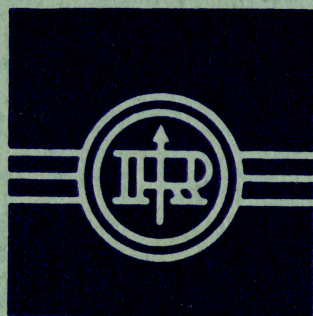


INSTRUCTION MANUAL

Type MSK2
CONVERTER



RADIOMETER

ELECTRONIC MEASURING INSTRUMENTS
FOR SCIENTIFIC AND INDUSTRIAL USE

INSTRUCTION AND OPERATING MANUAL
FOR

Type MSK2
CONVERTER

These instructions apply
to model MSK2 only

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INTRODUCTION

GENERAL

The type MSK2 extends the frequency range of the type MS26 FM-AM Standard-Signal Generator down to 0.1 Mc without changing the signal level or the modulation characteristics. The Converter can be used with any other generator that operates on the 150 to 205 Mc range.

DESCRIPTION

The principal elements of the Converter are a local oscillator operating at 150 Mc, a wide-band amplifier, and an output stage. With these circuits, input signals from 150.1 Mc to 205 are converted into a 0.1 to 55 Mc range.

By varying the local oscillator frequency around 150 Mc an incremental frequency facility is introduced. The dial is calibrated from -350 to +350 kc, and the calibration is independent of the output frequency.

The output-to-input voltage ratio is unity at a xl output with matched output, and about 5 at a high output (open circuit).

Output levels below 1 μ volt should preferably be drawn through a 20 dB pad to avoid noise from the local oscillator.

The instrument incorporates a regulated power supply for plates and filaments which ensures maximum stability of amplification and frequency.

SPECIFICATIONS

FREQUENCY

Output Frequency Range
0.1 to 55 Mc.

Input Frequency Range
150.1 to 205 Mc.

Incremental Frequency
0 to ± 350 kc read on a calibrated dial with divisions for every 10 kc.

xl OUTPUT VOLTAGE

The output voltage across a matched load is equal to the input voltage, i.e., the output voltage can be read directly on the attenuator dial of the type MS26.

Accuracy

The conversion ratio is accurate within ± 1 dB over the entire frequency range.

Stability

Less than 0.1 dB in output level is produced by a 10% change in the line voltage.

HIGH OUTPUT

The output voltage is uncalibrated. When the xl output is terminated in 75 ohms, the output voltage across a 10 pF load is approximately 5 times the input voltage over the frequency range.

INPUT IMPEDANCE

75 ohms nominal.

OUTPUT IMPEDANCE

75 ohms nominal at the xl output.

POWER SUPPLY

Voltages: 110 and 220 volts.
Line frequency: 50 to 60 cps.
Consumption: 35 watts

TUBES

2	ECC81	(12AT7)
2	5654	(6AK5)
1	EF80	(6BX6)
1	85A2	(5651)

OVER-ALL DIMENSIONS

Height	Width	Depth
200	565	285 mm
8	22 1/4	11 1/4 inches

WEIGHT

12.5 kilos net (28 lbs)

ACCESSORIES FURNISHED

1 type 6D6 coaxial cable (75 ohms) with BNC type UG-88/U plugs.
1 type 12G19-1.5 power cord.

EXTRA ACCESSORIES

TERMINATING UNIT type TPL2. Gives the correct matching to a 75 ohm generator output. The output impedance at the point is 37.5 ohms. The unit is furnished with a female BNC type UG-290/U socket.

20 dB PADS type FDL2/3. Small 20 dB attenuator terminated in a male and female type BNC connector. The impedances are:

type FDL2: 75 ohms
type FDL3: 50 ohms

BALANCING TRANSFORMER type UBT3 supplies a balanced output voltage. The frequency range is from 40 to 250 Mc.

Impedance ratio: 75 to 300 ohms

Voltage ratio: 1:1

VIDEO MODULATOR type MOD1 provides for video and pulse modulation of the signal generators. In addition, it can be used for high-quality AM. The frequency range is from 30 to 240 Mc.

Modulation frequency: d-c to 10 Mc (3 dB)

Amplitude modulation: 0 to above 95% AM with distortion less than 1%.

