**KCS COMPACTRON AMATEUR BAND RECEIVER**

**Part I — Design and Electrical Circuitry**

By Norman L. Morgan, W7KCS/9

---

**FEATURES —**

4 Compactrons perform 10 functions
Double-conversion superhetrodyne
Crystal-controlled HF oscillator
Accurate tuning dial calibration
2-Kilohertz selectivity for SSB

**THE KCS COMPACTRON amateur band receiver was developed to fill the need for a high-quality, high-performance receiver for the popular amateur bands that the experienced constructor could build using the usual home workshop tools. Only eight tubes are employed to perform a total of seventeen functions, including four of General Electric's new compactron tubes which perform ten circuit functions. Four modern types of conventional tubes perform the other seven functions.**

The KCS covers the principal amateur bands from 3.5 to 29.5 megacycles, in seven 500-kilocycle tuning ranges, plus the range from 9.75 to 10.25 megacycles for reception of WWV on 10 megacycles. Design objectives of the receiver included: minimum cross modulation from strong signals on adjacent channels; high stability and low frequency drift; excellent usable selectivity; sharp selectivity; low noise generated within the receiver; top-notch single sideband reception; a compact mechanical package; and, simplicity of adjustment and operation.

As can be seen from the panel views of the receiver, it is not a "knob-twister's delight." All the essential controls are on the panel; this simplifies operation. Only a signal generator, and a vacuum-tube voltmeter with an RF probe is needed for complete alignment. The critical circuits are aligned with adjustable capacitors and coils; however, an effort was made to eliminate all such adjustments where sufficiently precise fixed components could be used.

A readily-available war-surplus worm and worm-gear drive mechanism was incorporated into a home-made slide rule type dial giving a professional appearance and "feel" to the receiver. The tuning rate is 25 kilocycles per revolution of the tuning knob, slow enough for easy tuning of single sideband signals. The tunable oscillator was designed to give a nearly linear tuning rate, so that frequency can be read directly from the vernier scale on the tuning knob to within a kilocycle or two. A modern-appearing standard cabinet, plus standard chassis and sub-chassis type construction, simplifies mechanical fabrication and assembly.

**THE COMPACTRONS in the receiver — as shown in the block diagram, Fig. 1 — are:**

- a 6D10 triple triode (V2) as cathode-follower and mixer, and crystal oscillator; a 6J11 twin pentode (V4) as a two-stage IF amplifier; a 6AG11 twin-triode, twin diode (V3) as first audio amplifier, AGC gating stage, and AGC rectifier; and, a 6AL11 double pentode (V5) as audio power amplifier, and 100-kilocycle crystal calibration oscillator. The multi-function capability of compactrons thus contributes greatly to the simplicity of design and compact size of the receiver.

The four conventional tubes, and their functions are: a 6BB9 RF pentode (V1) as a tuned RF amplifier, a 608-A triode-pentode (V3) as second mixer and tunable oscillator; a 6AL5 twin diode (V5) as the detector for amplitude-modulated (AM) signals; and, a 6J8 double-plate shield beam tube (V6) as a product detector and IF carrier oscillator. The circuit was designed around those compactrons available at the time construction was started, but later additions to GE's compactron line will make possible the further combining of functions.

**High-stability tunable oscillator**

- Tunes 8-500-kilocycle segments
- 10 megacycle coverage of WWV

**Low-noise, high-gain first mixer**

Compact, modern styling

W7KCS/9 TRIES OUT his new receiver in actual operation on the 14-megacycle band after completing adjustments. Norm devoted a year to the design, construction and optimizing of circuits in this receiver to assure top-notch performance. Transmitter beneath receiver is also home-constructed, and runs 250 watts input on CW and AM phone. Norm is an experienced author; his previous article in HAM NEWS, "Transmitter Protective Circuitry," was published in the September-October, 1961 issue. He also has written several articles on electronic control circuitry for electrical industry magazines.

