SINCLAIR IC-10
10 WATT INTEGRATED CIRCUIT AMPLIFIER

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APPLICATIONS MANUAL

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What is an integrated circuit?

Over the past few years enormous efforts have been made by the electronic industry throughout the world to develop circuits in which the components were formed simultaneously onto a substrate or base of some sort rather than being made separately and then assembled onto a printed circuit board. Integrated circuits, as these products are called, were the subject of so much attention because they promised to be smaller, more reliable, more rugged and eventually less expensive than their conventional counterparts. It was also expected that their performance would be better. Three basic types of integrated circuits have evolved; the thin film circuit in which the resistors, capacitors and inductors are vacuum deposited onto a thin sheet of glass about one inch square to which individual transistors and diodes are later attached; the thick film circuit which is similar except that the components are screened or printed onto the substrate which is usually made of ceramic, and the monolithic circuit in which all the components are formed at the same time in a single chip of silicon less than a tenth of an inch square.

The monolithic circuit is the only one in which the transistors and diodes are formed at the same time as resistors and capacitors. In thick and thin film circuits the need to add individual transistors after the passive components means that the cost of these circuits may never be as low as is needed for very large quantity applications. In addition, the monolithic

process has the following advantages:

1 Because the circuits are so tiny a great number of them, typically 200 to 300 can be made simultaneously in a single slice of silicon just one inch in diameter by one hundredth of an inch thick. This silicon 'slice' is later cut up into 'chips' each of which is a complete circuit containing upwards of ten components.

2 Because all the components are formed together and because so many circuits are made at the same time, the cost of the finished circuit is potentially less than if it were made by any other process.

3 The components are so tiny that unwanted stray capacitances are minimised. Also the quality of the transistors formed is very high so that even in an audio amplifier like the Sinclair IC-10 the transistors used have the same cut off frequency as those used in the latest high speed computers.

4 The transistors in such a circuit are perfectly matched because they are made together. They are also in excellent thermal contact with one another which makes temperature stabilisation, normally a serious problem in power amplifier design, virtually automatic.

5 The reliability of a monolithic integrated circuit is almost unbelievably

good. For example the IC-10 is about 100 times more reliable than an amplifier of similar performance made with conventional components.

6 The circuit chip can be embedded completely in a solid protective coating making it virtually indestructible. The IC-10 chip is mounted on a steel heatsink—tiny wires connect it to pins—and the whole assembly is encased in solid plastic of a special type. Drop the IC-10 from the top of a 30 storey building and it will be completely unharmed.

From this list of advantages it is apparent that the monolithic integrated circuit or S.I.C. (short for silicon integrated circuit) has a very bright future indeed but it has taken years of research to perfect the process involved and it has only recently become possible to produce circuits with high output powers. In fact the IC-10, which is entirely British, is the first commercially produced S.I.C. of its power in the world. It is also the first to incorporate the pre-amplifier and power amplifier in a single chip.

The IC-10 is an important advance in another way however; for the first time an I.C. is being sold to the public at a price which is less than that of the conventional product. Thus the advantage of economy is added to the considerable performance advantages.
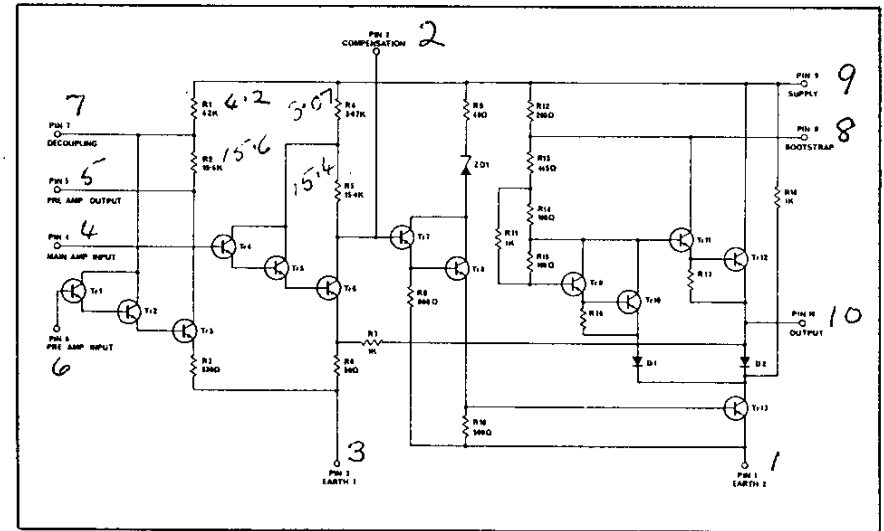
The IC-10 Circuit diagram   Fig. 1

Although S.I.C.s are made by so radically new a process the components they contain are still components in the normal sense. The transistors, resistors, diodes etc. work in the same way as normal components and it is quite easy to see which component is which if one examines an un-encapsulated circuit under a microscope. Thus the circuit diagram of the

IC-10 shown in Fig. 1 looks very much like that of a typical high fidelity amplifier except perhaps that it contains rather more transistors. This is due to the delightful fact that it costs no more to put a transistor onto an S.I.C. than it costs to put a resistor on. This is because the cost depends on the surface area employed by the components. The result is that the designer, instead of economising on the number of transistors as he would normally do, uses them liberally and is therefore able to design a better circuit.

The pre-amplifier part of the circuit consists of Tr1, Tr2 and Tr3 in Fig. 1. Tr1 and Tr2 operate as emitter followers to give the circuit a high input impedance. Tr3 is a common emitter amplifier and this stage provides the voltage gain of the pre-amp. R3 provides overall series negative feedback, and together with R1 and R2 defines the voltage gain accurately and thus reduces distortion. In normal operation a resistor with a value of about 1 megohm is connected externally between pins 5 and 6. This resistor biases the collector of Tr3 to just a little more than the base voltage of Tr1. In fact the input current to Tr1 is only about 0.05 microamps so the voltage dropped across the 1 megohm resistor will be only about 50 mV. Because the collector voltage of Tr3 is so well defined the collector can be directly coupled to Tr4 for the power amplifier circuit is so designed that the bias on the output stage will be correct under these circumstances. Because the amplifier and pre-amp are directly coupled throughout, the circuit will work down to d.c.

The power amplifier employs Tr4 to Tr13 in an arrangement which provides a very high input impedance with voltage gain defined by R6 and R7. The output transistors are Tr12 and Tr13, these two transistors can handle currents if up to 3 amps quite comfortably and they provide a high level of gain up to this level. The output stage is arranged in a 'totem pole' configuration, that is to say the lower output transistor, Tr13 also acts as the inverter and driver to the upper stage. This arrangement has the advantage of requiring only NPN transistors.

Tr9 and D1, together with the resistors which supply them, control the quiescent current of the output stage, because these devices are closely matched to the output transistors this current will be accurately defined and furthermore will not vary with operating temperature of the circuit as it would in a conventional circuit. Two important advantages result from this; the distortion will remain low under all conditions, and thermal runaway, which can destroy the output transistors in a conventional amplifier, will not occur.

