SIEMENS

Cathode Ray Relay Tester

9 T mse 109a

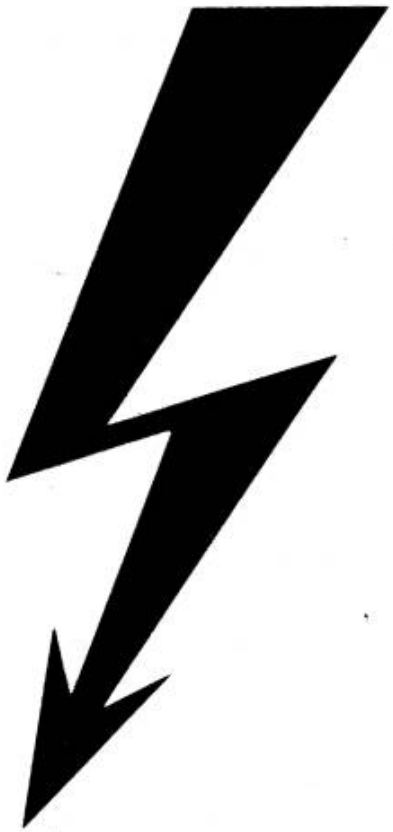
Description and Operating Instructions

Fs Bs and Ba 5634/10 engl
January 1961

SIEMENS & HALSKE AKTIENGESELLSCHAFT
WERNERWERK FÜR TELEGRAFEN- UND SIGNALTECHNIK · MÜNCHEN

CAUTION!

High Tension



Disconnect Power Source Before Opening The Equipment

Contents

1 DESCRIPTION

1.1 General

Supervision and maintenance of telegraph apparatus and transmission facilities include periodic checks of polarized telegraph relays as to their service reliability and their influence on the quality of the entire transmission system.

For this purpose, special relay testers have been developed which permit checking of polarized telegraph relays as to contact bounce and distortion.

The Cathode Ray Relay Tester shown in Fig. 1 is designed for testing and dynamically adjusting polarized relays. It permits the simultaneous reading of distortion and transition time. Thus, comparison of transition times is greatly facilitated and even the slightest chatter of the armature can be detected on the screen. Optimum reading accuracy is ensured as the entire width of the screen (7 cm diameter) of the cathode ray tube is used exclusively for displaying armature transitions.

The relay under test is energized by a 25 cps sinusoidal current. In case a 60-cps power current is used, the frequency of the energizing current amounts to 30 cps. The current draw must not exceed 20 ma.

A voltage selector switch permits the unit to operate from 50-cps power sources of 110, 125, 150, 220 and 240 volts. A special version is available for connection to 60-cps power systems.

1.2 Operating Principle

The operating principle of the relay tester is illustrated in Fig. 2. The power transformer supplies power to a frequency divider provided with an auxiliary relay which supplies the 25-cps (or 30-cps) sinusoidal current necessary for energizing the relay under test. In order to improve the quality of the sinusoidal waveform, a lowpass filter has been added.

The horizontal sweep (time base) is produced by applying a 50-cps (or 60-cps) sinusoidal voltage, the phase position of which can be adjusted relative to the energizing current of the relay under test, to the horizontal deflection plates of the cathode ray tube.

The armature movement of the relay under test is in synchronism with the horizontal sweep, but at half the frequency of the latter. The relay armature controls the vertical deflection of the beam so that the armature transition of the relay under test is made visible with each sweep of the time base, i.e. transitions from contact T to contact Z and from contact Z to contact T are shown in an alternate succession. On the screen, the two transitions appear therefore one above the other. The sinusoidal deflection voltage applied to the horizontal deflection plates is so chosen that the cathode ray tube will be overdriven to an extent where only a section of approximately 20%, corresponding to 4 milliseconds, becomes visible on the screen (Figs. 4a,b). Thus, the scale is virtually linear. During flyback, the beam is blanked by means of a blanking circuit. This produces a screen pattern as shown in Fig. 3. A potentiometer, mounted on the front panel serves to adjust the horizontal position of the waveform.

By means of a toggle switch, either the T to Z or the Z to T transitions can be displayed individually. Close examination of relay characteristics is thereby greatly facilitated.

With the relay armature on the T-contact (stop polarity), the cathode ray is deflected upwards; when it is on the Z-contact (start polarity), the cathode ray is deflected downwards.

In Fig. 3 the screen pattern of the CCT is shown and explained.

1.3 Design Characteristics

The basic circuit diagram of the relay tester is shown in Fig. 5.

Relay HR and capacitor C 5 form a parallel resonant circuit which is tuned to 25 cps (or 30 cps). Thus, armature hr transfers at a cycle rate half that of the applied power frequency (50 or 60 cps). After transients have died away, a 25-cps (30-cps) voltage exists between the armature of relay HR and solder point c1 of Tr1.

This alternating voltage is again connected to the resonant circuit HR/C5 via resistor Wi 2 for the purpose of decoupling and smoothing. The energizing current of relay HR lags by about 90° behind the resonant circuit voltage and actuates the relay

armature when the operating voltage has been reached. This "self-energizing" circuit requires a good magnetic symmetry of relay HR, i.e. the inductance is the same for both armature positions. On the other hand, contact symmetry is not critical.

Resistor Wi1 serves for adjusting the no-load voltage. It is followed by a lowpass filter C 3, L 1, C 4, on the output terminals of which appears a pure sine wave having a frequency of 25 cps (30 cps). The polarity of this current can be reversed by means of pushbutton U. This polarity reversal permits the energizing current of the relay under test to be checked for symmetry. In case the energizing current is unsymmetrical (relay HR magnetically biassed) different distortion patterns appear on the screen depending on the position of the pushbutton.

