Brüel & Kjær

Tunable Band Pass Filter

Type 1621

Valid from serial no. 694126

037–0225

Service

Tunable Band Pass Filter

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Valid from serial no. 694126

037-0225

Table of contents:

Trouble Shooting

If any faults should occur please check the instrument according to the Adjustment Procedure.

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 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.

Modifications

Due to the constant technical progress the instrument will be modified from time to time in order to provide continously improved performance.

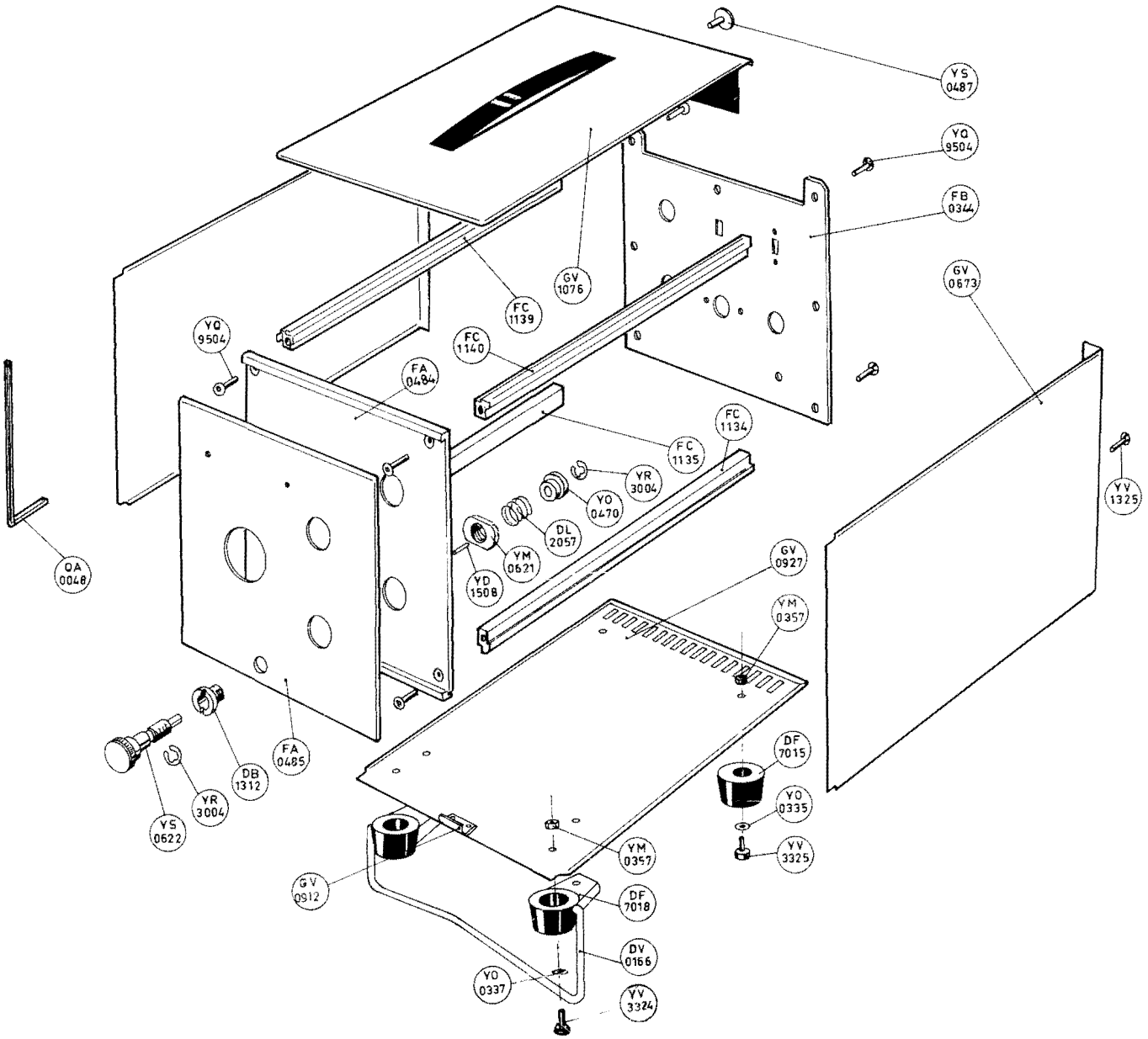
For this reason there may be small differencies between the instrument and the Service Instruction.

However, the local Representative Service is in possession of all information regarding the modifications that have been made.

Spare Parts

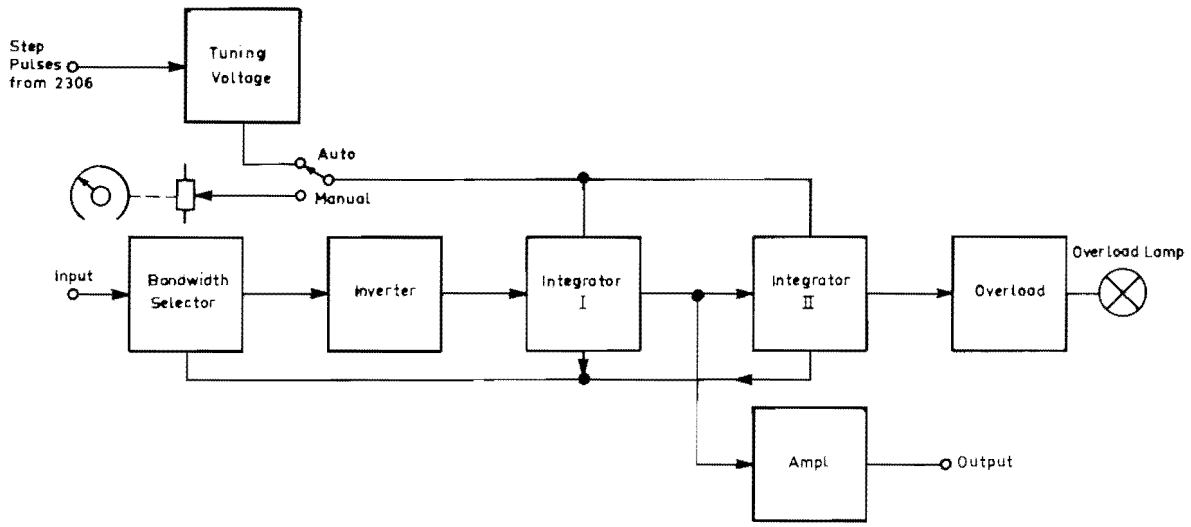
Please state type and serial number of the instrument when ordering spare parts.

