

BETTER DOUBLE SIDEBAND

Dr. Bruce Cameron, K9BDO

Bradley University
Peoria Illinois

If you want a rig which sounds as good as the best single sideband but is far easier and cheaper to build, read on. If you are convinced that all double sideband signals sound distorted and bassy, meet me on the air. If you want to own a piece of gear that is so complicated and tricky to wire that only a good commercial manufacturer or a highly skilled amateur could assemble it, forget it, because the Novice next door could build this one and sound as good as you do.

We will assume that all readers of CQ are familiar with the arguments pro and con sideband and are at this point interested only in the techniques. Several alternatives are available at this point. The first question in designing any sideband rig is the power level at which to generate the signal. Generating at high powers (above 100 watts) is of course cheaper than AM, but still inefficient because of the relatively large audio requirements, unless we use some sort of efficiency modulation. Extremely low level generation, such as is the practice with most filter type SSB rigs requires extra tuned stages and high amplification, which leads to inconveniences and unwanted feedback. Somewhere in between, around the three to ten watt level, we can achieve both simplicity and low cost.

The next decision concerns the type of modulation to be employed. The reason many DSB rigs on the air today sound bad is that they are screen modulated. Either control, screen, or suppressor grid modulation can be designed to sound good if drive, bias, feedback, and loading requirements are all met. Unfortunately, a departure from design value of any of these can degrade the signal. This is also true of AM operation, but less obvious due to the low average percentage of modulation and the less critical receiving techniques employed. Make no mistake about this: there are good grid modulated rigs on the air, but designing and operating one of these properly is a job for an engineer and not the average dx hound or rag chewer. For simplicity, dependability, and good sound, nothing has ever surpassed a Class C triode, plate modulated. This is why the

majority of AM men have always used plate modulation, and why we use it here, with suitable modifications.

The tubes we chose were the 6L6 and the 12BH7A, since we found this could produce ample rf to drive a class B stage to 40 watts output with modest speech and excitation requirements. In coupling the audio to the rf we used a circuit mentioned in some of the handbooks, but not reduced to practical values in any other rig we have heard on the air. (See fig. 1)

Circuit Operation

In this circuit the carrier is balanced out in the push-pull plate circuit, optimum balance being secured by means of a small trimmer from one plate to ground. (Which plate must be determined by experimentation after the rig is placed in operation.) We could achieve balanced operation by feeding the grids in push-pull and the plates in parallel, but this would increase second harmonic output, acting like a push-push doubler.

In this circuit the grids are driven into the Class C region and all "plate" power is supplied in the negative lead by T₁. Since we need no steady carrier, we need no steady plate supply, and the plates operate at dc ground potential. With no audio the tubes draw no current, and being balanced, pass on no rf. When we apply audio, each tube conducts half the time to produce sidebands which are the mix-

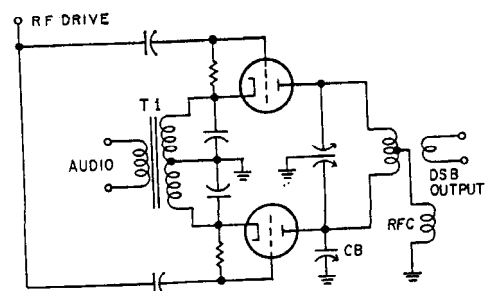


Fig. 1—Basic double sideband modulator.

BAND

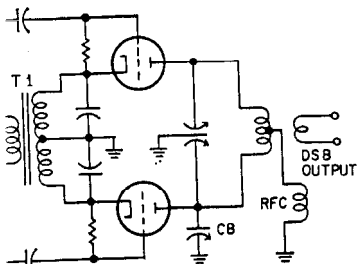
Dr. Bruce Cameron, K9BDO

Bradley University
Peoria Illinois

Men have always used plate why we use it here, with suitable choices were the 6L6 and the 6BE6. We found this could produce a class B stage to 40 watts modest speech and excitation recoupling the audio to the rf we mentioned in some of the hand-reduced to practical values in we have heard on the air. (See

