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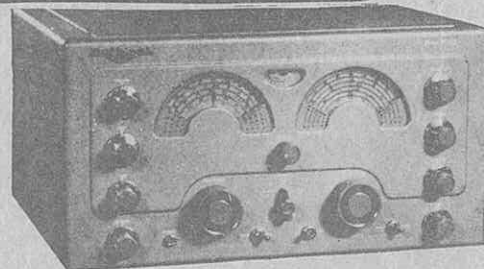
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March, 1951  
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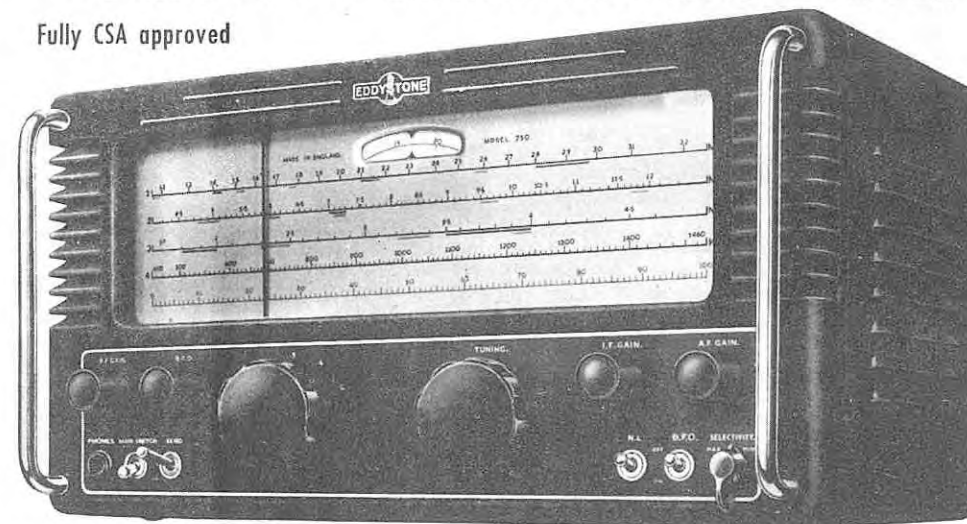
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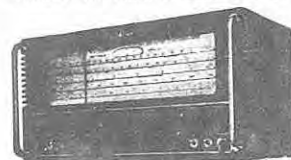
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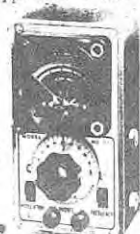
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# SKYWIRE

Vol. 4

No. 3

*Published monthly as*  
**THE CANADIAN RADIO AMATEURS' JOURNAL**  
*Editor - Fenwick Job, VE3WO*

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Club Activities and Sidebands -  
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March, 1951

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# SIDEBANDS

Listening across the various amateur bands in the last ten days, there have been numbers of comments passed on what some Canadian ops seem to feel is a severe encroachment on their rights.

Elsewhere in this issue you'll read the data on this change - with United States amateurs now authorized to operate as low as 3800 kcs on phone. This, to some thinking here, is a dastardly deed, since it has forced VE fones down below 3800 to avoid the interference caused by the high powered W's. Since the D.O.T. extended our phone exclusive another 25 kc (now 3725 to 3800 for our use only) the C.W. men are solidly up in arms, since, they claim, such extension conflicts with a great many net operations. In one or two club papers that have reached us, Alex Reid has been castigated for permitting this disaster.

But there are always a couple of sides at least to any story - and this one is no exception. Let's look into possibilities.

Three years ago C.G.M. Reid, VE2BE gave notice in a special message in QST that he would like your opinion on the division of bands between phone and C.W. and as a direct result of this, with the pending change in U.S. phone to 3800, we had our phone band lowered to 3750. Fifty kcs all to ourselves, and those who wanted to pound brass in there.

In other words, we were still favored as we were pre-war. The thinking was that we needed these extra kilocycles to get out, and not have to buck the kilowatts. But I've often wondered why we should be so privileged! Today, the operator who runs low power does so in most cases purely from choice because surplus made high power available at very reasonable cost to anyone who wanted it. Our W neighbors also have their low powered rigs and they get out beautifully with them because they have to do so. So could we - if we had to - so let's count anything out of the U.S. phone bands as an eighth wonder of the world and not squawk so loudly about our change.

March, 1951

And for C.W. men who are roiled up - remember the survey showing that 40 percent of the hams' rigs were used on phone and the split still is not unfair. Consider that a well adjusted phone rig must occupy about 2.5 kcs to get an intelligible signal into your shack, and that a C.W. signal can be reduced in effective width in a decent receiver to a fraction of this 2500 cycles, and you begin to wonder what the protests are all about.

Sure the bands are crowded - and there'll be more of it in the years ahead, but we can clean a lot of it up by changing our operating techniques to those now needed. The C.W. traffic nets are doing a wonderful job, and should be given every courtesy by rag chewers who sit on a net frequency without thinking about the other guy. More consideration will go a long way toward helping all of us enjoy our hobby. Play ball!

Important news came from Ottawa this past week in a release that a treaty has been agreed to by the U.S. and Canada which will clear the way eventually for amateurs from both countries to operate both in the Dominion and in the States.

It will take some little time to ratify the treaty and arrange the necessary regulatory material, but it is going to be a wonderful addition to our existing privileges. No longer will it be necessary to seal all rigs as the border is crossed. Permission to operate in either country like this will not only mean more pleasure from hamming during the vacation trips, but will integrate closely the amateur emergency service possibilities.

In addition, many States have granted, or are in the process of granting, authority to issue amateur call letter plates for cars, which will quickly identify a ham in an emergency. Conceivably, Alex Reid could institute this kind of thinking at Ottawa, for VE amateurs!!! It would take some doing, because the provinces would have the final say, but it would be a great thing to have.

de VE3W0

Page 5



# The ZB3 Converted for Two Metres

## Modifying a Surplus Unit

By E. DANDY, A.M.I.R.E.

(The ZB3 (AN/ARR-1 Homing Adaptor) was designed to work the range 234-258 mc, and so it is easily modified to operate as a 2 RF-mixer-oscillator converter on our 2-metre band. This article shows how. For those who may look for the circuit diagram, it was not thought necessary to give one in this case, since the photographs are keyed, the text is fully explanatory and the disturbance to the existing unit as wired is relatively slight.—Ed.)

THIS piece of ex-Service gear can now be obtained very cheaply on the surplus market, and is easily modified for working as a converter on the 145 mc band. The unit was used as a "homing adaptor" in conjunction with standard aircraft receiving equipment, and operated in the frequency range 234-258 mc.

### General Description

Electrically, the adaptor consists of three stages of inductively tuned RF amplification and a grid leak detector, all the valves being 954 acorns. The three RF amplifier stages—V101, V102 and V103—are coupled by means of four circuits, each consisting of a tuning coil and a trimmer condenser. The four circuits are tuned by means of four silver-plated cores which are moved simultaneously in and out of their respective tuning coils by means of a rack and worm arrangement driven from the main tuning dial. The aerial is connected through a co-axial plug and condenser C101 to the tuning coil L101 (see keyed photographs). The condenser C102 is adjustable from the front panel and is used to align the input circuit. The resistor R116 provides a means of furnishing extra bias for V101, and can be shorted in and out by means of an external switch. The plate and screen voltage supplies of this valve are quite conventional and coupling to the next stage is via C106 to the tuned circuit L102-C108. The circuits for the second and third RF amplifier stages are identical with V101, except that no provision is made for varying their bias.

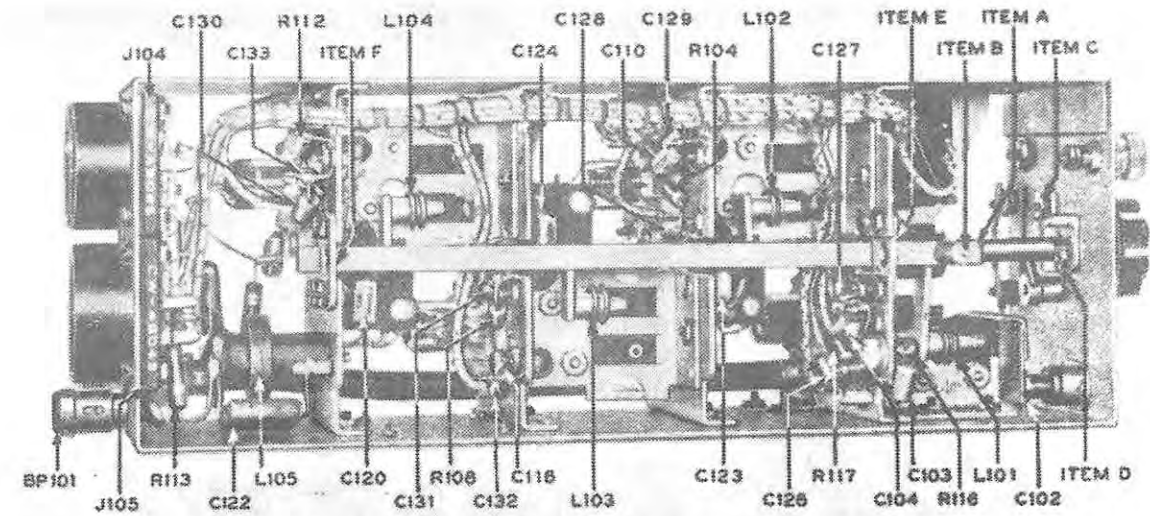
Condensers C102, 108, 114 and 118 are trimmers used to align all circuits at the middle of the frequency range covered by the adaptor. The detector circuit V104 is designed to demodulate the HF signals which are modulated by frequencies in the range 540-830 kc. The detector is of the grid leak type, and the plate of the valve is connected through R115, L105 and C125 into a low-capacity concentric transmission line, which is taken to the aircraft receiver through an external switched relay. A condenser C115 is provided from the plate of V104 to earth which, in combination with R115 and the distributed capacity of L105, serves to remove the carrier component from the output of the detector. When the switch S102 is connected to 24 volts, the four valve heaters are in series; with S102 thrown to the 12-volt position, they are connected in series-parallel. HT is fed in on pin 41 of the plug J105.

