TALKING ELECTRONICS®

THE MAGAZINE THAT SPEAKS FOR ITSELF

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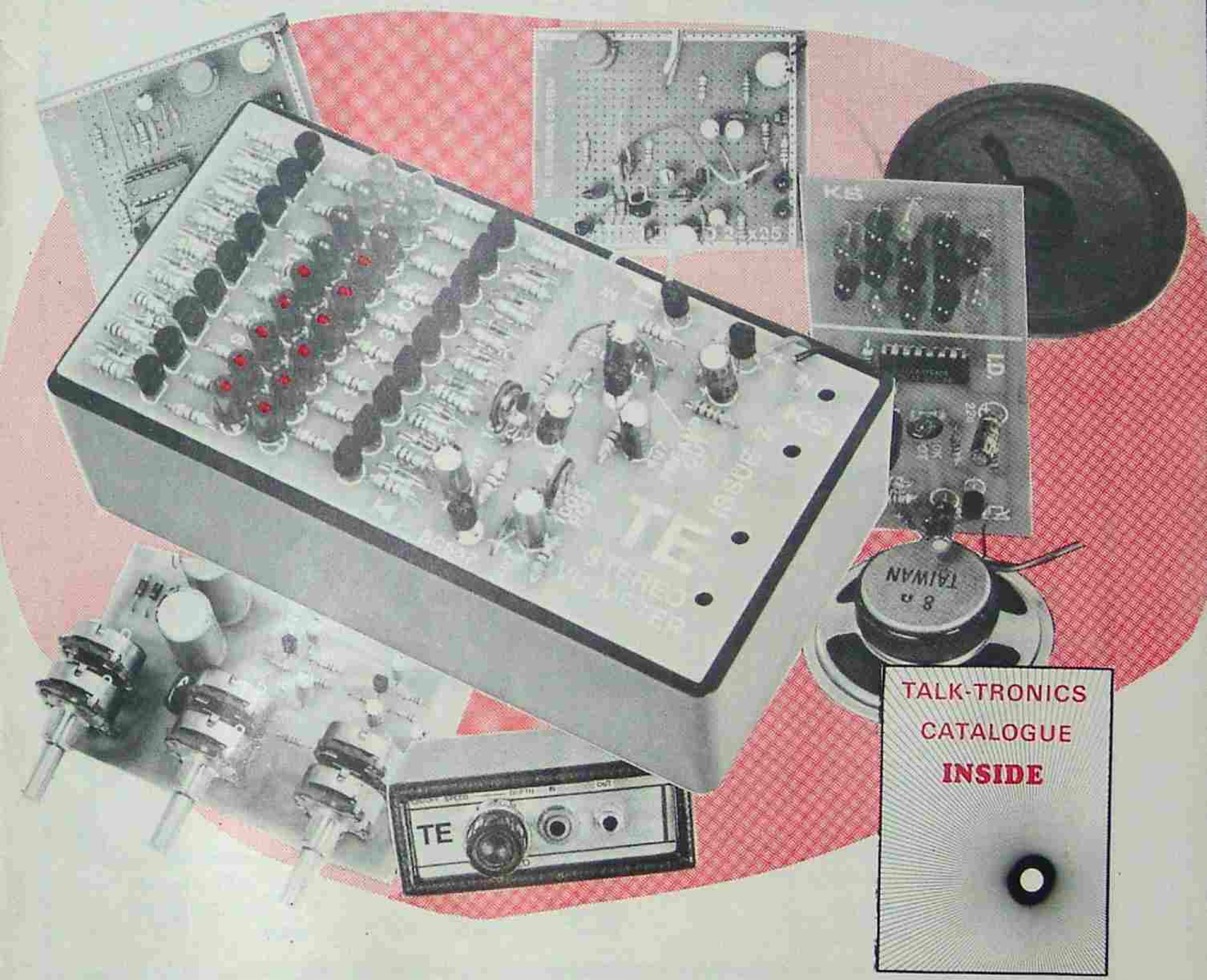

TALKING ELECTRONICS

Editorial... Vol. 1. No. 7.

They said it wouldn't work.

When I first approached printed circuit board manufacturers with an order for 20,000 printed circuit boards, they laughed "What! you're going to put them on 20,000 magazines!"

