OUR NEW PLAYMASTER: High power, modern styling

This is our latest Playmaster amplifier. In styling it is quite different from anything we have produced to date: straight line controls; push-button selector switches; and a functional panel layout. The circuit is also new and offers many features, including a power output of 40W per channel.

(PART ONE)

by GEORGE HUGHES

The current trend in high fidelity stereo amplifiers is towards single unit construction. The "low-long" styling is usually supplemented with attractively finished front panels, wooden cabinets, multi-function controls; and, possibly, a radio tuner.

Equipment of this type is usually lavished with an overabundance of controls, each purporting to add to the final audible result. One often wonders, when confronted with equipment of this nature, whether (a) possession of a "driver's licence" is needed to operate it; and/or (b) if all the controls provided are absolutely necessary.

In a lot of cases, people who are fortunate enough to own such equipment do possess at least a limited knowledge of how to use it properly. Such devices can, and do, perform impressively when correctly adjusted but weird sounds can emanate from the same equipment when the owner does not operate it properly. The expense involved in such gear is wasted in these circumstances.

To minimise this problem, our new Playmaster amplifier has been equipped with only those facilities which we consider essential for adequate control. These include the volume, bass, treble, and balance controls in the form of slider potentiometers, a "Source" switch which selects one of four inputs (phono, two auxiliary and radio), a "Mode" switch which selects one of three modes (stereo normal, stereo reverse, and mono), the mains switch (push on, push off), and the radio tuning control.

The tuner is the Playmaster 131 originally described in the February 1971 issue, to which has been added a simple but effective tuning indicator.

Rear panel facilities are four DIN sockets which allow phono, two auxiliary inputs, and an auxiliary output to be connected. Speaker output sockets are 2-pin polarised types, and are located towards the left-hand side. A 1A fuse holder is located near the mains lead feed through bush. The remaining terminal is a banana type used for connection of the radio antenna lead.

We settled on a 3½ inch panel height as our criteria for the final overall size and shape, keeping in mind an acceptable proportion of not being too short, and thus appear too "stubby", or too long and thus appear overblank, when relatively few controls are involved. The 3½ inch width also allows comfortable space for the straight-line potentiometers now available.

This approach also simplified chassis construction. We can use folded sections that fit together with a few small screws, rather than a complex multi-bend chassis formed from a single sheet of metal.

Those readers who undertake their own metalwork should not encounter any difficulty. As usual, drawings of the metalwork will be available through the reprint service for the usual 50c fee. Alternatively, chassis pieces should be available from metalwork suppliers.

The five major panel sections are fitted together with small machine screws, through mating holes. Before each piece is fitted, the wiring associated with that particular panel is undertaken, which makes assembly of the whole amplifier very easy.

The amplifier, mechanically, has been laid out in such a fashion that all circuit sections can be serviced with ease. The output amplifier boards, the input sockets and a section of the power supply have been placed towards the rear of the chassis, and can be quite easily removed if necessary.

The preamplifier and stabiliser/protection circuit boards are mounted on an intermediate shield panel. This panel has been mounted in such a way that it can be loosened from its mountings and lifted bodily to provide access to either board.

So much for the mechanical aspects of the amplifier.

There are four distinct sections in the signal processing part of this amplifier; the input preamplifiers which can be wired for either magnetic or piezo (crystal or ceramic) pickups, the push-button switching section, the Baxandall tone control system, and the power amplifier "business" ends. In addition, there is a protected and stabilised power supply.

The preamplifier channel TR1, TR2, TR3 is used for pickup equalisation. By selecting suitable circuitry, either type of pickup (piezo or magnetic) can be used. This preamplifier section is an updated version of that which appeared in the Dec 1965 issue of this magazine, using currently available silicon transistors.

We chose to provide a board with the necessary wiring pattern and holes to encompass either type of pickup circuit by suitable wiring, rather than waste a switch section on the "Source" switch, as most readers will have made up their minds as to the type of pickup they intend to use. More will be said about "type" selection of pickup at a later stage.

This stage is followed by the "Source" switch, which selects signals from either this preamplifier, two auxiliary inputs, or the radio tuner. The radio tuner switch section is provided with an extra contact to supply the necessary positive voltage to the tuner.

The signal output of the "Source" switch is fed to the "Mode" switch via an isolating resistor in each channel. These resistors mix the signals equally from each channel when the "Mono" mode, irrespective of the source of the signal. The resistors also provide protection against unintentional paralleling of the output stages of the "Phono" preamplifiers, or any auxiliary equipment output amplifiers which could introduce distortion due to loading.

