



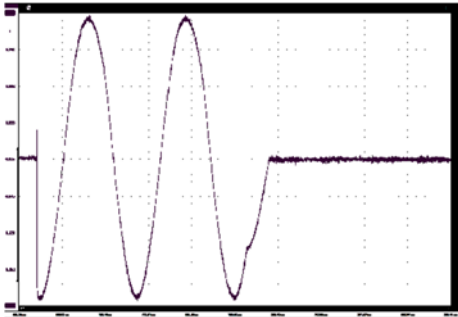
Thyristor Power Controller AKGrad32



AKA Automatismes
www.aka-automatismes.com
15, rue des Pyrénées
ZAC du Bois Chaland
91090 - LISSES - FRANCE
info@aka.fr

AKGrad32 Thyristor Power Controller

AKGrad32 SCR Power Controller performs a smooth and continuous regulation of the power dissipated by the heating elements connected to its Thyristors by switching ON or OFF every half cycle (10ms) of the AC electrical power line according to the Setpoint defined by the process.

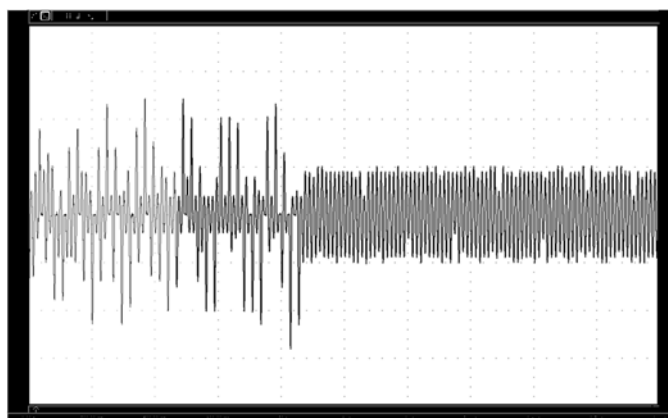


Each SCR/Thyristor is a switching device which can provide fast AC full wave or proportional phase angle conductions of electric power. AKGrad32 performs a well-balanced power regulation with the best accuracy for your heat process at the same time it guarantees an optimized heater life following the specifications of heating elements manufacturers.

Thanks to its powerful 32bits DSP processor, an AKGrad32 calculates true RMS U, I, P and R for each phase. This powerful measurement system enables:

- Very high precision +/- 0.1kW closed loop kW, rate %, I² or U² regulation and load failure diagnosis on the power line.
- Patented SYNCHRO power savings algorithm integrated into each AKGrad32 control card for flicker suppression
- Patented soft-start firing for inductive downstream transformer which avoid any over current peak due to magnetic current even in cost saving 2-Phases Control Three Phase Circuit.
- Phase angle soft start for loads with high cold/hot variation (Molybdenum, SiC)
- Protections against over current peak, instantaneous correction against voltage slowdown or load surge.

AKGrad32 Power Controller	Full Wave Mode with/without phase angle soft-start feature		Permanent Phase Angle with current limit "PA"
	Resistive Load "R"	Any Downstream Transformer "QR"	Any load with/without downstream Transfo
Single Phase	YES	YES	YES
Three Phase 2Phases Control	YES	YES	NO
Three Phase 3Phases Control	YES	YES	YES



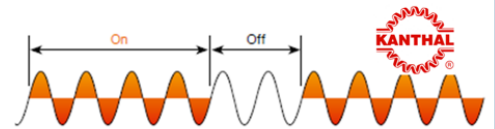
Global current: On the left side without SYNCHRO / On the right side with SYNCHRO

AKGrad32 Thyristor Power Controller

The modern **AKGrad32** power controller, equipped with 32 bits DSP CPU, gathers different functions that previously had to be operated separately and allows accurate control of full waves or phase angle for resistive or complex loads with or without downstream transformer.

	Phase Angle	Full Wave
Single phase	All types of resistances	All types of resistances
2 arms 3 phases		Ni-Cr resistance Silicon carbide SiC resistance
3 arms 3 phases	Ni-Cr resistance Silicon carbide resistance Molybdenum resistance Graphite resistance	Ni-Cr resistance Silicon carbide resistance Molybdenum resistance Graphite resistance

AKA Fast full wave Thyristor / SCR firing complies with Khantal spec



To minimize the effect of the 'on' burst, the time base of the firing cycle must be as short as possible and preferably less than 30 cycles of a 50 Hz supply (i.e. 50% power = 15 cycles 'on' + 15 cycles 'off').

