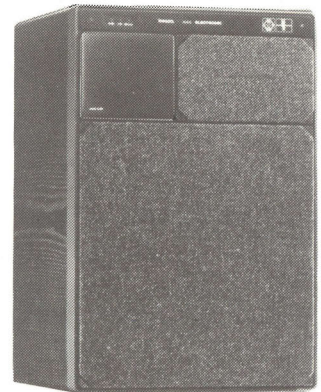


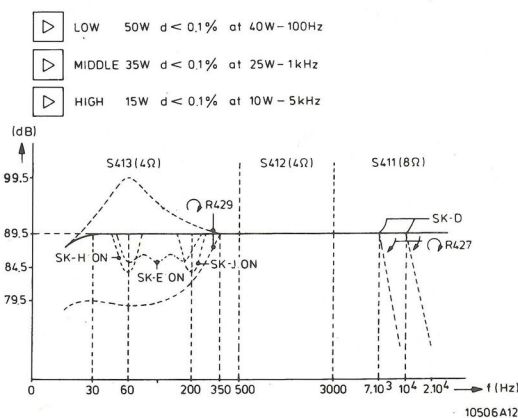
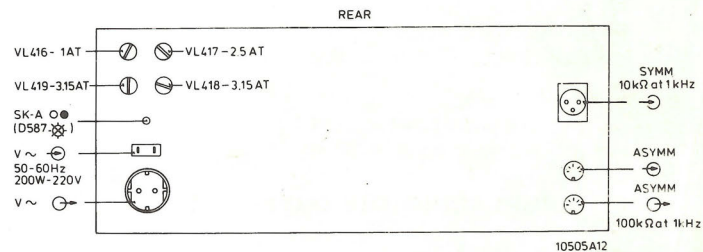
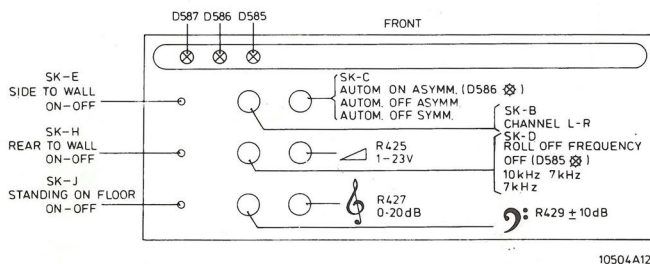
Service
Service
Service



8982 A2

Service Manual

DIMENSIONS: 650 X 436 X 320



Safety regulations require that the set be restored to its original condition and that parts which are identical with those specified, be used.

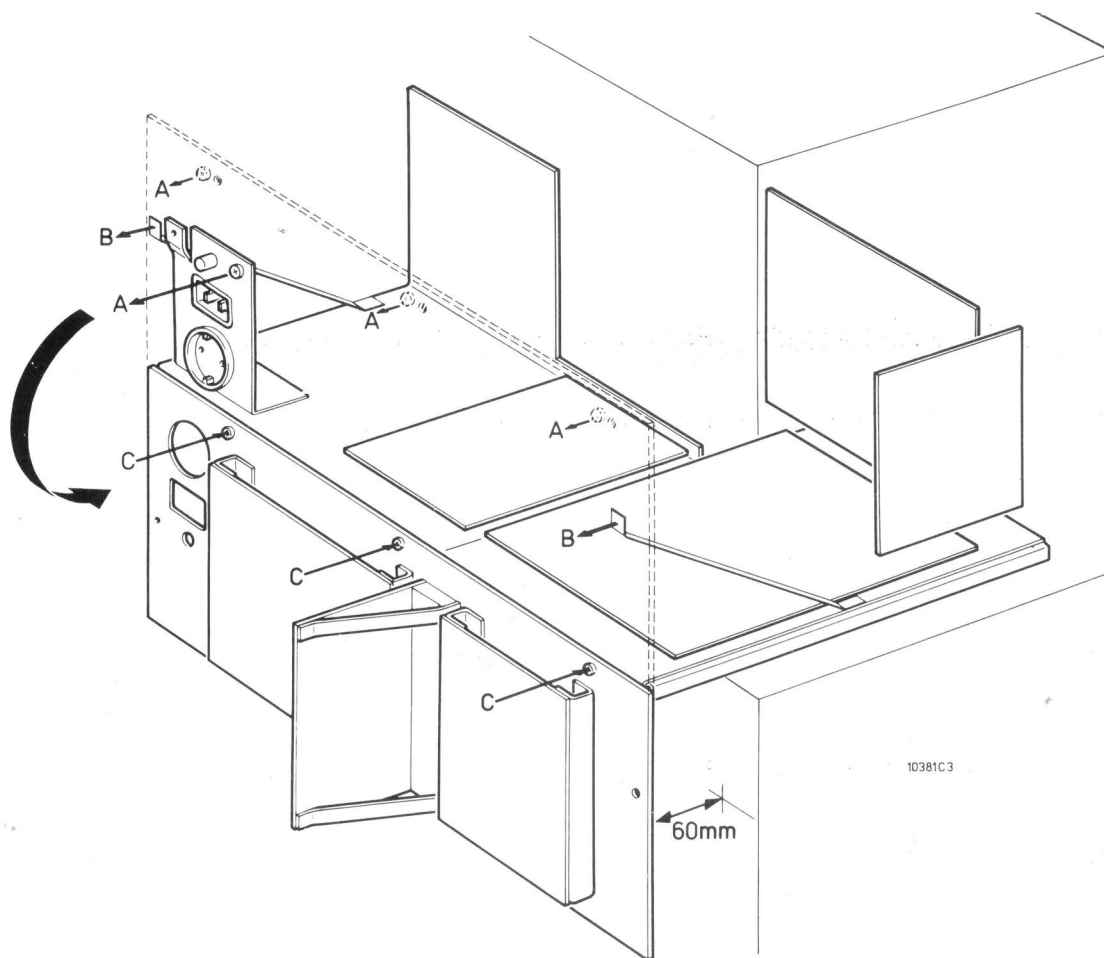
Documentation Technique Service Dokumentation Documentazione di Servizio Huolto-Ohje Manual de Servicio Manual de Serviço



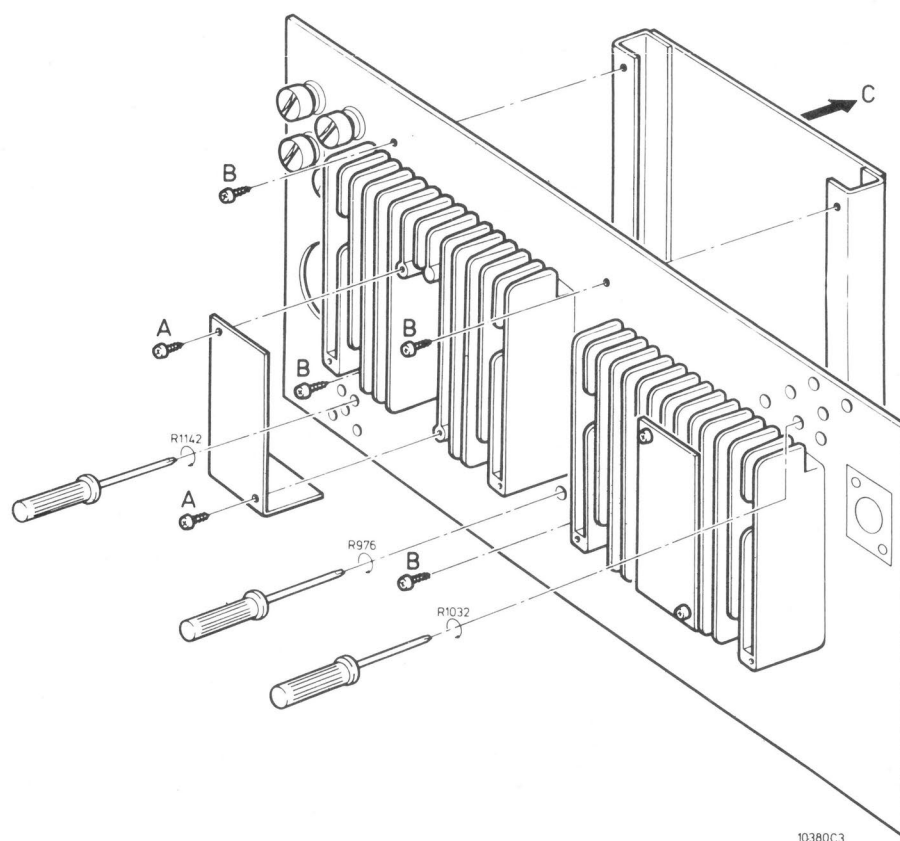
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PHILIPS

MEASUREMENTS ON THE SET



REPLACING THE OUTPUT TRANSISTORS



INTRODUCTION

The working of the system is shown in Fig. 2

With potentiometer R425, the sensitivity of the set can be adjusted between 1 and 23 V. To protect the pre-amplifier against overloading, D567 and D568 are applied as limiters, so that the signal on the input of TS435 can never be greater than 24 V peak-to-peak. After amplification in TS435, the signal is supplied to the rumble filter TS436. Then follows a low-pass filter, with which the cut-off frequency can be adjusted to 7 or 10 kHz. Besides, the slope can be varied from 0 to 20 dB/oktave. After the latter filter the signal for the high-note amplifier is branched off. This signal is first supplied to a high-pass filter, viz. TS496. After amplification via TS497 ÷ TS403b, this signal is fed to the high-note loudspeaker S411. The amplification amounts to 15 W.

After the low-pass filter for 7 and 10 kHz, the signal is also supplied to the low-note control, consisting of TS438 and TS439, with which a control range is possible of ± 10 dB at 60 Hz. Then follow three correction filters for the low notes. These filters are described later on. After these filters, the signal is fed to the middle-note amplifier on one hand and on the other hand to the low-note amplifier. As for the middle-note amplifier, the signal passes through a band-pass filter, consisting of low-pass filter TS447, TS448 and high-pass filter TS510.

After amplification in TS511 ÷ TS518b the signal is supplied to loudspeaker S412. The amplification is 35 W.

As for the low-note amplifier, the signal first passes low-pass filter TS477, TS478. This signal is supplied to the adding circuit TS479.

After amplification in TS526 ÷ TS537b, the signal is fed to MFB-loudspeaker S413. The amplification is 50 W.

The signal from the acceleration circuit of the MFB is supplied via the correction circuit TS549 ÷ TS551 to the adding circuit TS479. Further, the total amplification of the high-note amplifier can be adjusted with R976. With R1032 the total amplification of the middle-note amplification can be adjusted. With R1142, at the same time the MFB-feedback and the total amplification of the low-note amplifier is adjusted. The trimming of these resistors is dealt with in "Trimming Instructions".

Besides, the three loudspeakers are protected against overloading by means of a safety circuit consisting of D605, D607, D609, Smitt trigger TS452, TS453, the electronic switch TS451 and R826.

Finally, an automatic switch-on circuit is present, consisting of TS486 ÷ TS491 and relay Re407.

BASS CORRECTION FILTERS

- On floor
- Back against wall
- Side against wall

In an empirical way it was found that the bass reproduction of a loudspeaker box strongly depends on where in a room the box is placed.

All the possible positions of a loudspeaker box in a three-dimensional room can be reduced to three basic arrangements or combinations of same (see Fig. 3).

- a. The loudspeaker box is on the floor
- b. The back of the loudspeaker box is against a wall
- c. The side of the loudspeaker box is against a wall

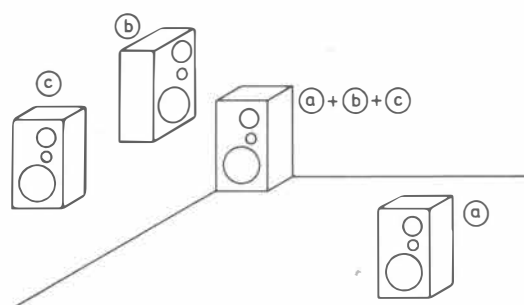


Fig. 3

It will be clear that a loudspeaker box positioned in a corner is a combination of these three basic arrangements, i.e. (a) + (b) + (c), see Fig. 3. The influence of the three basic positions on the acoustical frequency reproduction is shown in Fig. 4.

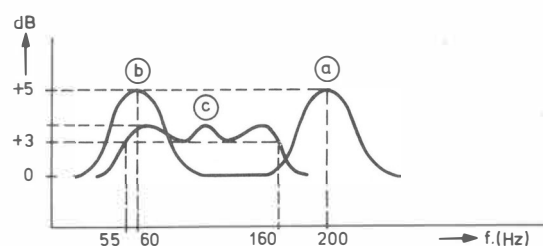


Fig. 4

a. Loudspeaker box on the floor

An increase of the acoustical power by 5 dB in the 200 Hz field.

b. Back of the LS-box against wall

An increase of the acoustical power by 5 dB in the 60 Hz field.

c. Side of LS-box against wall

An increase of the acoustical power by 3 dB between 55 and 160 Hz

Each of these three symptoms can be separately neutralized in the 22RH545.

Namely, it contains three bass correction filters with characteristics in reverse direction of those in Fig. 4 (see Fig. 5).

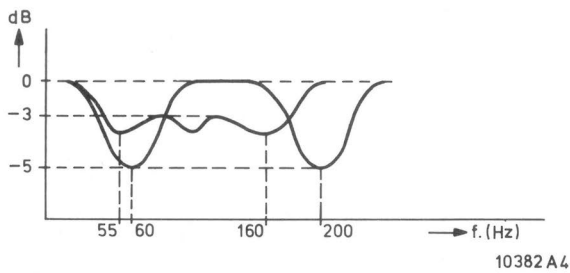


Fig. 5

In this way, the acoustical playback characteristic of any place in a room can be corrected by switching on the right correction filter(s). This is done by means of three switches on the front.

Design (see Fig. 6)

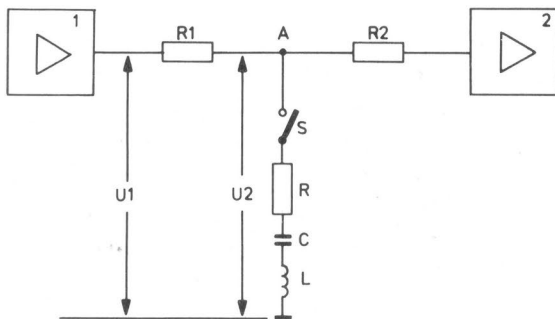


Fig. 6

In principle, a series resonance circuit is used, adjusted to the frequency that must be attenuated.

For an RLC-series circuit goes that $Z = R + j\omega L + \frac{1}{j\omega C}$

With series resonance, the imaginary part is zero,

$$\text{or } j\omega L + \frac{1}{j\omega C} = 0.$$

The absolute value of C is then $C = \frac{1}{\omega^2 L}$

If, e.g. L is 0.5 mH, then the corresponding capacitor at 60 Hz should have a value of 13,000 μF . It is evident from this impractical value that for economical reasons it is impossible to choose for a passive LC combination.

That is why refuge was taken to an "artificial" L. This "artificial" L is realized by means of a gyrator. One of the properties of a gyrator is that a capacitor, which is connected to the output poles, on the input is seen as a selfinduction (see Fig. 7).



Fig. 7

The working of a gyrator is described later on. When switch S in Fig. 6 is closed, we have a by-resonance $Z = R$. The voltage division obtained

on point A is shown as $\frac{U_2}{U_1} = \frac{R}{R+R_1}$. This may be

done, because the input impedance of amplifier 2 $\gg R$ (Amplifier 2 = emitter follower).

Practical example (see circuit diagram)

When switch H is closed, with resonance we get

$$\text{a voltage division of } \frac{U_2}{U_1} = \frac{R_{914}}{R_{914} + R_{856}} =$$

$$\frac{8.2k}{8.2k + 8.2k} = \frac{1}{2}$$

In dBs this means an attenuation of 6 dB. In Fig. 4 in the position "side against wall" we see that a frequency band of 55 to 160 Hz should be covered.

This is obtained by parallel switching of RLC-circuits with three different proper resonances, see Fig. 8.

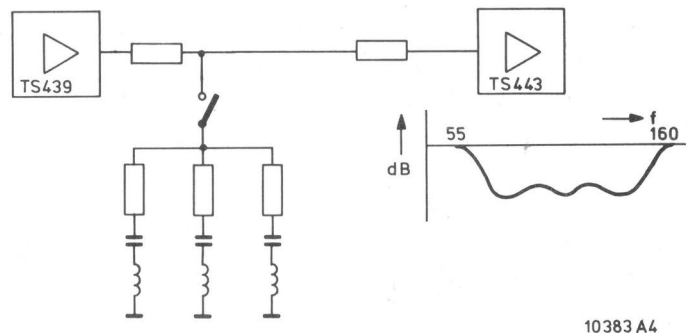


Fig. 8

To keep the gyrator working stable, a constant power source is used for the supply (see Fig. 9) and this is obtained by keeping the base of TS460 on a constant voltage by means of D570.

