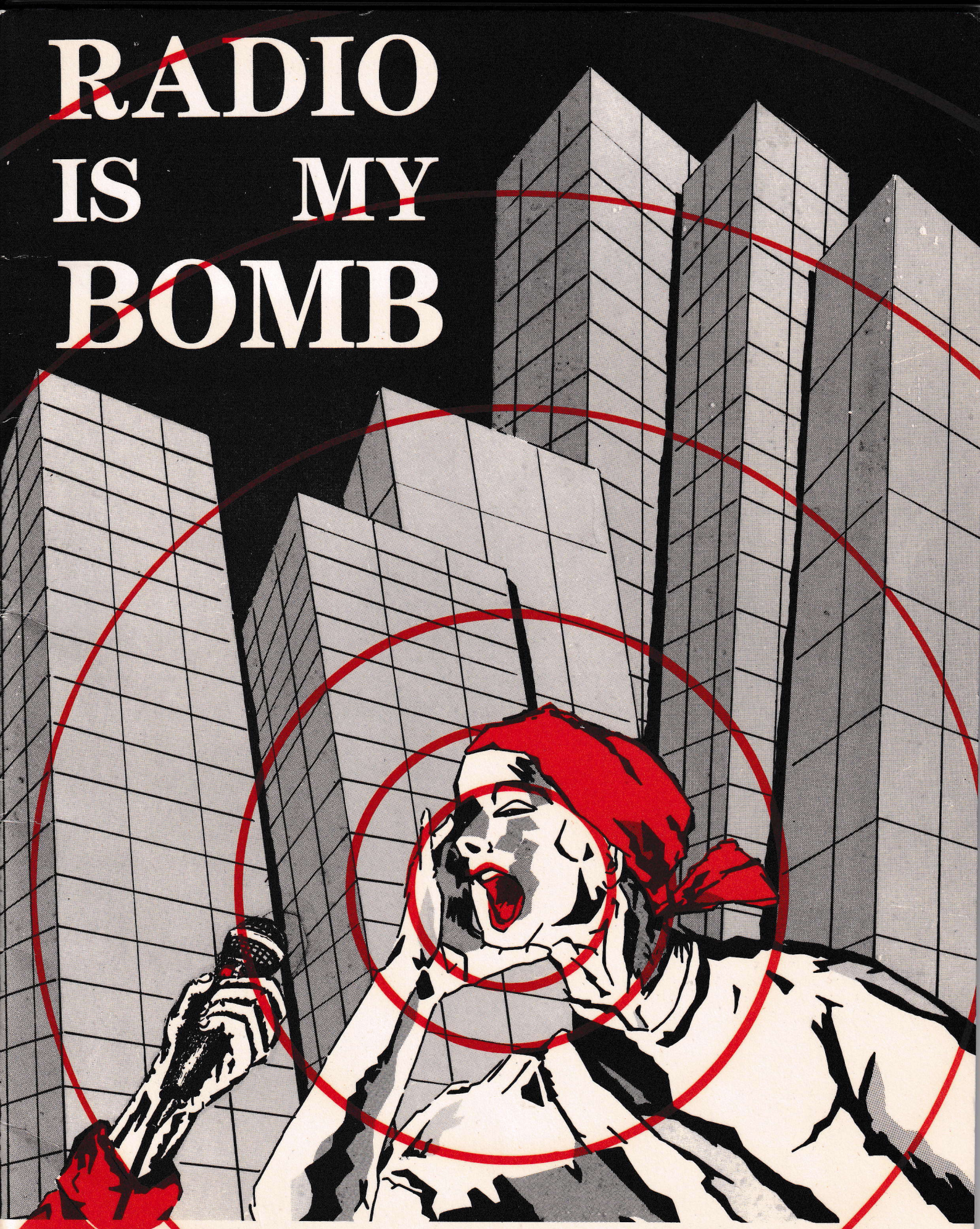
RADIO IS MY BOMB



A DIY Manual for Pirates

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HOOLIGAN
Tue. 17 Mar 1987

The title 'Radio Is My Bomb' comes from a quote from Chantal Paternostre, a Belgian anarchist, when being interrogated on trumped up charges of arson and bombings for the CCC guerillas. Chantal worked for Radio Air Libre, the Brussels pirate prior to her arrest on Aug 15th 1985. After more than a year in prison, most of it in solitary for resisting the system, the Belgian authorities finally believed her statement and let her go.

INTRODUCTION

This book was put together due to popular demand by a bunch of pirates, with a lot of help from the Free the Airwaves campaign and the D.R. Communications technical group in Bristol. Its been a long time coming but well worth waiting for. This is the First Edition, January 1987, its still a bit rough but we hope to update it regularily.

Its intended as a 'Do-It-Yourself' Pirate's Handbook, aimed at promoting neighbourhood, political and open-access radio pirates...But obviously you can use it as you wish...You can build the transmitters and use them to jam out Aunty Beeb, you can play your favourite music, or you can set up local open-access stations as we suggest...Or you can set up a fascist station and we'll come and kick your heads in!

This is an action propaganda book. We're not trying to 'cover the subject' or write an 'objective history'. We do include a brief section on recent political pirates in Britain, and another on radio pirates around the world. But the only purpose of this is to illustrate hard learned lessons and brilliant ideas to help and inspire the 'would-be' pirate of tomorrow.

The practical 'How To Be A Radio Pirate' section is a much longer and more detailed version of the pamphlet by Our Radio (the open-access pirate,1981-1983) which has been long out of print. This should kill off finally any 'technical mystery' on the subject which might be holding you back. It practically tells you how to do up your shoelaces before venturing forth to put your message on the airwaves. Its mainly about FM piracy, though we include a shorter section and a transmitter design for the less popular Medium Wave.

The aim of the large technical section is to spread the art of transmitter building from the few semi-professional technicians to the 1000's of eager electronics enthusiasts all over the world. Its just about possible for the complete beginner to build a transmitter from this book. And you can write to Free The Airwaves and D.R. Communications, who are more than happy to give you help and advice with problems as you go along. We also include projects for the more advanced, and contacts for obtaining still more advanced designs.

We also include a section on the legal situation in Britain, and a good range of contacts for current radio pirates and technical info sources. And 40 Elizabethan sonnets to round it all off.

Its quite logical really that this handbook was finally produced and printed by anarchists. No one else (least of all political parties) looks forward with glee to the undermining of the Institutions of The State, or to setting the radio media free for you and me and Joanna Soap to use as we wish!

Forward: LET 1000 AERIALS RADIATE

Welcome to 'Radio is my Bomb'. This is it, at last the manual of the guerrilla pirate, as complete as we can make it. Of course there have been radio pirates since radio was discovered, Marconi himself became the 1st pirate, when the authorities prevented him fully using his own discovery. But in the last 10 years, with the popularity of FM radio, becoming a pirate has become ever cheaper and more simple. You can't go out and buy a transmitter at the corner shop, but you can buy all the components. Now at last using the information in this book, and for the price of a couple of dole cheques, you and your friends can come on air on the half empty FM band as a local station.

In other countries, (France, Belgium, Italy, Holland and now Spain), the State has tried to control and own the radio waves, and simply been flooded by an uncontrollable mob of largely commercial local FM pirates.

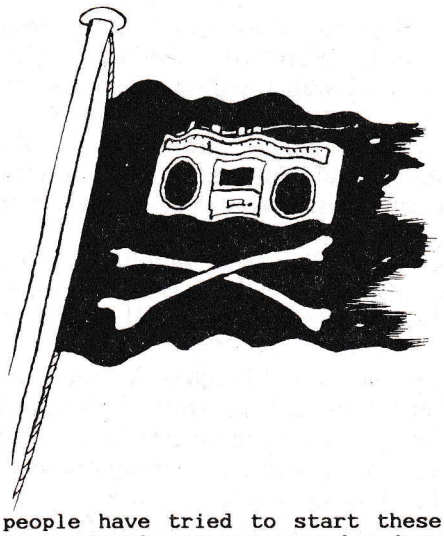
We want that to happen here too. Thats why we made this book. But we're not too keen on the commercial pirates, who spend their time trying to hog the technology imitate the commercial trash stations, and even sabotage the competition, and all to make quick cash for the businessmen who run them. The 'Free Market' is only free for the rich and powerful. Repeating tracks and ads at intervals designed by computer to entrap the non existant average MAN into buying their crap, till every station sounds exactly the same.

Nor are we turned on anymore by the traditional pirate DJ's, who tend to be all the same white sexist macho morons, preening their egos and spewing forth inane chatter in the hope of getting a fat career in the legal media.

We'd like instead to put everyone on air! To reclaim the airwaves from the parasites who infest it.



We'd like to see ethnic radio, womens radio, tenants, unions, anarchists, community groups, old people, prisoners, pacifists, urban gorillas, local info, gays, straights and of course every possible variety of musical entertainment.



A few people have tried to start these kinds of pirate stations in the recent past but have been stamped on by the State (by both Tory and Labour Governments). We can learn quite a lot from their experience, which we go into in following chapters. One thing thats clear is the value of numbers, simply that they can't stamp on everyone.

Another lesson is the value of being local, first of all because its much more difficult for the nasties to track and catch you, and less rewarding when they do, and secondly because there's a 'commercial gap', people can't make much money out of local stations, while anti-commercial pirates could survive and thrive. There is another reason why we're pushing for a new wave of local pirates, because we think radio should be a two way thing, with as much feedback as possible and lots of groups taking part and making their own shows. To hell with Broadcasting Authorities, Peers, Lords, Judges, MI5 moles and pontificating middle class professionals!

You may now be thinking this is an anarchist book trying to create chaos just to get back at Big Brother. Think what you like. We'd prefer radio chaos to the 'aural diahorrea' we have right now! But in fact chaos has nothing to do with it. For a start there's plenty of room, 'Free The Airwaves' have calculated there's room for 471 one mile FM pirates in London alone without interfering with anyone (then

radio

of course there's the space the police have 'pirated' and will eventually have to move off). We're talking about cooperation, not chaos and competition. About open access radio, where all kinds of people can share facilities and put out occasional shows or info as they wish. We're talking about frequency sharing, about community defence, about each ethnic group having programmes in their own language, etc. And when such a wave of local pirates begins we'll be talking aboutnetworks, or a movement, or a federation, or whatever we wish to call it. Like for instance the federations of the anti-commercial pirates in France or Spain (see International Section). So that problems and overlaps can be amicably sorted out and repression can be fought together. And we say now that any future Federation should be anti-commercial, and ban racists, fascists, sexists and all political parties from our ranks!

This may all seem a bit idealistic, and what is wrong with that! Any new wave of pirates will come from people and popular culture. It will certainly NOT come from the 'broad left', divided as they are in 100 fragments competing for power, members and soft jobs in a Labour Party regime. Nor will the new pirates come from the ''Community Radio'' (CR) movement, called into being by nazi Norman himself, and when denied licences have proved incapable of putting a single pirate on air, for fear of breaking the law. Now the CR activists are waiting for grants and token controlled licenses under Labour. These SLUMPies (Socialist Leaning Upwardly Mobile Persons) should beware, socialists love state control even more than Tories. Consider the Eastern Block with totally controlled media and pirates hunted down by police and army. The Labour Party has been the biggest pirate-buster of all (as well as bringing in Nuke Power, the Bomb, Internment etc) and even tried to jam Radio North Sea off the air (in 1970).

We are optimistic nevertheless, in fact we're quite sure the FM band will fill up with pirates again, simply because the technology is becoming so cheap and simple. The State knows this quite well, and seeks to postpone it with the carrot of controlled ''Community'' Radio and the big stick of the latest anti-pirate laws. This is where the real battle lies, and why we devote so much of this book to 'How to get away with it'. In fact its a complete myth that 'political' pirates get busted more often than others and even a half dozen 'open access' stations could flout the present laws, with a little organisation and imagination. But the State has more strings to its bow than brute force, as the history of pirates in other countries shows. If they can't bust us off the air, for whatever reason, they may try to buy us off - legalise a few under their control, infiltrate them with middle class professionals who will spout their ideology (they don't have to arrange this , these people will descend like locusts), and crack down harder on the rest. If this tactic failed to



work, for whatever reason, they might have to fall back on the 'Italian' solution. What happened there was there were suddenly so many pirates that the State just declared a free for all, in the knowledge that the big commercial, party and religious stations thus created would eventualy swamp the autonomous pirates off the air!

Some people still naively think that radio is somehow unbiased..Think again!. Apart from the authoritarian BBC and IBA control by rich people with upper class views, the kind of people employed can be relied on to spout the prejudices and preconceptions of their class (and this before thinking of the now proven infiltration by MI5 state agents!). Of course if you're a nationalist, sexist, fascistic little SUN lover you may notice nothing amiss. Its interesting the way we're conditioned and controlled by the media, you can look at it by listing the people, subjects, views, music, languages etc left out or barely represented. Or consider where the news on radio actually comes from and why its chosen as important.

When you say 'Free The Airwaves' you need to work out what you mean by Freedom. We know what WE want, and its a lot more than a 2 minute phone-in slot caged in the 'media zoo'. This book is for people willing to think, who know quite well what they want, and are prepared to take simple practical steps towards making a new reality from their own dreams, and even to have some fun in the process. The empty dial is tuned over to you!

If you have any more, or better information please send it in to us for the next edition to : RATS, c/o BM Hurricane, London WC1N3XX.

OUR RADIO



'This is OUR RADIO, London's only open access community pirate, coming to you on 103.8 FM'.

Our Radio was the most successful open access pirate so far, and what happened to it gives us some useful lessons for setting up non commercial, political, or community based pirates in the future. So we go into its interesting history here in some detail.

TELEPHONE

Our Radio grew out of a campaign for open access radio called Com Com, in the late 70's. This campaign got nowhere, and in 1980 some disillusioned members formed London Open Radio (LOR), a lobby group for alternative radio. LOR also got mowhere, but it was given some cash, and decided to go pirate instead.

Thus Our Radio was born, two of the real, unnamed, heroes were a couple of blokes who set about building transmitters (TX's). At that time TX designs were even more a guarded secret of commercial pirate engineers. The aim was to liberate such degigns, copy them, and develop a version which was easy to mass produce by non experts. They failed in this last aim (they were also happy to train anyone interested) but left behind a lot of info which provides the groundwork for much of the Technical section of this book. In the long run Our Radio was defeated on all fronts, after the last bust we had no TX's left (except a MW rig which turned out to be a dud) and no money, resources or energy to make more.

OUR RADIO

Regular Our Radio broadcasts began in Feb 82. It was announced as an open access station, and people were invited to make programmes. But the response was very slow. We had chosen 103.8, at the top end of he waveband beyond the police, as our frequency as it was officially declared an unused channel (later a whole range of pirates followed us) but we had no ready made audience like the music pirates. We had to fight for our audience by putting out regular programmes. A big problem was that there was no support network, and no income but what we put in ourselves (but we were mostly on the dole) or raised from a few benefit gigs. We knew that at a certain point we'd gain publicity and a mass following, and so get the people and cash to expand and make us very hard to stop. We chose Wednesday nights, with the idea of getting quietly established, at that time raids were normally made at the weekends. For a long time this tactic worked, but listener support still didn't materialise. It seemed that passive consumption of the media was as ingrained in our audience as any other. Nor could we go live, or do phone-ins, for one thing we didn't have a 'link' TX (though we were close to this when the final busts began).

One programme to join early and stay with us was UTAPIA, an independent cassette programme, produced mainly by one bloke with amazing energy and extensive contacts. It included poetry and plays as well as music which featured the Murphy Institute, Danny and the Dressmakers, Charles Bakowski, etc.

Gaywaves

Then there was GAYWAVES, the first programme i this country made bt and for homosexuals. Most criticisms of Gaywaves have been based on prejudice, i did sufter at first by being made mainly by just on man, but others quickly joined in and it became highly informative and entertaining, very soon it hac to be extended to two hours. It was a magazine programme, with music, news, humour, jingles etc. It was also an open access programme for gay people, gay men as it turned out, though a lesbian show was planned...'We wanted to involve other people to gather news and info, which would then go into the show. This was known as the Gaywaves Network and we got a few things through that. We had an arts section with poetry, stories and reviews of non commercial places...What we really wanted was a 6 hour show, with 2 hours of us, two of Lesbian programming and 2 of mixed humour, with a lot of camp fun and music to balance it all out'.

Gaywaves was attacked from all sides, not only by the press and the police, but by the straight gay media (papers) themselves, who were jealous and hated its left wing slant.

Of course Gaywaves wasn't restricted solely to gay issues. For example the first time Our Radio lost a transmitter we were playing a Gaywaves tape of Arthur Scargill speaking at a CND rally, hardly a gay issue but an important one all the same. To this day Gaywaves remains a unique and brilliant example.

For Our Radio as a whole Gaywaves was a big plus, just the kind of thing we were advocating. Phil Cox the presenter has since complained bitterly in print that we were slack, unreliable, unprofessional, not in stereo, and got up at 8.30 in the evening etc. This is pretty unfair, in fact a few people were working round the clock to keep all the gear going with no money or resources. For us the only problem with Gay-waves was that they remained consumers..ie they wouldn't help with the broadcasting side of it at all. So they hadn't much idea what was involved. For example, after a hard day of problems like locating and checking a new site, borrowing leads, repairing gear, collecting tapes, waiting for buses, missing rendezvous, setting up the aerial, hiding from neighbours, doubling back because of suspicious bods, rain, hail, wind and snow, we're finally ready to come on air and cover most of the London area, five minutes early! ...Then a lookout reports a police car parked by the next block..could be a bust..we start to dismantle everything but he soon drives off. We switch on at last, only 20 minutes late. A Victory! Then we get complaints about always being late, getting up at 8.30pm and not being in stereo! So it goes. In all we broadcast about 40 Gaywaves programmes, a lot of them 2 hour shows, and a lot of them under severe pressure. In fact when the police broke down the door at 9.30pm on 23rd March 83, in the bust that finally finished Our Radio, it was Gaywaves that they interrupted. The next programme would have been Women on the Waves.

Women On The Waves

WOMEN ON THE WAVES was a later addition to Our Radio. It began with a couple of women playing their favourite music, all by and for women, and quickly developed from there, with the Women in the City feminist group from Islington joining in, as well as anarcha-feminists from Brixton. Women On The Waves was a new and vitally necessary form of programme, a tiny women's space on the airwaves, in opposition to all the other media which more or less openly pro-

motes sexism, exploitation,attacks on women and the erosion of womens 'rights'. Women on the Waves began doing news, information and interviews of things like Greenham Womens Peace Camps, Womens Aid, prisoners, demos, music,womens music events etc. Unfortunately Our Radio was closed down before Women On The Waves could develop much further. There wasn't any division between Women On The Waves and the station as a whole



which was a good thing, some of the same women worked on The Message and other programmes, and were involved in organising, fund raising,controlled the cash (what there was), publicity and were becoming involved in the broadcasting. Not that Our Radio was free of sexism, but it was being confronted on a daily basis.

The Message

'If the time is 9 o clock, then this is THE MESSAGE on Our Radio, 103.8 FM'. The Message magazine programme was radical radio at its best, and really the heart and platform of Our Radio. Usually fantastic, occasionally diabolical, it was put together by four to ten people, who all brought material,prepared tapes and records to the Our Radio studio and crafted the whole lot together onto a one hour tape. Most other pirates hated us for being 'political' and for disproving the pirate myth that one word out of line will get you busted immediately. In fact Our Radio was only successfully busted twice in over a year (compare this to London Greek radio's recent record of 3 busts in one week!).

One original purpose of The Message was to lobby for Community Radio licences, on the lines of Australia or Canada. Another was simply to entertain, with music, mock advertising, outrageous spoofs and wild humour.A third purpose was to air the views and news that you never hear on the highly restricted, class based and self censoring British media. One advantage of The Message was that people with no experience could easily join in and quickly learn the basics of sound recording. For instance in Sept. 82 people from Brixton Squatters Aid heard the open access invitation and came along to do a spot. At that time there were only two such local groups among Londons 30,000 squatters and BSA were promoting (and still are!) such self organisation and resistance to evictions with their news sheet, 'Crowbar'. But BSA is based at 121 @ Centre, and within weeks half the anarchists in South London were reading out items on The Message, and bringing some welcome new energy into Our Radio. Almost everybody involved in Our Radio had something on the show, including one Labour Party member! Heres a short list of some of the favourite items and topics I remember :... Mock street interviews on the Nuclear Holocaust, Drug taking in the Falklands, Police Monitoring News, Greenham demo tapes, The Pope on Abortion, police death squads in Ireland, the Fallout Marching Band, the People of No Property, Shit of The Week Competitions, Rasta raps, Colin Roach demo tapes, The fake Queens Xmas Speech, Hip Hop News, 'Millions of Dead Cops' interviews, Comiso Campaign, Community Policing by Morons, Crowbar news, Christy Moore, Free The Airwaves and Cambridge Community Radio News, Anti Fascist Songs, Angry Brigade Communique..'Look over your shoulder, Pig...', Shoplifting Ad and Robin Hood rap, Prisoners News, Hippy take offs..'I feel like a used roach in the cosmic totality, man'.., Poison Girls, Windscale Expose, ALF Interviews, Drug Prices on The Block Exchange (joke), Crass, Vandal of The Month Awards, Billy Connolly, Macho morons sketch, CND slag off, Medical Experiments, Falklands: Remember the Dismembered, Pirate Listings, Soul music, Chile and El Salvador interviews, ...etc'

I think i tend to remember the outrageous stuff, we actually produced some serious researched material.

The Freespace

'This is THE FREESPACE, Anti Capital Radio on 103.8 FM'.. After a while The Message was getting so full that music and interviews were being crowded out. The Freespace was planned as a pure anarchist show, against all authority, but we only began making it at the end when the crackdown had already begun, and it was only broadcast once. Its hard to say how the programme would have developed. The first tapes were full of take offs, impressions, satire, attacks on the police and punk and reggae music.

'Here come BPAC on 103'...but they never did. BPAC was the Black Peoples Action Centre, a big youth squat and police monitoring group in Croydon, who had begun preparing tapes for Our Radio through anarchist contacts just before the final bust. The BPAC was burnt down by local fascists, with blatant police collusion.



The Bag

THE BAG, Our Radio's latenight show, was a programme of music and cut-ups without any nagging DJ to bother you. It was beautifully and skilfully made stuff, each programme had a theme eg. Religion, Money Society, etc and a title eg. The Undercover BAG Operation, The Good The BAG and the Ugly, The Five Pound BAG, etc. Lots of clever dubbing and playing round with film and TV theme tunes. Sometimes if things were going well the Bag could stretch on for two or even three hours, since it was the last show of the night. The person behind the Bag was one of the best and anonymous organisers of Our Radio, and was largely responsible for the open studio, music and sound resources, as well as working with the broadcasting crew and promotion to the bitter end.

Radio Solidarnosc

RADIO SOLIDARNOSC was a late addition to Our Radio's programmes, and usually went out first at 5.00 pm, half in English and half in Polish, and had a good audience among London's Polish minority. It was produced by one small group out of the large array of political Polish exiles, its purpose was to support the embattled Solidarnosc Free Trade Union ,and also provide contact, news and info. Its worth noting that Radio Solidarnosc (London), with Our radio was closed by State repression well before Radio Solidarnosc (Poland) was finally crushed by General Jaruzelski and the KGB. The main producer of Radio Solidarnosc was a rather volatile character, who had little sympathy with our increasing problems of prior-

ities, resources and repression. After we had failed to broadcast his tape a couple of times Radio Solidarnosc gave up and left Our Radio some weeks before the final bust.

DBC

DREAD BROADCASTING CORPORATION (DBC) started off with the help of Our Radio, in fact for their first 6 months or so they were borrowing our transmitter. DBC was a unique and exciting first radical black reggae station and gained instant popularity. It's been said in print that DBC left Our Radio because they disliked our politics. This is lies. We were happy to help DBC start up by lending our TX, that was the arrangement, and they broadcast as a seperate station on their own night, never declaring themselves part of Our Radio, much as we would have liked it, it wasn't their aim to be part of an open access station. They have their own unforgettable place in pirate radio history.

Mistakes and Failures

What went wrong with Our Radio, and what lessons are to be learnt. We were closed down by the State through the DTI and police, but they could only do this beacause we were already weak. By the start of 1983 the team of people around Our Radio were coming under heavy pressure. The main problem was lack of support, reflecting the wider divisions among the 'left' in London, the lack of any people's movement, just single issue campaigns, created, exploited and finally killed off by parasitical Trotskyist and Stalinist middle class intellectuals, for the sole purpose of increasing their own membership, profit and prestige. (phew. typist)

We decided to seek publicity, the alternative and music press weren't too interested so we tried to get on TV, and did a good interview with Thames, but the only part they screened was the shot of one of us putting up an aerial, the only bit we were worried about.

On the technical front we were building our own digital frequency counter, and also a 'link' TX and receiver so that we could go live. But we still didn't have a reliable repeatable TX design. After the bust of Dec 15th 82 we scrapped the 'link' and put the bits into a new TX. We had no money for parts, it was a case of borrowing the bus fare. In a place like London even keeping in touch with everyone can be a big hassle unless you have phones.

Another line of getting support at this period was through the GLC. This proved to be a blunder. Richard Barbrook, the sole Labour Party man in Our Radic set up a meting through his friend and big nob in the GLC, John McDonnell. We went along with it in the hope of some quick quiet cash for Our Radio. But it turned out that any cash would take much time and have to go through front groups like 'community studios'. Next thing the GLC started doing press conferences and publicity in support of us. Since the Tories were at the time trying to stifle and abolish the GLC completely, such publicity was like signing our own 'bust warrant'! Barbrook's own aim, as he admitted in the book 'Rebel Radio' was to hustle himself a career as a Labour Party spokesman on community radio. To him Our Radio was 'just agitprop' to establish his credentials and get a fat grant (he got up to £200,000 off them and Camden after we were closed down) for his next projects. (In fact Barbrook abandoned Our Radio after the March 83 bust, refused to be a witness at the trial or help with the bust fund for the squatter who got nicked, though he himself owned an apartment in Hampstead, and later wrote a load of lies (in Rebel Radio) attacking the feminists and anarchists in Our Radio, presumably to distance himself from us). The lesson from Our Radio's flirtation with the GLC must surely be 'Never trust a politician!'.

In fact there weren't many open political confrontations in Our Radio, though there could have been; we operated in a makeshift 'consensus' fashion, having no constitution or voting membership or anything like that. The consensus was 'nothing racist, sexist or fascist', but unfortunately didn't exclude political party members (since Our Radio had evolved from LOR which had Labour party sympathies). We were also anti commercials, though we weren't about to impose this preference on anyone else. In fact nothing was ever censored on Our Radio, though it could have been. For instance if Richard Barbrook had succeeded in getting any Labour Party groups to make tapes, we'd probably have refused to broadcast or 'lost' the tape (a bad solution) or called a general meeting and had a split. Open access can only go so far. In this instance we'd be daft, even if we agreed with Parties, to support one which has been the biggest pirate buster of all, even trying to jam Radio North sea off the air (back in 1970) in true Kremlin style, not to mention other indiscretions (like the Bomb, Internment , Nuclear Power, etc etc).

So the reasons for the end of Our Radio weren't as simple as they first appear. The main reason must have been that they disliked our politics, but it was also partly just cos 'our turn came up'. When they finally decided to get us we played 'cat and mouse' with them for about six weeks, since we could not afford to lose our last TX and gear. This enraged them and they turned all their resources against us. For the broadcasting team it all got quite exciting, though our schedule was decimated. Here's a brief countdown to closure:



The End of Our Radio

Wed. Dec 15th 82. The police and Home Office (now DTI) slip past our lookout and raid us on top of a Tower Block in Kilburn. One person was nicked and later fined £80 plus loss of all the gear. A 'bystander' gets fined for admitting 'listening to pirate radio', we are off the air for 5 weeks building a new TX.

February 1983. We notice the Home Office are shadowing us, by monitoring their radio channel, lookouts, etc but manage to keep clear of them and broadcast normally.

Wed 23rd Feb 83. They stage a full scale raid on us while broadcasting from a Tower block in Bermondsey. But our security works and we move ourselves and all the gear into a friendly squatted flat, with some seconds to spare. Fuck you Eric Gotts! Then we put out the story that we ran down 15 stories and hid all night in a cupboard.

Wed 2nd March 83. We broadcast a full show from Eddystone Tower in Deptford. Though the Home Office are about, watching us with night sights from a neighbouring Tower Block, and a police helicopter 'buzzes' us while putting up the aerial. We find out somehow that they can't get enough police support to bust us (there were only 3 of us!). Good sport.





Wed 9th March. We set up on top of a Tower Block in Camden, switch on, and after less than 10 minutes a half dozen plain clothes cars are moving in, keeping radio silence on their own channel. We switch off and just about escape with all people and gear to a nearby flat, as loads and loads of them storm the building. Shit. No show.

Wed 16th March. After barely a half hour on air we safely escape from another North London site, as five carloads plus a van of Home Office wait for the police to arrive. This is getting ridiculous.

Wed 23rd March. We're back to Eddystone Tower, no options left, so we prepare a 'dummy' TX and aerial at one end of the roofs, hoping thus to escape. We broadcast OK till 9.30, when they move in in force. Though we get everything down to the squat in time they now have a search warrant for the flat, and come straight there, ignoring the dummy TX. we shouldn't have been using the same flat again. We lose everything, though only one person is actually nicked.

March to Sept 83. Much reduced and demoralised by lack of support Our Radio struggles to raise cash for new gear and fines. We make several attempts to put out shows on our MW transmitter, but it turns out to be a lemon.
Our Radio continues in some form as a support group for new political pirates, and helps Sheffield Peace Radio and Rebel Radio in Bristol to get off the ground. The Our Radio 'How to be a Pirate' booklet is reprinted (also in the book 'Rebel Radio' though they cut out the entire technical and contacts sections, bastards!) several times, and finally turns into this manual.

Andromeda

Andromeda Independent Radio began on Jan 23rd 1979, broadcasting from the Pennines to the Manchester, Sth East Lancashire area. Andromeda didn't belong to any organi sation, or rent its gear from anyone, they were non-profir making and decided everything at collective meetings.."We believe that community radio CANNOT be commercial radio... We broadcast : Greenpeace info, tapes of local bands, details of anti-nuclear/CND activities in our reception area and details of times/frequencies of land based pirates". They also carried 'inverted advertising' which they called the 'Instant Rip Off' show, publicising goods making excess profits or just being shit.

Andromeda were an excellent advertisement for low-power local piracy. They claimed their transmitter had only ½ watt power, yet could be heard 35 miles away from their broadcast site in the hills, and they produced reception reports to prove it. The TX cost them a mere £6, and they were able to transmit so far due to their height and by using a directional aerial with 'gain'. . Andromeda were partly inspired by an earlier station, Radio Aquarius, which broadcast in the same area every weekend from April 1971 to May 1975. Aquarius finally gave up after repeated busts, one which followed a programme condemning the treatment of Black workers in South Africa. Andromeda too went for a long time and were busted several times before closing down around 1982.

Radio Active

Radio Active was another small anarchist pirate, who broadcast in the Tottenham area of North London in 1980. The collective put out a series of excellent programmes, concentrating on anti nuclear and anarcha-feminist issues, before closing due to other committments, they weren't busted. People inspired by Radio Active later went into Our Radio.

Radio Avalon

Radio Avalon was a 'Festival Pirate' a precursor of Sheffield Peace Radio, which took to the airwaves to entertain and inform the 30,000 crowd at the 1983 Glastonbury CND Festival, broadcasting 72 hours of programmes. It was very well received, and broadast with a tiny 1 watt transmitter, which covered the whole site and nearby Pilton village.

Cambridge Community Radio

We're sorry not to have a full report on CCR (see next edition!). Cambridge Community Radio began as an access station broadcasting music and local community news, an d developed into something more radical, until it was put off the air, with a series of heavy busts in 1983. People from CCR then took responsibilty for developing the Free The Airwaves Network and Campaign over the next couple of years, and produced a series of well researched technical, legal and news bulletins, before passing the job on to a London based group.

SPR

SHEFFIELD PEACE RADIO.

The idea of SPR came from Radio Avalon in 1983. At the time some CND supporters were flirting with the idea of setting up their own media in response to the almost total blackout by the press, TV and radio of their activities.

SPR broadcast in Sheffield during the CND conference on 2nd to 4th Dec. 1983 with a range of well programmes on peace issues and actions. But the CND hierarchy were hostile, refusing to endorse or advertise SPR (this was the 1st and last pirate at a CND Conference). However the broadcast itself was a great success, partly because of a cock-up by the DTI and police, who persuaded Sheffield's commercial station Radio Hallam to close down temporarily to aid them in tracking SPR on an adjacent frequency. In the end they didn't catch SPR, and when Radio Hallam closed everyone retuned to SPR. Lots of good publicity.

Encouraged by this a new, non party collective began broadcasting as SPR on Sunday evenings, starting in Feb 84. It consisted of music, news features and interviews on themes like the Miners Strike, the anarchist Stop The City demos, the Campaign against the Police Bill, Legalise Cannabis, anti nuclear and peace stuff, and not forgetting animal rights. The group developed quickly into a genuine radical local alternative station and received lots of encouraging interest and feedback. They also produced the booklet 'Sound Advice', advocating THAT MORE PEOPLE DO THE SAME THING. SPR was also active in the Free The Airwaves Campaign and friends with Rebel Radio in Bristol, Radio Pleb and Our Radio in London, and the short lived anarchist Radio Revenge in Leeds.

However on 20th May 84 the police and DTI followed the bus they took to their transmission site (a field) and nicked all four of the SPR team and all the

gear. Though fines were low (less than £100 I think, and spirits remained high, SPR stayed off the air, due mainly to lack of transmitters or the ability to build them.

Rebel Radio

Later in 1984 another local anarchist station came on the air in the Bristol area. Also on Sunday evenings Rebel Radio broadcast anti nuclear, womens, squatters, STC, and miners resistance news and apparently excellent music. While claiming to broadcast from a 'top secret hideaway' Rebel Radio actually went out from the roof of 'The Demolition Diner', the famous squat caff and shop in Cheltenham Road. Though the police made a few failed attempts Rebel Radio was never busted and closed down due to 'transmitter and group problems'.

The Jackie Conspiracy

Radio Jackie began way back in 1969, and gradually built up into a 24 hour per day station, becoming Britain's biggest and only tolerated pirate, broadcasting non stop pop and advertising to all SE England, using a big MW transmitter, from its base in Tory controlled Sutton Council. Radio Jackie is a company, though it illegally fails to submit Accounts or Annual Returns (Radio Jackie Ltd,No 1928150). It was wholly controlled by Peter Stremes and Michael Collis, who raked in at least £13,000 from advertising, while using volunteers to run the station. Jackie was no different from any ILR station (those set up by the Tories in '72) except it had none of the fees, restrictions and costs, but as a pirate it was unique..it never got busted!

Jackie put out a popular ''Community'' image, with free ads for local events,etc., while stating often that they were MORE self censoring than the BBC, and all other pirates should be blitzed! ''We broadcast nothing about homosexuals, drugs, CND, animal liberation, politics or anything that might be considered controversial..'' Michael Collis. ..''We have no links with other pirates. the ones who break into tower blocks and steal other peoples' electricity are criminals and should be stopped...'' With attitudes like this Jackie got the support of Tory Sutton Council, and even 2 QC's, no wonder they weren't busted. (A labour amendment in the Council calling for a token amount of 'community input' was heavily defeated).

As for Peter Stremes (co-owner, Director and Secretary of Jackie and editor of the trade paper Broadcast) he is a man of some interest, since he single handedly began and fucked up the 'Experiment in Community Radio'. He stands firmly in the fascist extreme right of the Tory party. He's also a spokesman and writer for the Adam Smith Institute and a Director of the Centre for Atlantic education in economics Ltd (No 1691243), both of which are fronts for the CIA! He also ran his own paper organisation called The Campaign for Successful Radio, which advocated US style commercial radio. Quite a bastard.

Community Radio Experiment

The recent programme for experimental Community Radio in this country began, not because of campaigning by the liberal lefty Community Radio Association, or due to pressure from pirates, but because Peter Stremes and the Adam Smith Institute put together a report on CR which was accepted by Leon Brittan, then head of the Home Office. The idea was to get Radio Jackie an open licence. People were then invited to apply for 21 local licences (for the whole country) and a Home Office Panel was set up to pick the winners. But the panel included members of the Community Radio Ass. (CRA). All kinds of problems arose, and the decision was delayed again and again, while several hundreds of groups applied. Radio Jackie stopped broadcasting (along with some others) to aid their application, after a symbolic bust. There were more problems, which ethnic station to choose? How to weed out lefty infiltrators? etc. With this CR carrot the new 1984 anti-pirate laws were being brought in. But the main problem was that the brief given by the Home Office panel obviously EXCLUDED commercial stations like Jackie and Horizon. When Peter Stremes and co realised this (they'd put in an extravagant bid reckoning they'd make £72,000 a year!) they determined to wreck the whole scheme. It was 2 years too late to stop the scheme, but they did it, probably by getting their contacts in the CIA and MI5 to make false reports to the Home Office that ther applicants were all lefty infiltrators trying to subvert the Tory controlled media. But more than that they persuaded the Government of the obvious truth..that the whole idea of CR (open access and non commercial, if tightly controlled) was the opposite of Tory philosophy. Among the hundreds of applicants were a couple used to scare the government off..A BLACK (horrors) station, JBC, supported by 'loony left' Brent Council, and an open access station ,Spectrum, supported by 'The Peoples Republic of Islington '!

Eventually (1986) Tebbit stepped in and announced that the whole CR experiment was being scrapped before it had even begun. as Clement Freud of the Liberals) commented..''Could it be that Mrs Thatcher is afraid of the voices of ordinary citizens; that its alright for Mr Murdoch to take over the Times, but too dangerous to allow 21 community stations to experiment''.We knew that all along of course, and the scrapping of CR is no surprise to us.

After the Axe

Our first reaction to the axing of CR was joy and hope. Maybe the 100's of applicants would now get transmitters and go on air, giving the DTI and police an impossible job. The answer to this was a loud NO. Few of the applicants had any real interest or committment and were pacified when the Home Office agreed to compensate them for their wasted time and money. The CRA, as the only recognised lobby group threatened its members that if they went pirate they would NEVER get a licence (the old 'wait till Labour gets in' trick). There were a few token protests and once ads on LBC radio were jammed, a group called Ancor briefly threatened to start an open access pirate and broadcast everyones tapes, but stopped after threats from the CRA.

Meanwhile Peter Stremes and his mates set about rectifying their blunder. In Oct 86, at a meeting of the pissed off CR applicants, a new pressure group was set up..the Assoc. for Broadcasting Development, to represent the lobby for legalising commercial right wing pirates, on the US model, with a token 'community' input. If the CR experiment is ever revived by a Tory Government it will be the likes of the new ABD (and NOT the CRA) who will be vetting the applications. If set up by a Labour Government the original scheme will certainly go ahead. The same old shit with different coloured bog paper!



RADIO WAPPING 50 watts Mobile?
Radio Wapping kept up regular broadcasts, on top of LBC, in North London, throughout June 86. These took place at various times, though usually in the morning on Saturday or Sunday.

We reprint below two articles from 'Radio Crimes'. . .

FREE THE AIRWAVES

BCM Box 1502, London WC1N 3XX

Free The Airwaves is still going strong, as an infor exchange and promotion group for radical local pirates. In this book we reprint their 5w transmitter design and add their new amplifier which takes it up to 25watts. (This amp. can be tuned for less power and used to feed the amp. design taking you up to 80Watts). Any technical queries, write direct to Free The Airwaves and join the network. 'Radio Crimes' is the name of the FTA bulletin, and will carry full technical updates on these designs, and much more. To join FTA and receive the bulletin send £2 (for organisations: £10) to the address above.

YOU AND THE HIT SQUADS

The idea of a community/neighbourhood Radio Station as part of a countrywide network has never been properly explored. In purely practical terms the viability of Free Radio has always been hampered by the activities of the 'Hit Squad' of the Dept. of Trade and Industry (The Radio Investigation Service). Stations able to afford highly sophisticated gear like a studio to transmitter microwave link have found themselves with court cases to be proud of and been put off the air with the confiscation of their gear. Few involved in 'propagandist' radio can afford such losses.

Low powered radio transmitters are cheap to replace(around £35 for a 4 watt one) but the most important factor for such stations to survive is to have the protection of the community they serve – safe houses and flats to disappear into, guaranteed escape routes and refusal to co-operate with the R.I.S would make such a station hard to put off the air. London could support 480 such stations operating over 1½ square miles, which would in itself make enforcement impossible. In Japan the manufacture of small FM transmitters (just a third of a mile range) has produced over 700 stations in Tokyo alone. Normal, 'big' radio has produced only one way communication to a false community invented simply by the act of broadcasting.

A small number of high powered transmitters means a greater filtering of input into the station as pressure on airtime grows and necessarily makes it more remote from the people who are supposed to be providing the programming. The only people who benefit from this are already organised pressure groups. Anyone with any pretensions to breaking down the mystification round transmitter and programme construction and providing a medium open to all is deluding themselves if they see high powered transmitters actually providing an 'alternative' voice, unless its the spurious 'alternative' of hip capitalism.. no matter how good the intentions, accounting inevitably becomes more important than content.

This is not to say that the use of high powered transmitters should be ruled out. Radio communication has the advantage of being nearly instantaneous, virtually tamper free and best of all, its possible to broadcast into areas the state would never allow left propaganda to go. In situations like strikes, occupations and evictions radio is unique in its ability to pull people together in mutual aid and defence. Pirate radio in the service of left wing causes has still enough novelty value to attract an audience, and unlike other forms of 'propaganda by deed' its more likely to win the sympathy and even the involvement of the unaligned.

The main contention is that this kind of broadcasting has to be on a 'hit and run' basis if its to have any chance of survival.

The only way of producing an open access, demystified democratically controlled revolutionary radio out of the hands of the state is for it to be organised on a small scale neighbourhood basis.

ANTI AUTHORITARIAN RADIO

Every establishment radio station wants us to conform to its cosy image of the listener. They assume what we are and tell us what we should be, just to make sure. We're condescended to, given our xmas turkey recipe (we all eat turkey, don't we?) a dose of God (we all believe in him/her?) train delays in Surrey (where we live of course), the shares in the city (that we all have) flight arrivals from rich paradises (where we spend the winter). And then there's the token bit of 'community' charity as porky middle aged middle class males read out a few low paid jobs for the rest of us. Then its time for the news values straight from the 'Daily Mail', with anything not favourable to the state and its chicklets (the Nuke industry, the police etc.) laundered, suppressed and moved to some tiny 30 second slot after the latest on some royal.

When we're told we have 'Free Speech' its in a controlled way. In London we have Brian Hayes, an irritable pompous man who may give us one minute to 'air our views'. Well, Big Deal. In phone-ins, people are caged in the radio zoo for entertainment..listen to the proles 'getting it off their chest'.

The broadcasting system in the UK reflects all the embracing State, Monolithic, Patriarchal and Inaccessible. The existing system is designed to maintain and reinforce Law,Family,God,Men,Meat,Military, Might and Money and its not about to be voluntarily dismantled by the British Government. By handing out a few licenses (or not, as it happens) the State hopes to buy off and neutralise dissent, complaint, protest and investigative news because these are harmful to its interests. The monster will not bite off its own head.

Some believe its possible to use the existing legal framework for back door radicalisation but the machinery of the IBA can easily pressurise or close down any of the stations (if they ever start up!).

Campaigning for change isn't easy but its best done by establishing alternative low tech stations of whatever types (specialist music,political,anarchist, everything). This would give broadcasting a volatile dangerous edge and create a climate for flushing the Brian Hayes and the Steve Wrights away forever, and with this, a climate for more general political change. If we can reclaim the airwaves that will be a start.

Pirate Radio Scripts

PROGRAMME EXAMPLES

There follows two examples of programme scripts, which may inspire or at least amuse you. The first is from the anarchist/squatters news section of a programme called The Message, which used to go out across London on the open access pirate Our Radio back in 1983. The second is from the Miners' pirate, known by the media as Radio Arthur. Both scripts were produced and broadcast by people with very little experience.

We have to print them small so that they can fit. . .

SQUATTERS NEWS FROM LAMBETH

Intro and backing music 'Dirty Squatters' (punk song) .Louder between items.

VICTORY

The right wing alliance in Lambeth Council collapsed this week with the defection of Councillor Gordon Ley..for the 2nd time!. Mr Ley has left the SDP and will now vote with the Labour group, giving them a one vote majority and bringing down the Thatcherite council. He claimed high motives for his defection, denying he has broken down under heavy pressure from local squatters.

MUSIC

In June when mass evictions of squatters became certain in Lambeth, Gordon Ley was one of the councillors who had his home graffitied with squatters slogans and got a fake Notice to Quit his home. Then his lorry was vandalised and then his shop windows were smashed several times, and finally his beautiful car was stolen, graffitied and burnt out... No wonder the poor man broke!..

MUSIC

JOY UNCONFINED

The news of the Council's fall (especially of the corrupt Thatcher imitation, Mary Leigh) was greeted with joy in the big squatted communities in Lambeth. It will mean at least a delay in the mass evictions and the demolition of the squatted streets in Heath Rd and Gypsy Hill, until the equally corrupt Labour Party get their act together.

MUSIC

BARRICADING FEVER

But down in Brixton town the squatters are showing no faith at all in Ted Knight and his new Labour Council. After all its only a fortnight since Labour agreed to and signed the order to evict and demolish the squatted black clubs at the Front Line in Railton Road.

MUSIC

Latest news is that at least five houses are being barricaded against the police and bailiffs , all face imminent eviction after losing their court cases. The collapse of the Tory-led council seems to have spurred on the squatters to defend their homes, and they are relying on strong doors and their own Alarm Network, rether than the whims of corrupt politicians

MUSIC FADEOUT...CRACK OF THUNDER...

Backing music from ITAL DUB or other suitable

And now for a COMMERCIAL BREAK..(womans voice)..

Are you homeless, sleeping out on cold winter streets?

Or are you just fed up with rents or mortgages?

Do YOU resent the Rat Race..Or are you lonely and just bored with life?..

(new voice) Well..TRY NEW SQUATTING TODAY!! Yes today, we can offer you a choice of 100's of fine homes, abandoned by their owners, for ABSOLUTELY FREE..So why not come along to your friendly squatters meeting every Sunday at 121 Railton Road in Brixton. Or phone 2746655 for more information.

SO TRY NEW SQUATTING TODAY.

THUNDER and FADEOUT

Intro (Freedom(prison music) louder between items)

RIOT CASES (with 'Brixton Incident' starting in middle)

Last Tuesday people nicked in the previous Mondays riot in Brixton came to court at last in Camberwell. Police had used severe brutality in at least one case, tried to get another remanded in custody and tried to stop another getting Legal Aid..

In another case they were forced to suspend a ban on entering the Railton area. All cases were remanded to Dec.16th in Camberwell Court.



MUSIC

BIG BROTHER (with clips of 'Left,Right,You're nicked)

This week we have more news of new security measure being tried in the Brixton area and Notting Hill. From now on the police will be using listening devices and 'other surveillance techniques'. This was in the 'Daily Express' on Nov 15th. A new instant printout exchange, 1st of its type in Britain, which can 'monitor' 200 phone calls at once, will also be installed in, guess where, Brixton.

MUSIC

MORE BIG BROTHER

It has been announced that the new Brixton police chief will be Alex 'headbanger' Marnoch, former head of the notorious SPG. An extra 29 ossifers have been permanently assigned to Railton Road (half of which is now demolished) under some pig called Inspector Bob Bligh.

MUSIC..'Dancing in The Streets'

POLICE MADE FOOLS OF

On Wed 18th a local black youth was stopped in Railton he refused to be arrested, broke away, and led the police a long and merry chase. Even when a vanload of SPG joined in he managed to elude them all with a classic sprint.

End of Music.....LAUGHTER.

And now ..back to our regular spot.. its this weeks TOP OF THE SHITS (new voice)

Well hello there . And this week we have a clearcut winner, in fact today is his birthday , yes its the Duke of Westminster, howdy baby, who owns 15,000 acres in Cheshire, 11,000 in Wales, 100,000 in Scotland 900 in Shropshire and thats just for starters. He has an estate in Fermanagh, shopping centres in Vancouver, a land development in Hawaii, a 10,000 acre sheep farm in Australia and 300 acres of Mayfair and Belgravia back home. This last little plot alone is worth a cool billion quid, , making it probably the biggest

stash in Europe. He's in his twenties and terribly camera shy. We're sorry we can't find his phone number, but he's definitely our TOP OF THE SHITS.

LAUGHTER

NOTRE DAME OCCUPIED (Hymn music)

Supporters of the Radio Libertaire, the Paris based anarchist radio pirate occupied the Notre Dame Cathedral on Saturday 5th November to protest at continued State Harassment

BREAK STRAIGHT IN

ANGRY...I'm Angry (poem with backing) cue tape ready)

TRUMPETS (womens voice)

LADIES AGAINST WOMEN ('Gismo My way' fade in)

Yes girls, you too can be a real lady, just listen carefully to our MANifesto

1) Make England a MAN again..Invade abroad.

