LETTERS

CABLE AND AMATEURS

As our very good friend Pat Hawker (G3VA) has mentioned on more than one occasion the question of cable tv (c.a.t.v.) being installed for tv links and its possible QRM (interference) to the amateur bands between 5MHz and possible infinity (GHz?) is looming.

With the notification of the RFI Bill 5.929 last September, it would appear that 'we' as the amateur population are dragging our feet somewhat.

Hopefully, as I ask you to publish these few words, someone somewhere, here in the UK at least, will take note to realise that if c.a.t.v. is to progress without (?) problems then parties must get together quickly.

It not only affects the amateur and/or industry-at-large but in some cases the s.w.l. and domestic listener/viewer.

Bear in mind that radio amateurs throughout the world form a substantial part of the balance of payments of varying countries, and after all, not every firm depends on MOD contracts. The naive idea that amateurs 'do not count' according to some professional engineers must be looked at in the light of future and past developments in both radio and tv. In short, what works in theory doesn't always work in practice, so consequently the need for liaison between interested parties, notably the RSGB on the one hand and industry and the Home Office on the other. The RSGB and others are aware of this problem regarding c.a.t.v. and it should not be allowed to drift.

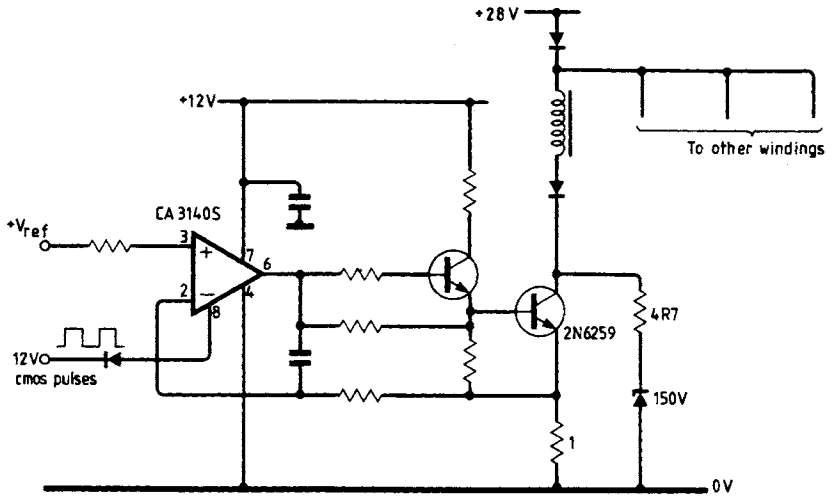
J. A. Holmes, G4LRS
Chingford
London

STEPPER MOTOR DRIVE

The 'Stepper motor driver circuit' article (*WW* February 1983) describes as novel a system which is certainly not new. A t.t.l. chopper drive circuit, while efficient, was found to cause excessive radiated interference (up to 400MHz) when fitted to an aircraft, so I designed a pulsed constant-current circuit using exactly the same principles as in Mr Bailey's article. A simplified circuit is shown below; it is a standard high-power current sink set at one amp. per volt of V_{ref}, and gated by the pulse train to pin 8. One circuit is required for each phase of the motor which in this case is a large V.R. type.

This circuit has been in use since early 1977; I had no reason to suppose it was novel then.

B. S. Beddoe
Wimborne
Dorset



HERETICAL PHYSICS

Those of us who are approaching the age of 80 can hardly bear to wait a month to find out what kind of Newer Physics is going to turn up in the *WW* "Letters". Some of the ideas are so oddly fascinating that it seems a real pity that they cannot all be right.

Attractive though this is, I cannot help remembering the professor of physics who reminded his students that what happened on the lab. bench was real, whereas what went on inside human heads was mostly fantasy, and often pathological fantasy at that.

P. C. Smethurst,
Bishop's Stortford, Herts.

ELECTROMAGNETIC DOPPLER

In your March 1983 issue, your correspondant J. Kennaugh asks how the Doppler shift is produced in electromagnetic waves. Specifically he quotes the relaticistic Doppler equation as:

$$\frac{f_o}{f_s} = \left(\frac{c-v}{c}\right)\left(\frac{1}{\sqrt{1-v^2/c^2}}\right)$$

and asks "what is the physical mechanism which produces the first term?". The "physical mechanism" is the velocity, v.

J. K says that if the wave propagation velocity is the same to both observers then the only possible variable is time. I don't understand why J.K. says this. If two objects are travelling away from each other then the distance between them is increasing.

