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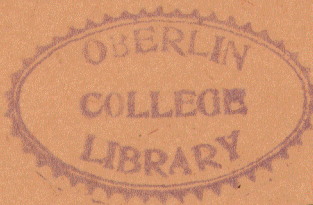
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TM 11-446

WAR DEPARTMENT TECHNICAL MANUAL

PANORAMIC ADAPTORS BC-1031-A, BC-1031-B, BC-1032-A, AND BC-1032-B



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WAR DEPARTMENT

28 DECEMBER 1944

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**PANORAMIC ADAPTORS
BC-1031-A, BC-1031-B,
BC-1032-A, AND BC-1032-B**



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DESTRUCTION NOTICE

WHY — To prevent the enemy from using or salvaging this equipment for his benefit.

WHEN — When ordered by your commander.

- HOW** —
1. Smash — Use sledges, axes, handaxes, pickaxes, hammers, crowbars, heavy tools.
 2. Cut — Use axes, handaxes, machetes.
 3. Burn — Use gasoline, kerosene, oil, flame throwers, incendiary grenades.
 4. Explosives — Use firearms, grenades, TNT.
 5. Disposal — Bury in slit trenches, fox holes, other holes. Throw in streams. Scatter.

USE ANYTHING IMMEDIATELY AVAILABLE FOR DESTRUCTION OF THIS EQUIPMENT.

- WHAT** —
1. Smash — Transformers, oscillator coils, tubes, capacitors, potentiometers, choke.
 2. Cut — Wiring.
 3. Burn — All equipment including this technical manual.
 4. Bury or scatter — Any or all of the above equipment.

DESTROY EVERYTHING

SAFETY NOTICE

Voltages as high as 1,100 volts are used in the operation of this equipment. These voltages are dangerous to life. Do not change tubes inside the set with the power ON. A few service checks must be made inside the set with the power applied. When making these checks, always have the immediate assistance of another person capable of rendering aid. Keep one hand in a pocket while making high-voltage measurements. This will help avoid touching the electrical circuit with more than one part of the body at one time. Be sure that high-voltage circuits are dead before performing preventive maintenance on this equipment. High-voltage capacitors in power supplies must be discharged manually before preventive maintenance operations are performed.

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This manual supersedes TM 11-446 30 July 1943.

SECTION I

DESCRIPTION

1. INTRODUCTION.

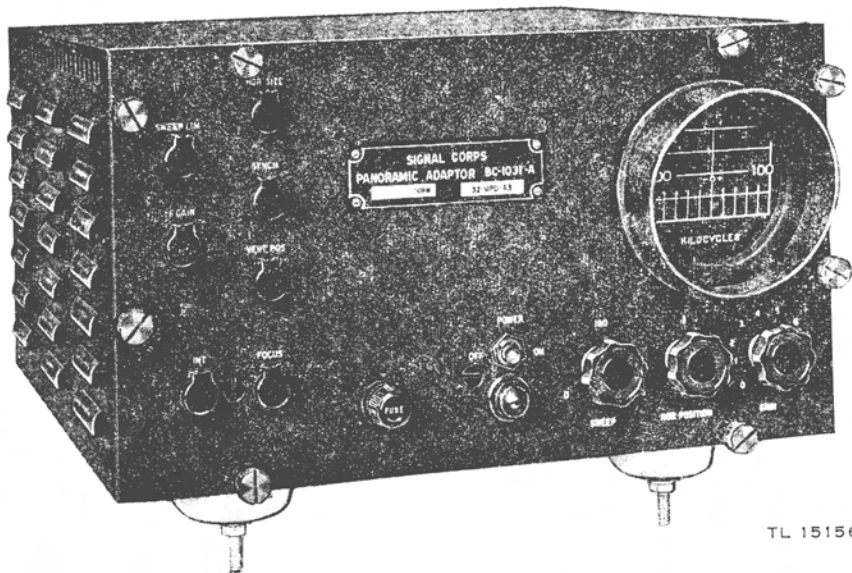
a. Panoramic Adaptors BC-1031-A, BC-1031-B, BC-1032-A, and BC-1032-B (figs. 1 (A) and 1 (B)) are electronic equipments which, when used in conjunction with a superheterodyne radio receiver, project signals on the screen of a cathode-ray tube (fig. 2). These signals can thus be observed visually in addition to being heard from the loudspeaker or headset.

