

# Brüel & Kjær

Measuring Amplifier

2608

valid from serial no. 395964

0037-0092



# Service

## Measuring Amplifier

### 2608

valid from serial no. 305064

0037-0092

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**Trouble Shooting:**

If some sort of trouble occurs with this instrument then first check the D.C. working voltages from the Power Supply.

Then use the Checking Procedure with Block Diagram in order to localize a trouble to be in one certain circuit.

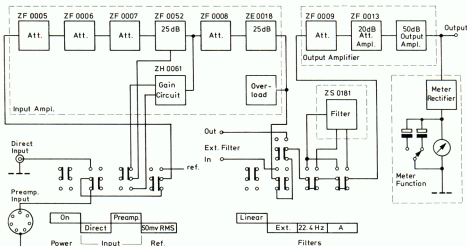
When a fault has been found and remedied the voltages and adjustments which are influenced by the remedy must be rechecked and the Checking Procedure can be used again to test if all basic functions of the instrument are fulfilled.

The tolerance stated in the instructions can only be used as a guide for adjustment and control, but any deviations must not be corrected without being sure that the tolerances of the instrument used for making the adjustment are so small as to have no influence on the measurements.

The instructions in this Manual are given purely as a guide to the service of equipment. Some faults, as f.inst. small deviations in tolerances require for their correction special control equipment and extensive experience, and in these cases it is necessary to send the instrument to the factory.

**Spare Parts:**

Please state type and serial number of apparatus when spare parts are ordered.



The Measuring Amplifier 2608 consists of an Input Amplifier with Attenuator, a Filter Circuit, an Output Amplifier with Attenuator and a Meter Circuit.

The first stage of the input amplifier is a 0–90 dB attenuator which is positioned on three circuit boards ZF 0006, 0006 and 0007.

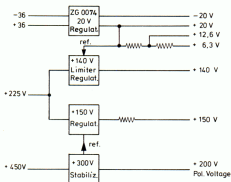
The input attenuator is followed by a low noise 25 dB amplifier ZE 0052 with protection diodes across the input.

Then comes a 0–30 dB attenuator ZF 0008 and another 25 dB amplifier ZE 0018.

The resulting Input Amplifier has an amplification of 50 dB and a 0–120 dB attenuation.

Furthermore the first 25 dB amplifier can be sensitivity adjusted by "Gain Control" (–12 dB) and "Direct Sens." and "Preamp. Sens." each having an adjustment range of +4 to –10 dB in respect to normal sensitivity.

An overload indicator positioned on the bottom circuit board is connected to the output of ZE 0018 to indicate when the output voltage is more than 13 dB above 1 V.



The output of ZE 0018 being low impedance is meant to feed a filter as first, the A-weighting network or HP 22.4 Hz filter placed on ZS 0181.

The "Lin. 2–200,000 Hz" selection corresponds a direct connection between input and output amplifier.

Also an external filter can be connected to sockets on the rear of the instrument.

The output amplifier section consists of a 0–20 dB attenuator with a 300 kHz LP filter ZF 0009, a 20 dB amplifier with 0–30 dB attenuation ZF 0013 and a 50 dB output amplifier which is mounted on the bottom circuit board.

This gives a resulting amplification of 70 dB and an attenuation of 0–50 dB.

The final stage of the output amplifier has a max. output voltage of 56 V Peak which ensures a crest factor of 5.

The output is overload- and short circuit protected by current limitation of the +140 V supply and by two diodes Q 14 and 15.

The last section of the whole amplifier is the meter section consisting of a passive diode circuit coupled to give true RMS indication on the succeeding moving coil instrument. A "Meter Function" selector selects two different meter time constants: "Fast" and "Slow".

The Power Supply for the instrument is designed according to the block diagram shown.

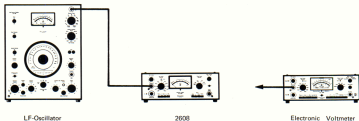
ZG 0074 is a shortcircuit protected + and –20 V regulator which supplies all the active circuits through the instrument.

Furthermore +20 V is led through two voltage droppers to power the filament of preamplifiers connected to the 7-pin socket, and is used as a reference voltage for the +140 V regulator.

+140 V is current limited to approx. 20 mA and supplies the final stage of the output amplifier.

+150 V (unloaded) supplies the preamplifier connected to the 7-pin socket on the front plate.

+200 V is the polarization voltage for condenser microphones through the preamplifier.



### 2.1. Sensitivity

- a. GAIN CONTROL: "10"  
POWER: "On"  
INPUT: "Direct"  
REF.: "Released"  
INPUT ATT.: "0.1 V"  
OUTPUT ATT.: "x1"  
FILTERS: "Linear"  
METER FUNCTION: "Fast"
- b. FILTERS to "A and HP 22.4 Hz"
- c. FILTERS to "Ext."

Input signal to "Direct Input" of 2608: 1000 Hz - 0.1 V exactly.

Adjust "Direct Sens." for 0.1 V deflection on 2608 meter (adjustment range for "Sens." adjustments approx. +4 to -10 dB).

Check the "Output" voltage with an electronic voltmeter: 10 V RMS  $\pm$  0.5 dB.