In order to obtain the proper energizing current, plug-type dropping resistors VWi are required.

Winding IV of power transformer Tr 1 supplies voltage to voltage divider Wi 3 - Wi 6 via rectifier Gr 1 and smoothing circuit C 1, Wi 17, C 3. From this voltage divider the anode voltage and the voltages for the focus and the vertical deflection plates are tapped.

For the vertical deflection of the beam, a bridge circuit is provided. The supply voltage (+15 v across Wi 3/Wi 12; - 15 v across Wi 4/Wi 11) is applied to one diagonal branch of this bridge, while the vertical deflection plates are connected to the other diagonal branch (D'2 to Wi 3/Wi 4; D2 to Wi 12/Wi 11). Depending upon the position of armature pr, Wi 11 or Wi 12 (both of which have a high ohmic rating) is shorted so that the ungrounded deflection plate D_2 is alternately connected to + 15 and - 15 v. During armature transitions, D_2 receives ground potential via Wi 11/ Wi 12.

Thus, the contact-to-contact DC voltage of the relay under test is 30 volts, while the contact-to-armature or ground (housing) voltage is 15 volts.

The voltage for the horizontal sweep (time base) is obtained from a separate transformer Tr2, because the secondary voltage of power transformer Tr 1 is no longer sinusoidal as a consequence of the intermittent load which half-wave rectifier Gr 1 represents. The amplitude of the sweep voltage can be adjusted by Wi 18. In order to preserve the sinusoidal waveform across Tr2 in spite of the resistor chain Wi 13, Wi 18 - Wi 20, the primary winding has been combined with a capacitor C 7 to form a resonant circuit which is closely tuned to the power frequency.

The secondary winding of Tr 2 is connected to a variable phase shifting lattice network which is symmetrical relative to the ground level (anode) of the circuit. It is composed of twin potentiometer Wi 14/Wi 15 and capacitors C 10 and C 11 and supplies the symmetrical deflection voltage for plates D_1/D'_1.

Winding II of power transformer Tr 1 is connected to a fixed phase shifter C9/Wi 10, the output voltage of which is applied via Wi 9 to control grid *g* of the cathode ray tube. This 50-cps (60-cps) voltage serves to blank the electron beam during flyback. By means of Wi 14/Wi 15 (variable phase shifting network), the horizontal sweep (time base) can be shifted relative to the vertical sweep which is under the control of the relay armature.

The basic value of the voltage applied to the control grid appears across C_6 and is adjusted by means of potentiometer Wi 17.

Blanking can be varied with the aid of toggle switch T^I/Z^I in such a manner that only the armature transitions from T to Z or Z to T become visible. In this case the 25-cps (30-cps) voltage supplied via Tr3 by the relay energizing circuit is superposed at the corresponding phase and polarity positions (C8/W 7) on the 50-cps (60-cps) blanking voltage. Rectifier Gr 2 serves for limiting the positive half waves of the 25-cps (30-cps) voltage to the basic value of the grid voltage set by potentiometer Wi 17, whereby a uniform brightness of the beam is ensured.

The potentiometers have the following functions:

Wi 17: brightness control
Wi 16: focus control
Wi 14/Wi 15: horizontal position adjustment
Wi 18: time base amplitude adjustment (factory adjusted).
The setting of this potentiometer may only be altered for recalibration (see para. 2.3).

1.4 Constructional Layout

Fig. 1 shows the Cathode Ray Relay Tester accommodated in a sheet metal case.

In the upper left hand corner of the control panel is the cathode ray tube for the display of the relay characteristics. Immediately below this tube is a toggle switch for distortion measurement (blanking either mark-space or space-mark transitions). The polarity reversing pushbutton to the left of this toggle switch serves to reverse the polarity of the relay energizing current. The dropping resistor for the relays to be tested is inserted into a jack strip at the right of the cathode ray tube. The rotary knob at the right of this jack strip permits the screen pattern to be shifted to either side. The power cable brought out at the upper right-hand corner of the control panel is secured in place in the cover during transportation and is fitted with a safety plug whose protective contact ensures proper grounding of the equipment. Two relay sockets, arranged in the lower right hand corner of the control panel, accept the relays to be tested (T rls 43 or T rls 63 and 64). A warning plate in the middle of the control panel warns of the hazard resulting from the high voltages carried by some components in the interior of the equipment which, for this reason, must be installed in the metal case before use.

All potentiometers are so arranged that the equipment can be adjusted without the necessity of removing it from the case. For adjustments, merely the HT warning plate has to be removed. Arranged on the right-hand side of the control panel are from top to

bottom: a power switch; a neon lamp for supervising the operating condition; a power fuse; and a voltage selector switch.

The inside of the cover bears a circuit and instruction label. The cathode ray tube is extremely sensitive to electric and magnetic interference. It is, therefore, accommodated in a separate compartment and completely shielded (Mu-metal). Also for this reason, the power transformer is so arranged that there can be no interference.

2 OPERATING INSTRUCTIONS

2.1 Relay Testing

Relay tests comprise zero-bias and armature transfer time adjustments as well as contact bounce elimination.

"Zero-bias" means that the contacts supply distortionfree signals with the relay energized by a symmetrical and sinusoidal test current. Transfer time adjustments become necessary when the test reveals excess deviation from the rated values. Detailed information may be obtained from the Maintenance Instructions for the respective relays.

