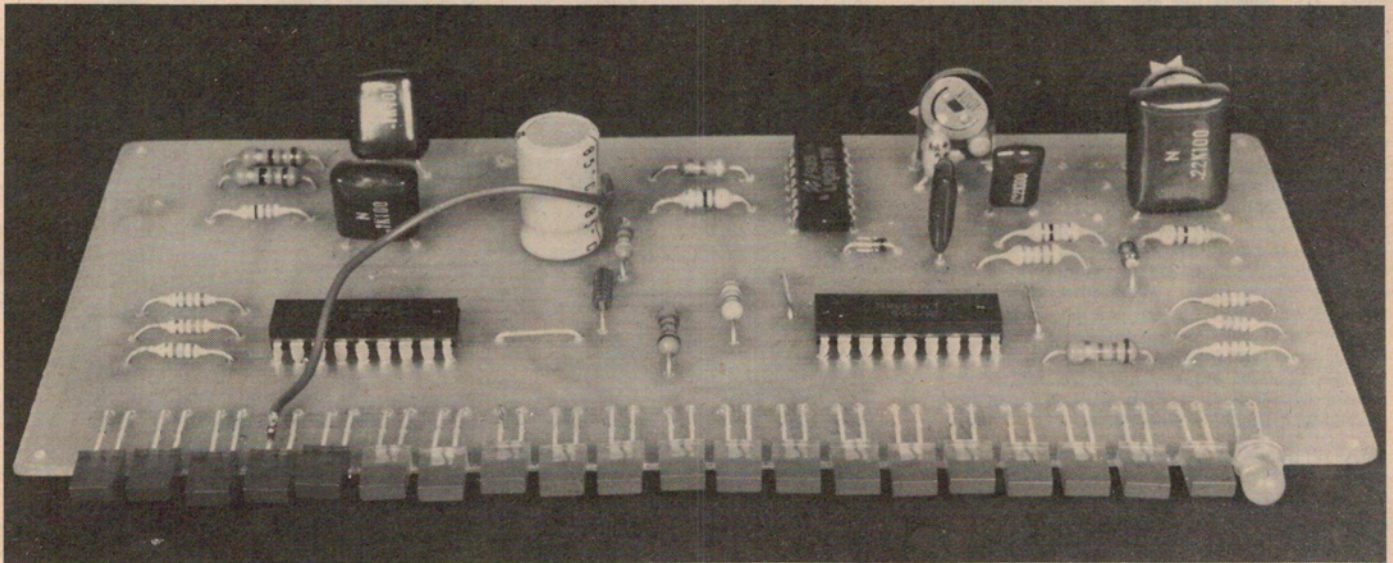


# Twin range tacho features LED bargraph display

## Staff

Another in our series of projects to "update your car electronically", this tacho has many advantages over conventional types.



FEATURING a bargraph display of 20 rectangular LEDs arranged in a single line, plus one 'zero' LED, this tachometer incorporates an over-rev alarm feature and a high/low range switch. It displays engine speed in an analogue form (as with a conventional tacho) as an illuminated section of the row of LEDs, the length of the 'bar' being proportional to engine speed. This form of display indicates at a glance what your engine is doing, without the necessity of having to mentally interpret a numerical display as you would with a digital tacho — you don't have to take your eyes off the road, nor try to interpret rolling numerals during acceleration or deceleration.

This unit may be used with virtually any type of multi-cylinder petrol engine. The two speed ranges are cali-

brated by means of preset trimpots to give any full-scale speed range required. The lower range is of great value when setting or checking an engine's ignition and carburation for recommended tick-over speeds. The unit has been designed for use on 12 volt, positive or negative earthed electrical systems. It can be used with conventional (Kettering), capacitor-discharge (CDI) or transistor-assisted ignition systems — where a contact breaker system is used. Only three connections are required to install the unit — one to the positive supply, one to the negative supply and one to the contact breaker points. Protection circuitry has been included to prevent noise on the supply from causing problems and high voltage spikes from the points and coil circuit damaging the electronics.

