Amateur RADIO

October 1983 90p

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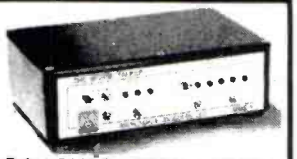

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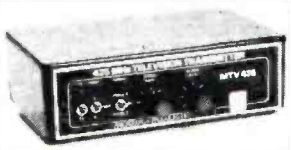

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Published by Goodhead Publications, 27 Murdock Road, Bicester, Oxon OX6 7RG. Telephone Bicester (08692) 44517.
Printing by Wiltshires (Bristol) Ltd., Bristol.

Typesetting by Cathedral Graphics, New Buildings, Trinity Street, Coventry CV1 5QR. Tel: 27792

Distributed by COMAG Ltd., West Drayton, Middlesex.

Front cover: The SWR and power meters tested by G3OSS, and photographed by Jay Moss-Powell.

CURRENT·COMMENT

Introducing you to this month's issue

Another thrill-packed episode of ***Amateur Radio*** for you, gents - getting just like Dallas here at sunny Bicester (phew - you can say that again - it's been too hot even to work on the antenna system and we've been reduced to typing for five minutes and drinking iced Coke for ten. By the time you purchase this or it falls through your letterbox, of course, there'll be torrential rain, hail, lightning, tropical revolving storms and about as much sunshine as there is auroral propagation at 47GHz.

"...it's been too hot even to work on the antenna system and we've been reduced to typing for five minutes and drinking iced coke for ten"

What's in store for you this month? We have an ***enormous*** contribution from Angus McKenzie, who's been driving himself bananas measuring power meters and SWR bridges of late and come up with some most interesting results - all good stuff. Angus also continues his Lab and Shack series. We've been out on the antenna test range again (in this heat, too. The things we do for our readers. If you fancy a quick way to get a suntan, try taking antennas to a test range, carting them about and generally doing the measurement bit with the sun pounding down on your person with what our French friends would call "very QRO" and a temperature of about a million degrees in the shade!) looking at a couple of Metalfayre's antennas - they're a new name in antenna manufacturing industry and, if the two we tried are anything to go by, they should do well.

Actually, they must be good because the dreaded Gresley has replaced his faithful 14-ele from a Great British Manufacturer with one of the MET ones and he's sworn by his beam for years and years.

We were going to review the Datong automatic notch filter and Woodpecker Blanker this month - well, we have reviewed them, actually, but Chairman Drake made a bit of a boo-boo with the contents list this month and we were trying to squeeze in rather too many things at once! Rather than not do them justice we've held that over until next month, but we can tell you that they're both splendid devices. As a matter of fact, we're also reviewing another Datong machine, the ASP speech processor. This is reckoned to be one of the best in the business, and our preliminary tests have shown it to be remarkably good - so keep an eye open for that upcoming review!

Dealer Profile this time round looks at Lowe Electronics up there in Matlock - Peter Dodson has been on the road again for another in this series. From the letters you send us, seems this series about dealers goes down well so we'll keep it going until either we run out of dealers to profile or you get bored or something.

Seriously, welcome to the new issue. Do you realise it isn't all that long to Christmas now? Only three months to count-down; we ought to think about a really spiffing Xmas issue with free linear amplifier in every issue. Seriously, our ***Amateur Radio Yearbook*** will hit the bookstalls somewhere between now and then - there's an ad somewhere in this issue which extols its virtues, so do keep a lookout for it.

And now - to the sound of trumpets, a large roll on the kettle drum and an enormous bang as the EHT supply flashes over, it is now may pleasant duty to introduce the new editor of this magazine (roars of applause, shouts of DRAKE OUT and such, ragged cheers from the staff at Bicester still left alive after the onslaught). Actually, I'll still be around, but as of the next issue the mag will have as its full-time editor Mr. Richard Lamont, G4DYA. Actually, in the Bicester tradition of silly nicknames he's already known as Lament.

Richard comes to us from Ham Radio Today but he's quite human and we've already forgiven him and given him a visa so he can get through the Hallowed Portals without Technical Bod's intruder alarm frying him alive. Drake becomes General Manager which means not a lot. Seriously, though, a big welcome to Richard, and as of now it means that much more

"... to the sound of trumpets, a large roll on the kettle drum and an enormous bang as the EHT supply flashes over..."

Niggly Greasy continues his Great British Exposition on how to pass the RAE this month and launching off in his inimitable (don't you mean illiterate? - MD) fashion about capacitors. And above all, there's that splendid feature Current Comment, written by your resident superstar.

effort can go into making this the best magazine around and, hopefully, not quite so many deliberate mistakes!

And so with that - hope you enjoy the magazine this month and we also hope you'll keep the letters rolling in.

73 de Chris Drake

QRM KILLERS

see us at
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is the definitive and long awaited answer to the Russian Woodpecker. Others claim to solve the problem of the distinctive RAT A - TAT TAT of the Russian radar system. **DATONG are the first to succeed with a fully automatic blanker.**

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L·E·T·T·E·R·S

Digital readout

I own a Realistic DX106 communications receiver and I am trying to find a suitable digital frequency counter for it (ready built or as a kit). As I intend to send reports to broadcasting stations in order to obtain QSL cards, so far I have ben out of luck because I cannot tell the broadcasting station the exact frequency I heard him on: I can only give a rough guess on the display that's on the receiver. I hope you can recommend one as I don't want to replace the receiver if I can help it, with one that has a counter already built in.

I would now like to tell you that I think your mag is great and I particularly like the section on shortwave listening and computing.

S. Buckley, Gainsborough.

The only people who might do a read-built unit are Ambit of Brentwood, and you can buy their latest catalogue (it's got a yellow cover) in W.H. Smiths. - Ed.

About the FRDX400

I am an avid reader of *Amateur Radio* and think your approach in material is just about right. Enjoyed article Collins 75A-4.

I have an FRDX400. Three queries:

a) How do I get a copy of your first issue? *(sorry, none left - Ed.)*
b) My manual for the FRDX400 states that to adjust the VFO dial, one should place the main dial at 0 and 500kHz and adjust trimmers and coils, with 0/100kHz dial at 0, and mode at SSB and adjust to zero beat. I does not say whether upper or lower side band.
c) When adjusting to 0 beat, there is a 3kHz difference between USB and LSB. Maximum 'S' meter reading is in between. What is the correct frequency?

I am now retired and active on 2 metres and at about nine words per minute at Morse, so hope to get an 'A' licence soon.

Have enjoyed amateur radio since about the age of 18.

Bob Astley, G6GFP, Norwich.

Regret we don't know the FRDX400 at all. Anyone out there who can help? - Ed.

A CB case

Congratulations on a readable and understandable magazine. Like many others, I have no real interest in what goes on inside the 'little black boxes'. My interest is more in antennae and propagation. So long as my 'black box' performs as it should, I'm happy.

Unfortunately, I am not yet licensed: I took the RAE last May - but the least said about that the better! Was I the only one to be completely baffled by Part II? However, I can transmit on CB. Don't knock CB. There are many excellent operators on legal FM. In fact, many would put so-called amateurs to shame. Plus, fantastic conditions can arise. I recently worked Northern Ireland and the East coast with telephone confirmation and QSL cards to confirm. I also had (on R456) a Norwegian station, but could not make the trip myself. Many other radio enthusiasts who use FM have also made similar contacts. I assume the propogation is sporadic - i.e. the signal being 59 most of the time but rapidly fading to 52 only to rise again. All contacts are made using proper 'Q-codes' and phonetic alphabet.

The sole purpose is to get confirmation of contact. There may only be time to get a telephone number across, and both stations concentrate hard. Moreover, listening stations do not break in, trying to gain 'glory' for themselves. After my DX contacts I found that most of the stations in the area were monitoring. Not one interfered, although they all had the capability of making the trip. I contrast that with the babble of stations on the amateur bands replying to a rare DX. Don't forget, Northern Ireland, Scotland and Norway are extremely rare for 27MHz FM.

This all sounds as though I'm anti-ham. Far from it. I want to become one, although the recent Part II will no doubt stop me this time. My point is this: I read nothing but bad reports about CB, I admit that a good deal is about illegal AM, but nothing good is ever said about FM either. OK, an 'open channel' radio is open to abuse, but many FM CBers are sensible folk who happen to be interested in radio communication. Surely, this is what amateur radio is about? It is still communication by radio.

So, please let us demolish this silly prejudice against CB. We are not all 'good buddies' riding 'the super slab'. Most of us just want to rare DX like any ham worth his salt. I am sorry to hear that your excellent SWL column gets only two letters a month! I am a short wave listener (BRS 50052) and may well write to you shortly. I have a Yaesu FRG7700 with ATU fed by a rather zigzag long wire. Still I did get a couple of VK's recently. Keep up the good work.

Steve Cowling, Shrewsbury.

DXpedition information

I would like to make one suggestion for your magazine. That is, could you use some of the information available regarding proposed DXpeditions and more detailed information on what is available or has occured in the HF bands on the lines of Radcom's MOTA or SWL news?

As your probably know better than I do, there are a number of news letters on the lines of 'DX News" which could be of interest to many operators and SWLs. It would be appreciated by hams like myself whose main interest in Radio is chasing DX with all its frustrations. There are so many facets to this hobby, one could find things that interest different poeple, i.e. Russian Oblasts - what do they represent, DX nets, special event stations etc. One could go on and on.

Only the woodpecker and the so-and-so who does not listen on frequency before screaming CQ, spoils this hobby. And if I do not switch off and go to bed it will be another late night or early morning.

Harold Moss, BRS 18529, Sevenoaks.

Thanks for the suggestions. - Ed.

Boy's own annual

The March issue of your magazine is the first issue I have read. It is the most interesting amateur radio mag I have ever seen! And I read amateur mags from all over the world. In comparison, our *Amateur Radio Action* is just like a "boy's own annual."

The article on the Racal RA17 receiver is most interesting - until recently I used to repair them. "New and used" is worth keeping - I hope to obtain an HF transmitter later on when I pass the code and can go on the air (at the moment the licence is just a "listening" one).

"Keep ahead" was the most interesting article of all. I have been looking for some way I could feed my RTTY terminal unit from my FRG-7 and listen to the output if necessary - this article was just what I was looking for so I constructed the little "box" and am now using it successfully.

Thanks again for such a fine magazine. If it wasn't almost impossible to send money overseas from Australia, I would send you a subscription.

Terry Robinson, Woodend, Victoria, Australia (VK3XCM)

Subscriptions are available to our overseas readers. - Ed.

L·E·T·T·E·R·S

Active aerials

As a newcomer to amateur radio I hope to set up SWL with a Trio R600 or similar, but am unable to use an outdoor aerial. I therefore read with interest in your magazine an advertisement for a device from "Datong" called an "Active antenna". In your opinion, would this type of aerial be suitable for a loft, or would a few feet of random wire be just as effective?

I do not expect you to praise or condemn advertisers' products, but would like an expert's view.

John Morris, Gloucester.

Yes, the Datong active antenna would be very suitable for the job by the sound of it. We haven't actually tested one but we've heard good reports and Datong's products are normally excellent. - Ed.

Black radio

A friend has loaned me the May issue of *Amateur Radio* in which I read Mr. Hawker's article on 'The Secrets of War Time Radio' with great interest. My recent book *The Black Game. British Subversive Operations Against Germany 1939-45* contains a detailed account of the clandestine black broadcasting operations which were organised by the Political Warfare Executive which originated in much the same egg which hatched SOE.

I was PWE's printed fakes and forgeries specialist and worked in close harness with the late Sefton Delmer, who was by far the department's most brilliant black specialist. At that time I met some of the members of his black German broadcasting team but did not know very much about the radio side at the time. Conversely they knew even less about my activities. Harold Robin, until recently Chief Engineer of the Diplomatic Wireless Service, gave me a list of hitherto missing information about the historical development of black broadcasting, as he was on the spot and installed all the transmitting equipment.

Finally, I have a new Grundig Satellit 3400 but don't know how to work it!

Ellic Howe, London.

We will review the book very soon. Thanks for the information. - Ed.

Readable

As the 'Straight and Level' column is so easily readable, how about calling it 'Q5'?

G. H. Greenwood, G6WFJ Preston.

SWL

I have just discovered your *Amateur Radio* mag. Quite good, but I *would* like to see.

(a) some regular articles for the SW Listener (types of aerial and tuners etc)
(b) monthly articles for the European and World-wide Broadcaster DXer with details of current English schedules, wavelengths and times.
(c) more varied and consise readers letters (hopefully like mine!)

By the way, what happened to Amateur Answers supposedly on page 53 of the April issue? They certainly do not appear in my copy.

M. Jones, Cheltenham.

Can't answer that question, sorry. Your suggestions gratefully noted! - Ed.

Receiver aerials

I am new to the hamming world and very interested, but I am not quite sure what I need to buy to accompany an HF receiver. Please could you give me some indication of what, why and how much?

J.R. Veal, Penzance.

Just an antenna to start with - see G3BGQ's articles. Then, take it from there. An ATU a la Dobbs would be good as well - Ed.

Bicester Buglers

How are the "Bicester Buglers?" The magazine is unique. The NEC article superb except for addresses, ie M & B, John Radio, R.H. Finch, Sansons and Birketts.

Now no longer biped but quadwheeled. Rallies are out, so if you can supply addresses I would be grateful.

Bill Hayles, Sheffield.

Radio News

In my 'archives' I have one or two copies of *Radio News* printed around 1938. They are not the sort of periodicals you chuck away - even after 40 odd years. They're still full of interest and very readable.

Many times after going through new copies of well known radio monthlies (or should I say rig catalogues) in ten minutes flat, I've wished that someone would produce a modern equivalent of *Radio News*.

Congratulations! You've done it. At last we have a magazine that's interested in the views of its readers - your 'letters' pages are great.

In my opinion, *Amateur Radio* is the best buy on the market, so - PW, SWM, RADCOM etc, watch your circulation. *Amateur Radio* is going places!

New Kirk G3JDK, Rotherham.

RAE question

Could you please tell me what is the percentage of correct answers required for Fail, Pass, Credit and Distinction in the RAE?

Also, is this percentage overall on each paper, ie, on 2nd paper do you have to have a percentage of each of the seven sections correct, or is it taken from the paper as a whole?

My wife and I are studying for the RAE together and hope to gain sufficient knowledge in the future to pass. In the meantime we are keen SWLs and run an AR88D on a 65ft long wire into an ATU. Being disabled with a heart condition, I find the whole aspect of radio a fascinating hobby.

My wife and I enjoy reading your mag and think it is ideal for beginners and experienced alike. Good luck for the future.

Don Hollingworth, Seaford, Sussex.

'Fraid we don't know chapter and verse but we think it varies - any RAE experts out there? - ED

Dip meter coils

Have just purchased a dip meter which I bought for half price with three coils missing, and was told I could obtain spare coils for it, but unfortunately I have been unsuccessful. If you or any other readers can help I would be grateful. The model is Tech Trodiper model number TE-15.

J. Vernon, Manchester.

Which receiver?

I am considering the purchase of a very good communications receiver and I have narrowed my choice down to either an R-70 or the JRC NRD515. In your view of receiving equipment your comments on the NRD515 are "very nice but not without faults". Question: are these faults serious enought not to consider the purchase of the NRD515?

J. Santman, Cobham, Surrey.

Well, we find it overpriced for what it will do - the performance in such matters as signal-handling and IF filtering isn't really much better for the average SWL as the ICOM R-70, say, at a third of the price. We used one professionally for a short time just after it came out and it didn't strike us as being the best value for money, to be brutally frank. But it's well put together and nice if you have the spare loot! Mind you, we'd still prefer the likes of an RA17.... Ed.

L·E·T·T·E·R·S

Novice licence

Fistly, I am not a licensed amateur, as I just don't have the cash to lay out on a course, and then the gear. I am a licensed CB fan, which is the only alternative, and I am an ex-RN 'sparks', for those who promptly think 'he's thick and knows nothing'. My proposals are:

1. Licence holder to be 18 or over.
2. Licence holder to also have a current CB licence.
3. Licence holder to understand cause and cure of TVI etc.
4. The Licence to be restricted to operation from home address or one mobile, address/road licence plate quoted. Mobile does not mean parked and working into any array on a mast, but a single vertical element, with the car body as a ground plane. Any legal aerial at home.
5. Licence to be restricted to max PEP of (say 10) watts RF, on 10 metres, 28MHz using switched frequency gear with say, 5% manual fine tune, as opposed to fully tuneable gear. The gear to be commercially manufactured no homebrews, and the TX only covering amateur 10m channels, the channel spacing at 10 K/cs.
6. The licence renewable annually with no time restriction. A and B licences are not banned from 10m.

My ideas are that this will act as a stepping stone between CB and ham, using cheap gear. There are some sets on the market now for £50. As both ham and CB can chat legally, the experienced folks can be approached for information, advice etc., as well as general conversation, but with better range than the very restricted and noisy CB channels. Maybe also the novice could use other types, powers, frequencies of ham gear under direct supervision of the amateur, allowing the novice 'hands on' experience of high class equipment, which of course is not legal now.

This would help to eliminate the person who goes to college, passes the RAE, goes to the shop, buys a huge rig, and hasn't the faintest idea of how to tune it, and can mess around, splattering all over, quite legally.

All this was triggered by an ad in a recent issue which states '10 metres, use it or lose it' as a headline.

Now, on a completely different subject; how about a series aimed at the experimenters amongst us, perhaps titled 'what happens when...?' covering things such as helically wound vertical dipoles at HF. Parallel resonant antennas, effective restricted size HF antennas which are not all loading coil, and work without matching. There must be a lot of other things that spring to mind. Look what happened when Marconi said it!

I had a chuckle at the 'Practically Witless' bit. How about Electroncis Today Intermittently, Hooby Electrickery, Wordless Wire, Deleator, Spectrum Misusers etc!

E. Bray, Warrington, Cheshire.

Titles

Could I offer a few suggestions for alternative titles for your "Straight and Level" news and views feature? How about:
(1) Ether and Thither
(2) Amradrilloes
(3) Leader Feeders (or (reversed)
(4) Band Adages
or even
(5) Amrad Band Adages

Continued success to your magazine, I am now a confirmed addict to same, although I must express disappointment in the lack of constructional or indeed circuitry items in the last two issues.

One often hears of the relevant disadvantages, for example, in using dual gate Mosfets as HF applying devices by reason of poor dynamic range, yet surely someone by now has devised a suitable alternative using VMOS or, more recently, TMOS devices (Silicons?) and I would dearly love to see something on those lines in order to update my extensively rebuilt RC312 (it currently has E88CC Cascade RF stages, twin triode mixer mechanical filter, product detector etc).

Kenneth Peter,
Little Haywood,
Staffs.

Back to valves

What an excellent article on valves by Ken Williams (AR June '83). Certainly my constructor's pendulum was swinging back towards building gear with valves after dabbling in transistors, mosfets and ICs with reasonable success.

My return to valves was due to the reasons listed by Mr. Williams, and so relevant too. They will stand much abuse and still allow you to use them after making your msitakes,an important point from a beginner's point of view. Transistors, as we all know, are not so forgiving, passing away in the silent blink of an eye.

As for the abuse that valves will stand, no doubt regular users could tell a tale to two, and my tale helps to illustrate their versatility. As a schoolboy ham, I modified an old ham TX to run a pair of 6146s in the PA with EHT, and I mean EHT on the anodes and about 750v on the screens, I forgot to connect the bias. On warm up, there was an almighty bank coupled with a blue flash from inside each valve. Not quite the northern lights, but just as spectacular. I switched off, righted my wrongs, mumbled a short prayer under my breath, and away they went for several years' faithful service.

Mr. Williams' comments on octal-based valves are very relevant as well. I required such a valve for a recently-built 10 MHz transverter to work as a driver for the PA. The junk box yielded a good old 6V6, something that will make the old timers smile. I hope this letter will encourage others to use valves. They are so easy, so faithful and ideal for all construction work.
Lastly, when I next need a PA valve, I have it ready and waiting in the junk box, the ubiquitous 807.

Bob Leask G4CEO,
Bedford.

Flung over a tree

With reference to the July issue, In the Resistance, I would like to point out that the wire tied to a stone and flung over a tree branch, worked either an 'A' or 'B' suitcase set with "skeds" to Monopoli in Italy, or Algiers. The sets were crystal controlled and the hard work was charging the battery with a band charger. I have been trying to acquire one of these sets for a long time so if anyone can help I would appreciate.

H. Hargreaves,
Tottington.

We will pass on any offers. - Ed.

Amrad forum

With regard to your column, named, at present Straight and Level, and your request for suggestions to find a new name for this excellent compilation of news and views from the various pens of the staff at *Amateur Radio*, I believe that your magazine has the right balance to succeed as the main publication read by the amateur radio fraternity, and I also think that it will soon become a household name, much the same as *Radcom* has been for years.

When loading computer programmes (such as frequency/antenna length conversions) from my personal computer onto tape, I always use the programme title "AMRAD". I believe your magazine will become affectionately known by this abbreviation, and for this reason I would suggest that

L·E·T·T·E·R·S

a suitable name for your column would be "Amrad Forum". A more jocular title, but equally fitting would be "Staff Notices" (Well they do don't they!).
R. Vernon,
South London.
The mag is already known as Amrad to all the staff here at Bicester, so perhaps we ought to perpetuate the nickname in the editorial text. - Ed.

Collins KWS-1 - sole survivor

I really had to buy your magazine when I saw you had a Collins article! Julian Shakespierre obviously shares my feelings on the 75A4 RX, but equally obviously has never seen a KWS-1 TX.

If he would like to, please ask him to contact me as I use a 75A4/KWS-1 combination as a main station on all HF bands. He might like to note that the floor standing cabinet is a power supply only and not a power amplifier. It weighs about 160 lbs and certainly is not hot enough to warm even a gnat's feet. The main PA is a pair of 4CX250Bs at 1kW input (not output) and is contained in the table top unit. The blower is in the supply cabinet, however, and tubing runs to the table top unit. Maximum output is about 600W PEP on sideband, 600-700W on CW.

Minor criticisms, but accuracy is important, I think! I believe there are but two or three KWS-1s in the UK and I am certain mine is the only one in active daily use. It was imported with the RX in 1957.

Julian may like to note also that Collins provided a slow motion drive as an extra, giving 25kc/s per turn on tuning - both my units have these and they really are superb.

Anyway, thanks for a rather better article than found in certain of your competitors'. If you want to hear the tone of a KWS-1, listen out for me!
Jonathan Butler, G4JOW, Wellington, Telford, Salop.

Don't abuse our airwaves II

I liked Keith Townsend's article on this subject and would like to make one or two commens.

Keith's impartiality between licensed and unlicensed operators is to be congratulated as no person of either creed condones this futile and wasteful practice. This leads me to my next point which is: I wonder what percentage of your regular readers/subscribers are actually holders of class A or B Amateur Licences? Or indeed SWL s registered with the RSGB?

I for one am neither, and am, as I know, one of many of your readers/subscribers who are "SSB operators" without a licence. We prefer to be so classed instead of being categorised as "dreaded CBers" as is the wont of so-called "respectable" licensed amateurs. I mention this simply in order to keep the record straight and if any of your "respectable" readers do not wish to lower their intelligence by reading on, they may stop now!

By classing myself as "unlicensed" I now come to another point in that this does not detract in any way from my own, or my fellow "unlicensed operators" outlook on keeping the airwaves clean in both senses of the word. In saying that, may I give you a quick run-down on my own 'working conditions' which are as follows: Yaesu FT 101ZD, low pass filter, ATU/PWR/SWR meters thru' cubical quad, delta loop and various wire dipoles (all homebrew). I maintain a 'clean' ship and have no irate neighbours knocking on the door with complaints of annoying and unwanted signal reception (licensed operators eat your heart out!).

In the operating sense, the majority of 'unlicensed operators' are no different from the majority of 'licensed operators' in that they are both courteous and complimentary on the air. Alas, I cannot say that this condition is improved upon by the mere possession of a 'ticket', for I have heard as many "wallies" over the years on the amateur bands as elsewhere, on R/T and CW, who throw their unwanted verbal litter all over the world.

"Sour grapes" did I hear you cry? I don't think so. I passed the PMG (professional Certificate in Radio R/T and CW (25wpm) in 1956, Radar Maintenance Certificate in 1958 and have worked the HF and VHF bands professionally and otherwise for the past 20 odd years and now await the result of the May RAE (1st attempt), so I have a little experience, and although 'unlicensed', feel entitled to give opinion, as the subject of "abuse of the airwaves" means just as much to the 'unlicensed' operator and listener as it does to anyone else. So keep the airwaves clean chaps (& girls) and don't leave your verbal litter cluttering up the ionosphere.
Middle aged "Bluebeard",Scotland.
P.S. If you do print this article, I feel it would show that you are liberally minded and forward thinking with all the many and varied aspects of the world of radio at heart, thus catering for the many, and not like some of the other publications who concern themselves with churning out reams of literary gobble-de-gook for the self-satisfied and narrow-minded.

Odd results

Regarding your article on the Mutek Board to IC251E, I wonder if my record of experience is in any way typical.

Using instructions supplied and SW magazine article October 1982.

R106 AGC Thresh-hold. No adjustment obtained. Tried varying AGC voltage between 0.5V - 5.5V, made no difference.
RG2 I F gain alters voltage at AGC pin on Mutek board. Resulted in 5.4V SWM say should be 3.8V, Mutek say 2V.
C199/200 Junction. Useful voltage test point for AGC voltages. Saves removing bottom lid.
R132 SSB Zero - no problem.
R26 SSB FSD - no adjustment obtained.
R167 Gave very slight increase on S meter.
T2 On Mutek board - made virtually no difference.
R161 No problem finally set on signal from local repeater.

FM seems OK but I've still to be convinced that SSB is as it should be.

PS Please give us some "nuts and bolts" articles and don't take off into orbit like *R & EW*. Eg, I have a brand new Hitachi Oscilloscope and four books on how to use the instrument. Not one of them tells you where and where not to connect it up to for various tests. The standard of instructions and text books is very poor.
A. Finlay, G6LKO, Stanley, Co. Durham.
Your experience baffles me, I cannot duplicate your measurements on the IC251 and it sounds as though there is something fundamentally wrong with your IC251, or with the T2 is quite a broad band but you'd expect that. I would suggest you badger Bartram Ed.

STRAIGHT·AND·LEVEL

News and views from the world of the radio amateur, compiled by the staff of Amateur Radio.

Okay, okay, we've put our foot in it again! Last-time-but-one we were rash enough to say "first to spot this month's deliberate mistake gets a year's free sub". We thought that we couldn't possibly, hadn't possibly, wouldn't possible make a single solitary mistake in that issue but being country yokels we really ought to have known better; our postbag is normally large enough to keep us busy for several full days in succession, but we really asked for it.

The main mistake wasn't ours - it happened at the printers, when the Editorial Knife forgot to notice that one paragraph in Angus's article had been typeset twice and had managed to stay there all through the various stages of proofreading, clearing pages and so on and so forth. However, Messrs E. Beilby of Hessle, North Humberside, R.J. Howes of Weymouth, M.J. Murrell of Great Wakering, Alex Morris of Wonersh and, last but by no means least, R.B. Purdy of Hong Kong, did a splendid job in telling us where we'd gone wrong. However, the funniest letter came from Peter Murray, G4UBV, of the Radio Malt Club, Kingston, Surrey, and it goes like this:

"Many congratulations from all of us here at the Radio Malt Club, on Hugh Allison (G3XSE)'s fine article "How much that used Radio" on page 33 of the July issue. As we are all of us mostly in the market for the budget priced thingies he described, it was an invaluable text and we will be keeping it and photocopying - with your permission - for members future reference.

"Some of our club members here at Radio Malt were so moved with the article that it was suggested a collection be taken up, and as a result we have pleasure in enclosing a £50.00 cheque, to be used as you think fit for the benefit of various contributors.

"Thanks for a marvellous mag and keep up the good work."

We think the £50 cheque suffered the same fate as G3XSE's article - there must be a jolly interesting bit of hyperspace somewhere into which all these articles, cheques, etc, disappear!

The Belgian Affair: No new developments but the UBA won a delay to the implementation

Anyway, we wouldn't do anything so rash as to offer free sub, but we devoutly hope that the number of errors starts to shrink somewhat from now on otherwise it's the Last Great Interview with the MD and then the ceremony of being hung from the driven element of the tribander....

Anyhow, what's been happening in the world of amateur rädio? The Belgian thing was, and is, a bit strange - after the initial shock it all went quiet as ministers and civil servants and assorted neddies in the Belgian government went off on their hols and things. The info we published last time was more or less the whole story, actually, and as we went to press there were no new developments - the UBA had won a delay to the initial implementation of the proposals, which was something, but those UBA people we've spoken to aren't what you might call happy about the outcome.

Merriman Report: What really came over was the tremendous pressure on the radio frequency spectrum, and not only in this country.

At least the so-called "novice licence" proposal has been amended to restrict it to 145 to 145.8MHz, but in many ways this is the most shabby and shameful part of the whole thing. Now this magazine, like others, is aware of the Amateur Radio Novice Licence Campaign which is run by Ian Abel G3ZHI; on the whole, we don't see that there's a really good case for a novice licence in the UK and we'd much rather see some proper standards being applied to the RAE and (dare we say it?) some stricter ones to the hobby as a whole. What has happened to Belgium, however, is that CB groups have got together with a couple of the smaller national societies (that's another part of the Belgian problem - there isn't just the UBA; there are various other societies) and pressed for this wretched "novice licence" which, to some peoples' minds, is just another way of finding some more frequencies for what amounts to CB operation.

An amateur was killed when an antenna he was putting up fell across a power line

We are not against CB; this mag is published by people who published various things in CB's heyday and there *is* a place for it. But that place is NOT in the middle of one of the most heavily-used amateur bands in the world. If we must have a CB service, then let is at least be (a) on a sensible frequency consistent with its supposed use as a short-range personal communications service - that means VHF or UHF (b) NOT, repeat NOT in an amateur band or anywhere near it, especially masquerading as a so-called "novice licence".

Amateur radio has already been devalued enough by an influx of people with no interest in, or respect for, its traditions and who simple want a personal communications system - well, fine, let's all have personal communications but not, please, in bands set aside for amateur radio.

Sorry, but the fact has to be faced - amateur radio only exists at all because governments and what-have-you get together to let us have some frequencies to use, and in terms of frequency space we do *incredibly* well. So let's not have "novice licence" proposals which are nothing to do with novices at all, but might devalue and reduce the credibility of the amateur service at national and international level. That's not to say that the ARNLC comes into this category, of course.

It's interesting really; we were at the press conference which launched the Merriman Report on the future of the radio spectrum between 30 and 960MHz, and what really came over was the tremendous pressure on the radio frequency spectrum - not only in this country but all over the world. And you can bet your life that the day amateur radio looks less than credible and useful to the powers-that-be, no amount of pleading and table-thumping is going to stop whole bands disappearing overnight. If you don't believe us, just remember the word "Belgium" the next time you're about to do something silly on, or in, an amateur band.

End of sermon, what's next? We had a mucho interesting press release from the Electricity Council, of all people, the other day. It was all about aerial safety. Basically, two chaps were electrocuted recently when a 30 foot CB radio aerial with which they were doing something, fell against an 11 kV overhead power line (we didn't think 30 foot antennas were legal for CB, but never mind). They were apparently up a tree at the time and possibly didn't realise that the power line was somewhere near, or even that they knew it was somewhere near but that they didn't know that it was live.

The press release goes on to say that:

"All overhead lines carry currents which can be lethal and which, in many cases, can jump a short distance to an aerial. Most materials conduct elecricity to some extent, and gloves do not provide any real protection against electrocution. It is therefore extremely dangerous to handle CB aerials near overhead electric lines. It would be safer and more sensible to talk to the local Electricity Board before erecting or dismantling CB aerials near lines"

Well, we can't quarrel with that at all, and the same goes for amateur radio antennas. Amateurs aren't immune - there was a picture of someone erecting an antenna under what seemed positively lethal circumstances to us in the August issue of the RSGB's magazine *Radio Communication* and we must admit to being a teensy bit surprised that they published the picture without pointing out the dangers.

"Felt a couple of kV in his fingers..."

There is another angle on this which the Electricity Council didn't mention - that's the electrified lines that British Rail have on some parts of the railway system. We know of one contest outfit who do their thing from a field right next to an electrified railway (funny, that - we'd thought that the QRM wouldn't have been exactly helpful) and if we remember rightly most of the railways which do have electrified lines use 25kV on them, which is pretty damned lethal. So all in all, let's use our common sense when messing about with antennas. We seem to remember a case a couple of years ago when an amateur was killed when the antenna he was putting up fell across a power line of some sort. So let's all aim to die peacefully in our beds.

Actually, this is one of the very few arguments against valve equipment; we must admit we love valves and like to use them where it still makes sense, but the high voltages needed are a bit hairy if you don't use a bit of common sense or you've used transistors all your life and you've never got yourself across the anode supply for valve equipment.

An electric shock is *not* one of life's more pleasant experiences, ever, and for such things as big valve linears you do tend to have rather a lot of volts floating about. So it you're heavily into big linears and suchlike, please TAKE CARE when messing about with the power supply side of things. If you get yourself the wrong side of the anode supply for a 4CX250B amplifier, for instance, you will wind up very dead. Remember - kilovolts can very easily become "killer-volts".

We had a nasty only the other day whilst we were messing about with apower supply for our HF bands linear amplifier - this job produces 3 kV at a few hundred milliamps fora pair of 813s and the tranny for it is about as big as the typewriter I'm typing this on and about four times as heavy. We were running it up from a Variac so as to make sure that the thing was stable after some mods to the neutralising and we were nicely at 3kV when the amplifier indicated that we still hadn't got the neuting quite right - so a quick shutdown was called for. The EHT is taken into the chassis via one of those PET connectors, and before diving into the amplifier we unscrewed this just to be on the safe side. However, the PET plug was one of those where the centre pin comes almost to the end of the shielded portion of the plug body, and Technical Bod happened just to brush his finger across it as he unscrewed it. The result was an almighty screech from T.B. as he felt a couple of kV in his finger (the bleeder resistors hadn't quite discharged) and inevitably his reflex action was to hurl the plug away. By a mischange, he hurled it in such a way as to hit the top panel of the EHT supply, and there was an ear-splitting BANG as the capacitors in the supply discharged rather quickly to the earthy metalwork. Not good. It blew the fuses on the secondary side, of course, but they aren't fast enough to prevent that sort of bang by a long way - so we were all a bit shook up, as they say!

Jolly interesting subject, fuses, actually - we ought to do an article on them one day. Did you know that the mechanism of a fuse blowing is incredibly complicated, and if you're trying to protect something clever like a power semicondictor you need to use special fuses? These was an article in *Short Wave Magazine* last month which showed one of those integrated circuit power control devices being used to control the voltage into the primary of a transformer - we'd have thought that was a distinctly dubious technique anyway, but what freaked us was that there wasn't a fuse in sight!

"Mechanism of a fuse blowing is incredibly complicated"

Power control devices, whether they're thyristors, triacs, integrated power controllers or whatever, all share one characteristic in common - when they fail they always, but *always* go dead short in our experience, and when they do that it's like a hand grenade going off.

Technical Bod told us of one occasion when he used to work for one of the leading electronics companies in the UK and he was one of a team working on theatre lighting dimmers using triacs - the lash-up used a 15A device on a largish heat-sink. One day there was a short circuit somewhere downstream of the dimmer; unfortunately there was no fusing anywhere in sight and the said triac failed. "Failed" apparently was an understatement - there was was Tech Bod called a Dirty Great Bang.

Part of the device cracked the plaster on the ceiling and embedded itself therein and the rest of it went through the heatsink, carried on through a die-cast box and broke a PCB clean in half before hitting the other end of the box and cracking it. Technical Bod says he's just relieved that it was the lash-up that the triac chewed up, and not him! Apparently you just have to be sure to use the right fuse which can blow fast enough to stop the rot.

And on that "explosive" note we'll love you and leave you for this time. Just one plea - we haven't had so much as a single solitary photograph for this column for ages and ages. Would anyone care to supply same for our edification and delight, and even publication? We have to fill the space up somehow!

See you next month.

At the Scottish Convention: Dr Michael Kelly, Glasgow's Lord Provost, listens out on the HF bands. Looking on is Anne Hood GM6PYQ.

The Exercise Book

...or, revision for the RAE. Part 7654/Z...

"A Guide to Electricity and Magnetism" is the handwritten title on the front of the child's exercise book that landed on the editorial desk the other day.

The subtitle read: "Happy half-hours with the harpischord." Now that should have given us some idea of what we were to expect within the covers of this antique "wide rule" exercise book. In fact, the little book is dated 23 June — 5 July 1941, and is a cherished possession of one H.J. Whitehouse, of Darlington, County Durham. The book, he writes to us, was found in the Wireless Courses lecture room, and obviously left there by Lt. Mansfield, RA.

Inside the front cover is the dedication "To Capt D. Newton, RA, and G. Warwick, RA, without whose help and advice this Book would have been written in half the time." And Chapter One begins with the immortal words: "Electricity is nothing more than a hell of a lot of electrons, chasing each other along bits of wire, string, tin cans, seed cake, and up, but seldom down, silk stockings."

We can do no more than quote more from this send-up from the Second World War. "When these electrons were first discovered, the man who discovered them (or invented them, I'm not sure which) thought they always ran from what we scientists laughingly call POSITIVE (+) to what we call, jokingly, NEGATIVE (—). In fact, they don't; quite the reverse. And ever since then, these poor electrons have been madly running, swimming, cycling and flying BACKWARDS..."

"What to do with electricity" is the title of Chapter Five. Our essay continues. "Having now obtained our electricity, we obviously want to put it to work, not to have it lying about for old Uncle Charles to trip over, or baby to swallow, or the cat to play with.

"Strangely enough, the silly mutts of electrons are actually willing, even anxious to work. They crowd forward, rolling up their sleeves, jostling and pushing to get the job done — all in gay laughter and elfin jollity. "Hi!" they shout. "Let us do it." So we will.

Electrical energy is always explained by the Water Analogy. This is it. Take a bucket and put it under a tap. Turn on the tap. The bu cket fills. If the bucket is now inverted, the water comes out. It is the same with electricity..."

Chapter Nine, aerials. "What, you may ask, is an aerial? Well, it is in reality, a bait, or decoy for those electrical stooges, the electrons. They see this tempting bit of apparatus and with cries of joy the interfering little beggars rush at the thing on foot, by air, on bicycles (Mk II), and in cars (Mk III) — all of course, backwards.

"Having enticed the electrons by the aerial, we now proceed to impede them, resist them, choke them, and condense them, which we will do in detail in Chapter CCXX.

There are various types of aerials, i.e., the common or clothes line aerial (fig. 62):

There is also an indoor aerial (fig. 61).

"Now, the theory of aerials. Say, an electron impinges upon an aerial. As he is travelling backwards (see Chapter One) his bottom will hit it first. This is important. Having hit the aerial, he dashes down it and by a series of cunning devices, he is inveigled into a TUNED CIRCUS..."

We at Bicester thought we could do no more than continue through the exercise book; we hope you find it a little amusing...

Valves

(Valva la France — French pervert)

"Our electron, the poor fish, is now in the valve, all ready to be properly lallapalloosed by a series of grids, filaments, anode and such devices. A valve (invented by Thomas Valva Edison) is a glass globe, such as contain fish, gold.

"Edison discovered that if this device were inverted, the water, and fish, would fall out through the top, not the bottom.

"From this, he deduced that a bottom was needed at the top. He did this, and the result was a valve, or VACOOM TOOB.

