

Section F. Technical Description

RF INPUT CIRCUIT

The RF input signal is fed to the BNC connector on the front plate of the instrument, then passed through a resistive attenuator (providing for 10 dB, 20 dB, 30 dB or 40 dB attenuation) which is inserted to avoid overloading of the mixer and to adapt the Modulation Meter to RF signals in the range 3 mV to 10 V r.m.s.

All components of the RF attenuator are numbered between 1300 and 1399.

TUNER (See diagram No.1)

The local oscillator consists of Q103 in a common-base Hartley coupling. The same circuit configuration is used in all ranges. Only the tank circuit (C_C , C_B , and L_A) and the emitter capacitor C_A are exchanged to obtain the different fundamental ranges from 7 to 200 MHz. Up to 200 MHz, the mixing takes place with the fundamental frequency of the local oscillator. Mixing with input signals which have a frequency higher than 200 MHz is accomplished with the 3rd or 5th harmonics of the local oscillator.

The intermediate frequency is chosen to be 2 MHz, and both sidebands can be used; however, only the lower sideband can be used at 5 MHz RF input signal because the lower frequency limit of the local oscillator is 7 MHz.

With the selector RANGE in position CRYSTAL OSCILLATOR, the local oscillator is disconnected, and an oscillator providing for operation at a fixed frequency, such as the Crystal Oscillator Unit, code 900-252, may be used.

The signal from the RF attenuator and that from the local oscillator or the Crystal Oscillator Unit are fed to the diodes CR101 to CR104 which form a balanced mixer and provide for good insulation between the input terminals and the local oscillator or the Crystal Oscillator Unit, and thereby reduce the influence of stray radiation. The resulting 2 MHz signal is fed to the IF filter via T102.

The tuner has its own current limiters, i.e., Q101 for +12 V, and Q102 for -12 V.

All components of the tuner are numbered between 100 and 199.

IF FILTER (See diagram No.II)

The output impedance of the mixer is matched capacitively to that of the IF filter. In this fashion, variations of the output impedance of the mixer become uncritical. From T102, the intermediate frequency signal of 2 MHz passes through a band-pass filter which rejects unwanted mixing products. It is of the phase-linear type, and it has a bandwidth of ± 400

kHz around the intermediate frequency. A high degree of phase-linearity is necessary to achieve measurements on FM signals with minimum distortion, especially when the modulation frequency is high.

All components of the IF filter are numbered between 200 and 299.

IF PREAMPLIFIER AND IF ATTENUATOR (See diagram No.III)

The three-stage IF preamplifier consists of Q301, Q302, and Q303. It protects the IF filter against load impedance variations from the IF attenuator. At the same time, it provides for amplification before the signal is fed to the IF attenuator. Amplification alongside with an almost ideal connection to the IF filter results in a minimum amount of noise at all input levels. The ohmic part of the IF amplifier input is matched by means of R304, and the reactive part by means of C306. The amplified IF signal is then fed to the IF attenuator via C308.

The IF attenuator (see Fig.F1) consists of R311 and the four diodes CR310 to CR304. R311 and the four diodes form a voltage divider with one fixed resistance and the variable resistance resulting from the combination CR301 - CR302 // CR303 - CR304. Combining these four diodes ensures linear characteristic and thereby minimum distortion. The resistance value resulting from the above combination depends on the biasing current of the four diodes. This biasing current is drawn from the collector of the current generator Q310. In position MAN. of the MAN.-AUTO switch, the base of Q310 is at a potential determined by the reference voltage source Q311. The emitter current of Q310, and thereby its collector current, is controlled by means of the potentiometer R1A (LEVEL) accessible from the front of the instrument. This results in regulation of the biasing current of the diode complex CR301 to CR304, and, therefore, in regulation of the IF level. Finally, the sensitivity of the IF attenuator at a given RF input voltage can be adjusted by means of R345.

When the switch MAN.-AUTO. is in position AUTO., the base of Q310 is at a voltage delivered by the AGC amplifier. The AGC amplifier consists of a differential amplifier Q512 and Q513 followed by a unity-gain amplifier Q308 and Q309. The base of Q513 is at a potential determined by the divider consisting of R1B (LEVEL), R552, R553, and R554. The base of Q512 receives a signal proportional to the IF level from the AM detector. The difference signal (if any) is then fed to the input (base of Q308) of the unity-gain amplifier driving the exponential amplifier Q310. The emitter of Q310 is at a voltage provided by the voltage reference source Q311. The emitter bias voltage of Q310, and thereby the biasing current of the diodes CR310 to CR304, is in this case controlled by the potentiometer R1B (LEVEL) and by the AGC amplifier.

All components of the IF preamplifier and IF attenuator are numbered between 300 and 399.

IF AMPLIFIER (See diagram No.III)

The signal from the IF attenuator is then fed to the IF amplifier which consists of the two wideband amplifier stages Q304, Q305 and Q306, Q307. The IF amplifier brings the IF signal to a voltage level higher than that required by the AM detector and thus provides for compensation of the attenuation in the following band-pass filter or phase-compensator.

All components of the IF amplifier are numbered between 300 and 399.

PHASE-COMPENSATOR AND BAND-PASS FILTER (See diagram No.IV)

The amplified IF signal is then fed to a phase-compensator or to a band-pass filter, according to the position of the IF BANDWIDTH switch. When the IF BANDWIDTH is in position ± 400 kHz, the phase-compensator is switched in. It provides for compensation of the phase-error that arises in the IF filter. This phase error is due to the theoretical

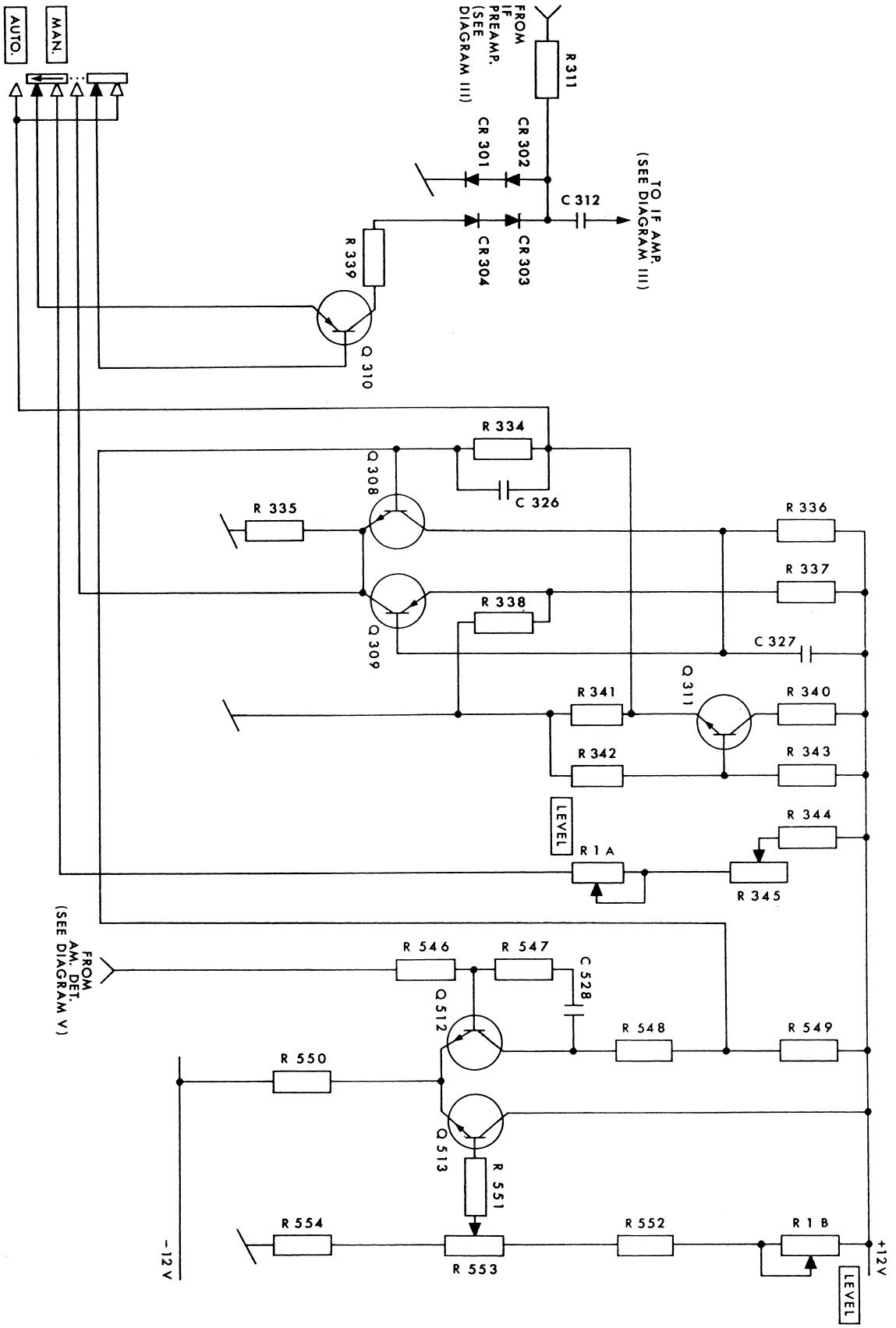


Fig. F1. IF attenuator and AGC amplifier.

asymmetry of the IF filter characteristic around the intermediate frequency. In the position ± 25 kHz of the IF BAND-WIDTH switch, the band-pass filter is switched on. It is of the same type as the IF filter concerning phase-linearity, but has a bandwidth of ± 25 kHz, and is intended for use when measuring on signals from narrow-band equipment.

