



SPHEREA
PUISSANCE PLUS

4Q POWER AMPLIFIERS AC - DC - THREE-PHASE - 3x7000VA

APPLICATIONS

- AC or DC grids
- Motor emulation / AC-AC AC-DC or DC-DC converters
- Harmonics generation

PERFORMANCES

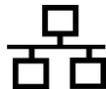
- Three insulated outputs:
 - From mains
 - From analog inputs
 - From each other
- Generation and absorption AC, AC+DC, DC
- Fast transients < 10 μ s
- Quadrant changes without transition
- High inrush current facilities (4 x I_n)
- Includes an AF synthesizer from DC to 5 kHz
- Wide bandwidth 70 kHz at -3dB
- Very low distortion < 0.3%
- Very low output impedance
- Low noise S/B > 70 dB
- High accuracy < 0.2%
- High stability < 0.1%
- Installed in a rack with safety management, On-Off buttons et Emergency Stop



Non-contractual picture



TOUCHSCREEN



ETHERNET



RS232

DESCRIPTION

Three-phase amplifier is real “4 quadrants” power amplifiers, three-phase, operating in **voltage regulation** or in **current regulation**:

- For each output, the analog input receives a “pilot” signal whose amplitude is 0~±10 V (7.07 VRMS) peak, coming from internal synthesizer or from an external synthesizer,
- Two analog outputs per power output, and insulated from power output, return images of voltage and current with amplitude 0~±10 V peak.

The linear technology used for these amplifiers allows:

- To provide power peaks up to 4 times its nominal power during 20 ms,
- An easy integration for “Real-Time” or “Power Hardware In the Loop” applications with simulators,
- An instantaneous quadrant changes from operation as generator, power factor +1, to operation as a load, power factor -1.

Entirely self-sufficient with its local control on touchscreen, they can be controlled remotely from a supervisor system via an Ethernet or RS232 link for easy integration in a complex test system.

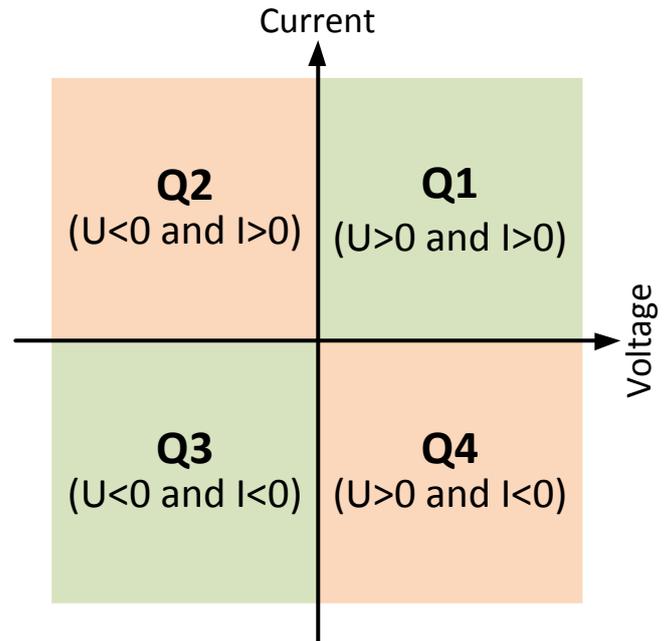


PERMANENT OPERATING AREAS

Following diagrams explain the relationship between the current and the voltage in the different quadrants, for each phase, in AC and then in DC. X-axis explain the voltage, Y-axis explain the current.

Continuous operation is allowed “insides areas” curves. Limitations are due to the heating of the power transistors. Operation “outside areas” will result in:

- An immediate switch-off by over-current protection if current is above the limits,
- A break after a delay by thermal protection in case of overheating of the power parts.



When amplifier is working as an absorber in AC, permanent current is around 50% of rated current of selected range. It can be upgraded to 100% using optional resistive pack.

