



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 oscillator kredse.

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 μ W.

Tilslutning for oscilloskop til kontrol af kurveform.

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

Metalkabinat i sølvgrå og hammerlakeret 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 μ W–100 W (+ 50 – + 50 dBm) i 8 områder med fuldt udslag for 10, 100 μ W, 1, 10, 100 mW, 1, 10, 100 W.

Skalaer:

0–100 μ W og 0–20 dB.

Indgangsimpedans:

2 \times 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:

HØJTALERE:

Ω : 2 \times 4 Ω , 2 \times 100 W max.

Σ : 2 \times 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.

Diøder:

4 \times OA85, 2 \times E250C750.

Nettilslutning:

110, 130, 220 eller 240 V

50/60 Hz.

Forbrug ca. 10 VA.

Dimensioner (kabinat):

Bredde: 323 mm.

Dybde: 210 mm.

Højde: 160 mm.

Vægt:

5,3 kg

Overflade:

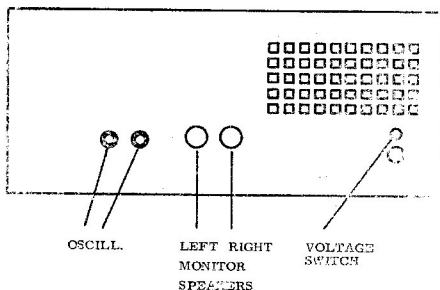
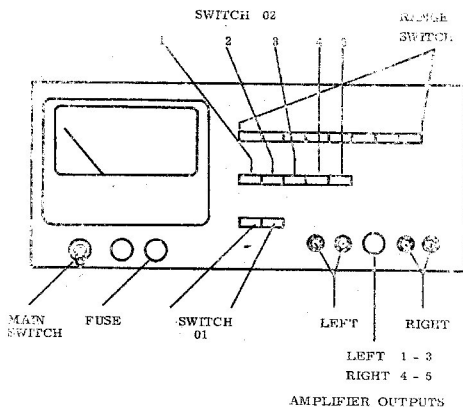
Sølvgrå og blå hammerlak.

Tilbehør:



1 instruktionsbog.

1 ledning 5 pol. DIN – 2 \times HT.

1 ledning 5 pol. DIN – 4 \times banan.



SPECIFICATIONS

Range:	0.01 μ W - 100 W (-50 - +50 dBm) in 8 ranges with full-scale deflection for 10 μ W, 100 μ W, 1 mW, 10 mW, 100 mW, 1 W, 10 W, 100 W.
Scales:	0 - 100 μ W and 0 - 20 dB.
Input Impedance:	2 \times 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 \times 4 Ω , 2 \times 100 W max.  2 \times 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 \times OA 85, 2 \times 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 μ W (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

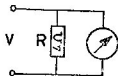
The RWM 4 may be operated from the following mains voltages: 110 V, 130 V, 220 V, and 240 V. Power consumption is approx. 10 W.

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 "4 Ω " 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.



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

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

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

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

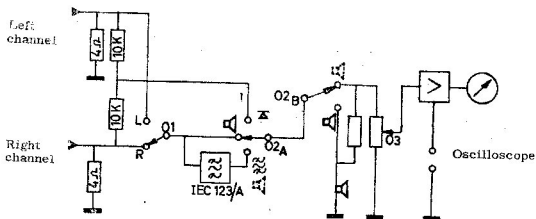
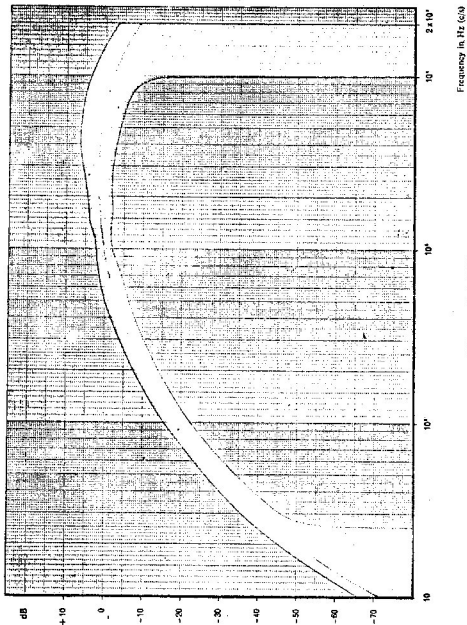


Fig. 2. Block diagram of RWM 4.






