SCOTTISH SCHOOLS SCIENCE EQUIPMENT RESEARCH CENTRE

Bulletin No. 107. September, 1978.

Contents

Opinion

A minor fashion has sprung up in the past few months of commenting critically on the degrees of obscurity achieved by those whose objective should be the reverse, in written reports which have to be read and understood by others. It is implied, probably with some justification, that the writer feels his prestige will be enhanced in proportion with the complexity of the language he uses, albeit at the expense of an increasing proportion of his readership who will not understand what he is saying. This paragraph, if you have not already spotted it, is a typical example.

There is a tendency in any growing field of knowledge for it to create its own language. Some of this is no doubt necessary, but the suspicion must arise in many minds that some of it is pursued for its own sake. It gives the subject and its proponents status, by excluding those not 'in the know'. It is the witch-doctor syndrome, and doctors were early in the field with their prescriptions written in Latin.

Pedagogy is no exception. The volumes of Bloom, Phenix, Hirst, Whitfield et al. are spattered with words not to be found in the Oxford Dictionary. Those familiar with the 'Call My Bluff' programme on television will realise there is scope for a parallel series based on the reverse hypothesis of words not in the dictionary but bandied about in all sorts of journals. The panellists should be those spokesmen who, interviewed on the box, are fond of such wordy phrases as 'at this moment in time', 'in this day and age', 'having said that..' etc.

One crude measure of obscurantism which has the merit of being quickly and easily applied to any prose passage, is the fog index. One chooses a passage of consecutive whole sentences which is about 100 words long - we set our limits between 90 and 110. The average number of words per sentence is calculated, and added to the total number of words of three syllables or over. In calculating the latter, proper nouns, hyphenated words (unless either part has 3 or more syllables), and verbs with third syllable -ed or -es are omitted. Forty per cent of this total is the fog index. Thus if a passage consisted of 5 sentences totalling 100 words, and contained 10 words of three syllables or over, the fog index would be $0.4(100/5 + 10) = 12$. This, according to the authors of one book*, should be the limit for informative reports. So how does some of our familiar, and compulsory reading material fare on the obscurity scale? The results are below.

Subject	How sampled	Max.	Min.	Mean
SCEEB Higher English	Interpretation passage I, one from each of years 1973 - 77	19	10	16
Ditto O Grade English	As above, one from each of years 1969 - 77	14	5	9
SSSERC bulletins	Introduction - one from each of Nos. 100 - 106	23	12	17
Occasional paper I	5 samples randomly taken	22	14	18
Munn report	One from each chapter	30	15	22
Dunning report	One from each chapter	22	10	16

* Student's Guide to Success, Cassie and Constantine, Macmillan.

Chemistry Notes

The ripples set off by the fire which was reported in Bulletin 97 have not yet died away. Rhodes Flamefast have greatly modified their model 702 burner by replacing the valve using neoprene O-rings with a brass valve. The neoprene rings were subject to deterioration thus giving rise to gas leaks in the base, particularly if the burner had a history of being run in a struck back manner.

Some teachers have recently felt disquiet on reading an article on the hazards of the burner in an Edinburgh University bulletin. We contacted the University's Safety Officer who was certainly concerned about the older model of the 702 but felt that the 701 (which is the popular model) is a satisfactory burner and if properly used with close attendance as would be the case in the school situation should not present any problems. Any school which may have purchased the 702 model, which can be identified by the fact that it has a control valve lever on the base and a pilot jet at the side of the chimney should check periodically for absence of leaks. It is our opinion that this model has little advantage over the 701 and costs approximately four times as much. Further, it may encourage the bad habit of having the gas supply turned off at the bunsen valve whilst the bench tap is left on!

All bunsen burners are potentially dangerous if misused and we would repeat that many of the problems with all makes of burner are associated with the properties of natural gas, namely the stability of the flame and the fairly quiet running of a natural gas burner in a struck back manner. The placing of a small piece of metal gauze over the top of the chimney makes it more difficult to blow out the flame. Clearly if a low flame is required then the air hole should be almost closed before reducing the gas pressure greatly. If a low flame is needed for a continuous period a microburner should be used.

Physics Notes

We have been informed of a misprint in the Teachers' Guide to Sections 1-7 of the revised worksheets for Integrated Science. It concerns one of the energy conversion experiments. A single dry cell is connected to a small d.c. motor, using it to lift a 70g mass. When the weight is allowed to fall the motor, now acting as a dynamo, lights a small lamp bulb. The error is a misprint in the Orbit motor number, which is given as 303 when it should read 505. There is no Orbit motor number 303, but there is a 305 which is too small to lift the weight specified. Orbit motors can usually be found in aero-modelling shops; we got ours from Harburn Hobbies who currently charge £1.35 for the Orbit 505.

