

BKF10
AUTOMATIC DISTORTION ANALYZER

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SECTION A - SERVICE NOTES

Service Notes from Radiometer concerning corrections and changes should be inserted here.

SECTION B - TECHNICAL DESCRIPTIONS

GENERAL DESCRIPTION (See block diagram, Fig. B-1)

The purpose of the apparatus is to make possible the measurement and registration on a recorder of distortion as a function of frequency in the range from 20 Hz to 20 kHz. The heart of the apparatus is therefore an oscillator whose frequency and amplitude can be electronically controlled and a distortion meter which automatically suppresses the input signal's fundamental frequency. The distortion meter is, however, independent of the oscillator, so that the input signal can come from any arbitrary signal source.

When using the built-in oscillator, however, one has the added advantage of being able to control the amplitude so that either the input or output voltage on the device under test is held constant during the measurement.

While distortion is being measured, an amplification measurement is also carried out on the device under test, so that a simultaneous registration is obtained of distortion and gain as functions of frequency.

Concurrently with the other measurements, the frequency of the distortion meter's input signal is also measured. This measurement can be used to drive the X input on an X-Y recorder.

Since it is possible to control the oscillator's amplitude, one can also plot distortion as a function of the output of the device being tested.

The block diagram for the entire BKF10 is shown on BLOCK DIAGRAM I, drawing 1433-A1.

MEASUREMENTS (See Fig. B-1 and BLOCK DIAGRAM I, 1433-A1)

Distortion measurements

From the device under test, the signal is fed to a 20 dB attenuator which is connected when the input signal is over 3 V. After the attenuator is an amplifier with a dynamic range of 50 dB and an automatic level control which holds the amplifier's output voltage constant at 1 V for input voltages from 10 mV to 3 V. The next stage is the first section of the HP-LP filter with a cut-off frequency of 250 Hz. This filter is normally disconnected, but can be used either to measure or filter out the signal's hum content.

The signal is then fed to the band-stop filter which automatically suppresses the fundamental frequency. This filter consists of 3 cascade-coupled, active band-stop filters. The filters' stop frequency is tuned to the vicinity of the signal frequency by the frequency measuring circuit. Fine tuning is accomplished on each filter by means of a phase-sensitive detector and a control circuit. Since it is desired to measure distortion over a range of 50 dB (0.03 - 10%), the amplification of the distortion signal is regulated in the first two filters. The regulation circuit consists of a detector which measures the output voltage of the band-stop filter and, via a control circuit, adjusts the gain in the first two band-stop filters so that the output voltage from the last filter is approximately 1 V. Since it is necessary to know the gain of the filters in order to find the distortion level, a circuit is used to measure this gain.

After the band-stop filter comes the second section of the HP-LP filter. The combined attenuation in the filter's attenuation range is approximately 20 dB. The reason for dividing the filter into 2 sections is found in the dynamic response of the band-stop filter. If the input signal's fundamental frequency lies in the HP-LP filters' attenuation range, it is still necessary that the band-stop filter have sufficient fundamental so that the tuning works properly. Because of this, the suppression is approx. 6 dB before the band-stop filter and approx. 14 dB after it.

Next comes the RMS detector which measures the size of the distortion signal. The detector's output signal is added to the signal from the gain measuring circuit, whereby an expression is obtained for the input signal's distortion factor.

A more detailed block diagram of the distortion measuring system is shown on BLOCK DIAGRAM II, drawing 2146-A2. Gain regulation is accomplished by Integrator I_1 which, with the help of two control circuits and two light-emitting diodes, adjusts photo-resistors R_2 and R_2' so that the output voltage from band-stop filter III is approx. 1 V as long as the distortion lies in the 0.1 - 10% range. Gain measurement takes place by way of Integrator I_2 , the LP filter and transistors Q_1 and Q_2 . The gain is measured at 0 Hz (DC) - the current in Q_1 being regulated so that the DC output voltage on band-stop filter II is -2 V. By proper selection of circuit constants, $V_2 = \log(A_1 \times A_2) - 1$ V is obtained. Letting k be the distortion factor, the detector's input voltage is $V_0 = A_1 \times A_2 \times A_3 \times k$. Its output voltage, then, for $A_3 = 10$ is: $V_1 = -1.5$ V - $\log(A_1 \times A_2) - \log k$. When voltages V_1 and V_2 are added, inverted and combined with a constant, $V = \log k$ results.

For sweep measurements, when the built-in sweep signal is used, the output voltage during fly-back is set to -4 V, corresponding to a distortion of -80 dB.

Response (IN/OUT RATIO) measurements

Response measurements are carried out using two detectors which measure the distortion meter's input voltage and the oscillator's output voltage respectively. These detectors give an output voltage proportional to the logarithm of their input voltage. The two output voltages are fed to a differential amplifier whose output is therefore a voltage proportional to the gain of the device under test. Since the measuring range is quite large (-40 - +90 dB), a polarity inverter is included in the meter circuit. A lamp indicates whether the reading is positive or negative dB.

During fly-back, the output voltage is set to 0, corresponding to 0 dB.

Frequency measurements

The frequency measuring circuit, which also coarse adjusts the band-stop filter, produces a voltage, $V = \log \left(\frac{f}{20 \text{ Hz}} \right)$, which is fed to the meter and can also be used to drive a recorder.

The oscillator

The signal generator itself is an RC oscillator whose frequency can be controlled by a DC voltage. This voltage can be taken from a potentiometer located on the instrument's face plate, a built-in saw-tooth generator, or an external source (e.g., a potentiometer which follows the paper advance on a chart recorder).

Amplitude regulation is likewise controlled by a dc voltage tapped from a selector switch on the face plate or fed in from an external source.

S/N measurements

For S/N measurements, the device under test is connected between the oscillator and the distortion meter in the same way as for distortion measurements. When the regulation circuit has adjusted itself (indicated by the steadying of the meter), the S/N button is depressed, whereby the oscillator signal is interrupted, and the distortion meter's pre-amp is locked at the sensitivity it had during the distortion measurement. The instrument will now read the noise's relationship to the signal present during distortion read-out.

CIRCUIT DESCRIPTIONS:

PRE-AMPLIFIER WITH AUTOMATIC LEVEL CONTROL

(See Schematic Diagram 1, drawing 1512-A1)

Principle of operation (See Fig. B-2)

The pre-amplifier circuit is built up around feedback amplifier A_1 . The feedback path for A_1 is comprised of amplifier A_2 and various resistor networks including two photo-resistors, R_1 and R_{11} . Regulation of the pre-amplification, V_o/V_i , is accomplished by regulating the gain of the feedback network using the two photo-resistors, each of which controls its own amplification range. When R_1 is active, the current in R_{11} 's light-emitting diode is so low that the current in R_{11} is negligible. R_1 , then, regulates the gain in the range from 5-100. When R_{11} is active, the current in R_1 is negligible, and R_{11} regulates the gain in the range from 0.3-5. The design of the control circuit includes provision for a sliding transition between the two regulating resistors.

The circuit which controls the photo-resistors includes an average-value detector which rectifies A_1 's output signal. The detector's output voltage is compared to a reference voltage, and any error voltage causes a current to flow to integrator I_1 which, via an LP filter, controls the photo-resistors. The LP filter removes any ac remnants coming from the detector.

For S/N measurements, switch S_1 is opened, thereby locking the integrator's output voltage as well as the amplifier's sensitivity.

Pre-amplifier circuit description (See Fig. B-3)

A simplified diagram of the amplifier is shown in Fig. B-3. The circuit can be roughly divided into the overload protection circuit and the two amplifiers, A_1 and A_2 . The overload circuit consists of 4 diodes which are normally back-biased. The two diodes which are directly connected to the input are boot-strapped so that no ac voltage appears across them. This eliminates the possibility of distortion due to leakage current variation. If the input is driven too hard, it is clamped to + or -12 V. The input is thereby protected against voltages of up to 250 V at 50-60 Hz and up to 50 V at an arbitrary frequency.

The input stage of amplifier A_1 is a field-effect transistor. To avoid distortion due to variation in the FET's output impedance in phase with the signal, the supply voltage to the drain is boot-strapped. The signal is then fed via a grounded-base stage to two cascaded amplifiers with shunt feedback.

These amplifiers are regulated so that the gain of A_1 is inversely proportional to the gain of the feedback path - thereby giving the overall input amplifier a constant bandwidth. Photo-resistors R_{Ia} and R_{Ib} and respectively R_{IIa} and R_{IIb} are mounted in pairs in the same housing and are illuminated by the same light-emitting diode.

Control Loop (Fig. B-4)

The control loop is shown schematically in Fig. B-4. The two photo-resistors R_I and R_{II} regulate the amplification. To achieve a smooth transition between the two regulation ranges and to ensure that the gain of the control loop is nearly independent of the input voltage, two control circuits have been included, each consisting of an exponential amplifier followed by a current amplifier. The principle of operation for these control circuits is shown in Fig. B-5.

LOGARITHMIC DETECTOR

(See Schematic Diagram 3, drawing 2148-A2 and Schematic Diagram 13, drawing 2152-A2)

Circuit Description

Principle of Operation

The detector's circuit diagram is shown on Schematic Diagram 3 (Detector for Distortion Meter) and Schematic Diagram 13 (Detector for Oscillator). The principle of operation is illustrated in Fig. B-6. It builds upon the following two characteristics of a diode (a diode-coupled differential transistor, Q212A/Q212B, is used for the two diodes, D_1 and D_2):

- 1) A diode's dynamic resistance is inversely proportional to the dc current flowing through it.
- 2) The dc voltage across a diode is proportional to the logarithm of the current flowing through it.

The detector's input voltage is changed to a current. This current is sent through diode D_1 through which flows a dc current I_D . An ac voltage is generated across the diode proportional to the dynamic resistance. This voltage is amplified and fed to an average value detector whose output voltage V_o is compared to a reference voltage. Any error

signal regulates, via an integrator and LP filter, the dc current I_D in D_1 so that there is agreement between V_D and V_{ref} . I_D will now be proportional to the ac current i_{in} and thereby to the ac voltage v_{in} . The dc voltage V_{D1} will therefore be proportional to the log of v_{in} and is amplified by the operational amplifier so that a change by a factor of 10 in the input voltage gives a change in the output voltage of 1 V. Diode D_2 , in which a constant current flows, serves to temperature compensate the circuit.

FREQUENCY COUNTER

(See Schematic Diagram 4, drawing 2149-A2)

Principle of Operation (See Fig. B-7)

The frequency counter is, in fact, a period counter which gives an output voltage proportional to the log of the period. By inverting the output voltage, a potential is obtained which is proportional to the log of the frequency. Since the definition of the natural logarithm is $\ln T = \int_0^T dt/t$, it is seen that a measure of the period T can be obtained by integrating a current which is inversely proportional with time t . The circuit's principle of operation is shown in Fig. B-7.

A fixed time T_0 after the start of the period, switch B closes, and capacitor C_1 is charged by current i which falls as voltage v rises. At the conclusion of the period, B opens and switch C closes, whereby capacitor C_2 is charged to the value $v(T)$. After a time of approx. $T_0/2$, C opens and A closes, hereby discharging C_1 while the voltage v_0 maintains the value $v(T)$ until a new measuring period has been run through.

When the frequency is swept, the output voltage becomes a staircase wave. Therefore, Q_2 is followed by an LP filter which smooths out v_0 .

HP-LP FILTERS

(See Schematic Diagram 2, drawing 2147-A2)

Circuit Description

Because of the dynamic response of the band-stop filters, the HP-LP filters are divided into 2 sections. The first section, which attenuates approx. 6 dB, is placed before the band-stop filters. The other section, which attenuates 14 dB, is coupled between the band-stop filters and the RMS detector. The filters take the form of 3rd order filters with a roll-off of 18 dB/octave. HP-LP filter I (Fig. B-8) is a 1st order RC filter. HP-LP filter

II (Fig. B-9) is principally an RC network with a combination of feedback and feed-forward. The filter can be switched from HP to LP or vice versa by 4 FET switches.

RMS DETECTOR

(See Schematic Diagram 8, drawing 2150-A2)

Circuit Description (Fig. B-10)

The detector's principle of operation is shown in Fig. B-10. The input voltage is fed to a voltage divider, a differential amplifier consisting of transistors Q_1 and Q_2 and amplifier A. The signal then goes to a multiplier which carries out a squaring operation. The multiplier's output is proportional to the square of the input signal's mean value. Using an integrator, an LP filter which removes vestiges of ac voltage, and transistor Q_4 , I_E and thereby the slope of input transistors Q_1 and Q_2 is regulated until there is agreement between the multiplier's output current and the reference current. Due to the logarithmic relationship between Q_4 's base-emitter voltage and collector current, an output voltage is obtained which is proportional to the log of the mean-square value of the input voltage. Q_3 serves as temperature compensation.

BAND-STOP FILTERS

(See Schematic Diagrams 5,6,7, drawings 1513-A1, 1434-A1, 1435-A1)

Principle of Operation (Fig. B-11)

The block diagram for the band-stop filter is shown in Fig. B-11. The complete circuits are shown on Schematic Diagrams 5, 6, and 7.

The filter consists of 3 cascade-coupled, active band-stop filters, each having its own frequency regulation. A frequency counter measures the input signal's fundamental frequency and tunes the 3 filters to the vicinity of the fundamental. For fine tuning, each filter is equipped with a phase detector and regulation circuit. The regulation range for fine tuning is limited so that the filter cannot tune itself to harmonics. To maintain a suitable fundamental frequency level, so that the fine tuning can function properly, the distortion amplification is regulated by the first two filters to keep the distortion signal constant at the output of the last filter.

Active Band-stop Filter (Fig. B-12)

The individual filter's basic unit is an active resonator utilizing two integrators. With this type of resonator, it is possible to attain high Q values and good stability. To achieve the greatest possible frequency variation, the 2 photo-resistors are varied simultaneously by illuminating them from the same light source. The resonator's amplitude characteristic is shown in Fig. B-12b.

If the resonator is inserted in the feedback path around an amplifier as shown in Fig. B-13, a band-stop filter results. Amplitude and phase characteristics are shown schematically in Fig. B-14. The resonance amplification is determined wholly by fixed circuit components and is independent of the resonance frequency. To keep the amplification of the fundamental constant, it is necessary to vary R_2 and R_3 simultaneously. In addition, Q remains constant if R_2 and R_3 are varied together with the amplification, A . The regulation of A , R_2 and R_3 is effected by 4 photo-resistors which are illuminated from the same light source.

The block diagram for the band-stop filter with amplitude and frequency regulation is shown in Fig. B-15, and the circuit's amplitude characteristic at distortion amplifications of 0, 10 and 20 dB is depicted in Fig. B-16.

The first two filters are constructed as shown in Fig. B-15, while the last filter has a fixed gain of 20 dB.

Filter Amplifier

An integrated operational amplifier having a large bandwidth is used in amplifier F_1 (See Fig. B-15), while the amplifiers used in the active resonators are built up of discrete components.

Frequency regulation loop

Fig. B-17 shows a block diagram of the regulation loop. A frequency counter, via an LP filter and a control circuit, adjusts photo-resistors R_A and R_B (See Fig. B-15) so that the band-stop filter's resonance frequency is in the vicinity of the input signal's fundamental. The LP filter serves to remove ripple on the output of the frequency counter. The phase detector, Φ , compares the phases of the two voltages, V_i and V_3 . As long as the phase angle is 90° , the average value of the output voltage is $V_D = 0$.

If the phase angle is not 90° , the detector gives an output voltage whose polarity depends on whether the phase angle is more or less than 90° . The detector's output voltage, via an integrator, LP filter and control circuit, regulates the two photo-resistors, R_A and R_B , and hereby the resonance frequency. The other LP filter serves to filter out the ac voltage coming from the phase detector.

Phase Detector

The phase detector, Fig. B-18, consists of 2 comparators, which transform the input signals to square waves of TTL level, and an exclusive OR gate.

As long as the phase angle between the two input signals is 90° and the two comparators' off-set voltages are zero, the output voltage will be a symmetrical square wave with a frequency twice that of the input signal.

Control circuit

The principle of operation is shown in Fig. B-19. The circuit consists of an exponential amplifier and a regulation loop.

To tune the band-stop filter's resonance frequency, two photo-resistors are used whose resistance can be varied by a factor of 1000 according to their illumination. These 2 resistors, together with a third photo-resistor of the same type, are housed together with a light-emitting diode which illuminates all three equally. The photo-resistors are selected to have equal resistance over the entire regulation range.

The exponential amplifier produces a current which is proportional to the anti-log of the voltage between the bases of Q1 and Q2. The regulation loop now adjusts the illumination of the resistors so that $R = V_{ref}/i$. Since the band-stop filter's resonance frequency is inversely proportional to the resistance R , the resonance frequency is therefore proportional to the anti-log of the control circuit's input voltage. By a suitable choice of circuit parameters, a relationship is established between the frequency and the output voltage of the frequency counter (sensitivity: 1 decade/volt).

Gain regulation

The gain regulation block diagram is shown in Fig. B-20. The amplification of distortion in the band-stop filter is varied from 20-60 dB by varying resistors R_2 , R_3 , R_6 and R_7 (See Fig. B-15) so that during distortion measurements in the 0.1-10% range, the distortion signal on the output of the last band-stop filter is held constant. This is accomplished by using a detector plus an integrator, 2 control circuits, 2 LED's and 8 photo-resistors in such a way that the detector's output corresponds to a given reference voltage.

The control circuits are the same type used in the amplifier, Fig. B-5, and have a sensitivity of 1/3 decade/volt.

Gain Measurement

The operating principle for gain measurement is shown in Fig. B-21. The dc amplification is measured in BSI and BSII. A dc current produced by the exponential amplifier is fed to summation amplifier BSI. This current is changed, by BSI, to a voltage which is amplified by BSII. The voltage V_1 which appears on the output of BSII is compared to a reference voltage. The integrator regulates the voltage V_O so that the exponential amplifier's output current has a value which results in $V_1 = -V_{ref}$. V_O will then be proportional to the logarithm of the gain of the two filters.

RC OSCILLATOR (Schematic Diagrams 10,11,12,13; drawings 1515-A1,2152-A2,1516-A1, 2152-A2)

Principle of Operation

The oscillator's block diagram is shown in Fig. B-22. An active resonator of the same type as found in the band-stop filters is used to determine the frequency. The resonator is followed by an output amplifier from which the feedback loop voltage is taken. Feedback is also taken from an amplitude dependent voltage divider in which is included an NTC resistor. Hereby, coarse stabilization of the amplitude is achieved.

Frequency regulation is effected by two photo-resistors whose resistance is varied by a light-emitting diode. A frequency counter of the same type as employed in the distortion meter measures the frequency of oscillation. The frequency counter's output voltage is compared to the impressed control voltage, and the current in the LED is regulated so that there is agreement between the desired and measured frequency.

Amplitude regulation is achieved in a similar manner using photo-resistors. A detector coupled to the output produces a voltage proportional to the log of the output voltage. This voltage is compared to the amplitude control voltage, and the photo-resistors' illumination is regulated to achieve agreement.

Oscillator circuit

The band-pass filter used is identical to the active resonator used in the band-stop filters. The output amplifier, F_7 , is equipped with a symmetrical class AB output stage in order to minimize distortion.

Control circuit (Fig. B-23)

The control circuit used here is somewhat simpler than the one in the distortion meter, since it is only necessary for the gain in the regulation loop to be somewhat independent of the oscillation frequency. The circuit's sensitivity is 1/2 decade/volt.

Amplitude regulation

The regulation loop block diagram is shown in Fig. B-24. The oscillator signal is fed to the amplitude regulation loop via a differential amplifier, F_1 . This amplifier separates the regulation loop's ground from the rest of the apparatus in order to avoid formation of a hum loop when the oscillator's output is connected to the distortion meter's input through the device under test. Any voltage induced in the circuit impresses itself across resistor R_s (10 Ω), since R_s 's impedance is substantially greater than the impedance of the rest of the loop (the shielded cable's outer conductor). Because of the differential amplifier's common-mode rejection, the induced hum voltage is balanced out.

Regulation is effected by a shunt feedback amplifier, F_2 , whose gain is regulated by the two photo-resistors, R_1 and R_4 , each of which regulates its own output voltage range (R_1 over and R_4 under 30 mV). After the output amplifier, the signal passes through a voltage divider so that the amplifier's noise becomes negligible compared to the thermal noise in a 600 Ω resistor. The control circuit, which is of the same type as utilized in the pre-amplifier's regulation circuit, provides for a suitable transition between the two photo-resistors' regulation ranges.

The logarithmic detector which measures the output voltage, e.m.f., is the same type used in the distortion meter. The detector is described on page B-7

The LP filter which attenuates the ripple on the detector's output is a 4th order elliptical filter identical to the one used in the pre-amplifier's regulation circuit.

Sweep Generator

The sweep generator's principle of operation is shown in Fig. B-25. In the idle state, the output voltage is 3 V. When the start button is depressed, switch S_1 is opened, whereupon capacitor C begins to charge. When the output voltage crosses zero, LS_1 gives a signal which closes switch S_2 , thereby discharging C. When $V_o = 3$ V, LS_2 gives a signal which opens S_2 and closes S_1 . The circuit then remains in this state until the next start pulse.

POWER SUPPLY

(Schematic Diagram 14, drawing 2153-A2)

Integrated voltage regulators are used throughout the power supply. An MC1463 regulator is used for -12 V and an MC1469 for +12 V. Both are equipped with extra series transistors.

The regulation of +5 V is accomplished by 2 LM309K's.

Besides this, power is supplied unregulated, except for a smoothed voltage of 36 V to the pre-amplifier. Regulation of this voltage is carried out at the pre-amp.

SECTION C - SPECIFICATIONS

DISTORTION METER

Fundamental frequency:	20 Hz to 20 kHz
Harmonics and noise (-3 dB):	10 Hz to 150 kHz
Distortion range:	0.02% to 10%
Accuracy (0.1% - 10% distortion):	± 1 dB
Intrinsic distortion:	$< 0.02\%$ 100 Hz - 20 kHz $< 0.03\%$ 20 Hz - 100 Hz
Input voltage limits:	10 mV - 30 V
Input impedance: $V_{in} = < 3$ V	1 M Ω
$V_{in} = < 30$ V	10 k Ω
Input noise voltage: (BW = 150 kHz)	< 8 μ V ms
Pre-amp. dynamic range:	50 dB
Min. sweep time (20 Hz - 20 kHz):	approx. 1 min.
S/N range:	-80 dB to -20 dB
Recorder output voltage:	$V_{dc} = \log k \left[\text{Volt} \right]$ (100% $\sim k = 1$) $k = \text{distortion factor}$
HP-LP filter: Cut-off frequency	250 Hz
Attenuation	20 dB

INPUT/OUTPUT RATIO METER

Frequency range:	20 Hz to 20 kHz
Measuring range:	-40 to +90 dB
Accuracy:	± 1 dB
Recorder output voltage:	$V_{dc} = \log \frac{V \text{ INPUT}}{V \text{ OUTPUT}} \left[\text{Volt} \right]$

INPUT FREQUENCY METER

Measuring range:	20 Hz to 20 kHz
Accuracy:	$\pm 5\%$
Recorder output voltage:	$V_{dc} = \log \frac{f}{20 \text{ Hz}} [\text{Volt}]$

OSCILLATOR

Frequency range:	20 Hz to 20 kHz
Output freq. control:	$V_{dc} = \log \frac{f}{20 \text{ Hz}} [\text{Volt}]$
Accuracy of frequency:	$\pm 5\%$
Time constant of freq. reg.:	0.16 s
Harmonic distortion:	$< 0.01\%$ 100 Hz - 20 kHz $< 0.02\%$ 20 Hz - 100 Hz
Output voltage (EMF):	1 mV to 1 V
Accuracy of output voltage:	$\pm 0.5 \text{ dB}$
Output impedance:	600 Ω
Output voltage control:	$V_{dc} = \log \frac{V \text{ OUTPUT}}{1 \text{ V}} [\text{Volt}]$
Input voltage control:	$V_{dc} = \log \frac{V \text{ INPUT}}{1 \text{ V}} [\text{Volt}]$
Time constant of V output reg.:	0.25 s
Power requirements:	115/220 V (95 - 130/190 - 260), 47.5 - 63 Hz, 50 VA
Ambient temp. range:	$+5^{\circ}\text{C}$ to $+40^{\circ}\text{C}$
Storage temp.:	-40°C to $+70^{\circ}\text{C}$
Dimensions (W x H x D):	440 x 144 x 344 mm
Weight:	9.5 kg

SECTION D - DISMANTLING

Opening the BKF10

- 1) Remove the 4 screws at the corners of the back cover plate (See Fig. D-1).
- 2) Remove the top and base plates.

Further opening for removal of printed circuit boards

- 3) Remove the 4 screws holding the back plate (Fig. D-2).
- 4) Flip the back cover plate upwards, and screw it fast to the upper edge of the BKF10 so that the print card can be taken out (Fig. D-3).

Meter removal

- 5) Remove the side plates by pulling them backwards.
- 6) Unscrew the 3 knobs on the face plate.
- 7) Unscrew the 2 screws which hold the grey-lacquered top plate from the inside. Remove the top plate.
- 8) Now the 4 screws which hold each meter can be removed.
- 9) When the 4 screws which hold the handles on each side of the apparatus are removed and the leads have been unsoldered, the face plate can be pulled off the BKF10. It may be necessary to pull the multi-plug from the mother board and unsolder some of the leads in order to gain access.

SECTION E - PERFORMANCE CHECK

Equipment

Coaxial cable, 50 Ω , code # 617-004

Frequency counter, 20 Hz-20 kHz

Digital voltmeter for ac and dc measurements

Variable dc power supply, 0-3 V

Tone generator, 20 Hz-20 kHz

Resistor, 1.00 k Ω

Resistor, 2.29 k Ω

Resistor, 88.9 k Ω

Servograph, REC61/S2

Procedure

- 1) Connect the INPUT and OUTPUT jacks using a 50 Ω coaxial cable, and also connect the OUTPUT jack to a digital voltmeter.
- 2) Set the BKF10's control as follows:
INPUT FILTER: FLAT
OUTPUT FREQ.: MAN. 1 kHz
MAX. INPUT: 3 V
VERNIER: CAL.
LEVEL CONTROL switch: 1 mV
LEVEL AT: OUTPUT
- 3) Depress POWER, and check that the POWER lamp lights.
- 4) Check that the INPUT OUT OF RANGE lamp is lit and that the digital voltmeter reads 1 mV $\pm 5\%$.
- 5) Set the LEVEL CONTROL switch to 10 mV, 30 mV, 100 mV, 300 mV and 1 V, and in each case, check that the INPUT OUT OF RANGE lamp is extinguished and that the ac voltage measured on the DVM is within $\pm 5\% \sim 0.5$ dB. (The output is in steps of 10 dB, so that the values 3-30-300 mV are the equivalent of 3.16-31.6-316 mV.)
- 6) Set the LEVEL CONTROL switch to 3 V, and check that the INPUT OUT OF RANGE lamp is out, that the OUTPUT OUT OF RANGE lamp is lit and that the DVM reads from 2.5 V ac to 3 V ac.
- 7) Set the LEVEL CONTROL switch to 1 V.
- 8) Turn the VERNIER knob until the OUTPUT OUT OF RANGE lamp just lights, and check that the DVM reads greater than 1.8 V ac.
- 9) Turn the VERNIER knob back to CAL.

- 10) Replace the DVM by a frequency counter.
- 11) Set the OUTPUT FREQ. knob so that the counter reads 20 kHz, 1 kHz, 200 Hz and 20 Hz, and in each case check that the INPUT FREQUENCY meter's reading lies within $\pm 5\%$.
- 12) Adjust OUTPUT FREQ. so that the frequency is 1 kHz, and remove the counter.
- 13) Set MAX. INPUT to 30 V, and check that the INPUT/OUTPUT RATIO meter reads 20.7 dB and that the -dB lamp and the +20 dB lamp both light.
- 14) Set the MAX. INPUT switch to 3 V.
- 15) Adjust the OUTPUT FREQ. knob so that the INPUT FREQUENCY meter reads 250 Hz.
- 16) Switch the INPUT FILTER from FLAT to HP, and check that the distortion meter's reading falls approximately 3 dB.
- 17) Switch the INPUT FILTER from FLAT to LP, and check that the distortion meter's reading falls approximately 3 dB.
- 18) Set INPUT FILTER to FLAT.
- 19) Adjust the OUTPUT FREQ. knob so that the INPUT FREQUENCY meter reads 1 kHz.
- 20) Depress the S/N button momentarily, and check that the distortion meter reads less than -80 dB (approx. -81).
- 21) Set OUTPUT FREQ. to SINGLE SWEEP, depress the OUTPUT FREQ. button, and check that the self-distortion read by the DISTORTION meter is less than 0.03% from 20 kHz to 100 Hz and less than 0.05% from 100 Hz to 20 Hz.
- 22) Set OUTPUT FREQ. to 1 kHz and the LEVEL CONTROL to 1 V, switch MAX. INPUT from 3 V to 30 V, and check that the DISTORTION meter's reading remains practically unchanged.

Checking the 25-pole multi-plug (Regarding pin numbering, see the BKF10 Operating Instructions)

All measurements are made relative to pin 20 (0 V)

- 1) Connect the INPUT and OUTPUT jacks using a 50 Ω coaxial cable.
- 2) Set the BKF10 as follows:
 INPUT FILTER: FLAT
 OUTPUT FREQ.: SINGLE SWEEP
 MAX. INPUT: 30 V
 VERNIER: CAL.
 LEVEL CONTROL switch: 1 V
 LEVEL AT: OUTPUT
- 3) Connect a DVM to pin 1, and check that it reads -1.03 V (corresponding to 20.6 dB on the INPUT/OUTPUT RATIO meter).
- 4) Move the DVM to pin 2, and check that it reads +3 V ± 5 mV.

- 5) Move the DVM to pin 4. Depress the OUTPUT FREQ. button, and check that the DVM reads approx. +4.8 V while the frequency sweeps downwards and approx. 0.15 V when it flies back.
- 6) Move the DVM to pin 3. Depress the OUTPUT FREQ. button, and check that the DVM reads close to -4 V during the frequency fly-back (corresponding to a reading of -80 dB on the DISTORTION meter).
- 7) Momentarily connect pin 18 to pin 20, and check that the DISTORTION meter reads -80 dB as in step 6.
- 8) Depress the OUTPUT FREQ. button again, momentarily connect pin 5 to pin 20, and check the INPUT FREQUENCY meter to see that the oscillator frequency is reset to 20 kHz.
- 9) Move the DVM to pin 14, and check that it reads $+3 \text{ V} \pm 1 \text{ mV}$.
- 10) Move the DVM to pin 16, and check that it reads $+3 \text{ V} \pm 5 \text{ mV}$ (corresponding to an INPUT FREQUENCY meter reading of 20 kHz).
- 11) Momentarily connect pin 19 to pin 20, and check the INPUT FREQUENCY meter to see that the sweep function from 20 kHz to 20 Hz begins.
- 12) Move the DVM to pin 23, and check that it reads approximately 5 V.
- 13) Move the DVM to pin 24, and check that it reads -12 V.
- 14) Move the DVM to pin 25, and check that it reads +12 V.
- 15) Connect a dc potential of +3 V to pin 15. Set the OUTPUT FREQ. switch to EXT., and check that the INPUT FREQUENCY meter reads 20 kHz. Remove the +3 V supply from pin 15.
- 16) Connect a dc source of -1 V to pin 17. Move the DVM to the OUTPUT jack (which must still be connected to the INPUT jack). Set the LEVEL CONTROL switch to EXT. Set OUTPUT FREQ. to SINGLE SWEEP. Set the MAX. INPUT switch to 3 V, and check that the DVM reads 100 mV ac. Remove the -1 V source and the DVM.

Checking the distortion measurement using a signal with known distortion

Test set-up

See Fig. E-2

Principle

Two low frequency signals having different frequencies are mixed in a known proportion, for example:

1 kHz, 1 V, from the BKF10, divided in the ratio 1/10.

2.5 kHz, 1 V, from an AF oscillator, divided in the ratio 1/100.

The 1 kHz signal will therefore contain 10% 2.5 kHz, and the distortion will be 10%.

Setting the BKF10

INPUT FILTER: FLAT
 OUTPUT FREQ.: MAN.
 VERNIER: CAL.
 LEVEL CONTROL switch: 1 V
 LEVEL AT: OUTPUT
 OUTPUT FREQ.: approx. 1 kHz

Setting of audio oscillator and check of BKF10

Frequency: approx. 2.5 kHz

Amplitude: 0.1 V. Check that the BKF10 reads 1% distortion ± 1 dB.

Amplitude: 1 V. Check that the BKF10 reads 10% distortion ± 1 dB.

DRAWING SELF-DISTORTION CURVES USING AN REC61/S2 SERVOGRAPH

Note: When corresponding with Radiometer concerning the BKF10, it will be a great help to include a curve of the BKF10's own distortion, since this will often make it possible to determine where the fault lies. Fig. E-1 shows a typical curve drawn from a properly functioning BKF10 in the way described below.

The REC61/S2 consists of the following:

REC61, Servograph
 REA110, 500 mV unit (or REA112)
 REA240, Distortion interface (or REA241)
 617-729, Interconnecting cable
 984-043, Recording paper

Drawing curves with the REA240

- 1) Connect the 617-729 Interconnecting Cable between the REA240 Distortion Meter Interface and the multi-socket on the rear of the BKF10.
- 2) Connect INPUT and OUTPUT on the BKF10 using a 50 Ω shielded cable, 617-004.

Setting the BKF10:

- 3) Set INPUT FILTER to FLAT.
- 4) Set OUTPUT FREQ. to EXT.
- 5) Set MAX. INPUT to 3 V.

- 6) Set VERNIER to CAL.
- 7) Set LEVEL AT to 1 V OUTPUT.

Setting the REC61/S2

- 8) Short circuit the INPUT terminals on the REA110.
- 9) Set CHART to its middle position.
- 10) Turn TRACKING POTENTIOMETER fully clockwise to the stop. (Check that the INPUT FREQUENCY meter on the BKF10 indicates 20 kHz $\pm 5\%$).
- 11) Set STAND BY/PEN to UP (REMOTE)
- 12) Using the PEN POSITION controls on the REC61, position the pen over the small circle on the recording paper marked SET ZERO, and set the STAND BY/PEN switch to DOWN. (Fine adjust the pen position if necessary).
- 13) Set the CHART FEED selector to 2 sec/cm.
- 14) Set the switch on the REA240 to the DISTORTION position.
- 15) Depress the CHART switch to the forward position. The sweep will then be automatically recorded in the appropriate field on the recording paper.
- 16) When the sweep reaches 20 Hz, set the STAND BY/PEN switch to STAND BY.
- 17) Check that the distortion is less than 0.03% from 20 kHz to 100 Hz and less than 0.05% from 100 Hz to 20 Hz.

Drawing curves with the REA241

- 1) Connect the 617-729 Interconnecting Cable between the REA241 Distortion Meter Interface and the multi-connector on the back of the BKF10.
- 2) Connect INPUT and OUTPUT on the BKF10 using a 50 Ω shielded cable, 617-004.

Setting the BKF10

- 3) Set INPUT FILTER to FLAT.
- 4) Set OUTPUT FREQ. to EXT.
- 5) Set MAX. INPUT to 3 V.
- 6) Set VERNIER to CAL.
- 7) Set LEVEL AT to 1 V OUTPUT.

Setting the REC61/S2

- 8) Short circuit the INPUT terminals on the REA110.
- 9) Set the REA241 to SET ZERO.
- 10) Set the CHART switch to the forward position.

- 11) Turn the TRACKING POTENTIOMETER fully clockwise to the stop. (Check that the INPUT FREQUENCY meter on the BKF10 indicates 20 kHz $\pm 5\%$.)
- 12) Set STAND BY/PEN to UP (REMOTE).
- 13) Using the PEN POSITION controls on the REC61, position the pen over the small circle on the recording paper marked SET ZERO.
- 14) Set the CHART FEED selector to 2 sec/cm.
- 15) Set the switch on the REA241 to the DISTORTION position.
- 16) Depress the SWEEP START button on the REA241. The sweep will then be automatically recorded in the appropriate field on the recording paper.
- 17) Check that the distortion is less than 0.03% from 20 kHz to 100 Hz and less than 0.05% from 100 Hz to 20 Hz.

SECTION F - REALIGNMENT

General Comments

Before realignment is begun, it is necessary to let the BKF10 warm up for an hour or so.

During realignment and trouble-shooting, it is practical to position the back cover so that it is screwed on above the printed circuit cards. (See Fig. D-3.)

The BKF10 and all measuring instruments must be grounded.

It is wise to interrupt the line voltage to the BKF10 while measuring leads are being connected or removed in order to avoid short circuits which can damage the apparatus.

The line voltage must be interrupted when changing print cards.

All voltage designations are given relative to 0 V (pin 16 on print card 1 to 12).

Trouble-shooting is made easier if a supply of pre-adjusted print cards for the BKF10 is available, since these can be used to pin-point defective cards. When a pre-adjusted card has been inserted into the BKF10 in place of a defective one, further adjustment of the apparatus should be superfluous if the other cards are in order. On the other hand, if a meter is replaced, it is usually necessary to adjust the appropriate trimmer. Specifically:

Trimmer R747 for INPUT FREQUENCY meter, M_1

Trimmer R966 for DISTORTION meter, M_2

Trimmer R964 for INPUT/OUTPUT RATIO meter, M_3

This is due to the fact that the meters' internal resistance and sensitivity can vary slightly.

The printed circuit board which is being trouble-shot or adjusted should be connected to an extension board so that the measuring leads can be easily connected.

Measuring equipment necessary for a complete realignment of the BKF10

2 dc power supplies whose voltage outputs can be continuously varied from 0 to 10 V.

1 digital voltmeter for ac and dc

1 frequency counter, 20 Hz to 20 kHz

1 audio oscillator, 20 Hz to 20 kHz

1 frequency analyzer

1 oscilloscope for measuring a 180° phase shift (e.g. one with a double beam)

- 1 50 Ω coaxial cable, code No. 617-004
- 1 extension print-board, 2 x 18 poles, code No. 900-641
- 1 extension print-board, 2 x 24 poles, code No. 900-639

POWER SUPPLY (printed circuit board 13, Schematic Diagram 14, drawing 2153-A2)

Equipment: Digital voltmeter

Do not use extension card

- 1) Connect a DVM between pt. 21/J29 and pt. 3/J29 (0 V).
- 2) Adjust trimmer R1313 so that the DVM reads $-12\text{ V} \pm 1\text{ mV}$.
- 3) Move the DVM lead from pt. 21/J29 to pt. 23/J29.
- 4) Adjust trimmer R1305 so that the DVM reads $+12\text{ V} \pm 1\text{ mV}$.
- 5) Remove the DVM and its leads.

PRE-AMPLIFIER (cards 1 and 2, Schematic Diagram 1, 1512-A1)

Equipment:

DC voltage source

Tone generator

Digital voltmeter for ac and dc

Control Circuit for R_1 (without regulation) (card 1)

- 1) Interrupt the current to R_{11} 's LED (CR117). This is best done by short circuiting the two solder points located on the printed circuit board under the middle of CR117.
- 2) Remove print card # 2.
- 3) Set the MAX. INPUT switch to 3 V.
- 4) Connect a control voltage of $+2\text{ V} \pm 2\text{ mV}$ between pt. 9/J17 and pt. 16/J17 (0 V).
- 5) Connect a tone generator to DIST. IN, and set the generator to $65\text{ mV} \pm 0.6\text{ mV}$, $1\text{ kHz} \pm 10\%$.
- 6) Connect a DVM between pt. 6/J17 and pt. 16/J17 (0 V).
- 7) Adjust trimmer R162 so that the DVM reads $1\text{ V ac} \pm 10\text{ mV ac}$.
- 8) Set the control voltage to $+4\text{ V} \pm 2\text{ mV}$.
- 9) Set the tone generator to $21\text{ mV} \pm 2\text{ mV}$.
- 10) Adjust trimmer R159 so that the DVM reads $1\text{ V ac} \pm 10\text{ mV ac}$.

- 11) Repeat steps 4 - 10 until the output voltage is $1\text{ V ac} \pm 50\text{ mV ac}$.
- 12) Remove the short circuit across CR117 (See step 1).

Control Circuit for R_{11} (without regulation) (card 1)

- 13) Interrupt the current to R_1 's LED (CR116). This is best done by short circuiting the two solder points located on the printed circuit board under CR116.
- 14) Set the control voltage at pt. 9/J17 to $-2\text{ V} \pm 2\text{ mV}$.
- 15) Set the tone generator to $0.6\text{ V} \pm 3\text{ mV}$, $1\text{ kHz} \pm 10\%$.
- 16) Adjust trimmer R147 so that the output voltage at pt. 6/J17 is $1\text{ V} \pm 10\text{ mV}$.
- 17) Set the control voltage at pt. 9/J17 to $-4\text{ V} \pm 2\text{ mV}$.
- 18) Set the tone generator to $1.8\text{ V} \pm 2\text{ mV}$, 1 kHz .
- 19) Adjust trimmer R144 so that the output voltage on pt. 6/J17 is $1\text{ V} \pm 10\text{ mV}$.
- 20) Repeat steps 14 - 19 until the output voltage is $1\text{ V} \pm 50\text{ mV}$.
- 21) Remove the short circuit across CR116 (See step 13).
- 22) Remove the dc voltage source and leads.
- 23) Remove the digital voltmeter and leads.
- 24) Replace print card # 2.

Output voltage (with regulation) (card 2)

- 25) Connect the DVM between pt. 7/J18 and pt. 16/J18 (0 V).
- 26) Set the tone generator (connected to DIST. IN) to $0.2\text{ V} \pm 2\text{ mV}$, $1\text{ kHz} \pm 10\%$.
- 27) Adjust trimmer R207 so that the DVM reads $1\text{ V ac} \pm 2\text{ mV ac}$.

Filter amplification (card 2)

- 28) Move the DVM to pt. 11/J18, adjust the output of the tone generator so the DVM reads 1 V ac and note the dc voltage measured there.
- 29) Move the DVM from pt. 11/J18 to pt. 14/J18.
- 30) Adjust trimmer R220 so that the dc voltage is 9.7 times smaller than the voltage noted in step 28.
- 31) Repeat steps 28 - 30 until the correct amplification of 9.7 is obtained.
- 32) Remove the DVM and its leads.
- 33) Remove the tone generator.

LOGARITHMIC DETECTOR FOR THE DISTORTION METER (See schematic diagram 3) (card 2)

Equipment:

Tone generator

Digital voltmeter for dc measurements

- 1) Remove print card 1.
- 2) Connect a tone generator between pt. 4/J18 and pt. 16/J18 (0 V).
- 3) Connect a DVM between pt. 12/J18 and pt. 16/J18 (0 V).
- 4) Set the tone generator to $0.5 \text{ V} \pm 1 \text{ mV}$, $1 \text{ kHz} \pm 10\%$.
- 5) Adjust trimmer R235 so that the DVM reads $0 \text{ V} \pm 2 \text{ mV}$ (corresponding to 1 V ac on INPUT).
- 6) Set the tone generator to $5 \text{ mV} \pm 0.1 \text{ mV}$.
- 7) Adjust trimmer R238 so that the DVM reads $+2 \text{ V} \pm 2 \text{ mV}$ (corresponding to 10 mV on INPUT).
- 8) Repeat steps 4 - 7 until the voltages measured in steps 5 and 7 are without the given tolerances.
- 9) Remove the DVM and leads.
- 10) Remove the tone generator.
- 11) Replace print card 1.

FREQUENCY COUNTER FOR THE DISTORTION METER (Schematic Diagram 4) (card 7)

Equipment:

Frequency counter

Digital voltmeter for dc

Tone generator

- 1) Remove print card 1.
- 2) Connect a tone generator between pt. 10/J23 and pt. 16/J23 (0 V).
- 3) Connect a DVM between pt. 8/J23 and pt. 16/J23 (0 V).
- 4) Set the tone generator to 1 V , $2 \text{ kHz} \pm 0.05\%$.
- 5) Note the dc voltage read on the DVM (approx. 1.2 V).
- 6) Set the tone generator to $200 \text{ Hz} \pm 0.05\%$.
- 7) Adjust trimmer R721 so that the voltage measured on the DVM is 1.000 V more than that read in step 5.
- 8) Repeat steps 4 - 7 until the error is less than 2 mV .

- 9) Set the tone generator to 20 kHz $\pm 0.05\%$.
- 10) Adjust trimmer R707 so that the voltage measured on the DVM is 1.000 V less than that read in step 5.
- 11) Adjust trimmer R745 so that the DVM reads 0.186 V.
- 12) Move the DVM from pt. 8/J23 to pt. 12/J23.
- 13) Adjust trimmer R727 so that the DVM reads 3.000 V.
- 14) Move the DVM from pt. 12/J23 to pt. 6/J23, and measure the voltage there.
- 15) Move the DVM from pt. 6/J23 to pt. 7/J23.
- 16) Adjust trimmer R740 so that the DVM reads the same voltage as that in step 14 within a tolerance of ± 1 mV.
- 17) Remove the DVM and its leads.
- 18) Ensure that the BKF10 is in its normal horizontal position.
- 19) Interrupt the line voltage, and adjust the mechanical zero point on the FREQ. METER so that it reads 20 Hz.
- 20) Reconnect the line voltage, and adjust trimmer R747 so that the FREQ. METER reads 20 kHz.
- 21) Remove the tone generator and leads.
- 22) Replace print card 1.

RMS DETECTOR (Schematic Diagram 8) (card 8)

Equipment:

Frequency analyzer

Tone generator

Digital voltmeter for dc

- 1) Remove print card 5.
- 2) Set INPUT FILTER to FLAT.
- 3) Connect a tone generator between pt. 10/J24 and pt. 16/J24 (0 V).
- 4) Set the tone generator to 0.316 V, 1 kHz $\pm 0.5\%$.
- 5) Connect a frequency analyzer between pt. 2/J24 and pt. 16/J24 (0 V).
- 6) Adjust trimmer R842 so that the frequency analyzer reads a minimum of 1 kHz content.
- 7) Set the frequency analyzer to 2 kHz.
- 8) Adjust trimmer R849 so that the 2nd harmonic voltage is 70 mV ± 1 mV.
- 9) Remove the frequency analyzer.

- 10) Connect a DVM between pt. 4/J24 and pt. 16/J24 (0 V).
- 11) Adjust trimmer R857 so that the DVM reads $0\text{ V} \pm 1\text{ mV dc}$.
- 12) Set the tone generator to 1.000 V.
- 13) Adjust trimmer R855 so that the DVM reads $-0.5\text{ V} \pm 1\text{ mV}$.
- 14) Repeat steps 11 - 13 until the error is less than 1 mV.
- 15) Remove the tone generator, DVM and all leads.
- 16) Replace print card 5.

BAND-STOP FILTER I (Schematic Diagram 5) (card 3)

Equipment:

3 variable dc power supplies

Tone generator

2 DVM's for ac and dc

Resistor, 4.42 k Ω

Frequency regulation

- 1) Remove printed circuit boards 1, 6, 7, 8 and 9.
- 2) Connect both pt. 9/J19 and pt. 11/J19 to pt. 16/J19.
- 3) Connect a variable dc voltage source between pt. 1/J19 and pt. 16/J19 (0 V), and set it to -10 V dc.
- 4) Connect an ac DVM between pt. 12/J19 and pt. 16/J19 (0 V).
- 5) Connect a tone generator between pt. 12/J19 and pt. 16/J19, and set it to $100\text{ mV} \pm 1\text{ mV}$, $2\text{ kHz} \pm 0.1\%$.
- 6) Connect a continuously variable voltage source between pt. 7/J19 and pt. 16/J19, and adjust the voltage to give a minimum ac reading on the DVM (approx. 40-70 mV ac for approx. +1.3 V dc). Measure and note the dc voltage.
- 7) Set the tone generator to $200\text{ Hz} \pm 0.1\%$.
- 8) Set the voltage on pt. 7/J19 to the same value as measured in step 6 + $1\text{ V} \pm 1\text{ mV}$.
- 9) Adjust trimmer R365 to give a minimum reading on the DVM connected to pt. 3/J19 (approx. 40-70 mV).
- 10) Repeat steps 6-9 until maximum attenuation is achieved.
- 11) Set the tone generator to $1\text{ V} \pm 1\text{ mV}$.
- 12) Set the voltage at pt. 7/J19 to 2.186 V.
- 13) Adjust trimmer R369 to give a minimum ac reading on the DVM connected to pt. 3/J19.

Gain regulation

- 14) Set the voltage on pt. 7/J19 to +3.2 V.
- 15) Connect a resistor of $4.42 \text{ k}\Omega \pm 0.5\%$ in series with the tone generator's output to pt. 12/J19, and set the output to $100 \text{ mV} \pm 1 \text{ mV}$, $1 \text{ kHz} \pm 10\%$.
- 16) Set the voltage at pt. 1/J19 to 0 V.
- 17) Adjust trimmer R354 so that the DVM connected to pt. 3/J19 reads $316.2 \text{ mV ac} \pm 3.2 \text{ mV ac}$.
- 18) Set the voltage source on pt. 1/J19 to $+2 \text{ V} \pm 1 \text{ mV}$.
- 19) Adjust trimmer R351 so that the DVM connected to pt. 3/J19 reads 150 mV ac (corresponding to a gain of 3.5 dB).
- 20) Repeat steps 16-19 until the error is less than 10% ($\sim 1 \text{ dB}$).

Gain measurement

- 21) Connect a dc voltage source between pt. 1/J19 and pt. 16/J19 (0 V), and set it to 0 V.
- 22) Connect a dc voltage source between pt. 13/J19 and pt. 16/J19 (0 V), and set it to 0 V.
- 23) Connect a DVM between pt. 12/J19 and pt. 16/J19 (0 V).
- 24) Adjust trimmer R327 so that the DVM reads $0 \text{ V dc} \pm 0.05 \text{ mV dc}$ (make sure that there is no dc connector between the output of the ac generator and the circuit.)
- 25) Adjust the dc voltage on pt. 1/J19 to give $322 \text{ mV ac} \pm 0.5 \text{ mV}$ on pt. 3/J19.
- 26) Adjust trimmer R306 so that the DVM reads $632 \text{ mV} \pm 1 \text{ mV dc}$.
- 27) Set the voltage on pt. 13/J19 to $-406.1 \text{ mV} \pm 0.4 \text{ mV}$.
- 28) Adjust trimmer R301 so that the DVM reads $1.610 \text{ V dc} \pm 4 \text{ mV dc}$.
- 29) Set the voltage on pt. 13/J19 to $+593.9 \text{ mV} \pm 0.4 \text{ mV}$ and check that the DVM reads $161.0 \text{ mV} \pm 0.4 \text{ mV}$ or steps 24 to 29 must be repeated.
- 30) Remove all instruments and leads.
- 31) Replace print cards 1, 6, 7, 8 and 9.

BAND-STOP FILTER II (Schematic Diagram 6) (card 4)

Equipment:

2 dc power supplies

Tone generator

2 DVM's for ac and dc

Frequency regulation

- 1) Remove print cards 3, 5, 6, 7, 8, 9.
- 2) Connect both pt. 9/J20 and pt. 10/J20 to pt. 16/J20 (0 V).
- 3) Connect a variable dc voltage source between pt. 6/J20 and pt. 16/J20 (0 V), and set it to -10 V dc.
- 4) Connect a DVM between pt. 4/J20 and pt. 16/J20 (0 V).
- 5) Connect a tone generator between pt. 3/J20 and pt. 16/J20 (0 V), and set it to 100 mV $\pm$ 1 mV, 2 kHz $\pm$ 0.1%.
- 6) Connect a continuously variable voltage source between pt. 7/J20 and pt. 16/J20 (0 V), and adjust the voltage to give a minimum ac reading on the DVM. Measure and note the dc voltage at pt. 7/J20.
- 7) Set the tone generator to 200 Hz $\pm$ 0.1%.
- 8) Set the voltage on pt. 7/J20 to the same value as measured in step 6 + 1 V $\pm$ 1 mV.
- 9) Adjust trimmer R459 to give a minimum ac reading on the DVM connected to pt. 4/J20.
- 10) Repeat steps 6-9 until maximum attenuation is achieved.
- 11) Set the tone generator to 1 V $\pm$ 1 mV.
- 12) Set the dc voltage on pt. 7/J20 to 2.186 V.
- 13) Adjust trimmer R463 to give a minimum ac reading on the DVM connected to pt. 4/J20.

Gain regulation

- 14) Set the dc voltage on pt. 7/J20 to +3.2 V.
- 15) Set the tone generator to 100 mV $\pm$ 1 mV, 1 kHz $\pm$ 10%.
- 16) Set the voltage on pt. 6/J20 to 0 V.
- 17) Adjust trimmer R448 so that the DVM connected to pt. 4/J20 reads 316.2 mV ac $\pm$ 3.2 mV ac.
- 18) Set the voltage source to give +2 V $\pm$ 1 mV on pt. 6/J20.
- 19) Adjust trimmer R445 so that the DVM connected to pt. 4/J20 reads 150 mV ac $\pm$ 1.5 mV ac.
- 20) Repeat steps 16-19 until the error is less than 10% ($\sim$ 1 dB).

