

BOSCH

Industrierausrüstung

3430-E4

Antriebstechnik



**BOSCH 2-PULSE
THYRISTOR AMPLIFIER**
Z 15 / Z 25

without axis switching

Connections
Integration Instructions

3430/E4-12/83



TECHNICAL DATA

BOSCH Z 15/25 Integration instructions

BOSCH 2-pulse Thyristor Amplifier is available in two versions

Technical data

Type	Z 15 - 1 A - 240 V	Z 25 - 1 A - 240 V
Max. connecting voltage power supply transformer voltage	2 x 240 V + 10 % - 15 %	
Max. output voltage	190 V	
Nominal current (60°C)	15 A	25 A
connecting voltage control phases	380 V + 10 % - 15 %	
mains frequency	50 Hz, switchable to 60 Hz	
form factor	1,3 - 1,4	
peak current for 0.5 s	40 A	65 A

The amplifiers are of compact construction and easy to service. All parts which are to be modified during the optimisation, i.e. pots, resistors and condensers are fitted on plug-in PCB (except: balance).

All connections coming to the amps. are plug-in ones except for the earth. This means that the amplifier can be changed very quickly should a fault occur, with the old optimisation board being plugged into the new unit. This way time consuming resoldering of parts is avoided.

All measuring points required for the integration can be reached from the front, without adapter.

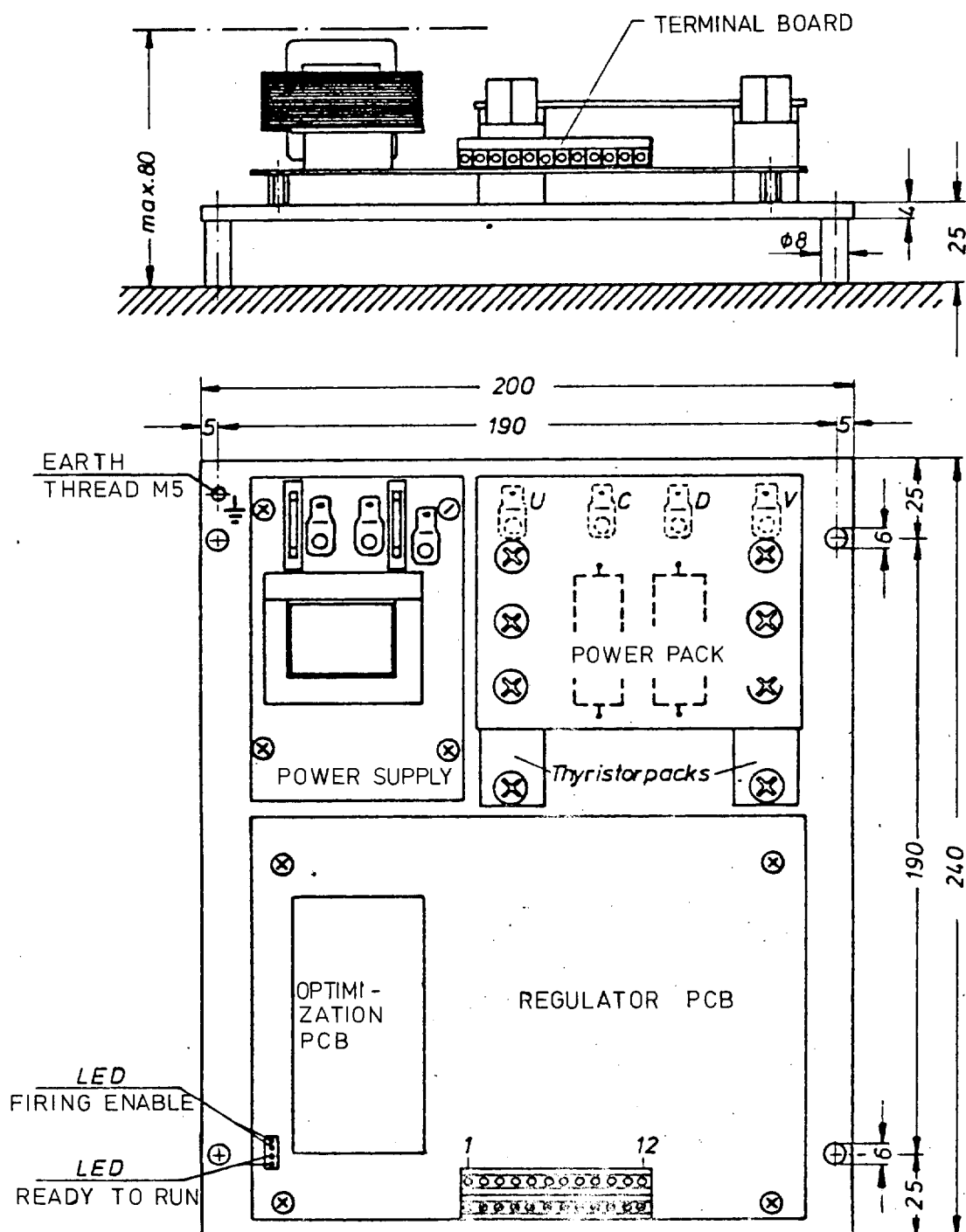
Power connections: via Faston connectors

max. power diameter: 6 mm²

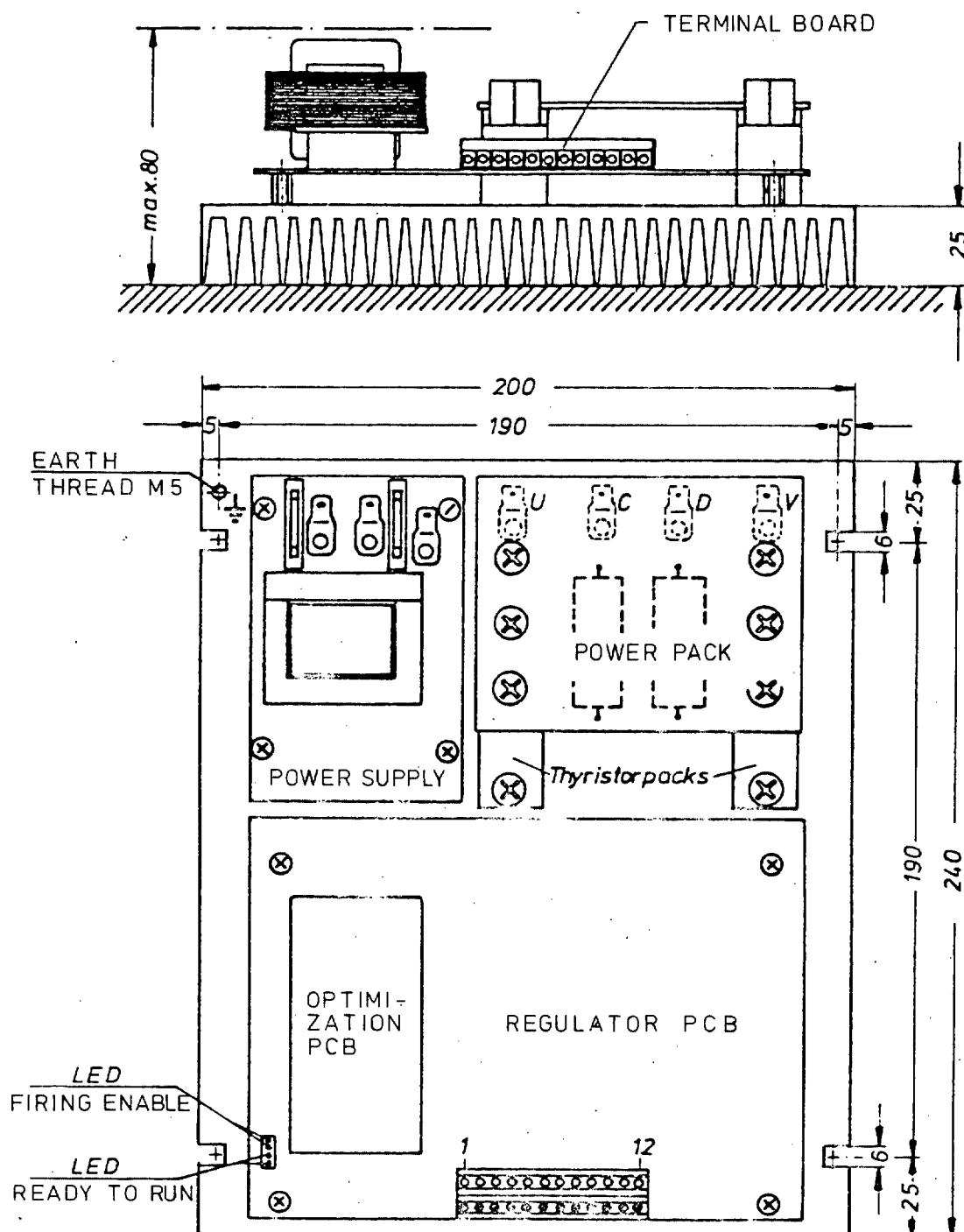
control connections: via combined clip-plug connectors.

