

Brüel & Kjær

2209

Impulse Precision
Sound Level Meter

valid from serial no. 496282

037-0114



Service

2209

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037-0114

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Trouble Shooting

If any faults should occur please check the instrument according to the procedure outlined below.

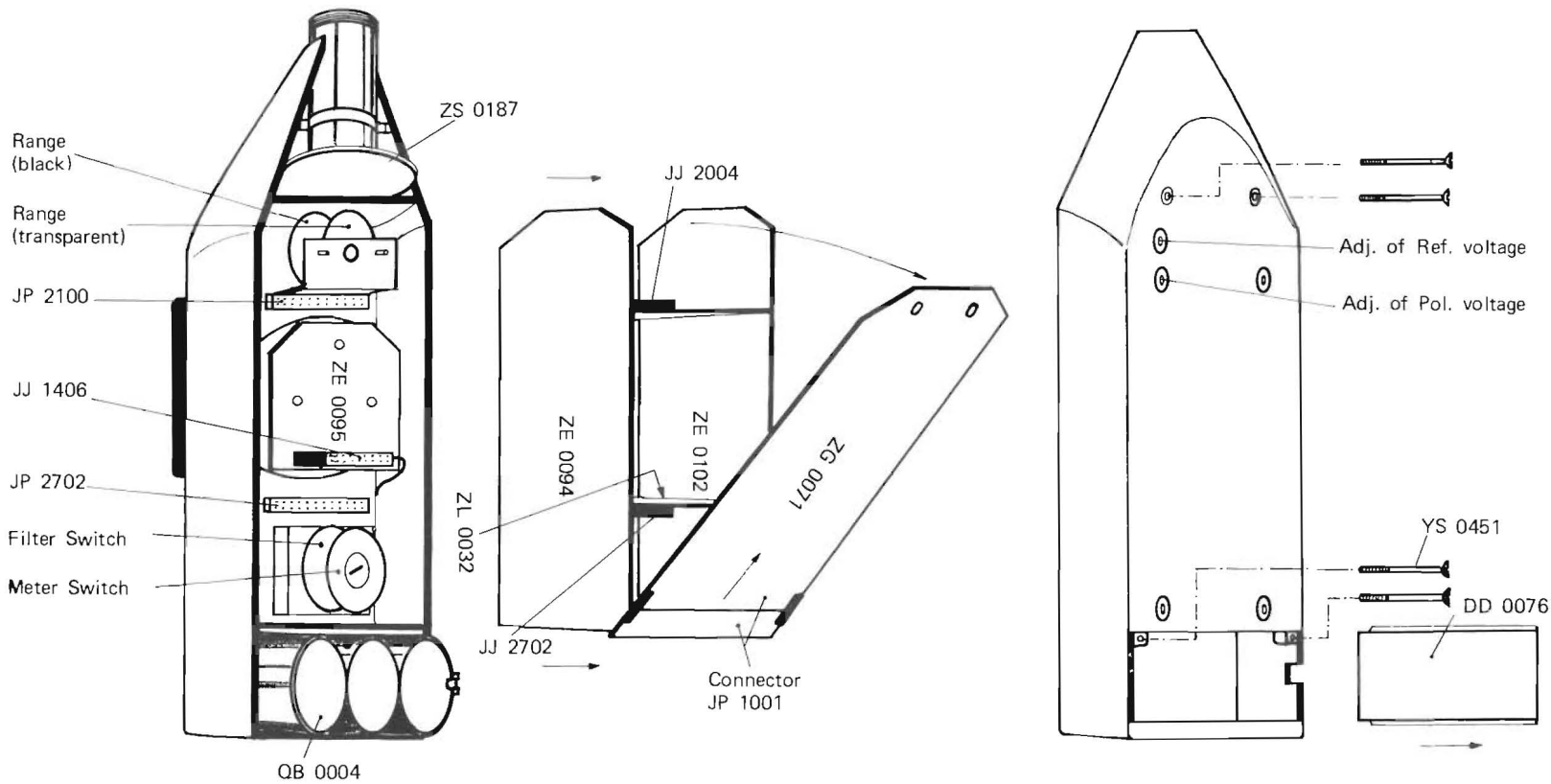
When a fault has been traced and corrected, the voltages and adjustments influenced by the correction must be rechecked. The complete instrument should then be tested according to the Checking Procedure to make sure that all basic functions are operative.

The tolerances given in these notes are intended for use as guide for adjustments.

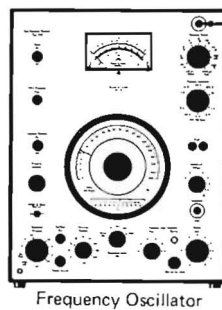
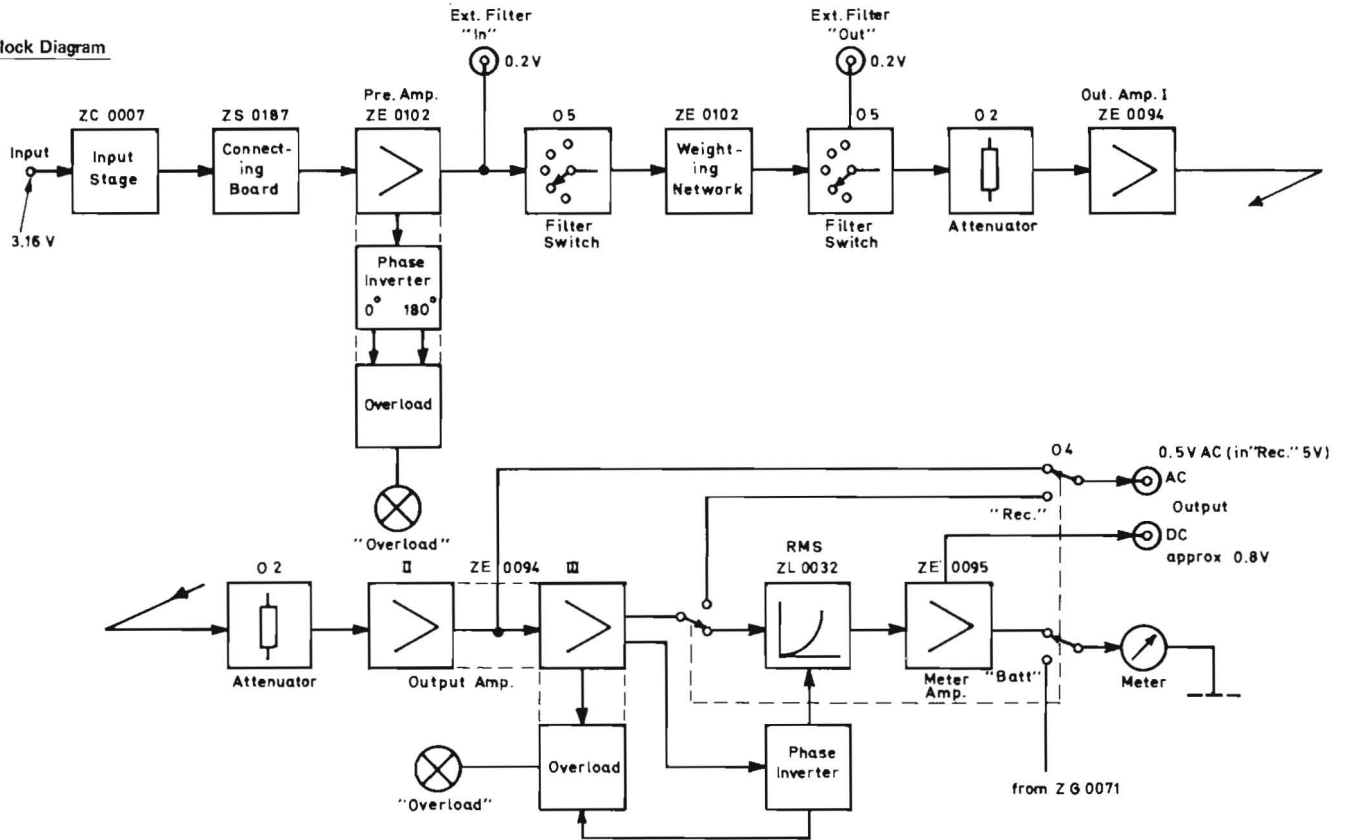
Before correcting any apparent deviation make sure that the measuring instrument has tolerances small enough not to affect the measurement.

Spare Parts

Please state type and serial number of the Impulse Precision Sound Level Meter when ordering spare parts.



Block Diagram



1.1. Sensitivity

- a. RANGE (black): "120"
 RANGE (transp.): "120"
 FILTER SWITCH: "Lin"
 METER SWITCH: "Fast"
- Input signal to front end of 2209: 3.16 V, 1000 Hz.
 Adjust "Gain Adj." for 10 dB deflection (Adjustment range for "Gain Adj." approx. + 3, -10 dB).
 Output voltage on "Ext. Filter In": 0.2 V
 "DC Output": Approx. 1 V (measured with High Imp. Voltmeter)
 "AC Output": Approx. 0.5 V
 "AC Output": 5 V for METER SWITCH in "Rec"
- b. FILTER SWITCH to "A-B-C-D"
- Deflection for all ranges: 10 dB ± 0.1 dB.

1.2. Frequency Response

- RANGE (black): "120"
 RANGE (transp.): "120"
 FILTER SWITCH: "Lin"
 METER SWITCH: "Slow"
- Frequency: 1000 Hz. Adjust the input voltage for a 9 dB deflection on 2209.
 Vary the frequency from 2 Hz (or 10 Hz) – 70 kHz.
 Meter deflection: 8–10 dB.

2209.1 Checking Procedure

1.3. Meter Circuit

- a. RANGE (black): "120"
RANGE (transp.): "120"
FILTER SWITCH: "Lin"
METER SWITCH: "Fast"
Frequency: 1000 Hz. Adjust the input voltage to give exactly 7 dB deflection on 2209.
- b. METER SWITCH: "Peak"
Meter deflection: 10 dB \pm 0.5 dB.
- c. METER SWITCH: "Imp. (Norm.)"
Adjust the input voltage to give a 8.6 dB deflection on 2209.
Disconnect the input signal by depressing "Oscillator Stop" on the Beat Frequency Oscillator and check that the deflection is 0 dB after 2-4 sec.
- d. METER SWITCH: "Imp. (Hold)"
Connect input signal. Meter deflection: 9 dB.
Disconnect input signal and check that the deflection drops max. 0.5 dB in one minute.

1.4. Overload Indicators

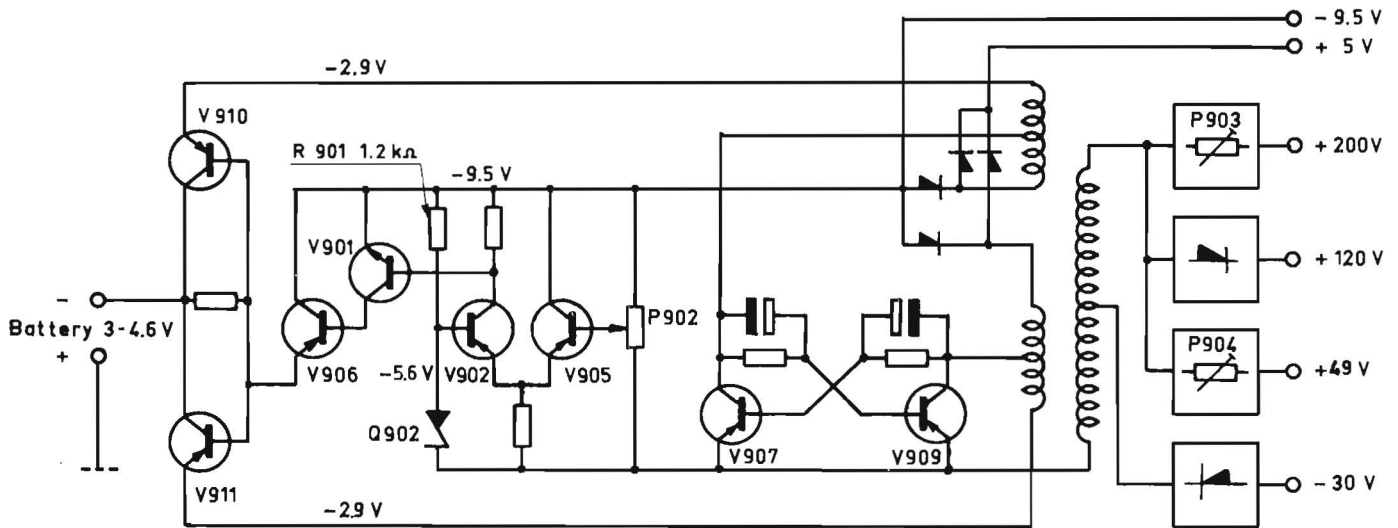
- RANGE (black): "110"
RANGE (transp.): "110"
FILTER SWITCH: "Lin"
METER SWITCH: "Fast"
Input signal: 7 V, 1000 Hz (corresponding to approx. 17 dB above full scale deflection).
Depress "Oscillator Stop" on the Beat Frequency Oscillator. When releasing "Oscillator Stop" both "Overload indicators" should light up a few times.

1.5. Noise

- a. RANGE (black): "60"
RANGE (transp.): "10"
FILTER SWITCH: "A"
METER SWITCH: "Slow"
Connect an Input Adaptor JJ 2615 to Type 2209 and shortcircuit its input.
Notice! Make sure that the contact surfaces are clean and dustfree.
Meter deflection: Below 0 dB.
It is essential that the measurement is carried out in a quiet room. If the Sound Level Meter has been overloaded, the instrument must work for several minutes before the meter reaches its normal deflection.
- b. RANGE (black): "60"
RANGE (transp.): "30"
FILTER SWITCH: "Lin"
METER SWITCH: "Fast"
Meter deflection: Below 0 dB
- c. RANGE (black): "130"
RANGE (transp.): "80"
FILTER SWITCH: "Lin"
METER SWITCH: "Fast"
Remove Preamplicifier ZC 0007, and measure the noise with open input.
Meter deflection: Max. 3 dB.

