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1. General notes on the frequency inverter

1.1 Why a frequency inverter?

LUMIDRIVE FU 200s are frequency inverters for low-loss continuous speed adjustment of three-phase asynchronous motors with shaft outputs ranging from 0.375 to 2.2 kW. By utilizing the most modern microcomputer technology, a compact, easy to use, economical unit has been designed. This further increases the possibilities for the electronic speed adjustment of three-phase motors. The extremely robust A.C. motor has become variable speed machine. A normal alternating current connection is sufficient – the three-phase current with variable frequency is supplied by the frequency inverter. By simultaneously changing the phase voltage according to the rev./f characteristic the motor is driven up to rated frequency with a constant magnetic flow. That means a constant torque up to rated speed. In addition, the generated power remains constant (above base frequency) to 240 Hz.

Any existing three-phase asynchronous motor can be re-equipped. In addition to the advantages of the variable speed, further advantages arise such as minimal maintenance, minimal material wear due the soft starting or higher speed with increased frequency. Matching the conveying speed of a conveyer belt to a continous operational process for example can be done without any problem. Today the speeds of pumps and fans as well are speed controlled with frequency inverters.

1.2 Special characteristics

sinusoidal motor current with the PWM process
low-noise
automatic self-testing
potential-free control inputs
directly PLC addressable
control output for operating and failure message
diagnosis system with 12 or 16 different operational or failure displays

1.3 Uses

The frequency inverters are implemented in conveying, moving and positioning when it's a matter of ensuring uniform motion without jerking or when an increase in the frequency is to be achieved while simultaneously reducing the mechanical wear parts.

For metering, air-conditioning, regulating when it's a matter of saving energy and reducing the mechanical wear parts or when especially fine metering and regulation with a high degree of process integration are required.

For processing and tooling when it's a matter of optimizing the working speed and keeping the cutting speed constant, and when the

2. Technical data

2.1 Output from motor

	Des.	Unit	FU201	FU202	FU203	FU205	FU207	FU208	FU209*
Rec. motor rated power appl. to 2 pole norm motor	P	kW	0,250	0,375	0,750	1,1	1,5	1,5	2,2
Units cont. power output	P	kVA	0,4	0,7	1,3	1,7	2,3	2,7	3,6
Phase current	I_s	A	1,1	1,9	3,5	4,5	6,2	7,5	9,5
Voltage	U	V	3 x 0 – 220 V						
Rot. field freq. Type S/SH	f	Hz	0 – 120 / 0 – 240						
Freq. resolution		%	0,4 %						
Overload			1,2 x I rated during 0.4 sec.						
Short-proof phase-phase	W/10 m motor lead or output choke KE 200								
Earth-fault detection:	automatic after every „Mains on"								
Earth-fault proof:	during operation w/option KE 200								
Stall test:	yes								
Load type:	ohmic/inductive, no capacitive loads, asymmetric load also permissible								

* FU209 is a FU208 with a fan LA 200 on the top.

2.2 Input from mains

Voltage	U		1 x 230 V – 20 % + 6 %				1 x 230 V – 14 % + 6 %		
Mains freq.	f	Hz	50 / 60						
Power input	P	kVA	0,45	0,75	1,37	1,78	2,42	2,85	3,6
Output cross-section		mm^2	1,5	1,5	1,5	1,5	1,5	1,5	1,5
Power factor	cos φ		> 0,98 (real output)						

2.3 General

Type of operation									
Holding torque			switchable						
Degr. of effic.	η	%	90	93	95	95	95	95	95
Dissipation f = 50 Hz, I = I_N	P	kW	0,05	0,05	0,07	0,08	0,120	0,150	0,200
Int. unit fusing	AF	A	8	8	8	8	16	20	20
Elec. connection			block terminals						

2.4 Environment

Surrounding temp.	t	°C	0 – 40	0 – 35	0 – 40
Type of ventilation			convection		
Max. housing temp.		°C	60 °C on side plating		
Output decrease dependent of temp.		%/°C	from 40 °C cooling air temperature on 1 % per °C, max. 50 °C		
Rel. humidity		%	0 – 90 non-condensing		
Max. install. elev. over sea level		m	1000		

2.5 Housing

			201 print	202	203	205	207	208	208 + * with fan
Dimensions	W x H x D	mm	133 x 256 x 77				208 x 256 x 125		
Type of protection			IP 00	IP 10 VBG 4					
Weight		kg	1,2				3,2		
Type of install.			vertical wall install.						

* see 9.5.2

3. Notes on the electr. installation

3.1 Specifications and regulations

Attention: Disconnect unit from mains before making any repairs. After a period of about 2 minutes, when the intermediate circuit condensers have discharged and have less than 65 V residual voltage, the unit may be opened and worked on.

During installation, general installation regulations such as the following should be observed:

VDE 0100 Stipulation for the installation of power current installations with mains voltages up to 1000 V

VDE 0113 Stipulations for the electrical equipment of production and tooling machines

VDE 0160 Equipping power current installations with electric operating devices.

Further regulations may have to be observed if a special use for the unit is planned.

As a protective measure, the following circuits may be used according to the utility company supplying power:

Fault voltage protective circuit,
Protective earth or protective multiple grounding (where permitted).

Fault current (FI) protective circuits can not be used in connection with frequency inverters. In some countries this is prohibited. There are two reasons for this:

a. All rectifiers (that is not only frequency inverters) can cause a direct current in the mains leads which can then reduce the sensitivity of the protective switch.

b. An asymmetrical load caused by radio noise suppression filters can trigger the FI switch prematurely which would cause the undesired loss of the drive.

3.2 Switching devices

According to the VDE regulations, the frequency inverters must be connected to mains in such a manner that they can be separated from mains with the appropriate circuit breakers (for example main switch, contactor, power protection switch). The motor connected to the frequency inverter may be separated by a contactor or motor protection switch.

Attention: Connecting energized motors or reversing the poles with pole-interchangeable motors as well as changing the direction of a motor (for example with reversing contactors) is not permitted during operation.

Gold-plated contacts or contacts with high contact pressure should be used in wiring the control contacts. Precautionary anti-interference measures should be taken for switch gears such as wiring protection devices and relays with RC sections or diodes, respectively.

3.3 Wiring

The mains supply line, motor supply line and the control lines should be laid in separate cables. If the individual wires are to be brought together in a cable trunk, then the wires of the control lines should be twisted over the entire length. To avoid interference, it is best to lay the electronic signal lines separate from the power and/or protective control lines and to twist the outgoing and return lines of the signal lines.

The set-value leads must be twisted inside the switch cabinet and screened outside it.

3.4 Fuses

The fusing from mains is dependent on the lead cross-section recommended or used, respectively and must done according to DIN 57 100 Part 430/VDE 0100 Part 430/6.81.

The factory fixes the lead cross-section for the mains, motor and braking chopper connections at 1.5 mm^2.

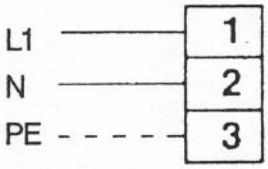
Si_1/Si_2 mains fuses
Si_4 (FU 207) intermediate circuit fuse

4. Power and control connections

4.1 Mains connection

Connecting the frequency inverter is done using cables with 1.5 mm^2 lead cross-section to mains (230 V, 50/60 Hz). The connection is made at the terminal block XO at the connectors: **1 = L1, 2 = N, 3 = PE.**

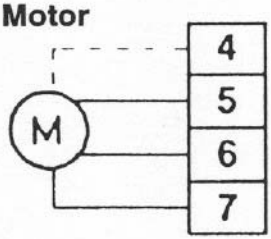
Connection plan, input from mains



4.2 Motor connection

Connecting the motor connection is done using cables with 1.5 mm^2 lead cross-section at the terminal block XO: at the connectors: **4 = PE, 5 = U, 6 = V, 7 = W.**

Motor



The type of load must be ohmic/inductive, capacities can lead to a defect in the inverter so that capaciter motors must not be connected. Three-phase asynchronous motors and single-phase motors with 220/240 V phase voltage can be connected.

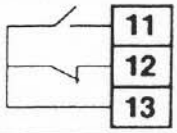
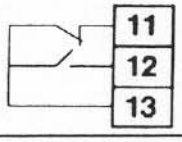
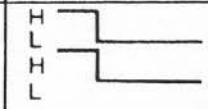
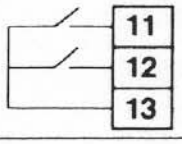
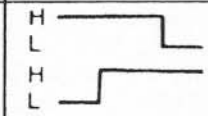
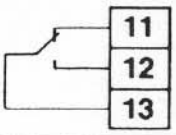
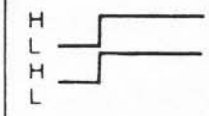
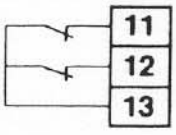
4.3 Braking chopper connection

The frequency inverters FU 202 + 203 can be operated with an external braking chopper. The connections for this external braking addition are described in the graphics of chapter 9.4.4 (6.3 mm flat cable plug: red = positive, black = negative).

The frequency inverter FU 207 is delivered with an integrated braking chopper. The corresponding brake resistor (accessory order FU 207-BC) can be installed on the inside of the housing at the factory on request. The braking power is approximately 1,2 kW. The brake resistor can also be installed later or connected externally to the connections 32 and 33 (R B Ext). This also reduces the temperature of the frequency inverter.

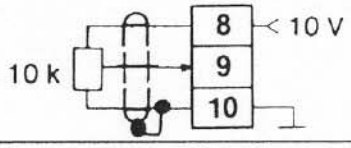
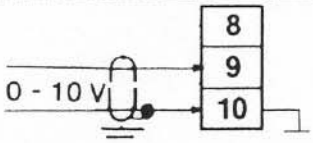
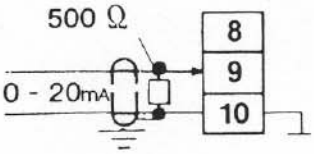
To increase the braking power an external braking chopper (BC 200) may be connected to the terminal block XO, connector 31 = ZK- (negative intermediate circuit voltage), 34 = ZK+ (positive intermediate circuit voltage).