They did not want to know about the feasibility or the economics or the practicality, they just didn't want to know.

So we went it alone.

From the outset, putting a PC board on the magazine was a resounding success. . . . Now their attitude has changed. Even with the HANGMAN and its limited appeal, the response has been most gratifying.

This month we have a STEREO VU METER. A handy piece of gadgetry which can be adapted from its original use to display decibel sound levels in noisy surroundings or become an LED VOLTMETER for low voltages. Next issue we are planning a DIGITAL CLOCK with an antenna capable of picking up stray 50Hz mains frequency in the air. You will have a choice of using a plug pack for constant display or a battery version using the antenna.

(It's still in the planning stage - it's designed as a Study Clock. You'll learn what we mean in the next issue.)

TE is necessary reading in many schools where it is beginning to have an impact on the type of material being taught.

Eventually we hope to prepare a Syllabus for the teaching of DIGITAL ELECTRONICS at junior level. From this we can follow through to higher levels. But we have to start at base level. The impact of digital operations has not yet entered the Education system and yet we are playing with $40 talking toys!

If this is not introduced poste haste, our electronics graduates will be unfamiliar with digital designs.

We will start by requesting further syllabii from teaching institutions and if you are curently following an electronics course containing digital operations, you will help us if you send in a copy of the topics being taught. This will get the ground-work started.

Cheers,

Colin Mitchell.

TECHNICAL

Colin Mitchell

ARTWORK

Ken Stone

ENQUIRIES

10 Minute queries will be answered on 584 2386

ADVERTISING

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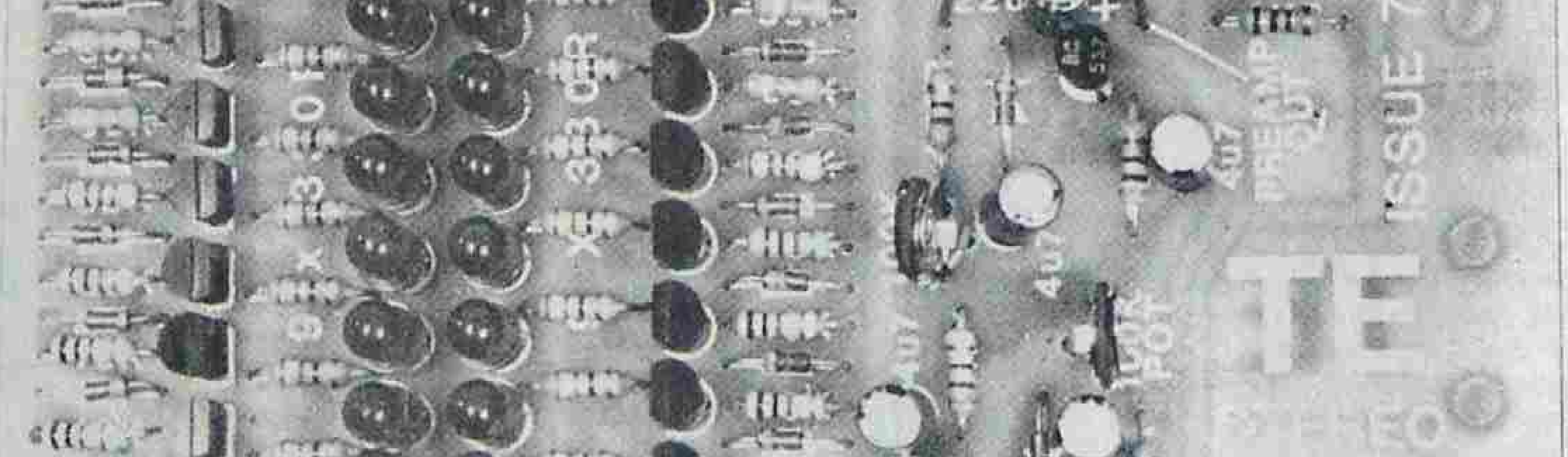
OUR COVER shows an array of this month's projects. The STEREO VU METER is a real winner!

