



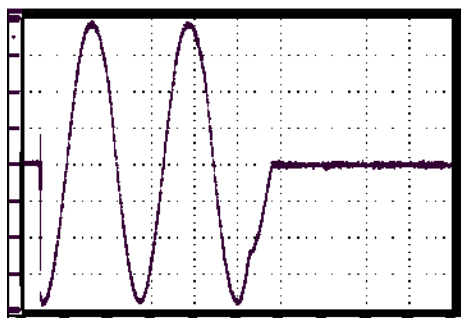
Thyristor Power Controller AKGrad32



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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.

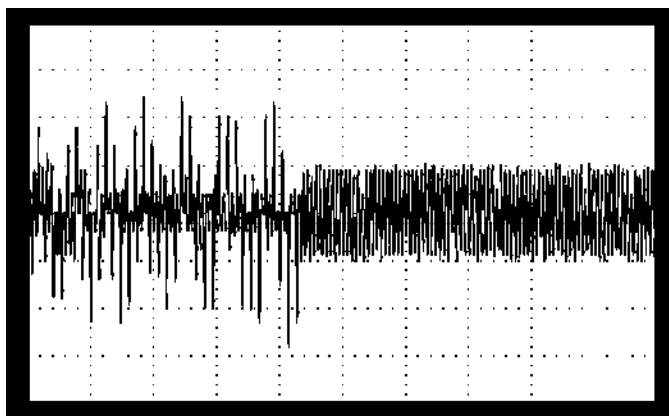


Each SCR/Thyristor is a switching device which can provide fast AC full wave or proportional phase angle conductions of electric power. AKGrad32 performs a well-balanced power regulation with the best accuracy for your heat process at the same time it guarantees an optimized heater life following the 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 closed loop kW, rate %, I^2 or U^2 regulation and load failure diagnosis on the power line.
- Phase angle soft start for loads with high cold/hot variation
- 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.
- Protections against over current peak, instantaneous correction against voltage slowdown or load surge.
- Patented algorithm integrated into each AKGrad32 control card for power savings and flicker suppression SYNCHRO

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



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 resistance
3 arms 3 phases	Ni-Cr resistance	Ni-Cr resistance
	Silicon carbide resistance	Silicon carbide resistance
	Molybdenum resistance	Molybdenum resistance
	Graphite resistance	Graphite resistance



AKgrad32 saves money and increases reliability with

- Downstream transformer 1,6 Tesla instead of 1,2 Tesla (gain 15 to 20%)
- Integrated industrial communication networks
- Integrated synchronisation (without dedicated master)
- Integrated PID controller

General characteristics

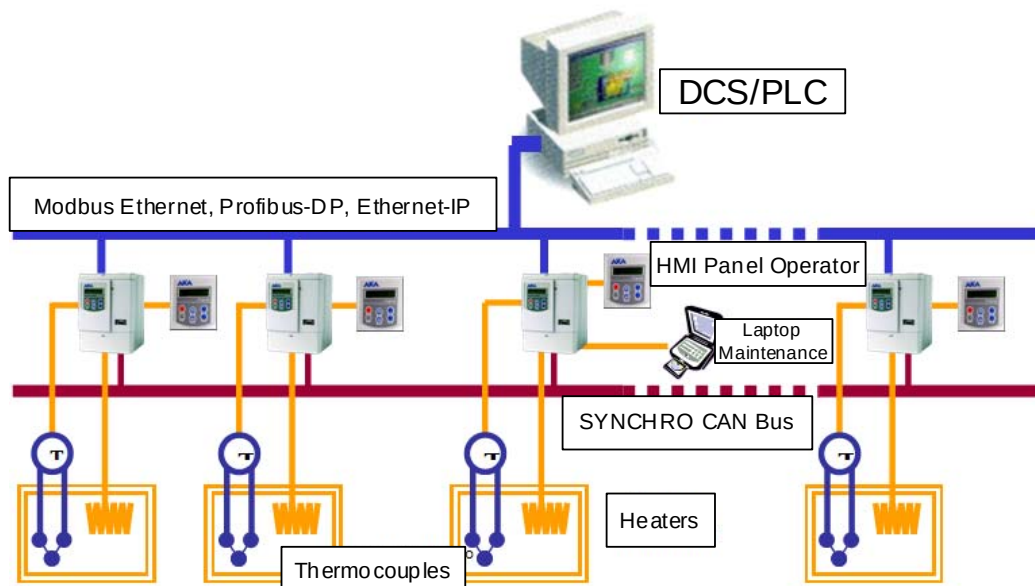
- Digital display of U, I, kW, % measurements
- Effective current limitation
- Synchronisation between up to 30 controllers
- Integrated PID controller
- Power regulation
- Resistance measurement
- Partial load failure
- Real time clock
- Remote display and keyboard

