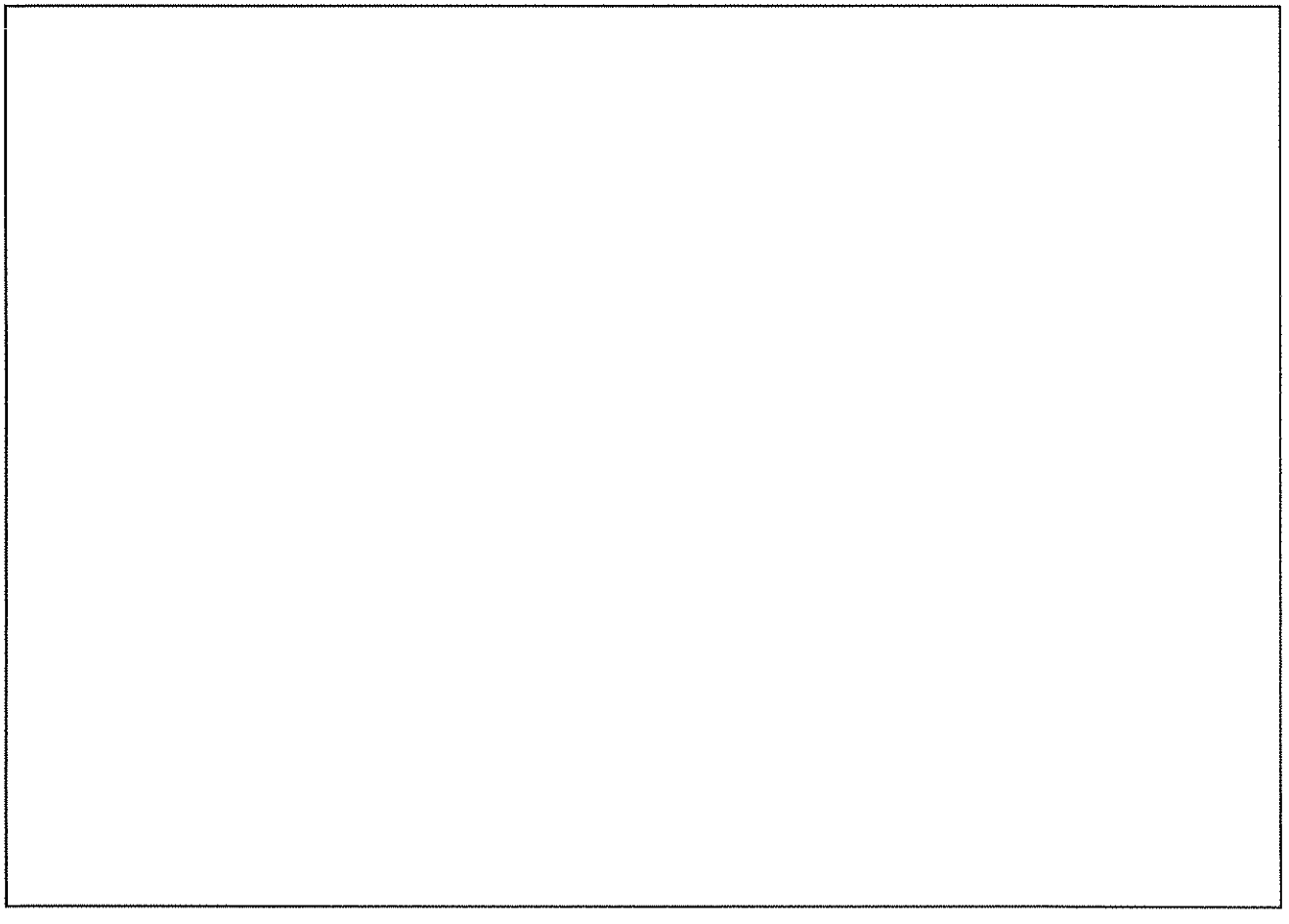
INDRAMAT

TRK 6-4U
6-pulse thyristor control amplifier for main drives



IE 109-530-4105/11.86

Description of Operation
and
Commissioning Instructions
TRK 6 - 4 U

109-53-4105-0

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1. General

The INDRAMAT TRK 6 thyristor control amplifier is an extremely compact converter unit with a three-phase bridge circuit B6C, which is free of circular currents. It has been designed as a standard drive for the main spindles of machine tools.

The unit has protection type IP 00 for panel mounting in a control cubicle.

It consists of five circuit boards FD 3, RE 6, AP 8, NS 1, ZAM 7, drive programming module TSS 10 and power output stage. The power stage contains the three-phase bridge circuits for the two converters in the armature circuit and the 2-pulse bridge circuit for the field supply.

The main spindle drive consists of commutation choke, thyristor control amplifier TRK 6 and a separately excited d.c. motor. All adjustments and optimization for this combination are carried out at the factory. This is of prime importance for trouble-free initial operation.

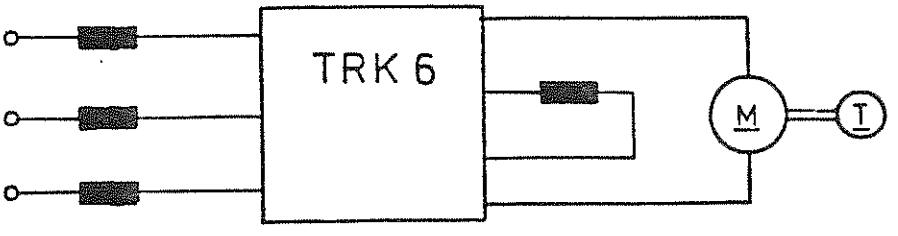


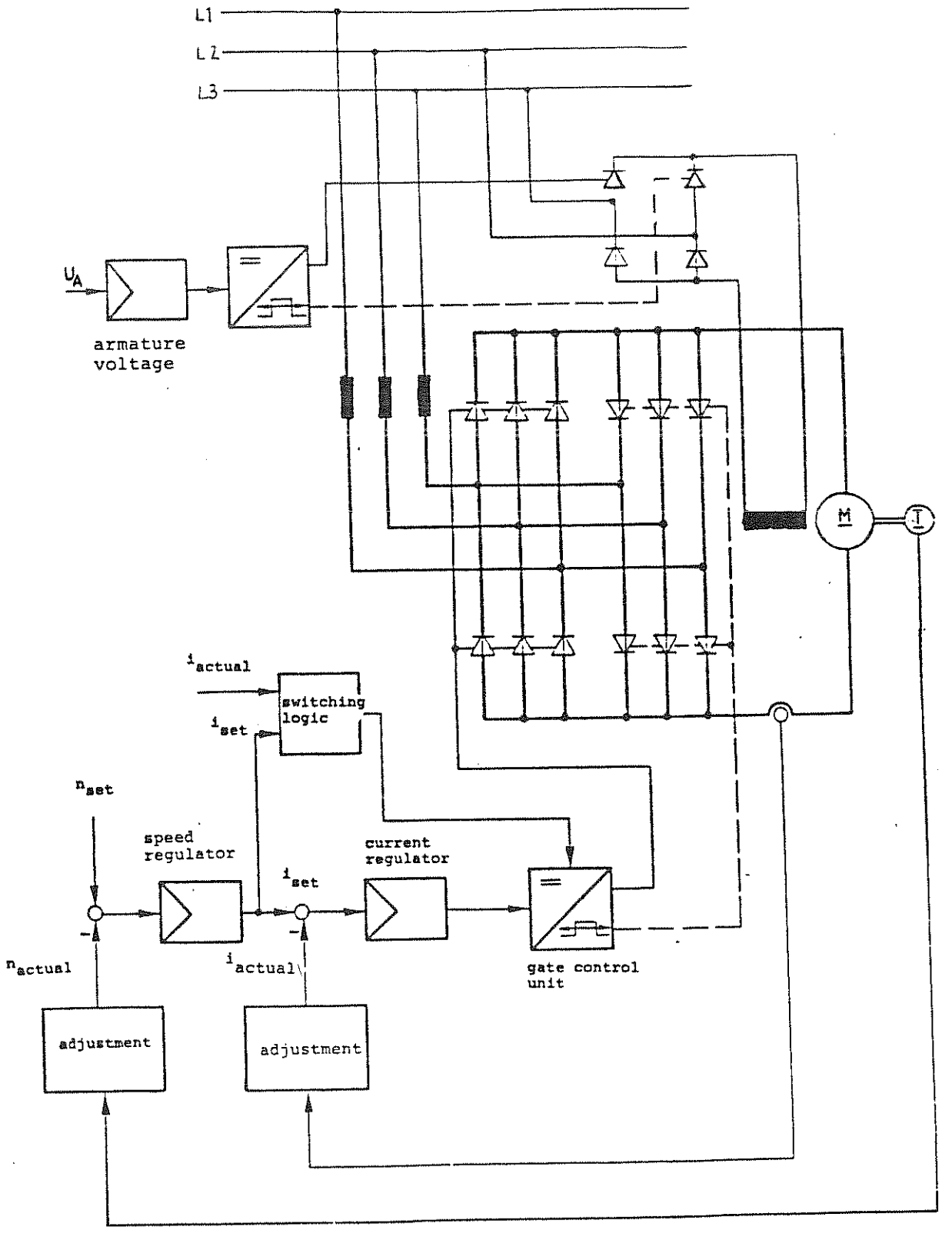
Figure 1: Main Spindle Drive

2. Description of Operation

The description should be read in conjunction with the diagrams included in the technical documentation.

Speed regulation with superimposed current control ensures an optimum dynamic control characteristic. The switching logic ensures that no circular currents appear in the reversing rectifier and that the switching intervals are kept short.

Figure 2: Control circuits in the TRK 6 control amplifier



2.1 Circuit board FD 3

2.1.1 Field voltage regulation

The purpose of the field voltage regulation is to keep the motor armature voltage U_A constant at the value $U_{A\ max}$ at speeds above the nominal value (adjustment via R54 and R55 on MP14). Starting with maximum field voltage (R50, R51), the excitation field is reduced to the minimum field voltage (R52, R53). The armature voltage (floating) is weighted by the factor K_3 = 0.02 V/V. This adjustment is made by INDRAMAT.

2.1.2 Speed monitoring circuit:

Incorrect measurement of the speed actual-value n_{actual} (tacho faulty) should not cause excessive speed and damage to the machine. The armature voltage U_A is therefore compared to the tacho voltage. If the difference is too great, the "ready" state is cancelled (indicated by LED h7 on circuit board RE 6).

2.1.3 Armature current actual-value display

This enables the value of the armature current to be displayed externally by a moving-coil meter on the control panel. This allows the actual cutting forces to be obtained, as the torque is proportional to the armature current. Matching to the nominal motor current by means of R134 and R133 is carried out by INDRAMAT. The weighting is 7.5 V at the nominal motor current. The maximum loading at the output is 1 mA.

2.1.4 Controller enabling signal:

The set-value of the speed is fed to the speed regulator immediately a positive 24 volts is applied to terminal RF of terminal strip X1. Transmission of the controller enabling signal to circuit board RE 6 can only occur if a set-value of speed of at least 100 mV is applied. The speed and current regulators are then enabled and the trigger interlock provides trigger signals.

The set-point is disconnected internally immediately the controller enabling signal is removed from terminal RF. The drive then slows down as set by the ramp. Removal of the controller enabling signal occurs on circuit board FD 3 only after a delay time of 350 ms and if the actual-value of speed is below 1200 rpm. Cancellation of the controller enabling signal is then transmitted to circuit board RE 6, where there is a further delay of 300 ms before the speed and current regulators and the gate control unit are desabled.

2.1.5 Internal processing of speed set-value via ramp generator:

The set-value of speed, which is applied to input E1A - E1B, is fed via a ramp generator to the speed regulator on circuit board RE 6. The set-point signal is only fed to the ramp generator via T5 if the controller enabling signal is present.

The maximum ramp slope permitted for the drive, and the set-value adjustment (on V12), is factory-set. The user may vary the slope of the ramp to suit the machine by means of P6, if link Br2 is not in place.

To prevent excessive speeds, the set-value, after ramp generation, is limited to +/-10V (test point MP 8).

2.1.6 Control status output

To obtain sequential NC control functions, it is necessary to know the control status of the main drive. The controlled state $n_{actual} = n_{set}$ and speed reduction below the minimum $n_{actual} < n_{min}$ are therefore indicated.

If red LED h2 goes out and relay d2 drops out, the set-value of speed coincides with the actual-value.

If red LED h1 goes out and relay d1 is de-energized then the actual-value of speed is less than the minimum speed n_{min} 30 rpm. The drive is then controlled and the set-value and controller enabling signal are disconnected.

2.1.7 Positioning:

In order to position the main drive, internal cancellation of the controller enabling signal when $n_{actual} < n_{min}$, may be inhibited. This is achieved by applying a + 24 volt signal to terminal POS of terminal strip X1. The drive may then be run up to zero speed. This assumes that the controller enabling signal is applied to terminal RF.

2.1.8 Signal sequence during the start-stop cycle

Figure 3 shows the timing diagram for the functions and signals as produced by the logic on circuit board FD 3. It is assumed that the "ready" signal is present and that the power stage is connected.

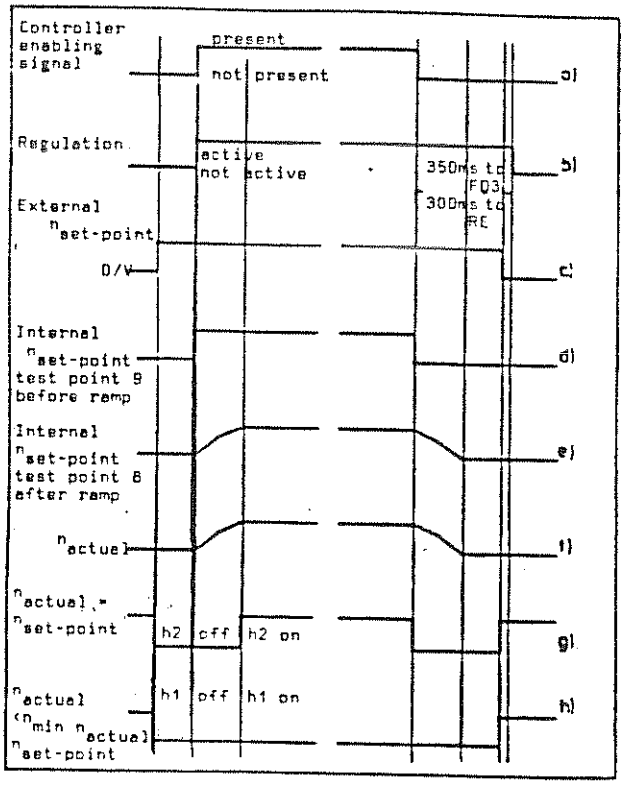


Figure 3: Signal sequence during stop-start cycle.

2.2 Circuit board RE 6 and programming module TSS 10

2.2.1 Controller enabling signal, trigger interlock:

See 2.1.4

2.2.2 Controller lockout:

When switching on, the controller must only be enabled when all switching functions are completed. On the other hand, in the emergency-off mode the speed and current regulators and the gate control unit must be immediately

interlocked. +24 volts should therefore be applied to the controller lockout input RS on terminal strip X2 via an auxiliary contact of the main contactor. The controller lockout and trigger interlock are cancelled after a 300 ms delay.

The entire control circuit is locked again immediately this voltage is removed (see emergency-off circuit).

2.2.3 Speed regulator:

The speed regulator generates the difference between the set-value of speed at input NR or E1 and the actual-value of speed which is detected by the tacho-generator. Its output voltage varies according to the difference (control deviation). The proportional-integral (PI) characteristic of the speed regulator ensures optimum control without steady-state error. The output voltage of the regulator is equivalent to the set-value of current, weighted with the factor K_5 (see Table 1)

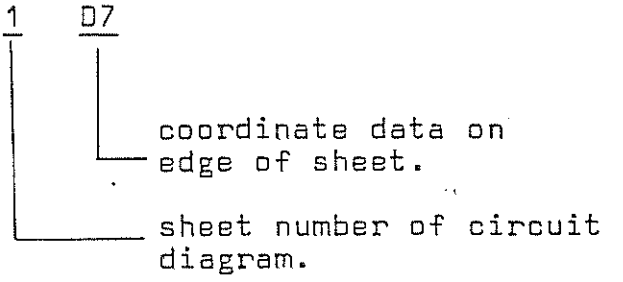
An operational amplifier with a high degree of temperature stabilization (temperature drift 3µV/°C) is used for the regulator. The offset voltage (speed zero drift) is balanced by means of potentiometer P2. The speed regulator configuration is matched to the drive on programming module TSS 10.

A plug-in link Br1 in the feedback loop allows the gain to be reduced during initial setting-up.

Table 1: Device constants

Designation	Value		Location		
			pcb	Coor-dinate	Test point
K1 Actual-value of armature current for current regulation.	0,025 V/A		RE 6	1E3	14
K2 Actual-value of armature current for display	7,5 V/nominal motor current		FD 3	1A6	10
K3 Actual-value of armature voltage for field regulation and monitoring.	0,02 V/V		FD 3	1B3	2
K4 Tacho actual-value adjustment	0,012 V/min^{-1}		RE 6	1C2	4
K5 Speed regulator adjustment (set-value of current)	IdN/A		RE 6	1C4	2
	60	0,06 V/A			
	100 150 195	0,0225 V/A			
K6 Current regulator adjustment (set-value of trigger-angle).	0,075 V/°el		RE 6	1D7	9

1) coordinate data on circuit diagram



2.2.4 Speed set-point and actual-value inputs

The set-point input NR is matched to the actual application via resistor R15 on the programming module TSS 10. The actual-value inputs are designed for tacho voltages of 20, 33 and 60 volts per 1000 revolutions.

Potentiometer P1 is used for fine adjustment of the actual-value of speed and this provides a weighting factor K_4 (test point 4). See Table 1. This weighted actual-value of speed is fed to circuit board FD3 and to the summing point of the speed regulator.

The speed set-point is adjusted on circuit board FD 3 by INDRAMAT to the customer's requirements.

It can if necessary, be reset by means of resistors R16, R72 and R74. The required input voltage U_E for a maximum speed n_{max} is calculated as follows:

$$R_{74} = R_{16} + R_{72} = \frac{7.5V.30\ kOhms}{U_E}$$

2.2.5 Current limiting

Current limiting is obtained by means of the current set-point.

2.2.5.1 Speed controlled current limiting

Peak current limiting is done on V8, V9, V10 and is set by means of R9, R10 on module TSS 10. The peak current limiting is reduced in proportion to speed when this exceeds the value n_o. This enables the maximum torque to be obtained from the motor without exceeding its commutation.

The ratio between current up-take and increase in speed is determined by R5 and R6 on the TSS 10 module. The cut-off point n_o of the speed-related current limiting is determined by R7 and R8 on module TSS 10. This adjustment is made by INDRAMAT.

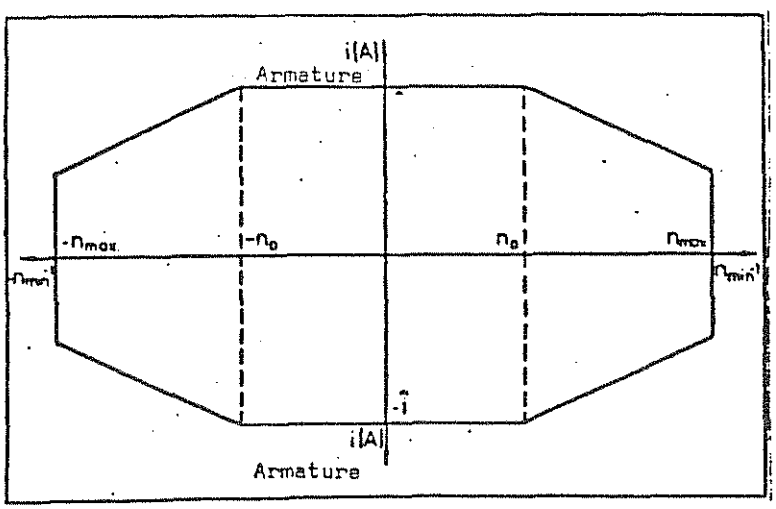


Figure 4: Speed-controlled peak current limiting.

2.2.5.2 Dynamic peak current limiting

In order to have increased current available during periods of acceleration, and to protect the control amplifier and motor against current overloads, the peak current is reduced after a short interval to the required continuous current level. The response time depends on the difference between the peak current and the fixed current, and is approximetely 200 to 500 ms. If the current exceeds the value set on potential divider R13, R14 on module TSS 10, V18 integrates in the positive direction and limits the set-value of the current.

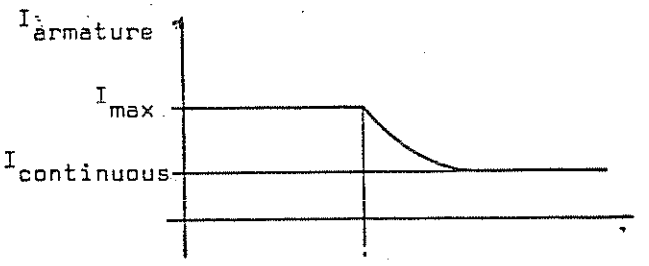


Figure 5: Dynamic peak current limiting.

2.2.5.3 Externally-controlled peak current limiting

If the motor must run with reduced torque (e.g with a change of tool), the current is limited to the value set on potentiometer P1 on the TSS 10 when +24 volts is applied to terminal IRED of terminal strip X2 (adjustment range: 3 to 18A).

Limiting is cancelled when the positive voltage is removed.

2.2.6 Polarity logic

In order to prevent mains short-circuit, only one direction of current is allowed at any one time. This is achieved by means of the polarity logic. The mode of operation, for a change from a positive to a negative direction of current, for example, is explained as follows:

When the polarity changes from a positive to a negative set-value of current, the positive direction of current is immediately blocked. The change-over interval commences only after the actual-value of current is 0

and at the end of this time the negative direction of current is allowed. Identical signals at PIN 1 and PIN 2 of IC 1 enable the triggering. If during the switching to a positive value, the positive direction is enabled and the negative remains blocked. The direction of current which is enabled is indicated by two green LED's h1 and h2.

The current regulator must be disabled via V11 and transistor T10 during the switching interval. (see Table 2).

Table 2: Polarity logic.

	IC1/1	IC1/2	IC1/3	h1	h2	$i_{set\text{-}point}$
Positive direction of current	"0"	"0"	"1"	on	off	+ $i_{set\text{-}point}$
Negative direction of current	"1"	"1"	"1"	off	on	- $i_{set\text{-}point}$
	"1"	"0"	"0"	off	off	0
Both directions blocked	"0"	"1"	"0"	off	off	0

2.2.7 Armature current regulator

The current regulator continuously computes the difference between the set-value and actual-value of current and its output voltage varies accordingly. The proportional-integral (PI) charateristic of the current regulator is optimized to the machine. This is done by INDRAMAT on the programming module TSS 10.