SPOT

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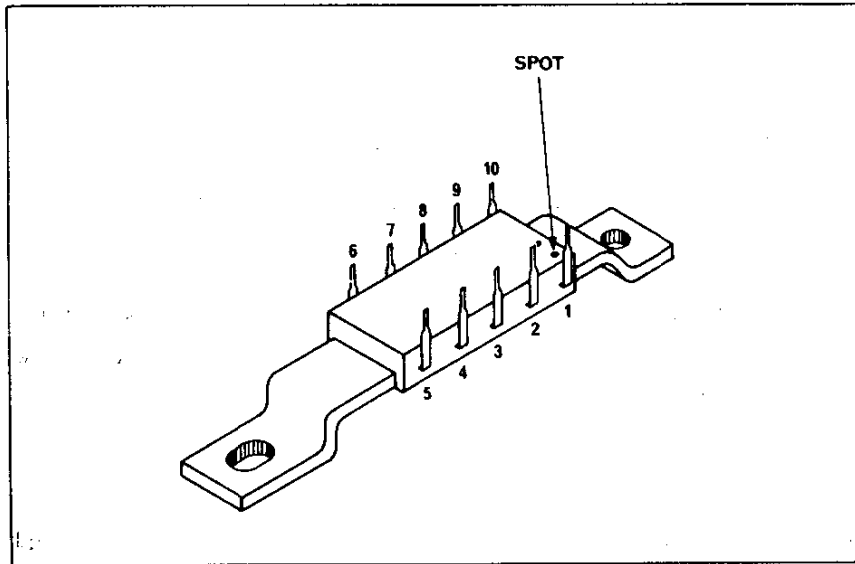
Making Connections to the IC-10   Fig. 2

Physically the Sinclair IC-10 consists of a small plastic package from which 10 pins and the two ends of a metal bar protrude. The I.C. itself is

mounted on the metal bar which acts as the heatsink and which may be bolted to a sheet of metal if a larger heatsink area is required. The bar should be connected to earth (supply negative) by the user in normal operation. Connections to the pins are shown in Fig. 2. The numbers relate to those shown on the circuit diagram in Fig. 1 and these same numbers are used on all the circuit diagrams which appear in this book. The pins can be soldered to directly without any danger of the device being damaged.

It is always worthwhile to bolt the IC-10 or both IC-10s in the case of stereo, to a piece of sheet aluminium or steel if space permits. The metal sheet should be at least two inches square and may be larger if desired. For normal music and speech applications however it is possible to use the IC-10 without an extra heatsink.

SINCLAIR IC-10 Integrated circuit amplifier and preamplifier Specifications

|	
Power output	10 watts peak
	5 watts R.M.S. sine wave
Frequency response	20 c/s to 100 Kc/s ± 1 db.
Total harmonic distortion	1% at full o/p 1 Kc/s.
Load impedance	3Ω minimum
Input impedance pre-amp	$20\ M\Omega$
Input impedance power amp	$100\ M\Omega$
Output impedance power amp	0.2Ω
Power gain	110 db
Supply voltage	9–18 v
Input sensitivity	5 mV into 2.5 $M\Omega$
Noise level	– 75 db
Size (excluding heatsink)	1″ x ½″ x ¼″.
Working temperature	0–70°C
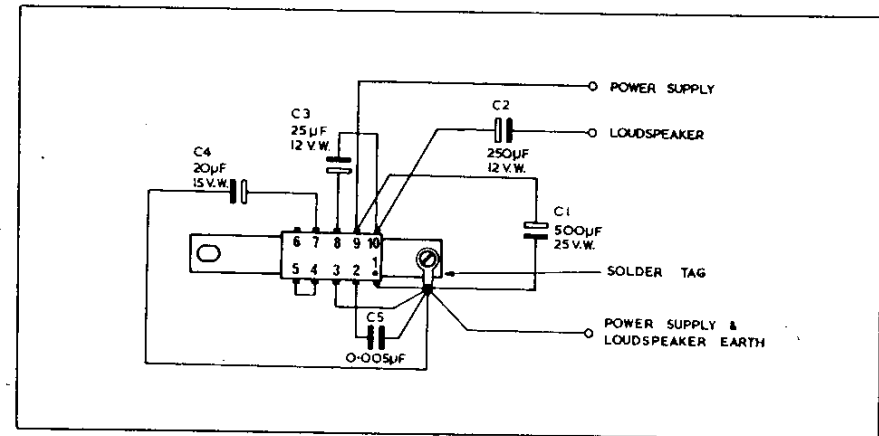
Fig. 3   The basic unit wiring diagram

Fig. 3 shows the wiring necessary when using the IC-10 for any audio applications. Of paramount importance concerning the wiring of the IC-10 is the need for a common earthing point; this may be taken, as in the diagram, to a solder tag under one of the screws which secure the IC-10 to the heatsink. However any rugged part of the earth wiring close to the output stage may be used. Incorrect earthing may cause hum, low frequency

instability, high frequency (parasitic) oscillation and distortion, therefore it is vital to follow the earth wiring shown. The added components have the following functions:

C1   The main power supply decoupling or smoothing; this must be soldered directly across the main earth point and pin 9 (positive supply). The value of 500μF given is minimal for normal applications, and the work-voltage rating of the capacitor should be at least as high as the supply voltage.   C2   The output coupling capacitor, connected to pin 10, and the other end to the loudspeaker. The value of 250μF is again minimal, and the working voltage rating should be at least half the supply voltage. C3   The bootstrap capacitor connected between pins 8 and 10. This provides extra drive for the top half of the output pair, during the positive half cycle, 25 μF is sufficient for normal audio applications, but may be increased if the IC-10 is being used for low frequency applications. The working voltage rating should be at least half the supply voltage. C4   The preamplifier decoupling capacitor, connected between pin 7 and the main earthing point. The value of 20 μF is minimal and may be increased if severe ripple from a power supply is causing hum on the output. This capacitor has a D.C. voltage across it of rather less than the supply voltage and 15 volt working is sufficient.   C5   Compensation, connected from pin 2 to the main earth point. The value of 5000 pF is normally sufficient in the main amplifier, however, should parasitics occur, and this

is usually audibly detectable and can cause the amplifier to become hot under low output conditions, then the value of C5 may be increased up to 0.02μF maximum. The lower the value of this capacitor however, the lower the distortion in the amplifier becomes. (See H.F. stability).
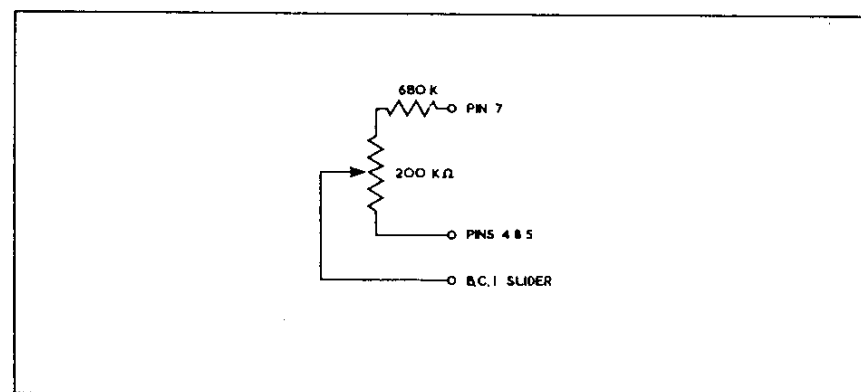
Bias Adjustment   Fig. 4

It is generally necessary to adjust the d.c. bias conditions for optimum results, and this is done by the above circuitry.

