DIETZ electronic

Static Frequency Converter

with sinusoidal output and intermediate potential circuit

WIRE DSV 5421

for infinitely adjustable rotation speed
control of standard 3-phase motors

Instructions for Putting Into Operation

These instructions include the following drawings:

Dimensions sheet	Dwg. No. 95421 001 001
Connection diagram	Dwg. No. 95421 001 002.1-3
Fitting diagram, electronics	Dwg. No. 95421 201 004
Fitting diagram, steering card	Dwg. No. 95421 202 004
Fitting diagram, output card	Dwg. No. 95421 203 004

We reserve the right to make technical alterations.

CAUTION !

Please check the following points before initial operation. We cannot accept any claims under warranty if these points are not followed

1. Vertical installation of equipment (temperature)
2. Ambient temperature maximum 35/45°C according to operating instructions
3. Correct connections according to terminal diagram
4. Note the correct direction of rotation if prescribed in the operating instructions
5. Proper selection of fuse according to operating instructions
6. Twist or screen nominal and actual value leads together
7. Special attention to potential adherent units (external nominal value - potential-free, testing equipment - ungrounded etc.)
8. Never adjust potentiometers locked with paint

07/85 - DSV 5421, edition 08/90
Modification status.....A 279

CONTENTS PAGE

1. DESCRIPTION AND CONSTRUCTION

The DSV 5421 series are static frequency converters with a single-phase mains supply and an intermediate potential circuit, which produces a sinusoidal, variable 3-phase current for the infinitely adjustable rotation speed control of the 3-phase motors available commercially.

The device is constructed on 3 levels:

Level 1 (bottom): Power part = 3 transistor modules with a superimposed base plate for the steering, registering actual current value, mains rectification and connection terminals.

Level 2 (middle): Circuit board with mains power unit, steering logic, monitor circuits , 3 LEDs for fault signals (1 x overvoltage, 2 x short circuit), rated current setting.

Level 3 (top): Analogue control electronics and digital PWM with all setting parts and 5 LEDs.

Stand-still signal → LED n 65 - yellow
Rotation speed nominal value =
" " actual value → LED n 64 - green
Impulse block → LED n 66 - red
Overvoltage → LED n 67 - red
Short circuit → LED n 68 - red

The inidvidual levels are connected quite simply by 16-pole flat cables. Only the power connections, which have been kept to a minimum by the special construction, are plugged or screwed with individual plugs.

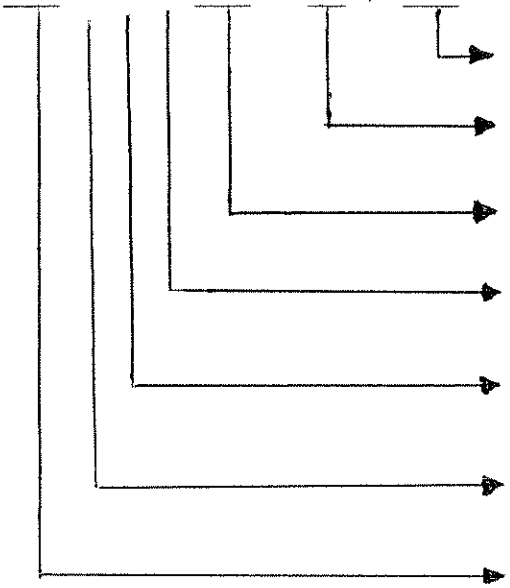
The power part (in level 1) consists of 3 transistor modules. Each module forms the branch of a 3-phase current bridge and consists in each case of 2 Darlington transistors switched in series.

Due to the use of transistor modules in a casing free of potential, the device is very compact and simply constructed.

The analogue and digital control electronics (level 3) with all the control inputs are completely separated in potential from the mains supply.

2. TYPE DESCRIPTION

D S V 5 4 2 1 - 20 / 220



Mains voltage in V +/- 10%

Nominal device current in A (effective value)

Generation

Type of circuit (4=DB circuit, fully controlled)

Used output semi-conductors (5=Transistor modules)

Number of operating quadrants (V=four quadrant operation)

Type of drive to be connected (DS = 3-phase motor)

3. TECHNICAL DATA

Type DSV 5421-	5/220	10/220	20/220
Mains supply voltage	220 V ± 10 %		
Mains frequency	50 - 60 Hz		
Rated motor output	0.75 kW	2.2 kW	4 kW
Power output	2 kVA	4 kVA	7 kVA
Nominal output voltage	3 x 220 V		
Output current (effective value)	5 A	10 A	20 A
Maximum dynamic increase of current limit for 3 secs. to (effective value)	10 A	15 A	20 A

Type DSV 5421	5/220	10/220	20/220
Output frequency	2 - 150 Hz / 400 Hz		
Stability of output frequency without regulation at constant nominal value	± 1 % of max. frequency		
Mains fuse, neutral	16 A	25 A	35 A
Device fuse for electronics	0.8 AM		
Supply voltages on the terminal strip of the electronics 1. Supply for external relay for stand-still , nominal value = actual value, overvoltage, short circuit signals 2. Supply for additional devices (IC-stabilized) 3. Nominal value standard for nominal value poti	 + 24 V to take external load of up to 60 mA + 15 V to take external load, - 15 V to + 30 mA + 10 V to take external load - 10 V to +15 mA		
Adjustment range with trimmer f_{max} (see also item 5.10)	appr.20-150 Hz, k 61 soldered in appr.40-400 Hz, k 61 soldered out		
Adjustment range with trimmer f_{min} (with nominal value potentiometer at 5 kOhm)	0 to approx. 30% of rated rotation speed		
Nominal value input voltage (Kl. 56 related to Kl. 52(0V)	-10 V ... 0V ... + 10 V		
Nominal value input impedance Kl.56	47 kOhm		

Type DSV 5421 -	5/220	10/220	20/220
Nominal value input with punched current	see dwg. no. 95421 001 (sheet 3)		
Operating temperature range	0° C - 45° C		
Installation position	vertical , terminal strip to the bottom		
Degree of protection	IP 00 to DIN 40050 Humidity rating E as per DIN 40040 Increased humidity protection special version		
Dimensions (base area x height)	275 x 275 x 220 mm		
Weight	approx. 6.5 kg		

4.) Supplyementary components for operation

In order to attenuate system perturbation, reactors must be connected in the power supply leads in accordance with VDE 0160 or the power must be supplied from an independent input transformer. Reactors with the same inductance must also be installed in the motor cable at the output of the frequency converter because of the cable capacitance if the motor cable between the frequency an motor is longer than 15 m. When dimensioning these reactors, the clock frequency of the converter has to be enquired at the works for the respective version.

5. Mains supply

Make sure that mains voltage conforms with name plate.

