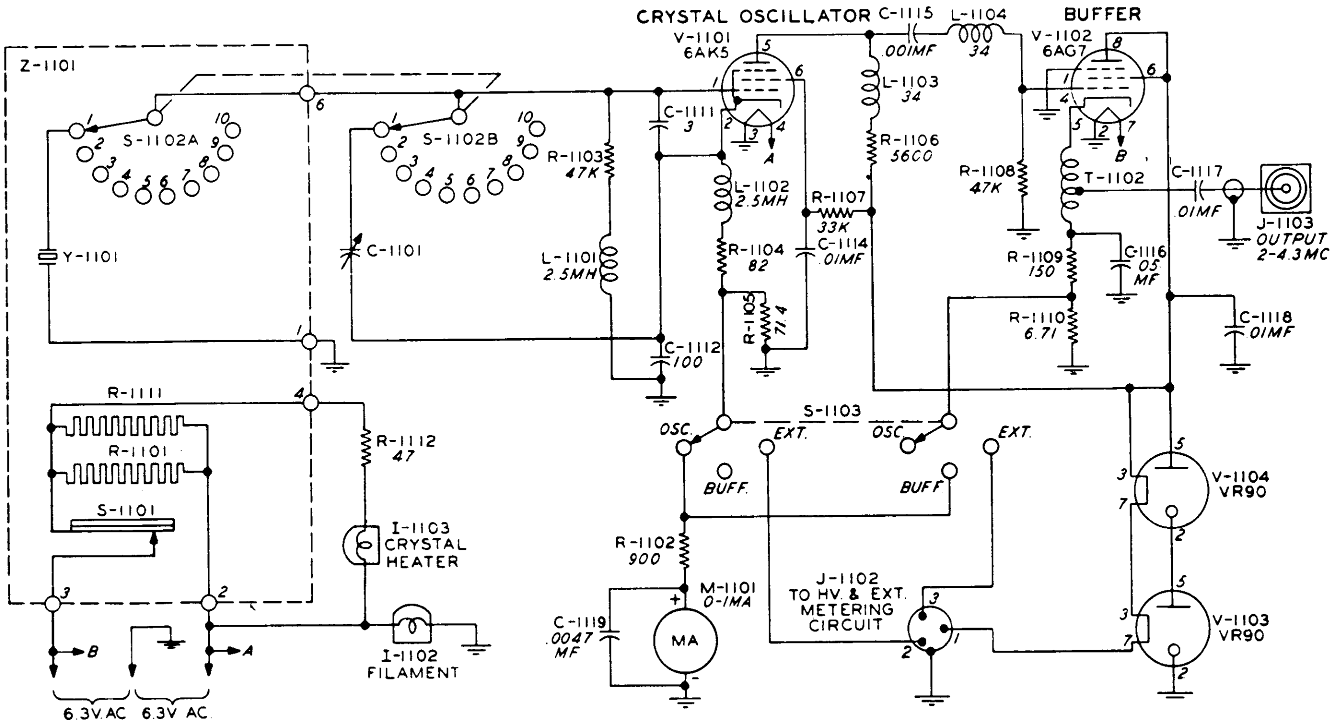


Figure 2—2. Simplified Schematic — RF Oscillator O-92A/FRT-5, Crystal Oscillator

metering is desired, special provisions must be made to make connections at these points.

(2) RF OSCILLATOR O-91A/FRT-5. — RF Oscillator O-91A/FRT-5 is a very stable automatic frequency-controlled (AFC) oscillator which covers a frequency range of 2 mc to 4.5 mc. It employs a master oscillator and amplifiers in conjunction with automatic frequency control circuits which maintain the output frequency constant at any selected value within its range. The actual circuits that provide power output to drive the transmitter are marked with an orange arrow on the chassis and are the master oscillator (V131), multiplier (V112) and final amplifier (V114). The remainder of the circuits, with the exception of the 450-kc amplifier (V106) and the 100-kc amplifier (V107), are the frequency control circuits. The 450-kc amplifier and the 100-kc amplifier are both provided with external jacks so that the output of either one may be used on any external equipment requiring a frequency source of this type. Figure 2–3 is a block diagram of the oscillator.

The stability of RF Oscillator O-91A/FRT-5 is derived from a 100-kc standard, either external or internal. This 100-kc standard signal is subdivided by a divider circuit to 25 kc and then is passed into a harmonic amplifier circuit whose output is in the range of 9.125 mc to 21.625 mc.

This 9.125-21.625-mc signal is mixed with the fifth harmonic of the output frequency (10-22.5 mc) to produce an intermediate frequency (IF) in the range of 875 kc to 900 kc. This IF is amplified and combined in a second mixer with a 75-100-kc signal which is obtained by subdividing the output from a 600-800-kc interpolation oscillator. The second IF is then a fixed frequency centered on 800 kc.

This 800-kc signal is then divided to 100 kc in a regenerative divider circuit. Any error involved in setting up the master oscillator will also appear in this 100-kc signal. This signal is then combined, in a pair of diode mixers, with a signal from the 100-kc standard to produce an output which is audible and is a definite measure of the frequency error. In one of the diode mixers, the 100-kc standard signal is shifted 90 electrical degrees, thus providing a two-phase audio output. This audio output from the mixers is passed into a pair of d-c amplifiers and thence into a pair of power amplifiers. The resultant two-phase output from the power amplifiers is fed to the AFC motor which rotates in such a manner as to adjust the master oscillator to the desired frequency.

In the following discussion of circuit details, the exciter circuits and frequency control circuits are discussed separately. While these circuits are interconnected, the excitation (magnitude) is not directly dependent upon the control circuits. In an attempt to clarify the explanation, the control circuits are explained by taking one signal and bringing it up to a mixer, returning and picking up the signal that it is to be mixed with and then proceeding with the discussion from the output of the mixer.

In more detail, the individual circuit theory is as follows:

(*a*) MASTER OSCILLATOR. — (Refer to figure 2–4.) — The oscillator assembly is a precision device which supplies output energy whose frequency is very stable under conditions of extreme temperature and humidity change. The circuit used is an electron-coupled type employing a type 6SJ7 tube (V131), and covering a frequency range of 1000 kc to 1500 kc. The output frequency of the oscillator is determined by the position of the tuning slug within grid inductor L103, and the capacity setting of C126 which is across the grid coil. The tuning slug position is determined by the setting of the MASTER OSCILLATOR dial [A-1]. The setting of capacitor C126 is adjusted by the AFC motor which is linked to it mechanically, and which operates in response to the output of the frequency control circuit.

(*b*) MULTIPLIER V112. — (Refer to figure 2–5.) — The multiplier stage, V112, employs a type 6BE6 miniature pentagrid tube operating as a class "C" stage with cathode bias. The input voltage is fed to the #1 grid of V112 through R242 which is used to reduce the input voltage slightly so that the multiplier stage will not be overdriven. In the plate circuit of V112 is a tuned circuit composed of a slug-tuned inductor T104, a trimmer capacitor C128D and one section of a variable ganged capacitor C120D. This

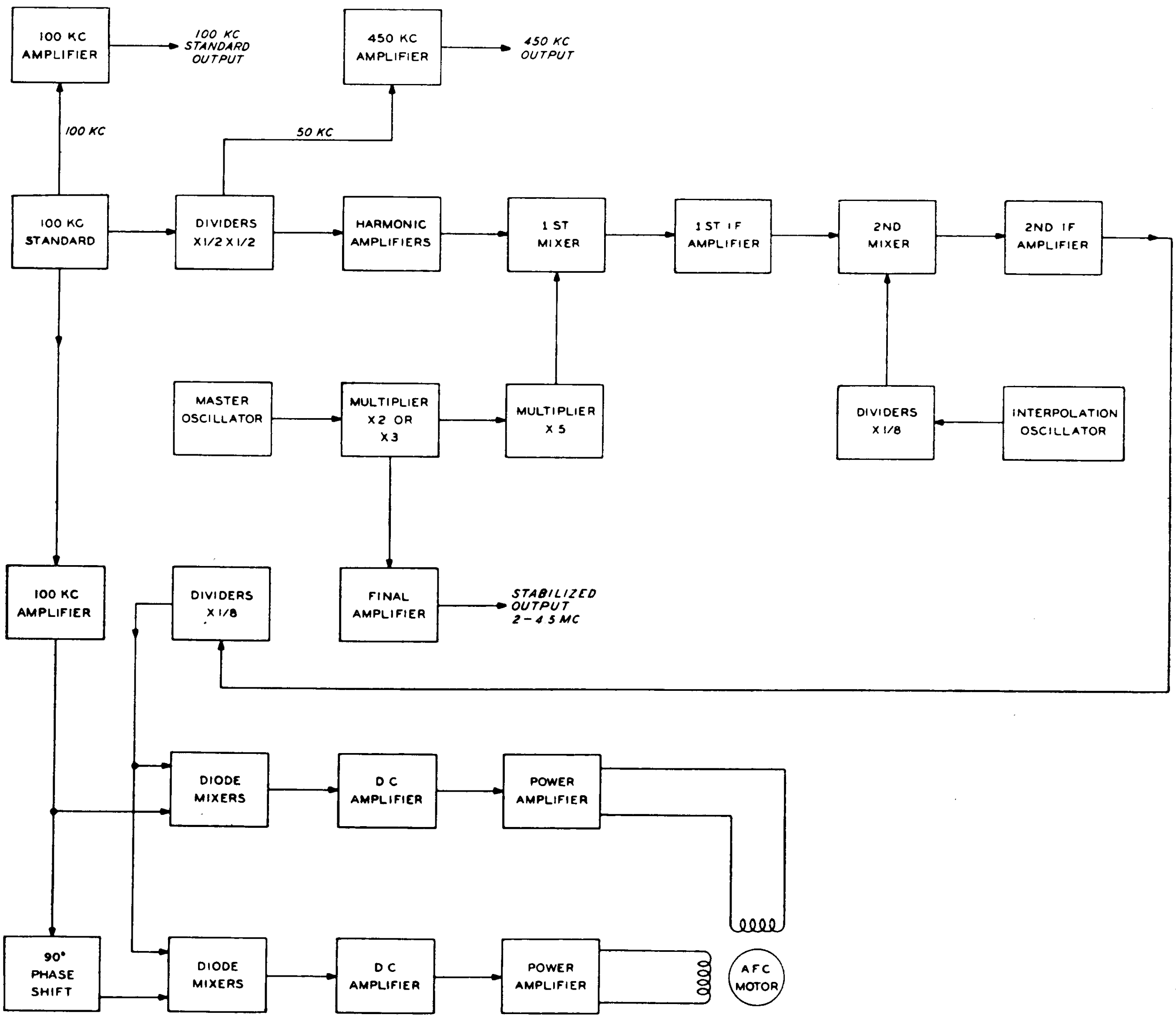


Figure 2—3. Functional Block Diagram — RF Oscillat r O-91A/FRT-5

tank circuit, T104, is tuned to twice the input frequency to produce an output frequency from the final amplifier of 2 mc to 3 mc, or tuned to three times the input frequency to produce an output frequency from the final amplifier of 3 mc to 4.5 mc. Tuning is accomplished by the OUTPUT TUNING dial [C-1] (C120D). The output of V112 is capacity coupled through C159 to the second multiplier grid, and through C154 to the final amplifier grid.

(*c*) FINAL AMPLIFIER. — (Refer to figure 2–5.) — The final amplifier is a class "A" stage operating as a straight amplifier and receiving its bias from cathode resistor R164. Input voltage is fed from the plate circuit of V112 through capacitor C154 to the control grid of V114. A voltage divider arrangement using a potentiometer, whose rider is connected to

