



# Ham Tips

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## SMALL OSCILLATOR DOES BANG-UP JOB ON 2 METER BAND

### Grid-Stabilized Circuit Uses RCA-815 Tube

By J. H. OWENS, W3ASZ/2

The revival of Ham Radio via a temporary allocation at 2½ meters put most of the uhf boys back in business and gave many of the low-frequency fellows their first taste of vhf work. But the venture was short lived, as the band was quickly shifted down to 2 meters.

Then, a great many Amateurs found that it's a long way from 116 Mc to 144 Mc. Mediocre 2½-meter design techniques did not work well on 2 meters. Likewise, many tubes that performed excellently on the lower frequency band were found to be little better than crutches at 144 Mc. An exception to this is the RCA-815 dual beam power tube. It is the purpose of this article to show how easy it is to use this tube in a nifty little oscillator-transmitter that will bring in complimentary reports consistently.

Furthermore, the circuit is not sensitive to minor changes in mechanical design—if the fundamentals are observed, the RCA-815 will perform nicely in a wide variety of arrangements.

### Grid Circuit Important

The primary factor that makes possible the excellent performance of this transmitter is the design of the grid circuit. In a TPTG oscillator, it is the duty of the grid tank to see that the grids receive ample driving power with low losses, and to assert a definite controlling effect upon the frequency of oscillation. These properties are fairly simple to build into low-frequency oscillators, but at 144 Mc, obtaining them can be very difficult because of such factors as, (1) the input resistance of a tube is low enough to load down the grid tank, and (2) the input capacitance of a tube is high enough to resonate a couple of inches of wire to a frequency lower than 144 Mc.

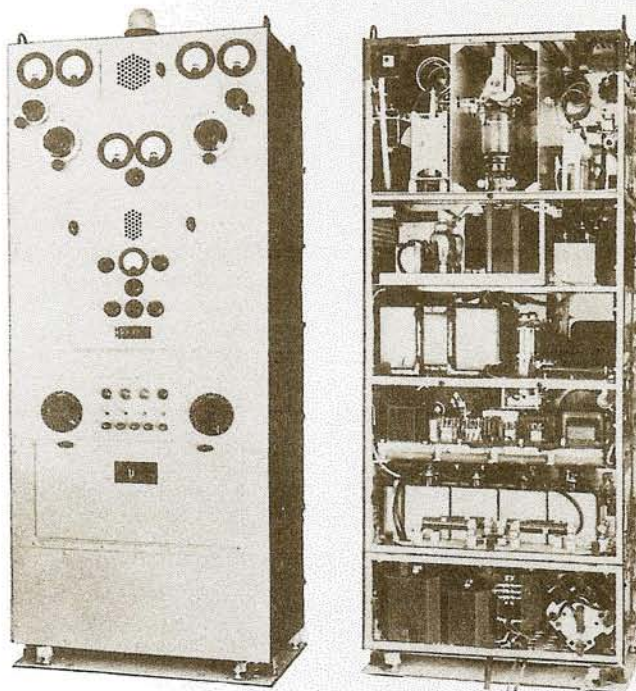
The solution to the problem turned out to be rather simple and straight-forward, once the problem

(Continued on Page 2, Column 1)

## "HAM TIPS" ANNOUNCES CONTEST FOR RCA TUBE EQUIPPED RIGS

Scheduled for each issue of HAM TIPS is a photograph and description of an outstanding Ham rig that is 100% RCA tube equipped. Send your photos, name, and Amateur call letters to the Editor of HAM TIPS, RCA Tube Department, Harrison, New Jersey. If you win, you will receive a check for \$10.00, and your rig will be pictured in a forthcoming issue. All entry material becomes the property of RCA, and cannot be returned.

### W2BFB WINS THE OPENING PRIZE



Congratulations and ten bucks go to James N. Whitaker, 93 Shepard Avenue, Englewood, New Jersey for the above photographs.

The front panel picture is very professional, but the rear view proves that Jim Whitaker is a regular cramming, jamming, space-conserving, ingenious Ham.

