Use your favourite records to drive the

Musicolour III

to modulate 240V lights for an exciting display

Here is the third Musicolour we have published. Like its predecessors, it is capable of producing an exciting kaleidoscope from your favourite records and tapes. The new model has all the features of the Musicolour II and includes a compressor stage to make the light display less dependent on amplifier volume control settings.

by LEO SIMPSON

These days there must be few people who have not seen, read about or actually built a Musicolour. It was our original circuit, published back in October 1969, which really popularised the device as a party livener and an almost essential appliance for any upcoming pop group.

Since then, it has had widespread applications, both frivolous and serious. We have seen it incorporated into juke boxes and used as an experimental aid for teaching deaf children to speak.

The Musicolour II was published in December 1971 and January 1972. It offered a big increase in sensitivity over the original model in that it required far less power to drive.

However the original model and the Musicolour II, despite their continuing popularity in 1976, suffered from one significant drawback. The control characteristic was narrow and too dependent on the audio level or the setting of the amplifier's volume control.

This meant that most classical music and other music with a large dynamic range was unsuitable for driving the Musicolour, because the lights were "saturated" during loud passages and extinguished in quiet passages.

This often led to the silly situation whereby people would search out the records in their collection which gave the best display. The music content and its appreciation became secondary—the important parameter was its effectiveness as source material for the Musicolour. Which is putting the cart before the horse!

We have obviated this problem in the Musicolour III, by incorporating a simple volume compressor into the circuit. This enables variations in the average input level of more than 30dB without appreciably changing the effectiveness or quality of the display.

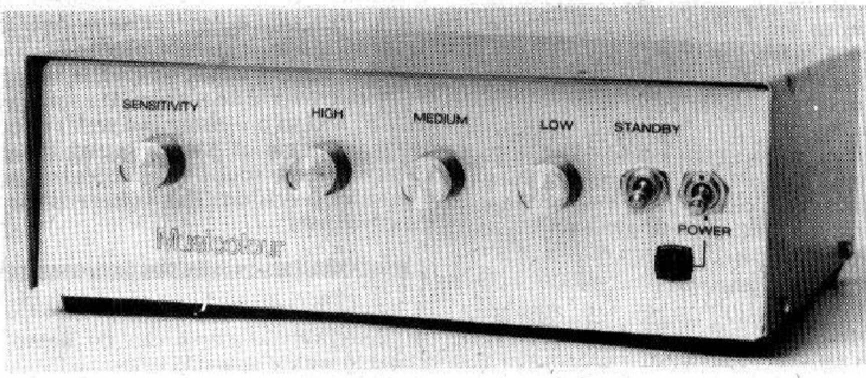
Now one can set the controls and listen to any piece of music or any record, without the necessity to adjust the controls to compensate for differing audio levels or a change in volume control setting on the audio amplifier. A convincing test of the effectiveness of the compressor circuit is to drive the new Musicolour with an amplifier having a mute switch which drops the audio output level by 20dB. Hit the switch, and the display does not change appreciably.

same as the superseded model.

Now let us describe in detail how the Musicolour works:

Basically, it splits an incoming audio signal into three frequency bands, referred to as the high, medium and low channels. The signal derived from each channel is used to control a Triac—a semiconductor device which varies the AC power to incandescent lamps. The power supplied to the lamps then becomes proportional to the amplitude of the derived signal.

Since the circuit uses Triacs, the full mains voltage is present in many sections and indeed, depending on how the power point from which it is operated is wired, the whole circuit board will have 240 volts applied to it—no section of the circuit is earthed. This means that the incoming



The new Musicolour III has updated circuitry and includes a compressor stage.

So that now you can listen to classical music and enjoy the visual effects produced by the Musicolour, without becoming irritated by its lack of control range. And the Musicolour can certainly add a different dimension to the enjoyment of any music. Not that we would ever claim that it could add to the emotive effect. Rather, it produces a certain fascination with the visual display produced by different types of music.

The displays are hard to describe, as we have noted in previous articles; and the description of how the circuit works certainly will not enlighten the reader in this regard. It is better to see one in action or better still, build one yourself! While the new Musicolour is more complicated in its circuit, it is easier to build and safer to troubleshoot and should cost about the

audio signal must be completely isolated —for safety's sake—from the Musicolour circuit.

The method of isolation uses a small mains transformer, 240V to 12.6V, working backwards. That is, the audio is applied to the 12.6 volt winding and is stepped up in the 240V winding. The reason for using a mains transformer instead of a better quality audio type, is that, apart from providing a suitable turns ratio at a modest cost, the transformers specified have very high insulation between windings. They conform to the specifications laid down for transformers used in battery chargers, model train controllers and similar "appliance" applications.

After passing through the step-up isolating transformer, the audio signal is fed via the sensitivity control to the compressor stage consisting of T1, T2, T3 and T4. T1 and T2 form a direct coupled amplifier with T3 acting as a buffer stage feeding three 4.7k potentiometers in parallel. These pots adjust the signal level applied to the high, medium and low channels.

Diodes D1 and D2 develop a negative DC voltage which is directly proportional to the output signal at the emitter of T3. This negative voltage is used to control the drain-source resistance of FET T4. The drain-source resistance is proportional to the negative DC voltage and has direct control over the gain of T1 and T2 by virtue of its insertion in the feedback loop from the emitter of T3 to the emitter of T1.'

If a large output signal is delivered from the emitter of T3, a proportionally large DC voltage is applied to the gate of T4, which reduces the gain of the whole compressor stage to bring the average audio level back to within narrow limits. The compressor stage can handle about 40dB input range for an output level change of 3dB. It is fairly crude in action, but effective enough for this application.