- The amplifiers must be mounted on a place surface so that the heat sink is in an upright position. For the type Z 25 care must also be taken that the cooling fins are also upright in order to ensure an adequate circulation of air.
- Cable ducts, contactors etc. must be fitted at a distance of at least 5 cm from the amplifiers.
- Chokes and transformers should be mounted with a distance of at least 30 cm from the amplifiers.
- The amplifiers should only be built into cabinets to standard IP 54.
For forced ventilation cabinets (IP 44) a dustfilter must be placed in front of the air in/outlet.

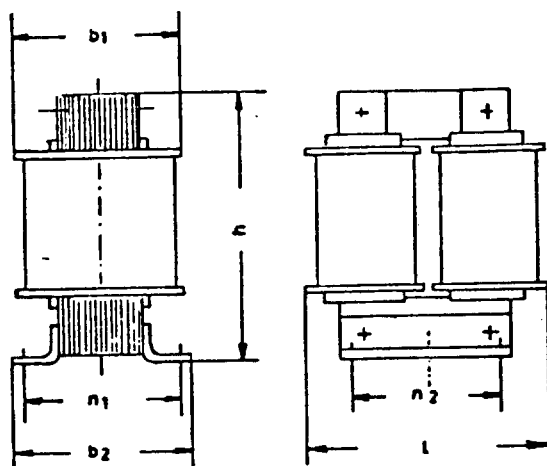
DIMENSIONS: Z 15



DIMENSIONS: Z 25



SINGLE - PHASE - TRANSFORMER (2-PULSE)



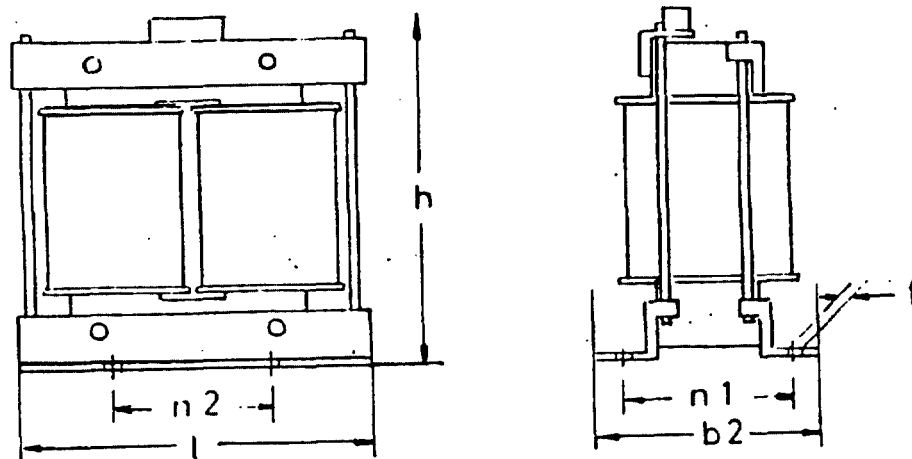
ONE-PHASE-TRANSFORMER

POWER kVA	L	b2	h	n2	n1	f	kg
1,0	142	172	195	120	111	11 Ø	16
1,5	175	153	260	130	116	10 Ø	25
2,0	199	133	290	150	95	10 Ø	24
3,0	223	179	320	170	154	10 Ø	45
4,5	239	169	345	180	140	12 Ø	52
6,0	239	184	345	180	155	12 Ø	60
7,5	239	184	345	180	155	12 Ø	57
9,0	279	204	435	210	165	12 Ø	80

AUTO-TRANSFORMER

POWER kVA	L	b2	h	n2	n1	f	kg
1,0	127	104	175	106	86	9 Ø	7,5
1,5	127	147	175	105	126	9 Ø	10,3
2,0	142	172	195	120	111	11 Ø	16,0
3,0	175	153	260	130	116	10 Ø	24,0
4,0	199	133	290	150	95	10 Ø	24,2
5,0	199	133	290	150	95	10 Ø	24,2
6,0	199	158	290	150	120	10 Ø	31,5
7,5	199	158	290	150	120	10 Ø	31,5
9,0	239	154	345	180	125	12 Ø	41,5

CHOKES:
(VDE 0550, Part 1,12, 60)