"Electricity is nothing more than a hell of a lot of electrons"

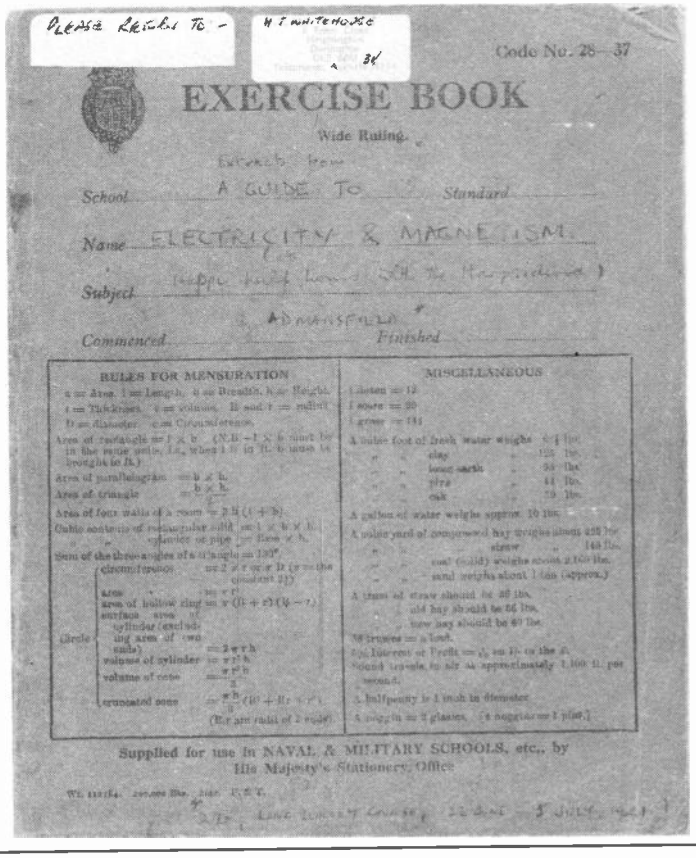
"Some man then thought it would be a kind act to put a kind of hammock or safety net across the valve, to prevent the poor mutts of electrons being dashed to pieces on the figment (or filament). This is known as a grid. If it is made of old tennis nets or some such thing, it is known as a temporary grid. If wire netting and screws are used, then it becomes permanent. It is the duty of the Survey Battery to put the electrons on a grid...

"By the time our electron has changed into a most futile creature known as a heterodyne, or damp osculation, or Auntie's Kiss.

"This now enters a double dyed trioxide, where it is finally converted into an audited fragrancy."

The exercise book had us in stitches, although something could be lost in the telling (or writing), and one has to imagine the scene; a possibly bored military man attending lectures on the subject about which he could know more than the lecturer... AGS (All Good Stuff.)

Many thanks to Mr. Whitehouse for sight of the book.



1984 Amateur RADIO YEARBOOK

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SWR and power meters

Amateur Radio's giant test and review by G30SS

It is always interesting to know just how much power someone else is using, so that you can compare your reports, watt for watt. It is also important to have a means of measuring your own power output so you can tune up the equipment appropriately.

There are many different types of power indication, and much confusion between carrier power and peak envelope power on SSB, and the estimation of maximum carrier power on CW as normally sent, rather than keydown power.

Standing wave ratio, known normally as SWR, gives an indication of how well power is radiated or absorbed by the antenna, and therefore, how much power is actually being returned from a mismatched aerial back down the feeder to the transmitter output or aerial tuning unit.

In this article I am reviewing many different power and SWR meters, covering a wide range of frequency bands in the process. Before reviewing the meters themselves, I thought it might be useful to explain some of the power measurement problems, and what it all actually means.

"Peak power is not only difficult to measure, but is commonly misunderstood."

Real power actually concerns the heating effect that the dissipation of the power would have. Power can be almost instantaneous, or can be variable with time, so one can say that one pulse contains a certain peak power within it, whereas one can talk about average power over a period of time. In amateur radio we are indeed concerned with both average and peak power, and whereas average power is simple to measure, and to specify, peak power is not only more difficult to measure, but is commonly misunderstood or misinterpreted.

There must always be a power loss between the output of the transmitter and the aerial, as relays, plugs and sockets, and coax or feeder cables all give a loss contribution. If the antenna is not matched properly you will also lose some power, but the actual power loss due to relatively minor, or even annoying mismatches can actually be much smaller than you might think. When the SWR in a system is poor, in all probability the direct power loss due to the mismatching itself is of minor importance and usually insignificant, but the effects on the equipment of returned power can often be very serious for one reason or another.

The Department of Trade and Industry now specifies our maximum allowable power outputs as power reaching the radiator of the antenna system, rather than the maximum power output allowable from the transmitter. In changing this ruling, they have actually clarified the situation, for amateurs who might have been using 800w output into their coaxial feeder, which might have had 3dB loss, and thus, 400w at the antenna, could have claimed that the feeder was part of the output tuning and loading circuit of the transmitter.

I am pleased to see "a clearing of the air", for we not only know where we stand, but we are able to make up the power loss of the transmission line (coax, ribbon feeder etc), and all the connections and relays. The new power ratings are all referred to a power of 1w, specified as a 0dB reference, and called 0dB. Remember that a power increase of 10dB is ten times, and 20dB is one hundred times. Please see the power/dB table which may assist you in rating powers in the now official manner.

Sometimes power levels are expressed in dBM, 0dBM referring to a power of 1mW. In RF technology, dBM are normally expressed with respect to 50ohms, but 0dBM is the same power into any impedance, the voltage varying, of course. Please also see in the table dBM/50ohms conversion to micro volts, millivolts, and volts. To put the record straight, RF voltages can be expressed either as EMF or PD. EMF voltages (EMF is electro motive force) refer to a voltage when a source is open circuit, having a rated source impedance of 50ohms, for example.

Herein lies the rub in most power meters!

The potential difference (PD) refers to the voltage across a circuit in its connected states, which can vary, in the example of an oscillator, as the load is itself varied. If you load a 50ohm antenna with a pure 50ohm resistance, the PD would be theoretically half, or 6dB below the EMF produced, but of course the transmission line may act as a transformer if it is not loaded correctly, etc. A station that is apparently being received at a PD of 1uV on one rig may measure a slightly higher or lower voltage on another, and this is because the input impedance may be other than 50ohms. Similarly, if you measure the voltage across your coax, which is, say, 50ohms, you can measure average power only if the transmitter, coax and antenna are all precisely 50ohms *and* you are measuring a continuous and steady carrier. Herein lies the rub in most power meters!.

I also quote in the table, dBM equivalents for 600ohms which are often used in audio technology. Rig sensitivities are often referred to in dBM/50ohms, or in microvolts EMF or PD. Scientifically speaking, dBMs should be used, but sometimes microvolts are easier to relate to, but do note that some reviewers use different standards. Quoting EMF delivered by the generator is actually more specific, but I normally refer to sensitivities as EMF/2 which is the PD that would be developed if an input stage was loading at precisely 50ohms. I use this since it relates more often with specifications,and with figures more frequently discussed in an amateur radio context.

To explain the difference between average and PEP power, let's look at a simple set-up, including two signal generators, both having a source impedance of 50ohms, which are combined in a power combiner whose output feeds an extremely good amplifier, whose output impedance, in turn, is stabilised with an attenuator, with its output feeding a power meter, oscilloscope, or spectrum analyser. The power meter can be switched to average power or PEP.

We will assume that the amplifier is well within its clipping point under all circumstances and everything in the system is as perfect as is reasonable. Both generators have output stages which can vary the output level whilst retaining their 50ohm output impedances. Each generator can be moved in frequency with respect to the other. The output impedance also remains, even when the generator is switched off.

Let's switch one generator on and select a 0dBM output level at a frequency of 1MHz, for example. The amplifier gain is adjusted so that the output average power reading is 10w. We note in passing that if we switch to PEP, the reading is the same. We then add another signal from the second generator which is also set to 0dBM, but at 1.001MHz. We note, perhaps with puzzlement, that whereas the average power meter reading is 20w, the PEP reading is 40w. The carriers are 1kHz apart, and the heating effect, ie., the average power, is doubled, but what is actually occurring is that the waveform is varying from twice the height down to nothing. Power actually relates to the total positive and negative areas within the curve with respect to a 0v axis. Average power corresponds to the addition of the areas either side of the axis integrated with time, but peak envelope power is the maximum power that can be detected over the duration of just one cycle, ie., the power developed over one complete RF sine wave when the peak-to-peak voltage is momentarily at maximum.

The PEP meter should be varying up and down like a yo-yo

In a two-tone test with both generators delivering the same power you can see that with time the power is apparently doubled, but when the 1kHz beat causes the maximum PEP, it is doubles the average power. A PEP meter has to measure these momentary peaks accurately, taking no account of variations in the signal below the peak value.

What happens, though, when the generators are brought closer together? Let's bring them within 1Hz of each other. The average meter will be going up and down quite a bit, depending on its damping and ballistics. The PEP meter, unless it has a peak hold facility, should be varying up and down like a yo-yo, one up and down occurring each second, the highest reading being equivalent to the real PEP. Most PEP meters, though, at least have a short hold time built in, so you may not see any significant variations from 10Hz upwards, but they may flap around with speech, without a peak hold switch.

A normal current meter has no hope of reading the real peaks

It is possible to make a crude estimate of the PEP output with an average meter with a controlled whistle, or more usually the dreaded 'WARLO'! If we assume that your whistle is a very pure sine wave, which it certainly won't be, then the average meter will be measuring the maximum output carrier power capability over the period of the whistle. If you manage to achieve two tones of equal amplitude (I can usually do this on request!), then your average power will apparently go down. You may choose to look at your HT volts, and the PA current, and multiply the two together as a check to get input power. You then might take note of the average power reading, and quote this as your estimated PEP.

You may be driving your rig too hard

You will probably be at least 20% under the real value. On a continuous whistle, the HT voltage will go down by perhaps up to 20%, if your power supply is not very well regulated. But when you speak, speech peaks are so short, that the power supply regulation will be much better, and the HT voltage, therefore, much steadier. Try looking at the HT voltage when your transmitter is on SSB, but you are not speaking, and preferably also have the microphone gain at minimum. There will be some current taken, which then goes up when you speak.

A normal current meter has no hope of reading the real current peaks, so multiplying the HT volts by the current drawn is inaccurate even for measuring input. The speech peaks, particularly if you are not using compression or clipping, may well hardly reduce the HT below the voltage measured with standing current only, but the instantaneous current would be that which would theoretically pass through at the HT voltage present when a continuous carrier went through without the usual HT reduction.

You can now see why you might be running 400w PEP, when your whistle infers perhaps 300w. The intermodulation performance of the PA is, of course, that created at the 400w level and not that created by 300w, so you may be driving your rig much too hard.

These meters are normally moving coil types, and are suitable only for indicating continuous levels. They give the same problems that audio VU meters give on older cassette decks, for example, although a few misguided manufacturers still use them. If we compare a VU meter with a peak reading meter on a tone, they should both read the same equivalent level, but if we put through a pulse having a duration of around 64mS, the peak reading meter should read correctly, whilst the VU meter may under-read the true peak by up to 8dB. On an even shorter peak, such as a passing 'S' or 'T', the VU type meter may under-read by more than 10dB. What goes for the VU meter, also goes for the PA current meter, which will, therefore, under-read speech peaks by at least 6dB. We would not see the full 10dB underreading for two reasons, the first being that the standing current keeps the meter well above its minimum, and therefore it does not have so far to go, but secondly, we are dealing with a considerably reduced bandwidth, usually of around 2.3kHz. This narrower bandwidth reduces the peak to RMS ratio of the human voice.

So often, I hear of an amateur whistling through his transmitter and noting a reading of 300mA, and then turning his microphone gain up so that he gets a similar reading on speech peaks. In all probability he will be splattering all over the place. If the standing current is set at 60mA, then he will probably be peaking 300mA when the meter is indicating peaks of around 150mA.

If a compressor/clipper is in use, then the duty cycle is higher, as the average power is greater, and so you can probably go to a reading of 200mA reasonably safely. If your rig has effective ALC you may be all right, but you will only see a reading of maximum indicated current on long vowel sounds, or whistles. A PEP meter is so much more useful for an SSB or CW power estimation, as it actually shows you what really is going out.

Professionals usually quote return loss rather than SWR

SWR, or more correctly, VSWR, is the ratio between the voltage peaks and voltage minima that would be measured along alength of line which is at least half wave at the test frequency. We thus have the well known expression of SWR as being (Vup + V down)/(Vup — V down). This may be more comprehensible if we have a look at its equivalent in watts up and down. Remembering that as you double the voltage, you multiply the watts by four, the equivalent in watts is (sq.rt.W up + sq.rt.W down)/(sq.rt.W up - sq.rt.W down).

A typical example would be, as measured with a Bird Thruline, 100w up and 10w reflected. This works out at an SWR of just under 2:1, ie., the system needs some attention! The ratio of the powers is 10:1 and so we can also express this as 10dB return loss, and look at a table to see the equivalent SWR. Professionals usually quote return loss rather than SWR as you can more easily see the nature of the problem. A 2:1 SWR on a nominatlly 50ohm system, in fact, means that the effective terminating impedance as measured by the SWR meter is 100ohms or 25ohms, and there is no easy direct way of telling which of these alternatives it is, without changing the bridge impedance to, say, 75ohms. A 75ohm bridge would either measure the SWR as 3:1, or 1.33:1. You could then tell which way the impedance was going. I actually have an almost antique Oscar power/SWR meter which has a 50/75ohm switch on it, but the meter was useless anyway, as it is so inaccurate!.

Things now look nasty, the SWR being not far short of 5:1!

An accurate meter shows you only the SWR existing at the point being measured. Supposing you have a cable loss of 3dB to the aerial, then you can calculate the approximate SWR of the aerial itself, assuming your cable is of the same nominal impedance as the meter. It's very simple, and taking the previous example, we would find that 50w reached the aerial (3dB down on 100w), and the reflected power would be doubled, ie., 20w, since the cable would attenuate the power coming back.

Things now look rather nasty, the SWR being not far short of 5:1! Remember that the cable is dissipating more than half the power, so let's work out what is actually happening to this power. Of the first 100w transmitted up the coax, 50w heats it up and is absorbed by the coax, and is thus radiated as heat. Of the 50w at the top, 20w is reflected and 10w reached the bottom, so 10w of heat again is dissipated. If the transmitter is matched perfectly to the line, it presents a 50ohms load on the return power, and thus the 10w returned does not go belting up the coax again.

But supposing the matching is other than precise. Perhaps the transmitter source may have the same SWR to the line, as the aerial has, and so 4w goes back up again, and 2w is dissipated in the coax. This power is again subject to reflection, 0.8w coming down again, but 1.2w being radiated. To all intent and purposed we see a situation in which, of the 100w originally sent up the coax, just over 31.2w is actually radiated from the aerial, and 61.4w, approximately, heats up the coax, with the remainder being dissipated within the transmitter!

The PA could conceivably pass out with the heat

Many transceivers have an SWR power cut and shut down circuit, and this works by detecting the returned power. 6w is not too much to dissipate within the PA circuit, but if the transmitter is working on or near the limits of power dissipation on a very hot day, and we've had a few recently, and there is no safety shut down circuit, the PA could conveivably pass out with the heat (like the operator!), although more usually it requires much more return power for demolition.

Let's have a brief look at what happens with lower frequencies. The coax loss will be much less, and 75 or 300ohm ribbon loses are even lower, even when there is a bad SWR. You match the transmitter power output to the line with an aerial tuning unit, and so all the reflected power goes up again. Hardly any of this is lost on the way up, and so the reflected power can reinforce that radiated from the first travel.

Unfortunately, there is one more problem to consider, that of the aerial or transmitter mismatch almost certainly being partly reactive. The reflections will then have an additional phase change of many degrees, in addition to the change brought on by the resistive component. This will mean that in certain circumstances the double reflected power arriving at the top may subtract from the first arrival power, and this slightly reduce it. At this point, despite putting a cold, wet towel around my head, I am beginning to show signs of mental fatigue, so I will leave it to discussions on the air, and letters to the Editor!.

Most power meters claim only 10% accuracy

Some people seem to have a fetish for squeezing the last ounce of power out of their rigs. Up go the intermodulation products, and many listeners to the nasty transmissions throw up their hands in disgust. If you back off the power by only 10%, you may be making an enormous improvement to the transmission, but you will lose only 0.5dB, a 20% reduction from, say 10w to 8w only representing 1dB the other end. You can use a power meter to give a measurement of power from a transverter, for example, and then tweak the input sensitivity pot to reduce that power by 20%, which then improves your quality, but also allows you to know that you are not flat topping the transverter.

Most power meters only claim 10% accuracy, and then only at full scale deflection. Many of the meters surveyed are fairly inaccurate, and so be very careful when complaining to your dealer that your linear amplifier is not giving its advertised power, *for it may well be achieving it.* Whether it is giving its proper power or not, it may be straining at the time, but that is another story.

We used a Racal 9303 terminating power meter as an accurate reference standard, haing checked it with various other standards in the lab. We interconnected with it a Rohde and Schwarz 30dB attenuator/load, the Racal head being placed on the output of the load. Various transmitters were interconnected with the load via each different power/SWR meter. We set up various power levels on the Racal and checked the reading of the power meter, this being done at various frequencies covered by each meter. It was essential to use rigs whose power could be varied. The R and S load had an extremely good SWR itself, even at 433MHz.

Well in excess of maximum power

For the SWR measurements, we used attenuator loads, which when left short circuit, presented calculated return losses, and thus predictable SWRs. We looked to see how each meter fared. We also determined whether the meter itself gave an SWR because of its internal connections being mismatched, referred to 50ohms.

We checked the PEP indication on those meters incorporating this measurement facility in two ways. We checked against the reading of a Bird digital power/PEP meter that had previously been calibrated, and we also used a 250MHz HP scope to compare a known, continuous power level with a PEP level. This allowed us to check the accuracy of each PEP meter.

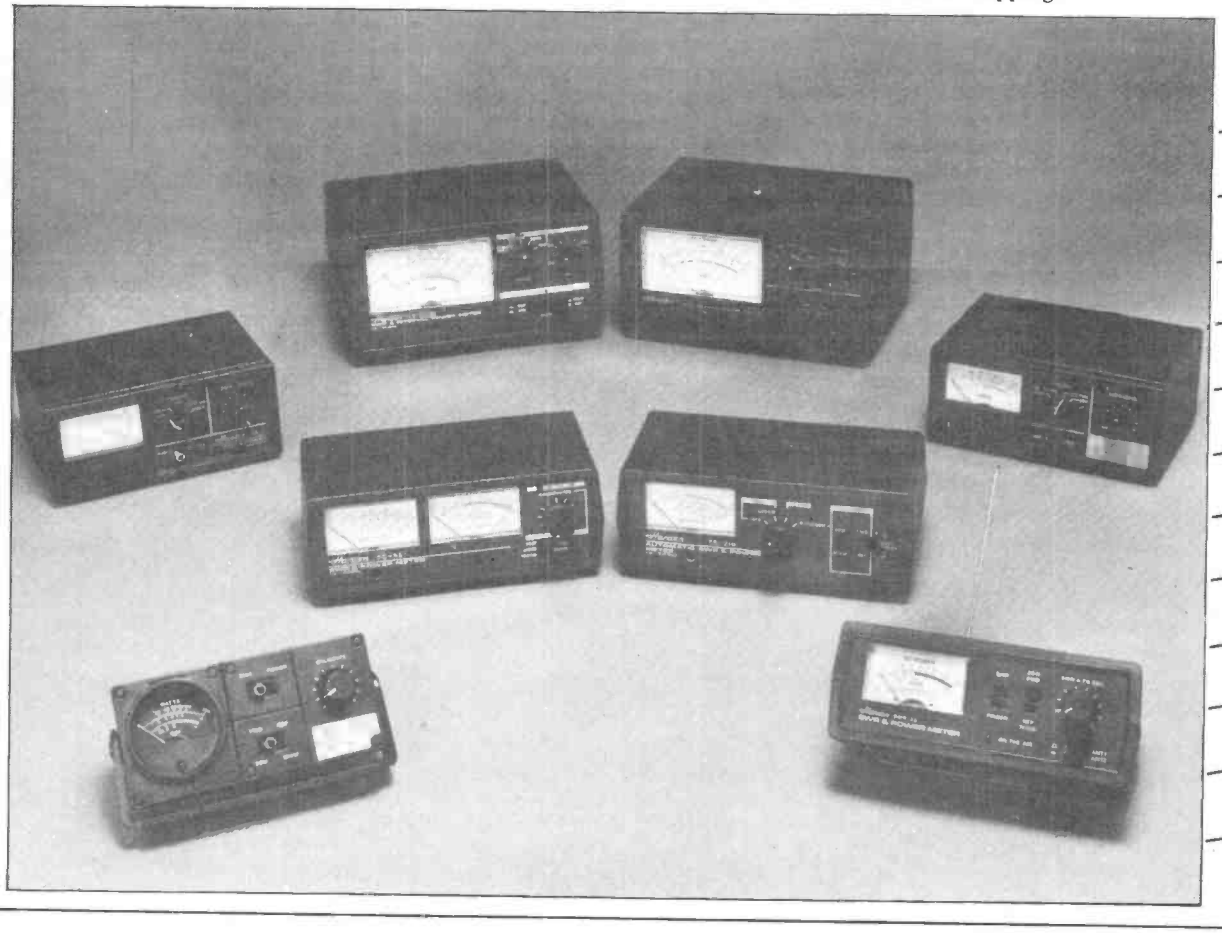
In the power accuracy tests, we checked the readings of three different power levels to get an idea of how the accuracy varied with level. It is in this area that we got some awful surprises! As I had previously had an SWR bridge which required well in excess of the maximum allowable power to make it read properly, since its sensitivity was so low, we checked to see approximately what was the minimum power required in the forward direction to obtain an appropriate SWR reading. Most meters required you to adjust a pot in the forward direction for full scale deflection, and then obtain a reading by switching to reflected, whilst a few meters did all this automatically, which is splendid. We also checked the insertion loss, input to output, to see if any problem showed up.

I was slightly dismayed to find that very few of the meters built for VHF and UHF were supplied with 'N' type input and output sockets, even one of the Bird models being fitted with S0239s because these are marginally cheaper, although Ns are available to special order. S0239 sockets introduce a measureable return loss at VHF, let alone UHF. At frequencies below 30MHz there is no problem, and PL259 plugs of good quality should not give any additional trouble.

Some meters had an automatic SWR position which is extremely useful

Some plugs sold in some CB shops, though, are not so hot, as they have a poor lossy insulator material in them. Many of the meters had more than one forward power range. For example, some of the Hansons had 20w, 200w and 2kW ranges. Some meters had an automatic SWR position which is extremely useful, since you can even obtain a reading whilst you are transmitting SSB or CW. Some meters can measure the returned power, but note the nomograph and return loss/SWR (reproduced courtesy of Bird Electronic Corporation) and you will see that what you might think is harmless (10% power returned is in fact nearly 2:1 SWR).

Most meters, for SWR measurement, require you to send a lowish level and adjust the FSD pot for full scale, and note the SWR reading after you have switched to the appropriate position. A few meters had a PEP position. On continuous carrier, the reading should be the same as for normal average power reading. On SSB, though, only the PEP reading will be correct, and the average reading will be a long way down, unless you are screaming with compression and clipping.



Some meters had remote heads coupling with the line. This allows you to put the coupling head where you like, and position the meter itself where it is most convenient. One Trio meter allowed you to use three separate heads interconnected with three different aerials, without changing connections all the time. Some meters required AC mains, whilst others were 12v DC operating.

Many meters are passive, which may be useful, whilst the Bird analogue PEP meter can be used with internal rechargeable cells, a built in charger also being fitted. It can be quite useful to have an instrument with two separate meters indicating power forward and reverse at the same time, as you can not only see your return power go down as you adjust your ATU, but you can also see the forward power change. You will find it fascinating to watch the SWR as you turn a beam, particularly on HF frequencies. You can actually get marked reflections back into the antenna from nearby objects, including houses and trees. The effect of varying capacity on the antenna's radiator as you turn it can be considerable, and if you can pump it up and down, you will see the SWR change.

Many writers have suggested that SWR is not too important, provided it is better than 2:1. Other things being equal, a 2:1 SWR on the antenna itself, and not as measured in the shack, is not a problem, since you will only lose a small fraction of a dB. What may be a problem, though, is the considerable radiation from the outer of the coax down to the shack. The polarisation of this will, of course, largely be vertical, whereas your beam may be horizontal. If 10% power is coming back again from a 2:1 SWR, then it may play havoc with electronic equipment in your house as well as the neighbours'.

HF TESTS

Power Accuracy at 100/50/25 watt levels as a percentage

Meter	1.9MHz at100W 50W 25W	7MHz at100W 50W 25W	29MHz at100W 50W 25W
Hansen FS601MH	- 6.5 + 3 + 10	+ 3 + 10 + 20	- 10 0 + 6
Hansen FS711H	- 11 - 3 + 4	+ 5 + 12 + 20	- 4 + 5 + 6
Hansen FS500H	- 7 - 8 - 8	+ 1.5 - 2 -2	- 10 + 12 +12
Hansen FS50HP	- 1 + 6 + 10	+ 9 + 12 + 20	- 8 - 2 0
Hansen FS210	- 1 + 12 + 12	+ 2.5 + 6 + 8	- 1.5 0 + 4
Hansen FS5S	+ 4 + 8 + 12	+ 1.5 + 5 + 12	0 + 5 + 12
Daiwa CN620A	+ 1.5 0 + 1	+ 15 + 14 + 12	+ 4 + 3 + 4
Trio SW200A	+ 14 + 14 + 8	+ 11 + 11 + 8	+ 6 + 4 + 2
Hansen SWR3S	- - -	+ 11 + 14 + 15	+ 12 + 18 + 20
Bird 4304	- - -	- - -	+ 8 + 4 + 20
Bird 4381 (100W plug)	+ 4 - 3 -3	+ 10 + 6 + 3	+ 4 - 4 -7
Bird 43 (100W plug)	+ 5 - 2 - 3	+ 12 + 5 + 5	+ 6 - 2 - 4
Bird 4314 (100W plug)	+ 3 - 3 - 3	+ 11.5 + 4 + 3.5	+ 5 + 2.5 - 10

I always thought that the use of an SWR meter was well understood...

I recently changed my LF antenna system from an old G8KW trapped dipole fed with coax, to a more complex trapped system for 40, 80 and 160m, the feeder being balanced 75ohm twin, not screened. I use a balun immediately after the Icom ATU. The interference to household electronics, including TV, hi-fi, computers and test equipment has decreased by at least 12dB, and in some circumstances, 20dB, as the aerial itself goes way above the roof and down the garden. The feeder line routing in both old and new installations is very similar,. so the improvement is due almost completely to the use of the balanced twin feeder, from which the two fields created from the wires almost completely cancel out beyond one metre from the feeder.

I always thought that the use of an SWR meter was well understood, as it is well and truly in the syllabus of the Radio Amateur Examination. The following true story, however, one of the funniest ever related to me, speaks for itself! Some years ago, an elderly radio amateur in the South of England decided he would go back on the air after a break of 20 years or so.

An embarrassing example of ignorance

His favourite band was 80m, but alas, he got terrible reports, and gave them too! One of his local amateurs, realising that there was something very strange going on, decided to visit him and find out what the problem was. After much grumbling about his bad earths, poor aerial, and hills getting in the way (all irrelevant) his friend watched him tune up. All was fine in the forward direction, the power going up and up. He then correctly reduced the power and set the SWR pot for a full scale deflection. He switched to read SWR and started tuning his ATU for a full scale deflection again, ie., an infinity SWR!

Just before he picked up the mic, he said: "There you are, it's 1:1". The reader will appreciate that he was loading up the transmitter almost into an effective open circuit (or short circuit) both on

VSWR into standard loads as measured by meters

Measurements at 29MHz/25 watts
Power to create FSD on SWR calibrate position at 1.9MHz

Meter	1:1	1.2:1	1.5:1	3:1	Sens(watts)
FS601MH	1.05	1.5	1.55	2.9	3.2
FS711H	1.1	1.12	1.6	2.7	3.0
FS500H	1.04	1.2	1.6	3.5	2.2
FS50HP	1	1.1	1.5	2.9	2.2
FS210	1.1	1.2	1.5	3.5	2.5
				* See Review	
FS5S	1	1	1.3	3.3	6.0
CN620A	1.03	1.05	1.44	2.9	5.8
SW200A	1	1.1	1.4	3	2.0
SWR3S	1.15	1.05	1.45	2.8	2.0
4304	1	1.16	1.5	3.2	.
4381	1.1	1.1	1.6	2.9	.
43	1	1.1	1.6	2.8	.
4314	1.05	1.08	1.6	2.9	.

VSWR into standard loads as measured by meters

Meausrements at 145MHz/20 watts
Insertion Loss in dB at 145MHz

Meter	1:1	1.2:1	1.6:1	3:1	Ins.Loss
FS 210	1.2	1.08	1.35	2.24	0.1
FS 5S	1	1	1.3	3.6	< 0.1
SWR 3S	1.2	1.25	1.35	2.9	0.4
FS 7	1.03	1.1	1.55	3	< 0.1
CN 620A	1	1.1	1.48	2.8	0.1
SW 100B	1	1	1.5	2.8	< 0.1
SW 200A	1	1.1	1.43	2.9	0.15
4304	1	1.14	1.6	3	< 0.1

transmit and receive. His friend was so embarrassed and asked for a cup of tea, and while the amateur was organising it, he quickly retuned the ATU for a perfect match. They had many highly successful contacts, but he had to tell his friend that he'd found the fault, corrected it, and now he had to adjust for minimum on the scale instead of maximum, and things would be so much better. This amateur is now happily on 80m, and I would never dream of giving his callsign or location away!

One more story, this time with me as the ignoramous. In the early 1960s I used to enjoy 80m mobile quite a lot, but didn't get out too well. I had tuned the whip for a magnificent low SWR at the transmitter end, and arranged a sked with an amateur in Cornwall who we were going to stay with. We were leaving Bridport, Dorset, and I called him on the appropriate frequency. He came right back to me, but said I was very weak. Almost all the other mobiles on the band were many S points stronger. Not until he looked at the aerial did he explain the problem to me. I had adjusted the whip length for minimum SWR, and not for resonance. A resonance low frequency car aerial is usually very low impedance at resonance. He resonated the aerial with a noise bridge and then measured SWR. It was now about 1.7:1, but in a test with a local, I was nearly two S points stronger over a broader band than I expected, although power fell off beyond a 50kHz bandwidth.

We all have to learn sometimes. So it's best to trim an aerial, especially if it is a high Q one, for resonance and not for best SWR. Note that normal dipoles can still perform well off their resonant frequency as they are not high Q.

We always used the absolute minimum of adaptors, and cable lengths between the power meters, and the R & S load were kept to an absolute minimum. Knowing that SO239/PL259s were regarded by experts as being poor at VHF, very poor at UHF and totally useless at SHF, we thought we would try a fun experiment by making up a string of adaptors, first including several PL259s and SO239s, and then substituting for the later an equivalent number of Ns, including in both strings common adaptors, the PL259 chain having two BNC matings, whilst the N chain was checked with and without an additional single BNC male to female to see what deterioration would occur.

The first chain included N f/f, N m/BNC f, BNC m/SO239, PL259/PL-259, SO239/SO239, PL259/PL250, SO239/SO239, PL259/BNC f, BNC m/N f, then 50ohm load. The 50ohm load used had a return loss of -44dB. All the adaptors used were of the best professional quality, and yet this extraordinary apparition gave an SWR of 1.5:1, ie. 14dB return loss.

We always used the absolute minimum of adaptors

Perhaps this brings home how a few bits of equipment and extension coaxes, and meters, with additional string, can give you a poorish SWR before you even consider the antenna. We then connected up the following odd accumulation: N f/f, N m/m, N f/f, N m/m, Nf/f and then the 50ohm load. The total overall SWR of this, somewhat remarkably, was 1.025:1, ie., -38dB return loss. We then added two additional adaptors, down to BNC and back, which increased the SWR, but only slightly, to 1.05:1, ie., 32dB return loss.

You can, of course, find that a string of miscellaneous plugs, sockets and adaptors could actually correct a mismatch in a particular situation, but of course it could make a perfectly acceptable one unacceptable. What surprised me here was the poor performance of the SO239 on 145MHz, the frequency used for this strange test, but also the fact that the N plugs were clearly superior to BNCs, which might not be relevant on VHF but could be significant on 1296MHz.

Hansen SWR3S

This little meter (having three SO239s) can be switched to feed either of two aerials, which is useful. It covers a frequency range from 3.5 to 150MHz. A 12v DC input socket can provide power for meter illumination, the meter scale being 3.5cms. Most usefully, a field strength probe and socket is provided on the back panel which can be used for determining aerial resonances, the pickup being quite adequate for this, provided you are close, making it particularly helpful for setting up mobile aerials.

On the front panel are the aerial 1/2 switch, SWR/power switch and 20/200w power switch which also selects forward/reverse on SWR. The usual pot provides FSD adjustment for SWR. The insertion loss on 145MHz is a little high,

because of the antenna switch, but the insertion SWR on the same frequency is quite acceptable.

All the power readings at HF were rather optimistic throughout, although readings on 2m were not quite so inaccurate. Very low SWR readings were inaccurate, the 1.2:1 reading better than a 50ohm load. Readings from 1.5:1 upwards were quite accurate though, and this is the best way to have any inaccuracy. On 2m, SWR readings were also a little out as will be seen from the table. At its price of £26.45 inc VAT, it's quite a reasonable buy. A useful little meter.

Hansen FS711H

This is another useful meter having a separate inline detector head with two SO239s for in/out, and a 180 degree five pole DIN socket for interconnection with the meter itself. The connecting lead is 1.8m, thus allowing the head to be placed wherever you need it, and the meter at a convenient position. The meter does not require any energising voltage although it has a 12v DC socket for illuminating the meter scale.

Switches on the front select 20 and 200w ranges, and forward/reverse SWR, a pot being provided for setting forward FSD. The meter itself is extremely small the scale being only 3.2cms long, and thus a little difficult to read, descrimination also of course, being limited. It is rated with a frequency range covering 160 through 10m. The VSWR of the through line was very good.

The SWR reading accuracy was poor for very good figures, but perfectly adequate above 1.5:1. Forward SWR sensitivity was extremely good, and power accuracy varied from good to rather poor. 7MHz at low powers was very optimistic! The price, including VAT is £36.80.

Hansen FS5S

This model is housed in a fairly chunky plastic case with strip rubber feet. SO239s are provided for input and output, and a 12v DC socket can be fed with juice for meter illumination. The frequency range covers 1.8 to 150MHz. There are two meters on the front panel for forward power, and forward/reverse SWR settings and readings.

Switches select 20/200/2kw ranges and power/SWR cal., the usual pot being provided for setting SWR forward FSD. The insertion SWR measured extremely well even on 2m. Insertion power loss was minimal on 2m, so it should be fine across its range.

Power reading accuracy at all levels was quite good for an inexpensive meter, 2m being surprisingly good. All good SWR measurements read even better, so you will get the impression that your set up is a little better than it actually is, although poorer SWR readings were more accurate, which is probably the best way to have it, as the meter will certainly show if there is a problem. This struck me as a useful little meter which is quite reasonably priced as it is very flexible. Note, however, the tendency to under read higher power levels on VHF, which is not unusual. The price including VAT is £37.95.

Hansen FS7

Metal encased, this model is fitted most helpfully with 50ohm N sockets and covers 2m and 70cm. The obling meter has a 5cms scale and is very well presented.

A five position rotary switch selects 5, 20 and 200w power ranges, and forward/reverse SWR. The usual pot provides FSD setting for SWR and a slide switch selects 145 or 433 MHz bands. Even on 70cm, the insertion loss is below 0.1dB which is excellent, whilst insertion is 1.25:1 on 70cms. which is rather high although it is better on 2m.

Medium and high powers on 2m read reasonably accurately but lower powers read optimistically. 70cms though was more accurate and good. On 2m, SWR indications were surprisingly accurate, as the insertion SWR was so much lower, but strangely, 70cm SWR readings were also quite good, possibly due to the instrument's reactive component slightly compensating its own errors at low readings. The price, including VAT, is £41. I can certainly recommend this product for VHF/UHF, and there are presets internally for improving the accuracy if you have a good standard.

Hansen FS601MH

This model is also encased in metal and is fitted with two SO239s for in/output. It has a 2-core mains lead (1.8m long) with a continental mains plug. A mains fuse is fitted on the back panel. The oblong meter has a scale length of 4.7cms, and the frequency range covered is 1.8 to 30MHz. A four position rotary switch selects 200w and 2kw as well as forward and reverse VSWR positions, an FSD pot being provided.

A slide switch selects normal, or PEP power indication. The mains supply is only required for operating the PEP measurement. Insertion loss and SWR were excellent and there is obviously no problem in its use here. On the average power ranges, the meter tended to under read high levels and over read low ones, considerable optimism being shown on 7MHz for low levels! PEP readings were rather pessimistic, so whilst you are putting out more power than you think, which will help you get good reports, beware of the man from the ministry.

Low SWR readings were indicated as being worse than they really were, although high readings were fairly accurate. Most usefully, you can get an SWR indication on the PEP position, so that you can see if voice peaks are causing any problem, eg., flash-over etc.

PEP Measurements

Percentage deviation from equivalent steady state reading

Meter	%Deviation
Hansen FS601MH	- 20.5
Hansen FS 500H	+ 16.4
Hansen FS 50HP	0
Trio SW 200A	- 2.5
Bird 4381	+ 15.4
Bird 4314	+ 4.7

VHF Tests

Power Accuracy at 145MHz
Power Levels 20/50/80 watts

Meter	20 watts	50 watts	80 watts
Hansen FS210	- 5	- 4	- 6.3
Hansen FS5S	- 5	- 8	- 8.6
Hansen SWR3S	+ 10	+ 12	+ 8
Hansen FS7	+ 15	+ 8	+ 6.3
Daiwa CN620A	+ 5	+ 2	+ 3.8
Trio SW100B	+ 10	+ 8	+ 12.5
Trio SW200A	0	+ 2	+ 2.5
Bird 4304	+ 10	+ 4	+ 3.1

PEP readings were fairly easy to observe, the rise time being quite fast, and fall back time not too fast, the damping being reasonable. Approximately 3.2w is required for reading SWR, so it's quite sensitive. The price, including VAT is £51.35, which is very reasonable indeed for the PEP facility, especially as it can be used on SWR. A recommended product, but pessimistic about high power PEPs.

Hansen FS210

Encased in an attractive plastic housing, this unit has SO239s for input and output, and a bug hutch cover on the back opens to reveal a compartment for two PP3 batteries for operating the auto SWR function. The frequency range covered is 1.8 to 150MHz. The meter scale is 4.8cm and is easy to read.

A rotary switch selects off, battery check, SWR automatic, and RF power, whilst slide switches select 20 or 200w, and forward or reverse power, thus allowing you to see the reverse power as well as measuring SWR automatically. The insertion loss on 145MHz was very low, although insertion SWR was 1.11:1 at 150MHz.

At high power levels the reading accuracy was quite reasonable, but lower levels were a little less accurate, though not badly so. Although the SWR reading accuracy was very good at lower power levels, at higher powers the meter gave readings which became more pessimistic, the auto SWR circuits limiting action being more like a compressor as the power went up. On 145MHz a 50ohm load gave a worse reading that a standard 1.2:1, higher SWRs all under reading, ie., too optimistic. On 29MHz it requires only 2.5w or so to read reasonably. The price, including VAT, is £55.20. I suggest this meter is most useful for power measurement, but not so hot on SWR.

Hansen FS500H

One of the larger meters, this model covers the range 1.8 to 60MHz, with SO239s for input and output. It is mains-operated, the two core captive mains lead being 1.8m long with a continental mains plug, the mains being required to operate the PEP facility etc. A fuse is fitted on the back panel. The meter scale is 7.2cms long which is most welcome, and is easy to read from a distance.

A rotary switch selects 20,200 and 2kw power ranges, forward and reverse SWR, an FSD setting pot being provided for forward SWR. Two push switches select normal or PEP power, and hold or faster fallback which is most useful for reading peak powers.

