Alphα Programmable Converters

Powering industry with High-Tech electronics

Alphα Programmable Converters

Highest accuracy
for laboratory and industrial applications

■ Main Features and Options

- Unipolar, bipolar option with polarity reversal switch
- Max. Voltage output 1000V – Max. Current output 300A
- Highest stability (8h) of the market 0.004% Voltage / 0.006% Current
- 7 Control modes: Current CC, Voltage CV, Power CP, Hybrid CCV, Function generator, Analog voltage, Analog current
- Dynamic Save Operating Area (SOA) – Autoranging
- Real time accuracy dynamic calculation
- Active input filter, PFC = 1 in all operation range for high power applications
- Very low harmonic distortion
- Noise immunity
- 93.5 efficiency
- ZVS switched topology
- Remote voltage sensing
- Dynamic air cooling by power consumption or internal temperature
- Floating / ground connection, manual. Commanded by software, **optional.**
- Precision (nA) ground current monitoring for load ground insulation check, **optional.** Ground fuse permanent check, **optional.**
- Data base store 16GB > 30 years without erasing
- 7-inch touch screen display
- Ethernet, Wi-Fi, USB, HDMI
- EPowerSys remote control software
- Multiple remote-control: EPICS, TANGO Framework, MODBUS over TCP/IP
- Centralized switch-on for a group of power sources
- Highest power density: 12KW in ½ 19” rack / heigh 4U / weight ~15 Kg

Linux ANDROID Modbus HDMI ETHERNET Wi-Fi CE

EPOWERSYS

your preferred electronics supplier

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Optional modules

The Alphα family has been designed with the highest technical requirements to suit with its default configuration most of industrial, tests or laboratory requirements. Anyway, for those customers who had specific application requirements, a modular approach has been considered, giving the customer the option to include specific modules to adapt the supply to different application requirements.

■ External 0 – 10 V Trigger input for additional control modes

External 0 – 10 V trigger input for Analog Current and Analog Voltage control modes, allowing a total of 7 control modes: Constant current CC, Constant Voltage CV, Function generator, Hybrid CCV, Constant Power CP, Analog voltage, Analog current

■ Precision ground current monitoring (nA)

Permanent ground current monitoring for load´s ground insulation checking and ground fuse checking:

- Constant ground fuse checking, in case of fuse blowing an alarm is triggered.
- Constant ground leaks monitoring, from 20mA (accuracy 0,5%) to 40nA (accuracy 10%) (Megger level 100MOhm). Predictive load maintenance analysis can be performed, detecting winding insulation to ground.

■ Floating/ground output reference commanded by software

Floating or ground connected output is commanded by software from the control screen, avoiding any need of the power supply mechanical manipulation.

■ Additional input/output interlocks

By default, the converter is provided with 1 external input interlock. Optionally, up to 4 input and 3 output interlocks may be added:

- 1 output interlock is solid state, works at fast speed.
- 2 output interlocks are potential-free contacts, mechanical relays that work at slow speed.
- All interlock inputs are hardware (fast speed).

■ Freewheeling diode

300 A free-wheeling diode located on the rear panel to protect the equipment against inductive loads.

■ Internal air flow monitoring and maintenance warning

Real time monitoring of the internal air flow by anemometer (not by fan speed) and displayed in Power Flow Screen. If the air flow <7m/s maintenance warning for filter cleaning is activated.

■ Power lock

Allows centralized switch ON/OFF of a group of power supplies. The power button of the units can be disabled allowing multiple devices to start simultaneously controlled from a master device.

■ Active temperature monitoring and dynamic cooling control by temperature

Key points temperature is monitored in the converter like semiconductors, ZVS, Vienna, etc.:

- Temperatures are displayed in the screen
- Activate warning or stop internal interlocks
- Command the cooling algorithm to optimize fans speed to the internal temperature

