



Régulateurs de courant pour inducteurs Current regulators for field windings

VW3-RZD1042 et VW3-RZD1042S167

guide d'exploitation
user's manual

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Français

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Presentation

Function

The current regulator is designed to supply d.c. machine field windings from a single phase a.c. mains. It is usually combined with a variable speed controller, notably the three phase Rectivar 4 family, in order to assure the following additional functions :

1. "controlled excitation"

in this case, in order to obtain the highest performance levels, the excitation current is regulated so as to be independent of the temperature of the machine and variations in the mains supply.

2. "field weakening"

if the motor has to operate above its rated speed at reduced torque, the excitation current must be reduced while armature voltage remains constant. For this type of operation a galvanic isolation option board must be used. Install the option on the power interface board on the speed controller associated with the regulator.

Composition

The following items are housed in a metal enclosure with a protective cover :

- thyristor/diode single phase half controlled bridge, comprising 2 modules mounted on a heat sink
- a Hall effect sensor
- a control transformer
- a sub-assembly comprising a power interface board and an excitation / field weakening control board.

- Power interface board (see page 27)

Comprising :

- the supply units
- the excitation bridge thyristor firing and protection circuits
- a control transformer supply adaptation link
- two power/control supply separation links
- a rating selection link.

- Excitation control board (see page 28)

Comprising the following functions :

- excitation current regulation
- pulse train firing circuit
- safety devices for switching on and off
- excitation presence safety devices
- voltage regulation
- "reduced flux" function
- sensor feedback presence when adding the galvanic isolation board
- overvoltage during field weakening operation safety device
- 3 signalling LEDs visible with cover fitted :

ON : excitation regulator on, green LED on

$U_A >$: armature overvoltage fault, red LED on

$i_F <$: excitation current fault, red LED on

Environment

Conformity to standards Special conditions

The electronic starters and speed controllers have been developed and checked for conformity with national and international standards, and according to recommendations relating to electrical industrial control equipment.

Standards relating to electrical equipment

NF C 63-850	Compatibility of outputs with standards for programmable controllers, minimum value : 16 V, 10 mA.
UTE 20-501	Connection terminal blocks.
NF C 20-030 IEC 536	Protection against electric shocks, class 1.
VDE 0110 IEC 664	Clearance and creepage distance.
BV IEC 664 IEC 255-22-1	Performance testing of control systems, section 16-9 part 3 : - 5 kV shock wave, (1,2-50 μ s, 0,5 Joules), - 1 kV damped oscillating wave in common and serial mode.
IEC 801-2	Electromagnetic compatibility, specification relating to level 2 electrostatic charges.

Standards relating to the environment

NF C 20-701 °C	Storage with cold withstand capability, non dissipating device : 500 h,- 25 °C IEC 68-2-1 Cold tested, dissipating device : 2 h, 0 °C.
NF C 20-702 IEC 68-2-2	Storage with dry heat endurance non dissipating device : 500 h, 70 °C. Dry heat tested, dissipating device : 2 h, 40 °C.
NF C 20-703 IEC 68-2-3	Continuous tests in dry heat without condensation (without pollution), Dissipating device : 96 h, 40 °C, 93 % humidity.
IEC 664	Insulation coordination. Degree of pollution 1.

- In the event of specific contamination conditions, refer to standard IEC 664 A (§ 10-3-1) to ascertain the appropriate precautions to be taken.
- Some electronic products which can be built into device may need to be placed in an enclosure with a degree of protection of at least (conforming to standard NF C 20-010 and publication IEC 529) :
 - particularly aggressive ou polluting environment,
 - large variations of temperature and relative humidity with risk of condensation and dripping water.