Although the meter read power quite accurately at LF, it under read high power HF, but over read considerably lower HF powers. Insertion loss was minimal, and on 60MHz insertion SWR was very good indeed, and onviously better still at lower frequencies. PEP readings were very optimistic, so that in combination with the power accuracies, PEP was quite accurate at HF, but very optimistic at 7MHz. SWR readings were generally very accurate which is excellent. Sensitivity on 1.9MHz was extremely high so you will have plenty in reserve for all normal applications. Priced at £69.75 this meter seems quite good value for money and can be recommended, especially as you will be able to use it on 50MHz if the band is opened up.

Hansen FS50HP

Very similarly styled and with the same back panel facilities, as the FS599H, this large meter has a rotary switch selecting off, SWR (automatic), and three power ranges; 20,200 and 2kw.

Two push switches select normal or PEP power, and indication hold or variable integration time, the latter being adjustable with the front panel pot. It has a frequency range covering 1.8 to 60MHz. Insertion loss and SWR were insignificant. Throughout the bands on which it was tested, low power readings were pulled up too much compared with the high power ones, so in the factory it must have been mis set (NB: extremely optimistic for low power on 7MHz, but slightly pessimistic for high power on 29MHz. PEP readings coincided with the equivalent normal power ones on lower integration times, but as this was made longer, readings became very optimistic. The hold function worked well and was useful.

Like other Hansens, the inside is festooned with presets

SWR readings were accurate from low to high which is most creditable. The SWR sensitivity was high which allows the meter to be used, at very low power levels. What is particularly helpful is that SWR readings were stable when power was altered from low to very high. Like many of the other Hansens, the inside is festooned with presets, so it could be set up more accurately on power readings, although the SWR side didn't require any recalibration. Although a circuit diagram is supplied, there is unfortunately no alignment procedure included, which is a pity because many folk would like to set up this model accurately with external equipment.

Power dBW-to-Watts conversion table

Power (dBW)	Power (watts)
-60	0.000001
-30	0.001
0	1
3	2
5	3.16
6	3.98
9	7.94
10	10
15	31.6
16	39.8
20	100
22	158
26	398
30	1000
60	1000000

Even so, this is a recommended model, and no doubt other samples would be calibrated better, but the odd one might be worse. The price is £89.70, which is reasonable for such a useful instrument, the PEP facility working of course, on SWR. I have used an earlier version of this model for some years which has proved satisfactory, mine omitting the variable integration time though, being the model FS710H

Trio Kenwood SW100B

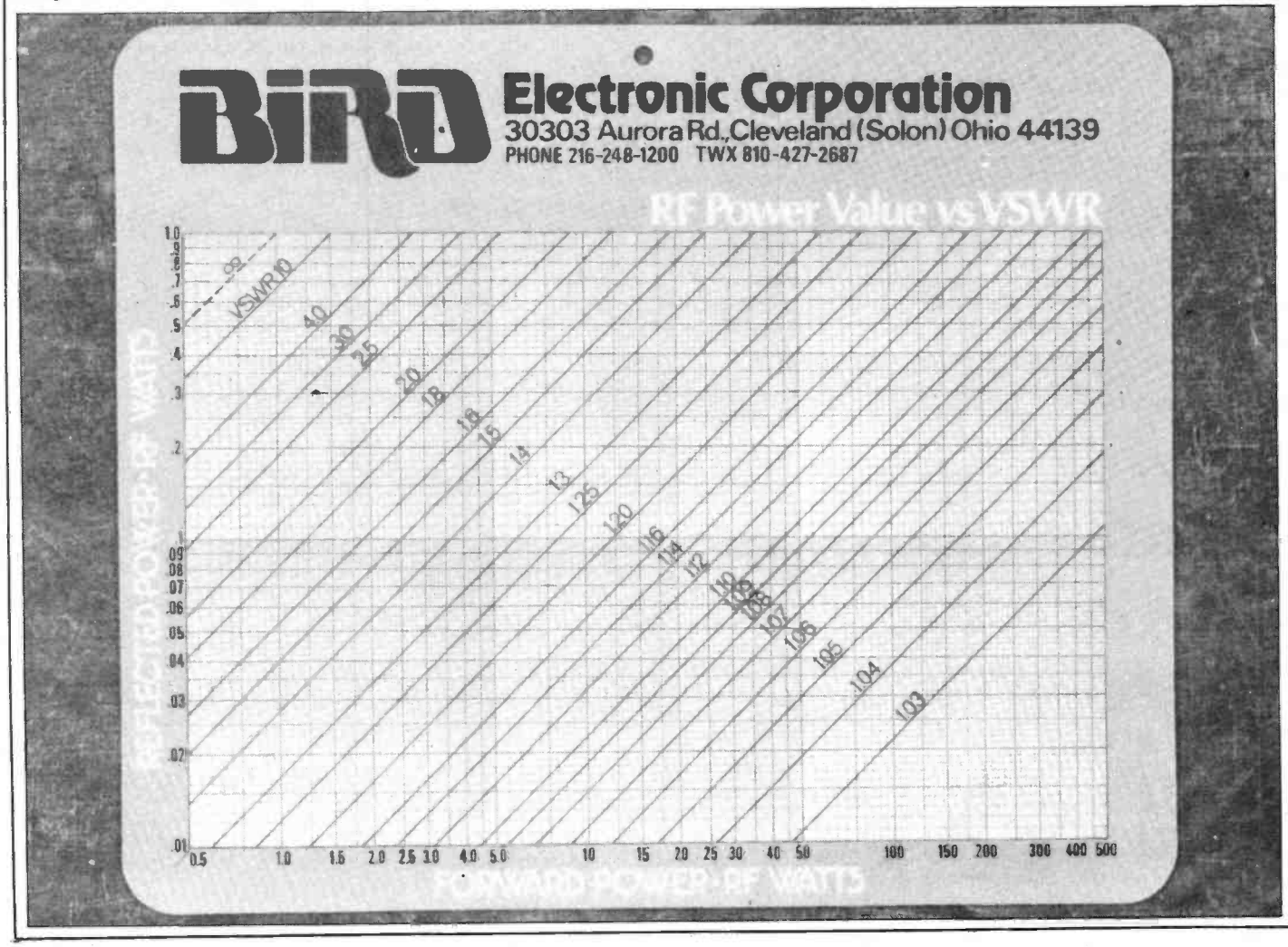
This very small meter is mounted in a cradle and is suitable for home or mobile use as the cradle has a Velcro pad on the bottom which is really useful. It is operated from 12v DC, required only for meter illumination, and has a separate measurement head with two SO239s for input and output, the extension lead being 1.35m. The 12v lead is 92cms which could be a little trying. The frequency range covered is 140 to450MHz.

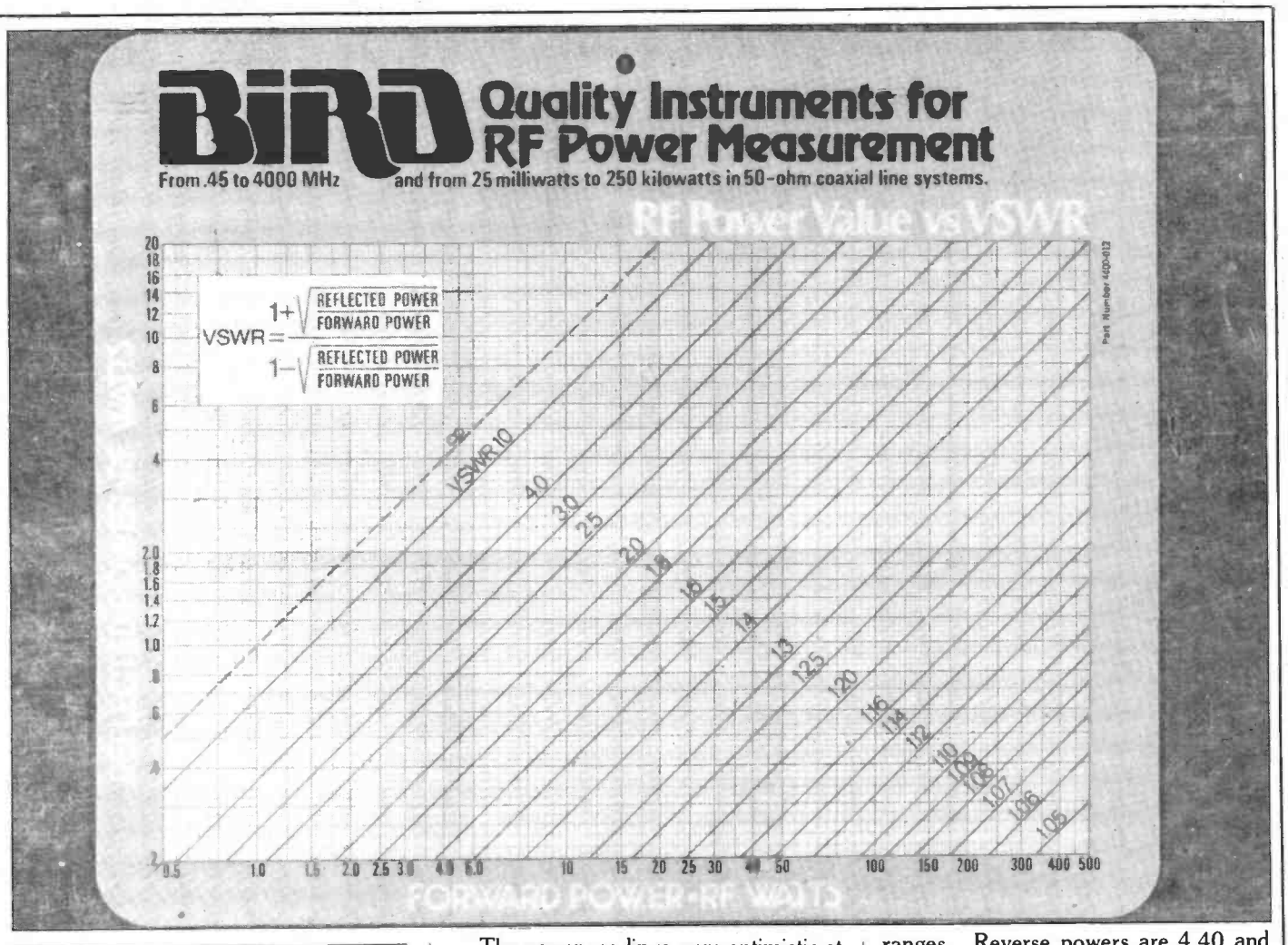
On the back of the plastic housing is an illumination switch, whilst on the front is a three position switch for power/SWR forward, SWR or battery check reading. On the side is an edgewise pot adjuster having an off switch for power measurements, whilst when switched on, the pot becomes one for setting forward FSD for SWR. A small LED indicates power on. The meter scale is 3.5cms which allows readings to be seen fairly well. Only one power range is incorporated, 150w FSD on both 2m and 70cms. Whilst the insertion loss is insignificant on 2m, it is just 0.25dB on 70cms, partly due to the inappropriate SO239s. Despite these though, insertion SWR on 459MHz was just 1.1:1 which is fairly harmless.

All the power readings on VHF averaged 10% optimistic, but at least this was consistent. It was very accurate on UHF at the levels checked which is splendid. We noted though that the scale is rather cramped above 60w. SWR readings on VHF were surprisingly accurate, but UHF readings rather optimistic. Sensitivity was more than sufficient to obtain SWR readings on low power. The price of this little box complete with remote head is just £37.26 which seems reasonable for the dinky little model which could be useful for mobile applications.

Input VSWR of meter at highest frequency of its range

Meter	VSWR
Hansen FS 601MH	1.02
Hansen FS 711H	1.04
Hansen FS 500H	1.05
Hansen FS 50HP	1.06
Hansen FS 210	1.11
Hansen FS 5S	1.03
Hansen SWR3S	1.07
Daiwa CN620A	1.11
Trio SW200A	1.04
Trio SW100B	1.11
Hansen FS 7	1.25
Bird 4304	1.4 at145MHz: 1.01 at 435MHz: 1.03
Bird 4381	1.04 (at1000MHz)
Bird 43	1.03 (at1000MHz)
Bird 4314	1.04 (at1000MHz)
Bird 4314 with RF sniffer	at1000MHz: 1.29:1





Trio SW200A

Trio's new power meter is encased in metal and can accommodate up to three completely separate heads so that they can each be left in circuit on appropriate aerials. A 12v input is provided, with a 1m connection lead, whilst the single head, covering 1.8 to 150MHz, has an interconnection lead 1.45m long, sockets on the rear panel accepting three 180 degree give-pole DIN plugs. The meter scale is 4.7cms for each of two indicators on the front panel, one indicating reverse power and SWR, whilst the other reads forward power.

A three position switch selects the required antenna line coupler, whilst lever switches select power/SWR cal/SWR read, reflected power 100w/10w, forward power, 200/20w and average or PEP. An FSD preset pot sets forward SWR. An LED indicates when the PEP mode is switched in, and three LEDs are provided to indicate that power has been switched to the required head from the transmitter to remind you that it is on and the head is live. All the heads unfortunately are fitted with SO239s, and Trio really should improve on this for their UHF head, (not supplied). We could only check the meter up to 145MHz, but insertion loss here is 0.15dB which is insignificant, whilst insertion SWR was actually very good.

The power readings were optimistic at LF but reasonable at HF whilst on 2m readings were remarkably accurate throughout which is most creditable. PEP accuracy was extremely good, so on 10m it would actually be more accurate than average. On 2m, the PEP readings were as accurate as my test equipment! SWR readings at 29MHz were only marginally optimistic, 145MHz readings also being reasonable. The sensitivity for SWR FSD was very good, so all in all I rather liked this meter which is so flexible in operation, but I wish the LF power accuracy could have been better. Recommended though with a price tag of £80.50 including VAT with one head. Additional heads will be available shortly but the price has not yet been fixed.

Daiwa 6N20A

Daiwa make an extremely useful range of accessories including power supplies, aerial tuning units and power/SWR meters. The plastic casing is slightly flexible; perhaps this could have been a little better. The unit is passive, and covers 1.8 to 150MHz, the input and output sockets being SO239. The meter scale is 4.9cms, and the meter has two needles which can criss-cross with their bearings at bottom left and bottom right of the meter panel. A scale is incorporated which allows you to read SWR from the intersection of the two needles, one needle indicating forward power, whilst the other one reads reverse.

One large knob selects 20,200 or 2kw ranges. Reverse powers are 4,40 and 200w, so you can more easily see what is going on. LEDs light up when RF power is passed through the instrument. Insertion loss on 145MHz is minimal, but SWR is 1.1:1 which although harmless is a pity, presumably due mainly to the SO239s. The power accuracy was extremely good on top band, but quite optimistic on 7MHz, but excellent again on 29MHz. On 145MHz it was quite accurate which is most welcome. What is particularly fascinating is that this meter is very accurate indeed relatively at different power levels, thus allowing you to know where you are if you can obtain one power calibration for each band used.

SWR readings were optimistic at the lowest levels, but became more and more accurate for worse SWRs which is how one would ideally want an error to be. Obviously it would be better still if very good SWRs were accurate, but this is too much to expect really on a passive instrument.

It was more accurate on 145MHz in SWR indications, and the sensitivity generally is adequate, but not good, as it will need nearly 6w on 1.9MHz to obtain a reading, which is precious near the legal limit for a CW carrier! The meter is fairly easy to read and very simple to use, though sometimes we found it difficult to see the correct indication line. Recommended as a simple little instrument, but priced rather high at £57, no doubt because of the complex meter instrument.

Bird 43 Thruline

This incredibly useful meter has been a standard for years and years in many a professional installation, as well as in being used by serious-minded amateurs. The basic simplest version incorporates a coaxial line feeding from one side to the other of the instrument, and terminating with any desired socket type, sockets being rapidly interchangeable with a Bird-patented system. Female Ns are normally supplied, and the meter can be used right up to microwave with extremely low insertion loss and SWR problems, 1,000MHz for example presenting only 1.03:1.

A plug in is needed for the required frequency band and power level, for example, 2 to 30MHz, 100 to 250MHz, 400 to 1000MHz etc. FSD powers are available in a 1,2.5 and 5 sequence from 1w to over 1kw, but on the lower frequencies lower power plug ins are not available other than in special cases. So the lowest plug in covering HF, is 100w. These plug ins can be turned so that the meter reads forward or reversed power, the meter scale (5.7cms) having 25,50 and 100 FSD marks. The meter is very easy to read and use, but it is not easy to see below 1% FSD power, ie., around 1.2:1 SWR ref full range power. You can however insert a lower power plug in for reading very good SWRs, but you have to be careful not to rotate a sensitive plus in inappropriately to forward. Note that the normal Bird meters read only power, although a table is supplied with which you can read off return loss and SWR, a nomogram also being available for SWR indications. The British agents, Aspen in Ruislip, Middlesex, have allowed us to reproduce the nomogram.

The FSD power accuracy is claimed to be within 10%, and with a 100w plus in on LF, FSD accuracy is far better than this, although at 7MHz it was just outside spec at FSD. We were well within spec again on 10m, and lower levels were also of almost equal accuracy. VHF, UHF and microwave plus ins were, in my experience, at least as accurate as the one tested. So it seems that we have hit the 100w one rather under the belt at 7MHz!

Reverse power readings were very accurate, but because it was difficult to see very low SWRs, these are inaccurate, but become easier to see when you change to a lower plug in. The unfortunate thing about this instrument is not only its high basic price of £129 plus VAT, but the additional cost of the plug ins from £45 to £94 plus VAT, which is rather crippling for the radio amateur. If you can justify the cost, I can heartily recommment the 43 as it is so useful.

Bird 4304 Thruline

This instrument has just been introduced for those who do not want to spend a fortune on plug ins. It is identically styled to the 43, and incorporates the same coaxial line principle. For some incredible reason, the review sample was fitted with SO239s, and you have to pay extra for Ns, which is a bit much!.

A switch selects forward to reverse power, whilst another gives ranges of 15,50,150 and 500w FSD, just right for average amateur use, and for many professional applications. It is rates to operate from 25 to 1000MHz, which means that it does not cover LF unfortunately, although you could probably use it below 25MHz. No calibration multipliers are given below 25MHz. Unfortunately, you have to multiply the reading by 2.3 times at 25MHz although from 100 to 1000MHz the multiplier is 1, thus giving direct measurements in this range.

A BNC socket at the back of the right hand side most usefully gives a sniffed RF output at around -43dB +/- 5dB for interconnection with a spectrum analyser or scope for example. At frequencies below 500MHz, insertion loss was below 0.1dB, but when we measured the insertion SWR at 1000MHz, we nearly fainted at 1.4:1, thus proving the ineptness of Bird's SO239s! I must admit though that insertion SWR on 432MHz was extremely good, so I forgive them slightly!

From the middle to the top of each range, accuracy was very good, but low powers on the 150w FSD range were extremely optimistic, so it is better to change ranges where possible. At VHF accuracy was better, but low levels were still optimistic. At UHF accuracy was excellent. Reverse power readings were always extremely accurate from full scale down to 1/25 of FSD, but unless you could switch sensitivity, very good SWRs were difficult to see. Within the accuracy of one's eyesight for lower meter readings, VHF and UHF readings were very accurate. When using a Bird for SWR nulling, the basic principle is to get the reverse power down so that the needle barely moves when the transmitter is switched on and off. This works well in practice.

This meter is expensive at £235 plus VAT, but is a nice reliable meter for professional use, but I have to mention that a wire had come off the switch on delivery of the review sample in the reverse power section, but we soon put it right. Recommended, but for goodness sake, buy it with N sockets. The meter would probably be perfectly satisfactory on 1.3GHz although Bird do not acknowledge this.

Power to create FSD on SWR calibrate position for VHF meters (watts)

SW100A	3 watts
FS7	1.5 watts

UHF tests

Power Accuracy at 10/100 watt levels as a percentage at 435MHz

Meter	10 watts	100 watts
Trio SW100B	-3	+ 2
Hansen FS 7	+ 5.7	+ 4
Bird 4304	+ 2	+ 4

VSWR into standard loads as measured by meters

Measurements at 10 watts on 435MHz
Insertion loss at 435MHz

Meter	1:1	1.2:1	3:1	Ins. loss (dB)
SW100B	1.05	1.05	2.4	0.25
FS7	1.1	1.1	3.1	< 0.1
4304	1	1.05	3	< 0.1

Power dBm-to-uV PD across 50ohms

Power (dBm)	PD (uv)
-147	0.01
-127	0.1
-120	0.22
-107	1.0
-100	2.2
-80	22.4
-60	224
-40	2240
-20	22400
0	224000
+ 30	7070000
+ 60	22400000

Power dBm-to-PD across 600 ohms

Power (dBm)	PD (uV)
0	770000
-60	770
-120	0.77

Bird 4314 Thruline

The model 4314 is identically styled to the 43 but has the additional feature of incorporating a PEP reading function. The same plug ins are used, and the through line is identical. As with the 43, there are two receptacles in the sides for storing spare plug ins. This model incorporates a nicad battery pack, a socket being fitted for interconnection to the mains for charging with the internal built in charger. A large mains fuse is incorporated. A battery check spring-loaded button is provided whilst another spring-loaded one when pushed in, selects PEP, and if it is turned, it can be locked on.

A mains voltage selector selects 115 or 230VAC nominal mains volts. Insertion loss and SWR is extremely low, and identical to that of the model 43, and power reading accuracy is virtually the same. Reverse power and calculated SWRs are also very similar. The average PEP readings on speech or CW are only very slightly high, although the first transient of a series of peaks, eg., when you first transmit and speak, is considerably over read, but the meter settles down, after a second or so, to give extremely good readings.

The internal batteries last for many hours, but very frequently, I have absent-mindedly left the meter on the PEP position and thus flattened the batteries overnight. Full charging takes several hours, but you can use the instrument with the mains charging lead plugged in provided the batteries are functioning. The meter covers the same range as does the 43. The price is extremely high at £540 plus VAT without plug ins, but it is, after all, a splendid professional analogue instrument which is useful for many applications.

Bird 4381 Digital Thruline

This remarkable instrument, a fairly recent one in Bird's range, is completely different in style, although possessing the same Thruline for measurements. Normally fitted with N sockets, the meter requires two plug ins with a power ratio of 10:1, although other powers can be used requiring you to recalculate.

The readout is digital, and this can be switched to read forward and reverse CW or PEP power, return loss in dB forward and reverse dBm, VSWR and percentage modulation for AM, useful for showing linear amplifier ripple for example. Addditional buttons select maximum or minimum readings from the built in memory or delta to indicate increasing or decreasing of any parameter. Small switches have to be set for the power of the forward plug in. Either plug in can be rotated to read forward or reverse so that the meter can be used backwards or forwards, as it were. A socket on the rear panel can be fitted to allow Bird's I.EEE adaptor to be used, thus the equipment can be operated remotely by computer control. A charging jack is fitted on the back.

This instrument is fantastic in its operation, but you will have to spend a fortune on the plug ins! SWR and return loss will only operate with forward powers above 10% full scale power and this is rather a bore on HF where the lowest power plug in is 100w, ie., you have to put 1kw for forward, and 100w reverse, and send more than 100w through unless you put a cold wet towel round your head and use two 100w plug ins! The same plug ins are required as those used in the model 43.

There are advantages and disadvantages in using a digital meter, for it is more difficult to see a reading that is varying, but more definite in obtaining fixed readings. We found that power indications were extremely close to those of the model 43, the PEP readings tended to be rather optimistic compared with the oscilloscope method that we used to check it, the indication normally being rather difficult to see as it was bobbing up and down with flashing numbers. The maximum facility seemed to take into account some initial over-read, but probably a computer could cope with a stream of figures and give a more accurate overall picture. A pure 50ohm match indicated 1.1:1 but higher readings were very accurate. Even at 1GHz the internal SWR insertion figure was just 1.04:1 which is extremely good. At lower frequencies the instrument was virtually perfect.

And now the price tag: £634.50 plus VAT, *plus* around £700 for the IEEE or RS232 interface box which can also power the meter. We found programming to be extremely simple, using an HP 85/I.EEE interface, and obtained useful print outs very quickly, the instructions being reasonably good.

This is not really an instrument for normal radio amateur use because of the digital readout and the PEP over reading tendency but it is a superb piece of text equipment which establishes a very high standard for checking an installation generally. No faults developed in use but you would expect superb reliability anyway.

I have tried to select meters for all purposes in this survey, and frankly we have all been almost knocked sideways by the amount of work involved, which we hope the reader will consider worthwhile. Many friends and colleagues have assisted in the project including Simon Roberts G8UQX, Mike Hatch, and Miles Capstick G4RCE, who did much of the hardest work, and who is now cheesed off with power meters!

It seems that the main problem with many of the meters is their inaccuracy at low levels, or relative accuracy between levels. I wish a little more care could have been taken in manufacture to calibrate them at one specified level and frequency really accurately, but even the Birds were not quite right, although within their specifications.

Many of the meters had internal presets so that you can adjust them yourself using a really good standard, but the problem is that such standards are unbelievably expensive, or difficult to drag away from standards laboratories! There seems to be no doubt that none of the meters was poor overall, for all of them are so much better than the cheapo apparitions that have been on sale in the past, and are probably still available in shops that specialise in other-then-true amateur radio equipment.

I can remember testing some ghastly CB SWR meters which were worse that useless. It is worth paying a bit for a good instrument which should be an investment for years. **Remember that 10% inaccuracy in power reading is only $^1/_2$dB, so perhaps even the worst meter is not really so bad!**

Personal thanks to Aspen Electronics, Lowe Electronics and SMC for loaning the instruments for quite a long period, and for allowing me to perform very cruel tests on them. I don't think we've blown jup any of them despite all the complicated power tests. Since every meter had its good and bad points, I am not coming out with any clear best buys, and I would not like to be said to be prejudiced, other than for my dislike of SO239 sockets.

Conversion table SWR return loss

SWR	Return loss (dB)						
17.3910	1	1.7849	11	1.1957	21	1.0580	31
8.7242	2	1.6709	12	1.1726	22	1.0515	32
5.8480	3	1.5769	13	1.1524	23	1.0458	33
4.4194	4	1.4985	14	1.1347	24	1.0407	34
3.5698	5	1.4326	15	1.1192	25	1.0362	35
3.0095	6	1.3767	16	1.1055	26	1.0322	36
2.6146	7	1.3290	17	1.0935	27	1.0287	37
2.3229	8	1.2880	18	1.0829	28	1.0255	38
2.0999	9	1.2528	19	1.0736	29	1.0227	39
1.9250	10	1.2222	20	1.0653	30	1.0202	40

By Glen Ross, G8MWR
News and topics of interest for the bands above 50MHz

Circulation is up!

Circulation in this case being Oscar 10. In case you did not know, the name Oscar is derived from Orbiting Satellite Carrying Amateur Radio! We went into a fair bit of detail last time as to the frequencies involved and the power levels required to work through the machine. All of that news was based on preliminary information, but how is it working out in practice?

Right from the start there have been problems. At least the rocket went in the right direction this time, but when the satellite was released the rocket managed to bump into it, doing a bit of no good to the mechanism used to put it into its final orbit. From the first orbit the data coming down on 145.810MHz was received at fair strength. There is a CW news broadcast on this frequency on the hour and half hour which gives a lot of information on the current status of the machine. So far so good.

The machine at this time was in a preliminary orbit. There should then have been a move into an interim orbit followed by (would you believe) a push into the final orbit. This is where things started to go wrong. The 'burn' into the interim orbit was longer than first expected, and due to the fact that fuel had been lost in the original bump, the final orbit has not been achieved.

"Somehow the rocket managed to bump into the satellite, doing the mechanism a bit of no good."

So what is the state of the art at the moment? Well, the main point is that the satellite is in a highly elliptical orbit with a maximum height in excess of 35,000km. This means that it can see an awful lot of the Earth's surface at any one time, and that the worldwide coverage has now arrived on VHF. It really is exciting to hear places like Australia, Japan, Korea, Mexico and other exotic prefixes on the two metre downlink. Hearing them is one thing, but what are the requirements to enable you to talk to them?

"If anyone out there has a foolproof anwer to this problem we'd like to hear from them"

My own system runs about 70 watts to a 48-element Multibeam on 435MHz (allowing for feeder losses). The 145MHz aerial is an eight-element Swiss quad, with a 1dB noise figure pre-amp at the masthead, and the aerials are at about 40 feet above ground. In other words a fairly typical set-up. I can hear my own signals on the downlink, but not normally better than about S2. It would improve matters by an S point or two if the aerials were helical, but the system as it stands is giving usable results. There are some very strong signals coming down, but these appear to be from stations running very high power and large aerial arrays. It is possible to hear these signals using something like an FT290 and a colinear! So take a listen; you could be very surprised at what you hear.

The real problem at the moment is that the very strong boys are taking more than their fare share of the downlink power, which of course is shared amongst the signals in proportion to the strength on the uplink. There is a facility which allows attenuation of the signals through the satellite to help to reduce this problem. In practice this will not really improve matters because ALL the signals are reduced by the same amount, so the big boys will still get through and most other people will start to look for ways to increase power so that they can compete.

This is a problem that has been with us ever since the first amateur radio satellites went up some twenty years ago, and indeed as long as there has been amateur radio. If anyone has a foolproof answer to this problem we would like to hear from them.

The ultimate answer would seem to be the idea now being put forward, for a very large metal reflector to be hung up in space. This would simply reflect the signals which hit it. You would then be able to work all round the world without a relaying system, and hence will be eligible for all the normal DX awards. There's a thought to conjure with!

Come fly with me

The me in this context being W5LFL. He will be a member of the STS-9 space shuttle crew, which is due to take a ride into space on the 28th of October. He has permission to take a two metre handheld with him, and will be looking for contacts as he flies overhead. Due to the fact that American handhelds move in 20kHz steps there may be some problems, and it seems likely that most operating will be done on 145.550MHz.

It will certainly be our first chance of working a man in space, and I have a feeling that the 'pile-up' is going to be something special. The fact that operating time is going to be rather restricted is not going to help matters. And the best of luck to you.

The Belgian affair

At the moment this seems to have ground to a halt, although there will be plenty going on backstage I have no doubt. There was a proposal to introduce a novice style licence allowing 15 watts of FM to be used anywhere on two metres. It seems that this was the result of a lot of pressure being placed on the Belgian authorities by the national CB groups.

"This seems a sensible compromise and could, perhaps, form the basis of a novice system in this country."

These proposals have now been amended, and the current one would allow 15 watts of FM, between 145 and 145.8MHz, after taking a simple exam. This seems a sensible compromise and could, perhaps, form the basis of a novice system in this country. Your comments would be interesting.

It's up t'committee, lad

The long awaited report of the Merriman Committee has now burst forth upon an eager world. This is the one which outlines what is likely to happen between 30 and 960MHz over the next few years. How much of it affects the amateur radio world? Nothing at all as far as we can see at the moment. At least it seems that no one is going to get away with any of our allocation in that region for some time. Or perhaps we have heard that one before, somewhere!

Opening time

It is a fairly widely held opinion that openings on the VHF bands start on 144MHz and then work up in frequency. In fact this could not be further from the truth, and 432, or even 1296MHz can well open when the two metre door is only ajar. Only a few nights ago I was working into the continent on 1296 when both 144 and 432MHz were dead. Do not assume that the bands are dead simply because you can't hear anyone when you tune around. I keep getting this picture of fifty people all tuning the band and switching off in disgust. If everyone made a point of calling CQ whenever they tune the band activity would increase dramatically. Why not give it a try?

Here and there

Overheard on two metres: "The QTH here is London, there." "The name is Jack, there." (he meant here). Why do people add "there" at the end of nearly every sentence? I am sure that they do not do it in normal conversation (there), but on VHF (there), it seems to be the normal thing (there). And what about the fellow who calls CQ and then informs us that he is listening "For any POSSIBLE call." What would he do if he received an impossible one? Again, heard on the local repeater only last night: "You are a fully quieting signal on the box, but I missed the QTH due to the noise on your signal." You work it out, I can't. QRZ? is not the same as CQ. It means "who is the station calling me?" and should be used only if you have missed the callsign of the station who is calling you. Small points perhaps, but well worth thinking about if you take an interest in your operating standards.

The LF end

The decision to issue licences to only forty people for operation on the 50MHz band did not go down too well with a lot of people. This was perhaps a pity because at least we have now got a foot in that particular door, and there is nothing to beat putting in a claim to a new piece of territory. As far as we know no problems have come to light, so we must at least be in with a chance. Those licenced to use the band are having a great time, despite the fact that the conditions on the band are now well passed the peak.

Contacts have even been made over the Atlantic into Canada, which would certainly not have been expected at this point in the sunspot cycle. It is about thirty years ago that we lost the band to the TV system, and the equipment available now is vastly superior to anything that was even dreamed of at that time. For those who are taking their first look at the band, remember that we are allowed to use it only outside TV hours, which is limiting. Point your beam to the South and listen for the Gibraltar beacon, or listen for GB3SIX. This is a band which has great potential and should eventually be available to the class B operator.

Glen Ross, G8MWR, first got involved with wireless in 1940 when he built an ST 300 kit, (and it worked). His interest in the bands above 50 MHz can be traced back to membership of the VHF Listeners Club in 1948. He is currently active on 144, 432, 1296 MHz, and 10 GHz from his QTH in Coventry, and is well known for his talks on microwave equipment.

You score each session as though it were a separate contest, but, if you are entering for the contest, you add the score of the three best results to obtain your total points. This means, of course, that you can miss two of the events and still submit an entry. The same stations can be contacted on each evening of the contest. So when is it all happening?

On 432MHz on the 7th October from 1930 until 2200 GMT and on 23rd October from 2030 until 2300 GMT. The times for the 1296MHz events are the same and the dates are the 15th and 31st of October.

Over the weekend of the 1st and 2nd of October you could really extend yourself and have a crack at the RSGB UHF/SHF contest. This will enable you to get involved on any amateur band from 432MHz to 24,000MHz. The contest times are 1400 to 1400 GMT and the event coincides with the IARU region one contest, so contacts into the continent should be available. (If you manage to do that on 24GHz we want to know about it). Looking forward into November, class A persons can make a note of the 144MHz CW contest, which will be held on the 5th. This may very easily produce some fireworks.

That's it for this month. Lots more news availble, but suffering from a lack of space. As the lady says: "That's life". Let's see if we can slide another bit passed the editor. *Practical Wireless* tell us that they have now sold 1,000 of those microwave dishes to the Great British public. That must mean a lot of people building for 10GHz. The Microwave Society membership is growing rapidly, and the possibility of building a complete transceiver for around thirty pounds can't be bad.

Don't forget to let us have your news and views on any matter to do with the top frequencies. See you on 10GHz?

"Contacts have even been made over the Atlantic to Canada, which would certainly not have been expected at this point in the sunspot cycle."

There are several contests taking place this month which are of interest to the Metrewave person. The 432 and 1296MHz cumulatives are always interesting affairs and, if nothing else they do give you the opportunity to catch up on some of the squares you still need. For the newcomer to the contests a little explanation may be useful. Each leg of the contest runs for a period of two and a half hours on each of five evenings, with a gap of two weeks between each session.

•PROCEDURES• 6

Technical Editor Nigel Gresley continues his dissertation on the language of Samuel Morse. Literally translated, of course, it doesn't mean anything to the layman. But it's an easy matter to interpret those rows of letters.

Here we are again, back with Mr Morse's Code and seeing what it can do. You'll remember that last time we were listening to GM2ZZZ calling CQ from Moffat in YP55d and he'd been answered by G2YYY in Cambridge, AM61b.

QTH locators are used by almost everyone for CW because they describe the actual location quite accurately and it's a good deal less tedious to send, say, ZM35c than Moreton-in-Marsh when the QSB is violent and signals aren't exactly setting the driven element of your beam on fire anyway! This, of course, isn't true for HF CW contacts but for VHF CW ones within the UK and Europe you'll find the QTH locator used a lot. It's sometimes known as the QRA locator, and Bill, G2YYY, used QRA in his reply to GM2ZZZ - he said that his QTH in Cambridge and that his QRA locator was AM61b; well, yes, but it isn't strictly correct to use QRA in this way.

If you want to be posh and proper, you could simply say QTH AM61B AM61B CAMBRIDGE CAMBRIDGE and save some extra sending and the chance of confusing the chap at the other end. Most continental stations don't know what QRA means either, so it's better not to use it at all.

Anyhow, back to these two gentlemen. Last time we got as far as copying the CQ call from GM2ZZZ and the reply to the call from G2YYY and then GM2ZZZ had the first over. It went:

G2YYY DE GM2ZZZ GE OM ES TNX CL UR RST 529 529 529 IN QTH YP55D YP55D MOFFAT MOFFAT NAME GEORGE GEORGE HW? G2YYY DE GM2ZZZ KN

And back came the reply:

GM2ZZZ DE G2YYY R R FB GEORGE UR RST 549 549 549 IN QTH CAMBRIDGE CAMBRIDGE QRA AM61B AM61B ES HE NAME BILL BILL OK? GM2ZZZ DE G2YYY KN

Last time we looked at GE, meaning Good Evening; you can also gear GM and GA, meaning Good Morning and Good Afternoon respectively. OM is Old Man, universally used at first in CW when you don't know the other chap's name. We also looked as ES, TNX and CL. So let's carry on and suss out what else is being said here.

Firstly, GM2ZZZ gives G2YYY his report, and you'll notice that there are three figures instead of just two such as you'd use for voice-type modes. George gives Bill in Cambridge a report of 529, and these correspond to readability, strength and tone. Readability and strength we've dealt with in these hallowed pages before, and the only point worth making *again* is that it's much better to give these by ear and ignore the S-meter or whatever it is on your rig. We'd be willing to bet that the S-meter needle on George's rig up there in Scotland isn't even moving, and it's even chance that that on Bill's rig isn't either!

Readability 5, of course, means perfectly readable, or, in other words, everything which was sent was copied at the other end. Strength 2 means very weak signals and strength 4 means fair signals - if you've forgotten, grab the issue a few months ago where we showed the table for RST and stand in a corner with it until you know it off by heart!

Not all CW is perfect by any means!

But what about the "T" bit? This means the "tone" of the transmission, which is whether the note of the CW signals sounds nice and clean. To be honest, it's a bit of an anachronism in these days of commercial rigs which key very well - it's a bit of a hangover from the days when everyone rolled their own (sigh) and if the tone wasn't too good you could say as much so that the bod could attack his new pride and joy and make it better.

It's extremely rare nowadays to hear anyone sending anything other than 9 for the "T" bit of the report, and this is a bit sad in many ways because even in this commercial age of ours not all CW is perfect by any means! If you listen around and HF bands, you'll gind a good many stations from Eastern Europe whose CW signals sound fairly horrible - the trouble is that (a) everyone sends them T9 reports and (b) I'm not sure that they understand anything other than a T9 report!! The last time I sent a UT6 station T7 he hadn't a clue what I was on about....

Digressing slightly, don't write off the Eastern Europeans with a superior smirk. We sometimes feel that they're the last true amateurs in the world - their gear is all homebrew, they probably have a very hard time getting bits and pieces and in general the average Boris or Vlad or Ivan is probably a damned sight more of a real radio amateur than you or I. He's got to be if he wants to be on the air at all.

So next time an Eastern European calls you on the key on 7 of 14 MHz with a peculiar note and maybe not-too-good sending, remember it's probably one of the great moments of his life and he's probably built it up out of goodness-knows-what old garbage! Think yourself lucky you can adjust the passband tuning on your FT1, move the 33rd VFO a bit to take him and maybe twiddle the keypad about whilst sipping your nice cold beer....

Anyway, where were we? Basically, you can expect a T9 report unless there's someone who really knows his stuff on the other end and your transmission sound positively appalling. The *only* exception is during an auroral opening, when every CW transmission sounds more like keyed white noise than anything else - so the T report just becomes the letter A, standing for auroral. If G2YYY was working GM2ZZZ during an aurora, in other words, he'd send him 54A instead of 549, but we'll consider the finer points of auroras and how to get the best out of them in a future article.