Frequency splitting for the three channels is accomplished by a combination of active high and low pass filters. These filters consist of a simple second-order filter (double RC network) combined with an emitter follower to act as a buffer stage. Each filter has a gain of slightly less than unity and an attenuation slope beyond the turnover point of 12dB/octave.

A high pass filter, using T5, is used for the high channel—it passes only those signals above 2kHz. Similarly, a low pass filter using T10 is used for the low channel—it passes only those signals below 300Hz.

The medium channel uses a high pass filter T7 followed by a low pass filter T8. The bandpass of the medium channel is from 300Hz to 2kHz. The frequency allocation of each channel has been selected to give a good visual display with music signals.

As noted above, the signal from the output of each channel is used to control a Triac and thus the brightness of lamps. To understand how this is achieved, the reader must be familiar with the operation of a Triac.

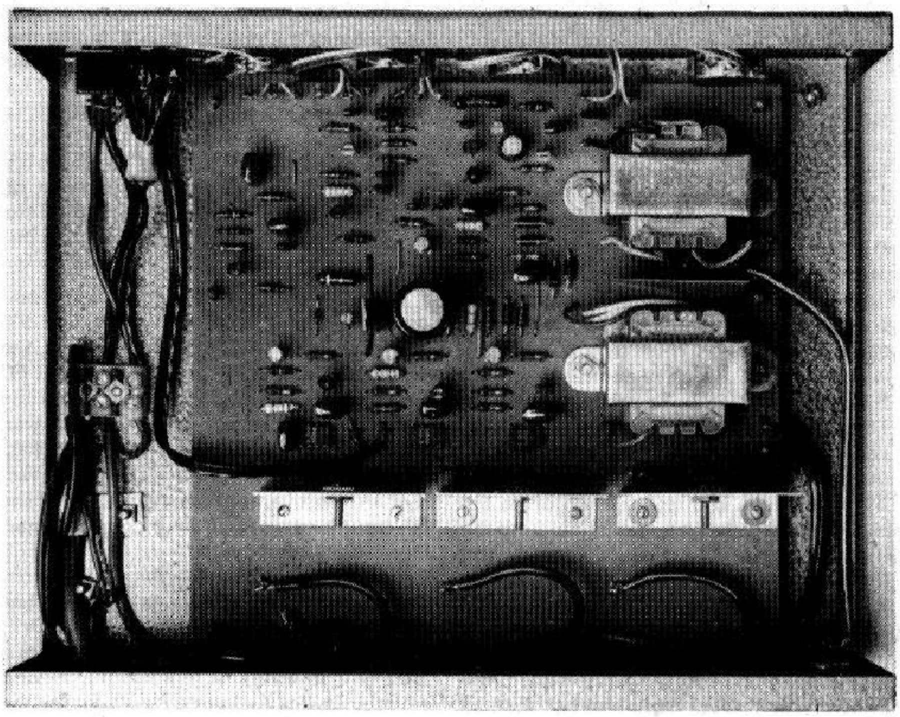
In essence, the Triac is a bi-directional switch which, after being triggered into conduction, stays "on" until the supply voltage decreases to zero or reverses polarity, when it turns off and can be switched on again. Used with AC, a Triac can be triggered into conduction at any point on either half cycle by a low voltage signal of either polarity applied between the gate electrode and terminal 1 (anode 1). Since the Triac is a bi-directional device it has no anode or cathode as such. The two end terminals are normally referred to as "anode 1" and "anode 2" or "terminal 1" and "terminal 2".

As the Triac is a switching device which is either fully conducting or "off", the only means by which it can provide variable control of power is to use it as a very rapid switch which closes for variable periods of time during each half-cycle of the AC voltage waveform—by adjusting the instant during the half-cycle when it triggers into conduction.

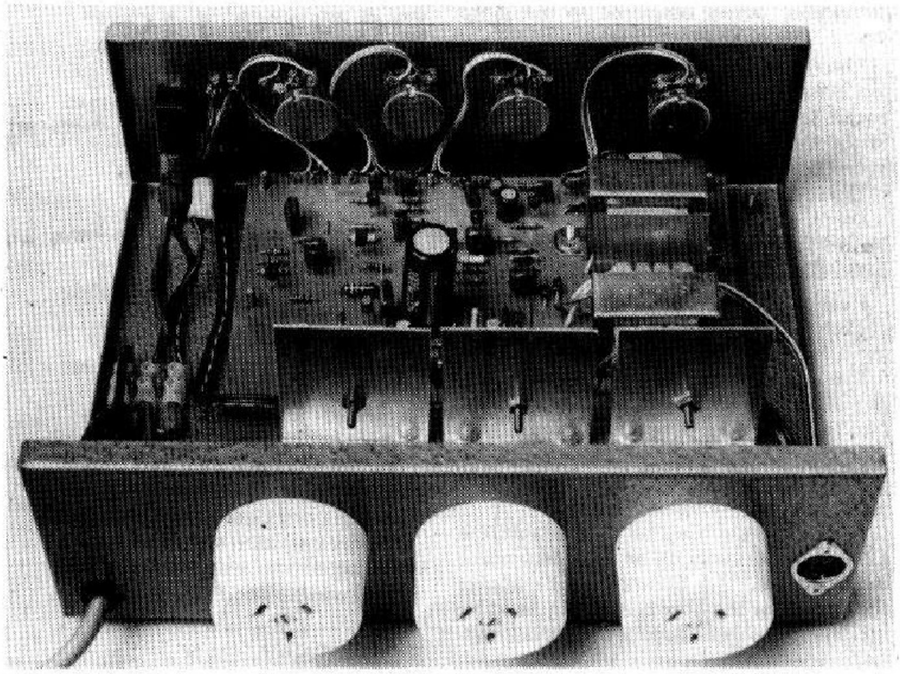
The method of triggering used here is to apply a negative DC voltage to the gate of the Triac using a 555 timer IC. The 555 timer is used as a "one-shot" monostable which is reset at the start of every AC half-cycle.

