CODAR A.T.5 TRANSMITTER

By D. V. NEWPORT, G3CHW*

THE first advertisement in the BULLETIN for the AT5 caught the writer's eye and it was resolved to investigate this device further. Subsequent inspection at last year's RSGB Exhibition led to the breaking of a long standing rule, never to buy anything, much less a transmitter; but it still remained to be seen if the spending was justified and that the transmitter lived up to its eye appeal or suffered on account of small size and low cost.

Clearly, having spent money, the writer is biased in favour, if only to prove that he was right, but having said that, facts only will be presented from here on.

The AT5 is a remarkably compact transmitter, complete with anode and screen modulation, covering 160 and 80m, and is small enough to escape the wrath of an XYL and disappear into any car; in fact an enthusiast could fit it to a bicycle, if he had a chain driven generator!

A Vackar derived v.f.o. with an EF80 valve is used followed by an EF80 buffer which is switched as a doubler for 80m. The p.a. is a 6BW6 with pi-section output, the constants of which have been chosen to cover both bands. This latter feature is an inevitable compromise and more will be said about it later. The modulator consists of a 12AX7 driving a 6BW6 which is auto-transformer coupled to the p.a.

V.f.o. control is by an epicyclic drive and although very slight mechanical backlash exists in the one reviewed it is low enough to be ignored. In fact, tuning is unusually smooth and is very pleasant. P.a. tuning and loading is by direct drive and no useful purpose would be served by reduction gears.

A 100 mA meter is fitted for tuning purposes and the legend PLATE CURRENT appears above it. In fact, the meter measures cathode current of the p.a.† and reference to the circuit diagram is necessary before this becomes clear. The writer would prefer the meter to read what it purports and the wiring will accordingly be changed.

Either c.w. or a.m. can be selected and on c.w. the modulator is disconnected by means of a c.w./a.m. switch located on the chassis rear apron. No netting position is fitted although such a device is included in the companion power supply and can, of course, be incorporated in any power supply by breaking the main h.t. line, but allowing through the required 150 volts for the v.f.o. On c.w. the key can be lifted.

External finish and appearance is excellent and is equalled by the internal wiring which is of a high standard.

The only complaint is the inability to get at the wiring without removing front panel controls. This is due to mechanical problems associated with the metal work used and it could be argued that a strong rigid assembly is the result. Nevertheless, a "cut out plate" in the base would be advantageous.‡

Performance Tests

A number of exacting tests were carried out with the aid of highly sophisticated test equipment and the results are tabulated below. These were designed to provide information on questions that usually go unanswered but in the absence of a reference some discretion should be observed. Remember the Chinese proverb about glass houses; under similar tests your transmitter might prove to be only tissue paper, and certainly the modulation test carried out on the writer's well loved and aged "Mighty Wurlitzer Longleat Rally Special" resulted in a complete rebuild, and this after many years of satisfaction with apparent potency.

With a nominal ten watts input a high purity sine wave of 1000 c/s was injected and a modulation depth of 70 per cent was achieved before visible distortion became apparent. This was monitored on a wideband oscilloscope at 1·9 Mc/s. An inexpensive Duvedal crystal microphone produced 100 per cent peaks before distortion crept in and from observations on all bands up to 144 Mc/s, it is better than can be said in a great many cases. A neon modulation indicator is fitted to the AT5 and this appeared to strike at about 80 per cent modulation on speech peaks.

Gain is entirely adequate and with the microphone in use nothing is to be got by using full amplification except distortion through overmodulation. The gain control can be backed off quite a long way. On the other hand, amplification is entirely inadequate for the station "ball and biscuit" moving coil microphone, but this has an embarrassingly low output.

Two r.f. loads were used: a very wide band slab line

Codar AT5 Evaluation Table

Plate Current Meter Correction		V.F.O. Calibration		Harmonic Output Fundamental = 0 db			
Indicated	Actual	Indicated	Actual				
55	48	1800	1798	F	1900	F	3650
52	45	1900	1898	2	−30	2	−26
49	41	2000	2000	3	−24	3	−27
42	35	3500	3499	4	−33	4	−24
30	18	3650	3644	5	−30	5	−40
25	15·5	3800	3797	6	−45	6	−46
20	8·4			7	−42		
		Provision exists for re-setting		8	−45		−db
Cathode	Anode						—

Drift from cold start: 1900 kc/s at 64°F			Power output, 75 ohms
After 5 minutes for	*5 minutes	25 c/s	52% 2 watts input
After 80 minutes for	5 minutes	52 c/s	64% 5 watts input
After 94 minutes for	15 minutes	180 c/s	62% 10 watts input
Unstabilized mains. *H.t. on for timed periods.			250 V nominal h.t.

