Måleinstrument information

WATTMETER RWM 4

Type 8800001

B&O WATTMETER RWM 4
- for måling af udgangseffekt.

WATTMETER RWM 4 er et instrument til måling af udgangseffekt indtil 2×100 watt i lavfrekvensområdet.

Indgangsbøsninger for to kanaler, venstre og højre, for målinger på stereoforstærkere. Til kontrol af udgangseffekt, signal/støjforhold, kanalseparation, kanalforskel, kanalbalance og som outputmeter ved trimning af antenne- og oscillatorkredse.

Indbygget belastning 4 ohm for begge kanaler. Måling på én kanal ad gangen, konstant belastning af begge.

Overskuelig, let aflæselig skala, kalibreret i både watt og dB.

Trykknapper for valg af måleområde og funktion, giver god overskuelighed og enkel og hurtig betjening.

Tilslutning for to monitorhøjttalere, der kan dæmpes 20 dB under målinger.

Frekvensområde 20 Hz – 200 kHz lineært. Indbygget »ørefilter«, der bl. a. anvendes ved signal/støj målinger og til undertrykkelse af »brum«.

Høj følsomhed, laveste aflæsning 0,01 µW.

Tilslutning for oscilloskop til kontrol af kurveform.

Høj stabilitet under lang tids drift og overfor netspændingsvariationer, 2 % ved 10 % netspændingsændring.

Metalkabinet i sølvgrå og hammertakeret udførelse. De ydre dimensioner indgår i et modulsystem, der svarer til andre B & O måleinstrumenter.

WATTMETER RWM 4 leveres komplet med måleledninger og instruktionsbog.

TEKNISKE DATA

Område:
0,01 µW – 100 W (÷ 50 – + 50 dBm) i 8 områder med fuldt udslag for 10, 100 µW, 1, 10, 100 mW, 1, 10, 100 W.

Skalaer:
0 – 100 µW og 0 – 20 dB.

Indgangsimpedans:
2 × 4 ohm (DIN 45500) for f ⩽ 100 kHz.

Frekvensområde:
Uden filter ÷ 3 dB: 8 Hz – 700 kHz.
Uden filter ÷ 1 dB: 16 Hz – 350 kHz.
Med filter ÷ 3 dB: 550 Hz – 12 kHz.
Med filter ÷ 20 dB: 100 Hz – 80 kHz.

Filter:
IEC 123 A – DIN 5045.

Udgange:
HØJTTALERE:
: 2 × 4 Ω, 2 × 100 W max.
: 2 × 4 Ω, + 20 dB (medhør).

OSCILLOSKOP:
Ca. 0,2 V_{pp} ved fuldt udslag på instrumentet.

Nøjagtighed:
5 % (typisk 2 %) af fuldt udslag.

Stabilitet:
2 % ved 10 % netspændingsændring.

Rør:
ECC 81, EF 80.

Dioder:
4 × OA85, 2 × E250C750.

Nettilslutning:
110, 130, 220 eller 240 V
50/60 Hz.
Forbrug ca. 10 VA.

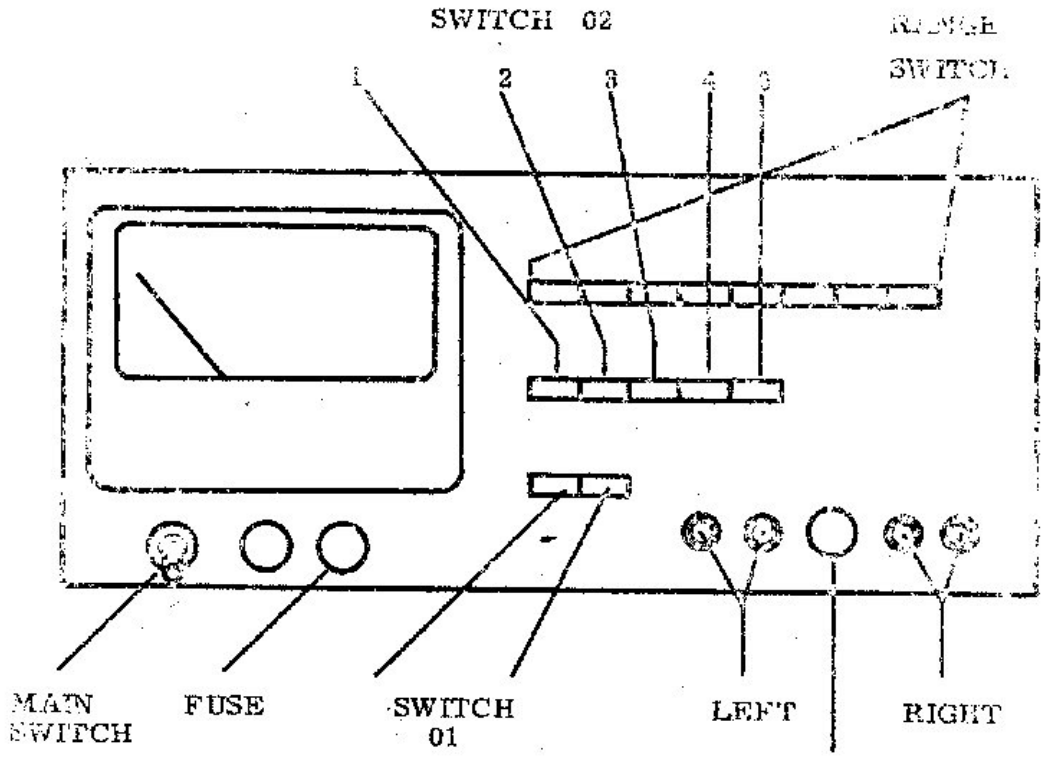
Dimensioner (kabinet):
Bredde: 323 mm.
Dybde: 210 mm.
Højde: 160 mm.

