RADIO IS MY BOMB

A DIY Manual for Pirates
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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 statements 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. It's been a long time coming but well worth waiting for. This is the First Edition, January 1987, it's still a bit rough but we hope to update it regularly.

It's 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. It's 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. It's 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 10 Elizabethan sonnets to round it all off.

It's 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 settling the radio media free for you and me and Joanna Soup 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 first pirate when the authorities prevented him from using his own discovery. But in the last 10 years, with the popularity of FM radio, becoming a pirate has become cheaper and more simple. You don'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 pole 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. That's 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 tocrap the non-existent average Marc age, building their crap till every station sounds exactly the same.

Nor are we turned on anymore by the traditional pirate DJs, who tend to be all the same white skin-tanched morons, preening their egos and spinning 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, women's 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.

This may all seem a bit idealistic, and we're wrong with that! Any new wave of pirate radio is NOT 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, SOFT jobs in a Labour Party regime.

pirate radio movement, called into being by the Norman bums and when denied licences have proved incapable of putting a single pirate on air, for fear of touching the law. Now the CR activists are waiting for and demanding controlled licenses under Labour. CLUMP Press (Socialist League Upwardly Mobile) should warn socialists about state control more than Tories. Consider the Eastern Block totally controlled media and pirate stations hunting down police and army. The Labour Party has been bought by calls pirate-buster of all (as well as bringing in Max Power, the Bomb, Incident etc) and even tried jam Radio North Sea off the air (in 1970).

We are optimistic nonetheless. In fact we're pretty sure the FM band will fill up with pirates simply because the technology is becoming so simple and simple. The State knows this quite well and seeks to postpone it with the carrot of control of 'Community' Radio and the big stick of the last anti-pirate laws. This is where the real battle lies and why we devote so much effort to 'get away with it'. In fact its a complete myth of 'political' pirates got busted more often than others and even a half dozen 'open access' stations could flaunt the present laws and little do the authorities imagine. But the State has more strings to its bow than brute force, as he history of print media in other countries (and radio in the air, for whatever reason, they may try to us off - legalise a few under their control, insist rate them with middle class professionals who don't speak their language (they don't have to arrange for their own), these people will descend like locusts, and come down harder on the rest. If this tactic failed

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

Some people still naively think that radio is done show unbiased. Think again! Apart from the authoritarian BBC and IRA 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 new

pilfering by MI5 state agents). Or 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,jects, views, music, languages etc left out or badly represented. Or consider where the news on radio actually comes from and why it's 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 carped in the media's laws This book is for people wanting to think, who know quite well what they want and are prepared to take simple practical steps towards making a reality from their own dreams, even to have some fun in the process. The empty dream is tuned over to you!
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 let's go into its interesting history in some detail.

Our Radio drew out of a campaign for open access radio called COX COX, in the late 70's. This campaign was the most innovative aspect of the campaign, and the result was the London Open Radio (LOR), a lobbying group for alternative radio. This was also successful, but it was given a poor name, and it 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 of a secret of commercial pirate engineers. The aim was to liberate such devices, copy them, and develop a version which was easy to mass produce by non-professionals. They failed in this aim but left behind a lot of info which provides the groundwork for 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.

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. At the beginning Our Radio had chosen 103.9, at the top end of the 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 radio was normally made on weekdays. 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. So we could 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 UTPAJA, 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 Doozmakers, Charlie Buckton, etc.

Then there was GAYWAVES, the first programme broadcast in this country made by and for homosexuals. Most critics of Gaywaves have been based on prejudice, I did suffer at first by being made wrongly by just one man, but others quickly joined in and it became highly informative and entertaining, very soon it had to be extended to two hours. It was a magazine programme, with music, news, humour, jokes 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 be added to the show. This was known as the Gaywaves Network and we got a few things through that. We had an arts section - poems, stories and reviews of non-commercial plays. 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 close the show.

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 us. It was 2 am when the last cop had left, and we were drinking beer. So long as this kind of thing we were advocating, Phil Cox the presenter has since complained bitterly in print that we were slack, unprofessional, not in stereo, and got up at 9:30 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 Gaywaves was that they remained consumers. So they wouldn't help with the broadcasting side of it at all. So they had much idea of what was involved. For example, after a hard day of programmes like locative and checking a new site, borrowing lots of repairing gear, collecting tapes, waiting for buses, missing rendezvous, setting up the aerial, hiding from neighbours, doubting below the gun of suspicious baddies, rain, hail, wind and snow, we're finally ready to come and cover most of the London area, five minutes early... Then a lookout reports a police car parked by the next block. Could it be a bust... We start to dismantle everything but he's then drives off. We switch on at last. Only 20 minutes late. A victory... Then we get complaints about music too.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 in 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, 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 was a later addition to Our Radio. It began with a couple of women playing their tapes and a few questions. I developed it and it quickly developed from there. It was with the Women in the City feminist group from Islington joining in, as well as anarchists from Brixton. Women on the Waves was a new and vital necessity form of programme, a tiny women's space on the airwaves, in opposition to all the other media which more or less openly pro-

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mutes sexism, exploitation attacks on women and the
evotion of women’s ‘rights’. Women on the waves began
doing news, information and interviews of things like
Greenham Women’s Peace Camps, Women’s Aid, prisoners,
demons, music, women’s 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 original, radical, control-radical, something (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.

If the time is 9 o’clock, then our THE MESSAGE
is 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 obnoxious, it was put together by four
to ten people, who brought material, prepared
and recorded to the Our Radio studio and
worked on the whole lot together on a one-hour tape.
Most other pirates hated us for being ‘political’
and for depoliticising 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 Creek 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 Australi
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
biased 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. 02 people
from Brixton Squatters Aid heard the open access invi
tation and came along to do a spot. At that time there
were only two such local groups among London’s
30,000 squatters and ESA were promoting (and still are)
such self organisation and resistance to eviction
with their news sheet ‘Crowbar’. But ESA is based
at 121 Century Lane and within weeks half the anarchis
in South London were reading our items on
The Message and bringing some new energy
into Our Radio. Almost everybody involved in Our Rad
io had something on the show, including one Labour

party member. Here’s a short list of some of the
いちばし items and topics I remember....

interviews on the Nuclear Holocaust, Drug taking
in the Falklands, Police Monitoring News, Greenham
Common tapes, The Pope on Abortion, police death in
Ireland, the fallout Marching Band, the people
No Property, Shit of The Week Competitions,
Spilairs, Colin Roach demo tapes, The Take Offs
Speedway, Hip Hop News, Billions of Dead光影
views, Comso Campaign, Community Policing by
Numpy, Crowbar news, Christy Moore, Free The Airwaves,
Cambridge Community Radio News, Anti Fascists
Anarchy Brigade, Grooming, ‘Look over your shoulder
please’. Shoptlifting Ad, and Robin Hood rap, Prison
News, Rippy take offs. ‘I feel like a used mechanical
cosmic totality, man”. Cologne, Expose, ALF interviews,
Drug Prices on The Black Market.

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

This is THE FREESPACE, Anti Capital Radio on
103.9 FM. After a while I had really
so full that music and interviews were being crowded
out. The Freespace was planned as a pure anarchy
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 what
the programme would have developed. The first tapes
were full of take offs, impressions, satire, attack
on the police and punk and reggae music.

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

THE BAG. Our Radio’s latenight show was a
programme of music and out-ups without any nagging
to bother you. It was beautifully and skillfully
made, each programme had a theme eg. Religion,
Society, etc and a title eg. The Undercover
Operation, The Good The BAG and the Ugly, The
Found BAG, etc. Lots of clever dubbing and plays
round with film and TV themes. Sometimes if things
were going well the BAG could stretch on for
or even three hours, since it was the last show
of the night. The person behind the BAG was one of
best and anonymous organisers of Our Radio, and
largely responsible for the open studio, music
sounds, as well as working with the broadcasting
crew and promotion to the bitter end.

Radio Solidarnosc

Radio SOLIDARNOSC was a late addition to Our Ra
dio’s programmes, and usually went out first at 5
pm, half in English and half Polish, and got a good audience among London’s Polish minority.

It was produced by one small group out of the large
community of Polish exiles. Its purpose was to
emphasise Solidarnosc and to provide contact, news and info. It was
called Radio Solidarnosc (London), with Our
Radio closed down by the police. The one exception well before Radio
Solidarnosc (Poland) was finally closed by the Poles
in Uzelisiki and the KGB. The main producer of Radio Solidarnosc was a rather volatile character, who Den
tied sympathy with our increasing problems, but
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 has 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 them our TX, that was the arrangement, and they broadcast as a separate station on their own right, never declaring themselves part of Our Radio, such 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 DRI and police, but they could only do this because we were already weak. By the end 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. (see new typist)

We decided to seek publicity, the alternative and music press weren’t too interested so we tried to get onto the 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 B2 we scrapped the ‘link’ and put the bits into a new TX. We had no money for parts, so we only built a cut down version of the bus fare. In a place like London even keeping in touch with everyone can be a big hassle unless you have phones.

Our Radio was on the air at this period through the BBC. This proved to be a blunder. Richard Barbrook, the sole Labour Party man in Our Radio set up a meeting through his friends and big boy in the Left John McDonnell for a meeting along with himself in the hope of some quiet quick 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 parties in support of us. Since the Tories were at the time trying to stifle and abolish the GLC completely, much publicity was like selling our own ‘bust warrant’! Barbrook’s own aim, as he tried to make the book ‘Rebel Radio’ was to hasten himself a career as a Labour Party spokesman on community radio. To him Our Radio was ‘just as good’ to establish his credentials and get a fat grant (he got the £200 000 offer and ran away after he was closed down) for his next projects. (In fact Barbrook abandoned Our Radio after the March B2 bust, refused to help us with a way to raise the £25000 needed as the GLC fund for the squatters 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 lessons from Our Radio’s flirtation with the GLC must surely be ‘Never trust a politican!’

Fact there aren’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 evicted one of the GLC, 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 wanted 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 respect we agreed with Parties, to support one which has been the biggest pirate buster of all, even trying to jam Radio North America off the air (back in 1976) in true gang style, single issue campaigns, etc. So the reasons for the end of Our Radio weren’t just that we ‘lost’ on the GLC, but that we had been that they disliked our politics, but it was also partly ‘cos ‘our turn came up’. When they finally decided to get us we played ‘out and about’ 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, so far our schedule was decided. Here’s a brief countdown to closure:

The End of Our Radio

Wed Dec 15th B2. The police and Home Office (now OFO) insist on our outlook and raid us on top of a Tower Block in Kilburn. One person was nicked and fined £80 plus costs for a wire. 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 our radio channel, lookouts, etc but manage to keep clear of them and broadcast normally.

Wed 20th Feb B2. They stage a full scale raid on us, broadcasting from the roof of a building. But our security works and we move ourselves and all the gear into a friendly squatted flat, with some seconds to spare. Pack you Eric Gotta! Then we put out the story that we ran down 15 stories and hid all night in a cupboard.

Wed 2nd March B2. We broadcast a full show from Redstone 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 that they can’t get enough police support to bust us (there were only 3 of us). Good sport.
Andromeda

Andromeda Independent Radio began on Jan 23rd 1979, broadcasting from the Pea-nies to the Manchester, 5th East Lancashire area. Andromeda didn't belong to any organisation, or rent its gear from anyone, they were non-profit-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 pirate. 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 commitments. 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 broadcast with a tiny 1 watt transmitter, which covered the whole site and nearby Pilton village.

Wed 9th March. We sat up on top of a Tower Block, channel switched on, and after hours than a half dozen plain clothes cops are moving in, saying radio silence on their own channel. We switch off and just about escape with all people and cars with a nearby flat, as coppers and icons of them the building. Shit. No show.

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

Wed 23rd March. We're back to Eddystone Tower, options left, so we prepare a 'dummy' TX and set up on the end of the roof, hoping to go on and broadcast OK till 9.30, when they move in for us. Though we get everything down to the squelch in they now have a search warrant for the flat, and we're right there. As we've apparently been using the same flat again. We lose everything, though only one person is actually nicked.

March to Sept 83. Much reduced and demoralised lack of support. Our Radio struggles to raise cash for new gear and times. We make several attempts to cut shoes on our MD 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 reprinted (also in the book 'Rebel Radio') though we didn't put out the entire technical and contacts section (bastards) several times, and finally turns into a manual.