Pulse modulation: On-off ratio at least 40 dB with a rise-time of approx. 0.04 μ sec.

CABLE, type 3D6 coaxial cable (75 ohms) with one BNC type UG-88/U and one UHF type PL259 plug.

SECTION 1

OPERATING PRINCIPLE

The drawing appended to the manual shows the complete circuit diagram of the converter.

1.1 LOCAL-OSCILLATOR

The left-hand part of the tube V1 is operated as a Colpitts oscillator with a grounded cathode. The tank circuit of the oscillator consists of the coil L1 and the capacitors C1-C6 and C44. The major part of the tank capacitance is fixed. With the variable capacitor C1, which is carrying the incremental frequency dial, the frequency of the oscillator can be changed within a range of ± 350 kc. The operating frequency of the local-oscillator is normally 150 Mc. However, this frequency can be adjusted to approx. ± 2 Mc by the capacitor C8. With a slotted shaft on the front panel, the frequency can be adjusted to fit the actual frequency of the signal generator. The signal from the oscillator is coupled to the mixer circuit with the coil L2.

1.2 MIXER AND WIDE-BAND AMPLIFIER

The right-hand part of the tube V1 is operated as an additive mixer. The input signal from the input terminal J1 is applied across the cathode resistor R3 via the cable W1. With a cathode resistor of 100 Ω the input impedance of the mixer matches the cable (W1). The anode load of the mixer consists of a low-pass filter. This filter separates the anode-capacitance from the grid-capacitance of the next tube (V2). The coupling between the tubes V2 and V3 is similar to the coupling between the mixer (V1) and the tube V2. With the potentiometers P1 and P2 the amplification of the converter can be adjusted. One of the potentiometers P2, has a slotted shaft, which can be reached through the front panel (ADJ. AMPLIFICATION). The last stage (V4) has two output circuits. One of these, the cathode circuit, gives a low impedance output (75 ohms). The anode circuit gives a somewhat higher output, with a correspondingly higher output impedance (approx. 200 ohms).

1.3 POWER SUPPLY

The power supply is unconventional because both the anode voltage sup-

ply and the filament supply are regulated.

The regulating circuit incorporates a reactor T1 in series with the power transformer. The voltage drop across the reactor is controlled by a d-c magnetizing current.

The output voltage from the main rectifier system (CR2, L13, C41A-B) is compared with the voltage across a voltage reference tube (V6) in the right-hand part of the tube V5. The difference between these voltages is fed to the grid of the left part of the tube (V5). The anode current of this is led through the control winding of the reactor (T1).

The rectifier system, CR1, L12, C40A-B is an auxiliary circuit which supplies the output stage of the d-c amplifier (left part of V5).

The power supply can be set to a line voltage of 220 or 110 volts with the line voltage selector (J5, PL1).

SECTION 2 OPERATING INSTRUCTIONS

2.1 CONNECTION

Before connecting the instrument to the power line, make sure that the line voltage selector (J5, PL1) is set to the correct voltage. The voltage selector is accessible when the cover plate at the back of the cabinet has been removed.

Before the instrument leaves the factory, the voltage selector is set to 220 volts. When the voltage is changed it may be necessary to change the line fuse. (Located on the front panel). The correct value is stated in the item FUSE in this section.

2.2 CONTROLS, DIALS, AND TERMINALS

2.21 INCREMENTAL FREQ.

Provides for small frequency deviations of the output frequency. The scale is calibrated from -350 to +350 kc. The reading is valid over the entire frequency range.

2.22 ADJ. FREQUENCY

Screw-driver adjustment of the local-oscillator frequency to fit the frequency of the signal generator. Set the output frequency of the signal generator to 150 Mc and the INCREMENTAL FREQ. dial of the converter to zero. Remove the plug button, connect the head phones to the terminal HIGH OUTPUT, and adjust to zero beat.

2.23 ADJ. AMPLIFICATION

Adjusts the amplification between the input and the xl OUTPUT. The control is accessible when the plug button has been removed.

The output voltage can be measured with an adequate vacuum-tube voltmeter. Be sure that the converted frequency is within the frequency range of the voltmeter.

