1 GHz FREQUENCY METER – TIMER

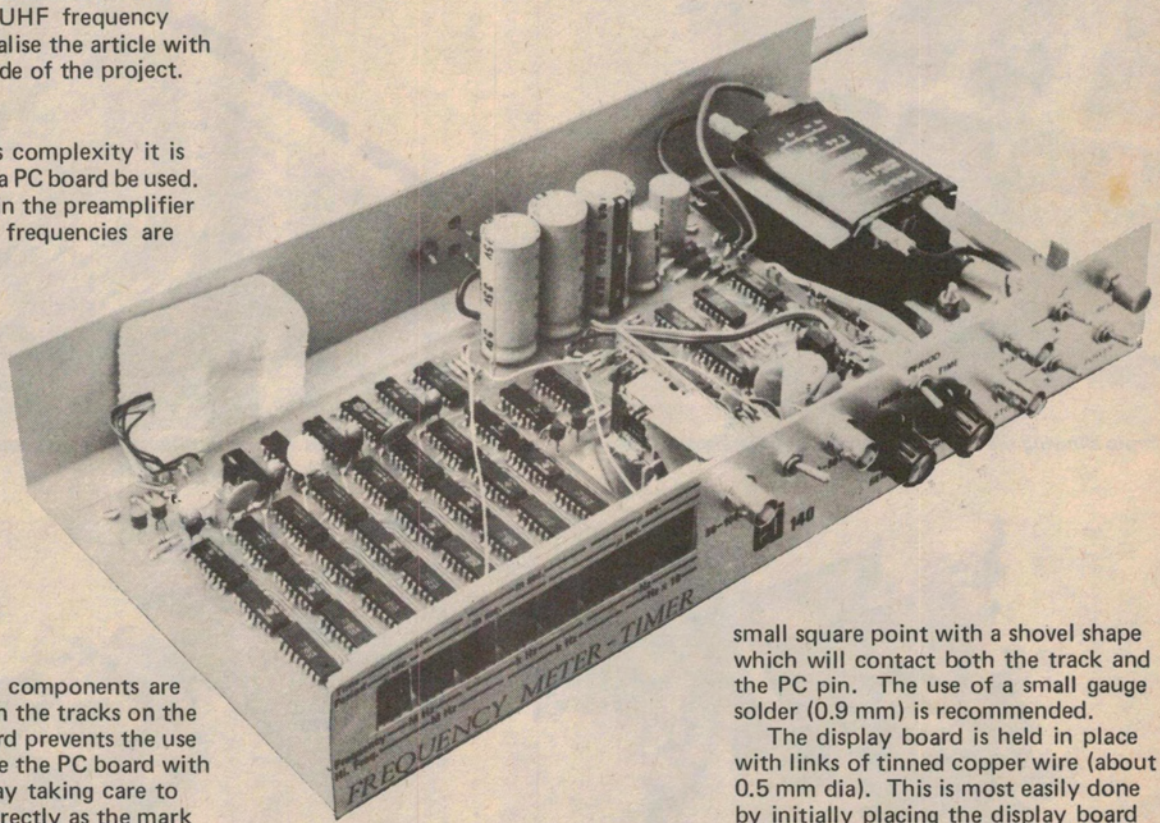
Pt.2 Construction

Lab-quality instrument offers superb performance and features at low cost.

LAST MONTH we described the circuit details of our new UHF frequency counter. We now finalise the article with the constructional side of the project.

Construction

For a project of this complexity it is almost essential that a PC board be used. This is especially so in the preamplifier section where high frequencies are involved.



The fact that the components are used as links between the tracks on the two sides of the board prevents the use of sockets. Assemble the PC board with the aid of the overlay taking care to orientate the ICs correctly as the mark is sometimes difficult to pick out. As the component leads are used as feed throughs it is not practical to build and test the unit in sections. Ensure that *all* pads on the top side of the board are soldered. Soldering the top surface is easiest if the tip of the iron is filed to a small square point with a shovel shape which will contact both the track and the PC pin. The use of a small gauge solder (0.9 mm) is recommended.

The display board is held in place with links of tinned copper wire (about 0.5 mm dia). This is most easily done by initially placing the display board horizontally on the main board and inserting loops of wire through the holes provided (see photo). When all the links are in place the board can be twisted into a vertical position and by pulling on the ends of the links the display board can be pulled down flush with the

main board. It can now be soldered into place. Two additional resistors are needed per digit; the photo shows their position. The potentiometers are mounted on a small bracket (see Fig.20) before being soldered onto the main board.

The prescaler, if used, is also mounted in a similar way except that due to the small number of connections the links should be passed through the holes in the prescaler, bent flush with both sides and then mated with the main board. Solder the pads on the underside of the main board only at this stage. On the prescaler board there is a tin plate shield which should be soldered into position with a fillet of solder. Don't solder the top edge yet as capacitor C15 can only be fitted after the unit is in the chassis. Also note that the capacitors C43 and C44 are mounted on the rear of the PCB as shown in Fig. 15 along with R116.

The crystal is fitted into a polystyrene box (about 50 x 40 x 25 mm) with transistor Q5, R86, 87 and TH1 being glued onto the crystal body to act as a heater and sensor.

Before mounting the unit into the chassis assemble all the front panel components, also glueing the polarised plastic into position. Note that there is an earth lug under the prescaler input socket and the nut for the socket should be in the position shown in Fig. 8 as the board fits between the nut and the earth lug which is bent back along the surface of the board.

The unit should now be temporarily mounted into the chassis to locate the prescaler board in its correct position between the nut on the input socket and the earth lug. Fix it in this position by running a small fillet of solder between the two boards. When the unit is removed run the fillet of solder the full length (where there is copper!!) on both sides of the prescaler board.

Assemble the unit finally and wire it up as shown in the wiring diagram. The transformer can be mounted and wired along with the 5V regulator. Insulation washers should be used with this regulator even though the case is at earth potential to prevent any problem of having two earth points (the other is the lug under the prescaler input socket).