Cambridge Community Radio

We're sorry not to have a full report on CCR (next edition!). Cambridge Community Radio began an access station broadcasting music and local community news on 94.0 FM, until it was put off the air, with a series of heavy busts in 1983. People from CCR then took responsibility for developing the Free The Airwaves Network and Campaign over the next couple of years and produced a series of well researched technical and legal news, before passing the job to a London based group.

SHEFFIELD PEACE RADIO.

The idea of SPR came from Radio Avalon in 1981. 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 programmes on peace issues and actions. But the hierarchy were hostile, refusing to endorse or advertise SPR (this was the 1st and last pirate at a Conference). However the broadcast itself was a success, partly because of a co-opt by the DTI police, who persuaded Sheffield's commercial station Radio Hallam to close down temporarily to aid in blocking SPR frequency and the police didn't catch SPR, and when Radio Hallam closed everyone returned to SPR. Lots of good publicity. Encouraged by this a new, non party collective began broadcasting a series of programmes in Feb 84. It consisted of music, news, features and interviews on themes like the Miners Strike. Theбинist Spring demo, the Police Bill, Legalise Cannabis, anti nuclear peace stuff, and not forgetting animal rights group developed quickly into a genuine radical alternative which received lots of exciting interest and feedback. They also produce a booklet 'Sound Advice', advocating THAT MORE DO THE SAME THING. SPR was also active in the The Airwaves Campaign and friends with Rebel Radio in Bristol, Radio Pleb and Our Radio in London the short lived anarchist Radio Revenge in February and March 84. However on 20th May 84 the police and DTI forced the bus took to their transmission site (s) and nicked all four of the SPR tapes and all...
The Jackie Conspiracy

Radio Jackie began way back in 1969, and gradually built up to a 24 hour per day station. Becoming Britain's biggest and only tolerated pirate, broadcasting non stop pop and advertising to all SE England by the Liberal Left Comunity Radio Association. Tory controlled Sutton Council. Radio Jackie is a company, though it illegally fails to submit Accounts to Annual Return Radio Jackie Ltd, No 1928550. It was wholly controlled by Peter Stremes and with Radio Jackie, who raked in at least £13,000 Free advertising, while using volunteers to run the station. Jackie was taken over by the Tories in '77) except it had none fees, restrictions and costs, while still be unique... it never got busted!

We put out a popular 'Community' image, with free advice for all events, even while state that they were more self censoring than the BBC, and all other pirates should be kicked. 'We broadcast nothing about homosexuality, drugs, CND, animal liberation, politics or anything that might be considered controversial...'' Michael Collins...

As for Peter Stremes (Co-owner, Director and Secretary of Jackie and editor of the trade paper Broadcasting) he is a man of some interest, since he single handedly began and kicked off 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 communications 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 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 DTT and police an impossible job. The answer to this was a loud no. Few of the applicants had any real interest or commitment 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 action on CR radio was to be continued. A second group briefly threatened to start an open access pirate and broadcast everyone's 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 Association for Broadcasting Development. To represent the lobby for legalising commercial rights and get rid of pirates. This was the US model, with a token 'community input'. If the CR experiment is ever revived by a Tory government it will be the model of the new DB (and NOT the CRA) who will be vetting the applications. If set up by a Labour Government the original blueprint... well we don't know... The same old shit with different coloured boxes paper!

RADIO WAPPING 50 Watts Mobile

Radio Wapping kept up regular broadcasts, on top of LRS in North London, throughout June. These took place at various times, though usually in the morning on Saturday or Sunday.
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 unsigned.

The main contention is that this kind of broadcasting has to be on a ‘hit and run’ basis if it’s 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 own 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 paradise (where we spend the winter). And then there’s that token bit of ‘community’ charity as porky middle aged middle class males read out a few low paid jokes for the rest of us. Then its time for the dreary ), with anything not favorable 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 States hopes to buy off and neutralise dissent, complaints, 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 pressure or close down any of the stations (if they ever start up!).

Campaigning for change isn’t easy but its been 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.

 Anti-authoritarian radio is an essential tool for THE NEW RADICeS / OTHER ROBOTS / 88

Free The Airwaves

Free The Airwaves is still going strong, as an informal exchange and promotion group for radical local pirate stations. 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 community 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 ‘propaganda’ 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. 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 pretentions to breaking down the mystification round transmitter and programme construction and providing a medium open to people together in mutual aid and defence. Pirate
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 lorries were vandalised and when the shop windows were smashed several times, and finally his beautiful car was stolen, graffitied and burnt out... No wonder the poor man broked...

MUSIC

JOY UNCONFINED

The news of the Council’s fall (especially of the corrupt Thatcherite minority, 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 it’s 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 squatters of the Tory-led council seem to have spared on the squatters to defend their homes, and they are relying on strong doors and their own Alarm Network, rather than the whims of corrupt politicians.

MUSIC FADROUT...CRACK OF THUNDER...

Back up music from ITAL DUB or other suitable

And now for a COMMERCIAL BREAK... (woman’s 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 Rd 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 picked in the previous Monday’s riot in Brixton came to court at last in Camberwell. Police had used severe brutality in at least one case, tried to get another removed in custody and tried to stop another getting Legal Aid...
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

ANGRY...I'm Angry (poem with backing cue tape ready)
TRUMPETS (women's voice)

LADIES AGAINST WOMEN ('Gym 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...inveade abroad.
2) Protect the rights of the unconceived...sems are people too, yet millions are murdered daily!
3) Restore Virginity immediately as an O level requirement.
4) Suffering not Sufferage...Let's get women out of the polling booth and into the maternity ward.
5) £1.50 an hour is TO... MUCH for women. Its quite un-ladylike 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.

That's 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 un-ladylike events in proper proester 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 Krugerrands or cheques from your husbands or father are ALWAYS welcome . Mistorial is powerful...Why not ask them to join our mens club?...Ladies against Women supports the Moral MANoply. We have the monopoly 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葉UOTS underground info bulletin. He is still in prison.

Also arrested is Natalia Lazareva, for her activities in the unofficial women's movement. She has been charged with anti-Soviet agitation 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 ten million people work part time as State spies. The CP Central Committee instance 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 consensus to join the army, and a growing number of conscientious objectors. One of these, Tibor Palk, was arrested in the Univer
ty church for staging a hunger strike to protest the confiscation of his passport. He was transferred to a psychiatric ward where he had 3 teeth broken by wardens while being force fed. The institutions 'experts' stated that he was suffering "negation of food" and "erroneous belief". Happily he 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, Eitham, London SE5.

And now for another poetry spot...this one was written on 22nd this year by the 18 year old Jimmy Hayes at 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 the July Jimmy was found mysteriously dead, hanged in his prison cell, alone...These are his words.

(5th 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...Fly J.H.H...CRISIS...PCS4.

We hope to have more of Jimmy 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 go to the TO, or get involved in a really exciting hobby. Any advice... Yours Al...Alienated.

Dear Alienated.......(women's 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... .......With love.....Auntie Annie.

Sound Effects FALLING CRASH LAUGHTER

Dear Auntie.....(women's 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 looking 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 group of women together, wait for him in a quiet spot. Then beat the shit out of the bastard. Can I come?.....Auntie.

Bucking Pink Panther theme fades 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 questions then YOU are the sort of chap we want in THE FREE MASONs!

AND HERE IS WHAT YOU GET! (fade in and out)

A supper set of handshakes to try out on strangers.

A super piney 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 CERENONY, 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 that 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...what 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 beds' pits to highest bidder. In the end there was nowt left to the mining industry. It was a terrible and shameful waste to the nation's best assets. It was 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, don't let your colliery become a thing of the past. Join the strike now, and never forget that today's blacklegs are tomorrow's dole queuees.

(No note. The start of this script is take-off c a Unigate Milk AD, and not a piece of rightwing nationalism! Ed.)

(Choir music, followed by the epitomised Northern tune 'You're a Lad' 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 government 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 laveratory.

(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.

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Voice of Arthur blights the air

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

It is the first recorded instance of a pirate radio station broadcasting taped pirate radio panic tapes on the world. British Television prior to its privatisation even more trouble, because it is probably being operated from a series of private homes or a car boot.

The Communications Act, and the "Fernando woman Ian MacGregor" have been going on in the Nottingham area on the same medium wave frequency (86.2) as Radio Trent in Nottingham. Earlier this week the transmissions were intercepted and Trent were more than willing to go out on VHF frequencies.

"It is a sinister development, because if my political material is now broadcasted on VHF frequency, it is likely to reflect badly on the world. British Television prior to its privatisation even more trouble, because it is probably being operated from a series of private homes or a car boot."

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Radios have complained to the Independent Broadcasting Authority at the House Office and the DTI. Unfortunately the DTI is short of staff in the Nottingham area which has cut down investigations.

"We would not say how the pirate radio is operating "penetrated the system of radio broadcasting. It is to put out on our VHF broadcast...", "We do not want to help other people do it", said Mike. "Things are not bad enough as they are."

---

Voice of Arthur blights the air
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..." 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', housewives, anarchists, squatters, workers, women groups, intellectuals, marxists, etc, all clamouring to get their views across. Everyone spoke and sang and put out an incredible range of programmes. It was a revolution on the airwaves. "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 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 party bosses began putting stations of up to 40 or so on the air.

The big commercials brought back uniformity of programming and less and less spoken word. To raise their advertising profits they formed small 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 movimiento (Movement) itself, before stupid acts of marxist terrorist resistance gave the State...
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.

Radio Rataplan

The Vrije Keizer was the main alternative pirate, dividing up its wavelength to allow women's 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, Zwarne 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...
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 problem for the State. VKR began as a small local FM pirate 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, and 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 whole 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 wavelength 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 Group 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 the police made a major attack on the Teitterode squatted buildings from where we were broadcast, but when our listeners heard it reinforcements rushed to the area, and the police had to fight their way 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 ones as backup. These were payed for by donations, and the new ‘Flux’ squatters disco which had begun in the Teitterode. The weekend group became ‘Radio Got’ (God) with a big new 200watt transmitter, which they shared for a time with the Vrouwensradio (womens), while the Anarchists and the Pijp group 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 others considered too trendy and became the new transmitters covered the whole city, better aerials and broadcast sites were also used. More volunteers came forward and things got better, with lots of brilliant programmes, especially on squatters 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, with legal hitch in stopping them because the Cable company’s constitution said the cable had to be switched on. The TV pirates put out creepy programs, advertising, music videos and lots of pretty green porn. That is except for Vrije Keizer TV (VKTV) which began transmitting excellent unsown videos on the squat movement, the German movement, the Womens Strike, the Third World, aids 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 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 and switched off the pirates. The VKTV group kept going for a while, making their own videos.
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, Robotnik 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 Womans Radio stopped sharing with Got, which split in two and Radio Twist (an anti-commercial music and politics group) was born. Then the Black Womans Radio began as well, and the new line-up was VKR... Tues,Wed,Thu, Radio Got... Fri & Sat, Radio Twist... Sun afternoon. Womans & Black Womans, 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 prison, 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 about 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 Robotnik, 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 10680, 1000ZB Amsterdam.
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 break 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 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 1984 they were doing 2 hours a day, and then jumped to 6 hours a day, with broadcasts from France beamed to mountain/forest transmitter and re-directed into Germany. The original anti-nuke pirate was also still going strong.

The daily news programmes dealt 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.

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 10 watt FM transmitters. Of these about 10 could be described as progressive, but only one, Radio Sokkeland, in Kbhavn, is run by alternative groups. In Radio Sokkeland about 100 activists put together 45 hours of radio a week. It's 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 regularly 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 anarchism, 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 dazzy notch-potch, one minute hunger striking prisoners, the next minute press releases from Action Diret, 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, cacophonous effect..."We don't want to be legalised at present 3,000 'projects' are still awaiting the licence. We say that licensing one means closures of 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 the 'radical' newspaper Liberation*.

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


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 range of rock stations and minority stations, often sharing frequencies, for a dozen different international tastes. Still strong at the end of 1986 are Radio Libertaire (94.8mHz), Radio Mouvance (106mHz), Frequence Gaite, anti-commerciality station (97.3mHz), Radio Ici at Maintenant, Ce Ras de 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 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, rhythmic, 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, Filliérd, 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 attempts at recapture (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 'Frequency 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 Arabie Paris'.

That evening Filioud announced that the FM 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 siege 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 Vom' then 'Radio Mouvance' and finally 'Jet Théorique'. Twenty two pirates had been seized since 17th Aug.