### 2.2. Frequency Response

INPUT: "Direct"  
FILTERS: "Linear"  
METER FUNCTION: "Fast"

Input signal: 1000 Hz adjusted to give an 18 dB deflection on 2608.

Vary the frequency from 2 Hz to 200 kHz: Deflection 18 dB  $\pm$  0.5 dB.

From 10 Hz to 50 kHz the tolerance is  $\pm$  0.2 dB (+ tolerance of generator).

### 2.3. Overload Indication

GAIN CONTROL: "10"  
INPUT: "Direct"  
INPUT ATT.: "0.1 V"  
OUTPUT ATT.: "x1"  
FILTERS: "Linear"

Input to "Direct Input": 1 kHz - 0.1 V RMS corresponding full scale deflection on 2608.

Raise the input signal to 11 dB above 0.1 V: No overload indication.

Raise the input signal to 13 dB above 0.1 V: Overload indication.

### 2.4. Noise

GAIN CONTROL: "10"  
INPUT: "Direct"  
INPUT ATT.: "3 mV"  
OUTPUT ATT.: "x0.01"  
FILTERS: "Linear"

The instrument must be in the cabinet or in other way effectively screened.

Max. noise deflection for correctly adjusted sensitivity: 14  $\mu$ V

Max. noise with shortconnected input: 7  $\mu$ V

### 2.5. Reference

- a. GAIN CONTROL: "10"  
INPUT: "Direct"  
INPUT ATT.: "0.1 V"  
OUTPUT ATT.: "x1"  
FILTERS: "Linear"  
REF.: "50 mV RMS"

Adjust "Direct Sens." for a deflection to the ref. mark on the 2608 meter scale.



## 2608.2 Checking Procedure

b. REF: "Released"

Input signal to "Direct Input": 1 kHz, exactly 0.1 V

Deflection on 2608: 0.1 V  $\pm$  1%.

If necessary see item 4.7.

### 2.6. Sensitivity with Microphone

a. GAIN CONTROL: "10"  
INPUT: "Preamp."  
INPUT ATT.: "0.1 V"  
OUTPUT ATT.: "x1"  
FILTERS: "Linear"  
REF: "50 mV RMS"

Connect a preamplifier to "Preamp. Input" and adjust "Preamp. Sens." to the correct sensitivity of the microphone and preamplifier.

b. REF: "Released"  
INPUT ATT.: "3 V"

Check the sensitivity with a Pistonphone type 4220 or a similar wellknown sound source.

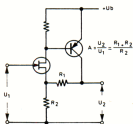
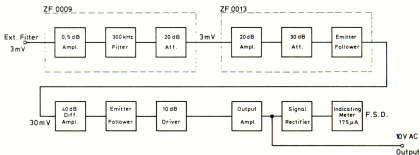
The meter deflection on 2608 should be equal to the Sound Pressure Level produced by the Pistonphone. (Remember corrections for the actual static pressure).

Tolerance: 0.2 dB (Pol. Voltage 200 V  $\pm$  1 V).

The following tells which care to take when replacing printed circuit boards with components:

#### By replacement of:

ZE 0018	25 dB Amplifier	Check items 4.1, 4.2 and 4.8
ZE 0052	Low noise 25 dB Amplifier	Check items 4.1, 4.2 and 4.8
ZF 0005	Attenuator	No adjustment necessary
ZF 0006	Attenuator Input	Check item 4.2 and 4.3
ZF 0007	Attenuator	Check item 4.2 and 4.3
ZF 0008	Attenuator, 0-30 dB	Check item 4.3
ZF 0009	Attenuator, 0-30 dB + LP Filter	Check items 3.3 and 3.7
ZF 0013	Attenuator, 0-30 dB + 20 dB Ampl.	Check items 3.1, 3.3 and 3.7
ZG 0074	20 V Regulator	Adjust P 440 for +20 V on V 450 <sub>E</sub> and check -20 V on V 449 <sub>E</sub>
ZH 0061	Gain Circuit	Check item 2.5
ZH 0062	Basic Circuit	Run through the whole Checking Procedure
ZS 0181	Filter	Adjust according to item 5.1



The sensitivities given on the block diagram are valid for OUTPUT ATT. in position "x 0,003".

When troubleshooting the passive meter circuit can be checked by applying 10 V AC into the "Output" socket corresponding full scale deflection.

The amplification of the small circuit shown to the left is dependent of the ratio between R1 and R2 as given by the formula. This type of circuit is used in ZF 0009 and ZF 0013.

### 3.1. Sensitivity

FILTERS: "Ext."  
OUTPUT ATT.: "x1"

Apply a 1 kHz signal to "Ext. Filter Out" and adjust the level to give exactly 10 V RMS on the "Output".

The input signal should be 1 V ± 0.5 dB.

If not check the 30 mV on V 360<sub>g</sub> (output from ZF 0013)

The meter deflection should be exactly full scale (10 V).

If necessary adjust P 6 (FSD on the bottom circuit board).

### 3.2. Frequency Response

FILTERS: "Ext."  
OUTPUT ATT.: "x1"

Input signal to "Ext. Filter Out": 1 kHz adjusted to give 10 V on "Output".