The plug-in link Br2 enables the characteristic to be changed to a purely proportional one (initial operation, fault-finding).

2.2.8 Linearizing network

This cancels out the non-linearity of the trigger angle/motor current relationship and provides stable operation at zero speed with a higher drive stiffness. The output voltage corresponds to the trigger angle.

2.2.9 E.m.f compensation

The tacho voltage, which is proportional to the e.m.f of the motor, is fed to the summing amplifier V1 via operational amplifier V2. This sets the e.m.f-related trigger angle via the gate control unit.

E.m.f compensation provides speed limiting in the event of a fault in the tacho.

2.2.10 Monitoring facilities

2.2.10.1 Field current monitoring

If the field current falls below the minimum value set on R119 and R120, the trigger interlock is operated and red lamp h5 "FUE" comes on.

2.2.10.3 Phase monitoring

At the moment of switch-on, a signal is generated via capacitor C18 which ensures that the gate control unit is interlocked.

If the sawtooth signal has been generated on circuit board NS 1, comparator V20 switches to -15V. If all 3 comparator signals are present on board NS 1, transistor T17 (on NS 1) switches input 7 to zero volts. If this state is maintained for more than 20 ms, the signal at C18 becomes zero and the trigger interlock is cancelled.

This ensures that the trigger interlock is not removed if one phase fails (periodic fault at mains frequency). Red lamp h3 "PUE" indicates that the phase monitor circuit has been activated.

Note: Phase balance between the synchronizing voltage and the voltage across the load is not monitored!

2.2.10.4 Temperature monitoring

If the heatsink temperature exceeds the permitted value, a thermal cut-out operates and disconnects the +15V to circuit board RE 6. Red lamp h6 "TUE" comes on and the gate control unit is interlocked.

2.2.10.5 Control voltage monitoring

If the control voltage exceeds or falls below (U_{VM} = +/- 15V), by more than 0.5 V, T23 or T24 are cut off. This removes the positive voltage at PIN 12 of IC 4 and the trigger interlock becomes operative.

2.2.11 "Ready" status

For external signalling, all monitor functions are combined in the "ready to operate" module.

If all monitor circuits indicate "go", green lamp h7 "BB" comes on, relay d1 is energized and closes a potential-free (floating) contact (loading 220V, 8A). (See Table 3).

Parameter	Designation		Colour	Location on circuit board
Pos. triggering	ZF +	h1	Green	RE 6
Neg. triggering	ZF -	h2	Green	RE 6
Phase monitor	PUE	h3	Red	RE 6
Speed monitor	DUE	h4	Red	RE 6
Field current monitor	FUE	h5	Red	RE 6
Temp. monitor	TUE	h6	Red	RE 6
"Ready"	BB	h7	Green	RE 6
Speed n_{min}	$n_{actual} > n_{min}$	h1	Red	FD 3
Drive not controlled	$n_{actual} = n_{set-point}$	h2	Red	FD 3

Table 3: LED display status

2.2.12 Programming module TSS 10/....

The TSS 10 programming module allows the TRK 6 thyristor control amplifier to be optimized to the corresponding drive combination. The serial number of the module determines the following adjustments:

- Linearizing network
- Set-point: input resistance and limiting
- Speed regulator feedback
- Current regulator feedback
- Preset current (U_{vor})
- Speed-controlled current limiting
- Dynamic current limiting
- Externally-controlled current limiting

Important user information is printed on the module (see Fig: 6).

Information on each line:

1.	Thyristor controller:	TRK 6-4U-380/150-K1
2.	Servo controller:	2G1340 IR...-3302 V1
3.	Commutation choke:	KD 2-D
4.	Input voltage (V)/speed (r.p.m):	10V/1 200
5.	Max possible continuous current:	94
6.	Max. possible peak current:	160

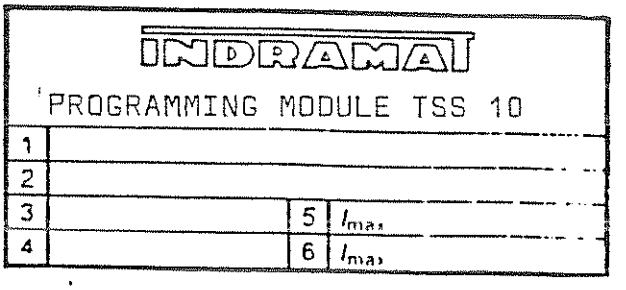


Figure 6: Programming module data

2.3 Circuit board AP 8

Circuit board AP 8 contains the trigger transformer, TSE circuit and fuses for the field supply. Also located on circuit board AP 8 are the synchronization stages and controller supply fuses, synchronization transformer and 60° phase-shifter.

2.4 Circuit board NS 1

2.4.1 Trigger interlock:

The trigger interlock for the gate control unit may only be removed by applying a positive voltage of more than +12 V to solder pin 3. The AND-gates in IC 9 prevent both the clock generator IC 10 and the positive and negative triggering from generating pulses in IC 5 to IC 8.

2.4.2 Positive and negative triggering

With positive triggering (ZF +), bridge I is enabled, the output voltage between A1 and A2 of the unit being positive.

With negative triggering (ZF-), bridge II is enabled. The output voltage between A1 and A2 is then negative.

2.4.3 Synchronization:

Synchronization of the gate control unit is derived from the a.c. voltage produced by transformers TR1, TR2 and TR3 on circuit board AP 8. This a.c. synchronizing voltage is phase-shifted by 60° (on AP 8) and fed to comparators V10 to V15.

Sawtooth waveforms are generated by the integrators. The position of the sawtooth waveforms is adjusted by means of poteniometers P1, P2 and P3 (see NS 1 block schematic).

Fine adjustment of the integration constants is done with potentiometers P4, P5 and P6. This precise adjustment of the sawtooth waveforms ensures maximum possible uniformity between current blocks, which is very important for smooth motor operation.

2.4.4 Conversion from trigger-angle voltages (W1, W2 to mains-synchronized trigger pulses:

The d.c. output voltage from the linearizing network representing the trigger angle is compared with the synchronous sawtooth waveforms. The time interval in which the sawtooth voltage is more negative than the trigger angle voltage, determines the trigger angle. Comparators V1, V3 and V5 determine the trigger angle for bridge I; V2, V4 and V6 do the same for bridge II (see Fig: 7)

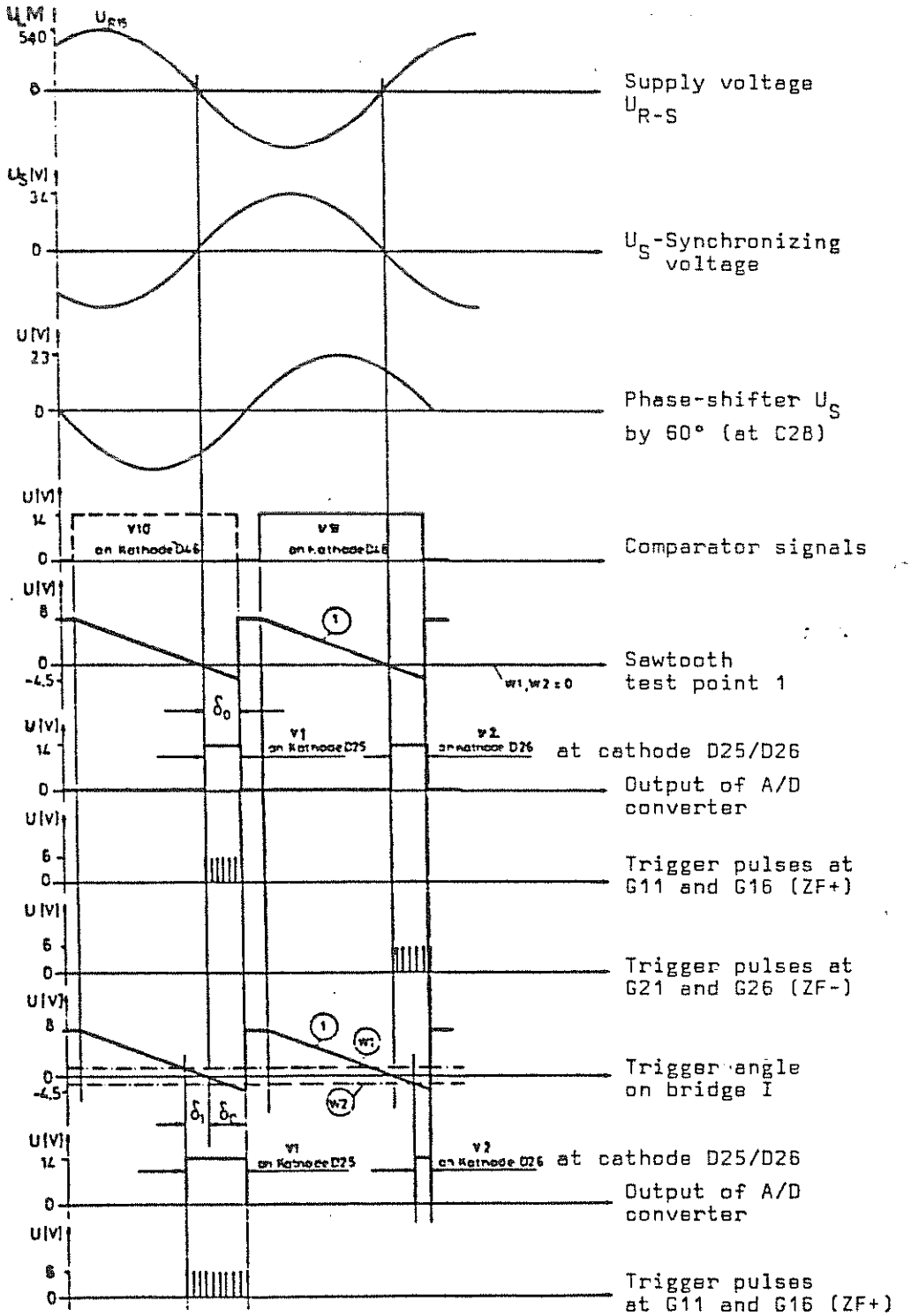
The square-wave signal determining the trigger angle (at the cathodes of D25 to D30) is synchronized with the clock-pulse generator IC 10 in the "pulse generator" (IC 1 to IC 8). Duplicate pulses are generated which trigger the corresponding thyristors via the output amplifiers (T1 to T12). (see Fig: 7).

2.4.5 Power supply unit and output voltages:

The central power supply is on circuit board NS 1; the associated power supply transformer is located on the heatsink.

The power pack provides the supply voltage for the electronics (UVM = ± 15V, UDD, USS) and for driving the thyristors. A separate supply voltage (+ UDD) is provided on each circuit coard for the IC's.

Figure 7: Generation of mains-synchronized trigger pulses



3. Design notes

3.1 Electrical connections:

3.1.1 Terminals:

Table 4: Terminal strip connections

Screw terminal strip X1 (pluggable), FD 3

Terminal No:	Designation	Remarks	Max. Cross-section of wire mm²
1	---	Unused	
2	+ IA	2 outputs for actual-value of armature current; 1 mA max.	
3	+ IA		
4	OVM	OV earth connection	
5	RF	Input for controller enabling signal (+ 24V)	
6	E1A	1 input for speed set-point	
7	E1B		
8	POS	Positioning input (+ 24V)	1,5
9	⏚	Screen connection	
10	S1	Signalling contact, $n_{actual} < n_{min}$	
11	M1		
12	OE1		
13	S2	Signalling contact, $n_{actual} = n_{set\text{-}point}$	
14	M2		
15	OE2		

Screw terminal strip X2 (pluggable), RE 6

Terminal No:	Designation	Remarks	Max. cross-section of wire mm²
1	+ 24VL	Output +24V, 100 mA max.	1.5
2	0VL		
3	IRED	+24V input for reduced peak current limiting	
4	-15VM	Output for ±15V, ±100 mA max.	
5	+15VM		
6	0VM		
7	⏚	Screen connection	
8	⏚		
9	0VM	0V earth connection	
10	3E2	20 V/1000 rpm tacho connection	
11	2E2	33 V/1000 rpm tacho connection	
12	1E2	60 V/1000 rpm tacho connection	
13	0VM	0V earth connection	
14	E1	Test input $n_{set\text{-}point}$	
15	RS	Cancel controller interlock, +24V	

Screw terminal strip X4 (pluggable), RE 6

Terminal No:	Designation	Remarks	Max. cross-section of wire mm²
1	---	Unused	1.5
2	---	Unused	

Screw terminal strip X3, AP 8

Terminal No:	Designation	Remarks	Max. cross-section of wire mm²
1	BB	"ready" contact (220V, 9A)	1.5
2	BB		
3	3U	Field supply connection	
4	3V		
5	F -	Field excitation connection	
6	F +		
7	2U	Controller internal power supply connection	
8	2V		
9	2W		

Power section connections

Terminal designation	Remarks	Screw connection
1U	Mains phase L1	M8
1V	Mains phase L2	M8
1W	Mains phase L3	M8
A1	d.c. voltage output A1	M8
A2	d.c. voltage output A2	M8
PE	Equipment earth	M8

3.1.2 Analogue control cables:

Analogue control cables (tacho, set-points) should as a general rule be screened and laid separately from power cables. Avoid running wires in parallel with power cables.

3.1.3 Controller internal power supply:

The power supply is derived directly from the mains and the only protection required is a miniature circuit-breaker, as fine-wire fuses are fitted to the primary of the power supply unit transformer. Terminals are designed for wire of 1.5 mm² cross-section. The power supply for the controller must be of the same phase as the power section supply as only this is used for synchronization.

3.1.4 Power input:

The power is supplied via semiconductor fuses, a circuit-breaker and the three-phase commutation choke. The cable cross-section may be selected according to the nominal motor current as the continuous current in the TRK 6 controller is set by the programming module to the nominal motor current and not to the nominal equipment current.

3.1.5 Earthing

The relevant local safety precautions should be observed when earthing the equipment. If there is a separate earth for the electronics, this should be at least 4 mm² cross-section and be connected to the earthing stud on the unit. Control cable screens should be connected at one end of the cable only, that is at the unit itself.

3.1.6 Recommended control circuit:

The control circuit shown in the diagram generates the correct switching sequence during switching-on and switching-off.

Switching-on:
When push-button S1 is operated, relay K1 is energized and connects
the power, field supply and motor fan. S1 must remain operated until the field current exceeds the minimum field current.

Switching-off:
If push-button S2 is operated, auxiliary relay K1 is de-energized and power contactors K2, K3 and K4 drop out.

Emergency-off:
In the emergency-off mode the supply to the contactors is disconnected via the emergency-off button S3 direct. In an emergency-off situation, until the drive has come to rest, it should be borne in mind that incorrect movement of the drive can occur at any time. Defective drive movement depends on the type of fault and the operational status at the instant it occurs.

For the power input we recommend the switching devices shown in Table 5:

I_{dN}/A	60	100	150	195
Mains contactor (Siemens)	3TB4714-..	3TB4814-..	3TB5014-..	3TB5214-..
Mains contactor (Télémecanique)	CN-FC133-..	CN2-GC133-..	CN2-HC133-..	CN2-HC133-.

Table 5: Recommended switching devices

3.1.7 Armature short-circuit braking:

With separately-excited d.c. motors, armature short-circuit braking is not possible during a sudden mains failure and can therefore not be used for the emergency-off mode.

3.2 Protective devices:

3.2.1 Controller internal power supply:

Only a circuit-breaker is required for the controller internal power supply. Equipment fuses are fitted to circuit boards AP 8 and NS 1. Table 6 shows the fuses to be used.

3.2.2 Field supply:

A circuit-breaker is all that is needed for protecting the field supply. Equipment fuses are shown in Table 6.

Designation	Protection for	Fuse type	Circuit board
F1	Controller internal power supply	M 0,315/250 C	AP 8
F2		M 0,315/250 C	AP 8
F3		M 0,315/250 C	AP 8
F4	Exciter field supply	F 6,3/250 G[1)]	AP 8
F5		F 6,3/250 G[1)]	AP 8
F6	+24V$_L$ controller power supply	M 1,25/250 E	NS 1

[1)] Switching capacity not less than G to be used.
Spare fuses are located on the heatsink.

Table 6: Fuses for controller and field power supplies.
Equipment fuses conform to DIN 41 57.1

3.2.3 Power input:

We recommend the thermal fuses shown in Tables 7 and 8 for the three phase fuses F16, F17 and F18 and armature protection F19.

I_{dN}/A	60	100	150	195
Siemens Silized	5SD 460 (50A) P_V = 60W subassembly 5SF 122 5SF 124	5SD 510 (80A) P_V = 84W subassembly 5SF 140	5SD 530 (125A) P_V = 210W subassembly 5SF 160	---
Siemens Sitor	3NE 4117 (50A) P_V = 51W subassembly 3NH 8220	3NE 4120 (80A) P_V = 78W subassembly 3NH 8220	3NE 4122 (125A) P_V = 135W subassembly 3NH 8220	3NE 4124 (160A) P_V = 138W subassembly 3NH 8220
	3NE 8017 (50A) P_V = 48W subassembly 3NH 7020 3NH 8020 3 pole	3NE 8020 (80A) P_V = 57W subassembly 3NH 7020 3NH 8020 3 pole	3NE 8022 (125A) P_V = 78W subassembly 3NH 7020 3NH 8020 3 pole	---
Ferraz Protistor[1]	URB (660V, 50A): X 85 994 (DIN 80) L 85 984 (DIN 110) P_V = 36W	URB (660V, 80A): V 85 992 (DIN 80) I 85 982 (DIN 110) P_V = 66W	URB (660V, 125A): S 85 990 (DIN 80) G 85 980 (DIN 110) P_V = 84W	---
	---	URG (600V, 80A): Y 89 859 P_V = 48W	URG (600V, 125A) A 89 861 P_V = 75W	URG (600V, 160A) B 89 862 P_V = 117W
	---	URB (660V, 80A) D 79 238 (DIN 80) M 79 269 (DIN 110) P_V = 72W	URB (660V, 125A) F 79 240 (DIN 80) P 79 271 (DIN 110) P_V = 99W	URB (660V, 160A) G 79 241 (DIN 80) Q 79 272 (DIN 110) P_V = 117W
SIBA Ultra-Rapid[2]	10 007 07 (50A) 20 001 04 (50A) 20 002 04 (50A) 20 003 04 (50A) 20 004 04 (50A) USA-Norm: 60 004 05 (50A)	10 009 07 (80A) 20 001 04 (80A) 20 002 04 (80A) 20 003 04 (80A) 20 004 04 (80A)	10 010 07 (125A) 20 001 04 (125A) 20 002 04 (125A) 20 003 04 (125A) 20 004 04 (125A)	---
BUSSMANN TRON US Standard	---	KAC (100A)	KAC (150A)	---

I_{dN} = Nominal d.c. of TRK 6 controller

P_V = Power dissipation of the three line fuses at the nominal current.

The DIN data refer to dimensions

1) = Ref. No.
2) = Type number

Table 7: Line fuses F16, F17 and F18.

I_{dN}/A	60	100	150	195
Siemens Silized	5SD 470 (63A) P_V = 25W subassembly 5SF 122 5SF 124	5SD 520 (100A) P_V = 42W subassembly 5SF 140	5SD 540 (160A) P_V = 85W subassembly 5SF 160	---
Siemens Sitor	3NE 4118 (63A) P_V = 22W subassembly 3NH 7121	3NE 4121 (100A) P_V = 30W subassembly 3NH 7121	3NE 4124 (160A) P_V = 46W subassembly 3NH 7121	3NC 2425 (200A) P_V = 40W subassembly 3NH 7420
	3NE 8018 (63A) P_V = 57W subassembly 3NH 7020 3NH 8020 (3 pole)	3NE 8021 (100A) P_V = 66W subassembly 3NH 7020 3NH 8020 (3 pole)	---	---
Ferraz Protistor 1)	URB (660V, 63A) W 85 993 (DIN 80) K 85 983 (DIN 110) P_V = 15W	URG (600V, 100A) Z 89 860 P_V = 20W	URG (600V, 160A) B 89 862 P_V = 32W	---
	---	URB (660V, 100A) E 79 239 (DIN 80) N 79 270 (DIN 110) P_V = 33W	URB (600V, 160A) G 79 241 (DIN 80) Q 79 272 (DIN 110) P_V = 39W	URB (600V, 200A) H 79 242 (DIN 80) R 79 273 (DIN 110) P_V = 46W
SIBA Ultra-rapid 2)	20 001 04 (63A) 20 002 04 (63A) 20 003 04 (63A) 20 004 04 (63A)	20 001 04 (100A) 20 002 04 (100A) 20 003 04 (100A) 20 004 04 (100A)	20 002 04 (160A) 20 003 04 (160A) 20 004 04 (160A)	20 003 04 (200A) 20 004 04 (200A)
BUSSMANN TRON US Standard	---	KAC (100A)	KAC (150A)	---

I_{dN} = Nominal d.c.
P_V =
The DIN data refer to dimensions

1) Ref. No.
2) Type number

Table 8: Armature fuse F19

3.3 Installing controllers and chokes

3.3.1 Installing controllers:

The controller is designed for panel mounting in a control cabinet. The dimensions and mounting are shown in the dimensional drawing (see technical documentation).

The ambient temperature at the installation site should not exceed 45°C at the rated power. Operation at higher ambient temperatures up to +65°C is possible if the nominal equipment current is reduced as shown in Table 9.

	I_{dN}/A			
	60	100	150	195
/°C	Reduced Id/A	Reduced Id/A	Reduced Id/A	Reduced Id/A
45	60	100	150	
50	58	105	142	
55	54	98	134	
60	52	92	128	
65	50	90	120	

Table 9: Power reduction at high ambient temperatures.

3.3.2 Commutation choke:

The commutation choke should be fitted as close as possible to the thyristor controller in order to minimize interference to the power supply.

Max.Armature current in Amps	30	60	100	150	195
Type of Commutation Choke	KD 4-D	KD 5-D	KD 6-D	KD 7-D	KD 8-D
Nominal power dissipation in watts					

Table 10: Choice of commutation choke.

3.4 Connection to mains supplies other than 380 V/50 Hz

3.4.1 Voltage adjustments:

Where the voltage differs from 380 V by more than 10% it is necessary to match all mains connections via a common autotransformer. The rated current must be at least equal to the total current of all loads. (see connection diagram).