1.6. Sensitivity with Microphone

- a. RANGE (black): "Ref"
RANGE (transp.): "Ref"
FILTER SWITCH: "Lin"
METER SWITCH: "Fast"
Adjust "Gain Adj." to the correct "Open circuit sensitivity" of the microphone.
- b. RANGE (black) to "120"
Check the sensitivity with a Pistonphone Type 4220 or Sound Level Calibrator Type 4230. The meter deflection on 2209 should be equal to the Sound Pressure Level produced by the Pistonphone (Remember to correct for the actual static pressure).
Tolerance: \pm 0.2 dB.



Simplified Diagram of Power Supply ZG 0071

2.1. DC Voltages

METER SWITCH: "Batt"

Normal delay from switching "ON" till the instrument is stabilized is approx. 30 sec.

Check the DC-voltages according to the drawing to the printed circuits XC 0335 showed on ZG 0071.

If the -9.5 V is present and the Oscillator frequency is approx. 2 kHz the transformer can be regarded as an ordinary mains transformer with secondary voltages for the various circuits.

Small deviations in voltages can be adjusted by the potentiometers according to following scheme, whereby greater deviations are rather due to a fault which should be corrected before adjustment.

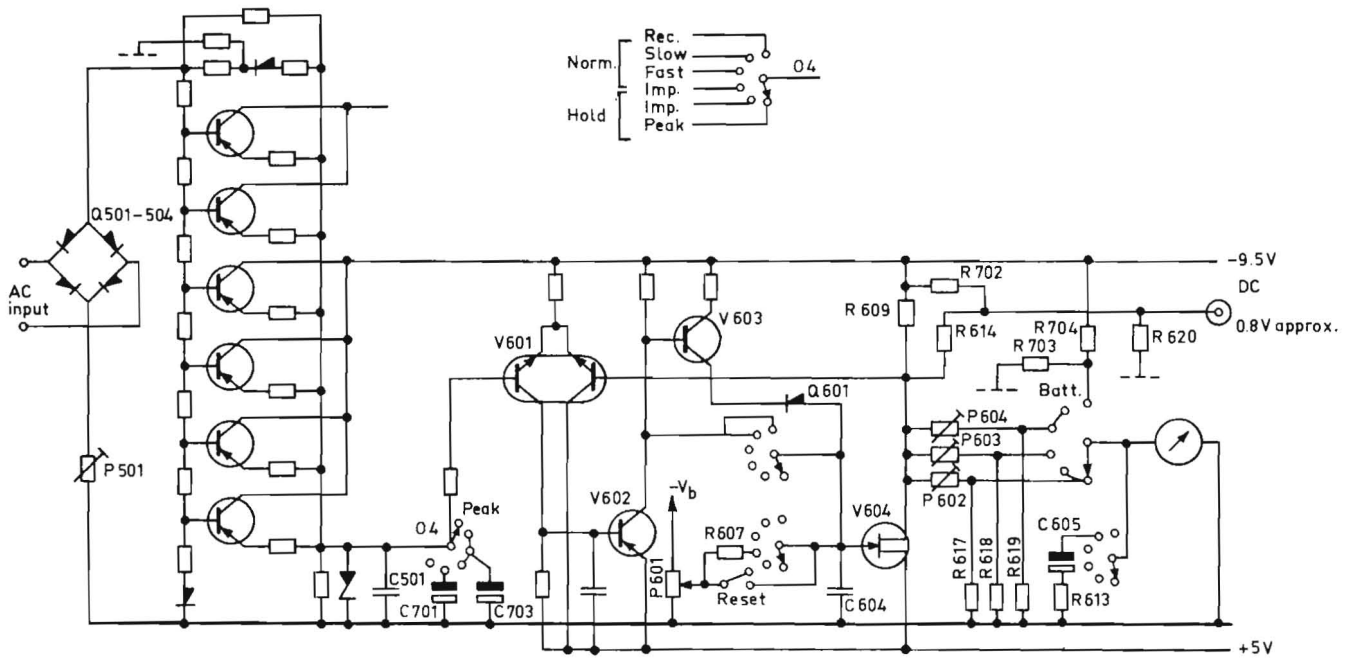
Consumption from the batteries in position "Ref" is approx. 210 mA.
"Ext. Filter" approx 195 mA.

Adjustment of P 902: -9.5 V
P 903: 200 V (Measured with a high impedance voltmeter)
P 904: 49 V

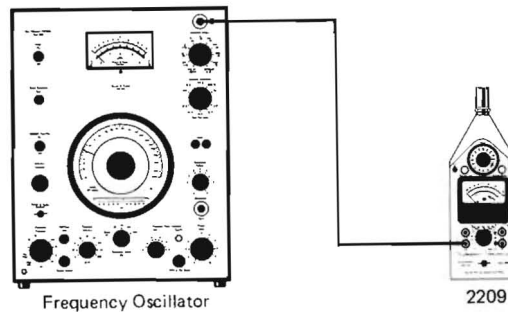
The transistors V 910 and 911 are acting as battery regulators and the emitter voltage on both should be approx. -2.9 V.

If this voltage is -2.9 V and the DC converter is not oscillating disconnect the different loads one by one. If oscillation is impossible even unloaded the transformer or the converter transistors (V 907 and 909) are likely to be defective.

If the -2.9 V is not present examine transistor V 901, 902, 905 or 906 for faults as this is the regulating circuit for V 910 and 911.



- Adjustment of:
- P501 RMS Balance
 - P601 OV DC on V 604 source
 - P602 Sensitivity "Hold"
 - P603 Sensitivity "Impulse"
 - P604 Sensitivity "Fast" and "Slow"
 - R703 Battery Indication



3.1. Sensitivity Check

- | | |
|---|---|
| <p>a. RANGE (black): "120"</p> <p>RANGE (transp.): "120"</p> <p>FILTER SWITCH: "Ext. Filter"</p> <p>METER SWITCH: "Rec"</p> | <p>Frequency 1000 Hz. Adjust the input voltage for 5 V_{RMS} on "AC output" socket.</p> |
| <p>b. METER SWITCH: "Fast"</p> | <p>Meter deflection: Exactly 10 dB.</p> |
| <p>c. METER SWITCH: "Imp. (Norm)"</p> | <p>Meter deflection: Exactly 10 dB.</p> |
| <p>d. METER SWITCH: "Imp. (Hold)"</p> | <p>Depress "Meter Reset" and release it again.</p> <p>Meter deflection: 10 dB.</p> |

3.2. Sensitivity Adjustment

- | | |
|---|---|
| <p>a. RANGE (black): "120"</p> <p>RANGE (transp.): "120"</p> <p>FILTER SWITCH: "Ext. Filter"</p> <p>METER SWITCH: "Rec"</p> | <p>Frequency: 1000 Hz. Adjust the input voltage for 5 V_{RMS} on "AC Output" socket.</p> <p>Check with an oscilloscope that the double rectified curves on the cathodes of Q 503 and Q 504 are equal. (ZL 0032)</p> |
| <p>b. METER SWITCH: "Fast"</p> | <p>If necessary adjust P 803. (ZE 0094) .</p> |

2209.3 Meter Circuit

- c. METER SWITCH: "Imp"
Disconnect input signal.
Unsolder one end of diode Q 601. Adjust P 601 (ZE 0095) for $0\text{ V} \pm 5\text{ mV}$ on V 604 source.
Connect input signal.
Adjust P 603 for full scale deflection (10 dB).
- d. METER SWITCH: "Fast"
When connecting input signal the deflection on 2209 should be exactly 10 dB.
If necessary adjust P 604.
- e. METER SWITCH: "Imp. Hold"
Depress "Meter Reset" shortly and check the meter deflection: 10 dB.
If necessary adjust P 602.
- f. METER SWITCH: "Peak Hold"
Adjust for a meter deflection: 10 dB.
Switch Meter Switch to "Fast" and check deflection: 7 dB.
- g. METER SWITCH: "Batt"
With a battery voltage of $3.0\text{ V} - 3.1\text{ V}$ the meter should deflect to the lower mark of the battery scale.
If necessary change in value of R 703.

3.3. Overshoot

RANGE (black): "120"
RANGE (transp.): "120"
FILTER SWITCH: "Ext. Filter"
METER SWITCH: "Fast"

Frequency: 1000 Hz. Adjust input voltage for an 6 dB deflection on 2209.

Disconnect the input signal shortly by depressing the "Oscillator Stop" on the Frequency Oscillator and check the overshoot.

Overshoot: 0.1–1.1 dB for METER SWITCH in "Fast"
0.1–1.6 dB for METER SWITCH in "Slow"
max. 0.1 dB for METER SWITCH in "Imp. Hold"*)

*) Before "Oscillator Stop" is released for check of overshoot depress "Meter Reset" on 2209.

3.4. Meter Decay Time Constants

a. RANGE (black): "120"
RANGE (transp.): "120"
FILTER SWITCH: "Ext. Filter"
METER SWITCH: "Imp"

Frequency: 1000 Hz. Adjust the input voltage for an 8.6 dB deflection on 2209.

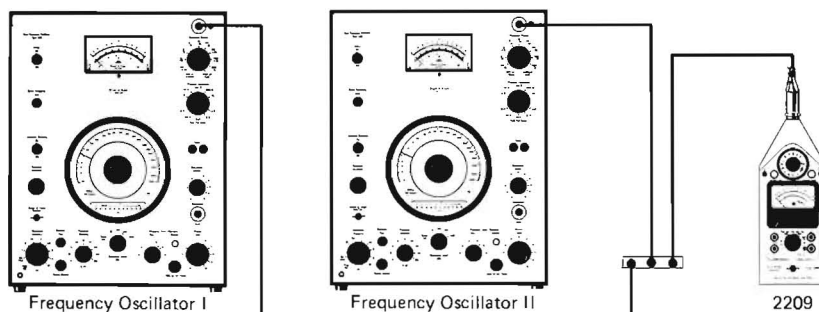
Disconnect the input signal and measure the time it takes for the pointer to decrease from 8.6 to 0 dB.

Tolerance: $3 \pm 0.5\text{ sec.}$

b. METER SWITCH: "Imp. Hold"

Adjust the input voltage for 10 dB deflection on 2209.

When the input signal is disconnected the meter deflection must not decrease more than 0.5 dB in one minute. (Only valid for 20°C and max. 60% relative humidity).

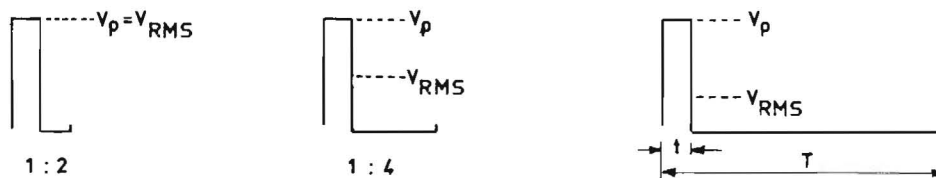
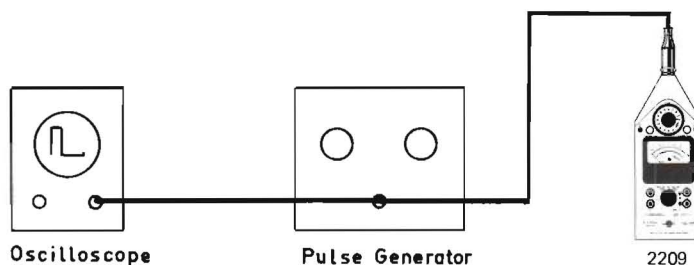


3.5. Check of RMS Rectifier

- a. RANGE (black): "120"
- RANGE (transp.): "120"
- FILTER SWITCH: "Lin"
- METER SWITCH: "Fast"

- a. Depress "Oscillator Stop" on Frequency Oscillator II and adjust output of Frequency Oscillator I to give a 7 dB deflection on 2209.
- b. Depress "Oscillator Stop" on Frequency Oscillator I and adjust output of Frequency Oscillator II to give a 7 dB deflection on 2209.

With signal from both oscillators the deflection on 2209 should be 10 dB ± 0.1 dB (evt. non-linearity of 2209 meter scale 0.2 dB).