### Modification for Two Metres

Now that the normal service operation has been outlined, proposals can be made for modification of the unit to work on the 145 mc band. It is suggested that V101 and V102 remain as RF amplifiers, with V103 as a mixer and V104 an oscillator, utilising a 10-mc IF.

First, remove the top cover of the instrument, by giving a half-turn to the two Dzus fasteners. Next, take off the bottom plate by withdrawing the six screws (three on either side) holding it in place. The adaptor is now fully accessible and is ready for attention. As it is

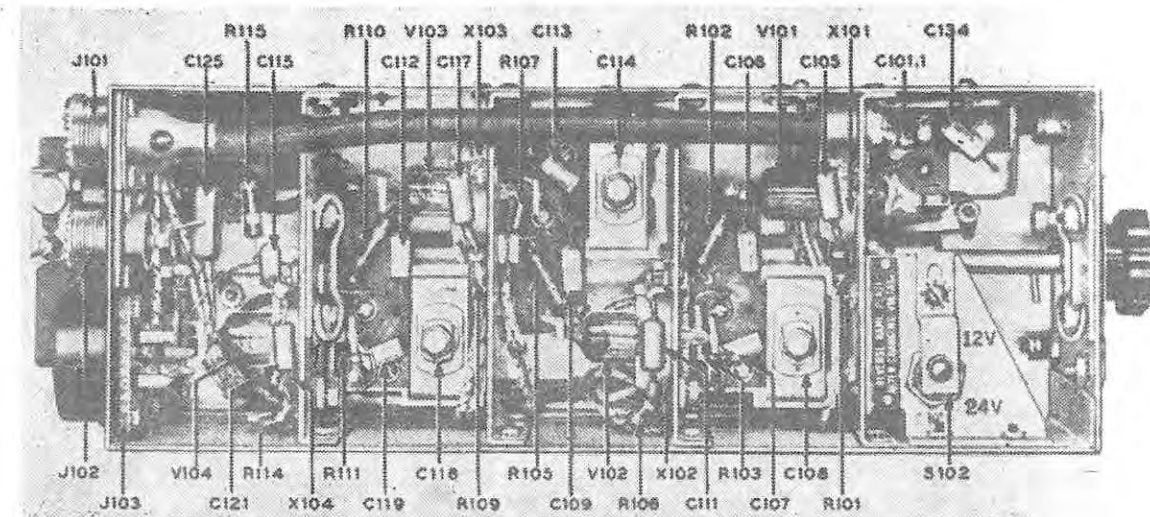
Skywire



Internal bottom view, with all parts identified; see text and table of values.

extremely difficult to obtain sockets to fit the plugs on this unit it is suggested that the three-pin plug J104 be removed and an octal valveholder fitted in its place. This is done by taking off the three connections to the plug, then severing the other ends of these wires from pins 42,

49, 52, and the earth tag on plug J105. In addition, also remove L105, C115, 122, 125 and R115, to facilitate the modifications to the plug wiring. The coil former will be required later for rewinding as an IF transformer. Due to the fact that the connecting wires are



Top view of the ZB3 unit, which can be modified to work as a 145 mc converter.

twisted around each soldering tag several times, it is advisable to use a very hot iron—one of the miniature types with the element in the bit is preferable, if available.

Now proceed to modify the heater connections. Turn the adaptor so that the tuning coil side is uppermost, with the tuning dial facing. Take out the black tracer wire from the left-hand heater pin of V103, and reconnect it to the right-hand pin. Now connect the left-hand pin by a short wire to the nearby earth tag. Cut off the plain white wire going to the right heater pin of V102, and locate the other end of this wire (which is attached to a terminal of the heater change-over switch), cut off, and withdraw from the cable form. Remove the black tracer wire from the same heater terminal of V102 and take it to the left-hand heater terminal. Now connect the right-hand tag to earth by a short lead. A brown tracer wire will be noticed going to the left-hand heater tag of V101; cut this and locate the other end at the change-over switch, disconnect and withdraw it from the cable-form. All that remains is to run a short wire from the left-hand heater pin of V104 to pin 2 of the new octal socket. Pin 7 of this socket should be connected to a convenient earth tag, and pin 5 by a short wire to pin 41 of socket J105.

This all *sounds* rather complex, but in fact these modifications can be carried out in a matter of a few minutes!

In order to wind new tuning coils it is necessary to take out the sliding tuning bar, which can be done by removing the two small end-plates holding the bar in position; it then comes out easily.

#### First RF Stage

The following alterations should be carried out to the first RF stage. Remove coil L101 and replace it with a three-turn coil (tapped at one turn from the earthed end) of the same wire diameter, gauge and spacing as the original. Connect the valve grid to the top end of the coil, *i.e.*, take the grid flying lead to the metal plate to which one end of the condenser C134

is connected. The aerial coupling condenser C101-1 is connected to the tap on the coil; this should be about right for a 70-ohm input match from the aerial. Finally, short out R116 by means of a wire to a nearby earthing tag. Moving on to the second RF stage V102, replace L102 by a three-turn coil identical to that in the first stage but with no tap. Now replace L103 and L104 by similar coils to that fitted to the second RF stage; make sure, incidentally, that all the coils are very rigid so that they will be unaffected by vibration.

#### Mixer Conversion

The next step is to convert the mixer stage V103; disconnect the suppressor grid from earth and fit a 47,000-ohm resistor to ground. Remove the condenser C112 from the anode of V103 and reconnect it to the suppressor grid of the same valve. There should be just sufficient wire on the condenser to enable this to be done. Take out the 30,000-ohm resistor R110; this leaves the anode of V103 free of all connections. Now change the bias resistance R108 to a half-watt 6,800-ohm resistor. The next stage is the rewinding of L105, which has already been removed from the set. The old coil should be taken off the former, and 28 turns of No. 26 gauge enamelled wire close-wound in its place. Four turns of No. 22 gauge plastic-covered wire should be wound over the top of the main winding in the same direction, at the end of the main coil remote from the tag panel. The windings should be stuck down in place with Durofix and an extra soldering tag fitted to the tag panel attached to the former.

The coil is now replaced in its original position in the adaptor, and reconnected as below: The end of the main winding nearest the tag panel should be wired to the tag in close proximity to the screened aerial input lead; in addition, a short wire from this tag should be taken through a small hole in the aluminium screen, and the other end connected to the anchoring point for the anode flying lead of V103.

Skywire

The other end of the main winding of the IF coil is then taken to the tag on the coil former opposite the one which has just been joined to the anode of V103. The resistor R110 (the other end of which is connected to pin 41 of plug J105) should also be soldered to this tag.

The 0.006  $\mu$ F condenser C122, which was previously removed with the coil, should now be reconnected between the above-mentioned tag and an adjacent earth point. A 3-30  $\mu$ F trimmer should also be connected, with stiff wire, across the main winding for tuning the IF transformer. The end of the four-turn winding nearest the chassis is now connected to earth. A screened lead of a low-capacity type should be led out through the rear of the chassis, the centre wire being soldered to the remaining end of the four-turn coupling coil. The outer braiding of this cable is earthed near the IF transformer; the other end will connect to the aerial and earth terminals of the communication receiver with which the converter is to operate.

#### Oscillator Stage

All that now remains is to modify the oscillator stage V104; remove the bias resistor and by-pass condenser R112 and C133. Connect the anode direct to the screen grid terminal. Change R114, at present 200,000 ohms, for a 30,000-ohm resistor. Now run a lead through a small hole in the aluminium screen from the cathode pin of V104 to a tap on the new three-turn oscillator coil, at a point one turn from the earthed end. This lead must be of at least 18 gauge wire and very rigid.

Now replace the tuning rod and holding plates, taking care that these plates are screwed up so that there is no side-play on the tuning rod. Also see that all four coils are positioned approximately the same, so that when the four slugs are fully withdrawn from the coils the front edges of all the slugs are the same distance from the nearest edges of their associated coils.