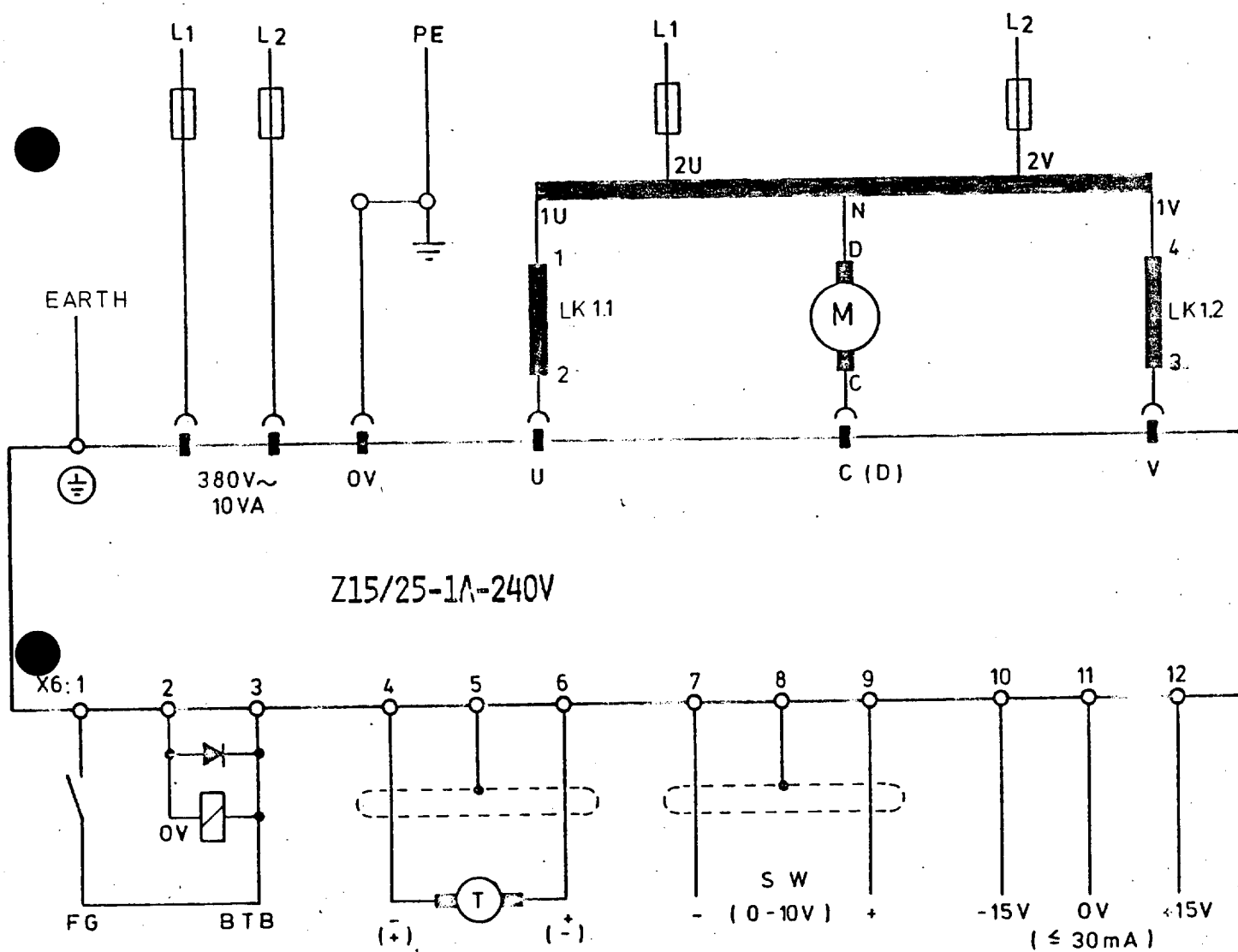


Inductance	L	b2	h	n2	n1	d	Gew. kg
2x20 mH-6A	136	92	185	90	65	7	5
2x 4 mH-20/100A 10 mH -20/100A 2x20 mH-12A 2x20 mH-16A 2x30 mH-12A 2x60 mH- 5A	152	98	210	100	70	7	8
2x 6 mH-20/100A	152	119	210	100	91	7	12
2x10 mH-14/56A 2x 2 mH-40/200A 6 mH-40/200A 2x60 mH-10A	168	112	230	115	85	7	12
2x 2 mH-65/240A	168	136	230	115	109	7	14
2x 4 mH-35/175A	200	127	270	130	90	10	19
2x 6 mH-35/175A 2x 2 mH-80/240A	200	153	270	130	116	10	25
2x15 mH-20A	200	127	270	130	90	10	19

CONNECTIONS

BOSCH Z 15/25
Integration instructions

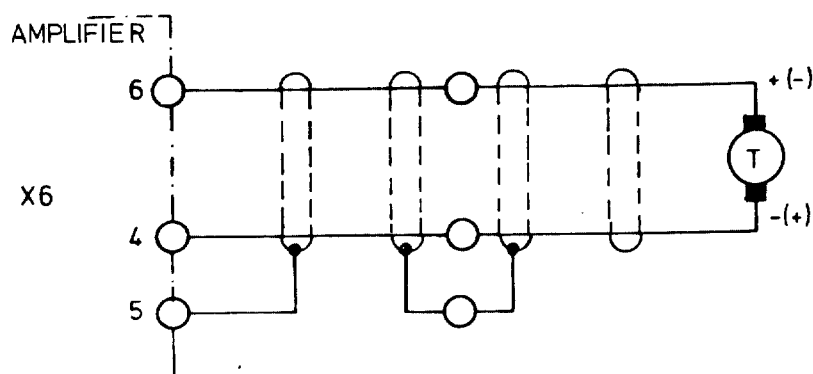
CONNECTION



CONNECTIONS

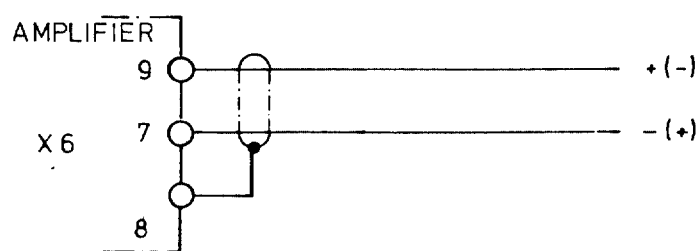
BOSCH Z 15/25
Integration instructions

1. TACHO CONNECTION



- screened 2core twisted cable
- The screen must only be connected to X6/5
- The screen must be insulated on the tacho side
- The screen must always run separately - also via any existing intermediary terminals.
- The tacho input is designed as a differential input
- Max. admissible tacho voltage at the unit: ± 75 V

2. COMMAND CONNECTION



Caution: For command values related to earth with only one command value line this must be connected to terminal 9.
Terminal 7 must then be connected to 0V (term. 8).

- With respect to the cable the same applies as for the tacho connection.
- The screen must be connected on one side, either on the amplifier term. 8. or to the command value source.
- The command value input is designed as differential input.
- The maximum admissible command voltage at the unit is ± 10 V. In special cases the command input can be reset to max. ± 15 V

3. GROUNDING

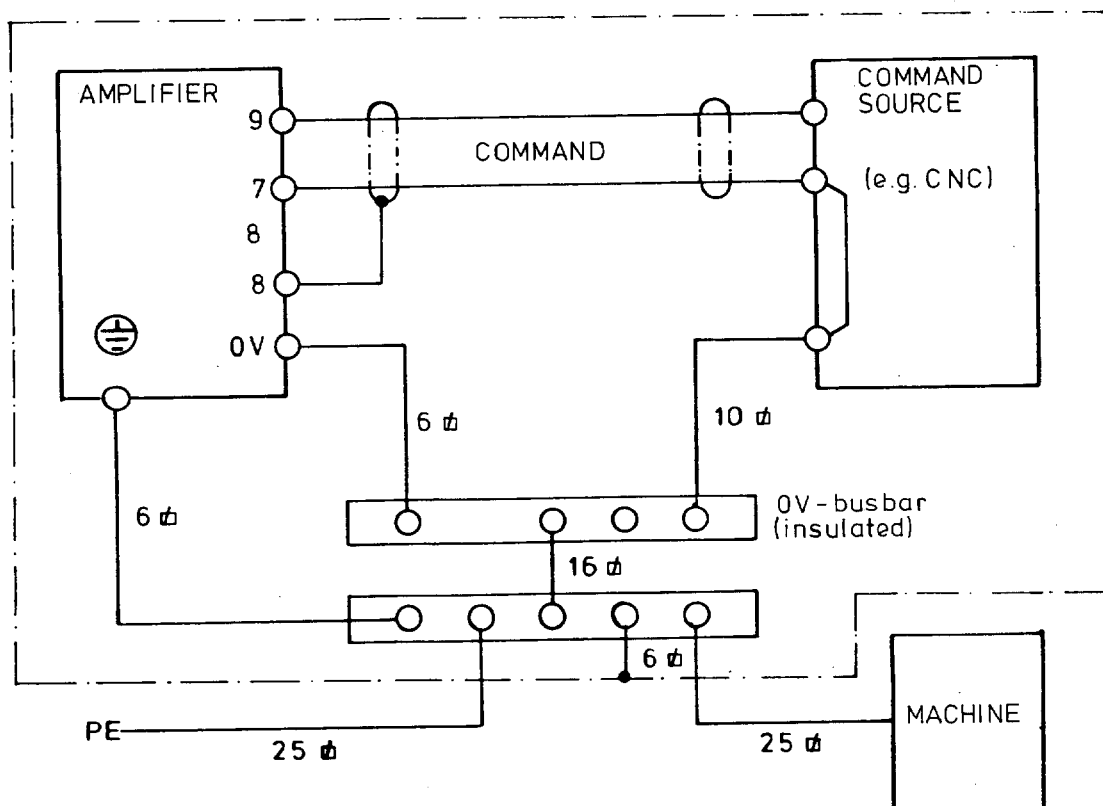
The amplifier has one connection each for "earth" and "OV". These two connections are not interconnected in the unit.

