

DIGITAL CAR TACHO

Compact unit offers both 10 rev resolution and short response time.

WE HAD OFTEN considered the design of a digital tachometer for automobile use, but had rejected several schemes as we were unable to get both good resolution and response time — the two seemed to provide a very good demonstration of Heisenberg's Uncertainty Principle.

Consequently, we were rather pleased when Mike Pratt of S M Electronics came to us with his phase-locked loop based design which got round the problem. Would we like to do it as a project, he asked? Obviously, we said yes, and here it is.

To make the project even more attractive, we arranged with Mike to do a special offer on a kit of parts — there's more information on the offer on page 53.

This tachometer features a fast response time, coupled with 10 Hz resolution, through the use of a phase locked loop frequency multiplier. It can be set up, by means of a single link, to work on 4, 6 or 8 cylinder motors.

Design Features

To measure the revolutions per minute of a motor is simply a matter of counting the number of ignition pulses over a given time. With a four cylinder, four stroke motor there is such a pulse twice per revolution. Therefore if we count these pulses for 30 seconds we will have revs/min with a one cycle resolution. Obviously this is much too long a sample period for practical use in a motor car and some compromise has to be made.



The usual solution is to use a 100 rev resolution and a sample time of 0.3 seconds (on 4 cylinders). We considered this inadequate which is why we have not published a design until now.

In this design an oscillator is used which is phase locked to the ignition pulses except at a higher frequency (x8 for 4 cylinder) allowing a short sample time (0.375 sec) with a 10 rev resolution. By using a different multiplication factor compensation for different numbers of cylinders can be made. Unfortunately with the multiplication factors used (x8, x6, x4) the sample time for 6 cylinders is not exactly the same as that used for 4 and 8 cylinder motors. Altering the ratios to x12, x8 and x6 would enable a 0.25 sample time to be used for all ranges, but this is not possible with the divider IC utilised in this design.

Construction

Assemble the pc board with the aid of the overlay ensuring the components are orientated correctly. The tantalum capacitors normally have a + mark indicating the positive lead, or a dot on the side. When soldering the CMOS ICs (4, 6, 7) earth the tip of the soldering iron.

Note that there is one feedthrough or link between the two sides of the board near C10.

Calibration

Initially place a link between the point 'C' and the terminal corresponding to the number of cylinders. Now with the power supply connected feed a 50 Hz signal of between 12 and 30V into the points input using the 0V as common. Now adjust RV1 until the display reads 1500RPM for 4 cylinders, 1000 for 6 or 750 for an eight cylinder car.

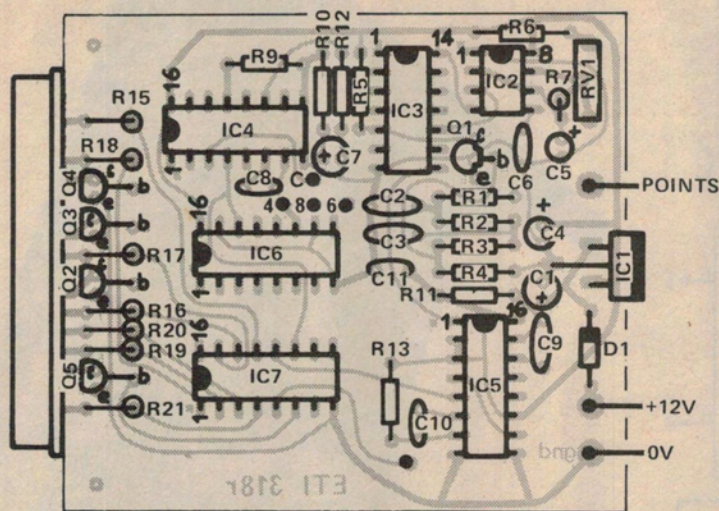


Fig. 1. The component overlay for the board. The board is double sided although only the lower surface is shown here. Note the link between the two surfaces of the board near C10.

PARTS LIST - ETI 318

Resistors all 1/4 W, 5%

R1,2	...	39k
R3,4	...	22k
R5	...	1k5
R6	...	100k
R7	...	100R
R8	...	not used
R9	...	10k
R10	...	390k
R11	...	10k
R12	...	270k
R13	...	10k
R14	...	not used
R15-21	...	27R

Potentiometer

RV1	...	25k trim
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Capacitors

C1	...	10μ 25V tantalum
C2,3	...	56n polyester
C4	...	10μ 25V tantalum
C5	...	4μ7 25V tantalum
C6	...	10n polyester
C7	...	1μ0 25V tantalum
C8	...	470p ceramic
C9	...	56n polyester
C10	...	10n polyester
C11	...	10n ceramic

Semiconductors

IC1	...	7805	regulator
IC2	...	555	timer
IC3	...	7413	dual schmitt
IC4	...	4046	PLL
IC5	...	74123	dual mono
IC6	...	4018	divide by n
IC7	...	74C925	4 digit counter

Q1 BC318

Q2-Q5 . . . BC338

D1 1N4004

Display . . . NSB5881

Miscellaneous

PC board ETI 318
Case to suit

SPECIFICATION - ETI 318

Range	100 to 9990RPM
Resolution	10RPM
Reading rate	
4 or 8 cylinders	2.66 per second
6 cylinders	3 per second
Power supply	7 to 15V @ 400mA
Suitable ignition systems	standard CDI transistor assisted * it will not operate on 'pointless' systems

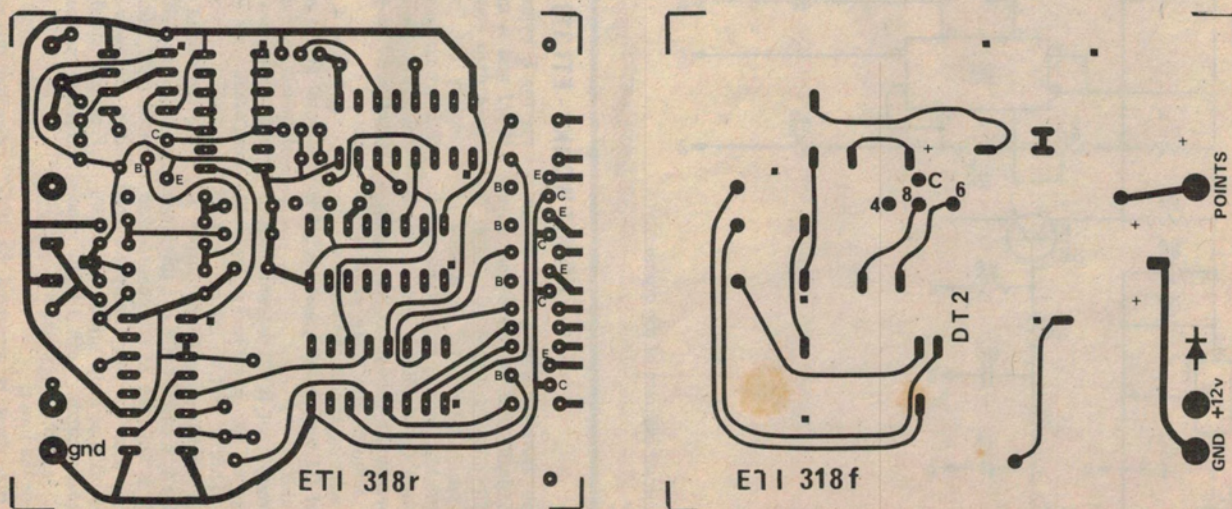


Fig. 2. The pc patterns shown full size. Unfortunately space did not allow us to reproduce these on the gloss paper and therefore they cannot be copied using our Scotchcal method.

