

# APERIODIC RECEIVER

OPERATING INSTRUCTIONS

SERIES K

*Manufactured for*

RADIO INTELLIGENCE DIVISION  
ENGINEERING DEPARTMENT  
FEDERAL COMMUNICATIONS COMMISSION

By

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## APERIODIC RECEIVER

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#### APPLICATION

The Aperiodic Receiver is a device suitable for intercepting radio signals within the frequency range of approximately 50 kc. to 60 mc. when the signal input to the receiver exceeds 10 millivolts.

This receiver is unusual as compared to other types of radio receivers in that no tuning is required. The Aperiodic receiver is therefore suitable for detecting the operation of transmitters operating on any frequency within the limits indicated without any tuning adjustments except for sensitivity. While the device requires a signal input of greater than 10 millivolts to produce an audible indication, a signal input of 2 millivolts can be detected visually in an Electron Ray Tube.

As in the case of ordinary radio receivers, the sensitivity of the Aperiodic Receiver is dependent upon the physical dimensions of the antenna used. For example, if the effective height of the antenna is 10 meters, audible indication will be obtained on signals having a field intensity of 1 millivolt per meter.

#### THEORY

The Aperiodic Receiver consists of a grid leak type untuned detector, directly coupled to an antenna and using a type 1G<sup>4</sup> tube. The change in plate current caused in this tube by the application of a signal to its grid results in a voltage change across its plate load resistor R<sup>4</sup> which, in turn, is applied to the grid of a DC amplifier, using the type 6F<sup>5</sup> tube. Following the DC amplifier is a vacuum tube bridge consisting of two type 6G<sup>6</sup> tubes. The amplified signal appearing across the plate load resistor R<sup>8</sup> of the DC amplifier is applied to the grid of the Active tube in the V. T. Bridge. The plate of the Bridge Detector tube is connected to the Active Bridge tube plate while the cathode of the Bridge Detector tube is connected to the plate of the Inactive Bridge tube. At balance the plates of the V. T. Bridge tubes are at the same potential and hence there is no current flow between the plate and the cathode of the type 6C<sup>5</sup> tube. The circuit is arranged so that when a signal is applied to the grid of the 1G<sup>4</sup> tube, the plate of the Active Bridge tube becomes positive with respect to the plate of the Inactive Bridge tube and the type 6C<sup>5</sup> tube functions as an amplifier. When this occurs, an audio frequency voltage that is applied to the grid circuit of the type 6C<sup>5</sup> Detector tube from the audio oscillator (Type 6SC<sup>7</sup> tube) through capacitor C<sup>7</sup> is amplified and appears across the primary of the Bridge Detector tube output transformer T<sup>1</sup>. This audio voltage appears across the secondary winding of the transformer and is applied through a volume control (R<sup>25</sup>) to the grid of the output audio stage (type 6V<sup>6</sup> tube) and can be heard in the loudspeaker coupled to the plate circuit.

In the absence of a signal, as for instance when S<sup>4</sup> is closed, it is necessary that the V. T. Bridge be balanced, otherwise, voltage appears in the plate circuit of the type 6C<sup>5</sup> tube and thus causing a continuous tone to be heard in the loudspeaker. Balance of the bridge is accomplished by adjustment of R<sup>5</sup> (Course) and R<sup>6</sup> (Vernier). Accomplishment of balance can be observed by noting that the shadow angle of the type 6U<sup>5</sup> Electron Ray tube is almost closed. Manipulation of the balance controls beyond this point will cause type 6U<sup>5</sup> tube to overlap and a continuous audio tone will be

heard in the speaker. On the other hand, if the balance control is turned in the opposite direction, type 6U5 tube will open to a 90° angle and cause the bridge to have lower sensitivity for all applied signal voltages. For maximum sensitivity the balance controls must be adjusted so that the Electron Ray tube indicates an angle between 0° and 10°.

The V. T. Bridge can be balanced so as to enable reception of type A1 or A2 emission signals operating in the presence of a modulated carrier signal such as those emitted by near-by broadcast stations. Under such operation, the audio modulation could be annoying but can be greatly attenuated by applying the audio component to both V. T. Bridge tube grids. This is accomplished by manipulation of the "Phase" control resistor R10. If reception of type A3 signals is desired, the Audio oscillator should be made inoperative and for maximum sensitivity, signal is applied only to the Active Bridge tube grid, by reducing "Phase" control.

