

IDEAS FORUM

On a number of occasions I have found that no-one makes quite the component I would have liked for an application, and that the design solution turns out to be disappointingly complicated for no other reason. Often in such a case the device could be a Schottky t.t.l. or c.m.o.s. i.c. and would simply be a rearrangement of on-chip components or gates already well-proven. This means that development of the chip should not pose any serious problems and the device could be manufactured easily enough.

This letter has been triggered by one such example. I am currently designing some equipment involving logic working from a +5V supply, and some audio circuits. To keep costs down, the audio circuits use $\pm 5V$ supplies, requiring only the addition of an extra fairly small -5V supply derived from the same centre-tapped transformer secondary. The logic controls the audio by c.m.o.s. switches, either 4016 or 4066, with V_{DD} and V_{SS} at +5V and -5V.

Now the rub is that level shifters are needed to translate Schottky t.t.l. signals to $\pm 5V$ logic swings needed by the analogue switches. This is not terribly hard; a p-n-p transistor and three resistors do the job (Fig. 1), but this niggles the switches themselves, and the number of them — four transistors and 12 resistors per switch package — increases manufacturing costs.

What makes the situation most frustrating is that the i.c. manufacturers have themselves already solved the problem elsewhere in the 4051, 4052, and 4053. These i.c.s are cheap, and contain 4066-type switches and level shifters which do exactly the job I need done. They also contain a few gates, but that is not too relevant to this point, except that gates can also be included easily.

The conclusion is obvious. Take a 4066. Put it in a 16-pin package instead and add the third V_{EE} power supply pin and level shifters. This leaves one pin spare, and the only remaining question is what to do with it (leaving pins unused is in my view a crime). It is not necessary to look very far for a solution to this! Some of my switches are controlled directly by microprocessor output port bits. If the switch i.c.s also contained transparent input latches with the remaining pin as a strobe (active low to connect directly to the address decoder), they could interface directly with the data bus and save me the cost of a port register as well! For situations where the switches are to be controlled directly by the input lines, the strobe is simply tied permanently low.

Thus arose my invaluable but cheap, and unfortunately imaginary, analogue switch i.c. (Fig. 2), with d.c. specification basically those of the 4051/2/3. They'd sell millions, and I could have been happier.

All this brings me to wonder how often other *WW* readers have had comparable thoughts in different applications, and whether *WW* could usefully serve both i.c. manufacturers and users by providing a forum for such ideas, perhaps as an extension to the Circuit Ideas columns. I would love to hear comments from *WW*,* its readers, and the manufacturers on this.

Finally, in fairness to Analogue Devices, I must point out that the AD7590 does pretty well exactly the job mine does, but compared with 4000-series switches it is a relatively expensive high performance device capable of operating from $\pm 16V$ supplies.

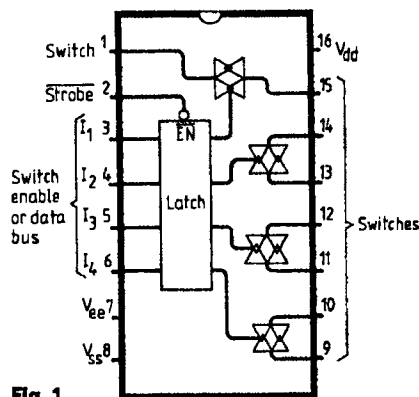


Fig. 1

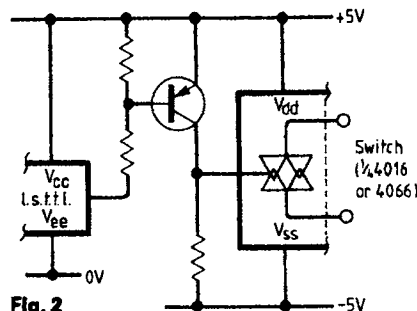


Fig. 2

Alan Robinson
London N11

* We will gladly collect together readers problems, and solutions where proffered, in a regular way given encouraging response — ed.