b. The conventional radio receiver will normally receive just one signal at a time, since it is designed to pass only signals within a band of frequencies 10 kilocycles (kc) wide, or less, for any single setting of the tuning dial. Upon connecting the panoramic adaptor, however, the operator will be able to see on the screen all signals receivable throughout a 200-kc band (see NOTE). This band extends 100 kc above and below the frequency to which the receiver is tuned. For example, when the receiver is tuned to a signal on a frequency of 3,000 kc, only that signal (interfering signals excepted) will be heard by the operator. On the screen of the cathode-ray tube, however, all received signals in the 200-kc band of frequencies between 2,900 kc and 3,100 kc will appear.

NOTE: Panoramic Adaptors BC-1031-A and BC-1031-B present on the screen all signals received throughout a band of 200 kc while models BC-1032-A and BC-1032-B present all signals received throughout a band of 1,000 kc.

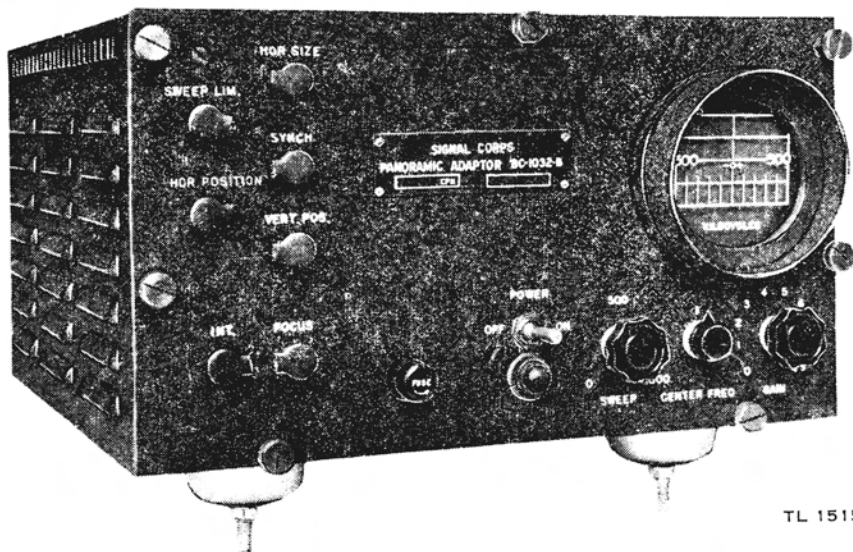
2. USE.

The panoramic adaptor is a device which allows the operator to visualize a portion of the radio spectrum on a two-dimensional surface (screen of a cathode-ray tube). On the horizontal axis



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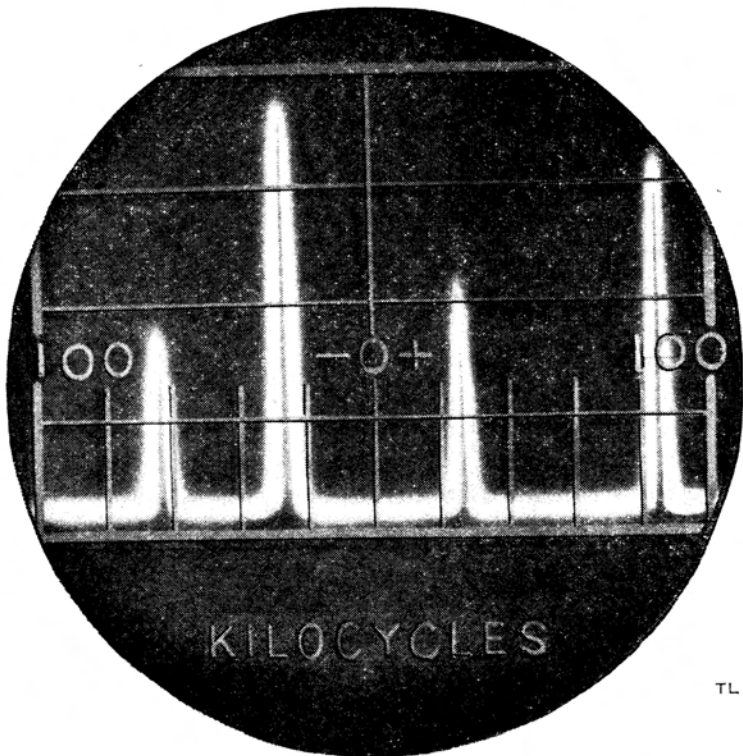
(A) Panoramic Adaptor BC-1031-A.