a) earth connection for the heat sink

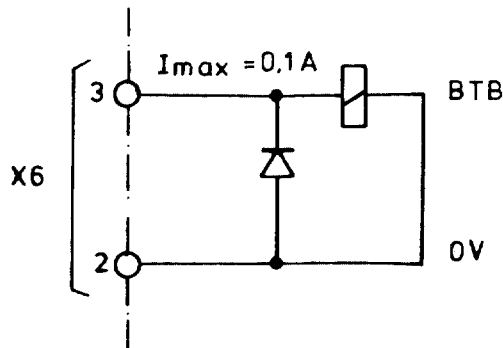
The connection between the star point (in the interface cabinet) and the earth screw on the heat sink must be of 6 mm^2 cable.

b) Flat connector "OV" for the grounding of the electronics

The connection between the OV busbar (in the I/F cabinet) and the connector "OV" on the amplifier power supply must also be 6 mm^2 .
The connection "OV" must not be connected directly with the grounding screw (danger of ground loops).

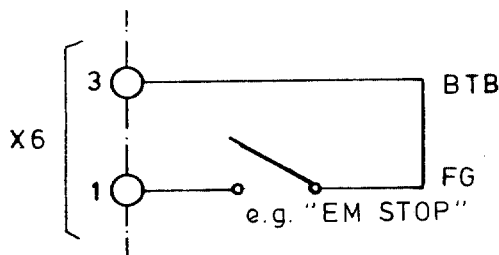


4. READY TO RUN



- The signal "ready to run" (BTB) on term. 3 has + 24 V level, when the internal voltage supply (+ 15 V) of the amplifier is working.
- The output can be loaded with a maximum of 100 mA.
- Signal Ready to Run must have an effect on the EMERGENCY STOP circuit of the unit.
- The READY state is signalled by a green LED
- If the signal is missing (level 0V) the output is switched off internally without delay.

5. ENABLE



- If there is a signal with + 24 V level present at term. 1 and an optimisation board plugged in, the output is activated and the speed regulator enabled.
- If the signal has 0V level or if there is no optimisation board plugged in the firing pulses at the output stage are inhibited, and the speed regulator is switched to low amplification (0.5). Also the command value between input amplifier and speed regulator is made "0V".

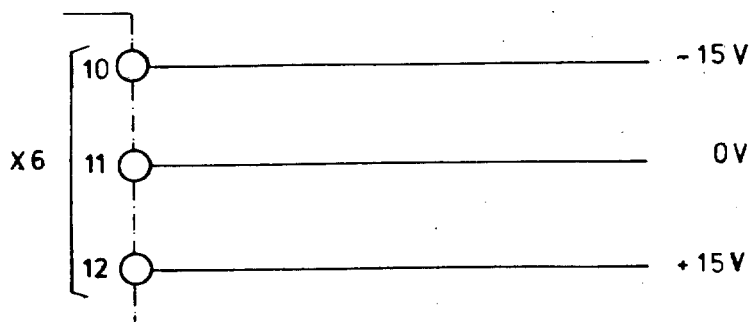
CONNECTIONS

BOSCH Z 15/25

Integration instructions

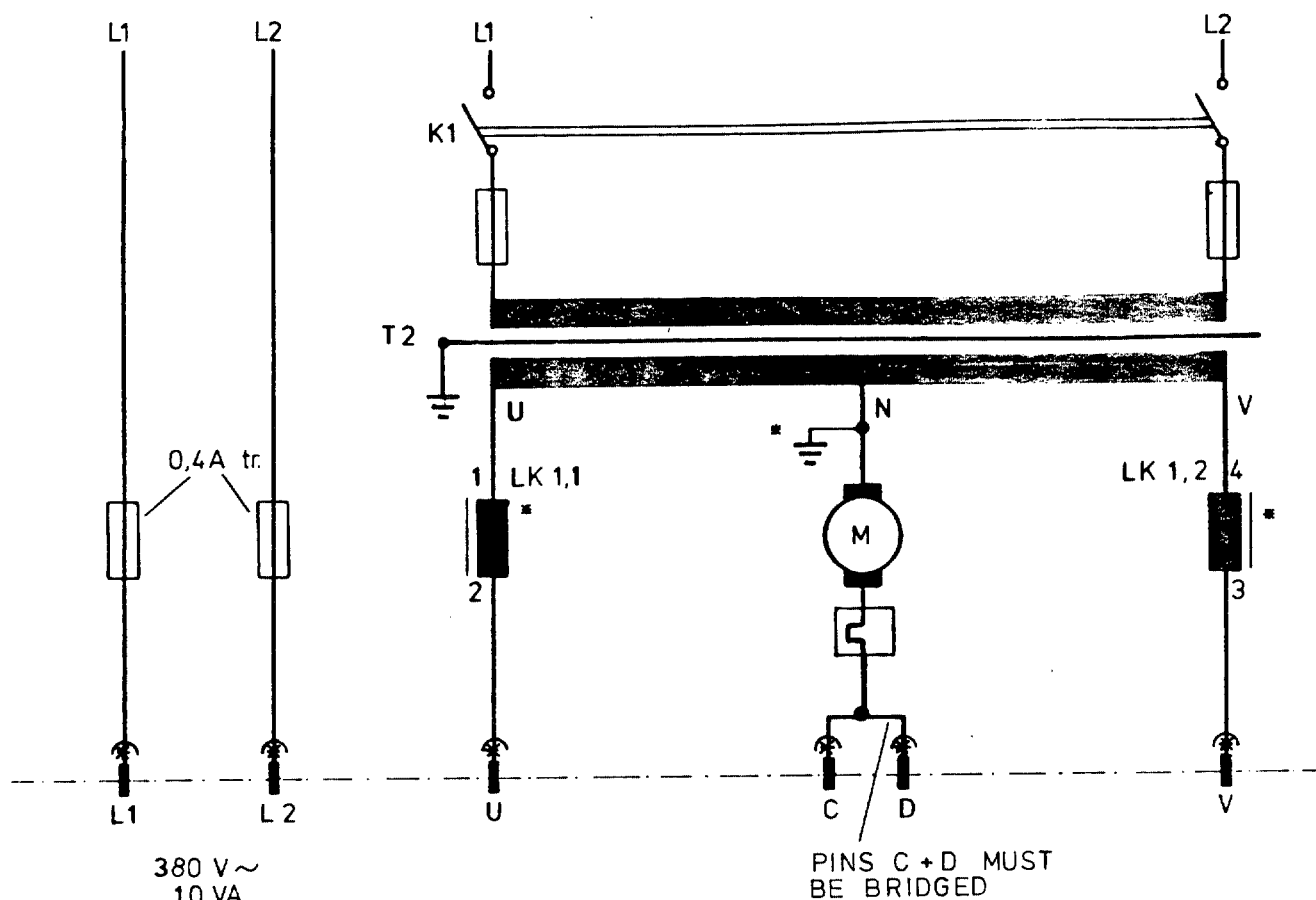
- As a standard feature the unit has a built-in switch-off delay of the enable signal of approx. 0.5 s. If this switch-off delay is not required, it can be eliminated by opening the connection (jumper) "ZF Verz." on the optimisation board.
- The status of the signal (after the switch-off delay) is indicated with a green LED.
- Caution:
The enable signal may not be switched off while the axis is moving, since the amplifier would no longer control the motor in this case.
- Exception
In the case of "EMERGENCY STOP" is must be switched off immediately (0V).