CLASS S

Mr Allinson's interesting letter (December) raises several points. I deal with them under his numbering.

1. Another altogether different class S may have been invented by B. D. Bedford in 1932 but neither I nor anyone I know had heard of it. As recycling and conservation is now in fashion I suggest that we recycle Mr Bedford's class S and associate the name with my circuit on the grounds of under-utilization!

From Mr Allinson's description the Bedford circuit sounds like class C with a filter added, hardly worth a class name to itself.

2. A2 may be a variant of the Howland circuit but it is novel, although the really novel feature of the scheme is the paralleling of the voltage and current drives to a load for the first time. However as now appears the voltage amplifier, far from being irrelevant, is vital.

3. Because the voltage source with its very low impedance is connected directly to the non-inverting input (my Fig. 4), A2 has no positive feedback applied to it. It is thus inherently stable.

4. Mr Allinson's figures of an improvement of 280 times or 49 dB runs counter to his general argument and strongly support the worth of the scheme. It is quite true that during the crossover region the load seen by A1 drops to about that of the load proper. But provided that the voltage amplifier can handle this i.e. that its output impedance is low, a quite achievable target, the spikes can be negligible. There is of course nothing to stop A2 being designed with less crossover distortion. Contrary to the belief of British industry's managers, we design engineers have to pay our telephone bills in cash and

even eat sometimes and so commercial considerations stop me publishing an improved and more practical class S circuit!

5. This in the conventional sense is not a multiloop amplifier. Finally I stand by my equations which clearly show that the problem of distortion can be pushed onto the voltage amplifier with all the advantages this has.

A. Sandman
London NW3

FREE SATELLITE TV?

When satellite television finally arrives, and I point my dish skywards, and only watch foreign broadcasts, will I still need to take out a licence?

Logic tells me "No, of course not", but a lifetime's experience of paying taxes on this sceptred isle makes me hazard a guess that I'll be required to take out *not one* — but *two* of them!

Douglas Byrne
Ryde, IoW

HERETICS GUIDE TO MODERN PHYSICS

I would like to echo M. G. Wellard's approval of the open-minded attitude taken by Dr Murray in his articles. I think, though, that he (Wellard) is being somewhat hard on Cerenkov and, for that matter, the Nobel Award Committee, my understanding of the situation is this. The speed of light is

$$c = \frac{1}{\sqrt{\mu_0 \epsilon_0 \epsilon_r}}$$

For light in free space, μ_r and ϵ_r are unity. This is the value for c used in the calculation for relativistic mass, and so on.

In the case of a medium other than free space μ_r and ϵ_r are greater than unity resulting in the speed of light through that medium being reduced.

This means that a particle can travel through that medium faster than light can without violating relativity.

It seems straightforward to me, or is this kind of idea going to come under the scrutiny of Dr Murray?

B. D. Runagle
Burton on Trent

Several readers rose to the defence of the "crank Cerenkov", and I must apologise for drawing them into my private war with the Establishment. They all gave the official explanation of why the Cerenkov effect does not invalidate special relativity. B. G. Bainbridge, B. J. C. Burrows, F. MacAlister and K. Wood all wrote briefly. J. S. Lindfoot hopes being a heretic will not exempt contributors from the standard of competence expected from others. D. Rawson-Harris dealt at some length with Dr Murray's Heretic's Guide.

My letter was a reaction to a book I had read through several times very carefully. The book, Fiction Stranger Than Truth, is published in Australia by N. Rudakov. The Fiction of the book's title is Einstein's theory of special relativity. Rudakov has dissected Einstein's 1905 paper with the skill of a surgeon, phrase by phrase, sentence by sentence, and equation by equation. His book is not suitable reading for ardent Relativists. He begins with a comprehen-

sive analysis of the Establishment's success in repressing all forms of criticism of its heroes and their theories, and he has collected, over a period of many years, more than enough evidence to show that the physics Establishment is in the hands of ideological extremists. Rudakov cites a review of H. Aspden's book, *Modern Aether Science*: Aspden is a crackpot, it says, and his book should not be acquired by libraries.

