



'STEREO 30' INTEGRATED TRANSISTORISED AMPLIFIER

INSTALLATION • OPERATION • MAINTENANCE

IMPORTANT —Do not connect any AC/DC device (TV, Tape or Radio) to the 'Stereo 30' amplifier. These devices may have high AC potentials on their chassis capable of causing serious damage to the 'Stereo 30' amplifier.

INSTALLING THE 'STEREO 30'

1. If you have bought the 'Stereo 30' already installed in the standard LEAK decorative wood case the mounting of the amplifier is completed.
If you have bought the 'Stereo 30' in chassis form it may be mounted in a LEAK tuner/amplifier wood case or on a panel of any thickness, through a cut-out of $12\frac{9}{16}'' \times 3\frac{1}{16}''$ (31.8 × 10 cms.). To mount on a panel: pass the body of the amplifier through the cut-out until the front plate butts against the panel, then pass the U-shaped bracket over the back of the amplifier and fix it by passing the wing screw through the hole in the bracket and into the threaded hank-bush in the centre of the rear panel on the amplifier. Tighten the wing screw just enough to prevent the front plate of the amplifier from slipping on the panel.

2. The mains transformer primary is wound for voltages of 110, 117, 130, 210, 230, 250 (40–60 c/s). The circular voltage selector (situated at the back of the amplifier) should be withdrawn to its fullest extent, rotated so that the arrow indicates the voltage nearest to your supply and then reinserted.

3. The amplifier is fitted with a 13-ft. (4-metre) power cable, either 2-core or 3-core according to the practice of the country to which it is shipped. This cable should be connected to the domestic power supply as follows:

(a) 3-core cable. If the power supply socket has a third (earth) contact, the green wire should be connected to the corresponding pin on the power supply plug and the red and black wires should be connected to the live and neutral pins respectively, usually marked 'L' and 'N'.

If the socket has only two contacts then connect the red and black wires to the pins of the plug fitting this socket. Cut off the green lead and run a separate earth (ground) lead from the 'EARTH' terminal on the rear of the chassis to the water system or to the steel conduit encasing the house wiring, provided that these systems themselves are properly grounded.

(b) 2-core cable. The plug fitted to the power cable should be connected to the domestic power supply socket. A separate earth (ground) lead should be run from the 'EARTH' terminal on the rear of the chassis to the water system or to the steel conduit encasing the house wiring, provided that these systems themselves are properly grounded.

It is very bad practice to omit this earth connection, and to ensure freedom from hum (caused by 'earth loops') no other earth connection should be made.

The amplifier is switched on by turning the volume control.

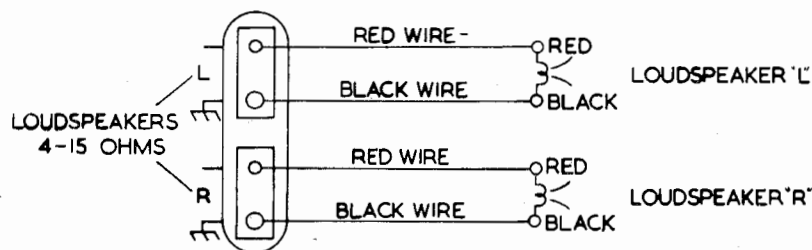
4. A double socket marked 'A.C. OUTLETS' is fitted as a convenient source of power supply for turntables, self-powered radio tuners, etc. The power taken from this socket should be limited to 100 watts or thereabouts. This socket is not fused but is controlled by the amplifier switch.

5. The amplifier has been designed to operate under domestic conditions for the reproduction of speech and music anywhere in the world—it will perform in accordance with the specification in ambient temperatures up to 45°C (112°F). Due to the very small amount of heat generated by the amplifier it is possible to mount the amplifier in a small cabinet and it is only necessary to ensure that the slots in the cover are uncovered. Sinewave testing at full power output *must* be of short duration, particularly at high frequencies, otherwise the 1 amp D.C. fuse will blow.

6. Fusing. In order to give the amplifier maximum protection against abuse we have fitted a D.C. fuse of 1 amp rating. Care should be taken to avoid shorting the loudspeaker leads as this may blow the fuse. When using a low impedance (4 ohms) inefficient loudspeaker system it may happen that excessive overloading of the amplifier on transients will cause the fuse to blow (the distortion under these conditions would be severe and audibly very objectionable). It is permitted under these conditions to increase the fuse rating to 1.5 amps.

7. Loudspeakers of any impedance from 4–15 ohms may be used and they should be connected by twisted pairs of wires to the plugs fitting the dual socket marked 'LOUDSPEAKERS 4–15 OHMS R and L'. It will be seen from the circuit drawing that one side of the loudspeaker winding is connected to the chassis, and no part of the loudspeaker wiring should be earthed elsewhere. The D.C. resistance of the connecting wires should be as low as possible, and not more than one-tenth the D.C. resistance of the loudspeaker. It is bad practice to operate any amplifier without a loudspeaker, and if it is desired to mute either loudspeaker by switching it out of circuit this should be accomplished by use of a changeover switch which replaces it with a resistor of corresponding value and rating. If for any reason only one loudspeaker is to be used then a similar resistor should be connected across the loudspeaker socket of the amplifier channel not in use.