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 and in Madrid the CNT (anarcho-syndicalist union) was received by the French ambassador, as was ANORG in Norway and the @ syndicalist Fed. in Sweden. The IPA, SIA and numerous groups, organisations and publications sent telegrams to the French Minister. In Paris a demo was called for 3rd Sept, at 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 bannens, 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 suspense...Supporters in their 1000's were streaming into the Place De La Republique. The demonstration streamed into the Boulevard de Magenta, showing 'Radio Libertaire will not be silenced'. Banners...
ried reading ‘Civil Liberties Union’, ‘Pacifist Union’, ‘CNI’, ‘Les Occupants Renouveleurs’, ‘Libre Pensée’, ‘CGT proofreaders’, etc. People were in great mood. No one wanted it to be a sombre funeral procession. Other pirates, including Radio Voka, Carbune 14 and Amplitudes FPI 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 existence 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.

Translation by M.W. (thanks)

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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 Toestol in Ghent. Its half financed by benefits and donations and has a democratic structure with at least 60 volunteers. In 1985 Radio Toestol was given a whole frequency and went legal, merging with Radio Central from Antwerp. 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.

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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 separatists, 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 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 groups: Commercial / Sub cultural, alternative / subversion anti-state / Community, participatory / and Revolutionary, nationalist.

In fact the label ‘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 (80% of the people). Such radios are an essential part of building and participating in a counter-revolutionary movement, in this case one postponed indefinitely by US intervention and the Death Squards 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 sabotage 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 60s, 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 3rd American pirates except that they are many. One is Radio Liberation, the voice of the Chilean resistance, which does ‘broadening’ onto State radio and TV broadcasts, calling for strikes, demos etc., against the fascist 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 ’60s (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 800 stations) was begun by the anarchists and pacificists of the KPFA station in Berkeley, 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
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.

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 licensed.

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 familiar 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 young people walked the streets listening on their walkmans, 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 has 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

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 program, among which you have something worth saying or doing. You don't even need a studio to start off with, just a chance someone's stenic and a microphone and start making practice recordings and good-quality cassette tapes.

C. A Transmitter. Ideally over 15 watt power, but if you can't manage that, just try to get a good one. Get a good one, and if you can't, then perhaps a lesser transmitter might do. Make sure you have a good antenna too.

D. Antenna (aerial). You can adapt a design yourself from an antenna book. (e.g. The Q-Band Antenna Handbook: Baluns, or TVC transmitters, or an amateur Radio handbook), or use one of our ready made designs (see Tech. Section). Look out for aluminum tubing or metal (on skis) 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, perhaps one or two good earphones, a roll of coax cable for aerial, a radio to listen to, etc. Also start collecting and saving Amateur Radio handbooks and all relevant writings.

VHF: Pros and Cons

First let's deal with FM (Frequency Modulated) broadcasting, which is your primary interest. The antennas are small and light and quite cheap. Reception tends to be either very clear or non-existent. It's excellent for music and for making friends and can quite easily be adapted to transmit in stereo (capable with AM). A major plus for the pirate is that it's easy to hide and transport, and simple, for small areas. However, the problem with this type of transmission is that it has only a very short range, and is very difficult to be heard over the noise of the air. Hence, it's necessary to have a good aerial, and to be able to make the signal stronger than the normal level. The disadvantage is that VHF FM is essentially a "line of sight" communication...Which means that your reception area depends mostly on the height of your aerial above the surrounding buildings. It is no problem if you can get on top of a hill or a tower block, but it does restrict the choice of broadcasting sites, making you easier to find and trace. With local broadcasting you have more choice of sites, in very large areas, unless you can get on top of a mountain, you'd better choose VHF, also if you want to broadcast to stationed communities over a wide area. Longer range covered with an FM aerial is up to 50 miles or so. 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 3 miles from the base of the tower, and if you built a directional aerial with some

The Broadcasting Site (FM)

TOWER BLOCKS

In cities, tower blocks are a good idea, and are usually more powerful because commercial companies (who often use FM) have found the ideal gives to the tower block, so as to "go live." A further advantage is that they are usually more powerful because commercial companies (who often use FM) have found the ideal gives to the tower block, so as to "go live." A further advantage is that there are usually more powerful because commercial companies (who often use FM) have found the ideal gives to the tower block, so as to "go live." A further advantage is that there are usually more powerful because commercial companies (who often use FM) have found the ideal gives to the tower block, so as to "go live." A further advantage is that there are usually more powerful because commercial companies (who often use FM) have found the ideal gives to the tower block, so as to "go live." 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On a hill within the town or city use good lookout ESCAPE, CATERS, OB's and have regular "escape"
drills.' Best place for the aerial is a high, easily climbable tree. If it's not too obtrusive leave it up there and have a ready. An added problem with tails is that you normally have to lug at least one car battery about, which is terrible if you have to climb fences, balconies at night (wear gloves and old clothes against acid spillage) and you're using a 250w inverter. However, food, maps, road-shorts for lookouts, etc. are good ideas. It gets boring after a few hours. CIVS are excellent, just get ones with earphones if possible to avoid noise.

**SO THE HOUSEWORK? IMAGINE BE A RADIO PIRATE!!**

If on a hill you can also use an ordinary house, flat, etc, or dormer, and just set up your aerial as high as practicable on the roof (including it up, using a scaffold pole, though a Skylight). It's better to get a high, easily spotting (if you're not by your door, specially on 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 DON'T leave dope, stolen goods, false ID's or other naughty lying about. It is possible to run your antennas cable from your house to the aerial on another roof and whip the cable off quickly if they come, but this would only work once, and you lose output power with every extra foot of coax cable going to your aerial. More of this in the How to get away with it section. NEVER leave your radios at the broadcast site. They'll confiscate the lot under the new laws.

**OTHER POSSIBLE BROADCASTING SITES**

**FESTIVALS.** especially large free festivals is an excellent and common broadcast site. A small ferrig will do fine. Set up on high ground in a tent or vehicle, and invite the festival goers to protect you from police attack. Such much unlikely in these circumstances. If possible, make a 'live' studio in a tent, caravan or truck and get everyone involved. (See Sheffield Peace Radio) In this case the broadcast can also be used for discussion, information and warnings of police movements, as well as for entertainment and music.

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

**OCCUPIED FACTORIES or industrial areas during the 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 gathering support. There have been many such opportunities in Britain over recent years.

**EYES-ins and protest occupations** (eg Greenspace) are another good possibility, which we don’t think has been tried. Especially occupations of high, visible buildings or for protest. It’s a good idea to get some support from the community in advance, and they may end up getting arrested, but there are plenty of inner city estates where the police rarely venture, especially on the evenings in the winter season, or after a heavy rain or worse from the roofs. A high building in such an area could be an excellent site, especially if you can get off the local youth to lend a hand. Whenever major rioting begins large areas are suddenly devoid of police. All they can do is get more men to the streets. See Amsterdam inint section (through you would need good security, disposable transmitter, quick getaway route, disguised voice, etc.)

**LIBERATED ZONES!** (Let us know if you find one!) Practically every guerrilla or Nat, Liberation movement is right or left wing, has its own pirate radio, which are a crucial influence in such wars, broadcasting from free zones or neighbouring countries. But you’re not likely to come across this in Britain.

**INTERNATIONAL WATERs** is of course a favourite

**How To Set Up Your Gear. (FM).**

**BEFORE YOU GO**

Before setting up you had best brief everyone, both newcomers, on what will or won’t happen. Talk about getting caught, for instance you have enough equipment to broadcast 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 your existence, otherwise you might have problems getting bail if you were arrested in this case keep your暴露 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. It’s surprisingly easy to find yourself on top of a Tower Block, or climbing some tree, only to discover that your cassette deck is left at home five miles away.

**HERE IS A SAMPLE LIST OF THINGS YOU NEED**

- Transmitter (TX)/ Transmitter loader or 2 clip on battery leads (large & well insulated)/ TX leads to cassette deck if you’re attached (cheap cassette deck plus mains lead or 2 clip on 6v and 6 volt battery charger)/ TX 12 watt on mains/ Antenna coaxial (check you have the butterfly bolts if collapsible)/ TX leads to TX if you’re attached to TX (fused) fuse box (if mains)/ programme headphones (optional)/ Portable tape recorder (optional)/ Plastic ‘gaffa’ tape (optional)/ Soldering iron and solder in case of broken leads (ideally)/ Warm clothes (jumpsuits)/ Bus fare.

**ON THE WAY**

Ideally you need four people, at least two. Carry the gear as inconspicuously as possible, in hotels or placky bags. The antenna is a problem. If it’s a big long one make it collapsible butting 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, the more standardised you are, 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 guy or a heavy rope over the long wall. For a roof situation the door nearby 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 regularly with cloth and alcohol. They don’t usually bother with fingerprint evidence, but they might start. The antenna must be cleaned regularly anyway for good transmissions. Set up your antennas as high as possible. Rake up 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 gaff tape, to a length of wood, 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 or attached) to the antenna, or attached with strong, must free one 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 necessary, you lose power with every extra foot, and should be good quality and well insulated. Your eyeballs should already be on station, with torrises or Ciba, one at the foot of the tower (perisher sitting in a car or flat) and one on the roof. Keep a quiet and wear soft shoes (in a court case Eric Gotta of the DTI’s court) claimed he recognised an Irish radio member from the ground, 18 stories up (see the joint case, etc.).

When the antenna is up securely, lend the coax back and plug or swap in to the back of your transmitter. Now plug in the TX to the cassette deck (TX antennas) and plug in your TV. Make sure you’ve got a true go in there.

On the TX feed up the TX to get the correct output. Adjust your TX to your liking, generally it’s possible to block by something solid like a wall, to
BROADCASTING...HOW TO GET AWAY WITH IT

KNOW YOUR ENEMY

On a lower block, in London, the DTV squads can tell where you are, within 20 meters, less than 10 minutes after you stop, and they can have your location ready for you within 20 meters, before you can even think of leaving. In such a situation, the DTV radio is the complete solution. But what do you do if you want to "get away" with broadcasting without being caught?

For large rich commercial pilots the game is to have plenty of transmitters lined up, and not to try and save them if the police and DTV radio think they are needed. They often have their own "hit list" of local police to call when they want to "get away" from the police. But when they do have to use transmitters, they usually do it in a way that is not too obvious, by using timers or radio signals, so they don't have to go back and change tapes and then get caught by the police. Instead, they often use "false" transmitters, by using false frequencies and making everyone think they are in the wrong place. But the police have their own ways of catching the pilots, by using "false" transmitters, by using false frequencies and making everyone think they are in the wrong place.

PRECAUTIONS

Don't talk or shout unnecessarily about your sites or studios. Work on a "need to know" basis from the start. Keep the"I was there" line short. Disable the transmitters. Don't try to save them if the police and DTV radio think they are needed. They often have their own "hit list" of local police to call when they want to "get away" from the police.

broadcasts can both get passed off and become a power elite ("I'm not transmitting this!""). This is often done by false location, real names or addresses. Don't give your phone number either, certainly in Britain, the days of phone numbers and instant access to phones are numbered (see legal Section). If you're really into phone-ups 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 fake address, or "PO Box", or "c/o" "PO Box" or "c/o" "PO Box".

THE RAID...SAVING THE GEAR

A) HIDING IT ON SITE

Some pilots have tried building the transmitter into walls, panes of glass, etc. You can conceal it under water tanks, central heating radiators, lift machinery. Better still hide it in a legal or "squat"ed 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 "waist" pipes. Another variation is to have your tape player is a flat, and a long concealed din lead to the TX on the roof. The possibilities are endless, and must be used. On one occasion We 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 "Deadly Poison" note. In all these cases you will need to keep your co-ax cable, but of course it's lead straight to your TX.

B) LOOKOUT

You need two, preferably three, and take it in turns, and if possible also monitor police and DTV radio channels. You can use two transmitters, one to cover the ground and one to cover the air. On CBs they turn very low, or use headphones, and use codewords, they're very public. Watch out for cars or vans with two strikers, electrical gear in the passenger seat, hanging around.

C) CAT AND MOUSE

This involves moving and hiding the gear, in false stair cupboards, lift shafts, hanging out windows, disguised as something else, etc. Normally they have a "hit list" of people to "fire" (bring it down fast) and often send a few young ones on the trail.

D) DISAPPEARING

When the DTV are really on your tail once thing you can do is take a week's rest, then come back with a different name, style and timing. Of course this fakes up totally your effect to make a name for yourself, but at least you've gone. The police, or "PO Box", or "c/o" "PO Box" or "c/o" "PO Box".