The final amplifier uses a pair of RCA 833-A's, driven by an RCA 4E27/8001 and modulated by a pair of RCA 810's. Power is furnished by four RCA 872A's in a bridge circuit. Jim, who is engineer in charge of Transmitter Division, Hammar-

lund Manufacturing Company, states "The 833A's will take 2500 watts input at 28 Mcs with a plate circuit efficiency of more than 82%."

Too bad he can't use that power on the air!

## RF CHOKE FORMULA HELPS MAKE COIL FABRICATION EASY

### Choke "Know How" Valuable in Rig Construction

By J. G. BEARD

RCA Engineering Products Dept.

Many amateurs who are building new transmitters or receivers for use on the vhf bands will need rf chokes. The best rf choke is one that has the greatest amount of reactance for a given value of resistance. This requirement can be met by the use of a length of wire equal to one quarter of the operating wave length.

The wire should be wound on a small mandrel of less than ½" diameter, and the mandrel should then be removed. The coil should be stretched a little so that adjacent turns do not touch. Use of #18 or larger wire will make the coil self-supporting and rigid.

### Formula Applications

The following table gives the correct length of wire for operation in the bands shown.

Freq. Band	Length of Wire
50 Mc— 54 Mc	56.6 inches
144 Mc—148 Mc	20 "
235 Mc—240 Mc	12.5 "

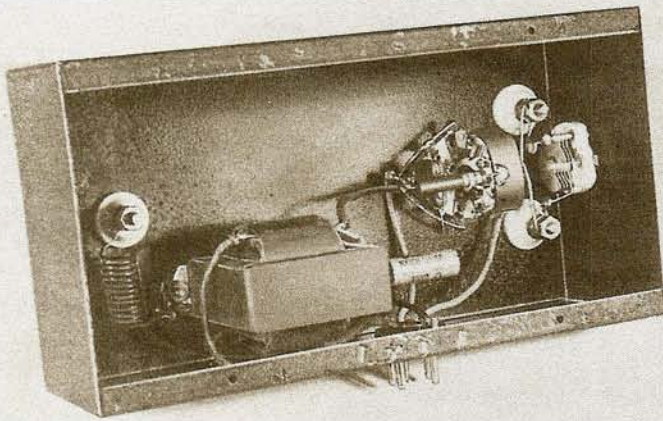
For other bands the required length of wire in inches can be determined by dividing 2953 by the frequency in megacycles. As long as the diameter of the choke coil is kept small, the formula gives a length of wire which is quite accurate.

Choke coils should be positioned in the apparatus so that they do not couple to each other or to tank circuits. They should also be mounted at right angles to the chassis, because mounting them parallel with the chassis has the undesirable effect of increasing their distributed capacitance. Hot and cold end connections should be kept as short as possible.

Quarter-wave chokes, for most effective operation, should have their "cold" ends by-passed with mica or air-dielectric capacitors having short leads. Coils made and utilized in accordance with these design specifications are very efficient in choking off RF.



### EASY-TO-BUILD TRANSMITTER



Bottom view photograph of Simple Oscillator, showing RF at one end and AF at the other, with plenty of space for meters and jacks.

#### SMALL OSCILLATOR

(Continued from Page 1, Column 1)

had been fully subjected to good reasoning. On a step-by-step basis, the answers popped up, as follows: (1) Rather than rely on or add to the tube's small grid-plate capacitance for feedback, it was decided to "over-neutralize" this small value of residual grid-plate capacitance.

Over-neutralization, accomplished by adding external capacitance from #1 plate to the #2 grid circuit, and external capacitance from #2 plate to the #1 grid circuit, provides better phase relationship between the rf currents in the grid and plate circuits than does the normal feedback path across the tube's grid-plate capacitance. (2) In order to give the grid some control over frequency, it is necessary to put a great deal of energy into the grid tank. This is done by using a large amount of "over-neutralizing" capacitance—far more than is necessary to sustain oscillations. With a low-loss grid tank, this design costs practically nothing. Because there is so much energy in the grid tank, the rf voltage is high, and the grids can be tapped far down to a low-impedance point where they will exert only a small loading effect. This permits good Q, and an appreciable control over the frequency of operation. The end result is improved frequency stability.