Before switching on the supply, the bias adjustment potentiometer must be set so that the slider is fully at the end connected to pins 4 and 5. Switch

on the supply and monitor the voltage on pin 10 with a meter, turn the potentiometer up carefully until the voltage on pin 10 is exactly half the power supply voltage.

At this time if the IC-10 is running from an 18 volt supply the quiescent current should be about 70 mA.

If an oscilloscope and signal generator are available the d.c. conditions may be set up more accurately under working conditions by adjusting the bias control so that the output waveform is limiting evenly on the positive and negative half cycles.

N.B. If the control is accidentally turned up too far and the quiescent current exceeds 200 mA, permanent damage to the IC-10 may occur. It is therefore a useful precaution during the setting up procedures to monitor the supply current.
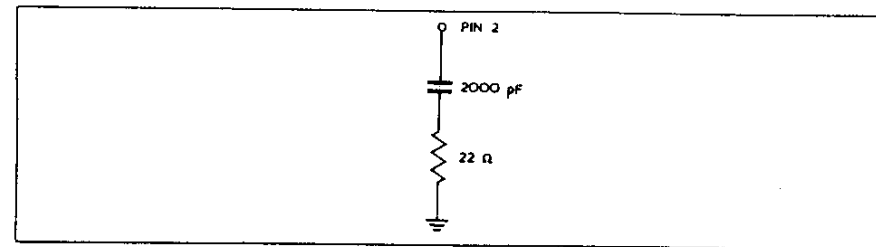
H.F. Stability   Fig. 5

In order to retain low distortion at high audio frequencies an alternative H.F. compensation network is recommended which replaces the capacitor C5. Fig. 3.

The network consists of a resistor and capacitor in series from pin 2 to earth (Fig. 5). The capacitor may be any type, a ceramic is quite adequate.

If difficulty is experienced in curing H.F. instability (usually due to to layout problems) some further steps may be taken:

1 Connect a resistor of value 10 ohms and a capacitor of 0.05 μF in series between the negative end of C2 Fig. 3 and the common earth, i.e. across the speaker.

2 Connect a 1000 pF ceramic capacitor between pin 9 and the common earth point, i.e. across the supply.

3 Connect a 250 pF capacitor from pin 4 to the common earth point.
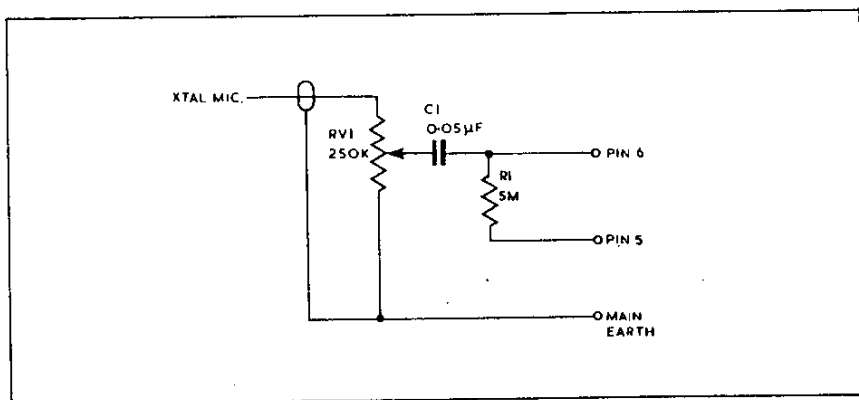
Some basic applications of the IC-10

Fig. 6. Use with a crystal microphone.

This circuit was designed as a small public address system and the volume control was mounted in the microphone. Long leads from the microphone to the amplifier gave rise to hum pick up and so a 250 KΩ potentiometer was used as the volume control to reduce the impedance of the input, and hence reduce the hum. Well screened wire however would obviate this problem if the leads were not too long, and then a higher value potentiometer could be used (2MΩ for example)

ADDENDA A

Hints on layout and wiring

The IC10 has an input sensitivity of 5mV at 1MΩ and an output of 5W into 3Ω, which corresponds to a voltage gain of 1,000 and a current gain of 300,000,000.

If there is therefore the slightest coupling between the output and the input trouble can ensue, giving distortion and instability. This coupling can occur in several ways.

1) *By capacitative coupling.* Two conductors near to each other will have some capacitance. The larger the conductor the more the effect and the nearer together the more the effect.

Therefore components in the output circuitry, such as output capacitors, output wiring and output sockets should not be near input components, wiring and sockets. If they must be close together a metal sheet can be placed between and connected to earth, to act as a screen.

2) *By inductive coupling.* Two wires near to each other, have mutual inductance: a current flowing in one will cause a current in the other so that the two act as a transformer. Therefore wires carrying high current, such as the loudspeaker and power leads, should not run close to input signal wires.

3) *By resistive coupling.* This can occur if components are mounted on a poor insulator such as wood, which is not suitable for electronic construc-

tion. Tag board should not be mounted with live tags touching the woodwork.

4) *By incorrect wiring.* The amplifier has one line (the earth connection) in common between input and output, but one end is carrying less than one millionth of an amp, while the other end is carrying one amp or so. It is therefore vital that these currents do not mix. There are two ways of doing this.

Fig. 12

A

B
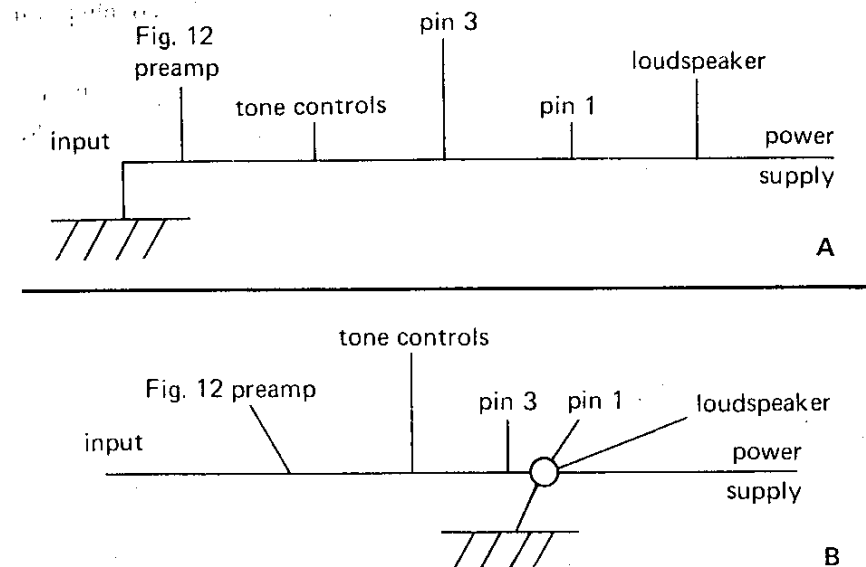
At A a bus bar is shown. Input currents are at one end, followed by preamp earth, tone control earth, preamp earth, output earth, power earth and loudspeaker earth.

