



Siemens/Klangfilm Postwar Cinema Amplifiers (W-Germany and Austria)

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The name "Klangfilm" stands for Siemens' famous cinema/theater range. Klangfilm directly translated means "the sound of cinema" or the "sound of the film". Siemens produced some of the most sought after power amplifiers and speakers, as well as some remarkable preamplifiers and mixers.

Made in W-Germany were the models: KL-401, KL-402a, KL-403a, KL-502a, KL-408a, KL-203/4 and the KL-V-410. There are other models, but they are ELA amps, using only 100 ohms output transformers and so not useful for the average audio enthusiast.

Made in Austria is the model KL-5418, there might be more Austrian models but in more than fifteen years research, this is the only one I came across, and I could not find any literature on this model.

Klangfilm used only three power tubes, the EF-12 (just after the war, which is a small version of the EL-156, and sounds very smooth and beautiful, if made by Telefunken); the German professional F2a11, and later the EL-34. The driver tubes were the EF-12, an early version of the famous EF-804 (very similar to the EF-86, but far superior); later the ECC-40, an early version of the ECC-82 (12AU7) and then the ECC-83. Rectifiers were the EZ-12 and, later, the GZ-34.

All amplifiers were designed for cinema use, which means that the ultra-sensitive inputs should not be used for home audio. It is a shame that one cannot make use of the outstanding input transformers, but... they can be used for other designs! Most users just connect the input to the grid of the 2nd, or if less gain is needed, even to the grid of the 3rd of the drivers. An input resistor in the region of 1 Kohms in series to the grid and a 100-220 picofarad C will

be all that is needed to suppress high frequency disturbances or oscillation.

With some luck one might find an old pair of matching input transformers and to use for balanced input. But beware, it is better stick with the simple "grid" entry, instead of using a bad transformer.

The heart of these amplifiers are their outstanding output transformers, which nobody can wind anymore with this quality. All parts are first class, it is not recommended to modify too much, and most of the electrolytic condensers will work for many years. In the early KL-401a only paper-in-oil condensers are used. These sadly can dry out, and it is recommended to replace them with similar types.

The build quality is typical W-German, Mercedes like, long lasting and precision mechanics, best parts quality: Siemens ceramic insulated silver foil coupling-C's (!!!), MP or paper-in-oil C's, etc., will be found as a standard! Tube rectification with highest quality chokes is standard, the power transformers are oversized, use the best materials and are usually 110/120/220/240 volts, 50/60 Hz.

All tubes can still be found easily, only the F2a11 is expensive, but then it is a professional long life tube and shall last at least 8000 hours, if matched pairs are used. Very important: do not use cheap EL-34's! Only original Telefunken, Valvo's (which are also sold under Philips, Miniwatt, Siemens, Amperex, and yes... also the famous Mullard was made by Philips Valvo in Holland!) must be used for full potential. Do not use the E-German EL-12 (also EL-12N) made by Huges, it is inferior! The best is the Telefunken, the stronger EL-12/325 and EL-12/375 can take higher plate voltages and are suited as well.

As the F2a11 (and the F2a, which just has a different base) are such extraordinary

pentodes, which cannot be found elsewhere, I decided to have the data here as well:

Type	Longlife prof. Tetrode
Filament	6.3V/2A (indirectly heated)
Platevolt.	250V
Platecurrent	97 mA
Max platevolt	425 V (some books suggest 600V max.!))
Gridvolt	250V (max. 425 V)
Neg. gridvolt	-19V
Platedissip.	30W

The way this tetrode is built makes it perfect for triode configurations. It sounds extremely natural if applied correctly, even in a non-triode circuit!

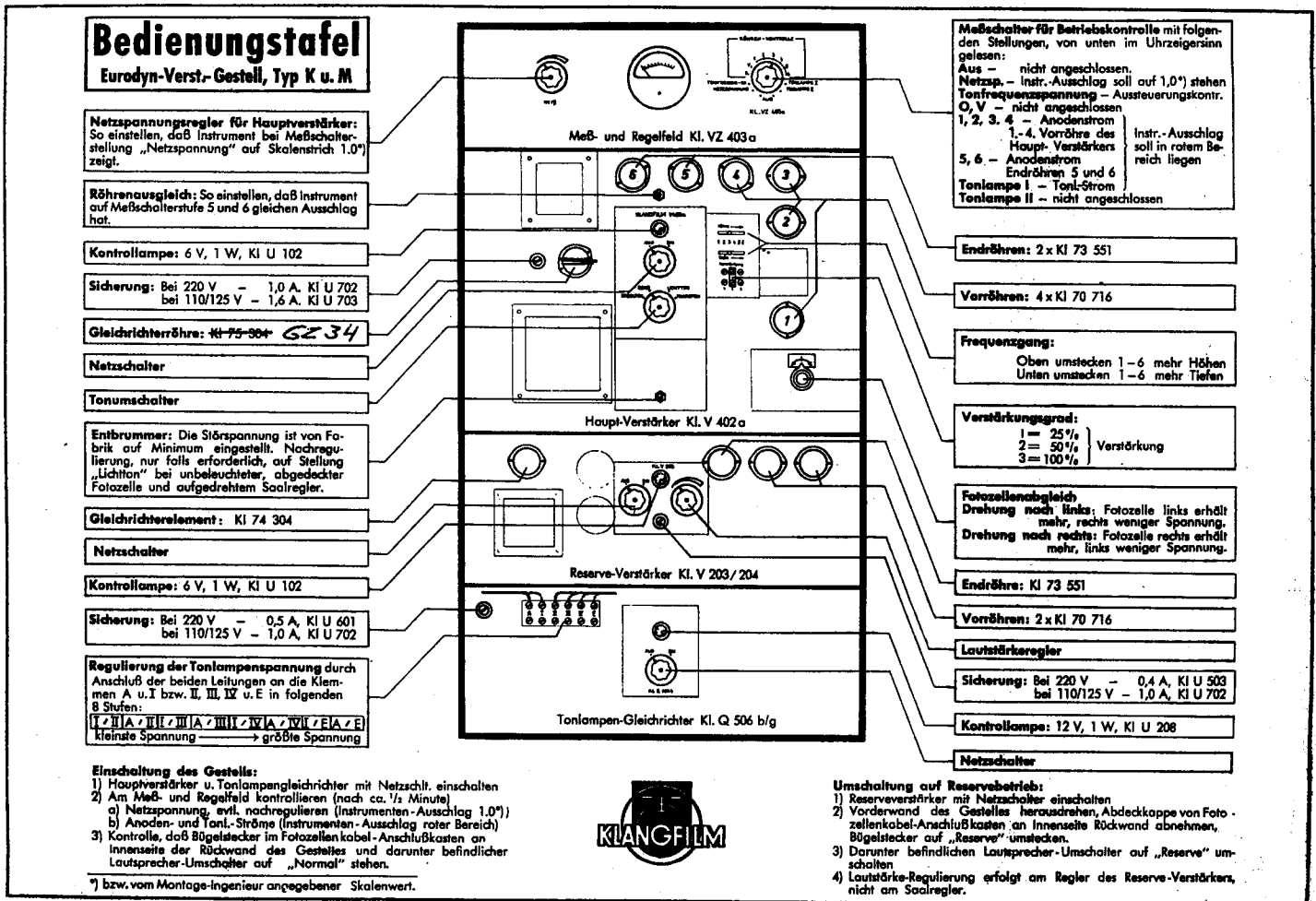
IMPORTANT: Klangfilm used a Klangfilm code for most of their tubes, starting with a KL like for the other units. For the postwar amps we have the most important codes: (prewar codes will be shown in part II!)