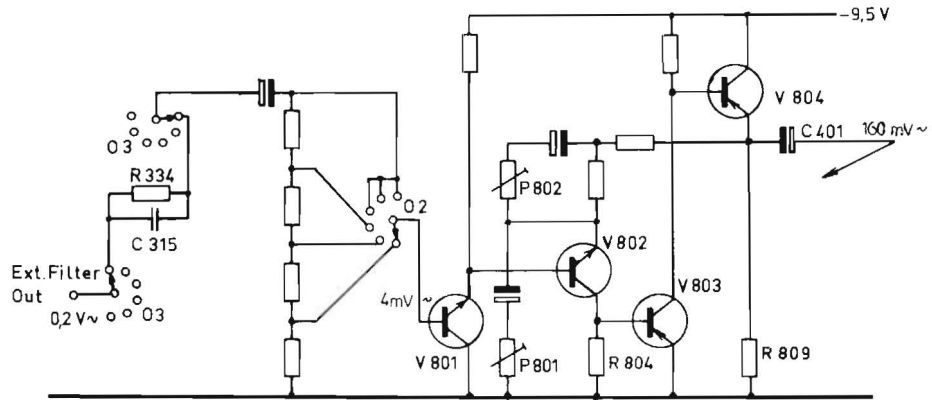
3.6. Check of RMS Indication

- RANGE (black): "120 dB"
- RANGE (transp.): "120 dB"
- FILTER SWITCH: "Lin"
- METER SWITCH: "Slow"

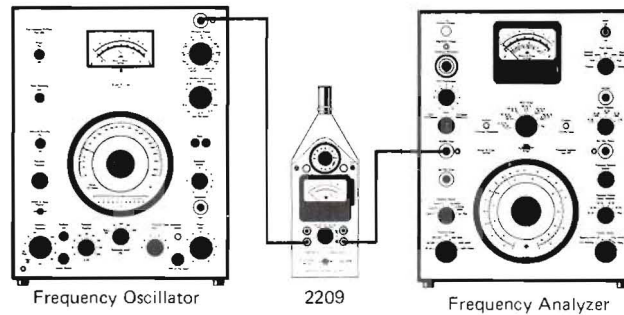
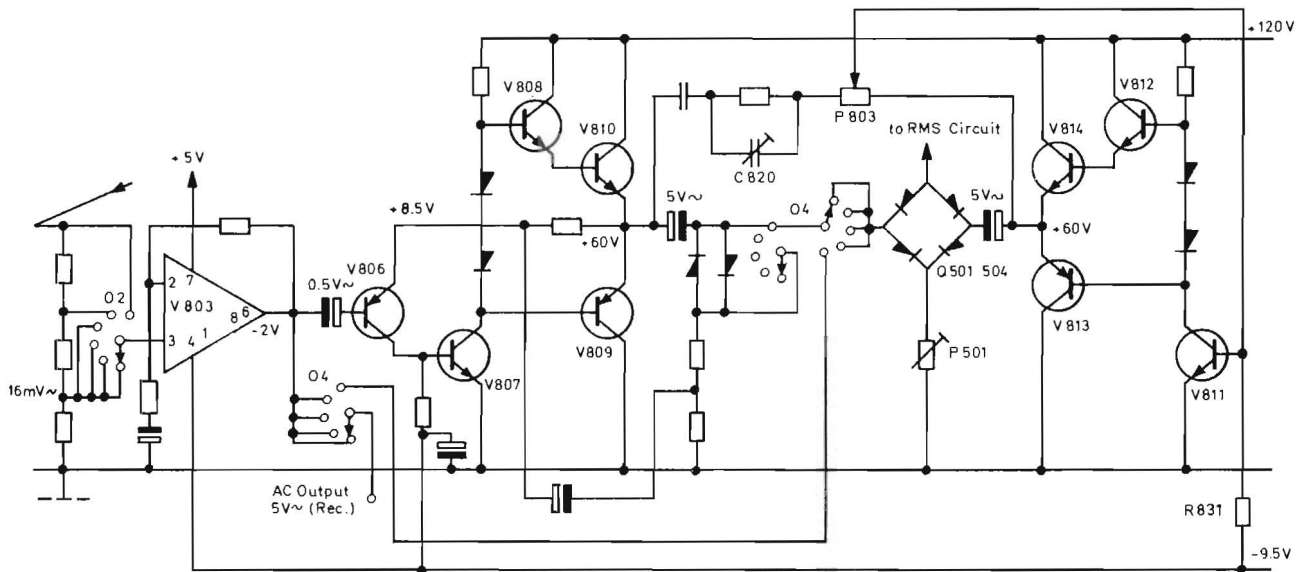
At a pulse duration of 0.1 m Sec. and a ratio of 1.2 the input voltage to 2209 should be adjusted to give a 0.2 dB deflection.

Check the indication for various pulse ratio according to following scheme.

RANGE (black)	$\frac{t}{T}$	$\frac{V_p}{V_{RMS}}$	Indication
120 dB	1 : 2	1	0.2 dB
110 dB	1 : 5	2	8.1 dB ± 0.5 dB
110 dB	1 : 10	3	5.6 dB ± 0.5 dB
110 dB	1 : 26	5	1.7 dB ± 0.5 dB
100 dB	1 : 100	10	6 dB ± 0.5 dB
100 dB	1 : 200	14	3 dB ± 1 dB
100 dB	1 : 400	20	0 dB ± 1 dB
100 dB	1 : 900	30	-3.5 dB ± 1.5 dB



Adjustment of: P801 Sensitivity
 P802 Sensitivity at 2 Hz
 P803 Symmetric Output
 P501 RMS Balance



4.1. DC-Voltages

METER SWITCH: "Rec"

The DC-voltages across R 809 should be approx. 4 V negative.

If necessary change in value of R 804.

From midpoint R 826, R 827 to ground the voltage should be 57–63 V.

If necessary change in value of R 822 (56–120 kΩ).

From midpoint R 835, R 836 to ground the voltage should be 57–63 V.

If necessary change in value of R 831 (47–82 kΩ).

2209.4 Output Amplifier

4.2. Sensitivity

- a. RANGE (black): "120"
RANGE (transp.): "120"
FILTER SWITCH: "Ext. Filter"
METER SWITCH: "Rec"
- Input signal: 0.2 V, 1000 Hz.
Output voltage on "AC Output" socket: 5 V.
If necessary adjust P 801 (ZE 0094).
- b. METER SWITCH to "Fast"
- Connect an Oscilloscope to Q 503, Q 504 (ZL 0032) and check that the two rectified curves are of the same height.
If necessary adjust P 803 (ZE 0094).
Change the signal frequency to 70 kHz and check the curves again.
If necessary adjust the height by C 820.

4.3. Attenuators

- RANGE (black): "120"
RANGE (transp.): "120"
FILTER SWITCH: "Ext. Filter"
METER SWITCH: "Fast"
- Frequency: 1000 Hz. Adjust the input voltage for an 8 dB deflection on 2209.
Check all attenuator steps of RANGE (transparent) by comparison to the attenuator of the Frequency Oscillator.
Tolerance: 0.2 dB (+ tolerance of Frequency Oscillator).

4.4. Output Impedance

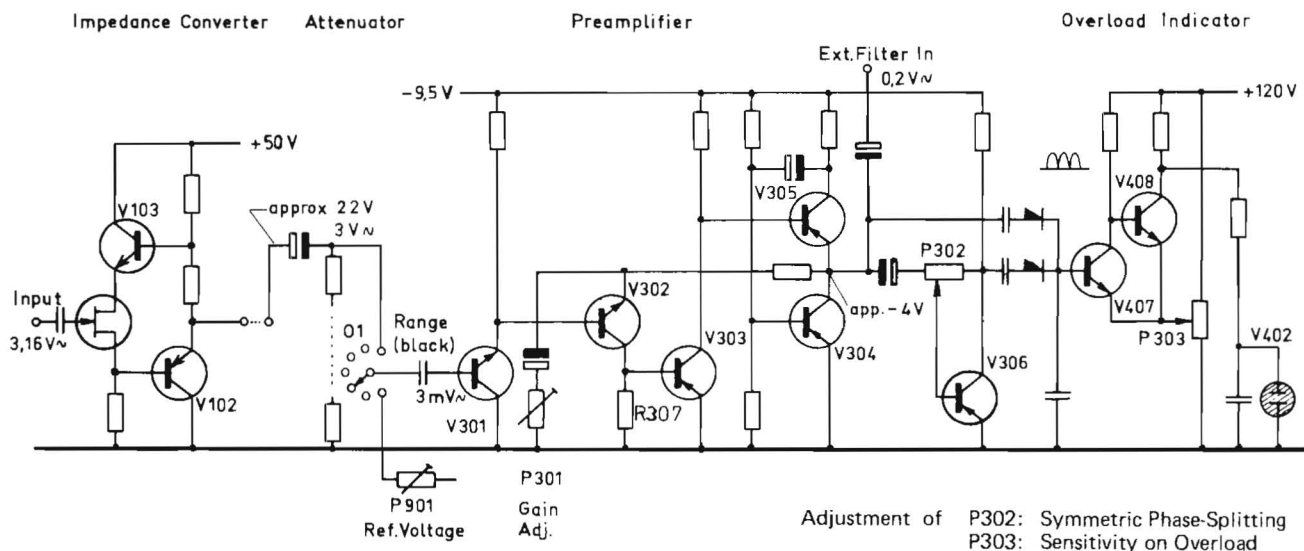
- RANGE (black): "120"
RANGE (transp.): "120"
METER SWITCH: "Rec"
- Frequency: 1000 Hz. Adjust the input voltage for an output voltage of 5 V on "AC Output" socket.
Load the "AC Output" with a resistor of 10 k Ω and check that the output voltage is not decreasing more than 0.2 dB.

4.5. Overload

- RANGE (black): "110"
RANGE (transp.): "110"
FILTER SWITCH: "Ext. Filter"
METER SWITCH: "Rec"
- Input signal: 7 V \pm 1 dB, 1000 Hz. (Corresponding to 17 dB above full scale deflection).
- a. Disconnect the input signal by depressing "Oscillator Stop" on the Frequency Oscillator. When releasing "Oscillator Stop" the "Overload Output" should light up a few times.
- b. Connect an Oscilloscope to "AC Output" socket and check that the signal is not limited.

4.6. Noise and Hum

- a. RANGE (black): "120"
RANGE (transp.): "120"
FILTER SWITCH: "Ext. Filter"
METER SWITCH: "Rec"
- Disconnect input signal to 2209. During measurement 2209 should be in its case and connected to ground.
Hum from the DC converter (approx. 2 kHz) and 2nd and 3rd harmonic selectively measured max. 1.5 mV.
Noise (2–40 000 Hz): max. 14 mV.
- b. RANGE (transp.) to "70"
- Hum: max. 50 mV.
Noise: max. 300 mV.



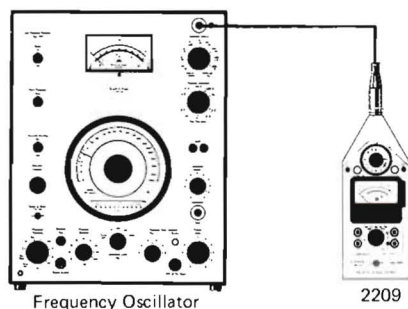
Simplified Diagram of Input Amplifier ZE 0014

5.1. DC-voltages

METER SWITCH: "Rec"

The midpoint of the output stage of the preamplifier (V 305_c, V 304_c) should be approx. 4 V negative. (XC 0331)

If necessary change in value of R 307 (5.6–10 kΩ).



5.2. Sensitivity – Reference

a. RANGE (black): "120"
RANGE (transp.): "120"
FILTER SWITCH: "Lin"
METER SWITCH: "Fast"

Input signal: Exactly 2.24 V (10 V – 13 dB) at 1000 Hz.

Adjust P 301 "Gain Adj." for 7 dB deflection on 2209.

Adjustment range for P 301: The total red scale area.

b. RANGE (black) to "Ref"

Adjust reference voltage P 901 (XC 0335) for a deflection to 50 on the red scale mV per N/m² (corresponding 7 dB).

5.3. Frequency Response

RANGE (black): "120"
RANGE (transp.): "120"
FILTER SWITCH: "Lin"
METER SWITCH: "Fast"

a. Turn the screw for low frequency cut-off (on Connecting Board ZS 0187) fully clockwise.

Frequency: 1000 Hz. Adjust the input voltage for an 8 dB deflection on 2209.

Vary the frequency from 2 – 70 000 Hz.

Deflection on 2209: 7 – 9 dB (+ tolerance of Frequency Oscillator: 0.5 dB).

If necessary the low frequency response can be corrected by adjusting the interrelationship between P 801 and P 802 (ZE 0094) but in this case check item 4.2 again. The high frequency response can be corrected by changing the value of C 819 (0–10 pF).

Frequency response for Input Amplifier on "Ext. Filter In" socket.

5 – 70 000 Hz tolerance: 0 to –0.5 dB
2 – 5 Hz tolerance: 0 to 1 dB

b. Turn the screw fully counter clockwise and check that the lower limit frequency is changed from 2 Hz to approx. 15 Hz.

2209.5 Input Amplifier

5.4. Attenuator

- a. RANGE (black): "120"
RANGE (transp.): "120"
FILTER SWITCH "Lin"
METER SWITCH "Fast"
- b. RANGE (black) through all positions

Frequency: 1000 Hz. Adjust the input voltage for an 8 dB deflection on 2209.

Check all attenuator steps of RANGE (black) by comparison to the attenuator of the Frequency Oscillator.

Tolerance: ± 0.2 dB (+ tolerance of Frequency Oscillator: 0.2 dB).

5.5. Output Impedance

- RANGE (black): "120"
RANGE (transp.): "120"
FILTER SWITCH "Lin"
METER SWITCH: "Fast"

Frequency: 1000 Hz. Adjust the input voltage for a 10 dB deflection on 2209.

Connect a 500Ω resistor across "Ext. Filter In" socket.

Meter deflection: 9.9–10 dB.

5.6. Overload

- RANGE (black): "110"
FILTER SWITCH "Ext. Filter"

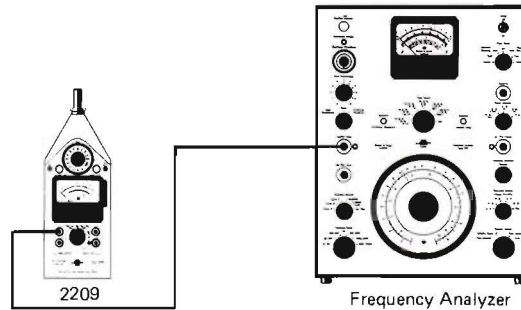
Frequency: 1000 Hz. Adjust the input voltage for an output voltage on "Ext. Filter In" socket of $1.4 \text{ V} \pm 1 \text{ dB}$ (corresponding to 17 dB above 0.2 V).