From the switch the signals are fed to an emitter follower, TR4. This presents a high input impedance, which is particularly useful in regard to auxiliary input circuits, and a low output impedance which is an ideal source for a Baxandall tone control system. From this same low impedance source a series 47K isolation resistor feeds signals to a DIN socket on the rear panel. External equipment such as a tape recorder, can take signals off at this point.

The balance control is connected at the input to the emitter follower. Its range is deliberately limited by means of a 47K series resistor at each end. This makes its action smoother and also ensures that it cannot place an excessive load on the preceeding circuits, even at an extreme setting.

The Baxandall tone control system (TR5) was based on another section of the Dec 1965 preamplifier. The circuit values have been modified, and two 150 ohm resistors added to the treble control circuitry to eliminate a possible oscillation problem.

The stage gain within the active tone control circuit is 20dB, but the treble boost

SPECIFICATIONS

Power Output: 45 watts continuous per channel into 8 ohm load, 23 watts continuous into 16 ohms.

Frequency Response: (Main amp): at 40W; 10Hz – 65KHz. At 1W: 10Hz – 80KHz. System, through "Aux" input, tone controls flat: at all levels: 18Hz – 45KHz. Distortion: Main amp at 1KHz: 40W: 0.1% 1W: 0.05% Through "Aux" input: 40W; 0.15% 1W; 0.2%

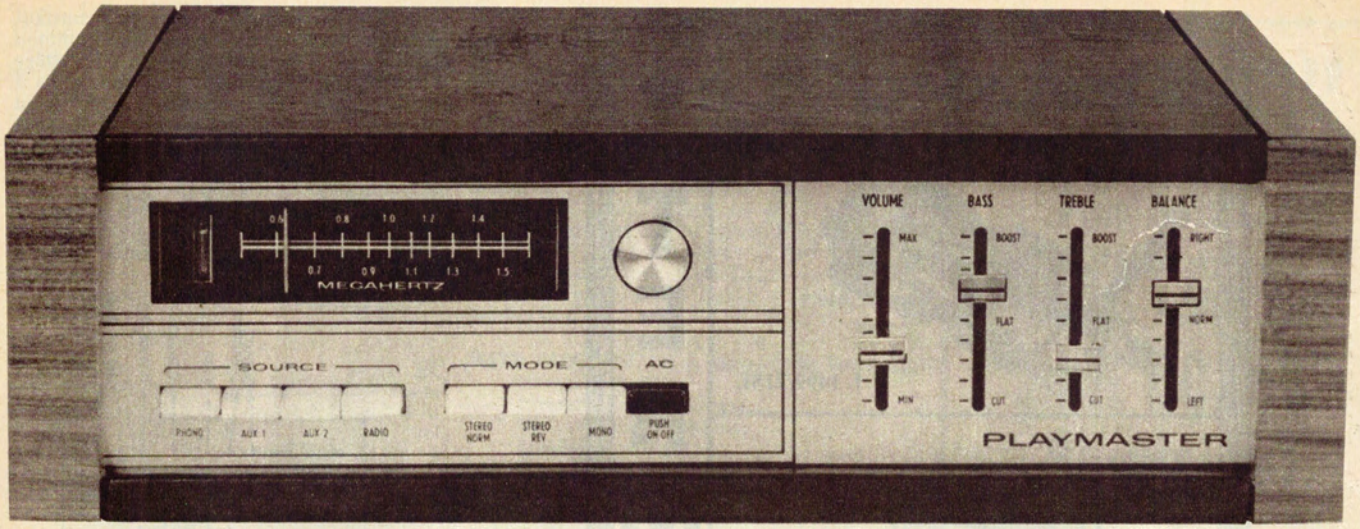
Damping factor: in excess of 56 relative to 8 ohm load.

Sensitivities and input impedances:

Main amp: approx 400mV RMS into 150K

"Aux" inputs: approx 500mV RMS into 100K

"Phono": Piezo: 60mV RMS into 2



and cut figures are limited to approximately 18dB by the series 150 ohm resistors previously mentioned.

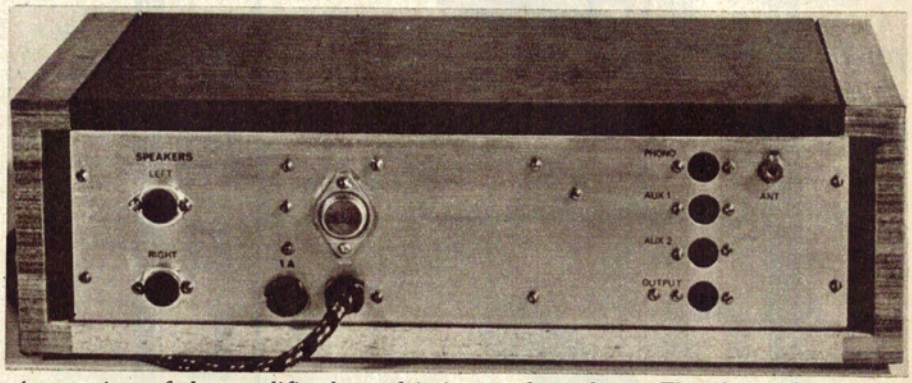
The volume control, a ganged 50K per section slider type potentiometer, is connected to the collector circuit of the active tone control stage by a blocking capacitor. The moving contact is connected to the input of the bass boost amplifier, TR6.