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Technical Specification

OUTPUT	Max Output Current	300A (> 10KA in parallel mode) *Note 1		
	Max Output Voltage	1000V *Note 1		
	Output power	1.5KW - 12KW (3x400V input)	1.5KW – 10KW (3x200V input)	1.5KW - 3.5KW (1x230V input) *Note 2
	Polarity	Unipolar *Note 3		
	Current adjustment range	0.5 – 100 %		
	Voltage adjustment range	0.5 – 100 %		
	Ripple & Noise	10 mVpp @ 1mV rms @ BW 20Mhz *Note 4 & 6		
	Switching Frequency	100Khz (200KHz Output)		
	Output Insulation	1000V		
INPUT	Input Voltage	110V - 480V *Note 5		
	Input Frequency	50 - 60Hz		
	Power Factor Correction	Active, for power > 5KW		
	Power Factor	PFC=1 in all range with active power factor correction >5KW PFC=0.9 at rated output power <5KW		
	Input Filter	Active		
	Harmonic Distortion THD	3%		
	Efficiency	93.5%		
	MAX AC Current	32 Arms		
	Inrush Current	Soft Start, no Inrush current with active PFC Vienna		
Constant Voltage CV	Temperature stability	10 ppm/°C (70ppm/°C for Vout > 100V)		
	Long term stability (8h)	0.004% FS (after 30 min warm-up)		
	Line Regulation	0.01% FS (±10% mains voltage) 0.005% FS (With active PFC Vienna)		
	Load Regulation	0.02% FS (0.5 -100% load)		
	Accuracy	0.02% (With active PFC Vienna)		
Constant Current CC	Temperature stability	75 ppm/°C (after 30 min warm-up)		
	Long term stability (8h)	0.006% FS (after 30 min warm-up)		
	Line Regulation	0.01% FS (±10% mains voltage) 0.005% FS (With active PFC Vienna)		
	Load Regulation	0.06% FS (0.5 -100% load)		
	Accuracy	0.06% (With active PFC Vienna)		
Display accuracy	Voltage CV	0.004% 15 bit read-back resolution		
	Current CC	0.001% 23 bit read-back resolution		
NOTE	1. Other voltage and current configurations are available upon request. Max 1000V @ 12kW 2. 3.5 kW by default, ask EPowerSys for other configurations up to 5 kW 3. Bipolar option with a polarity reversal switch 4. Ripple&Noise measured at 100A and 500mΩ Vout < 100V - JEITA RC-9141 standard 5. Automatic power derating based on safe operating area (SOA) 6. Tests performed with 2 mH inductive load (Vout < 100V)			

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Control	Programmable Ramp function	0,001A/s to 3000A/s or Step Response
	Control Modes	1 Constant current CC 2 Constant Voltage CV 3 Constant Power CP 4 Hybrid CCV 5 Function generator 6 Analog Voltage **(optional)** 7 Analog Current **(optional)**
	Loop adjustment	Predefined PIDs for accurate loop adjustment Manual adjustment by user
	Closed loop bandwidth	50 kHz (20µs)
	Remote sensing compensation	>2V
Ground connection	Default configuration	Floating
	Optional	**Floating / Ground selection by software (Local or Remote)**
	Ground Leaks Monitoring	**From 20mA (accuracy 0.5%) to 40nA (accuracy 10%), optional**
	Ground Insulation	1000V When floating
Local control	Display	7'' Touchscreen
	Operating System	Android (Linux)
Remote control	Digital Protocols	MODBUS TCP/IP, TANGO, EPICS
	Control Software	EPowerSys control software
	Analog Control by voltage	**0-10V With Trigger, optional**
Ports	Type	3 USB, 1 HDMI, 1 ETHERNET, 1 Wi-Fi
Data Storage	Data Storage period	30 Years
Modularity	Parallel Connection	Yes, current and voltage control with current sharing
General	Dimensions	width ½ 19" rack, height 4U ~15Kg for 12 KW
	Operating temperature	0 - 55ºC 90% humidity (Non-condensing)
	MTBF	≥150,000 hrs
	Air Flow control mode 1	Dynamic air flow control, fans speed by power consumption
	Air Flow control mode 2 (optional)	**Dynamic air flow control and monitoring with internal anemometer** **If air flow gauge <7 m/s, warning is displayed for filter cleaning**
	Freewheeling protection	Diode 300A **(Optional)**
	Output Leads	Cupper bush bars, Gold plated
	Applications	• Test & Measurement systems • Laboratory • Industrial Processes