6. Putting into Operation

The mains voltage on terminals 1-2 can be switched on and off with the impulse release switch (terminals 54-62) open or closed because the device has a switching on and off logic. However the mains switch should only be used when the machine is turned off for a longer period - e.g. for maintenance work - as otherwise the charging and discharging resistors for the intermediate circuit would be overloaded and could burn through. It is particularly important not to run a inching operation with the mains contactor. The impulse release switch is designed for this case and for normal operational switching on and off. When closed, the impulse release switch releases the impulses for the final stage; when it is open it blocks the impulses and thus frees the drive of torque. This is indicated by a red LED (n 66).

If the base point of the nominal value potentiometer is connected to terminal 53 (see dwg.-no. 95421 001 002, page 3), the lowest basic speed of rotation can be set with trimmer n_{min} when the nominal value potentiometer is turned as far it will go to the left. With the maximum nominal value input of +/- 10 V, the frequency set with trimmer f_{max} will then be emitted by the frequency converter at the output (see also item 5.10)

6.1 Operating without Tachometer Regulation

In operation without tachometer regulation the 3-phase asynchronous motor follows the frequency given by the frequency converter almost without any slip in neutral. However, when the motor takes a load, a difference arises between the rotation speed of the rotor and the stator frequency or stator rotating field - this is slip.

With 3-phase asynchronous motors up to 4 kW this slip is approx. 10% of the synchronous rotation speed, i.e. there is a drop in rotation speed of approx. 10% of synchronous rotation speed (synchronous rotation speed = rotation speed in neutral) between neutral and loading with rated torque. Thus, for example, a motor with a rotation speed in neutral of 3000 r.p.m. still runs at approx. 2700 r.p.m. when loaded with nominal torque and thus drops 300 r.p.m. in rotation speed.

N.B. This drop in rotation speed is an absolute size. For example, if the motor in question is run down by the frequency convertor to a rotation speed in neutral of 500 r.p.m., this rotation speed drops to approx. 200 r.p.m. when the motor is loaded with rated torque.

6.3 Nominal Value Input

The possibilities of nominal value input are illustrated in dwg-no. 95421 001 002, page 3.

N.B.: The smallest possible frequency setting of the device is 2 Hz and the direction of rotation is determined by the polarity of the nominal value at terminal 56. A minimum voltage of ± 100 mV in relation to 0V (terminal 52) is required there, so that the integrated logic can recognize the desired direction of rotation. If the nominal value is lower, the direction of rotation is indeterminate.

If a potentiometer is connected with its base point to terminal 53, this minimal voltage of ± 100 mV is guaranteed.

The nominal value of the frequency can also be input in digital form. Terminal 70 is available for this. A frequency of 768 x motor frequency with a level of +15 V related to 0V (terminal 52) must be input at this terminal. Here again, it must be remembered that the lowest motor frequency is 2 Hz.

6.4 Nominal Value Integration

Due to its rotating mass, a drive is not able to follow jumps in the nominal value without delay. For this reason, the device has been built with nominal value ramps which lead the motor frequency at a defined alteration speed to a new altered rotation speed nominal value. These ramps can be set separately for starting up (drive operation) and braking (brake operation) at the potentiometers r 105 and r 94 in the range from 1 - 10 sec. for an alteration of rotation speed from 0 to maximum rotation speed and vice versa.

If the resistor r 119 (standard value 100 kOhm) fitted on solder support points is reduced in size, this time can be reduced still further and amounts with r 119 = wire bridge to appr.200 ms. However, this only makes sense with very small motors with correspondingly small rotating masses.

6.5 Reversal of Direction of Rotation

If the nominal value polarity is altered at terminal 56, the direction of rotation of the motor also changes.

6.6 Dynamic Current Limit

The device has an integrated dynamic current limit, which permits an excess current for approx. 3 sec. (see item 3, Technical Data). With the 20 A and 30 A devices, the dynamic current limit can only be effective if the rated current limit (I_n) is reduced to below 20 A. Activation is effected by fitting resistor r 205 with 680 kOhm/0.25 W (standard fitting r 205 = bridge).

6.7 Running at Low Frequencies with Constant Torque

If the drive is to be run constantly at rated torque even at frequencies below 40 Hz, an additional ventilation system must be fitted to compensate for the drop in the cooling performance of the integrated ventilator. It is also advisable in this case to install thermic sensors in the motor winding (see also item 5.10, operation above 50 Hz).

6.8 Characteristic Curve Setting

The characteristic curve of the motor can be adjusted to suit the loading conditions with trimmer r 126. Turning r 126 as far as it will go to the right means full magnetization i.e. in the range up to 50 Hz the motor can give its rated torque (with appropriate cooling, see item 5.7).

With r 126 turned as far as it will go to the left, the magnetization is roughly halved, i.e. at 50 Hz the motor voltage is approximately 110 V, which then increases in linearity with the frequency to 220 V at approx.100 Hz. At this setting a constant torque is available in the entire range up to approx. 100 Hz.

Turning r 126 to the left reduces noise considerably. R 126 should therefore only be turned as far to the right as is necessary for the load in question.

6.9 Starting Torque

Due to the drops in voltage in the 3-phase motor, the available torque sinks, when the voltage: frequency ratio on the motor is constant, at small frequencies (smaller than approx. 10 Hz) below rated torque. If full rated torque is to be available in this range too, there must be a bridge between the two solder support points described with Br. 19 on the 5A and 10A devices, or a 33 kOhm/0.25 Watt resistor on the 20A devices. This also increases the noise of the motor in the lower range of rotation speeds.

Alternatively, there is the possibility of controlling the output voltage by voltage infeed at terminals 87 - 52 (0V). The voltage level should be within the range + 5 V (small output voltage) to + 2 V (pronounced increase in voltage). For this the resistor r 130 (on the solder support points) must be removed.

6.10 Setting the Mininimum and Maximum Frequency

The standard version of the device is supplied as follows:

Trimmer f_{min} = as far as possible to the left corresponding to approx. 2 Hz

Trimmer f_{max} = set to 50 Hz at nominal value $\pm$ 10 V at terminal 56

When the nominal value potentiometer is connected with its base point to terminal 53, f_{min} remains turned as far as possible to the left. The smallest frequency and/or rotation speed can be set with trimmer n_{min}.

In operation with control voltage the trimmer f_{min} should also be turned as far as possible to the left, the desired minimal frequency is determined by the voltage level at terminal 56. However, here the minimal frequency can be adjusted to the smallest available control voltage by adjusting f_{min}.

A maximum frequency of approx. 20 Hz to 150 Hz or 400 Hz respectively can be set with the Trimmer f_{max}.

Bridge Br.16 (highest cycle frequency) is only fitted in special cases if the device is to be used mainly at low frequencies to max. 50 Hz.

N.B.: The performance of the motor ventilator increases by the rotation speed to the power of 3. When operating a 50 Hz-motor above 50 Hz - the range of constant motor performance - the performance available to the motor shaft drops considerably. It can, therefore, be necessary in this range to remove the ventilator wings of the motor and to cool the motor externally.

6.11 Changing to Higher Frequency Range up to 400 Hz from the Manufacturer's 50 Hz Setting

In principle, the change should always be made by the manufacturer.