Circuit Operation

When the carrier is balanced out in the plate circuit, optimum balance is achieved by means of a small trimmer capacitor to ground. (Which plate must be adjusted by experimentation after the rig is in operation.) We could achieve balance by feeding the grids in push-pull, but this would reduce harmonic output, acting like a low-pass filter. When the grids are driven into the push-pull mode, the power is supplied by the carrier. Since we need no steady plate current, the tubes operate at dc ground potential. When no audio is present, the tubes draw no current. When audio is present, the tubes draw current, pass on no rf. When the carrier is present, each tube conducts half the carrier sidebands which are the mix-



Basic double sideband modulator.

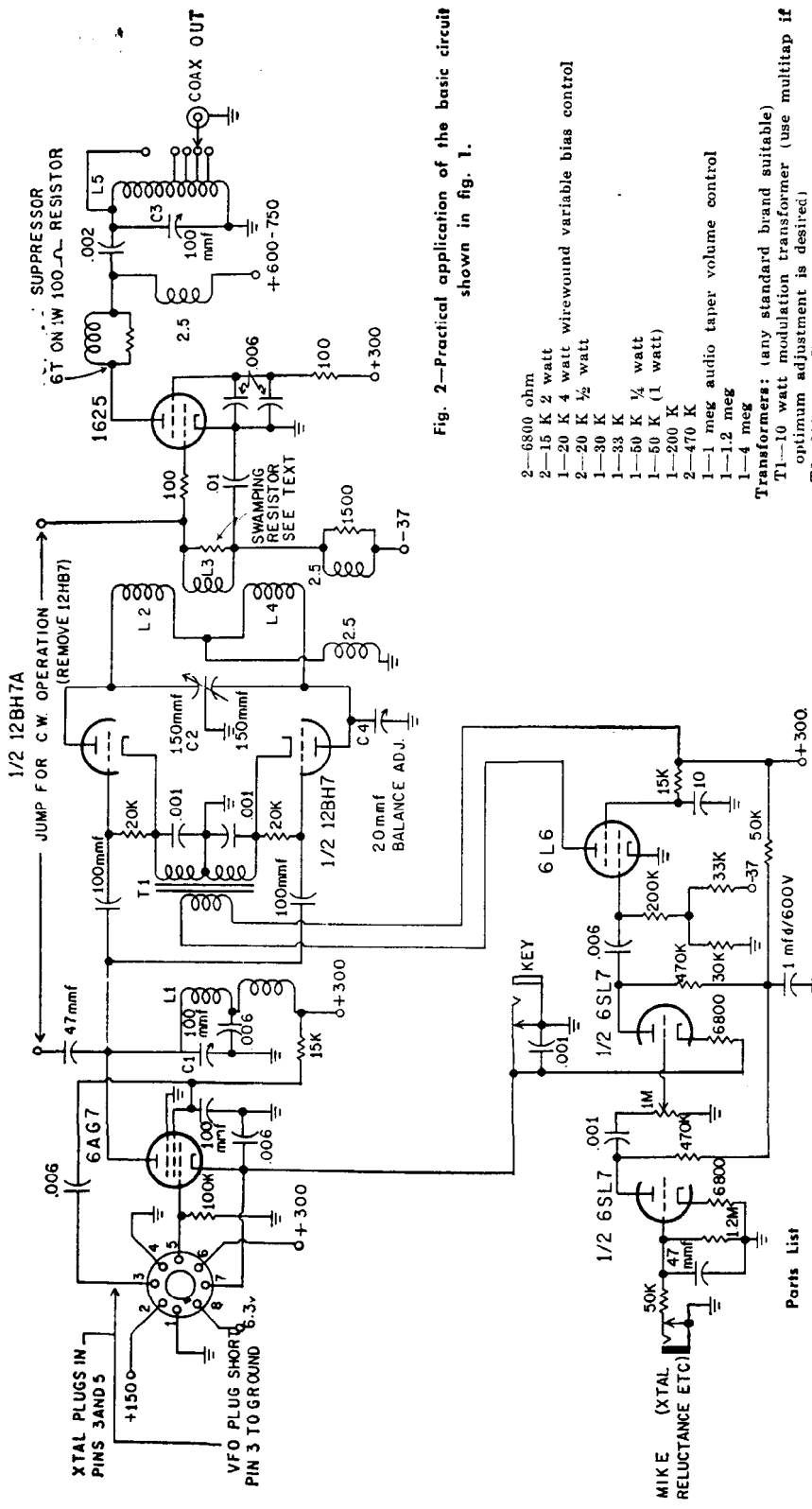


Fig. 2—Practical application of the basic circuit shown in fig. 1.