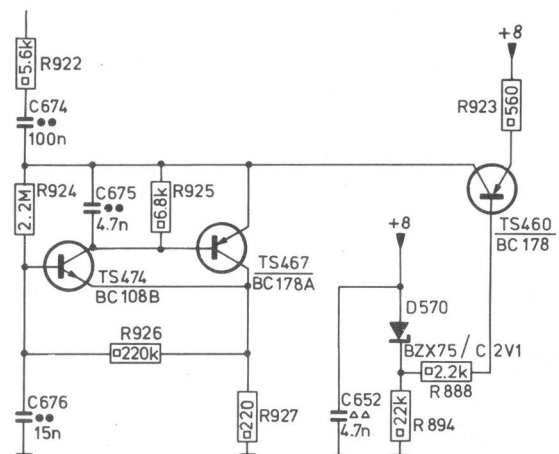


Fig. 9

Working gyrator (see Fig. 10)

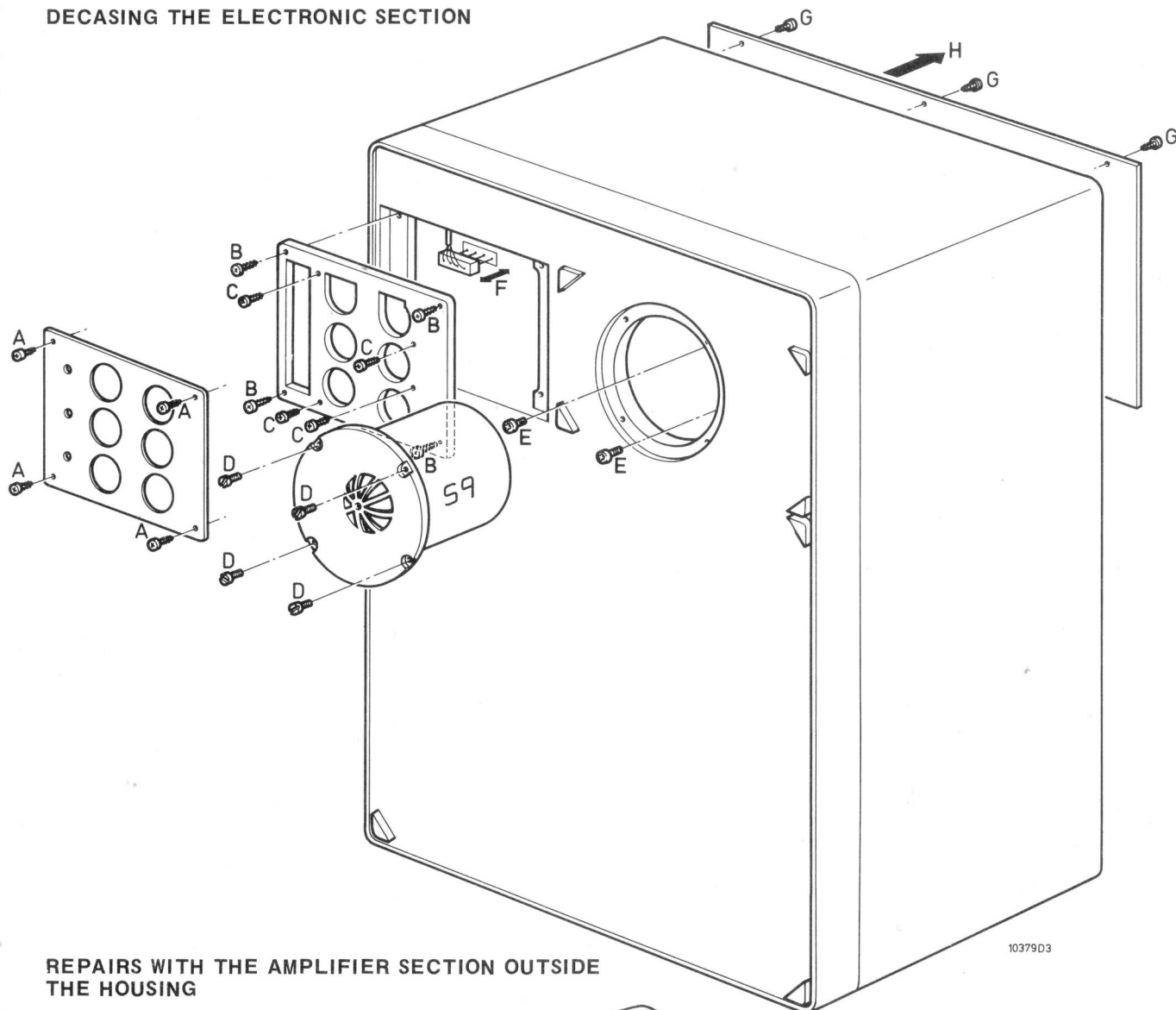
The base circuit consists of 2 amplifiers A and B switched antiparallel.

The steepness of amplifier A is g_1 (A/V), that of amplifier B is g_2 (A/V).

$$\text{It is also known that } I_2 = g_1 \cdot U_1 \rightarrow U_1 = \frac{I_2}{g_1}$$

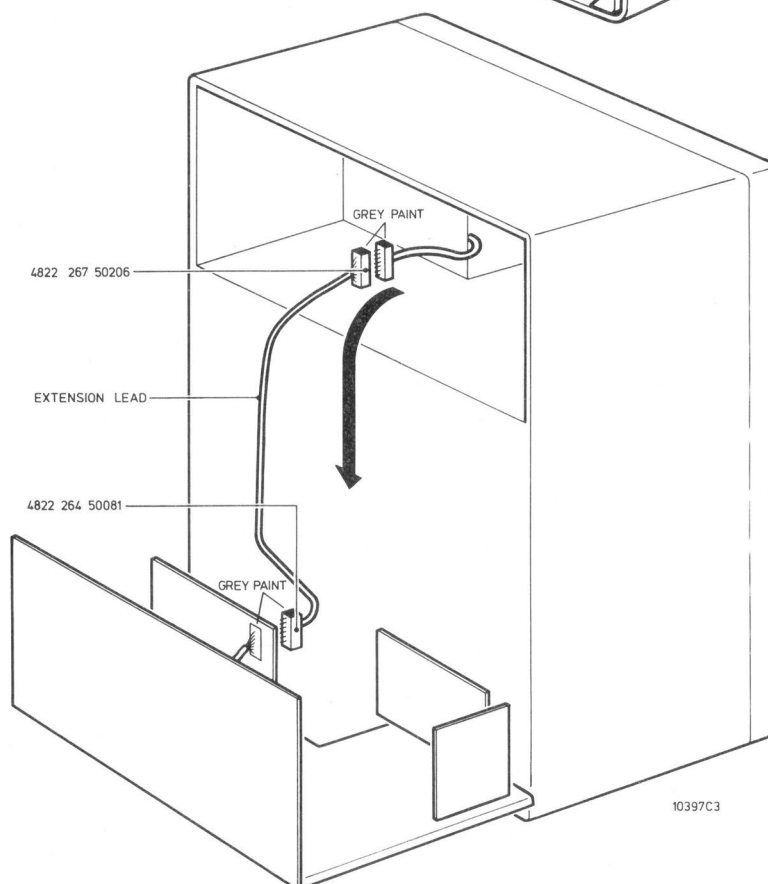
$$I_1 = g_2 \cdot U_2$$

DECASING THE ELECTRONIC SECTION



10379D3

REPAIRS WITH THE AMPLIFIER SECTION OUTSIDE THE HOUSING



10397C3

TRIMMING INSTRUCTIONS

According to the specifications, the playback characteristic of this set must lie between + or -1 dB (see Fig. 1).

It goes without saying that, with the spread in components, such a specification cannot be realized. For this reason, the level of the low, middle and high-note amplifiers can be adjusted with resp. R1142, R1032 and R976.

During production, the set is acoustically measured in a dead room and, afterwards, adjusted with R1142, R1032 and R976 (see Fig. 2).

The problem of repairing the box within specification can be split in two:

- After replacing one or more components in the output amplifier, does the set still meet the specifications.
- Ditto, after replacing one or more loudspeakers.

As for replacing parts of one of the amplifiers, we can say without more that the specification is not impaired. The negative feedback of the three amplifiers is so strong that the loop amplification is only determined by the components in the feedback net work and not by the components of the amplification section.

Replacing one or more loudspeakers is somewhat different, for the loudspeakers used may have a tolerance of $\pm 1,5$ dB in the acoustic output. In extreme cases this would mean that, when the same electrical power is supplied to two identical loudspeakers, the acoustical output may differ 3 dB. It will be clear that a set cannot be repaired within the specifications, if there is no dead room available for acoustical measurements.

That is why for service purposes there is another solution. Concern Service supplies loudspeakers with a sticker on the back indicating a voltage value x. This voltage value x states the acoustical power measured in a dead room. This acoustical power measured is up to the specifications.

When one or more loudspeakers must be exchanged, the following procedure must be followed:

- Knob "sensitivity" in position "1 V"
- Knob "automatic" in position "off asymmetric"
- Knob "roll off frequency" in position "off"
- Knobs "corrections low" in position "off"
- Knob "treble roll off" in position "0 dB"
- Knob "bass control" in position "0 dB".
- High-note loudspeaker:
Supply 50 mV sine, 6300 Hz to the asymmetrical input plug. Adjust R976 in such a way that across the loudspeaker the same value is measured as stated on the sticker on the loudspeaker.
- Middle-note loudspeaker:
Supply 50 mV sine 1100 Hz to the asymmetric input plug. Adjust R1032 in such a way that across the loudspeaker the same value is measured as stated on the sticker on the loudspeaker.
- Low-note loudspeaker:
Supply 50 mV sine 160 Hz to the asymmetrical input plug. Adjust R1142 in such a way that across the loudspeaker the same value is measured as stated on the sticker on the loudspeaker. In this way, also the acoustical feedback is correctly adjusted.

The above procedure implies that the box can be repaired within the specifications.

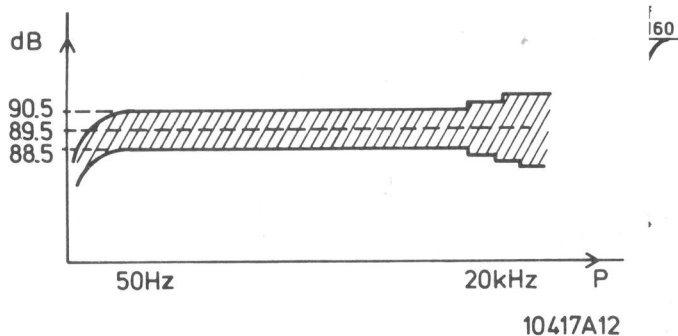


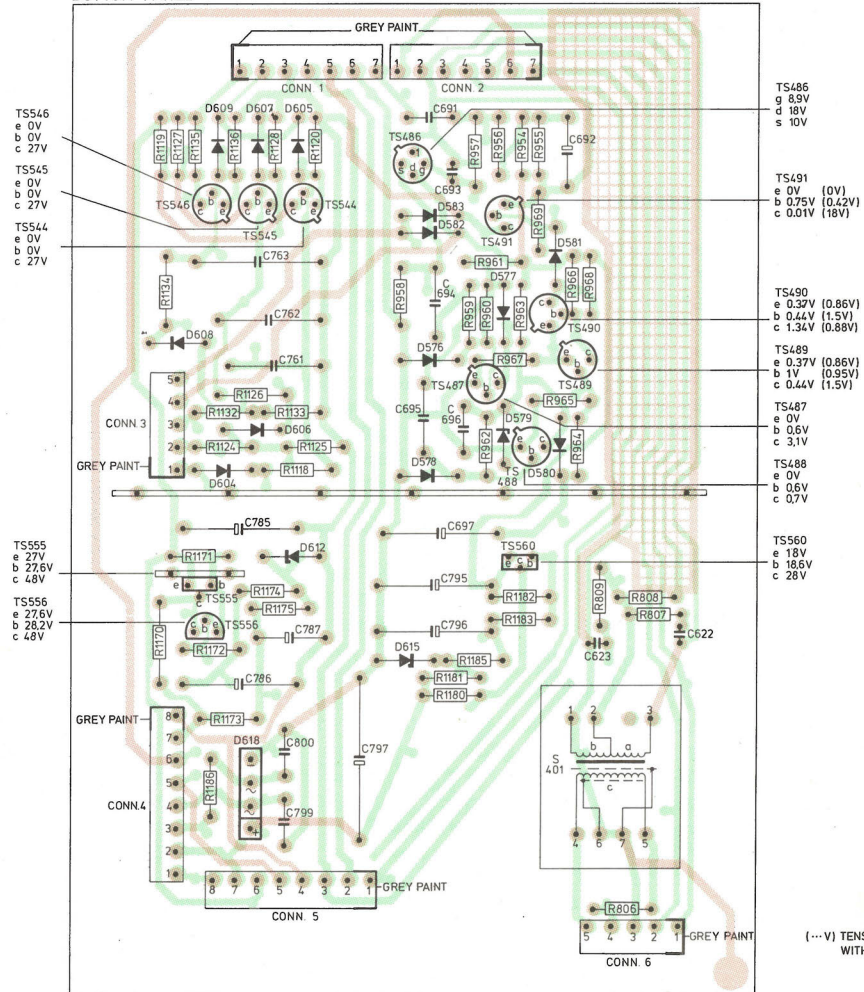
Fig. 1

-TS-		-C-	
435	E3	622	D4
436	E4	623	C4
437	E3	625	G3
438	E2	626	F3
439	E2	627	F3
443	J3	628	F3
444	J3	631	G3
445	J4	632	F3
451	E4	633	G4
452	E4	634	E3
453	E4	635	G3
456	J2	636	G4
458	J3	637	E2
460	J4	638	E2
463	J2	639	F2
464	J2	640	F2
465	J3	642	I2
466	J3	643	J3
467	J4	644	J3
470	J2	651	F4
471	J2	652	I2
472	J3	654	J2
473	J3	655	J2
474	J4	656	J2
486	C2	659	J2
487	C3	660	J2
488	C3	661	J2
489	C3	664	I3
490	C3	665	J3
491	C2	666	J3
544	B2	669	I3
545	B2	670	J3
546	B2	671	J3
555	B4	674	I4
556	B4	675	J4
557	J2	676	J3
560	C4	691	C2
		692	C2
		693	C2
		694	C3
		695	C3
		696	C3
		697	C4
		761	B3
		762	B3
		763	B3
		785	B4
		786	B4
		787	B4
		795	C4
		796	C4
		797	B5
		799	B5
		800	B5
-S-			
401	D5		
620	G4		
-D-			
567	F2		
568	F2		
570	I2		
571	F4		
576	C3		
577	C3		
579	C3		
580	C3		
581	C3		
582	C2		
583	C2		
585	G1		
586	G1		
587	G1		
605	B2		
606	B3		
607	B2		
608	B3		
609	B2		
612	B4		
615	C4		
618	B5		

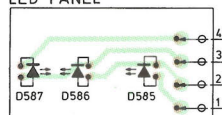
-R-

806	D5	823	E4	841	F2	857	I3	888	J2
807	D4	824	E4	842	F3	858	J3	889	J2
808	D4	825	F4	843	F2	859	J3	890	J2
809	C4	826	F4	844	E2	860	I2	891	J2
812	G3	828	E3	845	E2	861	J3	892	J2
813	G3	829	G4	846	E2	862	I3	893	J2
814	E3	830	G4	847	F2	863	J3	895	J2
815	E3	831	E2	848	E2	864	I3	898	I2
816	E3	832	E2	851	I3	865	J4	899	I2
817	F3	833	G3	852	I3	880	E4	900	J2
819	F3	834	E3	853	I4	881	E4	901	J2
820	F4	835	E3	854	I2	882	E4	902	J2
821	F4	836	E2	855	I3	883	F4	903	J2
822	E4	837	F2	856	I3	884	F4	906	I3