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 industrial networks in a cost-effective way. The temperature regulation function is integrated into the power controller, thus saving the external regulators and the expensive analog links.

Factory Automation :

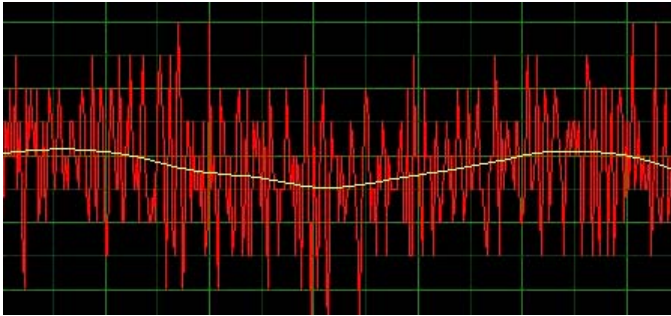


AKGrad32 Power savings SYNCHRO

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
- Reduction of the power supply transformer size
- Elimination of the flicker phenomenon



Instantaneous power without synchronisation

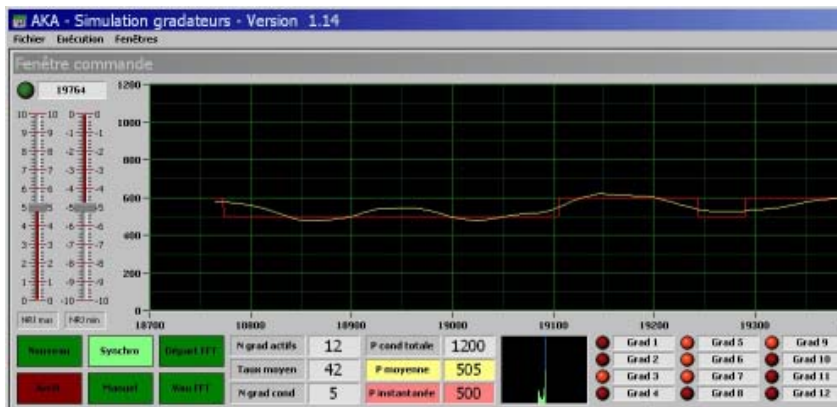


Instantaneous power with synchronisation

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 supervision systems on PC adapted to the **AKGrad32** power controllers:

- 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. »	Oui
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.