- 2—6800 ohm
 - 2—15 K 2 watt
 - 1—20 K 4 watt wirewound variable bias control
 - 2—20 K 1/2 watt
 - 1—30 K
 - 1—33 K
 - 1—50 K 1/4 watt
 - 1—50 K (1 watt)
 - 1—200 K
 - 2—470 K
 - 1—1 meg audio taper volume control
 - 1—1.2 meg
 - 1—4 meg
- Transformers: (any standard brand suitable)
 T1—10 watt modulation transformer (use multitap if optimum adjustment is desired)
 T2—300 m.a. TV replacement transformer, with two 6.3 windings if 1625 is used, one 6.3 winding if 807 is used
 T3—50 v 20 ma bias transformer
 T4—5 v 3 a filament transformer 1600 v insulation
 T5—1500 vac ct 100 ma plate transformer
 Chokes:
 PL1—10 henry 250 ma
 PL2—5 henry 100 ma
 3—2.5 mh 50 ma rf chokes (pigtail type)
 1—2.5 mh 100 ma rf choke (standoff transmitting type)

- 1—1 mfd 600 v oil filled (see text)
- 1—10 mfd 450 v electrolytic
- 1—70 mfd 450 v electrolytic
- 1—500 mfd 50 v electrolytic
- 5—6 mfd 1000 v oil filled (paralleled)
- Resistors: (one watt adequate unless specified)
- 3—100 ohm
- 1—1500 ohm
- 1—2500 ohm 5 watt wirewound

- Parts List
- Condensers:
 C1—100 mmf variable, C2 150-150 split stator, C3 100 mmf transmitting variable (1000 v spacing), C4 20 mmf APC air padder.
 6—006 mfd mica or ceramic
 1—002 mfd 1600 v mica
 4—001 mfd mica or ceramic
 3—100 mfd mica
 2—47 mmfd mica or ceramic
 1—01 mfd mica or ceramic

Table I
Coil Winding Data

	75 mtrs	40 mtrs	20 mtrs	15 mtrs
L1 Oscillator 4 prong 1 1/4" forms	26 turns #24 enam. closewound	13 turns #18 enam. spaced to 1" long	10 turns #16 enam. spaced to 1" long	6 turns #16 enam. spaced to 1" long
L2, L3, L4 Mixer 5 prong 1 1/4" forms	L2-4 16 turns ea. #24 enam. with 25 mmf fixed mica padder L3 14 turns #24 enam. with 25 mmf fixed mica padder (condensers in coil form)	L2-4 14 turns ea. #24 enam. closewound L3 10 turns #24 enam. closewound	L2-4 4 turns ea. #16 enam. spaced wire diameter L3 4 turns #16 enam. spaced wire diameter	L2-4 3 turns ea. #16 enam. spaced wire diameter L3 3 turns #16 enam. spaced wire diameter
L5 Output 6 prong 1 1/2" forms	23 turns #16 enam. spaced to 1 3/4" tapped at 3, 4, 5, 7 turns	13 turns #14 enam. spaced to 1 3/4" tapped at 1, 2, 3, 4 1/2 turns	Use same coil for both B&W coil material or 4 turns #14, 1 1/4" diameter, spaced to 3/8" long, mount by short leads to 6 prong tube base, tapped at 1/2, 1, 1 1/4, 2 1/2 turns	

