PHILIPS *Service*

Tape deck

EL 3501/02

SERVICE INFORMATION										

93 783 69.1.10

Printed in Holland

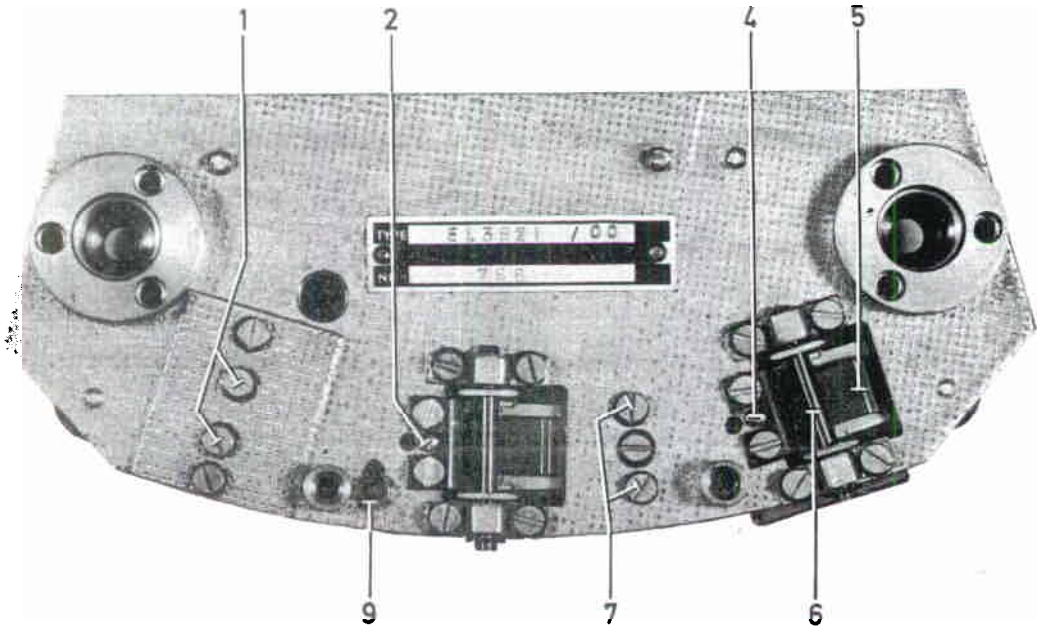

Fig. 1

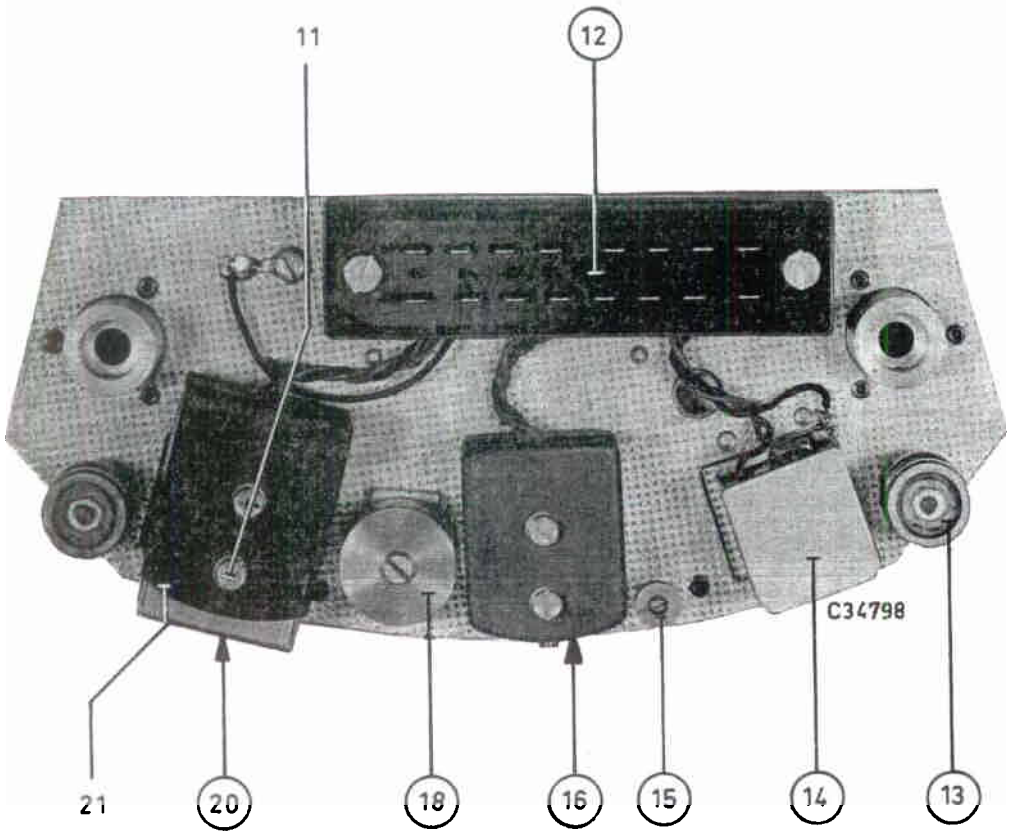

Fig. 2

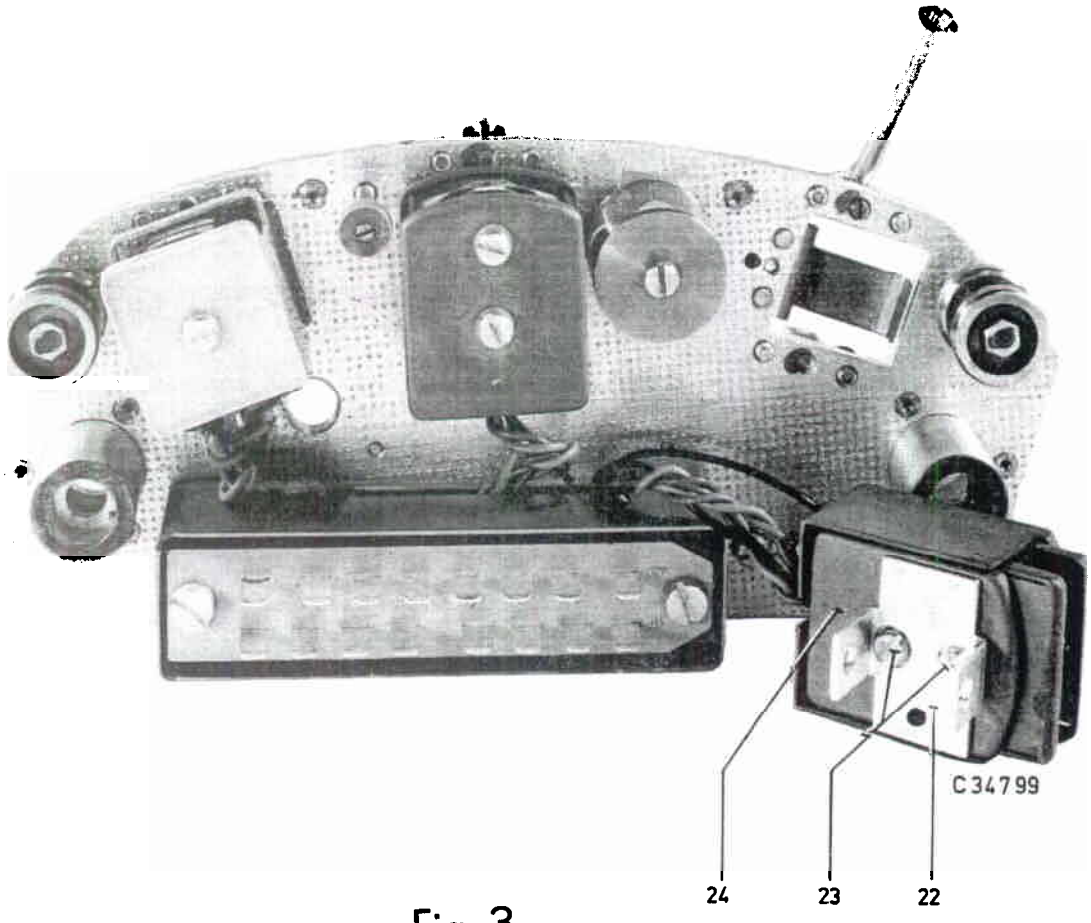

Fig. 3

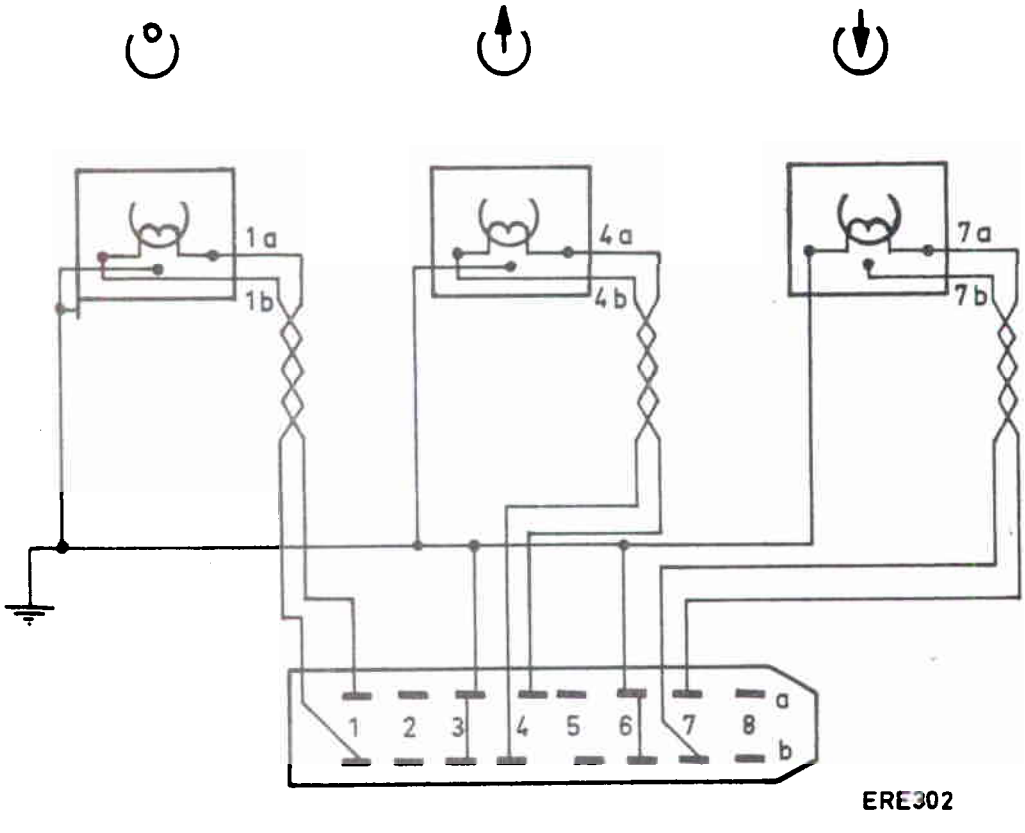

Fig. 4

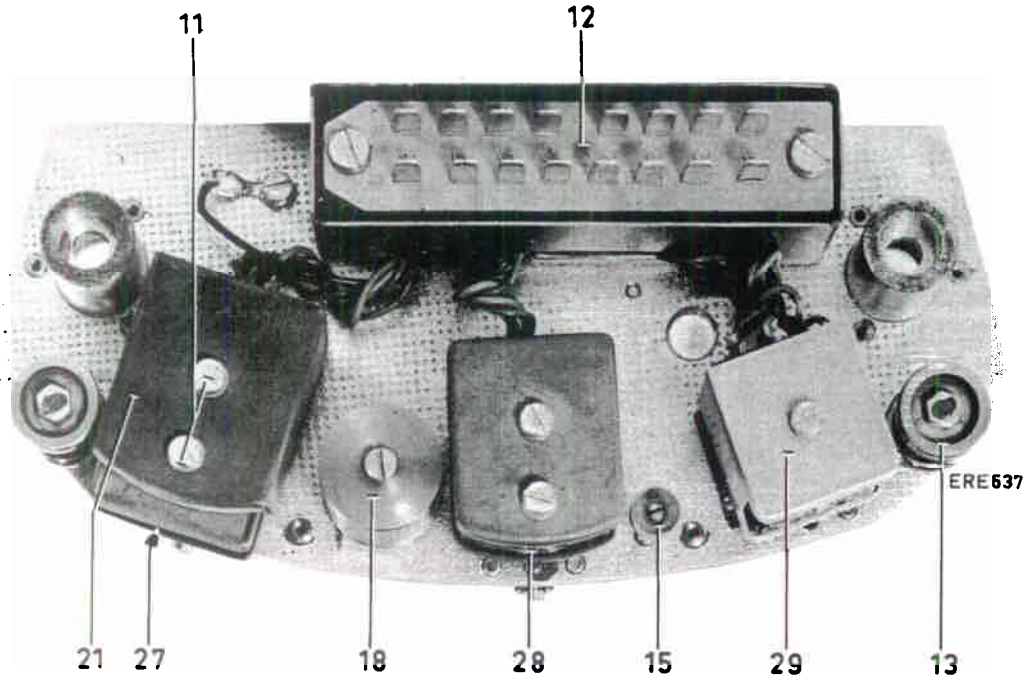
11
12
ERE637
21
27
18
28
15
29
13

Fig. 5

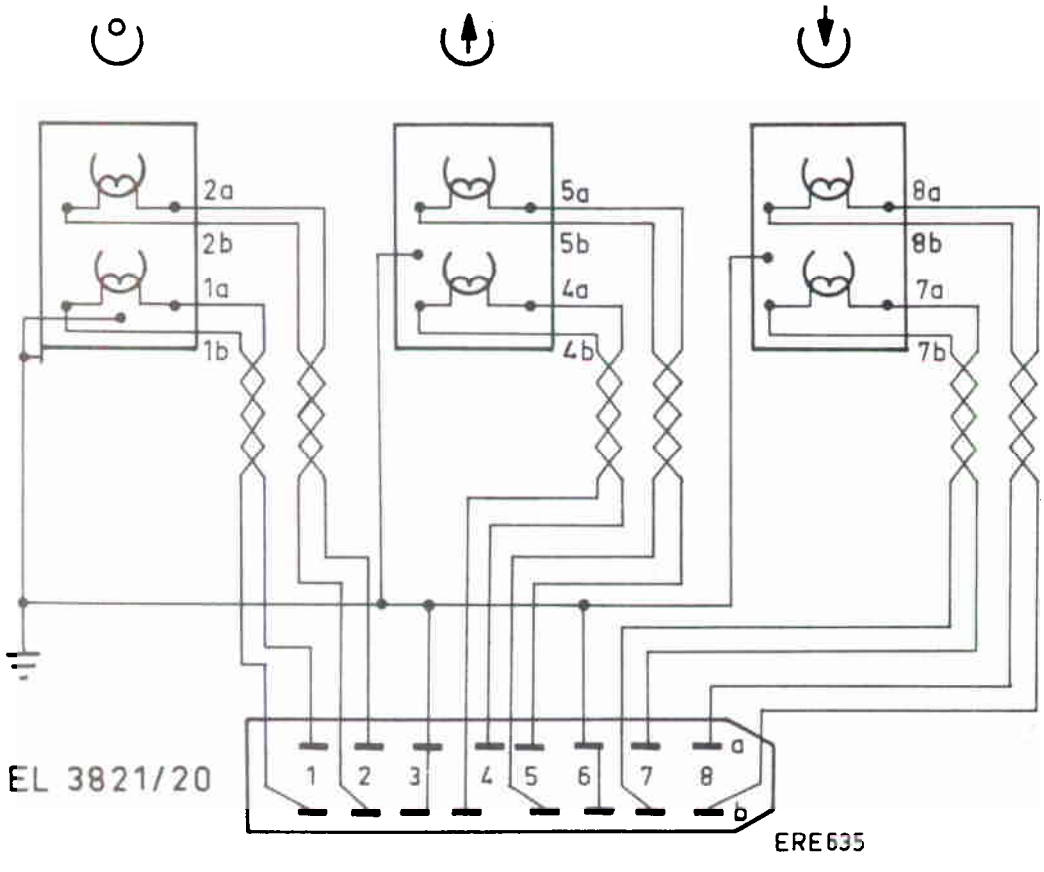
2a
2b
1a
1b
5a
5b
4a
4b
8a
8b
7a
7b
EL 3821/20
1
2
3
4
5
6
7
8
a
b
ERE635

Fig. 6

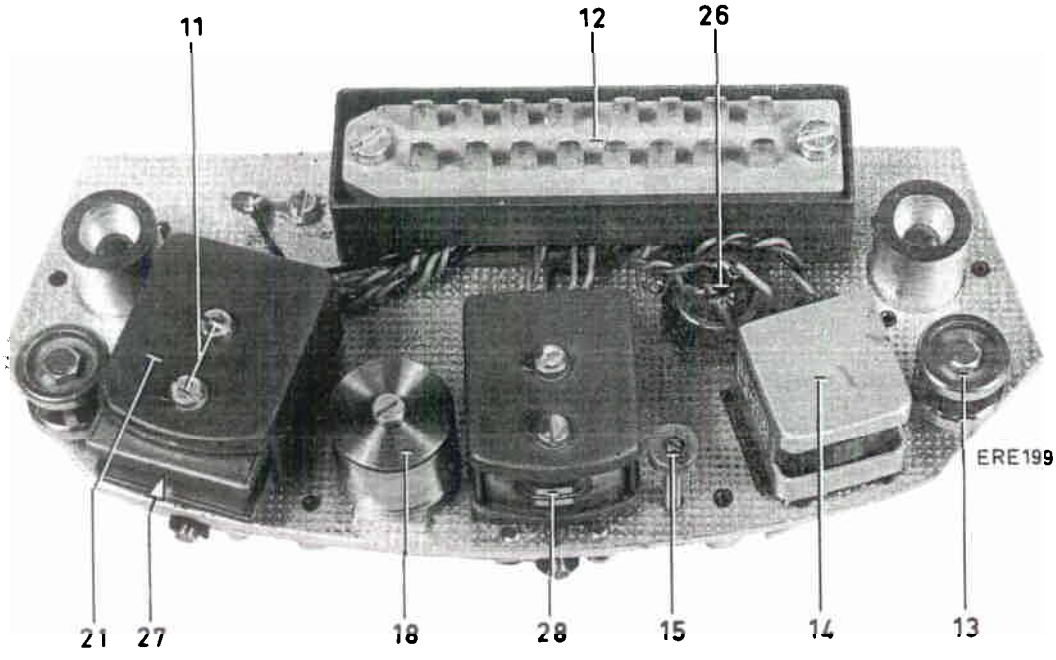
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Fig. 7