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(B) Panoramic Adaptor BC-1032-B.

Figure 1. Panoramic Adaptors BC-1031-A and BC-1032-B, front view.



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Figure 2. Screen showing typical pattern.

(baseline) of the screen, *frequencies* are shown, and on the vertical axis, *signal amplitudes* are shown (fig. 3).

a. Spectrum. The entire strip in figure 3 represents the portion of the radio-frequency spectrum covered by the tuning of the receiver.

(1) The circle in the center represents the frequency range or band visible on the screen of the panoramic adaptor.

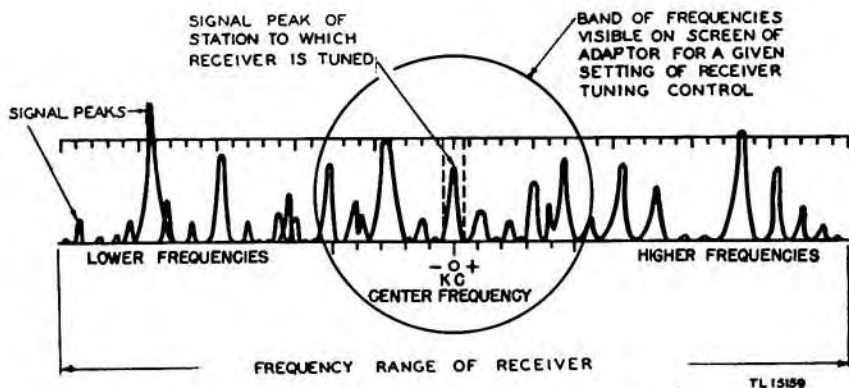


Figure 3. Portion of radio-frequency spectrum.

(2) The dotted section directly over the zero (0) on the scale represents the frequency to which the receiver is tuned.

b. Signal Peaks. The vertical peaks represent signals for stations. Every signal has its own separate peak or deflection which indicates the frequency, strength, and character of the signal.

(1) **FREQUENCY.** The position of the peak indicates the frequency of the signal with respect to the station to which the receiver is tuned. The screen has a calibrated scale (fig. 2), marked zero (0) in the center, plus (+) to the right, and minus (-) to the left.

(a) Zero (0) represents the frequency of the signal to which the operator is listening. This frequency is indicated by the setting of the receiver dial.

(b) Signals higher in frequency than that to which the receiver is tuned will appear to the right of the zero (0) line and signals lower in frequency will appear to the left of the zero (0) line.

NOTE: On some companion receivers with which the adaptor is used, the h-f oscillator of the receiver operates at a frequency higher than the signal frequency and, in this event, signals higher in frequency may appear to the left of the zero (0) line, and vice versa. This condition may also arise when certain companion receivers are used as the receiver band switch is changed from one frequency range to another. If this occurs, the operator must compute the frequencies by considering the plus (+) and minus (-) signs as reversed.

(c) Each division on the calibrated scale represents 20 kc on models BC-1031-A and BC-1031-B. On models BC-1032-A and BC-1032-B, each division represents 100 kc.

(d) To determine the frequency of a peak observed on the screen, note the frequency of the station to which the receiver is tuned (as indicated by the receiver dial) and to this frequency, add or subtract the calibration on the screen scale corresponding to the signal peak under observation. With practice, the operator will be able to tell at a glance the frequency of any peak (signal) on the screen. For example, four signal peaks are shown in figure 2. If the receiver dial indicated 3,000 kc, the signal peaks to the left of the zero (0) line would represent signals at frequencies of 2,975 kc and 2,938 kc, while the peaks to the right of the zero (0) line would represent signals at frequencies of 3,025 kc and 3,085 kc.

NOTE: This method of frequency measurement is only accurate when the sweepwidth control of the adaptor (knob marked SWEEP) is turned to its maximum clockwise position. For equipments delivered on Order No. 639-Phila-45, this control is marked SWEEP WIDTH FACTOR.

(2) **SIGNAL STRENGTH.** The height of the peak indicates the *approximate* strength of the signals that are shown on the screen. In general, strong signals have high peaks and weak signals have low peaks. With experience, the operator will be able to judge comparative signal strengths.