## Design

The tacho has been designed around a frequency-to-voltage converter IC, the LM2917, driving two LM3914 LED bargraph driver chips. We covered various applications of the LM3914 in 'Lab Notes' in our March issue (page 61).

The LM3914s have an alarm facility which we have incorporated as a feature of the circuit. The triggering point for the alarm is arranged by taking a connection to an appropriate LED in the display. When the engine revs reach the point where this LED is turned on, the alarm will be triggered and the display will flash. An optional audible alarm can also be attached, the better to attract the driver's attention.

We chose a conventional (round) orange LED for the (zero) indicator in ▶

# Project 324

## HOW IT WORKS ETI-324

The circuit consists of a pulse conditioning circuit, R4 - R6, C5 and ZD1, a frequency-to-voltage converter, IC1, and two LED bar display drivers, IC2 and IC3. Each display driver is capable of driving 10 LEDs, giving a total of 20, plus one 'zero' LED. The number of LEDs illuminated is proportional to the output voltage from the frequency-to-voltage converter.

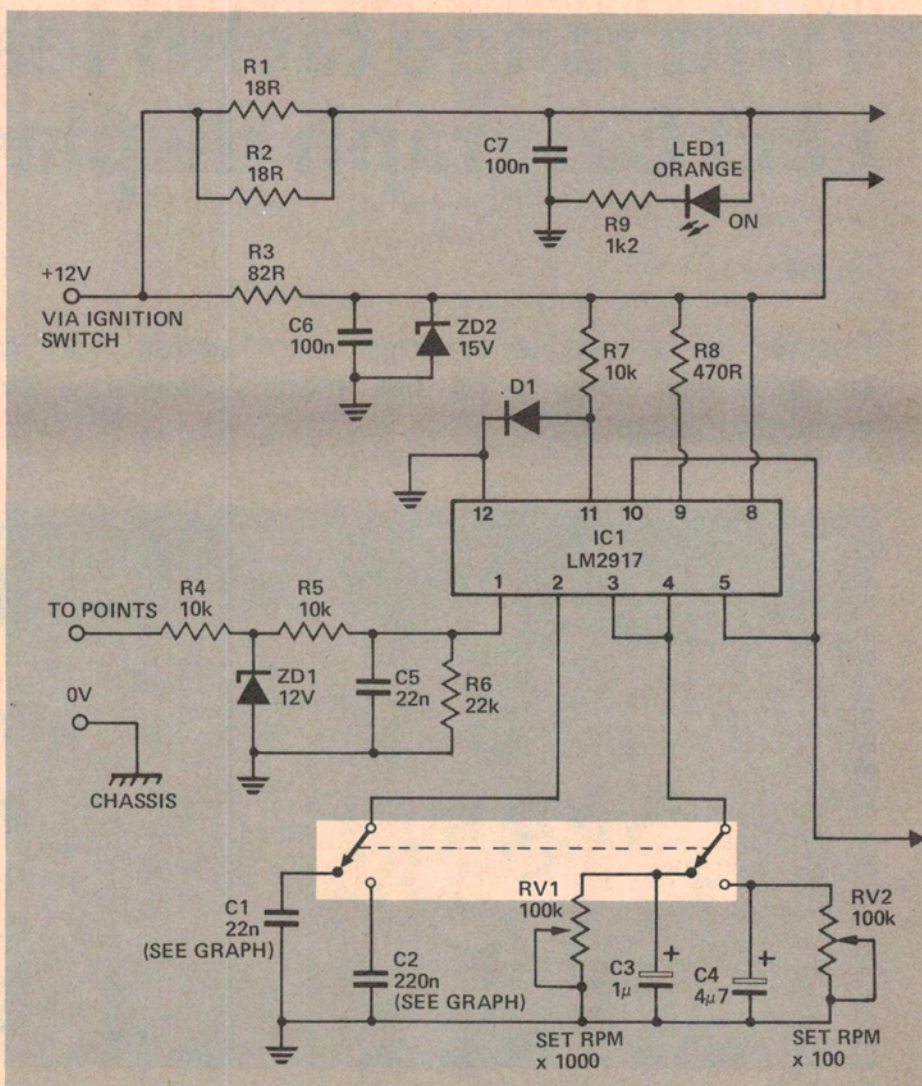
The ignition pulses from the contact breaker points in the vehicle have a repetition rate proportional to the RPM of the engine. The pulses from the points contain high voltage ringing components on the rising and falling edges of the waveform. These can be as high as 250 V at frequencies up to 10 kHz. These pulses would almost certainly damage the electronics so the input to IC1 is preceded by a pulse conditioning circuit. The 12 V zener diode, ZD1, shorts out any voltage spikes above 12 V while any remaining high frequency component is removed by R5 and C5.