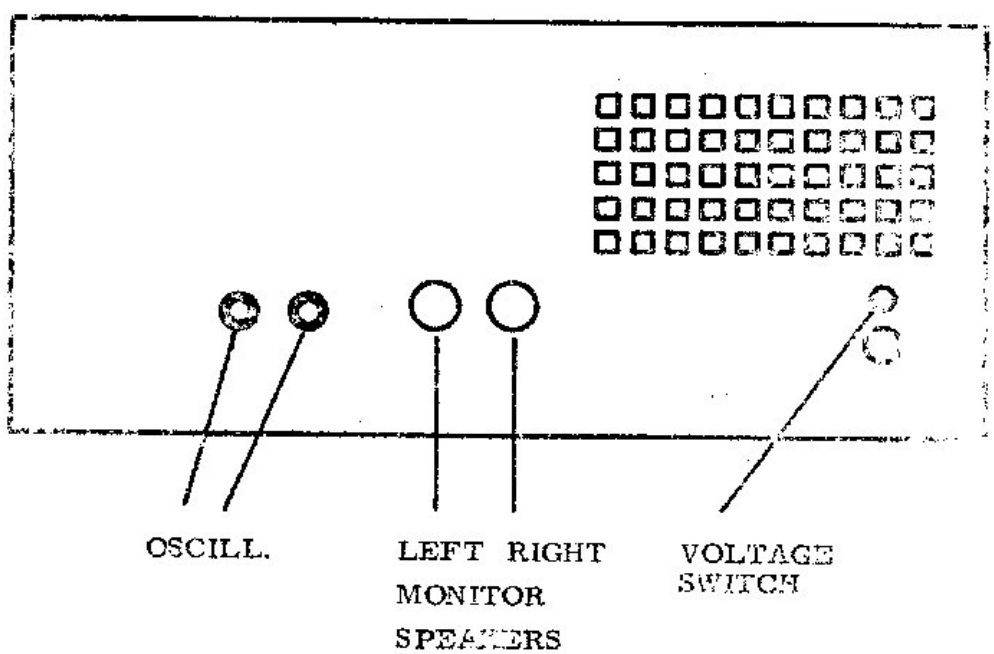
Vægt:
6,3 kg

Overflade:
Sølvgrå og blå hammerlak.

Tilbehør:
1 instruktionsbog.
1 ledning 5 pol. DIN – 2 × HT.
1 ledning 5 pol. DIN – 4 × banan.

BANG & OLUFSEN AVS / STRUER / DENMA


SWITCH 02
1
2
3
4
5
MAIN SWITCH
FUSE
SWITCH 01
LEFT
RIGHT
LEFT 1 - 3
RIGHT 4 - 5
AMPLIFIER OUTPUTS


OSCILL.
LEFT RIGHT
MONITOR
SPEAKERS
VOLTAGE SWITCH

SPECIFICATIONS

Range:	0.01 µW - 100 W (- 50 - +50 dBm) in 8 ranges with full-scale deflection for 10 µW, 100 µW, 1 mW, 10 mW, 100 mW, 1 W, 10 W, 100 W.
Scales:	0 - 100 µW and 0 - 20 dB.
Input Impedance:	2 × 4 Ω (DIN 45500) for frequencies below 100 kHz.
Frequency Range:	
without filter, - 3 dB	8 Hz - 700 kHz.
without filter, - 1 dB	16 Hz - 350 kHz.
with filter *, - 3 dB	550 Hz - 12 kHz.
with filter, - 20 dB	100 Hz - 80 kHz.
Speaker Outputs:	2 × 4 Ω, 2 × 100 W max.
	2 × 4 Ω, - 20 dB (monitoring)
Oscilloscope Output:	Approx. 0.2 V_{p-p} at full-scale meter deflection.
Accuracy:	5 % (typically, 2 %) of full-scale deflection.
Stability:	2 % at 10 % mains voltage change.
Valves:	ECC 81, EF 80.
Diodes:	4 × OA 85, 2 × E 250 C 750.
Power Supply:	110, 130, 220, 240 V - 50/60 Hz.
Power Consumption:	10 VA.
Dimensions:	325 mm wide. 225 mm deep. 165 mm high.
Weight:	6.3 kg.
Finish:	Silver grey and blue hammertone.

* IEC 123 A - DIN 5045.

DESCRIPTION

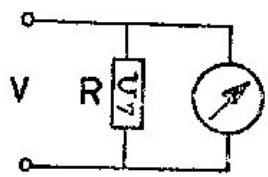
The B & O RWM 4 Wattmeter is a service instrument for power output measurements on radio and television receivers, amplifiers, record players, tape recorders etc., from a maximum of 100 W all the way down to 0.01 μW (10 nW) at a load impedance of 4 Ω (standardized impedance according to DIN 45500).
Power measurements may be made linearly in the frequency range 20 Hz - 200 kHz, or corrected according to IEC No. 123 (DIN 5045).
The RWM 4 has provision for connection of an oscilloscope (min. sensitivity 50 mV/cm) for curve-form checking, and two monitor speakers (left and right). These speakers can be attenuated 20 dB for monitoring (20 dB corresponds to a power reduction of 100 times - 1 W is more pleasant to listen to than 100 W!).

Installation

The RWM 4 may be operated from the following mains voltages: 110 V, 130 V, 220 V, and 240 V. Power consumption is approx. 10 W.
Make sure, before applying power to the instrument, that the voltage changeover switch on the back of the instrument is set for your local mains voltage. In order to minimize hum etc., the instrument should be earthed, for instance by connecting it to a wall outlet equipped with a protective earth contact. The buttons marked "100 W" and "⏚" should be depressed before applying power to the instrument.

Mode of Operation

The RWM 4 is a wattmeter for measurement of power levels at 4-Ω load impedance in the low-frequency range 20 Hz - 200 kHz.
Basically, it is a wattmeter having a known input impedance (4 Ω) and a moving-coil meter calibrated in watts.



$$P = V \cdot I = \frac{V^2}{R} \qquad (1)$$

$$V^2 = P \cdot R = 4P$$

$$V = 2\sqrt{P} \qquad (2)$$

Fig. 1. Using the RWM 4 as a voltmeter.

Consequently, the RWM 4 may also be used as a voltmeter at a load impedance of 4 Ω if the constant in eq. 2 is taken into consideration.