Modulator response relative to 1 kc/s: 420 c/s to > 20 kc/s ± 3 db. (A 0·01μF capacitor across the secondary of the modulation transformer will reduce the a.f. response to 4·2 kc/s.)

* The meter correction figures apply to older models only.

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† On the point of cathode current it is stated by the manufacturer that this was done for added safety reasons. It was felt that due to space considerations the meter terminals were closer than normally desirable to the modulation transformer stack (about $\frac{1}{4}$ in.).

Since the article was written Codar have rewired the meter circuit to read true plate current, and have fitted an insulating strip across the transformer stack to ensure that no danger of h.t. short-circuit exists. All AT5 transmitters produced in the future will be so wired and therefore the remarks about cathode current apply only to transmitters supplied before March, 1965.

A further modification has been introduced to improve the strength of NET signal. The switch wiring has been arranged to connect a 22 pF capacitor from the appropriate receiving tag to h.t. + wiring. The added stray pick up is said to result in a stronger NET signal than the modification devised by the writer.

These changes well illustrate the fact that reputable manufacturers are always prepared to act on criticism, provided that it is well founded and presented in a proper fashion, and this, of course, is one of the objects of BULLETIN reviews such as this.

‡ The suggestion regarding a cut out plate to gain ready access to under-chassis wiring had already been considered by Codar, but had to be rejected on grounds of high tooling costs. This would have meant that the selling price could not be kept down to it's present level, which, it must be agreed, is a perfectly sound reason.

The Codar AT5 1·8 and 3·5 Mc/s 12 watt miniature transmitter.

75 ohm power meter, and an end fed 270 ft. wire of unknown impedance but expected to be high. These disclosed loading difficulties brought about by using one pi-section to cover both bands.

It was not possible to reduce input from about 12 watts on 160m and the loading was too great for full modulation. This was on the 75 ohm load, whilst on 80m it was not possible to load the transmitter above about 6 watts. No such difficulty occurred on the high impedance aerial but instead it was noted that the p.a. tuning capacitor had to be fully meshed on 1·8 Mc/s and full loading could not be realized. In the instructions accompanying the AT5, reference is made that low impedance aerials on 160m may require some external capacitance for effective loading.

At this time it was noted that on 80m with it feeding into the power meter, r.f. feedback through the modulator took place with minimum loading. The feedback disappeared immediately loading was increased. No attempt was made to establish where the r.f. got in and in fact, the transmitter was tested throughout exactly as received through the post, except that the p.a. anode h.t. lead was broken to measure the true input power.

Could you send your transmitter through the post?

R.f. feedback also took place on 160m feeding the high impedance aerial directly into the transmitter. Under such conditions quite high r.f. voltages exist in the shack and are likely to produce feedback troubles. A simple parallel tuned, link fed aerial coupler completely cleared the feedback problems and the AT5 could then be loaded with ease on both bands. This is further proof that it is advisable to use some sort of aerial coupler whether existing transmitter arrangements will load directly into the aerial or not. It also indicates that the AT5 produces a respectable quantity of r.f. and efficiency figures are included in the table.

Frequency calibration and stability were checked using a 10 Mc/s counter, from cold up to 90 minutes later. Curiously, the transmitter was most stable when cold. Results are tabulated.

Attempts were made to measure harmonic output and the figures are offered as a guide only. An AR88LF with a calibrated S meter was used with a tiny pickup loop thought to offer a fairly equal mismatch on all frequencies, and the S meter was checked at each point by a standard signal generator. Nevertheless, the writer would not like to be quoted to closer than about 6 db, although results were considered to be satisfactory. They represent carrier distortion of about 1·5 per cent which is very reasonable, and an aerial tuning unit will further reduce this figure.

Harmonic output will vary with grid drive and since this is fixed, a variation between models is bound to be expected; yours in fact, might be better—if you prefer less drive.

Before progressing to the power supply, it is felt that further comment on the cathode meter system is needed.