How does the 555 apply a negative DC voltage to the Triac gate? And how does it work as a monostable? Let us consider the high channel alone for the moment.

After resetting at the beginning of each AC half-cycle, the output (pin 3) of the 555 is high, i.e., almost equal to the positive 12V rail. The 0.1uF capacitor at pin 6, 7 is charged by the 100k resistor towards a threshold which is 8V or less. When the threshold is reached, the output at pin 3 drops to a low state, ie, close to 0V. Now since terminal T2 of each Triac (and hence the neutral conductor of the AC mains) is connected to the 12V rail, this means that the 555 applies a negative



The PCB shown here is slightly different from that shown on page 41.



Note the galvanised steel shield between the two transformers. See text.

voltage to the Triac gate via a 100 ohm resistor.

With no signal applied to the high channel, the 8V threshold to which the 0.1uF capacitor must be charged is too high to be reached during a single AC half-cycle. And at the beginning of each half-cycle the 0.1uF capacitor is discharged. So with no audio signal to modify the conditions in the 555 circuit, the Triac is not triggered at all.

In order that the 0.1uF capacitor can charge to the threshold within the AC half-cycle, the threshold must be lowered. This is done by T6, which is connected to pin 5 of the 555 via a 1k resistor. T6 (and T9, T11) is actually a class-B detector. Its base-emitter junction rectifies the audio output of the high channel and lowers the 555 threshold in direct proportion to the audio signal. A large audio signal from the high channel drastically lowers the threshold so that the 0.1uF capacitor can quickly be charged to the threshold and allow the 555 to turn the Triac on early in the half-cycle. This delivers a large amount of power to the lamp load. Similarly, a small audio signal means a small reduction in the threshold and consequently the 555 triggers the Triac late in the half-cycle. This corresponds to a small amount of power delivered to the lamp load.

Thus the 555 together with its associated class-B detector provides a means of controlling the amount of power delivered to the lamps, in direct proportion to the average amplitude of the audio signal.

The 4.7uF capacitor connected to the collector of each class-B detector, T6, T9 and T11, provides filtering of the rectified audio signal.

Resetting of the 555's at the beginning of each AC half-cycle is achieved by applying a rectified 50Hz signal to pins 2 and 4. If this signal was disconnected, the output of each 555 would remain low and the Triacs would conduct continuously. This would mean that the lamps would be at full brilliance. This mode of operation is used in the Standby mode.

When no audio signal is available the Triacs are normally off and the lamps are extinguished. The Standby mode allows the lamps for the Low channel to be lit by inhibiting the reset function for this channel.

The 12V rail is supplied by a transformer of the same type as used for the input coupling transformer. A bridge rectifier rectifies the 12.6VAC and a 10k/33k voltage divider provides the reset function referred to above. The rectified waveform is also fed via diode D7 to a 1000uF/25VW smoothing capacitor. T12 and T13, in conjunction with a 13 volt zener diode, provide a regulated 12V supply.

So let us summarise the operation of the Musicolour III as follows: (1) Audio signal from an amplifier or other source is applied to the isolating transformer; (2) Signal from the transformer is applied to a compressor stage to make it less dependent on overall signal level variations; (3) Signal from the compressor is fed to the frequency-splitting filters to derive three channels, high, medium and low; (4) The signal from each of the three channels is rectified and used to control a 555 connected as a monostable and (5) the 555 monostables control the trigger point of the Triacs. If the Triacs are triggered into conduction early in each AC half cycle, the lamps will be bright and vice versa.

Mains interference suppression components have not been included in the published design. We tried them in the prototype (hence the slightly different PC board in the photographs) but found the results of marginal utility when compared with the cost and effort of making chokes. The problem is compounded by the fact that an improvement on one section of the RF bands can result in increased interference on other bands.

Having described the Musicolour circuit it is now appropriate to devote a few paragraphs on "driving the Musicolour". The input transformer primary presents a load of 250 ohms or more to the driving source. This is the same figure as for the Musicolour II. For the Musicolour II we recommended driving it directly from the headphone socket of a stereo amplifier.

This has proved to be not the most practical suggestion since, on most currently available stereo amplifiers, use of the headphone socket cuts out the loudspeakers. It also prevents users from listening to music via headphones, while using the Musicolour.

We have used a new system of input connection in the Musicolour III. The input socket is a three-pin DIN type, which means that a connection can be made to both loudspeaker outputs of a stereo amplifier. A single wire to pin 2 of the socket provides the common return path to the amplifier—just connect it to one of the earth terminals for the loudspeakers.

If the Musicolour is to be used with a single-channel amplifier, just connect a pair of wires (from pins 1 and 2 of the DIN socket) to the loudspeaker output terminals.

At right is the complete circuit. Note that T4 is shown correctly. It is a symmetrical device so the source and drain can be interchanged.