Khantal Handbook Extract

AKgrad32 saves money and increases reliability with

- Downstream power transformers 1.2 to 1.6 Tesla (cost effective)
- Integrated industrial communication networks (serial & Ethernet)
- Integrated power savings feature SYNCHRO (plug & play & reliable)
- Additional HMI Panel Operator in your language

Maintenance Diagnostics and softwares for Windows 7 / 8 / 10

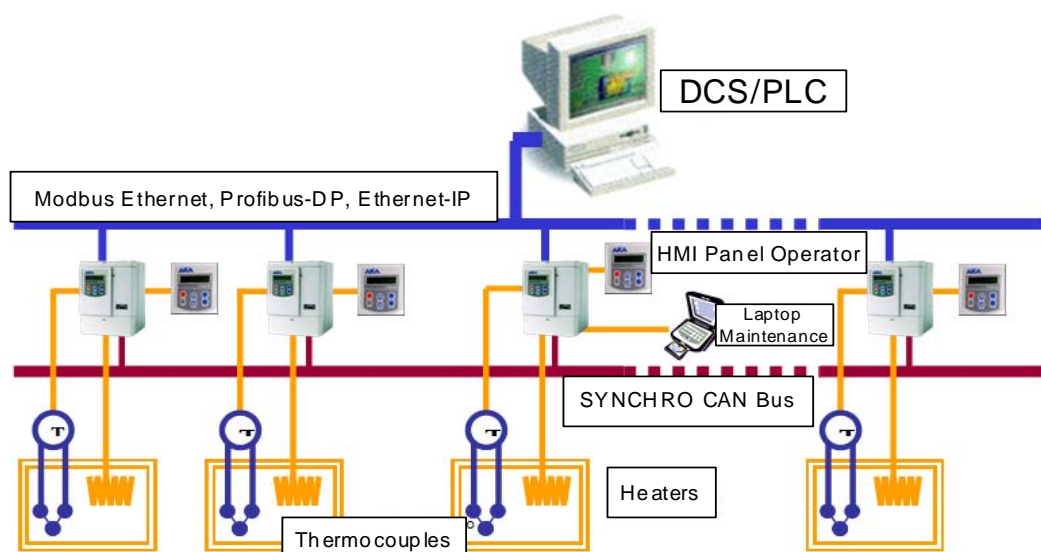
- Digital display of U, I, kW, % measurements
- Effective current limitation
- Partial and total load failure
- Software: upload to laptop and download from laptop
- Display and export measurements to Excel files or JPEG



AKGrad32 Factory automation

Allows the integration of the power controllers to the existing industrial networks

The **AKGrad32** power controllers are designed to be integrated in the factory automation in a cost-effective way. The Synchro power savings feature function is integrated into the power controller as a real-time plug & play mode, thus saving the less reliable external hardware and the expensive time spent to have it work.

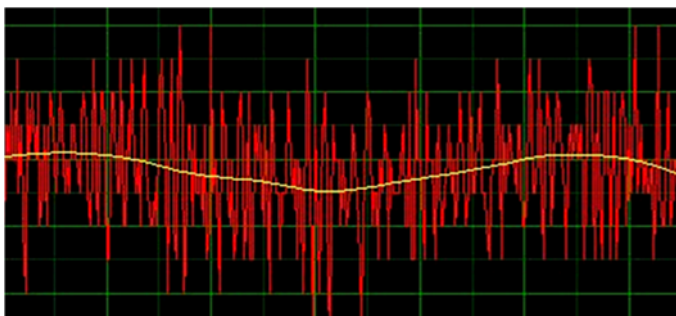


AKGrad32 Power savings SYNCHRO

Limitation of the instantaneous power peak and elimination of the flicker phenomenon

The synchronisation function makes it possible to smooth the instantaneous power peaks. This function uses a communication bus dedicated between the power controllers, without addition of a dedicated master:

- Reactive power = 0, $\cos \varphi = 1$
- Reduction of the wiring and of the cables sections (less dissipation)
- Reduction of the power supply transformer size (less oversizing)
- Elimination of the flicker phenomenon (no need for additional capacitive loads to improve the power factor)



Instantaneous power without synchronisation

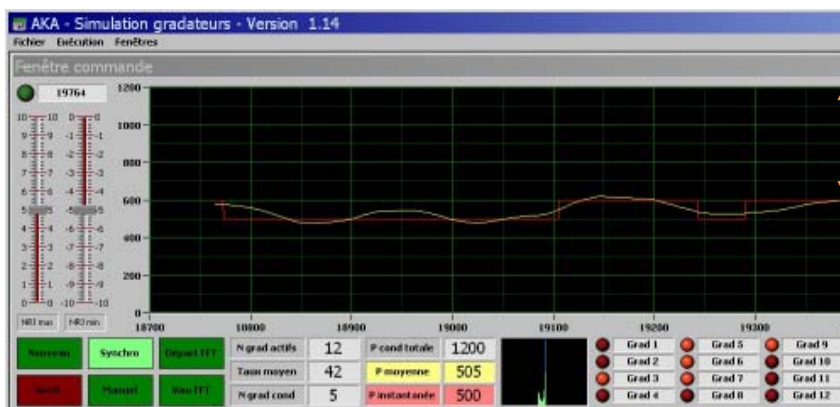


Instantaneous power with synchronisation

AKGrad32 Load Shedding Management

The optimum management of the overloads

The temporary overloads can exceed the available power. The intelligent power cut function coupled with the synchronisation allows the optimal use of the available power, without having to increase the installed power.



Max installed power

Available power

Power controller average power

AKGrad32 DCS / PLC

AKA is able to offer Factory Automation Fieldbus options to allow the AKGrad32 to communicate with modern PLC related to the DCS supervision of the factory: **Profibus-DP & Modbus Ethernet** options operate **simultaneously** in the AKGrad32 to offer:

- Management of the parameters and of the power controller states
- Management of the defaults & diagnosis
- Management of applicative parameters (ageing of resistances...)
- Histories of measurements, of defaults etc...

AKGrad32 Specifications

Operating modes

Modes	Magnetization	Phase Angle	Full waves
Single phase	Yes downstream transformer	Yes	Yes
2 arms 3 phases	Yes downstream transformer	« pre-heating. »	Yes
3 arms 3 phases	Yes downstream transformer	Yes	Yes

Display of physical values

The 2 lines 16 characters display panel makes it possible to display: U, I, P kW, τ %, R%, T°C

Differed starting

Temporisation between the time of reception of the start order and the effective start of the power controller. This function allows the starting of the power controllers at different times in order not to disturb the network, in particular in the case of a powering by a power generating unit.

Preheating / Soft Start / Current Limit

Progressive powering of the resistances in order to bring them to their operating temperature without mechanical constraint and overcurrent. Permanent Current Limit Mode.

Starting ramp

The set point is applied gradually according to a linear ramp.

Limitation of the effective current

Limit current not to be exceeded. Automatic limitation of the effective current. (In the case of an overshoot, a current default is activated).

Limitation of maximum power

Makes it possible to limit the maximum output power whatever the value of the set point.

Limitation of minimum power

Impose a minimum power of maintenance, even if the set point is at zero.

Set point in rate %

The set point 0-10V or 4-20mA must be connected to one of the analogical inputs or transmitted by serial communication. The delivered power is proportional to the set point.

Power set point

The set point 0-10V or 4-20mA (image of PkW) must be connected to one of the analogical inputs or transmitted by serial communication. The delivered power in kW is the image of the set point. It is corrected of the variations of U and R.

Hot/cold set point

Set point in V to heat and cool. Arches of annealing in glassmaking application.

Resistance measurement

The value of the equivalent load resistance is measured and displayed.

Partial Load Failure / Heater Break

The load often consists of several resistances in parallel. In the case of the breakage of one of the resistances, the AKgrad32 detects an abrupt variation of resistance and emits an alarm.

Ageing measurement

The silicon carbide resistances age in time. Their value increases (about 20%). The AKgrad32 measures in real time the value of the resistance and compares it with a threshold whose overshoot can activate an alarm.