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 wavelengths). The idea is to have the one going, the other being the "squat"ed flat. At last all mail is read, or use a forwarding address. When traveling to sites vary your means of transport.
When combined with Cat and Mouse tactics this can make you feel relatively safe. The problems are: you're using only a few blocks of frequencies in use; if you get too close, your opponent will be alerted; and you need plenty of darkness and a lot of time to make sure the job is done. But you're not just ready to wait. When you become determined they will still get you. We know of a person who, with approximately 400 miles of wire, made all 12 of his transmitters within 15 minutes.

Switching would work better when combined with tactics of forcing your way into broadcasting. Even if you did not have to use this, long-term broadcasting would be worthwhile. Particularly if you're a local station, where you need more choice of broadcasting sites.

**GUERRILLA RADIO**

This is one of the main ideas this book is trying to promote (see Chapter One). Guerilla Hit and Run radio is the way of the future. Most of all you can reduce the risk of getting caught by broadcasting at fixed times and may be with fixed names, or by being on only for a short period of time. The period of course is that you are a known and smaller. The guerilla idea is to get together a few stations broadcasting on the same frequency with cheap mass produced transmitters, thus forming one big tower station which listeners would have a good chance of catching. This way is usually very difficult for the DAE age police to stop.

**BREAKS**

Brackets are a higher and more effective form of guerrilla radio, as used in this country by Radio Antik and Radio Wapping. The idea is to grab your audience by broadcasting on top of a legal station. The sentences are much longer (see Legal Section) and there is little chance of getting caught if you keep your breaks short, say five minutes, on top of the news or advertising of a major station. You're taking advantage of a quality of AM broadcasting that the strength of the signal is weak, blending out the weaker one completely. With a small transmitter you might only 'win' for a short distance, but even a few hundred yards could cover a wide area. The main factor, a powerful transmitter, would be ideal, and your TX needs to be built and tuned carefully to make sure you can break in with your signal on the most popular channel at prime time. For breaks in all situations should be timed to be sure to clear away from the major station so you don't interfere with the same time or broadcast site again. It's as simple as that.

Breaks are also easily possible on TV, but only over the same time. Breaks are also common in countries where parties have been repressed, e.g., in W. Germany or the Eastern Block, and are ideal for exposures and demonstrations.

There is another and better way of doing breaks on FM, which may have been used by Radio Antik. That is, to use the VHF microwave transmitter, beaming your signal to the microwave dish on the same frequency, beaming the signals on a legal station's frequency. The dish does pick up your signal, and providing you're close enough to be heard, your signal, by microwave link, giving your breaks in perfect coverage throughout the transmission area.

However, we don't have technical plans to build such a microwave transmitter, and it would be too expensive. Through this type of breakers is possible, it is not very effective. It is easier to turn off the entire station. They will probably make it more difficult by using access codes to receivers dishes, as it is already done to avoid piracy of satellite dishes. Note: Don't play around with microwaves, they can be dangerous. See also Radio Antik and Radio Wapping.

**GOING MOBILE**

In theory, this is an ideal way of getting away with it, but there are a few problems. If you're going to a vehicle you can use an ordinary car cassette player, but you are better off having a separate 12 Volt battery to power the transmitter. The transmitter is on the same level as the vehicle, if you use a bigger, more expensive one it will be very obvious. Your coverage will vary greatly if you're driving any distance. Not much use for going mobile or developing an audience. The main advantage is that you will be much more difficult to stop.

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

**LINKS, TIMERS, SQUARE WAVES**

These aren't for the chopping plants, though you can build them cheap if you have the know-how. As we said earlier links often prevent you from being located. If you want to do live programmes, all it involves is:

1. **INFRA-RED LINK FROM STUDIO**
2. **MICROWAVE LINK**
3. **URF LINK**
4. **URF BROADCAST SIGNAL**

**CONFRONTATION**

A good timer if you can get away with it. The DTI and police are becoming increasingly being a few who are wide open to attack (the mouse becomes the cat when coming to get you). The problem is that a future you have to change your station name, frequency, equipment and usually the place you're on the air. The good thing is if you start attacking them, they have to bring more police with them, and can only do it when police space police, they are usually laughing over their shoulders, and have to be more careful with their surveillance work. One easy way to do this is by opening the side a corner, the lookout signals up when they're in and throw the main power switches in the lift room. (Careful you don't stay inside as well.) Then take your gear down the stairs, heating up any of them you must as the way, and make off. Their cars are also vulnerable usually they're parked unattended around the corner. If you're going to attack them, remember you're well masked and hooded up, and you have enough skill and numbers to get past them. Go straight for the police car, they have to use a lot of force to make their vehicles (in distress) call (male or female), not take the radio, or someone having jamming their frequencies). The most obvious ways of putting them on the DIT then attack their vehicles, attacking for their entire vehicle, booking them up, any form of direct attack should be anonymous and never spoken of or boasted about later, or before a friend.
Building Your Pirate Station.

We're not talking here about commercial pirates, in their effort to offend nobody and build towards a different kind of community. The truth is that most commercial pirates, in their effort to offend nobody and build towards a different kind of community 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 commitment (and cash) keep a station going. Many music bands use backing from clone, and are the platform for the comparatively egalitarian and simple DJ's which work in those clubs. Such solid backing is a good idea. If you're running a station you'll be hard pressed to fund raise as well. If you see your station as part of a wider movement (e.g. anti-war, women's, gay, anarchist, animal rights) you should try to get regular backing from that movement. Another good trick is to siphon off small amounts of cash regularly from council, charity or student union. Market breadth is involved in what you need is income, let's say £250 a week would do if regular. If some of your members have good ideas they might be able to do it, otherwise you could be tied in with a money making co-operative or something similar of this is the squatter 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 don't 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, through fear of going pirate in the present hostile climate.

The idea of 'Open Access' is to share a frequency, studio 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 be bought, 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 Airways Campaign, etc. Regular regular meetings of all involved (at least monthly) and insist on full attendance. You need a few good people who are into organizing it and making it work. Another problem is with broadcasting. "You should aim for everyone having their own gear and broadcasting as soon as you can, so you will be more difficult to stop by the police and DD.T. So you should insist on each group producing tapes providing at least two tapes (though people involved in the broadcast team and to work on the technical and backup side of it (building, repairing, saving etc.).

Open Access stations depend on cooperation, if you have any and all the other advantages bring into play, but are fighting all the time against our broadcasting, in this society, to be competitive and individualistic. The idea 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 Federal's 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 group. The straight media also love to happen.

LOCAL / "COMMUNITY" PIRATE RADIO

The word 'community' has lost all real meaning, through misuse and overuse (eg 'Community Policing'). The old style communities are a thing of the past, they are dead. But once 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 clever what you mean. If it's the Slate means by promoting (and thus censoring) such an idea 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 to build transmitters, closer contact and participation of listeners, etc.

In a big city it's 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 or 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, in coordination with. The whole idea of Open Access could be persuaded to make programmes on a local basis, and support is much easier to get, as is the possibility of mobilizing people to defend you when attacked, etc. a popular station in the middle of a large housing estate. Local broadcasting in inner city areas can have massive audiences, hundreds of thousands of potential listeners. Most of the other 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.
and on the first tape recorder, allow the needles to go into the red for music recording, but only half way up for speech recording. For group interviews on semi-directed mike can be used, and pay special attention to sound recording levels and background noise. Don't use a telephone in the studio. Though the phone is the lifetime of democracy radio, in the present climate it means you'll be heard and/or have everything in the room recorded by the police. You really do need two mics, and at least two cassette looks. All these tips, and more you'll pick up as you go along and its good to work out a standard 'how to use the studio' lesson for newcomers. Pay attention to safety, eg have a plug-in, check wall out of the read, and don't allow coffee or beer near the read. Read a book on basic sound principles.

One last tip, look it up well, especially if its not your own house, and hardwood and cover any windows. There are some sure thing about accumulating sound gear, sooner or later someone will nick it!

THE PROGRAMME

This entirely up to yourself. No need to follow any conventions. Just make the way you have to make it sound as good as it can possibly be. Make sure you make the programme not just as a way of getting it done, but as something different. Other say if you do that you'll never do anything different.

Again there are some hard learned tips for pirates.

First thing to tell all concerned before starting, make a list of all the material gathered, music, interviews, sound effects, news items, jokes, etc have a roll of tape before you put it into some kind of order. A signature tune or jingle isn't such a bad idea, as people recognize the programme by it. After you've forgotten the name. Repeat the same programme often, fast too often along with your frequency and broadcast time. Put your important items first, eg a demo next day, your appeal as always possible you may be trusted to do the whole programme early, but don't put all your best material first and keep the programme short. Use first names (false ones) try to have a friendly, relaxed audience and give everyone present a go on the microphones 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, and need breaking up, also remember people are continually taping in sound.

out and if doing long pieces you need to "flash back" the story so far. You need variety and interaction, without sticking in jeggles every 30 seconds. Try and vary the voices you use, play in the studio, and try to put it into some kind of order. A signature tune or jingle isn't such a bad idea, as people recognize the programme by it. After you've forgotten the name. Repeat the same programme often, fast too often along with your frequency and broadcast time. Put your important items first, eg a demo next day, your appeal as always possible you may be trusted to do the whole programme early, but don't put all your best material first and keep the programme short. Use first names (false ones) try to have a friendly, relaxed audience and give everyone present a go on the microphones and control desk.

The most powerful publicity and you should certainly count the limits running the local TV. A common experience that appears on your job is that people are the media who will ten out to G A little too much, they're rather like your radio people, letting you in on the secrets. If you have your own club, of course, you're laughing.

Join Free The Airwaves and get publicity in your paper. Write articles for radio papers, and do benefit gigs, public meetings, media stations 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 your effort!

Remember, if you want to be a pirate station, you'll have to get out and seek feedback. Get out on the street and do interviews wherever you can. Take your own programme, don't change, however bad and inexperienced you are. You can quite easily improve on some of the "ain't shit" being pumped out by legal stations on the airwaves, 24 hours per day!

PUBLICITY

Publicity is very important, especially when you're starting off your new station. Of course you main publicity is to keep coming back on the air, no matter what. But if you're looking for a much more effective way to tune in specially you need to advertise a lot where those people are likely to see or hear them. Be warned, there are quite a large number of people and large support for pirate stations, and people will not be put off or consume the media if it means many them will try to get you. It could take you a long time to build up the reputation of the station, and the solid support you need to attract new blood, new ears, financially.

If your local station your publicity is obviously a lot easier, and you can poster, graffiti or even leaflet your entire musical area. If you're a wider station you're always mentioned in the "whats on" papers and get articles or interviews into and you're also likely to get some interest. Press releases suit the local and national press, and try to cultivate contacts among the slimy reptiles (journalists). Almost any publicity is good, as those pirate stations elsewhere to listen in to you will also likely read behind the title of the TV bit. Oddly, one place you should certainly seek publicity is on radio, try for instance getting onto phone ins, or on radio you are already talking to people who listen to TV, TV, if you can find any way of stunt to get onto it.
Medium Wave

Advantages and Problems.

At the moment FM broadcasting, with all its advantages, is the favourite for pirates. But its too well pointing out that at least 25% of radio receivers in Britain can't even receive FM, so you won'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 pirates who want to build a wave 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 reliable and easy to fly, and because you use a crystal there's no problem with tuning out or 'grow' (harmonics). Though the antenna is a huge length just a roll of wire, and doesn't necessarily have to be up on a mast, there is a different, if still limited, range of possible broadcasting sites. MW works by bouncing radio waves high off the atmosphere, and only a fraction gets through.

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 waves, and often not the best choice for lot of people. However, the Medium Wave transmitters are fairly cheap, and you can use the same power to get a good signal.

ADAPTING A MW TRANSMITTER

I'm not exactly an expert on this and the following information comes from the US. Apparently you can buy second hand radio ham transmitters and adapt them. The transmitter is a simple circuit, and the radio then tunes into the frequency of the transmitter. The radio will then pick up the frequency of the transmitter, and then you can tune in the frequency and listen to the music. This is a very good way to get a good signal.

HOW TO BROADCAST ON MW (540 - 1600 KHz)

YOUR TRANSMITTER

Enough general talk. So you want to broadcast on MW? Here's how to start. First, your transmitter. Medium Wave transmitters aren't hard to build, but any good amateur radio builder could do it, and there's people around who will build them (recon to spend about £100). Next, your aerial. The aerial needs to be high, at least 50 feet, and the higher the better. This will help the signal to reach further.

