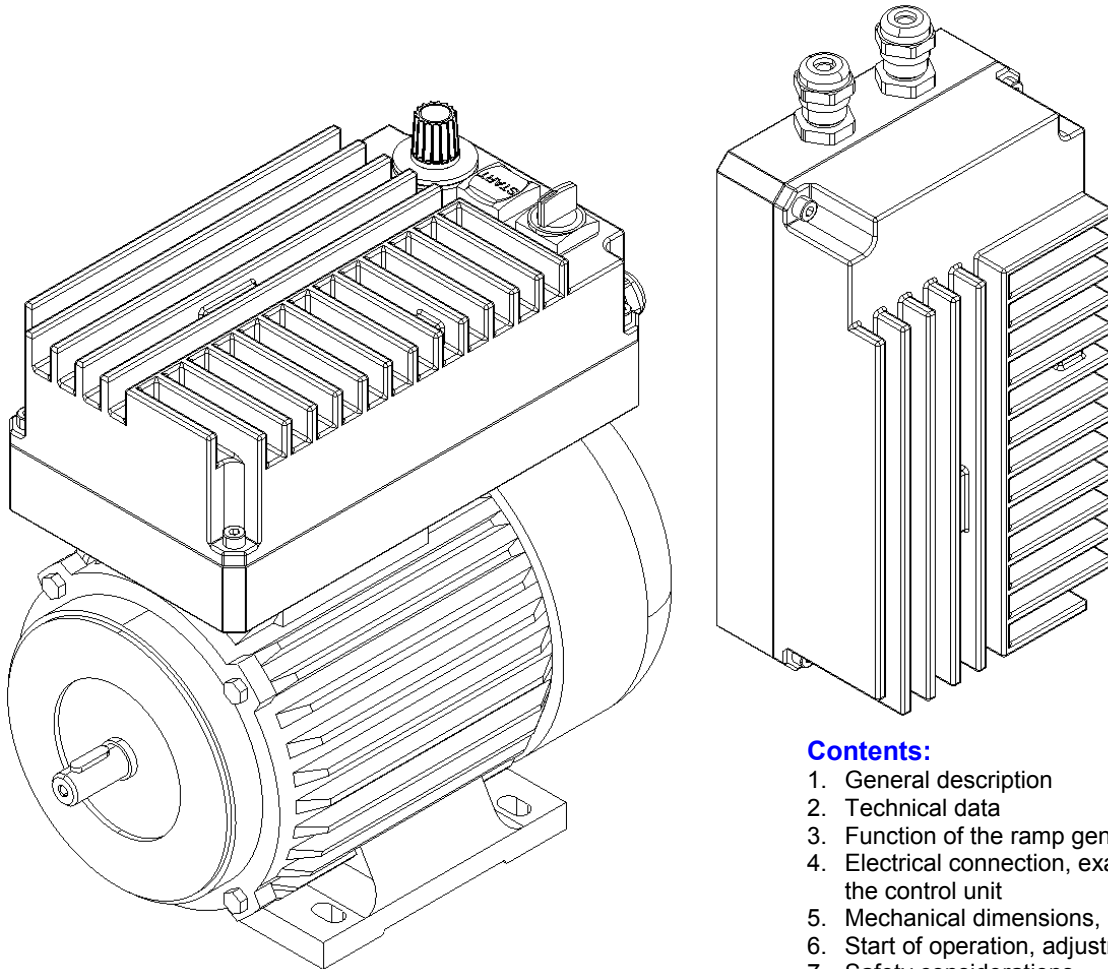


# TECHNICAL INSTRUCTIONS

## FOR INVERTER

### MFR 600-B / MFR 1500-B



#### Contents:

1. General description
2. Technical data
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4. Electrical connection, examples for the control unit
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## 1. General description

The frequency inverter MFR 600 / MFR 1500 is designed to regulate the speed of standard 3 phase squirrel cage motors from zero up to an adjustable maximum speed.

The mechanical design provides the assembling instead of the normal terminal case of a standard motor. By use of corresponding seals protection levels up to IP68 are possible. The main advantage of the assembling on the motor is the fact, that the connections to the motor are inside of the closed metal case. This is very important because the radiation of this connections is prohibited and there is also no capacitive load for the inverter to drive. This reduces both the power losses and the RFI level on the mains.

