350 470 E

Lenze

Antriebstechnik

Technical description

Speed controllers for DC motors 490 Series

Part no. 350 470

This technical description is valid for
Control board type 4091.2

3rd edition of: 15.11.1993

Date of print: 29.11.1993

Safety information

The equipment described is intended for use in industrial electrical drive systems.

This equipment can endanger life through rotating machinery and high voltages, therefore it is essential that guards for both electrical and mechanical parts are not removed.

The following points should be observed for the safety of the personnel:

- **Only qualified personnel familiar with the equipment are permitted to install, operate and maintain the devices.**
- **System documentation must be available and observed at all times.**
- **All non-qualified personnel are kept at a safe distance from the equipment.**
- **The system must be installed in accordance with local regulations.**

A qualified person, is someone who is familiar with all safety notes and established safety practices, with the installation, operation and maintenance of this equipment and the hazards involved. For more detailed definitions see IEC 364.

It is recommended that anyone who operates or maintains electrical or mechanical equipment should have a basic knowledge of First Aid. As a minimum, they should know where the First Aid equipment is kept and the identity of the official First Aiders.

These safety notes do not represent a complete list of the steps necessary to ensure safe operation of the equipment. If you wish further information, please contact your nearest Lenze representative.

The information in this technical description applies only to the hardware versions that are indicated on the cover page. If the version of your equipment is not listed, then this manual must not be used. Lenze cannot be held responsible for any malfunction resulting from the above.

The specifications, processes and circuitry described in this manual are for guidance only and must be adapted to your own specific applications. Lenze does not guarantee the suitability of the processes and circuitry described in this technical description for individual applications.

The specifications in this manual describe the features of the products, without guarantee.

Lenze personnel have carefully checked this manual and the equipment it describes, but cannot be held responsible for its accuracy.

Technical alterations reserved.

Table of contents

The Simplatron controller series 490 comprises five 4-quadrant DC speed controllers with 6.4 to 80 kW output power in compact design.

1. Special features

- Compact controllers with potential-free heatsink
- Highly dynamic due to six-pulse three-phase bridge design and discontinuous current adaptation
- Isolation due to current transformers
- Operation by tacho or armature voltage feedback with IxR compensation
- Self synchronisation of the phase shifter for 50-60Hz mains
- High interference margin by built-in synchronizing filters
- Pulse series firing in the power stage
- High operational safety due to static and dynamic voltage surveillance
- Display of operational states by LED