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Some time ago the Scottish Centre for Mathematics, Science and Technical Education (as it was then called), published in Memorandum

No. 26, Electricity for O Grade Engineering Science, the statement that the average body resistance from hand to hand is 2 kΩ for d.c. but only 400 Ω for 50 Hz a.c. This raised a few eyebrows here, both at what were thought to be very low resistance values, and at the claim that resistance to a.c. was much lower than to d.c. Both the Centre and ourselves have tried to trace the source of the '400 Ω' claim without success. If it were true, and putting it alongside another statement from Memo. 26, that a current through a vital organ of 20 mA is dangerous, then half our pupils would be at risk if they held the terminals of an 8 V supply, one in each hand.

Our own measurements were carried out using a nominal 12 V supply, asking each subject to grip firmly the vertical rod of two metal clamp stands, one in each hand. The experiment was repeated after rinsing the hands under a cold water tap and shaking off any surplus moisture. We confirmed the result that resistance to a.c. is less than to d.c., but not by the five to one margin quoted. Seven of our ten subjects had a lower resistance to a.c., but on average the ratio of d.c. to a.c. resistance was 1.6 for dry hands, and 1.3 for wet. The mean values for the ten subjects were:

	d.c.	a.c.
dry	31.3	19.5
wet	6.8	5.4 all in kΩ.

The least resistance was 3.2 kΩ, with wet hands on a.c. Using a.c., some of the subjects noticed a tingling sensation in the dry condition. All noticed this when the hands were wet, and some found it sufficiently strong to be unpleasant. There was no report of any sensation on d.c. We are curious as to why a.c. resistance should be lower than d.c., something we have been unable to find an explanation for in the literature. Also it would seem that although the body resistance may in exceptional circumstances (e.g. after a hot bath) drop to a few hundred ohms, in general it is one order of magnitude higher.

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The following itmes of surplus equipment are offered for sale, and will be subject to the usual ballot procedure. We still have many items from previous notices in stock, which we do not have space to mention here, and for which enquiries are invited.

Item 898. Freezer unit; dimensions 40 x 45 x 90 cm high. Capacity 10 trays each containing 44 one inch cubes. £15.

Item 899. Furnace; outside dimensions 45 wide x 83 deep x 60 cm high. Inside dimensions 56 x 19 x 13 cm. A thermal fuse, which could be removed, limits the temperature to 950°C. Pyrometer indicator. £20.

Item 900. Water cooler; dimensions 50 x 55 x 95 cm high (excluding swan neck tap). This unit has a settable thermostat so that it can deliver cooled water at any temperature into a shallow plastic basin which runs to waste. Inlet and outlet are standard pipe threads for permanent plumbing in, inside diameters 15 and 21 mm respectively. £20.

Item 901. Perspex offcuts; 125 x 50 cm clear in various thicknesses, £2; also at half and quarter this size and price. Coloured perspex, £1.50, and patterned perspex, 50p, both

full size only. Specify thickness when ordering, and we will supply the nearest available.

Item 902. Frequency standard, type D-890-A by Muirhead-Wigan. Range 0 - 100kHz x 1Hz on four decade switches and a x10 switch. Accuracy ±1Hz below 10kHz: ±0.2% 10 - 100kHz. Contains internal 2kHz oscillator and 25 mm dia. 'scope for Lissajou figure calibration, with provision for applying an external frequency. Outputs 0 - 30V at 600Ω and 0 - 150V at 8kΩ impedance, and dual range output voltmeter. £15.

Item 903. Frequency standard, type D-650-A by Muirhead-Wigan. Range 0 - 100kHz x 1Hz on four decade switches and a x10 switch. Accuracy ±0.2% below 10kHz; ±2% 10 - 100kHz. Output 0 - 150V, with output voltmeter. £10.

Item 904. Frequency meter, type JT2A by BTH. Large scale mirror-backed dual range indicator 0 - 30 x 0.5 and 0 - 100 x 1 scales. Six switched ranges 0.3 - 100kHz. Accepts sine wave input 0.5 - 300V, and also has photo-cell (OCP71) and lamp head for strobe timing. £5.

Item 905. Ratemeter, as used by Civil Defence. These were originally described under Item 50, Bulletin 39, and are in working order, although we cannot supply the battery or mains adaptor. We do provide a circuit diagram for a suitable power supply which will fit inside the battery compartment. £5.

Item 906. Regulated h.t. power supply providing +300V, 0 - 150mA, and -150V, 0 - 85mA with common earth. £5.

Item 907. E.H.T. power supply, type NE5302 by Nuclear Enterprises. Range 0.5 - 1.4kV on ten position switch, with multi-turn potentiometer and micrometer as fine control, giving 100mV per division. £5.