If you're a VHF addict it pays to know your locator

We've already had a look at the QTH bit - you'll remember that QTH is the Q code for the location of the station and this can be expressed either as a geographical point such as the town of Cambridge or as a QTH locator such as AM61b. You'll usually find both used, if only because the VHF and UHF fraternity are very familiar with the squares system and indeed because many people chase them for awards. So if you're a VHF addict it pays to know your locator - you'll need it if you're going to take part in a contest!

STARTING FROM SCRATCH

The two Rs at the beginning of Bill's transmission back to George mean Roger - ie everything received correctly. The Morse letter for R is, of course, .-. but you'll often hear it sent as though it was EN, ie with a space between the first dot and the dash. Quite why this is we've never found out. If you listen to ship's operators and such, you'll find they do it all the time and habit seems to have spread to the amateur bands as well, but if anyone knows the reason why, do write in and let us know. It used to baffle me when I was learning Morse by listening to coast stations and things, and I couldn't for the life of me work out why they kept sending EN to each other!

FB is the Morse abbreviation for Fine Business, meaning more or less what it says - if I'd just worked my first OZ on 1296MHz CW I'd probably send FB about 40 times.

How did you copy that lot!

So George gets to the end of his first transmission to Bill and he winds it up by sending HW? This means, basically: "How did you copy that lot?" and you'll hear it used a fair amount when conditions are a bit uncertain. He then sends the callsign of the distant station followed by DE (it's French,you know, Brian) his own callsign. But what's this? Not just K (which is an invitation to transmit) but KN, sent, furthermore, with the letters run into each other as though it were one character -.--. What can this be?

KN means, basically, that the station named is to go ahead ie as opposed to any others who may be waiting. You'll usually hear it used when conditions are good and there's something of a pile-up; the laddie on the receiving end only wants the station he's nominated to go ahead, as opposed to about sixty million others all in ZL and AL squares. KN is one of those groups like SK and VA which is always sent run together. Some books print this as KN or VA. The most common group sent in this way is, of course, AR, which means end of message as we mentioned last time.

By contract, Bill ended his transmission by sending OK? This means what you'd expect, and it just shows that there's no one "proper" way of ending a Morse transmission. The purists usually say that AR before the G2YYY DE GM2ZZZ bit is the proper way, but there are as many variations as there are radio amatuers and we all do something different. You may hear AR K or KN after the callsigns, but there again most East Europeans never seem to use AR under any circumstances! You'll often hear Russians sending PSE K instead, and we have even heard Americans just send AR without K or KN or anything else.

Above: AEA's latest Morsematic keyer does everything except provide free beer for the operator. Above right: a selection of manual Morse keys including the classic Vibroplex. Below right: Datong's Morse keyboard enables CW to be generated typewriter-style.

Anyhow, let's keep listening and see what happens next:

DE GM2YYY PSE AGN NAME PSE AGN NAME BK

DE G2YYY NAME BILL BILL BILL BILL BK

Now then, Obviously a bit of fading or interference of something caused George to lose the bit of G2YYY's transmission where he gave his name and George asked him to repeat it. PSE is please, of course, and AGN is again. Note how quickly it can be done on CW. It doesn't take much longer than saying on SSB "Sorry, I missed your name - please give me your name again, go ahead".

Better to use the QSK signal and leave BK just to mean "break"

The BK bit needs some thinking about, though, since it can cause problems. Generally, of course, it just means "break". In other words, please-answer-the-question-I've-just-asked-quickly-before-I-lose-my-train-of-thought-or-the-QSB-clobbers-you-again and it is sent as two separate letters, BK, not BK. The snag is that it can also mean that a station is equipped for what is know as "full break-in" working, which very few are, at least on VHF and UHF. It's better to use the Q-signal QSK if you are and leave BK just to mean "break".

Note, by the way, that the stations didn't go through the full rigmarole of G2YYY DE GM2ZZZ - they just sent DE GM2ZZZ and DE G2YYY. This is perfectly permissible, and slick CW operators do it all the time if they're firmly established in QSO or if there's a pile-up and the contact needs to be completed in as little time as possible.

So, on we go.

R R DE GM2ZZZ OK BILL SLD CPY BUT MISSED NAME IN QSB - CONDX ABOUT AVERAGE TONITE AND SUM QSB BUT ALL OK - RIG HR TRIO TS700 WID AMPLIFIER ABT W ES ANT 16 ELE YAGI AT ABT 40 FT AGL - QTH HR ABT 300 FT ASL WID GUD TAKEOFF UR WAY - HPE CPY OK AR G2YYY DE GM2ZZZ KN.

George copied Bill's name after he repeated it, and it seems that apart from a bit of fading the signal was quite reasonable from Cambridge (SLD CPY means "solid copy" if you hadn't guessed). Conditions ar about average and there's a certain amount of fading. George then goes on to tell Bill what equipment he's using, in the shape of a Trio TS700 with an amplifier of some sort producing about 100 watts; his antenna is a 16-element Yagi about 40 feet above ground, and his site is about 300 feet above sea level with a good take off in the general direction of Cambridge.

In other words, all good bread-and-butter stuff which one VHF man will tell another. George ends this over by saying that he hopes Bill is copying OK and he then sends the "end of message signal, AR," followed by Bill's and his own callsign and KN.

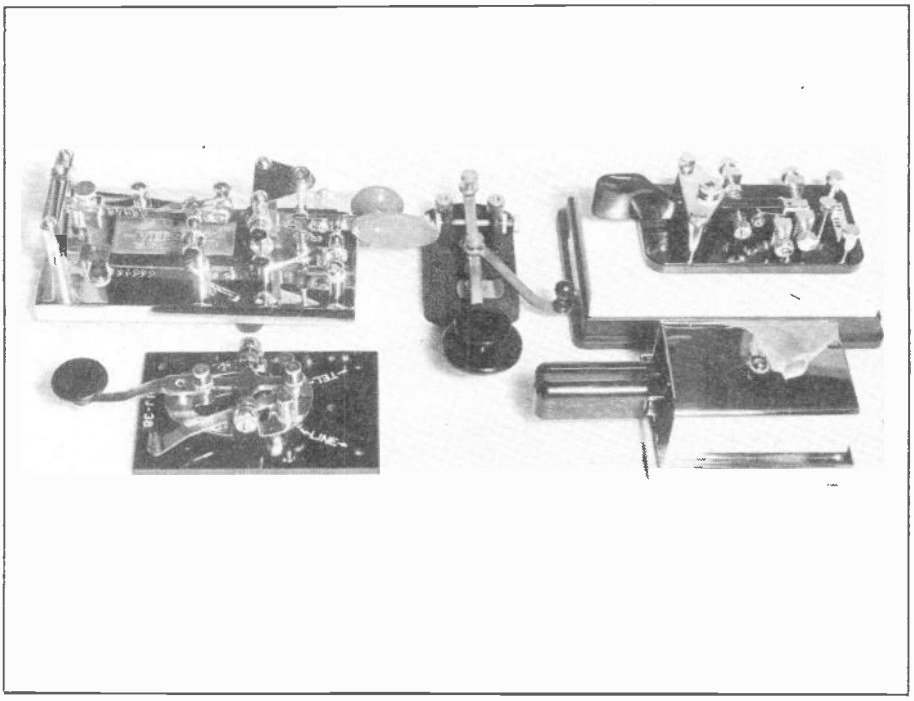
End of message - 73 ES CUL

So that the contact is well and truly under way. We'll leave it there for now - here's Bill's reply, and you can mull over it until next month! 73 ES CUL.

GM2ZZZ DE G2YYY FB GEORGE ES UR SIGS SLD NO QSB - MNI TNX FER NW QTH SQUARE - RIG HE IC251E WID MUTEK BOARD RNG ABT 10 WATTS ES ANT IS 14 ELE PARABEAM AT 60 FT AG L - QTH IS 30 FT ASL HI HI - HVNT WKD GM FOR SUM TIME ES VY NICE TO HE U TONITE GEORGE ES RU QRV 432? HVE NP E E E E NOT WKD GM ON 432 HW? GM3ZZZ DE G2YYY KN.

You should be able to work that out without too many problems. Oh, by the way, the hyphen is just -....- and it's used a lot to break up sentences and so on. CU on the wireless!

·PROCEDURES· 6



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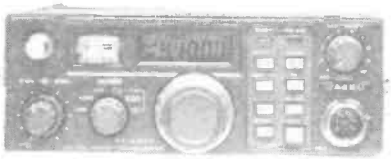

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TH2MK3	2 ele Yagi 10-15-20M 27.3'LE 6.0'B	£169.05	£3.50
TH3MK3	3 ele Yagi 10-15-20M 27.0'LE 14.0'B	£274.85	£5.30
TH5DXX	"Thunderbird" 5 ele 31.0'LE 18.0'B	£419.75	£6.70
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18TD	Dipole Tape 10, 15, 20, 40, 80M 132	£121.90	£2.80

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Build the amazing COJAF

...and listen to Morse in comfort

Project by Rev. G. C. Dobbs G3RJV

Step-by-step instructions, including how to obtain the parts, for building an add-on passive CW filter to improve the performance of any receiver or transceiver. The initials mean CRUD-O-JECT AUDIO FILTER, incidentally.

Most short wave receivers and transceivers offer optional extras for filtering when receiving CW (Morse) signals. When the beginner first listens at the low frequency end of each amateur band the CW signals sound like bedlam.

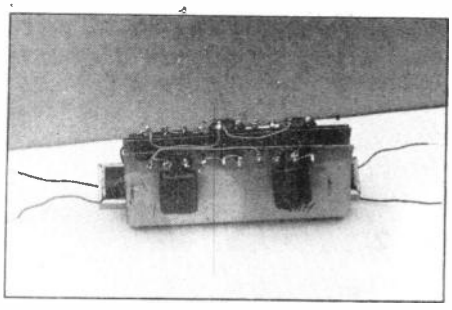
It seems that half the world is transmitting Morse signals on the frequency at the same time! Old timers smile wryly and point out that human ears are wonderful filters and the operator becomes accustomed to picking out the required signal from the rest.

We lesser mortals like to use some form of filtering to sort them out a little. The CW Morse signal is ideal for filtering. We are listening to a tone, and the transmission requires a very narrow bandwidth to produce that tone. We do not even have to listen to the whole bandwidth of the signal, because if we are tuning in a CW station we tune through it until the pitch of the signal is what we require for comfortable listening.

To put it simply, what we need to do is narrow down the portion of the band we hear so that, as far as possible, unwanted signals are outside our range and we just hear the CW signal at the pitch we require.

There are two common ways to apply filtering to a CW signal; one is to tackle the problem at the Intermediate Frequency (IF) stages in the receiver. In a superhet most of the amplification and the filtering of the signals occurs at this frequency before it is converted into an audio signal. Modern receivers often have cyrstal filters to give a specified bandwidth in the IF stages. This is commonly some 2 to 3 kHz which is ideal for SSB reception, but only just adequate for CW reception. Most manufacturers offer an optional extra crystal filter (usually 500 to 600Hz bandwidth) for CW reception). Apart from some minor technical problems, these filters are usually expensive.

The other approach is to add an audio filter for CW reception. This is a cheaper option and is simply added to the speaker or headphone output of the receiver or transceiver. These filters choose the



frequency of the tone that we wish to listen to, commonly 750 or 800Hz, and have a series of tuned stages which select this frequency at the expense of others. The signals at the required tone appear louder so the operator tunes the required CW signal to this pitch and it should stand out more clearly against other signals. Filtering at audio frequencies is a relatively simple and inexpensive exercise, so this is a neat way to solve the problem.

The commonest audio filters are active filters, so called because they use audio amplifiers which are tuned to accept the required signal tone. The usual arrangement is one or several integrated circuit operational amplifiers tuned to the required frequency of the CW note with networks of resistors and capacitors.

There may be several such amplifiers in series and depending upon how many are switching into circuit the bandwidth of the filter is made narrower. One problem is that these tuned acceptor amplifiers can easily become audio oscillators at the frequency chosen. This can be controlled in the design, but it is a common fault of audio filters to find that they "ring" when the bandwidth becomes narrow.

This produces a sharp, almost echoing sound which is hard on the ears. An alternative approach is to use a passive filter; that is one which does not amplify the signal. In this case the problem is that the filtering is done by inductors (coils) and capacitors. The inductors required quite high values of inductance for audio filtering work and such components are sometimes difficult to find.

There is also a slight insertion loss in these filters - the signal comes out smaller - but most receivers have audio gain to spare and the volume is just turned up a little to restore the signal. The advantage is that these filters do not ring, they cannot be easily overloaded to oscillation, and being passive they require no power supply. They merely plug in between the audio output socket and the speaker or headphones. However, the problem of finding those suitable inductors still remains!

Over the years a number of American circuits have appeared using 88mH inductors which are readily available in the USA as surplus items. These are telephone line loading coils, and have not been so easy to obtain in the UK. We do have such loading coils over here but they are not frequently seen as surplus items and the UK versions are not as convenient as the American coils which are wound to toroidal formers (formers like Polo mints) and are not sealed in resin.

Ed Wetherhold, W3NQN, is the acknowledged expert on the use of the American 88mH inductors and has designed several types of filter for radio amateur use with these coils. Through an arrangement with Ed, the G QRP Club is able to get hold of reasonable quantities of these 88mH inductors so their use in a cheap passive filter becomes viable. Perhaps the definitive passive CW filter was the circuit which Ed Wetherhold described in the 1982 and 1983 editions of the *ARRL Radio Amateur's Handbook*. This used no fewer than 11 88mH inductors. These commonly come in stacks of five in a cardboard or tinplate tube and two stacks of five with an extra inductor were used in the circuit.

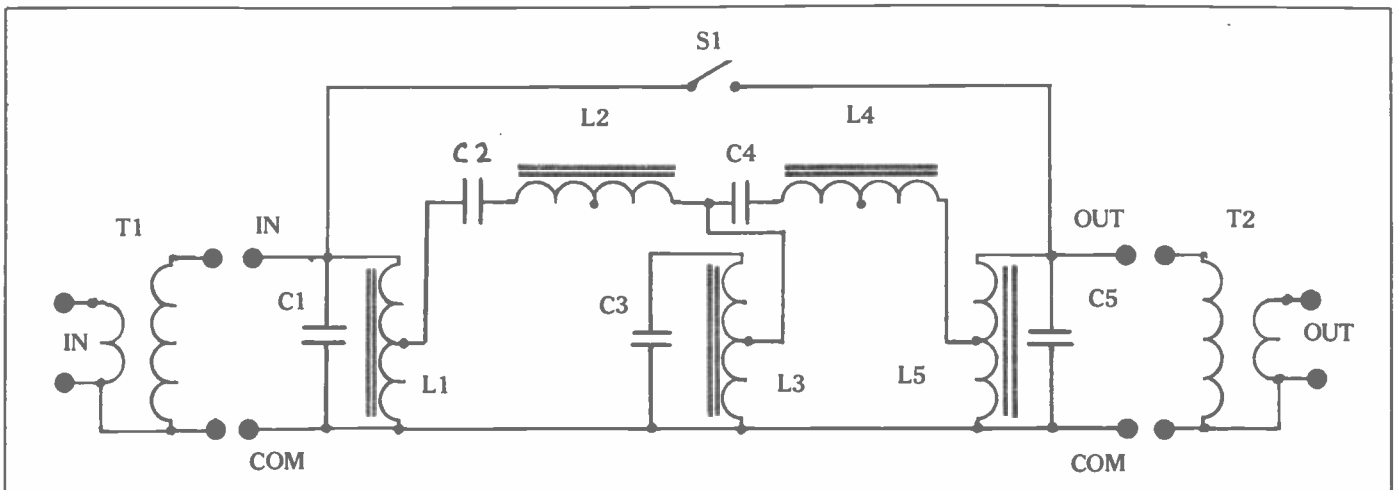


Fig.1 COJAF circuit

Unwanted frequencies or CRUD?

The COJAF is a somewhat simpler circuit based upon the use of one stack of give 88mH inductors. In the *QST* of February 1972, K1TD and W1XT described a passive audio filter which they called the CRUD-O-JECT. Although not a narrow filter it was useful in that it elimiated the high and low frequencies of the signal. They derived the name by describing these unwanted frequencies as Continuous Random Unwanted Disturbances, or CRUD. W3NQN redesigned this filter to use five tuned stages instead of the original three and the circuit we are to use here is that circuit reproduced by permission of W3NQN. COJAF means CRUD-O-JECT Audio Filter.

It is important that the values are well matched across the whole filter

The original W3NQN information is a gold mine of design and circuit calculations but we will simply consider the circuit and go directly on to how to put it together and get hold of the components. Fig 1. shows the circuit diagram of the filter. Ignore T1 and T2 and look at the circuit from the input (IN) to the output (OUT). The circuit is a Butterworth Filter with five tuned stages made up from C1/L1, C2/L2, C3/L3, C4/L4 and C5/L5. The combinations of L and C are arranged to tune the required audio frequency for the reception of the CW note.

For most CW transceiver purposes a frequency of around 750Hz is required. L1, L2, L4 and L5 and 88mH inductors in a stack of five as described earlier. L3 requires somewhat less inductance and is taken from the stack so that turns may be removed to obtain the required value. Nominally C1, 2, 4 and 5 require a value of some 500nF and C3 a value of 1uF.

Components list

C1, 2, 4, 5	=	0.5 *uF*	See text
C3	=	1.0 *uF*	
L1, 2, 4, 5	=	88mH	
L3	=	41mH	
T1, 2	=	1200 R:8 R Audio transformer	
S1	=	*Single pole miniature toggle switch.*	

Above: COJAF circuit diagram. Below: top view of inductor stack (L3 is modified coil). Centre below: input/output transformer T1 and T2 connections. Bottom: details of inductor wiring in the stack.

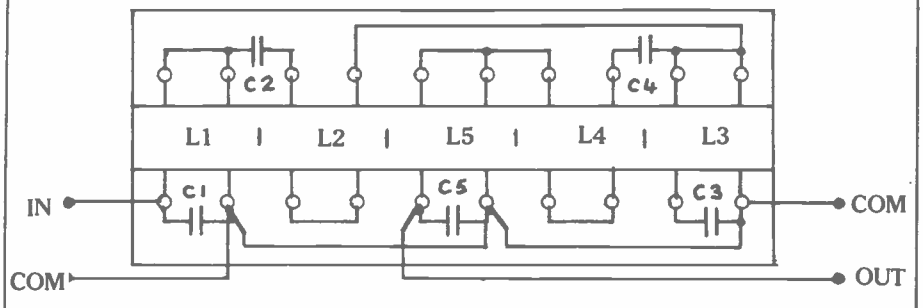


Fig 2: COJAF layout
Top view of inductor stack (L3 is modified coil)

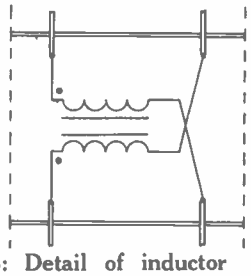


Fig 3: Detail of inductor wiring in the stack.
● = start of winding

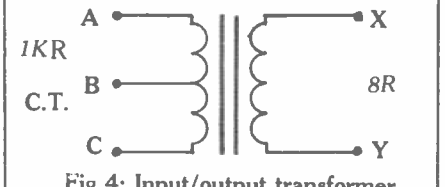


Fig 4: Input/output transformer T1 and T2 connections

It is important that the values are well matched across the whole filter so that the centre frequency is closely tuned in each stage. One way to do this is to match up sets of capacitors on a bridge. As this may be outside the realms of the average constructor, we can suggest matched sets of capacitors for the filter.

Sets of matched capacitors are supplied by W3NQN for a specified centre frequency. Fig 6. shows the information supplied from one such set. In this case the filter is for 759Hz and the values of capacitor have been matched to achieve this frequency - note that C3 is 1.07uF. The calculations include the value required for L3 (41.1mH) and a figure R-T of 627 ohms, which is the input and output impedance of the filter. Armed with the set of capacitors, this information and a stack of inductors, the filter is child's play!

Build the amazing COJAF

Because the filter has an input/output impedance of some 600 ohms and most audio outputs are light ohms, the filter has to be matched into the audio line. This is very simple. Two transformers T1 and T2 are used for matching. There is a large range of transistor output transformers which are around 1200 ohms, centre tapped into eight ohms. Half of the high impedance tapped winding gives about the correct match for the filter, so two of them may be used "back to back" as shown in Fig 1.

The filter switches in and out as required

Fig 4. shows how the connections on the transformer are used. X and Y are the eight ohm end, if they are not marked simply take the side of the transformer with only two leads, and A/B/C represents the high impedance end with a centre tap. The X/Y end goes to the speaker or the receiver output and half of the other winding, B/C (or B/A), goes to the filter.

The nationwide chain of Tandy stores sell a suitable transformer for T1 and T2 as part number 273-1380 or the common LT700 transformer can be used. Since the filter is only required when difficult CW signals are being copied, a switch (S1) is included to short out the filter when it is not required. This means that the filter can be left in circuit the whole time and switched in and out as required.

Fig 2. shows how the COJAF is built. The entire circuit is built up around the cylinder that contains the stack of five inductors. They cylinder has a number of terminals or pins along the top (Fig 2. is top view) and these are used as the solder points. In the making up of these stacks, each 88mH inductor consists of two windings on the same former which are connected together in series aiding to give the value of 88mH. Fig 3. shows how the windings are joined to two opposite pairs of tags in the stack. The extreme righthand inductor is removed from the stack and used as L3 after some turns have been removed. This operation is simple if the following instructions are followed.

So, get unwinding and counting!

The end of the cylinder is a disc of tinplate stapled into place so the staples have to be removed to allow the wooden end cheek to be taken away. The inductor can then be freed on the end of its wires.

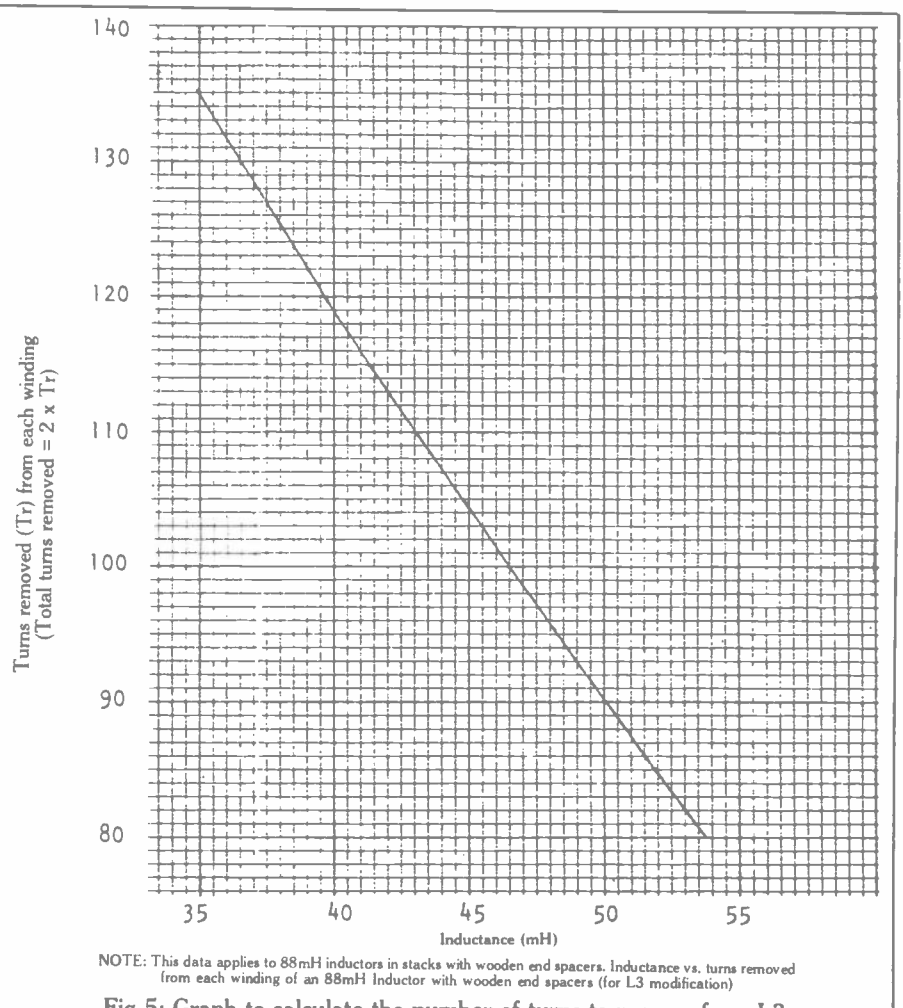
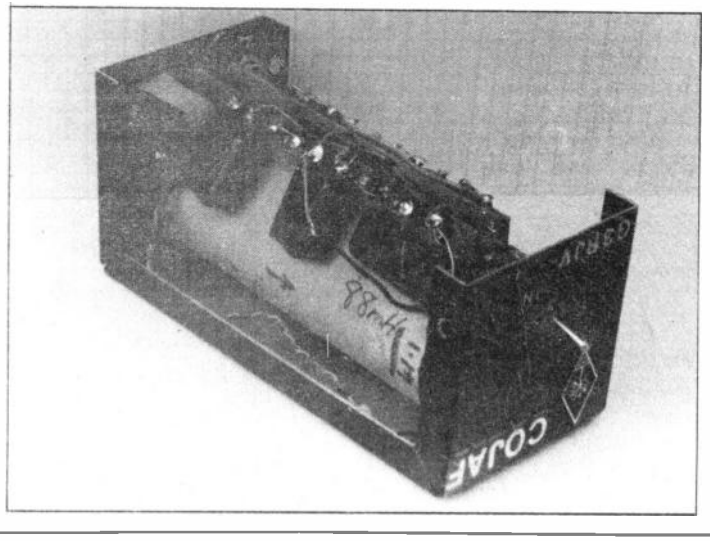


Fig 5: Graph to calculate the number of turns to remove from L3 (Ref. p8-28 ARRL Radio Amateur Handbook 1983)

```
   MATCHED CAP-SET FOR
  ONE-STACK C-O-J FILTER
(F-C WITHIN 2% OF 750 HZ)
-------------------------
EXACT DESIGN VALUES ARE:
F-CENTER (HZ)= 759
C1,C5 (NF)= 500
   C3 (UF)= 1.07
C2,C4 (NF)= 500
   L3 (MH)= 41.1
R-T (OHMS)= 627
```

Fig 6: Typical data supplied with matched set of capacitors for COJAF



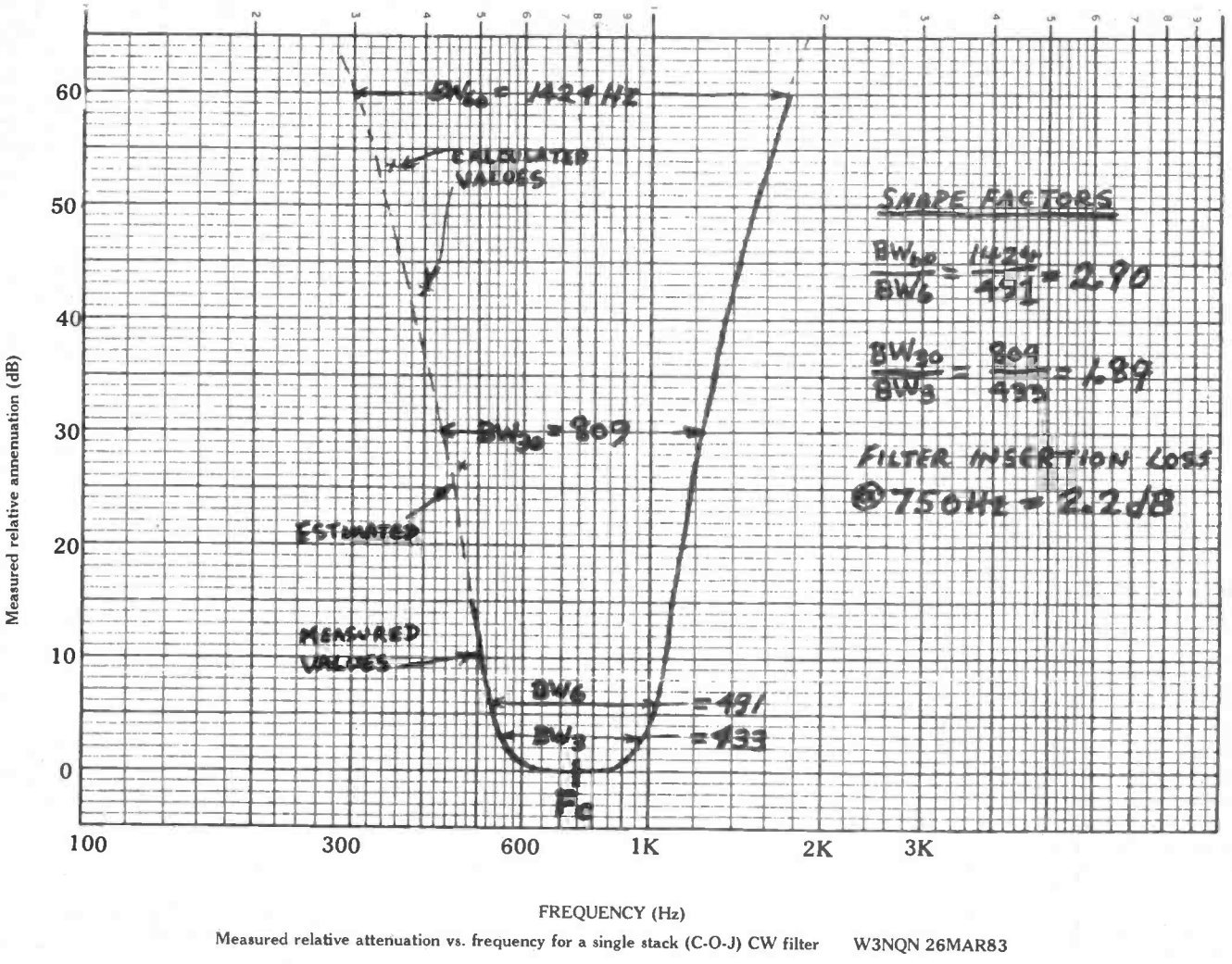


Fig 7: Response/shape factor

There are two windings separated by spacers and when removing turns, "TURN PAIRS" are removed. that is turns from windings of each coil. Care must be taken to ensure that the wires used to remove the turns go back to the same terminal point so the best way is to deal with each winding in turn and note carefully where the wire has come from on the four terminals.

Mounted in the box it looks a bit like a bomb!

Working out the number of turns that have to be removed from each winding is very simple. Refer to the information which comes with the matched capacitors to check the required inductance for L3. In the case of the set in Fig 6. it is 41.1mH. Fig 5. is a TURNS/INDUCTANCE graph which gives the number of turns to be removed from each stack.

So, get unwinding and counting - each time the wire passes through the hole of the core that is one turn removed. When the unwinding is completed the leads are soldered back into place and the inductor can be restored to the stack and the end cheek replaced.

The completion of the filter is just a simple matter of following the layout diagram Fig 2. Take care to include all the links. It is not a bad idea to mark which end of the stack is L3 before the wiring begins... mistakes can be made! In the prototype I mounted the matching transformers T1 and T2 on the ends of the stack. The transformers had base mounting tabs which I soldered directly onto the tinplate ends of the stack.

When the wiring has been completed the whole unit can be mounted in a suitable box with the switch, S1, on the front and input and output sockets on the back. Mounted in the box it all looks a bit like a bomb!

The required signal will peak up, the unwanted signals will disappear"

The filter is connected into the headphone or loudspeaker leads. With the filter switched out tune to the CW end of an amateur band and try to find a crowded portion. Switch in the filter and notice the difference. The signals at the centre frequency will really peak up and careful tuning will be required to get the desired signal into the filter bandpass. But what a difference it makes! The required signal will peak up, the unwanted signals will disappear (or be reduced) and the band noise and other "crud" will be greatly reduced. Fig 7. shows the Response/Shape Factor of the filter. It would cost quite a lot of good money to get that response from a crystal filter.

Getting the parts.

Through the kindness of the Chesapeake and Potomac Telephone Company (what a grand name!) and W3NQN, the G QRP Club are able to offer sets of components for the filter at a very low price. These sets consist of the stack of five 88mH inductors with a matched set of capacitors with all the design calculations worked out. For details send a SAE to The G QRP Club, c/o. 17 Aspen Drive, Chelmsley Wood, Birmingham B37 7QX

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Think about the IC-740, One of the most popular amateur bands transceivers, make a few improvements such as adding 36 memory channels, doing away with mechanical bandswitching and then add full HF receive capabillity (0.1-30 MHz) which is even an improvement on the famous R70 and you get a pretty good idea of what the IC-751 is like. It is fully compatible with Icom Auto units such as the AT-500 and IC-2KL and a further option for computer control can be added. There is also a digital speech synthesizer option which will be ideal for blind operators. For power supplies you have the option of the IC-PS740 (which fits inside) or the PS-15/PS20 range for external use.

As you would expect there is a built in speech processor, a switchable choice of a J-FET pre-amp, straight through or a 20dB pin diode attenuator and two VFOs allowing split frequency operation.

Other standard features include:- 36 memory channels with scan facility and start/stop timers, a marker, 4 variable tuning rates, Pass Band Tuning, notch, variable noise blanker, monitor switch, DFM (direct feed mixer) in the front end, full break-in on CW and AMTOR compatibility. The first IF is 70.045 MHz. Any XIT and RIT adjustment is shown on the display. The transmitter features high reliability 2SC2904 transistors in a low IMD (-32dB@ 100W) full 100% duty cycle. Power is restricted to 40W on AM and adjustable from 10W on all modes. FM and the IC-FL44A crystal SSB filter are both fitted as standard.

As you can see from this brief description the IC-751 is certainly a transceiver worth considering – Why not call us for further details?

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IC-R70, HF Receiver

The R-70 covers all modes (when the FM option is included), and uses 2 CPU-driven VFO's for split frequency working, and has 3 IF frequencies: 70MHz, 9MHz and 455KHz, and a dynamic range of 100dB. It has a built-in mains supply.

Other R-70 features include: input switchability through a pre-amplifier, direct or via an attenuator, selectable tuning steps of 1KHz, 100Hz or 10Hz, adjustable IF bandwidth in 3 steps (455KHz). Noise limiter, switchable AGC, tunable notch filter, squelch on all modes, RIT, tone control. Tuning LED for FM (discriminator centre indicator). Recorder output, dimmer control.

The R-70 also has separate antenna sockets for LW-MW with automatic switching, and a large, front mounted loudspeaker with 5.8W output. The frequency stability for the 1st hour is ± 50Hz, sensitivity- SSB/CW/RTTY better than 0.32 μv for 12dB (S+N)÷N, Am-0.5μv, FM better than 0.32 for 12dB Sinad. DC is optional

IC-740, HF Transceiver

Features of the IC-740 transceiver include a very effective variable width and continuously adjustable noise blanker, continuously adjustable speed AGC, adjustable IF shift and variable passband tuning built in. In addition, an adjustable notch filter for maximum receiver performance, along with switchable receiver preamp, and a selection of SSB and CW filters. Squelch on SSB Receive and all mode capability, including optional FM mode. Split frequency operation with two built-in VFO's for the serious DX'er.

The IC-740 allows maximum transmit flexibility with front panel adjustment of VOX gain and VOX delay along with ICOM's unique synthesized three speed tuning system and rock solid stability with electronic frequency lock. Maximum versatility with 2 VFO's built in as standard, plus 9 memories of frequency selection, one per band, including the new WARC bands. With 10 independent receiver and 6 transmitter front panel adjustments.

Options include:

- FM Module
- Marker Module
- Electronic Keyer
- 2 - 9KHz IF Filters for CW
- 3 - 455MHz Filters for CW
- Internal AC Power Supply
- Automatic Antenna Tuner

NEW! IC-271, VHF Multi-mode Base station

Icom have made improvements to the IC-251 and brought it up to date.

Power can be adjusted up to 25W on all modes SSB, CW and FM. Squelch works on all modes and a listen-input facility has been added for Repeater work.

RIT shift is shown on the display. Why not call us for further details?

Options include:

Speech synthesizer announcing displayed frequency.
22 Channel memory extension - with scan facilities.
10 Hz tuning facility. SM5 desk mic
Internal chopper PSU
There is a switchable front end pre-amp.

IC-251E, Available on Special offer

Icom produce a perfect trio in the VHF base station range, from 6 meters through 2 meters to 70cms. The IC-251E is the 2 meter station while the IC-451E is used for 70cms. The 251E is now available with Mutek front-end fitted.

IC-25H/25E, VHF, FM Mobiles

The FM mobile choice has to be the Icom IC-25E. It is so small yet boasts a powerful 25 Watt voice and a sensitive receiver. The new 25H now avaiable has a green display and 45 Watts output. There are five easily programmable memories, and facilities for changing the repeater shift from the default value of 600kHz. You can tune the VFO while in a memory without losing or changing the memory. You can listen on the input instantly, and there are also priority channel facilities should you want to be sure of not missing that private message. The HM10 scanning mike is supplied as standard, but the HM11 with tone call on the mike can be used.

THE IC-745... ICOM'S VERY LATEST TRANSCEIVER IS WAITING FOR YOU AT THANET ELECTRONICS

What's the celebration about? The IC-745...a new all band HF transceiver with SSB, AM, CW, RTTY and an FM option.. plus, a 100KHz – 30MHz general coverage receiver.

And...the IC-745 has a combination of features found on no other transceiver at such an incredibly low price.

The IC-745 is the only transceiver today that has so many standard features, options, and accessories available.

ICOM is simply the best amateur radio equipment built today. See the IC-745 at our shop and showroom at Herne Bay or contact your local authorised ICOM dealer for more information.

Compare these exceptional features

- 100KHz – 30MHz Receiver
- 16 Memories
- Full function Metering with a built in SWR Bridge
- IF Shift and Pass Band Tuning
- 10Hz/100Hz/1KHz Tuning Rates with 1MHz band steps
- Optional Internal AC Power Supply
- Adjustable Noise Blanker (width and level)
- Continuously Adjustable AGC with an OFF position
- Receiver Preamp
- 100% Transmit Duty Cycle

Other Standard Features:

- 100 Watt Output Transmitter with exceptionally low IMD
- VOX
- Speech Compressor
- Tunable Notch Filter
- RIT and XIT
- All Mode Squelch
- Scanning
- ICOM System Compatibility

Optional Accessories:

- IC-PS15 External Power Supply
- IC-PS740 Internal Power Supply for the ultimate in Portability
- IC-2KL Linear Amplifier
- IC-SP3 External Speaker
- IC-MB12 Mobile Mounting Bracket
- IC-AT100 Antenna Tuner (100W)
- IC-AT500 Antenna Tuner (500W)
- IC-BC10 Memory Backup
- IC-EX241 Marker Module
- IC-EX242 FM Module
- IC-EX243 Electronic Keyer
- IC-FL52A 500Hz 455KHz CW Filter
- IC-FL45 500Hz 9MHz CW Filter
- IC-FL54 270Hz 9MHz CW Filter
- IC-FL53A 250Hz 455MHz CW Filter
- IC-FL44A 2.1KHz 455Khz SSB Filter
- IC-SM6 Desk Mic
- IC-HM12 Hand Mic

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NEW! IC-120, 1296 MHz FM

Thinking of 1296? Then Icom IC-120 could be the answer.

Now you can have the sophistication of today's technology on this up and coming band-all built into a unit the same size as the IC-25E, very compact...

Features include:	Output Power = 1 W or more
Frequency coverage 1260 - 1300	Mode:- FM
Adjustable Repeater Shift	2 VFO's
6 Memories - with scanning facility	Deviation + 5 KHz
Spurious Emissions - 40dB or better	RIT

8 W and 16W (Puma) Linear Amps available shortly.

IC-290H, VHF Multimode Mobile

The recently introduced IC-290H has proved so popular that we have decided to concentrate on this (25W) model 2m multimode. With its bright green display, 5 memories, scan facilities on either memories or the whole band, tone-call button on the microphone and instant listen input for repeaters, this little box really is a beauty. The 70cm version, the IC-490E has similar features (although the output is only 10W in this case).

IC-2E, VHF/FM IC-4E UHF Portables

Nearly everybody has an IC2E – the most popular amateur transceiver in the world – there is also the 70 cm version which is every bit as good and takes the same accessories.