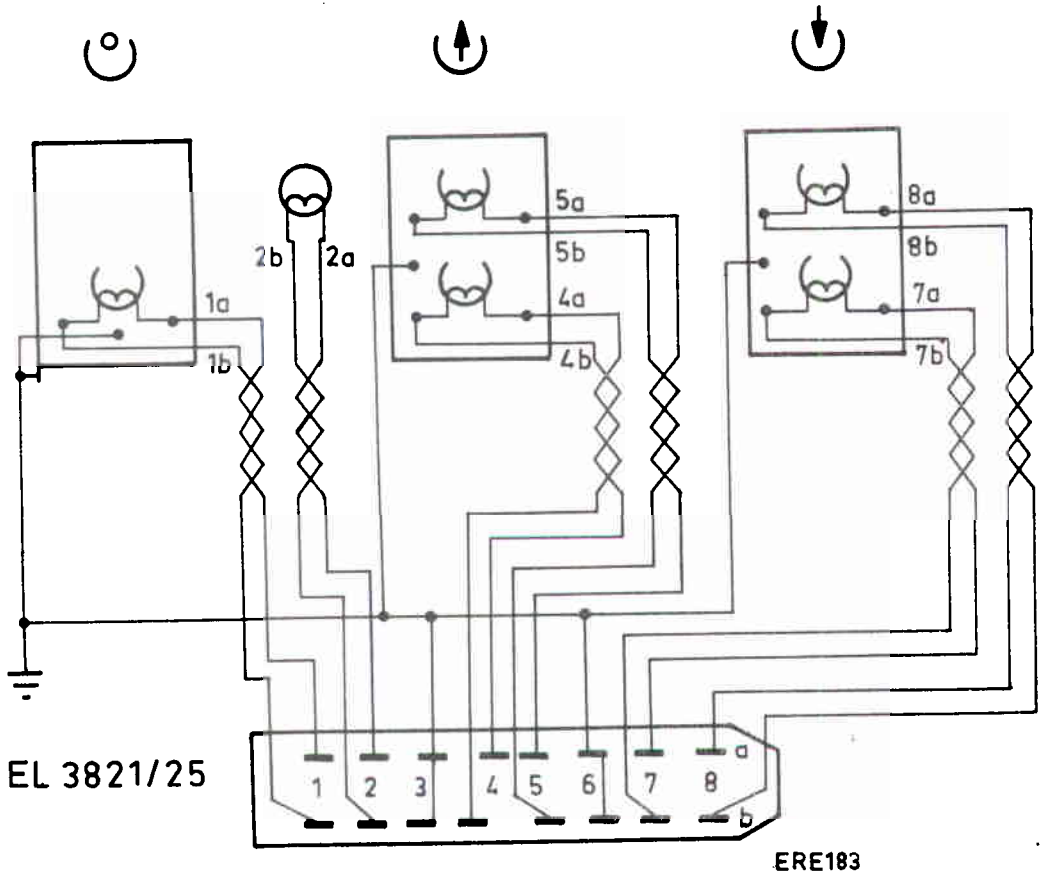

1a
1b
2b
2a
5a
5b
4a
4b
8a
8b
7a
7b
EL 3821/25
1
2
3
4
5
6
7
8
a
b
ERE183

Fig. 8

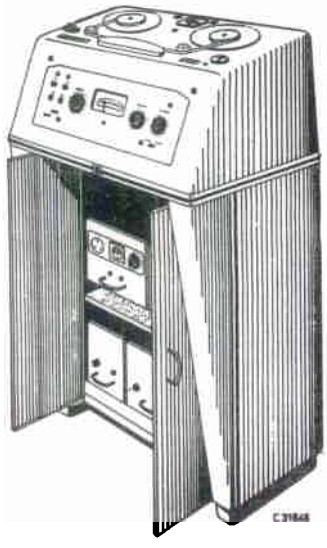
PHILIPS

E.L.A.

SERVICE DOCUMENTATIE

voor

DE MAGNETOFOON KAST



EL 3960

Gedrukt in Nederland

93.985.84.1.22.
7E

Algemeen

De magnetofoonkast voor loopwerk 15" en 7½" typenummer EL 3560 wordt met bedrading uitgebracht onder typenummer EL 3960.
De magnetofoonkast met bedrading is geschikt voor het inbouwen van de onderstaande apparaten.

Opname-versterker	EL 3901/01
Weergave-versterker	EL 3902/01
Voedingsunit 260 V ⎓	EL 3903/01
Voedingsunit 24 V ⎓	EL 3904/01
Monitor-versterker	EL 3905/01
Professionele magnetofoon	EL 3500/16
Kophouder van de prof.magnetofoon	EL 3945/00

Figuren

Fig.1 Bedradingsschema.
Fig.2 Vooraanzicht kast.
Fig.3 Achteraanzicht kast.
Fig.4 Onderaanzicht bedieningspaneel.
Fig.5a ÷ 5j Meterschakelingen.
Fig.6a ÷ 6c Monitorschakelingen.
Fig.7 Ingangstransformator T1.
Fig.8 Potentiometer R1, R2, R3.
Fig.9 Afstandbediening van het loopwerk.

Electrische gegevens.

Netspanning	220 V ~
Frekwentie	50 per.
Opgenomen vermogen ca.	450 W

Afmetingen.

Hoogte	: 1070 mm
Breedte	: 714 mm
Diepte	: 564 mm

Indicatielampjes

La1/La3	: 6,3 V, 1 W, type 8008 N
La4	: 6 V type 6864

Bedrading

Voor de aansluiting van de verschillende apparaten zie het bedradingsschema Fig.1.

Bedieningspaneel (Fig.1 en 4).

Schakelaar SK6 schakelt de netspanning in voor de voeding van de motoren en de voedingsunit 24 V ⎓.
De voedingslijn is beveiligd door een smeltveiligheid (V12) van 2 A. De indicatielamp La2 brandt, wanneer de schakelaar SK6 gesloten is. De indicatielamp krijgt spanning van de 6,3 V-wikkeling van de transformator in de voedingsunit 24 V over de contactpunten 4 en 5 van het 6-polige stopcontact, gemerkt HT1.

Schakelaar SK5

schakelt de netspanning voor de voedingsunit 260 V en de monitorversterker in. De voedingslijn is beveiligd door een smeltveiligheid (V11) van 2 A. De indicatielamp La1 brandt, wanneer de schakelaar SK5 gesloten is.
De indicatielamp krijgt spanning van de 6,3 V-wikkeling van de transformator in de voedingsunit 260 V over de contactpunten 4 en 5 van het 6-polige stopcontact, gemerkt HT1.

Volumeregelaar

"Input" (Fig.8) (R3) regelt het ingangssignaal van de opnameversterker over de verzwakker R16-R17. (verzwakker-verhouding ca. 1:17). De verzwakker is noodzakelijk om het relatief hoge lijnniveau te begrenzen. De versterker EL 3901/01 is zonder volumeregelaar uitgevoerd.

Meterschakelingen

In de drie standen van de telefoonsleutel SK3 kunnen de in- en uitgangsspanningen en de modulatiediepte gemeten worden.

a. Telefoonsleutel SK3 in de stand "input".

In deze stand wordt de grootte van het ingangssignaal gemeten, dat wordt toegevoerd aan het 3-polige penstopcontact "line in" van de opnameversterker.
De grootte van het signaal is in V.U.-'s op de meter afleesbaar.

b. Telefoonsleutel SK3 in de stand "output".

In deze stand wordt de grootte van het uitgangssignaal gemeten, dat afgegeven wordt aan de uitgangsklemmen van het 3-polige stopcontact "line out" van de weergaveversterker.
De grootte van het signaal is in V.U.-'s op de meter afleesbaar.

c. Telefoonsleutel SK3 in de stand "MOD" (modulatie).

In deze stand wordt de grootte van het L.F.-signaal gemeten op een punt in de opnameversterker over het 3-polige stopcontact "meter". De sterkte van dit signaal is een maat voor de modulatiediepte, die in procenten op de meter afleesbaar is.

In de drie standen van de telefoonsleutel SK2 kunnen drie meetbereiken gekozen worden, n.l. +4; +8 en +18.

a. Telefoonsleutel SK2 in de stand +18.

Deze stand wordt gebruikt, wanneer ingangssignalen, uitgangssignalen of modulatiediepten gemeten worden, die afkomstig zijn van een toongenerator.

b. Telefoonsleutel SK2 in de standen +8 en +4.

In deze standen wordt het ingangssignaal, uitgangssignaal of de modulatiediepte gemeten, waarbij de aard van de signalen hun ontstaan danken aan het gesproken woord of de muziek.

In de onderstaande tabel wordt verwezen naar de vereenvoudigde schema's, die getekend zijn voor de mogelijke standen van de telefoonsleutels SK2 en SK3.

SK2 in de stand:		+4	+8	+18
SK3 in de stand	"input"	fig.5a	fig.5b	fig.6c
	"mod."	fig.5d	fig.5e	fig.5f
	"output"	fig.5g	fig.5h	fig.5j

Volumeregelaar

"output" (fig.8) (R2) regelt het uitgangssignaal van de weergave-versterker. De versterker EL 3902/01 is zonder volumeregelaar uitgevoerd.

Monitor

Met de telefoonsleutel SK1 kunnen de ingangs- en uitgangssignalen van resp. de opname- en de weergave-versterker afgeluisterd worden.

a. Telefoonsleutel SK1 in de stand "input" (Fig.6a).

In deze stand wordt het signaal afgenomen van het 3-polige penstopcontact "line in" van de opname-versterker.
Via de ingangstransformator (T1); de verzwakker (R4÷R9) en de volumeregelaar (R1), wordt het signaal gelegd aan de koppelcondensator van buis B1 van de monitor-versterker.
De monitor-versterker, type EL 3905/01 is zonder ingangstransformator en volumeregelaar uitgevoerd.
Met het regelen van de potentiometer R4 kan het ingangssignaal, dat doorgegeven wordt aan de monitor-versterker, op gelijk niveau gebracht worden als het uitgangssignaal.
Het nut hiervan wordt duidelijk bij het omschakelen van de stand "input" naar "output" en omgekeerd.

b. Telefoonsleutel SK1 in de stand "output" (Fig.6b).

In deze stand wordt het signaal afgenomen van het 3-polige stopcontact "line out" van de weergave-versterker.
Via de ingangstransformator (T1); de verzwakker (R4÷R9) en de volumeregelaar (R1), wordt het signaal gelegd aan de koppelcondensator van buis B1 van de monitor-versterker.

c. Telefoonsleutel in de stand -20 dB (Fig.6c).

In deze stand is de schakeling identiek aan de stand "output", met dien verstande, dat het signaal over de volumeregelaar R4 20 dB verzwakt is.

Remote control

De 12-polige steker, die de punten I-1 en I-2 op de contrasteker BL. K (zie EL 3500/16; Fig.3) kortsluit moet verwijderd worden en de verbinding als aangegeven in Fig.1 tot stand gebracht worden.

Met de schakelaar SK4 kan naar wens het loopwerk op afstand bediend worden door omschakeling naar de stand "on". Hierdoor worden de knoppen SK2; SK3 en SK4 op het loopwerk buiten werking gesteld.
Fig.9 is het principeschema voor een afstandbedienings-systeem. De te gebruiken onderdelen zijn in de stuklijst opgenomen.

V.U. meter.

Theoretisch kan de sterkte van ingangs- en uitgangssignalen van geluids-installaties gemeten worden met meters, die de piekwaarde, de gemiddelde waarde of de effectieve waarde aanwijzen.
In het geval van een constant sinusvormig signaal is hiertegen geen bezwaar, omdat de verschillende aanwijzingen gemakkelijk tot elkaar herleid kunnen worden. Bij spreek- en muziek signalen is de herleiding van de aflezingen van de verschillende meters niet meer mogelijk.
Om eenheid te krijgen in de aanduiding van signaalniveau's werden in 1939 vele proefnemingen met de voorkomende meters verricht. De resultaten waren, dat een nieuwe eenheid, de "volume unit" (V.U.) werd geintroduceerd. Alsmede een meetinstrument, dat geschikt was om het geluidsniveau in V.U.-'s te meten.
De keuze is gevallen op een meter, die de gemiddelde waarde van het signaal aanwees. Voorts bleek, dat bij de verrichte metingen de beste aflezing werd verkregen, wanneer de wijzer 70% van de volle schaallengte uitsloeg.
Het meetinstrument, dat volgens deze eisen wordt geconstrueerd heeft de genoemde uitslag bij een constant sinusvormig signaal van +4 dbm bij 600 Ω (= 1,228 V). Dit punt wordt op de schaal het "0"-punt.
De betrekking tussen deze waarde en de aflezing van het meetinstrument is een functie van de golfvorm. Voor spreek- en muzieksignalen is deze functie niet constant, waardoor het onmogelijk is om het meetinstrument te calibreren met de dbm waarde. (dbm = 10 log. $\frac{W}{0.001}$; waarbij W het vermogen is van het te meten signaal.

Daarom is bepaald, dat voor programma-signalen de aflezing in "volume units" zal geschieden en dat het punt "0" op de schaal zal corresponderen met een programma-signaal van +4 V.U. Dit betekent, dat het niveau van het signaal aan de meterklemmen altijd +4 V.U. hoger ligt dan de meteraflezing.

Mechanische stuklijst.

Pos.	Omschrijving	Codenummer
1	Contrasteker	08 282 35
2	Steker 16-polig	V3 607 01
3	Steker 12-polig	V3 606 99
4	Steker 3-polig, klein	E2 555 43
5	Contrasteker 3-polig, klein	E2 555 46
6	Contrasteker 3-polig, klein	E2 555 46
7	Steker 3-polig, klein	E2 555 43
8	Contrasteker 6-polig, groot	E2 556 27.0
9	Aansluitblok 8-polig	E1 572 14.3
10	Contrasteker	08 282 35
11	Steker 6-polig, groot	E2 556 28
12	Steker 3-polig, klein	E2 555 43
13	Contrasteker 3-polig, klein	E2 555 46
14	Knop	V3 137 54
15	Steun	E2 544 41.0
16	Telefoonsleutel	V3 745 21
17	Lamphouder met dwergfitting	B1 505 80
18	Smeltpatroonhouder	B1 506 68
19	Schuifschakelaars 2-polig	A9 999 70/01AA
20	Steun	E2 544 41.0
21	Contrasteker 12-polig	V3 607 00
22	Steker 12-polig	V3 606 99
23	Stopcontact 3-polig, groot	E2 555 56
24	Steker 3-polig, groot	E2 555 44
25	Penstopcontact 2-polig	M7 603 27
26	Contrasteker	08 282 35
27	Knop	23 722 49
28	Penstopcontact	E2 555 50
29	Contrasteker 3-polig, groot	E2 555 47
SK1/SK2	Drukschakelaar)	E2 583 70
SK3	Drukschakelaar) bij Fig.9	E2 583 74
Re1	Relais)	SZB 1700/001/CYC/a

Electrische stuklijst.

T1	Transformator		EL 6801/00
C1	0,1 µF	350 V	A9 999 06/100K
C2	0,1 µF	350 V (Fig.9)	A9 999 06/100K
R1	Fig.8		
R2	Fig.8		
R3	Fig.8		
R4	50000 Ω	lin.	A9 999 16/GE50K
R5	4700 Ω	5%	A9 999 00/4K7
R6	150 Ω	5%	A9 999 00/150E
R7	1500 Ω	5%	A9 999 00/1K5
R8	6800 Ω	5%	A9 999 00/6K8
R9	27000 Ω	2%	A9 999 00/27K
R10	3600 Ω	2%	par. (A9 999 01/5K6 (A9 999 01/10K
R11	5600 Ω	2%	A9 999 00/5K6
R12	10000 Ω	2%	A9 999 00/10K
R13	12000 Ω	2%	A9 999 00/12K
R14	9100 Ω	2%	par. (A9 999 01/18K (A9 999 01/18K
R15	5600 Ω	2%	A9 999 00/5K6
R16	4700 Ω	5%	A9 999 00/4K7
R17	270 Ω	5%	A9 999 00/270E
R18	100 Ω	10%	A9 999 00/100E
R19	15 Ω	2%	A9 999 01/15E
R20	12 Ω	2%	A9 999 01/12E
R21	12 Ω	2%	A9 999 01/12E
R22	10 Ω	2%	A9 999 01/10E
R23	13 Ω	2%	A9 999 01/13E
R24	16 Ω	2%	A9 999 01/16E
R25	20 Ω	2%	A9 999 01/20E
R26	27 Ω	2%	A9 999 01/27E
R27	33 Ω	2%	A9 999 01/33E
R28	43 Ω	2%	A9 999 01/43E
R29	51 Ω	2%	A9 999 01/51E
R30	62 Ω	2%	A9 999 01/62E
R31	82 Ω	2%	A9 999 01/82E
R32	100 Ω	2%	A9 999 01/100E
R33	130 Ω	2%	A9 999 01/130E
R34	160 Ω	2%	A9 999 01/160E
R35	200 Ω	2%	A9 999 01/200E
R36	270 Ω	2%	A9 999 01/270E
R37	330 Ω	2%	A9 999 01/330E
R38	430 Ω	2%	A9 999 01/430E
R39	510 Ω	2%	A9 999 01/510E
R40	620 Ω	2%	A9 999 01/620E
R41	820 Ω	2%	A9 999 01/820E
R42	1000 Ω	2%	A9 999 01/1K
R43	100 Ω	10% (Fig.9)	A9 999 00/100E