SETTING UP YOUR AERIAL (Medium Wave)

Security precautions and preparation are not the same as for FM. But here's the simple idea. You're starting a total aerial length; a 200 yard length, or you could use a shorter length. The aerial would be 50 yards long. You use ordinary thin single strand wire. Buy a roll, keep it on the roll and measure out, metre by metre. Ideally the aerial would point straight up, but this isn't just feasible, unless you hang it from the side of a tower block or a steep tree. Then suspend it from a balloon (only the balloon blows away). The monopole is the 'dipping' 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, colour and about 30 to 40 metres apart. Now string the 'dipping' between the trees and down to your TX without touching branches or leaves. Sounds impossible? If you have a trained monkey that's just fine. Otherwise try something different.

Practice and patience is necessary. Bring along with you a catalaup, a long reel of tape to strength line, and plenty of lead fishing weights (not too heavy for the catalaup). Also some small plastic rings (cut out lid of plastic containers)

SAMPLE CHECKLIST: Things to bring when broadcasting on Medium Wave outputs.


If you have a TX on mains (200VAC) you have to get it adapted using a 'rotary inverter'. This is difficult. A very basic thing is a test, you'd better carry it on mains, and 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

trees too far apart than too close. When you finally go, it all set to hardly worth taking it down again after the broadcast, though you should loosen it off and pull it on the wind. Disguise it if possible. A further problem can be with kids and police, so disguise your setting, stringing along fishing rods or kites 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 and lot of more besides.
SWITCHING ON
Connect up your batteries, load your antenna, play with a 'trial tap' and you're ready to go. (See Diagram II.)
1. Turn tuning adjuster to the right until the meter gives the lowest reading.
2. Turn 'load adjuster until meter reads about 50 milliamps.
3. Tune again till it drops about 25 Ma.
4. Load up again as above.
5. Carry out procedure till you get a load of about 15Ma on a 120 watt transmitter, or 10Ma on a 10 watt rig. Your last tuning adjustment should produce strictly no dip on the meter needle.
6. Adjust modulation in relation to other channels to get your beat sound. Use a radio receiver held at least 50 yards away for testing.
If there is cracking, buzzing, or loud sound, repeat from the beginning. Check that your valves are in good to dingly ground, that all lines are well separated, that aerial isn't touching trees, hold receiver further away, etc.

PACKING UP
When you've finished switch off immediately. Then disconnect everything and pack into holdalls or large plastic bags. Be especially careful carrying the radio, TX, and instrument. You should have several sails, and switch off as often as you can. Don't leave a site after an unexplored boat. If you have a good dry safe stash and are coming back later leave your transistor, amber, and loaded the TV. But take the batteries back for recharging. Such a station should be in a cover, just like a loaded warden or bed with luminous rounds. If you are sitting in the area, it is likely that the DTI will send men to sneak up and watch you, prior to planning a blast, so be careful, even when not on air, don't relax till safety home.

WHEN ON AIR, PRECAUTIONS. (Medium Wave.)
Read the FM chapter 'How to Get Away With It'. A lot of these 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 disk, pirates, day 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 station, and certainly the serial, if you have too far. If you have transport or good escape routes you can try a closer gateway, but a safer method is to hide the gear well (not too close to the serial if it's left up) and keep it. We favour numbers, tunes, pre-dur and lined with waterproof, undercoats, with heavy lid covered with earth and bushes. In theory they could find these with dogs or metal detection, but we're never under follow their advice, especially if you're too far, they sometimes say 'plead guilty' just to save themselves trouble, if they decide that this cost you don't like this at all but it can be done. Get the DXL to ask for copies of the prosecutions witness statements at or near your station. Be sure you can see the moon dress neatly and be polite to the bastard (magistrate) and the staff. Have a good 'hard luck and fingerprint you. You can't refuse under the new Police Bill.

You need your best bet is to remain calm. Decide to ring your solicitor. Don't panic, it's not the end of the world. Smile at the bastards. Have a good chin 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 it all possible, and a good solicitor who knows about this, very complex legal situation. Faint NOT GUILTY, but beware if you have money, they may award costs against you if you lose.

Get your Riot Fund together, with generous radio appeals donations of £2 each round etc. It's good to campaign for your local station all the time. Most commercial (legal and) pirates don't do this, offering the best for responsibility so far as to ignore their own best weapon. Make sure the address you give when arrested is 'clean' they could possibly raid you for further evidence. If you're a political station watch out for suspicious breakins where nothing is stolen, the Branch often does 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 they decide that this cost you don't like this at all but it can be done. Get the DXL to ask for copies of the prosecutions witness statements at or near your station. Be sure you can see the moon dress neatly and be polite to the bastard (magistrate) and the staff. Have a good 'hard luck story for your solicitor to tell, it's always good to say you've just got married, starting a new job etc, but don't say you have money or the fines will be much 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 the written case on focus on these and your solicitor to cross examine, especially any police witnesses, who are more weak and inexperienced in this kind of case. Demonstrations outside the courts are for publicity and can intimidate the magistrate if big enough, but don't always help your case (eg if you're pleading ' manslaughter'how come all these people are so concerned about us? If you work hard, send out Press Releases at least a week in advance, so the press can put it in their diaries, and phone sound with reminders the day before.
Your case should be paid by the Riot Fund if at all possible. If not extra costs should be divided up among everyone in the stationAlways plead poverty and ask for time to pay.

When you've been bailed once you shouldn't, ideally, work on the broadcast or 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 possibility, in theory of getting the gang back, through 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 bought it before the bust.

BUSTS...IT 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. No use 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 change you, Legal Aid is still normally treated as a "summons offence". Which means they question you, let you go (eventually), then summon you by letter to appear in court. This opens possibilities of getting away with it. You may be able to build 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 nicked your flat may interrupt 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 where you can be interviewed by police and DTI. The "pretest change" 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, and if you can really talk 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

Radio Support Group
To join Radio Support Group and get updates and development ad write to:
Radio Support Group, c/o Drewed Hat Communications, Box 019, 27 Stone Court, DICTIONARY OF RATES LINES
Free The Airwaves
BCH Box 1521, London WC1N 3XX
Radio Crimes is the name of the FTA bulletin, and will now use changeable wave designs and much more. To join FTA and receive the bulletin send £2 (for organisation £10) to the address above.

JOIN NOW


Legal Briefing

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 PTA Bulletin (with full technical updates), to join and receive it send £2.00 (minimum donation) £10 for organisations to the above address.

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).

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 (s10.1) as referring to stations and apparatus for emitting 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. Slightly 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 props 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 substitute 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 telegraphy apparatus of any class or description. Any of the following 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 (Section 1.1) 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 £1,000 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 multiple 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 our Radio team being done for this (they couldn’t get him on anything else). He got a £50 fine.

FREE THE AIRWAVES
BM Box 1502, London WC1N 3XX

Free The Airwaves is a small, but powerful, 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 PTA Bulletin (with full technical updates), to join and receive it send £2.00 (minimum donation) £10 for organisations to the above address.

For more info on pirate radio, please contact THE AIRWAVES, Box 1502, London WC1N 3XX.
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 75 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 (s75) 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 has reasonable cause to suspect has committed, an offence 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 fifth power to arrest on suspicion.

UNDER ARREST

Once you've 'eicked' 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 and then 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, 5a 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 chalcs and carpet) and, though the case was denied and the TX gear was never found, the DJs 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 5a 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 belling 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 toadies (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 bonnify to pay your fine. You can appeal against the decision, and you can use 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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FOREWORD

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 concepts 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 various alternatives and additional background info, eg. the use of test equipment will be introduced.

Radio Frequency signals have AMPLITUDE and FREQUENCY. 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 (cps), which these days are known as Hertz (Hz). 1000Hz = 1kHz. 1,000,000Hz = 1MHz. The amplitude is the height that 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 amplitude of the carrier is determined at every instant by the amplitude of the audio signal, the carrier frequency 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 DEVUATION. 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 your 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 your 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 20 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 it's 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 let's 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 retrieve to a safer distance. Links are now being traced and studios licensed, and some of the biggest pirates (eg LWR) are going back to taped broadcasts. If the DTU trace your transmission and turn up all they can do is confiscate your tape player, 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 'Elect'or' 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 an 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 10kHz pilot tone. The pilot tone switches on the Stereo Decoder in people's receivers.

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:

\[
\begin{align*}
L+R &= (L+R) + (L-R) = 2L \\
L-R &= (L+R) - (L-R) = 2R
\end{align*}
\]

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 receiver 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 8 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 for 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 50k resistor to wire the circuit permanently for max roll off. If you're using a link between studio and TX and you want stereo you'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 distortion. The carrier 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 them requires slight modification. In a mono TX the pre-emphasis can be built into the front end of the exciter. For a stereo such a network must NOT be in the exciter or it'll get with the composite stereo signal from the encoder. If you need 2 networks, one for each channel, on the input to the stereo encoder, They're actually often built into the encoder.

**COMPRESSORS AND LIMITERS**

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

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 amplitude varies 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 'Tinny' fatigue' as constant compression can become boring and irritating to the ear, as if the music were rammed into it!
Compressor has other use, 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 N5760 or N571 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 particularly, 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 inherently limited by the recording process, no limiter needed. With live input to the TX it’s 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 OSCILLATOR 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 VARIOCAP 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 BJTs 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 BJTs 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 outside the TX’s case, this is known as the AMBIENT TEMP.

ERATURE. 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 will 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 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. This 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 frequency is higher by comparing the phases of the two signals. 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 frequency 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 what’s 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. (Seats me...typised).

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
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 what's 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 mice 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 EXCITATOR 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 fledging 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 impedance.

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 broadcast bands. Not good for a VHF pirate, but could be useful for an 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 than tuned amps and are much harder to design requiring extensive knowledge of the transistors used when the amp is constructed. Linear amps for VHF are uncommon.

Tuned amps only amplify a narrow band of frequency, 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 circuits have a RESONANT frequency. This can be adjusted by variable capacitors known as trimmers, to the desired frequency. The amp will produce maximum output when the tuned circuits resonant frequency is the same as the input frequency from the oscillator. 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 easier to design. The bandwidth is a trade-off with gain, the wider the bandwidth the less the gain. The advantage 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 have to return 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 max. power gain = output power 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: power gain (dB) = 10 log (output power / input power)

Amps also have a max output power. When this is reached increasing the input power won't 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 2N2222 transistor. According to the makers data sheet this has a max output power of 4W and a gain of 12dB. First we have to convert the gain in dB to ordinary gain:

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

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

...
Input power - Output power = 4 - 0.25w
\[ \text{gain} = \frac{15.85}{250} = 0.063\, \text{mW} \]

So for 4w output power we need 250mW input power. Most excitors can manage this, hence the popularity of the MRF237 in the 1st amp after the exciter. The joke 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. That’s how the makers (Motorola Corp.) planned it.

INPUT AND OUTPUT IMPEDANCE

Impedance is the alternating current (AC) version of resistance. The standard impedance outputs of exciters and outputs and inputs of amps is 50Ω. The impedance 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 affects the LOAD the amp has on the stage before it. Max power is transferred between stages when the impedance 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 it’s 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 switch is then adjusted to make the meter read full scale. The switch is then set to Reverse or the button is released. It now indicates the VSWR. A VSWR of 1:1 is perfect (no reflected power) and so unlikely. One of 0.6:1 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 an open 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 144mHz. Most test gear for this band (dummy loads, VSWR meters, power meters, wavemeters, RF voltmeters, 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 until 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...
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 ABSORPTION 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 you'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 circuit. 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 harmonic.

Even with all tuned right you're still going to have some harmonics generated by the last stage. A sensible pirate won't 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 wattter and you 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 impedance and be able to take the power your 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 example you used a speaker and had your oscillator on a shielded frequency of 92.25mHz...you could be interfering with parts of a local hospital as they use 81.15mHz. Proper screening and a bandpass filter will eliminate such possibilities.

CONNECTORS

As you may have guessed you can't use any connection on VHF as they have to match the amp and feeder. Use BNC on the UHF series (p1.259 plug and SO239 socket). UHF is better for higher power as you can get a wider cable into the place. 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 you 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 output stage at one end and the aerial at the other. This means, like the TX's output, the connectors and the aerial has an impedance and to match this should be 50. 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 RG58U. For longer runs or higher power use UB67. (UB67 and UR76 are available from Cirtkit).