Current calculations when selecting auto-transformers:
Controller internal power supply, I_{TRK6}=0.100A
Field supply I_{field}= 0.9x max. motor field current
Power input $I_{armature}$= 0.82 x nominal armature current
Motor fan I_{fan}= nominal fan current

- Nominal current of autotransformer
  $I_{transf,}=I_{TRK6}+I_{field}+I_{armature}+I_{fan}$
- Installed volume of auto-transformer:

The installed volume is proportional to the "voltage being transformed" and to the nominal current of the transformer. The product of the two variables is known as the "transformed power".

$$S_{transformed}=I_{transf}/\sqrt{3} \times (U_{mains}-380V)$$

To estimate the installed volume, a correction factor is applied to the transformed power.

$$S_{volume}= S_{transformed} \times U_{mains}/380\ V$$

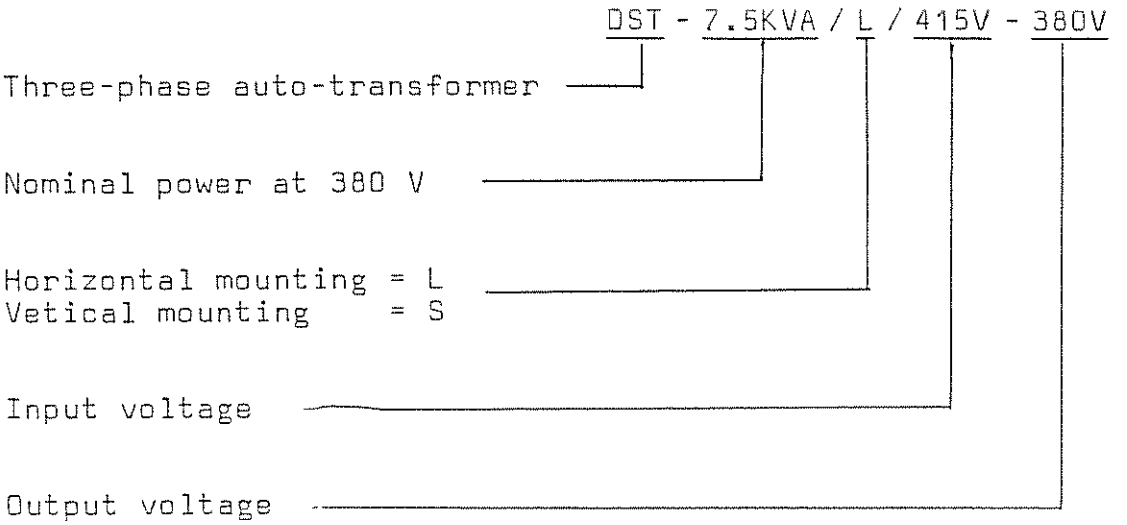
The dimensions of the three-phase auto-transformer are given in section 5 - technical documentation.

Ordering details of auto-transformer:
The power rating at 380 V should always be quoted when ordering. This is equivalent to the output power of the auto-transformer:

$$S_{380}= 380\ V \times \sqrt{3} \times I_{transf}$$

Other data required:
input voltage (existing mains voltage)
output voltage (380 V)
form of mounting (horizontal or vertical)

Example of ordering details:



3.4.2 Frequency adjustment:

See section 5 - Technical Documentation
No adjustments are necessary.

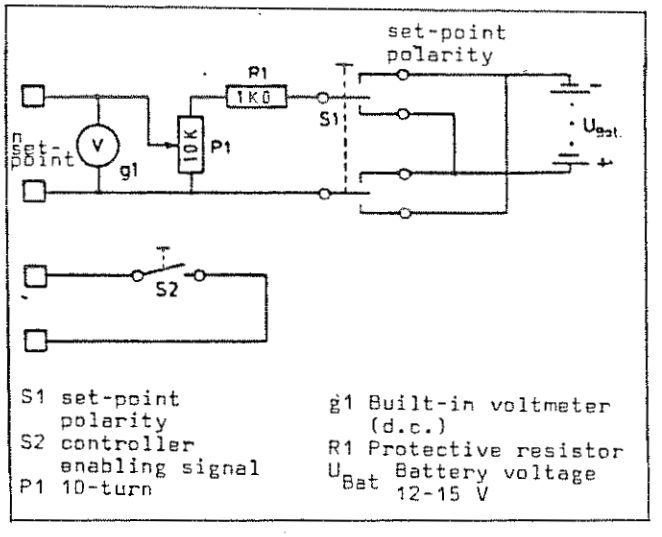
4. Commissioning

The following procedure should be adopted when operating the drive combination for the first time.

4.1 Equipment required for commissioning

Multi-range meter for d.c. and a.c. measurements.
Battery supply, as shown in Figure 8, for adjusting the speed set-point.

Figure 8: Battery supply unit



4.2 Checks

4.2.1 Programming module data:

The data on the TSS 10 module (amplifier, motor choke) must correspond to the installed equipment data; otherwise there is a risk of damage.

4.2.2 Mains voltage:

The local mains voltage must correspond to the equipment supply voltage. (For exception see section 3.4).

4.2.3 Mains frequency:

The local frequency must correspond to the operating frequency of the amplifier.

4.2.4 External wiring:

Check that external wiring corresponds to the connection diagram. Ensure that all wires are properly secured in the terminals.

4.2.5 Protective measures:

Check that relevant safety precautions have been taken - especially earthing conductor connections to earthing points of the unit, motor, transformer and choke.

4.2.6 Fuses:

The line armature fuses must be those specified in section 3.2 - "protective devices".

4.2.7 Power supply output voltages:

Connect only the mains supply for the controller internal supply (2U, 2V, 2W). Measure the following:-

- supply voltage at input terminals
- control voltage ±15 VM at terminal strip X2
- +24 VL output voltage at terminal strip X2

4.2.8 Phasing, clockwise field:

Red lamp h3 "PUE" is off for a clockwise field, if not, reverse connecting leads 2U and 2V. Lamp h3 must go out when the supply voltage is connected.

4.2.9 Phase coincidence:

Disconnect signal cable at RS
Connect controller internal supply and power
Check phase coincidence of 2U - 1U - 3U, 2V - 1V - 3V and 2W - 1W by measuring the voltages between:

- terminal 2U and busbar 1U
- terminal 2V and busbar 1V
- terminal 2W and busbar 1W
- terminal 2U and terminal 3U
- terminal 2V and terminal 3V

The residual voltage should be only a few mV.

4.2.10 Exciter field supply:

Check wiring to mains and motor exciter field against connection diagram (technical documentation).

The d.c. output voltage between F+ and F- must correspond to that on the motor rating plate.

Field current monitoring is indicated by red lamp "FUE". This goes out only if the field current is higher than the factor-set minimum current.

4.2.11 Operation and direction of rotation of fans:

Fan in unit:
Check the following on the built-in fan:-
- running (no jamming due to foreign bodies)
- direction of flow (air flow into the unit)

Motor fan:
The control circuit must ensure that the motor fan is also switched on when the field supply is connected. With the motor running in the correct direction, the air should be sucked in at the air filter. There must be a strong airflow at the cooling ducts.

IMPORTANT: Incorrect direction of rotation of the motor not only reverses the direction of the airflow, but also appreciably reduces it.

4.2.12 Tacho. connection:

Polarity:
If the armature is rotated clockwise, viewed from the shaft, the tacho-generator must be connected so that a positive voltage appears between tacho. input E2 and 0 VM.

Selection of tacho. input terminal E2:
This should correspond to the data on the motor rating plate as given below:-

- terminal 1E2/12 for tacho. emf 60 V/1000 rpm
- terminal 2E2/11 for tacho. emf 33 V/1000 rpm INDRAMAT tacho)
- terminal 3E2/10 for tacho. emf 20 V/1000 rpm

Screen connection:
The screen of the tacho. cable should only be connected to the TRK 6.

4.2.13 Switching sequences of controller interlock and controller enabling signals:

4.2.13.1 Controller interlock RS:
+24 V must be applied to terminal RS of terminal strip X2 via an auxiliary contact of the mains contactor in order to cancel the controller interlock.

4.2.13.2 Controller enabling signal RF:
If there is no internal machine interlock, +24 V must be applied to terminal RF of terminal strip X1 to activate the controller enabling signal when the mains contactor closes.

4.2.14 Emergency-off circuit:

In an emergency-off situation, until the drive has come to rest, it should be borne in mind that incorrect movement of the drive can occur at any time. This depends on the type of fault and the operational status at the instant it occurs. Risk of personal injury due to defective drive movement should therefore be eliminated, preferably at the plant end. The proper functioning of all safety devices should therefore be checked.

4.3 Initial motor start

If faulty movement of the drive might damage the machine, the drive motor should be uncoupled.

4.3.1 Connect "controller interlock" signal cable to terminal RS of terminal strip X2.

4.3.2 Connect "controller enabling signal" signal cable to terminal RF of terminal strip X1.

4.3.3 Connect battery supply unit set-point input to E1A and E1B of terminal strip X1 and set to 0 V.

IMPORTANT: If the tacho polarity is incorrect and the control and power sections are connected, the drive can start up uncontrollably. The emergency-off circuit should be operational at all times.

4.3.4 Switch on controller and power supply voltages.
Slowly increase the set-value of voltage from the battery box, starting from 0 V. The motor should start automatically when the set-value of voltage exceeds approximately 100 mV, and the motor speed must follow the set-value of speed.
If it starts uncontrollably, operate the emergency-off circuit and reverse the connections to the tacho.

4.3.5 Speed calibration:

This is necessary in order to compensate for the tacho. voltage tolerances. To do this, operate the drive at any set-value and set the set-point/speed relationship given on the programming module by means of trimmer P1 on RE 6.
The greatest accuracy is obtained if the unit is

calibrated at the maximum set-value.

4.3.6 Adjustment of speed set-point:

The set-point input has already been factory-set on the programming module TSS 10 so that a 10 V set-value of voltage corresponds to the maximum working speed of the motor.
Should adjustments still be necessary, however, these are made on circuit board FD 3 as described in section 2.2.4.

4.3.7 Ramp adjustment:

The slope of the set-point ramp may be matched to the machine criteria by means of potentiometer P6 on circuit board FD 3 if link Br2 is not in place.
If link Br2 is made, P6 is inoperative. The ramp can be made inoperative for commissioning purposes by plugging in link Br3.

4.3.8 Adjustment of externally-controlled peaked current limiting:

Depending on the application, the extenally-controlled peak current limiting (terminal I_{RED} of terminal strip X2), can be set between 8 and 18 Amps, by means of potentiometer P1 on programming module TSS 10.
(see section 2.2.5.3).

Technical documentation

Type code	109-530-4101
Technical data	109-530-4102
TRK 6-4U dimensions	109-530-3001
Connection diagram	109-530-3601
Frequency adjustment for 60 Hz mains supplies	109-530-4103
Block schematic of complete TRK 6-4U	109-530-3704
Block schematic of FD 3	109-530-3703
Block schematic of RE 6	109-530-3701
Drive adjustment TSS 10	109-530-3806
Circuit diagram NS1	109-530-3403
Circuit diagram AP 8, regulated field	109-530-3405
Circuit diagram AP 8, constant field	109-530-3409
Circuit diagram ZAM 6	109-530-3401
Circuit diagram LE 1	109-530-3406
Component layout FD 3	109-530-3504
Component layout RE 6	109-530-3502
Component layout TSS 10	109-530-3501
Component layout NS 1	109-530-3503
Component layout AP 8	109-530-3505
Component layout ZAM 6	109-530-3501
Commutation choke dimensions	
Three-phase auto-transformer dimensions	

Frequency adjustment for operating the TRK 6-4U servo drive from 60 Hz mains.

1). Fan unit:

No adjustment necessary

2). Motor fan:

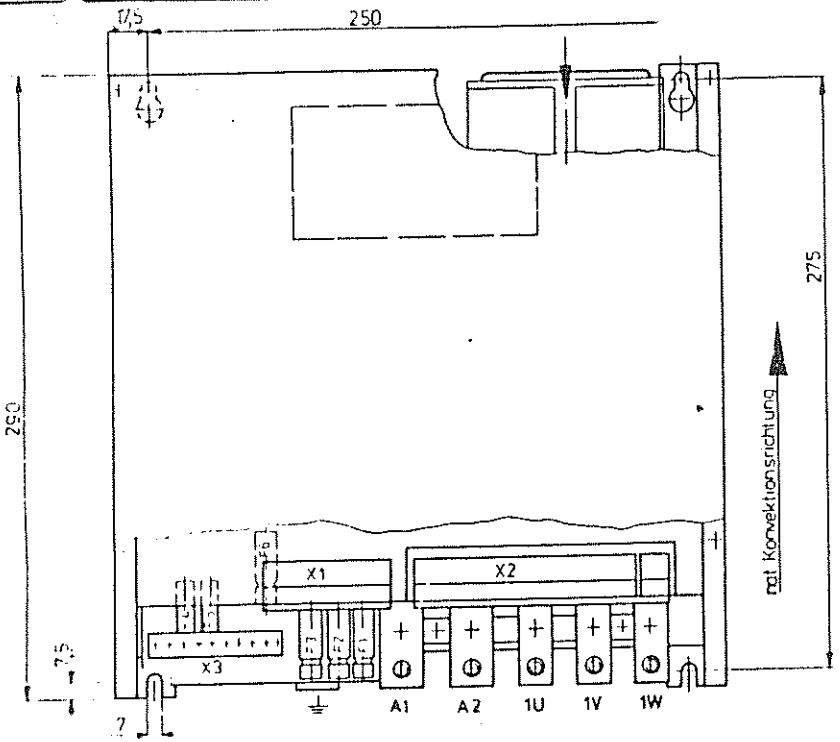
No adjustment necessary

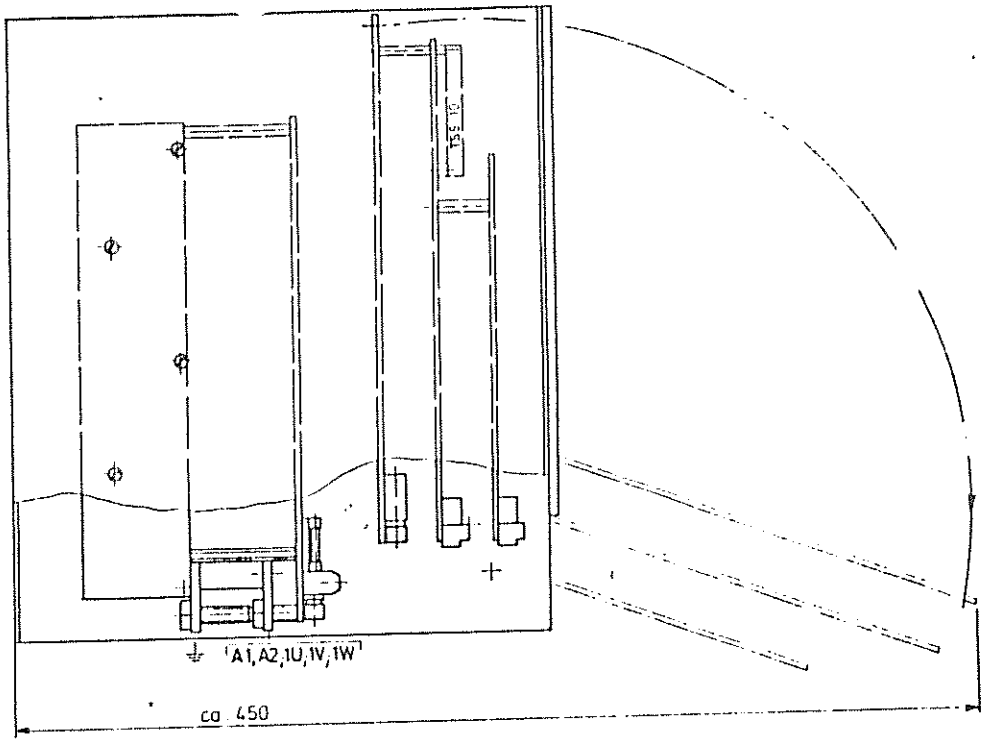
3). Thyristor controller:

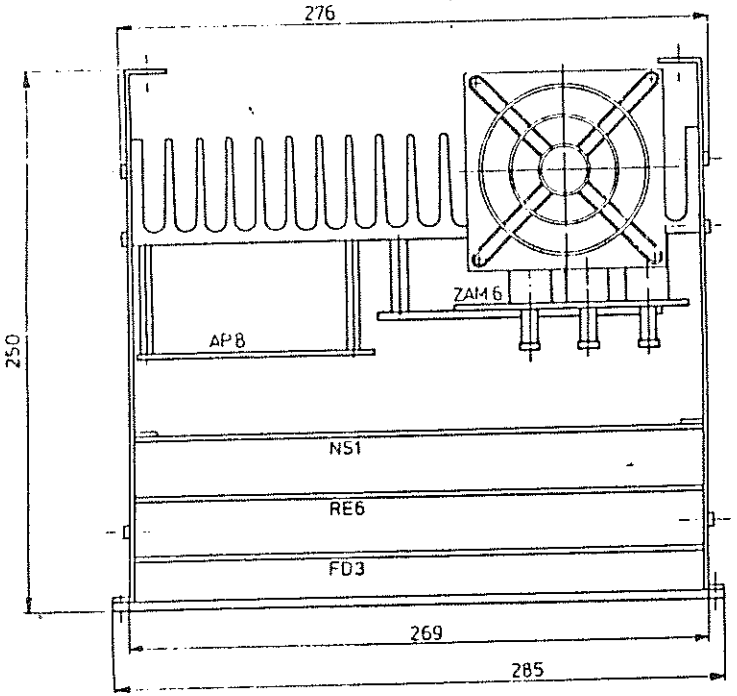
Circuit board	Coordinate	Component	Mains frequency 50 Hz	60 Hz
NS 1	1C2	Link Br1		
	1D2	Link Br2		
	1E2	Link Br3		
FD 3	1B6	Link Br1	not	fitted
AP 8	B4	Link Br1	fitted	
	C5	Link Br2		
	C7	Link Br3		

Frequency adjustment
Drawing No: 109-530-4103-0

Parameter	Symbol/ Unit		Value			
Nominal output current	I_{dN}	A	60	100	150	195
Nominal mains current	I_{StrN}	A	49	82	123	160
Nominal power	P	Kw	21	36	54	70
Apparent power-mains	S_N	KVA	23	38	57	74
Equipment power dissipation	P_{VN}	W	270	360	470	630
Fan fitted			No	Yes	Yes	Yes
Weight	m	Kg	10.5	11.0	11.0	13.5
D.C. output voltage	U_{dN}	V	360			
A.C. mains voltage	U_{Aa}	V	3x380V ± 10%			
Mains frequency	f	Hz	50 switchable to 60			
Control range			Analogue 1:2000			
Zero point stability	1/min°C		0,001			
FIELD SUPPLY						
Input voltage	U_{Aa}	V	3x380V ± 10%			
Mains frequency	f	Hz	50 switchable to 60			
Apparent power-mains	S_N	KFA	2,28			
Nominal power	P_N	Kw	2,05			
D.C. output voltage	U_{dN}	V	342			
Nominal output current	I_{dN}	A	6			
CONTROLLER INTERNAL POWER SUPPLY						
Input voltage	U	V	3x380V ± 10%			
Mains refquency	f	Hz	50 switchable to 60			
Apparent power-mains	S	VA	34			
Control voltage for external use	U_{VM}	V	±15;(max.100mA,W=0,1%)			
Output voltage for external use	U_{VL}	V	±24;(max.100mA)			
APPLICATION DATA						
Operating temperature range at Nominal power	T_B	°C	+5 to +45			
Max. operating temp. range at Reduced nominal power	T_{Bmax}	°C	+65			
Storage and transportation temperature	T_C	°C	-30 to +85			
Installation altitude	h	m	max.1000 above mean sea level			
Humidity class			F			
Protection type			IP 00 in accordance with DIN 40050			







X1 - max 1,5 mm² - Schraubklemme steckbar für FD3
X2 - max 1,5 mm² - Schraubklemme steckbar für RE6
X3 - max 1,5 mm² - Schraubklemme für AP8
⏚ A1, A2, 1U, 1V, 1W - M8 Anschlußbolzen Leistungsanschluß

1983	Datum	Name	x	Datum	Name	Ä M Nr	Kom Nr
Bearb	14. 01.						1:2,5
Gepr.							
Norm							

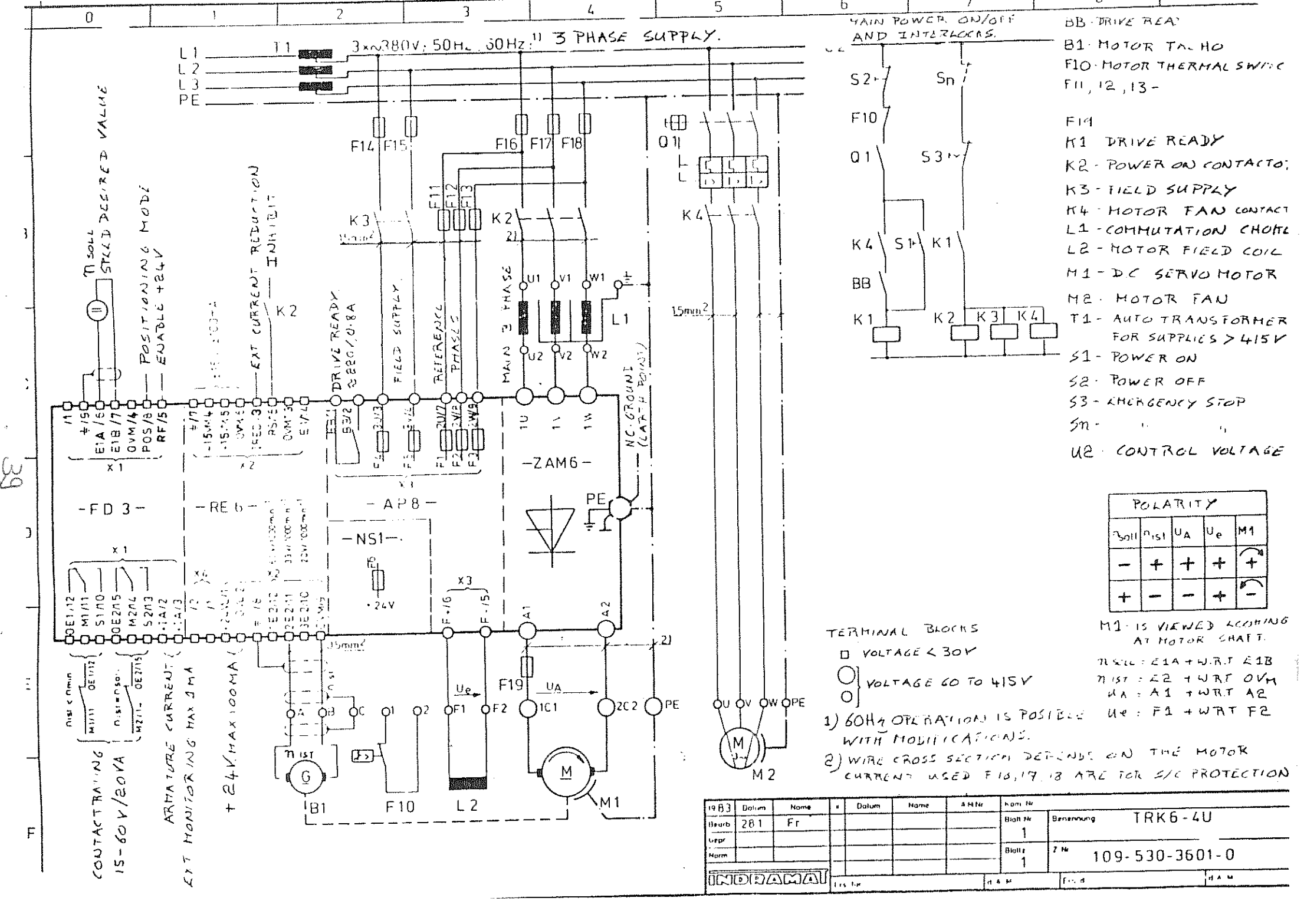
INDRAMAT

Ers. für | d. Ä.-Nr.