8. Phasing. It is vitally important that the diaphragms of your two loudspeakers move in phase, i.e. in the same direction at the same instant. To make sure of this note very carefully the following:
If you are using identical loudspeakers (as you certainly should if you want true stereo) the manufacturer will doubtless have kept to a convention when marking the terminals, very often simply red and black. In this case the loudspeakers will be in phase when connected as shown below.



If your loudspeaker terminals are unmarked or you are using dissimilar loudspeakers you can check the phase as follows: place the two loudspeakers as close together as possible; set the function switch to 'INPUT R' and the input selector to 'PICKUP'. Connect an unscreened length of wire (about 1 ft.) to the 'PICKUP R' socket. Turn 'BASS' control to maximum and then turn up 'VOLUME' control until the hum picked up by the unscreened lead is fairly loud. Then reverse the leads to *one* loudspeaker; the condition which gives you noticeably more bass hum is the correct connection, i.e. the loudspeakers are in phase.

9. Do not insert the input plugs into the input sockets unless an input device is connected to the plug via a screened cable. Failure to observe this instruction will result in high noise levels when the selector switch is turned to 'MIC', 'PICKUP' or 'TAPE HEAD'.

OPERATING THE 'STEREO 30'

10. BALANCE CONTROL

The 'BALANCE' control allows you to compensate for differences in sensitivity between loudspeakers, or the 'L' and 'R' sides of any stereo input device. The gain in each channel is identical when the pointer on the 'BALANCE' control knob is at 12 o'clock. A further function of the 'BALANCE' control is mentioned in para. 20.

11. VOLUME CONTROL

The input attenuators on the rear panel of the 'STEREO 30' should be set so that a normal level of reproduction is obtained with the main 'VOLUME' control set to '10 o'clock' or higher. It is better not to listen with the 'VOLUME' control below '10 o'clock', as the channel balance below this setting may vary by more than 1dB.

12. FUNCTION SELECTOR

A four position switch allows the choice of:

- (a) MONO. This parallels that L and R circuits, enabling a stereo pickup to play mono LP records.
- (b) STEREO.
- (c) INPUT R (mono, connects both amplifier channels to the 'R' input device).
- (d) INPUT L (mono, connects both amplifier channels to the 'L' input device).

Positions 3 and 4 enable you to reproduce mono signals through both the loudspeakers connected to the 'Stereo 30'. See para. 20.

13. NOISE (Hum and Hiss)

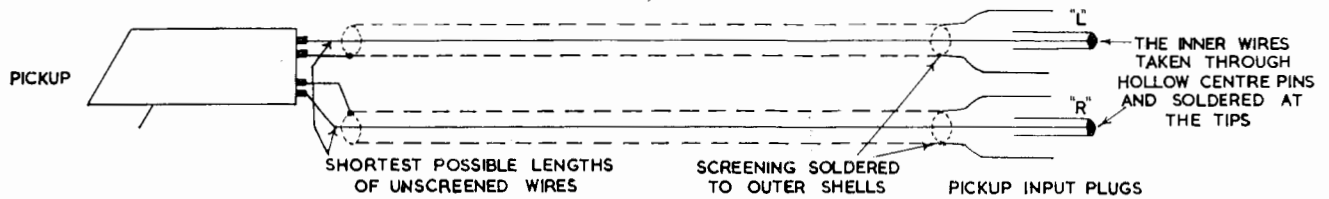
The 'STEREO 30' has a very low noise level which can be checked by removing all the input plugs and turning up the 'VOLUME' control. The high-pitched hiss associated with vacuum tube amplifiers is less noticeable with transistors, the irreducible noise being lower in pitch and unobtrusive.

N.B. When connecting an input plug to the 'STEREO 30' ensure that the screening of the co-axial lead does *not* touch the chassis of the amplifier as this may cause excessive hum.

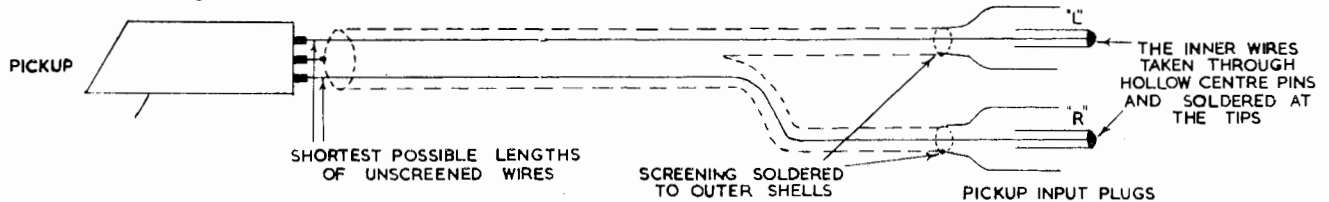
CONNECTING STEREO PICKUPS

14. (a) The greatest care has been taken in the design of this amplifier to ensure that any pickup generally available in the world can be connected to give optimum results, i.e. the highest quality obtainable from the chosen make of pickup. Our prime aim is for you to obtain optimum results from the pickup of your choice.

- (b) The pickup should be connected via screened co-axial cables to the sockets marked 'PICKUP 1' or 'PICKUP 2' at the rear of the 'STEREO 30', as shown below.



- (c) Some pickups will be fitted with two inner conductors covered by one outer screening; in this case the user should make sure that the screening of both inner conductors is maintained right up to the plugs fitting the sockets marked 'PICKUP 1' or 'PICKUP 2', as shown below.