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Interlocks	Input	1 hardware (fast speed, not controlled by software) 3 hardware (fast speed, not controlled by software) **Optional** 1 External trigger 0 – 10 V (for analog control) **Optional**
	Output	2 mechanical relay (slow speed) NO-NC **Optiona**l 1 solid state (fast speed) **Optional**
	Isolated	Optoisolated 1000VDC
	Energy activation	All input and output interlocks have their own floating power supply with 1000VDC isolation
	Errors (Forces emergency stop)	*Vienna Interlocks:* Voltage Symmetry, *Over-current*, Over-voltage, Communications, Synchronization, **Temperature >90°C (optional)** *ZVS Interlocks:* Primary Current, watchdog, Overvoltage, Communications, 1 Hardware Interlock, **Temperature >90ºC (optional), 3 extra Hardware Interlocks (optional)** *Control Interlocks:* ADC 24bits, Software Over-current, Software Over-voltage, Current deviation, Voltage deviation, Power deviation, Loop oscillation, Communications.
	Warnings (Shows notification)	*Vienna Warnings:* Phase lost, Under-frequency, Over-frequency, Relay soft-start, Setpoint Bus, **Air Flow <7m/s (optional), Temperature > 85ºC (optional)** *ZVS Warnings:* **Temperature > 85ºC (optional)** *Control Warnings:* Current loop, Communications 8 Fans, Failure 8 fans, **Fuse Ground (optional), Under Ground Impedance (Programmable) (optional).**
	Isolated	Yes, Optoisolated 1000VDC.
	Energy activation	Input interlock has own floating power supply with 1000VDC isolation
Cooling	Cooling	Forced air or water cooling
	Fans Speed	Dynamic, by instant power consumption or **internal temperature (optional)**
Extra features	Input	Waveform generator, standard curves or point-by-point
	Output	Real Time accuracy % in display All system variables are shown in graphic display

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MODELS

Alpha 1.5 KW series

Output rating	U	15 - 100	40 – 50	60 – 25	100 – 15	200 – 15	500 – 15	750 – 15	1000 – 15
Rated output voltage	V	15	40	60	100	200	500	750	1000
Rated output current	A	100	50	25	15	15	15	15	15
Rated output power	W	1500	1500	1500	1500	1500	1500	1500	1500

Alpha 3 KW series

Output rating	U	15 – 200	40 – 100	60 – 50	100 – 50	200 – 15	500 – 15	750 – 15	1000 – 15
Rated output voltage	V	15	40	60	100	200	500	750	1000
Rated output current	A	200	100	50	50	15	15	15	15
Rated output power	W	3000	3000	3000	3000	3000	3000	3000	3000

Alpha 5 KW series

Output rating	U	15 - 300	40 – 150	60 – 100	100 – 50	200 – 25	500 – 15	750 – 15	1000 – 15
Rated output voltage	V	15	40	60	100	200	500	750	1000
Rated output current	A	300	150	100	50	25	15	15	15
Rated output power	W	5000	5000	5000	5000	5000	5000	5000	5000

Alpha 7.5 KW series

Output rating	U	40 – 200	60 – 150	100 – 100	200 – 50	500 – 15	750 – 15	1000 – 15
Rated output voltage	V	40	60	100	200	500	750	1000
Rated output current	A	200	150	100	50	15	15	15
Rated output power	W	7500	7500	7500	7500	7500	7500	7500

Alpha 10 KW series

Output rating	U	40 – 250	60 – 200	100 – 100	200 – 50	500 – 25	750 – 15	1000 – 15
Rated output voltage	V	40	60	100	200	500	750	1000
Rated output current	A	250	200	100	50	25	15	15
Rated output power	W	10000	10000	10000	10000	10000	10000	10000

Alpha 12 KW series

Output rating	U	40 – 300	60 – 200	100 – 150	200 – 100	500 – 25	750 – 25	1000 – 15
Rated output voltage	V	40	60	100	200	500	750	1000
Rated output current	A	300	200	150	100	25	25	15
Rated output power	W	12000	12000	12000	12000	12000	12000	12000

- ***Consult EPOWERSYS for other configurations, max 1000V 300A at 12Kw***
- ***Higher current / power configurations by parallel configuration***
- ***12kW available with 3x400V input. 10kW with 3x200 input***

CE

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Main Features Description

■ High Voltage / Current output

Alphα converters can deliver up to 1000V of maximum voltage and 300A of maximum current, with up to 12KW of maximum power. Optionally, it can be equipped with a bipolar output stage for two-quadrant operations, enabled by a polarity reversal switch.