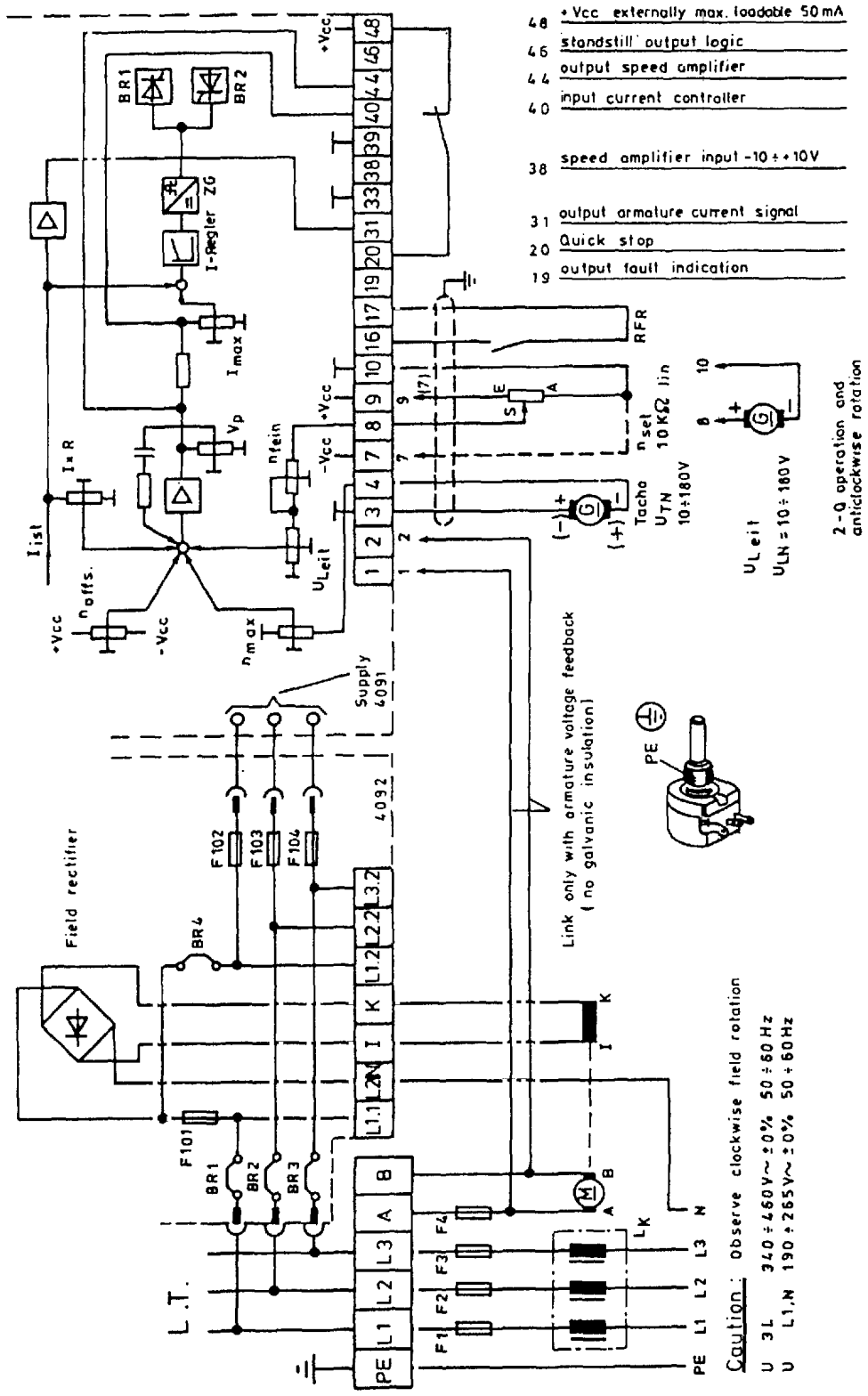
2. Technical data

Controller		492	493	494	495	496
Output power	P_{el}/kW	6.4	10	22	44	80
Mains voltage	U,3LN	340 - 460V ± 0%, 50-60Hz				
Field voltage	U_F	0.9 x U_{L1}, $U_{L2(N)}$				
Field current	I_F/A	3	8			
Armature voltage	U_A/V	400				
Armature current	I_A/A	16	25	55	110	200
Nominal master voltage	U_{LN}/V	10 - 180				
Nominal tacho voltage	U_{TN}/V	10 - 180				
Field fuse	F 101 part no.	1xFF4A (6.3x32) 308 054	1 x FF 16 A/500V (6.3 x 32) 305 725			
Electronic fuse	F 102 F 103 F 104	3 x F1A/450V (5x25) part no. 307 290				
Temperature range	T_U/°C	0 - 45				
Set value potentiometer	R_1	10 kΩ/1W/lin.				
approx. weight	kg	5.5	8.1	8.1	11	11
Control board 4091.2	part no.	325 333				
Chassis controller E	part no.	325 592	325 332	325 335	332 336	325 337

Accessories (to be ordered separately)

Recommended mains fuses F1, F2, F3 (3 off needed)	part no.	FF 20 A 14 x 51 305 321	FF 32 A 14 x 51 307 943	FF 63 A 22 x 57 305 239	FF125 A 00.80 307 247	FF200 A 00.80 321 542
Recommended armature circuit fuse F4	part no.	FF 20 A 14 x 51 305 321	FF 32 A 14 x 51 307 943	FF 80 A 22 x57 307 174	FF125 A 00.80 307 247	FF200 A 00.80 321 542
Fuse holders 4 off needed	part no.	332 721	332 721	308 291	326 308	326 308
Three-phase mains choke L_K	part no.	3x1.2mH 322 149	3x1.1mH 322 148	3x750µH 307 343	3x270µH 307 346	3x165µH 308 234

3. Connecting diagram



1. Screen cables for transmission of electronic signals
2. If the signals must be changed-over via relays, use suitable relay contacts (e.g. gold-plated contacts).

4. Installation instructions

4.1 When installing in an enclosure, ensure adequate ventilation. The ambient temperature must not exceed 45°C. Install the controller vertically with the terminals at the top. Ensure that there is adequate ventilation. Observe power losses. See 12.3.

4.2 When the switch RFR is closed, the controller is released.

4.3 Connect the potentiometer case to ground (PE).

4.4. Replace defective fuses only by the specified type.

5. Connecting instructions

5.1 Control cables must be screened. Connect screen at one side of the controller with PE.

5.2 The control electronics carries mains potential when using armature voltage feedback with **IxR compensation**.

5.3 Before switching off the mains, the motor must have come to standstill by opening the switch RFR or actuating the quick stop.
For automatic mains switch-off, see 9, terminal 46.

5.4 Two-quadrant operation. If only one motor direction is required, e.g. clockwise rotation, terminal **E** of the set value potentiometer is to be connected to terminal 9 or (in case of anticlockwise rotation to terminal 7) and terminal **A** to terminal 10. See chapter 3 connecting diagram.

5.5 Four-quadrant operation. If both motor directions are required, terminal **A** of the set value potentiometer is to be connected to terminal 7 and terminal **E** to terminal 9. See chapter 3 connecting diagram. Zero speed results, when the set value potentiometer n_{soll} (n_{set}) is in the middle position.

5.6 Separate supply of power stage and control electronics.
Caution: In case of separate supply of power stage and control electronics, ensure a correct phase connection betweeen power stage and control electronics.