Vary the frequency from 2 to 200,000 Hz and check that the "Output" voltage is 10 V ± 0.2 dB.

If necessary adjust trimmer capacitor FR on the bottom circuit board at 200 kHz.

Check that the meter deflection is correct for all frequencies as well.

### 3.3. Output Attenuator

FILTERS: "Ext."  
OUTPUT ATT.: "x1"  
METER FUNCTION: "Fast"

Input signal to "Ext. Filter Out": 1 kHz adjusted to give 18 dB deflection on 200<sub>h</sub> meter.

Check the steps of the OUTPUT ATTENUATOR compared to the attenuator of the Frequency Generator or a special Attenuator Box.

Tolerance: ± 0.1 dB (+ tolerance of the test attenuator).

At 200 kHz the tolerance is ± 0.2 dB.

**3.4. Meter Linearity**

FILTERS: "Ext."  
OUTPUT ATT.: "x1"  
METER FUNCTION: "Fast"  
  
OUTPUT ATT.: "x0.3"

Input signal to "Ext. Filter Out": 1 kHz adjusted to give exactly full scale deflection, (20 dB)

Deflection: 10 dB  $\pm$  0.3 dB.

**3.5. Output Impedance**

FILTERS: "Ext."  
OUTPUT ATT.: "x1"

Input signal to "Ext. Filter Out": 1 kHz adjusted to give exactly 10 V RMS on "Output".

Load the "Output" with a resistor at 1 k $\Omega$ .

The "Output" voltage should drop max. 0.5 dB corresponding an output impedance of 50  $\Omega$ .

The check should be made at 200 kHz as well.

**3.6. Distortion**

FILTERS: "Ext."  
OUTPUT ATT.: "x1"

Adjust a 1 kHz input signal to give 10 V RMS on "Output".

With a Frequency Analyzer type 2107 in Rejection Mode distortion down to 0.25% can be measured.

However, the tolerance for 2608 is 0.1% at 1 kHz and 0.3% at 50 kHz, but to measure this a more complex set up is necessary.

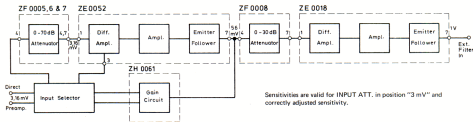
**3.7. Noise and Hum**

FILTERS: "Ext."  
OUTPUT ATT.: "x1"  
  
OUTPUT ATT.: "0.003"

Shortconnect "Ext. Filter Out" socket.

2–40,000 Hz Max.: 3 mV

2–40,000 Hz Max.: 50 mV



#### 4.1. Sensitivity

GAIN CONTROL: "10"  
INPUT ATT.: "0.1 V"  
INPUT: "Direct"  
FILTERS: "Ext."

Input signal to 2608 "Direct Input": 1 kHz 0.1 V.

Voltmeter connected to "Ext. Filter In" socket:  $1 \text{ V} \pm 0.5 \text{ dB}$  (for correctly adjusted sensitivity).

The DC voltage on "Ext. Filter In" socket should be from  $-0.5 \text{ V}$  to  $+2.5 \text{ V}$ .

#### 4.2. Frequency Response

GAIN CONTROL: "10"  
INPUT ATT.: "0.1 V"  
INPUT: "Direct"  
FILTERS: "Ext."

Input signal to "Direct Input": 1 kHz adjusted to give 18 dB deflection on a voltmeter connected to "Ext. Filter In". (1 V equal to 20 dB).

Vary the frequency from 2 Hz to 200 kHz.

Deflection on the voltmeter:  $18 \text{ dB} \begin{matrix} +0.1 \\ -0.2 \end{matrix} \text{ dB}$  (+ tolerance of generator and voltmeter).

If necessary adjust C 160 on ZE 0018 for that response at 200 kHz.

#### 4.3. Input Attenuator

GAIN CONTROL: "10"  
INPUT ATT.: "0.1 V"  
INPUT: "Direct"  
FILTERS: "Ext."

Input signal to "Direct Input": 1 kHz adjusted to give 18 dB deflection on a voltmeter connected to "Ext. Filter In" (1 V equal to 20 dB)

Check the steps of INPUT ATTENUATOR compared to the attenuator of the frequency generator or a special attenuator box.

Tolerance  $\pm 0.1 \text{ dB}$  (+ tolerance of the test attenuator).

At 200 kHz the tolerance is  $\pm 0.2 \text{ dB}$ .

If necessary adjust C 220-223 on ZF 0006 at 200 kHz.

#### 4.4. Overload Indicator

GAIN CONTROL: "10"  
INPUT ATT.: "0.1 V"  
INPUT: "Direct"  
FILTERS: "Ext."

Input signal to "Direct Input": 1 kHz adjusted to give exactly 5.6 V peak on a voltmeter connected to "Ext. Filter In".

The "Input Section Overload" should indicate overload within  $\pm 0.5 \text{ dB}$  of this condition.

Check at 200 kHz if the indication is still correct and with an oscilloscope that the output has not yet been limited.

If necessary adjust P 5 "Overl." until correct overload indication.

#### 4.5. Output Impedance

GAIN CONTROL: "10"  
INPUT ATT.: "0.1 V"  
INPUT: "Direct"  
FILTERS: "Ext."