#### Alignment

All the necessary alterations are now completed and for alignment purposes it only remains to connect up the octal plug at the rear of the chassis to a power pack. The connections to the plug are as follows: 6.3 volts at 0.6 amps, pin 2; 250 volts HT+, pin 5; and a common

#### Table of Values

ZB3 Conversion for 145 mc

Refer to keyed photographs

C101	= 2 $\mu$ F ceramic.
C102	= Variable trimmer.
C103	= 30 $\mu$ F ceramic.
C104	= 30 $\mu$ F ceramic.
C105	= 30 $\mu$ F ceramic.
C106	= 5 $\mu$ F ceramic.
C107	= 5 $\mu$ F ceramic.
C108	= Trimmer, air.
C109	= 5 $\mu$ F ceramic.
C110	= 30 $\mu$ F ceramic.
C111	= 30 $\mu$ F ceramic.
C112	= 5 $\mu$ F ceramic.
C113	= 5 $\mu$ F ceramic.
C114	= Air trimmer.
C115	= 20 $\mu$ F ceramic.
C116	= 30 $\mu$ F ceramic.
C117	= 30 $\mu$ F ceramic.
C118	= Air trimmer.
C119	= 5 $\mu$ F ceramic.
C120	= 30 $\mu$ F ceramic.
C121	= 30 $\mu$ F ceramic.
C122	= 0.006 $\mu$ F mica.
C123	= 30 $\mu$ F ceramic.
C124	= 30 $\mu$ F ceramic.
C125	= 0.006 $\mu$ F mica.
C126	= 30 $\mu$ F ceramic.
C127	= 30 $\mu$ F ceramic.
C128	= 30 $\mu$ F ceramic.
C129	= 30 $\mu$ F ceramic.
C130	= 30 $\mu$ F ceramic.
C131	= 30 $\mu$ F ceramic.
C132	= 30 $\mu$ F ceramic.
C133	= 5 $\mu$ F ceramic.
C134	= 2 $\mu$ F ceramic.

See also page 10

earth connection from HT— and the other side of the 6.3-volt supply to pin 7. The screened output lead should be connected to the aerial and earth terminals of the communication receiver, which must now be tuned to 10 mc.

Adjust the trimmer across the IF coil for maximum noise. The next step is to get the oscillator going on 135.5 mc. It is suggested that a small calibrated absorption type wavemeter be used for this

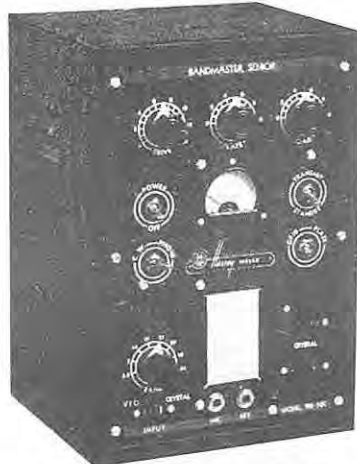
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purpose. First of all check with the  
trimmer C118 half-way out; if the  
frequency is too high, close up the turns  
of the oscillator coil, if too low open them  
slightly. Final adjustment can be made  
on the trimmer. Now, from the signal  
generator feed a signal at 145.5 mc into  
the aerial input socket of the converter.  
(The output impedance of the generator

### ZB3 Conversion

#### Parts List

(cont'd)

- L101 = Aerial coil.
- L102 = Second RF coil.
- L103 = Third RF coil.
- L104 = Detector grid coil.
- L105 = Detector output coil.
- R101 = 200,000 ohms,  $\frac{1}{2}$  watt.
- R102 = 30,000 ohms,  $\frac{1}{2}$  watt.
- R103 = 50,000 ohms,  $\frac{1}{2}$  watt.
- R104 = 1,000 ohms,  $\frac{1}{2}$  watt.
- R105 = 30,000 ohms,  $\frac{1}{2}$  watt.
- R106 = 200,000 ohms,  $\frac{1}{2}$  watt.
- R107 = 200,000 ohms,  $\frac{1}{2}$  watt.
- R108 = 1,000 ohms,  $\frac{1}{2}$  watt.
- R109 = 200,000 ohms,  $\frac{1}{2}$  watt.
- R110 = 30,000 ohms,  $\frac{1}{2}$  watt.
- R111 = 20,000 ohms,  $\frac{1}{2}$  watt.
- R112 = 10 ohms,  $\frac{1}{2}$  watt.
- R113 = 30,000 ohms,  $\frac{1}{2}$  watt.
- R114 = 200,000 ohms,  $\frac{1}{2}$  watt.
- R115 = 50 ohms,  $\frac{1}{2}$  watt.
- R116 = 100,000 ohms,  $\frac{1}{2}$  watt.
- R117 = 1,000 ohms,  $\frac{1}{2}$  watt.
- J101 = Coaxial input socket.
- J102 = Coaxial output socket.
- J103 = 4-terminal plug.
- J104 = 3-terminal plug.
- J105 = 8-terminal plug.

should be about 70 ohms.) Adjust the  
trimmers C102, 108 and C114 for maxi-  
mum output, using the communication  
receiver S-meter as check for this. If it is  
not possible to go through a maximum  
on either of these trimmers proceed as  
follows: If the greatest signal is obtained  
with the trimmer unscrewed, open out the  
coil spacing slightly; if the maximum  
signal is found with the trimmer fully  
screwed in, then the coil turns need  
closing up a little. When these adjustments  
have been made to all three stages, the  
ganging should hold across the amateur  
band.

Skywire

## Practice of QRP

### Notes on Low Power Working

By C. PROCTER (G5PR)

WHEN the writer was first licensed in 1934,  
he was handicapped by having no mains  
and for three years all work was done with low  
power from batteries. During that period  
excellent results were obtained and, in addition  
to numerous contacts on the lower frequency  
bands, WAC and WBE were achieved on 14  
mc with a power which never exceeded 5 watts.

#### Comparisons

The two chief differences between conditions  
to-day and those pre-war are: First, the greatly  
increased number of stations on the air; and  
secondly, the average power is much higher.  
Before the war many British amateurs were  
happy with 10 watts or less and the one- or  
two-watt station with a highly efficient aerial  
often produced a signal almost as strong as the  
10-watt man with a not-so-good aerial.

To-day, few stations use less than 25 watts  
and very many are around the 100-watt mark.  
One must therefore be resigned to having a  
weaker signal than the average and overcome  
this handicap by clever and thoughtful  
operating—in other words, by using the  
“tricks of the trade.” Incidentally, these same  
tricks might yield high dividends to some of  
the higher-powered stations and considerably  
reduce interference, but there is no need to tell  
them this. The best operators know them  
anyway, and that is why they are so successful  
in contests.

An important consideration in battery  
working is the cost of current, and anything  
which can be done to increase the life of the  
batteries and still produce the same net result  
is obviously well worth while.

We are helped considerably in this battery  
saving by the present practice of calling a  
station only on his own frequency. Pre-war  
when most stations used crystal control and  
searched the whole band for replies to CQ's

March, 1951

There is a large body of amateurs interested in getting  
results with low power—either for its own sake or by  
force of circumstances. Whatever the reason, there are  
few experiences more satisfying than working DX the  
hard way; this article is by an operator who is able to  
discuss the practical aspects of QRP working.—Ed.

it was necessary to give fairly long calls to  
make sure that the CQ'er had covered one's  
frequency. To-day, nearly all stations listen  
first on their own frequency after a CQ. Only  
a short call from the answering station is  
necessary, say, the called station's call three  
times followed by one's own twice.

#### Points on Procedure

One is forced to the conclusion that crystal  
control on a single frequency is a considerable  
handicap, particularly for low-power work  
where it is necessary to avoid interference. If  
crystal control is to be used one must have a  
number of crystals for the frequency to be  
varied so that the whole band is covered in  
steps. But it is so easy to build a stable VFO  
with modern components that the expense of  
several crystals seems hardly justified.

On the lower frequencies many fruitless  
calls can be avoided by careful listening. Let  
us take an example: A strong station CQ's  
on 3.5 mc. Before answering, wait a second to  
see if anyone else replies—. If a “big”  
station comes up the chances are he will put  
in a stronger signal than you and the CQ'er  
will usually take him as a matter of choice.  
Clearly, *your* chances of raising this station are  
small; by all means give him a short call on  
the offchance, but don't be surprised or dis-  
appointed if nothing happens. Pass on to the  
next station and try again. *Persistence* is the  
first essential qualification for low-power  
working.

Next, we come to the best way of making a  
contact. Generally, the writer finds that on low  
power more contacts are made by calling other  
stations than by sending CQ. This is logical  
enough when one thinks about it. The average  
amateur is a lazy sort of fellow; he picks the  
strongest signals because they are easiest to

read. Therefore, if you are an S5 signal in a band full of S7's, the chances are you will be passed over. Of course there are exceptions to this rule, and they make life just wonderful. So if you can find a clear spot on the band try an odd short CQ. But don't do it all evening and then complain that conditions are bad.