2) Protect the rights of the unconceived..sperms are people too, yet millions are murdered daily!

3)Restore Virginity immediately as an O level requirement.

4)Suffering not Sufferage Lets get women out of the polling booth and into the maternity ward.

5)£1.50 an hour is TOO MUCH for women. Its quite unladylike to accept money for working!

6)Burn homosexuals. What was good enough for the dark ages is good enough for the Thatcher years.

7)PROcreation not recreation..recriminalise sex..close your eyes girls and do your duty for Britain

Thats it girls, so hurry up and join us now..yes we Ladies against Women are seen and not heard..join NOW and be seen at urgent unladylike events in proper polyester attire, defending Ladies against Women.

(Mans voice)

To find out more..send your name, address and husbands permission to Ladies Against Women, The Thatcher for Ayatollah Committee, 4 Whitehall St, London EC1..

Donations, including Kruggerands or cheques from your hubbie or father are ALWAYS welcome. Misterhood is powerful! Why not ask them to join our mens club?...Ladies against Women supports the Moral MANopoly. We have the manopoly on Morality..and God Incorporated is on our side!

TRUMPETS fadeout to Poison Girls I'm not your fucking mother.

Intro ..INTERNATIONALE

And now listeners for some sad and serious news that has come to us form VOLYA, the bulletin for Solidarity with the Soviet Working Class

We are sorry to report the arrest last summer of the mathematician Valery Senderov, a member of the Soviet Free Trade Union, SMOT, on a serious charge of preparing and distributing SMOTS underground info bulletin. He is still in prison.

Also arrested is Natalia Lazaereva, for her activities in the unofficial womens movement. She has been charged with anti-Soviet agaitation and propaganda

Still in the Soviet Union, and Big Brother is here too. We report that the Soviet Press has recently been honouring the 50th anniversary of the death of a Young Communist informer, Pavlik Morozov, who effectively killed his own father by denouncing him in the purges of 1932. Pavlik was then killed by his grandfather and cousin in revenge and then they too were shot. Pavlik was then built up as a Stalinist hero, lauded everywhere by the State, with a statue and a Museum in his home village. Now the Morozov story is kept alive to revive the purge atmosphere. Most Russians assume that at least one in ten people work part time as State spies..The CP Central Committee for instance gets on average 1500 letters of Denunciation every day..



INTERNATIONALE fade up and down

And now a word from Hungary, where there is conscription to join the army, and a growing number of conscientious objectors. One of these, Tobor Pakh, was arrested in the University church for staging a hunger strike to protest the confiscation of his passport. He was transferred to a psychiatric clinic where he had 3 teeth broken by wardens while being force fed. The institutions 'experts' stated that he was suffering from "negation of food" and "erroneous belief". Happily he was eventually set free after protests by Hungarian intellectuals and Amnesty International. This comes from the Austrian journal, Profil.

INTERNATIONALE

You can get a copy of the latest VOLYA,bulletin for solidarity with the Soviet Working Class, from 83 Gregory Crescent, Eltham, London SE9.

And now for another poetry spot..this one was written on May 22nd this year by the 18 year old Jimmy Heather Hayes in Ashford Remand Centre, the notorious youth prison, where he was being held for petrol bombing Teddington police Station on 3rd March at the height of the Falklands War. On 7th July Jimmy was found mysteriously dead, hanged in his prison cell, alone.....These are his words.

(Sth London voice)

"I don't want no part
Of your death and glory
I don't want to rot
Under wooden crosses
I ain't going to die
For your fat rich bosses
I don't want a letter
Saying I died a hero
I don't want a wreath
Its just a colourful zero
I don't want no tales
Of patriotic deeds
Cos its off our deaths
That your system feeds".

MUSIC...For J.H.H....CRISIS...PC84.

We hope to have more of Jimmy Heather Hayes' poems for you next week. Meanwhile, to round off this part of The Message on a lighter note, we go over in a minute to our regular agony column with Auntie Annie.

OUR RADIO..JINGLE..AD..

Dear Auntie.....(middle class man's voice).....
I am a young go ahead business exec. in a consultancy firm. I have my own house and a sleek car and a nice little wife. All appears well, but still I'm dissatisfied. I'd really like to get to the TOP, or get involved in a really exciting hobby. Whats your advice.....Yours.....Alienated.

Dear Alienated.....(womans voice)

Yes I quite understand your terrible problem. My advice is to go down today to the Centre Point building in London. Take a lift to the very top. Open a window, break it if it wont open. Consider the panoramic view, and throw yourself out! .....with love.....Auntie Annie.

Sound Effects FALLING CRASH LAUGHTER

Dear Auntie.....(womans voice)

I have a problem. This man keeps following me home from the tube at night. Sometimes he follows me right up the stairs. Today I yelled at him to Fuck Off, but he just stood there leering at me in the shadows. What can I do?

.....yours.....desperate.

Dear Desperate

You're quite right to be worried. My advice is to get a gang of women together, wait for him in a quiet spot. Then beat the shit out of the bastard. Can I come?.....Auntie.

Backing Pink Panther theme fade in and out.

And here is a quick word from our sponsors
ARE YOU.....running a prosperous business? Wealthy but would like to get richer? Pompous? Self seeking? Open to corruption???
If YOU answered YES to all these questios then YOU are the sort of chap we want in THE FREE MASONS!
AND HERE IS WHAT YOU GET! (fade in and out)
A super set of handshakes to try out on strangers.
A super pinny to keep your pants clean when making Dirty Deals. .....The knowledge that you're part of an elite group helping to keep Britain where it is.....A super clip to keep your trouser leg hoisted! (fade in and out)
SOUNDS GOOD?? but there's a little catch. We have to approve you (we can't have any old riff raff). A big car and wage packet are a definite PLUS.
Contact us now. If you're a suitable candidate you'll be fully trained in the art of Corruption and finally will pass through a silly and embarrassing CEREMONY, full of mystical gibberish and hoisted trouser legs!
Note...Sorry ladies, this isn't for you..But if you ask hubby nicely he might bring you along to an overpriced and exclusive dinner!
MUSIC fadeout
If time. Barrier Block + Berlin Evictions
Well we're sorry thats all we have time for this week. After a very short crackle and click we'll pass you on to an hour of Women on the Waves, then Gaywaves, Radio Solidarnosc and finally late night music from the good, the BAG and the ugly.
fade in The Message theme. 'Don't push me cos I'm close to the edge'

Radio Arthur

(JULY 1984. Breaking in on top of news bulletin of Radio Trent, ILR station)

A: Coal Grandad...whats coal?

B: Coal's what made this country the workshop of the world.

From coal we've built an empire. We've fought two world wars and won. We exported coal all over the world. We had the finest coal industry in the world, and the finest miners.

A: But Grandad..what happened?

B: I'll tell thee, lad..Now, as I recall, a Tory government got into power and then the greedy fool closed down the pits destroyed the mining villages and sold off bes' pits to highest bidder. In the end there was nowt left to the mining industry. It were a terrible and shameful waste to the nation's best assets. It were an absolutely terrible, terrible shame

C: Mr Oppenshaw ! Wake up Mr Oppenshaw, you've been dreaming.

B: Dreaming? That were no bloody dream, that were a nightmare. Comrades, dont let your cola industry become a thing of the past..join the strike now, and never forget that todays blacklegs are tomorrows dole queues.

(Note: The start of this script is take-off of a Unigate Milk AD, and not a piece of rightwing nationalism! Ed.)

(Choir music, followed by the epitomised Northern tune 'You're a Lady' by Peter Skellern. Fade to...)

B: It is not the normal practice of this radio station to read extracts from the newspapers, but this particular article has a special significance and highlights the real dangers of privatisation, which are to smash the trade union power, to make the work force totally subservient, and to close down and asset strip any section of the industry that does not show enough short term profits. The article is from the TIMES newspaper...

(Reading of a newspaper clip relating to a cabinet sub committee discussing 'private investment' possibilities for the NCB)

B: So there you are..And that from the TIMES newspaper. This could well be the fate of the Nottinghamshire coal pits ..wholesale destruction of the industry. You have been warned Join the strike now and help to fight against privatisation.

(More music...)

B: This goverment is committed to destroying the NUM at any cost and, according to the City Of London analyst Phillips Andrew, has spent £15 million a week so far. Truly amazing. Millions of pounds spent on smashing a trade union, while doctors turn away sick people from hospitals and, in some cases, send them home to die in misery for lack of money for the health service. I wouldn't trust these Tories to run a public lavatory.

(Glory, Glory Hallelujah...)

B:...We were very pleased to see our brothers from Cortonwood in Nottingham on Thursday August 23rd. The men from Cortonwood are marching to the TUC Conference in Brighton. We wish them well and Godspeed.

(Welsh Choir...)

B: ..To the Nottingham working miners I say this. If you want to save the pits, don't believe the lies that the Coal Board tells you. Don't believe the renegade strike breakers. Don't be fooled by what you see or hear on the media. Listen to what your union tells you. We care about the mining industry, jobs, the future..And now is the time for you to join the strike !

(Glory, Glory Hallelujah again, building to 'His truth is marching onnnNNN!')

Voice of Arthur blights the air

GUARDIAN 22/8/84

POLITICAL pirate radio, a rarity in Britain, is rearing its head again. It has nudged its way into the coalminers' strike on the side of Arthur Scargill.

It is the first recorded instance of a pirate radio station broadcasting political material since Radio Enoch stopped its racial broadcasts when British Telecom investigators got close. That was at the beginning of last year.

The pro-Scargill pirate radio is causing the Department of Trade and Industry (which has now absorbed the investigative side of British Telecom prior to its privatisation) even more trouble, because it is probably being operated from a series of private houses or a car boot.

The denunciations of "scabs" and the "geriatric axeman Ian MacGregor" have been going out in the Nottingham area on the same medium wave frequency (301) as Radio Trent in Nottingham. Earlier this week the transmissions worried Radio Trent even more by also going out on VHF frequencies.

"It is a sinister development, because it may mean the pirates have found some way of getting in to the Independent Local Radio System," said Mr Ron Coles, managing director of Radio Trent.

For the past six weeks pro-Scargill Pirate Radio has been on air only spasmodically, exactly at the same time as Radio Trent news bulletins. Mr Coles said that he was not suggesting that Mr Scargill personally was broadcasting, but extracts from his speeches could have been taped from radio, television or live meetings.

Mr Coles has been inundated with telephone calls from angry listeners, especially housewives who think that it is Radio Trent itself which has been broadcasting the exhortations of Mr Scargill against a background of martial music or Parry's Jerusalem.

"Either they think it is us and are angry, or they know it is not us, but think we are doing nothing to stop it," said Mr Coles. "But it is difficult to stop because it is difficult to trace the broadcasts because they are so spasmodic and seem to be made from different places."

Radio Trent has complained to the Independent Broadcasting Authority, the Home Office and the DTI. Unfortunately the DTI is short of staff in the Nottingham area which has cut down investigations.

Mr Coles would not say how the pirates might have "penetrated the system" of ILR broadcasting itself to put out its newer VHF broadcasts. "I don't want to help other people do it," he said. "Things are bad enough as they are."

SECTION 3
INTERNATIONAL SECTION

A World Of Experience

The aim of this section is not to attempt any comprehensive view of pirates around the world, but to illustrate some examples and experiences useful to the small 'Do It Yourself' pirate broadcaster today.



The Italian Explosion

It all happened in Italy after 1975, when hundreds of FM political pirates (left wing) took to the air. "The idealism of that first hour, when we thought we had found THE medium of communication..by and for the masses". Round the clock discussions were the order of the day, as literally everyone seemed to be on the airwaves! There were 'autonomists',house wives, anarchists, squatters, workers, womens groups, intellectuals, marxists, etc, all clamouring to get their views across. Everyone spoke and sang and put out an incedible range of programmes. It was a revolution on the air waves. "We did it for contra-information, against the media and the monopoly of the RAI..
what went wrong in the end? Or was it just the 'live fast die young syndrome' at work?".

In 1975 there were suddenly hundreds of such stations in Italy. But by 1980 there were only 10's, and by 1985 probably not one.

The first repression of 76 to 77 was quite severe, but the pirates just kept coming back on air and had plenty of support. Then in 1977 a new tactic by the state...the law was suddenly changed in our favour, or so it seemed, as the RAI (State media body) was declared to be 'without authority'.

But this soon proved to be a curse in disguise, as swarms of commercial pirates began taking to the air. A long losing battle took place, as their money and high powered transmitters literally blotted us off the airwaves, one by one. A prime example of "free" capitalism destroying the creativity and collectivity of the people. By the end of 1977, as their numbers increased above 2000, commercial and party bosses began putting stations of up to 40 w on the air.

The big commercials brought back uniformity of programming and less and less spoken word. To raise their advertising profits they formed into chains, buying each other out and standardising their reactionary 'formula' programming.

As all this was happening the political pirates were themselves being divided, reflecting and reproducing the arguments then tearing apart the Movimiento (Movement) itself, before stupid and elitist acts of marxist terrorist resistance gave the State

excuse for ever heavier police repression, practically finishing us off altogether.

Some alternative radios turned commercial, just to survive. Others just closed down. Others found that the idea of total community participation wasn't as easy or as successful as they had hoped.

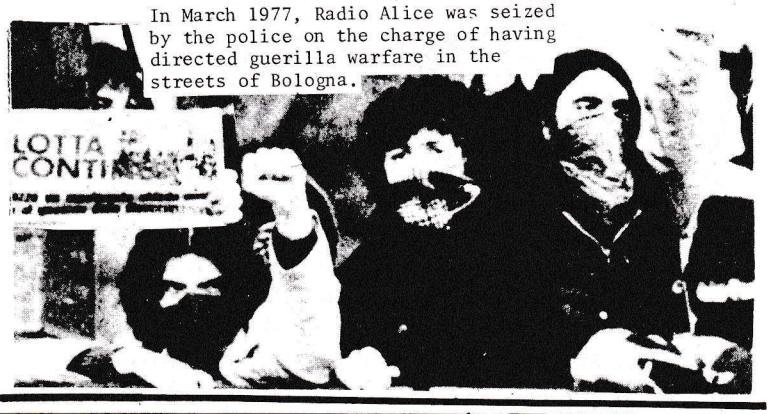
Radio Polare (Milano), is one of the few to survive since 1976, and to weather both the commercial assault and the collapse of the Autonomist Movement. Its now an alternative information station, financed by membership, workers, benefits and.... commercials.

The demand now is that part of the FM band (104 to 108 mhz) should be made free for non commercial pirates, with no regulations (other than that) from the State.

Radio Popolare,5-7 Via Pasteur, 20127 Milano.
Radio Citta Futura,Via Buomarrotti 51, 00147 Roma

"This is an invitation to speak and to think, and invitation to be always present in the situations in the town the neighbourhoods the schools the barracks the factories the roads, let's exhaust the enemy, let's wear the giant monster by beating it all over its body. Let's not talk about desires anymore, let's desire: we are desiring machines machines of war."

Collective A/Traverso:Radio Alice.

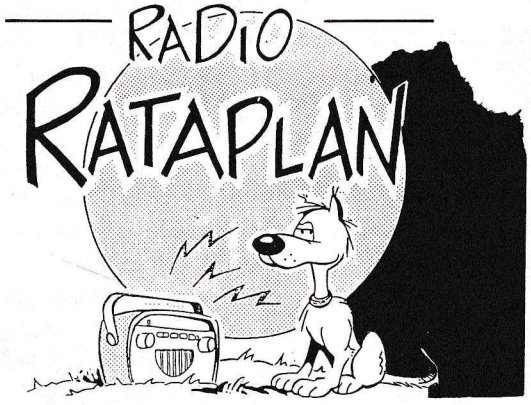


In March 1977, Radio Alice was seized by the police on the charge of having directed guerilla warfare in the streets of Bologna.

Netherlands

Pirate radio here began back in 1974, with popular sea pirates like Radio Veronica, followed by a wave of successful land based Medium Wave pirates. In 1979 the police were prevented from seizing the transmitter of Radio Paloma by 100's of outraged listeners.

The first FM pirates appeared around 1980, and the growth of the autonomous squatters movement after 1979 led to the first wave of Action Stations. The Vrij (Free) Keizer Radio was named after the huge squatted complex in the Keizersgracht in Amsterdam centre, where it broadcast from, and which proved impossible to evict. Others of the Action Stations still broadcasting today are Radio Rataplan and Radio Vrij Den Bosch. These stations broadcast mainly squatters and resistance news and music, and went live during big demos and riots. The police mainly tolerated them, , except during demos etc when there were some heavy confrontations.



The Vrije Keizer was the main alternative pirate, dividing up its wavelength to allow womens groups, local squat groups, anarchists,ethnic groups etc to do their own radio, but many other stations followed in other cities and towns (eg. Stads Radio, Oranje, Zwarte @ , etc.) Many of these no longer exist, partly due to the relative decline of the movement after 1983, and partly due to police raids. Also the format of such stations has changed, with more stress on sub- and anti- culture, and less on direct action (but this may change again). Nevertheless some excellent pirates, including the Vrije Keizer, and also Radio Rataplan and Vrij Den Bosch survive as brilliant examples to the rest of the world.

The number of commercial FM pirates exploded after 1980, with estimates of 6 to 10 thousand (Insiders say 10 to 20 thousand) pirates totally overwhelming the authorities. But this does not seem to have 'blotted out' any of the Action Stations, as happened in Italy (perhaps this has some relation to the flat ground?). Each year about 3500 pirates are raided, and there has been heavier repression since the start of 1985, but it still fails to stop them. There is a State plan to open up Cable Radio, in 86/87 as a means to divide and rule the pirates.

At the end of 1985 there was a youth conference in Amsterdam for pirates from around Europe. At the same time a new station. Factum FM had opened up, and also the 'Radio Cafe Marconi' which was a development of 'open Microphone programmes, with the aim of direct participation.

By 1986 times were changing, though the squatters were being slowly defeated the struggle had broadened a lot, with a whole range of Direct Action groups attacking sexism, racism, militarism, nuclear power,apartheid, pollution etc, giving the pirates plenty to report. In 1984 Radio Got had developed a wild new style, starting from the Vrij Keizer 'stable'

it soon distanced itself from the Movement to take in a wider audience. Activists saw Got as a trendy sellout, while the producers claimed they included all the action news, while adding their own music programmes. And they did broadcast live from mass squat centre of Wyers, during the struggle to evict and demolish it for a Holiday Inn. Got died soon after, and some of her crew went into legal stations, as predicted, while others joined Factum FM, to make radical news and documentaries, as well

as drama, experimental music and open access programmes.



Vrije Keizer Radio

The Vrije Keizer Radio (VKR) was born of the Amsterdam squatters movement, and has stayed a part of it ever since, reflecting the breadth and creativity, as well as the internal contradictions of that movement. It began at the end of 1979, broadcasting from six heavily barricaded squats, known as the Grote Keizer, in central Amsterdam. After the victory of the Vondelstraat Riots in Feb. 1980 the Grote Keizer became a symbol of freedom and a big proble for the State. VKR began as a small local FM pira at the beginning of the FM pirate boom, and broadcast on 101mhz throughout the gigantic 'Queens Day Uprising of April 30th,1980. The Grote Keizer could not be evicted, instead the Council bought the houses, and allowed the occupiers to stay there..on the condition that the Vrije Keizer Radio should MOVE OUT! But this divide and rule tactic turned out to be a blessing. VKR got itself a bigger transmitter and started broadcasting for 2 hours each day from a squat in a different neighbourhood (moving each day). This brought much wider support and interest, and many different groups came and went. For a long time the line-up was Womens Radio (Vrouwenradio) on Tuesdays, Anarchist Radio on Wednesdays, the Pijp area on Thursdays, weekends from the Central area, etc. The radio went on like this for years, basically different groups sharing a transmitter and moving it about, but it wasn't strong enough (or high enough) to cover the while city, and interest wasn't that high, except during actions or evictions.

RIOT RADIO.

Whenever there were actions, riots or evictions on a big scale everyone was suddenly tuning in to the Vrije Keizer for the real news. For instance during the Oct 82 'Lucky Luyk' evictions and resistance the VKR went live throughout, with on the spot interviews and instant information on police movements. This could be done through reporters and phone-ins, as well as a direct phone line we had with the 'Scanner Group'. This Scanner group are basically radio 'buffs' who tune in to the police radio (which is not on a public wave band as it is in the UK) and follow them with computer scanners. Important police communications are now 'scrambled' but it wasn't long till the Scanner-Groep had their own de-scrambler. Activists carried small radios with them, often with earphones under their hoods, tuned to VKR, they often knew in advance the exact movements of the mass of riot police, and could decide their own response in instant street meetings. In fact it got to the stage that, with all our resources and people, we had a better picture of the battle than the police themselves, and they too were tuning in to VKR to find out what was going on!

During that particular 'Lucky Luyk' eviction riot the police made a major attack on the Tetterode squatted buildings from where we were broadcasting, but when our listeners heard it reinforcements rushed to the area, and the police had to fight their way out, only to find they had seized two transformers instead of the transmitter! Within an hour VKR was back on the air, playing a crucial role in the struggle. There have been several other police attacks on VKR when broadcasting 'riot radio' but up to now they have never captured a transmitter.

By 1983 the weekend 'Central Amsterdam' group (mainly music) wanted to split off, with the reason that VKR was 'too unprofessional'. The solution was to build 2 new transmitters, and keep the present one as backup. These were payed for by donations, gigs, and the new 'Flux' squatters disco which had begun in the Tetterode. The weekend group became 'Radio Got' (God) with a big new 200watt transmitter, which they shared for a time with the Vrouwenradio (womens), while the Anarchists and the Pijp groups shared a 100watt rig. All the groups still used the same 95.5mhz wavelength, and co-operated for evictions, but otherwise not with Radio Got, who the others considered too trendy and becoming The new transmitters covered the whole city, and better aerials and broadcast sites were also used. More volunteers came forward and things got better, with lots of brilliant programmes, especially on squatting, anti-militarism, anti-nuclear anti-sexist and third world struggles, as well as many discussions, open microphone sessions and lots of recordings of live bands. VKR also occasionally broadcast gigs or conferences live from squatted buildings. By this time programmes had become more structured, with regular news times, and background programmes and features.

VRIJE KEIZER TELEVISION 1982 - 83.

In late '82 a gang of TV pirates suddenly appeared, broadcasting through the cable television networks. (Amsterdam is all cable) They did it after the regular channels had closed down, there was a legal hitch in stopping them because the Cable company's constitution said the cable had to be left switched on. The TV pirates put out crappy music, advertising, music videos and lots of pretty gruesome porn. That is except for Vrije Keizer TV (VKTV) which began transmitting excellent unshown videos on the squat movement, the German movement, the Womens Strike, the 3rd World, and ads for squatters bars etc. This was the first ever anarcho-squatters pirate TV, and of course it was superb. Making and editing videos is however 10 times the work of making a cassette tape (at least) for radio. Before the VKTV really got itself going well the Cable company got around their legal hitch and switched off the pirates. The VKTV group kept going for a while, making their own videos and

trying to get a regular TV transmitter together. This latter proved too hard and expensive (since everyone was on cable) but the videos still come out.

RECENT HISTORY

1984 brought new problems and challenges, with the decline of the squatters movement. The Spuigroep (anarchists) finally stopped broadcasting on VKR, and 'non commercial' music pirates began on the same frequency, these were WHS, Rabotnik and RVZ (a student pirate) and co-operated with Radio Got who had become popular, had their TX stolen twice (probably by commercial pirates). The Womens Radio stopped sharing with Got, which split in two and Radio Twist (an anti-commercial music and politics group) was born. Then the Black Womens Radio began as well, and the new line-up was VKR.. Tues,Wed,Thurs. Radio Got..Fri & Sat. Radio Twist.. Sun afternoon. Womens & Black Womens..Sun Eve.

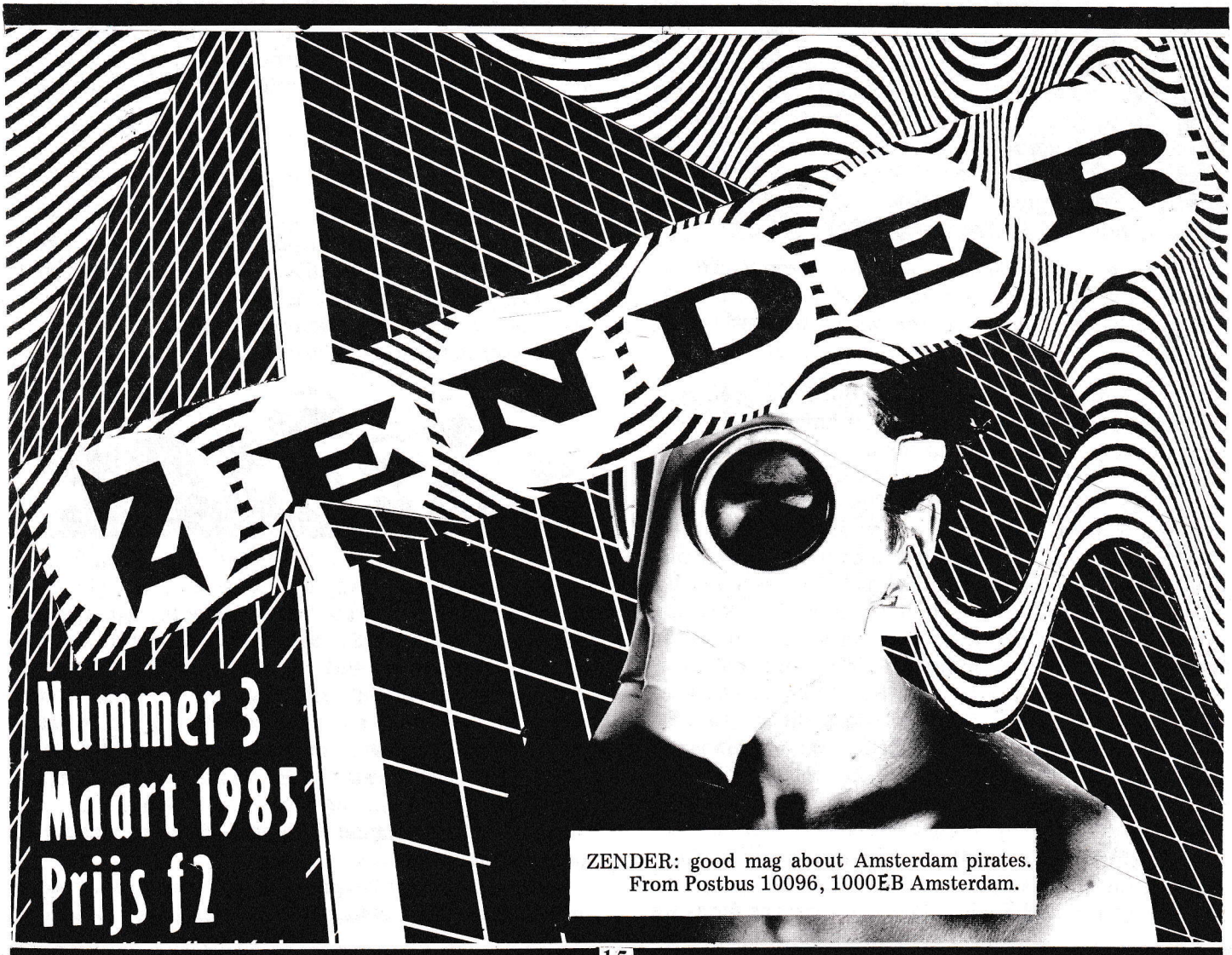
Due to regular fortnightly meetings the various groups managed to co-operate in sharing equipment, frequency and often studios, despite their obvious political diversity.

At the present time VKR reckons to have about 1000 listeners at any one time, with everyone tuning in for evictions or major demos. Recent feature programmes have included: Anti prisons, the junkie problem, the anti-Olympics campaign, Co-Ops, Ireland/Nicaragua/Iran/Sth Africa etc, a regular squat news programme, the anti gas price increases campaign,phone-ins, music, etc. Just now we're interviewing old people about their youthful experiences.

For a while a left wing Turkish group joined in on Monday evenings, before getting their own station together. But shortly afterwards their station (Halk Der) had to close after heavy fascist attacks. VKR itself then came under attack, after we made a programme anout the Turkish Fascists, the Grey Wolves, and their "democratic" fronts, with the names of those involved (often getting Council grants!) The programme was jammed out twice by the fascists, but went out the third time, starting a scandal. They did not attack our transmitter site, which is a heavily fortified squat with good escape routes.

In 1985 there were further changes. Radio Twist split off and Got died finally. Radio Factum began their Radio Cafe Marconi. A new GrachtenRadio (Centre) joined in, based on the big Frankrijk squat, cafe and pub, and finally a German group began International Radio (½ Dutch ½ German) on Fridays.

Due to regular meetings these diverse groups got on OK for a while, but eventually Rabotnik, WHS and Factum got together on 100mHz. By late 86 VKR had actually closed down, but may now be back on the air.



ZENDER: good mag about Amsterdam pirates. From Postbus 10096, 1000EB Amsterdam.

SWITZERLAND



LORA. Postfach 477, 8034 Zurich, Switzerland.

In Zurich the womens radio, WELLENHEXEN and SCHWARZ - KHATZE (black cat) still do some broadcasts. The police are very quick to attack any pirates, using the British pretext of 'causing radio interference'. Radio 24, the huge commercial pirate broadcasting from Italy is now closed down. In Zurich a group of alternative radio buffs and ex pirates got together under the name LORA and got a legal freqency from the State when some were handed out in 1982. 32 licences were given from 230 applications, to 31 commercial stations...and LORA, as a 5 year experiment. The irony is that only LORA is prospering, due to membership, donations, benefits and volunteer workers. Its quite a democratic station and encourages listener participation. Different groups put out Womens progs., newsnight, culture, music, etc., LORA's view is this.."If the state extends our licence in 1988 we can see our project as a failure".

West Germany

"Radio must be changed from a means of distribution to a means of communication"- wrote Bertold Brecht in 1932, and it is as true today. In East Germany the State has taken total control of the media, while in the West an unholy alliance of State and big business contrives to be nearly as authoritarian and restrictive. Historically the German workers have been among the first to practice free radio. During the 1918 uprising and Revolution people took control of radio stations and illegal radio broadcasts (ArbeiterRadioBund) persisted throughout the Weimar Republic.

Despite well organised and very serious efforts, pirate radio has now been all but wiped out (but for one notable exception) in the whole of West Germany.

The Action Radios still exist, but have been reduced to doing 10 minute programmes, with new names every time. And unfortunately there aren't enough 10 minute pirates on one wavelength to make them worth listening out for. The repression of any non conformist views, actions or even dress is now very heavy, with the squatters movement wiped out completely and activists continually persecuted by the computer controlled police force. It takes ten minutes from when you switch on your transmitter before a gang of riot police breaks down your door. Hence the 10 minute pirates. Such pirates can also occasionally be heard in the Eastern Bloc (eg Radio Solidarnosc) and in the USSR. The action stations are always trying to reappear, for instance during big demos (eg the broadcasts from moving cars during the StartBahn West campaign against the new US airbase at Frankfurt). In Berlin, Radio Metropolis now broadcasts from the Eastern Sector, where the position is slightly easier, and Radio Gaga still exists as far as we know. There are no commercial pirates to worry about in Germany. Another popular method pioneered in Germany is Break Ins (See How to Broadcast Section), quick interceptions of programmes on local or national radio, usually a quick message about a demo, or a responsibility claim for an action by one of the increasing number of guerrilla resistance groups.

RADIO DREYECKLAND

The only and total exception is Radio Dreyeckland, whose story is an inspiration. It was begun way back in 1977, by a coalition of French, Swiss and German anti-nuclear activists, who broadcast across the borders from mountainous forest to France and to the Freiburg area of Germany.



Radio Dreyeckland began with a weekly dual language programme and the police and PTT (French) had no luck finding the transmitter, despite attempted raids. After 1981 they were tolerated by the French authorities and the station split into five different transmitting sites, serving different local areas in Germany and France. By 1984they were doing 2 hours a day, and then jumped to 6 hours a day, with broadcasts from France beamed to a mountain/forest transmitter and re-directed into Germany. The original anti-nuke pirate was also still going strong.

The daily news programmes deal in subjects like the environment, 3rd World, gays, prisoners,

ethnic minorities and the independent music scene. By this time Radio Dreyeckland had much support in Freiburg, with democratic listeners meetings, support gigs, membership, donations etc. The pirate receives no state, party or commercial backing of any kind and is all volunteer, except for a few office workers. The French part is now legalised, but in Germany you can't even apply for legalisation! However in 1985 the German State put out feelers about licensing some commercial stations. Radio Dreyeckland responded by coming down from the mountains and attempting to broadcast in Freiburg itself!

On 20th April 85 Radio Dreyeckland began to broadcast in Freiburg, from a studio open to the public. Five days later in a massive police raid the entire building was smashed to bits, despite hundreds of people turning out to defend the station. But the transmitter could not be found anywhere, and meanwhile a second hidden transmitter was continuing the programme! Ha Ha.

In July there was a second raid, again everything was destroyed, and people were badly beaten up by the riot police. But again..the police COULD NOT FIND THE TRANSMITTER! Obviously Radio Dreyeckland had spent years in the mountains planning this strategy! There followed house raids on radio staff and supporters, confiscating much gear and personal possessions. But by now support and goodwill were at a very high point, especially in Freiburg, and after a summer break Radio Dreyeckland came back on the air, broadcasting 6 hours a day from Freiberg.

Radio Dreyeckland. Habsburgerstr. 9, 78000 Freiburg

Spain The next to Go

At the end of the 1970's Spanish radio was still much like that before World War Two in the rest of Europe, thanks of course to the fascist dictatorship of General Franco. A year after his death the State monopoly of radio was broken, and a year after that the first Free Radios appeared, along with commercial pirates.

In 1983 all the Free Radios in Spain united in the CRLE Federation and agreed on a common charter, to fight against commerce on the one hand, and State censure on the other. They voted to:

1) Keep independent of political parties and trade unions.
2)To promote independent artists labels.
3) To transmit only with a limited power, so as many as possible could get on the air.
4) etc.,

There are by now hundreds of good Free Radios in Spain, for example Radio Pica, broadcasting alternative culture, news and listener participation, 22 hours a day. Or Radio Luna in Madrid, more interested in anti-militarism, prison struggles, squatting, etc., broadcasting 6 hours a day and supported by its workers.

There are also some independent anarchist stations among the pirates, for example Radio Libertaria in Valencia.



Radio Pica. PO Box 9242, Barcelona, Spain.

Radio Clara
Apdo. 461 - Tel. 963/51.16.88
VALENCIA

Radio Cornellá
Tfos. 377.82.00/377.35.18
Cornellá (Barcelona)

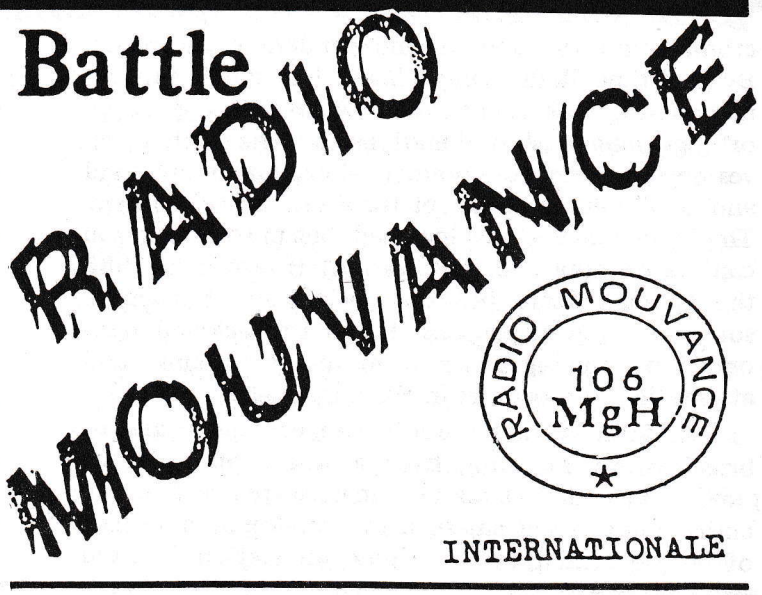
Aikario
Radios Llures, una practica alternativa
Ateneu Libertari
de Harmonia ,c/ Servat 15
Barcelona 08030.

Radio Linea IV
c/ Argullós, 92
Barcelona - 08016

Denmark

There aren't any pirates that we know of in Denmark. Two years ago 84 stations were legalised for a 3 year experiment on local radio and were given 10watt FM transmitters. Of these about 10 could be described as progressive, but only one, Radio Sokkeland, in Kobnhavn, is run by alternative groups. In Radio Sokkeland about 100 activists put together 45 hours of radio a week. Its mostly aimed at young people. Commercials are prohibited, cash is given by groups linked to the stations who can make programmes on the same basis as the workers, taking a part share in the technical and administrative work. Some of the Sokkeland people had tried a pirate station, a year earlier, but it was raided and sunk by the police within 48 hours. Now as long as they can say what they like, they don't mind being legal. There is some frustration, however, for instance an anarchist radio worker was put in jail in Aarhus for advocating an action on the air.

France : Political Battle



The pirate explosion in France in the late 70's was heavily repressed by the right wing regime led by Giscard D'Estaing, and there were a long series of busts, seizures and arrests. In France the battle was intense from the start, with many thousands of people involved in Free Radio (partly due to heavy political control of the 'straight' media) and the State taking the 'danger' very seriously.

The first to transmit regularily was Radio Verte in 1977, soon followed by stations like Radio Lorraine of the Longwy steelworkers and Radio Verte Fessenheim, an anti nuclear station in Alsace. The Federation, L'Association pour la Liberation des Ondes,ALO, (Free The Airwaves) began also in late '77.

In the run-up to the May 1981 General Election the continued repression of the pirates became an election issue, with the ascendant socialists supporting legalisation, and even setting up Radio Riposte, their own pirate, which of course got legalised when they won. After May '81 there was a huge explosion of cultural, music and political pirates all over France, with seeming 'carte blanche' from the new Socialist Government. But the State moved quickly to control the situation. From 1982 a number of 'Radio Projects' were indeed legalised, along with some of the Free Radios, but those favoured were the big commercial pirates, with their uniform music and style, while the State tried to keep a monopoly on the 'serious' radio listeners. It became very difficult for the smaller militant radio pirates to survive and fight off the superior power (in watts and money) of these commercial and State stations. There were by now several Federations, the FNRL with 300 stations wanted to remain non-commercial, with 'civic participation'. Repression began again, gradually, against the smaller militant stations who couldn't or didn't want licences, but also against the wave of unlicensed commercial pirates. The government was hostile to an 'Americanisation' of the airwaves, and took note of what had happened in Italy. This worked in favour of the militant anti-commercial Free Radios, though some left/cultural pirates also wanted to sell advertising.

One major success story is that of Radio Libertaire, the station of the French anarchist federation, which was raided, legalised, banned, raided and is now tolerated with an extensive listenership. (See next section).

Another from this stable is Radio Mouvance, which was started by an Anarcho-Syndicalist from Radio Libertaire in March '83 as a very radical 'youth experimental' station with open access to a range of left wing and minority groups and campaigns. Radio Mouvance refused to even consider legalisation, and began to broadcast 24 hours a day on an anti-racist, anti-fascist, anti-imperialist basis. It soon became a platform for many extreme left groups as well as anarchists, foreign workers, prisoners, 3rd World independence fighters (like the PLO and militant Kanaks), gays, etc. But it was the style of Radio Mouvance that made it so different.."it is a dazzling hotch-potch, one minute hunger striking prisoners, the next minute press releases from Actione Directe, then music"etc. To facilitate this style and lively participation 5 different phone lines were plugged into the mixer at all times, leading to a brilliant, if a bit cacaphonic effect.. **"We don't want to be legalised, at present 3,000 'projects' are still awaiting their licence. We say that licensing one means censoring the rest, and the licensing process has everything to do with promoting business and becoming commercial. For example 15 of the 22 legalised stations have already been bought and sold again, even that of the 'radical' newspaper Liberation".**

Big money had indeed become one of the main factors in the struggle. Mouvance itself had 3 failed attempts to seize their transmitter, followed by two successful raids by the police in July '85, but came straight back on air, despite more threats of raids and arrests. The station is anti-commercial, very much so, and functions by the support of listeners, workers, and from benefits. Its main demand is that part of the FM band, 104 to 108 mhz be given over for non commercial radio, with no further regulations by the State. With the return of Chirac and the right in 1986 the days of stations like Radio Mouvance were strictly numbered. There have since been further raids and persecution, and as far as we know Mouvance is not presently on air.*

Radio Mouvance: Ave.Trubaine 29, Paris.

FRANCE. . .LATE NEWS. . .Dec. '86

In Paris there are now about 80 stations on the FM band, as opposed to a mere half dozen in most parts of Britain. Of course many of the french stations are pirates, including a host of rock stations and minority stations, often sharing frequencies, for a dozen different international tastes. Still going strong at the end of 1986 are Radio Libertaire (89.4mHz),
* **Radio Mouvance (106mHz), Frequence Gaie, anti-commercial gay station (97.2mHz), Radio Ici at Maintenant, Ca Bouge dans ma Tete (93.8mHz) and many more.**
The CIA station ,Voice of America, has a pirate repeater on 94.8mHz, and there seems to be one right wing pirate, Radio Solidarite, on 99.3mHz.





RADIO LIBERTAIRE..ANARCHY ON THE AIR.

Radio Libertaire was set up as the pirate station of the French Anarchist Federation, and as such had plenty of militant supporters from the start. The station was busted, with strong resistance, then legalised, then rebanned and busted, then tolerated, and is now coming under increasing pressure as the right take control of France.

Radio Libertaire soon became much more than just a pirate for anarchists, partly because it allows other groups to use space on it, partly because of the good music and 24 hour per day broadcasts, and partly because listeners could expect something much closer to the 'truth' from a station opposed to ALL political parties. In any case a very large audience was built up, which was a big help in the campaigns against attacks by the State. Some broadcasts are re-broadcast on smaller pirates around the country.

Radio Libertaire: long, hot Summer

There follows an interesting interview with "Laurent" of Radio Libertaire on the attacks on the pirate in the summer of 83, and how they were successfully resisted.

Magazine Libertaire: At the start of summer '83 what was happening with the FM pirates, was Radio Libertaire prepared for an all-out attack?

Laurent: The campaign began with a concert in support of Radio Libertaire, featuring Bernard Lavilliers, at the Olympia on June 30th. It was typical of the 2 months that were to follow: heated, rythmic, intimate and full of surprises!

"Free Radios..Watch out for the Holidays" warned the headline of our weekly, Le Monde Libertaire, on July 7th. A few days before, Fillioud, the Minister responsible, had said that 11 complaints had been lodged against stations in Paris for "using frequencies without permission" and promised such pirates would be removed after a short delay to allow appeals under a plan by the Media Ministry. We saw this as a Declaration of War and began mobilising our supporters, listeners and sympathisers. A hot summer was upon us.

Magazine Libertaire: Was this kind of campaign really possible in mid-summer?

Laurent: During a June broadcast Leo Ferre (an anarchist who is also the most popular singer/songwriter in France) had proclaimed "You can count on me if things get rough and you're put off air". And furthermore 1000's of listeners were saying "We are with you". This mass support in July '83 hadn't come by the flick of a magic wand. Friendships and political alliances had been forming on a daily basis since our first broadcast in Sept. '81. Through Radio Libertaire (mainly) the idea of "an anarchist milieu" had come back after a long absence, allowing us to escape from the "folkloric marginality" the media and politicians had relegated us to. Radio Libertaire reached 1000's of people. A minority were anarchists, libertarians and sympathisers, but the vast majority weren't in any broad agreement with our politics. Yet everyone had got a strong attachment to the station, and this was clear as early as summer '82 when the 'List of Authorised Stations' was announced without Radio Libertaire on it. With this support we were already facing up to our old enemy, the State, in confident mood.

The holiday season was however a big drawback, as a big proportion of our listeners were away from Paris.

Magazine Libertaire: How did the summer's events unfold?

Laurent: It started with a long period of waiting.

Radio Libertaire proposed a 'common front' of all the Free Radios, but unfortunately there was no lack of manipulations, provocations and attampts at recuperation (even the rightwing paper Le Figaro was doing somersaults, waxing lyrical about 'justice and freedom for the Free Radios'). We steered well clear of this type of activity, and our stubborn determination was to be seen far away from the backrooms where the government and Free Radio representatives were plotting...the liquidation of the Free Radios themselves! Our attitude gained us respect and we became an important example to the rest. On 17th Aug., just as it was being suggested that the government might back down, 'Carbone 14' was busted off the air, sending a shock through the FM pirates. Radio Libertaire acted immediately against the "vandalism of the Carbone 14 studios". But another station 'Frequence Gaie' were quick to begin broadcasting on the same frequency, now allocated to them, and so shattering the so-called unity of the Free Radios.

At 6.00am on 20th August six more stations were raided by the CRS (French paramilitary police). These were 'Lumiere 101'(fundamentalist catholic), 'Made In Italy', 'La Voix du Cedre (Lebanese pirate), 'Radio Tiers Monde' (3rd World) who had all their gear smashed, and 'Radio Arabe Paris'.

That evening Filioud announced that 'the radio waveband is saturated, when a plane has 145 seats there's no room for 50 extra passengers'....

Magazine Libertaire: In this tense situation, what was the mood at Radio Libertaire?

Laurent: Tragic, cos we knew the seizure of our equipment was imminent, but our mood was fantastic. All of us there and the listeners and the militants of the Federation Anarchiste were prepared to fight to protect our station. We had no idea when they'd come so several teams were set up to patrol the area and to warn us by CB's if the police were coming. The studio was barricaded and we stayed on air 24 hours a day. The phones were ringing day and night with support calls. The government was mistaken if they thought the holidays would stop our support. We waited, hot and tense, till 5.40 am on Sunday August 28th..A militant had spotted police and the information was put on the air immediately. But by the time we could say they were definitely coming for us it was too late for supporters to get in. The police quickly cordoned off the surrounding area. The door was broken down by the CRS, those present were being beaten and kicked, and the aerial was cut.But we had got a phone call through to the pirate 'Ici Et Maintenant' (Here & Now), who began broadcasting news of the raid. Listeners and anarchists were already arriving, despite the early hour, but couldn't get through the CRS police lines. Further away militants in cars were being stopped by plainclothes cops pointing guns in their windows! Some Radio Libertaire listeners were beaten up as they were forced to watch the painful spectacle without being able to help. Technicians cut down the aerial, the equipment was loaded into a truck and driven away, and all those present in the studios were hauled off to the police station.

And that was that. Worse than the expected silence on the Radio Libertaire frequency 'France Culture' came on broadcasting early morning Mass!

There was no question of giving in. The raids were given the number one slot in the media. From the Anarchist Federation's HQ in Amelot Street the news went out to the 4 corners of the world: the response will be worldwide!

A little later in the morning the 'clean-up' of the FM band, so dear to Monsieur Filioud, was completed as the CRS, using tear gas, seized first 'Radio Voka', then 'Radio Mouvance' and finally 'Jet Theleme'. Twenty two pirates had been seized since 17th Aug. ust.

Magazine Libertaire: What kind of support work took place.

Laurent: Outside of Paris the French Anarchist Federation groups did a variety of actions as well as petitions. But the international anarchist movement also responded, with actions in Switzerland, Belgium,Germany, Italy, Australia, Japan, the USA, Mexico,etc. In Madrid the CNT (anarcho-syndicalist union) was received by the French ambassador, as was the ANORG in Norway and the @ syndicalist Fed. in Sweden. The IFA, SIA and numerous groups, organisations and publications sent telegrams to the Prime Minister. In Paris a demo was called for 3rd Sept, to which all the other Free Radios were invited. At this point the only way to contact Radio Libertaire was through the @ Fed. bookshop. A few other stations did great work, especially 'Ici Et Maintenant' in giving access to pirates who had been raided. Without stations of our own, we heard our listeners on other stations!



In a few days 1000's of tracts, posters and a special edition of Le Monde Libertaire were printed to tell our listeners of the demo. On the morning of the 3rd, militants who had hardly slept for 2 months, were making the final preparations, putting loudspeakers into cars, finishing up banners, etc. The bookshop was packed, beating all previous records, and the 2 phones couldn't cope any more. The hour of truth was approaching. By 2.00pm there was no longer suspense...Supporters in their 1000's were thronging into the Place De La Republique. The demonstrators streamed into the Boulevard de Magenta, shouting 'Radio Libertaire will not be silenced' . Banners unfu-

rled reading 'Civil Liberties Union', 'Pacifist Union', 'CNT'. 'Les Occupants Renavoteurs'., 'Libre Pense', 'CGT proofreaders', etc. People were in great mood. No one wanted it to be a sombre funeral procession. Other pirates, including Radio Voka, Carbone 14 and Amplitudes FFI had responded to the call. The mood was festive as we began to arrive at the Barbes. Not far away, in the studio devastated by the riot police, Julian, our technician, was preparing the highlight of the day: Radio Libertaire, back on the air!

