HAM RADIO TODAY

AN ARGUS SPECIALIST PUBLICATION

JUNE '83

90p

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LETTERS

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145 Charing Cross Rd,
London WC2 0EE.

AMERICAN WOODPECKER

OM, Enclosed you will find copies of an article from 'INTERAVIA' a technical magazine on the subject of another Megawatt over-the-horizon HF Radar system operating on the backscatter principle. If they are looking for backscatter back in Maine, USA, just think what we will be getting as *forward* scatter here in Europe! I have not yet been graced with a reply from Col. A Lee Snyder and probably have been put on computer for commenting on their system and branded as an undesireable. That may be, but I would like maximum publicity in the amateur press on the subject. Who do these people think they are, grabbing chunks of the HF spectrum and polluting it with Megawatt HF pulse transmissions? We have had enough with the Crimean Cackler, though that has abated very much lately, why?

DES WALSH E15CD

This set the alarm bells going here at HRT, and we've been asking the US Air Force (who are developing the system) some tough questions. The answers are on the Radio Today page — Ed.

SYNTHESISED HF TRANSCEIVER

Sir, I wish to congratulate you on your publication of your articles on the *Synthesised HF Transceiver*, an excellent project. Could you please tell me where the cores T37-6 and T37-12 specified for L1, 2 & 3 in the VCO can be obtained from and also the approximate inductance of these coils. Do you know when PCBs will be available for this project?

S NIEWIADOMSKI

The cores in question can be purchased from Ambit International, 200 North Service Road, Brentwood, Essex. The approximate inductance of the cores 0.6µH, 0.16µH, 400nH. The precise values are not critical since the VCO circuitry will compensate. A considerable degree of range overlap was designed in.

As for PCBs, we are not going to produce a set for the project as it stands. The transceiver was built at least 18 months before Ham Radio Today was ever thought of and the documentation which we have to design the boards is insufficient. However, don't despair. We are producing a mark 2 version of the transceiver which will offer enhanced performance, all modes and facilities such as a noise blanker that really works. I have mooted the design already in our Technicalities column and a series of constructional features will follow, possibly starting in July. We will offer a guaranteed supply of ready made PCBs kits of components and a ready made case. We anticipate that our new all mode, all band, transceiver would cost in the region of £250 in its basic form, and outperform nearly all the commercial gear currently available — Ed.

PLUMBING THE DEPTHS

Frank, As one of those illegal SSB CB users so often slagged by Ham and UK FM I am sick of reading in your very good and interesting mag about piggies — that is Ham OP's — blaming us for jamming repeater stations and other nasty things.

I have the equipment (mobile) with which to jam — disrupt — and do the nasty things we are blamed for, but my only interest in (Piggy) bands is to listen and learn, not to use for transmission.

Many (Piggies) use SSB and UK FM. Some who have been on the Ham bands for many years, at least two of them, both old hands, have admitted to having jammed the repeaters on 2m.

Myself and several friends who earwig have had a meeting on the subject. We are so fed up with being hounded by the Home Office — RSGB, we are thinking of doing what we are blamed for, so for the sake of peace on the airways, cool your (Piggies) and we will not cool down a bit. We expect some blame. We could, but we do not wish to take the RAE.

And one thing in our favour. We know where most of you live, but you do not know us. Most of your addresses are in the 83 Ham Year Book.

So remember to your Ham readers, leave us alone, and we will leave you alone.

I am not being offensive, just trying to state our case. Chow from SSB to Ham. May there be peace between us.

SSB CB USER
DORSET

Oink — Ed.

WOODEN STAKES

HRT, Really! You only print letters with comments like; "It's becoming another waveband for CB'ers" (re. 2m), to provoke a little controversy. I'd like to ask Brian Patchett, who seems to be judging 2m on a cursory glance at FM mobile operation, where on CB can you get QRO operation, SSB, CW, RTTY, satellite, choice of antenna, etc. etc. etc? 2M is a proper amateur band, if you take the trouble to use it as such.

Martin Smith's reference to the confining licenses to over 18's. When I hear opinions like that, I reach for the garlic and wooden stakes! This sort of retrograde idea, coupled with the unfortunate experiences of young J. Pelham, indicate to me that the real problems regarding relations between operators within the UK stem from snobbery and intolerance, from those old enough to know better!

I wonder, for example, who was the first person to sign a letter and to append his callsign to his signature? He started a trend which most of us follow, these days; but when you think of it, adding a callsign behind your name, as if it were a university degree, or a fellowship of some august society or institution, is a little pretentious. A callsign belongs to a *station*, and is used by whoever is licensed to use the station. If I visit my friend's house and use equipment, I use *his* call sign, *not* mine/A! But this is only a small point, so let it pass, except for the proviso that I will not be putting *my* callsign after my signature!

To end on a lighter (?) note, with a word to Tony Bailey, don't joke about TVI-stricken neighbours dismantling an antenna, instead of knocking on the door of the station. A friend of mine had this rotten trick pulled on him, and he blew every single transistor in his 101!

PAUL THOMPSON

SMALL NIGGLE

OM, I have bought each copy of your magazine since you started, and I will probably continue to do so because I think the level of its contents is pitched about right for the large majority of readers who do not appreciate the highly professional level of most articles in *Radcom*.

Just one small niggle — I have not been able to find the results of the competition in the January issue, which I would expect to have been published before now. If I have overlooked it please let me know the issue and page in which it appears, or explain why it has not appeared.

JOHN WINDCOMBE G62H

The answers you want appear (by a remarkable trick of fate) right here! They are: B,B,C,C,B,A,B,B,D,B,E,D,C,C in that order — Ed.

PLAIN SPEAKING

Sir, Help! I'm beginning to think I'm unique or thick or something.

You see, my problem is that I want to build my own equipment for 70cms, microwave etc. but, and it's a big but, I served my apprenticeship as a toolmaker and not as an electronics engineer.

I've always been interested in radio but until I studied for the RAE my knowledge of electonics was confined to wiring a plug, now at least I understand basics.

Can we have more projects with people like me in mind, people who don't understand properly how to use test and alignment equipment, and written in a language we understand.

So please think of me and all the others like me who want to enjoy our hobby to the full and carry on as you have started in your excellent magazine (the best on the market in my humble opinion) and simplify rather than mystify.

R K BAINBRIDGE G6HHV

RIFTS?

As one of your many EI readers, I would not like, or indeed be competent, to comment on your allegations of rifts in the UK between Class A and B licensees. Suffice to say, when setting out for my ticket, I personally can state I got nothing but help, encouragement, and patience from both A and B licensees, and I might add some SWLs.

Perhaps some of your newer amateurs may not be aware of some of the differences in regulations between the UK and EI.

A Class B licensee on passing his/her CW (similar test to UK) gets a class A call sign. For the first twelve months no phone is permitted on HF. The operator is confined to CW 25 watts on 20m and 40m. After this period applications may be made for all bands, phone and CW. All EI Class B callsigns have three letters ending in B, ie EI8AMB. (My old call sign).

The minimum age for holding either licence is 16 years.

As an unashamed 2m DXer, and chaser of squares, may I respectfully ask all newer, and some older, stations to please put QTH locator references on all cards that they might be good enough to send.

In conclusion, I would like to add that all QSOs to this station whether A or B will get a "Cead Mile Failte".

TONY BAKER E16EW

POSITIVE VETTING

Sir, The purpose of this letter is twofold. First, may I congratulate you on an excellent magazine. I especially liked the 80 metre QRP TX/RX — very impressive. Perhaps we could have a series of them for other bands (I fully intend to build this one, as soon as I can raise the money!)

Secondly, I would like to discuss the Home Office's decision to want 'positive indentification' when one is taking the CW test, ie. something like a passport, or similar document. However, not all of us possess a passport; so are we expected to go straight out and pay £X for one, just to take the morse test (which we don't have to go abroad for)?

I find this decision totally ridiculous, yet at the same time realise the Home Office's predicament. I think that all licensed radio amateurs should be issued with an identity card containing their photograph and signature rather than an amateurish (and in my case, a photocopied) copy of licensing conditions which is written on in Biro! How on earth do we expect suspicious policemen etc. to believe we have a legal right to use what he considers illegal equipment! Which of course we might promptly get arrested for!

DAIMON TILLEY G6PRY (age 16)

Modifying the DSB80 for the 1.8MHz band is quite straightforward; however at 7MHz the VFO may not be stable enough — Ed.

DUMMY LOAD CALLSIGNS

Sir, I wish to clarify the position regarding pre-war artificial aerial licences, as the statements made by G8PTH in his article 'Radio Yesterday' in your March issue are misleading.

Artificial aerial callsigns consisted of the numeral '2' followed by three letters, with no 'G' prefix. When licences were re-issued in 1946, holders of AA callsigns were granted full radiating facilities providing they passed the Morse test. They were then licensed under their previous artificial aerial callsign, with the prefix "G" added.

Incidentally, not all artificial aerial callsigns were issued in alphabetical sequence; I can recall that a station in the 2C-- series was licensed some time before my licence was issued.

N G HYDE G2AIH

RADIO TODAY

News about amateur radio compiled by Richard Lamont G4DYA

Western Woodpeckers?

Britain and the USA are both developing HF over-the-horizon radar systems for military applications, operating in the 5-28MHz range.

The American system, called *Conus OTH-B*, has already been operating in experimental form for three years. (The 'B' stands for Backscatter.) It consists of a transmitter site at the Moscow Air Force Station, Maine, North-East USA, and a separate receiving station 110 miles away at the Columbus Falls Air Force Station, also in Maine.

The system is intended to provide long-range detection of 'air-breathing' threats, ie. bombers and cruise missiles aimed at North America. It would provide the US with an early warning period of hours, rather than the minutes offered by conventional UHF radars.

In spite of the enormous transmitter powers involved (100 Megawatts ERP for the prototype alone) the USAF is claiming that interference is unlikely, because the system would only operate on empty channels in the fixed and broadcasting bands, and that certain frequencies including amateur bands would be considered as 'guarded frequencies' and not used at all. A spokesman for the USAF's Electronic Systems Division (which is developing *Conus*) admits "The Air Force is not denying the possibilities of interference. The signal is awfully small. One of the ham publications has compared this to the Woodpecker. There is no comparison. This system is very sophisticated, whereas the Woodpecker seems to use a brute force approach".

The present system was built by General Electric, which won the contract in 1975. Testing began in June 1980. This first installation is now being upgraded, and it will be the first operational radar, covering the Eastern approaches to the USA. The USAF plans to build a second site in the West over the next four years or so. Longer term plans exist for a third radar in the South.

British OTH radar

The American *Conus* system uses skywave propagation to achieve its range. The British defence establishment is working on a *surface wave* OTH radar system, operating in the same 5-28MHz frequency range as *Conus*. According to the Ministry of Defence, the British system is not intended to detect incoming nuclear bombers and missiles. The MoD, not surprisingly, refuse to say what the system *is* for. They did, however, divulge that the system has a pulse repetition frequency of a fraction of a Hertz, and is supposed to have a 'very long range'.

According to an American OTH radar consultant, the only place where you could expect very long range propagation of an HF surface wave is at sea, where the salt water provides a low resistance ground plane. A ship-based HF surface wave radar could be used to give warning of both enemy ships and sea-skimming missiles such as the *Exocet*. (It would hardly come as a surprise to learn that the MoD wants to improve ships' ability to detech such threats.)

In America, General Electric has conducted studies on surface wave HF radar, and there have been reports that the US Navy is (or has been) doing similar research.

The Ministry of Defence has not yet commented on the likelihood of interference from the British system to existing users of the HF spectrum, including amateurs.

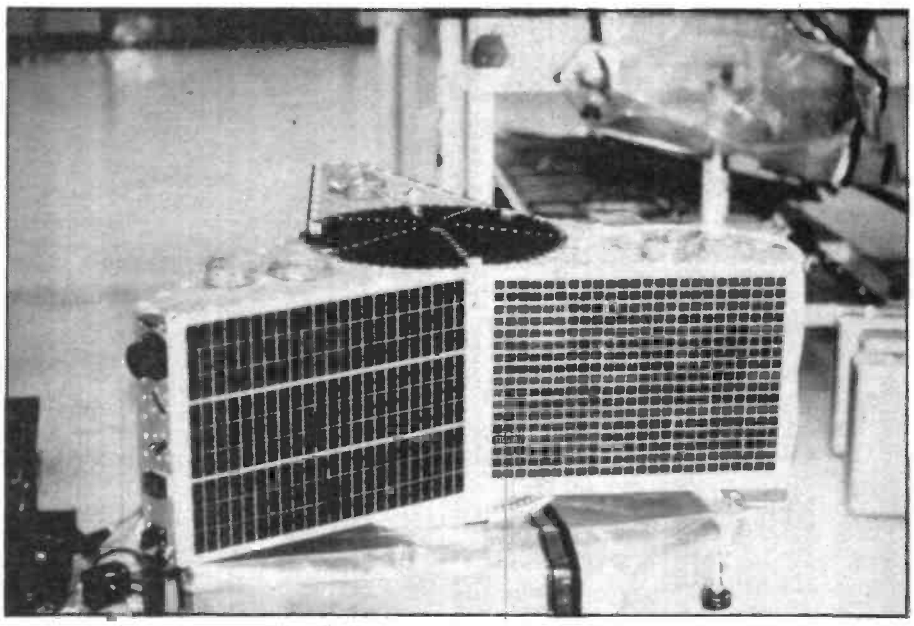
AMSAT LAUNCH

The Phase IIIB amateur satellite is (at the time of writing) due to be launched on June 4th or 5th. It will be put into a highly elliptical orbit by the European Space Agency's *Ariane 7*, from its launch site on Devil's Island, French Guiana.

Different parts of the satellite are being built in the USA, West Germany and the UK, at a cost of £270,000. It will be assembled in the AMSAT Space Laboratories in Washington.

If the satellite works satisfactorily it will be renamed *Oscar 10*. It will have an orbital period of 24 hours with its apogee (maximum height) above Greenland. As orbital speed varies in proportion to the inverse cube of height, the satellite will stay near its apogee point for a considerable time — long enough to keep it in range of the UK for about 12 hours a day. With an aerial pointing North North East from the UK, it should be possible to use the satellite throughout the evening without moving the beam.

This 24-hour elliptical orbit is not a new technique — it is, for example, used successfully by the Soviet Union for their *Molniya* communications satellites,



The AMSAT Phase-IIIB satellite will look like this (Phase-IIIA) when assembled

which distribute television programmes to transmitter sites.

The satellite will carry transponders for 70cm to 2m and for 70cm to 23cm. Each transponder will have three 'special service channels' at the high and low end of each passband. These channels will be called H1, H2, H3, L1, L2 and L3. The exact allocation of these channels has not been decided yet, but it looks as though L3 and H3 will be reserved for AMSAT engineering work. Also, a Sunday news bulletin with a European flavour will be broadcast on L1 and H1. This will be prepared jointly by the RSGB and AMSAT-UK. The Home Office has approved this scheme, and other countries may follow.

All the aerials in the spacecraft have left-hand circular polarisation, enabling ground stations to use plane-polarised aerials without fading. AMSAT-UK stresses the need to keep power levels on the 70cm uplink to no more than 500W (27dBW) effective isotropic radiated power (EIRP). EIRP is related to transmitter power and aerial gain by:

EIRP (dBW)=TX O/P power (dBW)+ aerial gain (dBi) — feeder loss (dB)

or

EIRP (dBW)=TX O/P power (dBW)+ aerial gain (dBd)+2.15dB — feeder loss (dB)

(dBi is aerial gain over an isotropic radiator, dBd is gain over a half-wave dipole.)

TELECOMMUNICATIONS BILL

The Government's Telecommunications Bill, which 'privatises' British Telecom and tightens up the Wireless Telegraphy Acts, has had its third reading in the House of Commons. It got through by 286 votes to 241, a Government majority of 45.

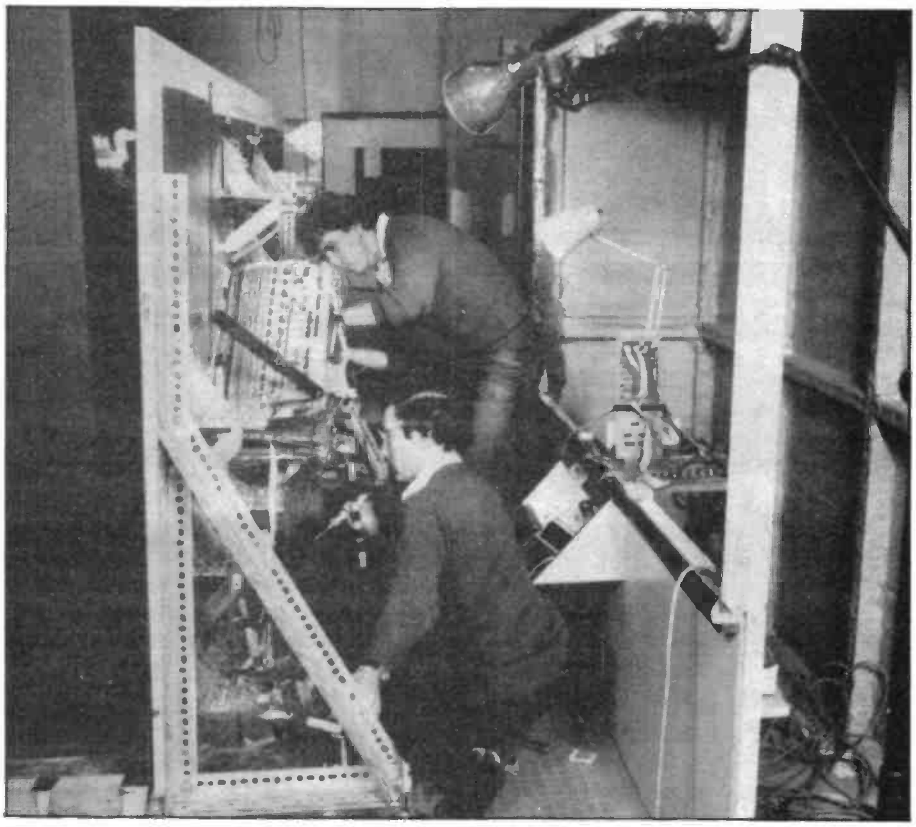
The implications of the Bill are explained in the *Radio Today* pages of our March issue.

NEW COMMUNICATIONS EXHIBITION OPENED

A major new exhibition has been opened at the London Science Museum, showing the growth of telecommunications from the early days of the telegraph to the present.

The exhibition is in two adjoining galleries — the first shows the history of both radio and 'landline' techniques, while the second shows some of the methods used in the present day international network.

The first section includes life-size mock-ups of the 1850 Tonbridge Railway telegraph office, a ship's radio cabin of 1910 and the radio operator's position in a Lancaster bomber. Technology is barely touched — the exhibition is aimed at the general public rather than people with technical know-how.



British Telecom engineers at work on a demonstration of 'Packet Switchstream' at the Science Museum's new communications gallery

The second gallery deals with modern systems, and includes a mock-up of the inside of a British Telecom manhole (complete with a mock-up of a British Telecom employee). Other displays aim to show things like packet switching, pulse code modulation and System X. There is also a cinema showing a short film, *Echoes*, made by STC, who sponsored the exhibition.

Amateur radio is not forgotten. Two 'black boxes' share a small display case with a CB set.

NOVICE LICENCE CAMPAIGN

The Amateur Radio Novice Licence Campaign (ARNLC) has been set up to campaign for (believe it or not) a novice amateur radio licence.

The Campaign accuses both the Home Office and the RSGB of 'dragging their feet'. The Campaign's secretary, Ian Abel G3ZHI, says "since 1947 the RSGB has failed in its negotiations with the Home Office to bring about the introduction of a Novice Class of licence. This is despite a promise in Parliament by the then Postmaster General in 1968, E Short, of his intentions to introduce such a licence "later in the year". The Novice licence is already available in a number of countries around the world.

"The Home Office has stated that they have no objection in principle to the introduction of a Novice Licence. However they are not convinced that there would be sufficient interest in such a licence. This is why the ARNLC has been formed."

If you're interested write to: Ian Abel G3ZHI, 52 Hollytree Avenue, Maltby, Rotherham, South Yorks. Tel: 0709 814911.

EXHIBITION SUCCESS

The RSGB's National Amateur Radio Convention, held at the National Exhibition Centre near Birmingham, attracted over 10,000 visitors during the two days it was open. There were slightly more people there on Saturday than Sunday. The move to the NEC was experimental, and the RSGB says that some traders were so pleased they have already booked space at next year's event, which will now also be at the NEC. The RSGB says "We hope, next time, to make it even better."

... and NARSA ...

Another two-day event was the Northern Amateur Radio Societies' Association exhibition at Southport (originally held at Belle Vue near Manchester). This event also attracted large crowds, but some traders say they were disappointed by low sales.

The Facts and Fiction of VHF/UHF Aerials

Amateur radio has distinct similarities with the pursuit of a better hi-fi system. Give or take a fraction of dB, all audio amplifiers are the same. The way to better audio lies in the choice of loudspeaker system and signal source. When it comes to RF, there is little to choose between the various Japanese black boxes except the price. The most important thing that you can have is a decent aerial system.

By Frank Ogden G4JST, Editor HAM RADIO TODAY

When buying an amateur radio station off the shelf, as much as half the total purchase price should go towards provision of the aerial system: a 10 watt two metre multimode costs, say, £350. A basic aerial system will add another £50. You want to put out a better signal so you invest a further £300+ on one of those magnificent Dressler linear amplifiers. The power goes up to 200W, the price goes up to £700+ and received reports should show another 2½ S points on everybody elses' S meters. Your meter, however, will still be giving the same reports as it always did.

Going back to square one you buy your 10W transceiver, spend £150 on a rotator (cheap ones are false economy) vertically stack four 8-element Yagis (£100) and divide the remainder of the investment between the purchase of Westlake's H100 feeder (much lower loss than UR67) and some strong aerial lashings. The result of this approach would be to collect an extra two to three S points on received reports while having improvements of the same order on your reception . . . all with a basic 10W set. If you then add one of Lexton's amplifiers, you will have a potent station indeed.

Aerials and feeder systems are important because there is no other aspect of a station which acts to improve both send and receive simultaneously (except perhaps moving house to a better location but that is expensive). Even the best in GaAsFET receive preamps will generally do less for your receive noise figure than just a very modest Yagi.

A general point

The performance of any aerial system is determined almost entirely by the amount of metal intercepting the incoming radio wave. The way in which a radio signal is converted to an RF voltage at the aerial socket is dependent on laws of physics, not advertising claims.

The corollary to this is that an aerial system having the same number and arrangement of elements will perform as well as a similar aerial system from any other manufacturer. When you choose between aerial manufacturers for a specific aerial type, for instance 2m 10-element X/Y, you must look for durability, wind loading and price, not the specified aerial gain. There will be minor differences such as slight variations in bandwidth from manufacturer to manufacturer although the perceived differences will be minimal or non-existent. More on the topic later.

Going mobile

All the points made in the last couple of paragraphs apply even more thoroughly to simple aerial systems than complex ones. A 5/8 boot mount is a 5/8 boot mount regardless of who makes it, a 2 x 5/8 base station co-linear has electrically the same characteristics as a similar arrangement of co-linears from any other manufacturer you care to name. Likewise with quarterwaves, halos and rubber ducks.

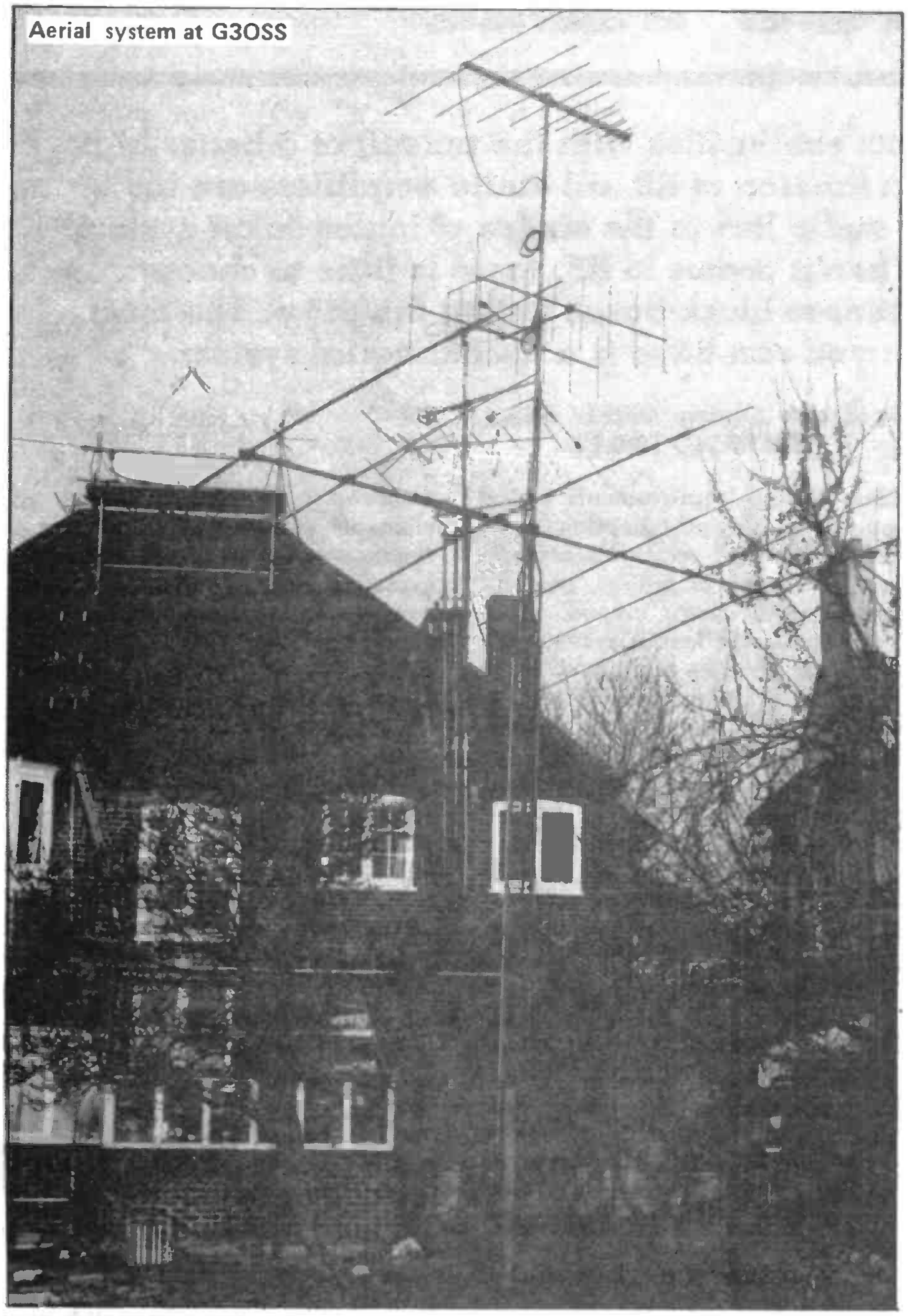
The only differences between types is in manufactured quality. A case in point, the ever popular 2m mobile 5/8 wavelength whip. I've had a number of these things on my car over the years and confirm that they all work equally well when new. However, the cheap types which use the integral loading coil suffer badly from internal corrosion of the loading coil guts after a couple of years' service. The rain and Winter salt spray gets in and the copper plated steel coil literally rots away. Against this, the expensive types with demountable aerial whips and coils sealed against the elements have always been nicked from the car before I've ever had a chance to see whether they deteriorate any slower.

There are pronounced differences between the aerial types. 1/4 wave aerial whips mounted centrally on the car roof perform better around town — where there are strong multiple reflections — than gain systems: 5/8, 7/8, etc. Short aerial whips produce less mobile flutter than the longer ones although in open countryside, the stronger signals of the big aerials offer a considerable advantage. In my opinion, the 5/8 system offers the best compromise between mobile flutter and signal strength.

Juggling figures

Manufactured quality, rather than specified performance, is the thing to look for in base station colinears. In any case, the specifications themselves are very misleading. Virtually all beam type aerial systems are referred to a simple dipole when it comes to calculating dB of gain. For some reason, the reference used to judge the performance of omni-verticals is the quarterwave groundplane. This gives most vertical aerials types 3dB more gain than they actually have when compared to a dipole. Put another way, a simple dipole exhibits 3dB of gain when compared with a quarterwave groundplane system.

Putting the record straight about mobile aerials, in comparison to a dipole (0dB) the 5/8 has 0dB gain, a halfwave exhibits 0dB as does a *Slim Jim* while the 7/8 shows all of 1.5dB real gain. The classic double 5/8 co-linear weighs in at around 2.5dB over a dipole. By contrast, the most basic 2-element beam returns roughly 3.5dB of gain over a dipole.



Aerial system at G3OSS

Hand portable

Handitalkies used as such are remarkably inefficient radiators. The body has to provide the ground image, the other side of the dipole. Since some rubber duck type aerials only have a radiation resistance of between five to ten ohms and acknowledging that the body is a lossy, high impedance radiator, very little RF actually gets out, or is received.

The answer is to use a halfwave

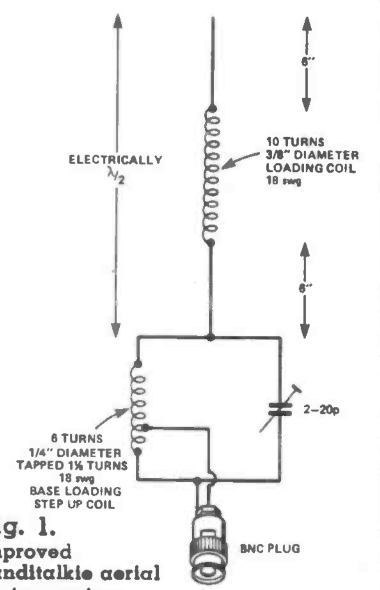


Fig. 1. Improved handitalkie aerial for two metres

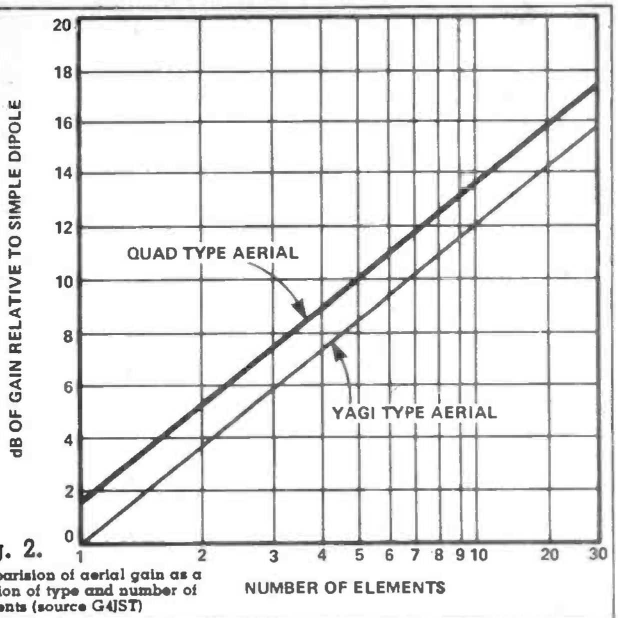


Fig. 2. Comparision of aerial gain as a function of type and number of elements (source G4JST)

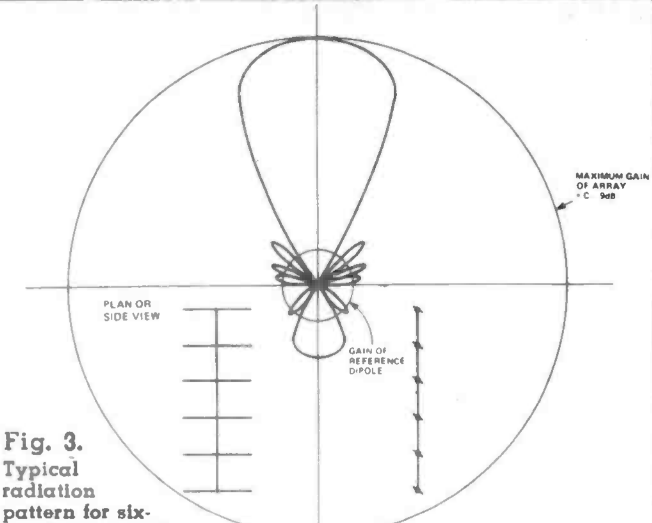


Fig. 3. Typical radiation pattern for six-element Yagi. This pattern would be typical for both the vertical and horizontal (beam elevation and beam heading) directions

aerial, a system which provides its own ground image. **Fig. 1** describes such a system. The bottom tapped loading coil steps up the resistance from the 50 ohms characteristic of the handitalkie to the several thousand ohms of the centre loaded halfwave dipole. Since the circulating currents into the handitalkie casing — and hence into the body — have been reduced by an order of magnitude, the system losses are reduced to minimal proportions. The perceived portable performance boost is dramatic. You can purchase ready made halfwave aerials for 70cm, but you will probably have to make your own for 2m use.

Beam Aerials

There are usually only two criteria for people who are putting up a beam aerial system for the first time: how much gain for how little money. It is a perfectly respectable attitude but there are other factors to take into account. For instance, what *kind* of gain do I want? Will my rotator take the weight and the windloading? Will the thing fall to bits in the first Autumn gale?

Kind of gain

It goes without saying that everyone wants the most gain that money can buy and I am not going to go against that view. **Fig. 2** shows a plot of aerial gain against the number of elements for both simple Yagi and quad aerials. When it comes to assessing performance, the precise method of manufacture is relatively unimportant. It is the number of elements that counts. However there are other ways of achieving gain which have distinct performance advantages.

Stacking of aerial arrays leads to increased gain at the rate of 3dB for each doubling of the number of aerial arrays. Dependent on how they are stacked (either side by side or on top of each other) the resulting radiation polar diagram can show distinct advantages over a single big Yagi or quad of the same nominal gain.

Fig. 3 shows the polar plot of a typical 6-element Yagi. The maximum forward gain will be around 9dB but the beam width — typically in the region of 40° — will be substantially the same in both the horizontal and vertical planes. With this pencil type of beam, you have to point the aerial fairly accurately to realise the system gain. This is fine providing that you know exactly where to look for a station. However,

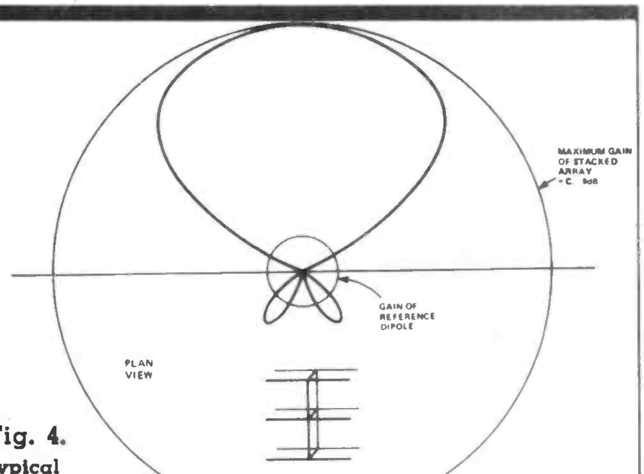


Fig. 4. Typical radiation pattern for two vericaly stacked three-element Yagi would show an identical pattern except that all lobes would be 3dB less in amplitude

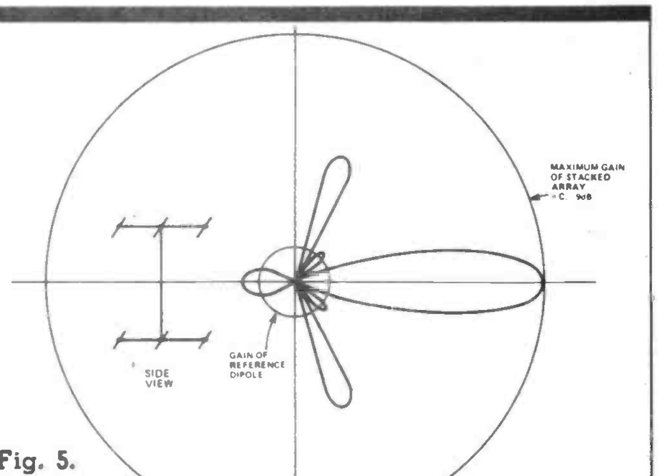


Fig. 5. Typical vertical radiation pattern of vertically stacked dual three-element Yagi array

if you are monitoring the calling frequency, you might not hear weak stations that are not exactly on your beam heading and thus miss a lot of the action.