#### Design Factors

The grid tank starts with a piece of copper strap, 1/2 inch wide and 3 inches long, soldered directly to the grid terminals of the tube socket. The next section of the grid tank consists of two 3-inch pieces of #14 wire criss-crossed and connected between the socket grid terminals and the feed-through insulators. A five-plate midget condenser is connected across the feed-through insulators at this point.

The feed-through insulators are the next section of the grid tank. On top of the chassis is the remainder of the grid tank which consists of two feed-back plates, 1/2 inch wide and 2 inches long, soldered to 2-inch pieces of #12 wire which are in turn mounted on the feed-through insulators.

The second design factor responsible for the overall simplicity and performance of this rig is the plate tank circuit. There, a strap has been used in place of the usual rods. The advantages are several, e.g., (1) the surface area of a 1/2"-strap is greater than that of the popular 1/4"-copper tubing, and (2) the copper straps are trimmed down to a width of 1/4" at their ends and soldered directly to the plate clips, eliminating the losses usually suffered in flexible leads at this point, and (3) the shorting bar and the variable resistance it inserts in the rf circuit is eliminated.

#### Tuning Is Simple

Tuning of the linear plate tank circuit is accomplished merely by varying the spacing between the elements. When the straps are farthest apart, their inductance is highest, but when they are spaced closely, their inductance goes down. Tuning is therefore a very simple process—squeeze or spread the straps and the frequency goes up and down. It's as easy as that. To prevent any strain being transferred to the tubes' plate caps when the tank is tuned, the two sections are supported by a pillar-type ceramic stand-off insulator at a point 1 1/4 inches from the open end.

The modulation transformer is novel, though perhaps not an original idea. Use is made of a universal output transformer of the open-mounting type. It is first disassembled, and the core separated into its "E" and "I" sections. The transformer is then reassembled, but the "I" section is spaced from

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## PRICES DOWN AND RATINGS UP ON POPULAR HAM TYPE RCA-813

Production Savings on Other Tubes Passed on to Amateur

The popularity of the RCA-813 promises to skyrocket to new heights as a result of a new low price of \$14.50 and the assignment to it of ICAS ratings. In Class C telephony, it will now take 200 ma plate current at 2000 volts, and in Class C telegraphy it will take 220 ma at 2250 volts. Two 813's will take 440 ma—virtually a kilowatt for \$29.00.

Other factors that have contributed to Amateur acceptance of the 813 are (1) full input to 30 megacycles, (2) operation without neutralization from "Ten" to "Seventy-Five," (3) low driving power, and (4) good linearity with simultaneous modulation of the plate and screen. Here is the answer to your requirements for a high power final. More details of this in the next issue of HAM TIPS.

#### "Know-How" Lowers Tube Costs

Quite a few Amateur types have gotten a break in an RCA tube general price revision which was recently authorized by the OPA. Although the trend is upward, wartime mass production methods have provided a cost reduction in some cases, and this saving is passed on to our friends, the Hams. In the following listing, note particularly the 826, 829-B, 832-A, 833-A and the 8025-A.

