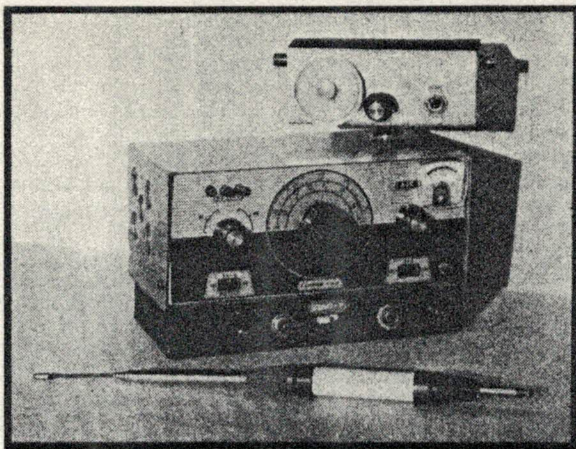

A problem sometimes faced by would-be purchasers of commercially-made gear is that none of the designs seems to provide all the subsidiary facilities required. It is often possible, however, to "personalize" commercial gear, making small additions and alterations to the basic unit, to bring it into line with one's needs.
This article shows how a Codar T28 receiver was modified to suit one amateur's requirements, and illustrates how the judicious use of published circuits and ideas can considerably extend the facilities of a straight-forward two-band receiver.

The complete "Pipsqueak" with the rotatable df aerial in place. The QRP transmitter is fixed beneath the receiver case, adding 1¼in to the overall height; in front of the unit is the telescopic 160m loaded whip

The "Pipsqueak"
—a modified Codar T28 receiver

by B. BLESSED, BSc, G3XWC*

WHEN the author was a student, he required a very compact transmitter/receiver which would serve as a complete /A station, without any extra units (power supplies, frequency meters, etc), and which would be light enough to be easily transported between home and temporary addresses. Time was limited by studies, so it was decided to purchase a commercially-built receiver as the basis of the project, and to this end the Codar T28, a splendid little two-band receiver, was chosen.

The T28 uses nine transistors, and is designed around Mullard i.f. and af modules, giving full coverage of the 160 and 80m amateur bands. A supply voltage anywhere in the range 10–15V can be used, current drain varies from 20mA standing to some 40mA when in service, depending on the volume control setting. A bfo is included for the reception of cw and ssb signals; the rf stage is separately tuned by a *peak* control, to assist in obtaining maximum performance from a variety of aerials. Negative or positive earth systems may be used, and the overall size (8 by 4 by 3½in) makes it ideal for portable or mobile use.

The additions and modifications made to the basic receiver were: (1) internal loudspeaker, (2) S-meter, (3) plug-in direction-finding coil, (4) 1MHz/1·93MHz crystal calibrators, (5) 0·5W QRP transmitter, cw and a.m., (6) noise limiter, (7) crystal-controlled bfo, (8) miniature loaded whip for 160m.

Case alterations

It is a good idea, before commencing the modifications, to alter the method of fixing the case top to the chassis, making the interior much more accessible. Both the metal fixing brackets must be removed from the inside of the case top (Fig 1), and some filing will be necessary as these are spot welded in place.

The simple alternative devised by the author was to cut four small right-angled brackets from aluminium and fix these to the underside of the chassis as shown in Fig 2. The case top is then drilled to align with the holes in these brackets, and held in place with self-tapping screws.

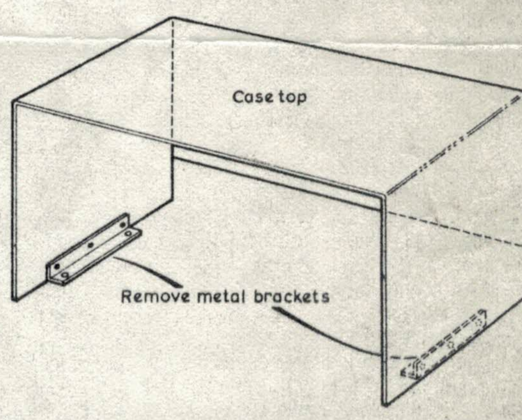

Fig 1. In the standard design, the case top is fixed to the chassis with two welded metal brackets. These are removed in the author's modifications