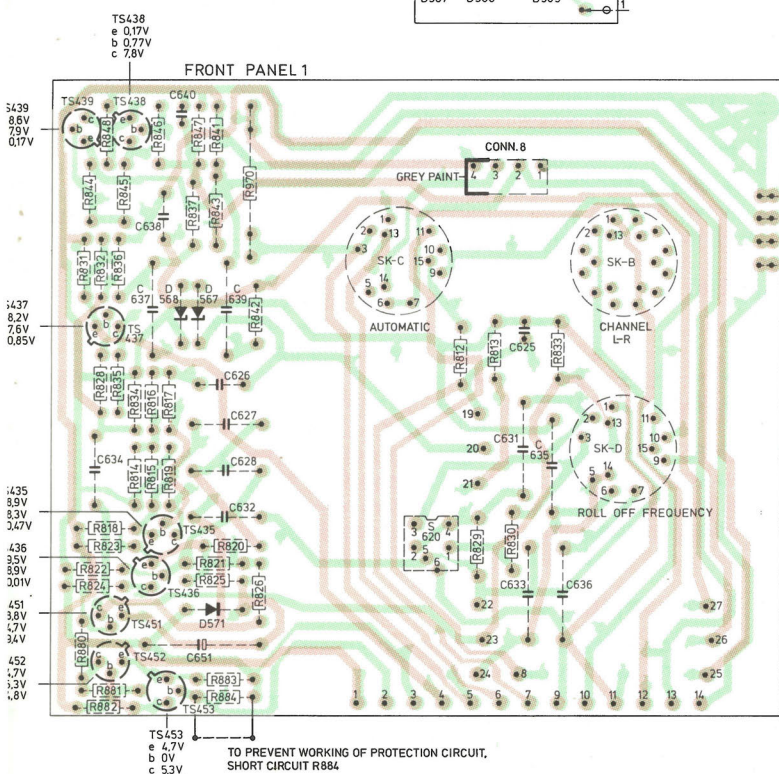
BOTTOM PANEL



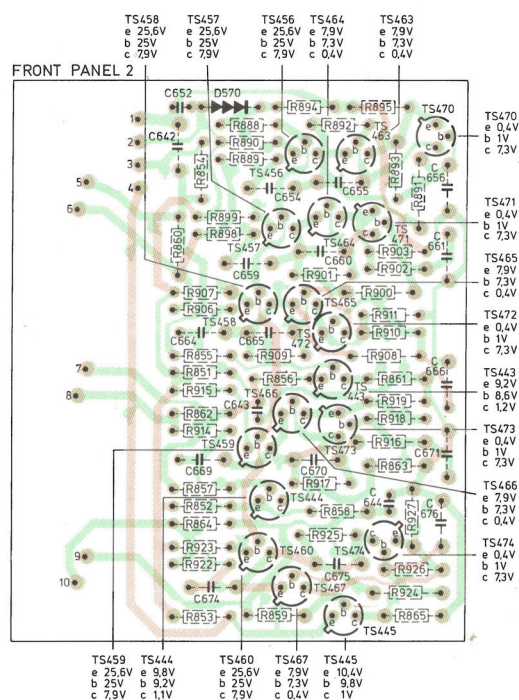
LED PANEL



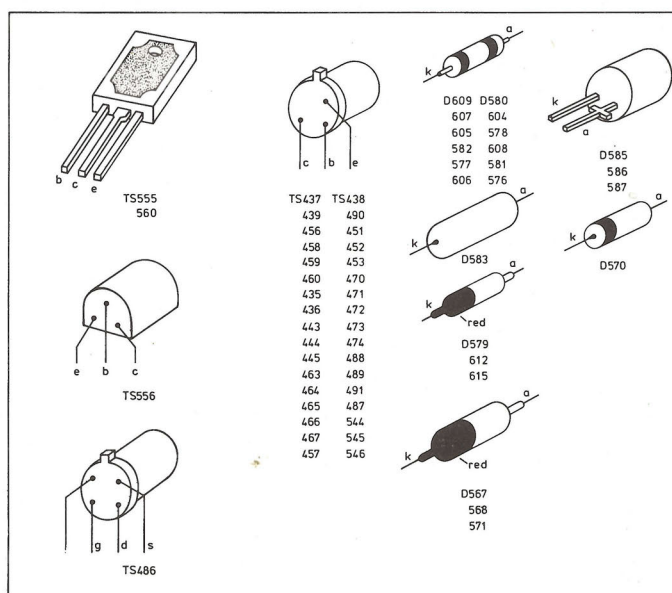
FRONT PANEL 1



FRONT PANEL 2



MEASURED IN POS. AUTOMATIC ON INPUT SIGNAL



10372E12

907	I2	925	J4	966	C3	1134	B3
908	J3	926	J4	967	C3	1135	B2
909	J3	927	J3	968	C3	1136	B2
910	J3	954	C2	969	C2	1170	B4
911	J3	955	C2	970	F2	1171	B4
914	I3	956	C2	1119	B2	1172	B4
915	I3	957	C2	1120	B2	1173	B5
916	J3	958	C3	1124	B3	1174	B4
917	J3	959	C3	1125	B3	1175	B4
918	J3	960	C3	1126	B3	1180	C5
919	J3	961	C3	1127	B2	1181	C4
922	I4	962	C3	1128	B2	1182	C4
923	I4	963	C3	1132	B3	1183	C4
924	J4	964	C3	1133	B3	1185	C4
						1186	B5

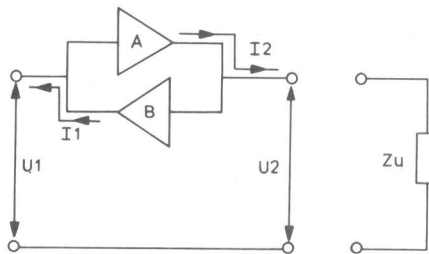


Fig. 10

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When an impedance Z_u is connected to the output of the gyrator (see Fig. 10), then follows that

$$U_2 = Z_u \cdot I_2 \rightarrow Z_u = \frac{U_2}{I_2}$$

The impedance seen on the input is now

$$Z = \frac{U_1}{I_1} = \frac{I_2}{g_1 g_2 U_2} = \frac{1}{g_1 g_2 Z_u} \quad (1) \text{ with}$$

$\frac{1}{g_1 g_2}$ as the gyrator resistance.

When Z_u is a capacitive reactance, then $Z_u = \frac{1}{j\omega C}$

After substitution in (1): $Z_i = \frac{j\omega C}{g_1 g_2}$, so that

$$L = \frac{C}{g_1 g_2}. \text{ Here } g_1 \text{ and } g_2 \text{ are constants.}$$

In the 22RH545 was chosen for a so-called asymmetric gyrator (Fig. 11).

Here, TS470 and TS463 are amplifier A of Fig. 10, and R891 is amplifier B of Fig. 10.

TS470 and TS463 constitute a voltage controlled current source.

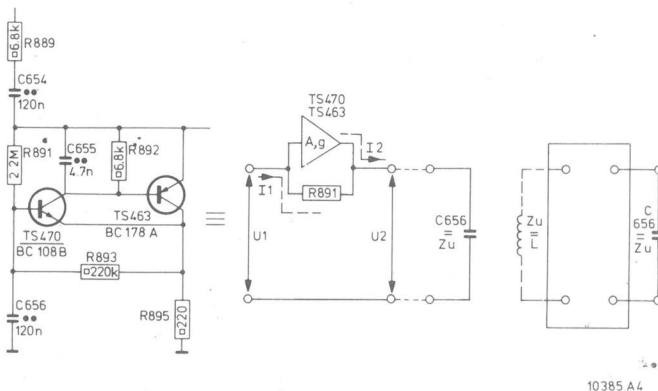


Fig. 11

Given is that amplifier A has a high input impedance (so I_1 flows practically entirely through

R891) and a high amplification (so $U_2 \gg U_1$).

Now, $I_2 = g \cdot U_1$

$$U_2 = I_1 \cdot R_{891} \text{ (as } U_2 \gg U_1 \text{)}$$

$$\text{If } Z_u = \frac{1}{j\omega C_{656}} \text{ then } U_2 = \frac{I_2}{j\omega C_{656}}$$

So, the impedance seen on the input, then is

$$Z_i = \frac{U_1}{I_1} = \frac{I_2 \cdot R_{891}}{g \cdot U_2} = \frac{I_2 \cdot R_{891} \cdot j\omega C_{656}}{g \cdot I_2}$$

$$\frac{j\omega C_{656} \cdot R_{891}}{g} \quad (2)$$

In this formula, C_{656} and R_{891} are known.

The steepness must still be calculated.

$$\text{You can calculate that } g = \frac{1}{R_{895}} \quad (6)$$

Practical example

From the comparisons (2) and (6) follows that $Z_i = j\omega C_{656} R_{891} R_{895}$ so that the "artificial" L is

$$\text{equal to } L = C_{656} \cdot R_{891} \cdot R_{895} = 120 \cdot 10^{-9} \cdot 2,2 \cdot 10^6 \cdot 220 = 58 \text{ Henry.}$$

Now, we can also calculate the resonance frequency of the RLC series circuit of e.g. Fig. 11

$$\text{With resonance } \omega^2 LC = 1 \text{ so that } f = \frac{1}{2\pi \sqrt{LC}} =$$

$$\frac{1}{6,28 \sqrt{58 \cdot 120 \cdot 10^{-9}}} = 60 \text{ Hz}$$

C655 is added for maintaining the steepness of an exactly defined value. R893 constitutes with C656 a low-pass filter to prevent that instability symptoms occur in the gyrator at higher frequencies.

Output amplifiers

The box has three separate output amplifiers for the high, middle and low notes.

The designs of the high and middle tone amplifiers are already known (see circuit diagram).

We see that these two amplifiers have a so-called bootstrap feedback through C711 and C731. This circuit serves to obtain a high input impedance. The drawback, however, is that e.g. the base voltage of TS516a may become higher than the collector voltage of TS516a, so that base-collector current may flow. This can be prevented with the diodes D594, D591.

As for the low-note amplifier, we will discuss some circuits that deviate from those already known (see Fig. 12).

It strikes us immediately that this amplifier is symmetrically supplied with +33 V and -33 V. An output elco is therefore superfluous and the loudspeaker is directly connected to point A. This means that on point A there must be no DC-voltage. Therefore, the base of TS525 is brought to 0 V via the resistors R1071 and R1069.

As these resistors together amount to 10.1 kΩ, there will be only a very small base current, so that the base of TS525 is practically at 0 V.

The base current of TS526 is the same as that of TS525, because R1075 has a value of 10 kΩ. The base voltages on the points C and B are therefore basically equal to 0 V.

If this is not the case, a correction is made as follows:

Suppose point A will switch over to -1 V (e.g. when TS537b supplies more current than TS537a). Then, also point B will go over to -1 V. So, the collector current of TS525 will increase, just like the collector current of TS528. This means that $I_1 > I_3$.

TS528 will drive current into TS535a on one hand and counteract the base current of TS535b on the other hand. The base current of TS535a will increase, just like the collector current of TS537a. The base current of TS535b will decrease, just like the collector current of TS537b. Point A therefore will go to 0 V again.

With TS481, D573 constitutes a constant current source. It is easy to see that the signal in the low note amplifier cannot pass through, as long as C687 is not charged. In this way, no annoying switch-on noises are audible.

Besides, there are two more current sources in this amplifier, viz. TS527 with D600 and TS530 with D600. This means that the collector currents of TS527 and TS530 are constant. TS525 with TS526 constitutes a differential amplifier. The feedback factor of the low-note amplifier is

$$\frac{R1077}{R1075 + R1077} = \frac{1}{101}$$

Consequently, the loop amplification is equal to 101. For higher frequencies feedback takes place via C745, R1076, R1077 and C749, for still higher frequencies via C747, R1077 and C749. So, on points B and C is the same AC-voltage signal. If this is not the case, a correction is made as follows:

Suppose on point C is 150 mV and on point B 100 mV. This means that the AC-voltage variation on point A would be too small. Now, TS525 is driven open more than TS526. So, the collector current of TS525 will increase (The collector current of TS526 will decrease to the same degree, because TS527 supplies a constant current). The voltage on the collector of TS525 decreases so that the voltage on the base of TS528 becomes more negative with respect to the emitter. So, TS528 is opened wider, so that the collector current of TS528 increases (I_1). As mentioned

earlier, the collector current of TS530 (I_3) is constant. All the current more supplied by TS528 than can flow away via TS530, is via R1088 supplied to the base of TS535a. Consequently, the collector current of TS535a also increases and so also the collector current of TS537a. As a result, the output voltage on point A will increase until the voltage on point B also amounts to 150 mV. D601 and D598 are applied to suppress switch-off noise.

D599 is applied to make the two output stages symmetrical. When we look at the signal path from point D to point A, then we see that two base-emitter junctions must be passed, viz. V_{BE} of TS535b and V_{BE} of TS539.

In order that also the signal path from point E to A goes via two base-emitter junctions, D599 is added. D602 is applied for the following reason: Suppose R1074 is connected to mass instead of via D602 to the positive supply voltage. When fuse VL418 would blow, there would be no more current through TS528. Consequently, TS530 would cause a very great base current in TS535b, so that this stage might be destroyed. With D602 added, there will be no voltage across D600 when VL418 blows, so that no current can flow through TS530.

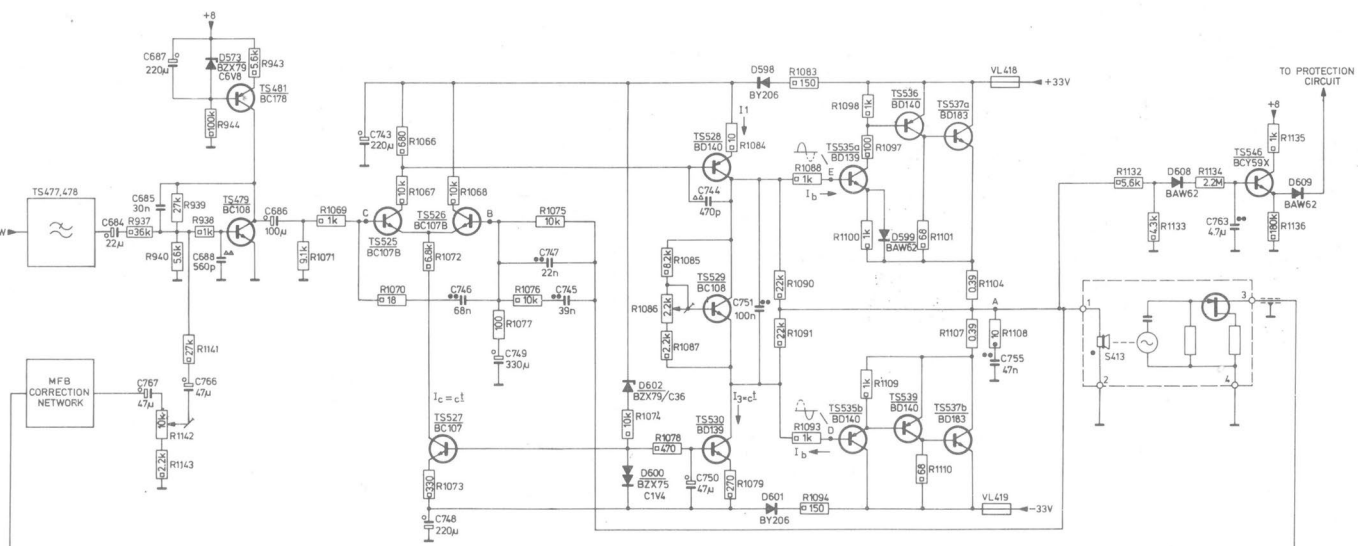


Fig. 12

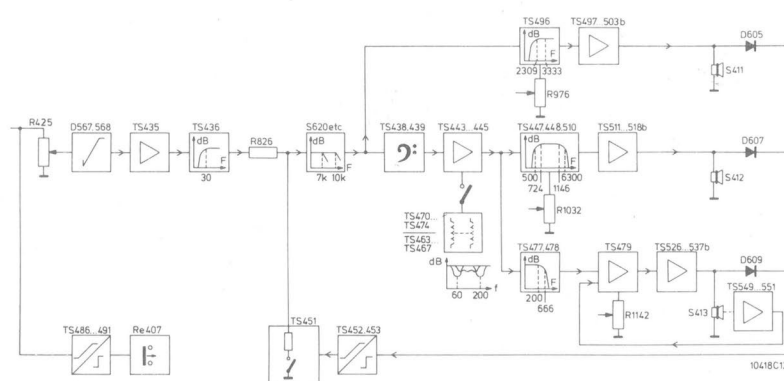
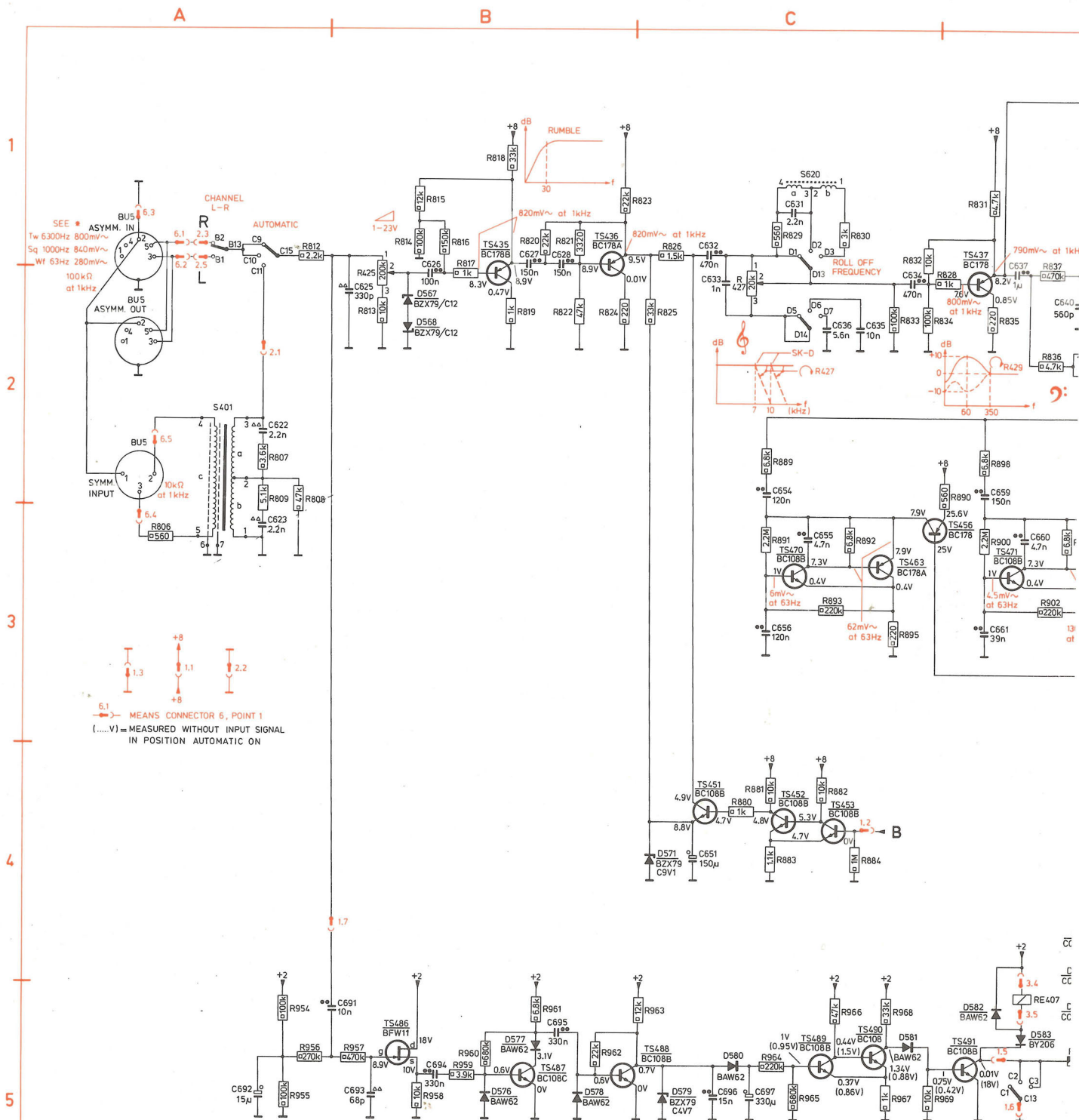