4.4 Control signal inputs

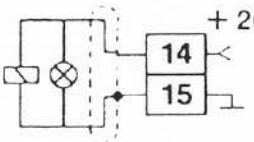
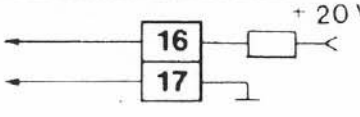
		porgram logic control	switch control	
start	clock-wise rotation			12 – 13 closed, 11 – 13 open, or control voltage on 12, resp., the frequency reaches the set value in the fiven time T_{UP}.
	counter-clock-wise rotation			11 – 13 close, 12 – 13 open, or control voltage on 11, resp., frequency reaches the set value in the given time T_{UP}.
	stop			By opening the start inputs 11 + 12, the output is switched dead and the motor coasts down.
Reversing				The turning direction is reversed by closing the start contact still open and opening the start contact which is active. Overlapping time: 50 msec. The frequency then reaches 0 Hz with T_{DOWN} and reaches the set value with T_{UP}.
Brakes				By closing the contacts 12 – 13 and 11 – 13 on 11 + 12 simultaneously, the frequency reacs 0 Hz with T_{DOWN}. **Attention:** See notes section 10.4 Brakes

H = 9 V . . . 30 V / L = 0 V . . . 7 V

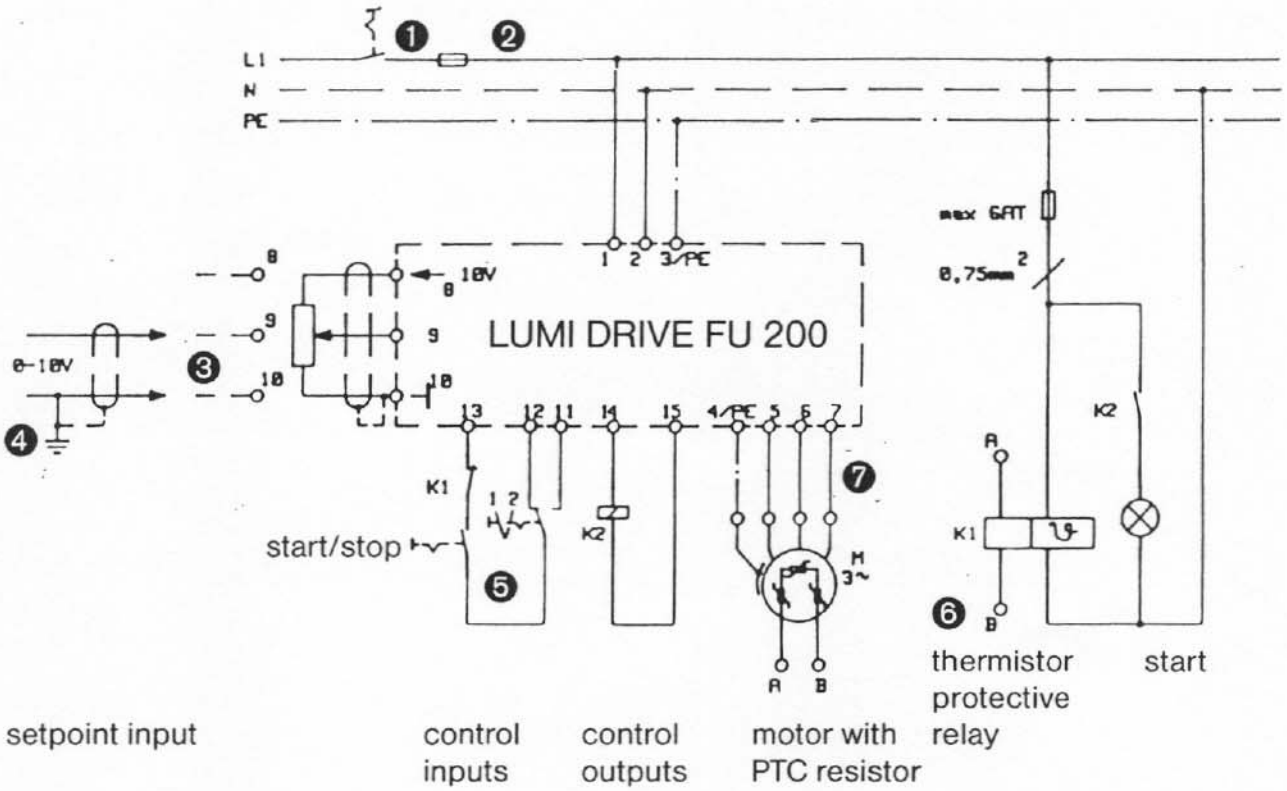
4.5 Reference values

potentiometer		frequency setpoint Ri = 60 k Ω standardization: 0 k Ω ≙ 0 % f_{max} ≙ stop 10 k Ω ≙ 100 % f_{max}
external 0 – 10 V		frequency setpoint Ri = 60 k Ω standardization: 0 V ≙ 0 % f_{max} ≙ stop 10 V ≙ 100 % f_{max}
external 0 – 20 mA		frequency setpoint Ri = 500 Ω standardization: 0 mA ≙ 0 % f_{max} ≙ stop 20 mA ≙ 100 % f_{max} Insert a 500 D resistor between connectors 9 + 10.

4.6 Control outputs

operation		Potential-free control output, 20 V DC + 20 % – 40 %, short-proof, 20 mA, if the start command is accepted internally and the motor voltage is released.
Failure or at stop, resp.		No voltage on 14.
Frequency output		For connecting a digital frequency display, a rectangular signal is available with 6 times the actual rotating field frequency, time ratio approc.2 : 1, + 20 V + 20 % – 40 % at 22 k Ω low at ≦ 0,8 V, high at complete stop, short-circuit-proof.

5. Suggested connection



❶ To avoid overloading the precharging circuit, the frequency inverter should remain continuously connected to mains as much as possible. It is possible to repeat the precharging circuit after 60 seconds.

❷ Fusing from mains (see 3.4).

❸ Setpoint input with twisted cable (see 3.3).

❹ One-sided, grounded on frequency inverter.

❺ Control contacts should be gold-plated or have high contact pressure to avoid faulty operation.

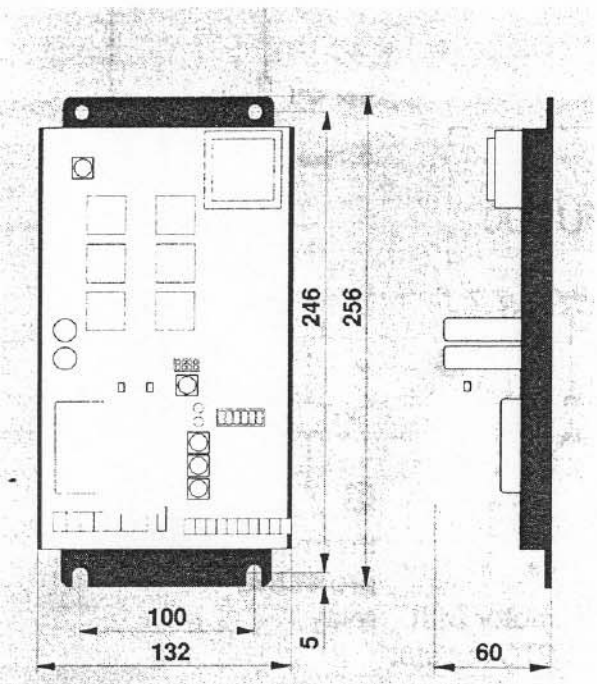
Attention: If power electronic units are operated in switch gears in the vicinity of the frequency inverter or from the same mains, then precautinonary anti-interference measures should be taken for the switch gears such as wiring protection devices and relays with RC sections or diodes, respectively.

❻ A thermistor protective unit is recommended for protecting the motor, since with thermistor protection carries out direct temperature monitoring at the motor.

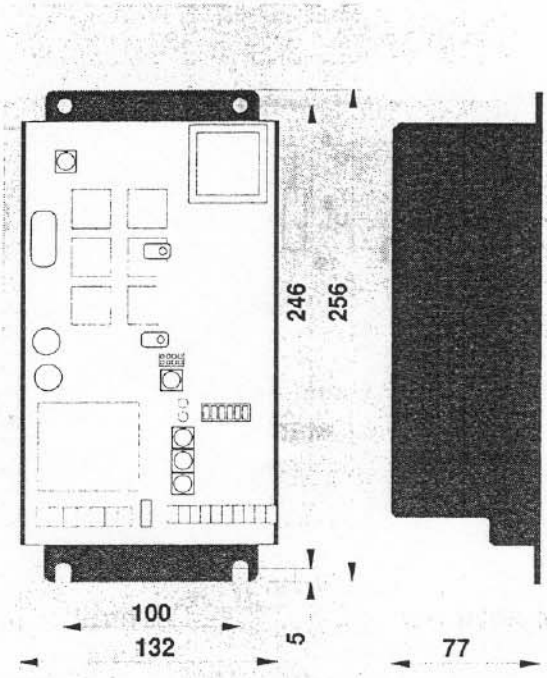
❼ The inverter is protected from short circuit and earth fault by a 10 m motor supply lead or using the accessory device KE 200 (see 9.4.1).