BUFFER AMPLIFIER (See diagram No.V)

The signal from the phase-compensator or the band-pass filter is fed to a buffer amplifier which separates filter, AM detector, and output amplifier. It consists of a two-stage unity-gain amplifier (Q501 and Q502) and serves to suppress any influence from the IF output. The signal from the buffer amplifier is fed both to the AM detector and to the IF output amplifier.

All components of the Buffer amplifier are numbered between 500 and 599.

AM DETECTOR (See diagram No.V)

The signal from the buffer amplifier is fed to the AM detector. It consists of a three-stage amplifier Q507, Q508, and Q509 with a mean-value detector CR505 and CR506 in the feedback loop. The feedback ensures a good linearity. A pair of output transistors, Q510 and Q511, provides for two outputs. The signal on the collector of Q511 is proportional to the IF level. This signal is fed via R546 to the differential amplifier which is part of the automatic level setting circuitry (described above), and, via R543 and R555, to a pair of complementary emitter-followers, Q514 and Q515, forming a dc output amplifier delivering voltage to the IF LEVEL (DC) output. The signal from the collector of Q511 is also fed via R544 to the indicating meter which provides for checking of the IF level.

The signal on the collector Q510 is the detected signal which is fed through a

first low-pass filter section (L701, L702, C710 and C711 on diagram VII), via the network consisting of R537, R538, R539, and C530. R539 is used to calibrate the AM detector.

Note: The low-pass filter and the following AF section are described below.

All the components of the AM detector are numbered from 500 to 599.

IF OUTPUT AMPLIFIER (See diagram No.V)

The signal from the buffer amplifier is also fed to the IF output amplifier which consists of the four stages Q503, Q504, Q505, and Q506, and which provides for amplification of the IF signal to the level required by the following limiter stages. The two diodes CR502 and CR503 are used to protect the limiter input stage against too high a voltage.

All components of the IF output amplifier are numbered between 500 and 599.

LIMITER STAGES (See diagram No.VI)

General

The amplified IF signal is fed to a series of three limiters.

All components of the limiter stages are numbered from 600 to 699.

First limiter stage.

The first limiter stage consists of two emitter-coupled transistors, Q601 and Q602. Their working point is determined by the current delivered by the constant dc current generator Q607. The amplified IF signal from the IF output amplifier is fed to the base of Q601, whilst the base of Q602 is connected to ground. When a sufficient IF level is reached, Q601 and Q602 are cut-off, and the output voltage of the first limiter (at C605) is a square-wave. The peak-to-peak value of this square-wave is fixed by the constant current generator Q607. The first limiter is provided with a regulation circuit which holds the zero-crossing of the square-wave output voltage. The regulation circuit consists of a peak-dif-

ference detector, CR601 and CR602, and a differential amplifier, Q603 and Q604, where any signal from the peak-difference detector is compared with the dc component of the square-wave. The output signal of the differential amplifier (if any) is fed to the bases of Q601 and Q602 via the two emitter-followers Q605 and Q606.

Subsequent limiter stages

From C605, the square-wave signal is fed to two subsequent limiter stages Q608-Q609 and Q610-Q611 where it is again limited. The resulting signal is then fed to the FM detector via Q612.

FM DETECTOR (See diagram No. VII)

The FM detector consists of a monostable multivibrator and an output stage.

The multivibrator consists of Q701 and Q702. It is triggered by the train of positive pulses from the last limiter stage. This train of pulses is fed to the base of Q701 via C701. Transistor Q701 is cut-off when no IF signal is applied to its base whilst transistor Q702 conducts, and conversely.

The multivibrator has a time-constant determined by R707, R708 and C703, and it delivers a square-wave signal across R702. The positive pulses drive the output stage which consists of Q703 and Q704. The working points of the two transistors of the output stage are determined by the constant dc current generator Q708. The peak value of the square-wave is detected by CR704 and amplified in Q705 and Q706, which in turn drive the constant-current generator Q708 via Q707, thereby regulating amplitude variations. As the width of the pulses and their amplitude are constant, the mean value of the output voltage of the output stage will vary according to the number of pulses per second of the square-wave, i.e., according to the modulating frequency. Frequency-modulation of the IF signal will cause a variation of the output voltage of the output stage. This signal

is then passed, via a low-pass filter consisting of L701, L702, C710 and C711, to the AF section described below.

A positive voltage, varying proportionally to the modulating frequency, is drawn from the collector of Q704 and, via R726 and R727, fed to a unity-gain amplifier stage consisting of the double transistor Q709 and Q710 and Q711. The amplifier signal present on the emitter of Q711 is fed via R734 to the IF FREQ. (DC) output, whilst the other part is fed via R736 to the meter when the selector FUNCTION is in IF CHECK position. R737 and R739 provide for fine adjustment of IF CHECK position and gain.

The monostable multivibrator and the output stage are provided with their own +10 V and -10 V regulated power supplies. They consist of Q613, Q614, Q615 and Q616 for +10 V, and Q617, Q618, Q619 and Q620 for -10 V. (See diagram VI)

All components of the FM detector are numbered between 700 and 799.

AF AMPLIFIERS I AND II (See diagram VIII)

The signal from the AM detector is fed to the second low-pass filter, consisting of L801, L802, L803, L804, L805, C801, C802, C803 and C804, when the selector FUNCTION is in one of the positions AM. The signal from the FM detector is fed to the second low-pass filter when the selector FUNCTION is in one of the positions FM. The low-pass filter is characterized by its good phase-linearity and its almost flat frequency response, which are both required for passing a stereo signal with minimum distortion.

The filtered signal is then passed through the first section of a two-section resistive AF attenuator (see diagram XII) and fed to the first AF AMPLIFIER, which consists of Q801, Q802, and Q803.

The amplified signal at the collector of Q803 is passed via the second section of the AF attenuator (see diagram XII) and fed to the second AF AMPLIFIER, which consists of Q804, Q805 and Q806. It provides for the necessary amplification and for the low output impedance required for coupling to the subsequent low-pass filter.

All components of the AF AMPLIFIERS I and II are numbered from 800 to 899.

AF AMPLIFIERS III - V (See diagram IX)

The amplified signal from amplifier II is fed to the low-pass filter, which consists of L901, L902, L903, C901, and C902, and which provides for limitation of the noise bandwidth in the AF section of the instrument without deterioration of the phase-linearity and frequency-response.

The filtered signal is then passed through the third AF amplifier. It is a unity-gain amplifier, consisting of Q901 and Q902, which is part of the active filter switched in when the FILTER/DEEMPHASIS selector is in position 3 kHz, 15 kHz and 50 Hz - 15 kHz (3 dB). It acts as a buffer in the other positions of the FILTER/DEEMPHASIS selector. For filter characteristics, see SECTION B - SPECIFICATIONS. The de-emphasis networks and the 6 dB/oct filter are regular RC networks.

The following AF amplifiers IV and V, consist respectively of Q903, Q904, Q905, Q906, Q907, and Q908, Q910, Q911 and

Q912. They bring the signal up to the level required by the AF detector.

The AF OUTPUT signal is drawn from the emitter of Q907 via R920 when the AF OUTPUT switch is in position DC, and via R920 and C911 when the AF OUTPUT switch is in position AC.

All the components of the AF amplifiers III - V are numbered from 900 to 999.

AF DETECTOR (See diagram X)

The signal from the emitter of Q912 is fed to the AF detector which consists of diodes CR1001 and CR1002. Diode CR1002 is used for detection of the negative peaks of modulation, whilst diode CR1001 is used for detection of the positive modulation peaks. Selection of the peak of modulation (positive or negative) is done by means of the FUNCTION selector in the positions AM or FM.