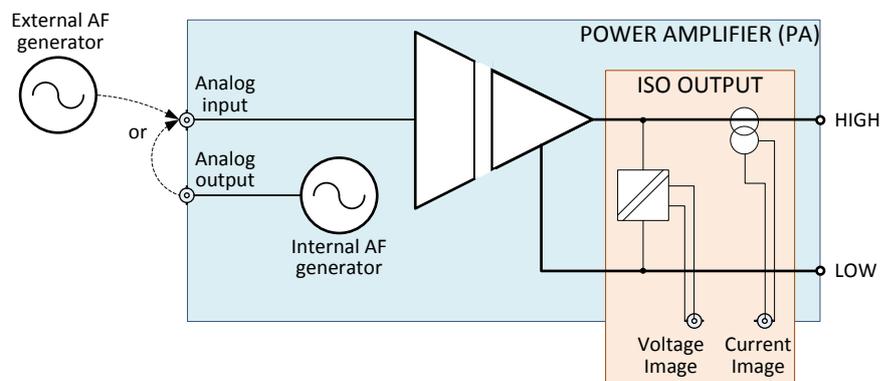
INTERNAL CONSTITUTION

PA-3x7000 amplifier is composed of three identical amplifiers of 7 kVA each.

Each amplifier is electrically insulated from the two others.

Each amplifier includes:

- one AF generator,
- one analog input,
- one power output,
- two outputs “Image”.



The internal AF generator can generate AC or DC pilot signal. In AC:

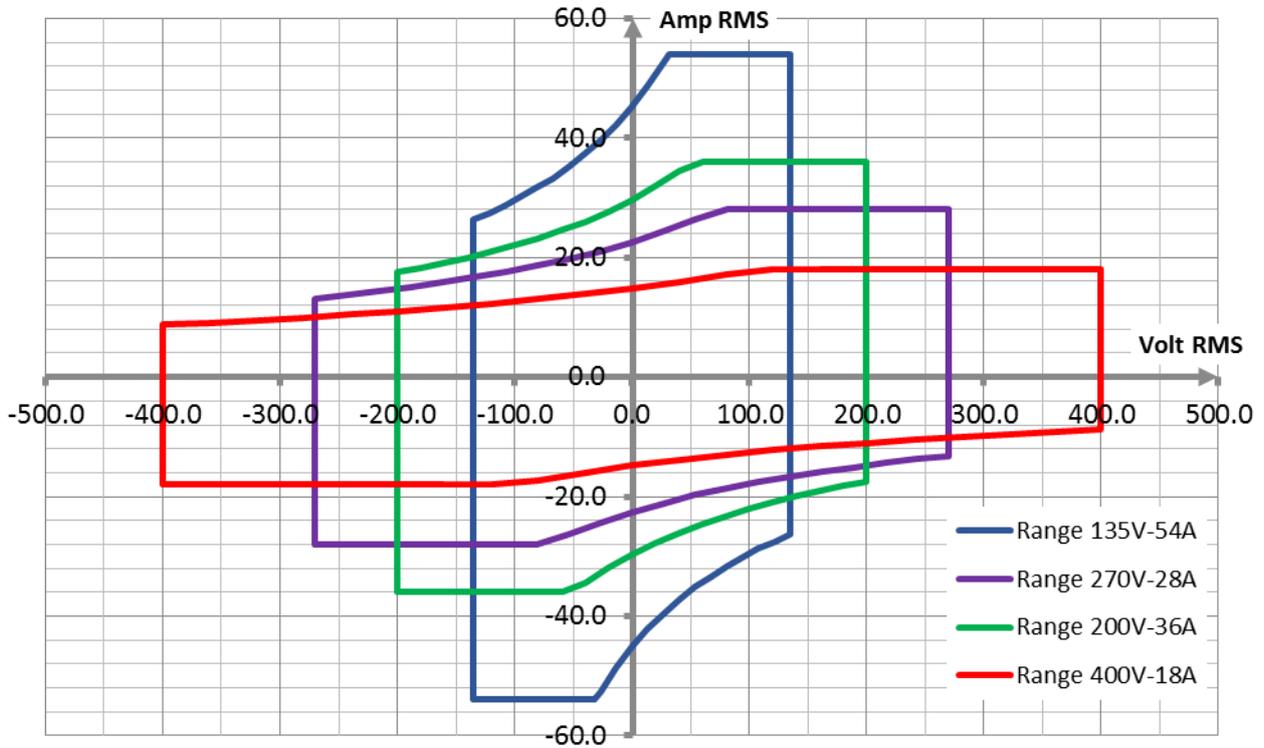
- Sine and customized waveforms can be used,
- Dephasing can also be programmed.

The outputs “Voltage Image” and “Current Image” are insulated from power outputs.