The 'cleaned-up' rectangular waveform is fed to pin 1 of IC1. This is a voltage-to-frequency converter, providing an output voltage directly proportional to the frequency of the input waveform. The operating range of the IC is determined by the value of a capacitor connected to pin 2, either C1 or C2, and by a timing resistor and smoothing capacitor connected to pins 3 and 4. (RV1, C3 or RV2, C4). In our application, two preset ranges are provided by the range switch, SW1. The IC contains a constant current charging circuit for the timing capacitors (to ensure an output that is linear with frequency) and an internal voltage regulator. The network of R7 and D1 provides an input threshold level to guard against false triggering from noise.

The dc output of IC1 is fed to the inputs of the display drivers IC2 and IC3. These are LED 'bar' or 'dot' display drivers. Each IC can drive a chain of 10 LEDs and the number of LEDs illuminated is proportional to the output voltage from IC1. Put simply, the ICs act as LED voltmeters. The two ICs are 'cascaded' such that they perform as a single 20-LED voltmeter with a full-scale range of 2.4 volts. The resistors R13 to R18 are wired in series with the display LEDs to reduce the power dissipation in the two ICs. LED1 is permanently illuminated, providing a 'power on' indication and a 'zero' point for the display.

The LM3914 ICs incorporate an alarm facility. The triggering point for the alarm can be connected via a flying lead to any of the LEDs, selecting the trigger point. When the selected LED is turned on, the voltage on its cathode goes low, triggering the alarm. Capacitor C8 discharges, blanking the display. The LED is then turned off and the alarm resets. The capacitor is then re-charged, the display lights, and the alarm is triggered once again. The audible alarm will sound and display flash a few times a second. As soon as the RPM drops so the selected LED does not light, the function of the tachometer returns to normal.

Supply line filtering of noise pulses is achieved by R1 - R3, C6 and C7. Reverse polarity and overvoltage protection is provided by ZD2.



position one (it also indicates power on), rectangular green LEDs in positions 2 - 18 for the normal driving range, and rectangular red LEDs for the positions 19 - 21 giving a 'red line' area of 25% of full display. We thought this was the most convenient arrangement but you may vary it to suit your particular situation. All round LEDs may be used if you wish, but we found the rectangular LEDs provide a better looking display.