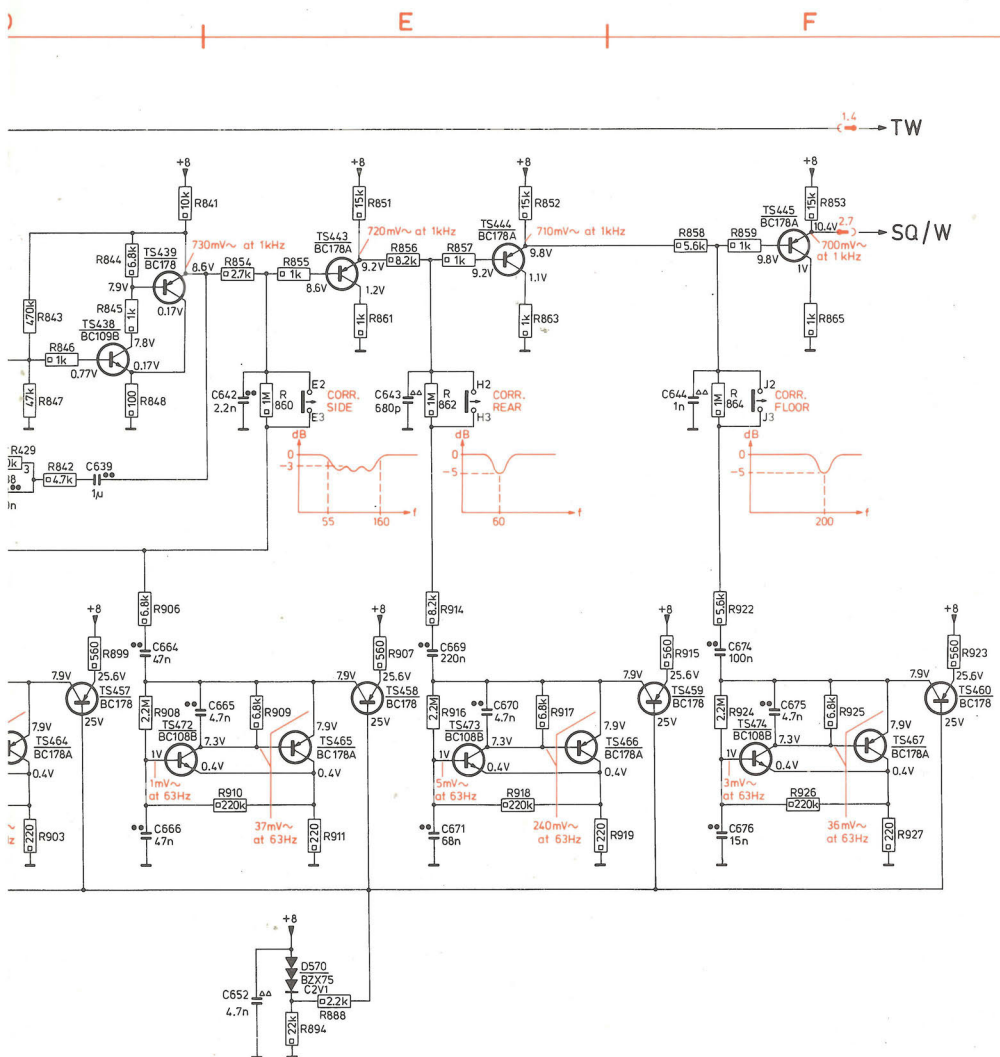
Fig. 2



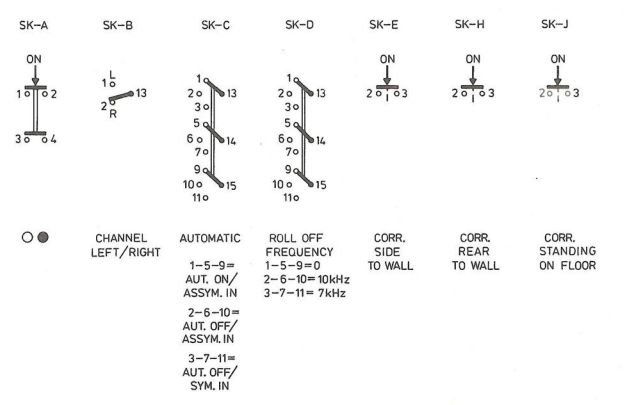
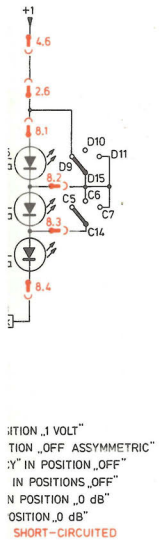
ALL TENSIONS ARE MEASURED WITH

- KNOB „SENSITIVITY“ IN
- KNOB „AUTOMATIC“ IN
- KNOB „ROLL OFF FREQ“
- KNOB „CORRECTIONS L“
- KNOB „TREBLE ROLL OFF“
- KNOB „BASS CONTROL“

* TO AVOID WORKING OF THE PROTECTION CIRCUIT, R884 HAS TO



-TS-	-C-	-R-
435 B1	622 A2	425 B1
436 B1	623 A3	427 C2
437 D2	625 B2	429 D2
438 D1	626 B1	806 A3
439 D1	627 B1	807 A2
443 E1	628 B1	808 A2
444 E1	631 C1	809 A2
445 F1	632 C1	812 A1
451 C4	633 C2	813 B2
452 C4	634 C2	814 B1
453 C4	635 C2	815 B1
456 C3	636 C2	816 B1
457 D3	637 D1	817 B1
458 E3	638 D2	818 B1
459 F3	639 D2	819 B2
460 F3	640 D2	820 B1
463 C3	642 E2	821 B1
464 D3	643 E2	822 B2
465 E3	644 F2	823 B1
466 E3	651 C4	824 B2
467 F3	652 E4	825 C2
470 C3	654 C2	826 C1
471 D3	655 D3	828 C2
472 D3	656 D3	829 C1
473 E3	659 D2	830 C1
474 F3	660 D3	831 D1
486 B5	661 D3	832 C1
487 B5	664 D2	833 C2
488 B5	665 D3	834 C2
489 C5	666 D3	835 D2
490 C5	669 E2	836 D2
491 D5	670 E3	837 D1
	671 E3	841 D1
	674 F2	842 D2
	675 F3	843 D1
	676 F3	844 D1
401 A2	691 A5	845 D1
620 C1	692 A5	846 D1
	693 B5	847 D2
	694 B5	848 D2
	695 B5	851 E1
	696 C5	852 E1
	697 C5	853 F1
		854 E1
		855 E1
		856 E1
		857 E1
		858 F1
		859 F1
		860 E2
		861 E1
		862 E2
		863 E1
		864 F2
		865 F1
		866 C4
		867 C4
		868 C4
		869 C4
		870 D2
		871 D3
		872 D3
		873 D3
		874 D3
		875 D3
		876 D3
		877 D3
		878 D3
		879 D3
		880 C4
		881 C4
		882 C4
		883 C4
		884 C4
		885 E4
		886 C2
		887 D2
		888 D3
		889 D3
		890 D3
		891 D3
		892 D3
		893 D3
		894 E4
		895 D3
		896 D2
		897 D2
		898 D2
		899 D2
		900 D3
		901 D3
		902 D3
		903 D3
		904 D2
		905 D2
		906 D2
		907 E2
		908 D3
		909 E3
		910 E3
		911 E3
		912 E2
		913 F2
		914 E2
		915 F2
		916 E3
		917 E3
		918 E3
		919 E3
		920 F2
		921 F2
		922 F2
		923 F2
		924 F3
		925 F3
		926 F3
		927 F3
		928 A5
		929 A5
		930 A5
		931 A5
		932 A5
		933 A5
		934 A5
		935 A5
		936 A5
		937 A5
		938 A5
		939 A5
		940 A5
		941 A5
		942 A5
		943 A5
		944 A5
		945 A5
		946 A5
		947 A5
		948 A5
		949 A5
		950 A5
		951 A5
		952 A5
		953 A5
		954 A5
		955 A5
		956 A5
		957 B5
		958 B5
		959 B5
		960 B5
		961 B5
		962 B5
		963 C5
		964 C5
		965 C5
		966 C5
		967 C5
		968 C5
		969 C5
		970 D5

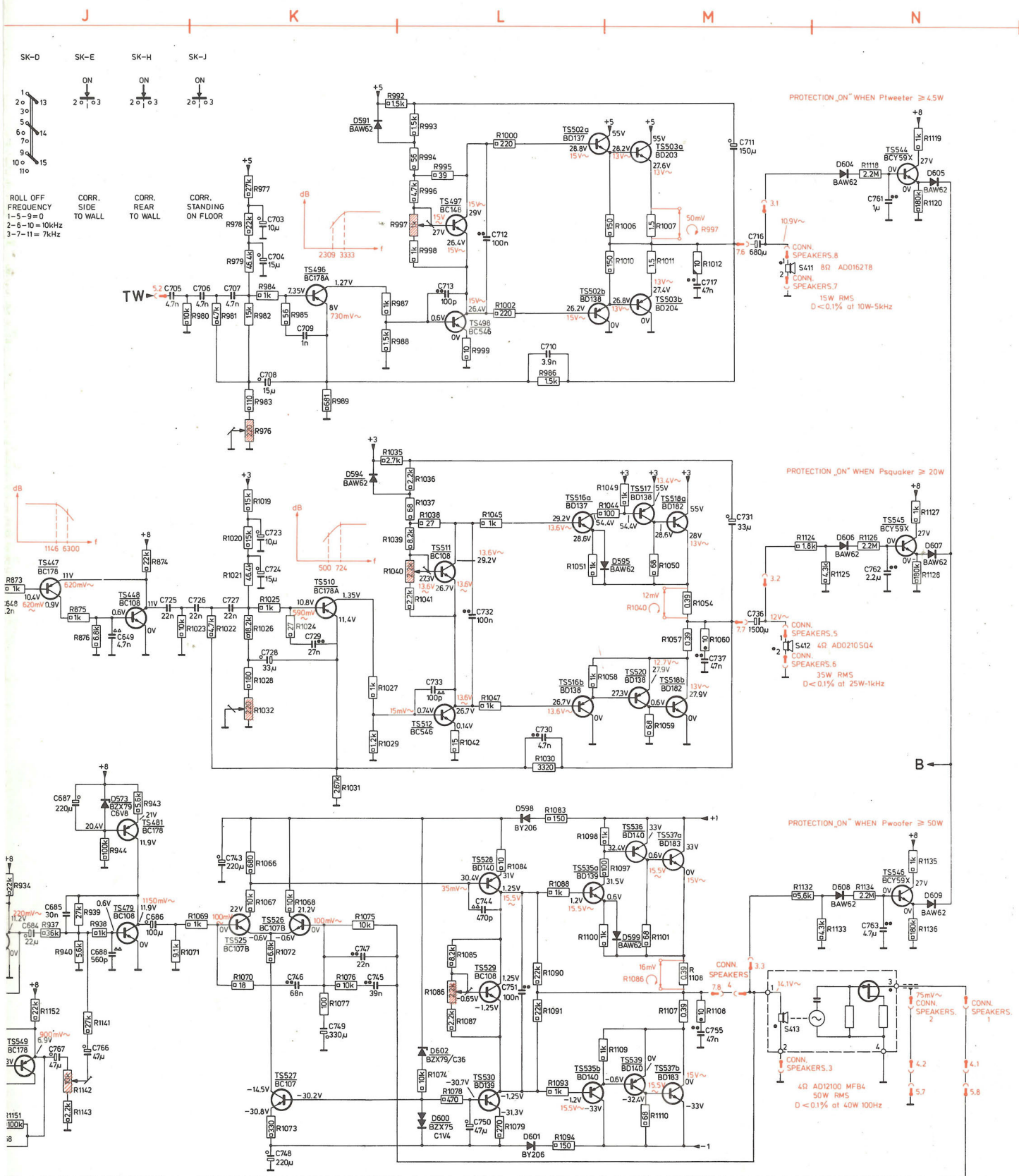


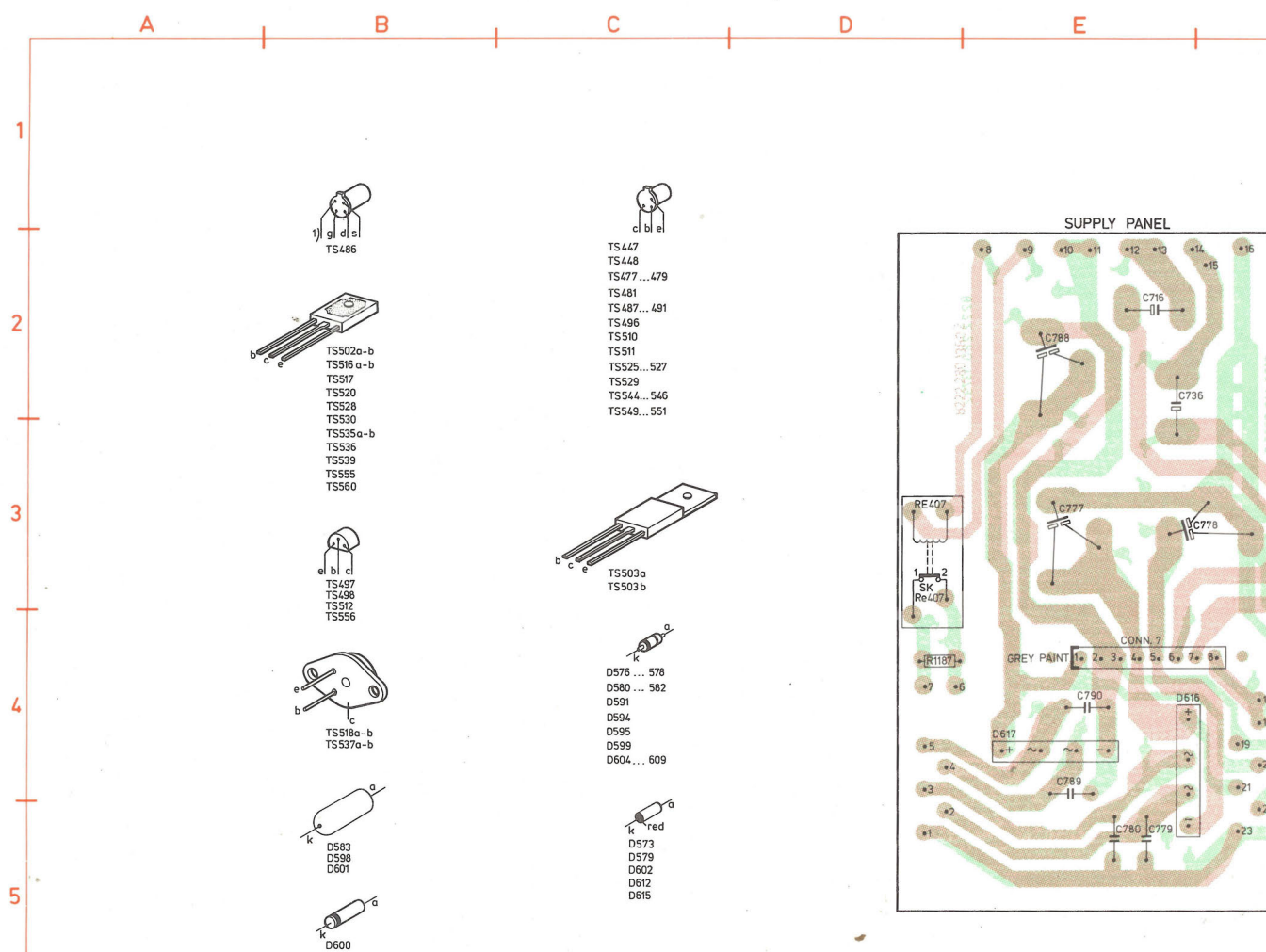
8682E7/A

CS56113

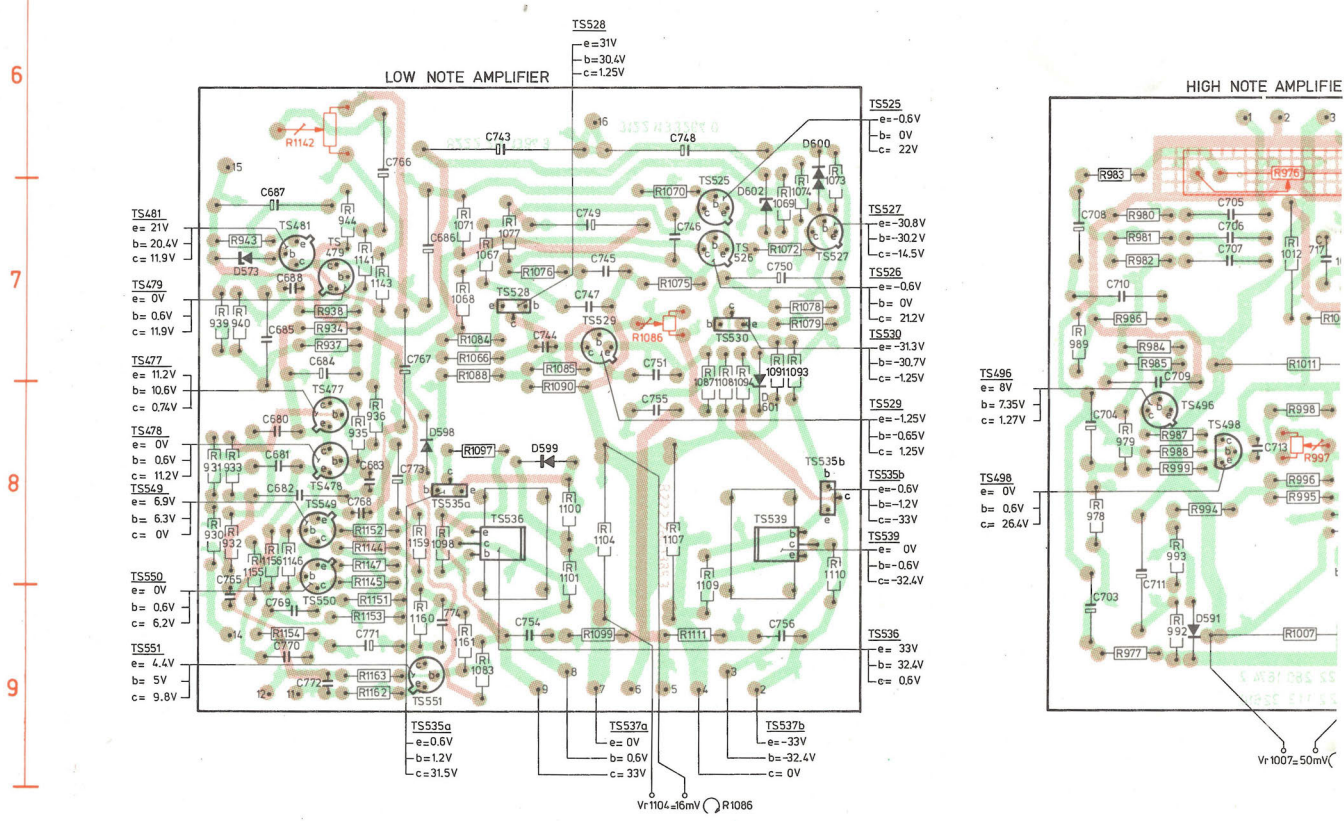
TO AV

	Carbon resistor E24 series
	Carbon resistor E12 series
	Carbon resistor E12 series
	Plate ceramic capacitor
	Flat-foil polyester capacitor
	Miniature electrolytic capacitor