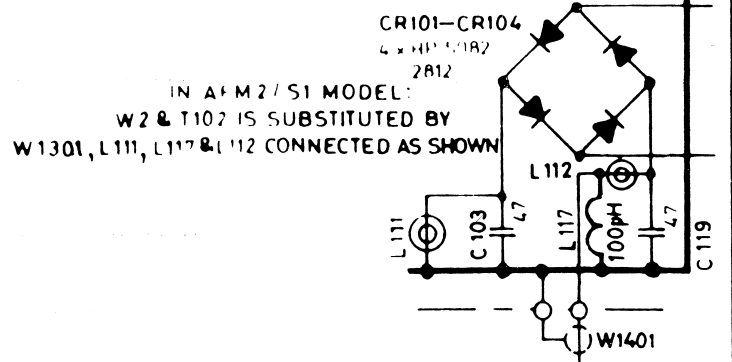
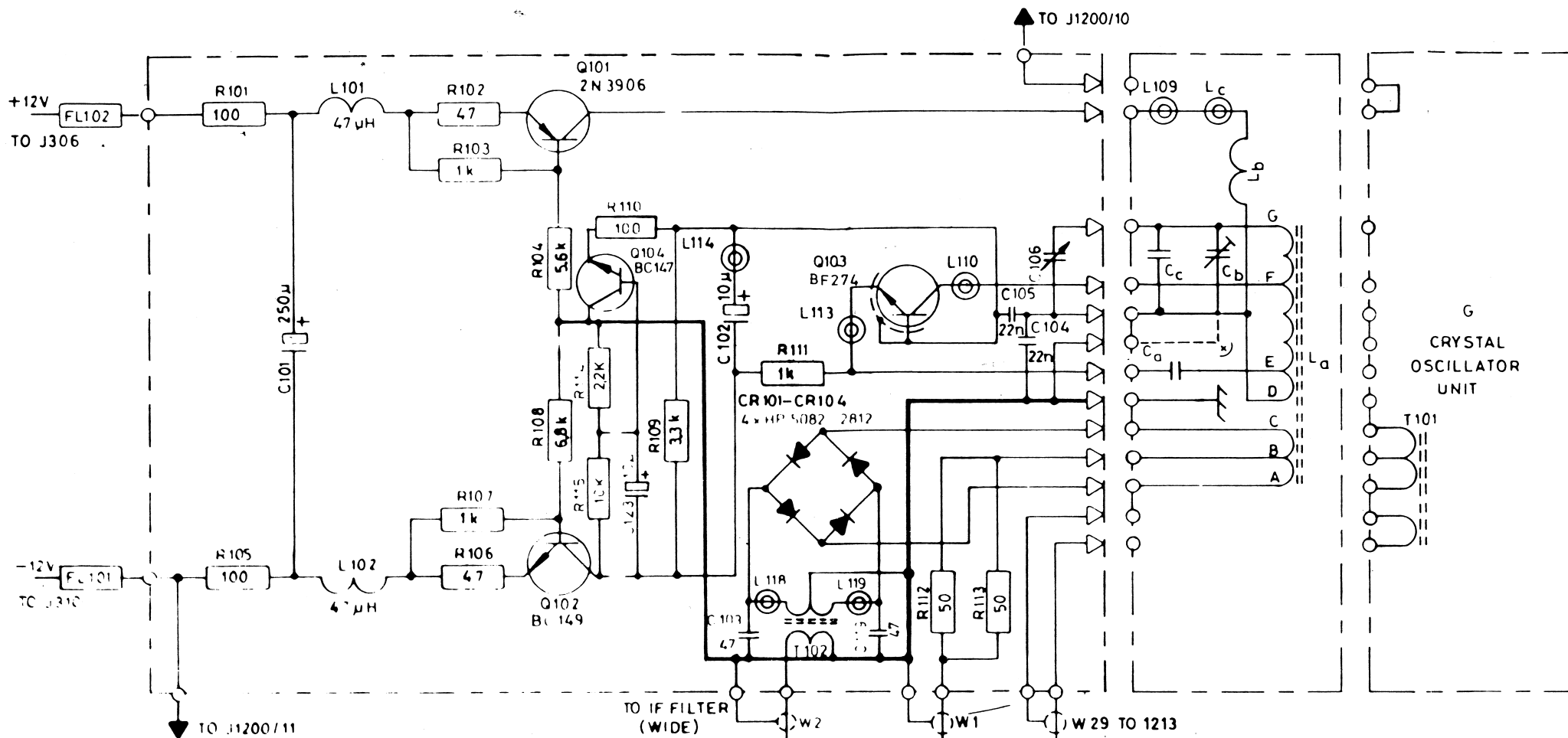
The detected signal is then fed to an impedance converter so that it can be fed to the MOD.LEVEL (DC) output and to the meter.

All the components of the AF detector are numbered from 1000 to 1099.

POWER SUPPLY (See diagram XI)

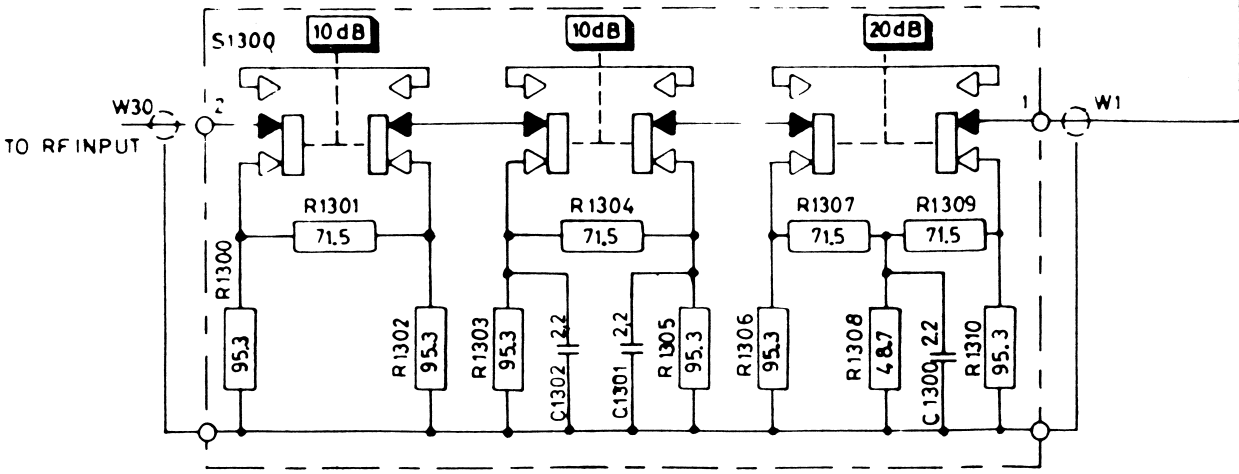
The power supply provides for the regulated dc voltages (-12 V, 0 V, +12 V) required by the different sections of the instrument. (For -10 V and +10 V supply, see FM DETECTOR.)

All the components of the power supply are numbered from 1100 to 1199.



FREQUENCY	L _a	L _b	L _c	C _a	C _b	C _c
A 7-12 MHz	L103 148 μH			C107 2.2 n	C108 3	
B 12-21 MHz	L104 5 μH			C109 1 n	C110 3	
C 21-37 MHz	L105 1.6 μH			C111 1 n	C112 3	
D 37-65 MHz	L106 530 nH			C113 470	C114 3	C122 15
E 65-110 MHz	L107 172 nH			C115 220	C116 3	C121 2.2
F 110-220 MHz	L108 60 nH	L115 47 μH	L116	C117 47	C118 3	
G	CRYSTAL OSCILLATOR UNIT					

ONLY IN RANGE F₁
VALUES IN Ω OR pF IF NOT
OTHERWISE SPECIFIED.
PRINT TERMINAL.



6	171216	3.8.70	SHM	Ja	Pk
5	155625	28.1.70	OH	All	Pk
	152230	26.8.69	SHM		
9	166201	2.2.72	OH	All	Pk
3	155575	4.1.70	OH	A.H	Pk
7	171265	1.1.70	SHM		
R: N:	Er: Fac: N:	Dato	Rt. af	Kont:	Norm:

RADIOMETER COPENHAGEN
72 EMDRUPVEJ NV

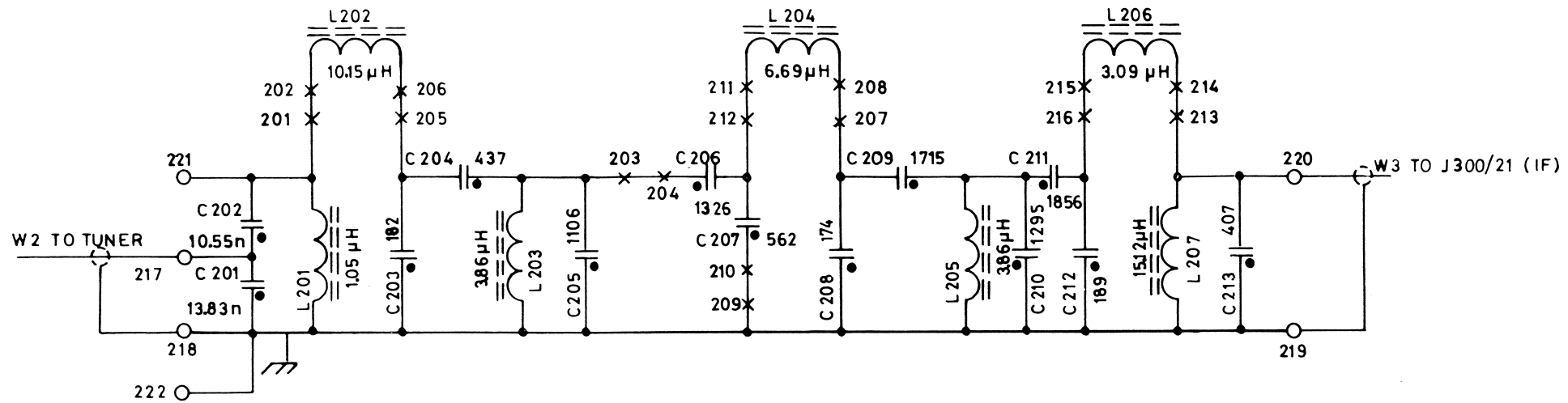
MODULATION METER
TYPE: AFM2b+c
TUNER DIAGRAM

Målestok: Tegn. A.T. 27.6.6
Konf. Ja 27.6.6
Norm. Pk 27.6.6

Erstatte: **1814-A2**
Erstatte af:

RADIOMETER A/S
COPENHAGEN

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○ PRINT TERMINAL
 ⊕ OUTSIDE ELECTRODE
 * TEST POINT
 VALUES IN Ω OR pF
 NOT OTHERWISE SPECIFIED

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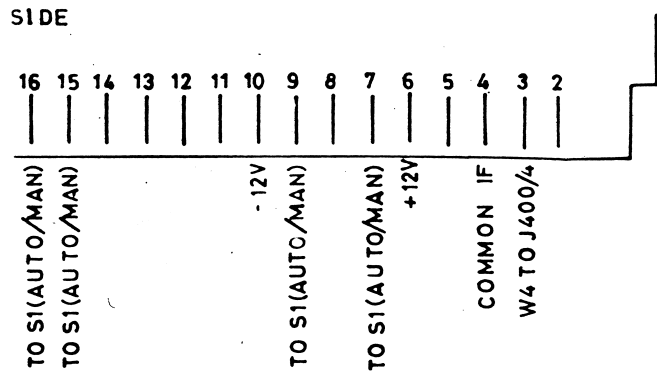
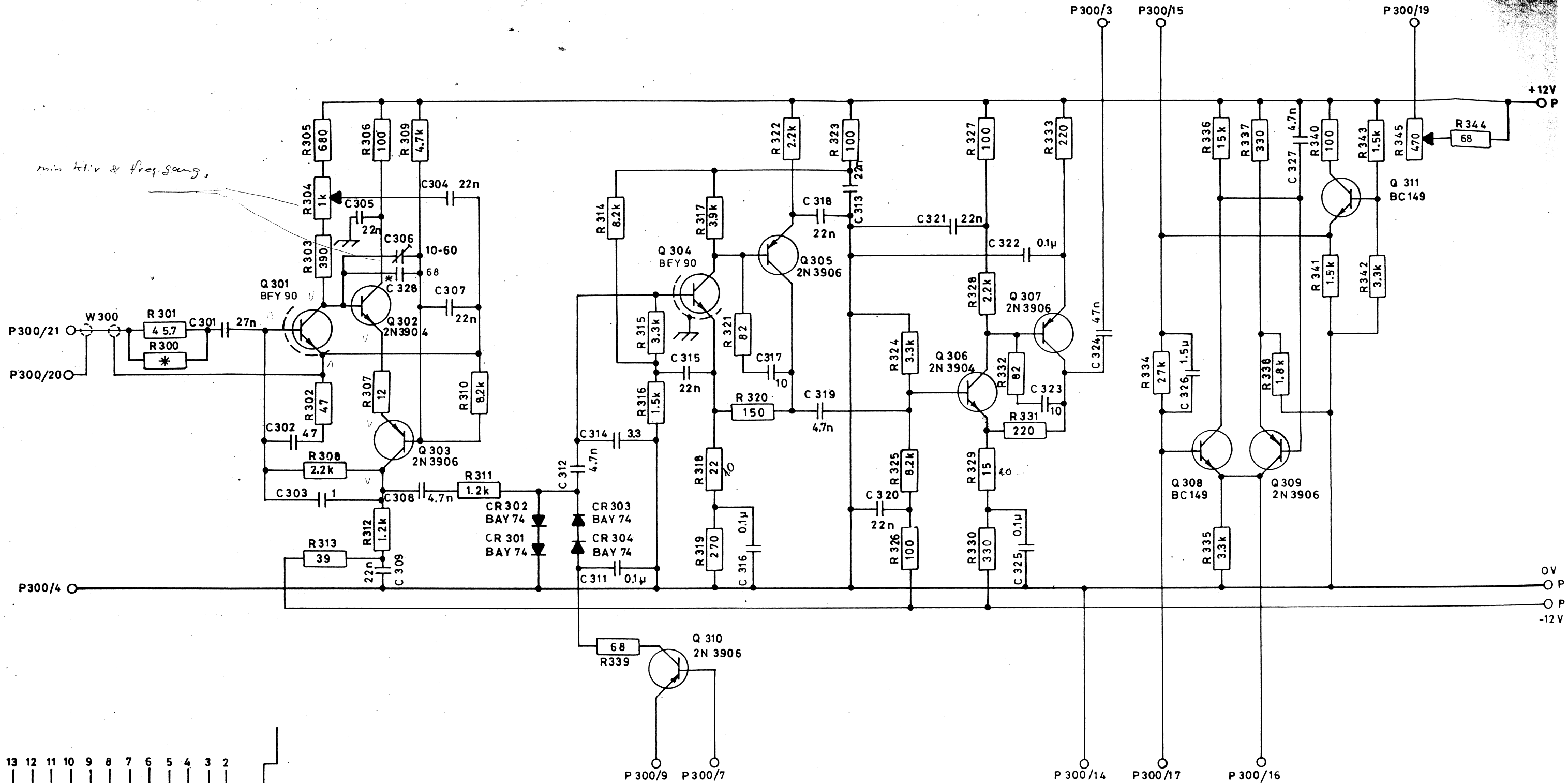
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Rt. Nr.	Fra Fab. Nr.	Dato	Rt. af	Konf.	Norm.		

RADIOMETER **COPENHAGEN**
 72 EMDRUPVEJ NV

IF FILTER (WIDE)
 900-241

From no. _____ to no. _____

Målestok	Tegn. J.H. 278
	Konf. _____
	Norm. PI 3.10.4
Erstatter	
1818-A2	
Erstattes af	