2.2 Placing into Operation

Insert the loosely supplied cathode ray tube. To do this, remove the components chassis after unscrewing the four fixing screws on the front panel. Make sure that the cathode ray tube is firmly seated in the tube socket with its base pins fully engaging. After loosening the fixing screws of the tube socket, turn the tube until the scale is parallel to the front edge of the front panel. Then fasten the fixing screws again and place the chassis into the case.

Adapt the unit to the power voltage by setting the voltage selector switch accordingly.

With the power voltage switched on, the neon lamp lights up. Now, place the relay to be tested together with the respective plug-type resistor into the sockets provided. Fig. 3 gives an explanation

of the screen pattern as obtained with a plugged-in relay. The zero position of the scale is arranged on the right-hand side of the screen because the break-transition-make cycle runs off from left to right and the distortion is defined by the difference between the make instants (see Fig. 3).

If only one armature transition is to be displayed, throw the toggle switch to its upper or lower position.

The polarity reversing pushbutton serves for checking the symmetry of the energizing current. In case the displayed distortion value changes with a change of the position of the pushbutton, the energizing currents are no longer symmetrical. If this unbalance exceeds 0.5 percent, the unit must be returned to the supplier for readjustment.

The voltage across the relay contacts is as low as 15 volts relative to ground, so that adjustment of relays during the test procedure does not involve safety hazards.

If the beam is not deflected in the vertical direction, the relay has a short to chassis or the armature is stuck between contacts.

It may occur that the waveform contains highly attenuated high frequency oscillations. This will be the case if the contacts of relay HR are bouncing, which can be remedied by cleaning the friction springs according to the maintenance instructions for polarized relays. This phenomenon has no effect on the display, however.

The relay under test is energized by sinusoidal current the amplitude of which must be adapted to the relay winding. For this purpose, dropping resistors have been provided.

Orders should be placed according to the following example:
Dropping resistor for Cathode Ray Relay Tester for relay T rls 64a, T Bv 3402/21.

2.3 Replacement of Cathode Ray Tube and Recalibration

If the brightness of the image decreases, this loss may be compensated for by varying the potentiometer Wi 17 accordingly. This readjustment must be performed without removing the relay tester from its metal case. The potentiometer becomes accessible after unscrewing the HT warning plate. (Use an insulated screwdriver).

The tube has an average life of approximately 5000 hours. The fact that the brightness can no longer be compensated by a corresponding readjustment of the potentiometer is a safe indication that this time limit has been reached.

Before removing the tube, pull the power plug from its socket and lift the tester out of its case. For inserting the tube see para 2.2.

Whenever a cathode ray tube has been replaced by a new one, the potentiometers must be readjusted. For this purpose place the tester into its case and connect it to the power network. Now, adjust the brightness by means of potentiometer Wi 17. Note that extreme brightness will affect the tube life. Also adjust the focus by means of potentiometer Wi 16.

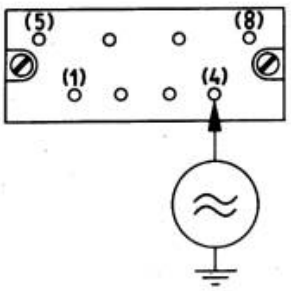
Further, calibration of the unit can easily be checked and corrected, if necessary.

For this purpose a tone generator is required which supplies a frequency of 225 cps (at a power frequency of 50 cps) or 210 cps (at a power frequency of 60 cps) with an output voltage of 20 to 30 v. Over this frequency range it should permit fine tuning.

The cathode ray relay tester must be connected to a safety socket during the process.

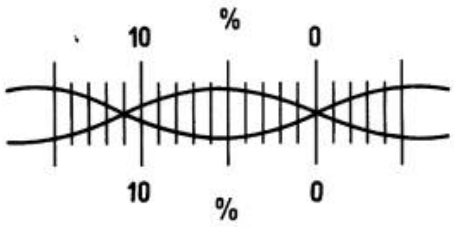
Set potentiometer IMAGE SHIFT to mid-position and transfer the toggle switch below the display tube to position DISTORTION.

Ground one pole of the output of the tone generator and connect the other pole to jack 4 of the socket for relay T rls 43.



225 cps (50 cps power frequency)
210 cps (60 cps power frequency)

On the screen of the cathode ray relay tester will then appear the following display,



which is to be made stationary by readjusting the tone generator. The intersections of the stationary sine wave must be 11% (at 50 cps power frequency) or 12% (at 60 cps power frequency) apart.

The adjustment, if required, can be carried out by means of potentiometer Wi18 (under the high-voltage warning plate on the control panel).

Variations of the power frequency, which are permissible up to 1% and cause the screen pattern to drift away, must be compensated by retuning the tone generator.

After adjustment potentiometer Wi18 is again to be secured with laquer.

3 TECHNIKAL DATA

Scale	%
Measuring range	20 %
Distortion measurement error	≦ 0.25% (100% ≙ 20 ms
Transfer time measurement error	≦ 1 %
Relay excitation	sinusoidal current of 25 cps (30 cps for special version connecting to 60 cps power supply)
Energizing voltage (no-load cond.)	44 v
Energizing current	≦ 20 ma, varies with relay specifications
Commercial power voltage	110/125/150/220/240v, ± 10 %
Commercial power frequency	50 cps ±1% (special version: 60 cps ± 1 %
Power draw	approx. 20va
Dimensions of case (max. dimensions) in mm	260 x 185 x 200
Weight	approx. 7 kg
Accessories	tool set for maintenance of relays, T.Wz. 83a
Spares	cathode ray tube 9 T mse 109, T 24; fuse 0,25 C DIN 41571
Ordering code	9 T mse 109 a, Fs Sk 5634/10

Differences in the Indication of Armature Transfer with Cathode Ray Relay Tester and Stroboscopic Relay Tester using Neon Lamp Indication

The cathode ray relay tester is a modern electronic instrument designed for the dynamic testing of polarized telegraph relays.