At B is shown a 'spider' earth, which is the same thing except that the bus bar has 'telescoped' into a single point. To this point are run separate wires from:

1) input earth (signal)
2) preamp earth (pin 3)
3) decoupling capacitors' earth (C3 in fig. 3)
4) power amplifier earth (pin 1)
5) loudspeaker earth
6) power supply earth.

(1) and (2) can usually be combined, but separate wires should be used for all other earths. Variations on this earthing are of course possible, but when in doubt use a 'spider' earth and run separate wires to it from all points.

For stereo a common earth line must be used with both pin 1 earths branching off at the same point etc. If the 'spider' earth is used the number of connections to it will be doubled: do not make two separate spiders.

It is not possible to easily diagnose the symptoms of a particular fault, since any of the above faults can cause any symptom from the complete destruction, non operation, overheating, interference with radio and television, motor-boating, h.f. instability (parasitics) or just simply distortion in any degree. A layout should be adopted which keeps wiring as short as

possible and has input components at one end and output components at the other. Decoupling components (such as C1 and C3 of fig. 3) can be placed between the output capacitor (C1 of fig. 3) and the input components, to act as a partial screen.

ADDENDA B

The bias control, Fig. 4, should be amended to
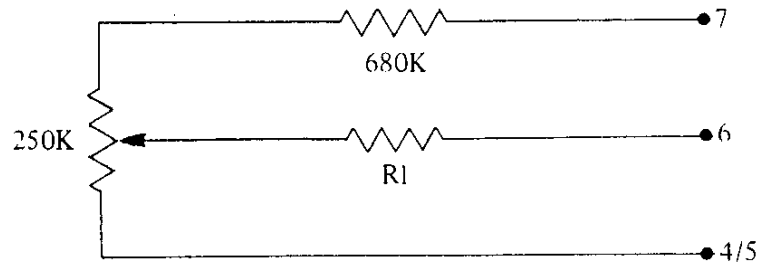
RI is the resistor, mentioned on page 6, which, if bias control is not required, is connected between pins 5 and 6. Its value can be adjusted between 250KΩ and 10MΩ. Lower values will give better bias stability but will reduce the input impedance and gain. RI in Figs 6 and 8 is not required.

The point marked 'BC1 slider' in figs. 7 and 11 should connect to the -ve of a 1uF 12vw capacitor whose +ve lead connects to pins 4/5. R1, above, should be about 1MΩ with this circuit.

Experimentation with the value of the potentiometer and the value of the resistor between pins 5 and 6 can provide correct matching to virtually any input except low impedance low output devices which would need a transformer.

The resistor between pins 5 and 6 may be seen from Fig. 1 to be the collector-base resistor of the first compound stage (TR1, TR2, TR3), and it sets the bias voltage of this stage; it does however affect the input impedance and hence the apparent sensitivity, the value may be varied between 250 KΩ and 10 MΩ to achieve the best results.
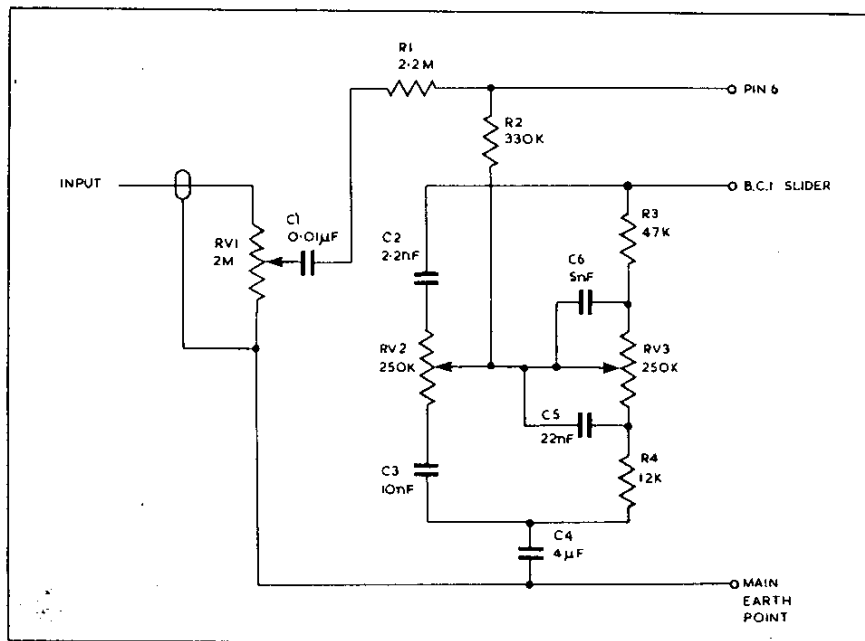
Fig. 7. Input with tone controls suitable for crystal/ceramic pickup

The tone controls consist of a modified Baxandall feedback circuit around the first stage. Bias to the first stage is provided via the 330KΩ and the bass control. This circuit should accept an input from any crystal or ceramic cartridge. As the input impedance of the IC-10 is high, there is no need for an equalisation stage.

N.B.   1nF = 1000 pF

A small list of suitable cartridges is as follows:
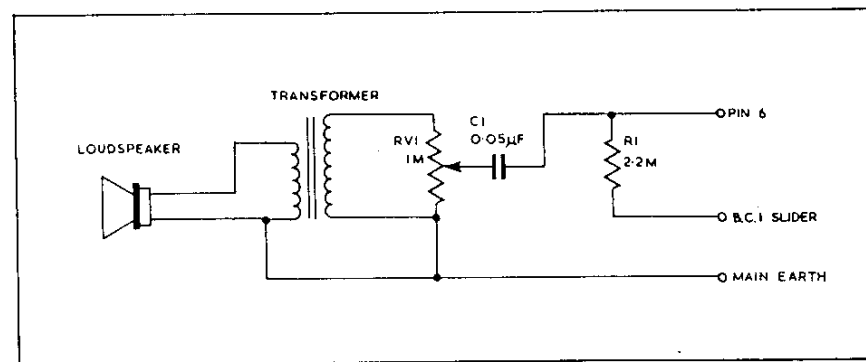Decca Deram, Golding CS90 or SX 10, Sonotone 9TAHC, Acos GP 93–1, B.S.R.C1.

Fig. 8.   Use in intercom using loudspeaker as microphone

This circuit is for use when it is desirable to use a loudspeaker both as microphone and loudspeaker in, for example, an intercom system.

The loudspeaker, typically of 8Ω impedance (a Q14 for example) is matched into the amplifier via an output transformer with a turns ratio of about 20:1, such as is used in many of the older transistor portable radios, then via the volume control and series capacitor to pin 6 on the IC-10. The value of the resistor between pins 5 and 6 given as 2.2 MΩ is not critical and may be experimented with for optimum results.

It is important to earth one side of both primary and secondary windings on the transformer to pin 3 or the main earth point otherwise hum will occur.