PARTS LIST

CHASSIS & HARDWARE

1 chassis and cover
1 front panel
4 knobs to suit front panel
2 SPST toggle switches
1 3-pin DIN socket
3 3-pin mains sockets
1 neon bezel with internal limiting resistor
1 50k (log or lin) potentiometer
3 4.7k (log or lin) potentiometers
1 solder lug
4 rubber feet
6 Richco CBS-6N PCB supports
1 three-pin mains plug and three-core mains cord.
1 mains cord clamp and grommet
1 3-way insulated terminal block
Miscellaneous screws, nuts, lockwashers and plastic sleeving.

PCB ASSEMBLY

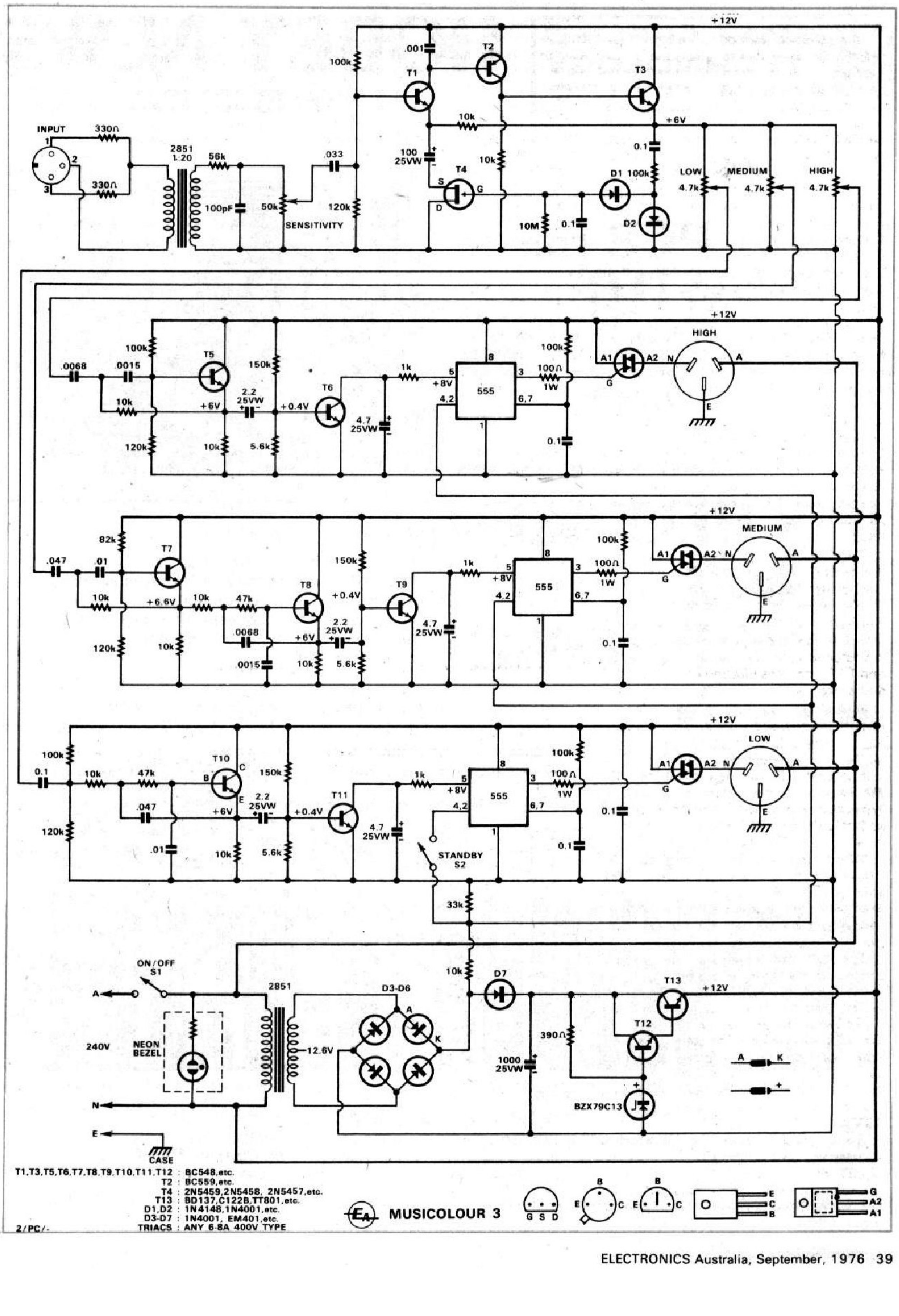
1 PC board, 76pc9, 183 x 167mm
3 aluminium heatsinks (see text)
2 power transformers, Ferguson PF 2851, DSE 2851 or A & R 6474
1 galvanised steel shield (see text)
23 PC stakes