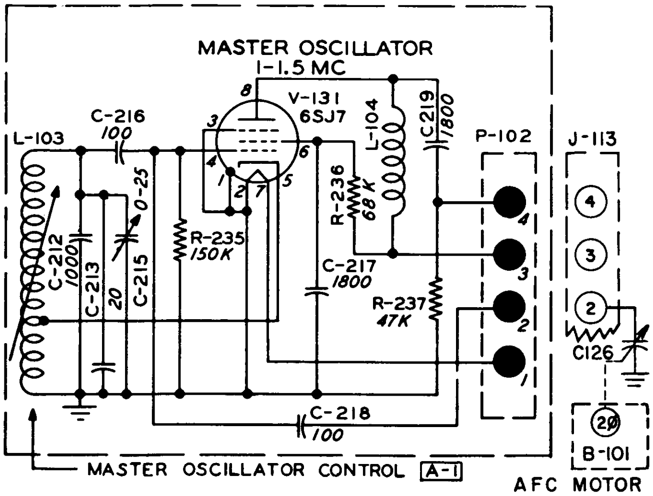
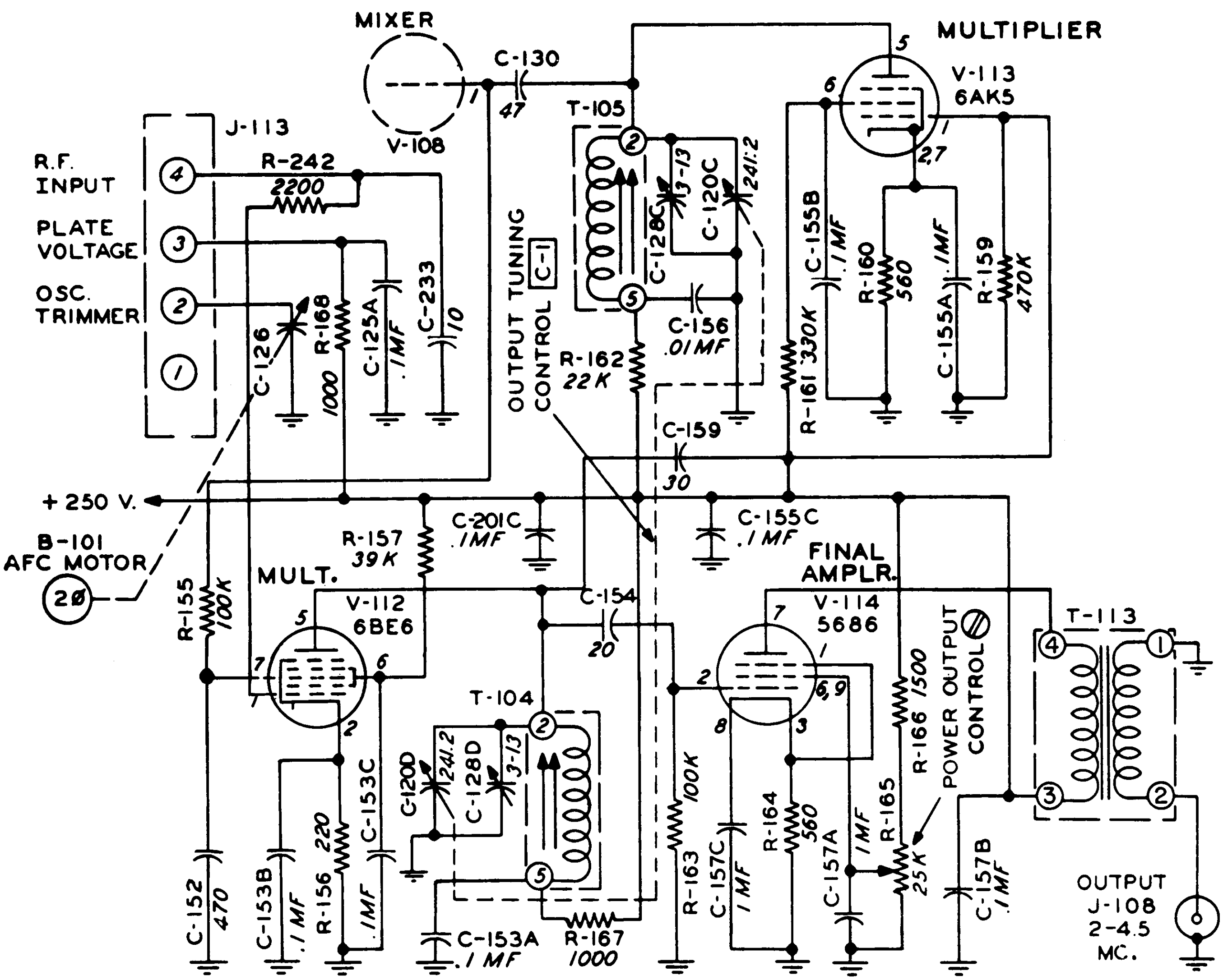


Figure 2–4. Schematic — RF Oscillator O-91A/FRT-5, Master Oscillator



Figur 2–5. Sch matic — RF Oscillat r O-91A/FRT-5, Output Circuit and Multiplier

the screen of V114, provides a means of varying the screen voltage, which in turn varies the power output of the final amplifier stage. The plate circuit of V114 contains an untuned transformer, T113, whose output winding is coupled to the transmitter through a coaxial cable.

Note

The frequency control circuits consist of: 100-kc crystal standard, 100-kc amplifier, crystal divider, harmonic amplifiers, first intermediate frequency amplifier (875 to 900 kc), second intermediate frequency amplifier (800 kc), interpolation oscillator, buffer, interpolation dividers, regenerative dividers, diode mixers, d-c amplifiers and power amplifiers.

(*d*) 100-KC CRYSTAL OSCILLATOR AND AMPLIFIER. — (Refer to figure 2–6.) — The 100-kc oscillator and amplifier circuit employs a type 2C51 triode tube (V101A/V101B). This circuit is designed so that either the 100-kc crystal supplied or an external 100-kc crystal can be used as a standard. When an external crystal oscillator is used, its output is fed to the cathode of amplifier V101A through jack J102, capacitor C101 and switch S105A/S105B which must be turned to its EXT position. In the EXT position one section of this switch opens the cathode circuit of V101B, thus disabling the internal 100-kc crystal oscillator. However, V101A continues to operate as an amplifier supplying a 100-kc signal to the 100-kc amplifiers, V107 and V129. When using the 100-kc crystal supplied with the oscillator, switch S105A/-S105B is turned to the INT position, which closes the cathode circuit of section "B" of V101. Section "B" of V101 is the internal 100-kc oscillator. It employs a regenerative type circuit. The plate circuit of V101B is tuned to 175 kc by means of inductor L107 and capacitor C231. The end of the tank coil opposite the plate is connected to one end of capacitor C229, while the other end is connected between the crystal and capacitors C102A/C102B, C103 and C232. Capacitor C229 is used to provide additional feedback voltage

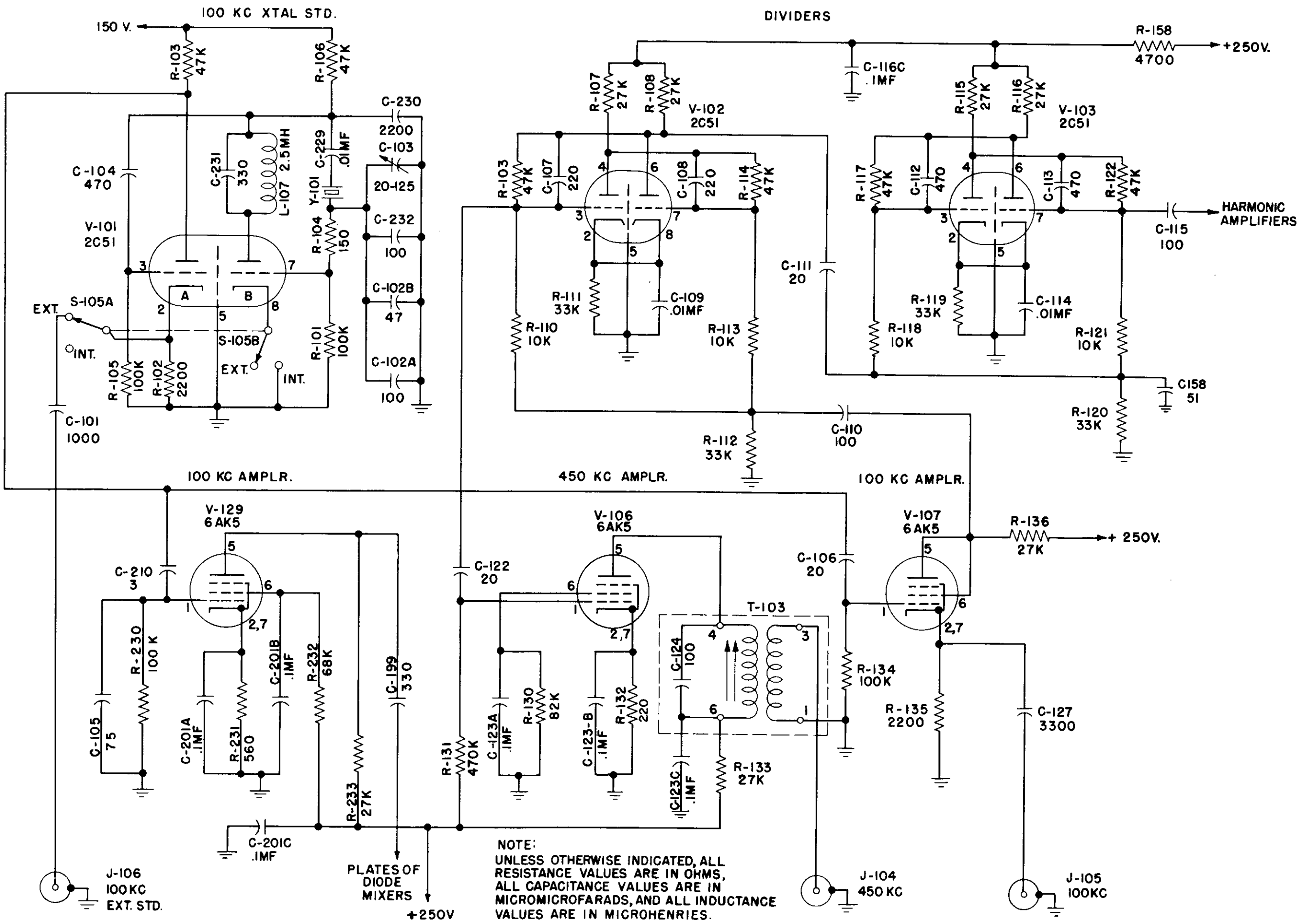


Figure 2—6. Schematic — RF Oscillat r O-91A/FRT-5, Crystal Oscillator, Divid rs and Amplifi rs

for better operation of the oscillator circuit. Capacitors C102A/C102B, C232 and C103 are connected in series with the 100-kc crystal to adjust the frequency to exactly 100 kc. The 100-kc crystal and the temperature-controlled oven in which it is located are contained in a sealed plug-in unit (Y101). When the 115-volt a-c power is applied to this oven, the pilot light (I101) designated as XTAL HEAT comes on, indicating that the heater resistors are energized to raise the temperature of the oven. The temperature is thermostatically controlled between 59° to 61°C (138.2°F to 141.8°F). When the temperature within the oven becomes stabilized, the heating cycle should be "heat on" for four or five minutes, then "heat off" for eight or ten minutes, provided the room temperature is constant. The required stability should be reached within one hour after power is applied. Capacitor C205 is connected across the thermostat contacts to prevent arcing.

The output of the crystal oscillator section is fed to the grid of section "A" of V101 through capacitor C104. Section "A" is operated as a class "A" amplifier and receives its bias from cathode resistor R102. There is no tuned circuit in the plate of V101A so the output of this amplifier is taken directly from the plate and fed to the grid of the 100-kc amplifier (V107) through capacitor C106, and to the grid of the other 100-kc amplifier (V129) through capacitor C210.

(*e*) 100-KC AMPLIFIER (V107). — (Refer to figure 2–6.) — The 100-kc amplifier, V107, employs a type 6AK5 pentode having its plate and screen tied together, and its suppressor grid and cathode also tied together, to make it operate as a triode. This stage is operated as a class "A" amplifier receiving its bias from cathode resistor R135, and serves as a buffer between the preceding amplifier (section "A" of V101) and the first crystal divider (V102). The output from V107 is taken from the plate and coupled to the grids of the first crystal divider, V102, through coupling capacitor C110. A second connection is made to the plate from J105 through coupling capacitor C127. J105, a coaxial connector mounted at the rear of the chassis, permits the supplying of any external source that may require a 100-kc signal.

(*f*) CRYSTAL DIVIDERS. — (Refer to figure 2–6.) — The crystal dividers and interpolation dividers are a type of trigger or "flip-flop" circuit. The purpose of this circuit is to divide the input frequency by two to supply an output frequency of one-half the input frequency. To explain the operation more thoroughly, consider the 50-kc divider V102 alone. The normal condition of the divider when no excitation voltage is being applied to the grids would be that one section of the tube, let us call it "A," would be drawing plate current, and at the same time the plate current in section "B" would be zero. Now when a negative voltage is applied to the grid of section "A" it will decrease its plate current. This causes a decreased voltage drop across R107 because of the coupling from the plate to the grid through R114 and C108, which in turn makes the bias on the grid of section "B" more positive. Consequently, the plate current of section "B" increases, increasing the voltage drop across R108. This makes the grid of section "A" (as coupled from the plate of section "B" through R109 and C107 to the grid of section "A") more negative, causing a further decrease in the plate current of section "A" and a resultant further increase in plate current of section "B". The process continues until section "A" is cut off, and only section "B" draws plate current, a condition which will continue until the next negative pulse is applied to the grid of section "B", at which time the action will reverse. The resultant differential of the negative pulse causes the circuit to make an abrupt reversal. The positive pulses do not possess the required differential to make the divider reverse. Referring to the divider circuit (V102) the 50-kc output voltage is fed from the plate of section "B" to the next stage through capacitor C111. The function of divider circuit V103 is the same as for V102 with the exception that its output has a 25-kc fundamental. This is fed to the grid of the first harmonic amplifier.

(*g*) HARMONIC AMPLIFIERS. — (Refer to figure 2–7.) — The harmonic amplifiers employ a type 6AK5 tube (V104) for the first harmonic amplifier and a type 6AS6 tube (V105) for the second harmonic amplifier. Grid bias is provided by cathode resistor R124 in the 1st stage and cathode resistor R127 in the 2nd stage. The plate of V104 contains a tuned circuit consisting of C120B, which is the main tuning capacitor, C128B, a trimmer capacitor in parallel with C120B, and a slug-tuned inductor, T101. Capacitor C119 is inserted in series with C120B and C128B of the tuned circuit to make grounding the rotor of C120B possible. The capacity of C119 is sufficiently large so that its effect on the tuned circuit is negligible. Capacitor C120B is controlled by the OUTPUT TUNING dial [C-1] on the front panel. The plate circuit of V104 is coupled to the grid of V105 through coupling capacitor C117. Harmonic amplifier V105 contains a tuned circuit similar to V104, whose tuning capacitor (C120A) is also controlled by the OUTPUT TUNING dial [C-1] on the front panel. The tuned circuits of both V104 and V105 are designed to cover a frequency range of 9.125 to 21.625 mc. In order to obtain good performance from these amplifiers it is necessary to supply regulated voltage (+150v) to the plate of V104 and to the plate and screen of V105. The plate circuit of harmonic amplifier V105 is coupled to the grid of mixer V108 through capacitor C129.

The first stage of the first i-f strip is a mixer (V108). The two signal voltages mixed in this tube are the output of the harmonic amplifier (V105) and the output from the multiplier (V113).

(*b*) MULTIPLIER V113. — (Refer to figure 2-5.) — The multiplier V113 receives its input voltage from the plate of multiplier V112 through coupling-capacitor C159. It operates as a class "C" amplifier and multiplies the input frequency 5 times. The tuned circuit of V113 consists of main tuning capacitor C120C, which is controlled by the OUTPUT TUNING dial [C-1] trimmer capacitor C128C, and a slug-tuned inductor, T105. Capacitor C156 is connected in series with C120C and C128C to make grounding of the rotor of C120C possible. C156 is sufficiently large so that it has a negligible effect on the tuned circuit. The plate of V113 is capacity coupled to mixer V108 through C130. Grid bias for V113 is supplied by grid resistor R159 and cathode resistor R160.

