

Project 462

IF YOU'RE INTO home recording studios but have those "lack of monitoring facility blues" or if you like listening to loud music late at night with a few friends but have the kind of neighbour that even your pet doberman is scared of, then here is the solution. This project allows up to four sets of headphones to be driven from the one source and provides separate volume control for each.

Design details

The circuit consists basically of an input gain stage which drives four voltage follower output stages. Both of the stages use op-amps from the TL07X series. The input uses a TL071 single op-amp and the output stages each use a TL074 quad op-amp package. Both of these ICs have the low noise and distortion figures and high slew rate necessary for audio work. Each headphone output has its own volume control which allows adjustment to suit individual users. An overall gain control allows the gain of the unit to be adjusted from -6 dB to +14 dB. This should provide enough control to be able to get a good headphone level from the headphone outlet of any cassette deck or amp.

The range of headphone impedances varies from around 8 ohms up to a few thousand ohms and there seems to be no real preference amongst manufacturers. This circuit will provide enough drive for any common impedance value headphone to be used.

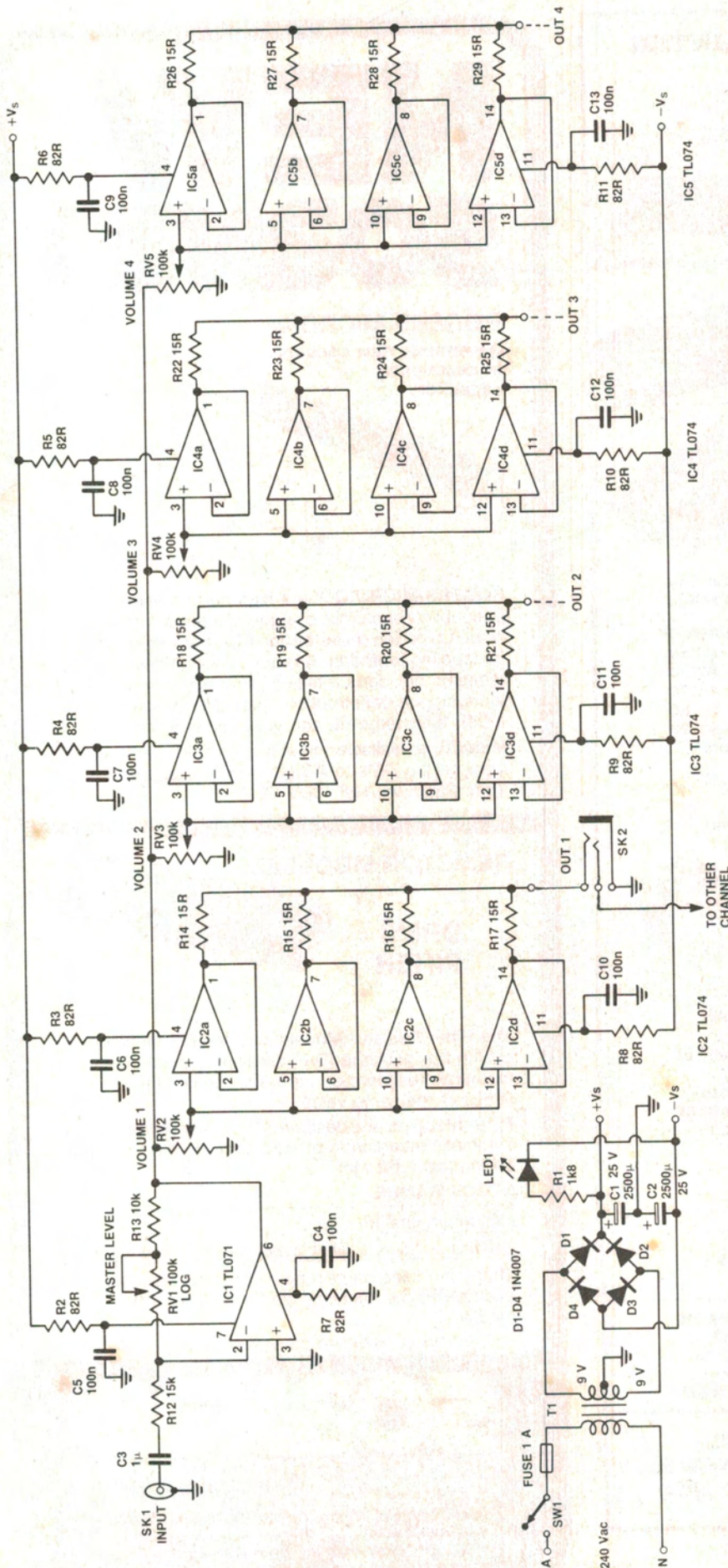
HOW IT WORKS — ETI-462

Referring to the circuit diagram it can be seen that all of the output stages are identical, therefore only output one will be described.