W7KCS/9 is an application engineer with General Electric's Specialty Motor Department, in Fort Wayne, Indiana. His department, as the name indicates, produces large quantities of special electric motors for appliances, portable power tools, and innumerable types of electrical industrial equipment.

---

**IN THIS ISSUE**

Copyright, 1962, by General Electric Company

- **KCS COMPACTRON AMATEUR BAND RECEIVER**
- **THE LOADBOX — A Power-Indicating Dummy Antenna**
- **Scanning the Spectrum**
tubes operate with a maximum of 180 plate supply volts, resulting in low power dissipation, while still providing high gain and good stability. Even in the compact cabinet the receiver runs quite cool during extended periods of operation.

**DESIGN CONSIDERATIONS AND CIRCUIT** - Specifications of the antenna input, the sensitivity, or signal-to-noise ratio, in a receiver can be made as high as practical by choosing low-noise RF amplifier and mixer circuits. Referring to the schematic diagram, Fig. 2, the 6BZ6 semi-remote cut-off RF pentode (V1) was chosen for the RF amplifier stage because of its low noise resistance, high gain-bandwidth product, and high input and output resistances. The tube operates with a fixed gain of approximately 5. Additional voltage gain in this stage is provided by the step-up ratio of the RF input coils.

Cross modulation from strong local signals on adjacent frequencies is minimized by using high-Q RF coils, and operating the 6BZ6 within the linear portion of its curve. The constant amplification eliminates the need for automatic gain control (AGC) of the grid circuit. Usually, AGC resistance in the grid acts as a shunting impedance, reducing the Q of the RF tuned circuit.

All RF coils (L1 to L6, and L7 to L12) were purchased with the secondaries prewound as standard items. The primaries were then wound on the coils by the author. With the possible exception of the universal-wound coils (L3, L13, L14, L15 and L16), the coils can be wound by the constructor on J. W. Miller type 42A000CB1 coil forms (2 1/4-inch diameter, 1 inch long) for L1 to L7, and an L15/4-inch x 7/4-inch long) for L13 to L16.

The antenna input is a fixed impedance for 50-ohm transmission lines; however, it is made adjustable between small limits by adjusting the slug tuning in the antenna coils. Although a lower capacitance could have been used for the tuned circuit, thus achieving higher Q, L10, and the pi-pieceradial capacitor (C1) provides easy coverage of all bands on the PRE-SELECT knob.

Both the input and output of the RF amplifier stage are tuned to the same frequency and use identical inductors so that tracking between the input and output is easily accomplished. Small errors in coils, and between sections of C14 and C1B, are compensated for by C2 and C6, RF gain can be reduced by the gain control (R3), which increases the negative grid-cathode voltage by making the cathode voltage more positive. In order to limit the cathode-to-heater voltage gradient, R1 and R3 form a bridge which holds the cathode-to-heater voltage below 100 volts when the function switch (S6) or an external mute switch is opened.

The type 6BZ6 pentode is a relatively quiet tube and the 6BZ6 long pentode represents the highest noise level in the receiver. This is in contrast to most receivers in that the maximum amount of noise is generally at the mixer stage. A lower noise RF amplifier tube such as a General Electric 6F9G5 shadow grid beam pentode could have been used, but this did not prove to be worthwhile at the frequencies at which this receiver operates. The 6F9G5 produces less noise than the 6BZ6 tube and would be an excellent choice for a receiver operating on the 50- or 144-megacycle amateur bands. Even with the 6BZ6 tube the KCS receiver has such low noise that it is difficult to realize that it is operating until a signal is tuned in.