(*i*) FIRST IF (875 to 900 kc). — (Refer to figure 2-7.)

1. MIXER. — The mixer stage employs a type 6BE6 (V108) pentagrid converter. Bias for the mixer is supplied by cathode resistor R140. The output frequency of harmonic amplifier V105 is fed to the #3 grid of V108 and the output frequency of multiplier V113 is fed to the #1 grid of V108. These two injected signals are mixed and the plate tuned circuit is tuned to the difference frequency. In the plate of V108 and the grid of V109 is an i-f transformer T106. This transformer consists of two slug-tuned coils and two fixed capacitors, one capacitor being connected across each coil. It is also required to pass a frequency range of 875 kc to 900 kc. To do this, it is necessary to overcouple the tuned circuit, so as to flatten out the peak of the i-f curve enough to pass the required frequencies.

2. AMPLIFIER. — (Refer to figure 2-7.) — The i-f amplifier operates as a class "A" stage and employs a type 6AK5 (V109) pentode tube. Bias is

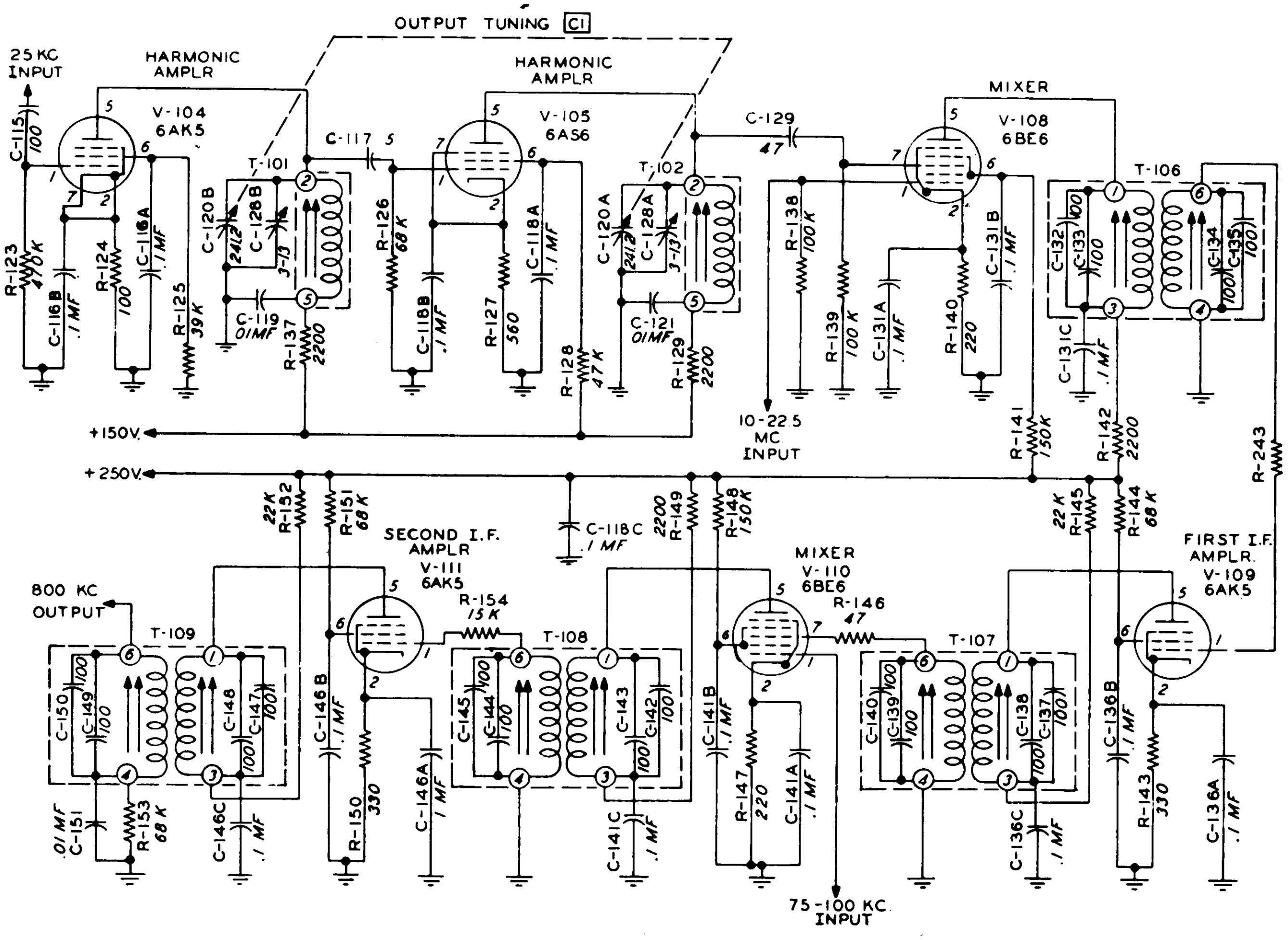


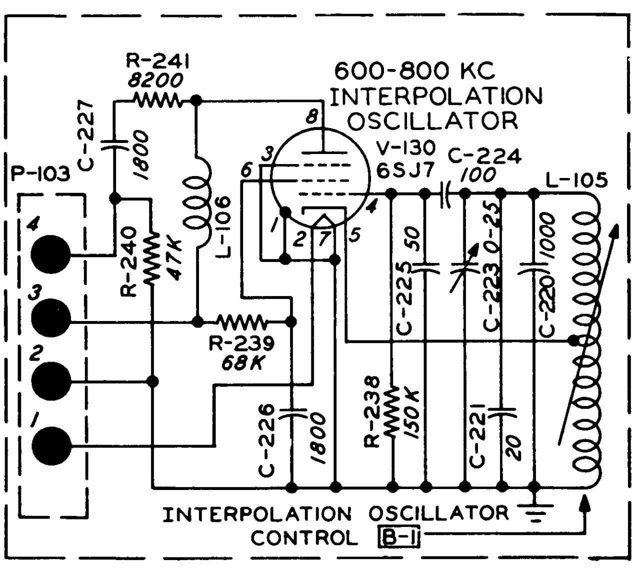
Figure 2–7. Schematic — RF Oscillator O-91A/FRT-5, IF Amplifier Strip

supplied by cathode resistor R143. The input voltage for V109 is supplied by i-f transformer T106. I-f transformer T107 is connected to the plate of V109 and the grid of V110. Transformer T107 is the same as T106, having two slug-tuned coils shunted by fixed capacitors and, like T106, is required to pass the frequency range of 875 kc to 900 kc. To do this it is necessary to overcouple the tuned circuit so as to flatten out the peak of the i-f curve enough to pass the required frequencies.

At this point we come to the mixer in the second i-f strip. One of the mixing voltages is that supplied by the first i-f strip, the other voltage is supplied by an interpolation circuit consisting of an interpolation oscillator, a buffer and three interpolation dividers.

(*j*) INTERPOLATION CIRCUITS.

1. INTERPOLATION OSCILLATOR. — (Refer to figure 2–8.) — The interpolation oscillator assembly is a precision device which supplies an output frequency that is extremely stable under conditions of extreme temperature and humidity change. The circuit used is an electron-coupled type employing a type 6SJ7 tube, V130, and covering a frequency range of 600 kc to 800 kc. The output frequency of the oscillator is determined by the tuned circuit made up of grid inductor L105 and the fixed capacity across the coil. The position of the tuning slug inside L105 is determined by the setting of the INTERPOLATION OSCILLATOR dial **B-1**. The plate circuit of interpolation oscillator V130 is untuned. The output of the interpolation oscillator is taken from the plate of the oscillator and fed to the grid of buffer V118 through coupling capacitor C227.



Figur 2–8. Schematic — RF Oscillator O-91A/FRT-5, Interpolation Oscillator

2. BUFFER. — The buffer operates as a class "A" amplifier employing a type 6AK5 (V118) pentode tube. Bias for this stage is supplied by cathode resistor R197. The plate and screen of V118 are tied together, as are also the suppressor grid and the cathode, to make it operate as a triode. The output voltage of V118 is capacity coupled to the grids of the first divider circuit V117 through capacitor C177. This buffer stage provides a means of isolation between the interpolation oscillator and the interpolation divider circuits.

3. INTERPOLATION DIVIDERS. — (Refer to figure 2–9.) — The interpolation dividers operate in the same way as the crystal dividers. Refer to the paragraph describing crystal dividers for the theory of operation (paragraph 2 *a* (2) (*f*), this section).

a. INTERPOLATION DIVIDER (300-400 kc). — The first interpolation divider, V117, has an input frequency of from 600 kc to 800 kc depending on where the INTERPOLATION OSCILLATOR dial is set. The output frequency of V117 is one-half of the input frequency, or 300 kc to 400 kc.

b. INTERPOLATION DIVIDER (150-200 kc). — The second interpolation divider, V118, has an input of from 300 kc to 400 kc. The output frequency of V118 is one-half the input frequency or 150 kc to 200 kc.

c. INTERPOLATION DIVIDER (75-100 kc). — The third interpolation divider, V119, has an input frequency of from 150 kc to 200 kc. The output frequency of V119 is one-half the input frequency or 75 kc to 100 kc. The output frequency of the interpolation divider (V119) is fed to the #1 grid of mixer V110, through coupling capacitor C163, and low-pass filter T110.

(*k*) SECOND IF (800 kc). — (Refer to figure 2–7.)

1. MIXER. — The mixer stage employs a type 6BE6 (V110) pentagrid converter. The output frequency of i-f amplifier V109 is fed to the #3 grid of V110 and the output of interpolation divider V115 is fed to the #1 grid of V110. These two injected signals are mixed and the plate circuit is tuned to the difference frequency. I-f transformer T108 couples the plate of V110 to the grid of V111 and is sharply tuned to pass only the band of frequencies centered on 800 kc. It consists of two slug-tuned coils and two fixed capacitors, one capacitor being connected across each coil.

2. AMPLIFIER. — The i-f amplifier operates as a class "A" stage and employs a type 6AK5 pentode tube (V111). The input voltage for V111 is supplied

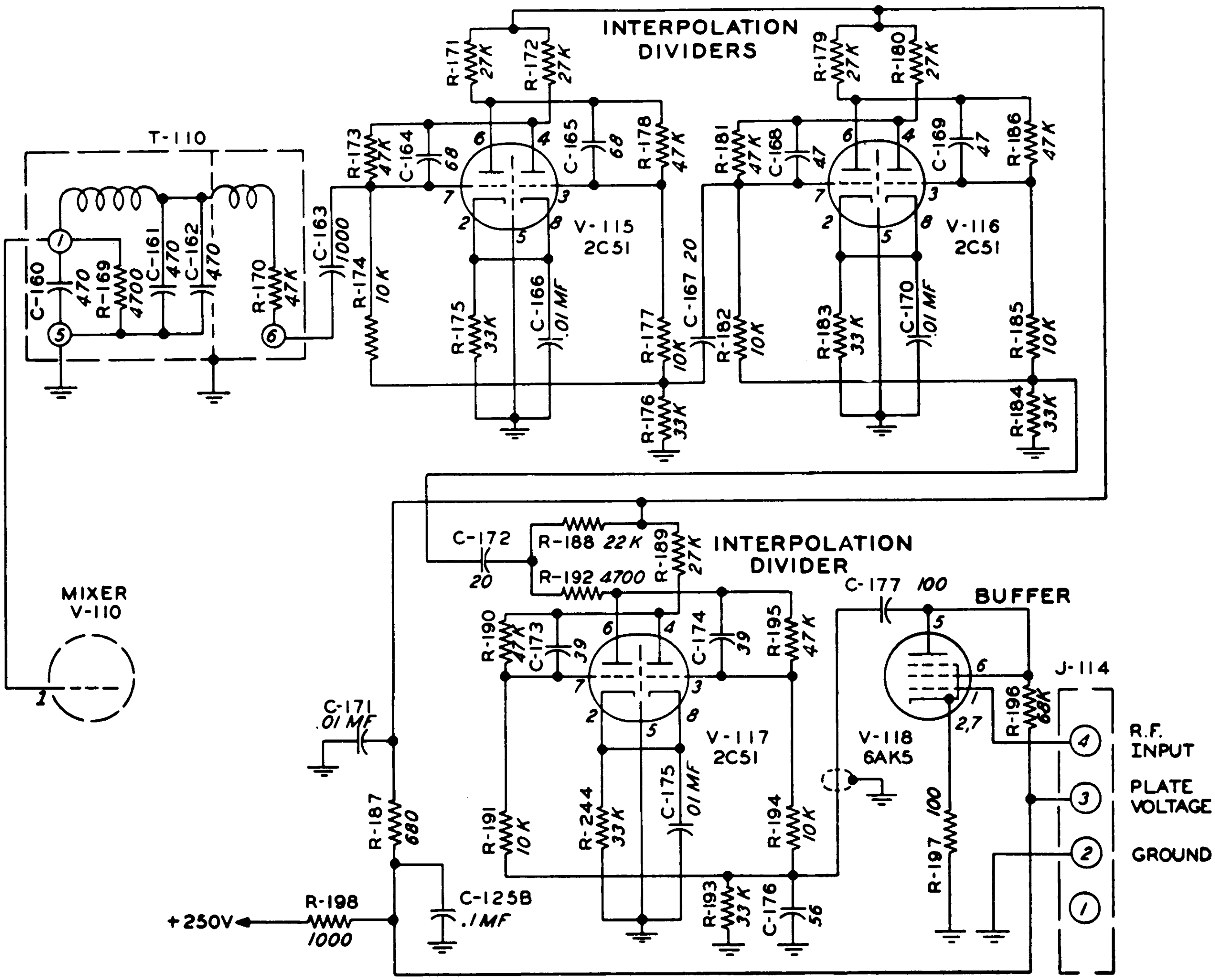


Figure 2—9. Schematic — RF Oscillator O-91A/FRT-5, Interpolation Oscillator Dividers

by i-f transformer T108. I-f transformer T109 connects the plate of V111 to the grid of V127 and is also sharply tuned to pass only the band of frequencies centered on 800 kc. This transformer consists of two slug-tuned coils and two fixed capacitors, one capacitor being connected across each coil.