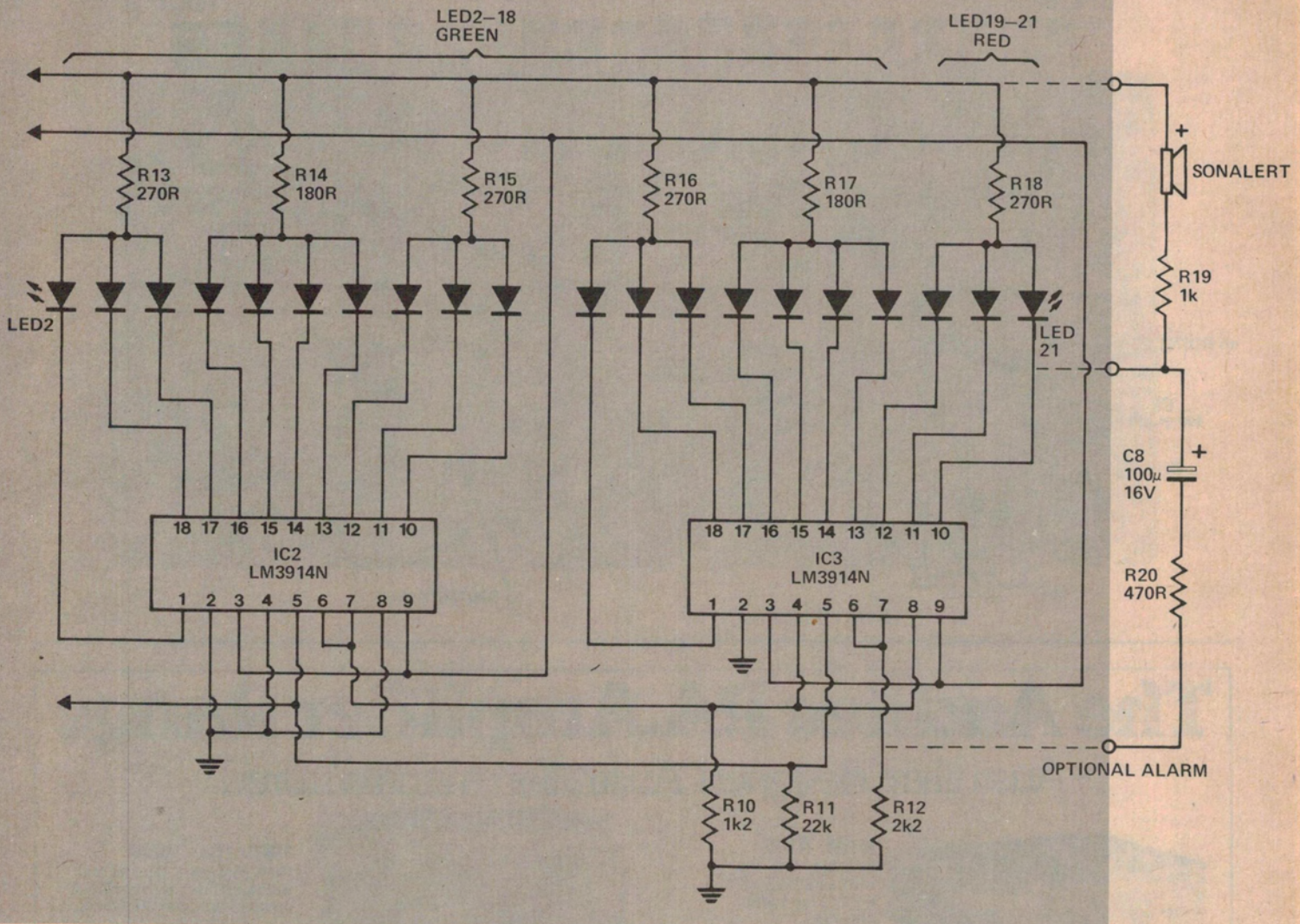
## Construction

Our printed circuit board is pretty well essential for constructing this project. The LEDs for the bargraph display are all mounted in a row down the front of the board. As you can see from the accompanying photographs, all the components with the exception of the

range switch and audible alarm are mounted on the pc board.

You will find construction easiest if you mount all the ICs, resistors and capacitors first, leaving the LEDs till last. Make sure you have the ICs correctly oriented, as well as the diodes and tantalum and electrolytic capacitors. Refer to the component diagrams and pc board overlay.