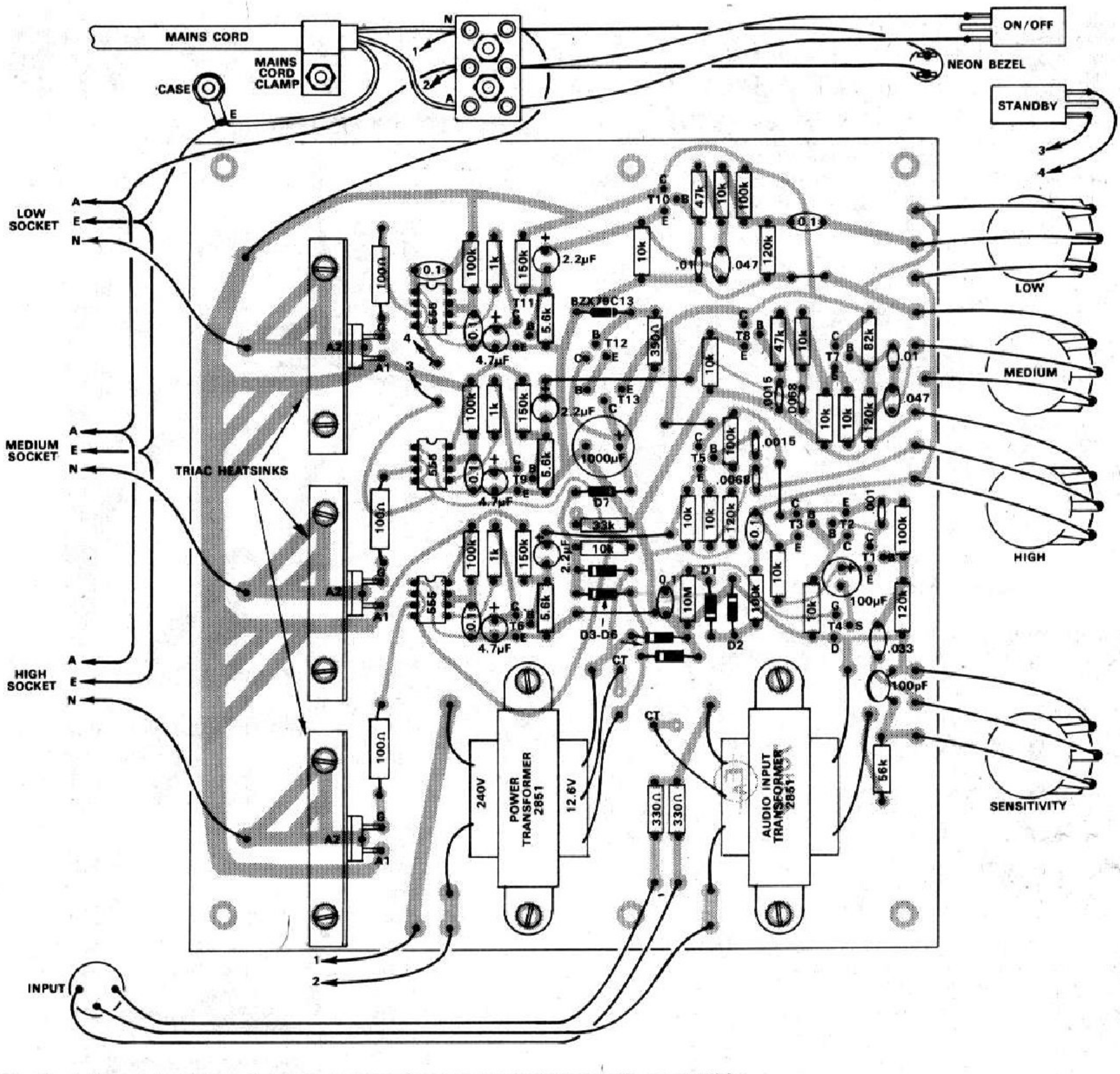
SEMICONDUCTORS
2 1N4148, 1N4001 silicon diodes
5 1N4001, EM401 silicon diodes
1 BZX79/C13 zener diode
1 BD137, TT801, C122B silicon NPN power transistor
10 BC548, BC108, silicon NPN transistors
1 2N5459, 2N5458, 2N5457 field effect transistor
3 555 timer integrated circuits
3 Triacs; any 6-8A 400V type, preferably plastic encapsulated for ease of mounting

CAPACITORS (all PCB types)
1 1000uF/25VW electrolytic
1 100uF/25VW electrolytic
3 4.7uF/25VW electrolytic
3 2.2uF/25VW electrolytic
7 0.1uF metallised polyester (greencap)
3 .047uF metallised polyester
1 .033uF metallised polyester
3 .01uF metallised polyester
2 .0068uF metallised polyester or polystyrene
2 .0015uF metallised polyester or polystyrene
1 .001uF metallised polyester or polystyrene
1 100pF ceramic or polystyrene

RESISTORS (10% tolerance, ¼W, unless otherwise noted)
1 x 10M, 3 x 150k, 4 x 120k, 7 x 100k, 1 x 82k, 1 x 56k, 2 x 47k, 1 x 33k, 11 x 10k, 3 x 5.6k, 3 x 1k, 1 x 390 ohms, 2 x 330 ohms, 2 x 330 ohms ½W, 3 x 100 ohms 1W.

NOTE: Where voltage ratings are not quoted they should be 25V or more. Components with higher ratings may be used provided they are physically compatible.