The microphones were attached to sticks of wood, and thanks to Julian's brilliant improvisation, it worked!..The transmitter was set up and purring on the toilet seat. At 4 o clock Lavilliers' 'Belonging To No One' was ready to be broadcast. If the cops returned this time there was nothing to stop them except the door which had already been smashed in!

The broadcast was heard, on some radios and via the sound gear we had set up in the demo, and was well received by the 1000's of people present.

Magazine Libertaire: What conclusions do you draw from this period of Radio Libertaire's history?

Laurent: By our determination we were able to go back on the air, and later to force the State to give us an infamous 'permit', whereas our enemies, who are very numerous, were saying our chances of survival were nil. Though the anti-anarchist laws are still in place, we have forced the state, the media and the rest to admit the existance of the anarchist movement.

The main thing that summer was that we discovered something new, which I think is crucial for the @ Federation and Movement: Radio Libertaire had found a true place in the heart of the public.

Transalation by M.W. (thanks)



Belgium: Victory for Pirate Flood.

As in Italy and France the first Belgian 'Radios Libres' began in the late '70s, followed by a deluge of commercial pirates. After a period of tolerance the State began legalising some stations after '81, and by mid '83 380 stations had been legalised on FM. Those especially favoured being stations which had fallen back into the standard 'professional' routine.

There are two federations, Free The Airwaves is the voice of the 'Radios Libres', but is losing out steadily to the commercial Federation (GRIB). There is still a deep gap between the Flemish (dutch speaking) and French speaking communities, and this is reflected among the pirates. In addition the 'straight' Belgian media is quite politicised, with the French channels mainly supporting "socialist" parties, while the Flemish being mainly Christian Democrat. The "Liberals" (the fascist party) don't get much air time, and have sometimes joined up with right wing commercial pirates to get on air. In a recent scandal Radio Free Europe (a CIA channel) made use of a Belgian pirate. So there's a deep division between the 'radios Libres' and the commercial pirates. In addition, in the French speaking areas commercials aren't allowed on any channel. Its all a bit confusing.

One of the least commercial and oldest of the FM pirates in Flanders is Radio Toestel in Ghent.It's half financed by benefits and donations and has a democratic structure with at least 80 volunteers. In 1985 Radio Toestel was given a whole frequency and went legal, merging with Radio Central from Antwerpen. In Brussels Radio Air Libre has now also been legalised,despite its name its mainly an art and culture station, though it does allow groups to make their own programmes. It was with Radio Air Libre that Chantal Paternostre was working at the time of her arrest and frame up for CCC bombings (see inside cover). We don't have more info at present about the radical FM pirates in Belgium.

Ireland

After a decade of confusion and a growing herd of mainly music pirates the Coalition Government have agreed amongst themselves to license a number of 'non-commercial, community managed' stations. There are already maybe a half dozen pirates calling themselves 'Community Radios' up and down the country, and this is good news for them, especially the famous Bray Community Radio. But the music pirates, some of which claim higher audiences than RTE the State system, will face a crackdown. Typical 'divide and rule' tactics. There aren't really any alternative music or politics stations on the air that we know of. Surprisingly Sinn Fein haven't got a pirate together, considering they're banned from speaking on state radio or TV.. The Irish republic has also been a haven for international short-wave pirates.

The Rest of the World

Once you move outside Europe you're talking about very different cultures and political situations, and the experience of such pirates is not so relevant .

Radio is a part of the international battleground, the medium , for instance was used effectively both by Hitler's fascists, who excelled at mass propaganda, and by the French and other resistance partisans. After the 2nd world war almost every conceivable guerrilla and national liberation movement had its own 'pirate' stations..the Irgun, the IRA, Basque seperatists, Kurdish rebels, Spanish or anti-communist exiles, etc., etc. During the Cuban revolution, for instance, there were at least 9 stations battling it out, 3 revolutionary and 6 run by the CIA and the Right. These included the famous 'Radio Rebelde' set up by Che Guevara in the Sierra Maestra in 1958, which set the tone for later resistance and 'people's' radio.

For the purpose of examining overseas pirates we can divide them roughly into five groupings: Commercial / Sub cultural, alternative / subversive, anti-state / Community, participatory / and Revolutionary, nationalist.

In fact the lable 'pirate' itself becomes quite meaningless, for instance in civil war struggles. And are not the superpowers, BBC World, Voice of America and their Soviet and Chinese equivalents, guilty of much worse than piracy in flooding wavelengths in every corner of the world with their more or less subtle power propaganda?

Central America

EL SALVADOR.,

A good example of a classic revolutionary / nationalist pirate is Radio Venceremos in El Salvador, broadcasting from the liberated Marazan mountains despite continuous army and air force attacks by the right wing US funded regime. Radio Venceremos is the voice of the FMLN federation of guerrilla movements and began regular broadcasts on 10th June 1981, after a year of sporadic 'people's revolutionary radio' in the capital city. During the '82 'elections' the air force failed to bomb Radio Venceremos off the air, and they had to be jammed out by US vessels offshore. The station gives a completely different world view to the State media, and is well supported by the poor and dispossessed (90% of the people). Such radios are an essential part of building and participating in a pre-revolutionary movement, in this case one postponed indefinitely by US intervention and the Death Squads campaigns. One danger of such radio, is that it can perforce become cut off from its supporters, and also lends itself too easily to institutionalisation as the 'party radio' of the new state after such a left nationalist revolution. Radio Venceremos has tried novel ways to gain audience participation, for instance in Jan '86 when they invited their audience to gather information on suitable targets for sabotage, and send it to a Box Number in Mexico City!

BOLIVIA.

Believe it or not there is, or was till recently, a tolerated 'community radio' system in Bolivia, existing alongside the State and commercial networks. Since the 50s, for instance, radio has been used by Bolivian miners in the course of their struggles, and many mining towns have for various periods sustained decentralised, autonomous and self managed radios with permission from nobody, in the face of military dictatorship. Now most mines have been closed, resistance smashed and the miners dispersed as penniless day labourers amid total economic collapse.

We don't have info on other Sth American pirates except that they are many. One is Radio Liberacion, the voice of Chilean Resistance, which does 'break-ins' onto State radio and TV broadcasts, calling for strikes, demos etc., against the fascistic Pinochet regime.

The USA

In the US everything is free if you have the money. Radio and the media at large seem to be in private commercial hands, though much of it is controlled by huge corporations enmeshed in the State and the 'military industrial complex'.

So, its free to go on the airwaves, but: 1) It takes years to go through the licence procedures of the controlling body, the FCC. 2) It costs many 1000's of dollars. 3) To get such a licence you need to be a 'respectable hierarchically organised group'.With Boards of Directors, etc. 4) What they give, they can take away, if you did by some miracle get a non-commercial licence they would stop it at the first wrong move.

"Public" radio in the US began to be licensed in the '50s (in the US context 'public' means non-profit and NOT run by the state directly). By now one in eight stations are 'public'. One in five of these 'public' stations are in the Community Federation and thus claim to 'have no institutional affiliation', in fact they see themselves as some kind of social workers. The community radio movement (now 60 stations) was begun by the anarchists and pacifists of the KPFA station in Berkely, SF, in 1949, and anarchist principles were incorporated into the charter. KPFA still exists today, and is the mainstay of the Pacifica Foundation (5 stations,one in New

York) which has come under increasing attack (despite all being "free") in the Reagan years. A right wing group called 'Accuracy in the Media' accused Pacifica of broadcasting 'filth, racism and communism' . Back in '81 a National Enquirer expose screamed 'Your Tax Dollars Support Red Broadcasters', but the licences have not yet been revoked.

While commercialism , rather than the State directly is the controlling force in the US, with most stations flooded by inane advertising and playing the same few top records, there is nevertheless such a big range of stations that you can find alternatives. For instance in New York you can tune in to over 60 channels on the FM band, including lots of ethnic language or 'minority' music stations if you look for them. In Britain by contrast you can find just 4 or 5 official channels on FM in most parts of the country. The argument that there is no room to legalise pirates in Britain is demonstrably ridiculous.

We have no information on any pirate stations in the USA.

Canada

Canada has a fairly liberal radio system and few if any pirates. In Quebec 'Community Radio' is a legal alternative, and in some places is the main local station. This idea is also strong in Vancouver.



Japan, mini TX boom.

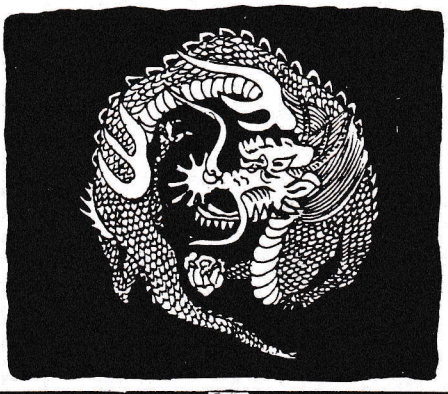
FROM RELAY MAG.

An intriguing loophole has created the possibility of legal piracy in Japan. Technical ingenuity has created wireless microphones, remote control devices for TVs, garage doors and model planes all of which use small transmitters. To ensure they are legal, all transmitters which generate less than 15 microvolts per metre 100 metres from the source are excluded from the regulations requiring broadcasters to be licenced!

A tiny FM transmitter, broadcasting in the 76-90 MHz band, and within legal limits, can reach a radius of 0.3 of a mile, an exciting prospect in a crowded city. Manufactured primarily for CB enthusiasts, and costing £20, the technology was easily available, and with 9 months of the first tentative experiment 100 stations were broadcasting. Soon the media had picked up on the phenomenon and there was an explosion. By August '83, just three months' later, there were 700 mini stations! Once again the fantastic demand for access all over the world was evident. And, as always there were very different interests involved. The first stations included two which illustrate the differences Radio Polybucket, started by free radio enthusiasts from Washo University; and the media wise Radio KIDS wanting an audience for their home-produced music cassettes. KIDS was backed by advertisers wanting a liberalisation in Japanese broadcasting law, and when publicised widely ensured most pirates were what one Japanese, in his first encounter with a style which seems all too familar to us, described incredulously as "childish monologues with American pop music!"

Radio Kids

In Tokyo there are severe restrictions on street life because of the riots in the late 60s and after. Even stopping on the street without police permission is illegal. But the freedom of the airwaves enabled Radio Contemporain to create a completely new kind of event. Broadcasting from vans they put out a mix of rock music and political protest against the visit of the US nuclear carrier Enterprise. As youngsters walked the streets listening on their Walkmen, the radio station drove amongst them. A mobile station and a mobile audience managed to have a demonstration, a public meeting and a benefit all at the same time!



The Japanese Government is worried, and have proposed ways of closing the loophole. But every day that passes brings new stations. How can they confiscate so many tiny transmitters, especially because they are so cheap to replace? And the draconian powers, not to mention the resources, needed to fully extinguish the movement would be out of all proportion to the harm they do.

Reflecting

Perhaps our own pirates are too eager to mimic normal radio, not just in content but in service area as well. Wanting to broadcast to a large population makes for relatively expensive equipment, and for fewer stations. If London were a maze of hundreds of small pirates enforcement would cease! And perhaps, as in Japan, the small scale would stimulate some real community radio.

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How To Be A Radio Pirate

This section tells you exactly how to go about setting up your own radio pirate, with all the tips learned from bitter experience. First of all here's a list of the main things you will need. So you want to be a radio pirate?...Read On.

What You'll Need

A. A group of committed people who get on with each other and have plenty of time and energy.

B. A programme, presuming you have something worth saying or playing. You don't even need a studio to start off with. Just borrow someone's stereo and a microphone and start making practice recordings onto good quality cassette tapes.

C. A Transmitter. Ideally over 10 watt power, but 5 watt is fine for local broadcasts,or when using an aerial with 'gain'.(see Technical section). You can't buy one over the counter in Britain, but here are some alternatives:

1) Buy one from another pirate (beware of rip-offs).
11)Buy one over the counter abroad (see Contacts). In Italy for instance you can get a high quality 50W transmitter over the counter for £200. You can buy kits in Belgium, France ,Netherlands,USA,etc. You then have to smuggle it home.
111)Build your own.A hobbyist can build a low power FM transmitter from the instructions in this book. You can add on amplifiers later if you need more power. Try to interest radio hams or dissident engineers. Its almost essential to have at least one person in your group with some technical know how.
1V) Get one built to your specifications. There are a few electronics engineers about who will build them for a reasonable price. Obviously we can't publish their names and addresses. If you write to the obvious addresses on the Contacts Page we may be able to give you a box number to contact.

D. Antenna (aerial). You can adapt a design yourself from an antenna book (eg. The 2 Metre Antenna Handbook:Babani or Tabs books, or an amateur Radio handbook). Or use one of our ready made designs (see Tech. Section). Look out for aluminium tubing or struts (on skips) which make good building material.

E. Odds and ends. You'll need basic tools (also look out for soldering iron,multimeter,SWR meter),a cheap cassette deck, probably one or two good car batteries, a roll of co-ax cable for the aerial, a radio to listen in on, etc. Also start collecting and reading Amateur Radio Handbooks and all relevant writings..

KEEP YER PEEPERS WIDE FOR ABUV STUFF!!

VHF : Pros and Cons

First lets deal with FM (Frequency Modulated) broadcasting, which is your probable choice. The advantages of FM are many. The transmitters are small, light and quite cheap. Reception tends to be either very clear or non existant. Its excellent for music and for recording off and can quite easily be adapted to transmit in stereo (impossible with AM). A major plus for the pirate is that its easy to hide and transport the gear, aerials are comparitively small and can be made collapsable. Its also possible to put it in a vehicle, even a bicycle, and go mobile, albeit with a smaller and changing reception area. The average 5 to 20 watt transmitter would be in a metal box not bigger than 12"by 6" by 3" in size, and weigh not more than 8 lbs with the rest of the gear (but not including the car battery,if you're using one). The aerial is not only shorter but more efficient and of course more practical than the long and tricky procedure for MW aerials. Also low power FM transmitters ('rigs') can be tuned to slightly different frequencies, on MW you're stuck on one, unless you get a new crystal.

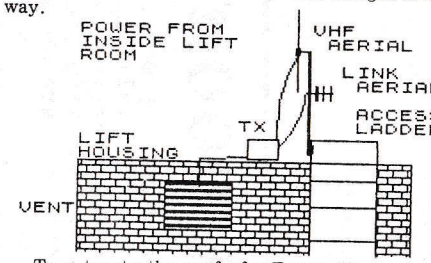
The disadvantage is that VHF -FM is essentially a 'line of sight' communication...Which means that your reception area depends crucially on the height of your aerial above large blocking objects. This is no problem if you can get up on a hill, or a tower block but it does restrict the choice of broadcasting sites, making you easier to find and trap. With local broadcasting you have more choice of sites. In very hilly areas, unless you can get up on a mountain, you'd better choose MW, also if you want to broadcast to scattered communities over a wide area. Distance covered with an FM rig depends as much on height as on power. A 40 watt rig on a 15 story tower block should cover a 15 mile radius if there are no blocking hills. A 4 watt rig should go 5 miles from the same height,but if you build a directional aerial with 'gain' you can multiply that power many times. You don't really need a big expensive and hard to build transmitter. Also don't assume a 100w rig is ten times as powerful as a 10w one,it doesn't work like that.

To sum up, FM broadcasting is the ideal for the guerrilla or community pirate, cheap,mobile and adaptable. Another advantage is that there's loads of room on the FM broadcast band,its literally half empty,and there will be more when the police eventually move off it. On MW its pretty crowded,and at night you're likely to be blotted out by continental interference.

The Broadcasting Site (FM).

TOWER BLOCKS

In cities tower blocks have been an ideal answer for good coverage and wide reception,and are especially favoured by commercial pirates (who often use a 'Link Transmitter' from the studio to the tower block so as to 'go live'). A further advantage is that there are usually electric sockets in the lift or heating rooms on the roof, so you can just plug in,provided your gear is so adjusted, rather than lug car or lorry batteries about. This is 'Stealing Electricity',of course, if you're caught boadcasting the Electricity Board could bring this additional charge,though in practice we've never heard of it happening.. The advantage of sticking to car batteries is that you can conceal your rig anywhere on the roof,rather than having it right by the plug socket, though in a surprise raid your aerial cable will lead them straight to it any way.



To get onto the roof of a Tower Block you need a crowbar,or better a key. The 'firemans keys' have to be standard for all blocks,so once you have one you can get onto most roofs easily. Try asking other pirates, or possibly a friendly caretaker or fireman. Or you can break the door,steal the mortice lock, get keys made up for it,then replace it,such keys may not fit all roofs.

When on the roof BE CAREFUL (sudden gusts of wind can blow you over at this height!) and always wear soft shoes and keep quiet. Lots of people have been busted simply because the tenants below heard them and called the police. Its useful to dress like a repair person, and claim if seen or challenged, to be a lift mechanic. The main problem with Tower Blocks is that, if raided, you can easily be trapped. (See How To Get Away With It.)

MEDIUM SIZED BUILDINGS

If you're a local station, or have a high power rig or an aerial with 'gain' (or if you're just testing) you don't need to be on a Tower Block. Any building higher than most others will do, and you can increase your height, for instance by mounting your aerial on top of a high,well secured scaffold pole (note:there must then be a wooden or plastic section between the pole and the actual aerial).

The advantage of lower buildings is that you can multiply both the available sites for broadcasting You will have to switch sites as often as possible, Also you will have many more escape routes and 'bolt holes' than on a tower block. Unfortunately this may also mean you have to watch more potential approach routes by the police and DTI,and you'll need more lookouts if you're planning to save the gear when attacked.

BROADCASTING FROM HILLS (FM)

If your town or city has hills this is a good option, the higher the better. You can use a piece of derelict or common land, or at night you can use parks,cemeteries or even allotments. A better option is if there are hills outside the built up area, then use a field or wood away from houses. If you use the directional aerial you can cover the city just as well. This was done by Andromeda radio, to good effect,they used to cover most of Manchester from a high hill outside, using a mere 4 watt transmitter with directional 'gain' aerial. If you can get up into mountainous forests you're even better off and can adopt classical guerrilla tactics,often see the enemy coming miles away, and be very difficult to stop.(See example of Radio Dreyeckland,International Section,who were never caught.)

On a hill within the town or city use good lookouts, escape routes,CB's etc and have regular 'escape



drills'. Best place for the aerial is a high,easily climbable tree. If its not too obvious leave it up there and have a spare ready. An added problem with hills is that you normally have to lug at least one car battery about, which is terrible if you have to climb fences, ditches,etc at night (wear gloves and old clothes against acid spills),something like a pram or shopping trolley can help. You can't leave the batteries on site as they need re-charging for your next broadcast.So mains electic is a big help if you can run a lead from somewhere. Outdoors all your gearmust be in waterproof cases, or covered with a tent or tarp. Tents are good if you can pretend to be camping. Take care also of yourself and your group (you need at least two people,preferably four. Hot drinks,food,waterproofs,short shifts for lookouts,etc are good ideas. It gets boring after a few hours. CBs are excellent,but get ones with earphones if possible to avoid noise.



If on a hill you can also use an ordinary house, flat,squat or derelict, and just set up your aerial as high as practicable on the roof (eg.sliding it up,atop a scaffold pole,through a skylight). Its better to get a place,by squatting or if you're rich. by renting, specially as a broadcast site, no one likes to live under constant threat of the police storming in. In practice you may have to use someone's house,then don't use it too often. If you must use your own place DONT leave dope, stolen goods, false ID's or other naughties lying about. It is possible to run your antenna cable from your house to the aerial on another roof,and whip the cable off quick if they come, but this would only work once, and you lose output power with every extra foot of co-ax cable going to your aerial. More of this in the 'How to get away with it' section. NEVER have your studio at the boadcast site. They'll confiscate the lot,under the new laws.

OTHER POSSIBLE BROADCASTING SITES

FESTIVALS, especially large free festivals are an excellent and common broadcast sit. A small 4w rig will do fine. Set up on high ground in a tent or vehicle, and invite the festival goers to protect you from possible police attack,much more unlikely in these circumstances. If possible make a 'live' studio in a tent,caravan or truck and get everyone involved. Try to get mentioned in pre-festival publicity,or do your own,so people will bring radios. This is pirate radio at its best.

DEMOS. especially long ones, like blockades for eg... of Nuclear Stations or War bases, can be equally worthwhile.(See Sheffield Peace Radio). In this context the pirate can be a perfect medium for discussion,information and warnings of police movements, as well as for entertainment and music.

BARRICADED SQUATS OR SQUATTED VENUES are another obvious and much underused site for the guerrilla pirate, especially during big meetings or gigs,which you can broadcast live from the roof. This has been done successfully forinstance in Amsterdam and Berlin.

OCCUPIED FACTORIES or industrial areas during strikes and disputes provide an excellent and often missed opportunity for the more political pirate group, and can provide vital communication for mobilising,publicising and gaining support. There have been many such opportunities in Britain over recent years.

SIT-INS and protest occupations (eg.Greenpeace) are another good possibility,which we don't think has been tried. Especially occupations of high towers, buildings or pylons for publicity. But in this situation capture is pretty certain, therefore a small disposable transmitter would be ideal. A good strategy is for everyone to deny using it,and to use any following trial for more publicity,eg. on the lines that the army etc and police are already hogging most of the airwaves.

'NO GO AREAS' are a step up from occupied factories. We know for instance that nationalist pirates broadcast from Free Derry and parts of West Belfast when they were 'no go areas' to the state. Of course there are now no true 'no go areas' in Britain, but there are plenty of inner city estates where the police rarely venture,especially in the evenings in the riot season,for fear of 'concrete rain' or worse from the roofs. A high block in such an area could be an excellent site, espcially if you can tip off the local youth to lend a hand. Whenever major rioting begins large areas are suddenly devoid of police,till they can group in numbers and re-take the area. This is another opportunity for 'on the ball' local pirates. By monitoring police radio. runners, and phoned in reports such 'uprising radio' could be a brilliant aid to the fighters on the streets (see Amsterdam in Int. Section) though you would need good security, disposable transmitter, quick getaway routes,disguised voices,etc.

LIBERATED ZONES ! (Let us know if you find one!) Practically every guerilla or Nat. Liberation movement,be they right or left wing, has their own pirate radios,which are often a crucial influence in such wars,broadcasting from freed zones or neighbouring countries. But you're not likely to come across this in Britain.

INTERNATIONAL WATERS is of course a favourite site, but out of the question for the small 'do it yourself' pirate.

GOING MOBILE, from cars,vans or even bicycles is discussed with 'Guerilla Radio' later in this Section.

How To Set Up Your Gear. (FM).

BEFORE YOU GO

Before setting out you had best brief everyone, especially newcomers, on what will or might happen. Talk about getting caught, for instance have good excuses made up for being at or near the site. If you are planning to give false names, for instance, you'll need an address where someone will confirm you live, otherwise you might have troubles getting bail if you were arrested. In this case keep your first names the same,to avoid being caught out. (See Legal Section).

Make out a standard 'check list' of all you need, and go through it before you set out. Its surprisingly easy to find yourself on top of a Tower Block, or climbing some tree, only to discover that your cassette deck lead is at home five miles away.

HERE IS A SAMPLE LIST OF THINGS YOU NEED Transmitter (TX) / TX mains lead,or 2 clip on battery leads(large & well insulated)/ TX lead to cassette deck if not attached/ cheap cassette deck plus mains lead or 2 clip ons and 6 volt bike battery / charged up car battery 12 volt,if not on mains / Antenna (aerial) check you have the butterfly bolts if collapsable) / the co-axial cable (with plug attached and clips or attached to aerial / fused plug board (if on mains)/ programme tapes (rewound to starting position) / small FM radio receiver(s) to monitor broadcasts/ CB's for lookouts,fairly essential,(£10 licence fee optional) /plastic 'gaffer tape'/soldering iron and solder in case of broken leads /torch / warm clothes/ munchies / bus fare/.

ON THE WAY

Ideally you need four people, at least two. Carry the gear as inconspicuously as possible, in holdalls or plakky bags. The antenna is a problem. If its a big long one make it collapsable,using butterfly nuts in assembly. Or try to keep it somewhere close to the site. On arrival at the site, especially if you've used it before, send an emptyhanded scout ahead, to be sure the police and DTI aren't waiting for you and all is clear. Check also you're not followed.

SETTING UP

In the case of a tower block. You should have been there beforehand, and have either a key or a broken lock, to get straight onto the roof. Lock the door quietly behind you. If there's two doors onto the roof have access through both. Take your gear to the lift/ heating room and find a plug in wall socket (if on mains). Check it works. Wear gloves when handling gear, and clean it regularily with cloth and alcohol. They dont usually bother with fingerprint evidence,but they might start. The antenna must be cleaned regularily anyway for good transmissions. Set up your antenna as high as possible, if possible on top of an extension pole or length of scaffold pipe. Often there's a pole already, left by earlier pirates. Attach the antenna securely,with bolts or strong gaffer tape, to a length of wood, then the bottom of the wood to the metal pole,(if there). The antenna must NOT be touching or blocked by metal. The co-ax can be soldered or bolted onto the antenna, or attached with strong,rust free car battery clips. The clips are recommended for fast dismantling and for testing and developing antennas,mark clearly which goes where. The co-ax cable should not be longer than absolutely necessary,you lose power with every extra foot, and should be good quality and well insulated. Your lookouts should already be on station,with torches or CBs, one at the foot of the tower (preferably sitting in a car or flat) and one on the roof. Keep low and quiet and wear soft shoes (In one court case Eric Gotts (head of the DTI squads) claimed he recognised an Our Radio member from the ground,18 stories up,at night.The judge accepted his word.)

When the antenna is up securely, lead the co-ax back and plug or screw in to the back of your transmitter. Now plug in the TX to the cassette deck (TX= transmitter) keeping the two as far as possible apart, if possible blocked by something solid,like a wall, to



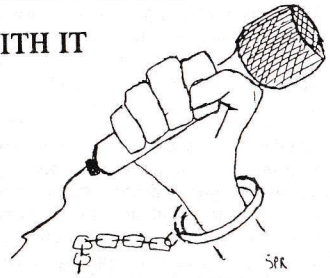
avoid interference. Keep the din lead well away from the power leads. Interference between leads can often cause loss of power and/or "Sprogs" (unwanted signals on the wrong frequency).You can go so far as to block leads from each other with bricks.

Plug in the cassette deck and the TX to your plug board (or connect to batteries) and switch on. If you have that facility just switch on the 'exciter' stage of the TX first for testing, no need to alert Big Brother prematurely. Go to the other end of the roof with your radio receiver and tune in. Then adjust the modulation on your TX, in relation to other channels, to get the best sound. If thats OK but there is unusual knocking or crackling sounds try moving the cassette deck further from the TX,or raise it above ground if possible. Try further separating or screening the power lines from the din lead.

You may well find that you have sprogs (harmonics or spurious signals) all over the waveband.Check for this. If so check reception with your lookout 100 yards away, normally such sprogs disappear by that distance and you're OK. But if your signal is still spread all over further away switch off and clear off. Your TX is fucked up and needs difficult repair or tuning you can't do on site. If you find you're interfering with fire,ambulance or pigs, stop, before they come after you. Most pirates are very careful not to do this.

When all checks out OK, insert your programme tape, switch off, and wait for the agreed time to begin. With practice you can easily set it all up and test it in 10 minutes, but its good to allow a half hour and to be methodical and cool. Never,for instance,switch on your TX without the antenna attached,you'll blow it. The amp stage of your TX should get quite hot when drawing power, if not its not working. With bigger transmitters you may need also a small electric fan to cool the heatsinks on the power transistors. Once you're on air its good to go and phone friends for reception reports further afield.

BROADCASTING....HOW TO GET AWAY WITH IT



KNOW YOUR ENEMY

On a tower block, in London, the DTI squads can tell where you are, within 20 metres, less than 10 minutes after you switch on. So they can bust you any time. In the case of new pirates the procedure is to monitor you for a while (in case you're just messing about) before busting you. It could easily be a few months before your first attempted bust. If you play anything but straight music they will record and keep all your programmes for possible further use against you (though voice prints aren't used in court). In other cities they are generally slower to get after you. In smaller towns they dont have permanent staff so will have to come specially, depending on your usual broadcast time, so switching your time is a big advantage.

The detection squads are now directed by the Home Office through the Department of Trade and Industry (DTI) and are officially responsible for stamping out "radio interference". They have recently been reorganised and upgraded with fancy new equipment. Their HQ is at Waterloo House by Waterloo Bridge and they have several other fixed triangulation stations in London, for instant tracking. We think their facilities are also connected to the GCHQ bases,and MI5. They use also mobile detection vans and lots of unmarked cars and have a depot in East London for vehicles and gear. We dont know where they keep their extensive horde of stolen transmitters prior to disposal. They also have their own radio frequencies, they used to be (and still may be) using around 86mhz, just off the commercial FM waveband.

The DTI squads are not supposed to arrest you, so they have to bring the local filth along on busts, which makes them a lot easier to spot and makes them less flexible,as they often have to wait till the cops have the time free.

For large rich commercial pirates the game is to have plenty of transmitters lined up, and not to try and save them if the police and DTI raid. They often use remote 'links' and can often switch on and off using timers or radio signals, so they dont have to go back and change tapes and no one need get caught in the act (but recently the DTI have cracked this by raiding the 'live studios' and nicking everyone and everything).

But for small community /political pirates with only one or two transmitters its essential to save the gear if at all possible. At the same time its now always cheaper to lose all the gear than to get caught and pay the fines. Nowadays even for the small pirate it may be more advisable to put energy into money raising and mass producing cheap transmitters than into trying to save the gear when they're hot on your trail (though you need to guard anyway against the curious and rip-offs by other pirates).

PRECAUTIONS

Don't talk or boast unnecessarily about your sites or studio. Work on a 'need to know' basis from the start. One method is to keep programme makers seperate from your broadcasting team..tapes can even be delivered to a 'dead letter drop' for instance. But if you can really trust each other its better if everyone takes a turn at broadcasting, otherwise the

broadcasters can both get pissed off and become a power elite ('I'm not transmitting this crap!').

Don't of course broadcast your location, real names or addresses. Don't give your phone number either, certainly in Britain, the days of phone-ins and instant access to pirates are numbered (see Legal Section). If you're really into phone-ins get a phone in a false name at a temporary address or squatted flat (NOT your studio). Tape the calls and check you're not followed there. For letters use a box number (BM boxes are best) and assume all mail is read, or use a forwarding address. When travelling to sites vary your means of transport.



THE RAID..SAVING THE GEAR



A). HIDING IT ON SITE

Some pirates have tried building the transmitter into walls, parapets, roof, chimney stacks etc. You can conceal it under water tanks, central heating or lift machinery. Better still have it hidden in a legal or squatted top floor flat (possibly 2nd to top would do) concealing your co-ax cable, either up the side of the building, by boring a hole in the roof, or by running it up ventilation or 'stink' pipes. Another variation is to have your tape player in a flat, and a long concealed din lead to the TX on the roof. The possibilities are endless, and most have been tried. On one occasion Our Radio tried the 'dummy transmitter' trick,with its own dummy aerial, leading the hounds to one end of the roof,while they left by another door. Inside the transmitter box was a can of beer and a 'Booby Prize' note. In all these cases you still need to at least remove your co-ax cable before the baddies arrive, or of course it'll lead straight to your TX.

B) LOOKOUTS

You need two,preferably three,and take it in turns, and if possible also monitor police and DTI radio channels. You can use torches or signals from ground to roof. If on CBs turn them very low or use headphones, and use codewords, they're very public. Watch out for cars or vans with too many aerials, electrical gear in the passenger seat, hanging around trying not to look suspicious, police cars passing several times, etc.Keep an eye on nearby tower blocks or anywhere they may observe the roof with field glasses. A raid is usually obvious, two or three cars with uniformed police accompanying them (though piggies may be also in an unmarked car). They usually try and rush in a side or back entrance, so watch out.. its quite embarrassing to have all your friends nicked, and you still standing out front yawning! Usually they take the lift (sometimes using a 'firemans key' to bring it down fast) and often send a few young ones up the stairs.

C) CAT AND MOUSE

This involves moving and hiding the gear, in flats, stair cupboards, lift shafts, hanging out windows, disguised as something else, etc., etc.,..Normally they have no case if they can't find it, but under the new laws they might try to do you anyway if you're caught. If your lookout system works you have at least 2 minutes warning before they reach the top of the tower block. You can delay them by switching off the power in the lift room, but if doing this be quite certain you're not trapping anyone,which is difficult. You can call the lifts immediately,and if you get them first jam the doors open. You should practice for quick dismantling and packing of the gear in advance. Sometimes its easier to leave the antenna and build a new one.

A good simple 'Cat and Mouse' is to run down several flights of stairs with the gear, hide it in a good spot (the ideal is the flat of a 'neutral' friend) and turn into 'normal' citizens. If you get stopped have a good excuse for being there.

Cat and Mouse is a good system to start off with.. But remember they have done it 1000s of times before. When they become determined to bust you you'll need more and more determined people and new broadcasting sites to stay ahead. After a certain point they're sure to catch you, as they learn more about you, your faces, your habits, your tricks, and as they put more and more men on the case. If you want to get away with it its time for a complete change of tactics.

D) DISAPPEARING

When the DTI are really on your tail one thing you can do is take a weeks rest, then come back with a different name,style and timing. Of course this fucks up totally your efforts to make a name for yourselves and gain a regular audience, but at least you're still on air, with maybe a few months grace before they start after you again. Also change your frequency and voices on tape if possible.

E) SWITCHING

In theory this is a good system, but you need a big team, your own transport, and two or three transmitters (on the exact same wavelength). The idea is this,..as the police and DTI close in on one location, the signal switches to a second site. Either you're using links, or havecopies of the programme tapes. The team at the first site evades the police and sets off for a 3rd site and sets up. If they go for the 2nd site you switch to the 3rd site and carry on,etc.

When combined with Cat and Mouse tactics this can make you difficult to stop. The problems are, if you're using tower blocks your choices are limited.. If you set up say 5 miles away your reception area may be completely different, and you'll need plenty of dedicated people ready to wait night after night to play games with the police..And when they become determined they will still get you. We know of one South London pirate, who used switching with apparent success, then one night all 3 of their transmitters were seized within 15 minutes!

Switching would work better when combined and varied with other methods of getting away with it. Particularily if you're doing a local station, where you don't need so much height, and have lots more choice of broadcasting sites.

F) GUERILLA RADIO

This is one of the main ideas this book is trying to promote (See Chapter One). Guerrilla,or Hit and Run radio is the war of the flea. First of all you can reduce the risks of getting caught drastically by broadcasting not at fixed times or with a fixed name, or by doing it only for ½ hour periods. The problem of course is that your audience is also random and small. The guerrilla idea is to get together quite a few stations,broadcasting on the same frequency with cheap mass produced transmitters, thus forming one big loose station which listeners would have a good chance of finding on air, while being very difficult for the DTI and police to stop.

BREAK-INS

Break-ins are a higher and riskier form of guerilla radio, as used in this country by Radio Arthur and Radio Wapping. The idea is to grab your audience by broadcasting on top of a legal station. The sentences are much higher (see Legal Section) but there is little chance of getting caught if you keep your break-ins short, say for five minutes, on top of the news or advertising of a major station. You're taking advantage of a quality of FM broadcasting that the stronger signal tends to 'win', blotting out the weaker one completely. With a small transmitter you'll only 'win' for a short distance, but even a few hundred yards could cover a whole high density estate. For break-ins strength of signal is the main factor, a big powerfull transmitter (100 - 200 Watts) would be ideal, and your TX needs to be built and tuned exactly to the required frequency so you can break in with your message on the most popular channel on prime time. For break-ins all precautions should be doubled, also be sure to clear right away from the area as soon as you've finished, and don't use the same time or broadcast site again. It's as simple as that.

Break-ins are also easily possible on TV, but only over the sound.

Break-ins are more common in countries where pirates have been repressed, e.g. in W. Germany or the Eastern Block, and are ideal for announcing demonstrations etc..

There is another and better way of doing break-ins on FM, which may have been used by Radio Arthur. This is to use the VVHF microwave transmitter, beaming your signal at the microwave dish recieving the signals of a legal station from their studio's. Their dish then picks up your signal, and providing you're close enough to be stronger than their signal, you get re-broadcast by their main transmitter, thus giving your break-in perfect coverage throughout their reception area.

However, we don't have technical plans to build such tricky VVHF transmitters, and it would be quite expensive. Though this type of break-in is possible at present. (To stop you fast, they'd have to switch off the entire station). They will probably make it more difficult by using access codes to receiver dishes, as is already done to avoid piracy of satellite dishes. (Note: Don't play around with microwaves, they can be dangerous). See also Radio Arthur, Radio Wapping.

GOING MOBILE

In theory this is an ideal way of getting away with it, but there are quite a few problems. If you' re going in a vehicle you can use an ordinary car cassette player, but you are better off having a separate 12 Volt car battery to power the transmitter. One problem is with the aerial. If you use a bigger, more efficient one it will be very obvious, one possibility is to have it under a tarpaulin tarpaulin on a roof rack. A bigger problem is height, unless you can park or drive up and down on a high hill, your coverage will be badly blocked. And then of course your reception area will vary radically if you're driving any distance, Not much use for gaining or developing an audience. The main advantage is that you will be much more d difficult to stop.

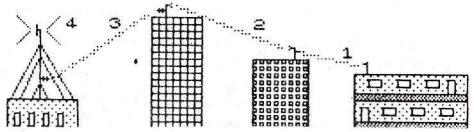
Going mobile is more practical as a publicity stunt, or possibly for local broadcasts. To a small extent, having a bigger TX will compensate for lack of height. Going mobile is good for broadcasting at random just for the hell of it.

Doing break-ins in this way would be great fun in the rush hour traffic.

LINKS, TIMERS, SQUARE WAVES.

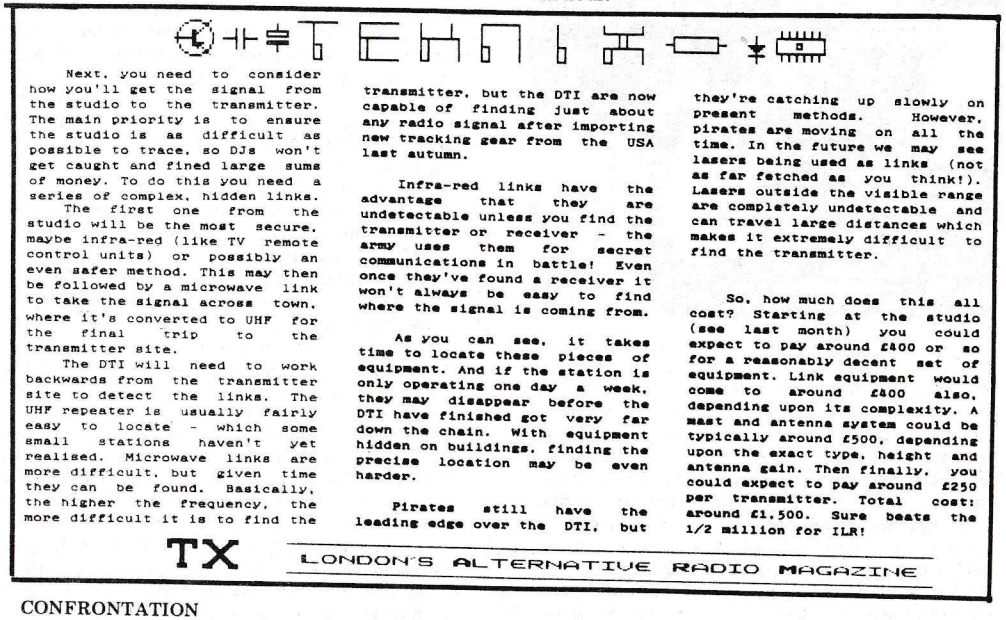
These aren't for the shoestring pirate, though you can build them cheap if you have the know-how. As we said earlier links often prevent you being busted personally, if you can afford to lose the gear, and allow you to do live progammes. All it involves is

1 INFRA RED LINK FROM STUDIO
2 MICROWAVE LINK
3 UHF LINK
4 UHF BROADCAST SIGNAL



using a receiver instead of a cassette deck, then beaming up your signal from your studio,or wherever, using a small UHF transmitter (eg on 370 mhz) or

adapted cordless telephone, or an FM exciter on a different frequency (or even over an ordinary phone line,though sound quality suffers). You also have to make a small directional high gain antenna. If you're using a low power link and a narrow beam its nigh impossible for the DTI to trace you,and it was assumed it was safe to link from the studio. But recently studios using links have been raided,in a few cases, with every bit of equipment, furniture, record collections etc etc seized under the 1984 laws (eg.a raid on Radio Horizon's studios in late 85 when over £20,000 worth of gear was 'stolen' legally. This may not however mean that the DTI's new gear can detect links. Its just as easy to find your location by gossip, phone taps or just by following you. Links can make you personally safe, if they can trace one you could always use two, or three...what they don't and can't do is protect your transmitter, its main advantage is that it allows you to go live from the studio. To protect yourself you might as well use a timer,to switch the gear off and on remotely. Timers are pretty easy to build, and you can buy kits, but good ones are hard to find 'off the shelf' as they can obviously be used to make bombs. A good one to buy is the plug in variety, used for fooling burglars when you're on holidays, or by landlords to deter squatters. For remote switching you can also make sound activated switches, via a radio link, or 'square wave' switches, via a phone line (see diagram in Tech Sect).. What none of these devices can do however is to turn over a tape, so you still have to go to the site to do this, unless you want to broadcast for less than an hour.



Next, you need to consider how you'll get the signal from the studio to the transmitter. The main priority is to ensure the studio is as difficult as possible to trace, so DJs won't get caught and fined large sums of money. To do this you need a series of complex, hidden links.

The first one from the studio will be the most secure, maybe infra-red (like TV remote control units) or possibly an even safer method. This may then be followed by a microwave link to take the signal across town, where it's converted to UHF for the final trip to the transmitter site.

The DTI will need to work backwards from the transmitter site to detect the links. The UHF repeater is usually fairly easy to locate - which some small stations haven't yet realised. Microwave links are more difficult, but given time they can be found. Basically, the higher the frequency, the more difficult it is to find the transmitter, but the DTI are now capable of finding just about any radio signal after importing new tracking gear from the USA last autumn.

Infra-red links have the advantage that they are undetectable unless you find the transmitter or receiver - the army uses them for secret communications in battle! Even once they've found a receiver it won't always be easy to find where the signal is coming from.

As you can see, it takes time to locate these pieces of equipment. And if the station is only operating one day a week, they may disappear before the DTI have finished got very far down the chain. With equipment hidden on buildings, finding the precise location may be even harder.

Pirates still have the leading edge over the DTI, but they're catching up slowly on present methods. However, pirates are moving on all the time. In the future we may see lasers being used as links (not as far fetched as you think!). Lasers outside the visible range are completely undetectable and can travel large distances which makes it extremely difficult to find the transmitter.

So, how much does this all cost? Starting at the studio (see last month) you could expect to pay around £400 or so for a reasonably decent set of equipment. Link equipment would come to around £400 also, depending upon its complexity. A mast and antenna system could be typically around £500, depending upon the exact type, height and antenna gain. Then finally, you could expect to pay around £250 per transmitter. Total cost: around £1,500. Sure beats the 1/2 million for ILR!

TX LONDON'S ALTERNATIVE RADIO MAGAZINE

CONFRONTATION

A good trick if you can get away with it. The DTI and police (they normally only bring a few) are wide open to attack (the mouse becomes the cat!) when coming to get you. The problem is that in future you'll have to change your station name, frequency, even your radio voice and they'll always be on your trail. The good thing is that if pirates start attacking them they have to bring many more police with them, and can only do it when spare police are available. Also they are always looking over their shoulders, and have to be more careful with their surveillance work.

One easy way to hit back, on tower blocks, is to trap them in the lifts. The lookout signals up when they're in and you throw the main power switches in the lift room. (Careful you don't trap residents as well). Then you take your gear down the the stairs, beating up any of them you meet on the way, and make off. Their cars are also vulnerable, usually they're parked unguarded around the corner. If you're going to attack them directly make sure you're well masked and tooled up and have enough skill and numbers to get past them. Go straight for the police officers and disable them before they can make their 'officer in distress' call (take or smash their radios, or have someone jamming their frequencies).

Other direct ways of hitting back are, attacking the DTI at their bases, attacking their vehicles at their depot, obtaining home addresses/phone numbers of chief officers and harassing them, etc.etc..

Remember, they have the entire state apparatus backing them up, any form of direct attack should therefore be anonymous and never spoken of or boasted about later. or before hahahahahahahah:

When the lookout signals a raid or anything very suspicious (e.g. a cop car cruising too close too often) immediatelly switch off, dismantle the gear and move it (switch off the TX first, then the tapedeck.DON'T rip out the aerial when the TX is still switched on!).

Building Your Pirate Station.

We're not talking here about commercial pirates, where its just a matter of having good financial backing,popular D.J.'s and hit records, plenty of ads,jingles and news replayed from legal stations.

We're talking about the 'do it yourself' community or political pirate, starting from square one, and doing something worthwhile and original. The truth is that most commercial pirates, in their effort to offend nobody and build towards a possible licence, practice heavy self censorship and are often as boring,banal,repetitive,capitalist,sexist elitist and even as anti-democratic as the legal ones, though there are a few exceptions.. Such pirates are obsessed with keeping their technology secret and attacking the 'competition at every opportunity.

Smaller,non-commercial pirates are in a different situation,and can only survive and develop by co-operation,with the eventual aim of breaking the state and commercial monopoly of 'Her Majesty's ' airwaves.

YOURSELF.

First thing you need is an interest in sound, and something worth saying or playing. Get a hold of a mike and a cassette deck and play around with it. Record yourself, record any and everything. Listen and record off the radio, off TV, off people's stereos, in the street. Play back your results, see where you went wrong, and try again. Note down your results and ideas and discuss them with others. Read and find out everything you can about sound and recording and think about why you want to be a radio pirate. Join the Free The Airwaves campaign and read their 'Radio Crimes" bulletins

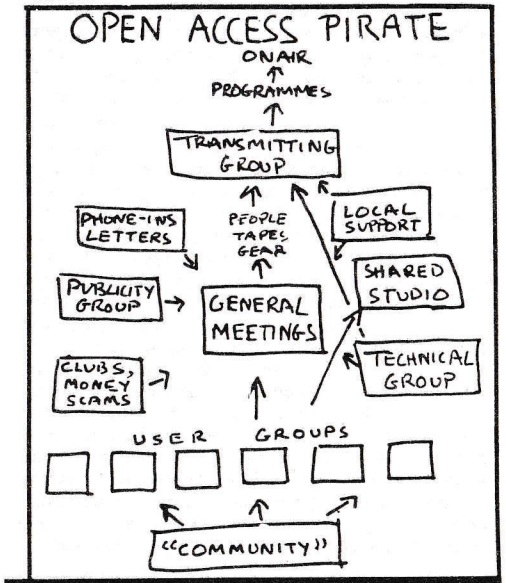
THE GROUP

You need to find more people with similar ideas, and not just 'hangers on'. You need to get to know each other well,find out who you can trust, and ditch those you can't! Members should be prepared to share in the tasks, risks and finances equally,according to their abilities (in practice this rarely happens). Hold regular meetings, just keeping in touch can be a problem in big cities. Go for the maximum openness,so everyone knows whats going on. Beware of the power freaks, ego trippers, party builders etc., who are sure to turn up sooner or later.

A good point to start is with fund raising, organising gigs, jumble sales, meetings, sponsored events or whatever, which can cement your group, attract more people, and advertise your station. How you do it depends a lot on the type of project you're doing. If for example you're planning a minority language station (and there's millions in Britain who have no radio in their first language) you'll want to advertise widely through ethnic organisations. If you're a 'revolutionary' group planning to claim responsibility for armed actions you wont want to advertise at all. Minority music stations are the most common. But we'd advise you to widen and deepen your group, or join with others, if you're going to build and maintain the committment (and cash) to keep a station going. Many music stations get backing from clubs, and are the platform for the disgustingly egotistical and inane DJ's who work in those clubs. Such solid backing is a good idea however. If you're running a station you'll be hard pushed to fund raise as well. If you see your station as part of a wider movement (eg. anti-war, womens, gay, anarchist, animal rights,etc) you should try to get regular backing from that movement. Another good trick is to siphon off small amounts of cash regularily from council, charity or student union funded bodies which your members are involved in. What you need is income, not a lot,even £20 a week would do if regular. If some of your members have good jobs they might be able to do it, otherwise you could be tied in with a money making co-op or small business. One example of this is the squatters pirates in Amsterdam, who can get a small regular income from a fund raised by a small tax on drink in squatted pubs and cafes.

OPEN ACCESS

Once your group is going well, and you've started to make tapes and get the gear and cash



together, you should think seriously about teaming up with other groups who you broadly agree with (or dont disagree). For example at the moment (late 1986) there are dozens of such groups who have failed to get Community Radio licences and are dying to get their stuff on air, though afraid to 'go pirate' in the present hostile climate.