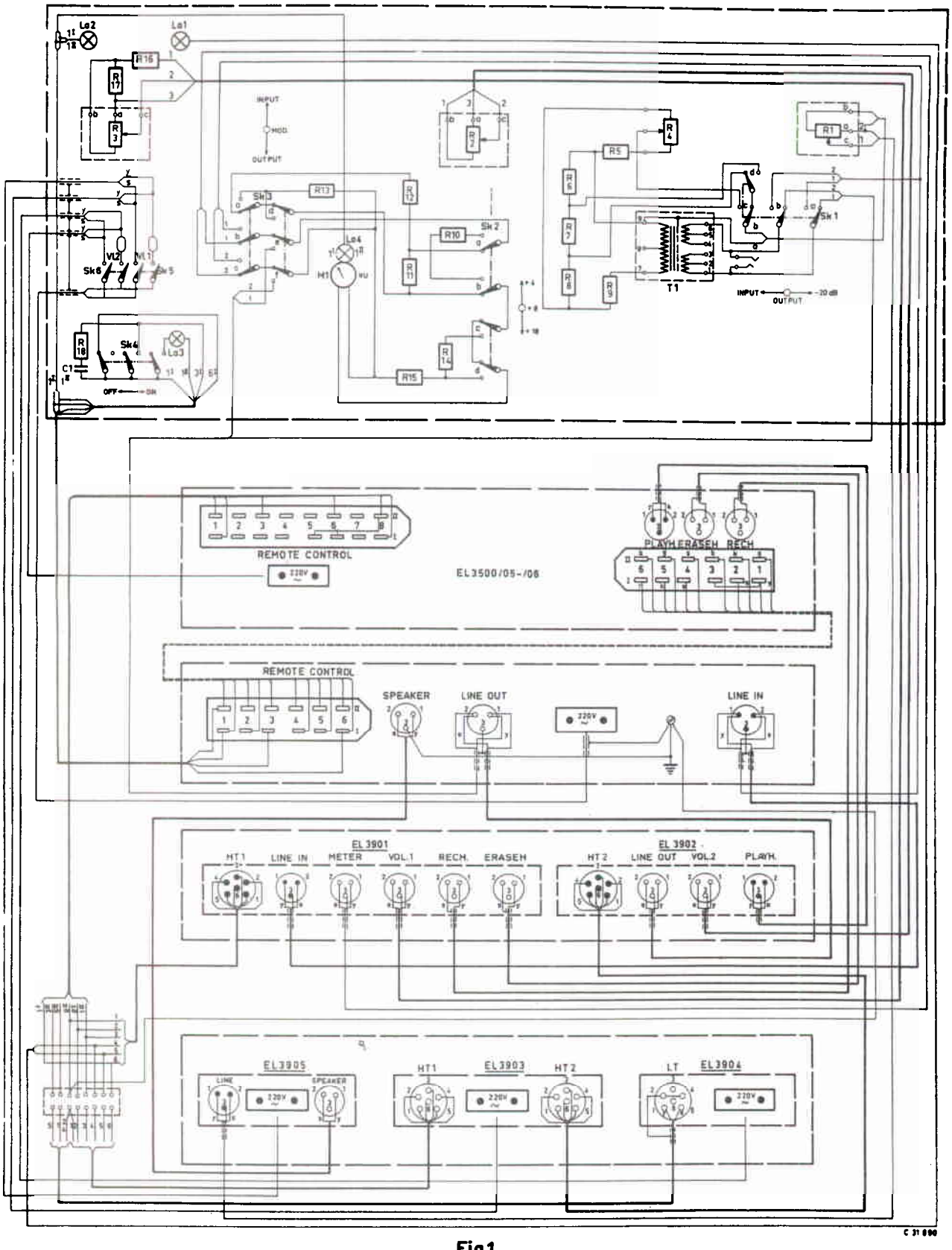

La2
La1
R16
R17
R3
INPUT
MOD.
OUTPUT
R13
R12
R2
Sk3
R10
Sk2
La4
M1
VU
R11
R14
R15
R5
R4
R6
R7
R8
R9
R1
Sk1
T1
INPUT
OUTPUT
-20 dB
VL2
VL1
Sk6
Sk5
R18
Sk4
La3
C1
OFF
ON
REMOTE CONTROL
220V
EL3500/05-/06
PLAY
ERASE
H
REC
H
REMOTE CONTROL
SPEAKER
LINE OUT
220V
LINE IN
EL 3901
HT 1
LINE IN
METER
VOL. 1
RECH.
ERASEH
EL 3902
HT 2
LINE OUT
VOL. 2
PLAYH.
EL3905
LINE
220V
SPEAKER
HT 1
EL3903
220V
HT 2
LT
EL3904
220V
C 31 890

Fig.1

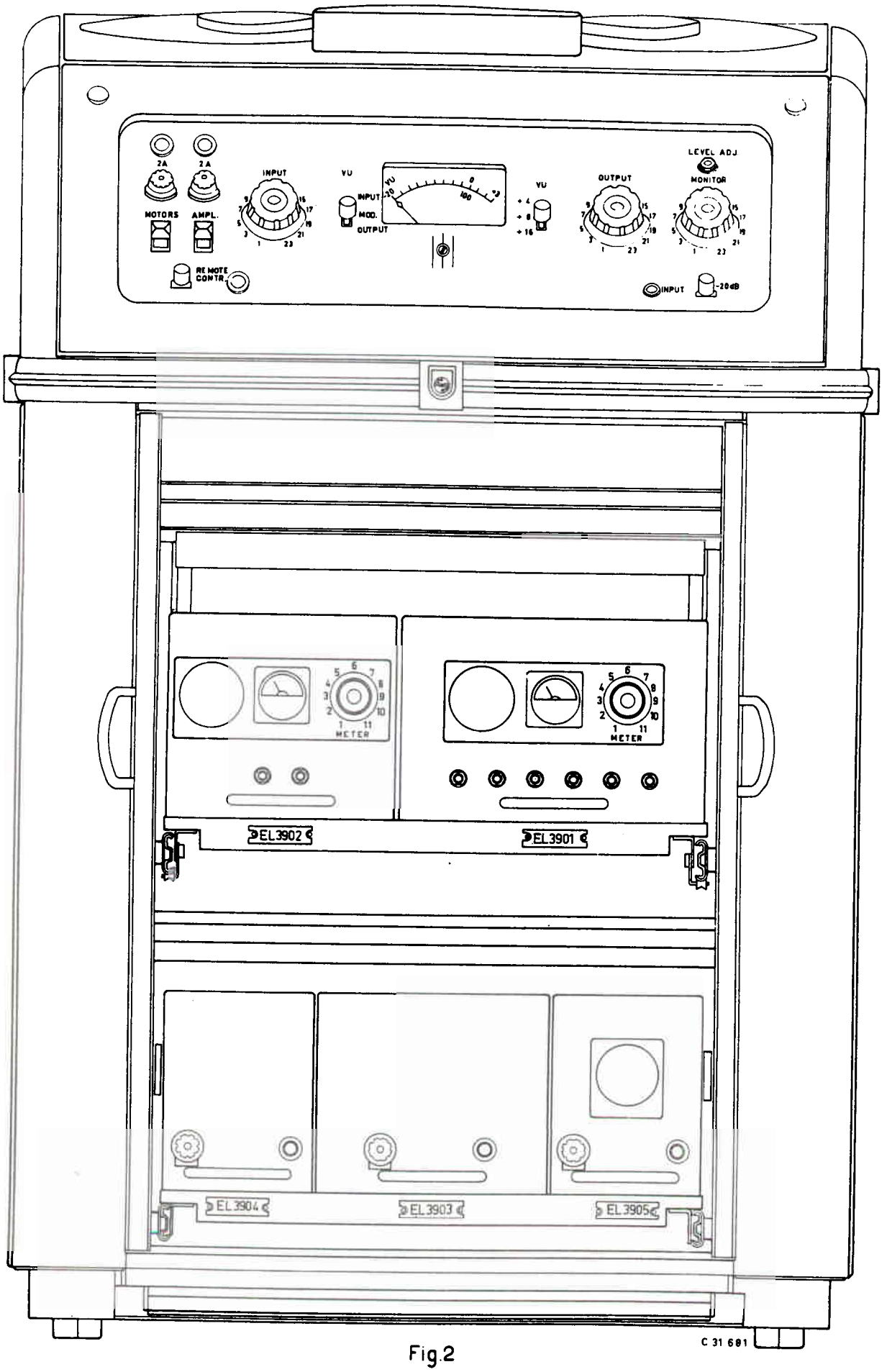

2A
2A
MOTORS
AMPL.
INPUT
VU
INPUT
MOD.
OUTPUT
VU
+4
+8
+16
OUTPUT
LEVEL ADJ
MONITOR
REMOTE CONTR.
INPUT
-20dB
METER
METER
EL3902
EL3901
EL3904
EL3903
EL3905
C 31 691

Fig.2

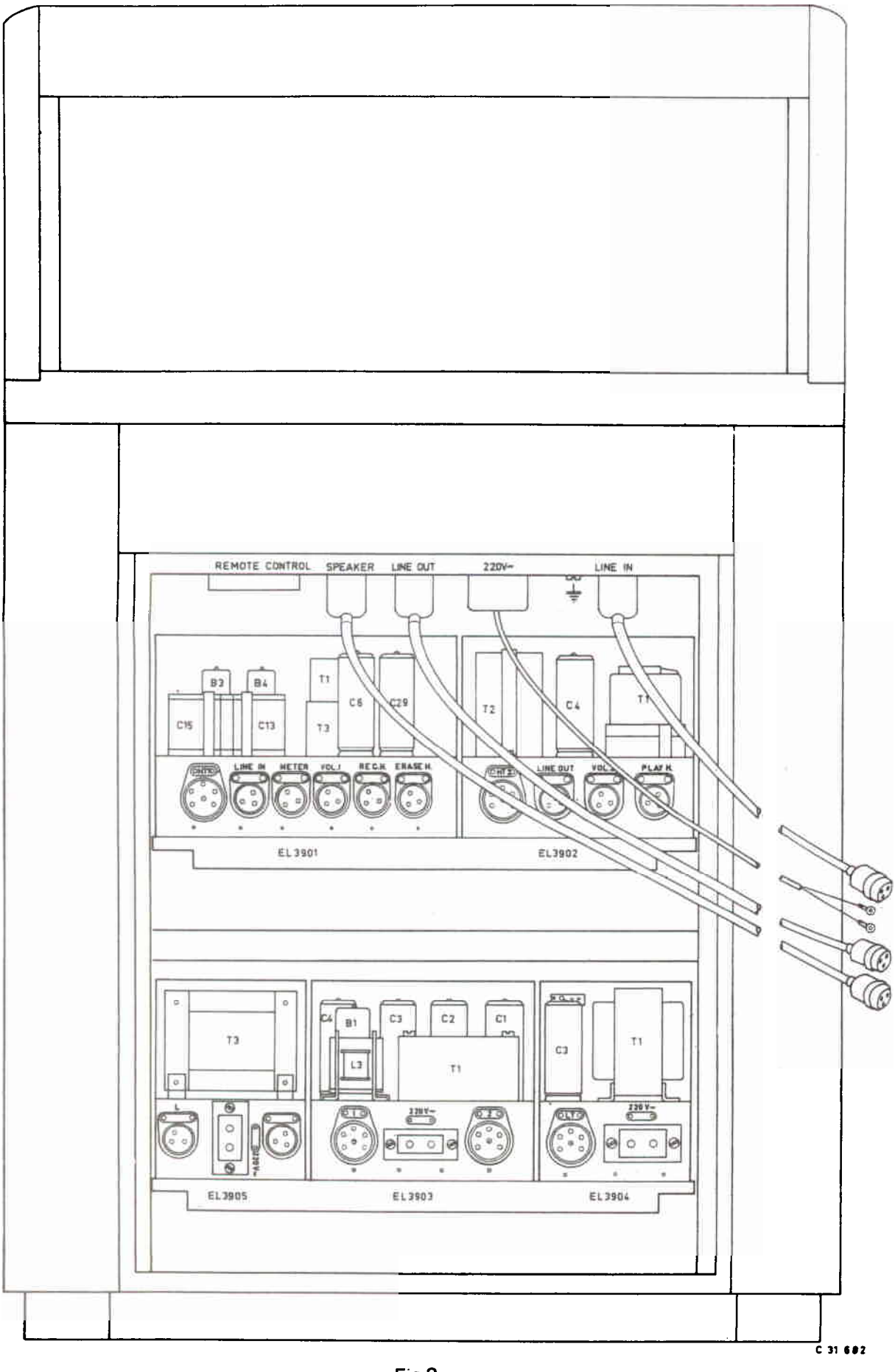
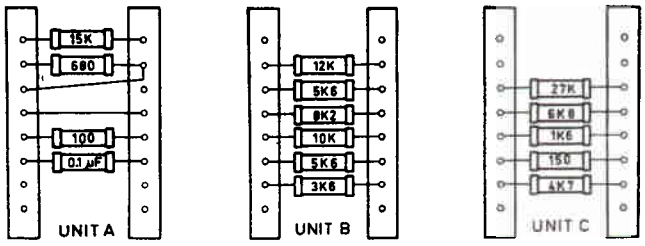

REMOTE CONTROL
SPEAKER
LINE OUT
220V~
LINE IN
B3
B4
C15
C13
T1
T3
C6
C29
T2
C4
T1
LINE IN
METER
VOL.I
REC.H.
ERASE H.
LINE OUT
VOL.
PLAY H.
EL3901
EL3902
T3
C4
B1
L3
C3
C2
C1
T1
C3
T1
220V~
220V~
EL3905
EL3903
EL3904
C 31 602

Fig.3


15K
680
100
0,1 µF
UNIT A
12K
5K6
8K2
10K
5K6
3K6
UNIT B
27K
6K8
1K6
150
4K7
UNIT C

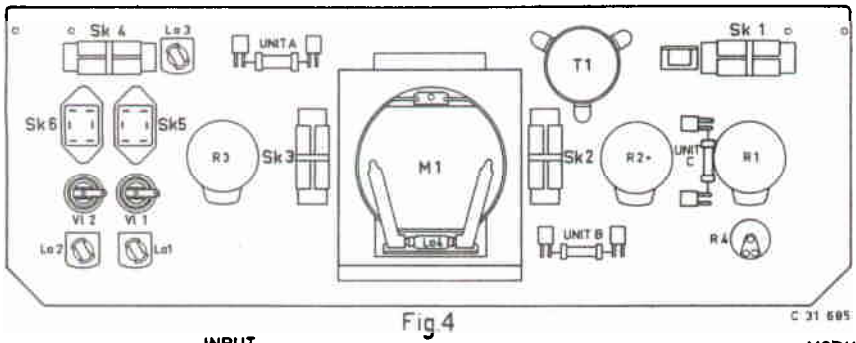
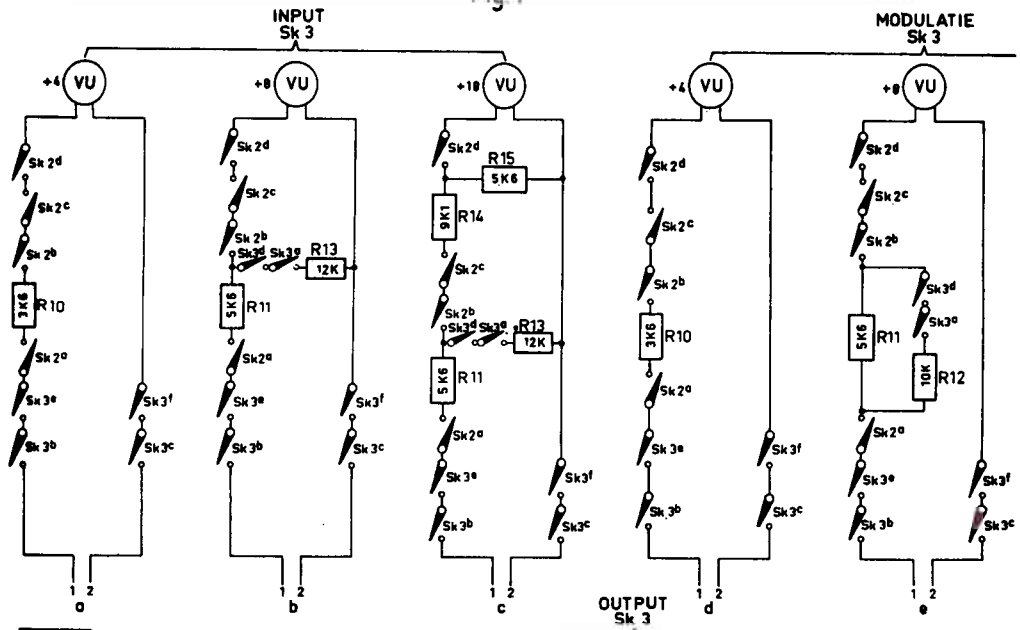

Sk 4
La 3
UNIT A
T1
Sk 1
Sk 6
Sk 5
R3
Sk 3
M1
Sk 2
R2
UNIT C
R1
Vi 2
Vi 1
La 2
La 1
UNIT B
R4
C 31 605

