

Brüel & Kjær

X-Y Recorder

Type 2308

Valid from serial no. 678214

036-0305

STABRO



Service

DIGITALY REMASTERED
OUT OF PRINT
TEST EQUIPMENT MANUAL SCANS

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X-Y Recorder

Type 2308

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Spare Parts

Please state type and serial number of the instrument when ordering spare parts.

Trouble Shooting

If any fault should occur, check the instrument according to the Checking Procedure.

The Checking Procedure is divided up into sections, where each section will refer to a subsection in the Service Instruction corresponding to a specific part of the instrument.

The subsection in the Service Instruction will normally consist of a Block Diagram, a Technical Description, an Adjustment Procedure and a Simplified Diagram where the test points are identified.

Before correction any apparent deviation make sure that the measuring instrument has tolerances small enough not to affect the measurement.

When a fault has been traced and corrected, the voltages and adjustments influenced by the correction must be rechecked. The complete instrument should then be tested to make sure that all basic functions are operative.

The tolerances given in these notes are intended for use as guide for adjustments.

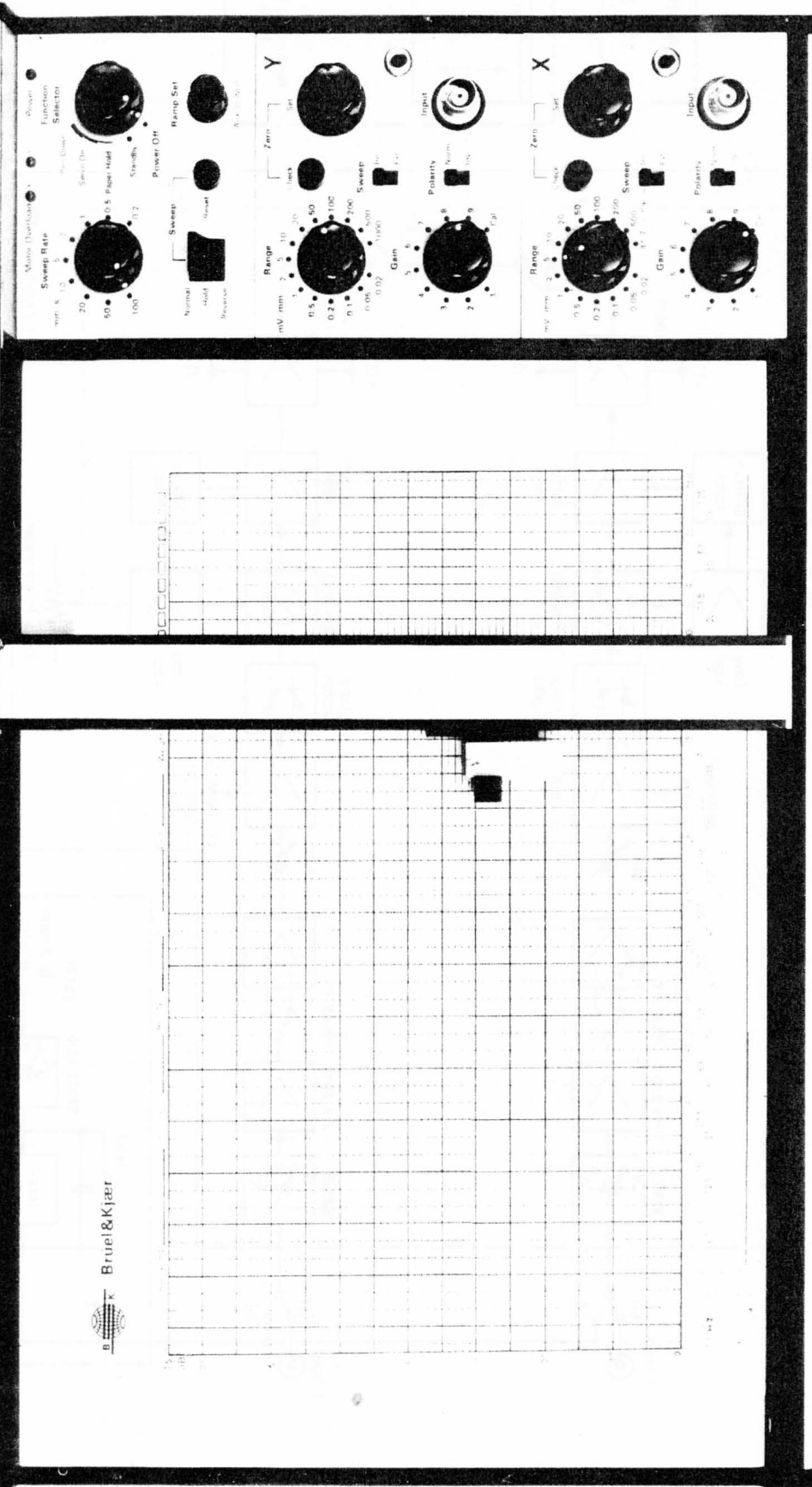
Updating

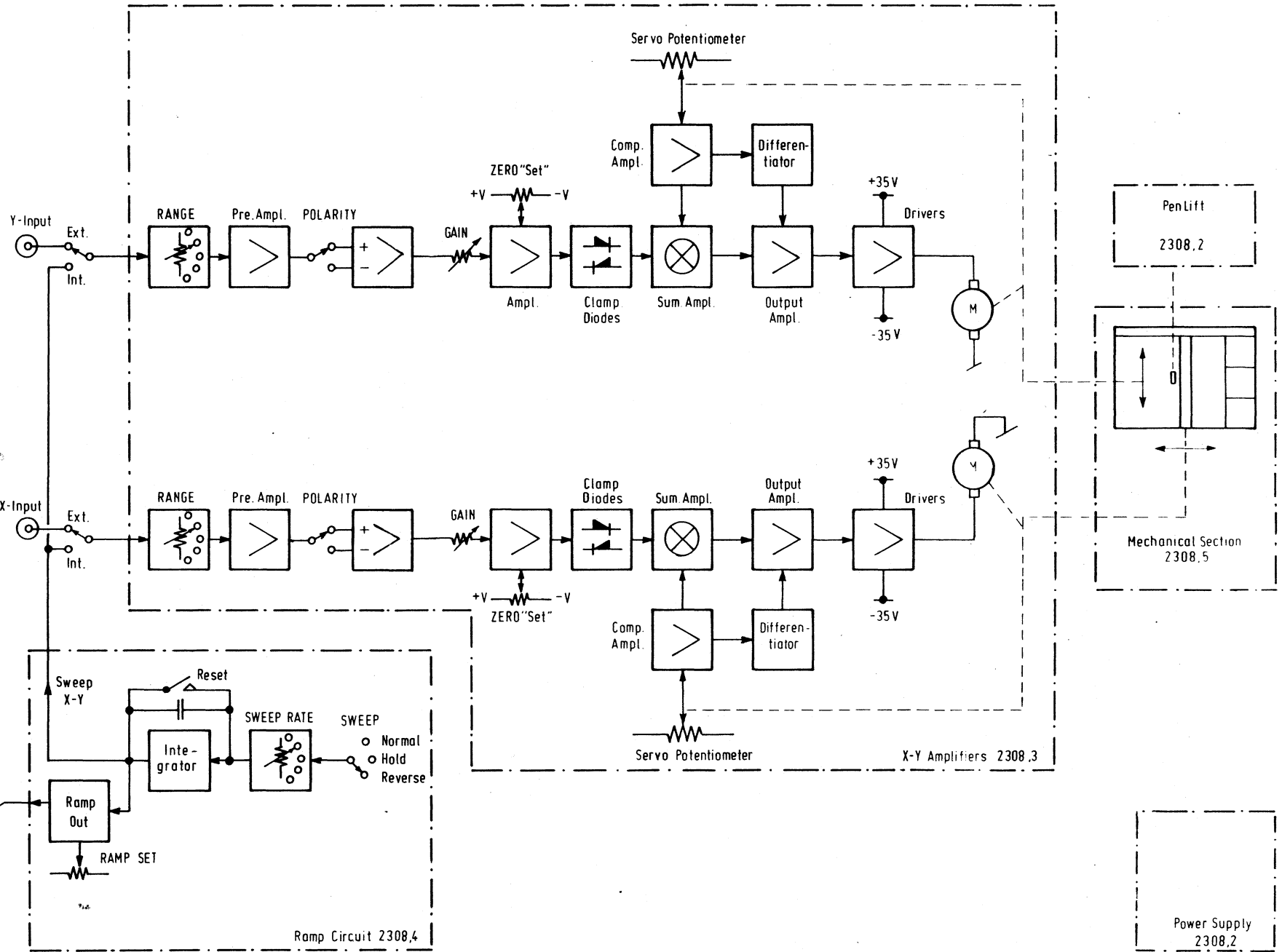
Due to the constant progress in technology the instrument will from time to time be brought up to date in order to provide continuously improved performance.

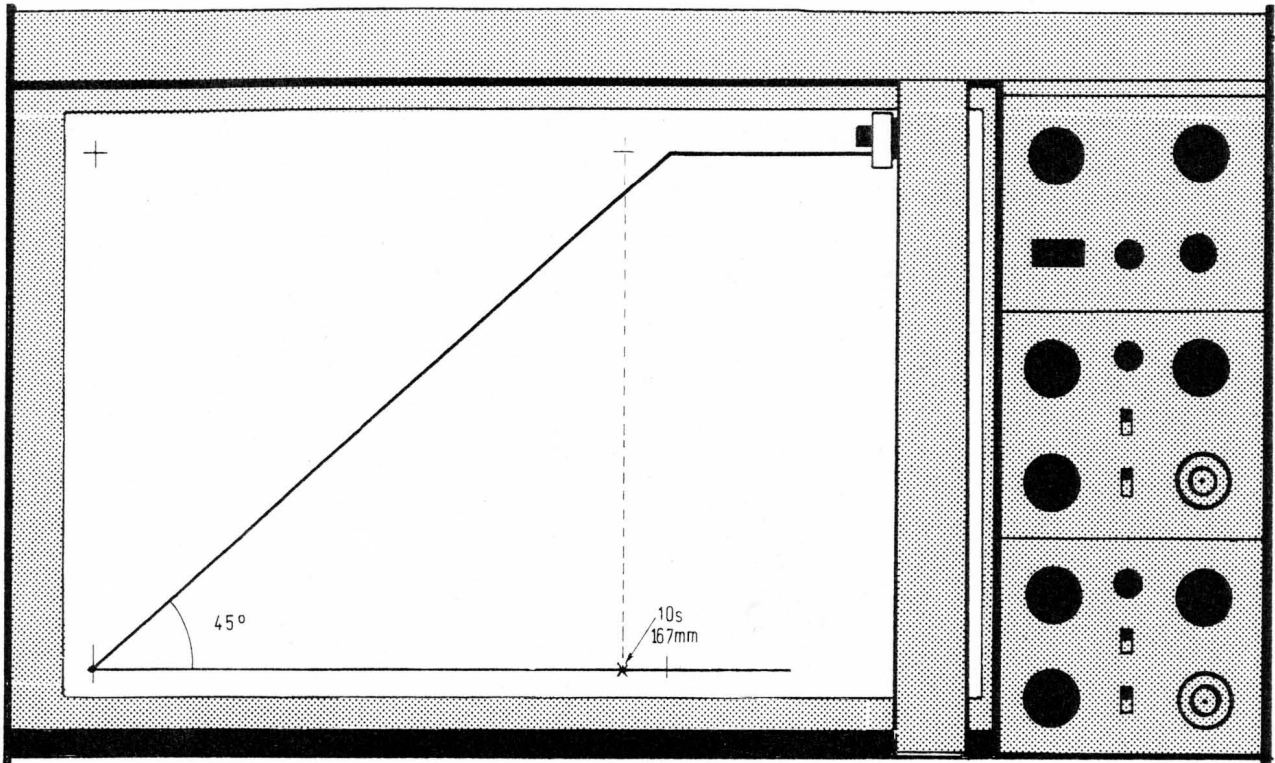
For this reason there may be small variations between the instrument and the Service Instruction.

However, the local Service Representative is in possession of all informations regarding any change that has been made.

X Y Recorder Type 2308







Function Check

FUNCTION SELECTOR: "Servo On"
SWEEP RATE: "2 mm/s"
SWEEP: "Hold"

X-Channel

RANGE: "5 mV/mm"
GAIN: "Cal."
SWEEP: "Int."
POLARITY: "Norm"

Y-Channel

RANGE: "5 mV/mm"
GAIN: "Cal."
SWEEP: "Int."
POLARITY: "Norm"

SWEEP to "Ext."

During the following Function Check the Sensitivity, Sweep Rate, Sweep Mode and Linearity is included.

Press SWEEP "Reset"

Adjust X-ZERO "Set" to the arm is 5 mm from the left hand stop.

Adjust Y-ZERO "Set" to the pen is 5 mm from minimum deflection.

Switch FUNCTION SELECTOR to "Pen Down"

SWEEP to "Normal"

Refer to the picture above and check as follows:

Ramp angle: $45^\circ \pm 1^\circ$

If not consult 2308.3

X-Arm movement: 167 mm in $10\text{ s} \pm 1\text{ s}$.

If not consult 2308.4

Move the pen and the arm to both end stop positions by means of ZERO "Set". Switch the FUNCTION SELECTOR to "Stand by" and check that the arm and pen was stopped 5 mm before the mechanical stop.

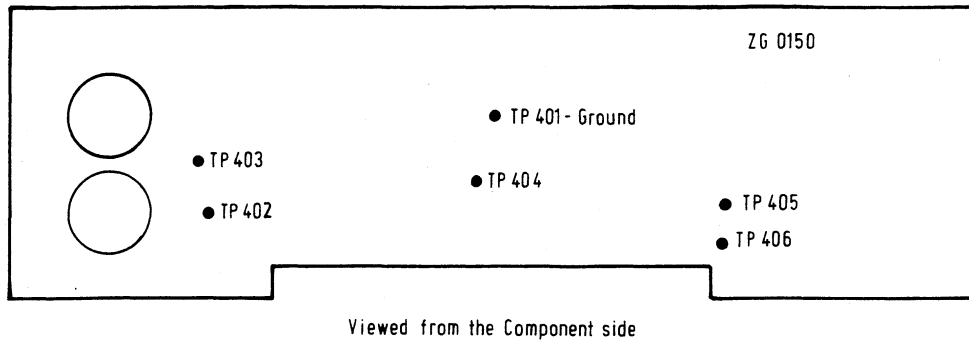
If necessary consult 2308.2

Check that the electrostatic paper hold function is working in FUNCTION SELECTOR positions "Paper Hold", "Servo On" and "Pen Down".

If not consult 2308.2

Check that pen lift is activated every time SWEEP "Reset" is depressed.

If not consult 2308.3



2.1. Voltage Check

FUNCTION SELECTOR: "Paper Hold"

Check the voltages at the following test points:

TP 402 = + 15 V \pm 0,2 V

TP 403 = -15 V \pm 0,2 V

TP 404 = + 5 V \pm 0,01 V

TP 405 = (+ 400 V) + 170 V \pm 30 V

TP 406 = (-400 V) - 170 V \pm 30 V

Notice: The above 400V adjustments are measured with a 10 M Ω DV Voltmeter thus the voltages should be approx. 170 V due to the 10 M Ω load.