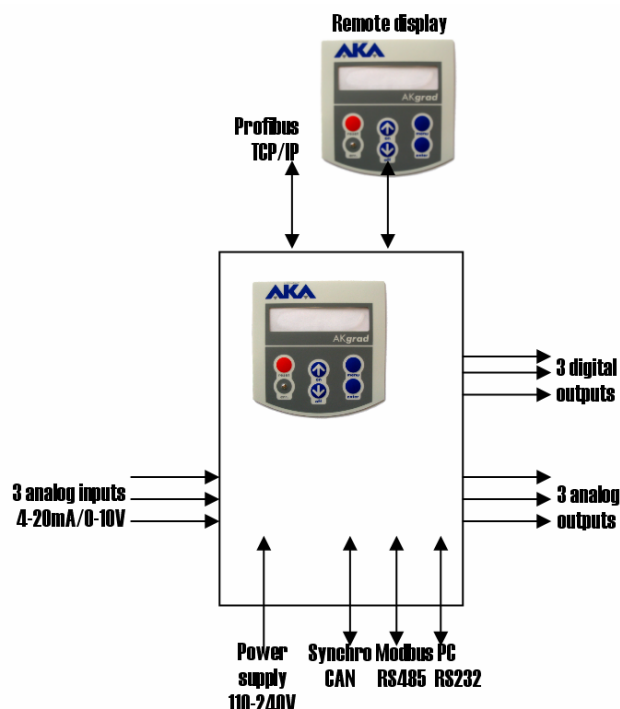
AKGrad32 Technical Features

- **Display keyboard**
2 lines 16 characters enlightened display board
- **Remote display board**
64x128 enlightened graphic display board
- **TOR inputs**
3or 5 digital inputs (free of potential)*
- **Analogical inputs**
2 or 4 0-10V or 4-20mA analogical inputs*
- **TOR outputs**
2 fault relays (220VAC, 2A)
1 static relay (48V 50mA)
- **Analogical outputs**
1 or 3 4-20mA analogical outputs*
- **Serial links**

	Protocol/support	Connector
Serial link 1	ModBus RS232/485/422	RJ45
	Modbus Ethernet	RJ45
	Ethernet/IP	RJ45
Serial link 2	Profibus-DP	SubD9
	Modbus RS232/485/422	RJ45
	CanOpen or Devicenet	SubD9
Serial link 3	Synchronisation	RJ11

- **Thyristors protection**
Each thyristor is protected by an electronic protection and its measurement: Overcurrent/ Voltage shutdown/ Short circuit. Standard distribution fuses are necessary. Prosistors can be provided on request.
- **Applicable standards**

CE european standard	BT european directives	N°73/23CEE du 19/02/73
	CEM european directives	N°92/31CEE du 28/04/92 N°93/68/CEE du 22/07/93
Security	IP20 CEI 60529 protection	
CEM	Immunity	EN61000-4-2
	Emissions	EN60947-4-3
UL american standard	UL Recognized	Being homologated



AKGrad32 Order Details

Designation : **Akgrad32 U-III-N-T-P-R-S**

	Voltage	Thyristor Size	Qty Thyristors arms	Downstream transformer	Inputs / Outputs	Automation Networks	Synchro savings
AKgrad32	U	III	N	T	P	R	S
	2= 70V-220V		1	0	F1 : Default I/O*	0	0
	4= 220V-460V		2	T	F2 : Extended I/O*	P= Profibus-DP	S
	6= 460V-690V		3			T= Modbus Ethernet	
						D/C= Devicenet/Canopen	
						M= Modbus Serial	
						I = Ethernet/IP	

Calibre		85A	100A	150A	230A	330A	420A	600A	950A	1500A	2500A
3 arms triphased AKgrad32	Lmm	175	175	175	175	293	293	375	370	565	565
	Hmm	295	295	295	295	377	377	440	655	820	820
	Pmm	228	228	228	228	285	285	310	310	425	425
2 arms triphased AKgrad32	Lmm	175	175	175	175	175	293	375	370	565	565
	Hmm	295	295	295	295	295	377	440	655	820	820
	Pmm	228	228	228	228	238	285	310	310	425	425
One channel AKgrad32 (3 channels)	Lmm	175	175	175	175	293	293	375	370	565	565
	Hmm	295	295	295	295	377	377	440	655	820	820
	Pmm	228	228	228	228	285	285	310	310	425	425

*Cf. I/O details on next page : I/O details on next page



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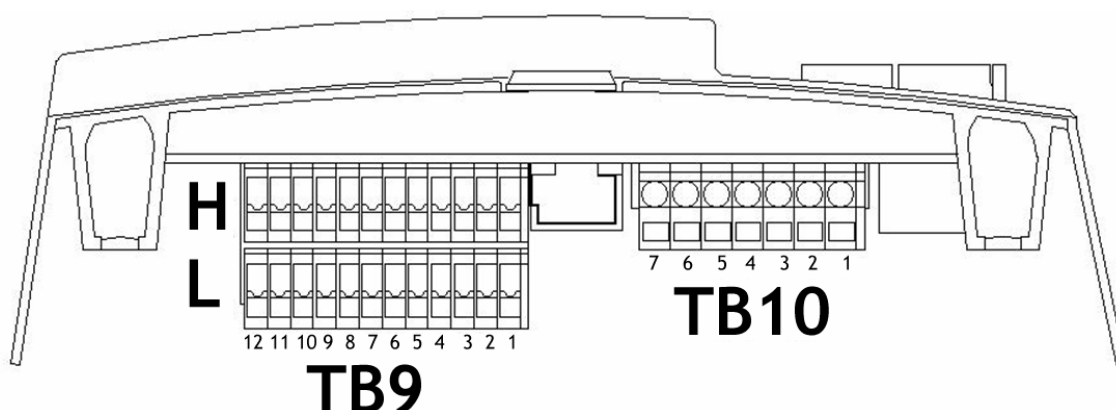
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SIRET : 343 685 558 00037 APE : 332B
TVA : FR 36343685558

AKGrad32 I/O Cabling

Terminal TB9H (default F1)	
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 (optional F2)	
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 (default F1)	
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.