(*l*) REGENERATIVE DIVIDERS. — (Refer to figure 2–10.) — The 800-kc output from T109 is fed to the #1 grid of V127. V127 is a mixer stage employing a type 6BE6 tube. A second voltage is applied to the #3 grid of V127 from the plate of V128. V128 employs a type 6BA6 tube in a regenerative oscillator circuit resonated to 700 kc. The tuned circuit in the plate of V128 consists of a slug-tuned coil with a fixed capacitor connected in parallel with it. The frequency is adjusted by varying the slug within the coil. In the mixer tube (V127) the 800-kc signal from the second i-f amplifier (V111) and the 700-kc signal from the regenerative oscillator (V128) are mixed to produce a difference frequency of 100 kc. The tuned circuit in the plate of the mixer (V127), which consists of a slug-tuned coil in parallel with a fixed capacitor, is resonated to this difference frequency. The inductance of the coil is varied by means of the slug. A second coil is inductively coupled to the tuned coil of V127 and its output is fed to the cathodes of the diode mixers V125 and V126. The tuned circuits of both V127 and V128 are contained in a common container with a shield between and designated as T111.

(*m*) 100-KC AMPLIFIER (V129). — The 100-kc amplifier (V129) employs a type 6AK5 tube which is operated as a class "A" amplifier, receiving its bias from cathode resistor R231. This stage acts as a buffer between the amplifier section of tube V101 and the plates of diode mixers V125 and V126. The 100-kc input voltage for the grid of V129 is obtained from the plate of V101A through coupling capacitor C210. The 100-kc output voltage is taken from the plate of V129 and fed to the plates of V125 and V126 through coupling capacitors C199 and C187.

(*n*) DIODE MIXER AND POWER AMPLIFIERS. — (Refer to figure 2–10.) — We must now compare the 100-kc voltage just mentioned with the crystal standard. This is done in the following manner: 100-kc voltage from the standard is taken from V101 and isolated by buffer amplifier V129. The output of V129 is coupled into the plate circuit of diode mixer V126 and one-half of T112. The regenerative divider output is coupled to the cathode circuit of V126 from the divider transformer, T111. All mixer products are attenuated by the low-pass filter network, R215, R216, C181 and C182, except the difference frequency which is audible. This filter terminates on the grids of d-c amplifier V124 which drives power amplifiers V121 and V122. One phase of the AFC motor (B101) is supplied from these two tubes. The second phase of the AFC motor is supplied from a circuit identical to the one just described but displaced 90 electrical degrees. The circuit for the second phase consists of diode mixer V125, d-c amplifier V123, and power amplifiers V119 and V120. The 90° phase shift is accomplished by a loosely coupled resonant circuit in the diode mixer circuit. This resonant circuit is the other half of T112 and is coupled to the plate circuit of diode mixer V125.

(*o*) 450-KC AMPLIFIER. — (Refer to figure 2–6.) — The 450-kc amplifier employs a type 6AK5

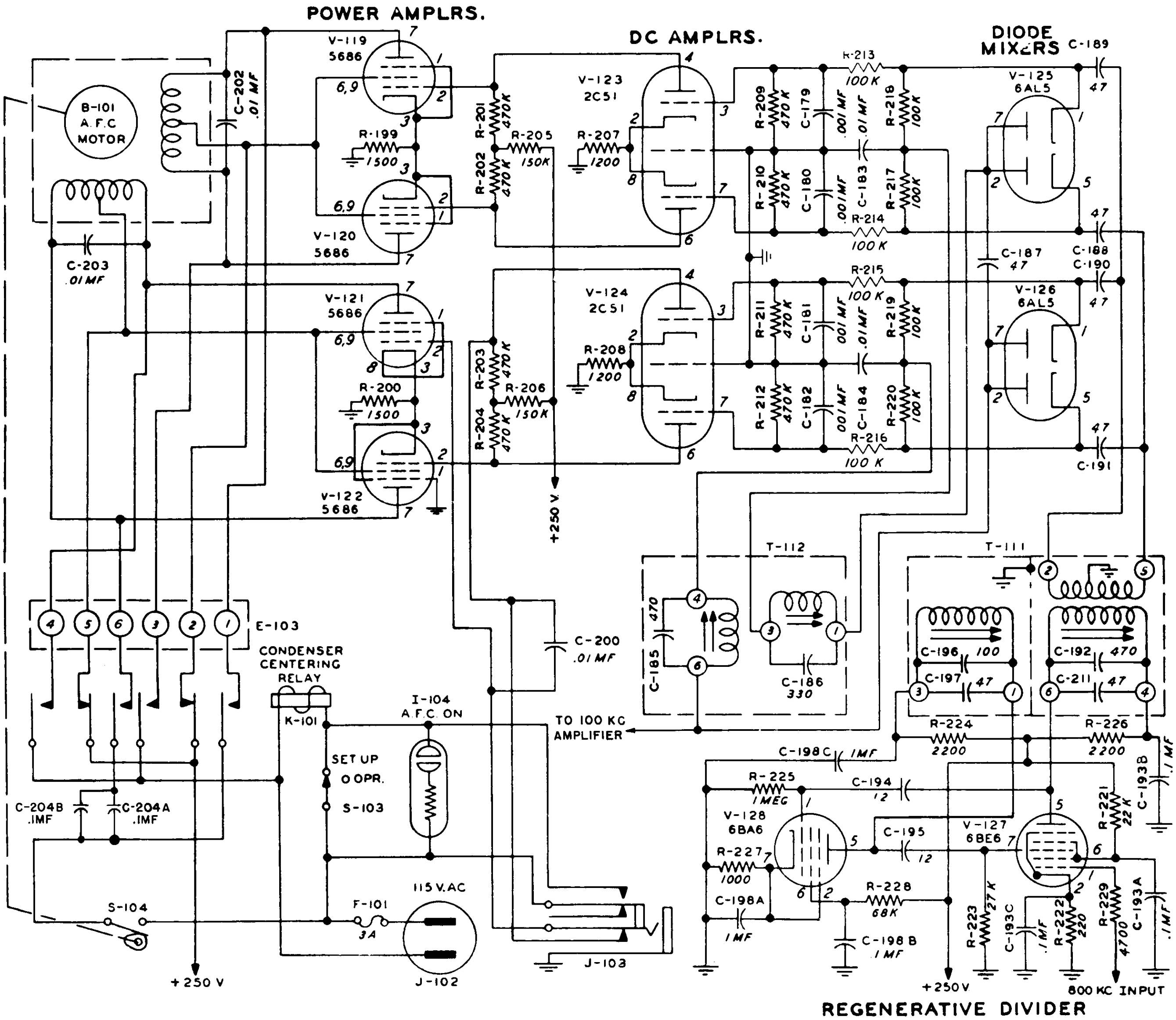


Figure 2—10. Sch matic — RF Oscillat r O-91A/FRT-5, Motor Control Circuit

tube (V106) which is operated as a class "A" amplifier and receives its bias from cathode resistor R132. A 50-kc voltage is supplied to the grid of V106 from the grid of the first crystal divider V102. The tuned circuit in the plate of V106 is resonated, by a variable slug, to the ninth harmonic of the 50-kc input voltage, thus creating a 450-kc output voltage. An output coil is inductively coupled to the plate coil of V106 with one end terminating at connector J104 and the other end going to ground. Both the plate coil and the output coil are placed in a common container and the assembly designated as T103.

(*p*) SET UP-OPERATE SWITCH (S103). — (Refer to figure 2–11.) — Turning the SET UP-OPERATE switch to the SET UP position energizes capacitor centering relay K101. The operation of this relay applies 115 volts ac to the automatic frequency control motor, B101, and opens the plate circuit of amplifiers V119, V120, V121 and V122. The applied 115-volt ac causes the motor to rotate until S104, a cam-actuated switch, opens the a-c line to the motor. This cam is an integral part of AFC capacitor C126, and serves to effect the centering of the AFC capacitor which is prerequisite to "setting up" the desired frequency. The AFC ON light I104 glows when the SET UP-OPERATE switch (S103) is switched to the OPERATE position indicating that the AFC is in operation.

Phone jack J103 is wired so that when the phone plug is in the jack, and the SET UP-OPERATE switch is in the OPERATE position, the AFC circuit will not operate. This is due to the fact that the phone jack circuit keeps relay K101 energized. As soon as the phone plug is removed from the jack, relay K101 be-