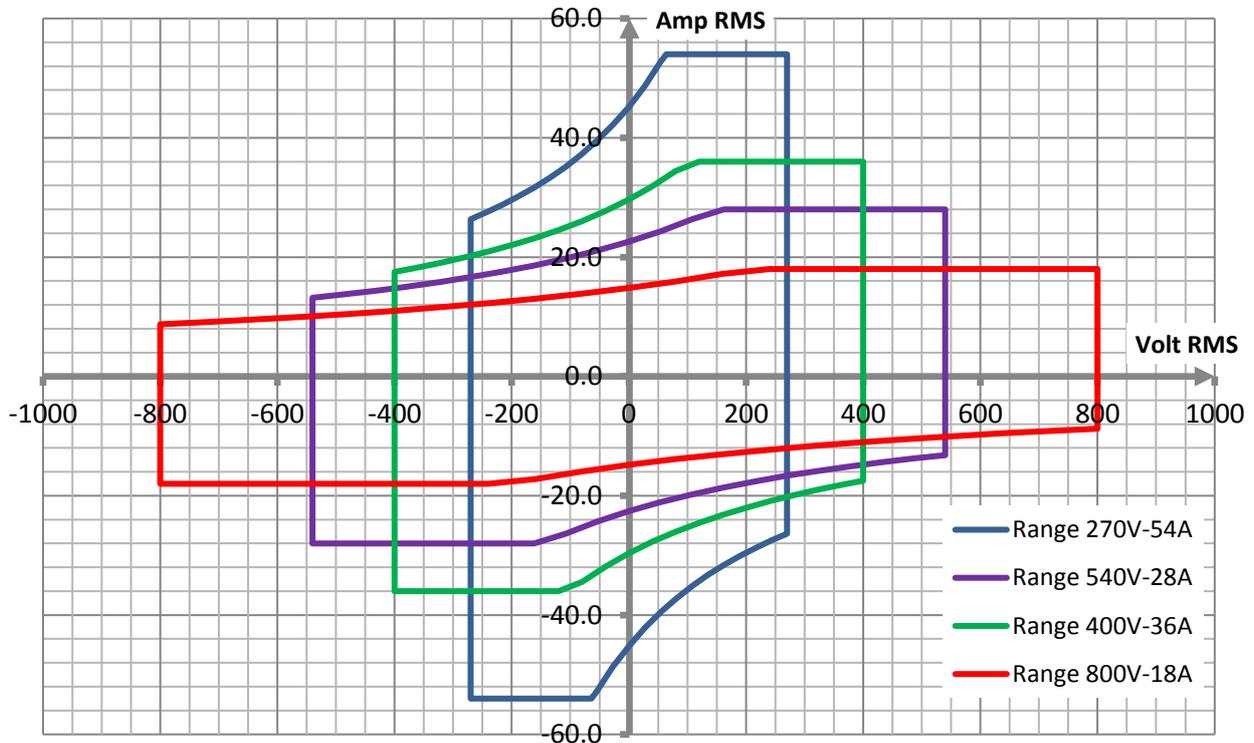
Four Modes are proposed:

- **LVAC** and **LVDC**: user has three independent outputs
- **HVAC** and **HVDC**: two amplifiers are internally connected in-series to increase output voltage