However, on his own responsibility, the customer can make the change himself with the help of a rev. counter and a voltmeter. The manufacturer can take no responsibility for damage caused to the device caused by wrong settings or for resulting damage.

Instructions for Setting:

1. Desolder k 61
   (At maximum nominal value the output frequency is then 100 Hz).

2. Change bridge Br. 17 over to bridge Br. 18
   (The voltage then reaches 220 V~ at 100 Hz)

3. Turn r 125 (previously painted over) as far as possible to the left, r 126 as far as possible to the right, n_{min} as far as possible to the left, r 105 as far as possible to the right (starting ramp), set nominal value to 1 V with nominal value potentiometer. (Measuring device at terminals 20 and 56)
   (= $\frac{1}{10}$ f_{max} $\underline{\sim}$ 10 Hz)
   Switch on impulse release.

Turn r 125 slowly to the right until the motor is just turning. Set nominal value potentiometer to maximum (100 Hz).

At 100 Hz the output voltage must be lower than the ratio:

$$\text{Output voltage at 100 Hz} = \frac{\text{Nominal Voltage} \times 100\ \text{Hz}}{\text{Nominal Frequency}}$$

Run motor slowly up to synchronous rotation speed (rotation speed in neutral) by turning f_{max} slowly to the right (N.B.: rotation speed change is not running over nominal value integrator now). When the rotation speed in neutral has been reached, the output voltage is to be set to rated voltage by turning r 125 to the right. If the rotation speed should drop when you are doing this, the device is approaching its current limit. Check whether I_N is turned as far as possible to the right.

By turning r 126 to the left the flow of current can be cut back and thus the development of noise can be reduced.

6.12 Operating Several Motors on One Frequency Converter

It is possible to operate several motors on one frequency convertor DSV 5421. The sum of the nominal currents of the connected motors may not exceed the rated current of the device. Individual motors can be switched on and off at any time during operation with their circuit breakers (see dwg-no. 95421 001 002, page 1). When switching on a motor to a group of motors which are already running, the starting up surge of current of the motor generally takes the frequency convertor to its current limit. To prevent the motors getting out of step in this case, the motor frequency and thus the rotation speed of the motors already running is reduced and all motors then run back up to the original rotation speed together.

6.13 Operation of high-frequency motors. Inductors

High-frequency motors, unlike standard three-phase motors with a usual voltage of 3 x 220 V/50 Hz, have a relatively low inductivity. To limit the current increase it must be checked whether an additional three-phase motor inductor has to be installed between device output and motor.

Such an inductor will always be necessary if the ratio

motor reference voltage : motor reference frequency
is smaller than or equal 1.5 volt seconds.

Example: motor reference voltage: 220 V
motor reference frequency: 200 Hz

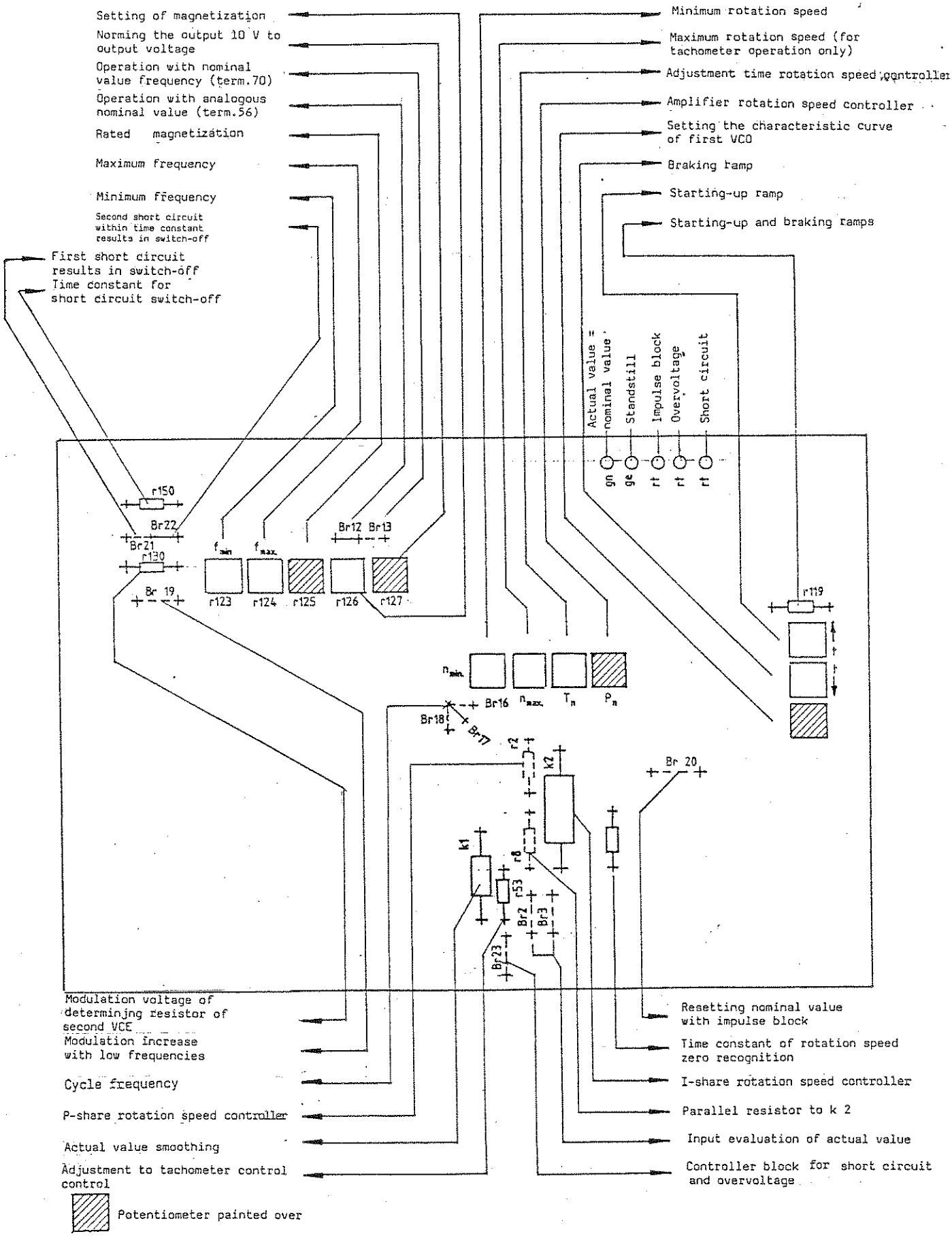
$$\frac{220\ V}{200\ Hz} = 1{,}10$$

As 1,10 is smaller than 1.5, an additional motor inductor has to be installed. Please enquire for the inductors in the factory.

6.14 Activating the Fault Cut-Out

By placing Br. 23 in position the fault signals"overvoltage"and"short circuit"result in a blockage of the controls, i.e. the device is switched off but the mains are not switched off.