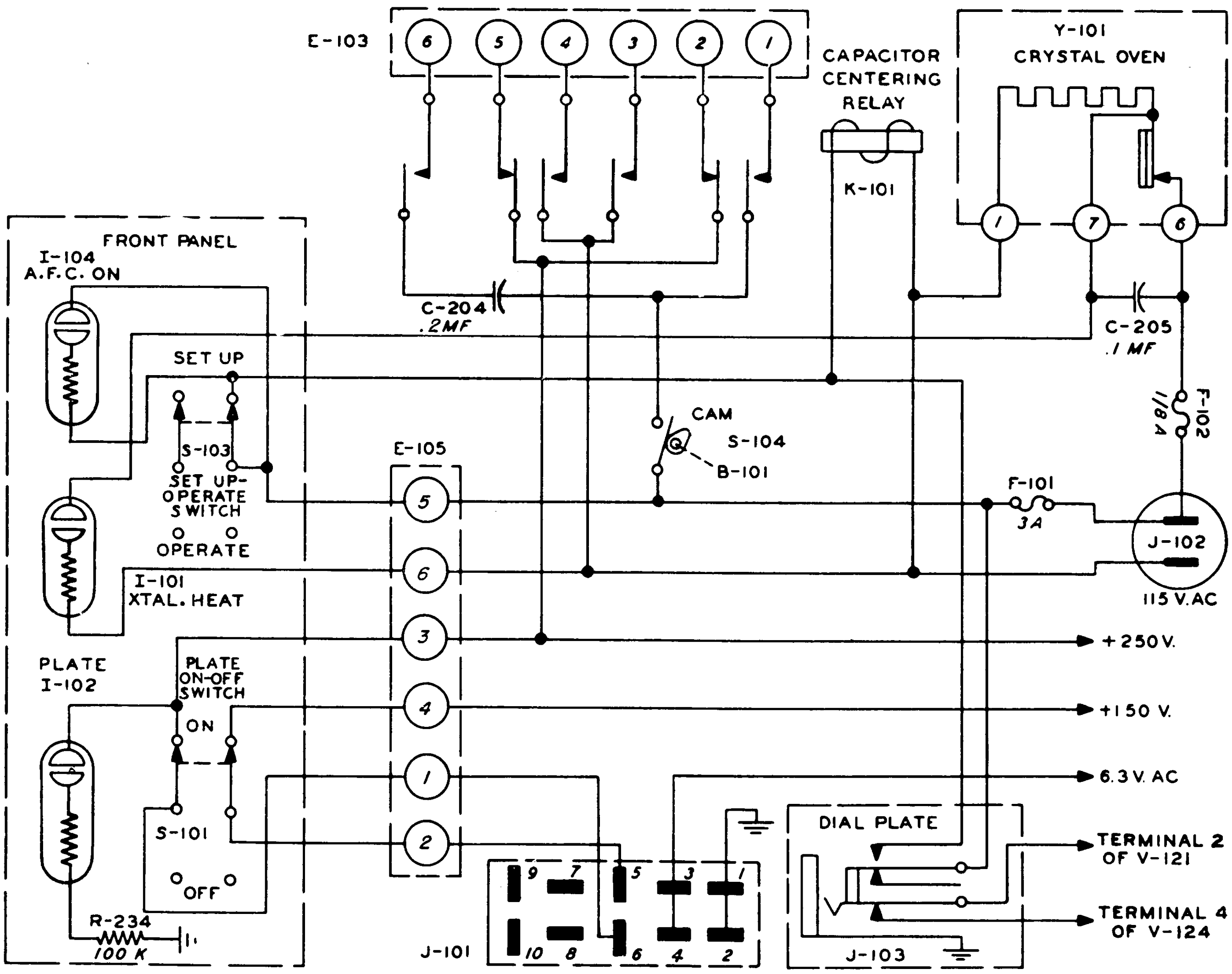


Figure 2–11. Simplified Sch matic — RF Oscillator O-91A/FRT-5, Contr l Circuit

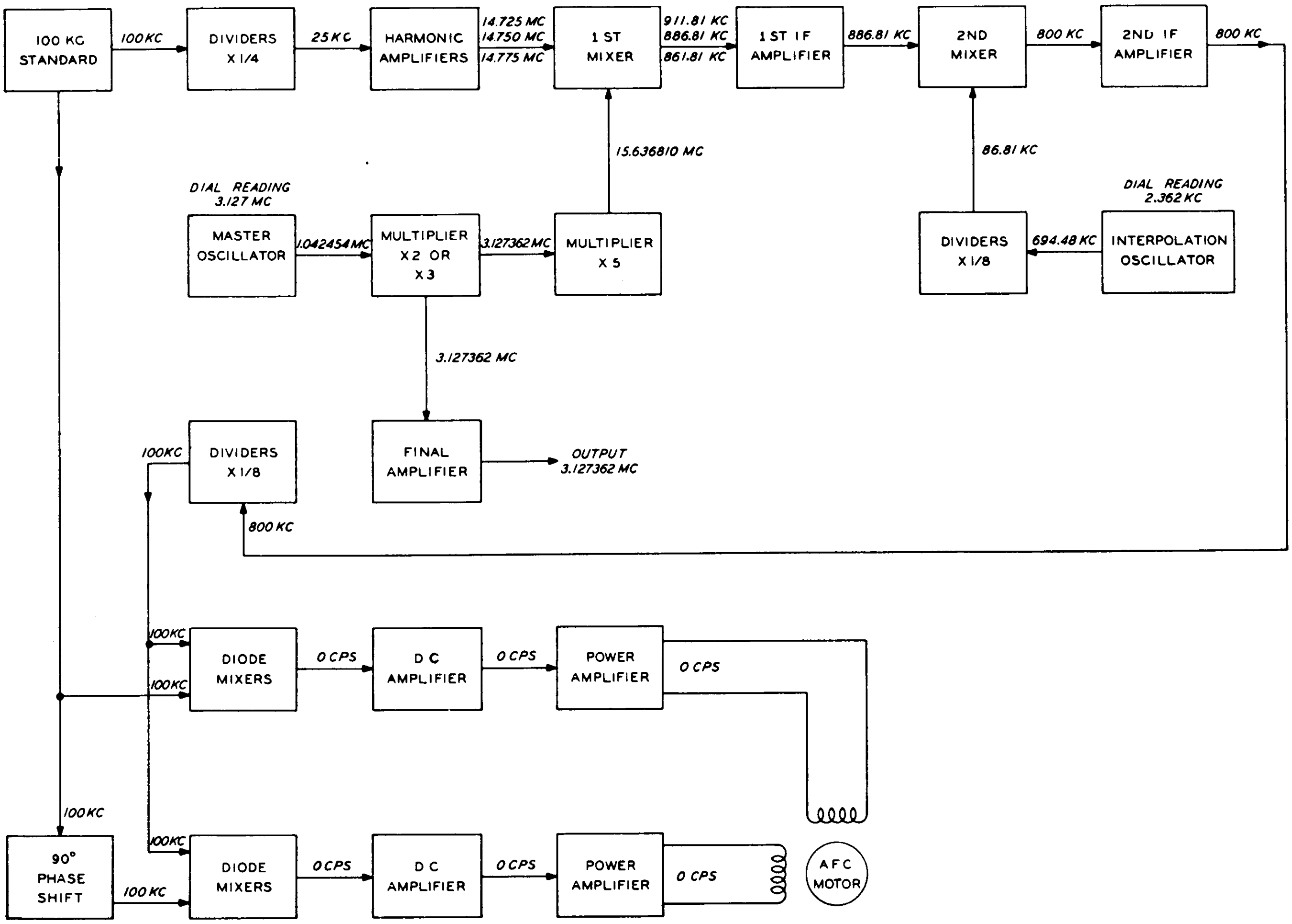


Figure 2–12. Block Diagram — RF Oscillator O-91A/FRT-5, Typical Frequencies During Operation, No Error in Master Oscillator Setting

comes de-energized and the AFC circuit then becomes operative.

(*q*) TYPICAL FREQUENCIES DURING OPERATION. — Figures 2–12 and 2–13 were included to tie together, in a more coherent fashion, the foregoing discussion of the individual circuits. Both charts were set up with the same output frequency, in this case, 3,127,362 cps, but figure 2–13 assumes that the master oscillator is set up with some error.

Figure 2–12 assumes that the master oscillator has no error in frequency, i.e., it was set up exactly on the desired frequency. The arrows indicating the frequencies involved should be quite clear; however, a short explanation may be required in the case of the harmonic amplifier and the 1st mixer. As seen in figure 2–12 only three frequencies are shown leaving the harmonic amplifiers, but in actuality a complete spectrum of frequencies, spaced 25 kc apart, is generated in this stage. For purposes of explanation, only the frequency used in this example and the one on either side of it are shown. In the same manner, three frequencies are shown leaving the 1st mixer; however, the two outer frequencies, 911.81 kc and 861.81 kc, have suffered some attenuation in the plate circuit of the mixer. The 1st i-f amplifier having a pass band of 875-900 kc further attenuates the two side frequencies so that only the one frequency, 886.81 kc, suffers no attenuation in the mixer.

Some difficulty may be encountered in the apparent difference in the INTERPOLATION OSCILLATOR dial reading and its actual frequency. The dial is calibrated from 0-5000 cps while the actual oscillator range is 600-800 kc. Thus with a reading of "0" on the dial, the oscillator is actually working at 600 kc, while with a reading of "5000" on the dial, the oscillator frequency is 800 kc. Since the ratio of the dial calibration in units (5000) to the frequency range of the oscillator in kilocycles (200) is 25:1, each unit of change in the position of the dial will represent 1/25th of a kilocycle change in the frequency of the oscillator. Therefore, for an intermediate setting of the dial, the corresponding frequency of the oscillator in kilocycles will be equal to the minimum frequency of the oscillator in kilocycles (600) plus 1/25th the reading on the dial (in units). In this example the dial reading is 2362, so the actual oscillator frequency in kilocycles would be 600 + (1/25 x 2362) or 694.48.

The remainder of the chart should be quite self-explanatory, with one exception. Take, for instance, a case where the output frequency is such that the 1st i-f amplifier would receive a frequency of 875 kc and also one of 900 kc. Since both of the frequencies lie in the pass band of the 1st i-f strip, both frequencies would be delivered to the second mixer with little or no attenuation. However, in any case of this sort, the output from the interpolation oscillator and interpolation dividers would be such that the output frequencies of the 2nd mixer would be 800 kc and 825 kc, and since the 2nd i-f amplifier will pass only a very narrow band of frequencies centered on 800 kc, the 825-kc signal would be attenuated in the 2nd i-f amplifier.

Figure 2–13 shows the frequencies which would result if the same output frequency (3,127,362 cps) were desired but with the master oscillator setting being in error by, e.g., 100 cps. It is evident that an output of a frequency other than zero will be obtained from the power amplifiers which will cause the AFC motor to rotate and correct the master oscillator frequency. As the master oscillator frequency error becomes smaller, the output from the power amplifiers also decreases in frequency until the master oscillator is set up on the exact desired frequency. Then the output frequency from the power amplifiers will again be zero cps and the AFC motor will cease to rotate.

(3) FREQUENCY SHIFT KEYER KY-45A/FRT-5.

(*a*) GENERAL. — The frequency-shift keyer is ordinarily used at the transmitting station of a frequency-shift radio-telegraph circuit. Telegraph signals are generated at a control point equipped with teleprinter keyboards and tape recorder. Both the transmitting and receiving radio stations may be remote from the communication centers and they are ordinari-

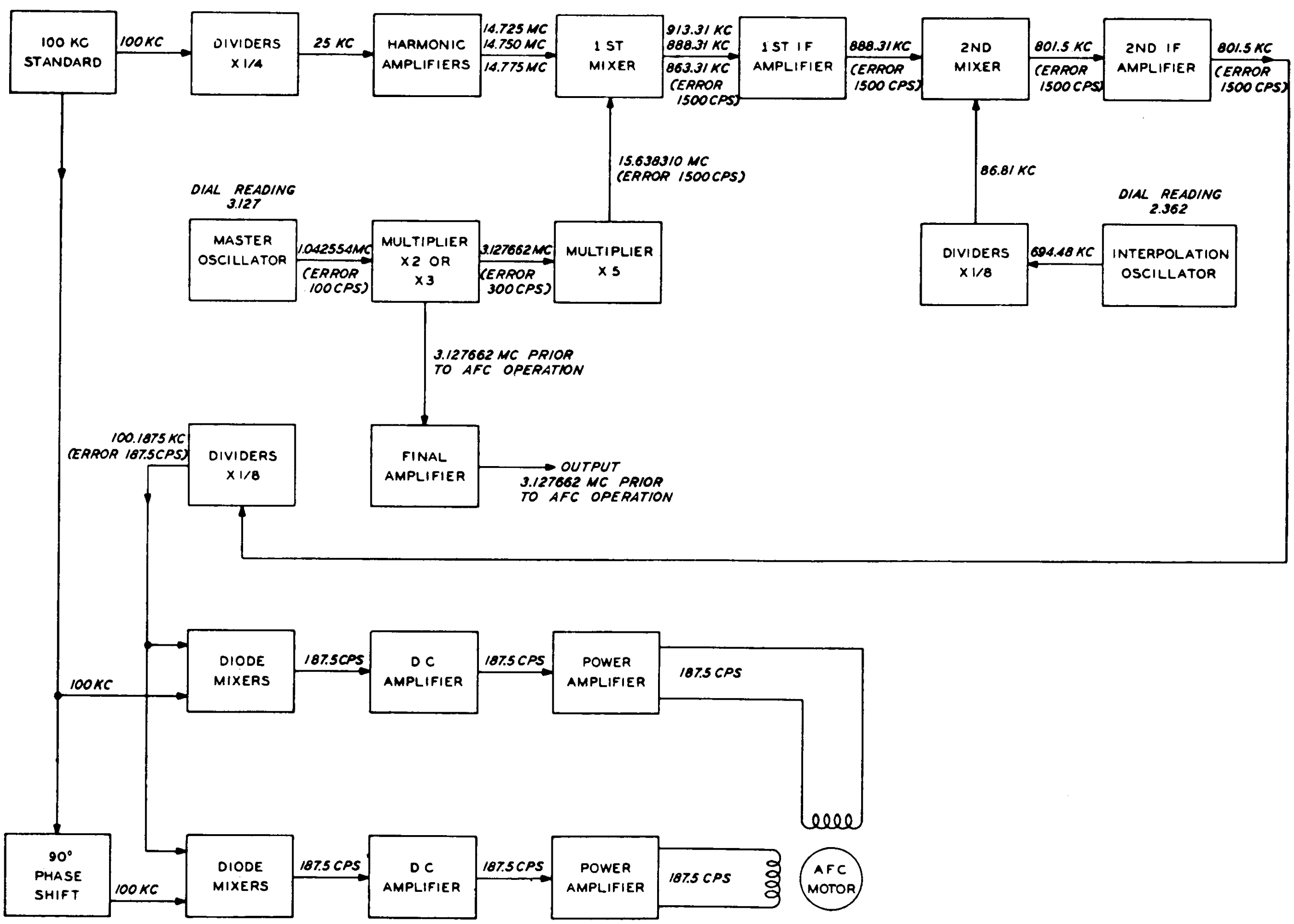


Figure 2—13. Block Diagram — RF Oscillator O-91A/FRT-5, Typical Frequencies During Operation, 100-cps Error in Master Oscillator Setting

TABLE 7–3. TUBE OPERATING VOLTAGES AND CURRENTS (KEY CLOSED) (C nt'd)

JAN TUBE TYPE	FUNCTION AND CIRCUIT SYMBOL	PLATE (VOLTS)	PLATE (MA)	SCREEN (VOLTS)	SCREEN (MA)	SUPPRESSOR (VOLTS)	CATHODE (VOLTS)	GRID (VOLTS)	HEATER (AC VOLTS)
Power Supply PP-454A/FRT-5									
5R4GY	Rectifier V1001	355AC(4) 355AC(6)							5
5R4GY	Rectifier V1002	355AC(4) 355AC(6)							5
6X4	Rectifier V1003	−465(1) −465(6)					363 AC		6.3
5R4GY	Rectifier V1004	363AC(4) 363AC(6)							5
OA2	Voltage regulator V1005	+160						0	
OA2	Voltage regulator V1006	+157						0	

checked systematically for continuity, defective resistors, shorted capacitors, loose connections, etc. An ohmmeter or a voltohmmeter should be available for making these tests.

When performing circuit continuity checks, or resistance measurements, take into account other components which may be in parallel with the part under test. For accurate results, disconnect one lead of the part being checked before proceeding with measurements. Manually close contacts which are normally open when the transmitter is not operating. This will prevent errors occurring in continuity checks.

3. ELECTRICAL ADJUSTMENTS AND ALIGNMENT.

a. RF OSCILLATOR O-91A/FRT-5.

(1) TEST EQUIPMENT REQUIRED.

(*a*) Ohmmeter — Simpson #260, or equal.

(*b*) A 115-volt and a 230-volt 60-cps a-c power source.

(*c*) Power Supply PP-454A/FRT-5.

(*d*) Voltage regulator — T313 (Sola #6090) or "Transtat".

(*e*) R-f signal generator — Boonton Model 65-D, or equivalent.

(*f*) Two vacuum-tube voltmeters — Simpson model #303 with r-f probe, or equivalent. Note: Use the probe for all r-f measurements.

(*g*) Oscilloscope.

(*h*) Headphones.

(*i*) Frequency meter — Bendix type IF-12, or equal.

(*j*) Secondary frequency standard.

(*k*) Audio signal generator.

(*l*) Two 50-ohm 5-watt carbon resistors.

(*m*) One 220-mmf mica capacitor.

(*n*) One 1000-mmf mica capacitor.

(*o*) One 10,000-ohm 2-watt resistor.

(*p*) One 10,000-mmf 600-volt capacitor.

(*q*) Five feet AN type RG-58/U coaxial cable.

(2) GENERAL SET-UP.

(*a*) Connect 10,000-ohm resistor to J105.

(*b*) Connect 50-ohm resistor to J104.

(*c*) Connect 50-ohm resistor to J108, at the end of five-foot length of RG-58/U coaxial cable.

(*d*) Install all tubes and crystal oven (Y101).

(3) POWER INPUT CHECK.

(*a*) Throw the PLATE ON-OFF switch (S101) to ON position; leave power plug P101 disconnected.

1. Measure resistance from pin #5 of J101 to ground; reading should be infinity.

2. Measure resistance from pin #6 of J101 to ground; reading should be 10,000 ohms, ±5 percent.

3. Turn PLATE ON-OFF switch OFF.

(*b*) Connect the 115-volt a-c line to J102.

1. The CRYSTAL OVEN — HEAT ON indicator (I101) should light indicating that the thermostat in the 100-kc crystal oven has closed.

(*c*) Set switch S103 in SET-UP position.

1. The AFC ON indicator (I404) should be dark.

2. Relay K101 should operate.

3. The AFC motor (B101) should rotate capacitor C126.

4. When C126 is centered, cam on shaft should open switch S104 and stop B101.

(*d*) Set switch S103 in OPERATE position.

1. The AFC ON indicator (I404) should light.

(*e*) Insert plug P104 in receptacle J101.

1. All filaments should light.

(*f*) Turn PLATE ON-OFF switch ON.