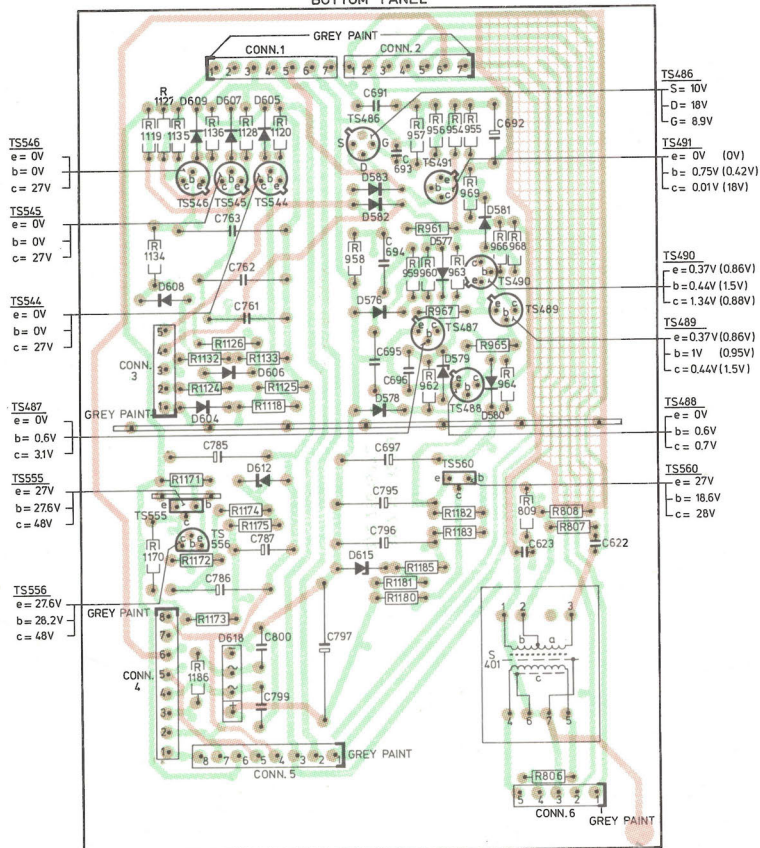




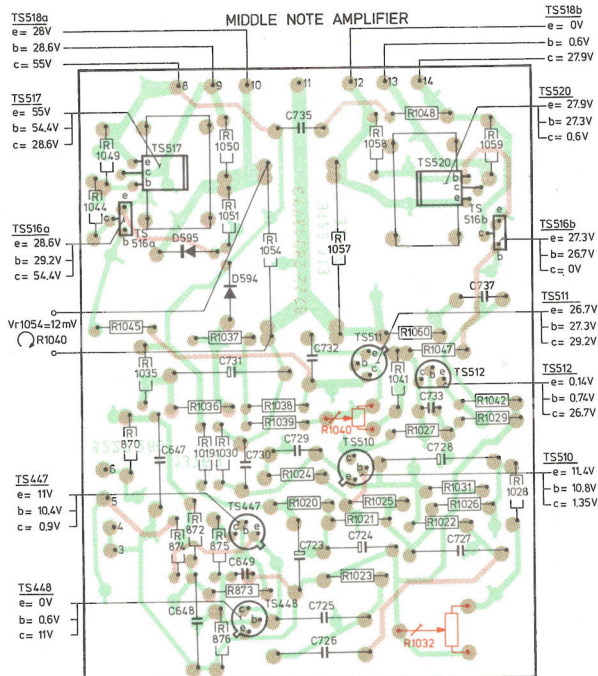
(...) TENSIONS MEASURED IN POSITION AUTOMATIC ON, WITHOUT INPUT SIGNAL.



BOTTOM PANEL



MIDDLE NOTE AMPLIFIER



-TS-	-C-	-R-
447 H8	622 I4	806 I5
448 H9	623 H4	807 I4
477 B8	647 G8	808 I4
478 B8	648 G9	809 H4
479 B7	649 H8	870 G8
481 B7	680 A8	872 G8
486 H2	681 A8	873 H9
487 H3	682 B8	874 G8
488 H3	683 B8	876 H9
489 H3	684 B7	930 A8
490 H3	685 A7	931 A8
491 H2	686 B7	932 A8
496 E8	687 A7	933 A8
497 F8	688 B7	934 B7
498 E8	691 H2	935 B8
502a F8	692 H2	936 B8
502b F7	693 H2	937 B7
503a F8	694 H2	938 B7
503b F7	695 H3	939 A7
510 H8	696 H3	940 A7
511 H7	697 H3	943 A7
512 H7	703 E9	944 B7
516a G7	704 E8	954 H2
516b I7	705 E7	955 H2
517 G6	706 E7	956 H2
518a H6	707 E7	957 H2
518b H6	708 E7	958 H2
520 H7	709 E7	959 H3
525 C6	710 E7	960 H3
526 C7	711 E8	961 H2
527 D7	712 F8	962 H3
528 B7	713 E8	963 H3
529 C7	715 F6	964 H3
530 C7	716 E2	965 H3
535a B8	717 F6	966 H2
535b D8	723 H8	967 H3
536 B8	724 H8	968 H2
537a C9	725 H9	969 H2
537b C9	726 H9	976 F6
539 C8	727 I8	977 E9
544 G2	728 H8	978 E8
545 G2	729 H8	979 E8
546 G2	730 H8	980 E7
549 B8	731 H7	981 E7
550 B9	732 H7	982 E7
551 B9	733 H8	983 E6
555 G4	735 H6	984 E7
556 G4	736 E2	985 E7
560 H4	737 I7	986 E7
	743 B6	987 E8
	744 C7	988 E8
	745 C7	989 E7
	746 C7	992 E9
	747 C7	993 E8
	748 C6	994 E8
	749 C7	995 F8
	750 D7	996 F8
	751 C7	997 F8
	754 C9	998 F8
	755 C8	999 E8
	756 D9	1000 F8
	761 G3	1002 F7
	762 G3	1003 F7
	763 G2	1006 F8
	765 A8	1007 F9
	766 B6	1010 F7
	767 B7	1011 F7
	768 B8	1012 F7
	769 B9	1019 H8
	770 B9	1020 H8
	771 B9	1021 H8
	772 B9	1022 H8
	773 B8	1023 H8
	777 E3	1024 H8
	778 F3	1025 H8
	779 E5	1026 I8
	780 E5	1027 H8
	785 G3	1028 I8
	786 G4	1029 I8
	787 G4	1030 H8
	788 E2	1031 I8
	789 E4	1032 H9
	790 E4	1035 G7
	795 H4	1036 H8
	796 H4	1037 H7
	797 H4	1038 H8
	799 G5	1039 H8
	800 G4	1040 H8
		1041 H8
		1042 I8
		1044 G7

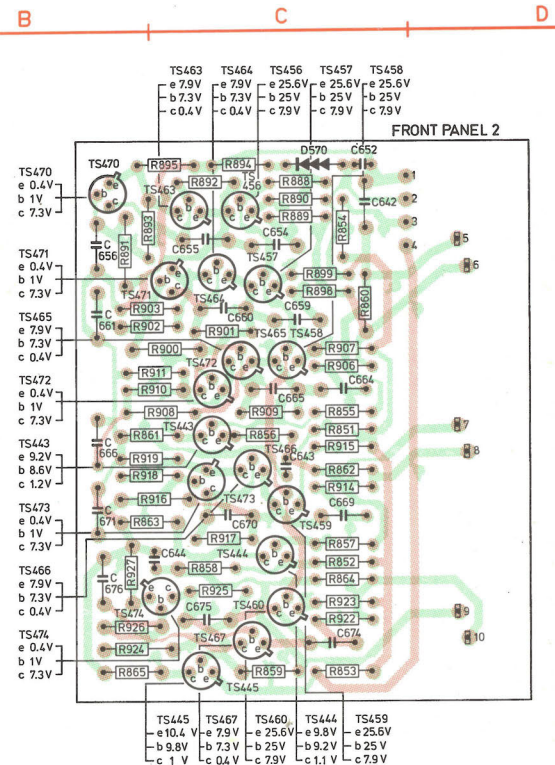
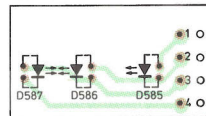
-S-

-Re-

-D-

-TS-	-C-	-R-
435 G3	622 E7	806 E8
436 G3	623 E7	807 E7
437 G2	625 E2	808 E7
438 G1	626 G2	809 E7
439 G1	627 G2	812 F2
443 C2	628 G3	813 E2
444 C3	631 E3	814 G3
445 C3	632 G3	815 G3
451 G3	633 E3	816 G2
452 G4	634 G3	817 G3
453 G4	635 E3	818 G3
456 C1	636 E3	819 G3
457 C2	637 G2	820 G3
458 C2	638 G2	821 G3
459 C3	639 G2	822 G3
460 C3	640 G1	823 G3
463 C1	642 C1	824 G3
464 C2	643 C2	825 G3
465 C2	644 C3	826 F3
466 C2	651 G3	828 G2
467 C3	652 C1	829 F3
470 B1	654 C1	830 E3
471 C2	655 C1	831 G2
472 C2	656 B1	832 G2
473 C2	659 C2	833 E2
474 B3	660 C2	834 G2
486 F5	661 B2	835 G2
487 F6	664 C2	836 G2
488 E6	665 C2	837 G2
489 E6	666 B2	841 G1
490 E6	669 C3	842 F2
491 F5	670 C3	843 G2
544 F5	671 B3	844 G1
545 F5	674 C3	845 G1
546 G5	675 C3	846 G1
555 G7	676 B3	847 G1
556 G7	691 F5	848 G1
560 E7	692 E5	851 C2
	693 F5	852 C3
	694 F5	853 C3
	695 F6	854 C1
	696 F6	855 C2
	697 F6	856 C2
	716 I6	857 C3
	736 I6	858 C3
	761 F6	859 C3
	762 F6	860 C2
	763 G5	861 B2
	777 I7	862 C2
	778 I7	863 B3
	779 I8	864 C3
	780 I8	865 B2
	785 G6	880 G3
	786 G7	881 G4
	787 F7	882 G4
	788 I6	883 G4
	789 I8	884 G4
	790 I8	888 C1
	795 F7	889 C1
	796 F7	890 C1
	797 F7	891 B1
	799 F8	892 C1
	800 F7	893 B1
		894 C1
		895 C1
		898 C2
		1187 J7

LED PANEL



(---) TENSIONS MEASURED IN
POSITION AUTOMATIC ON
WITHOUT INPUT SIGNAL

E

F

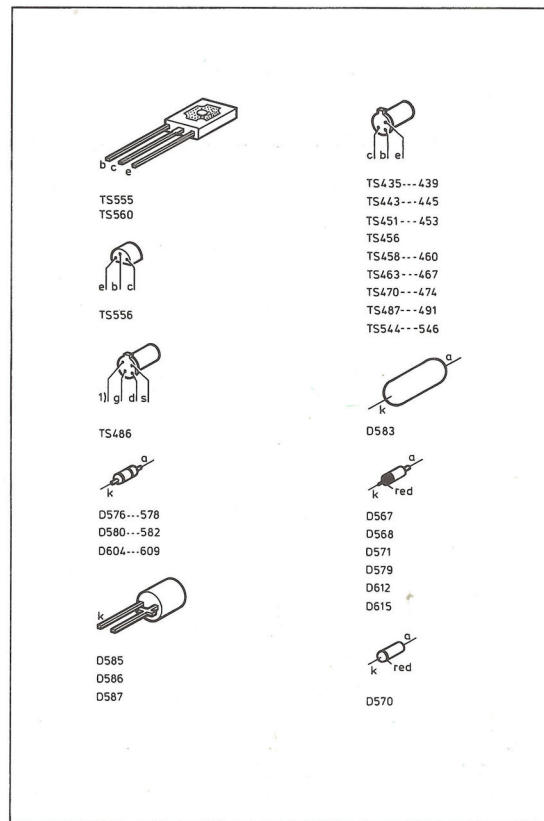
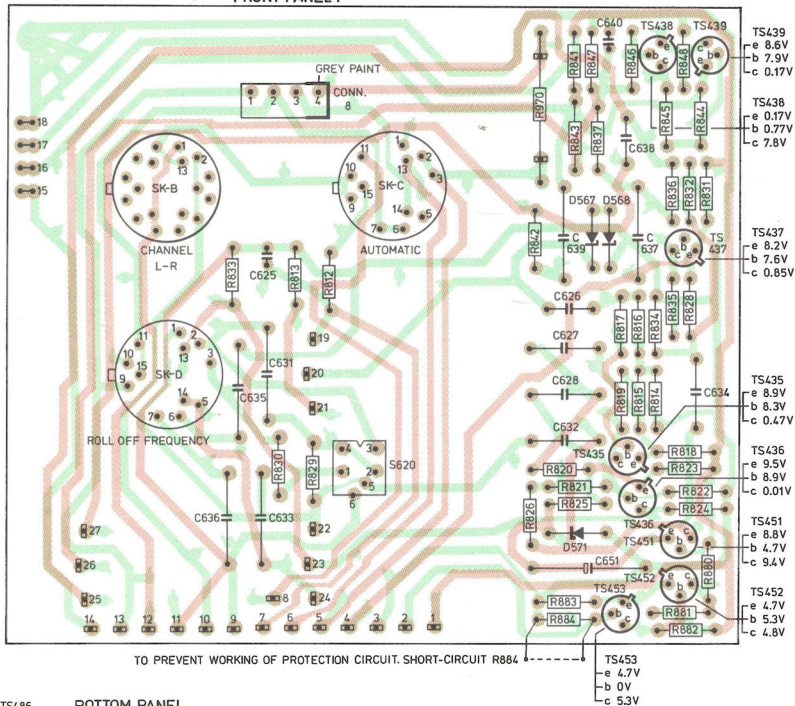
G