STAFF

OUR COVER FEATURE

Before you begin:
Check the PC board attached to the magazine to make sure all the holes have been drilled and inspect the underside for very narrow gaps between the tracks or even lands which touch. This is mainly in the BOOTSTRAP section.

STEREO VU METER



The completed unit in close-up. The overlay makes construction easy. Make sure the left-hand row of resistors starts with 47k at the bottom and 4k7 at the top. I saw one unit with the whole row reversed. It made very little difference to the performance of the unit, but it was not quite as sensitive as the correct version.

Use the attached PC board to make this self-contained VU meter.
It can be used 2 ways:
1. With its dynamic microphone pickup, or
2. Connected to the speaker leads of a stereo.
Either way, it produces and interesting effect and all the components are readily available.

Does your amplifier have a level indicator?
Have you always envied the fancy amps with LED level bar graphs?

Would you like to build your own STEREO LEVEL INDICATOR?

Pine no more, it's here. Our feature project this issue will suit all audio buffs. It is a STEREO LED LEVEL METER. It's the cheapest and best bar graph display available and best of all, it uses readily available components.

You only need a handful of LEDs, 22 transistors some resistors, diodes and a set of electros - it doesn't require any chips.

You may be wondering why we didn't choose the LM 3914 or LM 3915 bar-graph LED driver chips. The reason is simple. We learnt our lesson from the Mini Frequency Counter book. In this project we used a relatively novel chip, the CD 4026. And after releasing 10,000 copies of the magazine, with printed circuit boards attached, the chip became almost unobtainable in Australia. This proved to us that many of the readers were making the Mini frequency Project. Now, a chip such as the LM 3914 is scarce at the best of times. Can you imagine what would happen if we used it in a project? Ninety per cent of the readers would miss out. This means we must confine our projects to readily available components and avoid rare items, no matter how inviting they look.

We compared a LED level meter using the chip with our unit and the difference was negligible. Both had the same quick response-time and about the same readout values on the line of LEDs for the same input signal. But the big difference is in the cost of construction. By using transistors, you will save $4 over the cost of two chips. If you don't mind the additional time required to fit the extra components, the $4 is a valuable saving and by using discrete components, you can build it from parts you may already have in stock.

THE CIRCUIT

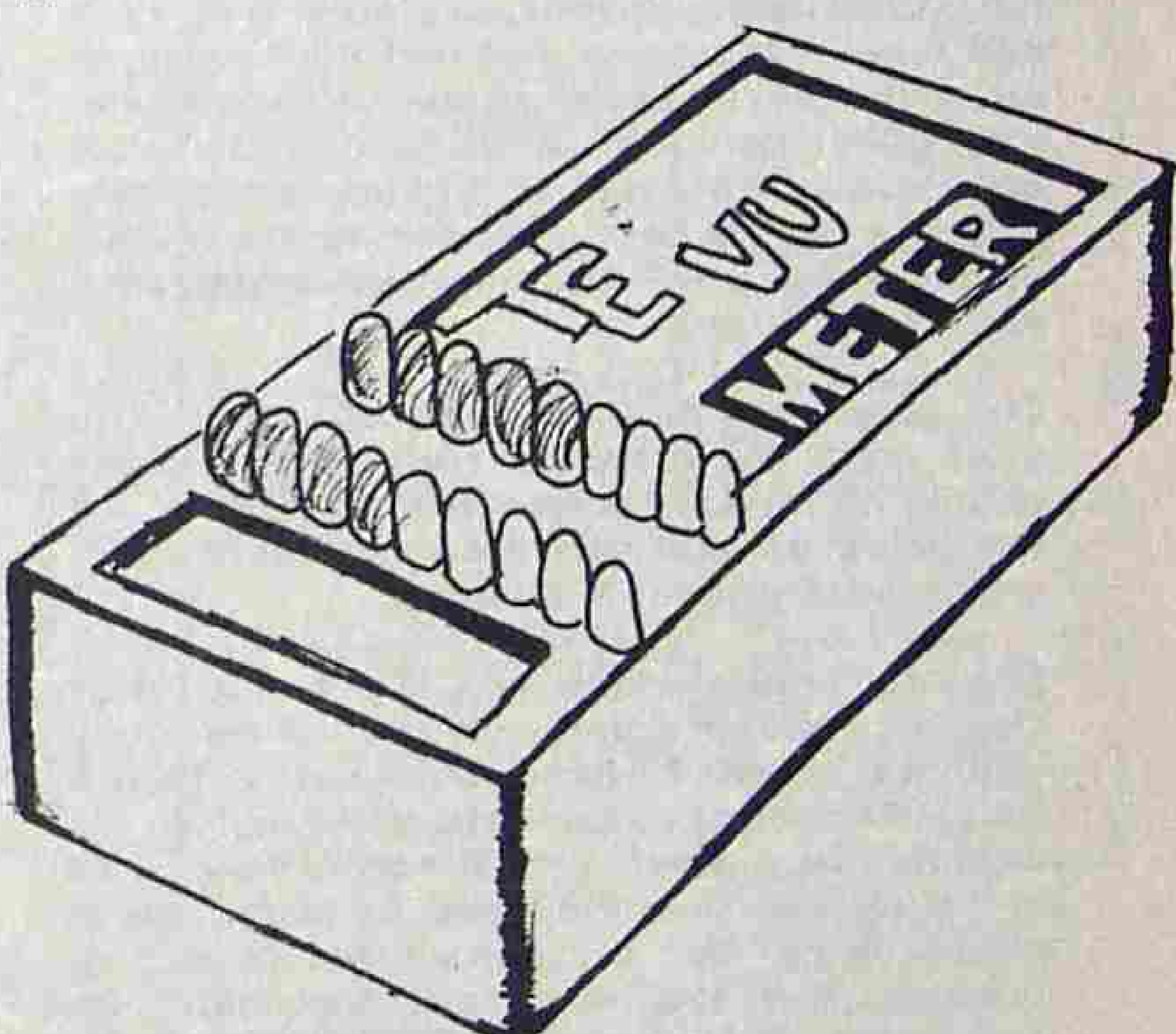
The circuit basically consists of two identical channels feeding two rows of LEDs. A high-gain bootstrap front-end is also provided to allow the board to be coupled to an inbuilt speaker/microphone which will give a mono readout of the sounds being picked up.