RTTY, Morse & ASCII

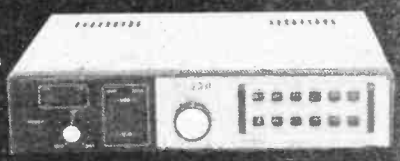
Shortwave listeners and amateurs are able to take more interest in other modes of transmission than speech with the latest range of decoders and senders available. As well as amateur transmissions, there is an abundance of news and other interesting broadcasts which can be read using these space-age devices.

Some models in our range are the Tono 550, 9000E and the Telereader CWR-670, CWR-685E and CWR-610E. There is now available a professional version of the Tono 9000E, the PRO-1, which has a built-in scrambler. The Telereader CWR-670 is also available with a built-in VDU which can include a 40 column printer.

TONO 9000E Sender/Decoder

CWR-610E, Decoder

TONO 550, Decoder



As U.K. importers of the renowned TONO and TELEREADER products, we can offer you a wide range, from a simple morse and RTTY reader which can be plugged into your TV.. to a complete send and receive system with memories and built-in displays, or outputs for high-definition VDU.

As well as stocking the complete ICOM range of equipment suitable for European use, we also sell Yaesu, Jaybeam, Datong, Welz, G-Whip, Western, TAL, Bearcat, Versatower and RSGB publications from our shop and showroom at the address below. Come in for a demonstration or just a chat, our qualified sales staff and technicians will be glad to assist you.

Do you know what time it is!

When the globe of this digital clock is revolved, a red lamp indicating a major city in the world will blink, and the current time of that city will be displayed in place of the date. At a glance know the current times of 24 different time zones throughout the world.

This mini-globe clock stands 195mm. high and also has an alarm fitted. This useful device should stop you getting your Amateur friends, on the other side of the world, out of bed in the middle of the night.

Agent Please telephone first, anytime between 0900 – 2200 hrs.
Thanet Northern, G3LEQ Tel: Knutsford (0565) 4040

Securicor or post despatch free, same day if possible.

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Thanet Electronics
143 Reculver Road, Herne Bay, Kent
Tel:(02273) 63859/63850

A New Look at Wire Aerials 7

SECRET ANTENNAS!

John D. Heys, G3BDQ, provides some good ideas for aerials for those living in top flats, next to hostile neighbours, who want, for some reason, hidden-away antennas.

Successful operation on the HF bands ordinarily depends upon the use of well elevated multi-element beams, long wires or some variety of vertical antenna. Wire aerials used indoors can be induced to radiate, but in the writer's view the old adage that 'a foot of wire outside is worth three indoors' remains true, and every effort should be made to put up a radiator outside a building.

It has become apparent from my many contacts on the 144MHz band that there are legions of would-be HF band operators who remain deterred from this activity by their inability to get out a decent aerial for the lower frequency bands.

Some amateurs have either miniscule gardens or even none at all; and far worse, (horror of horrors) are condemned to living in a modern 'skyscraper' block. Others may possess respectably sized gardens attached to their traditionally styled housing but they too remain reluctant to attempt HF band operation. The reasons often given by the latter are usually concerned with an unfriendly reaction to all 'sky hooks' by their neighbours or with certain not uncommon restrictive Clauses or Covenants within their tenancy or occupation agreements.

These restrictions are particularly nasty on large estates which have not been sold as freehold plots. In some areas even outside clothes lines are forbidden. Some amateurs have been so persecuted and victimised by their near neighbours that they have felt a compunction to go QRT or even sell up and move house.

"...unnoticed, but then came the hammering on the door"

One of the writer's 'locals' was hounded by an awkward character who claimed that a quite legal and officially approved tower was reducing the resale value of his house because it could be seen from the side (kitchen, bathroom and landing) windows! Another amateur who lives quite near the G3BDQ domain ran out a long wire across his own property which was at least 150 feet from a near neighbour's house. This latter character is well known in the district for his tetchiness and he spends much of each summer evening scanning the sky for the tell-tale smoke from distant bonfires and then he sets off to complain and insist they be quenched!

The long wire was unnoticed for more than a week, but then came the inevitable hammering upon the door of the offending G4--- and an insistent demand that the offending object be removed at once as it was spoiling his view. My G4 friend is not someone to be trifled with and I notice that the long wire remains in position!

"A favourite was the collapsible rod which could be easily pushed up a chimney..."

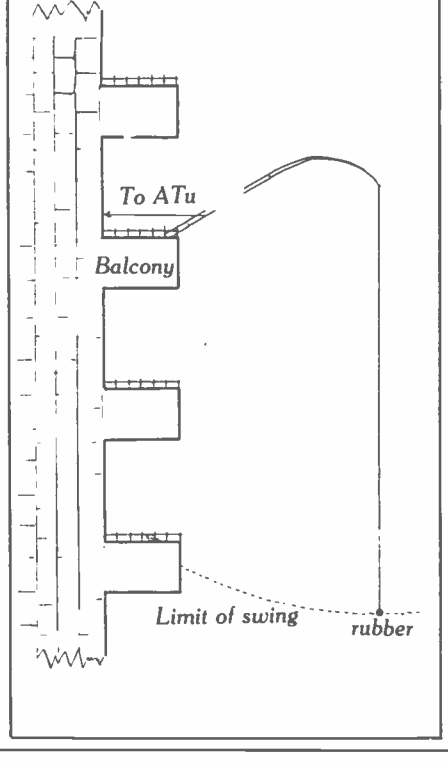
Most of us prefer a peaceful life rather than one fraught with aggravation. We will often suffer in silence and reluctantly forego our grandiose antenna plans in order that some semblance of neighbourliness and tranquillity may be maintained. It is primarily for we cowards that this article has been prepared and presented; and it is hoped that it will encourage some to operate on bands that have so far been denied to them because of 'difficult' local circumstances.

The many clandestine radio operators who heroically maintained communications links between the 'underground' movements in Occupied Europe and Britain during the last war were relentlessly hunted by the German detector vans. Their transmitters were designed to load into almost any length of wire which could be run out from a window to a tree or similar support. These wires unfortunately were sometimes seen and reported on to the authorities; action which often resulted in the imprisonment, torture or death of the operator at the hands of the Gestapo.

Some operators were constantly moving around, sometimes staying overnight in hotels where they operated their 'suitcase' rigs. A favourite aerial was a collapsible rod which could be easily pushed up the chimney from the (cold) fireplaces of their rooms. Even if the aerial rod protruded above the chimney pots it could not be noticed at night, and the lower end could be arranged to 'sit' upon the inevitable shelf which most fireplaces seem to have to collect detritus, and so remain out of sight from inside the room.

Many of our modern houses or apartments do not have fireplaces or even chimneys, but someone living in an older traditional property could do worse than to emulate those wartime operators. A shack located upstairs and having an unused fireplace would be ideal. The actual antenna could be made up from telescoping lengths of tubing and be quite flexible and able to negotiate any chimney bends.

Fig 1



It could also be made up from bamboo with thick wire taped along its length. For single band operation the chimney vertical is best cut to a quarter wavelength at the working frequency and there should be a piece of wire of identical length to run around the edges of the room or under the carpet to serve as the ground plane. Any other metal piping or heating radiators can also serve as additional earthing to supplement the single 'radial'.

"Some kind of wire from a window"

An outside earth lead running down from an upstairs room is useless and will exhibit few of the correct characteristic qualities of a 'real' earth which has a very short thick connection to ground. Two short lengths of 50 ohm coax connected in parallel will give a good match to the base of the vertical which has a feed impedance of about 25 ohms. An ATU between the coax and the transmitter is advised, for any mismatch might induce TV1 troubles, and in the case of a modern solid state output stage rig it could result in a partial power shutdown. The additional tuned circuit of an ATU will add some extra selectivity to the receiver front end and will help to reduce cross modulation effects caused by strong out-of-band signals. Harmonic radiation from the transmitter will also be reduced.

For all-band operation the 'chimney vertical' may be loaded up as an end fed and no coax used. The wire from the base of the vertical rod should go to an 'L' section or other suitable ATU capable of matching a wide range of input impedances to the rig. On the lower frequency bands the aerial will be very short and it may be loaded up with a coil at the base of the rod. This will certainly be necessary on 1.8 and 3.5MHz.

If the top of the antenna protrudes a few feet above the chimney stack it remains doubtful that anyone would notice. One even sees shrubs and young trees growing from chimneys that are no longer in use and they attractive little public attention. For real under-cover work however in accommodation (lodgings?) where amateur radio is taboo or frowned upon such a tactic may be employed only after dark; also remembering to use the 'phones and a quiet key at all times!

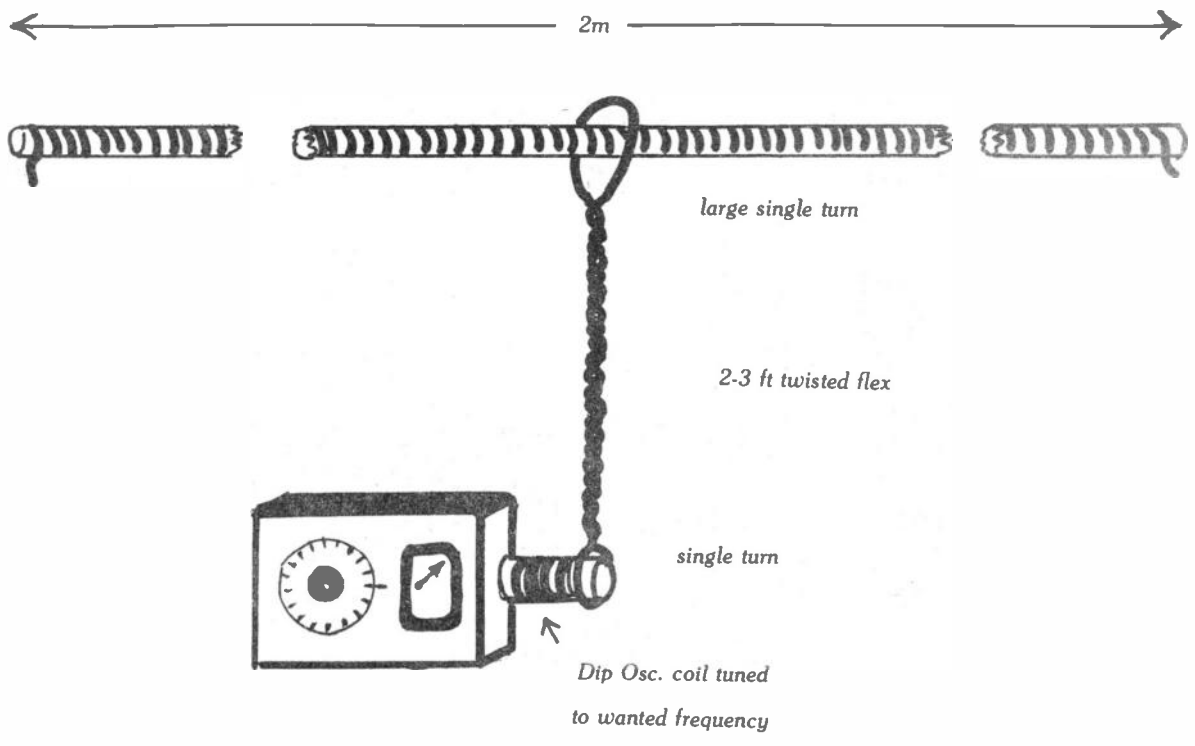
If an amateur is so unlucky as to be living in a flat within a modern town or city tower block with its attendant metal framed structure the only way to 'get out' on the HF bands is to have some kind of wire hanging from the window or by using a loaded whip lashed to the balcony should one be available.

Last winter I gave an S8-9 report to a Swiss station in Geneva on 1.8 MHz who was just using a bottom loaded three metre long whip antenna. His metal railed balcony was being used as a ground plane. When one thinks about this and considers that a quarter wave on that band will be about 130 feet long, this very successful use of a short vertical is really amazing.

Recently I heard a mobile who was parked awaiting service on the forecourt of my local filling station having a solid QSO on 14MHz SSB with a station in Brunei. His antenna was a conventional loaded whip working against the metal car body DOWN AT GROUND LEVEL. An elevated balcony with its floor area covered with galvanised mesh (chicken wire) and a similar mobile whip attached to the rail could offer advantages over the car aerial in certain directions away from the building. Such antennas are not very big and when clipped to the balcony rail would attract little attention.

For something a little more ambitious a long (preferably old and discarded) glass fibre fishing rod can be used as the basis of an effective antenna. At night the rod could be pushed out of a window or attached to a balcony rail so it runs at an angle of 45 degrees from the horizontal. A thin wire can be arranged to run up along the rod and at the tip drop down vertically for a considerable distance. A small solid rubber ball attached to the end of the wire will help to hold it down in all but very windy weather.

Fig 2



Setting up the ½ coil with a Dip Oscillator

A New Look at Wire Aerials 7

SECRET ANTENNAS!

Should this type of antenna be contemplated make really sure that the swinging ball cannot bang against any lower windows! The wire can be end fed and tuned with an ATU and its total length is not important, although as to be expected, for the lower frequencies longer wires are an advantage. The 'Zepp' feeding of a half wave vertical section out at the tip of the rod with some 300 ohm ribbon feeder (suitably modified with punched holes) is a possibility, and such an aerial would provide vertical polarisation for DX work.

The ultimate in secret serials for tower block dwellers has been devised and used by an amateur living not 100 miles from Skelmersdale New Town. This enterprising fellow puts up a thin and almost invisible and temporary wire THREE ELEMENT BEAM for Top Band when it is DX and contest time in mid-winter.

This antenna is not brilliant for inter-G working but the reports be receives from North America are phenomenal! His wires run across and between the roofs of adjacent tower blocks which are more than 200 feet high. His only worries begin when really strong winds threaten to bring it all down.

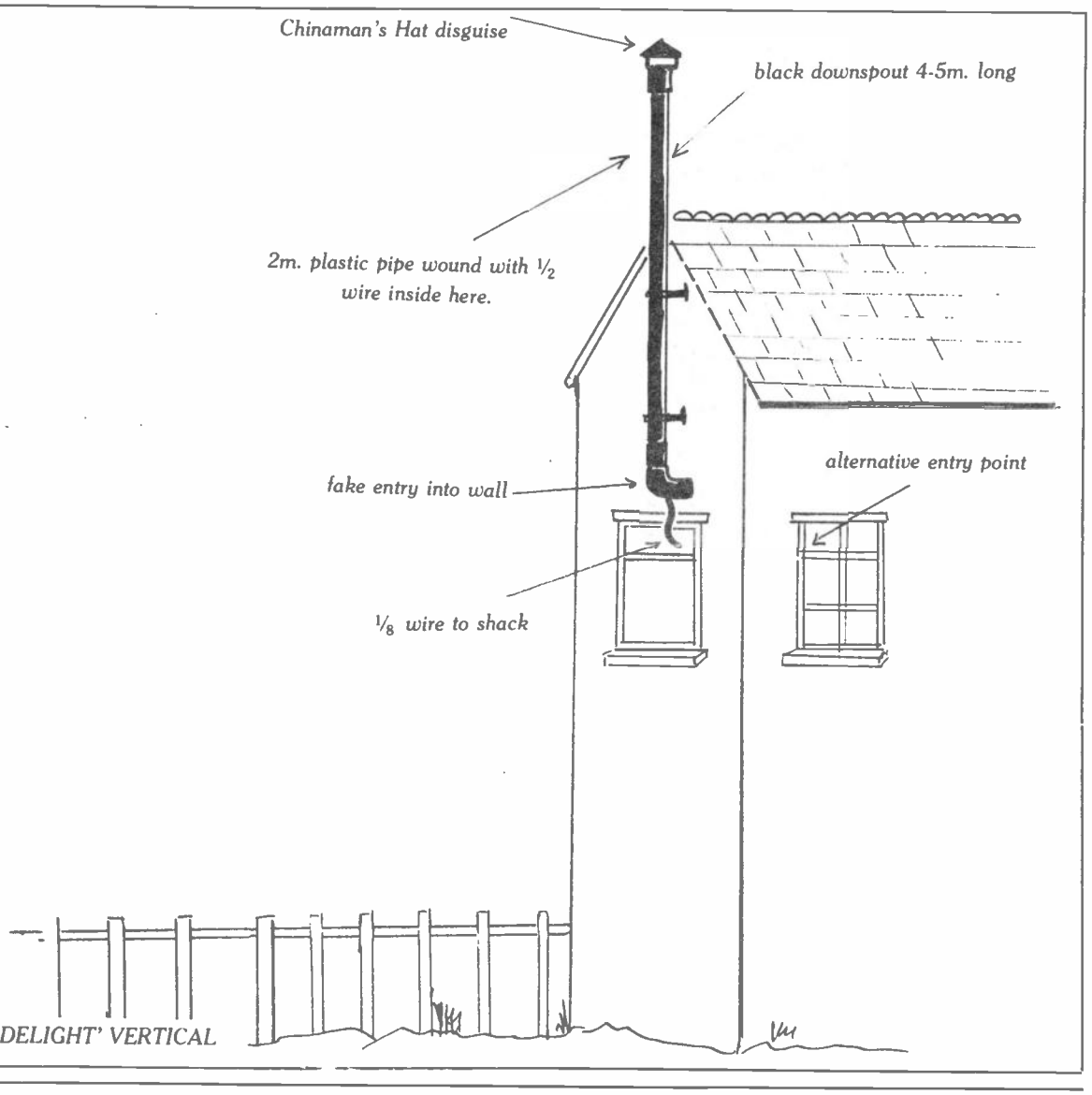
The original 'Plumber's Delight' was a three element beam of American origin made up entirely from copper water pipe which was electrically bonded to the boom and the supporting tower. This new model is so named because its chief components are normally used by plumbers today and it uses plastic rather than copper piping. It is a simple and unsophisticated device which can be put together for just a few pounds and which ought to be 'invisible' to nosey neighbours.

A secret antenna need not be hidden away. It can stick out like the proverbial 'sore thumb' and yet remain unrecognised for what it really is! This new Plumber's Delight is within the latter category and a visit to the nearest B & Q or similar DIY store will furnish the essential parts.

Resonant frequency

A half wavelength of insulated copper wire (W.H. Westlake, G8MWW can supply suitable heavy gauge PVC covered wire in 50 metre lengths) is space wound evenly around the entire length of a two metre piece of white 1½ inch diameter plastic pipe. Using a Dip Meter and a large diameter single turn link around the centre of the winding (the low impedance point) find out the resonant frequency. Take off turns until resonance is found at the wanted frequency and then connect an additional ⅛ wavelength of the same kind of wire to the lower end of the winding. You will now have a ⅝ wave antenna which will be very effective if positioned outside vertically and as high up as possible.

Fig. 3



THE 'PLUMBER'S DELIGHT' VERTICAL

If you don't really care what the neighbours think do just that and bring the lower wire into the shack and the ATU. If you wish to be more secretive hide the white pipe with its winding inside a length of black 68mm diameter heavy gauge downspouting which should be obtainable from the same DIY shop. This black pipe may be secured to a chimney stack or the gable end of a house and if possible set out 10-12 inches from the brickwork. Be careful when fixing to ensure that no closed loops of metal go around the pipe, for single shorted turns would ruin the operation of the antenna.

To really disguise this Plumber's delight a home made plastic 'chinaman's hat' painted black may be attached to the upper end of the pipe. This will keep out the rain and completely confound the curious. Further 'gilding of the lily' would be to put a right angle section of pipe at the lower end and make it seem that the pipe enters the building through the wall!

The $\frac{1}{8}$ wavelength section can be lengthened if it does not reach the ATU but so doing may result in a much higher impedance at its end. Try to avoid a 'feed' length of $\frac{1}{4}$ wavelength. Make it shorter or longer to escape matching problems at the ATU. A more elegant solution would be to have a small parallel tuned circuit at the bottom end of the complete $\frac{5}{8}$ wave system and tap a 50 ohm coax up the coil until a match and low SWR is achieved. A $\frac{5}{8}$ wave antenna working as a vertical does not require radials or groundplanes but it is always better to arrange for a quarter wavelength counterpoise wire to be connected to the ATU and so minimise the likelihood of RF in the shack. Should more than 100 watt PEP be contemplated it would be as well to solder a small brass ball to the top of the antenna winding. This will stop corona discharge. Old door knobs are admirable for this purpose!

Invisible to ordinary mortals

No one (except Telecom engineers) stares at telephone wires. We just take them for granted and they are part of the scenery, unless they begin to sag under a heavy burden of ice or fall into similar disarray. They are for all practical purposes 'invisible' to ordinary mortals. It is sometimes possible to get hold of the large jam-jar shaped porcelain insulators which are fixed atop telephone poles. If one of these can be attached to a suitable place on one's property (away from the real telephone wires) and just below the guttering near the shack window it will make a fine anchor point for a length of strong 14swg hard drawn copper aerial wire. This wire may then be pulled out under tension to some suitable position where it will not be seen easily by neighbours or the curious.

It must of course be suitably and conventionally insulated at the far end and may run conveniently into a copse and 'get lost' amid the trees. 'Fancy having two telephones' the busy-bodies may comment, whilst you are hard at it working the DX!

Mention was made in an earlier article (End-Fed Wires) of the thin wired invisible aerial. A wire of about 28 swg vanishes 25 feet away so if it is up at a reasonable height it ceases to exist for the neighbours. Thin copper wire tends to stretch or easily break and is only suitable for temporary work. A much stronger wire is that used to tether powered model aeroplanes, and although not made from copper its resistive losses are not high.

There must be many other ways to put up effective but unobtrusive antennas which will work on the HF bands and it presents a challenge to the amateur beset by the problems outlined earlier. Any piece of wire can be induced to radiate and the further it is placed, the more effective it will be. It may ben be possible as a last resort to put up some form of indoor radiator; but that is another story!

WHAT

The idea of this feature is to provide an easy-to-understand guide to all the currently available wirelesses of interest to the amateur and SWL; we list HF transceivers, VHF transceivers, VHF and UHF hand-helds, mobiles and HF receivers. Where

HF transceivers

Icom IC720A	£690	Good performer; includes general coverage Rx
Icom IC730	£580	Good, aimed at mobile use, but nice
Icom IC740	£720	Lovely rig – see review in Issue 3.
Trio TS530S	£520	Very good rig for the newcomer; reliable
Trio TS830S	£645	We love this one – see our review in Issue 2.
TS930S	£1000 approx	We don't know anyone who has one
Trio TS430S	£736	Very new
Yaesu FT102	£785	Nice – see review in Issue 3.
Yaesu FT980	£1115	New, and we haven't yet seen one
Yaesu FT1	£1349	It's a lot of radio, but a lot of bread
Yaesu FT902DM	£885	Rugged, reliable, nice machine
FT101Z	£559	Has got whiskers now, but a good old rig
FT707	£509	Didn't like this one much, but it's adequate.
Drake TR7A	£1199	A lovely machine, great signal handling
Drake TR5	£657	We'd love to review one . . .
Collins KWM380	£2195	It ought to be good for the price!
KW/Ten-Tec Argosy	£?	A good name, but we don't know the rig.
Yaesu FT77	£?	Replaces FT7B.

VHF transceivers

Trio TS780	£799	Covers 2m and 70cm; good reputation; bit deaf!
Yaesu FT290R	£265	Base-cum-portable 2m rig; see review in May 1983 issue.
Yaesu FT790R	£325	Ditto for 432MHz see review in May 1983 issue.
Trio TR9130	£395	Very nice 144MHz multimode – reliable and solid
Icom IC251E	£559	Good 144MHz multimode, see review in next issue.
Icom IC451E	£689	Ditto for 432MHz
Yaesu FT726	£649	Brand new

VHF and UHF portables

Icom IC2E	£169	Super 144MHz FM handheld; cousin of the IC4E. Review in April 1983 issue.
Icom IC4E	£199	We loved this – Review in April 1983 issue.
FDK Palm II	£109	144MHz 6-channel FM hand-held
FDK Palm IV	£109	Ditto for 432MHz
Azden PCS300	£179	144MHz

RADIO?

we know something about the radio we've appended a comment or two – if the column's blank it doesn't mean that we'd be sued if we said what we thought, but that we haven't come across one or heard anything either way about it.

		handheld; good Rx synthesised
Trio TR2300	£144	Big portable FM 144MHz box
Trio TR2500	£220	Keypad-synthesised 144MHz handheld; review in April 1983 issue.
Trio TR3500	£250	As above; review in May 1983 issue.
Icom IC202	£209	SSB 144MHz "portable", still going strong
Icom IC402	£245	ditto for 432MHz
Yaesu FT208R	£209	2.5w FM 144MHz hand-held – review in April 1983 issue.
Yaesu FT708R	£230	1w FM 432MHz hand-held – review in April 1983 issue.

VHF and UHF mobiles

There are many and they change almost every month, also allow for changes and new introductuions.

FDK M700AX	£180	144MHz 25watt FM – nice audio and good Rx
FDK M750AX	£269	144MHz multimode, 10 watts
Trio TR7730	£268	25watt 144MHz mobile, nice to use
Trio TR7800	£257	Much as above only bigger!
Trio TR8400	£299	A mobile 432MHz FM machine, good Rx, apparently
Trio TR9500	£428	Multimode mobile 10watt 432MHz
Yaesu FT230R	£239	25watts on 144MHz mobile/base station (FM)
Yaesu FT730R	£285	Ditto on 432MHz – 10watts. Rx a bit deaf
Yaesu 480R	£369	Multimode 144MHz rig; some have had problems
Yaesu FT780R	£399	Ditto for 432MHz
Yaesu FT720	£199/229	You can get a 144 or 432MHz head for these
Icom IC25E	£269	Nice 144MHz FM mobile rig – tiny, two VFOs
Icom IC290E	£375	144MHz multimode with a 25watt brother (IC290H)
Standard C5800E	£359	Lovely 25watt 144MHz multimode
KDK FM2030	£199	Compact mobile/base 144MHz 25watt FM; good

HF receivers

Trio R1000	£297	Synthesised, good performer
Trio R2000	£399	Lots of facilities,
Icom IC-R70	£499	See our review in March 1983 issue.
Yaesu FRG7	£199	The old "Frog"
Yaesu FRG7700	£330	Reputedly rather good.
NRD515	£985	Very nice, although not without its faults

S·W·L

For the short wave listener

Quite a few letters this month. First off the pile is a lovely letter from E.J. Martin of Ipswich, who is a real old timer and tells us how he used to listen to the Eiffel Tower time signals in 1919 on a crystal set! He asks whether any readers remember the experimental transmissions from Writtle, and mentions the new-fangled gadget (in 1925, this was) called the "thermionic valve".....

Mr. Martin wonders what frequencies are used for the two-way traffic between single-handed sailors crossing the Atlantic and "some amateur organisations in the UK". We must admit we don't know, and we aren't sure that it's amateurs that such sailors would be talking to - it'd be more likely to be the usual coastal radio stations at a guess, but if we're wrong perhaps someone could tell us.

The new-fangled gadget called the "thermionic valve"...

He also asks what kind of communications receiver would be suitable for picking up such stations. Well, as he says many of the old-time manufacturers aren't in business any more. Assuming you knew the frequencies, however, pretty well any receiver of the R-1000 class ought to do the job as long as the antenna is good enough - it's the antenna which is more important, assuming that the receiver is reasonably stable and selective.

Next off the pile is a letter from Australia - Mr. C. MacKinnon, to be precise, who takes us to task for recommending the AR88 so highly. He says in his letter "....I do feel those who praise it so highly in your magazine are those who questioned the need for Spitfires when you already had perfectly good Sopwith Pups. My purchase price of 18 Australian dollars (about £7) reflects its true market value here."

Well, the AR88 is still a good receiver provided you know how to get the best out of it. It isn't as easy to use as a modern synthesised job but in some ways it's just as good. Many people, especially the new SWL and maybe the old-timer on a pension or whatever, can't run to a new synthesised machine - and paying £30 or so for an AR88 would give you a hell of a lot more radio for your money than £30 on a similar modern machine. So we don't think the comparison is a fair one, and if you're on a limited budget and you have the room, the AR88 is still an excellent buy.

Mr. MacKinnon asks why receivers such as the R210, B47, C42 and C11, although made by Plessey in the UK, haven't been featured in amateur magazines over here. The main reason, we guess, is that there aren't any in amateur hands and they might well never have been used in the UK. We know of the R210, although we've never seen one in the flesh, and the others sound as though they might be current or recent Service machines of one sort or another. Anyone got any info on these machines?

The AR88 is still an excellent buy

Mr. Harry Davies, from Aintree, sent us a letter in exquisite copperplate handwriting (a lot better than Technical Bod's scrawl). He says that the SWL column in this magazine leaves a lot to be desired and recommends some of the following: information on receivers, their strong and weak points and accessories to go with them; indoor aerials; and QSLing procedure, i.e. how to send out reports to stations, both broadcast and amateur, and request a verification. He says "So please let's have some action and put some bod in charge of the SWL column who is perhaps an SWL and sympathetic to our needs."

The air and ship brigade don't use radio for our entertainment

We take your point, Mr. Davies, and we will certainly see what we can do. Some things do get covered elsewhere in the magazine, but maybe we need to get someone to conduct the column for us, as you say. The snag with a monthly magazine is that there's so little time to get it all together if you're going to do the job properly - as you'll see from the Current Comments this month, we've just appointed a full time editor and it may well be that we shall have to appoint someone to look after the column full time. The other thing is that maybe we've underestimated the amount of interest in SWLing; we didn't have any letters at all for a long while, but they're starting to come in now and it may well be time for a re-think! Thank you for your letter, sir, and happy listening.

Finally, Mr. E. Brown of Wellingborough takes us to task for missing a whole article out last month (we know, we know - see Straight and Level this time). It wasn't that we abolished the space to make way for an advertisement, Mr. Brown, we just goofed!

Mr. Brown goes on to suggest that we publish more info on DXpeditions - well, if we got the info we'd be happy to! He says "do the RSGB realise that there is such a creature as an SWL?"

This letter, as well as some others, have asked us whether we can publish any information on aircraft and marine bands. The problem is that we can't, strictly speaking, because in the UK it isn't legal to listen to them and we could be done for inciting people to commit an offence, according to our legal department. After all, the air and ship brigade don't use radio for our entertainment, though we don't really help there, unfortunately, except in general terms.

Mr. Brown goes on to ask for a feature on QSLing, so that't two in a row - OK, we get the message and we'll do something on those lines before the end of the year if we possibly can. Now - who'd like to write the definitive article on QSLing from the SWL point of view? We'll even pay you lots of filthy lucre if it's the real McCoy! Otherwise we shall have to research it ourselves and then all the Clever Dicks will write floods of letters pointing out where we went wrong.....

The clever Dicks will write floods of letters

Anyway, one and all, thank you for your letters and we will have to have something of a think about where we go with the column from here. Mr. Editor comments that he may have a splendid gentleman lined up to take over the column and make it the best bit of the magazine, so watch this space!

The quick brown fox...

Two new all-letter sentences to test your teleprinters/computers with: "John P.Brady gave me a black walnut box of quite a small size." And "Quick wafting zephyrs vex bold Jim" Taken from NHARS News.

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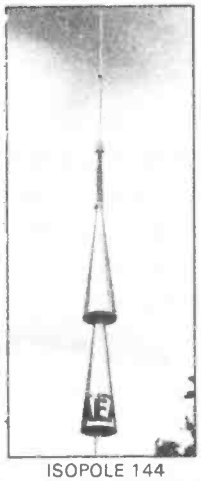
- Includes quick release mobile mounting bracket and up/down microphone.

TR9130 ALL MODE TRANSCEIVER £433 + car: £5.00



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HAM BYTE

After spending a few years playing with computers in amateur radio you tend to build up a library of simple programs and subroutines from which sections are taken to be built into other, more complex programs. This month I am going to give you a couple of programs for the ZX81 which you may well find useful in this way. The first needs 16k, but the second fits into 1k. By John Morris G4ANB.

The "QTH locator" is a system used by VHF and UHF operators to give their locations over the air. The system is described in the *Amateur Radio Operating Manual*, published by the RSGB.

Quite a few programs for converting QTH locators to latitude and longitude have been published; this one is tailored for the ZX81, and has an error-checking facility. facility.

Lines 10 to 120 make up a simple "main program" just to show how the subroutine is used. It is all quite straightforward, except perhaps for lines 80 to 110. These use the INT function to split the latitude and longitude into degrees and minutes parts, just for the sake of making the output look pretty.

You may well like to throw away lines 10 to 120 and use the conversion subroutine, lines 1000 to 1140, in your own programs. For example, by combining it with the distance and bearing program published a couple of months back, and changing a few lines here and there, you could fairly easily produce a program to give distance and bearing from QTH locators.

By combining it with the distance and bearing program, you could fairly easily produce a program to give distance and bearing from QTH locators.

The important part of the program consist of a subroutine at lines 1000 to 1140. When the subroutine is called (by a "GOSUB 1000") the string Q$ should contain the five-character QTH locator. The subroutine first makes sure the locator is valid (lines 1000 to 1080), and then calculates the corresponding latitude and longitude (lines 1090 to 1140).

If the locator was acceptable then when control is returned from the subrouting, the latitude (in degrees north) is in LAT and the longitude (in degrees east) in LONG. This is how the error checking facility is used: The variable ERR is used as an error flag. If it is zero then the locator was valid. If it is not zero then the locator was illegal in some way, and LAT and LONG do not contain useful values. In this case the main program should take some appropriate action - such as sending a rude message to the screen!

Add another couple of lines and you can make a simple VHF/UHF contest scorer. The way to do this is to calculate the distance from the locators, using the locator to latitude and longitude routine combined with a latitude and longitude to distance calculator. The points score in the RSGB "radial ring" system is then given by this formula:

Points = 1 + 2 * INT (kilometres/50)

This program is tailored for the ZX81, and has an error-checking facility.

If you really want to go mad you can keep on adding new features until you set an all-singing, all-dancing contest logger. This is how large programs are often put together; by taking a quite simple routine and then adding bits until it does everything you want.

Lines 60 to 80 perform the quite simple calculations, line 90 prints the results, and the whole lot is repeated. As an example, suppose you hve a transmitter which puts out 10w but want to reduce its power to 1w, maybe to try some QRP operation, and don't want to delve into the innards of the expensive rig. Its output impedance is 50 R

The second program calculates resistor values for PI attenuators. These are simple networks of three resistors and are used to reduce the power flowing into a circuit....

The second program calculates resistor values for PI attenuators. These are simple networks of three resistors, as shown in the circuit diagram. They are used to reduce the power flowing into a circuit. For example, if your receiver is being overloaded on HF then an attenuator in the antenna lead can help. Another common use is to drop the power from a transmitter down to a level suitable for feeding a transverter.

The resistor values have to be chosen to match the impedance in the circuit, as well as to give the required attenuation. The two "side" resistors are usually the same value. The program is written for the ZX81, but is easy enough to adapt for other computers. It fits easily into 1K.

Lines 10 to 50 ask for the impedance (typically 50 R if the attenuator is going in the output of a transmitter) and required attenuation in dB. An attenuation of 3dB drops the power to roughly a half; 10dB drops it to one tenth.

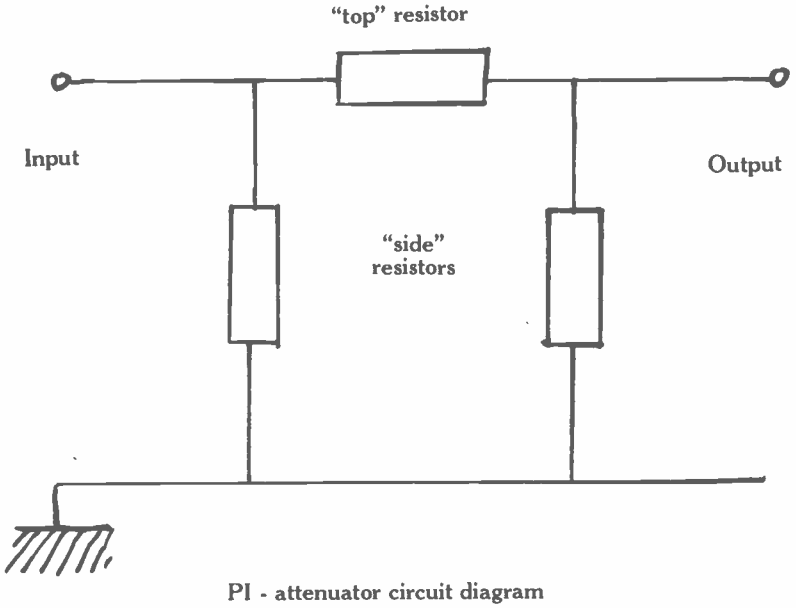
Going from 10 to 1 w means you need 10dB attenuation. Plugging 50R and 10dB into the program it tells me that the side resistors should be 96.247.. R , and the top 71.151.. R . In practice you would round these to the nearest preferred values, and use 100 for the sides and 70 for the top. They would have to be high powered resistors, because 10w will be going in but only 1w coming out. The rest will heat up the resistors. They must also be non-conductive to work properly at radio frequencies.

Right top of page: the QTH locator program. Note the subroutine at lines 1000 to 1140.

Right centre: the PI attenuator circuit diagram. Written for the ZX81, the program can be easily adapted to other computers.

Right bottom: the program as described in the text.

```
 10 PRINT ,,"LOCATOR? ";
 20 INPUT Q$
 30 PRINT Q$
 40 GOSUB 1000
 50 IF ERR=0 THEN GOTO 80
 60 PRINT "ILLEGAL LOCATOR"
 70 GOTO 10
 80 PRINT "LAT ";INT LAT;" DEG ";60*(LAT-INT LAT);" MIN NORTH"
 90 LET TEMP=ABS LONG
100 PRINT "LONG ";INT TEMP;" DEG ";60*(TEMP-INT TEMP);" MIN ";
110 PRINT "WEST" AND LONG<0;"EAST" AND LONG >=0
120 GOTO 10
1000 LET ERR=1
1010 IF LEN Q$<>5 THEN RETURN
1020 FOR J=1 TO 5
1030 LET T$=Q$(J)
1040 IF T$<"AA00A"(J) OR T$>"ZZ89J"(J) THEN RETURN
1050 NEXT J
1060 LET TEMP=(VAL Q$(3 TO 4)-1)/10
1070 IF TEMP<0 OR TEMP>7.9 OR T$="I" THEN RETURN
1080 LET ERR=0
1090 LET LAT=((T$<="B" OR T$="H")-(T$>="D" AND T$<="F"))/24
1100 LET LAT=LAT+CODE Q$(2)+(23.5-INT TEMP)/8
1110 LET LONG=((T$>="B" AND T$<="D")-(T$>="F" AND T$<="H"))/15
1120 LET LONG=LONG+2*(CODE Q$+TEMP-INT TEMP)-75.9
1130 IF LONG>=40 THEN LET LONG=LONG-52
1140 RETURN
```



PI - attenuator circuit diagram

```
 10 PRINT "PI ATTENUATOR",,,,"IMPEDANCE (OHMS)? ";
 20 INPUT Z
 30 PRINT Z,"ATTENUATION (DB)? ";
 40 INPUT D
 50 PRINT D
 60 LET D=10**(-D/20)
 70 LET S=Z*(1+D)/(1-D)
 80 LET T=Z*(1-D*D)/(D+D)
 90 PRINT "SIDES ";S;" OHMS","TOP ";T;" OHMS"
100 RUN
```

TRIODES: 1

MESSAGE IN A BOTTLE

First of a two-part series on that most adaptable of valves the - triode. Ken Williams discusses its uses as an amplifier, among other things. As stable as a rock, the triode has a very simple circuitry, but sadly is not recognised in the RAE syllabus.

In these days of solid state circuitry and complete amplifiers-on-a-chip, there would seem little justification for resurrecting the old fashioned triode valve - indeed, its solid state equivalent, the simple junction transistor will, in audio applications, do anything which a small, or even fairly big triode will do for a fraction of the power consumption in one tenth of the volume.