As Rudakov mentioned the Establishment's treatment of the late Herbert Dingle, I have since read Dingle's book *Science at the Crossroads*. This is a chronicle of Dingle's failure to extract from individual members of the Establishment, a simple answer to a simple question. His last failure was recorded in *Wireless World* July 1981 under the name of Wilkie. I first suspected the Establishment might be exhibiting symptoms common to all totalitarian states when I read in *Relativity and Time Signals* by L. Essen (*Wireless World*, September 1978) "The theory is so rigidly held that young scientists who have any regard for their careers dare not openly express their doubts." McCausland, in his comments accompany Dingle's article (October 1980) mentioned the "special provision" of editors of journals swearing allegiance to the Establishment, and quoted an article by Davies "Why Pick on Einstein" published in *New Scientist*. The *New Scientist* later published a short article summarising letters arising from Davies's article, headed Einstein 6, Cranks 1. We are the Greatest! I have deduced from a study of the behaviour of the Establishment of a country under the control of political extremists, that suppression of criticism is scientific proof that the theory — that the man in charge is there for the benefit of his charges — is seriously flawed, and I can only assume that the physics Establishment is suppressing criticism for the same reason, and is not defending a scientific theory at all. Herschel and Babbage formed the British Association in 1833 to destroy the corruption of the Royal Society. A repeat performance is overdue. *Wireless World* is now the only outlet for criticism of modern theory.

I have already given a simple mathematical analysis of special relativity based on Fourier's theory of dimensions, in my appreciation of Maxwell. Maxwell began his *Treatise* with an explanation of Fourier's theory, and in his chapter headed Dimensions of Electric Units, he analysed his electric and magnetic units, their products and ratios, into the three fundamental units of mass, time and length to show that the number of electrostatic units in one electromagnetic unit had the dimensions of a velocity, the velocity of light in free space. I cannot see how Maxwell could have developed his equations without the assistance of Fourier's theory. Using Fourier's theory, every quantity and equation of relativistic dynamics is absurd, and at least one third of Nobel Prizes for physics were awarded for theories and discoveries that cannot possibly fulfill Nobel's motive for his endowment. Cerenkov discovered his effect in 1934, but he had to wait 24 years for his prize because he was dismissed as a crank until someone amended Relativity.

Einstein attempted in his theory to justify Michelson and Morley's interpretation of their experiment, which implied that light did not obey Newton's laws of motion. Helmholtz had proved mathematically that the law of the conservation of energy could be derived from

Newton's laws of motion. This is why Maxwell insisted that electromagnetism was a dynamic science, and why he succeeded in constructing a mathematical working model of his ether using the equations of dynamics. Therefore Maxwell's equations predict that light obeys Newton's laws of motion. But Michelson and Morley implied that it didn't, and they also implied that light did not obey the law of the conservation of energy. The simplest way to avoid conforming to Newton's laws of motion is to vary the dimensions of the fundamental units of time and length.

There are two possible explanations of Michelson and Morley's interpretation of their experiment. Either light suffers a temporary loss of kinetic energy when passing an observer, or the observer loses kinetic energy when passing a wave of light. As Einstein could only predict the velocity of light he chose the first explanation. His measuring rod represents the dimensions of the fundamental unit of length and the time between each tick of his clock represents the duration of the fundamental unit of time. There is a reason why he chose to multiply the dimensions of the fundamental unit of length by Lorentz's factor $\sqrt{1-(v/c)^2}$, which is less than one when you move, and divide the duration of the fundamental unit of time by the same factor. A velocity has the dimensions of L/T, and if Einstein reversed his mathematical operations, the velocity of light would increase. Special relativity is a very simple theory. An observer is forbidden to travel at a velocity in excess of that of light, because light would then travel backward.