Item 908. Low voltage power supply, ex equipment: outputs 2 x 24V, and 13.5V, 1A. £1.

Item 909. Geissler tube power supply, 1.6kV a.c. On wooden stand with sockets to fit tube. £2.

Item 910. Chart recorder, type 88 by Rustrak. Dimensions 14 x 13 x 9cm. Motor requires 12V, 30mA d.c. supply. Chart speed 1 in/min. Meter 50μA d.c., 5kΩ impedance. Uses pressure sensitive paper. £6.

Item 911. Standard moving iron ammeter, by Elliott Brothers. Mirror-backed scale 0.05 - 0.5A x 0.005A. Accuracy ±0.5% for 50Hz a.c. Dual range ½ and 1A, selected by shorting links attached to wooden case. £3.

Item 912. Standard ammeter as above, but single range 2 - 20 x 0.2mA 2063Ω resistance. £3.

Item 913. Centre-zero galvanometer, Griffin and George Microid, nominal sensitivity 100 - 0 - 100μa. Adapted for use either as pointer instrument or with lamp and scale. £2.

Item 914. Millivoltmeter and control circuit. Millivoltmeter has sensitivity 1 - 6mV d.c.: blanking cards on the meter pointer operate relays through two photo-cells so that external circuits may be switched if the pointer strays more than 1mV on either side of a settable value. For use on 115V a.c. mains. £1.

Item 915. Vacuum gauge meters, offered for components. Contains large scale 1mA meter, but with logarithmic pressure scale, switches, potentiometers, power supply etc. £2.

Item 916. Trip amplifier, offered for components. These include edge scale (right-hand zero) 1mA meter, multi-turn 1kΩ potentiometer and micrometer scale, regulated power supply, transistors etc. £3.

Item 917. Mains interference suppressor, 2A. 20p.

Item 918. Mains relay, single heavy-duty change-over contact. 25p.

Item 919. Mercury wetted relays, t.t.l. compatible. These have two 1kΩ coils, a magnet, and single change-over contact. A pulse into one coil flips the switch, where it is held by the magnet until the second coil is pulsed, which flops it back again. 10p.

Item 920. Numeric displays, 50 x 90 x 28mm: numerals 23mm high. Each numeral is illuminated by a separate lamp requiring 15V, 100mA. We will supply one or two spare lamps with each order. 30p.

Item 921. Finned heat sink, 100 x 75mm, with 2N3055 transistor. 50p.

Item 922. As above but larger; 150 x 100mm, with 2 x 2N3055 and one 2N3054. 75p.

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In Bulletin 104 we gave an account of how the Philip Harris and Griffin and George scaler/timers could be converted from a decatron to a fully digital read-out, using either numericator tubes or 7-segment displays. We now offer a similar circuit for the conversion of the daddy of them all, the Panax 102ST scaler. Even if the decatron tubes have not gone faulty, this modification is worth making as it means that the first two digits of the read-out are made visible to the whole class. The Panax decatrons are both fitted on plug-in printed circuit boards, and because we have made no alterations to the original circuit, even the most diffident should be encouraged to have a go. At worst, if your home-made circuit does not work you only have to remove a few connections between it and the Panax circuit, plug the decatron boards back again, and the original circuit will still work. We hope that you would not stop there, but get in touch with us to find out what had gone wrong. The cost of conversion, using two 7-segment displays with 0.6 inch high characters, is under £12.

When the cover of the scaler has been taken off, it will be seen that the main circuit board covers all the back of the instrument and that four bolts hold it to the two side panels. These bolts have to be taken out, so that the circuit board can be moved far enough back to allow the decatron boards to be unplugged and removed. Then the main circuit board can be bolted back into place. The conversion circuit can be built on a single piece of Veroboard which bolts to the front panel so that the numeric displays appear in the holes left by the decatron tubes. Two fixing holes will need to be drilled in the front panel; another two, to hold a low voltage transformer, are needed in the right-hand side panel, and two or three small (1mm) holes are needed in the printed circuit board to take wired connections. No more disturbance of the original design is needed.