TO THE HI FI BUFF:

This is a fun project. It is not intended as a piece of test equipment or as an accurate reference source. It's sole performance is to provide a visual indication of an analogue signal. So don't expect too much.

Although you could continue further and calibrate the unit in dB, we have particularly stayed clear of any complex calibration as we do not think it is warranted. We hope you will use it in an open situation where the sensitivity can be adjusted so that the top LED is energised during the loud passages and the display shows 5 or 6 LEDs for the majority of the time.

Used correctly, it will add interest to your stereo by displaying the relative channel separation and highlight the peaks being produced. With its fast response-time, it will give a more accurate readout of the passage than a VU meter and will be much easier to read when comparing two channels.



By using a larger Zippy box, you can mount the board inside the box and allow the LEDs to protrude.

A mini trim pot is provided to set the sensitivity. This makes the project completely portable and it can be used as a SOUND LEVEL meter in a disco or other noisy situation. To give a readout in dB it would require calibration. The simplest method of calibration would be to compare it with a commercial unit and give each LED a value in dB.

By providing another bootstrap circuit, a portable stereo sound detector could be made. This could compare sound level in different parts of a room or compare the relative outputs from 2 speakers.

As designed, the stereo section needs to be wired into the output of each channel, across the speaker terminals, and the unit mounted in some prominant place for an eye-catching display.

Before you begin. Lay the components on the work-bench in a position relative to that on the PC board. Some of the parts have the same value, such as the 330R resistors. These should be positioned on the board with their tolerance bands all round the same way. Separate the two BC 557's from the other two transistors and be sure you can identify the 22mfd electrolytic from the 4.7mfd.

The board looks deceptively simple because most of the components are placed in rows. It will take at least one and half hours to construct the project and the most important facet throughout construction is to create a neat appearance. This means aligning each component with the next and keeping the heights all the same.Otherwise the neat appearance will be destroyed.

The suggested method of construction is to start with the resistors and diodes. These should be inserted alternately as required by the board so that you have maximum room when placing them in position.