Example: Power reading 100 W $V_{100\,W} = 2\sqrt{100} = 20$ V

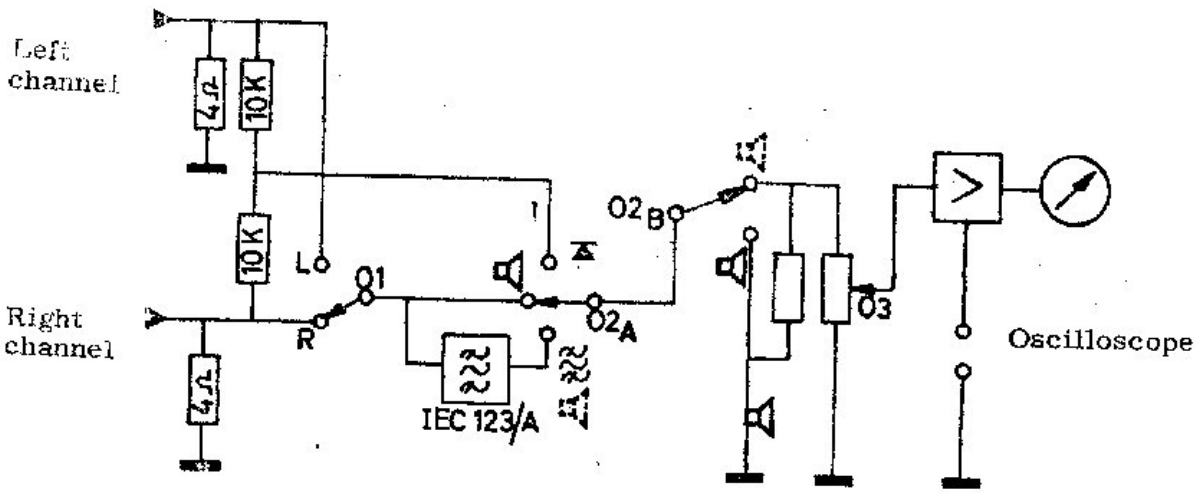


Fig. 2. Block diagram of RWM 4

The object under measurement are terminated in loads of 4 Ω each, on both left and right channels (see Fig. 2). Switch 01 selects the channel to be measured.

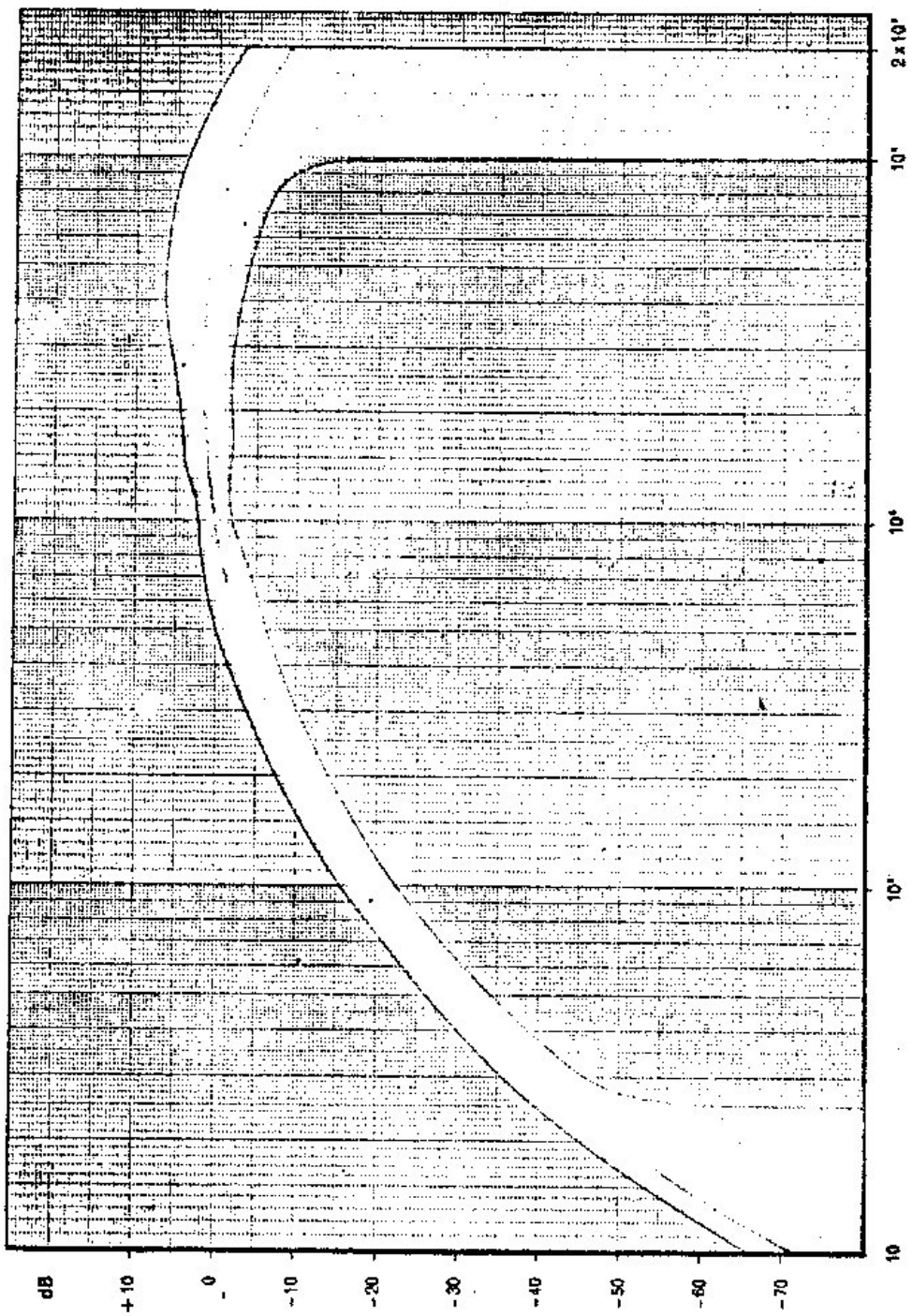


Fig. 3 Filter IEC 123
Weighting curve A.

Note that the 4-Ω load should not be removed.

Switch 02 selects the following functions:

(1) Measurement of power output on the built-in moving-coil meter.
Attenuated monitoring (- 20 dB) on external speakers.

(2) As under (1) above, but with a weighting curve filter connected - IEC 123/A (Fig. 3). This filter should be used especially in signal-to-noise and crosstalk measurements.

(3) As under (1) above, but without monitoring.

(4) Monitor speakers connected directly (unattenuated!).

(5) Measurement of channel balance. The moving-coil-meter reading approaches 0 when the signal voltages applied to the left and right channels are equal and 180 degrees out of phase. Attenuated monitoring as under (1) above.