The formula given by B. D. Runagle is due to Maxwell. The value of the quantity ϵ has been inverted in the SI system of units. Maxwell would have expressed this equation (squaring both sides) as $c^2 = \epsilon/\mu$ in free space. ϵ is the ratio of the electromotive intensity E, to the corresponding electric displacement D. Maxwell called this ratio "the coefficient of electric elasticity of the medium" (Art. 60 of his *Treatise*). This coefficient varies inversely as the specific inductive capacity, k. The electromotive intensity E is by analogy the stress in an elastic medium which produces a strain, the electric displacement of the medium, D. The ratio $E/D = \epsilon$ is the electrical equivalent of the mechanical ratio, stress/strain = Young's modulus of elasticity. μ is the ratio of the magnetic induction B to the magnetic force H, and represents the density of the electromagnetic medium. Magnetism is a flywheel effect of the medium with an electric current as its axle, and any change of the medium's density would change the flywheel moment of inertia. The equation $c^2 = \epsilon_0 \epsilon_r \mu_0 \mu_r$ tells us that the square of the velocity of light is directly proportional to the electromagnetic medium's elasticity or pressure, and inversely proportional to its density, just as the square of the velocity of a sound wave is directly proportional to the air pressure and inversely proportional to the air density (see equation 4 of Aspden's *Ether* article, October 1982). The energy of the air at every point of a sound wave is half kinetic and half potential. In Art. 792 Maxwell proved mathematically "that at every point of the wave the intrinsic energy of the medium" is half kinetic and half potential. Presumably Maxwell as a crank.

I cannot understand the scientific meaning of the phrase "a medium other than a vacuum", if there is no medium in a vacuum. If light passes

through a vacuum under the influence of a negative electrostatic field, light's velocity exceeds that of its 'constant' velocity in a vacuum, and a vacuum under the influence of a positive electrostatic field reverses this effect. If light passes through a hollow electromagnet in a vacuum in the same direction as the flow of the magnetic flux, the apparent velocity of light is in excess of its 'constant' speed. If light is directed against the flow of magnetic flux, its apparent velocity is below its 'constant' speed. This is a Doppler effect caused by the kinetic energy of a moving medium. Both ϵ and μ are ratios. Why then should the suffix r apply to a medium, and the suffix o apply to nothing, when their difference merely depends on changes of E, D, H and B? Maxwell said in Art. 428: "Magnetic induction is a directed quantity of the nature of a flux, and it satisfies the same conditions of continuity as electric currents and other fluxes do." The equation of continuity was discovered by mathematicians investigating the motions and strains of liquid media. To legitimately apply an equation of continuity to a system, a scientist should first be satisfied that a system has a continuous supply of a medium. The only medium to satisfy Maxwell's conditions is Aspden's continuum of positive electrostatic potential energy, if the word 'positive' is used to avoid all ideas of negative quantities.

Fiction Stranger Than Truth is available from the publisher, N. Rudakov, PO Box 723, Geelong, Vic. 3220, Australia. Price, including p&p Australian \$12.

M. G. Weiland

IMPACT OF THE PHOTON

Dr Scott Murray (Impact of the photon, *WW* October) believes that a single photon of radiation is unable to produce interference with a later arrival. He might be right. No doubt the experiment of G. I. Taylor would be worth repeating with modern equipment.

However, I see no reason why successive, single, photons shouldn't produce interference effects. To produce interference one uses an interferometer (or a simple doubly-reflecting system) in which the two interfering beams have

- (a) zero longitudinal displacement
- (b) zero lateral displacements
- (c) zero time displacement.

It is well-known that interference between two beams of radiation can still be obtained if (a) isn't quite satisfied, namely, if the two beams aren't quite the same lengths. In the case of light, the interference fringes look 'washed out' the blacks aren't quite black and the whites aren't quite white.

It is not so well-known that interference can still be obtained if (b) isn't quite satisfied, namely, if the two equal beams are laterally displaced. In the case of light, the fringes again look washy.