Check the voltages to the X and Y Amplifiers:

+ 35 V \pm 3,5 V }
- 35 V \pm 3,5 V } at the 4700 μ F and 1000 μ F capacitors on ZG 0162

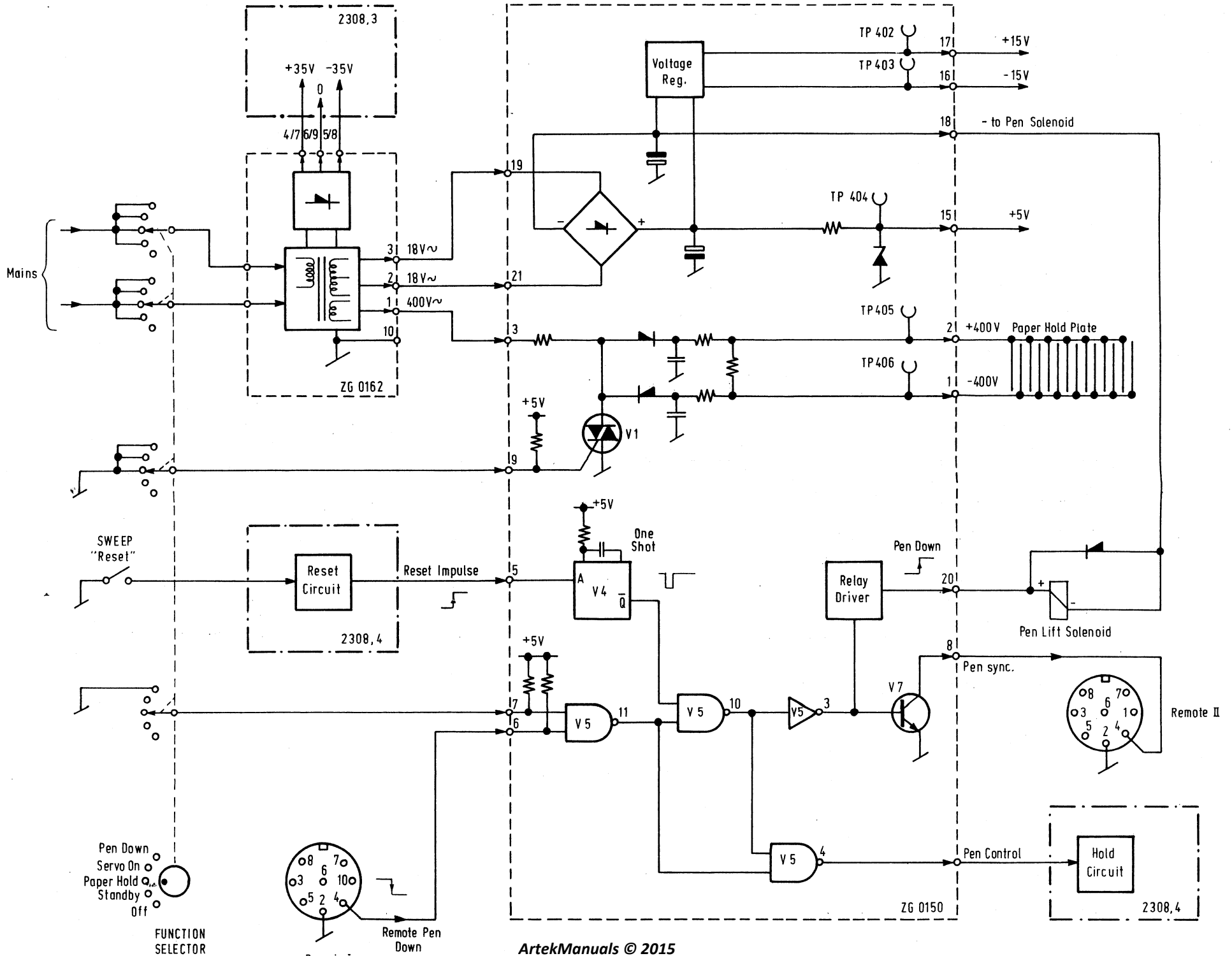
2.2. Pen Control

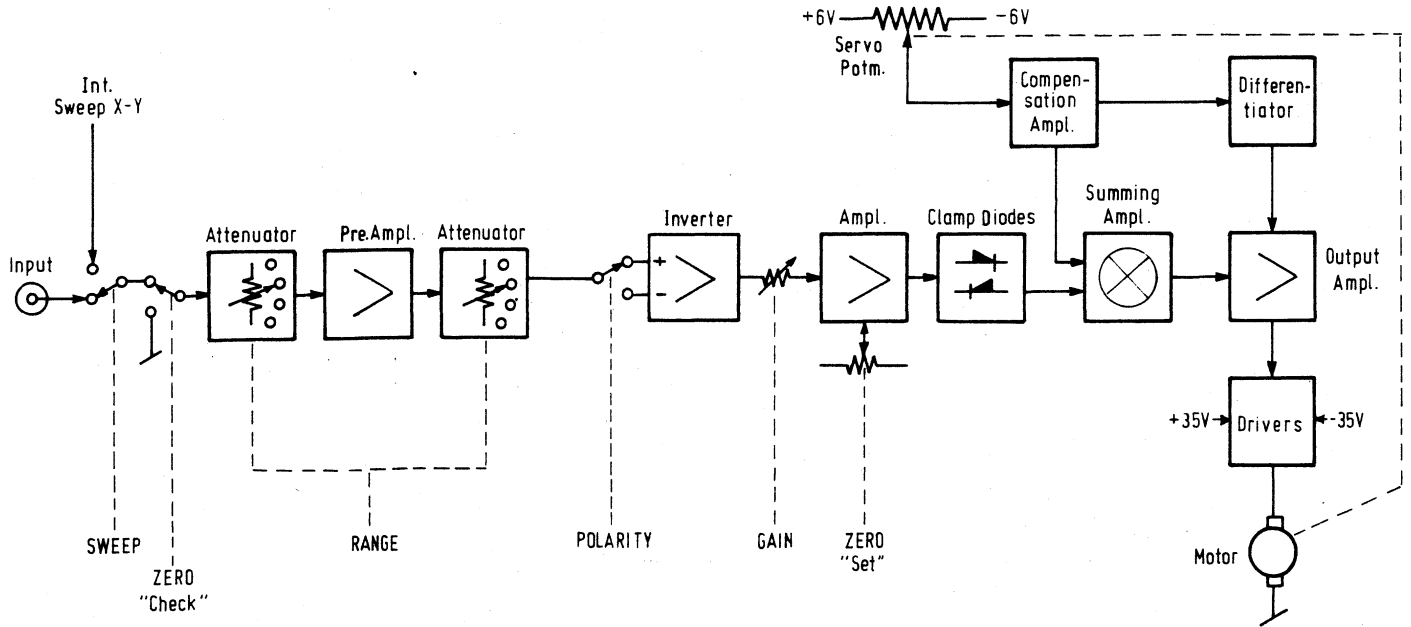
SWEEP: "Hold"

FUNCTION SELECTOR: "Pen Down"

Check that the Pen is down.

Press SWEEP "Reset" and check that the pen is shortly lifted of the paper.





Technical Description

The X and Y amplifiers which are almost identical works as follows:

The input signal is fed to an Attenuator a Preamplifier and an Attenuator in both the X and Y channels. The only difference between the X and Y Preamplifiers ZN 0226, ZN 0227 is that the Y Amplifier has a sensitivity up to 1000 mV/mm where as the X Amplifier has a sensitivity up to 500 mV/mm.

The output of the Attenuator can by means of the POLARITY switch, be either normal or inverted. The signal is then fed to a gain and off-set controlled Amplifier, the output of which goes to the Clamp Diodes on ZE 0240, ZE 0241.

ZE 0240 and ZE 0241 are identical except for some resistors which can be found on the original diagram ZE 0240, ZE 0241, Note 1.

The Clamp Diodes are working as an electronic stop of the pen and arm movements at the limits of the possible movements. The stop points can be adjusted by the potentiometers P201 and P202.

The signal from the Clamp Diodes is now summed with a DC voltage taken from the Compensation Amplifier which again is controlled by the Servo Potentiometer.

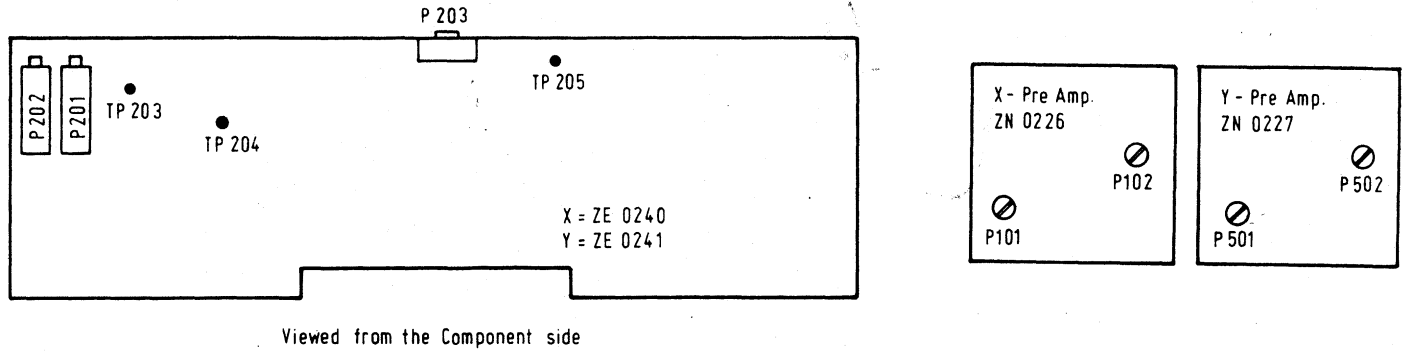
The output of the Summing Amplifier which can be between 0 and 6V is fed through an Output Amplifier to the Drivers which drive the Motor.

The Motors which drive the Y pen or the X arm are mechanical connect ed to the Servo Potentiometers.

The Servo Potentiometer gives a voltage between +6V and -6V to the Compensation Amplifier, depending of the position of the pen or arm. This voltage is then compared to the input voltage in the Summing Amplifier and when the two voltages are equal the output of this amplifier will be zero which again stops the motor.

The output of the Summing Amplifier will not exceed 6V due to two zener diodes at the output, and as the amplification of the Output Amplifier is 4 the motor voltage will not exceed 24V in order to protect the motor.

The output of the Compensation Amplifier also fed a Differentialiator the output of which is used to control the maximum speed of the pen or arm.



Adjustment Procedure

The adjustment of the X and Y Amplifiers is identical except the Writing Speed adjustments which will be described separately.

3.1. Pre Ampl.

- a. SWEEP: "Ext."
 RANGE: "0,05 mV/mm"
 GAIN: "Cal."
 FUNCTION SELECTOR: "Pen Down"
 SWEEP RATE: "2 mm/s"
 SWEEP: "Hold"

Shortcircuit the "Input" socket to ground and adjust ZERO "Set" for an arm position within the writing area.

Change POLARITY between "Norm" and "Inv."

The arm movement should be less than 2 mm.
 If not adjust P X01. (ZN 0226 and ZN 0227)

Remove the "Input" shortcircuit.

- b. RANGE to "10 mV/mm"
 POLARITY to "Norm"
 SWEEP to "Int."

Connect a DC Voltmeter to "Remote II" socket pin 8.

Activate SWEEP "Reset"

Switch SWEEP to "Normal". When the ramp voltage has increased to $1,5V \pm 15mV$ on pin 8, set SWEEP to "Hold".

Activate ZERO "Check" and keep it down.

Set the arm to the left position (X Amplifier) or the pen to the minimum deflection (Y Amplifier) by means of ZERO "Set".

Release ZERO "Check" and measure the distance of arm (pen) movement.
 The distance should be: $150mm \pm 0,2mm$

If necessary adjust P X02. (ZN 0226 and ZN 0227).

Check that all other RANGE positions are within $\pm 0,2\%$ of full scale.

3.2. Writing Width

- SWEEP: "Ext."
 RANGE: "10 mV/mm"
 POLARITY: "Normal"
 GAIN: "Cal."
 FUNCTION SELECTOR: "Servo On"

Move the arm or pen by means of the ZERO "Set" to the left position or minimum deflection respectively.

Switch FUNCTION SELECTOR to "Stand by" and check that the arm (pen) was stopped 5 mm before the mechanical stop.

If not adjust P201. (ZE 0240/41.)

Check as above that the arm or pen stops 5 mm before the mechanical stop to the right or maximum deflection respectively.

If necessary adjust P202 (ZE 0240/41).

3.3. Motor Overload

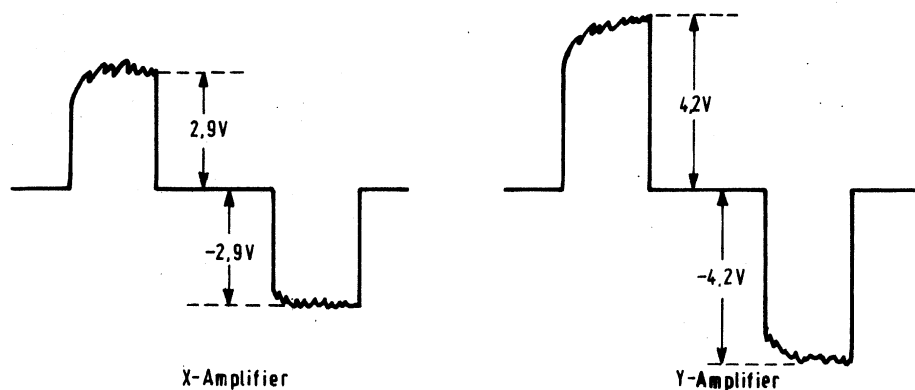
- FUNCTION SELECTOR: "Servo On"

Shortcircuit pin 18 (ZE 0240/41) to ground

Check that the "Motor Overload" lights up.

Check that the arm and pen can be moved freely

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The following adjustments of the max writing speed can only be done by means of a Storage Oscilloscope or a Meter with Peak Hold facilities.
If such an instrument is not available consult 3.6.

3.4. Writing Speed X Channel

- SWEEP: "Ext."
POLARITY: "Normal"
GAIN: "Cal."
RANGE: "2 mV/mm"
FUNCTION SELECTOR: "Pen Down"
SWEEP RATE: "1 mm/s"
SWEEP "Hold"
- SWEEP to "Int."

Depress ZERO "Check" and adjust by means of ZERO "Set" the arm to the left position.
Make a mark on the paper of the arm position.

Adjust by means of SWEEP "Normal", "Reverse" the arm to a position of 200 mm to right of the mark.

Connect the Storage Oscilloscope or the Peak Hold Meter to TP 204.
Depress ZERO "Check" and read the amplitude of the peak: $2,9V \pm 0,2V$.
Release ZERO "Check" and read the amplitude: $-2,9V \pm 0,2V$.
If necessary adjust P203. (ZE 0240).

3.5. Writing Speed Y Channel

- SWEEP: "Ext."
POLARITY: "Normal"
GAIN: "Cal."
RANGE: "2 mV/mm"
FUNCTION SELECTOR: "Pen Down"
SWEEP RATE: "1 mm/s"
SWEEP: "Hold"
- SWEEP to "Int."

Depress ZERO "Check" and adjust by means of ZERO "Set" the pen to minimum deflection.
Make a mark on the paper of the pen position.

Adjust by means of SWEEP "Normal", "Reverse" the pen to a position of 150 mm above the mark.

Connect a Storage Oscilloscope or a Peak Hold Meter to TP 204.
Depress ZERO "Check" and read the amplitude of the peak: $4,2V \pm 0,2V$.
Release ZERO "Check" and read the amplitude: $-4,2V \pm 0,2V$.
If necessary adjust P203 (ZE 0241)

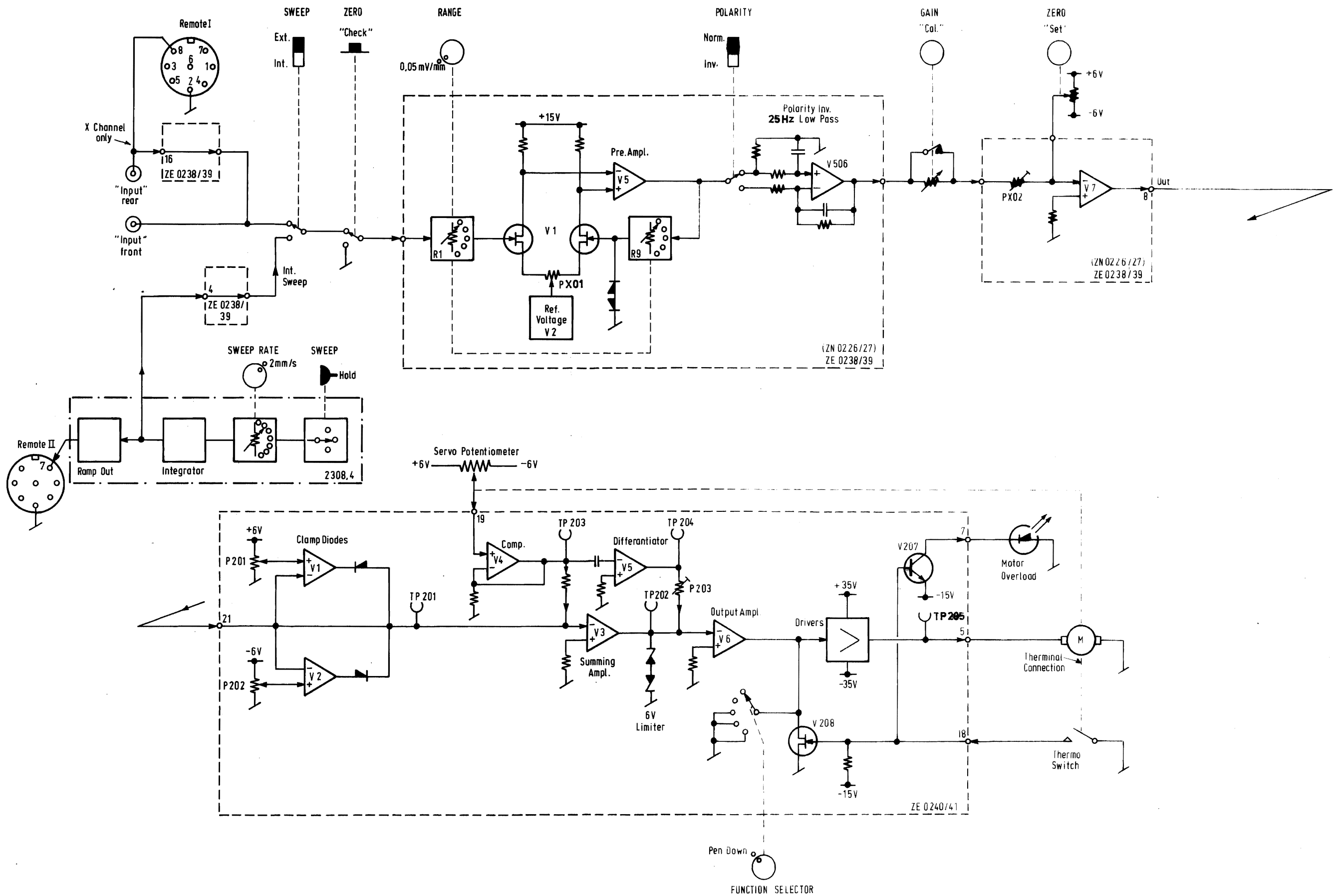
3.6. Writing Speed comparison

Y-X-RANGE "0,02 mV/mm"
GAIN: "Cal."
POLARITY: "Normal"
SWEEP: "Int."
SWEEP: "Normal"
FUNCTION SELECTOR: "Pen Down"

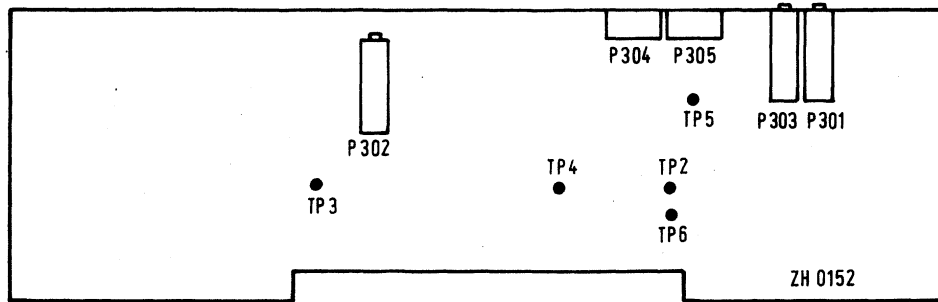
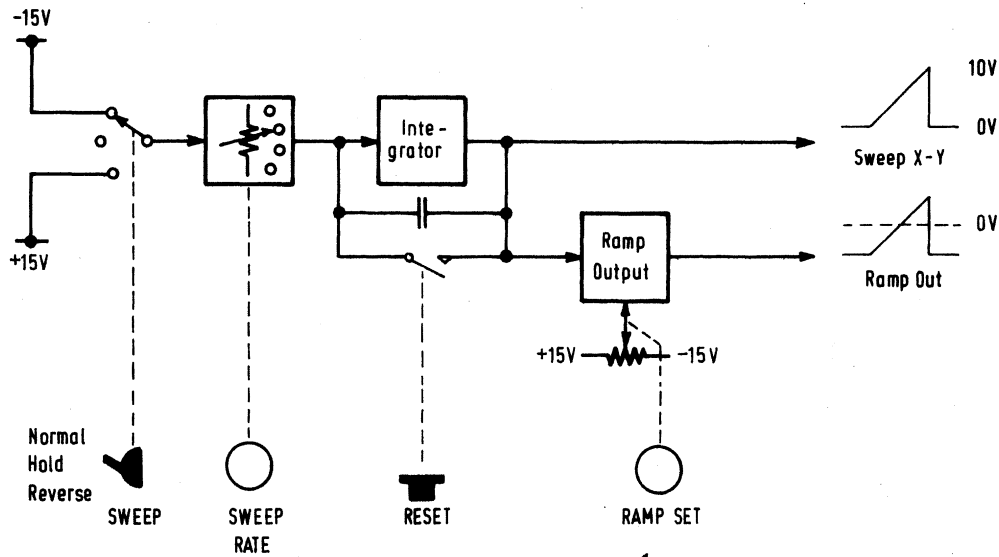
Depress X-Y ZERO "Check" and release both at the same time.