KL-70715	= EF-12
KL-70716	= EF-12k
(k stands for "klirrarm" = low noise)	
KL-73550	= EF-12
KL-73551	= F2a11
KL-76303	= RGN 2504

Tubes used in the later models like the EF-40, ECC-83, EL-34, GZ-34 have no KL code!

The KL-401a: This unit is made with a cast frame and is very heavy (about 60 lbs.). Four EF-12's are used, and a special tone control unit (volume, bass and treble) can be plugged into the circuit between the input tube and the 3rd stage (not advised for best performance). Without the tone control unit it is easiest to use the grid of the 3rd EF-12 as the input (V-3). The rectification is done with the EZ-12, a very common rectifier used in German studio and cinema technique, and in early models with the RGN-2504, which is in its mesh plate versions together with the RGN-2004 the very best rectifier I ever heard.

We find paper-in-oil condensers throughout the whole circuit and a wonderful output transformer with 15 ohms and 200 ohms. 200 ohms were not needed for ELA speakers, but for some special Siemens speakers which will be introduced in a later part. The EF-12/375's in the PP output stage are triode connected (without the usual 100 ohms resistor, the screen grid is directly connected to the plate!)



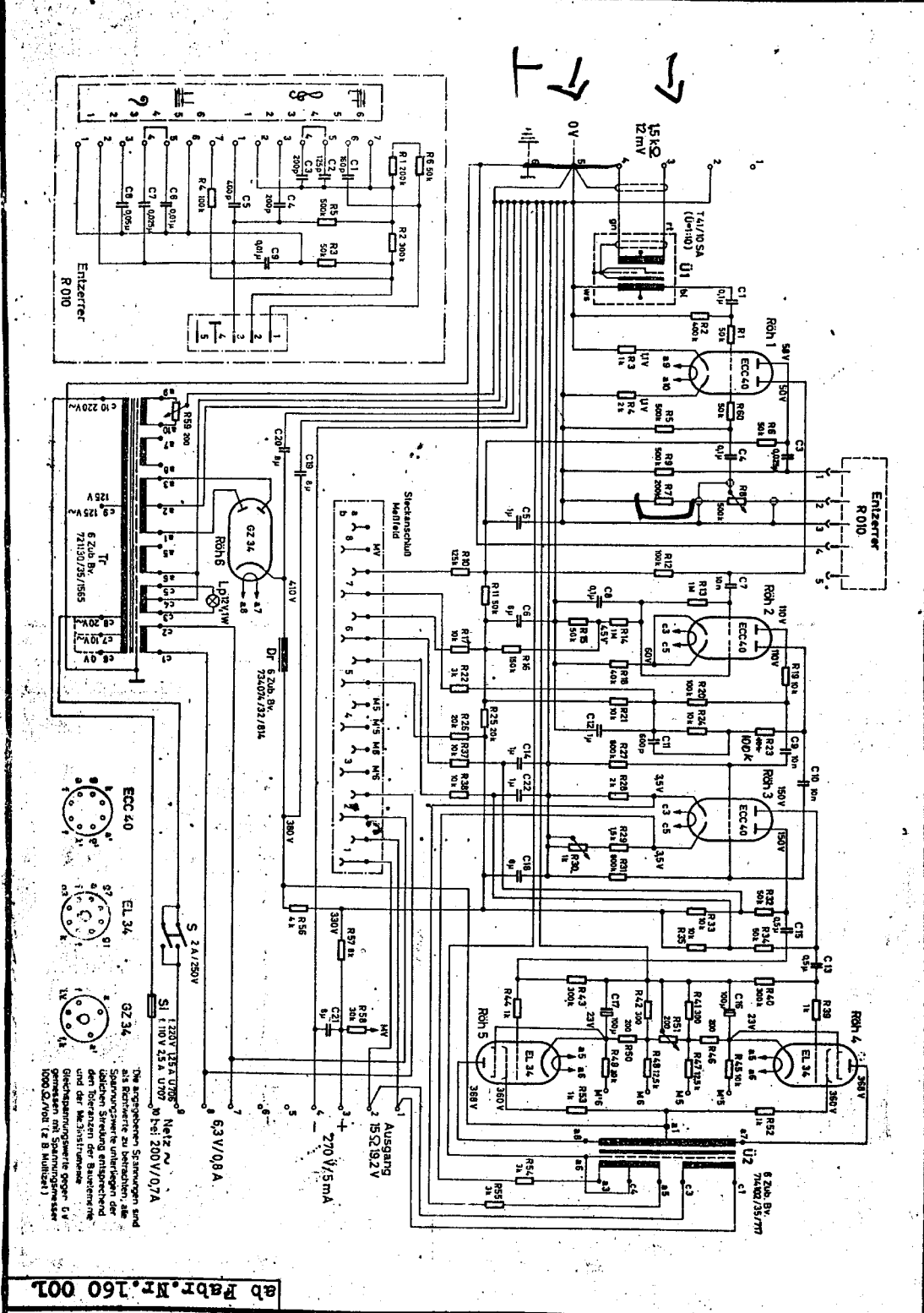
The KL-402a and 403a (identical): These amps are nearly the same in circuitry as the 401a, but use precision welded galvanized steel sheets in the case and are 19" rack-mount (like all amps built after the 401's). Instead of the EZ-12 the GZ-34 is used as a rectifier and a better tone control unit is used (if needed). MP-condensers replace the paper-in-oils (and are still better than all MKP's or electrolytic C's!) and we find Siemens silver foil coupling C's. I compared this amp with the famous Marantz 9's. The KL-403's outperformed the Marantz with ease! I am not kidding! Even the KL-502a, after modified to triode connection of its EL-34's did. The KL-403 is on the same level as the famous WE-86, and this means something as it does not use 300B's. It is as dynamic and immediate, a little less euphonic and with more clarity and speed. A fantastic amp. And built to last forever. And... the price is about 40% of the Marantz Model 9).