A typical three element Yagi has a gain of 6dB. If you connect two together — with a suitable matching harness of course — the forward gain rises to 9dB, the same as for the single 6-element case. It might seem pointless to go to the trouble of phasing and mounting two aerials where the same gain can be achieved with one but there are real advantages.

Fig. 4 shows the polar plot of two vertically stacked 3-element Yagis. There are two points to note. Firstly, the horizontal plane radiation pattern indicates a beam width of at least double that of a single 6-element Yagi even though the realisable gain is the same. In practical terms, the array is not nearly so critical of beam heading. The other point is that the horizontal lobe characteristic does not differ markedly from a single 3-element array. The same is true of four or more tier systems. **Fig. 5** shows that the beam narrowing occurs in the vertical direction only. This is relatively unimportant since the array elevation will nearly always be parallel with the horizon. In other words the vertical stacking changes the beam from the pencil form of the single Yagi to a fan shape.

Yagi v quad

It is possible to treat these two popular types of aerial in much the same way. The only real difference is the extra 1.5dB of gain that a quad system will have over a Yagi array of the same number of elements. Against this, the quad aerial, element for element, has almost twice the metal of a Yagi. This increases the wind loading and weight. However, there are compensations. Long quads are supposed to be easier to match than long Yagis. The main point about quads though is that they give more gain for a given boom length.

There is one proviso to all these quests for gain. It is important to get optimum matching and phasing. It is very easy to lose hard won performance. Home built aerial designs are prone to this but little trouble should be encountered with good quality professional units. Provided that the input SWR to the aerial is below 1.5:1 no significant performance shortfall will occur. Even system SWR's of 2:1 will not degrade performance particularly. Remember too that long feeders are lossy. UR67 or better should be used for all runs over about 20ft on 2m. 70cm requires UR67 for all runs over 8ft. I would personally recommend the new H-100 coax from W H Westlake. It has a much lower loss than UR67 yet costs just 80p/metre. ●

"Me and your mother are getting a bit worried about you son. Shut in here, night after night — get out and talk to people!"

Eleven to Ten

Converting 27MHz CB sets to the 10 metre amateur band

by Bill Sparks G8FRX

To the comparative old timers; that is the early G8_____s and later G3_____s the present multitude of black, grey and blue boxes must often cause nostalgic reflections back to the good old days of their amateur beginnings. In the late 60s and early 70s the normal way of getting on the air was either by rolling your own or modifying government surplus gear or ex-commercial equipment. The early days of two-metre expansion (when 144MHz was opened to the Class B brigade) meant that the majority of rigs were ex-PMR, Pye, Storno, Cossor etc. Nowadays an all singing and dancing rig capable of working at least six repeaters via a linear and multi-element beam seems an essential requirement of the newly licensed G6_____, and the state of two-metre operating confirms this fact. Many operators must have longings for the good old days and those who have moved on to Class A have such an escape open to them, namely mobile FM on 29MHz.

With the advent of CB, equipment capable of easy modification to 29MHz is available cheaply. Some of the transceivers around are of a reasonably high standard, giving scope for modification to good performance at very low cost. Cheap mobile aerials are also readily available.

40 channels

A typical block diagram of a 40 channel (10kHz spacing) CB set would be as in **Fig. 1.** For simplicity an AM set is chosen. Details on converting an AM set to FM (with a performance typical of 145MHz gear) will be given later.

The basic transmitter and receiver circuits are fairly conventional in that a low power PA is driven by a simple driver, both stages being modulated. The predriver stage is excited by a frequency synthesiser which also includes a safety circuit. This cuts the transmitter off if the synthesiser goes out of lock. The synthesiser consists of a voltage controlled oscillator operating (in this case) at the output frequency minus the first IF (generally 10.695MHz). The synthesiser is locked to a multiple of 10kHz, derived from 10.240MHz crystal. This 10.240MHz oscillator circuit also drives the second receiver mixer, giving a second IF of 455kHz. The VCO frequency is mixed with the 10.695MHz oscillator to transmit on the same spot as the RX input frequency. Suitable T/R switching is provided and the rig operates like just about any other transceiver. The main difference between the conventional amateur arrangement and the one discussed above is that the injection frequency to the first RX mixer is lower than the received channel, whereas it is normal amateur practice to operate receiver oscillators on the high side of the signal frequency. The variety of CB equipment is extremely wide but certain basic similarities are found. The major variations are in the frequency synthesisers. Since our aim is to transfer the operating frequency to a point some 2MHz higher we will consider the synthesiser stages first.

Basically, there are three main techniques used in synthesiser circuitry in CB sets although certain other oddball circuits exist. The three methods are as follows:

a) To prevent any form of conversion to additional frequencies a form of Read Only Memory is incorporated in the PLL whch is dedicated to giving only the forty channels recognised by the FCC in America. Typical devices are the (see Appendix 1) 7137, 7130 and 7131. These devices are invariably operated by programmed input lines usually by a 6 bit code.

b) Another form of pre-programmed device uses a SQ called 'random' code which is a variation of the 7 bit BCD code, eg. 9106 & 9109.

c) The major proportion of the sets used phase locked loop circuits controlled by a straight binary input and these are comparatively simple to re-tune. A brief explanation of binary arithmetic is given in Appendix 4.

Dedicated v binary

In type (a) & (b) the device is

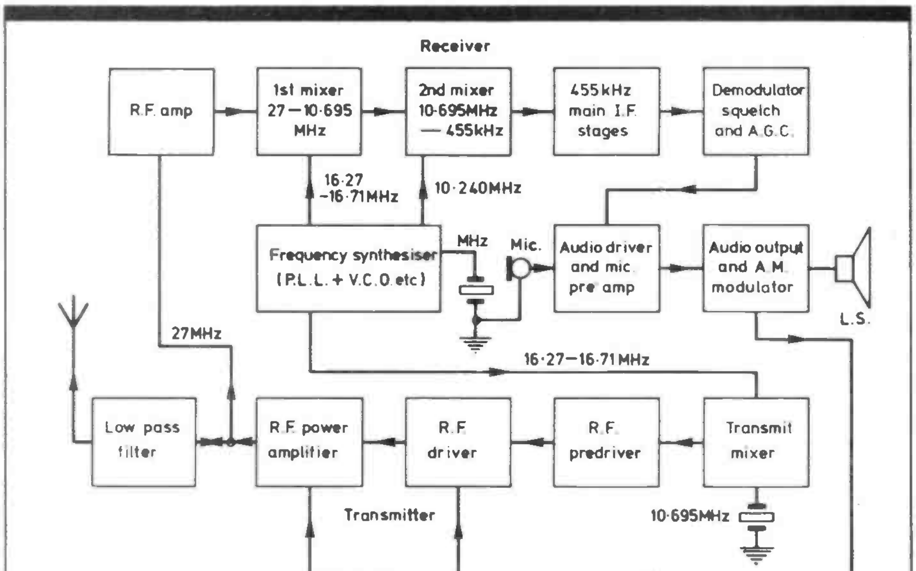


Fig. 1. Basic TCVR

usually loaded with forty discrete operations and these are called up by the input logic variation, but in type (c) the number of operations carried out by the device is controlled only by the binary number range the device will accept. In many cases as many as nine inputs or program lines are available, thus giving 2^9 variations, ie. 511 different lines. Since we originally stated that the channelling was at 10kHz intervals this gives a tuning range of 5.11MHz.

The simple operation of a synthesiser PLL circuit is shown in **Fig. 2**. When the reference frequency f_r and the VCO frequency f_o are applied to the phase detector, the phase difference is measured in the phase detector and converted into a DC output which is applied to the VCO via the low pass filter. Since the comparison is made every cycle there will be harmonics and noise at the output P, hence the need for the low pass filter. The integrated DC voltage applied to the VCO causes a frequency change to occur, the VCO output being returned to the phase detector. The closed loop will continue to operate until there is no phase difference between the voltage generated in the VCO and that of the reference. The VCO is then locked on to the reference frequency and the VCO output (f_o) is in phase lock with the reference.

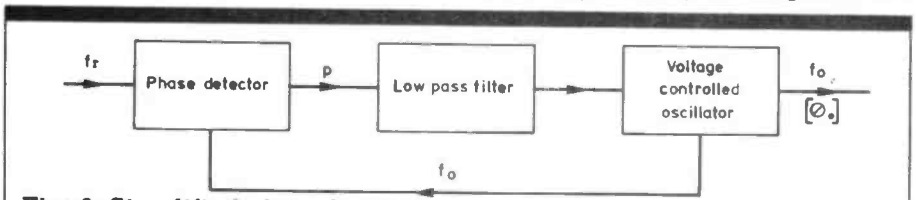


Fig. 2. Simplified phase lock loop.

To apply this technique in real terms some additional sophistication is required. Since variable frequency dividers used in these circuits have a fairly low frequency maximum count limit and we require a 10kHz channel spacing we have to accept that we are referring to a 10kHz reference and that our VCO frequency of approximately 17MHz has to be divided by some 1700. To overcome this problem the VCO frequency is mixed with an offset oscillator, to give a lower variable frequency which does not require such a high division ratio. **Figure 3** indicates a fully operational arrangement.

In order to achieve a range covering 29+MHz it is necessary to alter VCO to give 29.5-11.695MHz as the operating range.

In the example quoted the channel switch on channel 1 gives an output code of 136, so our new frequency on 29MHz at the lowest end of the range should be controlled by a 136 programmed input to the PLL to be used. By substituting a 17.245 crystal for the 14.910 crystal in the original circuit our transmit frequency should now be between 29.300 and 29.700. However, due to FCC regulations, the original FCC frequency allocation to CB had certain discrete gaps at 50kHz intervals. The channel switches were designed to skip these numbers in their output; so a typical output sequence from the switch used in our example would be 136, 137, 138, 140, 141, 142, 143, 145, 146, 147, 148, 150 and so on up to channel 20, where normal sequential counting took over up to channel 22. Channel 23 required a count of 165, whereas channel 22 was 162. The sequence at this point was channels 22 — 24 — 23 — 26; then normal counting up to level 44 or in our instance 180.

By interrupting the program lines from the switch and feeding them via a suitably programmed EPROM the necessary corrections can be made to the coding, so that the switch reading 1-40 gives a progressive binary input to the PLL, enabling a true 10kHz channel sequence.

In some instances the VCO coil may not tune to the new frequencies. This can be changed fairly easily either by reducing the length of the coil or by reducing the coil padding capacitor.

Where it is necessary to replace the synthesiser due to it being a dedicated device, the simplest method is to introduce a composite board containing the EPROM and the alternative synthesiser. A suitable board is shown in **Fig. 4** together with the circuit and layout in **Figs. 5 & 6.** As the circuit indicates the program lines are fed to the EPROM and the modified program is then fed to the synthesiser. The details of operation and installation will be dealt with later in the article.

PCB drawings Figs. 4, 6 and 9 will appear in a future issue. Unfortunately there were mistakes in the original artwork — Ed.

Another technique was often used to cut the number of crystals. By taking the 10.240MHz signal and dividing it by two, a 5.12MHz signal was derived. This frequency was multiplied by three to give 15.36MHz which was then mixed with the VCO. This was then submitted to the divide-by-N module, giv-

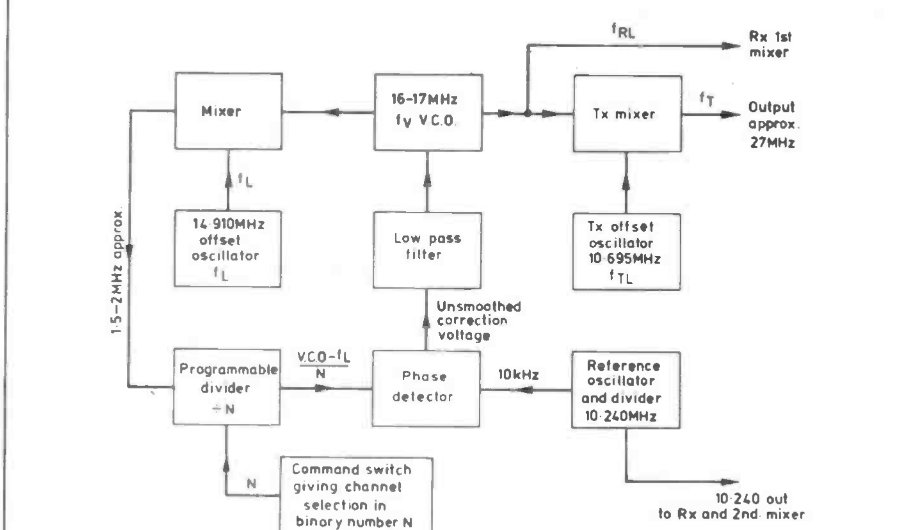


Fig. 3. Typical synthesiser arrangement.

ing a count range similar to the ones discussed previously.

From the discussions so far it would appear that the majority of sets around could be converted to operate on 29MHz FM.

The use of the 10.240MHz crystal as the reference oscillator permits a variety of functions.

a) The division by 2^{10} gives 10kHz since 2^{10} is 1024.

b) Division by two and multiplication by three gives 15.36MHz which is a handy offset frequency, also multiplication by two gives 20.480MHz, also a handy offset frequency.

c) The technique adopted in nearly all the units is to operate the VCO at either (input frequency + 10.695MHz) or (input frequency minus 10.695MHz), 10.695MHz being the value chosen for the first IF. By mixing this 10.695MHz with 10.240 in the second oscillator the standard 455kHz IF is produced.

Referring back to our original comment on (b) above, the device chosen for the alternative synthesiser was a Motorola device MC145106. This operation of this device is shown diagramatically in **Fig.8.** The particular device used has an effective counting range of 10^9 $(2^0 - 2^8)$ or some 512+ in binary steps. The technique finally adopted is to count in units of two, ie. 2, 4, 6, etc. and to utilise the 5kHz split so that each step is 10kHz (ie. 2 x 5kHz). However by switching internally the device can count in even pairs, ie. 2, 4, 6, 8 etc., or in odd pairs, 1, 3, 5, 7 etc. This technique allows for the 455kHz receiver IF. This is now derived by programming the device to read 91 steps which at 5kHz intervals is 455kHz and then mixing this with the 10.240 frequency to achieve the required output in the T/R switching.

ie. VCO + 455kHz + 10.240MHz = TX frequency

In practical terms the VCO output is fed to a simple transistor mixer which is hard switched by the 15.36MHz derived as shown in the circuit diagram for the board, **Fig.4.**

The two devices shown at the input to the dividers are Schmitt triggers, which assist in preventing random noise from operating the counters, by squaring the shape of the input pulses. In the case of conversion to MPT1320 the 5kHz technique permits a frequency shift of a straight 64 in count (27.605 — 26.965) and then 5kHz correction of the 27.605 to bring it to 27.600. A slight tweak to the 10.240 crystal then brings the resultant frequency to within 1-200 cycles of 27.60125. Similar techniques will permit the

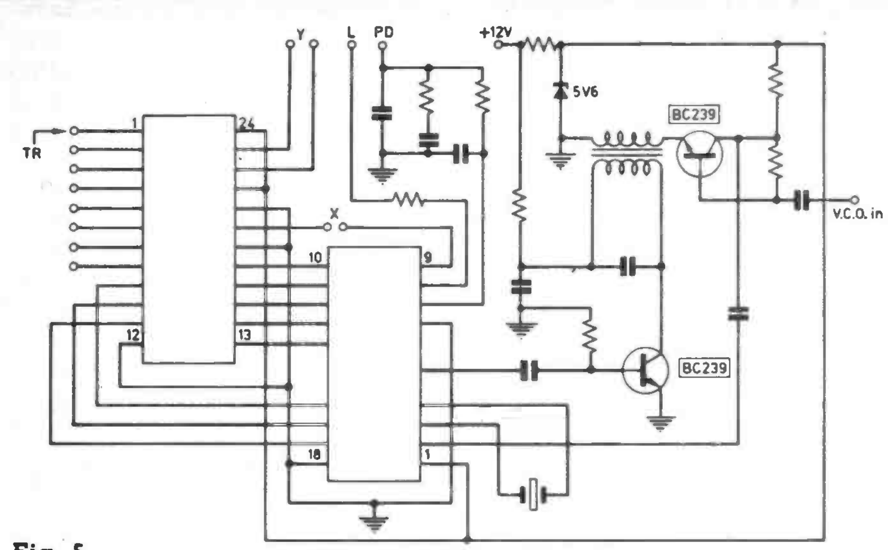


Fig. 5.

For 6 bit b.c.d. break at X, ground Y.

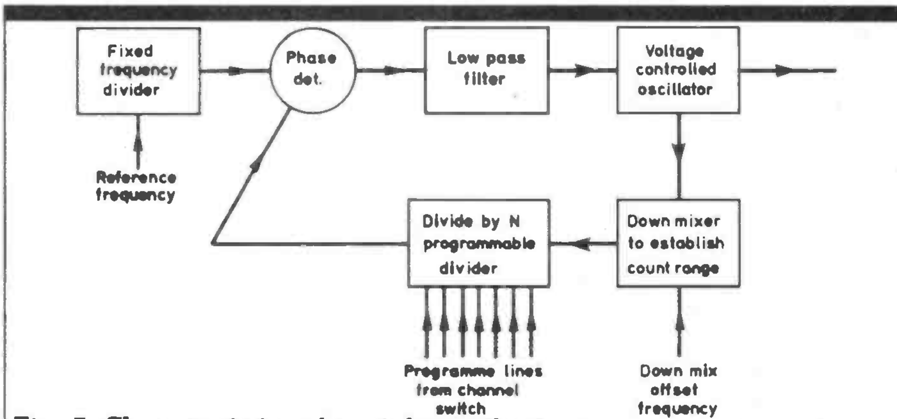


Fig. 7. Characteristics of straight synthesiser.

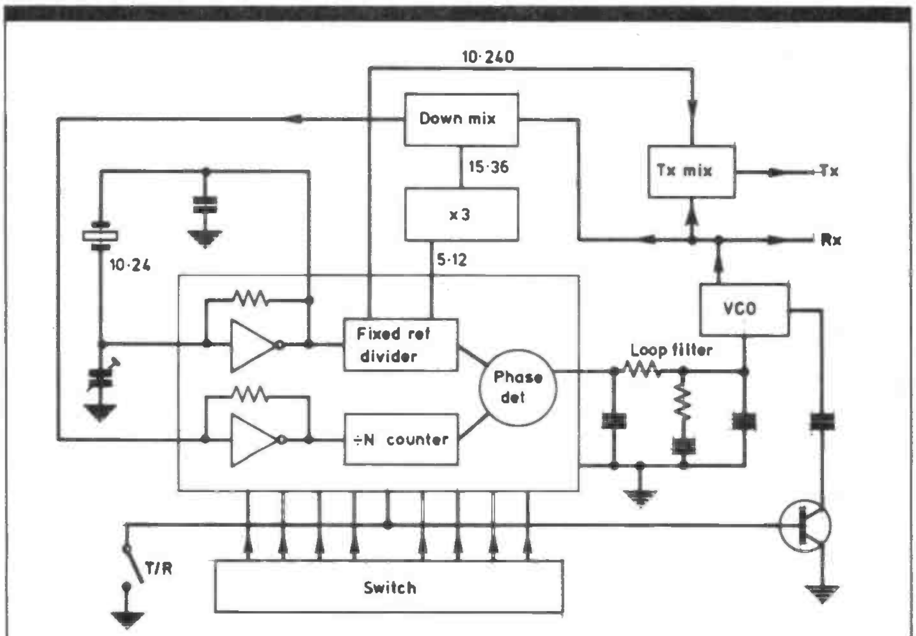
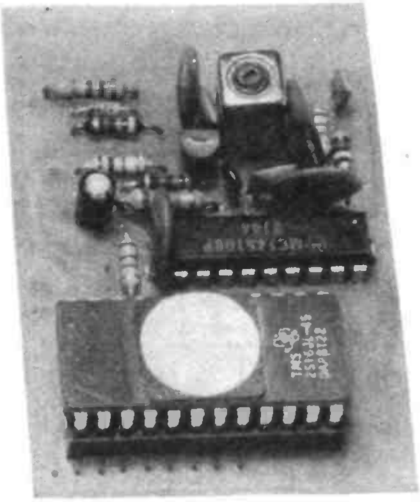
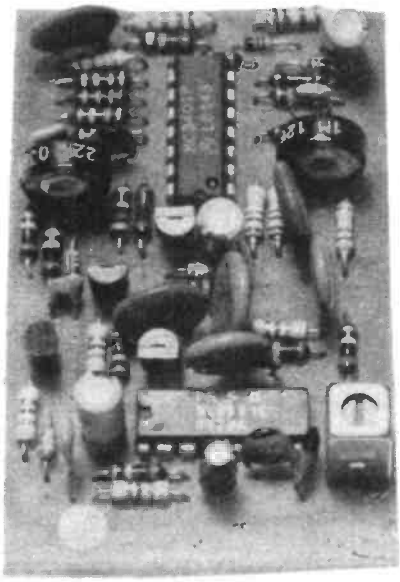


Fig. 8. Technique used in circuit adopted (MC145106)

circuit to operate at any required frequency within the capabilities of the counter and the VCO. To remove the gaps on the FCC sets, suitably programmed EPROMs could be used as follows. In the case of the sets using the straight binary input PLL where the original synthesiser can remain in situ, the technique adopted is to cut the tracks from the switch to the device, and feed the program lines from the switch to the input lines of the EPROM via the address lines, remembering to keep the lines in the correct order. See **Fig. 9.**

In the EPROM used on the board shown in **Fig.4** the least significant digit is fed to address line 8 and the most significant to address line 3 in the case of 6 bit BCD. Address line 2 is used as the T/R line to introduce the offset of 455kHz in the specific program on this EPROM but in the case of straight binary, address lines 8 — 1 are used as inputs. A suitable board layout for the code transfer is shown (**Fig.9**). This provides a facility for introducing a 5V regulated supply. It will be found in many cases that the leakage at the input of the EPROM address lines is so low that static charges can build up. It is therefore advisable to install pull-down resistors (50K — 500K 1/8 watt), across the wide earth line in the centre of the board. (Shown in **Fig.9.**





The loop filter shown in the diagram of the 145106 devices is important and due to its critical nature, when the system is being used as an alternative to dedicated device it is important to completely isolate the original loop filter to avoid incompatibility problems.

In order to explain the technique still further perhaps a look at a typical binary indication would help. In view of space restrictions only certain channels will be shown but the sequence, being additive should be easily followed as indicated in **Table 1.** (For further information on binary codes see appendix 3).

In the first example a difference offset frequency in which the VCO would be operating in the 36MHz region is shown. The offset frequency could be derived from a crystal oscillator operating around 37MHz or the circuit could use a 17MHz VCO with the 10.240 crystal oscillator being doubled to 20.48MHz if mixed with the 17MHz VCO this would give a down count for an increase in VCO frequency. Both techniques are used.

Table 1

Frequency	Code Sum	256 7	128 8	64 9	32 10	16 11	8 12	4 13	2 14	1 15	Powers of 2 Pin Number
27.601 9-15 only with	74	0	0	1	0	0	1	0	1	0	Using pins
27.701 technique	64	0	0	1	0	0	0	0	0	0	down count
27.801	54	0	0	0	1	1	0	1	1	0	
	256	1	0	0	0	0	0	0	0	0	Using all pins 7-15
	257	1	0	0	0	0	0	0	0	0	and up count
	260	1	0	0	0	0	0	0	0	0	
	511	1	1	1	1	1	1	1	1	1	
26.965	136	0	1	0	0	0	1	0	0	0	Pins 8-15
27.605	200	0	1	1	0	0	1	0	0	0	" "
27.995	239	0	1	1	1	0	1	1	1	1	" "
29.605	400	1	1	0	0	1	0	0	0	0	Pins 7-15

The interesting point is that the 40 positions on the channel switch can be placed at any point between the count of 1 and 511, this giving a frequency coverage of over 5MHz with a 10kHz channelling or 2.5MHz+ with 5kHz channelling. The important feature to recognise is that the code lines from the switch should not over-range the available program range. In other words the use of six program lines will only permit a count range between 63 and 0 so if the switch gives out 136 — 174, the range must include eight input lines. A simple device could be shown as in **Fig.10.**

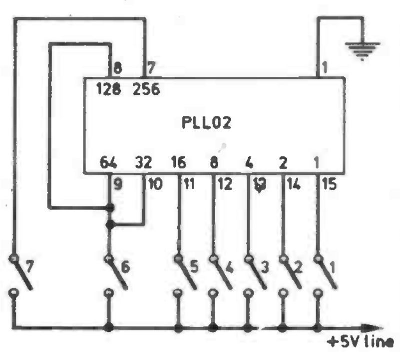


Fig. 10.

By closing switch 6 we have a pre-loaded count of 224 already in the line, using switches 1 — 5 gives us a count range of 31, so we have now an effective range of 224 — 255. By closing switch 7 and opening all the other switches we now have 256 count. By progressing through switches 1 — 5 gain with 7 closed we can now count to 287 so that in effect using the above technique we have a count range of 224 — 287, so 64 positions are open to us in this instance from the combinations of switches 1 — 7, and the 64 positions can be seen anywhere up to 511, ie. the 640kHz swing can be at any point in a 5MHz range. As can be seen we have pre-loaded 224 so that it becomes obvious that by preloading any quantity up to 256 we can set our operating range to suit, but in order to cover certain areas we may have to arrange an intermediate switching of the loaded point.

The practical operations involved are relatively simple and by using EPROMs to carry out the mechanical operation just described the techniques are well within the skill of the average amateur. The main problem is in the programming of the EPROMs. The important feature is to establish the program already being fed to the EPROM by preparing a truth table on the pattern shown for the MC145106. It is only necessary to check the code at channel 1 and channel 40, the rest can be calculated. The technique for establishing the code pattern is to check the voltage level on each of the program lines in turn at the selected channel switch position. A voltage of some five volts indicates a logic 1, and any voltage less than 0.5 indicated logic zero. It is advisable in these cases to use an analogue meter of some 20,000 ohms per volt to present a suitable load otherwise random static voltages may affect the readings.

In discussing the practical operation probably the most suitable manner would be to use one of the most common circuits. The one chosen is used by a variety of manufacturers and is given in **Fig.11.** The VCO control voltage is derived from pin 17 and goes via R201, C203 and R204 to the varicap diode D201 which is across the coil L203. C304 serves as the DC isolating cap and has a loading effect on frequency range, so being in series with the varicap controls the VCO operating range. The KC7310 device acts as the transmit mixer and VCO. The VCO output is tapped off at pin 2 of the 7310 and fed via C305 to the PLL, in this case a 7131. The VCO return via C305 is red to pin 19 of the PLL and in the PLL is fed to the programmable divider. This is controlled by an internal ROM and this ROM accepts the input lines from the channel switch (pins 1 — 6 incl.).

The T/R line instructs the internal ROM to read the offset and consequently moves the VCO frequency, as discussed previously. A certain amount of the RF is fed back to the PLL via pin 14 as a lock check and an out-of-lock indication causes the device to inhibit, this preventing any off-frequency transmission.

The channel switch controls the digital information to the device and at the same time this information is fed to the digital display.

The techniques required to override the synthesiser shown and to vary the output frequency to a previously determined range are all accomplished on one board. (**Fig.4**) This board accepts the incoming information and takes over control of the VCO in the following manner.

The program information is fed to the EPROM and this transforms it to an acceptable code for the PLL used. The control functions are taken over as per the layout shown for the device and the actual circuit used is shown in **Fig.4.**

The physical operations involved are to lift the end of R201 adjacent to TP1 and clear it from the board. Run a wire from Pin 7 on the new board (shown as output on diagram) to this resistor. The 10.240 crystal is removed and soldered on to the new board together with the 56pF capacitor. The other capacitor is replaced on the new board by a 33pF cap. The program lines are removed from pins 1 — 6 on the old board and inserted in pins 8 — 3 on the new board. A T/R line point is taken from the junction of R316 and diode MA150 (D209) and fed to pin 2 on the new board. The 12V point is fed from the set side of the on/off switch and a suitable earth connection made. The VCO return is taken from pin 2 of the 7310 mixer by first removing C305 and taking the wire from the 7310 side to the new board. The inhibit line is disabled by cutting the track at pin 14 on the 7130.

By connecting a voltmeter between pin 8 of the new board and earth the conversion should be complete. Initially set the channel switch to channel 20, then adjust the VCO coil until a voltage of some 5V appears at pin 8. This voltage should stay at 5 volts when the channel switch is moved from 1 — 40. This indicates that the circuit is in lock throughout the new frequency range. In the case of difficulty the check points are as follows:-

a) Check on pins 2 & 3 of the 145106 to ensure that the 10.240 oscilator is working.
b) Check pin 5 for 5.12MHz output.
c) Check at mixer transistor for 15.36MHz, if not present adjust tripler coil to give a maximum of 15.36MHz output (core flush with top of can).
d) Ensure that EPROM is receiving 5 volts and no more.
e) Check that T/R line is switching.
f) Ensure that VCO return is present.

The actual RF voltages as shown on a scope should be in excess of 0.6 volts in case of the RF return from

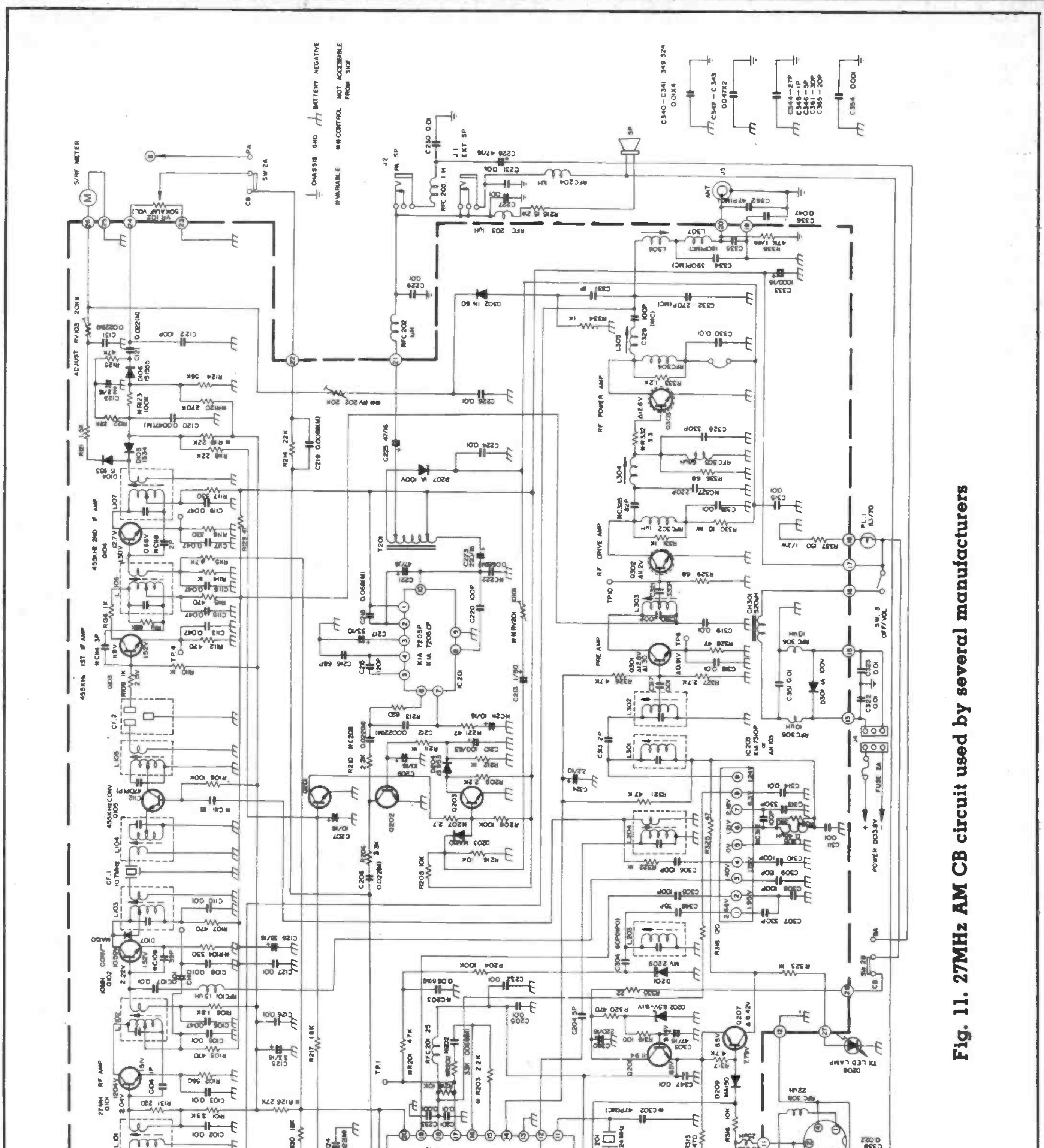


Fig. 11. 27MHz AM CB circuit used by several manufacturers

the VCO and the 15.36MHz injection to the mixer on the board as shown in the appendix.

Various techniques are available for a variety of circuits but all follow the basic arrangement as outlined above. The stability attainable is well within required standards and is more than adequate for normal requirements.

To convert the AM to FM operation is again a straightforward task. A small FM modulator circuit is introduced in which the microphone input line is lifted from the board at point 2 and inserted into the modulator/discriminator board. The modulator used consists of a quad operational amplifier in which the first stage includes an adjustable gain stage followed by a diode clipper and a filter network using one active and two passive filters. The circuit and board layout for the modulator is given in the appendix and the output from the varicap point is applied to pin 2 of the 7310 when it is in effect in parallel with the VCO via the bridge of C308/C307.

The pre-emphasis achieved is some 6dB per octave and the first low pass filter give a roll-off of some 6dB per octave after about 2,800Hz. The other filters give an additional roll-off of some 12dB per octave so the audio response is as in **Fig.13**.

The effect of using an adjustable gain stage in the initial part of the circuit followed by an amplitude limiter is to give a sensibly constant audio output over a range of inputs from some 20mV to 200mV. In effect the design operates as a very efficient speech processor with a high degree of distortion reduction at the output, and the audio quality obtained is of a very high standard indeed. The design is based upon a Motorola concept drawn around their MC3401 device, which operates very effectively at 9 volts.

The low capacitance added to the VCO by the varicap is compensated for by the control voltage so that at resting frequency the desired frequency is not pulled and audio variations across the diode cause a good quality FM signal to be created. The only setting up required is to advance the input pot to just below clipping level and to set the output pot to the required deviation level. In some circuits the amount of VCO swing may not be sufficient and in this case the output from the deviation control may be fed by a 1 μF electrolytic to the TP1 connection at R201. In this case the deviation will require stepping down on the pot since it is now possible to get up to 15kHz deviation. The signal sounds very loud but could be frowned upon! Alternatively the 100k resistor in the input could be by passed.

An audio oscillator of some 50mV output at 1500Hz connected to the mic input line acts as a suitable check for setting the deviation. Nor-

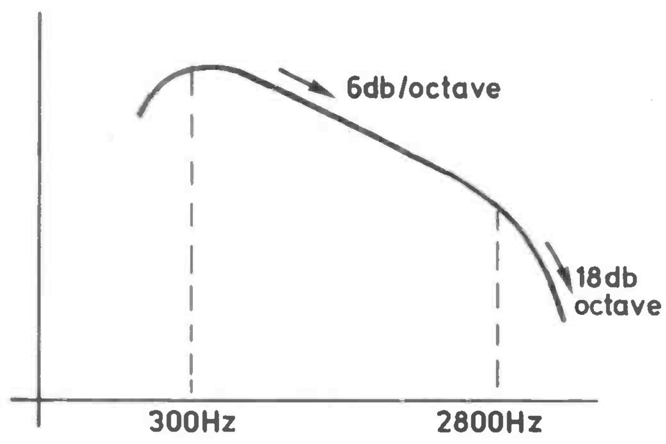


Fig. 13. Tailored audio response to achieve optimum value of modulation index at nominal 3.5kHz deviation max.