AERIALS

At last, the aerial! You can run a pirate knowing little about 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 paper back by Newton's technical books at £5.95. You may get it in the library. Lots in it isn't useful but goes into things like propagation, matching, VSWR in better detail. All the dimensions he gives are for the 2m amateur band centred on 144mHz. To convert to other frequencies all dimensions (including diameter of aerial element, etc) should be divided by your frequency in mHz and then multiplied by 145. eg 978mm for 2m becomes 978 X 145 = 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. 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 close to 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:

![Half Wave Dipole Diagram](image)

The elements can be bits of thin aluminium or copper tube. The lengths of each dipole, L, you get from your frequency by:

\[ L = \frac{\lambda}{4} \text{ metres} \]

(\( \lambda \) in MHz)

The impedance is about 72 \( \Omega \) which is close enough to 50 to be fed from a 50 \( \Omega \) 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:

![Half Wave Dipole Coverage](image)

which isn't very useful. Also a dipole needs a balanced feed. You need a BALUN (Balance to Unbalance) transformer. These can be easily made out of bits of coax cable. If you don't do this power will be radiated from the feeder. An aerial with an impedance greatly different from 50 \( \Omega \) needs an IMPEDANCE TRANSFORMER. Also made out of bits of coax cable, 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.

SITTING

Sitting 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!

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To join the Radio Support Group and get updates and development aid write to RSG, c/o Box 010, 37 Stokes Croft, Bristol. Avon BS13FY. It costs £5 to join. Make cheques payable to D.R. Communications.

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**APPENDIX B**

**UHF PLUG ASSEMBLY**

**UHF type (clamped screen)**

1. Cut end of cable even. Remove vinyl jacket tin. 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 fit. Bare tin 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 centre conductor to contact.
5. For final assembly, screw coupling ring on plug sub-assembly.

**UHF type (soldered screen)**

1. Cut end of cable even. Remove vinyl jacket tin.
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.
BIBLIOGRAPHY

How to Draw and Make your own PCB by R.A. Penrhyn
Babani Books, £1.95 from Maplin.

Two Meter Antenna Handbook by F.L. Judd G2BCX
Newnet 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 isn't. The chapter on aerials is worth a look. About a tenner.

60 WATT MEDIUM WAVE TRANSMITTER

RESISTORS
R1 4.7K 2W
R2 27K 3W
R3 22K
R4 22K
R5 33
R6 220 3W
R7 (between C7 & C8) 47K 3W

CAPACITORS
C1 0.005 mfd 500v
C2 0.005 mfd 500v
C3 30 pf 50v
C4 200 pf 50v
C5 10 pf 500v
C6 0.005 mfd 500v
C7 0.01 mfd 50v
C8 0.005 mfd 33v
C9 0.005 mfd 1KV MICA
C10 0.005 mfd 50v

VALVES
V1 EF 91 or 6AK5
V2 6L46 or 6068-20

MISC
M1 150 mA meter
X1 medium wave crystal (IMHs = 1.5 MHz)
T1 modulation transformer (wooden UM 1 or similar)

A Metering point. Disconnect R4 from earth. 6l46 grid current should be set to 1.4 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 C3 & C4.

50.
FREE THE AIRWAVES
TRANSMITTER PLANS

4WATT VHF Transmitter, parts and instructions

* Get some double-sided copper clad PCB, enough to make boards in Diag. II and IV, and a piece 1/4" x 3". Cut PCB with Stanley knife - score, bend, snap. Cut islands with junior hacksaw. Clean with emery cloth. Drill holes 1/8" bit. Mark islands with felt tip A to X (see Diags. II and IV). Mark board. Glue islands with Loctite 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 gnd.

4. 330Ω 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 zener diode
    Line nearest island.

13. 4N7 capacitor (or 4700pF, or 0.047uf)

14. 68KΩ (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. 2-12 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 μH
    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, enameled SWG copper wire. Wind wire through middle 6 times. Remove enamel from the ends, beat way to do this is to burn off then use emery cloth.

Actual Size 2-1/8" x 3-1/8" with islands for 4WATT DRIVER STAGE (Fig 2).
18-gauge enamelled SWG copperwire

Wind wire 9 times around pencil, shape legs, scrape off enamel and solder.

56 pf

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

4N7

RF choke, as above

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

SWG18 gauge enamelled copperwire 10 turns this time.

2-22 pf variable
Positive leg to P. Cut off leg facing leg on O.

The first board can now be tested once we have added piece of UPO7 Coax, or any heavy-duty 7mm CB Coax. (See diag. VI). We must fix Coax to a UHF male plug. (see diag. VII). Plus we need stereo 1/4" jackplug socket plus 250Q 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/motorhome battery.

b) A power/SWR meter—capable of up to 150MHz, plus dummy load—200W.

c) A frequency counter. This is the most expensive item. A Thermo/approx PFM200A is the best value.

We could do without a frequency counter, but if anything is shifted out, ie off the VHF band, then a radio receiver is no good to trace 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 Tendy's). 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.

See also Fig. 6.

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33. 3-90 pf variable capacitor (foill trimmer).
34. As above
35. 2 and a half turns of 18 gauge tin coated SWG using a 1/4" drill as former.
36. 47Ω resistor.
37. RF choke, same components but only 3 turns.
38. MRF227 transistor. Large heatsink.

39. 10 Ω resistor.
40. 'uf.
41. RF choke - 3 turns.
42. N18 (or 180pf)
43. 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.
44. 3-90pf trimmer
45. 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 TC SWG18 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 di. 6 and 8 for positions).

If all 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. VI 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 it's 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)**

- ¼" jack plug socket.
- 2 x 10 - ax. (see fig. 3)
- 4N7
- 12v output to aerial or 25w AMP
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 VHFU communication stations are possible in London. In the most dense areas we are talking about 50,000 people, e.g. 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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27 Stokes Croft,
Bristol.
Avon BS1 3PY.

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 corresponds 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 electrolytic 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 (winding) 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 (that's 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.

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TRANSMITTER CIRCUIT DIAGRAM

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OSCILLATOR (Fig. A)
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 ammeter, 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 R10 and C10 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 now 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) it is 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 & tune 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 exception.

If the oscillator doesn’t work at all, and the voltage supply is correct, either D8, D9, T4, or T6 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 T6 should be no more than 2 to 3mm above the PCB.

Rotating R19 antilockwise increases the transmission 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 antenna filters can only be done after finally building the transverter into its case and putting the top on. If you want to alter the frequency often rotate R19 fully antilockwise 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 another frequency under 80 Mhz add one turn to L1. If you use B9204 for D3 you can tune across the whole FM band with R18. The circuit is designed so that the modulation remains constant as you change the frequency.

The final oscillator layout stages (Figure D of the circuit diagram). Begin by mounting the resistors and capacitors. The ferrite bead D6 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 solder only on top. Construct the transformer L2:L3 (see Fig. K). Use 0.2 diameter enamelled copper wire for L2. bend a ferrite bead 3 times and tighten carefully. Don’t let 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 remains of the enamel with fine sandpaper. Then tin with solder. Put bits of sello tape on the ends so as not to confuse them with L2. Same thing now with L2, only its 6 windings the same. Dry three right and three left of L3, spread equally over the bead. Now mount L2:L3, keeping the wire ends short, and tin 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 wax (35-20w) 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.

Mount the trimmers on layout... X = Soldered Top and Underside
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 heatink 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 T7 (to be put on later). Using a high powered soldering iron (at least 60w) 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 heatink 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 be filed to 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 6v 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...be check there is no spurious output on other frequencies. Switch off again.

Finally mount Dr4 and Dr5 and clip a heatink onto the

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CIRCUIT DIAGRAM (Fig. D)

BUFFER

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INPUT ON RIGHT OUTPUT ON LEFT

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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 Ratio 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 ...¼, C32 ...¼, C33 ...¼ (i.e., C26 ¼ meshed, C27 ¼ meshed etc.)

[Image 1: PCB Design for Buffer Stage of Oscillator (The actual pattern you get on two sides of board is shown in Fig. 1A. [Fig. 1A for same board])]

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. 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 5 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. It is 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 1 - 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 reducing 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 dip meter 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 meshed at maximum output power then pull the turns of LA 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 planes extend to, and round the edges of the screening walls. Solder on the 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 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 transistor; if you assume an efficiency is 50-70% approx.

### 2m MODIFICATION

**Oscillator**

Fig. 6

oscillates at ¼ the frequency

**Doubler**

(Fig. H)

By modifying the circuit it is possible to transmit in the 2m band (130 - 130MHz). The oscillator now oscillates at half the transmitting frequency. The doubler is configured as a frequency doubler at its output. The frequency of its input is 130MHz.
Transformer L2: L3 wound on FX1115 ferrite bead.

(Fig. K)

COMPONENT LIST FOR 5 WATT TRANSMITTER.

<table>
<thead>
<tr>
<th>Component</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1</td>
<td>220</td>
</tr>
<tr>
<td>R2</td>
<td>470</td>
</tr>
<tr>
<td>R3</td>
<td>4.7k</td>
</tr>
<tr>
<td>R4</td>
<td>100k</td>
</tr>
<tr>
<td>R5</td>
<td>100k</td>
</tr>
<tr>
<td>R6</td>
<td>47k</td>
</tr>
<tr>
<td>R7</td>
<td>47k</td>
</tr>
<tr>
<td>R8</td>
<td>not required</td>
</tr>
<tr>
<td>R9</td>
<td>220</td>
</tr>
<tr>
<td>R10</td>
<td>470k</td>
</tr>
<tr>
<td>R11</td>
<td>47k</td>
</tr>
<tr>
<td>R12</td>
<td>1k</td>
</tr>
<tr>
<td>R13</td>
<td>4.7k</td>
</tr>
<tr>
<td>R14</td>
<td>470k</td>
</tr>
<tr>
<td>R15</td>
<td>100</td>
</tr>
<tr>
<td>R16</td>
<td>2.2k</td>
</tr>
<tr>
<td>R17</td>
<td>2.2k</td>
</tr>
<tr>
<td>R18</td>
<td>2.7k</td>
</tr>
<tr>
<td>R19</td>
<td>100k</td>
</tr>
<tr>
<td>R20</td>
<td>47k</td>
</tr>
<tr>
<td>R21</td>
<td>100k</td>
</tr>
<tr>
<td>R22</td>
<td>100k</td>
</tr>
<tr>
<td>R23</td>
<td>220</td>
</tr>
<tr>
<td>R24</td>
<td>180</td>
</tr>
<tr>
<td>R25</td>
<td>100k</td>
</tr>
<tr>
<td>R26</td>
<td>180</td>
</tr>
<tr>
<td>R27</td>
<td>100</td>
</tr>
<tr>
<td>R28</td>
<td>27k</td>
</tr>
<tr>
<td>R29</td>
<td>2.2</td>
</tr>
<tr>
<td>R30</td>
<td>52 or 47</td>
</tr>
<tr>
<td>C1</td>
<td>Inf ceramic</td>
</tr>
<tr>
<td>C2</td>
<td>Inf ceramic</td>
</tr>
<tr>
<td>C3</td>
<td>47µF 16V electrolytic, PCB mounting</td>
</tr>
<tr>
<td>C4</td>
<td>10µF 16V electrolytic</td>
</tr>
<tr>
<td>C5</td>
<td>1µF ceramic</td>
</tr>
<tr>
<td>C6</td>
<td>10µF 16V electrolytic</td>
</tr>
<tr>
<td>C7</td>
<td>15µF 16V electrolytic</td>
</tr>
<tr>
<td>C8</td>
<td>Inf ceramic</td>
</tr>
<tr>
<td>C9</td>
<td>1µF ceramic</td>
</tr>
<tr>
<td>C10</td>
<td>16µF 16V tantalum</td>
</tr>
<tr>
<td>C11</td>
<td>47µF ceramic</td>
</tr>
<tr>
<td>C12</td>
<td>10µF polystyrene foil</td>
</tr>
<tr>
<td>C13</td>
<td>680µF polystyrene foil</td>
</tr>
<tr>
<td>C14</td>
<td>16µF 16V tantalum</td>
</tr>
<tr>
<td>C15</td>
<td>680µF ceramic</td>
</tr>
<tr>
<td>C16</td>
<td>2.22µF min. foil trimmer 7.5mm, green (e.g. Circuit 06-22001)</td>
</tr>
<tr>
<td>C17</td>
<td>5.6µF ceramic</td>
</tr>
<tr>
<td>C18</td>
<td>plus C18', C19, and C20 1µF ceramic</td>
</tr>
<tr>
<td>C21</td>
<td>100µF ceramic</td>
</tr>
<tr>
<td>C22</td>
<td>Inf ceramic</td>
</tr>
<tr>
<td>C23</td>
<td>100µF ceramic</td>
</tr>
<tr>
<td>C24, C25</td>
<td>Inf ceramic</td>
</tr>
<tr>
<td>C26</td>
<td>2.27µF min. foil trimmer 7.5mm, red (e.g. Circuit 06-28001)</td>
</tr>
<tr>
<td>C27</td>
<td>5.5-80µF min. foil trimmer 10mm, red (e.g. Circuit 06-28001)</td>
</tr>
<tr>
<td>C28</td>
<td>Inf ceramic</td>
</tr>
<tr>
<td>C29</td>
<td>100µF ceramic</td>
</tr>
<tr>
<td>C30</td>
<td>16µF 16V tantalum</td>
</tr>
<tr>
<td>C31</td>
<td>Inf ceramic</td>
</tr>
<tr>
<td>C32, C33</td>
<td>As C27</td>
</tr>
<tr>
<td>D1</td>
<td>LED</td>
</tr>
<tr>
<td>D2</td>
<td>1N4148</td>
</tr>
<tr>
<td>D3, D3'</td>
<td>either BE105G (two) or one BB204G</td>
</tr>
<tr>
<td>D4</td>
<td>1N4001</td>
</tr>
<tr>
<td>T1</td>
<td>BC549, BC239, BC108 (pref C type)</td>
</tr>
<tr>
<td>T2</td>
<td>as for T1</td>
</tr>
<tr>
<td>T3</td>
<td>BC516</td>
</tr>
<tr>
<td>T4</td>
<td>BP286B or BP245B (not C type!)</td>
</tr>
<tr>
<td>T5</td>
<td>BP286B or BP245B (C type possible?)</td>
</tr>
<tr>
<td>T6</td>
<td>BP254 or BFY90</td>
</tr>
<tr>
<td>T7</td>
<td>2N3866 or 2N4427</td>
</tr>
<tr>
<td>T8</td>
<td>MRF 237</td>
</tr>
<tr>
<td>DR1</td>
<td>Wide band choke mounted directly on tape recorder socket</td>
</tr>
<tr>
<td>DR2</td>
<td>3 turns of 0.2mm (34SWG) enamelled copper wire on FX1115 ferrite bead</td>
</tr>
<tr>
<td>DR3</td>
<td>wide band choke</td>
</tr>
<tr>
<td>DR4</td>
<td>wide band choke</td>
</tr>
<tr>
<td>DR5</td>
<td>wide band choke</td>
</tr>
<tr>
<td>DR6</td>
<td>FX1115 ferrite bead on lead of R27</td>
</tr>
<tr>
<td>DR7</td>
<td>wide band choke</td>
</tr>
<tr>
<td>L1</td>
<td>4½ turns of 1mm (18SWG) silver coated copper wire on 6mm former, tapped at 1½ turns from cold end</td>
</tr>
<tr>
<td>L2</td>
<td>6 turns of 0.3mm (34SWG) on FX1115 ferrite bead</td>
</tr>
<tr>
<td>L3</td>
<td>2 turns of (same as above)</td>
</tr>
<tr>
<td>L4</td>
<td>7 turns of 1mm (18SWG) silver coated copper wire on 8mm former</td>
</tr>
<tr>
<td>L5</td>
<td>3 turns of 1mm (18SWG) silver coated copper wire on a 6mm former</td>
</tr>
<tr>
<td>L6</td>
<td>6 turns 1mm (18SWG) silver coated copper wire on a 6mm former</td>
</tr>
<tr>
<td>L7</td>
<td>as L5</td>
</tr>
<tr>
<td>78L08</td>
<td>8V voltage regulator</td>
</tr>
<tr>
<td>S1, S2</td>
<td>switches</td>
</tr>
<tr>
<td>Printed Circuit Board (PCB)</td>
<td></td>
</tr>
<tr>
<td>S0230</td>
<td>UHF socket with earthing tag</td>
</tr>
<tr>
<td>copper foil</td>
<td></td>
</tr>
<tr>
<td>braided wire</td>
<td>power supply connectors</td>
</tr>
<tr>
<td>input connectors</td>
<td>1A fast blow fuse and holder</td>
</tr>
</tbody>
</table>