6.15 Setting Potentiometer and Component Parts on Solder Support Points of Controller Card



7. Monitor Functions

7.1 Current Limitation

As long as the drive is not overloaded (e.g. by quick changes in rotation speed), the current adjusts according to the loading torque. For the protection of the semi-conductor modules, current limitation is integrated. As soon as this current limit is triggered, the number of revs. of an overloaded motor drops. To prevent the motor getting out of step and thus remaining continuously at the current limit, the nominal number of revs. is cut back within the device as soon as the current limit is triggered, so that the motor does not exceed its slip limit. This is particularly important when starting, when the drive is not able to follow the given starting ramp because of its rotating masses. In this case the drive automatically reduces the incline of the starting ramp. The green nominal-actual value display goes out for this period.

7.2 Overvoltage Cut-off

When braking, the energy of the rotating masses is fed into the intermediate circuit capacitor; the capacitor voltage increases. As soon as a value which is critical for the output semi-conductor is reached, the transverter is blocked, and the motor comes to a standstill.

The intermediate circuit capacitor discharges slowly via an integrated resistor. As soon as the voltage becomes uncritical again, the drive switches on independently.

Overvoltage is indicated by a red LED on the middle circuit board. If braking is often necessary and this display lamp lights up, the braking energy can be reduced by a braking option UBZ 4010 connected to terminal 24 (+) and 25 (-).

7.3 Fuses

In the case of a short circuit or ground circuit the current increases very quickly. Here the fuses are triggered. Two red LEDs on the middle circuit board indicate this by blinking.

7.4 Operating and Fault Signals on the Electronic Circuit Board

7.4.1 Red LED (n 66), Impulse Block

The following conditions are indicated:

- Open impulse release switch (term. 54-62). The impulses are blocked for at lease 0.3 sec. even if the switch is opened for a shorter time.

- Switch on the mains (for approx. 0.5 sec.)

7.4.2 LED green (n 64), Actual Value = Nominal Value

- The LED lights up when the output of the integrated nominal value integrator has reached the nominal value set at terminal 56. Motor frequency then equals nominal frequency. At the same time a relay draws up which can be connected to terminals 71 - 63 (24 V, 20 mA).

- If the device is operating at the current limit, this LED flashes on and off as the output of the nominal value integrator is taken back by the current limit.

7.4.3 LED yellow (n 65), Standstill

The LED lights up when the smallest frequency (n_{min} = turned as far as possible to the left) has been reached. At the same time a relay pulls up which can be connected to terminals 61 - 63. To prevent this signal coming up when the direction of rotation is changed and 0 is passed, a delay has been built in. This delay can be altered with resistor r 9 (on solder support points). The limits for r 9 are 0 Ohm to 1 MOhm, corresponding to a delay of 0 to approx. 10 sec.

7.4.4 LED red (n 67), Overvoltage

The LED lights up at the same time as the LED n 201 on the steering card and signals intermediate circuit overvoltage. At the same time a relay drops off which can be connected to term. 85 - 63 (24 V,30 mA). Operation = transistor conducting. The display is then self-maintaining and can be switched off with the main off switch (Br. 23 inserted).

7.4.5 LED red (n 68), Short Circuit

The LED lights up at the same time as the LED n 202 on the steering card and signals a short circuit or ground leak. At the same time a relay drops off which can be connected to terminals 89 - 63 (24 V, 30 mA). The display is self-maintaining and can be switched off with the mains on/off switch. With Br. 21 inserted the first short circuit is registered, with Br. 22 inserted the 2nd short circuit with 1 sec. results in a fault signal (Br. 23 inserted).

8. Measuring instruments for motor current and motor volage

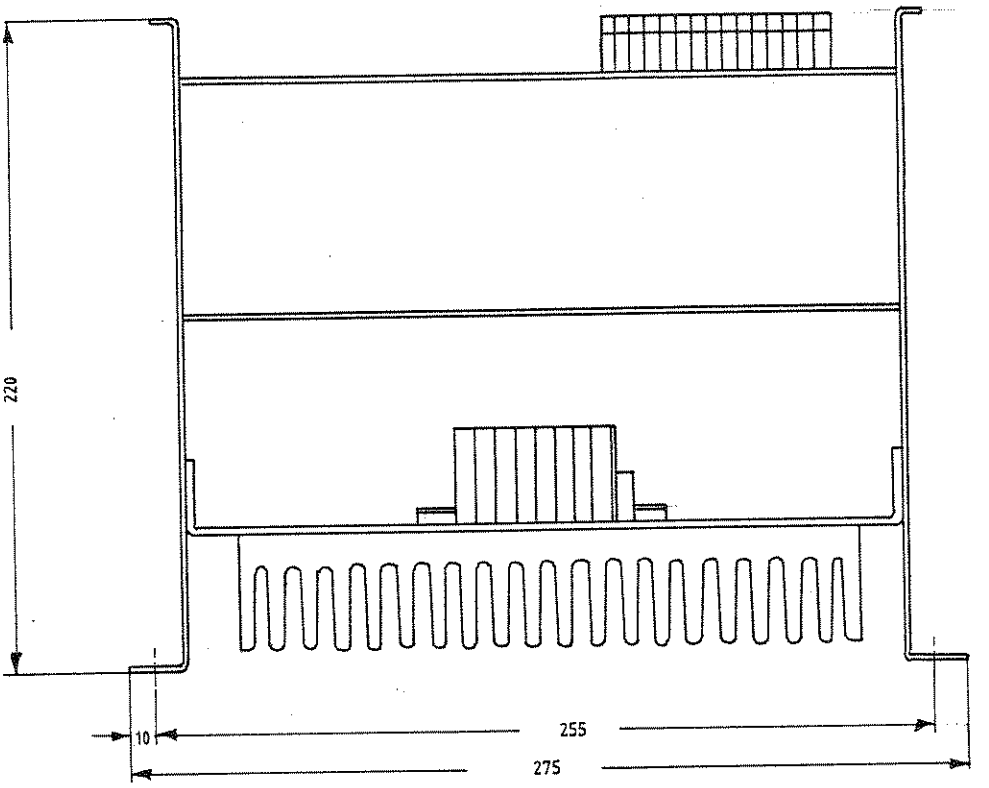
The usual and above all digital measuring instruments are not appropriate for measuring current and tension of clocked transistorized devices. You have to use moving-iron instruments (RMS responsive meters).

