POWER SUPPLIES AC
3x600VA - 3x1000VA - 3x2000VA Aero functions

PERFORMANCES

- High accuracy
- High stability
- Fast transients (10%-90%) < 10 µs
- High inrush currents up to 4 times rated current
- Full-wave frequency 300 to 2500 Hz
- Bandwidth 25 kHz at -3dB
- Very low noise
- Very low output impedance
- Absorption capacity: 45%
- Insulated outputs with or without Neutral
- Inhibition input

RS232

3x2000VA power supply

APPLICATIONS

- Single or three phases 115VRMS aircraft networks
  Tests according to DO-160, ABD100.1.8, MIL-STD-704:
  - Waveforms are downloaded in the power supplies
  - Software is available to create and modify sequences and waveforms

DESCRIPTION

- Power blocks are built in linear technology for high accuracy and dynamics.
- Controlled by digital synthesizer to create waveforms with harmonics up to the order 500.
- Almost no electrical pollution thanks to the linear technology, our AC power supplies can be used in anechoic chambers. Their fast regulation ensures stability even for severe and deforming loads (motor, inductance, rectifiers).
- These **"2 Quadrants"** power supplies can be used in generation of single-phase or three-phase network, but also in single-phase or three-phase load (current absorption).
- The isolated 0~±10V analog outputs, voltage image and current image, allow to use them with an acquisition unit, for example to record qualification tests.
- Entirely self-sufficient through their control / command card by touch screen, they can also be controlled remotely for an easy integration into an automatic system using the TCP/IP Protocol on Ethernet or SCPI on RS232.
- Provided with OPS1 and OPS3 software designed by Puissance+, the users can create waveforms and sequences to run qualification tests according to D0-160, ABD100-1.8 or MIL-STD-704 Standards.
- Robust and reliable: with permanent measurement of voltage, current, temperature of elements of power, these power supplies are tolerant to short-circuit and other severe conditions of use, they are particularly suitable for a laboratory use.

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POWER OUTPUT

OUTPUT	Power			
	Rated power	3x600 VA	3x1000 VA	3x2000 VA
	Output voltage	0~135V Ph-N	0~135V Ph-N	0~135V Ph-N
	Operation in generation (per phase)			
	Permanent current (rated)	4,4 ARMS	7,5 ARMS	15 ARMS
	Peak current during 200 ms	8,8 ARMS	15 ARMS	30 ARMS
	Peak current during 20 ms	16 A peak	30 A peak	60 A peak
	Operation in absorption (per phase)			
	Permanent current	1,9 ARMS	3,3 ARMS	6,6 ARMS

Connection in series is forbidden.

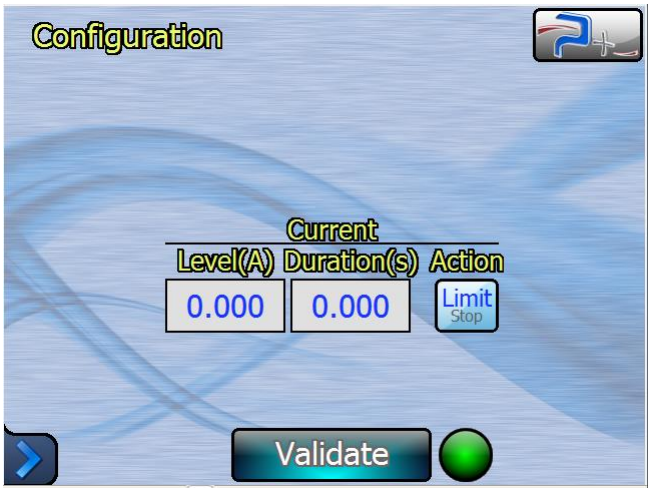
Connection in parallel is forbidden.

OVERCURRENT

Linear technology power supplies can generate up to 4 times their rated current during short periods. They operate in voltage regulation with current limitation: if the current exceeds the programmed value, a counter mechanism turns on.

This page on the touchscreen for programming and control allows to choose the action in case of overcurrent, after a delay programmable from 0.01 to 5 seconds:

- **"Limit"**: the power supply decreases its output voltage to make the current again below the programmed value.
- **"Stop"**: the power supply switches off its output



PROTECTIONS

Overload: limitation of voltage

In case of temporary overload, the voltage decreases to limit the current.

Short-circuit on output: automatic disconnection of the output

The output is switched off and must be reactivated by an action on the touch screen or an external command.

Overheating: automatic disconnection of the output

A temperature sensor is installed on each power element. It switches off the output in case of overheating. After cooling, the output must be reactivated by an action on the touch screen or an external command.