Block Di

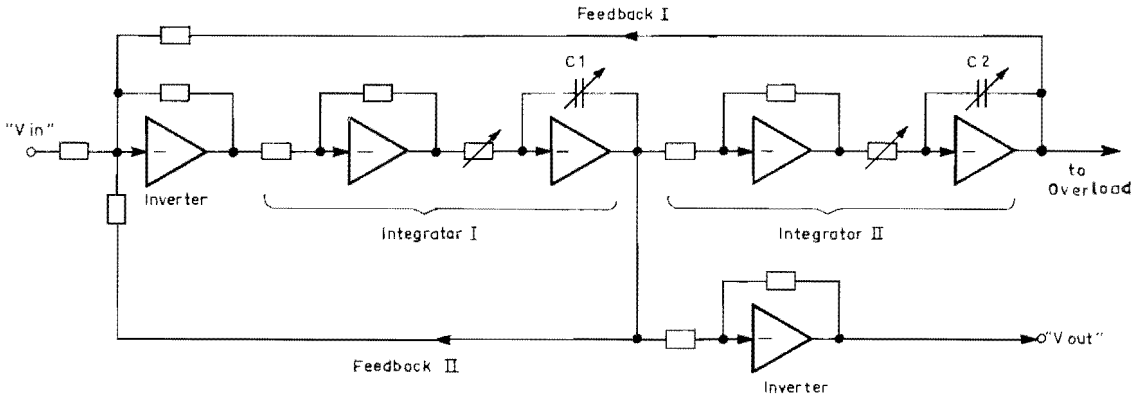


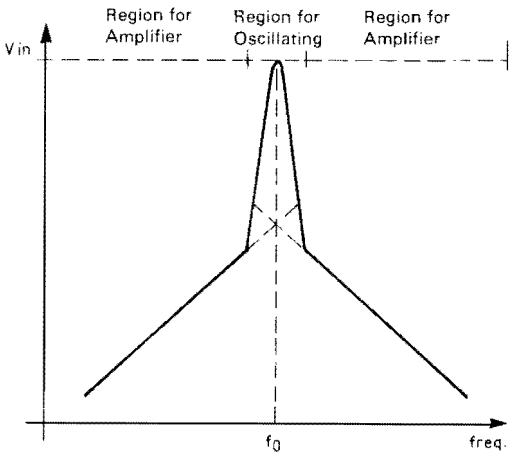
Principle

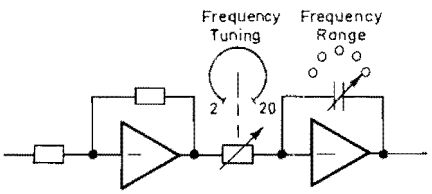
Block Diagram



Principle of the Filter circuit







The Type 1621 consists of a tunable single pole butterworth filter with switchable bandwidths.

The principle of the filter is as follows:

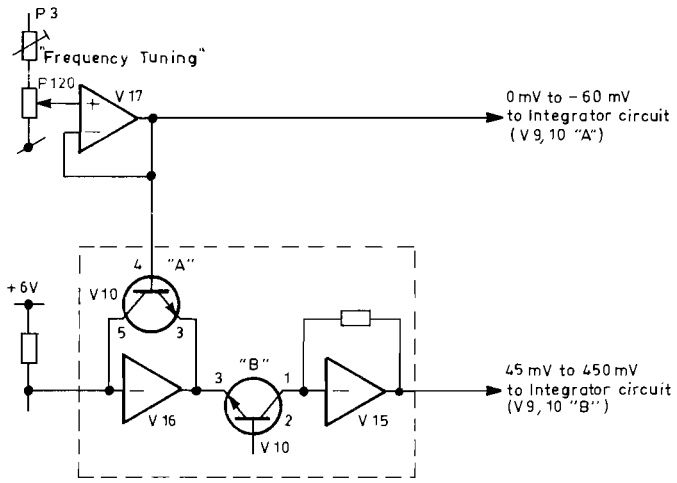
The Integrators I and II together with the first Inverter and feedback I, works as a tunable oscillator. The circuit starts oscillating when the input frequency is the same as the tuned-in frequency. Feedback II controls that the amplitude of the output is the same as the input amplitude.

When the input frequency and the filter is tuned to resonance the amplification of the integrators will be exactly × 1.

For an input frequency lower than resonance, the amplification of Integrator II will be very high due to C2 which through feedback I decrease the input to the first Inverter and thus stops the oscillating. Now the circuits works as a normal amplifier where the amplification is controlled by C1 and C2.

For an input frequency higher than resonance the output of Integrator I decreases due to C1 which then stops the oscillating and the circuit turns over to a normal amplifier condition.

The FREQUENCY RANGE switch select a subrange of the overall frequency range between 0,2 Hz and 20 kHz. The frequency is swept through the subrange by the FREQUENCY TUNING potentiometer

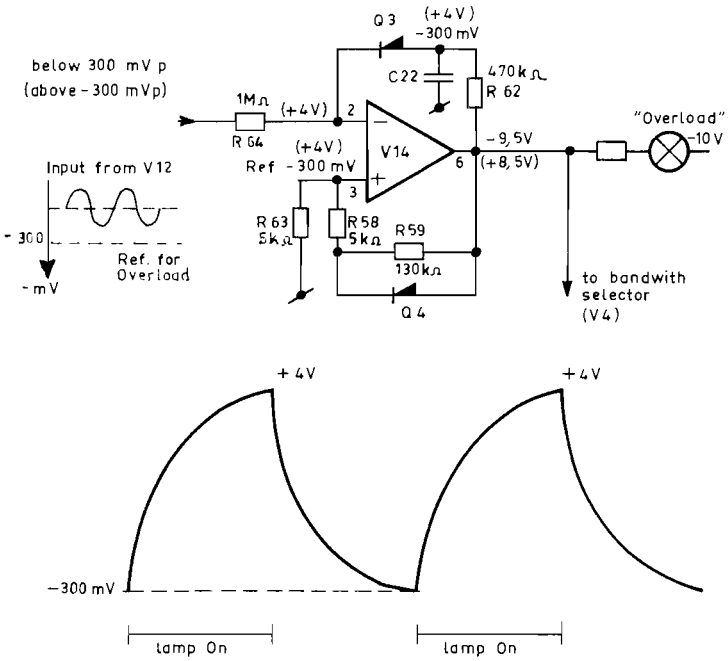


Frequency Tuning Circuit, Manual

The filter centre frequency is controlled by FREQUENCY TUNING potentiometer P120 on the front panel. The voltage to the potentiometer is taken from the voltage divider R20, R21 and P3. The output of V17 can be variated between 0 mV and —60 mV DC.

This voltage is fed to the transistor "A" in the tuning circuit (and to "A" in the two integrator circuits). Transistor "A" is basicly used to control the current to transistor "B" which acts as a variable resistor tuning the integrators within one decade, but "A" is also used for temperature and distortion compensation.