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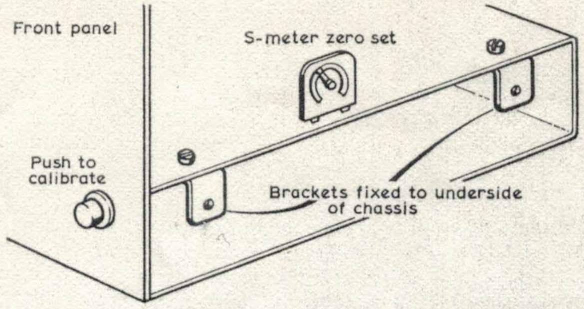

Fig 2. Once the original brackets have been removed the replacements can be fixed in place. They are mounted on the underside of the chassis, and the case top held in place with self-tapping screws

Internal loudspeaker

The loudspeaker used by the author is 4in in diameter, and rather too large for the amount of space available, although by carefully cutting the printed circuit board and relocating one of the aerial coils a reasonable fit can be obtained. If a 3in speaker is used, this operation is simpler. The position of the speaker is shown in Figs 3 and 4. It is important to keep the speaker coil from the aerial coils, if it is too close it will have a detrimental effect on the performance of the receiver.

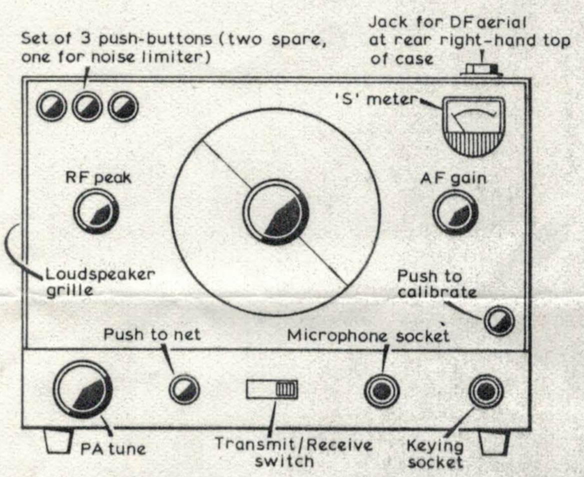

Fig 3. External appearance of the fully-modified station. The transmitter can be seen fixed to the base of the receiver, adding about 1½in to the overall height

A set of five holes was punched in the side of the case top of the receiver, and metal grille fixed to the inside with impact adhesive. The loudspeaker was fixed to the chassis and not to the case top, to simplify removal of the top.

S-meter

The meter used by the author was a 50μA level meter which had a simple red and green scale and was easily "calibrated" (using a fibre-tip pen) so that comparative signal reports could be given. The meter was mounted in the top right-hand corner of the front panel (Figs 3 and 4).

The amount of drive available from the i.f. module (Fig 5) is about 200μA on very strong signals, so a shunt resistor was required to adjust the fsd of the above meter. The value of resistance was calculated roughly, and then final adjustments made by trial and error.

The zero-set potentiometer (10kΩ) was of the skeleton preset variety, mounted as shown in Figs 2 and 4. In order to be able to adjust it from outside the case, a small hole was drilled in the right-hand side of the case, just large enough to permit the insertion of a trimming tool.

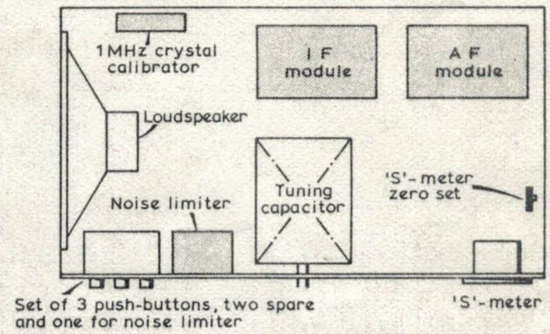

Fig 4. Positioning of components inside the receiver chassis. Note the position of the noise limiter, alongside the push buttons

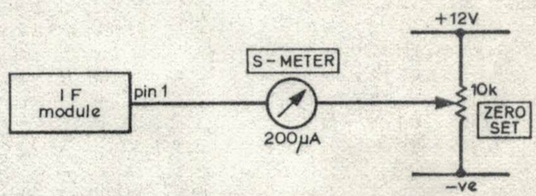

Fig 5. The S-meter and associated circuitry. Drive is taken from pin 1 of the i.f. module

Plug-in df aerial

The prototype df aerial consisted very simply of a tuned circuit plus ferrite rod (Fig 6). This was effective on strong signals, but left weak signals undetectable, so it was replaced by a more sensitive version consisting of a single-transistor rf amplifier coupled to a ferrite rod by a few turns of wire (Fig 7). Based on a Denco coil and MAT101 transistor, the completed aerial was found to be very sensitive, and it was now possible to use the receiver section without a long-wire or similar aerial. In fact, the majority of signals received on the long-wire could be received at a similar strength on the df aerial, which was considered to be a big bonus.