IC1 is a TL071 single op-amp configured as an inverting amplifier stage. Potentiometer RV1 and resistor R13 form a variable gain control by changing the amount of negative feedback applied to the op amp. When RV1 is set to minimum, the gain is given by R13/R12. When RV1 is set to maximum the gain is $(R13+RV1)/R12$. This gives a -6 dB to +14 dB range with the specified components. Resistor R12 also sets the input resistance of the unit to 15k. This will provide negligible loading of the headphone outlet being used to drive the unit and allows units to be connected in parallel to provide more than four headphone outputs if needed.

The output of IC1 drives into the four parallel pots (RV2, RV3, RV4, RV5) which control the level of the signal fed to each of the driver stages. Looking at output stage 1, you can see that it consists of a TL074 quad op-amp package with all of the op-amps configured as voltage followers and connected in parallel. This acts as a voltage follower with four times the drive capability of the individual op-amps. Resistors R14, R15, R16 and R17 make sure that the current is summed evenly from each op-amp.

The power supply is derived from an 18V, centre-tapped transformer and is full wave rectified by D1-D4 and filtered by capacitors C1 and C2. This provides +ve and -ve 12 Vdc rails. The supply rails are coupled to each op-amp via an 82R resistor and a 100n bypass capacitor which isolates each stage and provides additional supply filtering.



The output stage uses a TL074 quad op-amp with all four op-amps configured as voltage followers and connected in parallel. This increases the drive capability of the op-amps to a point where it can drive the headphones directly without the need for a transistor output stage.

Construction

Start construction with the pc boards. Two identical boards are used except that the power supply components are omitted on one board. For the remainder of this article the board with the power supply components will be referred to as BOARD 1 and the board without these components will be referred to as BOARD 2.

Begin with Board 1. Give it a thorough visual inspection, checking tracks and holes to see that all's correct. Assemble the components as per the overlay diagram. Solder in all the resistors and capacitors first, followed by the diodes and then the ICs. Make sure that all polarised components (ICs, diodes, electrolytic capacitors, etc.) are positioned in the right orientation. Finally, solder into place the solder pegs or 'pc stakes' for attaching the wiring.

The construction of Board 2 is the same as Board 1 *except* that components D1 to D4, C1, C2 and R1 are omitted. Also, the three solder pegs which connect to the main transformer can be omitted as Board 2 derives its supply from the rails of Board 1 via connecting wires.

Once the pc boards are complete, the metalwork can be tackled. Disassemble the case and drill the front panel using the panel artwork below as a template. Remove all burrs from the holes after drilling.

Small pilot holes should now be drilled in the Scotchcal front panel label. See that you can line up the label using one edge being very careful to ensure that the pilot holes are approximately in the centre of the front panel holes. Remove the backing from the Scotchcal, attach it along the line-up edge you chose and smooth it down in place working from that edge. Once the Scotchcal label has been lined up and attached, the holes can be carefully cut out using a scalpel or a very sharp pointed knife. Take care not to rip the Scotchcal when doing this.

Four channel stereo headphone driver

Robert Irwin



Received a noise abatement order lately for having the volume on the hi-fi too loud while you played Roxy Music's latest compact disc or the 1812 Overture? Maybe you've got your 'home studio' together but it lacks the monitoring facilities you need. This unit should fix all that.

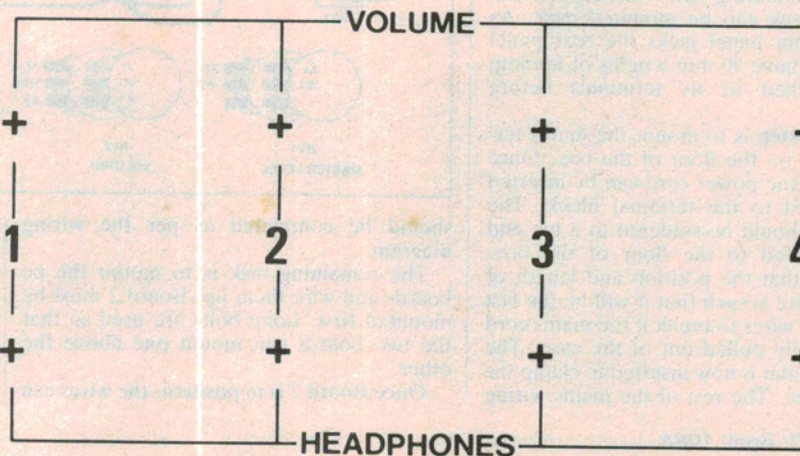
Next, the back panel can be drilled. Take the mains transformer and centre it on the back panel. Make sure that there is enough room on one side for the mains grommet and fuse holder and on the other side for the input jack. Mark the position of the transformer mounting holes and the hole centres for the mains grommet, fuse holder and input jack. These can now be drilled to the appropriate sizes.