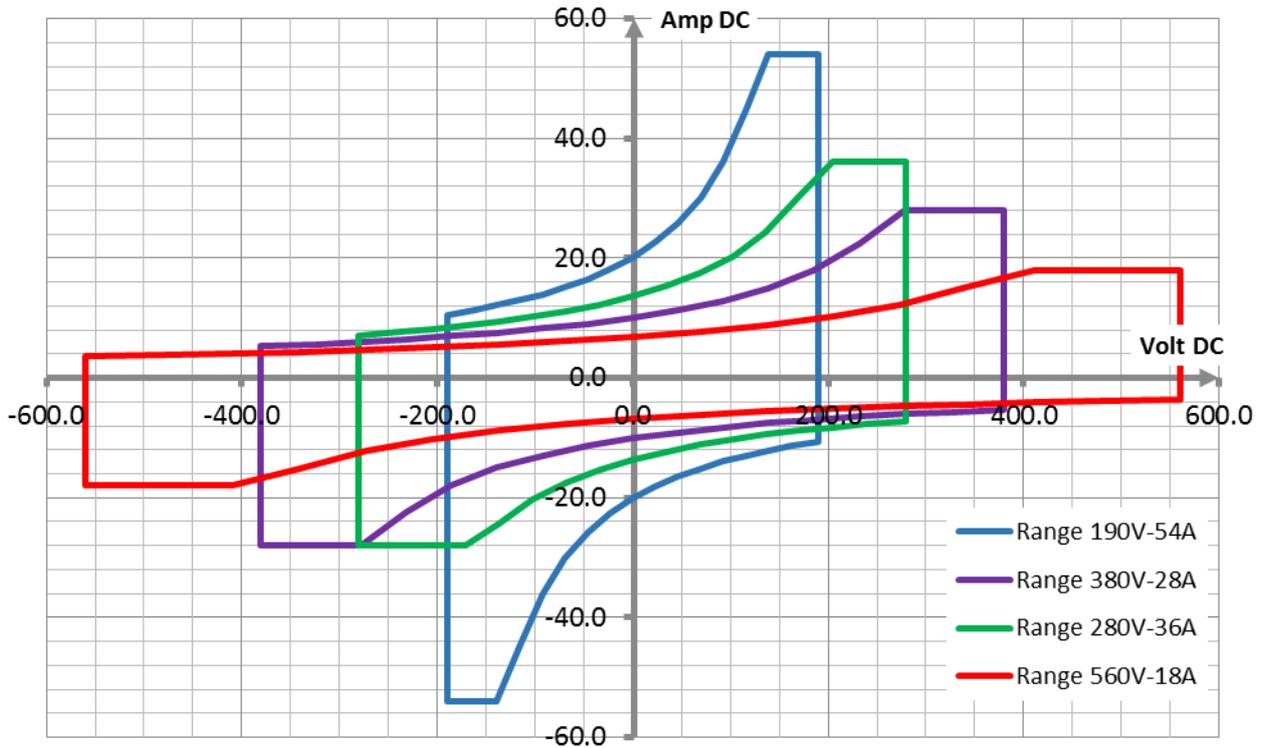
Amplifier in LVAC



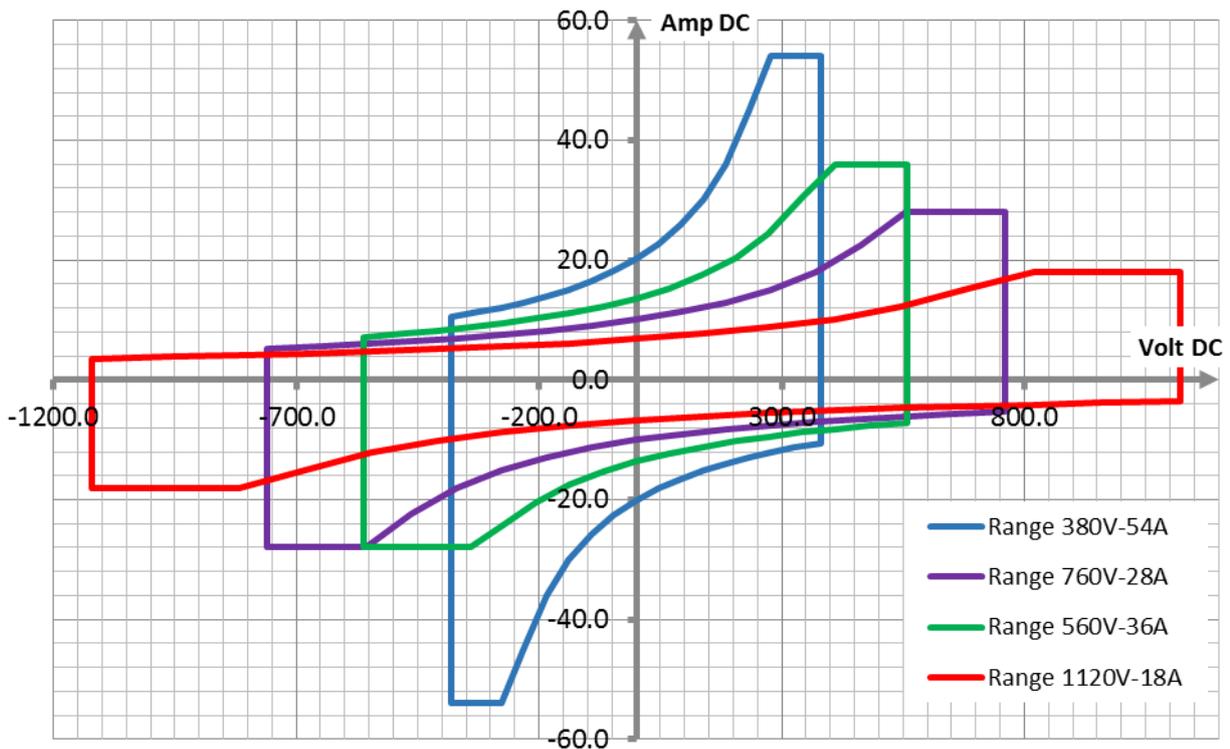
Amplifier in HVAC



Amplifier in LVDC



Amplifier in HVDC



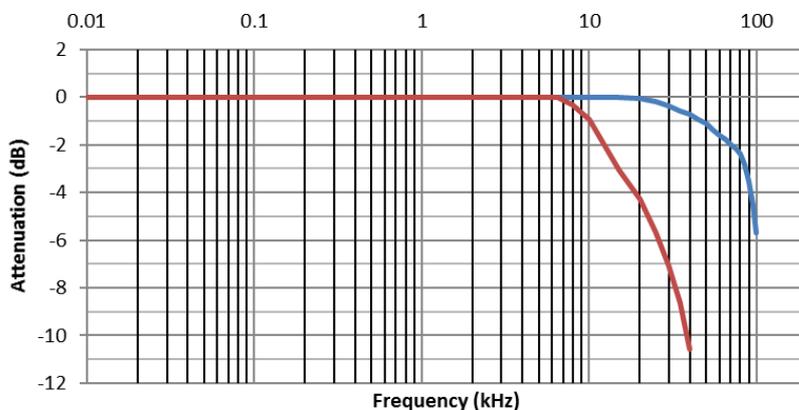
BANDWIDTH “small signals”

Blue trace:

In voltage regulation bandwidth at -3dB is 70 kHz.