■ AC Mains input

Single phase or Three Phase mains input supported

Note: In Single Phase input, as a safety precaution, by default the maximum power is limited 3.5 KW. For configurations in single phase up to 5KW consult EPowerSys.

■ Vienna rectifier

Active power factor correction by Vienna Rectifier, PFC=1 in all operation range, for power configurations >5KW.

This topology also provides with an active input filter and very low harmonic distortion.

Efficiency 97%.

■ Digital ZVS

The power module is based on a ZVS converter. ZVS performance has been adapted to our architecture and is processed in a DSP optimizing the converter operation in terms of reliability, robustness, efficiency, and noise immunity.

The power supply works with ZVS technology for the entire load range (ZVS with no-load), performs from 0% to 100% obtaining outstanding dynamic performance and accuracy.

■ Control loop

- Pre-defined control loop PID configurations ready to be selected according the load to achieve maximum accuracy.
- User selectable PID configuration, can be changed by user for fine tuning
- Real time – High speed digital control loop 50khz (20us)

■ High accuracy current control Technology

Special algorithm to control current loop with a high precision sensor is used, with long-term stability (8 h) less than 0.006% FS is achieved.

■ Dynamic load functionality for controlling the voltage loop

Precise regulation of the output voltage loop even when no load is connected.

Power supplies have difficulty regulating the output voltage loop without a load, that´s why many manufacturers generally require a load to be connected to be able to carry out correct voltage loop regulation. By means of the *dynamic load* functionality, Alpha power supplies have always a precise regulation of the voltage output loop, regardless of whether a load is connected or not.

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Control modes

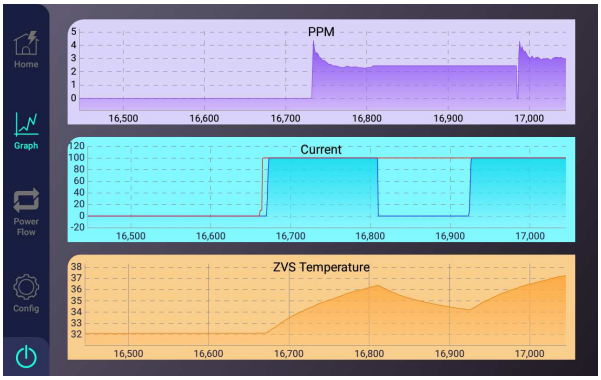
7 Control modes supported:

- Constant current (CC)
- Constant voltage (CV)
- Hybrid: both voltage and current can be programmed (CCV)
- Constant Power (CP): set point can be programmed in Watts.
- Analog voltage: set-point programmed via 0-10V analog trigger input (optional)
- Analog current: set-point programmed via 0-10V analog trigger input (optional)
- Function generator: dynamic set point follows programmed curves. Any curve can be programmed (up to 50Hz), and it is available in current, voltage and power.

Real time accuracy calculation

Real time accuracy display in % for the present load, in screen and in graph.

This feature is especially useful for control loops adjustment using different PID configurations.

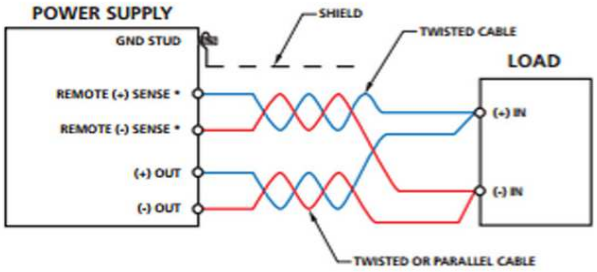


Load protection

- Extended dynamic range for ramp generation, from less than 0.01 A/s to over 3000 A/s or even step response.
- Hysteresis protection: Maximum deviation value between setpoint and measurement can be selected in voltage, current and power.