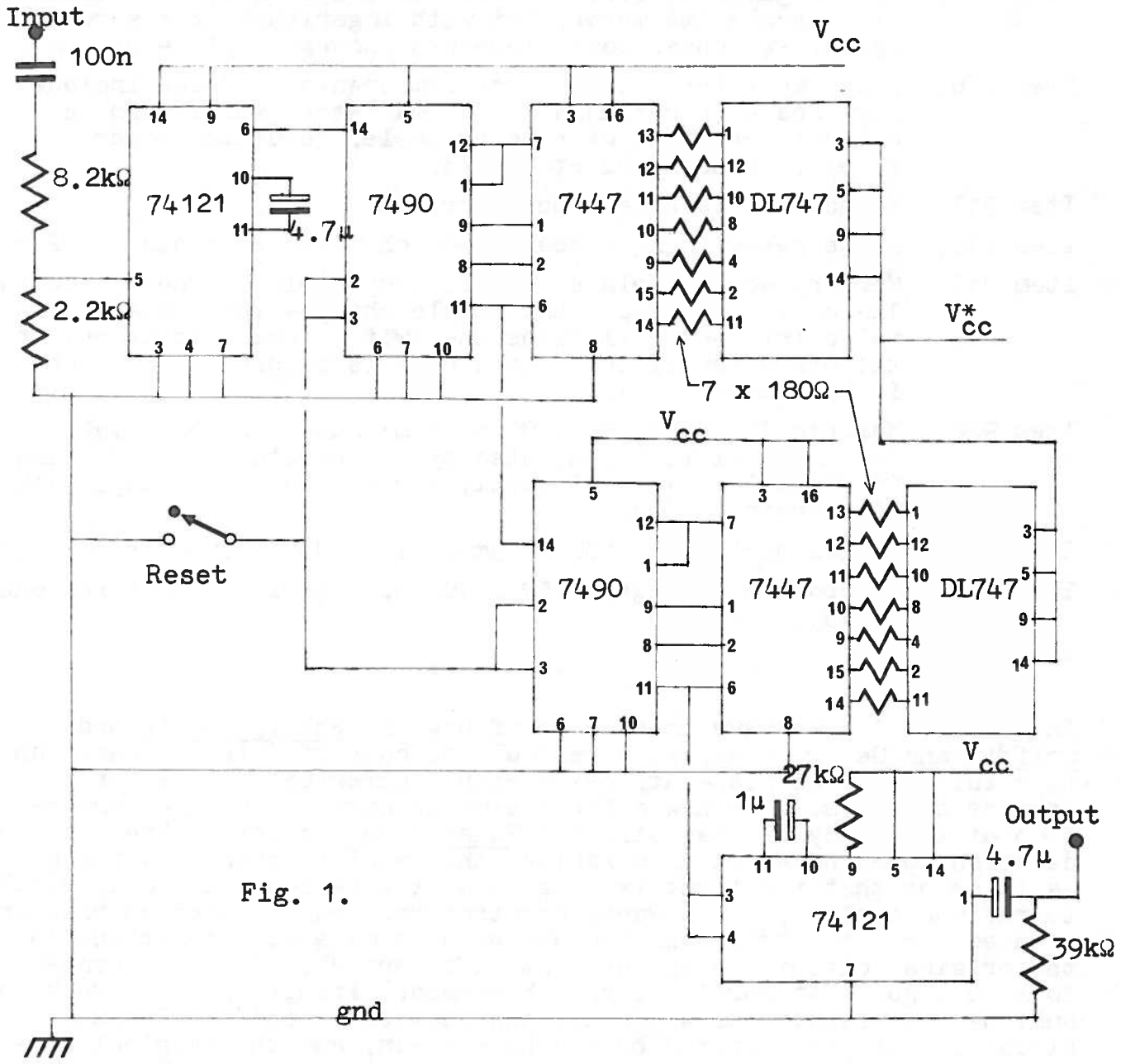

Fig. 1.

The circuit for the conversion is shown above. Only three connections - input, output and ground - have to be made to the main circuit board. Ground is the copper strip running along the top and down both sides of the board; it can be further identified by the printed label "common" at the bottom left of the board. A small hole can be drilled anywhere in this strip where the space on the other side is clear of any components. Input is one of the connections to the left hand plug-in board. These boards are easily identified on the main circuit board by two vertical rows of connections (see Fig. 2a). The middle of the set of five on the left is the one needed. Fig. 2b shows the pattern of the main circuit board in the region of the output, which is at top left of the board. The strip itself is marked CQ4. As the back of the main circuit board has been varnished over, a small area round each of the connecting holes will need to be scraped clean to expose the copper, before a soldered joint can be made.

The only other connections required to make the conversion are

the reset push-button, and the power supply. The reset button has no fewer than six change-over contacts, only one of which is used in the original circuit. Another of these sets of contacts has to be wired so that the reset switch shown in Fig. 1 is normally closed, and opens when the button is pushed. Fig. 3 shows the front view of the layout of the conversion circuit; the large circles mark the location of the decatron holes on the front panel of the scaler. The arrows are not connections but show the direction in which the signal is processed through the circuit.