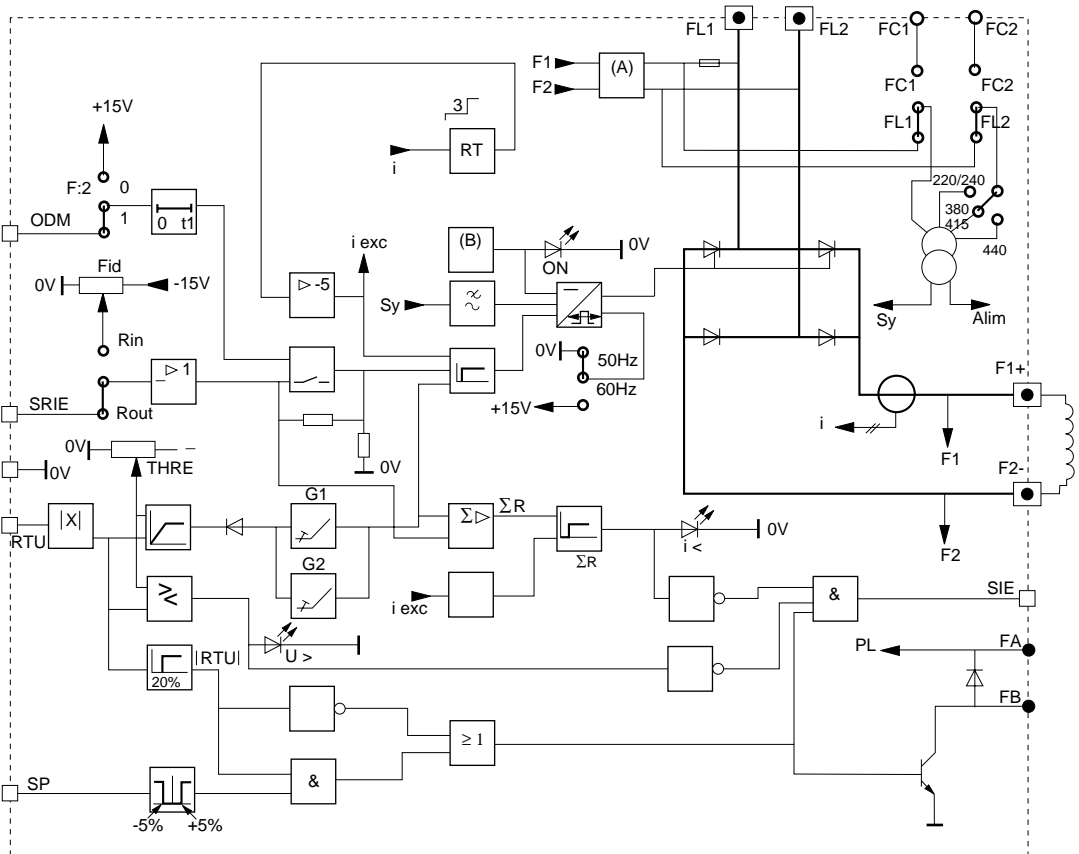
In this case, if the controller is switched off for long periods, a heating system must be fitted (0,2 to 0,5 W per square decimeter of the enclosure) which comes automatically as soon as the machine stops.

This device maintains the interior of the inclosure at a temperature slightly above the external temperature, thus avoiding any risk of condensation and dripping water while the controller is off.

Another option is to keep the machine swiched on when it is stopped (the heat produced by the machine itself is generally sufficient to bring about this temperature difference).

General

Block diagram



- (A) : Protection
 (B) : Mains validation
 RT : Current rating sélection
- Terminals
 control board (connector for interconnection to Rectivar)
 power bridge
 power interface board

Operation

Electrical characteristics Fonctionment

Electrical characteristics

Degree of protection IP 00

Ambiant air temperature

- **For operation** 0 °C to + 40 °C (operation possible up to + 60 °C by derating the current by 1,2 % for each additional °C)

- **For storage** - 25 °C to + 70 °C

Maximum using altitude 1000 m without derating (above, derate the current by 0,7 % for each other 100 m)

Vibrations and shocks test carried out according to IEC publication 68-2-8/FC

Single phase mains supply Voltage : 220/240 V \pm 10%, 380/415 V \pm 10% or 440 V \pm 10 %

Frequency : 50/60 Hz \pm 2 Hz

Excitation voltage Controlled excitation or field weakening with ramp \geq 5 s : U excitation \leq 0,8 U mains
Field weakening with short ramp : U excitation \leq 0,5 U mains

Excitation current **VW3-RZD1042** : 30 A maxi., minimum controllable rated current : 2,5 A
VW3-RZD1042S167 : 3 A maxi., minimum controllable rated current : 0,3 A

Fonctionment

The regulator can operate independently, or controlled by a Rectivar 4 series 541/641 or 74/84 with a rating of less than 800 A.

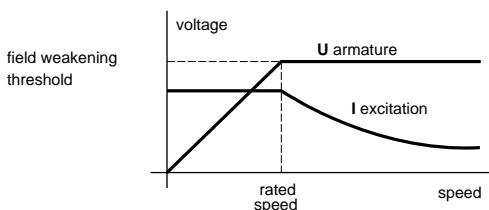
Independent operation only enables regulation of the excitation current.