Benennung: Maßblatt TRK 6-4Ü-

Z.-Nr. 109-530-3001

Ers. d. | d. Ä.-Nr.



BB - DRIVE READY
B1 - MOTOR TACHO
F10 - MOTOR THERMAL SWITCH
F11, 12, 13 -
F19
K1 DRIVE READY
K2 - POWER ON CONTACTOR
K3 - FIELD SUPPLY
K4 - MOTOR FAN CONTACTOR
L1 - COMMUTATION CHOKE
L2 - MOTOR FIELD COIL
M1 - DC SERVO MOTOR
M2 - MOTOR FAN
T1 - AUTO TRANSFORMER FOR SUPPLIES > 415V
S1 - POWER ON
S2 - POWER OFF
S3 - EMERGENCY STOP
Sn -
U2 CONTROL VOLTAGE

POLARITY				
n_{soll}	n_{ist}	U_A	U_e	M1
−	+	+	+	+
+	−	−	+	−

M1 - IS VIEWED LOOKING AT MOTOR SHAFT.

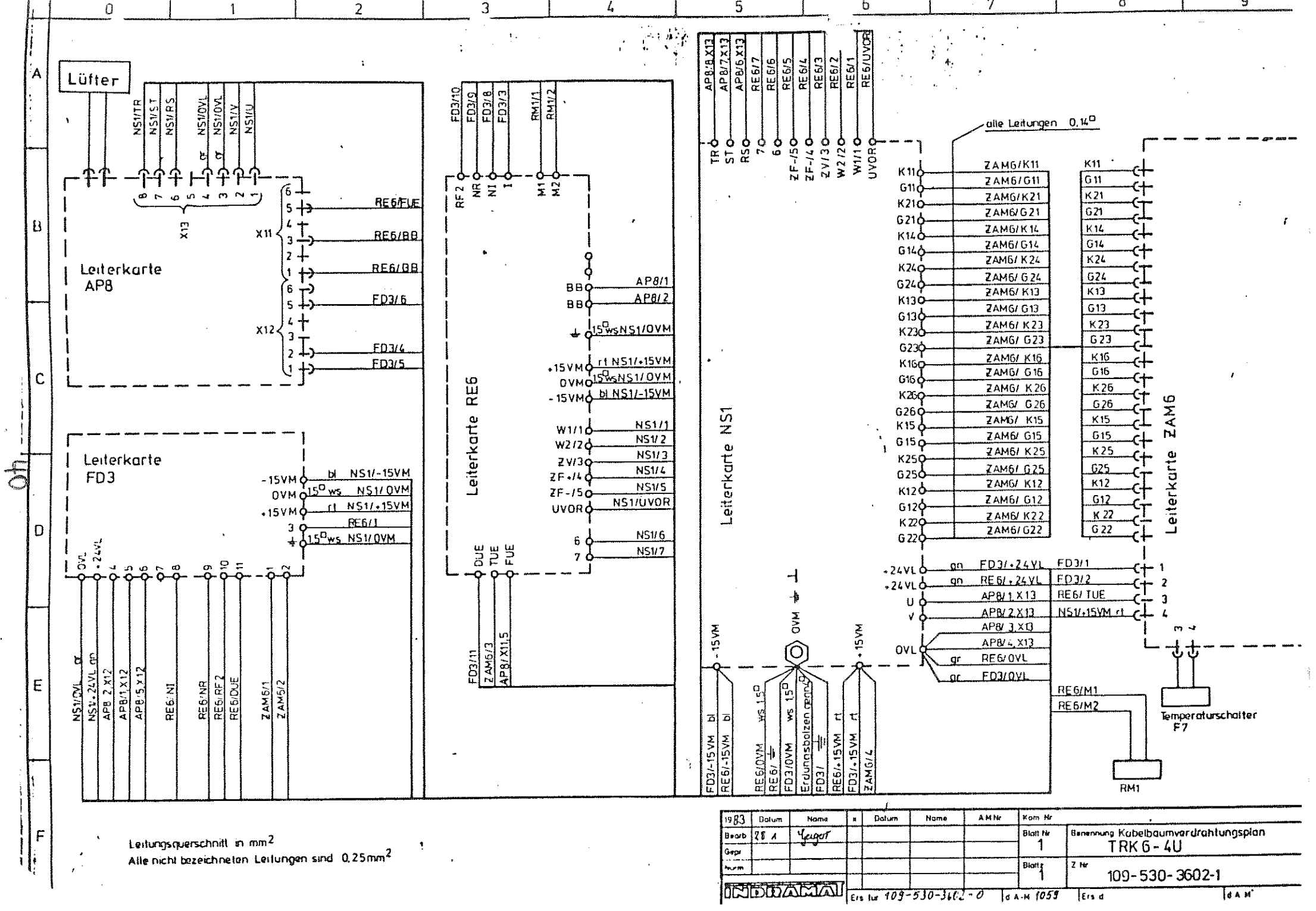
n_{SOLL} : E1A + WRT E1B
n_{IST} : E2 + WRT OVM
U_A : A1 + WRT A2
U_e : F1 + WRT F2

TERMINAL BLOCKS
□ VOLTAGE < 30V
○ VOLTAGE 60 TO 415V

1) 60Hz OPERATION IS POSIBLE WITH MODIFICATIONS.
2) WIRE CROSS SECTION DEPENDS ON THE MOTOR CURRENT USED F16, 17, 18 ARE FOR S/C PROTECTION

1983	Datum	Name		Datum	Name		Kom. Nr	
Bearb	28.1	Fr					Blatt Nr 1	Benennung TRK6-4U
Verpr							Blatts 1	Z. Nr 109-530-3601-0
Norm								

INDRAMAT



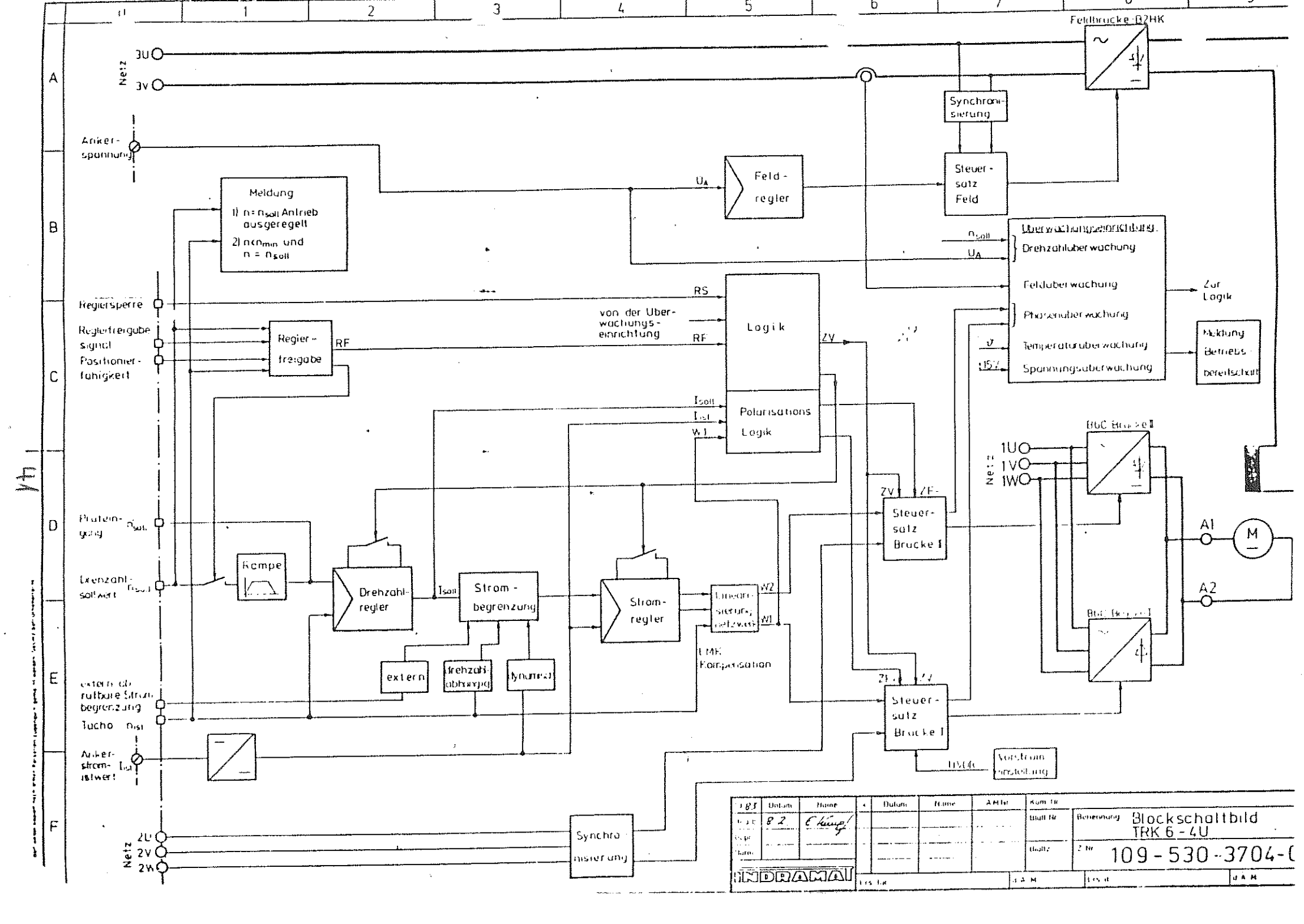
Leitungsquerschnitt in mm^2

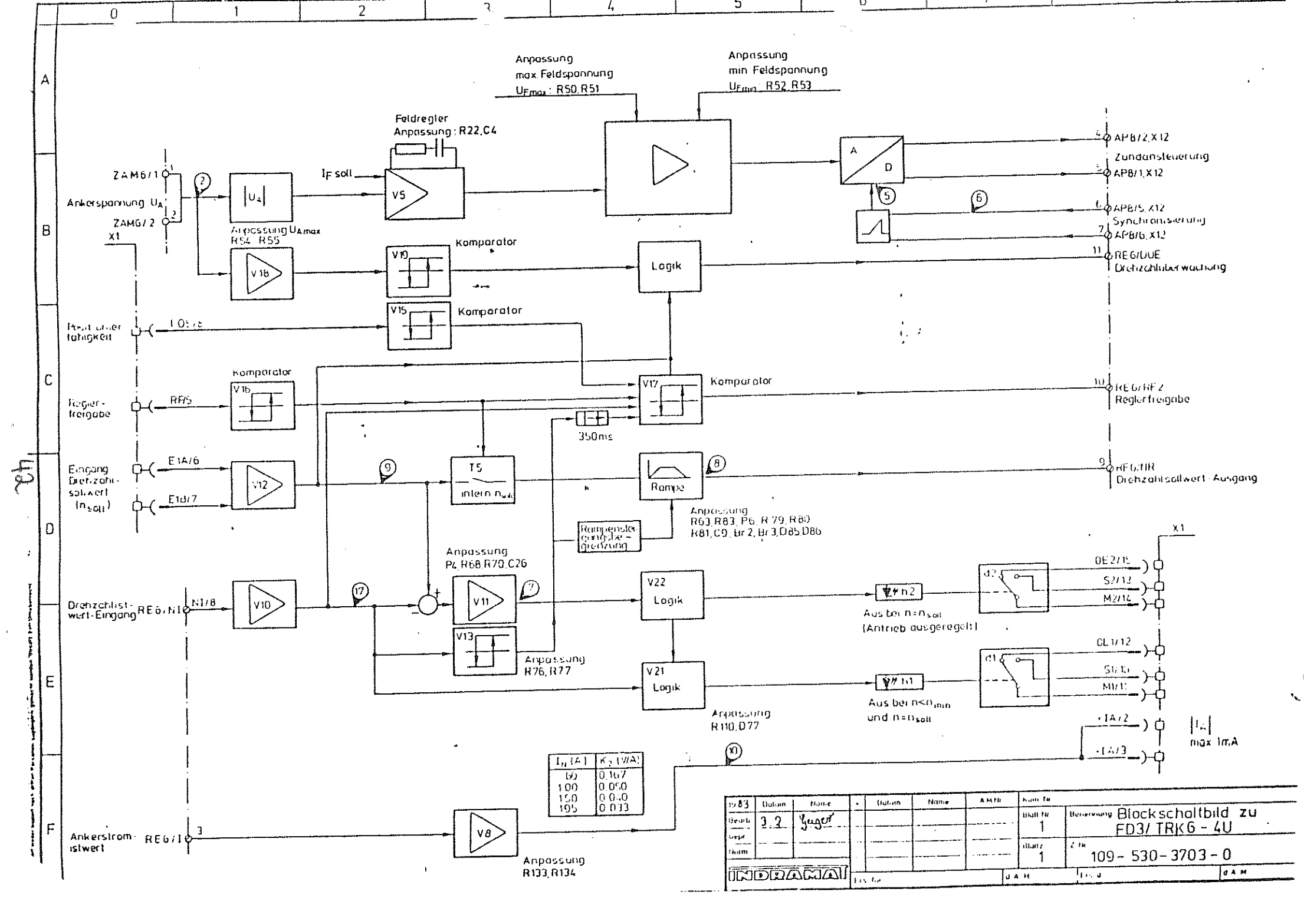
Alle nicht bezeichneten Leitungen sind $0{,}25\,mm^2$

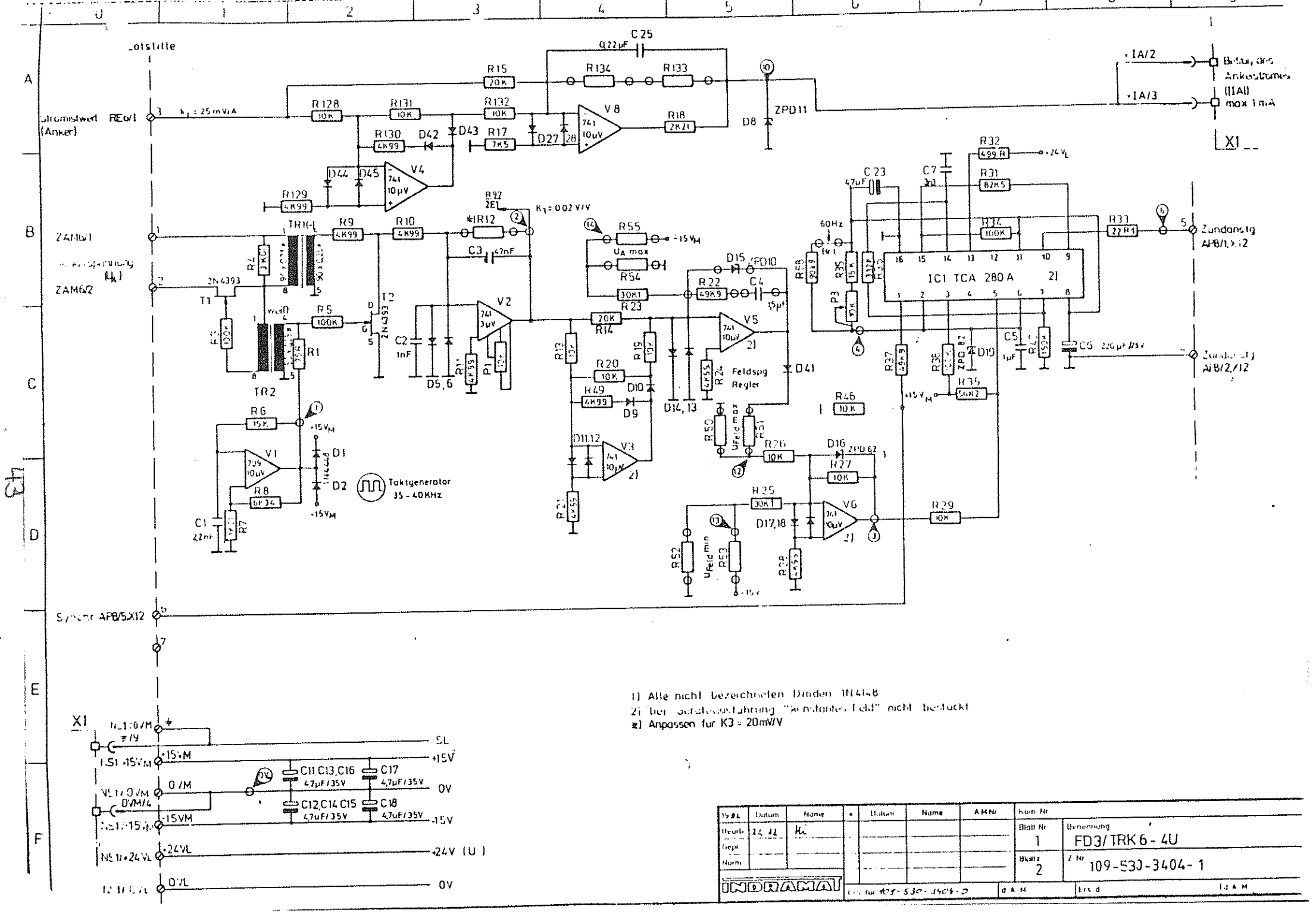
1983	Datum	Name	x	Datum	Name	AM Nr	Kom Nr	
Bearb	28.1	Geigert					Blatt Nr 1	Benennung Kabelbaumverdrahtungsplan TRK 6-4U
Gepr							Blatt 1	Z Nr 109-530-3602-1
Norm								

INDRAMAT

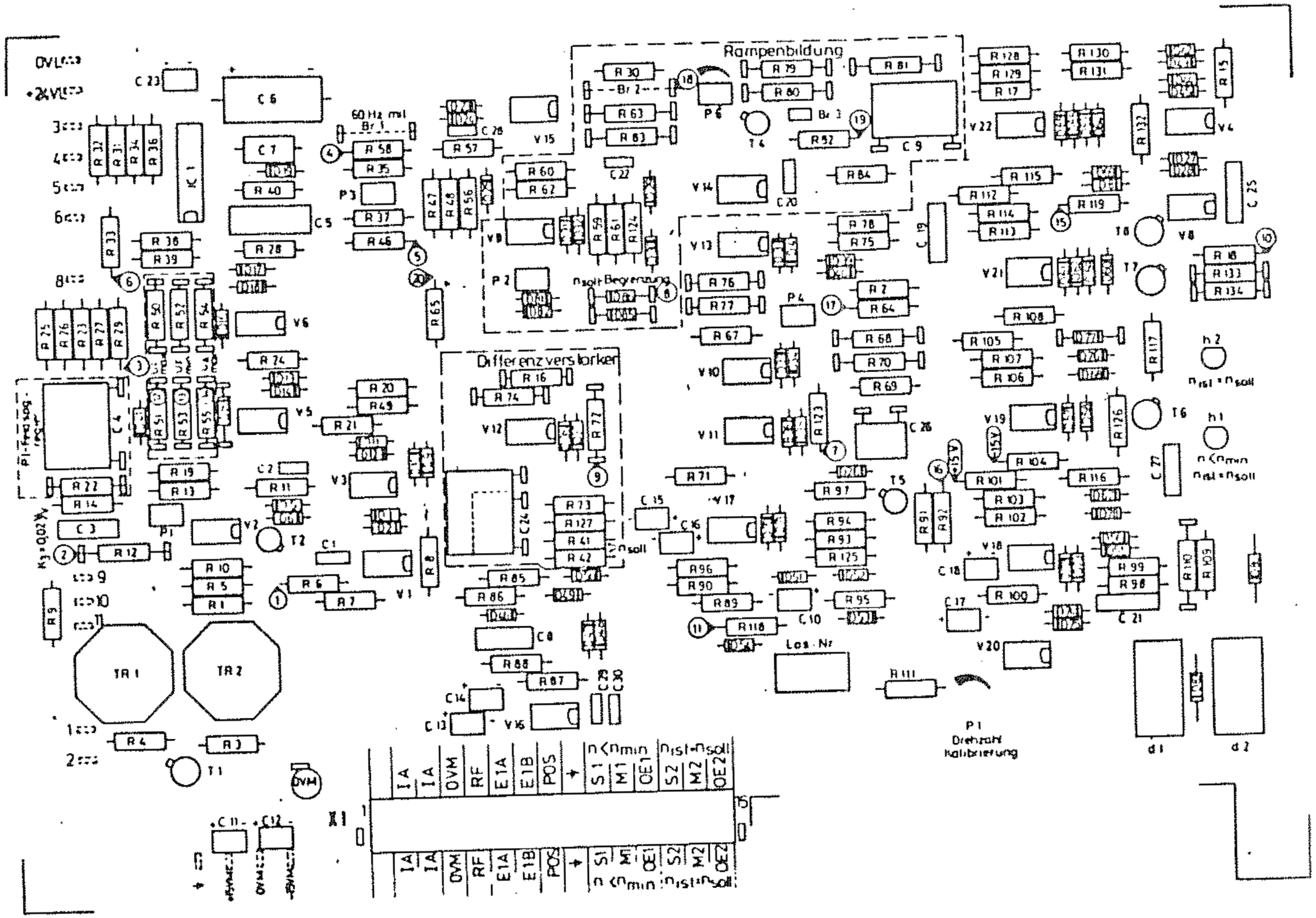
Ers für 109-530-3602-0 | dA-M 1059 | Ers d | dA M


Feldbrücke B2HK
Netz
3U
3V
Anker-spannung
Synchronisierung
Steuersatz Feld
Feld-regler
U_A
Meldung
1) $n = n_{soll}$ Antrieb ausgeregelt
2) $n < n_{min}$ und $n = n_{soll}$
Überwachungseinrichtung
n_{soll}
U_A
Drehzahlüberwachung
Felduberwachung
Phasenüberwachung
Temperaturüberwachung
Spannungsüberwachung
Zur Logik
Meldung Betriebsbereitschaft
Reglersperre
Reglerfreigabe signal
Positionierfähigkeit
Regler-freigabe
RF
RS
von der Überwachungseinrichtung
Logik
ZV
Polarisations Logik
I_{soll}
I_{ist}
W1
Netz
1U
1V
1W
B6C Brücke II
Steuersatz Brücke II
ZV
ZF
Drehzahl-regler
Rampe
Drehzahl-sollwert
n_{soll}
I_{soll}
Strom-begrenzung
Strom-regler
W2
W1
extern
Drehzahlabhängig
Synchron
extern abrufbare Strombegrenzung
Tacho n_{ist}
Ankerstrom-Istwert I_{ist}
EMK Kompensation
Steuersatz Brücke I
Vorsteuerung
A1
A2
M
2U
2V
2W
Netz
Synchronisierung
Datum
Name
Benennung
Blockschaltbild TRK 6 - 4U
Zeichnungs Nr.
109 - 530 - 3704 - 0
INDRAMAT