Switch 03 selects the desired measuring range. The switch connects to an amplifier which supplies the moving-coil meter with current (full-scale deflection 0.2 mA). The same amplifier has an output for connection of an oscilloscope for checking the curve form (0.1 - 0.2 V_{p-p} at full-scale deflection). The oscilloscope should have high-impedance input).

Applications

(1) Alignment of AM and FM Intermediate Frequency Circuits.

(Recommended for use only if no sweep equipment is available). Connect a signal generator to the IF section of the receiver in the usual manner. Depress buttons marked "⊙ 🔊" and " 100 mW". Advance the output attenuator until the RWM 4 reads approx. 50 mW.
Align all circuits for max. deflection in the sequence indicated by the manufacturer, stepwise reducing the signal-generator attenuator setting so that the RWM 4 continues to read 50 mW.

(2a) Alignment of AM/FM Oscillator and Signal Frequency Circuits.

Connect a signal generator to the receiver aerial input via a standard dummy aerial. Depress buttons marked "⊙ 🔊 " and "100 mW". Tune the oscillator and signal-frequency circuits for max. deflection on the RWM 4 whilst keeping the signal generator adjusted for 50 mW output. The 50 mW sensitivity may then be read on the signal generator.

(2b) Checking the Signal-to-noise Ratio. Using the set-up described under (2a) above, adjust the signal generator output (modulated) to produce a 50 mW deflection on the RWM 4. This corresponds to 17 dBm (dBm = dB over 1 mW).
Switch off the signal generator modulation and read the new deflection, X, on the RWM 4. The signal-to-noise ratio may then be found as

$$S/N_{(50\ mW)} = (17 - X)\ dB \qquad (3)$$

50 mW is normally employed as reference level, but 500 mW and 5 W are often used in recent receiver designs.

$$S/N_{(500\ mW)} = (27 - X)\ dB \qquad (4)$$

$$S/N_{(5\ W)} = (37 - X)\ dB \qquad (5)$$

Service manuals often specify the use of a weighting curve filter (Fig. 3). The RWM 4 incorporates such a filter. To use it, depress the "≋" button instead of "Ⓐ". The above formulas should be used ((3), (4) and (5)).

Example: To find the signal-to-noise ratio at 500 mW, adjust the receiver output for 500 mW, switch off the signal generator modulation, and read the wattmeter deflection, say X = - 10 dB (100 µW). Then

$$S/N_{(500\ mW)} = 27 - (-10) = 27 + 10 = 37\ dB.$$

(3) Measurement of Noise in AF Amplifiers with Volume Control at Minimum and Maximum, Respectively. Depress the "Ⓐ" or the "Ⓐ" button. Set the bass and treble controls as specified by the manufacturer. If it is desired to measure noise in the intermediate AF range - in other words, noise other than hum - depress the "≋" button.

To measure minimum noise, be sure to turn the volume control fully anti-clockwise.

To measure maximum noise, be sure to turn the volume control fully clockwise.

The results of both measurements are normally given in µW - not in dBm.

(4) Max. Power Output and AF Sensitivity are measured with either the "Ⓐ" or the "Ⓐ" button depressed. Connect an AF sine wave generator to the AF input of the amplifier and increase its output to the point where the wattmeter deflection stops rising. An oscilloscope should be connected to the RWM 4 in order to make it possible to prevent clipping. The amount of power read on the wattmeter corresponds to full drive (sine-wave). The AF generator output setting then represents the sensitivity at full drive, normally approx. 4 mV for low-impedance inputs, approx. 47 k Ω; and approx. 200 mV for high-impedance inputs, approx. 470 k Ω.
The measurement is normally made at 1000 Hz.

(5a) Difference between Channels in stereo amplifiers is measured with the "Ⓐ" or the "Ⓐ" button depressed. The amplifier's balance control should be in the neutral position. An AF sine wave generator should be connected to the amplifier input. The difference between channels is calculated as the difference between power level readings obtained for the right and left channels.

Example: Power level reading for left channel 25.2 dB
Power level reading for right channel 24.6 dB
Difference between channels = 25.2 - 24.6 = 0.6 dB.

(5b) Channel Balance. It is recommended that adjustment of the amplifier balance control be made with the control at " ▼ ", adjusting for minimum deflection. However, this method can be used only if the left and right channels are 180 degrees out of phase at the wattmeter input. If this is not the case, balance can be adjusting for identical deflections on the left and right channels with the " ⏻ " button depressed.

(6a) Cross-talk Attenuation (channel separation) is measured with the " ≋ " button depressed and with an AF sine wave generator connected to the left channel of the amplifier. Normal frequencies used for this measurement are 1000 and 10000 Hz. Depress the "L" button and increase the power output until approx. half drive is obtained, say 1 W (= 30 dBm). Depress the "R" button and note the cross-talk in the right channel.

Example: P_L = 30 dBm, P_R = - 22 dBm.

Cross-talk attenuation L/R = 30 - (- 22) = 52 dB.

The R/L cross-talk attenuation is measured similarly by driving the right channel to 30 dBm and measuring the cross-talk power in the left channel.

Example: P_R = 30 dBm, P_L = - 18 dBm

Cross-talk attenuation R/L = 30 - (- 18) = 48 dB.

(6b) Cross-talk Attenuation for Stereo-Multiplex is measured as described under (6a) above except that the AF generator should be replaced by a stereo generator connected to the receiver aerial input NOTE: The stereo generator should have a cross-talk attenuation of not less than 50 - 60 dB in order not to affect measurements.