The KL-502a: This amp uses the well-known EL-34 and is in my ears the very best EL-34 amp ever built, if triode con-

nected (connect each screen grid of each EL-34 via 100 ohms on the plate and only use "real" EL-34's as mentioned before). It

outperformed the Marantz 9 with ease, and is very close in its sonic signature to the KL-403a. The driver/input tubes are





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1	Metallpapierkondensator	C20	8	uF	
1	"	C21	8	uF	
1	"	C22	0,25	uF	
1	"	C23	0,25	uF	
1	"	C24	16	uF	
1	"	C25	16	uF	
1	"	C26	0	uF	
1	Metallpapierkondensator	C27	0,25	uF	
1	"	C28	8	uF	
1	"	C29	8	uF	
1	"	C30	8	uF	
1	"	C31	8	uF	
1	Entzerrer komplett		Kl. V 403 a Tz. 3		
1	Netztransformator	Tr1	Kf.Bv. 2509/00		
1	Eingangüberträger	Ue1	Kl. U 060		
1	Ausgangüberträger	Ue2	Kf.Bv. 2306/00		
1	Drossel	Dr	Funk.Bv. 2404/		
1	Signallampe	Sl	6 V, 1-W, Kl. U 102		
1	Schalter	S 1			
1	Schalter	S 2			
1	Sicherung	Sl	1,0 A, Kl. U 702		
1	Sicherung (Beipack)	Sl	1,6 A, Kl. U 703		

1	Schichtwiderstand	R44	100	KOhm	
1	"	R45	100	KOhm	
1	Drahtwiderstand	R46	300	Ohm	
1	"	R47	300	Ohm	
1	Drahtdrehwiderstand	R48	200	Ohm	
1	Schichtwiderstand	R49	5	KOhm	
1	"	R50	5	KOhm	
1	Drahtwiderstand	R51	180	Ohm	
1	"	R52	180	Ohm	
1	Schichtwiderstand	R53	10	KOhm	
1	"	R54	10	KOhm	
1	"	R55	10	KOhm	
1	"	R56	10	KOhm	
1	"	R57	50	KOhm	
1	"	R58	5	KOhm	
1	Drahtdrehwiderstand	R59	200	Ohm	
1	Schichtwiderstand	R60	100	Ohm	
1	"	R61	100	Ohm	
1	Papierkondensator	C1	0,025	uF	
1	"	C 2	0,025	uF	
1	Metallpapierkondensator	C 3	1	uF	
1	"	C 4	1	uF	
1	"	C 5	0,25	uF	
1	"	C 6	0,25	uF	
1	"	C 7	6	uF	
1	Keramik-Kondensator	C 8	100	pF	
1	Metallpapierkondensator	C 9	1	uF	
1	"	C10	2	uF	
1	Papierkondensator	C12	0,025	uF	
1	Metallpapierkondensator	C13	8	uF	
1	"	C14	1	uF	
1	"	C15	8	uF	
1	"	C16	1	uF	
1	"	C17	8	uF	
1	"	C18	1	uF	
1	"	C19	0,25	uF	

1	Schichtwiderstand	R 1	1	KOhm	
1	"	R 2	2	KOhm	
1	"	R 3	1	KOhm	
1	"	R 4	1	KOhm	
1	"	R 5	2	KOhm	
1	"	R 6	1	KOhm	
1	"	R 7	3	KOhm	
1	"	R 8	3	KOhm	
1	"	R 9	250	KOhm	
1	"	R10	1	KOhm	
1	"	R11	100	KOhm	
1	"	R12	500	KOhm	
1	Schichtdrehwiderstand	R13	500	KOhm	
1	Schichtwiderstand	R14	30	KOhm	
1	"	R15	100	KOhm	
1	"	R16	2	KOhm	
1	"	R17	30	KOhm	
1	"	R18	50	KOhm	
1	"	R19	60	KOhm	
1	"	R20	50	KOhm	
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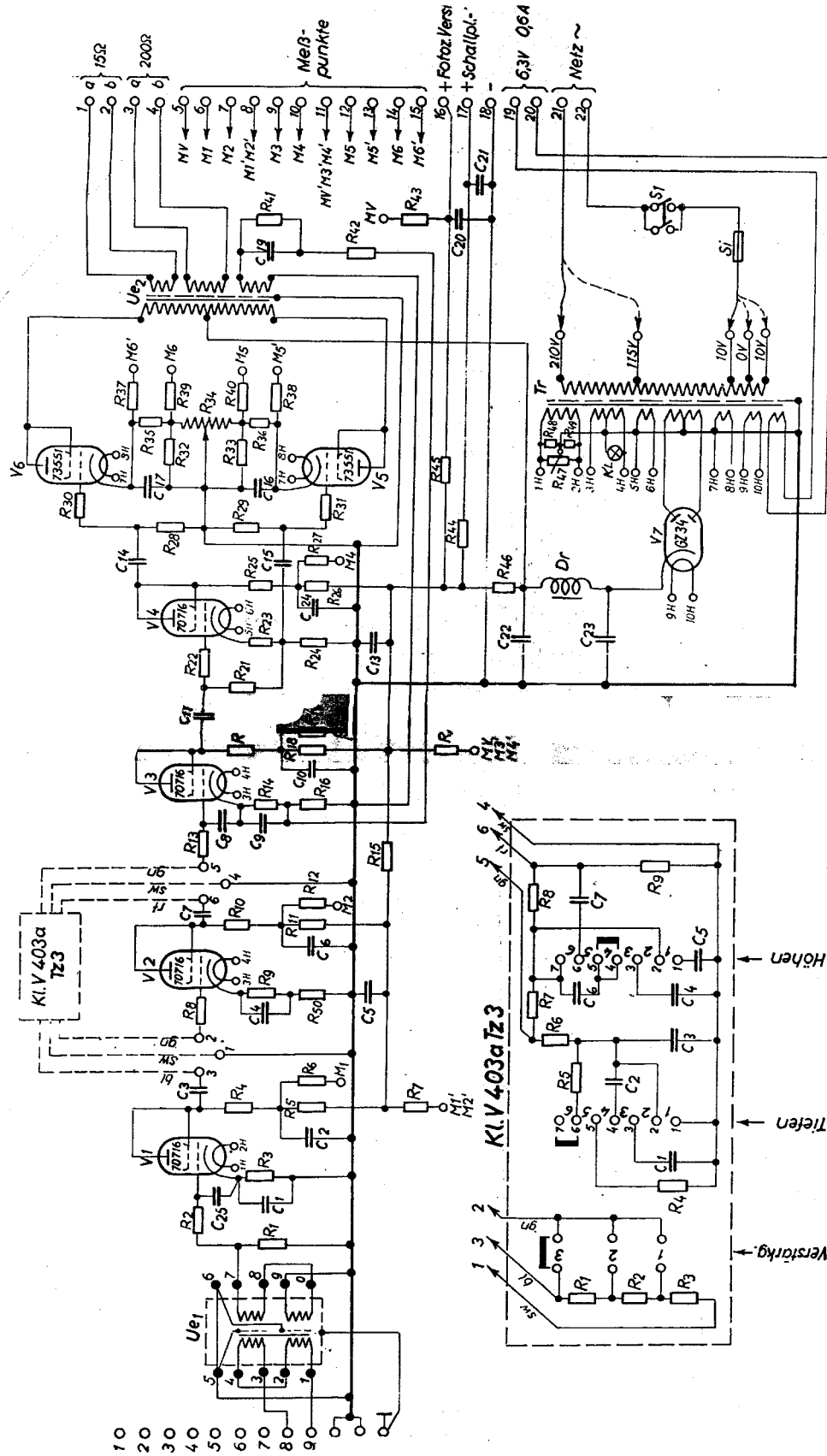
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Konstr.	13. 4. 51	Klangfilm G. m. b. H.	
Geprüft			
Normgepr.			
Stückliste für Verstärker		Kl. V 402 a Blatt 1	
Nicht für die Fabrikation! (3 Blätter)		Ersatz für: Ersatz durch:	