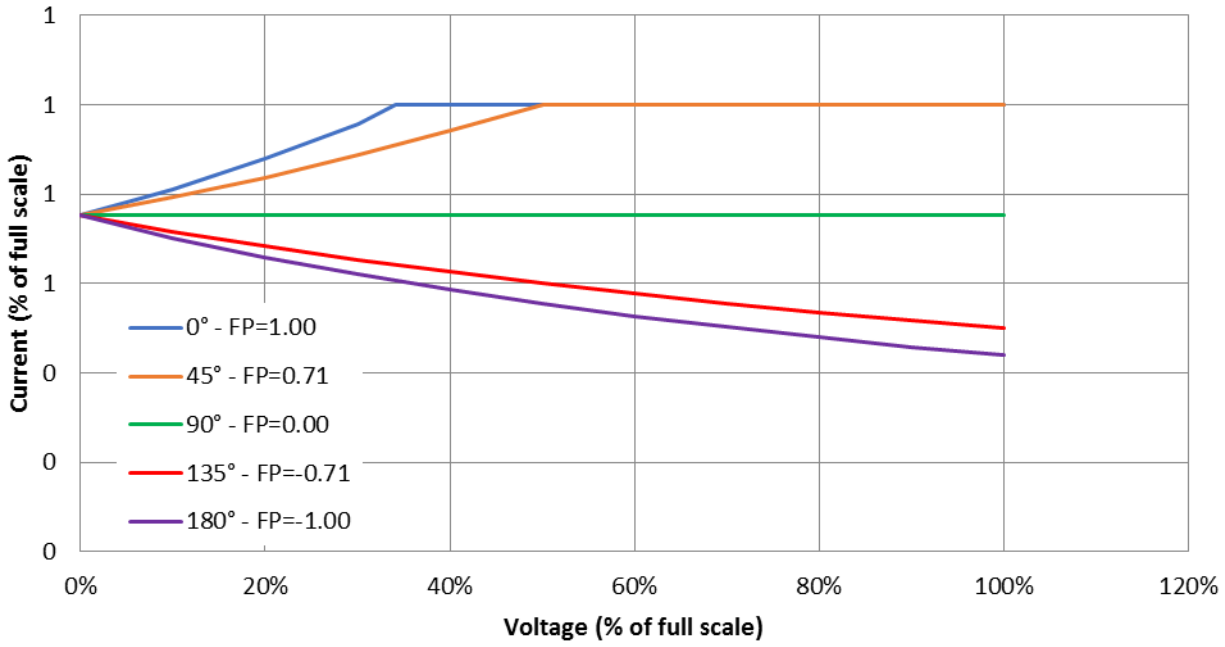
CONTINUOUS OPERATION

These diagrams express the relationship between current and voltage, for operation in generation or absorption for different values of phase shift between the voltage and current.

Permanent operation is allowed "underneath" the curves. The limitations are due to the heating of the power transistors. Operation "above" the curves will translate either:

- By an immediate switch-off: overcurrent protection if the current is above the limits
- By a break after some delay: thermal protection in case of overheating of the elements of power.

These characteristics apply for each phase.



Blue: phase shift between the voltage and the current is zero (in phase). FP power factor = +1 (generation on resistive load).

Orange: phase shift between the voltage and current is 45 degrees (π / 4).
FP power factor = + 0.71

Green: phase shift between the voltage and current is 90 degrees (π / 2).
FP power factor = 0 (generation on inductive load).

Red: phase shift between the voltage and current is 135 degrees (3π / 4).
FP power factor = -0.71

Purple: phase shift between the voltage and current is 180 degrees (in phase opposition).
FP power factor = -1 (full absorption).

OUTPUT FEATURES

SORTIE	Voltage accuracy (regulation)	
	Typical	0,1% of the range + 0,1% of programmed value
	Resolution	12 bits
	Current accuracy (limitation)	
	Typical	0,1% of the range + 0,1% of programmed value
	Resolution	12 bits
	Voltage regulation for a mains variation of +6% / -10%	
	Max	< 0,3% of rated voltage
	Voltage regulation for a variation of output current from 0 to 100%	
	Max	< 0,3% of rated voltage
	Noise	
	Max RMS	0,1% of rated voltage
	Max peak to peak	0,5% of rated voltage
	Variations	
	Rise time 10% / 90%	< 10 µs
	Fall time 90% / 10%	< 10 µs
	Transfer time	< 10 µs
	Variation according to the temperature	
	Typical	50 ppm/°C
	Max	100 ppm/°C
	Stability after 15 minutes of operation	
	Max	< 0,1% of rated voltage
	Output isolation versus ground	
	Measurement at 500 VDC	> 100 MΩ
	Accuracy of measurement displayed on the touch screen	
	Voltage measurement	0,3% of the range + 0,3% of the measurement
	Current measurement	0,3% of the range + 0,3% of the measurement

RISE TIME

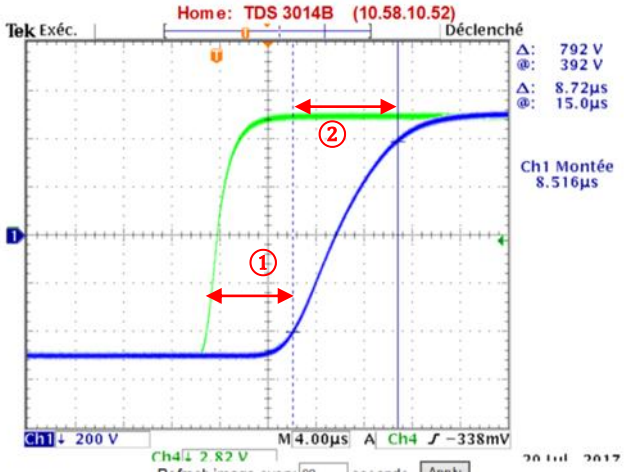
The measurements of rise time, fall time and transfer time must be done using square pilot signal.

For range in use:

- Rise time 10% - 90%: ≤ 8 µs
- Fall time 90% - 10%: ≤ 8 µs
- Transfer time: ≤ 8 µs

Example of measurements done on a ±400V power supply:

- ① Transfer time: 7.2µs
- ② Rise time: 8.5µs



CONTROL / COMMAND

2 possibilities to pilot the power supplies:

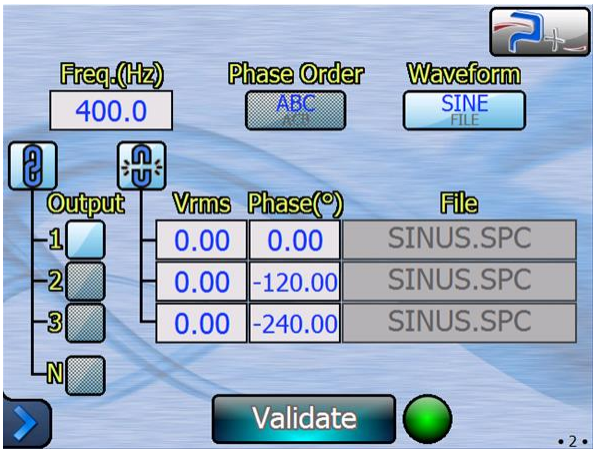
- **Local control:** with the touch screen on front panel to access to features and to voltage and current measurements
- **Remote control:** the control / command card has 2 communication links, TCP/IP on Ethernet and SCPI on RS232 or RS485, to remotely control with a computer or another communicating device

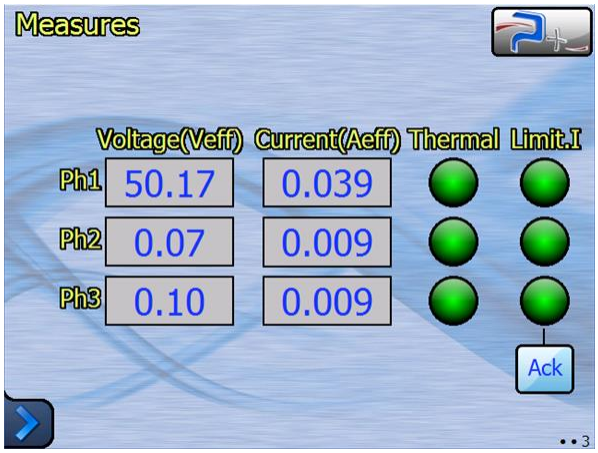
The shape of the output voltage can be set by two devices:

- The programming using the touch screen, of an AC voltage or a profile
- A points file downloaded in the memory of the power supply (see page 8),

The main screen displays the general commands:

- Frequency
- Phase order
- Waveforms (sinus or file)
- Command of output relays (one per phase and one for Neutral)
- Voltage programming
- Programming of the phase shift between phases





Measurement screen displays voltage and current measurements and overheating or overcurrent information.

In case of switch-off of the output due to an overcurrent, a acknowledge button must be activated to restart the power supply.

Configuration screen manages currents and overcurrent, in amplitude and duration (see page 2).

"INHIBITION" INPUT AND ANALOG OUTPUTS

ANALOG INPUTS AND OUTPUTS	"INHIBITION" input			
	Type	Dry contact		
	Maximal current to switch	1 ADC under 24 VDC		
	Insulation measured at 500 VDC	> 100 MΩ		
	Analog outputs			
	Qty	6 (3 for Voltage and 3 for Current)		
	Amplitude	±10V peak		
	"Voltage" scale factor	1 VRMS for 13,5 VRMS		
	"Current" scale factor VRMS / ARMS	PS-3x600 5,0 V / A	PS-3x1000 2,50 V / A	PS-3x2000 1,25V / A
	Insulation measured at 500 VDC	> 100 MΩ		

"INHIBITION" INPUT

- "INHIBITION" input directly acts on the command of output relays. A contact must be closed between the two points of this input to allow the generation. This input can be integrated in a safety loop and avoids an external contactor to ensure the switch off a unit under test.

ANALOG OUTPUS

They return two signals:

- Voltage image
- Current image

Used in "IMAGE" outputs, they deliver analog signals in the form of generated voltages or delivered currents.

The voltage images are independent and isolated each-other (2 wires per output).
The current images have a common reference.

MAINS

MAINS POWER	Mains	3x600 VA	3x1000 VA	3x2000 VA
	Number of phases	Single phase with Earth	Single phase with Earth	Three phases + Earth without Neutral
	Voltage	230 VRMS Phase Neutral -10% +6%	230 VRMS Phase Neutral -10% +6%	400 VRMS between phases -10% +6%
	Frequency	45 to 65 Hz		
	Mains current at full output power			
	Max current	16 ARMS	26 ARMS	18 ARMS per phase
	Protection	Magneto thermic breaker		
	Inrush current	Limited at 2 x Max current		
	Dielectric rigidity of the mains input versus output connected to case ground			
	Measure at 1500 VRMS / 50Hz	< 10 mA		

COMMUNICATION AND DRIVERS

COM	Communication (1)	
	Ethernet	TCP/IP on RJ45
	RS232	SCPI on SUBD 9 points

1) Specific communication protocols can be created on request on these links for a direct control of the equipment from your system

The power supplies are provided with OPS software (OPS1, OPS3, setting file) to generate specific waveforms or sequences of voltage variation and / or frequency variation (see on next page).

MECHANICAL FEATURES

MECHANICS AND ENVIRONMENT	Paint			
	Front panel	Painted aluminum RAL7021		
	Rear panel	Treated aluminum anodized black		
	Dimensions and weight	PS-3x600	PS-3x1000	PS-3x2000
	Width	483 mm (19 inches)		
	Height	600 mm		
	Depth	133 mm (4U)	222 mm (5U)	355 mm (8U)
	Weight	39 kg	59 kg	110 kg
	Temperature and humidity			
	Storage temperature	-10°C to +85°C		
	Operation temperature	+0°C to +35°C		
	Humidity	10% - 90% non-condensing		
	Noise (ventilation at full speed)			
	Measured at 1 m	< 70 dBA		
	Marking			
	Marking	CE		
	Protection index	IP20		

OPS SOFTWARE

OPS software are provided to control the power supplies and are composed of:

- OPS1
- OPS3 and the setting file

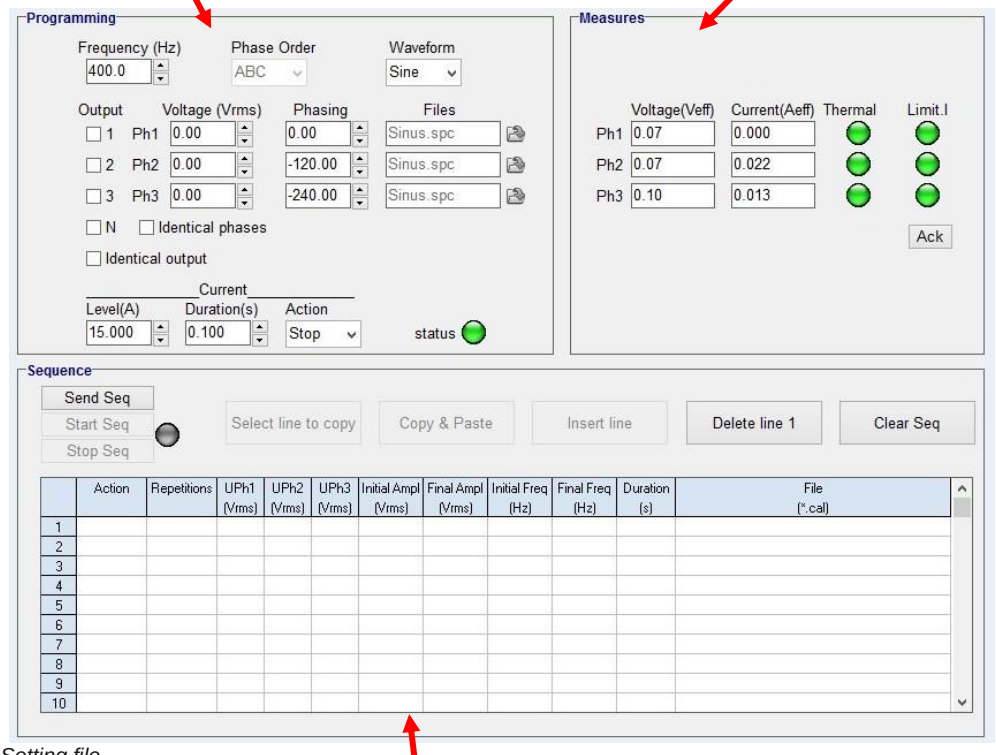
OPS3

OPS3 and the setting file allow an entire remote control of the power supplies.
OPS3 uses RS232 or Ethernet link.

Every programmable feature displayed on the touch screen of the power supply: voltage, max current, overcurrent, frequency, phase sequence…

Voltage and current measurements on each phase.

Status of the internal amplifier associated to each phase.



Setting file

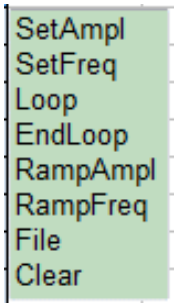
"Sequence" part is described on next page.

Create and run sequences

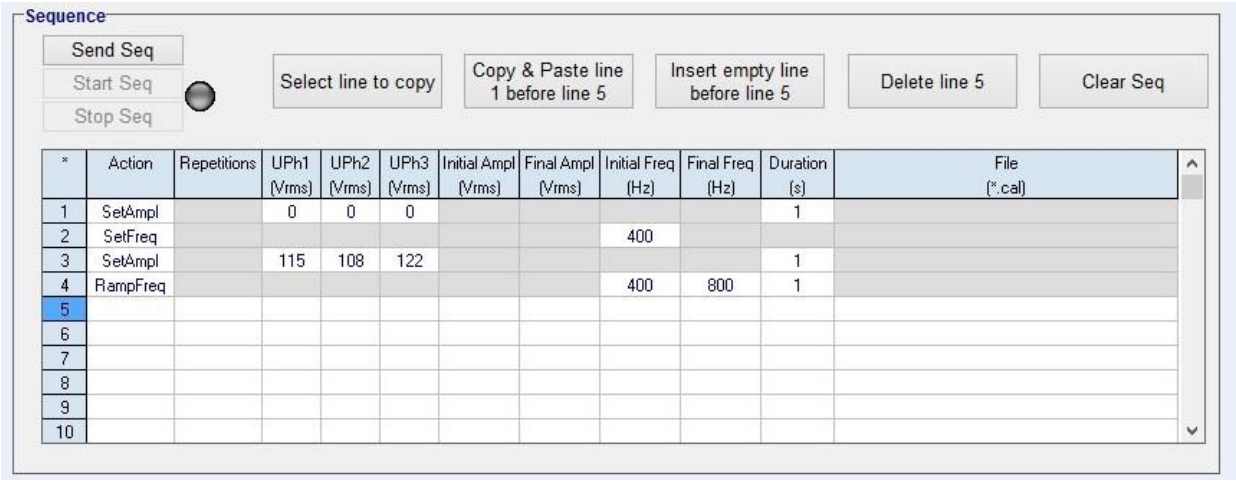
OPS3 software is used to create, save and modify test sequences.

The sequences are composed of standard "steps"

- Definition of an amplitude
- Definition of a frequency
- Beginning and end of loop
- Definition of a voltage ramp (variation of the amplitude)
- Definition of a frequency ramp
- Call for a waveform file



Max qty of steps in a sequence is 100.



*	Action	Repetitions	UPh1 (Vrms)	UPh2 (Vrms)	UPh3 (Vrms)	Initial Ampl (Vrms)	Final Ampl (Vrms)	Initial Freq (Hz)	Final Freq (Hz)	Duration (s)	File (*.cal)
1	SetAmpl		0	0	0					1	
2	SetFreq							400			
3	SetAmpl		115	108	122					1	
4	RampFreq							400	800	1	
5											
6											
7											
8											
9											
10											

Example: sequence with frequency changing

Theses sequences can be created and stored on the computer on which are OPS1 and OPS3 are installed, even if the computer is not connected to the power supply.