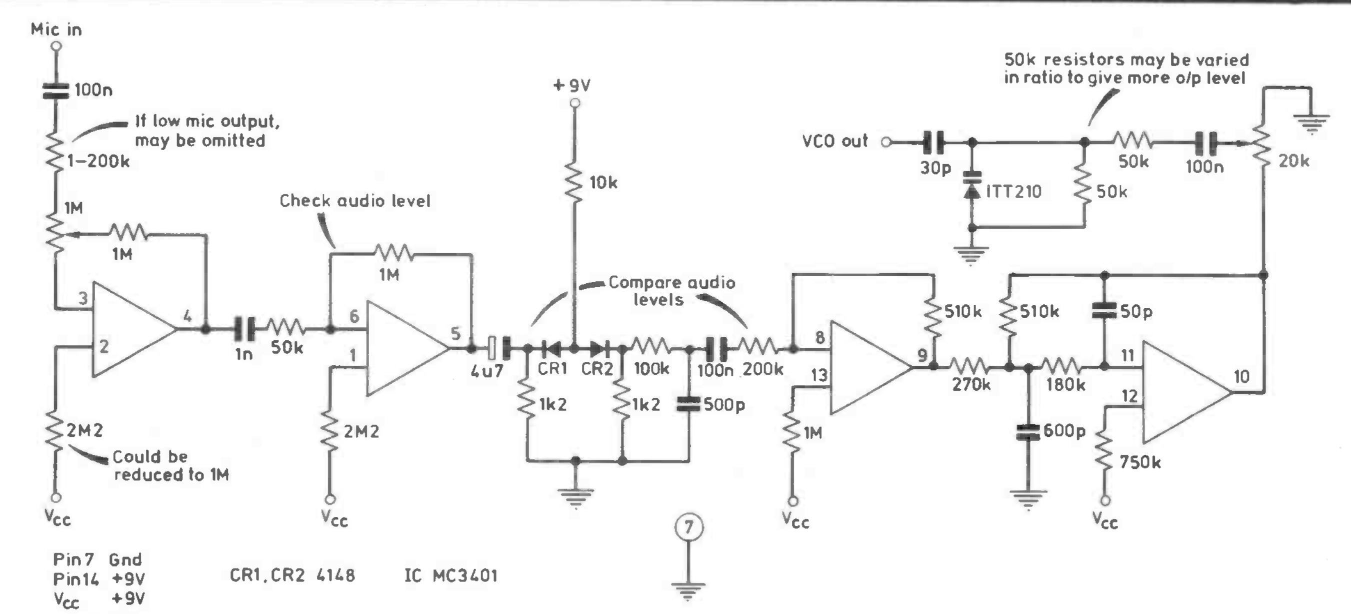


Fig. 12. Modulator circuit used.

mally it is not necessary to remove the modulation transformer but if desired C225 should be changed to 200uF, and a bridge taken from C223 to C225. The 12V line can then be taken across the original pins of the transformer from the 12V line to the diode D207.

In the receiver the IF output is taken from the base of Q104 (secondary of the IF transformer) direct to the board via a screened lead, the screen acting as the earth return. The audio output is then taken to the top of the volume control after lifting the wire from the C121/C122 function. This removes the AM detector from the circuit but allows the AGC and squelch to operate and keeps the signal meter in circuit.

The device used in the discriminator is the Plessey 6691, a high quality quadrature detector with its own built-in pre-amp and audio circuit. The audio output is adequate to drive the normal AF amplifier devices found in the sets commonly used and gives an extremely good performance with a high degree of AM rejection.

The use of a modulator and discriminator on the one board requires a degree of separation on T/R since the modulator can create audio oscillation if allowed to operate on receive. Accordingly, a T/R switching network which switches the modulator on and the discriminator off during transmit and vice-versa on receive is used. The T/R line operating this function is derived from the coil side of R325. Due to circuit conditions a certain residual voltage is present on this line in the off position so the 3V zener in series with the line at the input to the board ensures that at least 3V must appear before the circuit switches.

Prior to this the residual voltage was capable of leaving the modulator on during receive.

For anyone wishing to convert an AM to set to the HO MPT 1320 condition, the above conversions are acceptable to the HO and providing a Customs clearance form is filled in and the relevant fee paid a set infinitely superior to the majority of the so-called FM sets on the market today can be produced. It is easy to recognise a properly converted set since the audio quality is so superior to the normal 'muppet box'.

The discriminator shown can only operate at IF values up to 1.5MHz or so and a suitable circuit and board layout for a higher IF using a Plessey 6600 is shown in **Fig.14**. In this instance the use of tracking oscillator techniques gives a superb AM rejection and very good interference suppression since only frequency variations are recognised. By reducing the IF to 100kHz a good audio output level can be achieved.

The AM rejection of the discriminator normally used is very good and the only adjustment required is to adjust the core of the quad transformer for maximum readability on the FM signal. This automatically gives the best AM rejection. Final adjustments are to peak the RX front end to 29MHz and retune the TX stages to the new frequencies.

The only other consideration is the poor front end and early IF stages performance of the usual receiver. By changing the front end RF transistor for a more suitable type (choose one suitable for use up to 150MHz) with a slightly lower gain the cross modulation performance can be substantially improved. The normal ceramic 10.7MHz filter installed can also be changed for a crystal filter (costing from £3 — £6) with marked effect on adjacent channel performance. The crystal filters have centre frequencies of 10.695MHz. Appendix 1 shows the breakdown into types of most of the PLL devices commonly used. In some cases combinations of devices are used as in the Sharps series, where a divider is separate from the phase detector. In the Sharps (probably the best of the older CB sets) the mixing technique uses two 11MHz crystals for transmit and receive offset. When the count conversion is carried out by simply lifting the grounded 64 pin and putting it to logic 1 the frequency automatically moves up 640kHz. In order to bring the 4.75kHz required to meet MPT 1320 into operation, simply cut the track alongside each crystal and place a 27pF cap across the break. This shifts the crystals by about 4.75kHz.

The codes used in three different devices are shown in **Fig.15.** Only channels 1, 10, 20 and 40 are shown to illustrate the code sequences but the patterns should be obvious from the sequence shown.

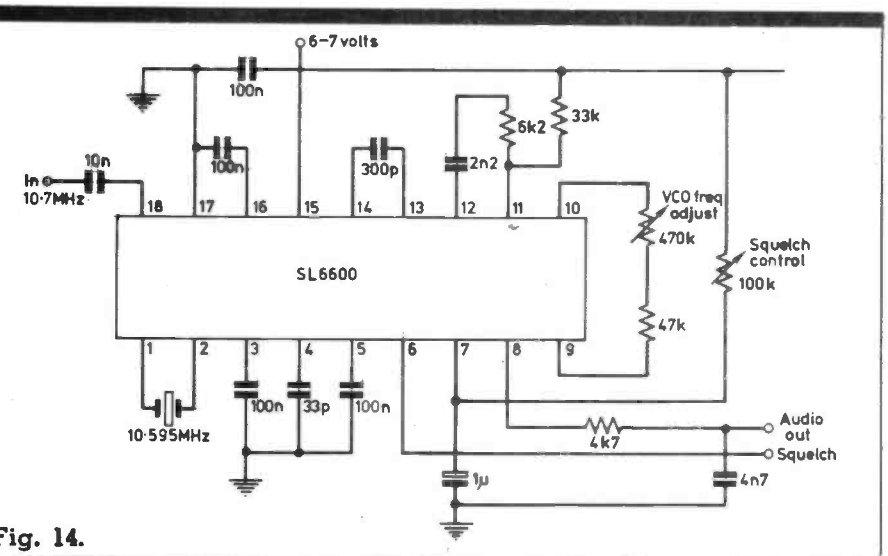


Fig. 14.

Device	2^n	→	64	32	16	8	4	2	1	
	Channel No	Code Sum	IC pin No							
			9	10	11	12	13	14	15	
PLL02A pins7&8 high	1	74	1	0	0	1	0	1	0	
	10	63	0	1	1	1	1	1	1	
	20	50	0	1	1	0	0	1	0	
	40	30	0	0	1	1	1	1	0	
			7 bit straight binary							
	Powers of 2^n		4	2	1	8	4	2	1	
	Pin No		13	14	15	2	3	4	5	
MSC42502 pin12 high	1	0·1	0	0	0	0	0	0	1	
	10	1·2	0	0	1	0	0	1	0	
	20	2·5	0	1	0	0	1	0	1	
	40	4·5	1	0	0	0	1	0	1	
			7 bit binary coded decimal							
	Powers of 2^n			2	1	8	4	2	1	
	Pin No			6	5	4	3	2	1	
LC7120	1	0·1		0	0	0	0	0	1	
	10	1·0		0	1	0	0	0	0	
	20	2·0		1	0	0	0	0	0	
	40	0·0		0	0	0	0	0	0	
			6 bit binary coded decimal							
	Powers of 2 not used in logical sequence									
	Pin No →		17	16	15	14	13	12	11	10
TC9109	1		1	1	1	1	1	1	1	1
	10		1	1	0	0	0	1	0	0
	20		1	0	1	0	0	1	0	0
	40		0	1	0	0	0	1	0	0
			8 bit random code							

Showing code distribution in different modes

Fig. 15. Powers of 2

And attempt has been made to bring about three objectives:

a) To stimulate interest in building something yourself at low cost.

b) To create activity on 29MHz before someone moves in because of lack of operation on the band.
c) To find a use of discarded CB sets now that new reforms are being introduced more stringently.

With minor variation the above techniques have been applied to SSB rigs in an effort to simulate mobile activity on 10 metre SSB.

Many CB aerials can be retuned to 28-29MHz with little difficulty and a host of reasonable test gear at very cheap prices is also available.

To date some 2 — 3000 conversions to 27MHz FM have been made to a variety of sets and basically the same technique applies to 29MHz.

Appendix 4

Binary Arithmetic

Binary arithmetic is an arrangement of numbers in ascending powers of two.

The standard arrangement is as shown in the table across the page (below).

Power of 2	0	1	2	3	4	5	6	7	8	9	10	11	12	2^n
Binary No.	1	2	4	8	16	32	64	128	256	512	1024	2028	4056	Code sum
Sample	0	1	0	1	1	1	0	0	1	1	0	0	0	826

As can be seen if each level could be selected and shown as being used by indicating as 1 whereas unused lines were indicated as 0 then any number between 0 and 8111* could be shown by using the above sequence. A typical arrangement showing a count of 826 is shown, ie the sum total of 512, 256, 32, 16, 8 and 2.

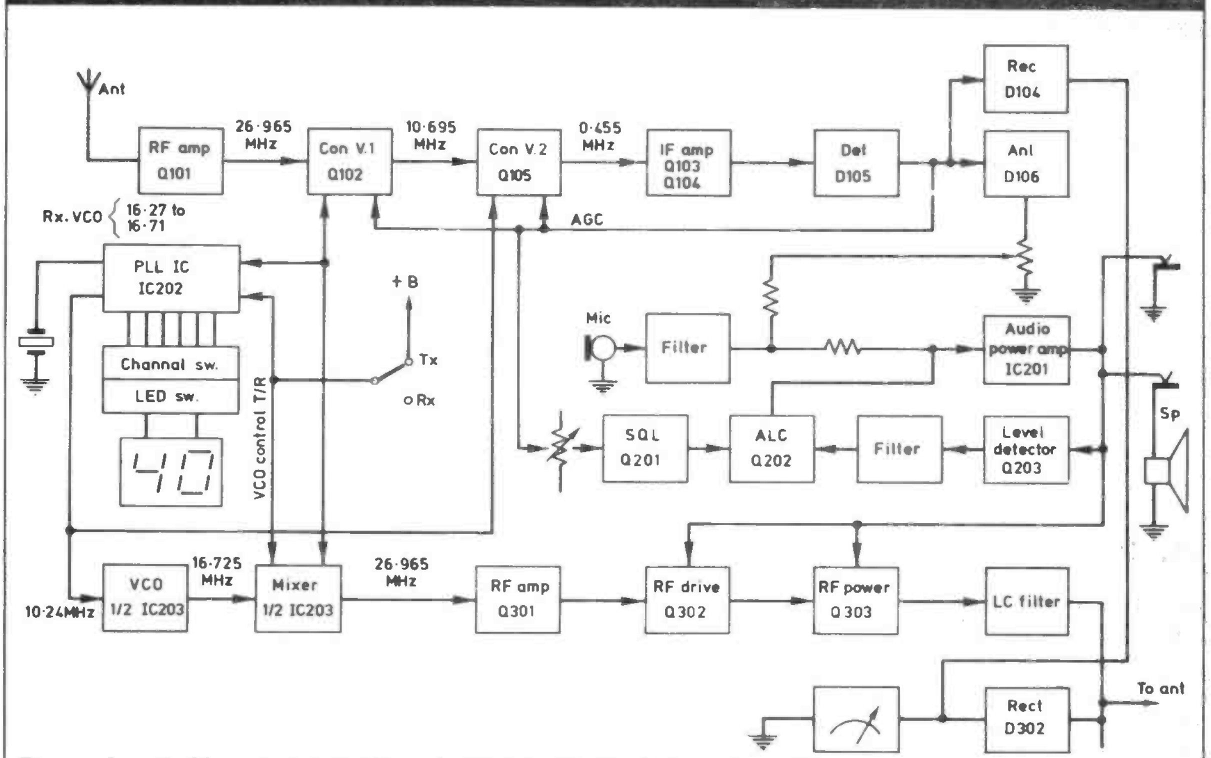
*8111 = sum of all values shown from 4056-1.

This system is known as straight binary. One other form is used in the systems discussed in the article ie. Binary Coded decimal or BCD. In this case only symbols up to 2^3 are used as number indicators, either two or three additional channels are used as decimal point indicators, and multipliers.

Appendix 1

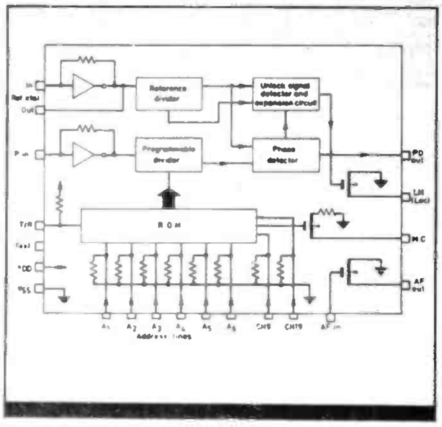
Codes Used in Various P.L.L. Devices

Binary Inputs	Binary in Internal ROM	BCD in BCD Code Convertor	Programme Inputs	Random Code
CC 13001	LC 7110	LC 7120	LC 7130	TC 9106P
CC 13002		UPD 861C	MSC 42502P	TC 9109P
LC 7113		UPD 2810C	UPD 858C	
MC 58472*		UPD 2812C		
MC 58473P		UPD 2814C	LC 7131	
MB 8719		UPD 2816C	LC 7135	
MB 8734		LC7137		
MC 145104				
MM 55104				
MM 55114		Require		Require
MM 55124		Synthesiser		Synthesiser
MN 6040 A		Replacement		Replacement
SM 5104				
MC 145106				
MM 55106				
MM 55116				
MM 55126				
MM 55108				
SM 5118				
MC 145107				
MM 55107				
SM 5107				
MC 14568				
MC 14526				
MC 145109				
PLL02A/AG				
SM 5109				
TC 9100P				
MSM 5807				
MSM 5907				
MDC 40013				
NIS 7261A				
NIS 7264B				
PLL01A				
PLL03A				
REC 86345				
TC 5080P				
TC 9102P				
TC 9103P				
PLL08A				



Appendix. 2. Showing circuit path of tranceiver chosen as sample

Power of 2		3	2	1	3	2	1	0	2^n
Binary No.	Code sums	4	2	1	8	4	2	1	Code sum
Sample	0.6	0	0	0	0	1	1	0	6
numbers	1.6	0	0	1	0	1	1	016	
shown	2.6	0	1	0	0	1	1	0	26
	3.6	0	1	1	0	1	1	0	36
	4.6	1	0	0	0	1	1	0	46



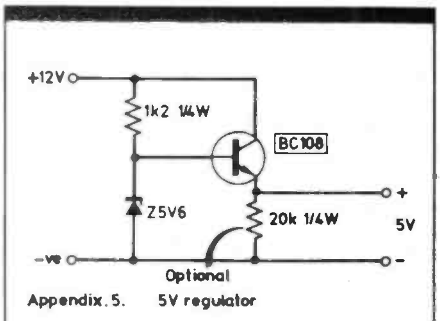
Appendix 3. Basic block diagram of dedicated device.

The BCD format shown is a 7 bit code but obviously by using two columns only in the left hand group* a 6 bit code counting 0-1, 10-19, 20-29, and 30-39 could be used ie a total of 40 lines using 0 as a signal line ie absence of all signals or a No.

Many other forms of binary code are in use but the ones shown are most commonly used. The so-called Random Code is a selective code used in certain devices only as a signalling technique rather than a significator technique and is actually only semi random.

From the above it is apparent that signalling is either by an on or off situation and can be effected by simple switching techniques. This is the principle by which the programmed instructions are issued to the phase lock loop devices.

For similicity of explanation the first table above is shown as reading left to right. It is more conventional to present the table reading right to left as shown in the second table and in **Fig. 15.**



Appendix 5. 5V regulator

Taking to the AIR

by Keith Townsend G4PZA

They say that history repeats itself. It certainly did so in my case with what, to me, were surprising results. About fifteen years ago I was introduced to a guy with a peculiar hobby. He spent all his spare time and a not inconsiderable amount of his spare cash in talking to people. Not merely to the neighbours. Not even just to those he knew. Oh no! This guy delighted in talking to strangers. Not merely to the strangers he met in the street but to strangers all over the world. His explanation that he was a radio 'ham' having produced instant mental images of the late, great Tony Hancock, I was greatly intrigued to learn more of the rites and mysteries practised by the devotees of this strange cult.

Taking the plunge

The result of this gentleman's best efforts was that one bright May evening found me lining up with about a hundred other hopefuls, prepared to do battle with the evil genie from the City and Guilds. having sailed merrily through part one, Welsh caravans and all, I sat down to part two, happy in the belief that I could cope easily with almost anything which my inquisitors might dream up . . . A belief which grew even stronger as I realised that I was able to answer the first few questions at a glance.

My balloon burst with one hell of a bang! Suddenly, from about question seven I was faced with a long string of questions which appeared either ambiguous or impossible and which had me groping for the right answers. in a state of advanced shock I even attempted to discover the total resistance in a parallel circuit by adding together the individual component values. Somewhat dazed, I emerged from the exam room at the appointed hour and lost no time in joining a number of fellow sufferers in a headlong dash for the nearest tavern in a vain attempt to wash away the memories of the last few hours.

Even worse

Worse was to come. Undaunted by his efforts to impart a basic understanding of radio theory and far more confident of my success than I felt, my erstwhile instructor conned me into accepting yet another challenge. Exhibiting considerably more confidence than I really felt, I accepted his assurances and embarked upon the task of learning Morse before the exam results were published. Again to my surprise his abilities matched his belief and my pleasure knew no bounds when, within a few days of learning that I was indeed entitled to apply for an amateur's licence I received a Morse test pass slip.

Besotted with my new-found power, I decided to spend a few quid, then, armed with my all singing, all dancing, FT480R I discovered the next pitfall. It seems that the Home Office did not share my eagerness for the world to hear my dulcet tones, with the result that a very frustrating ten weeks were to pass before my ambitions were realised. Ten weeks during which I and many of my former classmates were to develop an entirely new disease which affected the muscles in the thumb whenever it was placed within touching distance of a microphone. All in all I reckon that I spent more time in waiting for the results and then the licence than I did in studying to become a radio amateur.

At long last it happened. I arrived home one lunchtime to find my new licence waiting for me. In the ensuing confusion it took me a good five minutes to find the callsign, which I then repeated silently to myself a few hundred times, just to make sure that it came out right on the air. Since I spend most of the working day in my car I had fitted the rig to it long ago so, lunch forgotten, I returned to the car, plugged in the mike and made my first, very hesitant call. Utter silence! Either the band was deserted during the lunch hour, (was there any thing in the licence conditions to this effect?) or these amateurs were a damned unfriendly bunch. My second and third attempts having met with an equal lack of response I returned, disappointed, to a now cold lunch.

First contact

Fed and rested, I decided to give it one more try before deciding whether to sell the whole issue and buy an exercise bike. Whether I was more cautious this time, or simply less eager I don't know. Anyway I decided to check over the rig before keying the mike. There, right in front of me, was the cause of my earlier disappointment. In the midst of my self-congratulation I had left the damned repeater offset in. Having rectified this error, which I freely admit to having repeated on a few occasions since, I soon found myself in conversation with two fellow novices and we were all delighted by the friendly reception and encouragement which we received for a few older hands during the course of our chat. Probably the strongest single impression I have gained during my first few weeks on the air is of the strong cameraderie which exists among radio amateurs and the lengths to which they will go to extend a warm welcome to a newcomer.

The next task was to construct and erect a suitable antenna system for use at home. Armed with what seemed like miles of aluminium tubing, a rotator and an odd assortment of tools it was not long before I was finally in a position to attempt something more ambitious than the mobile contacts which were all that my log contained up to now.

A quick CQ call on two metre sideband met with instant response. At last I had my first real opportunity to work DX as all the LEDs began to dance at once and a voice came blasting through the speaker. If you regard two miles as DX then maybe I had achieved my objective. Undaunted, I tried again. This time the result was far more encouraging and I found myself in conversation with an experienced sidebander over a hundred miles away. What's more I did so without the half-expected howls of protest from the XYL, watching the box in the next room.

HF near disaster

My first visit to the HF bands was a near disaster. Hearing a Russian station calling CQ on ten metres I waited for a pause then eagerly attempted to answer his call. So nervous was I and so anxious to pronounce both of our callsigns accurately, that it took me a few moments to realise that, despite the pressure of my thumb on the PTT, my Russian had begun calling CQ yet again and what was more I could clearly hear him.

A quick dash for the soldering iron and we were soon back in business, faulty microphone lead reconnected just in time for a further break in transmission from the UK7 station. My answering call was returned immediately, accompanied by an irate delegation of avid commercial watchers from the front room. Promising to look into the TVI as soon as my contact was finished I called my Russian again. Within seconds of his coming back to me the entire ten metre band fell flatter than my chances of winning the pools. I can only assume that the KGB did not want an innocent comrade to be corrupted by talking to a trouble-maker like me.

"... don't you think it would help, dear, to switch it out of repeater shift"

At this stage I had not attempted to use CW on the air, though, like a number of my colleagues I had continued to attend the local Morse classes in the hope of increasing both my speed and confidence. It rather surprised me to learn that I was not alone in my reticence to appear on the key for real and so a small group of us decided to try a few short QSOs among ourselves. it is one thing to read and send simple messages in plain language and quite another to understand the shorthand of the airwaves, so we kept our messages short and simple to begin with, venturing into more detail only as our confidence begain to grow. These simple experiments were perhaps the most valuable form of self-instruction we could have devised and certainly did a great deal to ensure that when we finally took our courage into our own hands and joined the rest of the CW fans we would not simply clutter up the bands with a load of unintelligible rubbish. it is a method which I would recommend to anyone interested in CW, perhaps the most rewarding of all modes of transmission. To those who see the Morse test as some kind of hurdle I offer the observation that it is far easier to pass than you might think. Nobody could be less certain of their abilities than was I when I arrived at the test centre, only to find yet again clear evidence of the genuine friendship which exists among radio amateurs. Those conducting the tests do everything in their power to create a friendly, relaxed atmosphere, in which the test is far less of an ordeal than I had imagined possible.

Repeaters are not really my scene though, since I use the roads a lot I have made use of them on a few occasions. A trip into the heart of London brought me considerable amusement, as the inhabitants of GB3WL guided me through unfamiliar streets, ably assisted by one or two squeakies who, upon hearing that I needed some assistance, promptly stood aside until I reached my destination. They even had the cheek to ask 'Ave yer dun?' as I signed. My thanks go out to all concerned.

One of my rare visits to my local repeater, GB3BM, in search of a friend who could not be located on S20, found me talking briefly to a Dutch station. Though this is certainly not what repeaters are all about, I was very pleased by the occurence, since at the time I had spoken to nobody outside my own town, much less overseas.

First impressions

So what are my first impressions after only a few weeks as an amateur? Frankly, I reckon I wasted fifteen years. I should have become an amateur at my first encounter with the hobby. I have not yet fully grasped the range and the scope which my licence has put at my disposal and each attempt to use a new mode of transmission brings its own fascination. I have yet to try either RTTY or ATV but I see amateur radio as a hobby which I can develop over the next thirty years. My station will develop as my finances permit and as my knowledge increases.

RADIO YESTERDAY

There was a time when they were all two-letter callsigns

TWO-LETTER CALLSIGNS ON THE TARMAC

By Jack Hum G5UM

One of the famed two-letter callsigns of the Nineteen Twenties was 2FG, that of the late Leslie McMichael, founder of the firm bearing his name. This historic 53-year old picture (it sums up the sartorial elegance of the age) shows 2FG fourth from right. Fourth from left is the McMichael sales manager, the late Gus Allen, whose callsign G8IG was famed throughout the DX corners of the world. The photograph was taken on Boat Race Day, 1930, on the concrete apron at Croydon Aerodrome (the new fangled term 'airport' was barely known this side of the Atlantic in those days). As an enterprising publicity man G8IG would hire an Imperial Airways 'Argosy' aircraft every Boat Race Day and fill it with radio trade notabilities and pressmen generally, plus a selection of McMichael portable 'wireless sets' to enable all on board to hear the BBC Boat Race commentary while they were skyborne over the Thames, at the same time watching the progress of the University boats below them. The wood-and-canvas airliner chartered on such occasions can just be seen in the background.

"Is that yet another of them?". Wife Grace's voice came wafting up the stairway. In her kitchen below the radio room she hears through the floorboards much of what goes on during the G5UM operating sessions.

It was indeed "another one of them", probably the sixth that week, who was mystified by the two-letter callsign which was calling him.

"Go on, tell him you're not a foreign body!" came the voice up the stairway with a light chuckle. Upon which G5UM turned the transmission back to the person waiting at the other end of the 2m link and patiently explained that, yes, there *were* only two letters after the numeral, and that, no, it wasn't a visitor's licence: the reciprocal had three letters after the numeral, not two. Did not the person at the other end have a Callbook in the house? No, he did not, clearly one of many hundreds of new licence holders who had still to learn that The Callbook is perhaps the second most important document in a metrewave man's kit after his logbook.

Politely the distant communicator replied that he had thought about getting a callbook when his own callsign was likely to appear in it (inviting the riposte, hastily smothered, that it's not *your* callsign you want to look up: it's the other party's, all several thousand of them).

"Oh, well, when you do get yourself a callbook you will find that there are still a few G-Five-plus-twos listed in it (not to forget a few G-Six and G-Eights who are not Class B licensees) plus quite a few

G-Twos, G-Threes and G-Fours, all with two letters after their respective numerals".

The story in more detail would have taken the better part of an hour to explain to Polite Communicator on Two. If there *had* been time and fewer operators clamouring to use the frequency on which all this was going on (or if Polite Communicator had had 433MHz where more time and space exist) the story would have gone something like this:

At the very dawn of amateur radio in Britain the few hundred enthusiasts playing dangerously with spark-gap transmitters and less dangerously with crystal receivers used three-letter callsigns which were often self-assigned. After World War 1 when amateur radio enjoyed a second dawn the allocation of callsigns was put on to a more systematic basis. From the Twenties onwards British callsigns consisted of a numeral plus two letters, eg, 2LO, 5XX or 6BM (the 'Twos', the 'Fives' and the 'Sixes' were issued completely at random). This process was expected to yield almost two thousand callsigns, which in the view of the Licensing Authority would last into the indeterminate future.

How wrong they were became evident from the fact that within 16 years nearly all of the G2-plus-two, 5-plus-2 and 6-plus-2 assignments had been exhausted. The next callsign block to be issued — and this was in 1936 — was the G8-plus-2 — not a Class B licence: that particular concept was still 28 years into the future and World War 2 was yet to intervene.

Back then in the mid Thirties even the G8-plus-two series was to become rapidly completed for the good reason that radio communication technology was by then truly forging ahead, inter-Continental contacts were common — and there were even people using the esoteric metre-wavelengths with the aid of self-excited oscillators and super-regen receivers! It was even rumoured that television was coming along. And so as the G8-plus-twos ran out the G3-plus-two series was initiated followed soon by the G4-plus-two, a callsign block never completed: the start of World War 2 cut it short.

Holders of the earlier 2, 5 and 6 permits (yes, it was a Permit in those days, not a Licence) were not allowed to use the national prefix of 'G' except by express authority from on high, and then only if they stated that they proposed to use wavelengths capable of reaching outside the home country. Gradually, this restriction was eased. Stations in England were allowed to use their national prefix of 'G' and in Northern Ireland 'GI'. For some obscure reason Scotland initially used 'GC', possibly for 'Caledonia'. All other components of the United Kingdom were expected to use 'G'; it was not until much later that today's variants of GW, GD et al were to be heard.

Readers with long memories will have detected some significance in the callsigns of 2LO, 5XX and 6BM quoted above: they belonged to the BBC, who until the British Broadcasting Company became the 'Corporation' in 1927 were assigned amateur-style 'idents'. Very few of these have been reallocated to private radio amateurs. An illustrious exception is 5XX, the callsign of the mid-Twenties radiated by 'Daventry long wave' and today finding new expression as G5XX, the callsign of the Daventry Ariel Radio Club.

No national prefix of 'G' on this early QSL card used by G5UM (strictly 5UM) from his original location in north London, where gas mains were the rule, electric power came much later, and your HT power source was a string of dry batteries. You went off the air while your LT power source, a 2V accumulator, was away at the local garage to be charged.

Echoes from the past

Many other callsigns of yester-decade are tending to find new leases of life, often in a collective identity with radio clubs: G2XV, the callsign of a famous Cambridge pioneer of the Twenties, Gerald Jeapes, now belongs to the Cambridge club, and G6CW, once owned by the late John Curnow, has been taken up by his local club in Nottingham.

Another NottingHAM who has revivified an old callsign is Mike Mansfield, who upon passing his Morse test relinquished his identity of G8RXU and took up his grandfather's callsign, G2SP. Down in Hertfordshire much the same thing happened when G2PA reappeared two generations after the noted pioneer components firm of G.Z. Auckland & Co originally 'aired' it from their City of London premises back in the Twenties — and G2PA is still an Auckland.

There is a sprinkling of others. Their numbers will increase as old-timers quit the callbooks and their descendants pick up their two-letter callsigns to breathe new life into them once more. ●

Taking apart the

FT 101

Part 2

Troubleshooting and repair

by Harry Leeming G3LLL

Dismantling the FT101

Some circuit boards and parts are easily accessible once the lid and bottom covers have been removed. When servicing in the more difficult to get at sections, it is not worth struggling and risking doing damage, as it is very easy to remove the complete cabinet. To do this, proceed as follows:

1. Completely disconnect the *FT101* from the mains, aerial and all other equipment and place on bench in an inverted position.
2. Remove bottom cover and release hexagonal screws and two star-headed screws (four at the front and one at the rear) holding cabinet in place.
4. Gently slide cabinet off over rear of *FT101* ensuring that the lid catches do not foul the audio board or the metalic labels identifying this board's preset controls.

Faults and modifications

Mains fuse blows. If a replacement 3 amp fuse fails do not fit a larger one: there is a fault. The most likely cause of mains fuse failure is a short circuit in the HT rectifiers, and these should be checked with an ohm meter. A suitable replacement is the BY127 television type HT rectifier, and it is advisable to replace all eight rectifiers in the HT bridge even if only a couple are faulty. Note that early *FT101 Mk 1s* used only four HT rectifiers, but for reliability these should be replaced with eight rectifiers fitted with the 470k equalising resistors as in Fig. 1.

Set works on receive, but won't transmit, or vice versa. A common cause of this is that the junior operator has had his fingers on and has left the INT/EX/CH switch in the wrong position. Many *FT101s* have been returned for this.

No transmit, no PA current, receive OK. Check that power amplifier valve heaters are lit. The 11-pin plug at the rear must be fitted and must have a link between pins one and two before the power amplifier stage will function.

No SSB transmit, three or more S-points down on receive, final amplifier resting current OK at 50 to 60 mA. CW and tune gives full output. This fault is occasionally caused by Q1 on the IF board having blown. You can replace this FET with almost any RF FET such as the MPF102, provided that you get the pin connections correct.

Any weird fault, particularly if intermittent. High resistance contacts on the plug-in circuit boards can cause some very odd effects. Standard service procedure is to remove the plug-in circuit boards, squirt the contacts with contact cleaner, and plug them in and out half a dozen times to clean the connections.

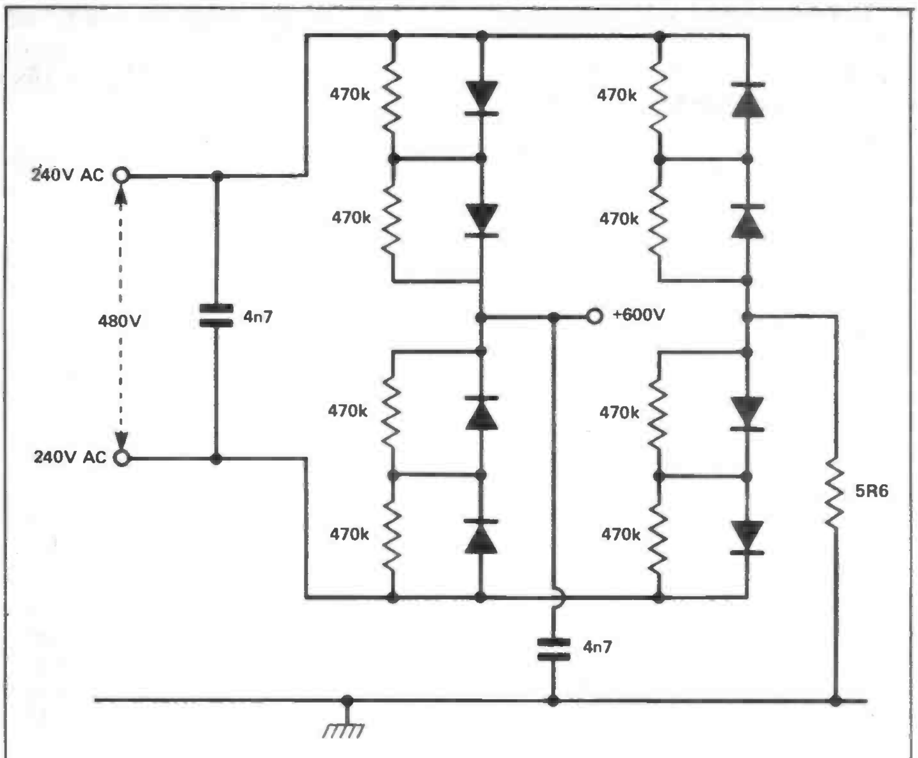


Fig. 1. HT rectifier circuit in most FT101s

Fuse blowing but HT rectifiers OK. Try operating the rig with the power amplifier valves removed. If all is OK, leave the valves out and measure the bias voltage at the grid connection of the power amplifier valves. This should be about −50V on transmit or −65V on recieve. Turn the band change switch and if the voltage falls below this, or even goes positive on any band, replace the relevant coupling capacitor from the anode of the driver valve. Note that a coupling capacitor of 80 or 100pF goes direct to the anode, whilst other capacitors are switched in parallel with this on 160m and 80m in some models. A short circuit here will have ruined the PA valves so once this fault has been cleared it will be necessary to fit new ones.

Fuse still blows, but PA and HT rectifiers OK. Sometimes the DC/DC inverter ('chopper') transistors go short circuit even if the rig is never used on a 12V supply, and cause fuse blowing. The *FT101* will work perfectly on an AC supply with the chopper transistors disconnected, hence the easiest way to test these is to disconnect them and try a new fuse. If these transistors are faulty, the cost of replacement is in the region of £20 to £40 a pair. If you do not anticipate DC operation simply remove them.

Fuse still blows! If all the suggested tests come to nothing try operating the *FT101* from a 24V AC supply. At such a low voltage even a bad short is unlikely to blow the fuse and every output of the rig's power supply should give one tenth of its rated voltage. Find the power supply output that is less than this and you are in with a fighting chance of discovering the cause.

ALC faults

Valves operating in class AB1 do not pass grid current until they are slightly overdriven. In the *FT101* any grid current caused by overdriving is rectified and fed back as a negative ALC voltage, rather like automatic gain control on a receiver, and so turns down the gain of a previous stage. In practice *slightly* over-driving a class AB1 amplifier does not do any harm and this system is used in much amateur equipment and works well.

No ALC indications. This is almost always a result of low drive to the power amplifier valves, and is commonly caused by an aging driver valve or misalignment.