When mounting the LEDs it is *most important* that they be placed in the board the right way around. One of the best ways of ensuring this is to first place them on the table or workbench in a row in front of you, with their leads all correctly oriented, just as they would be when mounted on the board. To ensure the leads are the right way around, refer to the overlay and the accompanying



The pc board patterns are on page 137

drawing showing LED orientation. Now comes the hard part — mounting the LEDs so that they're all level! Insert LED2 first and bend it such that it lies flat on the board with the base of the LED flush with the edge of the board — as shown in the pictures. Solder its leads. Bend it back upright and then insert LED3, carefully positioning it such that it is flush with LED2. Solder it in position. Proceed like this until all the LEDs are in place and then bend the whole row over, parallel to the board.

A flying lead is used to connect the alarm circuit to one of the LEDs. This determines when the display will flash and the audible alarm (if used) will sound. This lead should be left floating until the two speed ranges are set up. Attach flying leads for the

switch connections, supply and points connection.

### Mounting

Having built the unit, you'll have to consider where it is to be mounted. In fact, it may be prudent to think about this as your very first step! The tacho can be mounted such that the display is either horizontal or vertical, depending on your preference and available space in the dashboard. It is best mounted not too far from the driver's line of view so that it can be seen without his eyes leaving the road for too long, and to the side of his normal vision.

If you are brave enough, the unit can be mounted behind a slot cut in the vehicle's dash, as near to the speedometer as you can manage. Watch out that

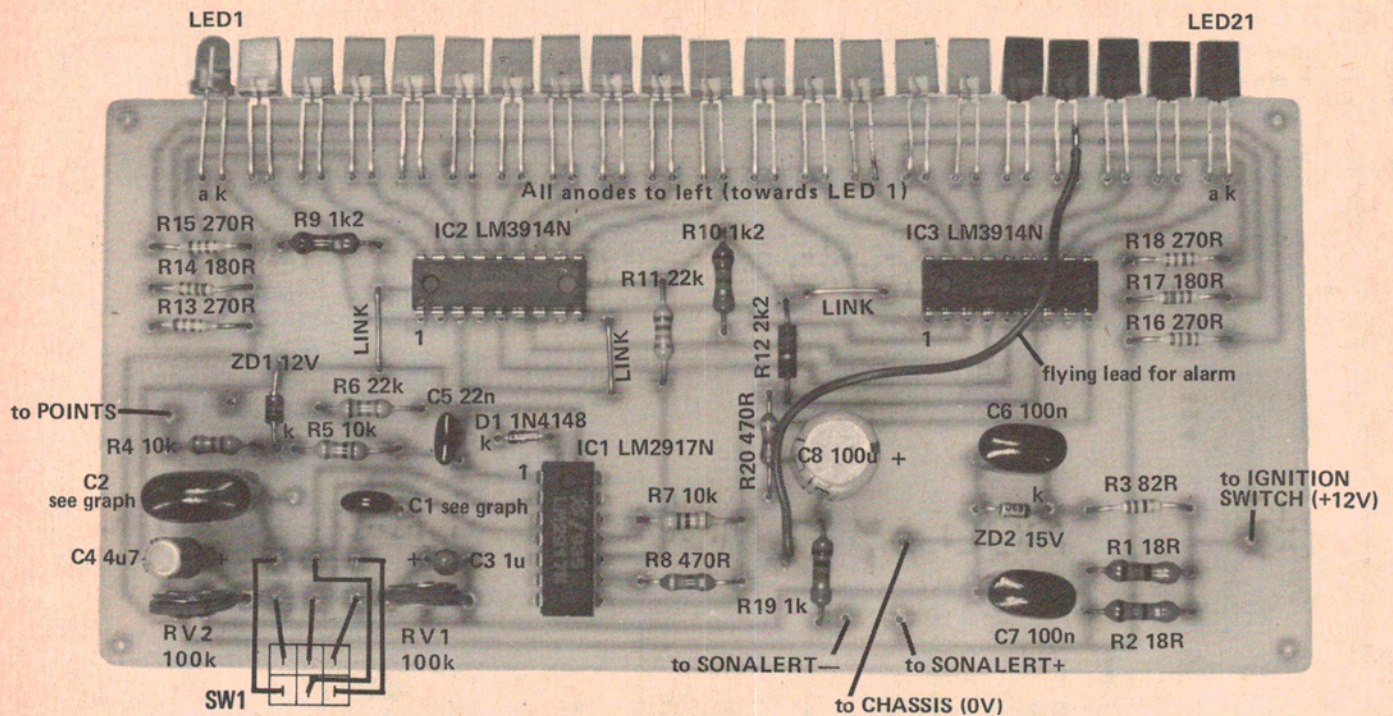
there's enough space to accommodate the unit behind the panel before you cut, though!