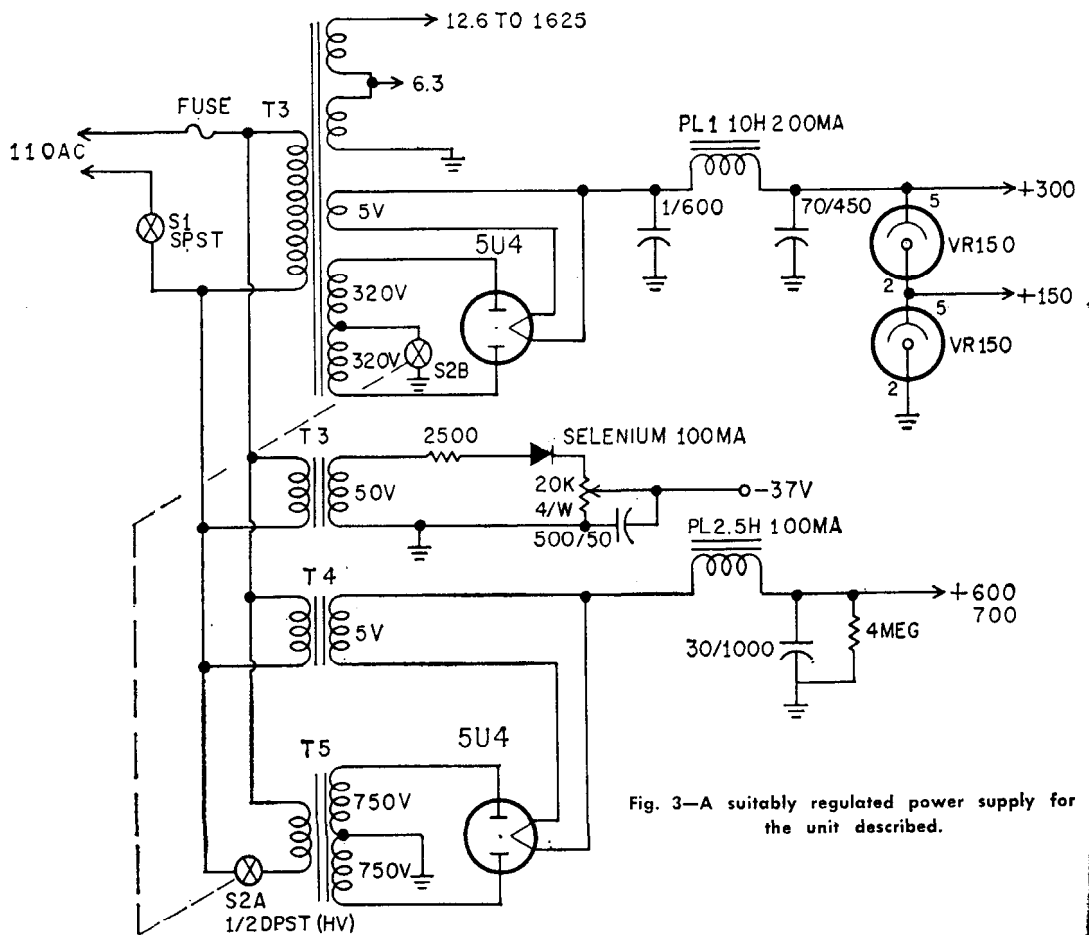


Fig. 3—A suitably regulated power supply for the unit described.

ture (s
freque
serve
put the
(2) th
the au
width o
Since
applied
a produ
It is di
pedance
optimiz
values a
achieve
necessar
some si
than enc
produce
excellent
it is eno
able, or
three or
The or
in the bal
to balance
are bi-syn
wiring, ca
anything
practical
The dy
reading th
own rig, b
describe in
at K9BDC
grams are
further ob
if that is de

Good sig
It will be se
except the s
300 volt s
modulation
sary to assu
output of th
can be regu
rig describe
adding the l
ly selecting
tubes lit at
filter were to
in series with
VR tubes, an
the VR tube
feasible to c
larger input
tentimeter to
hardly worth
transformers
age "as is" at
a condenser
minutes of exp
[Co

ture (sums and differences) of the rf and audio frequencies. The cathode bypass condensers serve two purposes simultaneously: (1) they put the cathodes at ground potential for rf and (2) they limit the high frequency response of the audio system and thus restrict the band width of the transmitted rf signal.