The pc boards should now be located. Take one board and position it on the floor on the box so that it is about 20 mm from the right hand side (looking from the front) and equidistant from the front and back panels. This will allow ample room for the mains wiring on the left hand side and also for the transformer on the back panel and pots on the front panel. Mark and drill the pc board mounting holes. Also on the floor

MASTER LEVEL

+

POWER **eti 462**
HEADPHONE
+ DRIVER
ON
+



of the box, holes should be drilled to mount a mains terminal block and earth lug. If a clamping type mains grommet isn't to be used then provision should be made for a mains cord clamp to be bolted to the floor as well. This is all done on the left hand side.

This completes the drilling. The case should now be reassembled but with the lid left off. You are now ready to mount the components. Firstly, take the four output jacks. Before mounting these you should attach 50 mm of hookup wire to each of the output terminals of the jacks (do not attach wires to the earth terminals yet). There is quite a bit of interwiring in this project so it is advisable to use a consistent colour code when attaching these wires. Once the jacks are mounted, the earth terminals should all be connected together and two wires soldered on to connect to the boards.

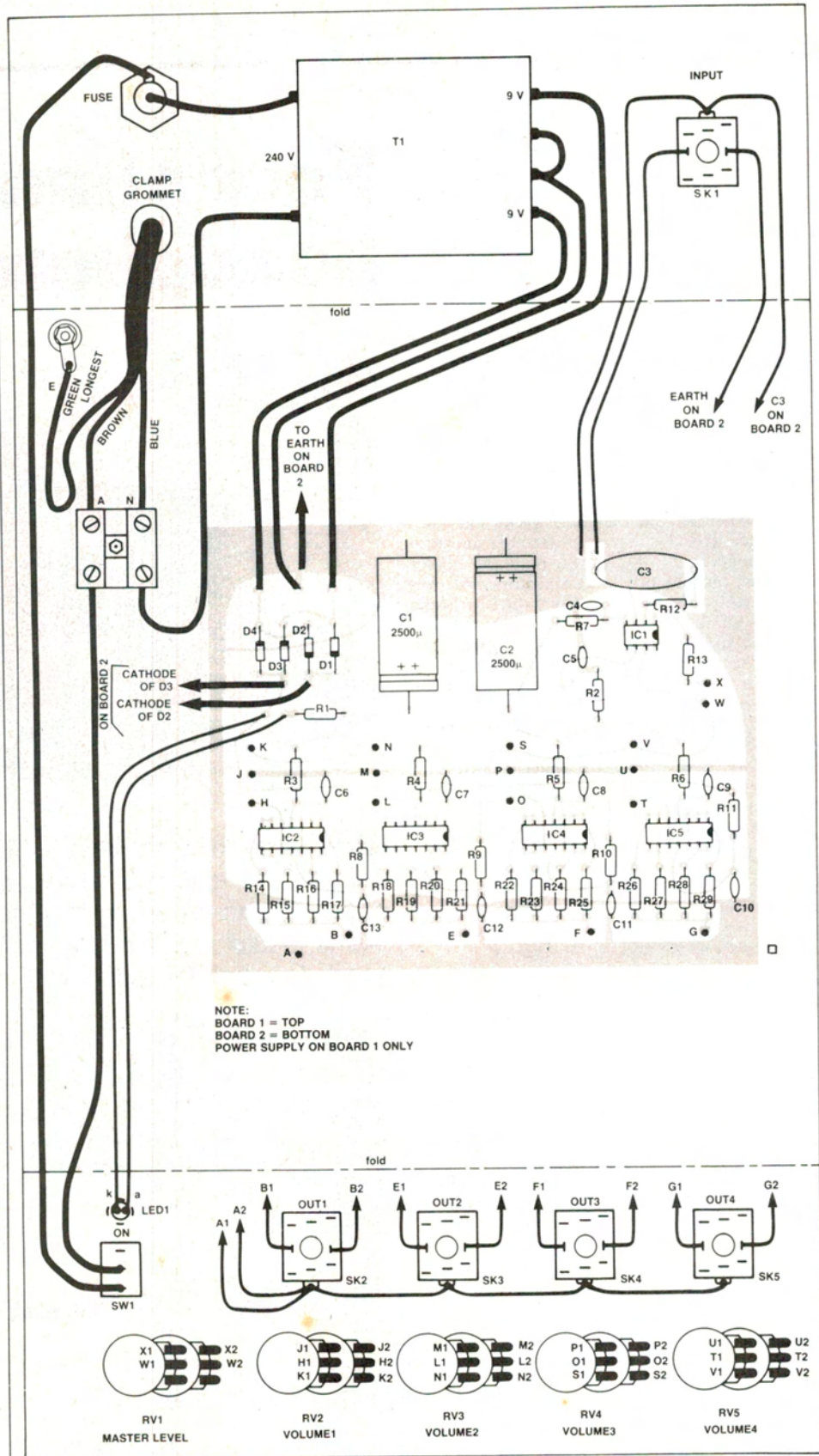
Next, 100 mm of wire should be attached to the four volume control pots. Once again a colour code should be used. Using a different colour for each of the three terminals on the pot and consistently wiring each pot the same way will greatly help when you come to wire the pc board. Once the wires have been attached, the pots can be mounted on the front panel. Make sure that none of the terminals are shorting out to the pot next to them. The master gain pot should be mounted and wired in the same way except that 200 mm lengths of wire are needed and only two of the terminals are used (see the wiring diagram).