Real time clock (Option)

The real time clock allows to horodate the events and/or to start orders. The date and the hour are saved by an integrated battery.

Human machine interface (Option)

An industrial display with integrated keypad communicates with a single thyristor power controller via Modbus RS232 digital communication. It operates as a local control/command system: commands kW very precisely, runs ON/OFF, resets faults, displays electrical measurements such as U, P, I & R for each phase.

AKGrad32 Technical Features

- **LCD Display & keyboard (integrated)**
2 lines 16 characters enlightened display LCD
- **Remote HMI Panel Operator Interface (option)**
480 * 272 4.3" TFT LCD Display with RS232 / RS485 / Ethernet
- **TOR inputs (integrated)**
5x digital inputs (free of potential)
- **Analog inputs (integrated)**
3x programmable 0-10V or 4-20mA analog inputs
- **TOR outputs (integrated)**
2 fault relays (220VAC, 2A)
1 static relay (48V 50mA)
- **Analog outputs (integrated)**
3x programmable 0-10V or 4-20mA analog outputs
- **Serial links (3 simultaneous COM)**

HMI Operator Interface



	Protocol/support	Connector
Link 1	ModBus RS232/485/422	RJ45
	Modbus Ethernet	RJ45
Link 2	Ethernet/IP or Profinet/Ethernet	RJ45
	Profibus-DP	SubD9
	Modbus RS232/485/422	RJ45
Link 3	CanOpen or Devicenet	SubD9
	Synchro Savings (ECO kW)	RJ11

- **Thyristors protection**
Each thyristor is protected by an electronic protection and its measurement: Overcurrent/ Voltage shutdown/ Short circuit. General distribution fuses are necessary. Fuses and Prosistors can be provided on request.
- **Applicable standards**
EN 60 947-4-3 Ed2.0 (05/2014) Safety / EMC emissions / EMC immunity
EN 60 947-1:2007 + A1:2010 + A2:2014 General rules
2014/35/UE (26/02/2014) Low Voltage Directive
2014/30/UE (26/02/2014) EMC Directive

AKGrad32 Order Details

Designation : AKGrad32 U-III-N-T-P-R-S

	Voltage	Thyristor Size	Qty Thyristors 1P/2P/3P	Downstream transformer	Option HMI	Factory Automation Fieldbus/Networks	Synchro savings
AKGrad32	U	III	N	T	P	R	S
	2= 70V-220V	100A	1 : 1 Phase	0 : No	HMI 4"	0 : 2x Modbus RS232 only	0 : No
	4= 220V-460V	To	2 : 2 Phases	T : Yes	HMI 7"	P= Profibus-DP	S : Yes
	6= 460V-690V	2500A	3 : 3 Phases			T= Modbus Ethernet	
						M= Modbus Serial 485/422	
						I = Ethernet/IP	
						N = Profinet / Ethernet	

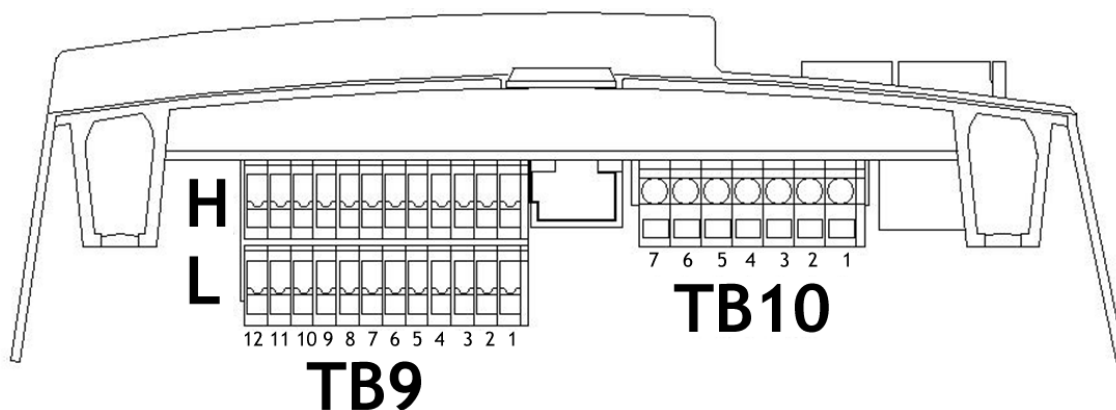
Calibre		60A	100A	150A	230A	330A	420A	600A	950A	1500A	2500A
3 thyristors / 3 phases triphased AKgrad32	I mm	175	175	293	293	293	537	537	537	537	537
	L mm	300	300	377	377	377	390	390	655	820	820
	H mm	235	245	285	285	285	335	335	335	425	425
2 thyristors / 3 phases triphased AKgrad32	I mm	175	175	175	175	175	293	375	375	537	537
	L mm	250	300	300	300	300	390	575	575	820	820
	H mm	235	235	245	245	245	325	385	385	425	425
1 thyristor / 1 phase single phase AKgrad32	I mm	175	175	175	175	175	293	375	375	537	537
	L mm	300	300	300	300	300	377	390	655	820	820
	H mm	235	235	245	245	245	285	335	335	425	425