Alternatively to using a matching transformer, a high impedance speaker (many older transistor portables use 80Ω speakers) will give quite satisfactory results connected directly across the volume control without the transformer.

A multi-channel intercom system may be built up using only one IC-10, the appropriate switching being required in the master unit to switch the speakers from output to input on the IC-10, and from channel to channel. As the leads to the speaker used will be low impedance there will not be the problem of hum pick-up which is usually prevalent with crystal microphones on long leads.
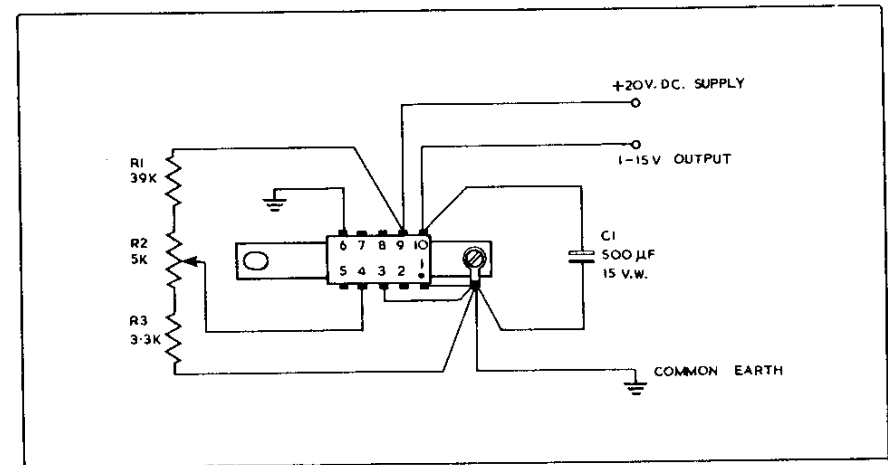
Fig. 9. D.C. Amplifiers

This circuit shows the IC-10 used in its simplest form of D.C. amplifier, in fact a basic adjustable power supply. The first stage is not necessary in this case, and pins 4 and 5 are no longer joined, instead pin 4, the main amplifier input is taken to the slider of a potential divider consisting of R1 and R3 with the potentiometer R2 in the centre. This provides a voltage variation of about 2 volts on the base of TR4 which, as the voltage gain

of the main amplifier is 20 times allows the output voltage to be controlled over most of the supply voltage by about 90° revolution of the potentiometer spindle. The IC-10 can itself dissipate about 3 watts if mounted on a heatsink of around 20 square inches, it must therefore be remembered, when dropping several volts across the IC-10, that large currents may not be drawn for very long without the IC-10 becoming rather hot. When it does become hot the IC-10 protects itself by allowing the output voltage to rise until the power dissipated internally is limited by the current available from the unregulated supply. It is obvious from the above, that the circuit shown does not provide a stabilised voltage.
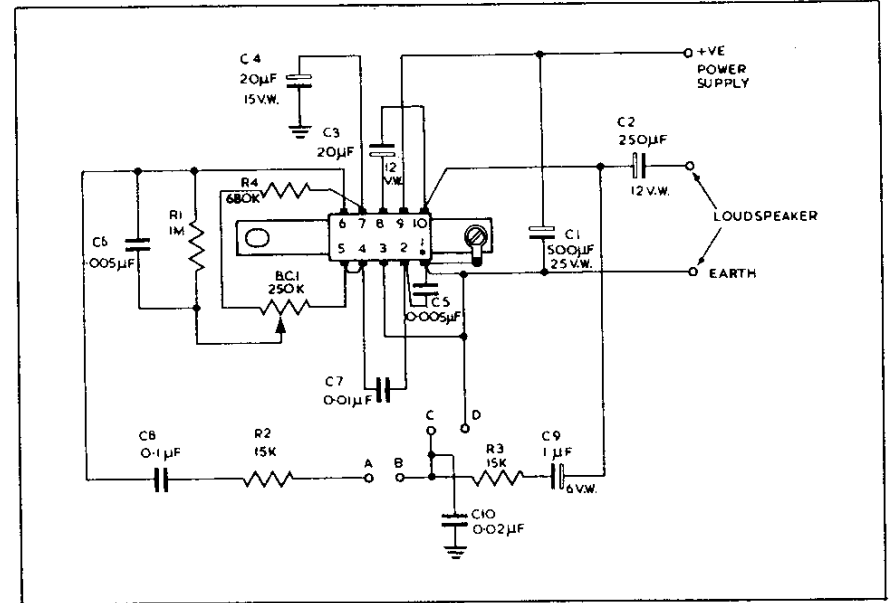
Fig. 10. Siren/Burglar alarm

This circuit shows the IC-10 used simultaneously as an amplifier and oscillator, using the component values shown will produce a loud piercing note at a frequency of about 2 Kc/s. The circuit consists of the basic unit

wiring with three stages of R.C. phase-shift introduced at various points in the amplifier. Firstly phase shift is produced by C6 in the preamplifier then by C7 in the main amplifier, and finally by the external phase shift path provided by the 'T' network consisting of R2, R3 and C10, D.C. decoupled by C8 and C9.

The points A, B, C and D are parts of the circuit wherein may be inserted the switching or sensing device, which in this case is a cadium sulphide phot-resistive cell such as an ORP 12, but of course many other devices may be used, most simply a make and break switch. If it is desired that the siren should sound when the light is falling on the cell, then the latter should be connected between points A and B and points C and D should be left open circuit. If on the other hand, the siren should sound when the cell is in darkness, then it should be connected between points C and D, and points A and B connected to each other.
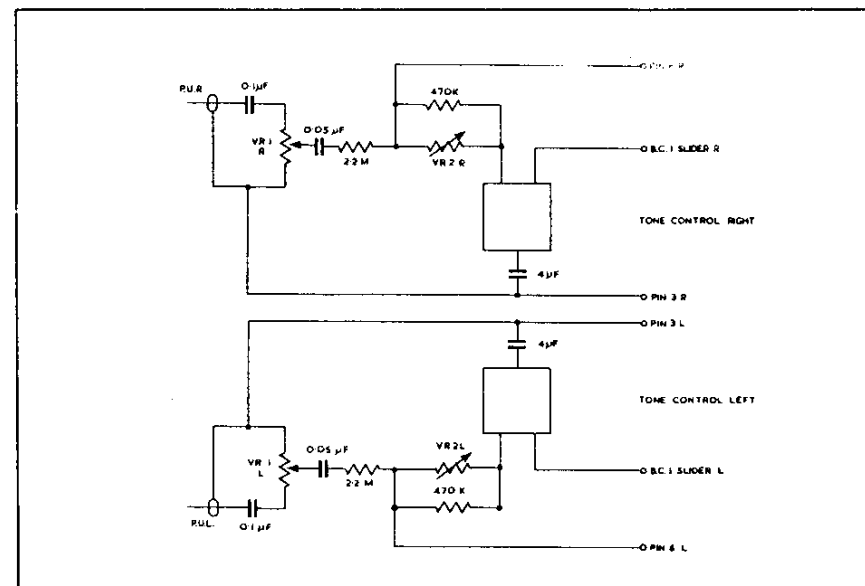
Fig. 11. Wiring for stereo

This is basically the same as Fig. 7 but in duplicate, using preferably ganged controls. The main addition is the balance control VR2, value 1MΩ

in parallel with 470 KΩ, which replaces the 330 KΩ resistor of Fig. 7. The balance controls, when utilising ganged controls must of course be wired in reverse to each other, so that one turns the volume up as the other turns it down.