1	Schichtwiderstand	R 1	100	K Ohm	
1	"	R 2	50	K Ohm	
1	"	R 3	50	K Ohm	
1	"	R 4	200	K Ohm	
1	"	R 5	500	K Ohm	
1	"	R 6	100	K Ohm	
1	"	R 7	200	K Ohm	
1	"	R 8	300	K Ohm	
1	"	R 9	1	M Ohm	
1	Papierkondensator	C 1	0,02	uF 250	
1	"	C 2	0,02	uF 250	
1	"	C 3	2500	pF 250	
1	Kunstfolien-Kondensator	C 4	150	pF 250	
1	"	C 5	300	pF 250	
1	"	C 6	100	pF 250	
1	Kunstfolien-Kondensator	C 7	250	pF 250	

Stückzahl	Bezeichnung	Teil	Zeichn. Norm	Bemerkung
Nr.	Art der Änderung	Tag	Name	Nr. Art der Änderung Tag Name

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Konstr.	28. 5. 1951	Klangfilm G. m. b. H.	
Geprüft			
Normgepr.			
Stückliste zum Entzerrerkasten (s. Kl. V 402a/403a/pri)		Kl. V 403 a Tz. 3	
Nicht für die Fabrikation!		Ersatz für: Ersatz durch:	



Firmen-Nr.		6 Kl.V. 403a		402a (401a)	
Name		COX			
Tag		29.3.51			
Baujahr		1951			
Mitarbeiter		Klangfilm G.m.b.H.		Ersatz für	
Benennung		Kino-Verstärker			
Mitarbeiter					

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- Verzeichnis:
 2 x 6X4 Techn.
 2 x 6X4 2V
 1 x 7Pr
 1 x Kl. V. 403a

the ECC-40's (3) the rectifier is the GZ-34. Best parts are used as in the KL-403.

The KL-408a: This was an amplifier built for smaller cinemas, and it is not on par with the models mentioned before, which does not mean that it does not sound good. It sounds pretty close to the Marantz Model 8b, and it is a matter of taste (as always) which one sounds better. There are two inputs which can be used, a 500 Kohms unbalanced and a balanced 3 Kohms using a very good permalloy input transformer. Again, this amp sounds best when the EL-34's are triode connected as described before. Sadly the C's in the PS are electrolytic types, but at least of good Siemens or Bosch quality. Check them and if you can, replace with MP's. The rectifier is again the GZ-34. Build quality is otherwise on the same level as the others.

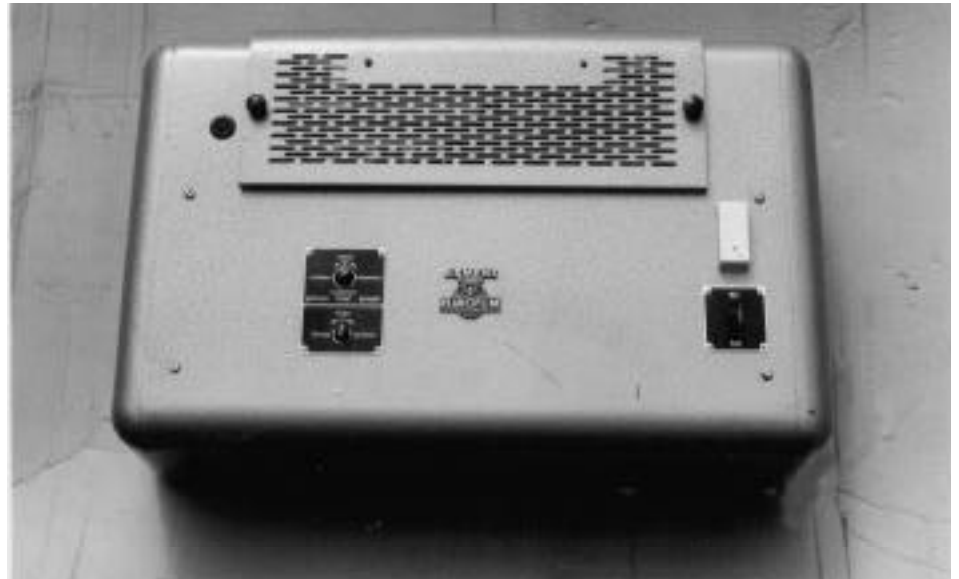
Now we come to the most sought after KL-amps, the KL-203/204 and the later KL-V-410 amps, which are so called "Reserve Verstärker" which means amps for emergency. Well, they are by no means cheaply built amps, only the power output is low, as they are single ended pentode amps (F2a11 SE) and produce therefore only about 7 watts, but they are very, very clean watts. But these amps are overrated! They are not on the same level as the others with the exception of the KL-408a, which are outperformed with more attack, clarity and "being there", which is typical for single ended designs.