Errata

On the power supply circuit diagram last month the transformer was specified as 240V/15V+15V. It should have been 240V/9V+9V. Also the diodes D16 and D17 have been shown in reverse polarity. The regulator IC47 should have been marked as a 7905 not 7915.

On the control logic circuit diagram the diode D17 should have been D18.

The resistor R117 was omitted from the preamplifier circuit diagram and is connected between pin 6 of IC44 and 0V. This is to reduce the sensitivity at high frequency and improve stability.

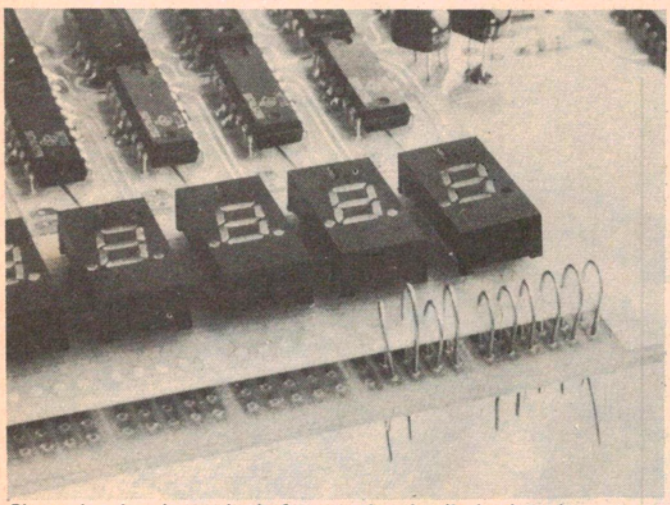
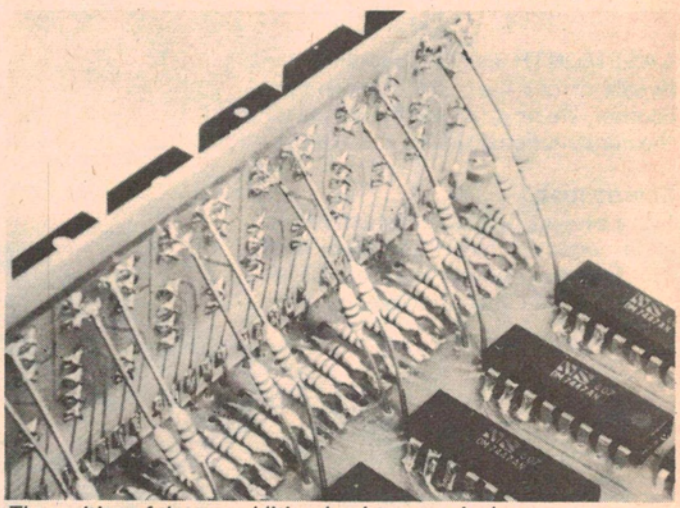
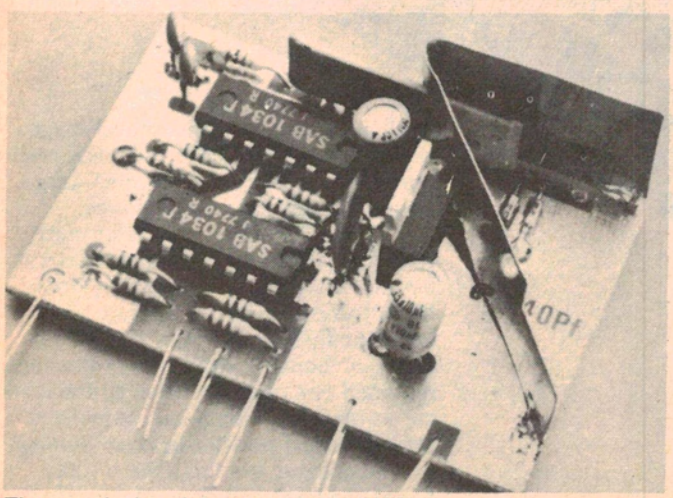


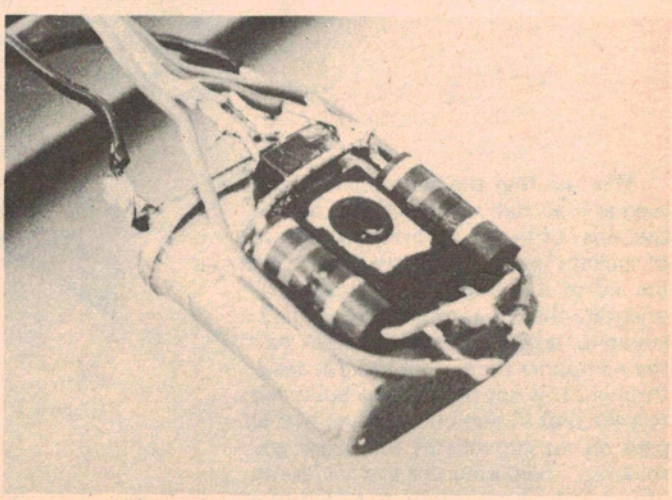
Photo showing the method of connecting the display board.



The position of the two additional resistors required per display is shown in this photograph.



The prescaler board showing the shield used.



The method of mounting the components on the crystal.