- a. Check with an Oscilloscope that the output voltage is not visible distorted.
- b. Check with an Oscilloscope that the rectified sine waves measured across C 310 are of the same height.

If necessary adjust P 302 (ZE 0102).

Disconnect the input signal by depressing "Oscillator Stop" on the Frequency Oscillator. When releasing it again the "Overload Input" should light up a few times.

If necessary adjust P 303 (ZE 0102).



5.7. Noise-Hum

- a. RANGE (black): "Ref"
RANGE (transp.): "Ref"
FILTER SWITCH: "Lin"
METER SWITCH: "Fast"
03 in position: 15 Hz
- b. RANGE (black) to "60"
RANGE (transp.) to "30"
- c. FILTER SWITCH to "A"
RANGE (transp.) to "10"

Connect an Input Adaptor JJ 2615 to Type 2209 and shortcircuit its input.

The apparatus must be in its case and evt. connected to ground.

Adjust "Gain Adj." for a deflection to 50 mV per N/m^2 .

Meter deflection: max. 0 dB.

Meter deflection: max. 0 dB.

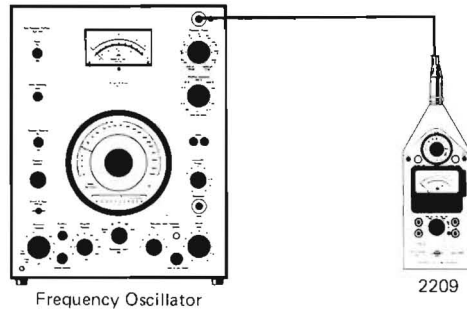
If the meter deflection exceeds the limit, check noise and hum for

Input Amplifier by measuring the output voltage on "Ext. Filter" socket. Check hum level measured selectively at the fundamental frequency of the DC-converter (approx. 2 kHz) and 2nd and 3rd harmonic.

Hum: max. $44 \mu\text{V}$.

Noise: max. $200 \mu\text{V}$ (Measured with Frequency Analyzer (2107) in lin. 2 – 40 000 Hz).

Output Amplifier check item 4.6.



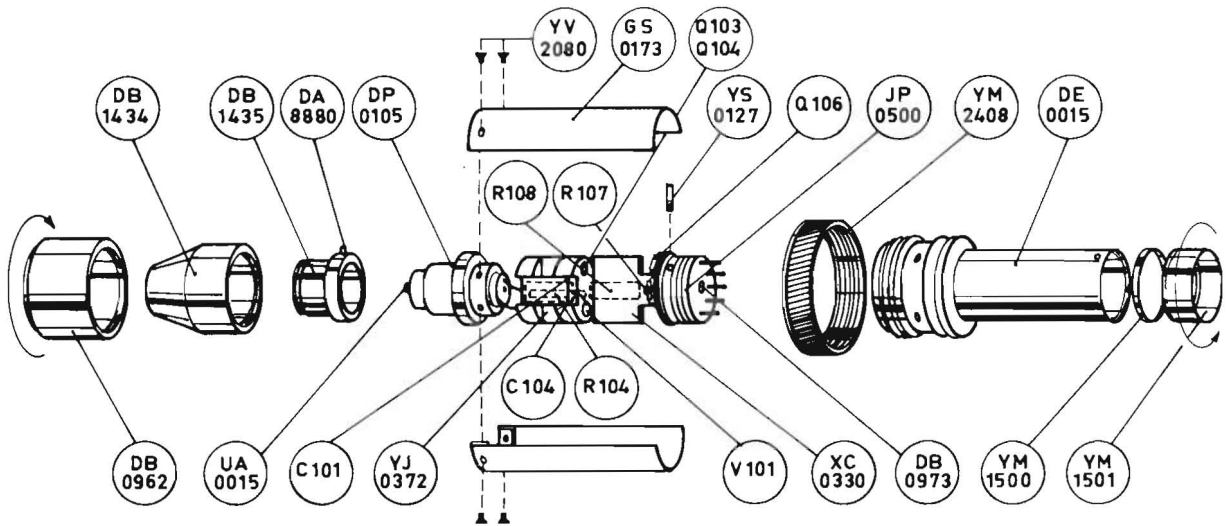
6.1. 1000 Hz Level

- a. RANGE (black): "120"
 RANGE (transp.): "120"
 FILTER SWITCH: "Lin"
 METER SWITCH: "Fast"
 Frequency: 1000 Hz. Adjust the input voltage to give exactly 8 dB deflection on 2209.
- b. FILTER SWITCH: in position "A-B-C-D"
 Check that the deflection is 8 dB ± 0.1 dB in all positions.
- If the deflection exceeds the limits adjust
- | | | | | |
|---|-------|----|-------|-----------|
| A | curve | by | P 304 | (ZE 0102) |
| B | curve | by | P 305 | - |
| C | curve | by | P 306 | - |
| D | curve | by | P 307 | - |

6.2. Network Curves

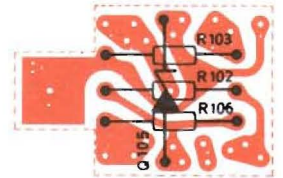
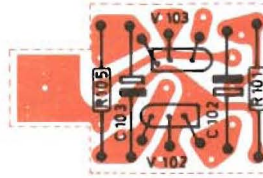
- a. RANGE (black): "120"
 RANGE (transp.): "120"
 FILTER SWITCH: "Lin"
 METER SWITCH: "Fast"
 Frequency: 1000 Hz. Adjust the input voltage to give 8 dB deflection on 2209.
- Check the filter curves according to following scheme.

Hz	Curve "A"		Curve "B"		Curve "C"		Curve "D"		
	Defl. on 2209	RANGE (transp.)	Defl. on 2209	RANGE (transp.)	Defl. on 2209	RANGE (transp.)	Defl. on 2209	RANGE (transp.)	RANGE (black)
10			-2.2-1.8	90	1.7-5.7	110	-1.6-2.4	100	120
16	-0.7-3.3	70	-2.5-1.5	100	-2.5-1.5	120	2.5-6.5	100	120
20	7.5-9.5	70	2.8-4.8	100	0.8-2.8	120	5.4-7.4	100	120
31.5	7.6-9.6	80	-0.1-1.9	110	4.0-6.0	120	-0.6-1.4	110	120
125	1.4-2.4	110	3.3-4.3	120	7.3-8.3	120	1.5-2.5	120	120
500	4.3-5.3	120	7.2-8.2	120	7.5-8.5	120	7.5-8.5	120	120
1k	7.9-8.1	120	7.9-8.1	120	7.9-8.1	120	7.9-8.1	120	120
2k	8.7-9.7	120	7.4-8.4	120	7.3-8.3	120	5.5-6.5	130	130
4k	8.5-9.5	120	6.8-7.8	120	6.7-7.7	120	8.4-9.4	130	130
8k	6.4-7.4	120	4.5-5.6	120	4.5-5.5	120	8.5-4.5	130	130
20k	7.7-9.7	110	5.9-7.9	110	5.8-7.8	110	-1.1-0.9	120	120



Attention: Do not open the preamplifier ZC 0007 unless it is strictly necessary.

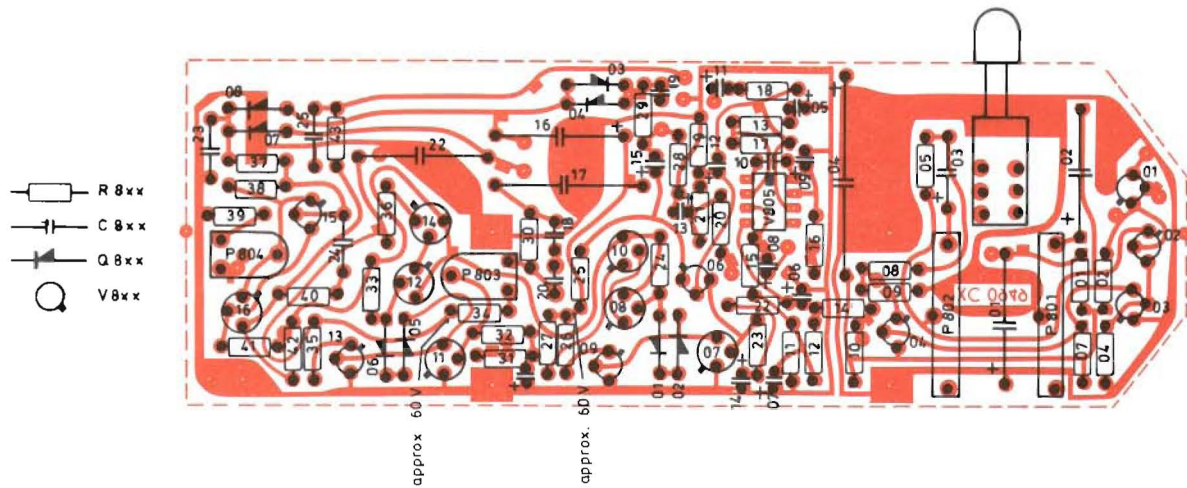
After repair it is necessary to clean all the parts with a mixture of 10% methylated alcohol and 90% Freon. When the circuit is completely dry, and clean, it should be coated with a mixture of 4% silicone oil (f. inst. Wacher WS 60) and 96% trichlorethylene. After coating the circuit is dried at a temperature of 120°C for one hour and immediately remounted.



CIRCUIT DIAGRAM REF.	COMPONENT TYPE			STOCK REF.	CIRCUIT DIAGRAM REF.	COMPONENT TYPE			STOCK REF.	
C 101	Glass		1 nF/300 V	CG 0001	R 107	Metal	1/4 W	1%	22.1 kΩ	RF 4221
C 102,103	Tantalum		6.8 μF/ 6 V	CF 0030	R 108	Carbon	-	10%	100MΩ	RH 0907
C 104	Glass		300 pF/300 V	CG 0002	R 109	Metal	-	1%	60.4 Ω	RF 1604
Q 103,104	Si. trans.	NPN	2 N 4292	VB 0533	R 110	-	-	-	2 kΩ	RF 3200
Q 105	Zener		56 V/4.5 mA	1 N 732 A	V 101	FET	N-channel		2 N 4867 A	VB 1037
Q 106	Si. trans.		150 V/0.3 A	BAX 16	V 102	Si. trans.	PNP		BCW 62 B	VB 0111
R 101	Carbon	1/8 W	5%	8.2MΩ	V 103		NPN		BCW 82 B	VB 0578
R 102	-	-	10%	10MΩ		Printed Circuit Board			XC 0330	
R 103	-	-	5%	180 kΩ		Protection Cap			DZ 9025	
R 104	-	-	20%	1,8GΩ						
R 105	-	-	5%	3.3 kΩ						
R 106	-	-	-	47 kΩ						