Anpassung
max Feldspannung
U_{Fmax} : R50,R51
Anpassung
min Feldspannung
U_{Fmin} R52,R53
Feldregler
Anpassung : R22,C4
ZAM6/1
Ankerspannung U_A
ZAM6/2
X1
$|U_A|$
Anpassung U_{Amax}
R54 R55
V18
I_F soll
V5
Komparator
V19
Logik
Komparator
V15
Betriebsbereitschaft
E0B/8
Komparator
V16
Reglerfreigabe
RF/5
V17
Komparator
350ms
Eingang Drehzahlsollwert (n_{soll})
E1A/6
E1B/7
V12
T5
intern n_{soll}
Rampe
Anpassung
R63,R83,P6,R79,R80
R81,C9,Br2,Br3,D85,D86
Rampengeber gesperrt-Freigabe
Anpassung
P4,R68,R70,C26
V11
V13
Anpassung
R76,R77
V22
Logik
V21
Logik
Anpassung
R110,D77
Drehzahlistwert-Eingang
RE6/N1
N1/8
V10
Ankerstromistwert
RE6/I
3
V8
Anpassung
R133,R134
A
D
APB/2,X12
Zündansteuerung
APB/1,X12
APB/5,X12
Synchronsteuerung
APB/6,X12
RE6/UUE
Drehzahlüberwachung
RE6/RF2
Reglerfreigabe
RE6/IIR
Drehzahlsollwert-Ausgang
Aus bei $n=n_{soll}$
(Antrieb ausgeregelt)
Aus bei $n<n_{min}$
und $n=n_{soll}$
X1
OE2/12
S2/13
M2/14
CL1/12
S1/13
M1/14
+IA/2
-IA/3
max 1mA
I_N [A] | K_2 [V/A]
60 | 0,167
100 | 0,050
150 | 0,040
195 | 0,033
1983 Datum Name
Bearb. 3.2 Jäger
Gepr.
Norm
Datum Name Änderung
Kom.Nr.
Bl.Nr. 1
Bl.Anz. 1
Benennung Blockschaltbild zu FD3/TRK6-4U
Z.Nr. 109-530-3703-0
INDRAMAT



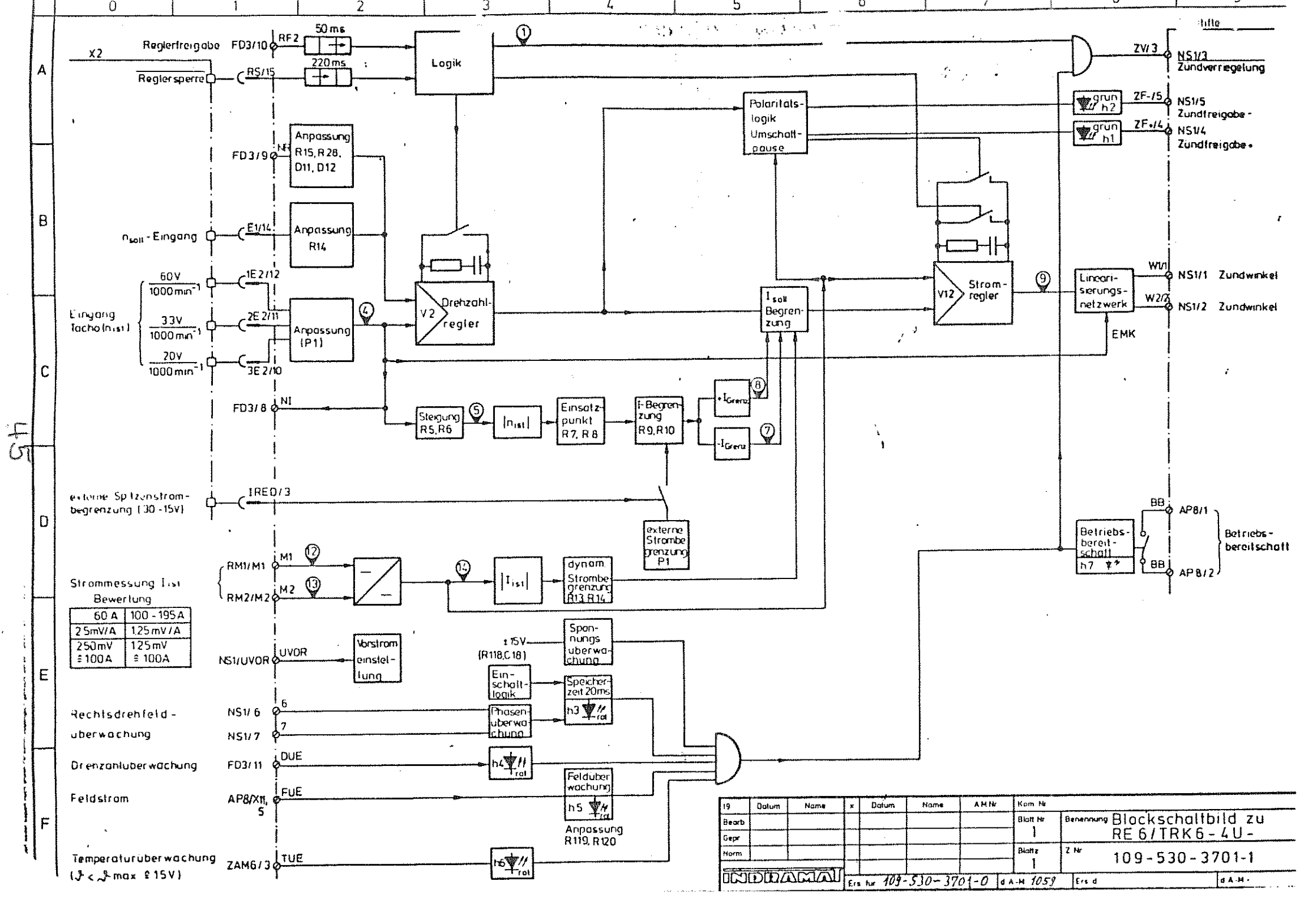
1) Alle nicht bezeichneten Dioden 1N4148
2) Bei Gefahrenschaltung "gemeinsames Feld" nicht bestückt
*) Anpassen für K3 = 20mV/V

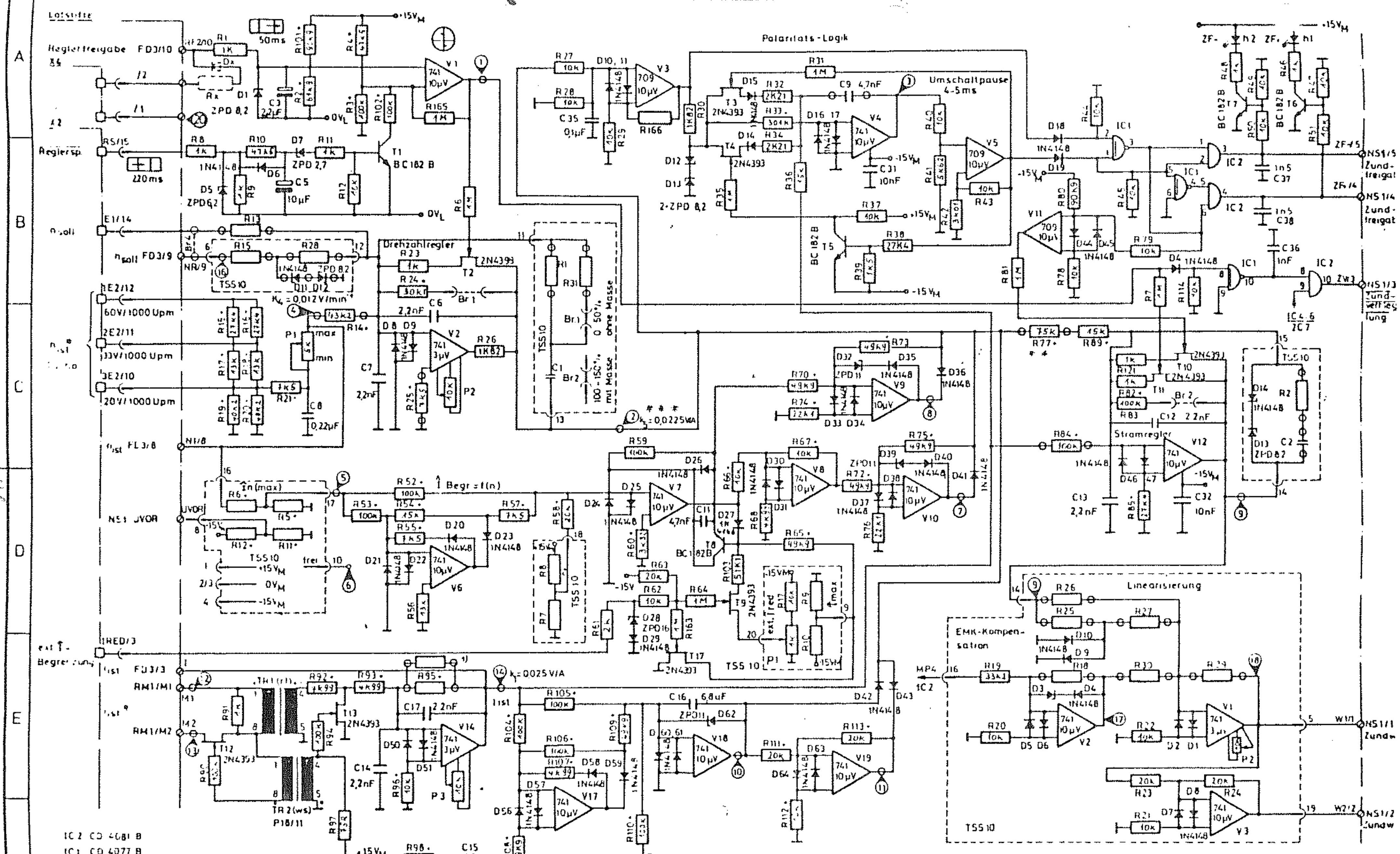


Blatt Nr. 1	BESTÜCKUNGSPLAN FD3
Blätter 1	109-0530-3504-00

INDRAMAT

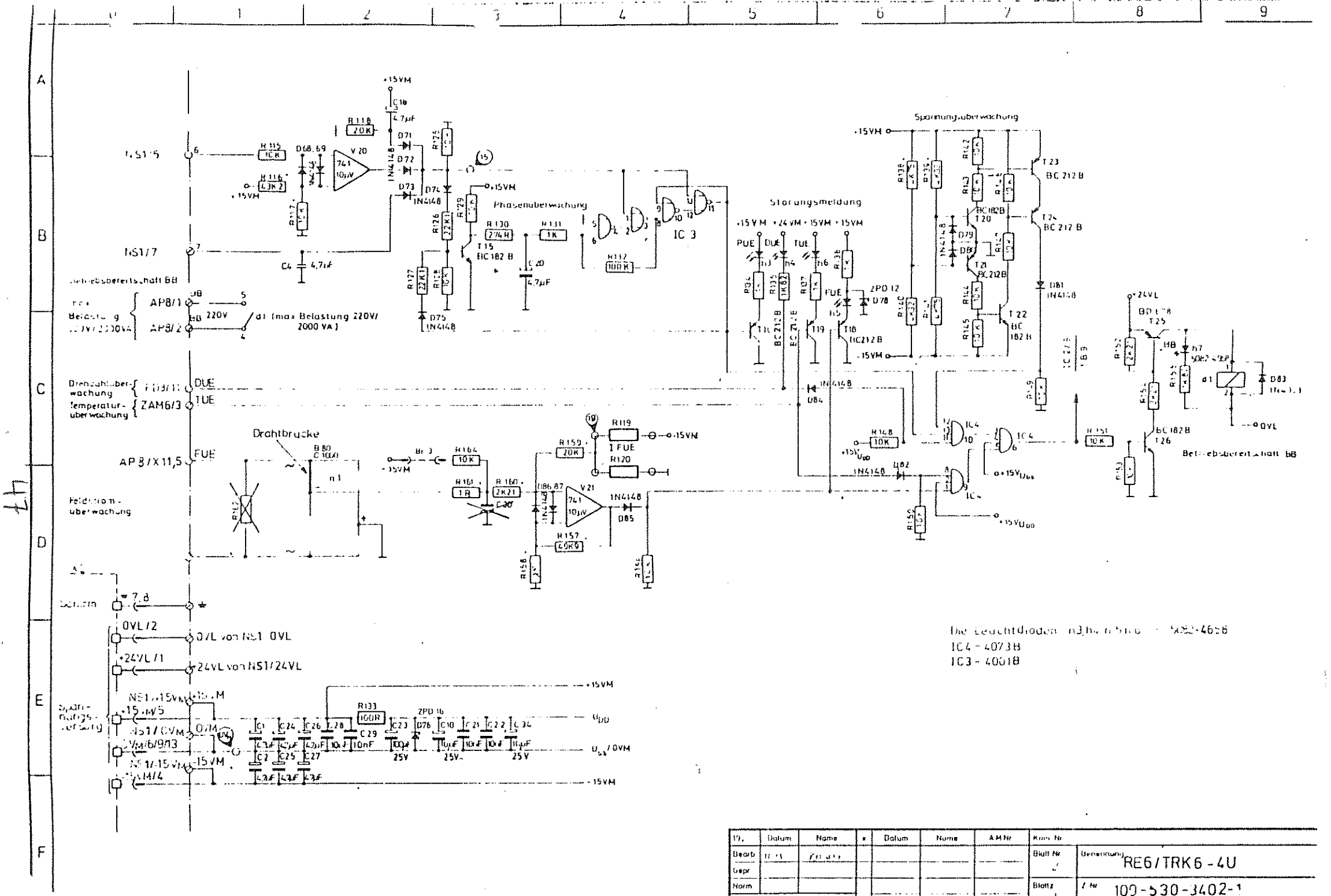
109-530-3504-0


Reglerfreigabe
FD3/10
RF2
50 ms
220 ms
X2
Reglersperre
RS/15
Logik
Polaritäts-logik Umschalt-pause
ZV/3
NS1/3 Zündverriegelung
grün h2
ZF-/5
NS1/5 Zündfreigabe -
grün h1
ZF+/4
NS1/4 Zündfreigabe +
FD3/9
NF
Anpassung R15, R28, D11, D12
n soll - Eingang
E1/14
Anpassung R14
60V / 1000 min⁻¹
33V / 1000 min⁻¹
20V / 1000 min⁻¹
Eingang Tacho (nist)
1E2/12
2E2/11
3E2/10
Anpassung (P1)
V2 Drehzahl-regler
I soll Begren-zung
V12 Strom-regler
Linear-isierungs-netzwerk
W1/1
NS1/1 Zündwinkel
W2/2
NS1/2 Zündwinkel
EMK
FD3/8
NI
Steigung R5, R6
|nist|
Einsatz-punkt R7, R8
I-Begren-zung R9, R10
+IGrenz
-IGrenz
externe Spitzenstrom-begrenzung (30 -15V)
IRED/3
externe Strombe grenzung P1
BB
AP8/1
Betriebs-bereit-schaft
BB
AP8/2
Betriebs-bereitschaft
RM1/M1
M1
RM2/M2
M2
|Iist|
dynam. Strombe-grenzung R13, R14
Strommessung Ist
Bewertung
60 A | 100 - 195 A
25mV/A | 125mV/A
250mV ≙ 100A | 125mV ≙ 100A
NS1/UVOR
UVOR
Vorstrom einstel-lung
±15V (R118, C18)
Spannungs überwachung
Ein-schalt-logik
Speicher-zeit 20ms
h3
Rechtsdrehfeld-überwachung
NS1/6
NS1/7
Phasen-überwachung
Drehzahlüberwachung
FD3/11
DUE
h4
Feldstrom
AP8/X11, 5
FUE
Felduber-wachung
h5
Anpassung R119, R120
Temperaturüberwachung (ϑ < ϑmax ≙ 15V)
ZAM6/3
TUE
h6
Titte
19 | Datum | Name
Bearb
Gepr
Norm
x | Datum | Name | AM Nr
Kom Nr
Blatt Nr 1
Benennung Blockschaltbild zu RE 6/TRK 6-4U-
Blattz 1
Z Nr 109-530-3701-1
INDRAMAT
Ers für 109-530-3701-0 d A-M 1059
Ers d
d A-M



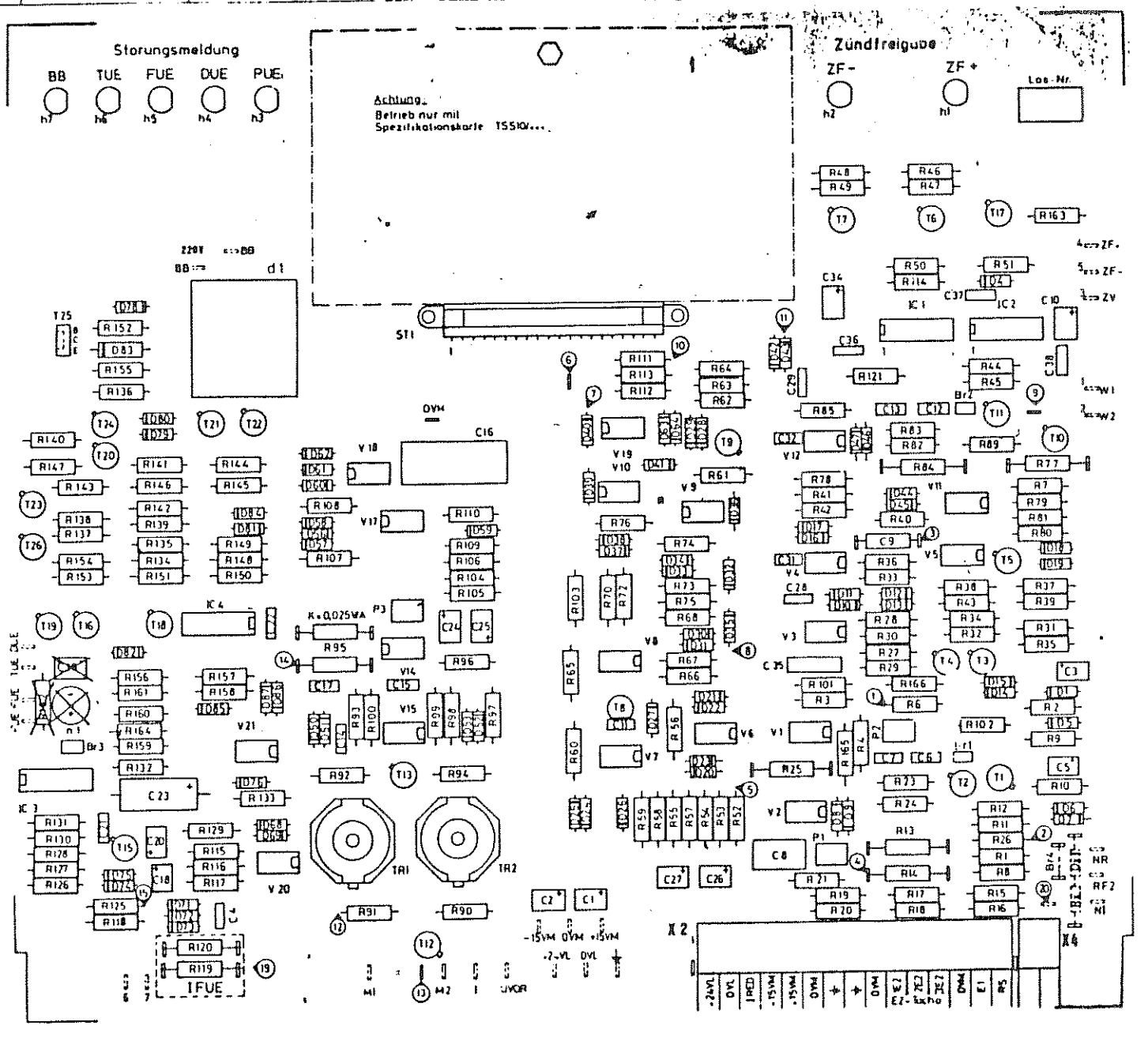
IC 2 CD 4081 B
IC 1 CD 4077 B
Alle bipolare Transistoren BC 182
Alle Feldeffekttransistoren 1N 4393
Dioden ohne Typenangabe 1N 4148
* nicht angepaßte Istwerte
** R77 (bei 60A-Typ = 221K)
*** Bei 60A Typ k_i = 0,06 V/A
Hanpassen auf k_i = 0,025 V/A

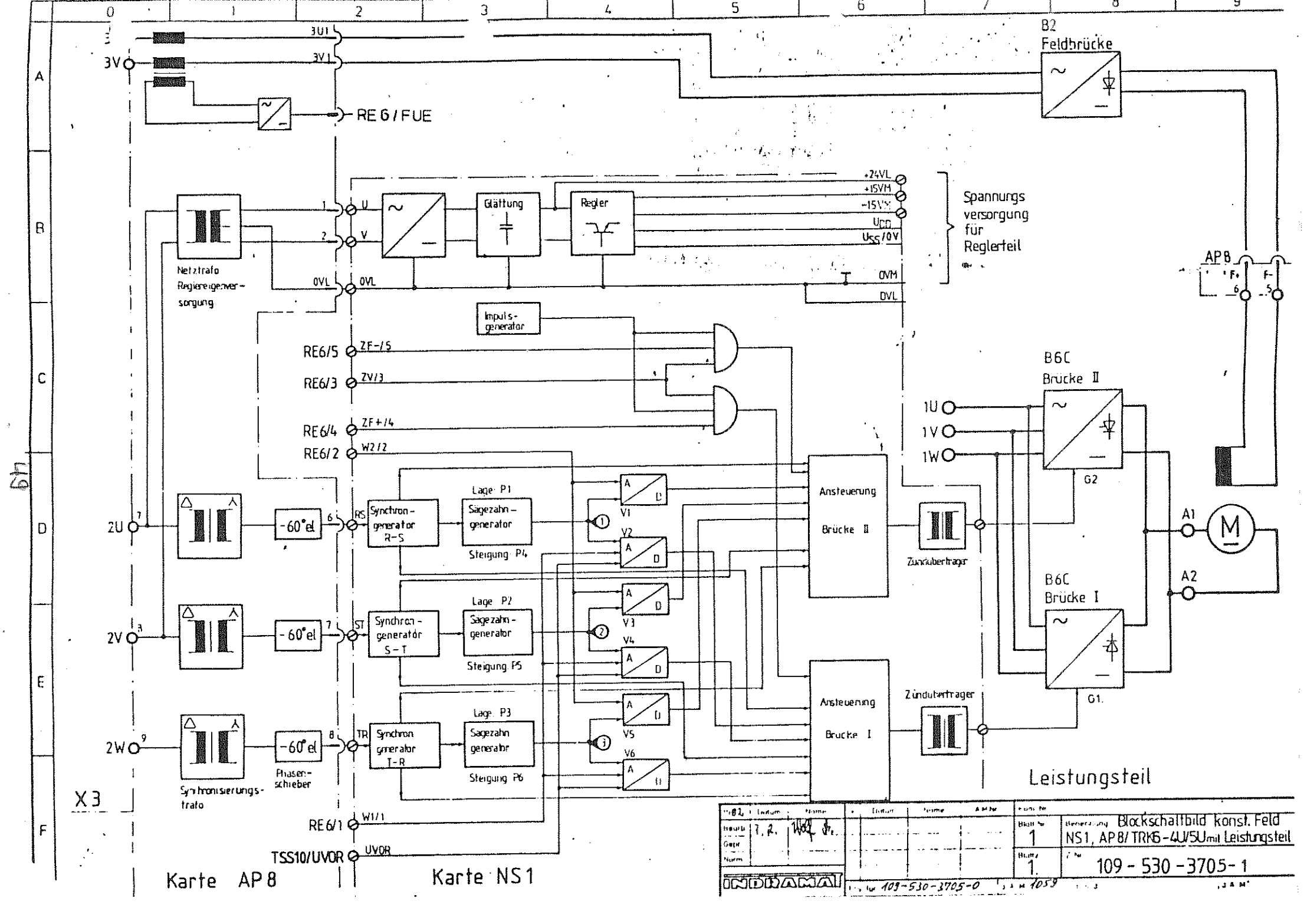
1981	Datum	Name	z	Datum	Name	AM Nr	Kom Nr	
Bearb	1.4.1.	Hilde					Blatt Nr 1	Benennung RE6/TRK6-4U
Gepr								
Norm							Blatt 2	Z Nr 109-530-3402-1
INDRAMAT	Ers. für 109-530-3402-0				d A M 4059		Ers. d	d A M.