Input signal to "Direct Input": 1 kHz adjusted to give 1 V RMS on "Ext. Filter In" socket.

Load the socket with a resistor of 200  $\Omega$ .

The output voltage should drop max. 0.5 dB corresponding an output impedance of 10  $\Omega$ .

This check should be made at 200 kHz as well.

## 260B.4 Input Amplifier

### 4.6. Distortion

GAIN CONTROL: "10"  
INPUT ATT.: "0.1 V"  
INPUT: "Direct"  
FILTERS: "Ext."

Adjust a 1 kHz input signal to give 1 V RMS on "Ext. Filter In" socket.

With a Frequency Analyzer type 2107 in Rejection Mode distortion can be measured down to 0.25%.

However, the distortion of 260B input amplifier is 0.01% at 1 kHz and 0.03% at 50 kHz, but to measure this a much more complex set up is necessary.

### 4.7. Reference

a. GAIN CONTROL: "10"  
INPUT ATT.: "0.1 V"  
INPUT: "Direct"  
OUTPUT ATT.: "x1"  
FILTERS: "Linear"

Input signal: 1000 Hz exactly 0.1 V RMS.

Adjust "Direct Sens." to exactly 10 V RMS on "Output".

Adjust P 6 FSD on bottom circuit board for full scale deflection.

b. REF. to "50 mV RMS"

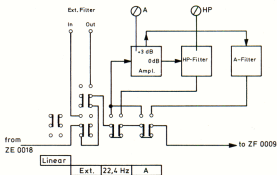
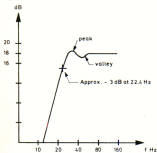
Adjust P 3 Ref. on bottom circuit board for a deflection to the reference mark on the 260B meter scale.

### 4.8. Hum

GAIN CONTROL: "10"  
INPUT: "Direct"  
FILTERS: "Ext."

Measure the hum on "Ext. Filter In" socket selectively according to following scheme:

INPUT ATTENUATOR	Input shortconnected			Input Open		
	50 Hz	100 Hz	150 Hz	50 Hz	100 Hz	150 Hz
3 mV	300 $\mu$ V	200 $\mu$ V	300 $\mu$ V	630 $\mu$ V	630 $\mu$ V	630 $\mu$ V
10 mV - 300 V	90 $\mu$ V	90 $\mu$ V	90 $\mu$ V	210 $\mu$ V	210 $\mu$ V	210 $\mu$ V



5.1. Filter Adjustment

- a. INPUT ATT.: "0.1 V"
- INPUT: "Direct"
- OUTPUT ATT.: "x1"
- FILTERS: "Linear"

Input to "Direct input" of 2608: 1 kHz adjusted to give 18 dB meter deflection.

- b. FILTERS to "A"

Adjust A (P 700 on ZS 0181) to give 18 dB deflection  $\pm 0.2$  dB.

- c. FILTERS to "HP"

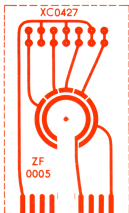
Vary the frequency around the filter frequency and adjust HP (P 701 on ZS 0181) to obtain a peak and a valley of the same value around 18 dB as shown.

CIRCUIT DIAGRAM REF.	COMPONENT TYPE	STOCK REF.	CIRCUIT DIAGRAM REF.	COMPONENT TYPE	STOCK REF.
O 1	Input Attenuator	OD 1017		Knob 20 mm	SN 2022
O 2	Output Attenuator	OD 1018		Knob 31.5 mm	SN 3222
	Contact Slider for above	OD 0179		Retaining ring for 31.5 mm knob	DB 0674
	M3 allen screw for do.	YQ 2003		M4 allen screw for do.	YQ 2083
	1.5 mm allen key for screw	QA 0042		2 mm allen key for above	QA 0043
O 3	See section ZH 0062			Metal Cabinet	KO 0099
O 4	See section ZH 0062			Mahogany Cabinet	KA 0026
				Retaining Nuts for cabinet	YM 0425
O 5	Power Voltage Selector	OA 0021			
O 8	Meter Function Selector	OH 2044		Rubber Feet, rear	DF 7015
				Rubber Feet, front	DF 7018
P 1	Gain Control      Carbon    10 k $\Omega$	PQ 3103			
V 21	Fuse	1 A      VF 0006			
V 23	Overload lamp	VS 0015		Front stand	DV 0141
	Retainer for do	JO 0016		Side handles	DH 0062
V 24, 25	Dial lamps	6.8 V/0.25 A      VS 1273			
T 1	Mains transformer	TN 0050	<b>Circuit Boards with Components:</b>	25 dB Amplifier	ZE 0018
	Moving coil instrument	IM 0029		25 dB Amplifier (low noise)	ZE 0052
	Screened socket	JJ 0127	Input Attenuator	ZF 0005	
	Preamplifier socket	JJ 0703	Input Attenuator	ZF 0006	
	Banana socket, insulated	JT 8344	Input Attenuator	ZF 0007	
	Banana socket	JT 6204	Input Attenuator	ZF 0008	
			Attenuator with 300 kHz LP Filter	ZF 0009	
			Attenuator with 20 dB Amplifier	ZF 0013	
	Multi socket, 10-way for circuit boards	JJ 1002	20 V Voltage Regulator	ZG 0074	
	Power Cord EUR	AN 0005	Gain Circuit	ZH 0061	
	Power Cord USA	AN 0006	Basic Circuit Board	ZH 0062	
	Screened Cable	AO 0013	HP and A-Weighting Network	ZS 0181	