- (d) We know from experience that the main troubles encountered by the music-lover at home are with the reproduction of records. There are five major reasons for these troubles:

(i) No record can possibly give perfect reproduction, and many records (perhaps the majority) contain noticeable distortions due to imperfections in recording and/or processing. These imperfections may show up as 'rattle', high surface noise, recorded hum and rumble and recorded 'wow'. Shrill treble may be due to a poor record, or to a pickup having its high-frequency resonance within the audible range, or to inferior loudspeakers.

(ii) No pickup is perfect and many have performances *very much* below those which are attainable.

(iii) Hum. This often arises because insufficient attention is given during the design of a pickup to the commonly-found circumstances in which it will operate, i.e. near an electric motor and near a power amplifier. Hum can also arise from incorrect connection of the pickup by the user.

If hum is to be kept to a minimum the outer screening of any pickup wiring should either have an insulated covering, or it should be prevented from touching any metal on the motor, motorboard or anywhere else. The outer screening *must not* be used for earthing any part of the motor and turntable assembly, which should be earthed by a separate wire taken to the 'EARTH' terminal below the 'SUPPLY POWER' grommet on the rear of the 'STEREO 30'. If the pickup arm is of metal and the outer screening is connected to it, then the arm must not make metallic contact through its bearings with the metal turntable and motor assembly.

Unfortunately, on some record-players and record-changers the screen is connected to the body of the motor mounting-plate. This is bad practice on the part of the makers, and is very likely to cause hum, particularly when using a low output pickup. If you have this type of wiring, you are most strongly urged to insulate the screening from the metal parts of the motorboard.

(iv) 'Rumble'. Vibration from the motor is transmitted to the pickup stylus and appears in the sound output as a rumbling or humming noise. Rumble disappears when the pickup is lifted from the record.

(v) Acoustic feedback. If a loudspeaker is placed in the same cabinet as a pickup, then vibration from the movement of the loudspeaker can be transmitted to the stylus of the pickup. As the volume is increased a stage is reached where a sustained roaring noise is set up. At volume levels considerably below this point distortion is noticeable. Acoustic feedback disappears when the pickup is lifted from the record.

- (e) The matching of stereo pickups.

(i) *Low-output moving-magnet, moving-coil or variable-reluctance pickups.*

The above types should be connected to the 'PICKUP 1' input sockets, which have an input sensitivity of 3.5mV and an input impedance of 47,000 ohms.

(ii) *Higher output moving-magnet, moving-coil or variable-reluctance pickups.*

The above types should be connected to the 'PICKUP 2' input sockets setting the associated gain-switch to 'HI'. The input sensitivity is 20 mV and the input impedance is 33,000 ohms.

(iii) *Crystal and Ceramic pickups.*

The above types should be connected to the input sockets marked 'PICKUP 2', setting the associated gain switch to 'LO'. The input sensitivity is 60 mV and the input impedance is 100,000 ohms. The input loading under these conditions forces this type of pickup to give approximately the same frequency characteristic as moving-coil and variable-reluctance pickups. This type of pickup may be accompanied by recommendations that a high input impedance (1 megohm) should be used; these instructions must be disregarded as they apply only when you are using a pre-amplifier which does not incorporate record compensation. If more bass is desired you should insert a 100,000 ohm resistor in series with each 'live' pickup input lead. As these resistors can pick-up hum unless screened, we strongly recommend that you solder the resistors to the co-axial input sockets inside the pre-amplifier. It may also be necessary to increase R3R and R3L to 10,000 ohms if more volume is required.

N.B. The sockets marked 'PICKUP 2' will be inoperative if a pickup is already connected to the 'PICKUP 1' input sockets.

OPERATING THE CONTROLS WHEN PLAYING RECORDS

15. (a) The 'RIAA' (same as British Standard 1928/61 for Fine Groove Records) playback characteristic has been incorporated in the 'STEREO 30' as this is an internationally agreed standard, and has been in world-wide use since 1955 for 33 $\frac{1}{3}$ and 45 r.p.m. records. This characteristic does not take into account the acoustics of the recording studio, the position of the microphones relative to the artistes, your pickup, your loudspeaker systems, the acoustics of your room and your particular ears! In other words, the playback characteristic is of use only as an approximation, and it may well be necessary to adjust the final result by using the controls marked 'BASS' and 'TREBLE'; this is the reason for their presence. When playing LP records (33 $\frac{1}{3}$ and 45 r.p.m.) made prior to 1955 the bass and treble controls may be used to correct for differences in the recording characteristic. When playing European 78 records the 'TREBLE' control should, theoretically, be turned to '2 o'clock' and the bass control to '11 o'clock' but, here again, you may prefer the results with the controls at '12 o'clock'!
- (b) The 'FILTER' switch can be used to give very comprehensive control of the treble frequencies. When the control is turned to '9' a filter is switched into circuit, the turnover frequency being 9 kc/s (i.e. the frequency at which the response falls 3dB). Other turnover frequencies of 6 kc/s and 4 kc/s are also obtainable. The 'SLOPE' control varies the rate of attenuation above the turnover frequency from 12 dB per octave ('GRADUAL') to 30 dB per octave ('STEEP'). The 'FILTER' and 'SLOPE' controls together with the 'TREBLE' control give an enormous range of high frequency attenuation which is very useful when reproducing music in which there is high distortion at high frequencies, for it is then possible to remove much of the offensiveness whilst losing a minimum of the musical content. The 'SLOPE' control is inoperative when the 'FILTER' is at 'OFF'.