Check the angel of the written line: approx. 45° .

If not the defective amplifier should be adjusted.
(P203 at ZE 0240/41).



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Viewed from the component side

Ramp Adjustment

SWEEP RATE: "100 mm/s"
SWEEP: "Normal"
FUNCTION SELECTOR: "Servo On"

Turn P305 fully clockwise.

Depress "Reset" and set SWEEP to "Hold" when the ramp voltage has increased to approx. 3V at TP5.

Adjust P302 to $0V \pm 50 \mu V$ at TP3.

SWEEP to "Normal"

Adjust P304 to: $+10,1 V \pm 50 mV$ at TP5

SWEEP to "Reverse"

Adjust P305 to: $-100 mV \pm 50 mV$ at TP5

SWEEP RATE to "5 mm/s"
SWEEP to "Hold"

Activate "Reset" and set SWEEP to "Normal"
Measure the time between 1 V and 10 V at TP5: $43,2 s \pm 0,5 s$.
If necessary adjust P301

SWEEP to "Reverse"

Measure the time from 10 V to 1 V: $43,2 s \pm 0,5 s$.
If necessary adjust P303

SWEEP to "Hold"

Activate "Reset"
Check at TP6 that the "Ramp Out" can be varied between: $+10,5 V$ and $-10,5 V \pm 0,5 V$ by means of RAMP SET.

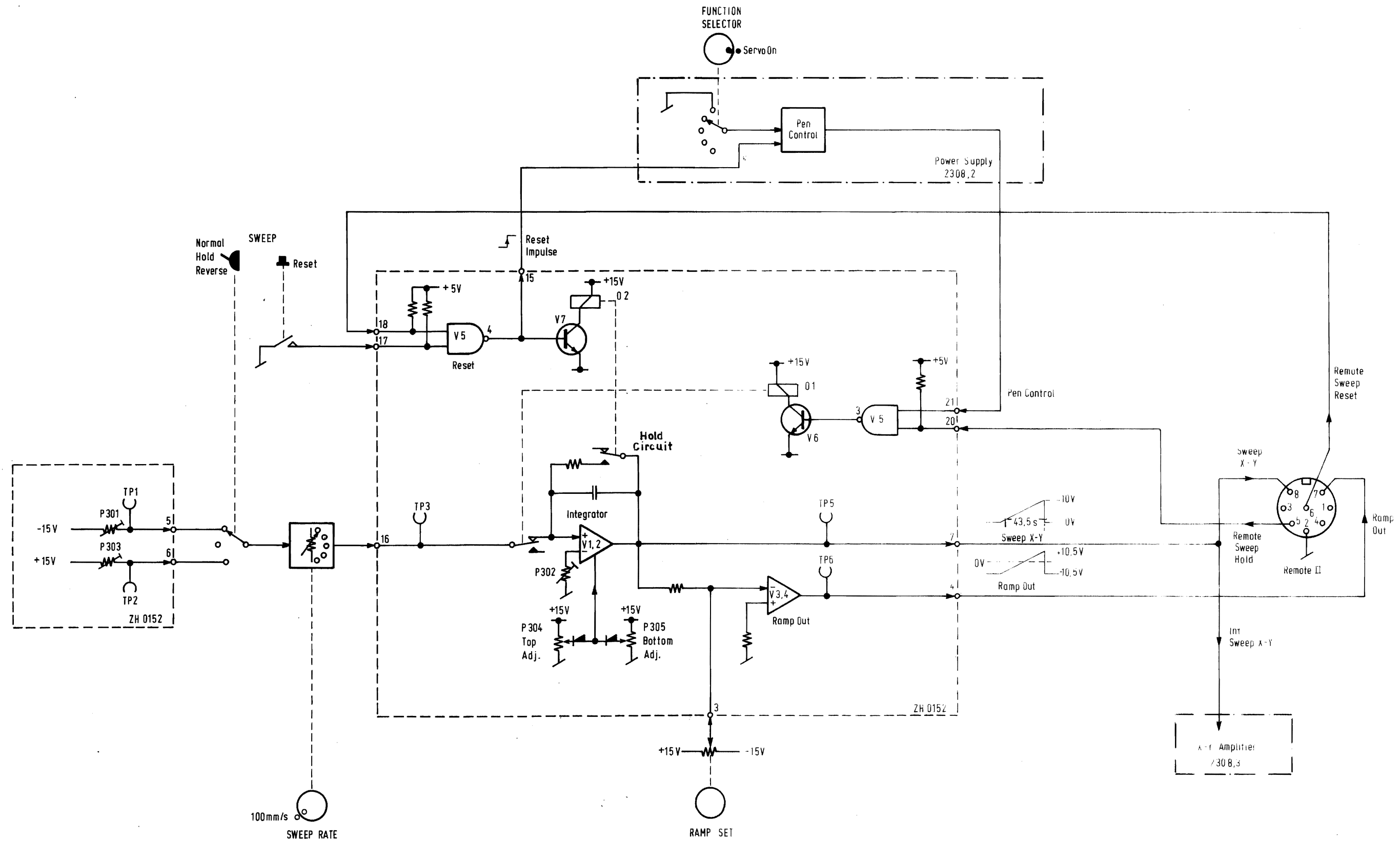


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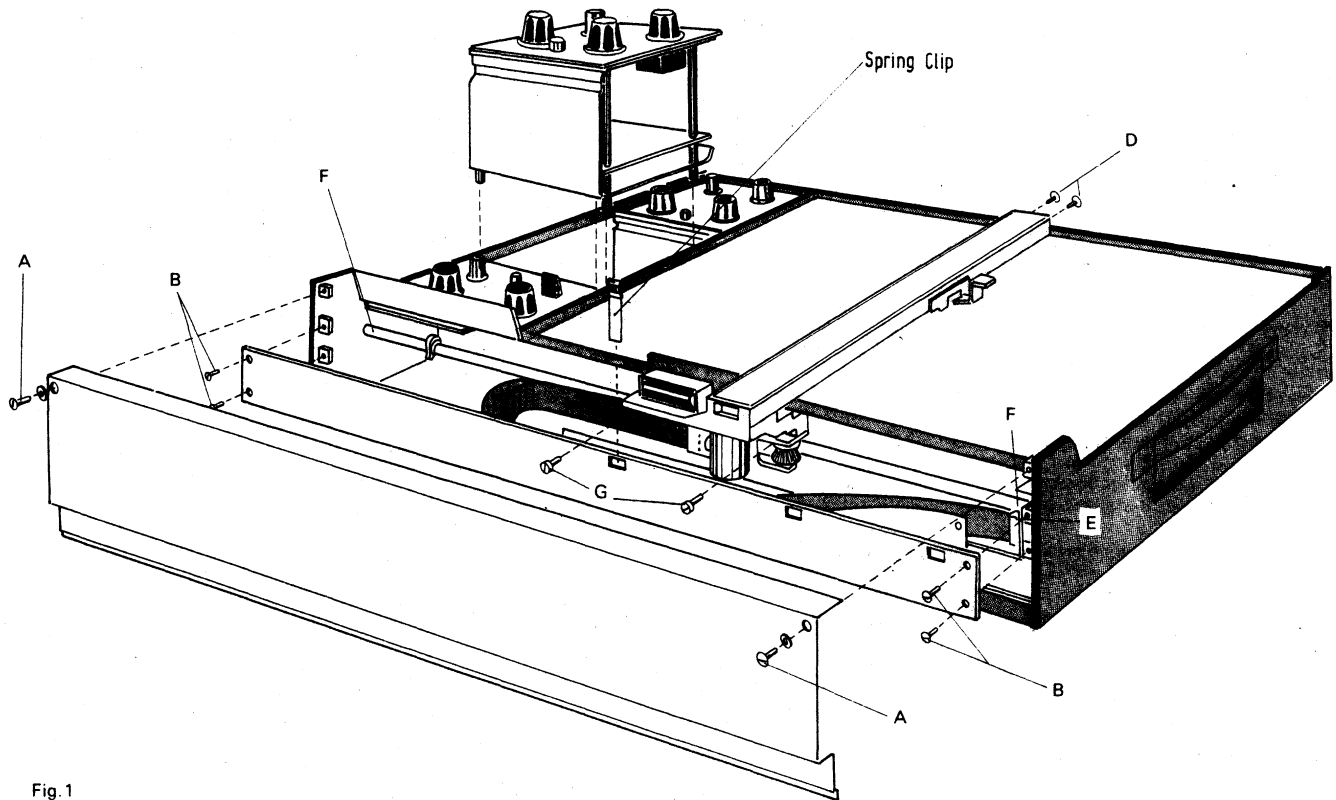


Fig.1

5.1. Removal of back cover, bottom cover and cable guide

Access to various parts of the recorder require removal of the Rear Cover, Cable Guide and Bottom Cover. Proceed as follows:

Rear Cover — remove two M3 × 6 screws with washers marked A.

Cable Guide — pull out the three spring slips, remove four M2.5 × 6 screws marked B.

For assembly place the cable guide in position with the steel guard band underneath. Before tightening the four screws B, align the steel band parallel with the edge of the cover. Insert the three spring slips and position the flexible cable parallel to the steel band. Pull the flexible cable tight.

Bottom Cover — loosen four M2 × 4 screws and lift off cover.

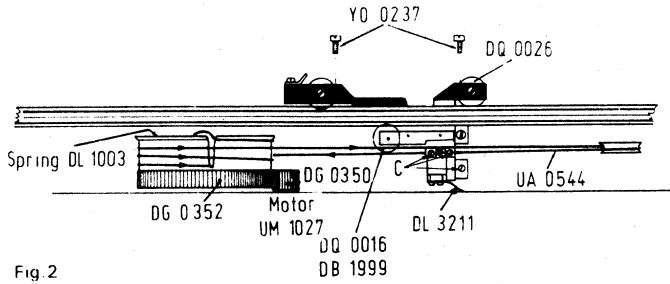


Fig. 2

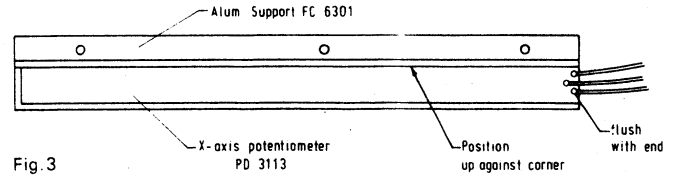


Fig. 3

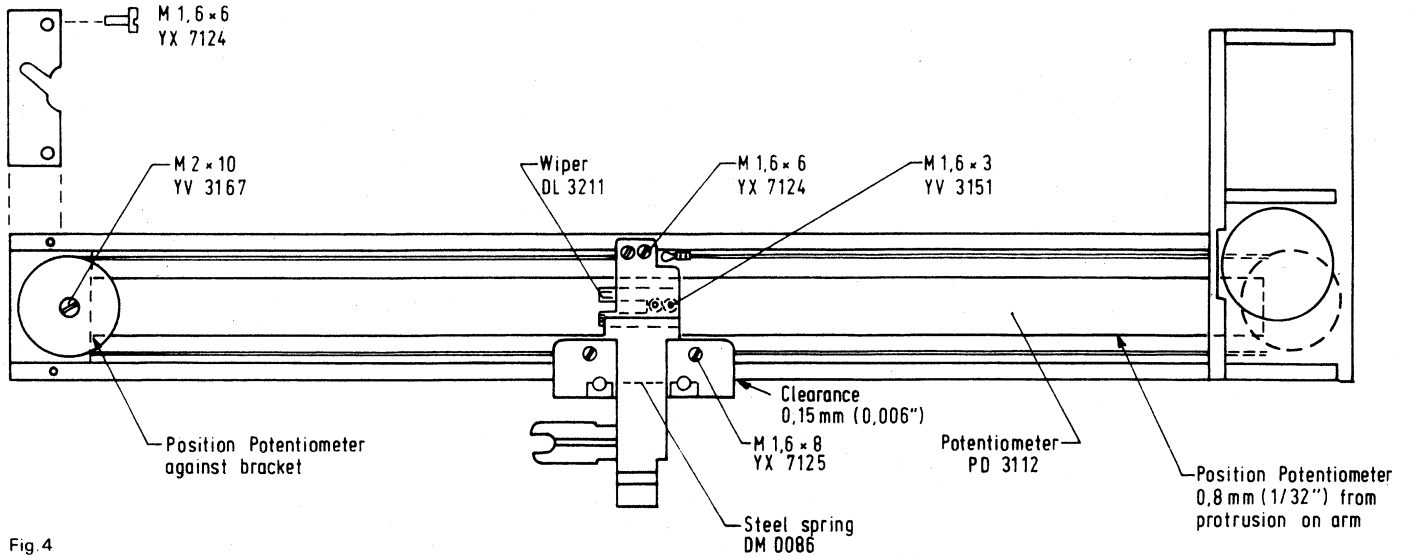


Fig. 4

5.2. Removal of X-carriage assembly

Remove the back cover, the cable guide and bottom cover. Refer to item 5.1.

Loosen the two M2,5 x 4 screws which clamp the X-carriage arm to the X-wire and the one M2,5 x 4 screw which clamps the X-carriage arm to the auxiliary wire two turn. (screws marked C at Fig.2).

Access to the screws are through a hole in the main chassis connecting the two side plates of the recorder frame.

Disconnect the small drive plate at the front end of the carriage arm, by removing the two M2 x 6 screws marked D. Fig.1.

Unplug the flexible cable from the small printed circuit board and remove the two selftapping screws holding the board marked E at Fig.1. Remove the two M3 x 16 screws marked F holding the round X guide rod and carefully slide out the entire X carriage assembly. Be careful not to damage the X-potentiometer wiper when passing the wire.

For reassembly reverse the procedure.

The drive plate at the front end of the X-carriage arm must be mounted before the auxiliary wire is clamped tight.

The X-wire must be positioned with its knot placed in the notch between the two screws of the clamp.

Check that the alignment of the Y-axis is correct. If not refer to item 5.16.

5.3. Removal of X-carriage arm

Remove back cover and cable guide. Refer to item 5.1.

Remove two M2 x 6 screws marked D. Fig.1. Remove two M2,5 x 8 screws with lock washers marked G at Fig.1.

Unplug flexible cable from printed circuit board marked E. Fig.1. Lift off the carriage arm.

For reassembly reverse procedure.

5.4. X-Axis potentiometer replacement

Remove the X-carriage assembly. Refer to item 5.2. Remove the three selftapping screws holding the potentiometer.

Unsolder the three leads from the potentiometer at the terminal board. Note colors.

Slide out potentiometer.

Remove the potentiometer from the support bar with a suitable tool.

Clean off possible remains of adhesive tape from support bar.

Remove protective paper backing on new potentiometer part no. PD 3113 and position it over the support bar. Press firmly in position. Refer to Fig.3.

For reassembly reverse procedure.

5.5. X-Axis wiper replacement

Remove the X-carriage assembly. Refer to item 5.2.

Remove two screws M1,6 x 3 holding wiper to X-carriage arm.

Install new wiper part no. DL 3211. The contact fingers should point towards the left side of the recorder.

Height of contact point over mounting surface in free position should be 4,5 mm (0,178").

For reassembly reverse procedure.

Check that the wiper is positioned correctly and contact the potentiometer properly.