ALC too active on one or more bands on some FT101's. The trouble here is usually caused by the radio frequency choke L12 picking up RF from the PA coil. The simple cure is to replace the choke with a 2.2K resistor. Only a limited number of *FT101Es* used this extra choke L12. Later *FT101Es* reverted back to the original circuit, see **Fig. 2.**

No transmit, ALC meter 'pings' hard over and is not adjustable. This fault is caused by a short circuit ALC transistor (Q1 on mod and oscillator board *FT101 Mk1, Mk2, B, EE, EX* and *E Mark 1;* or Q6 on processor on *FT101 Mk2* and *Mk3*). This fault may have been caused by a flashing PA valve or a leaky ALC coupling capacitor. As a replacement FET, an MPF102 will do if you get the connections right, or you can fit the 'spare' FET in the fix oscillator circuit which you are unlikely to use.

Set intermittently dead on one band, often 15m. This fault is usually caused by the first conversion crystal oscillator refusing to start. Slightly adjusting the relevant trimmer (see manual 'heterodyne crystal oscillator alignment') will usually bring it back to life again. The manual suggests adjusting using a

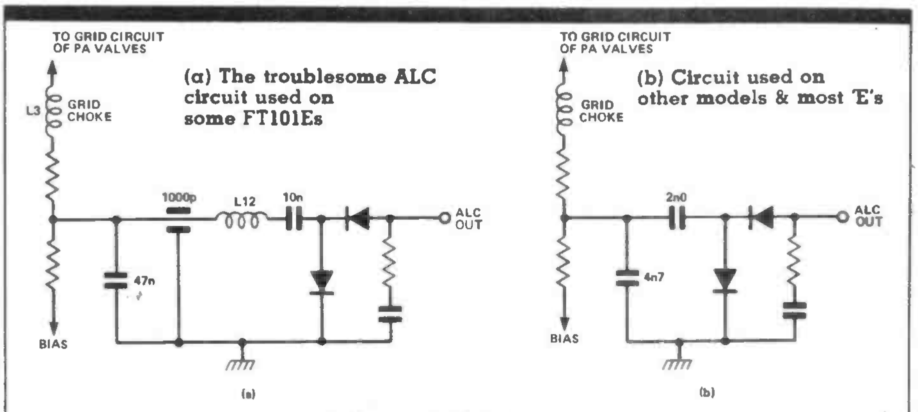


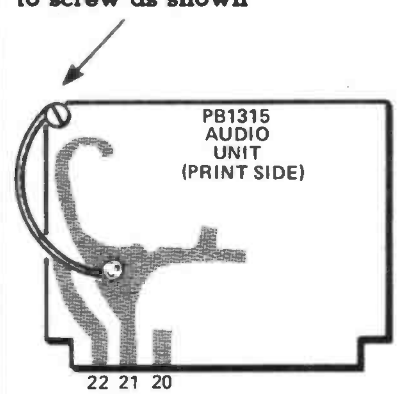
Fig. 2 ALC Circuits

diode probe volt meter, but in practice turning the trimmer the minimum amount needed to give reliable operation of the oscillator is all that is required.

Receive signals and calibrator very weak but sounds lively and transmits OK. This fault usually indicates that Q1 on the RF board has blown. It can be replaced with an RCA 40673 or 3N201 etc. If the replacement blows suspect that the 12BY7A driver valve is flashing over and damaging it.

Receive audio quality slightly below par — a bit 'gritty' FT101B Mk2 — FT101E. If you suspect the receive audio quality, try adding an extra earth wire to the audio IC as shown in **Fig. 3.** If there is an immediate improvement leave this wire in position.

Fig. 3 'Gritty' audio: add extra earth wire from printed circuit to screw as shown



Preselector peaks at different points on receive and transmit. This could be an alignment fault, but it also occurs if the wrong make of 12BY7A driver valve is fitted. Use a Toshiba or an NEC valve in this stage.

Drive slightly low on 10 and 15m even with new valves and after full alignment. This fault sometimes happens when the original Toshiba valves have been replaced by NEC, as these usually give a fraction less gain. Replace R22 in the RF unit (was 56 ohms) with a 22 ohm resistor. This modification is introduced by Yaesu in the last production batch of *FT101Es*. A little extra drive can also be obtained by turning VR1 on the RF unit the *minimum* amount that is needed to produce maximum output.

Transmit and receive frequencies not coinciding. This is a simple alignment problem. Set VFO in approximately mid-position and connect a general coverage receiver to a short length of aerial wire, and poke its *insulated* end through the centre of the eight pin VFO socket on the rear of the *FT101*. Tune the general coverage receiver around 9MHz and you will pick up the VFO of the *FT101*. Adjust the position of the length of pick up wire until the signal is about S9, and in the CW or SSB position of the general coverage receiver tune in a steady beat note. With the heaters of the *FT101 switched off* wait until things stabilise and any drift stops, and with the clarifier in the off position switch from PTT to MOX and the beat note should not change. If the note does change adjust the zero control on the regulator board until the note is the same on transmit as it is on receive. When this has been achieved switch the *FT101* to receive and adjust the preset control mounted at the rear of the clarifier underneath the chassis until the note is the same with the clarifier off as it is in the central position. These adjustments should be repeated until the note does not change with the rig switched to transmit or recieve, with the clarifier on or off.

Main tuning very lumpy or **loose.** The main gear box seldom gives trouble but the 6/1 epicyclic drive does wear or dry out after considerable use. This bit of the *FT101* is available quite cheaply, as (believe it or not) it is made for Yaesu in the UK. Whilst no doubt it could be cleaned and regreased it is much less trouble to swop it. Lay the set on its rear with the tuning knob pointed vertically and the bottom cover removed. Once the main tuning knob has been removed, how to remove the drive is self evident, but note the order of the various washers as you remove them. Otherwise, putting it back together again might not be as simple! While you are at it put a little grease or oil on the gears in the main gear box.

VOX operation — all models. The VOX has a tendency to 'hang on', especially if you talk too long without a breath! Much less critical operation will result if D3 and D1 are shunted with resistors of about 2 or 3 Megohms and C21 (in the Mk1 or C23 in the Mk2 or MkB) is shunted with an additional capacitor of about 100 or 200nF and the controls are reset.

Reduction in receive gain when operating mobile with low battery voltage FT101 Mk1. This is caused by the voltage on the low-frequency IF unit varying. To cure this defect, operate the *FT101* from a mains supply, tune in to the crystal calibrator, and note the S-meter reading. Disconnect the unit from the mains and connect an 11-volt Zener diode in parallel with C36 (this will be found at the top left-hand corner of the circuit on page 15 of *FT101 Mk1* manual. When the Zener diode has been fitted, connect the unit to the mains and note that the S-meter reading will have fallen. The gain can now be brought to normal by adjusting the value of R15 in the base bias circuit of Q2. Usually about 4.3k is correct, but the exact value will depend on the characteristics of the transistors. Once this modification has been carried out, the gain of the receiver will be much less affected by variation of battery voltage.

RF gain only works through one third of rotation. This effect is common and many hams have ordered new RF gain potentiometers only to find that no improvement ensues. The problem is one of compatibility between the RF/FET/Q1 on the RF board and the IC and transistor fitted in the IF amplifier. If the effect worries you try a few different 40673s or 3N201s as replacements for Q1;

No signals on receive but crystal calibrator at normal strength — FT101 Mk2 FT101E. This fault indicates a blown aerial protection lamp. This is mounted under a plastic cover adjacent to the aerial socket. A pilot lamp can be used as an emergency replacement here.

Intermittent non-operation of fan and transmit function on DC supply particularly when cold FT101 Mk2E. This is caused by the chopper/inverter transistors refusing to oscillate due to lack of gain. The cheap cure is to reduce the value of R3 to about 100 ohms.

Faulty heater switch. Intermittent operation of the heater supply is usually due to high resistance contacts on the heater switch. This switch is a double pole type, one pole for switching the sidetone oscillator on and off, the other pole switching the heater supply. A quick cure here is to clean the switch and swop the wires over as the slightly faulty contacts will usually handle the sidetone oscillator, and the original sidetone contacts will be as good as new.

Plugging phones in does not cut out speaker. This is usually caused by the use of the wrong type of jack plug. Stereo jack plugs or 'Post Office' types with small tips are not suitable, round tipped mono plugs being the order of the day. If this does not cure the trouble note that quite a few *FT101's* seem to have escaped with the phone jack socket wrongly wired, so if the internal speaker still does not cut out, consult **Fig. 4** and rewire if necessary.

Plenty of PA current but poor PA dip and RF output low. The causes of this effect can be many and have included a faulty 600V feed choke, faulty pi-tank coupling capacitor, or a blob of solder on the PA coil.

Oscillation or distortion as mike gain advanced at some frequencies on the 160m band. The trouble here is that the RF choke on the patch input socket is resonant. This can either be disconnected entirely if the socket is not used, or the choke can be replaced by one with a ferrite core. This fault seems to mainly occur on *FT101B's,* and probably later units are already fitted with a different choke.

Workshop manual. A very good operating and maintenance manual is supplied with the *FT101.* These notes — whilst it is hoped they will be of general interest — presume that this is available. Owners wishing to delve further into their rigs might like to know that a full workshop manual is also available via Yaesu dealers.

Safety. The on/off switch is a single pole type and does not isolate the *FT101* from the mains supply. You must therefore remove the mains plug from the wall socket before attempting service work. The *FT101* contains large capacitors and high voltages. Some points such as the top caps of the power amplifier valves remain live at 700V for some considerable time after the set has been switched off. *Never* touch any point in the PA cage without first shorting the top caps of the PA valves to chassis (leave the rig to stand for 1 minute after disconnecting mains supply before doing this, or use a resistor of a few hundred ohms to avoid an excessive discharge current.)

Fuses. The fuse should be a 3 amp quick blow type for use on 220/240 volt supplies.

Swopping the pilot lamps. Several owners have damaged their *FT101* by causing a short circuit when replacing the pilot lamps. These are run from the rectified DC supply, and a short circuit will burn out the rectifiers in the power supply. Do not try and swop them when the rig is switched on, or fit them wrongly so that the wire shorts to the chassis. Equipment which has been imported by the approved importer is normally stamped on the rear "234V". Many unofficial imports, and some *Sommerkamp* equipment is set on 220V and should be rewired as per the instructions in the manual. Operation at UK mains voltages on the 220 volt setting will considerably reduce the life of components in the *FT101.*

Valves. The *FT101* is designed to function with Japanese valves and NEC or Toshiba are recommended by Yaesu. Some other brands will give poor results, refuse to neutralise, or even oscillate in the receive mode and cause damage.

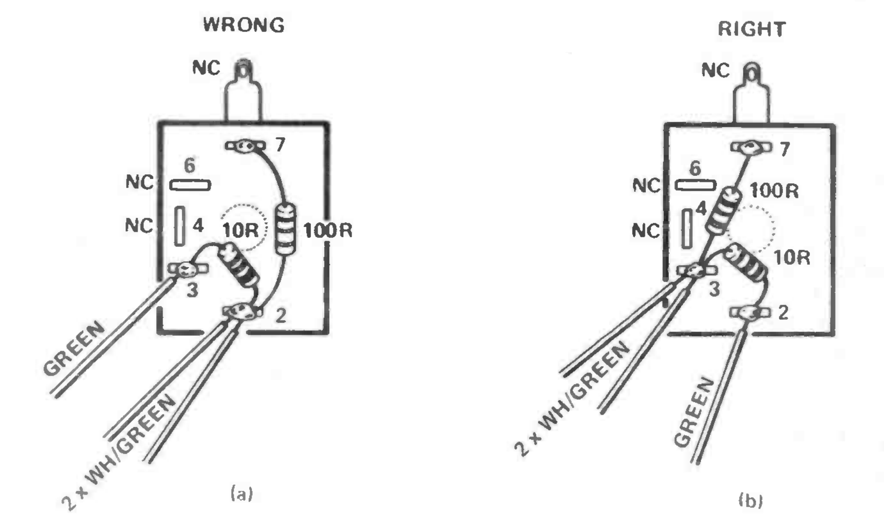


Fig. 4 rear view of headphone jack socket

Test generator. Pull the aerial out of the *FT101*, switch on the crystal calibrator and note the maximum reading which can be obtained with the pre-selector peaked, and set tuned to 14.2MHz. This should normally be between S9 and S9+20dB. Keep a note of this reading as it will be a most valuable guide when later making comparisons if there is any doubt as to whether or not the receiver is up to scratch.

Field effect transistors. The *FT101* contains a fair quantity of field effect transistors which can very easily be damaged by heat or voltage. Plugging the *FT101* into the mains supply — whether switched on or not — will usually guarantee a potential difference between the tip of your soldering iron and the circuitry. Touch the soldering iron on certain points and the nearest FET has gone for the chop! Your only safe way to solder on the *FT101* is to completely detatch it from the mains, aerial, earth, and any other equipment, and then to use an iron which is earthed to the chassis of the *FT101*. Familiarity with the normal bipolar transistors can lead one to become careless, but heat shunts really are essential when soldering FETs. A piece of cotton wool soaked in water provides ideal heat and static protection if stuffed between the four legs of MOSFETs when soldering. An elastic band and a pair of snipe nosed pliers provide a third hand and a heat shunt when working on the three legged variety of FET.

Harry Leeming asks us to point out that while he is happy to answer brief queries on the FT101 series, correspondence must contain a stamped, addressed envelope to obtain a reply.
Harry Leeming will be covering modifications in future articles. Alignment and fitting 10, 18 & 24 MHz will be covered, together with AGC and modifications and other receiver and transmitter improvements. But what about you?

'Bright ideas' and servicing experiences should be shared around so let us know what you have done with your FT101 — please type (or print CLEARLY) and send your contributions to the editor for possible inclusion in part 4 of the series. The best contribution will receive 12 months' subscription to Ham Radio Today.

NB In our April issue (p.21) the paragraph beginning "1976 FT101 Mark 2" should have been "1976 FT101E Mark 2".

G Line for the Gigahertz Men

By Andy Emmerson G8PTH

Ask your friends at the local club what G-line or G-string is and you'll probably get a bemused grin followed by a blank stare. Yet G-line (named after its 'inventor' Gobau) is a remarkable form of RF feeder which uses a single wire for transmission. What's more, it offers very low loss at UHF, comparable with the best hardline feeder. For all this, G-line has never found much favour and this article is an attempt to clear away some of the mystery surrounding Gobau's brainchild.

Finding information on G-line is not an easy task. My first encounter with it was in the October 1965 issue of *Practical Television*, which contained a description of the amateur TV station G6CTS/T located at Norwood Technical College, south London. This station was conceived back in 1947 by the Engineering Group of the Royal Television Society as an experimental station for UHF TV. A few years later it went on the air (vision frequncy was 427 MHz — those were the days of a 70cm band 30MHz wide!), and provided test transmissions with vision and sound for the London area. Two students at the college were involved with a research project relating to the transmission characteristics of surface wave feeders. This surface wave feeder was G-line, and photographs accompanying the article showed the G-line feeding the 70cm aerials and some strange looking cones. No further details were given, and it took me a while to track down more information.

An article by K6LK in the June 1974 issue of QST (the USA equivalent of *Radcom*) and some notes in microwave textbooks subsequently supplied the missing data, and fact turned out to be stranger than fiction. A bare metal wire may act as a waveguide for propagating electromagnetic waves, with losses smaller than most grades of coaxial cable. Virtually no radiation occurs from the wire and well-nigh all the energy is carried in a circular field close to the wire. Cone shaped launching and receiving devices are used to match the G-line to conventional coaxial feeder, with the result that G-line can be used for long runs, reserving the use of coax for the more complex connections at the transceiver and aerial ends.

No doubt this sounds like science fiction to some readers and while it is not, it must be admitted that there are some snags which restrict the utility of G-line. The line must be kept fairly straight, otherwise radiation will be lost at bends. G-line must be kept clear of metallic objects and standing waves are a serious problem. Nonetheless, workers who persevered have had success with G-line and after I have disposed of the theory I'll give some practical dimensions and details. Gobau, who popularised G-line, showed that for a bare copper wire of 2mm diameter stretched in air and excited at 3000MHz the attenuation was a mere 0.023dB per metre, and the extent of the field was such that 75 per cent of the transmitted energy was conveyed within a circle 36cm in diameter around the wire. A demonstration system is shown in **Fig. 1.** The inner conductor of the coax is joined to the G-line while the outer conductor is soldered to the launching horn. The angle of flare must be kept small to keep undesired transmission modes to a minimum. Calculated results are given in **Fig. 2** and in experiments the measured total loss has compared well with the calculated values.

George Hatherell, K6LK, made his experiments at 1296MHz with a number of types of wire. An acceptable compromise was with a 100 ft length of 14 SWG wire, which gave the following results:

Enamel coated wire . . . . loss 3.87dB
Ditto sleeved with Teflon loss 2,53dB
Plastic insulated household
wire (white) . . . . loss 3.62dB
Ditto (black) . . . . loss 3.87dB

Transmitted power was 10 watts. While these results were encouraging, subsequent 'souping up' of the system brought the total loss of the G-line and launchers and receivers to well under 2dB. His article gives all the constructional details of the launching and collecting horns and his method of suspending the G-line from tightly stretched monofilament fishing line.

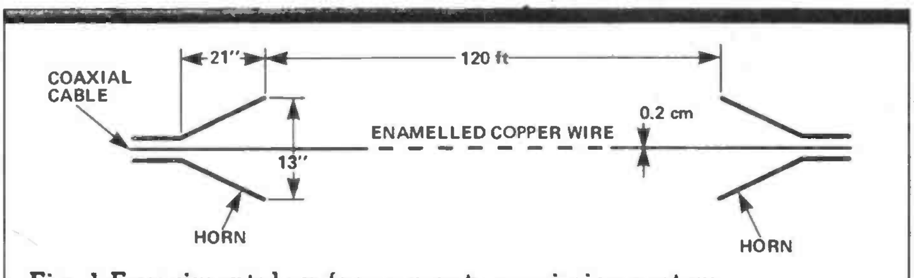


Fig. 1 Experimental surface-wave transmission system

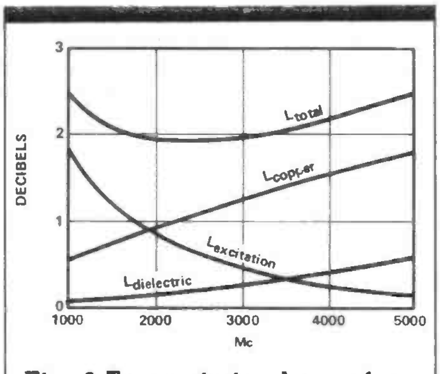


Fig. 2 Transmission losses for the 120-foot surface-wave guide shown in Fig. 1

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South Midlands

SMC YOUR SINGLE STOP SOURCE FOR RECEIVERS,

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* 12 Channel memory option with fine tune.
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* Advanced noise blanker fitted.
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* 20dB pad plus continuous attenuator.
* Switchable A.G.C. Variable tone.

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* Signal meter calibrated in "S" and SIMPO.
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* FRV7700A; 118-130, 130-140, 140-150MHz.
* FRV7700B; 118-130, 140-150, 50-59MHz.
* FRV7700C; 140-150, 150-160, 160-170MHz.
* FRV7700D; 118-130, 140-150, 70-80MHz.
* FRV7700E; 118-130, 140-150, 150-160MHz.
* FRV7700F; 118-130, 150-160, 170-180MHz.
* FF5; 500KHz (for improved VLF reception).
* MEMGR7700; 12 Channels (internal fitting).
* FRA7700; Active Antenna.

'7700 THE ONE WITH FM!
NON-MEMORY VERSION £335

JRC

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* Passband tuning ± 2KHz on SSB and CW.
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* No R.F. amplifier, balance U310 mixer.
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NHD518	96 (4 × 24) channel memory unit
NCM515	Remote keypad controller, LCD readout. Up/down step tuning, 4 channel memory
CQE515	Junction unit (NCM515 to NHD518)
NVA515	External 3W speaker 130 × 140 × 200mm
CFL260	600Hz mechanical filter
CFL230	300Hz crystal filter

FT726R MULTIMODE TRANSCEIVER £6489 inc. VAT @ 15% & SECURICOR

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*Option

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* 3 Bands*! 2 metres. 70cms* (10MHz) & 6M* plug-ins.
* Full Duplex*! Cross band Tx & Rx simultaneously.
* SSB-CW-FM! All optimumly catered for.
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* Separate channelised VFO! (for FM operation).
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* Instant reverse! *and* + & – splits *and* A/B.
* Twin meters; PO/DISC, S/ALC. Duplex switchable.
* Switchable; AGC, CW bandwidth, dial lock.
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		*option.
FT726R(2)	Transceiver c/w 144 MHz	£649.00
430T726	430-440MHz module	£208.90
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SAT726	Full duplex unit	£82.80

KDK FM2030 £199 inc VAT @ 15% & SECURICOR

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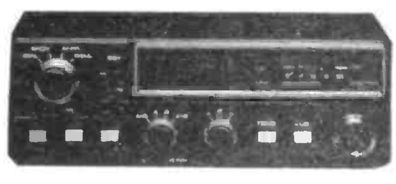

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- ★ Dual selectable pulse width noise blanker.

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- ★ AM, FSK, USB, LSB, CW, FM, (Tx and Rx).*
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- ★ Digital plus analogue frequency displays.
- ★ VOX built-in and adjustable.
- ★ Instant write in memory channel.**
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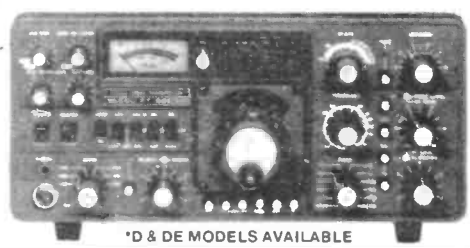

*D & DE MODELS AVAILABLE

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- ★ All modes:- LSB. USB. CW, AM‡, FM‡ (‡Option board).
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- ★ All modes AM, CW, LSB, USB, AFSK & FM (inc.)
- ★ IF shift & variable bandwidth 2.6kHz-300Hz.
- ★ Inbuilt keyboard operation + scanning.
- ★ Switchable attenuator 10, 20, 30dB.
- ★ Audio peak + notch filter — 40dB
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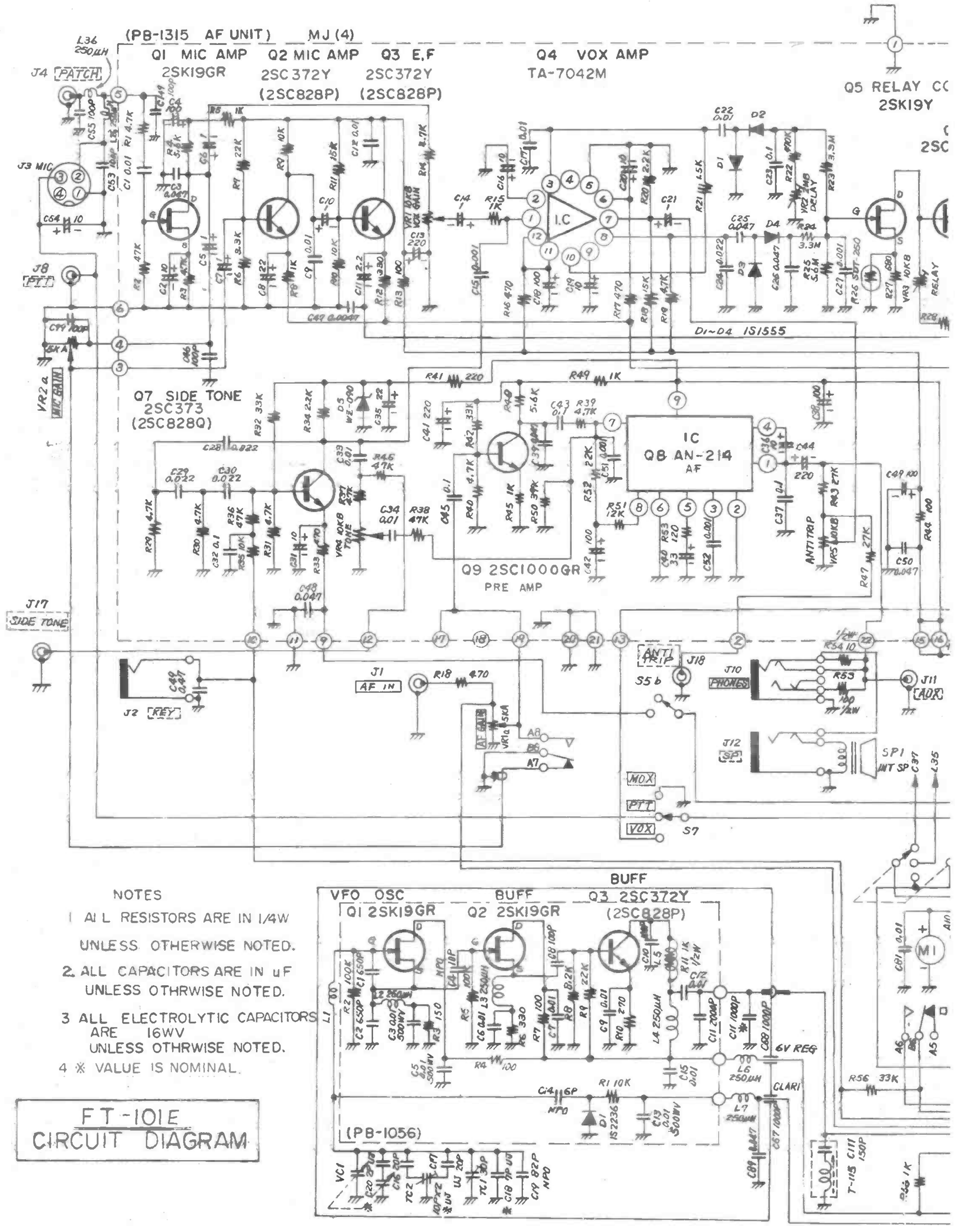
Bangor	John	G13KDR	(0247) 55162
Tandragee	Mervyn	G13WWY	(0782) 840656
Neath	John	GW4F01	(0639) 52374 Day (0639) 2942 Eve



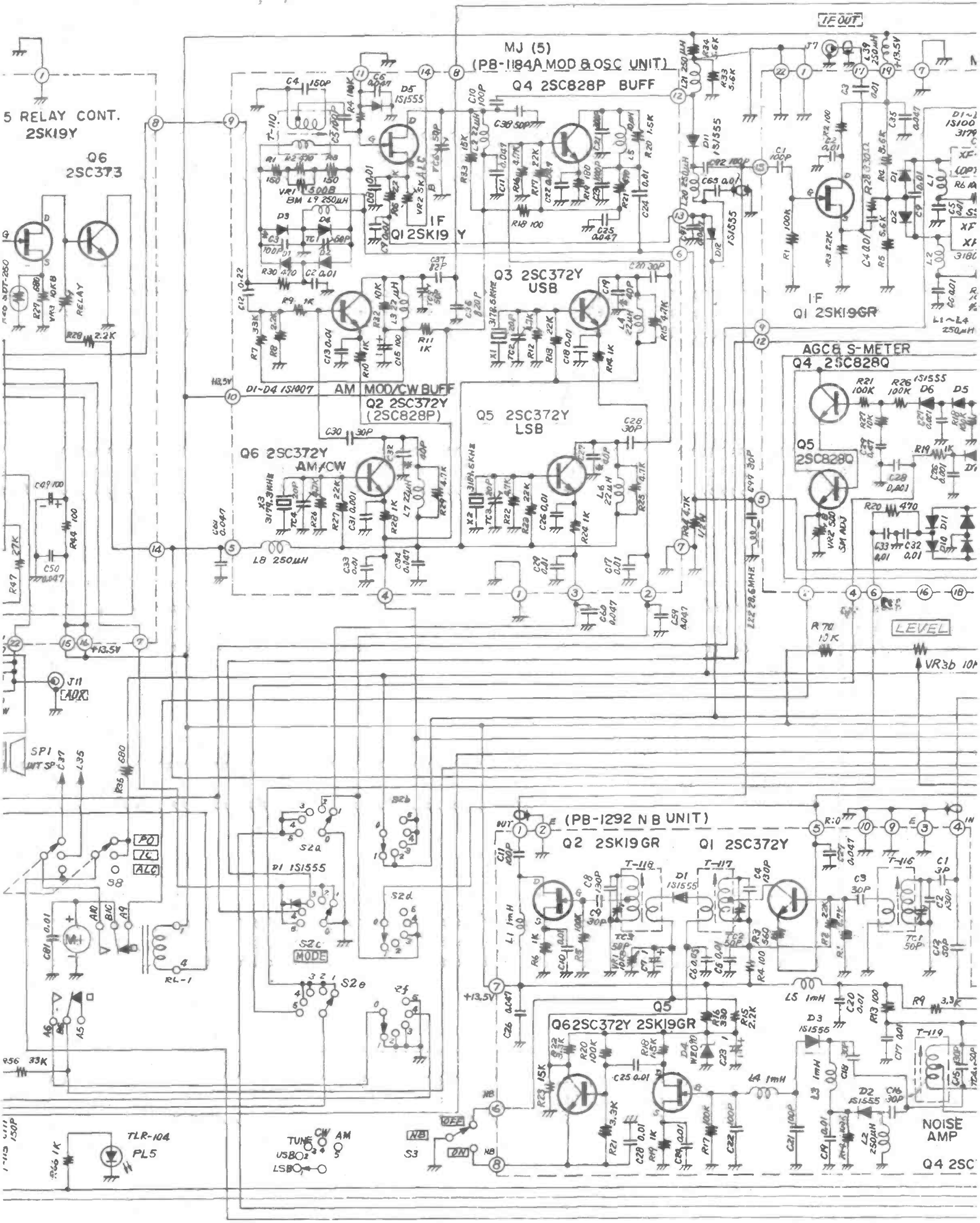
NOTES

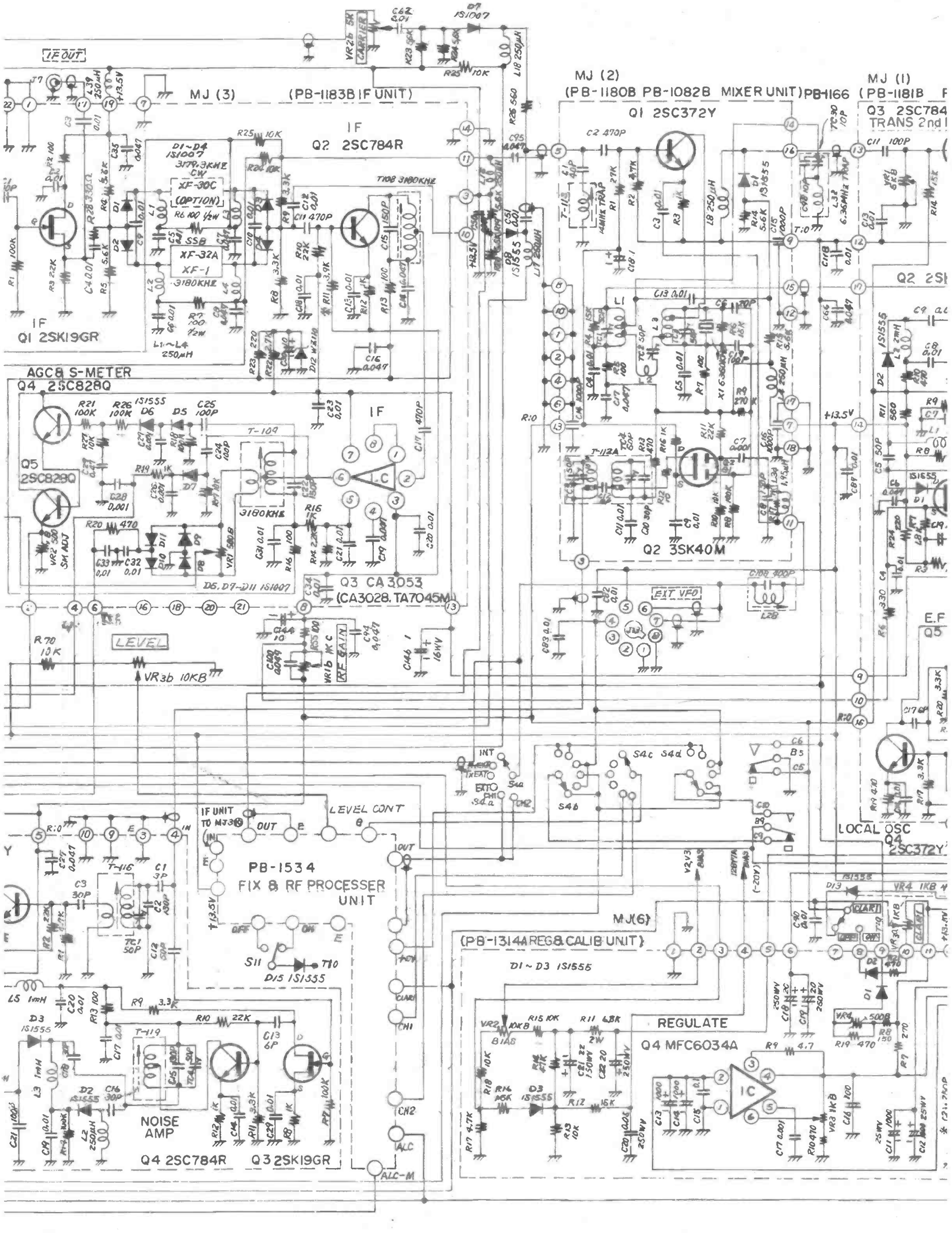
1. ALL RESISTORS ARE IN 1/4W UNLESS OTHERWISE NOTED.
2. ALL CAPACITORS ARE IN uF UNLESS OTHRWISE NOTED.
3. ALL ELECTROLYTIC CAPACITORS ARE 16WV UNLESS OTHRWISE NOTED.
4. ※ VALUE IS NOMINAL.