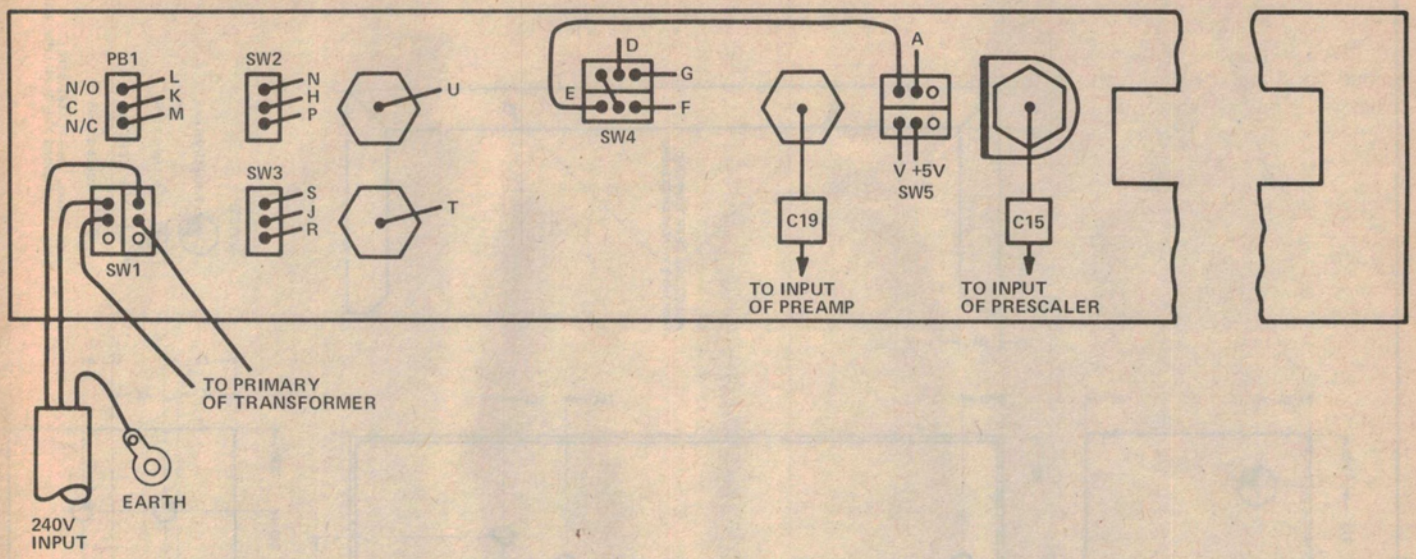


Fig. 8. Rear view of the front panel wiring.

ICs used in the prescaler.

Most of the ICs used in this project are standard TTL or CMOS and only the prescaler ICs are unusual. For this reason details of these ICs are given below.

OM335

This is a high frequency linear amplifier designed for instruments or TV amplifier.

Gain	27dB typ.
Freq. resp. ∓ 1dB	20–1000MHz
Input impedance	75ohm
Output impedance	75ohm
Power Supply	8–28V dc @ 35mA

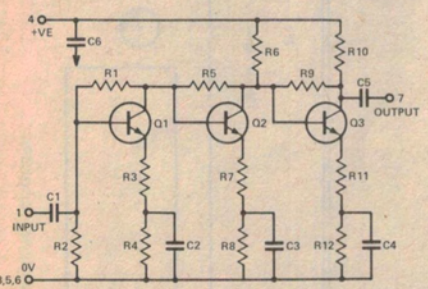


Fig. 9. Internal circuit diagram of the OM335.

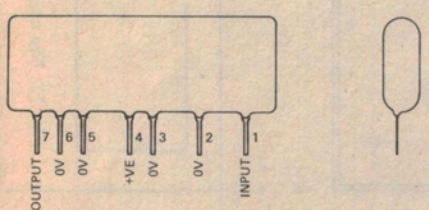


Fig. 10. Pin connections of the OM335.

SAB1048

This is a high frequency 4/1 divider (prescaler) and is designed to operate from a sinewave (50MHz min) or square wave (dc). The output is ECL compatable. The internal circuit - block diagram is given below. The differential inputs are internally biased and should be ac coupled. If only one input is used the other should be ac grounded.

Freq. range (sine wave)	50–1000MHz
Sensitivity	see graph
Power requirement	5.2V @ 53mA

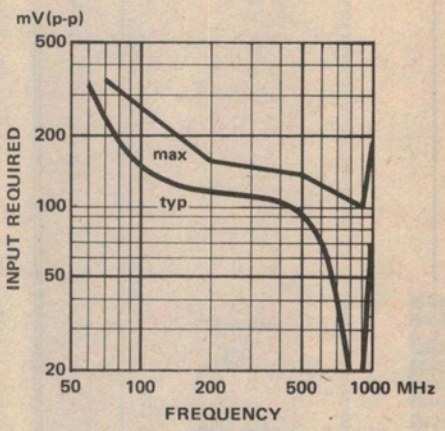


Fig. 12. Sensitivity of the SAB1048 with a sinewave input.

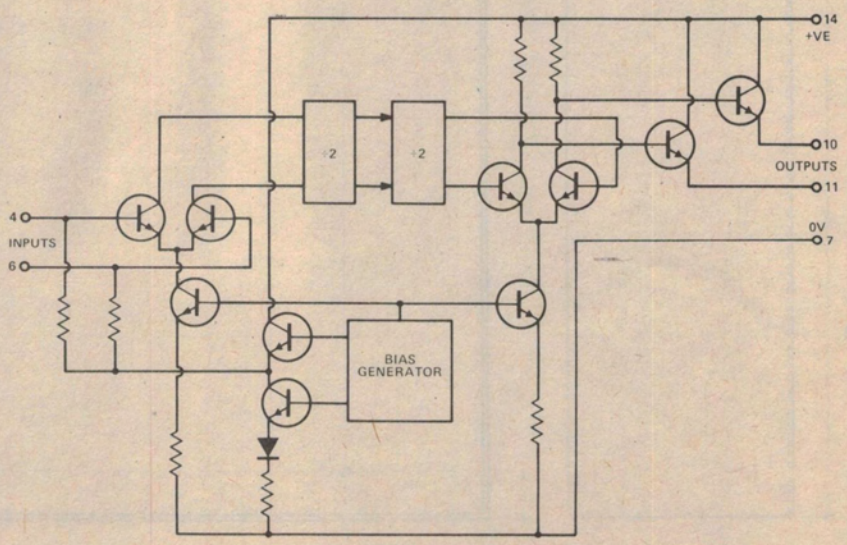


Fig. 11. Block diagram of the SAB1048.