**THE FIRST MIXER** - The first mixer stage uses a rather unusual cathode-coupled circuit. The first section of the 6D10 triple triode (V2A) acts as a cathode follower, isolating the signal input from the crystal oscillator injection signal. Signal voltage is coupled into the second section of V2A, loading the cathode resistor (R7). The second section, V2B, acts as a mixing triode with the local oscillator signal being injected into its grid. The remainder of the 6D10 tube (V2C) is the crystal controlled first conversion oscillator. Very low mixing noise is achieved with a triode mixer, and the circuit allows a triode to be used without neutralization. Because of the mutual cathode resistor there is a certain amount of self-limiting when strong signals are received, making necessary AGC control of the RF amplifier stage to prevent overloading. In order to produce linear mixing in this circuit the value of the triode's input (Gm) of V2A should be large compared to the transconductance of V2B. Consequently, the supply voltage for V2A is approximately 40 volts, while the supply voltage for V2B is reduced to approximately 40 volts. The advantages of the cathode-coupled mixer circuit can be utilized in the receiver with a single 6D10 triple triode capacitively coupled - say a twin triode, plus a single triode - were used in this circuit, two tubes are necessary and a large chassis area for the mixer circuit is required.

Since the crystal controlled first oscillator operates higher in frequency than...
the incoming signal on all tuning ranges, the resultant saturation in the mixer produces a noise signal in the 3- megacycle region. The crystals for the 3.5- and 7-megacycle bands operate in the fundamental mode, while the six crystals for the 5- and 6-megacycle bands operate in the third-overtone mode. If a matched set of crystals is obtained for $Y_1$ to $Y_8$, tuning dial calibration will remain virtually the same for all bands. The crystal-controlled first oscillator provides the advantage of high stability over a tunable first oscillator on the bands above 14 megacycles where it is needed.

SECOND MIXER — The output of the first mixer is fed into $T_2$. The tracking circuit, composed of $C_{23}, C_{24}, C_{25}, C_{26}$ and $C_{27}$, together with the secondary of $T_3$ tunes the variable IF frequency range of 3400 to 2990 kilocycles. The tunable oscillator ($V_{3B}$) output voltage is applied to the cathode of the 6US-A pentode section ($V_{3A}$) second mixer. The 6US-A tube is a good choice for this combination mixer-oscillator because of its low partition noise, good conversion characteristics, and low grid-plate interelectrode capacitance. By using cathode injection, interaction between the signal and oscillator is minimized. The fixed cathode resistor ($R_{p}$) presents essentially a constant load on the VFO.

A constant $k$ filter with low pass characteristics is composed of $L_{25}, L_{26}$ and $C_{76}$. This filter effectively attenuates harmonics of the VFO. The tracking of the mixer and VFO is accomplished by means of $C_{34}, C_{24}$ and the associated capacitors, and is designed to track with the grid leak, bias $R_{25}$ and $C_{20}$, together with cathode bias ($R_{16}$) on the mixer, a reasonable flat conversion gain can be achieved with moderate changes in the oscillator injection voltage.

TUNABLE OSCILLATOR — The triode section of a 6US-A ($V_{3A}$) in a tuned-grid circuit is used for the tunable oscillator. It delivers good stability and an easy method of obtaining oscillation without putting plate voltage across $C_{26}$. Additionally, all power consuming components ($R_{15}, R_{30}$ and $R_{16}$) are mounted below the chassis so that the heat does not dissipate into the VFO-mixer compartment.

The provision was originally made for a voltage regulator tube for the oscillator plate voltage but it was not necessary for moderate changes in line voltage. A check showed a frequency change of approximately 250 cycles for a voltage change between 105 and 125 volts. In locations where this voltage range might be greater, or where very low line voltage is encountered, it might be wise to add an OA2 150-volt regulator tube.

The second oscillator tunes backwards. For example, on the 3.5- to 4.0-megacycle range the oscillator tunes from 3.04- to 2.54-megacycles respectively. The combination of the crystal first oscillator and tunable second oscillator frequencies were chosen to minimize spurious beat frequencies. By use of the frequency combinations the lowest spurious frequency occurs on 7 megacycles with the fourth harmonic of the tunable oscillator and the first harmonic of the crystal oscillator. Since the attenuating network filter affects very minimizes the fourth harmonic of the local oscillator, this signal is extremely weak.