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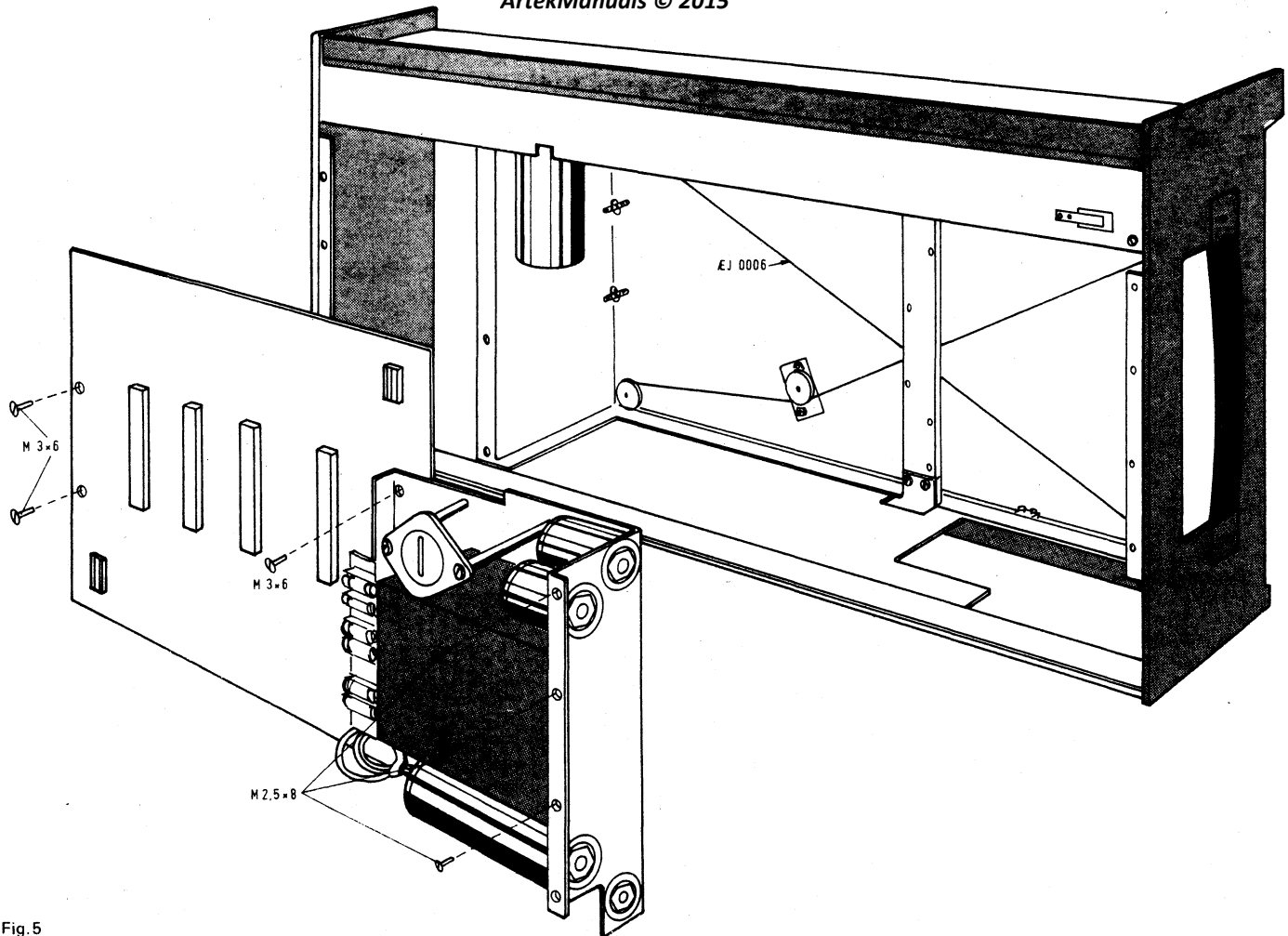


Fig.5

5.6. Y-Axis potentiometer replacement

Remove back cover and cable guide, refer to item 5.1.

Remove X-carriage arm, refer to item 5.3.

Remove two M1,6 × 6 screws holding the small guide piece for the pen lift bar at front end of the carriage arm. Swing bar free from assembly.

Remove the pen assembly by removing the two M1,6 × 8 screws with washers and loosening two M1,6 × 6 screws. Refer to Fig.4.

Be careful not to lose the flat steel spring located under the side slide bearing. Also avoid damaging the wiper.

Remove the frontend pulley by removing the M2 × 10 screw holding pulley to assembly.

Unsolder three leads from the potentiometer at the terminal board. Note colors.

Remove the potentiometer with a suitable tool.

Remove the potentiometer leads from the cable clamp.

Clean off possible remains of adhesive tape from carriage arm.

Place new potentiometer, part no. PD 3112, over arm and slide leads under cable clamp.

Remove the protective paper cover from the underside of the potentiometer and press it firmly in position on the arm. Refer to Fig.4.

For reassembly reverse procedure.

Check that the wiper contacts the potentiometer correctly.

When reassembling the pen carriage, leave 0,15 mm (0,006") clearance between the side slide bearing and the aluminium profil.

Check that the drive lug on the Y-wire is correctly seated in the pen carriage.

Position solder lug holding spring for pen arm pressure parallel to the carriage arm.

5.7. Y-Axis wiper replacement

Remove carriage arm. Refer to item 5.3.

Remove pen lift bar. Refer to item 5.6.

Remove wiper by unscrewing two M1,6 × 3 screws.

Install new wiper part no. DL 3211.

The contact fingers should point as shown on Fig.4.

Height of contact point over mounting surface in free position should be 4,5 mm (0,178").

For reassembly reverse procedure.

Refer also to item 5.6.

5.8. Removal of paper platten.

Remove the carriage arm. Refer to item 5.3.

Loosen the M2,5 × 4 screw, which clamps the auxiliary wire to the X-carriage assembly, two turns.

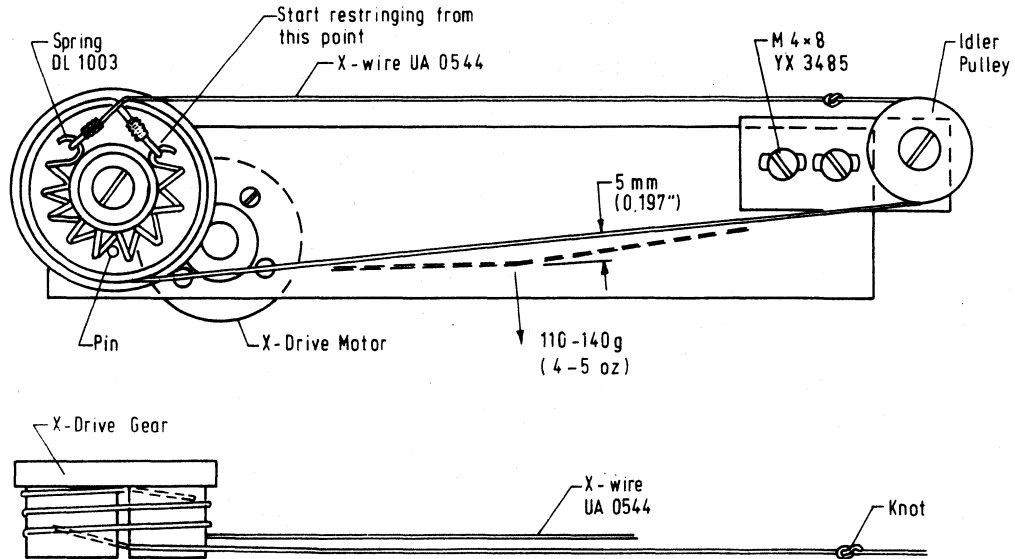


Fig.6

Remove the four plug-in printed circuit boards from the bottom of the recorder.

Remove the Power Supply unit by unscrewing four M2.5 × 8 counter-sunk screws and four M3 × 6 screws. Unplug connectors. Refer to Fig.5.

Remove four M3 × 6 screws from the bottom printed circuit board. Do not remove board.

Unsolder the two wires from the paper platten at the terminals of the bottom printed circuit board.

Remove the five M3 nuts with lock washers holding the paper platten to the frame and lift off the platten. Note position of possible strims.

For reassembly reverse the procedure.

Note: The wires can be soldered to either terminal. The M2.5 × 4 screw should be tightened as last operation.

5.9. X-Axis restringing and tension adj.

To restring the X-axis assembly the assembly should be removed from the recorder as follows.

Remove the backcover, the cable guide and the bottom cover. Refer to item 5.1.

Remove the four plug-in printed circuit boards. Unsolder the two motor leads. Note the wire colors. Unsolder the two leads from the thermostat.

Remove the X-carriage assembly. Refer to item 5.2.

Remove the X-axis potentiometer. Refer to item 5.4. (do not unsolder the leads). Fasten the potentiometer to the side of the recorder with adhesive tape.

Unscrew the three screws holding the rear connector bracket and place bracket outside of the recorder.

Unscrew the four M3 × 20 screws holding the X-axis motor assembly to the main chassis. The entire assembly can now be removed. Lift out idler pulley end first.

Remove one M4 × 8 screw and loosen the other screw holding the bracket for the idler pulley. Unstring the wire.

Start restringing by fastening the X-wire part no. UA 0544 to the coil spring. Start with the end of the wire which is furthest from the knot.

Place center of coil spring on pin inside the gear wheel. Draw the wire through the slot in the gearwheel and wind the wire 2 1/2 turns counterclockwise.

Bring the wire around the idler pulley and fasten the free end onto the spring. Refer to Fig.6.

Install the M4 × 8 screw in the idler wheel bracket and tighten the wire by moving the bracket away from the gearwheel. Tighten the two M4 × 8 screws.

Move the knot on the wire back and fourth between the gear wheel and the idler wheel. Check that the wire moves freely and that it runs correctly in the grooves of the gearwheel.

Measure the force required to deflect the X-wire 5 mm. (0,197''). It should be between 110—140g. (4—5 oz). If not move the idler pulley accordingly.

For reassembly reverse procedure.

5.10. Y-Axis restraining and tension adj.

To restring the Y-axis, the carriage arm must be removed from the recorder. Proceed as follows:

Remove the carriage arm. Refer to item 5.3.

Remove the pen assembly, pen lift bar and idler pulley as described in item 5.6.

Remove the Y-wire from the arm.

Install new Y-wire part no. UA 0543 with spring part no. DZ 1029 and replace idler pulley.

The tension of the Y-wire is correct when the spring is stretched between 10—12 mm (—0,394—0,472) as measured between the two wire ends.

For reassembly reverse procedure. Refer also to item 5.6.

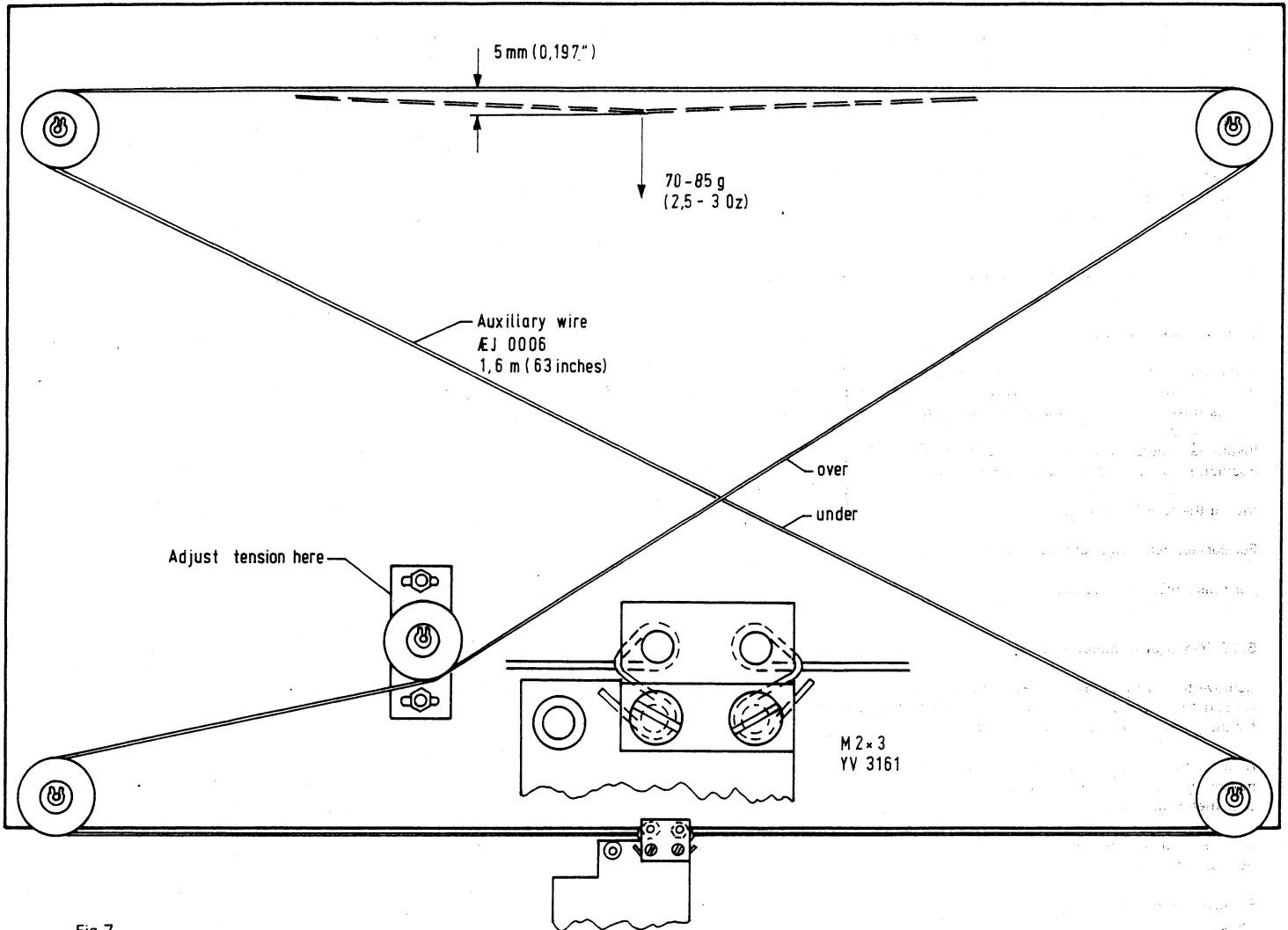


Fig.7

5.11. Auxiliary wire restringing and tension adj.

To restring the auxiliary wire it is necessary to remove the paper platten. Proceed as follows:

Remove paper platten. Refer to item 5.8.

Loosen two M3 nuts at the tension pulley.

Loosen four M2 × 3 screws at the small drive plate and draw out wire.

Restring the wire part no. AEJ 0006 the length of which should be 1,6 m (63").

Fig.7 shows in detail how the wire strung under the lug.

Cut ends of wire as short as possible.

The correct tension is obtained by moving the tension pulley until a pull of 70—85 g. (2,5—3 oz) will deflect the wire 5 mm (0,197").

Tighten the two M3 nuts.

For reassembly reverse procedure.

5.12. X-Motor gear back lash adjustment

Remove the back cover and the cable guide. Refer to item 5.1.

The X-motor is mounted with four screws M2 × 8. The bottom left screw, seen from the rear acts as pivot point when adjusting the motor position. This screw need not to be loosened. The remaining three screws should be loosened one turn. One screw has access through a hole in the large nylon gearwheel.

Adjust to motor position for minimum gear back lash, using a screwdriver as a lever to move the motor.

The rear shaft end of the motor can be held stationary with a pair of pliers in order to feel when minimum back lash has been achieved.

Tighten the three screws firmly.

Slide the X-carriage back and forth and feel if the two gears mesh properly.

Reassemble covers, refer to item 5.1.

5.13. Y-Motor gear back lash adjustment

Remove the back cover. Loosen 1/4 turn the M2 x 6 screw at the rear center of the X-carriage. With a thin wrench, 7 mm, turn the eccentric stud which carries the combined pulley and gear, clockwise a few degrees (as seen from above) for less gear back lash. Tighten the screw firmly.

To help feel when the correct position of the eccentric stud is reached, the Y-motor should be kept from turning. This can be done by carefully blocking the pivot gear on the motor with a small screwdriver or by turning on the recorder in order that the servosystem will keep the motor stationary.

Mount the back cover with the two washers and the two M3 x 6 screws.

5.14. X-Motor replacement

Remove X-axis assembly as described in item 5.9. Remove the motor by unscrewing four M2 x screws. One screw has access through a hole in the large nylon gearwheel. Note position of thermostat on the motor. Install new motor with thermostat and pinion (UM 1027). Position motor with thermostat facing upward.

Mount the four M2 x 8 screws.

For correct gear engagement refer to item 5.12.

For reassembly reverse procedure.

5.15. Y-Motor replacement

Remove the carriage arm as described in item 5.3. Loosen three turns two M1,6 x 6 screws holding the small guide piece for the pen lift bar at the front end of the carriage arm.

Remove three selftapping screws holding the carriage arm to the motor mounting bracket and swing the arm free of the bracket as far as the potentiometer leads will allow.

Note position of the pen lift solenoid with a mark and remove the solenoid as far as the leads will allow.

Remove the retaining ring holding the arm of the pen lift bar and remove the bar.

Unsolder the motor leads (note the colours) and unsolder the thermostat leads.

Remove three M2 x 4 screws holding the motor to the motor bracket. Note the position of the thermostat.

Install new motor with thermostat and pinion (UM 0085). Position the thermostat towards the outer corner of the motor bracket.

For reassembly reverse procedure.

Check the correct function of the pen lift solenoid. Check the Y-axis alignment. Refer to item 5.16.