The cathode ray produces an instantaneous and comprehensive image of what happens when the relay armature transfers. It permits highly accurate measurements of the relay timing characteristic with a relatively low measuring voltage (15 v) applied to the relay contacts. The stroboscopic neon lamp indicators (such as the Neon Lamp Relay Tester and the Relay Tester Unit of the distortion measuring set T aps 5), on the other hand, which are also performance-proven, depend on substantially higher voltages to be applied to the relay contacts. With units built up to and including 1953, this voltage comes to approximately 200 volts, and with units built in 1954 and later, it still amounts to 120 volts.

With the stroboscopic devices, it is the indicating neon lamp which depends on these relatively high contact voltages for firing. However, a result of this high voltage is that the electro-static field, set up at the instant of contact break, produces armature oscillations and, consequently, chatter. As the contact voltage increases, armature bounce with contact break will also increase, thus reducing the stroke time (transfer time = stroke time + bounce). In view of the ignition delay involved in the gas discharge of the neon lamp, armature bounce with contact break is not made visible by the neon lamp as it is of extremely short duration.

The low contact voltages applied by the cathode ray relay tester do not produce such armature oscillation. This is why discrepancies will exist between stroke times measured by the two equipment types. The cathode ray relay tester displays the actual stroke time, and the values registered by it will **necessarily** be larger than those of the stroboscopic devices.

The difference in stroke time measuring results, as ascertained from a major number of relays, amounts to an average of 3 percent of the current pulse. This applies to relays T rls 63 and 64 energized with a 25-cps alternating current. Other relay types showed a basically similar behavior; however, the amount of statistical information available is still insufficient to state closer particulars on the magnitude of the measuring differences.

In the adjustment, checking and maintenance instructions for the polarized relays T rls 63 - 67, the range of permissible values for the stroke time has been specified separately for the Cathode Ray Relay Tester and the stroboscopic devices, so that an adequate rating of relay characteristics is possible with either type of measuring equipment.

Both equipment types agree well in their indication of distortion and bounce with contact make.


Erläuterung des Schirmbildes
Bildverschiebung
Ein
Verzerrung
Umpolung
Prüfrelais

2

Block diagram of cathode ray relay tester

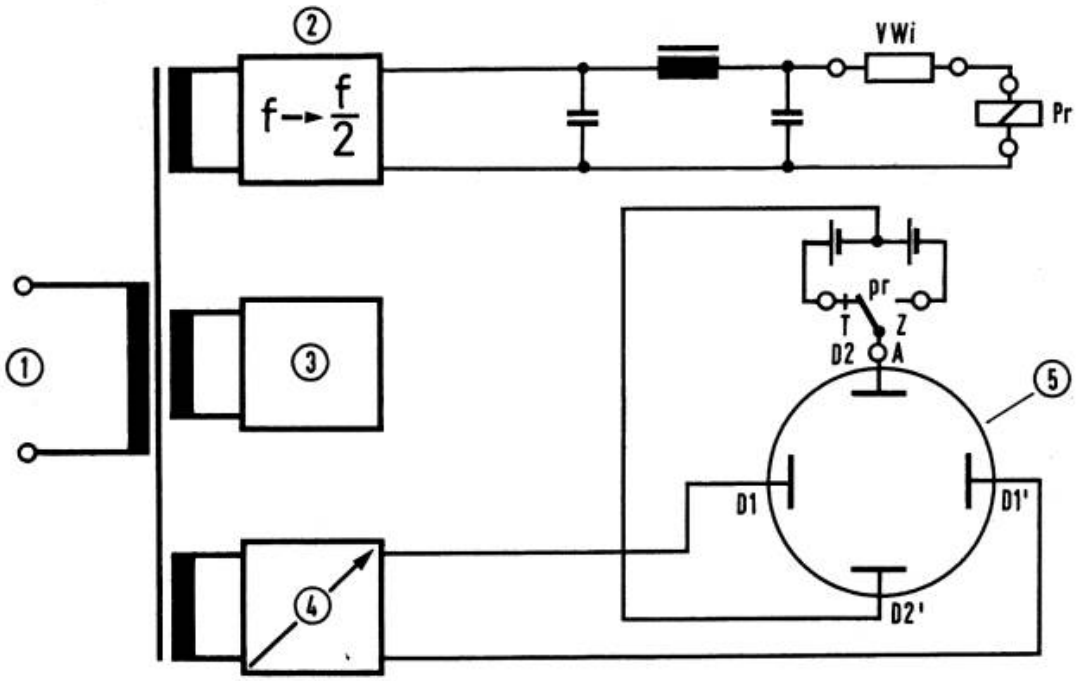
(1) = mains voltage
(2) = frequency divider
(3) = power supply
(4) = phase shifter
(5) = cathode ray tube