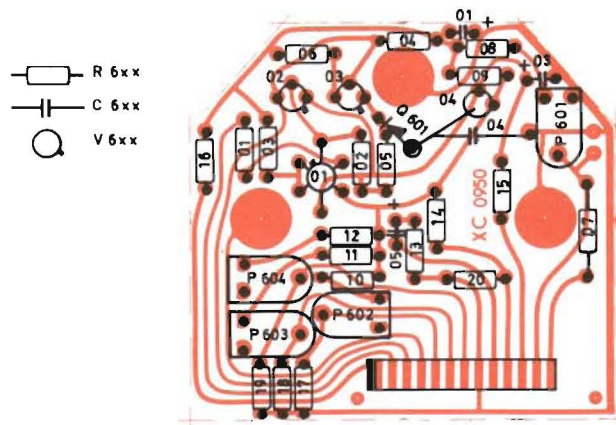
ZC 0007

2209 from serial no. 496282

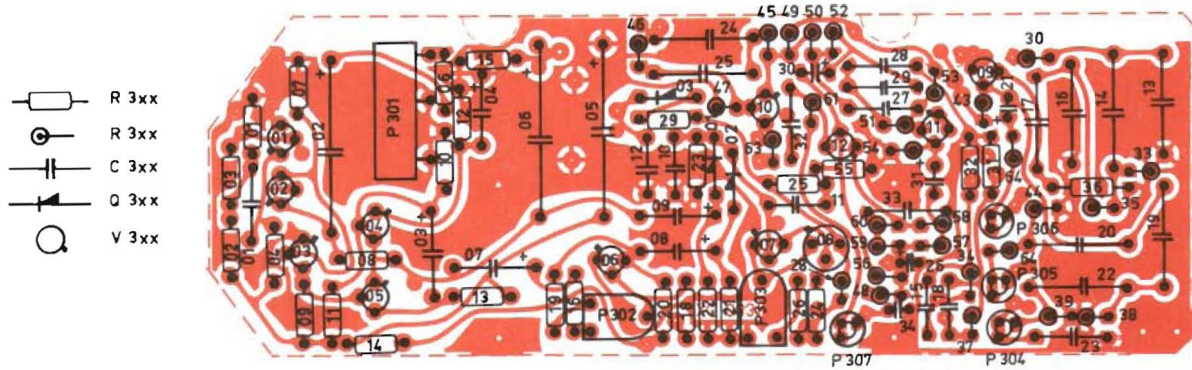


CIRCUIT DIAGRAM REF.	COMPONENT TYPE			STOCK REF.	CIRCUIT DIAGRAM REF.	COMPONENT TYPE			STOCK REF.	
C 801	Electrolytic	330 μ F/	10 V	CE 0211	R 814	Carbon	1/4 W	5%	10 Ω	RB 1100
C 802	Tantalum	220 μ F/	16 V	CF 0005	R 815	-	-	-	82 k Ω	RB 4820
C 803	-	6.8 μ F/	6 V	CF 0006	R 816	-	-	-	10 Ω	RB 1100
C 804	Electrolytic	400 μ F/	10 V	CE 0305	R 817	Metal	-	1%	100 k Ω	RF 5100
C 805	Tantalum	100 μ F/	3 V	CF 0019	R 818	-	-	-	604 Ω	RF 2604
C 806	-	33 μ F/	10 V	CF 0034	R 819	Carbon	-	5%	330 k Ω	RB 5330
C 807	-	6.8 μ F/	16 V	CF 0035	R 820	-	-	-	1.5M Ω	RB 6150
C 808	-	15 μ F/	16 V	CF 002B	R 821	-	-	-	150 k Ω	RB 5150
C 809	-	33 μ F/	10 V	CF 0034	R 822	-	1/8 W	10%	91 k Ω	RA 0041
C 810	Ceramic	2.7 pF/400 V		CK 0270	R 823	-	1/4 W	5%	6.8 k Ω	RB 3680
C 811	Tantalum	100 μ F/	3 V	CF 0019	R 824	-	-	-	220 k Ω	RB 5220
C 812	-	6.8 μ F/	16 V	CF 0035	R 825	-	-	-	470 k Ω	RB 5470
C 813,814	-	2.2 μ F/	35 V	CF 0022	R 826,827	-	-	-	270 Ω	RB 2270
C 815	-	33 μ F/	10 V	CF 0034	R 828	Metal	-	1%	8.45 k Ω	RF 3845
C 816	Electrolytic	22 μ F/100 V		CE 0616	R 829	-	-	-	90.9 k Ω	RF 4909
C 817	Polyester	0.68 μ F/100 V		CS 0342	R 830	Carbon	-	5%	330 k Ω	RB 5330
C 818	Ceramic	6.8 pF/400 V		CK 0680	R 831	-	-	-	56 k Ω	RB 4560
C 819	Ceramic	4.7 pF/400 V		CK 0470	R 832	-	-	-	10 k Ω	RB 4100
C 820	Trimmer	3-8 pF		CV 0027	R 833	-	-	-	220 k Ω	RB 5220
C 821	Tantalum	2,2 μ F/	35 V	CF 0022	R 834	-	-	-	330 k Ω	RB 5330
C 822	Electrolytic	22 μ F/100 V		CE 0616	R 835,836	-	-	-	270 Ω	RB 2270
C 823	Ceramic	1nF/500 V		CK 3100	R 837	-	-	-	4.7 k Ω	RB 3470
C 824,825	Polyester	0.1 μ F/250 V		CS 0402	R 838	-	-	-	2.2M Ω	RB 6220
P 801	Trimmer	Wire	500 Ω	PG 1502	R 839	-	-	-	180 k Ω	RB 5180
P 802	-	-	5 k Ω	PG 2505	R 840	-	-	-	4.7M Ω	RB 6470
P 803	-	Cermet	47 k Ω	PG 3471	R 841	-	1/8 W	10%	3.9M Ω	RA 0039
P 804	-	Carbon	25 k Ω	PG 3256	R 842	-	1/4 W	5%	1.5M Ω	RB 6150
					R 843	-	1/8 W	10%	3.9M Ω	RA 0039
Q 801,802	Si.	150 V/300 mA	BAX 16	QV 0217	V 806	Si. trans.	PNP		BC 179 B	VB 0100
Q 803,804	-	100 V/225 mA	BAY 72	QV 0219	V 807	-	NPN		BF 337	VB 0552
Q 805-808	-	150 V/300 mA	BAX 16	QV 0217	V 808	-	-		BF 337	VB 0545
					V 809	-	PNP		2 N 4289	VB 0058
R 801	Carbon	1/4 W	5%	22 k Ω	RB 4220	V 810	-	NPN	BF 337	VB 0545
R 802	-	-	-	270 k Ω	RB 5270	V 811	-	-	BF 337	VB 0552
R 804	-	-	-	18 k Ω	RB 4180	V 812	-	-	BF 337	VB 0545
R 805	Metal	-	1%	10 k Ω	RF 4100	V 813	-	PNP	2 N 4289	VB 0058
R 807	Carbon	-	5%	47 k Ω	RB 4470	V 814	-	NPN	BF 337	VB 0545
R 808	Metal	-	1%	10 k Ω	RF 4100	V 815	-	-	BC 10913	VB 0047
R 809	Carbon	-	5%	4.7 k Ω	RB 3470	V 816	-	-	BF 337	VB 0545
R 810	-	-	-	220 Ω	RB 2220					
R 811	-	-	-	270 k Ω	RB 5270					
R 812	-	-	-	1M Ω	RB 6100					
R 813	Metal	-	1%	3.24 k Ω	RF 3324					
									Meter Reset Switch	NN 0019
									Printed Circuit Board	XC 0949

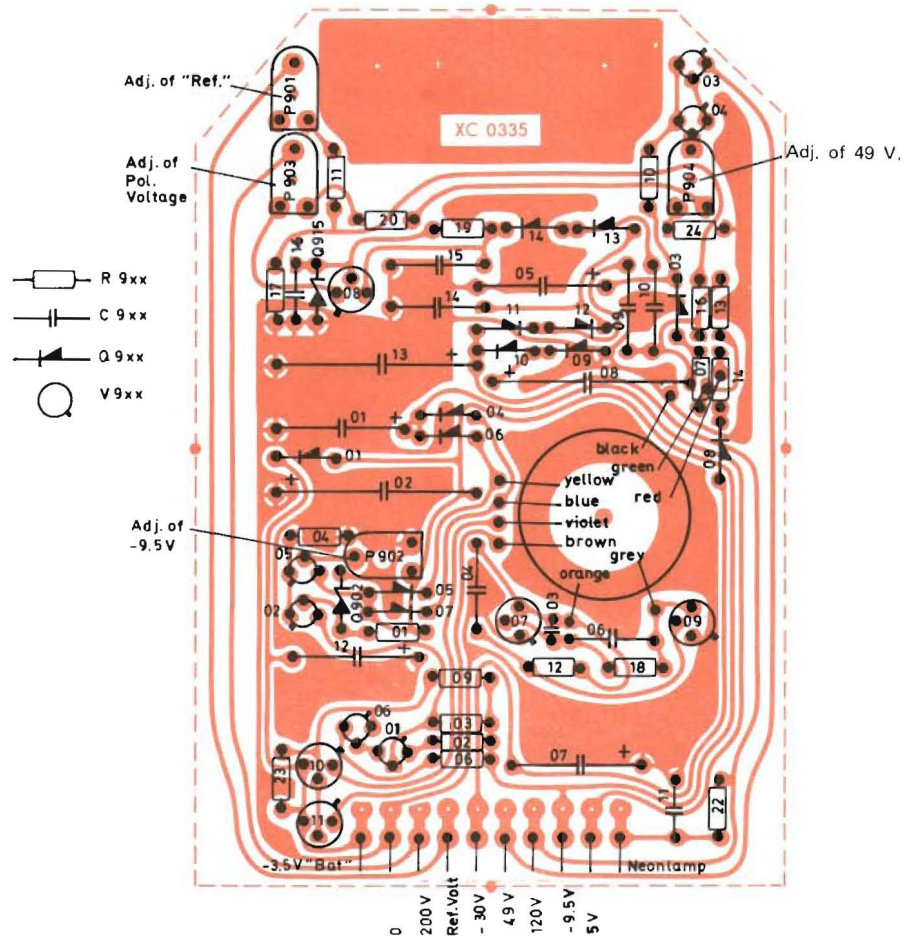
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CIRCUIT DIAGRAM REF.	COMPONENT TYPE			STOCK REF.	CIRCUIT DIAGRAM REF.	COMPONENT TYPE			STOCK REF.	
C 601,603	Tantalum		33 μ F/ 10 V	CF 0034	R 611	Metal	1/4 W	1%	26.7 k Ω	RF 4267
C 604	Polyester		0.15 μ F/100 V	CS 0337	R 612	-	-	-	29.4 k Ω	RF 4294
C 605	Tantalum		68 μ F/ 3 V	CF 0011	R 613	Carbon	-	5%	1 k Ω	RB 3100
P 601	Trimmer	Cermet	22 k Ω	PG 3221	R 614	-	-	-	68 k Ω	RB 4680
P 602-604	-	-	10 k Ω	PG 3109	R 615,616	-	-	-	10 Ω	RB 1100
Q 601	Si. trans.	NPN	SF 115	VB 0533	R 617	-	-	-	18 k Ω	RB 4180
R 601	Carbon	1/4 W	5%	100 Ω	RB 2100	R 618	-	-	33 k Ω	RB 4330
R 602	Metal	-	1%	3.92 k Ω	RF 3392	R 619	-	-	47 k Ω	RB 4470
R 603	-	-	-	18.2 k Ω	RF 4182	R 620	-	-	39 k Ω	RB 4390
R 604	Carbon	-	5%	33 k Ω	RB 4330	V 601	Si. trans.	dual NPN	BCY 87	VB 5302
R 605	-	-	-	220 k Ω	RB 5220	V 602	-	PNP	2 N 2894	VB 0093
R 606	-	-	-	68 Ω	RB 1680	V 603	-	PNP	BC 179 B	VB 0100
R 607	-	-	-	18M Ω	RH 0908	V 604	FET	N-channel	E 102	VB 1053
R 608	Metal	-	1%	100 k Ω	RF 5100					JP 1401
R 609	-	-	-	18.2 k Ω	RF 4182					
R 610	-	-	-	24.9 k Ω	RF 4249					
										XC 0950

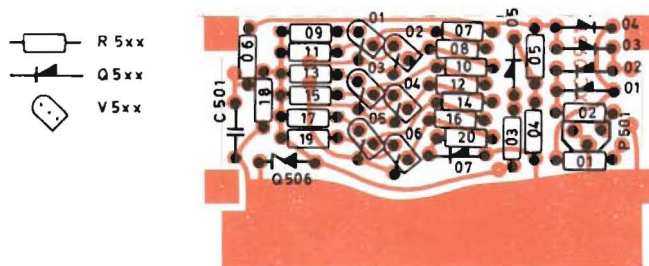


CIRCUIT DIAGRAM REF.	COMPONENT TYPE	STOCK REF.	CIRCUIT DIAGRAM REF.	COMPONENT TYPE	STOCK REF.
C 301	Tantalum 6.8 μF/ 6 V	CF 0006	R 314	Carbon 1/4 W 5% 220 Ω	RB 2220
C 302	Electrolytic 1000 μF/ 2.5 V	CE 0210	R 315	- - - 10 kΩ	RB 4100
C 303	- 22 μF/ 25 V	CE 2002	R 316	- - - 100 kΩ	RB 5100
C 304	- 47 μF/ 10 V	CE 0204	R 318	- - - 220 kΩ	RB 5220
C 305,306	- 400 μF/ 10 V	CE 0305	R 319	- - - 100 kΩ	RB 5100
C 307-309	- 47 μF/ 10 V	CE 0204	R 320	- - - 22 kΩ	RB 4220
C 310	Polystyrene 400 pF/125 V	CT 1011	R 321,322	- - - 47 kΩ	RB 4470
C 311,312	Polycarbonate 100 nF/250 V	CS 0402	R 323	- - - 2.2MΩ	RB 6220
C 313	Polystyrene 20 nF/ 63 V	CT 1125	R 324,325	- - - 4.7MΩ	RB 6470
C 314	Polycarbonate 0.47 μF/100 V	CS 0234	R 326	- - - 1.5MΩ	RB 6150
C 315	Ceramic 100 pF/400 V	CK 2100	R 328	- - - 1.5MΩ	RB 6150
C 316	Polystyrene 5.1 μF/ 63 V	CT 1124	R 329	- 1/8 W 10% 3.9MΩ	RA 0039
C 317	Polycarbonate 47 nF/250 V	CS 0235	R 330	Metal 1/4 W 1% 475 Ω	RF 2475
C 318	Ceramic 82 pF/400 V	CK 1820	R 331,332	- - - 215 kΩ	RF 5215
C 319,320	Polystyrene 20 nF/ 63 V	CT 1125	R 333	- - - 18.7 kΩ	RF 4187
C 321	Tantalum 6.8 μF/ 16 V	CF 0035	R 334	- - - 59 kΩ	RF 4590
C 322	Polystyrene 5.1 nF/ 63 V	CT 1124	R 335	- - - 2.26 kΩ	RF 3226
C 323	- 390pF/125 V	CT 1120	R 336	- - - 150 kΩ	RF 5150
C 324,325	- 5.1 nF/ 63 V	CT 1124	R 337,338	- - - 59 kΩ	RF 4590
C 326	Tantalum 33 μF/ 10 V	CF 0034	R 339	- - - 68.1kΩ	RF 4681
C 327	Polystyrene 820 pF/ 63 V	CT 1121	R 343	Carbon - 5% 27 kΩ	RB 4270
C 328,329	- 390 pF/125 V	CT 1120	R 344	Metal - 1% 63.4 kΩ	RF 4634
C 330,331	Tantalum 6.8 μF/ 16 V	CE 0035	R 345	- - - 11.8 kΩ	RF 4118
C 332	Polystyrene 2.4 nF/ 63 V	CT 1129	R 346	- - - 68.1 kΩ	RF 4681
C 333	- 2 nF/ 63 V	CT 1123	R 347	- - - 37.4 kΩ	RF 4374
C 334	Tantalum 33 μF/ 10 V	CF 0034	R 348	Carbon - 5% 1 kΩ	RB 3100
P 301	Trimmer Wire 1 kΩ	PG 2106	R 349	Metal - 1% 100 kΩ	RF 5100
P 302 303	- Cermet 25 kΩ	PG 3256	R 350,351	- - - 82.5 kΩ	RF 4825
P 304-307	- - 25 kΩ	PG 3254	R 352	- - - 68.1 kΩ	RF 4681
Q 301-303	Si. 15o V/300 mA BAX 16	QV 0217	R 353	- - - 100 kΩ	RF 5100
R 301	Carbon 1/4 W 5% 180 kΩ	RB 5180	R 354	Carbon - 5% 1MΩ	RB 6100
R 302	- - - 2.2MΩ	RB 6220	R 355	- - - 4.7MΩ	RB 6470
R 303	- - - 1MΩ	RB 6100	R 356	- - - 820 kΩ	RB 5820
R 304	- - - 270 kΩ	RB 5270	R 357	Metal - 1% 39.2 kΩ	RF 4392
R 306	Metal - 1% 182 Ω	RF 2182	R 358	- - - 11 kΩ	RF 4110
R 307	Carbon - 5% 6.8 kΩ	RB 3680	R 359,360	- - - 15 kΩ	RF 4150
R 308	Metal - 1% 22.1 kΩ	RF 4221	R 361	- - - 75 kΩ	RF 4750
R 309	Carbon - 5% 47 kΩ	RB 4470	R 363	Carbon - 5% 1 kΩ	RB 3100
R 310	- - - 33 kΩ	RB 4330	R 364,365	Metal - 1% 64.9 kΩ	RF 4649
R 311	- - - 100 kΩ	RB 5100	V 301,302	Si. trans. NPN BC 174 B	VB 0537
R 312	- - - 680 Ω	RB 2680	V 303-306	- PNP BC 179 B	VB 0100
R 313	- - - 470 Ω	RB 2470	V 307	- NPN BC 109 B	VB 0047
			V 308	- NPN BF 337	VB 0052
			V 309-312	- NPN BC 109 B	VB 0545
			Printed Circuit Board		XC 0331