When controlled by a Rectivar 541/641 the regulator enables :

- regulation of the excitation current
- to operate, if necessary, with reduced flux when no run signal is present
- to assure the field weakening function if the VW2-RZD2071 galvanic isolation board is fitted in the Rectivar's power interface board.

In this case, using a field weakening threshold adjustable by the THREE potentiometer on the controlled excitation board, constant armature voltage is maintained by decreasing the excitation current.

The field weakening function is shown in the figure below :



Controlled by a Rectivar 74/84 : see user's manual 42085.

Field weakening

The current regulator also includes a voltage loop which enables provision of the field weakening function. For this function, the galvanic isolation option must be added to the Rectivar's power interface board.

When used in this way, the "following" between the excitation current and the current reference is continuously verified, even during field weakening phases. A safety device checks the "voltage loop" function, i.e. that the armature voltage does not exceed rated voltage.

A "tachogenerator" safety device checks that the tachogenerator signal is present when the armature voltage reaches 20% rated voltage. This data is available on the FTA-FTB output (transistor with open collector : maximum load circuit 20 mA at 24 V) of the module's power interface board. The relay is closed when no fault is present.

All these faults are taken into account by the Rectivar as excitation faults.

Safety precautions :

1) ensure that the motor can accept this type of operation and check compatibility with the machine to be driven.

Example :

for hoisting, use a load cell which will lock the Rectivar's speed reference from a given load.

2) with other applications for switching problems connected with the machine's characteristics, it is advisable to reduce current limitation according to the speed. This can be achieved by adding the "current reduction" option board VW2-DF308L to the Rectivar's control board.

3) installation of a breaking device in the event of overspeed.

Controlled excitation

For independent operation set the Rin/Rout link on the controlled excitation board in the Rin position. The excitation current is set by the Fid potentiometer on this board.

For operation controlled by the Rectivar the Rin/Rout link on the controlled excitation board is set in the Rout position and the excitation current is adjusted by the FID potentiometer on the Rectivar's adjustment board. The FID link on the Rectivar's adjustment board is in position 1.

The 3 positions RT link on the regulator's power interface board enables adaptation to the excitation current

VW3-RZD1042 : (3) : 2,5 à 3,3 A (10) : 3,3 à 10 A (30) : 10 à 30 A

VW3-RZD1042S167 : (3) : 0,25 à 0,33 A (10) : 0,33 à 1 A (30) : 1 à 3 A

The excitation current fault is processed by the VW3-RZD1042 regulator to be entered on the SIE input on the Rectivar (terminal 46 on the J5 option terminal strip).

NOTE : If the galvanic isolation board is fitted to the Rectivar, a "tachogenerator" safety device checks that the tachogenerator signal is present when the armature voltage reaches 20% of the rated voltage. This data is available on the FTA-FTB output (transistor with open collector : maximum load circuit 20 mA at 24 V) on the regulator's power interface board. This fault signal is also entered on the Rectivar's SIE input.

This applies when feedback is provided by a tachogenerator.

In the event of controlled excitation maximum excitation voltage will be approximately 0,8 times mains voltage, e.g. : 304 V for 380 V mains.

Installation

Connections

Connections are made using a cable kit supplied with the regulator.

The kit includes :

- 1 multicore regulator-Rectivar connection cable; 40 cm long, fitted with one 25 and one 15 pin male connector
- 1 six core cable (N° 1) approximately 20 cm long, to be mounted inside the series 541/641 controller; this cable is fitted with a 25 pin female sub-base and a flat, 18 pin female connector
- 1 four core cable (N° 2) approximately 7 cm long, to be mounted inside the series 74/84 variable speed controller; this cable is fitted with a 25 pin female sub-base and a flat, 6 pin female connector
- 1 flat 6 pin female connector (N° 3), fitted with a single strap, only used with series 74/84 controllers.
- 2 pillar screws enabling the sub-bases of cable n° 2 or 3 to be fitted to the frame of the speed controller.

Association with Rectivar 541/641

Use cable N°1.

Fix the 25 pin sub-base (using the 2 pillar screws) to the upper moulded part of the Rectivar having cleared the location intended (remove the covering label) figure 2. Connect the 18 pin female connector to the J5 terminal strip of the Rectivar's control board, from J5-31 to J5-48 (figure 3 page 23) without modifying the other connectors connected to J5.

Association with Rectivar 74/84

Use cable N°2

Fix the 25 pin sub-base (using the 2 pillar screws) to the upper moulded part of the Rectivar having cleared the intended location (remove the covering label) figure 2. Connect the 6 pin female connector to the J3 terminal strip of the Rectivar's control board (figure 4 page 23).