H

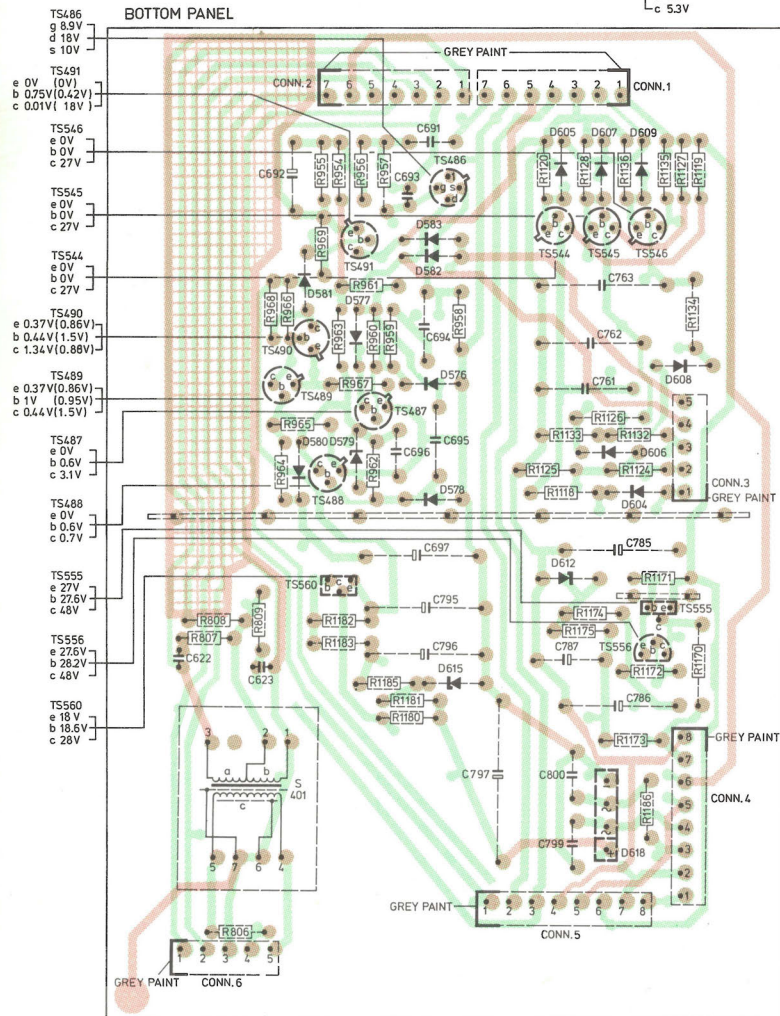
I

J

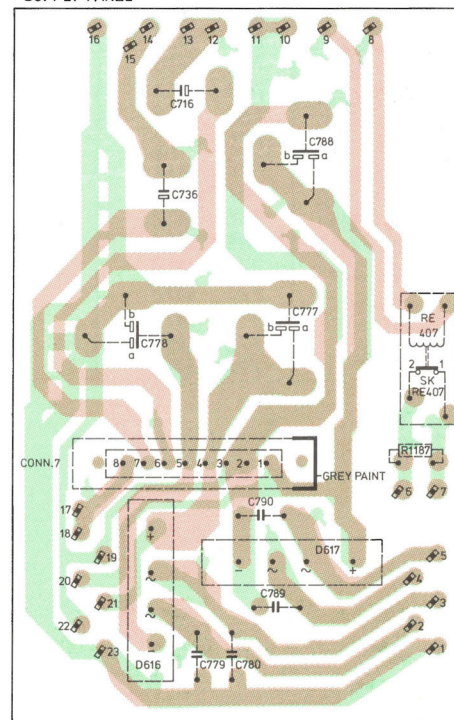
FRONT PANEL 1



BOTTOM PANEL



SUPPLY PANEL



-TS-		-C-	
447	T12	647	S12
448	T13	648	S13
477	M12	649	T13
478	M12	680	M12
479	M11	681	M12
481	M11	682	M12
496	Q12	683	M12
497	R12	685	M11
498	Q12	686	M11
502a	R13	687	M11+12
503a	R13	688	M11
503b	R11	703	Q13
510	T12	704	Q12
511	T12	705	Q11
512	U12	706	Q11
516a	S11	707	Q11
516b	U11	708	Q11
517	S11	709	Q12
518a	R15	710	Q11
518b	R16	711	Q13
520	U11	712	R12
525	O11	713	Q12
526	O11	715	R11
527	O11	717	R11
528	N11	723	T13
529	N11	724	T13
530	O11	725	T13
535a	N12	726	T13
535b	O12	727	U13
536	N12	728	U12
537a	Q15	729	T12
537b	Q16	730	T12
539	O12	731	T12
549	M12	732	T12
550	M13	733	U12
551	M13	735	T11
		737	U11
		743	N11
		744	N12
		745	N11
		746	O11
		747	N11
		748	O11
		749	N11
		750	O11
		751	O12
		754	N13
		755	O12
		756	O13
		765	M13
		766	M11
		767	M12
		768	M12
		769	M13
		770	M13
		771	M13
		772	M13
		773	M12
		774	N13

-VL-

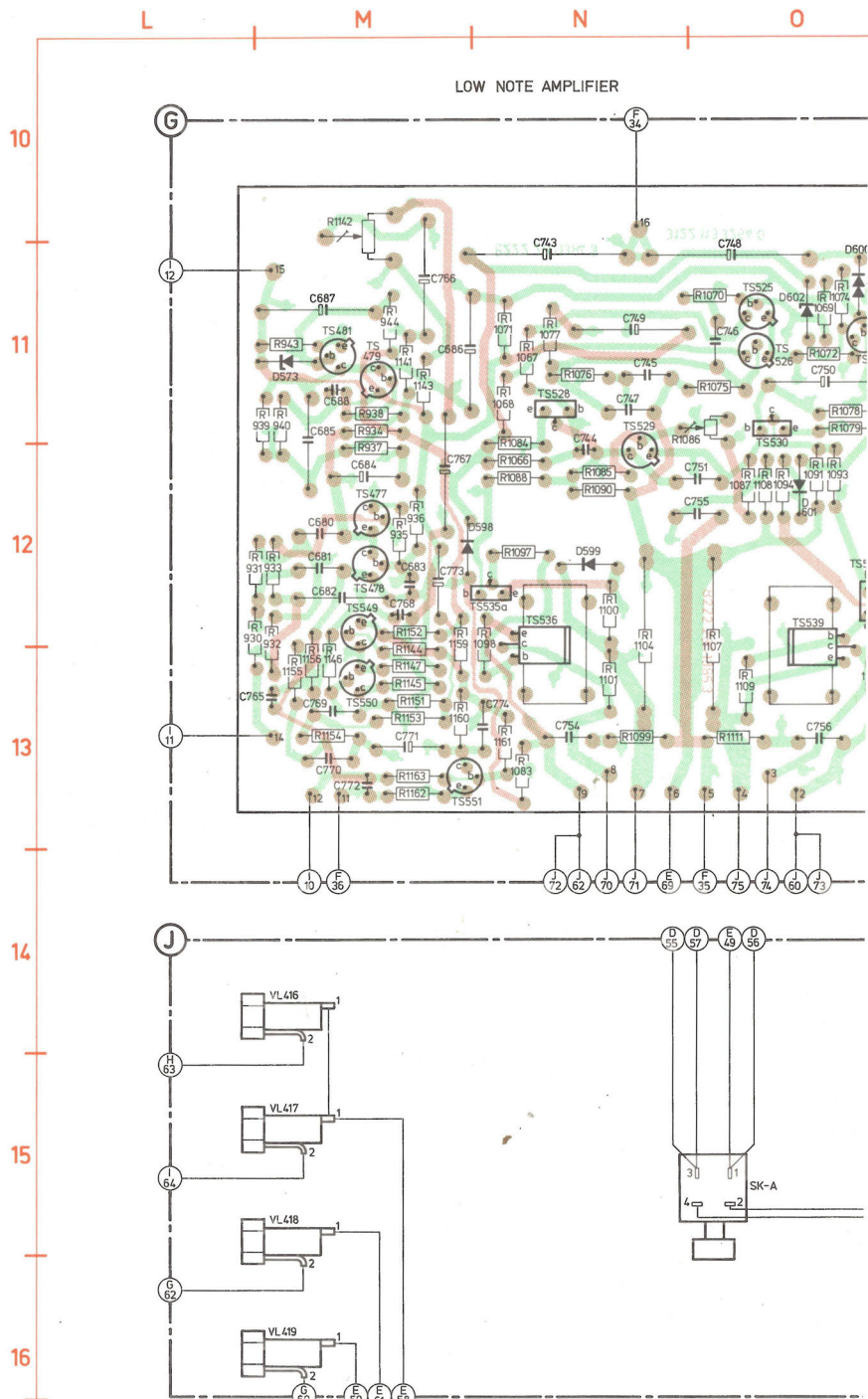
416	M14
417	M15
418	M18
419	M16

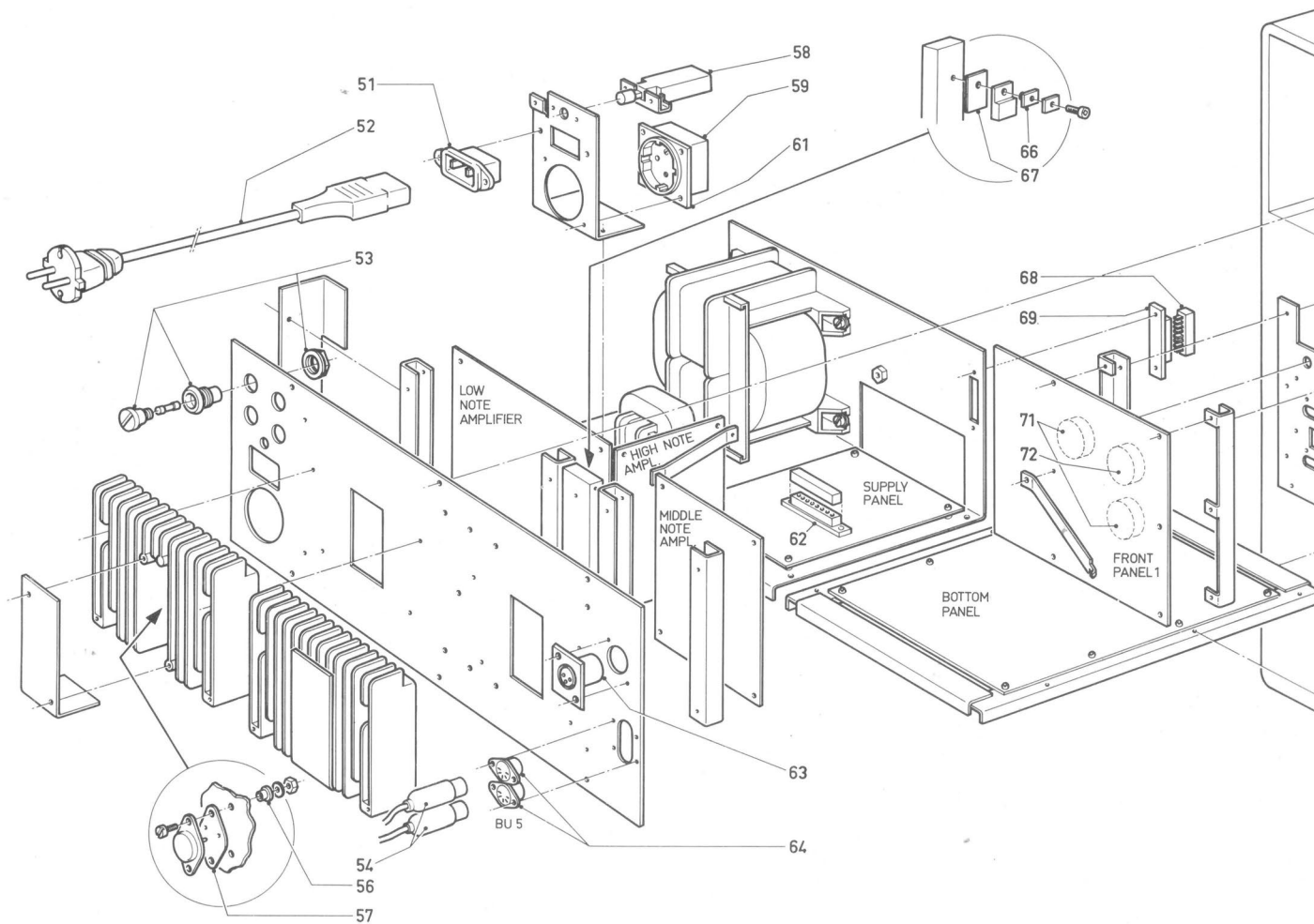
-D-

573	M11
591	Q13
594	T11
595	T11
598	M12
599	N12
600	O11
601	O12
602	O11

-R-

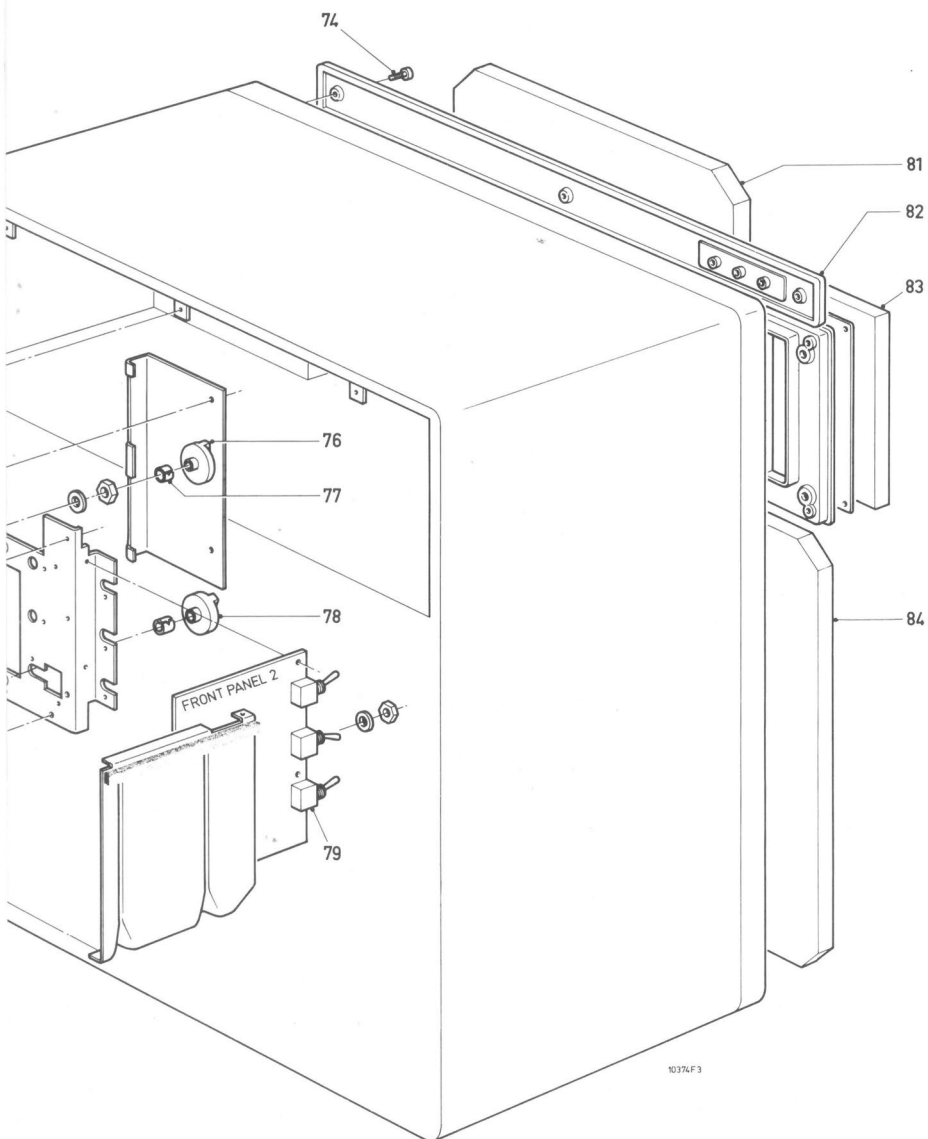
850	S12	976	Q11	997	R12	1027	U12	10
872	T13	977	Q13	998	R12	1028	U12	10
873	T13	978	Q12	999	Q12	1029	U12	10
874	S13	979	Q12	1000	R12	1030	T12	10
875	T13	980	Q11	1002	R12	1031	U12	10
876	T13	981	Q11	1003	R11	1032	U13	10
930	M12	982	Q11	1006	R13	1035	S12	10
931	M12	983	Q11	1007	Q13	1036	T12	10
932	M12	984	Q12	1010	R11	1037	T12	10
933	M12	985	Q12	1011	R12	1038	T12	10
934	M11	986	Q12	1012	Q11	1039	T12	10
935	M12	987	Q12	1019	T12	1040	T12	10
936	M12	988	Q12	1020	T12	1041	U12	10
937	M12	989	P12	1021	T13	1042	U12	10
938	M11	992	Q13	1022	U13	1044	S11	10
939	M11	993	Q13	1023	T13	1045	S12	10
940	M11	994	Q12	1024	T12	1047	U12	10
943	M11	995	R12	1025	T12	1048	U11	10
944	M11	996	R12	1026	U13	1049	S11	10



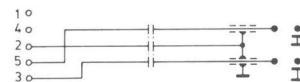
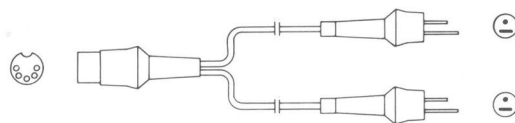


51	4822 265 20113
52	4822 321 10166
52	4822 321 10174 (16R;28R)
53	4822 256 40044
54	4822 264 40023
56	4822 325 80112
57	5322 255 40072
58	4822 276 10564
59	4822 267 30247
61	4822 268 40089
62	4822 267 50221
63	5322 267 40141
64	5322 267 40039
66	4822 532 50991
67	4822 255 40112

68	4822 264 50081
69	4822 267 50206
71	4822 273 30241
72	4822 273 30239
74	4822 502 11141
76	4822 413 50893
77	4822 492 61974
78	4822 413 50894
79	4822 277 10399
81	4822 445 30041
82	4822 333 60147
83	4822 426 40084
84	4822 445 30039

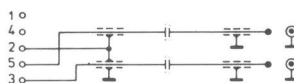
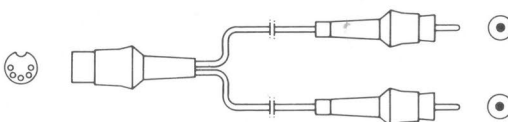