Why then, should I fill these pages with a load of waffle about triode valves? In the first instance, there are still many in excellent service in ham shacks all over the world. If, however, you own one and a fault occurs, it is probable that your friendly local emporium will either refuse to repair it or alternatively charge you an arm and a leg to sort out the trouble. If you understand thermionic circuits, you will, in all probability, have no trouble in clearing the fault yourself.

The sensitivity of many of the older receivers begins to fall off above 15MHz. This can be restored by a suitable preamplifier. If you fit a solid state pre-amplifier you will have the problem of finding a source of 9 - 12 volts DC but the power for a valve preamplifier can easily be tapped off the receiver supplies. Furthermore it will provide all the sensitivity you can use on HF and in all probability have a better cross modulation performance. At this point you might reasonably start wondering if valves are as obsolete as you thought.

I made this point to a friend of mine who is a engineer in one of Europe's top research laboratories. He said that they had now developed a transistor whose cross modulation performance was JUST AS GOOD AS A VALVE, but wouldn't be available commercially for some time. As virtually no new low power valves have been designed in the past twenty years, what he was really saying was that transistor RF amplifiers are now, in cross modulation terms, where valves were in 1960. It must be admitted that at VHF,

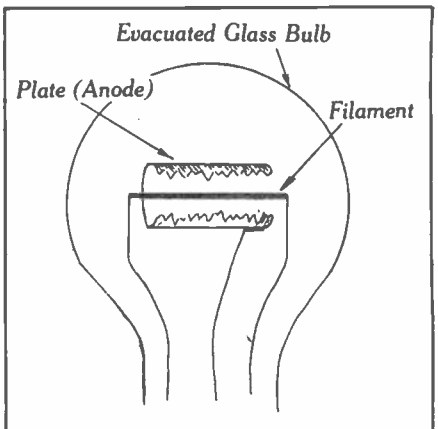


Fig. 1. Representation of a simple diode

devices such as the 3SK88 give a sensitivity which valves cannot match - but would this have been the case if valve development had continued. However, once power levels at RF are increased, valves come back into their own.

Although most professional manufacturers produce 1kW solid state amplifiers for HF, closer examination will show that in fact these use a number of low power (usually 100 - 150 watt) modules in parallel - quite a complication compared with valves such as a 4CX250 or a pair of 811As, either of which will give a power output approaching the Amateur Licence legal maximum.

The 4CX250 is, of course a tetrode, which introduces the discussion as to which is preferable, a triode or a tetrode. Both have their advantages and disadvantages which are often a function of the requirement of the time. The tetrode requires less drive - but is this an advantage if your prime mover has more than enough drive for either and, furthermore, when throttled back to tetrode drive levels produces an inferior signal to noise ratio. However, if the prime mover is an FT7 with only 10 watts available, then a big tetrode is the obvious choice.

An additional claimed advantage of the tetrodes is that they do not normally require neutralising, but a triode, when correctly neutralised is as stable as the rock of Gibraltar, which is more than can be said for many tetrode linears. A final point in favour of triode amplifiers is that, in general, the circuitry is more simple for, unlike the big tetrodes, no screen grid protection circuits are required. Overall, making the decision between triodes and tetrodes for RF power amplifiers is a matter of 'horses for courses' - use whichever is more convenient, or more likely, what you have in the junk box.

In view of the fact that it is probable that valve RF power amplifiers will be with us for a long time to come, it is sad that the powers-that-be have decided that valves should no longer appear in the RAE syllabus.

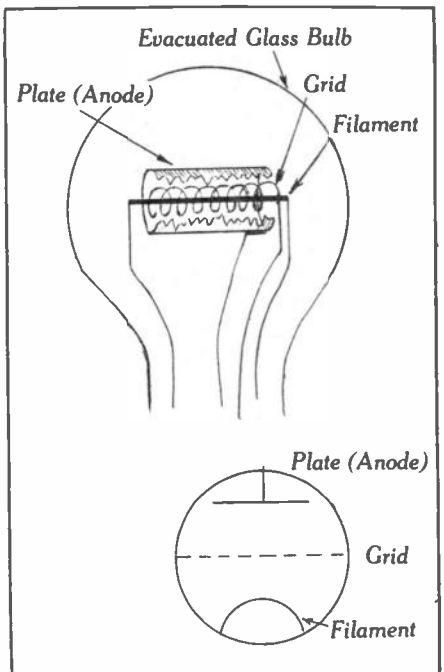


Fig. 2. Representation of a simple triode valve together with its circuitry symbol.

How do triodes work?

To understand this we have to go right back to the 19th century when Edison discovered that if he placed an electrode in an evacuated bulb together with an electrically heated filament, a minute electrical current would pass through an external circuit between electrode and filament. Other experiementers found that this current could be considerably increased if a positive electrical potential were placed on the electrode. However, a negative potential caused immediate cession of the current. This one-way effect led to the device being called, in Great Britain at least, a valve.

The reason for this effect is that when a wire is heated in a vacuum, it emits electrons (which are negatively charged) and these conglomerate in a cloud around the wire filament forming a 'space charge'. When the fringes of this cloud reaches the electrode, some are conducted back to the heated filament via the external circuit. If a positive potential is placed on the electrode, the electrons are attracted and the currrent increases. If a negative potential is applied, the electrons are repelled and the current ceases. This electrode soon became known as the anode (in Europe) or plate (in USA).

A few years later in 1907, it occurred to Dr. Lee de Forest that if a mesh were placed between the filament and the anode, and this mesh was subjected to a varying negative voltage, this could control the anode current, despite the anode voltage remaining constant. This was the first triode valve.

In this form the triode valve gradually gained acceptance over a period of twenty years, however by about 1930, users were getting fed up with having to provide a DC supply for the filament, a necessity for if AC were used, severe hum was generated in the amplifier output. This problem was overcome by encasing the filament in a metal tube insulated from the filament. The action of this is, that by heating the filament, the tube could be kept at constant potential whilst the filament could be fed with alternating current.

You can perform a series of experiments

In this technique, the tube is called the cathode (sometimes spelt kathode) and the filament, quite reasonably, the heater. The use of a separate cathode brought other benefits such as self biassing, but more about that later.

Having now reached the modern form of triode valve, perhaps it may well be worthwhile to have a look at how it will perform with differing voltages applied to the various electrodes. If you wire up the circuit shown in figure 4 you can perform a series of experiments such as: investigating how the anode current alters with varying grid voltages (positive and negative) while keeping the anode voltage constant, how the anode current varies when the anode voltage is changed while the grid voltage remains constant, etc.

If you then draw your results on a series of graphs you will get something like figures 5,6 and 7. From these can be deduced the three important parameters of your valve: u, the amplification factor; gm, the mutual conductance and Ra the anode resistance. These can be used in practical circuits to calculate gain of a stage, matching, etc. It is not necessary to measure each individual valve, however, for the manufactuers provide all this information in their data sheets.

Now what is the meaning of these mysterious figures?

u (the Greek letter 'mu') is the amplification factor and is: the rate of change of anode current with grid voltage, divided by the rate of change of anode current with anode voltage.

gm, the mutual conductance, is the rate of change of anode current compared with the grid voltage if the anode voltage is kept constant. This is measured in mA/V.

Ra, the anode resistance is the rate of change of anode current with anode current when the grid voltage is kept constant. This is measured in ohms.

From these definitions you will see that they can be rewritten as:

$$gm = \frac{S\ Ia}{S\ Vg} \qquad u = \frac{S\ Va}{S\ Vg} \qquad Ra = \frac{S\ Va}{S\ Ia}$$

Where: Ia is anode current, Va is anode voltage and Vg is the grid voltage. S is the Greek letter 'delta' and just means "a little bit of".

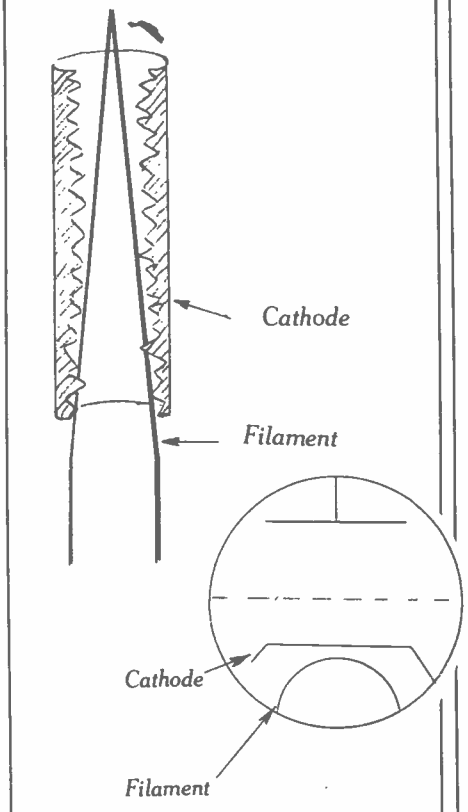


Fig. 3. Representation of an indirectly heated cathode and its circuit symbol.

Juggle these equations in your best RAE manner and you will get:

$$u = Ra\ Gm$$

from which it is quite easy to calculate u if you first measure Ra and Gm.

Audio amplifiers

Having now safely disposed of the basic parameters of triode valves, let us now see how they operate in a simple amplifier circuit.

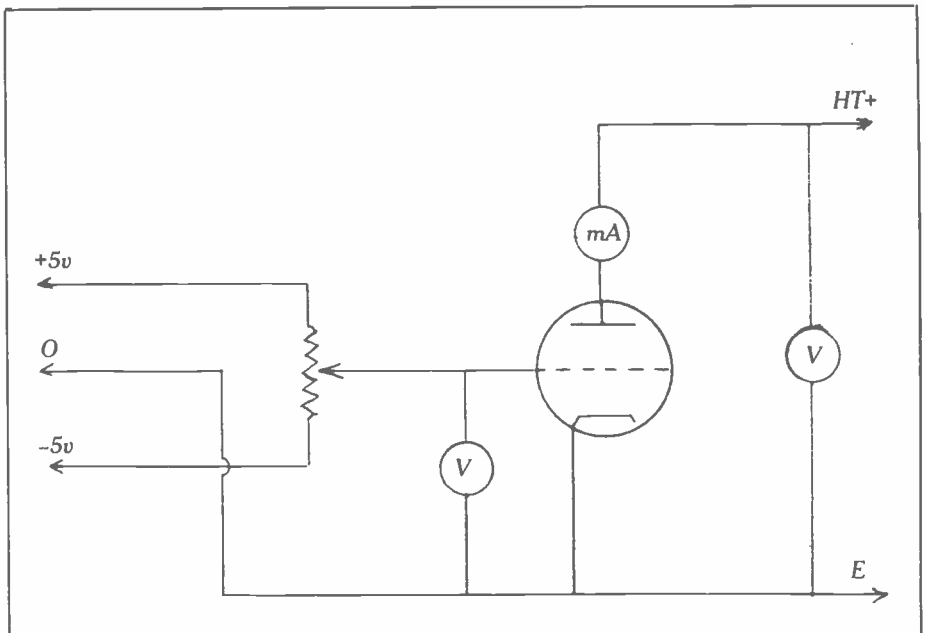


Fig. 4. The valve test circuit the valve may be any small triode

TRIODES: 1

MESSAGE IN A BOTTLE

In fig 8 you will see a triode with a funny symbol in the grid circuit (which is a representation of the source of the voltage which is to be amplified) and a resistor in the anode circuit. Consider what happens when the grid is taken positive by the incoming voltage. From fig 6 you will see that this causes the anode current to increase. As the current rises, so there will be more voltage drop across the anode resistor and the anode voltage will fall. If the grid is taken negative by the incoming voltage, conversely, the anode voltage will rise. Placing an alternative voltage on the grid will therefore cause an amplified version of that waveform to appear on the anode, the magnitude of which will be proportional to the amplification factor of the valve.

Now let us think for another moment about the circuit, the valve and its input circuit can be represented by the part of fig 9 lying within the dotted line. If RL is added to complete the circuit, it will be realised that the output is really developed across the anode load resistor which in turn is in series with Ra and the amplified input voltage.

The useable porportion of the output from the amplified input voltage is therefore only:

$$\frac{RL}{RL + Ra}$$

and the gain of the stage must be:

$$\frac{u\ RL}{RL + Ra}$$

Now this simple circuit is fine for explaining the operation of an amplifier but in practical terms it is worse than useless. Let us see, therefore, how it could be modified into a practical circuit.

Grid should be slightly negative

Looking back at fig 6, you will see that for optimum operation the grid of the valve should be slightly negative compared with the cathode. In the days of battery powered receivers, this voltage was obtained from a separate "grid-bias" battery. If, however, a resistor of a few hundred ohms is placed between cathode and earth, when the valve passes current, a few volts will be developed across it and, if the grid is earthed through a resistor, it will then be the required few volts negative of the cathode.

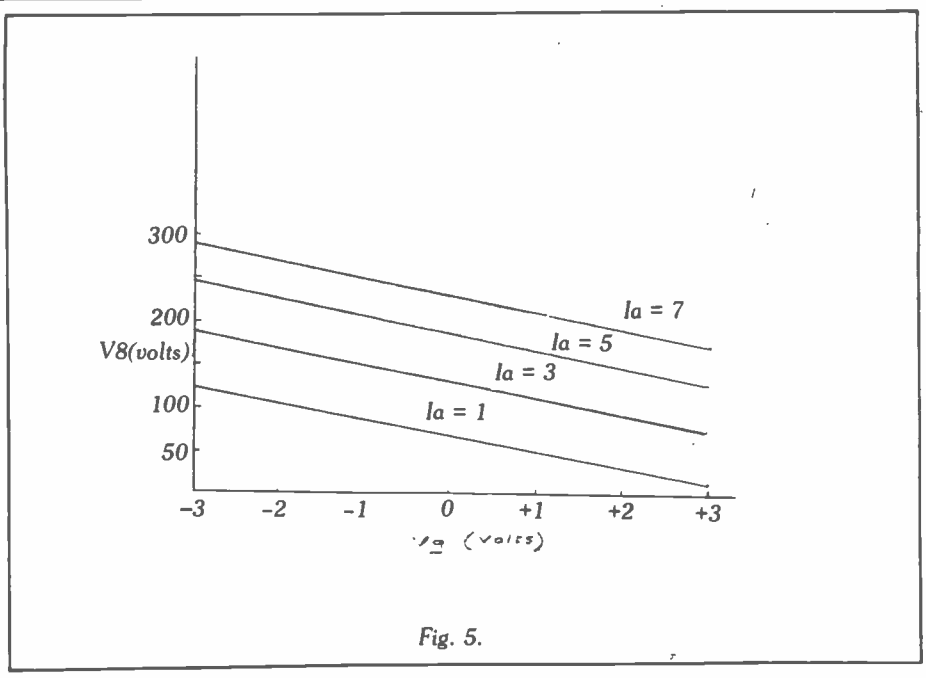


Fig. 5.

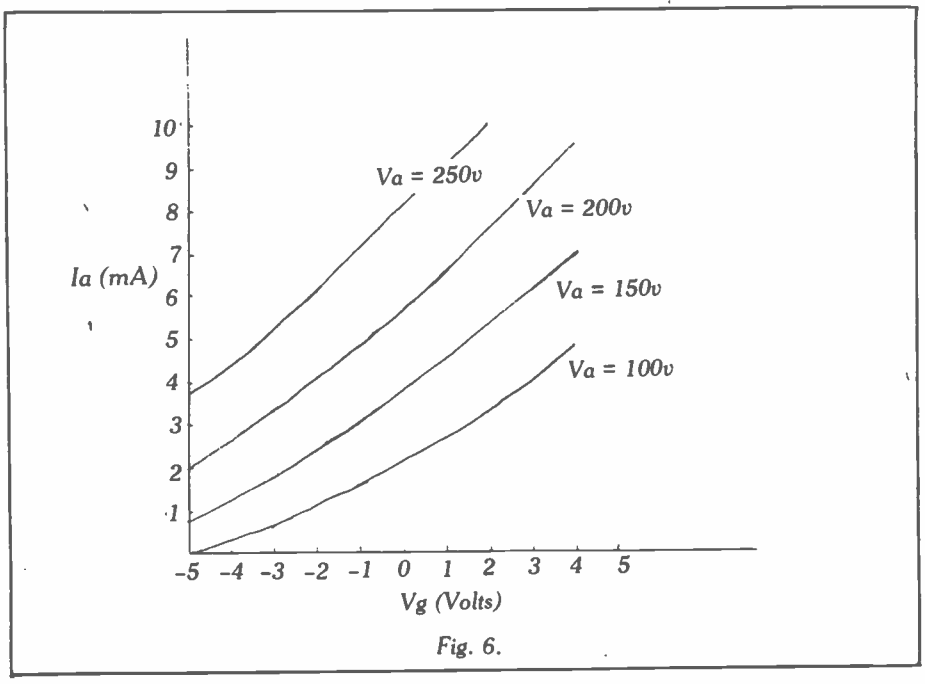


Fig. 6.

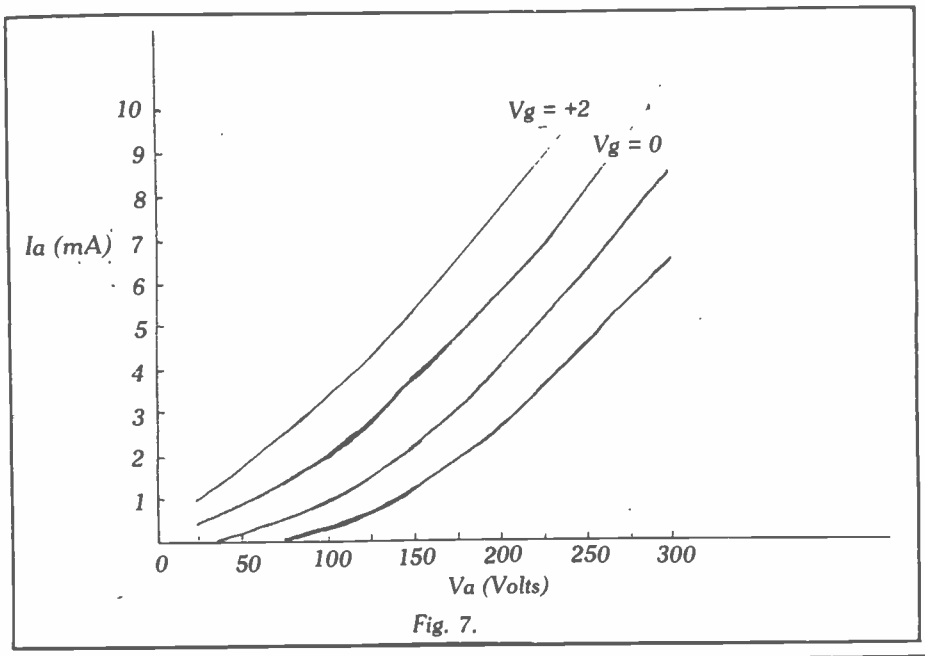


Fig. 7.

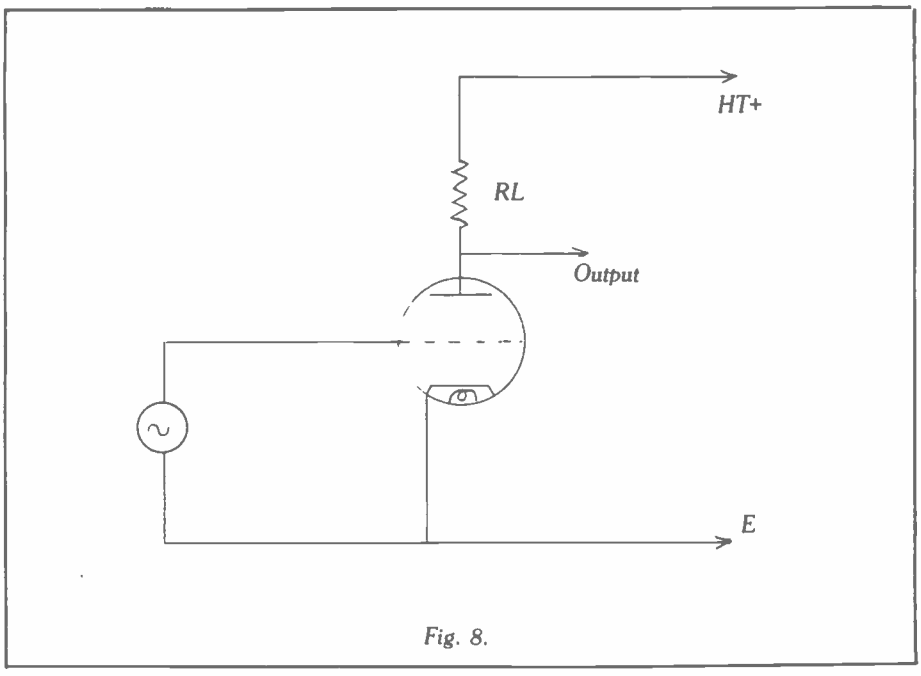


Fig. 8.

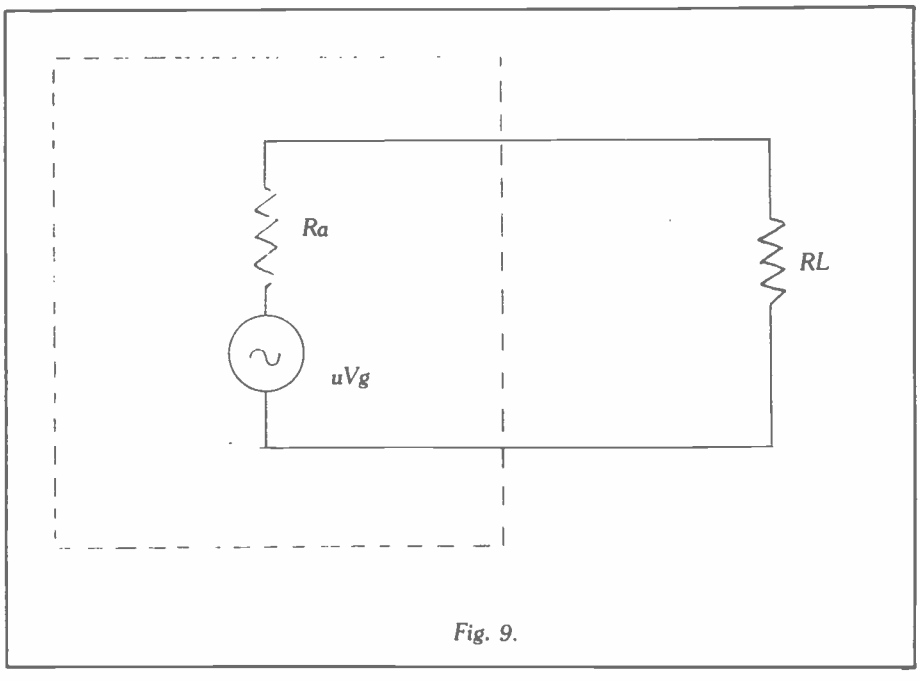


Fig. 9.

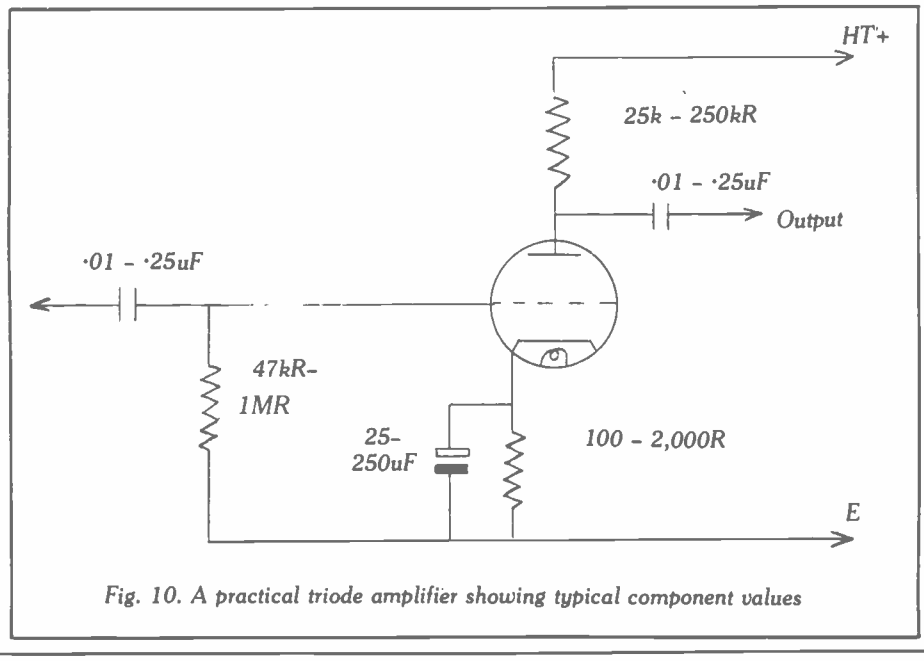


Fig. 10. A practical triode amplifier showing typical component values

One minor snag occurs with this technique; when a signal is fed to the grid, we have seen that the anode current and consequently the cathode current varies. Consequently the voltage developed across the bias resistor also varies, placing an additional negative voltage, out of phase with the incoming signal, on the grid and reducing the gain of the amplifier. This can be overcome by putting a high value capacitor in parallel with the cathode resistor. This effectively by passes the audio component to earth and stabilizes the cathode voltage.

The anode circuit usually comprises a resistor with the output to the succeeding stage being taken directly from the anode via a capacitor.

In some old circuits a transformer coupling was used whilst in some valve communications receivers, a transformer was fitted in the anode of the audio amplifier stage to give a low level output for headphones and also a capacitor from the anode fed the output stage to drive a loudspeaker.

A typical audio amplifier stage is shown in fig 10 but if the circuit is being used to drive a loudspeaker, the anode resistor and output coupling capacitor will be deleted and replaced by a transformer of suitable ratio to match the valve to the load.

The Cathode follower

A triode is sometimes used to isolate two other stages such as between an oscillator and an amplifier in a transmitter. For this purpose, no gain is required and the circuit frequently chosen is the cathode follower. This gives approximately unity voltage gain (but can sometimes give power gain) and good isolation between input and output circuits.

The cathode follower makes use of the output voltage developed across the cathode resistor which is not by passed by a capacitor. The anode circuit is unused and the amplified signal generated there is by passed to earth by a capacitor, the resistor in the circuit only serving to reduce the HT voltage on the valve.

The output inpedance of a cathode follower circuit is dependent only on the mutual conductance of the valve used and is equal to:

TRIODES: 1

$$\frac{1}{gm}$$

With a high gain valve, this can be in the order of only a few hundred ohms and in consequence this circuit is also frequently used as a wide band impedance matching device.

The phase splitter

It is sometimes necessary to produce two signals which are identical except that one is 180 degrees out of phase to the other. This may be achieved using a triode valve by splitting the anode load and placing one half in the anode circuit and the other in the cathode circuit. The two outputs are taken from the anode and cathode as shown in fig 12.

Other circuits will do this task, but the one shown is both simple and effective.

Push pull amplifiers

When a high output is required, it is frequently more convenient to use two small valves rather than one larger one. It is possible to merely place two valves in parallel, in fact, this is frequently the case in RF power amplifiers, however at lower frequencies, it is more usual to use the push pull circuit.

In this the valves are driven 180 degrees out of phase, thus when one grid is driven in a positive direction, the other is being driven negative. This technique gives several advantages. For example, it is possible to bias the valves to such a point that the anode current ceases to flow when not being driven by a signal. Each valve then amplifies only one half of the signal, thus leading to a considerable increase in efficiency.

The level of bias on a valve (or transistor) defines the 'Class' in which it is operating. If the bias is such that the valve is operating on the straight line part of its characteristic, it is said to be in Class A. When biassed just to the point where the valve passes no current except when a signal is present, it is said to be in Class B.

At various points between these limits, it will be in either Class AB1 or AB2. If the valve is biassed to such a degree that the anode current will flow only on the very peaks of the incoming drive signal, it is in Class C. The latter technique is very efficient for FM or CW operation at RF but is not suitable for any use where the output has to be proportional to the input signal.

Almost all the classic valve amplifiers, such as the Williamson, used push pull output stages and although these usually used tetrode valves such as the 6L6 or KT66, these were normally operated as triodes by the simple expedient of strapping screen grid and anode with a low value (usually 100 ohm) resistor. The performance of these amplifiers is hardly bettered today. The Williamson, which I have already mentioned, gave a level frequency response from 5Hz to almost 100 kHz at a distortion level far below that perceptable to the human ear. This may not seem earth shattering today, but a generation ago it was revolutionary.

In order to take maximum advantage of the efficiency of Class B operation, a special series of valves were developed known as "Class B zero bias" were developed. The characteristics of these were such that very little anode current was passed until the grid of the valve was driven positive. These valves provide a very efficient method of producing high power at both audio and radio frequencies in quite simple circuits.

Mention has already been made of the technique of using tetrodes or pentodes strapped as triodes. This can easily be achieved by connecting screen grid to anode with a 47 or 100 ohm resistor. This is particularly effective in the case of the small output valves such as the 6V6, 6L6, 6BW6 or 6AQ5. In the case of the rather larger 807, however, a rather better method can be used, for if the screen grid and control grid are strapped with a 100k ohm resistor and the drive fed to the screen grid, this forms a very efficient Class B triode. Two 807s strapped in this way, in a push pull circuit will provide a good 80 watts of audio.

Next issue

Throughout this article I have referred to audio amplifiers, a field where today there is not likely to be much practical application. However these circuits give an appreciation of the operation of the triode valve in amplifier service and lead to next month's article which will describe the use of triodes in RF signal and linear amplifier service. The latter being a field where they can match or better all that Silicon Valley can offer.

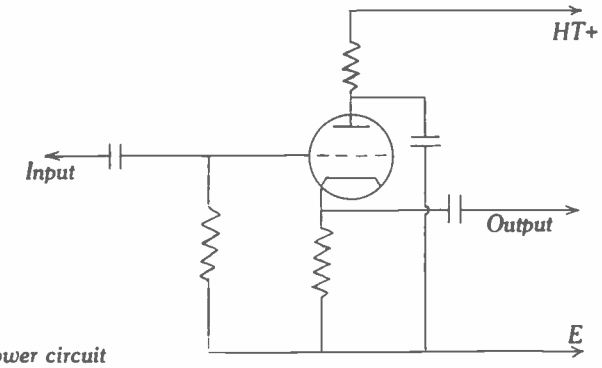


Fig. 11.
Typical cathode – follower circuit

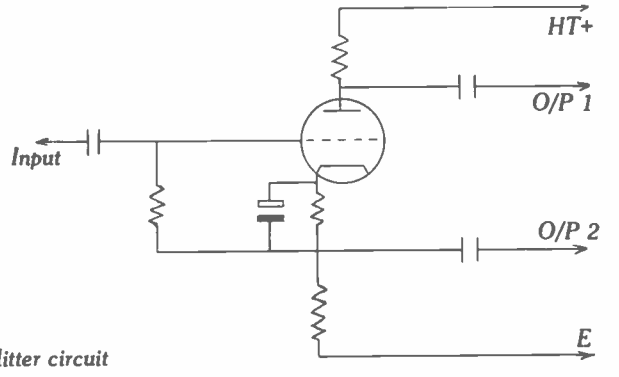


Fig. 12.
A typical phase – splitter circuit

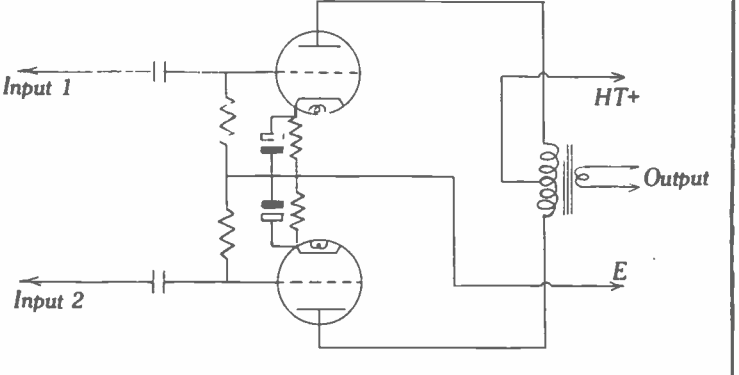
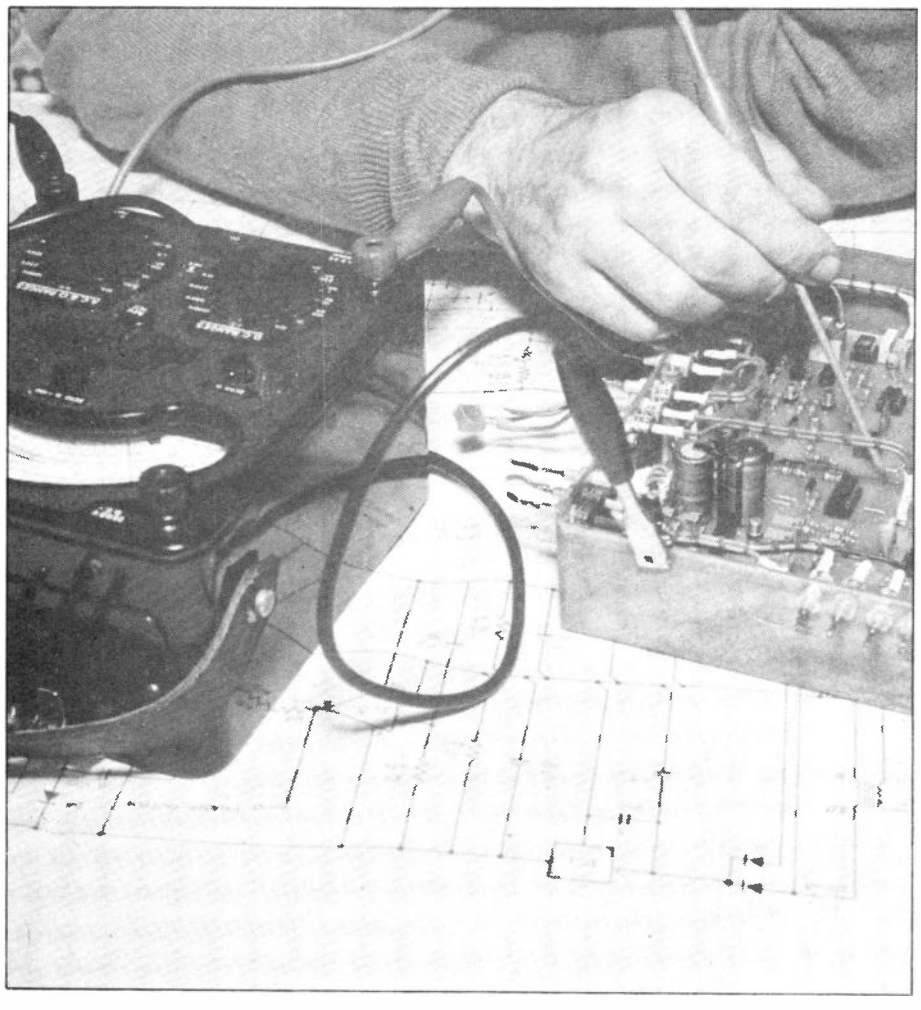


Fig. 13.
The basic push-pull amplifier circuit



From the lab to the shack

Over the last year or so a lot has been said about the performance of amateur rigs — the cleanliness of RF and VFO stages has come under particular scrutiny. Here, Angus McKenzie G3OSS puts in a plea for better audio output amplifiers and loudspeakers.

Almost all points I have discussed in previous parts of this series have (at least) indirectly affected the audio quality of a received signal. This month I come to the crunch, in that I discuss the direct factors controlling **overall audio quality** and **listening fatigue.**

If you are a regular user of the LF bands, you will know that CW carriers have a habit of popping up right on top of somebody that you are in QSO with. And while sometimes you put up with the interference, at other times the whistle is so bad it masks the received station.

Many receivers are fitted with what can be called a T notch filter, whistle filter, notch filter or just 'notch'. Usually, a button is used to switch in the notch, whilst a lever, or pot, varies the position of the notch in the IF passband. However the notch is produced, its effect should be to tune out the offending whistle by as many dBs as possible without materially affecting the received audio from the station being monitored.

To enable the whistle to be greatly reduced, the effective Q has to be very high, otherwise a sizeable chunk of the passband will go for the chop as well. Unfortunately, in recent designs the maximum notch is rather poor, although as little as 14dB, but perhaps 20dB. In my opinion, the notch should be substantially more than 30 and ideally 40dB, which means a very sharp Q indeed. This notch should be preserved across the complete tuning range of the potentiometer on both sides of centre, i.e., carrier frequency.

"Usually, the more sensitive a speaker is, the worse its quality will be".

A good notch filter can make the most startling difference to the readability of a received signal, having a carrier near the same frequency. It may not have struck you that it is far better to have an extremely good filter before, rather than post, detection. But the reason is interesting. A good receiver has reasonably low RF and IF intermodulation distortion, but distortion at the product detector usually leaves quite a lot to be desired. A product detector has to deal with transient overshoots and thus can produce significantly higher orders of distortion than can a steady tone.

If you can cut out the CW carrier before the detector, then the received audio is likely to sound cleaner, and this helps to reduce listening fatigue. If you use a notch filter in the audio path, then no matter how good the filter is, you will only remove the fundamental beat note and not its harmonics. You will also not

remove the intermodulation products developed in the detector between the beat note and the audio. Some receivers have quite low distortion detectors, unfortunately, only rarely below 1%, whereas others may measure 3% or so on a steady tone (e.g. beat note), but much higher distortions on transients, particularly those occurring on a consonant at the beginning of a spoken phrase.

Add-on filters

This is not to say that magnificent devices such as Datong filters cannot play an important part in cleaning up audio, and I regularly use their latest model FL3 automatic notch, which frankly is more convenient than having to tune the notch on the receiver itself. In my experience, whilst the Datong fundamental notch and Q is excellent, it cannot make up for the deficiencies of some detectors, and a good notch on the receiver seems to give cleaner results, in some cases.

For testing the quality of a notch filter, we send two equal level carriers spaced 400Hz apart (for example) and note how much rejection we can achieve on each of the carriers with respect to the other, and how much rejection there is of the wanted carrier. Having tuned the notch to one of the carriers, and noted the rejection, we can then move the other generator and draw a complete curve of the rejection slope which can be very revealing; some notches are excessively wide, i.e., taking away half the audio as well, which then comes up again with AGC action with a strange response indeed! A typical example of this is in the IC740, excellent in almost all other areas.

Many receivers have a tone control, but almost invariably these only roll off HF and do not affect lower audio frequencies. It is not so important to have LF control on SSB, although it can sometimes help here, but it is useful to be able to cut bass when listening to transmissions from rigs, such as the Trio TS700 which was very bassy on FM. I prefer a control which has a centre indent and which cuts bass one way from centre whilst cutting treble the other way. Such a control requires only minor additional components and is ergonomically useful.

Most powerful amplifiers for audio in receivers give only around 11v peak to peak swing, i.e., barely two watts output into eight ohms for 10% total harmonic distortion. We measure this by sending a strong carrier through the system and tuning the VFO for a 1kHz beat note. The audio gain control is then raised until 10% THD is shown by our automatic distortion meter. The output being loaded by eight ohms or four ohms if appropriate. Many rigs only specify eight ohms, and knowing that four ohms draws more current, we do not normally test into this impedance as we may harm the output stage with a tone virtually on clipping.

Bad audio

To gain an idea of the product detector or FM discriminator distortion, we lower the output level to get a voltage equivalent to 125mW. This distortion is usually introduced before the audio stages, but of course some bad audio amplifiers with crossover distortion actually produce more distortion at very low levels than at higher ones. There is a considerable problem in the optimisation of the matching between the loudspeaker and the audio output amplifier.