Gain measurement

- 21) Connect a DVM between pt. 3/J20 and pt. 16/J20 (0 V).
- 22) Adjust trimmer R420 so that the DVM reads 0 V dc $\pm$ 0.05 mV dc.
- 23) Replace all print cards, and remove all measuring equipment.

BAND-STOP FILTER III (Schematic Diagram 7) (card 5)

Equipment:

Tone generator

Variable dc power supply

DVM for dc

Frequency regulation

- 1) Remove print cards 4, 6, 7, and 8.
- 2) Connect pt. 9/J21 to pt. 16/J21 (0 V).
- 3) Connect a DVM between pt. 6/J21 and pt. 16/J21 (0 V).
- 4) Connect a tone generator between pt. 1/J21 and pt. 16/J21, and set it to 2 kHz $\pm 0.1\%$, 100 mV ± 1 mV.
- 5) Connect a variable power supply between pt. 8/J21 and pt. 16/J21, and adjust the voltage to give a minimum reading on the DVM. Measure and note the dc voltage.
- 6) Set the tone generator to 200 Hz $\pm 0.1\%$.
- 7) Adjust the voltage on pt. 8/J21 to the same value as that measured in pt. 5 + 1 V ± 1 mV.
- 8) Adjust trimmer R536 to give a minimum ac reading on the DVM connected to pt. 6/J21.
- 9) Repeat steps 5-8 until maximum attenuation is achieved.
- 10) Set the tone generator to 1 V ± 1 mV.
- 11) Set the voltage on pt. 8/J21 to 2.186 V.
- 12) Adjust trimmer R540 so that the DVM gives a minimum reading.
- 13) Replace all print cards, and remove all measuring equipment.

CONTROL CIRCUIT FOR FREQUENCY REGULATION OF THE OSCILLATOR

(Schematic Diagram 10) (card 11)

Equipment:

dc Digital voltmeter

Frequency counter

Variable dc power supply

- 1) Remove print card 12.
- 2) Connect a dc power supply between pt. 9/J27 and pt. 16/J27 (0 V), and set it to 0 V.

- 3) Connect a frequency counter between pt. 8/J27 and pt. J27 (0 V), and note the period.
- 4) Set the dc power supply to 0.954 V.
- 5) Adjust trimmer R1154 so that the counter reads a value 3 times that measured in step 2.
- 6) Set the dc power supply to $+3\text{ V} \pm 1\text{ mV}$, and note the period.
- 7) Set the dc power supply to $+3.954\text{ V} \pm 1\text{ mV}$.
- 8) Adjust trimmer R1157 so that the counter reads a period 3 times that noted in step 6.
- 9) Repeat 6-8 until the tolerance is smaller than 5%.
- 10) Set the dc power supply to 0 V, and note the period.
- 11) Set the dc power supply to $+4\text{ V} \pm 1\text{ mV}$.
- 12) Adjust trimmer R1159 so that the counter reads a period 100 times that measured in step 9.
- 13) Replace print card 12, and remove all measuring equipment.

FREQUENCY COUNTER AND CONTROL CIRCUIT FOR RC OSCILLATOR

(Schematic diagrams 10 and 11) (card 12)

Equipment:

dc digital voltmeter

Frequency counter

Variable dc power supply

- 1) Set OUTPUT FREQ. to position MAN.
- 2) Connect the DVM between pt. 3/J28 and pt. 16/J28 (0 V).
- 3) Adjust trimmer R1255 so that the DVM reads $3\text{ V} \pm 1\text{ mV}$.
- 4) Move the DVM from pt. 3/J28 to pt. 10/J28.
- 5) Connect the frequency counter to pt. 2/J28 and pt. 16/J28 (0 V).
- 6) Set the OUTPUT FREQ. potentiometer so that the frequency counter reads 100 Hz $\pm 1\text{ Hz}$ and read the DVM (approx. 2.5 V).
- 7) Set the OUTPUT FREQ. potentiometer so that the DVM reads $1\text{ V} \pm 0.25\%$ less than the voltage measured in step 6.
- 8) Adjust trimmer R1218 so that the frequency counter reads 1 kHz $\pm 10\text{ Hz}$.

- 9) Repeat steps 6-7-8 until the tolerances are achieved.
- 10) Move the DVM from pt. 10/J28 to pt. 13/J28.
- 11) Turn the OUTPUT FREQ. potentiometer counter-clockwise to the extreme left and read the DVM.
- 12) Move the DVM to pt. 11/J28.
- 13) Adjust trimmer R1232 until the DVM reads the voltage measured in step 11 ± 0.2 mV.
- 14) Set the OUTPUT FREQ. potentiometer so that the DVM reads $1\text{ V} \pm 1\text{ mV}$.
- 15) Adjust trimmer R1228 so that the frequency counter reads $200\text{ Hz} \pm 2\text{ Hz}$.
- 16) Turn the OUTPUT FREQ. potentiometer clockwise to the extreme right (the DVM reads $3\text{ V} \pm 1\text{ mV}$).
- 17) Adjust trimmer R1206 until the frequency counter reads $20\text{ kHz} \pm 100\text{ Hz}$.

CONTROL CIRCUIT FOR PHOTO-RESISTORS AND AMPLITUDE REGULATION FOR RC OSCILLATOR (See schematic diagrams 12 and 13) (card 10)

Equipment:

Tone generator

Variable dc power supply

DVM for measuring ac and dc

Photo-resistor control circuit

- 1) Remove print card 11.
- 2) Connect a tone generator between pt. 8B/J26 and pt. 9B/J26 (LOW to pt. 9B), and set it to $1\text{ kHz} \pm 10\text{ Hz}$, $3.1\text{ V} \pm 0.3\text{ V}$.
- 3) Short circuit light-emitting diode CR1022 (the two solder points directly under CR1022).
- 4) Break the connection between pt. 3A/J26 and pt. 3B/J26.
- 5) Connect a DVM for ac measurement between pt. 12B/J26 and pt. 13B/J26 (LOW to pt. 12B).
- 6) Connect a variable dc source between pt. 3A/J26 and pt. 16B/J26 (0 V).
- 7) Set the power supply to $-1.5\text{ V} \pm 1\text{ mV}$.
- 8) Adjust trimmer R1062 so that the DVM reads $100\text{ mV ac} \pm 2\text{ mV ac}$.
- 9) Set the power supply to $-3\text{ V} \pm 1\text{ mV}$.
- 10) Adjust trimmer R1066 so that the DVM reads $316\text{ mV ac} \pm 0.6\text{ mV ac}$.
- 11) Repeat steps 6-9 until the error is less than 5%.
- 12) Remove the short across diode CR1022 (see step 2).
- 13) Short circuit light-emitting diode CR1023 (the two solder lugs on either side of the insulated fastener).

- 14) Set the dc source to $+1.5 \text{ V} \pm 1 \text{ mV}$.
- 15) Adjust trimmer R1056 so that the DVM reads $10 \text{ mV ac} \pm 0.2 \text{ mV ac}$.
- 16) Set the dc source to $+3 \text{ V} \pm 2 \text{ mV}$.
- 17) Adjust trimmer R1060 so that the DVM reads $3.16 \text{ mV ac} \pm 0.06 \text{ mV ac}$.
- 18) Repeat steps 13-16 until the error is less than 5%.
- 19) Remove the short across diode CR1023 (see step 13).
- 20) Move the dc power supply from pt. 3A/J26 to pt. 4B/J26.
- 21) Remove the DVM from pt. 12B/J26 and pt. 13B/J26.
- 22) Connect the DVM between pt. 3B/J26 and pt. 16B/J26 (0 V) and set it for dc measurement. (The connection between pt. 3B and pt. 3A should still be broken.)
- 23) Set the dc power supply to $+1.030 \text{ V}$.
- 24) Adjust trimmer R1073 so that the DVM reads $10 \text{ V} \pm 50 \text{ mV}$.
- 25) Move the DVM from pt. 3B/J26 to pt. 6B/J26.
- 26) Connect pt. 3A/J26 and pt. 3B/J26.
- 27) Remove the power supply from pt. 4B/J26.
- 28) Set VERNIER on the BKF10 to CAL., and set LEVEL to 1 V OUTPUT.
- 29) Adjust trimmer R1081 so that the DVM reads $0 \text{ V dc} \pm 0.1 \text{ mV dc}$.
- 30) Move the DVM from pt. 6B/J26 to pt. 2A/J26.
- 31) Connect pt. 1B/J26 to pt. 16B/J26.
- 32) Adjust trimmer R1087 so that the DVM reads $0 \text{ V dc} \pm 0.1 \text{ mV dc}$.
- 33) Remove the connection between pt. 1B/J26 and pt. 16B/J26.

Amplitude regulation

- 34) Move the DVM from pt. 2A/J26 and pt. 16/J26 to pt. 12B/J26 and pt. 13B/J26 (LOW to pt. 12B).
- 35) Set LEVEL to 0.3 V OUTPUT (-0.5 V hereby appears on pt. 1B/J26).
- 36) Adjust trimmer R2004 so that the DVM reads $316 \text{ mV ac} \pm 6.32 \text{ mV ac}$.
- 37) Set LEVEL to 3 mV OUTPUT (there should now be approximately -2.5 V at pt. 1B/J 6).
- 38) Adjust trimmer R2007 so that the DVM reads $3.16 \text{ mV ac} \pm 0.06 \text{ mV}$.
- 39) Replace print card 11, and remove all measuring equipment.

PHASE DETECTORS (Schematic Diagrams 5, 6 and 7) (card 6)

Equipment:

Dual beam oscilloscope (on channel with inverting input.)

Phase detector for band-stop filter I (card 3)

- 1) Connect INPUT and OUTPUT together on the BKF10, and set the BKF10 as follows:
 MAX. INPUT: 3 V
 OUTPUT FREQ.: MAN., 2 kHz
 LEVEL CONTROL: 0.3 V
 VERNIER: CAL.
- 2) Remove card 8.
- 3) Connect pt. 1/J19 to -12 V (pt. 17/J19).
- 4) Connect pt. 12/J19 and pt. 16/J19 (0 V) to one channel of a dual beam oscilloscope.
- 5) Connect pt. 3/J19 and pt. 16/J19 (0 V) to the other channel of the oscilloscope, and invert it's input.
 Adjust the oscilloscope so that the two curves have exactly the same amplitude.
- 6) Adjust trimmer R623 (card b) so that the phase-difference is 180° . (The curves cover each other.)

Phase detector for band-stop filter II (card 4)

- 7) Connect pt. 6/J20 to -12 V (pt. 17/J20).
- 8) Move one channel of the dual beam oscilloscope to pt. 3/J20 and pt. 16/J20 (0 V).
- 9) Move the other channel of the oscilloscope to pt. 4/J20 and pt. 16/J20 (0 V) still with inverted input.
- 10) Adjust the oscilloscope so that the two curves have exactly the same amplitude.
- 11) Adjust trimmer R651 (card 6) so that the phase-difference is 180° . (The curves cover each other).
- 12) Remove the -12 V lead from pt. 6/J20.

Phase detector for band-stop filter III (card 5)

- 13) Move the oscilloscope lead from pt. 3/J20 to pt. 1/J21.
- 14) Move the oscilloscope lead from pt. 4/J20 to pt. 6/J21.
- 15) Set LEVEL CONTROL to 1 V.
- 16) Adjust the oscilloscope so that the two curves have exactly the same amplitude.

- 17) Adjust trimmer R677 so that the phase-difference is 180° . (The curves cover each other).
- 18) Remove all instruments and leads.

OUTPUT CIRCUIT (Schematic Diagram 9) (card 9 (card 8 still removed))

Equipment:

dc power supply

dc DVM

- 1) Connect a dc power supply between pt. 2/J25 and pt. 16/J25 (minus to pt. 2), and set it to 2.5 V dc ± 1 mV.
- 2) Connect test point TP1 to pt. 16/J25.
- 3) Connect a DVM between pt. 4/J25 and pt. 16/J25 (0 V).
- 4) Adjust trimmer R956 so that the DVM reads 0 V dc ± 1 mV dc.
- 5) Remove the connection between TP1 and pt. 16/J25.
- 6) Connect both pt. 13/J25 and pt. 14/J25 to pt. 16/J25.
- 7) Move the DVM from pt. 4/J25 to test point TP2.
- 8) Adjust trimmer R925 so that the DVM reads 0 V dc ± 0.1 mV dc.
- 9) Break the connection between pt. 13/J25, pt. 14/J25 and pt. 16/J25.
- 10) Move the DVM from TP2 to pt. 1/J25.
- 11) Connect TP2 to pt. 16/J25.
- 12) Adjust trimmer R930 so that the DVM reads 0 V ± 0.1 mV.
- 13) Move the DVM from pt. 1/J25 to test point TP3.
- 14) Adjust trimmer R938 so that the DVM reads 0 V ± 0.1 V.
- 15) Remove the connection between TP2 and pt. 16/J25, and remove all measuring equipment.
- 16) Replace card 8.

METERS (Schematic Diagram 9) (card 9)

INPUT/OUTPUT RATIO METER (M3)

Equipment:

Digital voltmeter

Audio oscillator

- 1) Adjust the meter's mechanical zero point.
- 2) Connect a DVM between pt. 1/J25 and pt. 16/J25 (0 V)

- 3) Set VERNIER at CAL.
- 4) Set LEVEL CONTROL at IV, level at OUTPUT.
- 5) Connect a DVM between pt. 1/J25 and pt. 16/J25 (0 V).
- 6) Connect the audio oscillator to the distortion INPUT (MAX. INPUT 3 V).
- 7) Adjust the audio oscillator (~ 10 mV), so that the DVM reads $-2.000 \text{ V} \pm 2 \text{ mV}$.
- 8) Adjust trimmer R964 so that M3, INPUT/OUTPUT RATIO reads -40 dB .
- 9) Switch LEVEL CONTROL to 10 mV.
- 10) Adjust the audio oscillator to $\sim 1 \text{ V}$, so that the DVM reads $+2.000 \text{ V} \pm 2 \text{ mV}$.
- 11) Adjust trimmer R965 so that the INPUT/OUTPUT RATIO meter M3 reads $+40 \text{ dB}$.
- 12) Remove the audio oscillator and the DVM.

DISTORTION METER M2

Equipment:

Resistor 8.29 k $1/2\%$

Resistor 88.9 k $1/2\%$

Resistor 1 k Ω $1/2\%$

AF GENERATOR

DVM (dc)

For adjusting the DISTORTION METER deflection a signal with known distortion has to be introduced.

FOR TEST Set-up

See Fig. E - 2

Setting the BKF10

All prints are mounted

Input filter: FLAT

Output FREQ.: MAN.

Output FREQ. $\cong 1 \text{ kHz}$

VERNIER: CAL.

LEVEL CONTROL switch: 1 V

LEVEL AT: OUTPUT

Setting of audio oscillator

Frequency: $\cong 2.5$ kHz

Amplitude: ~ 1.0 V

- 1) Adjust the meter's mechanical zero point.
- 2) Set power on the BKF10.
- 3) Connect the DVM. between pt. 3/J16 (Control-Recorder) and pt. 20/J16.
- 4) Adjust the output of the audio oscillator so the DVM shows -1.000 V ± 1 mV.
- 5) Adjust trimmer R966 so that the DISTORTION METER M2, reads 10%.
- 6) Change the output of the audio oscillator to 100 mV ± 0.5 mV, and see that the meter indicates 1% distortion and the DVM shows -2.000 V ± 20 mV. If not, the current-generator on diagram 5 could have a wrong slope (R301).
- 7) Remove the measuring equipment.

INPUT FREQUENCY METER (M1)

The procedure is discussed in the section "FREQUENCY COUNTER FOR THE DISTORTION METER", from step 18, but is repeated here for the simplified case when only the meter has been replaced - making complete adjustment of card 7 unnecessary, or when card 7 has been replaced and the meter's sensitivity must be adjusted to the new card.

Equipment: DVM

- 1) Connect INPUT and OUTPUT using a 50 Ω cable.
- 2) Adjust the meter's mechanical zero point.
- 3) Connect a DVM to pt. 12/J23.
- 4) Set the OUTPUT FREQ. switch to MAN.
- 5) Adjust the OUTPUT FREQ. potentiometer so that the DVM reads 3 V ± 3 mV.
- 6) Adjust R747 so that the INPUT FREQUENCY meter, M1, reads 20 kHz.
- 7) Remove the DVM and the 50 Ω cable.

CHANGING TO ANOTHER LINE VOLTAGE

- 1) Remove the BKF10's power plug.
- 2) Remove the two screws which hold the small cover plate located just beside the slide switch knob on the back of the BKF10.
- 3) Switch the slide switch to the opposite position.
- 4) Screw the cover plate down on the other side of the switch so that it covers the slide switch knob. (The slide switch knob is not being used.)

SECTION G - PARTS LIST

All electronic components and the most important mechanical parts are included in the parts list. Parts marked with an x are manufactured by Radiometer. The figure in parantheses indicates the quantity of a particular mechanical component in the event of more than one being used in a section. Measurements of mechanical components are given in millimeters unless otherwise specified.

As we are continually improving our instruments, it is important, when ordering spare parts, that you include the following information:

The code number and description of the part.

The circuit reference from the wiring diagram.

The complete type designation of your instrument.

The serial number of your instrument.

SECTION G - MAIN PARTS LIST

MOTOR

Designation	Type	Value	Code No.
B1	Fan motor	115 V, 50-60 Hz	580-115

CAPACITORS

Designation	Type	Value	Code No.
C1	ceramic	0.1 μ F 12 V	213-017
C2	ceramic	0.1 μ F 12 V	213-017
C5	ceramic	1 nF $\pm 20\%$ 5 kV	215-500
C6	ceramic	1 nF $\pm 20\%$ 5 kV	215-500
C7	polyester	0.1 μ F 630 V	226-000

DIODES

Designation	Type	Code No.
CR1	light emitting diode MV5024	350-029
CR2	light emitting diode MV5024	350-029
CR3	light emitting diode MV5024	350-029
CR4	light emitting diode MV5024	350-029
CR5	light emitting diode MV5024	350-029
CR6	light emitting diode MV5024	350-029

FUSE

Designation	Type	Code No.
F1	slow-blow, 5 x 20 mm 0.315A	450-015

CONNECTORS

Designation	Type	Code No.
J1	coaxial socket, BNC	800-108
J2	coaxial socket, BNC	800-108

CONNECTORS (cont'd.)

Designation	Type	Code No.
J14	coaxial socket, BNC	800-108
J15	phone jack, green	803-208
J16	multiplug, 25-pole	805-437
J17	edge connector, 18-pole	805-691
J18	edge connector, 18-pole	805-691
J19	edge connector, 18-pole	805-691
J20	edge connector, 18-pole	805-691
J21	edge connector, 18-pole	805-691
J22	edge connector, 18-pole	805-691
J23	edge connector, 18-pole	805-691
J24	edge connector, 18-pole	805-691
J25	edge connector, 18-pole	805-691
J26	edge connector, 2 x 18-pole	805-694
J27	edge connector, 18-pole	805-691
J28	edge connector, 18-pole	805-691
J29	edge connector, 2-pole	805-692
J30	edge connector, 2 x 24-pole	805-693

COILS

Designation	Type	Code No.
L1	RF mini choke 500 μ H	703-006
L2	RF mini choke 500 μ H	703-006
x M1	meter 450 μ A, with scale, INPUT FREQUENCY	482-157
x M2	meter 450 μ A, with scale, DISTORTION	482-158
x M3	meter 450 μ A, with scale, INPUT/OUTPUT/RATIO mounted with light emitting diodes CR1 and CR3	482-159

TRANSISTORS

Designation	Type		Code No.
Q1	transistor	BDY92	360-097
Q2	transistor	BDY92	360-097

INTEGRATED CIRCUITS

Designation	Type		Code No.
QA1	voltage regulator	LM309K	364-029
QA2	voltage regulator	LM309K	364-029

RESISTORS

Designation	Type	Value			Code No.
R1	metal film	1 k Ω	0.5%	0.1 W	140-444
R2	metal film	5 k Ω	0.5%	0.2 W	140-791
R3	carbon potm.	5 k Ω	lin.		180-006
R4	carbon potm.	10 k Ω	lin., with switch S7		180-184
R5	carbon film	150 Ω	5%	0.2 W	106-315

SWITCHES

Designation	Type	Code No.
S1	sliding switch, 2-pole, 2 positions	510-204
S2	micro switch	540-009
S3	sliding switch, 2-pole, 3 positions	510-205
S4	sliding switch, 2-pole, 3 positions	510-205
S5	micro switch	540-009
x S6	rotor switch, 1 x 9 positions	551-088
S7	(See R4)	
S8	sliding switch, 2-pole, 2 positions	510-204
S9	power switch	500-007
S10	power switch, 2-pole	500-111

TRANSFORMER

Designation	Type	Code No.
x T1	power transformer	770-631

MISCELLANEOUS

	Type	Code No.
	pushbutton	550-021
	knob, ϕ 14.5, black, ϕ 6 shaft (2)	852-606
	cover for knob, ϕ 14.5, grey (3)	852-607
	knob, ϕ 14.5, black, ϕ 4 shaft	852-617
	arrow for knob, ϕ 14.5, black	852-622
	rubber foot (4)	855-001
x	PREAMPLIFIER	900-453
x	LOG. DETECTOR	900-454
x	BANDSTOP FILTER I	900-455
x	BANDSTOP FILTER II	900-456
x	BANDSTOP FILTER III	900-457
x	FREQ. METER	900-458
x	PHASE DETECTOR	900-459
x	RMS DETECTOR	900-460
x	OUTPUT CIRCUIT	900-461
x	AMPL. REG.	900-462
x	OSCILLATOR	900-463
x	FREQ. REG.	900-464
x	POWER SUPPLY	900-465
x	LEVEL	900-507
x	MOTHER BOARD	970-450
x	front, printed	2190-A2
x	front plate, printed	2192-A2
x	top plate, printed	2195-A2
x	rear plate, printed	3477-A3
x	terminal plate, printed	8574-A4

PREAMPLIFIER 900-453

CAPACITORS

Designation	Type	Value		Code No.
C101	metalized paper	0.1 μ F	630 V	226-000
C102	ceramic	0.1 μ F	30 V	213-009
C103	ceramic	0.1 μ F	30 V	213-009
C104	polystyrene	22 pF		243-035
C105	ceramic	47 pF		213-209
C106	tantalum	47 μ F	6 V	267-012
C107	tantalum	47 μ F	6 V	267-012
C108	tantalum	1 μ F	30 V	267-006
C109	ceramic	0.1 μ F	12 V	213-017
C110	ceramic	33 pF		213-208
C111	polystyrene	10 pF		213-205
C112	tantalum	4.7 μ F	30 V	267-004
C113	ceramic	150 pF		213-212
C114	ceramic	2.2 pF		213-200
C115	polystyrene	150 pF		243-030
C116	tantalum	10 μ F	15 V	267-000
C117	ceramic	12.2 pF	2%	213-200
C118	ceramic	47 nF	30 V	213-016
C119	ceramic	47 pF	2% 100 V	213-209
C120	ceramic	47 nF	30 V	213-016
C121	tantalum	220 μ F	3 V	267-014
C122	ceramic	47 pF		213-209
C123	tantalum	10 μ F		267-000
C124	polystyrene	10 pF		243-081
C125	tantalum	220 μ F	3 V	267-014
C126	ceramic	270 pF		213-213
C127	tantalum	47 μ F	6 V	267-012
C128	ceramic	10 nF		213-020
C129	ceramic	2.2 nF		213-012
C130	ceramic	10 nF		213-020

CAPACITORS (cont'd.)

Designation	Type	Value		Code No.
C131	ceramic	2.2 nF		213-012
C132	ceramic	0.1 μ F	12 V	213-017
C133	polycarbonate	0.12 μ F	1% 63 V	242-012
C134	polycarbonate	0.14 μ F	1% 63 V	242-013
C135	polyester	0.2 μ F	63 V	241-031
C137	ceramic	1 nF		213-013
C138	ceramic	0.1 μ F		213-009
C139	tantalum	10 μ F		267-000
C140	ceramic	0.1 μ F		213-009

DIODES

Designation	Type		Code No.
CR101	diode	BAV10	350-022
CR102	diode	BAV10	350-022
CR103	diode	BAV10	350-022
CR104	diode	BAV10	350-022
CR105	diode	BAV10	350-022
CR106	diode	BAX16	350-023
x CR116	photo coupler		910-079
x CR117	photo coupler		910-080
CR109	diode	BAX16	350-023
CR110	diode	BAX16	350-023
CR111	diode	BAX16	350-023
CR112	diode	BAX16	350-023
CR113	diode	BAX16	350-023
CR114	diode	BAV10	350-022

RELAYS

Designation	Type		Code No.
K101	reed-relay	12 V, 530 Ω	570-063
K102	reed-relay	12 V, 530 Ω	570-063

TRANSISTORS

Designation	Type		Code No.
Q101	transistor	Si242N	360-140
Q102	transistor	2N5087	360-087
Q103	transistor	2N4124	360-086
Q104	transistor	2N5087	360-087
Q105	transistor	2N5087	360-087
Q106	transistor	BC157B	360-100
Q107	transistor	BC159B	360-085
Q108	transistor	BC157B	360-100
Q109	transistor	2N930	360-038
Q110	transistor	2N4124	360-086
Q111	transistor	BF274	360-123
Q112	transistor	BF274	360-123
Q113	transistor	2N2907	360-173
Q114	transistor	BC159B	360-085
Q115	transistor	Si242N	360-140
Q116	transistor	2N5087	360-087
Q117	transistor	2N4126	360-082
Q118	transistor	2N4124	360-086
Q119	transistor	BC159B	360-085
Q120	transistor	BC159B	360-085
Q121	transistor	BC157B	360-100
Q122	transistor	BC159B	360-085
Q123	transistor	BC159B	360-085
Q124	transistor	BC157B	360-100
Q125	transistor	BC148B	360-072
Q126	transistor	BC149B	360-072
Q127	transistor	BC149B	360-072

TRANSISTORS (cont'd.)

Designation	Type		Code No.
Q129	transistor array	CA3046	360-141
Q130	transistor	BC157B	360-100
Q131	transistor	2N2905	360-073
Q132	transistor	2N5550	360-109
Q133	transistor	BC149B	360-072

INTEGRATED CIRCUIT

Designation	Type		Code No.
QA101	op. amp.	LM310	364-025

RESISTORS

Designation	Type	Value			Code No.
R101	carbon film	1 M Ω	10%	0.1 W	107-710
R102	carbon film	680 Ω	5%	1 W	101-368
R103	carbon film	1 M Ω	10%	0.1 W	107-710
R104	carbon film	3.3 M Ω	5%	0.5 W	100-733
R105	carbon film	3.3 M Ω	5%	0.5 W	100-733
R106	carbon film	2.2 k Ω	5%	0.1 W	107-422
R107	carbon film	1 M Ω	10%	0.1 W	107-710
R108	metal film	4.75 k Ω	1%	0.1 W	140-583
R109	carbon film	1 k Ω	5%	0.1 W	107-410
R110	carbon film	6.8 k Ω	5%	0.1 W	107-468
R111	carbon film	1.2 k Ω	5%	0.1 W	107-412
R112	carbon film	470 Ω	5%	0.1 W	107-347
R113	metal film	3.16 k Ω	1%	0.1 W	140-483
R114	carbon film	18 k Ω	5%	0.1 W	107-518
R115	carbon film	6.8 k Ω	5%	0.1 W	107-468
R116	carbon film	270 Ω	5%	0.1 W	107-327
R117	metal film	27 k Ω	0.5%	0.1 W	140-451
R118	metal film	4.75 k Ω	1%	0.1 W	140-583

RESISTORS

Designation	Type	Value			Code No.
R119	metal film	22.6 k Ω	1%	0.1 W	140-632
R120	metal film	3.01 k Ω	1%	0.1 W	140-417
R121	carbon film	33 k Ω	5%	0.1 W	117-533
R122	carbon film	15 k Ω	5%	0.1 W	107-515
R123	carbon film	10 k Ω	5%	0.1 W	107-510
R124	carbon film	6.8 k Ω	5%	0.1 W	107-468
R125	carbon film	15 k Ω	5%	0.1 W	107-515
R126	carbon film	1 k Ω	5%	0.1 W	107-410
R127	carbon film	27 k Ω	5%	0.1 W	107-527
R128	carbon film	10 k Ω	5%	0.1 W	107-510
R129	carbon film	680 Ω	5%	0.1 W	107-368
R130	carbon film	270 Ω	5%	0.1 W	107-527
R131	carbon film	1 k Ω	5%	0.1 W	107-410
R132	metal film	71.5 k Ω	1%	0.1 W	140-519
R133	carbon film	1.5 k Ω	5%	0.1 W	106-415
R134	metal film	1.58 k Ω	1%	0.1 W	140-587
R135	metal film	511 Ω	1%	0.1 W	140-540
R136	carbon film	22 k Ω	5%	1 W	107-522
R137	metal film	10 k Ω	1%	0.1 W	140-423
R138	carbon film	10 k Ω	5%	0.1 W	107-510
R139	carbon film	1.8 k Ω	5%	0.1 W	107-418
R140	carbon film	1.8 k Ω	5%	0.1 W	107-418
R141	carbon film	1.5 k Ω	5%	0.1 W	107-415
R142	carbon film	680 Ω	5%	0.1 W	107-368
R143	metal film	14.7 k Ω	1%	0.1 W	140-716
R144	carbon potm.	4.7 k Ω	10%		182-032
R145	carbon film	3.3 k Ω	5%	0.1 W	107-433
R146	carbon film	15 k Ω	5%	0.1 W	107-515
R147	carbon potm.	10 k Ω	10%		182-033
R148	carbon film	220 Ω	5%	0.1 W	107-322
R149	carbon film	12 k Ω	5%	0.1 W	107-512
R150	carbon film	12 k Ω	5%	0.1 W	107-512

RESISTORS (cont'd.)

Designation	Type	Value			Code No.
R151	carbon film	3.3 k Ω	5%	0.1 W	107-433
R152	carbon film	1.5 k Ω	5%	0.1 W	107-415
R153	carbon film	10 k Ω	5%	0.1 W	107-510
R154	carbon film	1.2 k Ω	5%	0.1 W	107-412
R155	carbon film	68 Ω	5%	0.2 W	106-268
R156	carbon film	12 k Ω	5%	0.1 W	107-512
R157	carbon film	18 k Ω	5%	0.1 W	107-518
R158	carbon film	39 k Ω	5%	0.1 W	107-539
R159	carbon potm.	4.7 k Ω	10%		182-032
R160	carbon film	4.7 k Ω	5%	0.1 W	107-447
R161	carbon film	15 k Ω	5%	0.1 W	107-515
R162	carbon potm.	10 k Ω	10%	0.1 W	182-033
R163	carbon film	220 Ω	5%	0.1 W	107-322
R164	carbon film	1.5 k Ω	5%	0.1 W	107-415
R165	carbon film	3.3 k Ω	5%	0.1 W	107-433
R166	carbon film	12 k Ω	5%	0.1 W	107-512
R167	carbon film	12 k Ω	5%	0.1 W	107-512
R168	carbon film	10 k Ω	5%	0.1 W	107-510
R169	carbon film	470 Ω	5%	0.1 W	107-347
R170	carbon film	12 k Ω	5%	0.1 W	107-512
R171	carbon film	18 k Ω	5%	0.1 W	107-518
R172	carbon film	39 k Ω	5%	0.1 W	107-539
R173	carbon film	68 Ω	5%	0.2 W	106-268
R174	carbon film	15 k Ω	5%	0.1 W	107-515
R175	carbon film	15 k Ω	5%	0.1 W	107-515
R176	carbon film	3.9 k Ω	5%	0.2 W	106-439
R177	carbon film	22 k Ω	5%	0.2 W	106-522
R178	carbon film	22 k Ω	5%	0.2 W	106-522
R179	carbon film	22 k Ω	5%	0.2 W	106-522
R180	carbon film	150 Ω	5%	0.2 W	106-315

RESISTORS (cont'd.)

Designation	Type	Value			Code No.
R181	metal film	11.5 k Ω	1%	0.1 W	140-728
R182	metal film	4.42 k Ω	1%	0.1 W	140-775
R183	carbon film	12 k Ω	5%	0.2 W	106-512
R184	carbon film	12 k Ω	5%	0.2 W	106-512
R185	metal film	2.15 k Ω	1%	0.1 W	140-774
R186	carbon film	22 Ω	5%	0.1 W	107-222
R187	carbon film	1.2 k Ω	5%	0.1 W	107-412
R188	carbon film	100 Ω	5%	0.1 W	107-310
R189	carbon film	12 k Ω	5%	0.1 W	107-512
R190	carbon film	10 k Ω	5%	0.1 W	107-510
R191	metal film	46.4 k Ω	1%	0.1 W	140-576
R192	metal film	11.5 k Ω	1%	0.1 W	140-728
R193	metal film	12.1 k Ω	1%	0.1 W	140-515
R194	carbon film	22 k Ω	5%	0.2 W	106-522
R195	carbon film	22 k Ω	5%	0.2 W	106-522
R196	carbon film	1.5 k Ω	5%	0.1 W	107-415
R197	carbon film	1.5 k Ω	5%	0.1 W	107-415
R198	carbon film	2.2 k Ω	5%	0.1 W	107-422
R199	carbon film	39 Ω	5%	0.1 W	107-239
R200	carbon film	4.7 k Ω	5%	0.2 W	106-447
RT101	sensistor	220 Ω	10% at	25°C	160-050
RT102	sensistor	220 Ω	10% at	25°C	160-050

LOG. DETECTOR 900-454

CAPACITORS

Designation	Type	Value		Code No.
C201	tantalum	22 μ F	6 V	267-001
C202	ceramic	10 nF		213-020
C203	ceramic	150 pF		213-212
C204	ceramic	3.3 pF		213-202
C205	polyester	2.2 μ F	63 V	241-031

CAPACITORS (cont'd.)

Designation	Type	Value			Code No.
C206	ceramic	47 pF			213-209
C207	polycarbonate	0.1 μ F	1%	63 V	242-006
C208	polycarbonate	0.1 μ F	1%	63 V	242-036
C209	polycarbonate	0.2 μ F	1%	63 V	242-014
C211	polyester	2.2 μ F		63 V	241-031
C212	polyester	0.68 μ F		63 V	241-030
C214	tantalum	22 μ F	-20 +50%	15 V	267-019
C215	ceramic	10 nF			213-020
C216	ceramic	2.7 pF			213-201
C217	tantalum	47 μ F		6 V	267-012
C218	ceramic	10 nF			213-020
C219	ceramic	150 pF			213-212
C220	ceramic	3.3 pF			213-202
C221	polyester	2.2 μ F	10%	63 V	241-031
C223	polyester	0.47 μ F		63 V	241-038
C224	polyester	1 μ F		63 V	241-027

DIODES

Designation	Type	Value			Code No.
CR201	diode	1N914			350-018
CR202	diode	1N914			350-018
CR203	diode	BAX16			350-023
CR204	diode	BAX16			350-023
CR205	zener diode	C9V1-0.4			350-606
CR206	diode	1N914			350-018
CR207	diode	1N914			350-018

TRANSISTORS

Designation	Type		Code No.
Q201	transistor	BC157B	360-100
Q202	transistor	BC147B	360-074
Q203	transistor	U1899E	360-102
Q206	transistor	BC147B	360-074
Q207	transistor	BC147B	360-074
Q208	transistor	BC149B	360-072
Q209	transistor	BC149B	360-072
Q210	transistor	BC149B	360-072
Q211	transistor	BF274B	360-123
Q212	dual transistor	MONO - MAT - 01/-GH	360-129

INTEGRATED CIRCUITS

Designation	Type		Code No.
QA201	op. amp	LM301A	364-016
QA202	op. amp.	LM308	364-022
QA203	op. amp.	LM741	364-065
QA204	op. amp.	LM741	364-065
QA205	op. amp.	LM308A	364-116
QA206	op. amp.	LM301A	364-016
QA207	op. amp.	LM741	364-065

RESISTORS

Designation	Type	Value			Code No.
R201	carbon film	10 k Ω	5%	0.2 W	106-510
R202	metal film	20 k Ω	1%	0.1 W	140-630
R203	metal film	20 k Ω	1%	0.1 W	140-630
R204	metal film	20 k Ω	1%	0.1 W	140-630
R205	metal film	20 k Ω	1%	0.1 W	140-630
R206	metal film	10 k Ω	1%	0.1 W	140-423
R207	carbon potm.	22 k Ω			182-004

RESISTORS (cont'd.)

Designation	Type	Value			Code No.
R208	metal film	255 k Ω	1%	0.1 W	140-781
R209	carbon film	47 k Ω	5%	0.2 W	106-547
R210	carbon film	10 k Ω	5%	0.2 W	106-510
R211	carbon film	10 k Ω	5%	0.2 W	106-510
R212	carbon film	2.7 k Ω	5%	0.2 W	106-427
R213	carbon film	4.7 k Ω	5%	0.2 W	106-447
R214	carbon film	10 k Ω	5%	0.2 W	106-510
R215	carbon film	2.7 k Ω	5%	0.2 W	106-427
R216	carbon film	330 Ω	5%	0.2 W	106-303
R217	metal film	80.6 k Ω	1%	0.1 W	140-715
R218	metal film	78.7 k Ω	1%	0.1 W	140-653
R219	metal film	178 k Ω	1%	0.1 W	140-665
R220	carbon film	10 k Ω	10%		182-033
R221	metal film	93.1 k Ω	1%	0.1 W	140-578
R222	metal film	40.2 k Ω	1%	0.1 W	140-642
R223	metal film	100 k Ω	1%	0.1 W	140-474
R224	carbon film	56 k Ω	5%	0.2 W	106-556
R225	carbon film	18 k Ω	5%	0.2 W	106-518
R228	metal film	6.34 k Ω	1%	0.1 W	140-776
R229	carbon film	680 Ω	5%	0.2 W	106-368
R230	carbon film	22 k Ω	5%	0.2 W	106-522
R231	metal film	111 k Ω	0.5 %	0.1 W	140-796
R232	carbon film	1 k Ω	5%	0.2 W	106-410
R233	metal film	86.6 Ω	1%	0.1 W	140-793
R234	metal film	178 k Ω	1%	0.1 W	140-665
R235	carbon potm.	47 k Ω	10%		182-041
R236	metal film	34.8 k Ω	1%	0.1 W	140-486
R237	metal film	4.53 k Ω	1%	0.1 W	140-617
R238	carbon potm.	22 k Ω	10%		182-034
R239	metal film	3.16 k Ω	1%	0.1 W	140-483
R240	carbon film	33 k Ω	5%	0.2 W	106-533
R241	metal film	31.6 k Ω	0.5%	0.1 W	140-484

RESISTORS (cont'd.)

Designation	Type	Value			Code No.
R242	carbon film	33 k Ω	5%	0.2 W	106-533
R243	metal film	3.32 k Ω	1%	0.1 W	140-614
R244	metal film	10 k Ω	1%	0.1 W	140-423
R245	carbon film	100 k Ω	5%	0.2 W	106-610
R246	metal film	90.9 k Ω	1%	0.1 W	140-654
R247	carbon film	1.82 M Ω	1%	0.3 W	143-045
R248	carbon film	27 k Ω	5%	0.2 W	106-527
R249	carbon film	27 k Ω	5%	0.2 W	106-527
R250	carbon film	10 k Ω	5%	0.2 W	106-510
R251	carbon film	150 Ω	5%	0.2 W	106-315
R252	carbon film	2.2 k Ω	5%	0.2 W	106-422
R253	carbon film	10 k Ω	5%	0.2 W	106-510
x R254	wire-wound	46.4 k Ω	0.1%		152-134
x R257	nickel	180 Ω	1%	at 25°C	172-010
R258	carbon film	330 k Ω (match)	5%	0.1 W	107-633

BANDSTOP FILTER I 900-455

CAPACITORS

Designation	Type	Value		Code No.
C301	ceramic	1 nF		213-013
C302	tantalum	47 μ F	6 V	267-012
C303	ceramic	47 nF	30 V	213-016
C304	ceramic	3.3 pF		213-202
C305	ceramic	330 pF		213-214
C306	ceramic	47 nF	30 V	213-016
C307	ceramic	4.7 pF		213-203
C308	ceramic	47 pF		213-209
C309	ceramic	10 nF		213-020
C310	ceramic	4.7 pF		213-203
C311	ceramic	47 nF	30 V	213-016
C312	ceramic	47 nF	30 V	213-016

CAPACITORS (cont'd.)

Designation	Type	Value		Code No.
C313	ceramic	600 pF	3 V	243-027
C314	ceramic	47 nF	30 V	213-016
C315	ceramic	47 nF		213-016
C317	ceramic	220 pF		213-018
C318	ceramic	6.8 pF		213-204
C319	polystyrene	300 pF-400 pF	243-133	243-040
	or	600 pF	or	243-027
C320	ceramic	47 pF		213-209
C321	ceramic	4.7 pF		213-203
C322	ceramic	3.3 pF		213-202
C323	ceramic	330 pF	5%	213-214
C324	ceramic	47 nF	30 V	213-016
C325	ceramic	47 nF	30 V	213-016
C326	ceramic	10 nF		213-020
C327	ceramic	0.1 μ F	12 V	213-017
C328	ceramic	10 nF		213-020
C329	polyester	4.7 μ F		241-008
C330	ceramic	33 pF		212-208
C331	tantalum	10 μ F		267-000
C332	tantalum	10 μ F		267-000

DIODES

Designation	Type	Value	Code No.
CR301	diode	BAV10	350-022
CR302	diode	BAV10	350-022
CR303	diode	BAV10	350-022
CR304	diode	BAX16	350-023
CR305	diode	BAX16	350-023
x CR308	photo coupler		910-083
x CR309	photo coupler		910-088

TRANSISTORS

Designation	Type		Code No.
Q301	dual transistor	2N2453A	360-171
Q302	transistor	BC149B	360-072
Q303	transistor	BC157B	360-100
Q304	transistor	2N2907	360-173
Q305	transistor	BF274	360-123
Q306	transistor	BF274	360-123
Q307	transistor	2N4126	360-082
Q308	transistor	U1994E	360-108
Q309	transistor	2N2907	360-173
Q310	transistor	BF276	360-123
Q311	transistor	BF274	360-123
Q312	transistor	U1934E	360-108
Q313	transistor	2N4126	360-082
Q314	transistor	BF274	360-123
Q315	transistor	BF274	360-123
Q316	transistor	2N2907	360-173
Q317	transistor array	CA3046	360-141
Q318	transistor	BC157B	360-100
Q319	transistor	BC147B	360-074
Q320	transistor	BC159	360-085
Q321	transistor	BC157B	360-100
Q322	dual transistor	TD121	360-077
Q323	transistor	BC149B	350-072
Q324	transistor	BC157B	350-100
Q325	transistor	BD139	350-137

INTEGRATED CIRCUITS

Designation	Type		Code No.
QA301	op. amp.	HA2605	364-069
QA302	op. amp.	LM310	364-025
QA303	op. amp.	LM301A	364-016

INTEGRATED CIRCUITS (cont'd.)

Designation	Type		Code No.
QA304	op. amp.	LM741	364-065
QA305	op. amp.	LM741	364-065

RESISTORS

Designation	Type	Value		Code No.
R301	carbon potm.	4.7 k Ω	10%	182-032
R302	metal film	1.4 k Ω	1%	0.1 W 140-794
R303	metal film	6.98 k Ω	1%	0.125 W 140-738
R304	metal film	26.7 Ω	1%	0.1 W 140-792
R305	carbon film	120 k Ω	5%	0.2 W 106-612
R306	carbon potm.	47 k Ω		182-041
R307	metal film	604 k Ω	1%	0.5 W 140-682
R308	carbon film	470 k Ω	5%	0.2 W 106-647
R309	carbon film	27 k Ω	5%	0.2 W 106-527
R310	metal film	5.49 k Ω	1%	0.1 W 140-573
R311	carbon film	12 k Ω	5%	0.2 W 106-512
R312	carbon film	1.5 k Ω	5%	0.2 W 106-415
R313	carbon film	150 Ω	5%	0.2 W 106-315
R314	carbon film	680 Ω	5%	0.2 W 106-368
R315	carbon film	100 k Ω	5%	0.2 W 106-610
R316	carbon film	220 Ω	5%	0.2 W 106-312
R317	carbon film	12 k Ω	5%	0.2 W 106-512
R318	carbon film	10 k Ω	5%	0.2 W 106-510
R319	carbon film	5.6 k Ω	5%	0.2 W 106-456
R320	carbon film	560 Ω	5%	0.2 W 106-356
R321	carbon film	2.7 k Ω	5%	0.2 W 106-427
R322	carbon film	330 Ω	5%	0.2 W 106-333
R323	carbon film	22 Ω	5%	0.2 W 106-222
R324	carbon film	100 k Ω	5%	0.2 W 106-610
R325	carbon film	5.6 k Ω	5%	0.2 W 106-456
R326	carbon film	100 k Ω	5%	0.2 W 106-610
R327	carbon potm.	100 k Ω	10%	0.2 W 182-035

RESISTORS (cont'd.)

Designation	Type	Value			Code No.
R328	carbon film	1.5 k Ω	5%	0.2 W	106-415
R329	carbon film	330 Ω	5%	0.2 W	106-333
R330	carbon film	680 Ω	5%	0.2 W	106-368
R331	carbon film	120 Ω	5%	0.2 W	106-312
R332	metal film	3.65 k Ω	1%	0.1 W	140-616
R333	carbon film	12 k Ω	5%	0.2 W	106-512
R334	carbon film	10 k Ω	5%	0.2 W	106-510
R335	carbon film	100 k Ω	5%	0.2 W	106-610
R336	carbon film	8.2 k Ω	5%	0.2 W	106-482
R337	carbon film	1 k Ω	5%	0.2 W	106-410
R338	carbon film	330 Ω	5%	0.2 W	106-333
R339	carbon film	2.7 k Ω	5%	0.2 W	106-427
R340	carbon film	560 Ω	5%	0.2 W	106-356
R341	carbon film	10 k Ω	5%	0.2 W	106-510
R342	carbon film	12 k Ω	5%	0.2 W	106-512
R343	carbon film	680 Ω	5%	0.2 W	106-368
R344	carbon film	150 Ω	5%	0.2 W	106-315
R345	carbon film	220 Ω	5%	0.2 W	106-322
R346	carbon film	5.6 k Ω	5%	0.2 W	106-456
R347	carbon film	100 k Ω	5%	0.2 W	106-610
R348	carbon film	1.5 k Ω	5%	0.2 W	106-415
R349	metal film	3.65 k Ω	1%	0.1 W	140-616
R350	carbon film	5.6 k Ω	5%	0.2 W	106-456
R351	carbon potm.	4.7 k Ω	10%		182-032
R352	carbon film	39 Ω	5%	0.2 W	106-239
R353	carbon film	47 k Ω	5%	0.2 W	106-547
R354	carbon potm.	47 k Ω	10%	0.2 W	182-041
R355	carbon film	2.2 k Ω	5%	0.2 W	106-422
R356	carbon film	120 k Ω	5%	0.2 W	106-612
R357	carbon film	150 k Ω	5%	0.2 W	106-615
R358	carbon film	470 k Ω	5%	0.2 W	106-647

RESISTORS (cont'd.)

Designation	Type	Value			Code No.
R359	carbon film	680 Ω	5%	0.2 W	106-368
R360	carbon film	10 k Ω	5%	0.2 W	106-510
R361	carbon film	4.7 k Ω	5%	0.2 W	106-447
R362	carbon film	12 k Ω	5%	0.2 W	106-512
R363	carbon film	18 k Ω	5%	0.12 W	106-518
R364	carbon film	68 Ω	5%	0.2 W	106-268
R365	carbon potm.	4.7 k Ω	10%		182-032
R366	carbon film	6.8 k Ω	5%	0.2 W	106-468
R367	metal film	1.43 k Ω	1%	0.1 W	140-608
R368	carbon film	47 k Ω	5%	0.2 W	106-547
R369	carbon potm.	47 k Ω	10%		182-041
R370	carbon film	56 k Ω	5%	0.2 W	106-556
R371	metal film	26.7 Ω	1%	0.1 W	140-792
R372	metal film	12.1 k Ω match	1%	0.1 W	140-515
R373	metal film	90.9 k Ω	1%	0.1 W	140-654
R374	carbon film	82 k Ω	5%	0.2 W	106-582
R375	carbon film	3.9 k Ω	5%	0.2 W	106-439
R376	carbon film	150 k Ω	5%	0.2 W	106-615
R377	carbon film	22 k Ω	5%	0.2 W	106-522
R378	carbon film	150 k Ω	5%	0.2 W	106-615
R379	wire-wound	2.2 Ω	10%	2 W	120-122
R380	wire-wound	2.7 Ω	10%	2 W	121-127
R381	carbon film	3.3 k Ω	5%	0.2 W	106-433
R382	carbon film	3.3 k Ω	5%	0.2 W	106-433
R383	carbon film	10 k Ω	5%	0.2 W	106-510
R384	carbon film	10 k Ω	5%	0.2 W	106-510
x R385	nickel resistor	56 Ω	1% at	25°C	172-013
x R386	nickel resistor	56 Ω	1% at	25°C	172-009
R387	nickel resistor	68 Ω	5% at	25°C	152-132
R390	carbon film	10 k Ω	5%	0.2 W	106-510
R391	carbon film	10 k Ω	5%	0.2 W	106-510

BANDSTOP FILTER II 900-456

CAPACITORS

Designation	Type	Value		Code No.
C401	tantalum	47 μ F	6 V	267-012
C402	ceramic	47 nF	30 V	213-016
C403	ceramic	3.3 pF		213-202
C404	ceramic	330 pF		213-214
C405	ceramic	47 nF	30 V	213-015
C406	ceramic	4.7 pF		213-203
C407	ceramic	47 pF		213-209
C408	ceramic	10 nF		213-020
C409	ceramic	47 nF	30 V	213-016
C410	ceramic	3.3 pF		213-202
C411	ceramic	47 nF	30 V	213-016
C412	ceramic	150 pF		213-212
C413	polystyrene	4 nF	1%	243-043
C414	ceramic	47 nF	30 V	213-016
C415	ceramic	47 nF	30 V	213-016
C417	ceramic	220 pF		213-018
C418	ceramic	6.8 pF		213-204
C419	polystyrene	4 nF	1%	243-043
C420	ceramic	47 pF		213-209
C421	ceramic	4.7 pF		213-203
C422	ceramic	3.3 pF		213-202
C423	ceramic	330 pF		213-214
C424	ceramic	47 nF	30 V	213-016
C425	ceramic	47 nF	30 V	213-016
C426	ceramic	10 nF		213-020
C427	ceramic	0.1 μ F	12 V	213-017
C428	ceramic	10 nF		213-020
C429	polyester	2.2 μ F	63 V	241-031
C430	ceramic	33 pF		213-208
C431	ceramic	10 pF		213-205

DIODES

Designation	Type		Code No.
CR401	diode	BAV10	350-022
CR402	diode	BAV10	350-022
CR403	diode	BAV10	350-022
CR404	diode	BAX16	350-023
CR405	diode	BAX16	350-023
x CR408	photo coupler		910-084
x CR409	photo coupler		910-085

TRANSISTORS

Designation	Type		Code No.
Q401	transistor	2N2907	360-173
Q402	transistor	BF274	360-123
Q403	transistor	BF274	360-123
Q404	transistor	2N4126	360-082
Q405	transistor	U1994E	360-108
Q406	transistor	2N2907	360-173
Q407	transistor	BF274	360-123
Q408	transistor	BF274	360-123
Q409	transistor	U1994E	360-108
Q410	transistor	2N4126	360-082
Q411	transistor	BF274	360-123
Q412	transistor	BF274	360-123
Q413	transistor	2N2907	360-173
Q414	transistor array	CA3046	360-141
Q415	transistor	BC157B	360-100
Q416	transistor	BC149B	360-072
Q417	transistor	BC159B	360-085
Q418	transistor	BC157B	360-100
Q419	dual transistor	TD121	360-077
Q420	transistor	BC149B	360-072

TRANSISTORS (cont'd.)

Designation	Type		Code No.
Q421	transistor	BC157	360-100
Q422	transistor	BC147B	360-074

INTEGRATED CIRCUITS

Designation	Type		Code No.
QA401	op. amp.	LM301A	364-016
QA402	op. amp.	LM310	364-025
QA403	op. amp.	LM301A	364-016

RESISTORS

Designation	Type	Value			Code No.
R401	carbon film	10 k Ω	5%	0.2 W	106-510
R402	carbon film	12 k Ω	5%	0.2 W	106-512
R403	carbon film	1.5 k Ω	5%	0.2 W	106-415
R404	carbon film	150 Ω	5%	0.2 W	106-315
R405	carbon film	680 Ω	5%	0.2 W	106-368
R406	carbon film	220 Ω	5%	0.2 W	106-322
R407	carbon film	100 k Ω	5%	0.2 W	106-610
R408	carbon film	5.6 k Ω	5%	0.2 W	106-456
R409	carbon film	12 k Ω	5%	0.2 W	106-512
R410	carbon film	10 k Ω	5%	0.2 W	106-510
R411	carbon film	560 Ω	5%	0.2 W	106-356
R412	carbon film	2.7 k Ω	5%	0.2 W	106-427
R413	carbon film	330 Ω	5%	0.2 W	106-333
R414	carbon film	150 Ω	5%	0.2 W	106-315
R415	carbon film	8.2 k Ω	5%	0.2 W	106-482
R416	carbon film	5.6 k Ω	5%	0.2 W	106-456
R417	carbon film	100 k Ω	5%	0.2 W	106-610
R418	carbon film	10 M Ω	5%	0.5 W	100-810
R419	carbon film	4.7 M Ω	5%	0.5 W	100-747

RESISTORS (cont'd.)