Mount the 6 pin female connector n° 3 on the excitation control board at J52(Figure1).

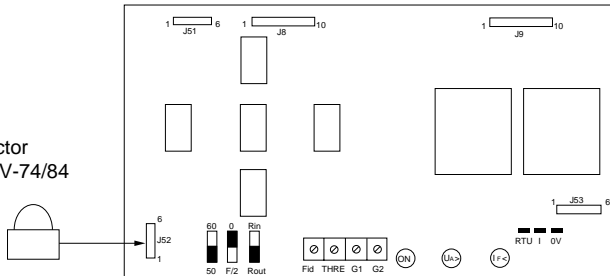
Connection

Connect the 2 blocks using the 40 cm cable, the 25 pin connector on the Rectivar, the 15 pin connector on the field weakening module (page 24).

Excitation control board

Fig. 1

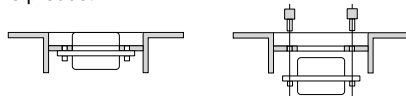
N°3 connector
only for RTV-74/84



Module and Rectivar interconnections

In order for the regulator to be controlled by the Rectivar they must be connected by the ribbon cable supplied with the product.

Fig.2



Installation

Connections

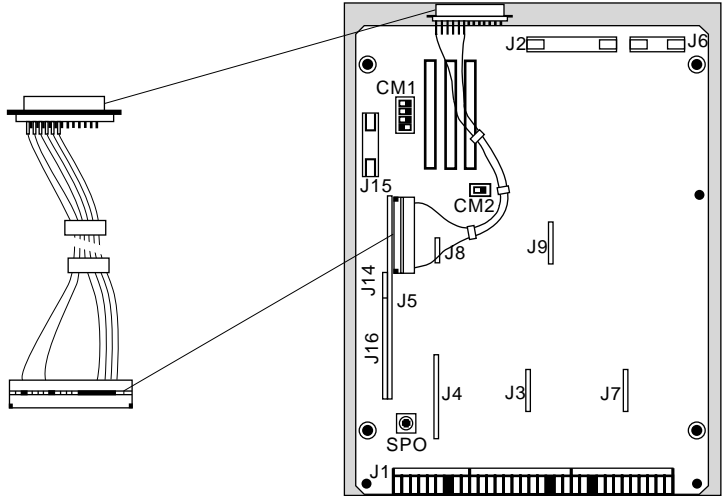
Rectivar 541/641 or RTV-74/84

Module and
Rectivar
interconnections

Cable N°1

Rectivar 541/641

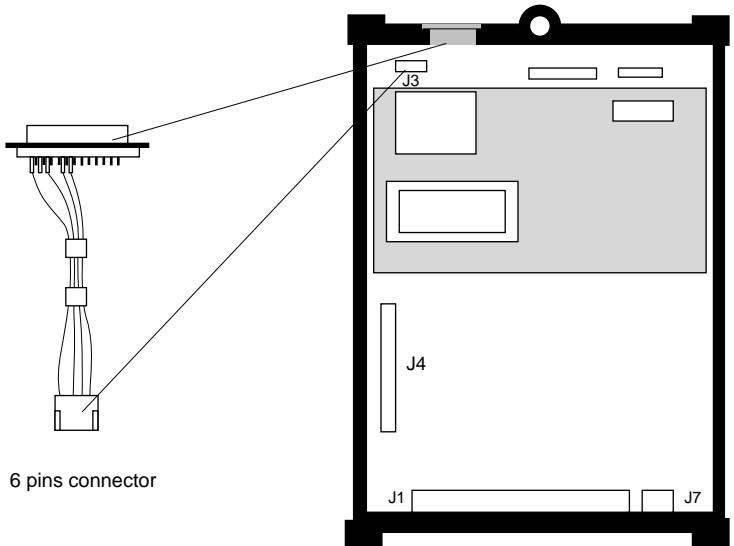
Fig.3



Cable N°2

Rectivar 74/84

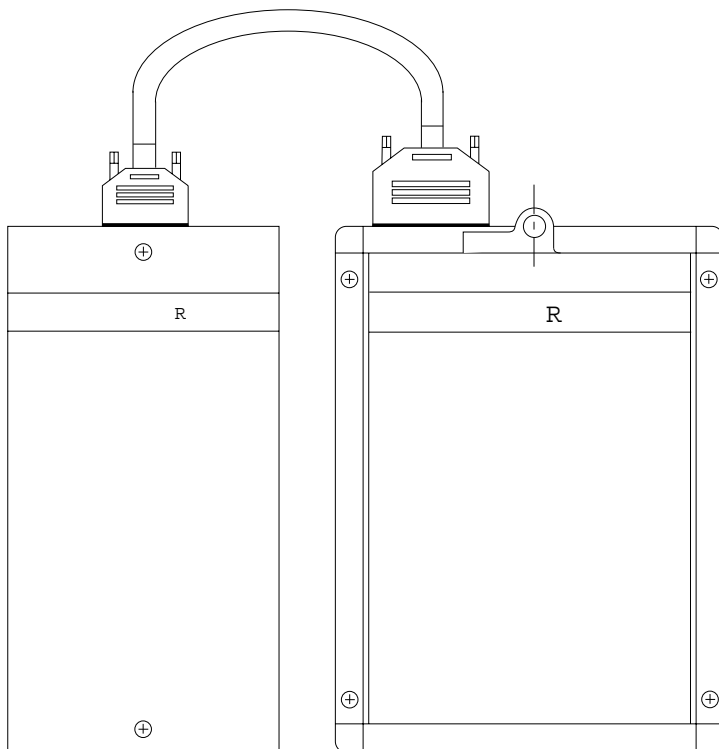
Fig.4



Installation

Connections

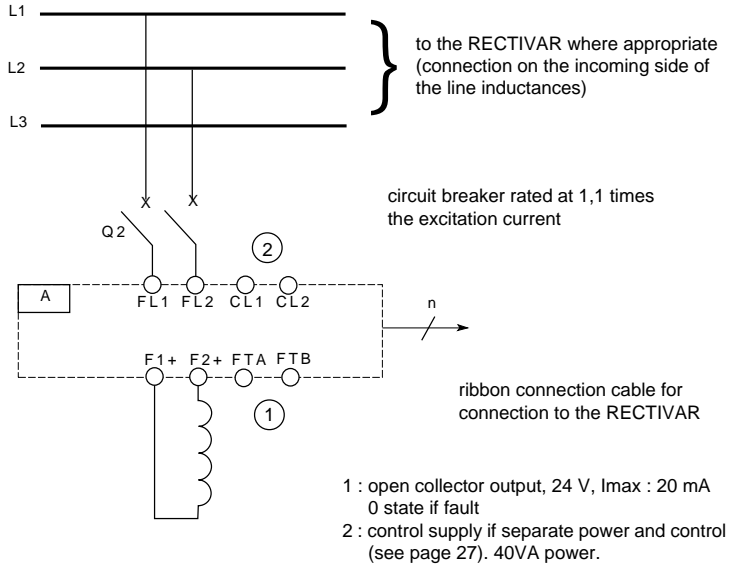
Regulator/speed controller interconnection