AKGrad32 I/O Cabling

Terminal TB9H	
Nb	Signal
1	0V Digital Inputs Ground
2	Digital Run/Stop Input
3	Digital Input 1
4	Digital Input 2
5	Analog input 1 : mA/V (-)
6	Analog Input 1 : mA/V (+)
7	Tension Référence +10V
8	Analog Input 2 : mA/V (+)
9	Analog Input 2 : mA/V (-)
10	Analog output 1 : mA/V (+)
11	Analog output 1 : mA/V (-)
12	0V Control Card

Terminal TB9L	
Nb	Signal
1	Analog output 2 : mA/V (+)
2	Analog output 2 : mA/V (-)
3	Digital Input 3
4	Digital Input 4
5	Analog Input 3 : 0V (-)
6	Analog Input 3 (+)
7	Reference voltage +10V
8	Analog Input 4 (+)
9	Analog Input 4 : 0V (-)
10	Analog output 3 : mA/V (+)
11	Analog output 3 : mA/V (-)
12	0V Control Card

Terminal TB10	
Nb	Signal
1	Control Card Power Supply 110/220V L
2	Control Card Power Supply 110/220V N
3	Control Card Power Supply – Earth
4	K1 Relay
5	K1 Relay
6	K2 Relay
7	K2 Relay
8	K3 Relay
9	K3 Relay



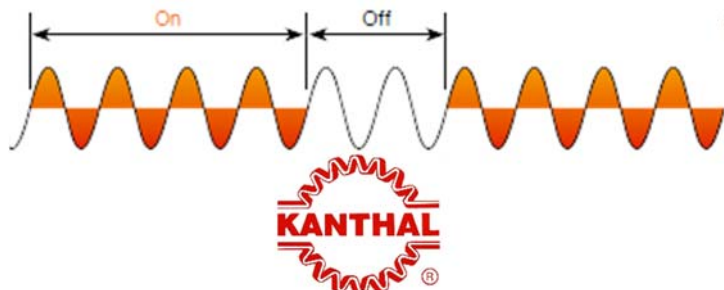
AKGrad32 Downstream Transformer (SiC, etc.)

The « Float Glass » or « vacuum ovens » applications require complex resistances of silicon carbide type, bisulfide of molybdenum or graphite, which it is necessary to power through a voltage step-down transformer.

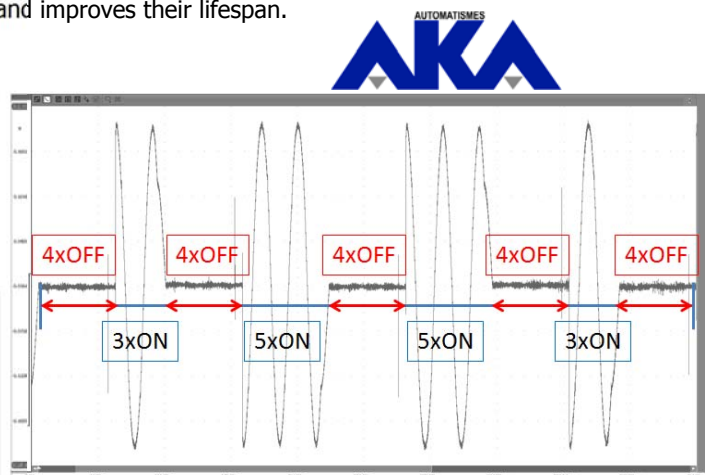
To avoid the saturation of these transformers usually at 1.2 Tesla, it is generally accepted to oversize them.