It doesn't appear to be known whether interference can take place if (c) isn't quite satisfied, namely, if any two photons don't arrive at their rendezvous at the same instant. My guess is that when Taylor made his experiment the disturbance of one photon lasted long enough to cause interference with its following photon.

In my opinion, if the above interference experiment were repeated with a stabilized laser as light-source, and sufficient time was allowed for

a single photon's disturbance to die away before the arrival of its successor, then and only then will Dr Murray's prediction come true.
A. H. Winterflood
London N10

Ideas about the fundamental nature of e.m. radiation, electromagnetism, the ether, elementary particles and so on become ever more diffuse. Contributions to *WW* over several years by Jennison, Wellard, Aspden and others are all fascinating but leave many of us lesser mortals more confused than ever. So many of the conflicting views seem eminently reasonable, at least until the next one comes along!

The latest by Aspden and Scott-Murray, (*WW* October, 1982), are likely to fuel the fires of the duality argument, i.e. waves vs photons. A unifying theme might possibly arise from phase-locked cavity research at the University of Kent, (*WW* June, 1979). Professor Jennison's enormously impressive work does however seem to require an acceptance of relativistic concepts which may be claimed by some physicists to involve paradoxes which are difficult to resolve.

Perhaps someone (possibly Prof. Jennison?) might agree to draw the threads together and show in summary form how these differing ideas could be reconciled or, at least, how they may have common ground. The last may be the most important; quite possibly each of the learned contributors has glimpsed a little bit of the truth. For example it does seem possible that phase-locked cavities could co-exist with Aspden's ether, the last mentioned perhaps providing a reason for the finite and specific value of the velocity of e.m. propagation in space. Adopting a "Machian" approach, should we not after all suspect that "c" can only be due to the presence of space and therefore to some property it must possess?

If one accepts the remarkably elegant and persuasive arguments for p-l cavity electrons, is it not probable that all fundamental particles are similar, though presumably having differing trapped radiation frequencies? In this event the inertia of matter and what we call mass (i.e. the inertial behaviour of matter), are both explainable in terms of the internal mechanistic properties of the constituent particles. Where then does this leave gravity? That delightfully vague concept of the distorting effects of mass on the enveloping space no longer seems tenable. Mass as such is not even real any more, it is simply a symptom of inertia which is an inevitable property of a p-l cavity!

Thus p-l cavities perhaps need either so that the trapped radiation fields can somehow interact with the surroundings to generate distortions which the relativists would presumably regard as distortions of space (the ether?), caused by the presence of mass. If these distortions could be shown to propagate, that may be gravity!

The possible existence of a family of p-l cavities having differing though specific sizes also needs to be explained. Does the presence of one size cause interactions with the surroundings which will give rise to another size; the specific sizes perhaps being influenced by whatever determines the specific value of "c"? Finally, with a family of p-l cavities, do we say that the smallest must be the ultimate fundamental particle? It would be ironic if this turned out to be a photon!

All this is very amateurish and speculative you may say. But then, can you do any better? If I have to believe in an expanding universe, I

would at least prefer whatever is expanding to have some definable properties!
M. G. T. Hewlett
Midhurst
W. Sussex

ELECTRONIC IGNITION

Following recent correspondence on CD ignition systems, readers may be interested in my experience. I built a kit (Jermyn Industries) in 1973 and fitted it to my Vauxhall Victor FD, then one year old. I have had no faults or failures. Starting has always been at first touch. Hence batteries have lasted well, my third being bought last winter.

No electronic or electrical maintenance has been needed. A garage once replaced the contacts by mistake so I am on set number two. From time to time I reset the gap and check timing. The gap needs no cleaning and shows no wear. Plugs also last well but have been replaced after an estimated 20,000 miles use.

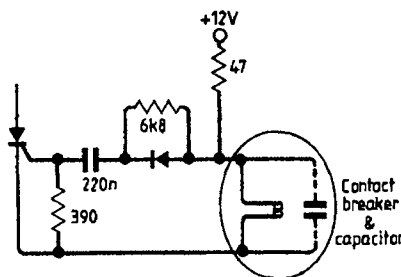
The real message after nine years is reliable starting requiring virtually no maintenance for an outlay of around £10.