To run a sequence, its content is checked by the software then it is downloaded in the power supply by the button "Send".

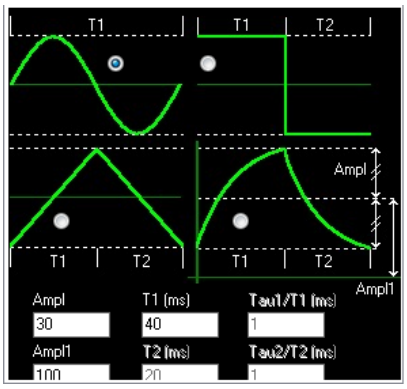
It is then stored in the nonvolatile memory of the power supply and can then be run as many times as necessary.

OPS1

Standard waveforms of ABD100 and UDC1 libraries of OPS1 are to generate sequences specific to aeronautical tests: voltage or frequency ramps, voltage dips…

These files are called "CAL" files (extension of their name).

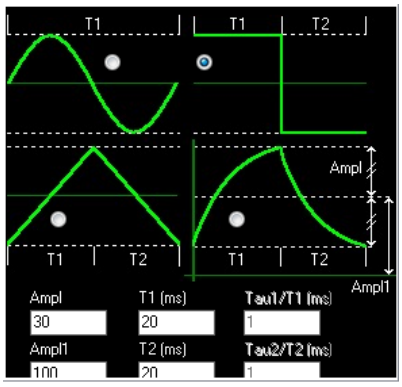
ABD100: modulation amplitude (sinus)



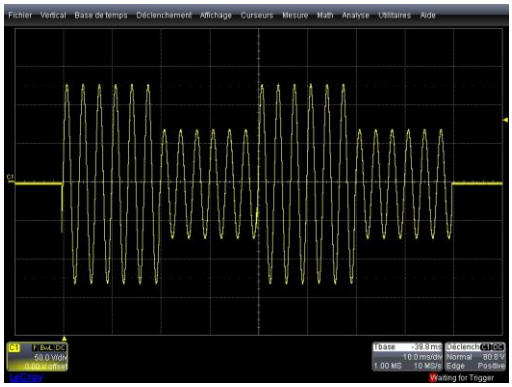
Setting

Waveform obtained

ABD100: modulation amplitude (square)

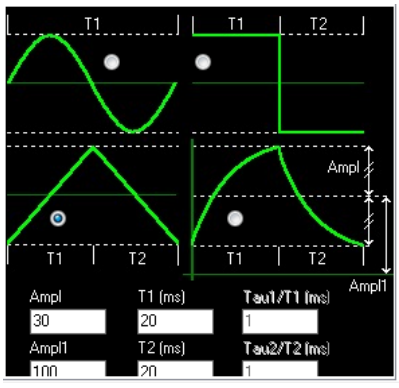


Setting



Waveform obtained

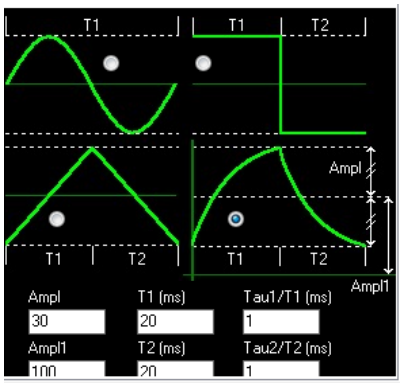
ABD100: modulation amplitude (triangle)



Setting

Waveform obtained

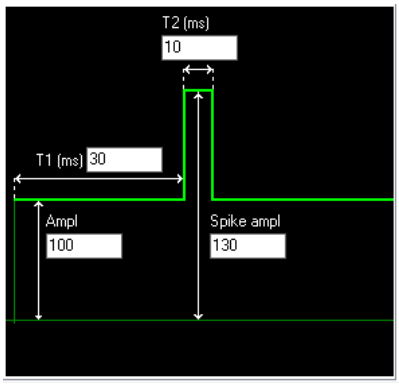
ABD100: modulation amplitude (exponential)