Red trace:

In current regulation, bandwidth at -3dB is 15 kHz.



RISE TIME, FALL TIME AND TRANSFER TIME

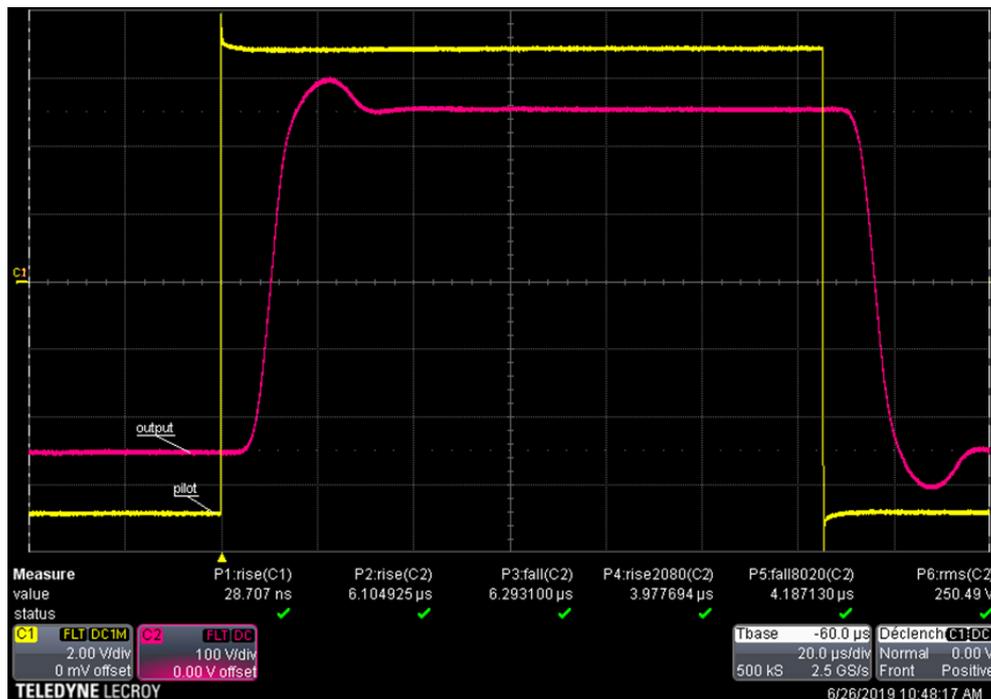
These measurements must be done using a square pilot signal. Here are the results using a 250 VRMS output.