Fig.4


INPUT
Sk 3
MODULATIE
Sk 3
+4 VU
+8 VU
+10 VU
R10
R11
R12
R13
R14
R15
a
b
c
d
e

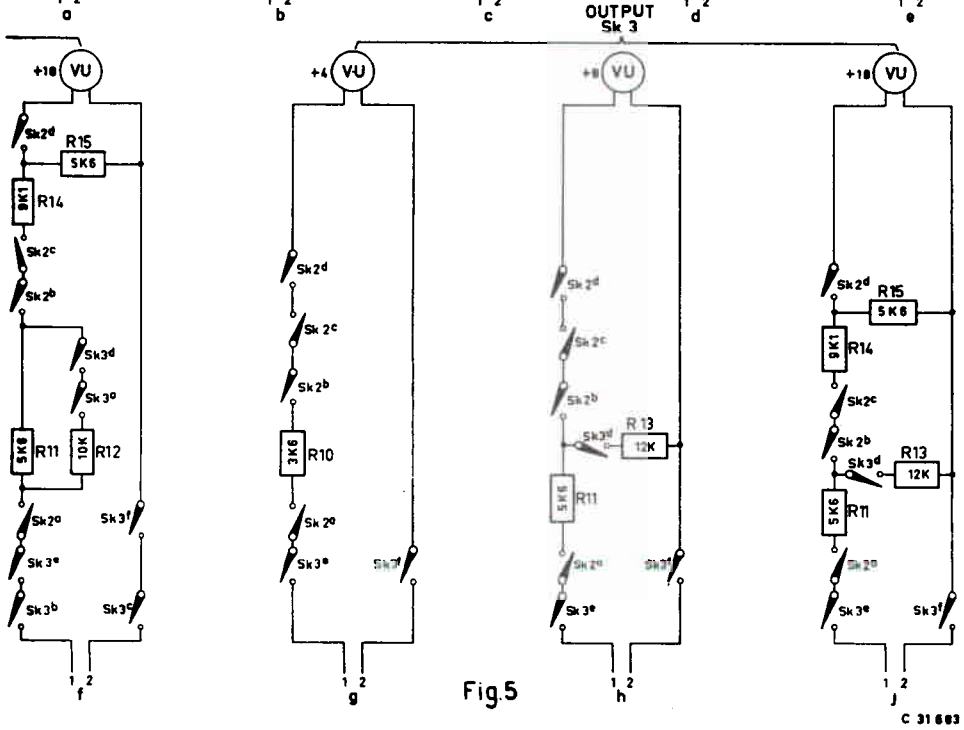

OUTPUT
Sk 3
+10 VU
+4 VU
+8 VU
+10 VU
R10
R11
R12
R13
R14
R15
f
g
h
j
C 31 603

Fig.5

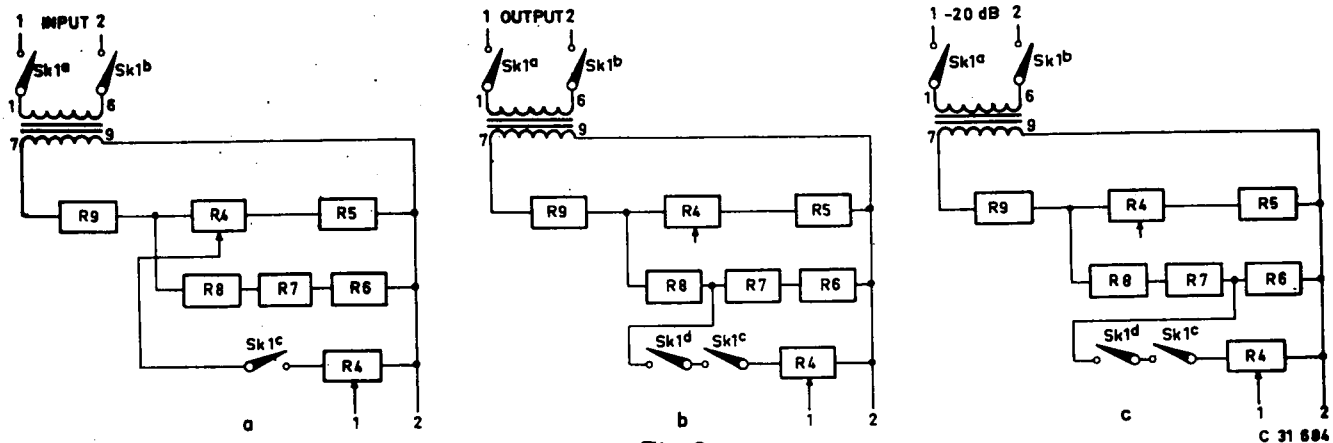


Fig.6

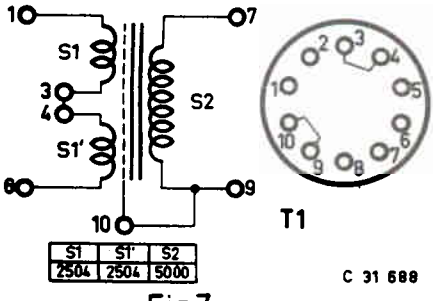


Fig.7

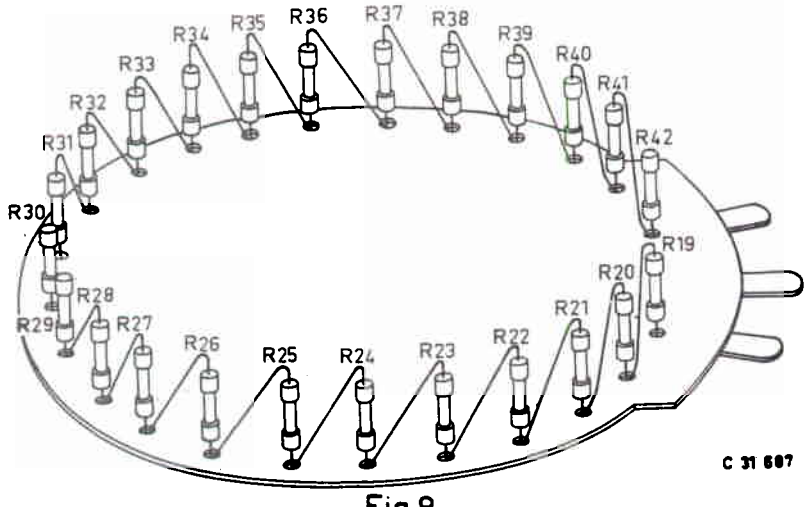


Fig.8

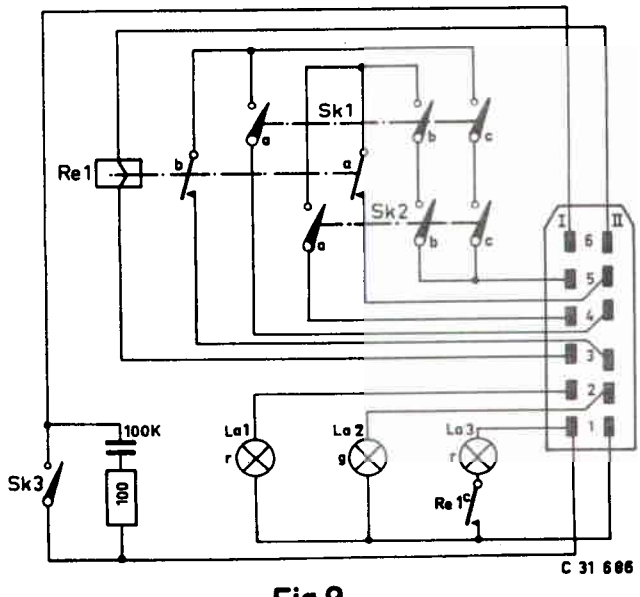


Fig.9

PHILIPS Service

ERE 1728

SLIDE-IN OSCILLATOR EL 3640/00

93788 16.1-10

158/66

SERVICE INFORMATION

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E. LIST OF PARTS 8

FIGURES

1. Measuring diagram
2. View of printed circuit
3. Circuit diagram

A. GENERAL INFORMATION

This slide-in oscillator is designed as a balance oscillator and is capable of supplying the erasing current and the bias current for two recording heads via separate outputs. It can, therefore, be used for both mono and stereo recording. Two oscillators must be used for twin-channel recording, and these oscillators may be coupled together via special synchronisation outputs. The bias current is separately contrallable for each tape speed. The oscillator frequency is 94 kc/s.

Technical data

Supply voltage	24 V
Current consumed	not loaded 120 mA loaded 330 mA
Oscillator frequency	94 kc/s ± 1 kc/s
Erasing current (erase head self-inductance 1.8 mH)	60...130 mV (adjustable)
Bias current (recording head self-inductance 7 mH).	1...20 mA (adjustable)
Transistors	1 x AC128 1 x ASY27 2 x ASZ15
Diodes	1 x BA100 1 x BZY63
Dimensions	Width 34.5 mm (1 3/8") Height 125 mm (4 7/8") Depth 200 mm (7 7/8")
Weight	780 g

B. CONNECTIONS

Points 1 and 2	Bias current output for recording head channel 2 (stereo only)
Points 3, 4 and 5	Synchronisation output (0 or more channel use only)
Point 6	Electrical earth
Point 7	-24 V supply voltage
Points 8 and 9	Output for erase head.
Points 10 and 11	Bias-over relay input
Points 13 and 14	Output for bias current for recording head channel 1
Point 15	Mechanical earth

C. CIRCUIT-DIAGRAM DESCRIPTION (fig. 3)

Oscillator

Together with T1, transistors TS4 and TS5 form a balance oscillator; the self-inductance of T1 is tuned with C11 to the oscillator frequency of 94 kc/s. RC-filters C5/R7 and C6/R8 provide the necessary feedback.

The erasing current is supplied to the erase head via S4 and terminals 8 and 9. The recording head of channel 1 obtains its bias current from S3 via 1re2, adjustable capacitors C9 or C10 and terminals 1-2. For stereo use, the bias current for the recording head of channel 2 is provided from S2 via 2re2, adjustable capacitors C7 or C8 and terminals 13 and 14.

At the high tape speed, these bias currents are set by means of C9 or C7. At the low tape speed, RE2 is actuated by means of the speed change-over switch from the tape deck. These bias currents are then set by means of C10 or C8.

HF voltage stabilisation

For the stabilisation of the HF currents, the voltage across S5 is half-wave rectified by diode GR2 and supplied to the d.c. voltage stabilisation circuit (the base of TS3). This base voltage may be adjusted by R6; the output voltage of the oscillator is also regulated by this means.

The stabilisation circuit works in the following way.

Let us assume that the output voltage of the oscillator is increasing, whereby the voltage across S5 becomes higher. The base voltage of TS3 now becomes more negative, with the result that the current through this transistor increases. The emitter voltage is kept constant by Zener diode GR1. Because of the heavier current through TS3, the voltage drop across R1 and R2 becomes greater and the base voltage of TS2 becomes less negative. The base and collector voltages of TS1 become less negative, which means that the supply voltage of the oscillator drops. Consequently the output voltage of the oscillator is brought back to its original level. If the HF output voltage drops, the opposite takes place.

Synchronisation when more channels are used

Here, two or more oscillator units are used. To prevent undesired interference frequencies, these units must be mutually synchronised. At the same time, care must be taken to ensure that the stabilisation of HF output voltages is equal. To this end, terminals 2, 3, 4 and 5 of all oscillator units are connected together.

As stated above, the value of the HF output voltage is partly determined by the value of the supply voltage. Connecting terminals 3 and 5 ensures that the base voltage of control transistors TS1 and TS2 of all units is equal. The supply voltages will then also be virtually equal. Connecting terminals 2 and 4 of the units windings S2 are connected in parallel via resistor R12. The oscillators thus connected will then oscillate at one common frequency.

D. CHECKING MEASUREMENTS

Measuring equipment required

24 V - 1 A stabilised supply unit (Philips PE 4805).
Valve voltmeter (Philips, type GM 6012).
Frequency counter (v.d. Heem, type 9908-3).
Oscilloscope (Philips, type GM 5602).
Multi-meter (AVO-meter).
Erase head, type EL 3941/01.
One recording head, type EL 3810/20.
One measuring resistor, 1 Ω ± 1 %.
Two measuring resistor, 10 Ω ± 1 %.

Note : The oscillator unit can, if necessary, also be measured outside the equipment by means of an EL 1465 "auxiliary measuring cassette". From the set of printed circuit boards supplied with the auxiliary cassette, find that one with the keyhole at the same point as the oscillator unit. Slide this board into the frame, slide the frame on the oscillator unit place in the cassette holder and slide the unit to be measured into the frame. All test points are now easily accessible, while the unit is measured under normal working conditions. For measuring the erasing and bias currents, the measuring resistor in the tape deck can then be used.

Oscillator frequency and output voltages

Erasing current

Connect the unit as shown in measuring diagram, Figure 1.
Connect the valve voltmeter and frequency counter to the 1 Ohm resistor.
Select such a value for C11, that the frequency is 94 kc/s ± 1 kc/s.
The voltage across the 1 Ohm resistor must be adjustable with the potentiometer R6 from ≤ 60 mV to ≥ 130 mV.
Set potentiometer R6 so that this voltage is 80 mV.

Bias current

Connect the valve voltmeter to the 10 Ohm measuring resistor connected to output terminals 13 - 14 (channel 1).
The voltage across this resistor must be adjustable with C9 from ≤ 10 mV ≥ 200 mV.
Close switch S (RE2 is actuated).
The output voltage may now be adjusted by C10.
Connect the valve voltmeter to the measuring resistor of output terminals 1 and 2 and repeat the measurements of channel 1.
The output voltage is adjustable by means of C7 or C8.

Synchronisation outputs

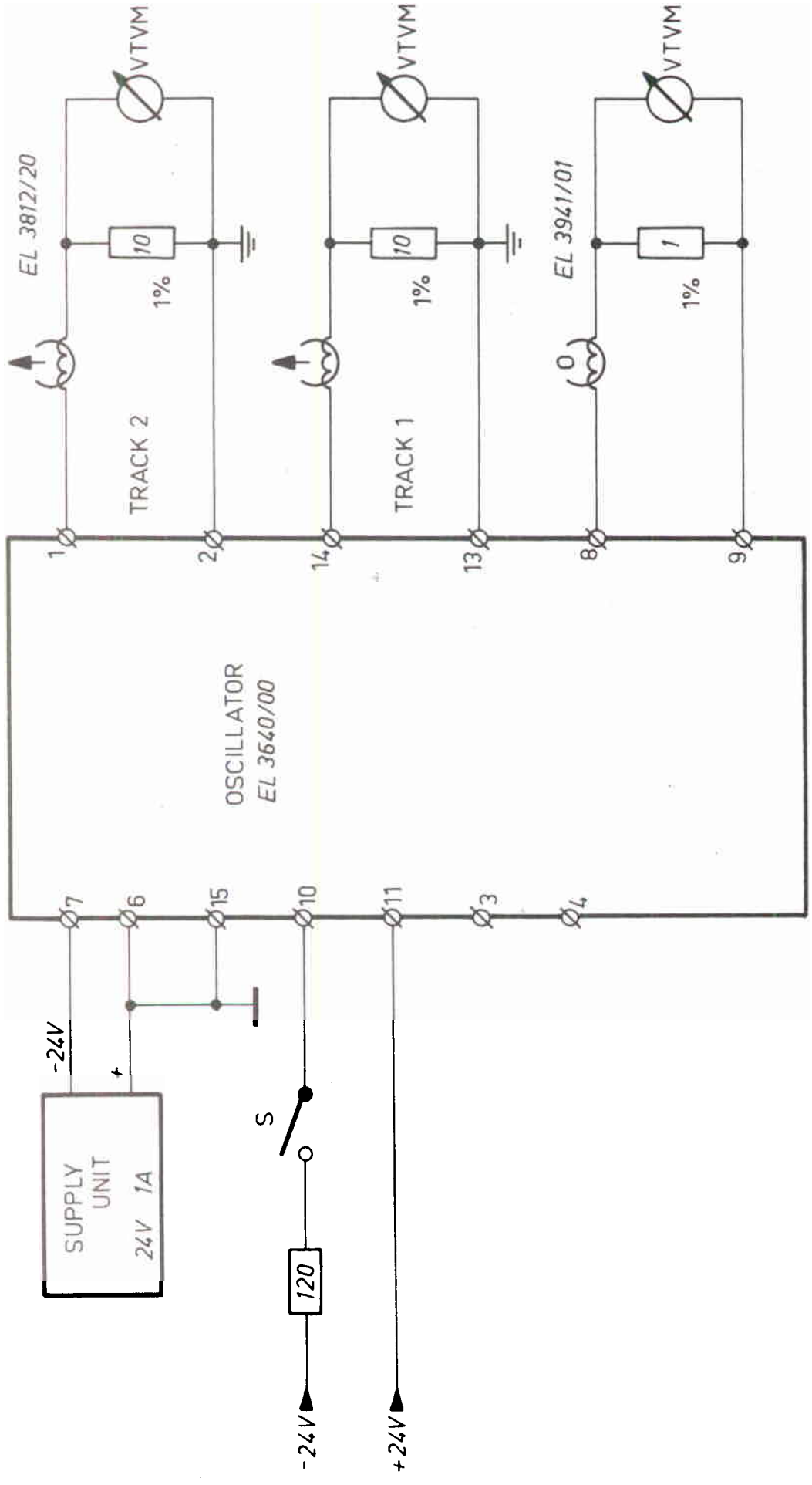
Measure the output voltage of terminals 4 and 2 (4 is the sensitive side) with the valve voltmeter. Value to be measured: 28...35 V.
Measure the d.c. voltage at terminals 3 and 5 with the multi-meter. Value to be measured: 12...15 V.

d.c. voltages

The transistor voltages given in the diagram (Fig. 3) are measured with the multi-meter in relation to zero volts.