Ceramic tube sockets and low drift capacitors are used in the tunable oscillator which is built into a rigid compartment of its own. Heat dissipating components of this stage are mounted below the chassis and out of the compartment for heat transfer to critical parts.

IF AMPLIFIERS — The output of the second mixer is fed directly into a Collins mechanical Filter ($FL_1$) which is tuned to resonance on the input side by $C_{27}$ and $C_{28}$, and on the output side by $C_{29}$ and $C_{30}$, the input capacitance of $V_{4A}$. If the receiver is to be used primarily for SSB reception, a 2.1-kilocycle bandwidth filter (Collins F455-21) is recommended. However, if good AM reception is important, then the 0.1-kilocycle bandwidth filter (Collins F455J-31) is recommended so that the AM carrier and one sideband will pass through the filter. Other types of mechanical filters — the Collins "Y," or "new low-cost "FA"" series filters — are also suitable, but will require different mounting than the 9-pin socket used on the "J" type filter.

A 6J11 twin pentode compactron ($V_{4A}$) — each section is similar to a 6E6 miniature pentode — operates as a two-stage IF amplifier. The 6J11 is ideal for this application, since it has high gain and saves considerable space over two separate tubes. It is the only tube controlled by the negative AGC bias voltage in the receiver, since all previous stages have constant gain. Resistors $R_{22}$ and $R_{23}$ together with capacitor $C_{39}$ provide effective decoupling in the AGC circuit between the controls grids of the first and second IF amplifiers stages. Because of the extremely high gain of these tubes (GM = 14,000) a neutralizing circuit was included. It consists of $C_{40}, C_{17}$ and $C_{41}$, and decoupling circuit $R_{39}, C_{40}$ and $R_{40}$.

The S meter circuit monitors the cathode voltage of $V_{3B}$ and compares it against a constant voltage across $R_{40}$. By using the S meter in the cathode circuit of the second IF stage, low voltage operation results which cuts down on the wattage rating of $R_{50}$ and the zero set potentialmeter ($R_{51}$). The S meter therefore reads the complete tube current of the second IF amplifier as AGC is applied to its control grid in a value which changes the grid-bias in proportion to the signal strength. On single side band and CW operation the AGC circuit is taken from the first audio amplifier so that the S meter follows the audio strength rather than the RF strength; as is the case with AM reception.

AM DETECTOR — The output of the IF transformer ($T_2$) is fed into an integrating diode. AM detection and also into the single side band product detector. The integrating diode detector, consisting of both sections of a 6AL6 twin diode tube ($V_{5}$) reduces distortion by presenting a capacitance load to the output transformer windings on both the positive and negative IF signal peaks. With positive peaks the output...
TABLE I—PARTS LIST

C₁,...10—100-pf, per section, two-section straight-line variable (Hammarlund MCD-100-M).
C₂, C₃,...2.5—13-pf, midget ceramic trimmer, zero-temperature coefficient (Centralab 822-B2).
C₉, C₁₂, C₁₃, C₁₄, C₁₅, C₁₆, C₁₇, C₁₈, C₁₉, C₂₁, C₂₃, C₃₉, C₄₂ and C₅₀—all zero-temperature coefficient ceramic in values marked on Fig. 2 (Centralab TCZ).
C₂₂,...3—12-pf, ceramic trimmer, zero-temperature coefficient C₂₄,...10—100-pf, per section, two-section midline type variable (Hammarlund MCD-100-M).
C₂₇, C₀₁, C₈,—100-pf, tubular ceramic, zero-temperature coefficient C₂₈,-6—20-pf, ceramic trimmer (Centralab 837-C).
C₃₄,—12-pf, ceramic tubular, zero temperature coefficient C₅₇, C₁₀,—1.8—8.7-pf, ceramic air trimmer (E. F. Johnson type M-160-104, 9M11).
C₄₇,—7—35-pf, ceramic trimmer (Centralab 827-D1).
C₆₀,—820-pf, 1.1 percent 500-volt silvered mica (Elmenco type CM-20).
C₆₈,—10—50-pf, air trimmer, zero-temperature coefficient CH₁,—1.5-henry, 200-milliamperere filter choke (Stancor C-2327).
FL₁,—Mechanical bandpass filter, 455-kilocycle center frequency, 2.1-kilocycle bandwidth for SSB reception (Collins type F-455-21 filter used in this receiver).
F₁,—1-milliamperere midget cartridge fuse, type 3AG, and holder.
CR to CR₄,—400-volt peak inverse, 750-milliamperere silicon rectifiers (G-E 1N1695).
J₁,—chassis type coaxial cable connector (SO-339).
J₂,—closed circuit type phone jack.
L₁,—135-UH universal wound coil; primary, J. W. Miller No. 42A154.
L₂,—secondary, 15 turns, No. 28 SE wire, random-wound 1/4-inch long and 1/4-inch spacing from primary.
L₂₁,—47-UH RF Choke, pi-wound coil (National B-15980).
L₂₄,—455-kc, tapped oscillator coil, midget type (Miller 5481-C).