The original transformer in the scaler has a single 12V winding, one side of which is earthed, and is rated at 0.2A. This is not enough to supply the conversion circuit which requires about 0.5A at 5V, so that we thought it preferable to fit separate supplies driven from a low voltage transformer (RS Components 6VA miniature). There is plenty of space to bolt this to the right hand (as viewed from the front) panel of the scaler, and to build the rectifiers, capacitors etc. on the same piece of Veroboard as the conversion circuit. Because there are two 6V windings on the transformer, and because the variable current drain by the led displays causes regulation problems we used two separate 5V supplies, one for the integrated circuitry, and one for the led displays only. These circuits are shown in Fig. 4.

The table below gives the cost in July of the necessary parts.

Item	Cat. No.	Supplier	Price
Transformer	196-296	RS Components	£1.55
2 rectifiers	261-328	"	0.87*
20 resistors, various	-	"	0.38*
7 capacitors, various	-	"	1.00*
2 SN7447	-	Technomatic	1.40
2 SN7490	-	"	0.66
2 SN74121	-	"	0.56
2 DL747	-	"	4.50
Printed circuit board	434-201	RS Components	0.50*
		Total	£11.42

* Approximate cost.

This cost can be cut by about £4 if one decides to use numericator tubes instead of the DL747 display. We can supply two of these, second-hand, for £1, and there is a further saving because only one power supply is needed. The h.t. to operate the tubes is taken from the Geiger tube 500V supply, which is the lowest of the plug-in board connections in Fig. 2a. The ZM1080 indicator tube is wire-ended, and we suggest sticking it to the Veroboard strip in the correct position for viewing through the front panel holes with Bostik or even plasticene, and soldering the wire ends direct to the strip connections. The finish will not be as professional as if a 7-segment display is used. Only the upper winding and circuit of

Fig. 4 will be needed, and the 12Ω resistor in the power supply should be changed to one of 27Ω, 1W. In either case the conversion circuit board is bolted to the front panel with two spacers on the bolts so that the display fits against the front panel itself.

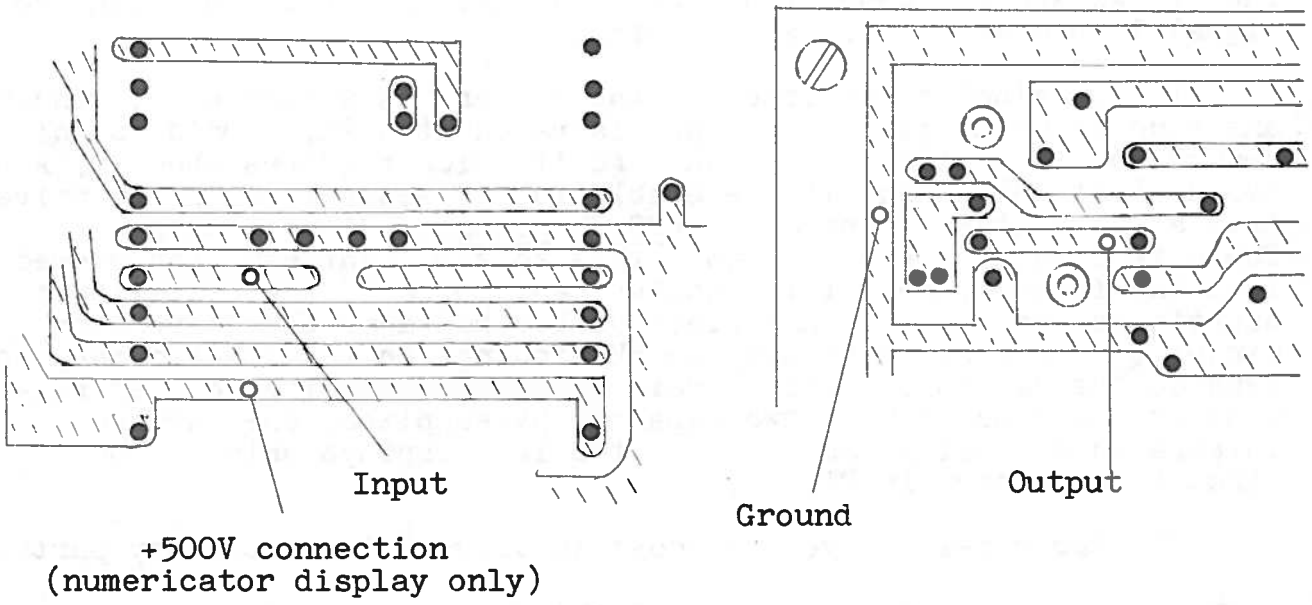

Fig. 2. Main circuit board in the region of the plug-in boards (a), and top left corner (b). Existing soldered connections are shown by dark blobs (●): proposed connections to conversion circuit by circles (o). Hatched areas are copper strip.