The rf amplifier was constructed on a small piece of Veroboard, and the df aerial itself mounted on a standard ¼in

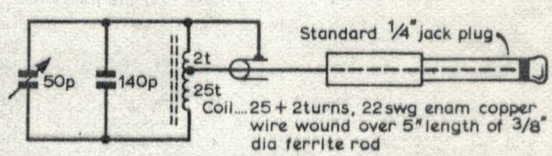

Fig 6. The prototype df aerial, subsequently abandoned in favour of the circuit shown in Fig 7

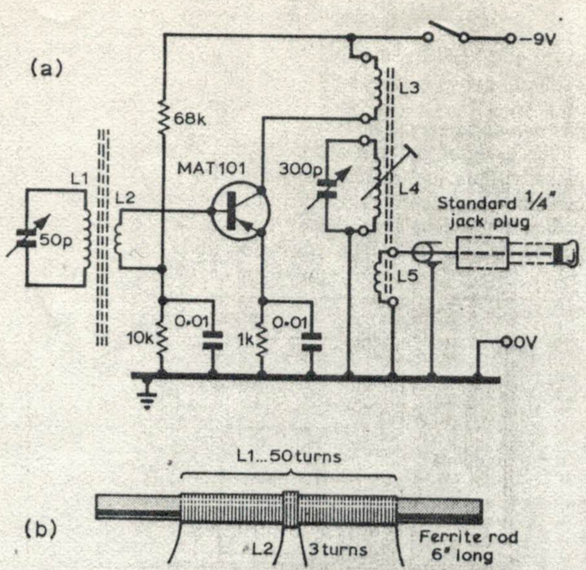

Fig 7. Use of this circuit as the df aerial gave considerably improved sensitivity, sometimes even to the point of equalling a long-wire in performance

jack-plug (Fig 8). The mounting was simply achieved by sandwiching the aluminium screen of the df aerial between the two halves of the plug (Fig 8c). The section of the plug which is normally enclosed in the screw cap is passed through a suitably-sized hole in the base of the screen, and the cap is then firmly screwed home. The matching jack-socket forms an excellent and very simple means of obtaining the desired rotating bearing for the aerial. In addition, it was now possible to unplug the aerial when not in use—another distinct advantage.

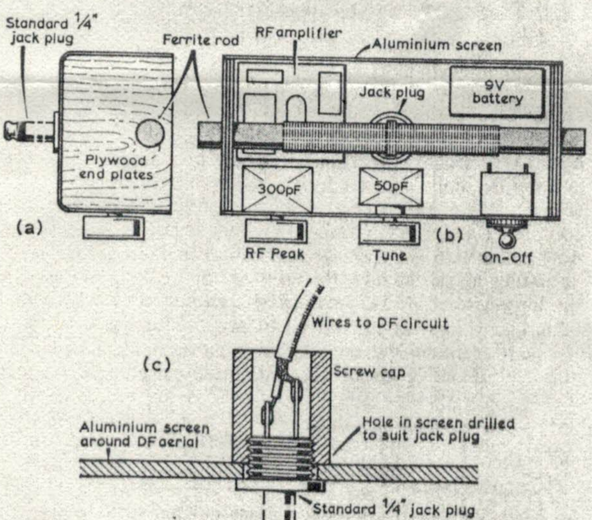

Fig 8. Constructional details of the df aerial. The use of a jack-plug in this way provides an ideal rotating mount for the aerial, as well as obviating the need for any connecting wires

The screen for the aerial was cut from sheet aluminium, with end-pieces cut from plywood.

On strong signals the aerial still works effectively if the rf stage is switched off. When close to a transmitter the aerial sensitivity may be further reduced by shorting a wire across the two sides of the aluminium case. This acts like a shorted turn around the ferrite rod and decreases its effectiveness.