An extra capacitor of 0.1 μF has been inserted in the input before the volume control, this may be left out unless the IC-10 is being fed from a preamplifier or other device that may have a D.C. component in its output. Care must again be taken in the wiring of the earth. The wiring shown is normally correct, but some pick-ups have a common lead to the two channels, and others have separate earth leads which are both connected to the chassis under the decks, either way this will cause a hum loop. To avoid this, in the latter case, it is advisable to separate the two earths from each other and from the deck earth, and leave the wiring as in the diagram, but add another wire from the deck earth to the main earthing point of the IC-10.

In the former case the remedy is to wire as shown, but do not connect the tone and volume stage earth of one channel to pin 3, as it will find its own earth via the common input earth to pin 3 on the other channel.
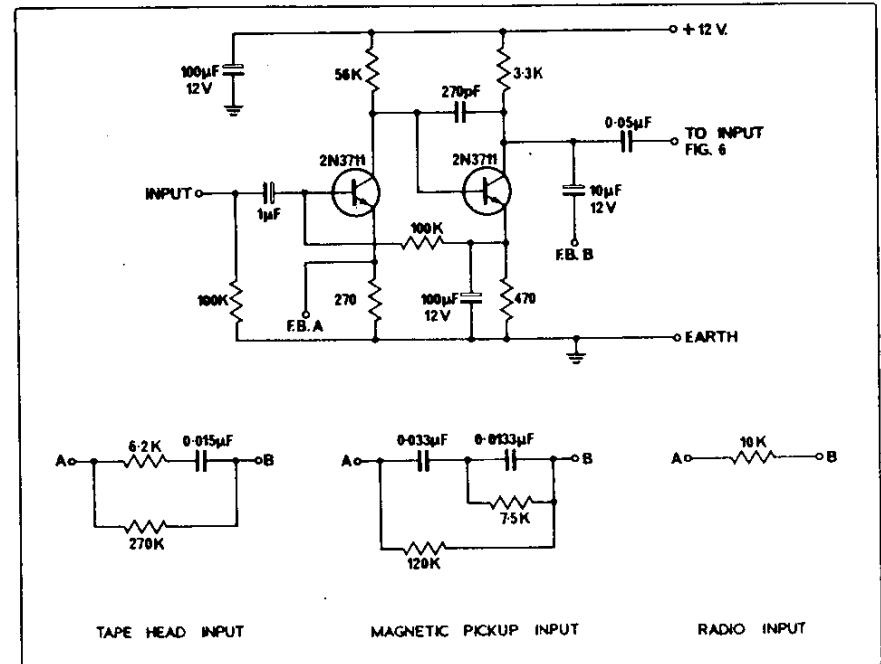
Fig. 12. Magnetic pickup, tapehead and radio low impedance inputs

Fig. 12 shows a two stage circuit for feeding the IC-10 from a magnetic pickup or a tapehead the output from this circuit may be fed into the tone control circuit input (Fig. 7) or the flat input (Fig. 6).

The feedback networks for tapehead is correct for C.C.I.R. 3¾ i.p.s. but individual tapehead characteristics must be taken into consideration for optimum results.
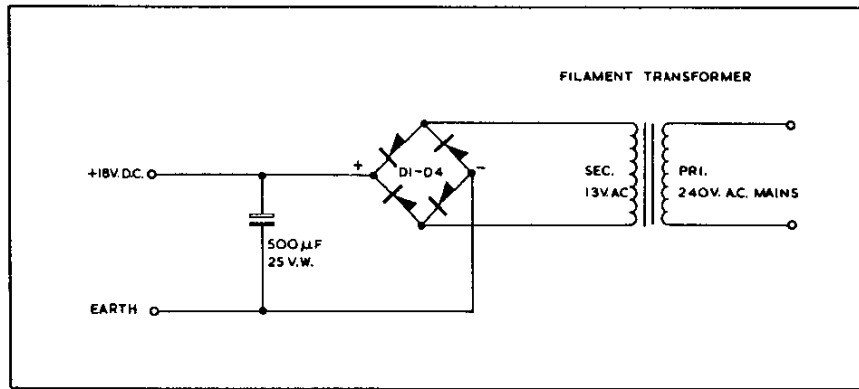

Fig. 13 Power Supply

This shows a very simple mains power supply suitable to drive one or two IC-10s. It consists of a standard filament (valve heater) transformer, with a 240V mains primary and a 13V 0.5A secondary, feeding a full bridge rectifier consisting of D1 to D4, then the D.C. is smoothed by the 500 μF reservoir capacitor which should have a working voltage rating of at least 20V.

Any other type of power supply will work provided it can supply up to 0.5A. The Sinclair PZ3 and PZ4 are also suitable. To obtain maximum power from the IC-10 an 18V power supply must be used, however the amplifier will function perfectly well on a supply as low as 9 volts. A car battery provides a good supply, or if the IC-10 is to be used in a portable unit, then dry batteries may be used. In fact for small units two PP4s may be used in series, but they cannot be expected to last for long if much power is taken from the amplifier.

POWER OUTPUT (WATTS) vs **POWER SUPPLY (VOLTS)** — curves labelled 3Ω, 4Ω, 6Ω, 8Ω, 15Ω
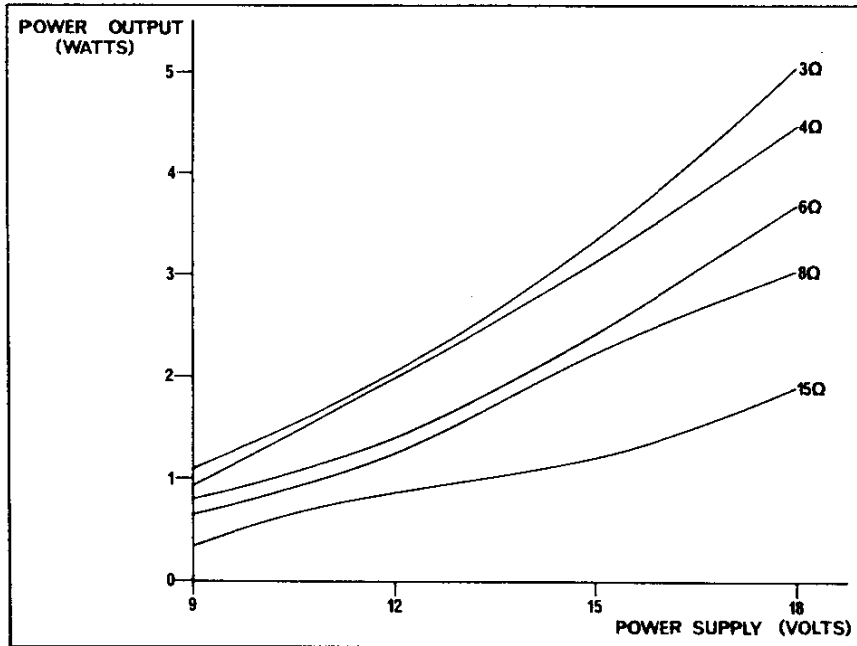
Power output of the IC-10   Fig. 14

Although the IC-10 is rated at 5 watts r.m.s. this is only obtained when running the amplifier from an 18V stabilised supply into a 3 ohms load.