5.6.1 Switch on control electronics and power stage at the same time (standard application).

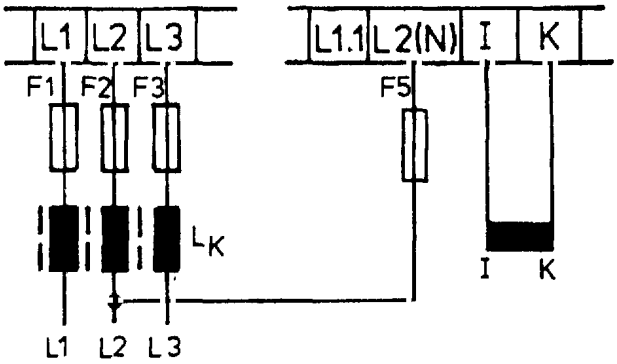
5.6.2 When switching on control electronics and then power stage, note:
Caution: As long as the power stage is without current the control inhibit must be active, see chapter 8.4 inching.

5.7 When connecting, check for the clockwise rotating field. In case of an anticlockwise rotating field the wrong phase sequence is displayed by lighting of the LED **SEQ**, the firing pulses are inhibited.

5.8 Capacity of the +Vcc supply.
For a supply of external option boards, a total output current of 50mA is available.

6. Special field voltages

6.1 Field voltage $U_F = 0.9 \times U_{L1, L2 (N)}$



U_{mains} L1, L2, L3 = 380/415V

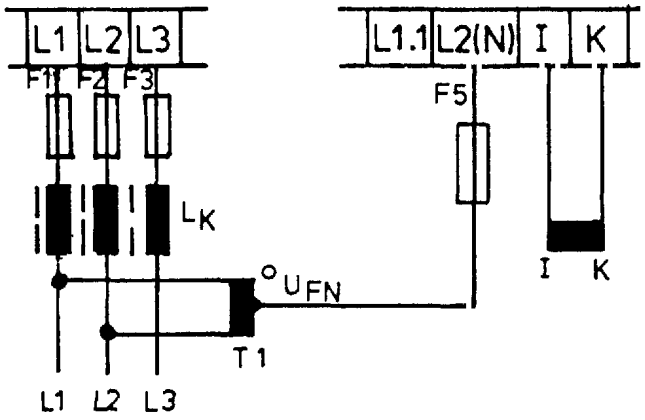
U_{field} I, K = 0.9 x $U_{L1, L2 (N)}$

e.g. $U_F = 0.9 \times 380V$

$U_F = 340V$

F5 for the protection against earth fault

6.2 Field supply by autotransformer



U_{mains} L1, L2, L3 = 340 to 460V

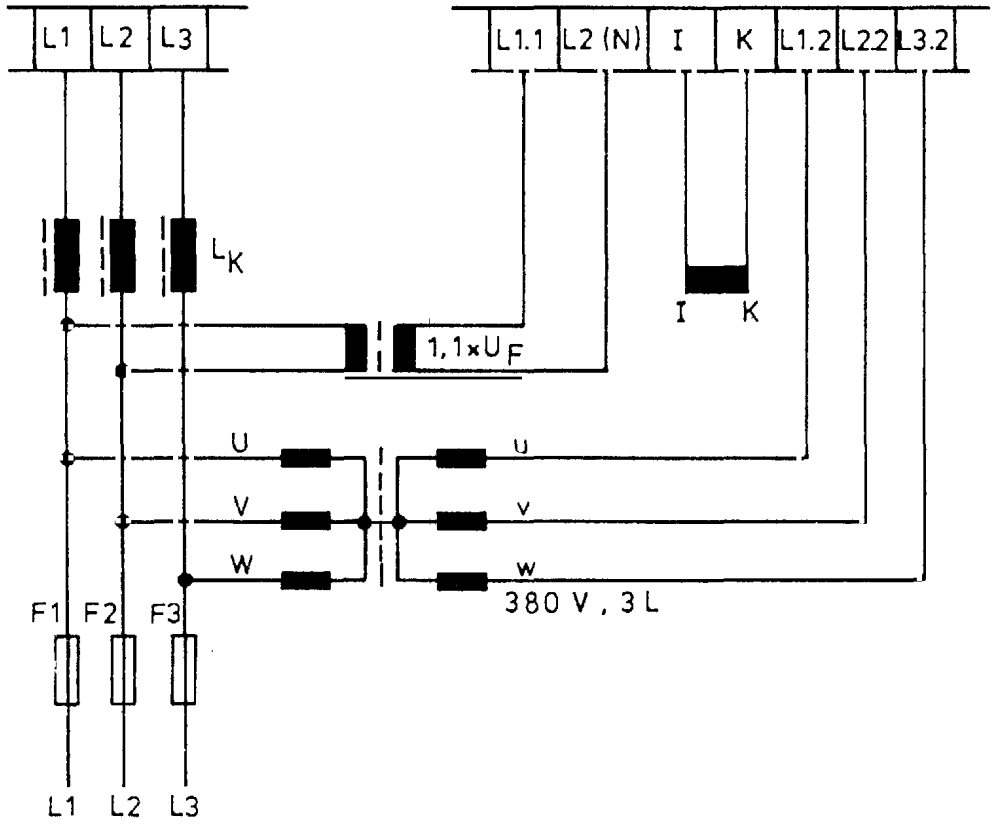
U_{field} I. K = 0.9 x $U_{L1, L2 (N)}$

$$U_{FN} = \frac{U_{field\ I,\ K}}{0.9}$$

F5 for protection against earth fault

For T1 an isolation transformer can be used.
See chapter 6.3.