Rise time

- (10% - 90%) < 7 μ s
- (20% - 80%) < 5 μ s

Fall time

- (10% - 90%) < 7 μ s
- (20% - 80%) < 5 μ s

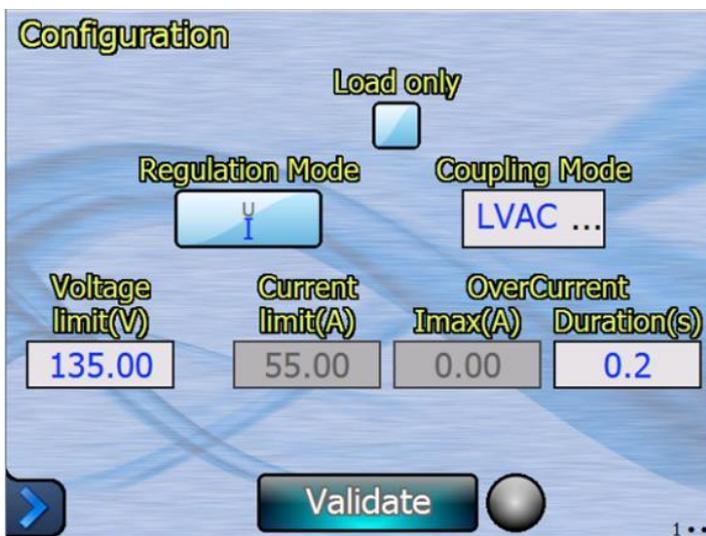


LOCAL OR REMOTE CONTROL

Managed by a Control board with a touch screen, the amplifier has two operating modes:

- **Local control:** The control device equipped with a graphical touch screen disposed in front panel gives access to all the control functions and the display of the measures.
- **Remote control:** The control device has one TCP/IP Ethernet link and two serial links, RS232 and RS485, for a control through a remote PC.

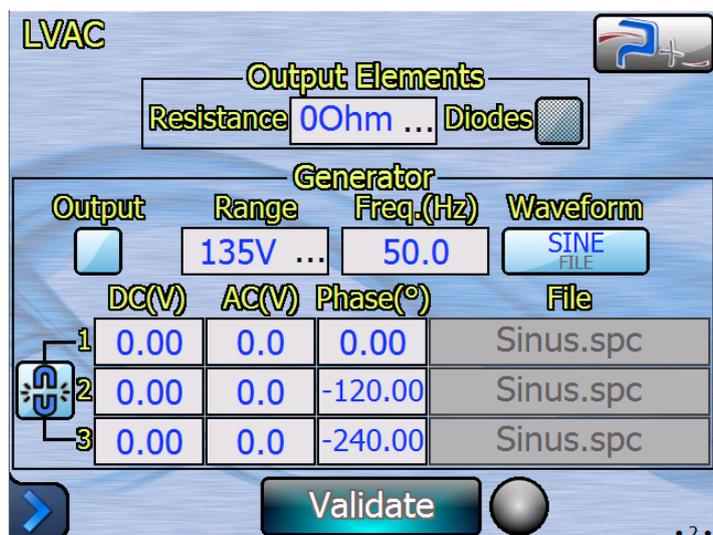
LOCAL CONTROL ON TOUCH SCREEN

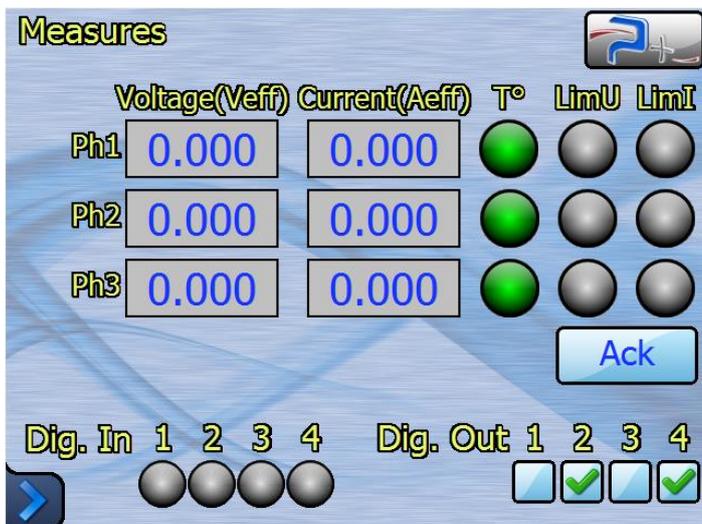


A first screen is for amplifier configuration:

- Coupling mode in LVAC, LVDC, HVAC or HVDC,
- Choice of current or voltage regulation,
- Voltage or current limitation programming in amplitude and duration.