The purpose of the type 6SL7 tube is to provide an electrical means for starting a signal recorder whenever a transmission occurs. Audio voltage is taken from across the primary of the output transformer T2 and through the "Relay Sensitivity" control R23 is applied to one grid and plate of the type 6SL7 tube, these elements serving to rectify the Audio signal. The rectified voltage is passed through the time constant circuit R29, C13 and then applied to the second grid of the type 6SL7 tube. The signal appearing in the plate circuit of this portion of the tube actuates a relay whose contacts may be made to start and stop a signal recorder inserted in receptical P1. The time constant circuit has been designed so that the relay closes instantly with the first element of the input signal and remains closed as long as the transmission of signal occurs. The time delay in the drop out of the relay is variable and is controlled by the adjustment of the Relay Sensitivity control R23.

The power supply of the Receiver consists of Power Transformer T3, rectifier tube type 5Z3. Filtering is obtained by suitable chokes and condensers. Regulation of important voltages is accomplished by Voltage Regulator tubes type VR105 and VR150 connected in series.

## OPERATION

Assuming that the Aperiodic Receiver has been connected to a source of AC power with all controls in the "Off" position and that an antenna and ground has been connected to the posts appropriately marked, advance "Volume" control knob to midway position. This applies filament power to all tubes. After 15 seconds warm-up period, turn "Plate Volts" to "On" position. Turn "Oscillator Control" to "On" position and manipulate the Balance and Balance Vernier controls until the Electron Ray Tube indicates balance. The Aperiodic Receiver is now ready for operation if the "Ant. Sw." is turned to the "On" position. If this last operation causes the Electron Ray Tube to overlap and an audio tone is heard from the speaker, this is an indication that an R. F. carrier is being received. If this is not the signal desired, readjust "Balance" and "Balance Vernier" until balance is restored as indicated by the Electron Ray Tube. If the undesired R. F. carrier is modulated, manipulate the "Phase" control for maximum attenuation of modulation. Large changes in power line voltage will cause V. T. Bridge unbalance and will immediately be indicated by the Electron Ray Tube. Under this circumstance the bridge should be rebalanced in order to maintain maximum sensitivity. For headphone operation, insert the phone plug in jack marked "Phones". This jack may be used for feeding the output of the Aperiodic Receiver into the input terminals of a signal recorder such as a dictaphone.

If it is necessary to operate the Aperiodic Receiver near a strong interfering radio station, it is recommended that a Series Type Wave Trap be connected between the antenna and ground binding posts and tuned to the operating frequency of the interfering station. A Parallel Type Wave trap will not be effective because of the high input impedance of the Aperiodic Receiver.

The Aperiodic Receiver can be operated from a storage battery in a manner similar to that used in the Hallicrafter Type SX28 receiver. The octal plug on the rear of the chassis is wired in a fashion similar to the Hallicrafter plug. It is pertinent, however, to point out the Aperiodic Receiver will not operate satisfactorily with the type VP-2 vibrapack because the input high voltage supply required is 375 volts, whereas, the vibrapack is capable of furnishing approximately 300 volts. The type A. T. R. converter can be used successfully provided the filament voltage for the Aperiodic Receiver is obtained directly from the storage battery instead of the filament winding on the power transformer T3. This is necessary because the power required for the Aperiodic Receiver is approximately 80 watts and with this load the type A. T. R. converter is not capable of furnishing 110 volts.

## MAINTENANCE

The voltages taken from the adjustable resistors R32 and R33 are critical as to adjustment and have been carefully set by the manufacturer. In the event V. T. Bridge cannot be balanced by manipulating the Balance Controls R5 and R6, it may be necessary to readjust the variable tap furnishing bias to the cathode of the type 6F5 DC amplifier. This adjustment is critical and should not be made without a complete understanding of the circuit functions. The tap on the resistor R32 furnishes fixed bias to the grid of the Inactive Bridge tube. This adjustment is not critical but should be made for 60 volts to 70 volts. The tap on the resistor which furnishes plate voltage to the type 1G4 tube is also not critical but should be roughly 30 volts to 40 volts. The position of the tap on R33 furnishing fixed bias to the 6F5 amplifier tube is critical in adjustment and depends upon the electrical characteristics of both the type 1G4 tube and the type 6F5 tube. If it is necessary to adjust the last mentioned tap, set the "Balance Control" resistors to mid position and adjust the tap until the Electron Ray tube just closes or until a weak audio signal is heard in the speaker. CAUTION--Care should be exercised in adjusting the resistor clamp. Rough treatment may damage the resistance wire.