6. VOLTAGE SUPPLY ± 15 V



- At terminals 10 to 12 there are ± 15 V present for the supply for options, command output etc.
- The loading of each output may not exceed 30 mA.

7. POWER CONNECTION



CAUTION: OBSERVE THE CHOKE POLARITY!

FOR AUTOTRANSFORMERS DO NOT GROUND THE CENTRE POINT (N).

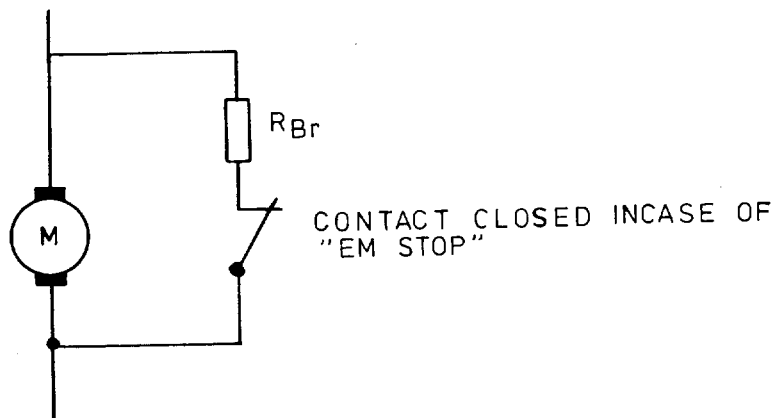
- The control voltage (L1 and L2) must be 380 V +10 -15 %.
Power approx. 10 VA.
- The signals on term. "L1" and "U", and on "L2" and "V" must be in phase.
- For the voltage adaptation of the power supply a single-phase transformer with secondary centre tap (T2) must be used. Since the control electronics of the amplifier is separated physically from the mains, an autotransformer can be used.
Caution: For autotransformers the centre point (N) must not be grounded!
- In an EMERGENCY STOP condition the transformer must be separated from the mains on the primary side (K1).
- We advise the use of double chokes (2 coils on one core) as smoothing chokes.
In the example Diagram 7 chokes LK 1.1 and LK 1.2 would be wound on to one core.

8. MOTOR PROTECTION

- A bi-metal relay (e.g. UA 5900 Siemens) is used to protect the motor against overload.
- The relay is placed single phase within the armature circuit of the motor. Should there be more DC motors with the same nominal current used on the machine one bi-metal relay can be used for those motors.
- The setting current is 0.9 time the nominal current of the motors.
- A normally closed contactor of the relay must be included in the "EMERGENCY STOP" circuit.

9. SHORT CIRCUIT BRAKING

It is advisable to use the short circuit braking technique for safe braking in the event of "EMERGENCY STOP" for permanently excited motors (which are in widespread use today).



For short circuiting the motor you can use a normally closed contact of a normal auxiliary contactor (e.g. Siemens 3TA66) or the auxiliary contact (normally closed contact) of a power contactor.

The braking resistance (in fig. 8: R_{Br}) is calculated as follows:

$$R_{Br} = \frac{E_{max}}{I_{max}} - R_a \quad [\text{Ohm}]$$

E_{max} = EMF with RAPID [V]

I_{max} = admissible peak current of motor with RAPID [A]

The resistor should be designed at least for a power of 50 W.

10. CONVERSION TO 60 Hz MAINS FREQUENCY

The standard amplifiers are set for a mains frequency of 50 Hz. A conversion to 60 Hz is done by soldering in three jumpers "60 Hz" on the optimisation board.

1. PREPARING THE INTEGRATION

1.1 CHECKING THE UNITS WITH RESPECT TO THE CUSTOMER SPECIFICATION

All components of the drive and their fitting must be checked and compared with the details given in the customer spec. This might include parts not delivered by Bosch. They are marked with a (*) in the spec.

Compare the following points:

- | | |
|--|-------------------|
| a) motor data | } see type labels |
| b) data of the smoothing chokes | |
| c) transformer data | |
| d) Specification number and AB number of the amplifier | |
| e) type and setting of bi-metal relay | |
| f) Optimising data (if given in the spec.) | |

Should, in some cases, the details in spec. not coincide with the information given in the section "Connections" the data in the specification is applicable.

1.2 CHECKING THE MOUNTING AND CONNECTION OF THE UNITS

- The amplifiers must be mounted with the heat sink in an upright position on a plane surface. For the Z 25 it must also be ensured that the ribs of the heat sink are perpendicular. If this is not observed it is possible that the amplifier might become overloaded before the type nominal current is reached. (see also section "Fitting instructions").
- The installation must be checked to be in keeping with the connection instructions as to be checked in the MTB drawings. This is particularly important on installations where our amplifiers are used for the first time.
- Special attention should be given to the choke polarity, since chokes with incorrect polarity can cause problems with the servo loop later (see connections fig. 7)

1.3 CHECKING THE OV CONNECTION

- Disconnect command lines at term. X6/7 (leave screen connected)!
- Open "OV" plug connection
- Take measurement of resistance between plug connection "OV" and ground star point in interface cabinet.
- There must be no connection to be measured!
Should there be any connection, locate and eliminate it!
- Reconnect command line
- Reconnect connection "OV".

2. INTEGRATION OF THE AMPLIFIER

2.1 INTEGRATION OF THE CONTROL MODULE

- Unplug connections L1, L2, C and D
- Switch on main switch
- Measure voltage L1 - L2 with multimeter
Should be: 380 V + 10 % - 15 %
- Switch off main switch
- Plug connections L1 and L2 back in and switch on main switch LED "BTB" must be on
- Switch on power supply (Transformer)
- Measure voltage between U and V and compare with details in spec. (Transformer data)

Example: Spec. : 2 x 180 V
 measuring U-V: 360 V

- Measure the phase relationship between L1 and U and between L2 and V with a scope. The signals between these points must be in phase.
Note: You must either use the centre point (N) of the transformer as reference point, or you must make a differential measurement (this is absolutely necessary in the case of an autotransformer, where point N may not be grounded).
- Switch off main switch
- Plug connections C and D back in.