The idea of 'Open Access' is to share a frequency, studios and even transmitting gear to start with, with different groups. The advantages are obvious..more money coming in from more sources, less equipment needed to begin with,a pooling of technical abilities,, more political clout, more participation, bigger audiences etc. A good way to approach this idea is by having public meetings, contact Free The Airwaves Campaign, etc.

The problems come with coordination, political rivalry,possible infiltration and the sharing of tasks. For an Open Access grouping you need regular democratic meetings of all involved (at least monthly) and insist on full attendance. You need a few good people who are into organising it and making it work. Another problem is with broadcasting .You should aim for everyone having their own gear and broadcast team as soon as you can, so you will be more difficult to stop by the police and DTI. So you should insist on every group producing tapes providing at least two trusted people regularily both to the broadcast team and to work on the technical and backup side of it (building, repairing, purchasing etc.).

Open Access stations depend on cooperation, if you have that then all the other advantages come into play, but you are fighting all the time against our training, in this society, to be competitive and individualist. The ideas of Open Access radio have been pioneered in this country by stations like Sheffield Peace Radio, Our Radio and Cambridge Community Radio and its worth studying their experience quite closely, as well as the example of such stations and Federations of pirates in other countries. (See elsewhere in this book). Its often fatal to allow one person,however benevolent they may seem, to become a leader or spokesperson for an Open Access grouping. The straight media also love this to happen.

LOCAL / "COMMUNITY" PIRATE RADIO

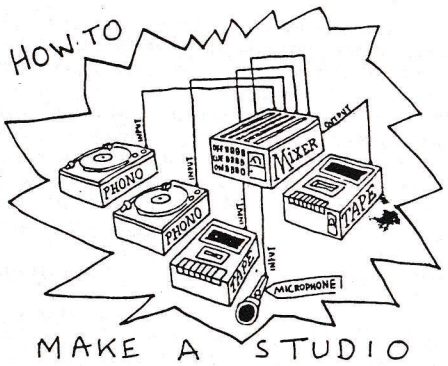
The word 'community' has lost any real meaning, through misuse and over-use (eg 'Community Policing'). The old style communities are a thing of the past (if they ever really existed) except on the Soap Operas, as the system breaks us all down into individual consumers. So if you're talking about "Community Radio" you should be quite clear what you mean by it, and what the State means by proposing (and then cancelling) such an idea. What class, ethnic, interest, political or gender sections of the people are you aiming your pirate at? Or better, creating your pirate with? Or are you really working on your own career? Or trying to create 'community' in your own head?.....

Local pirate radio is a more clear idea. There are many advantages to broadcasting locally, eg. more broadcast sites, harder to get caught, room for more pirates on the broadcast band, cheaper easier to build transmitters, closer contact and participation of listeners,etc. In a big city its a good idea for your station to base yourselves in one area, whether you're broadcasting locally or citywide.You need a local base, and local backing,financial if possible. If your station is appealing to one small section of listeners it may not however make sense to do a local station, because the potential listeners are fewer a local station should aim at a fairly wide section of the population. An open access station would work well on a local basis,as coordination would be easier, and all kinds of interest and minority groups could be persuaded to make programmes. On a local basis publicity and support are much easier to get, as is the possibility of mobilising people to defend you when attacked..eg. a popular station in the middle of a large housing estate. Local broadcasting in inner city areas can nevertheless involve hundreds of thousands of potential listeners. Most of the smaller existing pirates are, in effect, local stations, because of the limitations of height and the power of their transmitters, though very few allow any access or see themselves as a local voice and resource.



HOW TO MAKE A STUDIO

Back to square one, you've fooled around with tapes and microphones, but soon you're going to want your own studio. If you have no cash don't let that stop you! Most of the gear can be borrowed to start off with. For beginners purposes a studio is a small room, a couple of turntables and cassette decks, a microphone,headphones, a small disco mixer, a plug board, leads, some records and a table to put it all on. You'll also need some blank cassette tapes, and sound effects records if you can, (borrow from a record library).



After that its just practice and patience, knowing and collecting your material, and getting more or better sound gear as you go along.

Having said that there's plenty of tips we can give you. A permanent room is handy. Sound proof it if you can, cardboard, layers of carpet,egg boxes or styrofoam are all good. Try to plan it out before you start so as to have everything withing reach of the operator(s), while having enough room for the interviews and group work (See Diagram example). If you build your own control desk you can drill holes and arrange for all the leads to disappear and join up underneath, much less hassle. If you're buying cassette decks try to get something also suitable for outdoor work. Try it out before buying, eg don't get one which leaves a loud click on the recording whenever you lift the 'pause' button. Quality and editing are better if you record your final product from the mixer onto a reel to reel tape recorder, though that means re-recording onto cassettes for broadcasting, and a good cassette deck can give near as good results and is cheaper. If buying a microphone its worth getting a good directional one suitable for studio and outdoor interviews, and make sure the 'impedence' suits your mixer. A 'cheap' £50 disco mixer will do the job (you can even mix through some stereo units). If you have the cash go for the flashy new £150 range with built-in graphic equaliser with which you can do wonders. Another tip, keep mike leads, din leads and power leads well seperate from each other and make sure everything is well earthed (from the chassis if necessary). If you also have 'hum' problems with cassette decks try plugging in the power lead the other way round! (ie where it goes into the deck). Use cheap turntables, not automatics, and buy ones which use cheap cartridges, as you'll have to replace them often anyway. Use good quality cassette tapes however (TDK's are just about okay). C120s are best for length of programme, but get the best or they'll tear or jam. On the turntables put in your own on-off 'cue' switches, for ease of operation. When you've 'cued' a record to where you want to start, turn it a full turn back, by hand, to avoid 'slow start up noise. Try and have an LED meter on the mixer and on the final tape recorder, allow the needle to go just into the red for music recording, but only half way up for speech recording. For group interviews an omni-directional mike can be handy, and pay special attention to sound recording levels and background noise. Don't use a telephone in the studio. Though the phone is the lifeline of democratic radio, in the present climate it means you'll be busted and/or have everything in the room recorded by the police.. You really do need two turntables, and at least two cassette decks..All these tips, and more you'll pick up as you go along, but its good to work out a standard 'how to use the studio' lesson for newcomers. Pay attention to safety, eg have the plugboard (fused) well out of the way, and don't allow coffee or beer near the gear. Read a book on basic sound studios.

One last tip, lock it up well, especially if its not in your own home. and barricade and cover any windows. There's one sure thing about accumulating sound gear..sooner or later someone'll nick it!

THE PROGRAMME.....

This entirely up to yourself. No need to follow any conventions. Some people say you have to 'master' conventional programming before you can do something different. Other say if you do that you'll never do anything different.

Again there are some hard learned tips for pirates. Its good to talk with all concerned before starting, make a list of all the possible material gathered,(music, interviews, sound effects, news items, jokes, or whatever) and try to put it into some kind of order. A signature tune or jingle isn't such a bad idea, as people recognise the programme by it,often after they've forgotten the name. Repeat the name of your programme often, but not too often, along with your frequency and broadcast time. Put your important items first (eg a demo next day,your appeal,etc) as its always possible you may be busted before the programme ends. If you're expecting a bust put all your best material first and keep the programme short. Use first names (false ones) and try to have a friendly, relaxed atmosphere and give everyone present a go on the microphone and control desk.



While throwing out conventions don't forget that we're all conditioned to quick variety and short attention spans. Long single person interviews are not on, no matter how interesting, but need breaking up, also remember people are continually tuning in (and

out) and if doing long pieces you need to 'flash back' the story so far. You need variety and interaction, without sticking in jingles every 30 seconds. Try and make it interesting/enjoyable/entertaining both for you and the audience, otherwise why bother?

Style and themes are your department. Its easy on radio to get arrogantly carried away with an idea of your own ego, or with 'in' jokes or political hobby horse, watch out for this. Practice with using the gear, good preparation and research make everything go much more smoothly. Background music and fading music in and out can be very effective if done well. A large studio, tea breaks etc., help a lot. The more time you put in the better the result (usually), you can spend a whole night making a good one hour current affairs programme, for instance.

More than that its hard to say, so much depends on the people, the subject, the projected audience, the time of broadcast etc,.You should actively go out and seek feedback and opinions from people you know have listened. Probably you wont be able to do phone ins and mail is slow and erratic (dont worry if you dont get a big postbag,few stations or programmes really do). Its easy to become cut off and feel like you're talking into a vacuum, or get a completely wrong idea of what kind of people are listening.

Making programmes is really not that hard, however bad and inexperienced you are, you can quite easily improve on some of the 'aural shit' being pumped out by legal stations over the airwaves, 24 hours per day!

PUBLICITY

Publicity is very important, especially when you're starting off your new station. Of course your main publicity is to keep coming back on air, no matter what. But if you're hoping for a minority audience to tune in specially you need to advertise a lot where those people are likely to see or read it. Be warned, there's no real tradition in this country for large scale support for pirates, and people often tend to consume the media ie forget instantly they switch off. It could take you a long time to build up the regular, participating audience, and the solid support you need to attract new blood, break even financially etc.

If you're a local station your publicity is obviously a lot easier, and you can poster, graffiti or even leaflet your entire reception area. If you're a wider station make sure you're always mentioned in the 'whats on' papers and get articles or interviews into any paper likely to support you. Send out regular press releases to the local and national press, and try to cultivate contacts among the slimy reptiles (journalists). Almost any publicity is good, as those people likely to listen in to you will also likely read behind the bias of the Tory press. Oddly, one place you should certainly seek publicity is on radio, try for instance getting onto phone ins, . On radio you are already talking to people who listen to it! TV, if you can find any way or stunt to get onto it, is the most powerful publicity and you should certainly court the bastards running the local TV news, this kind of appearance really does stick in peoples minds and start them talking.. Strangely enough the media are not overly hostile to pirates, providing you're just an oddity, not a direct threat. Many media workers hate the shit they're forced to produce and admire the 'romantic' pirates. You should play on this for all its worth, and always try and get your frequency and broadcast times across. They will sometimes put you on, as an interesting item. Remember that pirate radio is a 'victimless' crime!

If you're a mainly music station you should publicise where people listen to that type of music, if you have your own club,of course, you're laughing. Join Free The Airwaves and get publicity in their paper. Write articles for radio papers, and do benefit gigs, public meetings, media stunts, whatever you can manage. Choose a catchy, hard hitting name for your station. If you're doing political stuff they're going to go for you anyway, so you might as well get value for effort!

Remember, if you want to be a participatory station, you'll have to go out and seek feedback. Get out on the street and do interviews wherever you can. Take along your cassette recorder to every type of event, the more different voices and views the better.

BUILDING UP YOUR PIRATE STATION

Its hard to give advice about longer term development, but there's a few things worth saying. First of all its important to pace yourselves. Its easy to start off with a lot of enthusiasm, then get busted off the air, or just burnt out with too much work or too few people. However good or different you are you will be very lucky to build up a regular audience or mass support overnight. Though your potential no. of listeners may be huge you can expect response to be slow. Breaking down passive consumption of the media is not easy. Having your own clubs, events, regular demos etc helps, as do dramatic publicity stunts. You need to work out what you're aiming at. We say support, participation and a large number of listeners is a good aim. But you may just be broadcasting as a way of pressuring for a licence (which is a bit of a sellout and a pipedream). Ideally you should plan ahead and gradually increase your broadcasting times, while developing all aspects of your station, rather than going all out and then collapsing at the first 'bust'. The best advice then is to operate well within your capabilities, and to join up with any other pirates who are not commercial and not racist, sexist or fascist. Your longer term aim, as a pirate, should be to reach a situation where you have so much support (money, volunteers, transmitters, listener support etc.,) that the state just cannot wipe you out at will. The best hope for pirates is to swamp the forces of repression by sheer numbers, as happened, at different times, in Belgium, the Netherlands, France, Italy, and now, it seems, in Spain. This does not imply chaos, but cooperation.

federations and sharing of the available airwaves and times. This swamping the airwaves is NOT going to be caused by the commercial pirates, hogging, hiding and mystifying the technology and even sabotaging each other. However if we do manage to start a non-commercial movement of pirates capable of doing this then commercial pirates will jump onto the airwaves, with more power, and try to force us off. This would be a major problem .(See International Section,especially Italy.)

It is a mistake and an excuse to blame the Tories and the new draconian laws for the lack of alternative pirates in Britain. The main thing stopping us is the lack of any strong combatative movement (whether it be workers, womens, anarchist, or whatever) in which to build a big wave of new pirates, though there are literally millions of sympathetic people about.

Medium Wave

Advantages and Problems.

At the moment FM bradcasting,with all its advantages, is the favourite for pirates. But its well worth pointing out that at least 25% of radio receivers in Britain can't even receive FM, so you can't pick up most pirates on older radios. Another thing, in some hilly areas FM broadcasts have a very bad coverage area. And a third advantage, you can cover a very much bigger area on MW, at least potentially. MW can be the best choice for you, especially if you're in a country area, or in hills or mountains, or only want to broadcast by day and aren't too worried about sound quality. MW transmitters are also fairly cheap and easy to build, and because you use a crystal there's no problem with tuning or with 'sprogs' (harmonics). Though the antenna is a huge length its just a roll of wire, and doesn't necessarily have to be up high,which gives you a quite different, if still limited, range of possible broadcasting sites. MW works by bouncing radio waves back off the stratosphere, not by line of sight like FM.

Of course there's lots of other disadvantages, one is sound quality, and stereo is out of the question, and there's not much free space on the wave band, chiefly because of a host of European stations, which become stronger at night, blotting out your relatively weak signal (this is due to atmospheric changes we are told). The TX is also bigger and heavier (about 12"X8"X6") and you'll probably need to use car batteries.

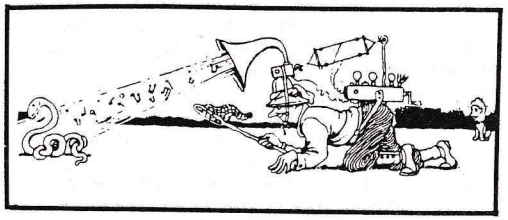
One thing I forgot, if you want to reach any of the 50,000 prisoners in Brit jails,you must use MW, FM is still banned in prison, for some typically petty reason.

It is also agreed that you're generally less likely to get busted. In the present repressive climate thats well worth considering.

HOW TO BROADCAST ON MW (540 - 1600 Khz).

YOUR TRANSMITTER.

Enough general talk. So you want to broadcast on MW. So here's how to do it. First, your transmitter. Medium Wave transmitters aren't so hard to build, any good amateur radio buff could do it, and there's people around who will build them (reckon to spend £100 to £150). The technology is tried and tested and our design (see Tech Section) is as good as any. The TX is valve operated and you use a crystal (which you have to order on the chosen wave length) which keeps you on frequency without the problems of FM. So you have to decide from the start which frequency you're going for and stick to it, or buy a new crystal. When choosing your frequency remember that it must be divisible by 9..MW frequencies are seperated by 9 Khz by international treaty. If your signal doesn't conform you'll probably have your signal ruined by a horrible whistle, and certainly have the DTI and police down on you faster. If you have problems getting a MW transmitter you may be able to buy a kit (See Contacts) or adapt an amateur radio transmitter.



ADAPTING A MW TRANSMITTER

I'm not exactly an expert on this and the following info comes from the US. Apparently you can easily buy second hand radio ham transmitters and adapt them. The best to go for is the Viking Valiant (200watt) or the Viking Ranger (75watt), both made by Johnson & Co. These ham radios are well built, have excellent audio, and moreover have built in VFO's (variable frequency oscillators) which make them simple to modify to work on the top end of the AM band. All you need to do to the RF (radio frequency) circuits is to add capacitance to the 160 meter tuned circuits. And all you must do to the audio circuits is to bypass the first pre-amp (assuming you're using a line level instead of a mike level. One other thing, you must bypass the speech frequency filter, which is located between the 2nd pre-amp and the driver.

When buying such a 2nd hand ham transmitter a) get one with 160 meter capability. b) Don't pay more than £100 for one. c) make sure it has plate modulation (look inside and check there are two transformers well seperated from each other), and e) don't get a 'kit built' one with dodgy wiring and if possible check the valves before buying, they're costly.

SETTING UP YOUR AERIAL (Medium Wave).

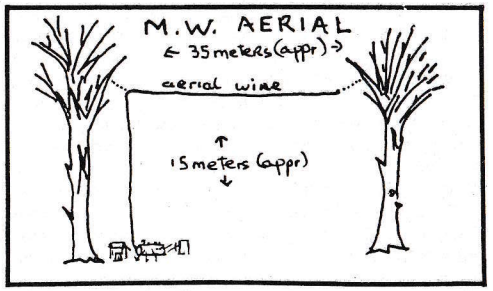
Security precautions and preparation are the same as for FM. But there the similarity ends. For a start your total aerial length is ¼ your wavelength, so if your wavelength was 200 meters, for instance, your aerial would be 50 meters long! You use ordinary thin single strand wire. Buy a roll, keep it on the roll and measure it out, metre by metre. Ideally the aerial would point straight up, but thats just not feasible, unless you hang it out from the side of a tower block or a steeple, or suspend it from a balloon (only the balloon blows away). The mormal method is the 'dogleg' which works just fine (See Diagram). The ideal site is a field, or deserted common land, far away from houses, with two tall trees (only 2 if possible,poplars are best) about 30 to 40 metres apart. Now string the 'dogleg' between the trees and down to your TX without touching branches or leaves. Sounds impossible? If you have a trained monkey thats just fine. Otherwise try our method. Practice and patience is necessary.

Bring along with you a catapult, a long reel of 70 lb strength fishing line, and plenty of lead fishing weights (not too heavy for the catapult). Also some small plastic rings (cut out lids of plastic containers work fine).

SAMPLE CHECKLIST. Things to bring along when broadcasting on Medium Wave outdoors.

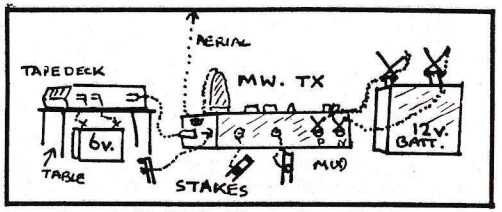
Transmitter. TX battery leads. Cassette Deck. and battery leads. Din lead from Cassette to TX. 12 volt and 6 volt batteries (charged). Earth leads and stakes. Aerial wire. 70lb fishing line and weights. Catapult. Plastic rings. Disguise gear (eg kite,fishing rods). Screwdriver & pliers. Soldering iron & solder with 12v transformer (if possible). Programme cassettes. CB's or torches or whistles. Plastic sheet or large umbrellas (for gear in rain). Fieldglasses. Food and drink. Radio receivers. Waterproofs (warm). Possibly a tent.

Tie one end of the fishing line to a lead weight, leaving the line coiled neatly and loosely on a piece of bare ground. Then fire the lead weight from the catapult right over the centre of a tree! Go and search for it (don't try this at night). Tie on your plastic ring in place of the weight and pass about 30 metre of your aerial wire through the ring. Now get your mate to pull in the other end of the fishing line, if it doesn't get tangled pull it till the ring is about 5 metres from the tree top. Tie the fishing line securely (to the tree), cut it, and head for the second tree. Repeat the performance, firing right over the tree from the far side. Pull the aerial end through, and this time tie it to the ring. Pull up as before to about 5m from the top and tie the line. Now back to the roll of aerial wire (extended with fishing line as necc.) and start pulling it in till its suspended without touching the trees! Its hard to get it just right so the aerial reaches your X and is tight, adjust fishing line lengths and/or position of TX. Better choose two trees too far apart than too close. When you finally get it all set its hardly worth taking it down again after the broadcast, though you should loosen it off or it'll snap in the wind.Disguise it if possible. A further problem can be with kids and passers by, disguise your actions, bringing along fishing rods or a kite is a good ploy. One of the best broadcast sites is a clearing in a large wood. On Medium Wave remember, you can go right outside the city and still cover it and lots more besides.



SETTING UP THE GEAR (Medium Wave).

See the Diagram. The transmitter should be on wet ground. If its dry, wet it. Mud is good stuff. The aerial wire should be taut all the way. Bushes are an advantage, for concealment, but don't let any touch the aerial. You power supply is a 12 volt car battery. Bring two, well charged up, if you're broadcasting for more than a few hours, Medium wave uses lots of power. If your TX is on mains (240vAC) you'll have to get it adapted using a 'rotary invertor', its not difficult. A lorry battery is the real thing, but what a drag to carry!If there's a chance to go on mains, by running a line from somewhere, you should go for it. Otherwise wear old clothes and gloves against acid spills. When choosing your site balance the need for



remoteness with the problems of moving the gear.

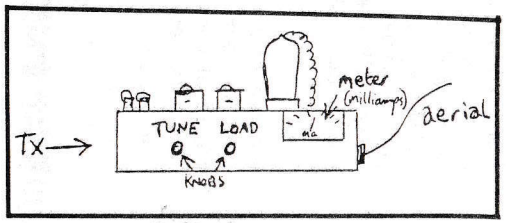
The Transmitter must be very well earthed, the earth is an essential part of the aerial system. Use a ring of metal stakes (eg tent stakes) and file off any rust or dirt for good connections. Attach the stakes securely to the chassis of your TX, with thick metal straps or wires held by butterfly nuts or strong clean battery clips.

So far so good. The cassette player, on the contrary, should be off the ground, on a box or whatever. As usual keep the din lead, battery leads, and aerial wire as far apart from each other as possible. The cassette player is normally powered by a 6 volt motor bike battery, with suitable leads. Torch batteries are dear and have a pathetic lifespan.

SWITCHING ON

Connect up your batteries, load up your cassette player with a 'trial tape' and you're ready to go. (See Diagram B):

1) Turn tuning adjuster to the right till the meter gives the lowest reading.
2) Turn 'load' adjuster till meter rises about 50 milliamps.
3) Tune again till it drops about 25 Ma.
4) Load up again as above.
5) Carry on procedure till you get a load of about 150Ma on a 20 watt transmitter, or 100Ma on a 10 watt rig. Your last tuning adjustment should produce virtually no dip on the meter needle.
6) Adjust modulation in relation to other channels to get your best sound. Use a radio receiver held at least 50 yards away for testing.
7) If there is crackling, knocking or bad sound, repeat from the beginning. Check that your stakes are in well to damp ground, that all lines are well separated, that aerial isn't touching trees, hold receiver further away, etc.



If you've done all the above you should be broadcasting loud and clear. If your signal is still wretched, chances are your crystal is burnt out, or something is blown. Then go home.

If all is well, switch off and await the time your programme is due to start. Don't detach aerial wire with the TX still turned on.

PACKING UP

When you're finished switch off immediately. Then disconnect everything and pack into holdalls or large plastic bag. Be especially careful carrying the TX with its delicate valves. You should have several sites, and switch as often as you can. Don't re-use a site after an attempted bust. If you have a good dry safe stash and are coming back best leave your transmitter,cassette deck and leads there, and just take the batteries back for recharging. Such a stash should be in cover, be quite sure a hidden watcher or bod with binoculars couldn't spot you stashing the gear. Its likely that the DTI will send in men to sneak up and watch you, prior to planning a bust, so be careful, even when not on air, don't relax till safely home.

WHEN ON AIR. PRECAUTIONS. (Medium Wave).

Read the FM chapter 'How To Get Away With It'. A lot of those precautions also apply.

At a MW site your chances should be much better, you need one person just to stay near the TX, in case of kids, passers -by etc., and to grab or hide it fast when they get the danger signal. On many sites you can work out lookout points to give plenty of warning. However you might as well abandon the batteries, and certainly the aerial, if you have to run far. If you have transport or good escape routes you can try a clean getaway, but a safer method is to hide the gear well (not too close to the aerial if its left up) and beat it. We favour bunkers, holes pre-dug and lined with waterproofs, under rocks, with heavy lids covered with earth and bushes. In theory they could find these with dogs or metal detectors, but we've never heard of them succeeding or even trying. (You could always bury bits of metal all over the place). The possibilities are unlimited, if you're on the ball there's no reason they should get the gear...and without that they have a lousy case against you.

BUSTS...IF ALL GOES WRONG

You're nicked. (See Legal Section).What you say to them depends on the circumstances. If they haven't got you, deny it point blank, give them your cover story and a verifiable address, and stick to your story no matter what. The problem with this is if they have nicked others and they give different stories, a different name for you etc. Best discuss all this beforehand. If caught on the hop, best say you don't know any of the others. You're caught in the act or with the gear. Give them a verifiable name and address and refuse to discuss the matter further. No matter what. People have managed to get off in the past, even with the gear in their hands, but under the new laws this is unlikely.

Although they can arrest and charge you, illegal broadcasting is still normally treated as a "summons offence". Which means they question you, let you go (eventually), then summons you by letter to appear in court. This opens possibilities of getting away with it — you may be able to bullshit them with a false name etc. (though they can now hold you on suspicion of doing this for three days). They will normally 'ask to accompany you to the station', or if they've raided your flat may interrogate you there and then. If you refuse to go to the station they will arrest you (for obstruction, insulting words, suspicion of stealing electric etc. etc.) and take you there, where you can be interviewed by police and DTI. The 'pretext charge' is often dropped later. When interviewed in the station it's better really to refuse to say anything, especially if there are several of you, coverstories ususlly fall apart under long and detailed questioning. However silence usually means they will hold you longer. If they get you to the station they are pretty certain to photograph

and fingerprint you. You can't refuse under the new Police Bill.

When nicked your best bet is to remain calm. Demand to ring your solicitor. Don't panic, it's not the end of the world. Smile at the bastards. Have a good kip in the cell - you've done your best.

FIGHTING YOUR CASE. (See Legal Section).

It's usually months before your summons arrives, if they decide they have a case. Get legal aid if at all possible, and a good solicitor who knows the,by now, pretty complex legal situation. Plead NOT GUILTY, but beware if you have money, they may award costs against you if you lose.Get your Bust Fund together, with gigs,jumble,radio appeals,donations all round etc. It's good to campaign about your bust on the air if your station is still going. Most commercial (read 'conservative') pirates don't do this,carrying their bid for respectability so far as to ignore their own best weapon. Make sure the address you gave when arrested is 'clean' they could possibly raid you to look for further evidence. If you're a political station watch out for suspicious break-ins where nothing is stolen,the Branch often do this.

Get your story straight, get any witnesses to write out their statements together,make copies and give them to your solicitor. Don't trust your solicitor too far, they sometimes say 'plead guilty' just to save themselves trouble, if he/she starts getting cold feet get yourself a new one (they don't like this at all but it can be done). Get your solicitor to ask for copies of the prosecutions witness statements in advance of the case and make sure you see them. In court dress neatly and be polite to the bastard (magistrate) and the filth. Have a good 'hard luck' story for your solicitor to tell, its always good to say you're just getting married/starting a new job,etc but don't say you have money or the fines will be bumped up higher. If you're going to 'bend the truth' a little don't tell your solicitor you're doing it, and be sure friends watching in court don't start laughing! The DTI and police will lie anyway,more likely than not, get your witnesses to focus on these lies and your solicitor to cross question them closely, especially any police witnesses,who are more stupid and inexperienced in this kind of case. Demonstrations outside the court are good for publicity and can intimidate the magistrate if big enough, but don't always help your case (eg. if you're pleading 'dumb bystander' how come all these people are so concerned about you?) If you want press, send out Press Releases at least a week in advance, so the hacks can put it in their diaries, and phone round with reminders the day before.

Your fine should be paid by the Bust Fund if at all possible. If not extra costs should be divided up among everyone in the station (always plead poverty and ask for time to pay).

When you've been busted once you shouldn't, ideally, work on the broadcasting end again, though you could still do lookout,backup, monitoring etc., as second offenders normally get the maximum fine.

If you win the case, as quite often happens, have a good party!

If you win there is also some possibliity, in theory of claiming the gear back, though this is much less likely under the new laws. Ask your solicitor about it, and if there's a chance get someone else, with some kind of receipt, to apply for it,saying they'd bought it before the bust.



Radio Support Group

To join Radio Support Group and get updates and development aid write to:
Radio Support Group, c/o Drowned Rat Communications,
Box 010, 27 Stokes Croft,
Bristol, Avon BS1 3PY

Free The Airwaves

BCM Box 1502, London WC1N 3XX

Radio Crimes is the name of the FTA bulletin, and will carry full technical updates on these designs, and much more. To join FTA and receive the bulletin send £2 (for organisations £10) to the address above.

JOIN NOW

Legal Briefing

(condensed and added to from:
FREE THE AIRWAVES. June 1984

The following is a summary of the legal aspects of unlicensed broadcasting on land in the UK. The Acts of Parliament are:

Wireless Telegraphy Act 1949
Wireless Telegraphy Act 1967
Telecommunications Act 1984
which we'll refer to as 'the 49 Act', 'the 67 Act' and 'the 84 Act'. We also include info about your rights under criminal law generally, but NOT details of changes under the Police and Criminal Evidence Bill. (Not then enacted. Ed).

FREE THE AIRWAVES
BM Box 1502, London WC1N 3XX
Free The Airwaves is still going strong, as an information exchange and promotion group for radical local pirates. In this book we print their transmitter designs, up to 25W, (any queries write direct to them).
***RADIO CRIMES* is the name of the FTA Bulletin (with full technical updates), to join and receive it send £2.00 (minimum donation) £10 for organisations to the above address.**

THE OFFENCES

The main offence is under section 1.1 of the 49 Act as follows
"No person shall establish or use any station for wireless telegraphy or install or use any apparatus for wireless telegraphy except under the authority granted by the Secretary of State, and any person who establishes or uses any station for wireless telegraphy or installs or uses any apparatus for wireless telegraphy except under and in accordance with such a licence shall be guilty of an offence under this Act".

The terms 'station for wireless telegraphy' and 'apparatus for wireless telegraphy' are interpreted (s19.1) as referring to stations and apparatus for emmitting or receiving over paths which are not provided by any material substance constructed or arranged for that purpose, of electromagnetic energy of a frequency not exceeding 3 million mHz, for purposes of conveying messages, sound or visual images, or for the actuation or control of machinery or apparatus, or for purposes of radar.

So 'apparatus for wireless telegraphy' includes relay transmitters (links) and remote control devices as well as broadcast transmitters. (And also TV transmitters but possibly not infra red 'links' Ed.) The term 'station' is ambiguous and isn't interpreted more under the 49 Act. Strictly speaking a station refers to a 'place set apart and equipped for some particular purpose' and in this case should only refer to the transmitting site, and only include the studio if progs. are live, or possibly if broadcasting takes place from the same premises as the studio.

For an offence to be made out under this section it has to be shown that you have been involved in setting up or using a transmitting site, or installing or operating transmitting gear. Any of the site crew could be charged on the angle of being 'involved in establishing or using a transmitting site'. But unless programmes are live it shouldn't include people who make programmes, supply tapes or interviews, advertise or provide a mailing address. The DTI did once threaten to do advertisers for aiding and abetting but this hasn't happened. (also not till 1986. Ed)
Under the 49 Act its unlikely that you'd be prosecuted unless the transmitting gear has been tracked down or traced.....
...(but under the 84 Act you can be. Ed).. and you had to be more or less caught in the act.

Section 7 of the 67 Act (as substitude by s77 of the 84 Act) provides for the Secretary of State, for the purpose of preventing or reducing the risk of interference with wireless telegraphy, to make orders applying restrictions to wireless telegrphy apparatus of any class or description. Any of the folowing actions are subject to restriction under this section:
a) manufacture (whether or not for sale)
b) selling or offering for sale, letting or offering to let on hire or indicating one's willingness to let on hire
c) having in one's custody or control
d) importation
(its made clear that manufacture includes construction by any method or the assembly of component parts).
When such 'orders' are in force a, b, or c are offences under the 49 Act, though in the case of c (possession) the words 'without reasonable excuse' are added.
In 1984 the only order in force was for d, importation, though this appeared to apply to only CB rigs (with an inbuilt or connected microphone or microphone socket). And the penalty for importation is only confiscation (under the Customs and Excise Management Act, 1979).
(However by 1986 it seems that a, and b, have been invoked by 'orders'. According to the Feature, 'Pirates and the Law' in TX magazine, Jan 86, with the same max fine of £2,000, no prison sentence. We have no reports of any prosecutions for sale or manufacture, and as late as Oct 86 a TX rig was returned by police after being taken in a drugs raid, with the advice..'You'd better not use that'. Ed).

THE PENALTIES

49 Act (Section1.1) The main offence of unlicensed broadcasting. Its a summary conviction (ie magistrates court) and the maximum penalty is 3 months in prison or a fine of up to £2,000 or both. In practice present penalties (1986) range from £200 to £1000 for a first offence. It depends where you are (in Central London fines tend to be much higher than elsewhere) and on the mood of the magistrate (check they haven't got shares in your local IBA franchise!) Fines are likely to be greater for persons seen as ringleaders, and for 2nd or 3rd offences, with the chance of a suspended sentence after more convictions. (But we have no reports of anyone going to prison yet, and some people have a dozen convictions. Ed 1986)

Also under the 49 Act (s1.1) its an offence to listen to pirate radio.So your entire audience is breaking the law! We have a record of one member of an Our Radio team being done for this (they couldn't get him on anything else). He got a £30 fine.

Under Section 7 of the '67 Act (manufacture, sale, possession, not importing) the penalty is a max. fine of £2000, when such 'Restriction Orders' are in force (see above).

Under Section 5a of the 49 Act (as amended by schedule s75 of the 84 Act) you can get a max £2,000 or 6 months prison or both for 'sending false or misleading messages by means of wireless telegraphy, which are likely to affect any safety of life service or endanger the safety of any person or of any vessel, aircraft or vehicle.

Under Section 13 of the 49 Act (as amended by schedule 3 of the 84 Act) its an offence if you're 'Using any apparatus for the purpose of interfering with wireless telegraphy'. (Deliberate interference or 'jamming'. The penalties are the same as for section 5a above.

POWERS OF ENFORCEMENT

To bring proceedings under the Wireless Telegraphy Act requires the consent of the Sec. of State. In practice this means that the DTI decides whether to press charges. So it was usually (and usually still is) a 'summons offence'. If you were taken to the copshop unwillingly it was either on a pretext charge (like suspicion of stealing electricity) or unlawfully. But the 84 Act (s76) (which applies to offences under s1.1, s5a, and s13 of the 49 Act) gave a constable power to arrest without a warrant a person who has committed, or whom the constable with reasonable cause suspects to have committed, an offence to which this section applies, if the name and address are unknown to and cannot be ascertained by the constable, or the constable has reasonable grounds for doubting whether the person has given their real name and address, or whether the person will be at that address for a sufficiently long period for it to be possible to serve them with a summons.

This hampers wily pirates from slipping off with a false name and address (but if such an address is easily verifiable it should still be possible. Ed) and in practice gives the filth power to arrest on suspicion.

UNDER ARREST

Once you're nicked its like any other arrest. You should try and take notes, get the number of the cop who nicked you, ask to see a solicitor immediately under the new 'Duty Solicitor' scheme, refuse to answer any questions, refuse to be photographed or fingerprinted (though they don't need a magistrate's warrant now to force this), only sign for your own possessions and not for the TX gear they may add on the list, etc.

In practice since its the DTI and not the cops who bring prosecutions under the Wireless Telegraphy Acts you won't be charged then and there. What they will do is interview you separately and then let the DTI (radio Investigation Service) interview you. You don't have to say anything to them either, especially don't talk to that old charmer Eric Gotts who will try and trick info and admissions out of you.

They're supposed to let you go as soon as they've decided not to charge you (you get that by a summons). But they can hold you up to 3 days. Keep banging on the door and asking for your phone call. The only delay should be while they check out your address, though of course they'll be checking if you're wanted for anything else. There should be no question of bail if you haven't been charged.

SEARCHES, CONFISCATIONS, FORFEITURES....

Section 19 of the 49 Act provides for the issue of search warrants. They last for a month and authorise anyone named by the Sec. of State to search a premises or vehicle and examine or test any apparatus they find. This didn't allow them to seize anything till the case came to court, but this loophole was never realised till 83, when there followed an upsurge of pirates till the 84 Act brought in new powers.

The search powers were extended by the 84 Act and brought in wholesale confiscation powers. (By s79 of the 84 Act which applies to offences under s1.1,s5a and s13 of the 49 Act and s7 of the 67 Act).. Subsection 79.2 provides for the inclusion in such search warrants of the authority to seize and detain, for the purpose of relevant proceedings, any apparatus OR OTHER THING found in the course of the search, which appears to have been used in connection with or to be evidence of the commission of any of these offences.

This new power allowed the current practice of tracing and raiding studios and confiscating everything, and was reaffirmed by the Horizon Radio case of 1985, when a studio valued at £20,000 was confiscated (down to chairs and carpet) and, though the case was denied and the TX gear was never found, the DJ's were found guilty and fined in addition to the confiscation.

When faced with a Search warrant don't open the door, examine it through a window or letter box. Check the date, (if its valid)who it allows to search, if it allows for body search, if it allows for seizure of evidence, any names etc. Then ask them for I.D. to check if they are those authorised. After that its an offence to obstruct them. If you have an escape route, use it!

Under s80 of the 84 Act they can order forfeiture of any gear restricted under s7 of the 67 Act whether anyone is charged or not. If you're convicted they must order forfeiture.

Proceedings must be brought within six months. After that you can forget it.

Apparatus of the station does NOT include the studio unless programmes are done live.

CLAIMING BACK YOUR GEAR

If you haven't been charged after six months, or if you've won your case (sometimes happens!) you can in theory claim back anything seized. You write to the Radio Regulatory Dept of the DTI or your local Radio Interference Division, or better get a good solicitor to write, giving a clear description of the gear and saying you're the owner and can prove it. Such proof could be receipts for items like batteries, cassette players or an identifying mark on the gear. Don't admit to anything else but ownership, any other evidence that you've committed an offence and you could still be prosecuted. (Ask your solicitor first if there is an 'Order in force under Section 7 of the 67 Act prohibiting 'custody or control' of TX gear).

GOING TO COURT

Usually its by Summons, (unless under s5a or s13 it'll be in the magistrates court) if you get one get yourself a solicitor who knows something about it and Legal Aid if at all possible. Even if you're caught red handed you can deny everything and sometimes get away with it. If you're bending the truth a little don't tell your solicitor as they won't go along with it. If you think you have any chance at all plead Not Guilty, often solicitors will tell you to plead guilty just to save themselves the bother. But remember that the Magistrates Court is basically controlled by the police and most magistrates are right wing tories (the old ones are often more liberal than the young Thatcher lovers). The police and the DTI witnesses will lie through their teeth if necessary to nail you. For instance the head of the DTI 's RIS squad, Eric Gotts once told a magistrate he recognised an Our Radio member putting up an aerial on top of a 22 story tower block at night,from ground level, the evidence was accepted.

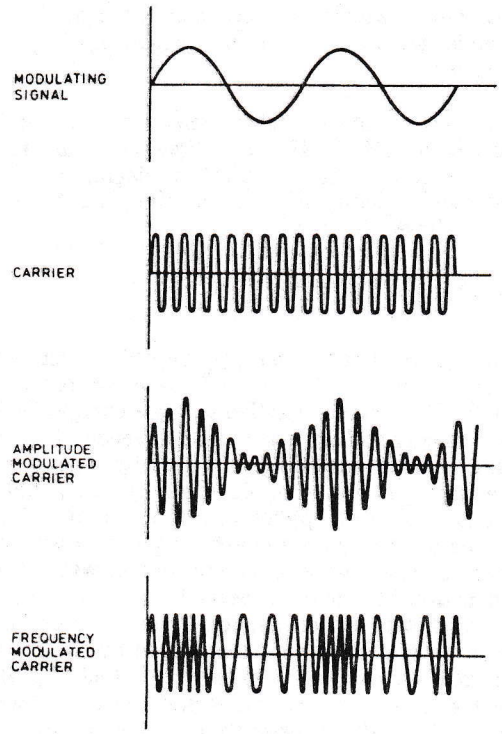
Be polite and courteous and smile at the bastards if you want to get off, and get your station to organise a bust fund and benefit to pay your fine. You can appeal against the decision, and you go to the Crown Court with a barrister, check with your solicitor if its worth it, you may have to pay high costs if you lose.

Radio Electronics (FM)
A General Introduction

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FOREWARD

The following is by no means an introduction to electronics, there are many such books that cover the subject, but intends to explore some of the ideas and concept involved in radio broadcasting that are relevant to the pirate radio operator on VHF FM. In particular we will go a step by step tour of a typical VHF FM transmitter system starting with the output from the tape recorder or mixer, and finishing with a brief discussion of aerials. At each stage we will discuss the pros and cons of varios alternatives and additional background info, eg. the use of test equipment will be introduced

Radio Frequency signals have AMPLITUDE and FREQENCY. The frequency is how fast the signal is oscillating from one extreme to the other and back again. Frequency is measured in cycles per second (cp/s), which these days are known as HERTZ (Hz), 1000Hz = 1kHz, 1,000,000Hz = 1 MHz The amplitude is to what extent the signal is oscillating. LEVEL or STRENGTH can be thought of as meaning the same as amplitude. Amplitude can be measured in Volts (v). There is more than one way of measuring amplitude.

INTRODUCTION

What we are trying to is get information from one place to lots of others. I'm using information here in a wider sense, meaning speech, music etc., rather than phone numbers of local hairdressers or whatever. Now I'm going to assume we're going to use radio broadcasting to achieve this, which immediately rules out things like standing on top of tall buildings and shouting really loud. We'll also assume we've got this info in the form of an audio frequency signal, ie. what comes out of a tape recorder or an audio mixer. You can't transmit audio frequency signals very easily so what we can do is impart the info in the audio frequency signal onto a higher frequency carrier signal. Two ways of doing this are AMPLITUDE MODULATION and FREQUENCY MODULATION (AM and FM).

In AM the ampltude of the carrier is determined at every instant by the ampltude of the audio signal, the carrier freqency remains constant. In FM the frequency of the carrier is determined at every instant by the amplitude of the audio signal, and the carrier amplitude remains constant.

Frequencies between 30 MHz and 300 MHz are known as Very High Frequencies or VHF. This corresponds to wavelengths between 10m and 1m. To convert between wavelength and frequency use the formula

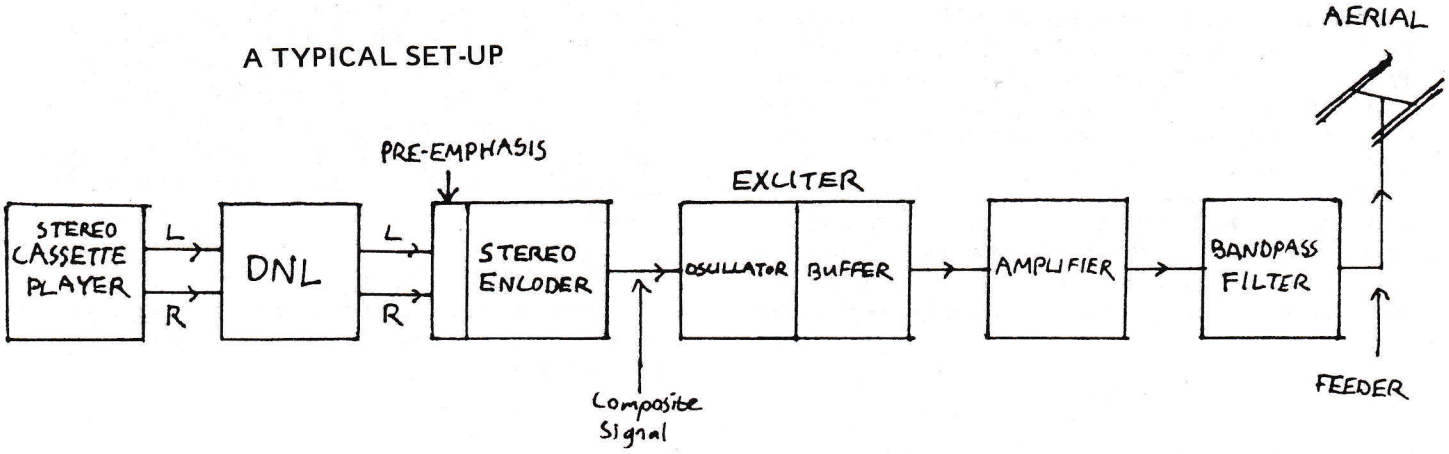
$$\text{wavelength (in metres)} = \frac{300}{\text{frequency (in MHz)}}.$$

FM

There are two sorts of FM, known as Narrow Band FM (NBFM) and Wideband FM. They differ by the maximum allowable frequency shift of the carrier when the transmitter is fully modulated. This frequency shift is known as the DEVIATION. Legal CB radios use NBFM with a maximum deviation of 3 kHz. Wideband FM is used by the BBC and IBA for radio broadcasting and for studio to transmitter links. The standard maximum deviation for FM radio broadcasting in this country is 75kHz. There is no simple way to set the deviation of a transmitter without a Deviation Meter which is an expensive piece of test gear. Probably the best way to do this is to vary the level of the audio signal going into the transmitter (TX) and listen on a receiver, until your signal sounds about the same loudness as the other (legal) broadcast stations. If you use too high a deviation you'll use a bigger than necessary chunk of the radio spectrum and be more likely to cause interference to others, which will make you even more unpopular with the DTI.

The police use NBFM as well, which is why if you listen to them on an ordinary FM receiver, which is wideband, you can hear more than one channel at a time.

A TYPICAL SET-UP



CHOOSING A FREQUENCY

If Your first action could be to reach for you receiver and tune through looking for a blank space, think again, for a kick-off the UK FM broadcast band is 88 to 97.6 MHz and 102.1 to 108 MHz. 97.6 to 102.1 MHz is used by the police, so is best left alone. What stations you can receive is determined by where you are, as well as by the nature and positioning of your aerial. If you look to our old friend the Maplin catalogue we find on P24 of the current issue a list of the frequencies and locations of all FM broadcast stations. What it doesn't say ,of course, is the frequency of existing pirates. TX Magazine gives a good rundown of these (see CONTACTS). Armed with this info you should make a list of all frequencies in use in, say, a 30 mile radius. If you write to the BBC or IBA's Engineering Info Offices they'll send you service maps of where their TX's are meant to be able to be heard. Then its just a question of finding a big enough gap between stations, with the proviso that your station shouldn't be nearer than 200kHz (0.2 MHz) to the frequency of any existing station. This is no problem as the band is half empty. Also don't choose a frequency which is 10.7 MHz away from any other station as for complex reasons (which involve the use of 10.7 MHz as intermediate frequency in FM receivers) reception will be hard for people listening to you and/or the other station.

Now lets take a little stroll through the whole system.

TAPE OR LIVE

What are we going to feed into our TX? The obvious two possibilities are

a) A tape or cassette player.

b) Live, either directly from the mixer or via some kind of link from studio to TX site (highly recommended).

TAPE. This is the safest approach in that you can put a tape on and then retire to a safe distance. Links are now being traced and studios busted, and some of the biggest pirates (eg LWR) are going back to taped broadcasts. If the DTI trace your transmission and turn up all they can do is confiscate your tape plater, TX and aerial, ie no arrests (unless they catch you changing the tape!). Its also the most inflexible alternative as tapes will have to be prepared in advance. Time checks, if you're into that, will be difficult and live phone ins are right out.

Give a little thought to your choice of tape recorder, as it will probably be the weakest link in terms of sound quality. In an old clapped out one the heads will be worn flat. Maybe you can use a 'Walkman' type of player, which are small, can be battery powered and have ok quality and are cheap. An amateur radio rally I was at recently were selling off very slightly damaged ones for £2 each. To reduce 'noise' or 'tape hiss' on such recorders, if you're doing programmes with quiet passages, you can use a circuit known as a Dynamic Noise Limiter (DNL), which is placed on the output and cuts off the 'noise' just in quiet pauses. DNLs are sometimes used in the soundtracks of old films. You can find a DNL circuit in part of the 'Audio Embellisher' project in the Jan 84 issue of 'Elector' magazine.

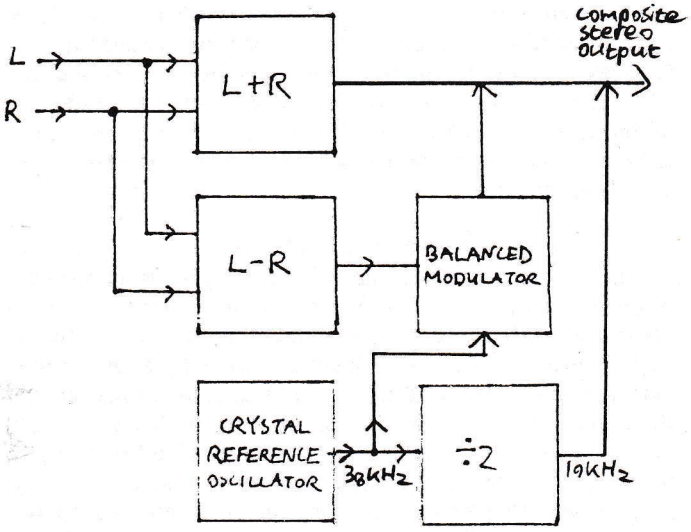
If you want to go upmarket you could use a proper ¼" reel to reel tape recorder, though few pirates do. The latest and greatest is to use 'Stack machines' which will change the tapes for you. Whatever you use get one that can be battery powered as you may not always have access to mains power.