(3) **CHARACTER OF SIGNAL.** The peak reveals, in addition, the character of the signal: cw, phone, pulse, etc. It also reveals whether amplitude or frequency modulation is being used. Paragraph 11 contains information describing the appearance of various types of signals that may be observed on the screen of the adaptor.

c. Interference. In case of interference, the screen will reveal the nature of the interference. Since the screen shows all of the stations received in the 200-kc channel, it shows where the clear spots are, so that a transmitter can go on the air *without station interference*.

d. Monitoring. The operator must be alert to catch all signals. The panoramic adaptor will help in spotting, identifying, and tuning in signals. The enemy tries many tricks to avoid interception and location. Changing frequencies and short, fast signals are among the most common tricks. The enemy may also attempt communication by transmitting random noise. This will appear on the screen as a train of small peaks, extending across the entire width of the screen. These small peaks will appear and disappear in unison as the enemy keys the random noise. Paragraph 11 contains more information on the interpretation of signals.

3. GENERAL.

The adaptor is mounted on shock mounts (figs. 1 and 4) and can be placed on top of its companion receiver. All models of Panoramic Adaptors BC-1031-A, BC-1031-B, BC-1032-A, and BC-1032-B, have similar outside appearance and dimensions.

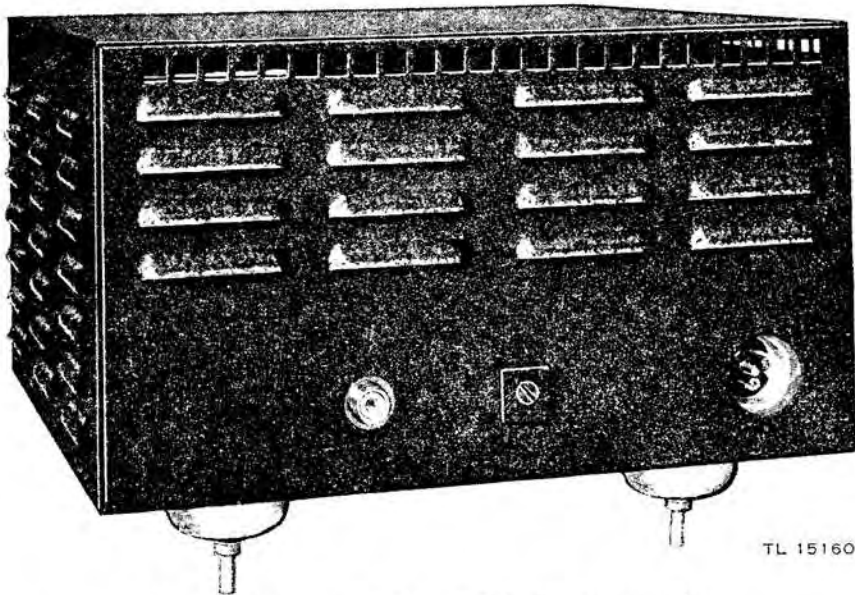


Figure 4. Panoramic Adaptor BC-1031-A, rear view.

a. All models are wired for 115 volts, 50-60 cycle, single-phase, alternating current. They can be made to operate on 230 volts by changing connections on the primary windings of the power transformer (figs. 24 and 25).

b. Panoramic Adaptors BC-1031-A and BC-1031-B have a maximum sweepwidth of 200 kc and operate in conjunction with a receiver having an i.f. of 450 to 470 kc. Panoramic Adaptors BC-1032-A and BC-1032-B have a maximum sweepwidth of 1,000 kc and operate in conjunction with a receiver having an intermediate frequency of 5.25 mc.

c. The POWER ON-OFF switch of the adaptor is located near the center of the panel directly above the pilot light which indicates whether power is on or off. To operate the adaptor, this switch, as well as the power switch of the receiver, must be turned ON.

d. The fuse, located directly to the left of the pilot light, is easily replaceable. The fuse can be removed without the use of tools by pushing in the fuse holder cap and turning it approximately $\frac{1}{8}$ inch to the left. Use only a 2-ampere, 250-volt fuse if replacement is necessary.

e. The cathode-ray tube is located on the extreme right side of the adaptor. A sponge rubber mounting, called a "boot", cushions the glass envelope of the tube to prevent breakage. A transparent plastic screen is placed over the viewing end of the tube. This screen protects the tube from damage and also protects the operator from shattered glass if the glass envelope should break. The green color of this plastic screen acts as a filter to make the trace (illumination) on the screen of the cathode-ray tube stand out in greater contrast. The calibration lines are marked on the plastic screen. The circular shade in front of and encircling the screen keeps out unwanted sunlight or artificial light. This exclusion of light allows the trace to be more easily viewed at a low setting of the intensity (brilliance) control which governs the brightness of the illumination on the screen. The life of the cathode-ray tube is considerably lengthened by using a low setting of the intensity control. Paragraph 10 explains the operation of all controls.