2.2 CHECKING DIRECTION OF MOTOR ROTATION AND TACHO POLARITY

- Remove resistors R25 and R26 on the optimisation board
- Instead of the RC combination R28/C18 solder in a resistor 62 kOhm in order to limit the speed regulator to 1:3 amplification.
- Turn the pot. R30 (current) to the clock-wise stop.
- Connect a variable command source (e.g. battery box) to X 6/7 and 9. (X6/7 must be connected directly to "OV").
- Switch on main switch and transformer
- The enable signal (X6/1) must come on (LED "FG" on).
- Introduce small command steps. polarity X6/7 = OV, X6/9 = +
- The axis must run in PLUS direction. If direction incorrect: change motor polarity.
- Measure tacho voltage on X6/4 and 6. polarity:
X6/4 = -, X6/6 = +. If polarity is incorrect:
change tacho polarity
- switch off main switch

2.3 DETERMINATION OF THE TACHO INPUT RESISTANCES

If the customer spec. does not give any details re the tacho input resistors (R25/26), these can be determined as follows:

$$1. \quad R_T = \frac{U_{T1000} \cdot n_N}{U_{SW} \cdot 1000} \cdot 13 \quad [\text{kOhm}] \quad \text{to be calculated}$$

$$U_{T1000} = \text{EMF of the tacho for } n = 1000 \text{ min}^{-1} \quad [\text{V}]$$

$$n_N = \text{required max. motor speed} \quad [\text{min}^{-1}]$$

$$U_{SW} = \text{command voltage for } n_N \quad [\text{V}]$$

2. choose the nominal value nearest to R_T

2.4 IMPORTANT NOTES

- a) For all measurements necessary for the optimisation you should use wither a storage scope or a recorder.
- b) During the measuring the recorder or scope must be ungrounded or differential measurements must be taken.
- c) All given voltages relate to OV.

2.5 SETTING THE CURRENT LIMITATION

- Solder in tacho input resistors R25 und R26 with values given in the specification (Optimising data) or determined as per chapter 2.3.
- Unsolder resistor (62 kOhm) across R28/C18.
- Connect an RC-decade instead of the resistor.
Rough values: $R28 = 220 \text{ kOhm}$
 $C18 = 0.15 \text{ uF}$
- Connect R-decade to resistor R29
Rough value: 68 kOhm

2.5.1 SETTING THE CURRENT LIMITATION WHILE THE MOTOR IS BLOCKED

On many small machines there is the possibility to block the motor mechanically or keep it still. In this case the setting of the current limitation is very easy:

- Block axis mechanically
- Connect current meter into the armature circuit of the motor.

Caution: Since the nominal currents given in the spec. or the motor data sheet always represent effective currents, the current meter used must be a moving-iron instrument. (~~A~~ scale).

The moving coil measuring values typical for multi-meters (A scale) are not suitable, because they show the arithmetic average, which, in the case of 2-pulse amplifiers might only be 60 - 70 % of the effective value in some circumstances!

Measuring instruments with digital displays are not suitable either!

- Switch on main switch and power transformer.
- Introduce high command value (e.g. 10 V)
- Adjust the current to the value specified under "I1" (current limit at $n = 0$) in the specification with potentiometer R30 (turning the pot. counter-clockwise increases the current).
- Switch off main switch
- Unblock the axis.

2.5.2 SETTING THE CURRENT LIMITATION WHILE THE MOTOR IS RUNNING

- Connect DC measuring transformer with physical separation between measuring circuit and output into the armature circuit of the motor.
- Connect oscilloscope to the measuring transformer
- If no measuring transformer is available, a measuring shunt can be used.

Please note the following - important

If an autotransformer is used for the voltage adaption half of the mains voltage (measured against Earth) is present at the Shunt, as long as the power contactor is switched on!

So, with the usual mains voltage of 380 V this will be 190 V!

It is therefore strongly advised to use a differential input when measuring with the oscilloscope, since otherwise the dangerous voltage is also present on the scope housing.

- Switch on mains switch and transformer,
- Introduce short command value steps. It must be ensured that the speed regulator will run into the limitation (limit. = + 10 V at TP 14).

Caution: The speed adjustment has not been carried out yet.

- peak current \hat{I}_1 to be adjusted with pot R30 to $I_1 \cdot \sqrt{2}$ (I_1 : see spec., item 7).

Example: $I_1 = 30 \text{ A}$

- peak current $\hat{I}_1 = 30 \text{ A} \cdot \sqrt{2} = 42 \text{ A}$
- Important: Make sure that the peak current never exceeds 100 A!

2.6 DRIFT ADJUSTMENT

- Introduce command value "0"
- If the motor drifts visibly it must be attempted to reduce this drift as near to "0" as possible.

2.7 ADJUSTMENT OF THE MAXIMUM SPEED

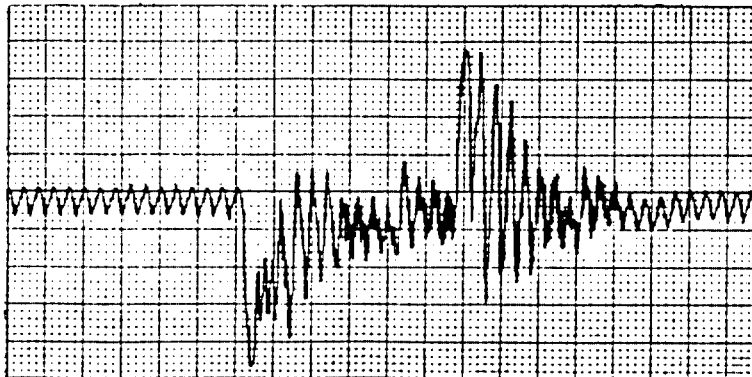
- Introduce half of the maximum voltage to be output later by the definite command value output at the command input. Slowly increase / decrease command value!
- Measure motor speed (preferably with manual speed meter).
- Use pot R23 to adjust the speed to half the value given in the spec.
- Introduce full voltage level. Slowly increase or decrease command value! The speed must reach the maximum value given in the spec. If it does not, correct with R23.

2.8 ADJUSTMENT OF THE FIRING ANGLE SHIFT

- Accelerate motor to maximum speed and brake again. (introduce command value as step function).
- Observe the current during the braking process with a scope.
- At the beginning of the braking the peak current must be $I_2 = I_1 \cdot \sqrt{2}$.
- At the end of the braking it should be $I_1 = I_2 \cdot \sqrt{2}$.
- For I_1 and I_2 see specification, item 7.
- The current flow can be changed with adjustment of R29
Caution: If R29 becomes equal to or smaller than the resistance set on R30 this might result in uncontrolled acceleration of the motor above the max. admissible speed.

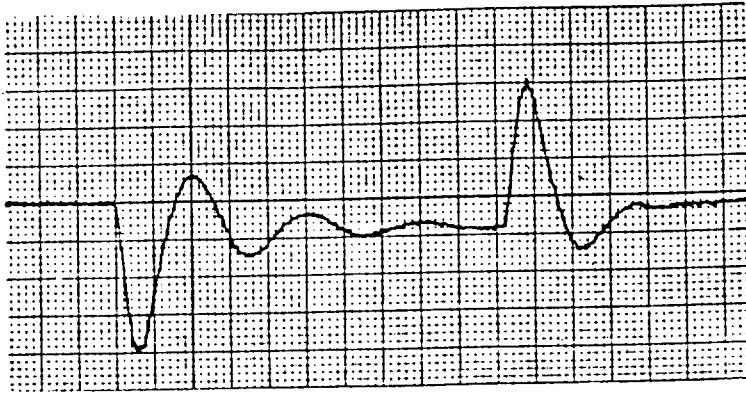
2.9 OPTIMISATION OF THE SPEED REGULATOR

- During the optimisation of the speed regulator the command value should be introduced acc to the same function as later in normal operation.
I.e.: if later the command will be introduced as E-function with 60 ms time constant (= KV1), an E-function should also be used during the optimisation. The time constant, however, should be approx. 10 % lower, i.e. approx. 55 ms.
- The command value should be such that the amplifier works just below the current limitation during acceleration and deceleration.
- Measure the speed regulator output (TP14) with a storage scope.
- If the P part (R28) is too large or the I part (C18) too small the speed regulator is instable (command value: E-function with 60 ms time constant).