However, TR6 does not function as a straight amplifier stage. While this stage was necessary to provide the required overall gain, the total gain which such a stage could provide was much higher than necessary. So, since we had to throw some gain away, we decided to make use of the situation.

Considering that most speaker systems tend to roll off rather sharply at some point below 100Hz we felt that it would be worthwhile to provide a small fixed amount of bass boost to help offset this. The main advantage of this arrangement is that it is designed to commence its upwards roll at around 100Hz, rather than at 500Hz as in the case of the normal variable bass boost control. The latter circuit, while commonly used to offset speaker limitiations, tends to produce a "lumpy" response by the time it is providing reasonable compensation. Our additional circuit, while not a complete answer by any means, does help reduce this "lumpiness" by a useful amount.

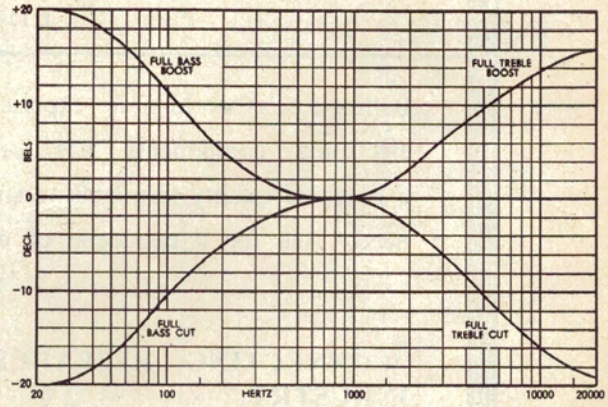
The gain of the stage is controlled by means of a feedback loop; a frequency selective feedback loop employing both resistance and capacitance. We have deliberately restricted the maximum boost which the stage provides to about 6dB. Not only is there little to be gained by trying to

megohms, flat response.
Magnetic: 1.5mV RMS into 50K, RIAA response.
Noise (measured with respect to 40W into 8 ohms):
Main amp: 80dB down.
Through "Aux" inputs: better than 73dB down.
Crosstalk (through "Aux" input, referred to 40W):
at 30Hz: 50dB
at 10KHz: 40dB
"External Output" voltage and impedance:
Approx 500mV out for 500mV in at "Aux" input, or
approx 500mV out for 3mV in at Mag phono, or
approx 500mV out for 120mV in at Piezo phono;
Impedance for all output levels: 50K.



A rear view of the amplifier housed in its wooden cabinet. This shows the position of all components mounted on the rear panel. The gaps at each end of the amplifier chassis are ventilation openings.

These response curves indicate that there is ample compensation available to cope with most likely variations in program material, speaker response etc.



"flog" most speaker systems beyond this point, there is the definite risk of driving the whole system into overload at very low, and quite useless, frequencies.

This stage is the last one on the preamplifier printed board. From here the signals are fed via a single screened lead to the power amplifier stage.

The power amplifier stage is based on a Philips report. It uses a complementary transistor pair BD139/140 (TR10, TR11) as driver and phase splitter and a pair of 2N3055s (TR12, TR13) as a conventional quasi-complementary single ended Class B push-pull system.

Two other transistors perform the functions of pre-driver and Class A driver (TR8), while a third (TR9) functions as a mid-point stabiliser and temperature compensator.

To avoid damage due to overdrive or overvoltage, the power supply is stablised. To guard against a short-circuited load, it is fitted with short circuit protection.

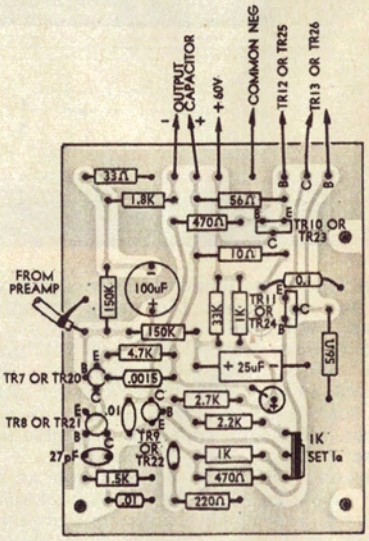
The power supply uses a full wave bridge rectifier consisting of four A15A diodes. These proved to be cheaper than an encaspulated bridge rectifier. With a nominal primary voltage of 240, DC voltage across the 4000uF capacitor is approximately 70.