5.16. Y-Axis alignment adjustment

If the Y-axis pen trace deviates from a correctly aligned paper grid, correct as follows:

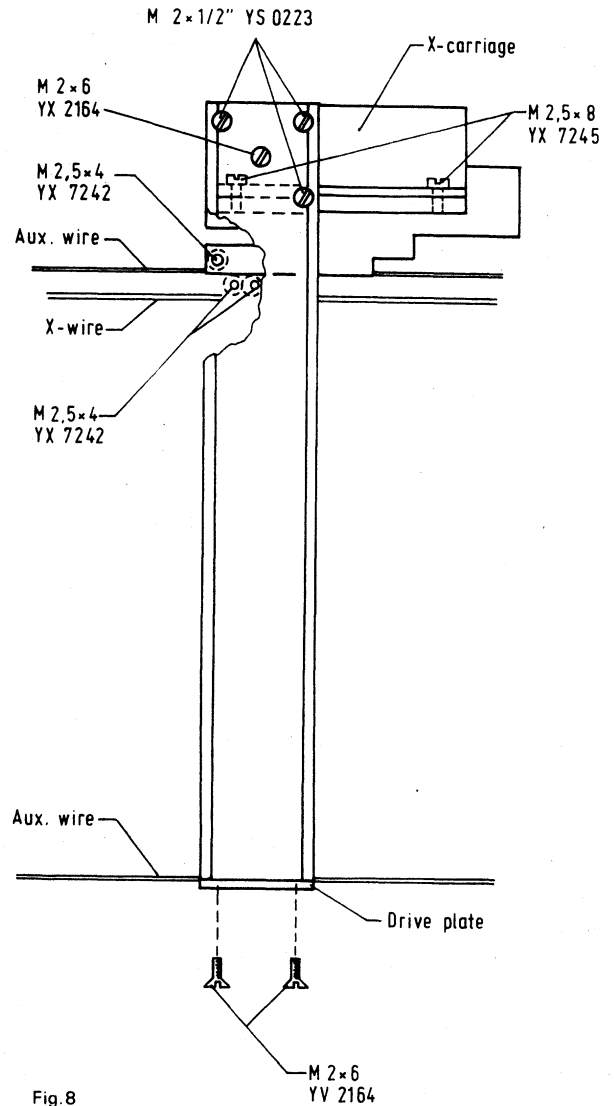


Fig.8

Remove the back cover and bottom cover.

Loosen screw holding the auxiliary wire to the X-carriage arm one turn. (M2,5 x 4 refer to Fig.8.)

Loosen three screws holding the carriage arm to the X-carriage 1/4 turn. (YS 0223). Carefully force carriage arm until correct Y-axis trace is obtained.

Tighten the three screws plus the auxiliary wire screw firmly.

Check the Y-motor gear back lash. Refer to item 5.13.

Reassemble the two covers.

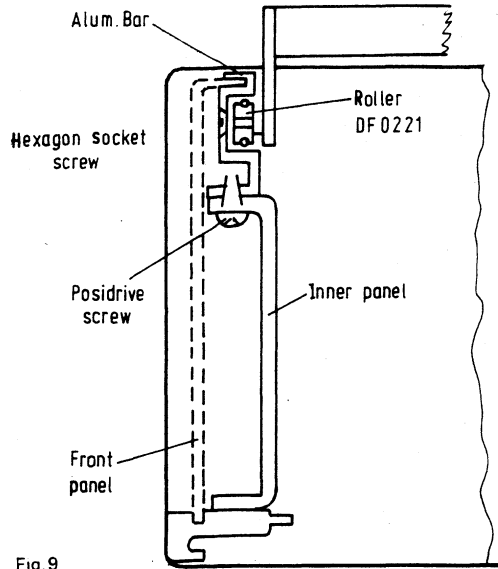


Fig.9

5.17. Replacement of carriage arm front roller

Remove the bottom cover.

Remove the Power Supply unit by unscrewing four M2,5 × 8 counter-sunk screws and four M3 × 6 screws. Unplug connectors.

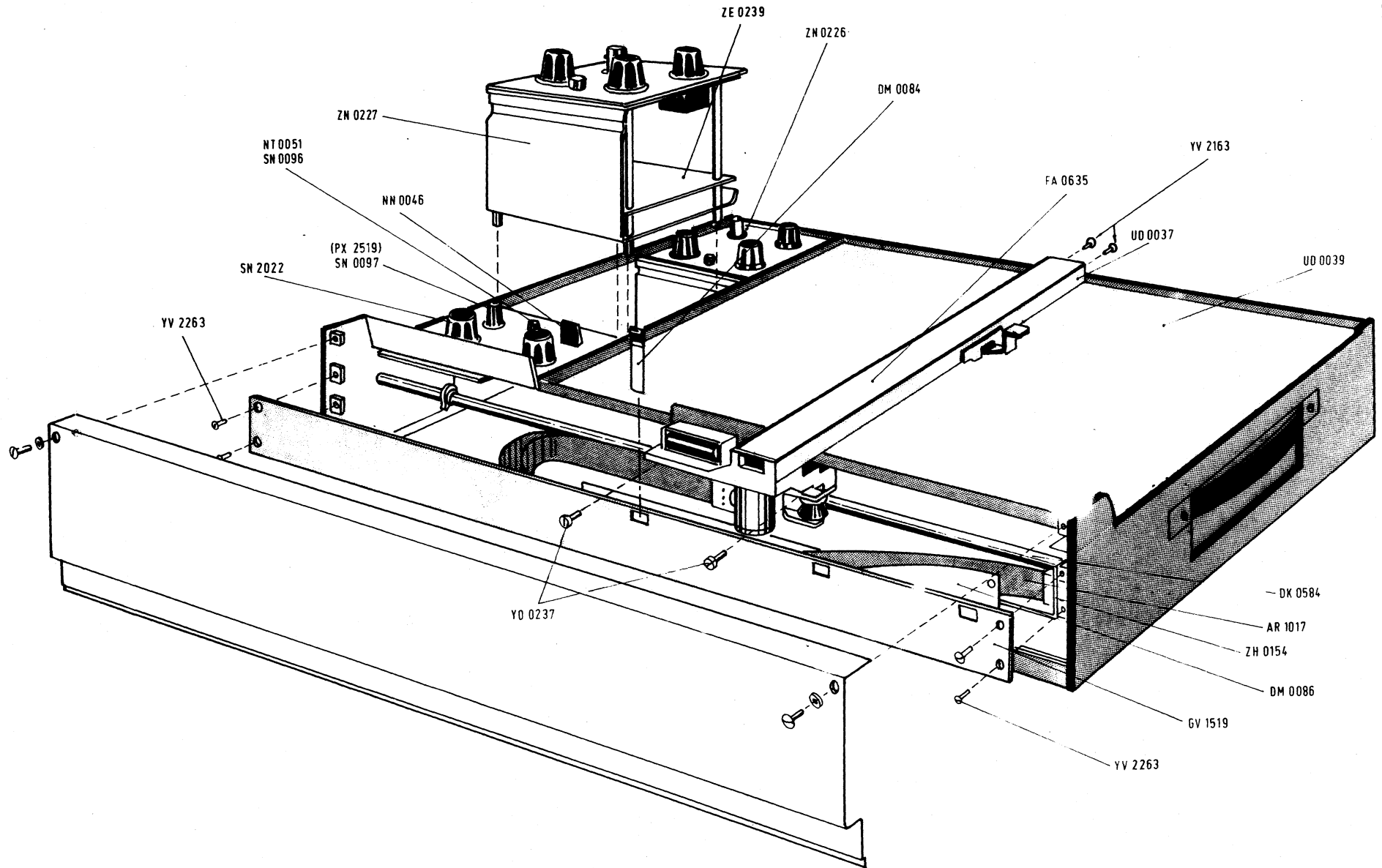
Remove the front panel by loosening 2 turns two Posidrive screws located at either end of the front top aluminium bar. Refer to Fig.9. Push top edge of panel outward.

Remove the three remaining posidrive screws holding the inner front panel to the aluminium bar.

Remove two M3 × 8 hexagon socket screws at both ends of the aluminium bar and remove bar.

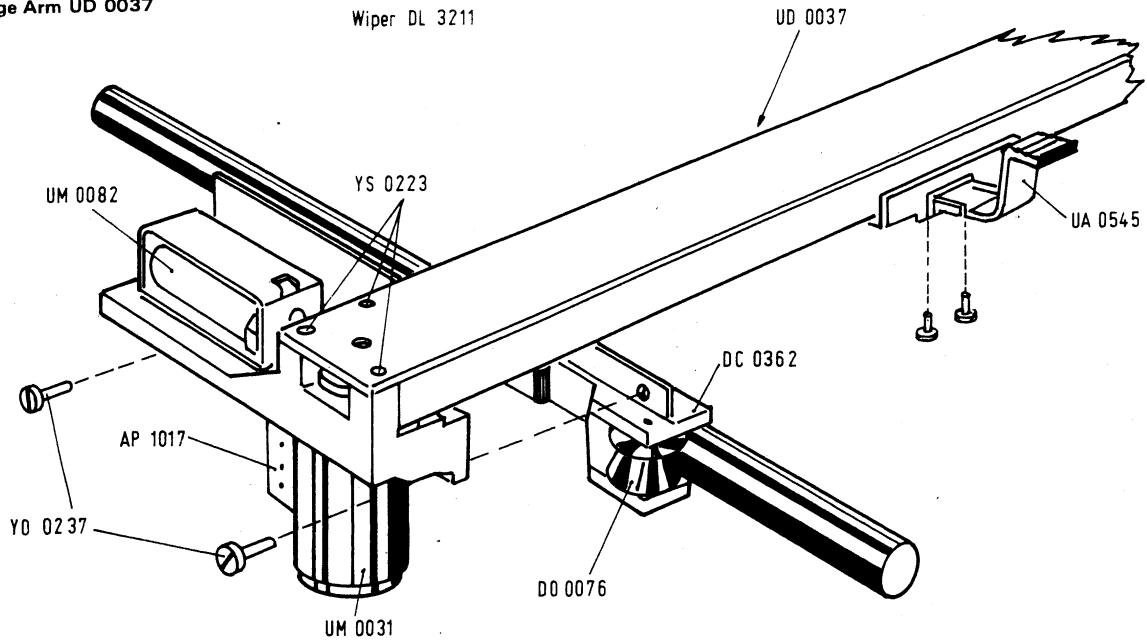
Replace carriage arm roller with a new roller part no. DB 0221. Add a slight amount of oil to the roller pin.

For reassembly reverse procedure.

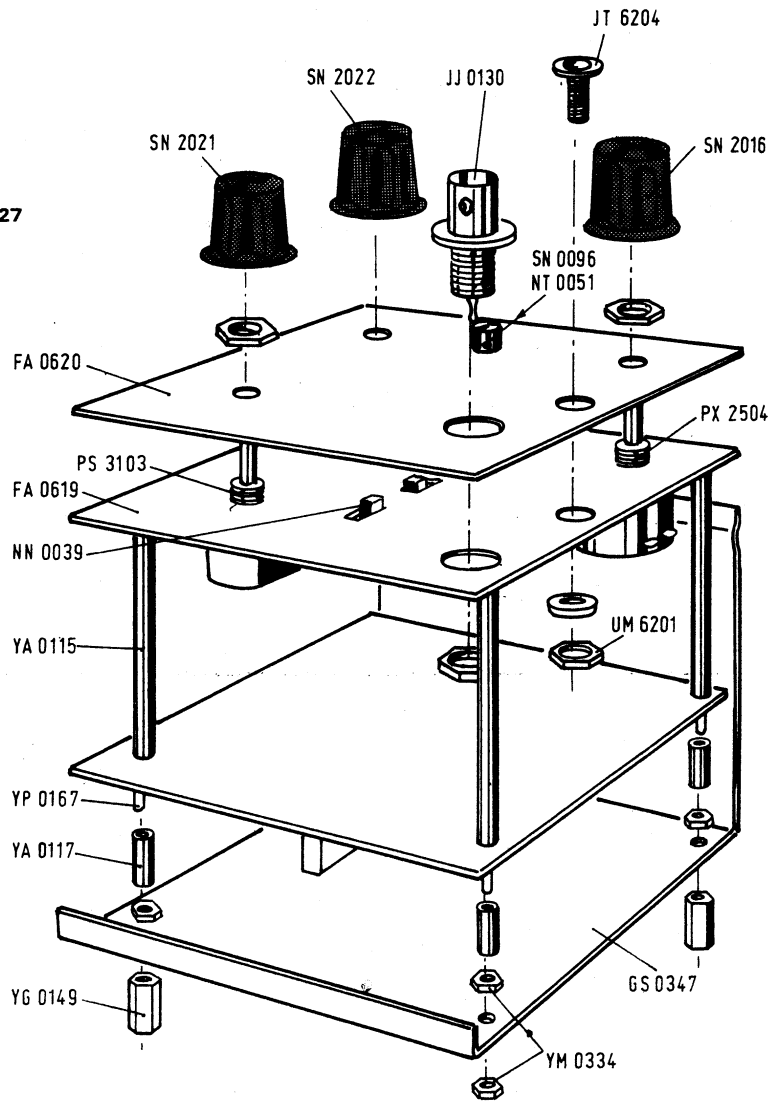


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X-Carriage Arm UD 0037



Preamplifier ZN 0226/0227



X and Y Pre. Amp. Module (ZN 0226, ZN 0227)

2308

	X-Pre.Amp.				ZE 0238
	Y-Pre. Amp.				ZE 0239
	Ceramic	1 nF/100 V			3103
	"Sweep" and "Polarity", switch				NN 0039
	"Zero, Check", switch				NT 0051
	Switch Mechanism				OD 1054
	"Gain", potentiometer	10 kΩ			PS 3103
	"Zero, Set" potentiometer	5 kΩ			PX 2504

Sweep Control Module (ZN 0228)

	Ramp Gen.				ZH 0152
R 701	Carbon	1/4 W	5%	1,5 kΩ	RB 3150
R 702	Thick Film Circuit				RZ 0454
Q 701	L.E.D., red				QV 4002
Q 702	L.E.D., yellow				QV 4011
	"Sweep", selector				NN 0046
	"Sweep Reset", switch				NT 0051
	"Sweep Rate", with components				OE 0174
	"Sweep Rate", without component				OH 3501
	"Function Selector"				OH 3500
	"Ramp Set" potentiometer			5 kΩ	PX 2519

ZH 0153 Mother Board

C 601,02	Ceramic			10 nF/1000 V	CK 4103
	Printed Circuit Board				XC 1510
	14-pin Socket for dual-in-line				JJ 1408
	16-pin Socket for dual-in-line				JJ 1622
	21-pin Socket for Circuit Board				JJ 2102

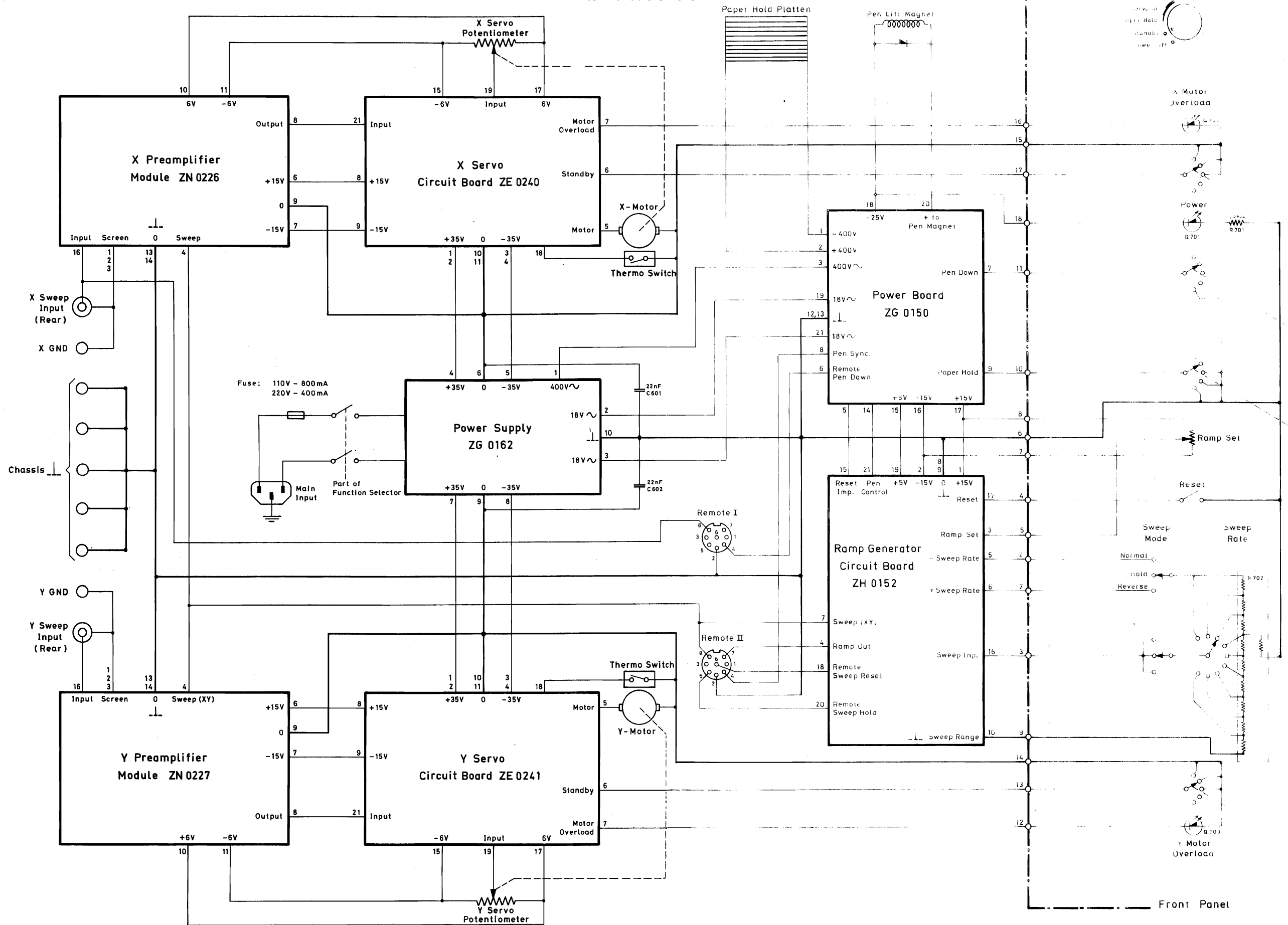
ZH 0154 Connector Board

	Printed Circuit Board				XC 1521
	AMP Connector				JJ 0812

	BNC Socket				JJ 0148
	BNC Plug				JP 0035
	8-pin Plug				JP 0805
	Mains Socket				OA 0042
	Y-Servopotentiometer	10 kΩ			PD 3112
	X-Servopotentiometer	10 kΩ			PD 3113
	Pens				QI 0003
	Writing Paper				QP 1000
	Silicon 1N4148	75 V/75 mA			QV 0216
	Pen lift Coil				UM 0082
	X- Motor				UM 1027
	Y- Motor				UM 1031
	Fuse Socket				JS 0037
	Fuse, slow			2A	VF 0010
	-			0,5A	VF 0023
	-			0,4A	VF 0039
	-			0,8A	VF 0050

Furthermore 2308 contains the following Sub-assemblies the details of which can be found under the respective numbers.