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



Filter IEC 123
Fig. 3 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

$$S/N (\text{dB over } 1 \text{ mW}) = (17 - X) \text{ dB} \quad (3)$$

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

$$S/N \text{ (500 mW)} = (27 - X) \text{ dB} \quad (4)$$

$$S/N \text{ (5 W)} = (37 - X) \text{ dB} \quad (5)$$

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 $X = -10 \text{ dB}$ (100 μW). Then

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

- (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 = $25.2 - 24.6 = 0.6 \text{ dB}$.

- (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: $P_L = 30 \text{ dBm}$, $P_R = -22 \text{ dBm}$.

$$\text{Cross-talk attenuation } L/R = 30 - (-22) = 52 \text{ dB.}$$

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: $P_R = 30 \text{ dBm}$, $P_L = -18 \text{ dBm}$

$$\text{Cross-talk attenuation } R/L = 30 - (-18) = 48 \text{ dB.}$$

- (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.

18 NOV 1969

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LAB. STYKLISTE

Kvt.	Enhed	Mat. nr.	Materialebetegnelse	Fabrikat	Perl.	Ald.	Blad	Pl. nr.	Pos. nr.	Bem.
R 1			Resistor 12 Ω - 30 W 23100	Vitrohm					62	
R 2			Resistor 12 Ω - 30 W 23100	Vitrohm					62	
R 3			Resistor 12 Ω - 30 W 23100	Vitrohm					62	
R 4			Resistor 12 Ω - 30 W 23100	Vitrohm					62	
R 5			Resistor 10,8+1,7 Ω - 30W 34-5239	Vitrohm					63	
R 6			Resistor 10,8+1,7 Ω - 30W 34-5239	Vitrohm					63	
R 7		5370003	Potentiometer 1 K Ω S 76 K	Ruvido					75	
R 8		501030	Resistor 1,2 K Ω - 5% 1/3 W - B	Beyschlag					54	
R 9		501030	Resistor 1,2 K Ω - 5% 1/3 W - B	Beyschlag					54	
R 10		501022	Resistor 470 Ω 5% 1/3 W - B	Beyschlag					52	
R 11		501044	Resistor 10 K Ω 5% 1/3 W - B	Beyschlag					56	
R 12		501044	Resistor 10 K Ω 5% 1/3 W - B	Beyschlag					56	
R 13			Resistor 15 K Ω 1% CEB/TO	Vitrohm					49	
R 14			Resistor 4,75 K Ω 1% CEB/TO	Vitrohm					47	
R 15			Resistor 2,2 K Ω 1% CEB/TO	Vitrohm					45	
R 16			Resistor 10 K Ω 1% CEB/TO	Vitrohm					48	
R 17			Resistor 3,16 K Ω 1% CEB/TO	Vitrohm					46	
R 18			Resistor 1 K Ω 1% CEB/TO	Vitrohm					44	
R 19			Resistor 316 Ω 1% CEB/TO	Vitrohm					43	
R 20			Resistor 100 Ω 1% CEB/TO	Vitrohm					42	
R 21			Resistor 46,3 Ω 1% CEB/TO	Vitrohm					41	
R 22		501074	Resistor 2,2 M Ω 5% 1/3 W - B	Beyschlag					59	
R 23		501029	Resistor 1 K Ω 10% 1/2 W - GBT	Vitrohm					61	
R 24		501026	Resistor 1 K Ω 5% 1/3 W - B	Beyschlag					53	
R 25		501044	Resistor 10 K Ω 5% 1/3 W - B	Beyschlag					56	
R 26		501040	Resistor 22 K Ω 5% 1/3 W - B	Beyschlag					57	
R 27		501074	Resistor 2,2 M Ω 5% 1/3 W - B	Beyschlag					59	
R 28			Potentiometer 100 Ω S 1420	Ruvido					76	
R 29		501007	Resistor 5 Ω 5% 1/3 W - B	Beyschlag					50	
R 30		501015	Resistor 150 Ω 5% 1/3 W - B	Beyschlag					51	
R 31		501022	Resistor 470 Ω 5% 1/3 W - B	Beyschlag					52	
R 32		501048	Resistor 22 K Ω 5% 1/3 W - B	Beyschlag					57	
R 33		5012041	Resistor 47 K Ω 5% 1 W - B	Beyschlag					60	
R 34		501074	Resistor 2,2 M Ω 5% 1/3 W - B	Beyschlag					59	
R 35		501022	Resistor 470 Ω 5% 1/3 W - B	Beyschlag					52	
R 36		5012041	Resistor 47 K Ω 5% 1 W - B	Beyschlag					60	
R 37		501077	Resistor 3,3 K Ω 5% 1/3 W - B	Beyschlag					55	
R 38		501050	Resistor 33 K Ω 5% 1/3 W - B	Beyschlag					58	

Udsendt af: BL

Udsendt: 10.10.968

3 Blade. Blad: 1

Angående:

Wattmeter, Replaceable Parts

Type:

RWM 4

Nr.