Setting

Waveform obtained

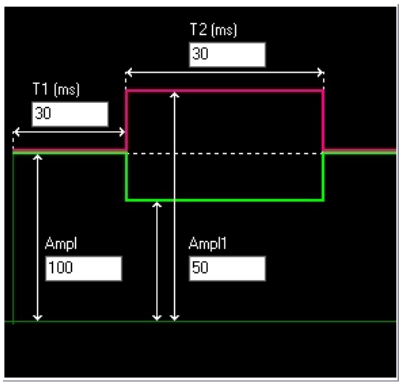
ABD100: spike amplitude



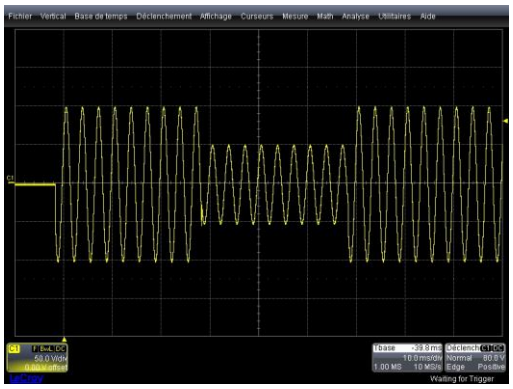
Setting

Waveform obtained

ABD100: surge amplitude

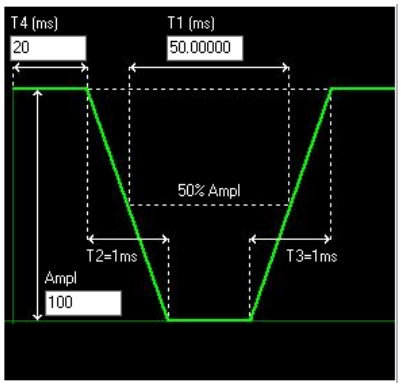


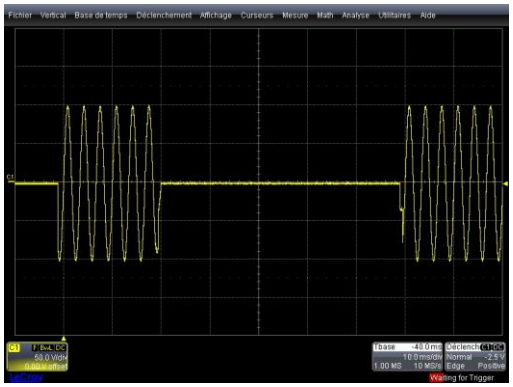
Setting



Waveform obtained

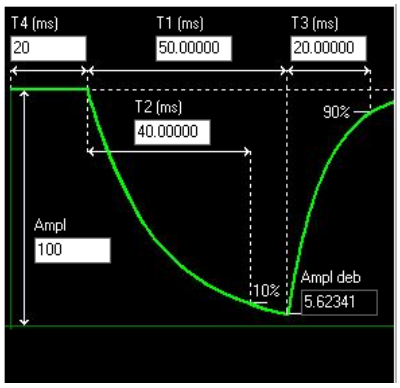
ABD100: switching transients A

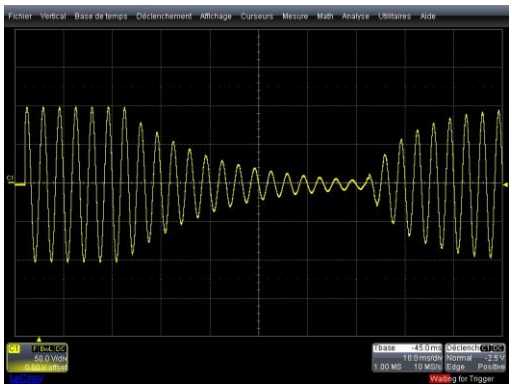




Setting Waveform obtained

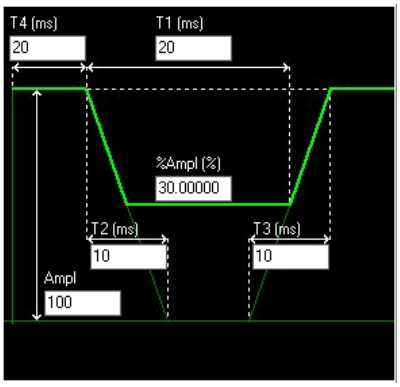
ABD100: switching transients B

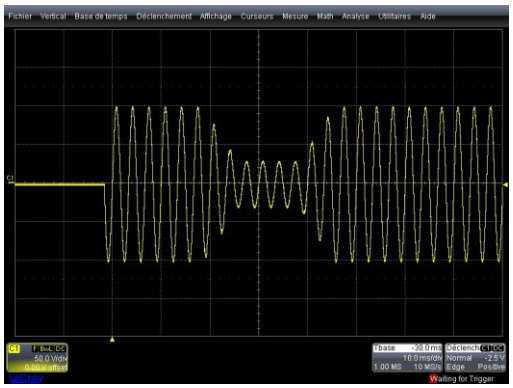




Setting Waveform obtained

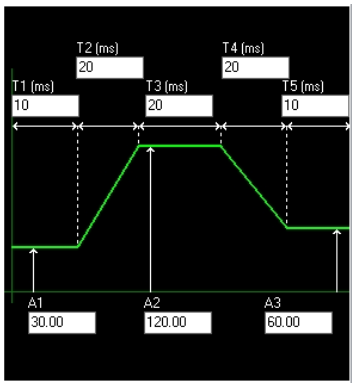
ABD100: switching transients C



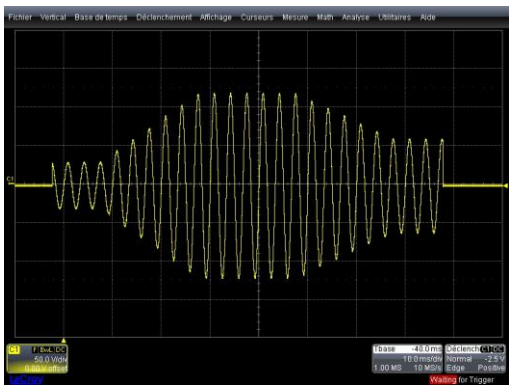


Setting Waveform obtained

UDC1: Pic

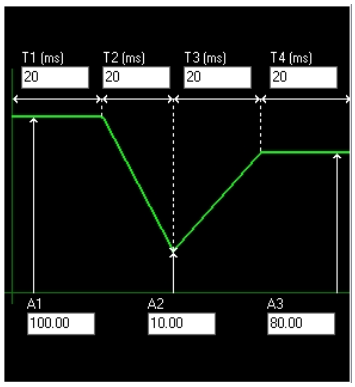


Setting

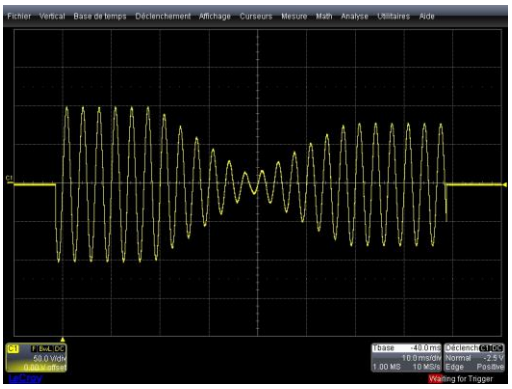


Waveform obtained

UDC1: Rebound A

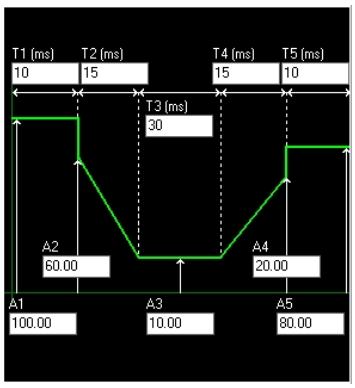


Setting

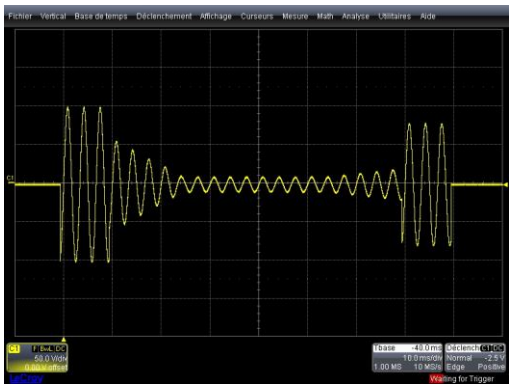


Waveform obtained

UDC1: Rebound B

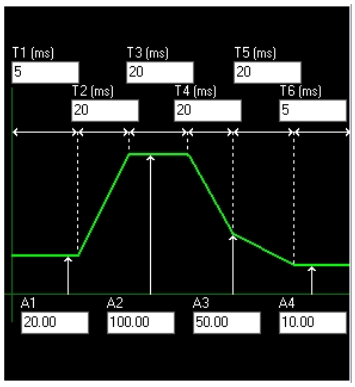


Setting

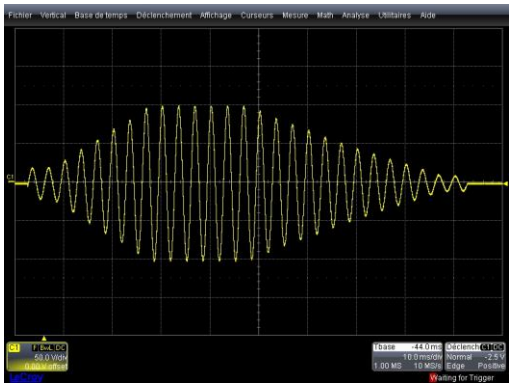


Waveform obtained

UDC1: DCS1

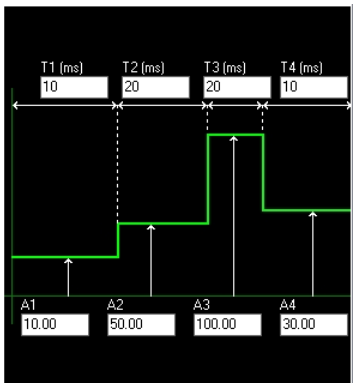