Remote sensing

Remote voltage sensing to avoid voltage drop in cables by measuring real voltage on the load.



LDO references

ADC and DAC Digital converters are powered by LDOs. This linear technology avoids commutations and noise, guaranteeing high accuracy in converter instrumentation and clean voltage.

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Save Operating Area (SOA) & Autoranging

The power supply can automatically control and adapt the output current and voltage to the maximum supported power or to a user preset power (always lower than max. supported power). This functionality provides high safety capabilities an enormous flexibility to supply configuration:

- Automatic SOA: automatic current or voltage autoranging. If demanded current - voltage configuration exceeds the maximum power, the supply will automatically adapt the other output according to the defined maximum power limit (e.g. for a 10 KW 1000V - 25A supply, if 25A are demanded, the output voltage will automatically be limited to 400V). This feature works independently of the selected control loop, current or voltage.
- Manual SOA configuration: voltage, current or power can be manually limited by user, this functionality is interesting for load protection.
- Automatic input voltage detection: 400V or 200V input voltage detection and maximum power adjustment. Depending on the input voltage the converter automatically adjusts the operation limits for device own protection.
- SOA limits and operation point are displayed in the screen.
- If the operating point is within the displayed SOA, the converter will perform normally.
- The configured software protection limits are also displayed.
- Voltage and current are monitored every 20µs

Dynamic fan speed

To optimize the fans usage, and to lengthen their operation live, fans speed is dynamically controlled by demanded instant power, minimizing the fans usage and the noise.

Optionally, with the active temperature monitoring module, the fans speed is controlled by internal temperature. With this feature, the converter will adapt the fans speed also considering the external air temperature conditions influence (e.g. in an air-conditioned room the use of fans will be different from a room at 35 °C).

Active temperature monitoring and dynamic cooling control by temperature

key points temperature is monitored in the converter: semiconductors, ZVS, Vienna, internal temperature, etc. This feature allow a deeper control about the converter operation status by:

- Temperatures are displayed in the power flow screen for a visual operation status control
- Internal control algorithm which activates a Warning interlock when ZVS or Vienna Temp reaches 85 °C and a Stop interlock when temperature reaches 90 °C
- Dynamic air flow control algorithm is commanded by internal temperature

Internal air flow control and maintenance

As an optional module, the supply's internal air flow can be monitored with an anemometer. This information is displayed in the power flow screen, generating a “filter cleaning” warning in the screen when the air flow <7m/s. This module is specially recommended for dusty environments.

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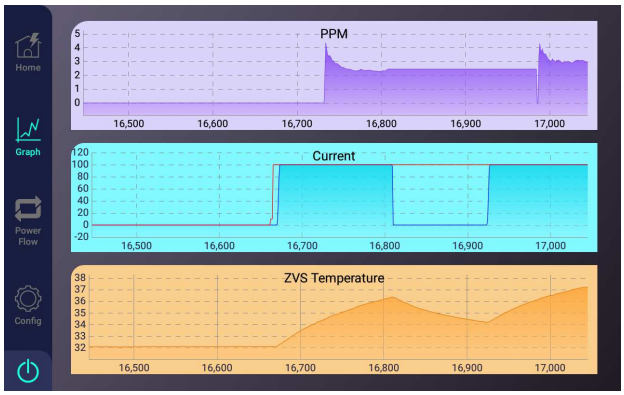
Front panel interface

7-inch touchscreen that provides unique user interface and information displaying capabilities, giving a really user friendly and easy to use user interface:

- Allows both instant analog information display and graphical information display.
- 1 HDMI output for duplicating screen on an auxiliary display
- 3 USB ports for database dumping or peripherals connecting, such as keyboard or mouse (plug and play)
- All status and internal systems information is displayed directly in the screen: Vienna rectifier, HF inverter, fans, output, operating time indicator, etc.
- Screen brightness control.
- Language selection.
- The display allows to locally monitor and modify any converter parameter.



Android (Linux) operating system

User interface is based on an Android (Linux based) operating system providing best user experience in terms of user-friendliness, connectivity, remote control, update, reliability, etc.