6. Notes on the mechanical installation

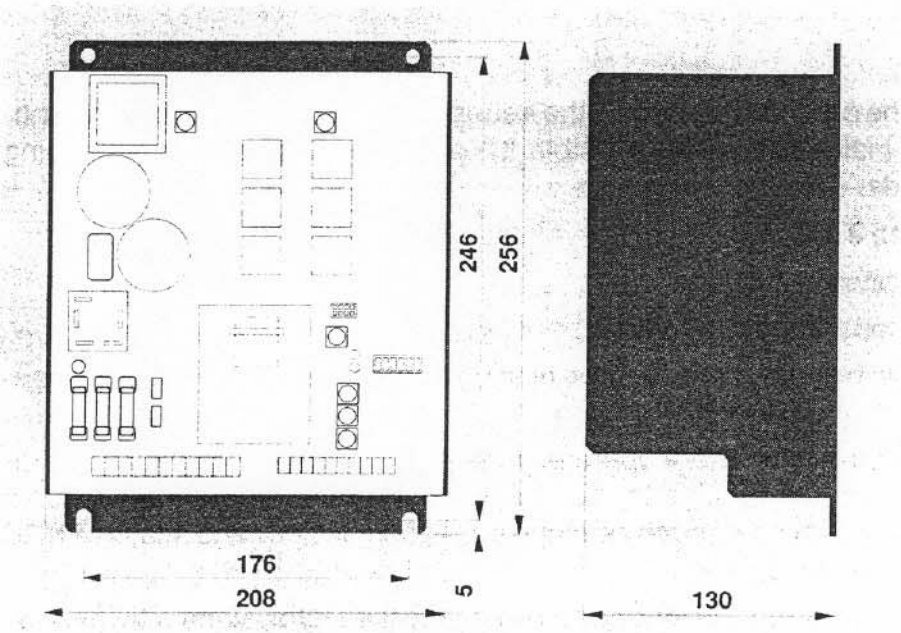
6.1 Unit dimensions



FU201



FU202 / FU203 / FU205



FU207 / FU208

6.2 Type of housing protection

The frequency inverters of the LUMI DRIVE FU 200 (not the FU 201) line are equipped with protection ot the type IP10 (international protection), which means that they are protected against the intrusion of large foreign objects (50 mm). This complies with accident prevention regulation VBG 4, which means that protection against contact with large areas of the body is guaranteed.

The terminal block X0 for the power connections also complies with accident prevention regulation VBG 4. No special protection is required for the control connections (X1), since they are potential-free and only carry low voltage.

6.3 Notes on installing the unit

All LUMI DRIVE FU 200 frequency inverters are to be fastened to a vertical mounting surface with four bolts. For the FU 202 and 203, this mounting surface must be at least 0.3 m^2 in size and made of metal to ensure sufficient heat conductance.

The installation area should be free of conducting dust, caustic gases and moisture.

6.3.1 Minimal clearances

Since they are cooled by convection, certain points should be observed when installing the frequency inverters to avoid heat build-up:

The installation angle of inclination must not exceed a maximum of 20° (optimal : vertical = 0 °). When installing several frequency inverters one above the other, a minimal interval of 150 mm (100 mm with the FU 207) should be maintained. If several units are installed next to each other, then a minimal interval of 70 mm (50 mm with the FU 207) should be maintained. If units without their own heat source are to be installed – for example cable channels – then a minimum interval should be maintained here as well. This interval is 100 mm above or below the units and 50 mm on each side.

6.3.2 Installation in a switch cabinet

If the units are installed in a switch cabinet, then the heat arising from dissipation should be eliminated by means of the appropriate ventilation.

The cover should be removed when installing in a closed cubicle.

The power data given in the technical data for the FU 207 are valid for a internal switch cabinet temperature of 0 – 40 °C, for the FU 202/203 from 0 – 35 °C.

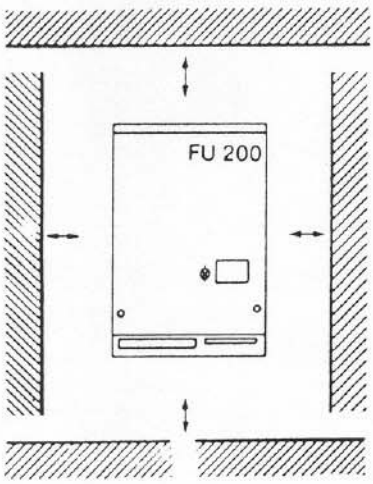


Fig. 1
Minimum clearances

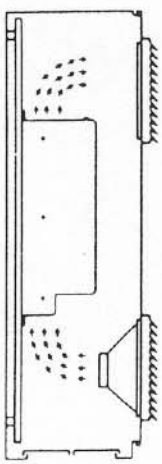
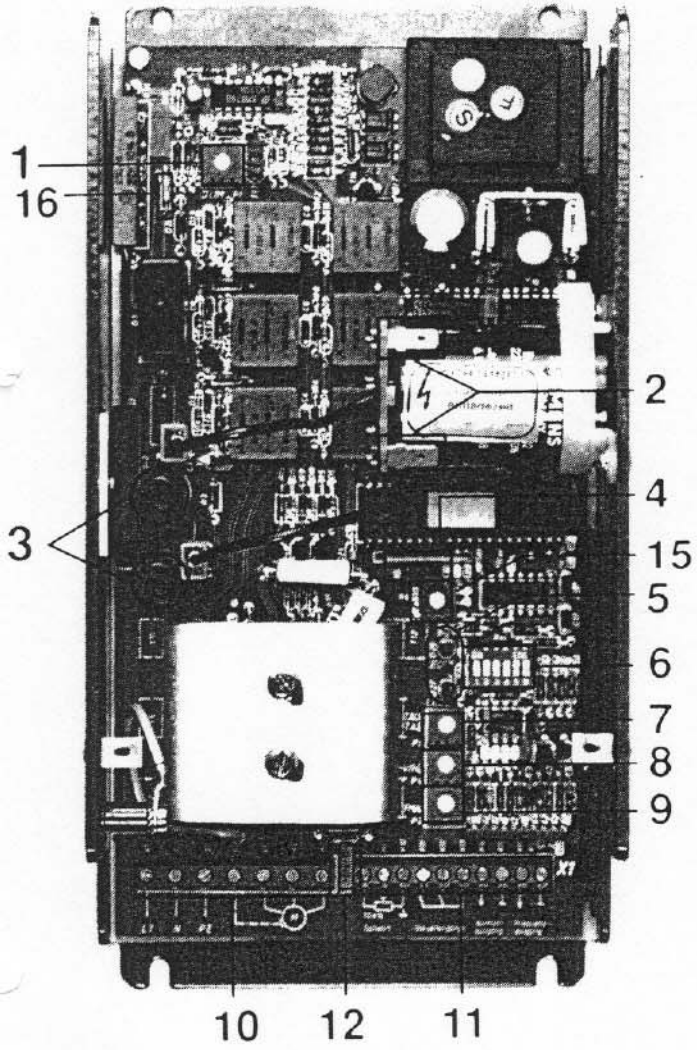
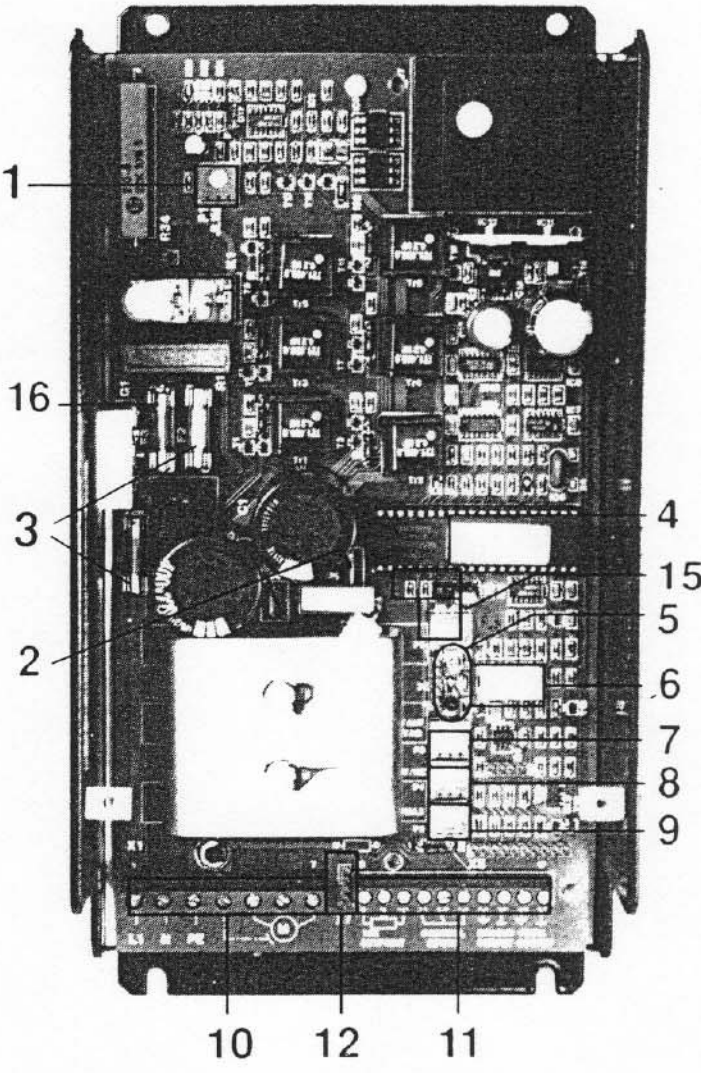