E. LIST OF PARTS

Item.	Code number	Description			
	4822 163 01068	Transistor support			
T1	4822 200 00655	Oscillator coil			
RE1-2	R6 014 97	Relay			
TS1	OC 23	Transistor			
TS2	AC128	Transistor			
TS3	ASY27	Transistor			
TS4-TS5	ASZ15	Transistor			
GR1	BZY63	Zener diode			
GR2	BA100	Silicon diode			
Capacitors					
C1	906/68K	Polyester	68000 pF	125 V	10 %
C2	909/X64	Electrolytic	64 µF	40 V	
C3	4822 069 00701	Electrolytic	3.3 µF	15 V	
C4	909/C160	Electrolytic	160 µF	25 V	
C5-C6	4822 069 01068	Polyester	12000 pF	250 V	10 %
C7÷C10	4822 169 00635	Variable	750 pF		
C11	905/D...	Mica	(select value as required, see chapter D)		
Weerstanden					
R1	902/K1K5	Carbon	1500 Ω	0.25 W	5 %
R2	902/K5K6	Carbon	5600 Ω	0.25 W	5 %
R3	902/K10K	Carbon	10000 Ω	0.25 W	5 %
R4	902/K3K9	Carbon	3900 Ω	0.25 W	5 %
R5	902/K22K	Carbon	22000 Ω	0.25 W	5 %
R6	E 097 AC/20K	Adjustable potentiometer 20000 Ω			
R7-R8	902/K3K3	Carbon	3300 Ω	0.25 W	5 %
R9-R10	E 017 BC/B5E6	Carbon	5.6 Ω	0.25 W	5 %
R11	902/K130E	Carbon	130 Ω		



ERE 1664

Fig. 1

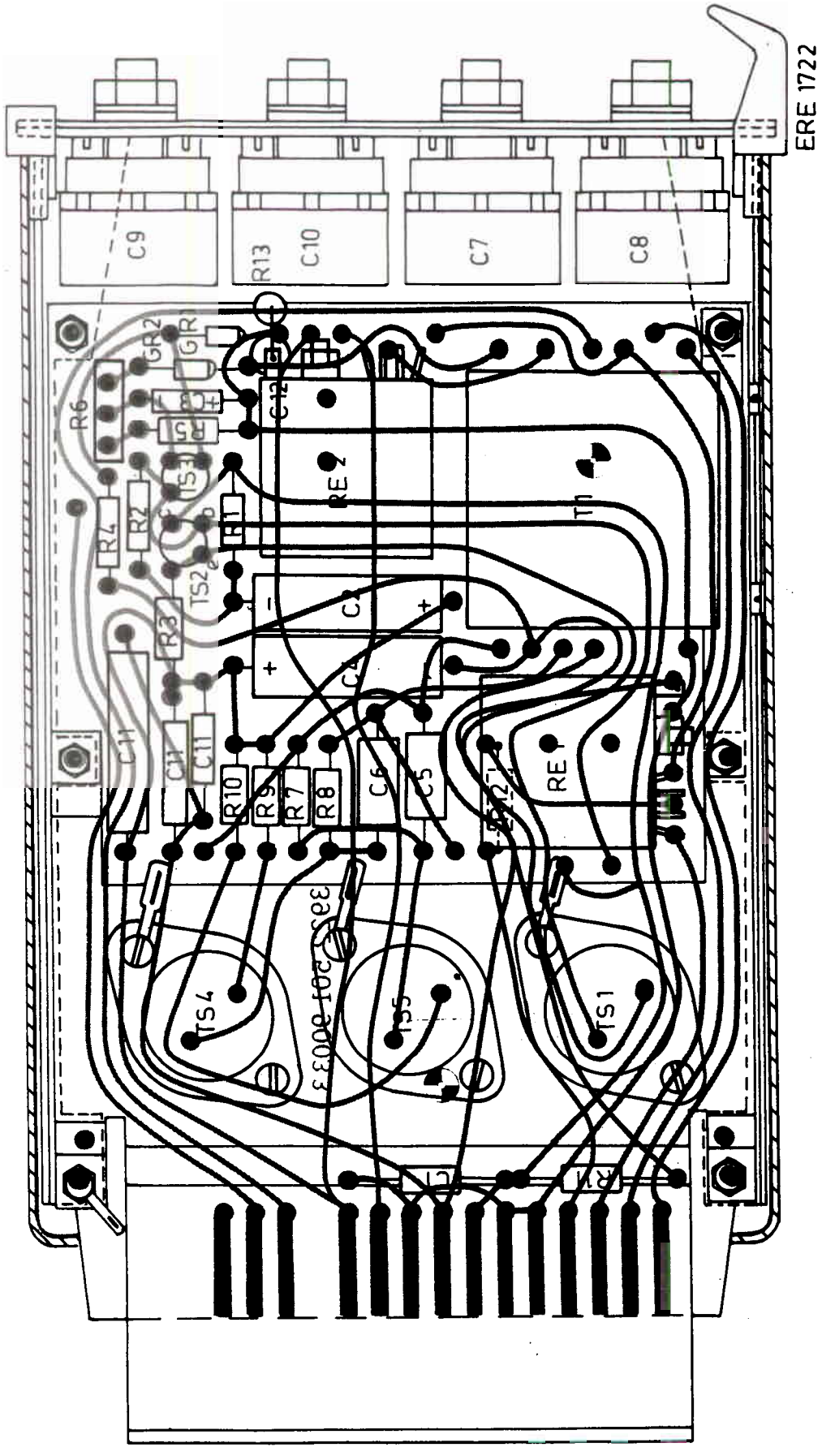

ERE 1722
C9
R13
C10
C7
C8
GR2
GR1
R6
R5
R4
R2
R1
C12
RE2
TH
TS3
TS2
C3
C4
R3
C14
C11
C13
R10
R9
R7
R8
C6
C5
RE1
TS4
TS5
TS1
C2
R11

Fig. 2

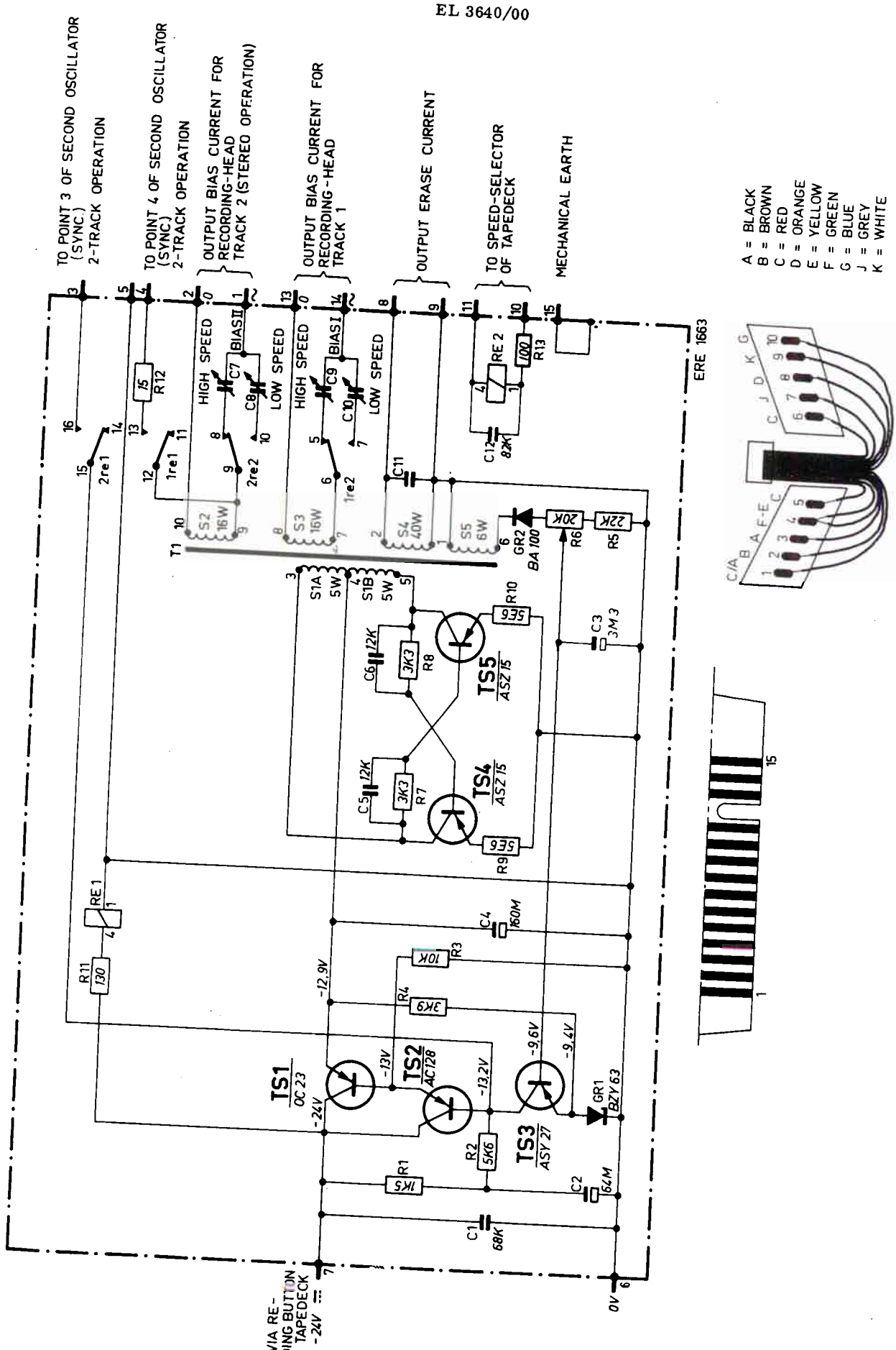

TO POINT 3 OF SECOND OSCILLATOR (SYNC.) 2-TRACK OPERATION
TO POINT 4 OF SECOND OSCILLATOR (SYNC.) 2-TRACK OPERATION
OUTPUT BIAS CURRENT FOR RECORDING-HEAD TRACK 2 (STEREO OPERATION)
OUTPUT BIAS CURRENT FOR RECORDING-HEAD TRACK 1
OUTPUT ERASE CURRENT
TO SPEED-SELECTOR OF TAPEDECK
MECHANICAL EARTH
HIGH SPEED
LOW SPEED
BIAS II
BIAS I
ERE 1663
TS1 OC 23
TS2 AC 128
TS3 ASY 27
TS4 ASZ 15
TS5 ASZ 15
GR1 BZY 63
GR2 BA 100
-24V
-12.9V
-13V
-13.2V
-9.6V
-9.4V
0V
VIA RE-CORDING BUTTON OF TAPEDECK -24V
A = BLACK
B = BROWN
C = RED
D = ORANGE
E = YELLOW
F = GREEN
G = BLUE
J = GREY
K = WHITE
T1 NG 866 99
(4822 200 00655)

Fig. 3

PHILIPS *Service*

PLAYBACK AMPLIFIER
EL 3642/01

4822 733 21579 15/269

SERVICE INFORMATION										

A. GENERAL INFORMATION

This slide-in amplifier incorporates equalisation filters according to IEC and NARTB standards. A2-position switch serves as a selector. The correction filters can be seperately adjusted at any tape speed and ensure a linear frequency response up to 15 kHz. The amplifier also incorporates a supply voltage stabiliser.

Technical data

Supply voltage	: 24 Vd.c.
Current consumption	: max. 35 mA output stage 17 mA
Supply voltage relay	: 24 Vd.c.
Input voltage at 1000 Hz for an output voltage of 2.5 V	: min. 1 mV
Input impedance	: matched to a playback head with an impedance of 40 mH.
Input	: asymmetrical
Output voltage at 1000 Hz and a distortion of 0.25 %	: 2.5 V
Back ground noise (peak value)	: -70 dB at 7½"/sec. -74 dB at 15"/sec.
Load impedance	: 120 Ω
Output impedance at 30 - 15000 Hz	: < 20 Ω
Equalisation: according to IEC	: 70 μ sec at 7½"/sec. 35 μ sec at 15 and 30"/sec.
according to NARTB	: 50 μ sec. and 3180 μ sec at 7½ and 15"/sec.
Compensation at 15 kHz adjustable between	: 0 dB and +7 dB
Frequency response	: see Figs. 4 and 5
Transistors	: 1 x AFY19 5 x ASY27 4 x BC109 1 x BFY11 1 x OC23 1 x 2N929
Zener diodes	: 1 x BZY63 1 x BZY59
Dimensions	: Width 34.5 mm (1 3/8") Height 125 mm (4 7/8") Depth 200 mm (7 7/8")

B. CONNECTIONS

1-2	Input
3	Earth
4-5	Not used
6	Electrical earth (+24 V)
7	-24 V supply voltage
9-10	Input of change-over relay for equalisation and filters
11-12	Output for remote control of the output voltage
13-14	Output
15	Mechanical earth

C. CIRCUIT DESCRIPTION

1. Stabilisation of the supply voltage

The supply voltage is stabilised by means of the voltage stabilising circuit formed by TS12 and TS13.
Stabilisation takes place as follows:
If for example the emitter voltage of TS12 becomes more negative, the base voltage of TS13 will also become more negative.
The emitter voltage of TS13 is kept at a constant level by means of Zener diode D2.
The current through TS13 increases. The voltage across R47 and R46 increases. This means that the base voltage of TS12 becomes less negative. As a result of this the d.c. resistance of the transistor increases and the supply voltage becomes less negative.
By means of C34 rapid change of the emitter voltage of TS12 are fed back to the base of TS13.

2. Amplifier

The amplifier consists of three amplifier stages:
- A pre-stage with equalisation filters
- An in termediate stage with gap correction filters
- An output stage.

The play-back head is connected to points 1 and 2. Point 2 is kept at a constant d.c. level by means of Zener diode D1. The input signal is amplified by means of the transistors TS1÷TS4.
Between the emitters of TS3 and TS1 a feedback filter is connected. This feedback filter has a time constant of 70 μ sec. From emitter-follower TS4 the signal is applied to the equalisation filters. These filters, in combination with the above mentioned correction filters, provide the correct time constants according to IEC and NARTB standards.
By means of interconnections which can be made on the printed circuit board more or less capacitors can be connected in parallel with the potentiometers R11 and R12. In this way it is possible to adapt the lower part of the frequency response curve of the amplifier to different types of heads (mono, stereo or two channel).
Potentiometers R11 and R12 serve for extra correction of the lower frequencies.
In the circuit diagram the connections to be made for the different tape speeds are indicated.
By means of SK1 the IEC or NARTB equalisation can be switched on.
The input of the intermediate stage, formed by TS5, TS6 and TS7, is provided with an LC series circuit.
This filter is tuned to the frequency of the bias current (94 kHz). This filter short-circuits any bias signals induced in the play back amplifier. Between the collector of TS7 and emitter of TS5 a frequency-dependent feed back filter is incorporated (for adjusting the higher frequencies). This filter consists of R21, R20, R19, C17÷C21 and is so dimensioned that gap lasses are compensated for.
For the tape speeds 7.5" and 15" this filter can be adjusted by means of SK2 and SK3a.
For the tape speeds 15" and 30" this filter can be adjusted by means of SK2 and SK3b.
The signal is applied to the output stage via: potentiometer R28 (for the high tape speeds) or R29 (for the low tape speeds), interconnections between 11 and 12 and via C27 in parallel with R27 and C26 (for NARTB) or C27 and C26 in parallel (for IEC).
According to NARTB standards the lower frequencies are attennuated by about 4 dB at 48 Hz (time constant of 3180 μ sec).
The output transistors TS10 and TS11 are connected in single ended push pull (class B).
The collector current is adjusted to a no-load current of 17 mA with R37.

In this way the distortion is reduced to a minimum. The output voltage is fed back by means of the resistors R38 and R39 to the emitter of TS8.

D. CHECKING AND ADJUSTING

Required measuring equipment.

. Stabilised power supply 24 V - 1 A	e.g. Philips PE4805
. Signal generator	e.g. Philips GM2317
. Valve voltmeter	e.g. Philips GM6012
. Distortion meter	e.g. Radiometer type BKF5
. Oscilloscope	e.g. Philips GM5602
. d.c valve voltmeter	e.g. Philips GM6020
. Playback head	EL 3813/00
. Measuring resistor	120 Ω ± 5 %

Note

If required, the amplifier can also be measured externally by means of an adapter unit EL 1465. From the p.c. boards supplied with the adapter unit, the board having the slot in the same place as the playback amplifier should be taken. Slide this board into the frame, slide this frame into the machine and slide the amplifier onto the unit. All check points and trimming potentiometers are now readily accessible, while the unit is measured under normal operating conditions.

Warning

The cabinet of the amplifier is made of mu-metal. Make sure that the amplifier is always refitted in the same cabinet.

OUTPUT STAGE

1. No-load current of the output stage

. Connect the amplifier as shown in Fig.1 except for the generator.
. Connect a d.c. valve voltmeter between the emitter of TS10 and the emitter of TS11.
. Adjust R37 so that the meter indicates 90 mV.
. Measure the current consumption; this should be 17 mA.

2. Sensitivity output stage

. Connect the amplifier as shown in Fig.1.
. Adjust the output of the generator to 75 mV at 1000 Hz.
. The output voltage should be 1 - 1.2 V (≈10 mW + 10 dBm)

3. Frequency response of the output stage

. Connect the unit as shown in Fig.1.
. Adjust the generator so that the output voltage of the amplifier is 1 V at 1000 Hz.
. Keep the input voltage constant and measure the frequency response.

f. (Hz)	position SK1 IEC	NARTB
31.5	-1	-6
50	-0.4	-3.2
1000	0	0
15000	-0.2	-0.2

tolerance ± 0.5 dB
at 30 Hz ± 1 dB

4. Noise level output stage

. Except for the generator connect the amplifier as shown in Fig. 1.
. Connect a resistor of 5 kΩ, 5 % between points 12 and 13.
. Set SK1 to position NARTB.
. The output voltage should be less than 0.2 mV (r.m.s.)

5. Distortion output stage

. Connect the amplifier as shown in Fig. 1.
. Also connect a distortion meter across the load resistor.
. Adjust the generator so that the output voltage is 2.5 V at 1000 Hz.
. Measure the distortion of the output voltage; this should be less than 0.25 %.

6. Overall sensitivity

. Connect the amplifier as shown in Fig. 2.
. Set SK1 to position IEC.
. Do not energine RE1.
. Turn potentiometers R11, R12, R28 and R29 fully clockwise.
. Adjust the input voltage to 41 mV at 1000 Hz.
. The output voltage should be 1.0 to 1.2 V (≈10 mW, +10 dBm)

7. Frequency response curves according to IEC

. Connect the amplifier as shown in Fig. 3.
. Turn the potentiometers R11, R12, R28 and R29 fully clockwise.
. Adjust the input voltage at 1000 Hz so that the output voltage is 0.8 V.
. Measure the output voltage as a function of the frequency.
The frequency response curves are shown in Fig. 4.
Tolerance ± 0.5 dB at 30 Hz ± 1 dB.
For each curve the control range of the treble switches SK2 and SK3 are given.
At each step of these switches the output voltage should change 1.3 - 1.8 dB.
- means fully anti-clockwise.
+ means fully clock-wise.

8. Frequency response curves according to NARTB

. Thes curves are measured in the same way as described under "7".
. However, SK1 must be set to position NARTB.
. Fig. 5 shows the curves. They are the same for all tape speeds. Tolerance 0.5 dB.
at 30 Hz ± 1 dB.
At each step of SK2 and SK3 (treble) the output voltage changes 1.3 - 1.8 dB.

8. Noise level

. Connect a properly screened playback head EL 1813/00 to the input terminals 1 and 2.
. Turn the switches SK2 and SK3 fully anti-clockwise.
. Turn the potentiometers R11 and R12 fully anti-clockwise and the potentiometers R28 and R29 (Level) fully clockwise.
. Interconnect terminals 11 and 12.
. Connect a valve voltmeter to the output terminals 13 and 14.
. Measure the output voltages under the following conditions.

SK1	Connections	Tape speed	Output voltage noise r.m.s	peak
IEC	7.5"-15"	7.5"	< 2 mV	< 1.5 mV	< 2.5 mV
IEC	7.5"-15"	15"	< 1.5 mV	< 1 mV	< 1.6 mV
IEC	15" -30"	15"	< 1.5 mV	< 1 mV	< 1.6 mV
IEC	15" -30"	30"			
NARTB	15" -30"	30"	< 1.7 mV	< 1.2 mV	< 2 mV

9. Absorption circuit

. Connect the signal generator to the terminals 1 and 2.
. Set SK1 to position IEC, RE1 not energised
. Interconnect terminals 11 and 12.
. Turn potentiometer R28 fully clockwise.
. Set SK2 to position 4.
. Connect a capacitor of 47 pF in series with a resistor of 100 kΩ between terminals 13 and 14.
. Connect a valve voltmeter across the above mentioned resistor.
. Adjust the generator to exactly 94.5 kHz. (check this frequency by means of a frequency counter) at 100 mV.
. Adjust L1 in such a way that the output voltage is < 3 mV.