### Conditions

This brings us to a study of conditions. Everyone has evenings when nothing goes right and whatever one's power it seems impossible to work anything. These evenings can happen all too frequently with only 1 watt of power. With a bit of practice one can spot them right away. The writer can usually tell in five minutes' listening whether he is likely to do any good. For example, when the 7 mc band is cluttered up with high power foreign phone and broadcast stations, one little watt of CW is unlikely to make much impression. The best thing to do at such times is to forget Amateur Radio entirely and go down to the local or, if you can't leave it alone, do some useful constructional job. If you continue to operate you will only run down your batteries, lose your temper and finish up at the local anyway.

Next, when a contact is made keep your transmissions as short as possible. This does not mean having only rubber stamp QSO's, but get the OK after each two or three sentences. With the present congested bands the chances of your channel staying clear for long periods are small. If possible, of course, work break-in; then you can often hear any interfering signal start on your frequency and in any case the station you are working can interrupt you if necessary.

Finally, when working CW keep to a steady 12-15 words a minute. Anything slower is tedious and by taking longer makes the transmission more liable to interference. Anything faster is the very devil to copy through interference.

### Some Results

Now what has the writer to show for all this good advice? With an indifferent 132 ft. end-on aerial slung over the roof and at the far end about 20 ft. up in a tree, S6 and S7 reports

Seldom has a contact been impossible when a schedule has been arranged and the usual comment when a new station is told of the power is "Very FB, OM." These results are obtained at odd and infrequent week-ends and no sleep is ever lost if conditions are poor and no contact is made. The writer has acquired a very philosophical attitude but has no doubt that if there was time for regular working many hundreds of contacts would be made annually. Twenty has not yet been attempted, but before the war a few persistent enthusiasts made WAC on about 2 watts. There is no reason why it should not be done to-day especially if a directional aerial is available, though it would be a good deal more difficult.

### DX QTH's

CE5AW	Box 560, Concepcion, Chile.
CR4AC	Box 61, Praia, Cape Verde Islands.
EA6EG	Box 324, Palma, Majorca.
KH6VX/KB6	c/o C.A.A., Canton Island.
MI3UU	Box 222, Asmara, Eritrea.
PK6XZ	Swortlaan 3, Macassar, Celebes.
SV0AL	Major A. L. Fayerman, 45 Nikis Street, Salonika, Greece.
VK2ACC	Farm 54, Fivebough, Leeton, N.S.W.
VK4SI/VR1	Ren Foster, Navy Base, c/o 3234, Box M.33, c/o Fleet P.O., San Francisco.
VP2AJ	AP0 855, c/o PM, Miami, Fla.
VQ3SS	P.O. Box 457, Dar-es-Salaam, Tanganyika.
W6AZA/KW6	c/o C.A.A., Wake Island.
YN1FTB	Francis T. Brown, U.S. Embassy, Managua, Nicaragua.
YS1RA	U.S. Embassy, San Salvador.
ZB1AJX	18 Bugeja Buildings, Prince of Wales Road, Sliema, Malta, G.C.
ZP2AC	Box 512, Asuncion, Paraguay.

Skywire

# HOW'S UR OBS IQ?

The American Radio Relay League

Official Bulletin Nr 279, Feb 8th, 1951. Amateurs who apply for renewal of their operator licenses after March 1st, 1951 must comply with the amended renewal requirements recently announced by the F.C.C. After that date, applications must show that the licensee has accumulated a minimum of either 2 hours operating time during the last three months, or five hours operating time during the last twelve months of the license term. Operating time is counted as the total of all that time between the entries in the station log, showing the beginning and end of transmissions, both during single transmissions and during a sequence of transmissions. The applications must also include a statement that the applicant can send by hand at a speed of not less than that which was originally required for the class of license being renewed.

Official Bulletin Nr 280, Feb 15th, 1951. Effective March 1st, 1951, the U.S. 75 meter phone band will be expanded to 3800 to 4000 kcs, and made a permanent assignment. The 10 and 20 meter N.F.M. assignments - 28,500 to 29,000 and 14,200 to 14,250 kcs are also made permanent. N.F.M. may be used throughout the 28 mc phone band because of wide band privileges already existing above 29 megacycles. On 50 mc, N.F.M. will be made available throughout the entire band. The

75 and 20 meter phone assignments of course will continue to be available only to Class A or Advanced Class licensees.

Official Bulletin Nr 281, Feb 23rd, 1951. In connection with Docket 92959, A.R.R.L. is formally requesting F.C.C. for re-argument on the Amateur Extra Class License, but without affecting the effective dates of other provisions of the Docket as proposed. The Leagues' request for re-argument is based on the desire to insure that all Class A holders will retain maximum operating privileges in the future.

Special Canadian Bulletin to all amateurs! To simplify the work of the Department of Transport at license renewal time, it has been suggested that all licensed Canadian amateurs send their fees for renewal to their local offices as quickly as possible. These offices are now responsible for all re-issuance of licenses in this country, and the earlier this work can be started, the simpler the job becomes. Please cooperate by sending your renewal immediately.

As of this writing, an agreement or treaty has been made between the U.S. and Canada, providing for portable mobile operation by W and VE amateurs in either country. See Sidebands, Page 5 this issue for details.



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**STARK**

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March, 1951

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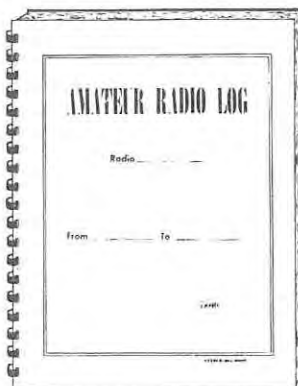
# HAMADS

Skywire Hamads must pertain to amateur radio. Rates are 20 cents per word, per insertion for commercial advertisements for profit, and 4 cents per word for all non commercial, non-profit advertisements by experimenters or licensed radio amateurs! Full remittance MUST accompany copy! Print plainly and count address in the total. Do NOT send personal checks unless exchange is included. Mail to Skywire, Toronto!

FOR SALE - C-2 Frequency Meter - AC-DC power supply built in, with line isolation transformer. First class condition and operation - \$35.00. H. Moray, 6702 McLynn, Montreal, EX. 2345.

WANTED - Used variable auto transformer Ferranti 100-RF or equivalent. State price wanted. VE7AS, 517 Burrard St., Vancouver, B.C.

FOR SALE - Class A Speech Amplifier - 6J7-6C5-pr of 6C5's in pp driving pair of 6A3's pp. Good condition, ready to go. Also Class B amplifier - pair 203Zs in pp. As modulator handles 700 watt



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transmitter, metered - 0-300 mil Triplet round. Universal modulation transformer, good condition ready to go. And Class C Amplifier using 304TH final, and 813 driver with meters - Triplet 0-200, 0-500, 0-150 mils. Write or see Rev. R. Keith Love, 54 Elizabeth St. Burlington, Ontario.... VE3CI.

## QSL CARDS

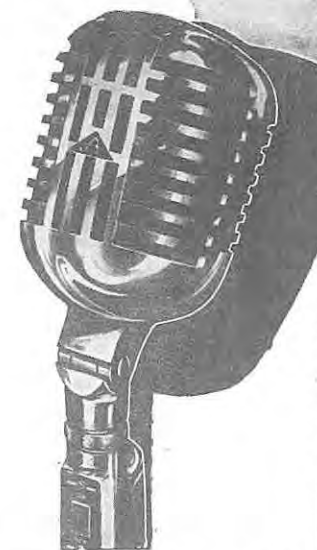
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● SERVICE  
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SAMPLES ON REQUEST

HARVEY WELLS All Band Transmitter and Power Supply! TBS-50 Bandmaster Jr., CMA-50 Speech Amplifier for use with a dynamic or crystal microphone, installed in unit for \$125.00 complete. APS-50 Power Supply for this - input 110VAC, 60 cycles, output 300 or 450 VDC at 275 ma. \$35.00, cables included. Also a National Select-O-Ject for \$35.00. R.K. Grant, VE2QQ, 72 Hudson Avenue, Apartment 5, Town of Mount Royal, Quebec.

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unidirectional cardioid crystal  
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*Astatic's* NEW SYNABAR MICROPHONE offers a new measure of clear-toned performance quality ... and its perfection does not diminish through long service life, thanks to a new ruggedness of construction. Perhaps the outstanding engineering achievement incorporated in this newly perfected unit is the use of a special sintered metal to cancel out 15 db front to back, making the Synabar, for practical purposes, dead to sound from the rear. Excellent frequency range, from 50 to 10,000 c.p.s., is further enhanced by a Response Selector switch, which provides choice of ideal pick-up characteristics for either crisp voice or general voice and music. The Synabar's crystal element has a special METALSEAL protection against moisture or dryness. A high impedance microphone, it has an output level of -54 db. It has a satin chrome finish, is furnished with detachable concentric cable connector and 20 feet of single conductor shielded cable, and is available in models with or without off-on switch.