Slow and sure wins the race. It is best to insert the parts one at a time and push them firmly onto the board. Nothing looks worse than a mass of floating components, some high, some bent this way, others bent the other way. Once you push them onto the board, bend their wires outwards so that the component is held in position. Turn the board over and solder the two connections quickly. Check that the component has not shifted then snip the two wires. Continue down each row, taking one item at a time.

If you find that you are closing over some of the holes with solder when you are soldering, I suggest you only tack-solder the leads and wait for the other component to be inserted, before finishing the joint. Tack soldering is very fast and requires almost no solder. This prevent the solder flowing over the land and filling up the remaining holes.

You may have noticed that the two channels are a mirror-image of one-another. This means the cathodes of the LEDs face outwards and before inserting each LED you should look into their opaque body to make sure they are being inserted correctly. In our prototype, the two top LEDs of each channel are a different colour, mainly to add interest to the display. You may choose to add another colour for the bottom two or three LEDs and produce an even more exotic display.

The driver transistor for each channel and the bootstrap circuit fit onto the right-hand portion of the board. All the component values are identified and the two BC 557's are shown as "FILLED IN", whereas the BC 547's are open 'D's'.

There are no jumpers on the board. However we have made provision for for connecting the bootstrap circuit to either one or both channels via one or two links. These links are taken from the 'pre-amp OUT' point to either the left hand channel or the right hand channel.

PARTS LIST:

18 - 33R
2 - 470R
1 - 1k
1 - 2k2
5 - 4k7
5 - 10k
2 - 22k
2 - 33k
4 - 39k
4 - 47k

4 - 4.7mfd 16v PC
2 - 22mfd 16c PC
20 - BC 547
2 - BC 557

18 - IN 914 or IN 4148

14 - 5mm red LEDs
4 - 5mm green LEDs

2 - 100k mini trim pot
1 - battery snap
1 - speaker 8 ohm

1 - VU METER PC board

HOW THE CIRCUIT WORKS

The VU METER consists of 3 sections:
1. BOOTSTRAP CIRCUIT
2. BUFFER TRANSISTOR
3. STAIRCASE VOLTAGE DETECTOR

The first section should not be new to you. We have presented the BOOT-STRAP circuit in a number of previous projects. It is very successful at allowing a dynamic microphone in the form of a 2¼in speaker to detect small sounds and have them amplified sufficiently to be fed into a normal amplifier.
The BOOTSTRAP is rather unique in its operation. It uses 2 directly coupled PNP transistors wired in a similar mode to cascade to give an enormous voltage gain. In our prototype we measured this to be about 1,000 times!

In the quiescent condition, the transistors in the bootstrap circuit are slightly turned on. This means they will accept a few millivolts from the speaker and turn the circuit on harder or turn it off. During idling conditions 2 millivolts is developed across the speaker due its resistance of 8 ohms.

Take the case where the speaker produces 2 millivolts which is in phase with the quiescent voltage and this will turn the transistor Q1, slightly off. The collector voltage will rise and in doing so, take the base of the emitter-follower Q2 with it. Under normal circumstances, the collector voltage would rise about .2v, for Q1. This will make the emitter voltage of the emitter follower rise .2v (which is normal for an emitter follower). Now the top 22mfd electrolytic will transfer this .2v to the join of the 10k and 2k2 resistors. Since Q1 is turned off, the .2v rise will appear on the base of the top transistor and turn it ON further and cause its emitter to rise another .2v . This action feeds back into the base via the electrolytic and the emitter rises to slightly less than rail voltage. Here it will stop due to the collector-emitter voltage drop preventing it going any further. At this stage the emitter has risen from 3.5v to 8.5v and the join of the 10k and 2k2 risen from 8.5v to 12.5v. Yes, that's right! The junction of the two resistors rises to greater than the supply voltage. The capacitor cannot hold its charge for ever and some of it is bled off via the 2k2 resistor. This reduces the base voltage and the transistor begins its downward excurtion.

I have taken the extreme case. If the first transistor does not turn on to quite the same extent, the emitter-follower will rise until the loss from the top electrolytic prevents the transistor from rising any more, and it begins to fall. The lower 22mfd prevents this swing from appearing on the base of Q1. It acts as a damper.