1MHz/1·93MHz crystal calibrators

The 1MHz crystal calibrator is quite straightforward, and was also built on Veroboard. The crystal was of the 10X type, salvaged from a Class D wavemeter, and, like the loudspeaker, was a little too big; however, it was put to good use in the circuit of Fig 9. The Veroboard was glued to one side of the crystal, and the whole mounted in position inside the case (Fig 4).

The switch was a small push on—release off button type, positioned in the bottom right-hand corner of the front panel (Figs 2 and 3). Only one hole was required, approximately ¼in in diameter.

It is unnecessary to inject the crystal oscillations into the receive circuitry as the small radiated signal is more than adequate for calibration purposes.

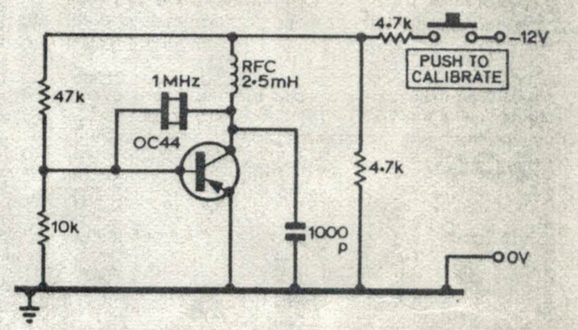

Fig 9. The 1MHz crystal calibrator. The circuit board is glued to the side of the crystal

The 1·93MHz calibration signal is another bonus. It is obtained from the netting signal of the 500mW QRP transmitter which is crystal-controlled on this frequency. Any crystal in the 1·8–2MHz band would do, but this particular frequency was chosen by the author as it was a very popular channel in his area.

500mW QRP transmitter

As can be seen from the circuit diagram (Fig 10), the transmitter is very simple, and yet, despite its simplicity, capable of satisfying results when used with a good aerial. With a highly active crystal, an input of about 500mW to the pa was obtained, a figure which was reduced by a low-activity crystal. With an input of only 60mW, stations within a radius of six miles could be worked with ease on a.m., A1 proved even more successful.

The layout is not critical, in fact it is very flexible, and constructed on Veroboard it occupied a space of about 2in by 3in by 1in. The modulation transformer T1 was salvaged

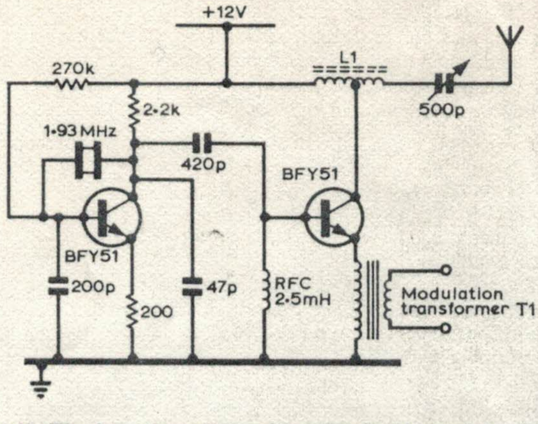

Fig 10. The low-power transmitter circuit. L1 consists of 30 turns 24swg enamelled copper wire, centre-tapped, close-wound on a 2in length of ⅜in dia ferrite

from an old transistor radio, and was quite small in size. The modulator itself was a 1W audio amplifier which happened to be on hand at the time, and the aerial coupling capacitor, a solid dielectric type, also came from the junk box. There was found to be no noticeable difference in performance between an air dielectric capacitor and a solid type in this application, so the solid type was chosen on account of its smaller size. Details of the layout are given in Fig 11. Current drain from the batteries is low when the transmitter is in use. For an input of 500mW, only 40mA is drawn on cw, and an average of 80mA on a.m. reaching a maximum of about 120mA on speech peaks.

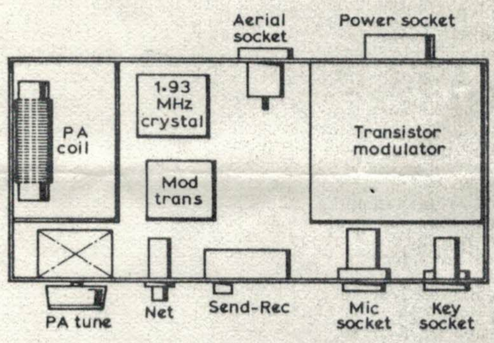

Fig 11. Layout of the 500mW transistor transmitter

The transmitter case measured 8in by 4in by 1¼in, and was fitted underneath the receiver, using the holes revealed when the plastic feet were removed. It was constructed of thin plywood, because metalworking facilities were not available at the time, which did pose some earthing problems, but as long as a constructor bears this in mind it should cause no difficulty.