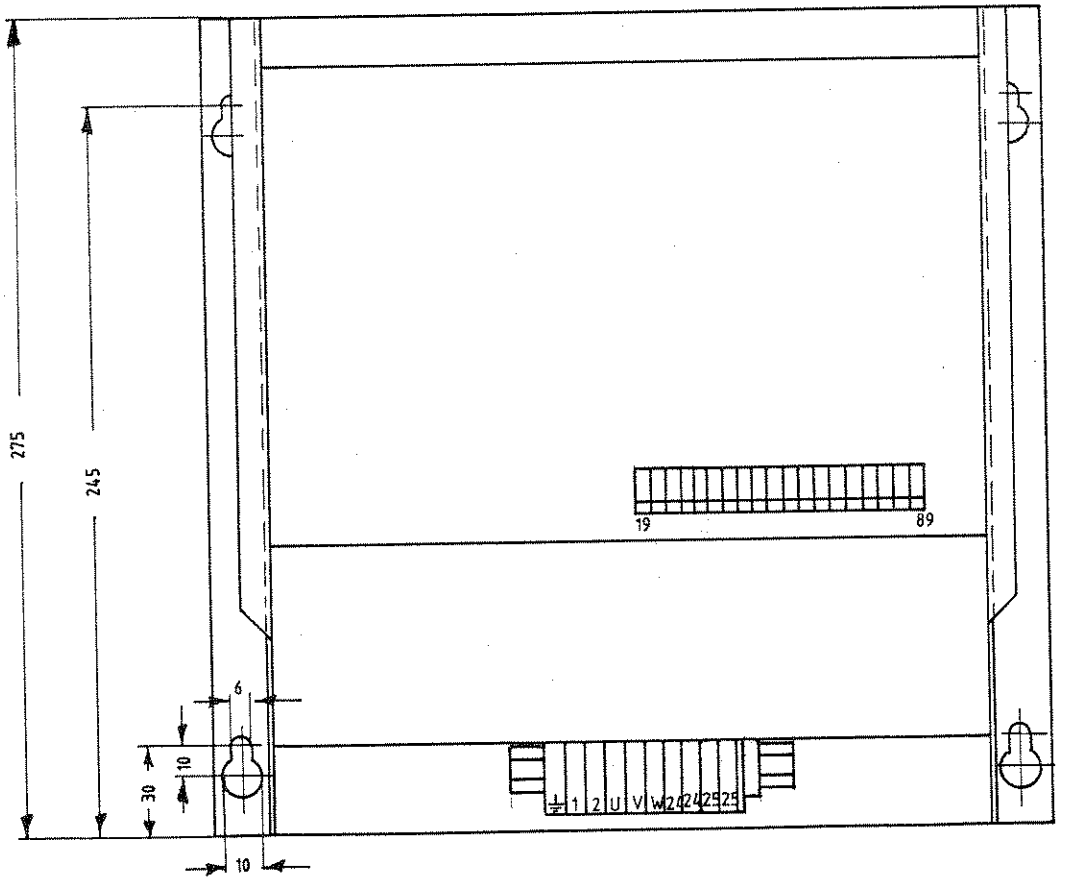
Note that the DSV 5421 is a frequency converter with secondary voltage circuit. In this system only the effective power is drawn from the mains, and no reactive power. Therefore, with constant motor torque, the mains current is approximately proportional to the motor speed, as the motor output, with constant torque, is proportional to the motor speed.

That means that with low speed the mains current will be smaller than the motor current and that, therefore, the motor current can never be measured in the mains line of the converter.

Maße ohne Toleranzangabe nach: DIN

Nicht bemaßte Rundungen sind R auszuführen!

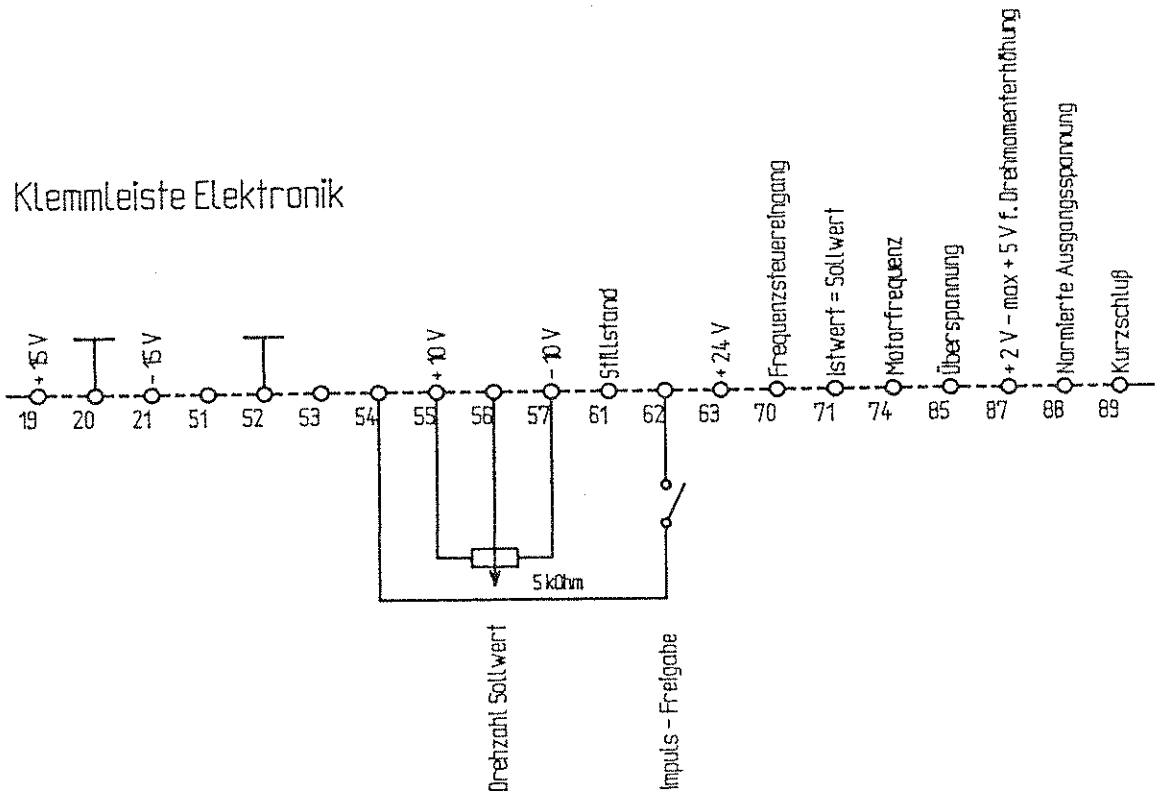




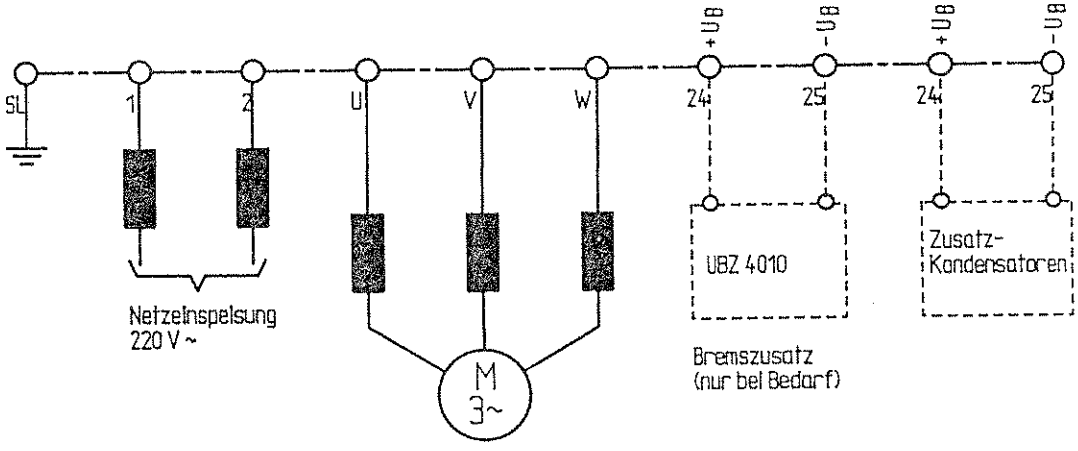
Ä.-Zust.	Datum u. Name	Gepr.	Änderung

Maßstab 1 : 2,5	Gez.: 22. 5. 84	Oberfläche:	Dimensions sheet
	Gepr.:	NGepr.:	
DIETZ electronic	Werkstoff:	Zeichn. Nr.: 95421 001 001	
		WIRE DSV 5421	