10. Voltages given in the circuit diagram

The voltage given in the diagram near the transistor connections are direct voltages measured with respect to 0 V.
The voltage values followed by a "~" sign are alternating voltages. To measures these, connect the amplifier as shown in Fig.2. The output voltage of the generator should be 90 mV at 1000 Hz.

E. LIST OF PARTS

Item	Code number	Description			
	4822 255 40006	Transistor support			
L1	4822 158 20147	Coil 3.5 mH			
SK1	4822 277 20004	Switch			
SK2-SK3	4822 273 40222	Switch 2 pole, 6 pos.			
RE1	4822 280 70004	Relay			
TS1÷TS4	4822 130 40239	Transistor BC109			
TS5÷TS7	4822 130 40269	Transistor ASY27			
TS8	4822 130 40092	Transistor ASY29			
TS9	4822 130 40269	Transistor ASY27			
TS10	4822 130 40283	Transistor AFY19			
TS11	4822 130 40327	Transistor BFY11			
TS12	4822 130 40276	Transistor OC23			
TS13	4822 130 40269	Transistor ASY27			
D1	4822 130 30132	Zener diode BZY59			
D2	4822 130 30245	Zener diode BZY63			
Capacitors					
C1	4822 120 60098	470 pF	500 V	5 %	Mica
C2	4822 121 50234	6K8		1 %	Polyester
C3	4822 124 20422	1500 µF	4 V		Electrolytic
C4	4822 124 20368	32 µF	10 V		Electrolytic
C5	4822 124 20078	125 µF	16 V		Electrolytic
C6	4822 121 40072	82 K	100 V		Polyester
C7-C8-C9	4822 120 40169	220 K	100 V		Polyester
C10	4822 121 40072	82 K	100 V		Polyester
C11	4822 121 50234	68 KpF	63 V	1 %	Polyester
C12	4822 121 50089	3900 pF	63 V	1 %	Polyester
C13	4822 124 20368	32 µF	10 V		Electrolytic
C14	4822 120 60105	820 pF	500 V	1 %	Mica
C15	4822 120 20074	56 pF	500 V		Ceramic
C16	4822 120 60065	27 pF	500 V	1 %	Mica
C17	4822 120 60112	1500 pF	125 V	1 %	Polyester
C18	4822 120 60118	2700 pF	125 V	1 %	Polyester
C19	4822 120 41123	3900 pF	63 V	1 %	Polyester
C20	4822 121 50299	5100 pF	63 V	1 %	Polyester
C21	4822 121 50234	6800 pF	63 V	1 %	Polyester
C22	4822 121 50355	9100 pF	63 V	1 %	Polyester
C23	4822 124 20395	200 µF	10 V		Electrolytic
C24	4822 124 20389	160 µF	25 V		Electrolytic
C25, C26	4822 124 20344	2,5 µF	16 V		Electrolytic
C27	4822 121 40095	150 KpF	100 V		Polyester
C28	4822 124 20379	80 µF	16 V		Electrolytic

Item	Code number	Description			
C29	4822 124 20402	320 µF	6.4 V		Electrolytic
C30	4822 120 60107	1000 pF	500 V	5 %	Mica
C31	4822 124 20371	40 µF	16 V		Electrolytic
C32	4822 124 20403	400 µF	16 V		Electrolytic
C33	4822 124 20384	80 µF	25 V		Electrolytic
C34	4822 124 20366	25 µF	25 V		Electrolytic
C35	4822 124 20374	50 µF	40 V		Electrolytic
C36	4822 121 40072	82 KpF	125 V		Polyester
Resistors					
R1, R3	4822 116 50463	10 kΩ	0.125 W	1 %	Carbon
R5	4822 111 20025	68 kΩ	0.125 W	1 %	Carbon
R6	4822 111 20044	27 kΩ	0.125 W	1 %	Carbon
R11, R12	4822 101 1074	22 kΩ			Potentiometer
R13	4822 116 50463	10 kΩ	0.125 W	1 %	Carbon
R14	4822 116 50158	5100 Ω	0.125 W	1 %	Carbon
R15	4822 116 50119	12 kΩ	0.125 W	1 %	Carbon
R17	4822 116 50463	10 kΩ	0.125 W	1 %	Carbon
R20	4822 111 20022	3900 Ω	0.125 W	1 %	Carbon
R21	4822 116 50463	10 kΩ	0.125 W	1 %	Carbon
R28	4822 101 30073	22 kΩ	Potentiometer log.		
R29	4822 101 30073	22 kΩ	Potentiometer log.		
R30	4822 110 60152	47 kΩ	0.125 W	1 %	Carbon
R31	4822 116 50106	39 kΩ	0.125 W	1 %	Carbon
R32	4822 110 60085	150 Ω	0.125 W	1 %	Carbon
R37	4822 101 10005	1000 Ω	Potentiometer		
R38, R39	4822 116 50117	4700 Ω	0.125 W	1 %	Carbon

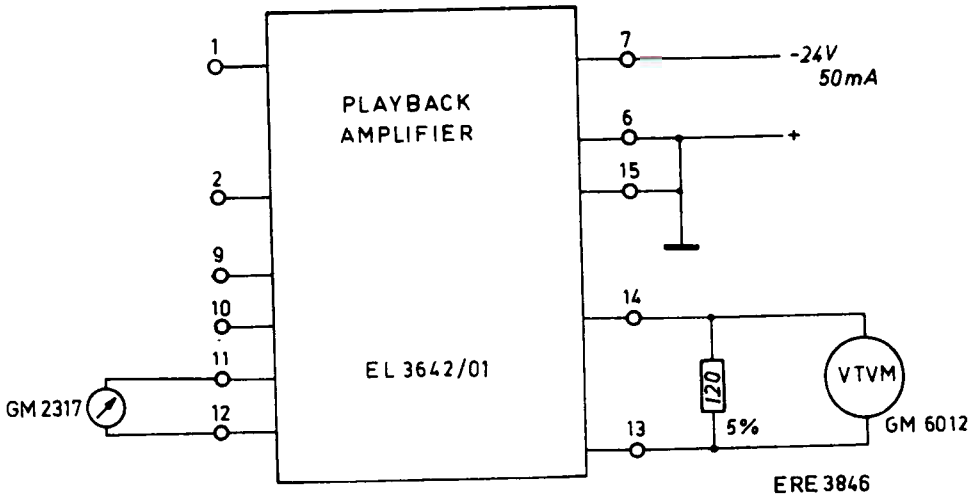


Fig. 1

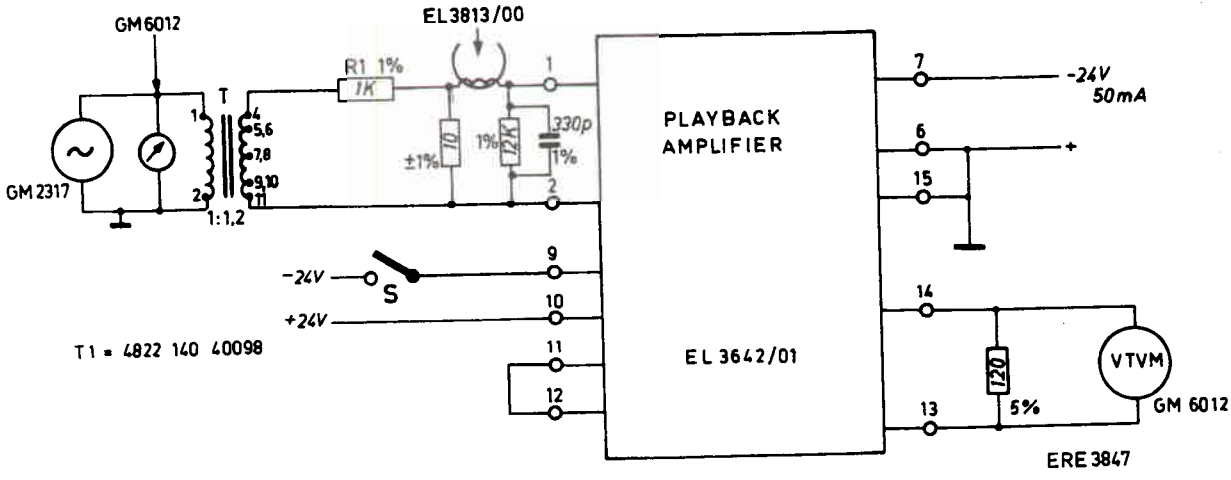


Fig. 2

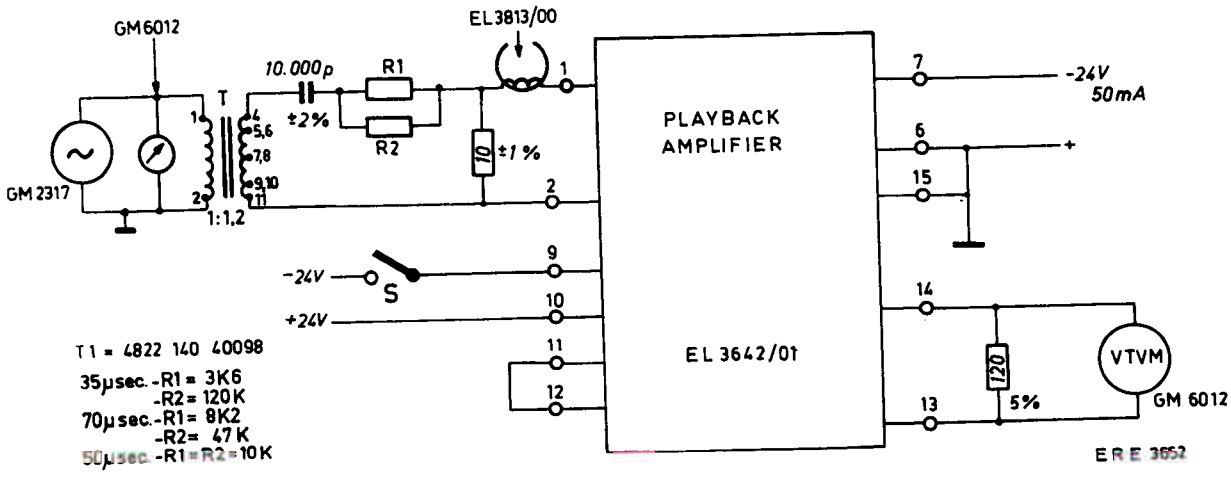


Fig. 3

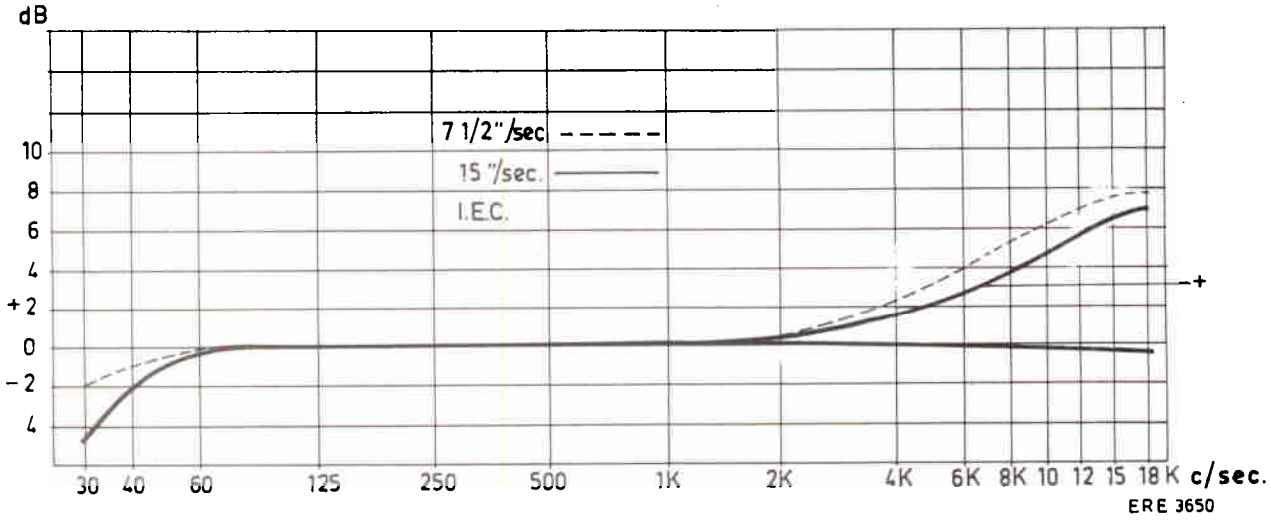

dB
7 1/2"/sec
15 "/sec.
I.E.C.
10
8
6
4
+2
0
−2
4
30 40 60 125 250 500 1K 2K 4K 6K 8K 10 12 15 18K c/sec.
ERE 3650

Fig. 4

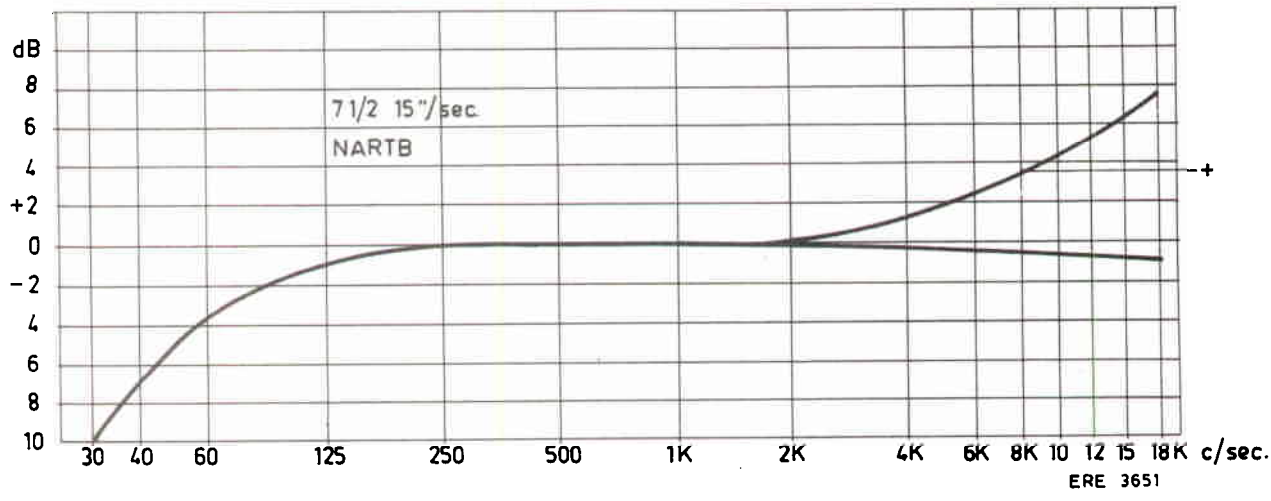

dB
7 1/2 15"/sec.
NARTB
8
6
4
+2
0
−2
4
6
8
10
30 40 60 125 250 500 1K 2K 4K 6K 8K 10 12 15 18K c/sec.
ERE 3651

Fig. 5

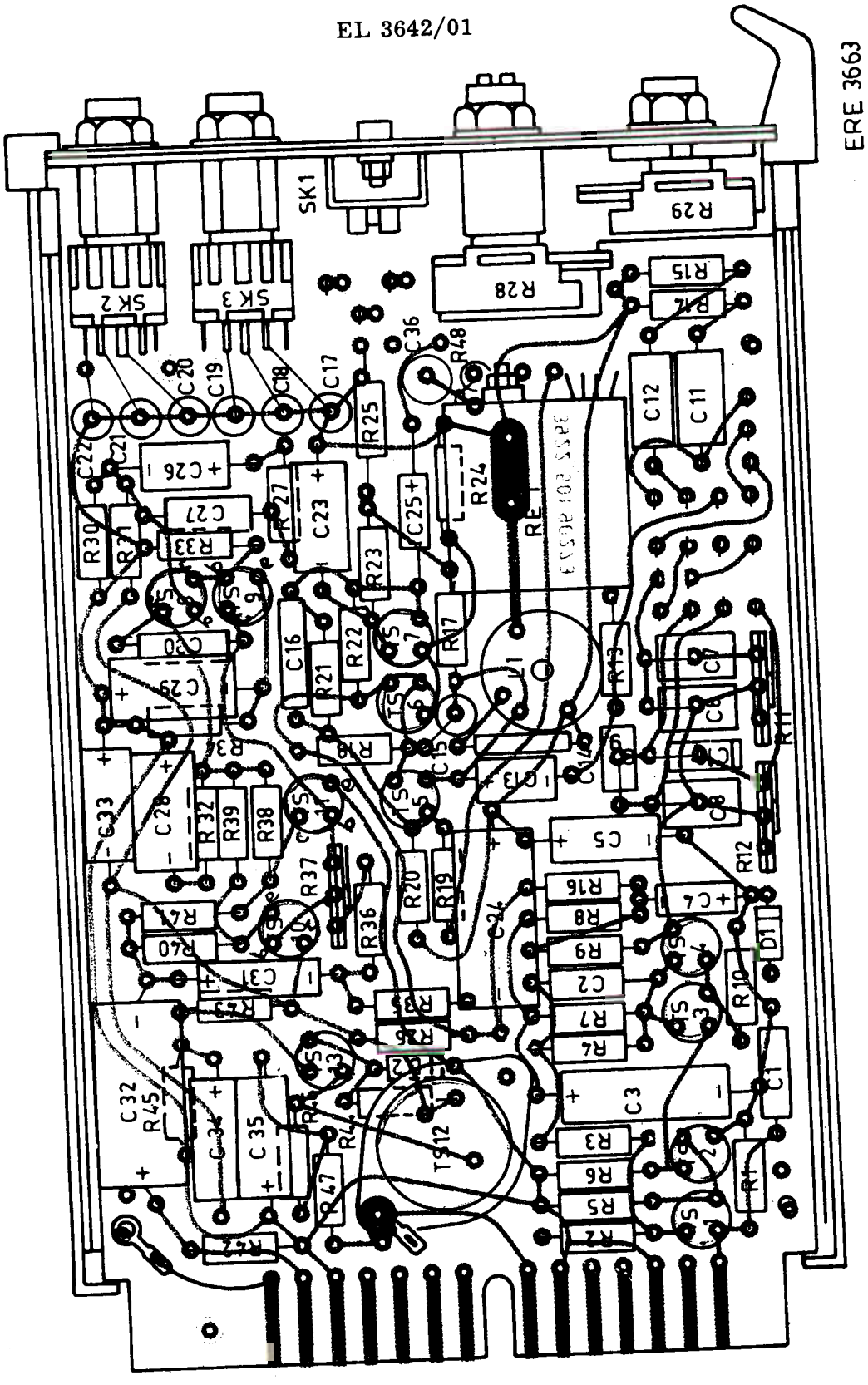

ERE 3663
SK1
SK2
SK3
R29
R28
R15
R12
C36
R48
C20
C19
C18
C17
R25
C12
C11
C22
C21
C26
C27
R27
C23
C25
R24
R1
R30
R31
R33
R23
R22
R17
C16
R21
C30
C29
R18
C15
R13
C7
C6
C8
R11
C33
C28
R32
R39
R38
R37
R20
R19
C24
C13
C5
R16
C4
R12
R8
R9
C2
R7
R4
R40
C31
R36
R35
R34
R42
C32
R45
C34
C35
R44
R43
T312
R47
R46
C3
R3
R6
R5
R2
C1
R10
D1
R14

Fig. 6

PHILIPS *Service*

EL 3641
ERE 1729

RECORDING AMPLIFIER

EL 3641/00

93 788 41.1-10 1/966

SERVICE INFORMATION

A. GENERAL

This slide-in recording amplifier has a two-stage amplifier section and a stabilised power-supply. The LC correction filters are adjustable for each tape speed.