Designation	Type	Value			Code No.
R420	carbon potm.	22 k Ω	10%		182-034
R421	carbon film	1.5 k Ω	5%	0.2 W	106-415
R422	metal film	3.65 k Ω	1%	0.1 W	140-616
R423	carbon film	120	5%	0.2 W	106-312
R424	carbon film	330 Ω	5%	0.2 W	106-333
R425	carbon film	680 Ω	5%	0.2 W	106-368
R426	carbon film	12 k Ω	5%	0.2 W	106-512
R427	carbon film	10 k Ω	5%	0.2 W	106-510
R428	carbon film	100 k Ω	5%	0.2 W	106-610
R429	carbon film	8.2 k Ω	5%	0.2 W	106-482
R430	carbon film	1 k Ω	5%	0.2 W	106-410
R431	carbon film	150 Ω	5%	0.2 W	106-315
R432	carbon film	33.0 Ω	5%	0.2 W	106-333
R433	carbon film	2.7 k Ω	5%	0.2 W	106-427
R434	carbon film	560 Ω	5%	0.2 W	106-356
R435	carbon film	10 k Ω	5%	0.2 W	106-510
R436	carbon film	12 k Ω	5%	0.2 W	106-512
R437	carbon film	5.6 k Ω	5%	0.2 W	106-456
R438	carbon film	220 Ω	5%	0.2 W	106-322
R439	carbon film	100 k Ω	5%	0.2 W	106-610
R440	carbon film	680 Ω	5%	0.2 W	106-368
R441	carbon film	150 Ω	5%	0.2 W	106-315
R442	carbon film	1.5 k Ω	5%	0.2 W	106-415
R443	metal film	3.65 k Ω	1%	0.1 W	140-616
R444	carbon film	5.6 k Ω	5%	0.2 W	106-456
R445	carbon potm.	4.7 k Ω	10%		182-032
R446	carbon film	39 Ω	0.2%	0.2 W	106-239
R447	carbon film	47 k Ω	0.2%	0.2 W	106-547
R448	carbon potm.	47 k Ω	10%		182-041
R449	carbon film	2.2 k Ω	5%	0.2 W	106-422
R450	carbon film	120 k Ω	5%	0.2 W	106-612
R451	carbon film	150 k Ω	5%	0.2 W	106-615
R452	carbon film	680 Ω	5%	0.2 W	106-368

RESISTORS (cont'd.)

Designation	Type	Value			Code No.
R453	carbon film	470 k Ω	5%	0.2 W	106-647
R454	carbon film	10 k Ω	5%	0.2 W	106-510
R455	carbon film	4.7 k Ω	5%	0.2 W	106-447
R456	carbon film	12 k Ω	5%	0.2 W	106-512
R457	carbon film	18 k Ω	5%	0.2 W	106-518
R458	carbon film	68 Ω	5%	0.2 W	106-268
R459	carbon potm.	4.7 k Ω	10%		182-032
R460	carbon film	6.8 k Ω	5%	0.2 W	106-468
R461	metal film	1.43 k Ω	1%	0.1 W	140-608
R462	metal film	33 k Ω	1%	0.1 W	140-426
R463	carbon potm.	47 k Ω	10%		182-041
R464	carbon film	100 k Ω	5%	0.2 W	106-610
R465	metal film	15 k Ω match	1%	0.1 W	140-575
R466	metal film	26.7 Ω	1%	0.1 W	140-792
R467	carbon film	120 k Ω	5%	0.2 W	106-612
R468	carbon film	120 k Ω	5%	0.2 W	106-612
R469	carbon film	3.9 k Ω	5%	0.2 W	106-439
R470	carbon film	180 Ω	5%	0.2 W	106-318
R471	carbon film	1.2 k Ω	5%	0.2 W	106-412
R472	carbon film	39 k Ω	5%	0.2 W	106-539
R473	carbon film	47 k Ω	5%	0.2 W	106-547
R474	carbon film	39 k Ω	5%	0.2 W	106-539
R475	carbon film	68 Ω	5%	0.2 W	106-268
x R476	nickel resistor	68 Ω	5%	at 25°C	152-132
x R477	nickel resistor	57 Ω	1%	at 25°C	172-009

BANDSTOP FILTER III 900-457

CAPACITORS

Designation	Type	Value		Code No.
C501	tantalum	10 μ F	15 V	267-000
C502	tantalum	47 μ F	6 V	267-012
C503	ceramic	3.3 pF		213-202
C504	ceramic	47 nF	30 V	213-016
C505	ceramic	47 nF	30 V	213-016
C506	ceramic	150 pF		213-212
C507	ceramic	47 nF	30 V	213-016
C508	ceramic	3.3 pF		213-202
C509	ceramic	330 pF		213-214
C510	ceramic	47 nF	30 V	213-016
C511	ceramic	4.7 pF		213-203
C512	ceramic	47 pF		213-209
C513	polystyrene	4 nF	63 V	243-043
C514	ceramic	47 nF	30 V	213-016
C516	ceramic	47 nF		213-016
C517	ceramic	220 pF		213-018
C518	ceramic	6.8 pF		213-204
C519	ceramic	47 pF		213-209
C520	polystyrene	4 nF		243-043
C521	ceramic	4.7 pF		213-203
C522	ceramic	47 nF		213-016
C523	ceramic	330 pF		213-214
C524	ceramic	33 pF		213-202
C525	ceramic	47 nF	30 V	213-016
C526	ceramic	10 nF		213-020
C527	ceramic	33 pF		213-208
C528	polyester	2.2 μ F	10% 63 V	241-031
C529	ceramic	0.1 μ F	12 V	213-017

DIODES

Designation	Type		Code No.
CR501	diode	BAV10	350-022
CR502	diode	BAV10	350-022
CR503	diode	BAV10	350-022
CR504	diode	BAX16	350-023
x CR506	photo coupler		910-086

TRANSISTORS

Designation	Type		Code No.
Q501	transistor	2N2907	360-173
Q502	transistor	BF274	360-123
Q503	transistor	BF274	360-123
Q504	transistor	2N4126	360-082
Q505	transistor	U1994E	360-108
Q506	transistor	U1994E	360-108
Q507	transistor	2N4126	360-082
Q508	transistor	2N2907	360-173
Q509	transistor	BF274	360-123
Q510	transistor	BF274	360-123
Q511	transistor	BF274	360-123
Q512	transistor	BF274	360-123
Q513	transistor	2N2907	360-173
Q514	dual transistor	TD121	360-077
Q515	transistor	BC149B	360-072
Q516	transistor	BC159B	360-085
Q517	transistor	BC147B	360-074

INTEGRATED CIRCUITS

Designation	Type		Code No.
QA501	op. amp.	LM301A	364-016
QA502	op. amp.	LM310	364-025
QA503	op. amp.	LM301A	364-016

RESISTORS

Designation	Type	Value			Code No.
R501	metal film	9.88 k Ω	0.5%	0.1 W	140-786
R502	metal film	10 k Ω	1%	0.1 W	140-423
R503	metal film	100 k Ω	0.5%	0.1 W	140-553
R504	carbon film	680 Ω	5%	0.2 W	106-368
R505	carbon film	150 Ω	5%	0.2 W	106-315
R506	carbon film	1.5 k Ω	5%	0.2 W	106-415
R507	carbon film	120 Ω	5%	0.2 W	106-312
R508	carbon film	12 k Ω	5%	0.2 W	106-512
R509	carbon film	10 k Ω	5%	0.2 W	106-510
R510	metal film	200 k Ω	1%	0.1 W	140-475
R511	metal film	1 k Ω	1%	0.1 W	140-477
R512	carbon film	2.7 k Ω	5%	0.2 W	106-427
R513	carbon film	330 Ω	5%	0.2 W	106-333
R514	carbon film	150 Ω	5%	0.2 W	106-315
R515	carbon film	1.5 k Ω	5%	0.2 W	106-415
R516	carbon film	3330 Ω	5%	0.2 W	106-333
R517	carbon film	680 Ω	5%	0.2 W	106-368
R518	metal film	4.75 k Ω	1%	0.1 W	140-583
R519	carbon film	100 Ω	5%	0.2 W	106-310
R520	carbon film	12 k Ω	5%	0.2 W	106-512
R521	carbon film	10 k Ω	5%	0.2 W	106-510
R522	carbon film	1 k Ω	5%	0.2 W	106-410
R523	carbon film	150 Ω	5%	0.2 W	106-315
R524	carbon film	330 Ω	5%	0.2 W	106-333
R525	carbon film	2.7 k Ω	5%	0.2 W	106-427
R526	metal film	1 k Ω	1%	0.1 W	140-477
R527	carbon film	10 k Ω	5%	0.2 W	106-510
R528	carbon film	12 k Ω	5%	0.2 W	106-512
R529	carbon film	680 Ω	5%	0.2 W	106-368
R530	carbon film	150 Ω	5%	0.2 W	106-315

RESISTORS (cont'd.)

Designation	Type	Value			Code No.
R531	carbon film	120 Ω	5%	0.2 W	106-312
R532	carbon film	1.5 k Ω	5%	0.2 W	106-415
R533	metal film	200 k Ω	1%	0.1 W	140-475
R534	metal film	173 k Ω	1%	0.1 W	140-665
R535	metal film	4.75 k Ω	1%	0.1 W	140-583
R536	carbon potm.	4.7 k Ω	10%		182-032
R537	carbon film	10 k Ω	5%	0.2 W	106-510
R538	metal film	1.43 k Ω	1%	0.1 W	140-608
R539	metal film	47.5 k Ω	1%	0.1 W	140-777
R540	carbon potm.	47 k Ω	10%		182-041
R541	carbon film	100 k Ω	5%	0.2 W	106-610
R542	metal film	26.7 Ω	1%	0.1 W	140-792
R543	metal film	15 k Ω match	1%	0.1 W	140-575
R544	carbon film	120 k Ω	5%	0.2 W	106-612
R545	carbon film	120 k Ω	5%	0.2 W	106-612
R546	carbon film	3.9 k Ω	5%	0.2 W	106-439
R547	carbon film	180 Ω	5%	0.2 W	106-318
R548	carbon film	1.2 k Ω	5%	0.2 W	106-412
R549	carbon film	39 k Ω	5%	0.2 W	106-539
R550	carbon film	39 k Ω	5%	0.2 W	106-539
R551	carbon film	47 k Ω	5%	0.2 W	106-547
R552	carbon film	68 Ω	5%	0.2 W	106-268
x R553	nickel resistor	56 Ω	1% at	25°C	172-009

FREQUENCY METER 900-458

CAPACITORS

Designation	Type	Value		Code No.
C701	tantalum	4.7 μ F	25 V	267-004
C702	ceramic	47 nF	30 V	213-016
C703	ceramic	10 nF		213-020
C704	ceramic	10 nF		213-020

CAPACITORS (cont'd.)

Designation	Type	Value			Code No.
C705	polystyrene	2.7 nF			243-128
C707	polystyrene	1 nF			243-014
C708	ceramic	0.1 μ F		12 V	213-017
C709	polystyrene	50 nF	1%		243-019
C710	ceramic	10 nF			213-020
C711	ceramic	10 nF			213-020
C712	ceramic	10 pF			213-205
C713	polystyrene	150 pF			243-030
C714	polycarbonate	0.1 μ F	10%	63 V	242-001
C715	ceramic	220 pF			213-018
C717	polycarbonate	1 μ F	1%	63 V	242-007
C718	polycarbonate	0.14 μ F	1%	63 V	242-013
C719	ceramic	220 pF			213-018
C720	polycarbonate	1.2 μ F	1%	63 V	242-015
C721	polycarbonate	1 μ F	1%	63 V	242-007
C722	ceramic	33 pF			213-208
C723	polyester	10 μ F	10%	63 V	241-028
C724	tantalum	10 μ F		15 V	267-000

DIODES

Designation	Type		Code No.
Q701	transistor	BC157B	360-100
Q702	transistor	BC147B	360-074
Q703	transistor	U1897E	360-116
Q704	transistor	BC157B	360-100
Q705	transistor	BC147B	360-074
Q706	transistor	BC157B	360-100
Q707	transistor	BC147B	360-074
Q708	transistor	U1898E	360-114
Q709	transistor	2N5087	360-087
Q710	dual transistor	MONO - MAT - GH	360-129
Q711	transistor	BC147B	360-074

DIODES (cont'd.)

Designation	Type		Code No.
Q712	transistor	BC147B	360-074

INTEGRATED CIRCUITS

Designation	Type		Code No.
QA701	voltage comparator	LM311	364-024
QA702	op. amp.	LM310	364-025
QA703	op. amp.	LM301A	364-016
QA704	op. amp.	LM310	364-025
QA705	op. amp.	LM741	364-065
QA706	op. amp.	LM301A	364-016
QA707	op. amp.	LM301A	364-016
QA708	op. amp.	LM310	364-025
QD701	monostable multivibrator	SN74121	364-044
QD702	monostable multivibrator	SN74121	364-044
QD703	monostable multivibrator	SN7400	364-009

RESISTORS

Designation	Type	Value			Code No.
R701	carbon film	12 k Ω	5%	0.2 W	106-512
R702	carbon film	10 k Ω	5%	0.2 W	106-510
R703	carbon film	22 k Ω	5%	0.2 W	106-522
R704	carbon film	330 k Ω	5%	0.2 W	106-633
R705	carbon film	470 Ω	5%	0.2 W	106-347
R706	carbon film	12 k Ω	5%	0.2 W	106-512
R707	carbon potm.	10 k Ω	10%		182-033
R708	carbon film	22 k Ω	5%	0.2 W	106-522
R709	carbon film	3.3 k Ω	5%	0.2 W	106-433
R710	carbon film	4.7 k Ω	5%	0.2 W	106-447
T711	carbon film	3.3 k Ω	5%	0.2 W	106-433
R712	carbon film	10 k Ω	5%	0.2 W	106-510
R713	carbon film	3.3 k Ω	5%	0.2 W	106-433

RESISTORS (cont'd.)

Designation	Type	Value			Code No.
R714	carbon film	4.7 k Ω	5%	0.2 W	106-447
R715	carbon film	4.7 k Ω	5%	0.2 W	106-447
R716	carbon film	22 k Ω	5%	0.2 W	106-522
R717	carbon film	5.6 k Ω	5%	0.2 W	106-456
R718	metal film	18.2 k Ω	1%	0.1 W	140-836
R719	carbon film	2.2 k Ω	5%	0.2 W	106-422
R720	metal film	1.4 k Ω	1%	0.1 W	140-794
R721	carbon potm.	4.7 k Ω	10%		182-032
R722	metal film	11 k Ω	1%	0.1 W	140-625
R723	metal film	26.7 k Ω	1%	0.1 W	140-792
R724	carbon film	3.3 k Ω	5%	0.2 W	106-433
R725	carbon film	15 k Ω	5%	0.2 W	106-515
x R726	wire-wound	10 k Ω	0.1%	0.1 W	152-032
R727	carbon potm.	100 k Ω	10%		182-035
R728	carbon film	1 M Ω	0.2%	0.2 W	106-710
R729	carbon film	4.7 k Ω	0.2%	0.2 W	106-447
x R730	wire-wound	37.6 k Ω	0.1%		152-201
x R731	wire-wound	10 k Ω	0.1%		152-032
x R732	metal film	6.34 k Ω	1%	0.1 W	140-776
R733	metal film	69.8 k Ω	1%	0.1 W	140-780
R734	metal film	105 k Ω	1%	0.1 W	140-657
R735	carbon film	180 k Ω	5%	0.2 W	106-618
R736	metal film	24.9 k Ω	1%	0.1 W	140-635
R737	metal film	34 k Ω	1%	0.1 W	140-640
R738	carbon film	56 k Ω	5%	0.2 W	106-556
R739	carbon film	22 Ω	5%	0.2 W	106-222
R740	carbon potm.	1 k Ω	10%		182-030
R741	carbon film	2.2 k Ω	5%	0.2 W	106-422
R742	carbon film	1 k Ω	5%	0.2 W	106-410
R743	carbon film	1 M Ω	5%	0.2 W	106-710
x R744	nickel resistor	56 Ω	1% at 25°C		172-013

RESISTORS (cont'd.)

Designation	Type	Value			Code No.
R745	carbon potm.	47 k Ω	10%		182-041
R746	metal film	121 k Ω	1%	0.1 W	140-522
R747	potentiometer	470 Ω	10%		182-038

PHASE DETECTOR 900-459

CAPACITORS

Designation	Type	Value			Code No.
C601	ceramic	100 pF	2%	100 V	213-211
C602	tantalum	4.7 μ F		25 V	267-004
C603	tantalum	4.7 μ F		25 V	267-004
C604	ceramic	10 nF			213-020
C605	ceramic	10 nF			213-020
C606	ceramic	100 pF	2%	100 V	213-211
C607	tantalum	4.7 μ F		25 V	267-004
C608	tantalum	4.7 μ F		25 V	267-004
C611	ceramic	0.1 μ F		12 V	213-017
C612	ceramic	22 pF			213-206
C613	ceramic	22 pF			213-206
C614	polyester	2.2 μ F		63 V	241-031
C616	polyester	0.15 μ F		63 V	241-047
C617	polyester	1 μ F		63 V	241-027
C619	polyester	1 μ F		63 V	241-027
C620	polyester	1.5 μ F		63 V	241-048
C622	ceramic	100 pF	2%	100 V	213-211
C623	tantalum	4.7 μ F		25 V	267-004
C624	tantalum	4.7 μ F		25 V	267-004
C625	tantalum	10 μ F	-20 +50%	15 V	267-000
C626	tantalum	10 μ F	-20 +50%	15 V	267-000
C627	tantalum	10 μ F	-20 +50%	15 V	267-000
C628	ceramic	100 pF	2%	100 V	213-211

CAPACITORS (cont'd.)

Designation	Type	Value			Code No.
C629	tantalum	4.7 μ F		25 V	267-004
C630	tantalum	4.7 μ F		25 V	267-004
C633	ceramic	22 pF			213-206
C634	ceramic	22 pF			213-206
C635	polyester	2.2 μ F		63 V	241-031
C637	polyester	2.2 μ F		63 V	241-031
C638	polyester	0.47 μ F		63 V	241-038
C640	polyester	2.2 μ F		63 V	241-031
C641	ceramic	100 pF	2%	100 V	213-211
C642	tantalum	4.7 μ F		25 V	267-004
C643	tantalum	4.7 μ F		25 V	267-004
C644	ceramic	10 nF			213-020
C645	ceramic	10 nF			213-020
C646	ceramic	0.1 μ F		12 V	213-017
C647	ceramic	100 pF	2%	100 V	213-211
C648	tantalum	4.7 μ F		25 V	267-004
C649	tantalum	4.7 μ F		25 V	267-004
C650	ceramic	22 pF			213-206
C651	ceramic	22 pF			213-206
C652	polycarbonate	1 μ F	1%	63 V	242-007
C654	polycarbonate	0.1 μ F	1%	63 V	242-006
C655	polystyrene	50 nF	1%		243-019
C657	ceramic	100 pF			213-211
C658	tantalum	2.2 μ F	-20 +50%	25 V	267-007

TRANSISTORS

Designation	Type		Code No.
Q601	transistor	2N3906	360-012
Q602	transistor	2N3904	360-064
Q603	transistor	2N3906	360-062
Q604	transistor	2N3904	360-064

TRANSISTORS (cont'd.)

Designation	Type		Code No.
Q605	transistor	2N3906	360-062
Q606	transistor	2N3904	360-064

INTEGRATED CIRCUITS

Designation	Type		Code No.
QA601	voltage comparator	LM311	364-024
QA602	voltage comparator	LM311	364-024
QA603	op. amp.	LM741	364-065
QA604	op. amp.	LM741	364-065
QA605	op. amp.	LM741	364-065
QA606	voltage comparator	LM311	364-024
QA607	voltage comparator	LM311	364-024
QA608	op. amp.	LM741	364-065
QA609	op. amp.	LM741	364-065
QA610	voltage comparator	LM311	364-024
QA611	voltage comparator	LM311	364-024
QA612	op. amp.	LM741	364-065
QA613	op. amp.	LM741	364-065
QD601	quad. 2-input pos. nand gates	SN7403	364-017
QD602	quad. 2-input pos. nand gates	SN7403	364-017
QD603	quad. 2-input pos. nand gates	SN7403	364-017

RESISTORS

Designation	Type	Value			Code No.
R601	carbon film	33 k Ω	5%	0.2 W	106-533
R602	carbon film	15 k Ω	5%	0.2 W	106-515
R603	carbon film	18 k Ω	5%	0.2 W	106-518
R604	carbon film	33 k Ω	5%	0.2 W	106-533
R605	carbon film	15 k Ω	5%	0.2 W	106-515
R606	carbon film	18 k Ω	5%	0.2 W	106-518
R607	carbon film	470 Ω	5%	0.2 W	106-347

RESISTORS (cont'd.)

Designation	Type	Value			Code No.
R608	carbon film	470 Ω	5%	0.2 W	106-347
R609	carbon film	4.7 k Ω	5%	0.2 W	106-447
R610	carbon film	4.7 k Ω	5%	0.2 W	106-447
R611	carbon film	4.7 k Ω	5%	0.2 W	106-447
R612	carbon film	1 k Ω	5%	0.2 W	106-410
R613	carbon film	220 k Ω	5%	0.2 W	106-622
R614	carbon film	18 k Ω	5%	6.2 W	106-518
R615	carbon film	18 k Ω	5%	0.2 W	106-518
R616	carbon film	390 k Ω	5%	0.2 W	106-639
R617	carbon film	100 Ω	5%	0.2 W	106-310
R618	carbon film	100 Ω	5%	0.2 W	106-310
R619	carbon film	56 k Ω	5%	0.2 W	106-556
R620	metal film	121 k Ω	1%	0.1 W	140-522
R621	carbon film	2.2 M Ω	5%	0.5 W	100-722
R622	metal film	121 k Ω	1%	0.1 W	140-522
R623	carbon potm.	100 k Ω	10%		182-035
R624	carbon film	82 k Ω	5%	0.2 W	106-582
R625	carbon film	82 k Ω	5%	0.2 W	106-582
R626	carbon film	150 k Ω	5%	0.2 W	106-615
R627	carbon film	39 k Ω	5%	0.2 W	106-539
R628	carbon film	15 k Ω	5%	0.2 W	106-515
R629	carbon film	56 k Ω	5%	0.2 W	106-556
R630	carbon film	33 k Ω	5%	0.2 W	106-533
R631	carbon film	15 k Ω	5%	0.2 W	106-515
R632	carbon film	18 k Ω	5%	0.2 W	106-518
R633	carbon film	33 k Ω	5%	0.2 W	106-533
R634	carbon film	15 k Ω	5%	0.2 W	106-515
R635	carbon film	18 k Ω	5%	0.2 W	106-518
R636	carbon film	470 Ω	5%	0.2 W	106-347
R637	carbon film	470 Ω	5%	0.2 W	106-347
R638	carbon film	4.7 k Ω	5%	0.2 W	106-447

RESISTORS (cont'd.)

Designation	Type	Value			Code No.
R639	carbon film	4.7 k Ω	5%	0.2 W	106-447
R640	carbon film	4.7 k Ω	5%	0.2 W	106-447
R641	carbon film	1 k Ω	5%	0.2 W	106-410
R642	carbon film	220 k Ω	5%	0.2 W	106-622
R643	carbon film	18 k Ω	5%	0.2 W	106-518
R644	carbon film	18 k Ω	5%	0.2 W	106-518
R645	carbon film	390 k Ω	5%	0.2 W	106-639
R646	carbon film	100 Ω	5%	0.2 W	106-310
R647	carbon film	100 Ω	5%	0.2 W	106-310
R648	carbon film	56 k Ω	5%	0.2 W	106-556
R649	metal film	121 k Ω	1%	0.1 W	140-522
R650	carbon film	2.2 M Ω	5%	0.5 W	100-722
R651	carbon potm.	100 k Ω	10%		182-035
R652	metal film	121 k Ω	1%	0.1 W	140-522
R653	carbon film	18 k Ω	5%	0.2 W	518-518
R654	carbon film	22 k Ω	5%	0.2 W	106-522
R655	carbon film	47 k Ω	5%	0.2 W	106-547
R656	carbon film	12 k Ω	5%	0.2 W	106-512
R657	carbon film	33 k Ω	5%	0.2 W	106-533
R658	carbon film	15 k Ω	5%	0.2 W	106-515
R659	carbon film	18 k Ω	5%	0.2 W	106-518
R660	carbon film	470 Ω	5%	0.2 W	106-347
R661	carbon film	33 k Ω	5%	0.2 W	106-533
R662	carbon film	15 k Ω	5%	0.2 W	106-515
R663	carbon film	18 k Ω	5%	0.2 W	106-518
R664	carbon film	470 Ω	5%	0.2 W	106-347
R665	carbon film	4.7 k Ω	5%	0.2 W	106-447
R666	carbon film	4.7 k Ω	5%	0.2 W	106-447
R667	carbon film	4.7 k Ω	5%	0.2 W	106-447
R668	carbon film	220 k Ω	5%	0.2 W	106-622
R669	carbon film	1 k Ω	5%	0.2 W	106-410
R670	carbon film	18 k Ω	5%	0.2 W	106-518

RESISTORS (cont'd.)

Designation	Type	Value			Code No.
R671	carbon film	18 k Ω	5%	0.2 W	106-518
R672	carbon film	390 k Ω	5%	0.2 W	106-639
R673	carbon film	100 Ω	5%	0.2 W	106-310
R674	carbon film	100 Ω	5%	0.2 W	106-310
R675	metal film	332 k Ω	1%	0.5 W	140-674
R676	metal film	255 k Ω	1%	0.1 W	140-781
R677	carbon potm.	1 M Ω	10%		182-037
R678	carbon film	6.8 M Ω	5%	0.5 W	100-768
R679	metal film	255 k Ω	1%	0.1 W	140-781
R680	carbon film	1.62 M Ω	1%	0.25 W	143-044
R681	carbon film	1.62 M Ω	1%	0.25 W	143-044
R682	carbon film	3.3 M Ω	5%	0.5 W	100-733
R683	metal film	205 k Ω	1%	0.1 W	140-751

RMS-DETECTOR 900-460

CAPACITORS

Designation	Type	Value			Code No.
C801	polyester	2.2 pF	10%	63 V	241-031
C802	polycarbonate	0.1 μ F	1%	63 V	242-006
C803	polystyrene	50 μ F	1%		243-019
C804	polystyrene	50 μ F	1%		240-019
C805	ceramic	100 pF			213-211
C806	ceramic	220 pF			213-018
C807	tantalum	2.7 pF		25 V	267-007
C808	ceramic	47 nF		30 V	213-016
C809	ceramic	3.3 pF			213-202
C810	ceramic	100 pF			213-211
C811	tantalum	2.2 μ F		25 V	267-007
C812	ceramic	47 nF		30 V	213-016
C813	ceramic	47 nF		30 V	213-016
C814	polyester	4.7 μ F	10%	63 V	241-051

CAPACITORS (cont'd.)

Designation	Type	Value		Code No.
C815	ceramic	47 nF	30 V	213-016
C817	polyester	1 μ F	63 V	241-027
C818	ceramic	10 nF		213-020
C820	polyester	4.7 μ F	10% 63 V	241-051
C821	polyester	2.2 μ F	63 V	241-031
C822	polyester	1 μ F	10% 63 V	241-027

DIODES

Designation	Type		Code No.
CR801	zener diode	C6V2-0.4	350-604
CR802	diode	BAX16	350-023
CR803	zener diode	C4V7-0.4	350-642
CR804	diode	BAX16	350-023
CR805	diode	BAX16	350-023
CR807	zener diode	C5V6-0.4	350-629
CR808	zener diode	C3V3-0.4	350-625
CR809	diode	1N914	350-018
CR810	zener diode	C7V5-0.4	350-261
CR811	zener diode	C7V5-0.4	350-261

TRANSISTORS

Designation	Type		Code No.
Q801	transistor	BC149B	360-072
Q802	transistor	U1898E	360-114
Q803	transistor	BC149B	360-072
Q804	transistor	U1898E	360-114
Q805	transistor	U1899E	360-102
Q806	transistor	BC147B	360-074
Q807	transistor	U1899E	360-102
Q808	transistor	BC147B	360-074

TRANSISTORS (cont'd.)

Designation	Type		Code No.
Q809	transistor	BC149B	360-072
Q810	transistor	BC149B	360-072
Q811	transistor	BC157B	360-100
Q812	dual transistor	MONO -MAT - GH	360-129
Q813	transistor	BC159B	360-085
Q814	transistor	BC159B	360-085
Q815	transistor	BC157B	360-100
Q816	transistor	BC147B	360-074
Q817	transistor	BC149B	360-072
Q818	transistor	BC157B	360-100
Q819	transistor	BC157B	360-100
Q820	transistor	BC149B	360-072
Q821	dual transistor	MONO - MAT - OI - GH	129

INTEGRATED CIRCUITS

Designation	Type		Code No.
QA801	analog multiplier	MC1494L	364-064
QA802	op. amp.	LM741	364-065
QA803	op. amp.	LM741	364-065

RESISTORS

Designation	Type	Value			Code No.
R801	metal film	10 k Ω	1%	0.1 W	140-423
R802	metal film	10 k Ω	1%	0.1 W	140-423
R803	metal film	1.37 k Ω	1%	0.1 W	140-607
R804	carbon film	3.3 k Ω	5%	0.2 W	106-433
R805	carbon film	22 k Ω	5%	0.2 W	106-522
R806	metal film	10 k Ω	1%	0.1 W	140-423
R807	metal film	10 k Ω	1%	0.1 W	140-423
R808	metal film	1.37 k Ω	1%	0.1 W	140-607

RESISTORS (cont'd.)

Designation	Type	Value			Code No.
R809	carbon film	3.3 k Ω	5%	0.2 W	106-433
R810	carbon film	22 k Ω	5%	0.2 W	106-522
R811	metal film	12.7 k Ω	1%	0.1 W	140-752
R812	metal film	12.7 k Ω	1%	0.1 W	140-752
R813	carbon film	100 k Ω	5%	0.2 W	106-610
R814	carbon film	4.7 k Ω	5%	0.2 W	106-447
R815	carbon film	39 k Ω	5%	0.2 W	106-539
R816	metal film	54.9 k Ω	1%	0.1 W	140-779
R817	metal film	47.5 k Ω	1%	0.1 W	140-777
R818	carbon film	1 M Ω	5%	0.2 W	106-710
R819	metal film	8.45 k Ω	1%	0.1 W	140-778
R820	carbon film	39 k Ω	5%	0.2 W	106-539
R821	carbon film	4.7 k Ω	5%	0.2 W	106-447
R822	carbon film	1.5 k Ω	5%	0.2 W	106-415
R823	carbon film	4.7 k Ω	5%	0.2 W	106-447
R824	metal film	10 k Ω	1%	0.1 W	140-423
R825	metal film	10 k Ω	1%	0.1 W	140-423
R826	carbon film	2.2 k Ω	5%	0.2 W	106-422
R827	metal film	24.3 k Ω	1%	0.1 W	140-634
R828	metal film	31.6 k Ω	1%	0.1 W	140-604
R829	metal film	27.4 k Ω	0.5%	0.1 W	140-771
R830	metal film	21.5 k Ω	0.5%	0.1 W	140-770
R831	carbon film	5.6 k Ω	5%	0.2 W	106-456
R832	carbon film	56 k Ω	5%	0.2 W	106-556
R833	carbon film	8.2 k Ω	5%	0.2 W	106-482
R834	carbon film	4.7 k Ω	5%	0.2 W	106-447
R835	metal film	100 k Ω	0.5%	0.1 W	140-772
R836	carbon film	4.7 k Ω	5%	0.2 W	106-447
R837	carbon film	10 k Ω	5%	0.2 W	106-510
R838	metal film	1.1 k Ω	1%	0.1 W	140-562
R839	metal film	1.1 k Ω	1%	0.1 W	140-562
R840	metal film	16.2 k Ω	1%	0.1 W	140-627

RESISTORS (cont'd.)

Designation	Type	Value			Code No.
R841	carbon film	47 k Ω	5%	0.2 W	106-547
R842	carbon potm.	10 k Ω	10%		182-033
R843	carbon film	470 k Ω	5%	0.2 W	106-647
R844	carbon film	22 k Ω	5%	0.2 W	106-522
R845	carbon film	22 k Ω	5%	0.2 W	106-522
R846	carbon film	1 k Ω	5%	0.2 W	106-410
R847	metal film	150 k Ω	1%	0.1 W	140-661
R848	metal film	121 k Ω	1%	0.1 W	140-522
R849	carbon potm.	47 k Ω	10%		182-041
R850	carbon film	68 k Ω	5%	0.2 W	106-568
R851	carbon film	68 k Ω	5%	0.2 W	106-568
R852	carbon film	22 k Ω	5%	0.2 W	106-522
R853	carbon film	10 k Ω	5%	0.2 W	106-510
R854	metal film	11 k Ω	1%	0.1 W	140-625
R855	carbon potm.	4.7 k Ω	10%		182-032
R856	metal film	121 k Ω	1%	0.1 W	140-522
R857	carbon potm.	47 k Ω	10%		182-041
R858	carbon film	47 k Ω	5%	0.2 W	106-547
R859	metal film	1.4 k Ω	1%	0.1 W	140-194
R860	metal film	26.7 Ω	1%	0.1 W	140-792
R861	carbon film	10 k Ω	5%	0.2 W	106-510
R862	carbon film	120 k Ω	5%	0.2 W	106-612
R863	metal film	121 k Ω	1%	0.1 W	140-522
R864	carbon film	150 k Ω	5%	0.2 W	106-615
R865	carbon film	1.8 M Ω	5%	0.5 W	100-718
R866	carbon film	150 k Ω	5%	0.2 W	106-615
x R867	nickel resistor	56 Ω	1% at	25°C	172-013
x R868	nickel resistor	56 Ω	1% at	25°C	172-013

OUTPUT CIRCUIT 900-461

CAPACITORS

Designation	Type	Value			Code No.
C901	polycarbonate	1.2 μ F	1%		242-015
C903	polycarbonate	1 μ F	1%		242-007
C904	polycarbonate	0.12 μ F	1%		242-012
C906	polycarbonate	1.2 μ F	1%		242-015
C907	polycarbonate	1 μ F	1%		242-007
C909	tantalum	220 μ F	-20 +50%	3 V	267-014
C910	ceramic	0.1 μ F		12 V	213-017
C911	polyester	2.2 μ F	10%	63 V	241-031
C912	ceramic	220 pF			213-218
C913	polyester	2.2 μ F	10%	63 V	241-031
C914	polyester	4.7 μ F	10%	63 V	241-008
C915	polyester	1 μ F	10%	63 V	241-027
C916	ceramic	220 pF			213-218
C917	ceramic	220 pF			213-218
C918	tantalum	47 μ F		16 V	267-012
C919	tantalum	47 μ F		16 V	267-012
C920	ceramic	220 pF			213-218

DIODES

Designation	Type		Code No.
CR901	diode	BAX16	350-023
CR902	diode	BAX16	350-023
CR903	diode	BAX16	350-023
CR904	diode	BAX16	350-023
CR905	zener diode	C6V2-0.4	350-604

TRANSISTORS

Designation	Type		Code No.
Q901	transistor	BC157B	360-100
Q902	transistor	BC157B	360-100
Q903	transistor	BC147B	360-074
Q904	transistor	U1898E	360-114
Q905	transistor	U1898E	360-114
Q906	transistor	BC147B	360-074
Q907	transistor	BC149B	360-072
Q908	transistor	BC149B	360-072
Q909	transistor	BC157B	360-100
Q910	transistor	BC147B	360-074
Q911	transistor	BC147B	360-074
Q912	transistor	BC147B	360-074
Q913	transistor	U1898E	360-114
Q914	transistor	U1898E	360-114

INTEGRATED CIRCUITS

Designation	Type		Code No.
QA901	op. amp.	LM741	364-065
QA902	op. amp.	LM741	364-065
QA903	op. amp.	LM741	364-065
QA904	op. amp.	LM301A	364-016
QA905	op. amp.	LM301A	364-016
QA906	op. amp.	LM301A	364-016
QA907	op. amp.	LM301A	364-016
QD901	monostable multivibrator	SN74121	364-044

RESISTORS

Designation	Type	Value			Code No.
R901	metal film	976 k Ω	1%	0.25 W	140-790
R902	metal film	162 k Ω	1%	0.1 W	140-662
R903	carbon film	150 k Ω	5%	0.2 W	106-615
R904	metal film	63.4 k Ω	1%	0.1 W	140-789
R905	metal film	38.3 k Ω	1%	0.1 W	140-788
R906	metal film	27.4 k Ω	1%	0.1 W	140-787
R907	metal film	11.5 k Ω	1%	0.1 W	140-728
R908	metal film	27.4 k Ω	1%	0.1 W	140-787
R909	carbon film	10 k Ω	5%	0.2 W	106-510
R910	carbon film	2.2 k Ω	5%	0.2 W	106-422
R911	carbon film	2.7 k Ω	5%	0.2 W	106-427
R912	carbon film	39 k Ω	5%	0.2 W	106-539
R913	carbon film	3.3 k Ω	5%	0.2 W	106-433
R914	carbon film	10 k Ω	5%	0.2 W	106-510
R915	carbon film	100 k Ω	5%	0.2 W	106-610
R916	carbon film	68 k Ω	5%	0.2 W	106-568
R917	carbon film	100 k Ω	5%	0.2 W	106-610
R918	carbon film	68 k Ω	5%	0.2 W	106-568
R919	carbon film	10 k Ω	5%	0.2 W	106-510
x R920	wire-wound	17.8 k Ω	0.1%		152-171
x R921	wire-wound	17.8 k Ω	0.1%		152-171
x R922	wire-wound	17.8 k Ω	0.1%		152-171
R923	wire-wound	17.8 k Ω	0.1%		4369-A5
R924	carbon film	4.7 M Ω	5%	0.2 W	100-747
R925	carbon potm.	22 k Ω	10%	0.1 W	182-034
R926	carbon film	10 M Ω	5%	0.5 W	100-810
R927	carbon film	18 k Ω	5%	0.2 W	106-518
R928	carbon film	22 k Ω	5%	0.2 W	106-522
R929	carbon film	4.7 M Ω	5%	0.5 W	100-747
R930	carbon potm.	22 k Ω	10%	0.1 W	182-034
R931	carbon film	10 M Ω	5%	0.5 W	100-810
R932	carbon film	39 k Ω	5%	0.2 W	106-539

RESISTORS (cont'd.)

Designation	Type				Code No.
R933	metal film	7.41 k Ω	0.5%	0.1 W	140-869
R934	metal film	20 k Ω	0.5%	0.1 W	140-473
R935	metal film	41.2 k Ω	0.5%	0.1 W	140-703
R936	metal film	7.41 k Ω	0.5%	0.1 W	140-869
R937	carbon film	4.7 M Ω	0.5%	0.5 W	100-747
R938	carbon potm.	22 k Ω	10%	0.1 W	182-034
R939	carbon film	12 k Ω	5%	0.2 W	106-512
R940	carbon film	10 M Ω	5%	0.5 W	100-810
R941	carbon film	33 k Ω	5%	0.2 W	106-533
R942	carbon film	33 k Ω	5%	0.2 W	106-533
R943	carbon film	10 k Ω	5%	0.2 W	106-510
R944	carbon film	4.7 k Ω	5%	0.2 W	106-447
R945	carbon film	33 k Ω	5%	0.2 W	106-533
R946	carbon film	150 Ω	5%	0.2 W	106-315
R947	carbon film	68 k Ω	5%	0.2 W	106-568
R948	carbon film	10 k Ω	5%	0.2 W	106-510
R949	carbon film	68 k Ω	5%	0.2 W	106-568
R950	carbon film	10 k Ω	5%	0.2 W	106-510
R951	carbon film	68 k Ω	5%	0.2 W	106-568
R952	carbon film	47 k Ω	5%	0.2 W	106-547
x R953	wire-wound	17.8 k Ω	0.1%		152-171
x R954	wire-wound	17.8 k Ω	0.1%		152-171
R955	metal film	1 M Ω	1%	0.5 W	140-686
R956	carbon potm.	47 k Ω	10%	0.1 W	182-041
R957	carbon film	47 k Ω	5%	0.2 W	106-547
x R958	wire-wound	142.4 k Ω	0.1%		152-202
x R959	wire-wound	85.44 k Ω	0.1%		152-203
x R960	wire-wound	17.8 k Ω	0.1%		152-171
x R961	wire-wound	626 k Ω	0.1%		152-163
x R962	wire-wound	18.78 k Ω	0.1%		152-204
R963	carbon film	5.6 k Ω	5%	0.2 W	106-456
R964	potentiometer	470 Ω			182-038

RESISTORS (cont'd.)

Designation	Type	Value	Code No.
R965	potentiometer	2.2 k Ω	182-031
R966	potentiometer	470 Ω	182-038

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CAPACITORS

Designation	Type	Value		Code No.
C1001	ceramic	0.1 μ F	12 V	213-017
C1002	ceramic	1 nF		213-013
C1003	ceramic	3.3 pF		213-202
C1004	tantalum	10 μ F	15 V	267-000
C1005	tantalum	47 μ F	6 V	267-012
C1006	ceramic	27 pF		213-207
C1007	ceramic	47 nF	30 V	213-016
C1008	ceramic	47 pF		213-209
C1009	ceramic	47 nF	30 V	213-016
C1010	tantalum	47 μ F	6 V	267-012
C1011	ceramic	2.2 nF		213-012
C1012	ceramic	2.2 nF		213-012
C1014	polystyrene	100 pF		243-037
C1015	ceramic	2.2 nF		213-012
C1016	ceramic	10 nF		213-020
C1018	polyester	0.68 μ F	63 V	241-030
C1019	polyester	2.2 μ F	63 V	241-031
C1021	polycarbonate	0.1 μ F	1% 63 V	242-006
C1022	polycarbonate	0.1 μ F	1% 63 V	242-006
C1023	polycarbonate	0.2 μ F	1% 63 V	242-014
C1024	ceramic	220 pF		213-218
C1025	polyester	1.5 μ F	63 V	241-048
C1026	ceramic	220 pF		213-218
C1027	tantalum	22 μ F	15 V	267-019
C1028	ceramic	2.7 pF		213-201

CAPACITORS (cont'd.)

Designation	Type	Value		Code No.
C1029	tantalum	47 μ F	6 V	267-012
C1030	ceramic	10 nF		213-020
C1031	ceramic	3.3 pF		213-202
C1032	ceramic	150 pF		213-212
C1033	polyester	2.2 μ F	63 V	241-031
C1035	polyester	0.47 μ F	63 V	241-038
C1036	polyester	1 μ F	63 V	241-027
C1037	ceramic	10 nF		213-020

DIODES

Designation	Type		Code No.
CR1001	diode	1N4002	350-409
CR1002	diode	1N4002	350-409
CR1003	zener diode	C9V1-0.4	350-606
x CR1023	photo coupler		910-089
CR1005	diode	BAX16	350-023
CR1006	zener diode	C9V1-0.4	350-606
CR1007	diode	BAX16	350-023
CR1008	diode	BAX16	350-023
CR1009	diode	BAX16	350-023
CR1011	diode	BAX16	350-023
x CR1022	photo coupler		910-08T
CR1013	diode	BAX16	350-023
CR1014	diode	BAX16	350-023
CR1015	diode	BAX16	350-023
CR1016	diode	BAX16	350-023
CR1017	zener diode	C9V1-0.4	350-606
CR1018	diode	1N914	350-018
CR1019	diode	1N914	350-018
CR1020	zener diode	C6V8-0.4	350-627

DIODES (cont'd.)

Designation	Type		Code No.
CR1021	zener diode	C6V8-0.4	350-627

RELAYS

Designation	Type		Code No.
K1001	reed-relay	5 V, 360 Ω	570-053
K1002	reed-relay	5 V, 360 Ω	570-053

TRANSISTORS

Designation	Type		Code No.
Q1001	transistor	S1242N	360-140
Q1002	transistor	2N5087	360-087
Q1003	transistor	BC157B	360-100
Q1004	transistor	BC157B	360-100
Q1005	transistor	2N4124	360-086
Q1006	transistor	BC147B	360-074
Q1007	transistor	2N4124	360-086
Q1008	transistor	BC147B	360-074
Q1009	transistor	BC149B	360-072
Q1010	transistor	BC149B	360-072
Q1011	transistor	BC149B	360-072
Q1012	transistor	BD140	360-138
Q1013	transistor	BC157B	360-100
Q1014	transistor	BC159B	360-085
Q1015	transistor	BC159B	360-085
Q1016	transistor	BC159B	360-085
Q1017	transistor	BC159B	360-085
Q1018	transistor	BC147B	360-074
Q1019	transistor array	CA3046	360-141
Q1020	transistor array	CA3046	360-141
Q1021	transistor	BC147B	360-074

TRANSISTORS (cont'd.)

Designation	Type		Code No.
Q1022	transistor	BC149B	360-072
Q1023	transistor	BC147B	360-074
Q1024	transistor	BC147B	360-074
Q1025	transistor	BC149B	360-072
Q1026	dual transistor	MONO - MAT - GH	360-129
Q1027	transistor	BF274	360-123

INTEGRATED CIRCUITS

Designation	Type		Code No.
QA1001	op. amp.	LM301A	364-016
QA1002	op. amp.	LM741	364-065
QA1003	op. amp.	LM741	364-065
QA1004	op. amp.	LM741	364-065
QA1005	op. amp.	LM301A	364-016
QA1006	op- amp.	LM301A	364-016
QA1007	op. amp.	LM308A	364-116
QA1008	op. amp.	LM301A	364-016
QA1009	op. amp.	LM741	364-065

RESISTORS

Designation	Type	Value			Code No.
R1001	metal film	17.2 k Ω	0.25%	0.1 W	140-756
R1102	metal film	17.2 k Ω	0.25%	0.1 W	140-756
R1003	carbon film	10 Ω	5%	0.1 W	107-210
R1004	carbon film	820 Ω	5%	0.1 W	107-382
R1005	metal film	4.95 k Ω	0.25%	0.1 W	140-333
R1006	metal film	4.95 k Ω	0.25%	0.1 W	140-393
R1007	metal film	169 k Ω	1%	0.25 W	140-663
R1008	carbon film	2.2 k Ω	5%	0.1 W	107-422
R1009	carbon film	3.9 k Ω	5%	0.1 W	107-439

RESISTORS (cont'd.)

Designation	Type	Value			Code No.
R1010	carbon film	1.8 k Ω	5%	0.1 W	107-418
R1011	metal film	16.5 k Ω	1%	0.1 W	140-628
R1012	carbon film	100 Ω	5%	0.1 W	107-310
R1013	carbon film	680 Ω	5%	0.1 W	107-368
R1014	carbon film	1.8 k Ω	5%	0.1 W	107-418
R1015	carbon film	2.7 k Ω	5%	0.1 W	107-427
R1016	carbon film	10 k Ω	5%	0.1 W	107-510
R1017	carbon film	120 Ω	5%	0.1 W	107-312
R1018	carbon film	2.2 k Ω	5%	0.1 W	107-422
R1019	carbon film	180 Ω	5%	0.1 W	107-318
R1020	carbon film	10 k Ω	5%	0.1 W	107-510
R1021	carbon film	2.2 k Ω	5%	0.1 W	107-422
R1022	carbon film	56 Ω	5%	0.1 W	107-256
R1023	carbon film	4.7 k Ω	5%	0.1 W	107-447
R1024	carbon film	3.3 k Ω	5%	0.1 W	107-433
R1025	carbon film	1.8 k Ω	5%	0.1 W	107-418
R1026	metal film	1.8 k Ω	0.5%	0.1 W	140-769
R1027	metal film	900 Ω	0.5%	0.1 W	140-768
R1028	carbon film	150 Ω	5%	0.2 W	106-315
R1029	carbon film	22 k Ω	5%	0.1 W	107-522
R1030	carbon film	3.9 k Ω	5%	0.1 W	107-439
R1031	carbon film	22 k Ω	5%	0.1 W	107-522
R1032	carbon film	22 k Ω	5%	0.1 W	107-522
R1033	wire-wound	10 Ω	15%	2 W	127-210
R1034	carbon film	470 Ω	5%	0.1 W	107-347
R1035	carbon film	1.8 k Ω	5%	0.2 W	106-418
R1036	carbon film	18 k Ω	5%	0.1 W	107-518
R1037	carbon film	68 Ω	5%	0.2 W	106-268
R1038	carbon film	4.7 k Ω	5%	0.1 W	101-447
R1039	carbon film	10 k Ω	5%	0.1 W	107-510
R1040	carbon film	12 k Ω	5%	0.1 W	107-512
R1041	carbon film	470 k Ω	5%	0.1 W	107-647
R1042	carbon film	1.5 k Ω	5%	0.1 W	107-415

RESISTORS (cont'd.)

Designation	Type	Value			Code No.
R1043	carbon film	390 k Ω	5%	0.1 W	107-639
R1044	carbon film	2.2 k Ω	5%	0.1 W	107-422
R1045	metal film	18.2 k Ω	1%	0.1 W	140-516
R1046	carbon film	220 Ω	5%	0.1 W	107-322
R1047	carbon film	12 k Ω	5%	0.1 W	107-512
R1049	carbon film	220 k Ω	5%	0.1 W	107-622
R1050	carbon film	1.8 k Ω	5%	0.1 W	107-418
R1051	metal film	18.2 k Ω	1%	0.1 W	140-516
R1052	carbon film	12 k Ω	5%	0.1 W	107-512
R1053	carbon film	12 k Ω	5%	0.1 W	107-512
R1054	carbon film	3.3 k Ω	5%	0.1 W	107-433
R1055	carbon film	33 k Ω	5%	0.1 W	107-533
R1056	carbon potm.	22 k Ω	10%		182-034
R1057	carbon film	12 k Ω	5%	0.1 W	107-512
T1059	carbon film	220 Ω	5%	0.1 W	107-322
R1060	carbon potm.	10 k Ω	10%		182-033
R1061	carbon film	2.7 k Ω	5%	0.1 W	107-427
R1062	carbon potm.	22 k Ω	10%		182-034
R1063	carbon film	22 k Ω	5%	0.1 W	107-522
R1065	carbon film	220 Ω	5%	0.1 W	107-322
R1066	carbon potm.	2.2 k Ω	10%		182-031
R1067	carbon film	2.2 k Ω	5%	0.1 W	107-422
R1068	carbon film	56 k Ω	5%	0.1 W	107-556
R1069	carbon film	18 k Ω	5%	0.1 W	107-518
R1070	metal film	40.2 k Ω	1%	0.1 W	140-642
R1071	metal film	100 k Ω	1%	0.1 W	140-474
R1072	metal film	93.1 k Ω	1%	0.1 W	140-578
R1073	carbon potm.	10 k Ω	10%		182-033
R1074	metal film	178 k Ω	1%	0.1 W	140-665
R1075	metal film	80.6 k Ω	1%	0.1 W	140-715
R1076	metal film	78.7 k Ω	1%	0.1 W	140-633

RESISTORS (cont'd.)

Designation	Type	Value			Code No.
R1077	carbon film	1 k Ω	5%	0.1 W	107-410
R1078	carbon film	8.2 k Ω	5%	0.1 W	107-482
R1079	carbon film	10 M Ω	5%	0.5 W	100-810
R1080	carbon film	4.7 M Ω	5%	0.5 W	100-747
R1081	carbon potm.	22 k Ω	10%		182-034
R1082	carbon film	22 k Ω	5%	0.1 W	107-522
R1083	wire-wound	46.4 k Ω	0.1%		152-134
R1084	carbon film	10 M Ω	5%	0.5 W	100-810
R1085	carbon film	10 k Ω	5%	0.1 W	107-510
R1086	carbon film	4.7 M Ω	5%	0.1 W	100-747
R1087	carbon potm.	22 k Ω	10%		182-034
R1088	carbon film	1 M Ω	1%	0.25 W	107-610
R1089	carbon film	10 k Ω	5%	0.1 W	107-510
x R1090	wire-wound	46.4 k Ω	0.1%	0.1 W	152-134
R1092	carbon film	15 k Ω	5%	0.1 W	107-515
R1093	carbon film	15 k Ω	5%	0.1 W	107-515
R1094	carbon film	3.3 k Ω	5%	0.1 W	107-433
R1095	carbon film	1.8 k Ω	5%	0.1 W	107-418
R1096	carbon film	680 Ω	5%	0.1 W	107-368
R1097	carbon film	1 k Ω	5%	0.1 W	107-410
R1098	carbon film	22 k Ω	5%	0.1 W	107-522
R1099	metal film	111 k Ω	0.5%	0.1 W	140-796
x R2000	PTC resistor	3.3 k Ω	10%	25 $^{\circ}$ C at	160-052
R2001	metal film	86.6 Ω	1%	0.1 W	140-793
R2002	metal film	100 k Ω	1%	0.1 W	140-474
R2003	metal film	178 k Ω	1%	0.1 W	140-665
R2004	carbon potm.	47 k Ω	10%		182-041
R2005	metal film	34.8 k Ω	1%	0.1 W	140-486
R2006	metal film	4.53 k Ω	1%	0.1 W	140-617
R2007	carbon potm.	22 k Ω	10%		182-034
R2008	metal film	3.16 k Ω	1%	0.1 W	140-483

RESISTORS (cont'd.)