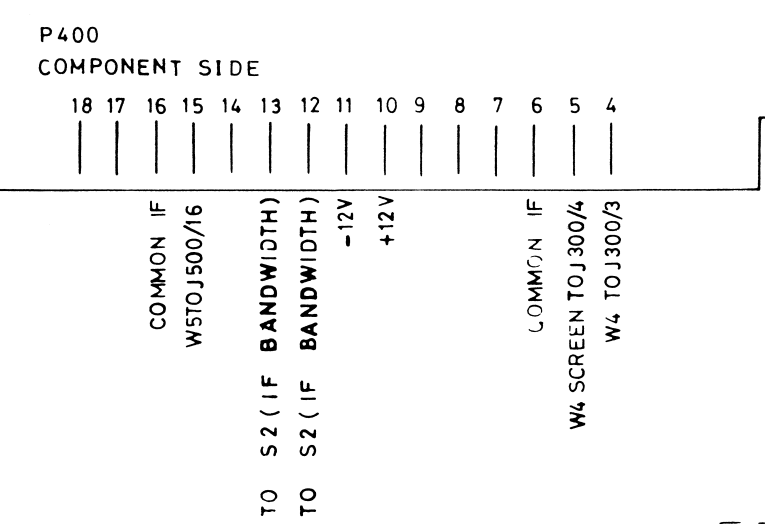
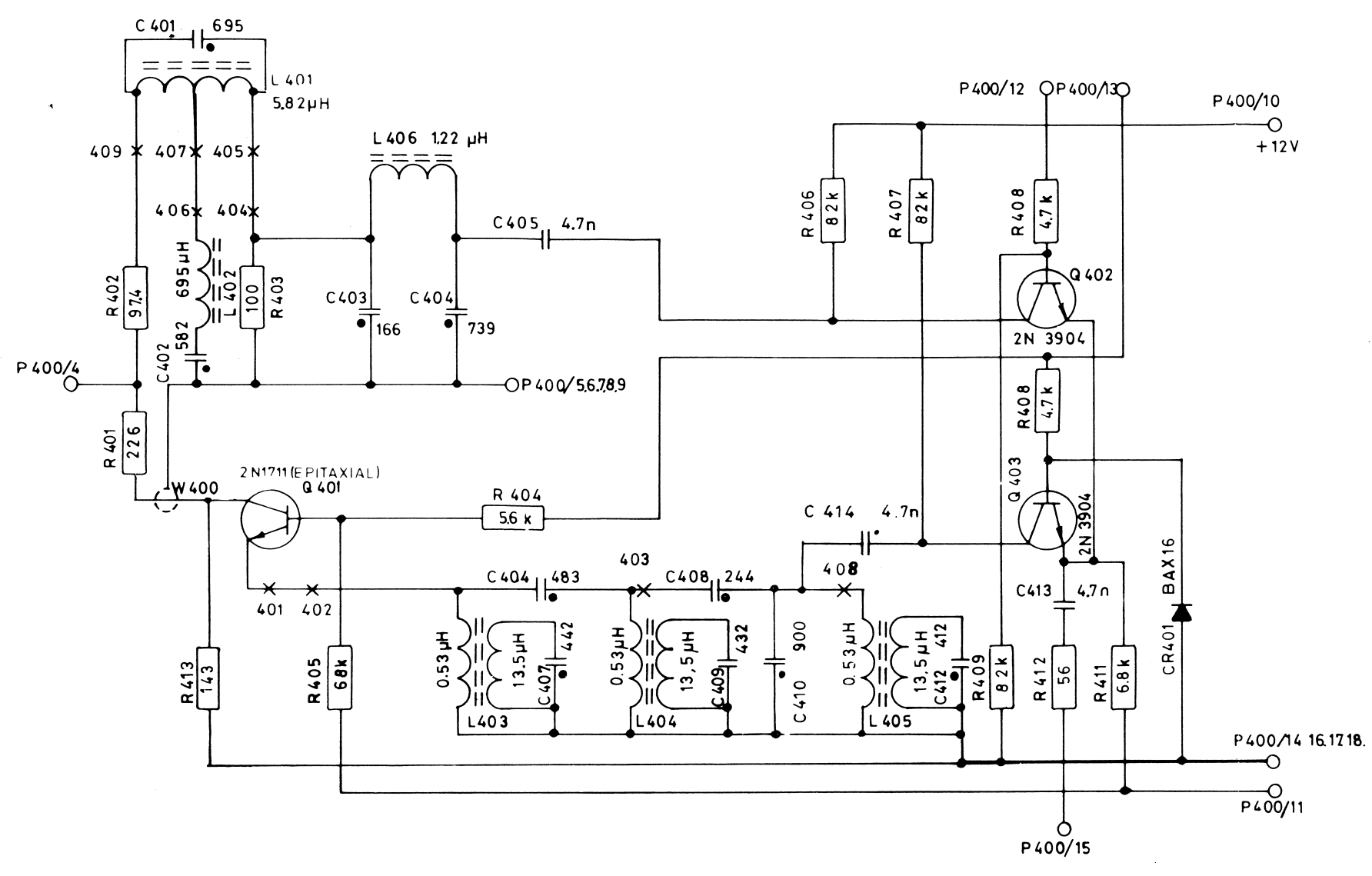


IF-PREAMP + IF ATTENUATOR

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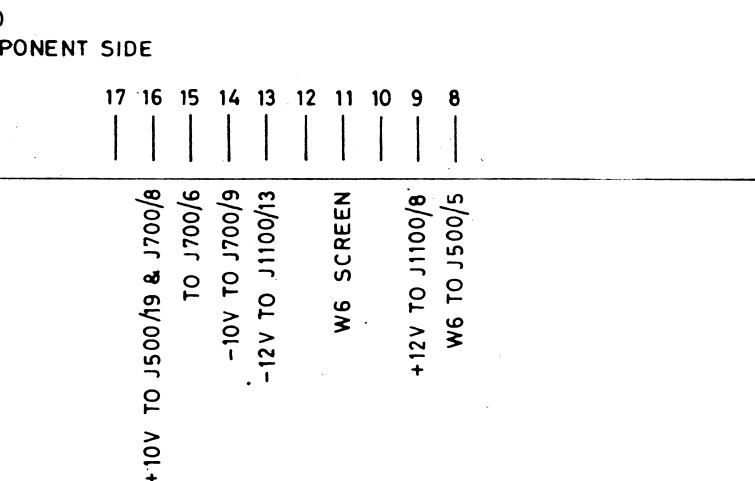
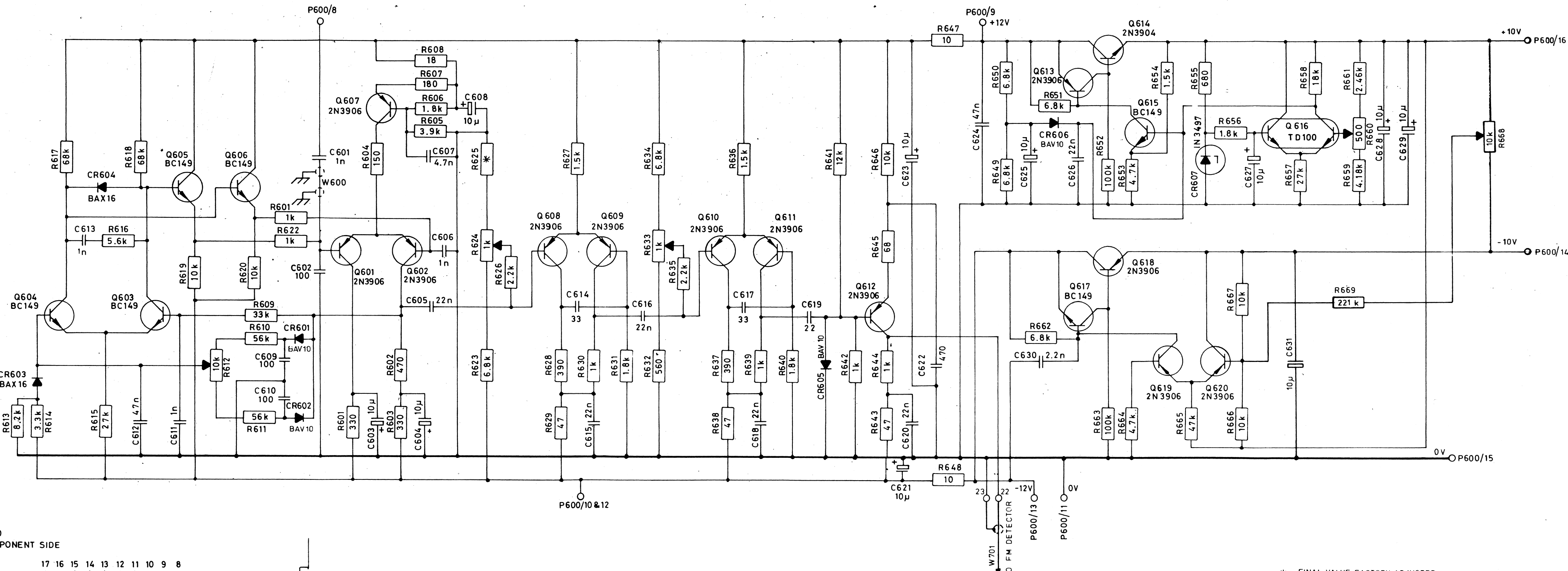
6	173611	11.11.70	E
5	155575	4.9.70	
4	149450	21.4.70	
3	155625	23.2.70	
7	191981	15.3.72	S



⊥ OUTSIDE ELECTRODE
 * TEST POINT
 VALUES IN Ω OR pF IF NOT OTHERWISE SPECIFIED

RADIOMETER A/S COPENHAGEN					
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Rt. Nr.	Fra Fab. Nr.	Dato	Rt. af	Konf.	Norm.
3	175311	11.11.70	B.G.	OH	
2	155625	5.2.70	OH		PK
1		20.9.68	SHM	HA	

RADIOMETER COPENHAGEN 72 EMDRUPVEJ NV		Material	Tegn. <i>D.H.</i>	28.8.68
		Konf.		
		Norm.	PK	3.10.68
IF FILTER (NARROW) 900-243		Erstatter		
		1817-A2		
From no. to no.		Erstatter af		



* FINAL VALUE FACTORY ADJUSTED

VALUES IN Ω OR pF IF NOT OTHERWISE SPECIFIED.