With high voltage supplies or triode amplifiers a good case can be made for such a system, but in the writer's opinion, the disadvantages are numerous with low power and pentode or tetrode amplifiers. Screen current will vary with drive and loading and will therefore mask any change in anode current. The difference between cathode and plate current cannot be linear and only an approximate correction can be made. Since a strict 10 watts input limit exists on 160m it would be too easy to overstep the mark, inadvertently of course, due to such an approximation.

A correction is given in the tables to convert cathode to plate current although this is certain to vary slightly from model to model. Correction approximates subtraction of screen current from the reading and this at 20 mA exceeds anode current, thus giving rise to the apparently large error.

Power Supplies

Power requirements are modest; 250 to 280 volts, 100 mA h.t.+, plus 150 volts stabilized, and the heaters are wired for either 6·3 or 12 volts. Changeover of the latter is automatic by plugging in the appropriate power supply cable.

A companion mains power supply unit, type 250/s, is already available, and a transistor d.c.-d.c. converter for use in mobile installations should be available by the time this article is published. The 250/s power unit is styled to match the transmitter in both size and style and is of attractive appearance.

In addition to providing h.t. and l.t., which, of course, could be utilized for other station equipment, it is fitted with a neon warning lamp and also aerial change-over switching which is combined with NET, STAND BY and TRANSMIT

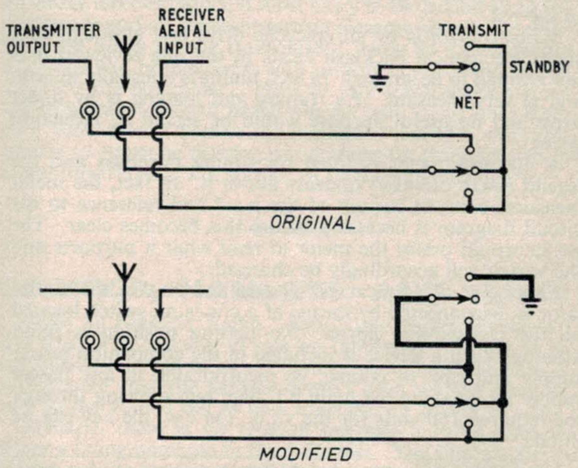

Fig. 1. A useful improvement to the wiring of early production models to increase the net signal.

positions: a most useful arrangement. On NET, 150 volts is switched to the v.f.o. with the aerial left connected to the receiver, but of course, the aerial is switched to the transmitter on TRANSMIT, and the receiver terminals shorted.

The NET position might be too weak for some receiver arrangements and in such cases a simple change in the wiring of the function switch will overcome the problem and result in a hefty NET signal. This could be advantageous for high speed contest operating and the writer has incorporated the wiring change. Details are shown in Fig. 1.

The neon warning lamp is arranged to give a steady glow on both NET and TRANSMIT, but continuous flashing on STANDBY. Some might consider the latter to be distracting whilst others would be glad of the indication. All the writer will venture to say is that on numerous occasions

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tage drop across this resistor will change quite handsomely for small changes in current through it. In this case, we monitor the current of V1 by measuring the voltage between the junction of R3C8 (positive) and chassis.

Reference should now be made to Fig. 1.

The horizontal axis of this diagram represents the total length of the former upon which L_N is wound. For the sake of clarity three formers are shown stacked so that the relative position of the core is quite clearly indicated. The vertical lines at the left hand end represent the winding. An iron dust core is shown in each former. Core A is central to the winding, core B central to the former, and core C wound down to the foot end of the former.

The vertical axis represents, in a purely arbitrary manner, the voltage at the junction of R3C8.

First take core B. As this is moved along the former from foot to winding, the graph illustrates the voltage excursion at the R3C8 junction. It starts high, drops, and then rises.

Consider now core A being moved in the same direction, that is from right to left. The voltage starts high and remains so until the core is well in, and then it starts to drop and reaches a minimum when the winding is centrally placed about the core.

Core C does precisely the reverse of core A.

In the case of core A, there are *insufficient* turns on L_N, core B is absolutely correct, while in the case of core C there are *too many* turns on L_N.

With the aid of this diagram, watching the voltage at R3C8, and noting the position of the core in your own neutralizing coil, you will quickly be able to tell what alterations you have to make to the turns on your particular L_N to get it spot on.