We finish Part I with the KL-5418, which was made by the Austrian branch of Siemens (called *Klangfilm* there as well). This branch produced some very remarkable units, for example the late "Ed" tube was made there (a famous European triode, the industrial version of the AD-1!) as well as an ultra rare speaker called the Klangfilm "Euronette", a full range wooden/textile tractrix horn (not to be mixed up with the prewar "Euronette" power amp).

This amp uses again EL-34's (ultralinear) and triode connected it sounds as good as the KL-502a. It uses a rare rectifier called the Z2c, which is again an industrial tube like the Ed, is totally different in its design approach to the German power amps. Most parts are Austrian made, and it is necessary to change all the orange coloured 100 uF electrolytic C's as they are prone to be dried out.



Austrian-made KI-5418— Shown without rectifier above



KL-401a —shown without tubes

SIEMENS

Hauptverstärker

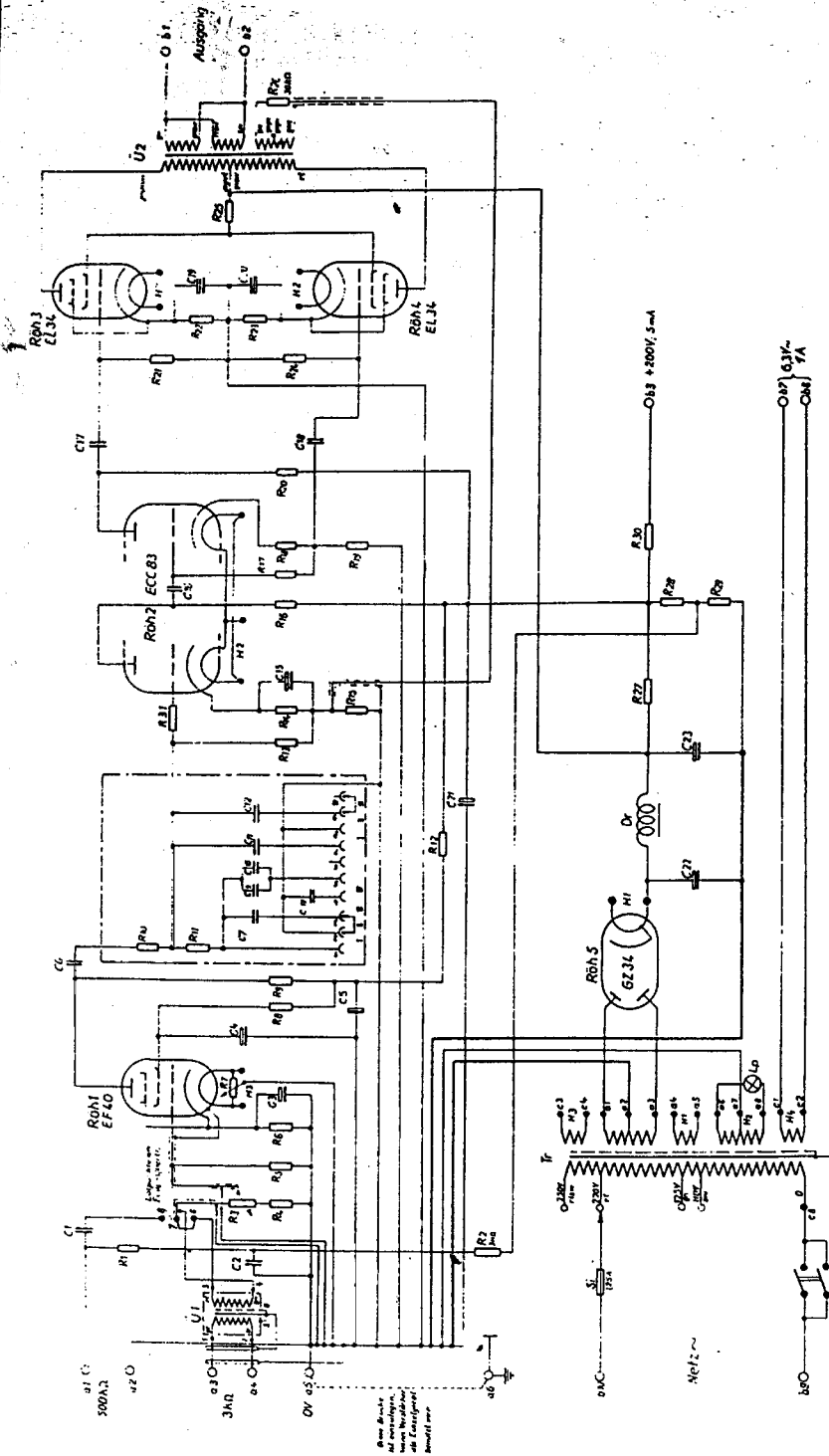
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März 1955

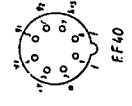
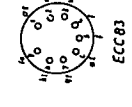
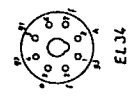
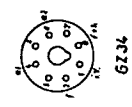
V 408