The variation of power output with load impedance and supply voltage is as shown.

Miscellaneous Further Applications

Baby Alarm—use Fig. 6 circuit with the speaker on long leads, and the microphone fairly near to the amplifier. **Loud Hailer**—use Fig. 6 circuit, and use a horn type loudspeaker. **Car Radio** output stage—use Fig. 6 or Fig. 7, IC-10 may be fed preferably from the detector stage of the radio, but may also be fed from the existing speaker terminals. **Electronic Organ**—a simple monophonic organ may be built by making the preamplifier stage into a phase shift oscillator the frequency of which may be switched, and feeding this into the main amplifier. **Telephone Amplifier**—the IC-10 may be fed as in Fig. 6 from a telephone pick up coil of fairly high impedance. **Thermo-Couple Amplifier**—due to its D.C. amplification ability the IC-10 is ideally suited for all sorts of instrumentation in laboratory work and may be used with all types of transducers. **Servo Amplifier**—again the D.C. abilities of the IC-10 plus its minute size make it ideal for use in servo systems particularly in model control applications. **T.R.F. Radio**—a simple medium wave radio may be made by connecting one end of an R.F. tuned circuit to earth pin 3 and the other end via a 1000 pF capacitor to pin 6. The rest of the IC-10 is connected as in Fig. 3 and 2.2 M resistor is connected between pins 5 and 6. The tuned circuit should utilise a ferrite rod (a Sinclair micromatic tuned circuit may be used) otherwise an external aerial will be necessary connected to the top of the tuned circuit.

Audio Amplifiers

Hints on layout and Wiring.

An audio amplifier has an input sensitivity of typically 3mV at 50KΩ and an output of typically 12w into 3Ω, which corresponds to a voltage gain of 2,000 and a current gain of 3,000,000.

If there is therefore the slightest coupling between the output and the input trouble can ensue, giving distortion and instability. This coupling can occur in several ways.

1) By capacitative coupling. Two conductors near to each other will have some capacitance. The larger the conductor the more the effect and the nearer together the more the effect.

Therefore components in the output circuitry, such as output capacitors, output wiring and output sockets should not be near input components, wiring and sockets. If they must be close together a metal sheet can be placed between and connected to earth, to act as a screen.

2) By inductive coupling. Two wires near to each other, have mutual inductance: a current flowing in one will cause a current in the other so that the two act as a transformer. Therefore wires carrying high current, such as the loudspeaker and power leads, should not run close to input signal wires.

3) By resistive coupling. This can occur if components are mounted on a poor insulator such as wood, which is not suitable for electronic construction. Tag boards should not be mounted with live tags touching the woodwork.

4) By incorrect wiring. The amplifier has one line (the earth connection) in common between input and output, but one end is carrying less than one millionth of an amp, while the other end is carrying one amp or so. It is therefore vital that these currents do not mix. There are two ways of doing this.

A

B
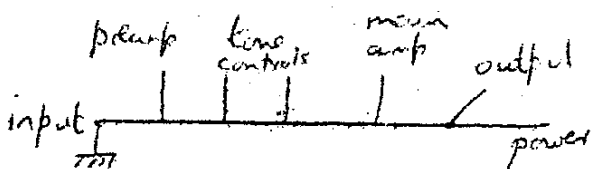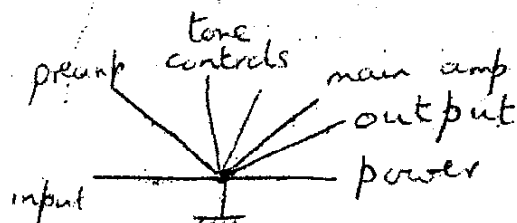
At A a bus bar is shown.. Input currents are at one end, followed by preamp earths, tone control earths, driver earths, outp earths and power earths.

At B is shown a 'spider' earth, which is the same thing except that the bus bar has 'telescoped' into a single point. To this point are run separate wires from.

   (1) input earth (signal)
   (2) preamp earths.
   (3) decoupling capacitors' earths.
   (4) power amplifier earth
   (4) loudspeaker earth
   (5) power supply earth.

(1) and (2) can usually be combined, but separate wires should be used for all other earths. Variations on this earthing are of course possible, but when in doubt use a 'spider' earth and run separate wires to it from all points.

It is not possible to easily diagnose the particular cause of the fault, since any of the above faults can cause any symptom from the complete destruction, non operation, overheating, interference with radio and television, motor-boating, h.f. instability (parasitics) or just simply distortion in any degree. A layout should be adopted which keeps wiring as short as possible and has input components at one end and output components at the other. Decoupling components (such as large electrolytic capacitors across the power supply) can be placed between the output capacitor and the input components, to act as a partial screen.

We hope the above hints are helpful and of interest but if further assistance is required may we request a rough sketch showing the layout and the earth wiring. Please do not send the whole set-up back to us.
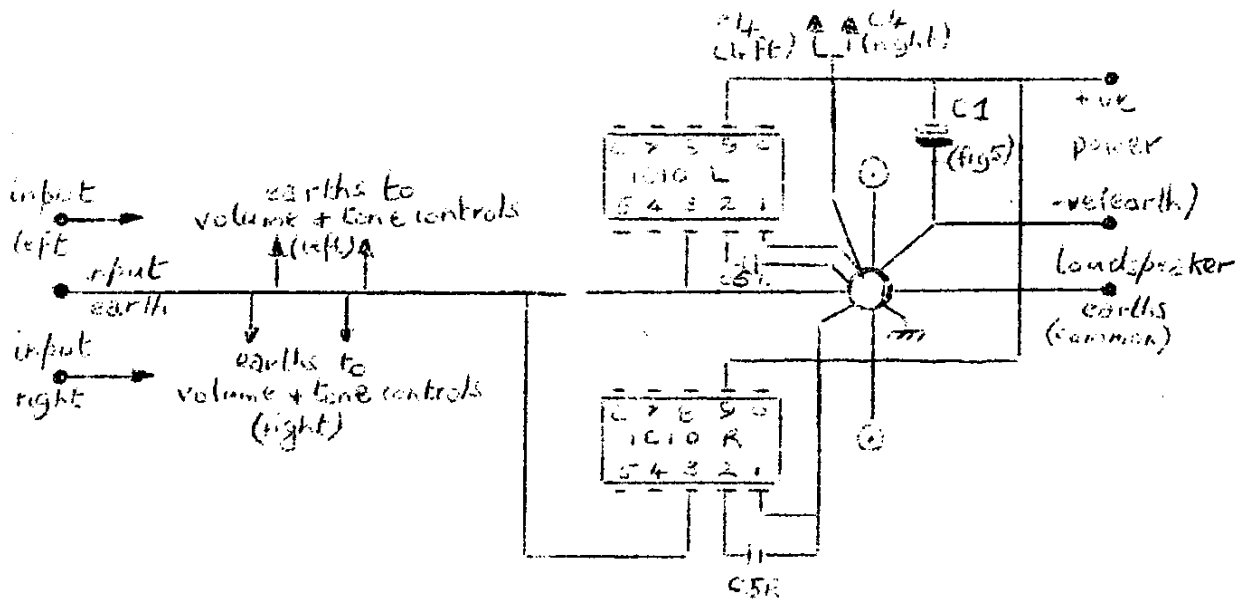
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I.C.10

Stereo Wiring.