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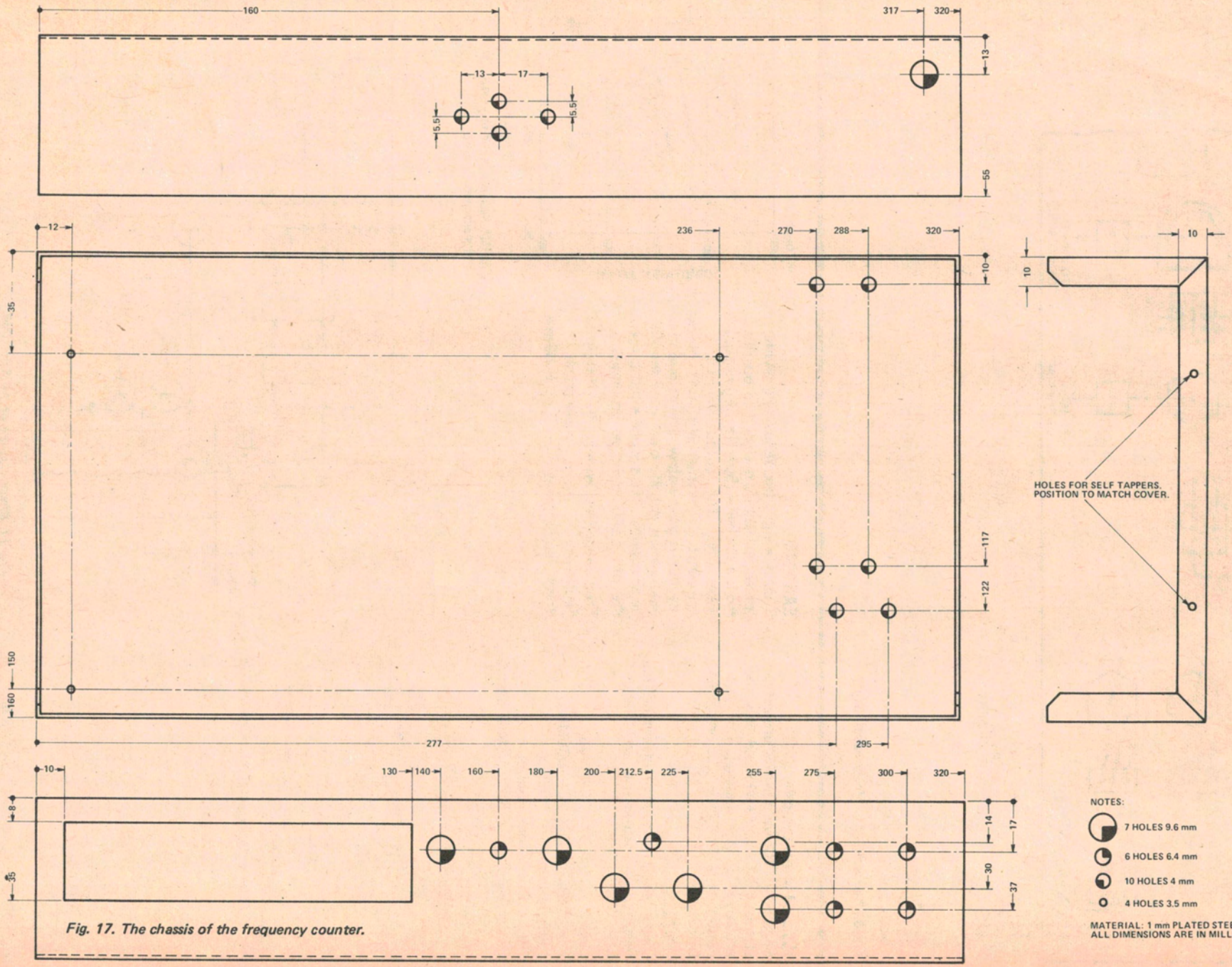

Fig. 17. The chassis of the frequency counter.

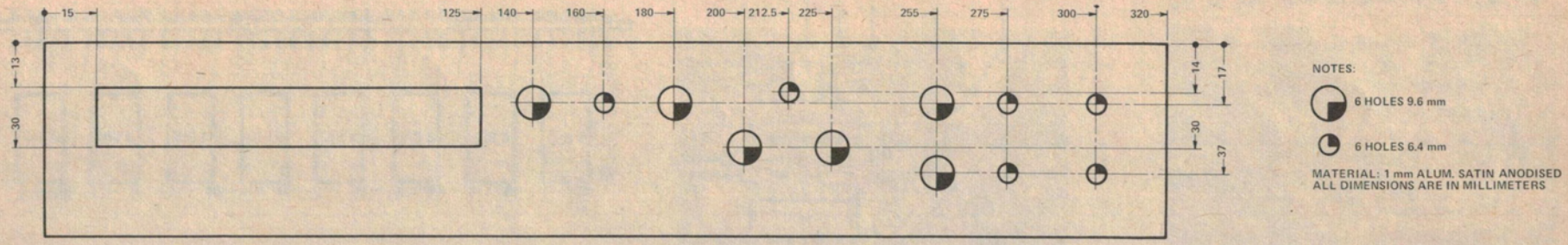

Fig. 18. The dimensions of the front panel.