6.3 Nominal mains voltage < 340V, 3L



With a mains voltage of less than 380V, the control electronics must be supplied separately or by transformer as shown in the drawing. The wire bridges BR1, BR2, BR3 and BR4 on the boards 4092 or 4093 must be removed.

Caution: Ensure by all means correct phase connection. Incorrect connection results in fuse failure.

6.4 Please contact the factory, if your mains voltage is higher than 415V.

7. Setting instructions

7.1 Turn trimmer n_{max}, V_p, IxR fully anticlockwise. The trimmers U_{leit} and n_{fein} are factory set for a standard set value potentiometer connection. Only when operating with a master voltage, U_{leit} must be turned fully anticlockwise and n_{fein} to middle position in order to enable subesequently a basic setting. The trimmer I_{max} is factory set to nominal controller current.

7.2 Setting of the current limit

This setting is only necessary when the motor current is lower than the nominal controller current.
Turn trimmer I_{max} fully anticlockwise.
Connect a moving coil instrument in order to measure the current to the armature cable; observe the polarity.
For positive set value the polarity at the motor terminal A is (+) and at terminal B (-).
For negative set value the polarity at the motor terminal A is (-) and at terminal B (+).

Block armature or disconnect when without voltage.
For armature voltage control disconnect cable to terminal [1].

<u>Caution:</u> Observe current capacity of the motor when at standstill!

Switch on the mains supply. LED ±Vcc and RSP light up. Close switch RFR. LED RSP is not lit anymore.
Set speed setting potentiometer fully clockwise or set master voltage to nominal value. LED I_{max} lights up. Turn I_{max} clockwise, until the desired armature current flows. The permissible output current of the controller must not be exceeded. See page 2, chapter 2, armature current.
Open switch RFR. Connect the field. Reconnect supply cable to terminal for armature voltage control.

7.3 Conditions for setting see chapters 7.3.1 and 7.3.2

Connect a moving iron instrument as voltmeter to terminals A and B of the motor. When setting the speed, ensure that the armature voltage does not exceed the permissible value of U_{Amax} = 400V.

7.3.1 Armature voltage control with IxR compensation

Connect terminal A of the motor to terminal [1] of the controller and terminal B of the motor to terminal [2] as shown in the connecting diagram. Set the set value potentiometer or master voltage to 0V. Open switch RFR. Switch on mains. LEDs RSP and ±Vcc are lit. Set the set value potentiometer or master voltage to maximum. For master voltage operation turn trimmer U_{leit} clockwise until +10 VDC are applied at the measuring point M1 (measured to terminal [3]). Set the set value potentiometer or master voltage to approx. 10% of the final value. Close switch RFR.
LED RSP is not lit.

Caution: If the drive accelerates in an uncontrolled way, open switch **RFR** immediately.

Terminals I and K of the field or armature voltage feedback are interchanged. After having checked and corrected the wiring, the commissioning can start again.
When the speed is stable, the desired maximum speed can be set. Set the set value potentiometer or master voltage to maximum. Turn trimmer n_{max} clockwise, until the desired maximum speed is obtained. Trimmer n_{fein} is used for the fine setting of the maximum speed.

Turn trimmer V_p clockwise, until the drive becomes instable (speed oscillations), then turn trimmer V_p back by approx. 20%, until the drive is stable again. Using trimmer **IxR** the speed is stabilized such thata minimum change results for the smallest speed between idle running and nominal load. Subsequently, the compensation of higher speeds must be checked.

7.3.2 Speed control using tacho feedback

For tacho feedback the trimmer **IxR** must be set fully anticlockwise. Set the set value potentiometer or master voltage to 0V. Open switch **RFR**. Switch on mains. LED **RSP** and ±Vcc are lit. Set the set value potentiometer or master voltage to maximum. For master voltage operation, turn U_{leit} clockwise, until +10VDC are applied at the measuring point **M1**. Then set the set value potentiometer or master voltage to approx. 10% of the final value. Close switch **RFR**. LED **RSP** is not lit anymore.

Caution: If the drive accelerates in an uncontrolled way, open switch **RFR** immediately.

Terminals I and K of the field or armature voltage feedback are interchanged. After having checked and corrected the wiring, the commissioning can be start again.
When the speed is stable, the desired maximum speed can be set. Set the set value potentiometer or master voltage to maximum. Turn trimmer n_{max} clockwise, until the desired maximum speed is obtained. Trimmer n_{fein} is used for the fine setting of the maximum speed. Turn trimmer V_p clockwise, until the drive becomes unstable (speed oscillations), then turn trimmer V_p back by approx. 5%, until the drive is stable again.