Klemmleiste Elektronik



Klemmleiste Leistungsteil

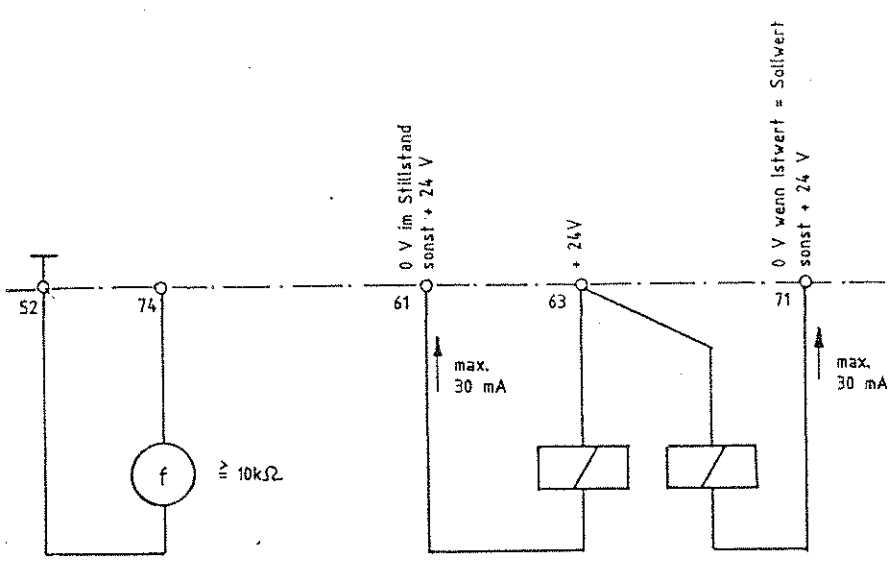


Motordrosseln siehe Pkt. 6.13
der Bedienungsanleitung

Für den Motorvollschutz sind in der Motorwicklung Kaltleiter sowie ein Kaltleiterauslösegerät vorzusehen.

Ä.-NR.	INDEX	DATUM U. NAME	GEPR.	ÄNDERUNG
_	A	19.12.91 La	_	Motorschutzschalter entfällt
64/90	_	11.09.90 La	_	Motordrosseln hinzu

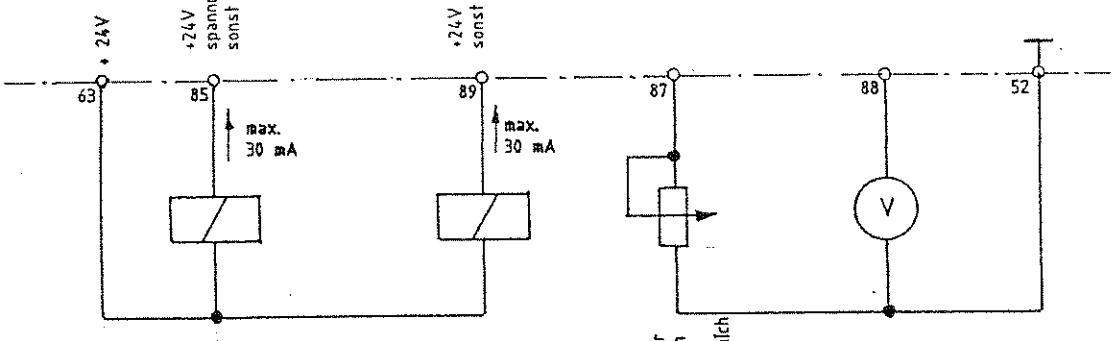
MAßSTAB 1:1	GEZ.: 11.09.90 Laufer	OBERFLÄCHE: _	BEZEICHNUNG: connection diagramm
	GEPR.: NGEPR.:	WERKSTOFF: _	ZEICHN.NR.: 95421 001 002 BL.1 / INDEX A
DIETZ electronic			DSV 5421 / BLATT: 1 VON: 1



Motorfrequenzanzeige digital, Pegel + 15V

Stillstand

Istwert = Sollwert

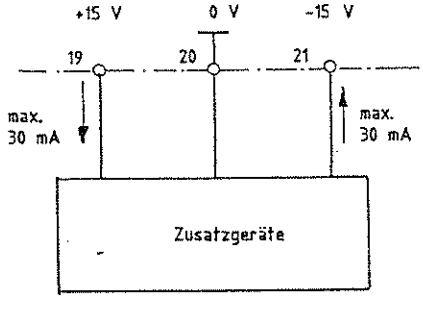


Überspannung

Kurzschluß

Anhebung der Modulation im unteren Frequenzbereich

0 – 10 V Modulationshöhe



Ä.-Zust.	Datum u. Name	Gepr.	Änderung
	11.06.90 La		Kl.51 entfällt
	30.09.86 Lauter		Kl. Text Pos. 85 u. 89 geändert

Maßstab	Gez.: 26. 4 85	Oberfläche:	Bezeichnung: Connection diagram
	Gepr.:	NGepr.:	
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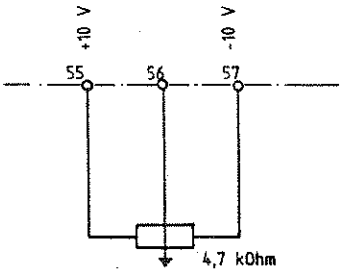
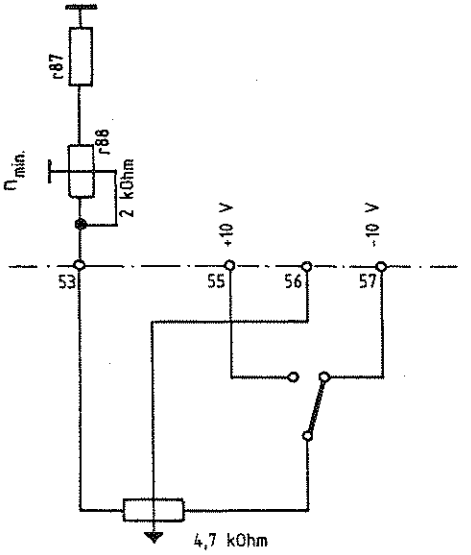
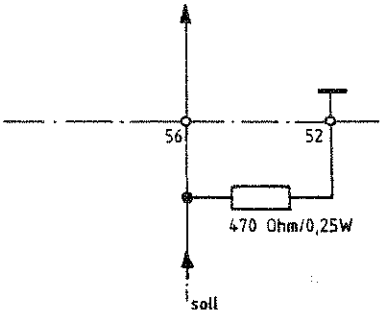
			DSV 5421