Since plate current flows only while audio is applied, even small receiving tubes can deliver a prodigious amount of rf without burning up. It is difficult to determine the optimum impedance values for the transformer, and the optimum grid resistances, but fortunately these values are not critical unless we are trying to achieve maximum output. This is not at all necessary, because a 6L6 and a 12BH7A or some similar combination can supply more than enough drive for a class B 1625 or 807 to produce a full forty watts output. This is an excellent level of output for an exciter, because it is enough to use by itself as a summer portable, or to drive a grounded grid linear up to three or four hundred watts.

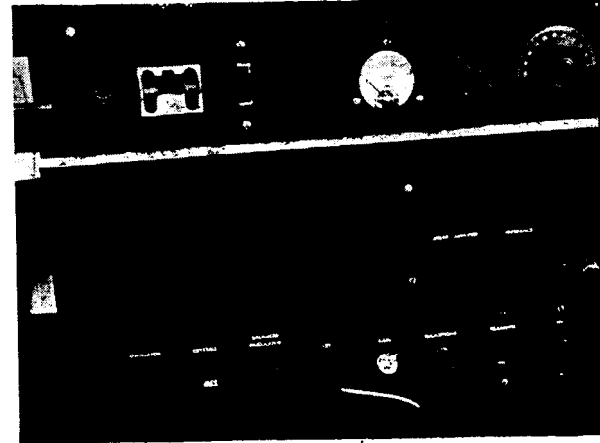
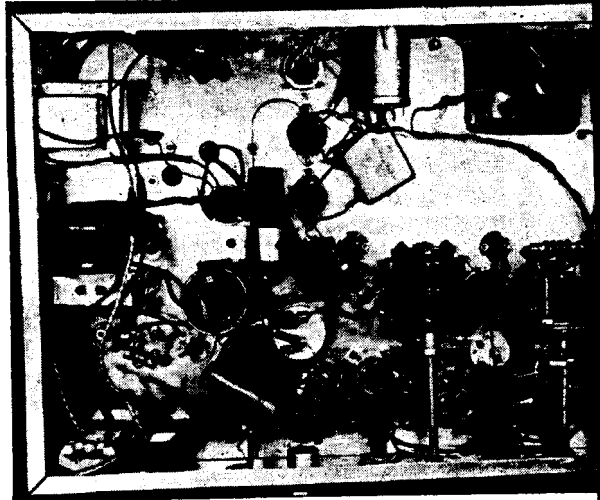
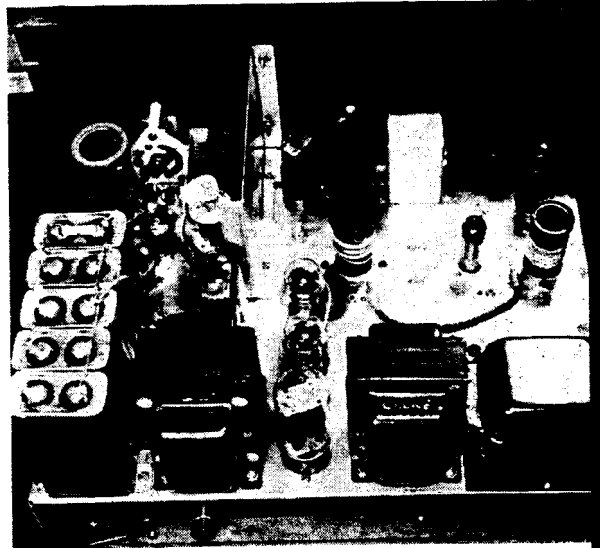
The only special mechanical consideration is in the balanced modulator, which will be easier to balance if the lead dress and parts placement are bi-symmetrical. Beyond this, point to point wiring, cabling, right angle buss-bar or almost anything can be used consistent with conventional practices. This is a very forgiving design.