Remote control

Alphα family can be remotely controlled via Ethernet or Wi-fi by MODBUS, EPICS, TANGO or using the EPowerSys Remote Control Software, providing a unique software infrastructure for use in building distributed control systems to remotely control multiple converters.

Such distributed control systems typically comprise tens or even hundreds of converters, networked together to allow communication between them and to provide control and feedback of the various parts of the device from a central control room, or even remotely over the internet.

Ethernet & Wi-Fi interfaces.

Long term data storage

Internal 16 GB database, allowing more than 30 years data storage. All stored parameters, can be displayed on charts, where the user can choose which parameters will be displayed, or downloaded from the USB port.

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Parallel operation mode

Alphα models can be connected in parallel to achieve higher output voltages and currents. The parallel mode is supported with current and voltage control with current sharing.

Master – slave protocol to allow centralized control. This feature combined with the **Lock Power option**, allows a centralized control and switch-on/off.

Reliable connections

Reliable Gold-plated cupper 10 mm x 10 mm busbars output to improve electrical connection and prevent oxidation.

Noise immunity

Switching semiconductors are driven by means of a fiber optic digital transmitter, achieving the highest performance in terms of speed, bandwidth, attenuation and noise immunity.

Optic fiber drivers

The power supply uses a high frequency transformer designed to minimize the dispersed flow, preventing induced currents and noise generation.

Hardware input / output interlocks

By default, the Alphα converters are supplied with one external input interlock, but optionally can be supplied with up to 4 input and 3 output interlocks:

- 1 output interlock is solid state, works at fast speed
- 2 output interlocks are potential-free contacts, mechanical relays that work at slow speed
- All interlock inputs are hardware (fast speed)
- Interlocks are optoisolated (or relay) 1000V insulation
- Energy Activation: All input and output interlocks are powered by floating power supply 1000VDC isolation
- Same control signal for all hardware output interlocks
- Hardware primary overcurrent interlock provides the converter with absolute robustness against shortcircuits

Internal interlocks

ERRORS (**Alphα forces emergency stop**)

Vienna Interlocks: Voltage Symmetry, *Over-current*, Over-voltage, Communications, Synchronization, **Temperature >90°C (optional)**

ZVS Interlocks: Primary Current, watchdog, Overvoltage, Communications, 1 Hardware Interlock, **Temperature >90ºC (optional), 3 extra Hardware Interlocks (optional)**

Control Interlocks: ADC 24bits, Software Over-current, Software Over-voltage, Current deviation, Voltage deviation, Power deviation, Loop oscillation, Communications..

WARNINGS (Alphα shows notification)

Vienna Warnings: Phase lost, Under-frequency, Over-frequency, Relay soft-start, Setpoint Bus, **Air Flow <7m/s (optional), Temperature >85 °C (optional)**

ZVS Warnings: **Temperature > 85 °C (optional)**

Control Warnings: Current loop, Communications 8 Fans, Failure 8 fans, **Fuse Ground (optional), Under Ground Impedance (Programmable) (optional).**