FT-101E

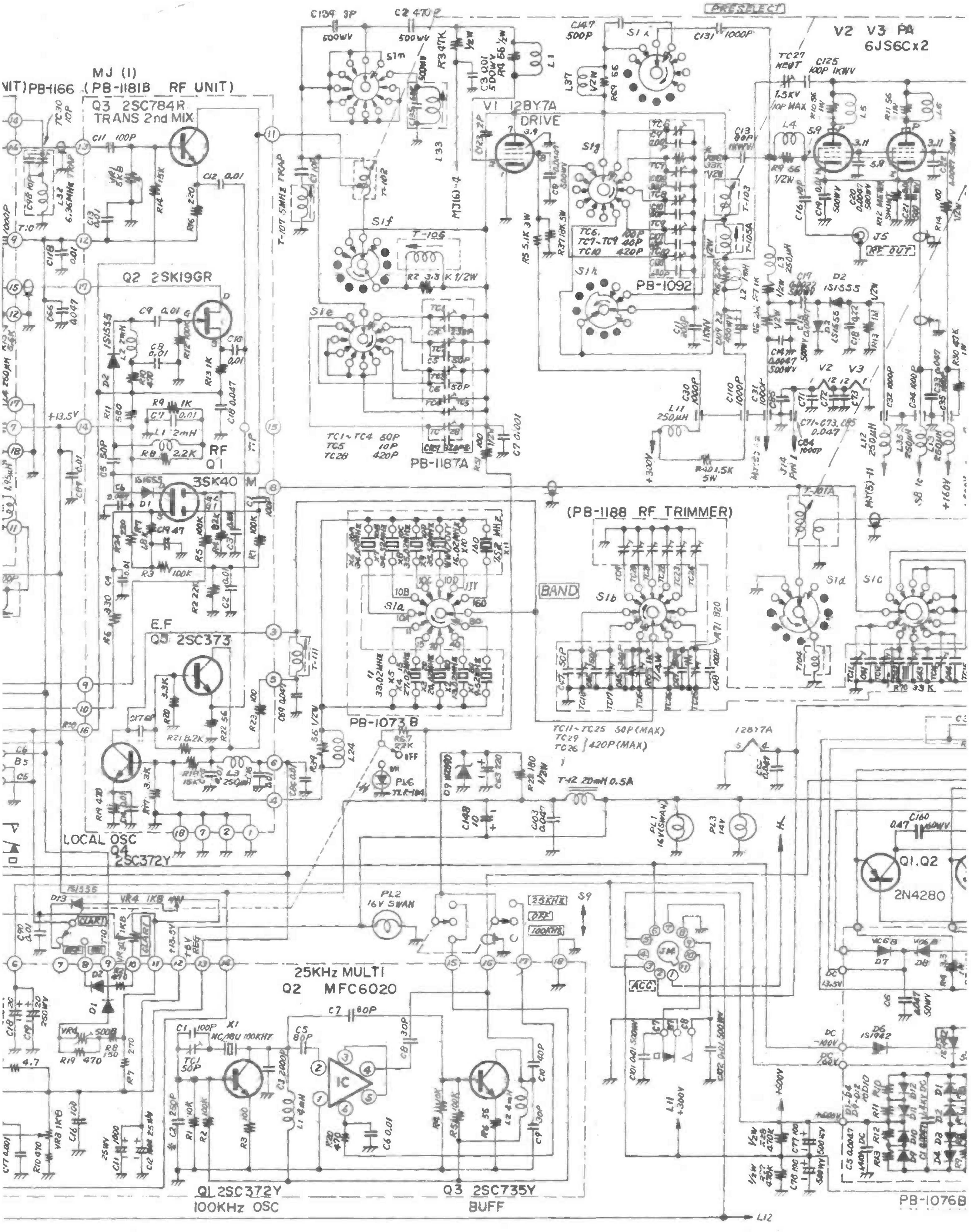
CIRCUIT DIAGRAM

T10

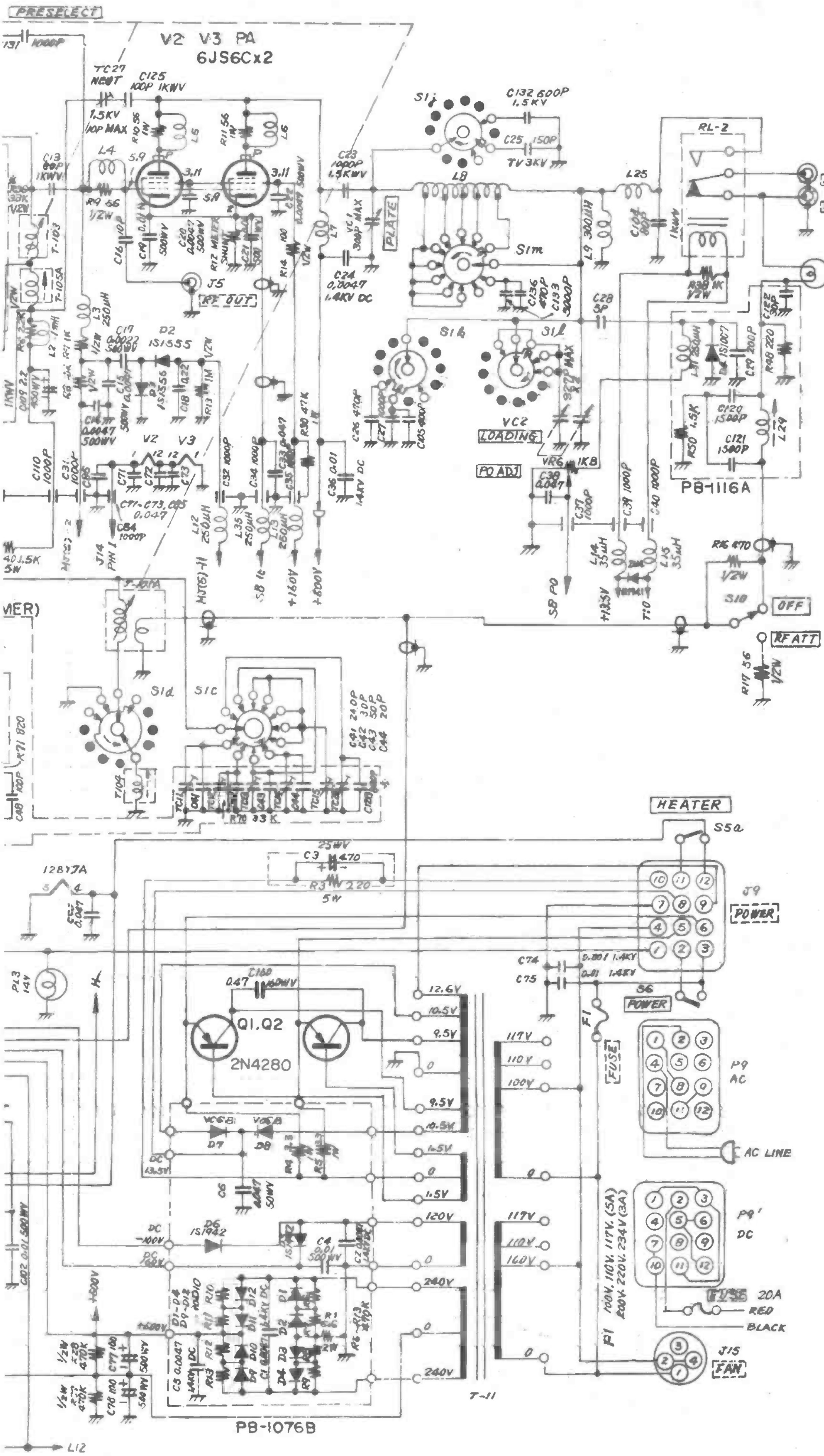

MJ (5)
(PB-1184A MOD & OSC UNIT)
Q4 2SC828P BUFF
IF OUT
5 RELAY CONT.
2SK19Y
Q6
2SC373
Q1 2SK19 Y
Q3 2SC372Y
USB
IF
Q1 2SK19GR
AM MOD/CW BUFF
Q2 2SC372Y
(2SC828P)
D1~D4 1S1007
Q5 2SC372Y
LSB
Q6 2SC372Y
AM/CW
AGC & S-METER
Q4 2SC828Q
Q5
2SC828Q
LEVEL
VR3b
L8 250μH
J11
AUX
SP1
EXT SP
PO
IC
ALC
S8
RL-1
D1 1S1555
S2a
S2b
S2c
S2d
S2e
S2f
MODE
(PB-1292 N B UNIT)
Q2 2SK19GR
Q1 2SC372Y
T-118
T-117
T-116
T-119
Q5
Q6 2SC372Y 2SK19GR
NOISE
AMP
Q4 2SC
TLR-104
PL5
TUNE
CW
AM
USB
LSB
NB
OFF
ON
S3
+13.5V



IF OUT
MJ (3)
(PB-1183B IF UNIT)
IF
Q2 2SC784R
MJ (2)
(PB-1180B PB-1082B MIXER UNIT)
PB-1166
MJ (1)
(PB-1181B
Q1 2SC372Y
Q3 2SC784
TRANS 2nd
XF-30C
(OPTION)
SSB
XF-32A
XF-1
3180KHZ
IF
Q1 2SK19GR
AGC & S-METER
Q4 2SC828Q
Q5
2SC828Q
T-109
3180KHZ
IF
IC
Q3 CA3053
(CA3028, TA7045M)
D6, D7~D11 1S1007
Q2 3SK40M
LEVEL
VR3b 10KB
VR1b 1KC
RF GAIN
EXT VFO
CARRIER
E.F
Q5
INT
EXTO
S4a
S4b
S4c
S4d
LEVEL CONT
IF UNIT
TO MJ3
OUT
PB-1534
FIX & RF PROCESSER
UNIT
LOCAL OSC
Q4
2SC372Y
MJ(6)
(PB-1314A REG & CALIB UNIT)
D1~D3 1S1555
REGULATE
Q4 MFC6034A
IC
T-116
T-119
NOISE
AMP
Q4 2SC784R
Q3 2SK19GR
S11
D15 1S1555
CLAR
ALC
ALC-M
CH1
CH2



PRESELECT
V2 V3 PA
6JS6Cx2
MJ (1)
(PB-1181B RF UNIT)
PB-1166
Q3 2SC784R
TRANS 2nd MIX
V1 12BY7A
DRIVE
T-107 5MHz TRAP
L32 6.36MHz TRAP
Q2 2SK19GR
PB-1092
PB-1187A
RF
Q1
3SK40
M
(PB-1188 RF TRIMMER)
BAND
PB-1073 B
E.F
Q5 2SC373
LOCAL OSC
Q4
2SC372Y
TC11~TC25 50P (MAX)
TC29
TC26 420P (MAX)
12BY7A
T-12 20mH 0.5A
RF OUT
J5
PL1 16V (SWAN)
PL3 14V
PL2 16V SWAN
25KHz
OFF
100KHz
S9
ACC
Q1.Q2
2N4280
25KHz MULTI
Q2 MFC6020
IC
Q1 2SC372Y
100KHz OSC
Q3 2SC735Y
BUFF
PB-1076B
CLARI
L12


PRESELECT
V2 V3 PA
6JS6Cx2
RF OUT
PLATE
LOADING
PO ADJ
RL-2
J6
ANT
J16
REC
PL4
16V
PB-116A
OFF
RF ATT
S1d
S1c
HEATER
S5a
J9
POWER
S6
POWER
Q1,Q2
2N4280
FUSE
P9
AC
AC LINE
P9'
DC
FUSE 20A
RED
BLACK
J15
FAN
T-11
PB-1076B
12BY7A
PL3
14V

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A Plainman's Guide to Masts & Towers

Part 5 Installation

By A S Barraclough G3UDO*

The final step is to decide where to site the aerial mast or tower you want, and prepare the foundations for it. However, very often, the process of choosing a suitable site and then laying the necessary foundations can present as many problems as selecting the mast or tower. So it is advisable not to rush this final stage, but spend a little time in planning your operation beforehand to save time and energy later on.

Hiding the thing

If you are fortunate enough to have a fairly large garden screened by trees the choice of a suitable site becomes a little easier. However, in the average suburban garden things may not be so easy, space could be at a premium and the choice of a suitable site limited. In general, masts or towers of the telescopic, tiltover type with an extended height of 30 to 60 feet would be practicable, and probably acceptable, in most urban locations where space is restricted. Masts and towers with a retracted height of about 21 feet or less can be ideal for such locations, because their low retracted height will enable the aerial to be effectively hidden by the ridge of the house, and so reduce any 'skylining' which could be a problem where appearance is a major factor (see **Fig. 1.**) In addition, a low retracted height enables the whole structure to be tilted over in a relativly small area. Where there are objections from the neighbours or the local authority against lattice towers then an unobtrusive tubular section telescopic mast could be more acceptable. Where a mast or tower can be wall-mounted against the side or end of a house, its structure can be masked to some extent. It will tend to 'blend' in with the house. However, the aerial would be close to the house and may suffer slight detuning, particularly in the lowered position. The amount of any detuning is not predictable but it should not be sufficient to cause any major problem.

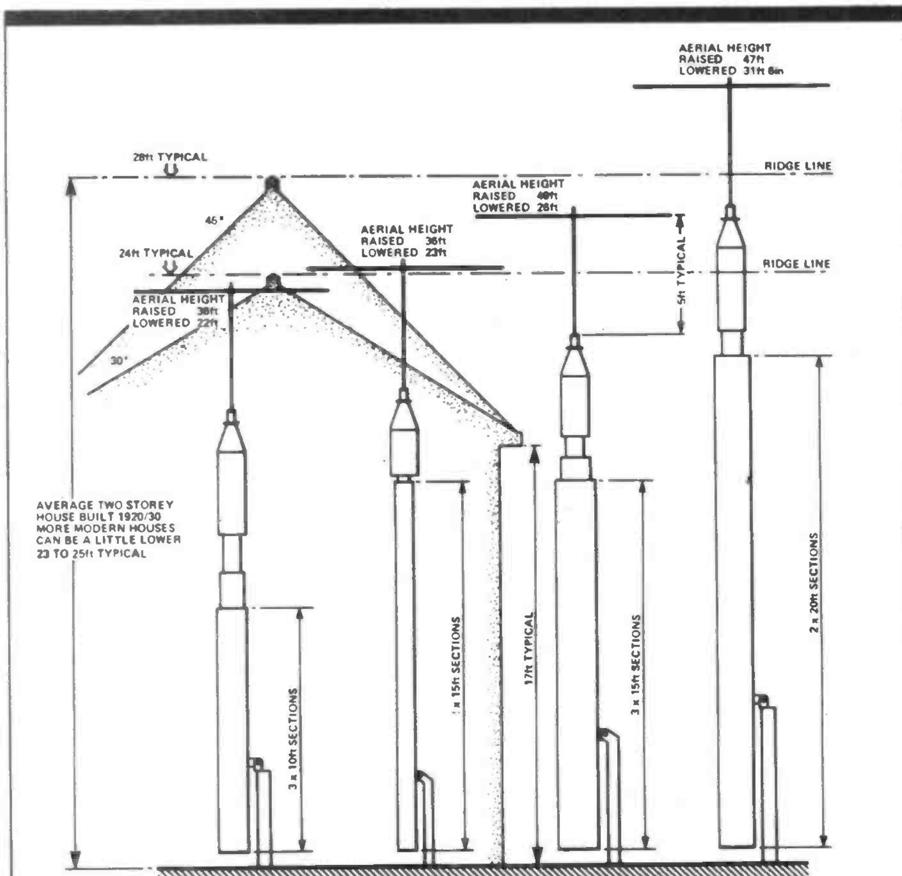


Fig. 1 Typical post mounted mast and towers showing 'skylining'

* Allweld Engineering

Post mounted masts or towers need not be too near any building and any detuning would be minimal, but their structures would be more exposed to view. Again if 'skylining' is kept to a minimum, with a low retracted height when the aerial is not in use, then the structure may not be too noticable. When deciding how far to position the tower or mast from the house, bear in mind the length of feeder and rotator cable needed. Long feeder cables mean higher losses. Merely placing the whole lot as far away from the house as possible may not be the most economical solution. As a general guide, keeping the aerials at a distance equal to at least a half-wavelength (at the lowest frequency to be used) should be practical. However, as is often the case, local conditions may dictate otherwise.

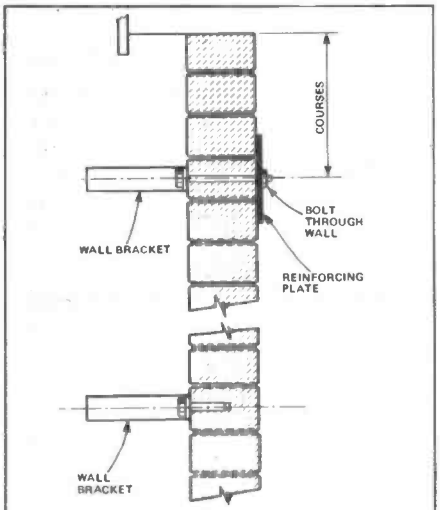


Fig. 2 Typical 9" wall section

The other limiting factor is the height above the hinge point the supporting bracket up the wall. As mentioned earlier in part 4, which concerned loadings, the higher up the wall bracket is fixed, the lower the the loads on the wall will be. However, it is not possible the fix the bracket to the very top of a wall and hope for the best, because the top part of the wall is not as strong as lower sections, so some sort of compromise height has to be found. Generally the wall bracket should be more than three courses of brickwork down from the top of the wall but it may have to be lower for a large tower. (See **Fig. 2**) From this it is clear that large towers and low walls are not compatible without some additional reinforcement being used. The wall bracket is usually anchored to the wall either with

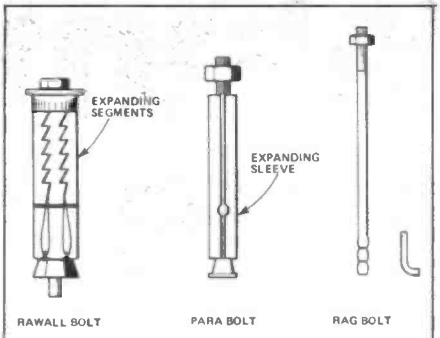


Fig. 3 Typical fixings

Rawall or Para bolts (**Fig. 3.**), or with studs going through the wall structure as in **Fig.2.** Para bolts are useful because they require a hole that is only slightly larger in diameter than the actual bolt, so that the wall can be drilled through the bracket itself, which saves having to mark the holes out seperately. When installing the ground hinge and wall bracket always use a spirit level to check that they are level and correctly aligned. The manufacturers instructions should be followed throughout.

Post mounting

With post-mounted masts and towers, the stucture is hinged part way up its outermost section and pivoted on a post that is either imbedded in, or anchored to, a concrete foundation. Using a winch and cable system, the structure can be tilted to the horizontal while it is in the fully retracted position. The size of the concrete base depends on the type of post and tower to be supported. The manufacturers specifications will usually state the dimension of the base needed. Digging out the foundation and filling it with concrete can be a tedious task, but one that cannot be hurried if it is to be done correctly. If you have any doubts then it may be advisable to get the job done by a local builder. Before any concrete is filled, the ground post should be positioned in the hole and held vertically in situ by four guy ropes or suitable lengths of timber as in **Fig. 4.** Check that it is vertical on all sides with a spirit level, and check that only the correct depth of post is being buried. Digging out an incorrectly placed post could be difficult to say the least! Where surface mounted posts (**Fig.5**) such as a base or frame post, are to be mounted, suitable ragged bolts (**Fig. 3**) are usually called for. A simple way to ensure that these are correctly spaced is to make up a timber pattern that corresponds to the fixing holes on the base. (**Fig.6**). Fix the ragged bolts onto the pattern and then, using lengths of timber, position the pattern over the hole with the rags hanging down into it. Use a spirit level to check that the pattern is level in all directions before filling in any concrete. Once the concrete has set, the pattern can be removed leaving the threaded ends of the rag bolts sticking up ready for the base to be bolted down. Concrete should be allowed to set for at least three days before handling and a week at least before any loads can be placed on it. Where a GROUND socket is to be used (**Fig. 7**) then the simplest way to bury it is to slip it on to the post and then set the post up as before. It may be a good idea to arrange some suitable drainage for the bottom of the socket to prevent it filling up with water. A simple way of providing some drainage for the socket is to stand it on a suitable number of engineering bricks placed at the bottom of the hole for the base. Engineering bricks are the sort that have a number of holes running through them. Bear in mind that waterlogged ground may not be firm enough for post mounted installations, and this sort of drainage will not help. If you have any doubts then again seek professional advice. Once a post-mounted mast or tower has been installed, there may be some slight settlement of the concrete base which, depending on the soil conditions, may tilt the structure mounted on it.

If you are going to carry out the concreting yourself you will need to know roughly what volume of

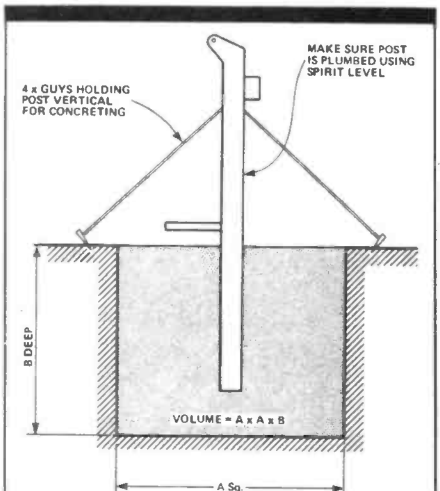


Fig. 4 Ground post

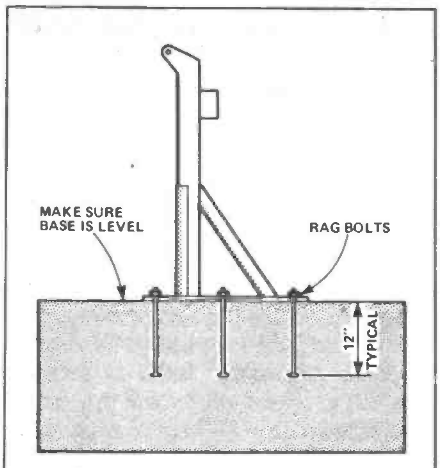


Fig. 5 Base or frame post

material is required. To find the volume of the base simply multiply the area of the bottom of the hole by its depth. Thus:

Volume = A x A x B

cubic feet or metres. (See **Fig. 4.**)

The weight of concrete in the base can be found by multiplying the volume base by the weight of concrete per cubic foot/metre. The approximate weight of concrete is 144lb per cubic ft, or 230kg per cubic metre. Buying the concrete ready mixed or having it mixed on your premises by a contractor is probably the cheapest and quickest method. If you are going to make your own then a mixture in the proportions 2:4:6 of cement: sand:coarse aggregate/broken-brick-filling should do the job providing the mix is not too dry and the hole is properly filled with it. In some circumstances, where the space available for the base is a little restricted, or when the soil is a little loose, it may be necessary to increase the resistance of the soil by spreading the loads over a larger area. This can be done easily by driving suitable lengths of steel angle or 1½ to 2 inch diameter pipe into the soil near the bottom of the hole, leaving a foot or so of the steel reinforcing sticking into the hole itself so that it will become embedded in the concrete when the hole is filled (See **Fig. 7.**) But remember, this is not a subsititute for a proper concrete base. The manufacturers specified dimensions should be followed.

Earthing

A conductive metal structure such as a mast or tower can be affected by the RF being transmitted at the aerial as well as by static electricity in the air and lightning.

In order to minimise these effects and eliminate the possiblities of getting an accidental static discharge, or the tower being damaged by a lightning strike, it is advisable to ground the structure to a suitable 'Earth' point. This can be done by burying up to 3 or 4 feet of copper rod (about 3/8" diameter) or a similar length of copper water pipe and then bonding the base of the mast or tower to it, using a flat strip of copper about 1" wide at least 1/16" thick (16 or 14 SWG). Earthing the tower in this way will also reduce the likelihood of any RF pick-up being reradiated, causing the inevitable TVI.

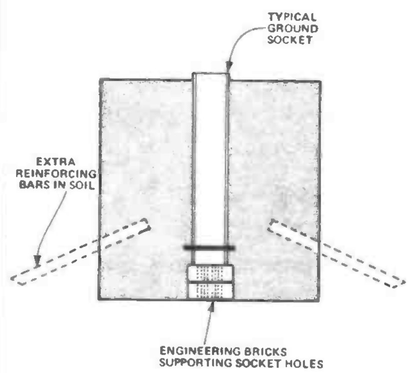


Fig. 7 Ground socket

Safety

Like all mechanical devices, a mast or tower can be dangerous if it is incorrectly used, poorly maintained or overloaded. Remember that safety and performance will depend to a large extent or correct usage and regular maintenance. Most of the problems that arise with mast and tower installations are due to one or both of these factors being ignored. When you are deciding where to position the tower, bear in mind its full retracted length, including the aerial array, and mark out where exactly it will come when lowered down.

Some do's and don'ts

Do read all the manufacturer's instructions before carrying out any operation.
Do observe the manufacturer's specified loadings.
Do inspect regularly for wear and tear.
Do lubricate such things as pulleys and cables regularly.
Do support the weight of the structure when it is horizontal.
Do check that cables are seated in their pulleys before any winching operation.
Don't overload the structure.
Don't tilt over with the mast or tower extended.
Don't allow anyone to stand in its 'line of fall' where tilting down.
Don't rush the operation or let an inexperienced person carry it out.
Don't heave and pull on the end of the structure while it is tilted over and unsupported.
Don't leave the mast or tower fully raised when you go on holiday. Lower it and immobilize it or lock it.
Don't leave yourself uncovered by insurance.

That's about it then, with a correctly installed mast or tower properly used and well maintained, you should be able to keep your aerials in tip-top condition and enjoy many years of happy amateur radio operating.

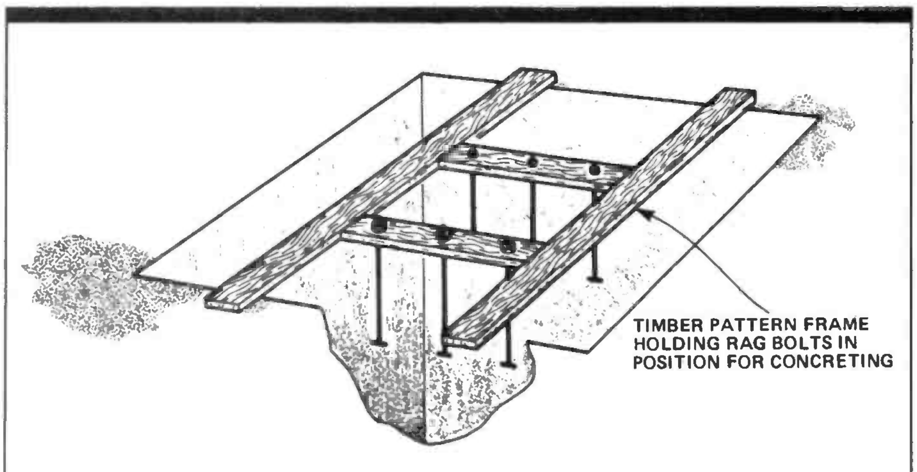


Fig. 6

Driving Lesson

By Richard Lamont G4DYA
Assistant Editor, Ham Radio Today

After being bitten by the amateur radio bug, the newcomer is often at a loss to know how to start. At first it may seem that all that can be done is to bone up on the RAE and the Morse test needed to get a Home Office licence.

Although the idea of just listening to radio amateurs may seem a bit boring compared to actually talking to them, it really can be a fascinating hobby in itself. I spent a couple of years (not all of it!) glued to a short wave receiver before getting a licence, with never a dull moment, because there is *always* something new to discover. Like the transmitting amateur, you can explore the mysteries of the ionosphere as it continually changes in the way it bends radio signals around the Earth's surface — sometimes slowly and subtly, sometimes so suddenly that you think a fuse has gone. This *propagation* of radio signals is one area of fascination. Another such is aerials — there is an infinite variety of aerials for different jobs, and endless scope for building, modifying and testing out your ideas and learning by experiment.

There are countless more reasons why SWLs the world over are content to just listen and not talk. They're willing to leave a 'ticket' until they've solved the challenges and answered the questions that SWLing inevitably brings.

If you've got this far and not decided that I'm bonkers then stick with us. The purpose of this article is to show the complete novice around the controls of a typical, reasonably modern, receiver or transceiver. Yes, while we're at it we might as well deal with the transmitting bits — they're easy. Let's find our way round the receiver first.

The first thing is to set the receiver to the right frequency, ie. somewhere in our chosen amateur band. (The bands allocated for amateur use are listed in **Table 1.**) There is always some kind of bandswitch which is marked in either frequency, measured in Megahertz (MHz), or wavelength (measured in metres). The table shows how the two quantities are related. note that as the frequency gets higher, the wavelength gets shorter.

Some bandswitches have a position marked WWV or JJY. This is usually a 10MHz band for listening to 'standard frequency' transmissions to check the receiver calibration.

Having chosen which band to listen on, the next step is to master the main tuning dial. There is a huge variety of these, but the easiest to read are the digital ones. These are included on virtually every modern rig. Older receivers often rely on a combination of two 'analogue', mechanical indications — a 'course' indication, usually on a dial behind a plastic window, and a 'fine' indication, often on a 'skirt' on the tuning knob itself. The skirt can usually be moved independently of the knob, enabling exact calibration. These dials reached near perfection in the Seventies, just in time to be ditched by digitals.

Crystal calibrator

Although these 'analogue' tuning dials can be set accurately, an accurate reference is needed to set them with. A crystal calibrator is the usual answer. This is a very accurate crystal-controlled oscillator that produces an output at several frequencies across the short wave spectrum, typically 100kHz apart. The trick is to switch the calibrator on and 'tune it in for zero-beat'; ie. adjust the dial until the pitch of the tone coming from the loudspeaker is so low that you can't hear it. Then adjust the skirt to the '0' position, *without moving the main control.* The receiver is now calibrated — at least for that band. Try checking the calibration up and down the band to see if it's OK at other 100kHz points.

Frequency range (MHz)	Approximate wavelength (metres)
1.810-2.000	160
3.500-3.800	80
7.000-7.100	40
10.100-10.150	30
14.000-14.350	20
18.068-18.168	17
21.000-21.450	15
24.890-24.990	12
28.000-29.700	10

Table 1: HF amateur bands (in UK)

Another commonly found control connected with setting the frequency is a *preselector* knob. This simply 'peaks' certain parts of the receiver for best performance at the chosen frequency. Simply adjust for maximum volume.

Intermediate frequency

All receivers, except *direct conversion* ones, change the frequency of the incoming signal to an *intermediate frequency* (IF) fairly early on. This is because it is easier to amplify and process a signal at a single frequency than over a whole range of frequencies. The intermediate frequency signal is eventually *demodulated* into *audio*.

Modes

There are several different ways of transmitting speech. On the HF bands *Single Sideband* (SSB) is used almost exclusively. There are two sorts of sideband — upper and lower (USB and LSB). On amateur bands below 9MHz it is usual to use LSB, whereas USB is the norm above 9MHz.

AM is rarely used by amateurs now, but it's useful to have it if you want to listen to broadcast stations. FM is very valuable if you envisage listening to the VHF and UHF bands, either on a VHF/UHF receiver or on an HF receiver with a converter.

CW stands for *continuous wave*, a rather inaccurate and old-fashioned term for Morse Code. (How can it be continuous if it's being keyed on and off?) The only difference to the receiver, compared to SSB, is that the *filter* used has a narrower *bandwidth*. The bandwidth is the difference between the lowest and highest frequencies it will let through. Morse consists of a tone of constant frequency that is keyed on and off (whereas speech uses a continuous range of frequencies) so a narrower filter will do.

When you discover how many signals are squashed into the short wave spectrum you will understand how important bandwidth is. You can minimise interference to the station you're trying to listen to by minimising the strength of stations on neighbouring frequencies. In other words you minimise the bandwidth.

Older receivers had switched filters, with bandwidths to suit the mode in use — typically 12kHz for amateur FM, 6kHz for AM, 2.7kHz for SSB and 600Hz for CW.

Modern receivers often have *IF shift* and *IF width* controls which allow continuous variation of the filter's response. **Figure 1** shows the effect of these controls. A typical crystal filter for SSB reception might be, say, 2.7kHz wide, symmetrical about the **intermediate frequency** (IF). Turning down the IF width might reduce this to, say, 1.8kHz. This would spoil the audio quality a bit, but it would certainly cut out 'adjacent-channel' interference.

The IF shift control doesn't affect the bandwidth, but moves the response up and down. It sounds a bit like turning the 'bass' down and the 'treble' up, or vice-versa. Again, this control can be used to get rid of interference on a close (or even overlapping) frequency.

Some rigs, eg. the Trio/Kenwood TS930 transceiver, do not have IF shift and width controls, but separate controls to move each side of the filter's response up and down in frequency.

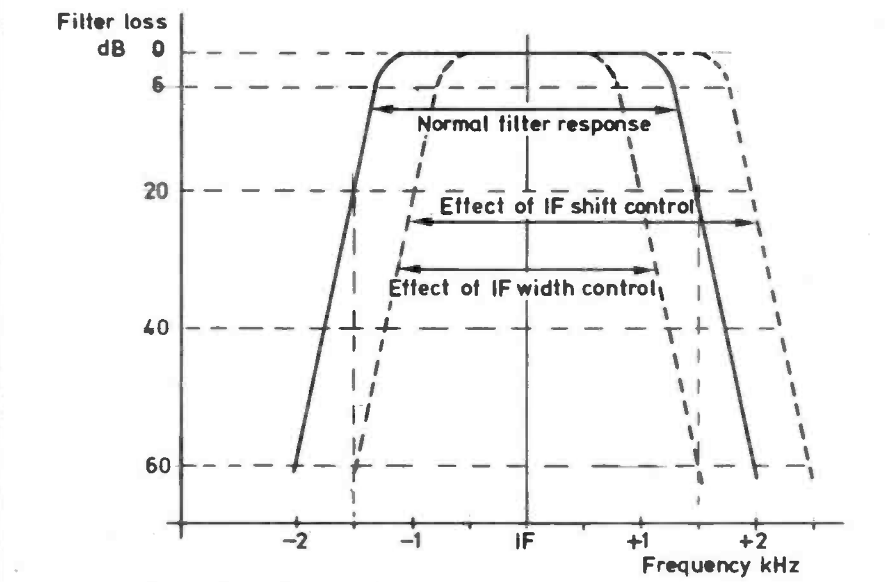


Fig. 1. Effect of IF shift and IF width controls on filter response.

Gain controls

'Gain' means the amount of amplification in the receiver. The various stages inside the set will, among other things, gradually amplify the signal bit by bit until it's strong enough to drive the loudspeaker. However it is important that the signal in each stage is of about the right voltage. If it's too strong, the stage will overload and produce *cross-modulation*. This means that you will hear interference from stations on different frequencies to the one you're tuned to. This can be avoided by reducing the *RF gain*, which controls the amplification of the earliest stages of the receiver. The drop in volume can be offset by turning up the *AF gain*, which controls the amount of gain in the last stages of the receiver. If, however, you turn the RF gain down too low and the AF gain up too high, the signal in most of the receiver's stages will be too low, and it will reward you with hiss.

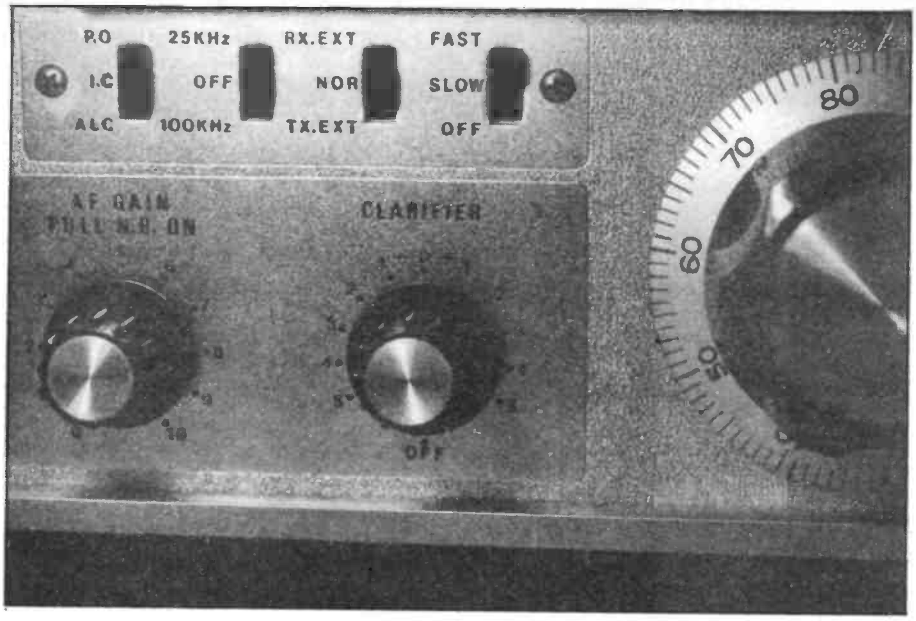
For SSB reception it is advisable to keep the RF gain set lowish for good audio quality.

Automatic gain control (AGC)

The range of signal strengths on the short wave band varies enormously from one transmission to another, so it's desirable to reduce the receiver's gain automatically on strong signals. This reduces risk of overloading, and prevents you from deafening yourself when a strong signal appears.

A good AGC system has a fast *attack* and slow *decay*. The fast attack means that when a strong signal appears, the AGC will cut the receiver's gain down very fast indeed — typically in a thousandth of a second. The slow decay means that when the strong signal goes, the gain is wound up slowly, so that if the signal reappears after a brief pause (such as the pause between words) the gain is only slighly too high and can be corrected easily.

Many receivers have a fast and slow AGC switch. Slow is normally the best for SSB reception, because



the background noise is not brought up as much in the pauses between words. If, however, the signal is suffering from 'flutter fading', which sometimes happens, the faster position can help the AGC cancel out the variations in signal strength.

Noise blanker

There are all sorts of both natural and man-made interference on the short wave bands. Noise blankers are designed to get rid of interference that consists of short, strong pulses. Interference from a car's ignition system is like this. The effectiveness of noise blankers varies enormously from receiver to receiver and from one type of interference to another. The only advice I can give is try them out.

Clarifier/ RIT/ IRT

These are all names for the same thing. The allow you to move a receiver's frequency a few kHz relative to the main dial. This is very valuable for listening to SSB conversations, where two stations may (for a variety of reasons) not be on *exactly* the same frequency.

Squelch

This isn't as disgusting as it sounds. It is simply a gadget that cuts off a receiver's audio if there is no signal at the input. This cuts out the irritating hiss. Squelch controls are universal on FM receivers but rare for SSB.

Transmitter controls

So far we've dealt exclusively with a receiver, or the receiving section of a transceiver. The transmitting parts are, perhaps surprisingly, simpler. The main trick to learn is 'tuning-up', and even this has been eliminated by the latest solid-state designs.