A single 2N3055 (BDY20) (TR16) is used as a series stabilising transistor which, in turn, is connected to a current amplifier (TR15) driven by a comparator amplifier (TR14).

The comparator amplifier is connected as a common emitter with its collector coupled directly to the current amplifier's base. Its reference voltage is derived from a zener

diode which clamps its emitter at a constant potential with respect to the common negative rail. A portion of the output voltage is fed to the base of the comparator via a resistive divider. This produces a proportional indication of any fluctuation of output voltage at this point and, compared to the emitter voltage, is amplified and applied to the stabiliser as a correction voltage.

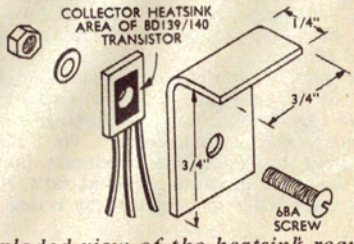
When the output voltage tends to rise, so does the base potential of the comparator amplifier. The rise in base potential causes a



Power amplifier board layout. Note orientation of BD139/140 transistors (TR10, TR23, TR11, TR24).

rise in collector current and a fall in voltage at the collector. The collector is coupled directly to the base of the current amplifier, which thus experiences a fall in base voltage. This, in turn, causes a fall in voltage at the emitter, which is directly coupled to the base of the series stabiliser.

Thus the series stabiliser experiences a reduction in base voltage, or a tendency to be turned off, whenever there is a tendency for the output voltage to rise for any reason.