When wiring I.C.10s in stereo, great care must be taken with the earthing and the circuit shown is the recommended method. Note in particular that all input wiring is common between channels and no other part of the earthing is shared with the input signal. All wires shown connecting to the earth point must be connected separately and independently.
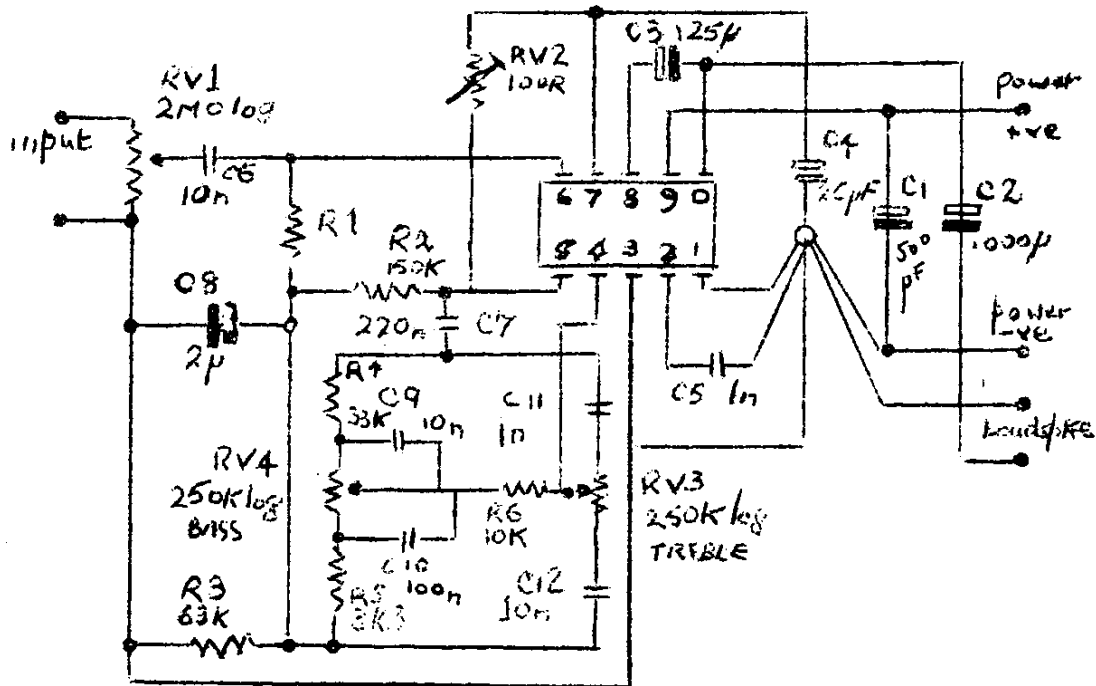
Care should also be taken with layout, to keep the input and control circuitry well away from the output circuitry.

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St. Ives, Huntingdon.

I.C.10

Alternative tone control circuitry

The circuit shows an alternative control to that in fig.7 of the manual.

In this the d.c. potential on pin 5 is fed to a potential divider, R2 and R3 and from the centre, which is decoupled, via R1 to the input, pin6. The potential at the junction of R2 and R3 is also fed via the tone controls, to bias the output stage. RV1 varies R2 of the I.C.10 and hence the biasing.

The tone controls are passive and are in circuit between preamp and power amp.

The circuit includes or replaces the circuits recommended in figs 3, 4 and 7 of the I.C.10 manual.

I.C.10

Simple amplifier circuit
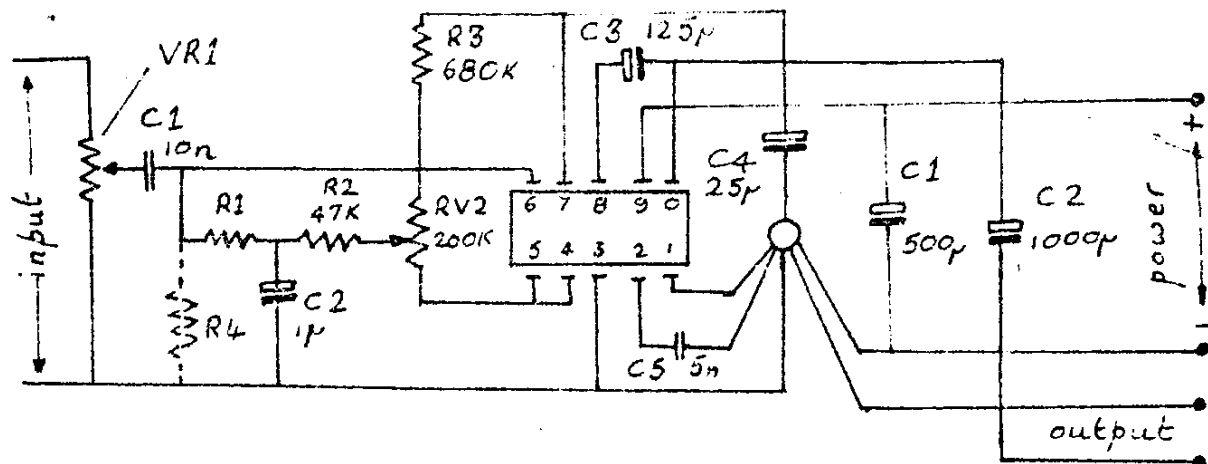
The above circuit shows all components needed for a simple audio amplifier and includes the circuits of figs. 3, 4 and 6 of the I.C.10 manual with changes where appropriate.

VR1 can be of any value up to $5M\Omega$: $2M\Omega$ is recommended for crystal and ceramic pickup and microphones. For tuners and other inputs a lower value potentiometer (down to $10K\Omega$) will give a better hum level.

R1 can be 250K to $10M\Omega$. In the circuit shown the value should not be less than the value of RV1 since the input impedance to point A will be roughly equal to R1.

For use with low impedance (less than $10K\Omega$) devices, R2 and C2 can be omitted and R1 connect direct to the wiper of RV2. In this case input impedance to point A will be about 1/30 of R1.

For best d.c. stability R1 should be as low as possible.

Normally the voltage on pin 10, with RV2 set with its wiper connected to pin 5, is greater than half the supply voltage. In the rare cases when it is less than this a resistor of about 2M2 (R4) can be connected as shown dotted.

Layout and wiring is important: in particular C4 and C7 should be kept away from RV1, C1, R1, R2 and RV2. All wires connecting to the earth point must go separately and independantly to this: do not make two connections with the same wire.

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