Designation	Type	Value			Code No.
R2009	carbon film	33 k Ω	5%	0.1 W	107-533
R2010	metal film	31.6 k Ω	0.5%	0.1 W	140-484
R2011	carbon film	33 k Ω	5%	0.1 W	107-533
R2012	metal film	3.32 k Ω	1%	0.1 W	140-614
R2013	metal film	10 k Ω	1%	0.1 W	140-429
R2014	metal film	90.9 k Ω	1%	0.1 W	140-654
R2015	carbon film	100 k Ω	5%	0.1 W	107-610
R2016	carbon film	1.82 M Ω	1%	0.25 W	143-045
R2017	carbon film	27 k Ω	5%	0.1 W	107-527
R2018	carbon film	27 k Ω	5%	0.1 W	107-527
R2019	carbon film	10 k Ω	5%	0.1 W	107-510
R2020	carbon film	150 Ω	5%	0.1 W	107-315
R2021	carbon film	2.2 k Ω	5%	0.1 W	107-422
R2022	carbon film	10 k Ω	5%	0.1 W	107-510
R2023	metal film	10 k Ω	1%	0.1 W	140-423
x R2024	nickel resistor	180 Ω	1% at	25°C	172-010
R2025	carbon film	1.5 k Ω	5%	0.1 W	107-415
R2026	carbon film	100 Ω	5%	0.1 W	107-310
R2027	carbon film	320 k Ω match	5%	0.1 W	106-633
RT1003	sensistor	220 Ω	5% at	25°C	160-050
RT1004	sensistor	220 Ω	5% at	25°C	160-050
RT1005	sensistor	220 Ω	5% at	25°C	160-050

OSCILLATOR 900-463

CAPACITORS

Designation	Type	Value		Code No.
C1101	ceramic	6.8 pF		213-204
C1102	ceramic	47 nF	30 V	213-016
C1104	ceramic	220 pF		213-218
C1105	ceramic	47 pF		213-209

CAPACITORS (cont'd.)

Designation	Type	Value		Code No.
C1106	ceramic	47 nF	30 V	213-016
C1107	ceramic	6.8 pF		213-204
C1108	ceramic	330 pF		213-214
C1109	ceramic	3.3 pF		213-202
C1110	polystyrene	600 pF	63 V	213-027
C1111	ceramic	47 nF	30 V	213-016
C1112	ceramic	330 pF		213-214
C1113	ceramic	3.3 pF		213-202
C1114	ceramic	6.8 pF		213-204
C1115	ceramic	47 nF	30 V	213-016
C1116	ceramic	47 pF		213-209
C1117	polystyrene	600 pF		243-027
C1118	tantalum	47 μ F	6 V	267-012
C1119	ceramic	330 pF		213-214
C1120	tantalum	22 μ F	10 V	267-001
C1121	ceramic	6.8 pF		213-204
C1122	ceramic	56 pF		213-210
C1123	ceramic	47 nF	30 V	213-016
C1124	ceramic	47 nF	30 V	213-016
C1125	polystyrene	15 pF		243-025
C1126	ceramic	2.2 nF		213-012
C1127	ceramic	220 pF		213-218
C1128	ceramic	47 nF	30 V	213-016
C1129	ceramic	2.2 nF		213-012

DIODES

Designation	Type		Code No.
CR1101	diode	BAX16	350-023
CR1102	diode	BAX16	350-023
CR1103	diode	BAX16	350-023
CR1104	diode	BAX16	350-023

DIODES (cont'd.)

Designation	Type		Code No.
CR1105	diode	BAX16	350-023
CR1106	diode	BAX16	350-023
CR1108	photo coupler		910-090

TRANSISTORS

Designation	Type		Code No.
Q1101	transistor	BF274	360-123
Q1102	transistor	2N4124	360-086
Q1103	transistor	2N2907	360-173
Q1104	transistor	U1994E	360-108
Q1105	transistor	2N4126	360-082
Q1106	transistor	BF274	360-123
Q1107	transistor	2N4124	360-086
Q1108	transistor	2N2909	360-173
Q1109	transistor	2N2907	360-173
Q1110	transistor	2N4124	360-086
Q1111	transistor	BF274	360-123
Q1112	transistor	2N4126	360-082
Q1113	transistor	U1994E	360-108
Q1114	dual transistor	TD121	360-077
Q1115	transistor	BC149B	360-072
Q1116	transistor	2N4126	360-082
Q1117	transistor	BF274	360-123
Q1118	transistor	2N4126	360-082
Q1119	transistor	BC147B	360-074
Q1120	transistor	BC147B	360-074
Q1121	transistor	BC157B	360-100
Q1122	transistor	BC159B	360-085
Q1123	transistor	BD140	360-138
Q1124	transistor	BC147B	360-074
Q1125	transistor	BC159B	360-085

TRANSISTORS (cont'd.)

Designation	Type	Value	Code No.
Q1126	transistor array	CA3046	360-141

INTEGRATED CIRCUIT

Designation	Type	Code No.
Q1101	ap. amp.	LM301A 364-016

RESISTORS

Designation	Type	Value			Code No.
R1101	carbon film	10 k Ω	5%	0.2 W	106-513
R1102	carbon film	12 k Ω	5%	0.2 W	106-512
R1103	carbon film	680 Ω	5%	0.2 W	106-368
R1104	metal film	4.75 k Ω	1%	0.1 W	140-583
R1105	carbon film	120 Ω	5%	0.2 W	106-312
R1106	carbon film	330 Ω	5%	0.2 W	106-333
R1107	carbon film	1.5 k Ω	5%	0.2 W	106-415
R1108	carbon film	330 Ω	5%	0.2 W	106-333
R1109	carbon film	2.7 k Ω	5%	0.2 W	106-427
R1110	carbon film	10 Ω	5%	0.2 W	106-210
R1111	metal film	1 k Ω	1%	0.1 W	140-477
R1112	carbon film	10 k Ω	5%	0.2 W	106-510
R1113	metal film	20 k Ω	1%	0.1 W	140-630
R1114	carbon film	12 k Ω	5%	0.2 W	106-512
R1115	carbon film	680 Ω	5%	0.2 W	106-368
R1116	carbon film	120 Ω	5%	0.2 W	106-312
R1117	carbon film	150 Ω	5%	0.2 W	106-315
R1118	carbon film	1.5 k Ω	5%	0.2 W	104-415
R1119	carbon film	33 k Ω	5%	0.2 W	106-533
R1120	carbon film	1.5 k Ω	5%	0.2 W	106-415
R1121	metal film	4.7 k Ω	1%	0.1 W	140-583
R1122	carbon film	680 Ω	5%	0.2 W	106-368

RESISTORS (cont'd.)

Designation	Type	Value			Code No.
R1123	carbon film	150 Ω	5%	0.2 W	106-315
R1124	carbon film	120 Ω	5%	0.2 W	106-212
R1125	metal film	20 k Ω	1%	0.1 W	140-630
R1126	carbon film	12 k Ω	5%	0.2 W	106-512
R1127	carbon film	10 k Ω	5%	0.2 W	106-510
R1128	metal film	1 k Ω	1%	0.1 W	140-477
R1129	carbon film	2.7 k Ω	5%	0.2 W	106-427
R1130	carbon film	330 Ω	5%	0.2 W	106-333
R1131	carbon film	2.7 k Ω	5%	0.2 W	106-427
R1132	carbon film	12 k Ω	5%	0.2 W	106-512
R1133	carbon film	10 k Ω	5%	0.2 W	106-510
R1134	carbon film	4.7 k Ω	5%	0.2 W	106-447
R1135	carbon film	15 k Ω	5%	0.2 W	106-515
R1136	metal film	3.32 k Ω	1%	0.1 W	140-614
R1137	carbon film	100 Ω	5%	0.2 W	106-310
R1138	carbon film	12 k Ω	5%	0.2 W	106-512
R1139	carbon film	470 Ω	5%	0.2 W	106-347
R1140	carbon film	5.6 k Ω	5%	0.2 W	106-456
R1141	carbon film	1 k Ω	5%	0.2 W	106-410
R1142	carbon film	270 Ω	5%	0.2 W	106-327
R1143	carbon film	3.9 k Ω	5%	0.2 W	106-439
R1144	carbon film	2.2 k Ω	5%	0.2 W	106-422
R1145	carbon film	3.3 k Ω	5%	0.2 W	106-433
R1146	carbon film	100 Ω	5%	0.2 W	106-310
R1147	carbon film	100 Ω	5%	0.2 W	106-310
R1148	carbon film	680 Ω	5%	0.2 W	106-368
R1149	metal film	10 k Ω	1%	0.1 W	140-423
R1150	carbon film	68 k Ω	5%	0.2 W	106-558
R1151	carbon film	1.8 k Ω	5%	0.2 W	106-418
R1152	metal film	12.1 k Ω	1%	0.1 W	140-515
R1153	carbon film	39 Ω	5%	0.2 W	106-239

RESISTORS (cont'd.)

Designation	Type	Value			Code No.
R1154	carbon potm.	4.7 k Ω	10%		182-032
R1155	carbon film	1.8 k Ω	5%	0.2 W	106-418
R1156	carbon film	2.2 k Ω	5%	0.2 W	106-422
R1157	carbon potm.	4.7 k Ω	10%		182-032
R1158	carbon film	39 Ω	5%	0.2 W	106-239
R1159	carbon potm.	22 k Ω	10%		182-034
R1160	carbon film	1.8 k Ω	5%	0.2 W	106-418
R1161	carbon film	3.3 k Ω	5%	0.2 W	106-433
R1162	carbon film	33 k Ω	5%	0.2 W	106-533
R1163	carbon film	15 k Ω	5%	0.2 W	106-515
R1164	carbon film	680 Ω	5%	0.2 W	106-368
R1165	metal film	12.1 k Ω	1%	0.1 W	140-515
R1166	carbon film	390 k Ω	5%	0.2 W	106-639
R1167	carbon film	470 Ω	5%	0.2 W	106-347
R1164	wire-wound	4.7 Ω	10%	2 W	121-147
R1169	carbon film	4.7 k Ω	5%	0.2 W	106-447
x R1170	nickel resistor	68 Ω	5%	at 25°C	152-132
x R1171	nickel resistor	68 Ω	5%	at 25°C	152-132
R1172	carbon film	100 M Ω	5%	0.5 W	143-014
R1173	carbon film	100 M Ω	5%	0.5 W	143-014
R1174	carbon film	100 Ω	5%	0.2 W	106-310
R1175	trimmer pot.	47 k Ω	10%	0.5 W	182-041
RT1101	nickel resistor	10 k Ω		at 25°C	160-006

FREQUENCY REG. 900-464

CAPACITORS

Designation	Type	Value		Code No.
C1201	tantalum	4.7 μ F	35 V	267-004
C1202	ceramic	10 nF		213-020
C1203	ceramic	10 nF		213-020

CAPACITORS (cont'd.)

Designation	Type	Value		Code No.
C1204	polystyrene	2.7 nF	5%	243-128
C1205	polystyrene	1 nF	2.5%	243-014
C1206	ceramic	0.1 μ F	12 V	213-017
C1207	ceramic	10 nF		213-020
C1208	polystyrene	50 nF	1%	243-019
C1209	ceramic	10 pF		213-205
C1210	ceramic	10 nF		213-020
C1211	ceramic	220 pF		213-218
C1212	polystyrene	150 pF	5%	243-030
C1213	polycarbonate	0.1 μ F	63 V	242-001
C1214	ceramic	220 pF		213-218
C1215	polyester	0.68 μ F	63 V	241-030
C1216	polyester	2.2 μ F	63 V	241-031
C1218	ceramic	100 pF		213-211
C1219	polyester	4.7 μ F	63 V	241-051
C1220	ceramic	220 pF		213-218
C1221	ceramic	10 nF		213-020
C1222	ceramic	10 nF		213-020
C1223	ceramic	10 nF		213-020
C1224	ceramic	10 nF		213-020
C1225	polycarbonate	10 μ F	20% 63 V	242-003
C1226	tantalum	10 μ F	15 V	267-000
C1227	tantalum	10 μ F	15 V	267-000
C1228	tantalum	4.7 μ F	-20% +50%	267-004
C1229	ceramic	0.1 μ F	-20 +80% 30 V	213-009

DIODES

Designation	Type		Code No.
CR1201	diode	BAX16	350-023
CR1202	diode	BAX16	350-023
CR1203	diode	BAX16	350-023
CR1204	zener diode	C3V9-0 4	350-641

TRANSISTORS

Designation	Type		Code No.
Q1201	transistor	BC157B	360-100
Q1202	transistor	BC147B	360-074
Q1203	transistor	U1897E	360-116
Q1204	dual transistor	MONO - MAT - GH	360-129
Q1205	transistor	2N5087	360-087
Q1206	transistor	BC157B	360-100
Q1207	transistor	BC147B	360-074
Q1208	transistor	BC157B	360-100
Q1209	transistor	BC147B	360-074
Q1210	transistor	U1898E	360-114
Q1211	transistor	2N930	360-038
Q1212	transistor	U1899E	360-102
Q1213	transistor	BC147B	360-074
Q1214	transistor	BC157B	360-100
Q1215	transistor	BC159B	360-085
Q1216	transistor	U1899E	360-102
Q1217	transistor	BC157B	360-100

INTEGRATED CIRCUITS

Designation	Type		Code No.
QA1201	voltage comparator	LM311	364-024
QA1202	op. amp.	LM310	364-025
QA1203	op. amp.	LM301A	364-016
QA1204	op. amp.	LM310	364-025
QA1205	op. amp.	LM301A	364-016
QA1206	op. amp.	LM741	364-065
QA1207	op. amp.	LM308	364-022
QA1208	voltage comparator	LM311	364-024
QA1209	voltage comparator	LM311	364-024
QA1210	op. amp.	LM301A	364-016
QD1201	monostable multivibrator	SN74121	364-044

INTEGRATED CIRCUITS (cont'd.)

Designation	Type		Code No.
QD1202	monostable multivibrator	SN74121	364-044
QD1203	quad. 2-input pos. nand gate	SN7403	364-017
QD1204	triple. 3-input pos. nand gate	SN7410	364-012
QD1205	quad. 2-input pos. nand gate	SN7400	364-009

RESISTORS

Designation	Type	Value			Code No.
R1201	carbon film	10 k Ω	5%	0.2 W	106-510
R1202	carbon film	12 k Ω	5%	0.2 W	106-512
R1203	carbon film	470 Ω	5%	0.2 W	106-347
R1204	carbon film	390 Ω	5%	0.2 W	106-339
R1205	carbon film	12 k Ω	5%	0.2 W	106-512
R1206	carbon potm.	10 k Ω	10%		182-033
R1207	carbon film	3.3 k Ω	5%	0.2 W	106-433
R1208	carbon film	22 k Ω	5%	0.2 W	106-522
R1209	carbon film	4.7 k Ω	5%	0.2 W	106-447
R1210	carbon film	5.6 k Ω	5%	0.2 W	106-456
R1211	carbon film	2.2 k Ω	5%	0.2 W	106-422
R1212	metal film	18.2 k Ω	1%	0.1 W	140-836
R1213	carbon film	3.3 k Ω	5%	0.2 W	106-433
R1214	carbon film	15 k Ω	5%	0.2 W	106-515
R1215	metal film	26.7 k Ω	1%	0.1 W	140-792
R1216	metal film	1.4 k Ω	1%	0.1 W	140-794
R1217	metal film	11 k Ω	1%	0.1 W	140-625
R1218	carbon potm.	4.7 k Ω	10%		182-032
R1219	carbon film	4.7 k Ω	5%	0.2 W	106-447
R1220	carbon film	22 k Ω	5%	0.12 W	106-522
R1221	carbon film	3.3 k Ω	5%	0.2 W	106-433
R1222	carbon film	3.3 k Ω	5%	0.2 W	106-433
R1223	carbon film	4.7 k Ω	5%	0.2 W	106-447
R1224	carbon film	10 k Ω	5%	0.2 W	106-510

RESISTORS (cont'd.)

	Designation	Type	Value			Code No.
x	R1225	wire-wound	36.5 k Ω	0.1%		152-205
x	R1226	wire-wound	137 k Ω	0.5%		152-206
	R1227	carbon film	2.2 M Ω	5%	0.5 W	100-722
	R1228	carbon potm.	100 k Ω	10%		182-035
x	R1229	wire-wound	36.5 k Ω	0.1%		152-205
	R1230	carbon film	4.7 M Ω	5%	0.5 W	100-747
	R1231	carbon film	10 M Ω	5%	0.5 W	100-810
	R1232	carbon potm.	22 k Ω	10%		182-034
	R1233	carbon film	10 k Ω	5%	0.2 W	106-510
	R1234	carbon film	10 k Ω	5%	0.2 W	106-510
	R1235	carbon film	33 k Ω	5%	0.2 W	106-533
	R1236	carbon film	18 k Ω	5%	0.2 W	106-518
	R1237	carbon film	40 M Ω	5%	0.5 W	143-054
	R1238	carbon film	820 k Ω	5%	0.2 W	106-682
	R1239	carbon film	2.7 k Ω	5%	0.2 W	106-427
	R1240	carbon film	2.7 k Ω	5%	0.2 W	106-427
	R1241	carbon film	10 k Ω	5%	0.2 W	106-510
	R1242	carbon film	3.3 k Ω	5%	0.2 W	106-433
	R1243	carbon film	4.7 k Ω	5%	0.2 W	106-447
	R1244	carbon film	47 k Ω	5%	0.2 W	106-547
	R1245	carbon film	4.7 k Ω	5%	0.2 W	106-447
	R1246	carbon film	4.7 k Ω	5%	0.2 W	106-447
	R1247	carbon film	4.7 k Ω	5%	0.2 W	106-447
	R1248	carbon film	220 k Ω	5%	0.2 W	106-622
	R1249	carbon film	220 k Ω	5%	0.2 W	106-022
	R1250	carbon film	4.7 k Ω	5%	0.2 W	106-447
	R1251	carbon film	220 k Ω	5%	0.2 W	106-622
	R1252	carbon film	1 k Ω	5%	0.2 W	106-410
	R1253	carbon film	220 k Ω	5%	0.2 W	106-622
	R1254	carbon film	1 k Ω	5%	0.2 W	106-410
	R1255	carbon potm.	100 k Ω	10%		182-035
	R1256	carbon film	2.2 M Ω	5%	0.5 W	100-722

RESISTORS (cont'd.)

	Designation	Type	Value			Code No.
x	R1257	wire-wound	30 k Ω	0.5%		152-207
x	R1258	wire-wound	10 k Ω	0.5%		152-032
	R1259	carbon film	8.2 k Ω	5%	0.2 W	106-482
x	R1260	nickel resistor	56 Ω	1% at 25°C		172-013
	R1261	carbon film	22 k Ω	5%	0.2 W	106-522
	R1262	carbon film	47 k Ω	5%	0.2 W	106-547
	R1263	carbon film	10 k Ω	5%	0.2 W	106-510
	R1265	carbon film	6.8 k Ω	5%	0.2 W	106-468
	R1266	carbon film	10 k Ω	5%	0.2 W	106-510
	R1267	carbon film	10 k Ω	5%	0.2 W	106-510
	R1268	carbon film	10 k Ω	5%	0.2 W	106-510
	R1269	carbon film	4.7 k Ω	5%	0.2 W	106-447
	R1270	carbon film	1 M Ω	5%	0.2 W	106-710
	R1271	carbon film	3.3 k Ω	5%	0.2 W	106-433
	R1272	carbon film	18 k Ω	5%	0.2 W	106-518
	R1273	carbon film	12 k Ω	5%	0.2 W	106-512

POWER SUPPLY 900-465

CAPACITORS

Designation	Type	Value		Code No.
C1301	electrolytic	220 μ F	35 V	260-052
C1302	electrolytic	220 μ F	50 V	260-017
C1303	electrolytic	47 μ F	50 V	260-016
C1304	polyester	0.22 μ F	63 V	241-032
C1305	ceramic	0.1 μ F	30 V	213-009
C1306	ceramic	10 nF	-20 +80% 40 V	213-020
C1307	electrolytic	100 μ F	16 V	260-011
C1308	ceramic	10 nF	-20 +80% 40 V	213-020
C1309	ceramic	0.1 μ F	30 V	213-009

CAPACITORS (cont'd.)

Designation	Type	Value		Code No.
C1310	polyester	0.22 μ F	63 V	241-032
C1311	electrolytic	100 μ F	16 V	260-011
C1312	electrolytic	2200 μ F	35 V	260-053
C1313	electrolytic	2200 μ F	35 V	260-053
C1314	electrolytic	4700 μ F	16 V	260-055

DIODES AND RECTIFIERS

Designation	Type		Code No.
CR1301	diode	10D4	350-419
CR1302	diode	10D4	350-419
CR1303	rectifier	B40C3200/2200	340-203
CR1304	rectifier	B40C5000/3300	340-209

TRANSISTORS

Designation	Type		Code No.
Q1301	transistor	2N1711	360-047
Q1302	transistor	BC147B	360-074

INTEGRATED CIRCUITS

Designation	Type		Code No.
QA1301	voltage regulator	MC1469R	364-067
QA1302	voltage regulator	MC1463R	364-068

RESISTORS

Designation	Type	Value			Code No.
R1302	carbon film	4.7 k Ω	5%	0.2 W	106-447
R1303	wire-wound	0.47 Ω	10%	1 W	120-047
R1304	carbon film	100 Ω	5%	0.2 W	106-310
R1305	carbon potm.	100 k Ω	10%		182-401
R1306	metal film	69.8 k Ω	1%	0.1 W	140-780

RESISTORS (cont'd.)

Designation	Type	Value			Code No.
R1307	wire-wound	17.38 k Ω	0.5%		152-208
R1308	wire-wound	6.8 k Ω	0.5%		152-209
R1309	wire-wound	0.68 Ω	10%	1 W	120-068
R1310	wire-wound	6.8 k Ω	0.5%		152-209
R1311	metal film	69.8 k Ω	1%	0.1 W	140-780
R1312	wire-wound	17.38 k Ω	0.5%		152-208
R1313	carbon potm.	100 k Ω	10%		182-401

LEVEL 900-507

CAPACITORS

Designation	Type	Value			Code No.
R1401	wire-wound	20 k Ω	0.5%		4383-A5
A1402	wire-wound	18 k Ω	0.1%		152-016
A1403	metal film	1 k Ω	0.1%		140-556
R1404	metal film	1 k Ω	0.1%		140-556
R1405	metal film	1 k Ω	0.1%		140-556
R1406	metal film	1 k Ω	0.25%		140-391
R1407	metal film	1 k Ω	0.25%		140-391
R1408	metal film	1 k Ω	0.25%		140-391
R1409	carbon film	150 Ω	5%	0.2 W	106-315
R1410	carbon film	150 Ω	5%	0.2 W	106-315
R1411	metal film	1 k Ω	0.5%		140-444

SECTION H - ILLUSTRATIONS AND DIAGRAMS

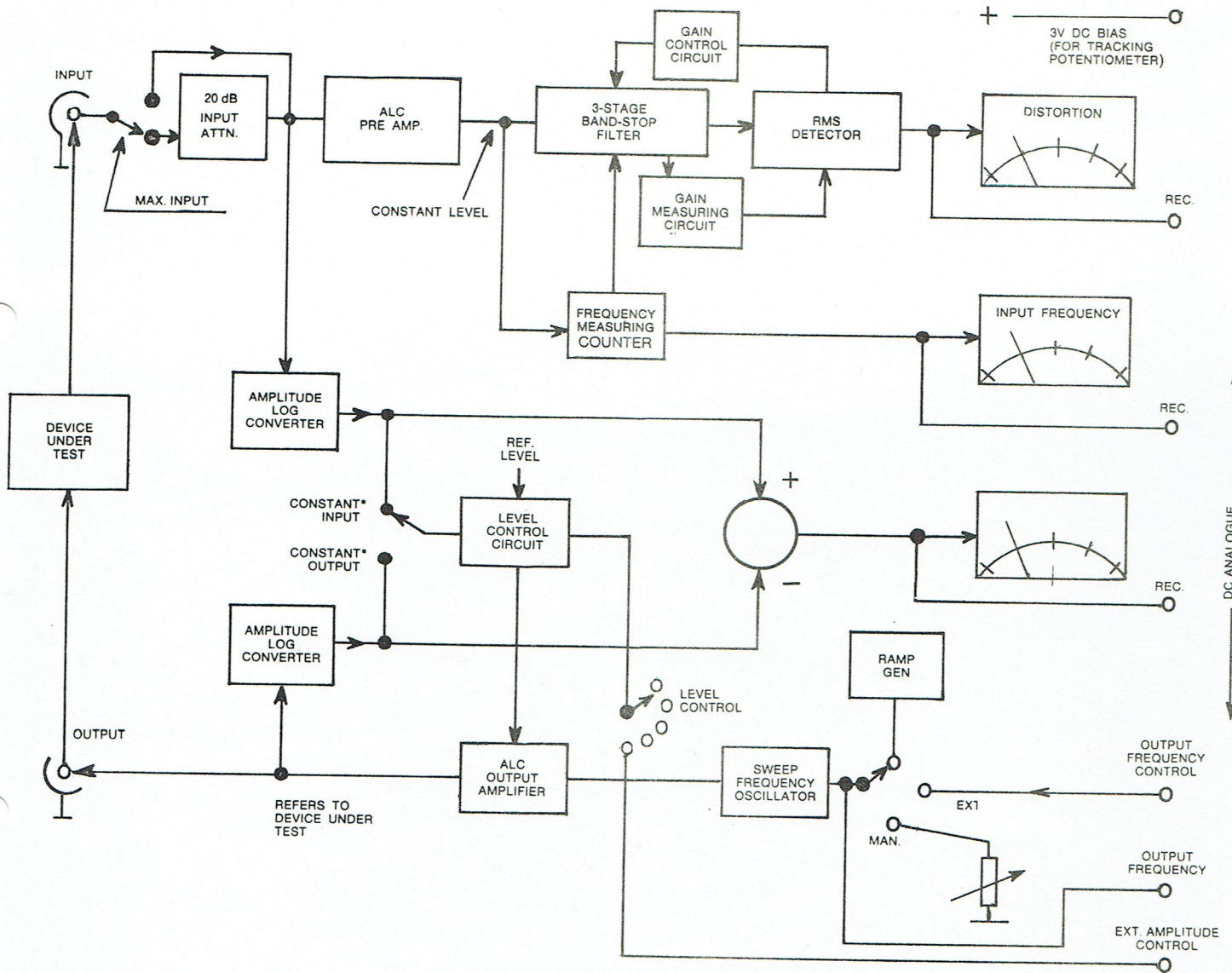


Fig. B - 1. Block diagram of BKF10.

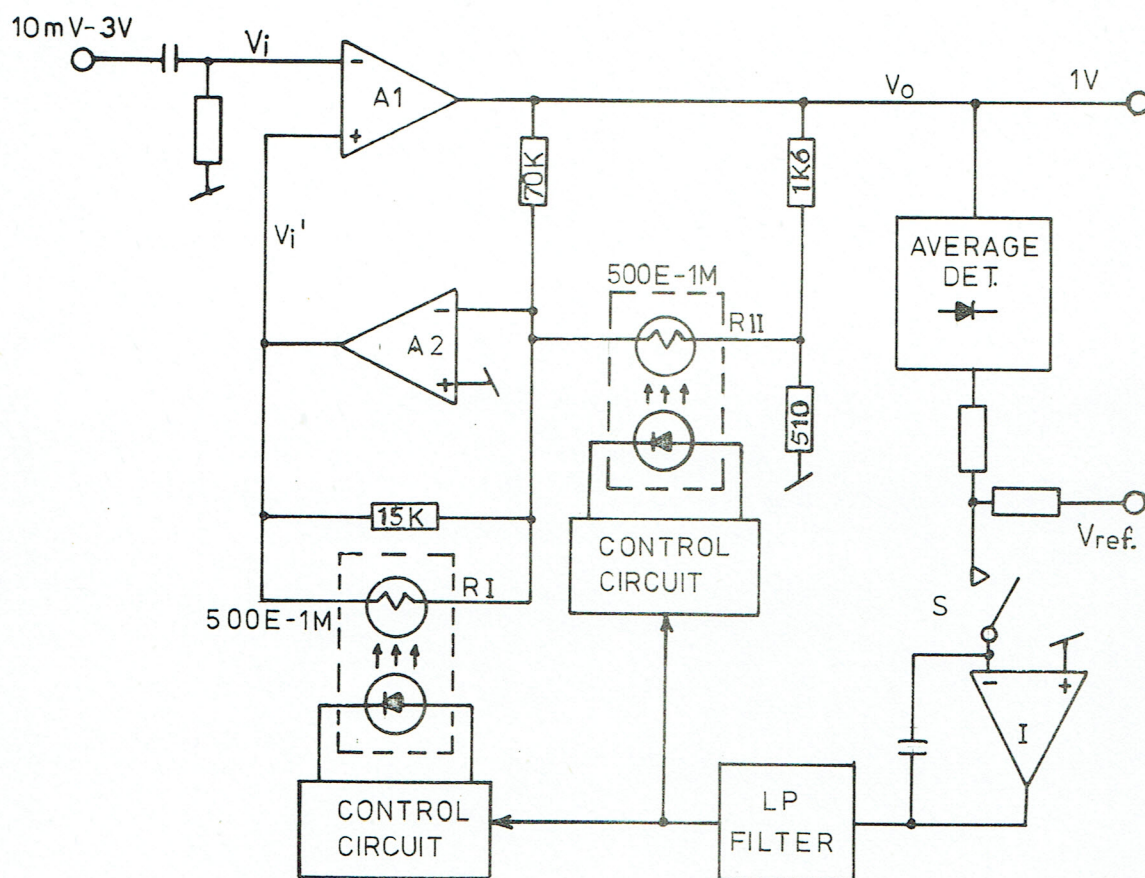


Fig. B - 2. Principle of Operation:

Pre-amplifier with automatic level control.

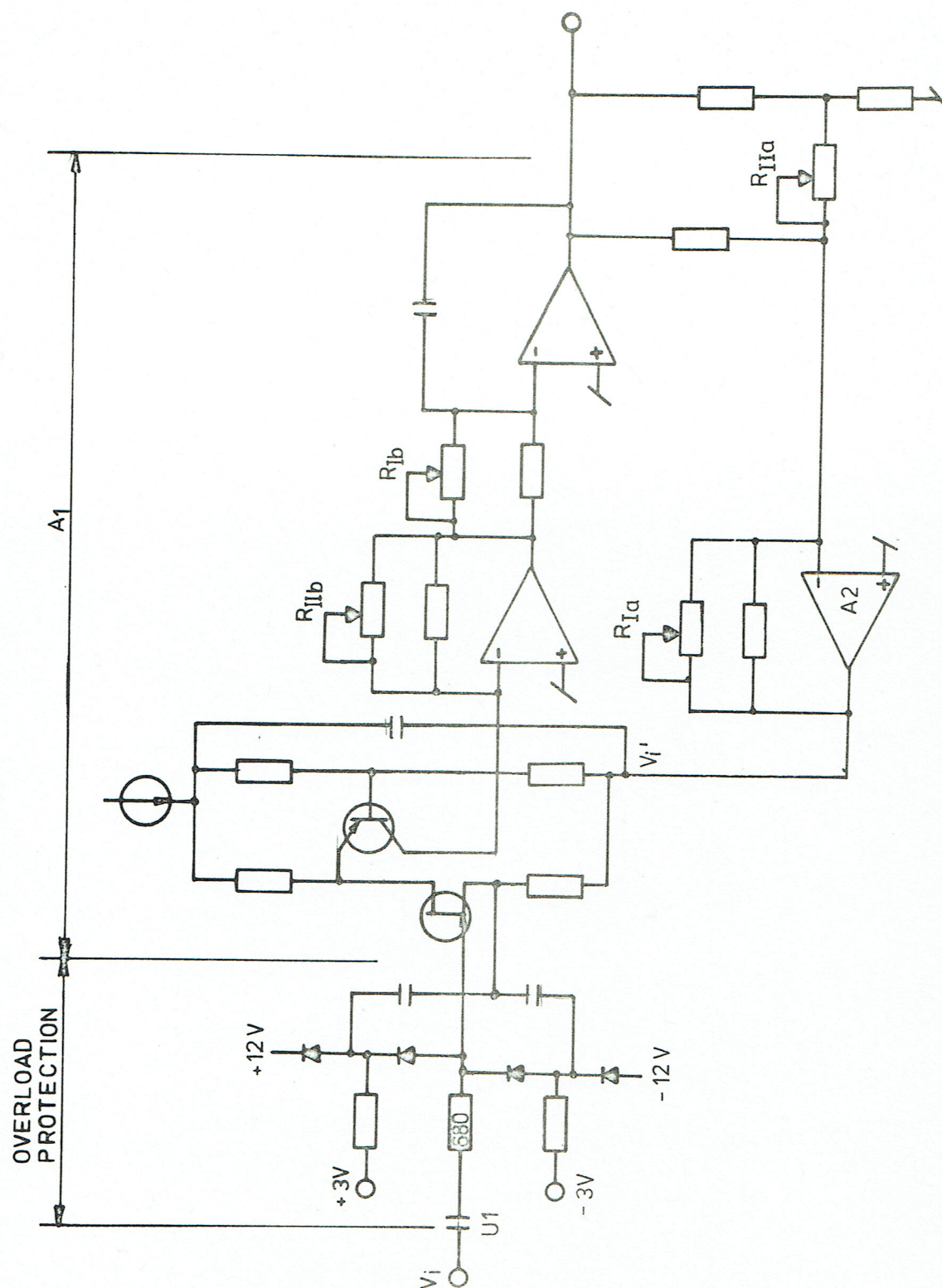


Fig. B - 3. Pre-amplifier Block Diagram.

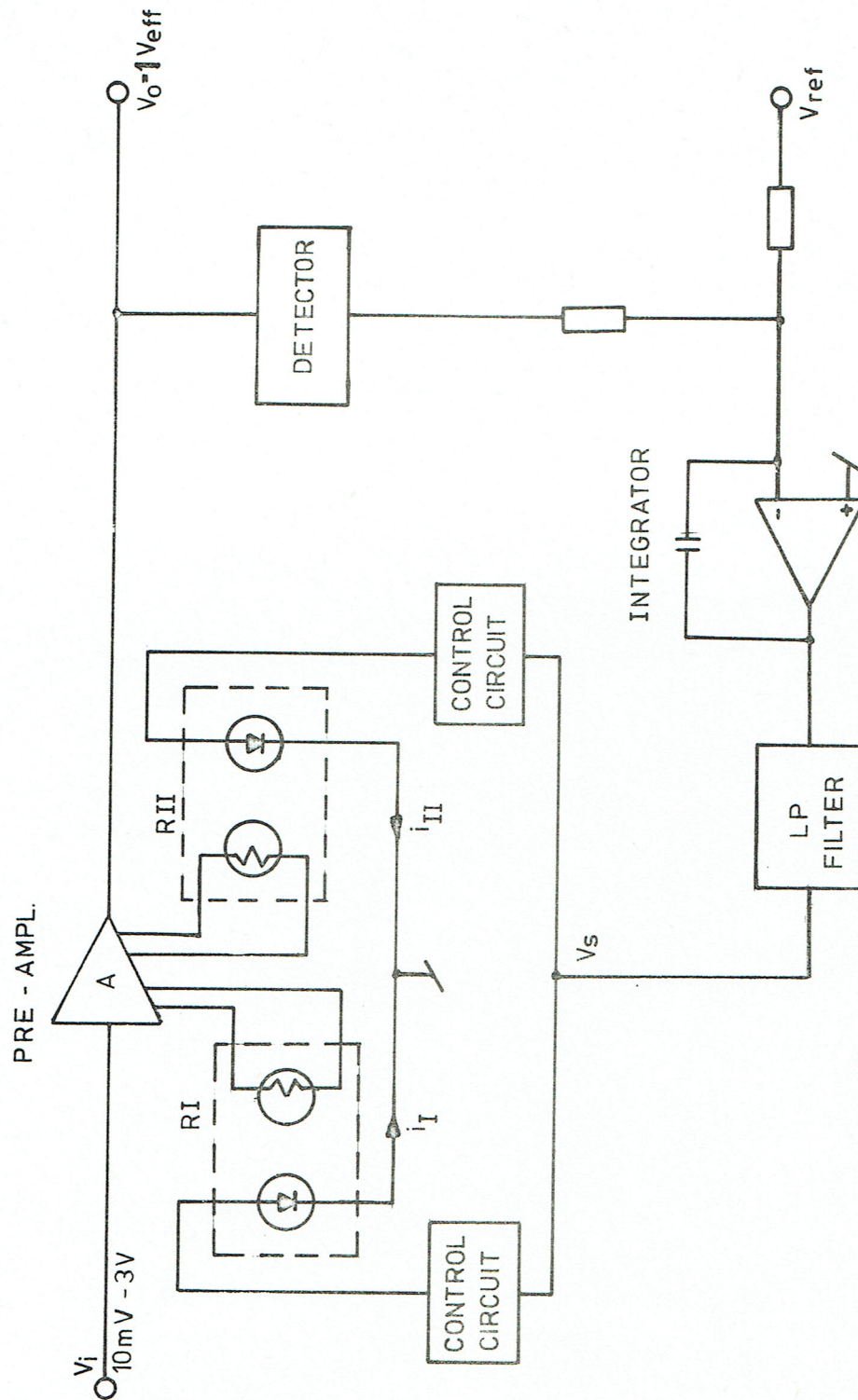


Fig. B - 4. Pre-amplifier Regulation Loop.

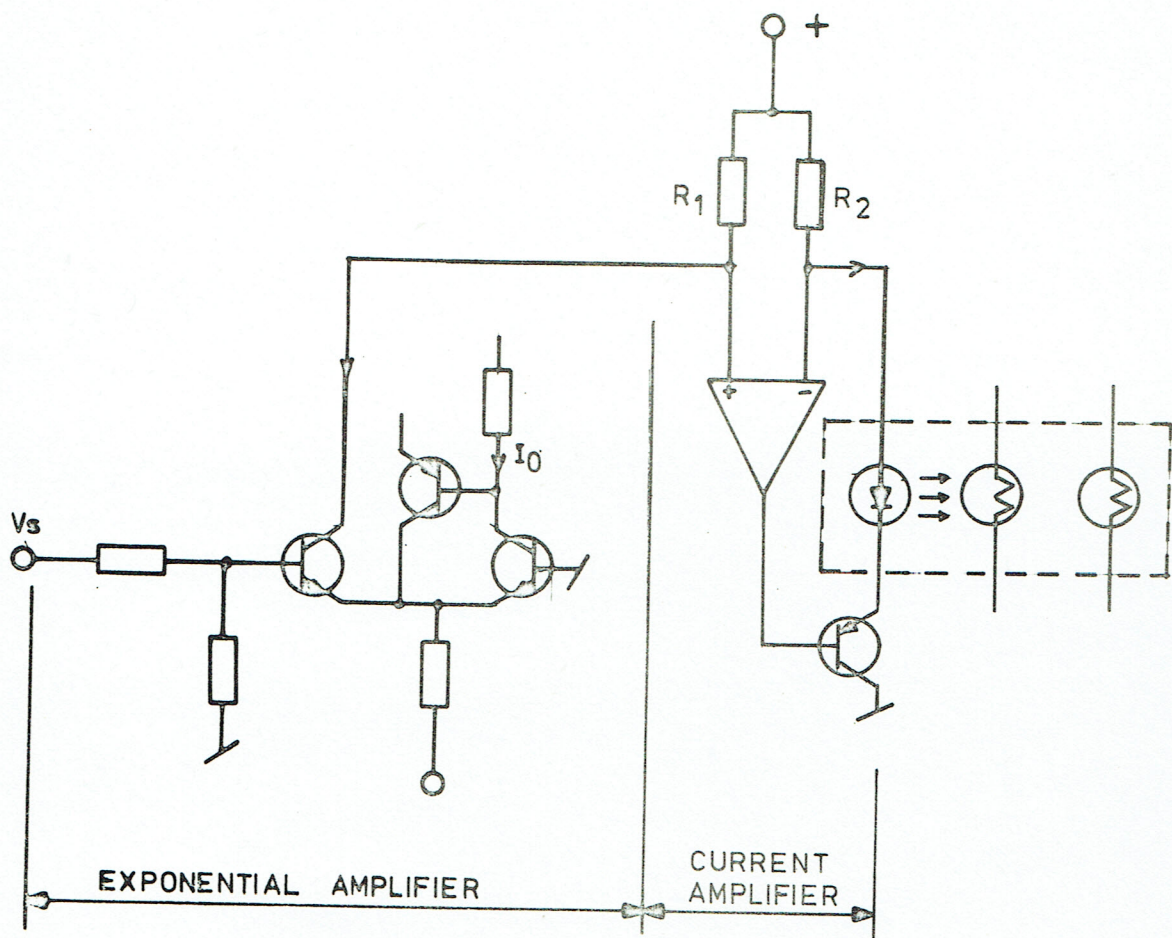


Fig. B - 5. Pre-amplifier Control Circuit.

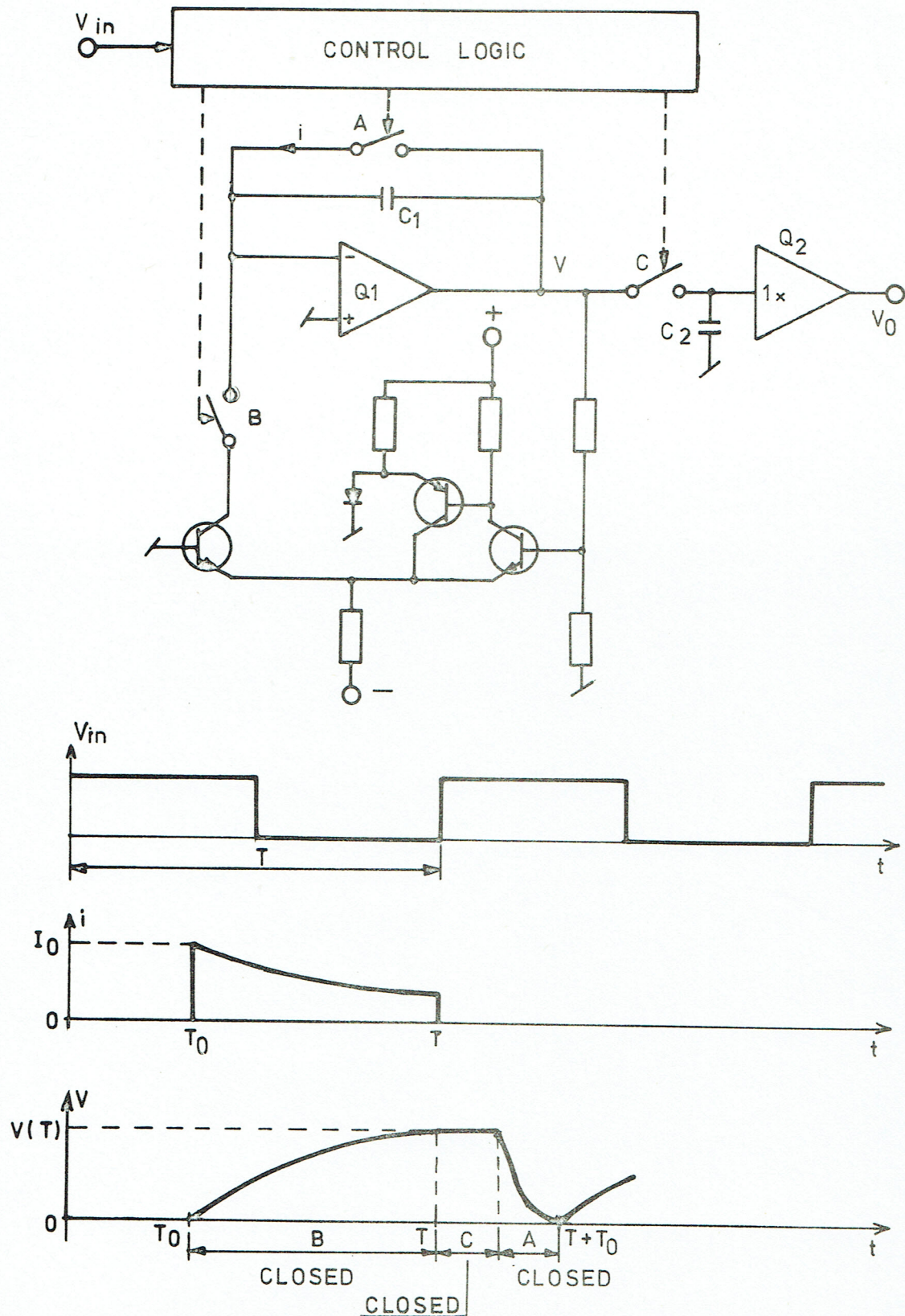


Fig. B - 7. Frequency Counter.

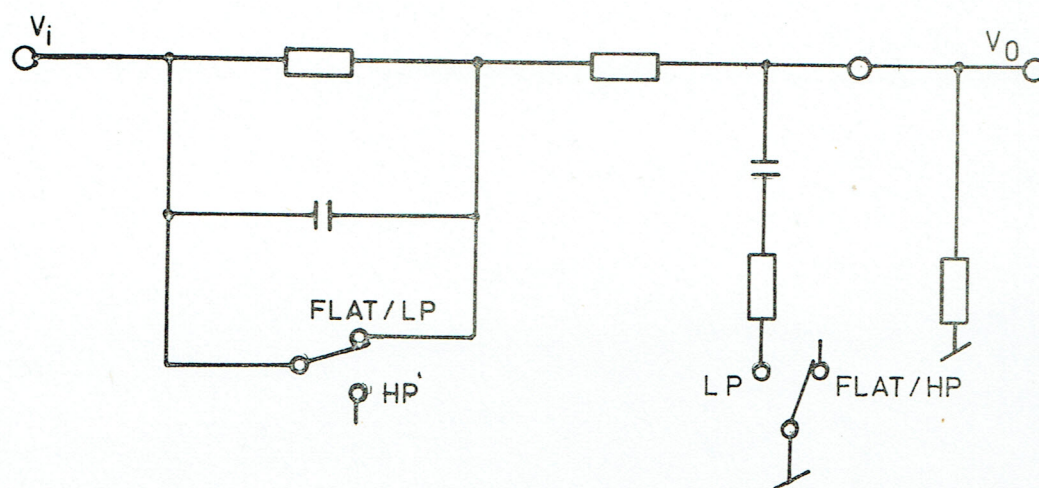


Fig. B - 8. HP-LP filter I (FLAT position).

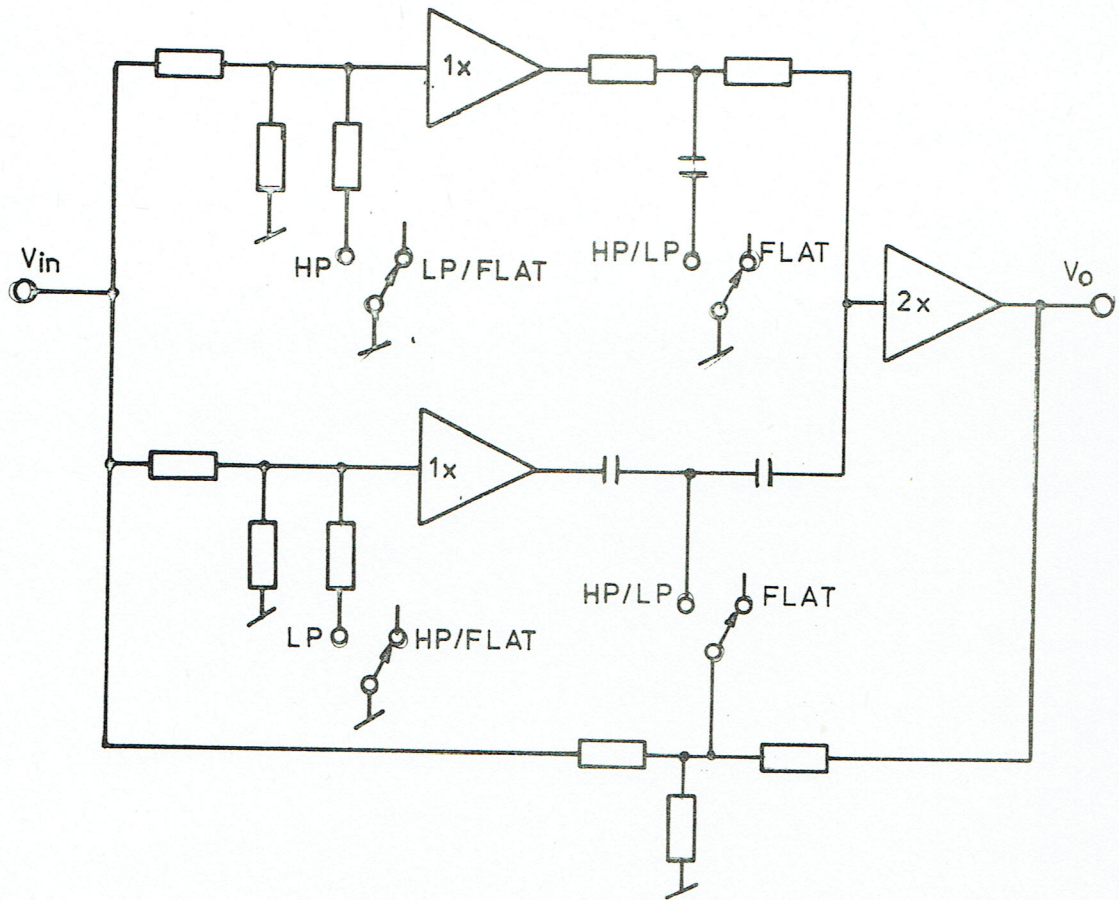


Fig. B - 9. HP-LP filter II (FLAT position).

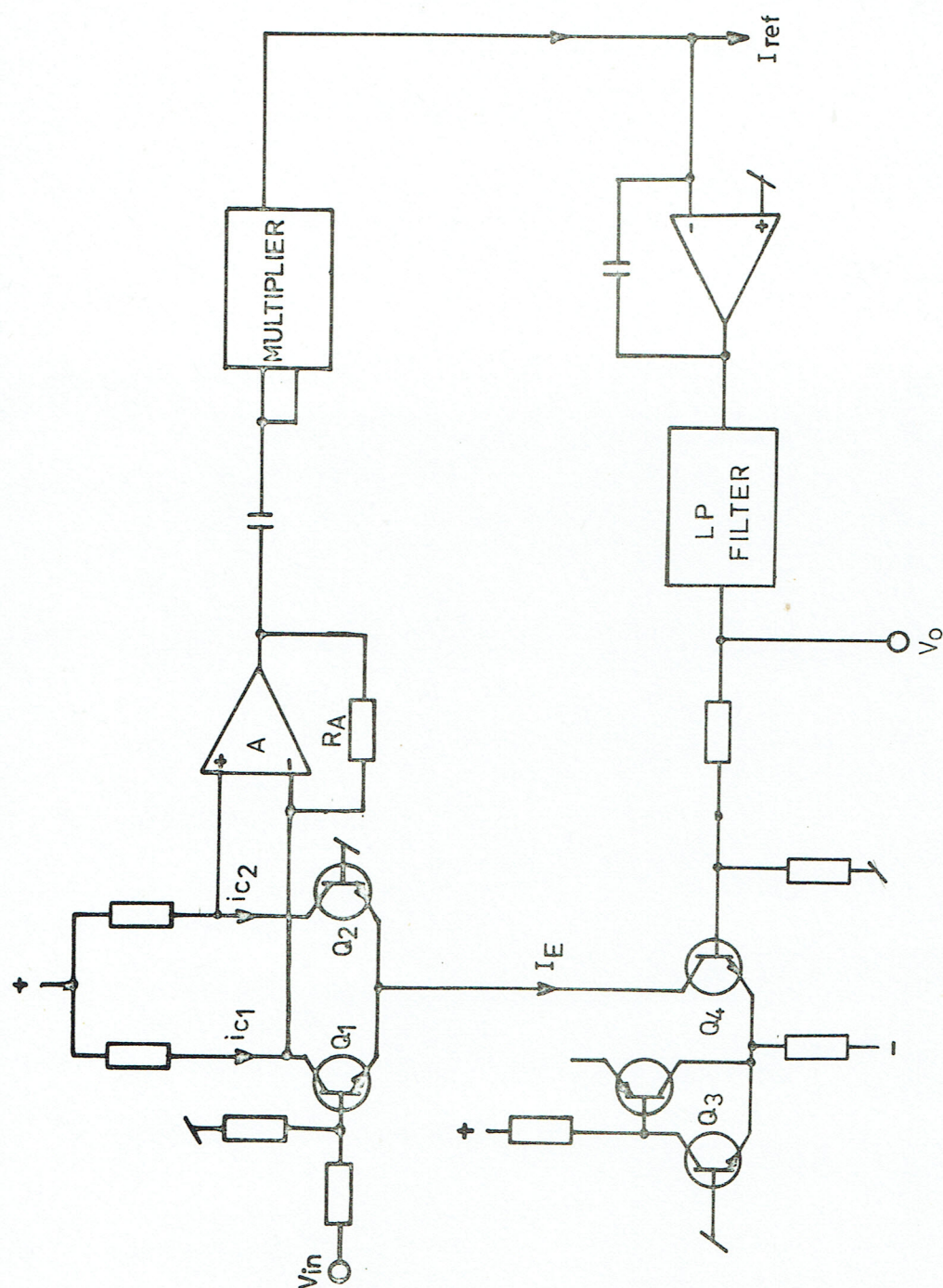


Fig. B - 10. RMS detector.