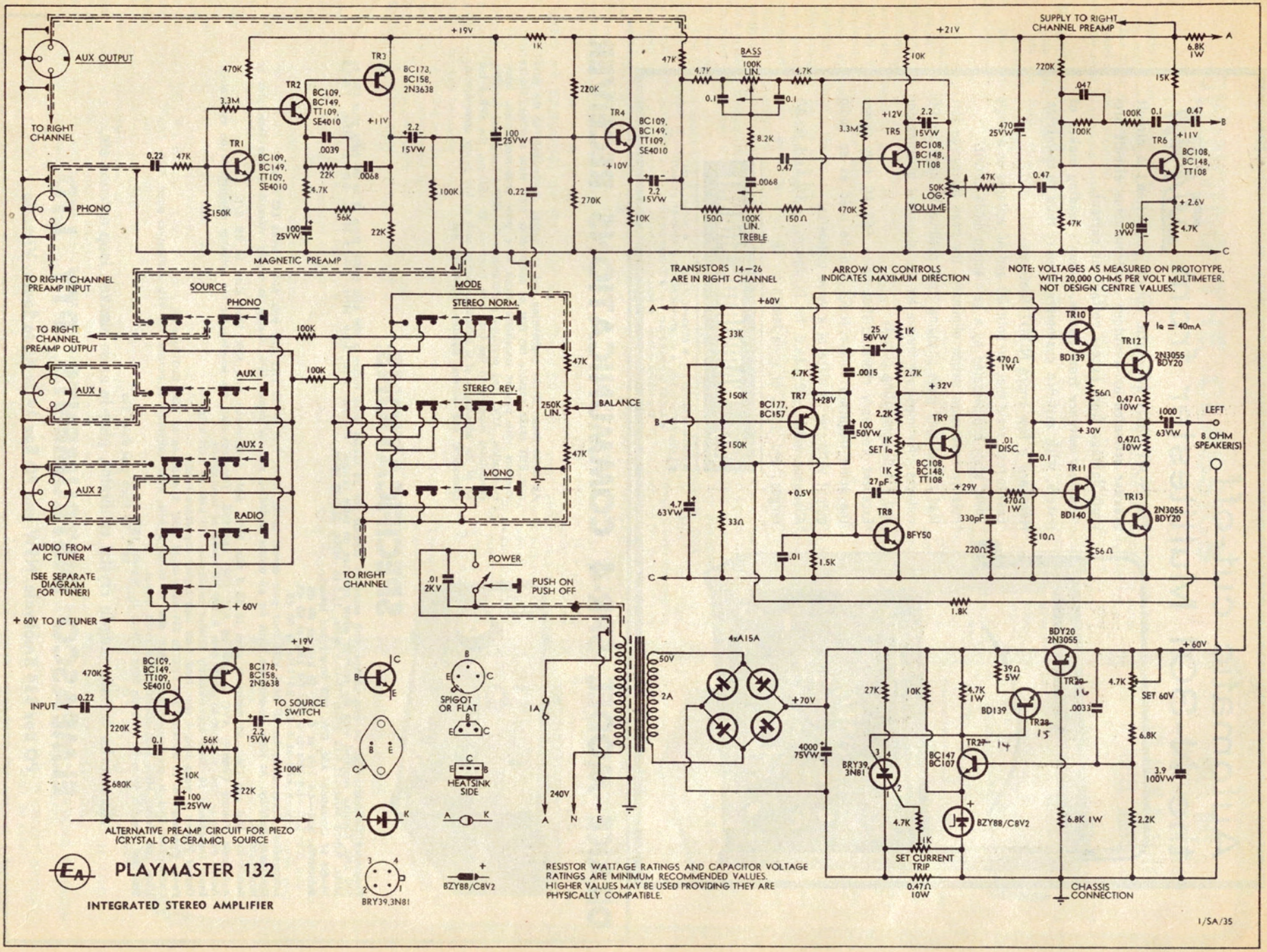


Exploded view of the heatsink required for the BD139/140 transistors. Make four from 16 gauge aluminium.

Similarly, any tendency for the output voltage fall, tends to "turn on" the stabiliser. As a result, voltage fluctuations from all causes are reduced to negligible proportions.

The stabiliser is also valuable as a filter element, because superimposed ripple is actually a rise and fall in output voltage at 100Hz.

Short-circuit protection can be provided by a simple current limiting characteristic built into the stabilised power supply section, but this type of power supply can still feed sufficient power into an overloaded circuit to cause damage. The safest method is to reduce the supply rail to an almost zero potential if the current limit is exceeded even briefly.


AUX OUTPUT
TO RIGHT CHANNEL
PHONO
TO RIGHT CHANNEL PREAMP INPUT
MAGNETIC PREAMP
TR1 BC109, BC149, TT109, SE4010
TR2 BC109, BC149, TT109, SE4010
TR3 BC173, BC158, 2N3638
TR4 BC109, BC149, TT109, SE4010
TR5 BC108, BC148, TT108
TR6 BC108, BC148, TT108
+19V
+11V
+10V
+21V
+12V
+ 2.6V
BASS 100K LIN.
TREBLE 100K LIN.
50K LOG. VOLUME
SUPPLY TO RIGHT CHANNEL PREAMP
TRANSISTORS 14–26 ARE IN RIGHT CHANNEL
ARROW ON CONTROLS INDICATES MAXIMUM DIRECTION
NOTE: VOLTAGES AS MEASURED ON PROTOTYPE, WITH 20,000 OHMS PER VOLT MULTIMETER. NOT DESIGN CENTRE VALUES.
SOURCE
PHONO
AUX 1
AUX 2
RADIO
MODE
STEREO NORM.
STEREO REV.
MONO
BALANCE
TO RIGHT CHANNEL PREAMP OUTPUT
TO RIGHT CHANNEL
AUDIO FROM IC TUNER
(SEE SEPARATE DIAGRAM FOR TUNER)
+ 60V TO IC TUNER
+60V
+ 32V
+28V
+30V
+29V
+0.5V
Iq = 40mA
SET Iq
TR7 BC177, BC157
TR8 BFY50
TR9 BC108, BC148, TT108
TR10 BD139
TR11 BD140
TR12 2N3055 BDY20
TR13 2N3055 BDY20
LEFT
8 OHM SPEAKER(S)
POWER
PUSH ON PUSH OFF
4xA15A
50V
2A
1A
240V
A N E
+70V
4000 75VW
BDY20 2N3055
TR20 16
TR28 15
TR29 14
BD139
BRY39, 3N81
BC147 BC107
BZY88/C8V2
SET CURRENT TRIP
SET 60V
CHASSIS CONNECTION
ALTERNATIVE PREAMP CIRCUIT FOR PIEZO (CRYSTAL OR CERAMIC) SOURCE
INPUT
TO SOURCE SWITCH
BC109, BC149, TT109, SE4010
BC178, BC158, 2N3638
SPIGOT OR FLAT
HEATSINK SIDE
BRY39,3N81
BZY88/C8V2
RESISTOR WATTAGE RATINGS AND CAPACITOR VOLTAGE RATINGS ARE MINIMUM RECOMMENDED VALUES. HIGHER VALUES MAY BE USED PROVIDING THEY ARE PHYSICALLY COMPATIBLE.
PLAYMASTER 132
INTEGRATED STEREO AMPLIFIER
1/SA/35