- The instability is mainly caused by the roughness of the tacho.

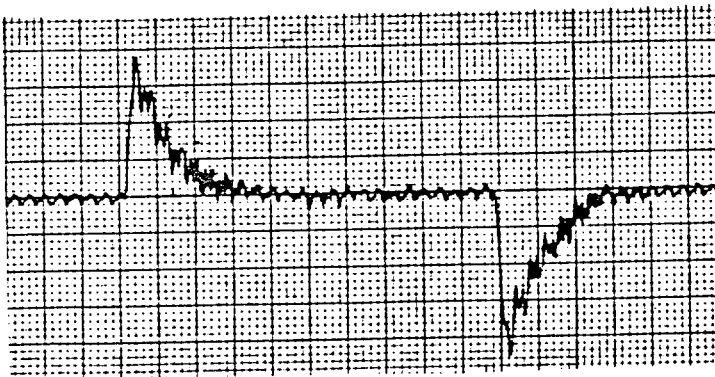
- If the R28 value is too small the speed regulator is also instable, but with a very low frequency.



- If C18 value is too large the speed regulator is stable, but because of the resulting high time constant and simultaneous low P-amplification it reacts too sluggishly.

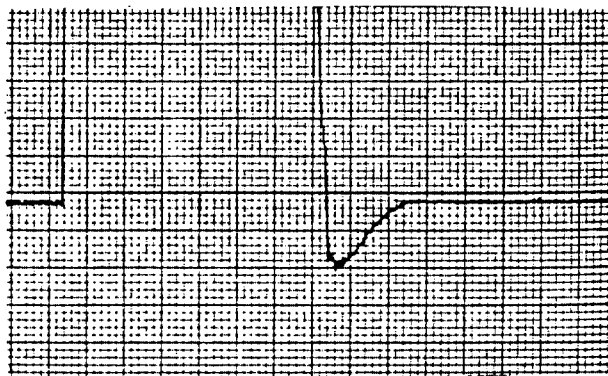


- When the adjustment of the speed regulator is at the optimum the signal is as follows.



2.9.1 D-Portion

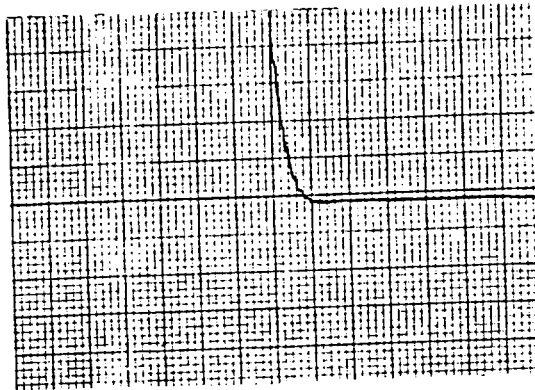
- Accelerate motor to max. speed and decelerate (command function as in 2.9)
- Measure tacho signal (TR15) with storage scope. Set scope to high resolution, so that only the low section of the signal appears.
- Observe the tacho signal during the deceleration operation.
- If there is a bad relation between inertia, motor power and acceleration or deceleration time the tacho signal overshoots:



- The overshoot can be eliminated with a D-portion in the tacho input (C17/R27)
- If there is overshoot, connect a C-decade to pos. C17 (rough value: 4.7 nF)
- Solder in 22 kOhm resistor in pos. R27
- Increase C17 from 4.7 nF in steps, until the overshoot is eliminated.

INTEGRATION

BOSCH Z 15/25
Integration instructions



- Measure the speed regulator output again with the scope. If C17 is too large it is possible that the speed regulator becomes instable, because the tacho roughness has more effect on it. In this case: make C17 smaller again until the signal roughness appears acceptable.
- Any further overshoot of the tacho signal then, can only be eliminated by increasing the command value time constant (smaller = worse KV-factor in the positional servo loop).
- Switch off main switch.

2.10 FINE ADJUSTMENT OF DRIFT AND SPEED AND KV-FACTOR

- Connect a definite command source (e.g. CNC) to term. X6/7 and 9
- Switch on main switch and transformer
- Adjust finely the drift of the motor at speed "0" or symmetry with Pot R9
- Introduce speed value
- On installations without positional servo loop:
Adjust the motor speed to the command speed with the aid of a manual speed meter (Poti R23)
- On installations with positional servo loop.
Set the required KV-factor with pot R23.

$$KV = \frac{|V|}{|S|} \quad V = \text{axis velocity} \quad \left[\frac{\text{m}}{\text{min}} \right]$$