The output of V15 will be approximately + 45 mV to + 450 mV DC depending of the P120 position.



Overload Circuit

The input to the overload circuit is taken from the Feedback I. The overload is activated when the feedback is more negative than —300 mV peak.

For an input voltage to the overload circuit more positive than —300 mV peak the voltages will be as follows:

V14 pin 6 (output) will be —9,5 V DC. and the "Overload" lamp is inactive. At pin 3 there will be approximately —300 mV DC due to the resistors R58, R59 and R63. The two diodes Q3, Q4 will not be conducting.

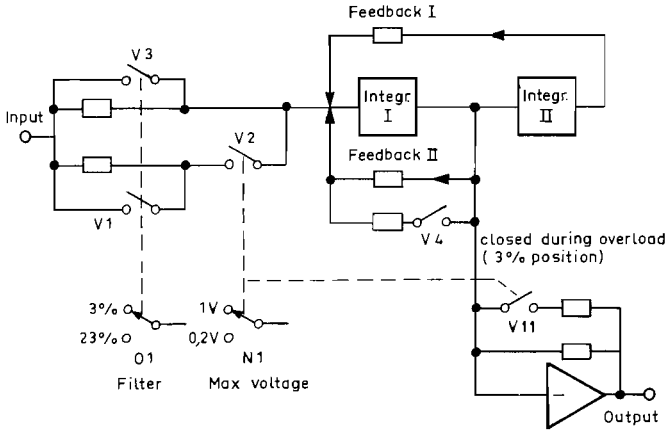
When the input voltage at pin 2 goes more negative than —300 mV peak, the output voltage (pin 6) changes to approximately + 8,5 V. The "Overload" lamp is now activated, and the voltage at pin 3 changes value from —300 mV DC to + 4 DC due to the diode Q4. C22 starts charging against + 8,5 V and the input at pin 2 increase as well due to the diode Q3.

When the voltage at pin 2 reaches + 4 V DC the circuit switches back to the previous position, —9,5 V DC at pin 6 which switches off the lamp, and —300 mV DC to pin 3.

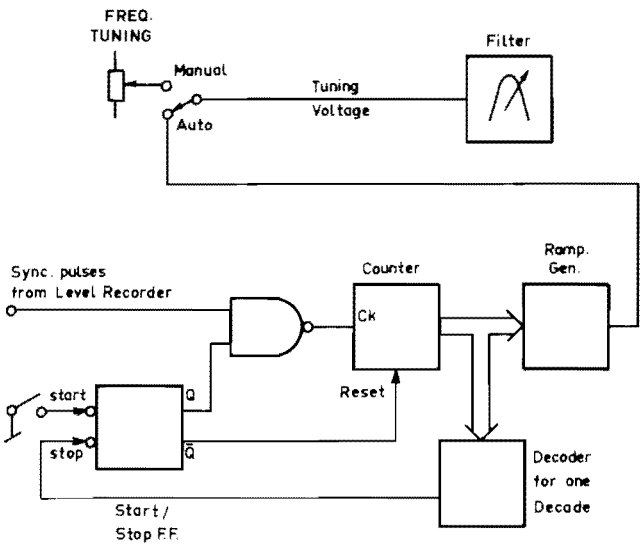
Now C22 discharges against —9,5 V DC. When the voltage across C22 is decreased to —300 mV DC the "Overload" is switched on again and a new cycle takes place.

This function will be continued as long as the voltage from Feedback I is more negative than —300 mV peak.

The drawing shows the voltage across C22 during overload.



The signal from the output of V14 pin 6 to the bandwidth selector is used to switch automatically the 3% bandwidth to 23% during overload. This is done in order to get a quicker reaction of the filter circuit especially at very low frequencies.



Frequency Tuning Circuit, Auto

This circuit will start paper movement of a Level Recorder, when SWEEP CONTROL is pressed down to "Start"

During movement of the paper, sync. pulses will be applied to 1621. These pulses clock up a Counter, when the number of pulses are equal to one decades movement of the paper a Decoder will reset a Start/Stop Flip-Flop and thus the paper movement will stop.
The output of the Counter is also applied to a Ramp Circuit which will generate a voltage for tuning the Filter in synchronization with the paper movement.

Power Supply

FILTER: "Linear"
INTERNAL BATTERY

Check the following voltages and adjust if necessary: + 12 V ± 0,3 V DC. (P113)
+ 10 V ± 0,1 V DC. (P111)
—10 V ± 0,1 V DC. (P112)

Frequency Tuning Voltage

FILTER: "Linear"
FREQUENCY TUNING: "2"
SWEEP CONTROL: "Manual"

Remove the connection between P3 and R26 on ZE 0161. (Marked "F" on the P. C board)

Adjust the voltage on the slider of P3: —1,20 V ± 0,05 V

Reconnect P3 to R26. Check the voltage across P120 FREQUENCY TUNING: 66 mV ± 2 mV.
If necessary adjust P10.

DC-Off-set Adjustment

FILTER "23%"
FREQUENCY TUNING: "20"
SWEEP CONTROL: "Manual"

Check if the voltages are 0 V ± 0,2 mV DC between ground on ZE 0161 and the following components (pin 2).

Component	V16	V15	V6	V12
If necessary adjust	P4	P6	P9	P8

Check the voltage between pin 2 and 3 on V17: 0 V ± 0,2 mV.
If necessary adjust P1.

Amplitude Control

FILTER to "Linear"
FREQUENCY RANGE: "200-2K"
FREQUENCY TUNING: "10"
MAX. VOLTAGE: "1 V"
SWEEP CONTROL: "Manual"

Input signal to "Filter Input": 1000 Hz adjusted for 1 V deflection on an electronic voltmeter connected to "Filter Output"

FILTER to "3%"

Fine adjust FREQUENCY TUNING for maximum output voltage.
Deflection: 1 V ± 0,6 dB.
If necessary adjust P114. (ZG 0109)

FREQUENCY RANGE to "2k-20k"

Change signal frequency to 10 kHz and check the output voltage
Deflection: 1 V ± 0,6 dB.
If necessary adjust P115. (ZG 0109)

For the positions of FREQUENCY RANGE "0,2-2", "2-20", "20-200" the tolerances are ± 0,6 dB, but no adjustments.

FILTER to "23%"

Check as above.
Tolerance: ± 0,3 dB
± 0,6 dB in "2 k — 20 k" range

Frequency Control, Manual

FILTER: "3%"
FREQUENCY RANGE: "20-200"
FREQUENCY TUNING: "2"
MAX. VOLTAGE: "1 V"
SWEEP CONTROL: "Manual"

Input signal: 20 Hz ± 0,01 Hz , 1 V

Fine adjust FREQUENCY TUNING for maximum output, voltage
Loosen the knob and turn the pointer to position 2.