3

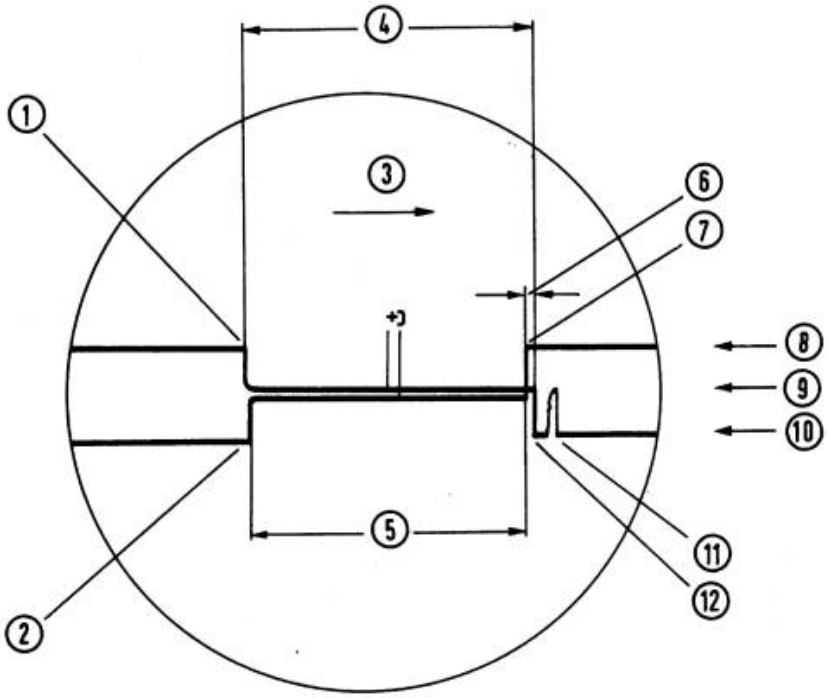
Screen image of the cathode ray relay tester

(1) = armature opens contact T
(2) = armature opens contact Z
(3) = time
(4) = stroke time to contact Z
(5) = transfer time to contact T
(6) = bias distortion resulting from difference in make times
(7) = armature closes contact T
(8) = armature rests on contact T
(9) = armature transition
(10) = armature rests on contact Z
(11) = contact bounce
(12) = armature closes contact Z

+) For a better understanding the two lines are shown one above the other.



2



3

4

Time diagram of test relay

a = undistorted

b = 5% distortion
(make time of armature on
contact T longer than on contact Z)

① = screen image

② = overload

③ = width of screen area

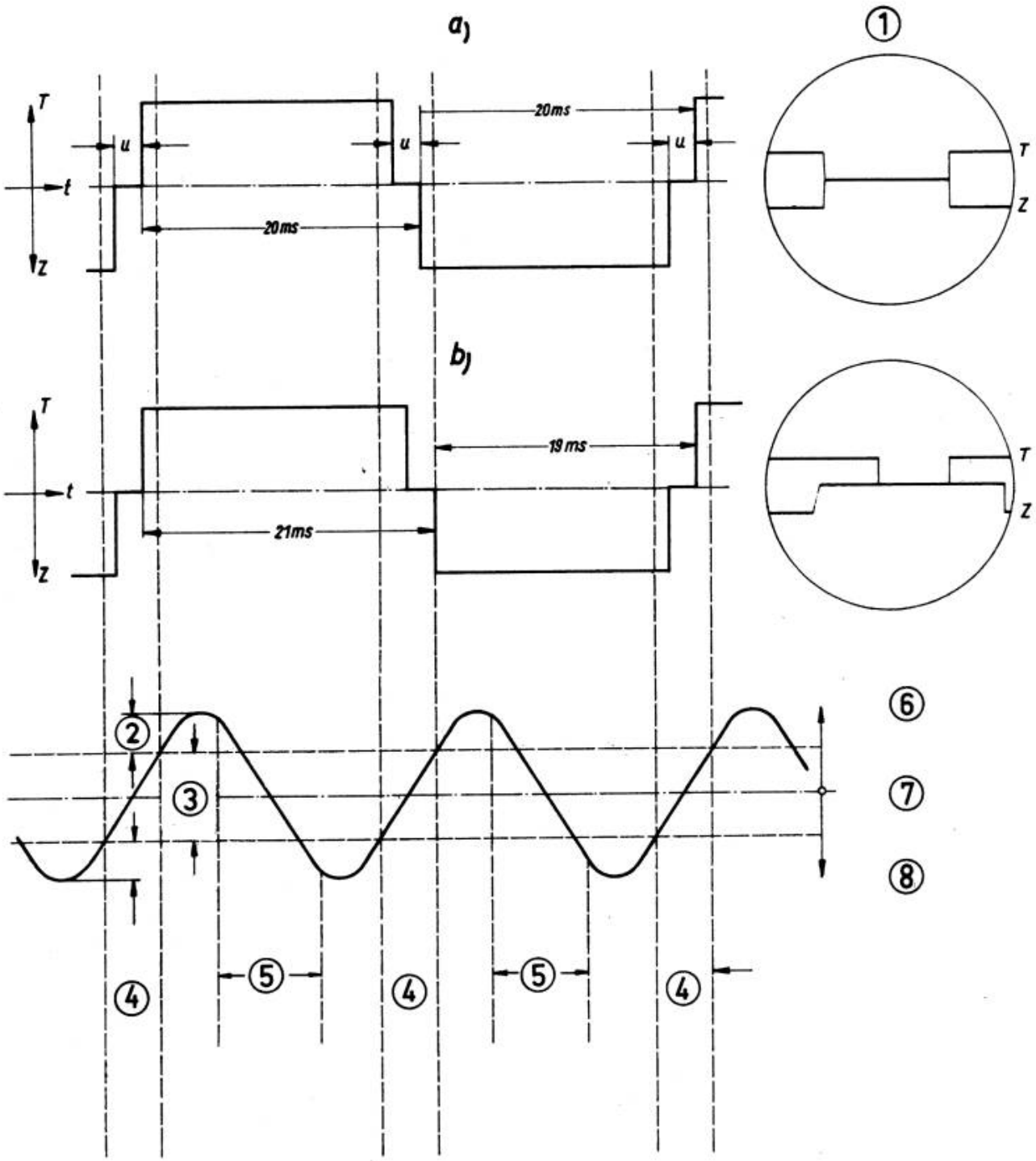
④ = visible section

⑤ = blanked section

⑥ = beam deflected to the right

⑦ = horizontal deflection

⑧ = beam deflected to the left


a)
b)
T
t
Z
u
20ms
19ms
21ms
①
②
③
④
⑤
⑥
⑦
⑧

5
Block circuit diagram

(1) = mains 110, 125, 150, 220 and 240 v AC, 50 c/s (special design 60 c/s)

