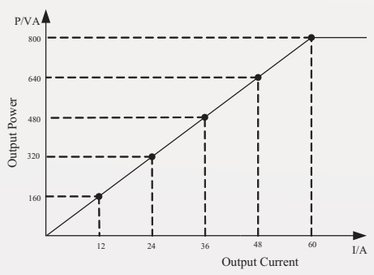
PA60CBi rear view

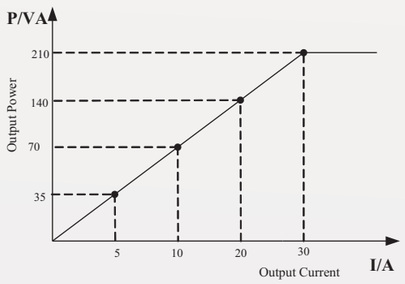


PAC60Ci rear view

Technical Data

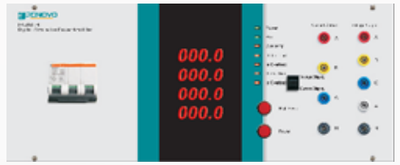
	3 Phase Current amplifiers(3x60A)	6 Phase Current amplifiers(6X30A)
Model	**PAC60Bi**	**PAC60Ci**
Current output	3 X 0~60A RMS	6 X 0~30A RMS
Max. output power	>800VA(60A output)	>450VA(30A output)
Input signal	0~7 V RMS (±10Vp-p)	0~7 V RMS (±10Vp-p)
Current accuracy	0.2%(0.5A-60A)	0.2%(0.5A-60A)
Current typical accuracy	<0.1%	<0.1%
Differential input impedance	20k	20k
Gain	8A/V	4A/V
Harmonic distortion ratio	≤0.2%	≤0.2%
Linearity	≤0.2%	≤0.2%
Phase accuracy	0.2°	0.2°
Frequency range	DC-5kHz±1dB	DC-5kHz±1dB
Step response	< 20us	< 20us
Input/output delay	< 20us	< 20us
Power supply	**3 phase** 380V AC 50/60 Hz	**3 phase** 380V AC 50/60 Hz
Chassis	4U 19 inches	4U 19 inches





PA30Bi, PA30Bi-H

PA30Bi front view



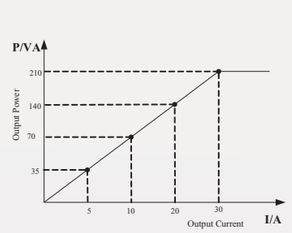
PA30B-Hi front view

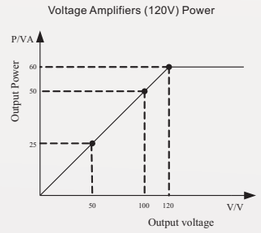
PA30Bi rear view

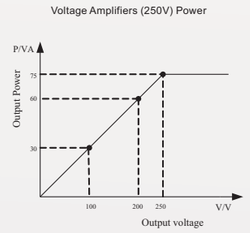
PA30Bi-H rear view

Technical Data

	3 Phase Current amplifiers	4 Phase Voltage amplifier
Model	**PA30Bi**	**PA30Bi-H**
Current output	3 X 0~30A RMS	3 X 0~30A RMS
Max. output power	>450VA(30A output)	>450VA(30A output)
Input signal	0~7 V RMS(±10Vp-p)	0~7 V RMS(±10Vp-p)
Current accuracy	0.2%(0.5A-60A)	0.2%(0.5A-60A)
Current typical accuracy	<0.1%	<0.1%
Differential input impedance	20k	20k
Gain	4A/V	4A/V
Harmonic distortion ratio	≤0.2%	≤0.2%
Linearity	≤0.2%	≤0.2%
Phase accuracy	0.2°	0.2°
Frequency range	DC-5kHz±1dB	DC-5kHz±1dB
Step response	< 20us	< 20us
Input/output delay	< 20us	< 20us
Voltage output	4 X 0~120V RMS	6 X 0~250V RMS
Max. output power	>60VA(120V output)	>75VA(250V output)
Input signal	0~7V RMS	0~7V RMS
Voltage accuracy	<0.1%(5V-120V)	<0.2%(5V-250V)
Voltage typical accuracy	<0.05%	<0.1%
Differential input impedance	20k	20k
Gain	20V/V	36V/V
Harmonic distortion ratio	≤0.1%	≤0.1%
Linearity	≤0.1%	≤0.2%
Phase accuracy	0.2°	0.2°
Frequency range	DC-5kHz±1dB	DC-3kHz±1dB
Step response	< 20us	< 80us
Input/output delay	< 20us	< 80us
Power supply	**3 phase** 380V AC 50/60 Hz	**3 phase** 380V AC 50/60 Hz
Chassis	4U 19 inches	4U 19 inches