M₁,—0.1-milliamperere, 2½-inch square panel meter (General Electric DW-91, Cat. No. 513X22).
PL₁,—6×3-volt pilot lamp and socket.
R₁,...2500-ohm control potentiometer for concentric shaft mounting on rear of R₅₀ (IRC Snaptral rear section, right hand semi-log taper, No. CR25 with SR16 shaft and DCl dust cover).
R₃₀,—500-ohm ½-watt control potentiometer, screw-driver slot R₄₀,—1-megohm control potentiometer, left-hand audio taper (IRC Snaptral front section No. CF26 with SF12 shaft and BUS bushing).
R₇₅,—2000-ohm, ½-watt potentiometer, screw-driver slot S₁,—6-pole, 6-section, 2-12 position steatite miniature, non-shorting rotary tap switch, stop set for 8 positions (Centralab PA-2025).
S₂,—3-pole, 1-section, 3-position, 2-5-position steatite miniature, shorting rotary tap switch, stop set for 3 positions (Centralab PA-2006).
S₃,—3-pole, 1-section, 4-position shorting tap switch
T₁,—455-kilocycle IF input transformer (J. W. Miller 12-C1).
T₂,—455-kilocycle IF output transformer (J. W. Miller 12-C2).
T₃,—1500-kilocycle IF input transformer, modified (Miller 13-W1).
T₄,—Power transformer, 115/150-volt secondary, 200 milliamperere. 6.3 volts at 5.5 amperere, 115-volt primary (Triad R-738).
T₅,—Audio output transformer, 4000-ohm primary, 5.2-ohm secondary, 3 watts (Stancor A-3328).
V₁—General Electric receiving tubes, types as indicated in Fig. 2.
V₂—Quartz crystals, ET-243 type holders; see TABLE II—COIL DATA, for frequencies.
V₅,—quartz crystal, FT-243 holder, 456.2 kilocycles, for lower sideband reception.
Y₁,—quartz crystal, FT-243 holder, 453.9 kilocycles, for upper sideband reception.
Y₁,—100-kilocycle standard frequency quartz crystal, HC-6/U holder (C-W Mfg. Co. type MX-100).
TABLE II—COIL DATA