(2) = link 1 . . . 2

(3) = links 2 . . . 3, 4 . . . 5

(4) = reversal of polarity

(5) = armature transfer T to Z

(6) = distortion measurement

(7) = armature transfer Z to T

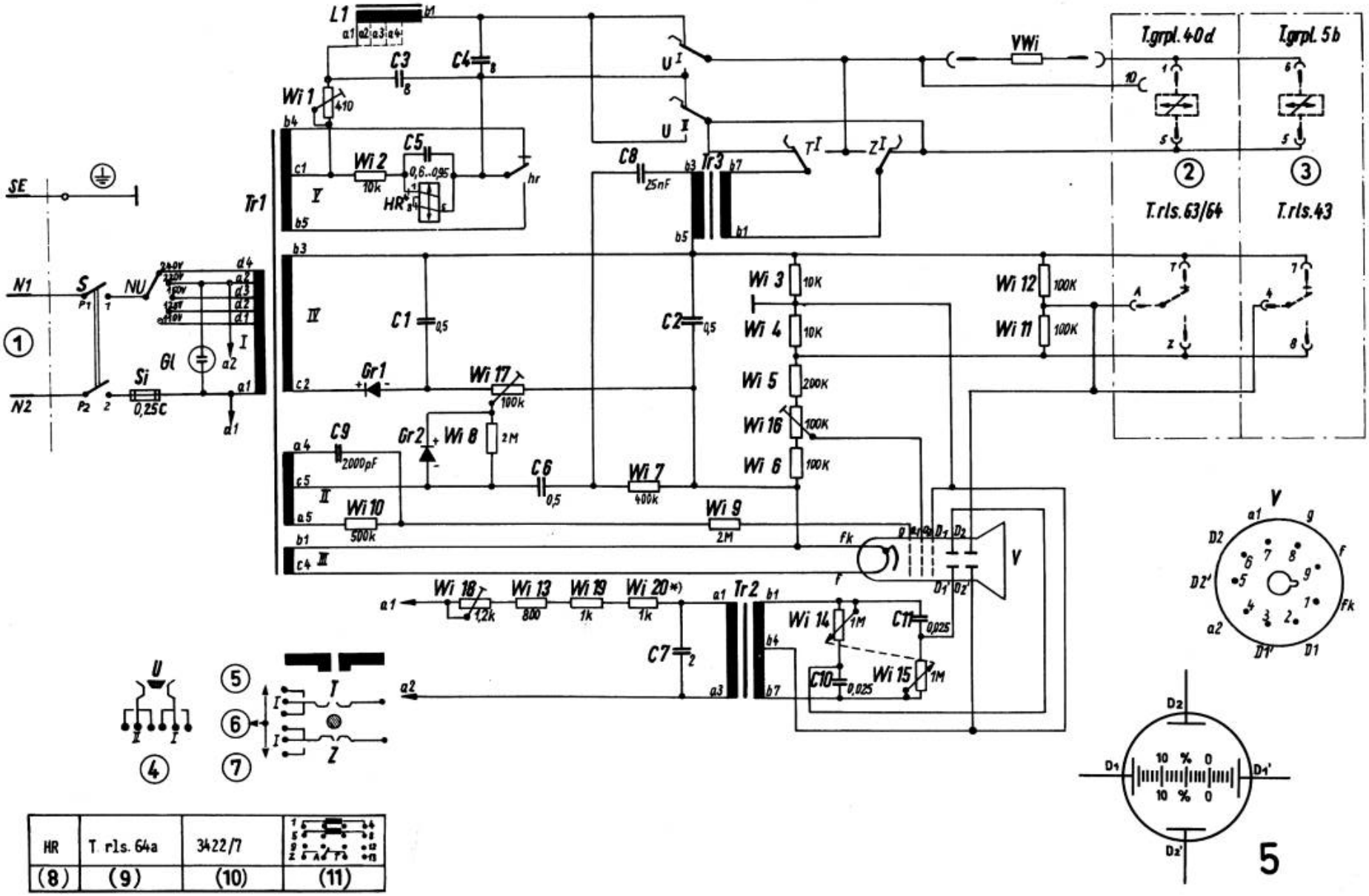
(8) = designation