Fig. 2
Switch cabinet mounting

7. Design plan FU 201/202/203/205



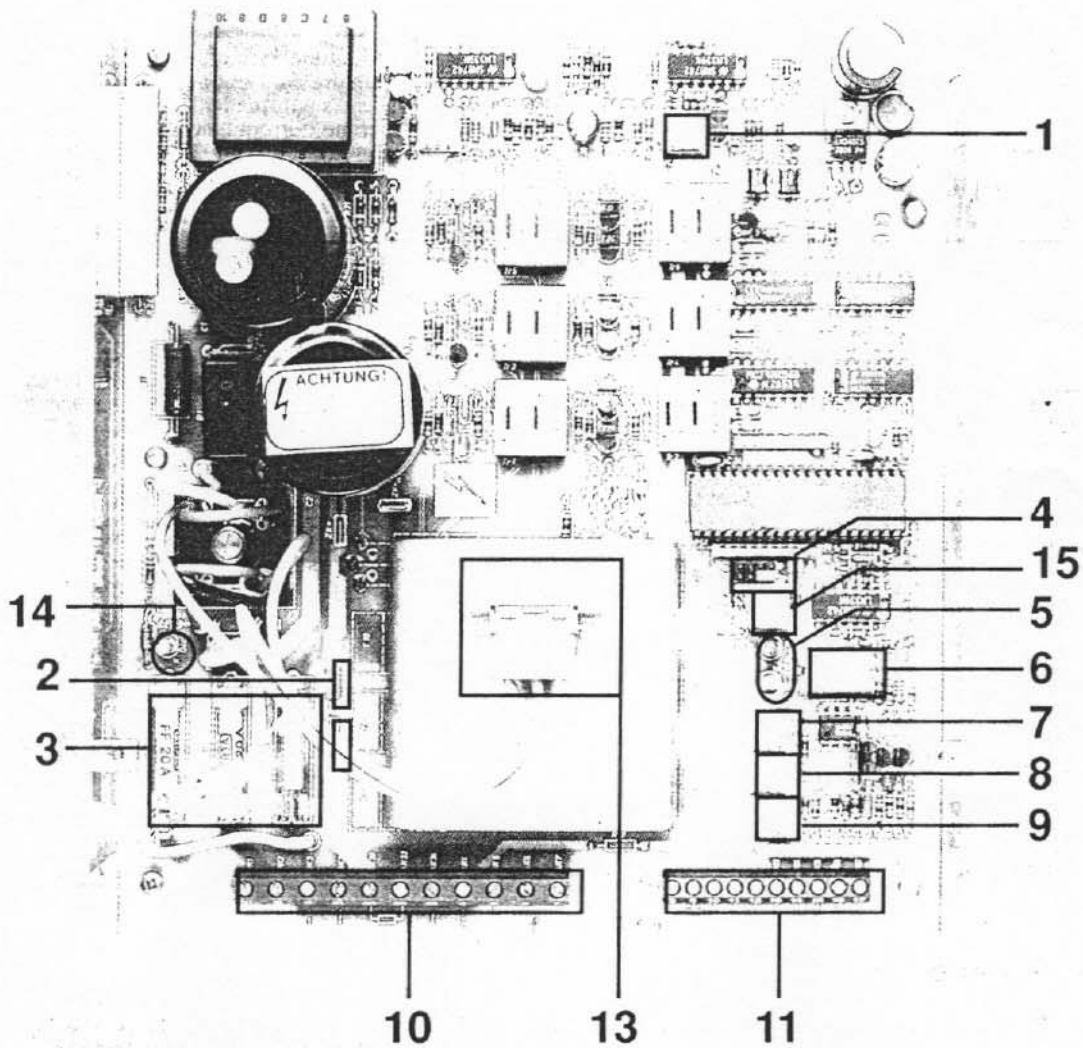
FU 200 Standard
Serial no. 0495.000.0



FU 200 SMD
Serial no. 0495.000.1

1 P1 Current limit I_{LIM}
2 Braking chopper connection
3 Si1/Si2 fuses
4 X6 Program plug
5 LEDs 1 + 2 Diagnosis
6 S1 – S6 Sliding switches
7 P3 acceleration/deceleration time
8 P4 voltage-frequency characteristic
9 P2 max. rotating field frequency
10 X0 power connections
11 X1 control inputs and outputs
12 connections for KE 200 detection of short circuit and earth fault
15 P5 various parameters (see description of options)
16 fuse for distribution transformer

Design plan FU 207, identical in construction with FU 208/209

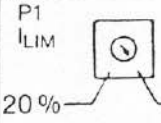


1 P1 Current limit I_{LIM}
2 Brake resistor
3 mains fuse, BC fuse
4 X6 Program plug
5 LEDs 1 + 2 Diagnosis
6 S1 – S6 Sliding switches
7 P3 acceleration/deceleration time
8 P4 voltage-frequency characteristic
9 P2 max. rotating field frequenc
10 X0 power connections
11 X1 control inputs and outputs
13 connections for fan attachmer LA 200 (for the FU 208 only)
14 LED 3 Diagnosis UZK
15 P5 other parameters (see description of options)

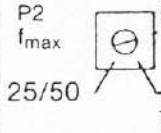
8. Setting the drive parameters

8.1 Potentiometer settings

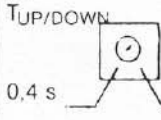
8.1.1 Over-current

P1 I_{LIM}  20 % 100 % I_{RATED} factory setting	I_{LIM}	0,2 – 1 x I_{RATED}	P_1	Individually adjustable current limit. LEDs 1 +2 light up when the set frequency is reached, the frequency is automatically held back, the drive runs at the current limit I_{LIM}. When the over-current cutoff (S4/S5) is simultaneously connected, the output is shut off after the given time.

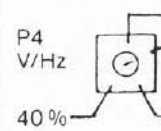
8.1.2 Speed limitation

P2 f_{max}  50/ 100 Hz 25/50 60 Hz/ 120 Hz factory setting	f_{max}	25 – 60 Hz 50 – 120 Hz (50 – 120 Hz)[1] (100 – 240 Hz)[1]	P_2	Limitation of the maximum output frequency to avoid damage to the motor and the working machine. Select the frequency area with S1.

8.1.3 Run-up and return interval

P3 $T_{UP/DOWN}$  0,4 s 100 sec factory setting	$T_{UP/}$ DOWN	0,4 – 100 sec (0,1 – 25 sec)[1]	P_3	Adjustment of the ramp steepness to the given time in which the output frequency reaches 60/120 or 240 Hz starting from 0, or drops from there back to 0, respectively.

8.1.4 Voltage/frequency characteristic

 80 % 100 % P4 V/Hz 40 % 120 % factory setting	U/f	Constant torque (torque increases by square)[1]	P_4	Adjustment of the curve slope to set the frequency at which the rated output voltage will be reached. The unit is factory-adjusted so thatat 50 Hz 220 V are available at the output. The behavior of the characteristic is such that constant torque is achieved up to the set-point. The quadratically increasing torque characteristic (pumps, ventilators) are given by changing plugs at the program plug (see options).

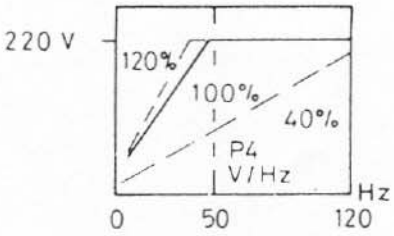
[1] see options

8.1.5 Multi-functions

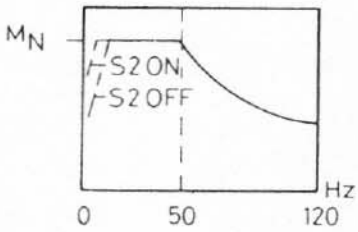
P5  no factory setting		– separate T_{AB} – adjustable VA – adjustable frequency setpoint	P_5	each function is activated by changing the position of the jumper in programmable plug X6 (see section 9.2)

8.2 Motor characteristics on the frequency inverter

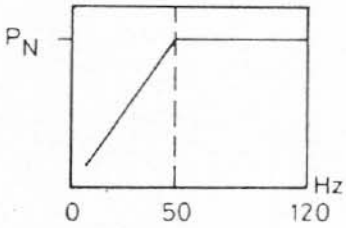
Motor voltage



Torque M



Power P



8.3 Internal switching with the sliding switches S1 – S6

8.3.1 Max. Frequency

	S1	OFF	The output frequency can be adjusted between 25 – 60 Hz (50 – 120 Hz)[2] with P2.
		ON	The output frequency can be adjusted between 50 – 120 Hz (100 – 240 Hz)[2] 2 with P2.

8.3.2 Starting torque

	S2	OFF	normal
		ON	increased due to raised voltage

8.3.3 Holding torque

	S3	ON	At the setpoint 0 V or with the control command "brake", the motor, ramp-guided, is braked to 0 Hz in the time given by the potentiometer P3 and direct current is applied to it to energize the holding torque. The control commend "stop" shuts off the holding torque.
		OFF	Holding torque switched off

8.3.4 Over-current cutoff I_{LIM}

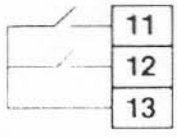
	S4–ON S5–ON	The frequency inverter shuts off after 3 – 10 sec.
	S4–OFF S5–ON	The frequency inverter shuts off after 10 – 30 sec.
	S4–ON S5–OFF	The frequency inverter shuts off after 30 – 100 sec.
	S4–OFF S5–OFF	No over-current cutoff at I_{LIM}
	S6–ON	Normal operation
	S6–ON–OFF–ON	Reset from error mode

[2] see options

9. Options and accessories

9.1 Options through internal software

With the program plug X6 (installed underneath the microprocessor), different options stored in the software of the microprocessor can be activited by plugging in or changing the position of the shorting link (jumper).

	measure	program plug	effect	control signal
9.1.1	short run-up and return time 0.1 – 25 sec. T_{UP}/T_{DOWN} 4 times shorter than normal **Attention:** required starting current must not be greater than I_{RATED}	X6  shorting link	timing sequence with start command start command counterclockwise/clockwise 0,1 sec. output frequency T_{UP} T_{DOWN} timing sequence with setpoint change setpoint jump output frequency T_{UP} T_{DOWN}	
9.1.2	fast stop (not with fast run-up time) **Attention: pay attention to the inertia**	X6 	The stop command brings the motor to a complete stop with 0.5 sec. T_{DOWN}.	stop  11 12 13
9.1.3	quadratically increasing torque curve.	X6 	The U/f characteristic is controlled in such a way that the motor torque increases quadratically, as with the pumps and fans.	standard
	standard program	X6 		standard
9.1.4	Control output operation		The control output 14/15 changes to high active once the frequency inverter completes the self-test and if there is no cut-out due to an error.	
9.1.5	Rapid trip actuation		The overload circuit breaker I_{LIM} responds 10 times faster.	