**Breaking All  
Performance  
Records**

NEW  
SYNABAR

NEW  
SYNABAR  
cardioid  
crystal  
microphone

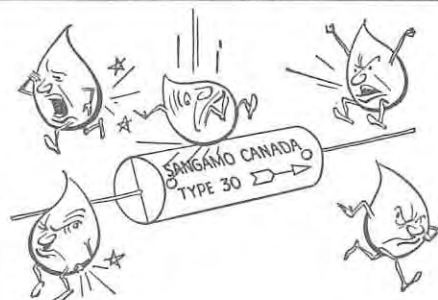
Compare style  
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TORONTO 13' CANADA



**MOISTURE-PROOF  
SANGAMO TYPE 30 PLASTIC  
CAPACITORS...**

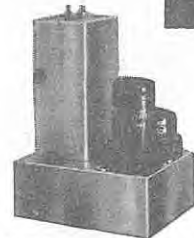
SANGAMO Type 30 Capacitors are completely moulded in Thermo-setting Plaskon - sealing the foil and paper against moisture, assuring longer life.

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# NC-183

see inside...



NFM-83 adaptor makes the NC-183 a top-notch NFM receiver. Instant selection of AM or NFM from front panel.

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## From 2-Stage RF to Push-Pull Audio ... Designed to Out-Perform!

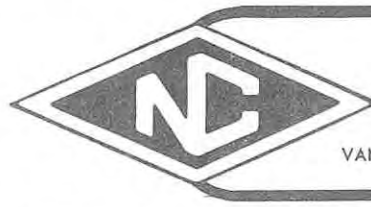
**COVERAGE:** Continuous from 540 kcs. to 31 mcs. plus 48 to 56 mcs. for 6-meter reception.

**FEATURES:** Two tuned R.F. stages. Voltage regulated osc. and BFO. Main tuning dial covers range in five bands. Bandspread dial calibrated for amateur 80, 40, 20, 11-10 and 6-meter bands. Bandspread usable over entire range. Six-position crystal filter. New-type noise limiter. High fidelity push-pull audio. Accessory socket for NFM adaptor or other unit, such as crystal calibrator.

**CONTROLS:** CWO Switch, CWO pitch, Tone, AF Gain, Main Tuning, Bandspread, Ant. Trimmer, Bandswitch, Send-Receive, Phono-Radio, Selectivity, Phasing, Limiter, RF Gain.

**TUBE COMPLEMENT:** Uses 2-6SG7 R.F.; 16SA7 1st det.; 1-6J5 osc.; 2-6SG7 I.F.; 1-6H6 2nd det.; 1-6SJ7 B.F.O.; 1-6AC7 A.V.C.; 1-6H6 noise limiter; 1-6SJ7 A.F.; 1-6J5 phase inv.; 2-6V6GT aud. out.; 1-VR-150 volt. reg.; 1-5U4G rect.

SEE THEM AT YOUR SUPPLY HOUSE

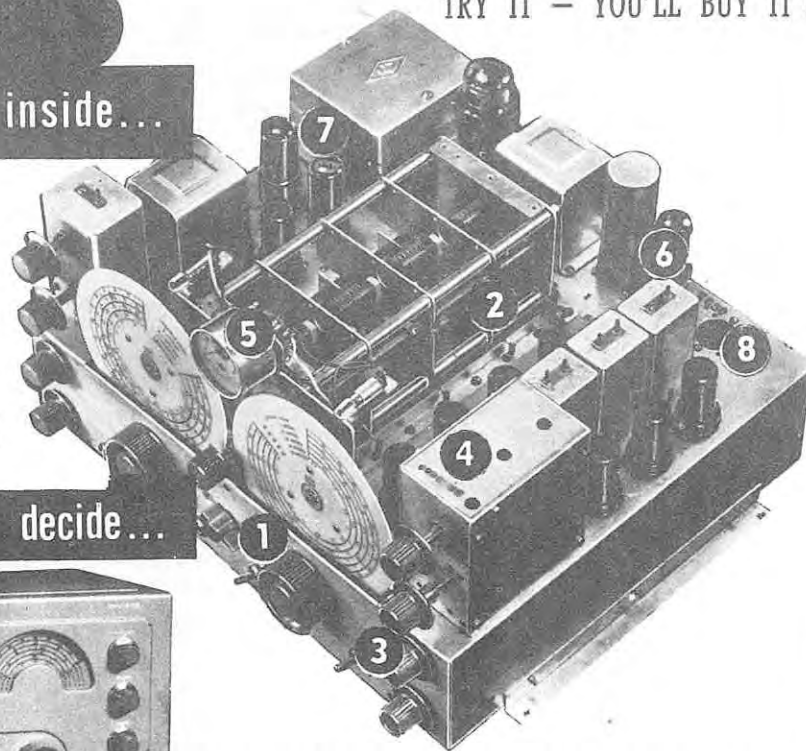


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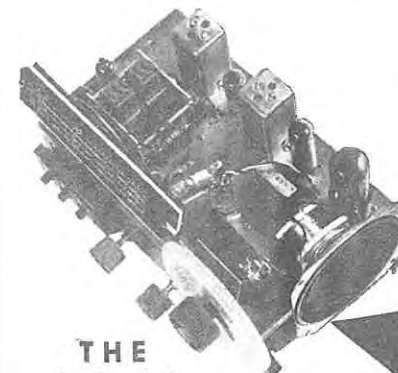
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## Sleek, Low-Priced Beauty is Most Compact General Coverage Receiver Ever Built!

**SIZE:** 11" wide 7" high, 7" deep.

**USES MINIATURE TUBES  
AND UNIQUE BANDSPREAD DIAL**

New miniature tubes make possible new sensitivity and performance. Unique plastic bandspread dial is adjustable to assure complete logging accuracy.

**TUBE COMPLEMENT:** 12BE6, converter; 12BA6, CW osc. —IF amp.; 12AV6, 2nd det.-1st aud.—A. V. C.; 50C5, audio output; 35Z5, rectifier.

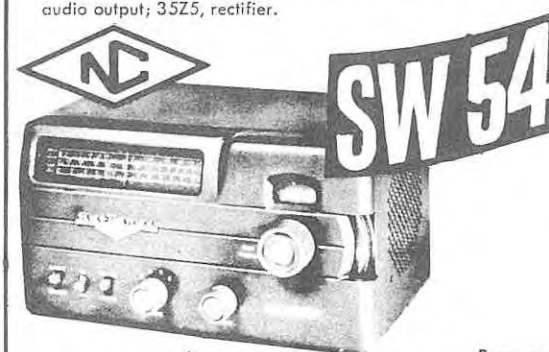
Here is National's latest engineering triumph! A complete superheterodyne receiver covering all major broadcast and shortwave bands that is smaller than the average table radio! New design makes possible a standard of performance never before achieved in so compact a receiver!

**COVERAGE:** Entire frequency range from 540 kc. to 30 mc. Voice, music or code.

**FEATURES:** Sensitive and selective superhet circuit. Slide rule general coverage dial with police, foreign, amateur and ship bands clearly marked. Separate bandspread logging scale usable over entire range. Built-in speaker.

**CONTROLS:** Main tuning, Bandspread, On-Off and Volume, Receive — Standby, Bandswitch, AM-CW, Speaker-Phones.

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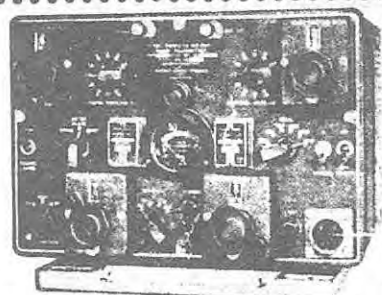
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One balloon, with hydrogen generator - \$2.50  
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**BALLOONS and KITES**



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300 - 0 - 300v at 100 ma.	275-0-275v at 60ma.	280 - 0 - 280 v at 65 ma.
6.3v at 3 amperes.	6.3v at 3 amperes.	6.3v at 2.1 amperes.
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ONLY - \$3.50!!	PRICED AT \$2.75	3 1/2 X 2 1/4 X 3 5/8 in
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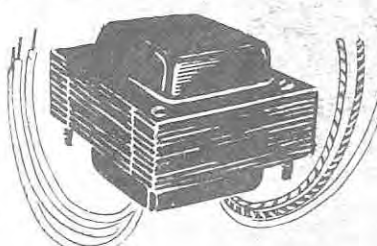
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6" PM	-----	\$2.50
10" PM	-----	\$4.50
10" PM	Rola made --	\$6.50
12" PM	-----	\$7.95

BRANDED RESISTORS -- NEW STOCK. THERE IS A GOOD ASSORTMENT NOW AVAILABLE IN ALL STANDARD VALUES OF RESISTANCE.

1/4 & 1/2 WATT -- 6¢ ea.  
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WRITE US YOUR NEEDS AND WE WILL SHIP AT ONCE!!

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## DX PREDICTIONS

Prepared by C.B. McKee, Engineering Division, CEC International Service

PREDICTIONS FOR MARCH, 1951

Skywire frequency predictions are for amateur communications on various circuits to almost any part of the world. These tables are for five major areas in Canada, and amateurs who are operating reasonably close to the cities indicated will find these predictions quite adequate.