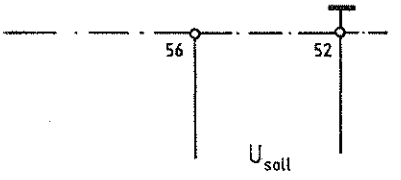
Drehzahleinstellung von Hand mit 1 Poti für beide Drehrichtungen



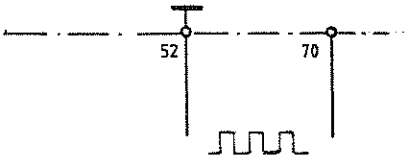
Gleiche Drehzahl für beide Drehrichtungen. Drehrichtungsumkehr durch Umschalter. Minimale Drehzahl einstellbar durch internen Trimmer $n_{min.}$



Drehzahlsollwert durch eingeprägten Strom ±0,2mA bis ±20mA



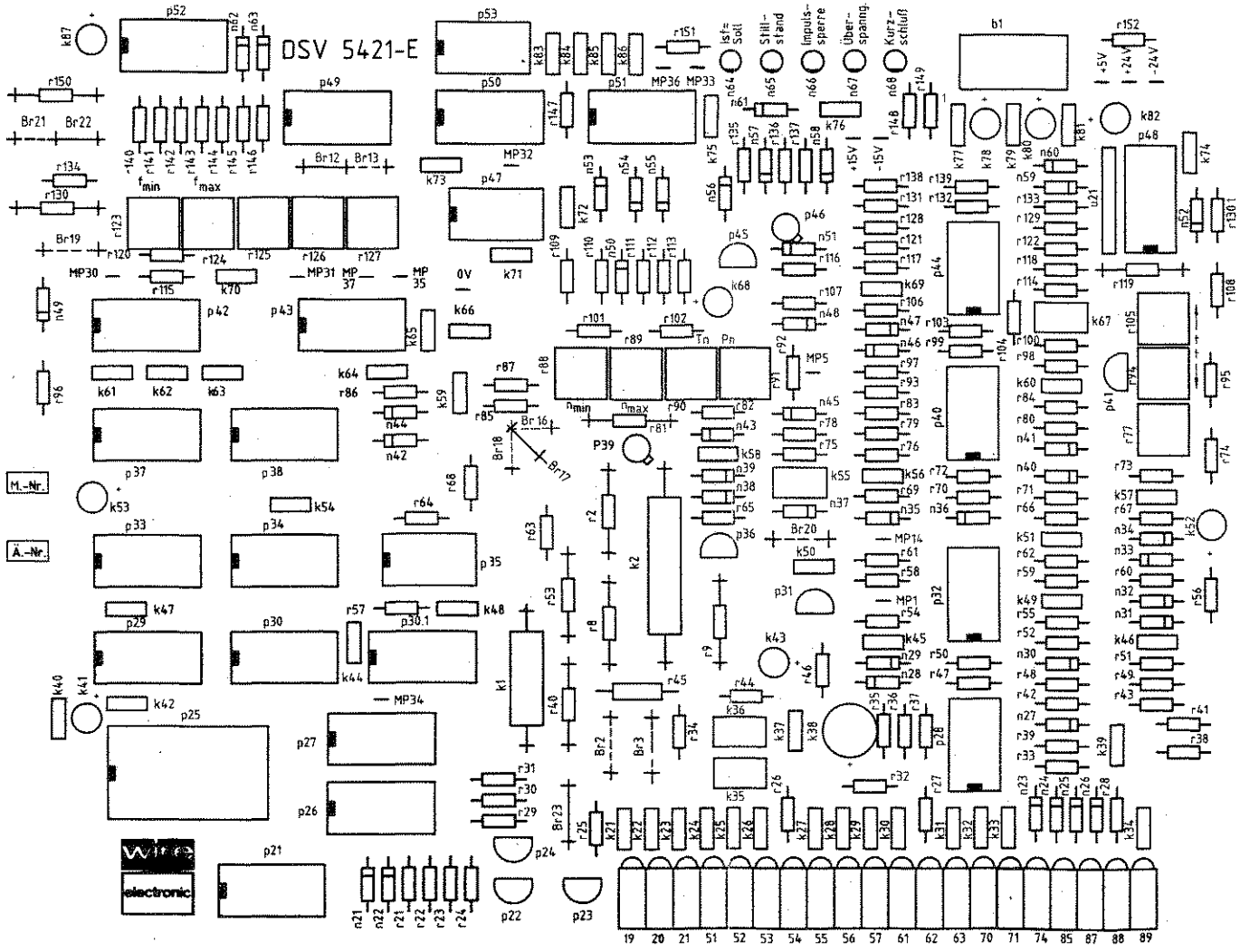
Drehzahlsollwert durch Steuerspannung ±0,1V bis ±10V