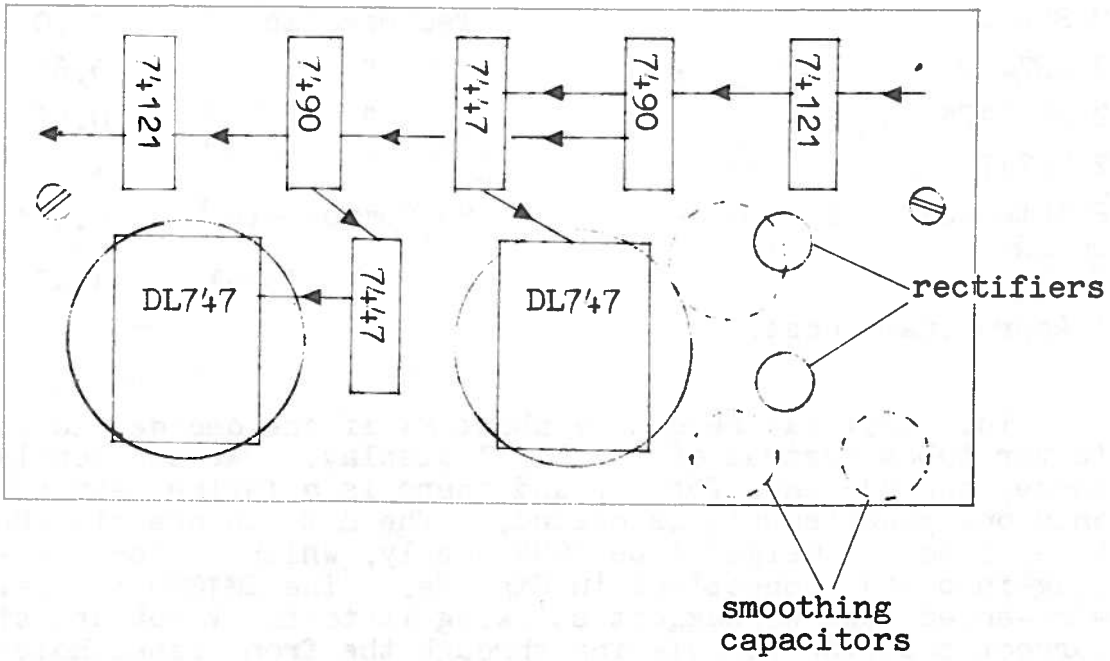

Fig. 3. Full scale layout of conversion circuit, front view. Smoothing capacitors for the power supplies are printed circuit type and are mounted on the reverse side of the board.

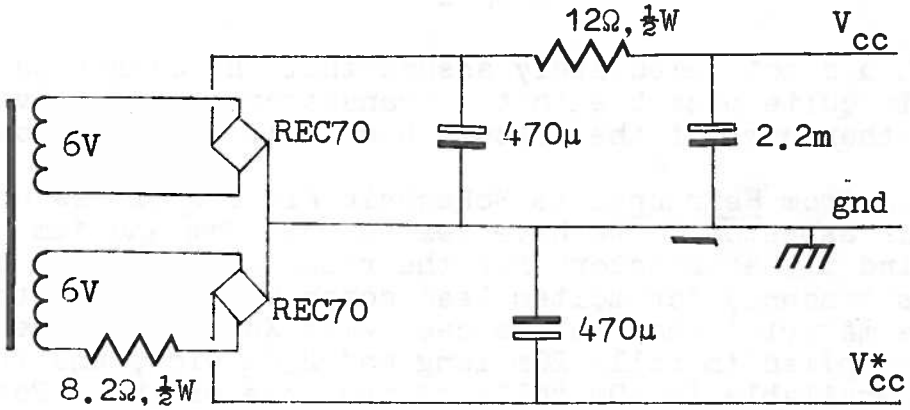

Fig. 4. Power supplies.