The drives are working with a chopper frequency of approx. 10 kHz (switchable to 16 kHz), providing smooth running of the motor also in the low speed range.

The drives are designed for 2-quadrant operation (driving in both directions). Braking is possible up to a power level equal to the power losses of the motor. While braking the induction of the motor is increased and therefore also the power losses of the motor.

By means of a DIP-switch (detailed description at 6.2) the drives can be switched to the following operation modes:

In the **'Normal operation'**-mode the frequency range reaches up to 150 Hz. In the low speed range the motor voltage can be increased by the adjustment of trimpot 'Boost' (P1). The increase of the motor voltage causes at zero speed a DC-current in the motor. This DC-current provides braking down to zero speed and is automatically switched off 4 sec after reaching zero frequency. This switch off is necessary to avoid heat-up of the motor at zero speed.

In the **'Pump operation'**-mode the maximum frequency reaches only 55 Hz and the ramp time is fixed at 5 sec. The trimpots 'Boost' and 'Ramp' are not active. In this mode the voltage to frequency-ratio is reduced with the frequency. This reduces the power losses of the motor at reduced speeds.

In the **'High-frequency operation'**-mode the maximum frequency range reaches up to 600 Hz. In this mode the trimpot 'boost' is used to adjust the required voltage/frequency-ratio.

In the operation-mode **'Long ramp'** the ramp-time-adjustment-range is switched from 0.2 - 15 sec to 4 - 300 sec (for a frequency step of 150 Hz / 600 Hz). This mode can not be combined with the pump operation-mode.

The operation-mode **'Motorpot'** enables the speed control of the drive by 2 keys (see 4.5).

In the operation-mode **'87 Hz'** the inverter generate a V/f curve with 230 V at 87 Hz. The Voltage (without boost function) at 50 Hz is 133 V. This operation mode demand special motor windings.

The selection of the required operation-mode has to be done without voltage on the mains and inside the inverter. After disconnecting the drive from the mains the circuit needs approx. 30 sec to be free of voltage. After this time a switch from one to another operation-mode can be done.

There are plug-in-terminals for the main voltage and the control connections. To protect the drive against dust, humidity, mechanical shock and vibrations the electronic unit is embedded in a soft casting resin inside an aluminium case.

The control-inputs of the drive are protection-insulated in accordance with VDE 0884. The drives are also protected against a direct short circuit between motor-lines and between motor-line and earth.

There is an electronic current limiter which controls the output power in function of the temperature on the surface of the housing. Between 0°...70°C the power is about 150 %. The integrated thermal protection switches off the unit at approx. 85°C surface temperature. This "switch off" must be confirmed by switching off and switching on the main voltage.

The input signal can be internal from potentiometer from an external voltage 0...10 V or an external current 0...20 mA or 4...20 mA . The selection for the input signal mode is made by the jumpers B1 and B2 (see 4. Examples for the control of the drive).

**Attention!** If the input signal mode is set for control from the potentiometer or with 0...10 V, a disconnection of the control-input (terminal 2) causes a control signal of half the adjusted maximum! Open control-input is therefore to be avoided.

To enable the drive a closed loop must be connected to the enable-input (contact or +24V (SPS)). The circuit is designed to accept loops with up to 1040 Ohm as closed loops, higher resistance values as open loops. This makes it possible to include a PTC-sensor of the motor in the enable-loop.

The drives show an operating notification (inverter ok) in case of main voltage or if there is no failure.