9.2 Parameters adjustable with the potentiometer P5

9.2.1	Separate T_{DOWN}		P3 is now set to acceleration time only, and independently of this P5 can be used to set the deceleration time between 0.4 and 100 seconds.
9.2.2	Adjustable U_A (I x R)		P5 can be used to set the initial voltage of the U/f characteristic to between 0 % to 20 %.
9.2.3	Adjustable frequency limit value		P5 can be used to set a frequency less than F_{MAX}. and the control output activated when this value is attained.

Note: only one of the described functions can be selected in each case.

9.3 Options with special software

9.3.1 High rotary field frequency 0 – 240 Hz

High rotating field frequency 0 – 240 Hz	The software is altered at the factory	The speed frequency is doubled using the special microprocessor with the SH program. By exchanging the processors, the 240 Hz version can be obtained.

9.4 Accessories for models FU 201 – FU 205

9.4.1 Short circuit and earth fault choke KE 200

To prevent phase/phase short circuits, this accessory device is needed for protection against shorting during service. The KE 200 device has a separate housing.

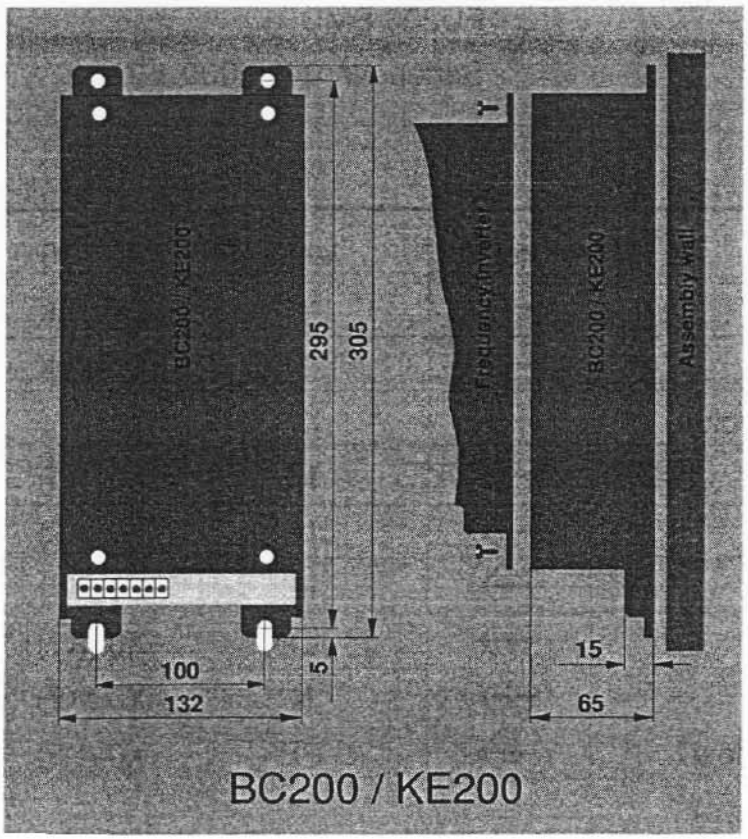
9.4.2 Braking chopper BC 200

On the LUMI DRIVE FU 201/202/203/205 an external braking chopper can be connected to the plug connection provided especially for this purpose on the intermediate circuit electrolytic capacitor (see section 7.).

The BC 200 braking chopper fits and is delivered under this ordering designation complete with the necessary connecting cables. The peak braking power is 1.2 kW max.

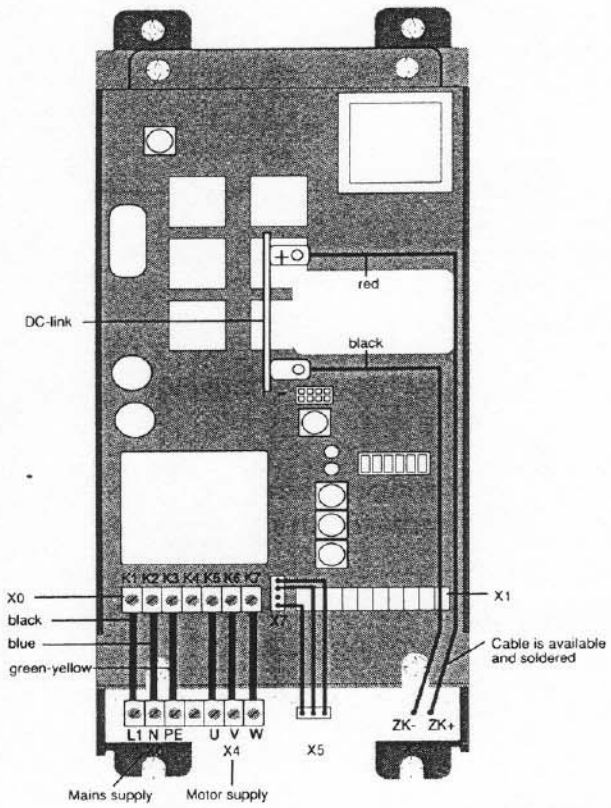
To prolong the life of the power transistors, the generator energy must not be greater than the motor energy (frequency inverter rated power).

9.4.3 Dimensions



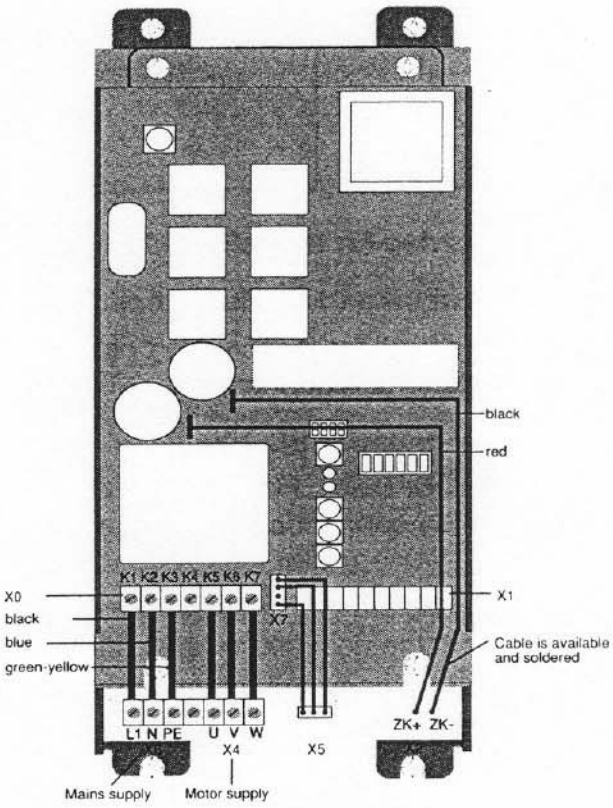
BC200 / KE200

9.4.4 Assembly and connection diagram BC 200/KE 200



FU200 Standard

Serien-Nr. 0495.000.0



FU200 SMD

Serien-Nr. 0495.000.1

BC / KE 200		color	to	lable	FU 200
X2	+ZK	red	→	+	DC-link
	- ZK	black	→	-	DC-link
X5		red/black/blue	→	X7	
X4	U	black	→	M	X0 (K5)
	V	black	→	M	X0 (K6)
	W	black	→	M	X0 (K7)
X6	L1	black	→	L1	X0 (K1)
	N	blue	→	N	X0 (K2)
	PE	green-yellow (lengthways)	→	PE	X0 (K3)

9.5 Accessories for models FU 207/208

9.5.1 Braking resistor RB 200

The LUMI DRIVE FU 200 is delivered with an internal braking chopper. When ordering the frequency inverter, the appropriate brake resistor can be delivered as well using the accessory designation -BC (FU 207 – BC) ❷. The peak braking power is approximately 1.2 kW.

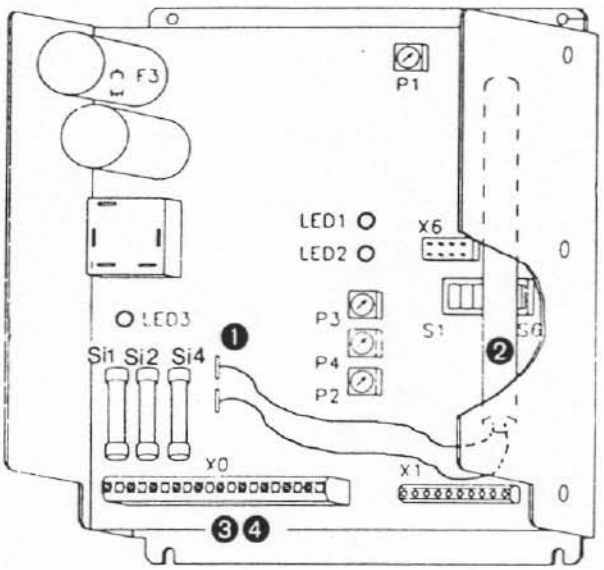
LED 3 (yellow) lights up when the brake resistor is activated.

The brake resistor can be installed later as well, or connected externally to the connections 32 and 33 ❸. This also reduces the temperature load on the frequency inverter.

The internal braking chopper is only active if the brake resistor provided is connected.

To increase braking power, an external braking chopper can be connected as well (BC 1515), which is then connected directly to the intermediate circuit voltage, connection 31 ZK-, connection 34ZK+ ❹.

Here as well: the braking power must be greater than the rated power of the frequency inverter.