Make a final check using the method where R3 is disconnected, and a strong local signal.

New Allocation Alignment

The revised alignment procedure for the new allocation is as follows:—

70·2 Mc/s—L1. 70·6 Mc/s—L2. 70·4 Mc/s—L3. 70·4 Mc/s—L4. 70·3 Mc/s—T1 primary. 70·5 Mc/s—T1 secondary. 70·1 Mc/s—T2 primary. 70·7 Mc/s—T2 secondary.

Make all adjustments for maximum signal.

I.F. Head Amplifier

One point which was not noted in the original article is that while the purpose of the i.f. head amplifier is to " lift " the rather low output from the triode-mixer to a level suitable for the main receiver, if the main receiver is itself a highly sensitive device, excessive gain in the i.f. head amplifier may make the converter sound noisy—which it certainly is not. Furthermore, under certain conditions, very high gain in the head amplifier could produce cross modulation effects. Particularly may these undesirable features be found when using a " hot " AR88 as the main receiver.

If you suspect that your converter is noisier than it should be, pick on a weak station and then find out by how much the cathode resistor of the i.f. head amplifier, R8, can be increased before the readability of the station starts to decrease. If you do have too much gain on board in the head amplifier, the noise will go down far more rapidly than the signal. Do be sure to use a *really weak signal* when checking out this point.

Strong Signal Reception

If you live in one of the many areas where mobile activity is high, you may well find that your whole receiving system " blocks solid " if a mobile really does park outside your door.

Two solutions are possible. Either a 10K ohms potentiometer can be fitted in the cathode of the converter i.f. head amplifier, and used as an r.f. gain control, or alternatively, the EF91 head amplifier can be changed for a 6BJ6 or W77. This latter course is only really advised if it is possible to bring out the a.g.c. line of the receiver and so automatically control the head amplifier gain of the converter.

In practice this system works well, and even a 50 watt transmitter less than half a mile away will not block out the receiver.

The circuit of a modified head amplifier is shown in Fig. 2.

Reference

[1] RSGB BULLETIN, April, 1964.

NEW BOOKS

UNDERSTANDING TELEVISION. By J. R. Davies. Published by Data Publications Ltd., 57 Maida Vale, London, W.9. Price 37s. 6d. net. 500 pages with numerous line diagrams.

This is undoubtedly one of the best books that aims to explain television in simple language, and has been a pleasure to read. Mr Davies proves beyond question that it is possible, with the aid of good, clear diagrams and most readable prose, to explain even the most complex circuitry without the prime aid of mathematics or a spate of Greek letters, and the publishers are to be congratulated for arranging, in almost all cases, for the diagrams to appear on the same page as, or facing the corresponding text. A small point perhaps, but one most helpful for easy reference.

For those readers desirous of studying television circuits for 405 or 625 lines, colour, or brushing up what they have already learnt, this is certainly the book. W. H. A.

ELECTRONS IN PICTURE TUBES. Booklet issued free of charge by Thorn-AEI Radio Valves and Tubes Ltd., 155 Charing Cross Road, London, W.C.2.

This booklet is another in the range *Electrons in. . . .* series. It describes the evolution and development of cathode ray tubes for television use, and is well illustrated. The company points out that they produced the first magnetically focused tubes used in this country. The other booklets in this series are also very useful, and deal with valve operation.

K. L. S.

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over the years he has called others only to find that it was necessary to switch on the transmitter to be successful.

If you do not want the facility then you can disconnect or mask off, or perhaps use it to amuse Junior.

Connection of the power supply to the transmitter is with B9A plugs and sockets. The plugs are wired to automatically adjust heater wiring for 6·3 volts and a separate cable, suitably identified, is available as an accessory for patching to 12 volts for mobile use.

No mobile tests have been carried out by the writer but as the AT5 is not particularly prone to mechanical shock, first class results are expected.

Conclusion

Reports over the air confirm that speech quality is excellent with no trace of spurious f.m. or hum and the note is T9. C.w. is good and free of chirps and clicks, with an available r.f. output in excess of 10 watts.

In conclusion, and this is an opinion, not a measurement, it is expected that the AT5 and power supply will give long and satisfactory service and should appeal especially to mobile operators. That was why it was bought, but it is beginning to look as though it is going to stay in the shack (anybody want to buy a large home constructed 160m transmitter?—Adv.).