(9) = type

(10) = specification

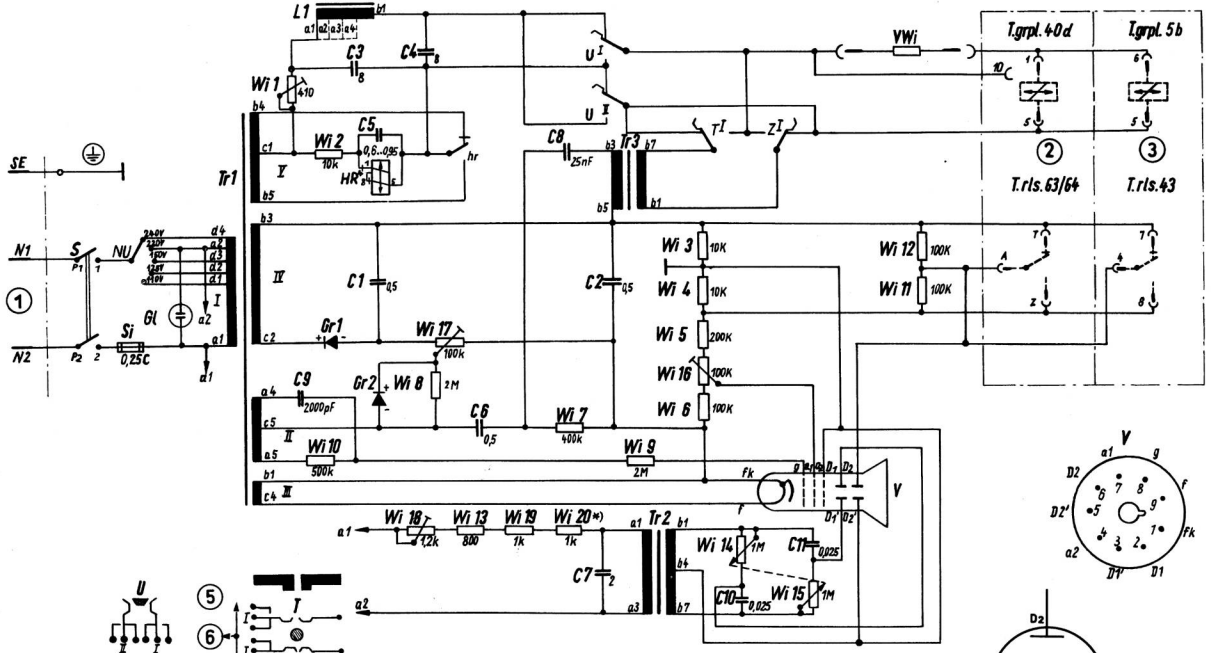
(11) = wiring

*) = with operation from 60 c/s mains, resistor Wi 20 = 600 ohms

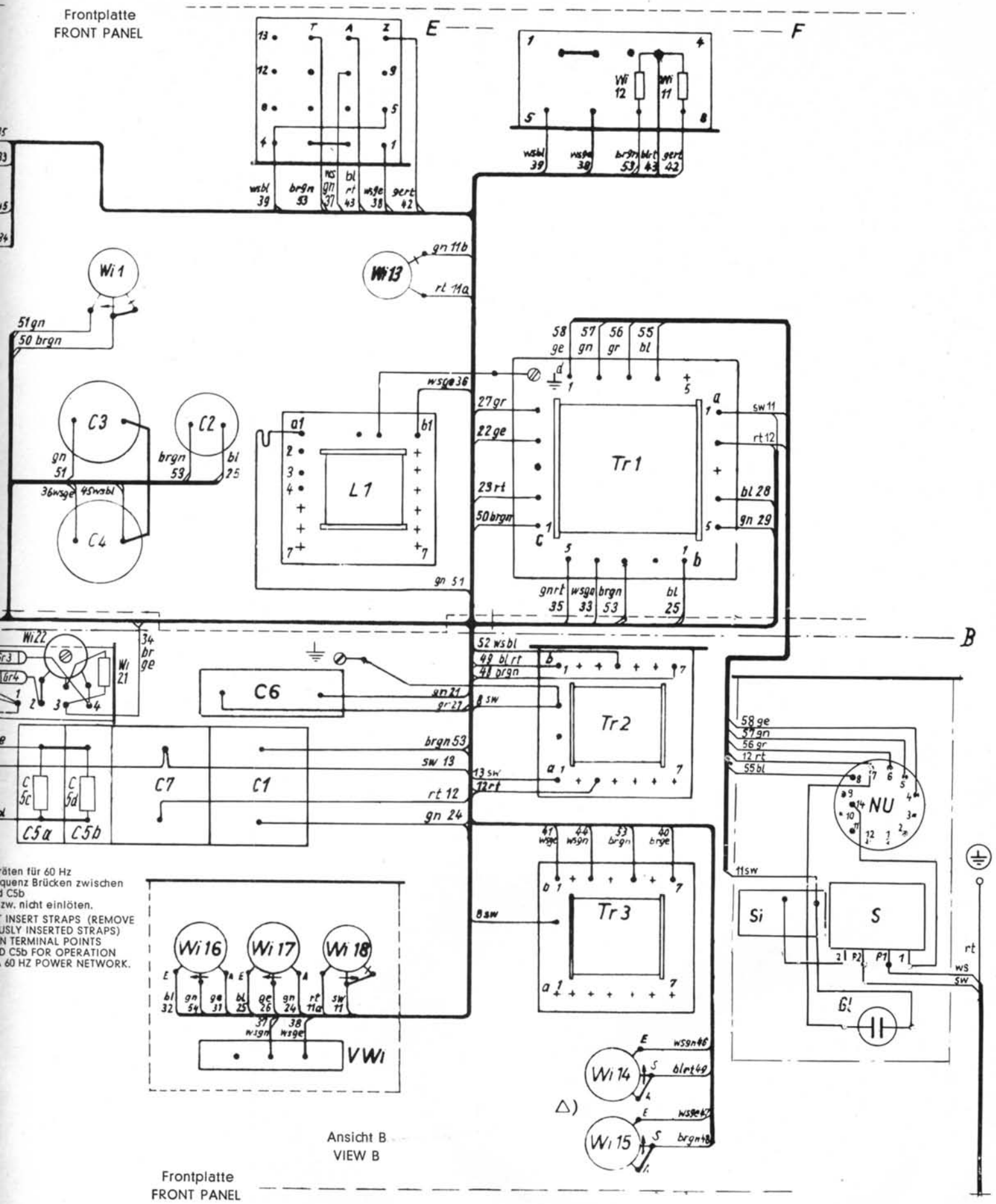


HR	T rls. 64a	3422/7	
(8)	(9)	(10)	(11)