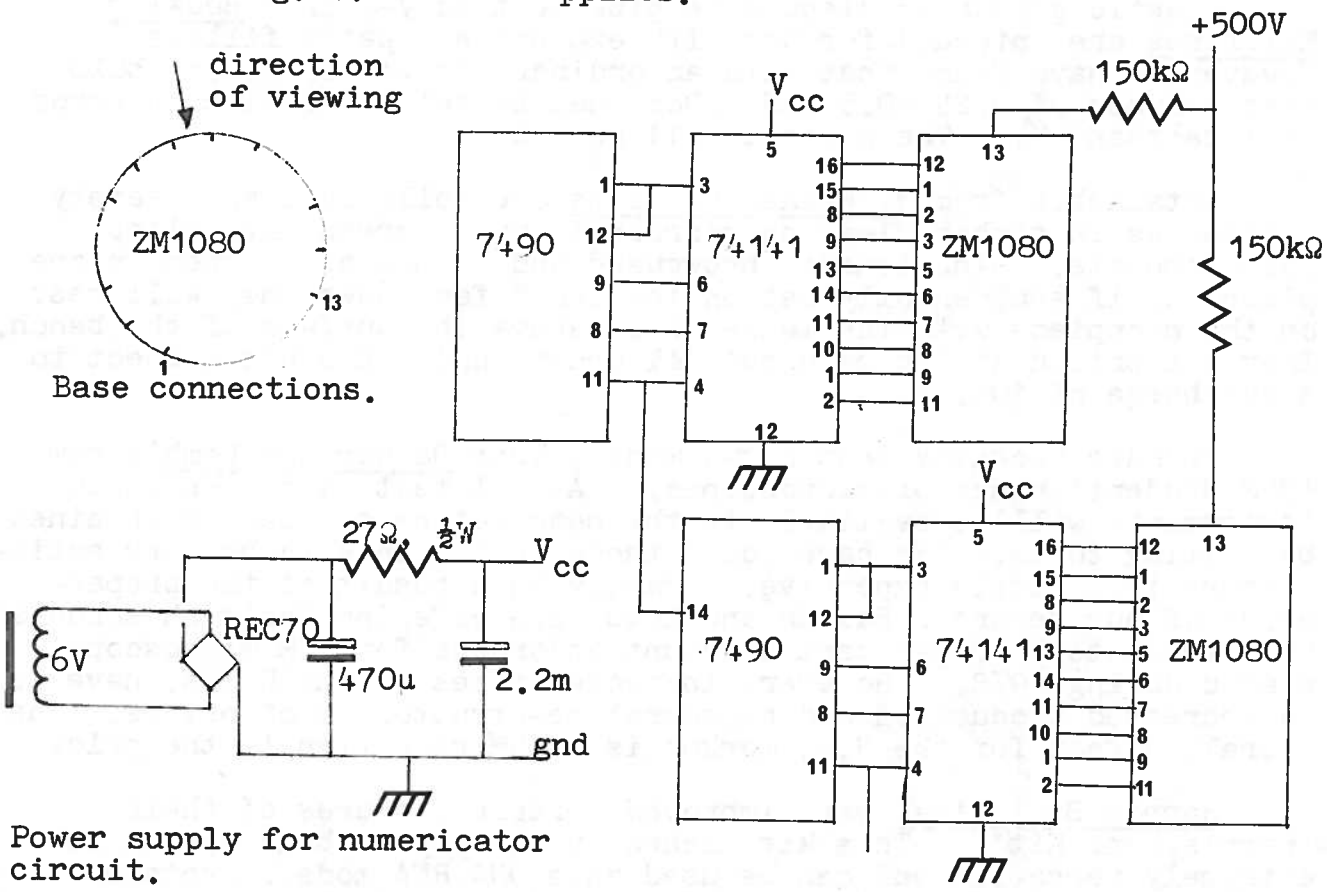

Fig. 5. Alternative circuit termination for numericator display.

Trade News

Following our note in Bulletin 104 of how to convert scalers from decatron display, we have a note from Griffin and George which states that anyone ordering their decatron scaler XKS-300-U will automatically be supplied with a re-designed model which uses numericator tubes. Its catalogue number is XKS-301-010L. Any request to them for replacement Z504S decatron tubes would be treated as a special purchase, and the customer would be advised of the price before the order was confirmed. Philip Harris will supply a digital scaler timer which uses 7-segment leds, if their P67340/2 decatron version is ordered. It costs £107.63 and has catalogue number P67342/6. Incidentally, as a manufacturer has pointed out, if a scaler goes

faulty one should not immediately assume that the decatrons are at fault. It is quite possible that a transistor or a passive component in another part of the circuit has failed to function.

Available from Refracpac is McKechnie Fibre which is another substitute for asbestos. We have tested both 2mm and 1mm thick sheets and find it satisfactory for the reduction of metal oxides. There is less tendency for molten lead compounds to "melt their way through" this material than is the case with Kaowool. The 1mm thick material is supplied in rolls 20m long and 25mm wide, and the 2mm thickness is available in 10m rolls of the same width. Both sell at £1.70 per roll.

Plastic graduated disposable pipette tips V-4 from Buckley Membranes are intended for use with expensive pipette fillers. However we have found that with an ordinary rubber or p.v.c. bulb teat volumes of 0.25, 0.5 and 1.0cm^3 can be delivered with an error of less than 5%. The price is £11 per 500.

Obtainable from W. Walker and Sons are Bolle Coverspec safety spectacles in either clear polycarbonate or in green anti-glare polycarbonate. The lenses, browguard and frames are shaped in one piece and if accidentally set on the bench face down they will rest on the nosepiece with the lenses kept above the surface of the bench. They are priced at 78p each but all orders under £10 are subject to a surcharge of 10%.