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 or in VHF circuits increases the chances of undesirable oscillations (properly called parasitic oscillations). To guard against this sort of component 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 earth- ing. There might be an earth contact from the MRF237 to the heat sink to the case but it’s 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. EARTHILY DELIGHTS.
It’s 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, it’s no use trying to solder it back on. A soldered joint doesn’t transfer heat at all well, so either the transis- tor overheats and is destroyed, or the heat melts the case and then it overmets and is destroyed.

Similarly any heatsink has to be one piece of metal. Even a setup like “threaded bolt-heat sink compound-case heatsink compound” does not provide enough heat to the outside air. (But here we’re talking about the mega power situations you won’t face with your 5 watters.)

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 the 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, that was its basic piece of test gear. See later under AERIALS.

WHERE TO GET THE PARTS:
Cricklewood Electronics, for instance, stock everything except the ferrite beads and the wire. Their MRF237 is much more expensive (£7.05).

Maplin has most of the bits except some semiconductors.

FX1898 and the silver coated wire.

Crickit stocks most of the bits including the ferrite bead (comes in packs of 10), the other ferrite beads and the silver coated copper wire. They don’t stock all the semiconductors but their MRF237 is cheaper (£4.48).

Cricklewood Electronics Ltd. 40 Cricklewood Broadway, London, NW2 8ET. Tel. 01-450 0995 or 01-462 0161. Free catalogue on request.

Maplin and Crickit catalogues from your local W.H.Smat.

TO MAKE A WIDE BAND CHOOSE:
Get a FX1898 ferrite bead or Crickit 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.

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 case.
15 to 80 WATT AMPLIFIER... approx. £70, excluding
PCB and case and heat sink.
**80 Watt Amplifier**

**General Description.**

The following describes a 80w VHF FM amplifier. Input and output impedances are 50 ohm. Output power is 80w with a 12.5v supply and 15w input power. It's 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 don't 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 that a reverse polarity, and high temperature. On reaching 90 degrees 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 power amplifier 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 up 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'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 bandwidth 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 impedance matching networks for input and output. Enormous currents flow through these capacitors so they have to be specially chosen eg Unics mica capacitors or Erie high Q chip capacitors with low pass C8-G dielectric. Because of the small size of the chip capacitors they've a tendency to overheat. Avoid this by using a combination in parallel 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 impedance transformation back to 50 ohms 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 impedance 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 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. Similarly 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...
amplifier, if the supply is connected the right way round. If the relay fails by eg. the contacts welding together, which can happen with 13A, 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 disconnects 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 accommodate 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 perpendicular 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 thick wire from the PCB earth plane to the case next to sockets. Either solder directly to the case material, or preferably use tags bolted through the sockets, mounting holes. BNC sockets have their own tags which you can use.

Drill the holes in the PCB. Apart from the holes for transistor the PCB should be bolted to the heatsink at least twice on the base and collector side of the PCB. Use 6.3 M3 or larger bolts. Solder brass or copper strips along the edges of the PCB to connect the top and bottom earth plates together, do the same by soldering strips through the holes where the emitter flanges of the transistors 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.

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 first through capacitor. To do this drill a small hole in the PL insert a thick wire, and solder on both sides. The earth pin should have a good connection both to the high frequency sockets and the negative supply connection.

After these plumbing jobs mount the transistor in above. Solder the whole length of the emitter flanges. These are the ones on the outside. The collector is the smaller of two inner flanges. Then mount capacitors C4 and C5. Cut to L5 out of copper or brass sheet and mount these as shown on the diagram together with C1 to C5. When soldering the capacitors make the joint as large as possible to keep stray inductance low and achieve better heat conduction. The 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 problems trying to tune the circuit with metallic instruments.

Before you solder in L7 you should mount C11, C12 and then D2 and D1. Leaving D1 out would be disastrous as negative base voltage = high collector current = new transistor. The feedthrough capacitor C14 can be fitted now, or left later, depending on which construction you’ve chosen.
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 3BA or M8 bolts. The PCB is then bolted to the heatsink in 4 places, using shakerproof washers above and below the PCB at such a height so as not to flex the PCB or put any stress on the transistor leads. 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 shakerproof 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 corresponding 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 meter (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 sensitivity 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 pentomimeter gang 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 the 2nd harmonic filter you’ll need a dipmeter or an absorption 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 power supply to connect the TX to a SWR meter. A lead to connect the SWR meter to the amp, having tested. A 12v 16A 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. 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 shows a SWR reading of 1:1 or less. The amplifier current consumption should be between 10 and 14A. The transmitter’s consumption 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, if it can get real hot and start smoking.

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

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 aperiodical 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 to that achieve max. power so that the power output and current consumption decrease again. (output power will be 66-80w).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 exit omes 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 won’t have all of them. Most are to be had by mail order from various sources.

The MRF 245 and MRF247 are also stocked by Raecdek Electronics at £25 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 diodelectric. The dipped mica capacitors are made by UNELCO. Also check out the SEMCO range of capacitors in the Circkit 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 C3C dielectric) 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. Circkit 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 C6 don’t try to use the layered 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 Circkit. 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, i.e. 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 Circkit.

<table>
<thead>
<tr>
<th>PARTS LIST FOR THE 80 WATT AMPLIFIER</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
</tr>
<tr>
<td>D1</td>
</tr>
<tr>
<td>D2, D6</td>
</tr>
<tr>
<td>D3</td>
</tr>
<tr>
<td>D4</td>
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<tr>
<td>D5</td>
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<td>SC1</td>
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<td>FL1</td>
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<td>FL2</td>
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<td>FL3</td>
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<td>FL4</td>
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<td>SW1</td>
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<tr>
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<td>C1</td>
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<td>L5</td>
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<tr>
<td>L6</td>
</tr>
<tr>
<td>L7</td>
</tr>
<tr>
<td>DR1, DR2</td>
</tr>
</tbody>
</table>

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

CIRKITES, Park Lane, Bronbourne, Herts, EN10 7QX, Tel: (0992) 444111.
RAECDEK Electronics, 102 Priory Road, Sibbend, Lane, Hall Green, Birmingham B28 0TB, Tel: 021 474 6000

Also useful are Circit 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. There 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 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 super low VSWR is not needed, a VSWR of 1.5 or even 2 to 1 is acceptable.
12. A 100 foot piece of RG-9 coax allows only 89% of the power to reach the antenna.
13. A 100 foot piece of RG-50 coax allows only 96% of the power to the antenna.
14. Radio waves travel at the speed of light through space and air.
15. Radio waves travel slower over wires and through cables.

Simple Stacked Vertical Dipoles (Fig. 1)

This is a very simple yet effective antenna. It is constructed from lengths of RG-9 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

<Diagram of 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 0.8" hole drilled through it. An SC-599 connector is fastened into the hole. The antenna is then fed with a 50 ohm coax such as RG-9. The feed impedance is closer to 50 ohms than 60 ohms so the VSWR will be about 1.4:1.

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 mast it could give up to 3 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 #2).

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-58 polv cox, design frequency of 100 MHz).**

<table>
<thead>
<tr>
<th>Section</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>1/4 wave (thin wire)</td>
</tr>
<tr>
<td>V</td>
<td>1/4 wave (polv cox)</td>
</tr>
<tr>
<td>2V</td>
<td>1/2 wave (polv cox)</td>
</tr>
<tr>
<td>D</td>
<td>1/4 wave (large wire)</td>
</tr>
</tbody>
</table>

**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 appearance.

In its simplest form the antenna is unidirectional with a pattern similar to Fig. C, pattern #4 even though this antenna is horizontally polarized. This wide spread between the two dipole signals determines how much horizontal and how much vertical polarization will be imparted to the signal. If the two dipole leads are almost straight up and down the signal will be mostly vertical. A wide spread between the two dipole wires makes the signal more horizontally polarized. This simple form is where two guy wires are 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 system) you'll make it unidirectional. This is because you'll be feeding the second set of guy wires 90 degrees out of phase with the first. The result is the radiated signal "splits" around the two dipoles thereby "pointing" in all directions. It completes one trip "around" during each cycle of your frequency. At 100 kHz this is 100,000,000 times each second.