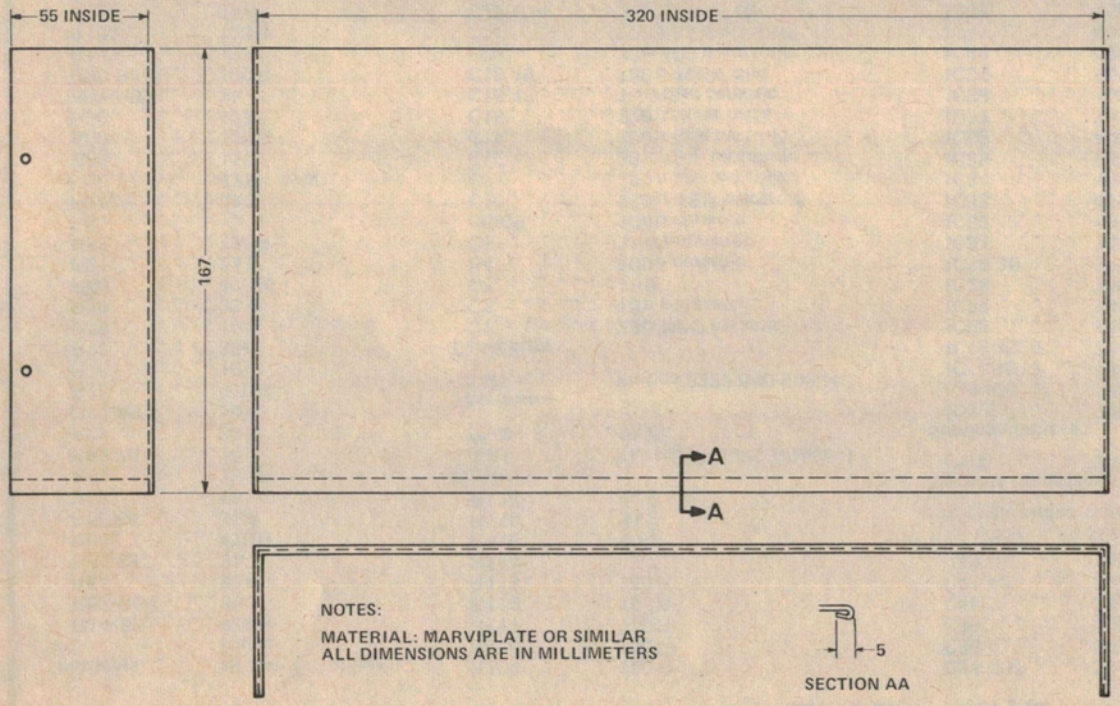

Fig. 19. The cover for the frequency counter.

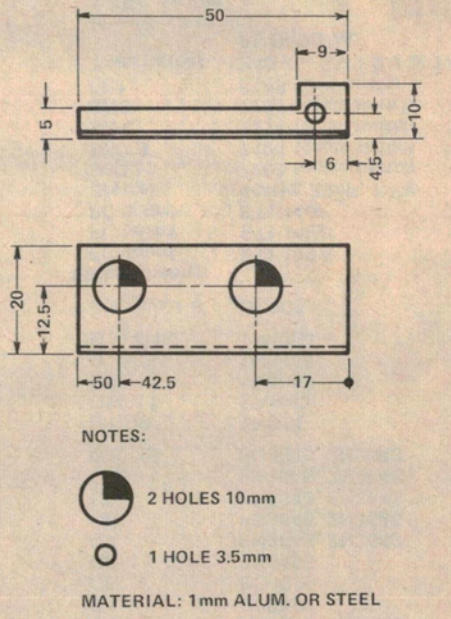

Fig. 20. The potentiometer mounting bracket.

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PARTS LIST – ETI 140

Resistors all ¼W, 5% unless stated

R1-R56 . . . . . 470R
R57-R60 . . . . 3k3
R61 . . . . . 33k
R62,63 . . . . . 3k3
R64 . . . . . 470R
R65,66 . . . . . 3k3
R67 . . . . . 15k
R68 . . . . . 330R
R69,70 . . . . . 10k
R71 . . . . . 3k3
R72-R74 . . . . 10k
R75 . . . . . 470R
R76 . . . . . 10k
R77 . . . . . 33k
R78 . . . . . 10k
R79 . . . . . 33k
R80 . . . . . 470R
R81 . . . . . 2k2
R82 . . . . . 220R
R83 . . . . . 1k
R84,85 . . . . . 3k3
R86,87 . . . . . 47R ½W
R88 . . . . . 1M
R89 . . . . . 220R
R90 . . . . . 47R
R91-R95 . . . . 1k
R96-R101 . . . 220R
R102 . . . . . 33R
R103 . . . . . 100R
R104 . . . . . 33R
R105,106 . . . 100R
R107 . . . . . 150R
R108 . . . . . 100R
R109 . . . . . 150R
R110 . . . . . 100R
R111 . . . . . 150R
R112 . . . . . 100R
R113 . . . . . 150R
R114 . . . . . 4k7
R115 . . . . . 10k
R116 . . . . . 3k3
R117 . . . . . 4k7

Potentiometers

RV1 . . . . . 1M log PR16PC (Plessey)
RV2 . . . . . 1k lin "

Thermistor

TH1 . . . . . Philips 2322 640 90004

Capacitors

C1 . . . . . 22p NPO ceramic
C2 . . . . . 10n polyester
C3 . . . . . 1n0 "
C4 . . . . . 100p ceramic
C5 . . . . . 1n0 polyester
C6-C9 . . . . . 100p ceramic
C10 . . . . . 220µ 16V electro *
C11 . . . . . 100n disc ceramic
C12,13 . . . . . 33µ 10V tantalum
C14 . . . . . 100n disc ceramic
C15 . . . . . 220p silver mica
C16,17 . . . . . 1n0 disc ceramic
C18,19 . . . . . 100n 100V disc
C20 . . . . . 10p 100V ceramic
C21 . . . . . 220µ 35V electro*
C22-C24 . . . . 2500µ 16V electro *
C25 . . . . . 220µ 35V electro *
C26 . . . . . 10µ 16V tantalum
C27 . . . . . 10µ 35V electro *
C28-C33 . . . . 33µ 10V tantalum
C34-C37 . . . . 33n disc ceramic
C38 . . . . . 10µ 35V electro *
C39 . . . . . 10µ 10V tantalum
C40 . . . . . 33µ 10V tantalum
C41,42 . . . . . 33n disc ceramic
C43,44 . . . . . 1n0 disc ceramic

* all electrolytic capacitors should be the single ended types.