Technical Data

Supply voltage	: 24 V
Current consumed	: 32 mA
Supply voltage for relay	: 24 V
Input	: asymmetric, one side connected to earth
Minimum input voltage for fully modulated tape at 1000 c/s	: 0.5 V
Input impedance (30...15,000 c/s)	: $\geq$ 5 kΩ
Source impedance	: $\leq$ 1 kΩ
Max. recording current	: 6.5 mA (adjustable)
Distortion at 1000 c/s	: <0,3 %
Compensation at 15 kc/s adjustable for	
$7\frac{1}{2}$"/sec. between	: 0 dB and +20 dB
for 15"/sec. between	: 0 dB and +13 dB
for 30"/sec. between	: 0 dB and +8 dB
Frequency response curves	: see Figs. 2, 3 and 4
Transistors	: 3x ASY27 2x ASY80 1x OC23 2x 2N929
Zener diode	: 1x BZY63
Dimensions	: width 1 3/8" height 4 7/8" depth 7 7/8"

B. CONNECTIONS

1-2	input
3...5	blank
6	electrical earth (+24 V)
7	-24 V supply voltage
8	blank
9-10	input of change-over relay of compensation filters
11-12	blank
13-14	output
15	mechanical earth

C. CIRCUIT DESCRIPTION

1. Supply voltage stabilisation

TS7 and TS8 stabilise the supply voltage and when employing several units, they prevent these units from influencing each other.
Stabilising is effected as follows: If the emitter voltage of TS7 (the supply voltage of the amplifier) becomes more negative, the base voltage of TS8 will also become more negative. The current through this transistor increases, as the emitter voltage of TS8 is kept constant with GR1. Due to the larger current through TS8 the voltage drop across R34 and R35 increases, the base voltage of TS7 becomes less negative and the emitter current decreases. Because the emitter current decreases the d.c. resistance of this transistor increases and the supply voltage is restored to its original value.

2. Amplifier

The amplifier comprises 2 amplifier stages viz.:
- a pre-amplifier stage with the correction filters
- an output stage

The input stage consists of transistors TS1 and TS2.
TS1 is a low-noise NPN transistor, so that also in case of small input signals, e.g. when employing sensitive tapes, a large signal-to-noise ratio is obtained. The modulation depth is adjusted with control R1 for low tape speeds and with R2 at high tape speeds. Between TS2 and TS3 a frequency-independent filter is inserted in order to obtain the required correction of the recording current.
The smaller the impedance of this filter circuit, the larger the signal applied to TS3.
If SK1 is in position 15/30", this filter basically consists of LC series circuit L1 and C7 with adjusting potentiometer R15, in parallel to which part of R17 is connected.
For frequencies up to approx. 1000 c/s (dependent on the position of R15 and R17) the impedance of the filter is determined only by the ohmic resistance of R17. Up to approx. 8000 c/s (also dependent on the position of R15-R17) this impedance is determined by parallel circuit C7-R17.
At increasing frequencies this impedance becomes smaller and the biasing current fed to TS3 increases. Above 8000 c/s the series impedance will further decrease according as the frequency approximates the resonant frequency of the LC circuit.
Adjusting potentiometer R15 also determines the quality factor Q of the LC circuit; this

means that the amplification at these frequencies is adjustable with R15. R13 ensures minimum clamping of this circuit, since otherwise the amplification would become excessively high. Relay RE1 automatically selects the correct filter for 15 or 30"/sec. tape speed (or $7\frac{1}{2}$ and 15"/sec., dependent on the position of SK1).

In the output stage, formed by transistors TS3, TS4 and TS5, a frequency-independent negative feedback circuit is inserted between the emitter of TS5 and the base of TS3 in position IEC of SK2. In position NARTB of this switch C10 is included in this circuit.

As a result the feedback decreases at the low frequencies and the gain thus increases. The time constant of this filter amounts to 3150 μsec according to NARTB standards.

The recording current is applied to the recording head via C13, output terminals 14 and 13. R30 closes the charging current circuit of C13, so that no charging or discharging currents can occur when fitting or removing the head assembly.

The d.c. current resistance of transistor TS6 is approx. 1000 Ω and the a.c. current resistance is very high.

The output resistance is formed by the parallel connection of R28 and R29 and is 2.5 kΩ. This impedance is high with respect to the impedance of the recording head, so that the amplifier can be considered as a current source.

D. CHECKING MEAUSUREMENTS

Recommended measuring equipment

. Stabilised power supply 24 V - 50 mV (PHILIPS PE 4805)
. Signal generator (PHILIPS type GM 2317)
. Valve voltmeter (PHILIPS type GM 6012)
. Distortion meter (Radiometer type BKF5)
. Oscilloscope (PHILIPS type GM 5602)
. Multimeter (AVO-meter)
. 1x Recording head EL 3810/00
. 1x Measuring resistor 100 ohms $\pm$ 1 %
. 1x Measuring resistor 10 ohms $\pm$ 1 %

Note: The recording amplifier unit can also be checked outside the equipment with the aid of a so-called measuring auxiliary casette. From the adapter prints delivered with the auxiliary casette, select the print with the slotted hole at the same place as the amplifier unit. Slide this plate into the frame, slide this frame in the casette holders in the place of the amplifier and slide the unit to be tested into the frame.

All test points are now readily accessible, whilst the unit can be checked under normal operating conditions. For measuring the premagnetisation and recording currents use can be made of the measuring resistors provided in the tape deck.

Sensitivity

. Connect the recording amplifier as shown in Fig. 1.
. Turn controls R1 and R2 clockwise and R16 and R17 fully counter-clockwise.
. Adjust the input voltage at 1000 c/s to 275 mV.
. The output voltage should now be 200-300 mV.
. Close switch S (RE1 is then energised).
. The output voltage should now be 200-300 mV again.

Distortion

. Adjust the input voltage at 1000 c/s so that the output voltage is 650 mV.
. Check that the distortion is < 0.3 %.

Frequency response curves according to IEC, at 7½-15"/sec.

. Replace the 100 ohm measuring resistor by a 10-ohm one.
. Set SK1 in position 7½/15" and SK2 in position IEC.
. Adjust the input voltage at 500 c/s so that the output voltage is 3 mV.
. Measure the output voltage as a function of the frequencies in the various positions of potentiometers R14 and R16.
. The frequency response curves are shown in Fig. 2.
Tolerance ± 0.5 dB.
The control range of potentiometers R14 and R16 is indicated as follows:
- means potentiometer fully counter-clockwise
+ means potentiometer fully clockwise

Frequency response curves according to IEC at 15-30"/sec.

These are measured as described above, however:
. SK1 should be in position 15/30"sec.
. The frequency response curves are shown in Fig. 3, in which the control ranges of R15 and R17 are indicated.

Frequency response curve according to NARTB

. This measurement is effected as above, whereby SK2 must be in position NARTB.
In Fig. 4 the frequency response curve is shown.
This curve is measured only with the potentiometers turned fully clockwise. This is because the NARTB correction only relates to the low frequencies.

Interference level

. Remove the signal generator, the recording head and the 10-ohm or 100-ohm measuring resistor.
. Turn potentiometers R1, R2, R16 and R17 fully counter-clockwise.
. Place the amplifier in a properly earthed metal box.
. Measure the output voltage at connection terminals 13-14. This voltage should be 0.15 mV.

Direct voltages

The d.c. settings of the transistors given on the circuit diagram (Fig. 6) are measured with a multimeter with respect to 0 V.

E. LIST OF PARTS

Item	Code number	Description			
	4822 163 01068	Transistor support			
L1	4822 200 00658	Coil 13 mH			
SK1-SK2	R7 429 93	Switch			
RE1	R6 014 97	Relay			
TS1	2N929	Transistor			
TS2	ASY27	Transistor			
TS3	2N929	Transistor			
TS4	ASY27	Transistor			
TS5-TS6	ASY80	Transistor			
TS7	OC23	Transistor			
TS8	ASY27	Transistor			
GR1	BZY63	Zener diode			
Capacitors					
C1	909/A6.4	Elco	6.4 µF	16 V	
C2	4822 069 00669	Elco	320 µF	6.4 V	
C3	4822 069 01004	Elco	250 µF	25 V	
C4	C 295 AH/C3K9	Polyester	3900 pF	63 V	2 %
C5-C6	4822 069 00838	Polyester	4700 pF	63 V	2 %
C7	C 295 AA/C2K7	Polyester	2700 pF		2 %
C8	909/A6.4	Elco	6.4 µF	16 V	
C9	905/D470E	Mica	470 pF		5 %
C10	4822 069 00864	Polyester	1.2 µF	250 V	10 %
C11-C12	909/A100	Elco	100 µF	6.4 V	
C13	4822 128 00256	Elco	16 µF	64 V	
C14	909/A100	Elco	100 µF	6.4 V	
C15	4822 069 00669	Elco	320 µF	6.4 V	
C16	4822 069 00592	Elco	80 µF	25 V	
C17	909/C25	Elco	25 µF	25 V	
C18	4822 069 01018	Elco	160 µF	40 V	
	909/V18,4	Plastic mounting support for C18			
C19	906/82K	Polyester	82000 pF	400 V	10 %
Resistors					
R1-R2	916/GL20K	Potentiometer	20000 Ω log.		
R3	902/K12K	Carbon	12000 Ω	0.25 W	5 %
R4	902/K82K	Carbon	82000 Ω	0.25 W	5 %
R5	902/K100E	Carbon	100 Ω	0.25 W	5 %
R6	902/K180E	Carbon	180 Ω	0.25 W	5 %
R7	902/K1K	Carbon	1000 Ω	0.25 W	5 %
R8	902/K4K7	Carbon	4700 Ω	0.25 W	5 %
R9	902/K330E	Carbon	330 Ω	0.25 W	5 %
R10	902/K330E	Carbon	330 Ω	0.25 W	5 %
R11-R12-R13	902/K1K2	Carbon	1200 Ω	0.25 W	5 %

Item	Code number	Description			
R14-R15	E 097 AC/5K	Adjusting potentiometer	5000 Ω		
R16-R17	4822 071 00892	Wire-wound potentiometer	10000 Ω lin.		
R18	902/K39K	Carbon	39000 Ω	0.25 W	5 %
R19	902/K10K	Carbon	10000 Ω	0.25 W	5 %
R20	902/K2K2	Carbon	2200 Ω	0.25 W	5 %
R21	902/K4K7	Carbon	4700 Ω	0.25 W	5 %
R22	902/K3K9	Carbon	3900 Ω	0.25 W	5 %
R23	902/K10K	Carbon	10000 Ω	0.25 W	5 %
R24	902/K4K7	Carbon	4700 Ω	0.25 W	5 %
R25	902/K120E	Carbon	120 Ω	0.25 W	5 %
R26	902/K82E	Carbon	82 Ω	0.25 W	5 %
R27	902/K100E	Carbon	100 Ω	0.25 W	5 %
R28	902/K3K9	Carbon	3900 Ω	0.25 W	5 %
R29	902/K6K8	Carbon	6800 Ω	0.25 W	5 %
R30	902/K33K	Carbon	33000 Ω	0.25 W	5 %
R31	902/K5K6	Carbon	5600 Ω	0.25 W	5 %
R32	902/K4K7	Carbon	4700 Ω	0.25 W	5 %
R33	902/K8K2	Carbon	8200 Ω	0.25 W	5 %
R34	902/K5K6	Carbon	5600 Ω	0.25 W	5 %
R35	902/K1K5	Carbon	1500 Ω	0.25 W	5 %
R36	902/K100E	Carbon	100 Ω	0.25 W	5 %
R37-R38	902/K22K	Carbon	22000 Ω	0.25 W	5 %

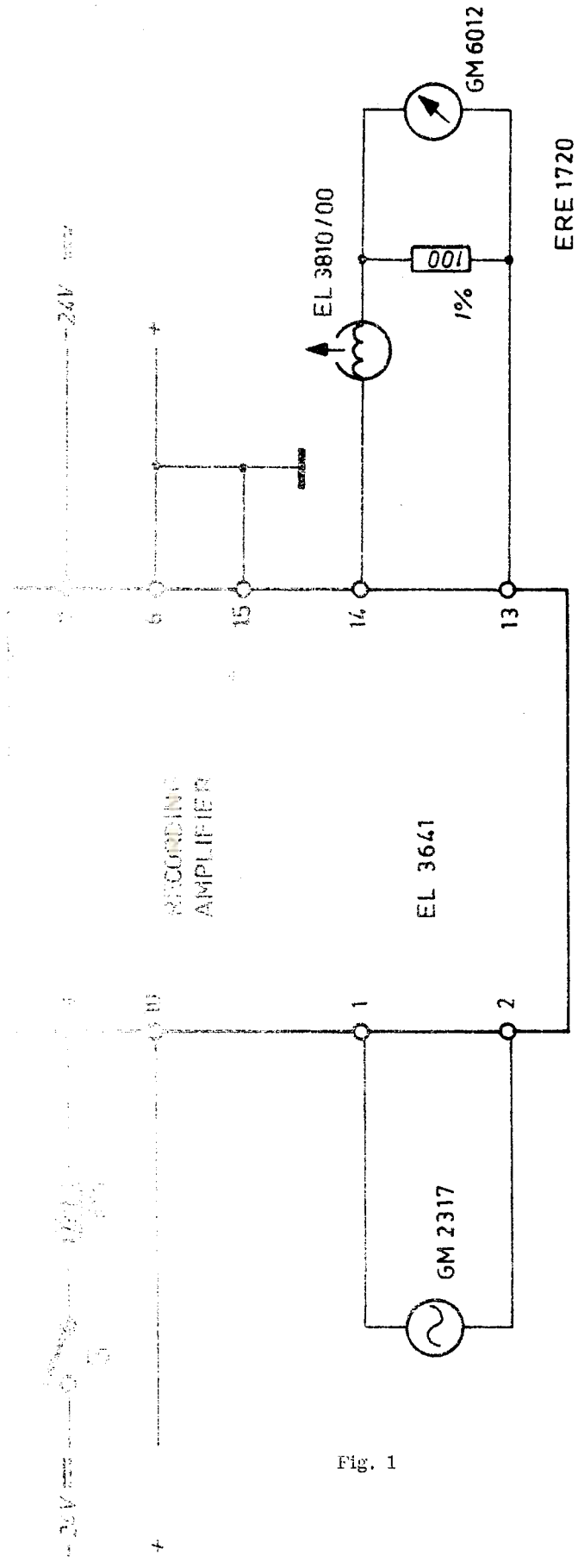
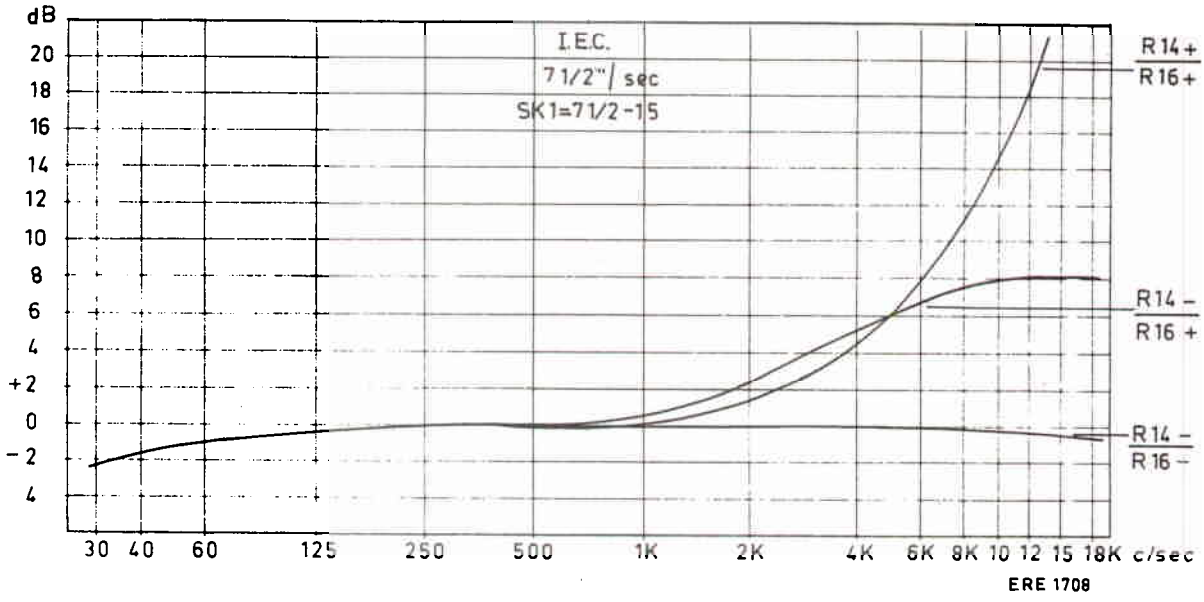