1. PLATE ON indicator I102 should light.

2. Potential from pin #5 of J101 to ground should be approximately +150 volts.

3. Potential from pin #6 of J101 to ground should be approximately +250 volts.

4. Turn PLATE ON-OFF switch OFF.

(4) 800-KC I-F ALIGNMENT (2nd IF).

(*a*) SET-UP.

1. Remove tubes V108, V109 and V128 from sockets.

2. Connect the r-f signal generator to pin #1 of V111.

3. Adjust the r-f signal generator frequency for exactly 800 kc.

4. Connect the VTVM to terminal #4 of T109 and set for "–15 v d-c" range.

(*b*) PROCEDURE.

1. Connect the 220-mmf capacitor across sec ondary (terminals #4 and #6) of T109.

2. Turn PLATE ON-OFF switch ON.

3. Tune primary of T109 for maximum reading on VTVM, by adjusting top slug. Reduce signal input level enough to keep output below –15 v dc.

4. Turn PLATE ON-OFF switch OFF.

5. Transfer 220-mmf capacitor to secondary (terminals #1 and #3) of T109.

6. Turn PLATE ON-OFF switch ON.

7. Tune secondary of T109 for a peak reading on VTVM by adjusting bottom slug.

8. Turn PLATE ON-OFF switch OFF. Transfer 220-mmf capacitor to secondary (terms #4 and #6) of T108.

9. Connect the r-f signal generator to pin #7 of V110.

10. Turn PLATE ON-OFF switch ON.

11. Tune primary of T108 for a peak reading on VTVM by adjusting top slug.

12. Turn PLATE ON-OFF switch OFF. Transfer the 220-mmf capacitor to the secondary (terms #1 and #3) of T108.

13. Turn PLATE ON-OFF switch ON.

14. Tune secondary of T108 for a peak reading on the VTVM by adjusting bottom slug.

15. Turn PLATE ON-OFF switch OFF.

16. Remove the 220-mmf capacitor.

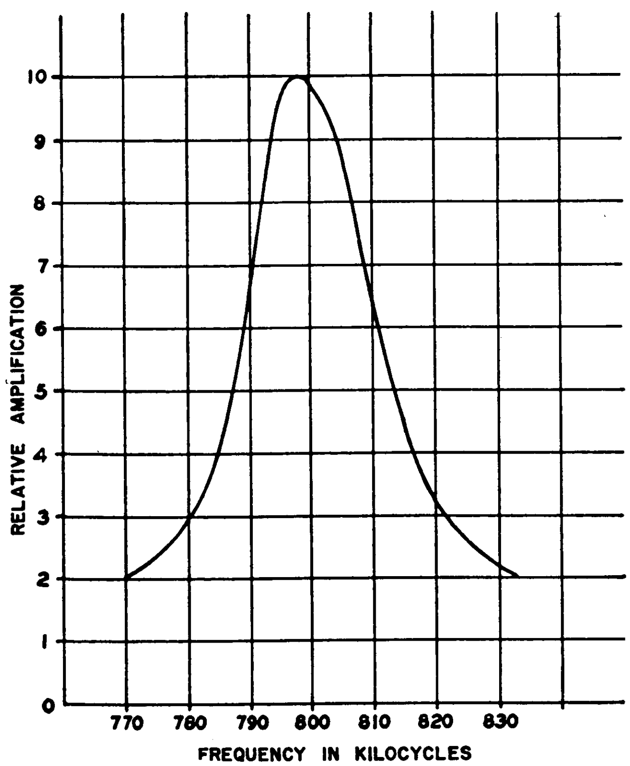


Figure 7—1. Selectivity Curve — RF Oscillat r O-91A/FRT-5, 2nd IF Stag

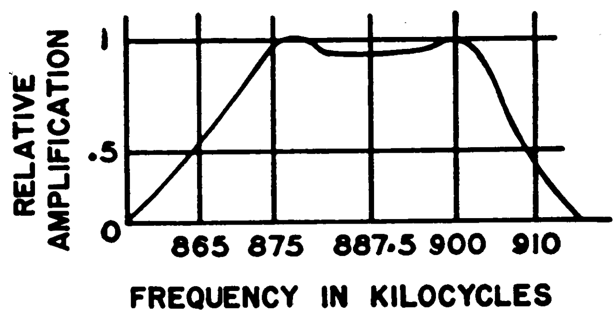


Figure 7—2. Selectivity Curve — RF Oscillator O-91A/FRT-5, 1st IF Stage

17. Turn PLATE ON-OFF switch ON.

18. Adjust the r-f signal generator output for a VTVM reading of –10 volts.

19. Reduce the r-f signal generator frequency until VTVM reading is –5 volts, but NOT BELOW 781 kc.

20. Increase the r-f signal generator frequency until VTVM reading is –5 volts, but NOT ABOVE 825 kc.

21. Turn PLATE ON-OFF switch OFF.

(5) 900-KC I-F ALIGNMENT (1st IF).

(*a*) SET-UP.

1. Insert tubes V108, V109 and V128 in sockets.

2. Remove tubes V113, V105 and V115.

3. Connect the r-f signal generator to pin #1 of V109.

4. Connect the VTVM to pin #5 of V110, or to terminal #1 of T108.

5. Connect the 1000-mmf capacitor across secondary (terms #4 and #6) of T107.

(*b*) PROCEDURE.

1. Adjust the r-f signal generator frequency for exactly 887.5 kc. Check this frequency.

2. Turn PLATE ON-OFF switch ON.

3. Tune primary of T107 for a peak reading on VTVM by adjusting top slug.

4. Turn PLATE ON-OFF switch OFF.

5. Transfer the 1000-mmf capacitor to the primary (terms #1 and #3) of T107.

6. Turn PLATE ON-OFF switch ON.

7. Tune secondary of T107 for a peak reading on VTVM by adjusting bottom slug.

8. Turn PLATE ON-OFF switch OFF.

9. Transfer the 1000-mmf capacitor to the secondary (terms #4 and #6) of T106.

10. Connect the r-f signal generator to pin #7 of V108, and the VTVM to pin #7 of V110, or to terminal #6 of T107.

11. Turn PLATE ON-OFF switch ON.

12. Tune primary of T106 for a peak reading on VTVM by adjusting top slug.

13. Turn PLATE ON-OFF switch OFF.

14. Transfer the 1000-mmf capacitor to primary (terms #1 and #3) of T106.

15. Turn PLATE ON-OFF switch ON.

16. Tune secondary of T106 for a peak reading on VTVM by adjusting bottom slug.

17. Turn PLATE ON-OFF switch OFF.

18. Remove the 1000-mmf capacitor.

19. Connect the VTVM to pin #5 of V110, or to terminal #1 of T108.

20. Turn PLATE ON-OFF switch ON.

21. Adjust the r-f signal generator output level for a VTVM reading of exactly two volts.

22. Reduce the signal generator frequency until the VTVM reads one volt, but NOT BELOW 840 kc.

23. Increase the signal generator frequency until the VTVM reads one volt, but NOT ABOVE 915 kc.

24. The frequency response in steps #22 and #23 should be relatively flat between 875 kc and 900 kc and should drop off sharply above and below this range.

25. Turn PLATE ON-OFF switch OFF.

(6) REGENERATIVE DIVIDER ALIGNMENT.

(*a*) SET-UP.

1. Remove tube V110 from its socket and insert tubes V105, V113 and V115 in place.

2. Connect the r-f signal generator to pin #1 of V127.

3. Adjust the r-f signal generator for a frequency of 100 kc and an output level of one volt, unmodulated.

4. Connect the VTVM of pin #1 of V128.

(*b*) PROCEDURE.

1. Turn PLATE ON-OFF switch ON.

2. Adjust top slug of T111 for a peak reading on VTVM.

3. Turn PLATE ON-OFF switch OFF.

4. Connect the r-f signal generator to pin #1 of V128.

5. Adjust the r-f signal generator for a frequency of 700 kc and an output level of 0.1 volt, unmodulated.

6. Connect the VTVM to pin #7 of V127.

7. Turn PLATE ON-OFF switch ON.

8. Adjust bottom slug of T111 for a peak reading on VTVM.

9. Turn PLATE ON-OFF switch OFF.

10. Connect signal generator to pin #1 of V111.

11. Adjust the r-f signal generator frequency for exactly 800 kc.

12. Connect the VTVM to terminal #4 of T109, and adjust for "–15 v d-c" range.

13. Connect headphones to jack J103, and set the EXT-INT switch (S105) in the INT position.

14. Turn PLATE ON-OFF switch ON.

15. The VTVM reading should be at least –15 v dc.

16. Vary the signal generator frequency over the range from 750 kc to 850 kc and note the frequencies at which the divider tone first becomes audible, as the frequency is varied toward 800 kc.

17. The divider should function between 780 kc and 820 kc.

18. If the divider does not function at 820 kc, set the signal generator for 820 kc and adjust the top slug of T111 until a smooth note is audible.

19. If the divider does not function at 780 kc, set the signal generator for 780 kc and adjust the bottom slug of T111 until a smooth note is audible.

20. Repeat steps #19 and #20, alternately, until alignment is obtained. One or two repetitions should suffice.

21. Turn PLATE ON-OFF switch OFF.

(7) 100-KC PHASE SPLITTER ADJUSTMENT.

(*a*) SET-UP.

1. Connect terminal #2 of V122 to the VERTICAL INPUT terminal of the oscilloscope, and terminal #2 of V119 to the HORIZONTAL INPUT terminal.

2. Connect the r-f signal generator to pin #1 of V111, or to terminal #6 of T108.

3. Adjust the r-f signal generator for a frequency of 800 kc and an output level of +0.10 volt, unmodulated.

4. Connect the VTVM to pin #2 of V122. (Use the a-c probe.)

(*b*) PROCEDURE.

1. Turn PLATE ON-OFF switch ON.

2. Shift the signal generator frequency slightly away from 800 kc until a 400-cps (approximately) tone is heard in the headphones. Disconnect headphones.

3. The VTVM reading should be between 15 volts and 20 volts.

4. The oscilloscope should indicate a 90° phase relationship between the two audio phases; the patterns should be similar to those shown below. Check the balance of the oscilloscope amplifiers to make certain that the vertical and horizontal traces are equal.

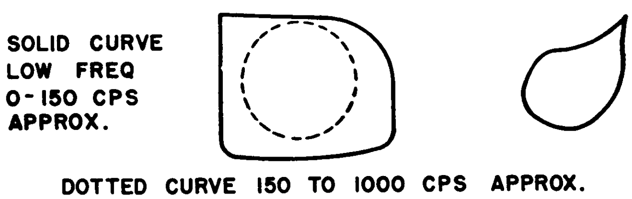


Figure 7—3. Oscillograms — RF Oscillator O-91A/FRT-5, 100-Kc Phase Splitter Circuit Phase Relations

5. If the patterns obtained are not similar to those shown, adjust the top and bottom slugs of T112.

6. Turn PLATE ON-OFF switch OFF.

(8) MOTOR CONTROL CIRCUITS CHECK.

(*a*) SET-UP.

1. Remove cover plate from capacitor C126 to permit observation of its rotation.

2. Connect pin #2 of V122 to the VERTICAL input terminal of oscilloscope.

3. Connect audio signal generator to HORIZONTAL input terminal of the oscilloscope.

4. Connect r-f signal generator to pin #1 of V111.

(*b*) PROCEDURE.

1. Turn PLATE ON-OFF switch ON.

2. Adjust the r-f signal generator for 800 kc. Capacitor C126 (driven by motor B101) should not rotate. If it does, a slight adjustment of the r-f signal generator frequency should stop it.

3. Slowly reduce the r-f signal generator frequency; the audio signal on the oscilloscope should increase in frequency. Check the highest and the lowest frequencies at which the motor (B101) will operate. Limits: 750 cps and one cps.

4. Repeat step #3, this time increasing the r-f signal generator frequency.

5. Turn PLATE ON-OFF switch OFF.

6. Replace tube V110.

(9) MASTER OSCILLATOR END POINTS CALIBRATION.

(*a*) SET-UP.

1. Loosen the set screw in the shaft coupling between the dial drive assembly and the master oscillator assembly (Z102).

2. Couple the frequency meter to pin #1 of V112.

(*b*) PROCEDURE.

1. Turn PLATE ON-OFF switch ON.

2. Adjust the master oscillator (Z102) for exactly 1.25 megacycles, by turning end of shaft with fingers.

3. Set the MASTER OSCILLATOR dial [A-1] to exactly 2.5 megacycles (on red scale).

4. Tighten the set screw in the shaft coupling, being careful not to disturb either the dial setting or the adjustment of Z102.

5. Check the end points of the dial calibration. At the 3.0-megacycle setting (red scale) the oscillator output should be 1.5 megacycles, and at the 2.0-megacycle setting (red scale) it should be 1.0 megacycle.

6. Turn PLATE ON-OFF switch OFF.

(10). MULTIPLIER ALIGNMENT (TRACKING).

(*a*) SET-UP.

1. Remove tube V105.

2. Set switch S105 in EXT position.

3. Set the MASTER OSCILLATOR dial [A-1] for 2.2 mc (red scale).

4. Connect one VTVM across the 50-ohm load resistor which was installed across J108 in step 3 *a* (2) (*c*), and the second to pin #1 of V108.

5. Set the OUTPUT TUNING dial [C-1] at 2.2 megacycles.

(*b*) PROCEDURE.

1. Turn PLATE ON-OFF switch ON.

2. Adjust slug in T104 for a maximum reading on first VTVM.

3. Adjust slug in T105 for a maximum reading on second VTVM.

4. Re-adjust T104 for a maximum reading.

5. Set the MASTER OSCILLATOR dial [A-1] for 4.2 megacycles (white scale).

6. Adjust the OUTPUT TUNING dial [C-1] for 4.2 megacycles.

7. Adjust trimmer capacitors C128C and C128D for maximum readings on the second and first VTVM, respectively.

8. Return the MASTER OSCILLATOR and OUTPUT TUNING dials to 2.2 megacycles.

9. Repeat steps #4 through #8.

10. Check tracking at each 100-kc interval from 2.0 to 4.5 megacycles. Track by means of the split end plates of variable capacitor sections C120C and C120D, if necessary.