J. M. Osborne
ILEA South London Science Centre

With reference to electronic ignition, the question of misfiring at certain engine speeds has been mentioned from time to time.

I found misfiring was due to the inverter oscillator locking in frequency, at various multiples of the ignition firing occurring when the oscillator would "pull" no more and changed, or tried to lock to the next notch. At these specific speeds the oscillator tended to "hunt" and spikes in the system degraded the firing pulse.

I used mostly 40506 thyristors in the few units I built, and theoretically a very small capacitor can couple enough energy to fire these. However, given a cause I up-rated the coupling values until the problem disappeared. I trust this may be of some help to others with the same problem.



G. Pirie
Craigavon
County Armagh

Mr Watkinson could not be aware of all the facts when he wrote his letter (*WW* November). I should be obliged for the opportunity to set the record straight and to correct some false impressions.

I had not hitherto regarded main distributors as normal retail channels of supply; nevertheless I extended my enquiries to them for the specified i.c. These included Quarndon Electronics who offered 54LS01J in lieu of SN5401J within a reasonable minimum order value of £5. It was soon apparent to me however

that to buy the i.c. on its own (I had already acquired TIL31 and TIL81) would make it a relatively expensive component. Taken together with the cost of catalogues, postage, etc." incurred during my enquiries (expenditure which, incidentally, would have enabled me to replace the conventional points several times over) I concluded the opto-electronic contact breaker could not be a cost-effective addition to my 4-cylinder car. It was a simple economic decision to abandon it (for the present at any rate) and did not imply any criticism of the author's choice of the component.

On the other hand, if Mr Cooper's ignition unit was to remain cost-effective, as he obviously intended it should, I considered it advisable to find a source for the transformer he specified without the hassle and expense involved in shopping for the SN5401J. It seemed at the time to be a sensible action to seek this timely direction. In the light of the reaction it has provoked I am now not so sure. Needless to say, Mr Cooper was unstinting in the help he gave. I was particularly gratified to learn that he at least appreciated the difficulties in procurement that can sometimes confront the non-professional.

In the case of the opto-electronic contact breaker, it made little sense to me to publish a circuit in April 1981 and then to follow it up ten months later with a deal of further information in response to "several enquiries" which, in my humble opinion, could have been anticipated having regard to the universal appeal of a circuit with an automotive application. Moreover, if what was stated in February 1982 needed to be said at all, it would have been better, and indeed more helpful, to have said it when the circuit was presented to readers. But as Mr Watkinson so rightly comments, you cannot satisfy everybody all the time. I do hasten to assure him, however, that I was not among those who would presume to question his judgement about components which he regarded as crucial to the reliable operation of the circuit in the hostile environment intended for it. I am sorry that as a result of my letter he should therefore feel it incumbent on him to defend it yet again.

J. E. Stevenson
Purley
Surrey

TAPE VOICES

With reference to Mr Stein's letter in the October issue, the existence of these voices has really been attributed to known physical effects, such as broadcast breakthrough, and people's ability to find form in random noise.

David Ellis has researched the subject at great length under a scholarship awarded by a Cambridge college, and reluctantly found very little evidence for any paranormal happenings. His researches are available in a book *The Mediumship of the Tape Recorder* (ISBN 0 9506024 0 X) for £2.25 from him at Fernwood, Nightingales, West Chiltington, Pulborough, West Sussex RH20 2QT. The book includes practical details which enable readers to perform their own experiments.

Another reference on this subject is by Professor W. R. Bennett, in *Scientific and Engineering Problem Solving with the Computer* (Prentice Hall 1976 ISBN 0 13 795807 2). This is really a book on computing. He mentions the Voices, in an exercise on non-linearity, but an earlier section on generating random text mea-