Attach 100 mm of wire to the terminals of the LED and mount this in the front panel. It is advisable to insulate the terminals of the LED from each other with heatshrink tubing to prevent accidental shorts.

The mains switch should have 200 mm of heavy duty hookup wire attached to its terminals and be mounted on the front panel. Once again, heatshrink tubing should be used to cover the exposed parts of the terminals. Remember that mains voltages are lethal and any mains wiring should be double checked and any exposed terminals should be insulated with heatshrink tubing to prevent anyone (especially you — we'd like you to remain a reader) from accidentally touching a live terminal.

The front panel should now be complete. The back panel component can be mounted next. Start with the transformer. This should be securely mounted to the back panel with mounting bolts. The fuse holder and input jack can be mounted next. As with the front panel jacks the rear panel jack should have 50 mm lengths of hookup wire attached to its terminals before mounting.

The next step is to mount the mains terminal block on the floor of the box. Once this is done the power cord can be inserted and attached to the terminal block. The earth wire should be soldered to a lug and securely bolted to the floor of the box. Make sure that the position and length of the earth wire is such that it will be the last of the three wires to break if the mains cord is accidentally pulled out of the case. The mains grommet is now inserted to clamp the cord in place. The rest of the mains wiring



should be completed as per the wiring diagram.

The remaining task is to mount the pc boards and wire them up. Board 2 must be mounted first. Long bolts are used so that the two boards can mount one above the other.

Once Board 2 is in position, the wires can

be attached. This should be done carefully and systematically to avoid mistakes. Start with the input and output jacks and then the pots. Finally, attach 100 mm of hookup wire to the +ve rail, -ve rail and earth pins. These will attach to the identical pegs on Board 1.

Once Board 2 has been wired, Board 1

should be mounted on top using 12 mm spacers as shown in the drawing here. Wiring up Board 1 is the same as for Board 2 except that the LED and transformer are connected on this board. Note that the two outside terminals of the secondary of the transformer are connected to the diode bridge and the two middle terminals are connected together and then to the earth peg.