V 408

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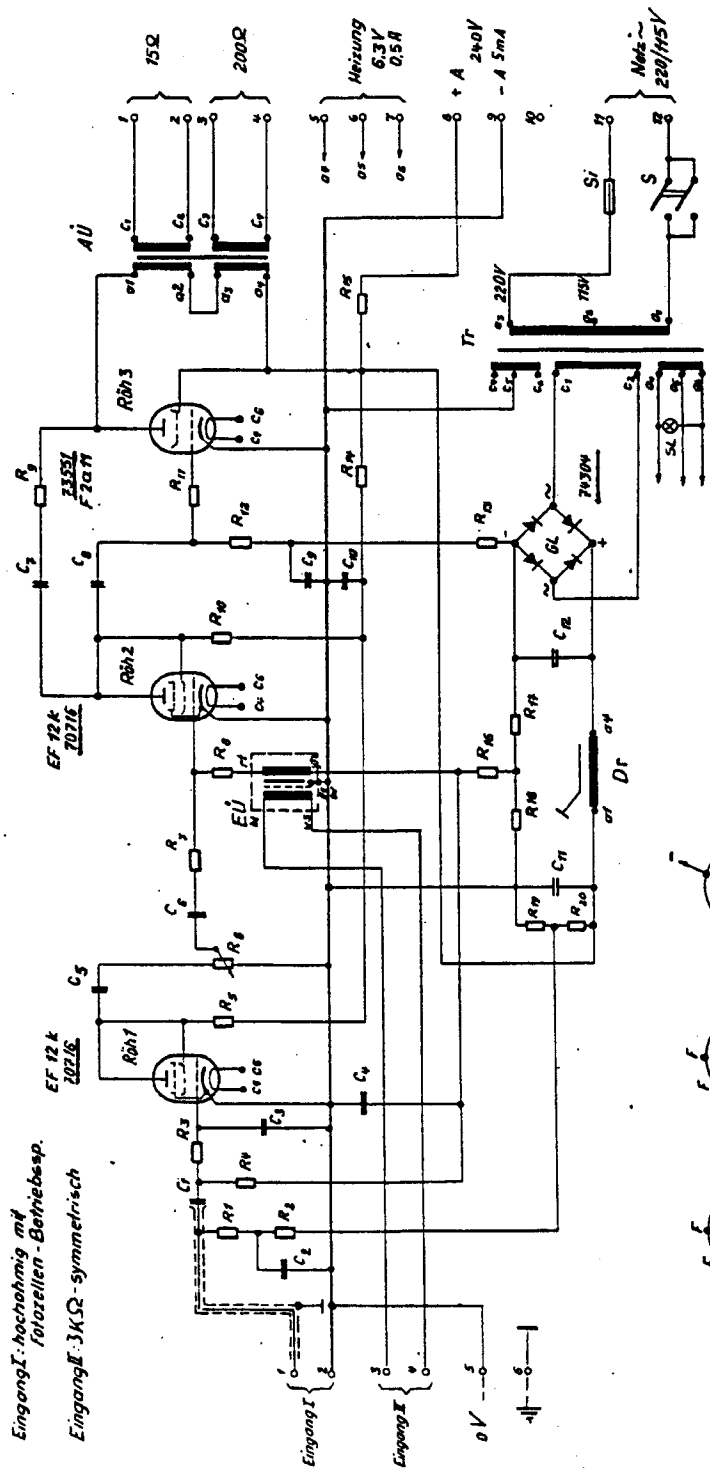
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Stellung II: ± 0 db	Stellung II: -5 db
Stellung III: +5 db	Stellung III: ± 0 db
Stellung IV: +10 db	



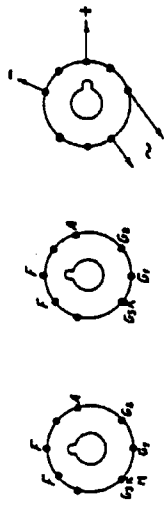
SIEMENS & HALSKE
Aktionselektrotechnik

WV 408 V 408 / Vertrieb Wiedergabe


Ni/Wa.