For special applications (improved speed control behaviour for exacter control pathes, speed control without overshoot), a differential component can be installed. This should only be done together with tachogenerators which have an output voltage with very low ripple (KTD3 or TDP02).

Approximate values for the differential component: resistance 10kΩ, R101 capacitor 10µF or two electrolytic capacitors 22µF antiserial C102.

Caution: Ensure that the components mentioned above have suitable voltage values.

7.4 Trimmer n_{offs}

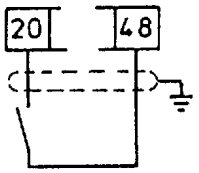
The offset of the trimmer is factory set; however, if a correction should be required, zero can be adjusted at the trimmer n_{offs} for set value provision.

8. Switching operation

8.1 Quick stop

When the switch **quick stop** is closed, the drive is decelerated to standstill with the nominal current.
(Set value is set to zero.)

Quick stop

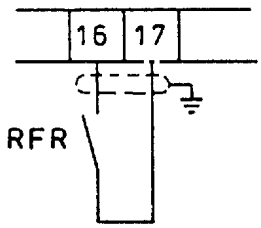


Use low current contact (15V/1.5mA)

See chapter 9, terminal 46 for mains switching off with standstill logic

8.2 Controller release

When switch **RFR** is closed, the controller is released. When switch **controller release** is open, the controller is inhibited. The firing pulses are set to the inverted limit position.



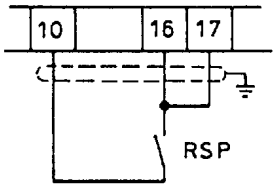
Use low current contact (15V/1.5 mA)

Caution: The controller must be released only at motor standstill.

8.3 Controller inhibit

The previously used function **RSP** (inhibiting the controller using a normally open contact) is still available.

When the switch **controller inhibit** is closed, the firing pulses are set to the inverted limit position.

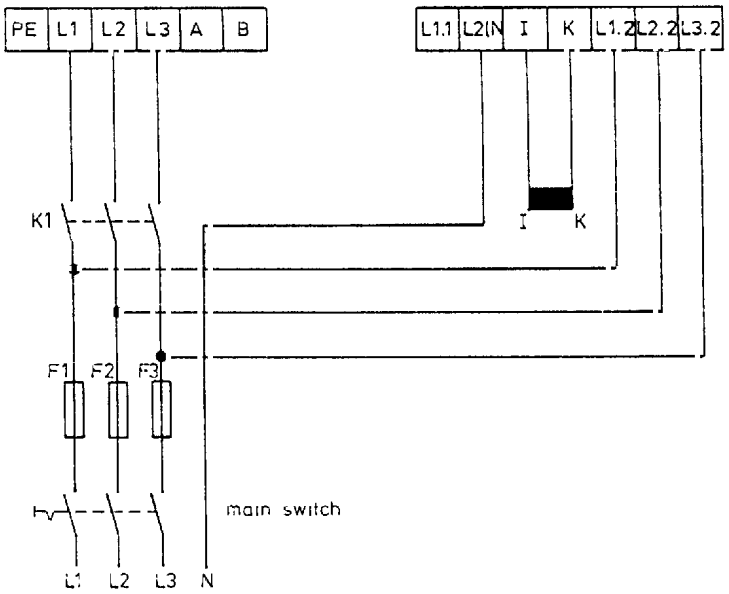


Use low current contact (15V/1.5 mA)

Caution: The switch **RSP** must only be opened at motor standstill.

8.4 Inching

The wire bridges BR1, BR2 and BR3 on the boards 4092 or 4093 must be removed.