If one of these objects generates something – say "wave crests" – at regular intervals, and if these wave crests travel through space to the other object, then each successive crest has further to travel and consequently takes longer over the journey. The frequency of arrival is lower than the frequency of departure. If we take the transmission frequency to be f_s and the received frequency to be f_o, the relative velocity between the objects as v and the propagation velocity as c, then for "modest" v a moment's work with pencil and paper gives:

$$\frac{f_o}{f_s} = \frac{c-v}{c}$$

In this equation f_o, f_s, c and v are all measured by the same observer. J.K. says that (c-v) is the velocity of light relative to the observer. Not true. (c-v) is the difference between the rate at which light (or radio waves) cross the gap (c) and the rate at which the gap is increasing (v).

Note that this last equation arises naturally from the definitions of velocity and frequency – no obscure "physical mechanism" is needed.

Another point. If both objects transmit at identical tramsmitter frequency then each will receive a lower frequency (Doppler shifted) than they transmit. At object A, the transmitter frequency f_A is higher than the received frequency from B (f_B) – $f_A > f_B$; at B, by the same process $f_B > f_A$. There is a sense in which $f_A > f_B$ *and* $f_A < f_B$. If you think that this "doesn't conform to the laws of mathematics" then you have three (not two) choices: reject the Doppler effect; reject maths; or find an error in your "deduction".

S. Hobson
Hampton
Middlesex

I have been unable to find the answer to what is superficially a straightforward question: what is the mechanism by which Doppler shift is produced in the case of electromagnetic waves?

In acoustics, when two observers in relative motion observe the same sound wave they measure different frequencies because the wave is passing each at a different relative velocity. If V_{R1} and V_{R2} represent the velocities of observers 1 and 2 relative to the wave then

$$f_1\lambda = f_2\lambda \qquad (1)$$

$$\text{or } \frac{f_1}{f_2} = \frac{VR_1}{VR_2} = \frac{V-v_1}{V-v_2} \qquad (2)$$

Equation (2) is the derivation of the more familiar form of the equation where the relative velocity of wave and observer is expressed in terms of the velocity of propagation in the medium V, and the velocity of the observers relative to the medium V_1 and V_2.

The e.m. Doppler shift equation (3) can be verified experimentally to a high degree of accuracy.

$$\frac{f_o}{f_s} = \frac{c-v}{c} \qquad (3)$$

Now if, as I have seen stated, "similar principles apply" one can deduce two things.

(1) that the velocity of light relative to the observer is c-v, which is in direct opposition to the postulate of relativity which insists that the velocity of light is always c independent of relative motion between source and observer;

(2) that the velocity of light is constant relative to the source, which would provide an ade-

LETTERS

quate explanation of the null result of the Michelson-Morley experiment and would support the corpuscular/photon model of light, photons being "shot" out of matter at constant "muzzle" velocity.

A further piece of evidence supporting (2) is that of star aberration. In 1729 Bradley showed that the apparent direction of a star is actually the vector sum of velocity of the light from the star and that of the earth. It would seem that there is at least some evidence to support the view that the velocity of light is constant with respect to the source and that this would resolve the dilemma presented to physics by the Michelson-Morley experiment. As physics has not accepted this path one can logically assume that there must be overwhelming evidence to the contrary which supports the postulate that the velocity of light is always constant independent of the velocity of the source. I have looked in vain for such evidence: most books seem to manage without any, the only evidence I have found being de Sitters' observation of double stars. If the whole of modern physics is based only on that I think we should all be worried.

The standard technique seems to be to ignore Doppler and aberration, to fudge the evidence in respect of the postulate and dive straight into the mathematics of relativity.

From this appear the relativistic Doppler shift equation and aberration equation. Thus having shown that both are embraced by relativity one never has to ask the questions I have raised. Now the relativistic Doppler equation may be written.

$$\frac{f_o}{f_s} = \left(\frac{c-v}{c}\right)\left(\frac{1}{\sqrt{1-v^2/c^2}}\right)$$

The second term is time dilation, which for modest values of v is equal to unity. My question is what is the physical mechanism which produces the first term which appears to be the ratio of two velocities. If the velocity of the wave is the same to both observers there is effectively only one other possible variable and that is time (note distance can be defined as the distance travelled by a light beam in unit time) so that if the first term is not due to a difference in velocity of wave it must be due to a time difference or time dilation. Both observers observe the same wave. They both observe that it is travelling at the same velocity yet they disagree as to its frequency because their clocks are ticking at a different rate. But whose clock is ticking faster. It depends on which observer is sourcing the beam of light. If both send a beam to the other simultaneously then we get the mathematical absurdity.

$$T_A > T_B \text{ and } T_A < T_B - \text{both true.}$$

This type of "paradox" has been mentioned in *WW* before, but surely either the result must be rejected because it doesn't conform to the laws of mathematics, or the laws of mathematics are wrong, in which case the derivation of the result must be rejected as being based on faulty mathematical laws.