$$S = \text{Lag} \quad [\text{mm}]$$

Example: $V = 10 \text{ m/min}$

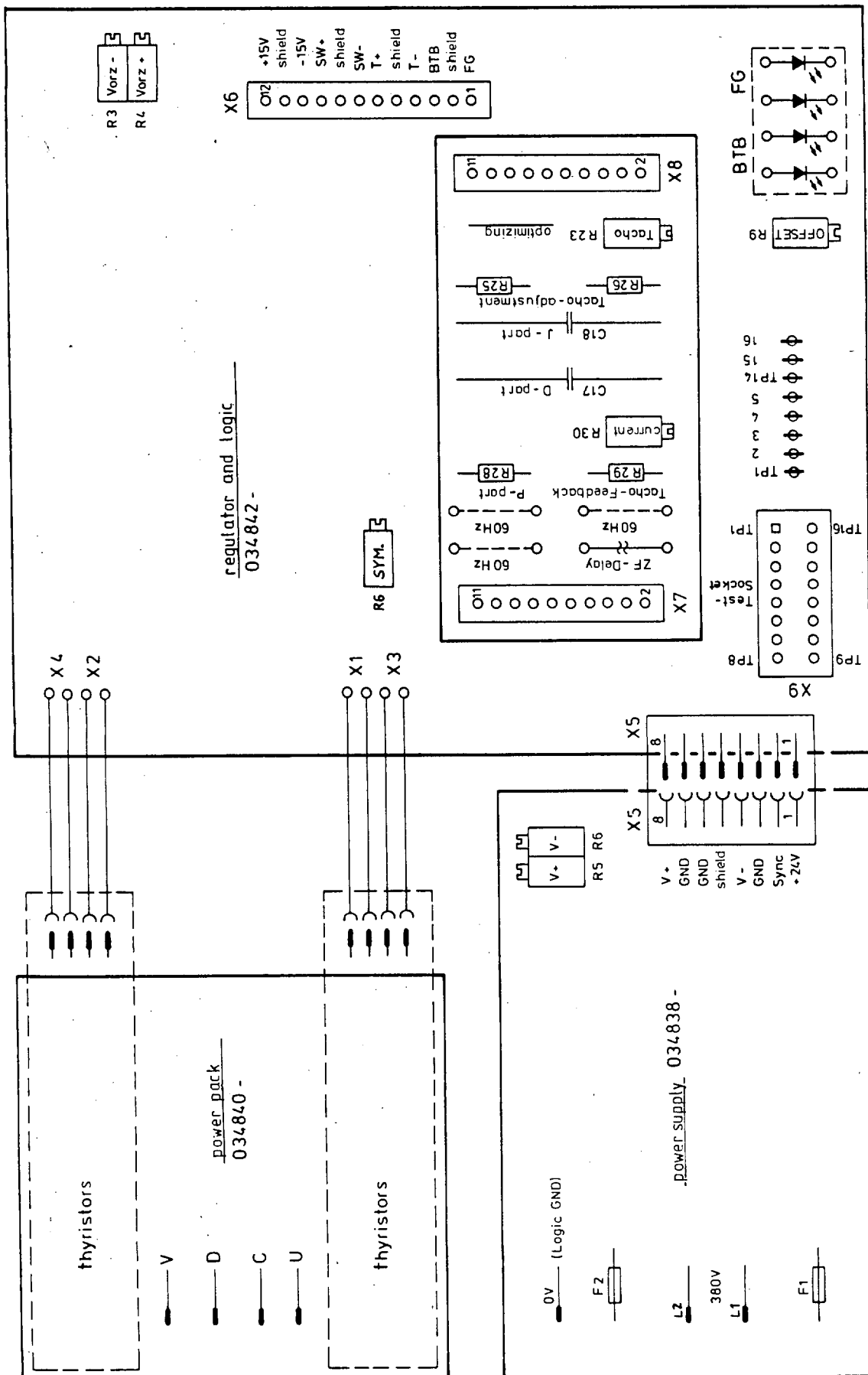
$S = 10 \text{ mm}$

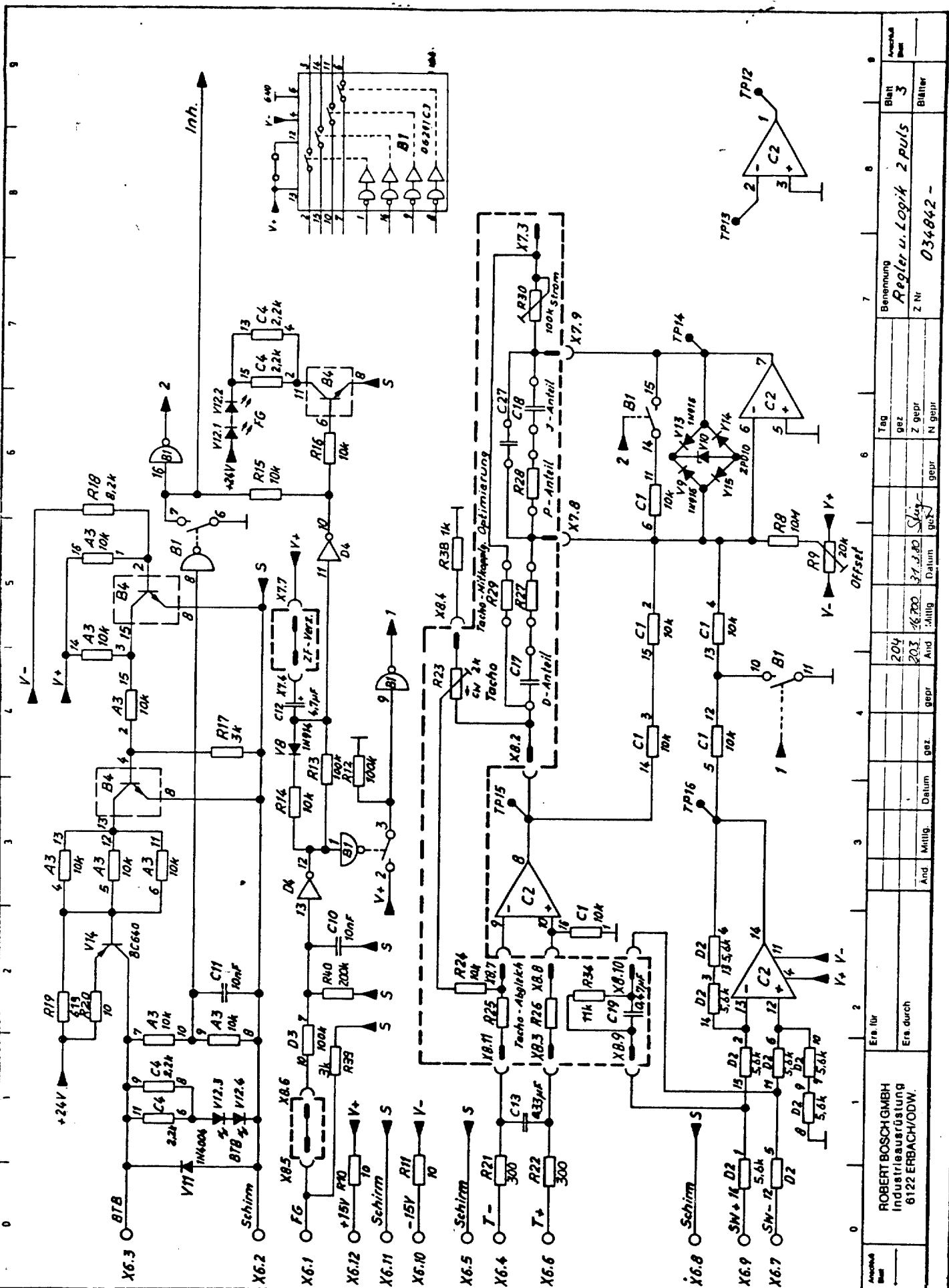
$$KV = \frac{10}{10} = 1$$

- Switch off main switch

2.11 CONCLUSION OF THE INTEGRATION

- Solder in all resistance and capacitance values determined with the RD-decade in the amplifier as fixed values (optimisation card).
- Seal all pots
- Note down all optimisation details not coinciding with the details in the specification and send list to VES3 (for pre-optimisation of future units).







6201 86 1020



**BOSCH**

Flexible Automation

Kursprogramm Th-V

THEMA**BOSCH THYRISTOR-ANTRIEB**
"Vorschub"**TEILNEHMER**Mitarbeiter aus den Bereichen:
Instandhaltung
Inbetriebnahme**VORAUSSETZUNG**Grundkenntnisse der Steuerungstechnik
Praktische Erfahrung mit NC-Werkzeugmaschinen**LERNZIEL**

Der Kursteilnehmer soll nach dem Kurs

- Arbeitsweise von Gleichstrom-Motor und Verstärker kennen
- Zusammenhänge der Regelkreise kennen
- Antrieb einstellen und optimieren
- Nötige Meßtechnik beherrschen
- Störungen erkennen und beheben

INHALT

- Einführung
Motoren, Stromrichter, 3-puls, 6-puls-System
Regler, Regelkreise
Lageregelkreis
- Gerätekunde
Aufbau, Funktion, Blockdiagramm
3-puls-Thyristor-antrieb
Schaltgruppen
- Praxis am Gerät
Inbetriebnahme und Optimierung am Gerät
Fehlersuche
- Hinweis auf 2-puls-Thyristor-antrieb

DAUER

5 Tage

Montag 10⁰⁰ Uhr
Freitag 13⁰⁰ Uhr

Robert Bosch GmbH
Schulungszentrum Flexible Automation
Berliner Straße 25, Postfach 1149
6120 Erbach/Odw.
Tel. 06062/78-258