2.24 Power input terminals

Located to the lower left on the front panel. Should be connected to the power line by the type 12G19-1.5 power cord supplied with the instrument.

2.25 INPUT terminal

To obtain the converted frequency range 0.1 to 55 Mc the input frequency should be from 150.1 to 205 Mc. The input impedance is 75 ohms nominal.

Max. input voltage: 0.5 volts

The terminal is furnished with a BNC type UG-290/U connector, which fits the cable type 6D6.

2.26 x1 OUTPUT terminal

A level equal to the input level can be drawn from the x1 output terminal. When the input frequency is varied from 150.1 to 205 Mc the output frequency varies from 0.1 to 55 Mc. The terminal is furnished with a BNC type UG-290/U connector. The output impedance is 75 ohms nominal. The connector fits the cable type 6D6 which is supplied with the instrument.

Output levels below 1 μ volt should preferably be drawn through a 20 dB pad to avoid noise from the local oscillator.

2.27 HIGH OUTPUT terminal

A level somewhat higher than the input level can be drawn from this terminal. With the x1 OUTPUT terminal terminated in 75 ohms the HIGH-OUTPUT LEVEL in a 10 pF load will be approx. 5 times the input level.

2.28 Power line fuse

Protects the instrument against overload. The power line fuse is accessible on the front panel. At 220 volts a 0.25 amp, and at 110 volts a 0.5 amp. slow-blow fuse should be used.

2.29 Pilot lamp

6.3 volts 0.3 amp.

2.3 STEP-BY-STEP OPERATION

- (1) Make sure that the line voltage selector is set to the correct voltage.
- (2) Connect the instrument to the power line, turn it on, and allow it to warm up for five minutes or more.

- (3) Connect the input terminal to the signal generator output and set the generator to 150 Mc.
- (4) Set the INCREMENTAL FREQ. dial to 0 kc. Turn the ADJ. FREQUENCY control to zero beat. (Indicated by headphones connected to HIGH OUTPUT).
- (5) Set the signal generator to the desired converted frequency plus 150 Mc.

SECTION 3

MAINTENANCE

3.1 GENERAL

The type MSK2 Converter is designed to withstand a certain amount of rough treatment, but careful handling and proper operation result in a longer life and higher reliability. Such repairs as are necessary should only be made by skilled personnel, with the sufficient equipment to ensure that the repair is properly made.

3.2 REMOVING THE INSTRUMENT FROM THE CABINET

The instrument can be removed from the cabinet when the four fixing screws along the edge of the front panel have been removed.

3.3 TUBE REPLACEMENT

All the tubes can be easily replaced when the instrument is removed from the cabinet.

Tubes with average characteristics can be used for any replacement.

3.4 OPERATING VOLTAGES AND CURRENTS

The voltages and currents listed below can be used as a reference when servicing the Converter. These values are mean values from a series of measurements, deviations up to 20% may be neglected. The voltmeter should have a negligible consumption (vacuum-tube voltmeter). All voltages are measured to chassis.

VOLTAGE MEASUREMENTS

				d - c volts	a - c volts
				180	6.3
	"x"				
	"y"				
tube V5		pin	1	405	
			3	181	
			6	179	
			8	85	
tube V4		pin	1	1.8	
			7	170	
			8	140	
tube V3		pin	6	150	
			2-7	3.5	
			5	177	
tube V2		pin	6	150	
			2-7	3.5	
			5	177	
tube V1		pin	1	170	
			2	-2.2	
			3	0.5	
			6	180	
			7	-9	

CURRENT MEASUREMENTS

Total primary consumption at 220 volt line voltage	225 mA \sim
" " " " 110 " " "	430 mA \sim
Average d-c current in control winding of choke T1	12 mA d-c

PARTS LIST

When ordering parts please include:

- (1) Complete description of the part, inclusive of circuit reference.
- (2) Complete type-designation and factory number of the instrument.
- (3) If the component is not listed below, give a description of the function and the location of it.

CIRCUIT REF.