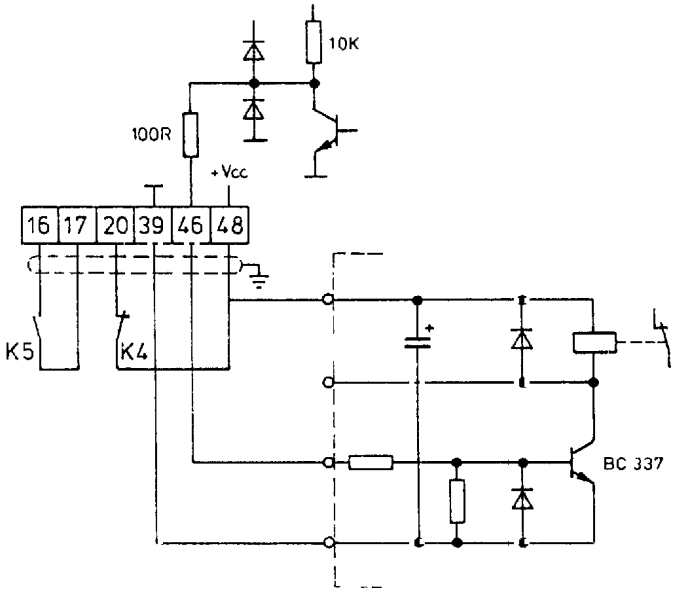


Configuration of mains contactors

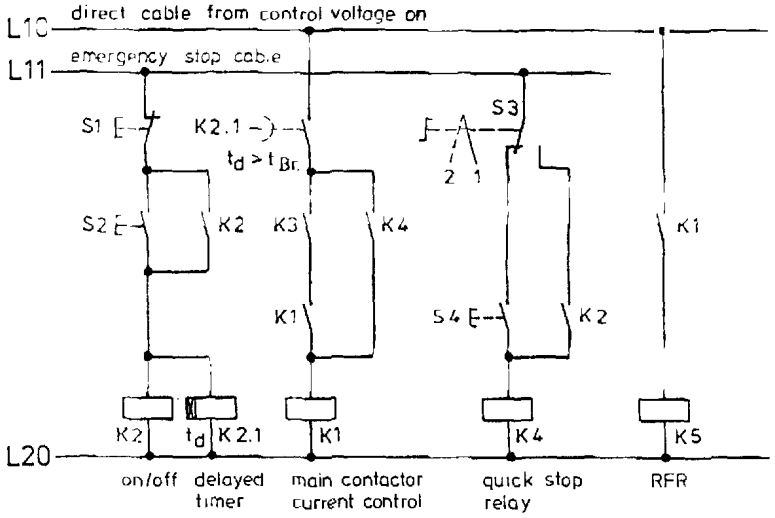
Caution:
When inching with K1 the electronic supply is still maintained. The mains is completely separated by a mains switch.

Application proposal for fast inching

Inching is done via S4 (switch).
The switching using quick stop causes fast deceleration in the inverter mode.



REL/TRP-15
part no. 321 351



BR	braking time of the drive		
S1	drive off	S3	1 inching 2 automatic
S2	drive on		
		S4	inching
K4, K5	relay with gold-plated contacts		

9. Connecting terminals

1 Input for armature voltage control using IxR compensation (motor terminal A), see 7.3.1.

2 Input for armature voltage control using IxR compensation (motor terminal B), see 7.3.1

For tacho operation with U_{TN} > 45V terminal **2** instead of terminal **4** can be used in order to obtain a better resolution of the n_{max} trimmer. C 101 must be removed in this case.

3 GND, controller reference point

4 Input for actual speed value with nominal tacho voltages from 10 to 180V. For high nominal tacho voltages (≥ 60V) the setting sensitivity of the n_{max} trimmer, which is used as an attenuator, can be reduced by soldering a series resistor R 101 instead of the normally used wire bridge. C 101 must be removed in this case.

The resistance of R 102 can be determined according to the following equation:

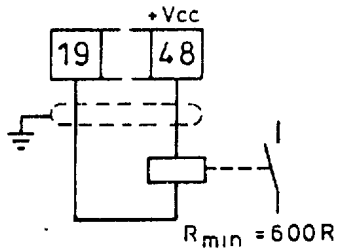
$$R\ 102 = \left(\frac{U_{TN}}{10V} - 1 \right) \ 30\ k\Omega$$

See also terminal **2**.

Note:
The position R 101 appears on the control boards 4091.2 (see red label on latest design). For older boards with the designation 4091.1 (see red label) this resistor is named R 102.

7	-Vcc= -15V= stabilized. Maximum external load is 50 mA
8	Input for actual speed value or master voltage from ±10 to ±180V.
9	+Vcc = +15V = stabilized. Maximum external load is 50 mA
10	GND, controller reference point
16	controller release, see chapter 8
17	controller inhibit, see chapter 8
19	transistor output fault indication

In the controllers 495 and 496 the temperature of the power semiconductors is supervised by a temperature sensor. If the heat sink exceeds the limit temperature ϑ_{limit} = 90°C, the controller inhibit **RSP** is activated inside the controller and the firing pulses are set to the inverter limit position, i.e. the motor is without current and idles. An electrical latching system prevents an automatic switch-on even after the controller has cooled (The self-holding circuit can only be released by switching the mains off and on again!) At terminal 19 U ≤ 0.6V are applied. The output can be loaded with maximum R_{min} = 600Ω and is suitable for the direct connection of a relay.



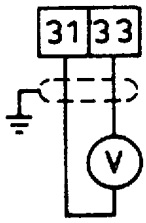
Relay: e.g. REL/TRP-15
part no. 321 351

For applications, where the motor must not automatically be without current after having exceeded the maximum cooling temperature of the motor, the resistor R 311 (on soldering posts) must be removed. In case of a controller fault only a fault indication is displayed.

Caution: The cause of the fault must always be removed as soon as possible, otherwise the operating safety of the controller is not maintained anymore.