4822 321 20337
0.15 m



5613A

4822 321 20299
0.15 m

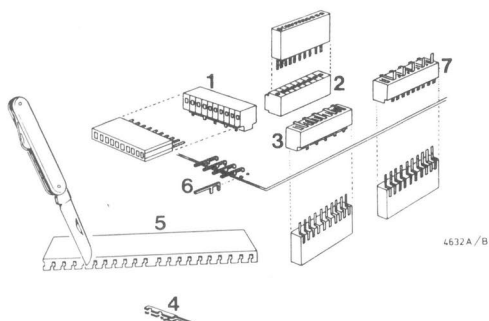


5620A

4822 321 20345
10 m



5622A



- 1 5322 267 64027 (10p)
- 2 4822 267 50209 (10p)
- 4 4822 268 10107
- 5 5322 267 64007 (20p)
- 6 5322 264 54017 (strip)

QA



-R- 			-TS- 		
425	Potmeter 200 kΩ lin.	4822 101 20473	435	BC178B	5322 130 40348
427	Potmeter 20 kΩ log.	4822 101 30317	436,443+445	} BC178A	5322 130 40348
429	Potmeter 20 kΩ lin.	4822 101 90067	463+467, 496,510		
809	5100 Ω	4822 110 60126	437,439,447	} BC178	5322 130 40355
821	Met.film res. 3320 Ω	5322 116 54005	456+460, 477,481,549		
822,847, 1156	Met.film res. 47 kΩ	5322 116 54671	438,550	BC109B	5322 130 40145
832,1075	Met.film res. 10 kΩ	5322 116 54619	448,478,479	} BC108	5322 130 40309
833	1100 Ω	4822 110 60108	490,511, 529,551		
834	Met.film res. 100 kΩ	5322 116 54696	451+453, 470+474	} BC108B	5322 130 40343
843,1153	Met.film res. 470 kΩ	5322 116 54336	488,489,491		
891,900, 908,916, 924,1118, 1126,1134	Met.film res. 2.2 MΩ	4822 110 42196	486	BFW11	5322 130 40408
939,977	Met.film res. 27 kΩ	5322 116 54652	487	BC108C	5322 130 40368
940	Met.film res. 5.6 kΩ	5322 116 54011	497	BC548	4822 130 40938
976	Multiturn potm. 220 Ω	4822 101 90066	560	BD135	5322 130 40645
978	Met.film res. 22 kΩ	5322 116 54003	498,512,556	BC546	4822 130 41001
979,1021	Met.film res. 46 kΩ	5322 116 50557	502a-b, 516a-b	} Pair BD137/BD138	4822 130 40704
982,1019, 1020	Met.film res. 15 kΩ	5322 116 54001	503a-b		
986	Met.film res. 1.5 kΩ	5322 116 54564	517,520	BD138	5322 130 40665
989	Met.film res. 681 Ω	5322 116 54534	525,526	BC107B	5322 130 40332
997	Trimpotm. 1 kΩ	4822 100 10037	518a-b	Pair BD182/BD182	4822 130 40905
1007,1011	W.W.res. 2.6 W 1.5Ω	5322 113 60092	527	BC107	5322 130 40357
1026	Met.film res. 18.2 kΩ	5322 116 54638	528,536,539	BD140	5322 130 40824
1030	Met.film res. 33.2 kΩ	5322 116 54005	530	BD139	5322 130 40823
1031	Met.film res. 26.7 kΩ	5322 116 54578	535a-b	Pair BD139/BD140	4822 130 40849
1032	Trimpotm. 220 Ω	4822 101 10046	537a-b	Pair 2-BD183	4822 130 41089
1040	Trimpotm. 2200 Ω	4822 100 10029	544+546	BCY59X	5322 130 44453
1054,1057, 1104,1107	W.W.res. 2.6 W,0.39Ω	5322 113 60093	555	BD137	5322 130 40664
1071	9100 Ω - 1/3 W	4822 110 60133	-C- 		
1077	Met.film res. 100 Ω	5322 116 54469	631	Micropoco 2N2 1%	4822 121 50415
1086	Trimpotm. 2.2 kΩ	4822 100 10029	633	Micropoco 1N 2%	4822 121 50424
1125,1133	4300 Ω - 1/3 W	4822 110 60124	635,647	Micropoco 10N 1%	5322 121 54154
1142	Trimpotm. 10 kΩ	4822 101 10021	636	Micropoco 3N6 1%	4822 121 50543
1160	Met.film res. 8.2 kΩ	5322 116 54558	646	Micropoco 12N 1%	4822 121 54162
1162	Met.film res. 1 kΩ	5322 116 54549	648	Micropoco 1N2 1%	5322 121 50438
1187	VDR	4822 116 21038	682	Micropoco 15N 2%	5322 121 54152
-D- 			685	Micropoco 30N 1%	4822 121 50606
567,568	BZX79/C12	5322 130 34197	705+707	Micropoco 4N7 1%	4822 121 50539
570	BZX75/C2V1	5322 130 34049	709	Micropoco 1N 1%	4822 121 50566
571	BZX79/C9V1	5322 130 34165	710	Micropoco 3N9 2%	4822 121 50091
573	BZX79/C6V8	5322 130 30768	716	Elco 680 μF-63 V	5322 124 74017
576 ÷ 578, 580,581	} BAW62	5322 130 30613	725+727	Micropoco 22N 1%	4822 121 50609
582,591, 594,595, 599, 604 ÷ 609			736	Elco 1500 μF-63V	4822 124 70246
579			777,778	Elco 2x3400 μF-40V	4822 124 70315
583,598,601			778	Elco 2x2350 μF-63V	4822 124 70198
585 ÷ 587			-S- 		
600	BZX75/C1V4	5322 130 34047	403	Mains transformer 1	4822 146 70032
602	BZX79/C36	5322 130 34098	405	Mains transformer 2	4822 146 20515
612	BZX79/C27	5322 130 34148	401	Input transformer	4822 146 20516
615	BZX79/C20	5322 130 30699	411	Speaker AD0162/T8	4822 240 70015
616,617	B80C5500-3300	4822 130 50311	412	Speaker AD0210/SQ4	4822 240 50103
618	BY164	5322 130 30414	413	Speaker AD12100/MFB4	4822 240 60076
-Miscellaneous-			620	Coil 60 mH	4822 156 10346
Re407	Relais	4822 280 70157			
VL416	Fuse 1 A slow	4822 253 30021			
VL417	Fuse 2.5A slow	4822 253 30026			
VL418,419	Fuse 3.15A slow	4822 253 30027			
VLa,b,c	Transformerfuse	4822 252 20001			

- Correction to service manual

C774 has to be deleted from the dotted and components print sides.

- Transformer S405 (for /00R/16R/28R) is now available under service codenumber 4822 146 20522. Transformers for /00R/16R/28R formerly supplied under codenumber 4822 146 20515, however, are usable, provided the factory code is 3122 138 2425.

Now, under codenumber 4822 146 20515 transformer S405 for the /44R is supplied.

- The cover frame, between items 82 and 84 in the exploded view, is now available under codenumber 4822 445 30044.
- To prevent instability, R1145 and R1146 have been changed to 100Ω 1/8 W, effective from factory code PL01.
- To prevent mechanical hum, two distance pieces have been added, from factory code PL02.

Dimensions: length: $17 \pm 0,5$ mm
inner dia : $5,5 \pm 0,1$ mm
outer dia : $7 \pm 0,1$ mm

Transformer S403 is now fitted to the wooden partition by means of two screws and the two distance pieces. These pieces fit in the holes of the partition, which have been enlarged for this purpose. The metal strip need not be glued on the partition any more.

- To improve the design, R1159 has been changed to $5,6 \text{ k}\Omega$ 1/8 W and R1163 to $15 \text{ k}\Omega$ 1/8 W, effective from PL03.
- To facilitate readjustments, potentiometer R976 has been changed to 470Ω (4822 101 90077) and R983 to 150Ω 1/8 W from PL04.

- To ensure that rattle is not made audible via the input of the amplifier, the supply voltage for the LED's (D585, D586, D587) is now taken from junction R1180-R1181.

- To prevent instability symptoms, some components have been changed, effective from PL05

C709 is now $5,6 \text{ nF}$ flat cap

R984 has been changed to $1,8 \text{ k}\Omega$ 1/8 W

R1025 has been changed to $2,2 \text{ k}\Omega$ 1/8 W

- To protect the bass speaker from DC-voltage (which may happen if one of the output transistors is short-circuited), a safety circuit has been added (from start production in /44R and also from PL05 in the other versions), located on a separate print (Figs. 3 and 5). As a result, also some other prints have been changed (Figs. 3 and 4). With this safety circuit is achieved that SK-Re40B cuts-off if a positive or negative DC-voltage appears at point A.

Moreover, a delay is built-in on the new print to suppress switch clicks of the amplifier.

The following components have been cancelled:

C687, D573, R944, TS481 and the cooling bracket of TS555.

The following components have been changed:

R1185 to $2,2 \text{ k}\Omega$ 1/8 W

R1180 to 180Ω 0,5 W

R1173 to $2,2 \text{ k}\Omega$ 1/8 W

R1170 to 39Ω 1/8 W

TS491 to BC107B (5322 130 40332)

C797 to $330 \mu\text{F}$ - 63 V

R943 to $22 \text{ k}\Omega$ 1/8 W

R963 to $4,3 \text{ k}\Omega$ 1/8 W

R970 to $2,2 \text{ k}\Omega$ 1,15 W

Codenumbers of new components:

Re 408 - 4822 280 60437

TS557,558 - BC546 - 4822 130 41001

D592,593,596,597,603 - BAW62 - 5322 130 30613

Diode D602 has been relocated, namely in parallel across C749.

To ensure that the signal in case of overload of the loudspeakers is attenuated for a longer period, D605, D607, D609 have been replaced with resistors of $22 \text{ k}\Omega$ 1/8 W and R1120, R1128 and R1136 have been changed to $470 \text{ k}\Omega$ 1/8 W.

- For safety reasons, the following components have to be mounted at a certain distance from the print:

R1097, R1099, R1108, R1110, R1111, R1044, R1048, R1058, R1060, R1003, R1170, R1180, C647, C648, C725, C726, C727, C682, C685, C631, C633, C635, C636, C705, C706, C707, C709, C710.

- To make switch-over of the input impedance possible, from start production in /44R and from PL06 in the other versions, switch SK-K (4822 278 90303), R810,811 (510Ω - 5322 116 54525) and disc A (4822 532 60643) have been added, see Figs. 1, 2, and 3).

Disc A is slid on the spindle of R425, so that this spindle had to be flattened over a greater length. The input impedance has now become:

$100 \text{ k}\Omega$ at 1 kHz with R425 in preamplifier position

$1 \text{ k}\Omega$ at 1 kHz with R425 in poweramplifier position

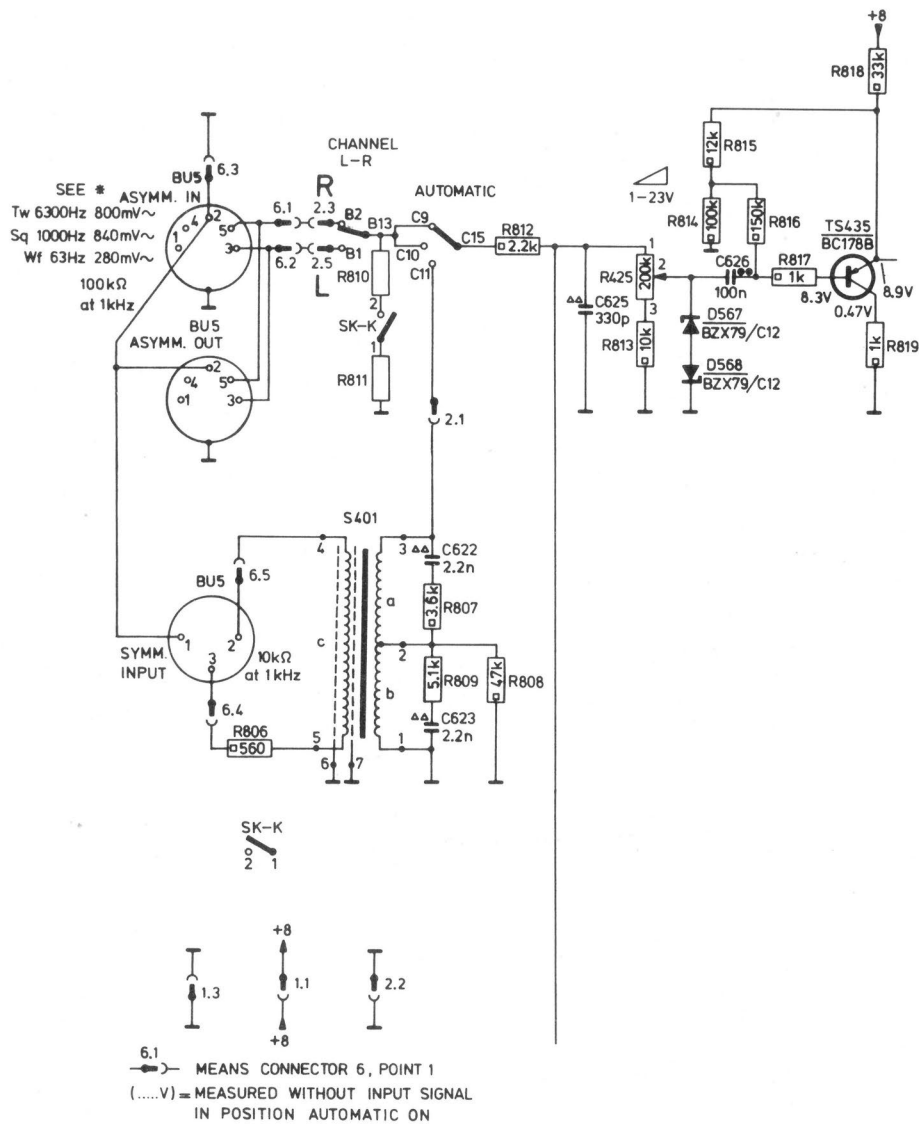
- For /44R only:

For safety reasons, the following changes have been effected from start production (see Figs 6 and 7):

- Added VL420 (0,5 A/125 V), code 4822 253 50047). Codenumber of the suitable fuse holder: 4822 256 30152

- Added VL415 (5 A/125 V), code 5322 253 54007.

- Relay Re407 and R1187 are not located on the supply panel any more, but on the metal plate on which also transformer S403 sits. Codenumber of Re407: 4822 280 80382.



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Fig. 1

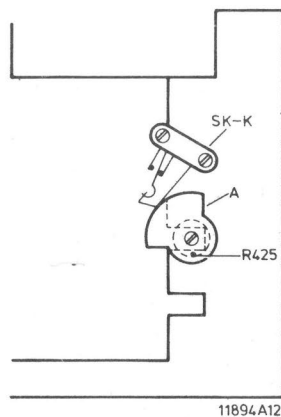
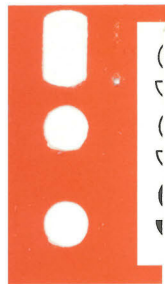