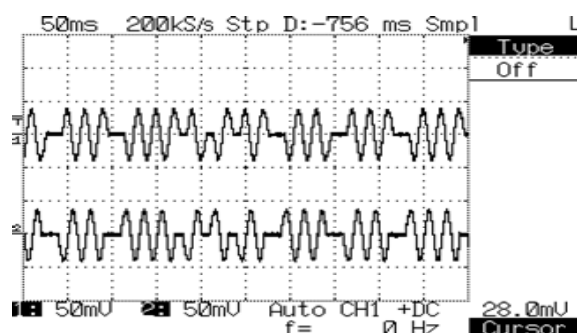
To avoid the saturation of these transformers usually at 1,2 Tesla, it is generally accepted to oversize them.

The process patented by AKA, using 1,6 Tesla transformers instead of 1,2, makes it possible to reduce the size of these transformers from 15 to 20% and to make important savings for purchases.

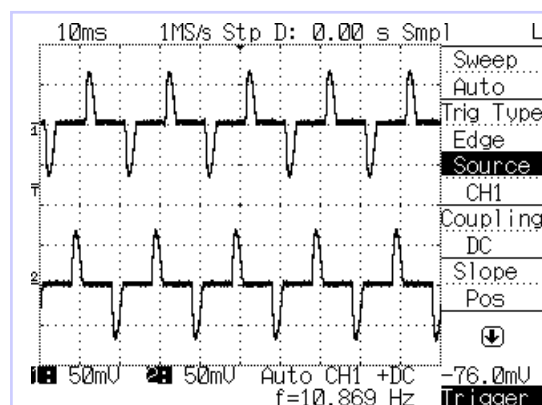
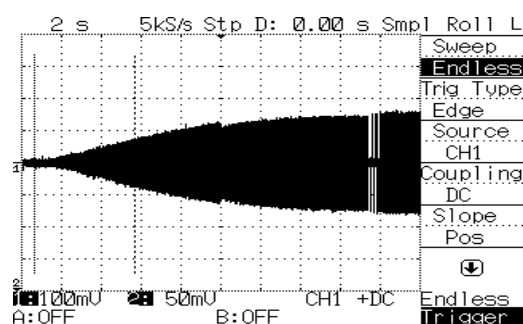
The algorithms of control reduce, moreover, the idle period between two wave trains of 200ms to 40ms and the duration of the wave trains themselves in the same proportions, which reduces as much the thermal stresses applied to the resistances and improves their lifespan.