Noise limiter

The circuit used was originated by G3XGP (see the August 1970 issue of *Radio Communication*), and is reproduced in Fig 12. When completed, it was fixed in position in the case (Fig 4). The on/off switch was one of three miniature push

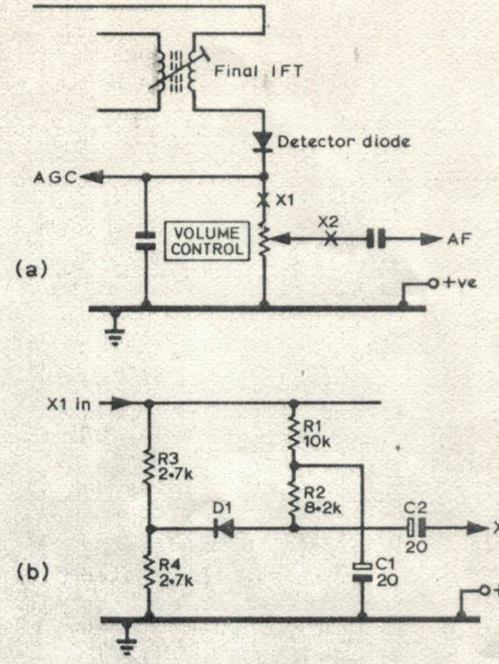

Fig 12. (a) detail of circuitry following the final ift, (b) the noise limiter circuit, originated by G3XGP, which can be switched in between points X1 and X2

on—push off button types mounted beside the noise limiter (Figs 3 and 4).

Crystal controlled BFO

The original bfo circuit was modified because it tended to drift and was also pulled noticeably by strong ssb and cw signals. Very simply, a 500kHz crystal was soldered into the bfo from the collector to the base of the transistor. The slug in the collector coil was adjusted until the LC frequency was the same as the crystal frequency, and the bfo was thus locked on to the crystal, and as stable as a rock.

Having altered the bfo, it was necessary to alter the i.f. to suit. Its centre frequency had to be lowered by 5kHz to 500kHz, so, with the bfo switched on, the slugs in the i.f. coils were carefully adjusted for maximum reading on the S-meter, thus ensuring that the i.f. passband is centred on the bfo crystal. (Incidentally, a harmonic of the crystal at 2MHz provided yet another calibration marker).

Miniature loaded whip (160m)

Experiments carried out with miniature loaded whips for Top Band showed that they could give favourable results in good conditions, despite their obvious limitations.

A 24in telescopic aerial was available and the final aerial was based on this, with a 3in length of ⅜in diameter ferrite rod used as the core for the loading coil. The whip was extended to 20in (allowing 4in for adjustments), and the number of turns on the ferrite rod adjusted until the gdo showed resonance at 1·93MHz. The coil was then potted, with the base of the whip, inside the two halves of felt tip marker

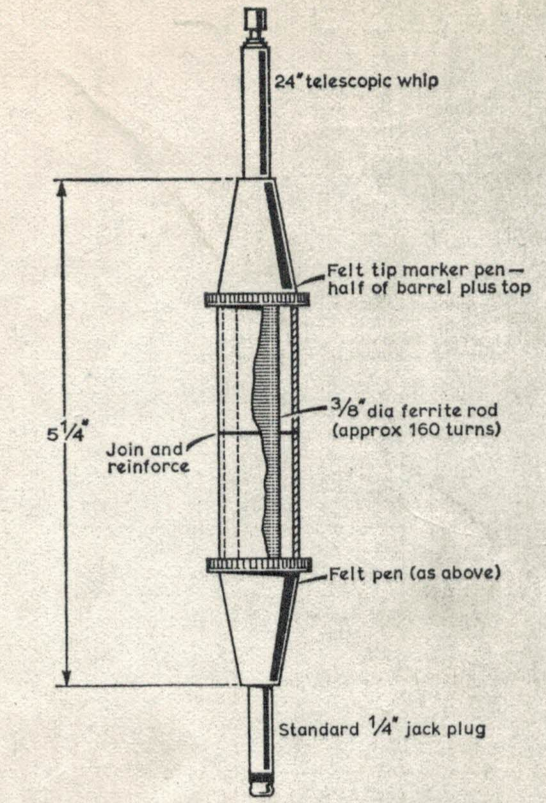

Fig 13. The miniature 160m whip, constructed from two halves of felt marker pens. For improved rigidity the join between the two halves should be reinforced

pens. As with the df aerial, the whip was mounted on a ¼in jack-plug (Fig 13), so that the two aerials are interchangeable.