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6	155625	26.1.70	OH	J/A	PK
5	152230	26.8.69	SHM	J/A	
9	171216	13.1.71	SHM		
8	175936	10.11.70	B.G.	OH	
7	171265	13.6.70	SHM	J/A	

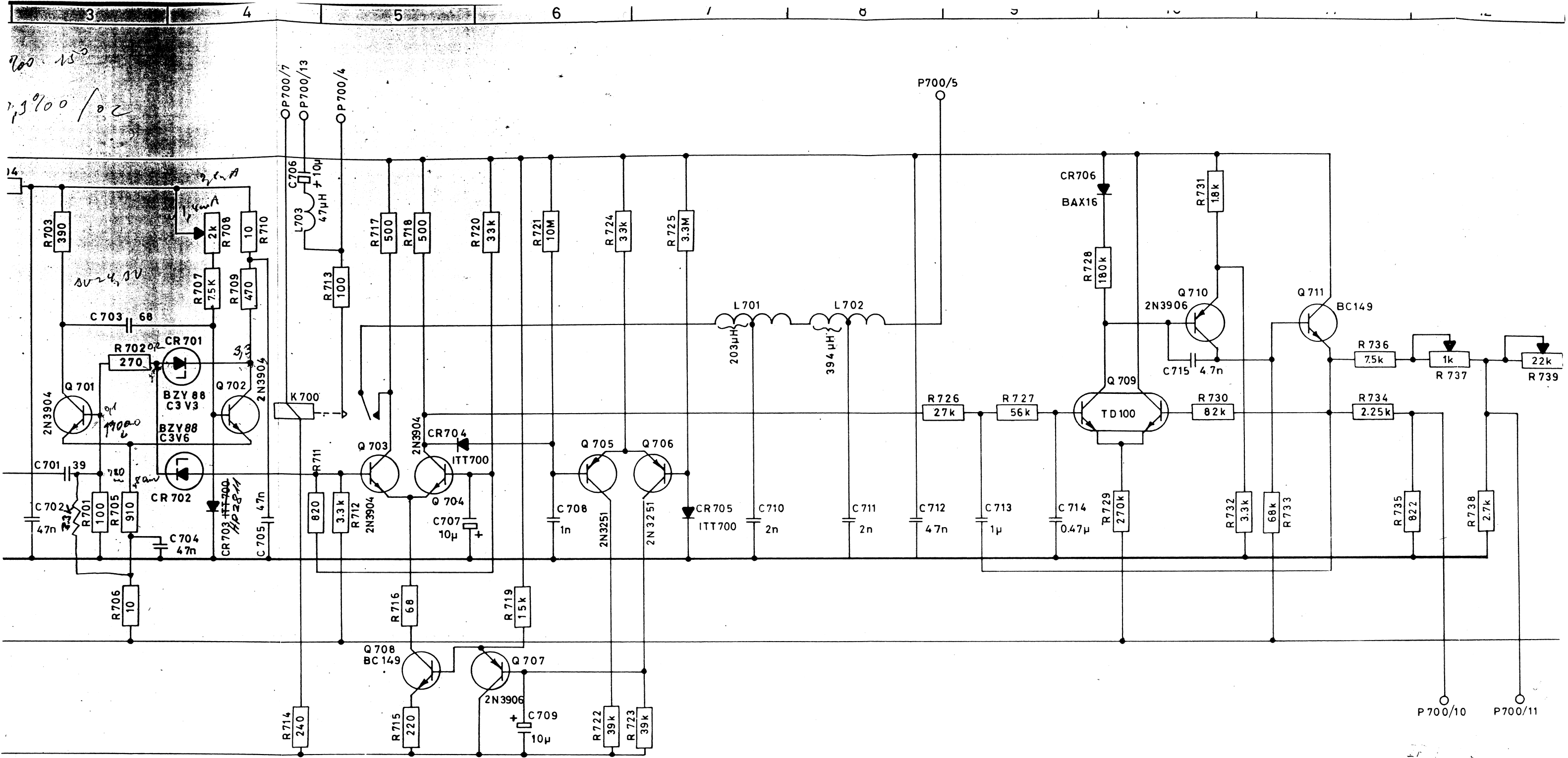
RADIOMETER COPENHAGEN
72 EMDRUPVEJ NV

LIMITER 900-245

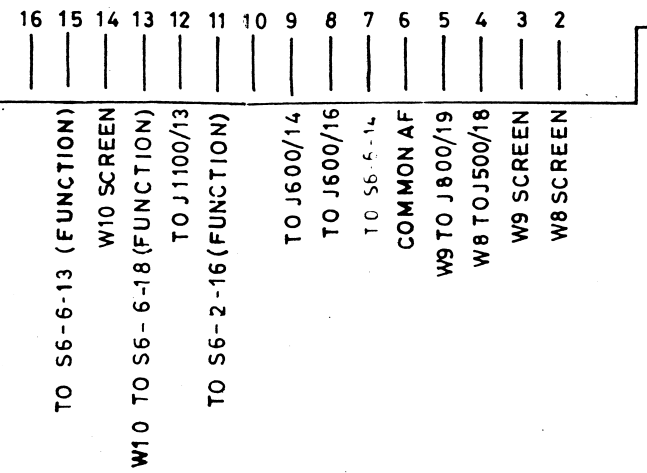
From no. _____ to no. _____

Material	Tag. EA	3.9.68
Konf.		
Norm.	PK	3.10.68

Estatter **1197-A1**



P700
COMPONENT SIDE



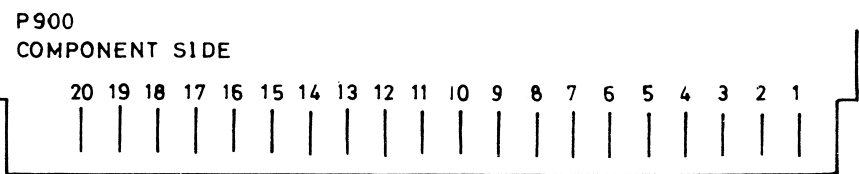
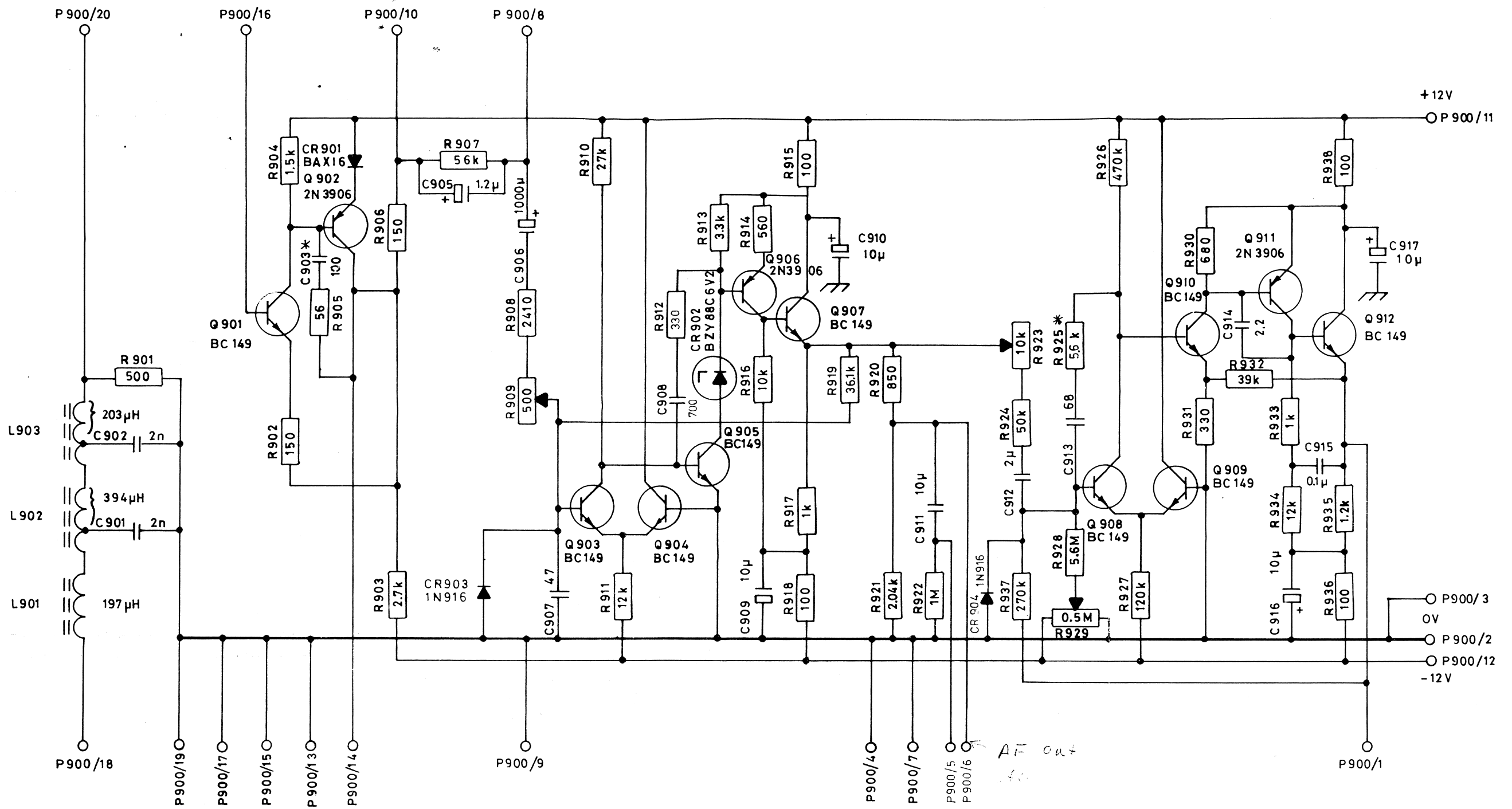
VALUES IN Ω OR NOT OTHERWISE

