The ASP strikes again

An ASP should be approached with caution, as H. Harper points out in his letter in the March issue. As it is, the ASP has struck again. Unfortunately Mr Harper gives no details regarding his analysis or the transistors used in his experiments. His results are rather misleading if it is assumed that transistors belonging to the class of popular small-signal audio transistors are used in the circuit. Typical examples are the BC107, BC109, BC169, BC257, etc.

Before I advanced the approximate analysis in my letter in the January issue, an exact analysis of the circuit shown in Fig. 1 was made. Approximations were made only after an experimental investigation. With the equations given, results should be within a 30% margin of error, which is not too far off the mark if all approximations are taken into account. The basic assumption was made that transistors with small values of h_{re} would always be used. I quote the following experimental results, which were obtained from the circuit shown in Fig. 1 — essentially the same as the circuit in my previous letter. A BC257A was used for Tr_2, and five different BC169Cs for Tr_1.

Using the approximate formula and manufacturer's data, the limits of the voltage gain using these transistors was calculated as approximately $600 < |A_v| < 2200$.

The following are the measured results with a 1mV r.m.s. input voltage:

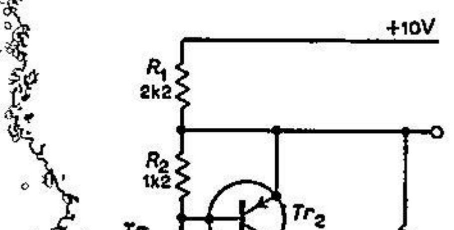

Fig. 1.

1. Voltage gain

frequency: 1000Hz

transistor Tr_1:	a	b	c	d	e
output V r.m.s.	1.45	1.15	1.54	0.90	1.40
voltage gain:	−1450	−1150	−1540	−900	−1400

2. Frequency response

frequency (Hz)	100	1k	10k	80k	100k
output V r.m.s	1.39	1.40	1.40	0.99	0.88
| voltage gain |	1390	1400	1400	990	880

Because Mr Harper furnished few details, I am at a loss to explain why his measured values were so low.

Referring to the case where the collector resistor of the transistor Tr_1 is connected to the 10-volt line, maintaining the same biasing levels and with no resistance in the emitter circuit of Tr_1, the voltage gain of the circuit is given to a good approximation (assuming h_{re1} is small) by

$$A_v = -h_{fe1}R_2/h_{ie1} \approx -g_{m1}R_2 \approx -I_{E1}R_2/25.$$

With the transistor Tr_1 biased at 0.5 mA, this comes to −20, as measured by Mr Harper, and not to −9, as predicted by his computer analysis.

Although the circuit could conceivably go into a state of oscillation when driving a capacitive load, and with the base of Tr_2 capacitively loaded, I have never experienced this in normal applications.

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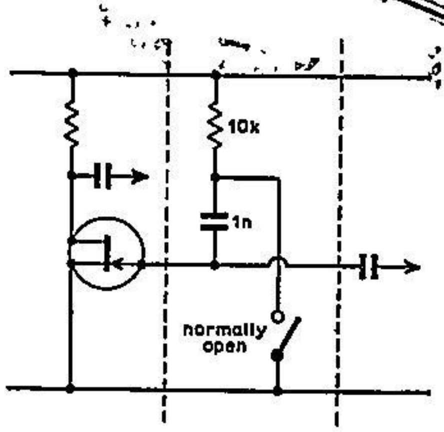
South Africa.

Voltage-controlled oscillators

Having a requirement for a voltage-controlled oscillator I constructed a 'lash-up' of circuits 2 and 4 of D. T. Smith's article 'Multivibrators with Seven-decade Range in Period' (February issue). Using 2N5458 (MPF 104) devices for the f.e.ts it was found that the oscillators were not self-starting, but required a negative-going pulse to one of the gates to trigger it. It was further found that if the input voltage was not limited, the circuit would 'latch-up'.

The addition of a resistor, capacitor and switch to one gate circuit, as shown, was found to be sufficient to start and restart the oscillator. The resistor and capacitor alone were sufficient to provide self-starting on switch-on, the switch only being necessary to re-trigger the circuit should the control voltage be allowed to get out of hand. Once started the circuit proved to be quite suitable for the function required of it.



Mr Stiles' addition to Mr D. T. Smith's circuit.

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Somerset.

Automatic telephone exchange

I would like to thank Mr P. F. Gascoyne and Mr N. Monk for their useful comments (April issue) on my design of an automatic telephone exchange (February issue). They have both criticized the power supply section, and I feel I should clarify the situation.

The first point is to assess the merits of using the switched power supply as in my original circuit, or to have a 'permanently on' power supply as suggested by Mr Gascoyne. Both methods have their advantages, and I based my original decision on the expected use of my exchange. Since there were liable to be prolonged periods of inactivity, I felt that a switched power supply would be most suitable. In practice this has worked very well, particularly as the small auxiliary battery lasts over a year. However, if heavy use of the exchange is expected, then perhaps a simpler 'permanently on' power supply would be more appropriate.

Mr Monk is correct to draw attention to the possibility of getting a shock from the mains switching relays. This danger can be avoided by ensuring that the exchange is adequately housed, and that the mains is switched off while it is being handled. Alternatively the contacts could be shielded by commercially available dust covers. More important is the possibility of mains contacts shorting with low-voltage ones. This is indeed possible if they are both wired into the same springset. However, the type 3000 relay has two sets of springs contacts side by side separated by a porcelain insulator; by using one set for mains only and the other set for low-voltage, the danger is overcome.