20	quick stop, see chapter 8
31	output armature current signal

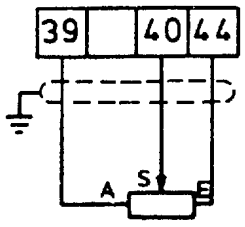
The output terminal 31 supplies a signal proportional to the armature current. (U_{31}) = 5V corresponds approximately to the nominal current of the controller and can be used for the direct current display with a measuring instrument.
The maximum load of terminal 31 is 10mA.



33	GND
38	Speed controller input

Terminal 38 leads to the summation point of the speed controller via Ri ≈ 50 kΩ. The permissible input voltage range is between +10V and -10V. When switching the controller inhibit the input is switched to zero. In this case Ri ≈ 25 kΩ. For positive set value or positive master voltage and negative actual value a positive armature voltage is applied at terminal A.

39	GND, controller reference point
40	input, current control, Ri ≈ 10 kΩ
44	output speed controller, Ri ≈ 200 Ω. The terminals 40 and 44 are connected internally via the resistor R 705 on soldering posts. For current ratio control or connection of an external current potentiometer this resistor must be removed. The desired maximum armature current is set using the internal trimmer I_{max} with fully open external current potentiometer.



Current set value 10 k/1 W lin
Remove R 705

46	output standstill logic

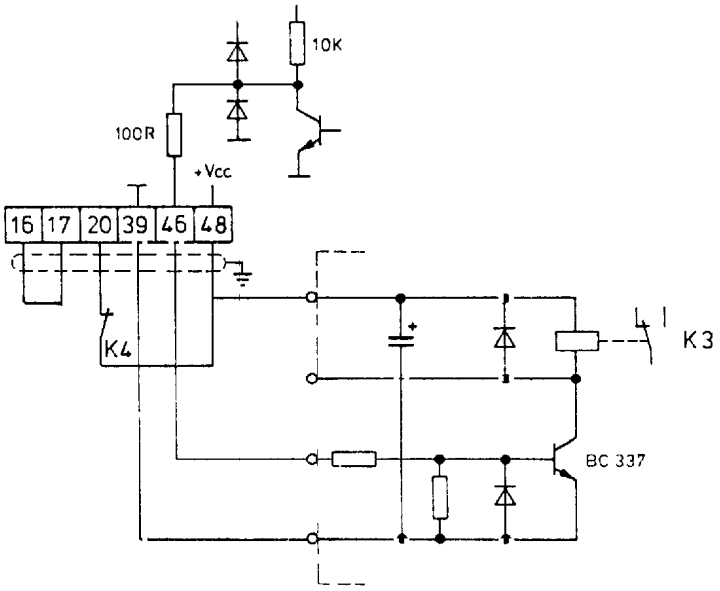
When the speed is less than $n = \frac{n_{max}}{50}$,

the transistor output terminal 46 switches to ≤ 0.6V

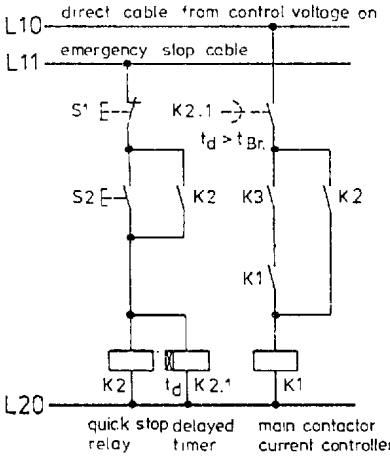
When installing a diode (e.g. 1N4004) on the position V 714 of the board 4091, the transistor output terminal 46 switches to 0.6 V if the speed is less than $n = \frac{n_{max}}{50}$ and the motor is without current.

The output is used for an automatic mains switch-off.

- Application proposal for fastest possible mains switch-off (faster braking in inverter operation). V174 must be soldered. See chapter 11.



REL/TRP-15
part no. 321 351



t_{Br} brake time of the drive
S1 drive off
S2 drive on
K2 relay with gold-plated contacts

48	+Vcc = 15V stabilized maximum external load of +Vcc is 50 mA

10. Optical display of the most important functions with LEDs

10.1 LED ±Vcc

±Vcc is lit, when the controller is ready to operate.
±Vcc is not lit when there is no power supply (±Vcc surveillance).

10.2 LED **RSP**

RSP is lit when:
- switch is open, **controller release**, see 8
- switch is closed, **controller inhibit**, see 8
- excessive temperature of the heatsink (for 495 and 496)
- bridge changeover
- phase failure.

When **RSP** is lit, the firing pulses are in the inverter limit position.

10.3 LED I_{max}

I_{max} is lit when the speed controller is operating at its limit.

10.4 LED **SEQ**

SEQ is lit when the rotating field is incorrect (CCW rotation) and the firing pulses are suppressed.