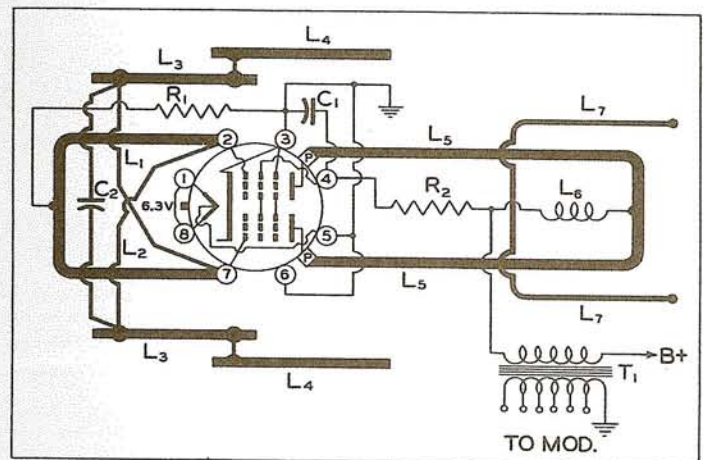
Type	Old Price	Amateur Net New Price
2C43	\$10.25	\$9.50
5R4-GY	1.00	1.29
6F4	5.10	5.48
6J4	4.50	4.84
805	11.00	9.00
807	1.95	2.30
809	2.50	3.50
810	13.50	12.50
813	18.00	14.50
815	4.50	6.25
816	1.00	1.25
826	12.00	9.25
829-B	17.00	14.75
832-A	13.00	10.47
8025-A	11.00	9.25

## HAM TIPS SERVICE FOR RIG QUERIES

That "brain twister" which every Amateur runs into at one time or other can now be submitted for solution to HAM TIPS' new question and answer service. Problems of general interest will be published in a monthly column to be conducted by Captain John L. Reinartz, USNR, back with RCA after seven years of military duty.

Well known to Hamdom for his long participation in amateur radio activities, his accomplishments include the design of the Reinartz receiver, the technical work "Reflection of Short Waves," published in 1925, and his communications work with the Byrd Arctic Expedition.

Readers are encouraged to send in problems concerning tubes and their application to RCA's Commercial Engineering Section, Harrison, New Jersey, which will act as a clearing house between Captain Reinartz and the editors of HAM TIPS. Each inquiry—whether it is published or not—will receive the attention of RCA engineering experts.



Schematic Diagram.



## RCA-807 IS "LITTLE MAGICIAN" TO HAMS USING VERSATILE TUBE

Conceived and developed by RCA engineers, the 807 was announced to the world away back in 1936. Now ten years old, the 807 is still the most popular type in its class. At the recent Framingham Ham Fest, a survey was conducted, which revealed that the tube has even wider acceptance than we suspected—it was found to be the most popular type for final-amplifier use, by a substantial margin over the nearest competing type, which incidentally was also of RCA origin.

The 807's versatility is probably the biggest single contributing factor to its popularity. It is an excellent crystal oscillator and electron-coupled oscillator; it is unparalleled for frequency doubler and tripler service; it will operate as a "straight-through" amplifier without neutralization, and it can be amplitude-modulated as easily as a triode—by simply connecting the screen dropping resistor to the modulation transformer together with the plate lead.

The high power-sensitivity of the 807, which is one of its desirable features, makes it require more careful handling than a low-gain triode. The plate and grid circuits must be fully isolated from one another, and an external shield should be used which extends up to the bottom of the plate element. In addition, a 0.005  $\mu$ f mica capacitor should be installed directly on the tube socket terminals between screen-grid and cathode. One side of the filament should be grounded, and the other side should be bypassed to the chassis right at the socket, or in case a center-tapped filament transformer is used, both of the filament terminals should be bypassed at the socket to the chassis with 0.005  $\mu$ f mica capacitors. If these few precautions are taken, no erratic behavior need be anticipated.

No wonder it is called the "Little Magician."

RCA - 807



## THREE NEW TUBES JOIN RCA FAMILY

The 2BP1 and 2BP11 are the latest additions to RCA's line of cathode ray tubes. Both are 2-inch tubes, and are alike except for the character of their screens. The 2BP1 produces green fluorescence with medium persistence, and the 2BP11 gives bluish fluorescence with short persistence.

Compared with older types such as the 902A and 2AP1-A, the new tubes feature higher deflection sensitivity, sharper and more uniform focus, better contrast, greater light output, less current drain, and a separate base-pin connection for each electrode. With slight circuit modifications, they can be used in equipment built around the earlier types.

The 2BP1 was designed especially for direct viewing service in oscillographs, modulation monitors, and other visual indicators. The 2BP11, with its highly actinic trace, is intended primarily for photographic work.