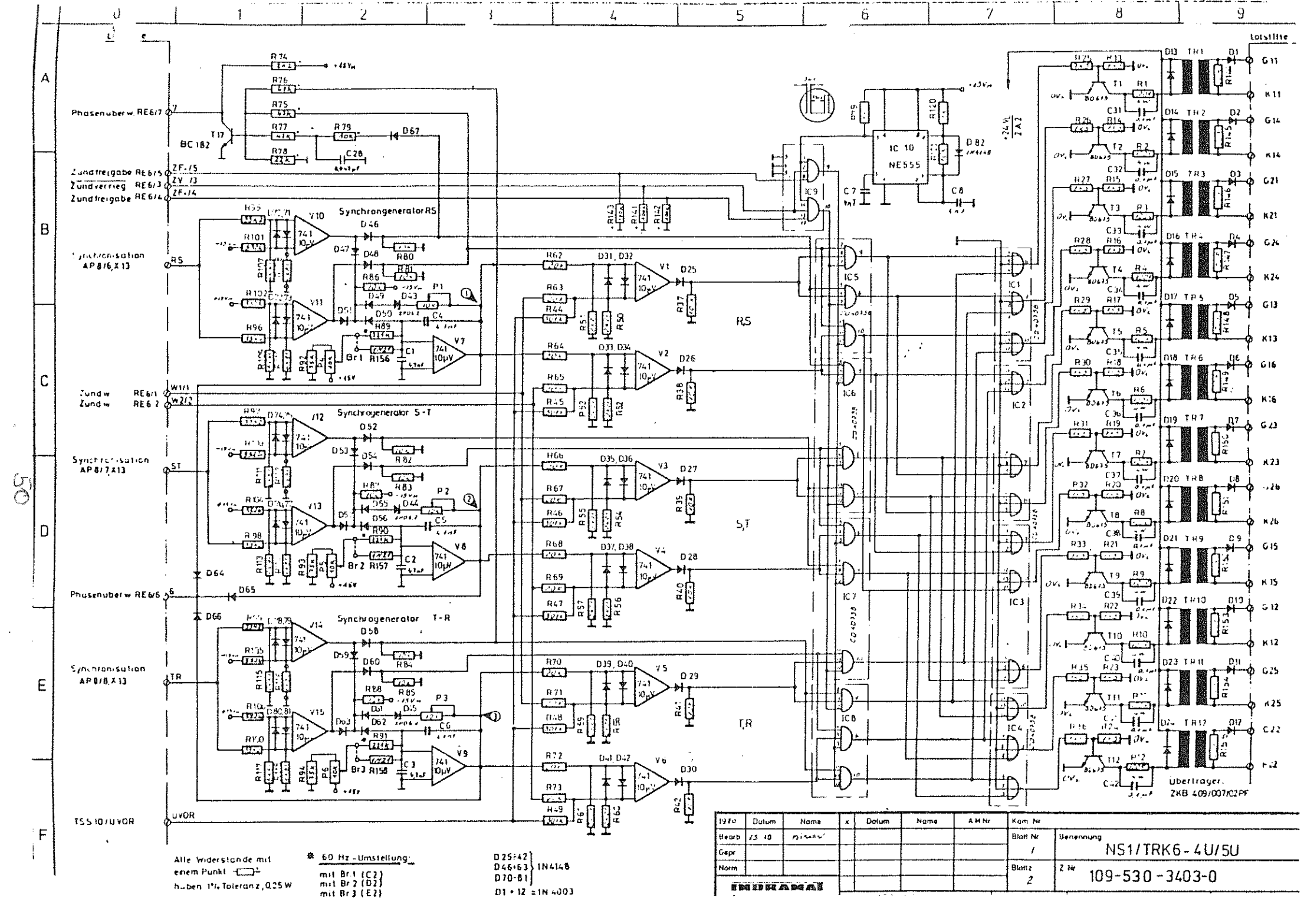


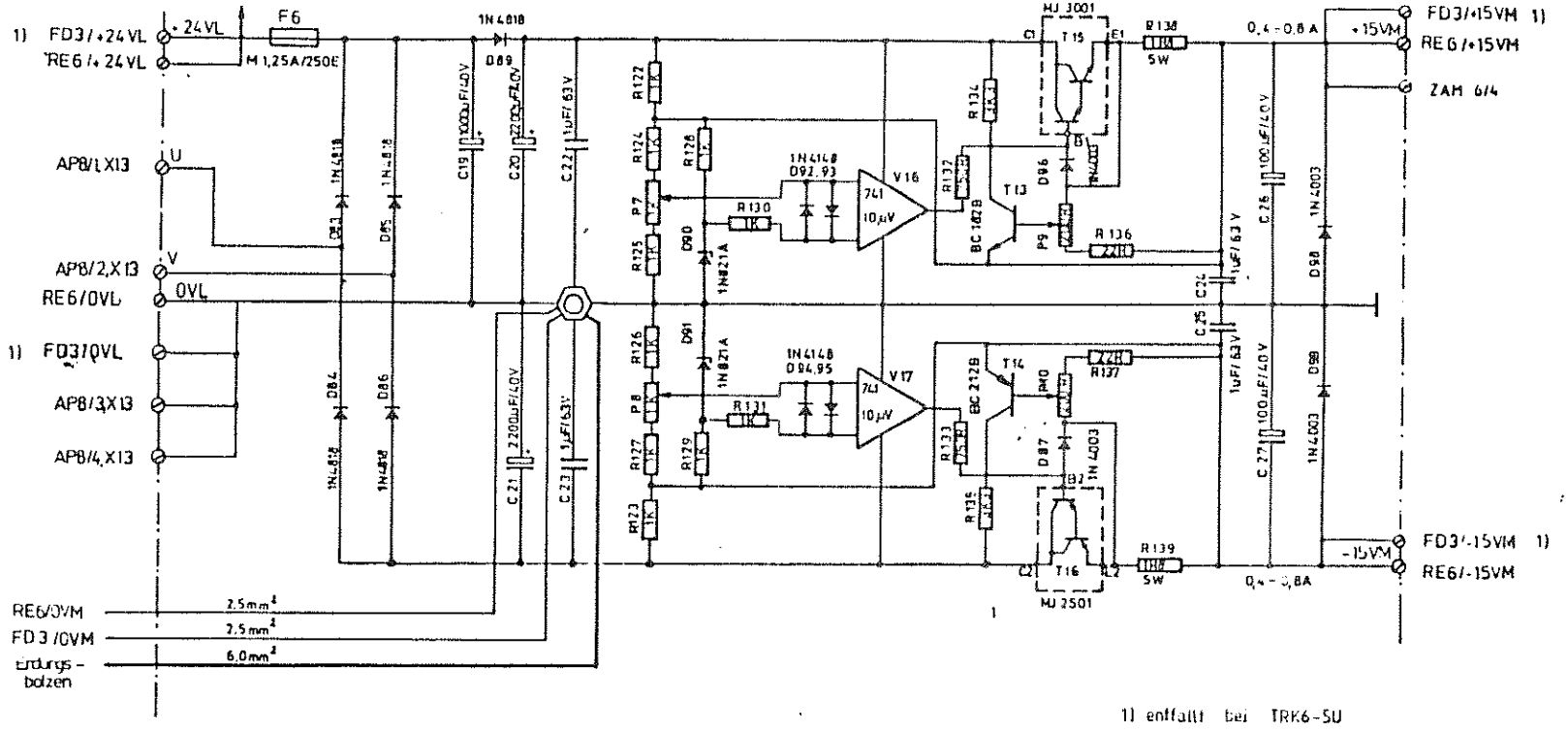
Ers.	Datum	Name	x	Datum	Name	AM Nr	Kom. Nr	
Bearb							Blatt Nr	Benennung RE6/TRK6-4U
Gepr								
Norm							Blatt	Z. Nr 109-530-3402-1

SIEMENS

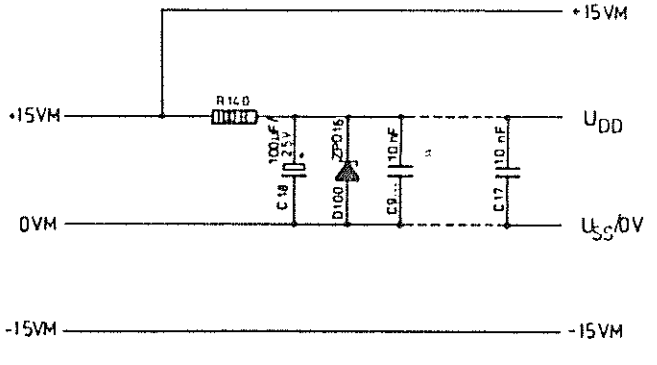

Störungsmeldung
BB
TUE
FUE
DUE
PUE
Achtung:
Betrieb nur mit
Spezifikationskarte TS510/...
Zündfreigabe
ZF-
ZF+
Los-Nr.
ST1
IC 1
IC 2
IC 3
IC 4
C16
TR1
TR2
IFUE
X 2
X 4
BESTUCKUNGSPLAN RE 6
109-0530-3502-01


3U1
3V1
3V
RE 6 / FUE
B2
Feldbrücke
+24VL
+15VM
-15VM
UDD
USS/0V
0VM
0VL
Spannungs
versorgung
für
Reglerteil
Glättung
Regler
Impuls-
generator
Netztrafo
Reglereigenver-
sorgung
AP 8
RE6/5 ZF-/5
RE6/3 ZV/3
RE6/4 ZF+/4
RE6/2 W2/2
B6C
Brücke II
1U
1V
1W
G2
2U
2V
2W
-60°el
Synchron-
generator
R-S
Synchron-
generator
S-T
Synchron
generator
T-R
Sägezahn-
generator
Lage P1
Steigung P4
Lage P2
Steigung P5
Lage P3
Steigung P6
V1
V2
V3
V4
V5
V6
Ansteuerung
Brücke II
Ansteuerung
Brücke I
Zündübertrager
Zündübertrager
B6C
Brücke I
G1
A1
A2
M
Phasen-
schieber
Synchronisierungs-
trafo
X3
RE6/1 W1/1
TSS10/UVOR UVOR
Karte AP 8
Karte NS1
Leistungsteil
INDRAMAT
Blockschaltbild konst. Feld
NS1, AP8/TRM6-4U/5Umil Leistungsteil
109 - 530 - 3705 - 1

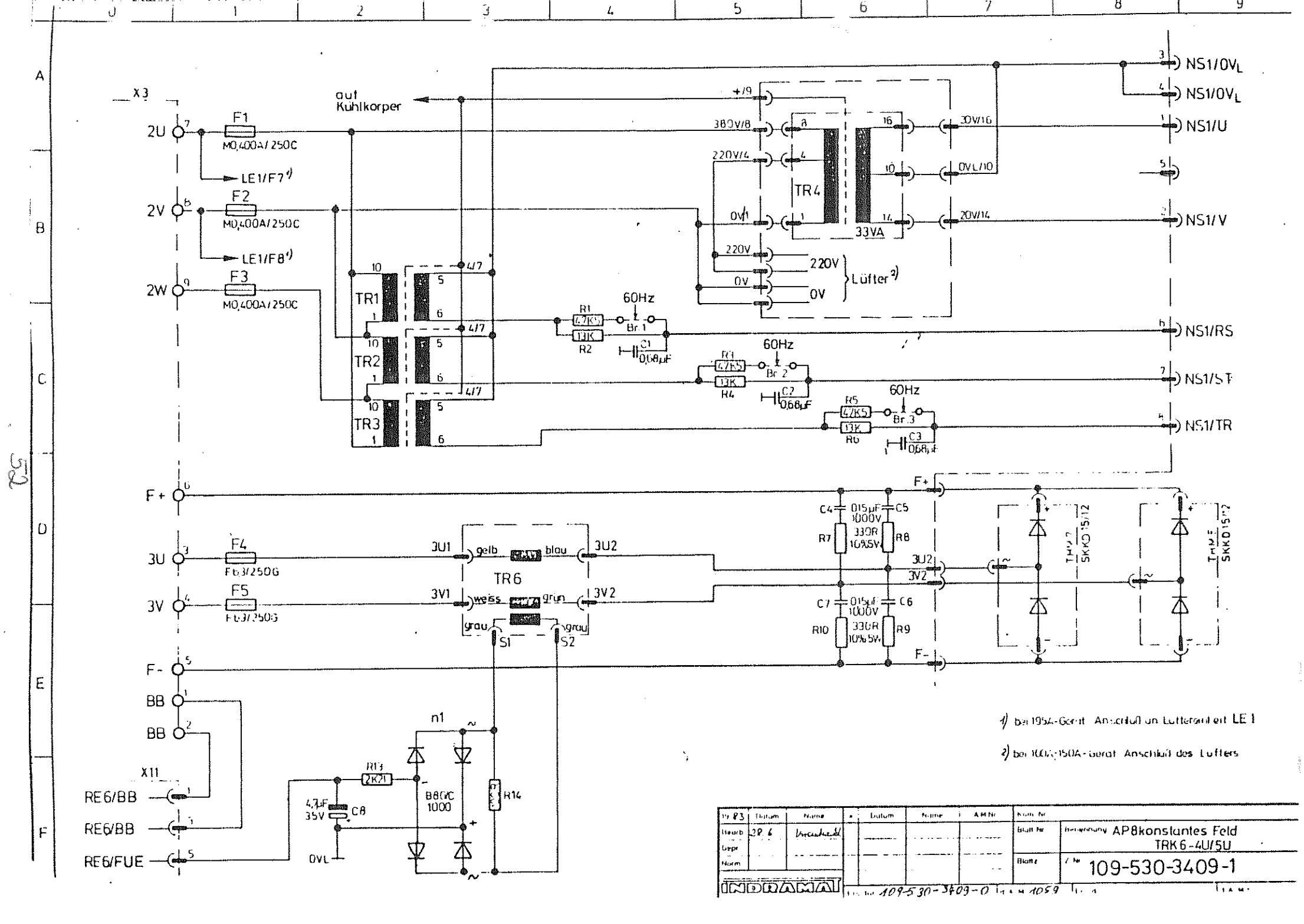

Lötstifte
Phasenüberw. RE6/7
Zundfreigabe RE6/5
Zündverrieg RE6/3
Zundfreigabe RE6/4
Synchronisation AP8/6,X13
Synchrongenerator RS
Zund.w RE6/1
Zund.w RE6/2
Synchronisation AP8/7,X13
Synchrogenerator S-T
Phasenüberw. RE6/6
Synchrogenerator T-R
Synchronisation AP8/8,X13
TSS10/UVOR
IC 10 NE555
RS
S,T
T,R
Übertrager ZKB 409/007/02PF
Alle Widerstände mit einem Punkt haben 1% Toleranz, 0,25 W
60 Hz-Umstellung: mit Br1 (C2) mit Br2 (D2) mit Br3 (E2)
D25-42, D46-63, D70-81 1N4148
D1 - 12 = 1N 4003
NS1/TRK6-4U/5U
109-530-3403-0



1) entfällt bei TRK6-5U



Ifd	Datum	Name		Datum	Name	AM-Nr	Korr Nr	
Bearb	5.11	Binder					Blatt Nr 2	Benennung NS1/TRK6 - 4U/5U
Gepr								
Norm							Blattz 2	Z Nr 109-530-3403-0
DRAMAL								



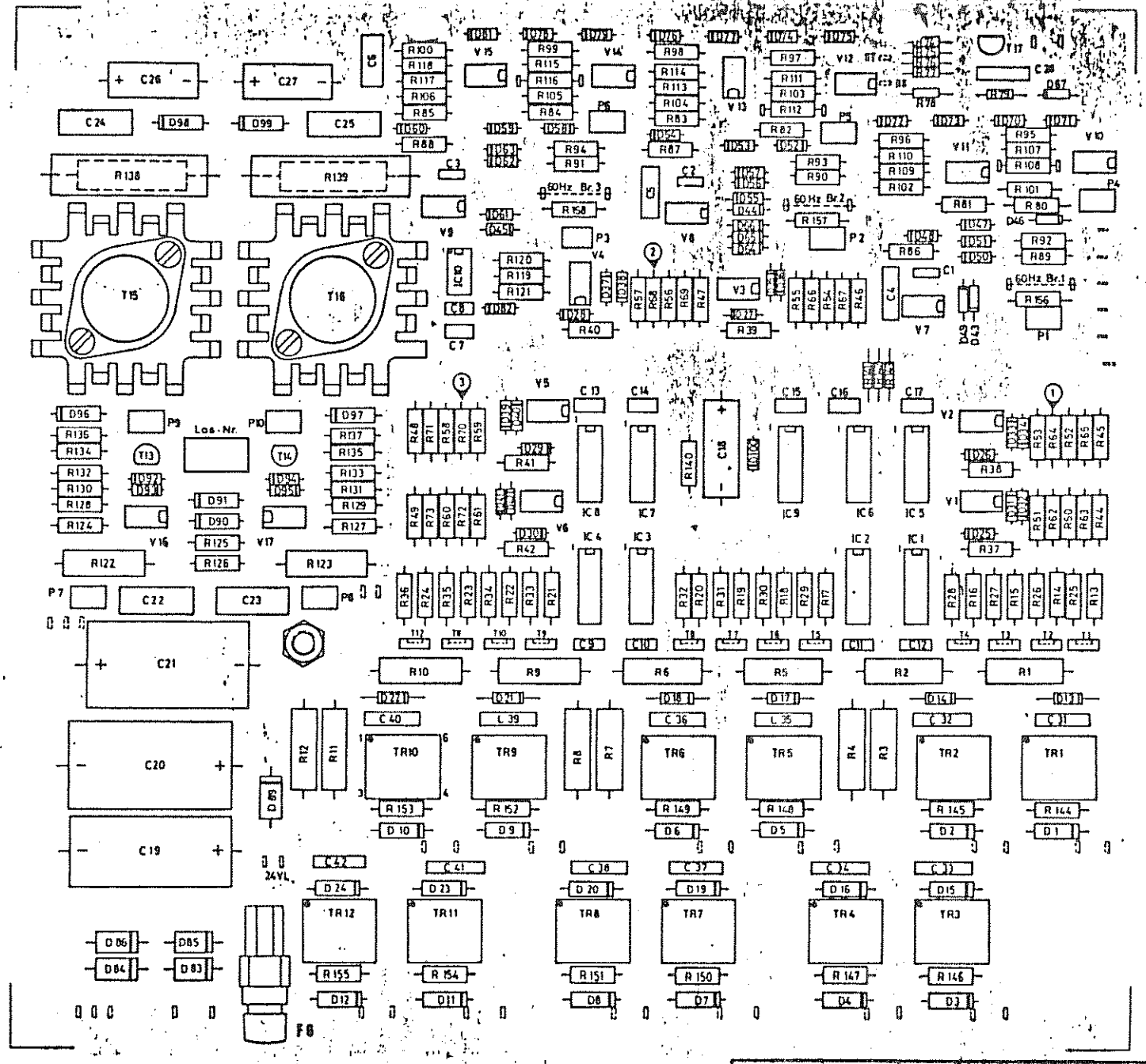
1) bei 195A-Gerät Anschluß an Lüftergerät LE1

2) bei 100A-150A-Gerät Anschluß des Lüfters

Ers. für	Datum	Name		Datum	Name	AM Nr	Kom. Nr	
Bearb	29.6	Brachwitz					Blatt Nr	Benennung AP8konstantes Feld TRK 6-4U/5U
Gepr							Blatte	Z. Nr 109-530-3409-1
Norm								