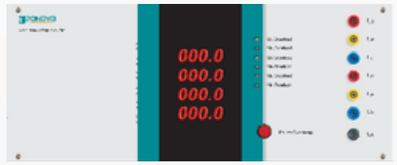






PAV250Bi, PAV120Bi

PAV250Bi front view



PAV120Bi front view

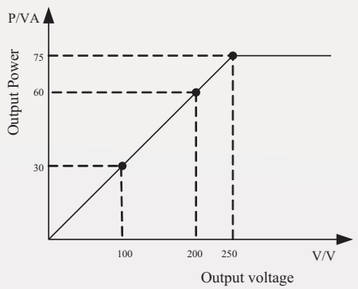
PAV250Bi rear view

PAV120Bi rear view

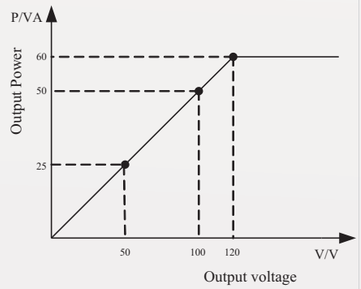
Technical Data

	6 Phase Voltage Amplifier(6 X 250V)	6 Phase Voltage Amplifier(6 X 120V)
Model	**PAV250Bi**	**PAV120Bi**
Voltage output	6 X 0~250V RMS	6 X 0~120V RMS
Max. output power	>75VA(250V output)	>60VA(120V output)
Input signal	0~7V RMS	0~7V RMS
Voltage accuracy	<0.2%(5V-250V)	<0.1%(5V-120V)
Voltage typical accuracy	<0.1%	<0.05%
Differential input impedance	20k	20k
Gain	36V/V	20V/V
Harmonic distortion ratio	≤0.1%	≤0.1%
Linearity	≤0.2%	≤0.1%
Phase accuracy	0.2°	0.2°
Frequency range	DC-3kHz±1dB	DC-5kHz±1dB
Step response	<80us	<20us
Input/output delay	<80us	<20us
Power supply	**3 phase** 380V AC	**3 phase** 380V AC
Chassis	4U 19 inches	4U 19 inches

Voltage amplifiers (250V) Power:



Voltage amplifiers (120V) Power:



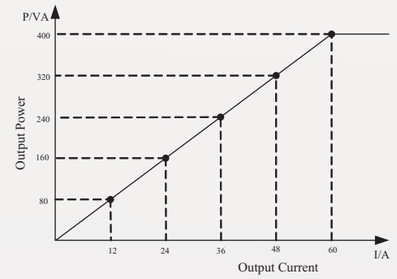
Portable

PAC60Bip, PAC60Cip

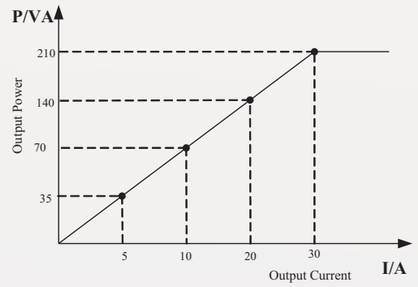
Technical Data

	3 Phase Current Amplifiers(3 X 60A)	6 Phase Current Amplifier(6 X 30A)
Model	**PAC60Bip**	**PAC60Cip**
Current output	3 X 0~60A RMS	6 X 0~30A RMS
Max. output power	>400VA(60A output)	>210VA(30A output)
Input signal	0~5 V RMS(±7.07Vp-p)	0~5 V RMS(±7.07Vp-p)
Current accuracy	0.2%(0.5A-60A)	0.2%(0.5A-60A)
Current typical accuracy	<0.1%	<0.1%
Differential input impedance	20k	20k
Gain	12A/V	6A/V
Harmonic distortion ratio	≤0.2%	≤0.2%
Linearity	≤0.2%	≤0.2%
Phase accuracy	0.2°	0.2°
Frequency range	DC-5kHz±1dB	DC-5kHz±1dB
Step response	< 20us	< 20us
Input/output delay	< 20us	< 20us
Power supply	**Single phase** 220V AC 50/60 Hz	**Single phase** 220V AC 50/60 Hz
Chassis	4U	4U