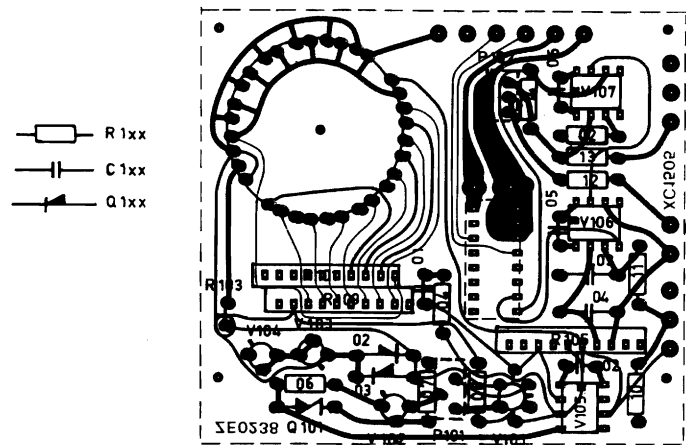
	X-Servo Amplifier				ZE 0240
	Y-Servo Amplifier				ZE 0241
	Power Regulator				ZG 0150
	Power Unit				ZG 0162



Circuit and Layout Diagrams with Parts List

ZE 0238

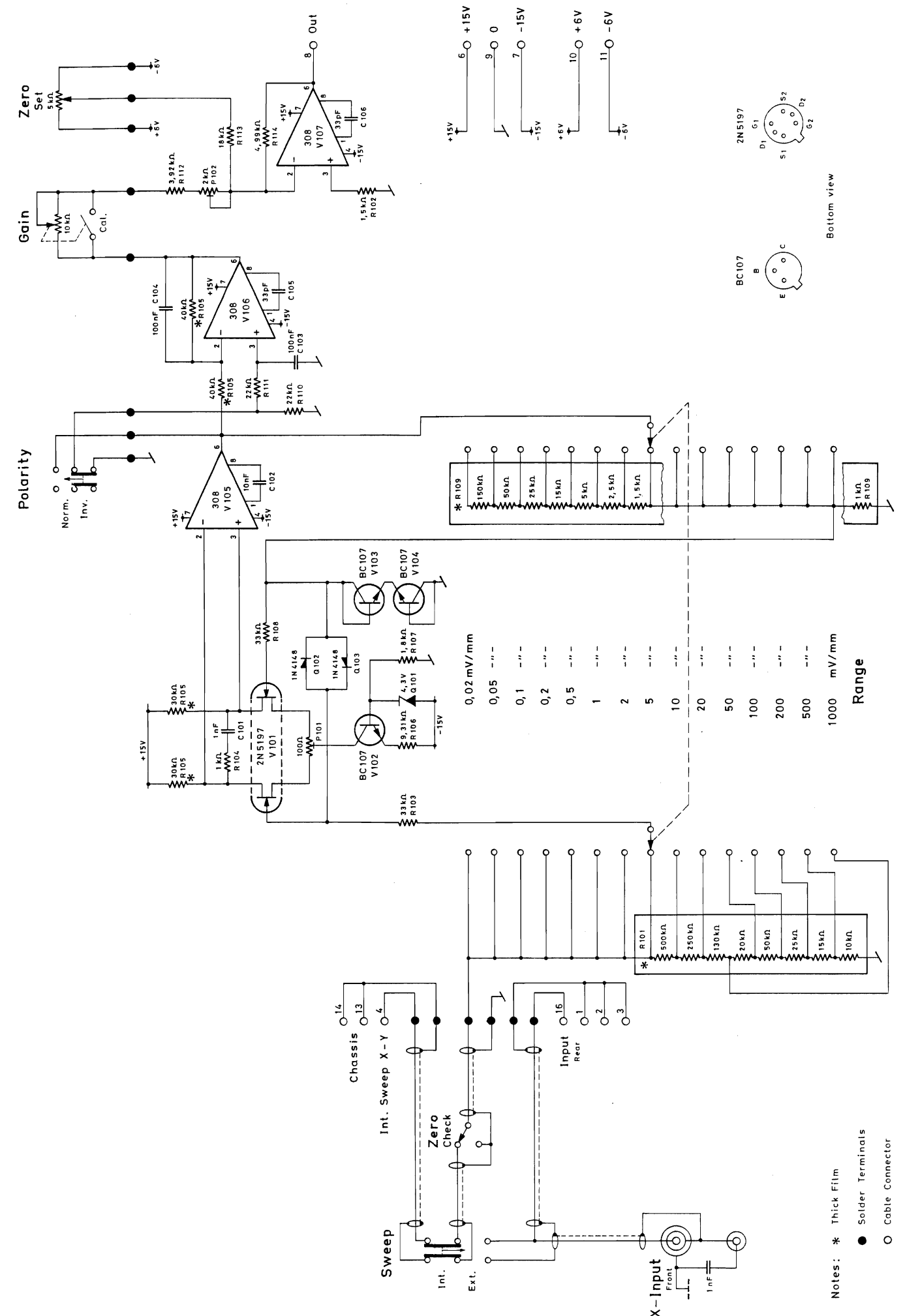
X-Pre Amp.



Viewed from the component side

Add 100 to all Circuit Diagram Ref. no.

CIRCUIT DIAGRAM REF.	COMPONENT TYPE	STOCK REF.	CIRCUIT DIAGRAM REF.	COMPONENT TYPE	STOCK REF.	
C 1	Ceramic	1 nF/400 V	CK 3101	Thick Film Circuit	RZ 0452	
C 2	-	10 nF/ 30 V	CK 4101	Metal 1/4 W	RF 3931	
C 3,4	Polycarbonate	100 nF/100 V	CS 0409	Carbon -	RB 3180	
C 5,6	Ceramic	33 pF/400 V	CK 1330	-	RB 4330	
P 1	Cermet 1/2 W	100 Ω	PG 1109	Thick Film Circuit	RZ 0451	
P 2	-	2 kΩ	PG 2217	Carbon 1/4 W	RB 4220	
Q 1	Ze. ZF4,3	4,0-4,6 V/0,25 W	QV 1110	Metal -	RF 3392	
Q 2,3	Si. 1N4148	75 V/75 mA	QV 0216	Carbon -	RB 4180	
R 1	Thick Film Circuit		RZ 0453	Metal -	RF 3499	
R 2	Carbon 1/4 W	5%	1,5 kΩ	RB 3150		
R 3	-	1/3 W	10%	33 kΩ		
R 4	-	1/4 W	5%	1 kΩ	RB 3100	
				Printed Circuit Board	XC 1505	
				Wafer	OD 1055	
			V 1	FET, dual	2N5197	VB 1005
			V 2-4	Silicon NPN	BC107	VB 0032
			V 5-7	Op. Ampl.	LM308	VE 0046



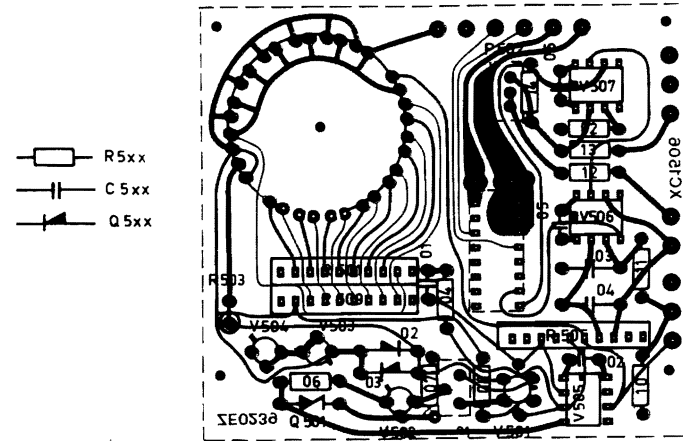
Notes: * Thick Film
● Solder Terminals
○ Cable Connector

Circuit and Layout Diagrams with Parts List

ZE 0239

Y-Pre Amp.

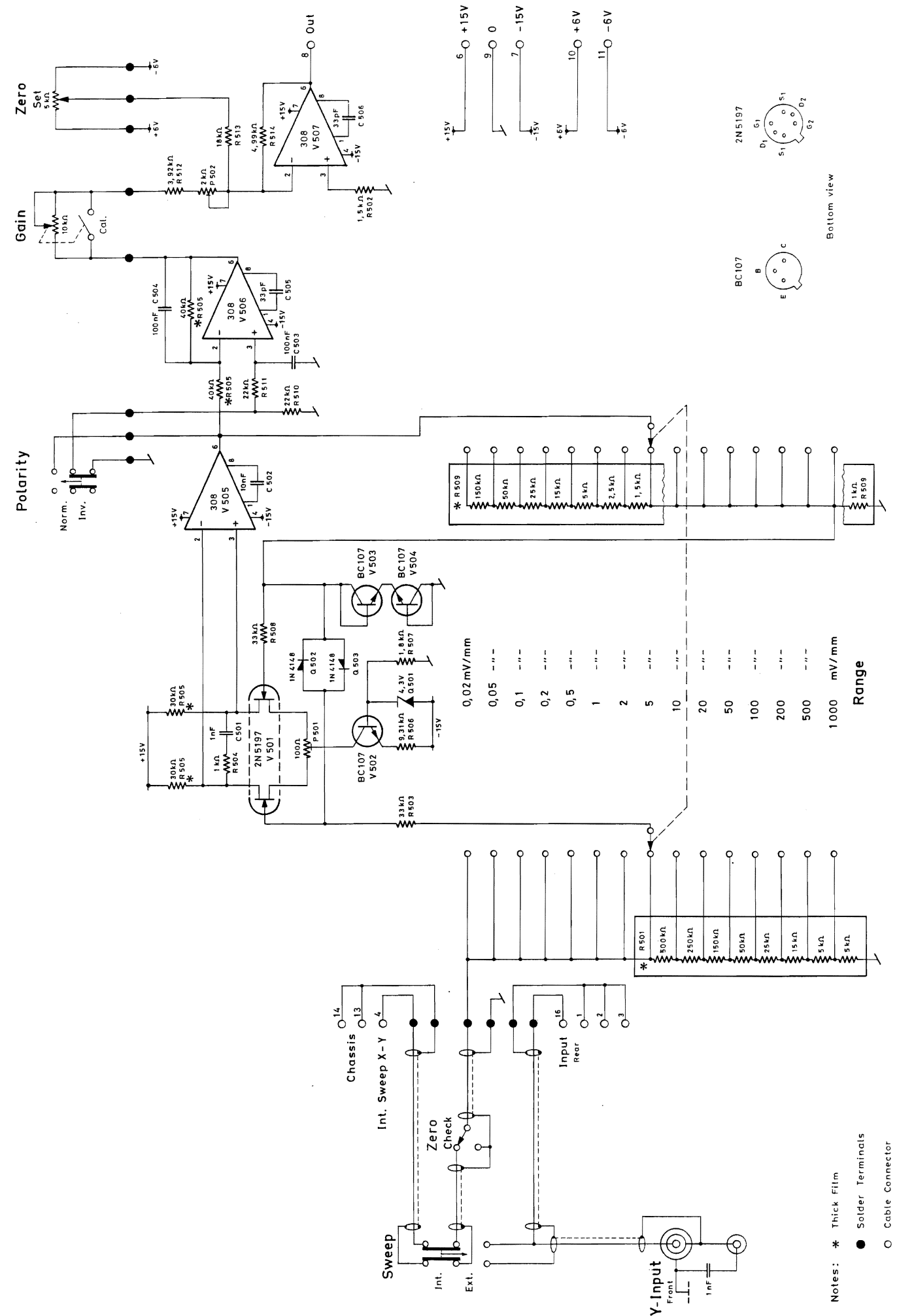
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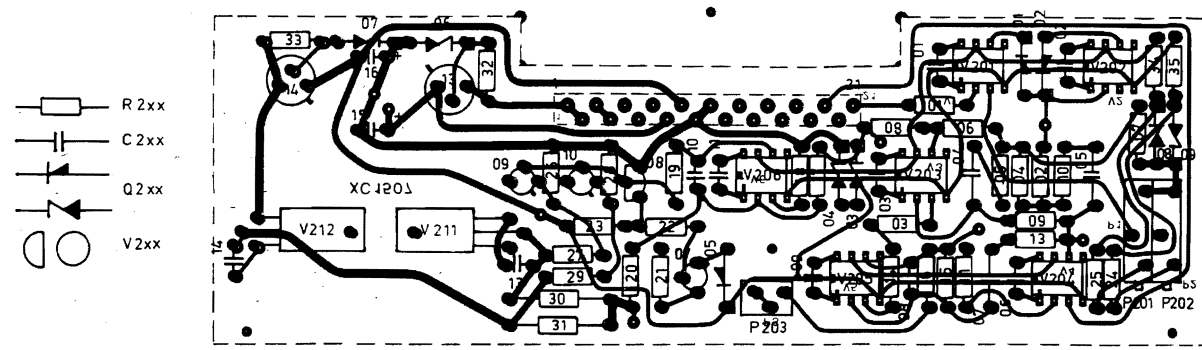
Viewed from the component side

Add 500 to all Circuit Diagram Ref. numbers

CIRCUIT DIAGRAM REF.	COMPONENT TYPE	STOCK REF.	CIRCUIT DIAGRAM REF.	COMPONENT TYPE	STOCK REF.
C 1	Ceramic	1 nF/400 V	R 5	Thick Film Circuit	RZ 0452
C 2	-	10 nF/ 30 V	R 6	Metal 1/4 W	RF 3931
C 3,4	Polycarbonate	100 nF/100 V	R 7	Carbon	RB 3180
C 5,6	Ceramic	33 pF/400 V	R 8	-	RB 3330
			R 9	Thick Film Circuit	RZ 0451
P 1	Cermet 1/2 W	100 Ω	R 10,11	Carbon 1/4 W	RB 4220
P 2	-	2 kΩ	R 12	Metal	RB 3392
			R 13	Carbon	RB 4180
			R 14	Metal	RF 3499
Q 1	Zener ZF4.3	4,0-4,6 V/0,25 W	V 1	FET, dual	2N5197
Q 2,3	Silicon 1N4148	75 V/75 mA	V 2-4	Silicon NPN	BC107
			V 5-7	Op. Ampl.	LM308
R 1	Thick Film Circuit				VE 0046
R 2	Carbon 1/4 W	5%			
R 3	- 1/3 W	10%			
R 4	- 1/4 W	5%			
				Printed Circuit Board	XC 1506
				Wafer	OD 1055