11. Turn PLATE ON-OFF switch OFF.

12. Replace tube V105.

(11) INTERPOLATION OSCILLATOR END POINT CALIBRATION.

(*a*) SET-UP.

1. Loosen the set screw in the shaft coupling between the dial drive assembly and the interpolation oscillator assembly (Z101).

2. Couple the frequency meter to pin #1 of V118.

(*b*) PROCEDURE.

1. Turn PLATE ON-OFF switch ON.

2. Adjust the interpolation oscillator (Z101) for exactly 700 kc by turning the end of the shaft with the fingers.

3. Set the INTERPOLATION OSCILLATOR dial [B-1] to exactly 2.5 kc.

4. Tighten the set screw in the shaft coupling, being careful not to disturb either the dial setting or the adjustment of Z101.

5. Check the end points of the dial calibration. At "0" on the dial the interpolation oscillator output should be 600 kc, and at 5 kc on the dial it should be 800 kc.

6. Turn PLATE ON-OFF switch OFF.

(12) SPECTRUM GENERATOR ALIGNMENT (TRACKING).

(*a*) SET-UP.

1. Remove tube V103.

2. Connect the r-f signal generator to pin #7 of tube socket XV103 through a 10,000-mmf capacitor.

3. Adjust r-f signal generator for exactly 10.125 megacycles.

4. Connect the VTVM to terminal #4 of T109.

5. Set the INTERPOLATION OSCILLATOR [B-1] at the "0" position.

6. Set the OUTPUT TUNING dial [C-1] and the MASTER OSCILLATOR dial [A-1] at 2.2 megacycles.

(*b*) PROCEDURE.

1. Turn the PLATE ON-OFF switch ON.

2. Adjust the slug in T101 for maximum (approximate) reading on the VTVM (output from term #4 of T109).

3. Adjust the slug in T102 for maximum output.

4. Always reduce the r-f signal generator output enough so that the input to the VTVM is less than 15 volts.

5. Repeat steps #2 and #3.

6. Adjust the r-f signal generator output for exactly 19.125 megacycles.

7. Set the OUTPUT TUNING dial [C-1] and the MASTER OSCILLATOR dial [A-1] at 4.0 megacycles.

8. Adjust trimmer capacitors C128B and C128A for maximum signal.

9. Change the signal generator frequency to 10.125 megacycles and repeat steps 3 *a* (12) (*a*) *4* through 3 *a* (12) (*b*) *8*.

10. Check tracking at each 100-kc interval from 2.0 to 4.5 megacycles. Track by means of the split plates on variable capacitor sections C120A and C120B, if necessary.

11. Turn PLATE ON-OFF switch OFF.

12. Replace tube V103.

(13) 100-KC CRYSTAL STANDARD ADJUSTMENT.

(*a*) SET-UP.

1. Allow at least one-half hour for crystal to warm up.

2. Set the EXT-INT switch S105 in the INT position.

(*b*) PROCEDURE.

1. Turn PLATE ON-OFF switch ON.

2. Adjust capacitor C103 to bring the crystal frequency to exactly 100 kc.

3. Check the frequency at J104; it should be 450 kc. Adjust T103 for maximum output at J104.

4. Set the EXT-INT switch S105 in the EXT position; this should reduce the voltage at J104 to zero.

5. Connect the r-f signal generator to J106, and adjust for 100-kc output.

6. Check for a 100-kc signal at J104.

7. Turn PLATE ON-OFF switch OFF.

(14) POWER OUTPUT CHECK AND CALIBRATION ADJUSTMENT.

(*a*) SET-UP.

1. Set the EXT-INT switch S105 in the INT position.

2. Turn AFC control on; AFC ON indicator I404 should light.

3. Rotate POWER OUTPUT control R185 to its maximum clockwise position.

4. Connect one VTVM across the 50-ohm load resistor installed across J108 in step 3 *a* (2) (*c*), above.

5. Connect the second VTVM to terminal #4 of T109.

6. Make sure all tubes are in their respective sockets.

(*b*) PROCEDURE.

1. Turn PLATE ON-OFF switch ON.

2. Measure the output voltage and frequency for each of the following combinations of settings of MASTER OSCILLATOR dial [A-1] and OUTPUT TUNING dial [C-1]. Limits: minimum voltage, 2 volts; maximum frequency error, 30 cps.

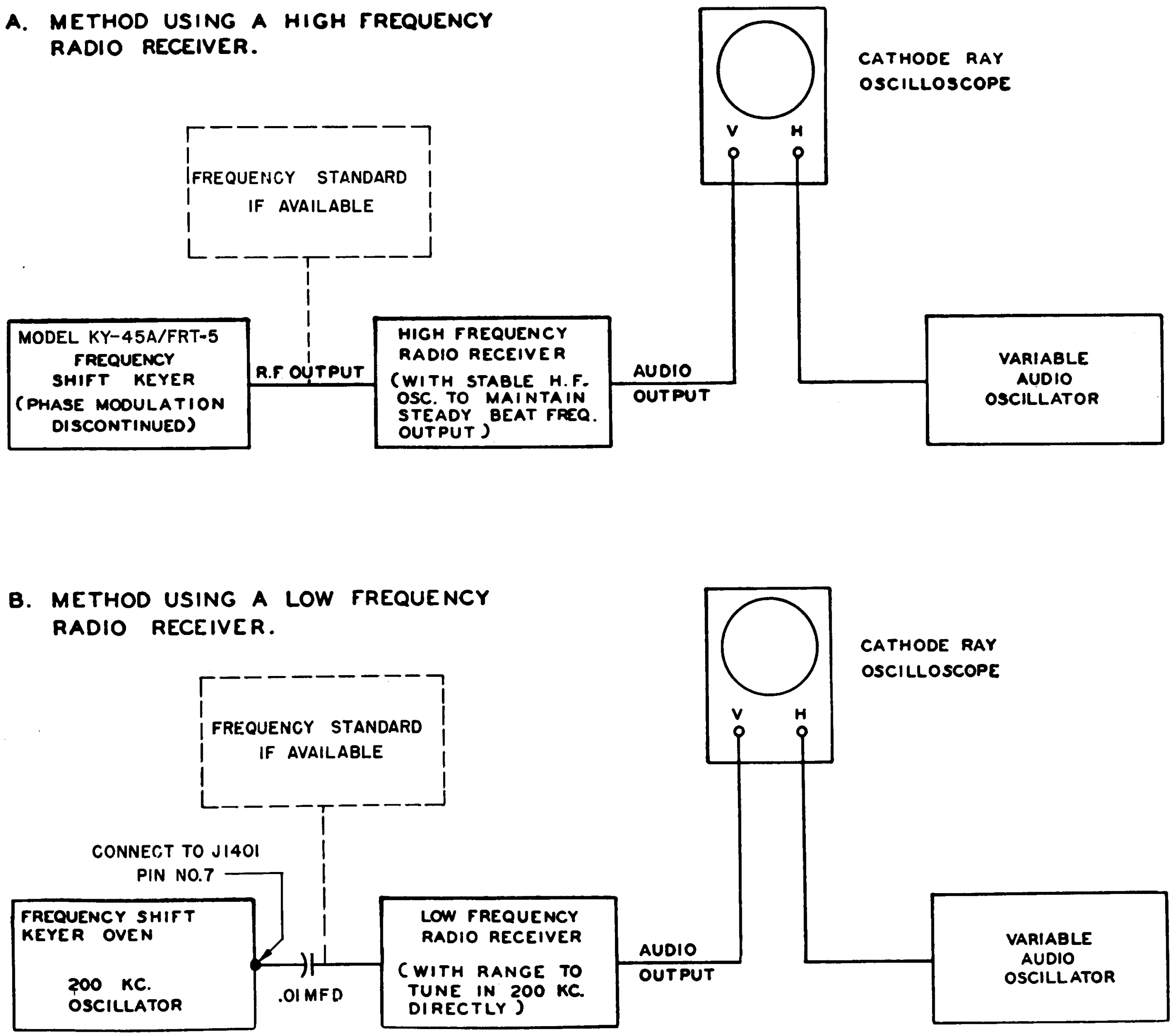


Figure 7—4. Test Set-Up Diagram — Frequency Shift Keyer KY-45A/FRT-5, M thod of Conn cting Oscilloscop t Display Patt rns f Different Frequ ncy Shifts

MASTER OSCILLATOR dial [A-1]	OUTPUT TUNING dial [C-1]
2.0	2.0
2.5	2.5
3.0 (doubling)	3.0
3.0 (tripling)	3.0
3.5	3.5
4.0	4.0
4.5	4.5

3. Minimum voltage over the band should be 4.0 v dc, as read on VTVM (output from term. #4 on T109).

4. Turn PLATE ON-OFF switch OFF.

b. ALIGNMENT OF FREQUENCY SHIFT KEYER KY-45A/FRT-5.

(1) TEST EQUIPMENT NEEDED FOR ALIGNMENT.

(*a*) Signal generator, General Radio type 805C.
(*b*) Secondary frequency standard.
(*c*) Oscilloscope.
(*d*) Square wave generator.
(*e*) Audio oscillator.
(*f*) Dummy load, 50 ohms.
(*g*) VTVM, Ballantine type 300A.
(*h*) Keying relay, Western Electric type 215A.
(*i*) Discriminator (refer to figure 7–7).

(2) EQUIPMENT SET-UP.

(*a*) Interconnect Frequency Shift Keyer KY-45A/FRT-5 and Power Supply PP-454A/FRT-5 with the power cable.

(*b*) Connect the line cord to a 115-volt 60-cps power source.

(3) RF ALIGNMENT.

(*a*) EQUIPMENT SET-UP.

1. Connect the power cable between J1002 on Power Supply PP-454A/FRT-5 and J1404 on Frequency Shift Keyer KY-45A/FRT-5.

2. Connect the 115-volt a-c line at J1406. Allow oven temperature to stabilize for 60 minutes.

3. Remove the 200-kc oscillator tube, V1411.

4. Set RF TUNING dial at 4.0 mc.

5. The METER SWITCH (S1402) should be in PA GRID position.

6. Connect the signal generator, tuned to 4.0 mc with an output of approximately two volts, to EXT. OSC. INPUT, J1401. THE EXT. OSC. ATTENUATOR should be at zero db.

7. Adjust all variable ceramic capacitors so that their plates are approximately five degrees engaged and all tuning cores half way in.

8. Place MODULATOR BALANCE control R1416 in either maximum or minimum position.

(*b*) ALIGNMENT PROCEDURE.

1. Place POWER switch in ON position.

2. Adjust capacitors C1406, C1408 and C1413 so that maximum grid current is indicated on M1401.

3. Change signal generator frequency and RF TUNING to 2.2 mc and adjust cores of inductors L1402, L1406 and L1407 for a maximum grid current indication.

4. Repeat steps #2 and #3, alternating between 4.0 and 2.2 mc until no further increase is noted.

5. Place METER SWITCH in PA PLATE position. Turn OUTPUT CONTROL R1430 to maximum.

6. Tune signal generator to 4.0 mc and adjust C1419 for a minimum plate current indication.

7. Return signal generator to 2.2 mc and adjust core in L1411 for minimum plate current. Repeat steps #6 and #7 until no retuning is required to bring plate current to minimum. Connect 50-ohm load at J1402.

8. Replace the 200-kc oscillator tube, V1411.

(4) MODULATOR BALANCE ADJUSTMENT.

(*a*) Connect the signal generator, tuned to 3.0 mc, to the EXT. OSC. INPUT jack (J1401). The EXT. OSC. ATTENUATOR should be set at zero db.

(*b*) Turn RF TUNING dial to approximately 2.8 mc. Grid current and output should be indicated.

(*c*) Turn RF TUNING dial to approximately 3.0 mc. Grid current and output should be indicated. Adjust MODULATOR BALANCE control R1416 to obtain minimum plate current.

(*d*) Turn RF TUNING dial back to 2.8 mc and check output and grid current. Output should be five watts with 2.0 volts input to J1401, and with EXT. OSC. ATTENUATOR at zero db.

(5) TEST OPERATE FUNCTION SWITCH SET-UP.

(*a*) Adjust BASIC SHIFT control to "0", TEST OPERATE SWITCH to carrier position, TRANSMITTER MULTIPLICATION FACTOR switch to "1" and PHASE MODULATION DEGREES control to "0" (off).

(*b*) Using the three-beat method, adjust the 200-kc oscillator until an exact zero beat is obtained. Use signals taken from the keyer, the frequency standard and the BFO.

Measure the 200-kc frequency by coupling the output from the terminal #7 of tube V1401 through a 0.01-mf capacitor to a radio receiver capable of tuning to this frequency.