FM DETECTOR

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6	173611	11.11.70
5	155625	28.10.69
4	152230	26.8.69
3	149450	10.6.69
7	191981	14.3.72
RI. N:		Date



VALUES IN Ω OR pF IF NOT OTHERWISE SPECIFIED

* FINAL VALUE FACTORY SELECTED



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5	173611	11.11.70	BG.	OK
4	152230	22.9.70	SHM	OK
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2	133815	19/2-69	Je.	Ja Ph
1	129861	11.10.68	Je.	Ja Ph

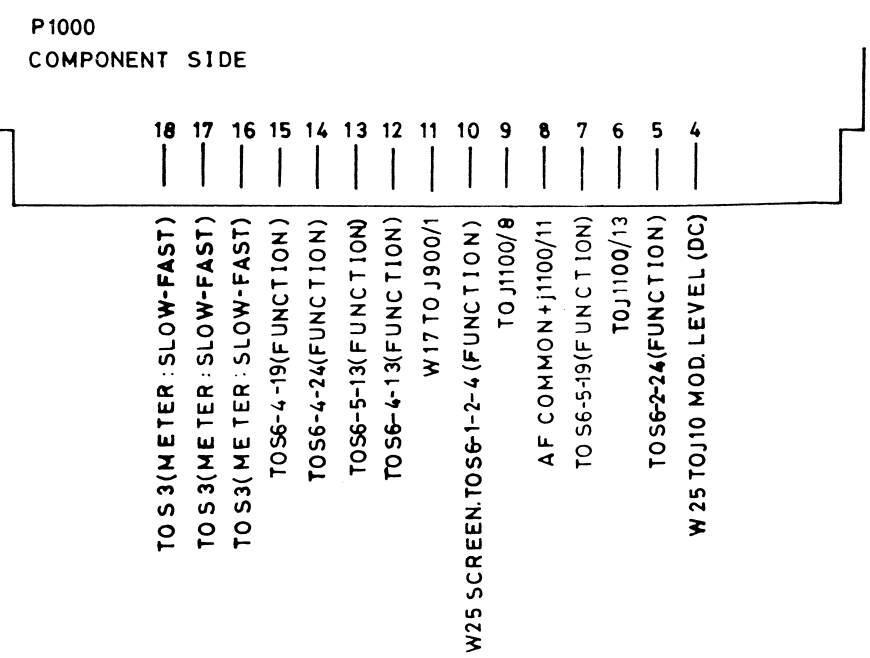
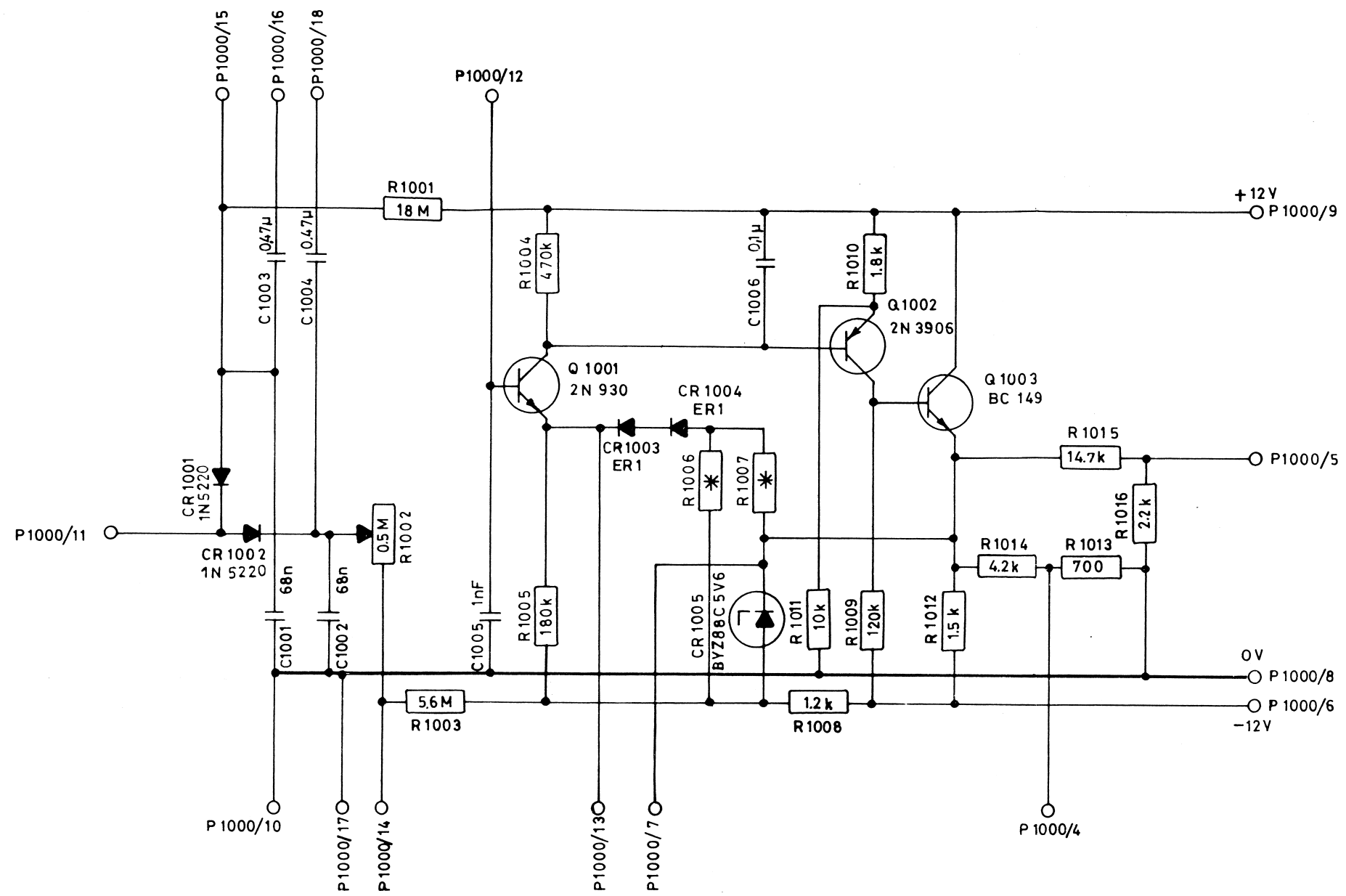
RADIOMETER COPENHAGEN
72 EMDRUPVEJ NV

AF AMPLIFIER III-V
900-248

From no. to no.

1813-A 2

Malestok: J.H. 30.8.68
Kont. Ph 3.10.68
Erstatte



*FINAL VALUE FACTORY ADJUSTED
VALUES IN Ω OR pF IF NOT
OTHERWISE SPECIFIED

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3	175936	10.11.70	B.G.	OH
2	171216	3.8.70	SHM	Ja
1	129836	31.10.68	Je. AJH	PK
R.N.	Exp. Fab. No.	Date	Pr. of	Kont. Norm