On the main screen, graphical objects like boxes, input boxes and dropdowns are to set it up.

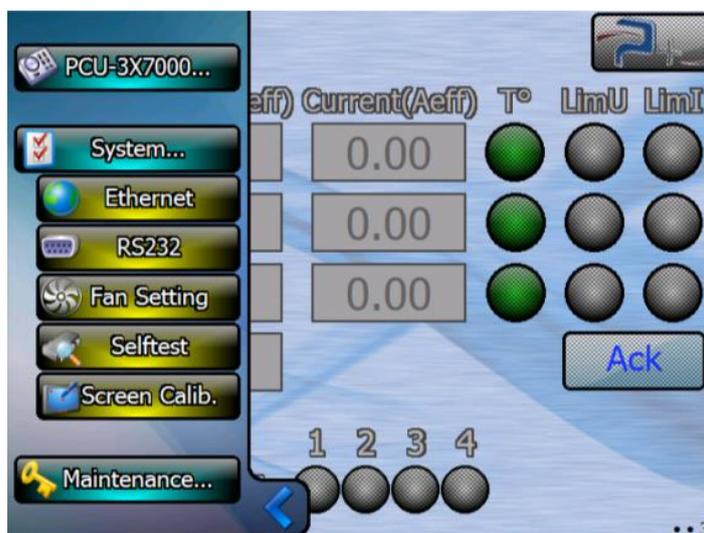




On the measurements screen, fields return the instantaneous values of voltage and current.

LEDs indicate status: thermal fault, overcurrent detected...

Other screens are to set up communications links or for the management of variable speed fans.





OUTPUTS: POWER								
Power								
Rated power per phase	7 000VA							
Rated power total	21 000VA							
AC ranges	130V / 200V / 260V / 400V / 520V / 800V							
DC ranges	180V / 280V / 360V / 560 V / 720V / 1120V							
Output type	Direct (without transformer)							
Voltage and current in AC (RMS values)	Low voltage ranges				High voltage ranges (1)			
	135V	200V	270V	400V	270V	400V	540V	800V
AC voltage (VRMS)	0-135	0-200	0-270	0-400	0-270	0-400	0-540	0-800
Permanent AC current "In"	0-54	0-36	0-28	0-18	0-54	0-36	0-28	0-18
Maximum peak current (1)	162	108	84	54	162	108	84	51
Voltage and current in DC	Low voltage ranges				High voltage ranges (1)			
	190V	280V	380V	560V	380V	560V	760V	1120V
DC voltage	±190	±280	±380	±560	±360	±560	±720	±1120
Permanent DC current "In"	±54	±36	±28	±18	±54	±36	±28	±18
Maximum peak current (1)	162	108	84	54	162	108	84	54

Notes:

- (1) In High voltage ranges, two outputs are connected internally in-series.
- (2) Three times rated current with a duration less than 5 s.

OUTPUTS: RESOLUTION / ACCURACY	
Voltage accuracy	
Typical	0,1% of range + 0,1% of programmed value
Resolution	12 bits
Current accuracy	
Typical	0,1% of range + 0,1% of programmed value
Resolution	12 bits
Voltage distortion at full output power	
Typical	< 0,3% (max < 0.7%)
Voltage regulation for a mains variation of +6% / -10%	
Max	< 0,1% of rated voltage
Voltage regulation for a current variation from 0 to 100%	
Max	< 0,1% of rated voltage
Noise	
Max RMS	0,02% of rated voltage
Max peak to peak	0,3% of rated voltage
Variation according temperature	
Typical	50 ppm/°C (max 100 ppm/°C)
Stability after 15 minutes of operation	
Max	< 0,05% of rated voltage
Insulation of the outputs versus case ground	
Measurement at 500 VDC	> 100 MΩ