FREQUENCY TUNING to "20"

Change signal frequency to 200 Hz ± 0,1 Hz
Adjust P5 (ZE 0161) for max. output voltage

Repeat the above adjustments as they influence each others.

FREQUENCY TUNING to "2"

Check the frequency for the other positions of FREQUENCY RANGE. Tolerance: ± 1%

In the range "2k-20k" the frequency can be adjusted by C118. (ZG 0109).

Bandwidth Control

FILTER: "Linear"
FREQUENCY RANGE: "20-200"
MAX. VOLTAGE: "1 V"
SWEEP CONTROL: "Manual"

Input signal: 63,2 Hz adjusted for 1 V on "Filter Output"

FILTER to "23%"

Check that the output signal is damped more than 15 dB with FREQUENCY TUNING at the positions 35,5 Hz and 112 Hz

FILTER to "3%"

Check that the output signal is damped more than 30 dB with FREQUENCY TUNING at the above mentioned frequencies

Overload Adjustment

FILTER: "3%"
FREQUENCY RANGE: "200-2k"
FREQUENCY TUNING: "2"
MAX. VOLTAGE: "1 V"
SWEEP CONTROL: "Manual"

Adjust P7 for 0 V ± 100 mV DC at the output of V6

Input signal : 200 Hz, 6 V peak

Adjust P2 to the position where the "Overload" lamp just starts flashing.

Check that "Overload" start flashing at the voltages mentioned in the scheme.

Input Frequency		20 Hz	200 Hz	20 kHz
MAX. VOLTAGE: "1 V"	3%	Output voltage: 5,5 V – 6,5 V peak		
	23%			
MAX. VOLTAGE: "0,2 V"	3%	Output voltage: 1,1 V – 1,3 V peak		
	23%			

Noise

Short circuit "Filter Input" to ground.
Check the noise on "Filter Output" according to the scheme below.

Notice! The noise should only be measured in the range from DC up to 20 kHz.

FREQUENCY TUNING		2			
FREQUENCY RANGE		"0,2 – 2"	"2 – 20"	"200 – 2 k"	"2 k – 20 k"
MAX. VOLTAGE "1 V"	3%	Noise below 10 mV			Noise 17 mV
	23%				
MAX. VOLTAGE "0,2 V"	3%	Noise below 2 mV			Noise 3,4 mV
	23%				

Distortion

FILTER: "Linear"
FREQUENCY RANGE: "2k-20k"
FREQUENCY TUNING: "20"
MAX. VOLTAGE: "1 V"
SWEEP CONTROL: "Manual"

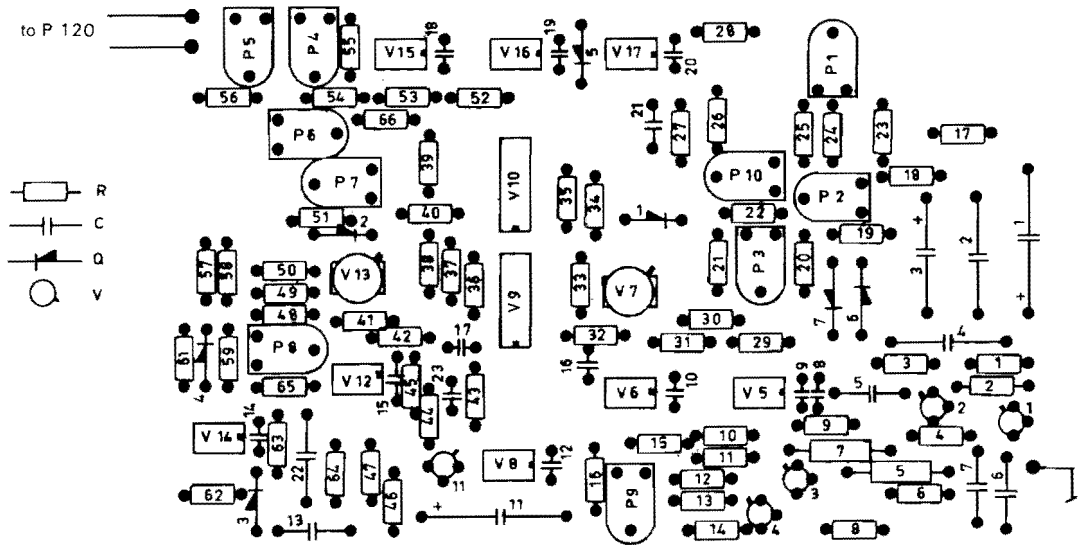
Input signal 10 kHz. 3 V RMS.

FILTER to "3%"

Check the distortion at 20 kHz to be below 40 dB at the 1621 output.

Frequency Control Auto

FILTER: "3%" FREQUENCY RANGE: "200—2k" SWEEP CONTROL: "Manual" MAX VOLTAGE: "1 V"	Input signal: 200 Hz, 1 V Adjust FREQUENCY TUNING for max. voltage on "Filter Output".
SWEEP CONTROL: "Auto"	Adjust P201 (ZH 0159) for max. voltage on "Filter Output".
SWEEP CONTROL: "Manual"	Change Input Frequency to 2 kHz and adjust FREQUENCY TUNING for max. voltage on "Filter Output".
SWEEP CONTROL: "Auto"	Short circuit pin 11 on V202 (ZH 0159) to ground. Remove the jumper between R204 and R211. Connect a cable for filter synchronization between Level Recorder Type 2306 and "Sync." on 1621. Press SWEEP CONTROL for "Start" of sweep. After one decade the "Auto" lamp will extinquish and 1621 will remain tuned in to 2 kHz. Adjust P202 for max. voltage on "Filter Output". After adjustment remove the short circuit and mount jumper between R204 and R211.