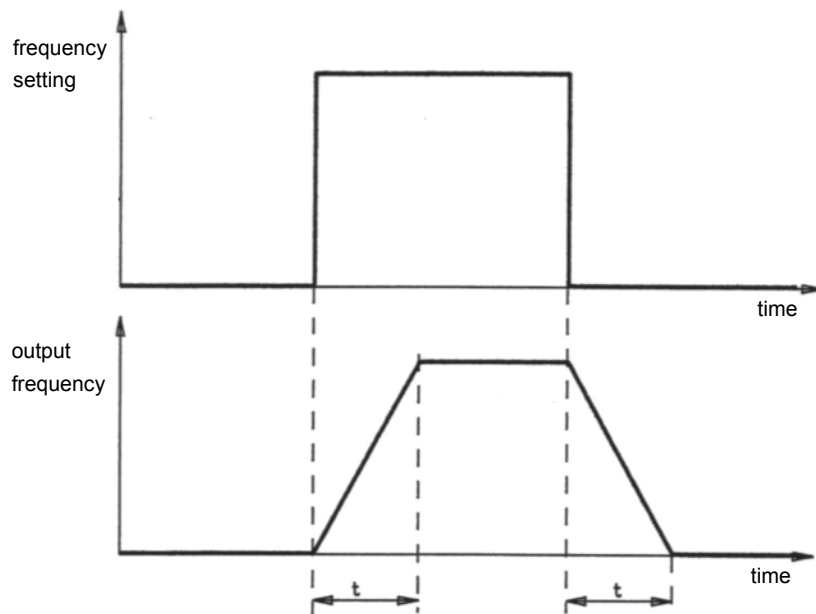
Control-lines with a length of more than 2 meters must be shielded. The shield should be connected to terminal 4. Below the length of 2 meters shielding is recommended if a high disturbance-level is present in the surrounding..

## 2. Technical data

|   | MFR 600           | MFR 1500                                  |
|---|-------------------|---|
| Main voltage / at reduced rating                            | 230 VAC / 115 VAC | 230 VAC / 115 VAC                         |
| Tolerance of the main voltage                               | +/-15%            | +/-15 %                                   |
| Frequency of the main voltage                               | 50 - 60 Hz        | 50 - 60 Hz                                |
| Recommended fuse in   | 6.3 A slow        | 10 A slow                                 |
| Motor power max.  | 375 W             | 750 W                                     |
| Nominal voltage of the motor                                | 3 x 230 VAC       | 3 x 230 VAC                               |
| Motor current 30°C inverter surface                         | 3 A RMS           | 5.5 A RMS                                 |
| Temperature range on inverter surface                       | 0 - 70°C          | 0 - 70°C                                  |
| Mechanical size (l x b x d) mm                              | 150 x 100 x 70    | 150 x 100 x 70                            |
| Weight kg   | 0.85              | 0.88                                      |
| <b>Output frequency ranges:</b>                             |                   |   |
| - Normal operation (DS1-4 'off')                            |                   | 0 - 150 Hz                                |
| - Pump operation (DS3 'on')                                 |                   | 0 - 55 Hz                                 |
| - High-frequency operation (DS2 'on')                       |                   | 0 - 600 Hz                                |
| Adjustment range for min. frequency (trimpot P4)            |                   | 0...50 % of the adjusted maximum          |
| <b>Ramp times:</b>  |                   |   |
| Normal operation, frequency step = 120 Hz                   |                   |   |
| - short ramp, DS1 'off'                                     |                   | 0.1 - 15 sec                              |
| - long ramp, DS1 'on'                                       |                   | 4 - 300 sec                               |
| High-frequency mode, frequency step = 660 Hz                |                   |   |
| - short ramp, DS1 'off'                                     |                   | 0.2 - 15 sec                              |
| - long ramp, DS1 'on'                                       |                   | 1.5 - 250 sec                             |
| Pump operation mode, frequency step = 55 Hz                 |                   | 7 sec                                     |
| 200 Hz operation-mode                                       |                   | 1 sec                                     |
| <b>Control signal:</b>                                      |                   |   |
| - B1 and B2 open  |                   | Potentiometer or ext. voltage 0... 10 VDC |
| - B1 closed, B2 open  |                   | 0...20 mADC                               |
| - B1 and B2 closed  |                   | 4...20 mADC                               |
| <b>Input resistance of the control input:</b>               |                   |   |
| B1 open   |                   | > 500 kohm                                |
| B1 closed   |                   | 470 ohm                                   |
| <b>Enable signal:</b>                                       |                   |   |
| Contact resp. transistor, load 10V/2mA or +24V, load 3-5 mA |                   |   |
| <b>Reversing signal:</b>                                    |                   |   |
| Contact resp. transistor, switchpoint 1040 Ohm              |                   |   |
| <b>Motor temperature monitoring:</b>                        |                   |   |
| <b>Operating notification (inverter OK):</b>                |                   |   |
| NPN-Open-Collector, max. 27V/100 mA                         |                   |   |