Figures shown are in megacycles and indicate the band to be used. They are for normal F layer transmission and don't consider Sporadic E which may provide unusual DX openings!

Sackville to:	EST	01	03	05	07	09	11	13	15	17	19	21	23
Europe	7	7	7	7	7	7	7	7	7	7	7	7	7
Africa	7	7	7	7	7	7	7	7	7	7	7	7	7
Caribbean	7	7	7	7	7	7	7	7	7	7	7	7	7
S. America	14	7	7	7	7	7	7	7	7	7	7	7	7
Australia	14	7	7	7	7	7	7	7	7	7	7	7	7
U.S. - West	14	14	7	7	7	7	7	7	7	7	7	7	7
U.S. - Central	14	14	7	7	7	7	7	7	7	7	7	7	7
U.S. - South	14	14	7	7	7	7	7	7	7	7	7	7	7
Vancouver	14	7	7	7	7	7	7	7	7	7	7	7	7
Montreal	7	7	7	7	7	7	7	7	7	7	7	7	7
Sackville	7	7	7	7	7	7	7	7	7	7	7	7	7

Montreal to:	EST	01	03	05	07	09	11	13	15	17	19	21	23
Europe	7	7	7	7	7	7	7	7	7	7	7	7	7
Africa	7	7	7	7	7	7	7	7	7	7	7	7	7
Caribbean	7	7	7	7	7	7	7	7	7	7	7	7	7
S. America	14	7	7	7	7	7	7	7	7	7	7	7	7
Australia	14	7	7	7	7	7	7	7	7	7	7	7	7
U.S. - West	14	14	7	7	7	7	7	7	7	7	7	7	7
U.S. - Central	14	14	7	7	7	7	7	7	7	7	7	7	7
U.S. - South	14	14	7	7	7	7	7	7	7	7	7	7	7
Vancouver	14	7	7	7	7	7	7	7	7	7	7	7	7
Montreal	7	7	7	7	7	7	7	7	7	7	7	7	7
Sackville	7	7	7	7	7	7	7	7	7	7	7	7	7

# IONOSPHERIC STORMS

by Clive B. McKee of

CBC International Service Engineering Department

IN OUR LAST ARTICLE, you will remember that we told you that frequency predictions are normally computed each month for any one transmission path. You will also remember that we told you that it was necessary for the engineer to reduce the Maximum Usable Frequency which he can use by a safety factor to take into consideration as far as humanly possible the variations that take place in the Ionosphere from day to day.

It should be clearly understood for purposes of this talk that storm conditions mean magnetic storms, etc., and do not in any way refer to the type of storm of wind, rain, etc. that we experience upon the surface of the earth. There are four main types of abnormalities which are known as Ionosphere Storm, Magnetic Storm, Sudden Ionospheric Disturbance, and Low Layer Absorption.

As we now know, ionization of the upper atmosphere is brought about by the sun's activity. It is therefore reasonable to expect that when great upheavals and other disturbances take place on the sun, the ionosphere also becomes disturbed. These upheavals, and the extra ultra-violet radiation caused by them, bring about abrupt changes in the ionization in various parts of the atmosphere.

Let us examine these abnormalities more closely, and commence our study with the ionosphere storm, as this storm constitutes the major form of disturbance to short-wave communication.

An ionosphere storm is a period of disturbance during which there is continuous variation of the height of the ionosphere and its absorption of radio waves. The ionosphere at this time becomes extremely unstable and turbulent, and its layer construction is broken up. During these storm conditions the upper part of the ionosphere is expanded and diffused. The critical frequencies are much lower and therefore the maximum usable frequencies are correspondingly lower than normal. The absorption of energy from the transmitted signal is much greater and therefore the signal upon its arrival at its destination is very considerably weaker than under normal transmission conditions.

Ionosphere storms are most severe in the areas around the North and South Poles, known as the auroral zones, and decrease in intensity towards the equator. These storms occur over wide geographical areas, and the condition of the ionosphere is therefore much less uniform from point to point than on undisturbed days.

During this type of storm, short-wave signals which are normally well received drop to a very low level, and often disappear entirely. The storms usually last for several days. It is thought that these storms are possibly caused by bursts of electrified particles shot out from the sun. They are known to occur during times of high solar activity and to recur at about 27-day intervals, the period of solar rotation.

So much for the ionosphere storm. This type of storm is, however, very often accompanied by a magnetic storm. A magnetic storm is a condition of unusually rapid and irregular fluctuations of the earth's magnetic field. These magnetic storms may be caused by interaction between the magnetic fields surrounding the sunspots and the world's magnetic field, and are usually characterized by rapid and irregular fluctuations of the earth's magnetic field. Recovery to normal conditions usually takes several days, depending upon the geographical latitude and the severity of the storm.

Although the ionosphere and magnetic storm appear to be connected, the start of these storms does not appear to be always simultaneous and the ionosphere storms usually persist for some time after the geomagnetic field has returned to a "quiet" state.

The next form of disturbance is known as the sudden ionosphere disturbance, called the Dellinger Effect after a well known scientist who investigated this type of disturbance. As its name implies, this type of disturbance occurs very suddenly and is manifested by a sudden fade out of signals. This phenomenon is the result of a burst of ionizing radiation from a bright eruption on the face of the sun, causing a sudden abnormal increase in the ionization of the D layer, and is frequently

accompanied by resultant disturbances in the earth's magnetic field.

The effect of this disturbance upon short-wave reception is most pronounced, for everything appears to go dead, even background "hiss" disappearing. The reason for this sudden loss of all signals is because the ionization of the D layer has been so very much increased it is difficult for the transmitted frequencies to penetrate this layer on their journey up into the higher layers of the ionosphere, and therefore they suffer considerable absorption in the D layer. The drop in strength of the transmitted signals to zero usually occurs within a minute or two. It will be readily understood that since this phenomenon is a direct result of solar activity it does not occur in those areas of the world where the sun is not shining, that is at night. The effects of this type of disturbance last from about ten minutes to an hour or more, and the lower frequencies are the first to be affected.

This type of disturbance is most intense in that region of the earth where the sun's radiation is perpendicular. You will see therefore that this disturbance is most likely to occur around noon and near the equatorial latitudes.

This type of storm therefore has more effect on a North to South path, say Sackville to South America than on an East to West path, say, Sackville to Great Britain. You will remember that we said that this type of disturbance does not occur at night. It would possibly be more accurate to say that it does not occur on a transmission path the whole length of which is in darkness. It is possible on certain transmission paths that a portion of the path is in daylight and the rest in darkness. This disturbance could occur in the daylight part of the path and therefore the whole transmission path be affected.

Now let us consider the last of our storms, low layer absorption or "black-out."

These "blackouts" are caused by periods of prolonged low layer absorption, and are similar to the sudden ionospheric disturbance in their radio effects and characteristics except that their beginning as

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well as their recovery is very gradual and this type of disturbance has a longer time duration, usually several hours.

The low layer absorption effect appears to be due to increased ionization of the D layer, exactly as in the case of the sudden ionosphere disturbances. The increased ionization is caused by an abnormally great outpouring of ultra-violet light from the sun, but in this case it is not so sudden as in the eruptions which cause the sudden ionosphere disturbance. As with the sudden type of disturbance the lower frequencies are the first to be affected.

Both phenomena occur at all seasons of the year, but the prolonged periods of low layer absorption have been found to occur more frequently during high sunspot activity, the disturbances being separated by more or less quiet periods sometimes lasting several months. They frequently, but not always, occur during periods when sudden ionospheric disturbances are prevalent.

One of the most unpredictable abnormalities of the ionosphere is known by the name of Sporadic E.

Sporadic E appears to be a form of very intense ionization of the atmosphere at the same height as the ordinary E layer, but does not take the form of an overall layer of ionized gases but appears rather to take on the form of heavily ionized patches. It is thought that these heavily ionized patches drift around in a manner very similar to the way clouds drift across our sky on a summer's day. These heavily ionized patches, if they drift across in the direct path of the transmitted frequencies, can, of course, cause the predictions to appear very inaccurate since of course, these predictions were made on the assumption that the signals would be reflected from the F layer.

Ionized patches of this description are beneficial to a very high frequency type of transmission. It should be remembered, however, that this form of communication is dependent upon the presence of these heavily ionized clouds, and as these are very patchy in both time and space, normal short-wave broadcasting by this means is impracticable.

Another abnormality which may be mentioned here is scattered reflections. In all previous discussions of the ionosphere we have assumed that it reflects the transmitted signal clearly. This is in actual practice not always the case and it is wise to consider the underside of the ionosphere as of rough and hilly construction and not as a smooth reflecting surface.

**This is the sixth in Clive McKee's series on "The Sun and Short-wave Broadcasting" originally prepared for use on CBC International Service.**



This turbulent underside of the ionosphere causes what are known as scattered reflections. These scattered reflections may cause signal distortion and flutter fading as the various rays of energy arriving at the receiver have, due to the turbulent reflecting surface, travelled different distances, and arrive from different directions.