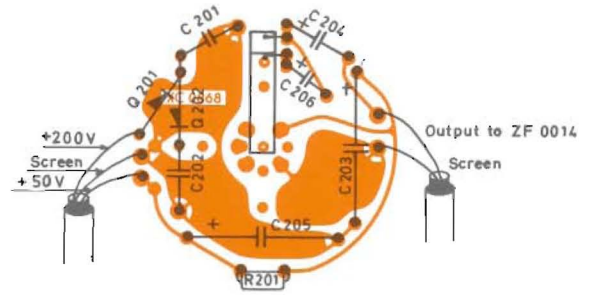
CIRCUIT DIAGRAM REF.	COMPONENT TYPE		STOCK REF.	CIRCUIT DIAGRAM REF.	COMPONENT TYPE		STOCK REF.
C 901	Electrolytic	220 μ F/ 6.3 V	CE 0208	R 901	Carbon	1/4 W 5%	1.2 k Ω RB 3120
C 902	-	470 μ F/ 10 V	CE 0305	R 902	-	-	220 Ω RB 2220
C 903	Ceramic	2.2 nF/100 V	CK 9103	R 903	-	-	5.6 k Ω RB 3560
C 904	Electrolytic	10 μ F/ 25 V	CE 0416	R 904	-	-	15 k Ω RB 4150
C 905	-	47 μ F/ 63 V	CE 0509	R 906,907	-	-	1 k Ω RB 3100
C 906	-	10 μ F/ 25 V	CE 0416	R 909	-	-	10 k Ω RB 4100
C 907	-	6.8 μ F/ 40 V	CE 0453	R 910	-	-	1 k Ω RB 3100
C 908	-	22 μ F/100 V	CE 0616	R 911	-	-	270 k Ω RB 5270
C 909	Polyester	47 nF/250 V	CS 0063	R 912	-	-	1 k Ω RB 3100
C 910	-	10 nF/400 V	CS 0101	R 913,914	-	-	470 Ω RB 2470
C 911	-	100 nF/250 V	CS 0402	R 916	-	-	1M Ω RB 6100
C 912	Electrolytic	100 μ F/6.3 V	CE 0207	R 917	-	-	3.9 k Ω RB 3390
C 913	-	33 μ F/160 V	CE 2038	R 918	-	-	1 k Ω RB 3100
C 914	Polyester	47 nF/250 V	CS 0063	R 919	-	1/8 W 10%	10M Ω RA 0025
C 915	Polyester	10 nF/400 V	CS 0101	R 920	-	1/4 W 5%	4.7M Ω RB 6470
C 916	-	47 nF/250 V	CS 0401	R 922	-	1/8 W 10%	10M Ω RA 0025
P 901, 902	Trimmer	Cermet	100 k Ω PG 4108	R 923	-	1/4 W 5%	10 k Ω RB 4100
P 903	-	Carbon	2M Ω PG 5202	R 924	-	-	1.5M Ω RB 6150
P 904	-	-	1M Ω PG 5102	V 901	Si. trans.	NPN BC 109	VB 0047
Q 901	Si.	150 V/300 mA	BAX 16 QV 0217	V 902	-	PNP BC 179	VB 0100
Q 902	Zener	5-6.2 V/ 5 mA	ZG 5,6 QV 1105	V 903,904	-	NPN BC 109	VB 0047
Q 903	Si.	150 V/300 mA	BAX 16 QV 0217	V 905,906	-	PNP BC 179	VB 0100
Q 904-907	Ge.	115 V/150 mA	OA 85 QV 0085	V 907	Ge. trans.	PNP ASY 80	VB 0069
Q 908-914	Si.	150 V/300 mA	BAX 16 QV 0217	V 908	Si. trans.	NPN BF 337	VB 0545
Q 915	Zener	220 V/ 15 mA	MZ 22 BA QV 1326	V 909-911	Ge. trans.	PNP ASY 80	VB 0069
					Converter Transformer		LB 0630
					10-pin Connector		JP 1001
					Printed Circuit Board		XC 0335

ZG 0071



CIRCUIT DIAGRAM REF.	COMPONENT TYPE			STOCK REF.	CIRCUIT DIAGRAM REF.	COMPONENT TYPE			STOCK REF.	
C 501	Polystyrene	510 pF/	63 V	CT 1135	R 507	Metal	1/4 W	1%	31.6 k Ω	RF 4316
P 501	Trimmer	Carbon	2 k Ω	PG 2206	R 508	-	-	-	11.8 k Ω	RF 4118
Q 501-504	Si.	100 V/200 mA	BAY 72	QV 0219	R 509	-	-	-	11 k Ω	RF 4110
Q 505	Si.	15 V/ 30 mA	SFD 121	QV 0100	R 510	-	-	-	5.23 k Ω	RF 3523
Q 506	Zener	6.2 V/ 35 mA	ZP 6.2	QV 1334	R 511	-	-	-	3.16 k Ω	RF 3316
Q 507	Si.	100 V/220 mA	BAY 72	QV 0219	R 512	-	-	-	3.01 k Ω	RF 3301
V 501-506	Silicon	PNP	BCW 62 B	VB 0049	R 513	-	-	-	1.27 k Ω	RF 3127
R 501	Metal	1/4 W	1%	100 Ω	RF 2100	R 514	-	-	2.21 k Ω	RF 3221
R 502	-	-	-	5.23 k Ω	RF 3523	R 515	-	-	422 k Ω	RF 2422
R 503	-	-	-	24.9 k Ω	RF 4249	R 516	-	-	1.1 k Ω	RF 3110
R 504	-	-	-	8.06 k Ω	RF 3806	R 517	-	-	100 Ω	RF 2100
R 505	-	-	-	2 k Ω	RF 3200	R 518	-	-	20 k Ω	RF 4200
R 506	-	-	-	68.1 k Ω	RF 4681	R 519	-	-	15.4 Ω	RF 1154
						R 520	-	-	1.1 k Ω	RF 3110
							Printed Circuit Board			XC 0951

CIRCUIT DIAGRAM REF.	COMPONENT TYPE		STOCK REF.
C 201,202	Polyester	0.22 μ F/250 V	CS 0405
C 203	Electrolytic	68 μ F/ 63 V	CE 0513
C 204	Tantalum	3.9 μ F/ 35 V	CF 0015
C 205	Electrolytic	68 μ F/ 63 V	CE 0513
C 206	Tantalum	0.15 μ F/ 35 V	CF 0033
C 401	-	47 μ F/ 6.3 V	CF 0023
C 402,403	-	2.2 μ F/ 35 V	CF 0022
C 701	-	47 μ F/ 6 V	CF 0017
C 703	-	3.3 μ F/ 15 V	CF 0025



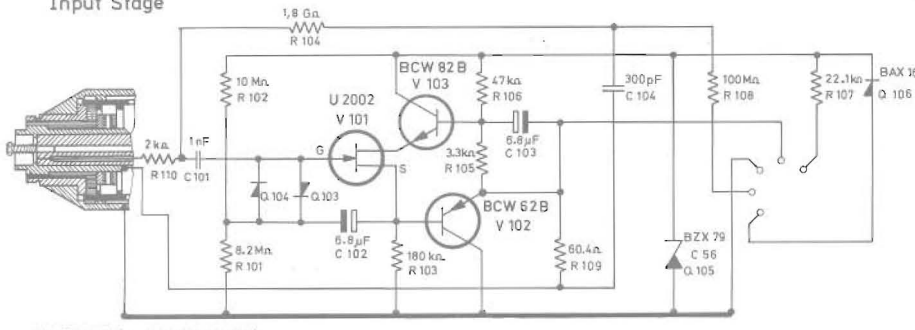
	Battery Cover			DD 0076	
	Carrying Strap			DH 0049 +YS 0418	
	Spring for Scales			OL 3053	
	Cabinet Top Half			FA 0409	
	Cabinet Bottom Half			FB 0197	
	Moving Coil Instrument			IM 0008	
	Coax Socket			JJ 0006	
	14-pin Connector			JJ 1406	
	20-pin -			JJ 2005	
	27-pin -			JJ 2702	
	10-pin -			JP 1001	
	21-pin -			JP 2100	
	27-pin -			JP 2702	
	Socket for ZC 0007			JY 0009	
	Meter Reset Switch			NN 0019	
O 3	Switch			OD 0207 OD 0208	
O 1,2	Attenuator Switch			OR 2204	
O 4,5	Meter and Filter Switch			OG 3003	
	Dry Cell 1.5 V			QB 0004	
Q 201,202	Si. diode	BAX 16	150 V/300 mA	QV 0217	
R 201	Carbon	1/4 W	5%	4.7 k Ω	RB 3470
R 401	Metal	-	1%	3.32 k Ω	RF 3332
R 402	-	-	-	10 k Ω	RF 4100
R 403	-	-	-	31.6 k Ω	RF 4316
R 404	-	-	-	100 k Ω	RF 5100
R 405	-	-	-	1 k Ω	RF 3100
R 406	-	-	-	3.16 k Ω	RF 3316
R 407	-	-	-	1.5 k Ω	RF 3150
R 408	-	-	-	10 k Ω	RF 4100
R 409	-	-	-	316 Ω	RF 2316
R 410	-	-	-	10 k Ω	RF 4100
R 411	-	-	-	100 Ω	RF 2100
R 412	-	-	-	31.6 k Ω	RF 4316
R 413,414	-	-	-	39.2 k Ω	RF 4392
R 413,414	-	-	-	12.1 k Ω	RF 4121
R 415	Carbon	-	5%	10 k Ω	RB 4100
R 415	Metal	-	1%	46.6 Ω	RF 1464
R 416	-	-	-	100 k Ω	RF 5100
R 701	Carbon	-	5%	220 k Ω	RB 5220
R 702	-	-	-	6.8M Ω	RH 0904
R 703	Metal	-	-	15.47 k Ω	
R 704	-	-	1%	69.8 k Ω	RF 4698
	Knob for Filter Switch			SN 0826	
	Knob for Attenuator, black			SN 1019 + DB 0345 + YM 1305 + DL 3053	
	Meter			IM 0052	

CIRCUIT DIAGRAM REF.	COMPONENT TYPE		STOCK REF.
	Knob for Attenuator, transp.		SN 1020 + DB 0965 + DB 0346 + YM 0906 + YS 1700
	Knob for Meter Switch		SN 1021
	10 – 130 dB	1 A	
	20 – 140 dB	1 B	SA 0012
	30 – 140 dB	2 A	
	40 – (160 dB)	2 B	SA 013
	50 – 160 dB	3 A	
	10 μ V – 10 V	3 B	SA 0014
	$3 \cdot 10^{-1} - 3 \cdot 10^5$	4 A	
	$10^{-1} - 10^5$	4 B	SA 0015
	$3 \cdot 10^{-2} - 3 \cdot 10^4$	5 A	
	$10^{-2} - 10^4$	5 B	SA 0016
	$3 \cdot 10^{-3} - 3 \cdot 10^3$	6 A	
	$10^{-3} - 10^3$	6 B	SA 0017
	$3 \cdot 10^{-4} - 3 \cdot 10^2$	7 A	
	$10^{-4} - 10^2$	7 B	SA 0018
	$3 \cdot 10^{-5} - 30$	8 A	
	$10^{-5} - 10$	8 B	SA 0019
	$3 \cdot 10^{-6} - 3$	9 A	
	$10^{-6} - 1$	9 B	SA 0020
	$3 \cdot 10^{-7} - 3 \cdot 10^{-1}$	10 A	
	$10^{-7} - 10^{-1}$	10 B	SA 0021
	Scale, blank		SA 0024
V 401,402 V 701	Neon lamp		VS 8011 VS 0013
05,04	Meter, Filter Switch		OE 0071
	Input Stage		ZC 0007
	Output Amplifiers		ZE 0094
	Meter Circuit		ZE 0095
	Preamplifier, Filter		ZE 0102
	Attenuators		ZF 0014
	Power Supply		ZG 0071
	RMS Circuit		ZL 0032
	Input Connector	p.c. board XC 0868	with comp. ZS 0187

2209.