LAB. STYKLISTE

Kvt.	Enhed	Mat. nr.	Materialebetegnelse	Fabrikat	Perf.	Afd.	Bånd	Pl.nr.	Pos.nr.	Bem.
R 1			Resistor 12Ω - 3o W 2311oo	Vitrohm					62	
R 2			Resistor 12Ω - 3o W 2311oo	Vitrohm					62	
R 3			Resistor 12Ω - 3o W 2311oo	Vitrohm					62	
R 4			Resistor 12Ω - 3o W 2311oo	Vitrohm					62	
R 5			Resistor 1o,8+1,7Ω -3oW 34-5239	Vitrohm					63	
R 6			Resistor 1o,8+1,7Ω -3oW 34-5239	Vitrohm					63	
R 7		537ooo3	Potentiometer 1 KΩ S 76 K	Ruwido					75	
R 8		5o11o3o	Resistor 1,2 KΩ -5% 1/3 W - B	Beyschlag					54	
R 9		5o11o3o	Resistor 1,2 KΩ -5% 1/3 W - B	Beyschlag					54	
R 1o		5o11o22	Resistor 47oΩ 5% 1/3 W - B	Beyschlag					52	
R 11		5o11o44	Resistor 1o KΩ 5% 1/3 W - B	Beyschlag					56	
R 12		5o11o44	Resistor 1o KΩ 5% 1/3 W - B	Beyschlag					56	
R 13			Resistor 15 KΩ 1% CEB/TO	Vitrohm					49	
R 14			Resistor 4,75 KΩ 1% CEB/TO	Vitrohm					47	
R 15			Resistor 2,2 KΩ 1% CEB/TO	Vitrohm					45	
R 16			Resistor 1o KΩ 1% CEB/TO	Vitrohm					48	
R 17			Resistor 3,16 KΩ 1% CEB/TO	Vitrohm					46	
R 18			Resistor 1 KΩ 1% CEB/TO	Vitrohm					44	
R 19			Resistor 316Ω 1% CEB/TO	Vitrohm					43	
R 2o			Resistor 1ooΩ 1% CEB/TO	Vitrohm					42	
R 21			Resistor 46,3Ω 1% CEB/TO	Vitrohm					41	
R 22		5o11o74	Resistor 2,2 MΩ 5% 1/3 W - B	Beyschlag					59	
R 23		5oo1o29	Resistor 1 KΩ 1o% 1/2 W - GBT	Vitrohm					61	
R 24		5o11o28	Resistor 1 KΩ 5% 1/3 W - B	Beyschlag					53	
R 25		5o11o44	Resistor 1o KΩ 5% 1/3 W - B	Beyschlag					56	
R 26		5o11o48	Resistor 22 KΩ 5% 1/3 W - B	Beyschlag					57	
R 27		5o11o74	Resistor 2,2 MΩ 5% 1/3 W - B	Beyschlag					59	
R 28			Potentiometer 1ooΩ S 1420	Ruwido					76	
R 29		5o11oo7	Resistor 33Ω 5% 1/3 W - B	Beyschlag					5o	
R 3o		5o11o15	Resistor 15oΩ 5% 1/3 W - B	Beyschlag					51	
R 31		5o11o22	Resistor 47oΩ 5% 1/3 W - B	Beyschlag					52	
R 32		5o11o48	Resistor 22 KΩ 5% 1/3 W - B	Beyschlag					57	
R 33		5o12o41	Resistor 47 KΩ 5% 1 W - B	Beyschlag					6o	
R 34		5o11o74	Resistor 2,2 MΩ 5% 1/3 W - B	Beyschlag					59	
R 35		5o11o22	Resistor 47oΩ 5% 1/3 W - B	Beyschlag					52	
R 36		5o12o41	Resistor 47 KΩ 5% 1 W - B	Beyschlag					6o	
R 37		5o11o37	Resistor 3,3 KΩ 5% 1/3 W - B	Beyschlag					55	
R 38		5o11o5o	Resistor 33 KΩ 5% 1/3 W - B	Beyschlag					58	

Udsendt af: BL | Udsendt: 1o.1d968 | 3 Blade. Blad: 1

Angående: Wattmeter, Replaceable Parts

Type: RWM 4 | Nr. 9o45o22

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820 815

457

LAB. STYKLISTE

Kvt.	Enhed	Mat. nr.	Materialebetegnelse	Fabrikat	Perf	Afd.	Bånd	Pl.nr.	Pos.nr
C 1		4133oo7	Capacitor 1 µF - 25o V polyest.	Philips					24
C 2		4133oo3	Capacitor 1o nF - 25o V polyest.	Philips					29
C 3		4133oo9	Capacitor 47 nF - 25o V polyest.	Philips					28
C 4		4134oo6	Capacitor o,1 µF - 4oo V polyest.	Philips					26
C 5		42o1o17	Capacitor 1o µF - 64 V electrol.	Philips					21
C 6		4134oo6	Capacitor 47 nF - 4oo V polyest.	Philips					27
C 7		42o1o17	Capacitor 1o µF - 64 V electrol.	Philips					21
C 8			Capacitor 16 µF - 45o V electrol.	Philips					2o
C 9			Capacitor 16 µF - 45o V electrol.	Philips					2o
C 1o		4134oo6	Capacitor 47 nF - 4oo V polyest.	Philips					27
C 11			Capacitor 16 µF - 45o V electrol.	Philips					2o
C 12		4133oo7	Capacitor 1 µF - 4oo V polyest.	Philips					24
C 13		42ooo42	Capacitor 125 µF - 16 V electrol.	Philips					22
C 14			Capacitor 16 µF - 45o V electrol.	Philips					2o
C 15		4134oo6	Capacitor 47 nF - 4oo V polyest.	Philips					27
C 16			Capacitor 16 µF - 45o V electrol.	Philips					2o
C 17		4o21oo1	Capacitor 4,7 nF - 5 KV ceram.	Ferroperm					3o
C 18		4o21oo1	Capacitor 4,7 nF - 5 KV ceram.	Ferroperm					3o
C 19		4134oo3	Capacitor o,47µF - 4oo V polyest.	Philips					25
D 1		831oo16	Diode E 25o C 75o ESK	Semikron					14
D 2		831oo18	Diode E 25o C 75o ESK	Semikron					14
D 3		83ooooo8	Diode OA 85	Philips					12
D 4		83ooooo8	Diode OA 85	Philips					12
D 5		83ooooo8	Diode OA 85	Philips					12
D 6		83ooooo8	Diode OA 85	Philips					12
I			Moving Coil Meter 2oo µA DS 12o B	Jensen Elect.					13
S			Fuse 8o mAT - 25o V	ELU					89
Tr			Power Transformer 16 - 12558	Jørgen Schou					95
		614o1o2	PW - board, amplifier	Y&F					78
V 1		92o1oo2	Tube ECC 81	Philips					64
V 2			Tube EF 8o	Philips					85
			Panel lamp. 38o628-2	AMP					37

Udsendt af: BL	Udsendt: 1o.1o. 1968	3 Blade. Blad: 2	
Angående: Wattmeter, Replaceable Parts		Type: RWM 4	Nr. 9o45o22