I would welcome any suggestions as to where I am going wrong.

Appendix
Double Stars

For those unfamiliar with this piece of evidence the idea is that if the velocity of light was constant with respect to the source then the light from a star in a binary system which is travelling towards us would tend to overtake that from the star going away from us with the result that their observed orbits would seem irregular. De Sitter observed double stars and no orbital irregularity. I have yet to find out when or where these observations took place, the magnitude of the expected irregularity, de Sitter's measurement accuracy, and why he didn't get a Nobel prize for this obviously vital work.

J. Kennaugh
Cornwall

DIMENSIONS

The arguments which appear in the letters to Wireless World month by month on the validity and meaning (if any), of D and B, E and H, the products of μ and ϵ and the ratio of μ and ϵ, seem never ending. As a student in the late 1940s I was obliged to learn such formulae and their "dimensions" in e.m. units, e.s. units and Gaussian units from the famous text books of S. G. Starling. The apparent duality of e.m.u. and e.s.u. systems and their quaint skew symmetry appealed to the mystics who mused on the inner meaning of the symmetries. At that time the main practical use to me was as a means of checking half-remembered formulae in examinations!

With the introduction of S.I. units, the theory of dimensions seems to have fallen into disuse or was considered 'not quite decent', except in the pages of *Wireless World*.

In the early 1950s, while designing and testing waveguide components, I was very impressed with the frequency with which the expression $(\sqrt{\mu/\epsilon}) = Z_o$ appeared in texts dealing with waveguides and aerials and the concept that Z_o was the characteristic impedance of free space for plane e.m. waves appealed to me. I remember noticing that if one listed such properties as charge, "magnetic pole", electric field, B and D, E and H and so on, with their e.m.u. and e.s.u. dimensions in separate columns, most of the e.m.u. dimensions occured in powers of $\epsilon^{1/2}$ or $\epsilon^{-1/2}$ while the e.s.u. dimensions of that property was usually expressed in corresponding powers of $\mu^{-1/2}$ or $\mu^{+1/2}$.

I then made up a third column in which the dimensions were the geometric means of the dimensions in the e.m.u. and e.s.u. columns, expecting to find an inconsistency, but to my surprise I found this was also a self-consistant system of dimensions in which the "4th dimension" was $(\sqrt{\mu/\epsilon})$, which I have denoted by Z in Table 1. Symmetry was greatly improved. The skew symmetry between e.m.u. and e.s.u. dimensions of analogous magnetic and electric properties had now vanished, so far as ML and T were concerned, and only appeared as opposite sign in the index of Z. I therefore added a 4th column in M,L,T and Y, where $Y=Z^{-1}$. The skew symmetry now reappears, but with no mystery, as *WW* readers have been considering the duality of networks expressed in terms of impedance and admittance for a very long time!

It would now seem that the duality of magnetic phenomena and electric phenomena has a very close affinity to that duality used in networks expressed in Z and Y. At this stage, I discovered that Fitzgerald had known about the M,L,T,Z system of dimensions in the late 19th Century but was unable to identify Z which he regarded as a "slowness" or "retardation" of some kind. So Fitzgerald abandoned the concept. The Z system of dimensions does not derive logically from inverse square laws of forces between magnetic poles and electric charges which many people regard as impossible experiments, anyway.

So far, I have never found any inconsistencies in the Z system outlined here and would be obliged to readers who can point any out to me. I have unfortunately now lost the reference to Fitzgerald's paper which may have appeared in an early series of *Proc. Roy. Soc.* or *Phil. Mag.* in the 1890s. Can anyone help?

It is well-known that despite similarity in the mathematical methods from which they are derived, resistance and reluctance are not analogous electric and magnetic phenomena. This is demonstrated in Table 1 in e.m.u., e.s.u. and also in Z systems of dimensions. I am inclined to believe that more attention should be paid to the nature of Z and the dynamic properties of e.m. radiation, following Maxwell, rather than tackling static properties like $\mu + \epsilon$, derived from impractical hypothetical experiments. A change from mass to 'spin' or 'action' is also interesting for simplifying charge and 'magnetic pole', B + D and flux.