PAC60Bip



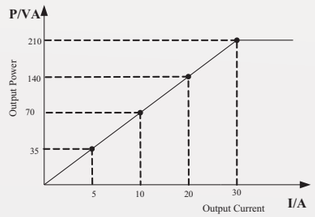
PAC60Cip

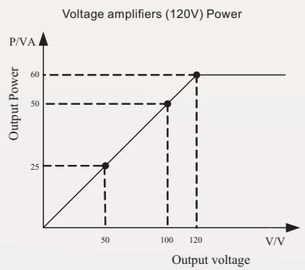


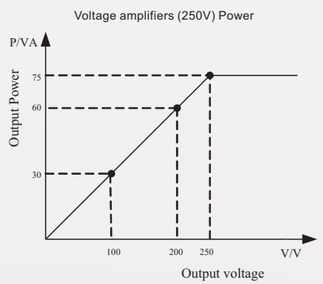
PA30BiP, PA30BiP-H

Technical Data

	3 Phase Current Amplifiers(3 X 30A) 4 Phase Voltage Amplifier(4X120V)	3 Phase Current Amplifiers(3X30A) 4 Phase Voltage Amplifier(4X250V)
Model	**PA30BiP**	**PA30BiP-H**
Current output	3 X 0~ 30A RMS	3 X 0~ 30A RMS
Max. output power	>210VA(30A output)	>210VA(30A output)
Input signal	0~5 V RMS(±7.07Vp-p)	0~5 V RMS(±7.07Vp-p)
Current accuracy	0.2%(0.5A-30A)	0.2%(0.5A-30A)
Current typical accuracy	<0.1%	<0.1%
Differential input impedance	20k	20k
Gain	6A/V	6A/V
Harmonic distortion ratio	≤0.2%	≤0.2%
Linearity	≤0.2%	≤0.2%
Phase accuracy	0.2°	0.2°
Frequency range	DC-5kHz±1dB	DC-5kHz±1dB
Step response	< 20us	< 20us
Input/output delay	< 20us	< 20us
Voltage output	4 X 0~120V RMS	6 X 0~250V RMS
Max. output power	>60VA(120V output)	>75VA(250V output)
Input signal	0~5V RMS	0~5V RMS
Voltage accuracy	<0.1%(5V-120V)	<0.2%(5V-250V)
Voltage typical accuracy	<0.05%	<0.05%
Differential input impedance	20k	20k
Gain	25V/V	50V/V
Harmonic distortion ratio	≤0.1%	≤0.1%
Linearity	≤0.1%	≤0.1%
Phase accuracy	0.2°	0.2°
Frequency range	DC-5kHz±1dB	DC-3kHz±1dB
Step response	<20us	
Input/output delay	<20us	
Power supply	**Single phase** 220V AC 50/60 Hz	**Single phase** 220V AC 50/60 Hz
Chassis	4U	4U