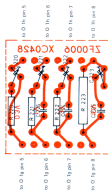




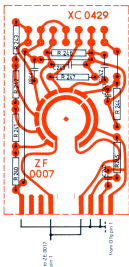
CIRCUIT DIAGRAM REF.	COMPONENT TYPE				STOCK REF.
R 146	Metal	1/4 W	1%	5.62 k $\Omega$	RF 3562
R 147	-	-	-	26.7 k $\Omega$	RF 4267
R 148	-	-	-	39.2 k $\Omega$	RF 4392
R 149	-	-	-	60.4 k $\Omega$	RF 4604
R 150	Carbon	1/2 W	10 %	20M $\Omega$	
R 151,152	-	1/4 W	5 %	100 $\Omega$	RB 2100
Q 140,141	Silicon	50 V/150 mA		BAX 13	QV 0223
V 140,141	Silicon	PNP		2 N 4289	VB 0049
V 142,143	-	NPN		BF 173	VB 0065
V 144,145	FET	N		E 102 (matched)	VB 1010
	Printed Circuit Board				XC 0712



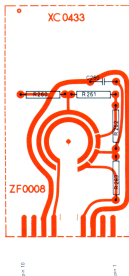
ZF 0005 Attenuator



ZF 0006 Attenuator



ZF 0007 Attenuator



ZF 0008 Attenuator

## ZF 0005 - 0008

CIRCUIT DIAGRAM REF.	COMPONENT TYPE		STOCK REF.
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## ZF 0006 Attenuator

C 220-223	Ceramic trim.	4.5-20pF/160 V	CV 0020
C 224,225	Ceramic	22 pF/400 V	CK 1220
C 226	-	47 pF/400 V	CK 1470

R 220	Metal	1/4 W	1/2%	684 k $\Omega$	RF 6009
R 221	-	-	-	900 k $\Omega$	RF 6014
R 222	-	-	-	958.4k $\Omega$	RF 6015
R 223	-	-	-	990 k $\Omega$	RF 6016
	Printed Circuit Board				XC 0428

## ZF 0007 Attenuator

C 240	Ceramic	3.9 pF/400 V	CK 0390
C 241	-	10 pF/400 V	CK 1100
C 242	-	47 pF/400 V	CK 1470
C 243	-	270 pF/400 V	CK 2270
C 244	-	800 pF/400 V	CK 2800

R 240	Metal	1/4 W	1/2%	316 $\Omega$	RF 6000
R 241	-	-	-	684 $\Omega$	RF 6002
R 242	-	-	-	2.162 k $\Omega$	RF 6005
R 243	-	-	-	6.384 k $\Omega$	RF 6007
R 244	-	-	-	316 k $\Omega$	RF 6008
R 245	-	-	-	1M $\Omega$	RF 6010
R 246	-	-	-	31.6 k $\Omega$	RF 6012
R 247	-	-	-	100 k $\Omega$	RF 6013
	Printed Circuit Board				XC 0429

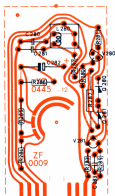
CIRCUIT DIAGRAM REF.	COMPONENT TYPE		STOCK REF.
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## ZF 0008 Attenuator

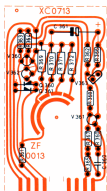
C 260	Ceramic	39 pF/400 V	CK 1390
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R 260	Metal	1/4 W	1/2%	462 $\Omega$	RF 6001
R 261	-	-	-	1 k $\Omega$	RF 6003
R 262	-	-	-	3.16 k $\Omega$	RF 6006
R 263	-	-	-	10 k $\Omega$	RF 6011

	Printed Circuit Board				XC 0433
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ZF 0009 – Attenuator