4. DIMENSIONS AND WEIGHTS.

The more important dimensions and weights are given below. These figures apply to all models of panoramic adaptors.

Over-all width	13 $\frac{1}{2}$ inches
Over-all height	8 $\frac{3}{4}$ inches
Over-all depth	15 inches
Panel width	13 $\frac{1}{4}$ inches
Panel height	7 $\frac{3}{8}$ inches
Depth of cabinet	13 inches
Cathode-ray tube shield (projection from front panel)	1 $\frac{7}{8}$ inches
Added height of shock mounts.....	1 $\frac{3}{8}$ inches
Weight of chassis (with tubes).....	32 pounds
Total weight of adaptor.....	43 pounds

NOTE: When packed for export, one panoramic adaptor (complete with spares) weighs approximately 151 lbs and has over-all dimensions of approximately 35" by 22" by 17".

6. TERMS AND DEFINITIONS.

The fact that panoramic adaptors fulfill certain functions not found in ordinary receivers necessitates the establishment of terms and definitions which apply particularly to this type of radio equipment. Some of these terms are defined below.

a. Panoramic Reception. Panoramic reception is the simultaneous visual reception of several radio signaling stations whose frequencies are distributed over a continuous portion of a given frequency spectrum. This definition distinguishes panoramic reception from the conventional reception which can be called "unisignal" reception and which can be either aural or visual, or both. The main distinction between panoramic and unisignal reception is the following: Panoramic reception is periodic reception over a wide range of the spectrum. Each signal is received at fixed, rapid intervals, for a short period of time. These signals are received so rapidly as to appear to be continuous when viewed on the cathode-ray tube because of the persistence of the screen material and retentivity of vision. Unisignal reception, on the other hand, is continuous reception of one signal at a time over a very narrow range of the spectrum.

b. Companion Receiver. The receiver with which the panoramic adaptor is operated is called the companion receiver.

c. Sweepwidth. Sweepwidth is the total band, measured in kilocycles, which can be observed by panoramic reception. Sweepwidth should not be confused with signal frequency, although both are measured in the same units (kilocycles).

d. Baseline or Sweep. The baseline, often called the sweep, is the horizontal line produced on the cathode-ray tube and along which the vertical deflections (signals) appear.

e. Center Frequency. The center frequency is the frequency of a signal which causes a vertical deflection at the center of the baseline. This deflection represents the signal to which the receiver is tuned.

f. Screen Scale. The screen scale is the scale adjacent to the baseline, which is calibrated in kilocycles above and below center frequency for a maximum sweepwidth setting.

g. Deflection Amplitude. Deflection amplitude is the visual equivalent of signal output strength and is represented by the height

of a given signal deflection (peak) measured from the baseline to the tip of the deflection.

h. Resolution. Resolution (fig. 5) is the visual equivalent of selectivity and is represented by the frequency difference between two signals of equal amplitude which intersect 30 percent down from their peak amplitude. It is said that the resolution is *better* as this frequency difference decreases.

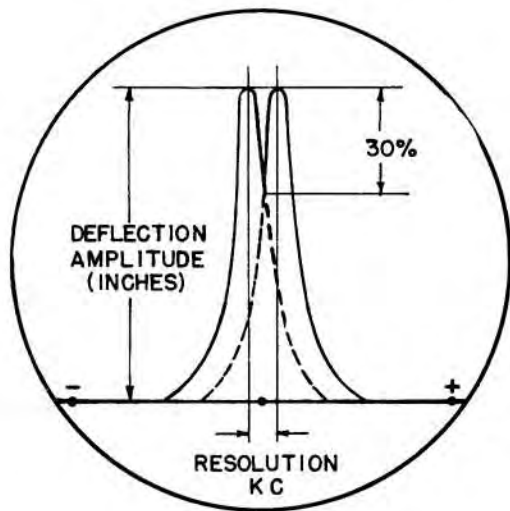


Figure 5. Resolution.