Whether the Z system will throw any light on the problems of your correspondents is incalculable; all I can hope is that by throwing yet another pebble into the pond perhaps some other obscuring ripple may be temporarily cancelled out, allowing a momentary glimpse of the underlying physics before too much mud is stirred up!

E. F. Dawson
Melton Mowbray
Leicestershire

TABLE 1

Property	Dimensions in ESU	Dimensions in EMU	Geometric mean of ESU & EMU $Z=\sqrt{\mu/\epsilon}$	$Y=Z^{-1}$
charge	$M^{1/2}L^{3/2}T^{-1}\epsilon^{1/2}$	$M^{1/2}L^{1/2}T^{0}\mu^{-1/2}$	$M^{1/2}L^{1}T^{-1/2}Z^{-1/2}$	$M^{1/2}L^{1}T^{-1/2}Y^{1/2}$
magnetic pole	$M^{1/2}L^{1/2}T^{0}\epsilon^{-1/2}$	$M^{1/2}L^{3/2}T^{-1}\mu^{1/2}$	$M^{1/2}L^{1}T^{-1/2}Z^{1/2}$	$M^{1/2}L^{1}T^{-1/2}Y^{-1/2}$
electric field E	$M^{1/2}L^{-1/2}T^{-1}\epsilon^{-1/2}$	$M^{1/2}L^{1/2}T^{-2}\mu^{1/2}$	$M^{1/2}L^{0}T^{-3/2}Z^{1/2}$	$M^{1/2}L^{0}T^{-3/2}Y^{-1/2}$
magnetic field H	$M^{1/2}L^{1/2}T^{-2}\epsilon^{1/2}$	$M^{1/2}L^{-1/2}T^{-1}\mu^{-1/2}$	$M^{1/2}L^{0}T^{-3/2}Z^{-1/2}$	$M^{1/2}L^{0}T^{-3/2}Y^{1/2}$
B	$M^{1/2}L^{-3/2}T^{0}\epsilon^{-1/2}$	$M^{1/2}L^{-1/2}T^{-1}\mu^{1/2}$	$M^{1/2}L^{-1}T^{-1/2}Z^{1/2}$	$M^{1/2}L^{-1}T^{-1/2}Y^{-1/2}$
D	$M^{1/2}L^{-1/2}T^{-1}\epsilon^{1/2}$	$M^{1/2}L^{-3/2}T^{0}\mu^{-1/2}$	$M^{1/2}L^{-1/2}T^{-1/2}Z^{-1/2}$	$M^{1/2}L^{-1}T^{-1/2}Y^{1/2}$
μ	$M^{0}L^{-2}T^{2}\epsilon^{-1}$	$M^{0}L^{0}T^{0}\mu^{1}$	$M^{0}L^{-1}T^{1}Z^{1}$	$M^{0}L^{-1}T^{1}Y^{-1}$
ϵ	$M^{0}L^{0}T^{0}\epsilon^{1}$	$M^{0}L^{-2}T^{2}\mu^{-1}$	$M^{0}L^{-1}T^{1}Z^{-1}$	$M^{0}L^{-1}T^{1}Y^{1}$
electric resistance R	$M^{0}L^{-1}T^{1}\epsilon^{-1}$	$M^{0}L^{1}T^{-1}\mu^{1}$	$M^{0}L^{0}T^{0}Z^{1}$	$M^{0}L^{0}T^{0}Y^{-1}$
capacitance	$M^{0}L^{-1}T^{0}\epsilon^{1}$	$M^{0}L^{-1}T^{2}\mu^{-1}$	$M^{0}L^{0}T^{1}Z^{-1}$	$M^{0}L^{0}T^{1}Y^{1}$
inductance	$M^{0}L^{-1}T^{2}\epsilon^{-1}$	$M^{0}L^{1}T^{0}\mu^{1}$	$M^{0}L^{0}T^{1}Z^{1}$	$M^{0}L^{0}T^{1}Y^{-1}$
magnetic reluctance	$M^{0}L^{1}T^{-2}\epsilon^{1}$	$M^{0}L^{-1}T^{0}\mu^{-1}$	$M^{0}L^{0}T^{-1}Z^{-1}$	$M^{0}L^{0}T^{-1}Y^{1}$