### 3. Function of the ramp generator

#### 3.1 Normal-, 87 Hz-, or high- frequency operation-mode:

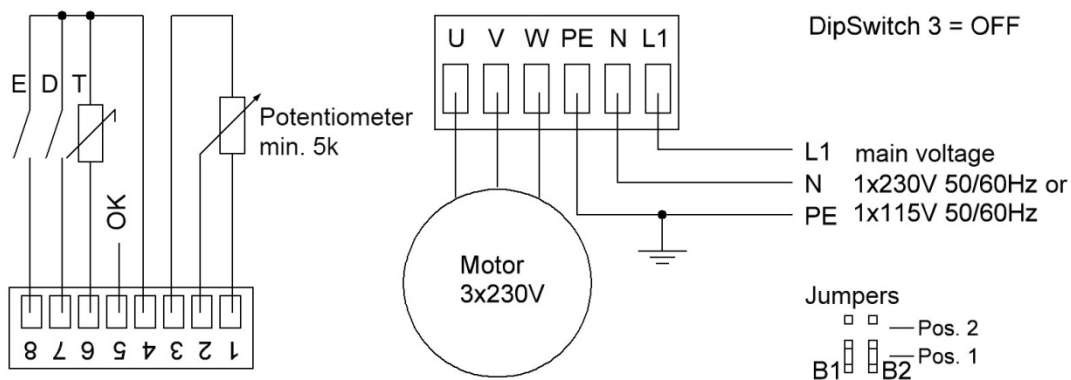


The adjustment of the ramp time  $t$  is made by trimpot P2.  
 With DS5 'off' the range of  $t$  is 0.1 ... 15 sec (for a frequency step of 150 Hz or 600 Hz).  
 With DS5 'on' the range of  $t$  is 1.5 ... 250 sec.

#### 3.2 In the mode 'pump operation' (DS2 'on') the ramp time is fixed to 7 sec (for a frequency step of 55 Hz)

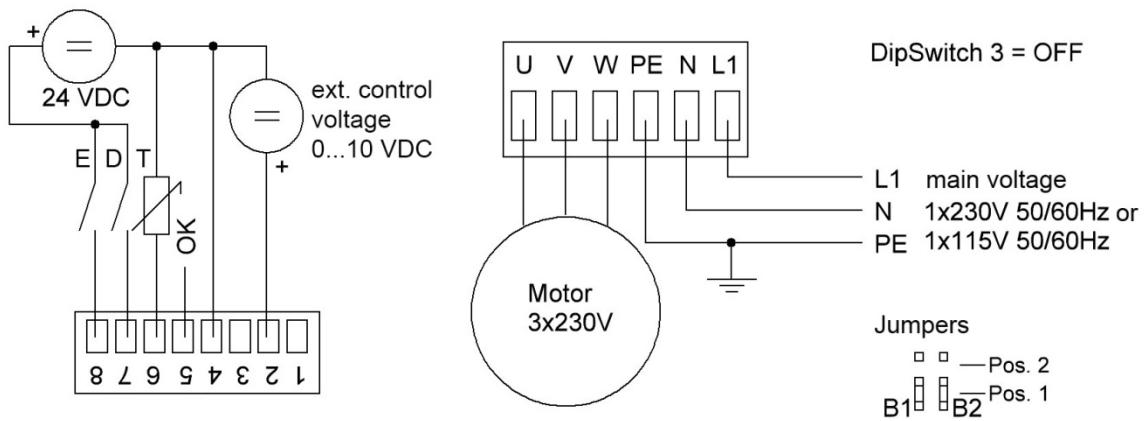
### 4. Electrical connection and examples for the control of the drive