Tuning up is the process of matching the *power amplifier*, ie. the final stage of transmitter, to the aerial feeder cable. Matching is necessary to ensure the most efficient delivery of power from the PA to the feeder — if any power isn't transferred it does not just disappear, it heats up the PA components. With a severe mismatch, a PA can suffer serious damage.

Most rigs have two PA tuning controls. The first is marked *tune, tuning, anode or plate*. The second is marked *loading*. To tune up set the controls to the position recommended in the instructions. Make sure that the aerial, or better still a dummy load if it's the first time you have attempted this, is connected to the rig's aerial socket.

Turn the mic gain/carrier/drive control fully anticlockwise and switch the mode switch to CW/tune. Switch to transmit. Measure the PA anode current on the meter — there is often a meter switch to select different measurements. Adjust the carrier and preselector controls to increase the current, but not too much! If necessary back off the carrier, then peak the preselector for maximum.

Having got a bit of drive to the PA the next step is to resonate the anode circuit. Adjust the anode control of minimum current.

After this stage the PA should be 'fine-tuned' to optimise the output power. The loading and anode tuning controls should be alternately adjusted for maximum RF. This should be done at maximum drive.

Having tuned up the PA the only other important adjustment is to set the mic gain or carrier control (depending on whether you're using SSB or Morse). The manufacturer usually gives instructions on how to set this. The important thing is to avoid tuning the mic gain to high on SSB, because 'flat-topping' can occur, causing your signal to 'splatter' onto adjacent channels. This would not make you popular!

Driving a transmitter is easy; it's the receiver that takes the skill. It's well worth SWLing before getting a licence to learn how to operate one. What's more in the process you'll pick up a lot of tips that'll help you through the RAE. ●

RIT – allows you to move a receiver's frequency a few kHz

A Simple Amateur Television Station

Part 3

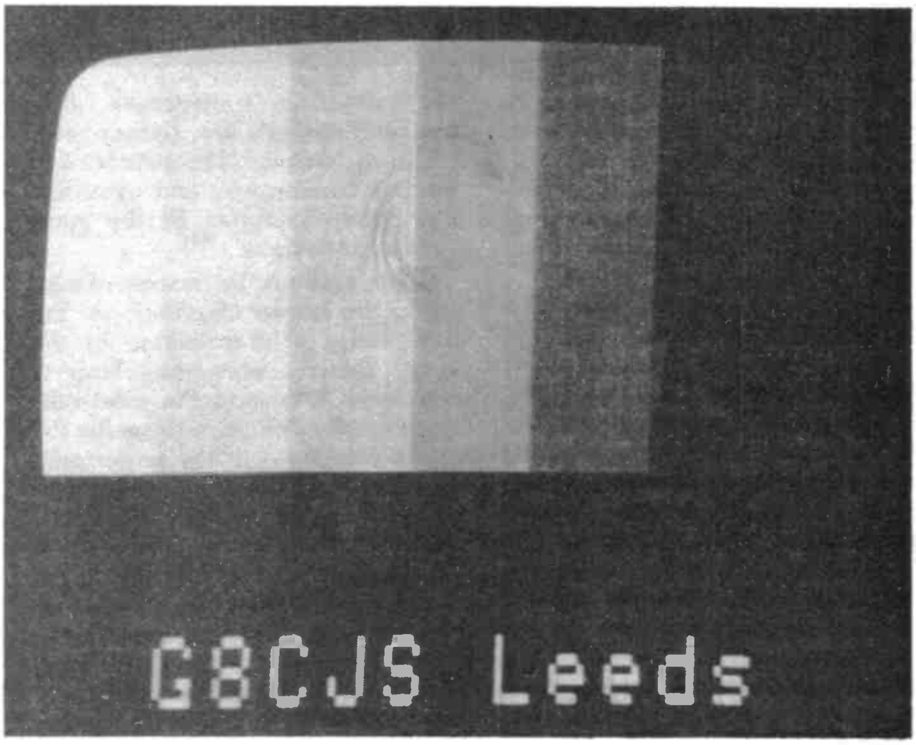
Adding a keyboard to the character generator.

By Trevor Brown G8CJS, General Secretary, British Amateur Television Club

So far in this series of articles I have shown you how to build a video test signal and sync pulse generator (Part 1), and how to display your callsign or QRA etc. electronically (Part 2).

In Part 3 I would like to show you how to add on electronic keyboard to the character generator described in Part 2. This uses an alternative module to the diode programme unit. The character generator in Part 2 was made up of two printed circuit boards mounted one above the other, with the diode matrix card being the uppermost, so as to facilitate plug-in modules pre-wired for different messages. When working portable (as in a contest) this system is ideal. All you need to display is one four-figure group of digits, which remain unchanged for the entire contest.

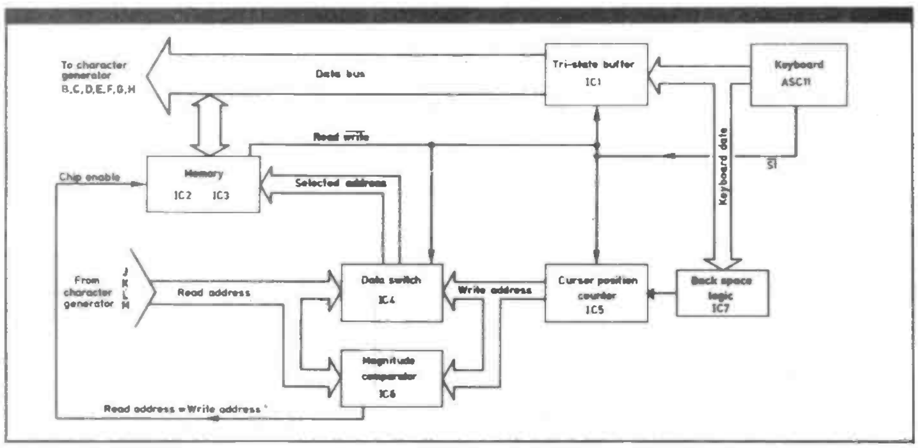
When we use our TV station in less strenuous conditions, eg. a quiet evening amusing three or four local stations, then our supply of pre-programmed messages will soon become exhausted. The module described in this article is pin-compatible with the diode matrix module and will simply plug-in in place of it. A standard ASCII keyboard can then be connected to the new module's input and it is ready to type directly onto the screen. The new module also has a page switch to facilitate up to eight pages of text so messages can be preset and 'brought on line' at the flick of a switch.



The pins J, K, L, M, carry a 4-bit address code from the character generator which changes every time it scans a different character. This code *was* used to address a different location in the diode matrix and bring on line to the data bus (B, C, D, E, F, G, H,) the information that was set by the diode programme in that location.

In the new module this 4-bit address code selects a location in RAM (Random Access Memory). When the memory is addressed the

Fig. 1. Block diagram of keyboard add-on unit.



information in that particular location is available to the data bus, in just the same way as the diode matrix.

The next stage is to be able to write to the RAM. To do this we need to bring the keyboard onto the data bus. An ASCII keyboard has seven data outputs, and supplies a code to these outputs dependent on which letter is selected. The keyboard also supplies a short pulse called 'strobe', every time we press a key. This strobe pulse could be 'active high' or 'active low'. Most keyboards provide both. Our circuit requires active low, often called $\overline{ST}$. When this signal occurs the outputs of IC1, (74LS244) which are normally floating, assume the same state as the inputs and thus feed the keyboard output to the data bus. The strobe pulse also passes to the RAM where pin 10 of our memory chips (2114) are driven low. This puts them into a 'write mode' so the keyboard data is stored.

The next problem is to control where the keyboard data is stored. By inserting IC4 in the address lines to the RAM we can switch the address lines in the write mode. IC4 (74LS157) is a 4-bit data selector and functions just like a 4-pole double-throw switch, in that when pin 1 is driven low the RAM address lines are fed from the QA, QB, QC, QD outputs of our counter chip IC5.

IC5 is a counter which counts up to 16 and then resets. By using the strobe pulse to advance it, its count will increase by one every time we press a key, ensuring that the selected letter is stored in the next location in memory. When IC5 has been clocked to location 16 it will automatically reset to character location 1.

The next stage is to display a 'cursor' so that we can see the next location to be typed into on the screen. To do this we compare the 'read' and 'write' addresses in the 4-bit magnitude comparator IC6 (74LS85). When the two addresses are the same ie. the character generator is scanning the location which we will next type into, then the output of the comparator, pin 6, goes high. This high state is connected to pin 8 of our RAM which is the chip enable pin (active low), so when our two addresses are the same the RAM is disabled, causing the data bus to be pulled high by the 10k pull-up resistors. This ensures the data bus assumes a high state in the absence of RAM data.

If the diode programme module is operating erratically then the addition of these pull-up resistors to the diode module may be the answer. It depends upon the diodes used.

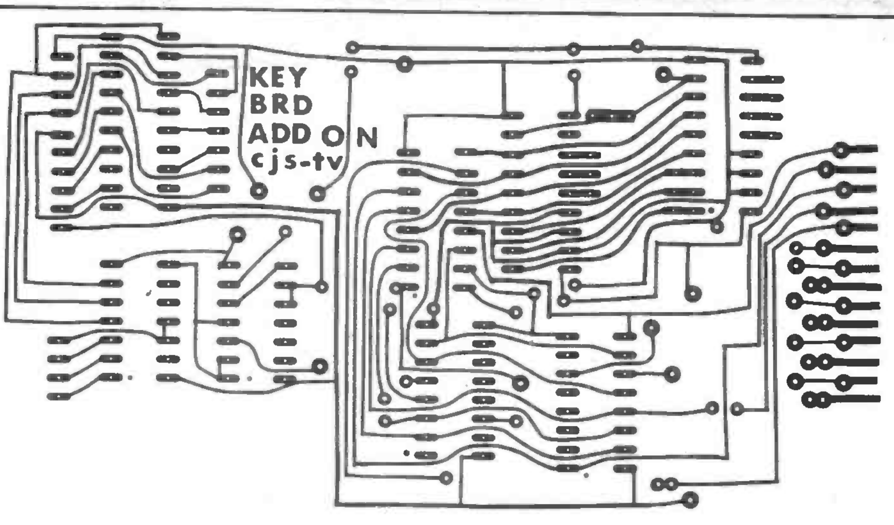


Fig. 2. Wiring side of double sided PCB

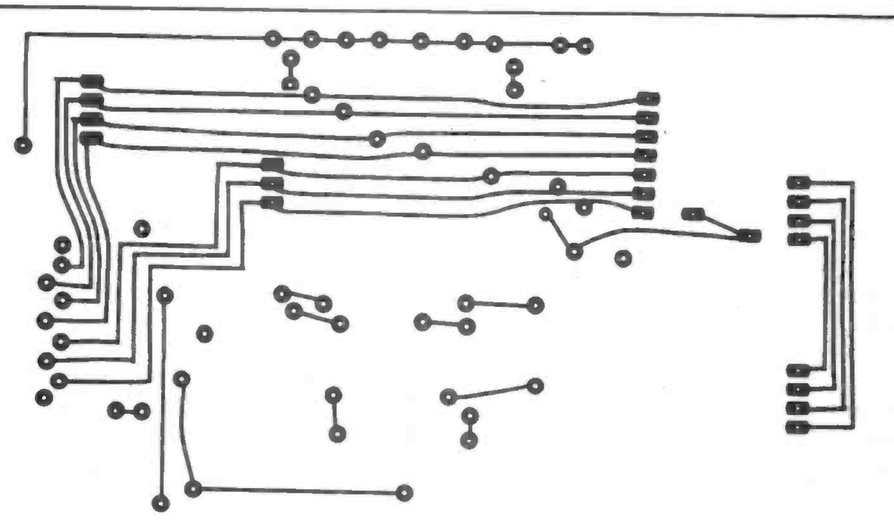


Fig. 3. Component side of double sided PCB

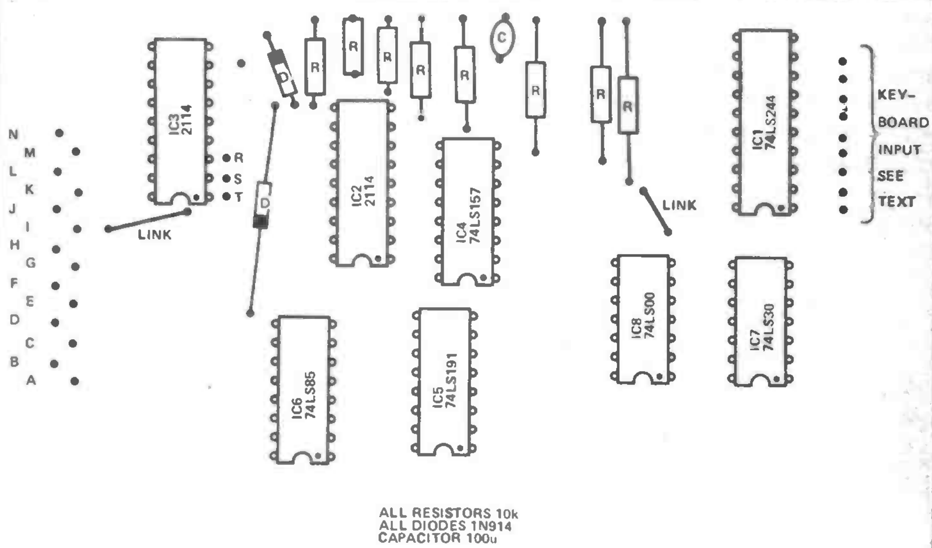
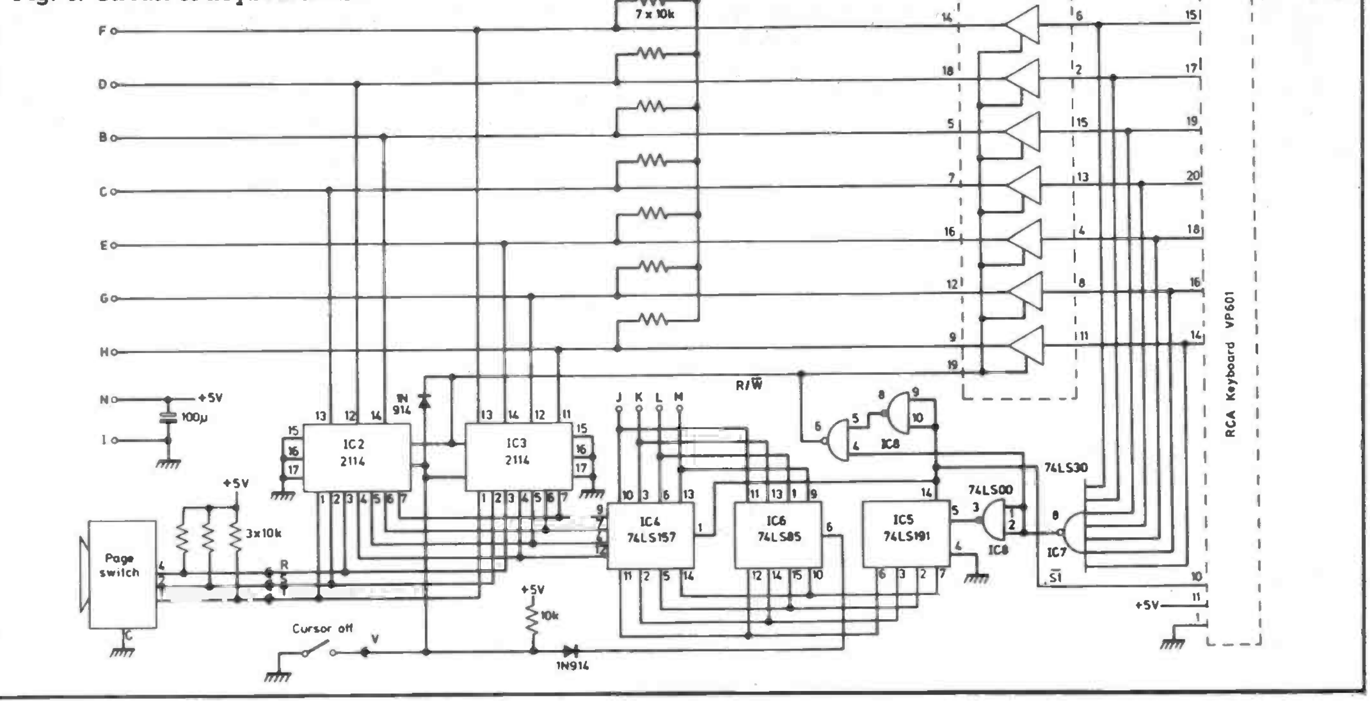


Fig. 4. Component layout

Fig. 5. Circuit of keyboard unit



If all the data bus bits are high then our character generator will generate a white block, which makes an excellent cursor.

The full ASCII code provides many things besides characters including cursor functions such as CURSOR HOME, BACK SPACE, DELETE etc. In order that this circuit is kept simple I have not decoded or used these functions, except code 7F (or keyboard outputs equal to 1, 1, 1, 1, 1, 1, 1, if you prefer). This is the DELETE code. IC7 (74LS30) is a 8-input NAND gate with 7 of its inputs looking at the keyboard output, so when the delete code is presented by the keyboard, the output of IC7 will be low. This signal is inverted and fed into our counter which has the following effect: when our counter is clocked by the strobe pulse it will count down instead of up. The output of IC7 is also used to inhibit and write signal to our RAM so the cursor will step back and the information in the RAM remains unchanged. In effect we have created a 'backspace' function; probably the most useful cursor function for a small character generator. The use of the DELETE key for this function instead of the backspace key simplifies our circuit and does not cause too much operator confusion as keys like this are rarely used in a touch type mode.

S1 is used to remove the cursor. Closing it inhibits the chip enable input of the RAM from going high, the state that generated the cursor.

The page switch is optional and if not required pins 1, 2, 3, of the RAM should be connected to ground. Note provision is not made (on the PCB) for the 3 x 10k pull-up resistors associated with this switch. These are best fitted directly to the back of the switch.

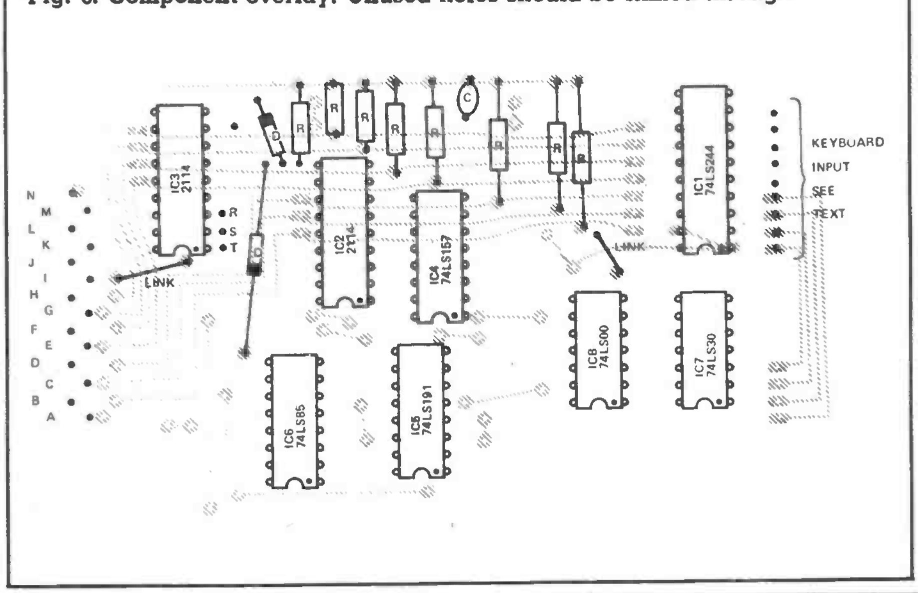
The only problem left is in connecting up a keyboard. I used an RCA *CP601*. The output is via a PCB mounted socket, which takes a 3M connector No. 3421-6020. I have shown how to connect that particular keyboard to my circuit by indicating pin numbers.

Those of you with other keyboards the strobe required is active low. The data outputs connect to pins 11, 8, 4, 13, 15, 2, 6 of the 74LS244 in that order, wtih pin 11 being the least significant bit.

If you want to avoid buying a keyboard the *Amateur Television Handbook Vol. 2* gives details of how to build your own, or how to control ASCII codes by using BCD switches.

The book is available from BATC Publications, c/o G3IQU QTHR. ●

Fig. 6. Component overlay. Unused holes should be linked through



Technicalities

Broadband transformer design by Frank Ogden G4JST, Editor Ham Radio Today

Ferrite based transformers offer one of the most powerful design tools available to the radio amateur. They can both isolate and match lumps of circuitry over the complete HF spectrum with virtually no loss. It is almost unthinkable to build a piece of gear without using them in some form or other so I make no apologies for presenting them in the *Technicalities* column.

Although RF transformers are manufactured from ferrite or dust iron cores, they use exactly the same principles as transformers operating at any other frequency. A current flowing in the primary coil induces a magnetic flux in the core. A second coil intercepting this flux, ie. wound on top of the first one, produces a voltage proportional to the applied AC voltage and the ratio of the turns between the two coils.

As with 50Hz mains transformers, there are limits. The primary represents an inductance in parallel with the applied voltage. If the inductance is too low, the circulating current will cause such intense magnetisation of the core that it will saturate it, and the losses will increase dramatically. Many people will have heard and smelt the distress of a mains transformer inadvertently connected to its 115V tapping. RF transformers can saturate in precisely the same way, but more about this later.

Small signal, wide bandwidth

Regardless of the operating frequency or core material, the transformer law, as shown in **Fig. 1** applies. The turns ratio (between primary

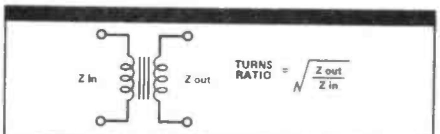


Fig. 1. The turns ratio is the square root of the impedance ratio.

and secondary) is the square root of the impedance ratio. Put another way, the impedance ratio is the square of the turns ratio. If you wind nine turns on a ferrite bead (excellent for small RF transformers) and then a further winding of three turns, a load of 50 ohms attached to the three turn winding will be transformed to a 450 ohm load as seen across the terminals of the nine turn winding. For those with a practical view, three turns on a ferrite bead in parallel with a 50 ohm source will handle up to about 100mW of power — transformed to an impedance dictated by the number of secondary turns — across the range 2 to 70MHz. Precise characteristics though will depend on the ferrite material from which the bead was made. An alternative statement of transformer law is shown in **Fig. 2.**

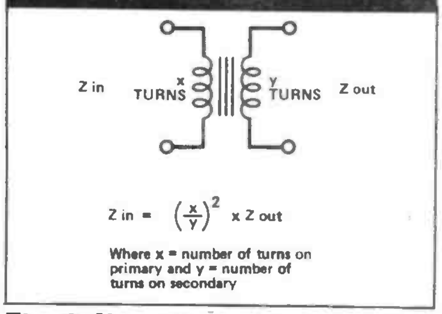


Fig. 2. If you know the turns ratio of a transformer and the impedance connected to one side of it, you can calculate the impedance 'seen' at the other side of the transformer.

Figure 3 offers a very practical application of simple wideband transformer design. This grounded gate JFET preamp provides about 14dB of very low noise gain right across the range 1 to 30MHz. Above 30MHz, there is a gentle falloff in gain; the unity figure is reached around 100MHz. Strangely, the gain slope has almost nothing to do with the ferrite transformer and everything to do about circuit parasitics. The transformer is shown wound with a ratio of 5:1. This transforms the 50 ohm output load to

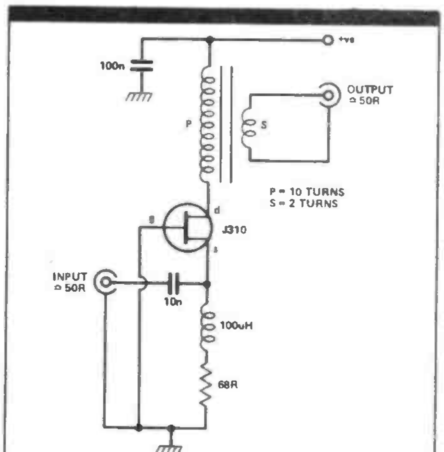


Fig. 3. A broadband low noise RF pre-amp

1250 ohms at the JFET drain. The device output capacitance is about 5pF. The upper computer graph shows the predicted response due to the loading effect of 5pF across 1250 ohms. The real plot would show slight ripple due to the leakage inductance of the transformer resonating with this capacitance.

The effect of capacity loading in small signal broadband transformers is clearly shown in the second plot. The turns ratio has been increased to 10:1. Although the circuit gain now rises to 20dB, the frequency rolloff is much more marked. In this, there is a profound truth for the circuit designer: the bandwidth of a circuit is inversely proportional to its gain. The parasitic components which determine the gain of the circuit shown in **Fig. 3** are brought out in **Fig. 4.** The sample holds one more lesson which is directly related to the ferrite material. The transformed load resistance, Rp if **Fig. 4**, is directly in parallel with the primary inductance of the transformer. The lowest operating frequency will be determined when the inductive reactance of the primary winding has the same value as the transformed load resistance. Since the transformer primary inductance will be a function of the core material, the LF frequency response is totally dependent on the grade of material used in the core. Furthermore, the core is most likely to saturate at the bottom end of the range.

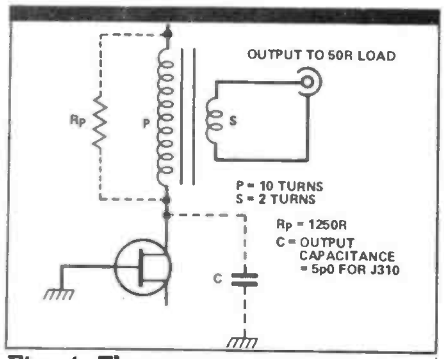


Fig. 4. The unseen components of Fig. 3. It is these, and not the characteristics of the ferrite which largely determine the frequency response of a broadband circuit.

Leakage inductance

The earlier circuit example showed that high impedance, transformer coupled broadband circuits exhibited a bandwidth determined mostly by external loading capacitance. It therefore came as quite a shock to me

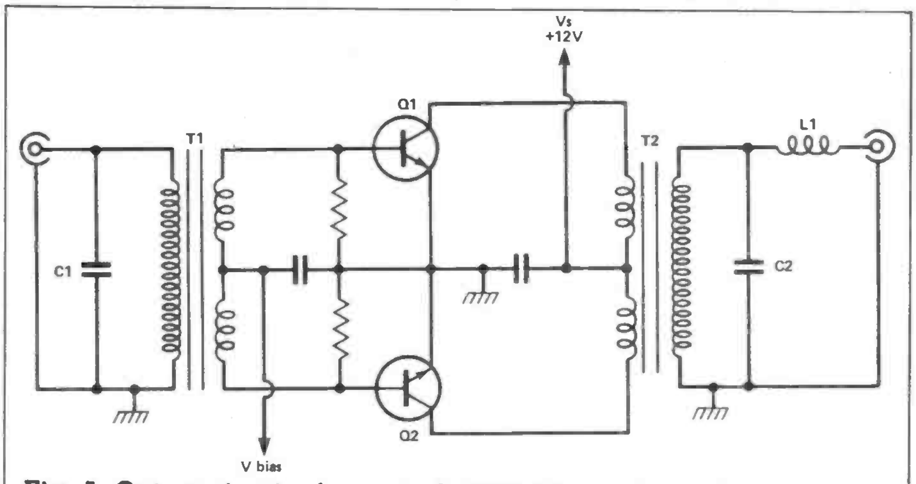


Fig. 5. Output circuit of a typical 100W HF transistor PA

when I saw high power transistor circuits with extra capacitance added in parallel with the windings. It struck me as very odd indeed.

Figure 5 is just such a circuit example. It depicts the standard 12V 100W broadband HF PA stage using stacked ferrite rings as the basis for the input and output transformers. The transistor input and output resistances are very similar at this level of power and supply voltage. Without going into too many details, please accept as fact that the ratio between primary and secondary on T1 should be 4:1, and 1:4 on T2. Why is Cl across the primary of T1 (typical value 150pF) and C2/L2 across T2 (typical values 220pF, 100nH)?

The answer is leakage inductance. If T1 and T2 were perfect transformers, the extra components would not be necessary. In the real world, the total flux induced by the primary circuit does not completely encompass the secondary winding with the result that some of this magnetic path 'gets lost'. This is like adding a low value inductance in series with both the primary and secondary windings. This has all sorts of implications.

High power

In high impedance circuits, such as the preamp of **Fig. 3**, leakage inductance doesn't matter too much. As I said earlier, the most that it will normally do is to cause a ripple in the frequency response. With a typical value of a few nanohenries for a small transformer, this series reactance is very low compared with the load impedance, even at the highest operating frequency. In the circuit example of **Fig. 5** the load impedances are in the region of a couple of ohms at most. It only takes a touch of stray inductance to insert unacceptably high reactances in series with the load. The effect of these is to reduce the current swing available in the RF signal. In uncompensated circuits, the high frequency falloff in output power (and gain) is very marked. A design which delivers 100W at 3.5MHz may only give around 40W at 29MHz. Similarly, the available gain may fall from 20dB to 8dB or less. Unfortunately, the falloff due to leakage inductance in the transformers looks almost identical to the rolloff curve of poor quality PA transistors. It is no wonder that many people are left scratching their heads about disappointing performance.

The answer lies in the arrangements shown in **Figs. 6** and **7**. You can't design a broadband transformer which doesn't have leakage inductance. You have to find a way of living with it. Like all these things, there is almost a conspiracy against the RF designer. To build powerful amplifiers you must use components, ie. ferrite transformers, which are man enough to handle the expected power. This means that they must be large. The larger they are, the more leakage inductance they must exhibit therefore the worse the problem is. You have to treat the leakage inductance as if it was a separate component. In **Fig. 6**, a schematic representation of the input circuitry, the stary inductance is resonated with the capacitor C1. In theory, C1 could be connected in series with the primary to form a series resonant circuit. However, this would provide cancellation at one frequency only. Connecting C1 as shown produces a less complete, but adequate cancellation over a much wider frequency range. On the LF side, C1 has a high reactance and T1 performs its job in the normal manner. As C1 starts to resonate with the leakage inductance towards the HF end, the impedance at the input rises although not excessively because the Q is low. The equivalent of 2:1 SWRs can easily be tolerated at the input which is the sort of value that might be expected across the range 1 to 30MHz. A more complete conpensation is required on the output transformer.

The output circuit

Figure 7 shows the schematic details. If a transistor output stage is to deliver a specified output power over the HF spectrum, the load resistance which the devices actually see needs to be kept to within around 10 per cent variation on the mean value. In this case, leakage inductance is accomodated by making it part of a T filter arrangement with a rolloff designed for just above the operating range. The stray inductance provides one arm and L1 provides the other. C2 acts as the bottom of the T. In practice the only way to find a value for L1 and C2 is empirically. There are people who say that this type of network can be calculated but, frankly, I don't believe it. In a 100W design, insert about 80nH for L1 and around 100pF for C2 as ballpark values. Chop and change until you obtain the most level response. The precise values will depend completely on the characteristics of the transformer, so that should be designed first. (I suppose that goes without saying.)

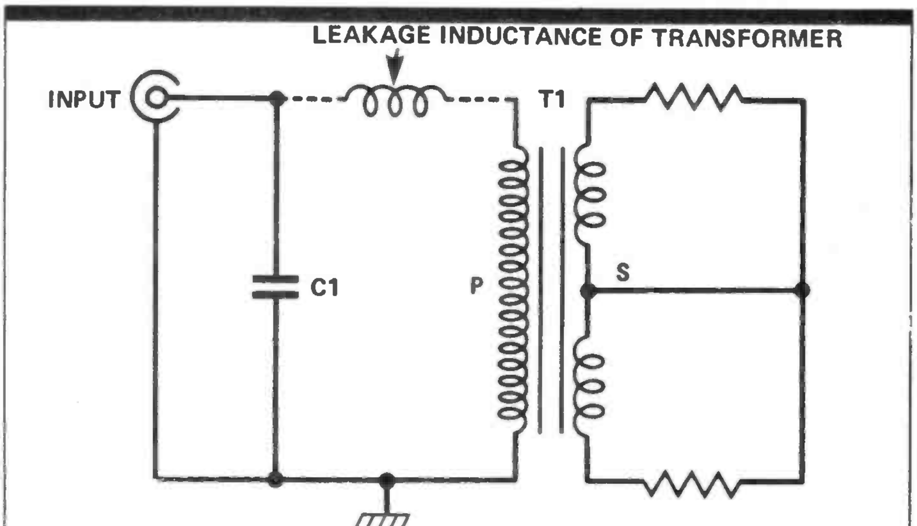


Fig. 6. Tuning out the leakage inductance. Capacitor Cl is chosen to resonate with the leakage inductance at the highest frequency which the transformer is required to match.

RF power transformer design

This is a pretty complex business and I propose to deal with the 'how' rather than 'why'. You need, at minimum, to know the following things about the ferrite material. I have assumed the use of ferrite rings typical of the power designs usually published. I have also assumed that one winding of the transformer will operate to or from a 50 ohm load. The other winding is dictated purely by the transformation requirements. **You must know:**

The outer diameter of the ring: Do (mm)
The inner diameter of the ring: d(mm)
The height of the ring: h (mm)
The relative permeability: μr
The turns ratio of the transformers: n (this assumes that the secondary, the collector or base winding, will comprise a single turn made out of copper or brass tube, and that n will be the number of turns on the primary for connection to a 50 ohm load)
The minimum operating frequency: Fmin (MHz)
The power to be transformed: Po (Watts)
The power loss per cubic cm of ferrite material at a given frequency and specified magnetic induction: Ploss (mW)

The last two quantities need only be known if loss calculations are to be made.

Other quantities: μo (permeability of free space) = 4 x Pi x 10^{-7}

First calculate the cross sectional area of an individual core: s (m^2)

s = h x (Do -d)/2 x 10^{-6} square metres

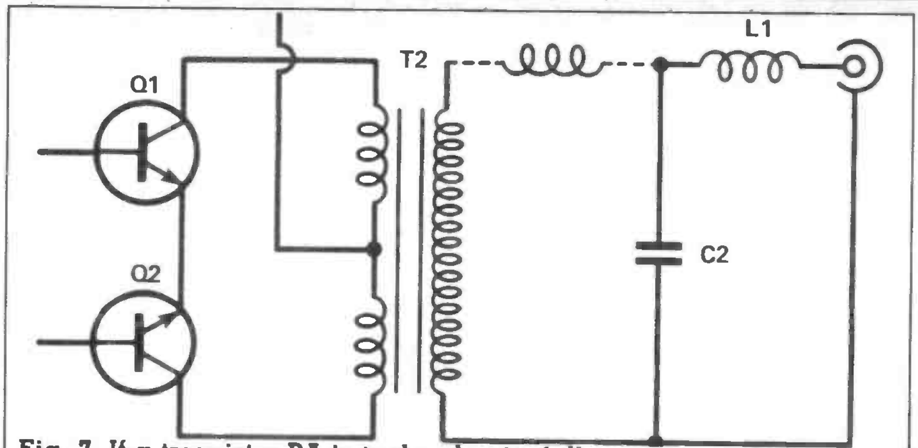


Fig. 7. If a transistor PA is to develop its full power over the range 1.8 to 30MHz, the transformer leakage inductance must be carefully cancelled out over the same frequency span. The inductance is made to form part of a 'T' filter arrangement with a characteristic cut-off frequency just above 30MHz.

Next, calculate the magnetic path length: l

l = (Do -((Do -d)/2)) x Pi mm

Now you need to know the minimum inductance which the circuit design can tolerate. Generally, a minimum reactance of 150 ohms will be adequate for a 50 ohm system.

Lp = 150/2 x Pi x Fmin μH

The number of ferrite cores, Nc, required to achieve the desired performance is:

Nc = (Lp x l x 10^{-9})/ (μo x μr x n^2 x s)

Round the value Nc up to the nearest whole even number.