SPECIAL NOTE

With our previous Varislope pre-amplifiers a number of users reported that the filter 'does not work' on the 9 kc/s and 6 kc/s positions. In every case on our checking the pre-amplifier it was faultless.

The explanation must be that either the high frequencies were not being reproduced due to inadequate complementary equipment, i.e. pickups, loudspeakers, etc., and/or the particular listener could not hear large changes of intensity at high frequencies.

(c) BASS CONTROL

Consumer opinion in some countries insists on a magnitude of available bass boost which, if used at maximum, can only result in a travesty of the original music. We have provided you with an availability of bass boost which you certainly should not need if your pickup and loudspeakers are moderately good. It is not possible to obtain *true* bass from small loudspeaker systems by turning the 'BASS' control to maximum, though an intermediate setting may be helpful, particularly when listening at low intensity levels (as in an apartment late at night).

NOTES ON THE CHOICE AND PERFORMANCE OF STEREO PICKUPS

16. (a) Pickup Arms.
An arm should be as light and as rigid as possible, with the lowest possible friction in the pivots. A heavy arm will be necessary with a pickup cartridge (head) which is inferior in respect of its bass-resonance frequency being initially too high. Ideally, an arm and cartridge should be designed conjunctively; it is not possible to specify the performance of one without the other.
- (b) The Stylus.
We most emphatically recommend *only* diamond. The initial cost will be greater, but the long term cost is much less, for diamond will last 100 times longer than the next best material, sapphire. Furthermore, because diamond does not chip and retains its contour it is less likely to damage expensive records.
- (c) Pickup Cartridges for Stereo.
There are presently four basic types:
- (i) Moving-magnet, and (ii) Variable-reluctance (magnetic, moving-iron). These are the most widely used types, and, assuming a high degree of design skill, the performances are comparable. They are robust and relatively simple to manufacture.
 - (iii) Moving-coil (Dynamic). Ideally, the moving-coils should be wound on a non-magnetic former. A low impedance coil together with a shielded transformer is essential for the best signal/hiss ratio. The moving-coil type is more difficult and more expensive to manufacture than types i and ii.
 - (iv) Crystal and Ceramic types. These are the cheapest, and because the output is high, the hum and hiss levels can be extremely low. However, to date these types give lower fidelity than the moving-coil, moving-magnet or variable-reluctance types of pickup.

GRAMOPHONE (PHONOGRAPH) MOTORS OR TURNTABLES

17. The main trouble with cheaper turntables and record changers is vibration, which is transmitted to the pickup stylus and appears in the sound output as a low-pitched 'rumble'. This 'rumble' will be more obtrusive when reproducing from stereo records because a stereo pickup is sensitive to vertical vibrations. Expensive transcription turntables are relatively free from 'rumble' because they are more precisely engineered than mass-produced units.

CONNECTING STEREO TAPE HEADS

18. Tape heads can be connected directly to the 'STEREO 30' 'TAPE HEAD' input sockets for the *reproduction* of tapes. For recording purposes it is necessary for you to have a bias and erase oscillator and recording amplifier. Each coil of a high impedance stereo tape head should be connected via a screened co-axial cable to the co-axial plugs fitting the sockets marked 'TAPE HEAD'. When using low impedance stereo tape heads it is, of course, necessary to use matching transformers, the secondaries of which should be connected via screened co-axial cables to the sockets marked 'TAPE HEAD'. The screening of the co-axial cables should not touch the metal parts of the deck if minimum hum levels are to be obtained. The deck and motors should be earthed to the 'EARTH' terminal below the 'SUPPLY POWER' grommet on the rear of the 'STEREO 30'.

As regards the various replay characteristics the same instructions apply as to record characteristics (see para. 15 (a)). As an approximation we suggest the following:

NAB $7\frac{1}{2}$ i.p.s. with the tone controls at 12 o'clock

CCIR $7\frac{1}{2}$ i.p.s. 'BASS' at 12 o'clock 'TREBLE' at 2 o'clock

NAB $3\frac{3}{4}$ i.p.s. 'BASS' at 11 o'clock 'TREBLE' at 3 o'clock

European $3\frac{3}{4}$ i.p.s. 'BASS' at 10 o'clock 'TREBLE' at 3 o'clock

CONNECTING MICROPHONES

19. Any dynamic (moving-coil or ribbon) microphones, together with their associated grid-matching transformers, may be plugged into the sockets marked 'MIC'. For stereo operation you must follow the maker's recommendations on the positioning of the microphones.

CONNECTING MONO TUNERS, PICKUPS, TAPE HEADS & MICROPHONES

20. These input devices may be connected via a screened co-axial cable to either the right or left-hand socket of the appropriate input. The unwanted channel can then be muted by full rotation of the 'BALANCE' control. If, however, mono reproduction is required through both channels then the function switch should be turned to 'INPUT R' or 'INPUT L' when the appropriate input socket will feed both channels simultaneously. When a tuner is used a separate earth (ground) connection should NOT be made to the tuner as this will be effected by the screening of the co-axial input cable.

CONNECTING TAPE RECORDERS

21. In general, any normally designed tape system can be connected, using the shortest possible lengths of screened cables, to the co-axial sockets marked 'TAPE AMP' on the rear of the 'STEREO 30' for replay purposes, or to the sockets marked 'RECORD' for recording purposes.