MONO OR STEREO

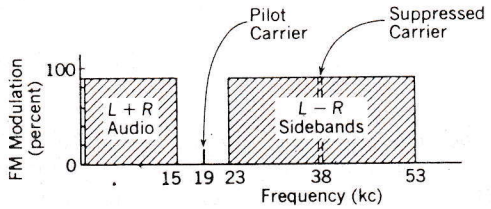
The advantages of mono are that the TX is kept as simple and cheap as possible, and you don't need as much power as on stereo to get the same result. The disadvantages are you don't sound as professional, quite small pirates are now using Stereo Encoders, and maybe people might dial past when the red stereo light on their receivers doesn't flash. With stereo the listener can get quality the same as legal stations. Weigh against this the extra cost, extra circuitry and more output power needed for the same signal.

What you need is a Stereo Encoder, which combines the left and right stereo signals into a single composite stereo signal which is then fed into your TX.

BLOCK DIAGRAM OF STEREO ENCODER



For those interested a brief technical description follows. The left (L) and Right (R) signals are fed into a summing and differential amp to get a L+R and L—R signal respectively. The L—R signal is mixed in a balanced modulator with a 38kHz sub carrier to produce an amplitude modulated double sideband
suppressed carrier signal. The 38kHz signal is derived from the same source as the 19kHz pilot tone. The composite output is formed by mixing the L+R signal, the sidebands containing the info of the L—R signal, and a bit of 19kHz pilot tone. The pilot tone switches on the Stereo Decoder in peoples' receivers.



Composite modulating signal.

Back in the receiver, once the Stereo Decoder has extracted the L+R and L—R signal the original left and right signals are easily got by (L+R) + (L—R) = 2L
(L+R) — (L—R) = 2R
The reason L+R and L—R signals are encoded rather than L and R is so that a mono receiver can just demodulate the L+R bit and ignore the rest of the signal. If L and R were encoded a mono reciver would only be able to hear the left channel. The 19kHz pilot tone is usually got from a crystal oscillator, to be quite accurate and stable. A crystal resonating on 4.8640 MHz is convenient as 4864 divided by 2 eight times is 19 kHz. This can easily be done by digital logic chips. But its highly unlikely you'll be able to buy a 4.8640 crystal off the shelf, so you'll have to have one made to order.

We had hoped to include a design fo a Stereo Encoder in this book, but we haven't got it yet. See CONTACTS for where you can buy the design or a ready made system.

It doesn't matter if you didn't understand all of the above but one thing is important. The standard FM broadcast audio bandwidth extends only to 15kHz and Stereo Encoders are designed to assume this figure. If you put signals into them with frequencies above that the L+R signal and the lower side band of the L—R signal could spread into each other and you will get a right bloody mess. With a tape recorder you can't really get over 15kHz, but if you're live its quite possible. In that case you need a LOW PASS FILTER on each input to a stereo encoder. Maplin have a high quality design on page 243 of their current catalogue (summer 86). The pot could be replaced with a 500k resistor to wire the circuit permanently for max roll off. If you're using a link between studio and TX and you want stereo wou'll have to know the bandwidth of the link. If its 53kHz (= 38+15) or more you can use it after the encoder. Otherwise you'll need two links and have to encode at the TX end.

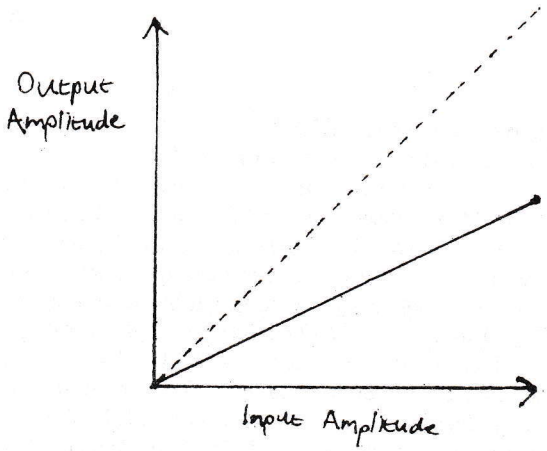
PRE- EMPHASIS

In a typical audio signal the high frequency sounds have less energy than the low ones and so produce less deviation of the carrier. This in turn makes them susceptible to 'noise' when received. To avoid this high frequencies are boosted before being transmitted by PRE-EMPHASIS. In the receiver the frequencies are cut by the same amount by DE-EMPHASIS. So the overall frequency response of TX to receiver stays flat, but the level of background noise is reduced a lot.

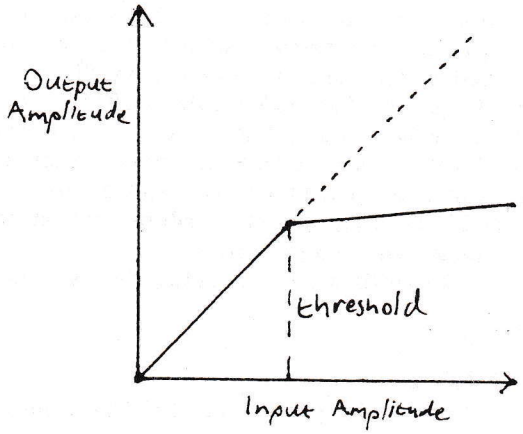
Pre and De-emphasis networks are characterised by their TIME CONSTANT. In the USA the standard is 75 µS, but in UK its 50 µS so anything designed or bought from there needs slight modification. In a mono TX the pre-emphasis network can be built into the front end of the exciter. For a stereo TX such a network must NOT be in the exciter or it'll play hell with the composite stereo signal from the encoder. Instead you need 2 networks, one for each channel, on the inputs of the stereo encoder, They're actually often built into the studio encoder.

COMPRESSORS AND LIMITERS

Compressors and Limiters operate on the same principles, but their effects and the reasons for using them are completely different.



COMPRESSOR



LIMITER

A compressor compresses, it reduces the DYNAMIC RANGE of its input signal. This means as the input amplitude varies over a certain range, the output ampltude varies over only a fraction of that range. The graph shows a 2:1 compression characteristic. In this case with every change in the input amplitude the output changes only half as much. The dotted line shows a 1:1 non compressed characteristic.

But a Limiter passes its signal unaffected till the input amplitude reaches its THRESHOLD. At this point the limiter prevents the output increasing much by compressing its input much more strongly than in compressors eg 10:1.

Some American music stations and some pirates compress their programmes to make it seem 'louder' and more 'upfront' than other stations, This occurs cos the compressor keeps the average level of the signal high, even in quiet parts of the prog. The flip side of this is listeners can soon get 'listener fatigue' as constant compression can become boring and irritating to the ear, as if the music were rammed into it!

Compression has other uses, you might compress your programme as you transfer it to tape to stop quieter bits fading into background tape hiss when played. The process of recording and replaying does this to some extent anyway. Don't compress the output of a tape recorder as it'll make tape noise worse. Guitar effect units, labelled compressors, are unlikely to be much use. Compressors intended for use in home studio recording are worth experimenting with. A stereo compressor with a 2:1 characteristic can be simply constructed around a NE570 or NE571 IC.

Limiters are used to stop a signal's amplitude going over a certain level. Eg when cutting a master disc in record manufacture, large PA systems at gigs to stop loudspeakers blowing every time someone burps in a mike and, surprise surprise, in broadcasting. In FM particularily, as the signal level increases so also does the bandwidth of the transmitted signal, risking interfering with other stations. With tape input to your TX the output is imherently limited by the recording process, no limiter needed. With live input to the TX its different. Though you might set the levels right to start, along comes a loud record or voice and you could be interfering with the next station. Use a limiter.

Any limiter based on 2 back to back diodes is little more than a guitar fuzz box and will sound like one.A suitable high quality limiter was described in the May 83 issue of 'Electronics Today' International Magazine.

THE OSCILLATOR

At the heart of everything is the OSCILLLATOR that generates the VHF signal. The Frequency of this is modulated by applying an audio signal to it. The most common way of doing this is by using one or two VARICAP diodes. When a varicap diode is operated with a reverse bias the capacitance of the diode varies with that bias. The diode(s) is/are connected to a frequency determining part of the oscillator. The audio signal is connected across the diode to achieve frequency modulation. Also by varying the DC reverse bias the oscillator can be fine tuned. The higher the voltage, the lower the capacitance, the higher the frequency.

The VHF signal can either be generated directly, or the oscillator can oscillate on a lower frequency eg a third or half that desired and then followed by a TRIPLER or DOUBLER stage. There are three main types of oscillator:

a) Variable Frequency Oscillator (VFO).
b) Crystal Oscillator.
c) Phase locked Loop Oscillator (PLL).

VFO's

These are simple oscillators which can be built round a single transistor. This can be:
Bipolar Junction Transistor (BJT).
Field Effect Transistor (FET).

The problem with oscillators based on BJT.s is that the frequency is too dependent on the temperature of the transistor. ie a few degrees temperature change will result in a significant change in transmitting frequency. For this reason oscillators based on BJT's are UNSUITABLE for serious use as a TX. FET's don't suffer from this problem so badly, so they can be used, but you should still bear it in mind.

The FET will heat itself up slightly, and other bits of the TX, like the power amps, will be fair old chucking heat out, and are usually built into the same case as the oscillator. The frequency will drift most when the TX is 1st switched on as all the components will be at the same temperature as the air ouside the TX's case, this is known as the AMBIENT TEMPERATURE. After the TX is turned on the heat from the amps will warm the air in the case directly or indirectly.As the FET warms the frequency will drift a bit. When heat loss equals heat gain you get THERMAL EQUILIBRIUM and it wont drift more. Keep your TX out of drafts to avoid messing this up. If you have a frequency counter plug in to a dummy load and see how long it takes for the frequency displayed to settle down, maybe about 15 minutes. If you have time you can arrive at the TX site early and run your TX for the warm up time with no input into a dummy load. This avoids listeners who tune in immediately having to retune as you r frequency drifts.

CRYSTAL OSCILLATORS

This is also a simple oscillator but incorporates a crystal into the frequency determining network. There are various types of crystal (fundamental, 3rd overtone, 5th overtone etc) and various ways of using them (series mode, parallel mode) but their basic properties are the same. They're resonant on one frequency which is determined by the crystal's characteristics when made. This is their problem, whereas VFO's are not very stable crystal oscillators are too bloody stable and its a job to get enough deviation. You'll probably lose the higher frequencies of your programme and stereo is right out. Also chances are you'll have to get a crystal made to order for your desired frequency so if you want to change it you'll need a new one. There are places which make crystals to order.

PHASE LOCKED LOOP (PLL) OSCILLATORS

The way its done properly is with the Phase Locked Loop oscillator. Tis combines the ease of tuning and wide deviation of a VFO with the frequency stability of a crystal oscillator. It works thus: A crystal oscillator is used to provide a reference frequency. This is digitally divided by logic chips to a relatively low frequency, say 25kHz. A VFO provides the output, which is also digitally divided to give another relatively low frequency. These two low frequencies are presented to a PHASE COMPARATOR which basically decides which freqency is higher by comparing the phases of the two siganls. The phase comparator generates an ERROR VOLTAGE which is connected back to the input of the VFO through a LOW PASS FILTER (LPF). This is the loop bit.

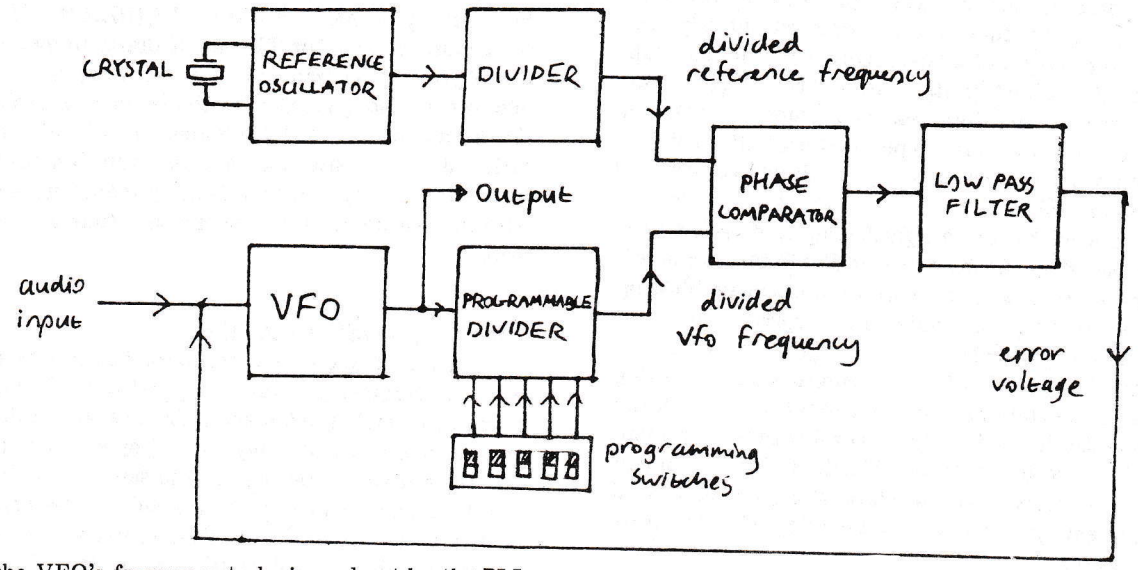
If the VFO is running too fast the phase comparator decreases the error voltage so as to slow it down till the phases at its input are the same. If its running too slow the error voltage is increased to speed it till the phases are the same. All this happens instantaneously of course so the output frequency remains constant.

In this way the temperature stability of the VFO isn't important and it can be built round a BJT, as its output freqency is phase locked to the crystal oscillator, and the frequency of this is very good. Clever eh?

Two more things to explain. How do you change the output frequency? By making the VFO's divider programmable. Say its set to divide by the number N. The phase comparator is a simple minded sort of soul, concerned only with equalising the phases at its inputs, it doesn't know whats really coming out of the VFO, which is N times the divided reference signal. Because this signal is so low compared to the VFO frequency N can be made to have hundreds of different values, giving hundreds of different output frequencies from the VFO. So changing the frequencies is just a matter of clicking some little switches. (Beats me...typissed).

Hang on a sec, the VFO is being frequency modulated by the audio input, so its frequency at any given instant depends on the voltage of the audio output. We don't want THIS

PHASE LOCKED LOOP OSCILLATOR BLOCK DIAGRAM



variation of the VFO's frequency to be ironed out by the PLL system so we 'iron out' the error voltage from the phase comparator, so it just contains the underlying trend rather than whats happening at any split second. This is the purpose of the low pass filter.

This system can be simplified by leaving out the dividers. If this is done you end up with an output frequency determined solely by the crystal. You've still got the wide deviation capability of course, which distinguishes this system from one based on a simple crystal oscillator. This sort of fixed frequency oscillator is used for things like wireless mikes and could be used for studio to TX links. Programmable PLL oscillators are used in all manner of professional communications equipment, including broadcast TX's.

We don't include a PLL oscillator design in this book. Its a bit complex to start with and the IC's are expensive. . See CONTACTS for where to get the design. or ready made.

BUFFERS

Any oscillator, regardless of its type, is followed by a buffer. This is usually one or two transistors operating in what is known as class A mode. Its function is to protect the oscillator from what is going on further along the circuit, especially from changes in its 'load' as the following stage is tuned. The combination of oscillator and buffer together is called the EXCITER and is a small but fully fledged TX. Small in respect to its output power. Typical values are in the region of 100 - 500 mW (1000mW = 1W).

AMPLIFIERS

To increase the power output of our fledgling TX we need to add an amplifier. Obviously we are talking about Radio Frequency (RF) amps, not audio amps. RF amps have certain important characteristics: a) Bandwidth b) Gain and maximum power output c) Input and output impedence.

BANDWIDTH This is the range of frequencies the amp will amplify properly. The Bandwidth is ultimately limited by the characteristics of the active devices in the amp (ie the transistors or valves) but more specifically by its type, LINEAR or a TUNED amplifier.

A linear amp will amplify quite a large range of frequencies and they have a good bandwidth, commonly 1.8 - 30 MHz which covers all of the amateur shortwave broacast bands.. no good for a VHF pirate, but could be useful for a MW pirate. They operate in class A or B mode and have the advantage that they don't need adjusting when the frequency is changed. Their disadvantage are they're more complex and dearer then tuned amps and are much harder to design, requiring extensive knowledge of the transistors round which the amp is constructed. Linear amps for VHF are uncommon.

Tuned amps only amplify a narrow band of frequencies, they have a small bandwidth, centred on one frequency which is determined by the TUNED CIRCUITS in the input and output networks of the amp. Tuned circuit have a RESONANT frequency. This can be adjustedby variable capacitors known as trimmers, to the desired frequency. The amp will produce max output when the tuned circuits resonant frequency is the same as the input frequency from the exciter. Tuned amps often operate in the class C mode, which is more efficient than A or B. This means more of the power being drawn from the battery or whatever turns into watts up the aerial rather than heat in the amp. They are relatively simple circuits, and are easier to design. The bandwidth is a trade-off with gain, the wider the bandwidth the less the gain. The disadvantages of a tuned amp is, of course, you have to tune it to the frequency you're using and if you change the frequency you'll youLll have to retune to maintain the gain of the amp.

GAIN AND MAXIMUM OUTPUT POWER

The POWER GAIN (as opposed to a voltage or current gain which is different) of an amp is defined as a ratio:

$$\text{power gain} = \frac{\text{output power}}{\text{input power}}$$

and is a measure of the amps ability to make its input 'bigger'. Power gains are often expressed in DECIBELS (dB) which are defined:

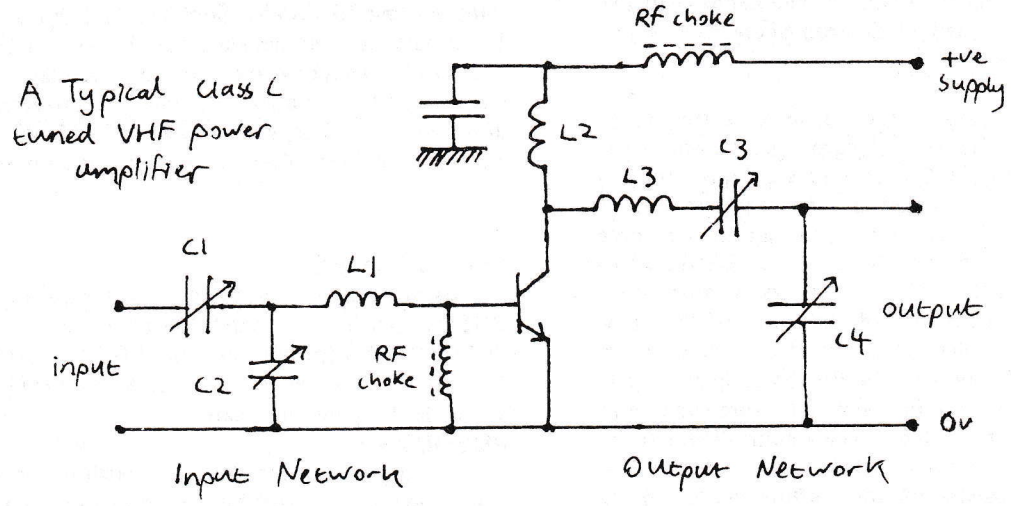
$$\text{power gain (dB)} = 10 \log_{10} \frac{\text{output power}}{\text{input power}}$$

Amps also have a max output power. When this is reached increasing the input power wont result in more output power and may damage the amp.

In the case of single stage (ie one transistor) class C tuned amps the gain and max output power of the amp is basically the gain and max output power of the transistor. Knowing these we can calculate the power necessary to produce the max output power. EG lets consider the popular MRF237 transistor. According to the makers data sheet this has a max output power of 4w and a gain of 12dB. First we've to convert the gain in dB to ordinary gain :

$$\text{gain} = 10^{\frac{\text{gain (dB)}}{10}}$$

$$\text{for example gain} = 10^{\frac{12}{10}} = 10^{1.2} \simeq 15.85$$



Input power = $\frac{\text{Output power}}{\text{gain}} = \frac{4}{15.85}$ = 0.25w

= 250mW

So for 4w output power we need 250mW input power. Most exciters can manage this, hence the popularity of the MRF237 in the 1st amp after the exciter. The joker in the pack is that all these figures are for a frequency of 175mHz, that on which the transistor was designed. You can't predict what happens at 100mHz and have to experiment.

The MRF238 has 30w output power and a gain of 9dB, so it needs 3.8w input power. This can be had from the MRF237. Thats how the makers (Motorola Corpse.) planned it.

INPUT AND OUTPUT IMPEDENCE

Impedence is the alternating current (AC) version of resistance. The standard impedence outputs of exciters and outputs and inputs of amps is 50Ω. The impedence of the input and the output networks of an amp is altered by the tuned circuits which you recall also tune the circuit in a tuned amp. The INPUT IMPEDENCE is important as it effects the LOAD the amp has on the stage before it. Max power is transferred between stages when the impedence of the output and input are equal. If the impedences aren't equal a MISMATCH is said to occur and in this case some energy is reflected back from the input of a stage into the output of the preceding one, where its wasted as heat.

THE VSWR METER

Some of you may know that we can use a VSWR meter (also known as Voltage standing wave ratio meter, SWR meter or a Reflectometer) to detect mismatch between TX and the aerial, but the VSWR meter is just as much at home doing this between amp stages. VSWR is the ratio of the forward (or incident) and reflected power. Except for dear ones they work the same. The switch is set to Forward or the SET button is pressed. The knob is then adjusted to make the meter read full scale. The switch is then set to Reverse or the button is pre-released. It now indicates the VSWR. A VSWR of 1:1 is perfect (no reflected power) and so unlikely. One of 00:1 shows all the power is reflected back into the amp, you'll get this with a VSWR connected to the amp output with nothing on the VSWR output (unless its got a built in dummy load). You'll also get it if there's a short circuit in the VSWR meter. In either case switch off IMMEDIATELY or you'll blow your power transistor.

The point of all this is to get the max power output from the amp into the aerial, instead of a hot TX and a bad signal.

To tune such an amp you need a LOAD connected to the output (or it'll blow up). We could use an aerial but this introduces an extra unknown quantity..the characteristics of the aerial. As well as the fact that we'd be broadcasting. What we need is a DUMMY LOAD.

THE DUMMY LOAD

This is basically a resistor, made so it presents a load to the amp's output independent of frequency (unlike the aerial). The 3 things about a dummy load we're interested in are:
a) It should be suitable for the frequency we're interested in, about 100mHz.
b) It should be rated to take the power we're trying to make.
c) It should have a resistance of 50Ω.To match the output network of the amp.
When buying ask for one for the 2 meter band, amateur radio, centred on 145mHz. Most test gear for this band (dummy loads, VSWR meters, power meters, wavemeters, RF volt meters, frequency counters etc) will work on the frequencies we're interested in.
The amp should first be tuned with reduced input power and supply voltage. Adjust the input network trimmers C1 & C2 for the best input match (lowest reading on a VSWR meter connected to the input side) and adjust the output trimmers for max output power. Be sure the extra power is in the frequency you want and not in the HARMONICS. Check with a wave meter (more of this coming up). Another VSWR meter can be used for a relative indication of the output power, or the RF PROBE, described on page will give an absolute indication. The pairs of trimmers are very interdependent, adjust one and you'll have to adjust the other, and so on.

This done, if all OK, increase the input power by increasing the voltage supply to the previous stage, and the voltage supply slightly and repeat the tuning. Do all this a few times till you reach the required levels. Listen in on a nearby (but not too near) receiver. The signal should be in just one place on the dial with no funny noises or modulations going on. Check with a wave-meter. Altering the trimmers and varying the input power and supply voltage should result in smooth variations of the supply current and output power with no steps or jumps. The exception is, as the input power is reduced at some point the amp will switch off, a characteristics of Class C amps.

To vary the supply voltage you need a Variable Stabilised Power Supply Unit. If you can't get hold of one you could

build one. They're not expensive and are well handy, and give you some experience, if needed, of electronic construction.

HARMONICS

Harmonics are multiples of the transmitting frequency. For a frequency of 100mHz, the 1st harmonic, known as the FUNDAMENTAL is 100mHz, The second is 200mHz, the 3rd id 300mHz etc. They're produced as side effects in various parts of the circuit and will interfere with other users of these frequencies if let escape from the TX. Known as RADIO FREQUENCY INTERFERENCE (RFI). Tuned class C amps dont amplify harmonics, as they're out of the range of the amps abilities. But the use of Class C means that harmonics are generated by the amp along with the desired frequency. The strongest ones (apart from the fundamental) from such amps are usually the 3rd, then the 5th etc. The amplitude of harmonics is minimised if the output networks are tuned properly, but they're still there. Oscillators and Buffers can also make harmonics if not set up right.

WAVEMETERS

To detect harmonics we need an ABSORBTION WAVEMETER usually called just a wavemeter. Or we can use a GRID DIP OSCILLATOR (GDO) or a gate dip oscillator, both of which are known as DIP METERS. Most dipmeters have a switch which turns them into wavemeters. A wavemeter has a tuning knob, calibrated in frequency, a meter showing signal strength, and some kind of short aerial. You hold the aerial near a coil in the bit of the circuit your're interested in, and tune the wavemeter. It shows how much signal is present on the frequencies shown on the scale. So you can see what frequencies are being generated in that part of the cicuit. Ideally you'll just find the fundamental, unless the circuit is a frequency tripler or something.

If you buy a wavemeter be sure it covers the right range, from below 100mHz to get the fundamental to above 300mHz to get the 3rd harmoinic.

Even with all tuned right you're still going to have some harmonics generated by the last stage. A sensible pirate wont let these reach the aerial, e.g. if you're using a frequency of 102.35mHz the third harmonic is 307.05Mhz which happens to be that used by USAF Upper Heyford's Control Tower. You might think this funny but you won't stay on the air for long. To stop harmonics reaching the aerial we need a BANDPASS FILTER.

Each amp bumps up the power some more, cos the transistor in each one can only supply so much gain. So if you're the proud owner of a 5 watter and you're offered a 1000w amp its useless as you'd need probably 100w input to drive it so you'd need amps in between.

To tune a series of amps on your TX you must break in, physically if needed, to tune each one at a time. Do this by unsoldering components and soldering in short bits of co-ax with plugs to connect to dummy load and VSWR meter.

BANDPASS FILTER

This filter only allows through a narrow band of frequencies, ie it has a narrow bandwidth, a good one would be less than 1MHz. It needs standard 50 input and output impedence and be able to take the power you're using and be tuned to the frequency you want let through. Other frequencies are reduced drastically, by an amount known as INSERTION LOSS

reduced drastically. It reduces also the desired frequency slightly, by an amount known as INSERTION LOSS. To keep this loss low bandpass filters for high output powers are usually pretty chunky numbers.

Pirate gear doesn't have this filter built into the final stages so if you need one you have to add it on.It needs a well screened case to stop harmonics leaking out. In fact your whole TX should be well screened for the same reason. Say for eg you used a shoebox and had your oscillator on a third of a frequency of 92.25mHz..you could be interfering with pagers of a local hospital as they use 31.75mHz. Proper screening and a bandpass filter will eliminate such possibilities.

CONNECTORS

As you may have guessed you can't use any connectors on VHF as they have to match the amp and feeder. Use BNC or the UHF series (pl.259 plug and SO239 socket). UHF is best for higher powers as you can get a wider cable into the plug. N type is also good but dearer

FEEDERS

So you've got your nice clean harmonic free signal coming out of your bandpass filter..we're on the home run. All that's left is to get the signal up the aerial feeder to the aerial and we're away. BUT the aerial cable needs to MATCH the TX's output stage at one end and the aerial at the other. This cable like the TX's output, the connectors and the aerial has an impedence and to match this should be 50Ω. It also needs LOW LOSS or your watts will escape as heat. Not the same as a bad VSWR where you lose energy in the TX, a good VSWR does not mean the cable's okay. Decent cables for short runs are UR76 and RG56U. For longer runs or higher powers use UR67. (UR67 and UR76 are available fron Cirkit).

AERIALS

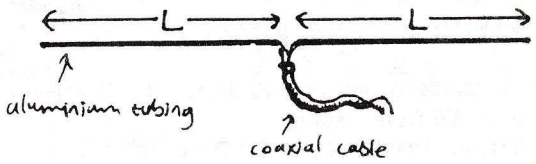
At last, the aerial! You can run a pirate knowing little of TX's, but if you know nothing of aerials you'll have few listeners. So you must read a book on it. I recommend *'The Two Metre Antenna Handbook'* by FC Judd G2BCX. It's a paperback by Newnes technical books at £5.95. You may get it in the library.Lots in it isn't useful but he goes into things like propagation, matching, VSWR in better detail. All the dimensions he gives are for the 2m amateur band,centred on 145mHz. To convert to other frequencies all dimensions (including diameter of aerial element, etc) should be divided by your freqency in mHz and then multiplied by 145. eg 978mm for 2m becomes $978 \times \frac{145}{103}$ = 1377mm for 103mHz.

POLARISATION

One thing to decide is what polarisation to use. The main ones are HORIZONTAL and VERTICAL. To simplify you can say a horizontally placed aerial produces horizontally polarised radio waves and a vertically placed one vertically polarised radio waves. To receive a horizontally polarised signal you need a horizontally polarised aerial, and for a vertical one a vertically polarised aerial. Most receivers on FM have horizontally polarised aerials, but all car aerials are vertically polarised. So what polarisation you go for depends on the audience you expect. Eg on Sunday afternoon you'd expect people at home so use horizontal, while in rush hour you might favour vertical. You can build an aerial which splits the power between both, as used in legal stations, known as MIXED polarisation. But the effect of radio waves bouncing off buildings etc tends to twist the polarisation of your signal from horizontal to vertical and vice versa, so your signal could still be picked up by the wrong aerial.

Your transmitting site will affect your choice of aerial (see also Ch 2,How To Get Away With It). In the middle of the area you want to cover you'll need an OMNIDIRECTIONAL aerial which transmits equally all ways, while outside your coverage area you can beam the signal in , with a DIRECTIONAL aerial.

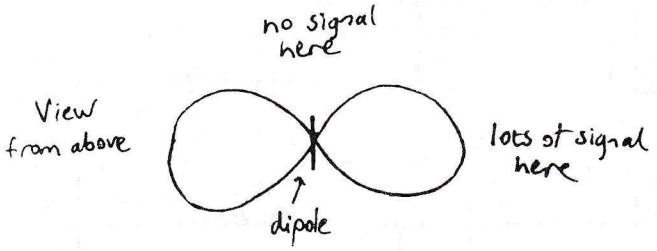
The simplest possible aerial for VHF is known as the HALF WAVE DIPOLE and looks like this:



The elements can be bits of thin aluminium or copper tube. The lengths of each dipole, L, you get from your frequency by: $L = \frac{71}{f \text{ (in MHz)}}$ metres

The impedence is about 72 Ω which is close enough to 50 to be fed from 50 Ω cable without too much power loss.

A half wave dipole used vertically is omnidirectional, but when used horizontally it has a fig of eight coverage like this:



which isn't v. useful. Also a dipole needs a balanced feed. You neeed a BALUN (BAlance to UNbalance) transformer. These can be easily made out of bits of co-ax cable. If you dont do this power will be radiated from the feeder.An aerial with an impedence greatly different from 50 Ω needs an IMPEDENCE TRANSFORMER Also made out of bits of co-ax, see aerial book for details.

Before going on air get a low VSWR by adjusting the position of the aerial and any adjustable pieces. Aim for 2:1 or less. Use low power into the aerial when tuning it up and adjusting, if using 100's of watts and a bit came off in your hand the VSWR could be so bad as to blow the final transistor. For the same reason check the continuity of the aerial with an ohmmeter before plugging in, to be sure its what its meant to be, either a short circuit or an open one, depending on the type.A dipole should be an open circuit.

SITING

Siting is very important. Height is the main factor, even more than watts! Since VHF radio waves go almost in straight lines. 100w in your front room will only reach your neighbours, while 5w up high and unblocked will go 5 miles or more. The waves do bend a bit so you'll cover more than you can see but its hard to say how much. GO for it!

To join the Radio Support Group and get up dates and development aid write to RSG. c/o Box 010, 37 Stokes Croft, Bristol. Avon BSI3PY. It costs £5 to join. Make cheques payable to D.R. Communications.

Appendix A.
THE FREQUENCY COUNTER

If you can get hold of one setting up an exciter is so much easier, you can see what frequency you're on and if its drifting. You don't need a physical connection to the circuit to use it as this can upset things. Either connect a single bit of wire to the input or use a BNC lead ending in a pair of crocodile clips clipped together to form a little loop.Frequency Counters are normally sensitive enough to get a reading when the wire or loop is placed near a coil. You might get lots of other readings as you move it about..look for a stable one near the frequency you expect (use receive or a wavemeter if you're not sure) Its a bit of an art but you'll soon get the hang. For our purposes a frequency must have:

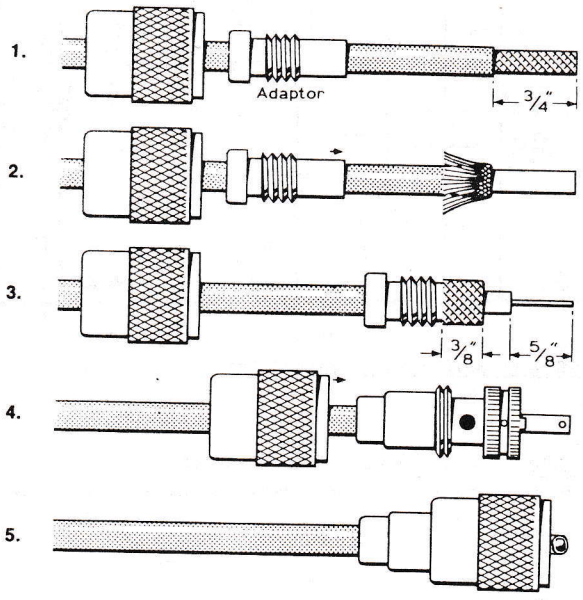
a) The bandwith, up to at least 150MHz.
b) The Resolution i.e. number of digits on display. Four isn't good enough, six is OK, 8 is preferable.

The Thandor PFM200A is around £75 plus vat from Cirkit.

APPENDIX B
UHF PLUG ASSEMBLY

UHF type (clamped screen)

1. Cut end of cable even. Remove vinyl jacket ¾in. Slide coupling ring and adapter on cable.
2. Fan braid slightly and fold back as shown.
3. Position adapter to dimension shown. Press braid down over body of adapter and trim to ⅝in. Bare ⅝in of conductor. Tin exposed centre conductor.
4. Screw plug sub-assembly on adapter. Solder braid to shell through solder holes. Use enough heat to create bond of braid to shell. Solder conductor to contact.
5. For final assembly, screw coupling ring on plug sub-assembly.

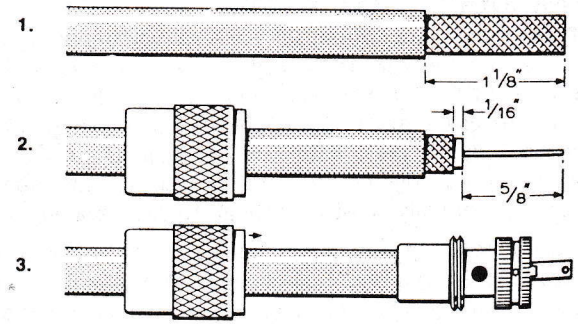


UHF type (clamped screen)

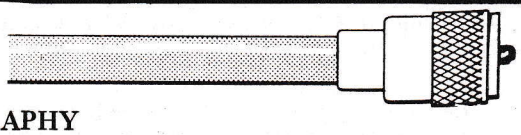
UHF type (soldered screen)

1. Cut end of cable even. Remove vinyl jacket 1⅛in.
2. Bare ⅝in of centre conductor. Trim braided shield. Slide coupling ring on cable. Tin exposed centre conductor and braid.
3. Screw the plug sub-assembly on cable. Solder assembly to braid through solder holes. Use enough heat to create bond to braid to shell. Solder centre conductor to contact.
4. For final assembly, screw coupling ring on plug subassembly.

UHF type (soldered screen)



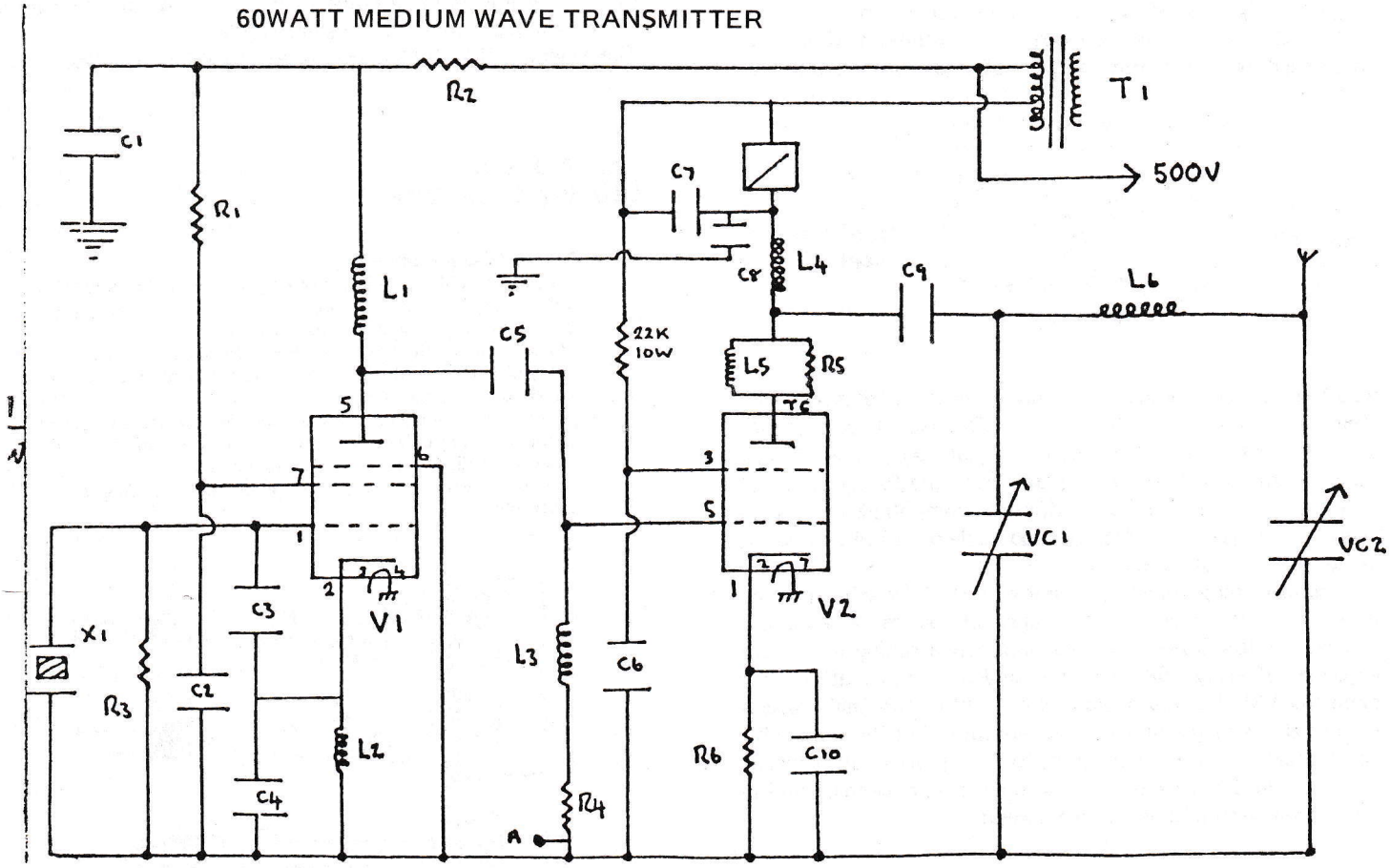
4.



BIBLIOGRAPHY

How to Draw and Make your own PCB by R.A.Penfold
Babani Books. £1.95 from Maplin.
Two Meter Antenna Handbook by F.L.Judd G2BCX
Newnes Technical Books £5.95.
VHF UHF Manual edited by G.R.Jessop G6JB RSGB
This book is a mish mash of info aimed at Radio Amateurs. Some is relevant, most isnt. The chapter on aerials is worth a look. About a tenner.

60WATT MEDIUM WAVE TRANSMITTER



60 Watt medium wave transmitter

RESISTORS - all ½ watt unless stated

R 1 4.7K 2W
R 2 27K 3W
R 3 22K
R 4 22K
R 5 33
R 6 220 3W
R 7 (between C7 & C6) 47K 3W

COILS

L 1 2.5 mH RF Choke
L 2 2.5 mH RF Choke
L 3 2.5 mH RF Choke
L 4 2.5 mH RF Choke 200 mA
L 5 6 turns 22 swg en. cu. wire round resistor
L 6 70 turns 22 swg en. cu. wire round 1¾" former.
Tapped at 5 40 turns
and then every 5 turns.

CAPACITORS

C 1 0.005 mfd 500v
C 2 0.005 mfd 500v
C 3 30 pf 50v
C 4 200 pf 50v
C 5 100 pf 500v
C 6 0.005 mfd 500v
C 7 0.01 mfd 1Kv
C 8 0.005 mfd 1Kv
C 9 0.005 mfd 1Kv MICA
C 10 0.005 mfd 50v
VC 1 500 pf (wide spa
VC 2 1000 pf

VALVES

V 1 EF 91 or 6AM6
V 2 6146 or QV06-20

MISCELLANEOUS

M 1 150 mA meter
X 1 medium wave crystal (1MHz - 1.5 MHz)
T 1 modulation transformer (Woden UM 1 or similar)
A Metering point. Disconnect R4 from earth. 6146 grid current should be set to 3.4 mA by changing the value of EF 91 screen grid resistor if necessary.)

ERROR There should be a link between the cathode of V1 and the junction of C 3 & C 4.

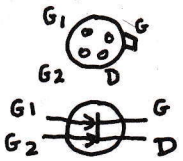
FREE THE AIRWAVES TRANSMITTER PLANS

4WATT VHFM Transmitter, parts and instructions

*** Get some *double-sided copper clad PCB*, enough to make boards in Diag. II and IV, and a piece 1½" x 3". Cut PCB with *stanley knife* – score, bend, snap. Cut islands with *junior hacksaw*. Clean with *emer y cloth*. Drill holes *1/8" bit*. Mark islands with felt tip A to X (see Diags. II and IV). Mark board. Glue islands with *Lochite superglue* – one drop will do. Clean islands of any glue. Apply liberal amount of *solder* to islands with a decent *iron*, 25watt Weller is a good buy, small style.**

DIAGRAM I. ASSEMBLY ORDER

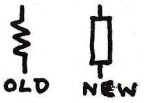
1. *3SK51 or 40673 dual-gate mosfet transistor*
   Cut two legs off to about 2/10", opposite sticking-out bit. Apply solder. Try not to handle transistor, but use legs to position. Stick these legs to islands B and E. Cut other legs, press down and solder to islands D and F.



2. *33pf capacitor*
   Same principle, cut one leg, apply solder, use other leg to position.



3. Wind *2 x 33pf* capacitors legs together. Solder to islands F and the negative rail, which is the board.



4. *330 Ω resistor, 1/4 watt (orange/orange/brown)*
   Keep close to 3, island F to board.

5/6/7/8. *4 x 220KΩ 1/4 watt (red/red/yellow)*

9. *33pf*

10. *56pf*

11. *BB105B or BB205B varicap diode*
    Spot nearest island.



12. *9V1 zenner diode*
    Line nearest island.

13. *4N7 capacitor (or 4700pf, or .0047uf)*

14. *68K Ω (blue/grey/orange)*

15. *.1UF capacitor (or 100N, or 100,000 pf)*

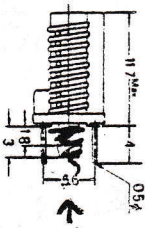
16. *110Ω (brown/brown/brown)*

17. *Single piece of insulated 3-amp wire*. 17a. Same

18. *2-22 pf foil trimmer/variable capacitor (plastic)*
    Odd leg is positive and goes to island G



19. *MC108 Toko VHF mounted coil inductor 5.5 turns, 0.64 μ.H*
    This is the most tricky component in the circuit, due to difficulty in raising ferrite core. Sharpen a piece of plastic with Stanley Knife to act as trimmer. Be patient. Order a number of different coils near this one, so that you can experiment, as it is this component and the variable capacitor above that combine to create the frequency for transmission.

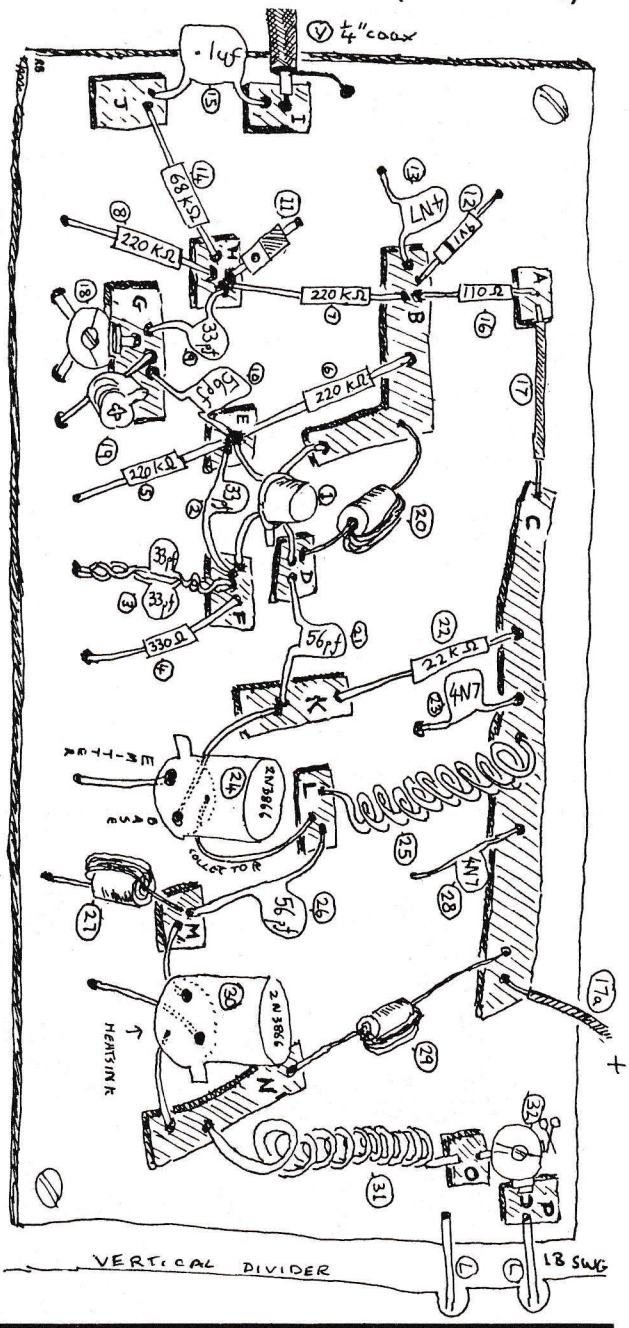


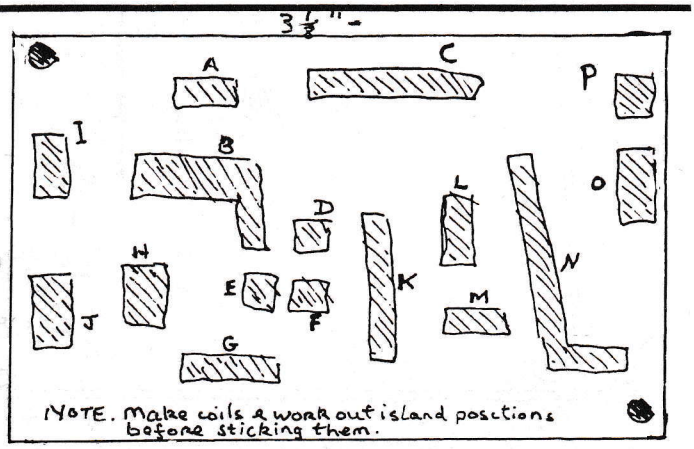
MC 108 TOKO: Another way of getting into the ferrite core is to heat up a needle in a flame, pierce underneath, and then push up.

20. *RF choke, fixed inductor*
    This isn't ready-made, but you have to build it yourself. Get a dozen *FX 1115* ferrite beads and some *28-gauge, enamelled SWG copper-wire*. Wind wire through middle 6 times. Remove enamel from the ends, best way to do this is to burn off then use emery cloth.