If that doesn't appeal to you, the unit may be housed in a slim plastic case which is then mounted in a convenient position on the dashboard.

The range switch and audible alarm may be mounted in any convenient position, no matter where or how you mount the tacho itself, as lead length to these components is not at all critical.

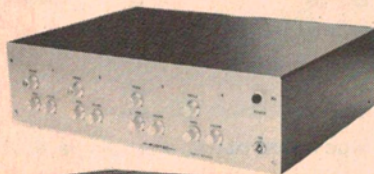
Only three connections are made to the vehicle's electrical system: battery +12 V, contact breaker points and chassis (0 V). The battery connection should be taken after the ignition switch so the unit is only on when the ignition is on. The wire to the points will have to be taken through the fire wall to ▶

# Project 324



## The Auditec P.A. Amplifier Range

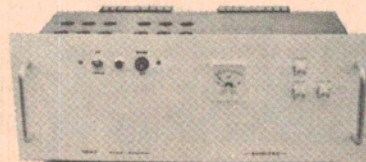
-Australian designed, Australian manufactured



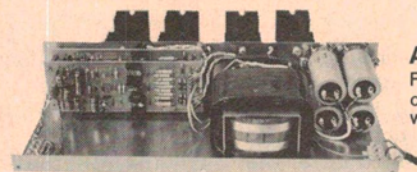
**K104, K105**  
Free standing 120 watt amplifiers with either 2 or 4 input channels.



**2033, 1034**  
Rack mounting 2 x 100 watt and 200 watt studio monitoring amplifiers. Where reference amplifier quality is required.



**1009, 1027, 2009**  
Rack mounting 120 and 250 watt amplifiers with optional preamplifiers and VU meters.



**A-SERIES**  
For mounting into a case or cabinet. In 2 x 60 watt, 120 watt, 250 watt, 2 x 120 watt.

There are three reasons why you should install an Auditec instead of an imported amplifier: **QUALITY, RELIABILITY and PRICE.**

**AUDITEC MAJOR STOCKISTS.** VIC: ZEPHYR PRODUCTS, 70 Batesford Road, Chadstone, 3148. Phone (03) 568-2922. QLD: DELSOUND PTY. LTD., 1 Wickham Terrace, Brisbane, 4000. Phone (07) 229-6155. SA: NEIL MULLER PTY. LTD., 8 Arthur Street, Unley, 5061. Phone (08) 272-8011. WA: WILLIS ELECTRONICS, 993 Hay Street, Perth, 6000. Phone (092) 321-7609. ACT: MUSIQUE BOUTIQUE, 29-31 Colbee Court, Phillip, 2606. Phone (062) 81-5255. NT: DARWIN COMMUNICATIONS SYSTEMS, 2420 Scriven Street, Casuarina, 5792. Phone (089) 85-3184. FARMER & DAVIES ELECTRONICS, Weber Sales Bld., Fogarty Street, Alice Springs, 5750. Phone (011) 52-2967. TAS: UNITED AUDIO, 37 Elizabeth Street, Hobart, 7000. Phone (002) 34-4412.