Eingang I: hochohmig mit
Fotozellen-Betriebsp.
Eingang II: 3kΩ-symmetrisch



70716
EF 12 k
73551
F 2 a H
74304
GN
Anschlüsse der Röhren- bzw. Gleichrichter-Fassungen

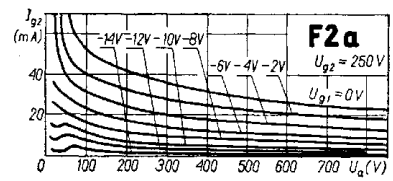
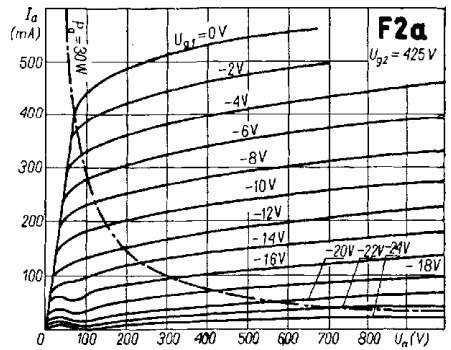
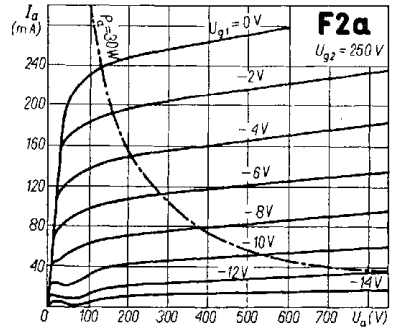
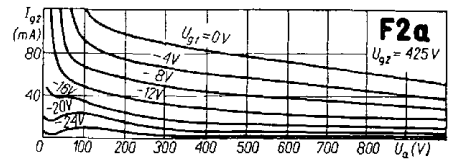
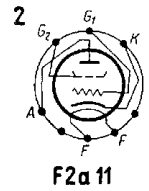
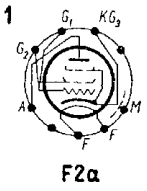
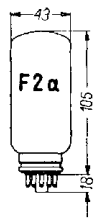
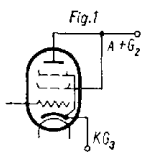
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<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10%; vertical-align: top;">R 1</td> <td style="width: 40%;">Schichtwiderstand</td> <td style="width: 30%;">100 kOhm</td> <td style="width: 20%;"></td> </tr> <tr> <td>R 2</td> <td>Schichtwiderstand</td> <td>3 MOhm</td> <td></td> </tr> <tr> <td>R 3</td> <td>Schichtwiderstand</td> <td>100 kOhm</td> <td></td> </tr> <tr> <td>R 4</td> <td>Schichtwiderstand</td> <td>1 MOhm</td> <td></td> </tr> <tr> <td>R 5</td> <td>Schichtwiderstand</td> <td>150 kOhm</td> <td></td> </tr> <tr> <td>R 6</td> <td>Schichtdrehwiderstand</td> <td>500 kOhm</td> <td>pos.log.</td> </tr> <tr> <td>R 7</td> <td>Schichtwiderstand</td> <td>500 kOhm</td> <td></td> </tr> <tr> <td>R 8</td> <td>Schichtwiderstand</td> <td>150 kOhm</td> <td></td> </tr> <tr> <td>R 9</td> <td>Schichtwiderstand</td> <td>500 kOhm</td> <td></td> </tr> <tr> <td>R 10</td> <td>Schichtwiderstand</td> <td>100 kOhm</td> <td></td> </tr> <tr> <td>R 11</td> <td>Schichtwiderstand</td> <td>1 kOhm</td> <td></td> </tr> <tr> <td>R 12</td> <td>Schichtwiderstand</td> <td>200 kOhm</td> <td></td> </tr> <tr> <td>R 13</td> <td>Schichtwiderstand</td> <td>100 kOhm</td> <td></td> </tr> <tr> <td>R 14</td> <td>Schichtwiderstand</td> <td>50 kOhm</td> <td></td> </tr> <tr> <td>R 15</td> <td>Schichtwiderstand</td> <td>2 kOhm</td> <td></td> </tr> <tr> <td>R 16</td> <td>Schichtwiderstand</td> <td>1 MOhm</td> <td></td> </tr> <tr> <td>R 17</td> <td>Schichtwiderstand</td> <td>60 Ohm</td> <td></td> </tr> <tr> <td>R 18</td> <td>Schichtwiderstand</td> <td>30 Ohm</td> <td></td> </tr> <tr> <td>R 19</td> <td>Schichtwiderstand</td> <td>150 kOhm</td> <td></td> </tr> <tr> <td>R 20</td> <td>Schichtwiderstand</td> <td>125 kOhm</td> <td></td> </tr> <tr><td colspan="4"> </td></tr> <tr> <td>C 1</td> <td>Kondensator</td> <td>5000 pF</td> <td></td> </tr> <tr> <td>C 2</td> <td>MP-Kondensator</td> <td>2 µF</td> <td></td> </tr> <tr> <td>C 3</td> <td>Keramik-Kondensator</td> <td>50 pF</td> <td></td> </tr> <tr> <td>C 4</td> <td>MP-Kondensator</td> <td>2 µF</td> <td></td> </tr> <tr> <td>C 5</td> <td>Kondensator</td> <td>0,01 µF</td> <td></td> </tr> <tr> <td>C 6</td> <td>Kondensator</td> <td>0,01 µF</td> <td></td> </tr> <tr> <td>C 7</td> <td>Kondensator</td> <td>1000 pF</td> <td></td> </tr> <tr> <td>C 8</td> <td>Kondensator</td> <td>20000 pF</td> <td></td> </tr> <tr> <td>C 9</td> <td>MP-Kondensator</td> <td>1 µF</td> <td></td> </tr> <tr> <td>C 10</td> <td>MP-Kondensator</td> <td>1 µF</td> <td></td> </tr> <tr> <td>C 11</td> <td>MP-Kondensator</td> <td>16 µF</td> <td></td> </tr> <tr> <td>C 12</td> <td>MP-Kondensator</td> <td>16 µF</td> <td></td> </tr> <tr><td colspan="4"> </td></tr> <tr> <td>Tr</td> <td>Netztransformator</td> <td></td> <td></td> </tr> <tr> <td>Dr</td> <td>Siebdrössel</td> <td></td> <td></td> </tr> <tr> <td>AÜ</td> <td>Ausgangsübertrager</td> <td></td> <td></td> </tr> <tr> <td>EÜ</td> <td>Eingangsübertrager</td> <td></td> <td></td> </tr> <tr><td colspan="4"> </td></tr> <tr> <td>S</td> <td>Netzschalter</td> <td></td> <td></td> </tr> <tr> <td>Si</td> <td>Sicherung (für 220 V)</td> <td>0,5 A</td> <td>Kl U 601</td> </tr> <tr> <td></td> <td>Sicherung (für 115 V, im Beipack)</td> <td>1 A</td> <td>Kl U 702</td> </tr> <tr> <td>Sl</td> <td>Signallampe</td> <td>12 V/ 1 W</td> <td>Kl U 105</td> </tr> <tr><td colspan="4"> </td></tr> <tr> <td>Röh 1</td> <td>Röhre EF 12 k</td> <td></td> <td>Kl 70716</td> </tr> <tr> <td>Röh 2</td> <td>Röhre EF 12 k</td> <td></td> <td>Kl 70716</td> </tr> <tr> <td>Röh 3</td> <td>Röhre F 2a 11</td> <td></td> <td>Kl 73551</td> </tr> <tr> <td>GL</td> <td>Steckgleichrichter</td> <td></td> <td>Kl 74304</td> </tr> </table>			R 1	Schichtwiderstand	100 kOhm		R 2	Schichtwiderstand	3 MOhm		R 3	Schichtwiderstand	100 kOhm		R 4	Schichtwiderstand	1 MOhm		R 5	Schichtwiderstand	150 kOhm		R 6	Schichtdrehwiderstand	500 kOhm	pos.log.	R 7	Schichtwiderstand	500 kOhm		R 8	Schichtwiderstand	150 kOhm		R 9	Schichtwiderstand	500 kOhm		R 10	Schichtwiderstand	100 kOhm		R 11	Schichtwiderstand	1 kOhm		R 12	Schichtwiderstand	200 kOhm		R 13	Schichtwiderstand	100 kOhm		R 14	Schichtwiderstand	50 kOhm		R 15	Schichtwiderstand	2 kOhm		R 16	Schichtwiderstand	1 MOhm		R 17	Schichtwiderstand	60 Ohm		R 18	Schichtwiderstand	30 Ohm		R 19	Schichtwiderstand	150 kOhm		R 20	Schichtwiderstand	125 kOhm						C 1	Kondensator	5000 pF		C 2	MP-Kondensator	2 µF		C 3	Keramik-Kondensator	50 pF		C 4	MP-Kondensator	2 µF		C 5	Kondensator	0,01 µF		C 6	Kondensator	0,01 µF		C 7	Kondensator	1000 pF		C 8	Kondensator	20000 pF		C 9	MP-Kondensator	1 µF		C 10	MP-Kondensator	1 µF		C 11	MP-Kondensator	16 µF		C 12	MP-Kondensator	16 µF						Tr	Netztransformator			Dr	Siebdrössel			AÜ	Ausgangsübertrager			EÜ	Eingangsübertrager							S	Netzschalter			Si	Sicherung (für 220 V)	0,5 A	Kl U 601		Sicherung (für 115 V, im Beipack)	1 A	Kl U 702	Sl	Signallampe	12 V/ 1 W	Kl U 105					Röh 1	Röhre EF 12 k		Kl 70716	Röh 2	Röhre EF 12 k		Kl 70716	Röh 3	Röhre F 2a 11		Kl 73551	GL	Steckgleichrichter		Kl 74304
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T.	U _f V	I _f A	Cl.	U _a	U _{g2}	U _{b(g2)}	R _{g2}	U _{g1}	I _a	I _{g2}	S	R _i	R _k	R _p	P ₀	U _{g1, max}	h	P _{g1}	P _a				
				V	V	V	kΩ	V	mA	mA	mA/V	kΩ	Ω	kΩ	W	V	%	W	W				
F2a F2a II	Siem	1	6,3	2	A stat	250	250		-7	95 ÷ 97	14 ÷ 20												
					AB	425	425		-19	60	10												
					B	250	250			114 ÷ 128	16 ÷ 32												
						330		330	1	136 ÷ 160	20 ÷ 33												
						425		425	3	120 ÷ 154	18 ÷ 30												
					Siem	2	6,3	2	A	250	250		-11	60 ÷ 140	9 ÷ 32								
	AB	330		330					1	76 ÷ 160	11 ÷ 33												
	B	425		425					3	50 ÷ 160	8 ÷ 31												
		425		425					1,5	56 ÷ 190	9 ÷ 40												
		Fig. 1	330						330		90 ÷ 94	(μ = 17)											
	Fig. 1	250		250						100 ÷ 108													
		330		330		140 ÷ 152																	
425			425		130 ÷ 146																		