DESCRIPTION

CAPACITORS

C1	variable	drawing no. 981-A4				
C2	ceramic	40 pF	±5%	500 V	T.C.	-750.10 ⁻⁶ /°C
C3	ceramic	5 pF	±5%	500 V	T.C.	approx. 0
C4	ceramic	10 pF	±5%	500 V	T.C.	approx. 0
C5	ceramic	5 pF	±5%	500 V	T.C.	approx. 0
C6	ceramic	10 pF	±5%	500 V	T.C.	approx. 0
C7	ceramic	50 pF	±5%	500 V		
C8	variable	drawing no. 981-A4				
C9	ceramic	10 pF	±5%	500 V		
C10	polyester	2.7 nF	±10%	400 V		
C11	polyester	47 nF	±10%	400 V		
C12	polyester	2.7 nF	±10%	400 V		
C13-C15	trimmer	2.5 pF				
C16	polyester	0.1 μF	±10%	400 V		
C17-C18	polyester	47 nF	±10%	400 V		
C19	polyester	2.7 nF	±10%	400 V		
C20-C22	trimmer	2.5 nF				
C23	polyester	0.1 μF	±10%	400 V		
C24-C25	polyester	47 nF	±10%	400 V		
C26	polyester	2.7 nF	±10%	400 V		
C25-C29	trimmer	2.5 pF				
C30	polyester	0.1 μF	±10%	400 V		
C31-C34	ceramic	2 nF	±10%	400 V		
C35-C36	polyester	47 nF	±10%	400 V		
C37	polyester	2.7 nF	±10%	400 V		
C38	trimmer	4 pF				
C39	trimmer	6.4 pF				
C40A-B	electrolytic	2 x 24 μH		320/350 V		
C41A-B	electrolytic	2 x 24 μH		320/350 V		
C42-C43	metallized	1 μF		250 V		
	paper					
C44	trimmer	2.5 pF				
C45-C47	feed-through	2.5 nF		500 V		
F1	fuse, slow blow	0.4 amp	250 V (at 220 V)			
	fuse, slow blow	0.8 amp	250 V (at 110 V)			
I1	pilot lamp	0.3 amp	6.3 V			

CIRCUIT REF.		DESCRIPTION
J1-J2	connector	BNC type UG-262/U
J3	connector	BNC type UG-260/U
J4	power line socket	SBI 145-j
J5	socket tube octal	type 6014/1
J6	banana jack	4 mm non-insulated

INDUCTORS

L1	oscillator tank		drawing no. 988-A4
L2	oscillator coupling		drawing no. 988-A4
L3	RF	6 μ H	drawing no. 1867-A4
L4	RF	2.8 μ H	drawing no. 1867-A4
L5	RF	3 μ H	drawing no. 1867-A4
L6	RF	2.8 μ H	drawing no. 1867-A4
L7	RF	2.9 μ H	drawing no. 1867-A4
L8	RF	0.28 μ H	drawing no. 1867-A4
L9	RF	1.7 μ H	drawing no. 1867-A4
L10	RF	0.28 μ H	drawing no. 1867-A4
L11	RF	1.7 μ H	drawing no. 1867-A4
L12	choke filter	7 H	type DO-250
L13	choke filter	7 H	type 52-559

P1-P2	potentiometer	wirew.	500 Ω	1W
P3	potentiometer	wirew.	10 k	1W

PL1	plug	octal	drawing no. 979-A4
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RESISTORS

R1	carbon film	560 Ω	5%	0.5 W
R2	carbon film	22 k	5%	0.5 W
R3	carbon film	100 Ω	5%	0.5 W
R4	carbon film	22 k	5%	0.5 W
R5	carbon film	1 k	5%	0.5 W
R6	carbon film	680 Ω	5%	0.5 W
R7	carbon film	100 k	5%	0.5 W
R8	carbon film	39 Ω	5%	0.5 W
R9	carbon film	470 Ω	5%	0.5 W
R10	carbon film	10 k	5%	0.5 W
R11	carbon film	68 k	5%	0.5 W
R12	carbon film	1 k	5%	0.5 W
R13	carbon film	680 Ω	5%	0.5 W
R14	carbon film	100 k	5%	0.5 W
R15	carbon film	39 Ω	5%	0.5 W
R16	carbon film	470 Ω	5%	0.5 W
R17	carbon film	10 k	5%	0.5 W
R18	carbon film	68 k	5%	0.5 W
R19	carbon film	1 k	5%	0.5 W
R20	carbon film	390 Ω	5%	0.5 W
R21	carbon film	100 k	5%	0.5 W
R22	carbon film	150 Ω	5%	0.5 W
R23	carbon film	68 k	5%	0.5 W
R24	carbon film	10 k	5%	0.5 W

RADIOMETER

CIRCUIT REF.