C 1	Electrolytic			47 µF/ 40 V	CE 8965
C 2	Polycarbonate			330 nF/100 V	CS 0340
C 3	Electrolytic			47 µF/ 40 V	CE 8965
C 4	-			10 µF/ 40 V	CE 0458
C 5-7	Polystyrene			2 nF/ 63 V	CT 1123
C 8	Ceramic			2,2 pF/400 V	CK 0220
C 9	-			15 pF/400 V	CK 1150
C 10	-			30 pF/400 V	CK 1330
C 11	Electrolytic			100 µF/ 40 V	CE 0443
C 12	Ceramic			10 pF/400 V	CK 1100
C 13	Polystyrene			2 nF/ 63 V	CT 1123
C 14	Ceramic			3,3 pF/400 V	CK 0330
C 15	-			30 pF/400 V	CK 1330
C 16,17	-			100 pF/400 V	CK 0077
C 18-20	-			30 pF/400 V	CK 1330
C 21	-			47 nF/ 30 V	CK 4470
C 22	Polycarbonate			680 nF/100 V	CS 0388
C 23	Trimmer			2,5-5 pF/400 V	CV 0033
P 1	Cermet	0,5 W	lin.	22 kΩ	PG 3221
P 2	-	-	-	1 MΩ	PG 5108
P 3	-	-	-	220 Ω	PG 1221
P 4	-	-	-	100 kΩ	PG 4108
P 5	-	-	-	220 Ω	PG 1221
P 6	-	-	-	100 kΩ	PG 4108
P 7	-	-	-	1 MΩ	PG 5108
P 8,9	-	-	-	100 kΩ	PG 4108
P 10	-	-	-	2,7 kΩ	PG 2207
Q 1,2	Silicon	BAX13		50 V/150 mA	QV 0223
Q 3,4	-	1N4004		400 V/ 1 A	QV 0237
Q 5	-	BAX13		50 V/150 mA	QV 0223
Q 6,7	Zener	1N825		5,9-6,5 V/ 0,4 W	QV 1346

R 1	Metal	1/4 W	1%	249 kΩ	RF 5249
R 2	-	-	-	1 MΩ	RF 6100
R 3	-	-	-	374 kΩ	RF 5374
R 4	-	-	-	174 kΩ	RF 5174
R 5	-	-	-	1 MΩ	RF 6100
R 6	Carbon	-	5%	100 kΩ	RB 5100
R 7	Metal	-	1%	1 MΩ	RF 6100
R 8	Carbon	-	5%	100 kΩ	RB 5100
R 9	Metal	-	1%	14,3 kΩ	RF 4143
R 10	Carbon	-	5%	820 Ω	RB 2820
R 11	Metal	-	1%	14,3 kΩ	RF 4143
R 12	-	-	-	487 kΩ	RF 5487
R 13	-	-	-	71,5 kΩ	RF 4715
R 14	Carbon	-	5%	100 kΩ	RB 5100
R 15	-	-	-	820 Ω	RB 2820
R 16	-	-	-	1 MΩ	RB 6100
R 17	Metal	-	1%	71,5 kΩ	RF 4715
R 18,19	-	-	-	1 kΩ	RF 3100
R 20	-	-	-	6,04 kΩ	RF 3604
R 21	-	-	-	1,4 kΩ	RF 3140
R 22	Carbon	-	5%	560 kΩ	RB 5560
R 23	Metal	-	1%	60,4 kΩ	RF 4604
R 24	-	-	-	249 Ω	RF 2249
R 25,26	-	-	-	4,99 kΩ	RF 3499
R 27	Carbon	-	5%	560 kΩ	RB 5560
R 28	-	-	-	4,7 MΩ	RB 6470
R 29,30	Metal	-	1%	4,99 kΩ	RF 3499
R 31	-	-	-	332 Ω	RF 2332
R 32	Carbon	-	5%	820 Ω	RB 2820
R 33	Metal	-	1%	27,4 Ω	RF 1274
R 34	-	-	-	90,9 kΩ	RF 4909
R 35	-	-	-	9,09 kΩ	RF 3909
R 36	-	-	-	27,4 Ω	RF 1274
R 37	-	-	-	90,9 kΩ	RF 4909
R 38	-	-	-	9,09 kΩ	RF 3909
R 39	-	-	-	27,4 Ω	RF 1274
R 40	-	-	-	90,9 kΩ	RF 4909

Continued

1621 from serial no. 694126

R 41	Carbon	1/4 W	5%	820 Ω	RB 2820
R 42	Metal	-	1%	4,99 kΩ	RF 3499
R 43	Carbon	-	5%	820 Ω	RB 2820
R 44	Metal	-	1%	7,87 kΩ	RF 3787
R 45	Carbon	-	5%	820 Ω	RB 2820
R 46	Metal	-	1%	31,6 kΩ	RF 4316
R 47	-	-	-	127 kΩ	RF 5127
R 48	-	-	-	332 Ω	RF 2332
R 49	-	-	-	4,99 kΩ	RF 3499
R 50	-	-	-	17,4 kΩ	RF 4174
R 51	Carbon	-	5%	560 kΩ	RB 5560
R 52,53	-	-	-	820 Ω	RB 2820
R 54,55	-	-	-	1 MΩ	RB 6100
R 56	Metal	-	1%	2 kΩ	RF 3200
R 57	Carbon	-	5%	820 Ω	RB 2820
R 58	Metal	-	1%	4,99 kΩ	RF 3499
R 59	-	-	-	130 kΩ	RF 5130
R 61	Carbon	-	5%	820 Ω	RB 2820
R 62	-	-	-	470 kΩ	RB 5470
R 63	Metal	-	1%	4,99 kΩ	RF 3499
R 64,65	Carbon	-	5%	1 MΩ	RB 6100
R 66	Metal	-	1%	9,09 kΩ	RF 3909

V 1-4	FET	N	NF510	VB 1021
V 5	Op. Amp.		LM301AN	VE 0017
V 6	-		770P	VE 0035
V 7	-		AD318	VE 0083
V 8	-		LA301AN	VE 0017
V 9,10	Diode array		3821N	VE 0088
V 11	FET	N	NF510	VB 1059
V 12	Op. Amp.		770P	VE 0035
V 13	-		AD318	VE 0083
V 14	-		LM301AN	VE 0017
V 15,16	-		LM308N	VE 0046
V 17	-		201AH	VE 0084

8 pin dual in line socket	JJ 0804
14 pin dual in line socket	JJ 1408
Printed Circuit Board	XC 1239

CIRCU
DIAGR
REF.