INPUT
330Ω
330Ω
2851
1:20
56k
100pF
50k
SENSITIVITY
.033
100k
120k
.001
T1
T2
T3
T4
10k
100
25VW
S
G
D
10k
+6V
0.1
100k
D1
D2
10M
0.1
LOW
4.7k
MEDIUM
4.7k
HIGH
4.7k
+12V
.0068
.0015
100k
T5
10k
+6V
120k
10k
2.2
25VW
150k
5.6k
+0.4V
T6
4.7
25VW
1k
+8V
555
8
5
3
4,2
6,7
1
100k
100Ω
1W
0.1
A1
A2
G
N
A
E
+12V
.047
.01
82k
T7
10k
+6.6V
120k
10k
10k
47k
.0068
.0015
T8
+6V
10k
2.2
25VW
150k
+0.4V
5.6k
T9
4.7
25VW
1k
+8V
555
100k
100Ω
1W
0.1
MEDIUM
+12V
100k
0.1
10k
47k
.047
.01
120k
T10
B
C
E
+6V
10k
2.2
25VW
150k
5.6k
+0.4V
T11
4.7
25VW
1k
+8V
555
100k
100Ω
1W
0.1
0.1
STANDBY
S2
LOW
33k
10k
ON/OFF
S1
240V
NEON
BEZEL
N
E
CASE
2851
12.6V
D3-D6
K
D7
+12V
T13
T12
390Ω
1000
25VW
BZX79C13
T1,T3,T5,T6,T7,T8,T9,T10,T11,T12 : BC548,etc.
T2 : BC559,etc.
T4 : 2N5459,2N5458, 2N5457,etc.
T13 : BD137,C122B,TT801,etc.
D1,D2 : 1N4148,1N4001,etc.
D3-D7 : 1N4001, EM401,etc.
TRIACS : ANY 6-8A 400V TYPE
MUSICOLOUR 3
G S D
2/PC/-



Duplicate the wiring layout shown here to make your Musicolour as safe as possible.

Any amplifier capable of about 100 milliwatts or more can drive the Musicolour, directly from its loudspeaker output terminals.

Each channel of the Musicolour can drive up to 1000 watts of incandescent lamp load. Each individual lamp should not have a rating of more than 150 watts. These maximum ratings are quoted to protect the Triacs against surges and arc-over in lamps.

Note that fluorescent lamp loads must not be used. Note also that, although each channel can handle up to 1000 watts, the total load should not exceed 2400 watts. This limitation is set by the 10-amp rating of most mains power points.

The Musicolour is mounted on a U-shaped chassis measuring approximately 245 x 80 x 200mm (W x H x D), fitted with a wrap-over cover. These are the same overall dimensions as for the Musicolour II. In fact, the new PC board fits into the old metalwork with space to spare. We imagine that many readers will update their old Musicolour to the new circuit.

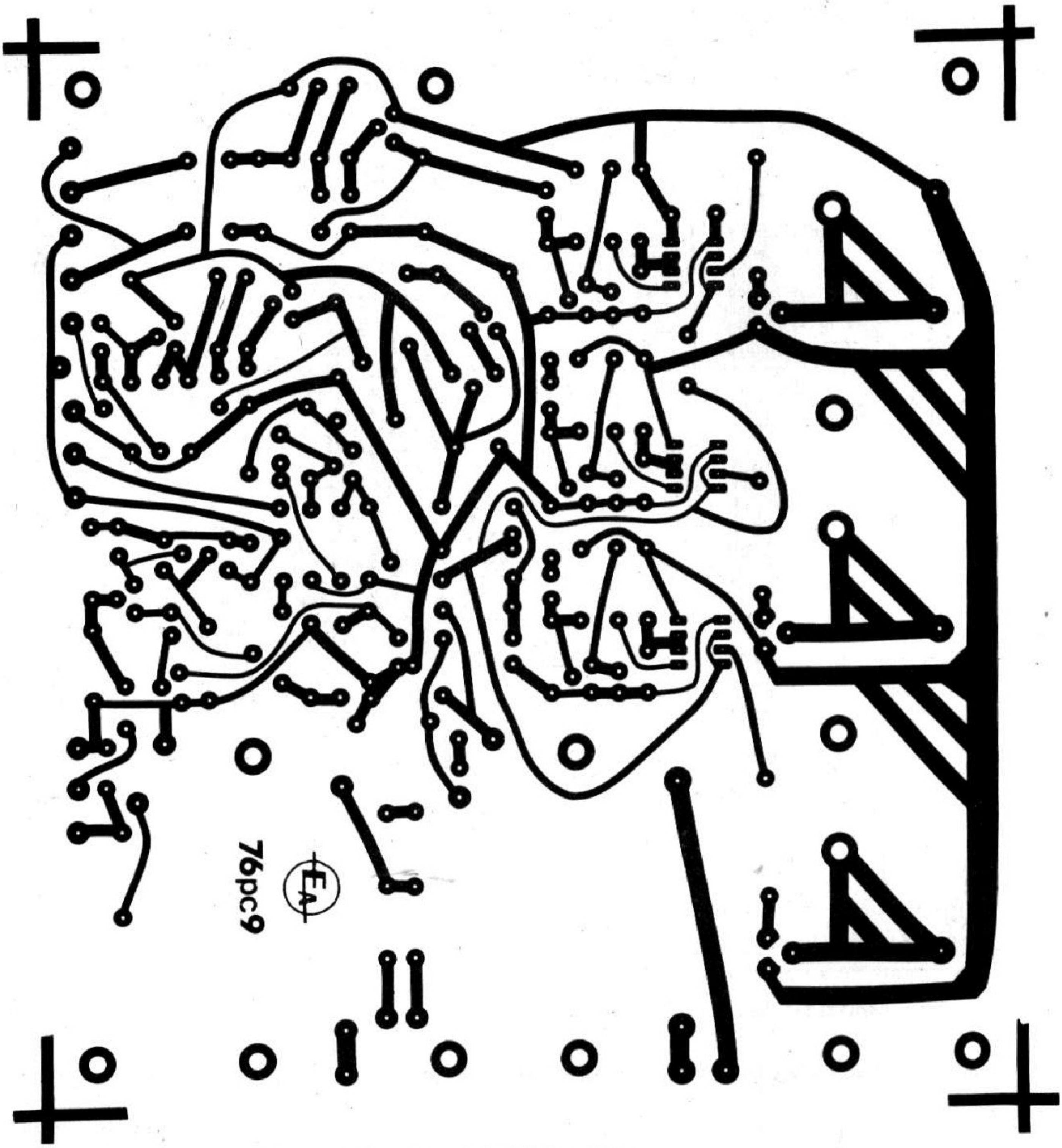
Controls on the front panel comprise the four knobs for Sensitivity, High, Medium and Low, two switches for Power and Standby and a neon pilot light. On the rear panel, there are three 3-pin mains sockets for the load of each channel, plus the 3-pin DIN input socket.