5



HR	T rls. 64a	3422/7	
(8)	(9)	(10)	(11)



räten für 60 Hz
quenz Brücken zwischen
d C5b
zw. nicht einlöten.
T INSERT STRAPS (REMOVE
USLY INSERTED STRAPS)
N TERMINAL POINTS
D C5b FOR OPERATION
60 HZ POWER NETWORK.

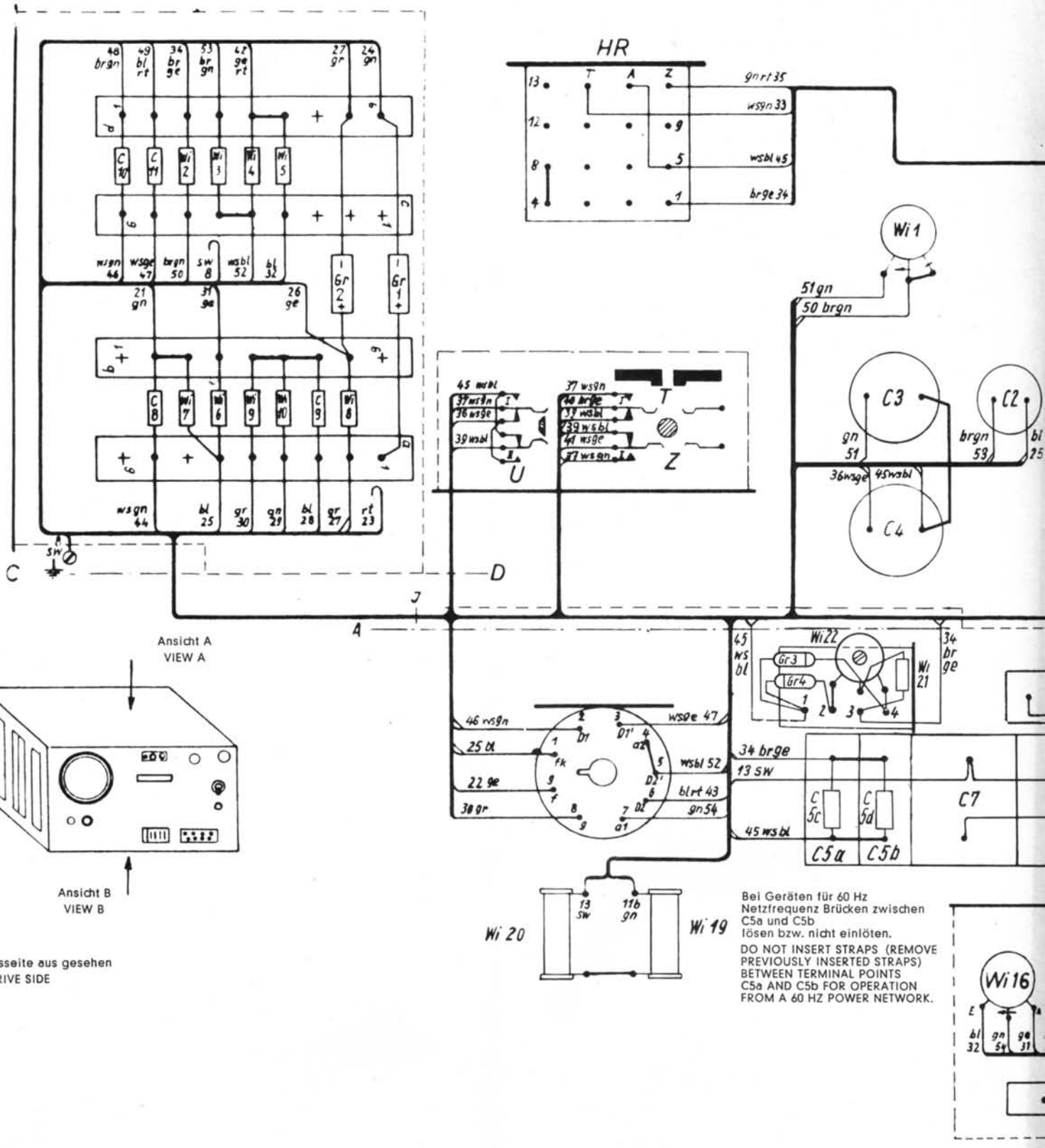
△)

Kathodenstrahlrelaisprüfer
CATHODE RAY RELAY TESTER
9 T mse 109a

Fs Ms 5634/10 V

Frontplatte
FRONT PANEL

Ansicht A
VIEW A



Bei Geräten für 60 Hz Netzfrequenz Brücken zwischen C5a und C5b lösen bzw. nicht einlöten.

DO NOT INSERT STRAPS (REMOVE PREVIOUSLY INSERTED STRAPS) BETWEEN TERMINAL POINTS C5a AND C5b FOR OPERATION FROM A 60 HZ POWER NETWORK.

△) Von der Antriebsseite aus gesehen
VIEWES FROM DRIVE SIDE

Frontplatte
FRONT PANE