C 101,
C 103
C 104
C 105
C 106,
C 108,
C 109,
C 111,
C 112,
C 113
C 117
C 118
C 124

L 101

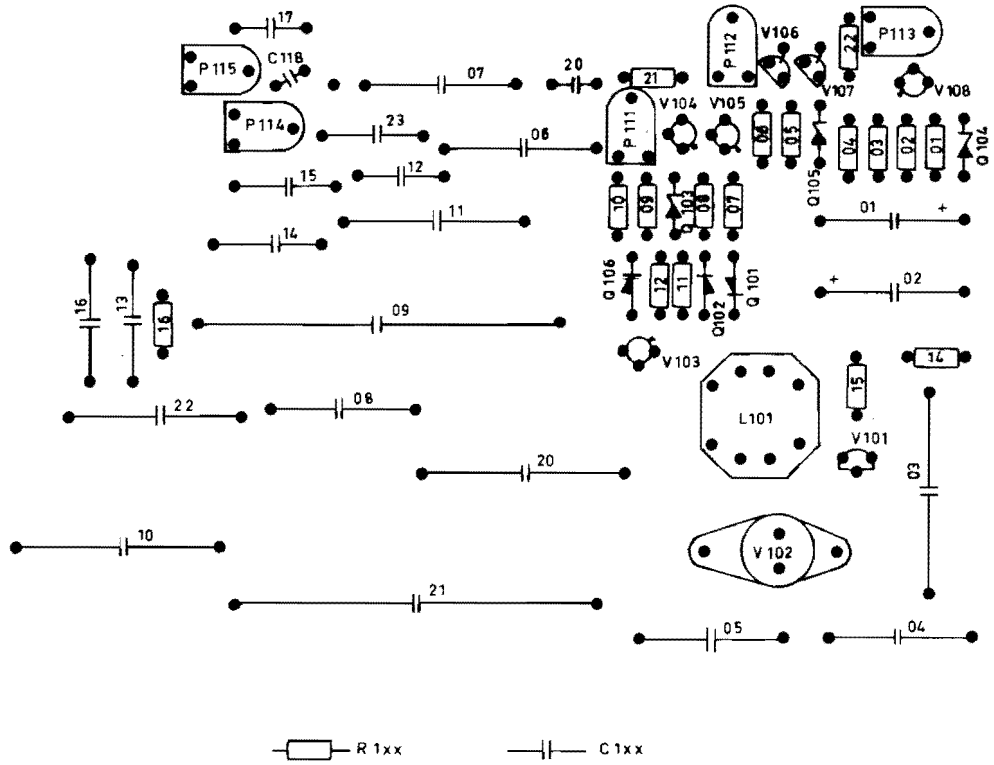
P 111-
P 114,

Q 101,
Q 103
Q 104
Q 105
Q 106

Layout Diagram with Parts List

ZG 0109

Filter and Power Supply Circuit



CIRCUIT DIAGRAM REF.	COMPONENT TYPE			STOCK REF.
C 101,102	Electrolytic		100 µF/ 40 V	CE 0443
C 103	-		1000 µF/ 25 V	CE 0419
C 104	Polystyrene		47 nF/ 63 V	CT 1521
C 105	-		6,8 nF/ 63 V	CT 1511
C 106,107	Polycarbonate		1,5 µF/100 V	CS 0343
C 108,110,120	-	Match. Set 1/4%	10 µF/ 50 V	CZ 0006
C 109,114,121	Polystyr.	Match. Set 1/4%	1 µF/ 30 V	CZ 0007
C 111,115,122	-	Match. Set 1/4%	0,1 µF/ 63 V	CZ 0008
C 112,116,123	-	Match. Set 1/4%	10 nF/ 63 V	CZ 0009
C 113	-		1 nF/ 63 V	CT 1546
C 117	-		965 pF/ 63 V	CT 3529
C 118	Trimmer		10-60 pF/125 V	CV 0032
C 124	Ceramic		47 nF/ 30 V	CK 4470
L 101	Converter coil			LB 0850
P 111-113	Cermet	0,5 W	lin 4,7 kΩ	PG 2470
P 114,115	-	-	- 470 Ω	PG 1504
Q 101,102	Si.	BAX16	150 V/300 mA	QV 0217
Q 103	Ze.	ZF6,2	5,9-6,5 V/0,25 W	QV 1333
Q 104	-	ZF9,1	8,5-9,6 V/0,25 W	QV 1109
Q 105	-	ZF6,2	5,9-6,5 V/0,25 W	QV 1333
Q 106	-	1N4738	8,0-8,4 V/0,25 W	QV 1344

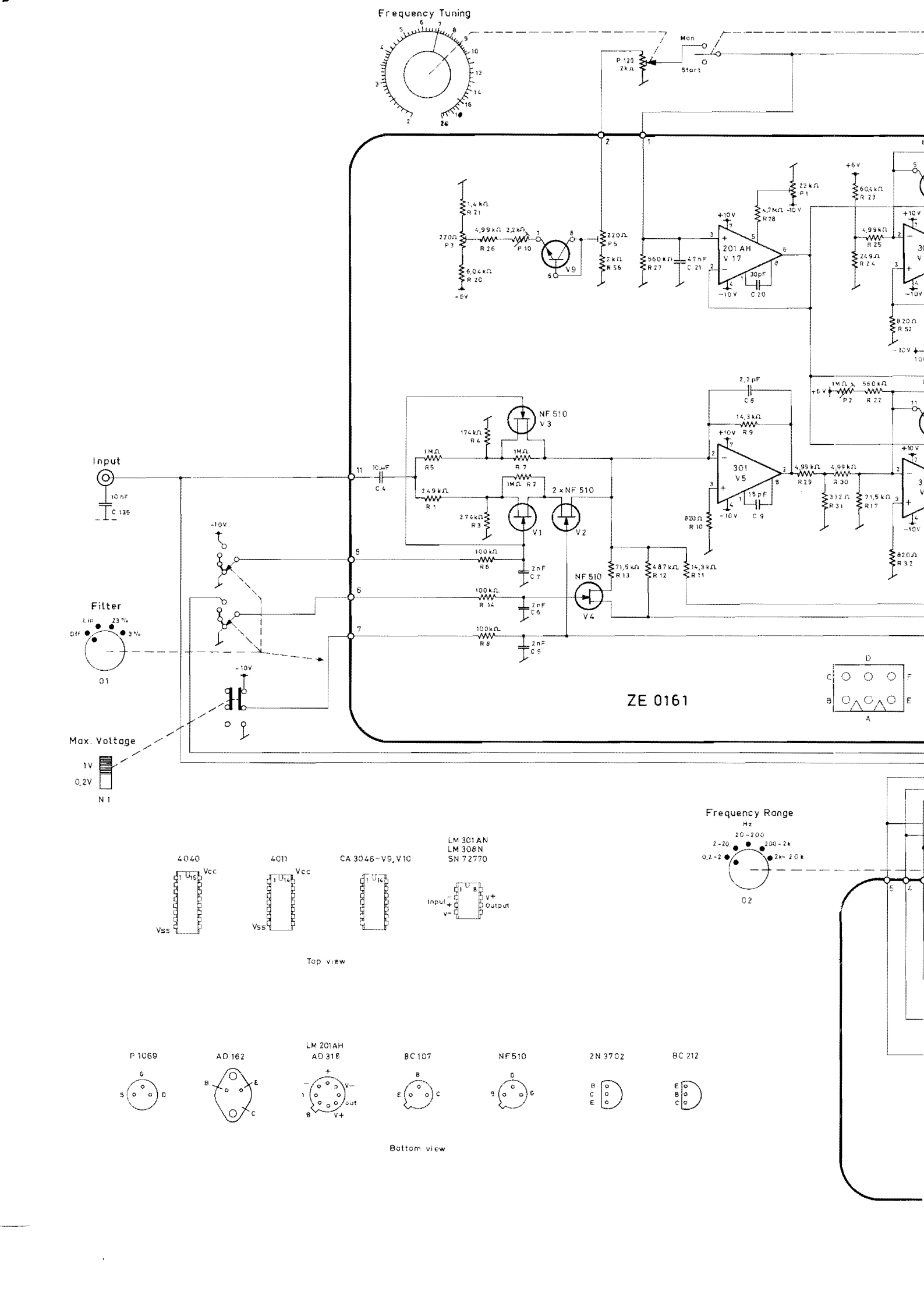
CIRCUIT DIAGRAM REF.	COMPONENT TYPE			STOCK REF.
R 101	Carbon	1/4 W	5% 27 kΩ	RB 4270
R 102	-	-	- 18 kΩ	RB 4180
R 103	-	-	- 820 Ω	RB 2820
R 104	-	-	- 1,5 kΩ	RB 3150
R 105	-	-	- 27 kΩ	RB 4270
R 106	-	-	- 10 kΩ	RB 4100
R 107	-	-	- 820 Ω	RB 2820
R 108	-	-	- 1,5 kΩ	RB 3150
R 109	-	-	- 27 kΩ	RB 4270
R 110	-	-	- 10 kΩ	RB 4100
R 111	-	-	- 2,7 kΩ	RB ø270
R 112	-	-	- 390 Ω	RB 2390
R 114,115	-	-	- 33 kΩ	RB 4330
R 116	-	-	- 470 Ω	RB 2470
R 121,122	-	-	- 56 Ω	RB 1560
V 101	FET	N	NF510	VB 1021
V 102	Germanium	PNP	AD162	VB 0078
V 103-105	Silicon	NPN	BC107	VB 0032
V 106,107	-	PNP	2N3702	VB 0038
V 108	-	NPN	BC107	VB 0032
	Printed circuit board			XC 1238