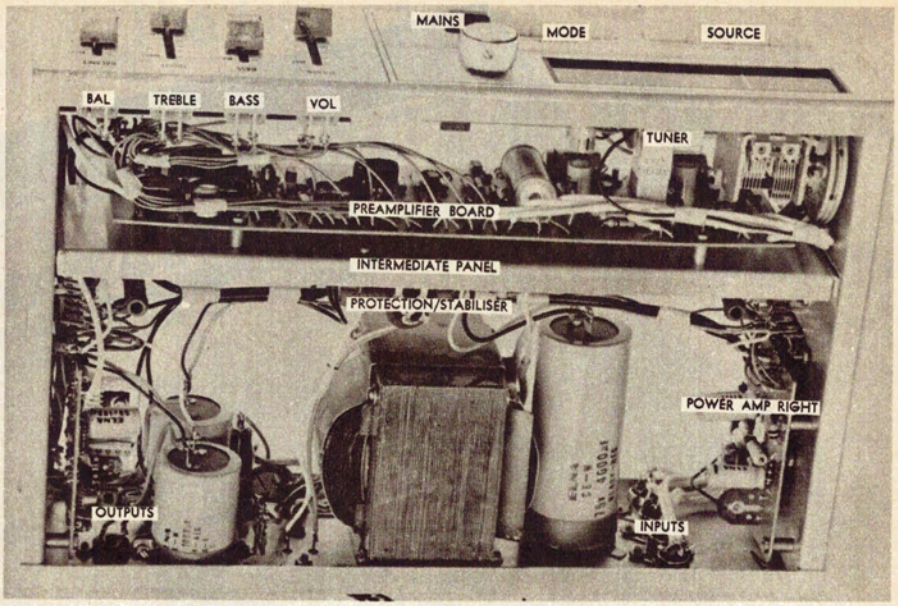
This is done by cutting off the series stabiliser transistor and its associated current amplifier by clamping the current amplifier's base to the common negative rail. In this circuit we use a small fast acting SCS (BRY39, etc) as a clamp. It is triggered from a sensing resistor (0.47 ohm) which monitors the total power supply current.

Correct trigger voltage for the SCS is obtained from a preset potentiometer connected in parallel with the current sensing resistor. The current setting procedure of this part of the circuit will be discussed in the second part of this article.

Now that we have dealt with the operation of the various sections of our amplifier, we can turn our attention to assembling it.

As mentioned earlier, the amplifier chassis is made from five separate pieces, fitted together with small machine screws. The front and rear panels are shallow "U" channels of the same dimensions, but differing in the number, sizes and positions of holes. The side panels are two identical pieces with a 3/8in fold-up all round. These four pieces fit together to make a rectangular frame. (See photograph.)

The fifth, or intermediate, panel is shorter than the front and rear panels, and is provided with 3/8in fold-ups all round. It is drilled with only 10 holes, four for mounting and six for



A topside shot of the amplifier, coded for clarity. Difficulty should not be experienced in assembly if this photograph is read in conjunction with the text. Note the accessibility of the various sections for service, if required.

PARTS LIST

- *1 Complete set of metalwork including front and rear panels, two side pieces, intermediate panel, sub panel and switch bracket.*
- *1 Front panel label (see text).*
- *1 Power transformer; 240V primary, electrostatic shield; secondary 50V @ 2A (Type PT7369 or PF3259).*
- *2 Printed boards, 71/sa4a*
- *1 Printed board, 71/sa4b*
- *1 Printed board, 71/sa4c*
- *1 Playmaster 131 Program Source (see February 1971 issue).*
- *1 MSP Type 72000/063 switch unit.*
- *1 MSP Type 72000/064 switch unit.*
- *4 DIN 3-pin sockets*
- *2 2-pin polarised speaker sockets.*
- *1 Banana receptacle*
- *1 ½in Heyco locking cable bush (Part No 6P-1).*
- *2 5-lug tagstrips*
- *1 3-lug tagstrip*
- *1 5-lug tagstrip (miniature)*
- *4 Slider control knobs (Watkin-Wynne)*
- *1 Fuse holder and 1 amp fuse.*
- *1 3-core power flex of desired length with 3-pin plug attached.*
- *6 1/8in x ¼in long brass spacers.*
- *6 1/8in whit x ¼in brass spacers.*
- *2 1/8in whit x ¾in brass spacers.*

The following list itemises all components used in the amplifier except certain ones in the preamplifier channels. Alternative components are presented in two separate lists and the list chosen will be determined by the particular pickup head to be used.