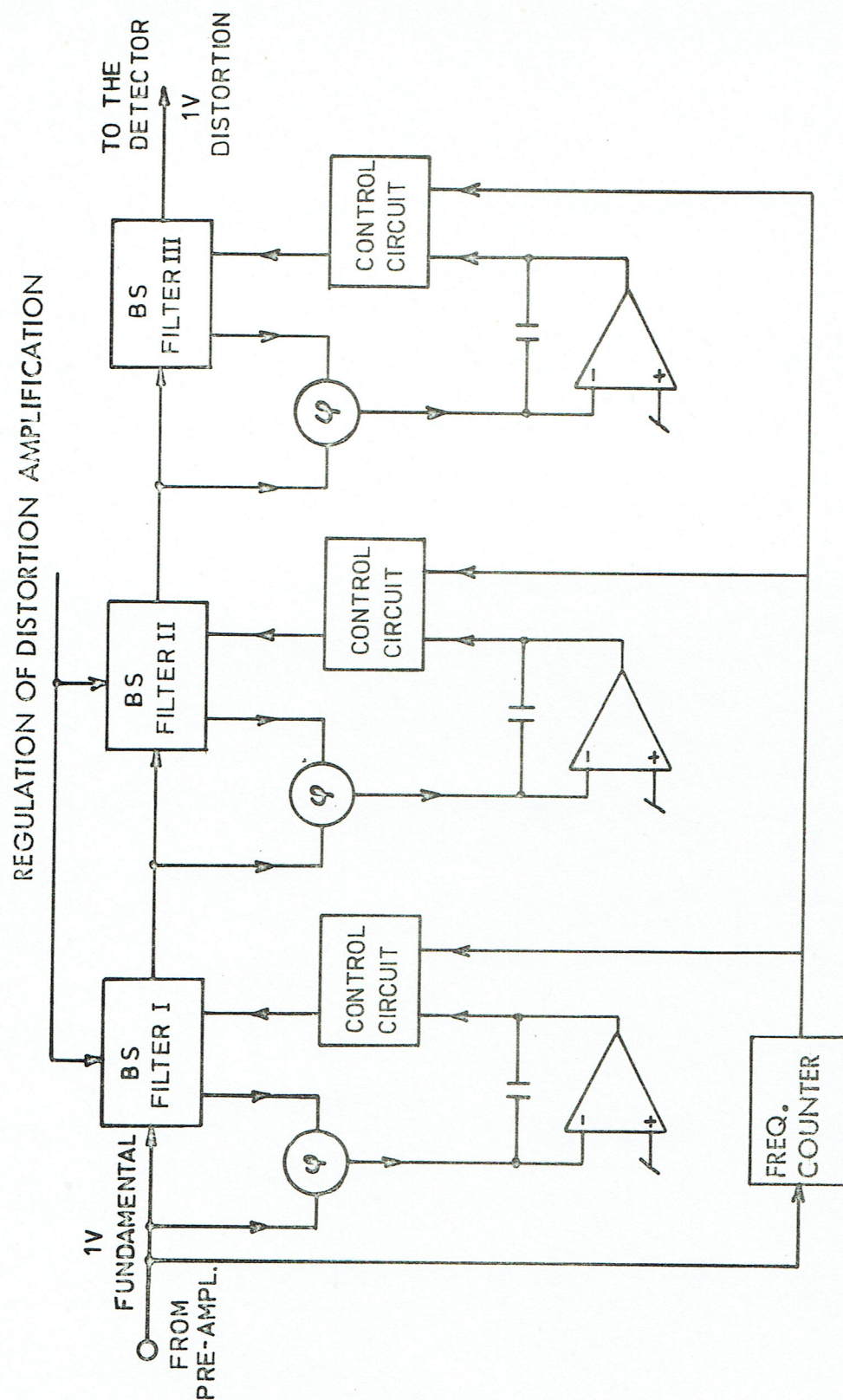


Fig. B - 11. Band-stop filter.

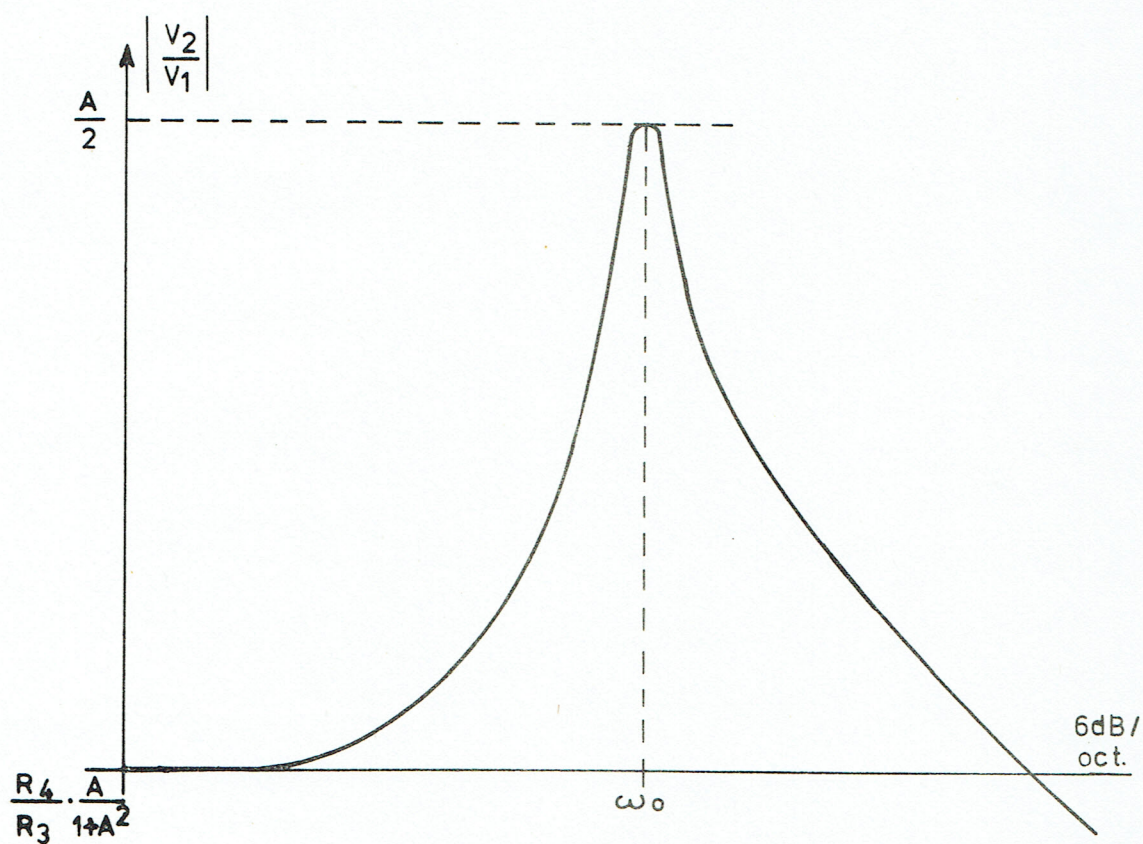
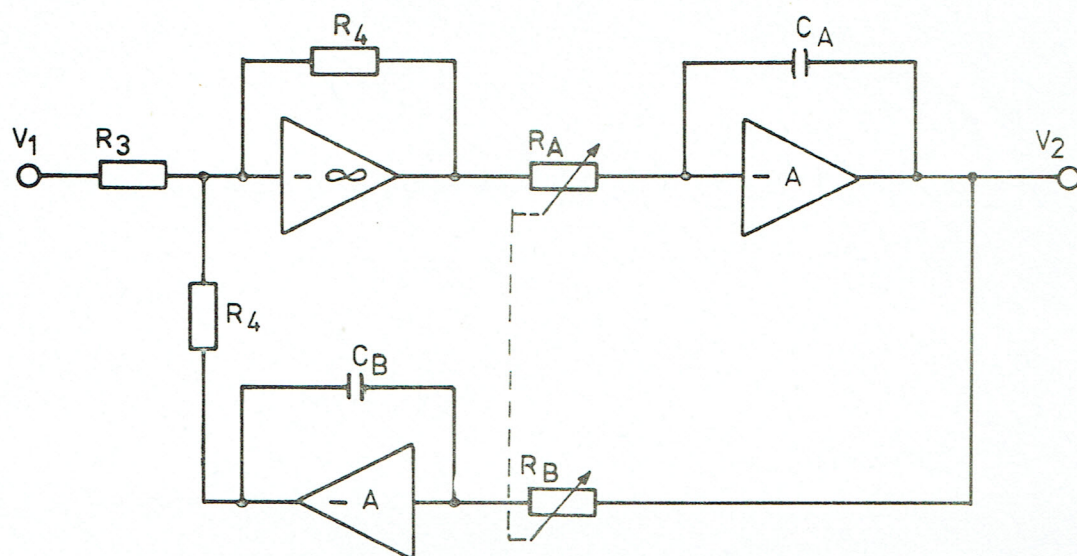


Fig. B - 12. Active resonator for band-stop filter.

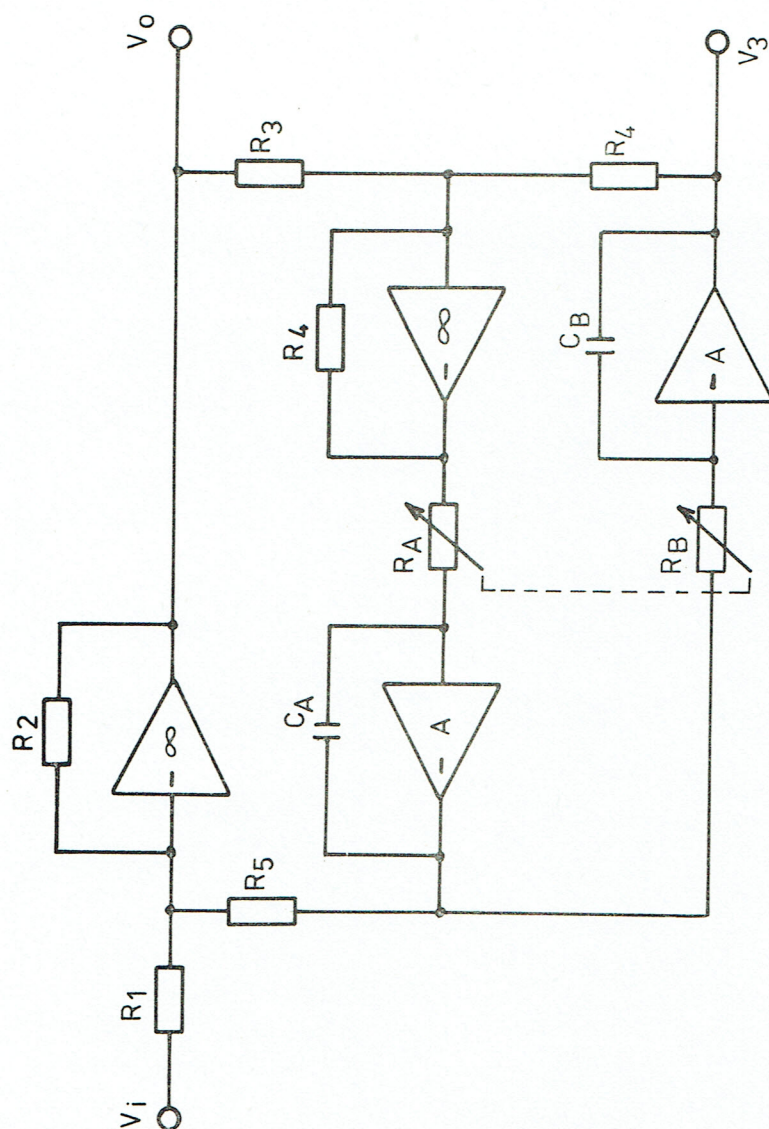


Fig. B - 13. Active band-stop filter.

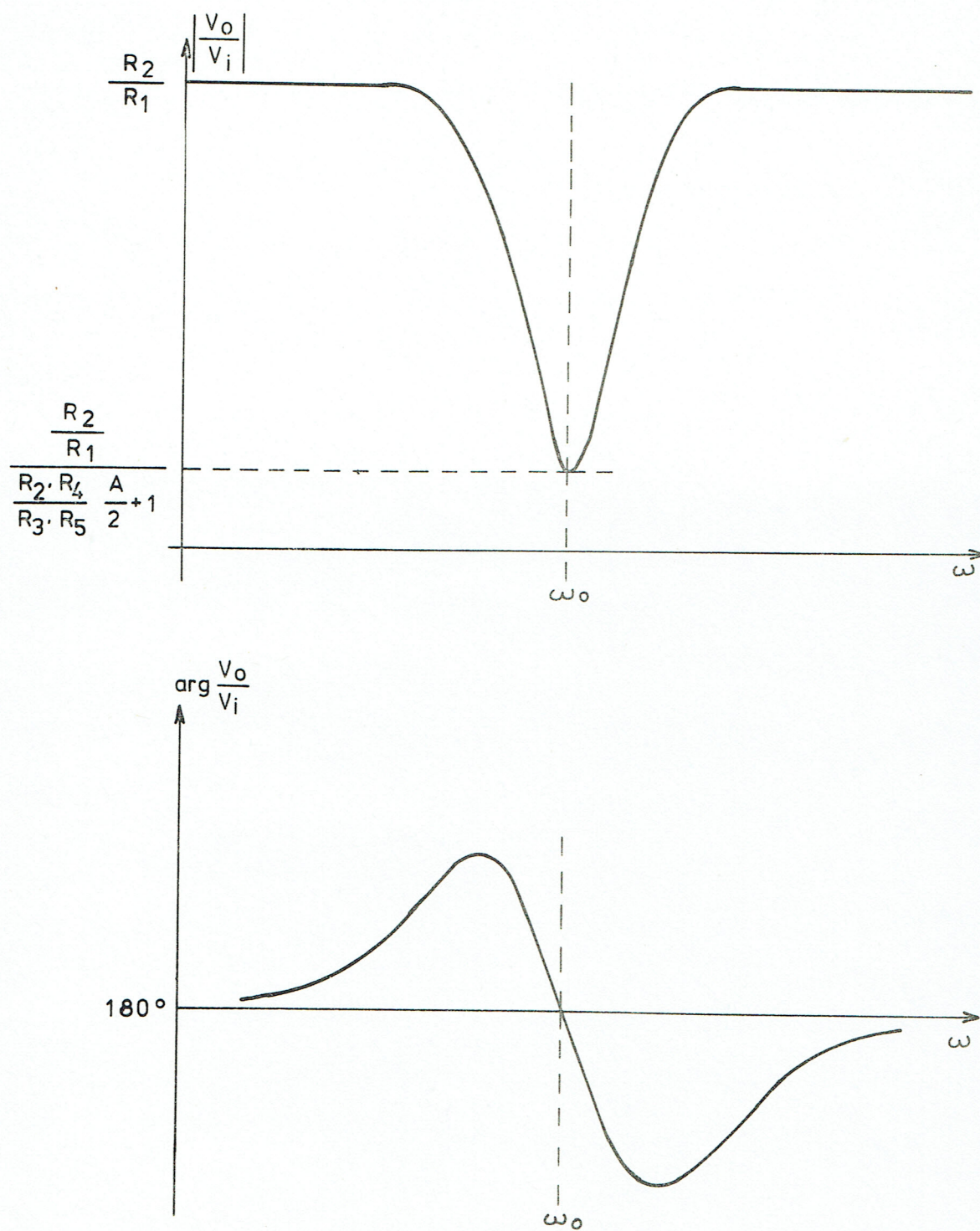


Fig. B - 14. Band-stop filter -
amplitude and phase characteristics.

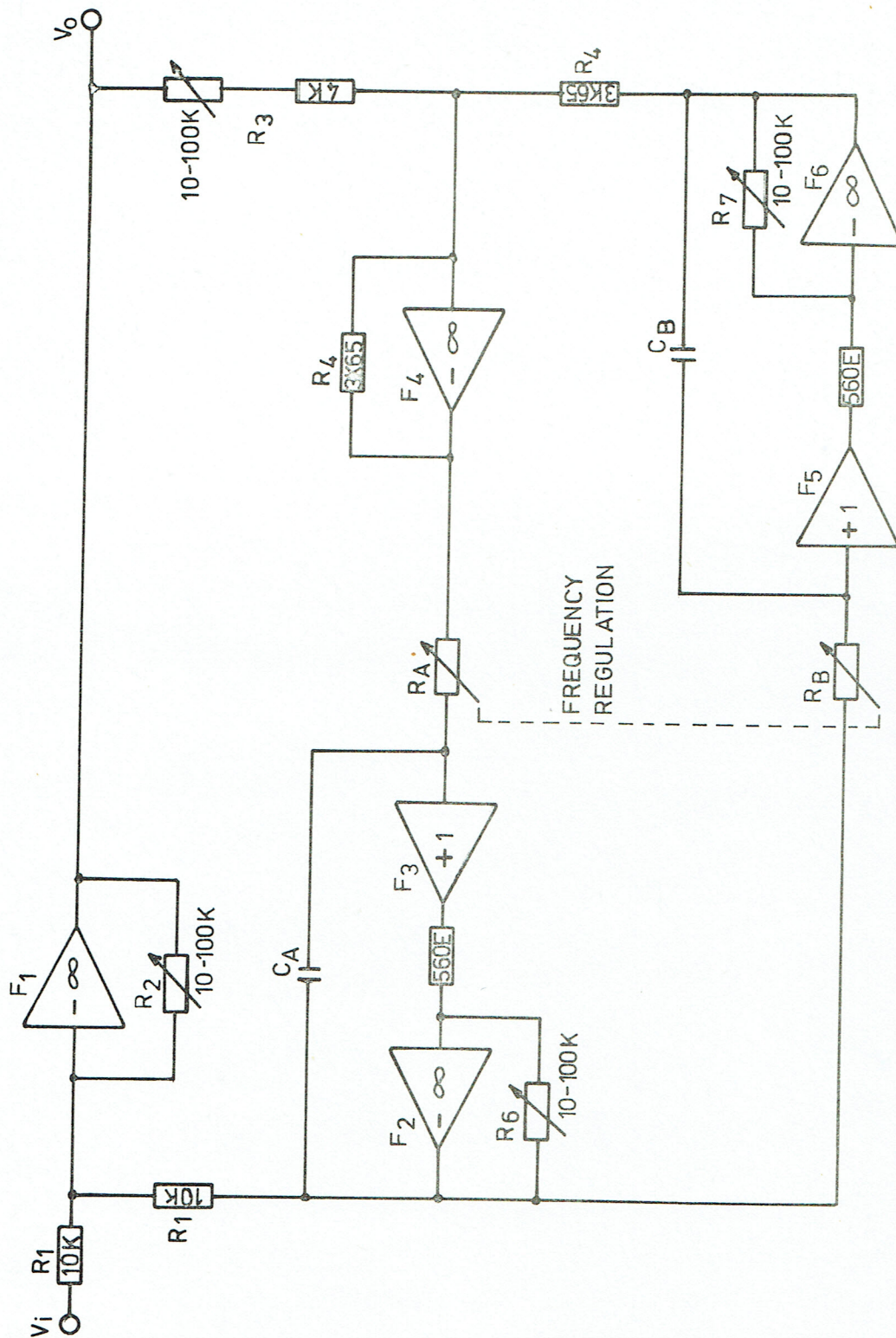


Fig. B - 15. Band-stop filter.

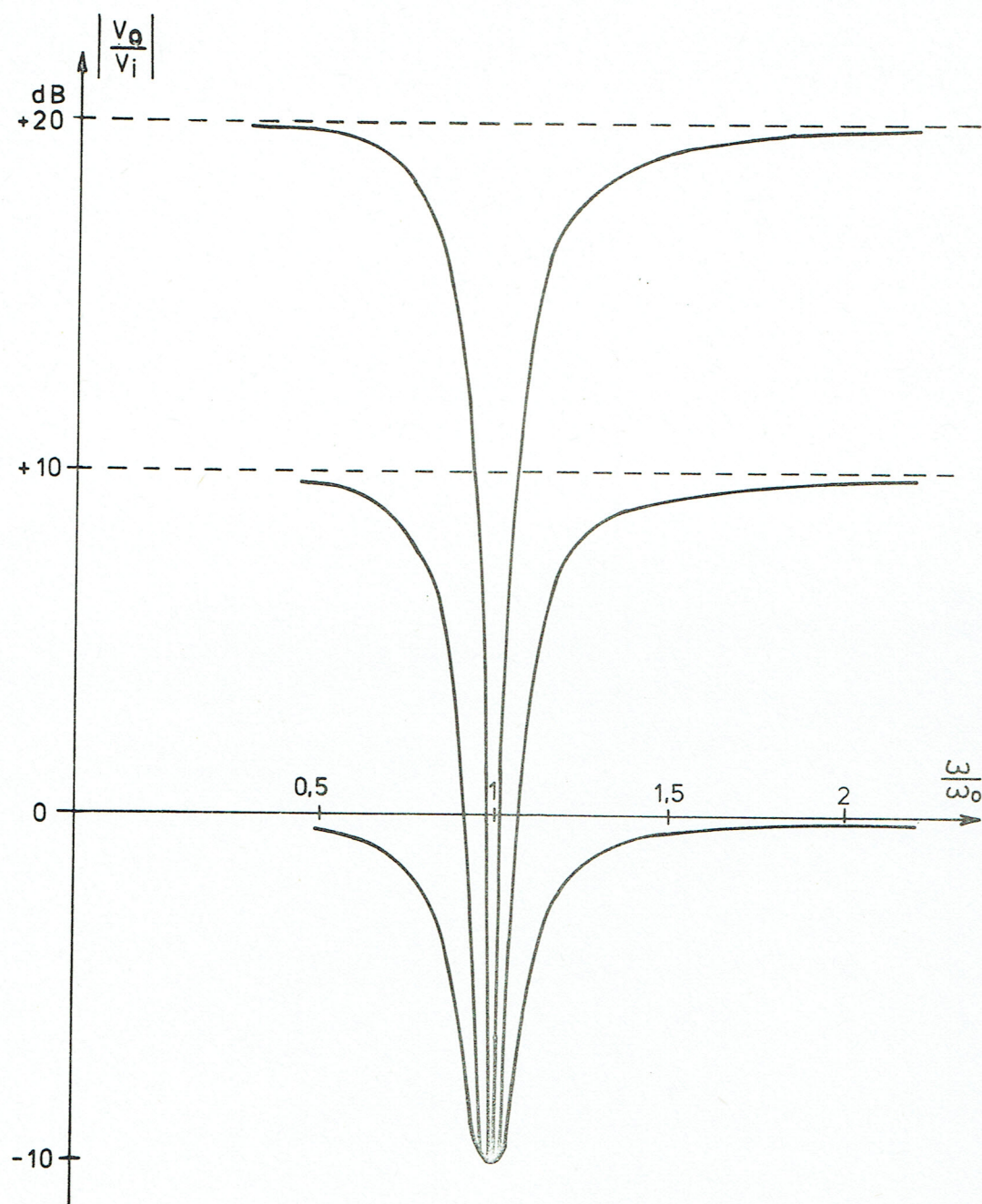


Fig. B - 16. Band-stop filter -
amplitude characteristic.

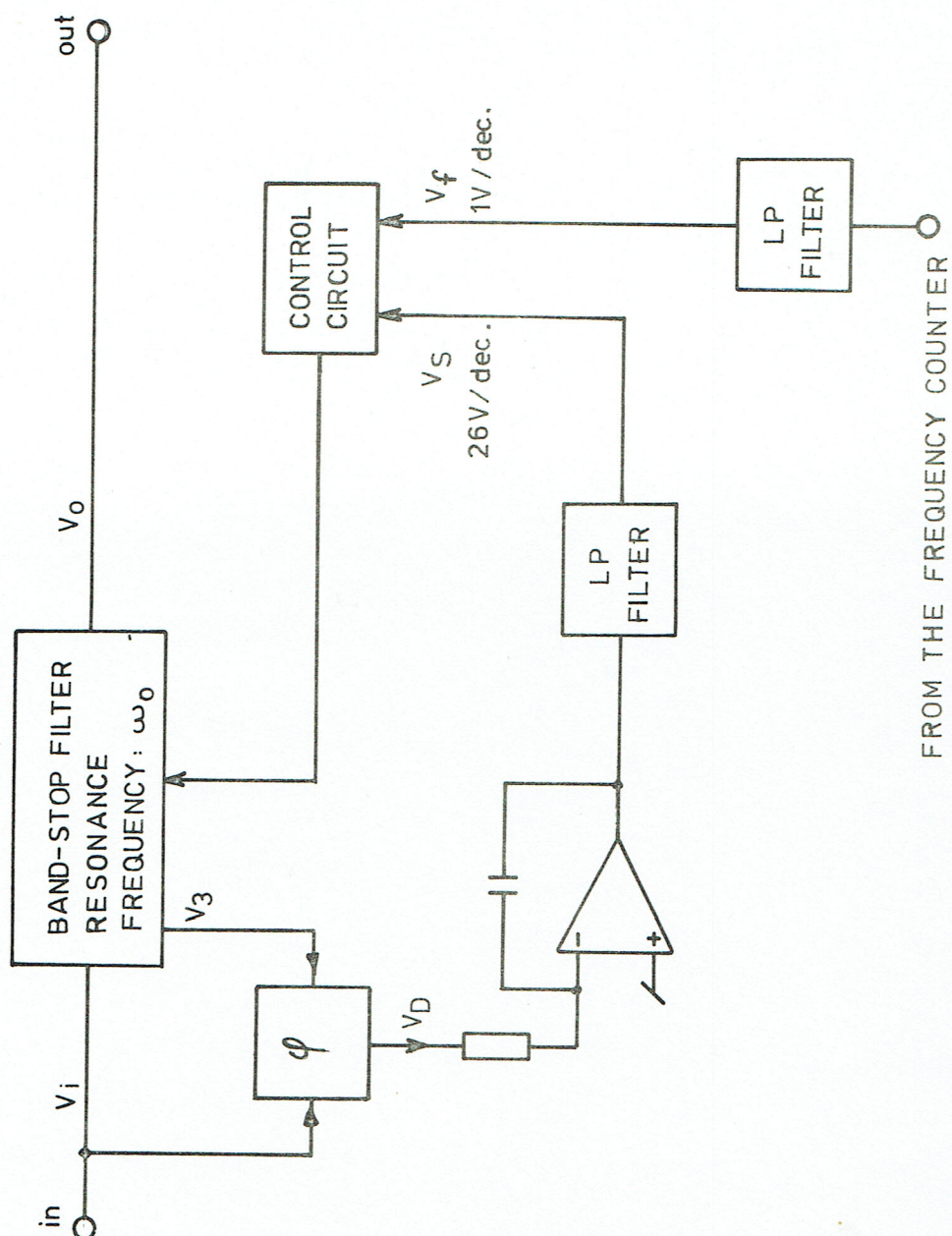


Fig. B - 17. Band-stop filter - frequency regulation loop.

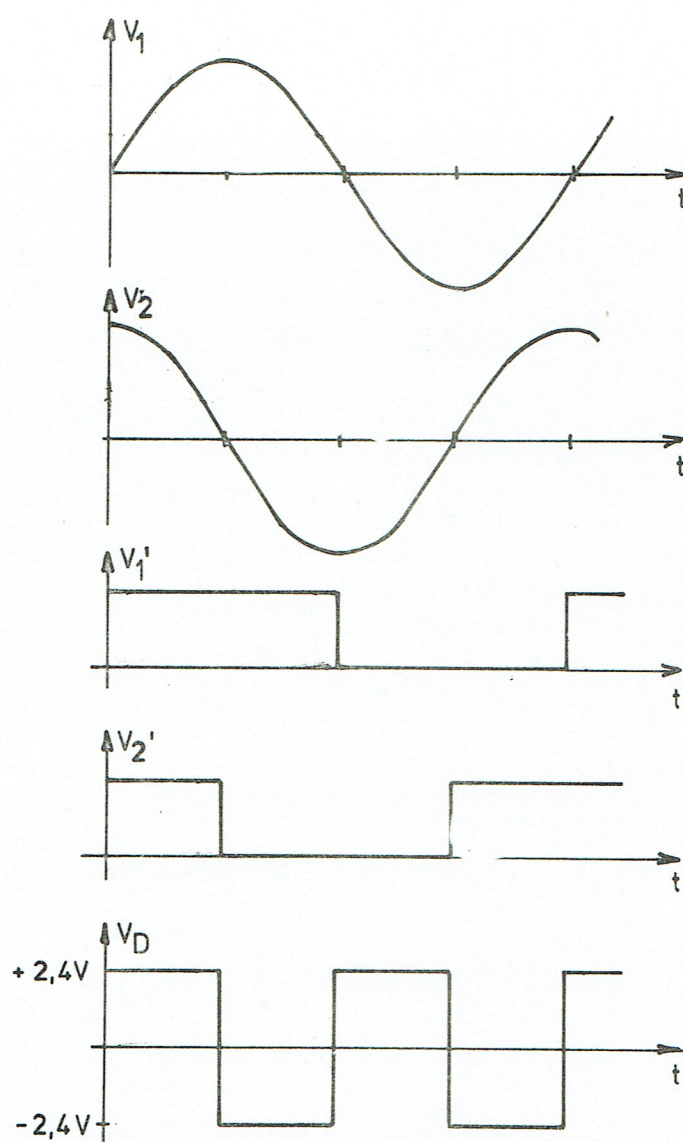
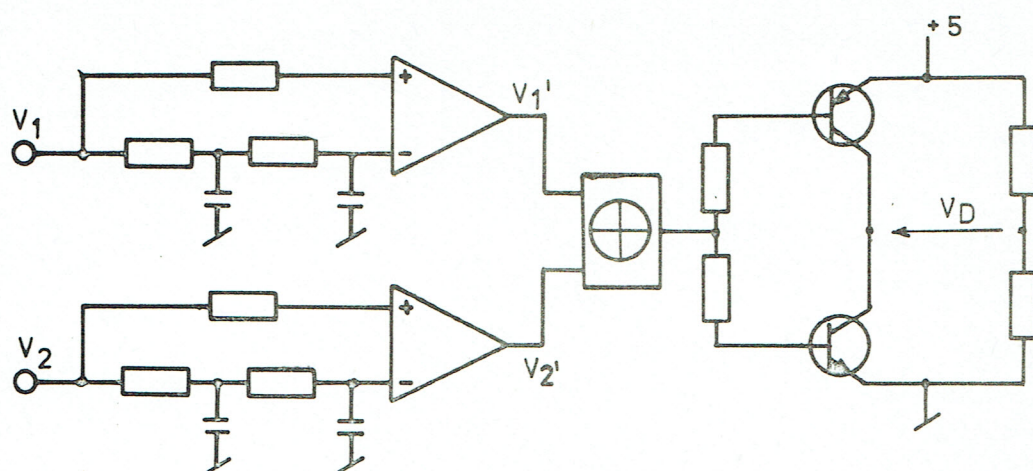


Fig. B - 18. Band-stop filter - phase detector.

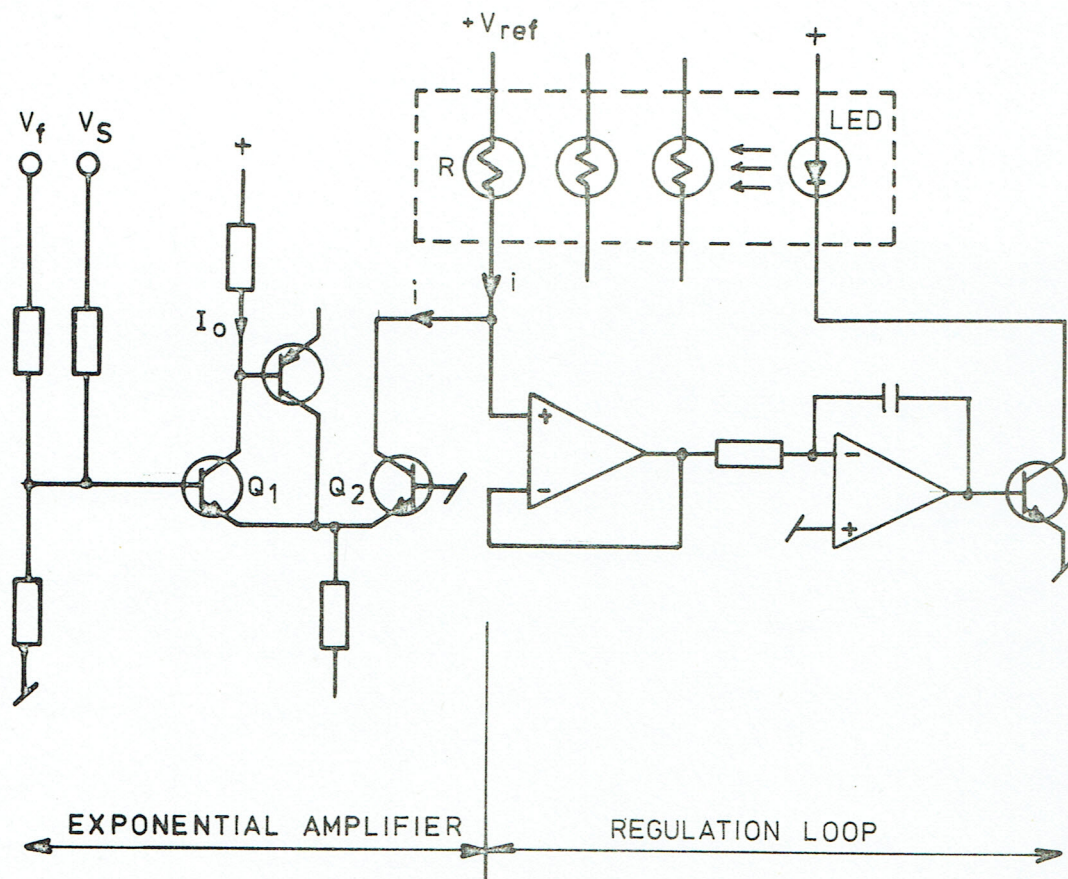


Fig. B - 19. Band-stop filter - control circuit.

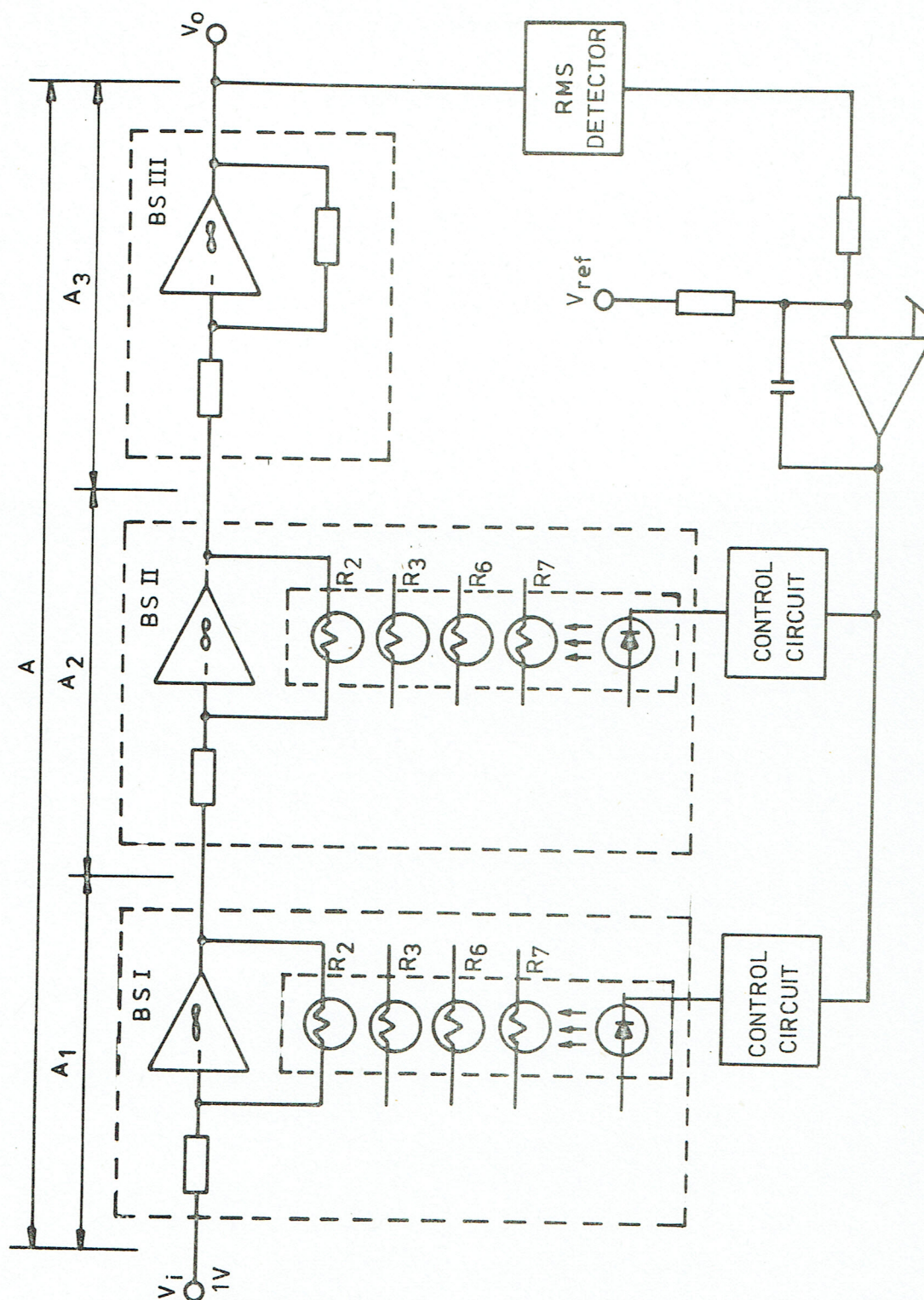


Fig. B - 20. Band-stop filter - gain regulation.

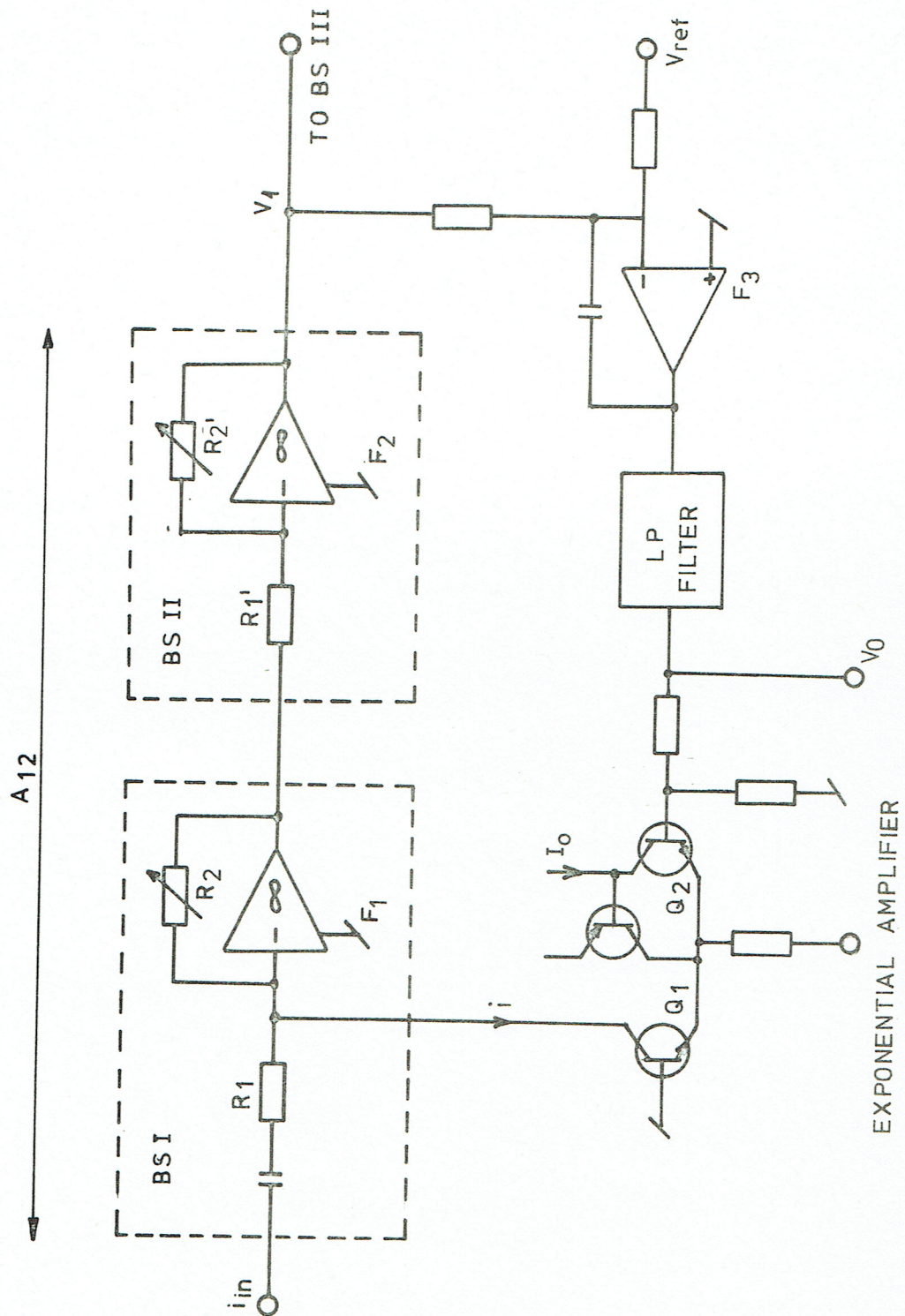


Fig. B - 21. Band-stop filter - gain measurement.

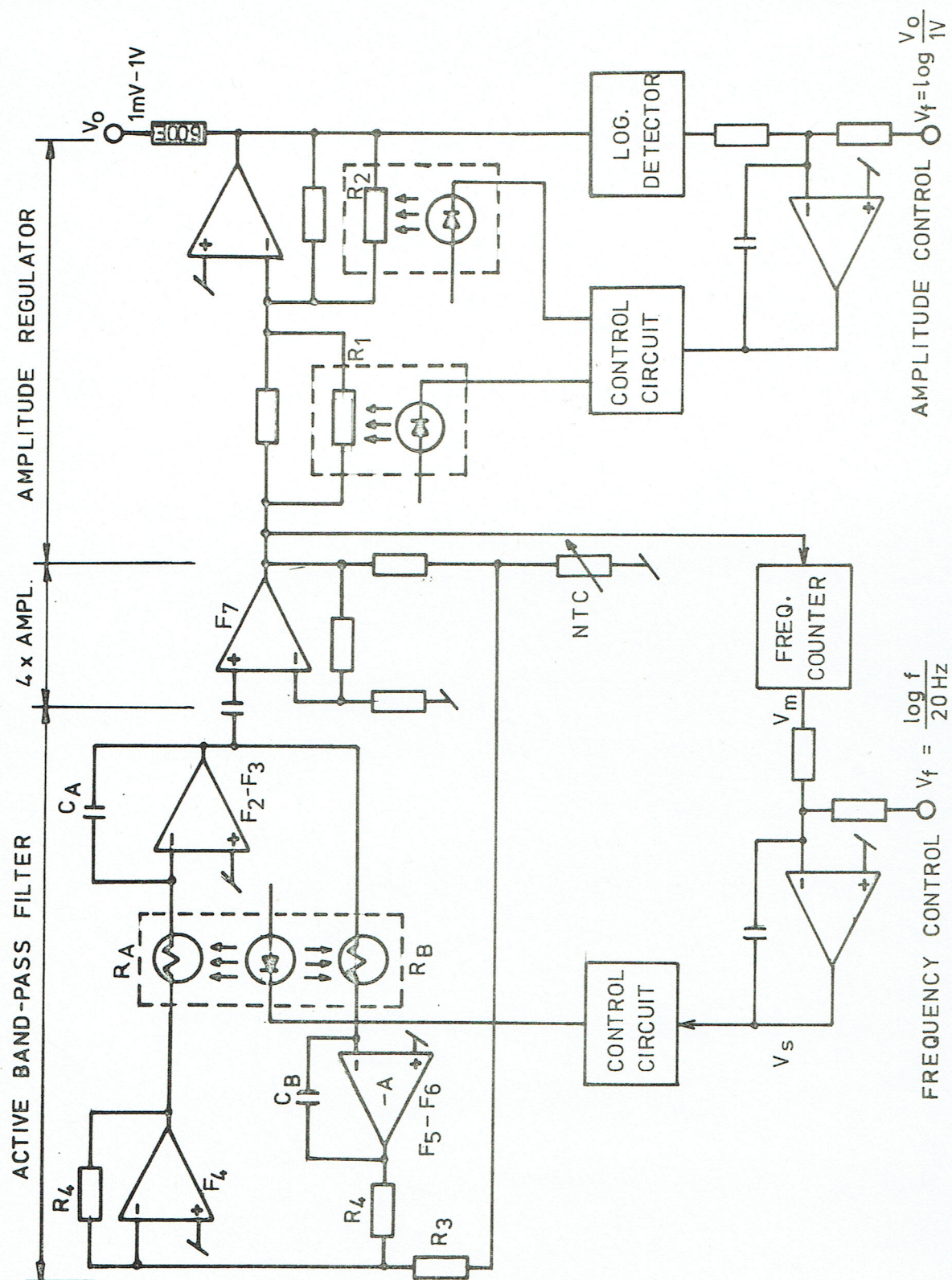


Fig. B - 22. Oscillator.

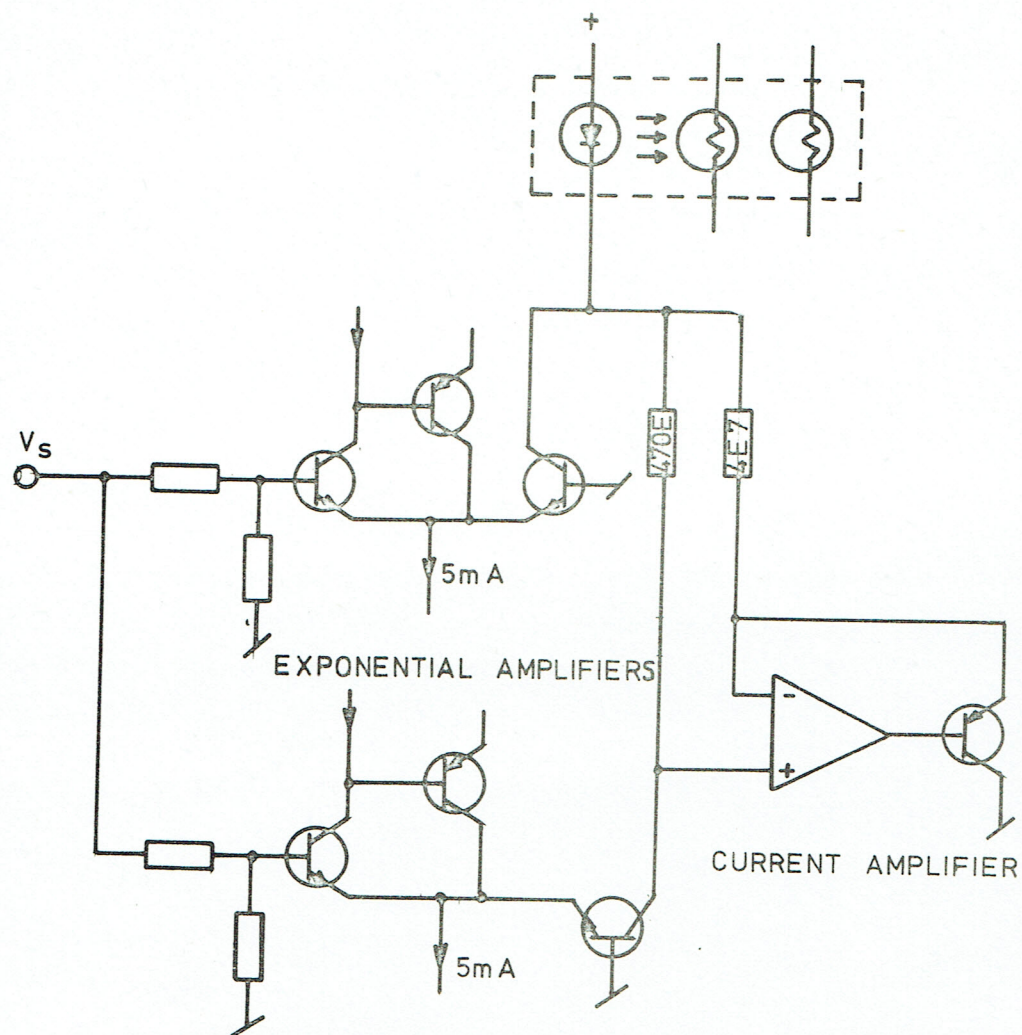


Fig. B - 23. Oscillator -
control circuit.

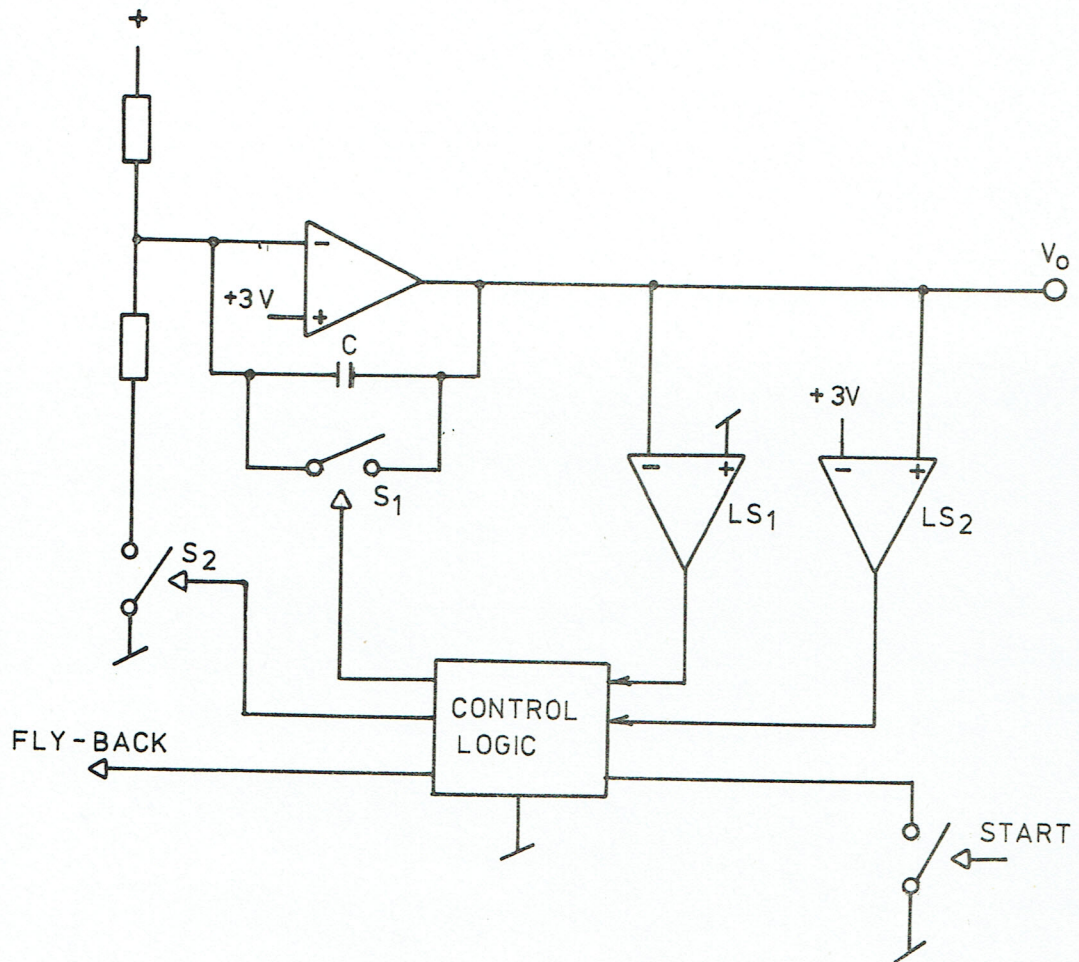


Fig. B - 25. Oscillator - sweep generator.