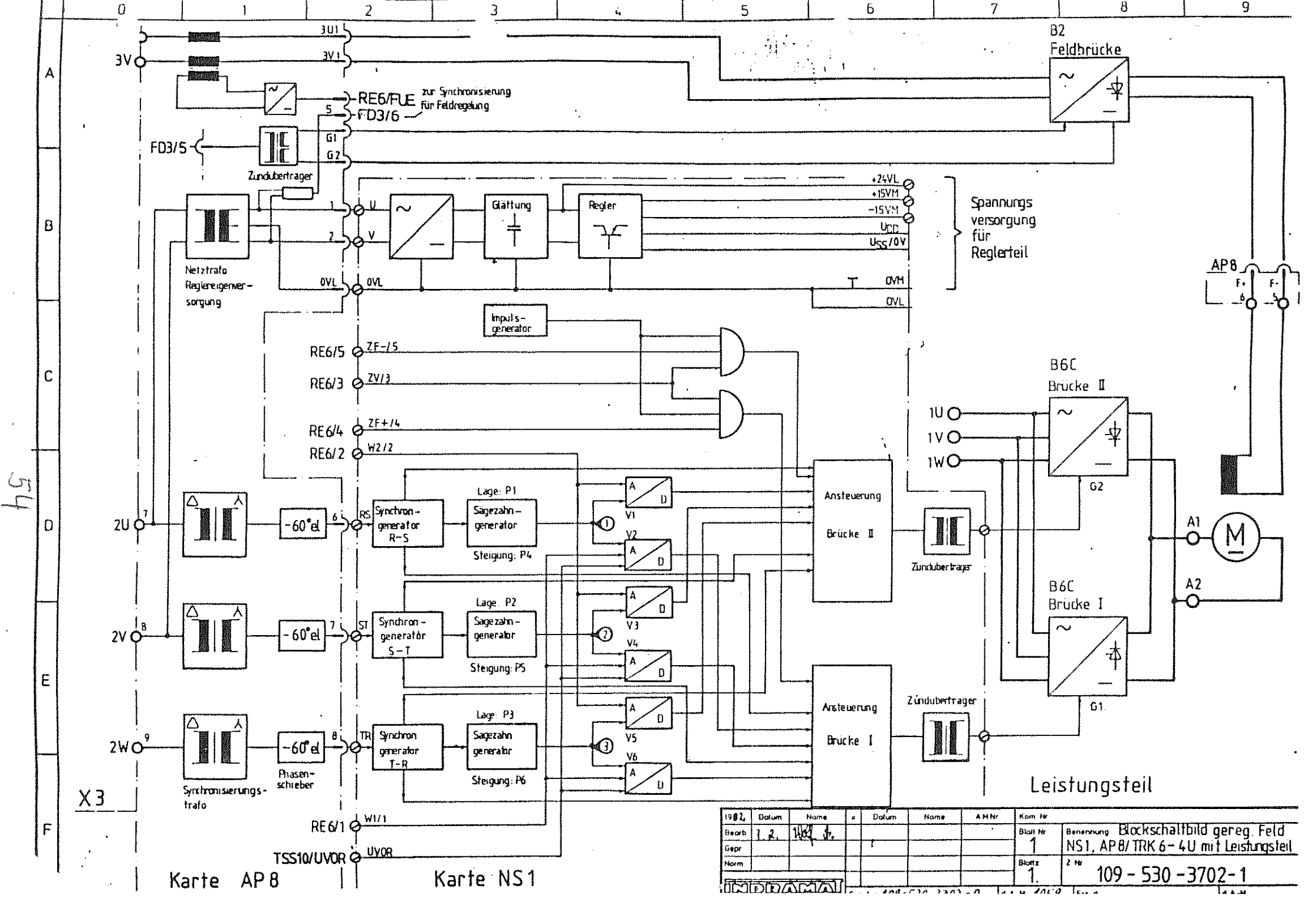
INDRAMAT

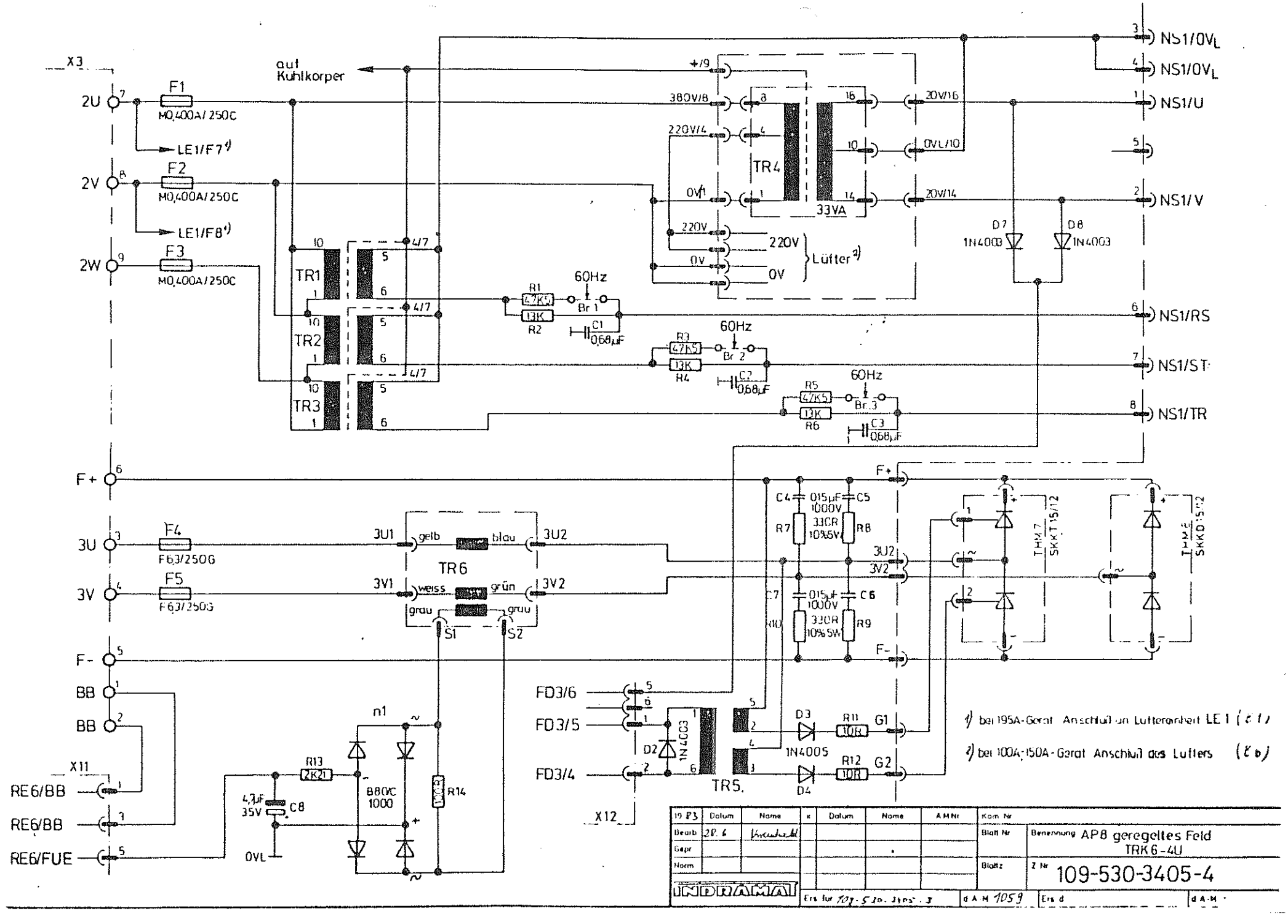
Ers. für 109-530-3409-0 TAM 1059

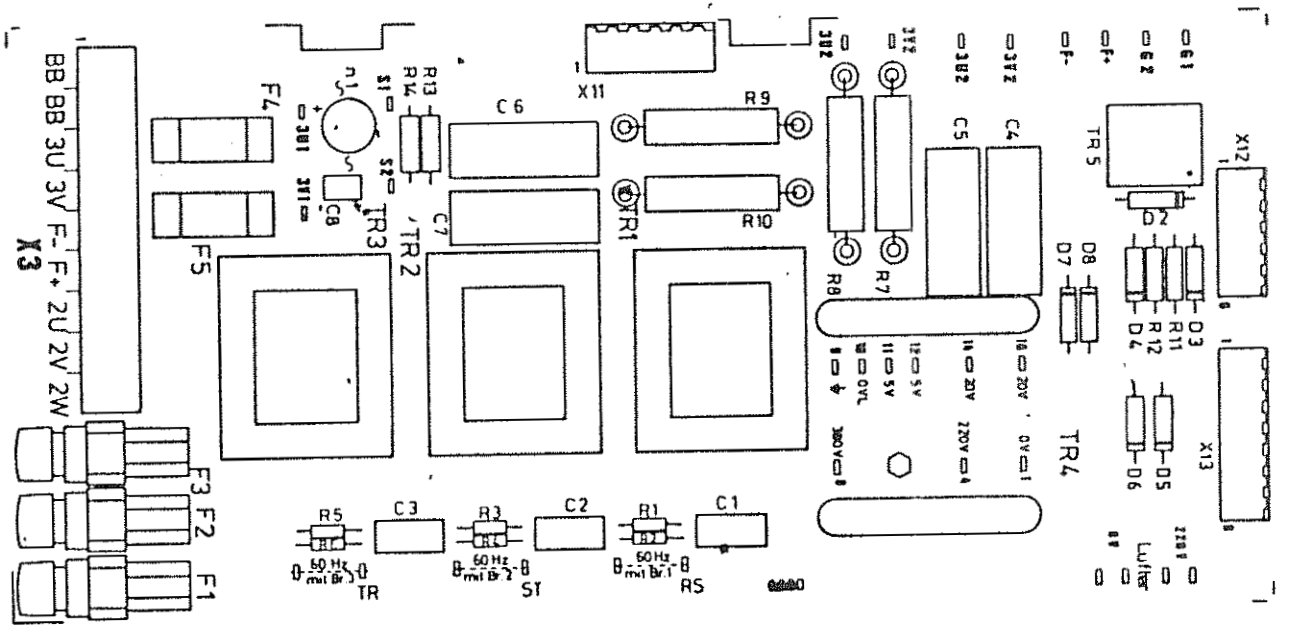


							Blatt Nr. 1	Benennung BESTÜCKUNGSPLAN NS1
							Blattz. 1	Z. Nr. 109-0530-3503-00

INDAMAT


B2
Feldbrücke
3V
3U1
3V1
RE6/FLE
FD3/6
zur Synchronisierung
für Feldregelung
FD3/5
Zündübertrager
G1
G2
Netztrafo
Reglereigenversorgung
Glättung
Regler
+24VL
+15VM
-15VM
UDD
USS/0V
OVM
OVL
Spannungsversorgung
für
Reglerteil
AP8
Impulsgenerator
RE6/5
ZF-/5
RE6/3
ZV/3
RE6/4
ZF+/4
RE6/2
W2/2
B6C
Brücke II
1U
1V
1W
2U
2V
2W
-60°el
Synchrongenerator
R-S
S-T
T-R
Lage: P1
Lage: P2
Lage: P3
Sägezahngenerator
Steigung: P4
Steigung: P5
Steigung: P6
V1
V2
V3
V4
V5
V6
Ansteuerung
Brücke II
Ansteuerung
Brücke I
Zündübertrager
B6C
Brücke I
A1
A2
M
Synchronisierungstrafo
Phasenschieber
X3
RE6/1
W1/1
TSS10/UVOR
UVOR
Karte AP8
Karte NS1
Leistungsteil
Datum
Name
Bearb
Gepr
Norm
Blatt Nr
1
Benennung Blockschaltbild gereg. Feld
NS1, AP8/TRK 6-4U mit Leistungsteil
Blattz
1.
Z Nr
109-530-3702-1
INDRAMAT


X3
2U
2V
2W
F1
F2
F3
M0,400A/250C
LE1/F7 1)
LE1/F8 1)
auf Kühlkörper
TR1
TR2
TR3
4/7
R1
R2
R3
R4
R5
R6
47KS
13K
60Hz
Br 1
Br 2
Br 3
C1
C2
C3
0,68µF
+/9
380V/8
220V/4
0V/1
220V
0V
TR4
33VA
20V/16
0VL/10
20V/14
Lüfter 2)
D7
D8
1N4003
NS1/0VL
NS1/0VL
NS1/U
NS1/V
NS1/RS
NS1/ST
NS1/TR
F+
F-
3U
3V
F4
F5
F6,3/250G
3U1
3U2
3V1
3V2
gelb
blau
weiss
grün
grau
TR6
S1
S2
C4
C5
C6
C7
0,15µF
1000V
R7
R8
R9
R10
330R
10%5W
THM 7
SKKT 15/12
THM 6
SKKD 15/12
BB
RE6/BB
RE6/FUE
X11
n1
R13
2K21
4,7µF
35V
C8
0VL
B80C
1000
R14
1K21
FD3/6
FD3/5
FD3/4
D2
1N4003
TR5.
D3
D4
1N4005
R11
R12
10R
G1
G2
X12
1) bei 195A-Gerät Anschluß an Lüftereinheit LE1 (c1)
2) bei 100A;150A-Gerät Anschluß des Lüfters (c6)
19 P3
Datum
Name
Bearb
Gepr
Norm
UNDRAMAT
Kom Nr
Blatt Nr
Benennung AP8 geregeltes Feld TRK 6-4U
Blattz
Z Nr 109-530-3405-4
Ers für
Ers d
d A-M

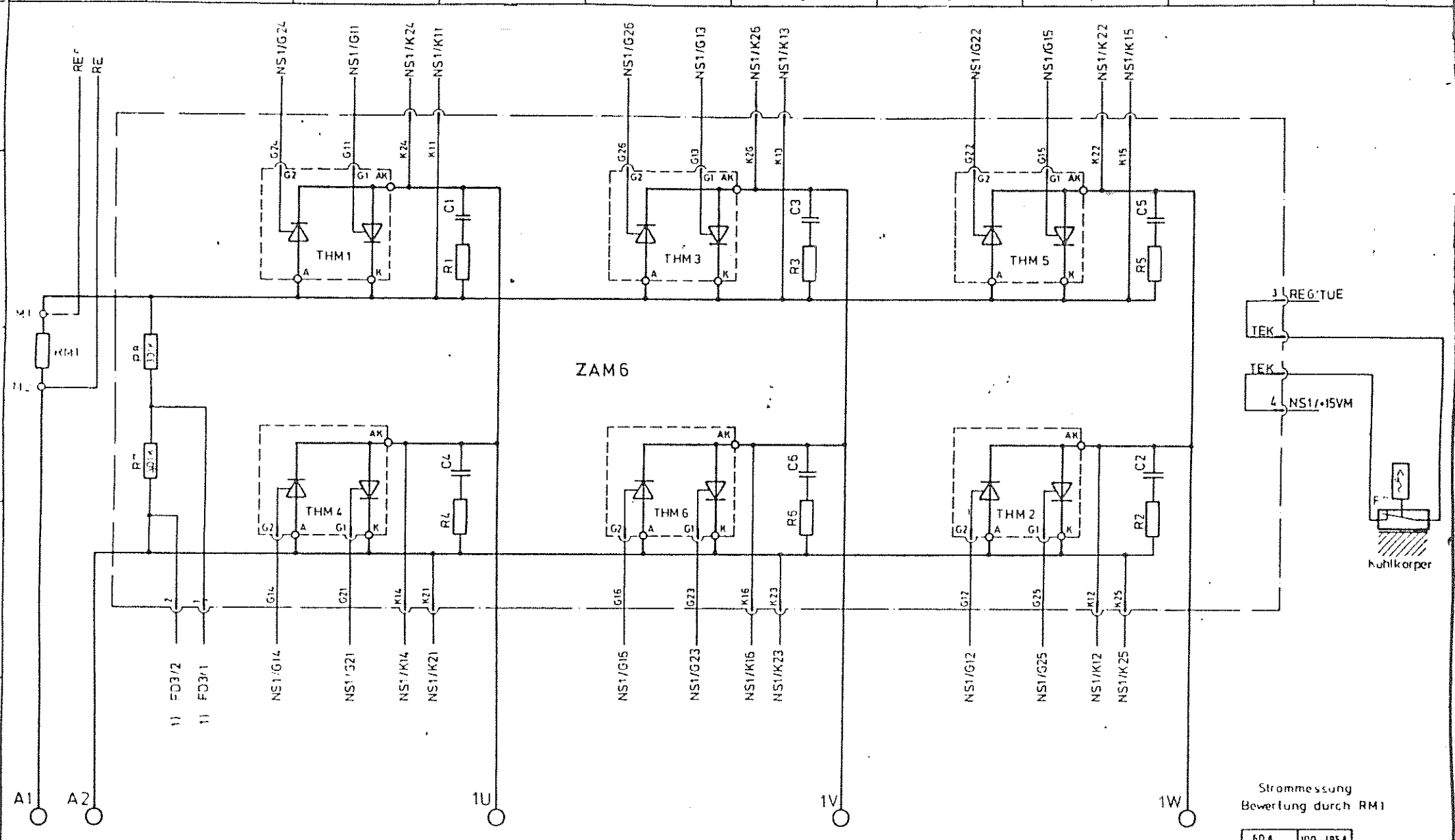


INDRAMAT								

109-530-3505-00

Bestückungsplan AP 8

109-530-3505-01



Strommessung
Bewertung durch RM1

60 A	100 - 195 A
2,50 mV/A	1,25 mV/A
250 mV ≙ 100 A	125 mV ≙ 100 A

Alle nicht bezeichneten Widerstände 33 Ω /5W

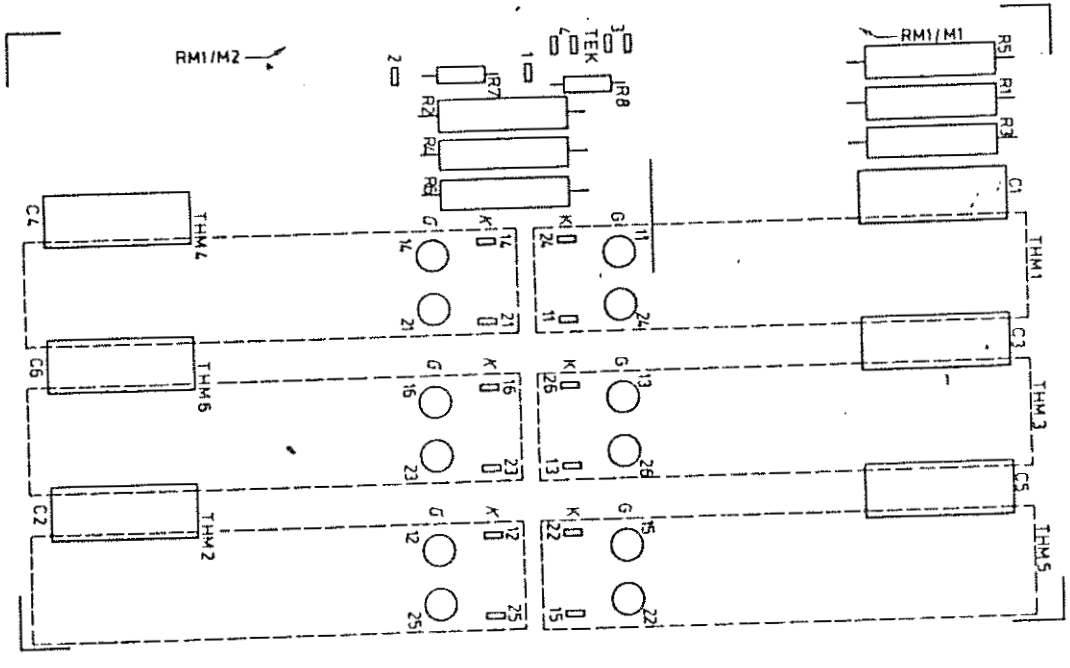
Alle nicht bezeichneten Kondensatoren 0,15 µF/1000 V

1) entfällt bei TRK6-5U

	Datum	Name		Datum	Name	ÄM Nr	Kom. Nr.	
Bearb.	25.4	IA					Blatt Nr. 1	Benennung: Verdrahtungsplan auf der Karte ZAM 6/TRK6-4U/5U
Gepr.								
Norm							Blattz. 1	Z.Nr. 109-530-3401-0

INDRAMAT

Ers. für | d.Ä.-M. | Ers. d. | d.Ä.M.



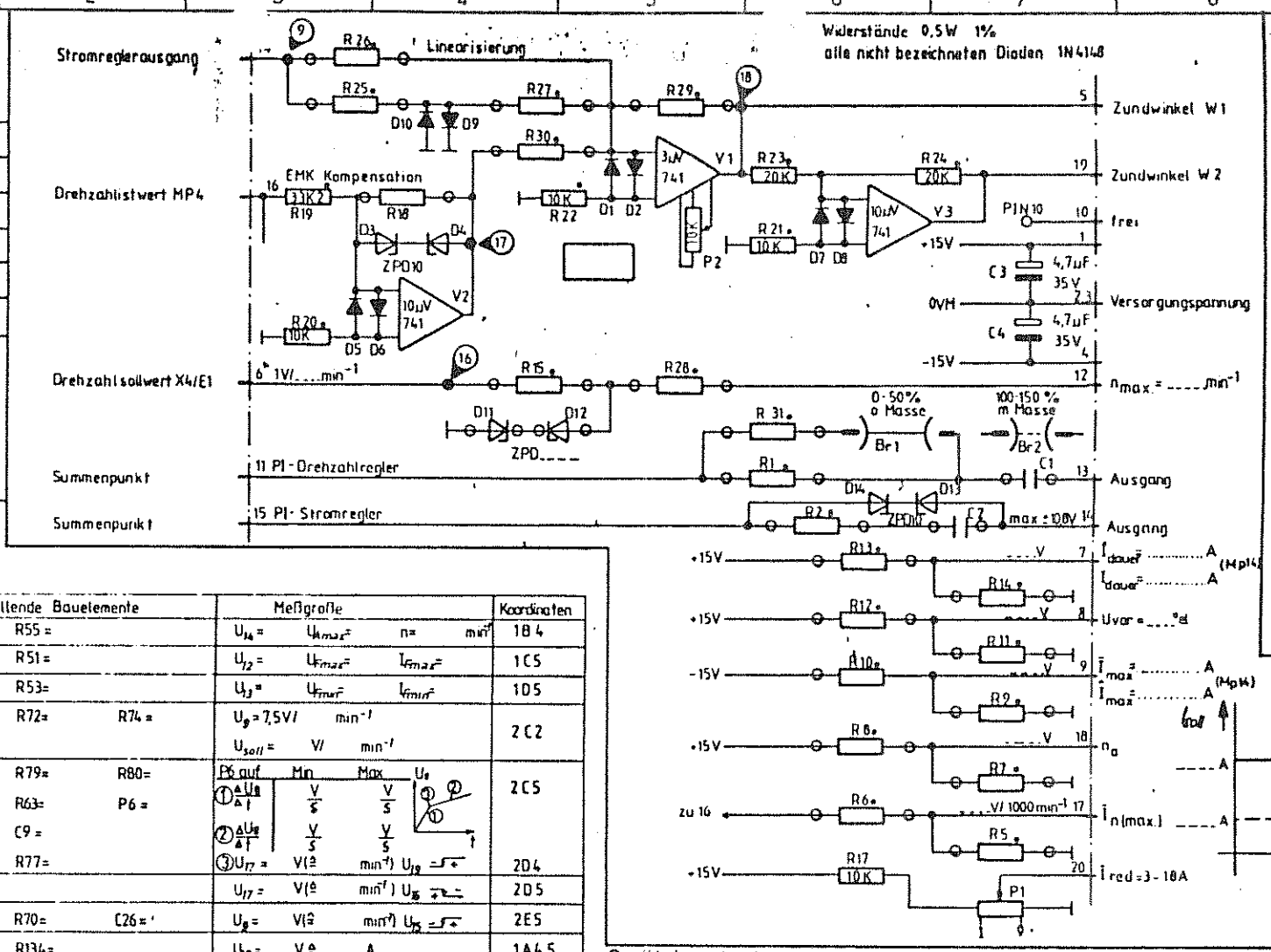
		1	BESTÜCKUNGSPLAN ZAM 6
		1	109-0530-3501-00
INDRAMAT	109-530-3501-0		