**OTHER AGENTS.** NSW: RAY WALSH SOUND SYSTEMS, 448 Swift Street, Albury, 2640. Phone (060) 21-1502. W.M.R. ELECTRONICS, "Wirra-Willa", Belmont Road, Glenfield, 2167. Phone (02) 605-1203. DAWES SOUND SYSTEMS, 7 Mitchell's Pass, Blaxland, 2774. Phone (047) 39-4421. D.R. HI-FI & ELECTRONICS, 657 Pittwater Road, Dee Why, 2099. Phone (02) 982-7500. LANDERS MUSIC CENTRE PTY. LTD., 302 Summer Street, Orange, 2800. Phone (063) 62-6515. TRILOGY WHOLESALE ELECTRONICS, 40 Princes Highway, Fairy Meadow, 2519. Phone (042) 83-1219. R. ARCHER & SON, 107 Bungaree Road, Wentworthville, 2145. Phone (02) 631-4538. QLD: BUNDABERG HI-FI, 244 George Street, Bundaberg, 4670. Phone (071) 71-3176. KELLER ELECTRONICS, 94 Ellena Street, Maryborough, 4650. Phone (071) 21-4559.

For full details of these amplifiers phone, write or call at . . .

**AUDITEC**  
**AUSTRALIA PTY. LTD.**

10 Waitara Avenue, Waitara, NSW 2077  
(Adjacent to Pacific Highway)  
Phone (02) 48-4116

## PARTS LIST — ETI-324

<b>Resistors</b>		all 1/4W, 5%
R1, R2	.....	18R
R3	.....	82R
R4, R5, R7	.....	10k
R6, R11	.....	22k
R8, R20	.....	470R
R9, R10	.....	1k2
R12	.....	2k2
R13, 15, 16, 18	.....	270R
R14, R17	.....	180R
R19	.....	1k
<b>Potentiometers</b>		
RV1, RV2	.....	100k, miniature vert. mounting trimpots
<b>Capacitors</b>		
C1	.....	22n greencap (see text)
C2	.....	220n greencap (see text)
C3	.....	1u, 16V electro. or tant.
C4	.....	4u7, 16V electro
C5	.....	22n greencap
C6, C7	.....	100n greencap
C8	.....	100u, 16V electro.
<b>Semiconductors</b>		
IC1	.....	LM2917N
IC2, IC3	.....	LM3914N
D1	.....	1N914, 1N4148 or similar
ZD1	.....	12 V, 400 mW zener
ZD2	.....	15 V, 400 mW zener
LED1	.....	Orange LED, round or rectangular
LEDs 2 - 18	.....	Green LEDs, round or rectangular
LEDs 19 - 21	.....	Red LEDs, round or rectangular
<b>Miscellaneous</b>		
SW1	.....	DPDT miniature toggle switch, ETI-324 pc board, case (if required), Sonalert (if required).