Setting

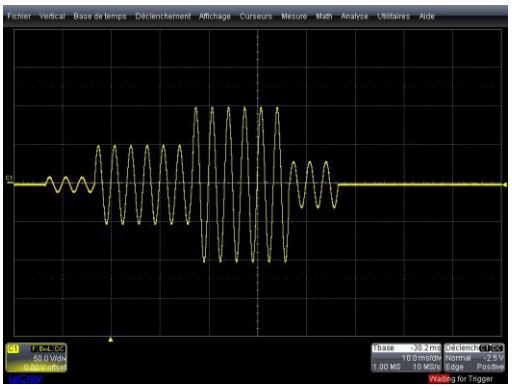


Waveform obtained

UDC1: DCS2

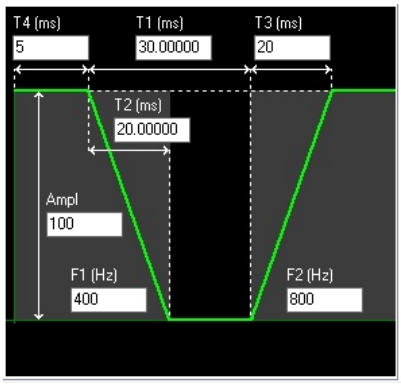


Setting

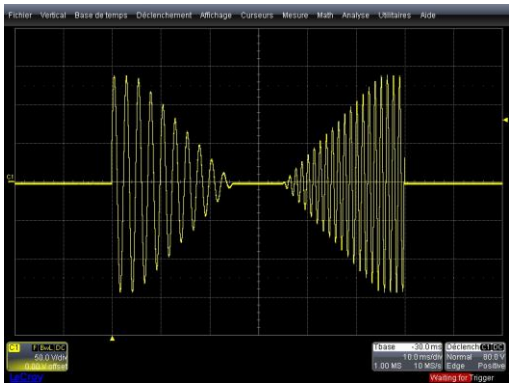


Waveform obtained

ABD100: frequency excursion



Setting

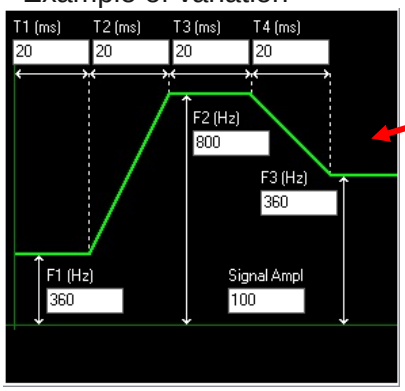


Waveform obtained

Frequency ramps

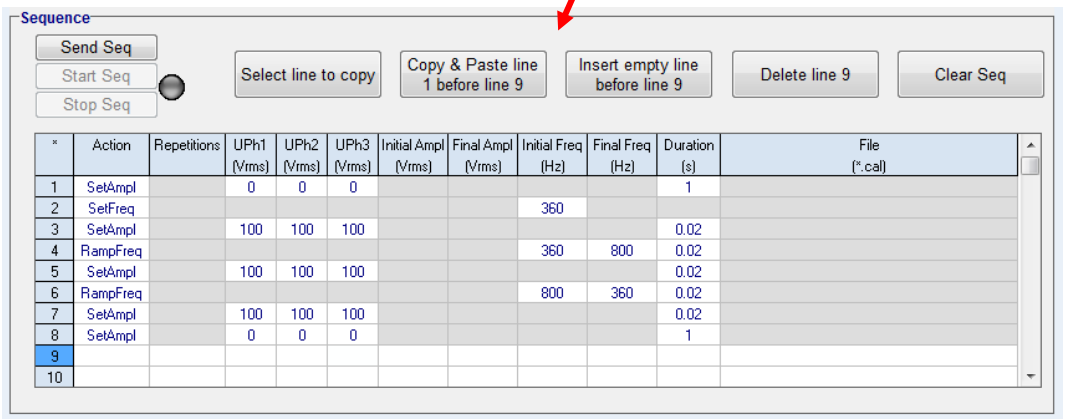
Frequency ramps are directly defined by OPS3.

Example of variation



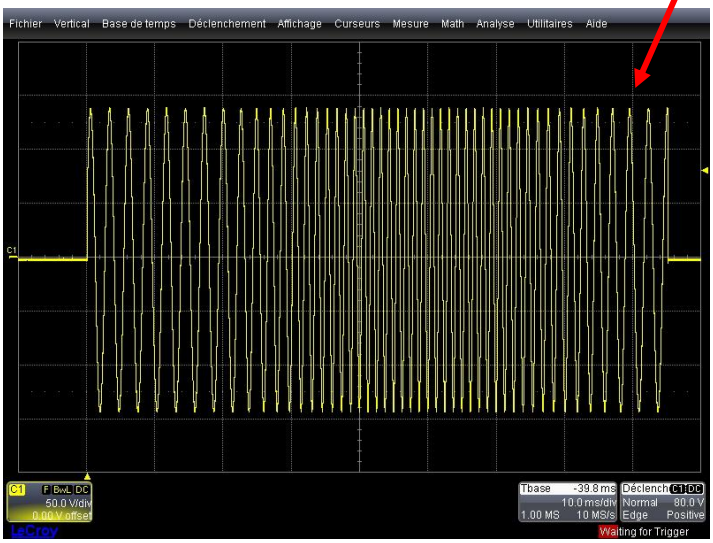
Example of variation

Transposition using OPS3



*	Action	Repetitions	UPh1 (Vrms)	UPh2 (Vrms)	UPh3 (Vrms)	Initial Ampl (Vrms)	Final Ampl (Vrms)	Initial Freq (Hz)	Final Freq (Hz)	Duration (s)	File (*.cal)
1	SetAmpl		0	0	0					1	
2	SetFreq							360			
3	SetAmpl		100	100	100					0.02	
4	RampFreq							360	800	0.02	
5	SetAmpl		100	100	100					0.02	
6	RampFreq							800	360	0.02	
7	SetAmpl		100	100	100					0.02	
8	SetAmpl		0	0	0					1	
9											
10											

Waveform obtained



Execution of "CAL" files (waveforms)

Each "CAL" file defines amplitude and duration of the signal.
It is possible to call the files using the sequencer and then follow their execution

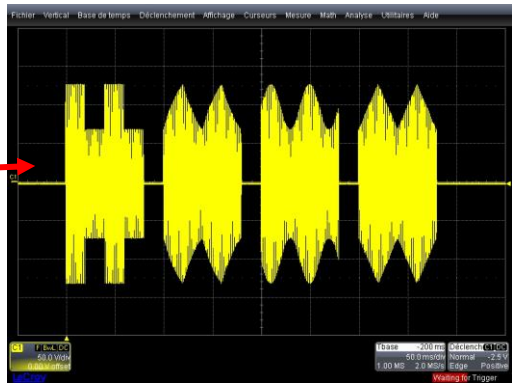
Sequence