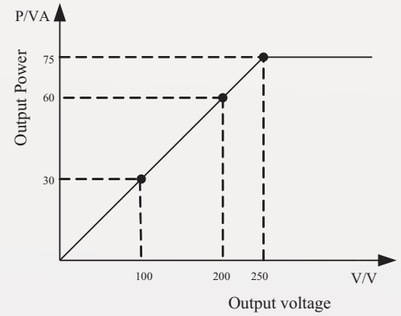


PAV250Bip, PAV120Bip

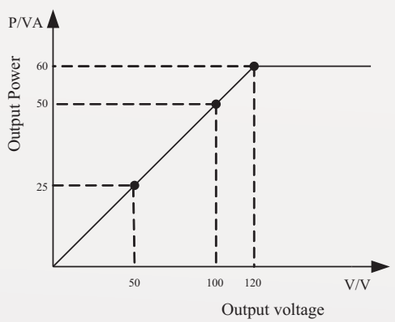
Technical Data

	6 Phase Voltage Amplifier(6 X 250V)	6 Phase Voltage Amplifier(6 X 120V)
Model	**PAV250BiP**	**PAV120BiP**
Voltage output	6 X 0~250V RMS	6 X 0~120V RMS
Max. output power	>75VA(250V output)	>60VA(120V output)
Input signal	0~5V RMS	0~5V RMS
Voltage accuracy	<0.2%(5V-250V)	<0.1%(5V-120V)
Voltage typical accuracy	<0.1%	<0.05%
Differential input impedance	20k	20k
Gain	50V/V	25V/V
Harmonic distortion ratio	≤0.1%	≤0.1%
Linearity	≤0.2%	≤0.1%
Phase accuracy	0.2°	0.2°
Frequency range	DC-3kHz±1dB	DC-5kHz±1dB
Step response		<20us
Input/output delay		<20us
Power supply	Single phase110or 220V AC	Single phase110or 220V AC
Chasis	3U	3U

Voltage amplifiers (250V) Power:



Voltage amplifiers (120V) Power:



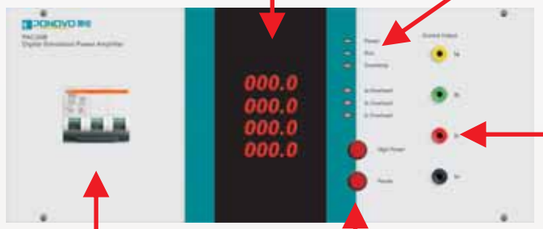
Panel Configuration for panel mount type amplifier

Amplifier output display

The in-built sampling unit in the amplifier is designed to sample the real time output signal and the output value for each current/voltage channel will be displayed in the display area.

LED indicator for amplifier working status

a) Power On display
b) Operation display
c) Overheat display
d) Current open circuit display
e) Voltage short circuit display



Amplifier outputs

Three phase power supply switch

Panel control button

a) High power output button
b) Output pause button

Amplifier protection

The following protection is designed for current/voltage amplifier

a) Current open-circuit
b) Voltage short-circuit
c) Overload
d) Overhead

Main power supply

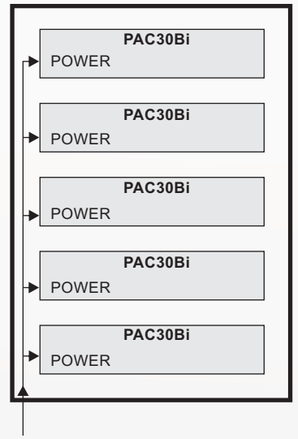
Three phase power supply will be used to drive the amplifier and can be designed according to customer requirement, such as 240Vac, 380Vac, 400Vac, etc.

Why three phase power supply is considered?

In case a number of amplifiers working together and generating the maximum power at the same time the power consumption for the main power supply may become huge. If single power supply is there It may cause the unbalance for the three phase power supply system.

In the following example we have 5 PAC30Bi amplifier units (6*30A) mounted on the panel. The maximum main supply power for each unit is about 2.5-3.0kVA and the total power supply required is 12.5-15kVA. If this 15kVA power is supplied by single phase power supply source we may experience the unbalance. This is the reason for us to design three phase main supply on the panel.

Power supply and distribution



Why large output power is required?

Some factors are to be considered when designing the amplifier output power

1. Cable length connecting amplifier and RTDS system
2. Number of relays to be connected together

Relationship between cable type/length and output power can be better explained with the following calculation table.