<table>
<thead>
<tr>
<th>Band &amp; Freq.</th>
<th>Ant. &amp; RF Coils</th>
<th>PRIMARY</th>
<th>SECONDARY</th>
<th>OSCILLATOR</th>
<th>CRYSTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>L Pri.</td>
<td>Wire</td>
<td>L Space</td>
<td>Wire</td>
</tr>
<tr>
<td>10A—29.2</td>
<td>L1 &amp; L2</td>
<td>0.35</td>
<td>4</td>
<td>22</td>
<td>1/4</td>
</tr>
<tr>
<td>10B—28.7</td>
<td>L1 &amp; L2</td>
<td>0.35</td>
<td>4</td>
<td>22</td>
<td>1/4</td>
</tr>
<tr>
<td>10C—28.2</td>
<td>L1 &amp; L2</td>
<td>0.35</td>
<td>4</td>
<td>22</td>
<td>1/4</td>
</tr>
<tr>
<td>15—21.0</td>
<td>L1 &amp; L2</td>
<td>0.44</td>
<td>5</td>
<td>22</td>
<td>1/4</td>
</tr>
<tr>
<td>20—14.0</td>
<td>L1 &amp; L2</td>
<td>0.60</td>
<td>5</td>
<td>24</td>
<td>1/4</td>
</tr>
<tr>
<td>40—7.0</td>
<td>L1 &amp; L2</td>
<td>1.2</td>
<td>7</td>
<td>28</td>
<td>1/4</td>
</tr>
<tr>
<td>80—3.5</td>
<td>L1 &amp; L2</td>
<td>2.5</td>
<td>10</td>
<td>30</td>
<td>1/4</td>
</tr>
<tr>
<td>WWV—9.75</td>
<td>L1 &amp; L2</td>
<td>1.0</td>
<td>6</td>
<td>28</td>
<td>3/4</td>
</tr>
</tbody>
</table>

NOTES

All coils wound on J. W. Miller ceramic slug-tuned coil forms, Part No. 42A000CB1, 1/4-inch diameter, 1 inch long.

Inductance values given are those actually in circuit.

All coils closewound unless specified.

Enamel wire used on all coils unless otherwise specified.

DCC = Double Cotton-covered wire.

SE = Silk-enamelled covered wire.
6BW8 diodes with separate cathodes. AGC voltage then runs through the AGC diode (CR12) and one diode section of V6C. The resulting DC voltage is applied across the charging time constant composed of V6C and C45. This provides a fast attack with very slow release for the AGC. The release voltage time constant is provided by R4, C45 and the back resistance of V6C and R45.

This network provides a release time of approximately 5 seconds. The single side band AGC voltage follows audio signal strength; however, because of the time constant involved, it does not rapidly fluctuate with instantaneous changes of audio level. Since only one of the 6AG11 compactron diodes is used in this receiver, it would be possible to use the unmodulated diode section as a noise limiter if the constructor felt it desirable.

**POWER SUPPLY** — The power supply consists of a full wave bridge rectifier system using General Electric type 1N1695 750-milliampere silicon rectifiers. The semi-circular arrangement minimizes space requirements in the power supply compartment. The pi-section filtering components (C7A, C7B and C11A) were chosen to result in a very low ripple voltage of 0.01 percent, which is barely discernible with the audio volume control wide open. Because of high capacity, the capacitors do have a surge limiting resistor (RS) to prevent damage from the first charging cycle.

Note that all tube heaters are connected together by means of twisted wire and are grounded at only two points. There is a ground at the power transformer (T4) and also on pin 8 of the 6J18 tube (V8). In order to reduce hum in the single side band product detector it was necessary to ground pin 5 directly to the chassis. This pin is also connected to the internal shield and focusing electrodes of this tube. Rather than a single heater wire and a direct chassis ground for the other side of the heater, the twisted pair of wires reduces any tendency of hum pickup in the audio output. This extreme may not be necessary, however, other methods have not been tried to determine its superiority.

Note that switch S5 is a shorting switch or make-before-break type rotary switch which allows the next circuit to be energized before the previous circuit is disconnected. This prevents transient voltages from being

---

**FOOTNOTES**

1. Those persons who are interested in the details of the cathode-coupled mixer circuit can refer to C. R. C. G. M. A. G. I. E., 1970 (see also Circuits and Applications). The circuit consists of a 2k-kilohertz bandwidth. Model No. F455 PA. 21. It is housed in a "barb"-type case, 7% inches long. The connections can be made on the chassis of the KCS receiver in place of the 9-pin plug shown in this model, with connections brought down through the chassis on each side of the shield as shown in the bottom view. The terminal is $25.00.