Variable Capacitors

CV1 . . . . . 2–10p trimmer

Semiconductors

IC1,2 . . . . . 74S74
IC3-IC9 . . . . . 74LS90
IC10-IC17 . . . 74LS75
IC18-IC25 . . . 74LS47
IC26 . . . . . 74S02
IC27 . . . . . 74LS90
IC28 . . . . . 74S10
IC29,30 . . . . 74LS00
IC31 . . . . . 74LS73
IC32 . . . . . 4518 (CMOS)
IC33 . . . . . 4520 (CMOS)
IC34 . . . . . 4081 (CMOS)
IC35 . . . . . 4518 (CMOS)
IC36 . . . . . 4011 (CMOS)
IC37 . . . . . 74LS123
IC38 . . . . . 4001 (CMOS)
IC39 . . . . . 4011 (CMOS)
IC40 . . . . . 4013 (CMOS)
IC41 . . . . . 4011 (CMOS)
IC42 . . . . . 9582 (ECL)
IC43 . . . . . OM335
IC44,45 . . . . SAB1048P,SAB1034P
IC46 . . . . . 7805 (TO3 package)
IC47 . . . . . 7905 (500mA version)
IC48 . . . . . 7818 (500mA version)
IC49 . . . . . 7805 (500mA version)

Q1,2 . . . . . PN3643, 2N3643
Q3,4 . . . . . BC559
Q5 . . . . . BD139
Q6 . . . . . 2N5485
Q7 . . . . . PN3643, 2N3643
Q8 . . . . . PN3645, 2N3645
Q9 . . . . . PN3643, 2N3643
Q10,11 . . . . PN3645, 2N3645
Q12,13 . . . . PN3643, 2N3643

D1-D9 . . . . . 1N914
D10,11 . . . . . BAW62
D12,13 . . . . . 1N4004
D14,15 . . . . . 1N5404
D16-D18 . . . . 1N4004

Displays 1-8 . . DL707

Miscellaneous

PC board . . . . ETI 140A
PC board . . . . ETI 140D
PC board . . . . ETI 140P
Crystal . . . . . 4MHz, 30pF, 70°c
SW1 . . . . . 7201 toggle switch
SW2,3 . . . . . 7101 toggle switch
SW4 . . . . . 7211 toggle switch
SW5 . . . . . 7201 toggle switch
PB1 . . . . . 8168 push button
Transformer . . 240V – 9V+9V @ 1A PL18/20VA
Metalwork to suit
4 B&C sockets
3 core flex and plug
cable clamp
Piece of polarised plastic

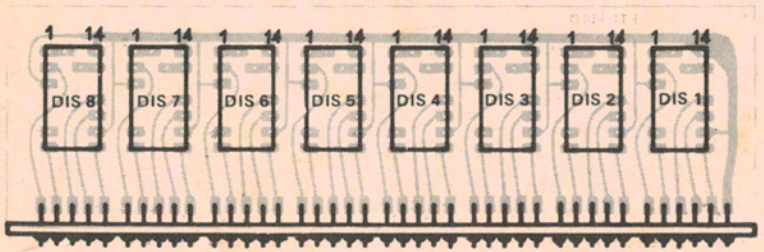


Fig. 13. Component overlay of the display board.

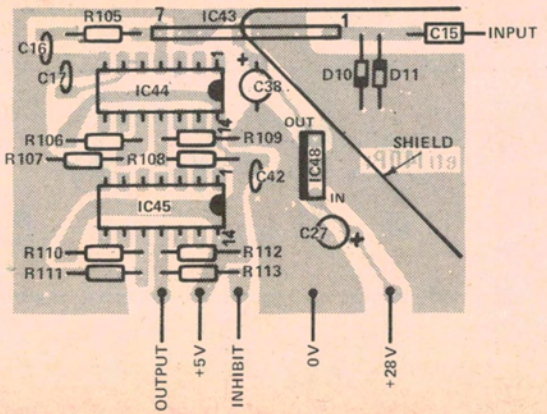


Fig. 14. Component overlay of the prescaler.

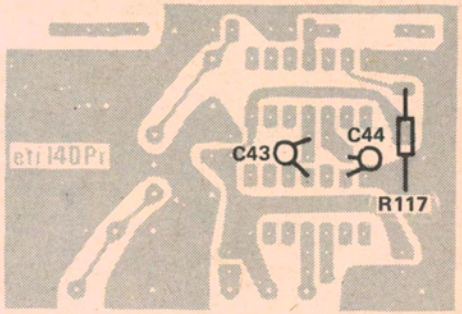


Fig. 15. View showing the position of C43, 44 and R116 on the rear of the prescaler board.