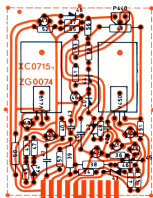


ZF 0013 – Attenuator

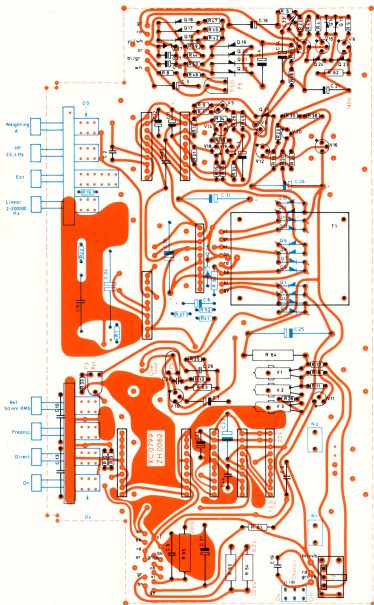
viewed from the printed circuit side

CIRCUIT DIAGRAM REF.	COMPONENT TYPE			STOCK REF.	
<b>ZF 0009</b>					
C 280	Polystyrene		1 nF/ 63 V	CT 1132	
C 281	-		470 pF/125 V	CE 0315	
C 282	Electrolytic		200 µF/ 10 V	CE 0306	
C 283	Polyester		10 nF/250 V	CS 0403	
<b>Q 280,281</b>	Silicon	50 V/150 mA	BAX 13	QV 0223	
R 280	Carbon	1/4 W	5 %	47 Ω	RB 1470
R 281	-	-	-	22 kΩ	RB 3220
R 282	Metal	-	1 %	715 Ω	RF 2715
R 283	-	-	-	147 kΩ	RF 5147
R 284	-	Stab.	0.5 %	1.462 kΩ	RF 6004
R 285	-	-	-	3.16 kΩ	RF 6005
R 286	-	-	-	10 kΩ	RF 6011
R 287	Carbon	1/2 W	5 %	1.25 kΩ	RF 6006
R 289	Metal	1/4 W	1 %	31.5 kΩ	RF 4316
<b>L 280</b>	300 kHz LP Filter		0.518 mH	LB 0666	
V 280	Silicon	PNP	2 N 3702	VB 0038	
V 281	FET	N	2 N 4302	VB 1025	
	Printed Circuit Board			XC 0445	

CIRCUIT DIAGRAM REF.	COMPONENT TYPE			STOCK REF.	
<b>ZF 0013</b>					
C 360	Polyester		10 nF/250 V	CS 0403	
C 361	Electrolytic		200 µF/ 12 V	CE 0315	
<b>Q 360,361</b>	Silicon	100 V/225 mA	EC 401	QV 0213	
<b>R 360,361</b>	Carbon	1/8 W	10 %	10MΩ	RA 0025
R 362	-	1/4 W	5 %	4.7 kΩ	RB 3470
R 363	-	-	-	10 kΩ	RB 4100
R 364	-	-	-	47 kΩ	RB 4470
R 365	Metal	-	1 %	162 Ω	RF 2162
R 366	-	-	-	2.21 kΩ	RF 3221
R 367	-	-	-	3.01 kΩ	RF 3301
R 368	-	-	-	31.6 kΩ	RF 4316
R 369	-	Stab.	0.5 %	462 Ω	RF 6001
R 370	-	-	-	1 kΩ	RF 6003
R 371	-	-	-	3.16 kΩ	RF 6006
R 372	-	-	-	10 kΩ	RF 6011
V 360	Silicon	NPN	BC 107	VB 0032	
V 361	FET	N	E 102	VB 1009	
V 362	-	N	E 102	VB 1025	
V 363	Silicon	PNP	2 N 4289	VB 0049	
	Printed Circuit Board			XC 0713	

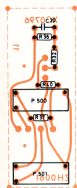


CIRCUIT DIAGRAM REF.	COMPONENT TYPE			STOCK REF.	CIRCUIT DIAGRAM REF.	COMPONENT TYPE			STOCK REF.	
C 440,441	Polycarbonate		1 $\mu$ F/100 V	CS 0384	R 440,450	Wire	1 W	5%	2 $\Omega$	RO 1106
C 442,443	Ceramic		4.7 nF/500 V	CK 3470	R 451,452	Metal	1/4 W	-	140 $\Omega$	RF 2140
P 440	Cermet	0.5 W	lin.	1 k $\Omega$	PG 2106	R 453	-	-	2.49 k $\Omega$	RF 3249
Q 440,441	Si. diode	150 V/ 0.3 A	BAX 16	QV 0217	R 454,455	-	-	-	4.02 k $\Omega$	RF 3402
Q 442	Ze. diode	6.8 V/0.25W	ZG 6.8	QV 1106	R 456	-	-	-	4.75 k $\Omega$	RF 3475
Q 443,444	-	6.2 V/0.25W	ZG 6.2	QV 1322	R 457	-	-	-	11.5 k $\Omega$	RF 4115
Q 445,446	Si. diode	150 V/ 0.3 A	BAX 16	QV 0217	R 458	-	-	-	12.1 k $\Omega$	RF 4121
R 436,437	Carbon	1/4 W	5%	8.2 k $\Omega$	RB 3820	V 440-443	Si. trans.	NPN	BC 107	VB 0032
R 438,439	-	1/3 W	-	3.9 k $\Omega$	RB 3470	V 445-448	-	PNP	BC 177	VB 0071
R 440-443	-	1/4 W	-	470 $\Omega$	RB 2470	V 449	-	PNP	2 N 4919	VB 0061
R 444,445	-	-	-	1.2 k $\Omega$	RB 3120	V 450	-	NPN	2 N 4922	VB 0063
R 446,447	-	-	-	4.7 k $\Omega$	RB 3470					
R 448	-	-	-	3.3 k $\Omega$	RB 3330					
						Printed Circuit Board				XC 0715

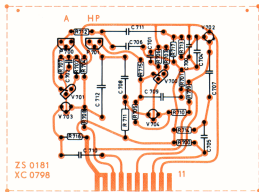


Black Components are mounted on the Top Side  
 Blue Component are mounted on the Bottom Side  
 viewed from the bottom of the instrument