9045022

LAB. STYKLISTE

Kvt.	Enhed	Mat. nr.	Materialebetegnelse	Fabrikat	Perf	Ald	Blad	Pl nr	Pos. nr
C 1		4133007	Capacitor 1 μ F - 250 V polyest.	Philips					24
C 2		4133008	Capacitor 10 nF - 250 V polyest.	Philips					24
C 3		4133009	Capacitor 47 nF - 250 V polyest.	Philips					28
C 4		4134006	Capacitor 0.1 μ F - 400 V polyest.	Philips					26
C 5		4201017	Capacitor 10 μ F - 64 V electrol.	Philips					21
C 6		4134006	Capacitor 47 nF - 400 V polyest.	Philips					27
C 7		4201017	Capacitor 10 μ F - 64 V electrol.	Philips					21
C 8			Capacitor 16 μ F - 450 V electrol.	Philips					20
C 9			Capacitor 16 μ F - 450 V electrol.	Philips					20
C 10		4134006	Capacitor 47 nF - 400 V polyest.	Philips					27
C 11			Capacitor 16 μ F - 450 V electrol.	Philips					20
C 12		4133007	Capacitor 1 μ F - 400 V polyest.	Philips					24
C 13		4200042	Capacitor 125 μ F - 16 V electrol.	Philips					22
C 14			Capacitor 16 μ F - 450 V electrol.	Philips					20
C 15		4134006	Capacitor 47 nF - 400 V polyest.	Philips					27
C 16			Capacitor 16 μ F - 450 V electrol.	Philips					20
C 17		4021001	Capacitor 4.7 nF - 5 KV ceram.	Ferroperm					30
C 18		4021001	Capacitor 4.7 nF - 5 KV ceram.	Ferroperm					30
C 19		4134006	Capacitor 0.47 μ F - 400 V polyest.	Philips					25
D 1		8310016	Diode E 250 C 750 ESK	Semikron					14
D 2		8310016	Diode E 250 C 750 ESK	Semikron					14
D 3		8300008	Diode OA 95	Philips					12
D 4		8300008	Diode OA 85	Philips					12
D 5		8300008	Diode OA 85	Philips					12
D 6		8300008	Diode OA 85	Philips					12
I			Moving Coil Meter 200 μ A DS 120 B	Jensen Elect.					13
S			Fuse 60 MAT - 250 V	ELU					89
Tr			Power Transformer 16 - 12558	Jørgen Schou					95
		6140102	PW - board, amplifier	K&F					76
V 1		9201002	Tube ECC 81	Philips					64
V 2			Tube EF 80	Philips					85
			Panel lamp. 380628-2	AMT					37

Uregis.
Erug for
P. 10. 1968
L. 10. 1968
L. 10. 1968

Udsendt af: BL

Udsendt: 10.10. 1968

3 Blade. Blad: 2

Angående:

Wattmeter, Replaceable Parts

Type:

RWM 4

Nr.

9045022

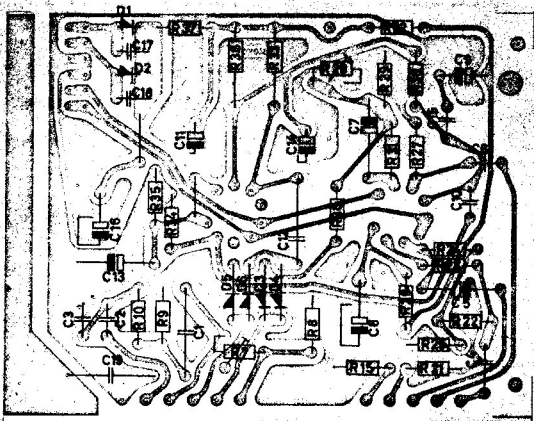
LAB. STYKLISTE

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END

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INSTRUMENT YRDA.