The process patented by AKA, using 1.6 Tesla transformers instead of 1.2T, makes it possible to reduce the size of these transformers from 15 to 20% and to make important savings for purchases.

Moreover the algorithms of control reduces the idle period between two wave trains of 200ms to 40ms and the duration of the wave trains themselves in the same proportions, which reduces as much the thermal stresses applied to the resistances and improves their lifespan.



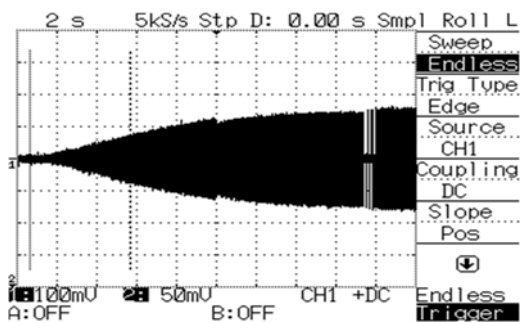
To minimize the effect of the 'on' burst, the time base of the firing cycle must be as short as possible and preferably less than 30 cycles of a 50 Hz supply (i.e. 50 % power = 15 cycles 'on' + 15 cycles 'off').



AKGrad32 Firing Features

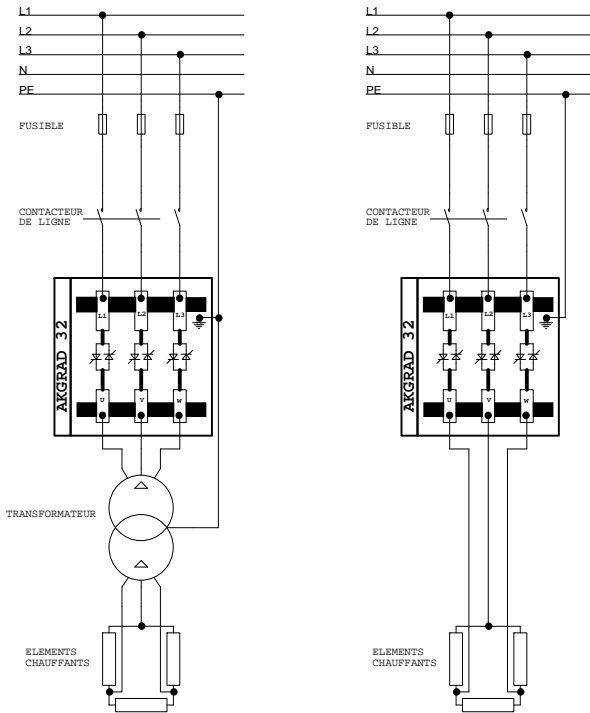
Fast full waves on standard resistance