The output from the BOOTSTRAP can be as high as 2v p-p and this is ample to drive the buffer stage. In fact the signal needs to be attenuated by a pot so that the range can be set according to the amplitude of the input signal.

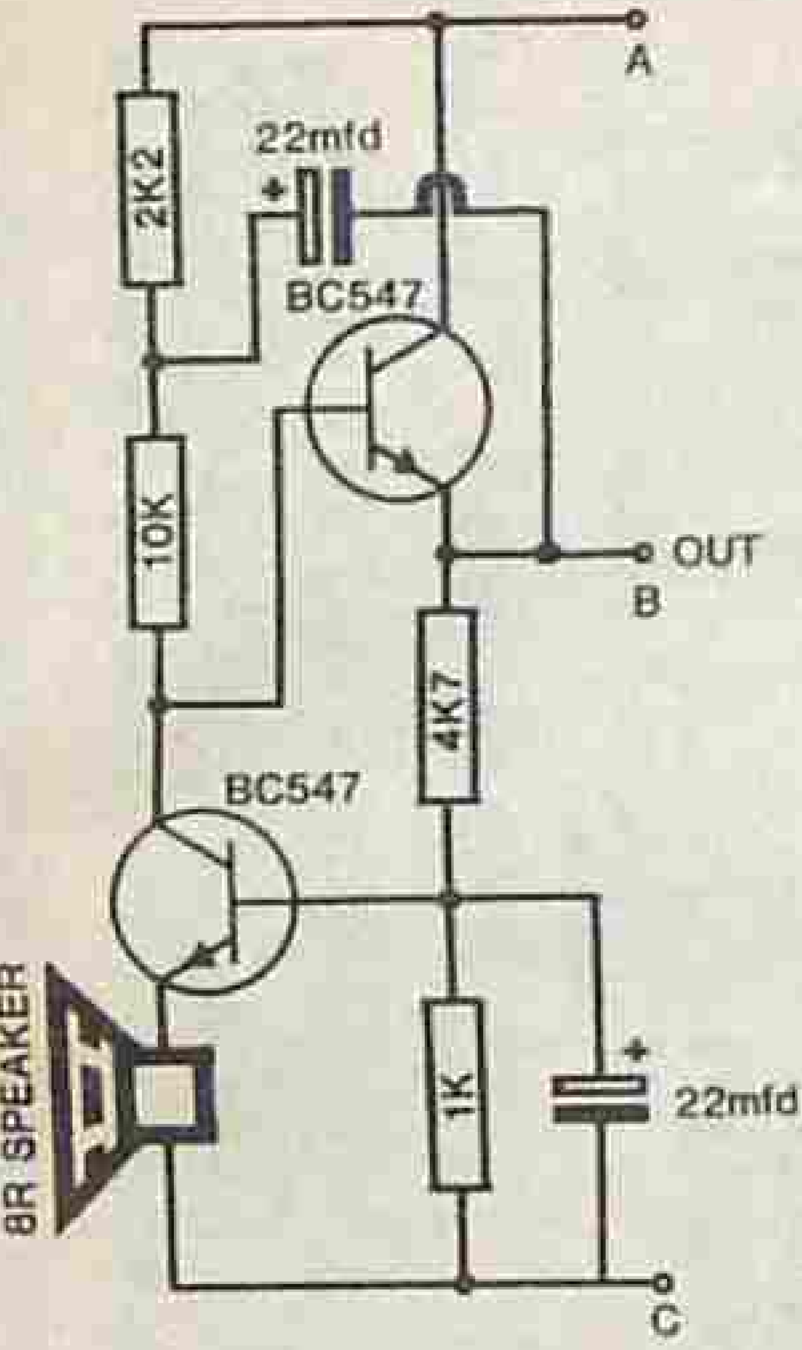
The 470R resistor in series with the pot is only needed when the VU meter is connected di rectly across speaker lines.

The BC 557 is not an emitter follower. Don't get confused. It is wired as a normal common emitter stage for a PNP transistor. Thus it will provide a high gain in this situation. The AC voltage appearing out of the 100k trim pot will pass through the 4u7 electrolytic and become rectified by the 1N 914 diode. With no signal present, the voltage on the base will be 9v. As the input signal increases, the voltage on the base will drop to 8.35v and this is sufficient to turn the transistor ON fully.