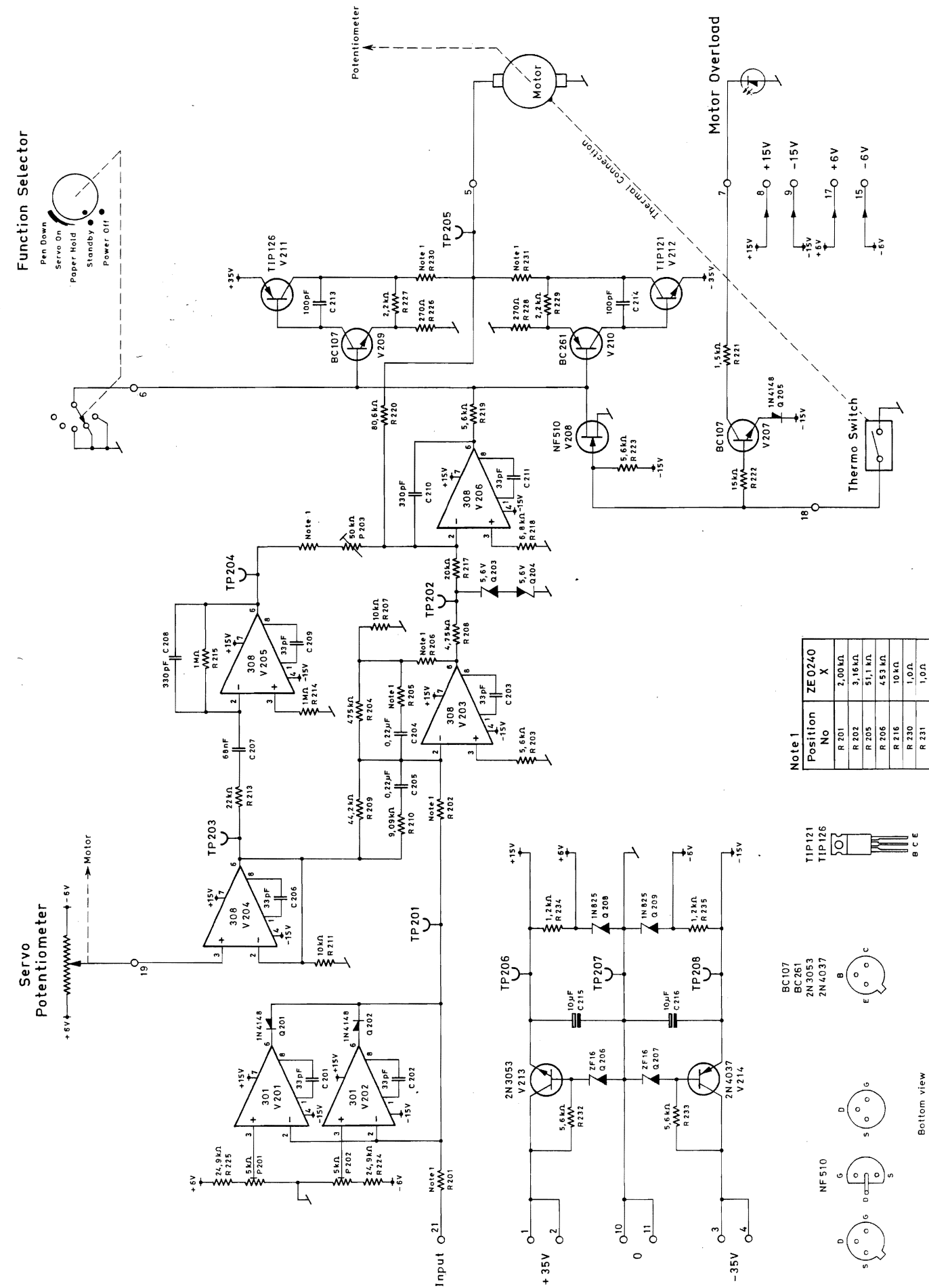
Notes: * Thick Film
● Solder Terminals
○ Cable Connector



Viewed from the component side

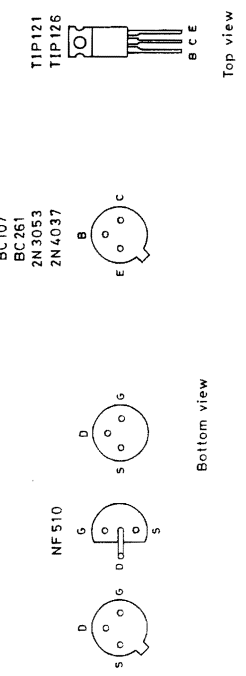
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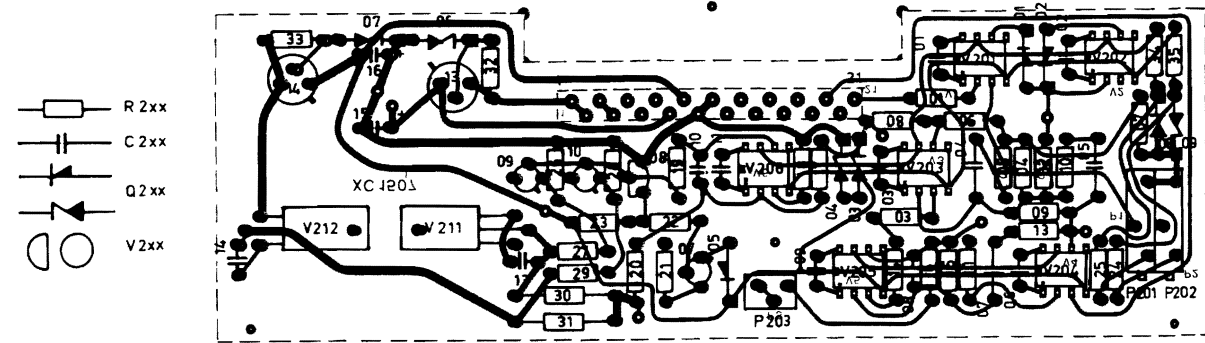
CIRCUIT DIAGRAM REF.	COMPONENT TYPE	STOCK REF.	CIRCUIT DIAGRAM REF.	COMPONENT TYPE	STOCK REF.
C 1-3	Ceramic	33 pF/400 V	CK 1330	R 17	Metal 1/4 W 1% 20 kΩ RF 4200
C 4,5	Polycarbonate	220 nF/100 V	CS 0389	R 18	Carbon - 5% 6,8 kΩ RB 3680
C 6	Ceramic	33 pF/400 V	CK 1330	R 19	- - - 5,6 kΩ RB 3560
C 7	Polycarbonate	68 nF/100 V	CS 0392	R 20	Metal - - - 80,6 kΩ RF 4806
C 8	Ceramic	330 pF/400 V	CK 2334	R 21	Carbon - - - 1,5 kΩ RB 3150
C 9	-	33 pF/400 V	CK 1330	R 22	- - - 15 kΩ RB 4150
C 10	-	330 pF/400 V	CK 2334	R 23	- - - 5,6 kΩ RB 3560
C 11	-	33 pF/400 V	CK 1330	R 24,25	Metal - - - 24,9 kΩ RF 4249
C 13,14	-	100 pF/400 V	CK 2103	R 26	Carbon - - - 270 Ω RB 2270
C 15,16	Tantalum	10 μF/ 35 V	CF 0064	R 27	- - - 2,2 kΩ RB 3220
p 1,2	Cermet 3/4 W	5 kΩ	PG 2516	R 28	- - - 270 Ω RB 2270
P 3	- 1/2 W	50 kΩ	PG 3515	R 29	- - - 2,2 kΩ RB 3220
Q 1,2	Silicon 1N4148	75 V/75 mA	QV 0216	R 30,31	Wire - 1 W - 1 Ω RR 0001
Q 3,4	Zener ZG5,6	5,0-6,2 V/0,25 W	QV 1105	R 32,33	Carbon 1/4 W - 5,6 kΩ RB 3560
Q 5	Silicon 1N4148	75 V/75 mA	QV 0216	R 34,35	- - - 1,2 kΩ RB 3120
Q 6,7	Zener ZF16	15,3-17 V/0,25 W	QV 1118		
Q 8,9	- 1N825	5,9-6,5 V/0,25 W	QV 1346		
R 1	Metal 1/4 W	1% 2 kΩ	RF 3200	V 1,2	Op. Ampl LM301 VE 0017
R 2	-	3,16 kΩ	RF 3316	V 3-6	- - - LM308 VE 0046
R 3	Carbon	5% 5,60 kΩ	RB 3560	V 7	Silicon NPN BC107 VB 0032
R 4	Metal	1% 4,75 kΩ	RF 5475	V 8	FET N NF510 VB 1021
R 5	-	51,1 kΩ	RF 4511	V 9	Silicon NPN BC107 VB 0032
R 6	-	453 kΩ	RF 5453	V 10	- PNP BC261 VB 0071
R 7	-	10 kΩ	RF 4100	V 11	- TIP126 VB 0128
R 8	-	4,75 kΩ	RF 3475	V 12	- NPN TIP121 VB 0595
R 9	-	44,2 kΩ	RF 4442	V 13	- 2N3053 VB 0251
R 10	-	9,09 kΩ	RF 3909	V 14	- PNP 2N4037 VB 0067
R 11	Carbon	5% 10 kΩ	RB 4100		
R 13	-	22 kΩ	RB 4220		
R 14,15	-	1 MΩ	RB 6100		
R 16	-	10 kΩ	RB 4100		
				Printed Circuit Board	XC 1507
				21-pin Plug for Circuit Board	JP 2100
				Heatsink	DK 0413
				Heatsink	DT 0036



Note 1

Position	ZE0240
No	X
R 201	2,00 kΩ
R 202	3,16 kΩ
R 203	51,1 kΩ
R 204	453 kΩ
R 205	10 kΩ
R 206	1,0 Ω
R 207	1,0 Ω



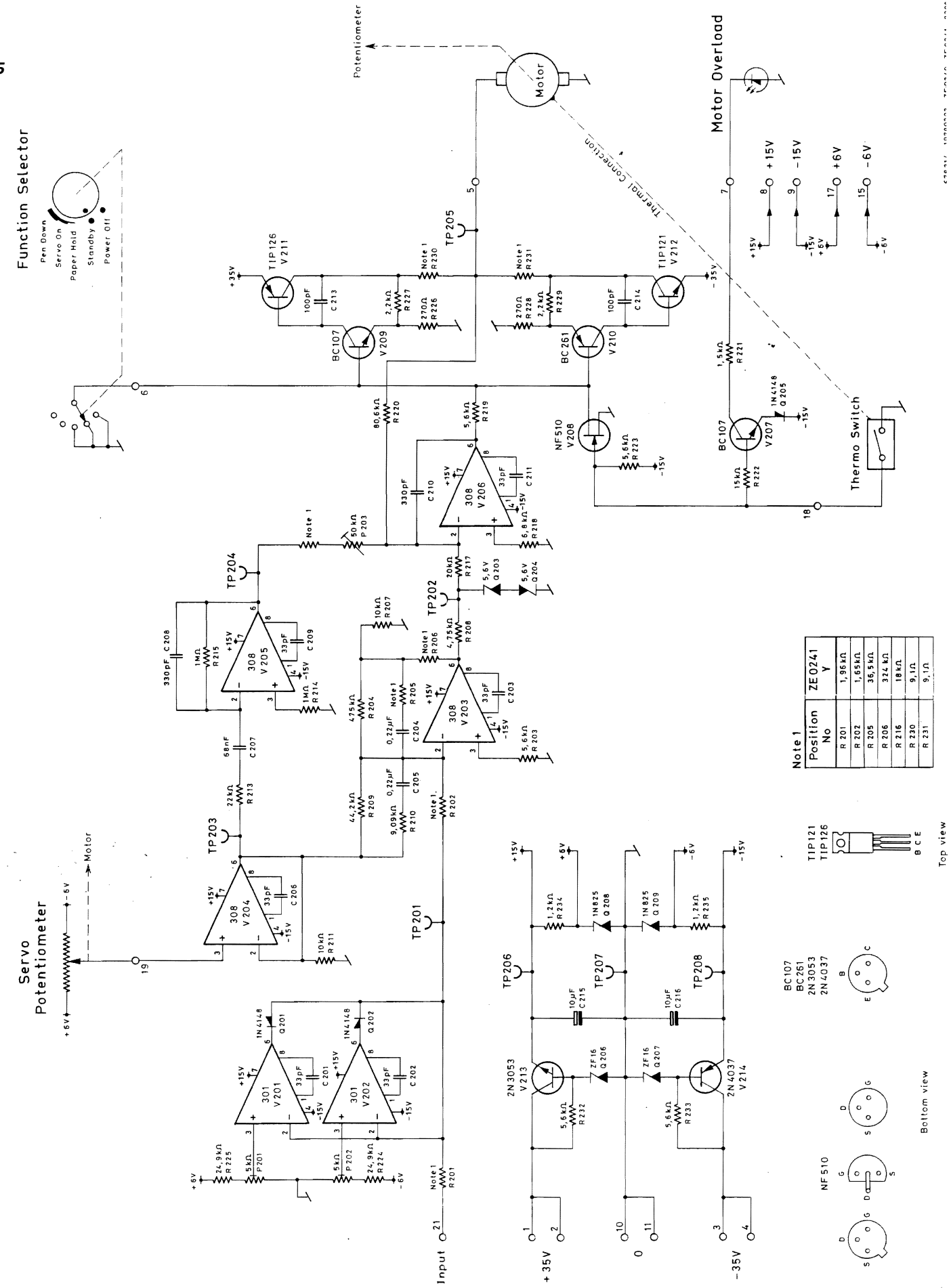


Viewed from the component side

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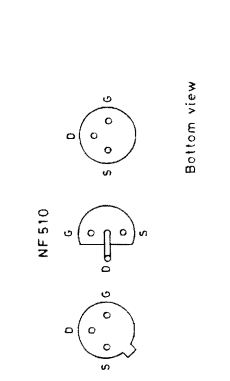
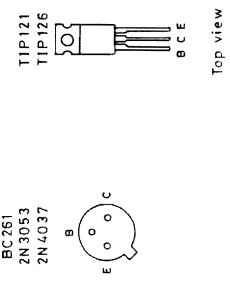
CIRCUIT DIAGRAM REF.	COMPONENT TYPE	STOCK REF.	CIRCUIT DIAGRAM REF.	COMPONENT TYPE	STOCK REF.
C 1-3	Ceramic	33 pF/400 V	CK 1330	R 17	Metal 1/4 W 1% 20 kΩ RF 4200
C 4,5	Polycarbonate	220 nF/100 V	CS 0389	R 18	Carbon - 5% 6,8 kΩ RB 3680
C 6	Ceramic	33 pF/400 V	CK 1330	R 19	- - - 5,6 kΩ RB 3560
C 7	Polycarbonate	68 nF/100 V	CS 0392	R 20	Metal - 1% 80,6 kΩ RF 4806
C 8	Ceramic	330 pF/400 V	CK 2334	R 21	Carbon - 5% 1,5 kΩ RB 3150
C 9	-	33 pF/400 V	CK 1330	R 22	- - - 15 kΩ RB 4150
C 10	-	330 pF/400 V	CK 2334	R 23	- - - 5,6 kΩ RB 3560
C 11	-	33 pF/400 V	CK 1330	R 24,25	Metal - - 24,9 kΩ RF 4249
C 13,14	-	100 pF/400 V	CK 2103	R 26	Carbon - - 270 Ω RB 2270
C 15,16	Tantalum	10 μF/ 35 V	CF 0064	R 27	- - - 2,2 kΩ RB 3220
P 1,2	Cermet 3/4 W	5 kΩ	PG 2516	R 28	- - - 270 Ω RB 2270
P 3	1/2 W	50 kΩ	PG 3515	R 29	- - - 2,2 kΩ RB 3220
Q 1,2	Si. 1N4148	75 V/75 mA	QV 0216	R 30,31	Wire 1 W 2% 9,1 Ω RO 0009
Q 3,4	Ze. ZG5,6	5,0-6,2 V/0,25 W	QV 1105	R 32,33	Carbon 1/4 W 5% 5,6 kΩ RB 3560
Q 5	Si. 1N4148	75 V/75 mA	QV 0216	R 34,35	- - - 1,2 kΩ RB 3120
Q 6,7	Ze. ZF16	15,3-17 V/0,25 W	QV 1118	V 1,2	Op. Ampl. LM301 VE 0017
Q 8,9	1N825	5,9-6,5 V/0,25 W	QV 1346	V 3-6	- - - LM308 VE 0046
R 1	Metal 1/4 W	1% 1,96 kΩ	RF 3196	V 7	Silicon NPN BC107 VB 0032
R 2	-	- 1,65 kΩ	RF 3165	V 8	FET N NF510 VB 1021
R 3	Carbon	5% 5,60 kΩ	RB 3560	V 9	Silicon NPN BC107 VB 0032
R 4	Metal	1% 475 kΩ	RF 5475	V 10	- - - PNP BC261 VB 0071
R 5	-	- 36,5 kΩ	RF 4365	V 11	- - - TIP126 VB 0128
R 6	-	- 324 kΩ	RF 5324	V 12	- - - TIP121 VB 0595
R 7	-	- 10 kΩ	RF 4100	V 13	- - - NPN 2N3053 VB 0251
R 8	-	- 4,75 kΩ	RF 3475	V 14	- - - PNP 2N4037 VB 0067
R 9	-	- 44,2 kΩ	RF 4442		
R 10	-	- 9,09 kΩ	RF 3909		
R 11	Carbon	5% 10 kΩ	RB 4100		
R 13	-	- 22 kΩ	RB 4220		
R 14,15	-	- 1 MΩ	RB 6100		
R 16	-	- 18 kΩ	RB 4180		

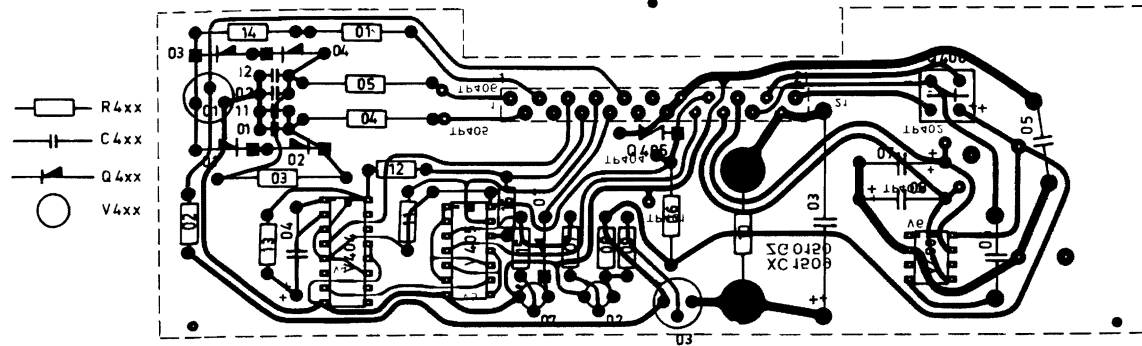
Printed Circuit Board XC 1507
21-pin Plug for Circuit Board JP 2100
Heatsink DK 0413
Heatsink DT 0036



Note 1

Position No	ZE0241
R 201	1,96 kΩ
R 202	1,65 kΩ
R 205	36,5 kΩ
R 206	324 kΩ
R 216	18 kΩ
R 230	9,1 Ω
R 231	9,1 Ω