2. A matched set of crystals for the KCS receiver, which includes both crystals for Y1, is available as set MRS-KR from the G.W. Manufacturing Co., P.O. Box 2045, Elfin Cove, Calif., for approximately $27.00.
THE LOADBOX — A POWER-INDICATING DUMMY ANTENNA

By Phillip E. Haffield, W9GFS

HIGH-QUALITY SIGNALS from amateur transmitters are more important today than ever before, but with today's crowded amateur band conditions, on-the-air testing is frowned upon. Thus, a dummy-antenna load is a necessity in the amateur station.

The LOADBOX is a modernized version of one of the dummy loads described in an earlier issue of G-E HAM NEWS. It features complete shielding to reduce radiation and an internally mounted RF ammeter to allow comparative power readings.

It is built in a 4x5x6-inch aluminum utility box. An unpainted box was used, since good contact between the body of the box and the covers will decrease unwanted radiation. The covers furnished with the box were replaced by covers cut from perforated aluminum sheet (Reynolds Home Aluminum) to assist in cooling the resistor assembly.

The resistor assembly consists of ten, non-inductive, wirewound, 600-ohm, 10-watt resistors connected in parallel to give a nominal resistance of 50 ohms. Two copper disks (see photos) were used to parallel the resistors. Copper connection straps were fastened to the center of the disks with machine screws and soldered before the resistor assembly was made. The resistor leads were slipped through the holes around the edges of the disks and soldered, and clipped. One strap was used to connect the resistor assembly to the bottom of the aluminum box and the other to connect to the RF ammeter, as shown in the schematic diagram.

The RF ammeter is mounted on supports inside the box with the face visible through the screened hole on the front of the box. The meter used in this model has a 0–1.0-ampere range, which allows power inputs up to approximately 110 watts.

The front of the box also carries the input coaxial connector and the variable capacitor used to compensate for the reactance of the resistor assembly.

The resistor assembly may be connected by forming a SWR bridge, to a source of RF and adjusting the variable capacitor on the front of the box for a null indication on the SWR bridge at the center of each band on which the Loadbox is to be used. Marks may be made on the front of the box to allow resetting of the capacitor.

In operation, approximate power being dissipated in the load may be calculated by squaring the reading of the RF ammeter and multiplying by 50. However, the Loadbox is most useful for determining whether changes in a piece of equipment increase or decrease the power output. This is difficult to do with a light bulb load as most of us are unable to "remember" the intensity of a light bulb between tests.

The resistance of the model illustrated was measured from 1.7 to 50 Mc. The results are shown on the curve. From this it can be seen that some error in calculated power output will prevail at all frequencies if a resistance of 50 ohms is assumed, but that the error will increase sharply above 30 megacycles. However, this does not affect the usefulness of the Loadbox as an indicator of relative power at a given frequency.

Although the nominal rating of the resistor assembly is 100 watts, powers as high as 300 watts may be dissipated for short intervals. However, if this is done the RF ammeter must have the proper range and the overload should not be applied for more than one minute, followed by a fifteen minute cooling-off period. Cooling may be assisted by using a fan or blower to move air through the perforated covers of the box.

For maximum convenience, the Loadbox may be connected to the transmitter through one position of a coaxial cable selector switch (B & W Model 550A, or Waters Mfg. Co. Model 385) which also selects the "live" antenna. So, whenever you test out your transmitter even for only a minute or two — connect it to the Loadbox and prevent needless interference to other stations.

FOOTNOTES

*W9GFS is a technical data engineer with General Electric's Electronic Tubes Department, Owosso, Michigan. He is an Associate of the American Radio Relay League, and a member of the American Radio Relay League, and a member of the Radio Amateur Club of America, and a member of the G-E HAM NEWS.
FOUR NEW SMALL G-E TRANSMITTING TUBES ANNOUNCED

RADIO AMATEURS who are planning to build new mobile equipment will find two new compactrons, and two 9-pin miniature tubes ideal for transmitter circuits. All four new tubes—picted at the left—have been designed specifically for reliable and economical mobile communications at frequencies up to 175 megacycles.