**Fig. 3 Phase delay harness.**

This is a balanced antenna. If it is to be fed with unbalanced line (coax) it needs a decoupler. Four or five long 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 1/2" copper pipe. A 1/2" to 1/2" reducer is soldered to one end. The other end 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 1.4:1. A lower VSWR can be had if the 1/4 wavelength of coax leaving the antenna is a 50 ohm impedance (RG-59) 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.**

<table>
<thead>
<tr>
<th>Section</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>1/4 wave (thin wire)</td>
</tr>
<tr>
<td>Y</td>
<td>1/4 wave (thin wire)</td>
</tr>
<tr>
<td>Z</td>
<td>1/4 wave (thin wire)</td>
</tr>
</tbody>
</table>

**Effective power gain.**

<table>
<thead>
<tr>
<th>Section</th>
<th>Power Gain (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>2</td>
</tr>
<tr>
<td>Y</td>
<td>4</td>
</tr>
<tr>
<td>Z</td>
<td>4</td>
</tr>
</tbody>
</table>

**Fig. 4 1/4 wave decoupler.**

**Half-Wave Phased Coax (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.
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) 50 1/7" (L = any length of 50 ohm coax such as RG-8)
- **N**: 1/4 wave (pipe) X 0.63 17 5/8" (L = any length of 50 ohm coax such as RG-8)
- **NG**: 1/4 wave (pipe) X 0.24 9 3/4"
- **N**: 1/4 wave (pipe) X 1.1 3"
- **KP**: 1/2 wave (poly) 500' 59" (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.

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 braided shield at that end so it can be pushed through hole Z from the inside. Do it, while showing the SO-239 into the
open end of the "T" fitting. Solder the shield to the outside of the "T" fitting. Now solder the SC-239 into place. If the SC-239 has been placed it may be necessary to file off some of the plastic 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 goes 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 the second hole at an angle toward the first hole to make pulling wires through 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 slit, fillers or tubing 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 to 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 two-1/16" hole (3-32 self-tapping screw) through the "T" fitting, the filler bushing, and partway into the plastic (Caution: not too far). Install the screw to secure the plastic in place. Now do the same for the coax braid end of the fitting.

Now slide on the dipole positions 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.

POINTING UP to maintain the proper phase relationships between units. The length of the little mounting stub (two "U" bolts) is not critical, 2" or 4", it is 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) | 26" |

AN OMNI-DIRECTIONAL, 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 both "T" fittings) 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 the 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 complete the dipole arms should be horizontal, the mounting end of the support boom vertical, and the SC-239 pointing down. When stacking these units be sure that the 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 in 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)
STACKING ANTENNAS FOR MORE GAIN (Figs. 6-1)

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. 6 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 or 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 horizontally 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:

<table>
<thead>
<tr>
<th>Power Increase</th>
<th>Distance 1.4 X</th>
<th>Power Increase</th>
<th>Distance 3.66 X</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>1.73 X</td>
<td>4</td>
<td>2.03 X</td>
</tr>
<tr>
<td>3</td>
<td>2.03 X</td>
<td>5</td>
<td>3.0 X</td>
</tr>
<tr>
<td>4</td>
<td>2.45 X</td>
<td>6</td>
<td>3.16 X</td>
</tr>
</tbody>
</table>

This holds true for increases in transmitter power also. Doubling your transmitter power results in only a 1.414 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 73 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 be vertical, or both horizontal, or may be one of each. If both antennas are the same polarizing it would have an ERP of 2. If you have one of each then the ERP is 1 - but with both horizontal and vertical polarizations. The total feed impedance of the coax T is new 1/2 of 76 ohms. This 37.8 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 19.125 or 84.125 long depending on whether you are using poly or foam coax. The cables from the antennas to the coax T (M) 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 achieved when the spacing between centers of antennas is about 18 X wavelength in air. This is 94 1/2 inches at 100 MHz. (E = 94 1/2 X)

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 in between 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. 6. Dimension E is still 94 1/2 at 100 MHz.

The length of connecting cables Y1 may also be of any convenient length BUT both must be of the same length! Again in Figs. G and H you have paralleling two 75 ohm impedances (Y2 + Y1). This point may be fed with a 50 ohm coax (VSWR of 1.33 to 1).
If you want to feed it with 75 ohm coax you'll need another 1/4 wave transformer, just like that used in Fig. E. 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. 1. Just remember: all V₁'s are the same length, all V₂'s are the same length and (for Fig. 1) all V₁'s are the same length and all junctions need an impedance matching transformer.

A bit of information you may find disconcerting. 100 feet of RG-8 coax allows only 63% of the transmitter power to reach the antenna system; RG-58 is worse. It allows 95% 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 transmitter. Of course the higher up your antenna the better it will go 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 beams are actually touching, and the horizontal units straddle the vertical you are close!

Look at Fig. 1 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 V₁ cable any length that is convenient, but make the horizontal's V₁ cable 1/4 wavelength longer! Repeat the above for all vertical/horizontal pairs. All 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, and 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 somevaromer in between). This also holds true for the stacked verticals and horizontal with 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 gain = 60% efficiency = F
2-bay horizontal = gain of 4 (V₁) x 4 = 25.2 watts
2-bay vertical = gain of 4(V) = 9

Therefore:

TPO x F x G = actual ERP

However:

only 1/2 of the power is going to each polarization, so... you have only 15.6 watts (25x2) and 12.5 watts

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. Harmonics, 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 300 kHz. This means the filter's pass-band must 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 PANAMIC RFI are:

<table>
<thead>
<tr>
<th>Pass Band</th>
<th>Insertion Loss (dB)</th>
<th>Power Output (%)</th>
<th>Resultant Field (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 MHz</td>
<td>-0.1</td>
<td>0</td>
<td>95</td>
</tr>
<tr>
<td>1 MHz</td>
<td>-0.7</td>
<td>85</td>
<td>92</td>
</tr>
<tr>
<td>3 MHz</td>
<td>-0.9</td>
<td>90</td>
<td>90</td>
</tr>
</tbody>
</table>

As an example, with the RFI adjusted for a 1 MHz pass band, the insertion loss would be .7 dB, resulting in 95% 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 downwards. In this example the range would be out back to 95% of the range obtainable without the filter.

The graph at the left illustrates a 500 kHz bandwidth (~dB point) and a 1 dB insertion loss. Output drops off rapidly for frequencies half-wash from the center frequency. In the 100 MHz being used as the center, up to 50 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 no little trouble. The two coils are wound in OPPOSITE DIRECTIONS. This is important because when they are installed you 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 extra wire and make a loop to be sure. If the wire is not kept taut, it will create problems...
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 and wire so it will center the coil between the bottom and top of the box when the coil 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 pass band and the greater the power transfer. About 3 thicknesses of this paper fitting between these wires will give about a 2 MHz pass band. Further 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!

**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 (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 shield to make your shield.

**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.

**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 input or output.

Adjust each variable capacitor 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 fake 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.
each of the turns a wire diameter apart. You could do it of course by simply
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With a pair of long (or needed) nose pliers bend the wire ends of the coil at right
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Solder the coils to their respective capacitor supports as shown. The wire
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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 top position of the appropri-
tate 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

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cast aluminum box, 2.4&quot; x 4.4&quot; by 1.0&quot;</td>
</tr>
<tr>
<td>2</td>
<td>All variable capacitors, .4&quot; x .4&quot; square, 1/4&quot; mount, 10 PF max</td>
</tr>
<tr>
<td>0</td>
<td>Coax connectors of your choice, Type F, BNC, Ch-623, etc.</td>
</tr>
<tr>
<td>2</td>
<td>4-40 x 1/4&quot; machine screws</td>
</tr>
<tr>
<td>2</td>
<td>4-40 nuts</td>
</tr>
<tr>
<td>1</td>
<td>Solder lugs, 64 hole</td>
</tr>
<tr>
<td>1</td>
<td>Aluminum strip approx. 4.5&quot; long, .06&quot; wide, 1/16&quot; thick</td>
</tr>
<tr>
<td>2</td>
<td>Feed # 14 or # 12 bare copper wire (silver plated heat if you can get it but not absolutely necessary) (Try hardware store)</td>
</tr>
</tbody>
</table>

MOUSE ELECTRONICS  
1440 Woodside Ave  
Santee, CA 92071  
(619) 647-6022

RADIO SHACK  
Check local phone listings (Full info)

PANAXIS  
Fig. 2 Assembly Drawing

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
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Turn on your transmitter. Tune one filter variable until you get an output. Then
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Radio Support Group

D.R.COMMUNICATIONS: c/o 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 WC1N 3XX
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 Fontainbeau, B.P. 38, 75010 Pringy-Pontbribery, France. Tel (6) 438 1159. (cost: expensive. Send reply coupon).

RESEARCH COMMUNICATIONS: Unit 3, Dane John Works, Gordon Rd, Canterbury, Kent. Offering transmitters of 50w for a mere (wait for it) £780 plus £30 post plus VAT. Who are they kidding?

PANAXIS PRODUCTIONS: p.O.Box 130, Paradise, CA 90569 USA. Sell TX's, and everything else by mail order. Good catalogue. But Parade 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 exciters, it's 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-wives, Nth St,Clewkerne TAL87AR, or from Goldie Electronics, Merrittor, Somerset YAI65NS 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 Radio Sales, PO Box 1103, Lima, Ohio 45802, USA.
OUR RADIO, c/o RATS, BM Hurricane, London WC1N3XX.

RELAY MAGAZINE (may be dead after loss of grant, middle of the road) top press. still going strong at: GUN MACHINE, BRISTON RD, LONDON.

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, Radio Waves and a weekly report called AUK (good). Also distribute all kinds of pirate paraphernalia of that you have to sell it. Have a catalogue. From PO Box 539, Blackpool, Lancashire FY14 2RE.

THE FREE RADIO RENDEYU: (TFR): Short wave Pirates, inc. news and logs of stations on air. From Pendworth, Pennington Lane Lanner, Redruth, Cornwall TR1651W.

LONDON SQUATTERS PIRATES: 3 local stations starting April 87. Nth St and East London. Radio interference (S.Lon) can be heard at present on 106mhz around 6pm Fri. All c/o BCM 1502, Lon WC1N3XX.

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 A6). From Roger Tidy, 11a St Philip Hae, Lloyd Baker St, London WC1 9BA.

HACKNEY BROADCASTING AUTHORITY: Common 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). Plays prog 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. 94mhz. Address lost.

SPECTRUM RADIO: Open access group, developed from CCC which developed from Our Radio etc. At one time had 6 paid workers from a GLC grant. Went for CR licence. Never broadcast (not the rock station of same name). Interchange, 15 Wilshire, London W3 3NG.

VOICE OF NICARAGUA: English broadcast Mon-Sat. 1200 and 5.00pm on 6015KHz.

PEOPLES COMMUNITY RADIO LINE: have returned in Birmingham after 2 bouts.
103.7mhz. c/o 151 Dudley Rd, Edgbaston, Birmingham B16 7QY.

JBC-BLACK MUSIC FOR BENT. Best and most regular (mostly 7 days) of the good dozen black music stations. Have recently started Irish and Asian programmes. Not busted much, maybe cox on low power and move TX regularly. 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 £1260! Commercial.
106mHz Po Box 225, London N19 4GN.

FREETEC: most efficient, reliable and helpful place to get ready made technical gear. Bandmaster FM 35w, £85. Sw- complete £40 etc. Have no address, but Free Radio Waves will forward mail. Freetec, c/o Free Radio Waves, FLAGSONES, West Heath Lane, Sevenoaks, Kent TN13 1TA.

BROADCASTING: VHF rigs etc. forwarding address CW BCM Box 225, London WC1N3XX.

ANFIELD COMMUNITY RADIO: c/o111 Pinehurst Ave, Anfield, Liverpool, L4 TUG. 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.


FREE RADIO WAVES: Pirate buffs. some good info, worth a read. From Flagstones, West Heath Lane, Sevenoaks, Kent. 90p (40pp A6).

CONTACT
Here is a list of all our titles. All prices include post and packaging.

The Free £1.80
Best selling thriller set in a revolution in the near future. Last of the first edition still available.

Ideal Home £2
Selfhousing handbook. How to squat, travel, truck, make benders, floating homes, teepees etc.

A year of our lives £2
The miners and families of Hatfield Main tell in stories and pictures how they organised and fought the great strike 1984/85.

The Faction File £2
Full sized souvenir edition. Fantastically vicious and hilariously graphic illustrations. Plus Tales from the Front line.

Radio is My Borrib £2.40
Complete DIY guide to Pirate Radio—from A to Z. Advocates a pirate in every street.

Squatting in West Berlin £2
Photographs of a creative political movement and how it was destroyed

From Beneath the Keyboard £2
A collection of new short stories and poetry from the lunatic fringe

Written in Flames £1.50
For the first time the names and addresses of the British ruling class and a trip through the corridors of Power, Privilege and Property.

HOOLIGAN PRESS, BM Hurricane, London WC1N 3XX