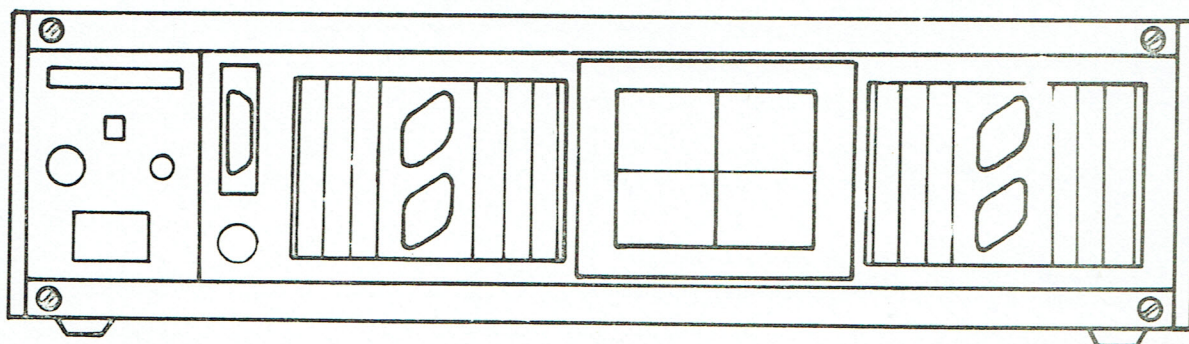


Fig. D - 1. BKF10 - seen from the back.

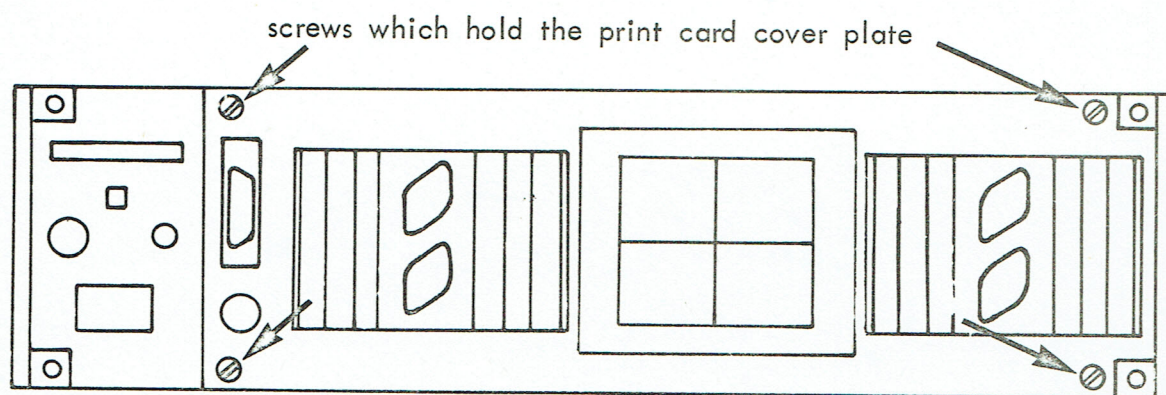


Fig. D - 2. BKF10 with top, bottom and sides removed.

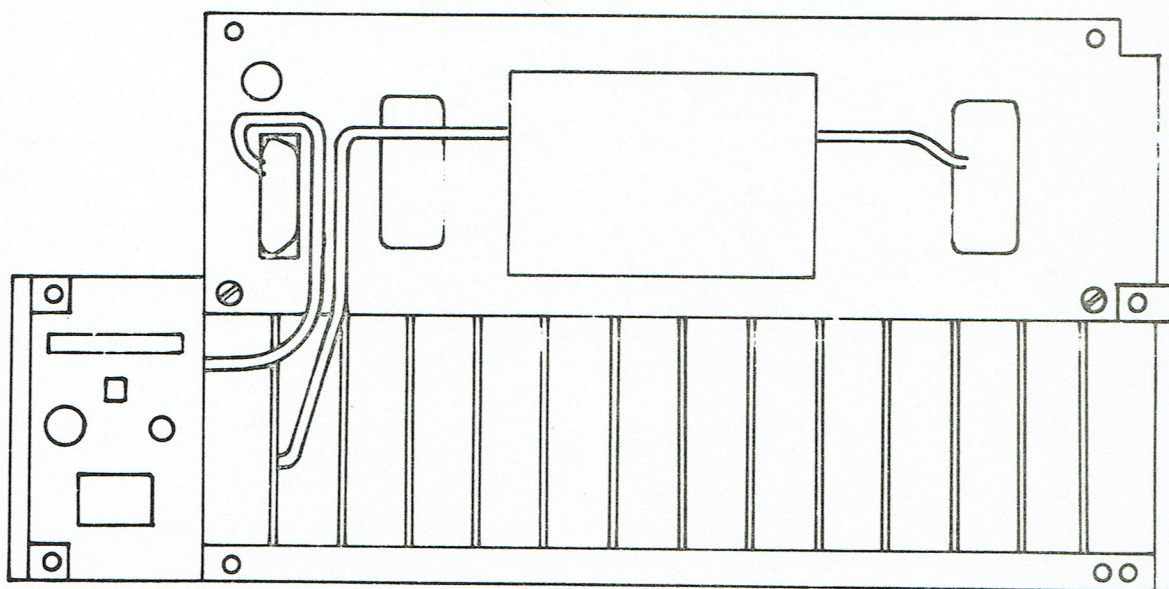
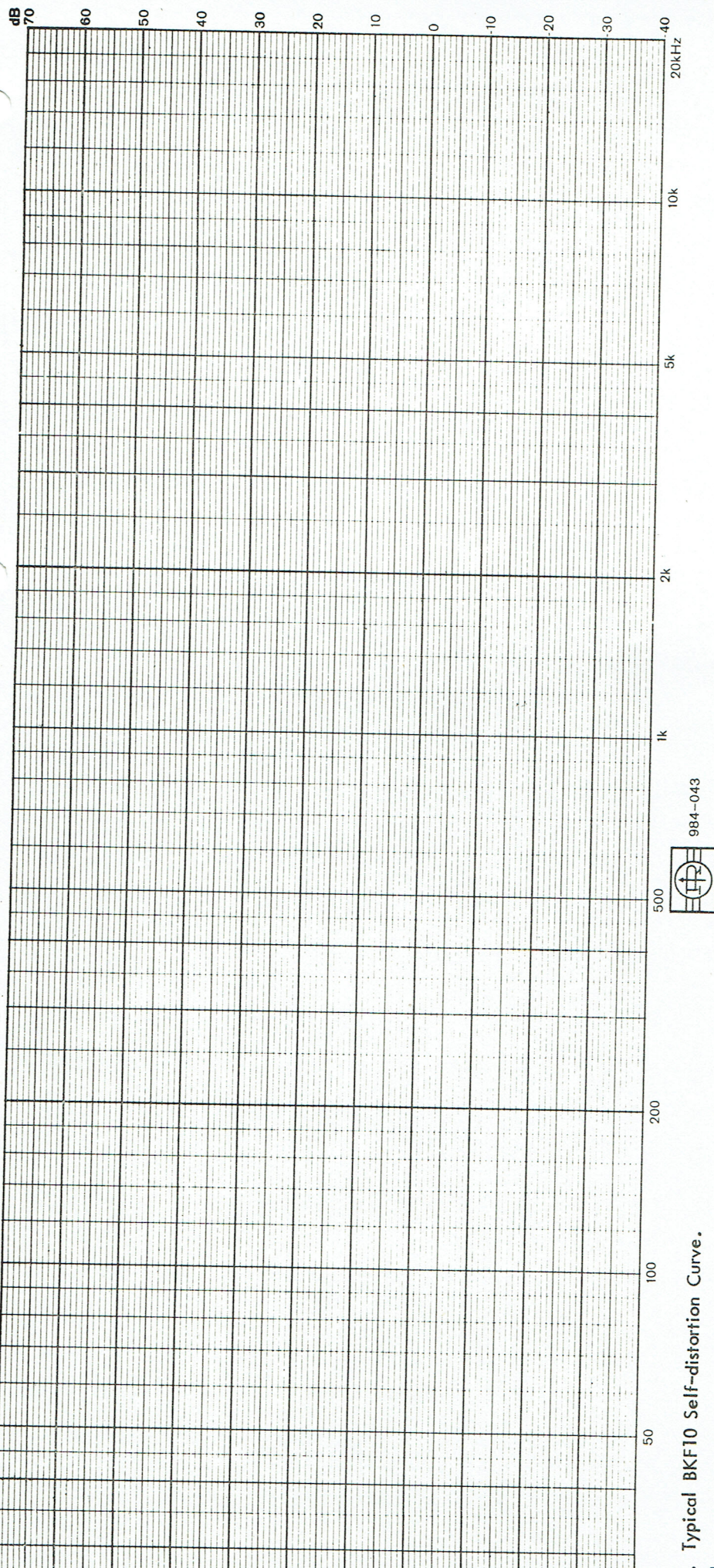
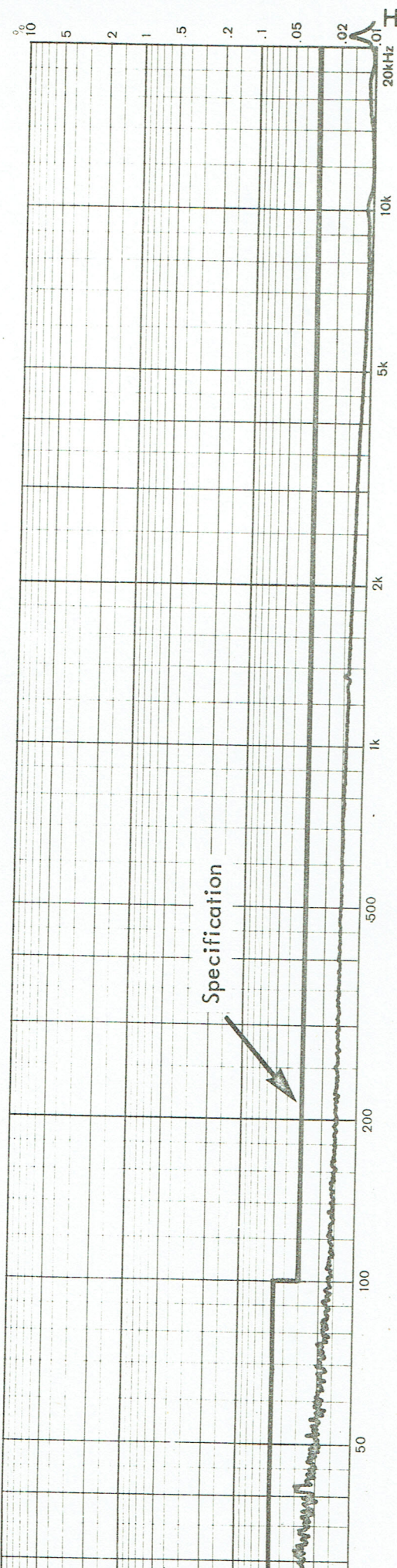
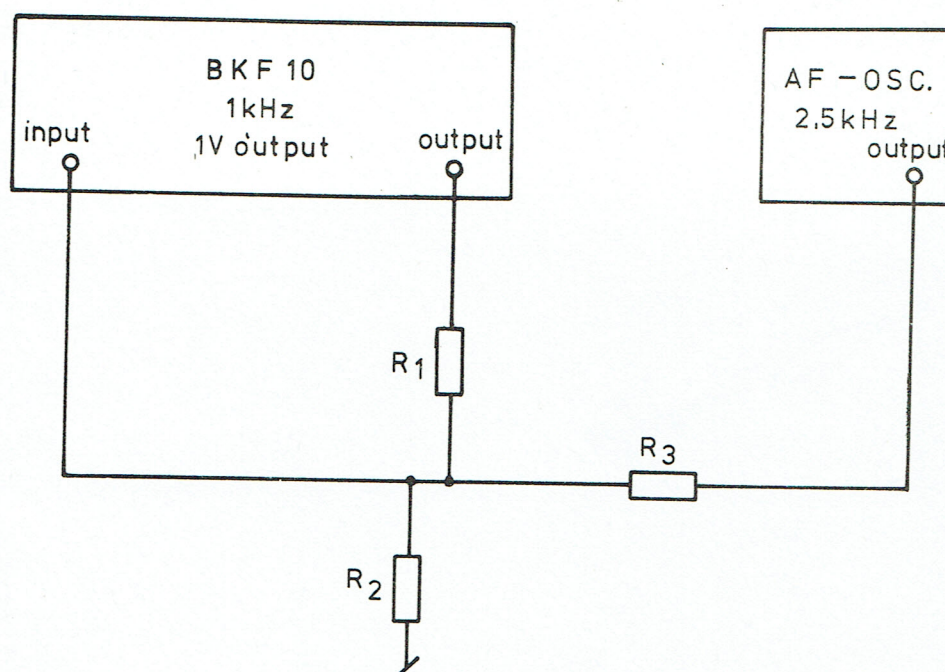


Fig. D - 3. Cover plate mounted reversed over the BKF10 so print cards can be removed.



Typical BKF10 Self-distortion Curve.





$$R_1 = 8.29 \text{ k}\Omega$$

$$R_2 = 1.00 \text{ k}\Omega$$

$$R_3 = 88.9 \text{ k}\Omega \text{ minus the output impedance of the AF-oscillator}$$

Fig. E - 2. Arrangement for generating a signal having a known distortion.

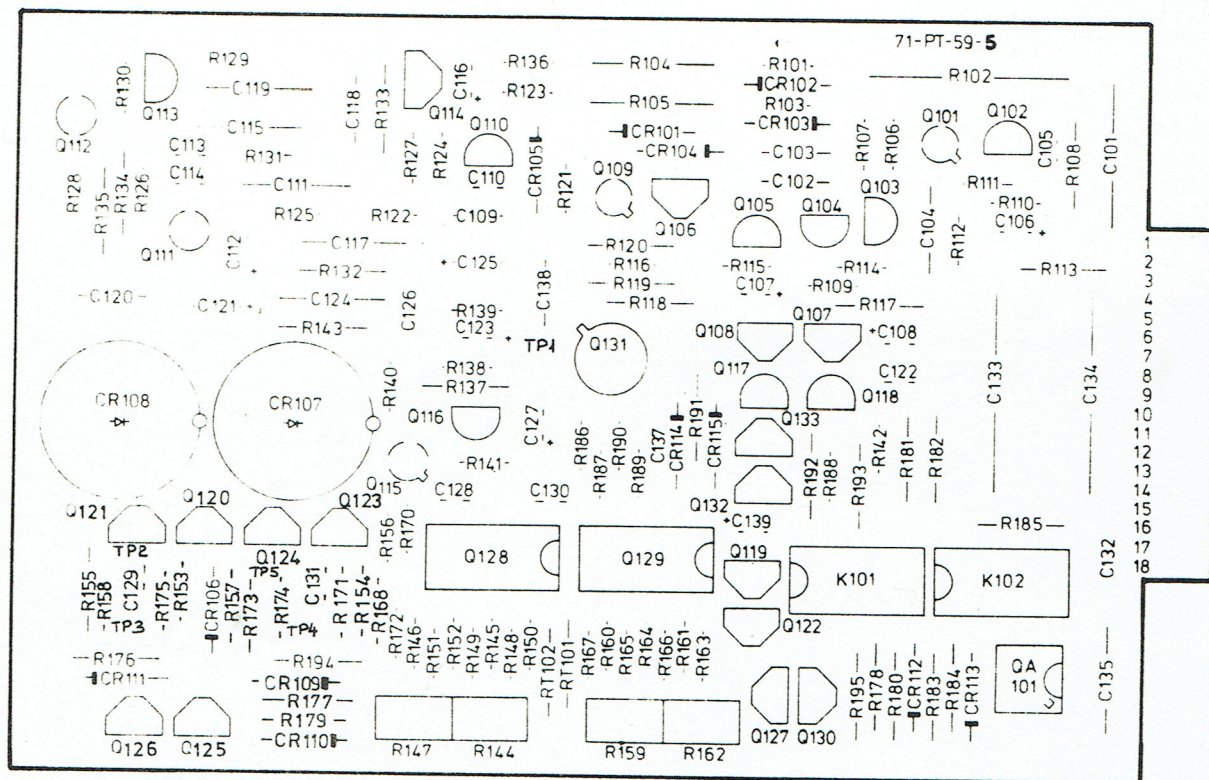
Position from the left side	Printed Circuit Boards	Terminal Strip	Components are shown on SCHEMATIC DIAGRAM No.													
			1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	900-453 Pre-Ampl.	J17	x	x												
2	900-454 Log. Det.	J18	x													
3	900-455 Bandstop filter I	J19		x												
4	900-456 Bandstop filter II	J20		x		x										
5	900-457 Bandstop filter III	J21		x			x									
6	900-459 Phase Det. I-II-III	J22			x	x										
7	900-458 Freq. Meter	J23			x	x										
8	900-460 RMS Det.	J24				x			x							
9	900-461 Output Circuit	J25		x						x						
10	900-462 Ampl. Control	J26										x				
11	900-463 Oscillator	J27									x					
12	900-464 Freq. Reg.	J28									x					
13	900-465 Power Supply	J29														
	900-507 Level		x												x	x

Table 1. Schematic Diagram Survey.

Position of the PC-Boards listed from the left	Printed Circuit Boards	
1	900-453	I 144 147 159 162 ^I
2	900-454	II 207 220 ^I III 235 238 ^I
3	900-455	IV 301 306 327 351 354 365 369 ^I
4	900-456	V 420 445 448 459 463 ^I
5	900-457	VI 540 536 ^I
6	900-459	VII 623 ^I VI 651 ^I VII 677 ^I
7	900-458	VIII 707 721 727 740 745 747 ^I
8	900-460	IX 842 849 855 857 ^I
9	900-461	X 925 930 938 956 964 965 966 ^I
10	900-462	XI 1056 1060 1062 1066 1073 1081 1087 ^I XII 2004 2007 ^I
11	900-463	XIII 1154 1157 1159 ^I
12	900-464	XIV 1206 1218 1228 1232 ^I XI 1255 ^I
13	900-465	XV 1305 1313 ^I

The Roman numerals indicate on which Schematic Diagram the trimmers are shown.

Table 2. Trimmer Survey.



Seen from component side.

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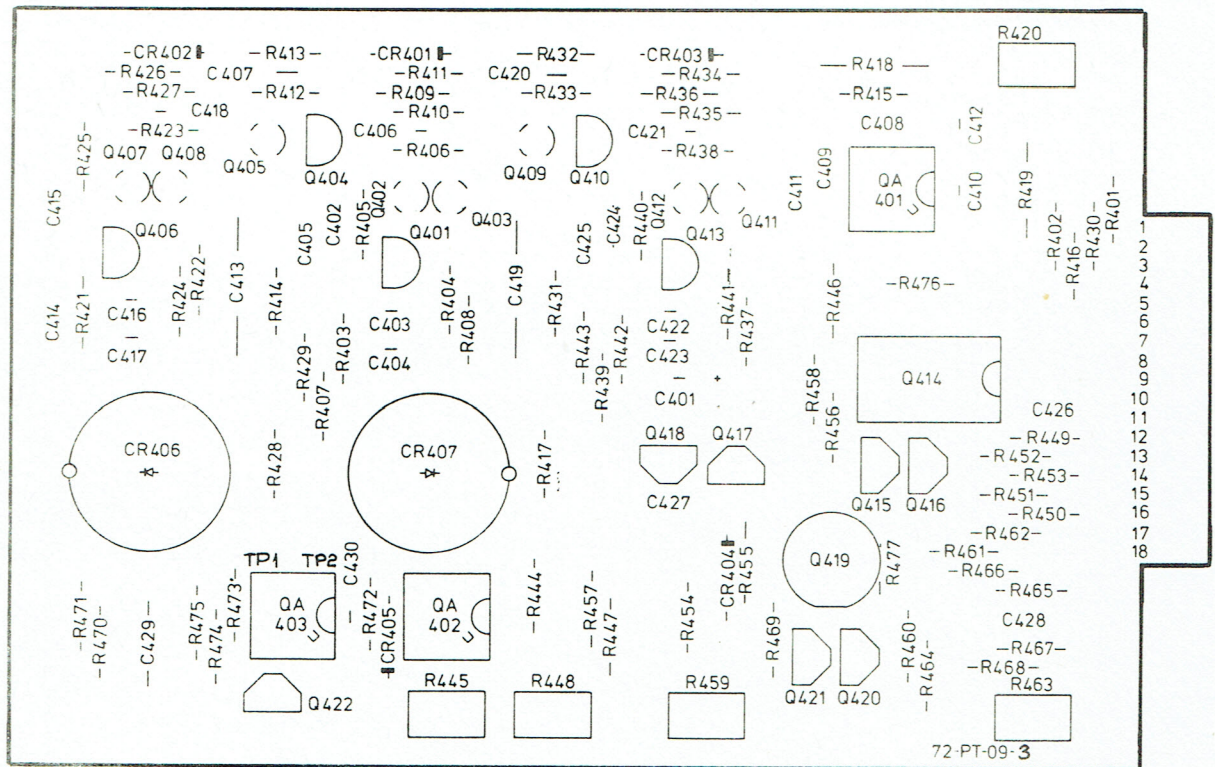
RADIOMETER A'S

EMDRUPVEJ 72
DK 2400 COPENHAGEN NV
DENMARK



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CHECKED BY KA 4.1.73
APPR BY N03 19.2.73

PRE - AMPLIFIER



Seen from component side.

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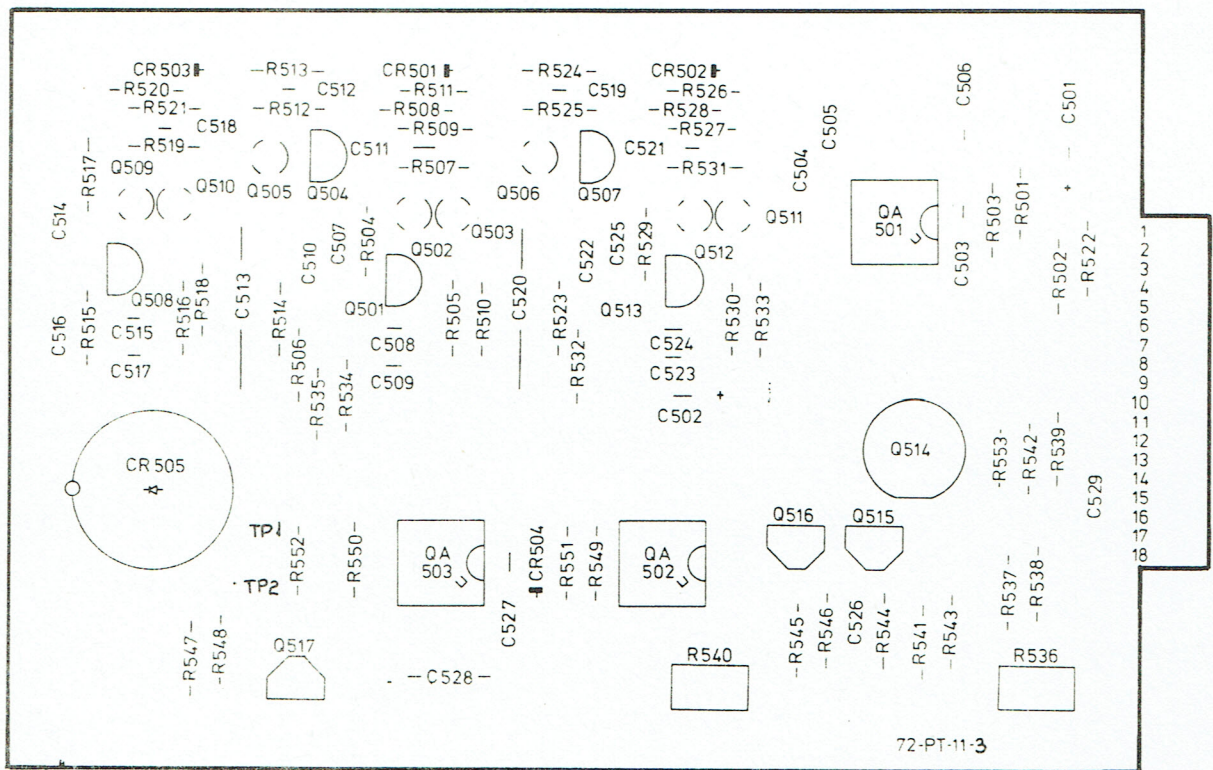
RADIOMETER A/S

EMDRUPVEJ 72
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DENMARK



DRAWN BY EE 10.173
CHECKED BY KA 10.173
APPR. BY NOB 14.273

BANDSTOPFILTER II



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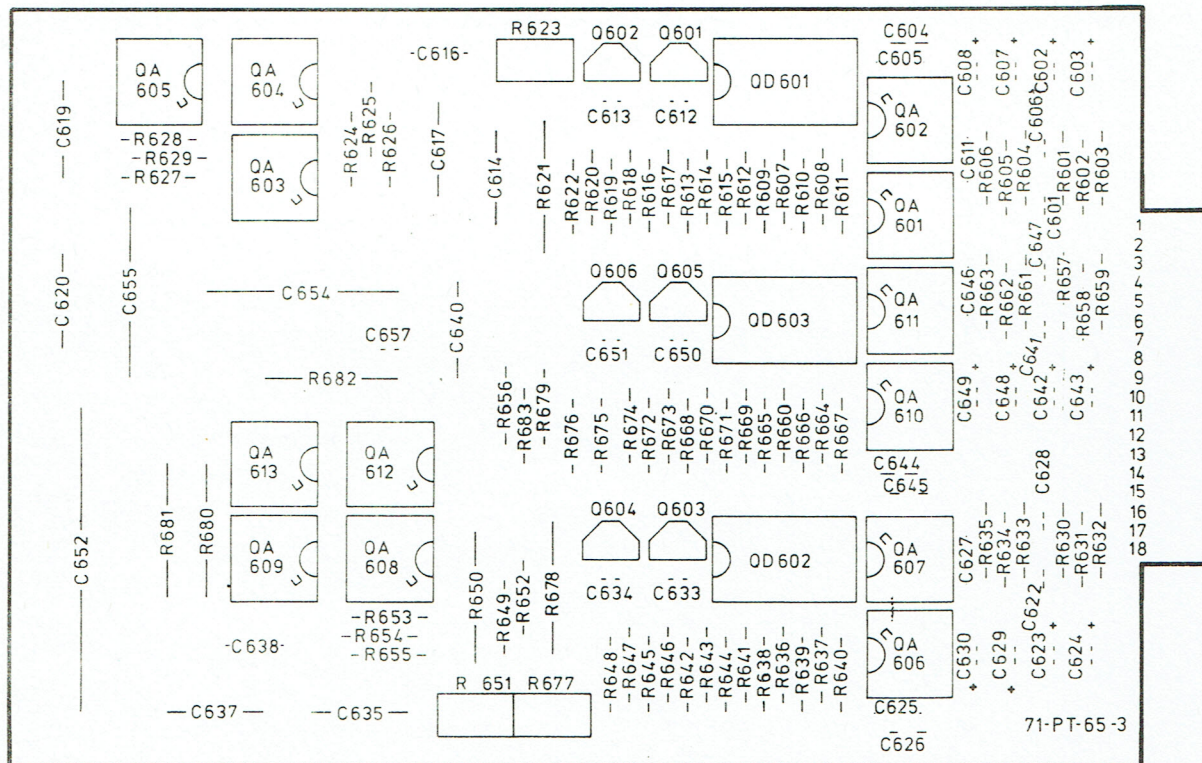
RADIOMETER A/S

EMDRUPVEJ 72
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APPR. BY WOB 14.2.73

BANDSTOPFILTER III



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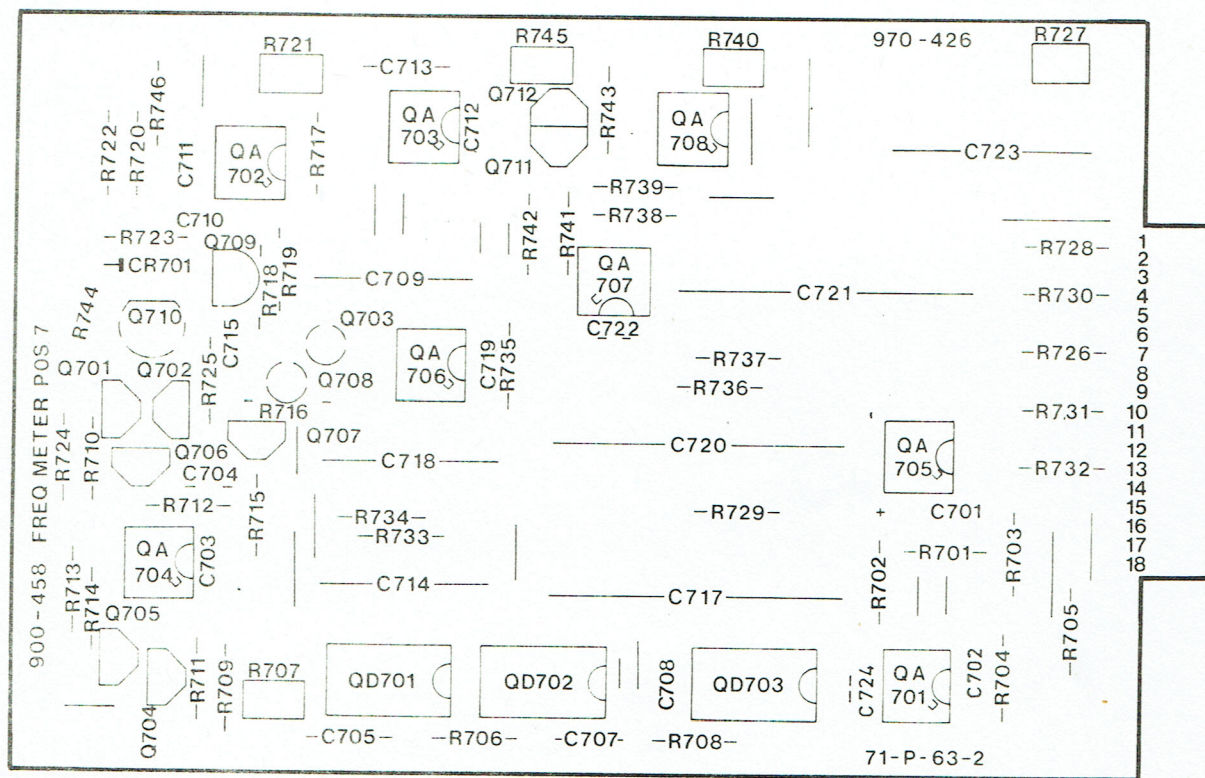
RADIOMETER A/S

EMDRUPVEJ 72
DK 2400 COPENHAGEN NV
DENMARK



DRAWN BY	EE	4.1.73
CHECKED BY	KA	4.1.73
APPR. BY	NOB	19.2.73

PHASE DETECTOR



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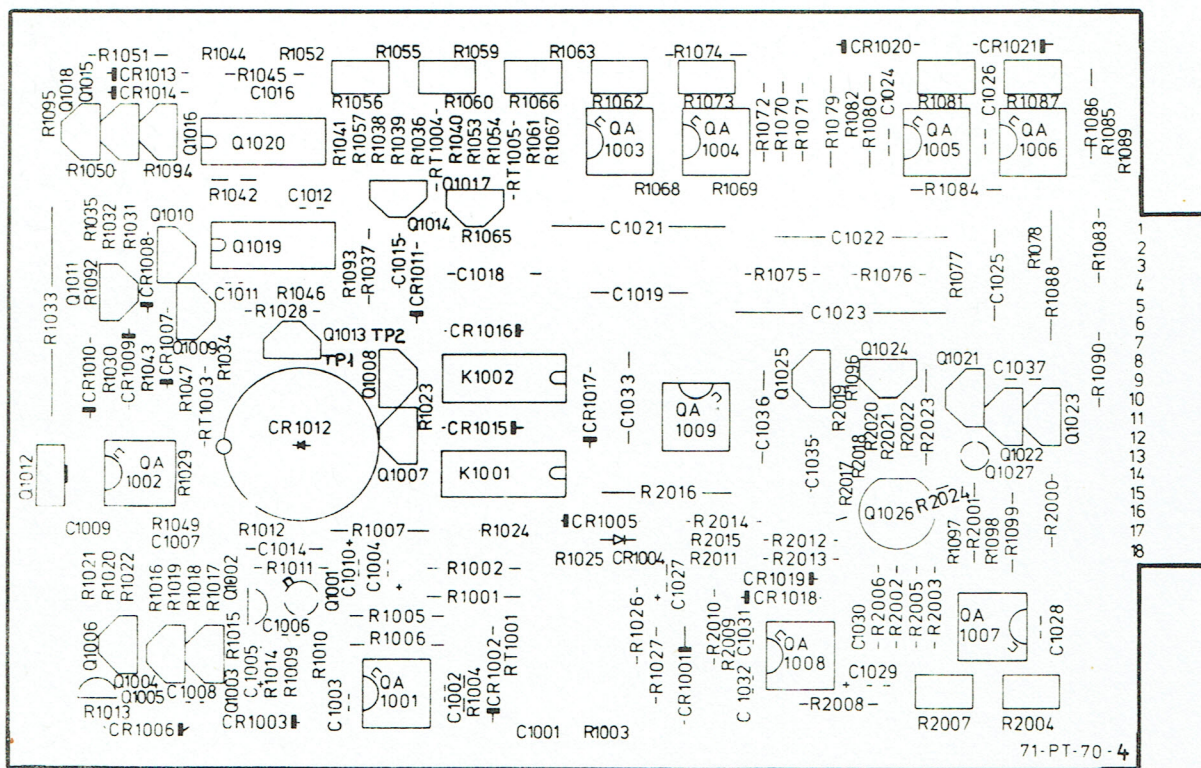
RADIOMETER A/S

EMDRUPVEJ 72
DK 2400 COPENHAGEN NV
DENMARK



DRAWN BY EE 4.1.73
CHECKED BY KA 4.1.73
APPR. BY WOB 19.2.73

FREQ METER



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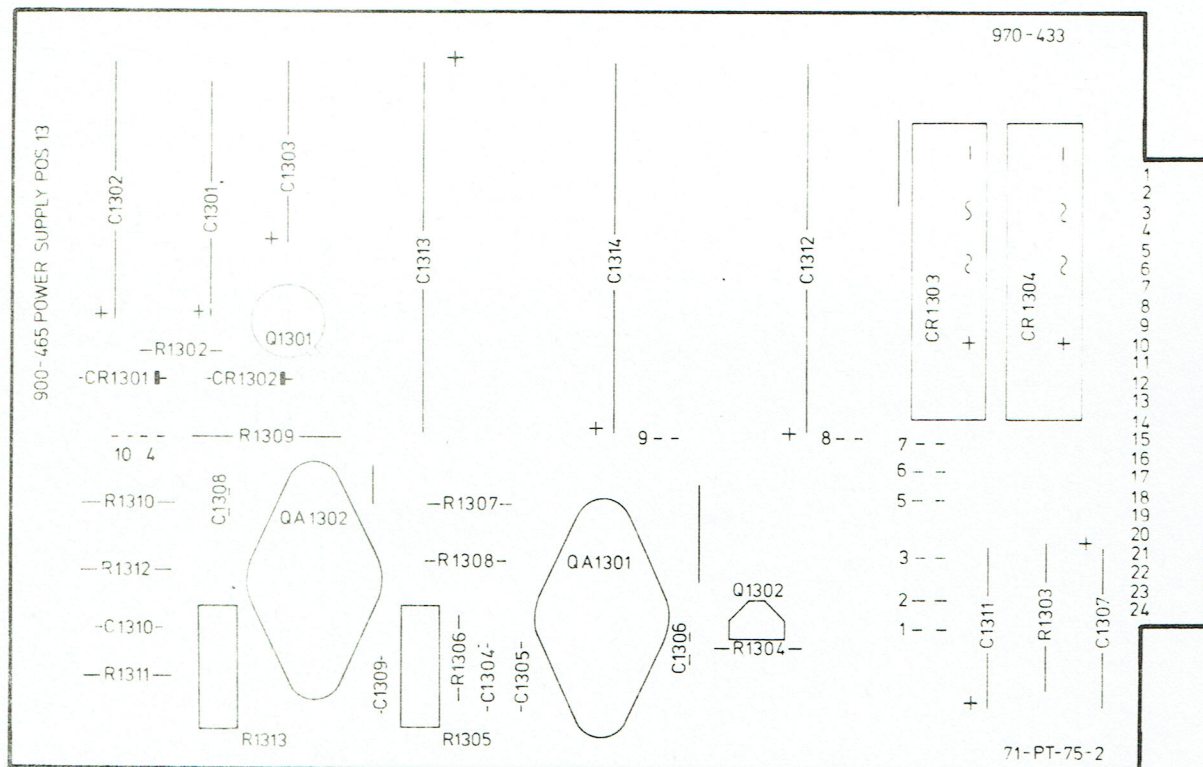
RADIOMETER A/S

EMDRUPVEJ 72
DK 2400 COPENHAGEN NV
DENMARK



DRAWN BY EE 10.1.7
CHECKED BY KA 10.1.7
APPR. BY NOB 19.2.73

AMPLITUDE CONTROL



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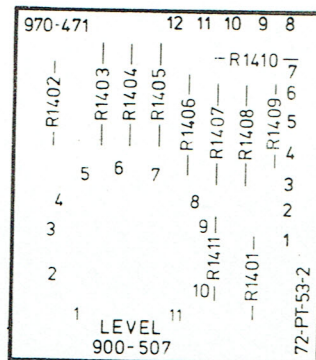
DRAWN BY EE 4.1.73

CHECKED BY KA 4.1.73

APPR. BY NOB 14.2.73

Power Supply

Automatic Distortion Meter



Seen from component side.

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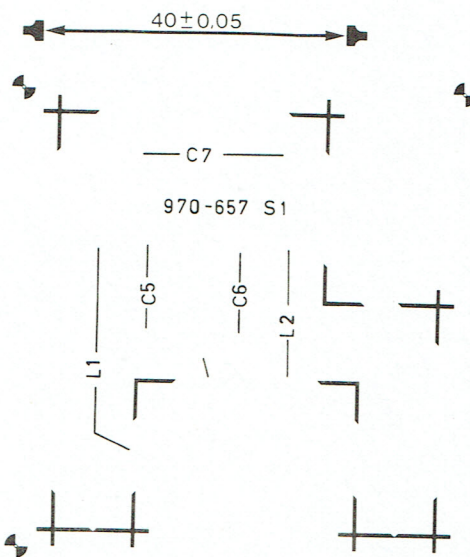
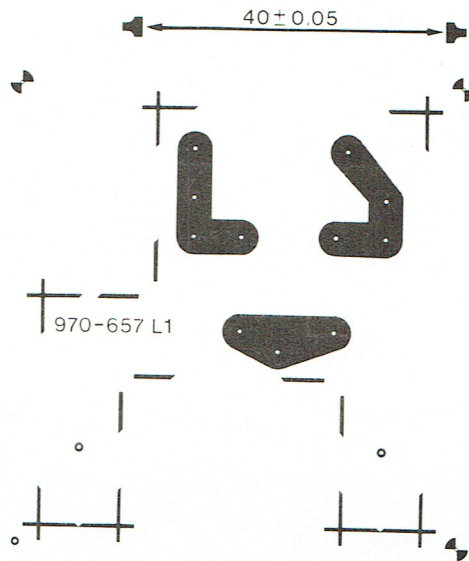
REVISIONS

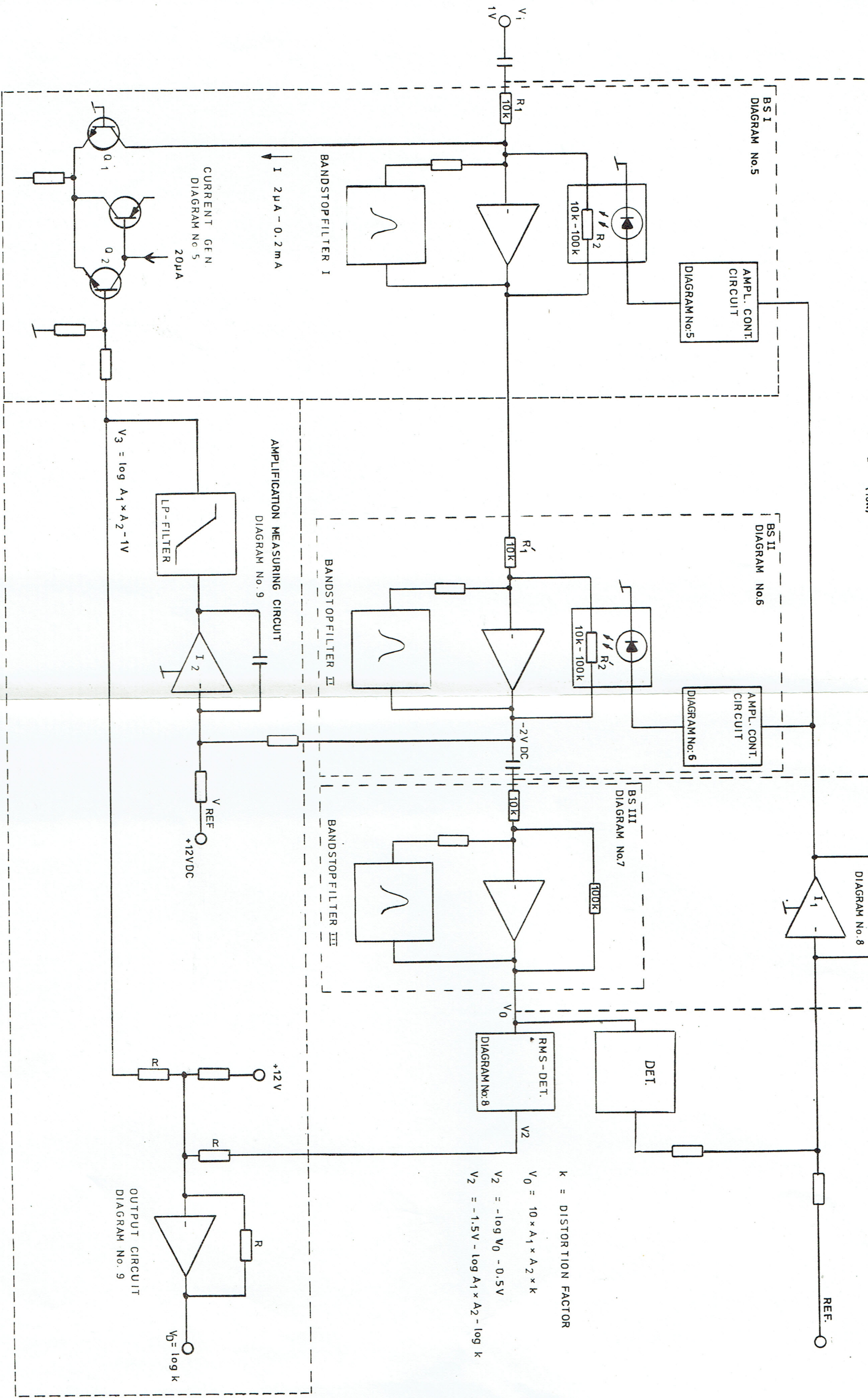
RADIOMETER A/S

EMDRUPVEJ 72
DK 2400 COPENHAGEN NV
DENMARK



DRAWN BY EE 10.1.73
CHECKED BY KA 10.1.73
APPR. BY NOB 14.2.73

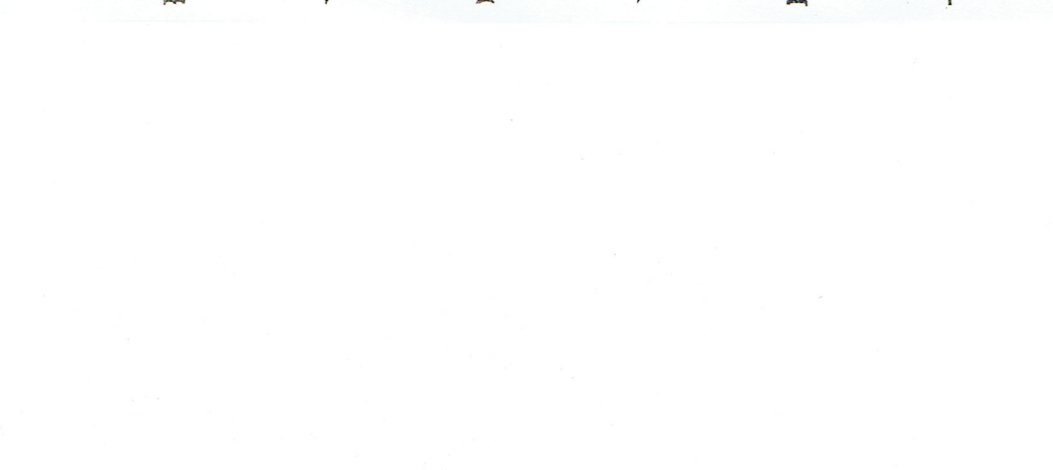
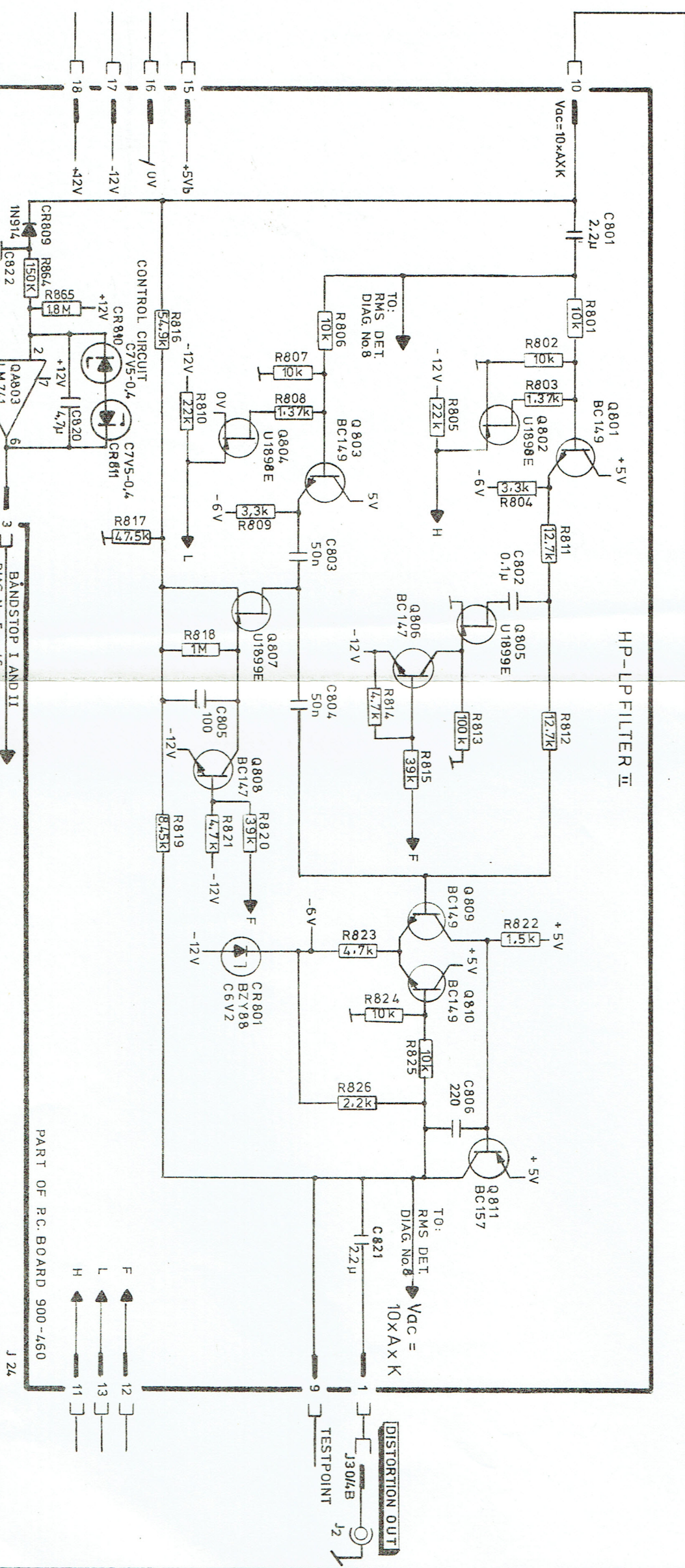
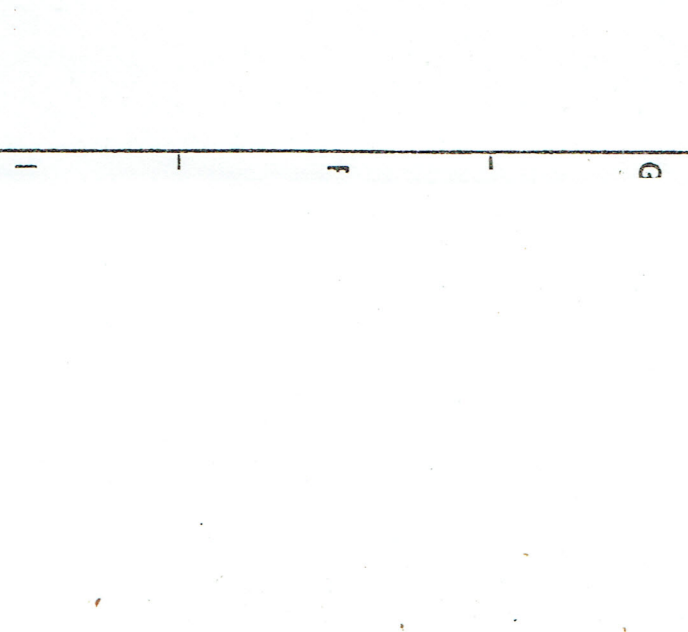
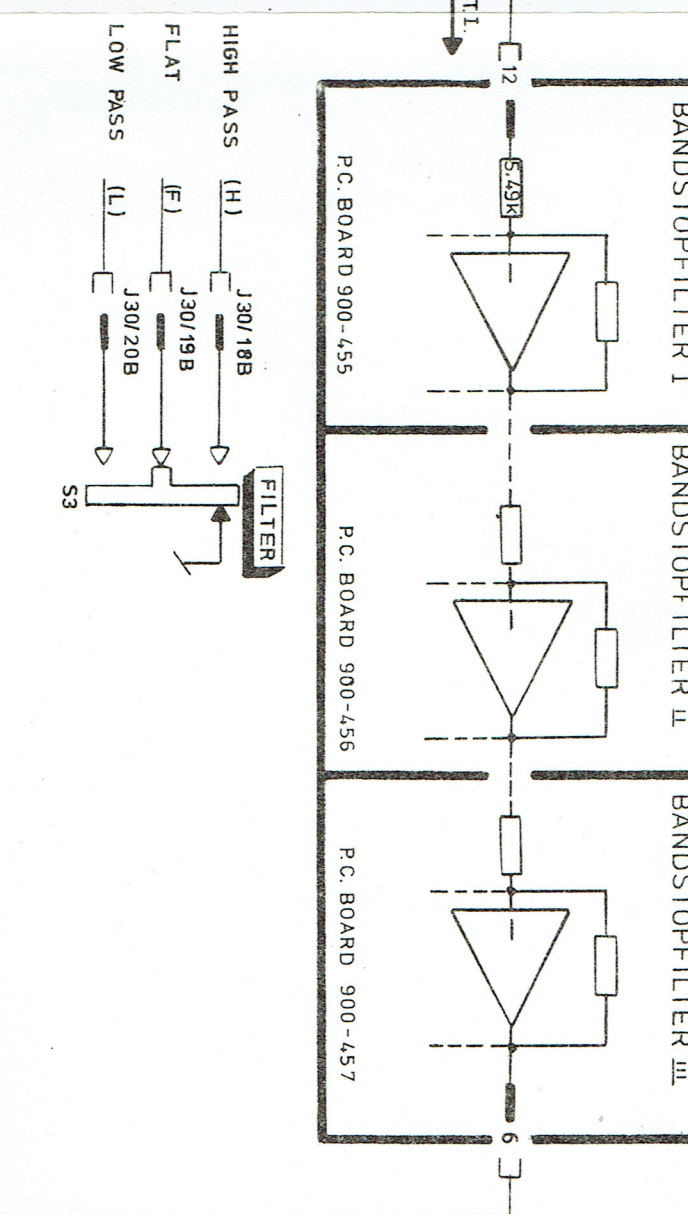
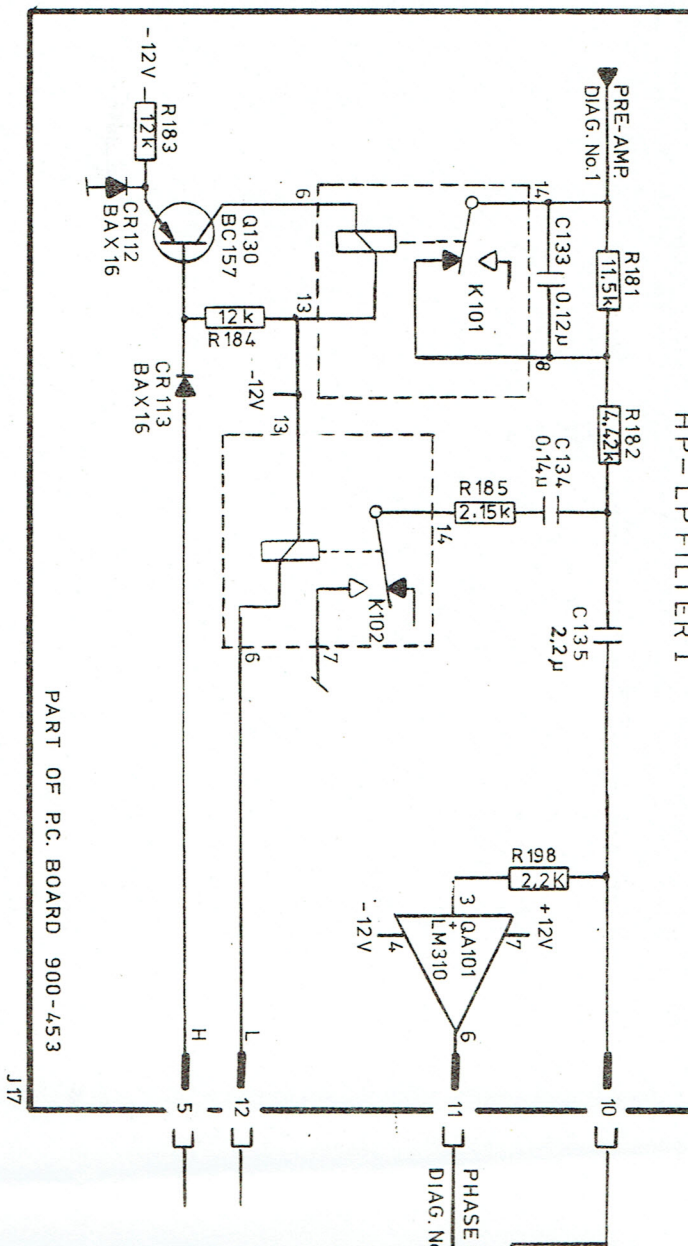




REVISIONS			
ISSUE	FROM NO.	DATE	DRAWN BY
1		31.1.75	EE
2	238384	10.6.75	OH

RADIOMETER A/S	
EMDRUPVEJ 72 DK 2400 COPENHAGEN NV DENMARK	
DRAWN BY	KJK
CHECKED BY	NO. 3
APPR. BY	NO. 3

BLOCK DIAGRAM II	
TYPE	BKF 100
FROM NO.	TO NO.
2146-A2	



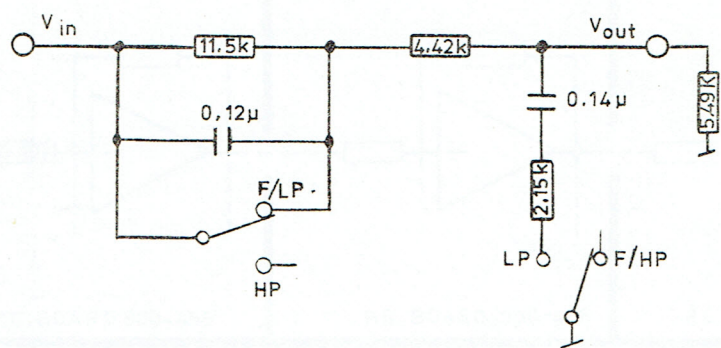
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ISSUE	FROM NO.	DATE	BY
1	20.2.87	22.2.73	OH
2	20.7.77	18.3.74	OH
3	23.8.84	11.6.75	OH

RADIOMETER A/S			
EMDRUPVEJ 72 DK 2400 COPENHAGEN NV DENMARK			
SCHEMATIC DIAGRAM No. 2			
PRE-AMPLIFIER RMS-DETECTOR TYPE BKF100			
FROM NO.			
DRAWN BY		KJK	
CHECKED BY		KJK	
APPR. BY		KJK	

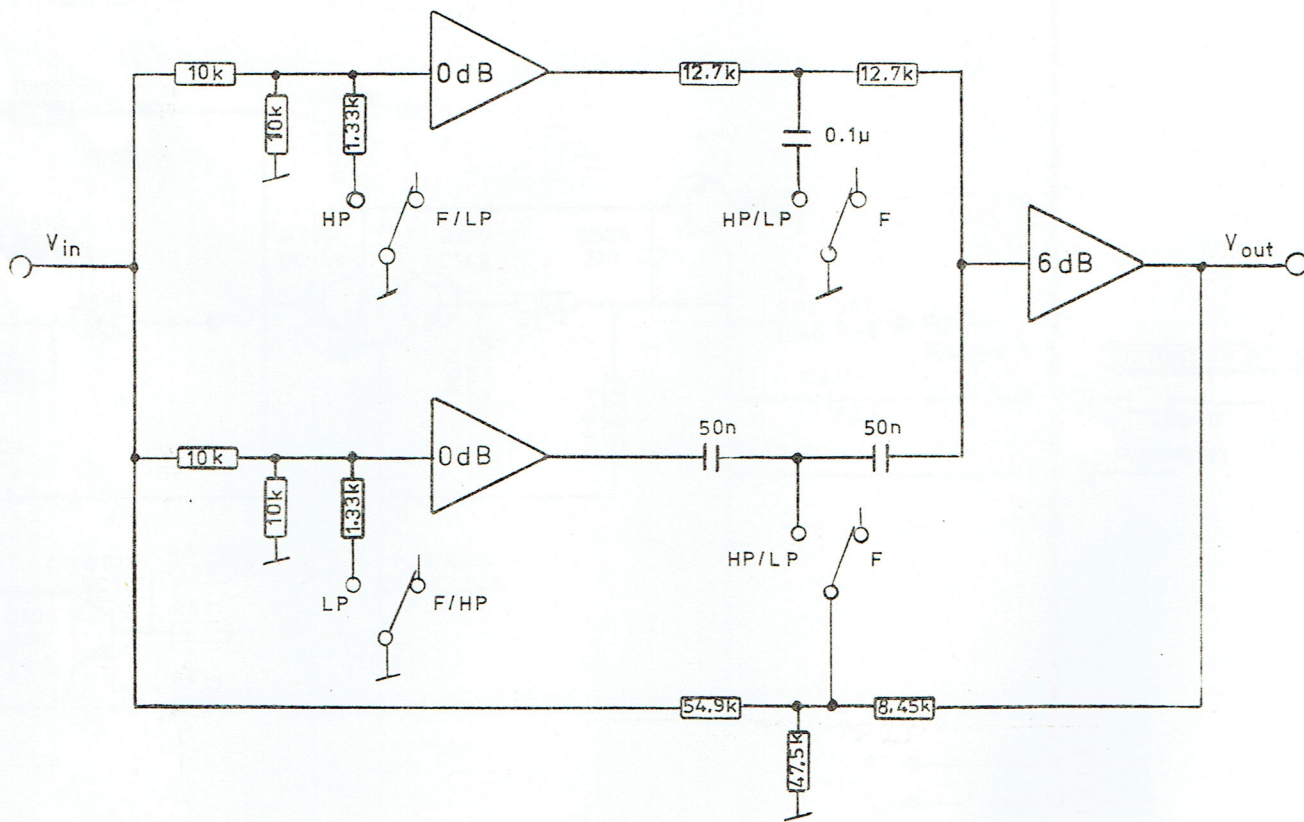
VALUES IN Ω OR pF IF NOT OTHERWISE STATED.
J30: diag. No. 15.