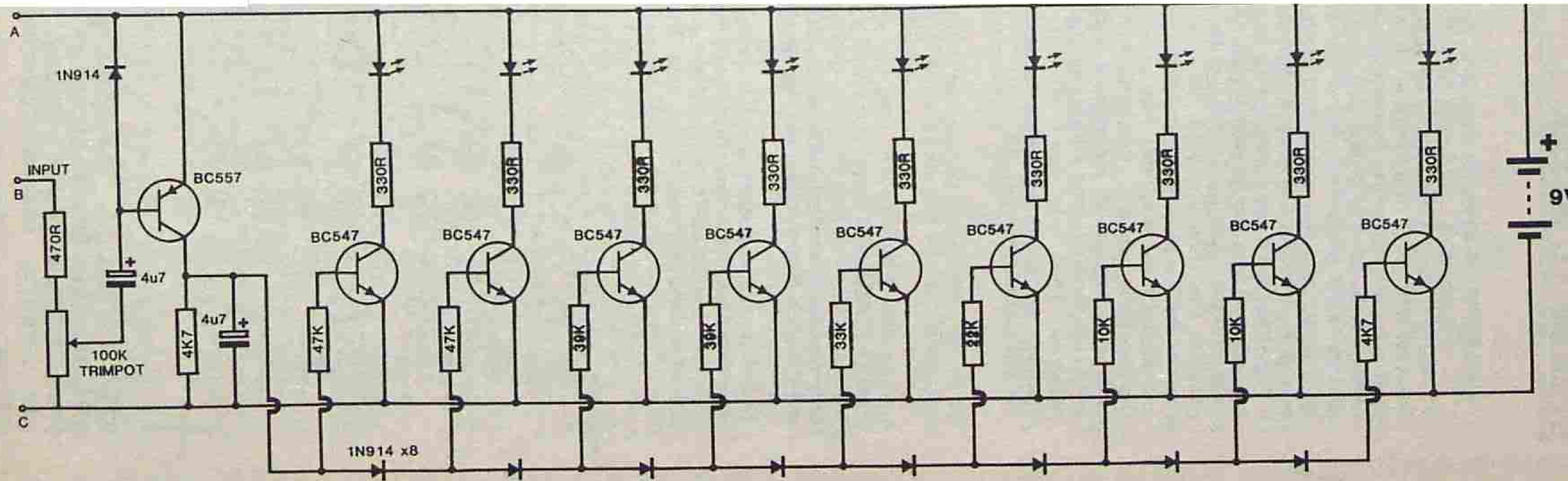
The voltage on the collector will range between 0v and 8.5v. This voltage is stored in the lower 4u7 electrolytic and applied to the chain of 8 diodes. The 4u7 dictates the decay rate and gives the LEVEL METER its rapid attack, slow decay characteristic and allows even brief peaks to be detected. To reduce the decay time you can increase the electrolytic to 22 mfd and this will keep the LEDs illuminated for a longer period, similar to the commercial units.

Between each diode is a high value resistor. As the voltage rises to about .6v, the first transistor turns ON. At this stage the voltage on the cathode of the first diode is 0v since the .6v has been dropped across it.

The voltage needs to rise to about 1.2v before the second transistor turns ON. This continues down the line with each transistor turning ON at its allotted voltage level.
The set of 330R resistors limit the current through the LEDs to a safe value and the base resistors serve as a voltage dropper so that the base will not be forced to go higher than .6v.
The number of transistors which can be operated in this staircase arrangement is limited to the battery voltage available since each transistor and diode will take .6v from the voltage supplied by the BC 557 buffer transistor.



The BOOTSTRAP circuit connects to the LED bar graph via A, B, and C. Only one BOOTSTRAP circuit is provided on the board. It is capable of driving both bar graphs in a mono mode. For stereo readout, via a bootstrap circuit, you will need to build another bootstrap. This will give a portable STEREO SOUND LEVEL INDICATOR.



A
B
INPUT
C
1N914
BC557
470R
4u7
100K
TRIMPOT
4K7
4u7
BC547
330R
47K
47K
39K
39K
33K
22K
10K
10K
4K7
1N914 x8
9V