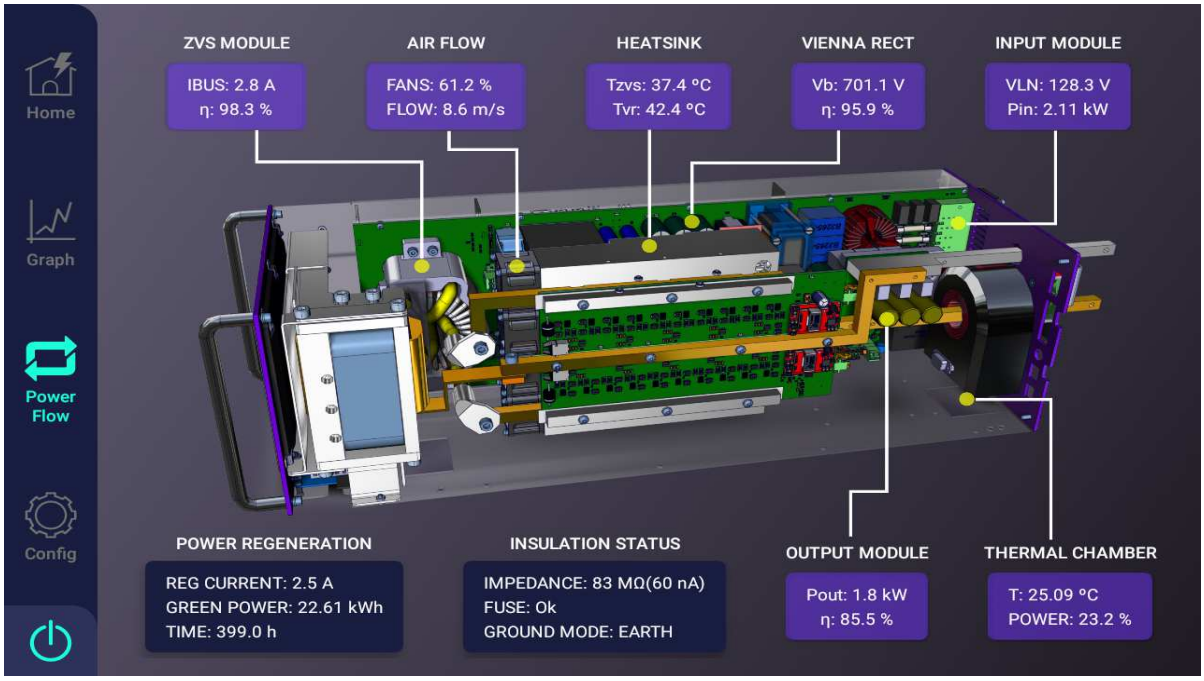
Floating/ground output reference commanded by software

By default, the Alpha models are delivered in floating configuration. If the customer wants a ground connection, this must be done manually.

For those situations where constant reference changes must be made, the optional *Floating/*ground by software module can be added to the supply. In this case, floating or ground configuration is commanded by software from the control screen, avoiding any need of the power supply mechanical manipulation.

Power Flow screen

Shows all status control information unified on a single screen



Small size and weight

Alphα has achieved one of the highest power density available in the market:

12 KW device dimensions: width ½ 19 ”rack, 4U height, ~15 kg weight.

Applications

Laboratory applications

Test & Measurement systems

Medical Imaging and treatment systems

Industrial processes

Renewable energies

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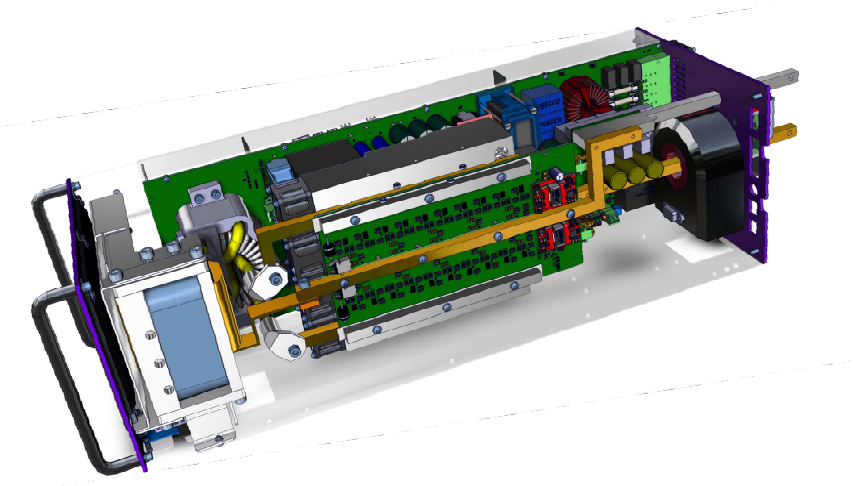
Model numbering

ALPHA	-	10000	-	1000	-	15	-	T-I-G-L-F-T-A-S
Model		Power		Output voltage		Output current		**Optional modules selected:** • T - External 0 – 10 V Trigger • I - Additional input/output interlocks • G - Precision ground current monitoring • L - Power lock • F - Freewheeling diode • T - Active temperature monitoring and dynamic cooling control by temperature • A - Internal air flow monitoring and maintenance warning • S - Floating/ground output reference commanded by software



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