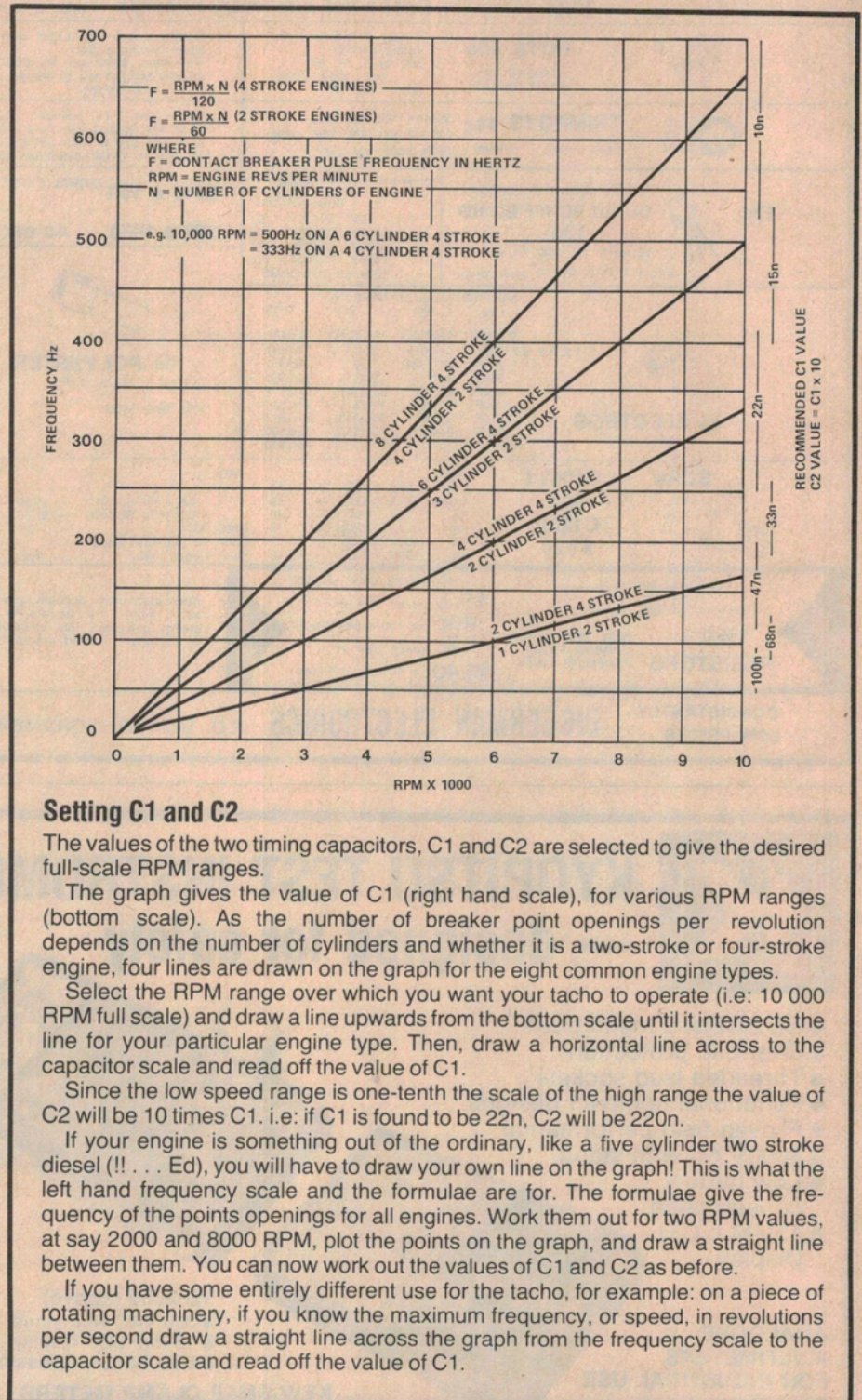
the points terminal on the outside of the distributor. The easiest way, rather than drilling a hole in the firewall, is to run the wire next to a wiring loom or the speedo cable, through an existing hole. Make sure the wire is well insulated and there is no possibility of the insulation being rubbed off, causing the points to be shorted to the chassis. The chassis connection can be made to any convenient point on the car body under the dash.

## Setting up

All that's left is to set the two RPM ranges by adjusting the two trimpots and to set the point when the alarm triggers.

The easiest way to set the RPM ranges is to borrow a friend's tacho. All good dwell angle test meters have an RPM range so it shouldn't be too hard to find a suitable unit.

Run the engine at half the required maximum RPM range and set RV1 so that the *eleventh* LED just lights. Full scale will then be *twice* the engine speed. This technique avoids having to run the engine at full RPM with no load which can be very damaging to your



engine as well as you ears!

The low speed range can be set by adjusting RV2 until the *21st* LED just lights at the desired engine RPM. As this is a low speed range there is no danger to the engine.

The alarm triggering point is set by soldering the flying lead directly onto a LED cathode lead. We set ours on the

lead of the second red LED. This can be made to trigger at say 6000 RPM by adjusting RV1 for a full range of 7000 RPM. If you don't need the alarm, the flying lead can be left off or the optional components left off the board completely.

That's it — project completed, calibrated and ready to roll!