AKGrad32 Firing Features

Fast full waves on standard resistance

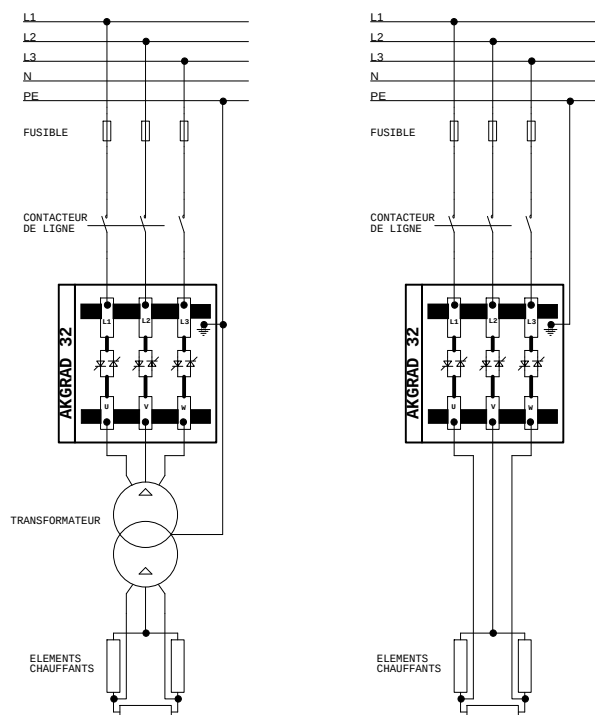


Fast full waves on downstream transformer

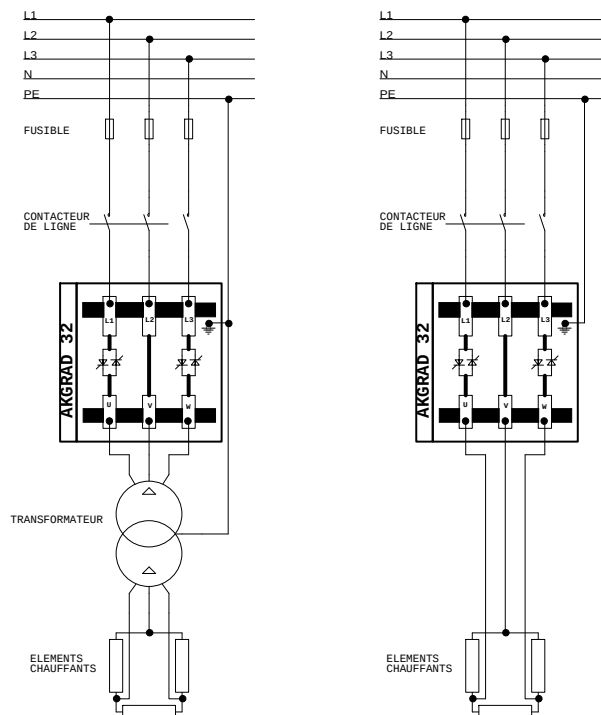


AKGrad32 Electrical Schematics

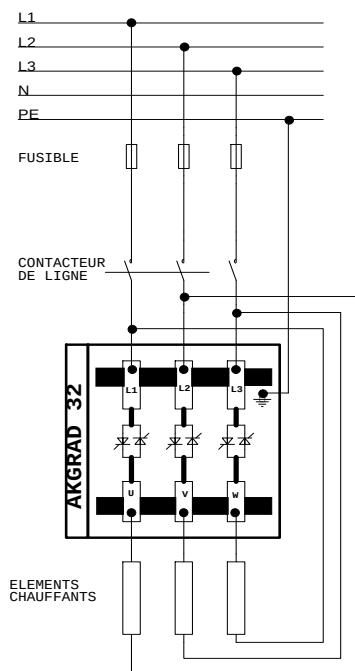
3 arms 3 phases AKgrad32



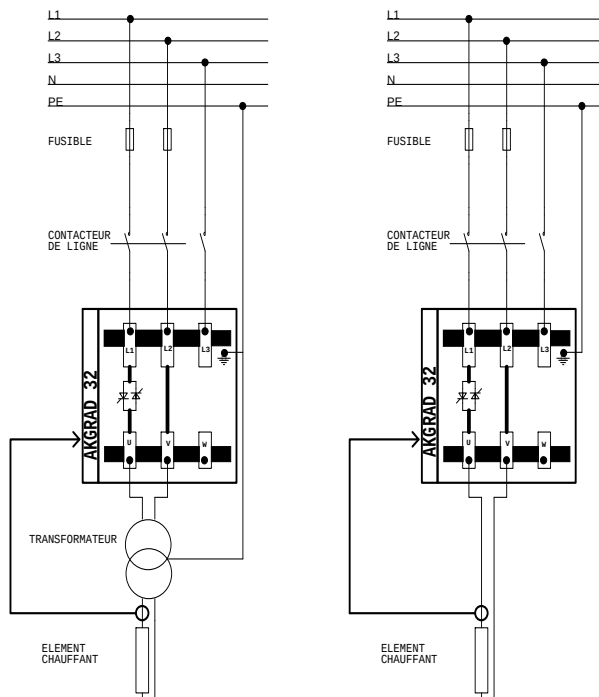
2 arms 3 phases AKgrad32



Single phase AKgrad32 3 channels (Delta open)