#### 4.1 Control by potentiometer:



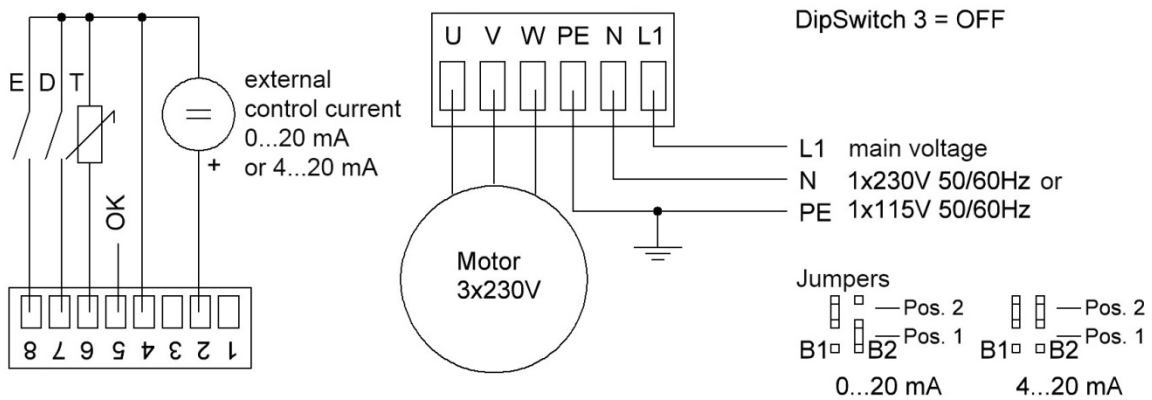
E = enable, D = direction, T = motor thermistor, OK = Inverter OK

#### 4.2 Control by external voltage 0...10 VDC:



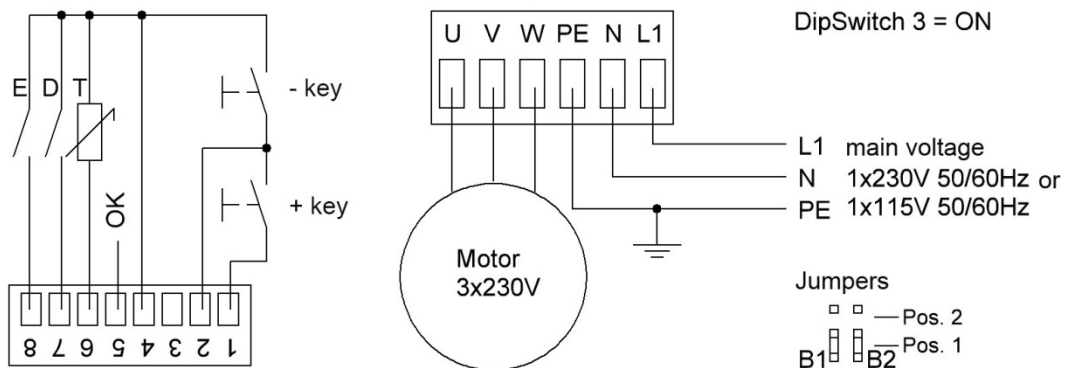
E = enable, D = direction, T = motor thermistor, OK = Inverter OK

#### 4.3 Control by external current 0...20 mA (4...20 mA):



E = enable, D = direction, T = motor thermistor, OK = Inverter OK

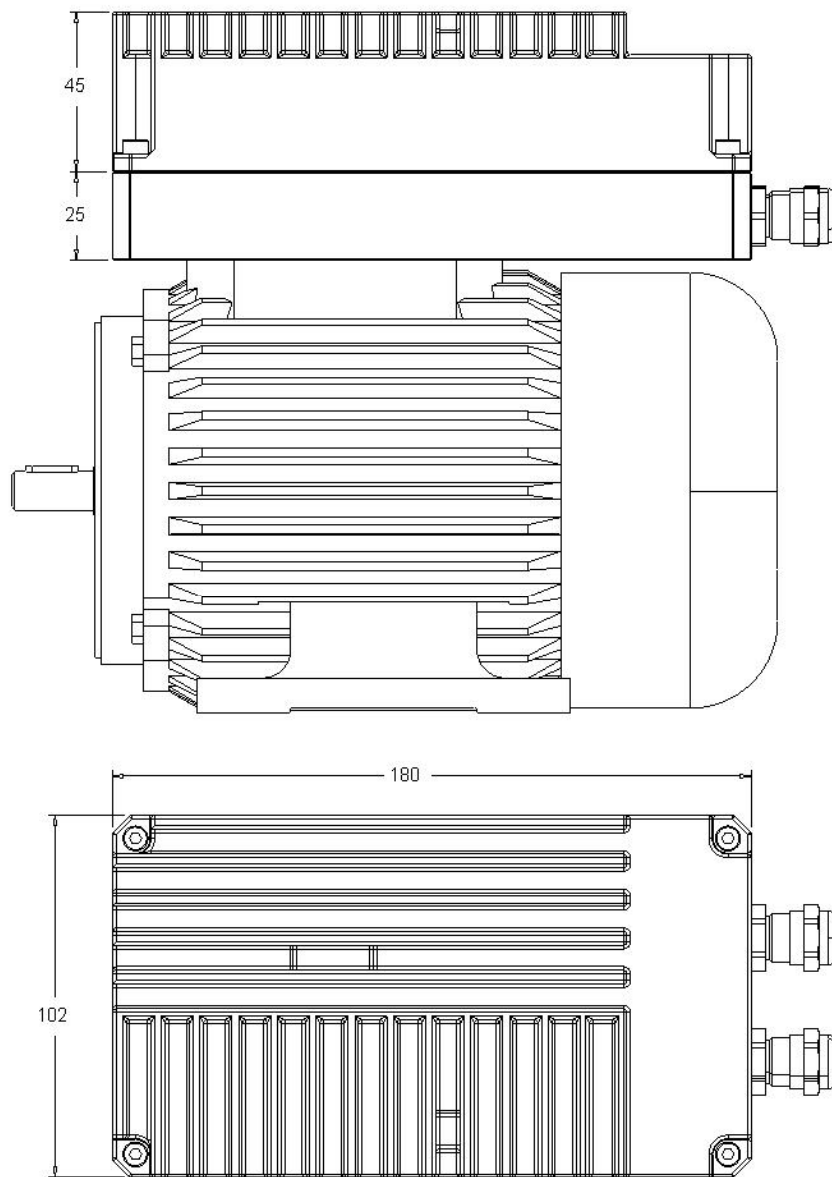
#### 4.4 Control by 2 keys in the mode 'Motorpot'