DESCRIPTION

RESISTORS

R25	carbon film	1 k	5%	0.5 W
R26	carbon film	330 Ω	5%	0.5 W
R27	carbon film	33 k	5%	0.5 W
R28	wirew.	10 Ω	5%	0.5 W
R29	carbon film	270 Ω	5%	1 W
R30	carbon film	47 k	5%	0.5 W
R31	carbon film	47 k	5%	0.5 W
R32	carbon film	820 k	5%	0.5 W
R33	carbon film	33 k	5%	0.5 W
R34	carbon film	68 k	5%	1 W
R35	carbon film	10 k	5%	1 W
R36	carbon film	1 M	5%	0.5 W
R37	carbon film	2.2 k	5%	0.5 W
R38	carbon film	150 Ω	5%	0.5 W
R39	carbon film	120 k	5%	0.5 W

S1	switch	toggle	6 A	type RP 1915
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T1	transformer	power		drawing no. 84-24-17
T2	reactor			drawing no. 84-24-18

TUBES

V1	ECC1 (12AT7)	Philips
V2-V3	5654 (6AK5)	Philips
V4	EF80 (6BX6)	Philips
V5	ECC81 (12AT7)	Philips
V6	85A2 (5651)	Philips

W1-W2	cable	coaxial	75 ohms	type K19M
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INCREMENTAL FREQ.