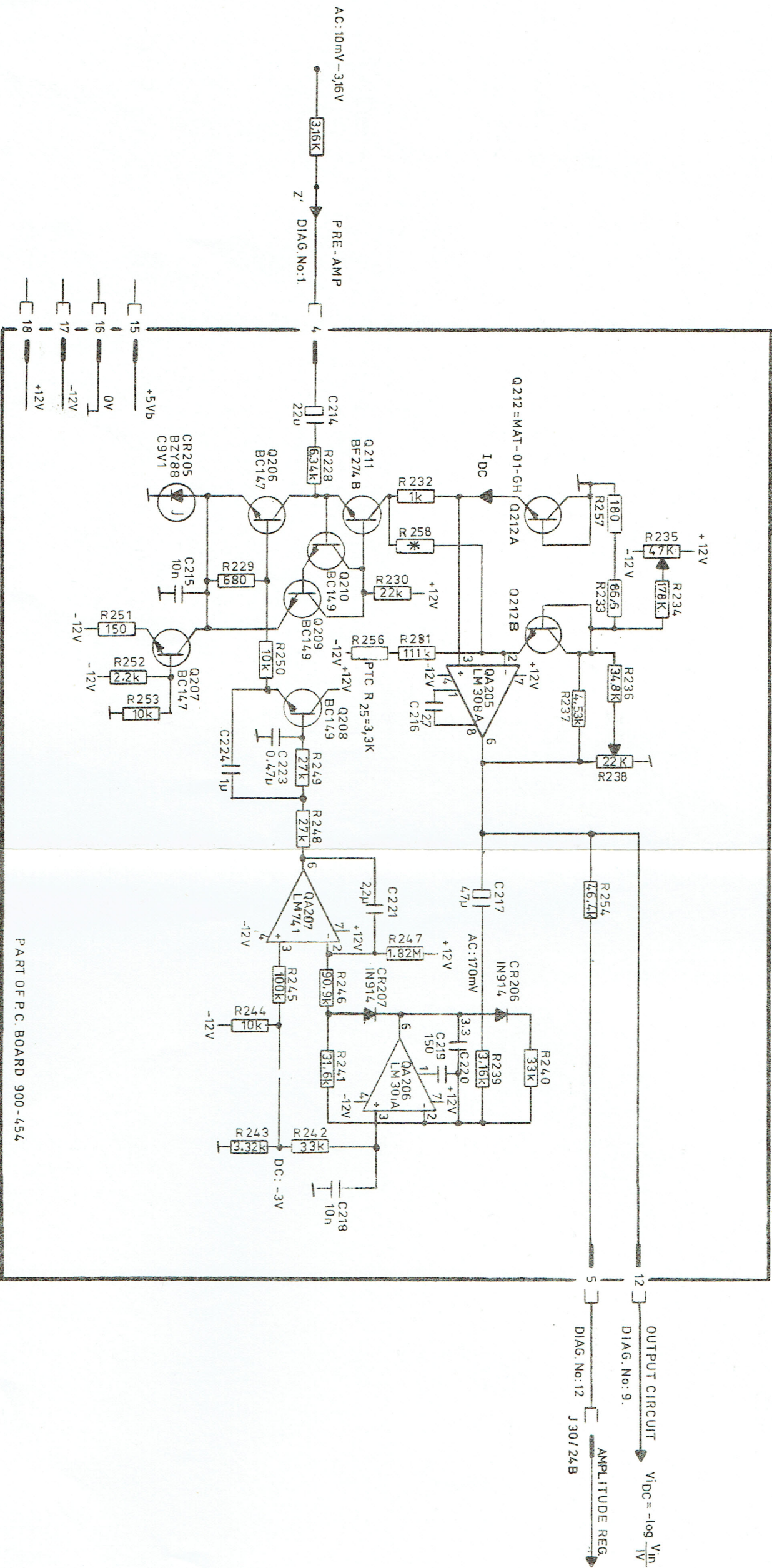
2147-A2

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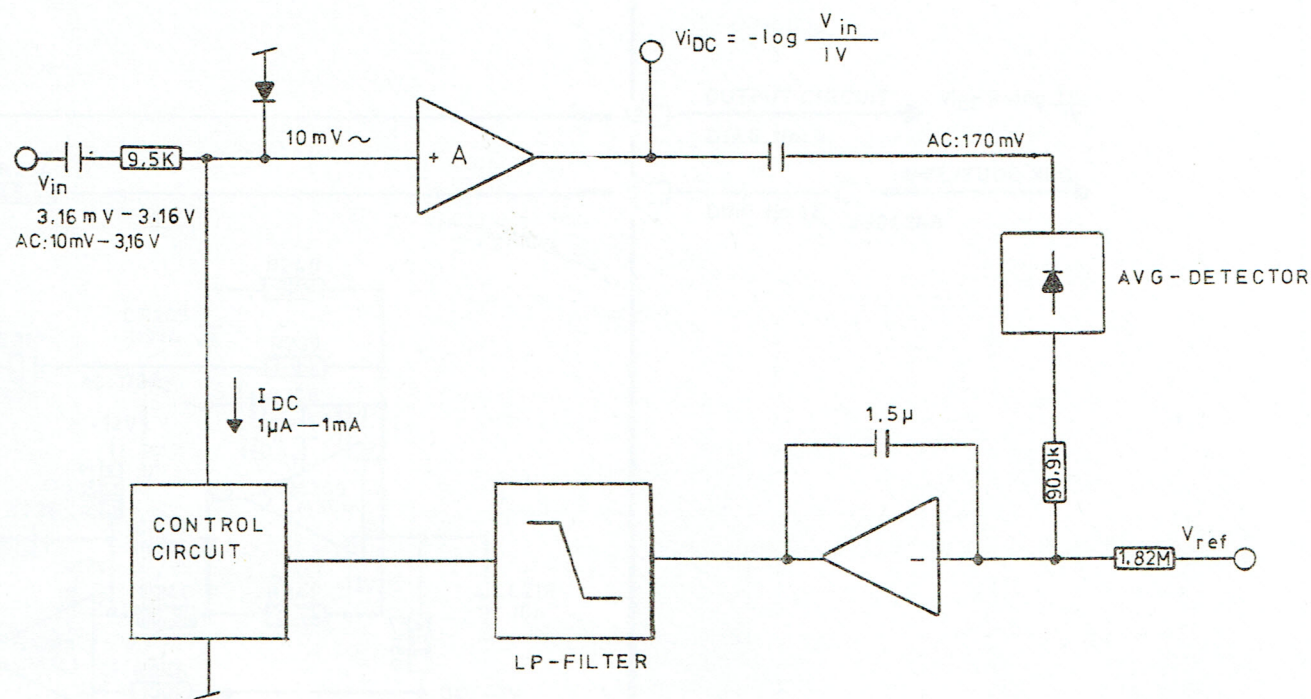


HP-LP II (BLOCKDIAGRAM)



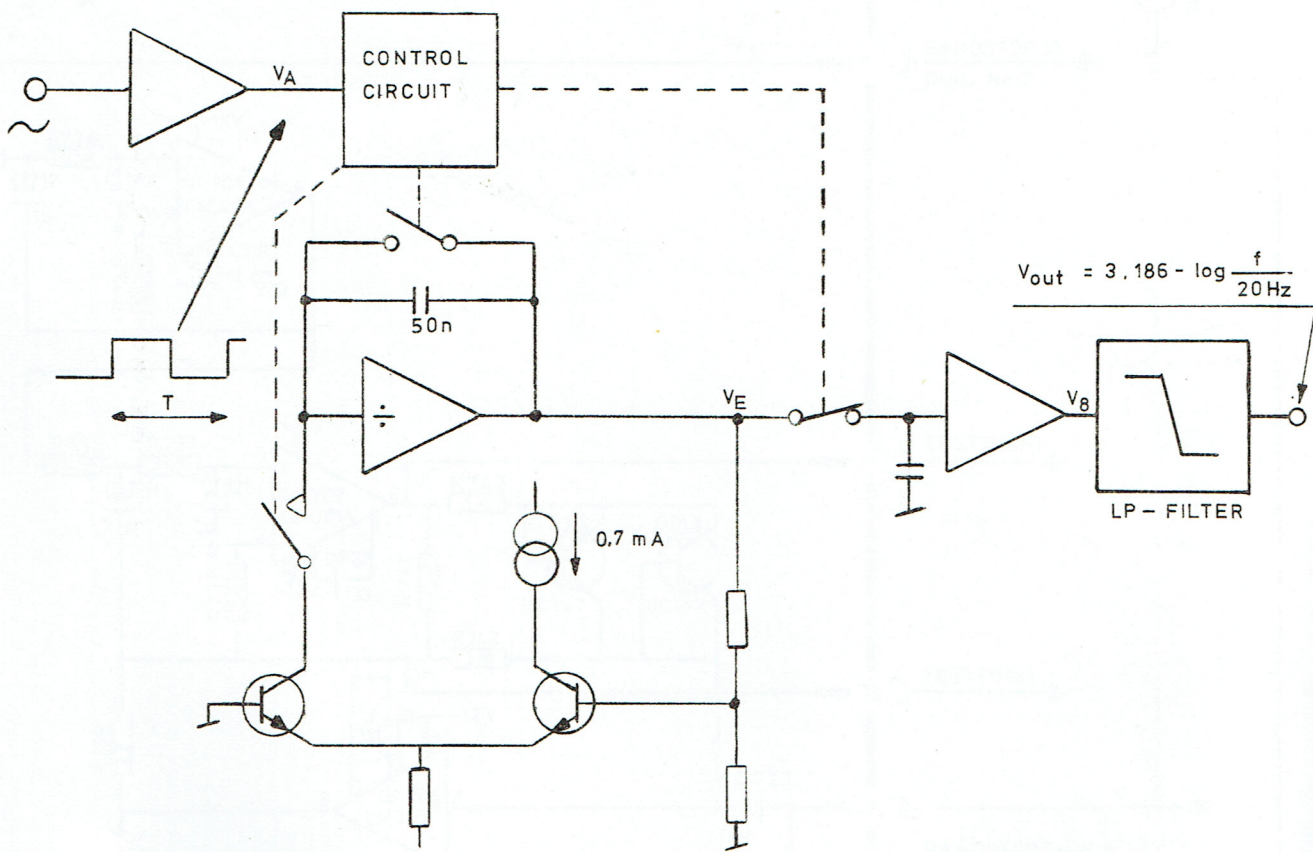


LOG. DETECTOR (BLOCK DIAGRAM)

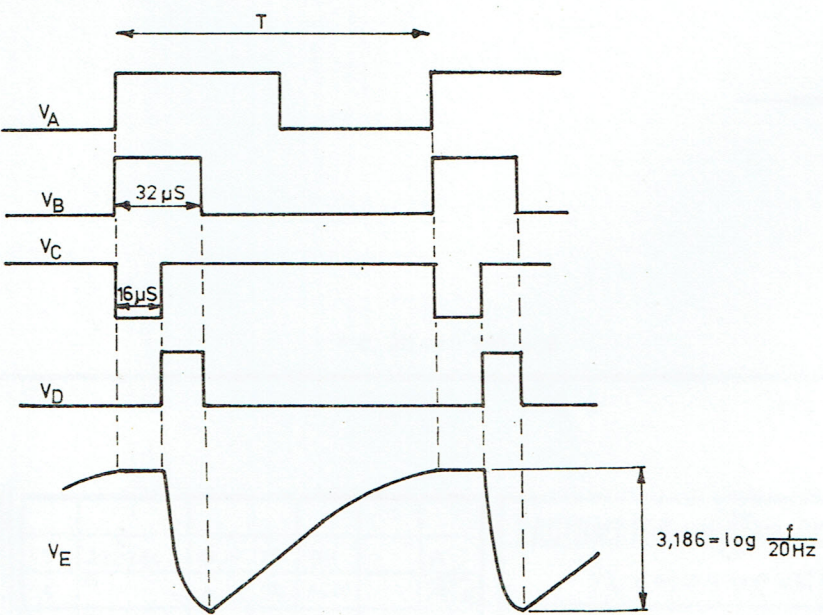


$V_{in} (AC)$	I_{DC}	V_{DC}
10 mV	3 μ A	2 V
100 mV	30 μ A	1 V
1 V	300 μ A	0 V
3.16 V	1 mA	-0.5 V

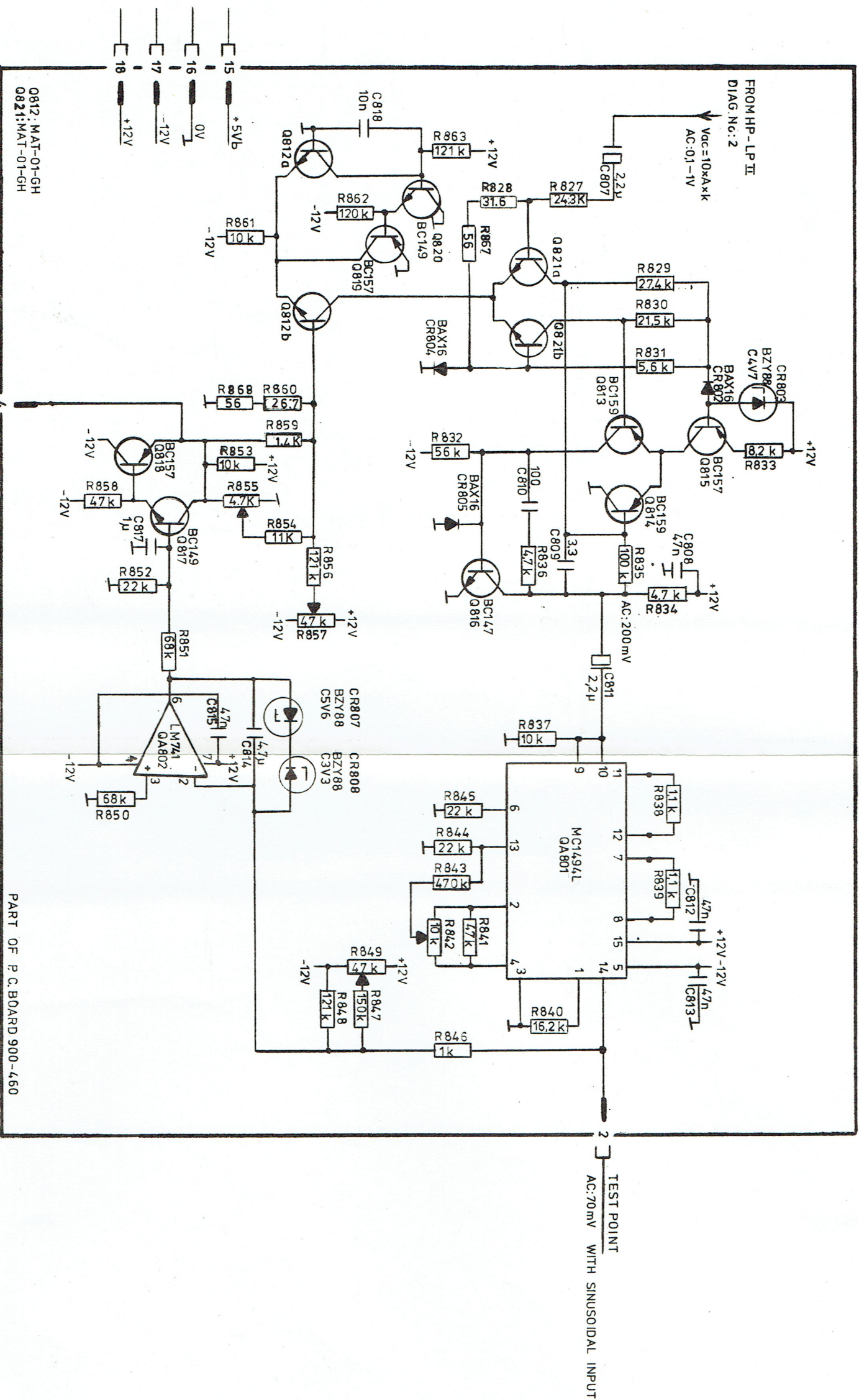
FREQ.METER (BLOCK-DIAGRAM)



$$V_{out} = 3.186 - \log \frac{f}{20\text{Hz}}$$



f_{in}	$V_7 - V_8$	V_{AC}
20Hz	3.186V	0
200Hz	2.186V	1V
2KHz	1.186V	2V
20KHz	0.186V	3V



J24

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Rt. Nr.	Fra. Fab. Nr.	Dato	Rt. af	Kont.	Norm.
6	238384	10. 6. 75	OH		
5	218078	26-2-75	BLØ		
4	204817	26. 8. 74	OH		
3	202462	20. 3. 74	OH		
2	202462	17. 8. 73	OH		
1	202487	22. 2. 73	OH		

RADIOMETER **COPENHAGEN**

72 EMDRUPVEJ NV

SCHEMATIC DIAGRAM No. 8.

RMS. DETECTOR

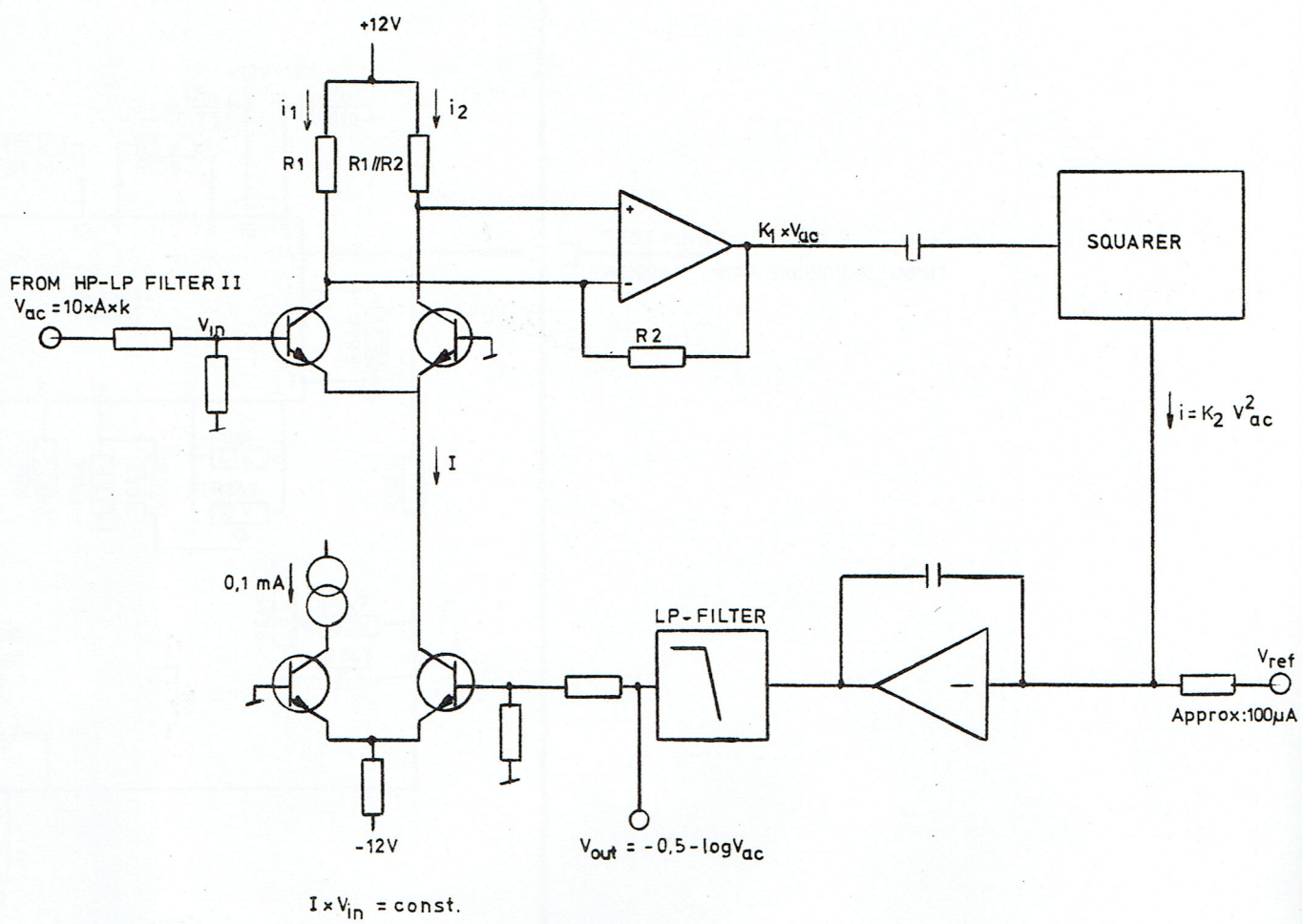
TYPE: BKF 10a.

Malssk. Teg. KJK 6-10-75

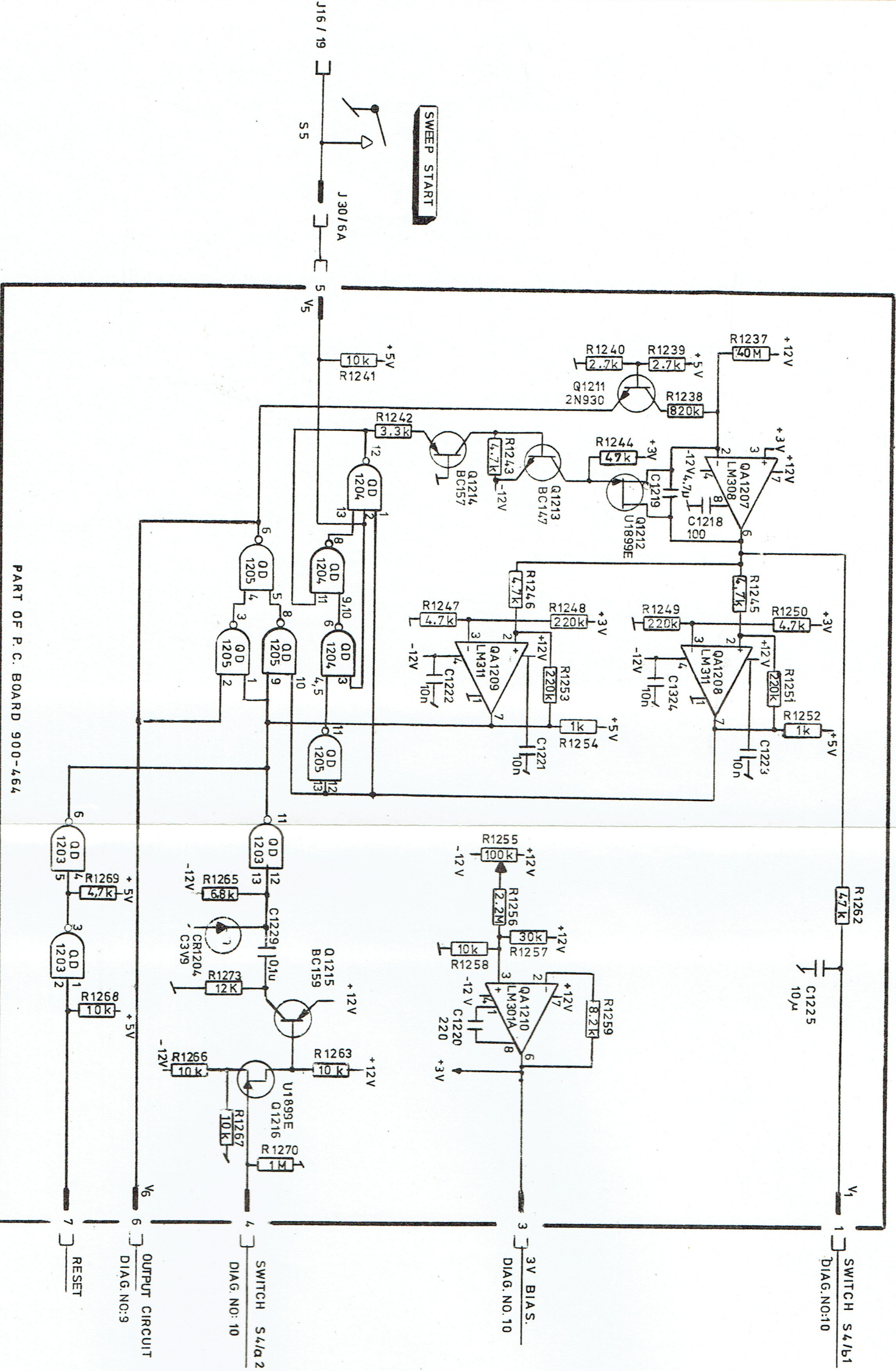
Kont. No. 19.12.72

2150-A2

RMS DETECTOR (BLOCK DIAGRAM)



V_{AC}	V_{OUT}
0.1V	+0.5V
0.316V	0V
1V	-0.5V

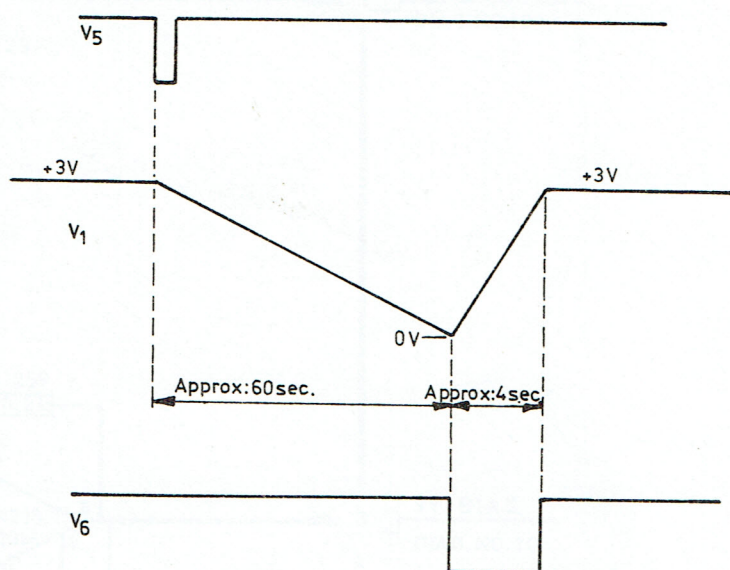


PART OF P. C. BOARD 900-464

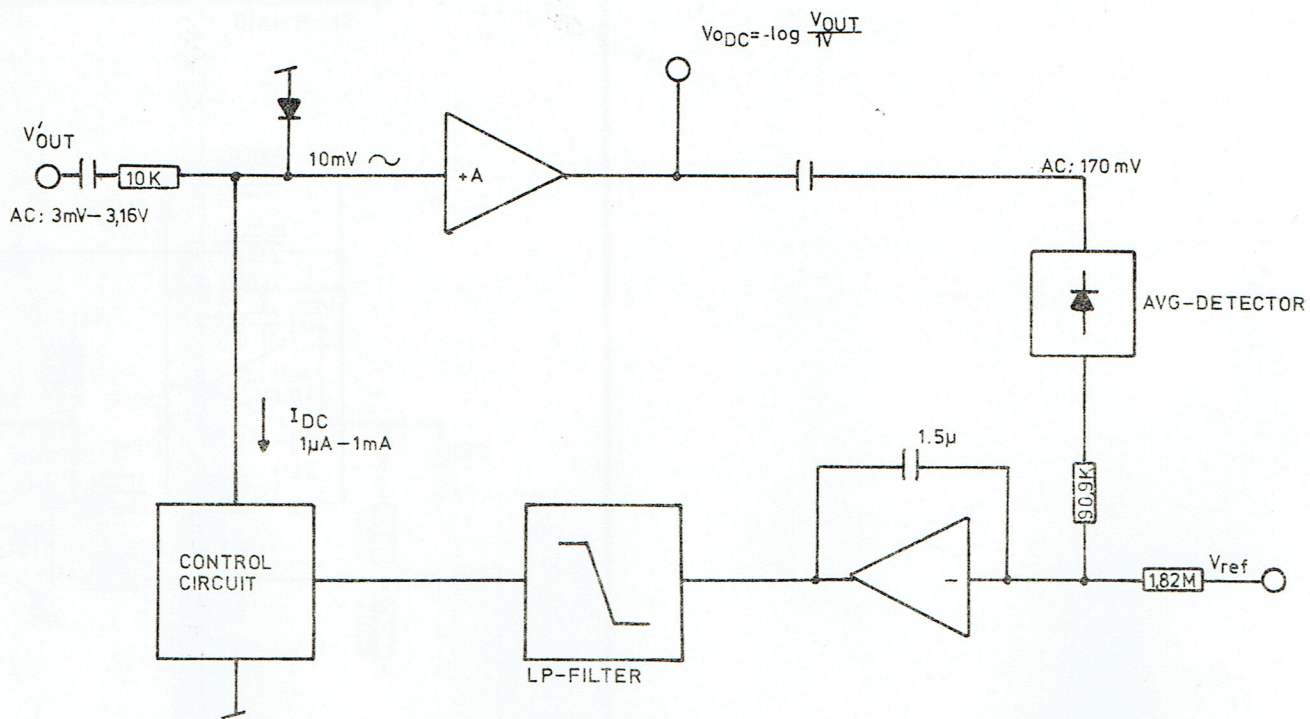
OD1203 : QUAD.2-IN POS.NAND GATE O.C.
OD1204 : TRIPLE 3-IN POS.NAND GATE.
OD1205 : QUAD.2-IN POS.NAND GATE.
VALUES IN Ω OR pF IF NOT OTHERWISE STATED.
J16 AND J30: DIAG.NO. 15

RADIOMETER				
COP. 1111				
5	238364	10.6.75	OH	K7
4	210683	1.11.74	BL Ø	
3	204817	4.9.74	OH	
2	204817	26.8.74	OH	A/H
1	202487	22.2.73	OH	KØ5
Rt.Nr.	Fra Fdb. Nr.	Dato	Rt. af	Norm.

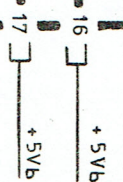
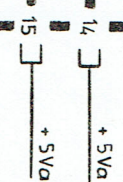
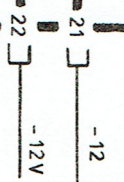
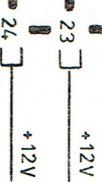
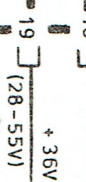
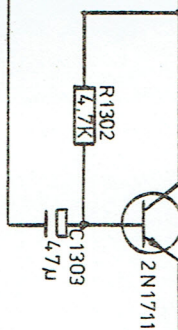
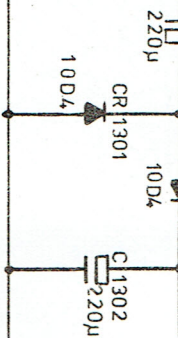
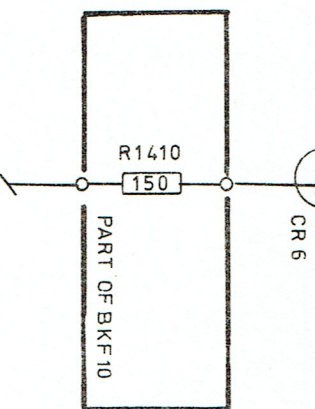
RADIOMETER COPENHAGEN				
72 EMDRUPVEJ NV				
SCHEMATIC DIAGRAM No:11.				
SAWTOOTH GENERATOR				
TYPE: BKF10.Q.				
2151-A2				
Malesik Tegh. KJK 6-10-71				
Norm. No: 19.12.72				



LOG. DETECTOR (BLOCK DIAGRAM)

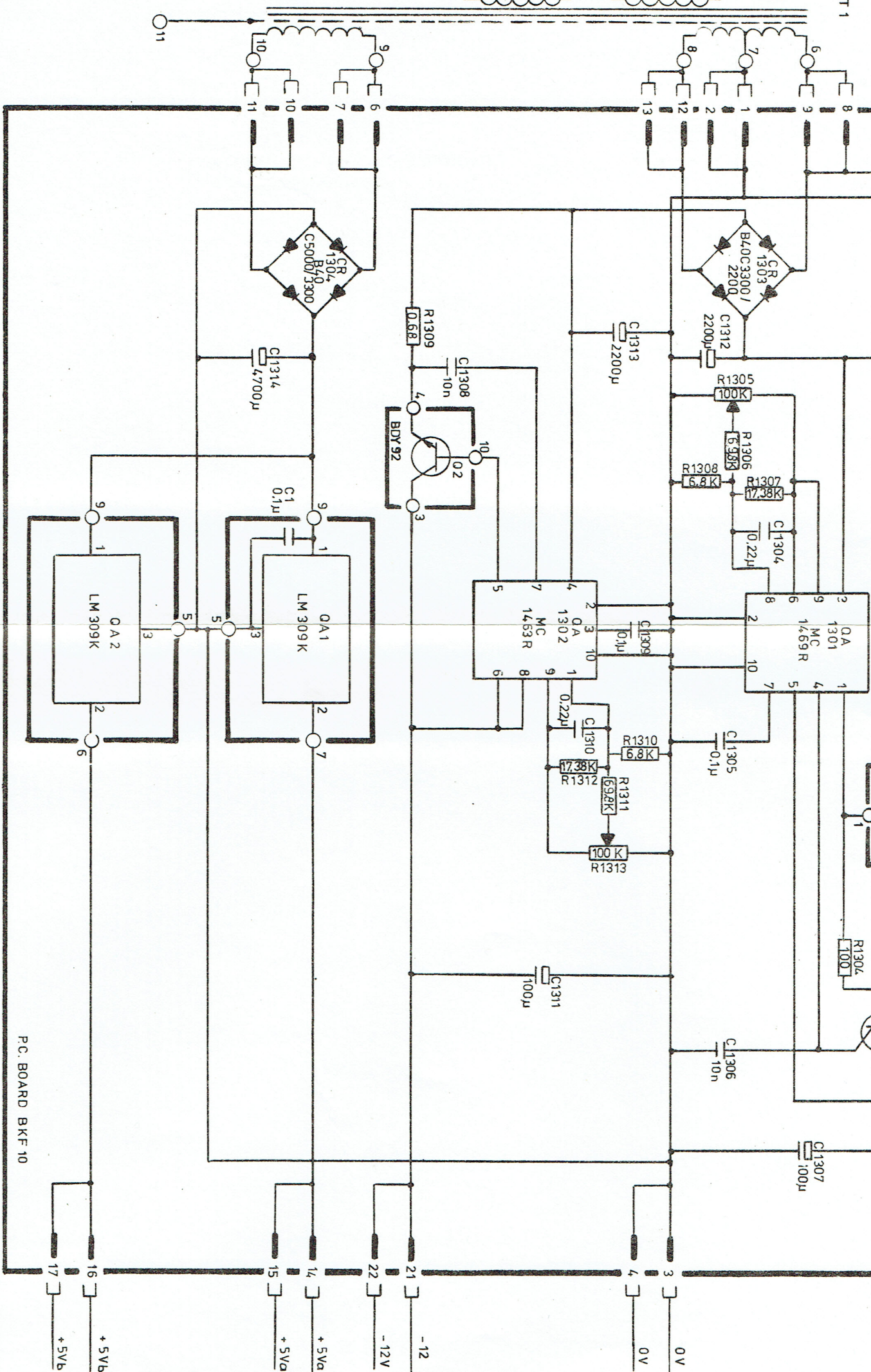


V_{OUT}	V'_{OUT}	V_{0DC}	I_{DC}
1 mV	3 mV	3 V	1 μ A
10 mV	30 μ V	2 V	10 μ A
100 mV	300 mV	1 V	0,1 mA
1 V	3 V	0 V	1 mA

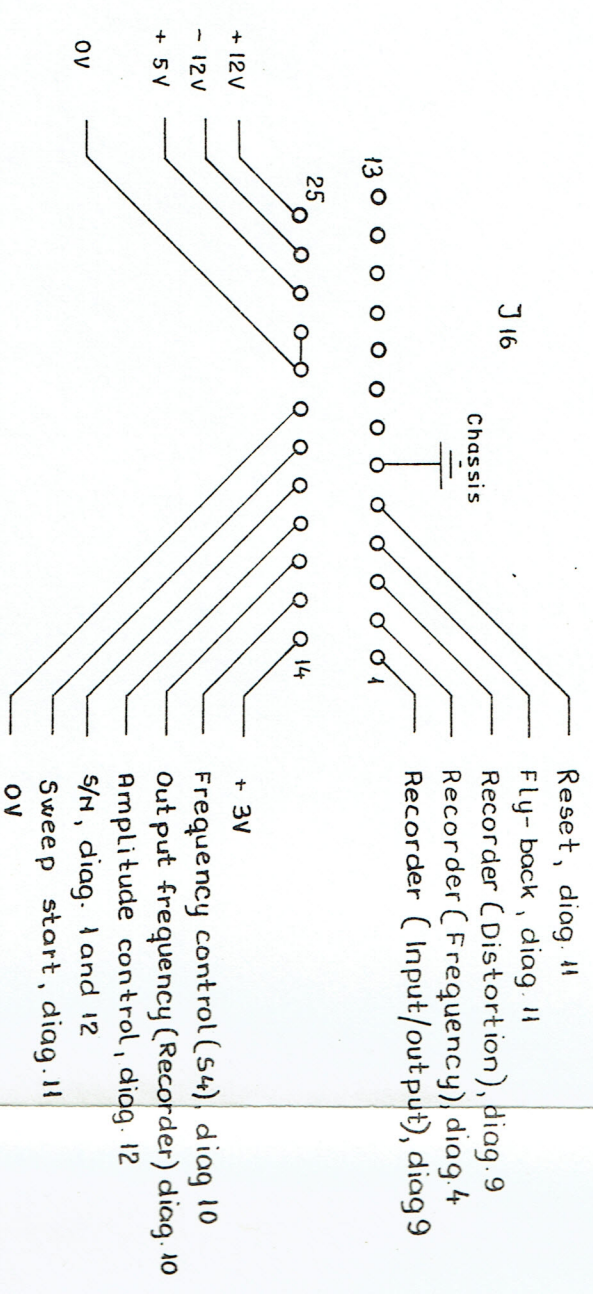


P.C. BOARD BKF 10

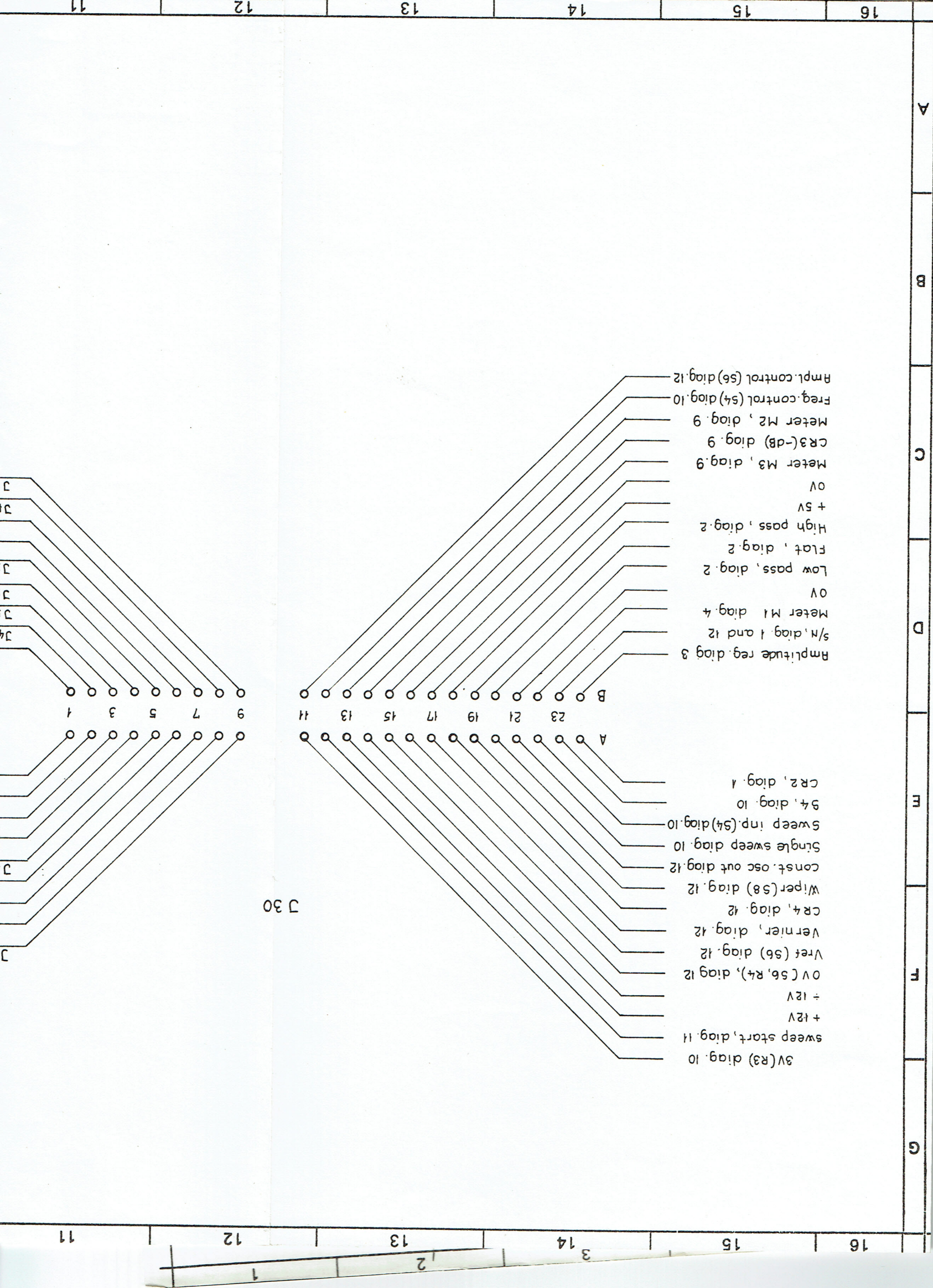
J 29

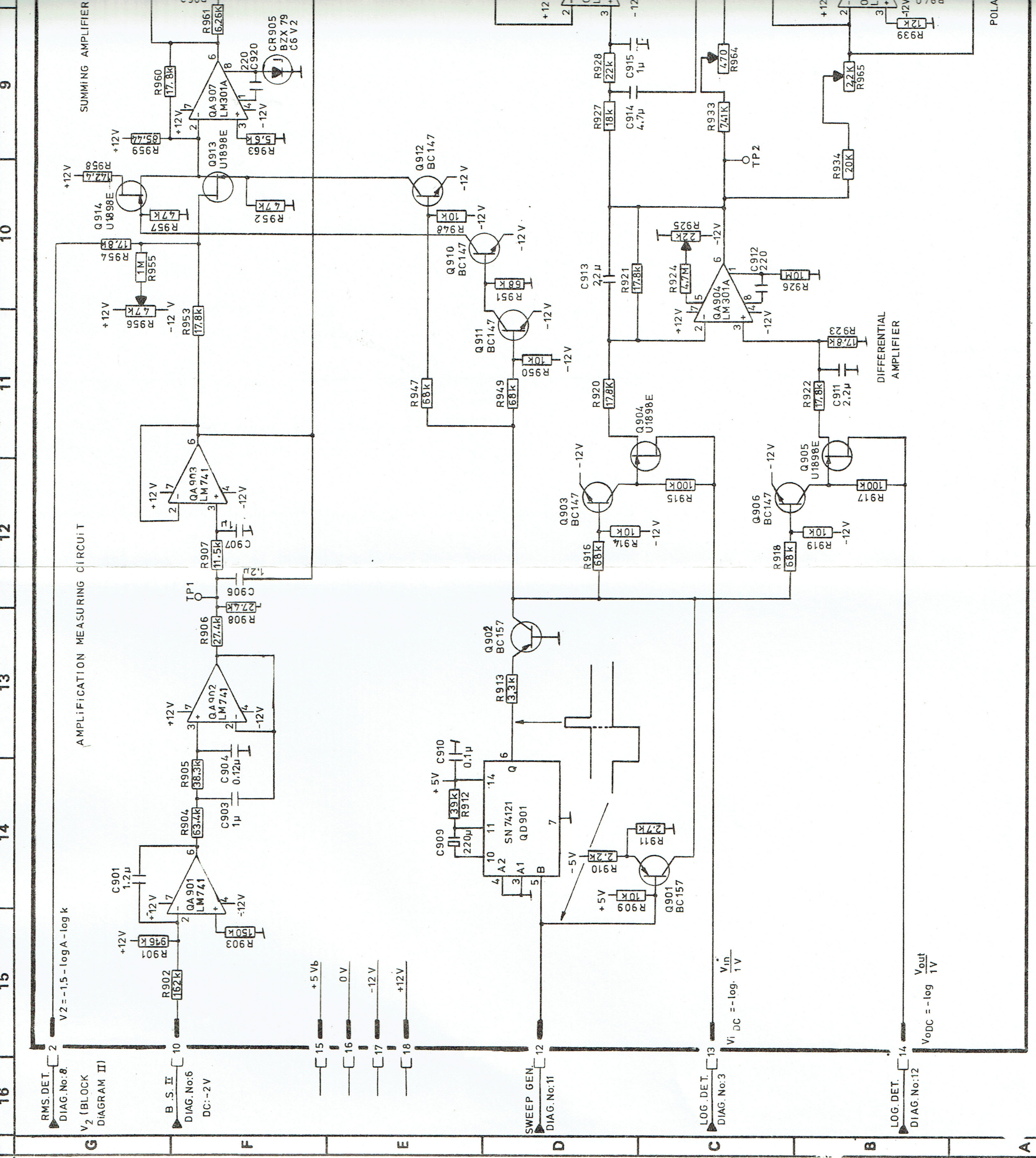


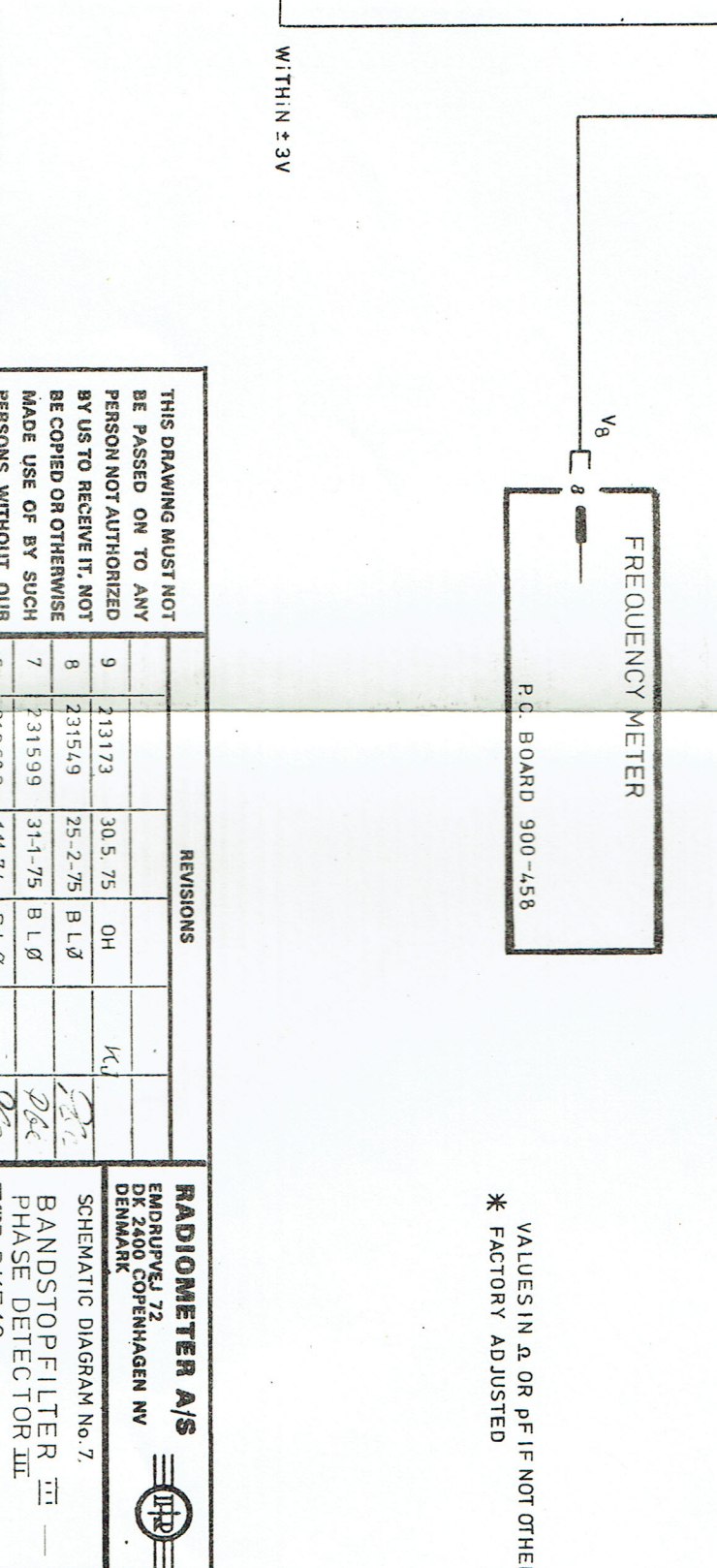
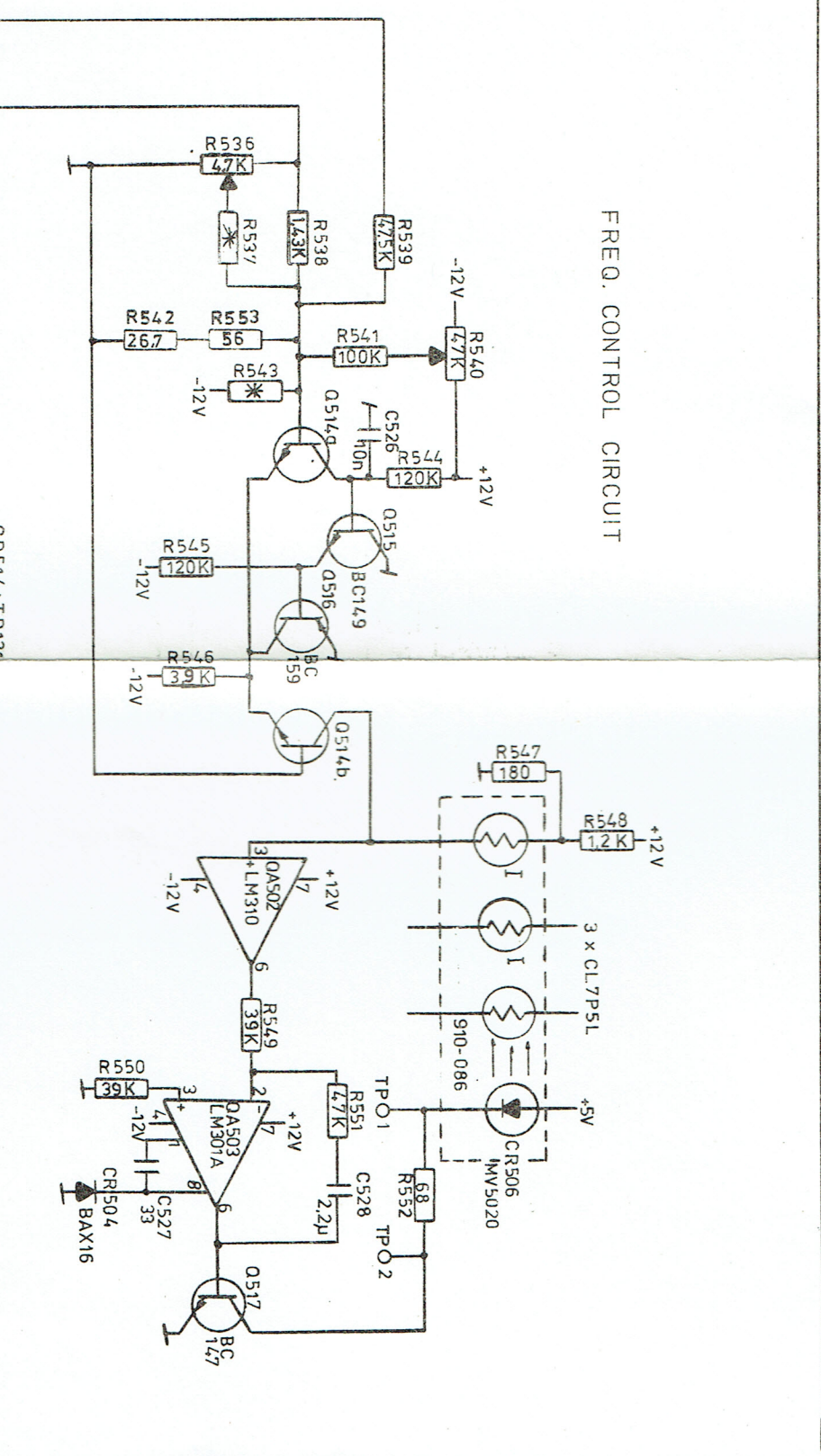
- 3V Bias , diag. 11
- + 5V
- Fly- back , diag. 11
- Sweep start, diag. 11
- Output frequency (recorder), diag. 10
- + 12V
- 12V
- 0V
- 5/N , diag. 1 and 12
- Reset , diag. 11
- Recorder (Distortion) diag. 9
- Recorder (Input / out put ratio) diag. 9
- Distortion out, diag. 2
- Recorder (Input frequency) diag. 4
- 0V
- 0V
- Freq. control (54) diag. 10
- Ampl. control (56) diag. 12