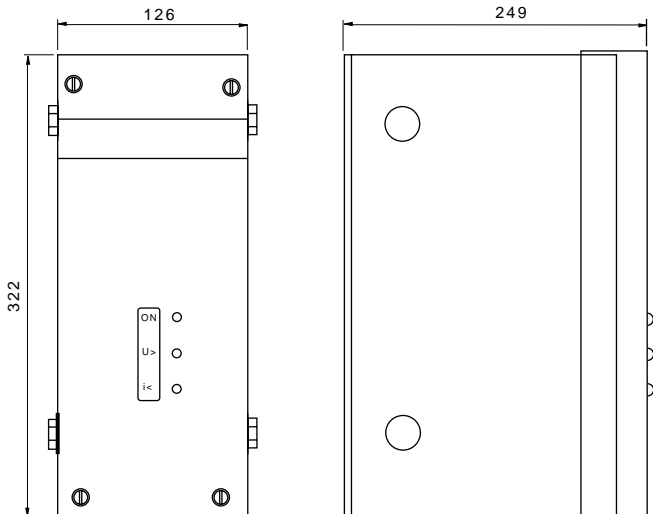
Installation

Connections Dimensions and weight

Connection diagram



Dimensions and weight

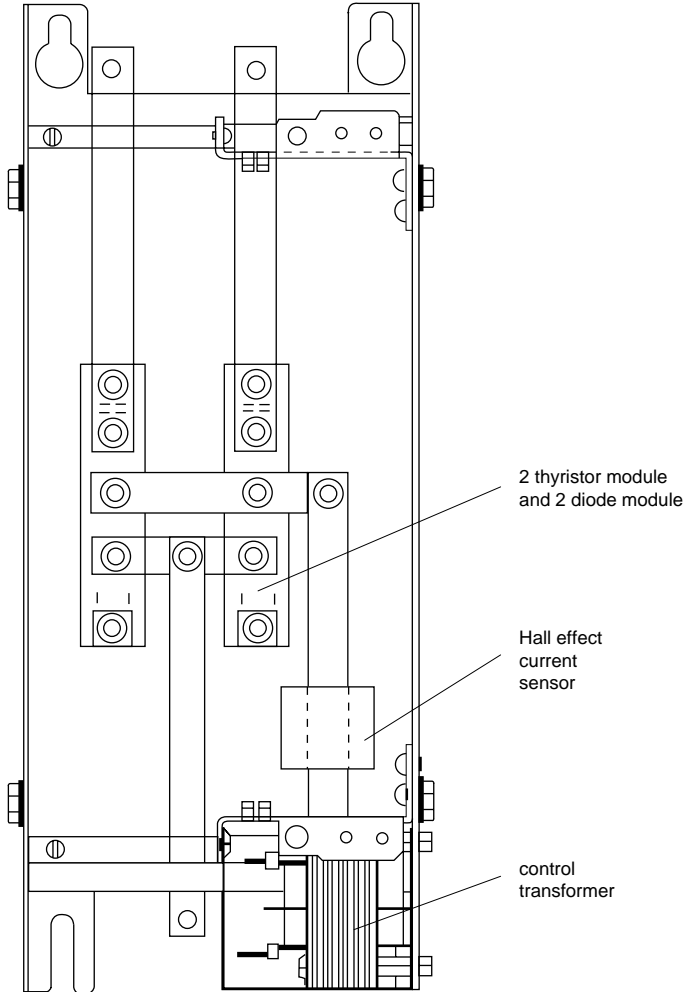


Fixings : 290 x 104 - Ø 5,5

Weight : 6 kg

Layouts

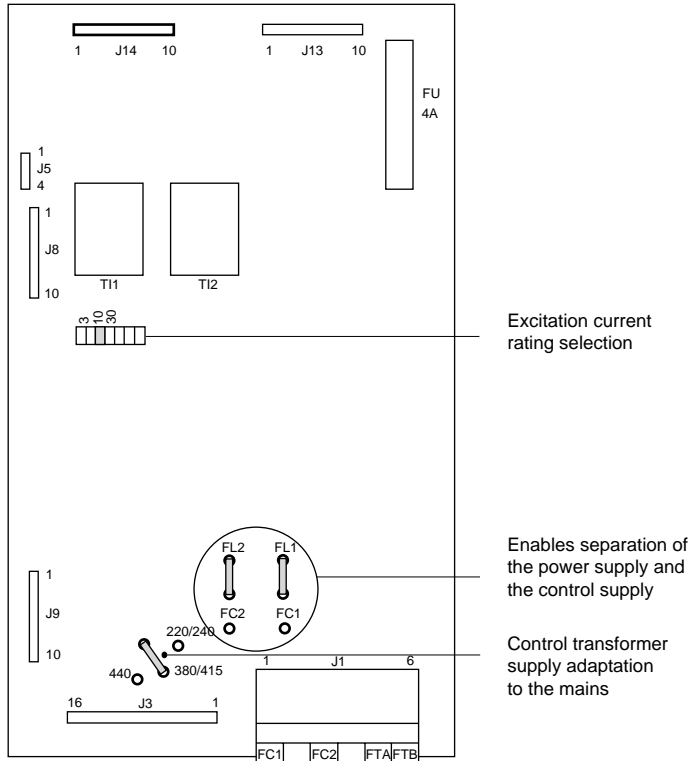
Power bridge



Layouts

Electronic boards

Power interface board

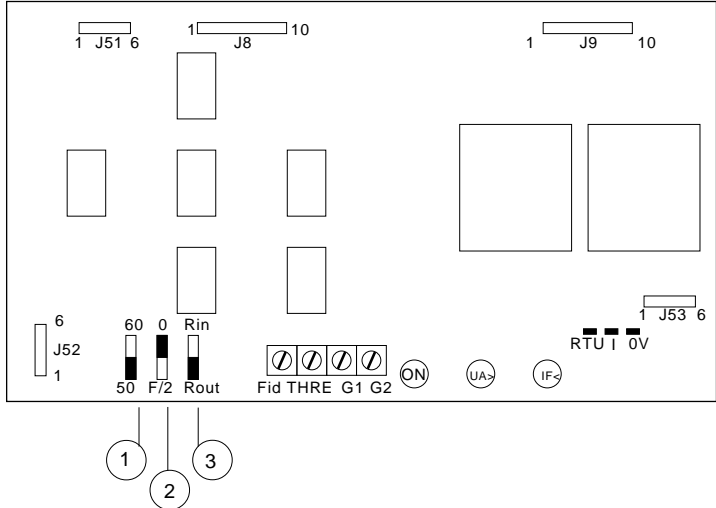


- J1 : customer connection terminals
- J3 : control transformer connection ribbon cable
- J5 : excitation current feedback data
- J8 : connections with control board
- J9 : connections with control board
- J13 : Rc + excitation internal supply take-off
- J14 : connections with excitation thyristors

Layouts

Electronic boards

Excitation control board



LEDs:

ON : excitation on
 $U_A >$: armature overvoltage
 $i_F <$: excitation fault

Potentiometers :

Fid : adjustment of the excitation current
THRE : adjustment of the armature voltage threshold for the field weakening function
G1 and G2 : adjustment of the current loop gain (only with field weakening)

Fid, G1 and G2 against the stop in the anti-clockwise direction
G1 : low speed adjustment
THRE against the stop in the clockwise direction
G2 : high speed adjustment

Links :

- ① : Mains frequency selection.
- ② : 1/2 flux operation.
- ③ : Internal or external reference.

Rectivar 4 adjustment board

FID against the stop in the anti-clockwise direction, for others see Rectivar 4 user's manual

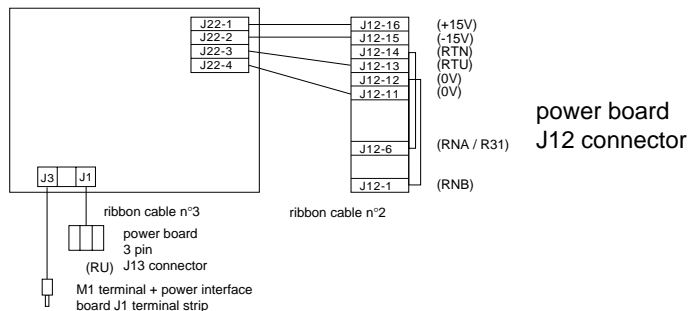
Link FID in position 1 (operation controlled by the Rectivar)
Link FID in position 0 (independent operation)

Initial setting up

Preliminary checks

• With the supply disconnected

- check that the mains, regulator, and motor are compatible
- check that the wiring conforms with the sequence circuit diagram