Calculation condition:

1. Relay impedance : 0.1-0.2 ohm
2. Cable type: 4 sq mm at 25 °C

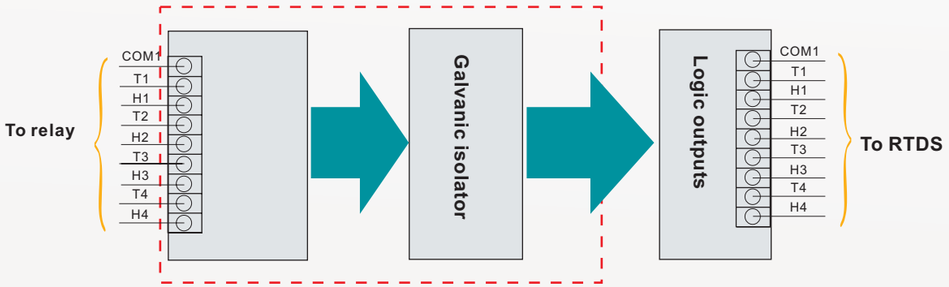
Relationship between the voltage across current output and cable length

		Output Power(VA)	Voltage across current output(V)	Max Load(ohm)	Max cable length (M)
PONOVO 30Bi/60Bi	7.5A(L-N)	120	16	2.13	10…20
	22.5A(L-N)	342	15.2	0.68	4…8
	30A(L-N)	458	15	0.5	2..4
	50A(3L-N)	600	12	0.24	1..2
	180A(3L-N)6 X 30A	1260	7	0.26	1..2
Others	7.5A(L-N)	70	9.3	1.24	6…12
	22.5A(3L-N)	210	9.3	0.41	2..4
	30A(3L-N)	200	6.66	0.22	1...2
	50A(3L-N)	160	3.2	0.06	0

Optional accessories

PDA24/PDA36 : the binary input & output converter

It is used to create gavalnic isolation between protective relay and RTDS system
Inputs : 24 or 36 binary inputs, dry or wet (15-250Vdc)
Outputs : compatible to TTL, CMOS , Opto-coupler

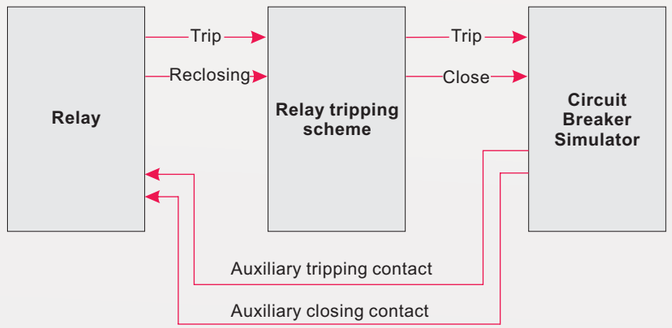


PSS series Circuit Breaker Simulator

Application: simulate circuit breaker operation

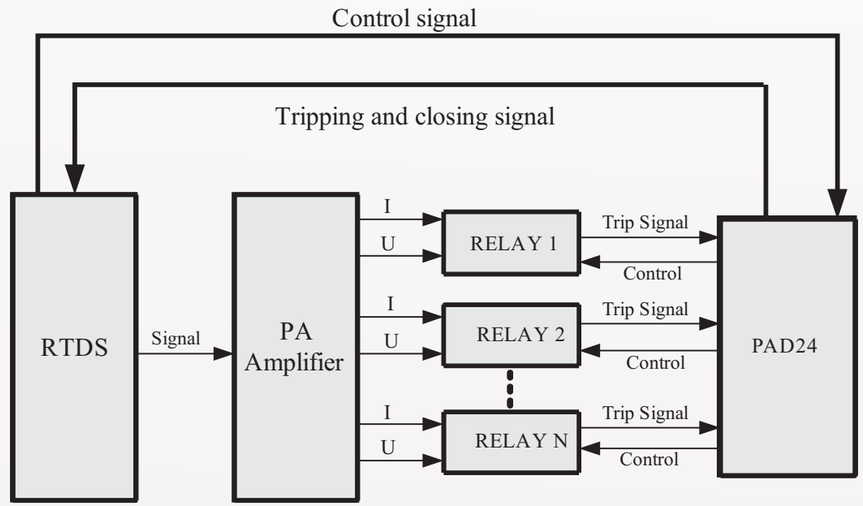
Features:

- Can select 3 pole or 1 pole tripping
- Separate coil for single closing and single tripping
- Can simulate circuit breaker failure
- Separate settings for tripping and closing time
- Separate settings for tripping and closing current
- Provide circuit breaker auxiliary contacts for complex test applications
- Can select single tripping coil and two tripping coils