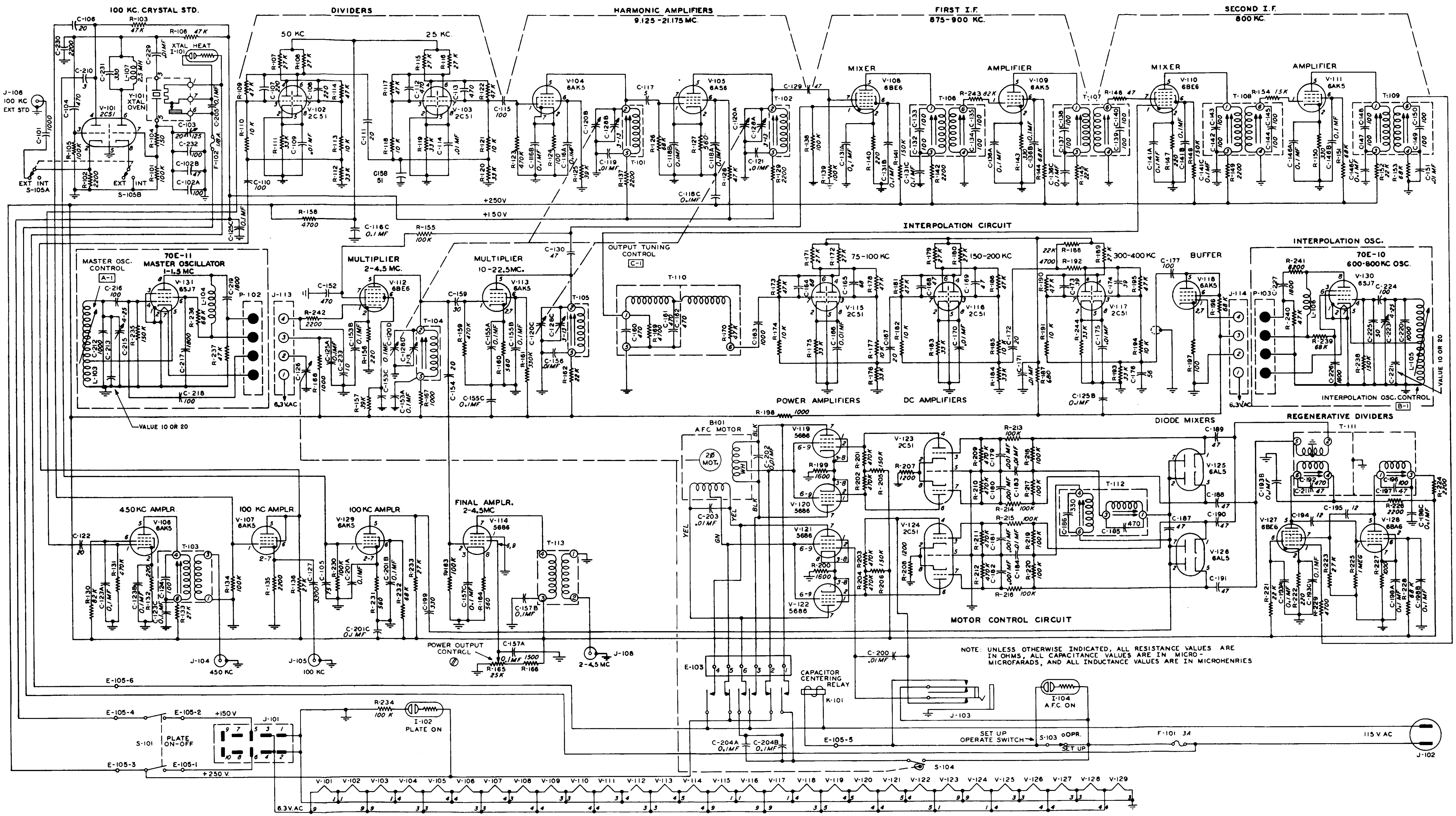


Figure 7–51. Schematic — RF Oscillator O-91A/FRT-5

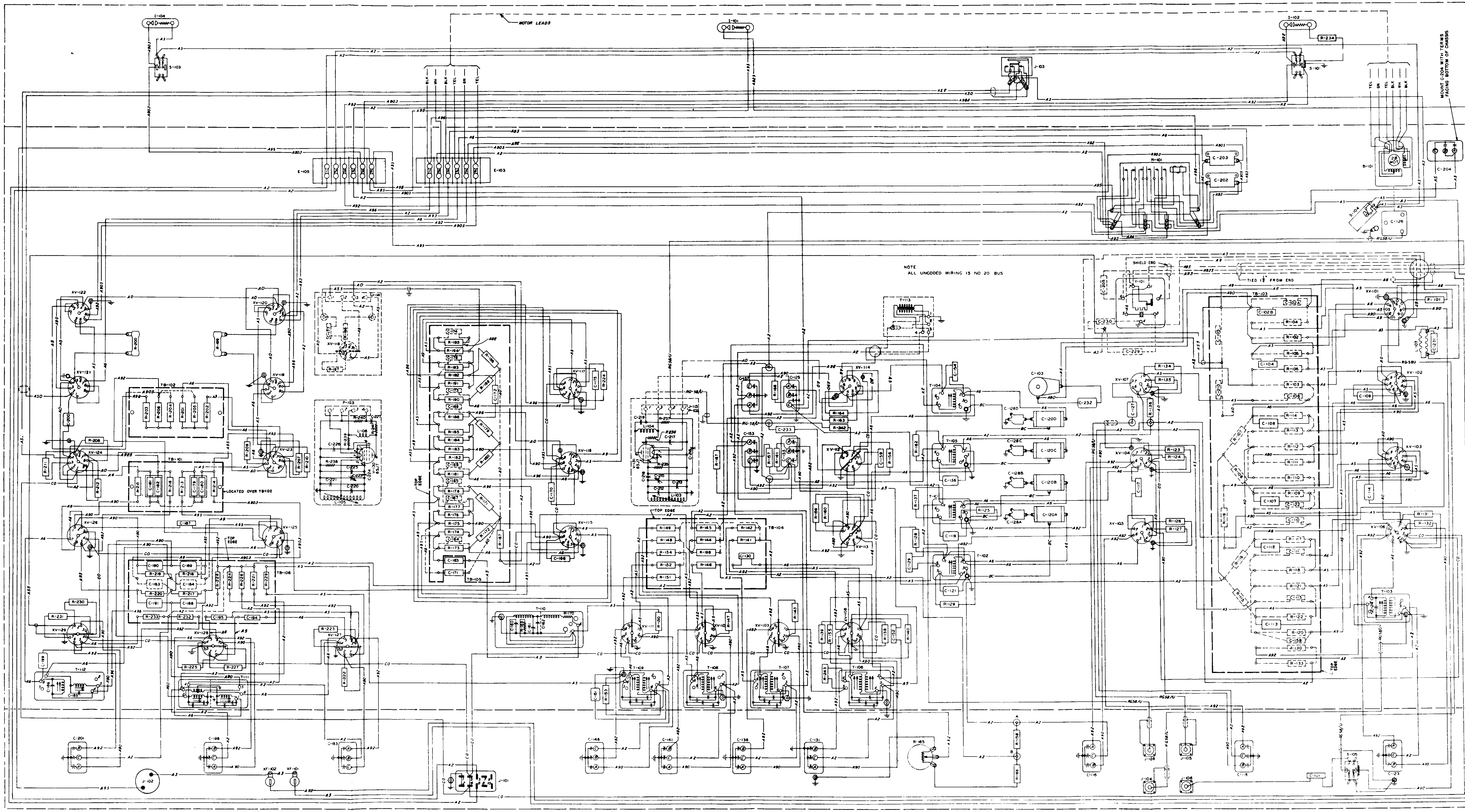


Figure 7–52. Wiring Diagram — RF Oscillat r O-91A/FRT-5

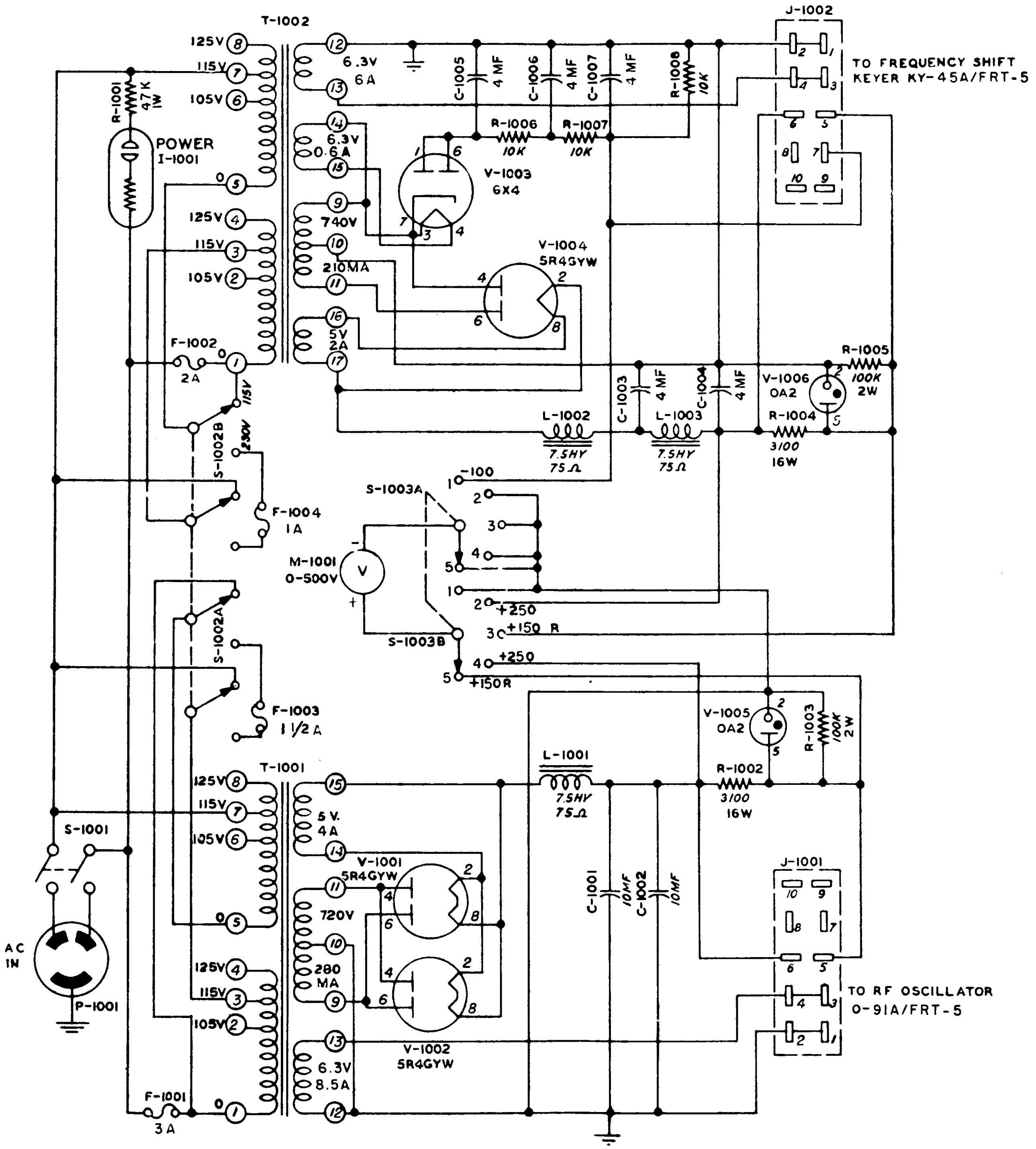


Figure 7—49. Schematic — Power Supply PP-454A/FRT-5

Y101	——— N16-C-96177-3001 ———	CRYSTAL UNIT, quartz: Navy type -40346; single xtal pl; 100 kc; incl heater and thermostat; temp range minus 20°C to plus 60°C; stud 7 prong base, hollow pins; 2 pins 5/32" diam x 9/16" lg; 5 pins 1/8" diam x 5/8" lg; cyl body 3¾" diam x 5-7/16" h o/a; no air gap adj; oven temp 60°C at 110 v AC; J. Knights type JKO-7.	100-kc crystal for crystal standard
Y1101	———	CRYSTAL UNIT: Type CR-27/U	Frequency control
Y1102	———	CRYSTAL UNIT: Type CR-27/U	Frequency control
Y1103	———	CRYSTAL UNIT: Type CR-27/U	Frequency control
Y1104	———	CRYSTAL UNIT: Type CR-27/U	Frequency control
Y1105	———	CRYSTAL UNIT: Type CR-27/U	Frequency control
Y1106	———	CRYSTAL UNIT: Type CR-27/U	Frequency control
Y1107	———	CRYSTAL UNIT: Type CR-27/U	Frequency control
Y1108	———	CRYSTAL UNIT: Type CR-27/U	Frequency control
Y1109	———	CRYSTAL UNIT: Type CR-27/U	Frequency control
Y1110	———	CRYSTAL UNIT: Type CR-27/U	Frequency control
*Z101	2C2711-3 N16-O-55023-4765 1760-213575938	OSCILLATOR, RF: freq range 600 to 800 kc; not crystal controlled; 0.001 w output; integral coils; mounts in sealed metal case; (includes C220, C221, C223 through C227, J116, L105, L106, R238 through R241, V130, XV130, P103); FTRC part #FRL-31628-1-1.	Interpolation oscillator
*Z102	2C2711-4 N16-O-55036-7755 1760-213575939	OSCILLATOR, RF: freq range 1 to 1.5 mc; not crystal controlled; 0.001 w output; integral coils; mounts in sealed metal case; (includes C212, C213, C215 through C219, J115, L103, L104, R235 through R237, V131, XV131, P102); FTRC part #FRL-31628-1-2.	Master oscillator
Z701	——— N16-D-901161-152 ———	SERVO UNIT: c/o motor (B701A, B701B, B701C, B701E or B701G), capacitor (C701), 2 switches (S701 and S702), connector (J701), resistor (R701), reduction gears and assembling hardware; 6-13/16" lg x 3-11/16" wd x 6⅜" h o/a; FTRC part #FRL-30637-2-6 and dwg #B1002836.	1st freq. multiplier (V502) tuning. Used with gear O701A
Z702	———	Same as Z701	2nd freq. multiplier (V503) tuning. Used with O701B
Z703	———	Same as Z701	Driver (V504) tuning. Used with gear O701C
Z704	———	Not Used	
Z705	———	Same as Z701	Output coupling (L516/L517 to L518/L519) adjustment. Used with gear O701E
Z706	——— ——— N16-D-901161-151 ———	SERVO UNIT: Same as Z701, except includes gear O701F; FTRC part #FRL-30637-2-1 and dwg #B1002836.	Tuning drive for output coils (L518 and L519)
Z801	2C451-9 ——— 1760-211307537	AMPLIFIER, AF: 2.2 w; input 30 v, 60 cps, single ph; 1 input channel; output impedance 18,000 ohms pl to pl; metal cabinet; FTRC part #FRL-30413-1.	Servo amplr for Z701 (V502 tuning)
Z802	———	Same as Z801	Servo amplr for Z702 (V503 tuning)

*This item should be returned to supply for repair and recalibration.