The following points should be noted:

- (a) An earth (ground) connection should not be made to the tape recorder, as this may cause an 'earth loop' and hum. The recorder will be earthed automatically through the 'STEREO 30' amplifier.
- (b) For replay purposes the input switch should be set to 'TAPE AMP'.
- (c) For recording purposes the input switch should be turned to the input from which it is desired to record.
- (d) The function, 'BASS', 'TREBLE' and 'FILTER' controls are operative when recording or replaying.
- (e) The output level (which is unaffected by the 'BALANCE' or 'VOLUME' controls) from the 'RECORD' sockets on the 'STEREO 30' will be approximately 125 mV and normally these sockets should be connected to the low sensitivity inputs on the tape recorder, which should have an input impedance of at least 50,000 ohms.

With some tape recorders the output from the 'STEREO 30' power amplifier may not fully modulate the tape; in this case the high sensitivity inputs on the tape recorder should be used. To avoid overloading the high sensitivity tape recorder inputs, the output from the 'RECORD' sockets can be reduced to 12.5 mV by setting the 'OUTPUT' switch to 'LO'. This switch is situated below the 'RECORD' sockets.

- (f) TAPE MONITOR SWITCH

If you use a tape recorder having a separate replay head and separate record and replay amplifiers, it is possible for you to compare instantaneously the original signals being fed to the tape recorder with the recorded signals taken from the tape immediately after recording.

With the 'TAPE MONITOR' switch set to 'OFF' the loudspeakers will reproduce the signals being fed to the tape recorder. With the 'TAPE MONITOR' switch set to 'ON' the signals from the tape replay amplifier will be fed via the 'VOLUME' control and the power amplifier sections of the 'STEREO 30' to the loudspeakers. The 'RECORD' sockets will continue to feed steady recording signals (unaffected by the 'VOLUME' or 'BALANCE' controls) to the tape recorder.

N.B. THIS SWITCH MUST BE SET TO 'OFF' IN ORDER THAT THE AMPLIFIER MAY FUNCTION NORMALLY. ONLY SWITCH TO 'ON' FOR MONITORING PURPOSES WHILST MAKING A TAPE RECORDING AS DETAILED ABOVE.

SERVICE INSTRUCTIONS

22. COMPONENT LAYOUT

- (a) (i) Components not shown on the layout diagram or the printed board are either mounted on the filter switch or on the input sockets on the inside of the rear face of the chassis. If access is required to components on the inside of the rear face of the chassis then capacitors C30, C38 and C39 can be removed easily by undoing their fixing nuts on the underside of the printed board.
- (ii) When removing components from a printed circuit board care must be taken to avoid overheating the copper foil as this may damage the adhesive. We suggest that you use a small-bit instrument type soldering iron.
We have *not* crimped the component leads and they can be removed easily from the board if the solder round the lead is melted.
- (iii) When removing transistors from the printed board the transistor should first be removed from its clip and then the transistor leads should be gently pulled one at a time and at the same time applying the soldering iron to the soldered connection on the underside of the board.
- (iv) When removing horizontally mounted components the body of the component should be gently prised at one end (using a small screwdriver) and in this manner the lead-out wires removed one at a time.
- (v) When removing vertically mounted components the centre terminal should be unsoldered and the component gently pulled away from the board. The side wire can then be removed more easily.
- (vi) Should you for any reason wish to remove the supply voltage to the pre-amplifier section of the 'STEREO 30' the wire link marked 'PRE-AMP' should be removed.

b) VOLTAGE ADJUSTMENTS

For optimum results from the 'STEREO 30' two voltages on each channel must be correctly set. These are set at the factory and should not need adjustment unless a transistor has become faulty and been replaced.

- (i) The voltage at the collector of T9L and T9R should be set at -23 V for a line voltage of -42 V. This voltage is set by adjusting P6L and P6R which are situated immediately behind the 'VOLUME' control. When carrying out this adjustment use a screwdriver with an insulated shaft to obviate shorting to the A.C. switch terminals on the rear of the 'VOLUME' control.
- (ii) The voltage at the collector of T1L and T1R must be set at -4.5 V. This test point is shown by two white rings round the collector leads of T1L and T1R on the top of the printed board. The voltage is set by adjusting P1L and P1R.

(c) CURRENT ADJUSTMENTS IQL AND IQR

On the underside of the printed board are two pairs of soldering tags marked 'IQL' and 'IQR'. Each pair is linked by a piece of wire, and this wire link may be removed and an ammeter inserted to measure the quiescent (no-drive) current of the output transistors. The current should be between 15 and 20 mA and it can be set by adjusting P7L and P7R. This adjustment should be made after the amplifier has been switched on for approximately five minutes and then rechecked after ten minutes. The amplifier must *not* be driven while the meter is in circuit. The amplifier *must never* be switched on without the wire links or ammeters connected across the soldering tags as this can easily damage the driver transistors (particularly T6).

(d) PRECAUTIONS

- (i) Avoid shorting the loudspeaker output leads while driving the amplifier as this will blow the D.C. fuse.
We have fitted a 1A fuse in order to give maximum protection against fault conditions causing thermal runaway. This fuse can be increased to 1.5A (see para. 6) but this value must not be increased further. If the fuse continues to blow then a fault must be present.
- (ii) Do not sustain full-power sine wave drive, particularly at high frequencies, as this will overheat the output and drive transistors and cause the D.C. fuse to blow.
- (iii) Do not short together the lead-out wires of the transistors as this can cause rapid failure of the transistor, particularly under drive conditions.