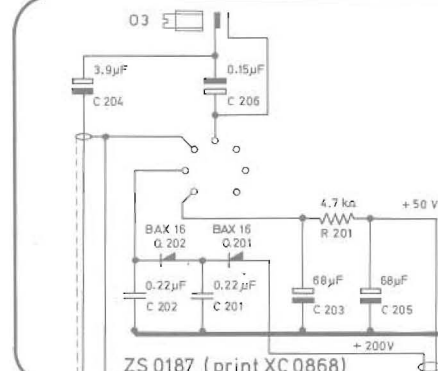
Valid from serial no. 496282

Input Stage



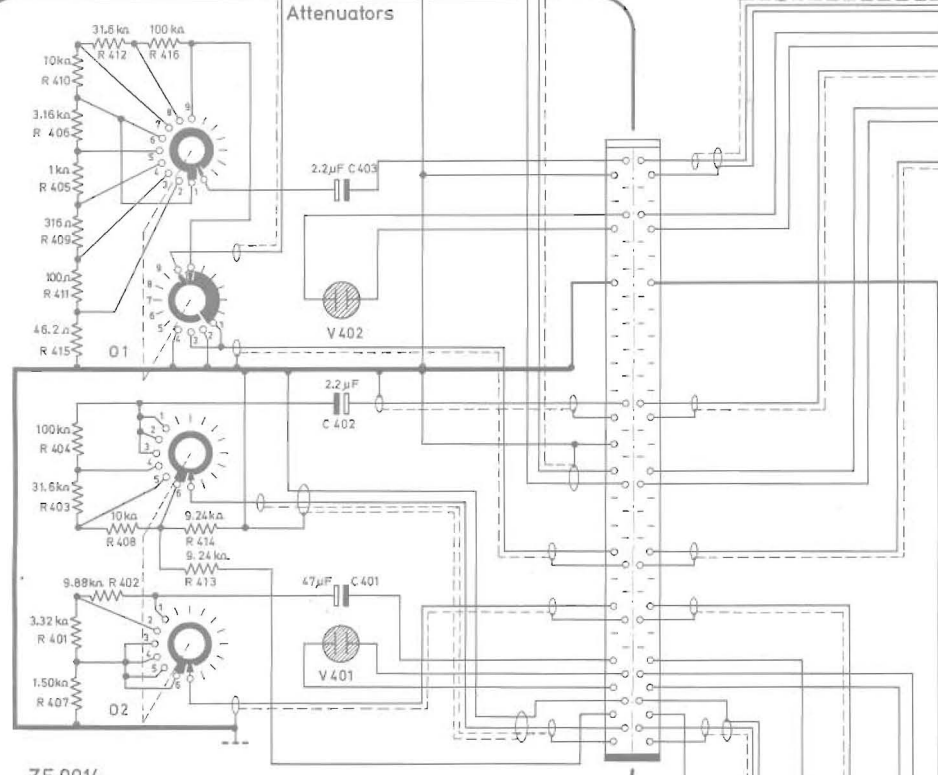
ZC 0007 (print XC 0330)

O3



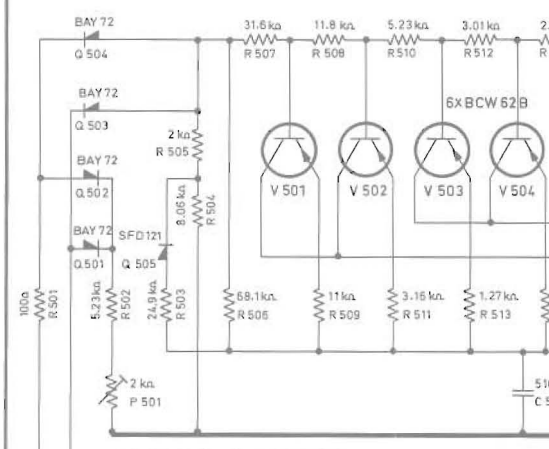
ZS 0187 (print XC 0868)

Attenuators



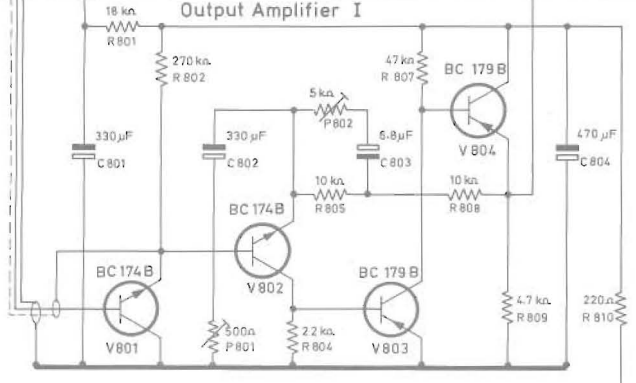
ZF 0014

RMS Circuit



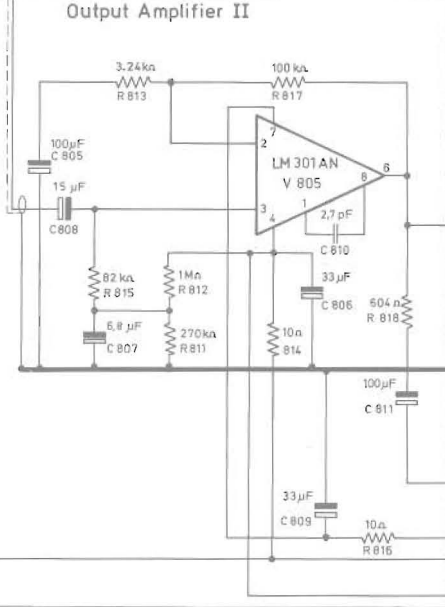
ZL0032 (print XC 0951)

Output Amplifier I

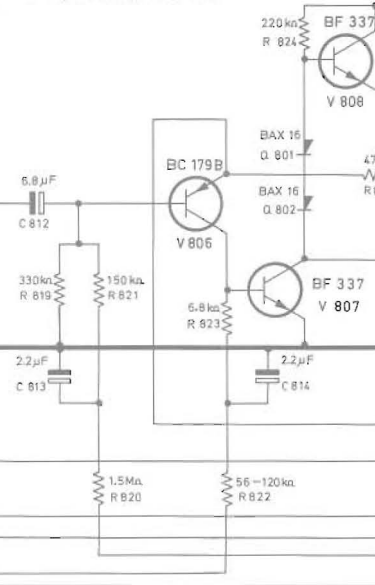


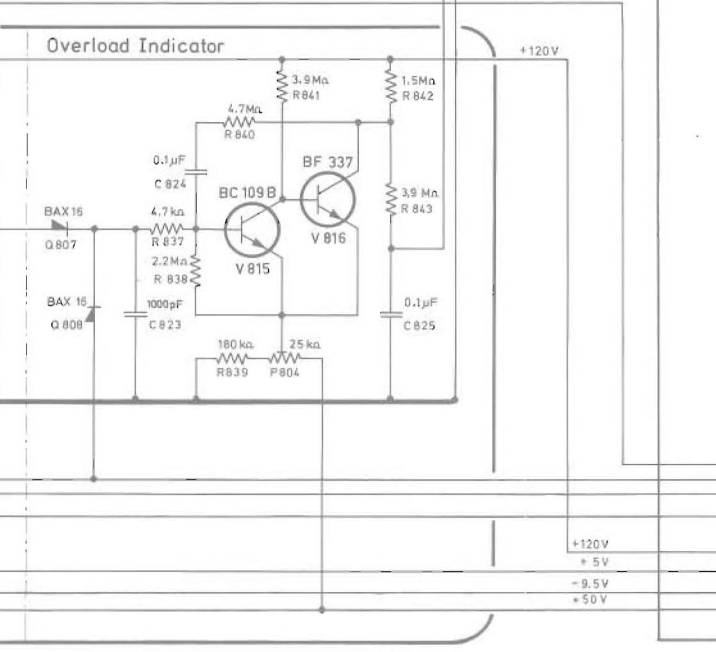
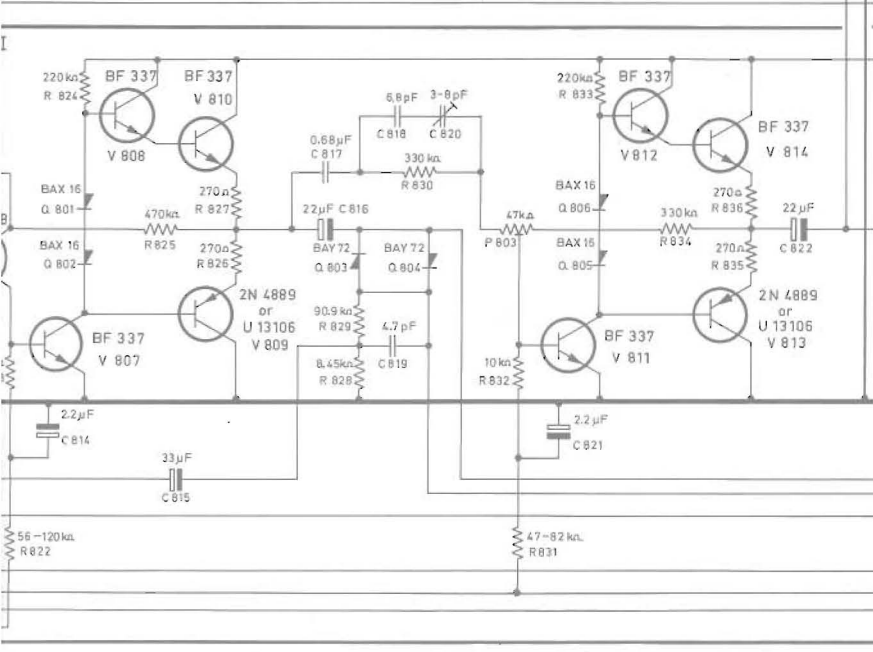
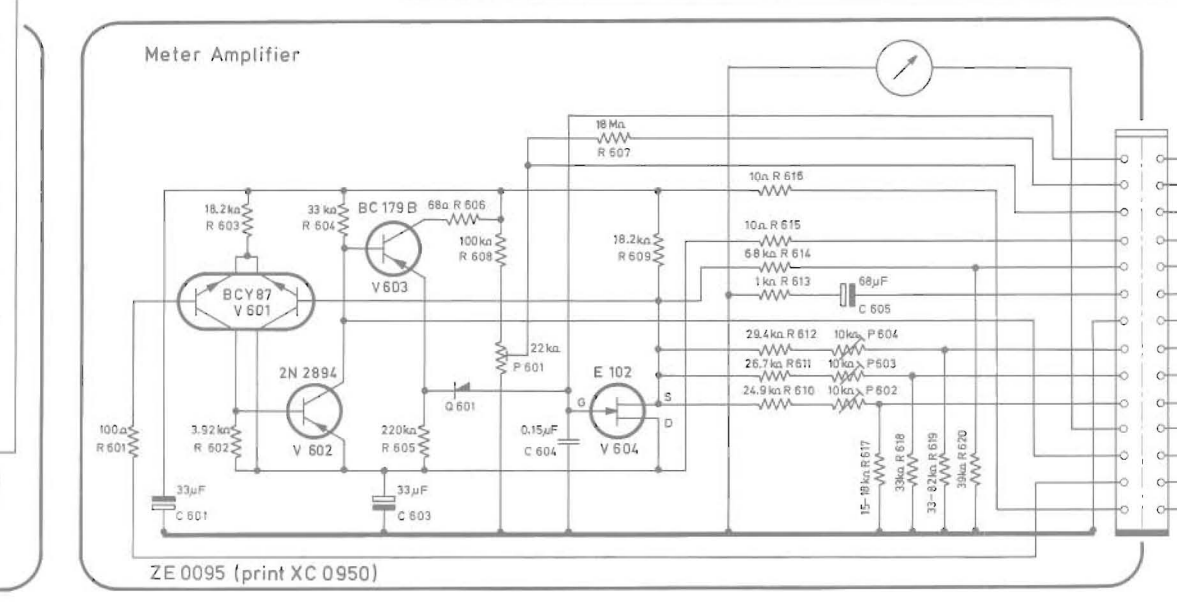
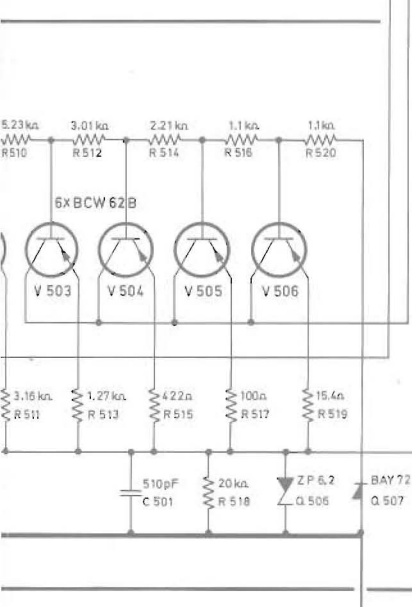
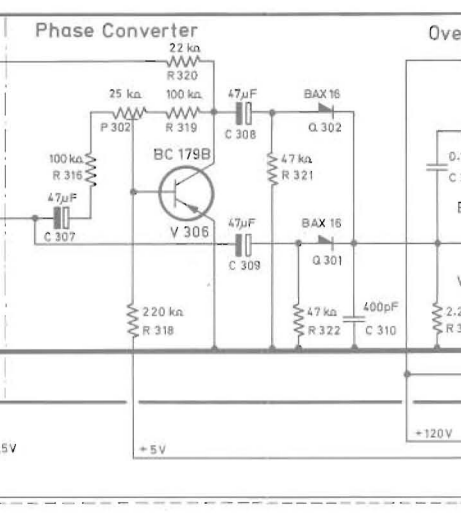
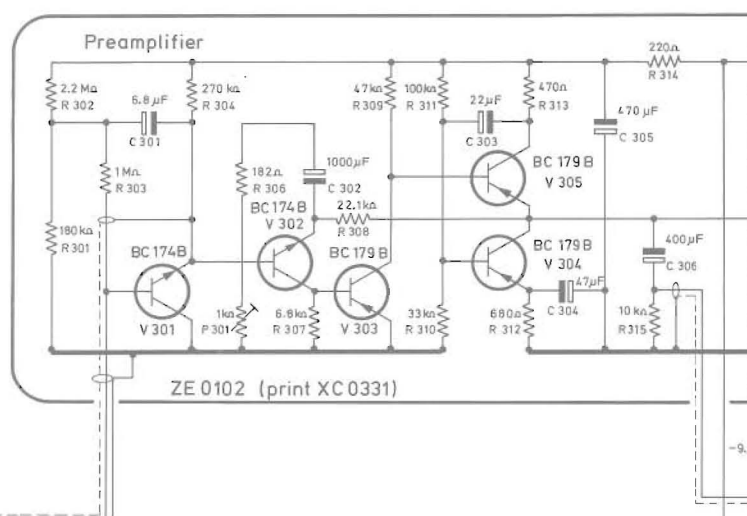
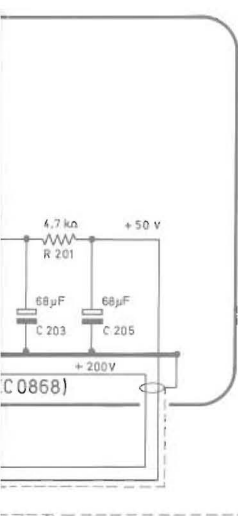
ZE 0094 (print XC 0949)