TRANSISTORS AND DIODES:

- *2 BC149, BC109, TT109, or similar*
- *6 BC148, BC108, TT108, or similar*
- *1 BC147, BC107, TT107, or similar*
- *2 BC157, BC177, or similar*
- *2 BFY50 or similar*
- *1 BD139*
- *2 BD139/140 complementary pairs.*
- *2 2BDY20 or 2 pairs 2N3055 (matched) and mounting accessories.*
- *1 BDY20 or 2N3055 and accessories.*
- *1 BRY39 or 3N81 SCS*
- *4 A15A silicon diodes*
- *1 BZY88-C8V2 zener diode*

RESISTORS: (½ watt, 10% unless specified):

2	*3.3M*	*9*	*4.7K*
2	*470K*	*2*	*2.7K*
2	*270K*	*3*	*2.2K*
4	*220K*	*2*	*1.8K*
4	*150K*	*2*	*1.5K*
8	*100K*	*6*	*1K*
8	*47K*	*4*	*470 ohm 1 watt*
2	*33K*	*2*	*220 ohm*
1	*27K*	*4*	*150 ohm*
2	*15K*	*4*	*56 ohm*
5	*10K*	*1*	*39 ohm 5 watt*
2	*8.2K*	*2*	*33 ohm*
2	*6.8K 1W*	*2*	*10 ohm*
1	*4.7K 1W*	*5*	*0.47 ohm 10 watt.*

POTENTIOMETERS:

- *1 250K linear slider.*
- *2 100K linear stereo slider.*
- *1 50K log stereo slider.*
- *3 1K preset.*
- *1 4.7K preset.*

CAPACITORS:

- *1 4000uF 75VW (Elna RG3E).*
- *2 1000uF 63VW (Elna RA2Z).*
- *1 470uF 25VW*
- *2 100uF 50VW (vertical mt'g).*
- *2 100uF 3VW (vertical mt'g).*
- *2 25 uF 50VW (vertical mt'g).*
- *2 4.7uF 60VW*
- *4 2.2uF 15VW*
- *1 3.9uF 100VW polyester.*
- *6 0.47uF 200VW polyester.*
- *2 0.22uF 100VW polyester.*
- *8 0.1uF 100VW polyester.*
- *2 0.047uF 100VW polyester.*
- *1 0.01uF 2KVW disc ceramic.*
- *2 0.01uF 100VW polyester.*
- *2 0.01uF 25VW disc ceramic.*
- *2 0.0068uF 100VW polyester.*
- *1 0.0033uF 100VW polyester.*
- *2 0.0015uF 100VW polyester.*
- *2 330pF 200VW polystyrene.*
- *2 27pF disc ceramic.*
- *4 aluminium heatsinks to suit BD139/140 transistors (see accompanying dw'g).,*
- *4 1/8whit x 3/8in c'sunk screws.*
- *2 1/8whit x ½in c'sunk screws.*
- *2 1/8whit x 1in c'sunk screws.*
- *27 1/8whit x 3/8in screws.*
- *18 6BA x 3/8in screws (used in transistor bushes and BD139/140 heatsinks).*
- *12 1/8whit x 5/8in screws.*
- *4 6BA x 3/16in screws.*
- *4 No 6 x ¼in self-tapping screws.*
- *50 1/8whit hex nuts.*
- *18 6BA half-nuts*
- *4 1/8in flat steel washers*
- *5 solder lugs.*

Single screened, stereo screened, screened pair cable. 10/010 hookup wire in different colours. 5/.0076 hookup wire in different colours.

COMPONENTS FOR PIEZO PREAMPLIFIER:

- *2 BC149, BC109, or TT109 transistors*
- *2 BC158, BC178 transistors*

RESITORS: ½watt 10%

2	*680K*	*2*	*56K*
2	*470K*	*2*	*22K*
2	*220K*	*2*	*10K*

CAPACITORS:

- *2 100uF 25VW*
- *2 100uF 25VW (vertical mt'g).*
- *2 2.2uF 15VW*
- *2 0.22uF 100VW polyester*
- *2 0.1uF 100VW polyester*

COMPONENTS FOR MAGNETIC PREAMPLIFIERS:

- *4 BC149, BC109, TT109 transistors*
- *2 BC158, BC178 transistors*

RESISTORS: ½watt 10%

2	*3.3M*		
2	*470K*	*2*	*47K*
2	*150K*	*4*	*22K*
2	*56K*	*2*	*4.7K*

CAPACITORS:

- *2 100uF 25VW*
- *2 100uF 25VW (vertical mt'g).*
- *2 2.2uF 50VW*
- *2 0.22uF 100VW polyester*
- *2 0.0068uF 100VW polyester*
- *2 0.0039uF 100VW polyester*

supporting the preamplifier and stabiliser circuit boards.

To shield the amplifier against external interference, aluminium foil is fitted around the inside of the wooden cabinet. Contact is made to this when the amplifier is screwed into the cabinet. This will be dealt with in greater detail in a subsequent article on the cabinet and its construction.

Incidently, the cabinet is both simple and cheap to make. It can be made from offcuts of plywood or chipboard, yet it has an attractive professional finish.