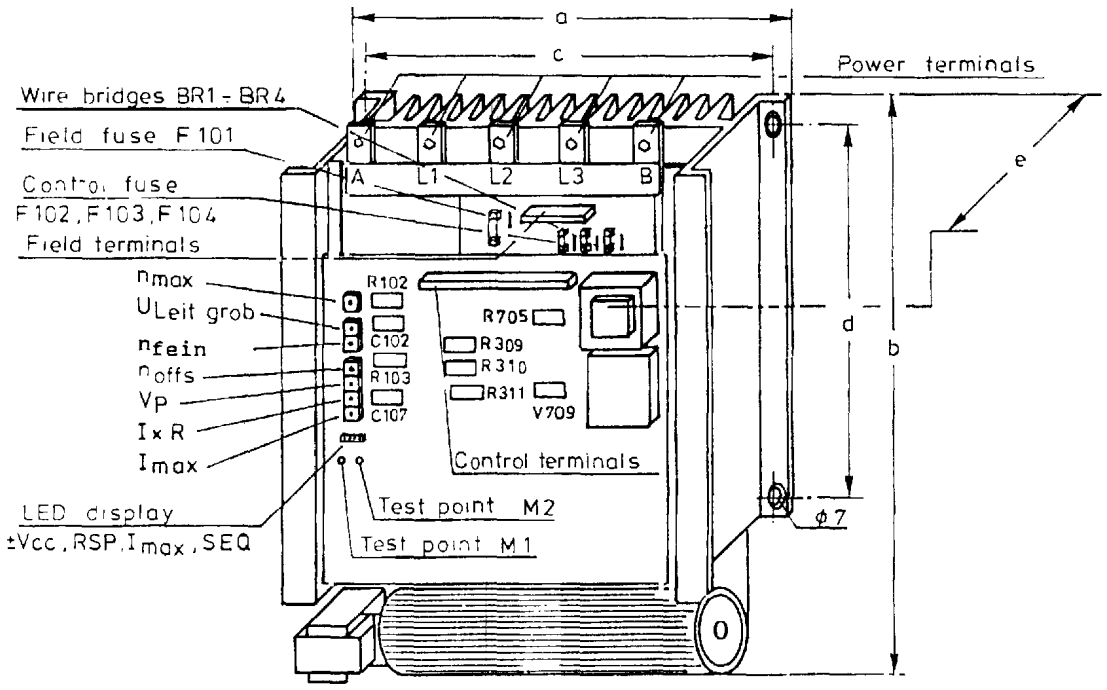
11. Additional soldering posts

* no standard element

C 107*	integral component of the speed controller
C 102, R 101	actual speed value (differential component), standard wire bridge
R 103	No n_{offs} when the 1.5mΩ resistor is removed
R 207, R 209	for option board
R 305	quick stop for option boards SWI, standard 24K3Ω
R 309	When actuating the quick stop, the integral component of the speed controller is inhibited
R 310	Hysteresis of the direction sensor, standard 100 Ω
R 311	When removing R 311 only fault indication at terminal 19 without controller inhibit
R 621	Amplification for I control, standard 39 kΩ
R 705	Speed controller output for external I_{max} potentiometer
R 719	Adaptation of the current controller, standard 3K3Ω For fully compensated motors it may be necessary to increase the resistance in order to stabilize the current controller
V 714	n_o indication with I_A = 0 indication

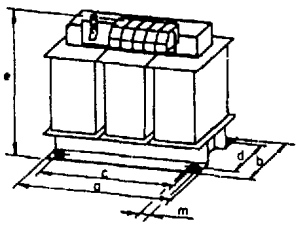
12. Dimensions

12.1 Controller



Type	a		b		c		d		e	
	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.
492	240	9.4	280	11	224	8.8	260	10.2	165	6.5
493	285	11.2	280	11	271	10.6	260	10.2	200	7.8
494	285	11.2	280	11	271	10.6	260	10.2	200	7.8
495	285	11.2	430	16.9	271	10.6	310	12.2	200	7.8
496	285	11.2	430	16.9	271	10.6	310	12.2	200	7.8

12.2 Mains choke



Type	part no	L	I	a mm	a in.	b mm	b in.	c mm	c in.	d mm	d in.	e mm	e in.
492 L_K	322 149	3x1.2 mH	3x17 A	120	4.7	66	2.6	110	4.3	53	2.1	162	6.3
493 L_K	322 148	3x1.1 mH	3x25 A	150	5.9	75	3.0	140	5.5	60	2.8	180	7.0
494 L_K	307 343	3x750 uH	3x45 A	180	7.0	85	3.3	163	6.4	69	2.7	218	8.5
495 L_K	307 346	3x270 uH	3x105A	228	9.0	107	4.2	207	8.1	91	3.6	273	10.7
496 L_K	308 234	3x165 uH	3x170A	264	10.4	128	5.0	240	9.4	104	4.0	260	10.2

L_K = commutating choke
(mains choke)

12.3 Power losses

	Series 492	493	494	495	496
Pv/W current controller	60	108	185	288	577
Pv/W mains and armature fuse	18	33	63	112	140
Pv/W mains choke	30	55	80	130	170

13. Items supplied

Installedfield and electronic fuses,
set value potentiometer 10 kΩ

You must order separately: mains choke
knob and scale for set value potentiometer, mains fuses, armature fuse and fuse holder

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