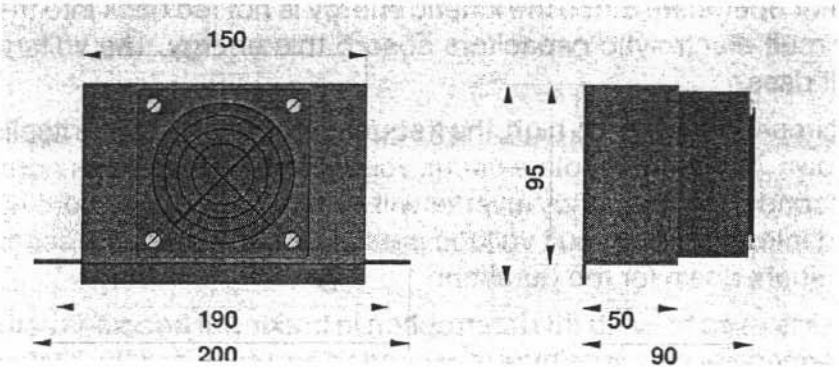


❶ Braking resistor connection
❷ Braking resistor
❸ Connection for ext. braking resistor
❹ Connection for ext. braking chopper

9.5.2 Fan attachment LA 200

The FU 208 frequency inverter with a 7A phase current requires a fan attachment to reduce the thermal stress of the inverter. When used in conjunction with a fan, the FU 208 can handle a constant phase current of 9A. The fan is easy to fit, using just 2 screws.

The fan should be electrically coupled to the existing connection cable via the socket provided (see section 13.).



10. Method of operation

10.1 Control section

A **microcomputer** constantly monitors all input signals and monitoring signals and from their conditions deduces the PWM switching pattern for the power steps to form a sinusoidal motor current. Every disturbance, for example undervoltage or over-current (see section 16.), leads to a temporary or permanent shutdown of the frequency inverter and the appropriate display.

Warning:

If undervoltage occurs, the inverter only shuts off when the voltage is too low, and restarts automatically when the voltage returns to within the tolerance range.

The **control section** has 2 control inputs: clockwise rotation and counterclockwise rotation. A + 8 to + 30 VDC signal activates the frequency inverter in the appropriate rotational direction (input impedance 2.2 k Ohm).

Speed is adjusted by applying 0 – 10 VDC (0 – 20 mA) at the **setpoint input** or by using a 10 k Ω potentiometer. Maximum speed for 10 VDC input can be set with P2 in the range 25 – 60 Hz, or 50 – 120 Hz (switch S1).

A **control output** is active when the motor voltage is switched on and provides + 20 VDC (50 mA) for feeding an external display or a relay.

The frequency output is provided for connecting frequency measuring devices. Its output is 6 times the speed frequency.

The control section is electrically separate from the power section.

10.2 Displays

Two light emitting diodes display the current operational status (continuous signal) or show malfunctions (blinking).

10.3 Power section

The frequency inverter operates with a 300 VDC intermediate circuit and a soft-loading circuit to avoid start-up current surges. Undervoltage or overvoltage in the intermediate circuit leads to a shutdown of the output stage.

The motor voltages, variable in frequency and voltage, are produced by means of pulse width modulatin (PWM) by the six power MOS transistors. An over-current cutoff protects the power stage against overload.

10.4 Notes on the braking chopper

If the motor is braked by lowering the frequency of the frequency inverter, the motor switches to generator operation. Since the kinetic energy is not fed back into the mains, the intermediate circuit electrolytic capacitors absorb this energy. The voltage of the intermediate circuit rises.

If the intermediate circuit voltage is too high, the frequency inverter protects itself by temporarily shutting down. If the intermediate circuit voltage drops back to its normal level again in under 6 seconds, the frequency inverter will switch back on and continue braking. If the increased intermediate circuit voltage persists for longer than 6 seconds, the frequency inverter shuts down for the duration.

The braking chopper is used to avoid this interruption in braking. It becomes active when the permissible intermediate circuit voltage is exceeded and switches the brake resistor onto the intermediate circuit, thus converting the excess energy into heat.

If large inertias are to be braked, it should be noted that the internal brake resistor of the FU 207 or the BC 200, respectively, is designed for 1,2 kW of braking power. Braking power requirements exceeding this must be covered by an external braking chopper.

Please note that in the interest of prolonging the life of the power transistors, the generator energy should not exceed the rated power of the frequency inverter.

11. Operating characteristics

11.1 Power and speed

The frequency inverter is designed for the specified motor size (adjustment V/Hz = 100 %). The torque produced remains constant up to the rated speed, in addition to which constant power is produced in the weak field range. Adapting to other motors is possible with the V/Hz adjustment.

In the low-speed range, the torque can be raised with the switch S2.

The frequency correcting range extends from 2 ... 60 Hz or 2 ... 120 Hz, depending on switch S1. With sitch S3 "ON", the correcting range extends to complete stop.

(Warning: Motor heats up due to holding torque).

11.2 Brakes

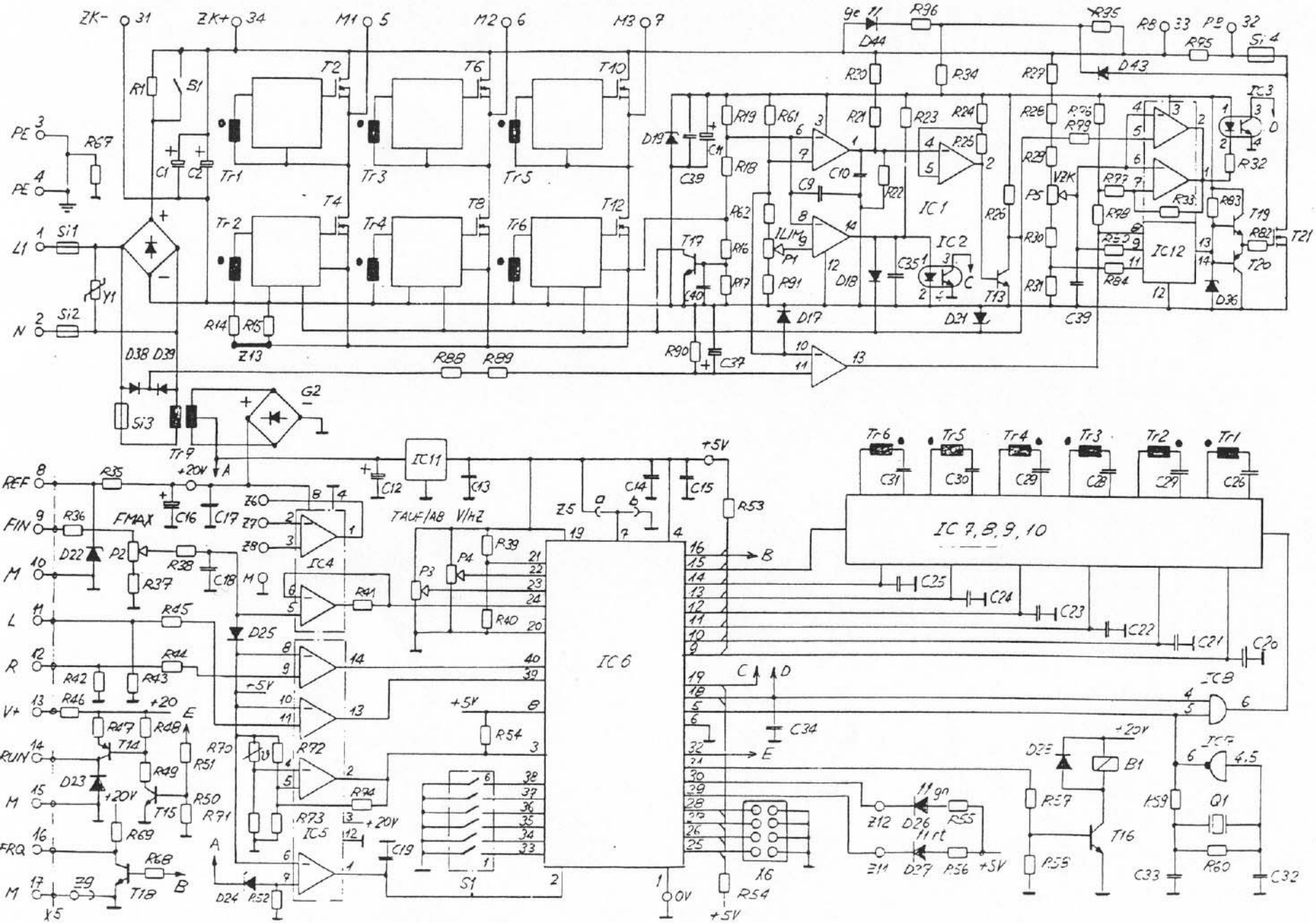
If LED 2 blinks when braking or reversing, a braking chopper must be used or the acceleration and braking time must be extended until LED 2 no longer blinks when braking. See also desciption under section 10.4 Brakes.

11.3 Current limitation

The frequency inverter has an overload cutoff which activates at approx. 1.2 times the rated phase current after approx. 0.4 seconds and shuts down the power stages. This overload protection protects the frequency inverter against rough load surges. A second current limit adjustable with I_{LIM} permits limitation of the motor current. When limit is exceeded, LED 2 activates and the speed is reduced until the current has lessened. With switches S4 and/or S5 an over-current condition is activated which leads to a frequency inverter shutdown after 3 – 10, 10 – 30 or 30 – 100 seconds. If S4 and S5 are "OFF", then only the frequency is reduced with over-current. An over-current cutoff does not occur.