LAB. STYKLISTE

Kvt.	Enhed	Mat. nr.	Materialebetegnelse	Fabrikat	Perf.	Afd.	Bånd	Pl.nr.	Pos.nr	Bem.
		74o1oo1	Mains tapping switch	Teckent					71	
			Power switch B 82 MA/S	Torotex					1	
		74o2o73	L/R switch MATL - 2	MEC					73	
		74o2o75	Function switch MAT - 5	MEC					74	
		74o2o74	Range switch MATL - 8	MEC					7?	
			Input termination PKi 1o A - red	Hirchmann					32	
			Input termination PKi 1o A - black	Hirchmann					33	
		7212oo7	Input socket, 5 - pin 533 A	Jungbecker					88	
			Oscilloscope termination RC 12 - red	Zehnder					93	
			Oscilloscope termination RC 12 - black	Zehnder					94	
		7211o17	Loudspeaker socket 554 A	Jungbecker					87	
		72o3oo3	Socket for V 1 - V 2 199 GV 12	IE					15	
		31o3ooo	Rubber foot Form 124	Skan.Gum					17	

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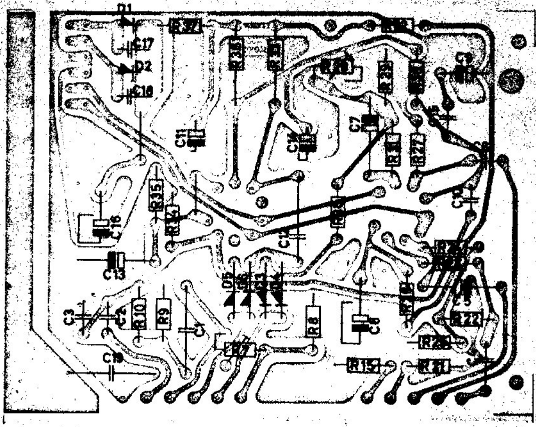
Udsendt af: BL | Udsendt: 1o.1o.1968 | 3 Blade. Blad: 3

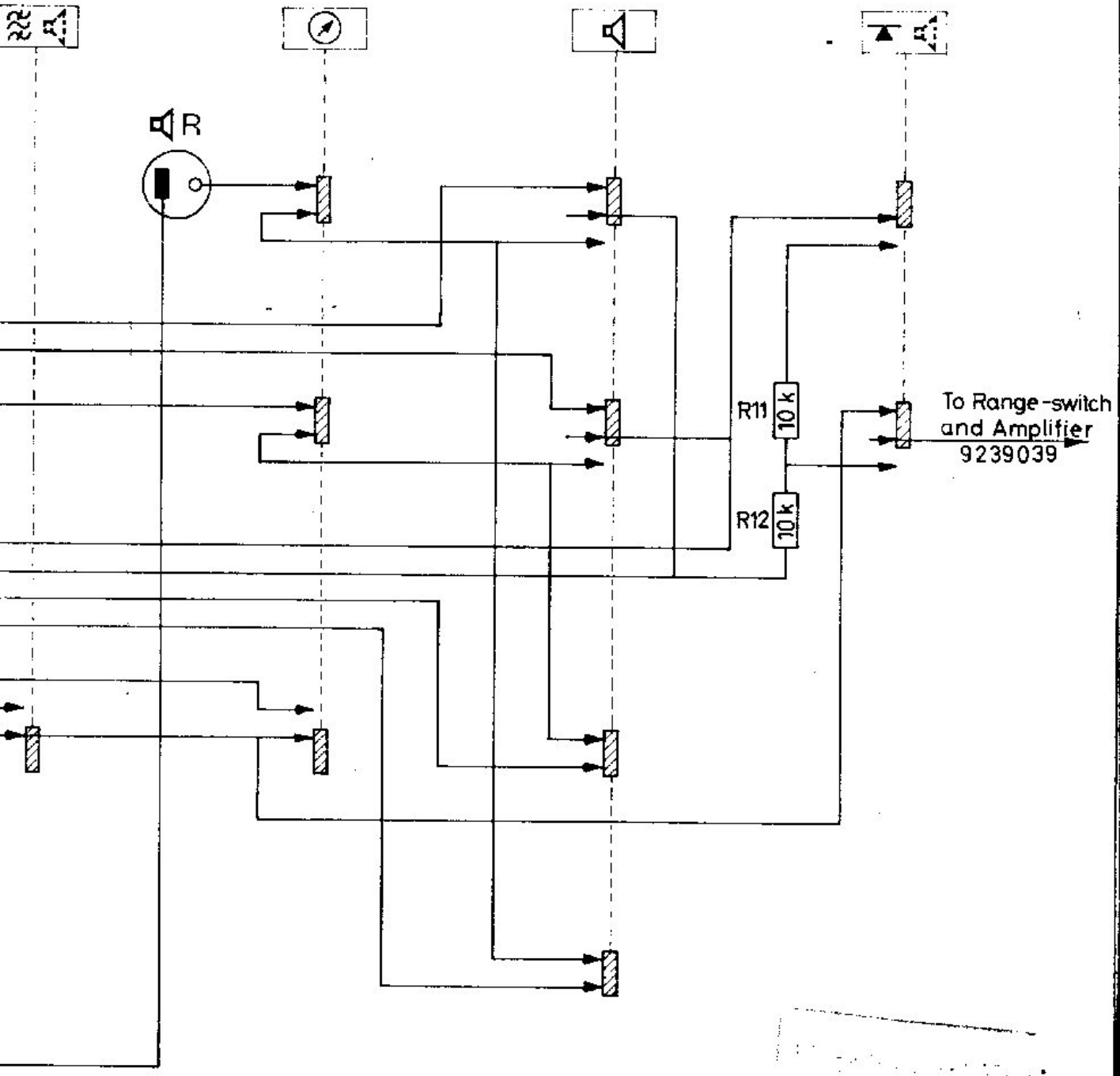
Angående: Wattmeter, Replaceable Parts | Type: RWM 4 | Nr. 9o45o22



REGISTRET AFD.	AN-TAL
18 NOV. 1969	

INSTRUKTION VEDR.	UDSTEDT 15-10-68	1 BLADE – BLAD 1
Wattmeter RWN4 Component Location	KONTR.	8045021
	GODK.	