We have recently tested two models from Bausch and Lomb's new 'HSM Student' range of microscopes. A full test report on these instruments will be available in the near future and can be obtained by writing to us. We have found these instruments to be very satisfactory if a little expensive. Partly as a result of the preparation of our reports, Bausch and Lomb were offering Scottish schools an introductory 10 per cent discount on orders for HSM microscopes placed during 1978. However, increased sales in the U.S.A. have led to increased production and a general re-structuring of prices. The overall effect for the U.K. market is a 15% reduction in the price.

Harris Biological have improved certain features of their 'Harris Gene Kit'. This kit, based on the poppet bead system is extremely versatile and can be used as a DNA/RNA model, protein synthesis model, demonstration of mitosis and meiosis, chromosome aberration model, gene pool and population genetics model. It is claimed that the kit can be adapted for use from elementary through to advanced levels and is designed for student use as well as for demonstrations. The kit, with teaching notes, Cat. No. M89101/7 is priced at £15. A fully descriptive leaflet is also available.

We have recently tested an Olympus CH microscope from Griffin and George. Although we found it very satisfactory we do not intend to produce a test report because at £170 for the basic instrument, we think this too expensive for schools to purchase on a pupil scale. However it could be of interest to those seeking a teacher demonstration instrument or a student microscope for college use.

Largely because the cathode ray tube is no longer being made, Tektronix have ceased production of the Telequipment Serviscope Minor. This means that the only small oscilloscope for pupil use now on the market is the Unilab 032.601 at £83.60. Tektronix hope that service parts for the Minor may be available for another ten years.

Bulletin Supplement

Summary of stereo-microscope tests. The instruments shown below were tested according to our published procedures. Individual detailed reports on these instruments can be borrowed for up to one month by writing to the Director. The overall assessment classifications are: A - most suitable for use in Scottish schools; B - satisfactory: C - unsatisfactory. All measurements given are in mm.

Model	Swift M14T stereo-magnifier	Swift M19T	ASV
Supplier	Pyser Optical	Pyser Optical	Opax
Price	£39.50	£76	£75
Magnification (claimed)	x15; x30	x20	either x10 or x20
Change mechanism	by changing eyepieces	none	none
Fields of view	7.2; 6.4	7	16; 8
Working distances	72	75	102; 91
Eyepiece separation	53 - 70	45 - 70	52 - 78
Distortion	B	B	B
Blurring	B	A	A
Lamp	none	none	240V, 15W incident illumination unit at extra cost.
Head adjustment	none	none	none
Weight (kgf)	0.97	1.37	2.0
Assessment*	(1) B (2) C (3) C (4) C**	(1) B (2) A (3) B (4) B	(1) B (2) B (3) C (4) B

* (1) Ease of use: (2) Performance: (3) Versatility; (4) Overall assessment. Assessments 1 - 3 are the results of field trials in Scottish schools.

** Because of an optical and mechanical performance which does not meet our specification for Scottish courses.

S.S.S.E.R.C., 103 Broughton Street, Edinburgh, EH1 3RZ.
Tel 031 556 2184.

Bausch and Lomb Optical Co. Ltd., Lenten House, Lenten Street, Alton, Hampshire, GU34 1JD.

Buckley Membranes Ltd., Chequers Parade, Prestwood, Great Missenden, Bucks, HP16 0PN.

Griffin and George Ltd., Braeview Place, Nerston, East Kilbride, Glasgow, G74 3XJ.

Harburn Hobbies Ltd., 124 Leith Walk, Edinburgh.

Philip Harris Ltd., 34/36 Strathmore House, Town Centre, East Kilbride, Glasgow, G74 1LQ.

Philip Harris Biological Ltd., Oldmixon, Weston-super-Mare, Avon.

Opax Ltd., 142 Silverdale Road, Tunbridge Wells, Kent, TN4 9HU.

Panax Equipment Ltd., Willow Lane, Mitcham, Surrey, CR4 4UX.

Pyser Ltd., Optical Division, Fircroft Way, Edenbridge, Kent, TN8 6HE.

Refracpac Ltd., Beechwood, Fore Road, Kippen, Stirling, FK8 3DT.

Rhodes Flamefast Ltd., Pendlebury Industrial Estate, Manchester, M27 1FJ.

RS Components Ltd., P.O. Box 427, 13/17 Epworth Street, London, EC2P 2HA.

Technomatic Ltd., 54 Sandhurst Road, London, N.W.9.

Tektronix U.K. Ltd., Beaverton House, P.O. Box 69, Harpenden, Herts.

Unilab Ltd., Clarendon Road, Blackburn, Lancs, BB1 9TA.

W. Walker and Sons Ltd., Clydeway Industrial Estate, 8 Elliot Place, Glasgow.