E = enable, D = direction, T = motor thermistor, OK = Inverter OK

## 5. Mechanical dimensions. assembling on the motor

(Drawn is one possible assembling. In accordance to the requirements the drive can also be assembled in different modes.)



### **Assembling steps:**

1. Drilling and milling of the lower case part in accordance to the flange of the motor-terminal case. Drilling the holes for the cable connections.  
**Caution!** Take care that the capacitors of the drive do not bump into the terminals of the motor!
2. Assembling of the lower case part on the motor.
3. Assembling of the cable connections.
4. Assembling and fastening of the cables.
5. Connecting of the plug-in terminals to the wires of the cables and the motor winding.
6. Placing the seal.
7. Plug-in the connectors to the converter.
8. Fixing of the upper case part on the lower case part.

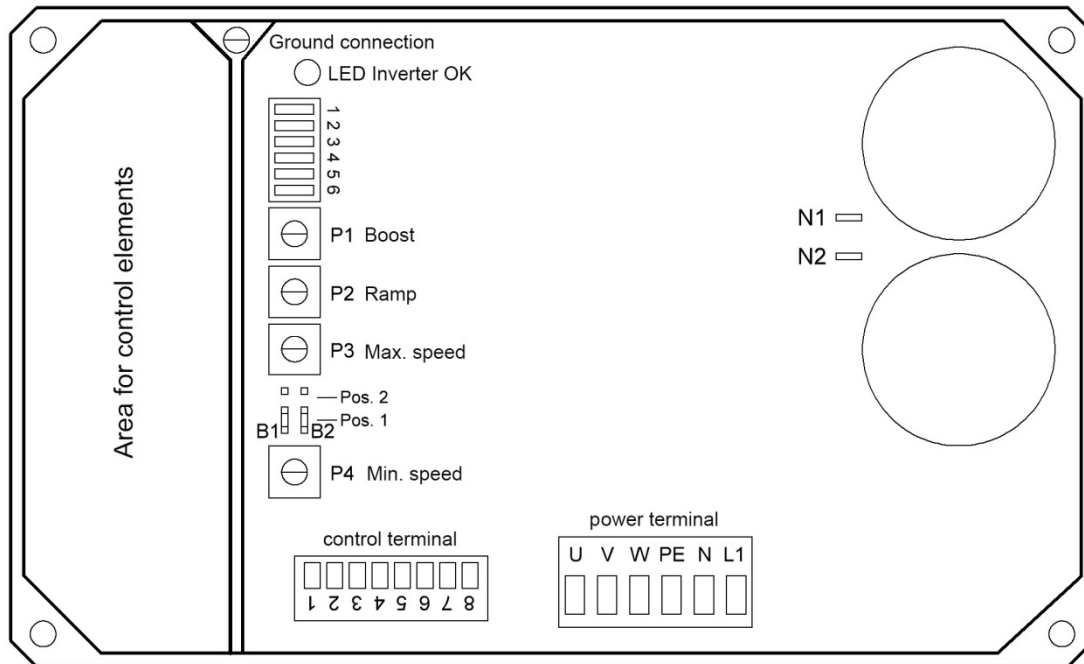
## 6. Adjustments, start of operation

Because of the fact, that an adjustment is impossible if the drive is assembled, parameters and limits have to be adjusted before assembling.