Send Seq | Start Seq | Stop Seq | Select line to copy | Copy & Paste line 2 before line 6 | Insert empty line before line 6 | Delete line 6 | Clear Seq

	Action	Repetitions	UPh1 (Vrms)	UPh2 (Vrms)	UPh3 (Vrms)	Initial Ampl (Vrms)	Final Ampl (Vrms)	Initial Freq (Hz)	Final Freq (Hz)	Duration (s)	File (*.cal)
1	File										amplitude modulation carré.cal
2	SetAmpl		0	0	0					0.02	
3	File										amplitude modulation log.cal
4	SetAmpl		0	0	0					0.02	
5	File										amplitude modulation sinus.cal
6	SetAmpl		0	0	0					0.02	
7	File										amplitude modulation triangle.cal
8											
9											
10											

Example of sequences of 4 files

Waveform obtained



COMMERCIALE REFERENCES

Power supplies ready to use with OPS1 and OPS3 software:

PS-3x600-AC-130V-4.6A
3x600 VA

PS-3x1000-AC-130V-7.5A
3x1000 VA

PS-3x2000-AC-130V-15A
3x2000 VA

OPTIONS (please consult us)

PS-3xAERO-180V
Three phases transformer 3x2000 VA to increase output voltage up to 180VRMS to run the test with overvoltage at 180VRMS

PS-3xAERO-US
Three phases power supply with power stage suited to mains networks 200V between phases 50-60Hz

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