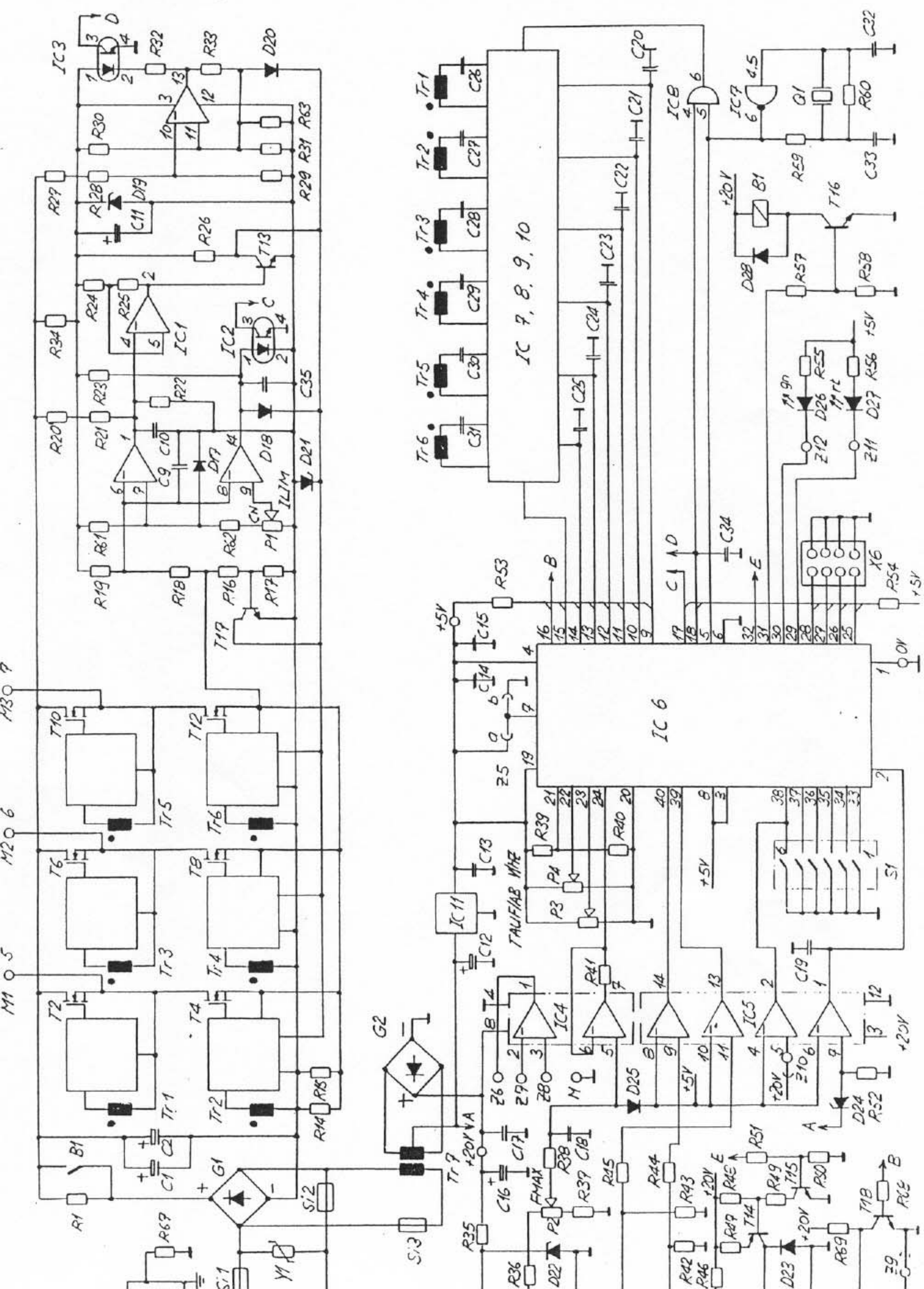
11.4 Failure/Reset

After a shutdown due to a failure, the unit can be put back into operation by switching mains connection "on" again or by switching S6 OFF-ON.

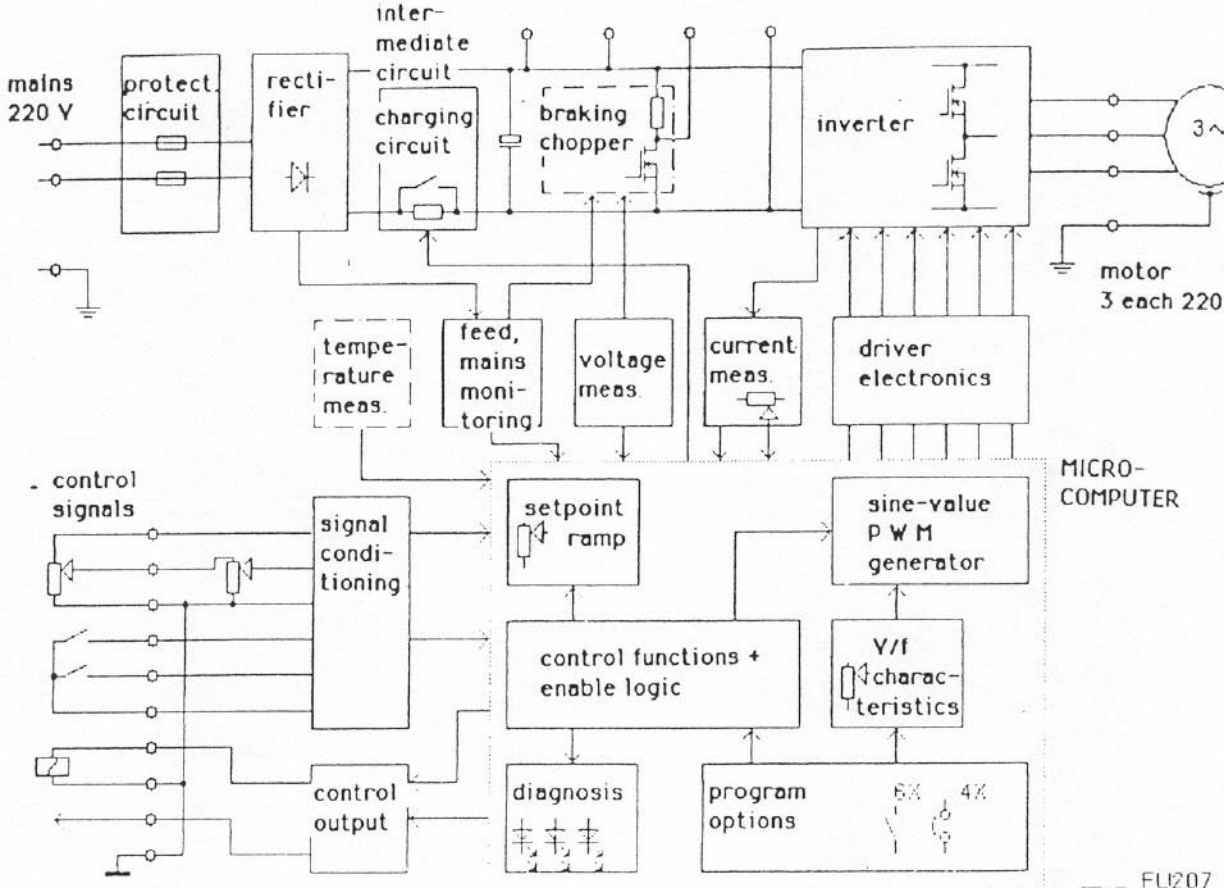

ZK- 31
ZK+ 34
M1 5
M2 6
M3 7
PE 3
PE 4
L1 1
N 2
Si1
Si2
Si3
Y1
R67
C1
C2
S1
R1
Tr1
Tr2
Tr3
Tr4
Tr5
Tr6
T2
T4
T6
T8
T10
T12
R14
R15
Z13
D38 D39
G2
Tr9
+20V
A
REF 8
FIN 9
M 10
L 11
R 12
V+ 13
RUN 14
M 15
FRQ 16
M 17
X5
R35
C16
C17
FMAX
D22
P2
R37
R38
C18
R36
IC4
R41
R45
R44
R42
R43
R46
+20
R47
R48
T14
R49
R50
R51
T15
R69
R68
T18
D23
Z9
D25
R70
R71
R72
R73
R74
IC5
D24
R52
C19
IC11
C12
C13
TAUF/AB
V/HZ
+5V
C14
C15
R53
Z5
P3
P4
R39
R40
IC6
R54
S1
X6
0V
+5V
C
D
E
C34
R96
D44
R95
R8 33
P8 32
Si 4
D43
R20
R34
R29
R19
R61
R21
R23
R24
R26
R25
R18
C9
C10
R22
IC1
R62
R16
R17
T17
C40
P1
R91
D18
C35
IC2
T13
D17
D21
C39
R90
C37
R88
R89
R27
R28
R99
V2K
P5
R30
R31
IC3
R32
R33
R97
R98
R83
T19
R82
T21
T20
IC12
R84
D36
IC7, 8, 9, 10
C31
C30
C29
C28
C27
C26
C25
C24
C23
C22
C21
C20
IC8
IC9
4.5
Q1
R59
R60
C33
C32
D28
B1
R57
T16
R58
Z12
D26
11 gn
R55
Z11
D27
11 rt
R56
+5V

12. Wiring diagrams

12.1 Circuit diagram FU 201/202/203/205



12.3 Block diagram FU 200



13. Notes on drive sizing

13.1 In general

The LUMI DRIVE FU 200 frequency inverters are connected to the single-phase alternating current mains and produce a three-phase current with a phase voltage of 0 – 230 V, according to the rotating field frequency. Three-phase squirrel-cage motors with a phase voltage of 220 V can be connected. Whether a 220/380 V motor is wired in "delta" configuration, or a 127/220 V motor is wired in "y" configuration is not important; the rated current of the frequency inverter per phase determines the output of the connected motor. If AC voltage motors are connected, it is imperative that there are no start-up or operating condensers. The motor power data in the technical data refer to a 2-pole motor.