The popular 6146 transmitting tube has been compactronized in such fashion that it delivers more power output in the VHF range (at 175 megacycles) but at the same time requires less driving power. It bears the EIA designation of type 7984, and is rated for 46 watts output, as compared with the rated 35 watts of the 6146 under similar conditions.

Seated height is only 2.5 inches, as compared with the 3.22-inch seated height of the 6146. The saving is gained because the 7984 has neither a composition base, nor a top cap. Eliminating the top cap for the plate connection in mobile equipment is advantageous because it eliminates a long loose wire lead which is difficult to keep from vibrating or otherwise moving about.

Maximum ratings of the 7984 in intermittent mobile RF service, class C telegraphy and FM telephony, are: DC plate voltage, 750 v.; DC screen-grid voltage, 250 v.; DC grid No. 1 current, 4.0 ma.; and plate dissipation, 35 watts. Typical operation as amplifier at 175-megacycles: plate voltage, 450 v.; screen-grid, 125 v.; grid No. 1, —69 v.; plate current, 150 ma.; screen-grid current, 12 ma.; grid No. 1 current, 2.5 ma.; driving power, 2 watts; and power output, 46 watts.

Another new compactron, type 8156, is a medium power tube with 15 watts plate dissipation. A new multiplier-driver tube, the 8106, is rated at 6 watts plate dissipation. The 8106 can double and drive the 7984, can drive two 7984's in push-pull, can double and drive a pair of 8156's. For frequency tripling and FM modulator, the triode-entode pentode miniature tube is available.

Other significant characteristics are:

8156—This beam pentode compactron has four pins for connecting to the cathode and beam plates, three plate pins, and two screen-grid pins. Ratings are: 600 volts maximum DC plate, 250 volts screen grid, 100 ma. plate current, 5 ma. control-grid current, 15 watts plate dissipation, and 2.5 watts screen-grid dissipation. In typical operation at 175 megacycles with 400 plate volts, 170 screen-grid volts, and minus 60 control-grid volts, the tube draws 90 ma. plate current, 10 ma. screen-grid current, and 3 ma. grid current. With 1.0 watt of driving power, the useful output is 21 watts.

8106—A 9-pin miniature beam pentode, the tube features three cathode-beam plate pins, and two screen-grid pins. Maximum ratings are: 330 plate volts, 300 screen-grid volts, 6.0 watts plate dissipation, and 40 ma. DC cathode current.

8102—A 9-pin miniature triode-pentode, the tube has a large cathode cross section, and the pentode section is rated to carry 20 ma. cathode current. Both plates are rated at 250 volts maximum, and 2.5 watts dissipation. In typical operation at 125 volts, the plates draw 12 and 13.5 ma., respectively.

These new tubes will bring higher efficiencies to amateur radio mobile equipment, as they are doing for commercial VHF two-way radio.

---

Complex or Simple? . . .

We feel that with articles like the KCS receiver and LWM-3 transceiver,1 we are helping to advance the “state of the art” in home-constructed amateur radio equipment. We have shown that the equivalent of fine commercial equipment can be constructed at home. And, we estimate from mail received that at least 400 to 600 SSB transceivers similar to the LWM-3 are being constructed, and many more SSB exciters are being converted to include transceive operation. However, for those who like simple projects, we publish shorter articles too, like the LOADBOX in this issue, and thus provide a balanced "diet" of articles. See November-December, 1961, and January-February, 1962 issues.

While the KCS Compactron receiver is admittedly an ambitious project, the construction and alignment are well within the capabilities of the experienced radio amateur. It enables amateurs with a good supply of parts on hand to "step-up" to a higher performance receiver at low cost. The KCS receiver also is a "goldmine" of circuit and constructional ideas for thousands of other amateurs who may not construct a complete receiver, but who can use these ideas in equipment they now have, or are constructing.

—Lighthouse Larry