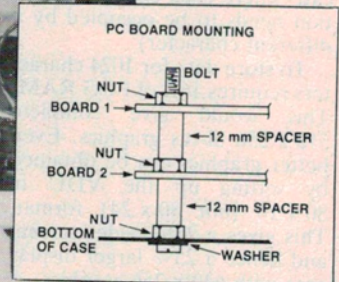
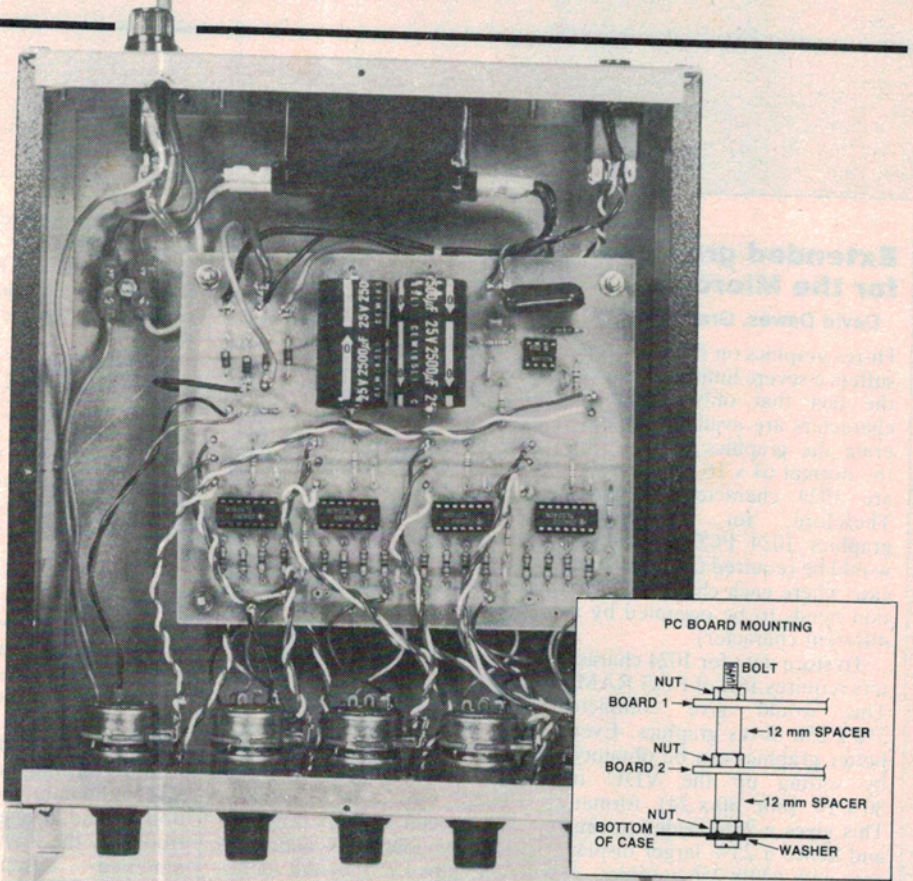
This completes the construction and all that's left to do is push on the knobs, install a 1A fuse, plug it in, power it up and check that all's well. A simple voltage check with a multimeter will quickly show if you're ready to roll or not.

Using it

The first thing to do is to plug the unit into the headphone outlet of your cassette deck or amplifier. For this you will need a stereo cord with a 6.5 mm stereo plug on each end. If you can't buy one from your local stereo shop then you can easily make one. Get a suitable length of balanced microphone cable (which contains two cores plus an earth wire) and solder a 6.5 mm stereo plug on each end. This cord will plug from the headphone outlet on the cassette or amp to the input jack on the back of the Headphone Driver.

All you need to do now is plug your headphones into one of the outputs and turn the volume up to the desired level. The master gain control should initially be set to about half way and then adjusted to give a good overall maximum volume.

OK buddies — rock on (or waltz, if you prefer)!



PARTS LIST — ETI-462

- Resistors**.....all 1/4W, 5%
- R1.....1k8
 - R2, 3, 4, 5, 6, 7, 8, 9, 10, 11.....82R #
 - R12.....15k #
 - R13.....10k #
 - R14-29.....15R #
 - RV1-RV5.....100k/C dual-gang pots
- Capacitors**
- C1, C2.....2500µ/25 V axial electro.
 - C3.....1µ greencap #
 - C4-13.....100n ceramic bypass #
- Semiconductors**
- D1-D4.....1N4002 or similar
 - IC1.....TL071 #
 - IC2, 3, 4, 5.....TL074 #
 - LED1.....TIL220R 5 mm red LED

— two of each required

Miscellaneous

- SW1.....SPDT miniature toggle switch
- SK1, 2, 3, 4, 5.....6.5 mm switched insulated stereo jack sockets
- T1.....Ferguson PL18/20 VA low profile 9-0-9 V secondary transformer.

ETI-462 pc board (two off); 5 mm LED holder; one 3AG panel mount fuse holder; 1A rated 3AG fuse; mains terminal block; 8 x 12 mm long pc board spacers; case — 203 x 76 x 228 mm — Horwood type 93/8/V or similar; Scotchal front panel label; mains cord and plug; clamp type cable grommet or grommet and cable clamp; hookup wire; nuts, bolts, etc.

Price estimate: \$90-\$100