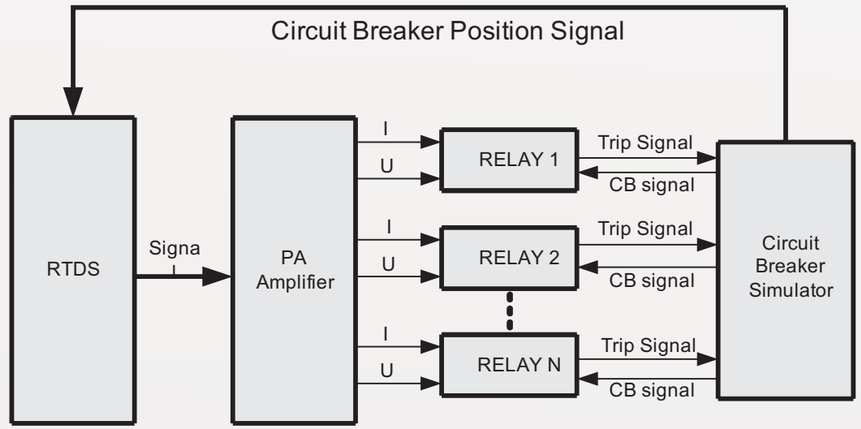


Typical Application Configuration

Relay Test Simulation – with PAD24



Relay Scheme Simulation - with Circuit Breaker Simulator



Project Examples

*State Grid Consrtuction Company Limited




*Beijing Sifang Automation Co.,Ltd

*East China Electric
Power Test & Research Institute

*North China EPRI


*State Grid Nanjing Automation Research Institute

Main Customers

Customer Name	Time of Operation	Voltage Source	Current Source
VNIIR,JSC (Russia)	2008	12*120V	9*200A
Beijing Jiaotong University	2009	14*120V	9*60A/6*30A
China Agricultural University	2009	18*120V	9*60A/6*30A/3*200A
North China Electric Power University	2009	18*120V	12*60A/6*200A
Xi'an Jiaotong University	2004	18*120V	6*60A/3*200A
Tianjin University	2005	16*120V	12*60A
South China University of Technology	2006	12*120V	9*60A
Tsinghua University	2008	6*120V	3*30A/3*30A/6*200A
Zhejiang University	2008	24*120V	18*30A
China EPRI	2005/2008/2009	64*120V	24*60A/12*30A/15*200A
*North China EPRI	2003	28*120V	12*60A/12*30A/6*200A
*East China Electric Power Test & Research Institute	2003/2005	24*120V	9*60A/6*200A
Sichuan EPRI	2002	18*120V	9*60A/3*200A
Fujian EPRI	2004	14*120V	6*30A/3*200A
Shandong EPRI	2003	12*120V	9*60A
Jiangsu EPRI	2004	20*120V	9*60A/6*200A
Jiangxi EPRI	2008	16*120V	24*60A
Hebei Province EPRI	2007	24*120V	12*60A/6*30A/3*200A
Shanxi Province Electric Power Research Institute	2007	6*120V	6*200A
Inner Mongolia EPRI	2008	24*120V	8*60A/12*30A
Chongqing EPRI	2008	12*120V	24*60A/6*200A
Anhui Power Electric Test & Research Institute	2008	16*120V	12*60A/9*30A
Shanxi Province North West Grid Technology Center	2009	10*120V	6*60A/3*200A
China Southern Power Grid CO.,LTD	2005	52*120V	39*60A/6*200A
*State Grid Nanjing Automation CO.,LTD	2003/2007	60*120V	27*60A/12*200A
Beijing Yiqun Engineering Consultant Co., LTD	2003/2007/2008	12*120V	63*30A
Nari-Relays Electric CO.,LTD	2005/2006/2007/2008	108*120V	48*60A/24*30A/24*10A/3*200A
State Grid Nanjing Automation Research Institute	2003/2007	196*120V	27*60A/56*30A
XJ Group CO.,LTD	2003/2005/2007/2009	26*120V	48*60A/3*200A
Shanghai Electric Power Transmission & Distribution Group	2007	14*120V	6*60A/3*200A
*State Grid Consrtuction Company Limited	2003/2009	60*120V	66*30A/30*60A
*Beijing Sifang Automation Co.,LTD	2004/2005	16*120V	12*60A/6*200A