(e) TRANSISTORS

The transistor types used are shown on the circuit diagram and other replacement types should not be used unless full facilities for testing the amplifier are available.

(f) THERMISTORS AND DIODES

The thermistor types used are VA 1055 (TH1) and VA 1039 (TH2). These have a D.C. resistance at 25°C . of 15,000 ohms (VA 1055) and 500 ohms (VA 1039); other thermistors having the same characteristics may be used as replacements.

The diodes used are type 20AS but any silicon diode having an average current rating of 0.5A and a PIV (peak inverse voltage) rating of 200 V can be used as a replacement.

FAULTS WHICH MAY OCCUR

SYMPTOM

Fuse repeatedly blows

Test point voltage cannot be adjusted to -23 V
 Excessive noise when volume is advanced
 Excessive noise with volume control at minimum

LIKELY CAUSE

Loudspeaker leads are shorting out
 Failure of T6
 Open circuit TH2 or P7
 Failure of T4 or T5
 Fault developed in T1 or possibly T2
 Noisy T4

SPECIFICATION

INPUT SENSITIVITIES: for full power output at 1,000 c/s into a 15 ohm load.
 When using a 4 ohm load the sensitivities will be twice as high for the same power output.

	HI	LO
PICKUP 1 (RIAA CHARACTERISTIC):	3.5 mV	—
Input impedance:	47k ohm	—
or		
PICKUP 2 (RIAA CHARACTERISTIC):	20 mV	60 mV
Input impedance:	33k ohm	100k ohm
TUNER:	30 mV	200 mV
Input impedance:	50k ohm	50k ohm
TAPE AMP. (TAPE MONITOR SWITCH 'OFF')	125 mV	250 mV
Input impedance:	50k ohm	100k ohm
TAPE AMP. (TAPE MONITOR SWITCH 'ON')	125 mV	620 mV
Input impedance:	20k ohm	72k ohm
MICROPHONE:	3 mV	125 mV
Input impedance:	33k ohm	150k ohm
TAPE HEAD:	3 mV	—
Input impedance:	47k ohm	—

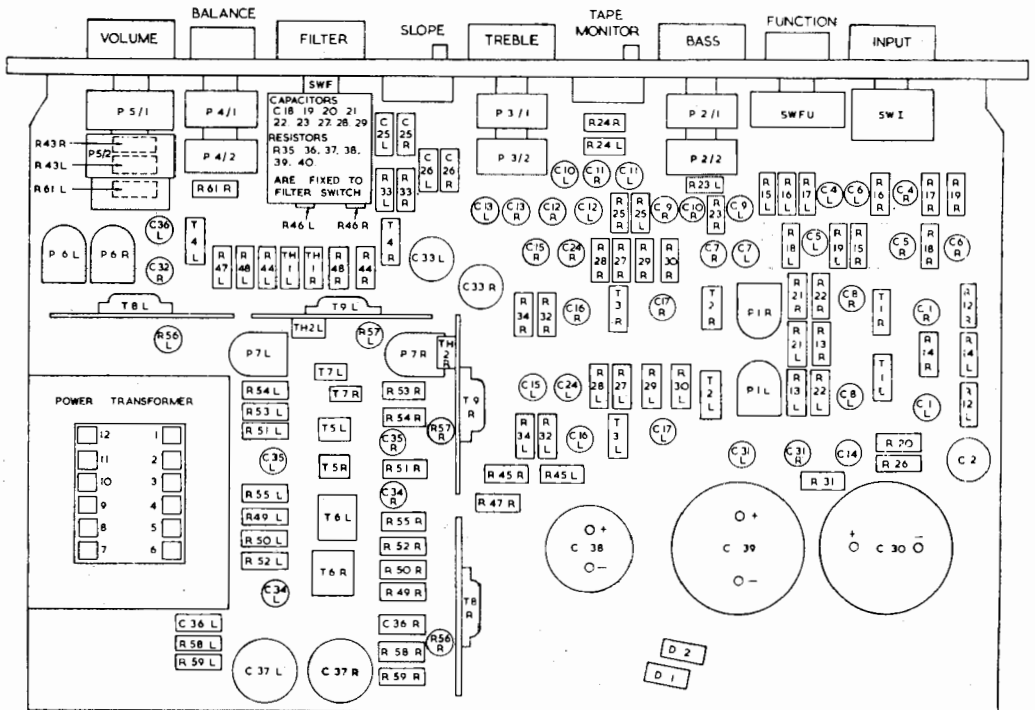
POWER OUTPUT:
 10 watts into a 15 ohm load
 IHFM music rating.
 15 watts into a 4 ohm load
 IHFM music rating.

DISTORTION:
 0.1% for 8 watts output per
 channel (IHFM) at 1,000 c/s
 into a 15 ohm load.