Modulbeschriftung

TSS 10/_____

1	TRK 6_
2	
3	
4	V/ (min⁻¹)
5	I_{dauer}=____A
6	I_{max}=____A

1) Thyristorregelverstärker
2) Servomotor
3) Kommutierungsdrossel
4) Eingangsspannung / Drehzahl (min⁻¹)
5) max möglicher Dauerstrom
6) max möglicher Spitzenstrom (Mittelwert) während 200 ... 500ms



Widerstände 0,5W 1%
alle nicht bezeichneten Dioden 1N4148

Rxx =
R26 =
R27 =
R18 =
R29 =
R30 =
R15 =
R28 =
ZPD11/12 =
R1 =
R31 =
C1 =
R2 =
C2 =
R13 =
R14 =
R11 =
R12 =
R9 =
R10 =
R7 =
R8 =
R5 =
R6 =

Grundbestückung TSS 10
109-360-4814-1

Karte FD3

Nr	Bezeichnung	Einzustellende Bauelemente	Meßgröße	Koordinaten
1	U_A max	R54 = R55 =	U_{14}= U_{Amax}= n= min⁻¹	1B4
2	U_{Feld} max	R50 = R51 =	U_{12}= U_{Fmax}= I_{Fmax}=	1C5
3	U_{Feld} min	R52 = R53=	U_{13}= U_{Fmin}= I_{Fmin}=	1D5
4	n_{soll} Eingang	R16 = R72= R74 = C24 =	U_9=7,5V/ min⁻¹ U_{soll}= V/ min⁻¹	2C2
5	n_{soll} Rampe	Br.2 ja/nein R79= R80= R81= R63= P6 = R83= C9 =	P6 auf Min Max U_9 ①$\frac{\Delta U_9}{\Delta t}$ V/s V/s ②$\frac{\Delta U_9}{\Delta t}$ V/s V/s ③U_{17}= V(≙ min⁻¹) U_{19} =	2C5
	Umschaltung n_{soll} Rampe	R76= R77=		2D4
6	$n < n_{min}$	R110=	U_{17}= V(≙ min⁻¹) U_{15} =	2D5
7	$n_{soll} \geq n_{grenz}$ (RFein)	R68 = R70= C26 =	U_8= V(≙ min⁻¹) U_{15} =	2E5
8	Bewertung d. I_A-Ausgabe	R133= R134=	U_{10}= V≙ A	1A4,5
9	$n_i < n_{min}$ ⊗ $n_i = n_{soll}$ mit D77	Diode D77 ja nein	Anzeige h_1	2D7
10	Feldregelung	R 22 = C4 =	U_{2max} = V	1C5
11	RF-Verzögerung	C10 =	τ ≈ ms auf FD3	2A5

Karte RE

1	$I_F < I_{Fmin}$	R119 =	R120 =	U_{19}= ... V (bei U_F=200V) I_{Aus} max ... A min ... A I_{FEin}= ... A	2CD4

Beschleunigungszeiten:

Bei Sollwertsprung von ... min⁻¹ auf ... min⁻¹	Hochlaufzeit	Bremszeit
Mit Masse		
Ohne Masse		

Motordaten:

Nennleistung P_N =	KW
Nennmoment M_N =	Nm
Nenndrehzahl n_N =	min⁻¹
max Drehz. n_{max} =	min⁻¹

Gerätekonstanten:

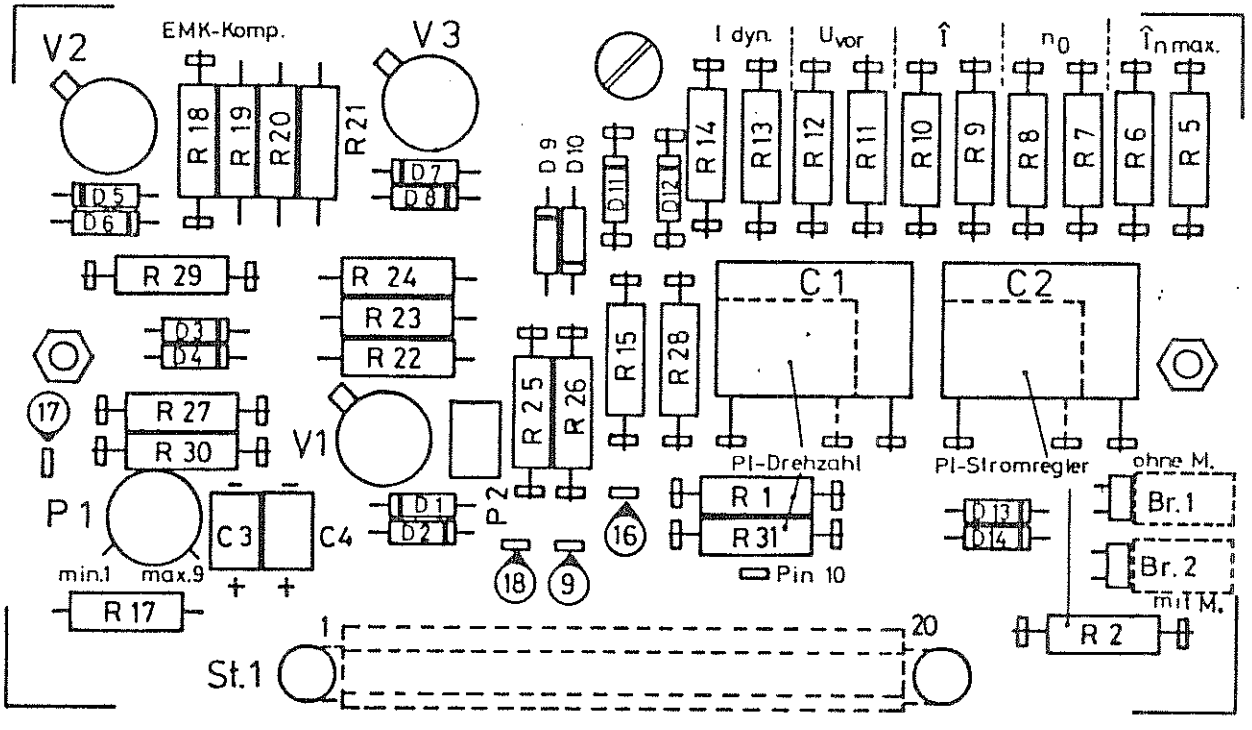
Nr	Bezeichnung	Einzustellende Bauelemente	Meßgröße	Koordinaten
1	Abgleich $n_i = n_{soll}$	P4 abgleichen	stabiles Einschwingen $\|U_{12}\| \leq$ 100mV bei n_{max}	FD3/2E4
2	Anpassung U_{Amax}	R 12 anpassen	K_3 = 0,02V/V	FD3/1B3
3	Ankerstrommessung	R 95 anpassen	U_I = 0,025 V/A	RE6/1E2
4	Stromsollwert	R77=	..... A Geräteennstrom	RE6/1C7
5	Stromistwert	R84 =	..... A	RE6/1C7
6	Tacho	R14=	K_4 = 0,012V/min⁻¹	RE6/1C2
7	Umschaltpausenzeit	C9 =	ms am Mp 3	RE6/1A5

1983	Datum	Name	x	Datum	Name	AM Nr	Kom. Nr
Bearb	24.4	Ygagoff					Blatt Nr
Gepr							Blattz.
Norm							Z. Nr 109-530-3806-1

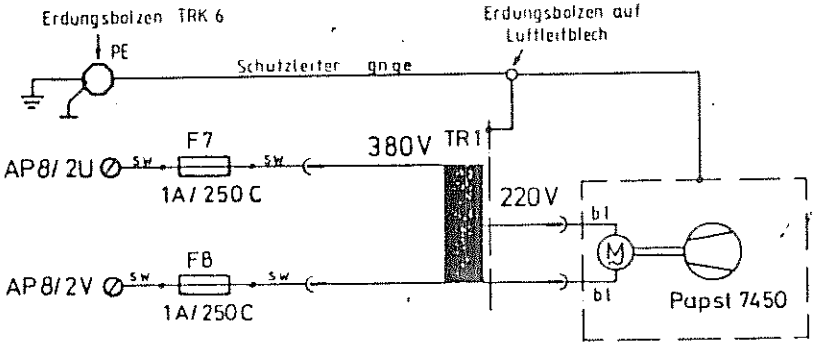
Benennung: Antriebsanpassung TSS 10

INDRAMAT

Ers. für: 109-530-3806-0



		1	BESTUCKUNGSPLAN TSS 10
		1	109 - 0360 - 3501 - 00



Alle Drahtquerschnitte 0,75 mm²

Bearb	29.6	Brandwidl				Blatt Nr	LE1 Lüftereinheit
Gepr						Blattz	109-530-3406-0
Norm							

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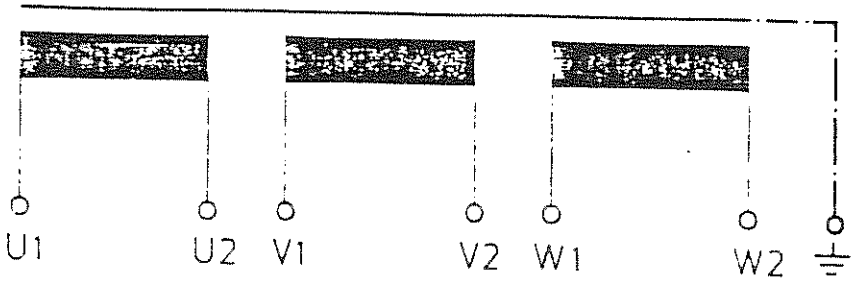
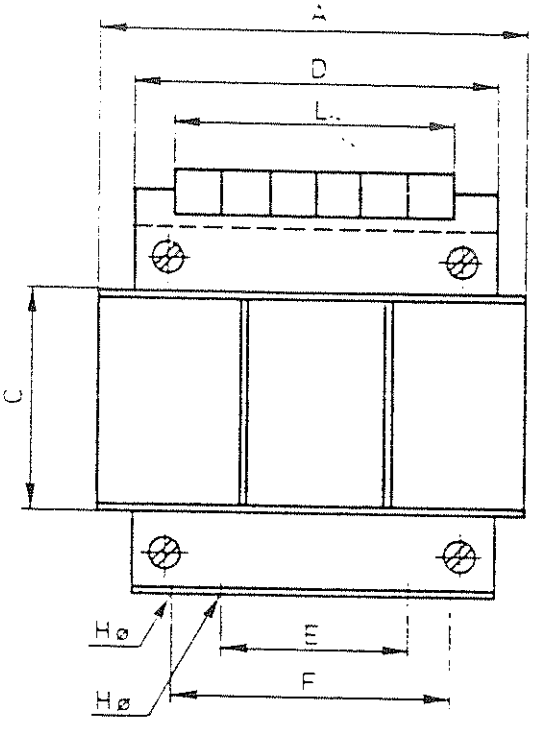
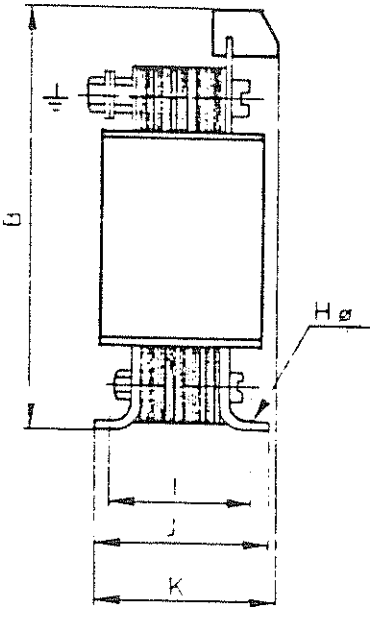




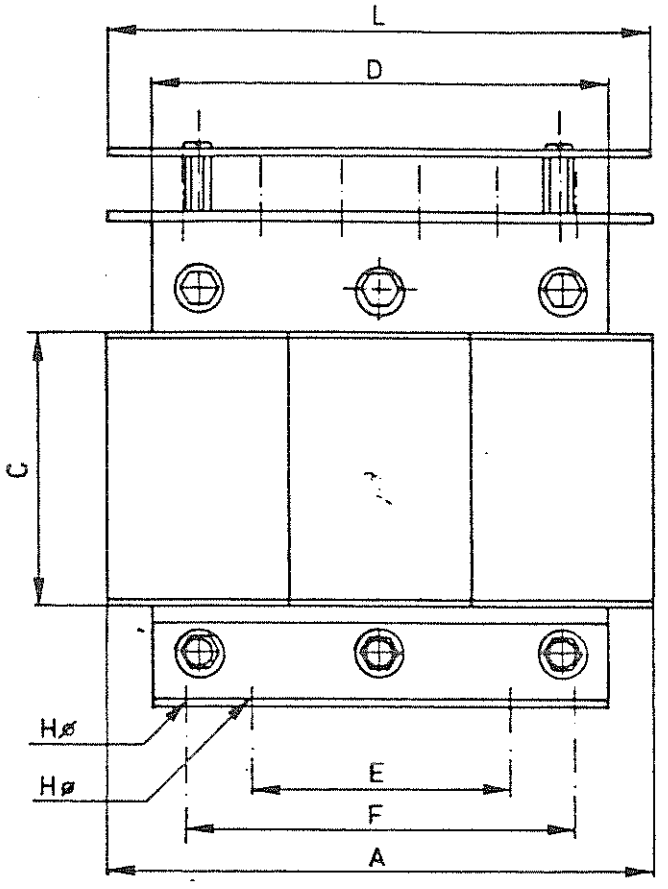


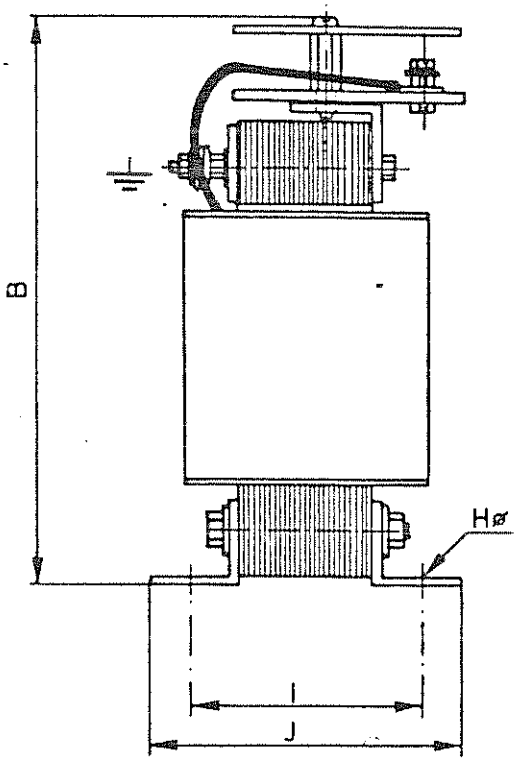
Type	mH/A	Maße in mm											Gew
		A	B	C	D	E	F	L	Hø	I	J	K	kg
KD4-D	1/30	119	129	66	112	60	80	80	6	55	71	78	3,2
KD5-D	04/48	150	155		125	70	100		8	70	90		

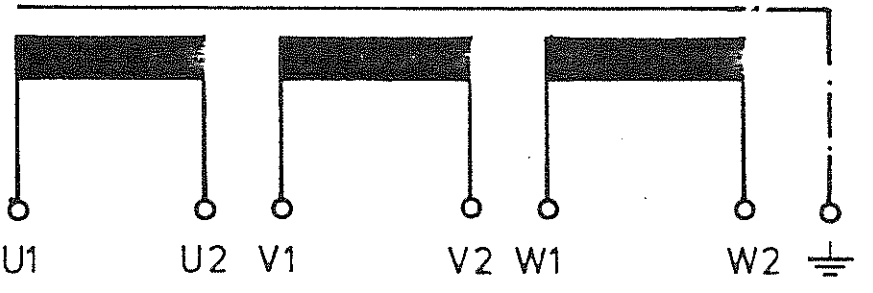
1983 Datum Name	x Datum Name A M Nr	Kom Nr	
Bearb 19.4 Kilde		Blatt Nr	Benennung Dreiphasen – Kommutierungsdrossel
Gepr		Blattz	Z Nr 109-252-4005-0
Norm			
INDRAMAT	Ers für d A-M	Ers d	d A-M

Diese Unterlag... weder kopiert noch dritten Personen zugänglich gemacht werden ...tz bei... Urheberrec...nt

Diese Unterlage o. weder kopiert noch dritten Personen zugänglich gemacht werden. Gew. Urheberrecht.







Type	mH/A	Maße in mm											Gew kg
		A	B	C	D	E	F	L	Ho	I	J		
KD6-D	0,3/82	180	195	95	150	80	125	180	7	66	92		7,8

19	Datum	Name	x	Datum	Name	A. M. Nr.	Kom. Nr.	
Bearb.	14.5.83	Klum					Blatt Nr.	Benennung Kommutierungsdrossel
Gepr.								
Norm							Blattz.	Z. Nr. 109-252-4006-0

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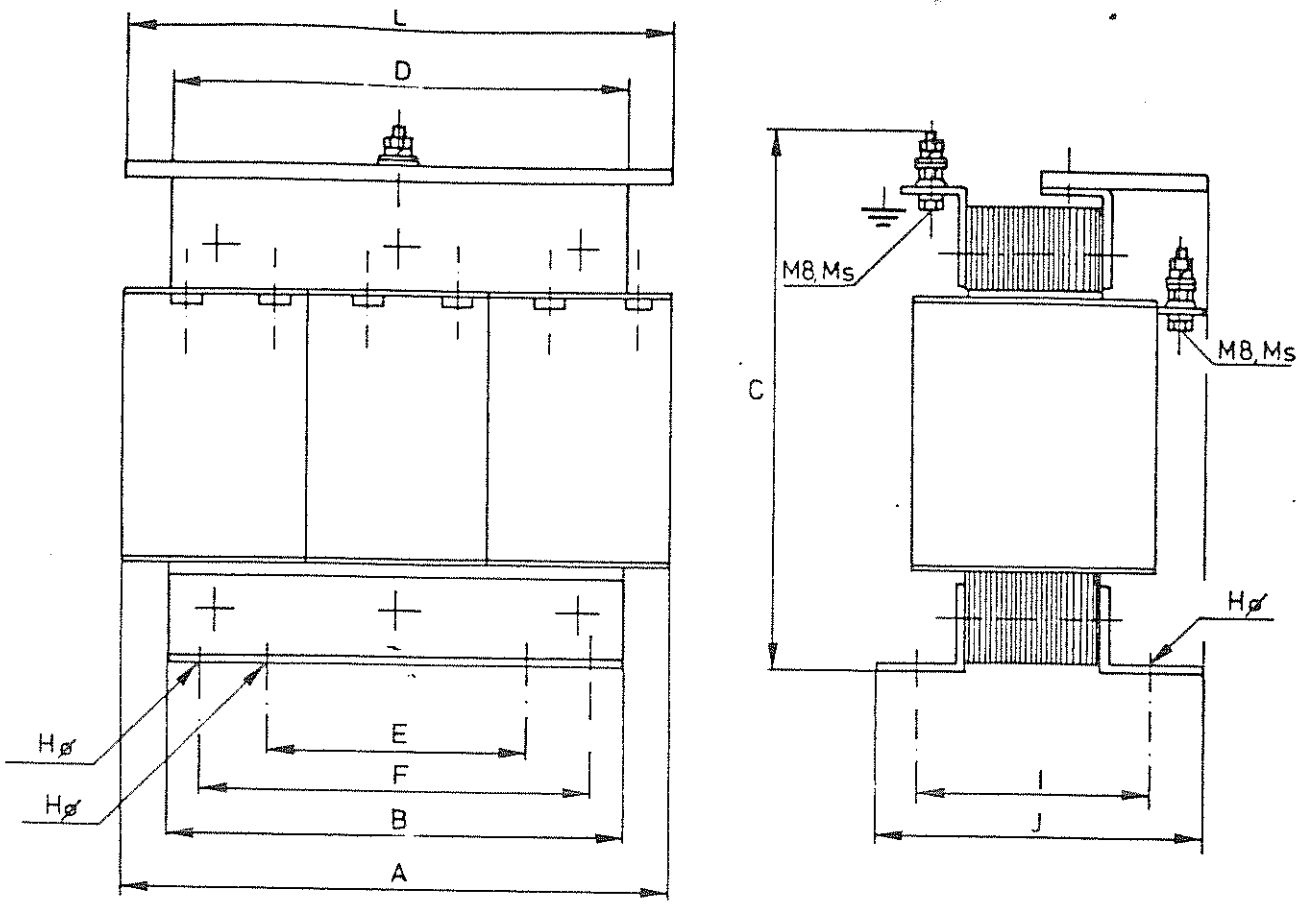
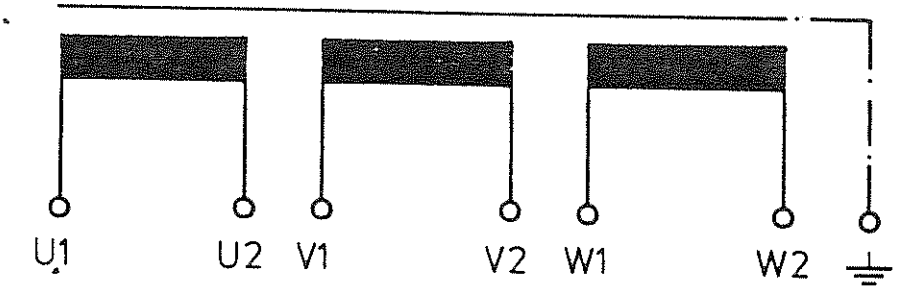
Diese Unterlage darf weder kopiert noch dritten Personen zugänglich gemacht werden. Gesetz betr. Urheberrecht





Type	mH/A	Maße in mm											Gew kg
		A	B	C	D	E	F	L	Hø	I	J		
KD7-D	0,2/123	210	175	215	175	9,5	145	210	7	97	135		17
KD8-D	0,15/164	240	200	240	200	110	170	240	11	125	165		29

19	Datum	Name	x	Datum	Name	A. M. Nr	Kom. Nr.	
Bearb.	16.3.83	Glaue					Blatt Nr.	Benennung: Kommutierungsdrossel
Gepr.								
Norm.							Blattz.	Z. Nr. 109 - 252 - 4007 - 1

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Ers. für 109 - 252 - 4007 - 0 | d. A.-M. | Ers. d | d. A.-M.

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