The dyed-in-the-wool experimenter can quit reading this article right now and go plan his own rig, but for those less experienced we will describe in some detail the exciter now in use at K9BDO. The photographs and circuit diagrams are largely self-explanatory, but a few further observations may simplify duplication, if that is desired.

Power Supplies

Good signals require good power supplies. It will be seen that all B voltages are regulated except the supply for the 1625 plate. Since the 300 volt supply faces a varying load with modulation some initial experimenting is necessary to assure that the voltage available at the output of the filter falls within a range which can be regulated by the two VR tubes. In the rig described here this was accomplished by adding the 1 mfd input capacitor, experimentally selecting a value which would keep the VR tubes lit at all times. If the output from the filter were too high, a resistor would be added in series with the power supply ahead of the VR tubes, and the regulated output taken from the VR tubes themselves. It would even be feasible to correct low voltage by using a larger input condenser in series with a potentiometer to ground but such refinement is hardly worth while. Most TV replacement transformers will put out about the right voltage "as is" and correction by the addition of a condenser or resistor takes only about ten minutes of experimentation.

[Continued on page 124]



15 mtrs

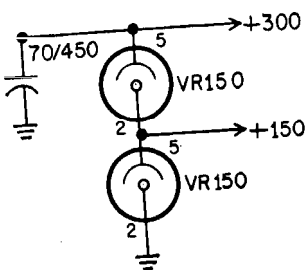
6 turns
#16 enam.
spaced to
1" long

L2-4 3 turns ea.
#16 enam.
spaced wire
diameter

L3 3 turns
#16 enam.
spaced wire
diameter

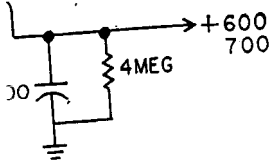
coil for both
ial or 4 turns #14,
spaced to 5/8" long,
t leads to 6 prong
ed at 1/2, 1, 1 1/4, 2 1/4

000MA



-37V

1000MA



stably regulated power supply for
the unit described.

CRYSTALS inc.
ACCURACY DEPENDABILITY QUALITY
 and **ONE DAY SERVICE**

AMATEUR BAND CRYSTALS

Not surplus! New quartz ground and etched to your exact specified frequency. Checked on HP cycle counters.

1500 KC to 2000 KC.....\$2.00 ea. postpaid.
 2001 KC to 8995 KC.....\$1.50 ea. postpaid.
 8996 KC to 11000 KC.....\$2.50 ea. postpaid.

SSB FILTER CRYSTALS

Plated type in FT241A holders. All channels 370 to 534 KC (except 500 KC) \$1.00 ea. postpaid. 500 KC \$1.75 ea. postpaid.

Channel Groups Accurately Matched, No Extra Charge.

MARINE FREQUENCIES

All channels. Guaranteed accuracy. Supplied in MC7 or FT243 holders (specify which type) \$3.75 ea. postpaid.

VERY THIN CRYSTALS

Supplied in very thin FT243 holders. Order by fundamental frequency. \$2.00 ea. postpaid.

Minimum Order \$2.00 No CODs.
 Satisfaction Guaranteed or Your Money Back!
 ILLINOIS ORDERS . . . Please Include Sales Tax

CRYSTALS inc.
ODELL, ILLINOIS

For further information, check number 60 on page 126.

THE SKYLANE QUAD

"Worked 100 countries in 2 mo. 20 days. Total now 150"—K4DRO

- 8 db. gain on 20.
- 10 db. on 10-15.
- Better than 20 db F/B.
- Very low SWR.
- Aluminum boom and spiders.
- Very low wind resistance.

54.95 FOB
 Write for free brochure.

SKYLANE PRODUCTS
 5320 Nebraska, Tampa 3, Fla.

YES, WE AND THEY SURE
HAVE COLLINS—WILL TRAVEL

Get in touch with **WILSON** — "That's all"
 QCWA **WILLARD S. WILSON, INC.** YWOA
 405 Delaware Ave., Wilmington, Del.
 Est. 1920

diction of this law under the Department of Commerce.