- check that the terminal connections are tight, and that the connectors are firmly pushed in and locked
- check that the position of the links corresponds correctly to the application (pages 27-28)
- if the mains supply is other than 220/240 V, 380/415 V or 440 V set the 2 CAL links on the power interface module to positions FC1 and FC2 and connect a $\geq 40\text{VA}$ autotransformer between terminals FC1 and FC2 to supply the control at 380 V. Set the link to 380/415 V (page 27)
- *independent operation*
 - set link ③ on the controlled excitation board to position Rin
 - set potentiometer Fid against the stop in the anti-clockwise direction
- *operation controlled by Rectivar 541/641*
 - set link ③ on the controlled excitation board to position Rout on the Rectivar's adjustment board, set potentiometer FID against the stop in the anti-clockwise direction and link FID to position 1,
- *Sensor presence check (operation without field weakening)*
 - used with controlled excitation when the speed feedback data is supplied by a tachogenerator.
- . Fit the galvanic isolation board in position on the Rectivar's power interface board
- . connect it using ribbon cables 2 and 3 and set the link according to the maximum voltage. See notice supplied with the board.



Ensure that the THREE potentiometer on the controlled excitation board is fully against the stop in the clockwise direction so that field weakening is inhibited.

- *Field weakening*

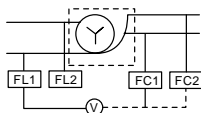
- fit the galvanic isolation board as shown above, ensure that the THREE potentiometer is against the stop in the clockwise direction.

If use of the VW2-DF308L current reduction board (see page 21) is necessary, fit it onto the Rectivar's control board and adjust according to the notice supplied with the board.

Initial setting up

Adjustments

Static adjustments



• Equipment required.