½WATT DRIVER STAGE (DIAGRAM 1)





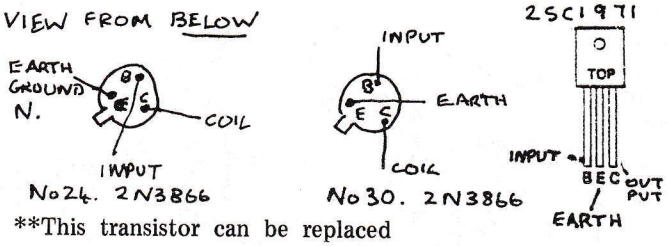
Actual Size 2-1/8" x 3-1/8" with islands for ½WATT DRIVER STAGE (Fig 2).

21. *56pf*

22. **22KΩ**

23. *4N7*

24. *2N3866 transistor*
Before bending legs into right position relative to islands, we must ***heatsink*** transistor. Small heatsink will do. Plus we need ***silicon grease*** in a syringe. Put grease around sides of transistor can, prise open heatsink with screwdriver, slide tranny in, take out screwdriver. Bend legs and cut. Solder. Make sure with crossover that no legs touch.



**This transistor can be replaced by 2N4427 if used with 2SC 1971 in place of the MRF237.. 2N4427 has the same pin position.

25. *18-gauge enamelled SWG copperwire*
Wind wire 9 times around pencil, shape legs, scrape off enamel and solder.

26. *56pf.*

27. *RF Choke. Fixed inductor.*
Same as no. 20.

28. *4N7*

29. *RF choke, as above*

30. **2N3866** The larger the heatsink, the better. See No. 24.

31. ***SWG18 guage enamel copperwire*** 10 turns this time.

32. ***2-22 pf variable***
Positive leg to P. Cut off leg facing leg on 0.

** The first board can now be tested once we have added piece of ***UF67 Coax,*** or any heavy-duty 7mm CB Coax. (See diag. V). We must fix Coax to a UFH male plug (see diag. VII). Plus e need ***stereo 1/4" jackplug socket*** plus ***250KΩ log pot*** and some insulated 3-amp wire.
To properly test and develop we need:

a) a ***power supply*** – a CB 13.8v 3-amp unit, or a 12v car/motorbike battery.

b) a power/SWR meter–capable of up to 150mHz, plus dummy load-25W

c) A frequency counter. This is the most expensive item. A Thandor PFM200A is the best value
We could do without a frequency counter, but if anything is slightly out, ie off the VHF band, than a radio receiver is no good to find a fault.

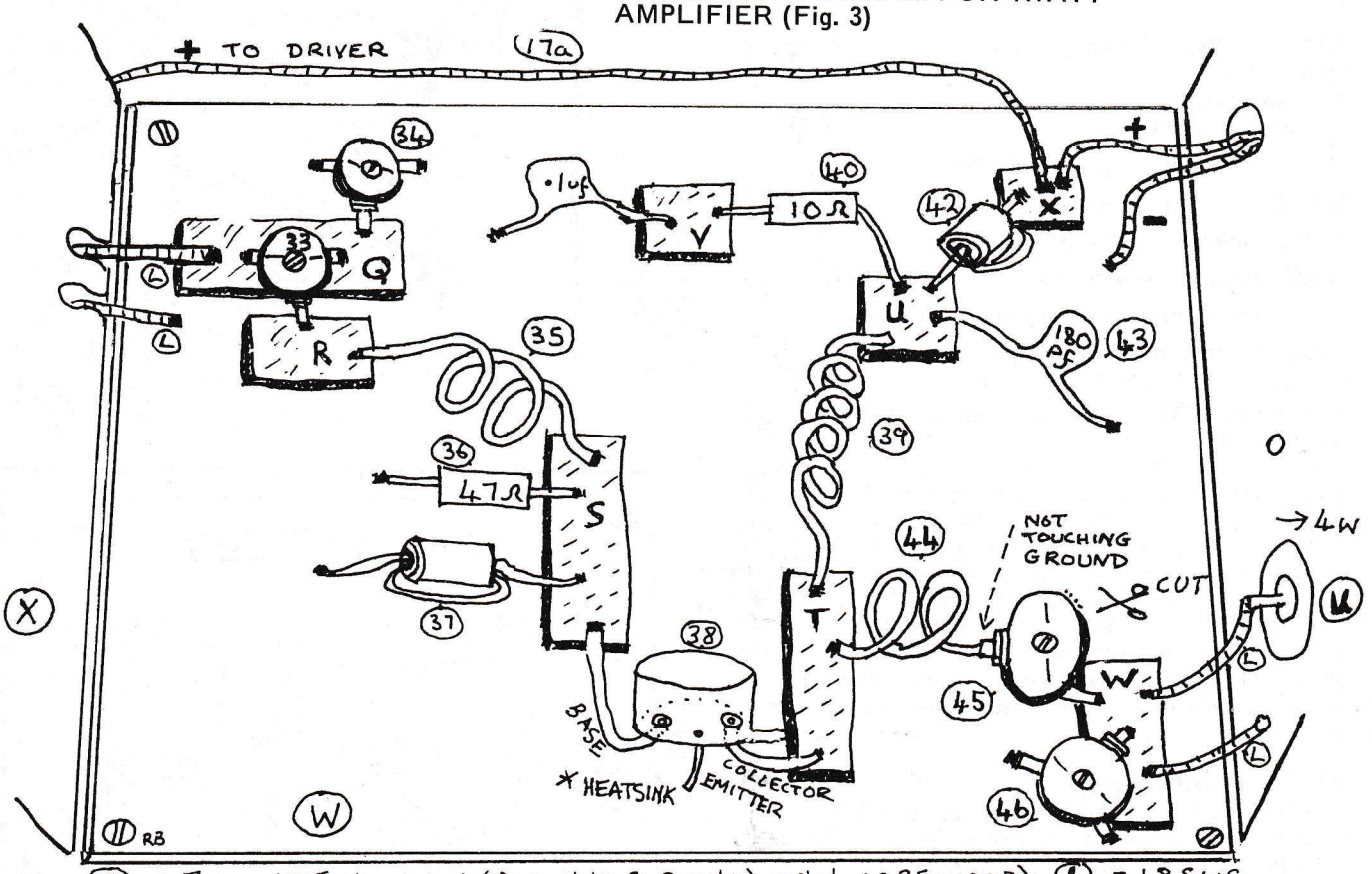
d) A cassette-player with a 5-pin Din plug.

e) A radio receiver

Fit to power supply, fit to power meter. Turn on frequency counter. Set counter to 0.2 gate, put probe into left-hand socket (probe can be just a piece of single core insulated wire). Turn on power. Adjust parts no. 18 and no. 19. See the reading change. Choose a free frequency. To adjust power, turn part no. 32 (to adjust variable capacitors, use a plastic trimmer).

If all's going well, plug in cassette (5-pin Din plug to 1/4" jack Tandys). Put in your favourite tape, turn on radio, and if everything's okay you should hear your tape on the radio. If something is wrong, check and double-check. If you can't work it out, send board back to us via Free The Airwaves and we will see what's wrong. If everything's okay then you can go to the next stage.

SCHEMATIC DIAGRAM FOR 4WATT AMPLIFIER (Fig. 3)

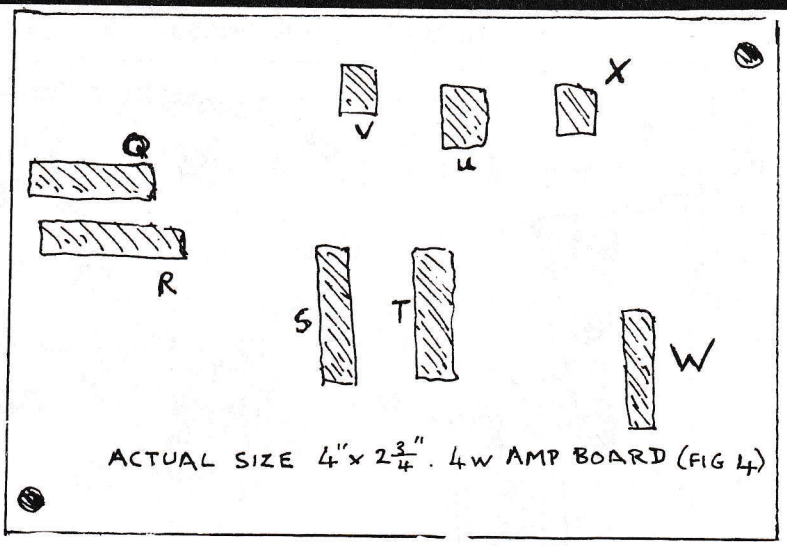


(U) = 7mm UHF plug socket (Output to SWR meter/aerial OR 25w amp) (L) = 18 SWG
(X) = soldered dividing wall. (W) = board and islands, double sided copper clad PCB superglued. See also Fig. 6.

33. *3-90 pf variable capacitor* (foil trimmer).
34 As above
35. *2 and a half turns of 18 guage tin coated SWG using a 1/4"drill as former.*
36. *47Ω resistor.*
37. *RF choke*, same components but only 3 turns.
38. *MRF237 transistor* Large heatsink.



40. *10Ω resistor.*
41. *.1uf.*
42. *RF choke – 3 turns.*
43. *N18 (or 180pf)*
44. *2 turns 18 TC SWG* Solder directly to positive leg of part no. 45, which is a *3-90pf* trimmer. Cut off leg facing away from island W.
45. *3-90pf trimmer*
46. *3-90pf trimmer*





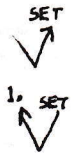
We are now ready to fit into a box (see diag. VI). Get 8" x 3" x 1½" aluminium box. Drill holes. To put in divider, solder along dotted line in diag. 111 and solder along side of divider. Don't solder together yet. Solder TCSWG18 wire between earth and islands P and Q. With the second wire make sure there is no contact with earth. Now solder divider, also making sure no contact with P and Q connection. Last points to solder, using same wire: from island W to centre of UHF female plug, and from earth to outer. Solder *4N7 capacitor* from the stereo plug to earth. see dia. 6 and 8 for positions).

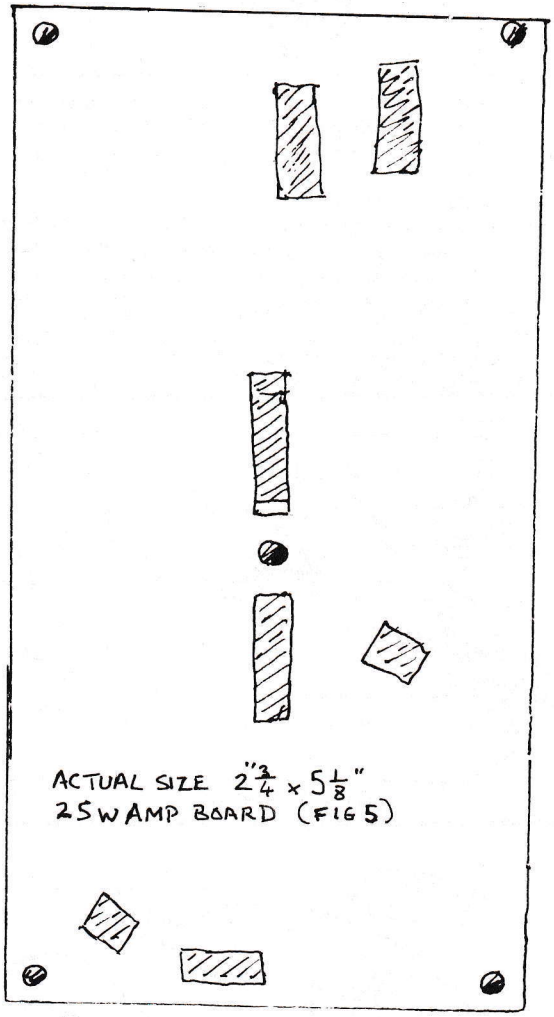
If alls well on testing, using same procedure as with first board - you should get nearly 5 watts with the 13.8v supply. To trim up power, go through each variable capacitor starting from island P until you get the maximum reading from each capacitor.

Now you must make an aerial. Get *10 metres of UR67 Coax. 4 metres of ½" aluminium tubing* (either go to a specialist metal supplier, or get an old H or X 407 VHF TV aerial). Cut to the frequency required (see diag. V11 for calculation). Plus we need some *½" electrical conduit and about 3 feet of 2" by 1" wood.*

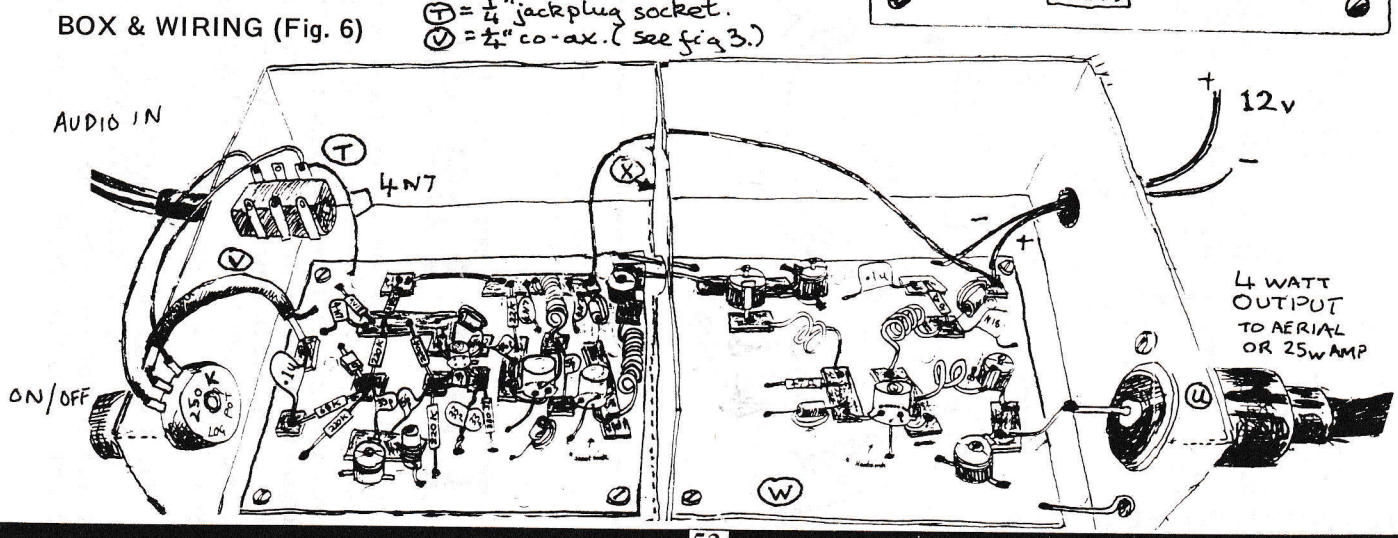
To tune aerial to its maximum efficiency, we want a setting nearest to 1 on the SWR scale. Experiment first with dummy load. Remember, maximum watts and a rubbish SWR reading won't help you get a better signal.

To test press SWR button, press SET button, slide scale till the meter reads SET, then press TEST button- if its properly tuned, the needle will drop to 1. Now try with aerial- don't worry about power reading- with a setting of 2,5 SWR, this will get you over a mile with a 12v battery. Try aerial in different positions and locations. The best results will only come with experience and experimentation.

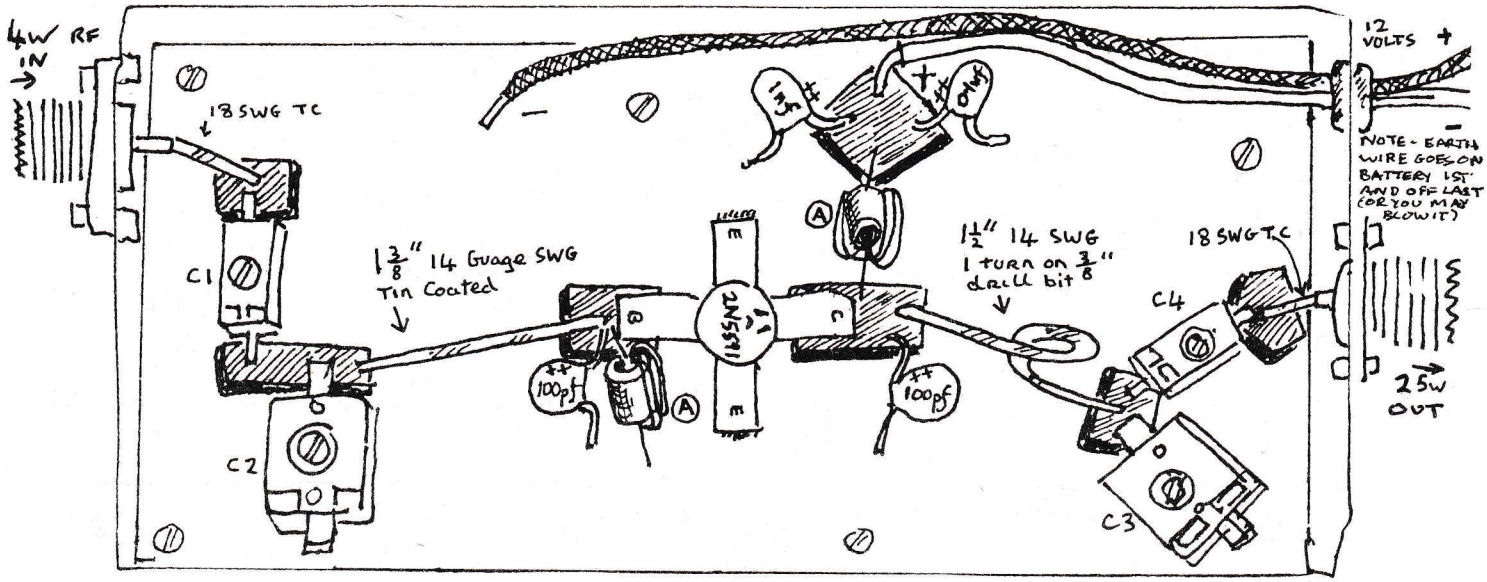




BOX & WIRING (Fig. 6)



SCHEMATIC DIAG. 2N5591 25 WATT AMP. (Fig. 7)



C1 5-80 pf C2 ARCO 464 25-280 pf
C4 5-80 pf C3 " " "
(A) FERRITE BEAD - 3 TURNS SWG 28 RF CHOKE

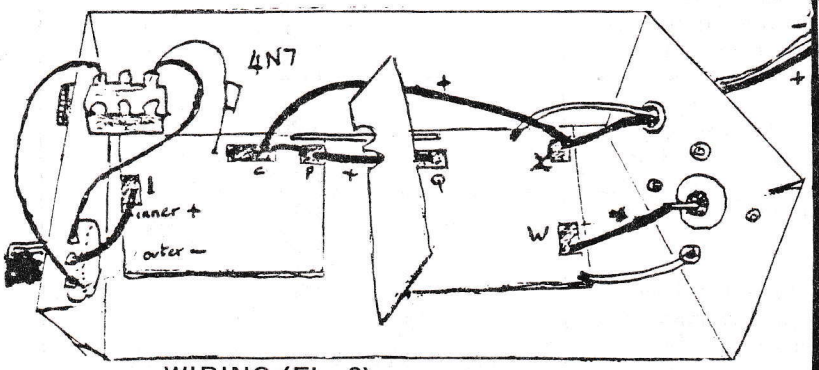


NOTES.

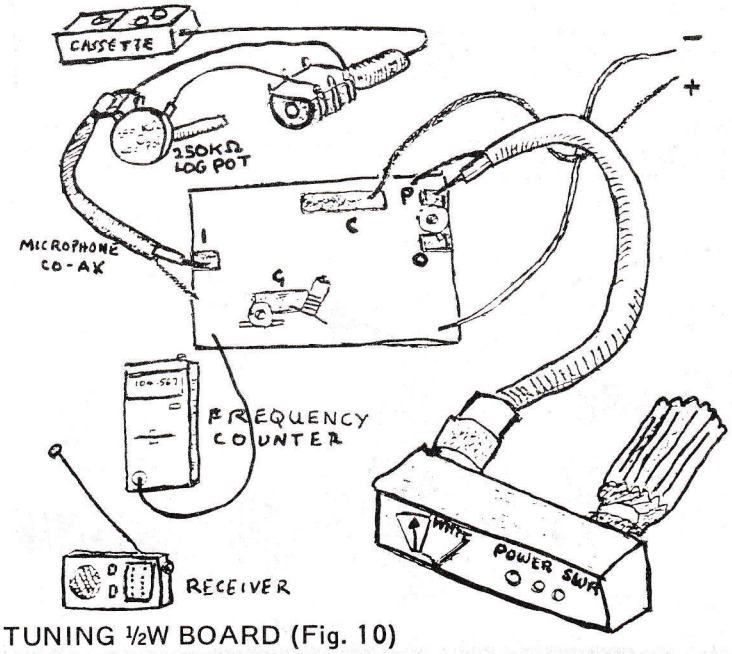
1). AS WE GO TO PRESS WE FIND THAT THE ARCO CAPACITORS (C3 AND C4) ARE NO LONGER EASILY AVAILABLE. WE CAN GET ROUND THIS BUT DON'T HAVE TIME TO TEST THE NEW DESIGN. ANYONE WITH A SOURCE OR STOCK OF ABOVE PLEASE CONTACT 'FREE THE AIRWAVES'.

2.) LAST ONE WE BUILT WE USED SILVER INSTEAD OF TIN COATED WIRE WITH BETTER RESULTS.

3). 25W is the MAX OUTPUT. SHOULD BE OK WITH 80W AMP (P.61).



WIRING (Fig. 8)

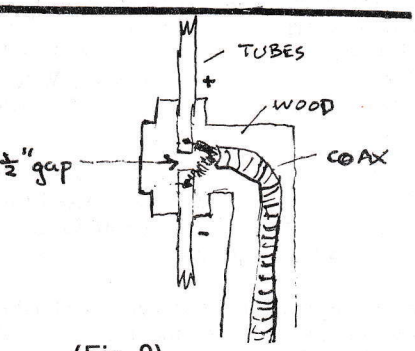


TUNING ½W BOARD (Fig. 10)

Aerial design

Keep inner wire as short as you can and as covered as you can

Face dipole with inner wire upward.



(Fig. 9)

LENGTH OF TUBING = $\frac{300}{f} \div 4$

Anyone who has any better ideas, why not let us know so we can make them available. Or, if you have any queries, or want to get parts, or even ready built, please write.

Free The Airwaves

Approximately 480 one - mile - radius local VHFM commune - ikation stations are possible in London. In the most dense areas we are talking about 50,000 people, eg. the Elephant and Castle district. For less dense areas, where, say, only 12,000 people live in a 5 - mile radius, we are trying to develop a 10 watt transmitter Again, if anyone knows any useful information, don't sit on it, give it to Free The Airwaves.

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5 Watt Transmitter. Complete Building Instructions.

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We reprint here complete details of a more sophisticated 5W TX which has been translated and developed by our Radio Support Group in Bristol. The approximate cost of parts (excluding PCB board and case) is a mere £16, once you've got old of the tools and testing gear.

To join Radio Support Group and get updates and development aid write to:

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Box 010,
27 Stokes Croft,
Bristol,
Avon BS1 3PY.

GENERAL DESCRIPTION

The following describes a small VHF FM transmitter with an output power of 5 watts, adequate to cover a 3 or 4 mile radius reception area from a suitable high transmitting site. The microphone or cassette recorder can be connected directly to this transmitter. To test and tune it you will need a multimeter, a dipmeter and preferably a RF power meter.

With just a modicum of effort this 'peoples transmitter' achieves acceptable frequency stability, low feedback from output to input, and a stable power output. In-built pre-emphasis means that the audio quality is good.

5 Watt Transmitter : CIRCUIT DESCRIPTION

T1 is configured as a microphone pre-amp with enough sensitivity for low impedence microphones. T2 and T3 are configured to provide standard pre-emphasis. D4 provides protection against the supply being connected the wrong way round. The field effect transistor (FET) T4, (BF245) is configured as an oscillator (and is a very good feature for stopping the frequency from wandering). Two varicap diodes D3 and D3' (BB105) or a double varicap diode (BB204) allow the frequency of the oscillator to be modulated. T5 is configured as a buffer. T6 and T7 are cascoded to form a high performance amplifier, with high stability. The transformer L2 ; L3 enhances the performance of this amplifier. C25 and R9 protect T7 from overload. T8 is the power amplifier.

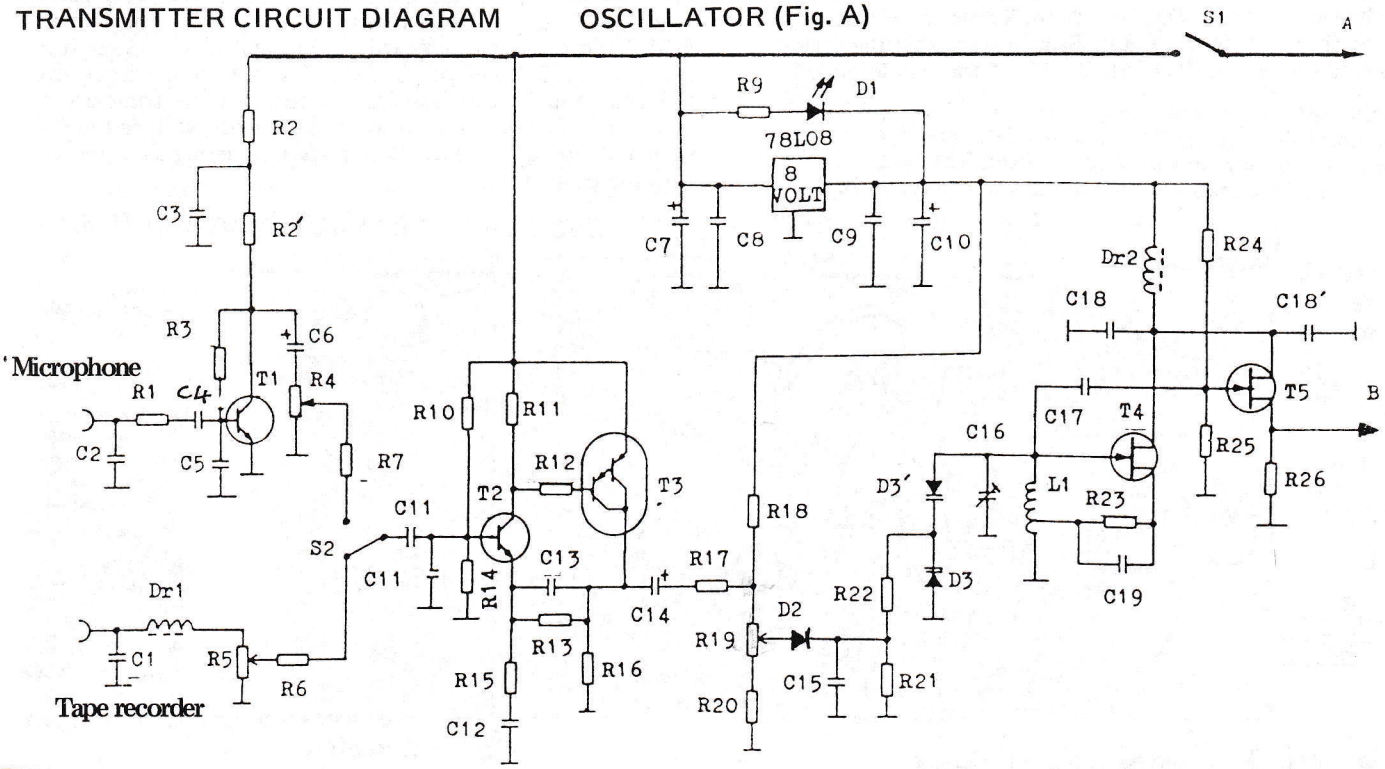
If the transmitter is tuned up at a frequency of about 98 Mhz (see later) the desired frequency can be set with C16 without the power output falling below 4 watts, i.e. it should not be necessary to re-tune.

When drilling the printed circuit board (PCB) use 3mm diameter for mounting holes, 1mm diameter for trimmers and coils, and 0.8mm diameter for the rest. Mark the mounting holes on the bottom of the case.

Begin by constructing the low frequency section, and the oscillator and the buffer, i.e. all the parts in Figure A of the circuit diagram. First mount the resistors, then the diodes. The symbol for a diode in the circuit diagram is an arrow with a bar in front of it. The bar corresponding to the broad ring of the diode and the varicap, and the middle lead on the BB204.

Next mount the capacitors and trimmers. Be careful when bending the leads of the ceramic capacitors near the body of the capacitor, as it can crack. Ensure the elecrolitic and tantalum capacitors are mounted the right way round. Finally mount the semiconductors and the coil L1. The coil should touch the PCB with all its turns (windings) and should be inserted with no tension on the turns. After testing stick it to the PCB with UHU (glue). This will improve frequency stability and help prevent microphony. The coils are best wound on drill bits of the correct diameter. R23 and C19 are soldered 1½ turns from the cold end of the coil (thats the end connected to earth). Use solder sparingly to avoid damaging the coil. Mount the semiconductors the right way round. The pinouts are shown from below.

TRANSMITTER CIRCUIT DIAGRAM OSCILLATOR (Fig. A)



This is the underside of the board viewed from below (Components on other side). (A) lines up with (A) on Fig F. Make your PCB board from this.



(A)

OSCILLATOR PCB DESIGN
Actual Size
Fig. B

Now check whether the right component is in the right place. Inspect the track side of the board for short circuits and breaks. Check for short circuits across the power supply connections with an ohm-meter. Apply 12 volts via an am-meter, preferably from a stabilised power supply with current limiting Otherwise put a 1 amp fast-blow fuse in the positive supply lead. If it blows there is either a short circuit, or D4 is the wrong way round, or the power supply is the wrong way round. Check D4 each time the fuse blows. There should be a current of 20 to 25 milli-amps (mA) (without the LED connected). Tune a receiver to the desired frequency and adjust R19 and C16 until the receiver goes quiet. This means the oscillator is OK. With C16 in its middle position the oscillator frequency will probably be between 100 and 104 mhz.

Now connect an audio signal to an input. Switch S2 has to have been connected to do this. adjust the two pre-set resistors , R24 for the microphone input and R5 for the tape recorder input, so that the signal can be heard in the receiver as loud as possible without distortion. It can be a bit louder than all the other broadcasting transmitters. If you can hear your signal on several frequencies as you tune the receiver, use the transmitter without an aerial or take it into another room. If you can still hear it in several places then something is wrong.

If you have a dip-meter (or absorption wavemeter) its much easier to check whether the oscillator only oscillates on one frequency. If it does oscillate on more than one frequency, re-solder R23 /C19 onto the coil L1 a turn from the cold end. The best point of contact is when the oscillator only oscillates properly on any one frequency in the FM band. In 90% of all cases the point of contact is 1½ turns. Exceptionally high gain FET's are responsible for the exceptions.

If the oscillator doesn't work at all, and the voltage supply is correct, either D3, D3', T4, or T5 are the wrong way round, or there is a short circuit. Bear in mind that the oscillator is THE MOST CRITICAL PART of the whole circuit.

Mountains of solder and dry joints (to be avoided anyway) are most harmful here. All parts, especially L1, have to be completely stable and must not move on impact. The bodies of T4 and T5 should be no more than 2 to 3mm above the PCB.

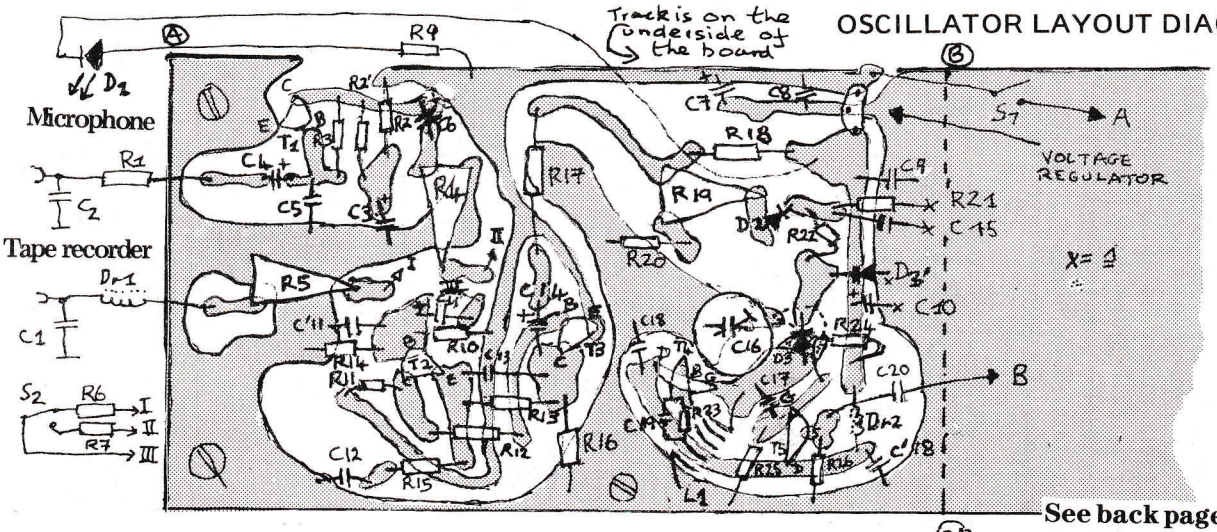
Rotating R19 anticlockwise increases the transmitter frequency as does unmeshing C16. The frequency should be adjustable between 80 - 150 Mhz. (If you want a higher frequency see later '2M Modification').

The final adjustment of the oscillator and tuning the amplifiers can only be done after finally building the transmitter into its case and putting the top on. If you want to alter the frequency often rotate R19 fully anticlockwise and set the highest wanted frequency with C16. The frequency can now be altered using R19. You could possibly replace C16 with a ceramic capacitor (colour black or red!). If you want to use a frequency under 80 Mhz add one turn to L1. If you use a BB204 for D3 you can tune across the whole FM band with R19. The circuit is designed so that the modulation index remains constant as you change the frequency.

Now the VHF amplification stages (Figure D of the circuit diagram). Begin by mounting the resistors and capacitors. The ferrite bead Dr6 is threaded onto one of the R27's leads. All connections which go to earth (X in the circuit diagram) solder onto the top and bottom of the PCB. In all other cases solder only on top. Construct the transformer L2:L3 (see Fig K). Use O.2 diameter enamelled copper wire for L3. Wind round a ferrite bead 3 times and tighten carefully. Don't cut the wire too close to the bead. Tin the ends. If you can solder through the enamel, no problem. Otherwise hold the ends of the wire in a lighter flame and carefully scrape off the remainder of the enamel with fine sandpaper. Then tin with solder. Put bits of sellotape on the ends so as not to confuse them with L2. Same thing now with L2, only its 6 windings this time, three right and three left of L3, spread equally over the bead. Now mount L2:L3, keeping the wire ends short, and fix it in place with glue.

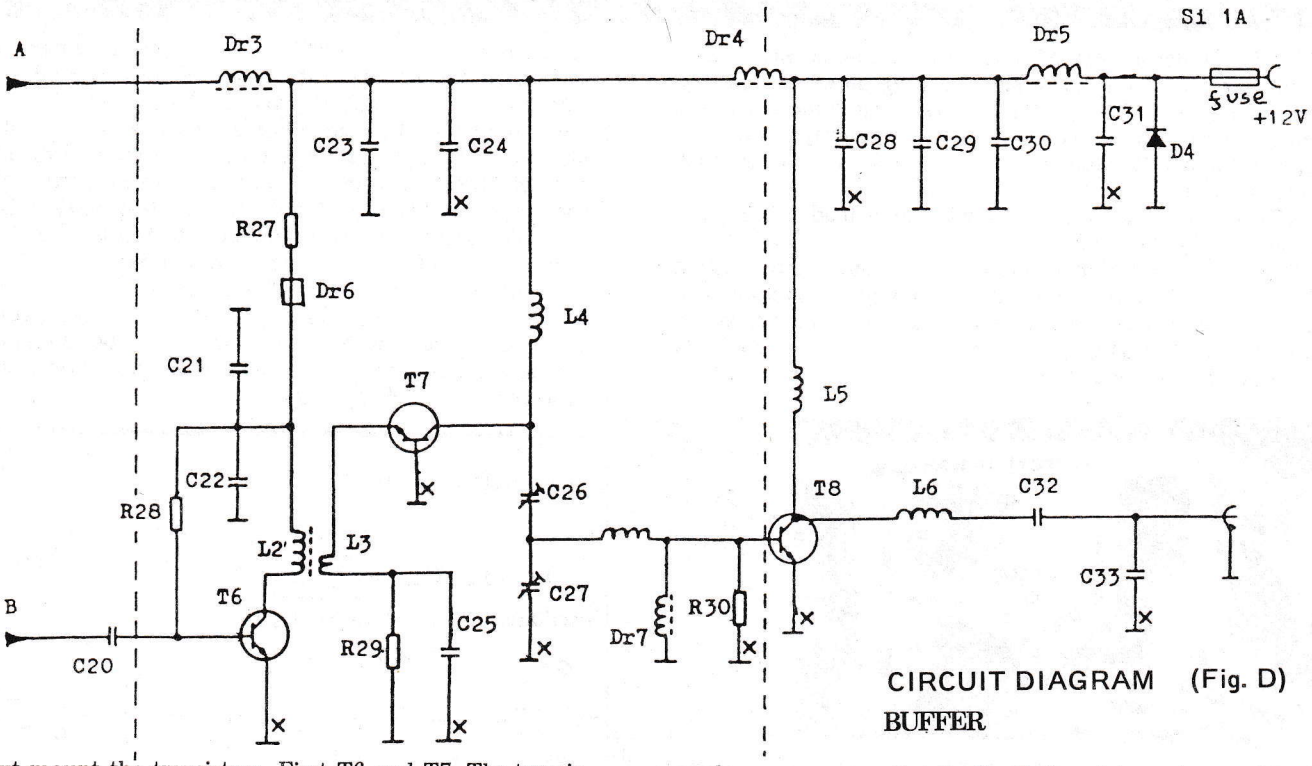
Next mount the trimmers. All the legs that are going to be soldered on top of the PCB should be tinned with solder beforehand, as should their respective contact points on the PCB. Bend these legs outward at right angles so that the trimmer will lie flat against the PCB. Use a little soldering iron (15-20w) and be very careful, the material the trimmers are made of can't take much heat at all. It must NOT be touched with the tip of the iron. Check after soldering that you can turn the trimmers easily.

OSCILLATOR LAYOUT DIAGRAM (Fig. C)



See back page for blow-up of design.

on layouts... X = Soldered Top and Underside



CIRCUIT DIAGRAM (Fig. D)
BUFFER

Next mount the transistors. First T6 and T7. The transistors should be mounted close to the PCB (2-3mm) . This is especially important for the emitter of T7 (base to earth). Ensure that nothing metallic touches T7's case as this is connected internally to its collector. Now mount the MRF237. Slightly countersink the base and collector holes on the underside of the board with a 3mm drill. This is to prevent a short circuit between the transistor's base and collector leads with the earth plane. Mount the transistor underneath the board onto the earthplane, having first put some heatsink compound on the bottom of the transistor (ie between the transistor and the board). Push the transistor against the PCB and solder base and collector on top. You can either cut off the emitter lead beforehand (this is connected internally to the case) or put it through its hole, and bend it so it can be soldered to the screen to the left of T8 (to be put on later). Using a high powered soldering iron (at least 50w) solder the case of the transistor to the earth plane. This has to be done as fast as possible. Rather hot and fast than slow and cold!

Now wind and mount the remaining coils. It doesn't matter in which sense you wind them (clock or anticlock-wise) except that they should stand at right angles to each other (at each stage) and be as far as possible from the sides of the case. This is especially important for L4 and L6. L6 should be approx. 5mm above the PCB.

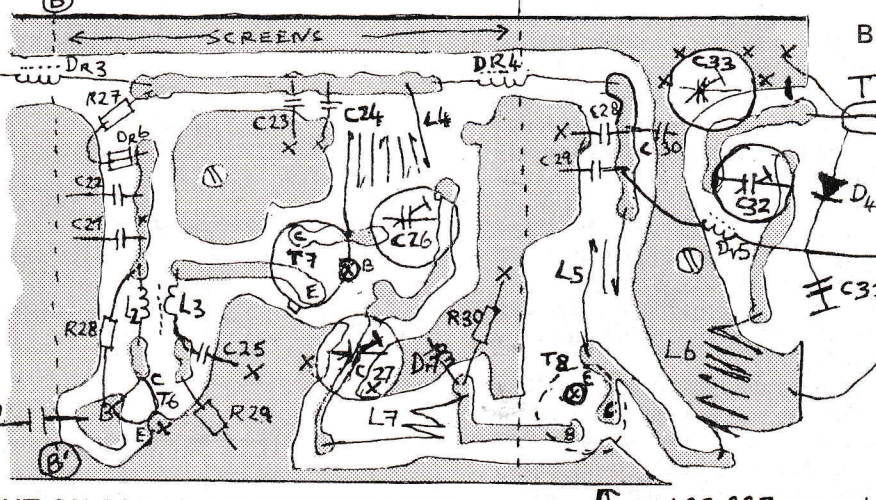
The printed circuit board should be attached to the bottom of the case in such a way that the MRF237 is gently pressed against the bottom of the case. This is done with bolts washers, spacers and nuts. Don't forget to put some heatsink compound between the transistor and the case.

The screens to the left of T6 and T8 are made from bits of single or double sided PCB. They should be measured to fit neatly with the sides and top of the case. Where a PCB track goes from one chamber to the next the screen will have to filed at the bottom to prevent shorting. Watch the trimmers when soldering!

The circuit is complete now, only Dr3, Dr4, Dr5 are missing. Connect 12v to the input of the 8v regulator and to the top of R27. There should be a current of 30-50 mA. The collector of T6 should be at 10-11v. If it is 0v, L2 is an open circuit. If the voltage is too low, R28 has to be increased, and if too high (rarely) decrease R28. Now mount Dr3. Put trimmer C27 into middle position. Turn C26 so it is ¼ meshed. Connect the 12v supply again, the current should be 80-120 mA. Write down the current and then adjust C26 and C27. The current consumption will change and T7 will get hotter than T6 (but should still be cool enough to touch). If the current consumption is still 50 mA as before there is a mistake somewhere. There should be a 12v on the case of T7. If there are no short circuits and no tantalum capacitors connected the wrong way round (Do check each stage meticulously before connecting the supply) the only possibility is a broken trimmer. If you have a dip meter or absorption wavemeter hold it near L4 and tune through..ie check there is no spurious output on other frequencies. Switch off again.

Finally mount Dr4 and Dr5 and clip a heatsink onto the

In the FIG C half of board the track is on underside. But on the Buffer half the track is on top and below is solid copper. All components on this side. In Fig C they connect through drilled holes! Geddit? (B) and (B') line up with Fig. C.



BUFFER STAGE (Fig. E)

(Right half of component side viewed from above)

X = soldered on both sides.

INPUT ON RIGHT OUTPUT ON LEFT

MRF 237 mounted on underside.

MRF 237. Solder a piece of co-ax cable to the output. Connect the cable by soldering a suitable plug onto the end to a dummy load via a Voltage Standing Wave Radio meter (VSWR meter) with power indication. Alternatively use the circuit in Fig.2 as the dummy load and a VSWR meter without power indication.

NEVER use the transmitter without a load! Short circuits can destroy the MRF237!

Check with an ohm meter that your dummy load has a resistance of 50 ohm. Now adjust your power supply to a maximum current of 800mA (if you can, that is). Adjust the trimmers C26...¼ C27...½ C32...¼ C33...¼ (ie. C26 ¼ meshed, C27 ½ meshed etc.)

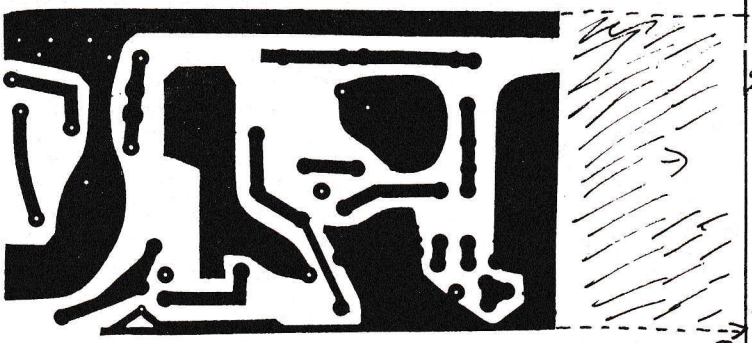


FIG. F PCB DESIGN FOR BUFFER STAGE OF OSCILLATOR (A)
(the actual pattern you get on topside of board is mirror of this)
Viewed from below. (Figs B E F on same board!)
ACTUAL SIZE

After switching on watch simultaneously power output and input current. Tune for max output power. Use a brass or aluminium tuning tool with an insulated handle. Tune C26, then C27 (doesn't have much effect) then C32, lastly C33. For the Ist 2 trimmers increasing power output results in an increase in input current. Not so with the final stage, if you mistune that current consumption can get too high.

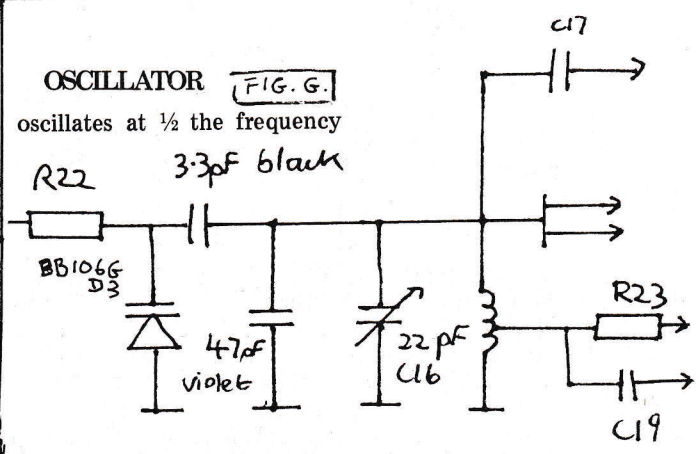
Some power supplies go mad with high frequencies..try and get one which is high frequency stabilised. Very careful people start tuning with low power supply voltages, but the stage supplied by the voltage regulator needs 12v to make sure the V regulator is working properly. You should repeat the tuning several times to get the feel of it. Maximum output power is 6 watts with a 12v supply and a MRF237, which corresponds to an input current of 750 mA to the whole circuit, of which 640mA goes to the MRF237. Under these conditions the transistor dissipates 8w (as heat) which it can handle if it has good heatsinking. If you have a trial run outside the case, the earth plane will just about keep the transistor cool The MRF237 can cope with 700mA for some time, but bear in mind that the voltage of a lead/acid battery can be up to 13.5 volts..ie its better to lower the output power by 0.5w, which isn't noticeable, than to risk low reliability by the transistor running too hot and blowing.

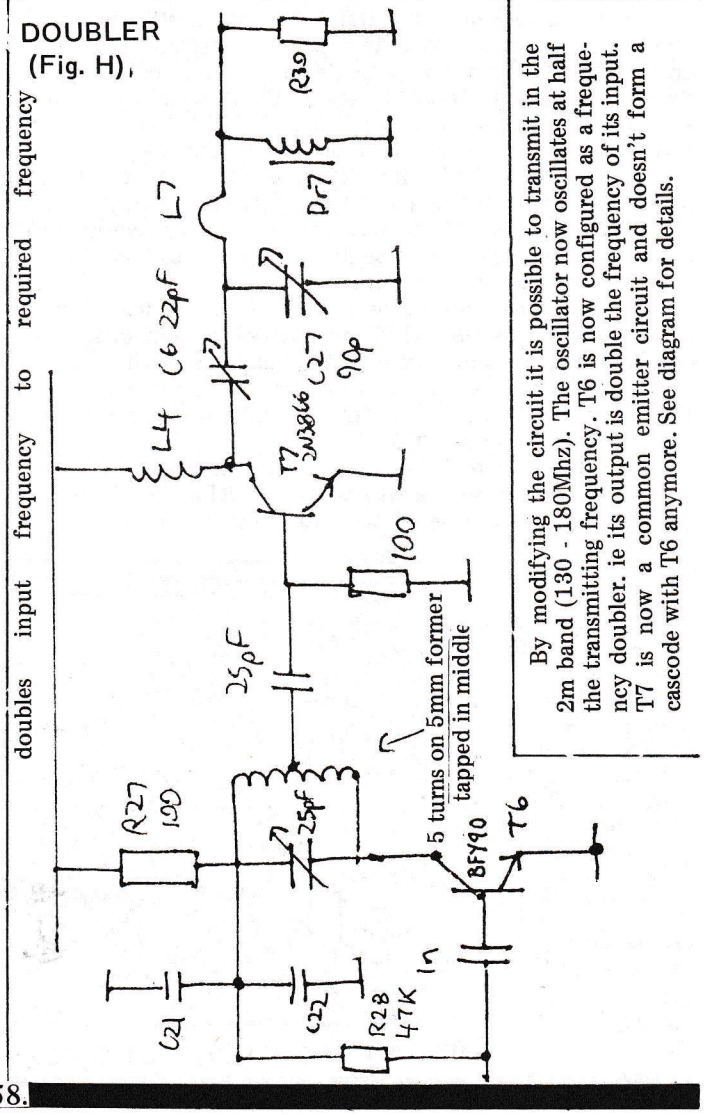
Using the formula I = w/v (w over v), you can calculate the maximum allowable input current for a particular supply voltage V, and W = 8 watts. The power can be easily reduced by adjusting C27. You should only do this after everything is built into the case as the sides of the case affect the coils and lower the circuit's amplification. In any case there is enough spare gain in the circuit to tune it uncritically and still supply the MRF237 with enough input drive. With a dipmeter switched to absorption wavemeter mode check all stages are working on only the oscillator frequency. If the amplifier stages have sufficient gain the tuning should be completely uncritical and the oscillator should have good stability, even when used outside the case. This is in spite of the broadband circuit design. If C26 is completely enmeshed at maximum output power then pull the turns of L4 apart slightly.