All of you who listen regularly on the short-waves will at some time or other have experienced the phenomenon known as fading. This occurs when the intensity of the signal arriving at your antenna is not constant, and is normally caused because of fluctuations of various kinds in the ionosphere.

These fluctuations cause the various rays of energy which arrive at your receiving antenna to travel different distances, and because of this to arrive at the antenna at different times. This time difference is extremely small, possibly thousandths of a second but it is sufficient to cause a variation in intensity of the signal received.

One form of fading which is particularly objectionable is that known as "selective fading." As was explained before, the received signal is made up of the carrier frequency and the audio or voice and music frequencies. Certain frequencies when passing through the ionosphere may experience more difficulty than others, and the signal therefore sounds distorted and unmusical. The term selective fading is used because the ionosphere is envisaged as "selecting" or allowing certain frequencies easier passage than others.

Now let us just summarize briefly the

outstanding details of this month's article. An ionosphere storm is a period of disturbance during which the ionosphere becomes extremely unstable and turbulent, and its height varies very rapidly. In consequence the frequency predictions which were made for a normal ionosphere are useless and the broadcasting service severely affected. These storms are most severe in the areas around the North and South poles.

A magnetic storm is caused by an unusual fluctuation in the earth's magnetic field. The effects of this type of storm are noticed first in the F layer and then move downwards through the other layers. These storms are possibly caused by interaction between the sunspots and the world's magnetic field.

The sudden ionosphere disturbance is caused by a burst of ultra-violet radiation from a bright eruption on the face of the sun, and causes a very sudden fade out of signals. This type of disturbance occurs only in the sunlit portion of the globe, and more frequently near the equator than in other latitudes.

Low layer absorption occurs, as its name implies, when the D layer becomes so heavily ionized that the signal journeying upwards to the F layer is unable to pass through and is absorbed.

Then last but by no means least is that condition which cannot be regarded as a storm, Sporadic E. This is a cloud type of ionization which is so unpredictable that its use is impracticable for international broadcasting.

These storms and their effects are just some among many of the variable factors with which a broadcasting organization has to contend.



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THE NORTH BAY AMATEUR RADIO CLUB IS sponsoring the Northern Ontario Hamfest Picnic, scheduled for July 1st and 2nd, 1951, at North Bay. This is advance notice of the Hamfest so you can make plans to be there early enough to get your tickets before they're all gone. VE3EAW, VE3ACZ or VE3AHH will all see that tickets are reserved for you, if you write or send a message. Last year the top prize was an Eddystone 750, so you can have an interesting time at this years gathering. Plan NOW for it.

A QSO Contest, open to all Ontario amateurs sponsored by the Ontario 'Phone Club, will be held on Sunday, March 11, 1951, from 10 A.M. to 10 P.M. The purpose of the Contest is to enable c.w. and 'phone operators to become more familiar with both types of operating. Two awards will be made. The c.w. trophy will be known as the "Sparton Radio Trophy" and the 'phone award as the "Columbia Record Trophy." Both trophies, donated by Sparton of Canada, will be suitably engraved with the winner's call and the year of presentation. Permanent possession of the trophy will be given to the person winning it on three occasions. Following are the rules: Frequencies from 3500 kc. to 3750 kc. will be allotted for c.w. operation. 3750 kc. to 3800 kc. is allotted to mobile 'phone stations running a power of 100 watts and under. 3800 kc. to 3850 kc. will be used by any 'phone station using 101 watts and up. No multipliers will be used and one point for contact from 'phone to 'phone, 'phone to c.w. and vice versa, provided contacts are made in the portion of the band above designated. Any station may operate 'phone or c.w., provided his operation takes place in the proper portion of the band. Judges of the contest will be: C.w. — VE3HP and VE3DU. 'Phone — VE3YJ and VE3FQ. Contest logs should be forwarded to E. Kimble, c/o Sparton of Canada, Limited, London, Ontario, up to midnight March 31, 1951.

## Amateur Radio WRITERS WANTED

To write articles on transmitters, receivers, antennas, test equipment, and any material of general interest to amateurs. Articles should be typewritten, between 2000 and 2500 words in length, accompanied by suitable diagrams, photos, and parts lists. Liberal payment made upon acceptance.

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# WILD DUCK JAM

By J. C. R. Punchard



Word is being passed around in wild duck circles to avoid Hornby, Ont., where strong magnetic waves from the new CBL-CJBC transmission station are jamming the radar of migrating birds.

**S**OONER or later everyone comes across a fish story, but recently a rival has appeared that may prove even more popular. It is known as the duck story. According to reports printed in the nation's press, a flock of wild ducks was grounded for three days at Hornby, Ontario, due to the strong radio frequency fields radiated by the recently opened CBL-CJBC transmitting station.

The ability of homing pigeons and migratory birds to navigate accurately over long distances has long been a matter of wonder to mankind, but recent experiments have revealed a possible explanation. Some specialists believe that birds can recognize their home locality at the intersection of a characteristic line of the earth's magnetic vertical field with a characteristic line of latitude.

The theory has been put forward that the bird is sensitive to both the magnetic force and the rotational velocity of the earth, and it is this latter force which enables him to establish latitude. Since the equator travels a far greater distance than the poles as the earth whirls on its axis, the rotational velocity varies from zero at the poles to 1080 m.p.h. at the equator, and the bird can sense the magnitude of this velocity with its own portable radar set as he flies to or from the equator. When the bird combines this line of force with the line of force set up by the magnetic vertical field, it can establish its whereabouts.

In extensive scientific experiments to prove this theory, tiny hyflux-chrome magnets were attached to the wings of experienced homing pigeons. The magnets cancelled out the value of the earth's magnetic field, just as ships were de-gaussed or demagnetized during the war, and the pigeons were so confused that many of them failed to return home.

Also pigeons released over certain portions of the earth, where the forces exerted by the earth's magnetic field and its rotational velocity are both equal and parallel, tend to fly in any direction.

## Difficult Problem

Of much more importance than the effect of electrical waves on the radio compass in a wild duck is the engineering aspect of the work carried out at Hornby in order to feed two 50,000 watt transmitters operating with different programs into a common antenna. The problem of preventing interaction between the transmitters was an extremely difficult one, and Northern engineers can congratulate themselves on a job well done.

Months of calculation on reams of paper were necessary before all concerned were satisfied that such an installation would be practical at such high power levels. Since liars figure and figures don't lie, the results obtained have substantiated the calculations and one is able to listen to two separate programs broadcast from the same antenna without the slightest interaction which the ear can detect.

To accomplish this feat, two special 50,000 watt filters were constructed by the Electronics Division. These filters employ coils several feet in diameter using up to two inch copper tubing. They are tuned by means of gas-filled variable condensers, instead of air, employing nitrogen and freon gas at pressures up to 200 pounds as dielectrics. The peak voltages encountered in this filter run to the order of 23,000 volts.

A considerable amount of technique was required to avoid ghostly corona discharges—a luminous brush discharge occurring between two conductors carrying extremely high voltage—from meter scales, wire braid connectors, screw

threads and so on. This corona is highly undesirable since it precedes a flash-over, which is actually a complete breakdown of the air. Many nerve-racking nights were spent in the coupling house at the base of the antenna, while CBL was off the air, solving the many problems encountered during the construction and test of this high-powered filter.

## Short-Circuit Test

One of the interesting tests called for by CBC engineers was a short circuit test to be made directly at the antenna with both transmitters operating and actually on the air. It was necessary for an engineer to short circuit the spark gap at the base of the 647 foot vertical antenna tower to simulate the effects of lightning discharges across this gap. This was done by means of a piece of copper tied to the end of a broom handle. The average power short circuited was about 135 kilowatts.

This test was made many times, and the protective and over-load circuits operated so perfectly that the transmitters would be taken off the air instantly and returned automatically after an interval of about half a second, thus minimizing the period of time off the air which is normally caused by a serious lightning discharge. This is considered a very serious test on transmitters at this power, and speaks well for the engineering which has gone into their design.

Northern can be most proud of this twin station, since both transmitters were built and installed by the Electronics Division. This is the only installation on the continent in which two 50 KW transmitters are applied to one antenna. A very difficult engineering job has been tackled and the final result is an unqualified success.

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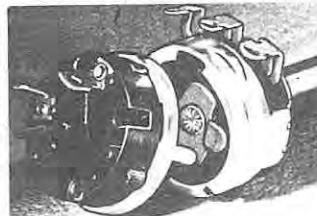


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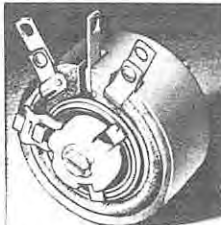
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# TELEVISION

## TELEVISION R. F. AMPLIFIERS

WM. P. MUELLER

In last month's article, Television Fundamentals, the essentials of the television system in general were described to provide a background for a proper understanding of the operation of a television receiver. In this article we will begin tracing the signal through the receiver, starting with the antenna and going through the RF stage. Subsequent articles will trace the signal through the remainder of the receiver, treating each essential circuit function in detail.