All the circuit components, with the exception of the potentiometers and switches, are mounted on a PC board measuring approximately 183 x 167mm. Code of the PCB is 76pc9.

Each Triac has a separate heatsink, which is mounted on the board. With the heatsinks specified, the 1000W/channel rating holds up to ambient temperatures of 40 degrees C. If ambient temperatures rise above this, the load should be reduced, eg, if the temperature rises to 45 degrees C, the load per channel should be reduced to 800 watts.

Just about any Triac with a rating of 6 or 8 amps and 400 volts can be used, although the plastic encapsulated types are more convenient to install. The leads have to be bent slightly to match the PC board.

We hesitate to recommend the use of higher rated Triacs. For one reason, they may have inadequate sensitivity. And even if higher rated Triacs are used, we do not recommend that the load rating be increased.



For those who wish to make their own PC board here is the full size pattern.

Each Triac heatsink is made from a piece of 20-gauge aluminium, 70mm long by 50mm wide, bent so that it has a 10mm flange. The heatsink should be drilled to suit the Triacs used.

Both transformers are the Ferguson PF 2851, the DSE 2851 (as supplied by Dick Smith Electronics) or the A&R 6474. Other types should not be used unless they are exact equivalents. The transformers should be spaced off the PC board by the thickness of two washers. This is to avoid undue stress to the board when the transformer mounting screws are tightened.

We found it necessary to shield the input coupling transformer from the power transformer. This is achieved with a piece of 24-gauge galvanized steel (not aluminium) 40mm wide and 70mm long, bent so that it is secured under the core of the power transformer.

Even with this shield, some hash and hum is coupled into the input-coupling transformer. This has the following result: With no audio signal applied and all controls at maximum, there is a tendency for the high and low lamps to light. The unit is sensing its own mains-generated hash. As soon as a signal is applied, the compressor acts to reduce the system gain and a normal display is produced. The only complete cure for this problem is to mount the power transformer off the board, away from the input transformer.

We think that most readers will take the simpler approach, as we have, and simply not use the unit with all controls at maximum.

A suggested order of construction is as follows: First mount all the small components, such as resistors, capacitors, wire links and diodes. Next mount the transformers and heatsinks. The heatsinks will always be "live" at 240VAC, whether or not an insulated case Triac is used. Connections are provided on the PC board for the centre-taps of the transformer low voltage windings. Use lockwashers under all mounting screws.

Now mount the semiconductors. Ensure that they are correctly inserted. Damage will occur to the 555's if they are incorrectly soldered in and power applied. A similar warning applies to the other semiconductors.

A special note is required on the regulator power transistor, T13. While we have tabulated several types on the circuit diagram, the type we actually used was a C122B. This is a power transistor of Japanese manufacture commonly available from parts outlets, at least in Sydney. Do not confuse it with the General Electric 200V SCR of the same type number! This is a trap, and you have been warned!

PC stakes are recommended and any type may be used provided they are a tight fit in the PC board holes before soldering. These allow connections to the PCB to be quickly broken to remove the board from chassis.

Having checked the board carefully for wiring errors, components may be installed in the chassis. Rubber feet are secured with a screw and nut, the nut being held in the foot itself.

The mains cord is passed through a grommeted hole in the rear of the chassis and anchored by a clamp. The active and neutral wires are terminated in an insulated terminal block. The earth wire is soldered to a lug which is bolted to the chassis. The earth wire should be left with a loop of slack so that, if the cord is strained to the limit, the earth wire is the last to break.

Proper earthing of the chassis is the most essential step in the construction of the Musicolour. If it is not properly earthed a wiring mistake or component failure could make the chassis "live" and lethal!

Care is particularly necessary where the equipment is to be used in a public situation, in association with a public address system, musical instrument amplifiers, coloured spotlights, festoon lighting, etc. In these circumstances, the Musicolour unit itself should be checked by a qualified electrician, along with the lighting fixtures to be connected to it.

Note that the mains wiring to the output socket and the mains cord and plug and the mains switch, should have a rating to suit the total load the Musicolour is intended to drive. If 2400W is the intended load, 10-amp wiring must be provided, particularly the mains cord and plug.

Cut all the potentiometer shafts to a length to suit the knobs. Mount all the pots and switches but leave the front panel off at this stage to avoid scratching it. It can be installed after the unit is fully operational. Before soldering wires to the mains switch and neon bezel, push a length of plastic sleeving over the wires and after soldering, push the sleeving over the terminals.

The PC board can now be dropped into place in the chassis and mounted on "Richco" insulating plastic supports. Both board and chassis should be drilled to suit these supports. Six are required. Now make all connections exactly as in the wiring diagram.

Before the unit is connected to the display lamps and power applied, several checks should be made. First and most important, that there is a direct connection between the earth pin of the mains plug and the chassis. Also, check that there is high resistance (eg, several megohms) between the heatsinks and the neutral line of the mains. There should be high resistance between both sides of the mains and the chassis. These checks should be made with a multimeter.