Now mounting the board onto the case. Drill holes above the trimmers in the top of the case so the final tuning of the trimmers and R19 can be done with the top in place. Drill holes also for the switches, sockets and LED. Power supply and output sockets should be on one of the shorter sides. In the high frequency part of the board put thin copper foil round the edge of the PCB, as far as the earth plane extends to, and round the edges of the screening walls. Solder on both sides of the PCB and the screening walls. Now using spacers, etc, mount the PCB. Don't forget heatsink compound for the MRF237. Mount the sockets and switch with all the components which are to be mounted on them (see diagram). Connect the output socket to C33 with the shortest possible length of wire. The earth connection can be soldered to a tag, which is bolted to one of the socket's mounting holes.

Now the final tuning. This is the same as the trial run. You should not use a dummy load with a SWR worse than 1 : 1.4. In practice the output power can be estimated from the power consumption of the transmitter, if you assume the efficiency is 60-70% approx.

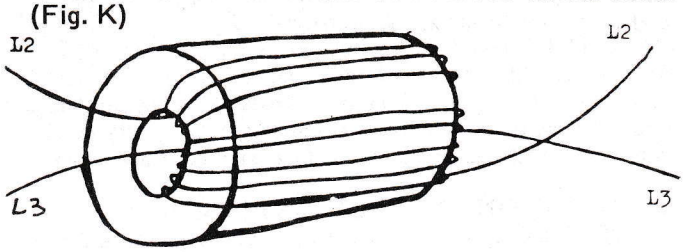
2m MODIFICATION.





By modifying the circuit it is possible to transmit in the 2m band (130 - 180Mhz). The oscillator now oscillates at half the transmitting frequency. T6 is now configured as a frequency doubler. ie its output is double the frequency of its input. T7 is now a common emitter circuit and doesn't form a cascode with T6 anymore. See diagram for details.

Transformer L2:L3 wound on FX1115 ferrite bead. (Fig. K)



COMPONENT LIST FOR 5 WATT TRANSMITTER.

R1 220
R2 470
R2' 4.7k
R3 1m
R4 100k min.trimmer,horizontal
R5 100k " " "
R6 47k
R7 47k
R8 not required
R9 220
R10 470k
R11 47k
R12 1k
R13 4.7k
R14 470k
R15 100
R16 2.2k
R17 2.2k
R18 2.7k
R19 100k min.trimmer,horizontal
R20 47k
R21 100k
R22 100k
R23 220
R24 150k
R25 100k
R26 180
R27 100
R28 27k
R29 2.2
R30 52 or 47

C1 Inf ceramic
C2 Inf ceramic
C3 47 µf 16v elect.PCB mounting
C4 10 µf 16v elect.
C5 1 nf ceramic
C6 10 µf 16v elect.
C7 15 µf 16v elect.
C8 1nf ceramic
C9 1 nf ceramic
C10 16 µf 16v tantalum
C11 47 pf ceramic
C12 10 nf polysyrene foil
C13 680pf polystyrene foil
C14 16 µf 16v tantalum
C15 680pf ceramic

C16 2-22pf min. foil trimmer 7.5mm,

green. (eg. Cirkit 06-22001)
C17 6.8pf ceramic
C18 plus C18', C19, and C20 1 nf ceram.
C21 100 nf ceramic
C22 Inf ceramic
C23 100nf ceramic
C24 , C25 Inf ceramic
C26 2-27pf min. foil trimmer 7.5mm,red
(eg. Cirkit 06-36001)
C27 5.5-80pf min. foil trimmer 10mm,red
(eg. Cirkit 06-80001)
C28 Inf ceramic
C29 100nf ceramic
C30 16nf 16v tantalum
C31 Inf ceramic
C32, C33 As C27

D1 LED
D2 1N4148
D3, D3' either BB105G (two) or one BB204G
D4 1N4001

T1 BC549,BC239,BC109 (pref C type)

T2 as for T1
T3 BC516
T4 BF256B or BF245B (not C type!)
T5 BF256B or BF245B(C type possible)
T6 BF254 or BFY90
T7 2N3866 or 2N4427
T8 MRF 237

screen — connect to earth plane

DR1 Wide band choke mounted directly on tape recorder socket
DR2 3 turns of 0.2mm (34SWG) enammelled copper wire on FX 1115 ferrite bead
DR3 wide band choke
DR4 wide band choke
DR5 wide band choke
DR6 FX1115 ferrite bead on lead of R27
DR7 wide band choke

L1 4½ turns of 1mm (18SWG) silver coated copper wire on 6mm former, tapped at 1½ turns from cold end
L2 6 turns of 0.3mm (34SWG) on FX1115 ferrite bead
L3 2 turns of (same as above) " "
L4 7 turns of 1mm (18SWG) silver coated copper wire on 8mm former
L5 3 turns of 1mm (18SWG) silver coated copper wire on a 6mm former
L6 6 turns 1mm (18SWG) silver coated copper wire on a 6mm former
L7 as L5

78L08 8v voltage regulator
S1, S2 switches
Printed Circuit Board (PCB)
S0239 UHF socket with earthing tag
copper foil
braided wire
power supply connectors
input connectors
1A fast blow fuse and holder

viewed from below

IN OUT

FOOTNOTES

Here is some info for people who aren't too knowledgeable about high frequency circuitry, and who probably have had even less experience on a practical level.

1. COMPONENTS SHOULD HAVE SHORT LEADS.

Every additional unnecessary length of wire in VHF circuits increases the chances of undesirable oscillations (properly called parasitic oscillations). To guard against this solder components as close to the Pcb as you can, to get an unambiguous output on just ONE frequency!

2. WE WON'T GET ANYWHERE WITHOUT EARTH.

The case must be earthed. ie be at zero volts potential relative to the negative side of the supply. Use a tag bolted to

the output sockets' mounting holes. Solder a thick bit of braided wire between the tag and the neg. supply input socket. This will earth the case, but the circuit board still needs earthing. There might be an earth contact from the MRF237 to the heatsink to the case but its better to provide an additional safe earth connection. Another piece of thick braided wire will work. Solder one end to the earth plane and connect the other to the case near the power supply connections.

If you use metal connectors for the microphone and tape recorder input sockets they will be earthed through the case. If you use plastic ones you'll have to solder a wire between the earth tag on the connector and the earth plane on the board. Better still regardless of choice of connector is to use a piece of screened audio co-ax.

3. EARTHLY DELIGHTS.

Its important to use a double sided PCB for the High Frequency stages, so that any part of the circuit can be easily earthed.

4. HEAT HAS TO GET OUT.

If, for eg, the threaded bolt of a high power transistor has broken off, its no use trying to solder it back on. A soldered joint doesn't transfer heat at all well, so either the transistor overheats and is destroyed, or the heat melts the joint and then it overheats and is destroyed.

Similarily any heatsink has to be all one piece of metal. Even a setup like "threaded bolt- heatsink compound- heatsink -case-heatsink compound- another heatsink" does not transfer enough heat to the outside air. (But here we're talking about mega power situations you wont face with your 5 watter).

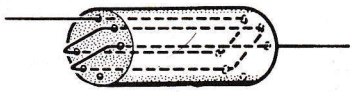
5. CAN YOU PUT ANY ONE IN ANY POSITION?

No. We'll have to wait till after the revolution for that. If you want to use different transistors than those mentioned you'll have to check the pin outs to see which is base, collector, etc. There are nearly as many pin outs as there are transistors. Check in a catalogue or data book that replacements are compatible.

6. MATCHMAKING

If you want to use a telescopic aerial check the matching before each use. You'll get much better results with a proper aerial. You might get a better match without using the full extension. How far you can pull such an aerial out depends (among other things) on the transmitting frequency..Matching can only properly be done with a VSWR meter, thats why its a basic piece of test gear.. See later under AERIALS.

Detail Of A Wideband Choke. FIG. I



TO MAKE A WIDE BAND CHOKE:

Get a FX1898 ferrite bead or Cirkit stock no. 55-25111. Wind 2½ turns of 24 SWG tinned or enamelled copper wire through 5 of the 6 holes as shown on the diagram.

WHERE TO GET THE PARTS:

Cricklewood Electronics, for instance, stock everything except the ferrite beads and the wire. Their MRF237 is rather expensive (£7.05).

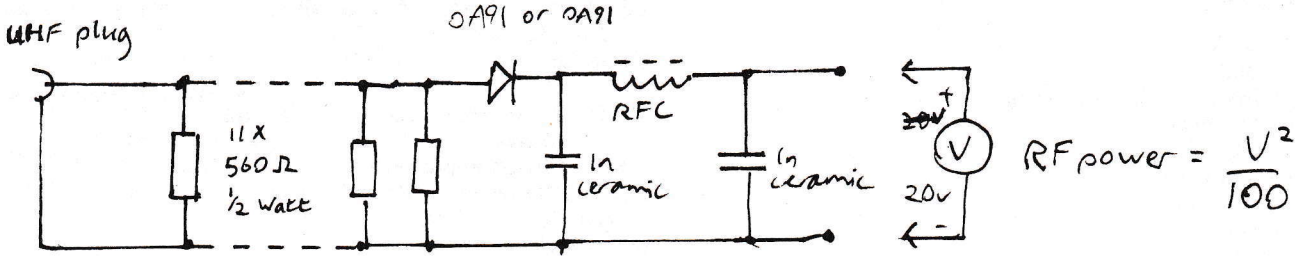
Maplin has most of the bits except some semiconductors, FX1898 and the silver coated wire.

Cirkit stocks most of the bits including the FX1115 ferrite beads (comes in packs of 10), the other ferrite bead, and the silver coated copper wire. They don't stock all the semiconductors but their MRF237 is cheaper (£4.46).

Cricklewood Electroniccs Ltd. 40 Cricklewood Broadway, Lon NW23ET. Tel. 01-450-0995 or 01-452-0161. Free catalogue on request.

Maplin and Cirkit catalogues from your local W.H.Smut.

(5WATT TRANSMITTER) DUMMY LOAD WITH POWER MEASURING CIRCUIT (Fig. J)



RFC is five turns (34SWG) on FX1115 ferrite bead.

If you buy a dummy load (loads less hassle, a 30w one will set you back £9) you can build the rest of the circuit (ie the diode, capacitors and choke) into the body of a UHF plug.

Get a UHF T-piece connector and you can connect the transmitter output into the dummy load and power measuring circuit at the same time

MAKING YOUR PCB BOARD

You can make your PCB board photographically by using the blacked in Fig. B & F.

A paperback book which describes the whole and several alternative processes in intimate detail is *'How to Design and Make Your Own PCB's'* by R.A. Penfold. Published in the Babani Series of electronic books. It's available from the Maplin Catalogue, Page 48, (costs £1.95), and there's a good chance your local library will have it.

COST

5 WATT TRANSMITTER. . . approx. £16, excluding PCB and case.

15 to 80 WATT AMPLIFIER. . . approx. £70, excluding PCB and case and heatsink.

80 Watt Amplifier

This Amp should be quite suitable to attach onto the 25W (max.)—design on p54. We haven't built one ourselves yet.

General Description.

The following describes a 80w VHF FM amplifier. Input and output impedences are 50 ohm. Output power is 80w with a 12.5v supply and 15w input power. Its possible to increase the input power to 25w but this does not increase output power significantly. You shouldn't use more than 25w of input power without using an input attenuator.

The power supply has to be much more serious affair than for a 25w design. The power amp can draw up to 14A DC. Adding this to the current drawn by a 25 watt transmitter and we're talking 16A. You'll have to work with a car battery or similar lead/acid battery rated at least 20Ah. If you have a RF stabilised mains power supply with a 20A output capability you could apply 13.5 volts to the amplifier and achieve an output power of 110w. We suggest you only try this if you have proper heatsinking and guaranteed low SWR. (The manufacturers data sheet says dont exceed 100w output power (on the transistor). The bandwidth of this amp is 5Mhz for a 20% decrease. You can only use this bandwidth if you use a low pass filter on the output, otherwise the simple built in bandstop filter L6/C10 (tuned to the 2nd harmonic) will restrict the usable bandwidth to 2 Mhz.

Our prototype used a relay to provide reverse polarity protection. Three LED's indicate ready, reverse polarity, and high temperature. On reaching 90degrees C the amplifier is disconnected from the supply. The transmitter feeding this amplifier should also be connected via this relay, as the power transistor doesn't take kindly to having input power applied to it when it doesn't have a supply voltage.

The amplifier power supply should be connected using crocodile clips or big plugs...something like a DIN plug could not handle the current. The supply cables should be of 3-5 square mm cross section and no longer than 100cm.

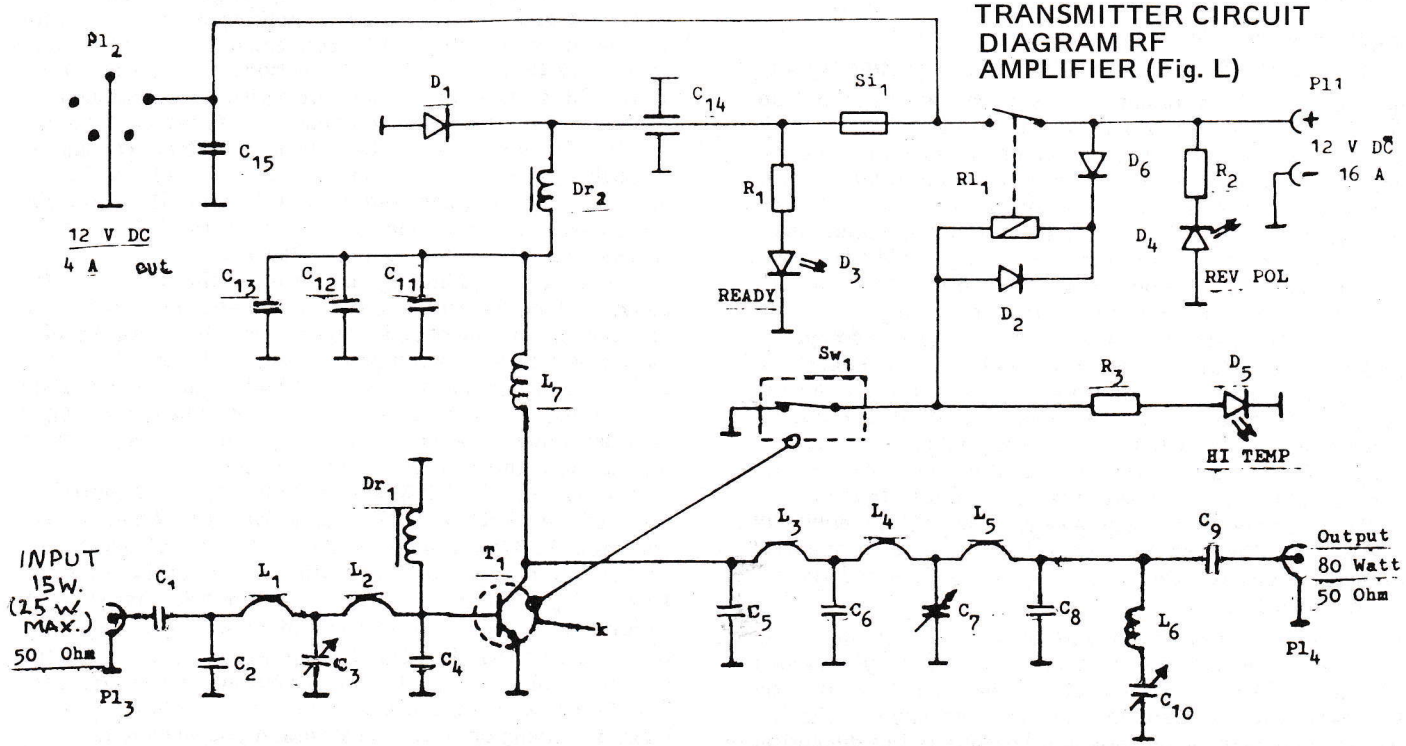
CIRCUIT

The heart of the circuit is the RF power transistor MRF 245. This is a controlled Q transistor with internal base and collector matching. This transistor is designed for the 145-175 Mhz VHF band and exhibits broad band characteristics within this range. The circuit is tuned as the development of a linear amplifier, and would require extensive knowledge of the transistor and extensive calculations. The transistor's characteristics in the frequency band we are interested in are not published by the maker and we you'd need loads of expensive test gear to find them for yourself. Therefore this circuit was developed mainly by experiment. If you had all the test gear you could probably achieve a better bandwdth and greater harmonic suppression.

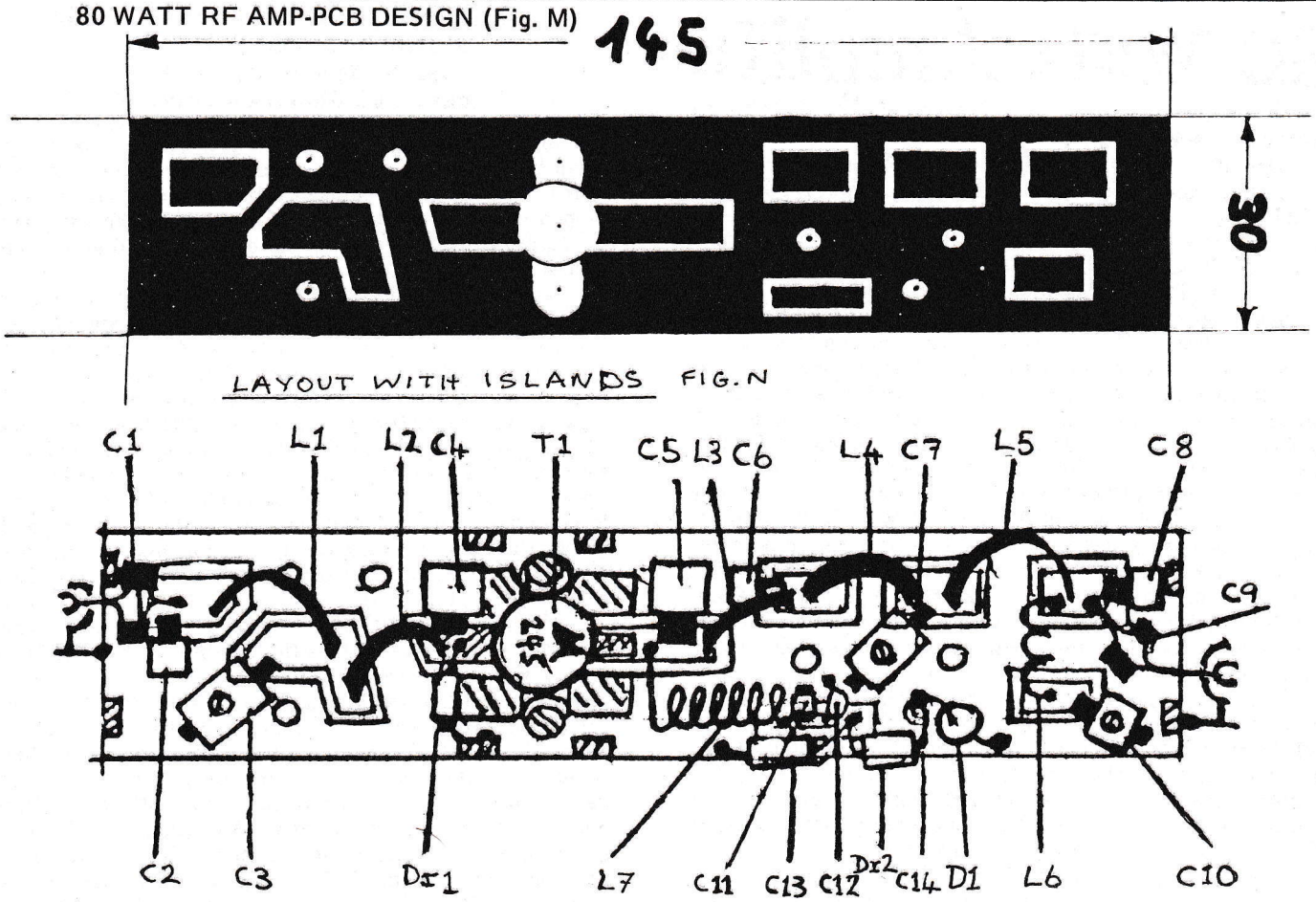
At the base and collector of the MRF245 are the relatively high value capacitors C4 and C5. These are part of the low pass impedence matching networks for input and output. Enormous currents flow through these capacitors so they have to be specially chosen eg Unelco mica capacitors or Erie high Q chip capacitors with low pass C3G dialectric. Because of the small size of the chip capacitors they've a tendency to overheat. Avoid this by using a combination in parallell to add up to the correct value, which is 440-550 nf. The only variable component of the input network is the trimmer C3. This allows the input network to be tuned across a wide range of frequencies, The input network has a narrower bandwidth than the output network.

The transistor MRF245 operates in class C mode, and so has no base bias, Dr1 ensures this condition is met. The power supply voltage is applied to the collector via L7. The output impedence transformation back to 50 ohm is performed by three pi networks with low pass characteristics. This network is tuned with C7. L6 and C7 form a bandstop filter which is tuned to the 2nd harmonic. It works by providing a low impedence path to earth for frequencies in that region, thereby reducing the power output of the 2nd harmonic. If you can't get a dipped mica capacitor for C9 use two or three readily available ones in parallel. The purpose of this capacitor is to isolate the DC supply from the aerial output, it doesn't do any matching. Using ceramic capacitors in parallel is necessary cos it keeps the parasitic inductance small. Similarily for C1 use a dipped mica or 2 or 3 ceramic capacitors in parallel.

The power supply decoupling is very important. The capacitors C11, C12 and C13 have different orders of magnitude as they're only efficient at preventing parasitic oscillations in a particular frequency range. Together they'll do it over a wide range. The supply is further decoupled by choke Dr2 and feedthrough capacitor C14. The amp is protected from reverse power supply polarity by a relay. The relay's contacts only close, allowing the supply voltage to the



80 WATT RF AMP-PCB DESIGN (Fig. M)



amplifier, if the supply is connected the right way round. If the relay fails by, eg, the contacts welding together, which can happen with 16A, D1 will short the supply voltage and the fuse will blow. Reverse polarity on plug PL1 is indicated by the green LED D4. 'Ready' is indicated by red LED D3. The amplifier is protected by a thermal switch. If the heatsink exceeds 90 degrees c the supply to the relay coil is interrupted which diconnects the power to the amp. This is shown by yellow LED D5. The amp is reconnected when the heatsink cools below 70 C. Plug PL2 supplies the exciter (12v max 5 A) which should also be protected from overheating or reverse polarity.

CONSTRUCTION

Use double sided glass fibre PCB. The suggested layout is only one of many possibilities. If you change the layout do NOT alter the size or shape of the islands on the PCB to which any of the inductors L1 to L5 or the transistor are soldered. This is to ensure the inductors have the same bending radius and therefore inductance as they have on our prototype The suggested circuit plan was designed to use miniature mica compression trimmers. Anything else will probably be too big to fit on our design. If you enlarge the PCB by 10mm on both sides you'll have more room for alternative set-ups.

You should have all parts on hand and then redesign the PCB layout accordingly, bearing in mind what you're going to do about heatsinking and putting the whole thing in a case. You might need to drill another hole in the PCB to accomodate the temperature switch. Decide how you'll mount and position the feedthrough capacitor,bearing in mind that its fragile and shouldn't be subjected to any mechanical stresses.

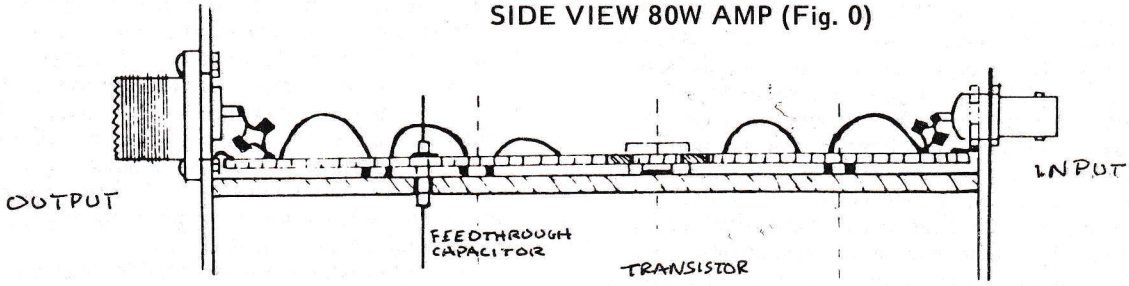
We recommend you introduce a second PCB, completely screened from the High Frequency PCB, on which is mounted the reverse polarity protection relay, the LED's and the DC output socket PL2.

The high frequency input and output sockets should be mounted on the case directly over the PCB so they're perpenicular to the PCB. Or the sockets can be over the ends of the PCB, parallel to the board, in which case the length of the PCB dictates the length of the case and heatsink in this dimension. The sockets must have a durable and flawless connection to the earth plane on the PCB. The best thing is to connect a thick wire from the PCB earth plane to the case next to the sockets. Either solder directly to the case material, or preferably use tags bolted through the sockets. mounting holes. Most BNC sockets have their own tags which you can use.

Drill the holes in the PCB. Apart from the holes for the transistor the PCB should be bolted to the heatsink at least twice on the base and collector side of the PCB. ? Use 6BA/ M3 or larger bolts. Solder brass or copper strips along the long edges of the PCB to connect the top and bottom earth planes together, do the same by soldering strips through the hole where the emitter flanges of the transistor are to be soldered. This is so the emitter will be connected to both the top and bottom earth planes next to the body of the transistor. If your PCB is much wider than our design we recommend you introduce such 'through contacts' two times each near the emitter. There should also be a through contact near the feedthrough capacitor. To do this drill a small hole in the PCB, insert a thick wire, and solder on both sides. The earth plane should have a good connection both to the high frequency sockets and the negative supply connection.

After these plumbing jobs mount the transistor from above. Solder the whole length of the emitter flanges. These are the ones on the outside. The collector is the smaller of the two inner flanges. Then mount capacitors C4 and C5. Cut L1 to L5 out of copper or brass sheet and mount these as shown on the diagram together with C1 to C9. When soldering the capacitors make the joint as large as possible to keep stray inductance low and achieve better heat conduction. The loose ends of C1 and C9 will be soldered directly to the central contacts of the BNC or UHF sockets later on. When soldering the trimmers ensure to solder the contact which is connected to the rotating part to earth, otherwise you'll have big poblems trying to tune the circuit with metallic instruements. Before you solder in L7 you should mount C11, C12 and C13 then Dr2 and Dr1. Leaving Dr1 out would be disastrous (positive base voltage = high collector current = new transistor). The feedthrough capacitor C14 can be fitted now, or left till later, depending on which construction you've chosen.

SIDE VIEW 80W AMP (Fig. 0)



After finishing work on the PCB it can be bolted to the heatsink. Put a thin coat of heatsink compound on the bottom of the mounting flange of the transistor. Bolt this flange to the heatsink with 6BA or M3 bolts. The PCB is then bolted to the heatsink in 4 places, using shakeproof washers above and below the PCB at such a height so as not to flex the PCB or put any stress on the transistors leadouts. If this is done right the PCB will end up about 2mm above the heatsink. Obviously you'll have drilled holes in the heatsink corresponding to those in the PCB and the transistor mounting flanges. The use of shakeproof washers ensures good contact on both sides and stops loosening by vibration. Provisionally attach a fuse and the input and output sockets and you can start tuning.

TUNING

Tuning the amplifier is relatively simple, but you have to have the right test gear. You'll need a 100w power meter and a correspondingly rated 50 ohm dummy load. Most shortwave dummy loads can be used up to 100Mhz, eg. the well known oil cooled tin models. At 80w they can be used without the oil for several minutes. If you use a dummy load in conjunction with a feed through power metre (or calibrated SWR meter) this must be able to cope with 100w at 100Mhz as well. The best solution is to get a complete dummy load power meter. For brief standing wave and relative power measurements you can use the normal little SWR meter, but its recommended that you reduce their sensistivity by adding a resistor of about 10 K ohms in series with each gang of the twin potentiometer. This prevents the meter indicating FSD with the sensitivity set just above zero. Also the matching of the pentiometer gangs is not guaranteed at the extremes of its travel, which could result in a wrong SWR reading. If you use the SWR meter for more than brief periods, at a power over 40w, the diodes will get warm and your readings will be inaccurate. So switch on transmitter and amp just to take a reading and then switch off.

To tune the2ndharmonic filter you'll need a dipmeter or an absorbtion wavemeter (or a spectrum analyser if you've a few grand to spare). You'll need two ammeters, a 5A for the TX (transmitter) power supply and a 15A for the amp power supply, assuming they're not part of any mains supply units you may be using. Useful, but not necessary, are two volt meters, one of each supply.

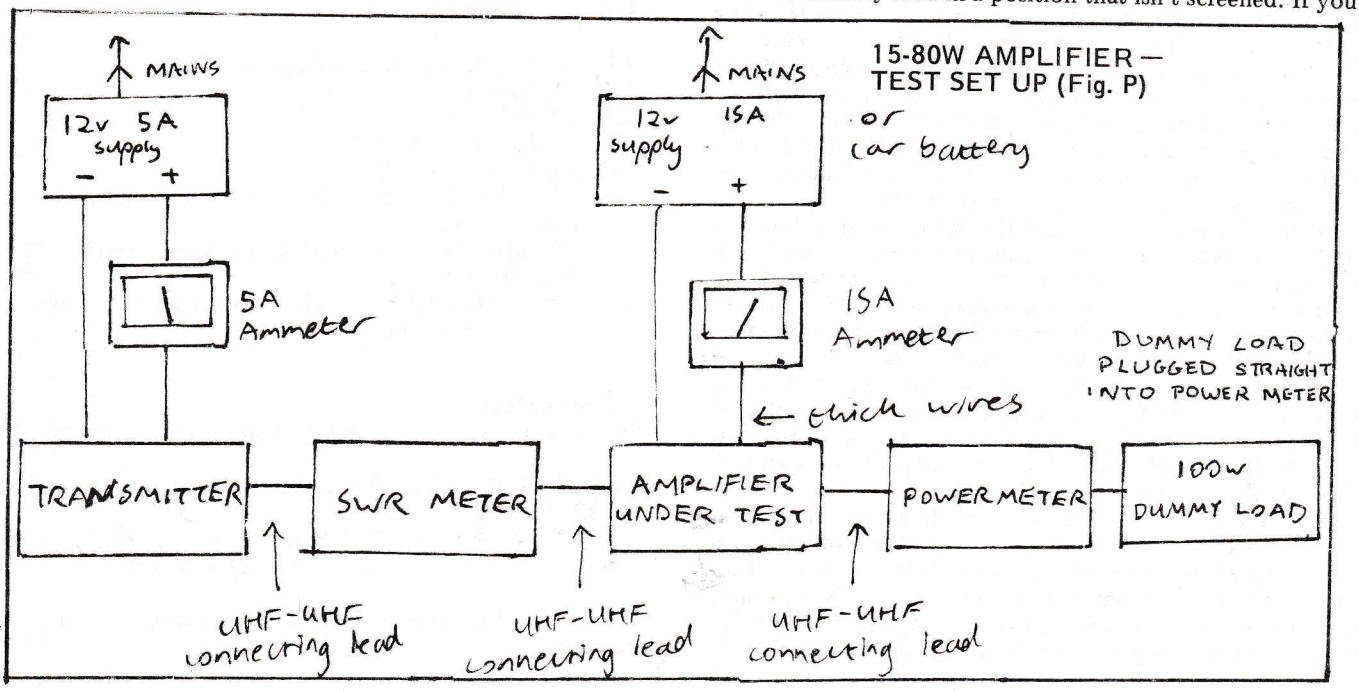
To sum up,to tune the amp you need: A transmitter, ideally 15-20w output power,tuned to the desired frequency. A 12v 5A mains power supply to run the TX. A 5A amp A lead to connect the Tx to a SWR meter. A lead to connect the SWR meter to the amp. being tested. A 12v 15A mains power supply or 12v car battery. A 15A ammeter. A lead to connect the amplifier into the power meter. A power meter. . . A lead to connect the power meter into the dummy load. The dummy load. The dip meter (see diagram)

Tuning is as follows. Switch on the amplifier. It should draw practically no current, Now switch on the 15w TX which obviously has to work properly. Read the 5A ammeter and the SWR meter. The SWR value will probably be bad and the amp still drawing hardly any current.. and the power meter showing a low reading. Carefully adjust C3. Suddenly the current shown on the 15A ammeter will rise sharply, and the power meter will follow more or less. Adjust C3 so the current is about 7A, Now adjust C7 for maximum power output, for this C10 should be completely unmeshed (min. capacitance) .Adjust C3 and C7 alternately to trim the amplifier for max power output. Depending on the supply voltage and the thickness of the supply leads you should be able to get 80- 110 watts. The little SWR meter between the TX and the amp. should show a good SWR reading (less than 1 : 2) The amplifier current consumption should be between 10 and 14A. The transmitter's consumpton should be about the same as if it was driving a dummy load (check it if you can't remember).

If you run into problems and things aren't clean switch it all off. Think. This stuff is power electronics..ie it can get real hot and start smouldering.

After this rough tuning tune the amp's harmonic filter. Set up the dipmeter so it covers 100-250Mhz. It has to be near the dummy load in a position that isn't screened. If you

15-80W AMPLIFIER — TEST SET UP (Fig. P)



can't find such a position you could for example unscrew the top off the dummy load, but beware, you're now transmitting!

Approaching with the dipmeter you'll detect a definite indication at the desired frequency, even at some distance. Now set the dipmeter to double the frequency and approach the dummy load again. Tune the dipmeter..you shouldn't get any other readings but the one on double the transmitting frequency. If you get a reading that increases steadily as you tune up the scale of the dipmeter this is an aperiodal coupling to the dummy load.. the readings are meaningless.

If you get close enough to the dummy load to get aperiodic coupling but still no indication of the first harmonic, the amp should be OK as far as that harmonic is concerned , but there is usually a fairly strong indication at double the frequency after rough tuning.

Keep the dipmeter in position tuned to the 2nd harmonic and using an insulated screwdriver with a short blade adjust C10. Suddenly the indication on the dipmeter will disappear completely, but the output power will fall as well. Adjust C7 to improve the power output again, and then adjust C10 to obliterate the 2nd harmonic again. This will give you optimum tuning for a bandwidth of about 1Mhz.

If you want a wider bandwidth you'll have to tune up differently. When performing the rough tuning (C10 completely unmeshed as before) turn C7 further than to achieve max power so that the power output and current consumption decrease again. (output power will be 65-80w).Now tune the TX to the lowest frequency of the desired frequency range and minimise the 2nd harmonic using a dipmeter and C10 as described above. Check the power output across your desired frequency range.

The wider the bandwidth you want the more output power you'll have to sacrifice. Tuning for a bandwidth of more than 4Mhz involves a lot of high precision work. C3 could be used to keep the output power constant across a wide bandwidth but this can result in the in SWR readings of 1:3 between the TX and the amp at the ext emes of the band. In this situation the TX has to be cooled well.

PARTS

The biggest problem in building a VHF amp for this output power is getting the necessary parts. Often CB and amateur radio specialist shops wont have all of them. Most are to be had by mail order from various sources.

The MRF 245 and MRF247 are also stocked by Raedek Electonics at £33 each. Phone for current prices (See CONTACTS below). The fixed capacitors C2, C4, C5, C6 and C8 are special due to their high quality and extremely low inductance leads. Use either dipped mica or high quality ceramic chip capacitors with C3J dialectric. The dipped mica capacitors are made by UNELCO. Also check out the SEMCO range of capacitors in the Cirkit catalogue. There are two different sizes,the principle of construction is the same Several layers of metal foil are insulated from each other by layers of very thin mica. Every second layer of foil is led to the outside to the tag of the capacitor, the other foil layers connect to the metal clip holding the system together. This side should be soldered to earth and the tag soldered to the PCB islands. The ceramic chip capacitors (ERIE high Q ones with C3G dialectric) are symmetrical. At each end of the almost square chip (about 4X4mm) is a solderable metal strip. Which one of these is earth doesn't matter. Cirkit stock a small range of chip ceramics. They call them Leadless Ceramic.

If you can't get the right value you should think of using smaller values in parallel. Unelco capacitors can be soldered on top of each other if you haven't space. This shouldn't cost too much if you don't build too many amps. For C4 and C5 definitely use the larger dipped mica. If you can only get ceramic chip use two in parallel cos of their tendency to heat up. For the trimmers C3 and C7 you can't use anything but mica compression trimmers. . These work by compressing metal foils insulated from each other with mica. By tightening the bolt you compress and increase the capacitance. For C10 you should use a miniature air spaced trimmer cos of its low capacity.

To make the strip inductors get some copper or brass sheet metal of about 0.1mm thickness. This can be had hopefully from craft shops. The silver coated copper wire is available from Cirkit. You could use insulated copper wire for L7.

The heatsink largely determines the looks and construction of the amp. There are special heatsinks the above described PCB can be sunk into. If you can't find one best use a standard heatsink of enough cooling capacity, ie. thermal resistance less than 0.5 degrees C/W. The shape of the heatsink will determine the problems when designing the heatsink protection, feedthrough capacitor, case, etc.

For better bandwidth use MRF247 instead of MRF 245.

Naturally you wouldn't even consider using an amp of this power into some crummy piece of TV co-ax cable, Get some Uniradio 67 from Cirkit.

PARTS LIST FOR THE 80 WATT AMPLIFIER

T1 MRF245 or MRF247 (Raedek)
D1 IN5402
D2, D6 IN4002
D3 Red LED
D4 Green LED
D5 Yellow LED
SC1 16A fuse and fuse holder
PL1 Din socket 5 pin 240 degree, or what you fancy
PL2 two 4mm sockets, one red, one black
PL3 BNC socket or UHF S0239 socket with earth tag
PL4 S0239 UHF socket with earth tag
SW1 90 degree C thermal switch (not thermal fuse)
R1, R2, R3, 1k ohm
RL1 Relay 12v 150ohm, 16A contacts
C1 500pf dipped mica capacitor or two nf ceramic in parallel
C2 10 or 15pf Unelco or Semco or Erie high Q C3G dialectric
C3 10 to 80pf or 15 to 115pf or 30 to 120pf mica compression trimmer
C4 500pf (440 to 510) Unelco or Semco or two Erie 220pf in parallel
C5 as C4
C6 100pf Unelco, Semco or Erie
C7 as C3
C8 22pf Unelco or Semco or two 10pf Erie in parallel
C9 as C1
C10 5 to 15pf Air trimmer
C11 3.3nf ceramic, preferably chip ceramic
C12 100nf ceramic
C13 10µf 35v tantalum
C14 4.7nf feedthrough capacitor, boltable
C15 3.3nf ceramic

L1 3 X 35 X 0.1mm brass or copper strip
L2 3 X 25 X 0.1mm " " "
L3 3 X 15 X 0.1mm " " "
L4 3 X 25 X 0.1mm " " "
L5 3 X 35 X 0.1mm " " "
L6 3½ turns 1mm (18SWG) silver coated copper wire on 6mm former
L7 6 turns 2mm (14SWG) silver coated copper wire on 7mm former
Dr1, Dr2 wideband ferrite choke (see parts list of 5w transmitter for details of these)

Copper or brass sheet
Heatsink, thermal resistance less than 0.5 degrees C / W

CIRKIT, Park Lane, Broxbourne, Herts, EN10 7NQ. Tel. (0992) 444111.
RAEDEK Electronics, 102 Priory Road, Scribers Lane, Hall Green, Birmingham B28 0TB. Tel. o21 474 6000

Also useful are Cirkit and Maplin catalogues, from your local W.H.Smith.

FM Aerials: Construction Plans.

These plans include details for the construction of antennas suitable for the FM broadcast band. Their is nothing magical about their design, just basic rules governing the construction of antenna systems. They can therefore be modified to work at other frequencies as well. They work equally well for the transmission of AM, FM, PM, PCM, and CW.

BASIC RULES:

(1) An antenna and its transmission line should have the same value of impedance.
(2) An half-wave dipole antenna has a nominal feed impedance of 75 ohms.
(3) Two similar antennas connected in parallel have 1/2 of the normal impedance.
(4) Generally, the effective power increases directly to the number of antennas used.
(5) An effective power gain in one direction results in a power loss somewhere else.
(6) There is always a loss of power in a transmission line.
(7) The smaller the size of a transmission line, the greater its loss.
(8) A 1/4 wavelength of transmission line can act as an impedance transformer.
(9) A 1/2 wavelength of transmission line exhibits the same impedance at both ends.
(10) A 1/4 wavelength of transmission line can act as an RF decoupler.
(11) A 1/4 wavelength of transmission line delays a signal by 90 degrees (1/4 cycle).
(12) Radio waves travel at the speed of light through space (and air).
(13) Radio waves travel slower over wires and through cables.
(14) A super low VSWR is not needed, a VSWR of 1.5 or even 2 to 1 is acceptable.
(15) A 100 foot piece of RG-8 coax allows only 63% of the power to reach the antenna.
(16) A 100 foot piece of RG-59 coax allows only 50% of the power to reach the antenna.
(17) Radio waves travel at .66 light speed through cables with "poly" insulation.
(18) Radio waves travel at .82 light speed through cables with "foam" insulation.
(19) Radio waves travel at .95 light speed over large wires (pipe, etc) (uninsulated).
(20) Radio waves travel at light speed over very thin wires (uninsulated)

The above are simple rules that do contain exceptions. But for our purposes they will do just fine.

ANTENNAS DISCUSSED

Simple Stacked Vertical Dipoles	(Vertical Polarization)
Inverted Vee Antenna	(Horizontal Polarization - some Vertical)
Half-Wave Phased Colinear	(Vertical Polarization)
Stackable Vertical Dipoles	(Vertical Polarization)
Stackable Horizontal Dipoles	(Horizontal Polarization)
Circular Polarization	

CALCULATIONS:

		Answers for 100 MHz
(1)	Wavelength in inches = 11811/ f_{MHz}	11811/100 = 118.11 inches
(2)	1/4 Wavelength (poly) coax = .66 x .25 x	.66 x .25 x 118.11 = 19.49 "
(3)	1/4 Wavelength (foam)coax = .82 x .25 x	.66 x .25 x 118.11 = 24.21 "
(4)	1/4 Wavelength (large wire)= .95 x .25 x	.95 x .25 x 118.11 = 28.05 "
(5)	1/4 Wavelength (thin wire) = 1.0 x .25 x	1.0 x .25 x 118.11 = 29.52 "
(6)	1/2 Wavelength (poly) coax = .66 x .50 x	.66 x .50 x 118.11 = 38.98 "
(7)	1/2 Wavelength (foam)coax = .82 x .50 x	.82 x .50 x 118.11 = 48.43 "
(8)	1/2 Wavelength (large wire)= .95x .50 x	.95 x .50 x 118.11 = 56.10 "
(9)	1/2 Wavelength (thin wire)=1.0 x .50 x	1.0 x .50 x 118.11 = 59.06 "
(10)	.8 Wavelength (space or air)= .80 x	.80 x 118.11 = 94.49 "
(11)	3/4 Wavelength (thin wire) .75 x	.75 x 118.11 = 88.58 "
(12)	5/4 Wavelength (thin wire) 1.25 x	1.25 x 118.11 = 147.64"

Above answers "rounded-off" to the nearest 1/8" for 100 MHz

(1) 118 1/8 "	(7) 48 3/8 "
(2) 19 1/2 "	(8) 56 1/8 "
(3) 24 1/4 "	(9) 59 "
(4) 28 "	(10) 94 1/2 "
(5) 29 1/2 "	(11) 88 5/8 "
(6) 39 "	(12) 147 5/8 "

The above calculations have been made for 100 MHz as a "center" frequency for the FM band. For precise results you may wish to do your own calculations for your particular frequency of operation. Simply divide 11811 by your frequency in MHz to obtain your wavelength in inches. Use that figure with the other equations to obtain the necessary dimensions.

SIMPLE STACKED VERTICAL DIPOLES (Fig. 1)

This is a very simple yet effective antenna. It is constructed from lengths of RG-8 coaxial cable. The uppermost radiator is just a small wire of 1/8th inch or less in diameter. It may be soldered to the center conductor of the coax, or you may simply use the inner conductor of the coax itself. You can hold it up straight by attaching a wood splint along its length and securing that splint to the coax below.

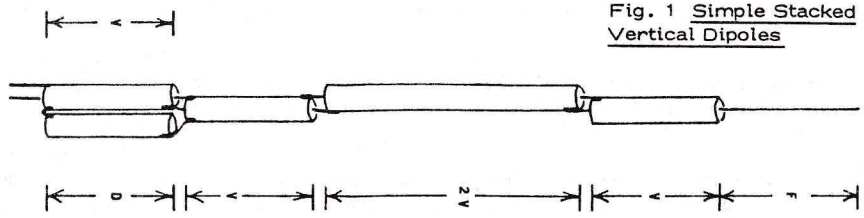


Fig. 1 Simple Stacked Vertical Dipoles

The center conductor of one coax is soldered to the outer conductor of the next coax, and so on down to the bottom. The bottom section on the right is a piece of coax with the center conductor cut off completely. It is used as a 1/4 wavelength

"decoupler". This allows the antenna to be fed with an unbalanced transmission line (coax). Without this decoupler the feed coax would also radiate signal and upset the coverage pattern of the system.

When completed the whole thing can be slipped into a section of 3/4" PVC pipe. The top end is covered with a PVC cap glued in place. The bottom end cap has a 5/8" hole drilled through it. An SO-239 connector is fastened into the hole. The antenna is then fed with a 50 ohm coax such as RG-8. The feed impedance is closer to 36 ohms than 50 ohms so the VSWR will be about 1.4 to 1.

If the antenna is free standing or mounted on a wood support the coverage pattern will be omnidirectional (see Fig. C , pattern #1). If the antenna is mounted 1/4 wavelength out from a metal support (such as a tv mast) it will be "shadowed" on the mast side but will show some "gain" toward its front side (see Fig. C, pattern # 4).

The antenna itself exhibits a 3 dB gain (2 X power) because of the two dipoles and would have a coverage distance (in respect to a single dipole) similar to Fig. D, pattern # 2. If it is mounted 1/4 wavelength out from a metal mast it could give up to a 6 dB gain (4 X power) as seen in Fig. D, pattern # 4. The increased distance however is at the expense of lost coverage area in the "shadow" of the mast (Fig. C, pattern # 4).

The top dipole consists of two 1/4 wave sections (F) and (V). The top dipole is fed from the bottom dipole by a 1/2 wave transmission line (2V). The bottom dipole consists of sections (V) and (V).

Dimensions (using RG-8 (poly) coax, design frequency of 100 MHz)

F	1/4 wave (thin wire)	29 1/2"	NOTE: If the lowest V section
V	1/4 wave (poly coax)	19 1/2"	is made from foam type coax it
2V	1/2 wave (poly coax)	39 "	will be almost as long as the D
D	1/4 wave (large wire)	28 "	section for easier connections.

INVERTED VEE ANTENNA (Fig. 2)

Although simple in construction this antenna can get out quite well. Part of its appeal is that it doesn't look like any more than a regular TV mast. You can even have your tv antenna on top without spoiling its operation.

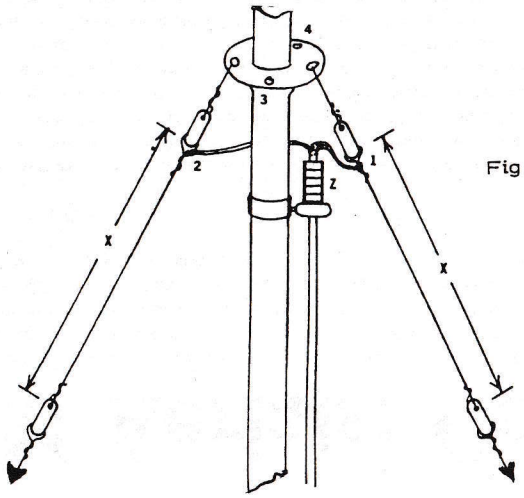


Fig. 2 Inverted Vee Antenna

In its simplest form the antenna is unidirectional with a pattern similar to Fig. C, pattern # 4 (even though this antenna is horizontally polarized). The wider spread between the guy wires selected determines how much horizontal and how much vertical polarization will imparted to the signal. If the guy wires are almost straight up and down the signal will be mostly vertical. A wide spread between wires makes the signal more horizontally polarized. This simple form is where two guy wires on the same side of the mast are selected. Maximum power is radiated in that direction.