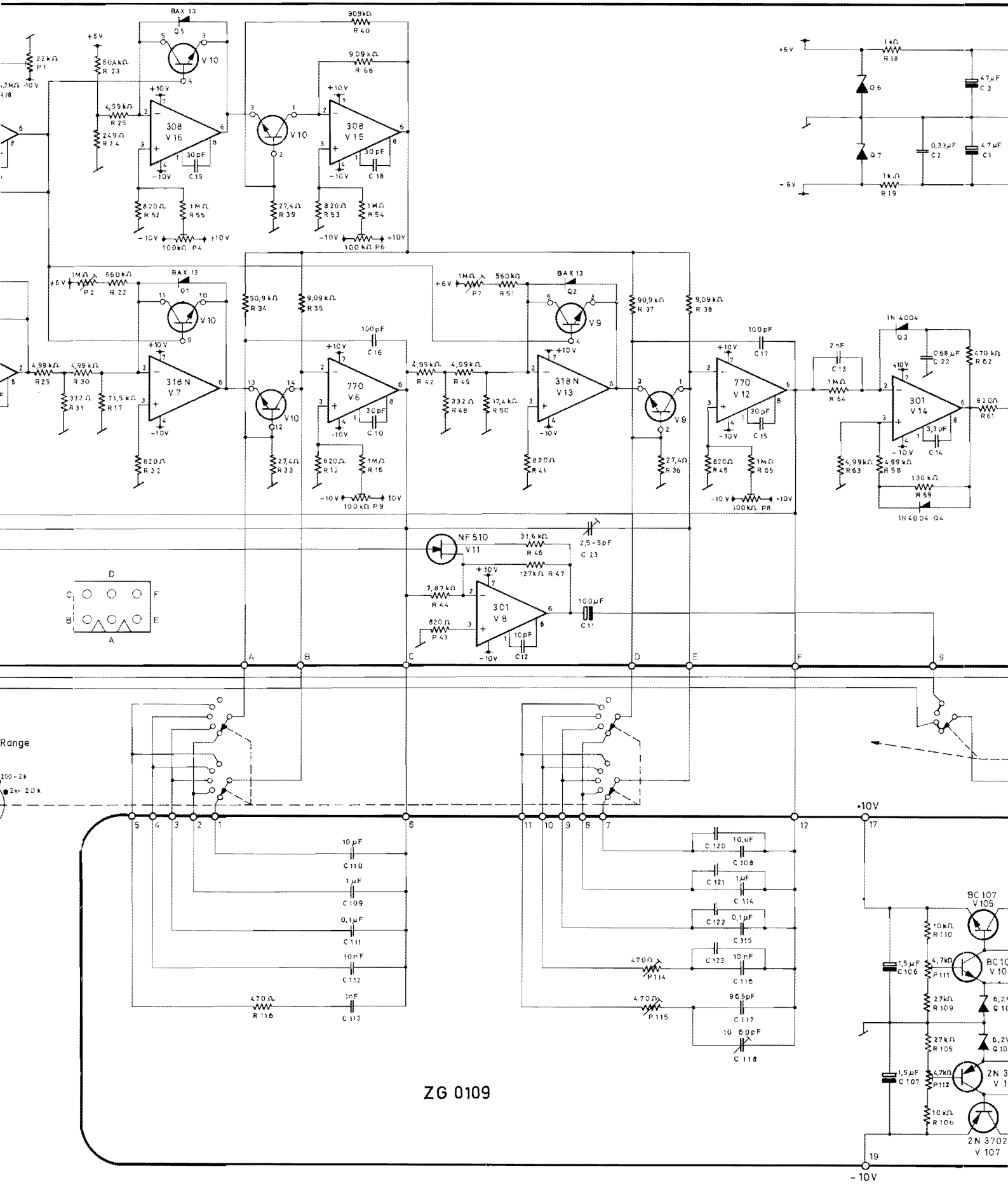
CIRCUIT DIAGRAM REF.	COMPONENT TYPE			STOCK REF.
C 130-137	Ceramic 10 nF/ 30 V			CK 4101
N 1	"Max Voltage" switch			NN 0031
N 2	"Ext. Power Supply" switch			NN 0035
N 3	"Man./Start" switch			NN 0050
O 1	"Filter" switch			OE 0139
O 2	"Frequency Range" switch			OH 3052
P 120	"Frequency Tuning" 2 kΩ			PQ 2201
Q 120,121	LED	TIL209	1 V/20 mA	QV 4000
Q 122	Silicon	1N4004	400 V/1 A	QV 0237
Q 123	LED	TIL209	1 V/20 mA	QV 4000
R 120	Wire	4 W 1%	15 Ω	RO 1221
	Power cord			AN 0010
	BNC socket			JJ 0130
	7-pin socket			JJ 0709
	8- socket			JJ 0802
	BNC plug			JP 0035
	7-pin plug			JP 0703
	8-pin plug			JP 0802
	Banana socket			JT 6204
	"Frequency Tuning" knob			SN 0070
	"Filter" knob			SN 2522
	"Frequency Range" knob			SN 2522
	Retaining ring for knob			DB 0674
	Socket screw for ring			YQ 2083
	Key for screw			QA 0048
	Fuse	0,5 A		VF 0023
	Battery container			ZG 0117
	Battery R20 "D" 1,5 V			QB 0004