Specifically, this law required operators to be licensed, established punishment for unlicensed operation and confined operation to specific wavelengths. It prohibited willful and malicious interference with radio communication. Uttering or transmitting false or fraudulent signals was punishable by a fine of \$2500.00, imprisonment for not more than five years, or both.

To be continued

DOUBLE SIDEBAND [from page 3]

Bias Supply

The bias supply could just as well be replaced by batteries, if preferred. We used the variable circuit shown here because it lent itself to experimentation, but nothing was actually gained by this except some nasty reports on the air when we ran the bias too high or too low. In any event 37 volts is about optimum. If you use this kind of supply don't think you can omit the large filter condenser. This is not to reduce hum but to provide stability. The bias wants to soar under modulation otherwise. The 6L6 could be operated with cathode resistor bias at slightly reduced output, but one bias supply can well serve both tubes, so we used fixed bias on both.

Oscillator

The crystal oscillator is an old friend, the modified Pierce, and is readily converted to a multiplier or driver when the vfo is plugged in. The plug needs only to include a jumper to shunt the .006 screen condenser to ground instead of to the crystal, thereby making it an rf bypass condenser instead of a dc blocking condenser as it is when the crystal is in use. The octal socket on the front panel provides plenty of extra terminals for supplying power and keying circuits to the vfo. K9BDO uses a heterodyne vfo but you can use whatever you prefer, or else stick to crystals.

Speech Amp

There is nothing very special about the speech amplifier, and if you have one you prefer, by all means use it. Note only that this one includes rf filtering, and that one of the cathodes is keyed to prevent any audio feedback when the mike is close to the loudspeaker. (Even low level leakage signals can be annoying.)

No provision has been made for voice control for two reasons: (1) push to talk is simpler to build, and (2) we don't like voice control because unintended transmissions occur through its use. Most hams prefer it, of course, and there is ample room on the chassis to include this feature if desired. Suitable circuits are

readily available

Plug-in coils mainly for sim of possible cha plug-in coil rig simply rewind seen in the 16 on a six prong taps to permit sition rotary s pedance and o permits us to r ed grid final, antenna tuner, is no dc on l ground, this m put system you involved.

The oscillat on four and fi grid swamping lected experim ed in the botto not critical, no necessary, but load on the b power supply ter where sidef est value of re drive to the 16 typical.

AM people are included i they are entir is best done w a blue bead di in turn. Once and mixer are need only sli output from t light bulb. If the mike it s then some. O air, the best v is with a field urement is to

Except in t parts a dece hams can bu ent junk bo power suppli are blessed v pile them on. have used m

That's abc build a dece this one, an not even not less you tell t xyl to figure

Department of

ired operators to
ishment for un-
ined operation
hibited willful and
radio communica-
g false or fraude-
e by a fine of
r not more than

ued

page 3]

as well be replaced
used the variable
t lent itself to ex-
as actually gained
eports on the air
gh or too low. In
optimum. If you
n't think you can
er. This is not to
stability. The bias
n otherwise. The
i cathode resistor
put, but one bias
tubes, so we used

n old friend, the
ily converted to a
vfo is plugged in.
lude a jumper to
iser to ground in-
y making it an rf
dc blocking con-
stal is in use. The
el provides plenty
ig power and key-
OO uses a hetero-
atever you prefer,

pecial about the
ave one you pre-
only that this one
hat one of the
t any audio feed-
to the loudspeak-
signals can be an-

de for voice con-
to talk is simpler
like voice control
ons occur through
t, of course, and
chassis to include
table circuits are

readily available elsewhere.

Coils

Plug-in coils are used throughout this rig mainly for simplicity, but also in anticipation of possible changes in band allocations soon. A plug-in coil rig does not go out of date; you simply rewind the coils! An unusual feature is seen in the 1625 output coil. This is wound on a six prong form, the extra pins going to taps to permit impedance matching. A 5 position rotary switch selects from four low impedance and one high impedance point, which permits us to match the cathodes of a grounded grid final, a coaxial line to an antenna, an antenna tuner, or what-have-you. Since there is no dc on the coil, and it is returned to ground, this makes about the most flexible output system you can have for the effort and cost involved.