We can now start to assemble the amplifier. Although there is no hard and fast rule as to the order of assembly, it would be wise to follow the order that we have set out.

The easiest portion to assemble is the rear panel. This carries four DIN sockets, two speaker sockets, the main reservoir capacitor (4000uF), two output coupling capacitors (1000uF each), the series stabiliser transistor, the fuse holder, the antenna receptacle, one tagstrip and the power transformer.

All these items, except the power transformer, can be mounted on the panel and wired. The transformer, being a weighty item, should be left until last.

Before mounting the stabiliser transistor, check that the panel surface around its mounting area is quite smooth to the touch, as any foreign matter or sharp edges could puncture the mica insulator between the transistor and the chassis and short-circuit the power supply. Use silicone grease on each side of the mica washer to improve heat transfer.

When wiring this section, it is wise to connect flying leads to the transistor terminals for connection to the stabiliser circuit board at a later date. Each lead should be approximately seven inches long and different colours will help identify the connections. Mark the colours on the circuit diagram if it helps.

Adequate size hookup wire (10/.010) should be used for the power supply, the two power amplifier board interconnecting leads, and ALL common returns to the power supply. Excessive resistance in these leads can lead to common coupling and low frequency instability in some circumstances.

The next two sections to fabricate are the side panel assemblies which carry the output transistors, the driver and phase splitter boards, and the tagstrips carrrying the wirewound resistors in the output transistor circuits.

Assemble the driver/phase splitter circuit boards first. Connect coloured flying leads to every point on the boards, making all but one about three inches long. The exception is the one that picks up the feedback signal from the speaker socket (negative pole of the output capacitor). It should be about 12 inches long. The two boards, one for each channel, should be colour coded identically.

To complete each board, the BD139/140 driver transistors should have a small heatsink mounted on each of them using a 3/8in 6BA screw, washer and nut. Details are shown in the small accompanying diagram. They are made from scrap 18 gauge aluminium.

Before mounting the output transistors, check the surface as before. If satisfactory, mount the transistors using mica washers and silicone grease. Place a solder lug under one of the two clamping nuts of each transistor. Be sure to use a matched pair on each panel.

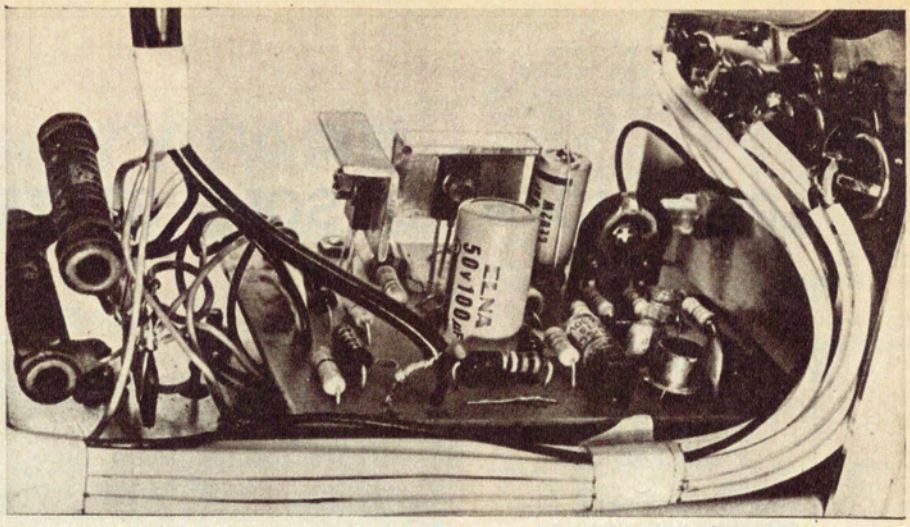
Before mounting the driver/phase splitter boards, make up the resistor tagstrip assemblies that are connected between the power transistors in each amplifier channel. Mount these strips and connect them to their correct transistor electrodes on each side panel.

Mount the finished driver/phase splitter boards on the side panels using three 3/8in long brass bushes, ½in long screws, and nuts. Connect them into circuit, being careful not to interchange connections. Wire up one panel first, check it, wire up the second independently and then compare the two. If there is any discrepancy, double check and correct. Check for fouling collector lugs also.

This is all we have space to discuss this month, but it is enough to get you well on the way with the project. Next month we will discuss the few remaining constructional points and the setting up procedure.

The power amplifiers must NOT be switched on until they are correctly set up.

Next month we also plan to present full constructional details for the attractive cabinet which houses our amplifier.



Close-up of one power amplifier/phase splitter board (see right side photo page 49). Note the heatsinks attached to the BD139/140 transistors, the power transistor stabilising resistors (left) and the DIN sockets (upper right). Connections to the power transistors are brought out from under the board.