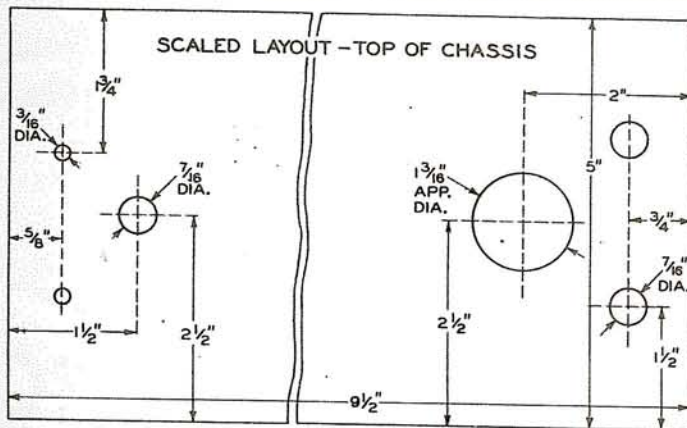
The Amateur Net price for the 2BP1 is \$8.75; for the 2BP11 it is \$10.00.

### A Triode for 2 Meters

The RCA-6C24 is a new external anode power triode that will interest progressive Amateurs who contemplate putting high power on the 6- and 2-meter bands. In Class C telephony service it will take a kilowatt at 148 megacycles.

Designed especially for FM and television, the 6C24 has low inter-electrode capacitances, low lead inductance, center-tapped filament, small size, and efficient copper radiator for forced-air cooling. The price is \$45.00 net to the Amateur.

For further information on these and other RCA tubes, see your nearest RCA power tube distributor or write to the RCA Commercial Engineering Section, Harrison, N. J.



Templet Layout.

## SMALL OSCILLATOR

(Continued from Page 2, Column 2)

the "E" section by an air gap made from two thicknesses of ordinary writing paper. This change permits the high-impedance side to handle the 815 plate and screen currents without saturation. Of course, the inductance is reduced, and the extreme low-frequency response is chopped off, but this is a desirable characteristic for speech modulation. It helps to make voice reproduction crisper and more intelligible, and at the same time reduces the amount of ac hum on the carrier. See QST, January 1946, page 51, "Link Coupled Modulator."

For the initial tune-up, connect a 25-watt Mazda lamp across the antenna hairpin loop. Then, with the feedback (grid circuit) plates set about 1/4 inch from the 815 envelope, rotate the capacitor to a point where the tube oscillates. Next, squeeze or spread the plate tank to get the oscillator on frequency, and reset the grid capacitor. Then, adjust the antenna hairpin loop to give maximum RF with minimum coupling.

With a plate voltage of 400 volts and a plate current of 150 ma, there should be enough RF output to light a 25 watt lamp to full bril-

liancy. Those who have been there know that it takes much less than 15 watts of RF at 144 Mc to bring in R9 reports.

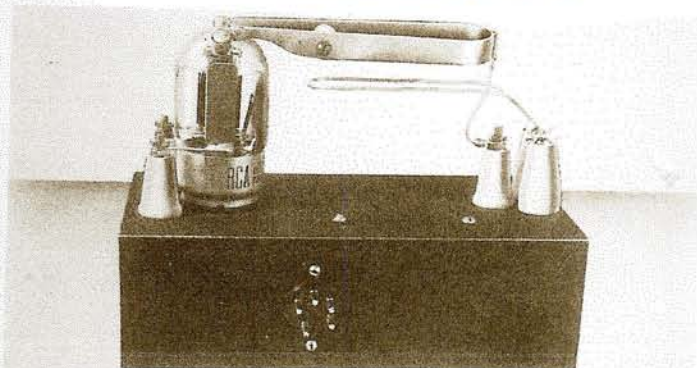
A 15-watt speech amplifier will put a great deal of audio on the carrier generated by this transmitter. The quality, as heard on a super-regenerative receiver, will be as good as the audio amplifier and modulator will permit.

Here is a hot little package that can be built at small cost, with a minimum of time and trouble—one that will "get you upstairs" and how!