TIME FEATURES	
Output signal (internal generator)	
Frequency	DC or 40 Hz to 2 kHz Resolution 0.1 Hz
Dephasing	$\pm 360^\circ$ Resolution 0.1°
Amplitude	0 to 7,07 VRMS $\pm 10V$ peak
Output bandwidth	
Full scale	DC – 15 kHz
Small signals at -3 dB	70 kHz
Output variation with a square signal pilot (3)	
Rise time 10% / 90%	< 7 μ s (voltage regulation) < 100 μ s (current regulation)
Fall time 10% / 90%	< 7 μ s (voltage regulation) < 100 μ s (current regulation)
Transfer time	< 7 μ s (voltage regulation) < 100 μ s (current regulation)
Transition from Q1 to Q4	< 10 μ s

Notes:

- (3) Explained in slew rate, rise time and fall time are up to 65 V/ μ s in range LVDC 560V.

LOW VOLTAGE INPUTS	
Input signal amplitude	
Insulation	> 10 M Ω (4)
Voltage for full output scale	7,07 VRMS / $\pm 10V$ peak
Max. voltage	$\pm 15 V$ peak
Input impedance	10 k Ω
Input signal frequency (external generator)	
Fundamental	DC – 20kHz
Harmonics (small signals)	Max 100 kHz
Digital inputs (4 inputs)	
Type	DC 0-24V
“Low” level	< 5V
“High” level	> 11 V
Input impedance	10 k Ω

Notes:

- (4) The analog inputs are insulated from power outputs.



LOW VOLTAGE OUTPUTS	
Images (5)	
Voltage image accuracy	1 VRMS for 83,3 VRMS
Current image accuracy	1 VRMS for 15,56 ARMS
Connectors	BNC sockets
Accuracy of the measurements displayed on the touch screen	
Voltage measurement	0,3% of range + 0,3% of measure
Current measurement	0,3% of range + 0,3% of measure
Digital outputs (4 outputs)	
Type	Optoswitch
Rated voltage	+24 VDC
Max current	10 mA

Notes:

- (5) The analog inputs are insulated from power outputs.

MAINS POWER SUPPLY	
Mains network	
Number of phases	Three-Phases + Neutral + Earth
Voltage	400 VRMS \pm 10%
Frequency	47 - 63 Hz
Input current	
Max at full output power	55 ARMS / Phase
Protection	Magneto-thermal breaker
Inrush current	Limited to 2 x max current
Dielectric strength mains input versus outputs connected to case ground	
Measured at 2500 VRMS / 50Hz	Current < 10 mA



MECANICAL AND ENVIRONMENTAL	
Material and surface treatment	
Frame	Aluminum painted RAL7021
Sides and rear panels	Aluminum painted RAL7021
Dimensions and weight	
Width	800 mm
Depth	800 mm
Height	1950 mm (38U)
Total weight (6)	550 kg
Handling	
Width	Four wheels d 125 mm with brakes
Temperature and humidity	
Stockage temperature	-10°C à +85°C
Operation temperature	+0°C à +50°C
Humidity	10% - 90% non-condensing
Noise (fans at full speed)	
Measured at 1 m	< 70 dBA
Marking	
Marking	CE
Protection	IP20

PROTECTIONS

Against overload: current limitation

Amplifiers in linear technology can generate up to four times their rated power during short time. They are using voltage regulation with current limitation: if current is higher than programmed value, a timer starts. At the end of a programmable time between 0.1 and 5 seconds, output voltage decreases to limit current to the programmed value.

Against short-circuit on output: automatic output switch-off

Output is switched off on all phases et must be reactivated using touchscreen or an external command.

Against overtemperature: automatic output switch-off

A temperature sensor is installed on each power part. It switches off outputs of the three phases in case of overheating. After cooling, output must be reactivated using touchscreen or an external command.

ORDER INFORMATION

PA-3x7000-AC-DC-400V-54A-4G-<options>

Amplifier 3x7000 VA with limited absorption

AVAILABLE OPTIONS (to order separately)

PA-3X7K-BW	bandwidth small signals increased from 25 kHz to 70 kHz
PA-3X7K-RI	amplifier can be used in in voltage and in current regulation
PA-3X7K-MAINS	modification of mains input for a 200 VRMS between phases network

DELIVERIES

Amplifier is delivered with its user manual, its performances list (acceptance test report), its UE declaration.

Specification may change without notice