Power supplies

In the author's system, the whole unit was powered by batteries; two 6V bell batteries were used and gave several months' of service. They were housed in a leather bag with a carrying strap for easy handling.

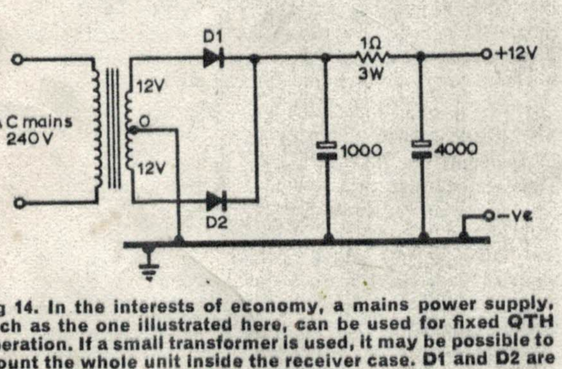

Fig 14. In the interests of economy, a mains power supply, such as the one illustrated here, can be used for fixed QTH operation. If a small transformer is used, it may be possible to mount the whole unit inside the receiver case. D1 and D2 are BY100s, or similar

If operated from a fixed QTH, the power supply circuit of Fig 13 could be used, and provided a small enough transformer is available it should be possible to mount it inside the T28.

Conclusion

The completed station has been in use now for several years and in that time has proved a very versatile unit. For example it has been used as a "pedestrian portable" station, using the miniature loaded whip, with a range of up to half a mile in good conditions!

The various circuits and ideas described can obviously be put to good use elsewhere, apart from the T28; the crystal calibrator and noise limiter are small enough to be included in the most crowded chassis. It should be pointed out that the author claims no originality for any of the circuits used.

It is hoped to follow up the capabilities of the QRP transmitter when a more permanent QTH is decided upon. Until then, working up to the 1,000 miles per 1W level, or 60 miles per 60mW, must remain an unfulfilled ambition!

BOOK REVIEW

A Course in Radio Fundamentals by George Grammer [Technical Director, ARRL, and Technical Editor, *QST*, (retired)]. Published by ARRL, 184 pages, over 200 illustrations, *QST* format. Obtainable from RSGB, 35 Doughty Street, London WC1N 2AE, price £1.15 post paid.

This popular book achieves its independence in the present edition. Thirty years and five editions ago it was developed from a series of articles in *QST*, and in later years it used *The Radio Amateur's Handbook* as a basic text.

The functions of a regularly progressing handbook and a fundamental educational course are sufficiently dissimilar to make this increasingly undesirable, and the *Course* has now been entirely rewritten, modernized, and expanded in scope and length, to almost double its previous size. It is concerned with principles and not with applications.

The book is now a self-contained study manual, with exercise questions at the chapter ends, and answers. Descriptions of simple practical experiments to be conducted for a fuller understanding of the lesson material are included, and the apparatus required is simple and either available or easily obtainable.

The treatment is of "intermediate technical level", and it is suggested that the novice "probably will benefit if, as a preliminary, he first takes the even simpler path offered by *How to Become a Radio Amateur* and *Understanding Amateur Radio*, and then later follows with this *Course*."

The reviewer agrees with this advice, because the pace must of necessity be faster and the manner concise, when such a broad field is covered; and this might be uncomfortable for the absolute novice. This is not to say that a reader who has a simple familiarity with elementary algebra and physics should have the slightest difficulty, but 26 chapters in 142 pages only gives about five or six pages to each subject.

The coverage includes electric and magnetic fields, simple dc and ac circuits, phasers, impedance matching, transformers, radio-frequency circuits, filters, feeders, valves, semiconductors, field-effect and bipolar transistors, amplification and amplifier circuits, feedback, and radio-frequency amplification.

The presentation is clear, skilful, and visually attractive, as one would expect from such an experienced writer.

The *Course* is strongly recommended to all those who want to establish, or refresh, their radio fundamentals in a sound, enjoyable way.

T.P.A.