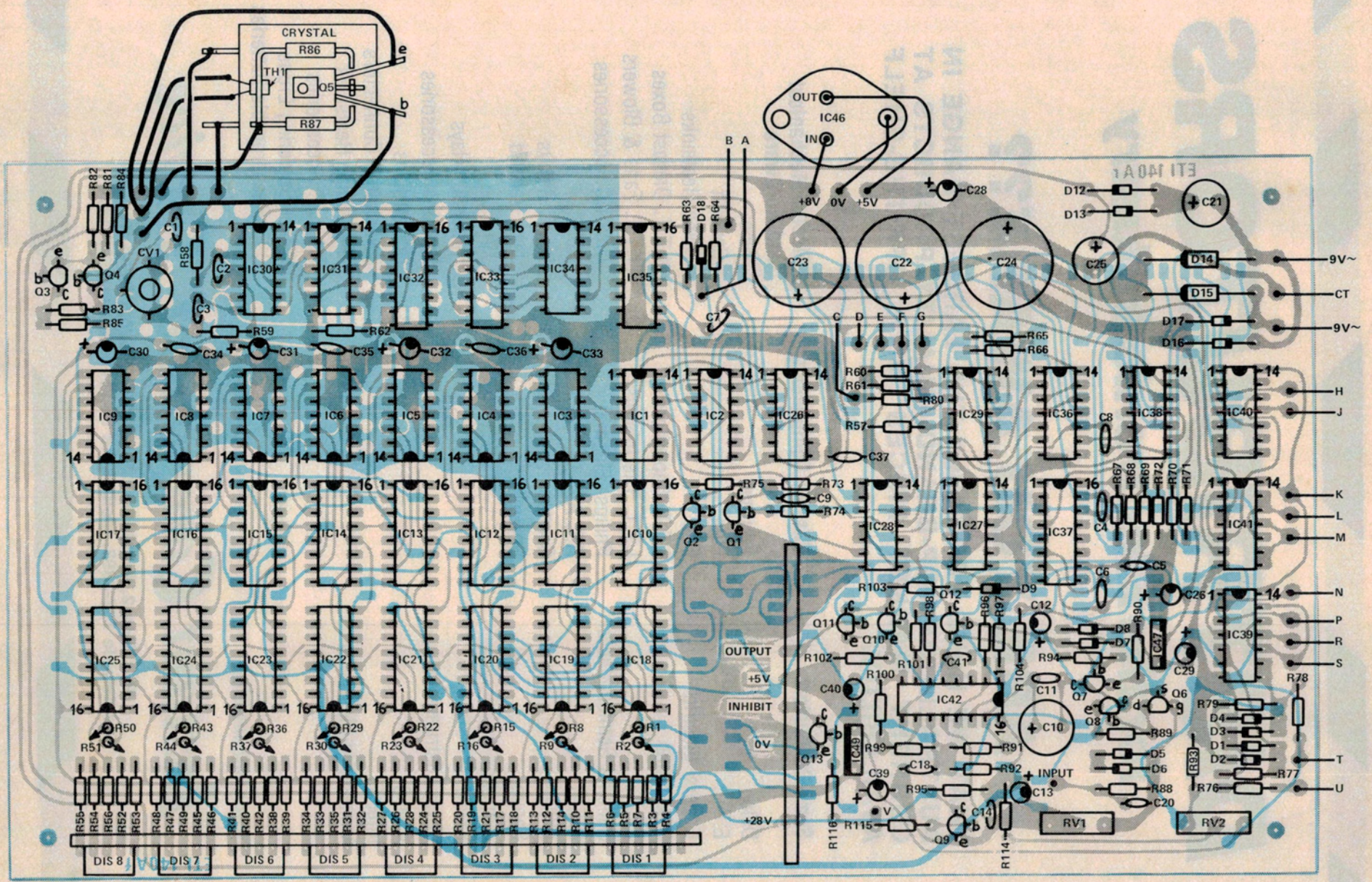
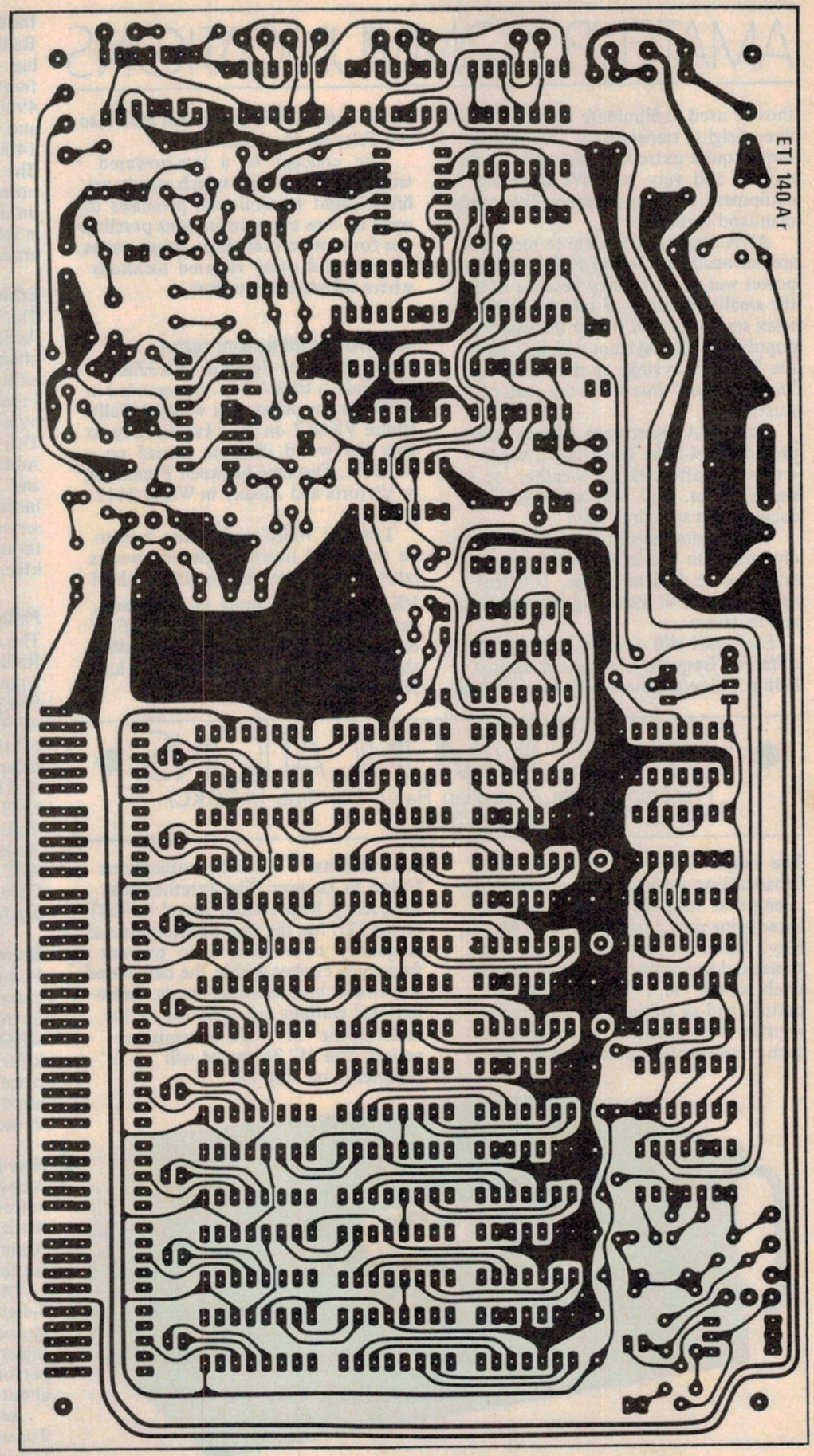
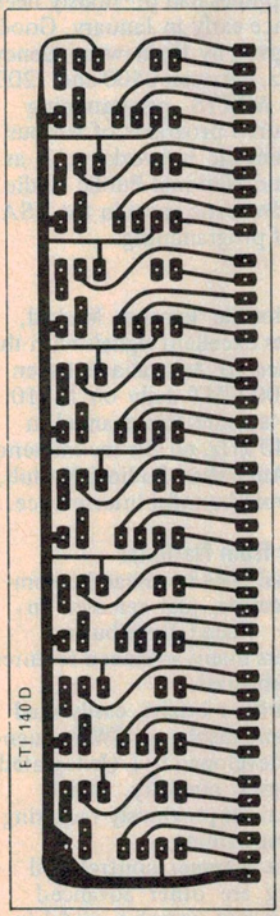
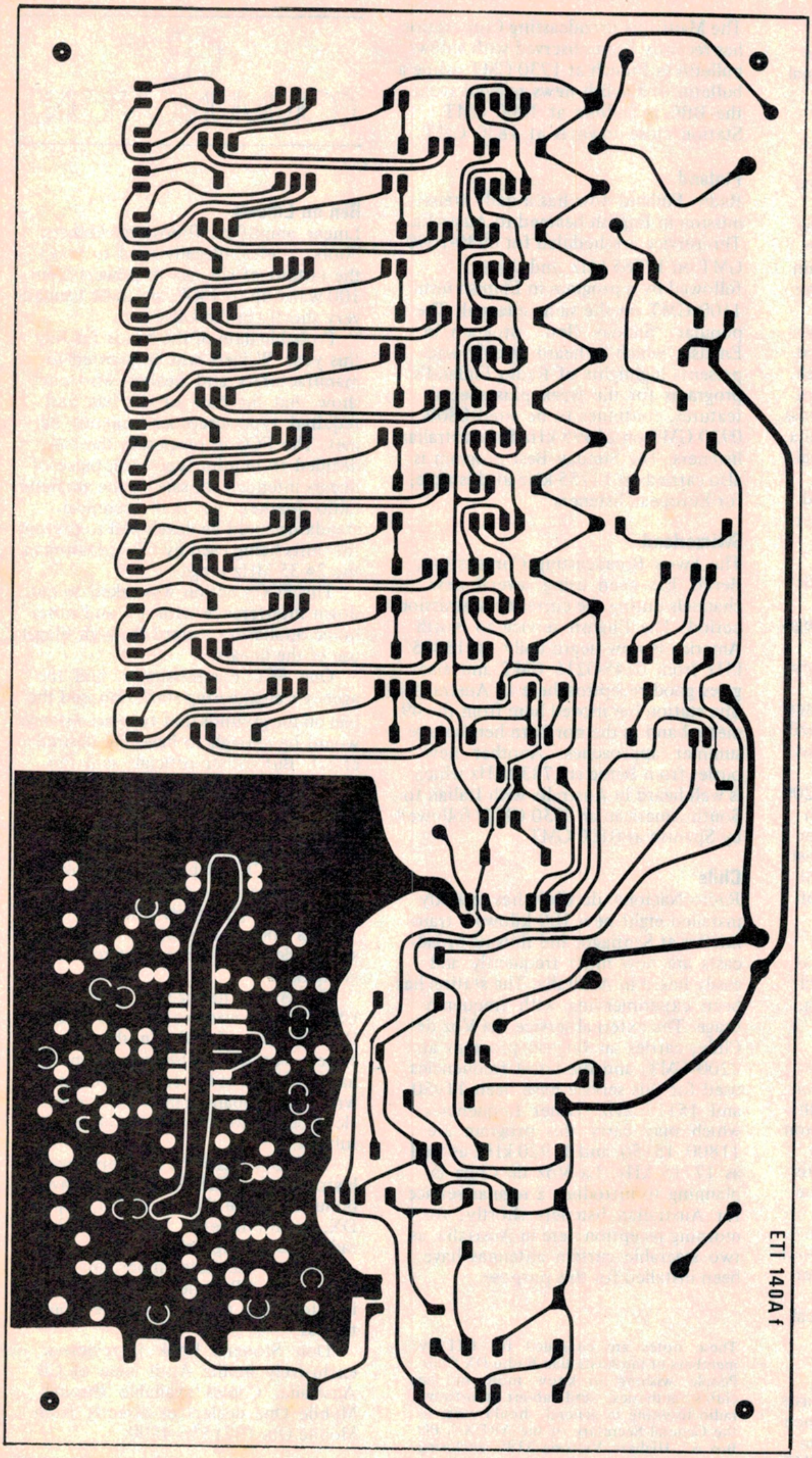