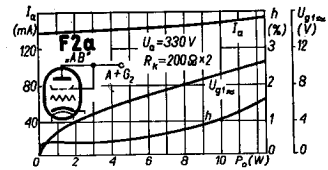
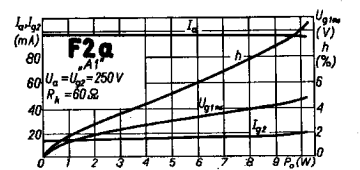
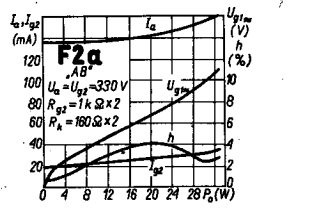
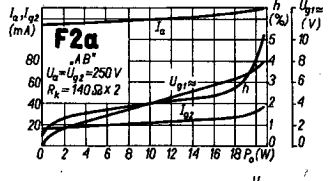
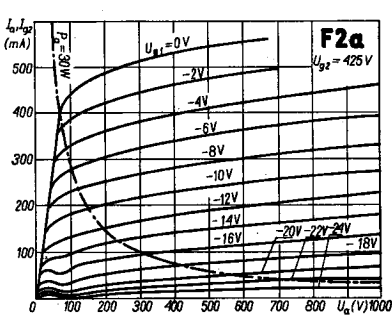
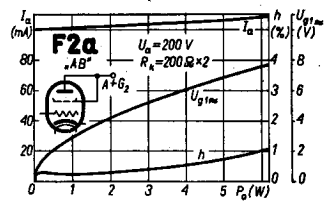
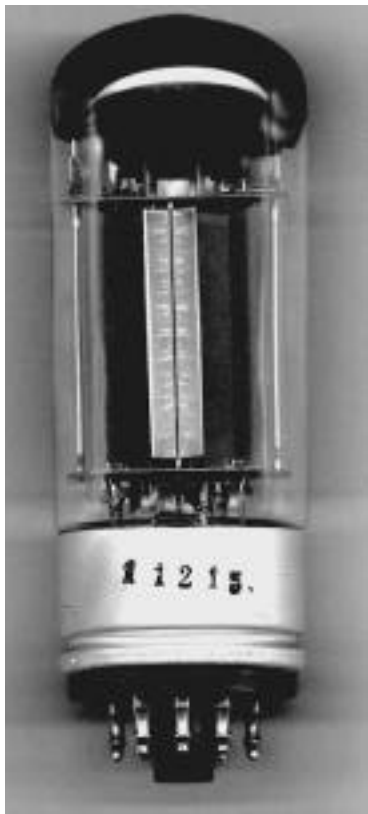
maximum (I_k = 140 mA; R_{g1} = 0,5 MΩ; U_{f,k} = 80 V)

1) vide * 4

C _{g1}	C _a	C _{g1+a}
pF	pF	pF
20,5	13	0,45
14	15,5	7



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T.	Image	U _f V	I _f A	Cl.	U _o	U _{g2}	U _{g1}	I _o	I _{g2}	S	R _i	μ	R _k	R _o	P _o	U _{g1k}	h				
					V	V	V	mA	mA	mA/V	kΩ	g ₂ /g ₁ (a/g)	Ω	kΩ	W	V	%				
EL 51	eur	1	6,3	1,9	stat.	500	500	- 22	95	12	11	33	16								
					stat.	750	750	- 42	40	6	7	55	16								
					AB	500	500		(95 ÷ 115) × 2	(12,5 ÷ 30) × 2							100	4,8	70	20	6
					B	750	< 750	- 42	(40 ÷ 150) × 2	(6 ÷ 35) × 2							100	6	125	29	7
maximum (I _k = 200 mA; P _o = 45 W; P _{g2} = 7 W; R _{g1} = 0,7 MΩ; U _{flk} = 50 V)																					
EL 151	Tif	2	6,3	1,9	stat.	400	400	- 36	75	7											
					AB	450	450	- 24	117 × 2	20 × 2						200	2,8	90	19		
						800	450		maximum (P _o = 60 W; P _{g2} = 5 W; R _{g1} = 0,1 MΩ)												
EL 156	Tif	2	6,3	1,9	stat.	800	300		55 ÷ 65		10	25	13								
					A 1	350	250		120 ÷ 116	15 ÷ 24					60	4	15	6	8		
					A 1	450	280		112 ÷ 108	17 ÷ 27					90	3,8	25	9,2	9		
					AB	600	300		(80 ÷ 95) × 2	(10 ÷ 18) × 2					160	8,5	65	13,5	4		
					AB	600	350		(80 ÷ 100) × 2	(10,5 ÷ 24) × 2					200	7,6	80	18,5	4		
					B	800	300	- 20	(45 ÷ 100) × 2	(4,5 ÷ 20) × 2						11	105	15	5		
					B	800	350	- 24	(45 ÷ 120) × 2	(5 ÷ 25) × 2						9,5	130	18	6		
					stat.	350		- 16	140					12,5	0,8	(12)	(Fig.1)				
AB	500			(110 ÷ 120) × 2					(Fig.1)		250	2,8	30	22	2						
maximum (I _k = 180 mA; P _o = 50 W; P _{g2} = 8 W; R _{g1} = 0,1 MΩ; U _{flk} = 50 V)																					