### PARTS LIST

- L1 = Copper strap, 1/2" wide, 3" long, bent in shape of "U"
  - L2 = #14 wire, 3" long
  - L3 = Feed-through insulators.
  - L4 = Copper strap, 1/2" wide x 2" long, soldered to #12 wire, 2" long
  - L5 = Copper strap, 1/2" wide, 12" long, bent into hairpin, tapered to 1/4" at each end.
  - L6 = RFC. #16 copper wire, 20" long, wound on 1/4" mandrel.
  - L7 = Antenna hairpin, #12 wire, 10" long
  - R1 = 15,000 ohms, 2 watts, carbon
  - R2 = 10,000 ohms, 10 watts, wire wound
  - C1 = Mica capacitor, 500  $\mu$ f.
  - C2 = 5 plate variable capacitor
  - T1 = Universal output transformer, Thordarson T-13542 or similar.
- RCA-815 \$6.25 at your distributor.

## SIMPLE OSCILLATOR ALL SET TO GO



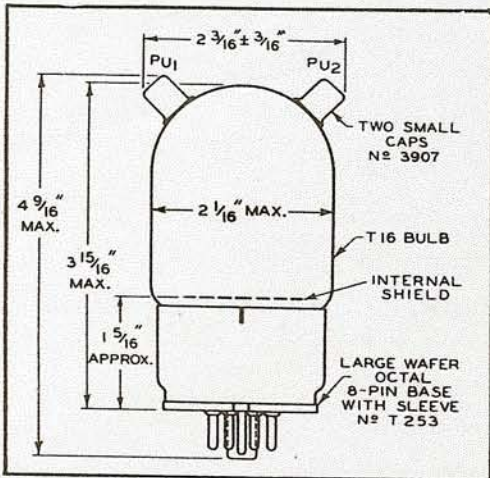
Top view of the transmitter. A little bit of copper and a few ceramic insulators put the 815 to work.



# PUSH-PULL BEAM POWER AMPLIFIER

75 WATTS INPUT TO 2 METERS :

Amateur Net \$6.25



## RCA 815

### Features

- THE ABILITY OF THE 815 TO TAKE FULL POWER INPUT AT LOW PLATE VOLTAGE PERMITS THE USE OF A LOW-COST POWER SUPPLY.
- CLOSE SPACING OF THE PLATES REDUCES RADIATION LOSSES, AND SYMMETRICAL ARRANGEMENT OF THE ACTIVE ELEMENTS MAKES THE 815 IDEAL FOR VHF SERVICE.
- DOUBLE-ENDED CONSTRUCTION, EXCELLENT INTERNAL SHIELDING, AND LOW RESIDUAL GRID-PLATE CAPACITANCE MAKE THE 815 EASY TO NEUTRALIZE.
- THE GLASS BUTTON STEM, LOW-LOSS MICANOL BASE, AND THE GROUNDED METAL SHELL MAKE AN EXCELLENT FOUNDATION FOR THE RCA-815.

### Application

**Frequency Multiplication** With push-pull grids and push-pull plates, the 815 is an excellent tripler. With push-pull grids and parallel plates, the 815 is a high-efficiency doubler.

**Plate Modulation** The 815 makes an excellent modulated final amplifier, with the screen-grid fed from the modulated plate supply through a series resistor by-passed for RF only.

**Intermittent Telegraphy** The 815 may be keyed in its grid, screen, or plate circuits. Under key-up conditions, electrode potentials should never exceed minus 175 volts on the control grids, 225 volts on the screen grids, or 600 volts on the plates.

**Neutralization** The high power gain of the 815 requires that the grid circuit be shielded from the plate circuit. Complete neutralization can be performed by putting a copper tab near each plate and connecting each tab to the opposite grid terminal.

**Driving Power Requirements** At moderate frequencies, the driving stage should furnish one watt of useful power. At 150 Mc the driver should have about 3 watts output. A pair of 6C4's in push-pull is recommended.