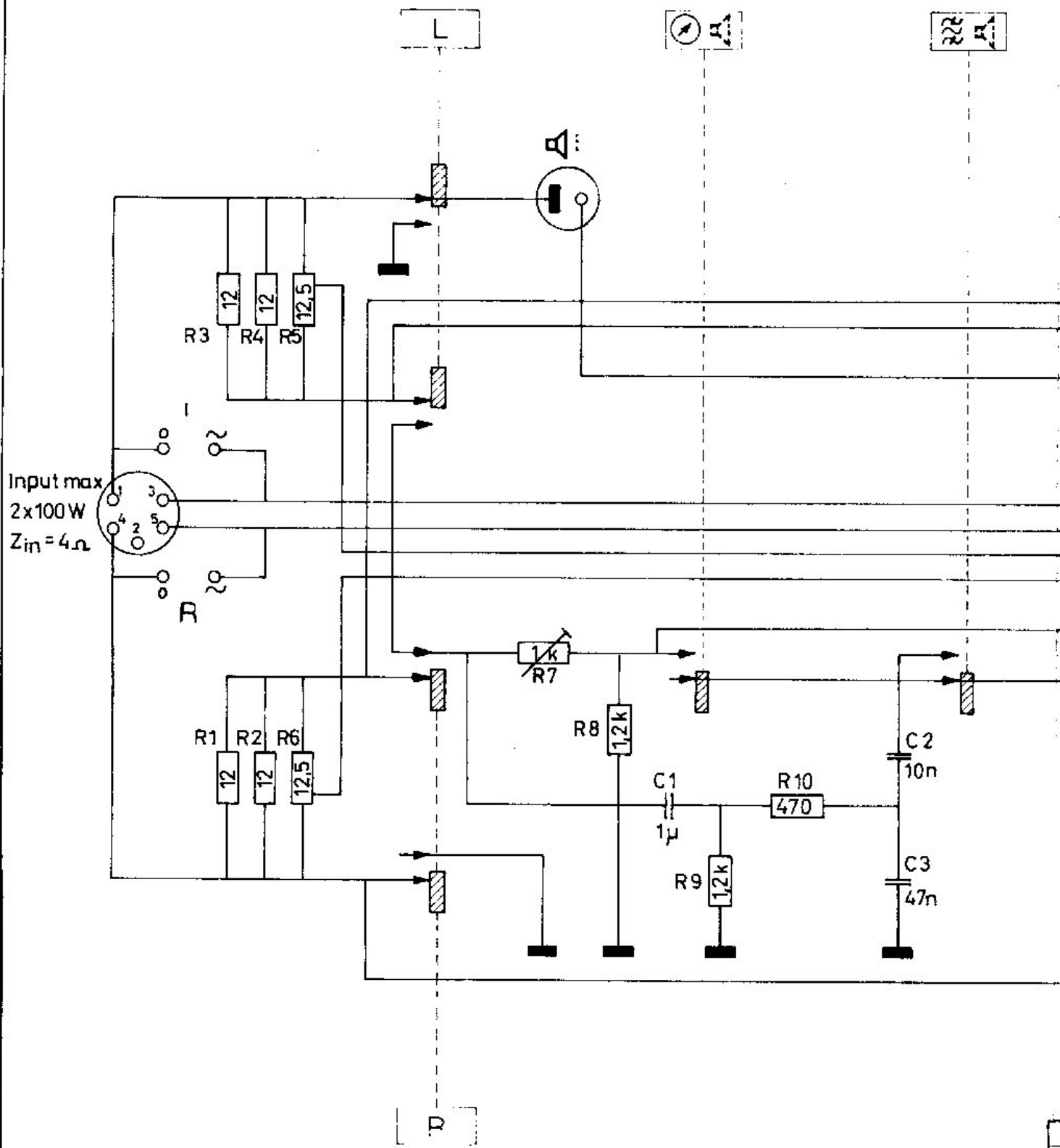
Bang & Olufsen A/S | SETTET | A | B | C | D | E | F