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REVISIONS			
ISSUE	FROM NO.	DATE	DRAWN BY
1	20 2487	22.2.73	OH
2	20 4817	27.8.74	OH
			APPR. BY
			AEH
RADIOMETER A/S			
EMDRUPVEJ 72			
DK 2400 COPENHAGEN NV			
DENMARK			
SCHEMATIC DIAGRAM No. 15.			
WIRING DIAGRAM.			
TYPE BKF 10			
FROM NO.			
TO NO.			
DRAWN BY			
AEH			
20.12.72			
CHECKED BY			
APPR. BY			
NØB			
20.12.72			
1519-A1			





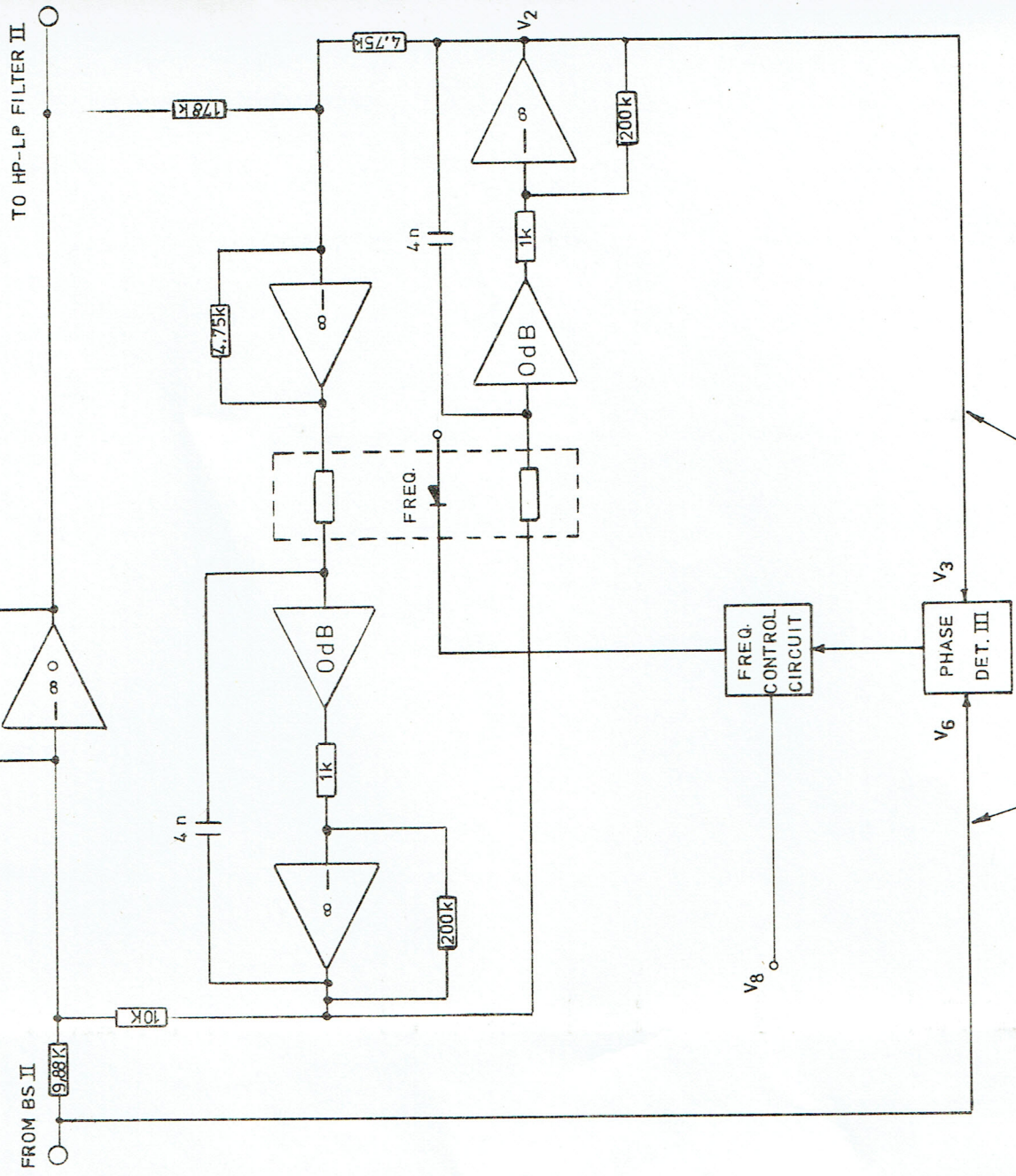


P.C. BOARD 900-458

* FACTORY ADJUSTED

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REVISIONS			
ISSUE	FROM NO.	DATE	DRAWN BY
9	213173	30.5.75	OH
8	231549	25-2-75	B L Ø
7	231599	31-1-75	B L Ø
6	210683	11.1.74	B L Ø
			14.7
RADIOMETER A/S EMDRUPVEJ 72 DK 2400 COPENHAGEN NV DENMARK			
			
SCHEMATIC DIAGRAM No. 7.			
BANDSTOPFILTER III PHASE DETECTOR III TYPE BKF 10-A			
FROM NO. TO NO.			
DRAWN BY		KJK	
CHECKED BY			
APPR. BY		NOG/19.12.72	
1435-A1			

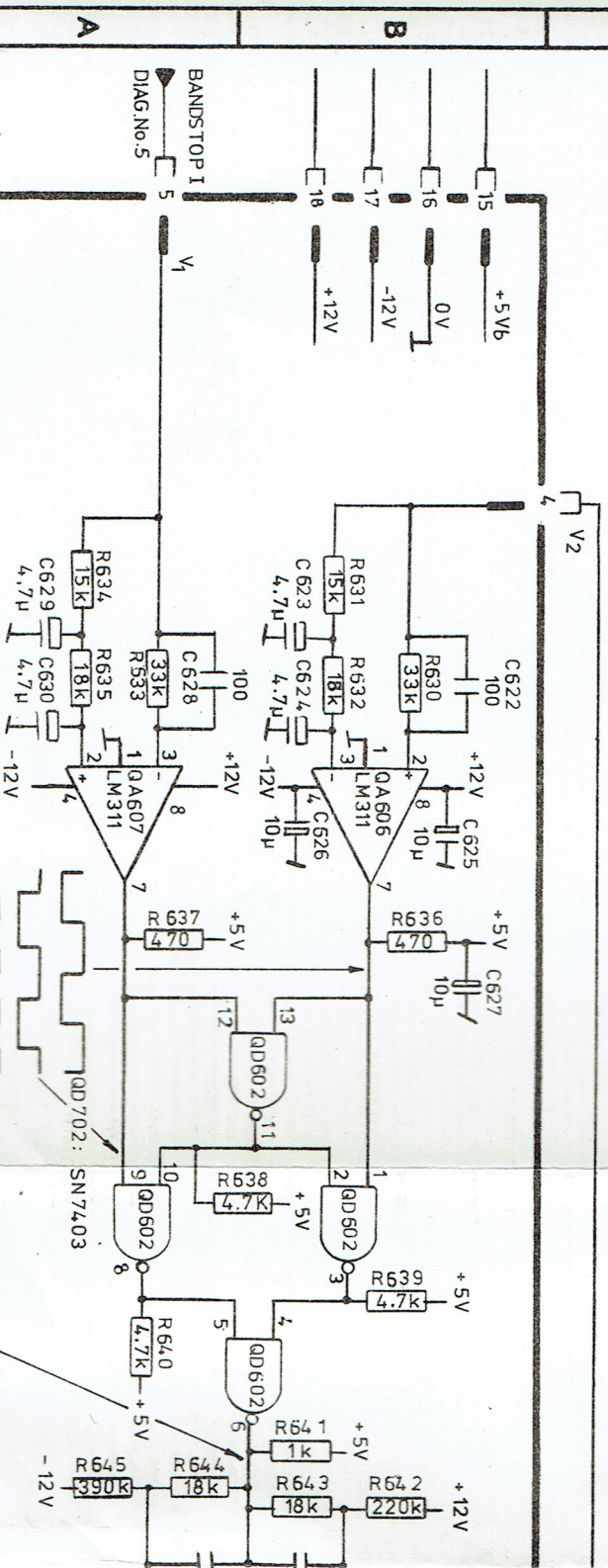
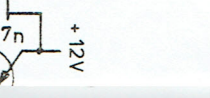
BANDSTOP FILTER III



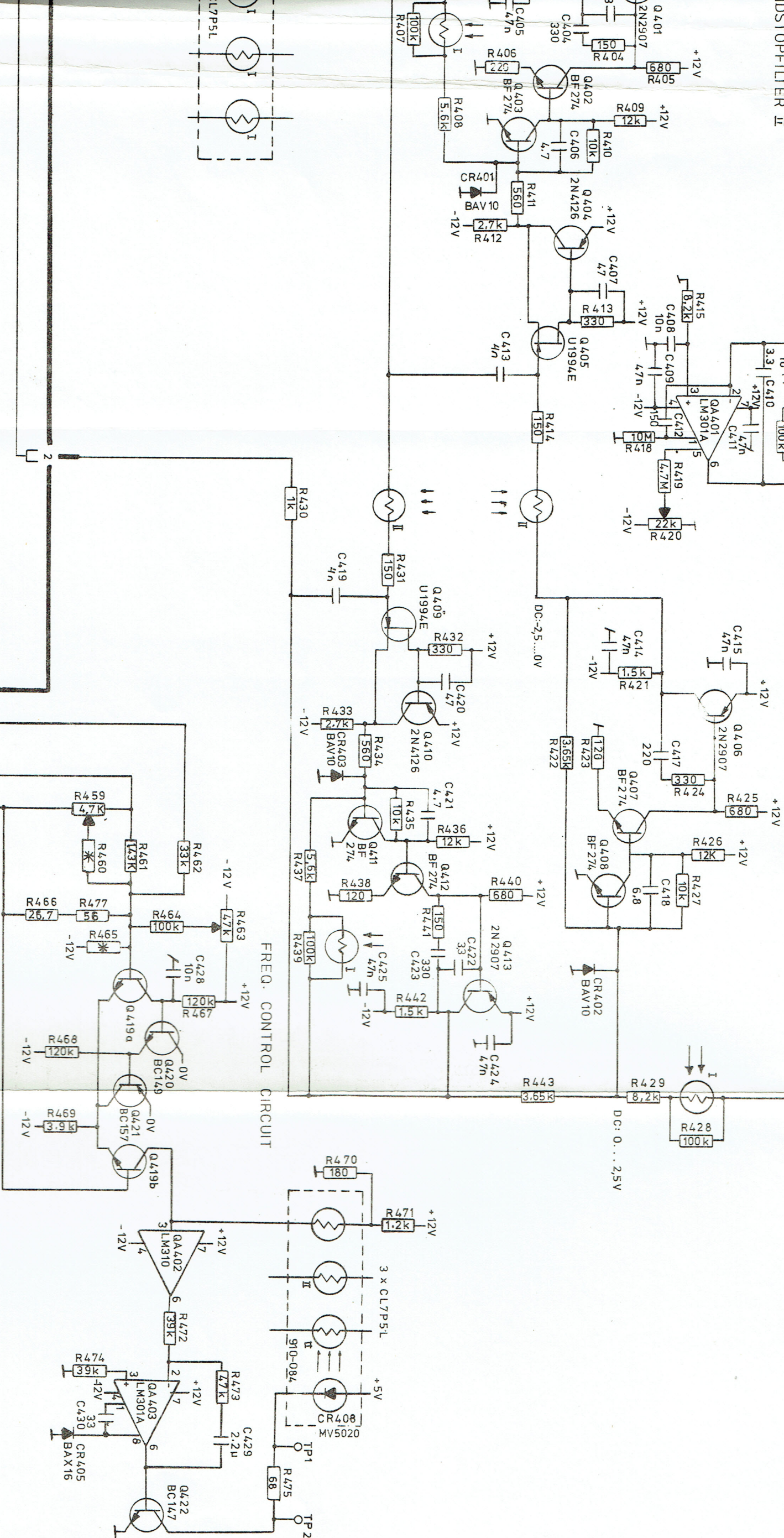
f	V_8
20Hz	3,186 V
200Hz	2,186 V
2KHz	1,186 V
20KHz	0,186 V



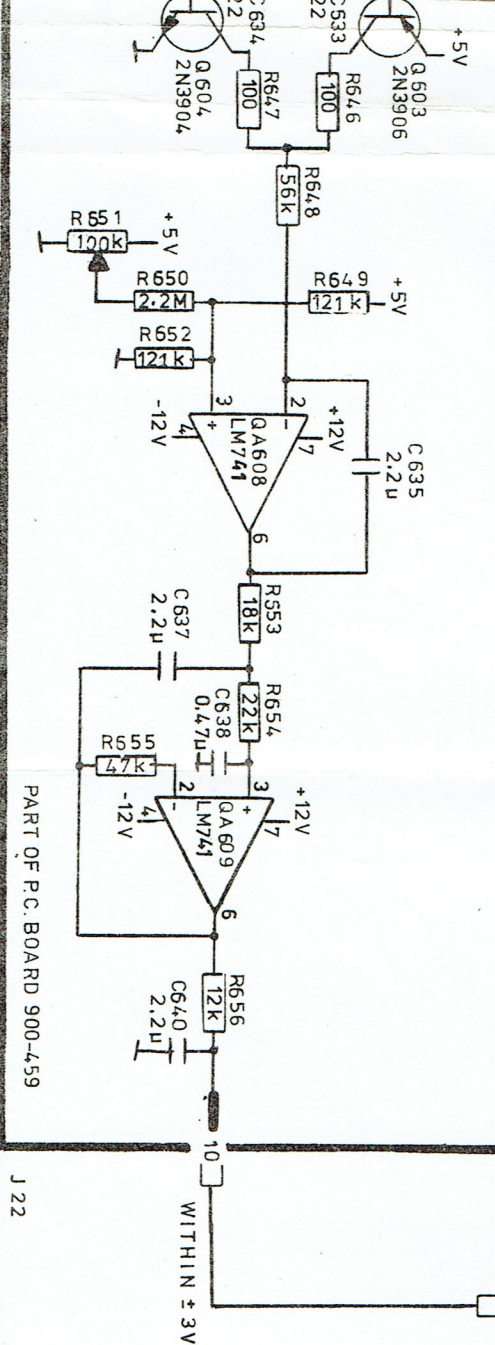
DC:-2,5...0V



F	V ₇
20 Hz	3,186 V
200Hz	2,186 V
2KHz	1,186 V
20KHz	0,186 V



PHASE DETECTOR II.



Q419: TD121

P.C. BOARD 900-456

J 20

FREQ. METER

P.C. BOARD 900-458

VALUES IN Ω OR pF IF NOT OTHERWISE STATED
* FACTORY ADJUSTED

REVISIONS

REV.	DATE	BY	CHKD.	APPR.
1	21.06.83	B.L.G.		
2	31.11.74	B.L.G.		
3	25.2.75	B.L.G.		
4	23.15.49	B.L.G.		
5	21.06.83	B.L.G.		
6	30.5.75	B.L.G.		
7	23.15.49	B.L.G.		
8	21.06.83	B.L.G.		
9	21.06.83	B.L.G.		

RADIOMETER A/S

EMDRUPVEJ 72
DK-2400 COPENHAGEN NV



DRAWN BY KJK
CHECKED BY WOS
19/12/72

SCHEMATIC DIAGRAM No. 6.
BANDSTOP FILTER II
PHASE DETECTOR II
TYPE BKF 10.0.

1434-A1

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PART OF P.C. BOARD 900-459

J 22

6

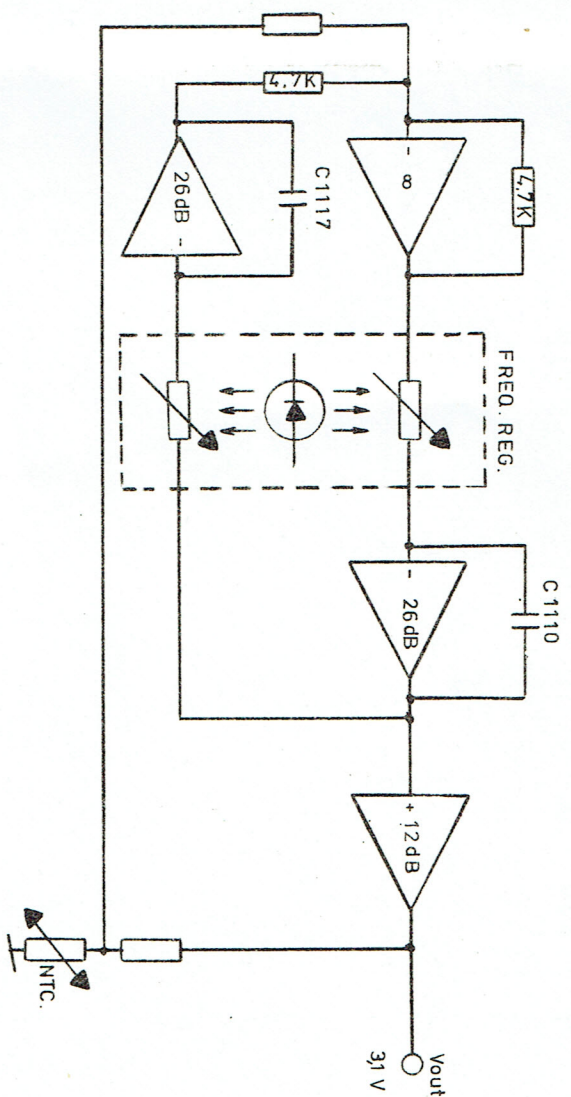
5

4

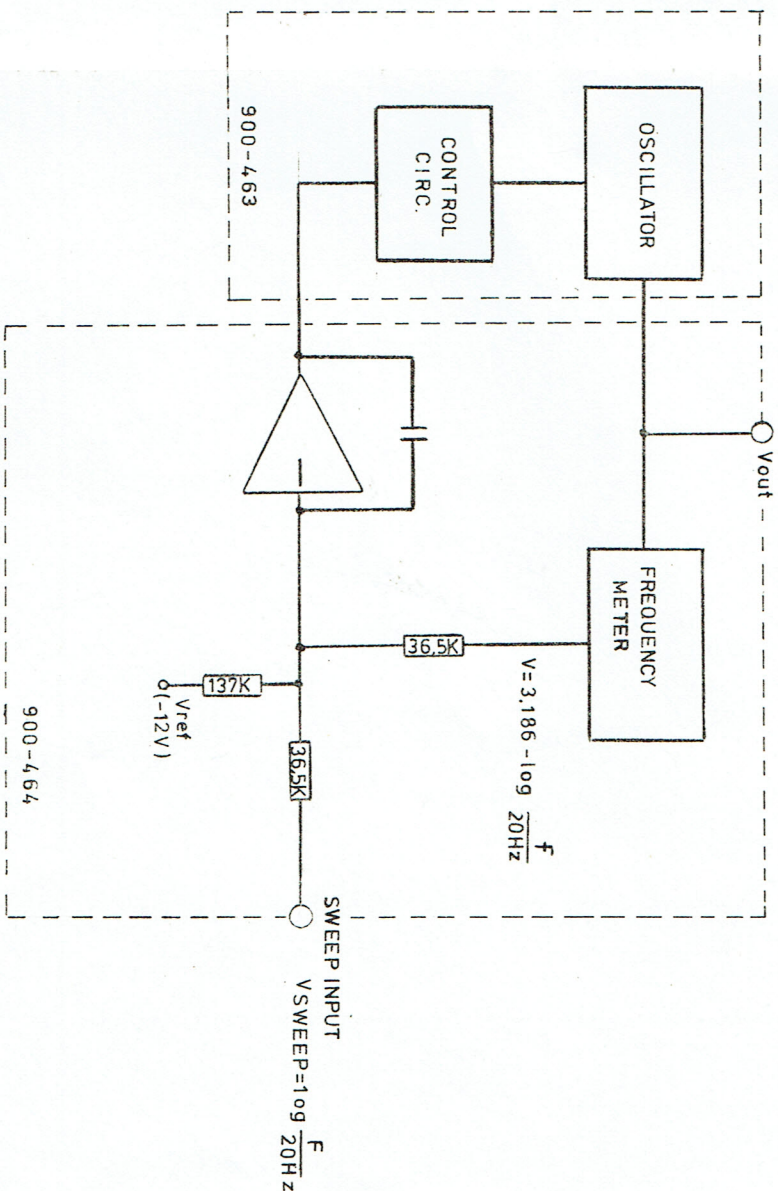
3

2

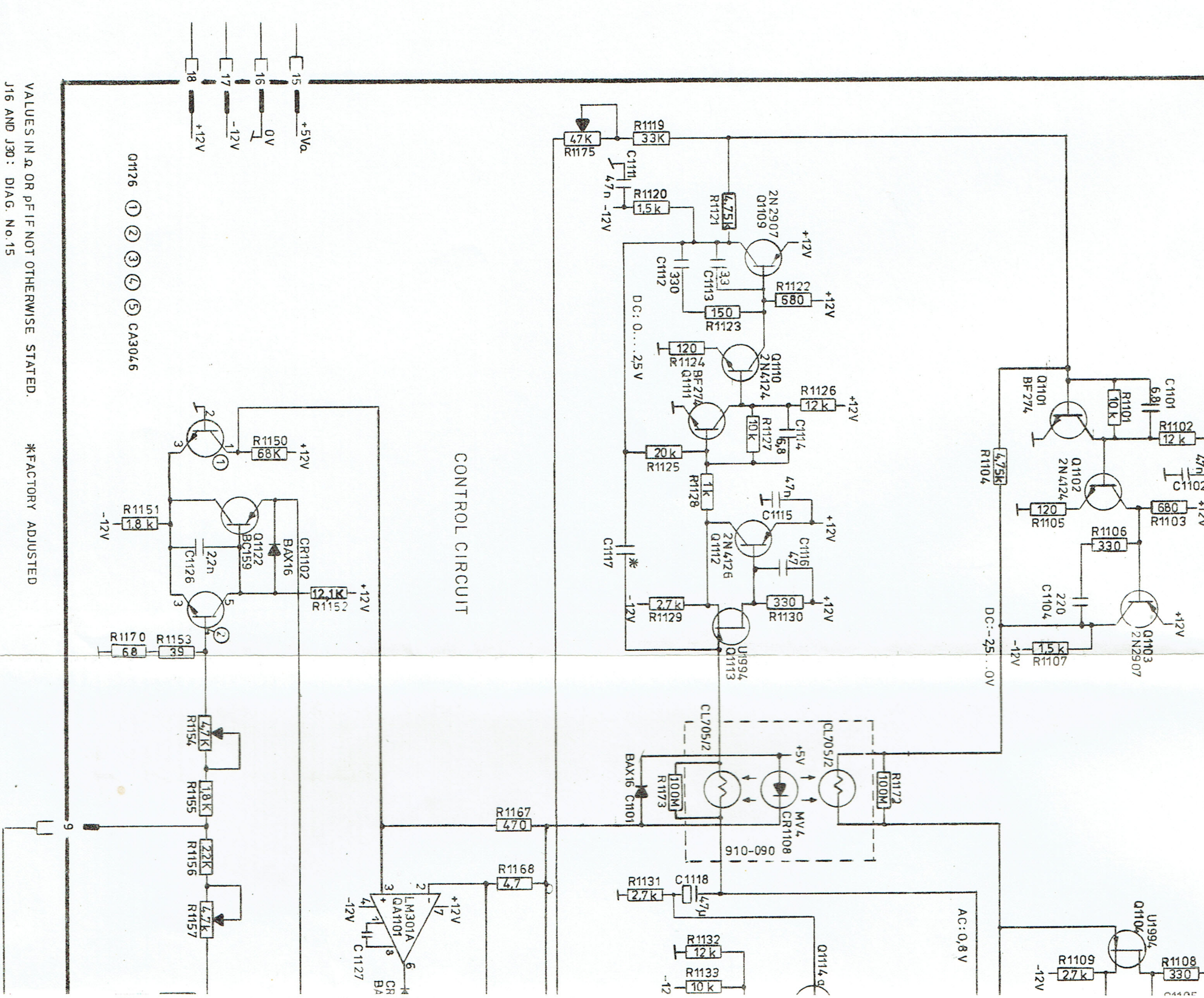
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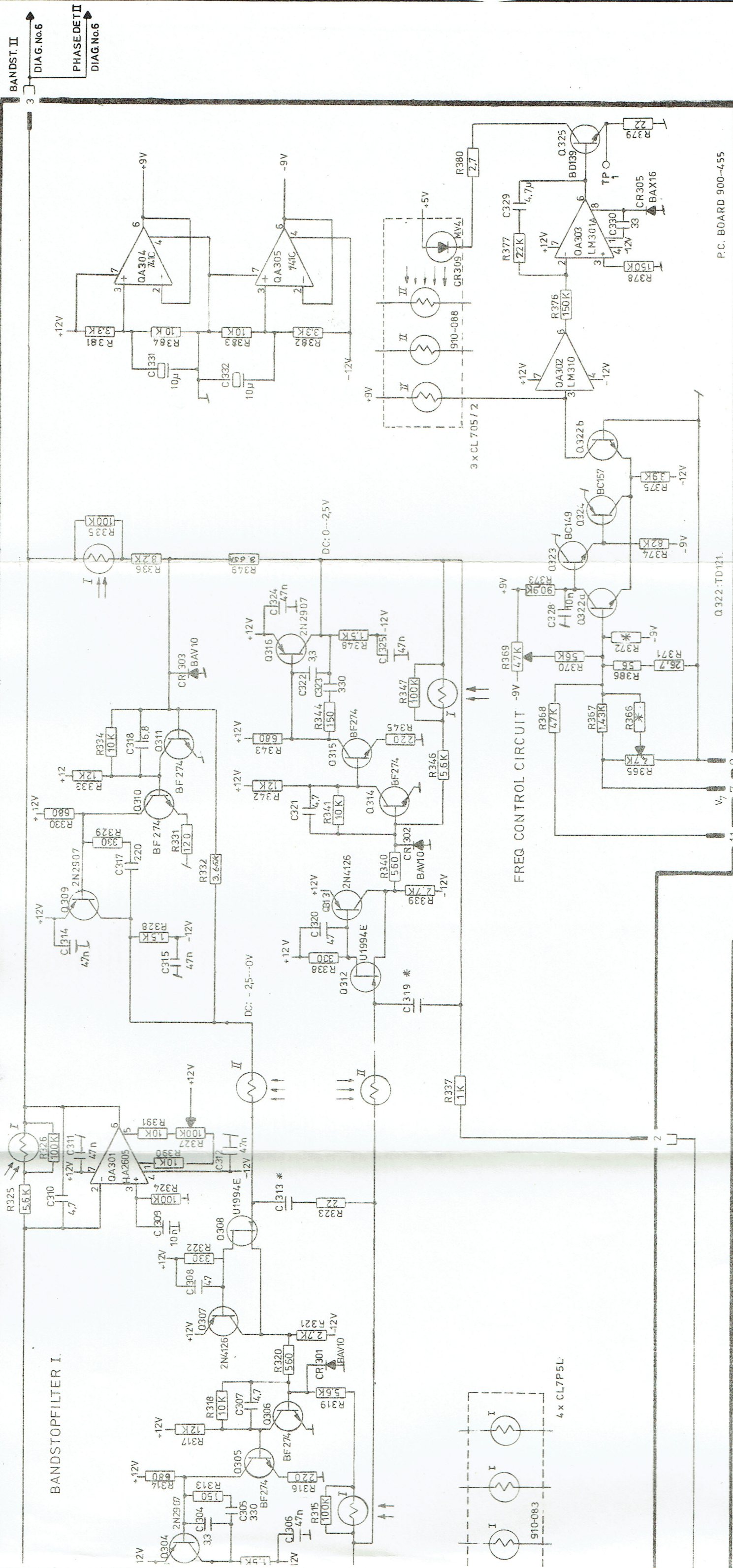


FREQUENCY REGULATION (BLOCK DIAGRAM)

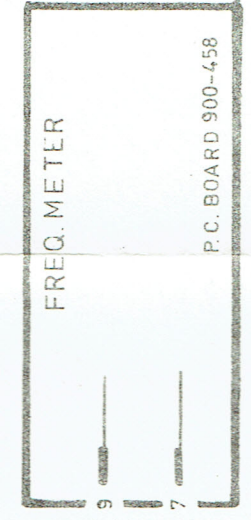


A B C D E F G



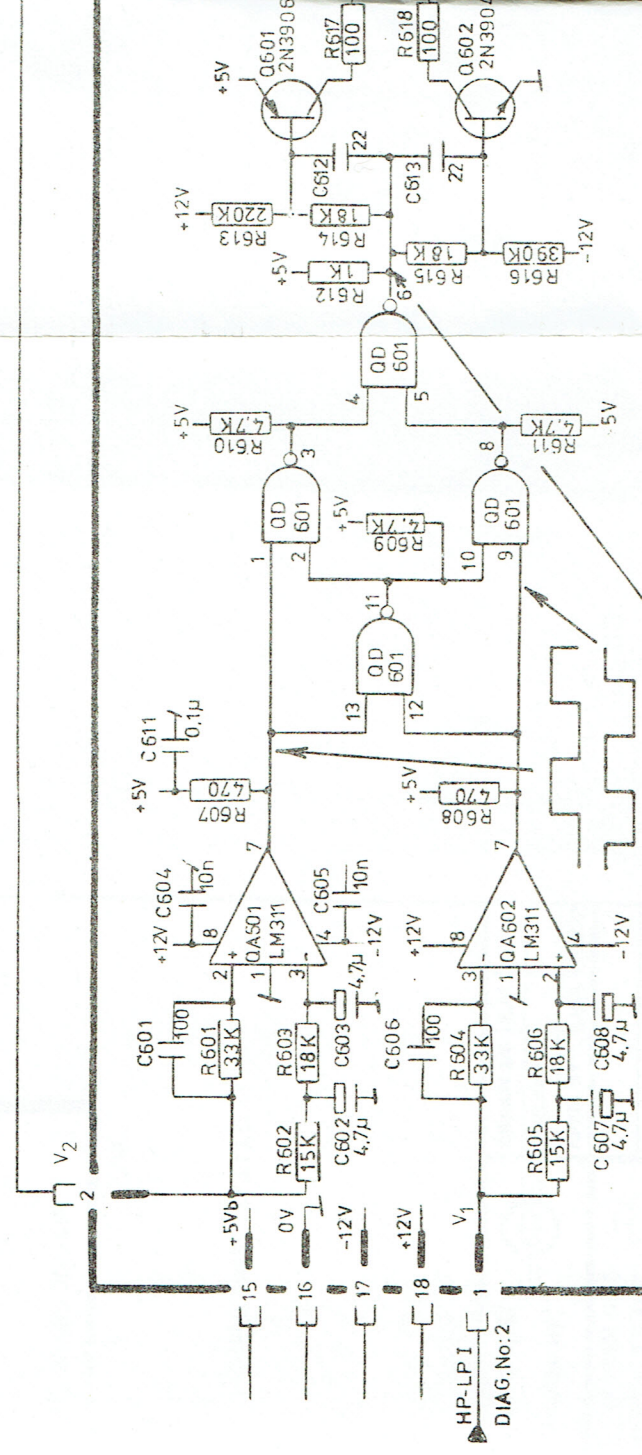
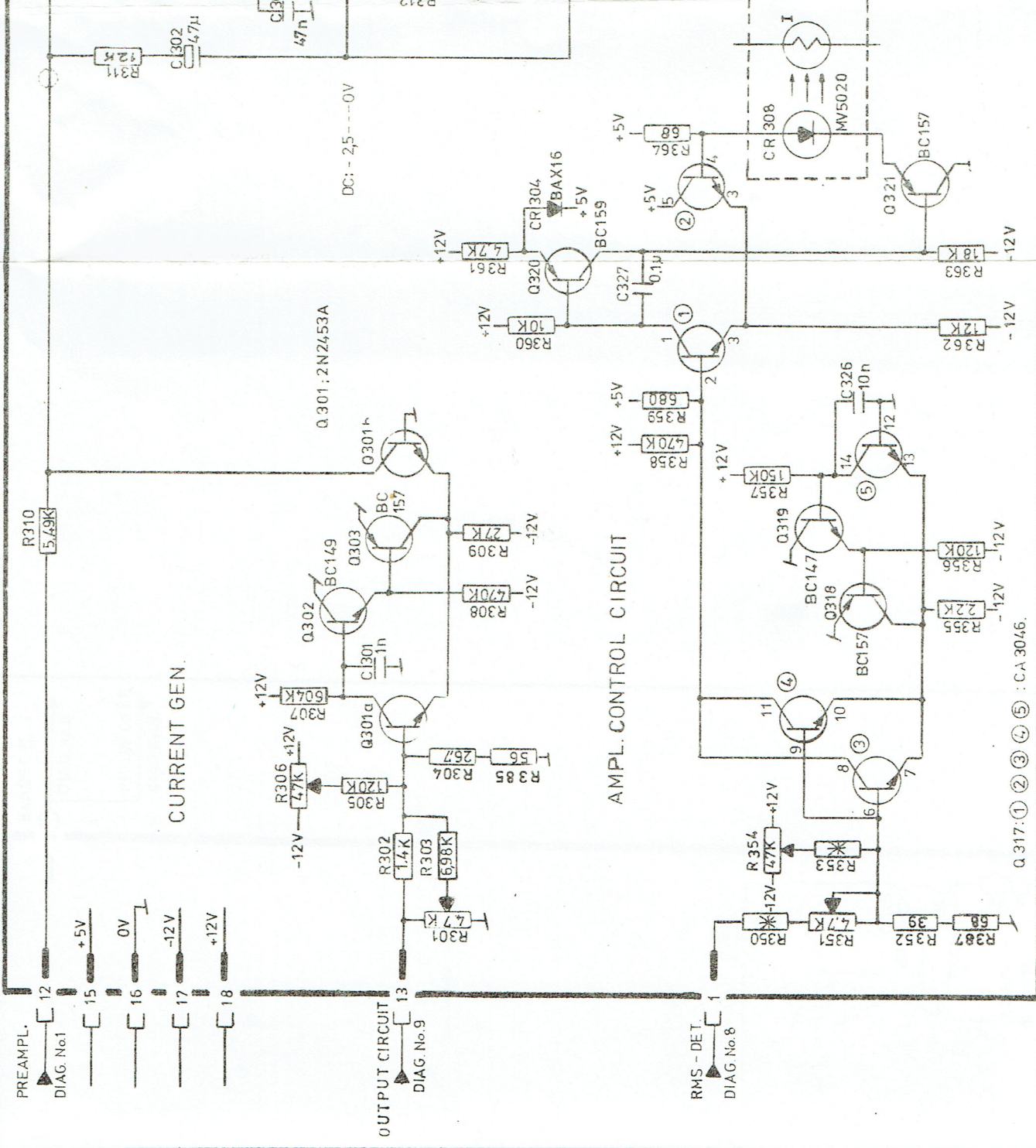


PHASE DETECTOR I



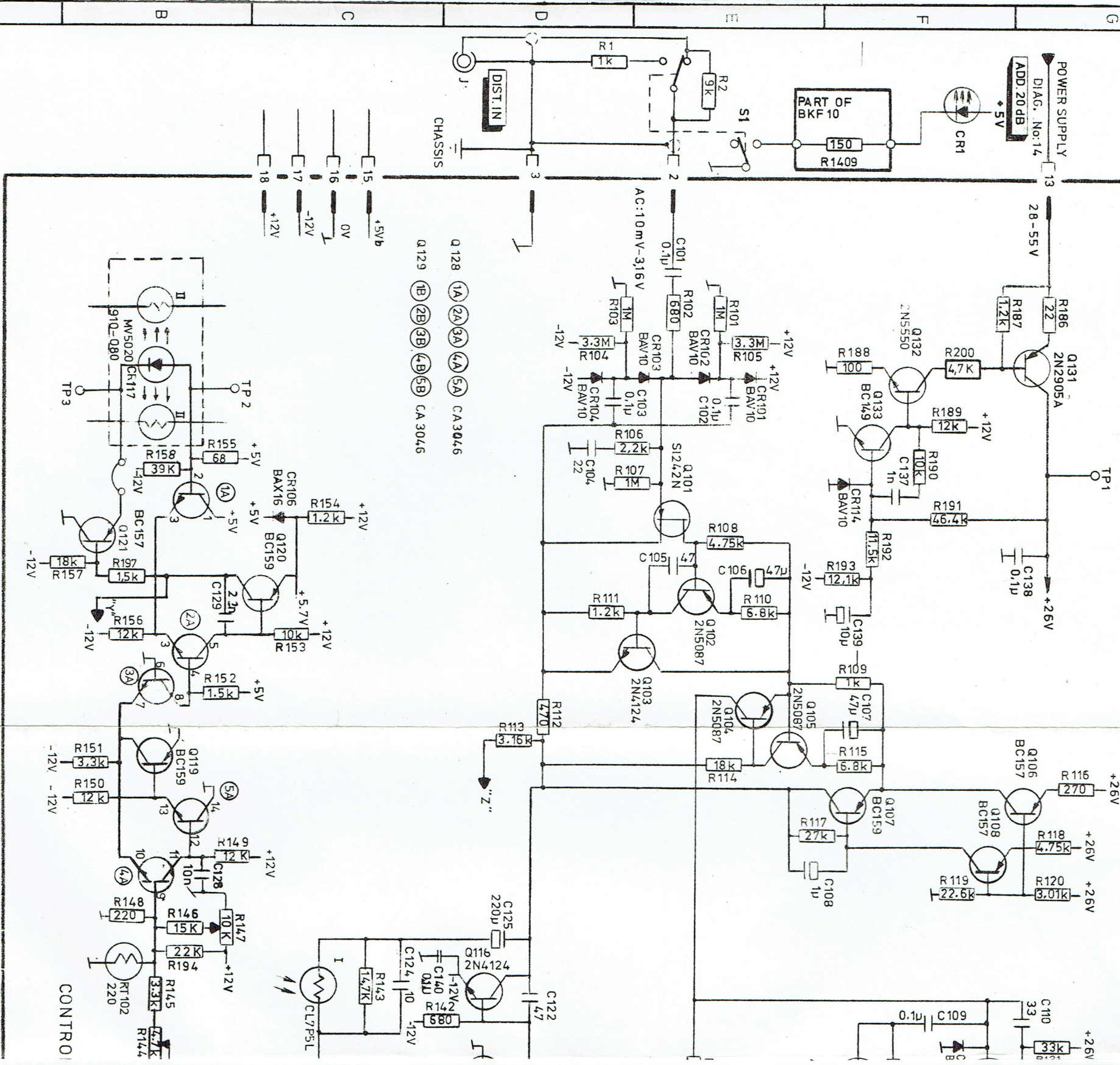
VALUES IN Ω OR ρ IF NOT OTHERWISE STATED.
* FACTORY ADJUSTED

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	10	210683	22-4-75	BLØ					
	9	21549	25-2-75	BLØ					
	8	21560	20-1-75	BLØ					
					SCHEMATIC DIAGRAM No. 5				

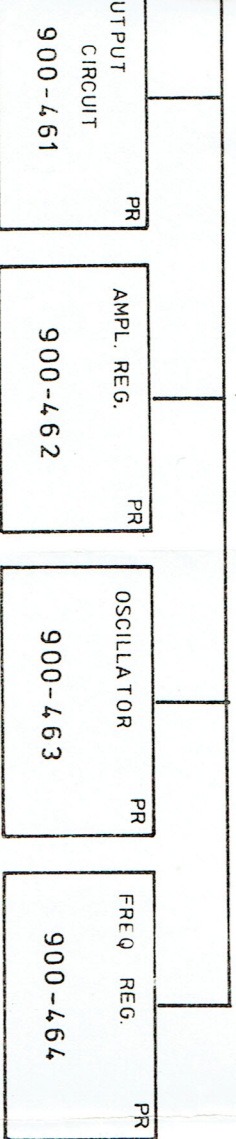


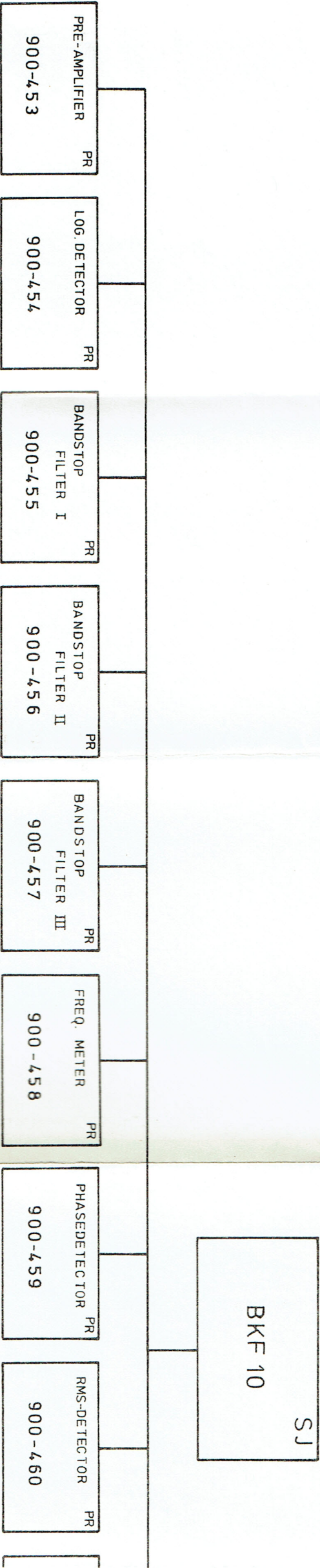
[illegible]

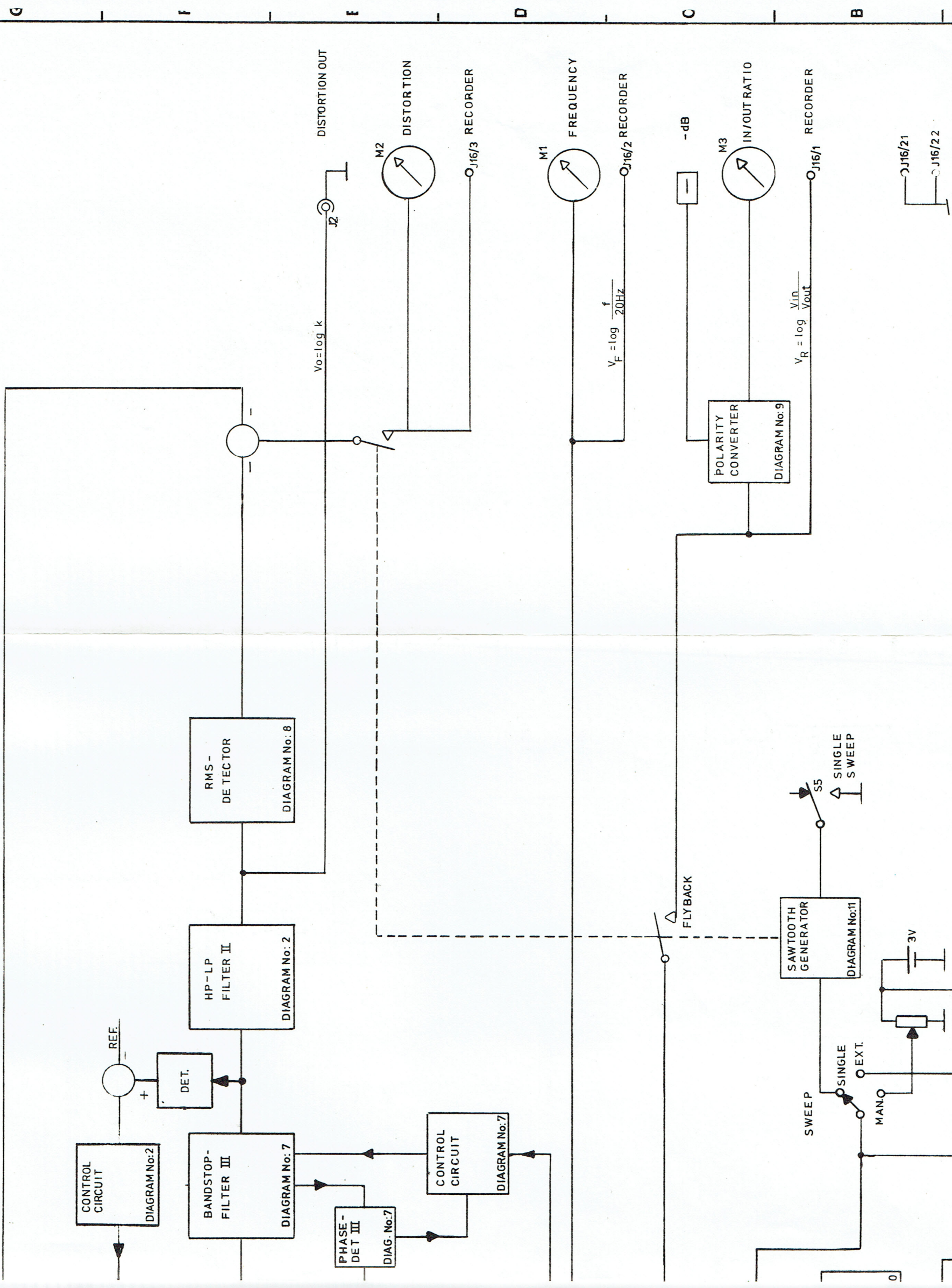
V_{in} (AC)	V_g (DC)
21mV	4 V
65mV	2 V
200mV	0 V
0,6 V	- 2 V
1,8 V	- 4 V



VALUES IN DOR PF IF NOT OTHERWISE STATED.
J16 AND J30: diag. No.15.

[illegible]





REVISIONS				RADIOMETER A/S			
3	238384	11.6.75	LTJ	EMDRUPVEJ 72	DK 2400 COPENHAGEN NV	DENMARK	
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				CHECKED BY			
				APPR. BY NOB 12/22			

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