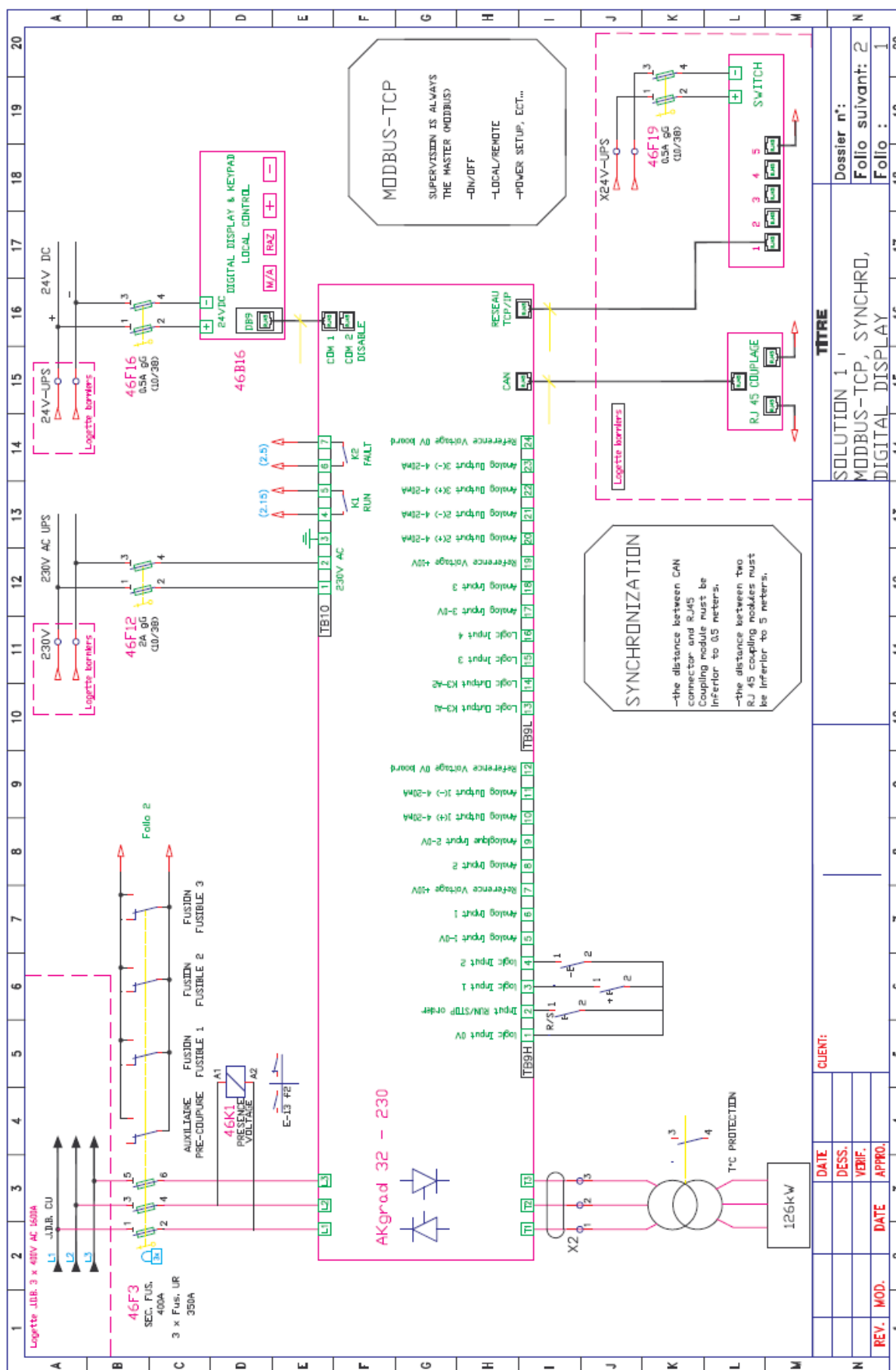


Single phase AKgrad32 One channel





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AKGrad32 Range of Products

PRODUITS

ARL

Démarrreur liquide
pour moteur à bagues
30 à 600 Kw.



AK-EP

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



AK-dem

Démarrreur électronique
à contrôle vectoriel
16 à 1 200 A.



AK-dem MT

Démarrreur électronique
moyenne tension
2200 à 7200 Volts



AK-grad

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



AK-wind

Contrôleur 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.



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