Fig. 16. The main component overlay. For the connection of wires marked A — U see Fig. 8. Wire B goes to the decimal point on DIS 5 (Pin 6) while wire C goes to the decimal point of DIS 1 (Pin 6).

Owing to space restrictions, we have had to omit our propagation predictions this month. Normal propagation will be resumed next month.



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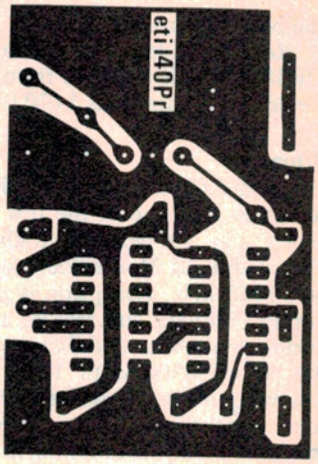
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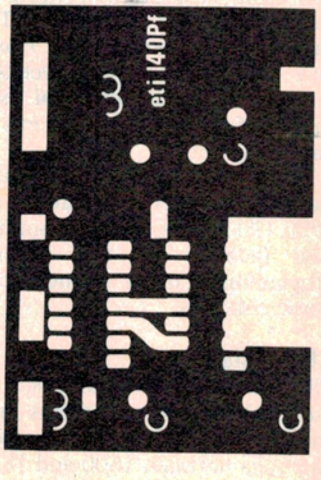
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