Fig. 1


dB
20
18
16
14
12
10
8
6
4
+2
0
−2
4
I.E.C.
7 1/2" / sec
SK 1=7 1/2-15
R 14 +
R 16 +
R 14 −
R 16 +
R 14 −
R 16 −
30 40 60 125 250 500 1K 2K 4K 6K 8K 10 12 15 18K c/sec
ERE 1708

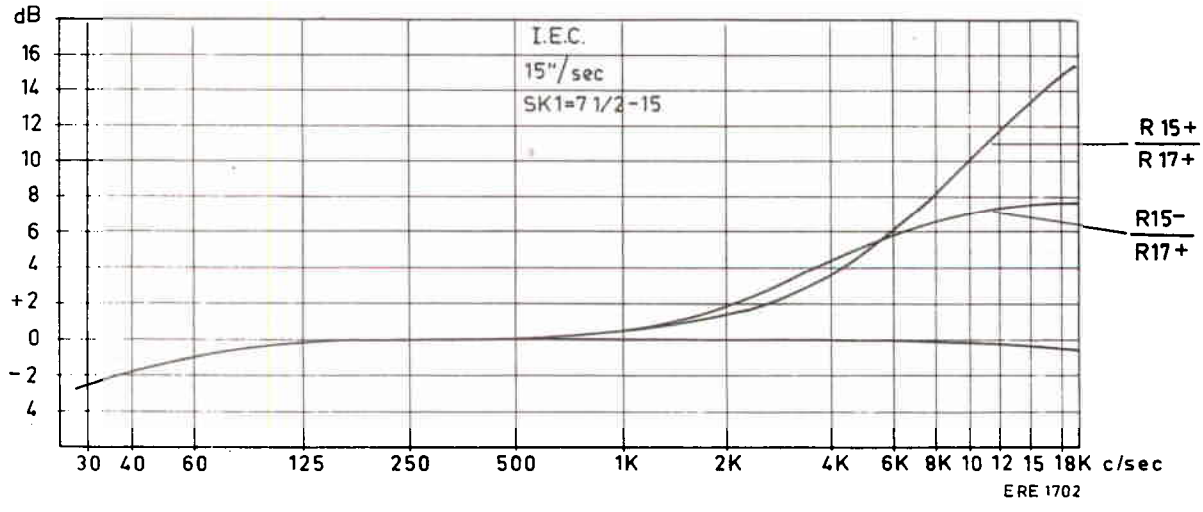
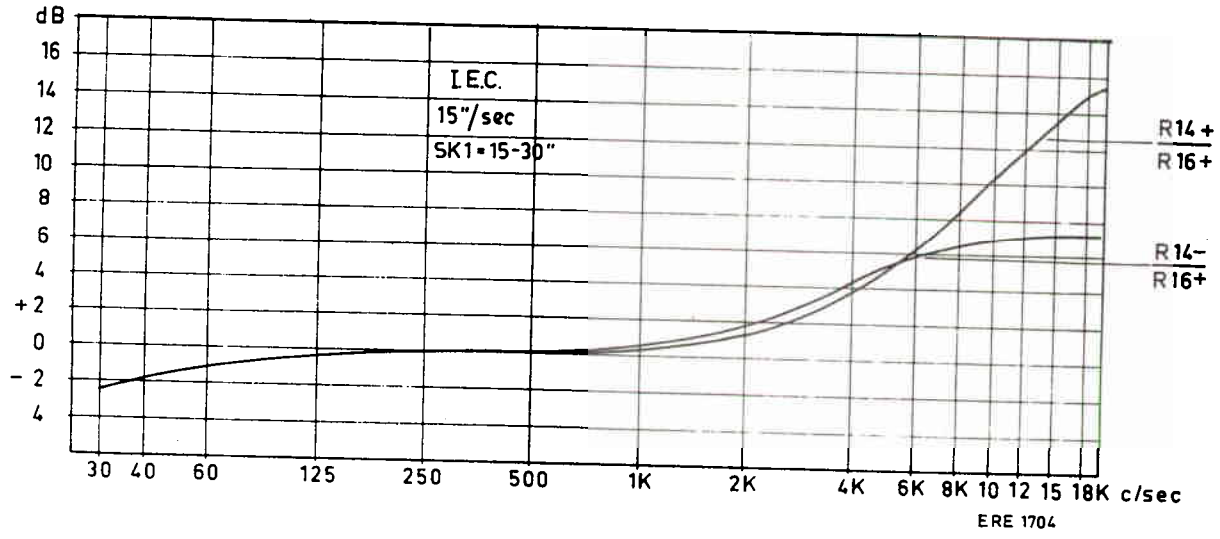

dB
16
14
12
10
8
6
4
+2
0
−2
4
I.E.C.
15" / sec
SK 1=7 1/2-15
R 15+
R 17+
R15−
R17+
30 40 60 125 250 500 1K 2K 4K 6K 8K 10 12 15 18K c/sec
ERE 1702

Fig. 2


dB
16
14
12
10
8
6
4
+2
0
-2
4
I.E.C.
15"/sec
SK1=15-30"
R14+
R16+
R14-
R16+
30 40 60 125 250 500 1K 2K 4K 6K 8K 10 12 15 18K c/sec
ERE 1704

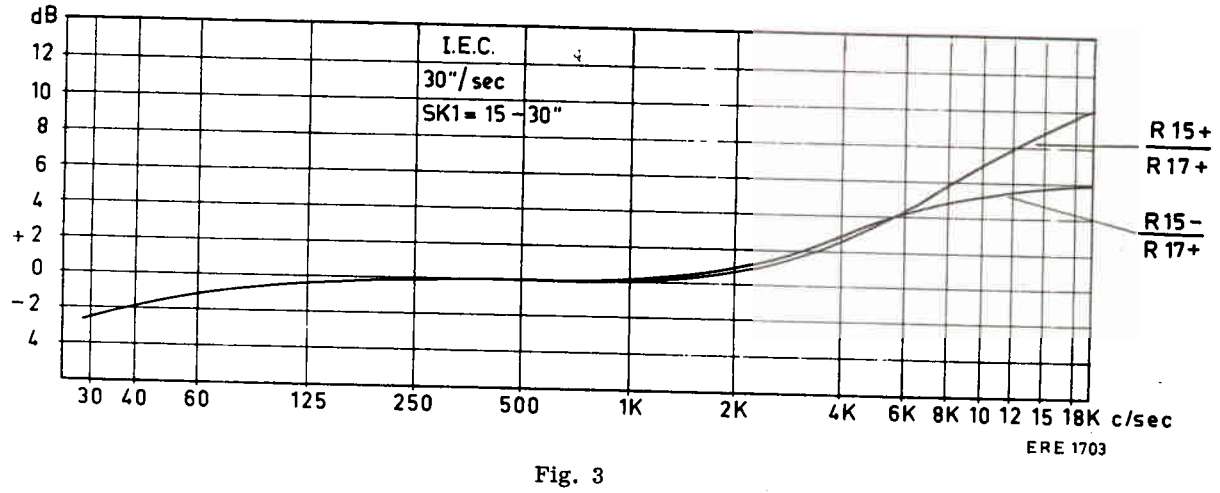

dB
12
10
8
6
4
+2
0
-2
4
I.E.C.
30"/sec
SK1=15-30"
R15+
R17+
R15-
R17+
30 40 60 125 250 500 1K 2K 4K 6K 8K 10 12 15 18K c/sec
ERE 1703

Fig. 3

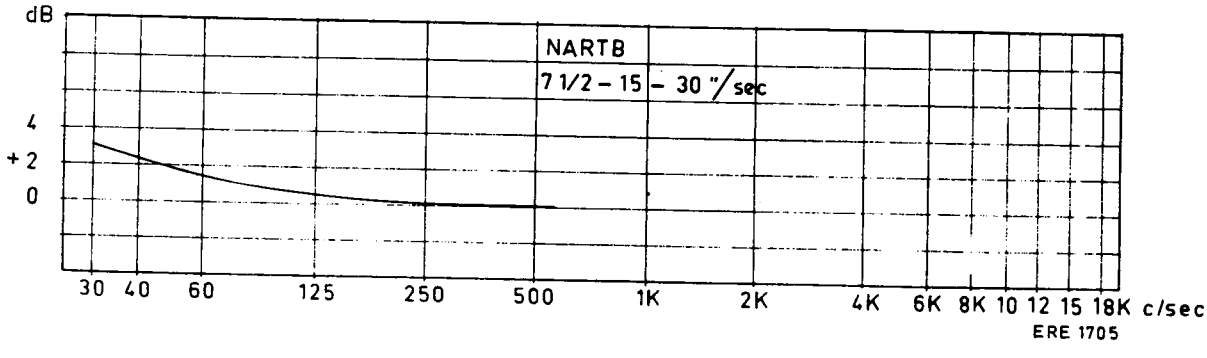

dB
4
+2
0
NARTB
7 1/2 - 15 - 30 "/sec
30 40 60 125 250 500 1K 2K 4K 6K 8K 10 12 15 18K c/sec
ERE 1705

Fig. 4

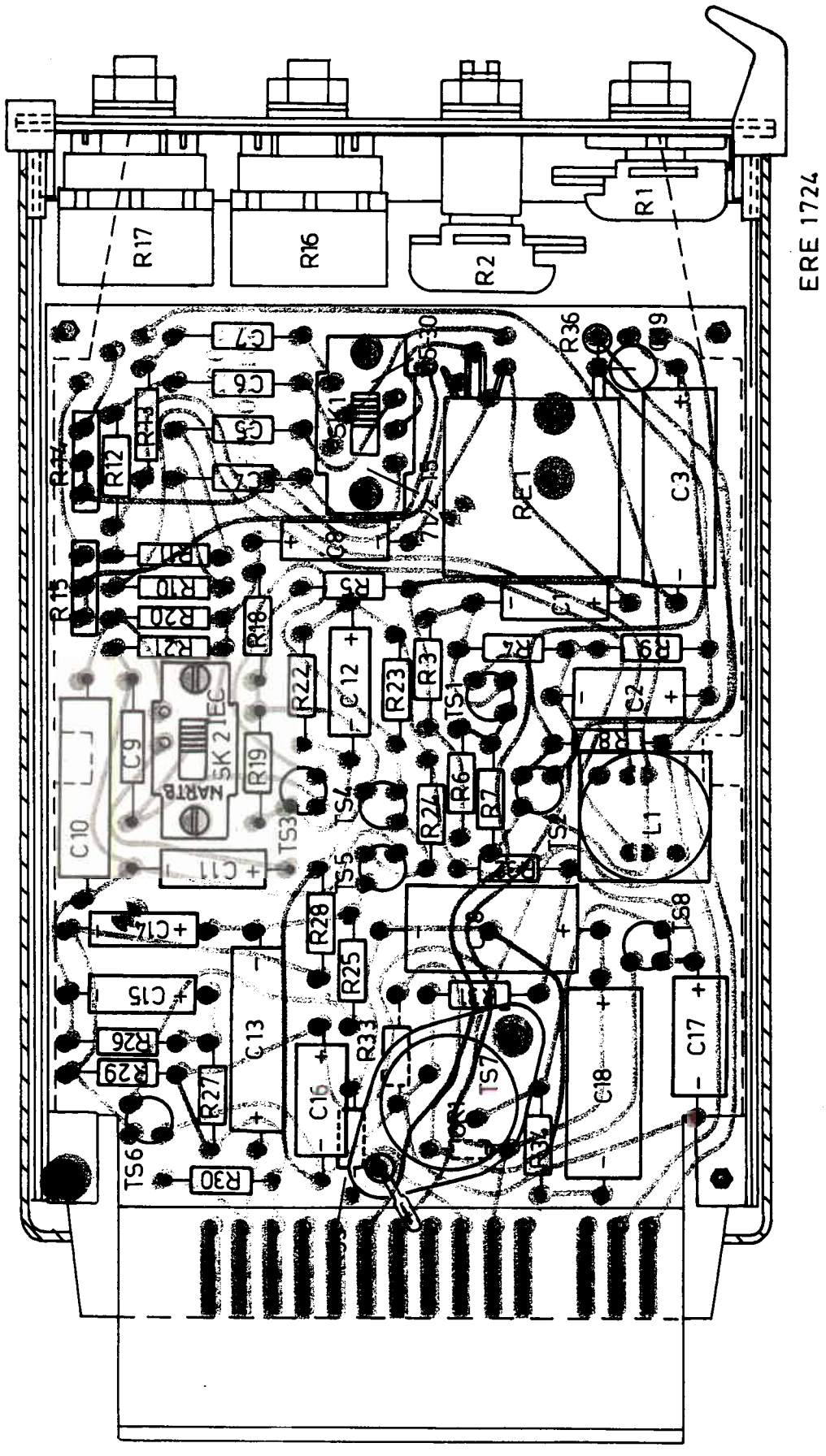
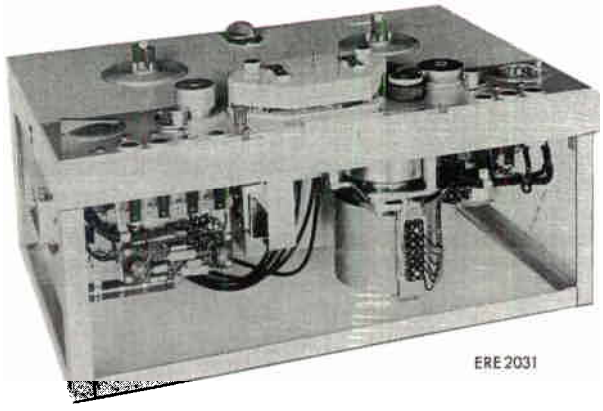

ERE 1724
R17
R16
R2
R1
R36
R14
R15
R12
R13
R10
R20
R21
R18
R22
R23
R3
R19
R6
R7
R24
R28
R25
R33
R26
R29
R27
R30
R31
R32
C10
C9
C11
C12
C13
C14
C15
C16
C17
C18
C2
C3
RE1
SK1
TS1
TS2
TS3
TS4
TS5
TS6
TS7
TS8
L1
NARTB
SK 21EC

Fig. 5

PHILIPS *Service*



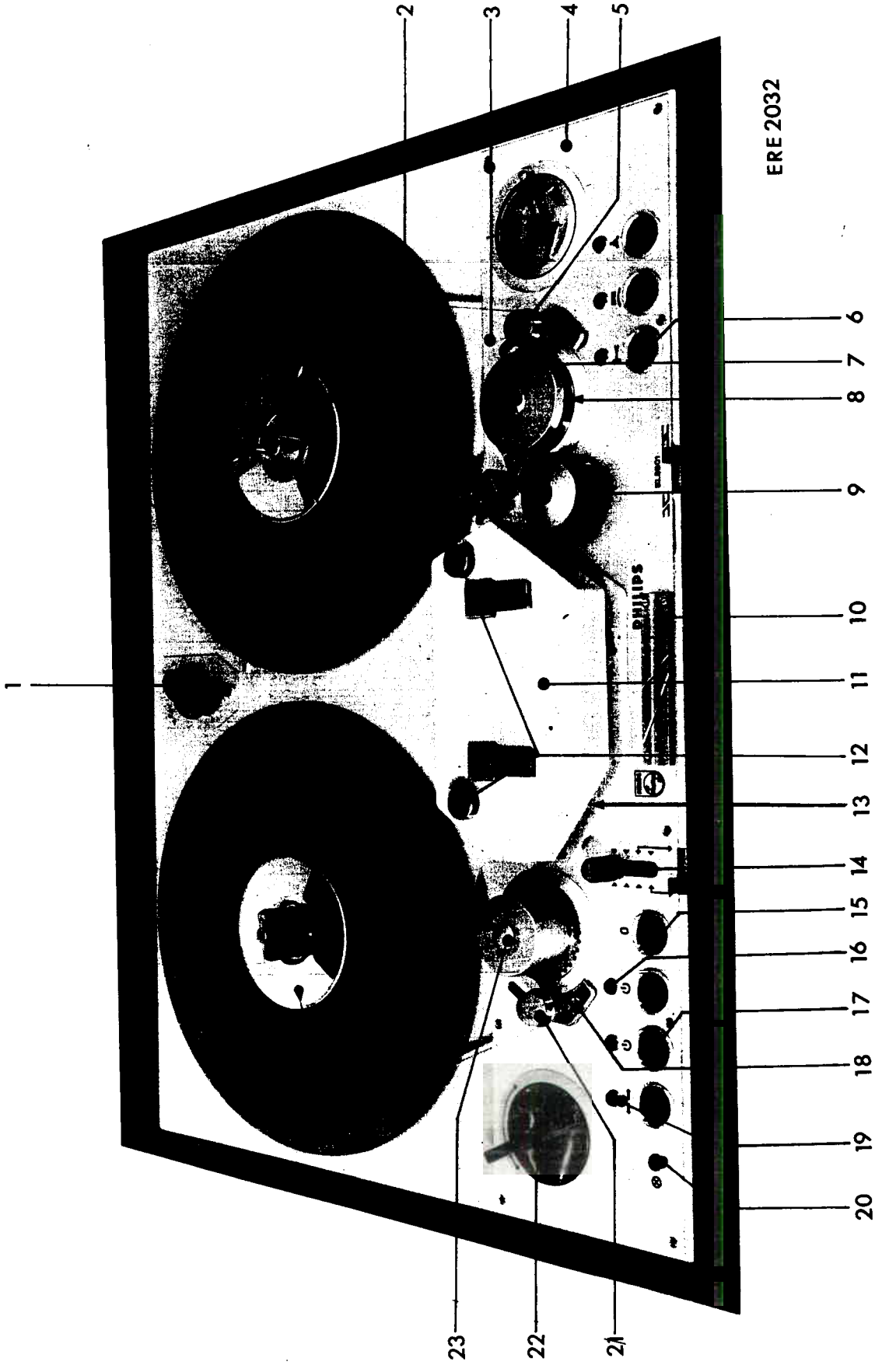
TAPE DECK

EL 3501/04

4822 733 11032 15/967

SERVICE INFORMATION										

CS10632


ERE 2032
PHILIPS
1
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22
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Fig. 1