It is recommended to make these adjustments combined with incoming inspection.

For OEM applications we offer as a special service without additional costs to make the adjustments within the final inspections in our house.

### 6.1 Position of the switches, jumpers and trimpots:



### 6.2 Selection of the operation-mode

|                               | DS1 | DS2 |
|-------------------------------|-----|-----|
| Normal operation, short ramp, | On  | On  |
| Pump operation                | Off | On  |
| High frequency operation      | On  | Off |
| 87 Hz-operation               | Off | Off |

#### Selection of additional options (combinations possible):

|                                      |     |    |
|--------------------------------------|-----|----|
| Motorpot function                    | DS3 | On |
| Chopping frequency change to 16 kHz: | DS4 | On |
| Long ramp:                           | DS5 | On |
| Inverter not self triggering         | DS6 | On |

#### Auswahl der Steuermöglichkeiten:

|                                     |                    |
|-------------------------------------|--------------------|
| Control by Potentiometer / 0...10V: | B1 & B2 Pos.1      |
| Control 0...20mA:                   | B1 Pos.2, B2 Pos.1 |
| Control 4...20 mA:                  | B1 & B2 Pos.2      |

### **6.3 Adjusting the trimpots in the 'Normal operation'-mode:**

- 6.31 Connect main voltage, motor and control connections.
- 6.32 Switch on main power, close control switch F and turn potentiometer CW to the end position. Adjust required max. frequency by turning trimpot P3 (check of motor speed with tacho is recommended).
- 6.33 Turn potentiometer CCW to the end. Adjust required min. frequency by turning trimpot P4 (check of motor speed with tacho is recommended).
- 6.34 Turn the potentiometer fast from CCW to CW and back again. Adjust acceleration/deceleration time by turning trimpot P2.
- 6.35 If you wish a higher torque in the low speed range, adjust the boost ratio V/f by turning trimpot P1.

### **6.4 Adjusting the trimpots in the 'High- frequency' operation-mode:**

These adjustments runs similar to 6.3. The required V/f-ratio must be adjusted at trimpot P1; the 'boost' function is inactive.

### **6.5 Adjusting the trimpots in the 'Pump operation'-mode:**

These adjustments runs similar to 6.3, but steps 6.34 and 6.35 are inactive.

After these adjustments the inverter unit can be assembled on the motor and operation can start.

## **7. Safety considerations**

The following safety considerations must be observed during all phases of operation, service and repair of this device. Failure to comply with this precautions violates the intended use of this device.

To minimize the shock hazard the drive must be connected to an electrical ground. Terminal PE or the metal case must be connected to the electrical ground (safety ground) of the power outlet.

Do not operate in an explosive atmosphere!

The operation of this device in the presence of flammable gases, fumes or dusts may cause of an ignition of this atmosphere and is to prevent.

#### **CAUTION!**

To prevent potential shock hazards do not expose this device in the open state to moisture, rain or wetness. Wetness inside the case may cause an electrical connection between mains and the inputs.

Installation, adjustment and service of this device must be made by qualified personal. Works at the electrical parts of the device are very dangerous because of the high voltage the device is working with. This high voltage is capable of causing death and is present even after disconnecting mains. Before starting of service it is necessary to wait at least 30 sec after disconnecting mains.

This device must not be used as an electrical disconnection. It is not allowed to work at the output lines without a mechanical disconnection from mains, even if the driven motor does not carry voltage or current.

Do not attempt internal service or adjustment unless another person, capable of disconnecting mains and rendering first aid is present.

Do not touch the electrical parts of this device. During operation the electrical parts are carrying dangerous voltages. Out of operation a touch may cause a defect by electrostatic discharge.

To prevent additional hazards, do not make modifications at this device.