Fast full waves on downstream transformer

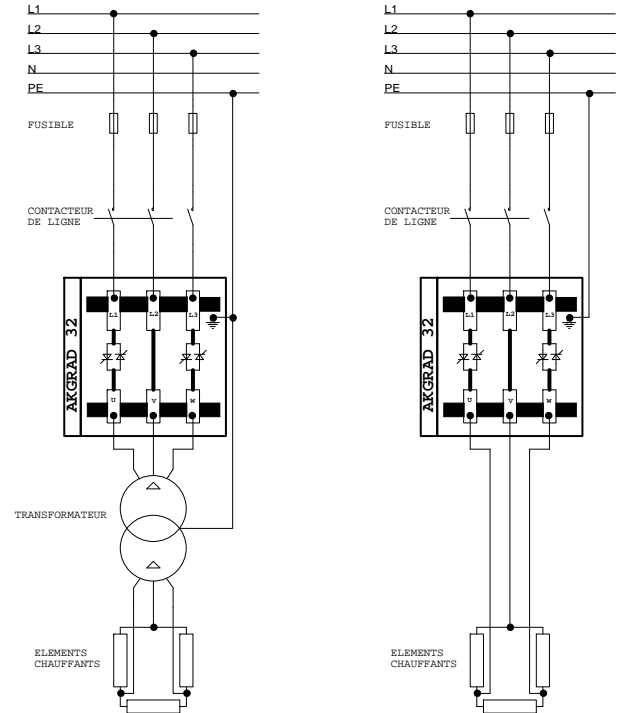


AKGrad32 Electrical Schematics

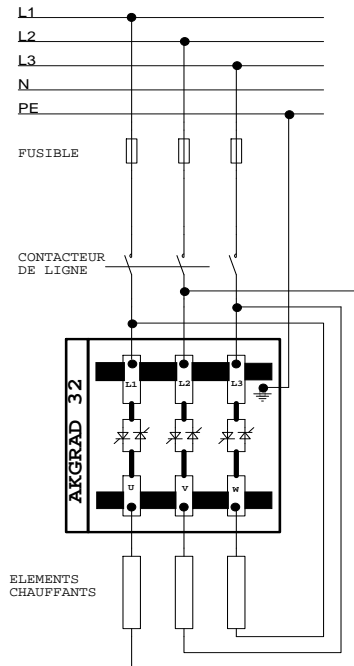
True 3 phases AKGrad32



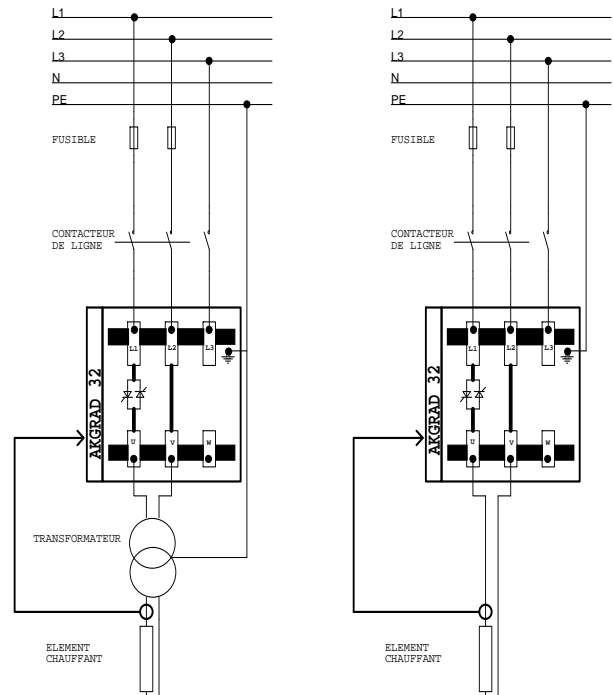
2 phases economic circuit AKGrad32

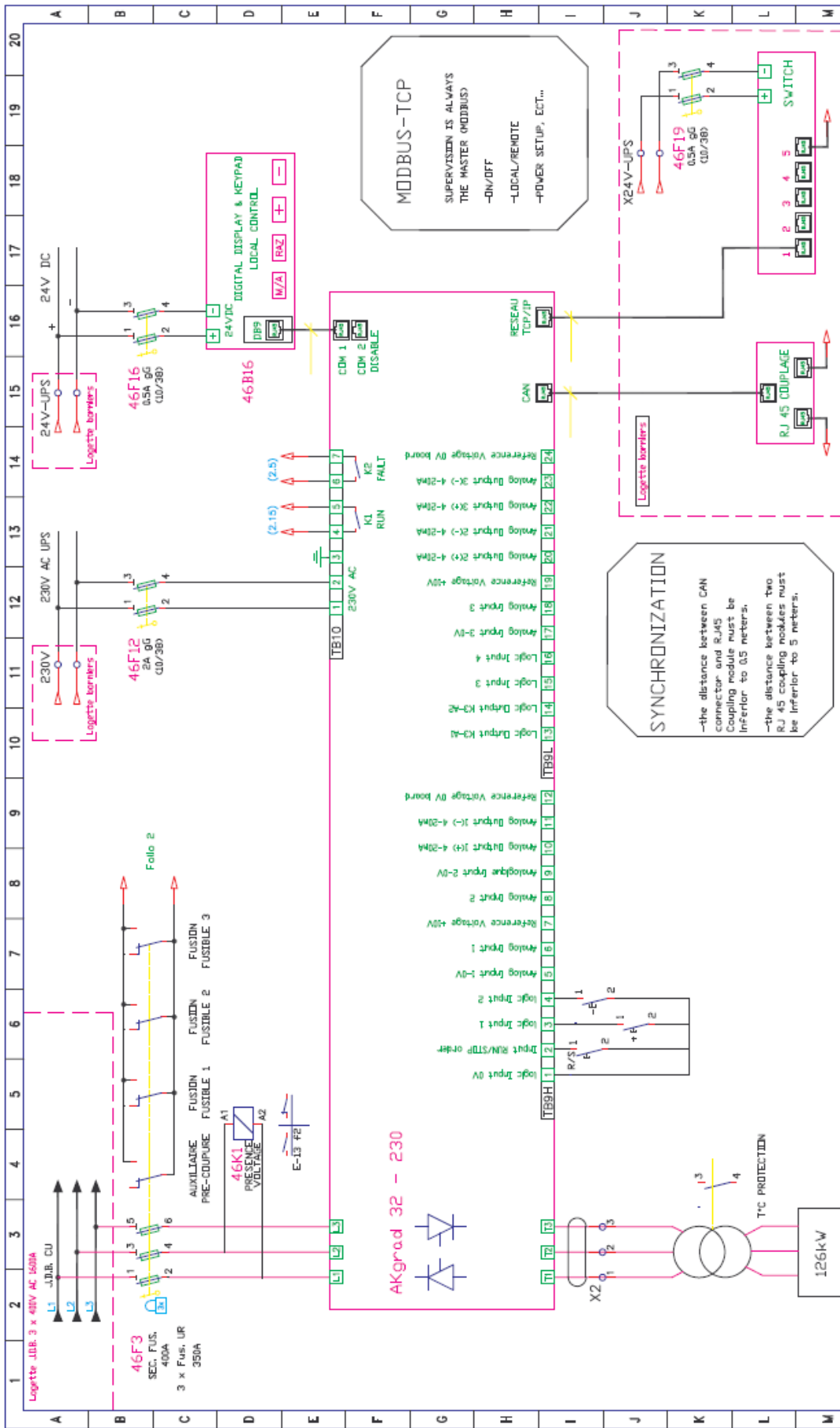


Single phase AKGrad32 3 channels (Delta open)



Single phase AKGrad32 One Phase Control





REV.		MOD.	DATE	APPRO.	DATE	CLIENT:		
DESS.		VERIF.						
TITRE								
SOLUTION 1 :								
MODBUS-TCP, SYNCHRO,								
DIGITAL DISPLAY								
Dossier n°:						Folio suivant: 2		
Folio :						1		

AKGrad32 Range of Products

PRODUITS

ARL

Démarréur liquide pour moteur à bagues 30 à 600 Kw.



AK-EP

Démarréur liquide pour moteur à bagues à variation continue de résistance 500 à 15 000 Kw.



AK-dem

Démarréur électronique à contrôle vectoriel 16 à 1 200 A.



AK-dem MT

Démarréur électronique moyenne tension 2200 à 7200 Volts



AK-grad

Gradateur à thyristor à onde entière 45 à 2 500 A.



AK-wind

Controléur d'éolienne 15 à 1 000 Kw.



PRODUCTS

ARL

Liquid starter for slip ring motor 30 to 600 Kw.

AK-EP

Liquid starter for slip ring motor with continuous resistance variation 500 to 15 000 Kw.

AK-dem

Vector control electronic soft starter 16 to 1 200 A.

AK-dem MT

High voltage electronic soft starter 2200 to 7200 Volts

AK-grad

Full wave thyristor power controller 45 to 2 500 A.

AK-wind

Wind mill governor 15 to 1 000 Kw.



Contact us:

15 rue des Pyrénées
ZAC Du Bois Chaland
91090 Lisses
FRANCE

Phone 0033 1 60 76 15 55
Fax 0033 1 64 97 24 87

www.aka-automatismes.com

info@aka.fr

Rev 3.0
Ref : 60120158