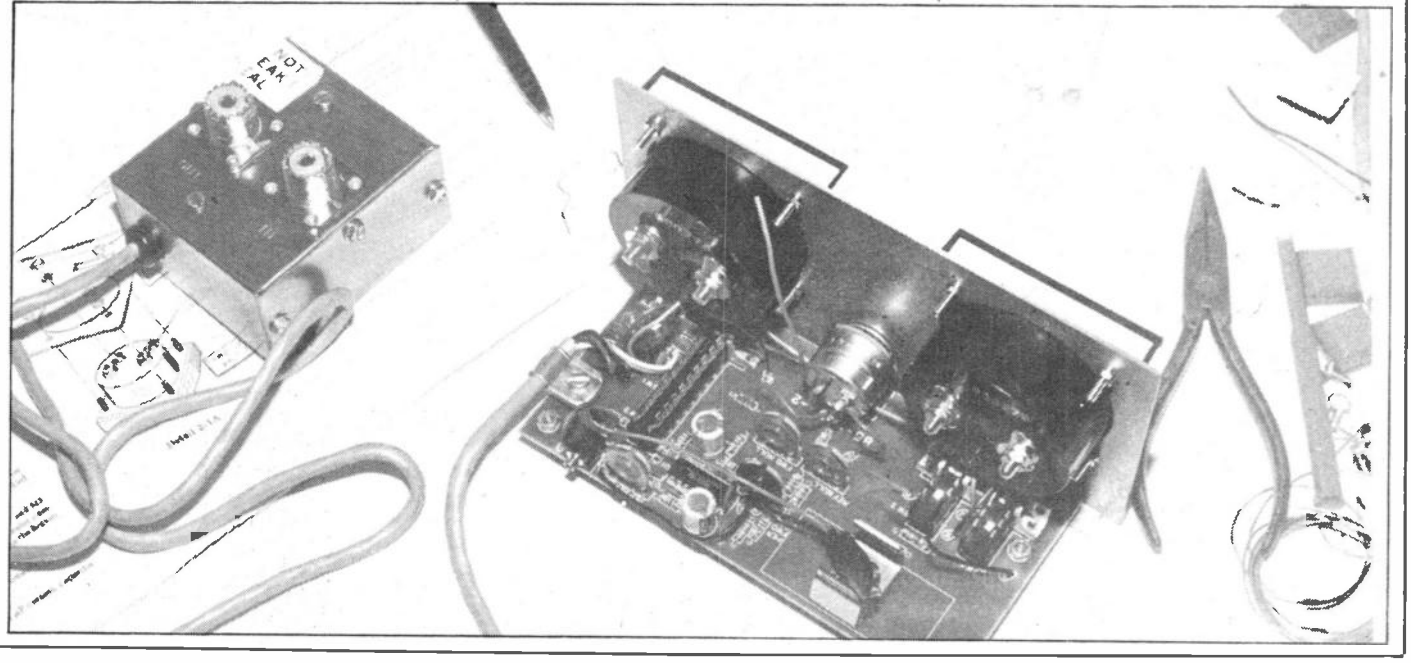
Loudspeaker quality

Speakers can vary widely in their efficiency, i.e., the amount of audio output volume given for a fixed input level across the speaker terminals. Usually, the more sensitive a speaker is, the worse its quality will be, and the greater will be the colouration. Some Japanese accessory speakers have the most abominable responses even when considering the limited bandwidth of 300Hz to 3kHz. Some nasty speakers have an atrocious peak just below 3kHz which grossly emphasises hiss, and this can reduce readability as well as cause listening fatigue.

Other loudspeakers make a respectable transmission sound, as if the amateur the other end is talking with his head in a bucket. While I am convinced that some people do regularly talk through a Wellington boot, some audio quality I have heard has been ludicrously bad. The unfortunate thing here is that somebody with a bad installation in this area may not realise how much better it could be. Listening fatigue (which is subconscious) might gradually introduce psychological stress.

Only when such a person hears a significantly better set-up in their own environment do they realise how bad the quality has been in the past. A loudspeaker with a smooth response over the required pass band is not necessarily more expensive, especially if you buy the speaker itself and make your own baffle. Unfortunately many reasonable 130mm diameter speakers are fairly insensitive, and may well need four watts of undistorted power to give a reasonable volume, whereas a honk box might need only 400mW.

Sometimes ignition noise can be troublesome, and whilst the set-up might be just loud enough to avoid clipping, any interference can cause the output amplifier to go over the top and sound most unpleasant. I am very sorry to see that far too many audio output stages run with only 12v DC supply, and this is inexcusable if the rig is a mains-only box. An 18v rail can give double the power, and be much more desirable.



From the lab to the shack

Some headphone matching circuits are designed that they will only properly accommodate low impedance models. Even cheap music centres get over the problem with a standard network of two resistors driven from the loudspeaker output. Cannot Japanese manufacturers use similar circuits on receivers? We often like to make a tape recording of a QSO, and whilst some receivers include a phono socket driven from the top of the volume control (so that the maximum level is reasonably constant) too many rigs either omit this, or feed an auxiliary pin with the volume controlled audio signal, which is ridiculous.

Amplifier response

Some receiver audio amplifiers I have checked have a response which is extended to be far too wide, perhaps flat, from 20Hz to 20Hz. This allows all the harmonic distortion of the detector to be reproduced, which is unwelcome. Even more serious, though, is the receiver having such an amplifier following too much IF and audio amplification after the filters. The result is an extremely broad band white noise on which is superimposed the narrow band noise of, say, an SSB or even narrower CW received signal. This interferes with signal to noise measurements, and can make what could be a good receiver measure and sound quite a lot worse.

The amount of gain provided after the volume control can often be excessive, so that the audio gain control is almost always used below '10 o'clock'. This is particularly silly if the receiver has plenty of RF and IF gain, so that weak signals are brought right up in level by AGC. On many receivers, particularly valve ones, the volume control is of such a high impedence as to grossly alter response, even within a 3kHz bandwidth between different volume control settings. The worst example of this, believe it or not, is on the Racal RA17L, but the old AR88 was almost as bad. How much better was the BRT400 valve receiver for audio quality!

It is worth giving a warning here about headphones. If you often have to listen for weak signals, you may get into the habit of turning the wick up rather more than you need. I have tested perhaps 60 different types of headphone in the last few years, and have found it is all too easy to have an average noise level of up to 100dB sound pressure level arriving at the ear drum, and this is not too good for you over long periods. It can end up after some years with what is known in the acoustics business as 'occupational hearing loss'.

Always listen at or near the minimum level necessary to obtain reasonable copy if a signal is present. Headphones are very useful, though, when readability is difficult, as they can allow you to concentrate more on the copy rather than noises in the room, including perhaps loud linear amplifier fans, etc.

Returning to detector distortion, I find a really good and well aligned discriminator or product detector can make a received signal sound much cleaner than a bad detector can. Distortion, surprisingly, can also affect noise, and clipped noise is extremely unpleasant, particularly if the noise is bumpy and variable.

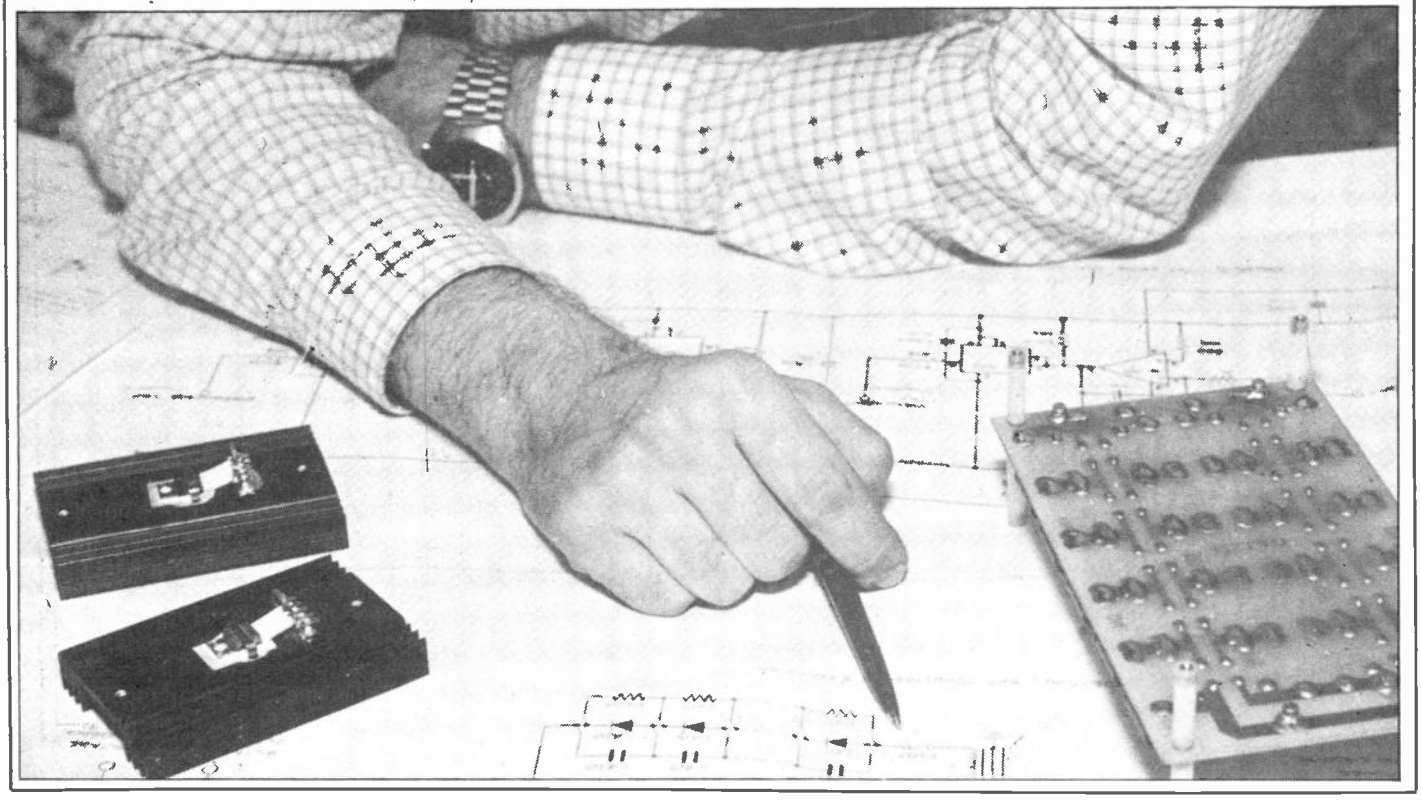
The Datong FL3 can be useful in improving the readability of many transmissions, not only with its auto notch filter, but with the low and high pass variable filters. The low pass one can be used to cut off audio distortion harmonics above 3kHz, for example, whilst the high pass filter can be set so that all hum components can be virtually cut out without affecting speech quality.

"Bells and whistles"

Is it not time though for manufacturers to think about putting the equivalent circuits into the receiver itself? Many receivers have variable band pass filters at IF of one type or another, but almost inevitably the shape factor of the filter slope degrades as bandwidth is reduced. On the TS830 there is a variable selectivity control which indeed decreases bandwidth, but seems to make the band pass more and more pointed, rather than allowing a flat top with reduced width, whilst retaining very steep skirts.

So often I feel I would prefer fewer bells and whistles, and better intrinsic receiver performance, and somewhere I feel that designers have frequently chosen wrong priorities, probably due to pressure from marketing people whose only aim in life is to increase the apparent potential of saleability by adding gimmicks, which can readily be advertised, whilst ignoring really good overall performance, especially in esoteric areas.

Next month we will take a look at the microphone and input stages of the transmitter sections. All too often the quality of the microphone itself is taken for granted, but some mics are diabolically bad, producing the 'head in a bucket' or 'Wellington boot' effects.



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PASS THE R·A·E

RESISTORS & CAPACITORS

PART 6

Even more about that most important of things — the resistor, plus an introduction to capacitors. It's revision time, says Nigel Gresley.

First of all, the answers to the evil questions we posed last onth. Cor blimey, it's worse than passing the real RAE, this stuff! In question number one, we said that you had built some bizarre circuit which required 10 volts to make it work and could draw up to half an amp of current. A power supply rail of 24 volts was already available elsewhere. We added that this was stabilised and that the value of 10 volts wasn't at all critical. The question was, how to derive 10 volts from 24 volts with resistors?

This is the sort of question the newcomer tends to have to face when he's thinking about equipment and which people sometimes ask us. You can do it with resistors after a fashion, but as we'll see it isn't a brilliant way to do it. Before we wade into the answer, can you see why? Remember that the question said "...up to about half an amp". In other words, the current drawn can vary to some extent.

If we didn't have to think about the current, the answer to the question would be simple. Given that the voltages are in the ratio of 10 to 24, all you'd need to derive 10 volts from 24 would be two resistors whose values were in the ratio 10:14. Look at the diagram below:

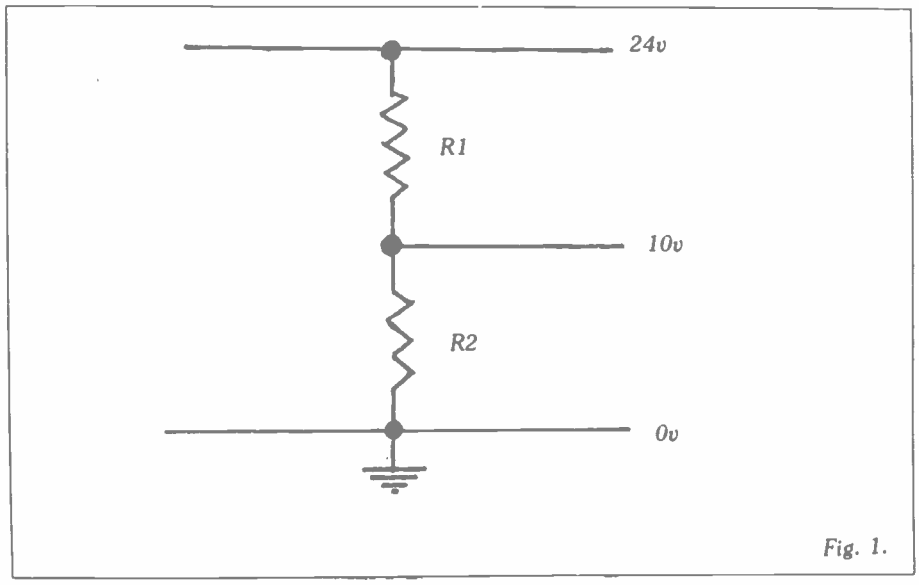


Fig. 1.

If R1 was 14 ohms and R2 was 10 ohms, for example, their total value would be 24 ohms and, by Ohm's Law, a current of 1 amp would flow in the resistor chain. Again, by Ohm's Law, the voltage dropped across the 14 ohm resistor R1 would be 14 volts and the ditto across R2 would be 10 volts (V = IR - yes, Brian, of *course* you remember it. Well stand in the corner and repeat to yourself 1000 times "voltage drop is I times R").

Okay, so the centre junction of the two resistors would certainly take up a potential of 10 volts, and they would do the same if the resistors were 10 and 14 ohms or 10 and 24 megohms come to that - it's all a matter of the ratio of them to each other. However, this is only a *potential* of 10 volts, such as you might measure with a clever meter. If you start putting a load on that 10 volt point and asking it to supply current, you're upsetting the operating conditions of the circuit because you're effectively putting a resistor in parallel with R2, are you not? Look at this diagram:

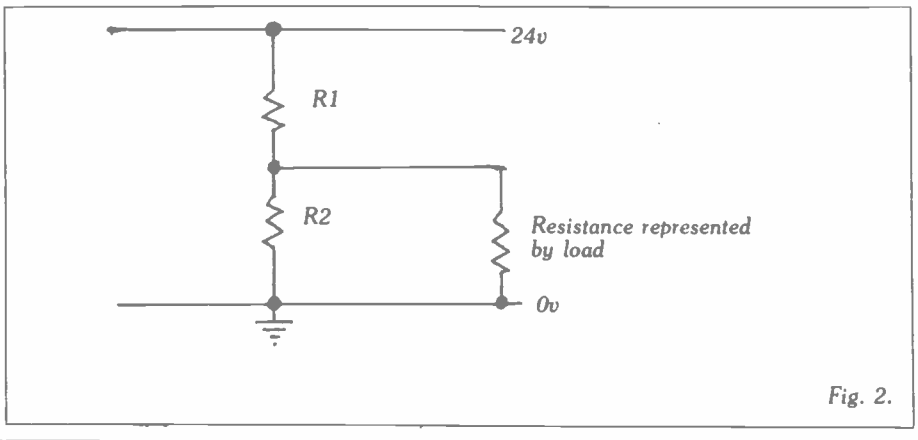


Fig. 2.

In other words, it is not the standard "potential divider" it used to be because there's now an effective resistance in parallel with R2. And this means that the voltage at the junction of R1 and R2 isn't going to be 10 volts any more - you can work out what it will be with the standard Ohm's Law formula, given that the load represents a resistance given by the voltage divided by the current in the usual way. It's an interesting exercise to try, mainly because you'll find that with some resistor values you can't get half an amp out of the supply without the voltage at the junction between the resistors disappearing altogether!

If you do it with 14 ohms for R1 and R2, you'll find that the resistance of the load looks like 10/0.5 = 20 ohms in parallel with R2 - you could redraw the diagram and call the load resistance R3 if you wanted. This now means that R1 is in series with 20 ohms and 10 ohms in parallel, or in other words about 6.6 ohms. So the current flowing is 24/20.6, or 1.165 amps more or less; the voltage at the "10 volt" point on the first diagram isn't 10 volts at all but 14 times 1.165 volts, or just over 16.3 volts. Hmmm, 24 minus 16.3 volts is 7.7 volts, so your 10 volt point has now fallen to 7.7 volts.

This may actually be tolerable (it all depends what the circuit is doing) but it's horribly inefficient because you're dissipating almost 33 watts in the resistors in order to obtain your voltage (the dissipation in the resistors will be 14 times 1.165, which is 20.6 watts, and 10 times 1.165, which is 11.65 watts). And if you increase the resistor values to try and made the thing a bit more efficient, you'll drop even more volts and you sure as hell won't end up with even a 7.7 volt rail.

You're dissipating almost 33 watts in the resistors...

Sorry to have gone via Land's End and John O'Groats with the answer to this question, but it is jolly important to see the problem! In practice, as your load drew more and more current, up to its half-amp maximum, the voltage would fall from 10 to 7.7, and, as we'll see later, it's at times like this that you need to approach the problem differently.

Bashing rapidly onwards, the next question was nice and easy, viz would a 1k 10w wirewound handle a current of 50 mA? The point here is the power rating of the resistor, which is the 10w bit, and you'll remember that power could be calculated as I^2R. Well, 50 milliamps is 0.05 A and 1k is 1000 ohms, so let's see what we get. 0.05 squared is 0.0025, and that times 1000 is 2.5 - so 50 milliamps implies a dissipation of 2.5 watts in the resistor. Since it's rated at 10 watts - no problem, snap it up before some other chap does!

How would you know a 2.2k 10% resistor if you fell over one?

Question three effectively wanted to know what power rating was required for a 10 ohm resistor carrying 1 amp and also what voltage would be found across it when in use. Well, here again I^2R looks a reasonable bet - 1 squared is 1, of course, and 1 times 10 is - er, oh dear, er 10, so 10 watts is yer actual dissipation. The voltage across it will be given by I times R, which is 1 times 10 as well - erm, 10 volts, Simple, huh?

Okay, next question was: it you connect three 10k resistors in parallel across a 30 volt supply, how much current will flow in each resistor and what wattage ought each one to be? This was a bit of a trick really, 'cos we bet some of you saw "three 10K" and "30" and didn't quite notice the word "parallel" Anyway, these 10k resistors in parallel add up to 3.3k, more or less, and the current flowing will be a whiff over 9 milliamps all told. Or, a better way of doing it would be to read the question again! Each resistor will draw three milliamps (see - we asked what current would flow in each resistor, not the total current drawn from the supply, so you didn't even have to work out the value of the three in parallel). Wattage-wise, it's I^2R yet again, and a value of 0.09 watts.

Finally, how would you know a 2.2k 10% resistor if you fell over one on a dark night? Well, the colour for the significant figure 2 is red, so the first two bands on the resistor would be red. The multiplier we need to get to 2200 (ie, 2.2k) from 22 is 100, and the colour for that multiplier is also red - so the first three bands will be red, red and red. Was a 2.2k a good choice for this question, we ask ourselves?

Passing rapidly onwards, 10% tolerance is usually denoted by a silver hand, although it's white on some older cracked carbon jobs we've seen. So, red, red, red, silver was the answer we were looking for. Some modern metal-film types have another band on them which denotes their temperature coefficient but I wouldn't worry about that. The main thing is to read the code from the right end of the resistor, which is always the end which has a stripe or band closest to it.

Heaving a big sigh, let's leave resistors for now and move on to other matters. The next topic for our consideration is a class of components known as **capacitors**, and these are Number Two of the Big Three of the components world - the others are resistors, which we've just dealt with, and inductors, which are a pleasure to come....

Wot's a capacitor? Well,, there are several ways of looking at what it does, and maybe the easiest way to grasp the idea of capacitors and capacitance is to go back to the earlier parts of this series and remember what we said about the concept of **charge**. Let's imagine that we take two metal plates about six inches square and mount them so that they are parallel with each other but not touching - let's then connect them up to a battery via a switch:

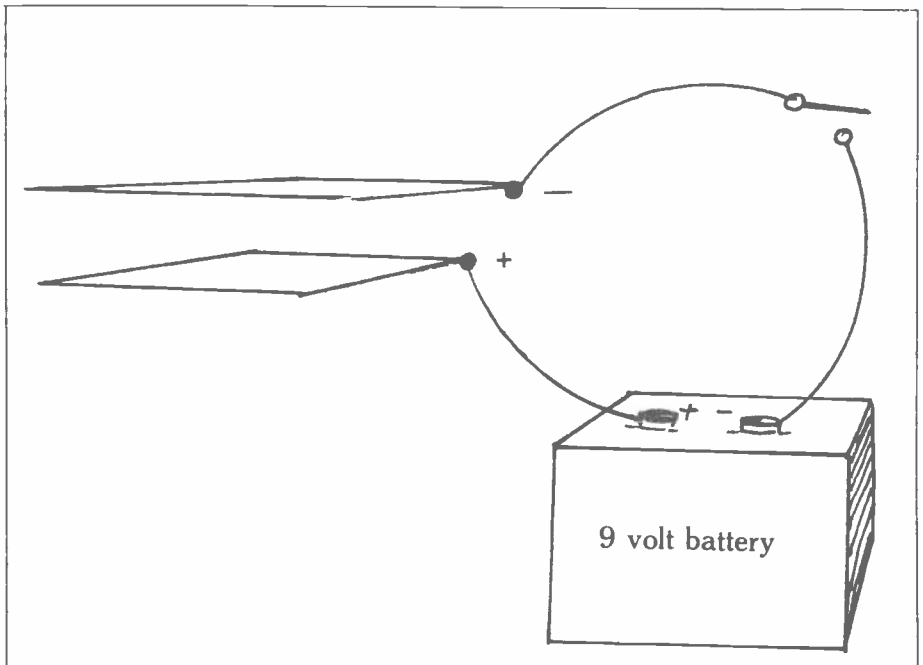


Fig. 3

PASS THE R·A·E

Let's close the switch. At the instant we do so, the electrons in the metal of the lower plate will be attracted to the positive terminal of the battery and likewise the same number of electrons will be repelled into the upper plate from the negative terminal of the battery. The amount of electrons which do their thing is equal, and the emf between the plates ends up as the same as the emf between the poles of the battery, just as you'd expect.

Now then; if the switch was opened after we've done the first bit - the magic word here is **charged**, because that's what we've done - the bottom plate has a deficiency of electrons and the top plate has a surplus, something has to happen. Basically, the plates remain charged since there's no obvious place for the electrons to go, and so they stay put, more or less.

If you had a very sensitive meter of some sort, such as a device called an **oscilloscope** or an ordinary multimeter with a very high input impedance (if these words mean less to you than the Acts of the Apostles in Ancient Greek, don't worry about it) you'd be able to measure the charge.

In other words, the two metal plates have been able to **store** enercy from the battery, and one definition of a capacitor is a device which can store electricity.

Air is a pretty good insulator - it does not conduct current

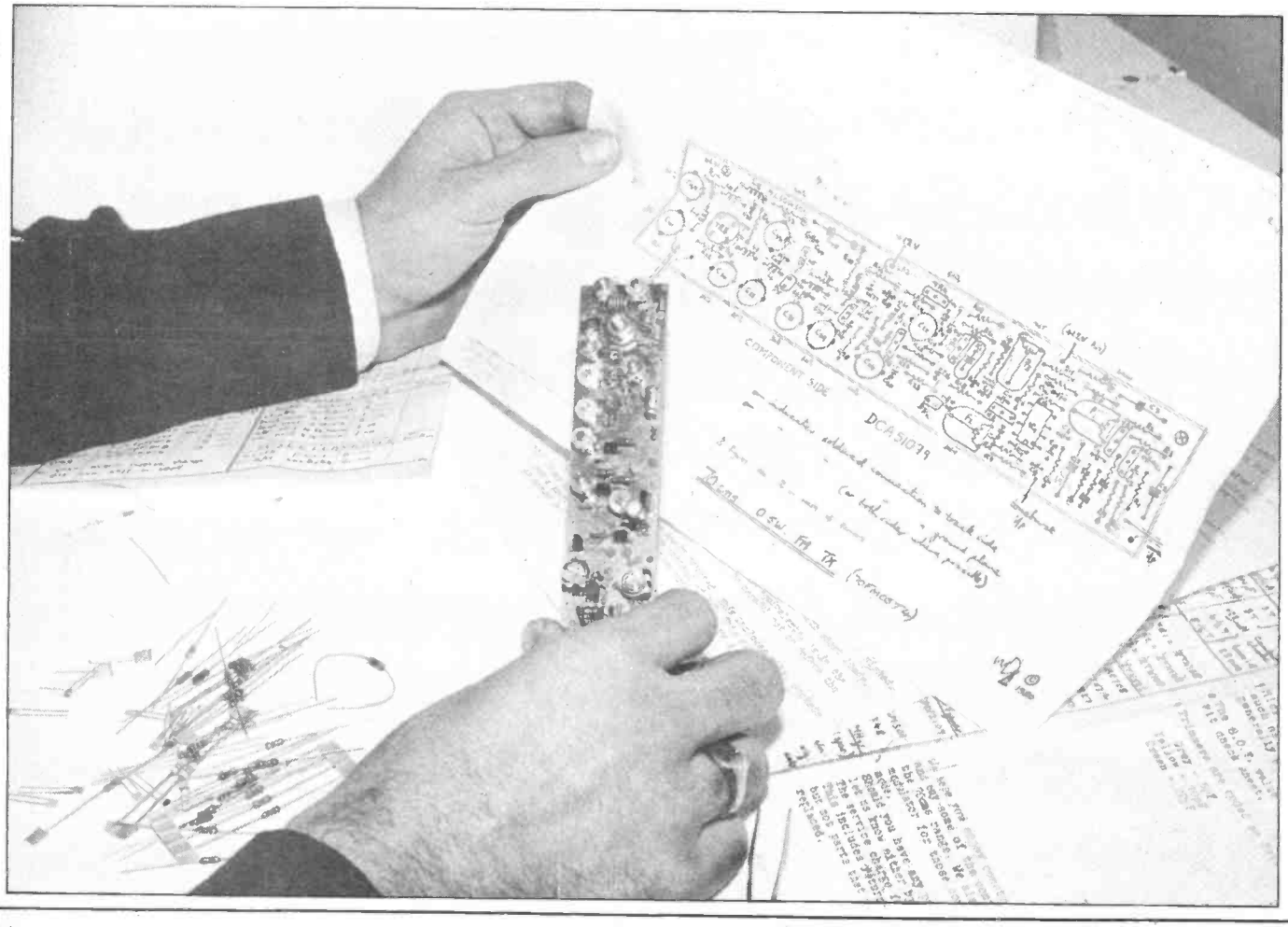
You might wonder how the devil it does that. Well, the answer is that the electricity is stored in the electric field which gets set up between the metal plates.

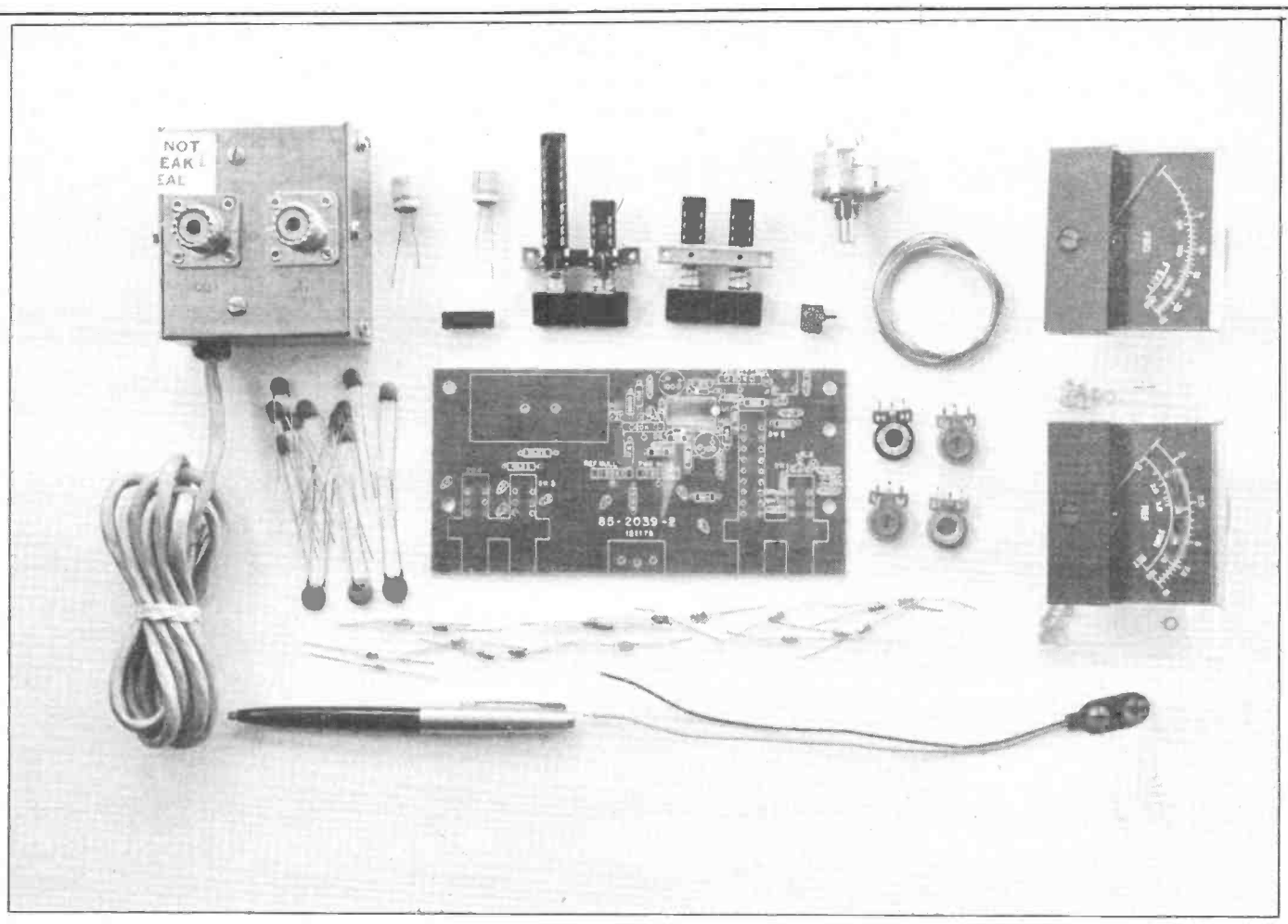
Now then, it's obvious that electric current can't actually flow between the plates of the "capacitor" we made, since there's good old British fresh air in between them and air is, as everyone knows, a pretty good insulator ie it don't conduct. However, when the "capacitor" charges a current does flow and, similarly, when it "discharges" ie when you connect a resistor or similar across the plates.

This is jolly significant as we'll see later on, but for now it's worth noting that a capacitor of any kind will not allow DC through but, if the frequency is high enough, AC will get through a capacitor as long as it can charge and discharge rapidly enough. That's making it a bit simple for now, but it's essentially true.

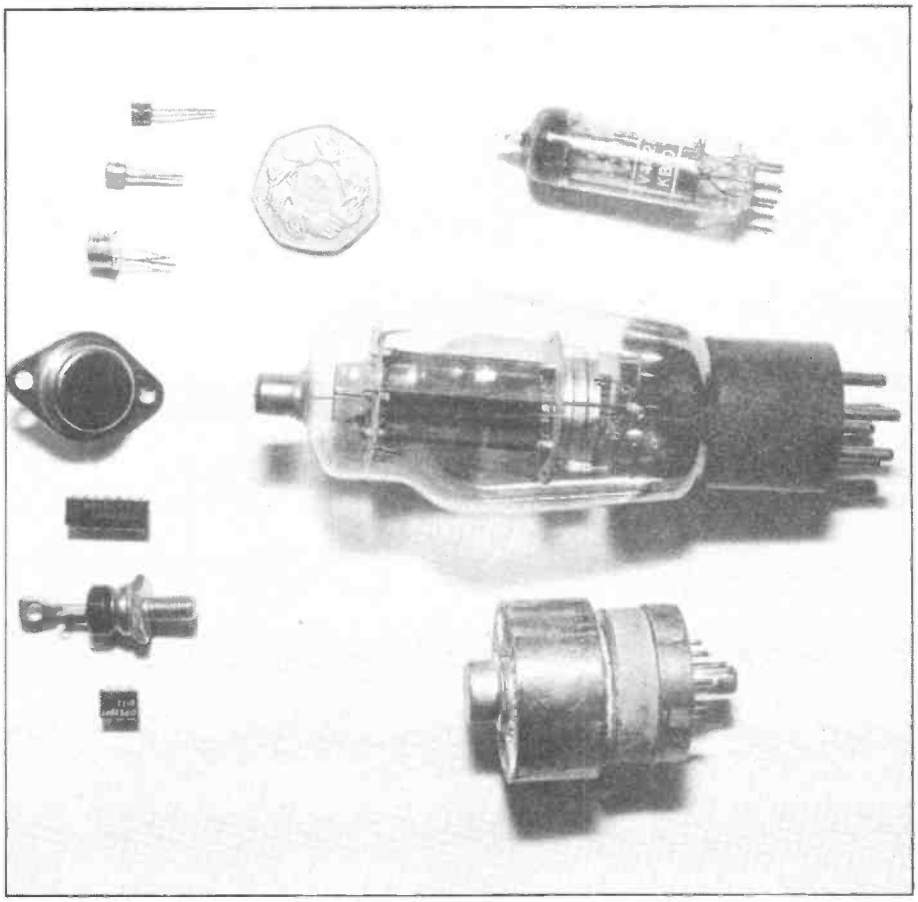
The actual quantity of charge which can be accepted by a capacitor is proportional both to the voltage you stick across it and to the "amount of capacitance" it possesses. Basically, the size of the plates and the distance between them define the capacitance of a capacitor; the larger the plates and the smaller the distance between them, the greater the amount of capacitance it possesses.

The unit of capacitance is called the **farad** which comes from the name of the late, great Sir Michael Faraday who did lots of the early work in this area with glass jars and things. However, the farad is an enormous unit which is far too large for wireless type work - if you think about the capacitor we made earlier, for instance, that would have had a value of about 16 picofarads if you'd spaced the plates $^1/_2$in apart, and a picofarad is a millionth of a millionth of a farad. Yuk, that's 10^{-12} farads. It might not be a bad idea to bone up on index notation before going much further, since you'll certainly need it later on....





Pictures on these pages show resistors and capacitors (and a few other things as well) in their rightful positions as components of working radio. Note the comparison in size when seen next to valves and a 50p coin. Incidentally, the construction pictures show projects from previous issues of Amateur Radio.



Actually, 16 pF is quite a low value and in radio you'll not use values below 10 pF very often. The highest value you're likely to use will be in low-voltage high-current power supplies, where you might find a capacitor of 100,000 uF - the uF is the symbol for the microfarad, or one-millionth of a farad, which is still small. It's obviously 1 times 10^{-6} farads from the index point of view.

You might well wonder how it's done if two six-inch square metal plates only possess such a small capacitance? Well, it's the fact that the space in between the plates was filled with air that's part of the story, and also that they were spaced quite wide apart.

The substance between the plates of any capacitor is called the **dielectric** and from the point of view of capacitor manufacturing, air isn't a good dielectric at all; its **dielectric constant**, which describes how good it is at being a dielectric, is 1, which means every other dielectric is better than *it* is!

Anyhow, that's enough of that for now so we'll leave it there this month. Next time we'll be looking at how we suss out the energy which a capacitor contains and some of the more theoretical aspect of capacitors which you'll need to know before you can really use them.

DODSON ON THE ROAD. The fifth of a series of profiles of distributors who serve the amateur radio fraternity.

DEALER PROFILE

Lowe Electronics Ltd.

A company with a £3m annual turnover, and with branches in several places throughout the country, Lowe Electronics is the sole authorised importer of Trio equipment. And alongside this range you'll find JRC, Nihon, Dengyo, Signal airband equipment, Daiwa power meters, AOR hand helds, Holushin and Jaybeam antennae. Visits to amateur radio clubs feature as a regular service. "It's an easy way of demonstrating a big range of equipment to a large number of people in the shortest possible time."

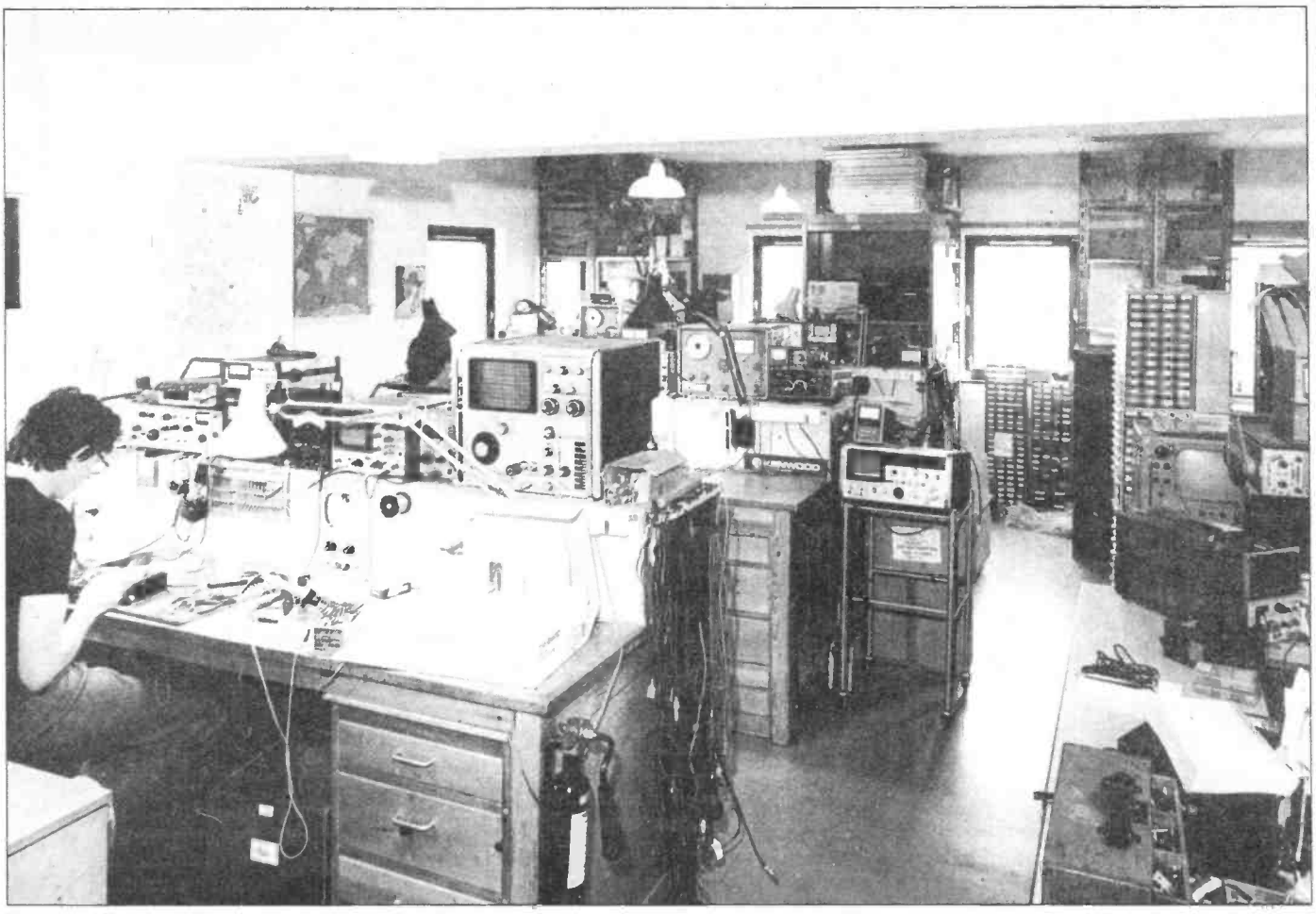
Back in 1964, a certain William Lowe returned to the shores of Britain from Canada, and bought himself an amateur radio rig. And after a relatively short period of time, he was so appalled by the after-sales service provided for his wireless set that he said: "I could do better myself" and proceeded to put his money and his skill where his mouth was.