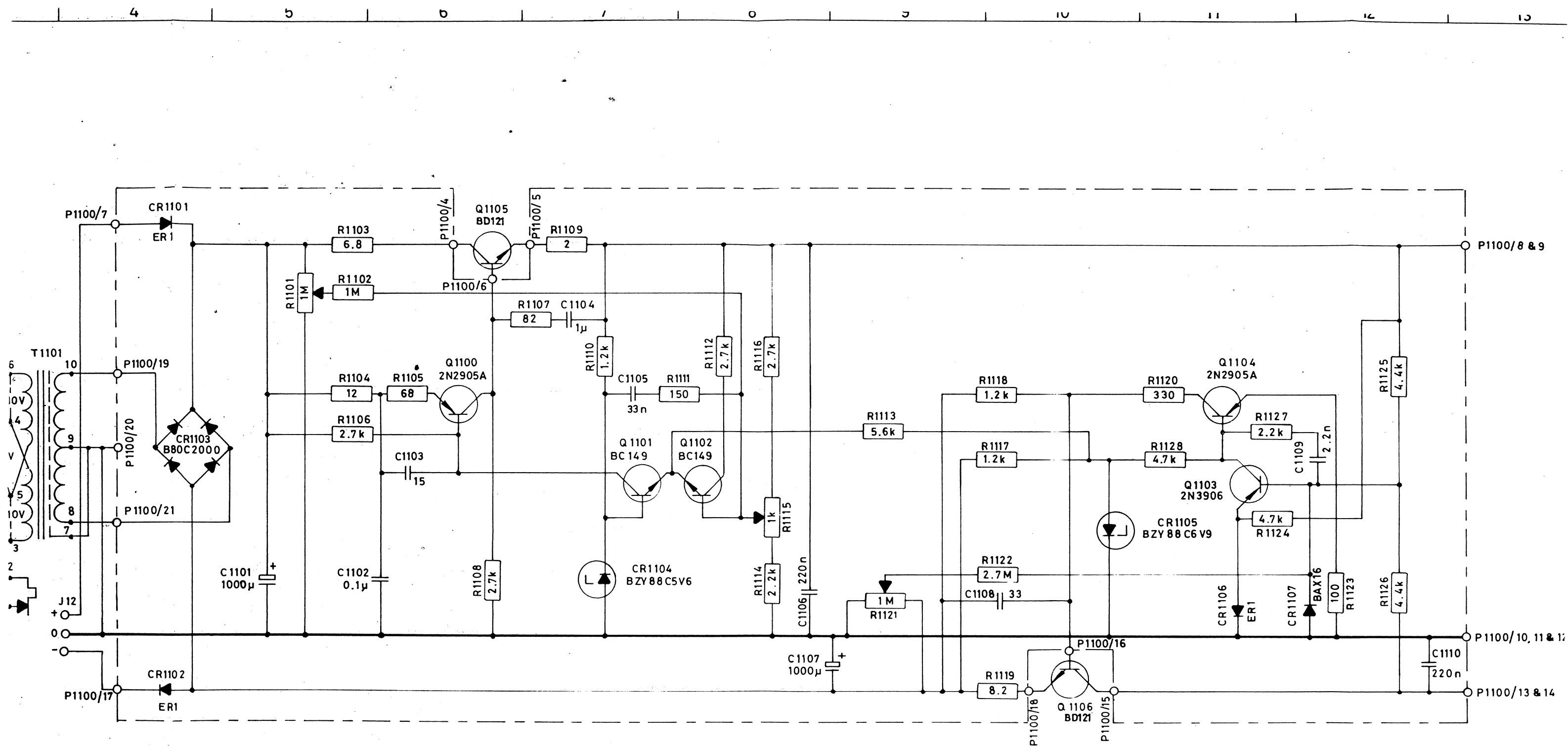
RADIOMETER COPENHAGEN
72 EMDRUPVEJ NV

Malestok: Tegn. **JH 29.8.68**
 Kont. Norm. **PK 3.10.68**

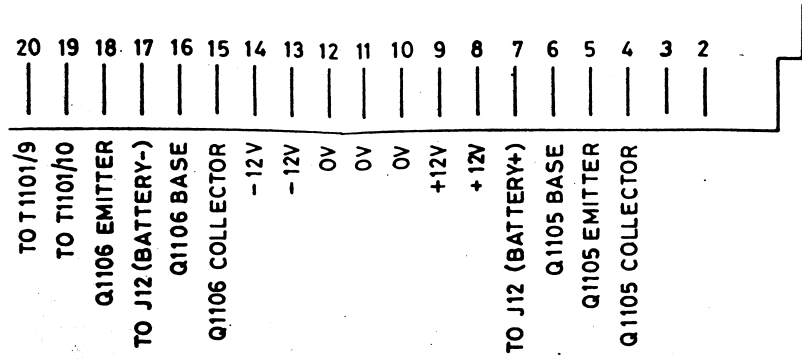
AF DETECTOR 900-249

Erstatet **1816-A2**

From no. _____ to no. _____



100
MPONENT SIDE

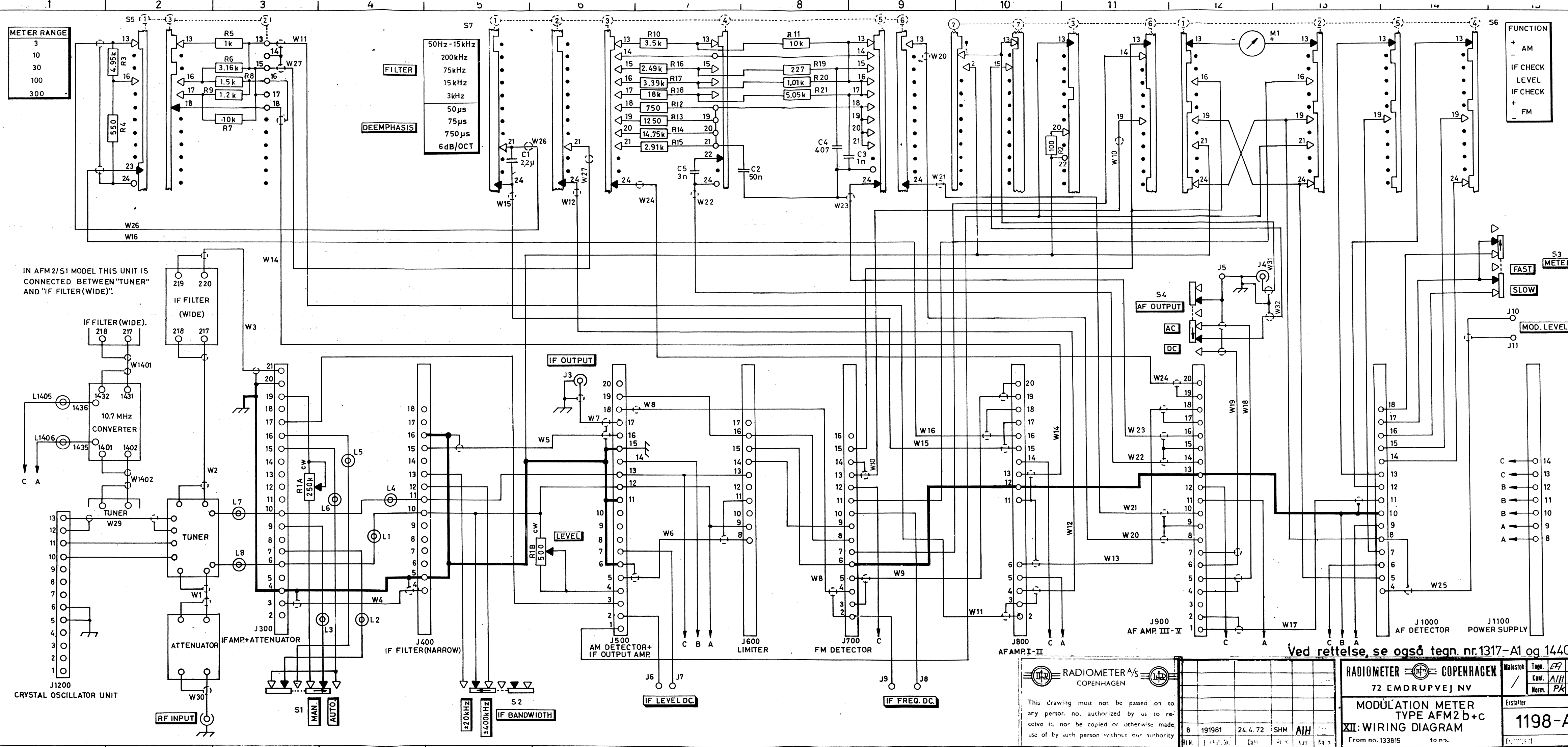


VALUES IN Ω OR pF IF
NOT OTHERWISE SPECIFIED

RADIOMETER A/S
COPENHAGEN

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4	175936	10.11.70	B.G.	OH	
3	144435	6.6.69	NH	AIH	PK
2	133865	25.9.68	NH		PK
1		5.7.68	SHM	AIH	PK



METER RANGE

3
10
30
100
300

FUNCTION

+	AM
-	IF CHECK
LEVEL	LEVEL
+	IF CHECK
-	FM

IN AFM 2/S1 MODEL THIS UNIT IS CONNECTED BETWEEN "TUNER" AND "IF FILTER (WIDE)".

Ved rettelse, se også tegn. nr. 1317-A1 og 1440-

RADIOMETER A/S
COPENHAGEN

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8	191981	24.4.72	SHM	A/H	
RLN.		Dato	Art. nr.	Kont.	Kont.

RADIOMETER COPENHAGEN

72 EMDRUPVEJ NV

MODULATION METER
TYPE AFM2 b+c
XII: WIRING DIAGRAM

From no. 133815 to no.

1198-A