- Two multimeters, preferably 20000 Ω/V .
- A two channel oscilloscope, if required. The apparatus must be isolated from the mains supply. Do not connect the oscilloscope earth to another earth of the installation.
- A d.c. ammeter if required, with shunt, if necessary.

• Precautions

When controlled by the Rectivar, check that the interconnection between LS(C.J1.30) and PL(C.J1.28) has been made.
Do not select a direction of rotation (FW or RV).

• Synchronisation check

- In the event of separate power/control.
- Switch on the supply to the regulator, the green "ON" LED is on.
- Check the phase sequence : measure FL1-FC1 and then FL1-FC2. For the lowest voltage measured, connect the corresponding wire to FC1, and the remaining wire to FC2. Switch off.

• Excitation current adjustment

- Set link ② on the controlled excitation board to position 0.
Insert a d.c. ammeter or shunt in the field circuit.
Switch on; the ON LED should go on.
- Independent operation (link in position Rin)
Set the excitation current using potentiometer Fid on the controlled excitation board. Turn the potentiometer gradually in the clockwise direction until the required current is obtained.
Check that the excitation voltage is correct. Switch off.
- Operation controlled by Rectivar 541/641 (link in position Rout)
in this case, the current is adjusted using the FID potentiometer on the Rectivar's adjustment board. The adjustment procedure is exactly the same as the one described above.
- Operation controlled by Rectivar 74/84 : see user's manual 42085.

Operation with reduced flux at standstill

Set the F/2 link on the controlled excitation board to position 1 having adjusted the full flux excitation current.

NOTE : with this type of operation, the excitation fault appears at standstill.

Field weakening

Operation with field weakening requires feedback by a tachogenerator and the presence of the galvanic isolation board.

Having carried out the checks and adjustments given on page 27 and above, carry out the initial setting up of the RECTIVAR, except for the high speed adjustment.

• High speed adjustment

Connect a voltmeter across terminals RNA, RNB (tachogenerator input) of the power interface board and a second to the M1+ et M2- terminals (armature voltage) of the power board.

Initial setting up

Special uses

Spare parts

Field weakening

Example of an application :

Motor 1500 rpm - 400 V armature

tachogenerator : 60 V/1000 rpm

field weakening up to 3000 rpm

- set the HSP potentiometer on the Rectivar's adjustment board against the stop in the anti-clockwise direction
- set the G1 and G2 potentiometers on the controlled excitation board against the stop in the anti-clockwise direction and the THRE potentiometer against the stop in the clockwise direction
- switch on the equipment
- select RUN then FW or RV,
- set a speed reference, the motor should rotate
- increase this reference up to the value corresponding to the rated speed at full flux, i.e. 1500 rpm

In our example the field weakening ratio is 2. Check that :

speed ratio : $\frac{1500}{3000} = 1/2$ corresponds to a speed reference $\frac{10\text{ V}}{2} = 5\text{ V}$

measure this value between 0E1 and E1 on the control board

- if necessary, adjust the motor rated speed using the HSP potentiometer on the adjustment board and measure the armature voltage between M1+ and M2-
Do not exceed the recommended voltage (e.g. : 400 V)
- check that this voltage corresponds correctly with the rated speed, i.e. 90 V between RNA and RNB; if not, adjust the excitation current via the FID potentiometer on the adjustment board.

The full flux adjustments are complete.

• Field weakening adjustment

- set the speed reference to obtain rated speed at full flux, i.e. 5 V in the above example
- turn the THRE potentiometer on the controlled excitation board, in the anti-clockwise direction, until the armature voltage begins to decrease
- alter the speed reference slightly and check that the armature voltage remains stable; if not, turn the G1 potentiometer on the controlled excitation board in the clockwise direction
- turn the speed reference gradually to 10 V, ensuring that the mechanical and safety conditions enable field weakening (e.g. : motor uncoupled)
- check that the armature voltage remains stable (e.g. : 400 V), in the event of instability, turn the G2 potentiometer on the controlled excitation board in the clockwise direction
- check that the speed obtained is that requested, i.e. 180 V between RNA-RNB, if not adjust using HSP
- check that all the adjustments are correct :
for a 10 V speed reference : armature voltage 400 V, tachogenerator feedback 180 V.

Spare parts

Description	Characteristics	Unit reference	Weight (kg)
Power interface board		VX5-RZD104	0,400
Controlled excitation board		VX4-RZD104	0,350
2 thyristor module	26 A 1200 V	VZ3TM2026M12	0,125
2 diode module	45 A 1200 V	VZ3DM2045M12	0,125

Notes