Now in semi-retirement, he can look with justifiable pride upon the custom-built premises of Lowe Electronics, as they nestle against one of the hillsides that roll down to the Derbyshire town of Matlock.

But it has taken fourteen hard-working years to earn the view from the elegant building that Lowe Electronics now enjoys. From his downtown Matlock premises in Wellington Street, Bill Lowe moved across the street in 1967, and to his first purpose-built offices in Cavendish Road in 1970. And it was in that year that he was to be joined by Alan Whitford, present Managing Director; a year later the post of Technical Director was created, and filled by John Wilson who had just returned from South Africa.

Modern, custom-built premises

The man who had a major part in the design of the Cavendish Road building was David Monkhouse, an architectural technician. On his no doubt frequent visits, he too caught the radio bug. His addiction was such that not only did he become a licenced amateur, but he also hung up his set-squares and sent to work for the Lowe organisation to become Marketing Director. So, with the help of their in-house architectural expert, the present home of Lowe Electronics came into being. Custom built it may be - ostentatious it is not; planning authority conditions stipulated that the new building should be below eye-level from the road that runs above Matlock - and that it is. A two-storey building comprising workshops and storage for the one million pounds worth of stock downstairs, with the offices and showroom above. Now, with a staff of 29, ten of whom hold amateur licences, the House of Lowe-on-the-Hill conducts its business.



Expansion, however, has not been limited to head office; In September 1981 Andy Beckett was put in charge of the new London showroom, a year later to the month, Sim Weir was installed in the Glasgow branch and on May 1 this year, Don Callender took over at the Darlington premises. Each branch is a replica of the headquarters showroom and all three managers hold licences.

Opposite: the main entrance to Lowe Electronics. Above: the comprehensive workshop with Bob Ellis in the foreground hard at work. Below: the men behind the success of Lowe. (from left to right) Alan Whitford, David Monkhouse and John Wilson.

The service department at Matlock (which also handles work from the branches) is impressive with an average of £20,000's worth of test gear on each of the six work positions. With five full-time and one part-time technicians necessary to handle the work-load, every item of equipment is fully tested before sale - a full-time occupation in itself. The company also has a home computer department which employs a further half dozen technicians. Lowe Electronics also has its own printing and picture reproduction facilities and through their Telex, lightweight 'bits' can be delivered from Japan almost as quickly as through the British postal system - which when you think about it, wouldn't be very difficult!

Lowe sell British whenever possible

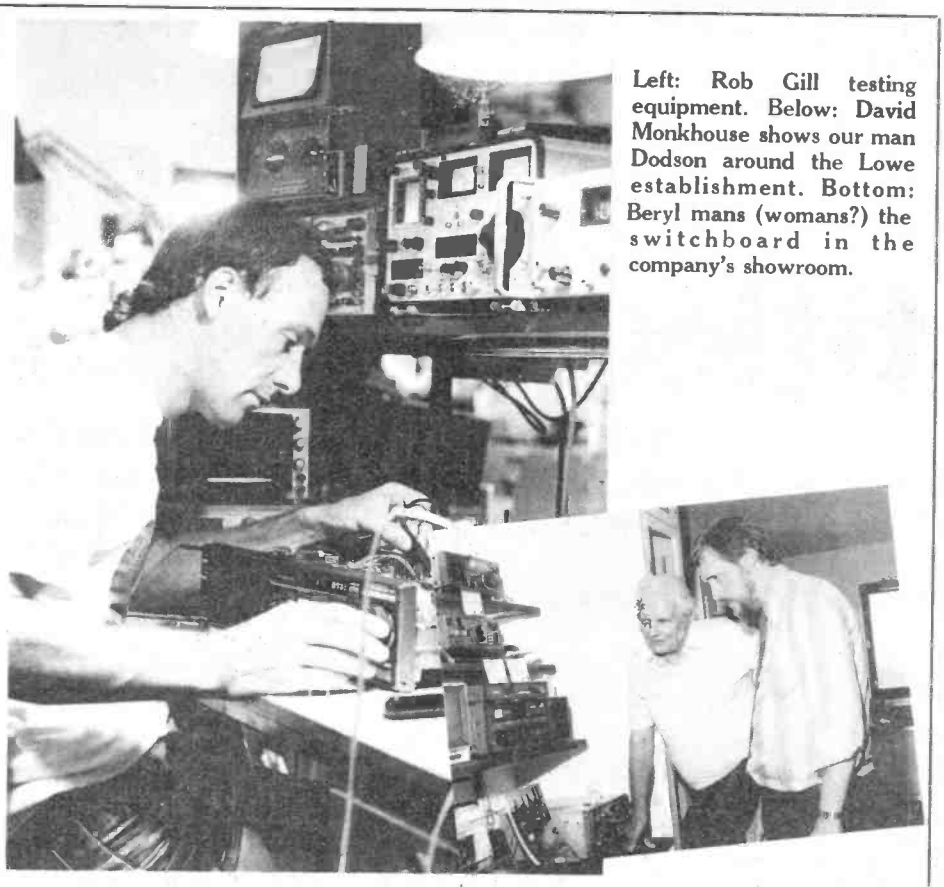
The lowe Organisation is the sole authorized importer of Trio equipment. The manufacturer's selection of Lowe was made by the all but unannounced appearance of two Japanese gentlemen who arrived on the doorstep one morning and declared their intention of looking the place over. They must have liked what they saw, because Bill Lowe got the job.

Then followed the difficult, not to say frequently contentious, task of allocating distributorships throughout the United Kingdom by Lowe. Additionally, the Matlock firm are agents for JRC, Nihon, Dengyo, Signal air-band equipment and Daiwa power meters. They also sell AOR (Authority on radio) hand-held rigs and aerials by Holushin and Jaybeam. Whenever possible, Lowe sell British which, unfortunately, confines such products to accessories.

Corny as it may seem in this jet-set age, Lowe Electronics believe in old-fashioned honesty. They believe, for instance, that every product they sell must carry the full weight of after-sales service, not only on current equipment, but on dated gear as well. No way were they going to get involved in the illegal ways of AM CB; their investment even in legal FM CB was minimal. Having anticipated the short lifespan of this aspect of radio, their TX40 represents a modest venture into the breaker market. John Wilson summed up the attitude of Lowe Electronics when he said: "We don't sell cardboard boxes" with obvious reference to the less reputable dealerships.

It is almost as if the organisation is run on a co-operative basis

But more than that, Lowe Electronics will advise a customer against buying equipment that is obviously not suited to his requirements; they might lose a good sale at the time, but a grateful client will thank them at a future date. Telephoned and written requests for assistance are answered free of charge, and even private deals between amateurs frequently take place through the good offices of the Lowe post bag.



Left: Rob Gill testing equipment. Below: David Monkhouse shows our man Dodson around the Lowe establishment. Bottom: Beryl mans (womans?) the switchboard in the company's showroom.

Like everyone else, Lowe Electronics trade in used radio equipment; exchange values of up to two thirds of the original price are quite the norm - some specialised equipment actually enhances in value. Short term interest-free credit facilities are not a feature of the Lowe service. However, they are licenced to use the Club 24 credit system. "In our experience, it allows amateurs to buy new radio gear immediately without waiting to sell the old equipment. When it is eventually sold, the proceeds usually go straight back to Club 24 and the client pays very little in the way of interest" As John Wilson explained.

The same honesty that exists in the showroom also extends to the boardroom. Lowe Electronics is big - very big, with a three million pound turnover. They are also big enough to admit to a negligible growth-rate over the past two years, although prior to that, it was as high as 40%. On the other hand, the top brass at Lowe's were *not* willing to admit to the localities being currently considered for new branches "just look for the gaps in the map!" was the most they would reveal by way of future plans!

But what is most striking about Lowe Electronics is the cheerful enthusiasm with which everyone goes about their respective tasks. What is more, no single person at director level emerges as the dominant character with the "I'm in charge" bit. It is almost as if the organisation is run on a co-opeative basis.

Visits to amateur radio clubs feature as a regular service by Lowe; a full range of Trio equipment goes in the David Monkhouse hatch-back in specially designed holders to venues as far away as Chester. "This is not a sales pitch" says David "but an easy way of demonstrating a big range of equipment to a large number of people in the shortest possible time"

Coming from anyone but David Monkhouse this might sound insincere. On the other hand, he reckons he can't remember the names of the eleven attractive ladies who work for Lowe Electronics!

Secondhand prices

One titled owner...

The world of secondhand radio equipment. It's knowing when, where and what to buy that matters, says Hugh Allison, G3XSE.

Your scribe has visited the Brighton, Anglian and Woburn rallies since the last column and has some good news and some bad news. The good is that the price of Pye pocketphone chargers has fallen (to around £2); the bad news is that the Pocketphone transmitter is now virtually unobtainable. It appears that the Home Office are still releasing chargers, batteries and receivers but no more TXs are getting through. The dreaded law of supply and demand has hit, making the few that are about hit the £10 to £15 mark.

The Brighton rally Bring and Buy was a little cramped, being one of the "put-the-gear-on-the-tables-and-fence-it-off-from-the-public" affairs, but plenty of assistants made sure that you didn't have to wait too long to view the item of your choice. A bargain was a Diawa Search RX with six crystals fitted for £15. These super little receivers normally fetch between £25 and £30 secondhand, depending on the number of crystals fitted. Not a bad choice for either the up and coming CB type or the experienced HF man who wants to have a dabble on two metres.

The Anglian do was somewhat marred by a thief who made a nuisance of himself both on the bring and buy and round the stalls. His haul included a hand portable, a DVM and a Microwave Modules two metre converter. I know all about the converter because it was mine! The car boot sale only attracted one car; it's never been done at Stanway before and I hope it has more takers next year.

Woburn cost £1.70 to get in, and this caused many moans. OK, that was for a car full of people, but is a bit much if you are on your own. Next year everyone is planning to go with friends and share the cost. A can of coke was 35p; those with friends are planning to take their own refreshments next year as well!

Remember the Tamaphone? About the size of a library book, two metres FM only one watt as a portable from its own internal batteries or 10 watts from a car battery. Frequency selection via thumbwheel switches or six pre-set diode matrixes.

Not a lot sold in the UK, and the few secondhand ones seen, go for about £60. Well, a certain Mr. John Watts brought one into the bring and buy area, not working, for £25. A swift haggle ensued, and said Tamaphone was bought by yours truly for £20. A checkout the following day revealed the fault exactly "as stated", ie. naff all happening. A quick wave of a 'scope probe' around the synthesiser revealed no reference input to the phase locked loop, and a new CD4060 chip soon had it going a treat.

This early Yaesu multimode rig normally goes for about £165 in good secondhand condition, but can often be picked up not operational for a song. If the fault is that the rig works only on one mode then there is a good chance that it may have a simple cure. The problem is that some of these units had the board that generates the 10.7 MHz injection signal, in the mode selected, made of a paper based material. This board has plated through holes, and the ingress of moisture into the paper causes the paper to expand, thus spoiling the plated throughness of the holes.

It isn't really worth bothering to fault find the board in the conventional way; just pull the board out and solder every top track to the lead that comes through. This cures 85% of faults on this otherwise fine machine. An interesting point to note with this rig is that the microphone socket is the same as the mains socket. Your scribe bought one that had been abused in this manner, and that did take a bit of sorting.

AR88s are now fetching good prices secondhand. A few years ago one in good nick would fetch about £25 or so. You would be lucky to beat the £45 that they now seem to go for. Tempted by this high price many owners seem to have decided to part with their once treasured possession, and find that when they get it down from the loft it doesn't work any more.

A non-working AR88 will go for £20 to £25, and this could again be a good buy. The problem here is that one or more of the capacitors have gone a short. That may sound a bit definite, but six out of six that have come my way recently have had this fault. Try and determine what happened when it was plugged in. If there was a loud buzz and a hot smell after about thirty seconds then the main electrolytic has probably gone.

If it all went fairly quietly then one of the decoupling capacitors has probably gone. Get the brute out of its case and up-end it. Your modern amateur will probably not recognise the decoupling capacitors used thirty years ago; they are the silver things bolted to the side of the chassis with two connections. The tip here is to bung the black lead of your Avo, on the low ohms range, on the chassis, and with the unit turned off, put the red lead on all the decoupling capacitor lead-outs. If the Avo reads, replace the cap! Still if you aren't sure what they look like, they are about the size of a small matchbox!

I've found over the years that a 0.1uF 250v will do as a replacement. If you still haven't found the fault, stand it up the right way and turn it on. The neon stabiliser should light as the HT comes up. Keep your eyes on the rectifier and stabiliser for the first thirty seconds. If the anodes of the rectifier start to glow red, turn off quick and check for HT shorts. If the neon stabiliser doesn't have a purple glow after a minute, turn off and check its decoupling capacitor, which is a moulded resin one located some way away from the neon.

A local CBer recently passed the RAE. Being a lad with ambition he bought a secondhand FT101 and a Microwave Modules transverter. Unfortunately he used his CB 12 volt power supply to run the transverter. Being a trusting type he had assumed that the so called 6 amp CB, PSU would easily supply the two amps or so that the transverter takes on transmit.

After an hour or so the PSU went on the blink. Since it was the series regulator transistor that went short circuit, it put 22 volts up the transverter. An inquest revealed all appeared lost, nearly all the semiconductors in the transverter were open circuit. The luckless lad decided to send it off to MM for repair, and started saving.

In ten days he had it back as good as new with a bill for £10. Considering that the list price of the transistors was over £15 the guy had a lucky escape. The moral of the tale is never use cheap PSUs on expensive gear, or, if you must, use both the correct fuse and fit a crowbar over voltage protector.

Happy bargain hunting.

CLUB NEWS

Tell others about what's happening in your club - give us the information and we will try and print it here.

RAE Courses

A 20-week RAE course commencing Thursday 29th September 1983 (from 7.30 for two hours) is being organised at Hilderstone Adult Education Centre in Thanet. Write for further information to Hilderstone House, St Peters, Broadstairs, Kent. Lecturer will be Dr Ken Smith G3JIX.

CHESTHUNT and District Amateur Radio Society have arranged RAE courses at the East Herts College at Turnford starting in September 1983 for three terms. Details are available from Jim G30JI (QTHR) on Ware 4316, or the East Herts College, Turnford, Herts. Telephone Hoddesdon 66451 asking for Mr J. France.

HENDON College of Technology are running RAE courses on Tuesdays from 27th Setpember 1983 at 7.30 for two hours. Enrolment day is 13th or 14th September 1983. Details can be obtained from Mr A. M. McDonagh on 01-202-3811 extension 7.

SANDIACRE Adult Education Centre, Friesland School, Nursery Avenue, Sandiacre, near Nottingham are running RAE courses on Tuesdays from 20th Setpember at 7.15. Enrolment day is 13th September at 7.15. The course tutor will be G2VGW and further details can be obtained from H. G. Crowther, the Principal, at the centre.

DERBY College of Further Education are running RAE courses on Wednesdays from 28th September. Enrolment days are 12th and 13th September. Further details can be obtained from F. Whitehead G4M11, the course tutor at the College, Telephone Derby 73012.

A 25-week RAE course is being organised at Tretherras School Newquay on Monday evenings between 7.00 and 9.00. Enrolment day is Wednesday 21st September between 6.30 and 8.30 or by post to the Adult Education principal, MCCFE, Palace Road, St Austell, Cornwall. The course will commence on 26th September. Further details are available from Bob Lawrence G4LDA, course tutor, on Wadebridge 3649.

HECKMONDWYKE Grammar School are running RAE courses on Mondays between 7.00 and 9.00 and Morse courses on Wednesdays; enrolment days are 6th and 7th Setpember and the courses start on September 12th 1983. Further details can be obtained from G3TEE Mr F. Storm at 75 Waterloo Lane, Bramley, Leeds LS13 2JE.

DACORUM College, Hemel Hempstead will be running RAE courses on Wednesdays between 6.30 and 9.00, and Mondays between 6.30 and 9.00, if there are sufficient numbers, starting September 21st. Enrolment for this course is September 5th. Further details can be obtained from the College by telephoning 0442 63771. The course tutor will be C. B. Burke G3VOZ.

Courses

Courses in Logic. A short evening course in logic theory and practical design is on offer.

It is intended for those who have a basic knowledge of electronics (to RAE standard) but who have no previous knowledge of logic. The course is intended for a very small group (about three people at a time) at any convenient venue. Contact should be made with Godfrey Manning G4GLM on 01-958-5113 who is offering the course.

An Amateur Radio Morse class will be held at St Hugh's CE Comprehensive School, The Avenue, Dysart Road, Grantham, Lincs on Monday evenings between 6.30pm and 8.00pm commencing on 12th September. Enrolment takes place at the class. Full details can be obtained from the school or from the College of Further Education, Stonebridge Road, Grantham.

The London Borough of Enfield, Theobalds park College, Bulls Cross Ride, Waltham Cross, Herts, are holding a course on broadcasting, from Marconi to Channel 4, on 11th - 13th November 1983. The course director is Ralph Barrett. Fees for the weekend course are £28 (sharing) or £50 single. Why not make up a party? Further details can be obtained by telephoning Waltham Cross 37255.

Devon Radio Rally

The Third Devon Radio Rally is to be held in Bradworthy Memorial Hall (near Holsworthy) on Saturday November 5th between 10.30am and 5.00pm. There will be a bring and buy stand etc, and a talk-in on 2 metres (S22) G8MXI. Information from K. Nicholls, G8MXI, of Flexbury, Bradworthy, Holsworthy, Devon.

Theobalds Park College

There will be a house party at Theobalds Park College (GLC Enfield) on 11th November where all aspects of radio and television will be discussed with practical demonstrations. Contact Ralph Barrett on 01-845-6807 for further information.

Bath DAR Society

The Bath and District Amateur Radio Club hold their meetings on alternate Wednesdays at the Englishcombe Inn, Englishcombe Lane, Bath at 7.45pm. Further information can be obtained from either Trevor Whitehead on Bath 319150 or Mike Mason on Bath 3112046.

Maltby AR Society

Meetings are held every Friday at 7.00pm by the Maltby Amateur Radio Society at the Methodist Church Hall, Blythe Road, Maltby. Further information is available from Peter Goben G4BVV, Ian Abel G3HZI or Simon Hindle G8NVS. The club also holds Morse classes and have a computer enthusiast's corner.

Kidderminster DAR Society

The Kidderminster and District Amateur Radio Society hold fortnightly meeteings on Tuesday evenings from 8.00pm at the Aggborough Community Centre, Hoo Road. Further information available from A. F. Hartland G8WOX on Kidderminster 751584.

Inverness AR Club

The Inverness Amateur Radio Club meets every Thursday at the Cameron Youth Club, Planefield Road, Inverness at 7.30. Their present projects include building a power supply unit, and a 2m transceiver. Morse tuition classes are also held each week. Further information can be obtained from Bob Irwin, 40 Lawers Way, Inverness, tel Inverness 221056.

CLUB NEWS

Stockton DAR Group

The Stockton & District Amateur Radio Group meet on Mondays at 8.00pm in the Oxbridge Hotel, Stockton-on-Tees. Membership is 50p and entry to the meeting is 20p. They will shortly be starting classes on the RAE examination. Anyone interested in amateur radio is welcome. Further details can be obtained from J. A. Walker G6NRY at 7 Widdrington Court, Stockton on Tees TS19 8UF

Swale AR Club

The Swale Amateur Radio Club have two more events planned in the near future, on 3rd October a talk by G3VTT on 2RP operating and G-2RP Club and on the 17th October a talk by G4AXD on HF amplifiers. Both meetings will be at Nino's Restuarant, 43 High Street, Sittingbourne. More details about the club can be obtained from B. Hancock G4NPM on Minster 873147.

Radio Club of Thanet

The Radio Club of Thanet hold meetings on the second and fourth Tuesdays of each month at the Grosvenor Club, Grosvenor Place, Margate at 8.00pm. Morse classes also take place on these days at 7.30pm. Further information can be obtained from I.H. Gane G4NEF at 17 Penshurst Road, Ramsgate, Kent. CT11 8ES.

Audiojumble

An Audiojumble is being held on Saturday 8th October at St James' Hall, Gloucester Terrace, London, W2: proceeds are being donated to the St John's Ambulance Brigade. The sale beings at 1.00pm and finishes at 5.00pm; this is an excellent oppportunity to sell off your unwated audio equipment. Admission to the sale is 90p.

North Yorkshire AR Society

The North Yorkshire Amateur Radio Society hold their meetings on Wednesdays at 8 pm at the Bradshaw Tavern. Further information on how to join or forthcoming events can be obtained from Brian Aspinall G6CJL on Bradford 834442. The NHARS also have a splinter group at Keighley meeting on the last Tuesday in every month at the Globe Inn, Parkwood Street.

Midlands VHF Convention

The Midlands VHF Convention is being held this year at the British Telecom Training School at Stone in Staffordshire on Saturday October 15th. Doors open at 11.00. The convention will feature lectures by G3RKL on the GB3SF experimental pilot SSB repeaters G3RZP on solid-state power amplifiers and G3USF experimental pilot SSB repeaters G3RZP on solid-state power amplifiers and G3USF on the first six months of UK 50MHz operation. Further details can be obtained from J. P. H. Burden G3UBX at 28 Coalway Road, Wolverhampton WV3 7LX

Fareham Radio Club

The Fareham Radio Club meet every Wednesday at the Portchester Community Centre, Room 12 at 7.30pm. They have the following items planned 21st September NN/OTA; 28th September History of the RSGB by G6NZ; 5th October NN/OTA; 12th October S meters and PL259s by G4JCC and G6BBS; 19th October NN/OTA. Further details on the club can be obtained from Brian Davey G41TG on Fareham 234904.

Lincoln SW Club

The Lincoln Short Wave Club are holding the following special events: October 1st fox hunt/treasure hunt organised by G8HMZ: October 5th - RAE/CW; October 12th a talk/demonstration on slow scan television by J. Stace G3CCH: October 19th RAE/CW; and October 26th a film show - European Steam Trains, given by Alan Hoggett. The Club have also asked us to publicise the Lincoln Hamfest to be held on 6th May 1984 at the Lincolnshire Showground which is four miles north of Lincoln City on the A15. The show opens at 11.00am and closes at 5.30pm. Further details can be obtained from G8VGF c/o City Engineers Club, Central Depot, Waterside South, Lincoln.

Edgware DRS

The Edgware and District Radio Society have the following items planned for the next month or so, 3/4th September SSB Field Day at Copthall Playing Fields, 8th September, an Information meeting, 22nd September a talk on Basic Programming by John Bluff G3SJE, 2nd October Sunday Afternoon HF Hunt, (160/2m) and on 27th October a talk on propagation by Reg Flavell G3LTP. The society hold meetings on the 2nd and 4th Thursday of each month at 8.00pm. Further details can be obtained from Howard Drury G4MHD on Northwood 22776.

Midland Amateur Radio Society

To commemorate World Communications Year (1983) the members of the Midland Amateur Radio Society will hold a forty eight hour radio operating marathon, with the object of maintaining radio contact with fellow amateurs in a variety of countries throughout the world.

Using the 'special event' callsign GB4MAR, the station will commence operation at 1700hrs GMT on Friday 23rd September and will be available for contact until 1700hrs GMT on Sunday 25th, from the club's registered address, 294a Broad St., Birmingham 1.

Between these hours GB4MAR will be active internationally within the recognised HF bands, whilst short range contact will be maintained within the 2 metre VHF band. All normal modes of transmission will be employed.

News of this event has engendered considerable interest among radio amateurs and they are hoping that a number of records will be established during its course. The question of possible sponsorship in aid of charity is currently under discussion.

They welcome contact with all fellow amateurs, both at home and overseas, throughout the duration of this event. Further details may be obtained from R. Blaikis (G40GR), 22 Eileen Rd., Sparkhill, Birmingham. B11 4HX. Tel. (021) 449 4541, or K. K. Townsend (G4PZA), 1163 Yardley Wood Rd., Yardley Wood, Birmingham. B14 4LE. Tel. (021) 474 6517.

Classified Ads

•**XS FORMERS** 240/110vAC isolated double wound metalcased fused heavy (very) duty plate rated continuous 2.0Kw another 750 watt originally used for American kitchen equipment. Sensible offers please. Buyer must collect. Bournemouth. 0202 33624.

•**YAESU** FRG7 18 months old, mint codition, no mods, ring Faversham (Kent) 533143. £120.

•**YAESU** FRG7700 and FRT7700 ATU unwanted gift as new. Original boxes and manual £250. 4 Taylor Rd, Ashtead, Surrey. Tel. Ashtead 77640.

•**YAESU** FT290R charger, Bicads and 5 ele Halbar Yagi £190. Buyer collects. Tel. G3MLP 0733 63851 (Peterborough)

•**SALE** MBA - RO morse/Rtty reader LED display, boxed £150 ono. 30 Ferrites for PA FB-43-2401 £3.20 QRP frequency crystals (4) 3.5-21 £3.20. Tel. Mildenhall 713350.

•**SADLY DUE** to new (x) YL my trio TS130R, ICOM IC2E and Sinclair ZX81 are for sale. Reasonable offers, swaps and Px's please, all enquiries with SAE. Martyn Bolt; 112 Leeds Road, Mirfield, W. Yorks.

•**WANTED** by new G6 2m.15w linear also up/down desk mike and other equipment suitable for FTI290R. Please contact A. Barnett 10 The Larches, Warfield Park, Bracknell, Berks. Tel. 0344 882255.

•**EXCHANGE** Panasonic DR49 for realistic pro 2002. Programmable scanner or bear cat 250 scanner receiver in good cond. C. Amess, 45 Rosevale Grove, Spring Bank, West Hull. (0482) 503482

•**S.E.M.** 2 metre transmatch £15. S.E.M. 2 metre preamp unused fit inside rig £5. S.E.M. 3 way antenna switch £10. All mint, lot £25. or swop stand microphone or audio notch filter. G6RBY 01 446 4932 evenings.

•**R.A.E.** learn at home. details from P.J. Pennington (94EGQ). 146 Elms Vale Road, Dover. CT17 9PL

• **WANTED:** Marconi morse key roller bearings and pinch bolts to yoke. Metal Base with key crick filters and anti spark. First class condition only. Your price paid. - 5H3TM, PO Box 1426 Abeya Tanzania.

•**SWOP SONY** ICF 2001 Scanner keyboard entry and LCD frequency display. Good working order for Sinclair 48K spectrum or 16K spectrum with software. Tel. Oxford 65156.

• **WANTED:** Burndept UHF 3 channel Handportable transiever crystalled for 70 cms or not with/without Varta Nicads. Must be in excellent condition. Top money paid for good transceiver - Tel: 0204 653230 G6MIW.

•**COMMUNICATION** receiver Tandy DX 302 10KHz to 30MHz Quartz synthesised digital frequency display CW/LSB/USB/AM 240v AC 12vDC or batteries £160. R Walker, 1 Summerhill Gardens, Market Drayton. Tel. 0630 4646.

•**FT901DM** £545. FU901DM £145. FC901 £95. CPU2500RK £150. NM200 £95. YC305 £50. SR-C830/M15 Marine Handheld, base charger 5,6,9,16,25 £80. No offers. May liss (073 082) 2143.

•**TELDIS PA1345** upconverter with gain control 4-6dB variable output frequency, as new £25. Tel. 04492 672710.

•**FOR SALE** Belcom LS-102L microphone A Donis 601 £225. Tel. Bognor Regis 822115.

•**WANTED** 32 foot lattice tower also 5PF7 tube suitable for SSTV monitor. Tel. 0532 550486 (preferably Yorks. area).

•**FOR SALE** Standard C78, nicads, case, etc. £165. Adonis mobile microphone unwated gift £30. Jaybeam 5XY with harness £30. AR88 £55. Buyer collects. John Rowlands G4OJS. 021 445 3207 after 7pm.

•**FOR SALE** Trio TR9000, slightly marked £240. TR2400, carry case mic £130. Mizuho SB2M, nicads £80. Codar ATS, T28 PSU, etc. £60. DIAWA AF606 filter £50. Alan Welly G4LVK 021 445 2088.

•**FOR SALE** IC211E 2m multimode rig fitted pre-amp and pip tone with ICRM3 remote control with scanning mod. vgc £375. Also ICSM2 desk mic. £20. GW3WSU QTHR Tel. Bonvilston (04468) 261.

• **WANTED:** SX200N Scanner must be in good working order and mint condition. A good price offered - Tel: Burnely 0282 59320 after 5 pm please.

• **WANTED:** Electonics QP166 Anateur Bands only "Quoilpax" also Eddystone 898 dial unit. Price & details to - Mr D Stephenson, 701 Bishport Avenue, Withywood, Bristol 3. BS13 9EH or Tel: 0272 642101.

• **HEATHKIT** DX100U AM/CW TX and R.A.1 valve RX A bargain at £50 the pair. Buyer collects (Leics) Ring - 050 981 2004 early evenings.

•**YAESU FT101Z** MK1 fan mic. ext. spkr. spare PA's mint codition. £400. Tel. 0484 661708 (Huddersfield).

• **EXCHANGE:** EUMIG 8mm super sound projector with sound on sound facility plus spools, splicer screen and new motorised editor for any 2 metre rig or Grundig satellit 3,000. - Steele, Mayberry, Chilbolton, Stockbridge, Hants.

•**IC2E** Boxed as new complete with two battery packs, mains charger and car charging lead etc. £125. Tel. Maldon 57227 (Essex).

•**SALE/EXCHANGE** Yaesu FT 480R & mods £230. Bremi 10A 13.8V PSU £35. Yaesu FRG 7 £130. Mirage B108 £85. Nikon EM plus motordrive plus 50mm F1.8 lens £100. Alvin Challen G6DTW Ashtead, Surrey. 77945 not QTHR.

• **MAINS** transformers, 'Gardners' 6.3V 5A, 6.3V 1A output £3; 'Gilson' output 300.0.300, 150mA, 6.3V 4A CT, 6.3V 1A, 5V 2A, £4; Many others. 2E26 RF output valve £2. Edwards, Tel. 01-445-4321 (Nth. London).

• **NEMS** Clarke RX & grequency extension unit 30-475 MHz with handbook £120 ono; Ultrasonoscope monitor scope £25 ono; Canadian 58 set with PSU £15; Collins HF control monitor head with frequency display £25 ono - 0733 231639.

• **FOR** sale Trio TR 7800 2M FM mobile, good condition, boxed with Nicads £175 Tel. 01-989-5855.

• **HAVE** one month old Atari TV game with 3 games, swap for two Pye Westminsters or 1 Pye 10 channel on VHF with mic-speaker and power lead or swop for SX200N FT290 Mk400 BI 20/20 and Wanted: Bantex BTA B4, 34A 085 MD BSU 095 310 DD 340 and 4 Pye PF 2UB - A Graham, 27 Crichton Road, Pathhead Midlothian, Scotland. - Tel: 0875 320 640.

• **COMPUTER** Sharp MZ-80K (48K) excellent condition with £100 worth software including SP5025 basic, forth language, many games and documentation. Originally cost over £500 will accept £295 ono. Tel: Derby (0332) 760773 (GGMGI).

• **FOR SALE:** Ham international Concorde two. Zetagi BU131 linear. No reasonable offer refused, or exchange for YAESU FRG 7 with cash adjustment - Tel: Tamworth (0827) 250075.

• **FOR** sale ETI magazine 1977 & 79-82 complete years £10 for each year plus p.p. Avo model 8 Mk 5 £65. Phone: 0252-511048 after 6pm.

• **YAESU** FT290R complete with Nicads and charger, Case & strap, mobile mount, 7/8 whip and gutter mount. Adonis mobile mike, Jaybeam 1.0 element x.y. beam with co-ax and two-way antenna switch. The package only 14 months old, yours for £275 G4M & M as QTHR or ring Grantham 75983.

• **FOR** sale Realistic D X 160 Communications receiver, covers 150 KHz to 30 MHz also manual, good working order, £50, buyer collects. Phone Newcastle Tyne Wear 656728.

• **REAL** money given for unwanted QSL cards. After Shack clearances don't throw them out, but send in bulk to G3BDQ. "Whitefriars", Friars Hill, Guestling, Near Hastings, TN35 4EP.

• **WANTED** Handbook Racal RA17L receiver. Sale YAESU FRDX 400 receiver with matching speaker £130; Sale: Arac STE 107 receiver 28 to 30 MHz 420 to 440 MHz 12VDG £60, buyer collects. S. Smith, 19 Hyde Road, Kenilworth, Warwickshire. Phone: Kenilworth 54609.

• **HAM** International Jumbo, nearly new 26.565 to 27.865 10KC drop switch plus Bremi BRL200 will swap for good second hand FT101ZD or sell at £285 ono - Julie PO Box 122, Earls Barton, N/Hants Tel: (0480) 69303.

• **WANTED:** to buy or borrow — manual for Heathkit DX40U with VF-1U - Anne Edmondson, GM4 TCW, 52, Elm Row, Edinburgh EH7 4AH.

• **TRIO** TS515 complete with new VFO power unit, in very good condition 2 owners from new, open for exchanges etc. Sommerkamp, or any transistorised transiver must cover 26, 27 megs. - Derek Wakefield 363663.

• **BACAL** RAITT/18 rack type with dust cover £100; HRO MX complete with power pack coils £45; Marconi Altanta £50; Kenwood R820 Mint £300 - R.H.V. Draper, 60 Enderby Road, Perry Common, Birmingham B23 5AL.

• **SALE**: Palm IV RB4, RB14, SU20, SU 19, SU18, SU17, with charger £95 - 021-360-5429.

• **WANTED:** FRG7, FRG7700, Trio R1000, etc, also FT708R, - 021-360-5429.

• **WANTED:** Any documentation on: Ithaca intersystems DPS-1 Microcomputer, Shugart 4001 Winchester disk, Moutain hardware real-time clock; also WANTED: ASC11 VDU and keyboard for above, eight inch floppy drive and S-100 controller card - St. Albans 32759.

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• **WANTED:** Clandestine radios, Spy sets; also compact Ex--gout. Transmitters, receivers and vintage radio equipment, accessories, boxed, unused valves, early four, five pin output types, W.H.Y. - John 01-450-6449.

• **FRG 7** perfect condition instruction manual - ring New Milton 617740 £100 ono.

• **SALE:** Realistic DX100L general coverage receiver 0-15 to 30 MHZ, manual, £55 ono; DAIIWA Sr-9 2 metres FM receiver, 3 fixed crystals £30 both good condition - write G. Donnellan, 89, Locking Road, Weston Super Mare or phone - 23412.

• **TRIO** R-1000 communications receiver, mint and boxed, all modes plus FM £220 ono or part exchange Spectrum or Cobra 148GTLDX covering 10M band - ring Storrington (Sussex) 2435.

• **EXCHANGE:** Trio 2200G fully Xtald RO, R2, R3, R4, R5, R6, R7, S14, S19, S20, S21, S22, comp with two sets of Nicads and charger and telex procom mic. for any synthesised 2M mobile rig. also Harrier CBX 4 watt legal CB, RF gain, mic. gain, Delta tune and mobile aerial for rotator with aerial or ancillary equipment - Dennis Truby, G6 UTY, 16, Lothersdale Close, Burnley, Lanc. Tel: (0282) 54445.

• **OFFERS Wanted:** for Taylor model 45C valve tester. Tests most types of valves with 20 holders, also tests TV Cathode ray tubes black & white with tube adaptor model 445. With instructions, old but good condition; AVO all wave oscillator g.c.; AVO test bridge g.c. - Mr E Jeater, 151 Arundel Road, Walton, Peterborough PE4 6JQ.

• **WANTED:** Rack mounted case 19" wide 10½**8** high and at least 16½" deep and any books or info or spares or shot Hammarlund SP600 bits any condition, I will collect - Brian, evenings 736 6581 - days 736 4656.

• **WANTED:** any radio magazines, Practical Wireless 1940s, 50s, 60s, any old books etc. Fair price paid - John Savage, 7 Weyhill Close Pk North Swindon Wilts.

• **RTTY on ZX81** Maplin keyboard Scarab terminal professionally aligned. offers. Heavy duty collapsible 7 metre mast, offers; Channel master 9502 offset rotator and top bearing can deliver south B'ham Redditch areas - phone your offers to - Andy G40IN 021-451-25

• **WANTED:** FT707 or IC730. Chris G8EDQ QTHR. Please phone - Yeovil (0935) 823475.

• **FOR SALE:** DX302 receiver, boxed mint condition; 101CHZ-30 MHZ HD270 indoor arial with pre.amp gives plus 10db, will swap for 2 MTR hand held preferably Trio 2400 - phone Mr Sharon 01-550-2346 Ilford.

• **EDDYSTONE** 730/4 general coverage receiver complete with Codar A.T.U. £80; Bang and Olufsen record deck 1001 £50; Trio 2200GX fully Xtaled £95. G6TEE 021-472-3571 anytime.

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• **YAESU FT-290-R** Two metre portable multimode carrying case, NI-Cads, charger, mobile mount, Handbook. Very little used, therefore as new condition. £250 o.n.o. - G6EIJ Thanet (0843) 293263 evenings. Delivery possible.

• **YAESU FRG 7700 M** all mode general coverage HF receiver with matching FRT 7700 ATU, mint condition in original packing, together with D270 DATONG active aerial. Cost £468 18 months ago will accept £325 ono - Mr. P.G. Hutton, 22 Sospel Court, Farnham Royal, Bucks. SL2 3BT - Tel: Farnham Common 2199.

• **FOR SALE:** YAESU FRG 7000 general coverage receiver 250KHz to 30 MHz: Digital frequency readout: AM/SSB/CW.AC: preset automatic recording: with Stephens-James MkII Multi-tuner ATU £200 condition as new - E. Pearce, 70 Duncroft, Plumstead, London SE18 2 JA.

• **QUARTZ 16** FDK 2M 1/10 watts S20, S21, S22, S23, S24, R4, R5, R6, R7. R3. R0, S12, immaculate. Ideal cheap mobile £80 ono - Dave G4NOW - 01-850-4848 evenings weekends.

• **FOR SALE:** Collectors RX, S27 VHF overhauled, good cond. £70; HRO MX p/pack, coils, £65; BC348 £48; Wanted: Racal RA17L, RTTY and SSB adaptors. Wanted: Han.Band RX - Milton Keynes (0908) 314095 between 2-30pm and 10 pm.

• **HAVE FT 290R** mint condition, swap for TS700G - G4TBM Lewes (Sussex) 6099.

• **WANTED:** Output transformer for AR88D also spare set of valves and details for construction of ATU - Ray Johnson, 15 George Street, Darlington. Co. Durham.

• **WANTED:** receiver FRG7 with all modifications fitted could collect - phone G$BTL Woking (04862) 62671 evenings.

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*Projects for Book 8 were in an advanced state at the time of writing, but contents may change prior to publication (due 13th August 1983).

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