Wetmeter RWN4 Component Location

UDSTEDT 15-10-60

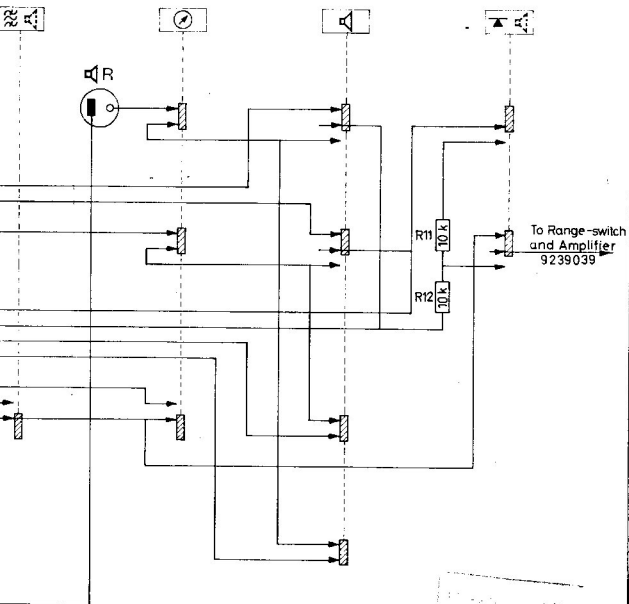
KONTROL

SOOK

1 BLADE - BLAD

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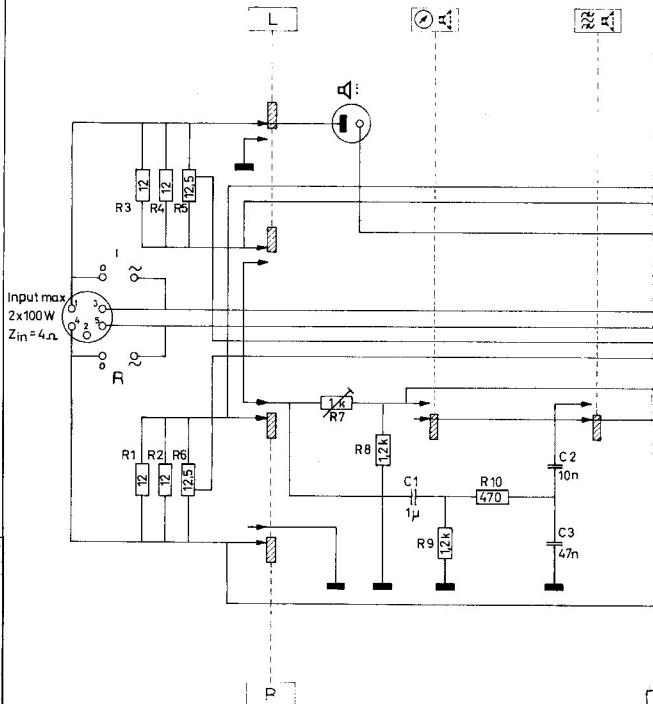
REYLET

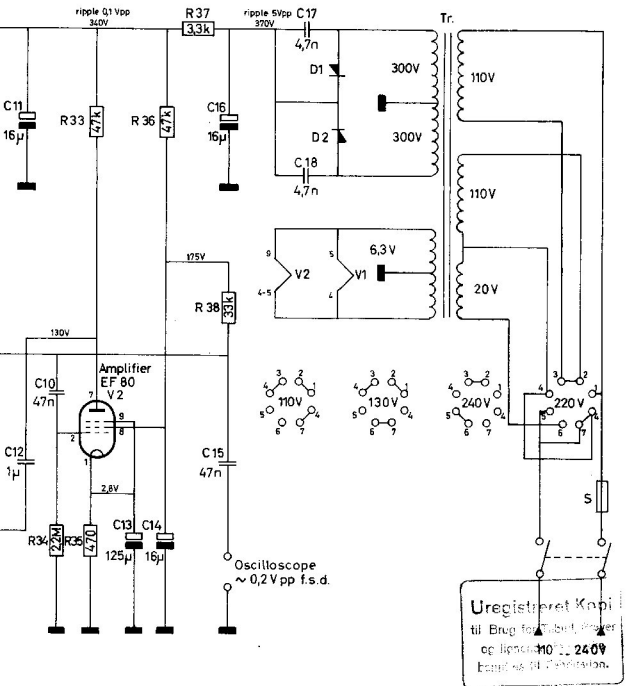


RETTET	A	B	C	D	E	F	G	H
KONTR/GODK.								
MATERIALE	OVERFLADE				AFVIGELSE FOR ALLE MÅL UDEN TOL- RANGEANGIVELSE, DS 2075			
DIMENSION					FORM - OG POSITIONSTOLERANCER, DS/R 2083.1-2			
VÆGT	KONSTR.	TEGNET	KONTR.	GODKENDT	MÅLESTOK	ERSTATNING FOR		
	BL	9-10-68	FB	BL	BL	ERSTATTES AF		

Band & Olufsen * DIAGRAM 1 WATTMETER BWM 4

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RETET	A	B	C	D	E	F	G	H
KONTR./GODK.								
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	FB	<i>Bl</i>	<i>Bl</i>		ERSTATTES AF		
	8-10-68							