CIRCUIT DIAGRAM REF.	COMPONENT TYPE	STOCK REF.	CIRCUIT DIAGRAM REF.	COMPONENT TYPE	STOCK REF.
C 1	Electrolytic	100 $\mu$ F/ 6.4 V	CE 0207		
C 2	Ceramic	33 pF/400 V	CK 1330	R 1	Carbon
C 3	Electrolytic	100 $\mu$ F/ 15 V	CE 0310	R 3	1/4 W
C 4	-	200 $\mu$ F/ 10 V	CE 0306	R 4,5	1/8 W
C 6	Polyester	0.1 $\mu$ F/250 V	CS 0013	R 6,7	1/4 W
C 7	Electrolytic	200 $\mu$ F/ 10 V	CE 0306	R 8	-
C 8	-	10 $\mu$ F/ 25 V	CE 0416	R 9	-
C 9	Polycarbonate	0.22 $\mu$ F/400 V	CS 0117	R 10	-
C 10	-	0.33 $\mu$ F/400 V	CS 0119	R 11,12	-
C 11,12	Electrolytic	10 $\mu$ F/ 25 V	CE 0416	R 13	-
C 13	Polycarbonate	1.5 $\mu$ F/100 V	CS 0343	R 14	-
C 14	Electrolytic	100 $\mu$ F/ 35 V	CE 0443	R 15,16	-
C 15	Polycarbonate	5.6 $\mu$ F/100 V	CS 0346	R 17,18	-
C 16	Electrolytic	32 $\mu$ F/150 V	CE 2038	R 19,20	-
C 17	Tantalum	4.7 $\mu$ F/ 10 V	CF 0018	R 21-23	-
C 18	-	22 $\mu$ F/16 V	CF 0031	R 24	-
C 19	Ceramic	100 pF/400 V	CK 2100	R 25	-
C 21	Electrolytic	4 $\mu$ F/250 V	CE 2034	R 26-28	-
C 22	-	100 $\mu$ F/ 35 V	CE 0443	R 29	-
C 23	-	10 $\mu$ F/ 25 V	CE 0416	R 30	Metal
C 24	-	10 $\mu$ F/ 25 V	CE 0416	R 31	1%
C 25	-	16 $\mu$ F/550 V	CE 0616	-	-
C 26	-	32 $\mu$ F/250 V	CE 0711	R 33	-
C 27	-	32 $\mu$ F/250 V	CE 0711	R 34,35	-
C 28	Ceramic	330 pF/400 V	CK 2331	R 38,39	-
C 29	Polyester	0.1 $\mu$ F/250 V	CS 0013	-	-
C 30,31	Electrolytic	400 $\mu$ F/ 40 V	CE 0417	R 41	-
C 32	Polycarbonate	1.5 $\mu$ F/100 V	CS 0443	R 42	-
C 33	Trimmer	4.5-20 pF/	CV 0020	R 43	-
C 44	Ceramic	56 pF/400 V	CK 1560	R 44	-
N 12	Power Switches		NT 0021	R 45	-
O 3	Filter Selector		OJ 0024	R 46	-
O 4	Input Selector		OJ 0023	R 47	-
O 15	Chassis on/off switch		NN 0032	R 48	-
P 2	Carbon	0.5 W	50 k $\Omega$	PB 3501	-
P 3	Germet	0.25 W	470 $\Omega$	PG 1507	-
P 5,6	-	-	10 k $\Omega$	PG 3109	-
O 14	Silicon	1200 V/150 mA	BYX 10	OV 0025	R 54
O 5,8	-	400 V/ 1 A	1 N 4004	OV 0237	Wire
O 10-13	-	1200 V/150 mA	BYX 10	OV 0025	5,5 W
O 14,15	-	50 V/150 mA	BAX 13	OV 0223	10%
O 16	Germanium	45 V/100 mA	OA 79	OV 0079	30 $\Omega$
O 17,22	-	115 V/150 mA	OA 85	OV 0085	-
O 23-25	Silicon	150 V/300 mA	BAX 16	OV 0217	Carbon
O 26	Zener	6.0-7.5 V/0.25 W	1 N 710	OV 1106	1/3 W
O 27	-	11-13 V/0.25 W	MZ 716	OV 1117	5%
				V 1-3	Neon Stabilizers
				V 5,6	Silicon
				V 8-12	PNP
				V 14	NPN
				V 15	PNP
				V 16	NPN
				V 18-20	NPN
					22 1000
					2 N 4289
					BF 178
					2 N 2905
					MM 4003
					2 N 3440
					BC 107b
T 1	Mains Transformer		TN 0060		VA 0088
	(separate item, not included in ZH 0062)				VB 0049
					VB 0052
					VB 0059
					VB 0066
					VB 0250
					VB 0257