To work out the system losses v, the maximum peak voltage across the primary (50 ohms) is calculated:

v = square root of (Po x 100)

Work out the maximum induction within the core: B (mT)

B = 10 x (v/(2 x Pi x Fmin x 10^3 x n x Nc x s)) mT . . . milliTesla

Next work out the volume of the core in cm^3

Vol = Pi/4 x (Do^2 - d^2) x h x Nc x 10^{-3}

The total power lost in the core = vol x Ploss mW

I have devised a computer program suitable for the Sinclair Spectrum which takes the chore out of transformer design. The listings and program output have been included. For guidance, the typical loss figure for ferrite materials with a μr in the region of 100 to 200 is 200mW/cm^3 at a maximum induction of 12mT at 1.8MHz.

```
   5 REM "Broadband"
  10 PRINT "Enter details of toroid cores"
  15 PRINT "All dimensions to be in mm"
  20 INPUT "Specify outer diameter ";Do
  30 CLS
  40 INPUT "Inner diameter ";d
  50 CLS
  60 INPUT "And the height ";h
  70 INPUT "Specify  relative permeability ",ur
  80 PRINT "Next, the turns ratio"
  90 INPUT "How many turns on primary? ";n
 100 CLS
 110 LET uo=4*PI*10↑-7
 120 LET s=h*((Do-d)/2)*10↑-6
 130 LET l=(Do-((Do-d)/2))*PI
 140 PRINT "Primary inductance"
 145 PRINT "This assumes reactance","is equal to three times ","operating impedance normalised","to 50 ohms"
 150 INPUT "Specify lowest frequency MHz ",Fmin
 155 CLS
 160 LET Lp=INT (150/(2*PI*Fmin)): PRINT "Primary inductance = ";Lp;" uH"
 170 LET Nc=INT ((Lp*l*10↑-9)/(uo*ur*n↑2*s)+.5)
 175 PRINT
 180 PRINT "[illegible]:"
 185 PRINT
 186 PRINT "Outer diameter ";Do;"mm"
 187 PRINT
 188 PRINT "Inside diameter ";d;"mm"
 189 PRINT
 190 PRINT "Height ";h;"mm"
 191 PRINT
 192 PRINT "Relative permeability ";ur
 193 PRINT
 194 PRINT "Minimum frequency ";Fmin;"MHz"
 195 PRINT
 200 PRINT "Number of primary turns = ";n
 205 PRINT
 220 PRINT "Number of cores = ";Nc
 225 PRINT
 230 INPUT "Enter transferred power (W)","assuming a 50 ohm matched ","load ";Po
 240 LET v=SQR (2*Po*50)
 250 LET B=INT (10*(v/(2*PI*Fmin*10↑3*n*Nc*s)))/10: PRINT "Max induction = ";B;"mT"
 260 INPUT "Power loss density of ferrite","material at the maximum flux","induction level and the minimum","frequency: mW/cm↑3 ";Ploss
 270 LET vol=PI/4*(Do↑2-d↑2)*h*Nc*10↑-3
 280 PRINT
 290 PRINT "Power loss in core is ";INT (Ploss*vol);"mW","at ";Po;"W transferred power level"
```

Fig. 8. Sinclair Spectrum transformer design program.

```
[illegible]:
Outer diameter 12.7mm
Inside diameter 6.35mm
Height 6.35mm
Relative permeability 220
Minimum frequency 1.8MHz
Number of primary turns = 3
Number of cores = 8
Max induction = 12.9mT
Power loss in core is 965mW
at 50W transferred power level
```

Fig. 9. Program output (above)

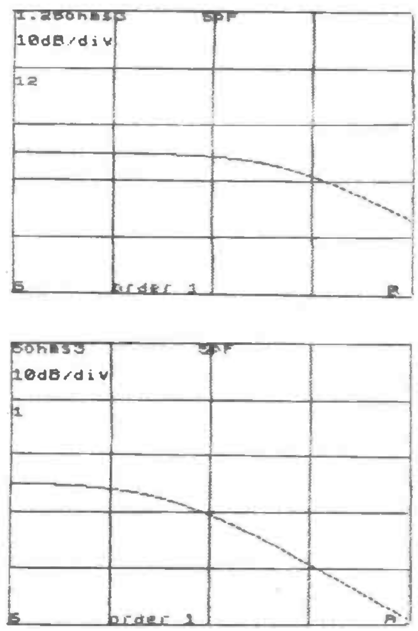


Fig. 10. The two computer plots (above) show the effect of output resistance changes on frequency response for the circuit shown in Fig. 3.

RADIO TOMORROW

7-8 May	432/1296/2320MHz Contest (rules in March *Radcom*)
	CQ M Contest (rules in April *Radcom*)
8 May	144MHz Low Power Contest
	Lincoln Hamfest, Lincolnshire Showground, 11am-5.30pm, talk-in S22 & SU8.
	Mid-Ulster Amateur Radio Club Rally, Parkanaur House, opens 12 noon.
11-14 May	*Nu Piscids* meteor shower (max 12 May)
14 May	GB2WEC special event station at the Old Power Station, Bargates, Christchurch, Dorset. (Home of Wedgewood Electrical Collection.) On air 10am-5pm, 2m FM & 80/20/15/10m SSB/CW. Special QSL card.
15 May	WAB LF Phone Contest (rules in April *Radcom*)
	Region Round-up Contest (rules in April *Radcom*)
	Swindon Radio & Electronics Rally, 10am, Park School, Marlowe Avenue, Swindon. Talk-in S22 & SU8.
	Northern Mobile Rally, The Great Yorkshire Showground, Harrogate; opens 11am (10.45am for disabled visitors), talk-in.
16 May	Radio Amateurs' Exam
21-22 May	144MHz Contest
22 May	British Amateur Television Club Exhibition, Post House, Leicester.
	432MHz CW Contest (rules in March *Radcom*)
	RATEC 83 Rally, South Manchester, 11am-5pm, talk-in S22.
22 May (contd.)	Barry College of Further Education Radio Society — Welsh Amateur Mobile Rally, Memorial Hall, Barry, 11am-5pm, talk-in S22.
29 May	East Suffolk Wireless Revival: rally at Civil Service Sportsground, Bucklesham, Ipswich.
	Plymouth Radio Club Rally: 10am, Tamar High School, Paradise Rd., Stoke, Plymouth. Talk-in S22 & SU8.
30 May-18 June	*Arietids* Meteor Shower (max 8 June)
1-16 June	*Zeta Perseids* meteor shower (max 8 June)
4-5 June	National Field Day (rules in February *Radcom*)
	Phase IIIB satellite launch on *Ariane 7*
5 June	Spalding Rally, at Springfields, Spalding, Lincs. Talk-in S22 & SU8. Opens 11am.
12 June	70MHz Contest
	RNARS Mobile Rally, HMS Mercury, Nr. Petersfield
	Elvaston Castle Mobile Rally, Elvaston Castle Country Park, near Derby, 10am, talk-in.
19 June	Denby Dale Amateur Radio Society mobile rally. Shelley High School, Shelley, Nr. Huddersfield. 11am-5pm (open 10.30am for RAIBC)
22-30 June	*June Perseids* meteor shower (max 26 June)
25-26 June	Summer 1.8MHz Contest
26 June	WAB 2m/70cm Phone Contest
	Longleat Mobile Rally, Longleat Park, Nr. Warminster, Wilts. Opens 10am.

If you would like your event publicising in this column then send details *at least two months in advance of the cover date* to Richard Lamont G4DYA, Ham Radio Today, 145 Charing Cross Road, London WC2H 0EE.

NEW PRODUCTS

VHF/ UHF multimode multiband rig

The Yaesu *FT726R* offers FM, SSB and CW on the 50, 144 and 432MHz bands, by using separate plug-in RF modules for each band. An optional satellite unit allows crossband full duplex working, making it possible to hear your own signal coming back from an *Oscar* without the need for a separate receiver.

The VFO A/B system has ten programmable memories, and can be tuned in 20Hz steps on SSB/CW, or selectable steps (on a separate knob) for FM.

The basic unit, covering the 144MHz band only, costs £649 inc. VAT and is imported by both SMC and Amateur Electronics UK.

10,18 & 24MHz on the FT101 Mk. 1E

Harry Leeming (G3LLL) is producing a modification kit to put all three new HF bands on the *FT101 Mk. 1E*, using the CB and WWV positions, together with a relay in the 21MHz position. The kit will produce full output, but it is recommended that power is kept to 50W or less for maximum reliability.

This modification will be described in a later part of the *Ham Radio Today* series on the *FT101*. We are, however, asked to point out that the kit is for this model only, and that it will not be produced for any other Yaesu rigs. The kit costs £15.75 inc. VAT and carriage, and is available from Holdings Photo Audio Centre, Mincing Lane, Darwen Street, Blackburn, Lancs., BB2 2AF.

Dipole tuning chart

The maker of the *Slinky Dipole* aerial is offering a free tuning chart to owners who want to use the aerial on the 10MHz band. No extra attachments are necessary, but the maker says this extra information is needed.

If you want a copy of the chart then send two IRCs to the Blacksburg Group, Inc., PO Box 242, Blacksburg, Virginia 24060, USA.

Locator map

The Intermedial *Locatorset* is a new map of Europe supplied with a transparent plastic ruler to enable rapid measurement of the distance between stations. It also offers a quick method of working out QTH/QRA locators.

The map has a scale of 1:3,000,000 and a claimed accuracy of 0.5%, which is within contest tolerances.

It is available from Intermedial Ltd., 3 Beech Avenue, Eastcote, Ruislip, Middlesex HA4 8MG.

Auto notch filter

Model *ANF* from Datong is a new automatic notch filter designed to remove 'tune-up whistles' and heterodyne interference automatically. It connects in series with the receiver's speaker.

The *ANF* has two interesting new features — firstly a horizontal LED bar graph display to show the notch frequency. Secondly, a speech compander (compressor/ expander) is used to ensure the filter is operating at the optimum level no matter where the receiver's volume control is set.

The *ANF* scans the audio range from 270 to 3500Hz, and locks onto and notches out a whistle in about a second. Datong says the notch is "typically better than 40dB at 3.5kHz."

The notch can also be moved manually if desired, but with AFC to 'lock it on' once it is set within 100Hz of the unwanted signal.

The filter can also be used in a 'peak' mode to provide a narrow CW filter, with a 3dB bandwidth of 60Hz at a frequency of 800Hz.

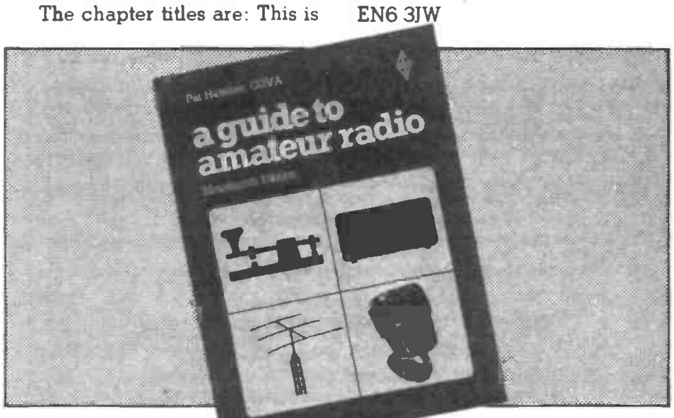
The *ANF* costs £67.85 inc. VAT and is available from either Datong stockists or Datong Electronics Ltd., Spence Mills, Mill Lane, Bramley, Leeds LS13 3HE.

BOOK: A Guide To Amateur Radio

This new and expanded (19th) edition of the *Guide* seems to offer something for every radio amateur and listener. The beginner will find an introduction to amateur radio; for the listener there are tips on starting as an SWL, with a list of Q-codes and prefixes etc; the RAE candidate should find the technical explanations of many radio topics useful; while the licensed amateur may find the book a useful reference.

The chapter titles are: This is amateur radio; Fundamentals of electronics; Getting started; Amateur radio equipment; Communication receivers; Transmitters; The antenna; Workshop practice; The licence examinations; Operating an amateur radio station; The RSGB and the radio amateur; International amateur radio organisations. There are three appendices — 1982-85 RAE syllabus and objectives; Sample RAE questions; Safety pointers.

The book is a 160 page paperback, and costs £2.75 (or £3.44 by post) from the RSGB, Alma House, Cranborne Road, Potters Bar, Hertfordshire EN6 3JW



TS430 REVIEW

Trio TS 430S Multimode HF Transceiver
By Angus McKenzie MBE, C.Eng, FIERE, G3OSS

Many readers will have used Trio's earlier *TS120* and *130* SSB/CW LF and HF band transceivers, and will probably have admired them for their simplicity of operation coupled with good ergonomics and reasonable performance. Despite constant criticism over the years, Trio have never incorporated an FM facility on their HF rigs before, but at last we have in the *430* one in which an FM transmit and receive capability is complemented by AM, upper and lower single sideband and CW. Most unfortunately, the FM facility together with narrow SSB and CW filters are optional extras, at £31 to £35 each, but this review sample was loaned to the magazine by Ham International, who could not supply accessories at the time.

Facilities and Ergonomics

The *TS430* is basically a 13V DC rig which draws up to around 16A peak current on transmit. It will work equally satisfactorily as a home station with a suitable external power supply (around £100) or in the car. On receive the rig covers from 150kHz up to 30MHz, stepping up or down in 1MHz steps or from one amateur band to the next, dependent on the position of a switch labelled '1MHz'. Two rates of tuning are provided, with 10 or 100Hz per step, but unfortunately the 'kHz per rev' is not quite constant across each 1MHz band. For example, we measured anywhere between 8.5 and 9.5kHz per revolution on the smaller step position, despite Trio's claim in the manual that it should be 10kHz. To the left of the main tuning knob is a row of five push buttons selecting LSB, USB, CW, AM and FM modes. On the left hand side is the 13V on/off switch and rockers for TX/RX, VOX controlled TX, processor on/off, ALC or current metering, narrow/wide IF filter (only wide supplied for review). The normal multipin Trio microphone socket is on the bottom left, and a Trio hand mic with PTT and 'up and down' buttons was supplied with the review sample. On the left side is also ¼" headphone jack (plenty of volume here) and concentrically mounted rotary gain controls for mic and carrier insertion levels. A fluorescent green digital frequency readout above the timing knob displays the nearest 100Hz, (or to the nearest 10Hz if an internal jumper is cut). To the left is the meter which on receive is a normal S meter but on TX reads total current of ALC. Behind another window, to the right, is the display showing the selected memory channel.

Unlike Trio's earlier models, this latest *TS430* has very many push buttons to the right of centre, as well as some rotary switches, which can provide some most useful facilities, but perhaps also a few that you may well never use. The main memory switch selects any one of eight memory channels, insertion of any frequency into these requiring just the touch of the MEMORY IN button. The 6th and 7th memory positions also serve a select start and stop frequencies for continuous scanning, another button putting the box into the scanning mode, with an accompanying button to hold the scan. Two seperate VFOs are provided, a four-position rotary switch selecting either of these of a criss-cross arrangement allowing you to transmit on one and receive on the other, or vice versa.

Poor documentation

Additional buttons provide facilities for inserting VFO B's frequency into A, frequency lock, small or large frequency steps, memory recall (this sets the chosen VFO to the selected memory frequency from which the VFO can then move), fixed memory channel, and memory scan. Large up and down buttons shift the band either to the next amateur band, or to the next 1MHz band, determined by another switch. Further switches select receiver incremental tuning (the pot for this is concentrically mounted with the IF shift control which has a centre indent), noise blanker, 20dB antenna attenuator and finally a very good notch filter, the pot for which is concentrically mounted with a squelch control which acts on all modes. The only other controls on the front panel are concentrically mounted rotaries for RF and audio gain.

On the top of the rig are four very

small slide faders allowing adjustment of VOX gain, VOX delay, anti-VOX and scanning speed (this is also controlled by the 10/100Hz step switch). The loudspeaker is mounted in the top, and whilst this will usually be convenient, it could be a nuisance in some positions in a car. You might have to plug in an external speaker. Underneath the front of the rig is a level tilt bar which lifts the front of the rig up when it is resting on a table, and this was rather nice. On the back of the rig is a heavy duty 13V power socket (lead supplied with heavy duty fuse), ¼" key jack, external speaker 3.5mm jack, an SO239 RF in/output socket and a large wing nut terminal for earth connection. Three multi-pin standard Trio DIN type sockets are provided. The REMOTE socket has seven pins with inter-connections for external ALC, loudspeaker output, a pin which shorts to deck on TX for controlling an external linear (for example) and an external PTT line. The ACCESSORY socket had eight pins, and this can be connected to external equipment requiring logic information from the *TS430* regarding the band in use. A 12V DC voltage on TX only id available on one of the pins, and another pin, when grounded externally, reduces the rig's output power to about 50W. Amongst the eight pins on the TRANSVERTER socket are provisions for input/output and controlling an external transverter.

At this point I would like to criticise rather heavily the unhelpful manual since it is very difficult to find out more details of these pin connections and there seems to be generally a considerable lack of basic information as compared with Yaesu and Icom instruction books. On the back panel of the rig is an enormous heat sink, and built into this is quite a powerful fan which comes on as and when the temperature of the heat sink demands it.

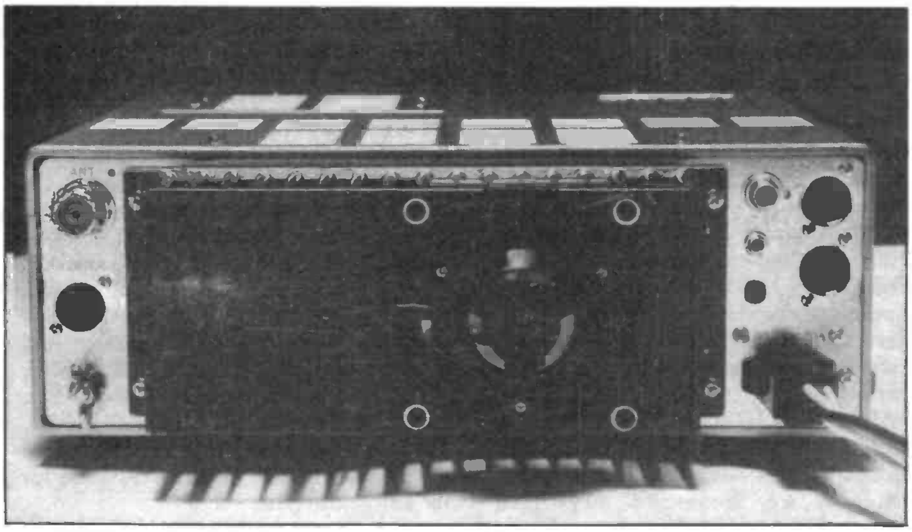
The rig is reasonably compact, and contains a remarkable number of facilities and has room for many options when one considers its size and weight. (275 × 105 × 335mm abd 6.5 kg).

Subjective comments

I used the rig on SSB, and briefly on CW, over a period of two weeks on a number of bands, and found it very easy to use, although it took some time to work out how to operate all the facilities. Transmitted audio quality frequently received favourable comments, the compressor being liked as well. The transmission seemed to have a good deal of punch to it, and was very clean, all listeners finding the transmission quite narrow even when the processor was in use. It was such a pity that Ham International could not supply the FM board because I would have liked to have tried the rig on 29.6 MHz, the international 10m FM calling frequency. The three new bands, in the 10, 18 and 24MHz segments were not supplied 'enabled', although ones supplied by Lowe electronics normally have this provision.

Although I was concerned that the tuning rate was not exactly 10/100kHz per rev, the tuning ergonomics were very good indeed. The scan buttons on the microphone operated in the same way as usual, again the scanning speed being controlled by the slider on the top of the rig, and the step switch. Even when the rig is in the 'amateur bands only' mode, rather than the general coverage 1MHz up/down steps mode, complete receive coverage is possible by continuing tuning below or above the appropriate amateur band. I tuned all the way from 30MHz down to 0Hz to check on this, not quite wearing out my finger in the process. However, the absence of a slip ring around the finger hole, (such as on the *TS830*) is a pity. This makes it possible to whizz up and down very rapidly. On my scan across the frequency coverage of the rig I noticed a large number of minor sprogs, and one extremely bad major one, this check being carried out with a screened dummy load screwed onto the aerial socket, and even with a ferrite ring close to the set on the 13V lead. The bad sprog was audibly over S9 at 21.562MHz, although the meter only read S3 on it. The minor 'birdies' would not be disturbing on lower frequencies, but you might be very slightly disturbed by one or two which were equivalent to an audible S3 to S5 or so on the 10m band, which did not, however, register on the S meter. The worst ones were on 28.888, and 28.921MHz.

Rear view showing heatsink and quiet cooling fan



I checked the performance audibly on 160, 80 and 40 metres, both during the day and at various times in the evening, and I was impressed with the clean reproduction of DX and local stations, with no apparent cross mod or RFIM problems, the 20dB attenuator taking good care of this when signal strengths were way up well after dark. The RF sensitivity appeared to be adequate even on 10 metres, although the IC740, for example, is slightly better. Selectivity seemed to be good, but rejection of extremely strong CW well off channel did not seem to be as good as that on one or two competitive rigs. The T-notch filter was extremely good, indeed one of the best that I have measured in some time.

It is unfortunate that only one AGC speed is available, and I felt that this was sometimes rather fast, particularly on strong 80 metre stations. If, however, you consider putting in the attenuator during the daytime on 80 metres, then even fairly strong signals will become a little hissy with the attenuator in. Turning the RF gain control down (with attenuator out) improved the sound quality. What upsets me a little about an AGC that acts a little too quickly is that voices tend to pump, and background noise in the shack, including reverberation, becomes too audible. I cannot remember a receiver built specifically for amateur use that had an AGC facility that I would have regarded as too slow. I do like the option of twiddling with the recovery speed, which is what is lacking here. I also note that there is no apparent way of turning the AGC off, a useful facility for CW reception sometimes.

The IF shift control, which is usefully centre indented, and thus marking a nominal centre position, was very useful. Sometimes this facility is termed 'bandpass tuning', and basically alters the position of the filter with reference to where an injected carrier would have to be correctly inserted to demodulate the SSB at the right pitch. It can, for example, give you the pass band from say 100Hz to 2.5kHz, or from 500Hz to 2.9kHz if you prefer male voices to change sex! It can also be used more seriously to filter out, or at least to reject more efficiently, carriers or interference just off frequency. As the narrow SSB filter and CW filters were not supplied, I cannot comment on their performance.

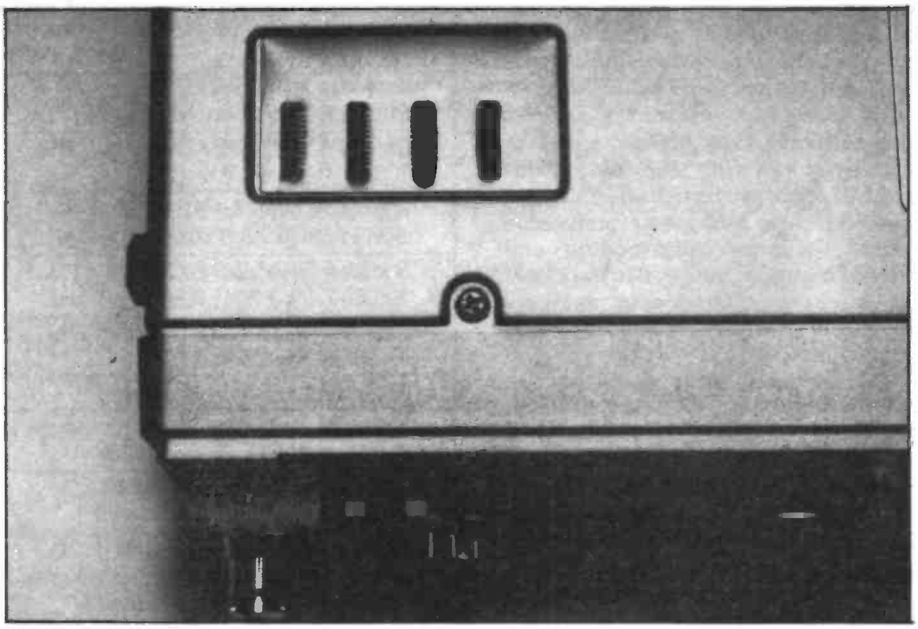
Memory function

Squelch action on SSB signals operated well, provided the signals were reasonably strong, and no problems were experienced with the RIT. Memorising frequencies and recalling them, particularly when I wanted to move the VFO either way from a memory frequency, operated superbly well. This facility is most useful, although I cannot see that there would be much use for punching in the memory channel button and operating exactly on a memory frequency without the facility for VFO'ing, unless you were using the FM option on fixed 10metre channels. Memory 8 will be useful here, for it allows the memorising of separate TX and RX frequencies for 10m repeater operation. The scanning, defined by memories 6 and 7, would probably be found when you want to scan relatively small frequency areas continuously, but I don't expect many would want to use the scanning for continuously monitoring large chunks of spectrum other than to leave the receiver running on a large section of 10 or 15M when the bands is closed to indicate the first signal that pops through after band opening.

What cost?

The VOX control worked satisfactorily on transmit, and the setting of gain, delay and anti-trip was very simple. One strange feature provided by the rig is the ability to transmit on one band and receive on another, which I suppose could be useful to the odd person, but certainly not to me. I cannot help but feel that despite the excellent general ergonomics of this rig, Trio have made it too complicated, and thus the price is higher than it need have been. I would have preferred, to have had FM plus the filter options in with the price, but some of the esoteric microprocessor functions perhaps available as options, but I do realise that this suggestion rather defeats the design idea. Let's put my suggestion another way, then, that Trio ought to release a rig with identical specifications, including FM, CW and SSB, but without general coverage receive, and microprocessor functions, which overall would be regarded as an inexpensive successor to the *TS130*, at a lower price than the present rig, which, with options, will be typically around £800. Even if the average user does not want to use FM on 10m, and most certainly not on any of the lower bands, he is very likely to use a transverter with the rig up to 2metres for example, and in this case it will be very simple to cope with repeaters, although you would have to either whistle your way in, or use an external tone burst generator. We were not able to try the rig into a transverter because of inadequate instructions, and time, but if the transverter feed is similar to that from the *TS830*, the level would be very low.

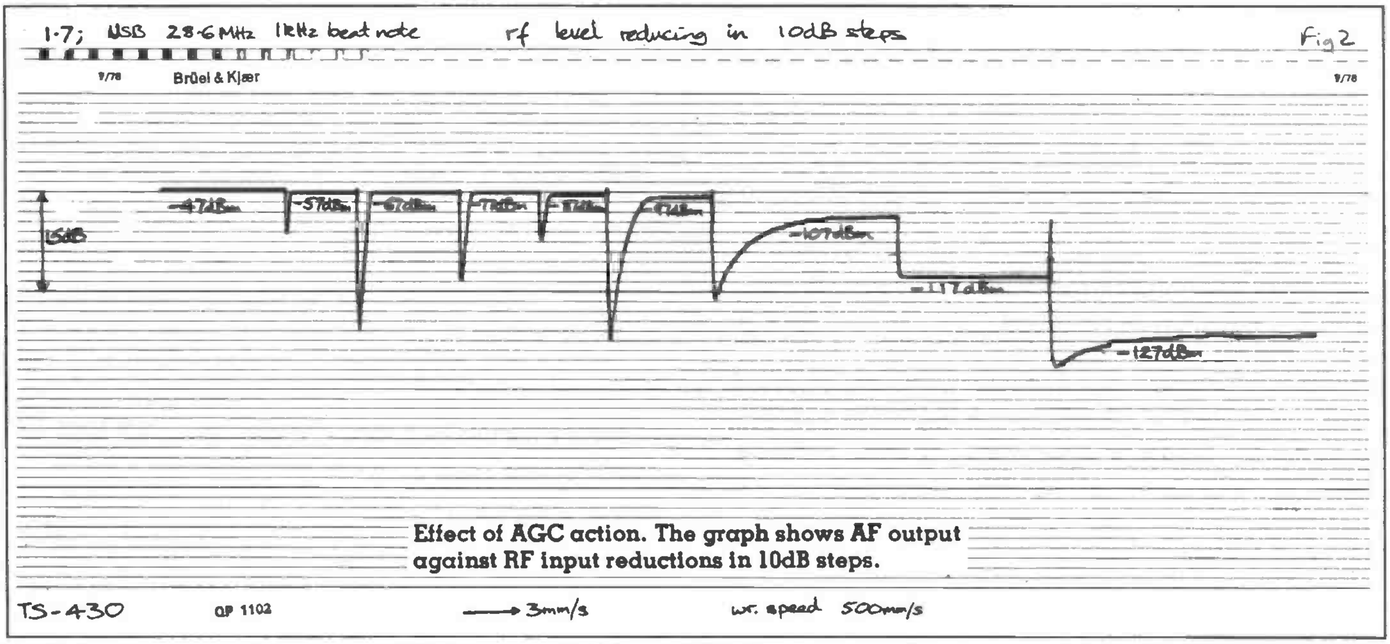
Incidentally Microwave Modules transverters can be supplied with extra sensitivity to work with modern low transverter feed level outputs, although you may have to modify older models.



VOX and Scan controls mounted on top panel

Feelings

To sum up my own feelings for the rig, I can report that I was impressed with its general performance, but would prefer something simpler for mobile use, but a little more comprehensive for fixed station use. Whilst Trio's provision of DIN



Effect of AGC action. The graph shows AF output against RF input reductions in 10dB steps.

type sockets for many of the external facilities may lead to a tidier shack, I much prefer lots of phone sockets because I am, and always have been, rather a fiddler, liking to try all sorts of external combinations in a hurry. If I can avoid the nexessity of soldering wires onto a DIN socket, at almost any cost, I will do so, but I must admit to being very prejudiced against them for longstanding and personal reasons! I used to like the larger old 'Granny-type' 8-pin octal auxiliary sockets, but terminals or phonos are even better.

I could find no actual snags in either the receive or transmit side which would stop me recommending at least a good look at the rig, which is therefore certainly worth consideration. Don't forget to ask about accessories and after sales service facilities before you commit yourself to purchase, for this may influence where you buy the rig, as well as perhaps minor differences of price.

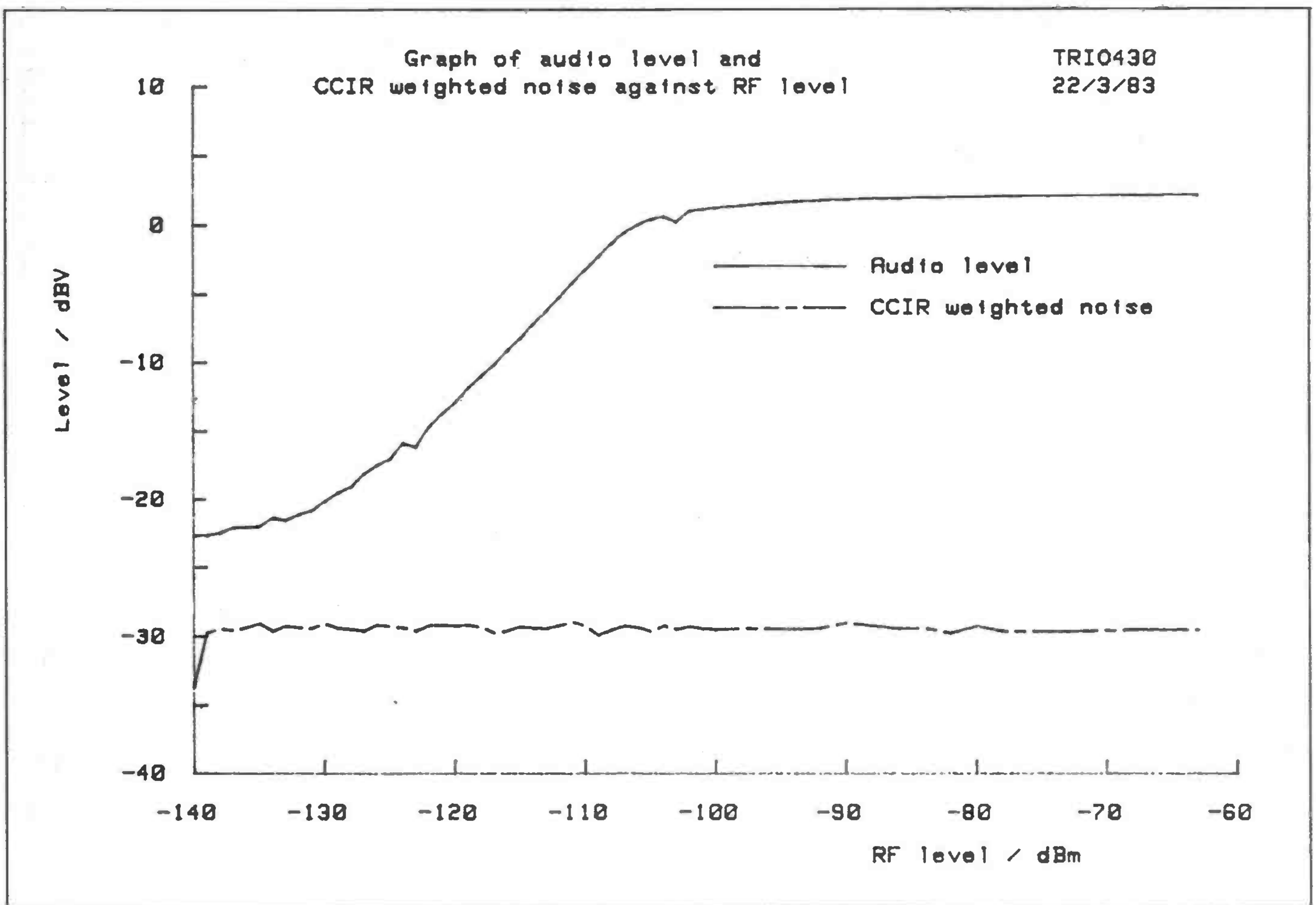
Lab test

Having had a play with the rig for several days we applied some very extensive tests to check performance in many areas, and probably the best way to comment on the test results is to first follow a received signal through from aerial input to loudspeaker out, and then in the same way have a look at the transmitter results.

The RF input sensitivity varied from band to band from excellent to good, to 10m sensivity unfortunately being one of the poorest, although completely acceptable, equivalent to a noise figure of around 8dB or so. Ironically, the most sensitive band was 14MHz, on which you don't really need ultimate sensitivity. RF intermodulation performance was checked with two carriers 10 and 20kHz off channel at three levels, the two carriers always being at the same level relative to each other. The first level was that required to develop a third order 1m product of 12dB SINAD, whilst the second and third levels produced products reading S5 and S9 respectively. Our choice of such close in tones spaced only 10 and 20kHz is a difficult test indeed, and my interpretation of the results is that the TS430 comes out pretty well. The reciprocal mixing test involved checks on the local oscillator sideband noise at 20 and 100kHz off channel, and whilst the 100kHz test result was very good, the 20kHz one was average, some rigs being better by quite a few dB. This close-in noise was quite possibly a contributory factor to the disappointing selectivity measurement for -60db, although the filter was good down to around -40dB, and thus the shape factor which works out at around 2.9 is not good. During the selectivity test we heard a series of small whistles etc. while we were measuring the -60dB point, which we assume to be synthesiser modulation components on the local oscillator. Selectivity was checked at two separate RF levels about 15dB apart with the same result. I must particularly praise the excellent S meter, characteristic of many Trio rigs, for its far better than usual law from low to very high levels. As can be seen from the chart, there is 35dB difference between S1 and S9, S5 being reasonably half way in dynamic range between these two points. S9 however, at

Parameter **RX Measurements**		**Comment**
Sens. for 12dB SINAD SSB @ 28.6/21.3/14.25 MHz (μV p.d).	0.17/0.14 /0.12	Good/V.good /excellent
Sens. for 12dB SINAD SSB @ 7.05/ 3.65/1.9 MHz (μV p.d.)	0.17/0.14 /0.14	Easily good enough
S meter: Levels for S1/S5/S9 + 20dB SSB @ 28.6 MHZ (μV p.d.)	1.2/11 69/400	Excellent
S meter: Levels for S9 SSB @ 21.3/ 14.25/7.05/3.65/1.9 MHZ (μV p.d.)	65/56/82 68/59	
Selectivity: SSB 3dB bandwidth /60dB bandwith (KHz)	2.3 16.6	Fair
Selectivity: SSB shape factor	2.9	Fair
RFIM: Listening at 28.6 MHz. Sending + 10 and + 20 KHz	1.6/7.1/14	Good
Level from each for 12dB SINAD/ S5/S9 product (mV p.d.)		
Reciprocal mixing: Level @ + 20 and + 100 KHz for 3dB degrad. in 15db SINAD Signal (mV p.d.)	2.2 120	Fairly good
T-notch: Max rejection of 1.4 KHz rel. 1 KHz beat (dB)	33	Excellent
T-notch: Max rejection of 1 KHz rel. 1.4 KHz beat (dB)	32	Excellent
Audio output distortion @ 125mW into 8 Ω (%)	0.5	Excellent
Audio output power in @ 10% THD 8 Ω (W)	1.7	Slightly restrictive
Frequency accuracy of readout (Hz)	within 20	V. good.
Current @ 13.8 V D.C. supply audio gain min. (A)	1	
TX Measurements		**Comment**
CW output power: 13.8 V.D.C. Supply 1.9/3.65/7.05 MHz (W)	85 /100/100	Good
CW O/P power @ 14.25/21.3/28.6 MHz (W)	100 /90/85	V. good
SSB O/P power @ 1.9/3.65/7.05 MHz (W P.E.P.)	140 /140/140	
SSB O/P power @ 14.25/21.3/28.6 MHz (W P.E.P.)	150 /140/140	
Current drawn on full power CW. 13.8 V supply (A)	16	Very efficient
Current drawn on SSB, mic gain min. (A)	2	Good
Harmonic O/P, CW @ 1.9/3.65/7.05 MHz (2nd/3rd) (dBc)	(-60/ -58) /(-66/ -54) /(< -68/ -49)	Good /Fairly good /Fair
Harmonic O/P, SSB @ 14.25/21.3/28.6 MHz (2nd/3rd) (dBc)	(-64/< -53) /(-64/< -65) /(< -65/< -65)	Fairly good /excellent /excellent
SSB Carrier rejection relative to full CW power: 28.6 MHz (dB)	-62	Superb!
Transmit freq. error on CW @ 28.6 MHz (Hz)	-160	Adequate

Table of Lab test results



around 70μV right across all the amateur bands, is perhaps a little insensitive, and I would have preferred it to have been at the more usual 50μV. The T-notch filter gave a remarkable maximum notch with hardly any reduction of signal level 400Hz away, which is splendid. The AGC characteristics can be seen very clearly in the pen chart recording in which we knock down the RF level in 10dB steps from a very high to a very low level. Note the recovery time at the various levels, together with the fact that normal level is not restored on lower level signals. My colleague, Simon G8UQX, thought of a rather nice computer test to apply, in which computerised test equipment monitored the audio output level whilst stepping up the RF input level automatically from a Marconi 2019 signal generator, finally plotting the result.