### The Antenna and Transmission Line

The block diagram of a typical television receiver is shown in Figure 1. It is similar to a conventional superheterodyne broadcast receiver, except for the addition of several more circuit functions required to obtain the picture. Let us confine our attention for the present to the antenna, transmission line and RF amplifier.

The types of antennae used for television are similar to the dipoles described for FM reception in the March issue of SYLVANIA NEWS, but they are required to operate over a much wider range of frequencies. For instance, if we consider only the lower band channels, Nos. 2 to 6, the frequency range, or spread, is nearly two to one. (Before channel No. 1 was dropped it was exactly two to one.) A simple dipole antenna which is a half wave length long and is fed at its center has an impedance of about 72 ohms. At

twice the frequency for which it was designed, the antenna is a full wave length long and the impedance at the center is about 2000 ohms. In order to obtain reasonable power transfer from such an antenna over such a wide frequency range, the characteristic impedance of the transmission line which connects the antenna to the receiver should be approximately the geometric mean of 72 and 2000 ohms, or about 380 ohms.

This figure has been rounded off to 300 ohms since the impedance of a folded dipole antenna is 300 ohms and this value has been standardized by the RMA as the balanced to ground input impedance of a television receiver. Some receivers, however, have been designed for 75 ohms balanced to ground input impedance, and require a 75 ohm

transmission line for proper operation.

There is a wide variety of commercial television antennae now available. These include simple dipoles, folded dipoles, dipoles with reflector, and stacked arrays consisting of two or more dipoles with reflectors. The stacked dipoles are recommended by their manufacturers for operation over channels 2 to 6, for the higher-band channels 7-13 or for operation over all the channels 2-13. The more complicated antennae, besides having more gain, are much more directional. Directivity is desirable for eliminating reception over several different paths due to reflection from high buildings or hills, etc. Reception over different paths is undesirable in that it may result in several images or "ghosts" appearing upon

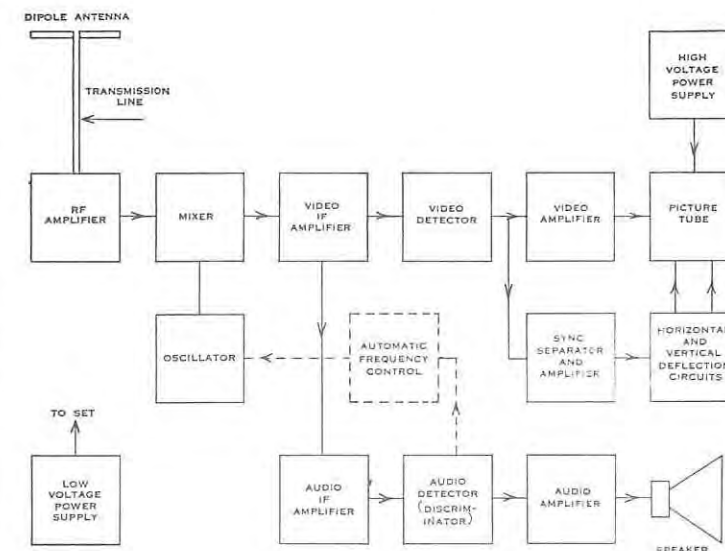


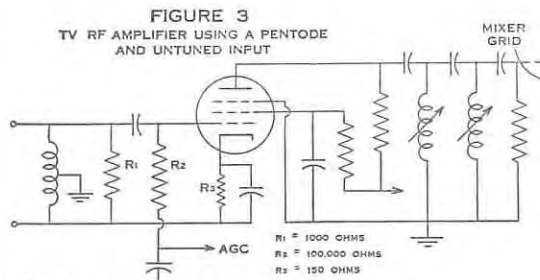
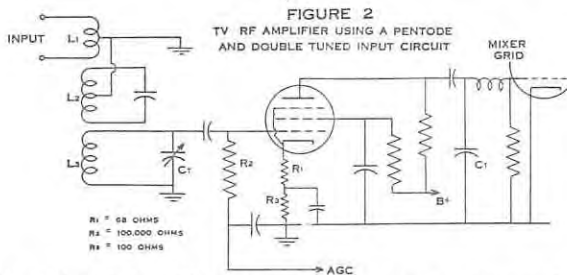
FIGURE 1

BLOCK DIAGRAM OF A TYPICAL TELEVISION RECEIVER

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$$\text{Gain} = \frac{G_m}{2\pi BW C}$$

where  
 $G_m$  = mutual conductance  
 $BW$  = bandwidth  
 $C$  = total capacity output to ground.

The need for keeping  $C$  small has led to the use of variable inductance tuning mechanisms, or separate coils switched into the circuit for each channel. The various physical means of tuning the RF amplifier are common to the mixer and oscillator as well, and will be covered in a future article which deals with the mixer and oscillator.

The five features desirable in an RF stage are not easily obtained in any one design. Some typical RF amplifier stages used in commercial TV receivers are shown in Figures 2, 3 and 4. The circuit of Figure 2 features two tuned circuits in the input to the RF amplifier or three tuned circuits in all at signal frequencies. The purpose of the unbypassed resistor in the cathode circuit is to eliminate changes in the input capacity and resistance of the tube when the grid bias is varied by the automatic gain control.

Another pentode stage is shown in Figure 3, which makes use of an untuned input circuit. Balanced input is obtained by feeding into both the grid and cathode of the tube and a good termination of the input transmission line is obtained.

Triodes inherently produce less noise than multigrid tubes, which make them desirable for the input stage. A double triode RF amplifier is shown in Figure 4. Excellent match to the transmission line is obtained by terminating the line with a 300 ohm resistor, but the input circuit is untuned. The triodes are neutralized to prevent excessive oscillator radiation.

the picture tube. These images are separated a small distance horizontally from each other, due to the finite difference in the time of arrival of the signals over the different paths. If the transmission line is not properly terminated in its characteristic impedance, or if the impedance of the line is altered appreciably by allowing the transmission line to lie against metal objects, reflections may be set up on the transmission line itself, causing ghosts to appear. Since horizontal polarization is used in television transmission, the receiving antenna should be horizontal with respect to ground.

#### The RF Amplifier Stage

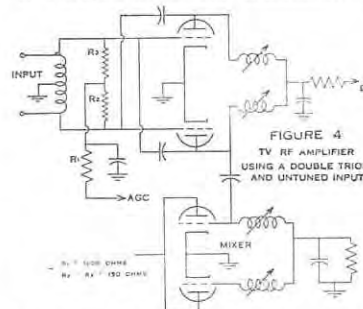
The RF amplifier provides amplification at signal frequencies. Since it must pass both picture and sound carriers in addition to the picture modulation sideband, it must amplify as uniformly as possible over a 4.5 to 6 mc band of frequencies. The purpose of the RF stage is:

1. Provide more gain.
2. Reduce interference from services at frequencies far from the signal frequency.
3. Reduce oscillator radiation.
4. Provide a better signal to noise ratio.
5. Terminate the transmission line in its characteristic impedance.

Let us consider these in order. More gain is obviously desirable to receive a weaker signal, or to eliminate the need of an elaborate outdoor antenna. Gain is probably easier to obtain in the IF amplifier, however, than at signal frequencies. To reduce interference at frequencies far removed from the signal frequency requires several tuned circuits tuned to signal frequency. Such interference may occur at image frequencies, IF frequency, or

even at frequencies which are plus or minus the IF frequency away from harmonics of the oscillator frequency. A convenient way of coupling several tuned circuits at signal frequency together is by means of an RF amplifier stage. The level of power radiated by the local oscillator may cause intolerable interference to nearby TV receivers. The improvement obtained by using an RF amplifier stage to isolate the oscillator from the antenna is considerable, but the amount of oscillator signal radiated is still objectionable in many cases. The ultimate limit upon the sensitivity of a TV receiver is determined by the noise generated in the first tube.

A slightly better signal to noise ratio can be obtained by using a tube as an amplifier rather than as a mixer. To eliminate the possibility of reflections on the transmission



line the input to the RF stage should present a resistive load equal to the standard input resistance of 300 ohms.

High mutual conductance, low input and output capacity tube types are required for the RF stage because of the wide bandwidth required. A small physical structure is also required, so that the circuit can be tuned to as high as 216 mc. The gain of the stage is related to these factors by the equation

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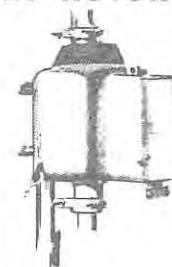
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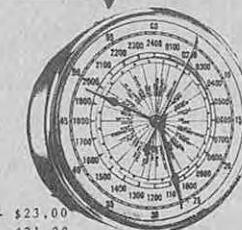
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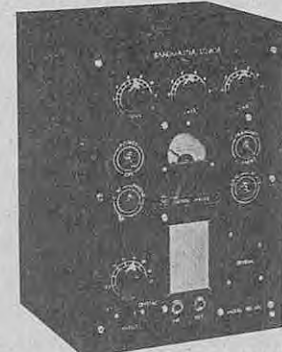


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