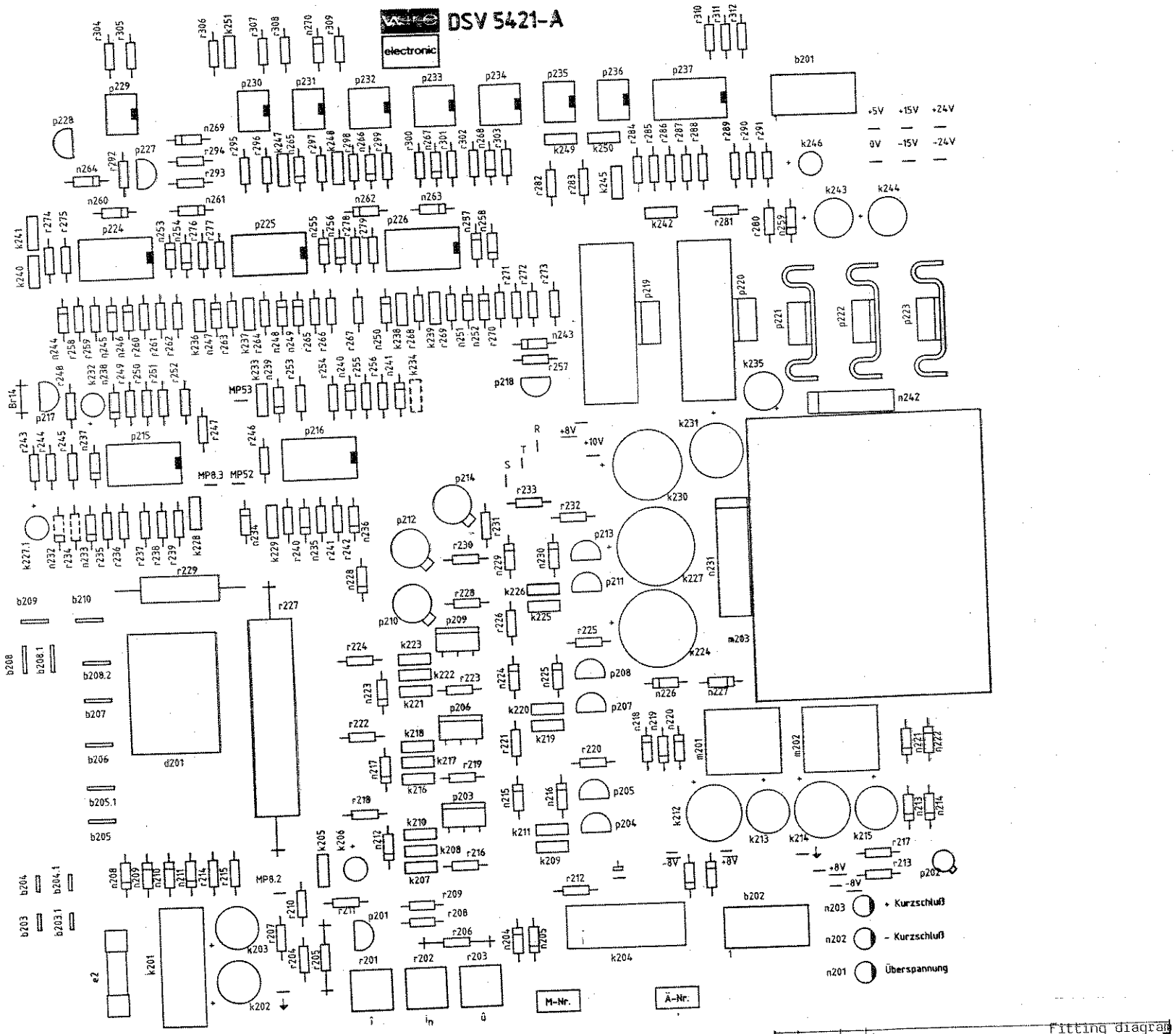
Drehzahlsollwert durch Frequenz = 768 x Motorfrequenz (Pegel +15V)

Ä.-Zust.	Datum u. Name	Gepr.	Änderung

Maßstab	Gez.: 22. 5. 84	Oberfläche:	Connection diagram
	Gepr.:	NGepr.:	
DIETZ electronic		Werkstoff:	Zeichn. Nr.: 95421 001 002 Bl.3
			WIRE DSV 5421



Datum 25.7.85	Gez.: Kobler Gepr.: Hfm Mo		Fitting diagram electronics
DIETZ electronic			Zeichn. Nr.: 95421 201 004
			Kom. Nr.: WIRE DSV 5421

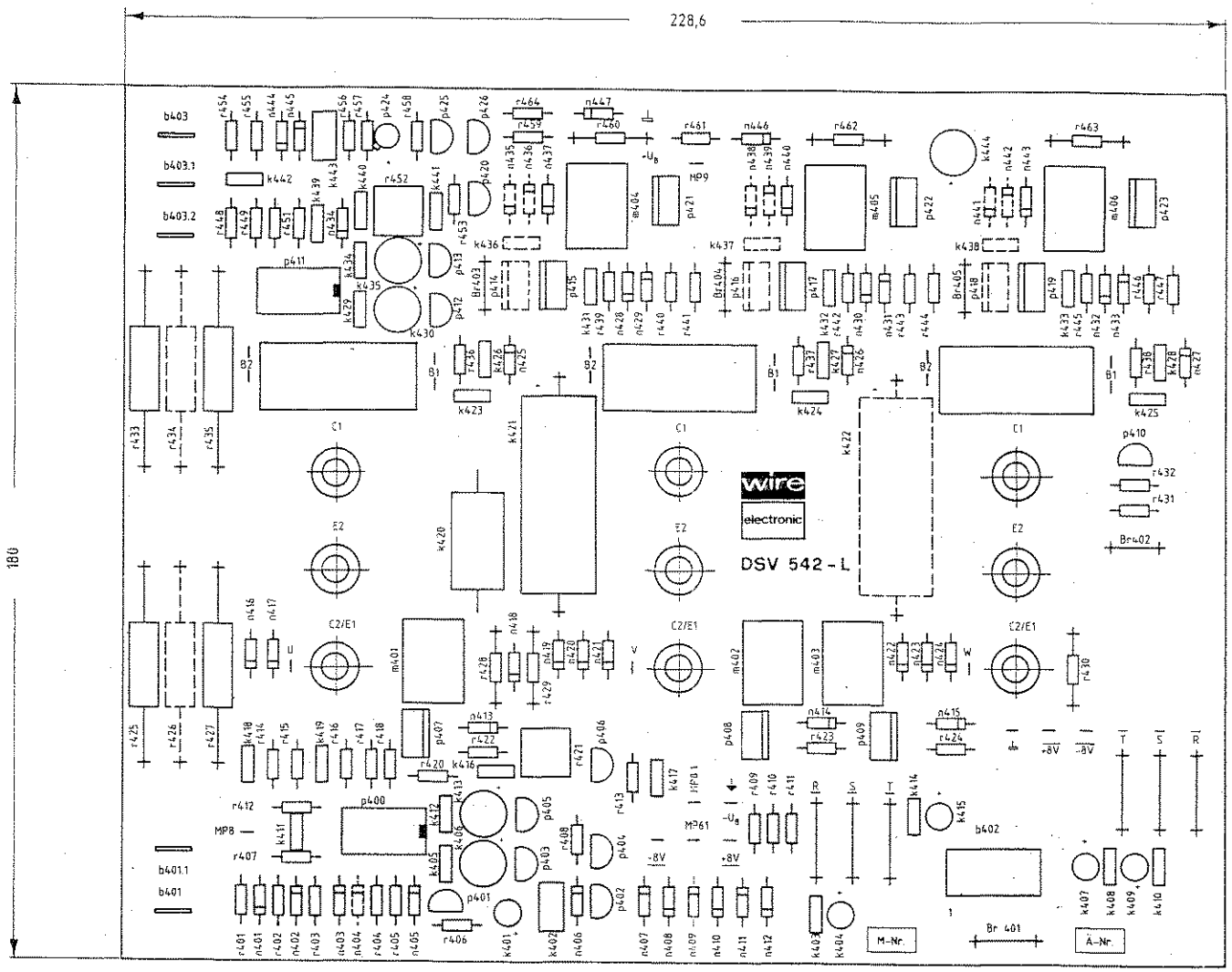


Fitting diagram
steering card

DIETZ electronic

95421 202 004

WIRE DSV 5421



Ä.-Zust.	Datum u. Name	Gepr.	Änderung
Maßstab 1: 1	Gez.: 17. 1. 85		Oberfläche:
	Gepr.:	NGepr.:	
DIETZ electronic			Werkstoff:

Fitting diagram
output card

Zeichn. Nr.: 9542 203 004

WIRE DSV 542