Additionally, the CCIR/ARM weighted noise was plotted with unity gain held at 2kHz, this being the audio output noise at the test gain control setting for no RF input, It can be seen that full audio output is reached at around 2μV input, above which the level is fairly constant, with just a gradual slope. At very low levels indeed there was slight computer noise breakthrough, but even so I would ideally have preferred full level to have been reached at a much lower RF level, particularly for 10m where band noise can be so extremely low relatively.

I have already commented favourably on the good audio quality, and so it was not quite so surprising to see the very low distortion measurement at 125mW output from a carrier giving a 1kHz beat in the product detector. The loudspeaker was fairly sensitive, which is fortunate for the maximum available output into 8 ohms was slightly limited. The only other receiver measurement which seems very relevant is the high current drawn, which is easily suficient to flatten a car battery if the rig is left on inadvertantly for more than a day. I would have thought that with modern circuit design the standing current could have been a mere fraction of what it was.

The transmitter took around 16A peak which is very reasonable indeed, showing a high efficiency PA. The current drawn by the entire transmitter on transmit, but with mic gain at minimum, was considered quite low, only double that of the receiver, and so the average consumption from a car battery will be surprisingly low, unless speech compression is selected, which will, of course, greatly increase the DC duty cycle. Frequency accuracy on transmit was checked on CW, such that the output frequency measured 160Hz below that indicated, and this is perhaps just a little bit further out than I might have expected, although the receiver was exceptionally accurate. Maximum power output on CW was either at, or only very marginally below, the legal limit, so you certainly can't grumble, and SSB peaks were well in excess of the CW output, which is very useful. No drift problems were noted, either on TX or RX, after a warm up period. We checked harmonic and spurious outputs on a spectrum analyser on all bands from top band to 10 meters, and must particularly praise the harmonic suppression on the latter. The worst band was 40 meters with 3rd harmonic just a little high, but fortunately the harmonic was in another amateur band! SSB carrier suppression was fantastically low, showing a very well designed balanced modulator. The microphone circuits seemed to have a good overload margin, and no problems were noted with the transmitter, which is praiseworthy. ●

Equipment used by Angus McKenzie Laboratories Ltd. for this review.

Two programmable Marconi *2019* signal generators, Marconi *995* generator, coaxial attenuators by Greenpar, Marconi, Rhode and Schwartz and Narda; hybrid transformer by Elcom; power meters by Racal and Bird, analysis equipment, including Hewlett Packard *8903* audio analyser, and *3580* spectrum analyser, an RF specrum analyser: Hewlett Packard *8558B*, a Takeda Riken eight digit frequnecy counter (four parts in 10^9 accuracy), a Bruel and Kjaer and HP pen charting/plotting equipment, and computer control were appropriate was with a Hewlett Packard *9816* computer with *82901* dual disc drive.

MON-FRI 9-5.30

HAM
INTERNATIONAL (U.K.)

SAT 9-12.15

24 BUCKLAND RD
LEICESTER

TEL 0533-761731
TLX 341928

TS 930.
Superb high performance, all solid state HF transceiver, capable of operating in the SSB, CW, FSK and AM modes, on all amateur bands (160 to 10 metres). Incorporating a general coverage receiver.
Optional extras:—
Built in A.T.U.
SP 930 — Extension speaker with filters

TS 430.
The latest 'state of the art' HF transceiver from Trio-Kenwood. This new set has full amateur band coverage, including the three new bands and also incoporates a general coverage receiver. SSB, CW, AM and also FM modes are available (FM with optional board). Fitted with twin VFOs and all the usual filters you have come to expect from Trio-Kenwood transceivers.
Optional extras:—
PS 430 Matching power supply
SP 430 Matching extension speaker

FT 102.
Represents significant strides in the advancement of amateur transmitter signal quality, previously restricted to top of the line transmitters. For the amateur who wants a truly professional quality signal the answer is the Yaesu FT 102.
Optional extras:—
FC102 Antenna toner
SP 102 Matching extension speaker

FT 77.
This new full feature mobile transceiver from Yaesu has 100 watts of RF power on all amateur bands from 3.5 to 30 mhz (including new bands) and has FM as an option. Its unbelievable small size and lightness coupled with its low price will make this set a firm favourite as a first time rig or a handy second set to use anywhere.

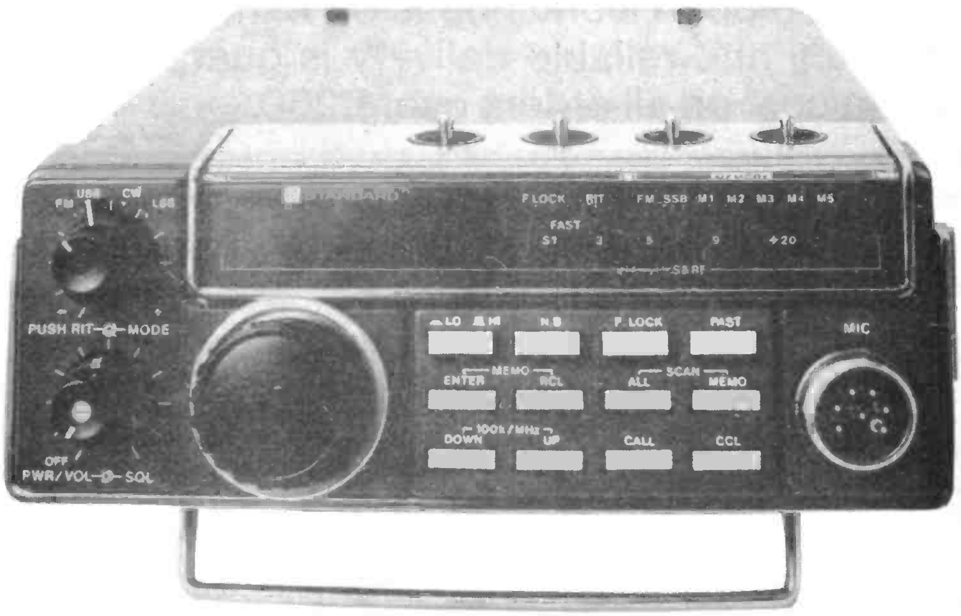
£269.95

FDK 750A.
Offers VHF operation on FM, SSB, CW. Excellent value for the new operator looking for SSB facility on VHF. Also fitted with dual VFO. The set has the facility to use the optional 'Expander 430' giving full coverage on the 70cms band.

C5800 REVIEW

By Peter Metcalfe
G8DCZ

What's that I hear you say — 'another 2m multimode'! Yes STANDARD COMMUNICATIONS CORP. of Japan (where else) released their answer to the 25W 2m multimode market in England about four months ago, following on from their *C8800* FM only model and accompanying the *C58* portable version. Standard's attack on Yaesu/Trio/Icom has reputedly been delayed by "six months of field testing to get it right". With statements like this abounding I am sure that you will forgive a little scepticism. Have they got it right or is this just another standard (forgive the pun!) rig?



Documentation

The rig comes complete with a very comprehensive manual which has only a couple of strange translation quirks (eg. in the description of the SSB TX amplifier, reference is made to a "younger amplifer" — is this some new technique I haven't heard of ?). The operating instructions, especially of the synthesiser functions, are well laid out and easy to follow. The circuit diagrams, board layout and instructions on how to take the rig apart are very good and there is a particularly nice section on TX and RX adjustments. The part of RF circuit operation is a little sketchy, but adequate for those with previous knowledge of common techniques. However, the five pages devoted to the PLL and digital side of things, while being very thorough, takes some reading.

Circuit

There is nothing very earth shattering here; the now conventional final power module (M57727A), protected against high VSWR by an LC coupling circuit sensing reflected signals and hence shutting down drive to the unit. There is a double superhet plus quadrature detector on FM receive and a vari-cap tuned VCO on transmit. For SSB operation, Standard employ a technique similar to the Icom *IC290* for generating the two sidebands; ie. only one crystal is used, rather than the more usual two, and the different frequencies are diode switched by adding or subtracting L and C tuned circuits. While I'm not too happy with this method of sideband generation, it seems to work fairly well, so don't knock it! The rest of the SSB side is fairly straightforward with single conversion on receive, a double balanced modulator, etc.

A CW side tone facility exists, which should help with morse practice, and on the display side a bargraph type LED power/signal meter is employed. One surprising feature is the external meter socket on the rear panel which allows one to connect a conventional (100uA) moving coil meter to supplement the power/signal display. If, like me, you don't like LED meters, take note. The extensive use of LSI devices in the synthesiser and control section along with "a large capacity 4K micro-processor never before used in a mobile transceiver" provide enough functions to keep the digital freak going for months.

Visual Impressions

The first thing that strikes one about the *5800* is just how small it is (about 5½" by 8" by 2"). In fact it is barely bigger than the *C58* portable and one begins wonder how Standard cram it all in. The second point to notice is the angled front panel, which makes the display and controls nicely accessible, with certain provisos, when the rig is mounted low down in a car. However, here is where a problem arises, for there are four function switches mounted near the front but on top of the unit. This means that the rig cannot be mounted flush with the dash or, when used as a base station, used on a shelf higher than eye level. A nice touch is the fold back bench stand (how many times has this part been lost when transferring other rigs from car to shack ?). The mobile mount was adequate but the review model's was a little stiff to use (perhaps it will loosen up). As mentioned before, the main problem with mounting is that the unit must protrude from any vertical surface and therefore the mount must be fixed quite a long way behind the rig's centre of gravity. This produced considerable vibration of the transceiver when using the available bolt holes in my vehicle, which can't be good for it.

The microphone fits neatly into the hand but the PTT button is a little small for my liking and could cause quite a bit of finger cramp on long QSOs. The general impression of the *5800* is one of a very well put together, neat and tidy rig (and oh so small!).

Inside

When the top and bottom panels are removed it soon becomes apparent how Standard gets it all in. The lower board, which looks like paxolin (yeuk), is quite frankly a mess. There is no real attempt at micro-miniature components and so the inside is obviously very crowded. However, what really spoils it is the profusion of wires linking parts of the same board and coming from the panel controls. OK, so it's a small rig with nowhere to hide these wires, as in different models, but surely they could have made more extensive use of ribbon cables or flexible PCB's (as in the *IC2E*). A rather better plan would have been to spend more time designing the PCB itself to eliminate the need for all these flying leads. I feel that if modification or servicing is needed, it would be very difficult on this board. Not surprisingly, the speaker is a mere 2" in diameter, however, it does a remarkable job considering it's size but I would still recommed an external device wherever possible (10% distortion in a noisy vehicle is rather difficult to listen to for long periods).

The top board looks more acceptable; agreed it is still *very* crowded, but more plug/sockets are used and there is an attempt to route cables round the sides. This means that at least you can see where you are. Being dedicated to the PLL and digital circuitry, this board looks more professional (fibreglass, shadow masked etc.). The inclusion of a small piggy-back board containing the toneburst circuitry indicates the European version of the rig.

The final board making up the transceiver is the power module and its associated drive circuitry. This is mounted at the back in a metal enclosure and with a little dismantling should be fairly easy to get at.

Generally, this is not the type of rig to play around with unless you have experience of fitting quarts into pint pots.

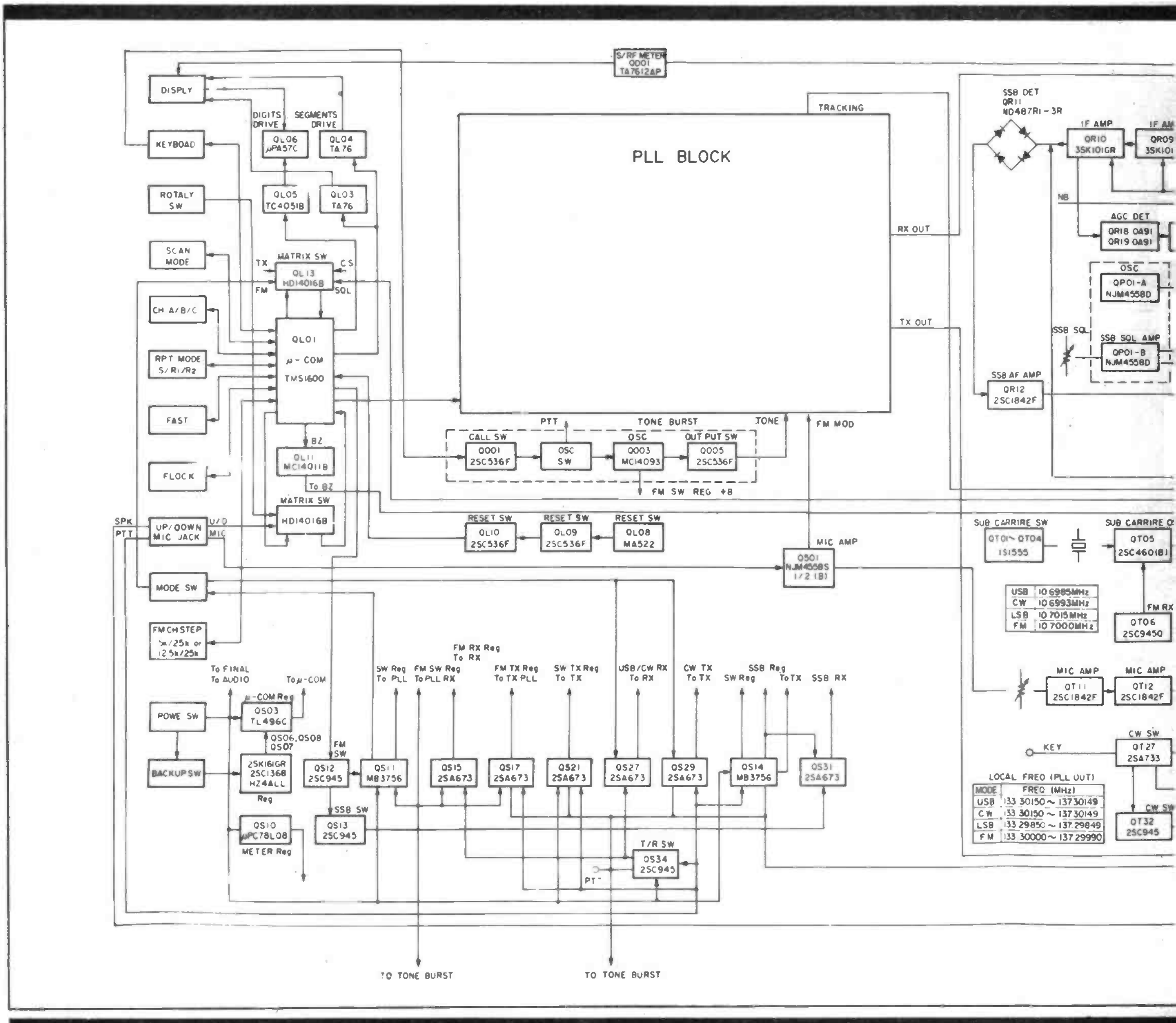
Operating Impressions

With such a small front panel, the controls are necessarily packed in tight. This presents a few problems when operating; for instance, the mode switch is very awkward, being concentric with the RIT control. The squelch control is even worse and has to be adjusted from underneath, if one is not to alter the volume setting (it was very difficult to use when mobile). A little more room between volume/squelch and the main tuning dial control would have helped here. While on the subject of mobile operation, again we have a rig with a profusion of similar looking, multi-function buttons which require very little travel to operate them. This makes the rig confusing, not to say dangerous, to use in the car. The microphone plug obscures many of the push buttons when the set is mounted to the left of the operator and I feel that, for true mobile use, many of the features of this rig must remain unused; certainly any change of mode is risky. The five digit, green, fluorescent display in rather dim and difficult to read on a sunny day (yes, there was one in December!). Also there is an annoying multiplexing flicker present.

Generally, I was not terribly impressed by the layout of the controls from a mobile point of view. As a base station or /P, it is a different matter for then one can put up with a few hardships and it is the functions that matter. Indeed, the *5800* has some very nice facilities but also some very confusing ones. The size of the frequency step depends on the setting of three controls in addition to the mode. The exact effect is an iterative process of trial and error. As well as this, there is also available, from one of the keyboard buttons, 1MHz (FM) and 100 kHz (SSB/CW) up/down steps. I found this feature rather useful, especially as the rig has the annoying quirk of coming up on 146MHz when first switched on. A useful addition, especially for mobile work, is the inclusion of a frequency lock button which disables most of the keyboard and the up/down microphone switch, but does not affect the "Call" button. This "Call" facility seems a rather pointless addition, especially as the *5800* has auto-toneburst. In fact, being positioned near one of the most used keyboard buttons (Clear), it is a positive disadvantage and can cause some embarassing moments.

Listening on FM showed that the *5800* is quite a sensitive rig although the rather 'toppy' audio made it difficult to pick out weak signals from the general noise level and made working 'DX' on FM a bit of a strain on the ears. The two position RF gain switch, "DX/LOC", seemed to behave in a particularly odd fashion with strong S9 signals being reduced to around S2 but weaker signals (eg. S1) hardly being attenuated at all. The usefullness of this switch was therefore nullified as interference could still occur between local and distant stations on the same frequency. The usual problem associated with led signal strength meters was experienced ie. weak, but Q5, signals caused no indication on the display. However, the external meter socket could be used by those who like to see something happening. (It seems psychologically reassuring to have some indication of just how weak a signal is!)

SSB listening also showed up the sensitive front end of the *5800* and the audio in this mode was quite pleasant to listen to. The RIT control gives ± 1.2KHz shift and surprisingly this also operates in the FM mode. Possibly due to its sensitivity, the rig was very susceptible to static noise and the noise blanker, while not being particularly effective,



MODE	FREQ (MHz)
USB	133.30150 ~ 137.30149
CW	133.30150 ~ 137.30149
LSB	133.29850 ~ 137.29849
FM	133.30000 ~ 137.29990

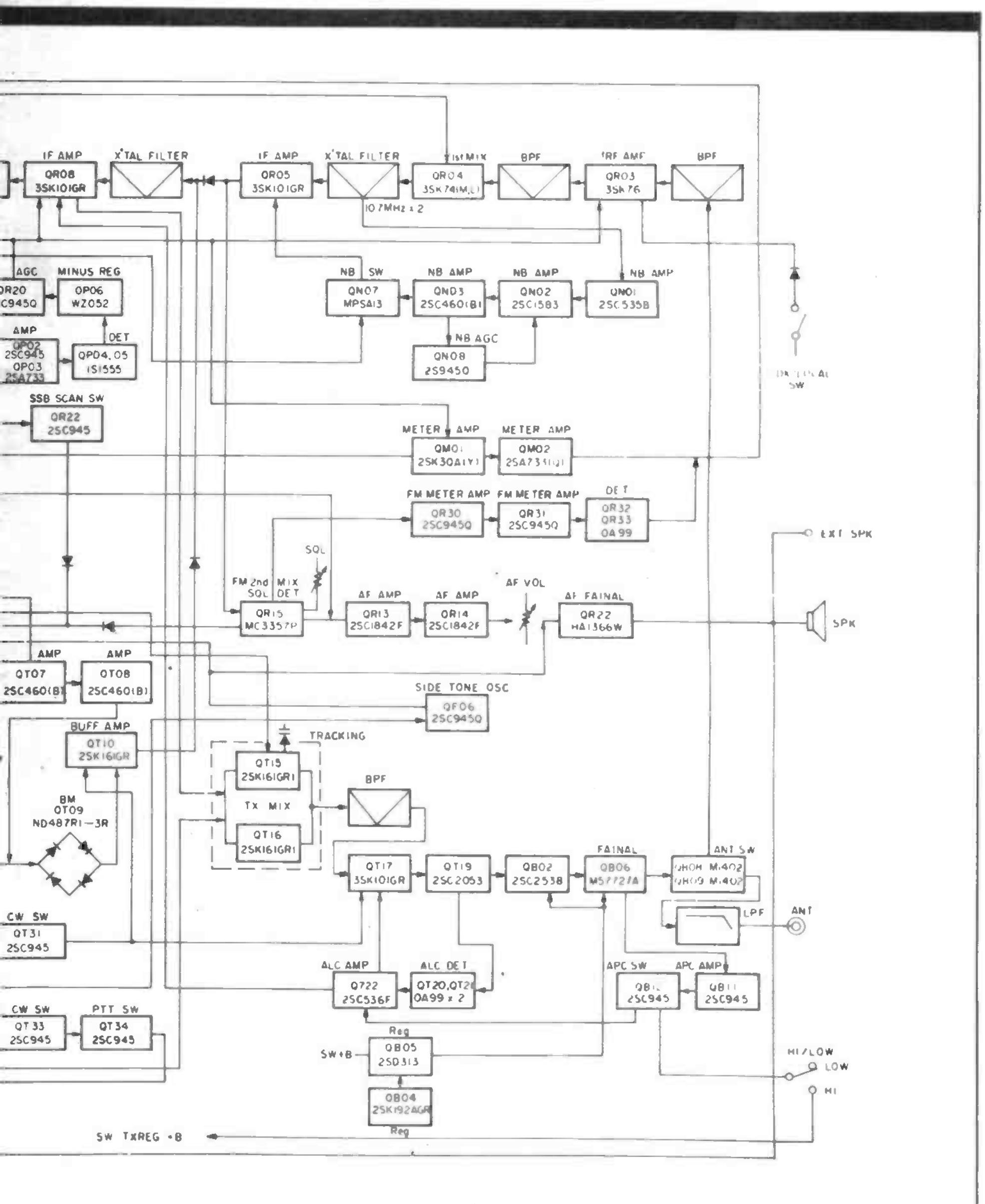
USB	10.6985MHz
CW	10.6993MHz
LSB	10.7015MHz
FM	10.7000MHz

needed to be on all the time. A second problem noticed, concerning this aspect, was the excessively long "hang" time on the AGC. The manual does, however, indicate the relevant R/C components and perhaps a useful mod would be to reduce this time constant to prevent huge chunks of the QSO being missed.

Reports received from FM transmission were of quite good audio quality and modulation level but the large dynamic range of the rig, while giving excellent signals locally, was not too good at cutting through the noise for DX work. This was particularly noticeable when used by a female operator so perhaps some tailoring is called for. (I wonder why manufacturers haven't woken up to the fact that there are many more YL operators nowadays!) Obviously due to the physical size of the rig, and hence its correspondingly small heatsink, I found that the set became very hot indeed during long FM QSOs and so Standard's warning about mounting the rig in a well ventilated position be taken seriously if disaster is not to follow!

Repeaters

Repeater operation shows up two very awkward features. Firstly, the toneburst is activated automatically if the PTT is pressed, released and then pressed again in quick succession. Now while this could be useful for mobile operation, the fact that it cannot be switched off for simplex FM work, coupled with the small PTT button, can cause some odd tones to appear when not wanted. Also, as with many rigs, the tone is rather long, but this could easily be modified. Secondly, the three position S/R1/R2 switch takes some getting used to. "S" is the normal TX/RX on the displayed frequency. "R1" gives − 600 kHz repeater shift from the displayed frequency which means that switching from simplex to repeater operation is time consuming, as one has to switch to R1 and then retune to the desired repeater output. The "R2" setting gives true reverse repeater operation and TX is 600kHz up from the display frequency. As the set covers the full 144-148MHz range and there is no out of band switching above 145.999, there could be problems if you don't keep your wits about you! Out of band protection below 144MHz takes the form of a rather blunt "OFF" message on the display (one or two suggestions were forthcoming as to a more pointed display here!). Strangely, this does not protect one from transmitting (surely a little extra logic could have been employed). A good point is that "listen on input" is instantly realiseable by switching from "R1" to either "S" or "R2" and that the toneburst and call facilities are defeated on SSB/CW operation. However, the repeater shift is *not* switched out on sideband and as this switch is one of those on top of the rig, it can easily be forgotten (red faces all round!). Odd repeater shifts are not catered for by the *5800* and so using it with a transverter could cause problems.



Reports from SSB contacts indicatd a very nice "full, rich sound" and, apart from confusion over frequency step size, the *5800* was pleasant to operate in this mode. Being a regular horizontal FM/SSB operator, I found the absence of a second VFO troublesome when moving from sideband up to FM frequencies, but the 100kHz up/down function, with practice, came in useful here. Yet again, Standard adopt the strange habit of having 25/1W settings on FM but only 25W on SSB, which could cause problems when using linears requiring eg. 10W of drive; I'm sure a modification will arise.

STANDARD C5800 LABORATORY TEST RESULTS

Test frequencies 145.000MHz (FM mode) 144.300 (SSB/CW)
Power supply voltage 13.8V unless otherwise stated
Deviation 3kHz (5kHz for selectivity measurements)

The review sample was loaned by Lee Electronics Ltd of Edgware Road, London.

The engineering section of the review was carried out at Angus McKenzie Laboratories

RECEIVER SECTION		OUR OBSERVATIONS
FM sensitivity for 12dB SINAD (measured as PD)	0.18uV	At least as good as every other 2m multimode that we have tested. Top class
SSB sensitivity for 12dB SINAD	0.15 uV	Once again, top of the pile although in theory, there is still room for improvement
FM selectivity 12.5kHz either side of test frequency	–64dB/61dB	Adequate but not stunning
FM selectivity 25kHz either side of test frequency	72dB/73dB	As above
RF intermodulation performance, two generators 25kHz and 50kHz away from RX frequency for 12dB SINAD on IM product, FM mode	0.7/0.4mV PD	Dynamic range 90dB, pretty good
SSB selectivity at –6dB and –60dB	2.5kHz/5.6kHz bandwidth	OK, but doesn't compare with a decent HF transceiver
RF intermodulation (SSB +50kHz, +100kHz) for S5 IM product (equivalent to 4.5uV PD)	7.9mV	Dynamic range 65dB in SSB mode. Not good but better than some
S Meter calibration characteristic FM mode S1/S5/S9/S9+20dB	0.35/2.0/3.2/4.5uV	This S meter characteristic is a joke. Stick to audio reporting
S Meter calibration characteristic SSB mode S1/S5/S9/S9+20dB	2.2/4.5/7.9/14.1uV	The joke is wearing a bit thin
Generator frequency shift for best SINAD at 145MHz	0.8kHz	Satisfactory

TRANSMITTER SECTION		
FM power output (high low setting)	23.7W/0.9W	
FM power output (12V supply)	19.8W/0.9W	
Maximum current consumption	5A	
2nd and 3rd order harmonic products, full power FM mode	–63dB/–70dB re. carrier power	Good
PEP SSB output power	35W PEP	Excellent.
As above but 12V	30W PEP	Excellent
Dial calibration accuracy	–200Hz	Excellent
FM deviation (peak transient/average peak)	6.4/5.2kHz	A bit on the high side
1750Hz toneburst accuracy	+20Hz	A bit off. Might not access some boxes
AF THD at 125mW audio output	3.2%	
Audio power output, 8ohms at 10% THD	2.9W	
Misuse survival. Infinite VSWR for10s total (5s open circuit, 5s short circuit)	Satisfactory	

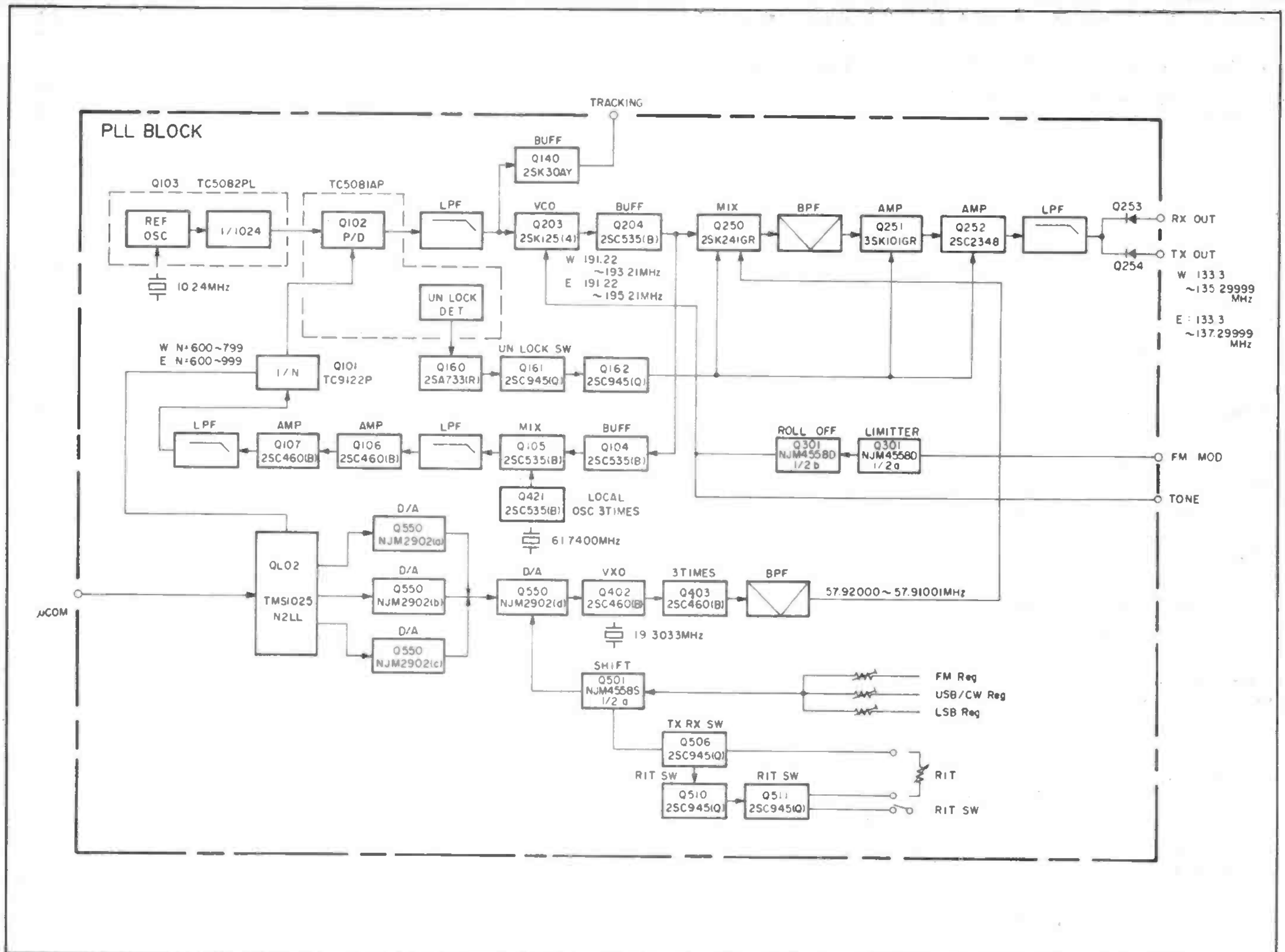
OUR CONCLUSIONS

I had an opportunity to play around with the Standard C5800 before its despatch to the testing house and can confirm that it is a desirable little box. It compares equitably with the 2m multimodes from Yaesu (FT-480R) Trio (9130) and Icom (IC-290E). At £359 the price is on par and, with 35W of SSB on tap, the C5800 is the most powerful 2m multimode that we have tested to date. Furthermore, the receiver sensitivity is just a nose ahead of the competition although I feel that the difference here is not significant.

There is of course a minus side. The strong signal handling characteristics were not outstanding and the Trio 9130 still comes out best in this respect. The shortfall in respect of the C5800 would not be noticed in day to day operation of the set and would only have real importance when operating a contest from a crowded hilltop, or if another amateur sets up a station next door to you.

The SSB operating bandwidth is another detraction but unfortunately seems to be fairly general with VHF gear. Either the manufacturer cuts corners by specifying a cheap filter unit or, as is more likely, the manufacturer still has not come to grips with synthesiser design producing machines with noise sidebands all over the place. However, this must be put into perspective. Thankfully, the VHF bands are not as crowded as the HF ones and any shortfall will not be noticed in day to day operation.

G4JST



Memories and Synthesiser Functions

The *5800* has ten memories in all, with five for each of FM and SSB. I found the display very good when entering memories, a flashing led tells you if that memory is empty, and one is reminded of the mode by other leds. The only awkward part of memory entry and recall is that one has to step sequentially through all five memories to get to number five. The manual states that if the "RCL" (recall memory) button is kept depressed, then the unit steps through all the memories sequentially. However, I found this not be the case. A multi-way switch would have been nicer, but there is hardly room for that on the panel! The loud "bleep" which accompanies many function settings is useful for mobile operation especially. A very nice touch is that if one recalls a memory, it is possible to tune from that frequency using the dial.

Memory and frequency scanning on the **5800** are very versatile with the option of scanning all occupied memories of the selected mode or complete sections of the band (1MHz blocks for FM and either 1MHz or 100KHz blocks for SSB/CW). The type of scanning depends on the position of a three-way switch on the top panel indicating when, if at all, the rig is to stop scanning. The options are to stop on Busy, Vacant or Free channels. This last option means that it doesn't stop but continues the preselected scan taking no account of any signals present. The scan speed in this mode is slower than in any other mode and gives one ample time to listen for a familiar voice on the band! The "Fast" button doubles the speed of the scan and when scanning the memories for a "Busy" channel with this button depressed, it zooms through the frequencies at quite a rate.

Generally, the synthesiser functions on the **5800** are very useful and practice one can set up the rig to fend for itself quite happily, while one gets on with something useful (like working out all the mods. required to bring the set up to an ideal standard!).

Perhaps because of the use of LSI devices, the quoted current consumption on this rig is surprisingly low with 3.7A for 25W TX and 450mA for receive standby. This being the case, it should help give an extra hour or two of /P operation; always a useful point.

Summary

In conclusion, although there are many minor irritations present in the *5800*, and it is hardly the best choice for mobile use, I feel that it is a nice rig to use containing some very useful functions and generally good RF design. There seem to be many modifications that one could think of and here problems could arise due to the internal layout. I wouldn't say that Standard have got it completely "right" but it's close. ●

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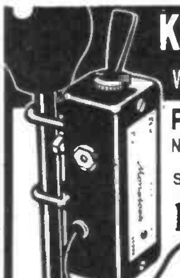

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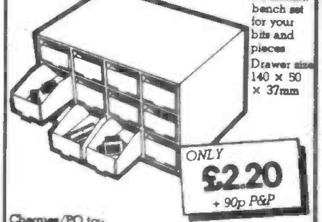

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