### CHARACTERISTICS and RATINGS

Unless otherwise specified, values are for both units

HEATER (A. C. OR D. C.):		
Voltage per Unit .....	6.3	Volts
Current per Unit .....	0.8	Ampere
TRANSCONDUCTANCE, for plate current of 25 ma. ....	4000	Micromhos
GRID-SCREEN MU-FACTOR .....	6.5	
DIRECT INTERELECTRODE CAPACITANCES (EACH UNIT):		
Grid-Plate (With external shielding) .....	0.2 max.	μμf
Input .....	13.3	μμf
Output .....	8.5	μμf

### MAXIMUM CCS and ICAS RATINGS with TYPICAL OPERATING CONDITIONS

As Plate-Modulated Push-Pull R-F Power Amplifier—Class C Telephony  
Carrier conditions per tube for use with a max. modulation factor of 1.0

	CCS	ICAS	
D-C PLATE VOLTAGE .....	325 max.	400 max.	Volts
D-C SCREEN VOLTAGE (Grid No. 2) .....	225 max.	225 max.	Volts
D-C GRID VOLTAGE (Grid No. 1) .....	-175 max.	-175 max.	Volts
D-C PLATE CURRENT .....	125 max.	150 max.	Ma.
D-C GRID CURRENT .....	7 max.	7 max.	Ma.

PLATE INPUT .....	40 max.	60 max.	Watts
SCREEN INPUT .....	4 max.	4 max.	Watts
PLATE DISSIPATION .....	13.5 max.	20 max.	Watts
TYPICAL OPERATION:			
D-C Plate Voltage .....	325	400	Volts
D-C Screen Voltage# .....			
From a fixed supply of .....	165	175	Volts
From a series resistor of .....	10000	15000	Ohms
D-C Grid Voltage of .....	-45	-45	Volts
From a grid resistor of ** .....	11250	15000	Ohms
Peak R-F Grid-to-Grid Voltage .....	112	116	Volts
D-C Plate Current .....	123	150	Ma.
D-C Screen Current .....	16	15	Ma.
D-C Grid Current (Approx.) .....	4	3	Ma.
Power Output (Approx.) .....	30	45	Watts

As Push-Pull R-F Power Amplifier and Oscillator—Class C Telephony  
Key-down conditions per tube without modulation

	CCS	ICAS	
D-C PLATE VOLTAGE .....	400 max.	500 max.	Volts
D-C SCREEN VOLTAGE (Grid No. 2) .....	225 max.	225 max.	Volts
D-C GRID VOLTAGE (Grid No. 1) .....	-175 max.	-175 max.	Volts
D-C PLATE CURRENT .....	150 max.	150 max.	Ma.
D-C GRID CURRENT .....	7 max.	7 max.	Ma.
PLATE INPUT .....	60 max.	75 max.	Watts
SCREEN INPUT .....	4.5 max.	4.5 max.	Watts
PLATE DISSIPATION .....	20 max.	25 max.	Watts
TYPICAL OPERATION:			
D-C Plate Voltage .....	400	500	Volts
D-C Screen Voltage .....			
From a fixed supply of .....	145	200	Volts
From a series resistor of .....	15000	17500	Ohms
D-C Grid Voltage .....			
From a fixed supply of .....	-45	-45	Volts
From a cathode resistor of .....	260	265	Ohms
From a grid resistor of ** .....	10000	13000	Ohms
Peak R-F Grid-to-Grid Voltage .....	116	112	Volts
D-C Plate Current .....	150	150	Ma.
D-C Screen Current .....	17	17	Ma.
D-C Grid Current (Approx.) .....	4.5	3.5	Ma.
Power Output (Approx.) .....	44	56	Watts

# Fixed supply, modulated simultaneously with the plate supply, is recommended. Series resistor connected to modulated plate-voltage supply may also be used.

\*\* The grid-circuit resistance should never exceed 15000 ohms (total) per tube, or 30000 ohms per unit. If additional bias is necessary, a cathode resistor or a fixed supply should be used.

HAM TIPS is published by the RCA Tube Department Harrison, N. J., and is available to Amateurs and Radio Experimenters through RCA tube and parts distributors.