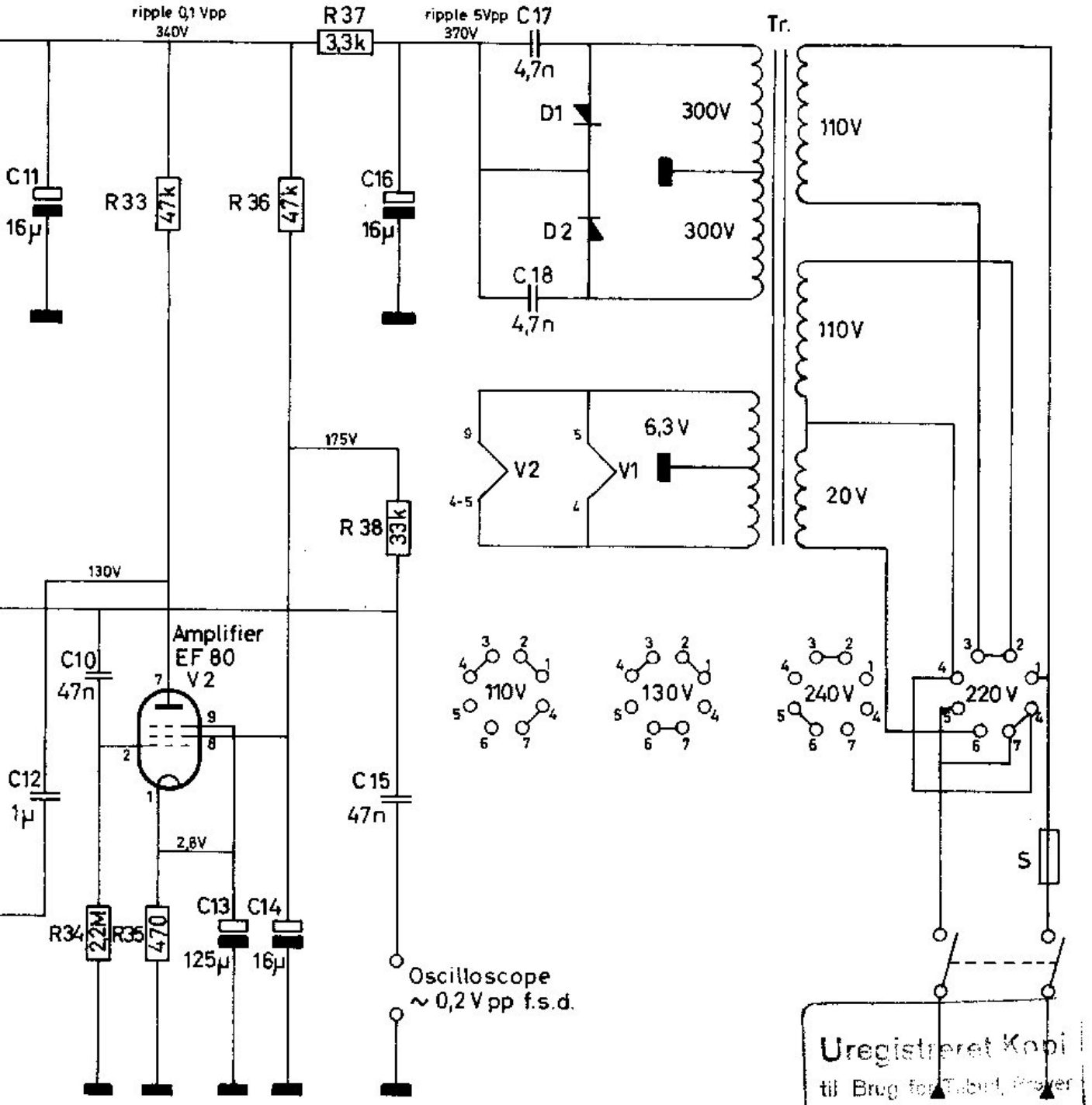


RETTET KONTR./GODK.	A	B	C	D	E	F	G	H
MATERIALE				OVERFLADE		AFVIGELSE FOR ALLE MÅL UDEN TOLERANCEANGIVELSE, DS 2075		
DIMENSION						FORM- OG POSITIONSTOLERANCER, DS/R 2083.1-2		

VÆGT	KONSTR.	TEGNET	KONTR.	GODKENDT	MÅLESTOK	ERSTATNING FOR
	BL 9-10-68	FB	BL	BL		ERSTATTES AF

Bang & Olufsen % DIAGRAM 1 WATTMETER, BWM 4 9130037

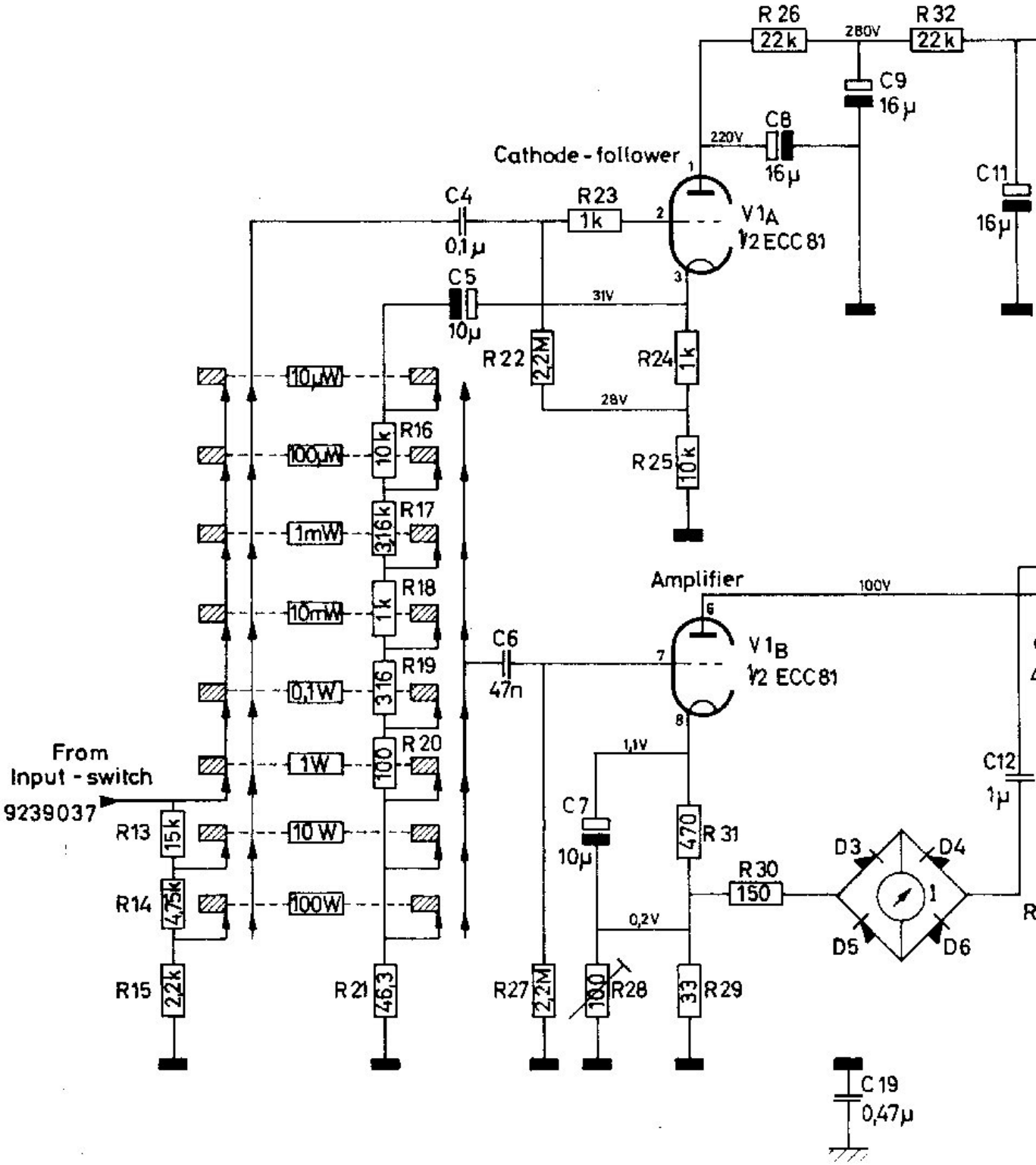




RETTET / KONTR./GODK.	A	B	C	D	E	F	G	H

MATERIALE				OVERFLADE		AFVIGELSE FOR ALLE MÅL UDEN TOLERANCEANGIVELSE. DS 2075	
DIMENSION						FORM – OG POSITIONSTOLERANCER, DS/R 2083.1-2	
VÆGT	KONSTR. BL 8-10-68	TEGNET FB	KONTR. BL	GODKENDT BL	MÅLESTOK	ERSTATNING FOR	
						ERSTATTES AF	

Bang & Olufsen A/S	DIAGRAM 2. WATTMETER RWM 4.	9239039



REGISTR. AFD.	ANTAL

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