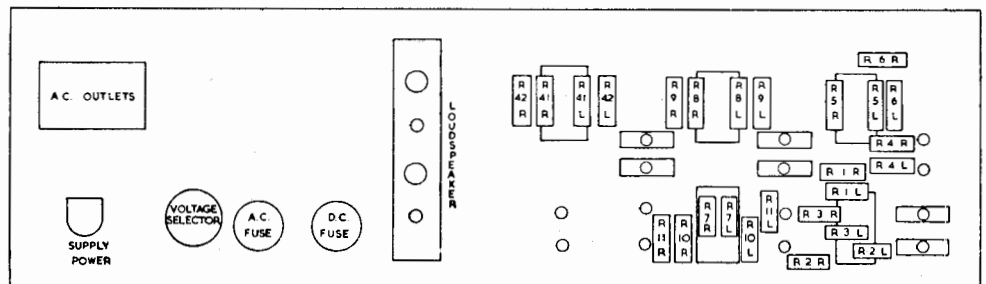
HUM AND NOISE:
 66 dB below full output
 on 'TUNER' and 'TAPE
 AMP', and 52 dB below
 on other inputs.

DAMPING FACTOR:
 60 measured at 1,000 c/s.

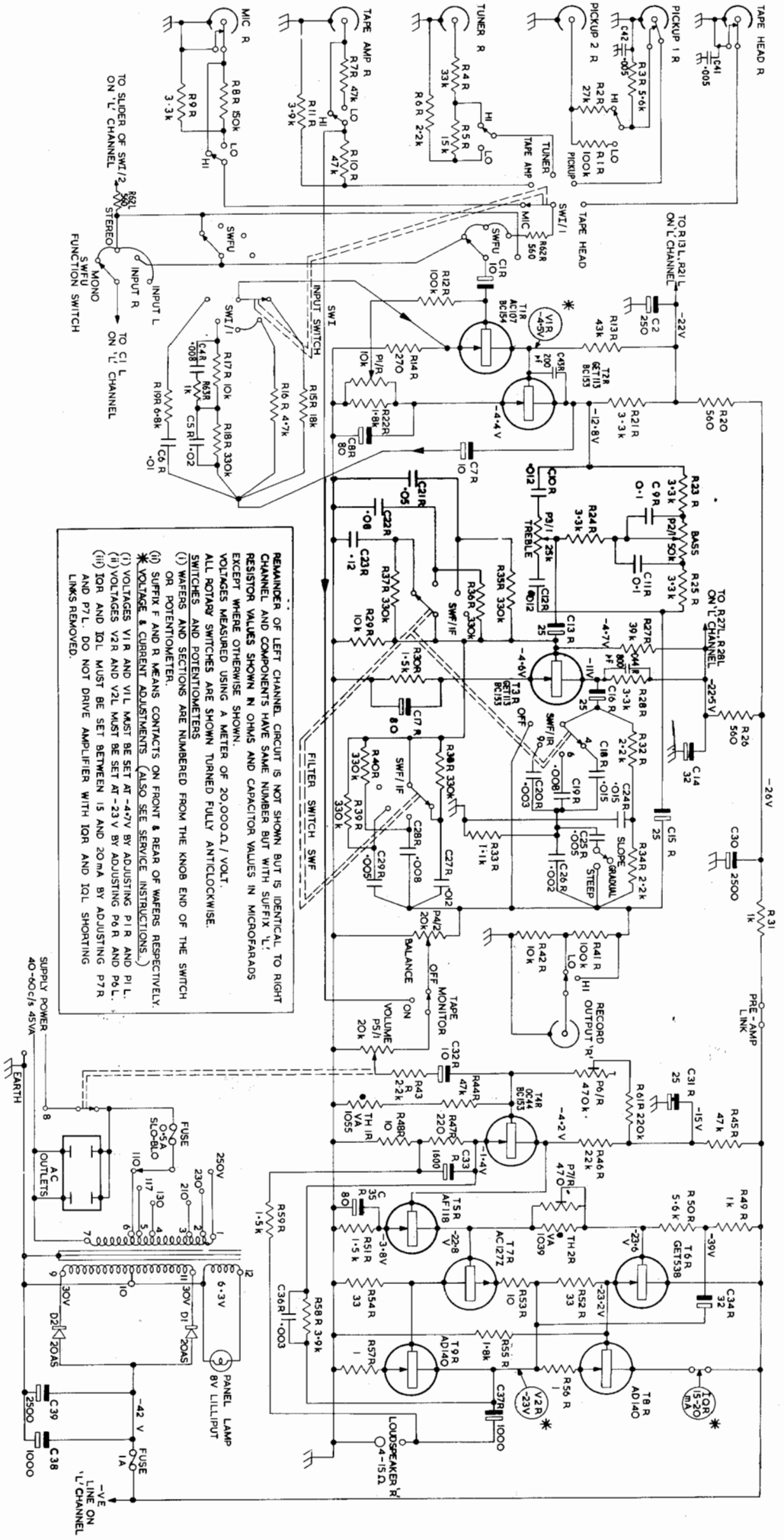
CROSS-TALK:
 Between 'L' and 'R' channels
 -50 dB up to 1,000 c/s.
 -30 dB at 10,000 c/s.