Output Amplifier II

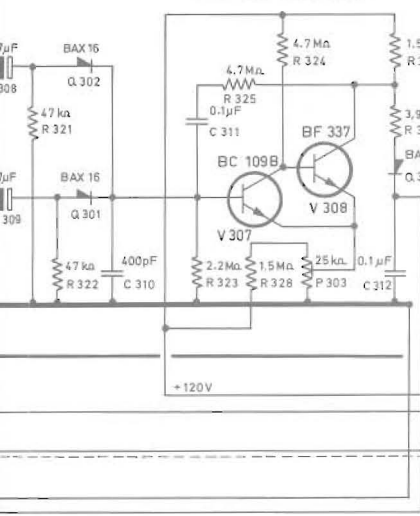


Output Amplifier III

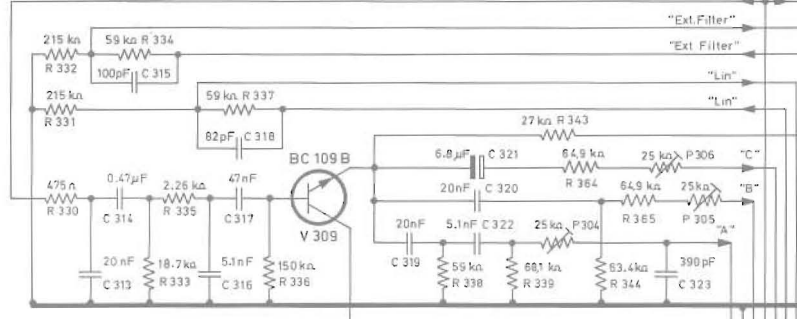




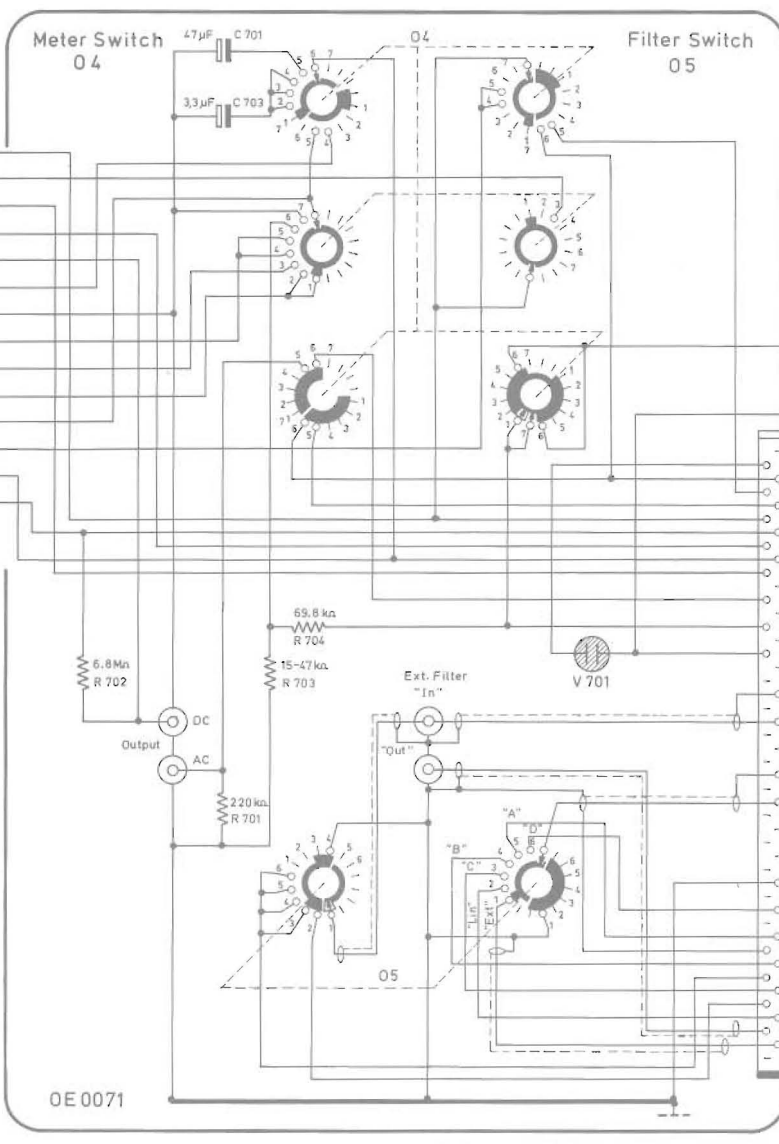
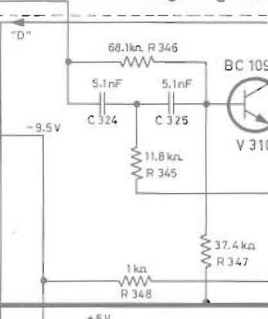
Overload Indicator



Weighting Network "A", "B", "C"



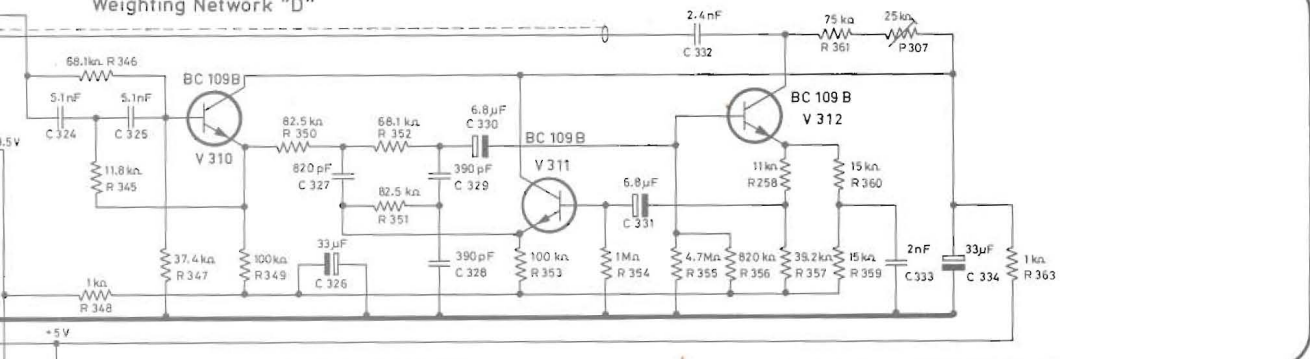
Weighting Net



OE 0071

+120V
+5V
-9.5V
+50V

Weighting Network "D"

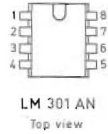


O1: Attenuator

- 1: Ref.
- 2: 130dB
- 3: 120 "
- 4: 110 "
- 5: 100 "
- 6: 90 "
- 7: 80 "
- 8: 70 "
- 9: 60 "

O2: Attenuator

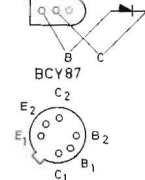
- for O1 in pos. 60 dB
- 1: 10dB
 - 2: 20 "
 - 3: 30 "
 - 4: 40 "
 - 5: 50 "
 - 6: 60 "



ASY 80

- BC 109 B
- BC 179 B
- BF 337
- U 13106
- 2N 2894
- 2N 4889

Q 103, 104, 601, Collector-Bose Diode of Transistor Type SF 115

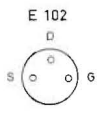
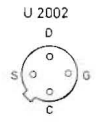


O5: Filter Switch

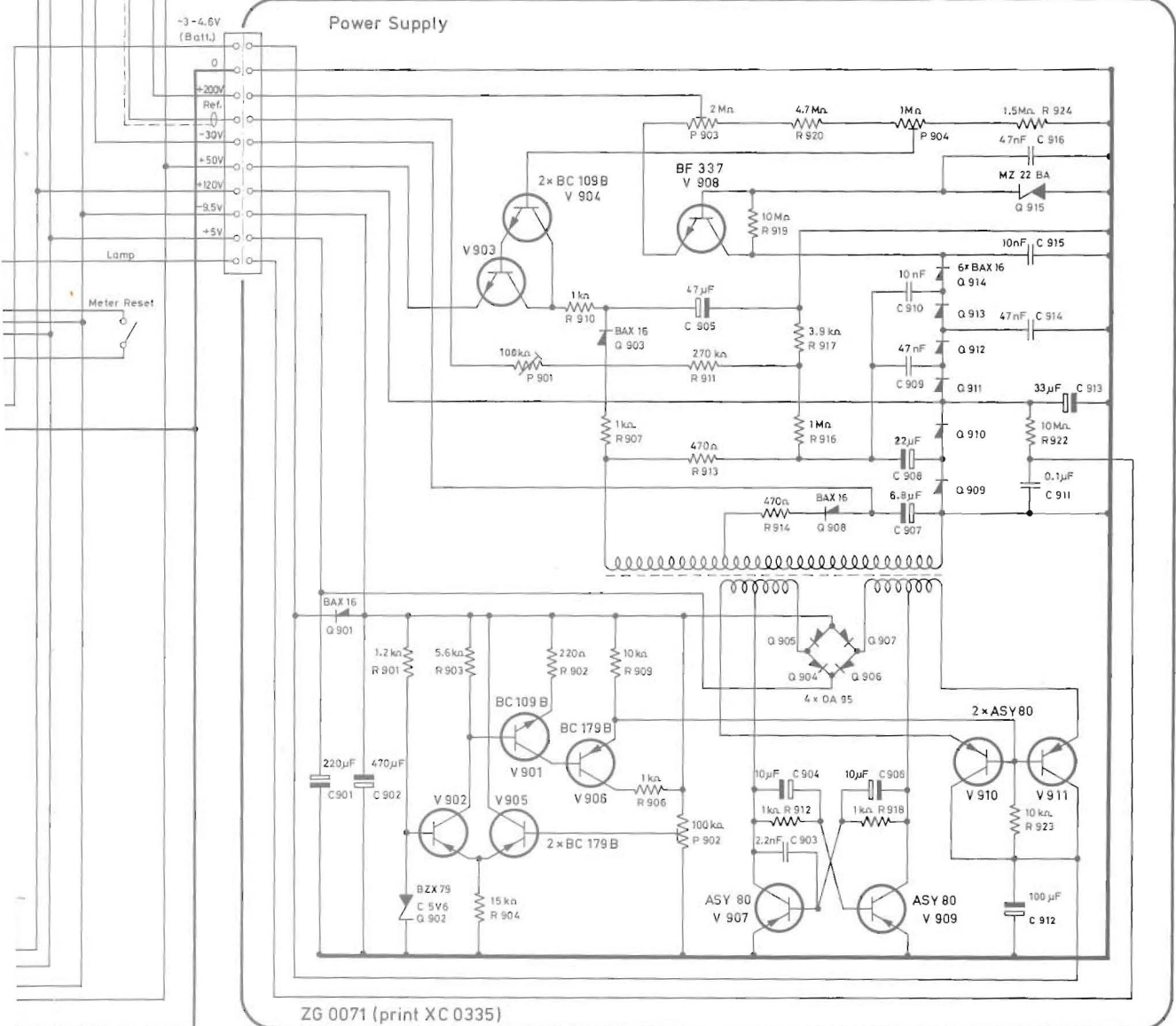
- 1: Ext. Filter
- 2: Lin.
- 3: C
- 4: B
- 5: A
- 6: D

O4: Meter Switch

- 1: Peak Hold
- 2: Impulse Hold
- 3: Impulse
- 4: Fast
- 5: Slow
- 6: Battery (Recorder)
- 7: Off



Power Supply



ZG 0071 (print XC 0335)