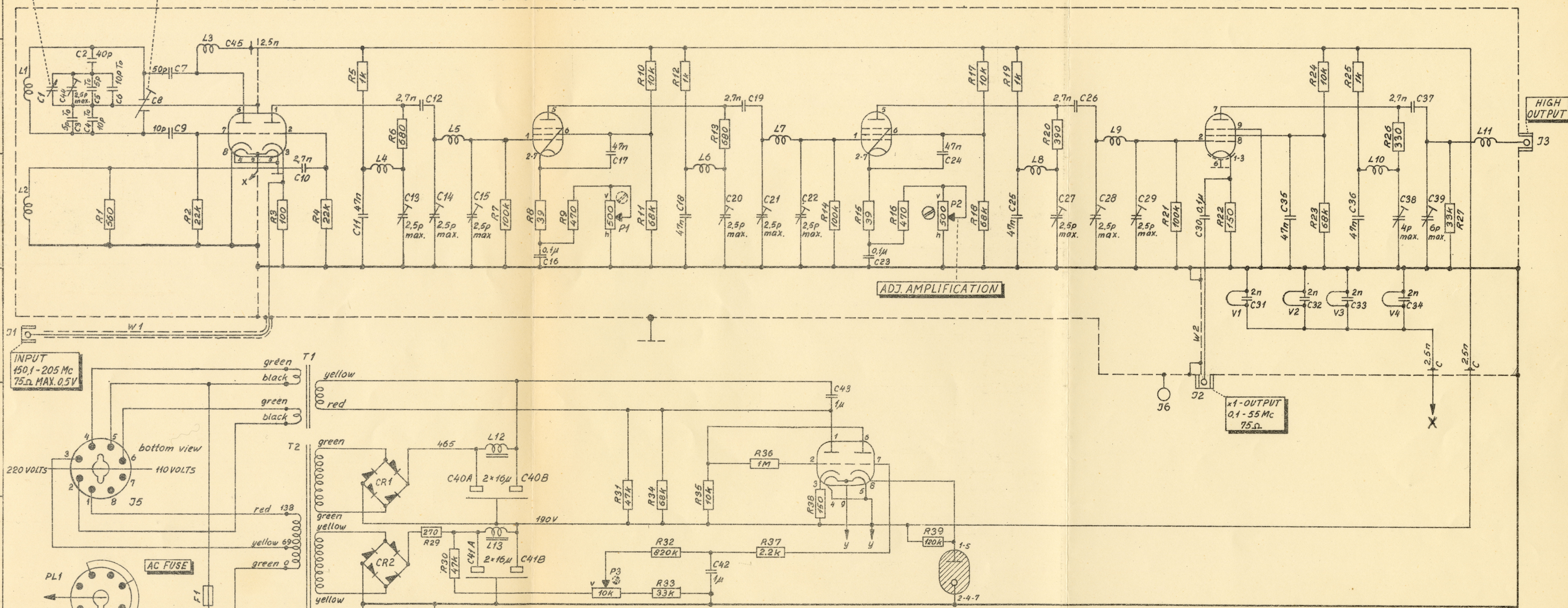
ADJ. FREQUENCY

LOCAL OSCILLATOR/CATHODE FOLLOWER
V1 - ECC81-12AT7

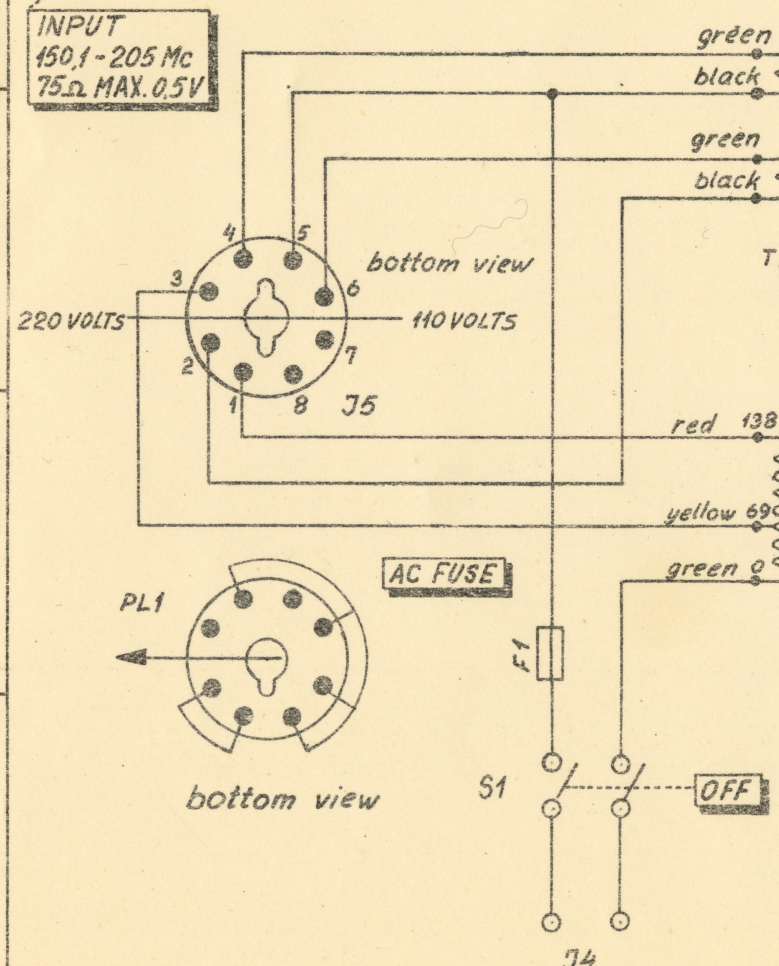
1. AMPLIFIER
V2 - EF95-5654-6AK5

2. AMPLIFIER
V3 - EF95-5654-6AK5

3. AMPLIFIER
V4 - EF80-6BX6



ADJ. AMPLIFICATION



REGULATOR AMPLIFIER
V5 - ECC81-12AT7

REFERENCE TUBE
V6 - 85A2-5651

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This drawing must not be passed on to any person not authorized by us to receive it, nor be copied or otherwise made use of by such person without our authority.

RADIOMETER COPENHAGEN		Årstatist	Årstatist
72 EMDRUPVEJ NV		Kont.	Kont.
Converter		Norm.	Norm.
TYPE MSK 2a		1279-A2	
From no.	to no.	Erstatet af	