The oscillator and mixer coils are wound on four and five prong forms respectively. The grid swamping resistor for the 1625 is selected experimentally for each band and mounted in the bottom of the coil form. Its value is not critical, nor is the resistor even absolutely necessary, but swamping helps stabilize the load on the balanced mixer, and just as with power supply circuits, the more stable the better where sideband is concerned. Use the smallest value of resistance consistent with adequate drive to the 1625. A resistance of 5000 ohms is typical.

Operation

AM people may be surprised that no meters are included in this exciter. The reason is that they are entirely unnecessary. Initial tune up is best done with a single turn loop soldered to a blue bead dial light bulb coupled to each coil in turn. Once the dial settings for oscillator and mixer are determined and recorded, they need only slight touching up later on. The output from the 1625 can be fed to a 40 watt light bulb. If all is well, when you whistle into the mike it should light to full brilliance and then some. Once the exciter is actually on the air, the best way to adjust all the tuned circuits is with a field strength meter. Any other measurement is too indirect for real significance.

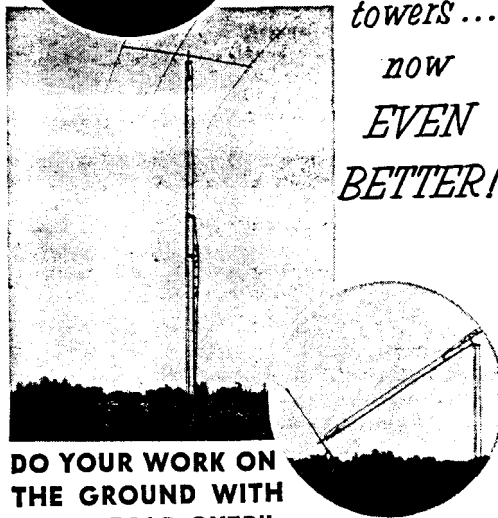
Except in the few instances noted, no special parts are required, which means that many hams can build this rig right out of their present junk box. Anything which improves the power supplies improves the signal, so if you are blessed with lots of fine filter condensers, pile them on. We used what we had, and would have used more if they had been handy.

That's about all there is to it. If you can build a decent CW or AM rig, you can build this one, and most of the sideband gang will not even notice that it is double sideband unless you tell them. I'll leave it to you and to the xyl to figure up all the money you can save.



the BEST in
antenna
towers ...

now
EVEN
BETTER!



DO YOUR WORK ON
THE GROUND WITH
ROHN FOLD-OVER"

- Hot-dipped galvanized after fabrication
- Structurally sturdy enough for all sizes and types antennae
- Excellent workmanship — superior design — yet economical in cost
- A complete tower made especially for amateur use
- FREE literature and nearest source of supply gladly sent on request

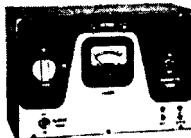
ROHN Manufacturing Company

116 Limestone, Bellevue, Peoria, Ill.

"Largest Exclusive Manufacturer of
TV-Communications Towers"

For further information, check number 61 on page 126.

LOWEST COST AMATEUR RADIO SET!



50 WATTS POWER—ALL BAND OPERATION — For beginners or experts alike! For CW (code) on 80-40-20-15-10 meter bands—power enough to be heard all over the world! Especially made for new All-band Trap antennas but can be used with any antenna. Simple, trouble-free, foolproof — Easiest to operate. Self-contained in 6x6x6 grey steel cabinet. Crystal controlled 1625 power tube with 5Y4 rectifier, H.D. power transformer. Complete step by step instructions furnished. Model AT-50 Complete Kit with parts, tubes \$24.95
Completely wired and tested. Ready to use. Guaranteed (COD) **SEND ONLY \$5.00** and pay postman balance (COD plus postage on arrival or send full price plus \$2.00 for P. O. insured delivery in USA. The best, most powerful All-band Amateur Radio Transmitter for the money anywhere in the world. Order Now—The price may go up soon.

WESTERN RADIO Dept. TCQ-3 KEARNEY, NEBR.