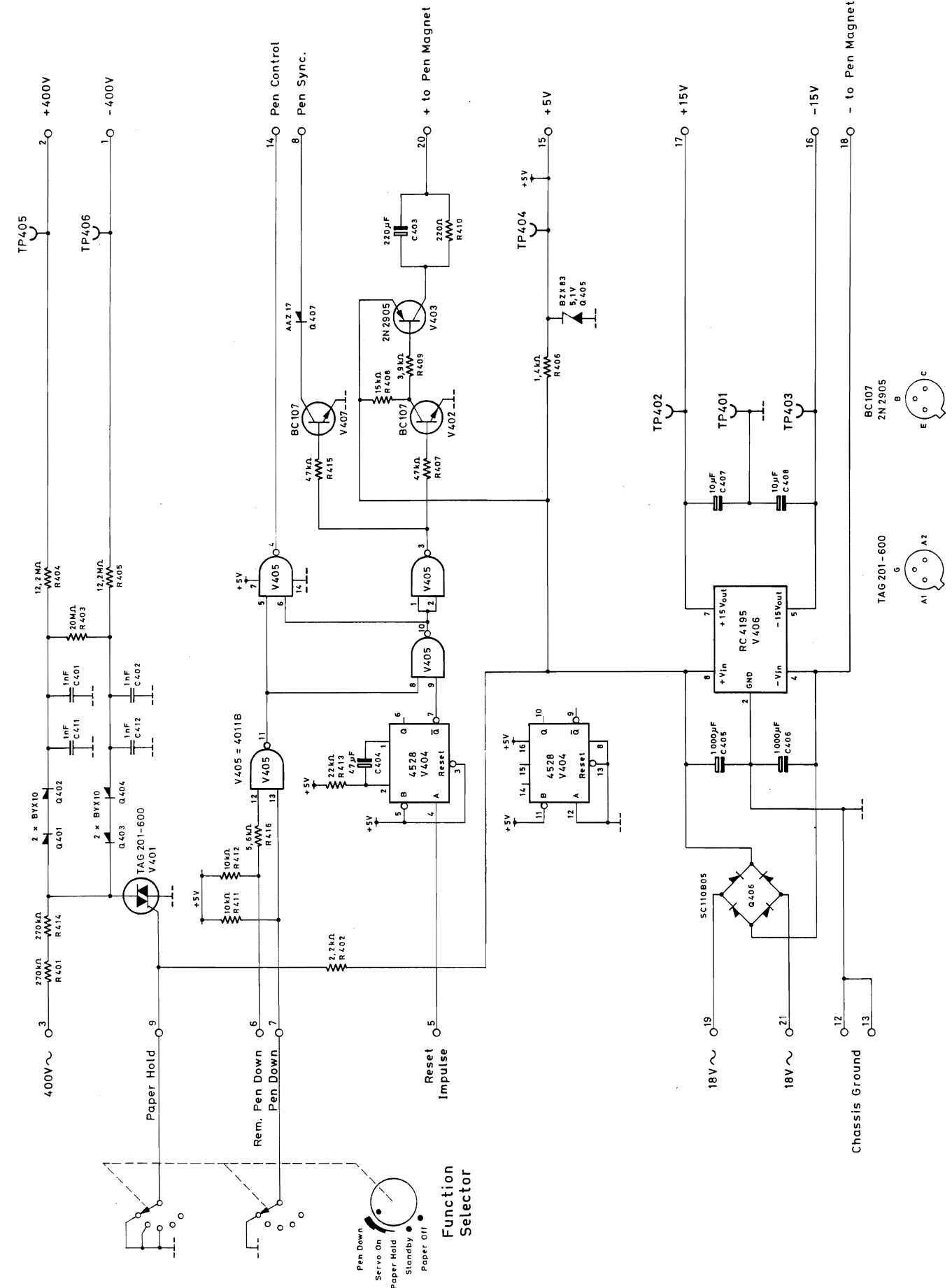




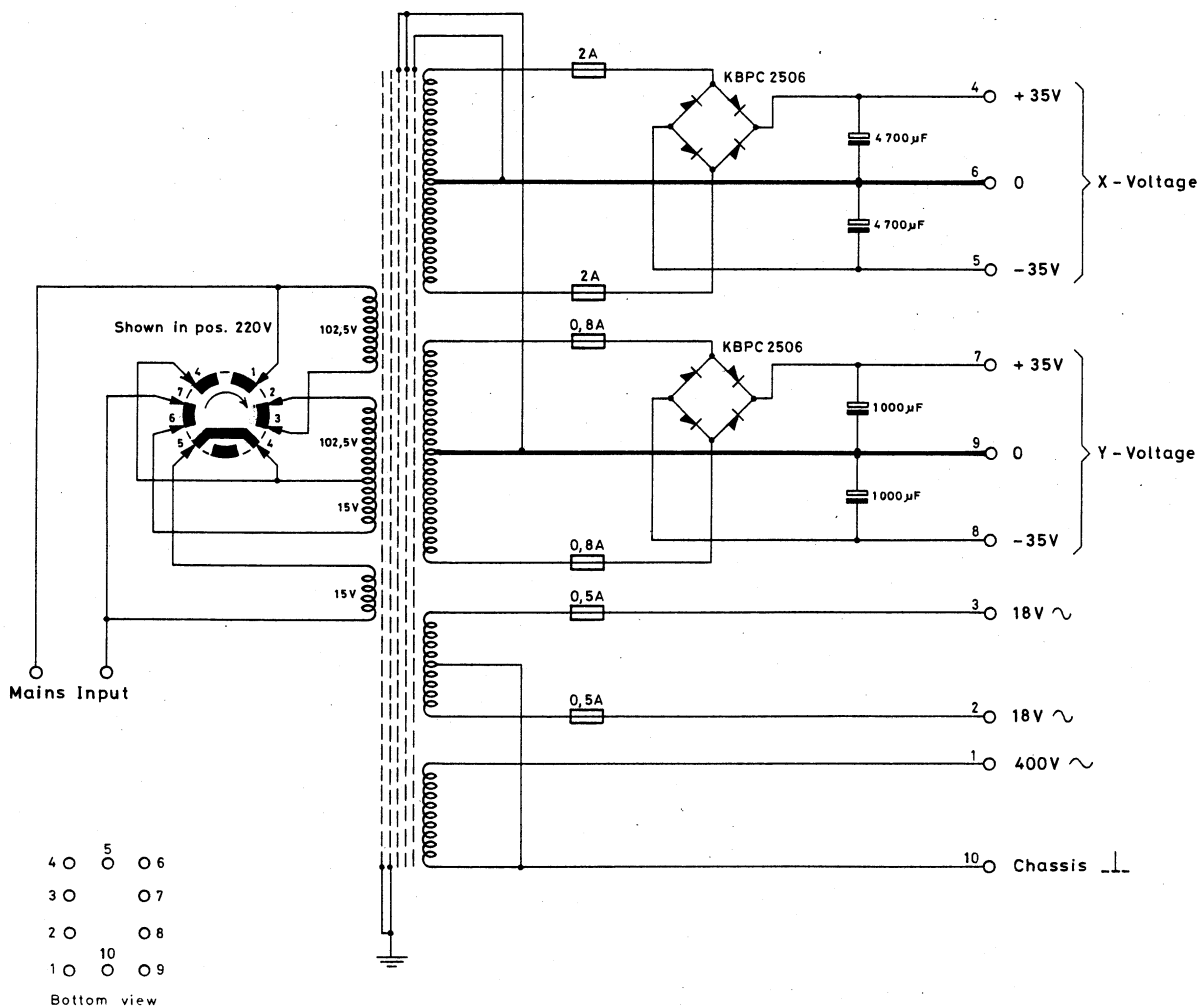
Viewed from the component side

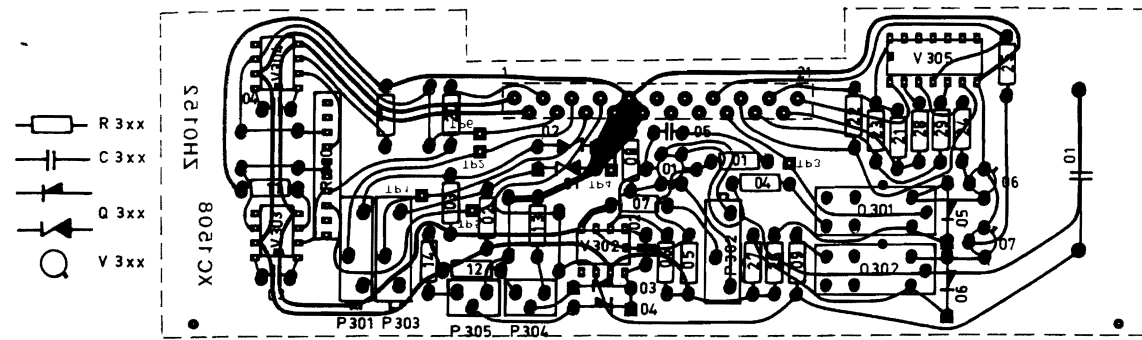
Add 400 to all Circuit Diagram Ref. no.

CIRCUIT DIAGRAM REF.	COMPONENT TYPE	STOCK REF.	CIRCUIT DIAGRAM REF.	COMPONENT TYPE	STOCK REF.
C 1,2	Ceramic	1 nF/1000 V	R 7	Carbon	1/4 W 5% 47 kΩ RB 4470
C 3	Electrolytic	220 μF/ 65 V	R 8	-	15 kΩ RB 4150
C 4	-	47 μF/ 10 V	R 9	-	3.9 kΩ RB 3390
C 5,6	-	1000 μF/ 40 V	R 10	Wire	4.2 W 220 Ω RX 0312
C 7,8	-	10 μF/ 24 V	R 11,12	Carbon	1/4 W 10 kΩ RB 4100
C 11,12	Ceramic	1 nF/1000 V	R 13	-	22 kΩ RB 4220
Q 1-4	Si. BYX10	1200 V/150 mA	R 14	-	1/3 W 10% 270 kΩ RB 4470
Q 5	Ze. BZC83	4.8-5.3 V/0.25 W	R 15	-	1/4 W 5% 47 kΩ RB 4470
Q 6	Bridge Rectifier	SC110B05	V 1	Triac	TAG201-600 VB 2502
Q 7	Ge. AAZ17	75 V/250 mA	V 2	Silicon	NPN BC107 VB 0032
R 1	Carbon	1/3 W 10% 270 kΩ	V 3	Silicon	PNP 2N2905 VB 0059
R 2	-	1/4 W 5% 2.2 kΩ RB 3220	V 4	2 × MMV	4528 VD 2032
R 3	-	1 W 2% 20 MΩ RH 0014	V 5	4 × 2 Input	NAND 4011 VD 2004
R 4,5	-	12.2 MΩ RH 0012	V 6	± 15 V Reg.	RC4195 VE 0068
R 6	Metal	1/2 W 1% 1.4 kΩ RF 0120	V 7	Silicon	NPN BC107 VB 0032
				Printed Circuit Board	XC 1509
				21-pin Plug for Circuit Board	JP 2101



CIRCUIT DIAGRAM REF.	COMPONENT TYPE	STOCK REF.	CIRCUIT DIAGRAM REF.	COMPONENT TYPE	STOCK REF.
	Electrolytic	1000 μ F / 63 V 4700 μ F / 63 V	CE 0434 CE 0535	Bridge Rectifier	QV 0036
	Housing, 12-pin Plug		DB 0257	Stand Off	XL 0163
	Terminal Plug		JS 0042	Fuse Socket	JS 0008
	Mains Selector		OA 0050	Fuse, slow	2A VF 0010
	Mains Transformer		TN 0114	Fuse, slow	500 mA VF 0023
				Fuse, slow	800 mA VF 0050

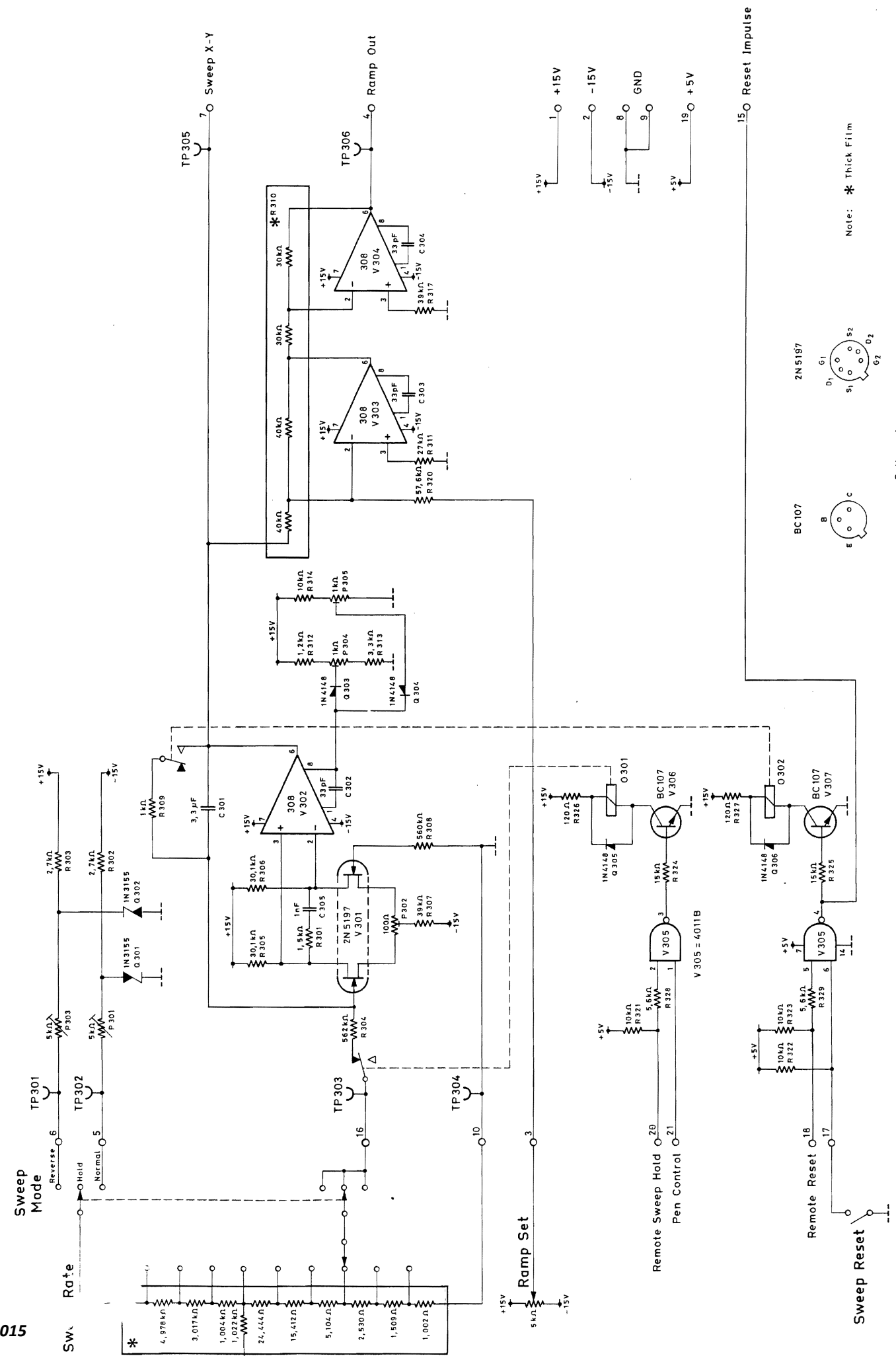




Viewed from the component side

Add 300 to all Circuit Diagram Ref. no.

CIRCUIT DIAGRAM REF.	COMPONENT TYPE	STOCK REF.	CIRCUIT DIAGRAM REF.	COMPONENT TYPE	STOCK REF.	
C 1	Polypropylen	3,3 μF/160 V	R 7	Carbon 1/4 W 5%	39 kΩ RB 4390	
C 2-4	Ceramic	33 pF/400 V	R 8	-	560 kΩ RB 5560	
C 5	-	1 nF/400 V	R 9	-	1 kΩ RB 3100	
O 1,2	Relay	12 V	R 10	Thick Film Circuit	RZ 0452	
P 1	Cermet 3/4 W	5 kΩ	R 11	Carbon 1/4 W 5%	27 kΩ RB 4270	
P 2	-	100 Ω	R 12	-	1,2 kΩ RB 3120	
P 3	-	5 kΩ	R 13	-	3,3 kΩ RB 3330	
P 4,5	-	1/2 W	R 14	-	10 kΩ RB 4100	
Q 1,2	Ze. 1N3155	8,0-8,8 V/0,25 W	R 17	-	39 kΩ RB 4390	
Q 3-6	Si. 1N4148	75 V/75 mA	R 20	Metal	57,6 kΩ RF 4576	
R 1	Carbon 1/4 W	5%	R 21-23	Carbon	5%	10 kΩ RB 4100
R 2,3	-	-	R 24,25	-	15 kΩ RB 4150	
R 4	Metal	1%	R 26,27	-	120 Ω RB 2120	
R 5,6	-	-	R 28,29	-	5,6 kΩ RB 3560	
V 1	FET, dual		V 2	Op. Ampl.	2N5197 VB 1005	
V 2-4	-	-	V 5	4 × 2 Input NAND	LM308 VE 0046	
V 5	-	-	V 6,7	Silicon NPN	4011 VD 2004	
V 6,7	-	-			BC107 VB 0032	
				Printed Circuit Board	XC 1508	
				21-pin Plug for Circuit Board	JP 2101	



Note: * Thick Film

Bottom view