TOP CHASSIS LAYOUT



INSIDE VIEW OF REAR FACE



CIRCUIT DIAGRAM

REMAINDER OF LEFT CHANNEL CIRCUIT IS NOT SHOWN BUT IS IDENTICAL TO RIGHT CHANNEL AND COMPONENTS HAVE SAME NUMBER BUT WITH SUFFIX 'L' EXCEPT WHERE OTHERWISE SHOWN.
RESISTOR VALUES SHOWN IN OHMS AND CAPACITOR VALUES IN MICROFARADS
VOLTAGES MEASURED USING A METER OF 20,000Ω/VOLT.
ALL ROTARY SWITCHES ARE SHOWN TURNED FULLY ANTICLOCKWISE.
SWITCHES AND POTENTIOMETERS
(1) WAGERS AND SECTIONS ARE NUMBERED FROM THE KNOB END OF THE SWITCH OR POTENTIOMETER.
(2) SUFFIX F AND R MEANS CONTACTS ON FRONT & REAR OF WAGERS RESPECTIVELY.
(3) VOLTAGE V1R AND V1L MUST BE SET AT -4.7V BY ADJUSTING P1R AND P6L.
(4) VOLTAGES V2R AND V2L MUST BE SET AT -23V BY ADJUSTING P6R AND P6L.
(5) VOLTAGES V3R AND V3L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(6) VOLTAGES V4R AND V4L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(7) VOLTAGES V5R AND V5L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(8) VOLTAGES V6R AND V6L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(9) VOLTAGES V7R AND V7L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(10) VOLTAGES V8R AND V8L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(11) VOLTAGES V9R AND V9L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(12) VOLTAGES V10R AND V10L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(13) VOLTAGES V11R AND V11L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(14) VOLTAGES V12R AND V12L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(15) VOLTAGES V13R AND V13L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(16) VOLTAGES V14R AND V14L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(17) VOLTAGES V15R AND V15L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(18) VOLTAGES V16R AND V16L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(19) VOLTAGES V17R AND V17L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(20) VOLTAGES V18R AND V18L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(21) VOLTAGES V19R AND V19L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(22) VOLTAGES V20R AND V20L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(23) VOLTAGES V21R AND V21L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(24) VOLTAGES V22R AND V22L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(25) VOLTAGES V23R AND V23L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(26) VOLTAGES V24R AND V24L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(27) VOLTAGES V25R AND V25L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(28) VOLTAGES V26R AND V26L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(29) VOLTAGES V27R AND V27L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(30) VOLTAGES V28R AND V28L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(31) VOLTAGES V29R AND V29L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(32) VOLTAGES V30R AND V30L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(33) VOLTAGES V31R AND V31L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(34) VOLTAGES V32R AND V32L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(35) VOLTAGES V33R AND V33L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(36) VOLTAGES V34R AND V34L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(37) VOLTAGES V35R AND V35L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(38) VOLTAGES V36R AND V36L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(39) VOLTAGES V37R AND V37L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(40) VOLTAGES V38R AND V38L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(41) VOLTAGES V39R AND V39L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(42) VOLTAGES V40R AND V40L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(43) VOLTAGES V41R AND V41L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(44) VOLTAGES V42R AND V42L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(45) VOLTAGES V43R AND V43L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(46) VOLTAGES V44R AND V44L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(47) VOLTAGES V45R AND V45L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(48) VOLTAGES V46R AND V46L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(49) VOLTAGES V47R AND V47L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(50) VOLTAGES V48R AND V48L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(51) VOLTAGES V49R AND V49L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(52) VOLTAGES V50R AND V50L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(53) VOLTAGES V51R AND V51L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(54) VOLTAGES V52R AND V52L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(55) VOLTAGES V53R AND V53L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(56) VOLTAGES V54R AND V54L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(57) VOLTAGES V55R AND V55L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(58) VOLTAGES V56R AND V56L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(59) VOLTAGES V57R AND V57L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(60) VOLTAGES V58R AND V58L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(61) VOLTAGES V59R AND V59L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(62) VOLTAGES V60R AND V60L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(63) VOLTAGES V61R AND V61L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(64) VOLTAGES V62R AND V62L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(65) VOLTAGES V63R AND V63L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(66) VOLTAGES V64R AND V64L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(67) VOLTAGES V65R AND V65L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(68) VOLTAGES V66R AND V66L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(69) VOLTAGES V67R AND V67L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(70) VOLTAGES V68R AND V68L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(71) VOLTAGES V69R AND V69L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(72) VOLTAGES V70R AND V70L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(73) VOLTAGES V71R AND V71L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(74) VOLTAGES V72R AND V72L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(75) VOLTAGES V73R AND V73L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(76) VOLTAGES V74R AND V74L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(77) VOLTAGES V75R AND V75L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(78) VOLTAGES V76R AND V76L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(79) VOLTAGES V77R AND V77L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(80) VOLTAGES V78R AND V78L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(81) VOLTAGES V79R AND V79L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(82) VOLTAGES V80R AND V80L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(83) VOLTAGES V81R AND V81L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(84) VOLTAGES V82R AND V82L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(85) VOLTAGES V83R AND V83L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(86) VOLTAGES V84R AND V84L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(87) VOLTAGES V85R AND V85L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(88) VOLTAGES V86R AND V86L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(89) VOLTAGES V87R AND V87L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(90) VOLTAGES V88R AND V88L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(91) VOLTAGES V89R AND V89L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(92) VOLTAGES V90R AND V90L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(93) VOLTAGES V91R AND V91L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(94) VOLTAGES V92R AND V92L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(95) VOLTAGES V93R AND V93L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(96) VOLTAGES V94R AND V94L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(97) VOLTAGES V95R AND V95L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(98) VOLTAGES V96R AND V96L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(99) VOLTAGES V97R AND V97L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(100) VOLTAGES V98R AND V98L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(101) VOLTAGES V99R AND V99L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.
(102) VOLTAGES V100R AND V100L MUST BE SET AT -23V BY ADJUSTING P7R AND P7L.

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