Now switch the unit on, with all lamps connected. The lamps should flash once at switch on and then go out. Switching to Standby should light the Low channel lamp(s).

In operation, it will be found that there is an optimum setting for the controls to obtain the best light display. This is in spite of the internal compressor. If controls are set too high, the lamps will tend to remain alight and vice versa.

If the Musicolour does not function first time, here are a few points on troubleshooting. Remember, though, that this procedure can be hazardous because the full mains voltage is present in the circuit. If you do not have a multimeter and/or do not feel confident about your ability to cure a fault in the device, leave it strictly alone. Take it, along with this article, to a competent serviceman.

The first step in trouble-shooting is to measure all the DC voltages shown on the circuit. These should be taken with no audio input signal applied to the input. Before making measurements, disconnect the AC mains neutral to the PC board at the insulated terminal block. Disconnect the lamp cords from the three output sockets. This renders the Musicolour safer to work as the mains is removed from all the circuitry with the exception of the power transformer primary, on-off switch and the neon bezel. Mains connections to these components should be fitted with plastic sleeving, as noted above.

DC voltage measurements shown on the circuit should be taken as a guide, not gospel. If the readings on the PC board are within about 10% of those on the circuit, there is no need to worry. These measurements should pinpoint most of the problems in the low voltage circuitry, with the exception of faults in the 555.

With no signal applied, voltage at pin 3 of the 555 should be close to 12V. Now short the collector of T6 (or T9, T11) to its emitter. This should drop the voltage at pin 3 to less than 2V. If this occurs, the 555 is okay. If the same result is achieved by shorting the base of T6 (or T9, T11) to its collector, then T6 is okay.

If the fault appears to be in a Triac it can be checked in the following way. Disconnect the 100-ohm gate resistor from the associated 555. Now reconnect the mains neutral and mains lamps. Turn on. If the lamp is alight, carefully short the gate of the appropriate Triac to its A1 terminal; if the lamp is still alight, the Triac is shot.

If the lamp will not normally light, the Triac should be checked in the following way. Disconnect the gate electrode as before and connect it to A2 via a 1k resistor. The lamp should now light. If not, replace the Triac.

Remember that mains voltage is applied to all the circuit when the whole unit is functioning. Use absolute care at all times. Preferably, do not work alone but with a companion who can check your actions. You cannot be too careful. Dead readers do not buy "Electronics Australia" (at least as far as we know!), so that for our sake as well as your own, take care.

To conclude, here are a few ideas for making a light display:

Most of the displays can be built around 25-watt or 40-watt coloured globes. These are available in red, yellow, green and blue. The blue lamp will not appear nearly as bright as the red and yellow types. This is because the eye is less sensitive to the blue end of the spectrum, and tungsten filaments emit most of their light in the red and yellow region of the spectrum. This means the blue filter stops most of the light. In general, the power needed for the blue lamps will be two or three times that for red and yellow lamps.

The display lamps should not be viewed directly. The basic materials needed to make interesting patterns are crinkled aluminium foil and frosted, fluted or patterned glass.

The simplest display is to mount three or more coloured lamps on a board and place them behind a stereo cabinet so that they light the wall behind it.

Another idea is to mount a number of lamps along a board, place frosted glass in front of them, and mount the whole display on top of the stereogram, organ or in the "interest point" in the room. Lights can be placed inside a cabinet, with crinkled aluminium foil behind them, and frosted glass in front.

For higher power displays, coloured spotlights will be required. Coloured spotlights are marketed by Philips and available from trade houses which specialise in lighting. The lamps are in the Philips Comptalux range and are available in red, yellow, green and blue.

Many interesting displays could be obtained with these spot lamps aimed against walls, using beam splitting mirrors and rotating mirror balls. Your imagination is the only limit.

NOTES & ERRATA

AM SYNCHRODYNE RECEIVER (June 1976, File No 2/TU/41): Readers have reported difficulty in obtaining the BA163 varicap diode. The author has suggested an alternative. Substitute a BB105G varicap as used in the Playmaster FM tuner and increase the series 47pF capacitor (C24) to 0.01uF.

3.5MHz SOLID STATE TRANSMITTER (September 1976, File No 2/TR/60): On the circuit diagram, the 270pF and .0012uF [redacted]

MUSICOLOUR Mk III (September 1976, 2/PC/23): To ensure reliable operation with all 555 IC's, the 10k and 33k resistors at the output of the bridge rectifier should be changed to 330 ohms and 1k respectively.

Car Burglar Alarm . . . from p. 57

since, in most car electrical systems, bypassing the ignition switch, as a thief would normally do, will cancel the alarm in the same way as operating the switch itself.

Fig. 4a shows how a double pole switch is wired in series with the accessory switch and push button. With this fitted the thief has not only to bypass the accessory or ignition contacts, but also find and disable the second switch.

The purpose of the switch in the push button circuit is to prevent children—or curious adults—setting the alarm when the car is parked with the ignition switch in the off position.

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1975 article. This arrangement is the obvious one to use on 5.8GHz and work is proceeding in that band at VK2AHC.

Fig. 13 shows the complete circuit of my 3400MHz equipment. It illustrates the FM crystal oscillator circuit and the use of 723 regulators, VHF amplifiers and varactor multipliers.

CONCLUSION. It is hoped that this may serve to help the newcomer to amateur UHF and microwave. Current programs at VK2AHC are aimed at investigating super refraction effects at 5.8GHz and 10GHz and keep abreast of techniques used in the rest of the world, particularly in the UK where activity at this time is extremely high.