In choosing the size of the drive, it is imperative to pay attention to the motor current actually required depending on the required torque, breakaway torque and run-up time. If the motor rated current at rated frequency is equal to the rated current of the frequency inverter, the motor shaft power will be reduced by about 5 %. This is dependant on the degree of motor efficiency and motor design.

13.2 Operating with a low rotating field frequency

When a self-ventilated motor is continuously operated at 25 Hz, special attention should be paid to a rise in motor temperature, because the self-ventilation might not be sufficient. The problem can solved by means of an additional external ventilator, or reducing the torque to be produced or by using a larger motor.

13.3 Operating with fast start

If an especially short run-up time or increased breakaway torque is required, the frequency inverter should be chosen according to the required start-up current and not according to the rated current of the motor.

13.4 Operating pumps and fans

If pump or fans drives are to be controlled or regulated with the frequency inverter, the quadratically rising U/f characteristic can be used for conserving energy in the partial load range and for reducing noise in the low-speed range. See section 9.1.3.

13.5 Operating several motors from a frequency inverter

Several motors can be operated simultaneously from a LUMI DRIVE FU 200. In choosing the frequency inverter, first ascertain whether the motors will always be started simultaneously or if they are to started one after the other.

In the first case, simultaneous starting, the sum of all rated motor currents should not exceed 90 % of the frequency inverter rated current.

In the second case, staggered starting, the frequency inverter must be sufficiently sized to accommodate the starting current of the motor(s) to be started. This means: The sum of all motor rated currents plus the sum of the starting currents of the motors to be started (approx. 6 – 8 times I_{NENN}). This is necessary because the motor to be started is connected with the frequency inverter which has already run up, which in terms of current is comparable to connecting it to mains. The power ratio of the motors among themselves should not exceed 1 : 2.

If the individual motors have a very small output compared with the frequency inverter output (less than 10 %), the required start-up voltage for the motors at 2 – 3 Hz can exceed the voltage at the frequency inverter output. Then the motors will not start. The voltage increase with switch S2 could then be sufficient for starting.

14. Commissioning

If the LUMI DRIVE FU 200 is being put into operation for the first time, you should proceed according to the following checklist.

- Installation and wiring of the units according to sections 3., 4., 5. and 6.
- The output of the frequency inverter (motor) must not yet be connected.
- The installation carries no voltage, that means the main switch has not yet been turned on.
- Check mains voltage connection; the ground conductor must be connected.
- Check all tightness of all screw terminals.
- Check agreement of basic adjustment of the unit with the description (see section 15.).
- Pay attention to stipulations according to VDE 0100 and VDE 0113.

With the mains switch turned off and the motor disconnected, the fuses for the power and control sections may be installed.

- Switch the start switch of the control inputs to "stop".
- The reference setpoint to zero.
- Turn on main switch.

After the frequency inverter has been connected to mains it will automatically test itself. The two LEDs (LED 1 green and LED 2 red) light up for two seconds during the automatic test.

After the pre-charging relay responds, LED 2 (red) shows that the frequency inverter is ready for operation.

- Adjust setpoint potentiometer to maximum speed or put 10 V DC ont the connectors X1-9/X1 – 10, respectively.
- Select function start clockwise or start counterclockwise.
- When the start function has been selected, LED 2 (= red) goes out and LED 1 (= green) lights up.
- The control output becomes active and produces 20 V DC, max. 20 mA (see section 4.6).
- The frequency output produces a rectangular voltage with an amplitude of 20 V DC, a pulse duty factor of 2 : 1 with 6 times the rotating field frequency (see section 4.6).
- Adjust setpoint potentiometer to speed zero or put 0 V on the connectors X1-9/X1-10 (see section 4.5).

  LED 1 (= green) goes out
  LED 2 (= red) lights up, the frequency inverter is ready for operation
  Control and frequency outputs are passive again.

If all functions have been fulfilled up to this point, the frequency inverter can be connected to the motor cable. The motor must be designed for operation with 230 V, that means with standard 220/380 V motors, it must be connected in delta. Motor and frequency inverter must be designed to accommodate the drive machine in terms of torque and acceleration

- Turn off main switch or disconnect frequency inverter from mains, respectively.
- Connect motor cable to frequency inverter (connectors X0-4, 5, 6, 7 – see 4.2).
- Turn on main switch.
- Adjust setpoint potentiometer to maximum speed or 10 V DC on setpoint input, respectively.
- Select function start clockwise or start counterclockwise.

When the start function has been chosen, the red LED goes out and the green LED lights up. The control and frequency outputs become active. The motor starts turning in the given direction.

Should the motor not start up, switch S 2 can be used to set a higher starting torque.

Fine adjustment of the starting torque or the torque characteristic, respectively, can be carried out with P 4 (see 5.❹). If the motor starts up but cuts out after a few revolutions, the run-up time should be extended with P 3 (see 5.❸).

If the setpoint is at the maximum (10 kΩ or 10 V), the maximum frequency (see 8.3.1) or the maximum speed, respectively, can be set with P 2.

If the drive performs as desired up to this point, then only the braking test under maximum load remains to be performed.

- Begin braking by selecting zero speed.

  The drive is brought to a complete stop with the set ramp time (P 3). If the LED 2 (red) blinks, the ramp time must be extended with P 3 or P 5 (see section 9.2) a braking chopper must be used (see section 10.4).

  The FU 207 has an internal braking chopper which is active when the corresponding brake resistor (see 9.5.1 and 10.4) is connected. The braking time should be selected so that LED 3 (yellow) does not light up longer than 6 seconds.

15. Standard factory calibration

Potentiometer

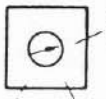
over-current

P1
I_{LIM}

20 % — 100 %
I_{RATED}

speed limitation

P2
F_{MAX}

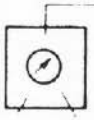


50 Hz/
100 Hz

25/50 — 60 Hz/120 Hz

run-up/return time

P3
T_{UP}/T_{DOWN}

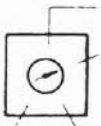


6 s

0,4 s — 100 s

voltage/frequency characteristic

P4
V/Hz



80 %
100 %

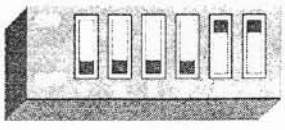
40 % — 120 %

Multi-functions

P5: This potentiometer can be used for a variety of functions so does not have a factory setting (see sections 8.1.5 and 9.2).

Slide switches

Pos. 6 slide switch:	functions that are enabled by different switch positions.
S1 max. frequency	OFF
S2 starting torque	OFF
S3 holding torque	OFF
S4 over-current circuit	OFF
S5 over-current circuit	ON
S6 function reset on	ON

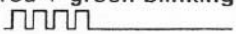
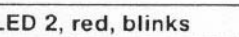


Program plug

X6

Shorting jumper
in park position

16. Operational and failure diagnosis

diagnosis	light-emitting diodes	message	cause	measure
operational status and failure display for the units FU 201 – 208	LED 1 = green LED 2 = red both off _____	no power from mains		check int./ext. fuses
	red + green blinking 	internal automatic test	after every switching on to mains, frequency inverter checks all internal voltages and output short and earth faults	check sliding switches S1 – S6
	red on _____	ready	the frequency inverter is operational. Final stage ready.	
	green on _____	Frequency inverter operating	clear final stage	
	red + green on _____	operating in current limit	the frequency inverter is being operated at the current limit I_{LIM}.	
	red on intermittently, green simultaneously off intermittently	temporary over-current	load surge	
	green inter-mittently off	voltage on intermediate circuit temporarily too high	generator operation temporarily too high, the frequency inverter switches itself off and then on again. After 6 sec. gen. operation frequency inverter shuts down perma-nently	use braking chopper or set T_{UP}/T_{DOWN} longer
	LED 1, green, blinks	shut down after	data processor test, internal malfunction	return to factory for inspection *
	1 x 	automatic testing		
	2 x 	mains failure	mains voltage was less than 180 V	check mains, then "mains on" again
	3 x	short or earth fault in output after mains ON	short circuit phase/phase or phase/ground	check connections, cables and motor
	4 x 	short in intermediate circuit	defect in power section	return to factory for inspection *
	LED 2, red, blinks	shut down after	I_{LIM} limit longer than adjustment with S4/S5, exceeded	raise I_{LIM}, check drive for smooth motion, select larger frequency converter
	1 x 	over-current to long		
	2 x 	motor overload	peak current 1.2 times I_{NENN} longer than 0.4 sec. mains voltage to low	check sizing, eliminate load surges on the drive machine, monitor mains voltage
	3 x	overvoltage earth fault detection with KE 200	a) mains or b) intermediate circuit voltage to high c) if KE 200 is operational: earth fault	a) stabilize mains voltage wire in transformer b) lengthen T_{DOWN}, use braking chopper c) check motor cable, connections and motor

Diagnosis for FU 207/ 208 only	4 x ⎍⎍⎍⎍⎍⎍⎍⎍	temp. over 70 °C	temp. at inverter housing to high	reduce coolant air temperature, select larger switch cabinet, better ventilation or larger frequency inverter
only if internal or external brake resistor is connected	**LED 3, yellow off**	no voltage on intermediate circuit	no mains voltage	
	dimly lit	U intermediate circuit normal		
	blinks intermittently	braking chopper temporarily active	temporary overvoltage in intermediate circuit, for example due to return flow of generator energy while braking	normal
	brightly lit	braking chopper continuously active	continuous overvoltage in intermediate circuit, for example due to return flow of generator energy while braking very large masses. **ATTENTION:** with braking times > 12s, the braking chopper automatically reduces the braking power by 20 %. ED 20/80 (braking time/pause time)	normal double the braking power, lengthen T_{DOWN} or use larger frequency inverter
	brightly lit without start command	defect BC	failure of brake resistor or fuse F4 due to excessive braking energy	check brake resistor and fuse F4 and replace defective part; greatly reduce braking procedure

* Please include connection plan and a description of the implementation. Thank you!