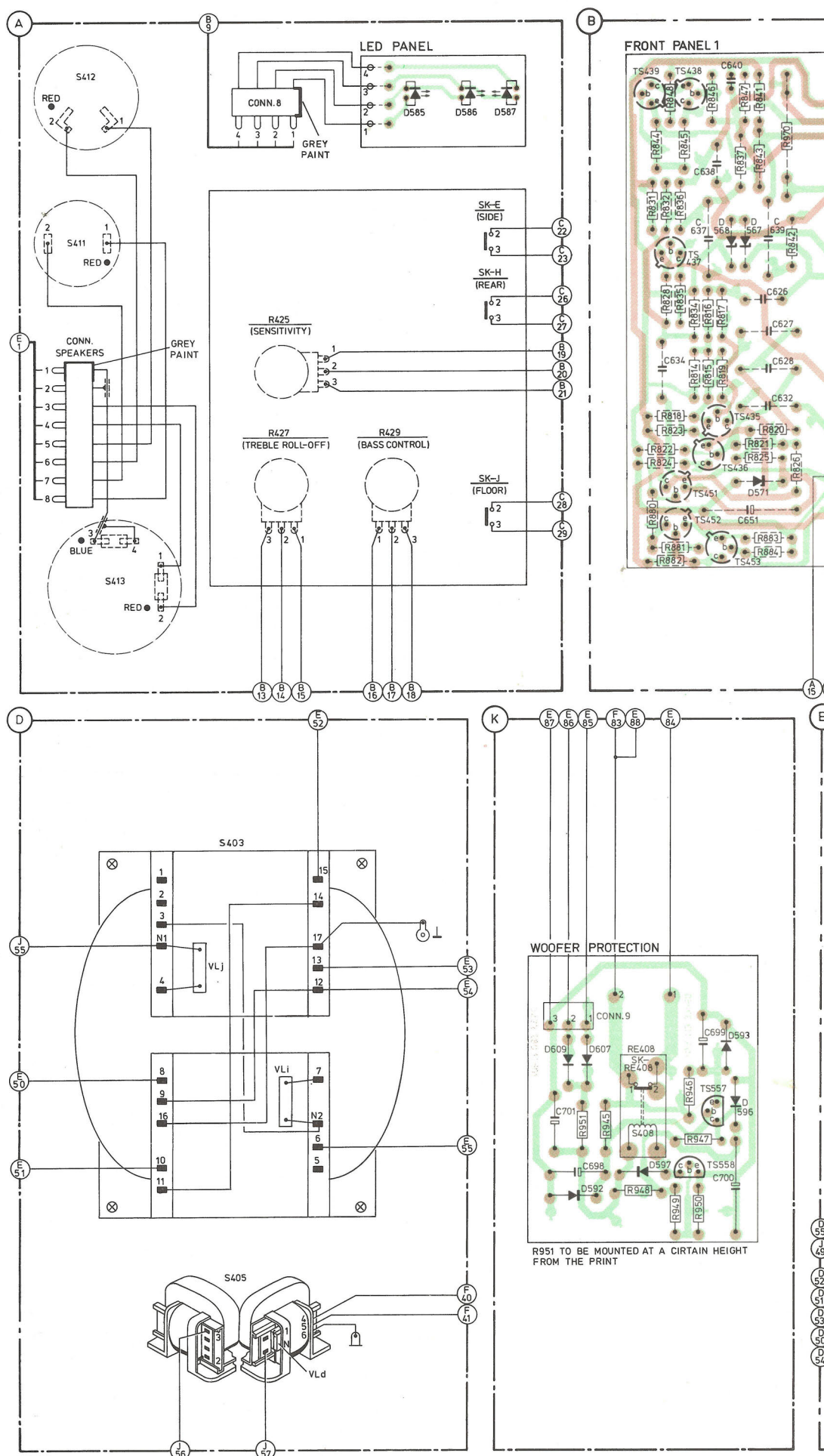
Fig. 2

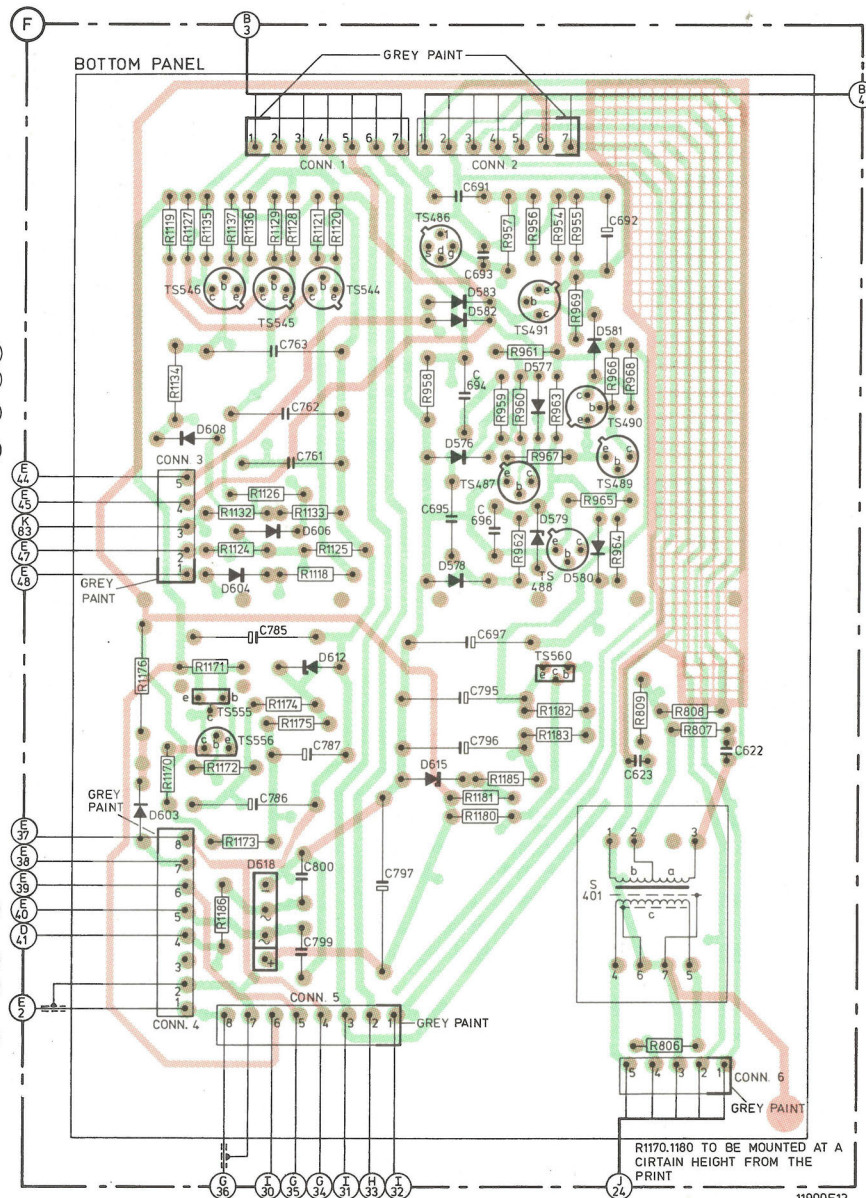
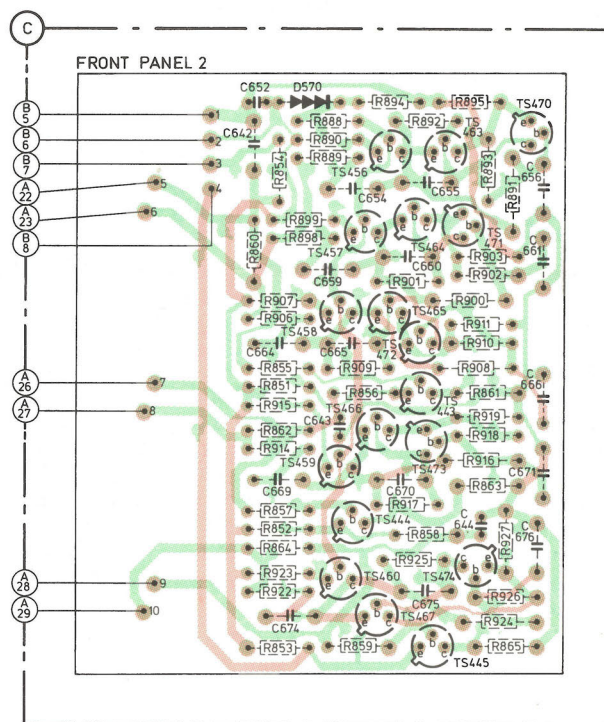


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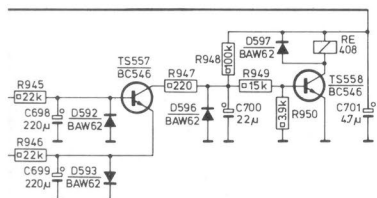
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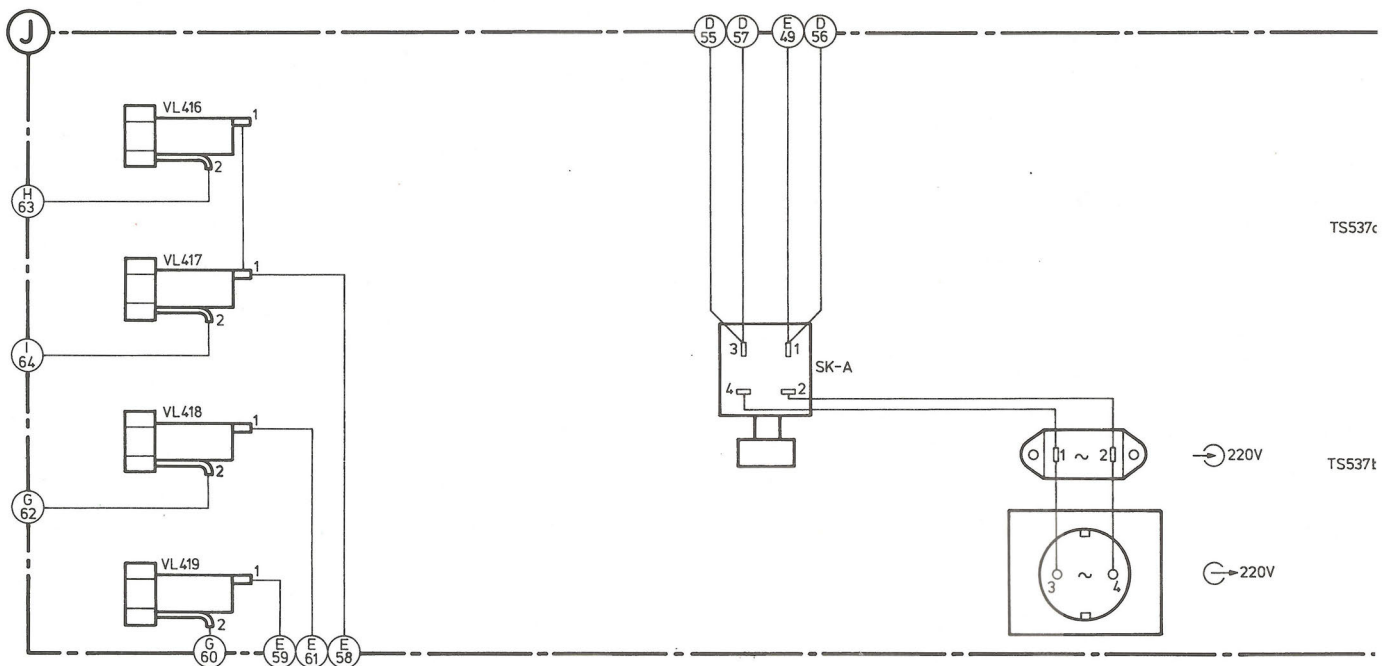
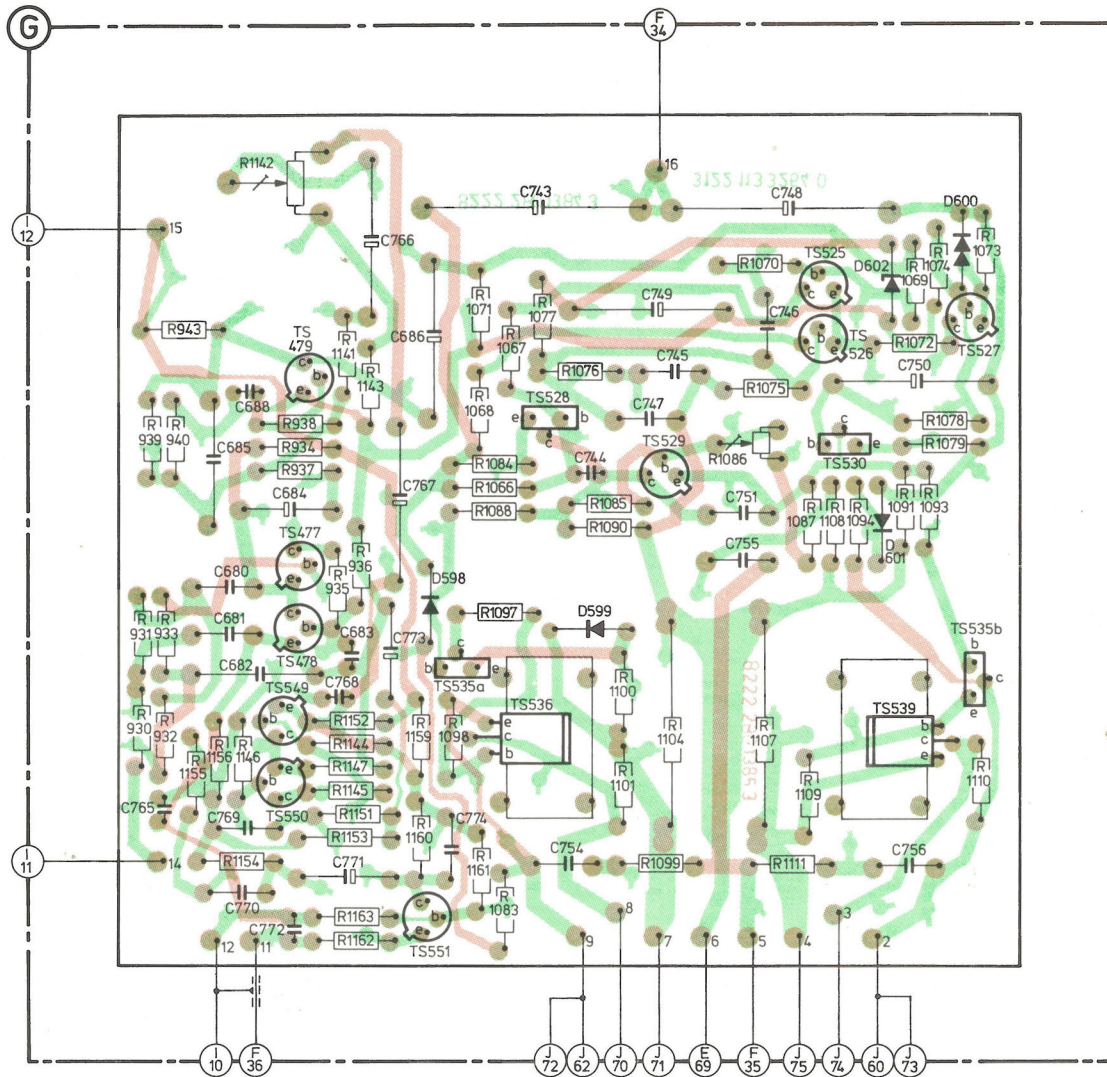


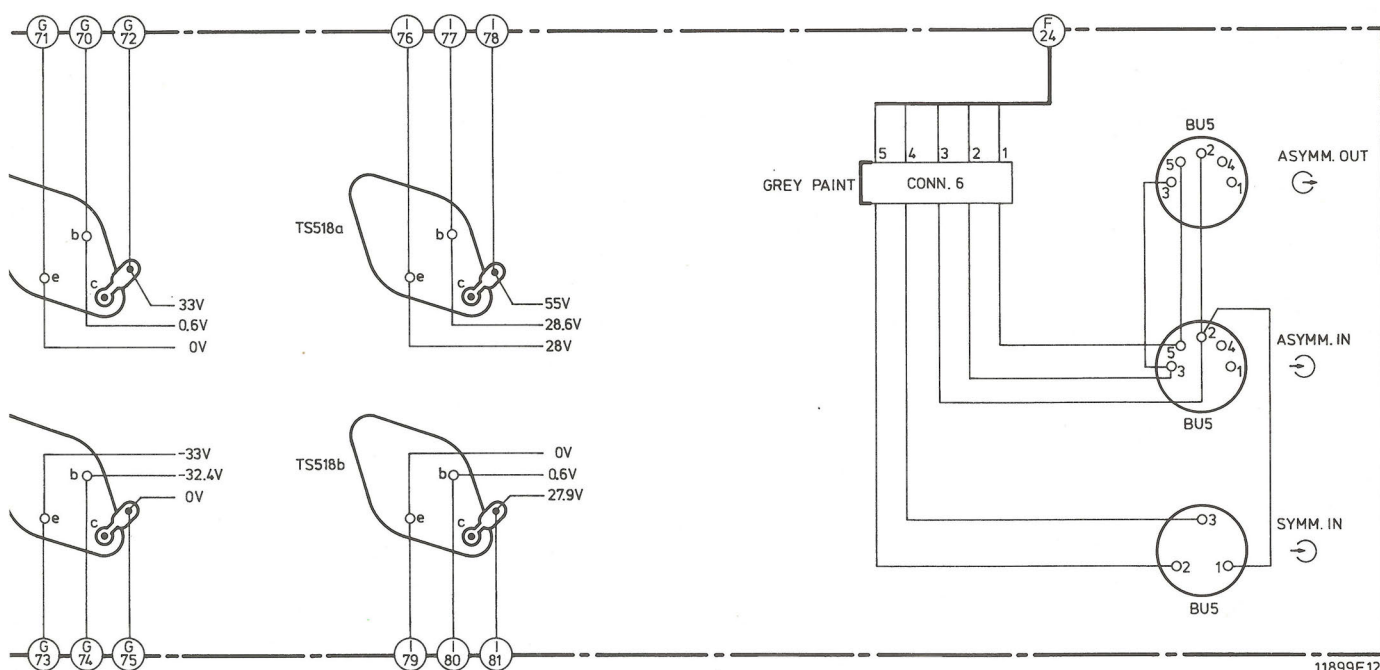




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LOW NOTE AMPLIFIER





- Correction to A77-208

Please read: "transformers for /00R/16R/28R formerly supplied under code number 4822 146 20515, however, are usable, provided the factory code is 3122 138 34250".

- From the introduction of the DC-protection relay Re408 has been changed to 4822 280 60399.

Reason: The control voltage of the old relay was too critical.

- To be added in service manual

For safety reasons the following components are mounted in raised positions:

R951, R994, R1003, R1012, R1037, R1044, R1048, R1058, R1060, R1083, R1094, R1097, R1099, R1108, R1110, R1111, R1170, R1180, R1186.

The following resistors are safety resistors:

R951 - 220 Ω - 4822 111 30415
R994 - 56 Ω - 4822 111 30412
R1037 - 68 Ω - 4822 111 30426
R1094 - 150 Ω - 4822 111 30406
R1170 - 39 Ω - 4822 111 30409
R1180 - 180 Ω - 4822 111 30159
R1186 - 10 Ω - 4822 111 30405

Already published: A76-243, A77-208, A77-234.

For commercial reasons, the tweeter type AD0162/T8 and the squawker type AD0210/SQ4 have been replaced with types AD0163/T8 and AD0211/SQ4 resp. The two squawkers are interchangeable. For service purposes type AD0210/SQ4 is supplied. After depletion of the stock it will become AD0211/SQ4, both under the same code-number 4822 240 50103.

For this MFB-box, the two tweeters are not interchangeable.

The characteristic of the new AD0163/T8 is slightly different from that of the AD0162/T8. Therefore, the capacitors C705, 706 and 707 have also been changed from 4,7 nF to 3,9 nF (4822 121 50091).

These capacitors are fitted on the high-note amplifier print.

The new special tweeter AD0163/T8 is available under code 4822 240 70022.

These changes are effective from factory code PL07.