If you have a four-wire guy system and select opposing guy wires you will have a bi-directional coverage similar to Fig. A, pattern # 2. Much the same as any horizontal dipole.

If you connect the 1/4 wave phase delay harness (Fig. 3) to the other two opposing guy wires (four-wire guy system) you'll make it omnidirectional. This is because you'll be feeding the second set of guy wires (second dipole) 90 degrees out-of-phase with the first. The result is the radiated signal "spins" around the two dipoles thereby "pointing" in all directions. It completes one trip "around" during each cycle of your frequency. At 100 MHz this is 100,000,000 times each second!

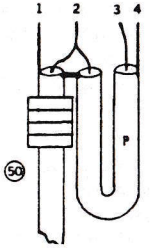


Fig. 3 Phase delay harness

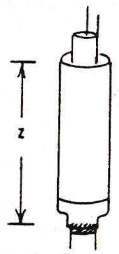


Fig. 4 1/4 wave decoupler

This is a balanced antenna. If it is to fed with unbalanced line (coax) it needs a decoupler. Four or five large ferrite beads may be slipped over the coax, close to the end, to act as the decoupler. If you prefer a decoupler can be made from a piece of 1" copper pipe. A 1" to 1/2" reducer is soldered to one end. The whole thing is slipped over the coax. A bit of coax insulation is removed and the small end of the reducer is soldered to the coax shield. The other end of the pipe is left open (see Fig. 4).

When the phasing delay harness is used you'll have two antennas connected in parallel. When fed with a 50 ohm cable (RG-8) you'll have a VSWR of 1.4 to 1. A lower VSWR can be had if the 1/4 wavelength of coax leaving the antenna is a 50 ohm impedance (RG-8) acting as a impedance matching transformer. The rest of the coax all the way back to the transmitter would have to be 75 ohm coax.

Dimensions, design frequency of 100 MHz			Effective power gains Uni-	Bi-	Omni-
X	1/4 wave (thin wire)	29 1/2"	2	1	1/2
	3/4 wave (thin wire)	88 5/8"	4	2	1
	5/4 wave (thin wire)	147 5/8"	8	4	2
P	1/4 wave (poly coax)	19 1/2"	(use 75 ohm coax such as RG-59)		
Z	1/4 wave (pipe)	28"	(Fig. 4 decoupler)		

HALF-WAVE PHASED COLINEAR (Fig.5)

This is a fairly rugged antenna. It is constructed from 1/2" copper water pipe and 1/2" copper pipe fittings. It mounts to mast with a single "U" bolt. It may be polished and then sprayed with a clear lacquer for a real professional appearance.

It consists of two 1/2 wave elements , one above the other, which are fed from a 1/4 wave "shorted stub". The "stub" is the "U" shaped section whose dimensions

Fig. 6 1/2 Wave Balun

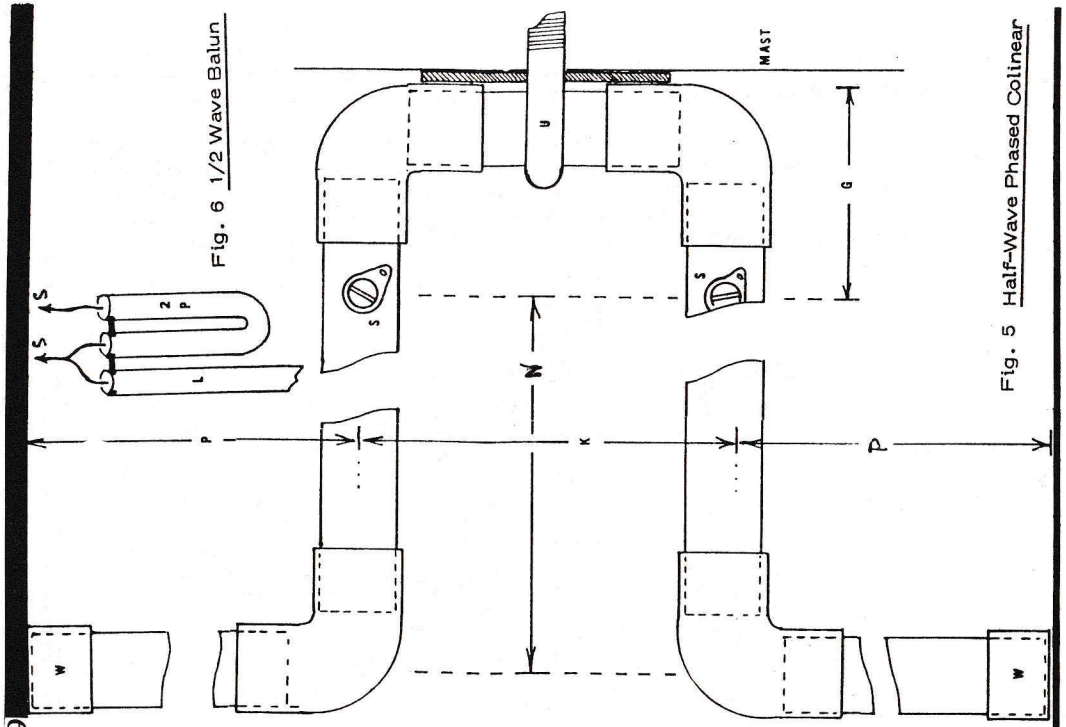


Fig. 5 Half-Wave Phased Colinear

N + G = 1/4 of a wavelength. Since this is a balanced antenna which will be fed by an unbalanced line (coax) it will need a "balun". A balun is a device that adapts a BALanced line to an UNbalanced load. Both antenna elements must be fed in the proper phase relationship so a 1/2 wave balun is used. This is shown in Fig. 6.

The balun is made from 50 ohm coax (RG-8) with the shields of all ends connected together. The shields will not connect to the antenna however. Only the center conductors, marked with an "S" will connect to the antenna screws, also marked "S".

Begin by cutting all your copper pipe to the appropriate lengths. Fit the sections of pipe into the 90 degree elbows. Slip on the end caps (W) (to keep water out when it rains). Lay the whole thing down on a flat surface and check your overall dimensions. Adjust the pipe lengths if required so your dimensions are exactly as shown below. Now solder each joint (fitting). After it has cooled, drill two holes for the screws (S). The hole should be threaded for a 6-32 screw. A self - threading screw may be used (not a sheet metal screw). Use a solder lug under the screw for connection of the balun.

If the antenna is mounted on a metal mast a piece of hard rubber should be used as an insulator. Only the exact center of the 1/4 wave stub may be connected to a metal object. If a wooden support is used this is not a concern. You can even use two "U" bolts if you want.

The antenna gives a power gain of at least 2 when mounted on a wooden support. The coverage pattern is similar to Fig. C, pattern 1 (omnidirectional). The distance and angle of the radiation is similar to Fig. D, pattern # 2. If the antenna is turned so it is horizontally polarized it will have a bi-directional (horizontal) coverage as shown by Fig. A, pattern # 2. A metal or wood mast may be used.

When the antenna is mounted on a metal mast it will exhibit additional gain (up to a gain of 4) but will be unidirectional as in Fig. C, pattern # 4.

Dimensions, design frequency of 100 MHz

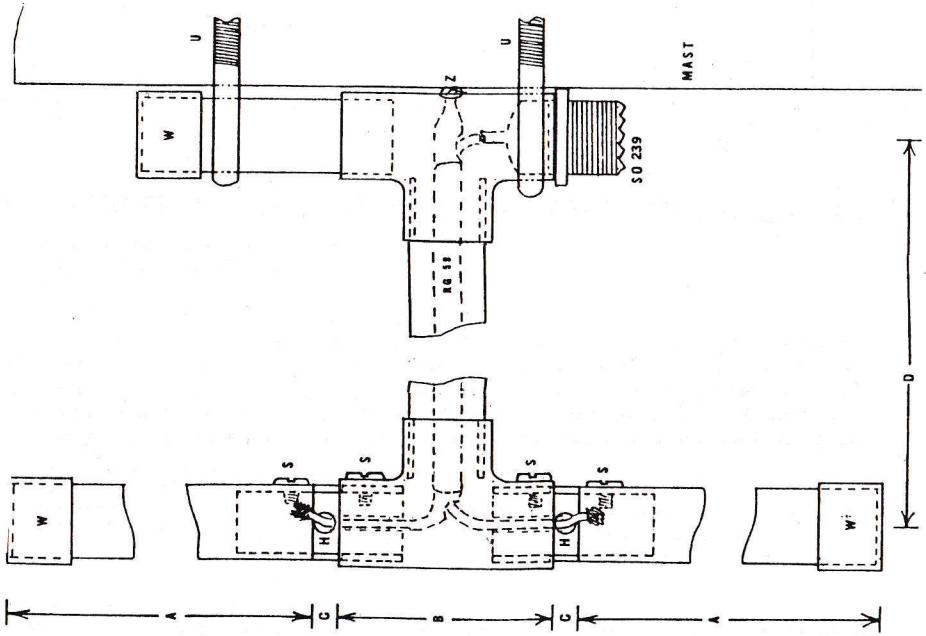
P	1/2 wave (pipe)	56 1/8"
N	1/4 wave (pipe) X .63	17 5/8"
G	1/4 wave (pipe) X .34	9 3/4"
K	1/4 wave (pipe) X .11	3"
2P	1/2 wave (poly) coax	39" (RG-8)

L = any length of 50 ohm coax such as RG-8

A STACKABLE VERTICAL DIPOLE (Fig. 7)

This is a rugged vertical dipole which, when stacked with others, gives a power gain of a little greater than the number of dipoles used. A stack of 2 (also known as 2 bays) has a gain of about 2.1. A 4 bay antenna may have a gain of up to 4.5! Figs. E through I show various stacking arrangements. These stacking arrangements are discussed later on.

Fig. 7 Stackable Vertical Dipole (Side View)



The dipole is constructed from 1/2" copper pipe, two 1/2" "T" fittings and three end caps. The area marked "H" show pieces of 1/2" diameter plastic such as lucite or polystyrene. These plastic pieces are the last pieces to be installed.

Cut all the pipe sections to the appropriate length. Slip on the fittings and check your dimensions. Do not install the coax, plastic, or SO-239 yet! Solder all the fittings and end caps into place. Keep it all straight by holding it against a flat surface. Drill a 3/16" hole at point "Z".

Cut a piece of RG-59 coax to a length longer than dimension D. Remove some of the outer insulation as shown in the drawing. Spread apart the braided shield a bit and carefully pull out the center conductor (still insulated). Prepare the cable as shown in the drawing. Solder the center conductor of one end of the coax to the solder pin of the SO-239. Twist the the braided shield at that end so it can be pushed through hole Z from the inside. Do it, while shoving the SO-239 into the

open end of the "T" fitting. Solder the shield to the outside of the "T" fitting. Now Solder the SO-239 into place. If the SO-239 has been plated it may be necessary to file off some of plating before it will solder well. CAREFULLY - not too hot!

Two holes have to be drilled now in the plastic pieces. Use a 3/16" drill bit. One hole starts at the end of the piece and ends half-way through. The second hole starts at the side of the piece and goes half way through to meet the first hole. You may drill this second hole at an angle toward the first hole to make pulling wires through it a lot easier.

The inside of the "T" fitting is made for the outside diameter of the 1/2" pipe. The plastic piece will fit too loose if installed directly. So...cut filler bushings out of 1/2" pipe (about 1/2" long) and slip into the open ends of the "T" fitting.

Bring the center conductor of the coax out the bottom end of the "T" fitting and feed it through one of your plastic pieces. Bring the coax braid (twisted) out of the other end and pull it through a plastic piece. Slip the plastic pieces into the "T" fitting. Drill a tap size hole (6-32 self-tapping screw) through the "T" fitting, the filler bushing, and part way into the plastic (Caution- not too far!). Install the screw to secure the plastic piece in place. Now do the same for the coax braid end of the fitting.

Now slide on the dipole sections of pipe. Secure to the plastic with a 6-32 self-tapping screw. Solder the coax leads as shown in the drawing. An alternate method of connecting the coax leads is shown in Fig. 9.

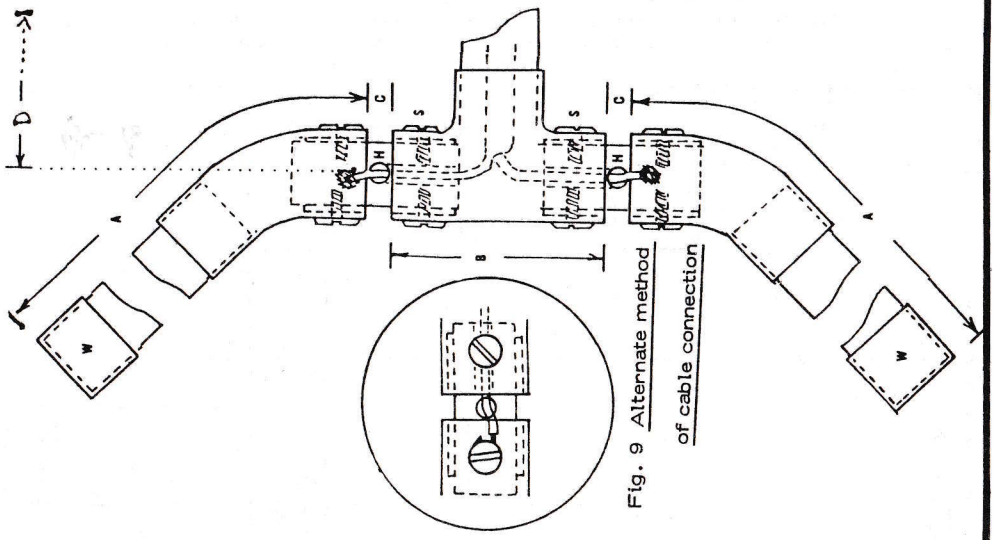


Fig. 8 Omnidirectional Horizontal Dipole (Top View)

Fig. 9 Alternate method of cable connection

Finishing touches include polishing the copper pipe and coating it with clear lacquer. Close up any holes with silicone sealant to keep out moisture. Check with an ohmmeter for shorts between dipole elements and shorts between the elements and the supporting boom. Check also for continuity between the center pin of the SO-239 and the lower dipole element.

Mount on the mast so the SO-239 is facing down. A little grease on the threads when you screw on the plug later will help to keep moisture out.

When stacking these units the dipole connected to the coax braid MUST BE POINTING UP to maintain the proper phase relationship between units. The length of the little mounting stub (top "U" bolt) is not critical, 2" to 4", it's just for a mounting spot for the "U" bolt anyway.

Dimensions, design frequency of 100 MHz

A	1/4 wave (pipe)	28"	C	large enough for wire	3/16"
B	Standard "T" fitting	2"	D	1/4 wave (pipe)	28"

AN OMNIDIRECTIONAL, STACKABLE, HORIZONTAL DIPOLE (Fig. 8)

The previous vertical dipole can be modified to make a horizontally polarized antenna. By simply rotating the dipole elements (and the "T" fitting) at the end of support boom 90 degrees you have a horizontal antenna. The coverage pattern would be bi-directional however, similar to Fig. A, pattern # 2.

By bending the dipole elements forward slightly we can further modify the antenna so it will present a nearly omni-directional coverage. The coverage would then look like Fig. A, Pattern # 1.

Of course bending copper pipe is a bit of a chore so we'll use 45 degree 1/2 " copper fittings instead. With the exception of the above modifications and the addition of two 45 degree fittings, the construction is the same as the vertical dipole. Just use those instructions for its assembly.

When completed the dipole arms should be horizontal, the mounting end of the support boom vertical, and the SO-239 pointing down. When stacking these units be sure that right dipole element is the one with the coax braid connected to it. This is necessary to maintain proper phasing. If proper phasing is not maintained one antenna will tend to cancel out the radiation from one of the other units - result is terrible coverage or no coverage at all!

Dimensions, design frequency of 100 MHz
All same as stackable vertical dipole.

Fig. A Horizontal Coverage (Top view)

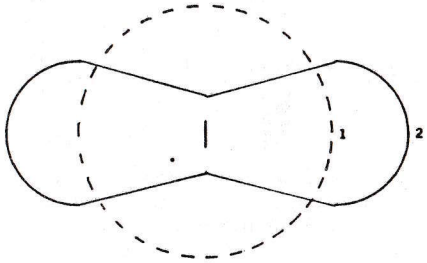
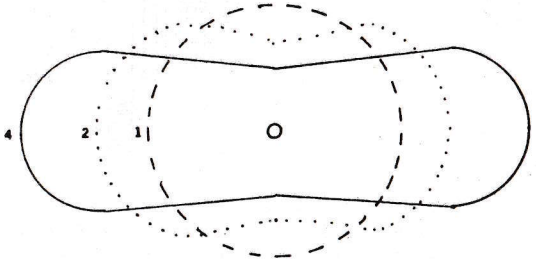


Fig. B Horizontal Coverage (Side view)



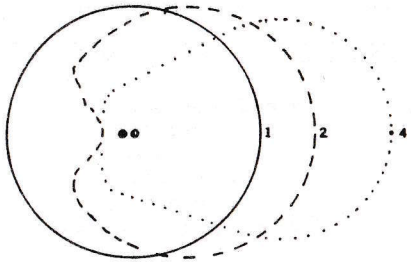


Fig. C Vertical Coverage (Top view)



Fig. D Vertical Coverage (Side view)

STACKING ANTENNAS FOR MORE GAIN Figs. E - I)

When we speak of an antenna as having gain we are really talking about its EFFECTIVE RADIATED POWER or simply its ERP. The antenna can be made to concentrate the power fed to it by sending it out in one or more directions. This means however that some other direction will not receive as much power. Simply, more distance in one direction means less distance in another direction.

Stacking of vertical antennas tends to lower the radiation angle. Less power is radiated up toward the sky, being channeled outward instead. This of course increases the coverage area. Fig. D shows the relationship of stacking versus the effective distance. Pattern # 1 is for a single antenna. Pattern #2 shows the results of 2 stacked verticals with an ERP of about 2 X. Pattern # 4 shows a 4-bay antenna.

The above is the case where the antennas are mounted on a wooden support. If a metal tower or mast is used it will reflect some of the power forward. This also results in additional ERP. This raises the overall ERP by a factor of about 2. This means that a 4-bay vertical on a metal mast could have an ERP of 2 times 4 for a total of 8 times the power! Of course coverage area is lost behind the tower as we see in Fig. C, pattern # 4.

Stacking of horizontal antennas compresses the radiation angle. Instead of the signal being sent off into space or toward the earth, it is "focused" outward. This can be seen in Fig. B. Pattern # 1 shows a single horizontal dipole. Pattern # 2 shows a flattening and pushing outward of the radiated energy. Pattern # 4 shows the results from a 4-bay antenna.

Although a metal tower will produce a shadow area behind omni-directional horizontals also, it is not nearly as pronounced as with verticals. In most cases it is not worth worrying about.

The most practical number of horizontal bays seems to be 4. More than that tends to concentrate the "beam" of radiation too much. It gets out further but can actually travel "over" nearby receiving antennas.

The amount of distance obtained related to effective increases in power is equal to the square root of the power increase. These relationships are shown below:

Power Increase	Distance	Power Increase	Distance
2	1.4 X	7	2.65 X
3	1.73 X	8	2.83 X
4	2.0 X	9	3.0 X
5	2.23 X	10	3.16 X
6	2.45 X		

This holds true for increases in transmitter power also. Doubling your transmitter power results in only a 1.4 X increase in distance.

Fig. E shows a single antenna. It may be a vertical or a horizontal unit although a vertical one is shown here. Its feed impedance is about 75 ohms. The horizontal antenna's feed impedance is slightly less due to the elements being angled forward. For lowest VSWR it should be fed with a 75 ohm coax. It may be fed with a 50 ohm coax however with only a 1.4 to 1 VSWR.

Fig. F shows two stacked antennas. They may both be vertical, or both horizontal, or may be one of each. If both antennas are the same polarization it would have an ERP of 2. If you have one of each then the ERP is 1 - but with both horizontal and vertical polarization. The total feed impedance at the coax T is now 1/2 of 75 ohms. This 37.5 ohm impedance can be fed with a 50 ohm coax with only a 1.33 to 1 VSWR. If you want to feed it with 75 ohm coax you must have a 1/4 wave impedance matching transformer. This is shown as the # 50 with a circle around it. This is piece of 50 ohm coax 1/4 wavelength long. This is either 19 1/2" or 24 1/4" long depending on whether you are using poly or foam coax. The cables from the antennas to the coax T (Y1) may be of any convenient length BUT....they must be the SAME length. If they are different lengths the phasing between antennas will not be correct! Highest gain is acheived when the spacing between centers of antennas is about .8 X wavelength in air. This is 94 1/2 inches at 100 MHz. (E = 94 1/2")

Fig. G shows a 4-bay vertical system. Fig. H shows a 2-bay vertical with a 2-bay horizontal. You could just as easily have a 4-bay horizontal for Fig. G. In the case of Fig. H the vertical antennas can be fitted inbetween the horizontal units. This takes up a little less tower space. Note this is also done in the 4-bay vertical, 4-bay horizontal system of Fig. I. Dimension E is still 94 1/2 " at 100 MHz.

The length of connecting cables Y2 may also be of any convenient length BUT both must be of the same length! Again in Figs. G and H you are paralleling two 75 ohm impedances (Y2 + Y2). This point may be fed with a 50 ohm coax (VSWR of 1.33 to 1).

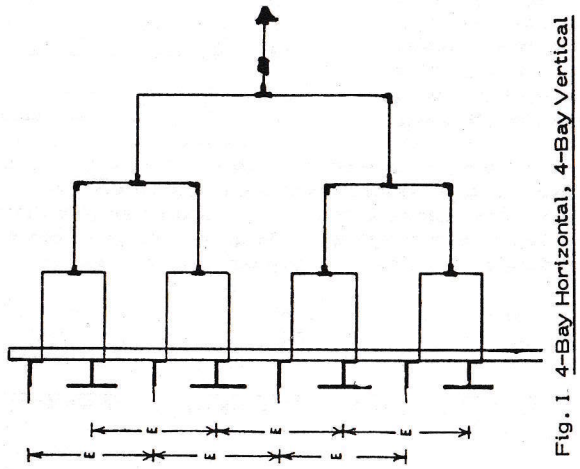


Fig. I 4-Bay Horizontal, 4-Bay Vertical

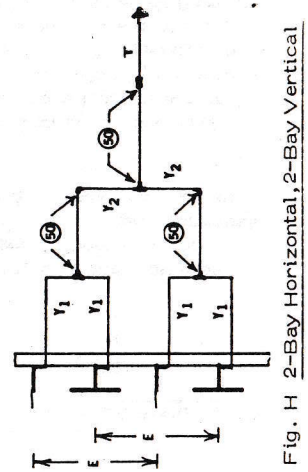


Fig. H 2-Bay Horizontal, 2-Bay Vertical

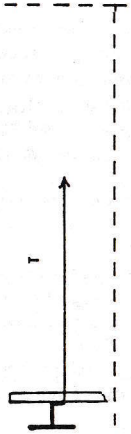


Fig. E Single Bay Antenna

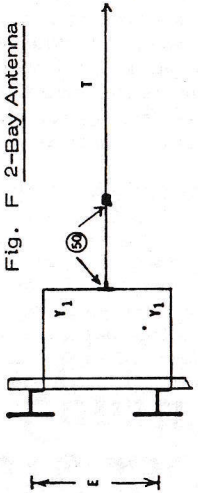


Fig. F 2-Bay Antenna

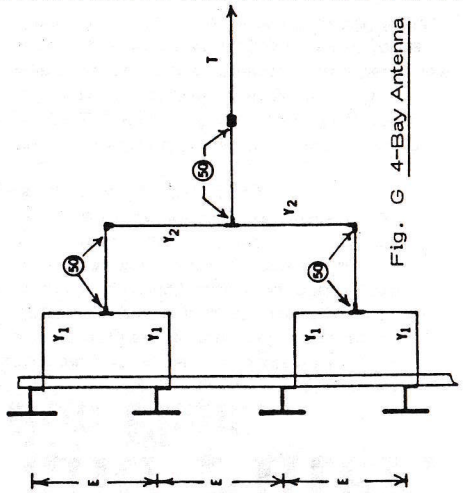


Fig. G 4-Bay Antenna

If you want to feed it with 75 ohm coax you'll need another 1/4 wave transformer, just like that used in Fig. F. All 50's with a circle around denote 1/4 wave-50 ohm transformers.

By now you should be an old pro and can figure out the harness arrangement for Fig. I. Just remember: all Y_1's are the same length, all Y_2's are the same length, and (for Fig. I) all Y_3's are the same length, and all junctions need an impedance matching transformer.

A bit of information you may find discouraging. 100 feet of RG-8 coax allows only 63 % of the transmitter power to reach the antenna system. RG-59 is worse! It only allows 50% of the transmitter power to reach the antenna (100 feet). In other words, use RG-8 as much as you can, keep the transmission line short between the antenna and the ttansmitter. Of course the higher up your antenna the better it will get out, but this means longer transmission lines. You'll have to come up with a compromise between antenna height, transmission line length, and antenna gain.

CIRCULAR POLARIZATION

You may modify your antenna system to achieve circular polarization. If you stack a horizontal unit directly above a vertical unit, so the support booms are actually touching, and the horizontal unit straddles the vertical you are close!

Look at Fig. H for a moment. Picture the top horizontal unit resting right on top of the top vertical element. Their radiation centers would be almost at the same point. Now make the vertical's Y1 cable any length that's convenient, BUT, make the horizontal's Y1 cable 1/4 wavelength longer! Repeat the above for all vertical/horizontal pairs. All the other cables and transformers remain the same as before.

The extra 1/4 wavelength of cable going to the horizontal unit delays the signal by 90 degrees. The signal is first radiated by the vertical, then 90 degrees later by the horizontal, then the vertical, then the horizontal, and so on. The signal is now spun out in all directions at 100,000,000 times each second! While the other systems of stacked antennas gave both horizontal and vertical polarizations, this method gives all other polarizations in between!

The gain in any one polarization does not change however. When you mix the polarizations equally you have 1/2 power going horizontal and 1/2 power going vertical (or somewhere in between). This also holds true for the stacked verticals and horizontals without circular polarization.

Example: 1/2 power goes to 2-bay vertical with gain of 2...total gain = 1
1/2 power goes to 2-bay horizontal with gain of 2...total gain = 1

Therefore: a 4-bay antenna, with 2 horizontal and 2 vertical has a gain of only 1 but its a gain of one in each polarization.

Now, a final mind blower! Here is a typical example of what you will be fighting to get out a decent signal:

Transmitter power = 10 watts = TPO
100' of RG-8 = 63% efficiency = F
4-bay horizontal = gain of 4 (H) = G
4-bay vertical = gain of 4(V) =G

TPO x F x G = actual ERP
Therefore:
10 x .63 x 4 = 25.2 watts
However:
only 1/2 of the power is going to each polarization, so....you have only 12.6 watts (H) and 12.6 watts

GOOD LUCK!

Suppressor and Filter:
Construction Plans.

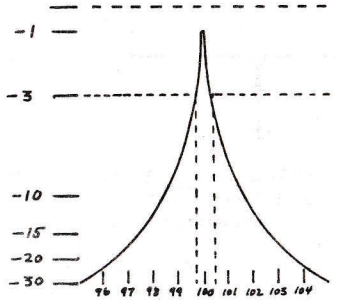
One of the biggest problems with any transmitter is the production of undesired frequencies. These may be produced by secondary resonant circuits within the oscillator stage or amplifier stages. These frequencies have no relationship to the desired frequency whatsoever and may appear anywhere on the band or out. Harmonic frequencies, multiples of the desired frequency, are produced by the non-linear characteristics of the amplifying devices themselves, either tubes or transistors. This means an FM transmitter operating at 100 MHz may produce harmonics at 200, 300,400,500.... etc MHz. The most common non-linearity produced frequencies are the odd harmonics, 3rd, 5th, 7th, etc.

A filter which will reduce or eliminate all but the desired frequency must have a finite pass-band. In the FM band we have a channel width of 200 KHz. This means the filter's pass bandmust not be less than 200 KHz or signal quality will suffer. Unfortunately as band width is made narrower in a filter the insertion loss becomes greater. A compromise then is where an acceptable band width (pass band) joins an acceptable insertion loss (power loss). The RFI is tunable from 80 to 120 MHz.

General pass band and insertion loss characteristics of the PANAXIS RFI are:

Pass Band	Insertion Loss (dB)	Power Output(%)	Resultant Field (%)
2 MHz	.45	90	95
1 MHz	.70	85	92
.5 MHz	.97	80	90

As an example, with the RFI adjusted for a 1 MHz pass band, the insertion loss would be .7 dB, resulting in 85% of the power being transferred from input to output. This sounds bad until you consider that the field strength voltage decreases as the square root of the power decrease. In this example the range would be cut back to 92% of the range obtainable without the filter.



The graph at the left illustrates a 500 KHz bandwidth (-3dB point) and a 1 dB insertion loss. Output drops offrapidly for frequencies farthest away from the center frequency, in this 100 MHz is being used as the center. Up to 30 dB of attenuation at 5 MHz away from the center frequency is possible with proper adjustment. SWR is approximately 1.05 to 1 with a 50 ohm input/output. SWR will be about 1.5 to 1 with 75 ohm input/output, unless taps are adjusted for 75 ohm operation only.

The coils are a little tricky but if you take your time you should have only a little trouble. The two coils are wound in OPPOSITE DIRECTIONS. This is important because when they are installed you'll want the "tap" point to be correct. The tap is at one full turn from the bottom of each coil. The long leg at the bottom of each coil is part of the impedance of the tap and is required - do not shorten it by more than 1/2 inch!

Wind the coil on a 3/8" drill bit shank or other 3/8" diameter object. You'll want 8 full turns with extra wire left at each end. Take a short piece of the same wire size and push it in between a couple of the turns near the end of the coil. Rotate the coil while holding the spacer wire between the turns. In this way you'll space

each of the turns a wire diameter apart. You could do it of course by simply pulling the turns apart but the spacing would not be uniform or look all that neat!

With a pair of long (or needle) nose pliers bend the wire ends of the coil at right angles to the coil turns. See Fig. 2 for more detail. The "top" end of the coil is the toughest. It must be bent so the end wire comes up and over the supports of the variable capacitor.

The second coil is made in the same manner except it is wound in the OPPOSITE DIRECTION. Again, bend the top end wire so it will center the coil between the bottom and top of the box when the end wire is resting on the variable capacitor's supports.

Solder the coils to their respective capacitor supports as shown. The wire ends at the "top" of the coils are placed very close together and cut off just before it can touch the opposite capacitor. These two wires, one from the "top" of each coil, are purposely placed close to each other. A very small capacity exists between them - this is your coupling capacitor between resonant circuits! The closer they are the greater your passband and the greater the power transfer. About 3 thicknesses of this paper fitting between these wires will give about a 2 MHz pass band. Farther apart will narrow the pass band and reduce power transfer.

Cut the bottom wire of each coil to the proper length to solder to the solder lugs. The solder lugs should not be attached to the box when you do this. The box will act as a heat sink making soldering difficult. After soldering attach the lugs to the box with the 4-40 screws. Install the shield at this time.

Now solder the center pin of each coax connector to tap position of the appropriate coil. This should be about 1 full turn. Put the lid on the box and put it to work!

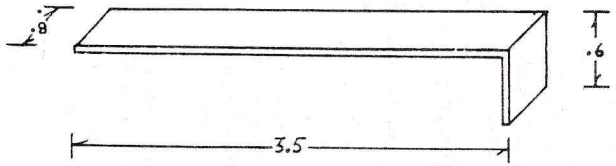


Fig. 3 Shield detail

PARTS LIST & SOURCES

Quantity	Description
1	Cast Aluminum box, 2.4" x 4.4" by 1.0 "
2	Air variable capacitors, .4" x .4" square, 1/4" mount, 10 Pfd max
2	Coax connectors of your choice, Type F, BNC, CH-239, etc.
2	4-40 x 1/4" machine screws
2	4-40 nuts
2	solder lugs, #4 hole
1	Aluminum strip approx. 4.5" long, .8" wide, 1/16th" thick
2	Feet # 14 or # 12 bare copper wire (silver plated best if you can get it but not absolutely necessary.) (Try hardware stores)

MOUSER ELECTRONICS
11433 Woodside Ave
Santee, CA 92071
(619) 449-2222

RADIO SHACK
Check local phone listings

PANAXIS
(Full kits)

ASSEMBLY INSTRUCTIONS

Begin by drilling the appropriate mounting holes. Dimensions are given in Fig. 2 at right.

The cast aluminum box is just 1" thick (deep). All holes are drilled midway on each side, in other words .5" up from the bottom of the box.

Install the variable capacitors and coax connectors. The coils (inductors) are installed almost last. Position the capacitors so the "open" part of the plates is toward the bottom of the box. This puts the bottom of the cap with its support brackets at the top so you can solder your coil to it.

Next wind your coils and bend your aluminum stip to make your shield.

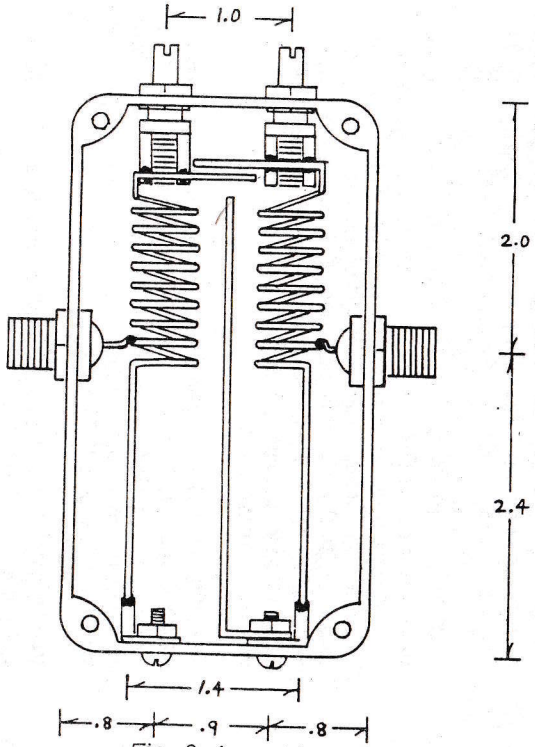
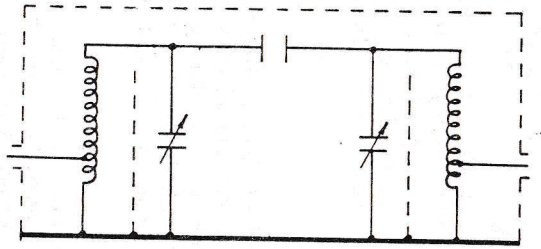


Fig. 2 Assembly Drawing

THEORY OF OPERATION

The filter consists of two parallel resonant circuits very loosely coupled by a small capacitor. Coupling between inductors by their magnetic fields is kept to a minimum by a shield.



ETC.

OPERATION

Operation is very simple. Just connect the output of your transmitter to one of the coax connectors. Connect the other coax connector output to your antenna. The unit is symmetrical so either coax connector may be used as an input or an output.

Adjust each variable capacitor to to about the center of its range. Connect some means to monitor the filter's output. This can be an RF voltmeter, an SWR meter or power meter. The antenna should be connected or false tuning may result. You may also use a field strength meter to indicate when you have tuned the filter for maximum power output. As a last resort you can even use the tuning meter of your FM receiver. Tune it to your frequency.

Turn on your transmitter. Tune one filter variable until you get an output. Then tune the other variable capacitor to increase that output. Repeat this several times until both capacitors have been "peaked" for maximum output.

CONTACT

Radio Support Group

D.R.COMMUNICATIONS: c/0 37 Stokes Croft, Bristol
A technical aid, development and research group for radical pirates. Membership £5, for which you get a free copy of this book, and advice, updates and help building the designs in it. Money goes to buy better test gear and parts. Donations welcome.

Free The Airwaves

FREE THE AIRWAVES: BCM Box 1502. London WC1N3XX Produce RADIO CRIMES (same address and all good book shops, 30p + stamp). Campaigns for local neighbourhood pirates. A Clearing house for pirate info. Membership £2.00 for individuals £10 for organisations. Design simple transmitters and answer technical queries on them.

TRANSMITTERS BUILT TO ORDER: write to LEE. 71 Ave de Fontainbleau. B.P. 38, 77310 Pringy-Ponthierry, France. Tel (6) 438 1159. (cost: expensive. Send reply coupon).

RESEARCH COMMUNICATIONS: Unit 3, Dane John Works, Gordon Rd, Canterbury, Kent. Offering transmitters of 50 w for a mere (wait for it) £780 plus £30 post plus Vat. Who are they kidding!

PANAXIS PRODUCTIONS: p.o.Box 130, Paradise, CA 95969 USA. Sell TX's, and everything else by mail order. Good catalogue. But Paradise don't come cheap. Even to buy the design and building instructions for e.g. their Stereo Encoder (Model SG - P) will cost you 15 dollars. Don't go for their cheap exciter, its a dud toy. (In USA standard preemphasis is 75 us, here its 50 us, so a few values have to change in stereo generators etc.).

CRYSTALS MADE TO ORDER: from IQD Communications D evices, Nth St,Crewkerne TAI87AR, or from Golledge Electronics, Merriott, Somerset YA165NS.Tel.0460 73718.;

RADIO AMATEURS HANDBOOK: published by American Radio Relay League (ARRL) yearly. Goldmine. Costs 20 dollars but second hand books often available from Fair Radio Sales, PO Box 1105, Lima, Ohio 45802, USA.
OUR RADIO. c/o RATS, BM Hurricane, Lodon WC1N3XX.

RELAY MAGAZINE (may be dead after loss of grant,middle of the road) STOP PRESS. STILL GOING STRONG AT: BON MARCHÉ, BRIXTON RD, LON SW9.

TX. LONDON'S ALTERNATIVE RADIO MAGAZINE: contains excellent rundown of current pirates, commercial but will print news, boasts that dreadful sexist bigot,Chris England on the 'crew'. from BCM Box 225, Lon WC1N3XX. 90p.

ANORAKS UK: Distributors, do TX, Free Radio Waves and a weekly report called AUK (good). Also distribute all kinds of pirate parphernalia (if thats how you spell it). Have a catalogue. From PO Box 539, Blackpool, Lancashire FY14RE.

THE FREE RADIO RENDEVU: (TFRR): Short wave pirates, inc. news and logs of stations on air. From Pengarth, Pennance Lane Lanner, Redruth, Cornwall TR165TW.

LONDON SQUATTERS PIRATES: 3 local stations starting April 87..Nth Sth and East london. Radio Interference (S.Lon) can be heard at present on 106mhz around 6pm Fri. All c/o BCM 1502, Lon WC13XX.

MEDIA MONITOR: Nice little mag. Covers short wave and FM and legal. Weekly. 50p + stamp. No 37 has good feature on worldwide jamming wars. (28pp A5). From Roger Tidy, 11 St Philip Hse, Lloyd Baker St, London WC1 9BA.

HACKNEY BROADCASTING AUTHORITY: Community pirate, started on Oct 4th Day of Action called by CRA, but were drowned out due to broadcasting too close to the powerful Kiss FM (maybe they could be heard in Hackney). Did progs on Battle of Cable St, housing, Latin American music and history etc. Have 2 paid workers and went for CR licence, supported by Hackney Council. Not heard since.
94 mHz. Address lost.

SPECTRUM RADIO: Open access group, developed from CCR which developed from Our Radio etc. At one time had 5 paid workers from a GLC grant. Went for CR licence. Never broad cast (not the rock station of same name). Interchange, 15 Wilkin Street, London NW5 3NG.

VOICE OF NICARAGUA: English broadcast Mon-Sat,1.00 and 5.00pm on 6015kHz.

PEOPLES COMMUNITY RADIO LINE: have returned in Birmingham after 2 busts.
103.7mHz. c/o 151 Dudley Rd, Edgbaston, Birmingham B18 7QY.

JBC:BLACK MUSIC FOR BRENT. Best and most regular (mostly 7 day) of the good dozen black music stations, have recently started Irish and Asian programmes. Not busted much, maybe cos on low power and move TX regularily. Supported by Brent Council in CR licence bid.
104.75mHz 126a Roundwood Road, London MW10.

SINA RADIO: seems to be the last Asian pirate left. Broadcast with low power, 7 days to the Southall area, don't seem to be busted as much as others. Bilingual Hindi/English.

LONDON GREEK RADIO: has been busted at least 100 times, but survives by sheer persistence where other Greek pirates have vanished. Scored a legal precedent in Aug 86 when the landlord of their Tx site was busted and fined £1250! Commercial.
105mHz Po Box 225, London N19 45N.

MAY NOW BE CLOSED

FREETEC: most efficient, reliable and helpful place to get ready made technical gear. Bandmaster FM 35w,£85. 5w complete £40 etc. Have no address, but Free Radio Waves will forward mail. Freetec, c/0 Free Radio Waves, FLAGSONES, West Heath Lane, Sevenoaks, Kent TN13 1TA.

BROADCASTING: VHF rigs etc. forwarding address C/o BCM Box 225, London WC1N3XX.

ANFIELD COMMUNITY RADIO: c/o111 Pinehurst Ave, Anfield, Liverpool, L4 7UG. 1413 kHz. MW.

RADIO LIBERTARIA: Spanish anarchist pirate. San Martin 5 1a, Valencia, Espana.

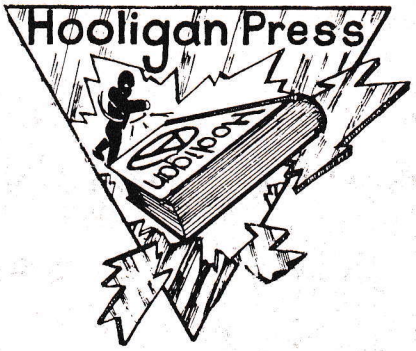
NUOVA ELECTRONICA: sell complete TX's and all kinds of gear and kits, including PLL exciters. Write in Italian (all instructions also come in Italian) to Via Cracovia 19, Bologna, Italy.

ELEKTRONIKA: sell transmitter kits etc. Guy in shop speaks English. Address: Papaverhoek 22 .Amsterdam Noord, Holland Tel. Amsterdam 327514.

FREE RADIO WAVES: Pirate buffs. some good info, worth a read. from Flagstones, West Heath Lane, Sevenoaks, Kent . 90p (40pp a5).

CROWBAR, @ SQUAT PAPER + BLACK FLAG, @ NEWS FORTNIGHTLY: BM HURRICANE, LON. WC1N 3XX.

HOOLIGAN PRESS



Here is a list of all our titles. All prices include post and packaging.

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Best selling thriller set in a revolution in the near future. Last of the first edition still available.

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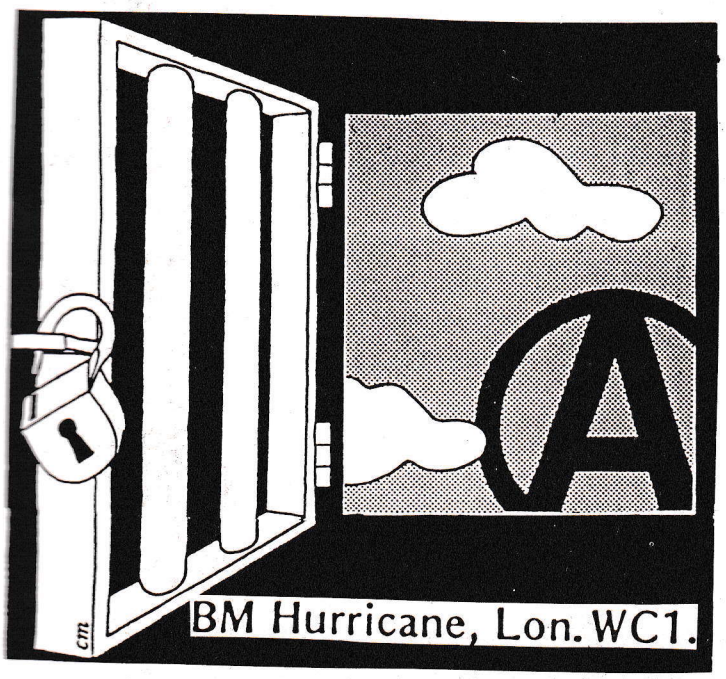
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For the first time the names and addresses of the British ruling class and a trip through the corridors of Power, Priviledge and Property.

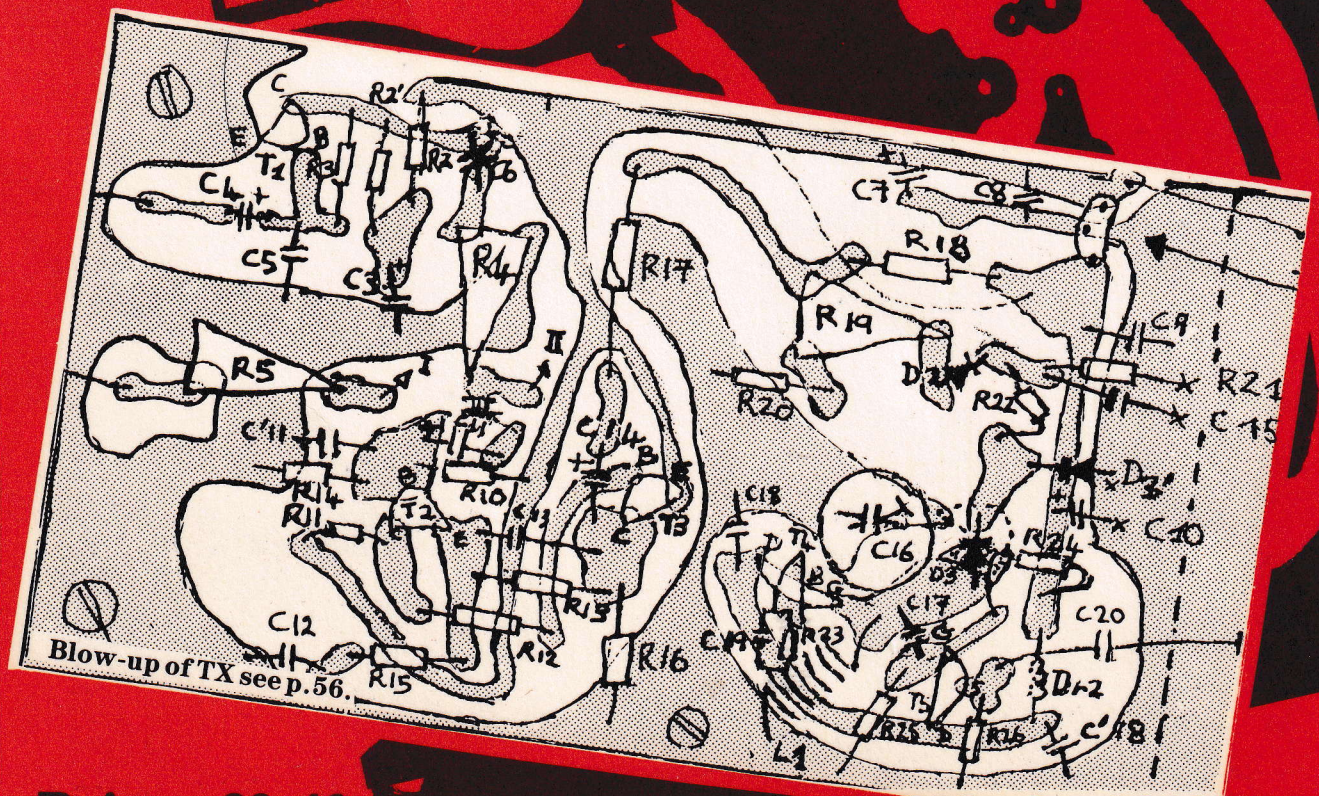
HOOLIGAN PRESS, BM Hurricane, London WC1N 3XX





"... the entire history of ancient and modern states is merely a series of revolting crimes; ... kings and ministers, past and present, of all times and all countries—statesmen, diplomats, bureaucrats, and warriors—if judged from the standpoint of simple morality and human justice, have a hundred, a thousand times over earned their sentence to hard labor or to the gallows. There is no horror, no cruelty, sacrilege, or perjury, no imposture, no infamous transaction, no cynical robbery, no bold plunder or shabby betrayal that has not been or is not daily being perpetrated by the representatives of the states, under no other pretext than those elastic words, so convenient and yet so terrible: **for reasons of state**.

... No sooner are these words uttered than all grows silent and everything ceases; honesty, honor, justice, right, compassion itself ceases and with it logic and good sense. Black turns white, and white turns black. The lowest human acts, the basest felonies, the most atrocious crimes become meritorious acts."



Blow-up of TX see p.56.

Price: £2:40

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