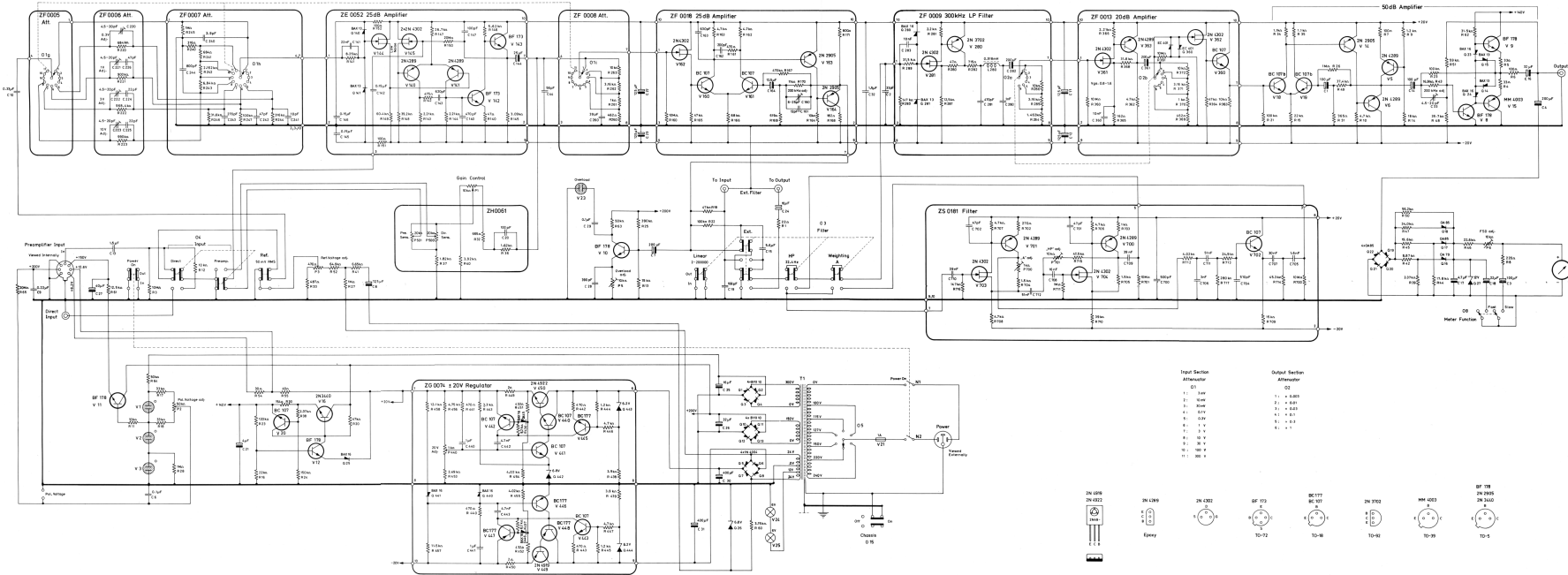
ZH 0061 - Gain Circuit  
viewed from component side



ZS 0181 - Weighting Network  
viewed from printed circuit side

CIRCUIT DIAGRAM REF.	COMPONENT TYPE		STOCK REF.	CIRCUIT DIAGRAM REF.	COMPONENT TYPE		STOCK REF.
ZH 0061				ZS 0181			
C 20	Ceramic	100 pF/400 V	CK 2100	R 700,701	Carbon	1/8 W 10 %	10MΩ RA 0025
R 32	Metal	1/4 W 1 % 685 Ω	RF 2685	R 702	-	1/4 W 5 %	270 Ω RB 2270
R 36	-	-	RF 3162	R 703	-	-	1 kΩ RB 3100
R 37	-	-	RF 3182	R 704,705	-	-	1.5 kΩ RB 3150
R 40	-	-	RF 3392	R 706-708	-	-	4.7 kΩ RB 3470
P 500,501	Wire	1/2 W lin 20 kΩ	PG 3203	R 709	-	-	15 kΩ RB 4150
	Printed Circuit Board		XC 0796	R 710	-	-	39 kΩ RB 4390
ZS 0181				R 711	Metal	1/2 W 1 %	1MΩ RF 0111
C 700	Ceramic	500 pF/400 V	CK 0083	R 712	-	1/4 W -	4.02 kΩ RF 3402
C 701,702	-	-	CK 1471	R 713	-	-	24.9 kΩ RF 4249
C 704	Polystyrene	1 % 470 pF/125 V	CT 1111	R 714	-	-	45.3 kΩ RF 4453
C 705	-	-	CT 1152	R 715	-	-	47.5 kΩ RF 4475
C 706	-	-	CT 1157	R 716	-	-	147 kΩ RF 5147
C 707	-	-	CT 1519	R 717	-	-	280 kΩ RF 5280
C 708	-	-	CT 1539				
C 708,710	-	-	CT 1541	P 700	Cermet	0.5 W lin	1 kΩ PG 2109
C 711,712	-	-	CT 1542	P 701	-	-	10 kΩ PG 3110
				V 700,701	Silicon	PNP	2 N 4289 VB 0049
				V 702	-	NPN	8C 107b VB 0257
				V 703,704	FET	N	E 102 VB 1025
					Printed Circuit Board		XC 0796





Input Section Attenuator

G1	1: 100
2: 1000	
3: 2000	
4: 5000	
5: 10000	
6: 100000	
7: 1000000	
8: 10000000	
9: 100000000	
10: 1000000000	
11: 10000000000	

Output Section Attenuator

G2	1: 1.000
2: 1.0000	
3: 1.00000	
4: 1.000000	
5: 1.0000000	
6: 1.00000000	
7: 1.000000000	
8: 1.0000000000	
9: 1.00000000000	
10: 1.000000000000	
11: 1.0000000000000	