- R1 5 Meg.  $\frac{1}{2}$  watt
- R2 300 ohm  $\frac{1}{2}$  watt
- R3 300 ohm  $\frac{1}{2}$  watt
- R4 300M ohm  $\frac{1}{2}$  Watt
- R5 2000 ohm pot. Balance Control
- R6 200 ohm pot. Balance Control
- R7 1250 ohm  $\frac{1}{2}$  Watt
- R8 300M ohm  $\frac{1}{2}$  Watt
- R9 20M ohm 10 Watt
- R10 500M ohm pot. Phase Control
- R11 10M ohm 10 Watt
- R12 2000 ohm 10 Watt
- R13 10M ohm 10 Watt
- R14 15M ohm 10 Watt
- R15 40M ohm  $\frac{1}{2}$  Watt
- R16 1500 ohm  $\frac{1}{2}$  Watt
- R17 100M ohm  $\frac{1}{2}$  Watt
- R18 25M ohm  $\frac{1}{2}$  Watt
- R19 25M ohm  $\frac{1}{2}$  Watt
- R20 25M ohm  $\frac{1}{2}$  Watt
- R21 25M ohm  $\frac{1}{2}$  Watt
- R22 10M ohm  $\frac{1}{2}$  Watt
- R23 25M ohm pot. Relay Sensitivity
- R24 750 ohm 10 Watt
- R25 100M ohm pot. Volume Control
- R26 1 Meg.  $\frac{1}{2}$  Watt
- R27 750 ohm  $\frac{1}{2}$  Watt
- R28 50M ohm  $\frac{1}{2}$  Watt
- R29 20 Meg.  $\frac{1}{2}$  Watt
- R30 3M ohm 10 Watt
- R31 10M ohm 10 Watt
- R32 5M ohm 10 Watt Adj.
- R33 10M ohm 10 Watt Adj.

- C1 100 mmf mica
- C2 100 mmf mica
- C3 100 mmf mica
- C4 .01 mf 600V. paper
- C5 .1 mf 600V. paper
- C6 .1 mf 600V. paper
- C7 .03 mf 600V. paper
- C8 .006 mf 600V. paper
- C9 .006 mf 600V. paper
- C10 .2 mf 400V. paper
- C11 50 mf 25V Electrolytic
- C12 .01 mf 600V. paper
- C13 .25 mf 600V. paper
- C14 8 mf 600V. Electrolytic
- C15 8 mf 450V. Electrolytic
- C16 8 mf 450V. Electrolytic
- C17 8 mf 450V. Electrolytic

- T1 3 to 1 interstage Transformer
- T2 Output Transformer
- T3 Power Transformer
- L1 .035 Hy.
- S1 S.P.S.T. Switch
- S2 S.P.S.T. Switch
- S3 S.P.S.T. Switch
- S4 S.P.S.T. Switch
- P1 A.C. Receptical
- P2 Octal Plug
- F1 2 Amp Fuse

### *Terminal Voltages*

*Potentials measured with 1000 ohm per volt voltmeter and with V. T. Bridge in balance.*

Tube	Pin No	PLATE to GND.	Pin No	SCREEN to GND.	Pin No	CATH. to GND.	Pin No	GRID to GND.	Pin No	FIL. to GND.
1G4	3	.7					5	0	2	1.4 DC.
6F5	4	4.3			8	8.5	GRP	.7	2	6.3 AC
6G6 <small>ACTIVE</small>	3	250	4	180	8	65	5	50-60	7	6.3 AC
6G6 <small>INACTIVE</small>	3	250	4	180	8	65	5	58	7	6.3 AC
6C5	3	245			8	245	5	200	7	6.3 AC
6SC7	5 2	210 240			6 6	0 0	4 3	0 -.5	8	6.3 AC
6SL7	5 2	0 400			6 3	0 2	4 1	0 0	8	6.3 AC
6V6	3	400	4	250	8	17	5	0	7	6.3 AC
5Z3	3	420							4	5 AC

# APERIODIC RECEIVER Series-K