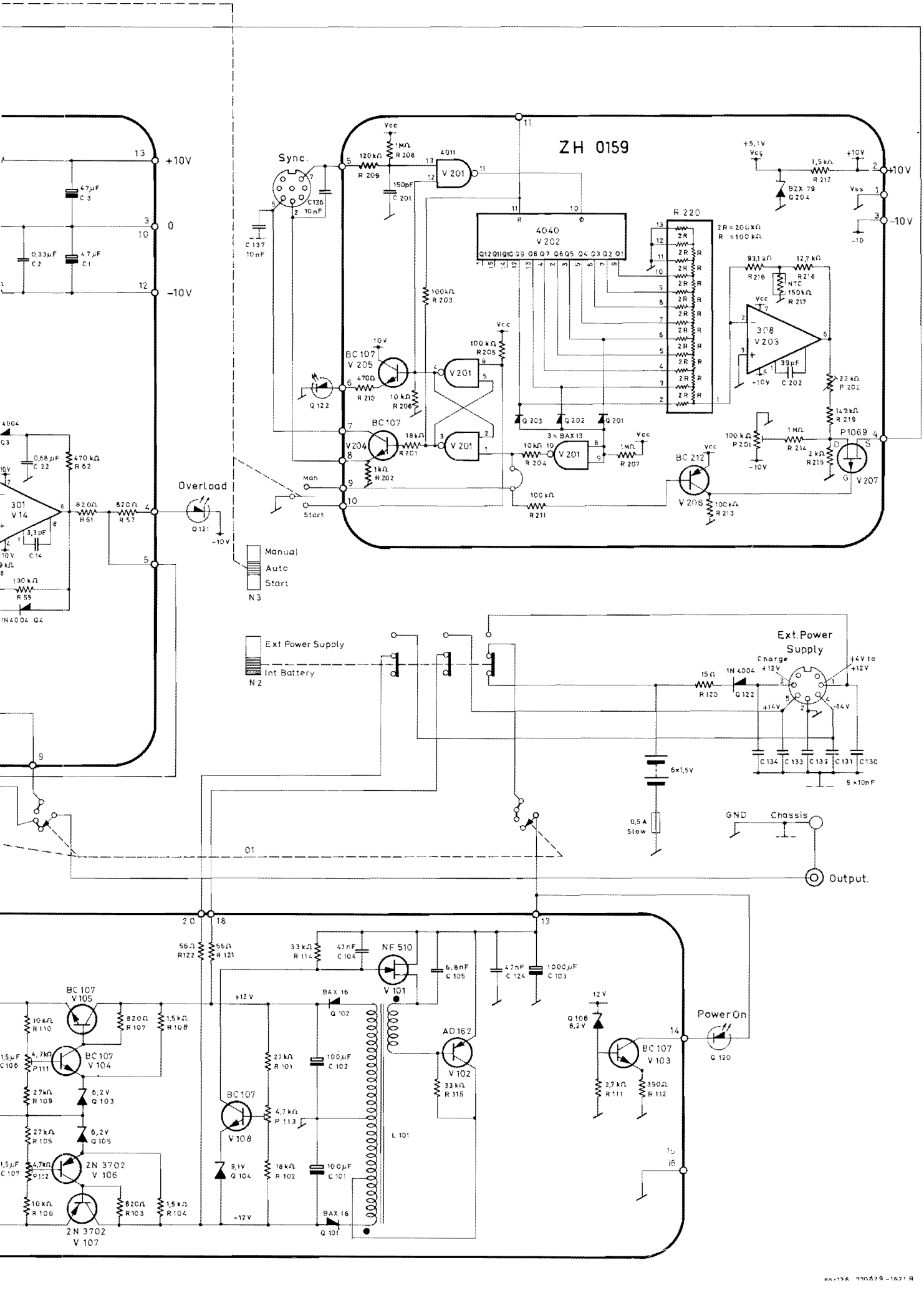
Furthermore 1621 contains the following Sub-assemblies the details of which will be found under the respective numbers

Filter Circuit	ZE 0161
Filter and Power Supply Circuit	ZG 0109
Synchronization Circuit	ZH 0159

On page 0—2 will be found an exploded view of the instrument showing details and stock ref. numbers of the cabinet parts


Frequency Tuning
Man
Start
P 120
2 kΩ
Input
10 nF
C 135
Filter
Lin
23 %
Off
3 %
01
Max. Voltage
1V
0,2V
N 1
ZE 0161
NF 510
V 3
2 x NF 510
V1
V2
NF 510
V4
201 AH
V 17
301
V5
V9
10 µF
C 4
2 nF
C 7
2 nF
C 6
2 nF
C 5
2,2 pF
C 8
15 pF
C 9
30 pF
C 20
47 nF
C 21
Frequency Range
Hz
20 - 200
2 - 20
200 - 2k
0,2 - 2
2k - 20 k
02
4040
Vcc
Vss
4011
Vcc
Vss
CA 3046 - V9, V10
LM 301 AN
LM 308 N
SN 72770
Input
V+
Output
Top view
P 1069
AD 162
LM 201 AH
AD 318
BC 107
NF 510
2N 3702
BC 212
Bottom view


ZG 0109
Range
+10V
-10V
+6V
-6V


ZH 0159
Sync.
Overload
Manual
Auto
Start
N3
Ext Power Supply
Int Battery
N2
Ext.Power Supply
Charge
Output.
GND
Chassis
Power On
+10V
0
-10V
Start
Man
4040
V 202
R 220
2R = 200 kΩ
R = 100 kΩ
308
V 203
4011
V 201
BC 107
V 205
BC 107
V 204
BC 212
V 208
3 x BAX 13
P1069
V 207
NF 510
V 101
AD 162
V 102
BC 107
V 105
BC 107
V 104
BC 107
V 108
BC 107
V 103
2N 3702
V 106
2N 3702
V 107
BAX 16
Q 102
BAX 16
Q 101
L 101
Q 120
Q 121
Q 122
Q 202
Q 203
Q 204
Q 106
8,2V
Q 103
6,2V
Q 105
6,2V
Q 104
9,1V
6x1,5V
0,5 A
Slow
5 x10nF