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i. Sweep Frequency. Sweep frequency is the frequency of the voltage applied to the horizontal plates of the cathode-ray tube.

7. DIFFERENCES IN MODELS.

Signal Corps panoramic adaptor equipment consists of four models, BC-1031-A, BC-1031-B, BC-1032-A, and BC-1032-B.

a. Models BC-1031-A and BC-1032-A have similar operating characteristics with the following exceptions:

(1) Model BC-1031-A has a sweepwidth of 200 kc while BC-1032-A has a sweepwidth of 1,000 kc.

(2) Model BC-1031-A has an input frequency of 450 to 470 kc while BC-1032-A has an input frequency of 5,250 kc (5.25 mc).

b. Models BC-1031-B and BC-1032-B contain modifications not found on models BC-1031-A and BC-1032-A (sec. IV and par. 33).

SECTION II

INSTALLATION AND OPERATION

8. INSTALLATION PROCEDURE.

The panoramic adaptor is packed in an air-cushioned carton.

a. Unpacking. To unpack the equipment proceed as follows:

- (1) Place the carton on a table or other flat surface with the *top up*.
- (2) Open the top of the carton using the hands, a knife, or any other instrument. Pull up each of the four flanges which form the top of the carton.
- (3) Under the top is an air cushion marked INSTRUCTION BOOK-HERE and CABLES-HERE. Lift up this air cushion and remove the instruction book and cables.
- (4) The adaptor proper is wrapped in waterproof paper and positioned by air cushions which protect it against shock while in transit. Remove the two air cushions with closed tops to gain access to the equipment.
- (5) The adaptor is packed upside down, with a mounting template over the shock-mounts. Lift the adaptor out of the carton (it weighs 43 pounds) and set it down *carefully*.
- (6) Remove the waterproof paper.
- (7) Take off the nuts from the shock-mount studs and place them where they will be available later.
- (8) Remove the pressed wood template which is used to center the four 5/16-inch holes when mounting the adaptor.
- (9) Unpack all spare parts and inspect carefully for mechanical damage.
- (10) Repack all spare parts as carefully as possible and place in some type of compartment or on shelves.

b. Mounting. The adaptor may be mounted on a bench or table or other suitable surface. It is recommended that it be mounted on top of the radio receiver with which it will be used. When so mounted, care must be taken to keep the ventilation openings in the top of the radio receiver uncovered.

c. Connecting Adaptor to Receiver.

(1) Make sure the receiver has an intermediate frequency which corresponds to the input frequency of the adaptor (par. 7).

(2) Cord CD-806 is a coaxial cable with identical male plugs at either end. Fit one plug into the one-pole, threaded, female receptacle near the center of the back of the adaptor (fig. 4). Fit the other end into the receptacle in the radio receiver. If the companion receiver is not provided with a receptacle for operation with a panoramic adaptor, proceed as follows:

(a) Drill a $\frac{3}{4}$ -inch hole through the receiver cabinet somewhere near the plate prong of the mixer tube, and fit the rubber grommet supplied with the equipment into the hole.

(b) Connect the 50,000-ohm resistor supplied with Panoramic Adaptor BC-1031-A or BC-1031-B (25,000 ohms for models BC-1032-A or BC-1032-B) as closely as possible to the plate prong of the mixer tube of the receiver.

(c) Insert the free end of the coaxial cable through the grommet in the $\frac{3}{4}$ -inch hole and connect the inside conductor of the cable to the other end of the 50,000-ohm resistor.

(d) Connect the outside conductor (shield) of the cable to the receiver chassis. Make sure that a good ground (chassis) connection is obtained. A clamp supplied with the equipment will hold the coaxial cable in place.

NOTE: A permanent coaxial cable with its blocking resistor may be installed in the receiver and terminated in a female receptacle (as in the adaptor). When fitted with a suitable plug, the input cable from the adaptor can then be attached to this receptacle. *Only a plug and receptacle with extremely low-loss insulation should be used.*

d. Connecting to Power Source. When the adaptor has been mounted in the position in which it will be used, attach the power cable (Cord CD-807) to the adaptor. This cable is fitted with a polarized plug. A three-pole twist-type power receptacle is located at the back of the adaptor near the right-hand edge (fig. 4). A

right turn locks the plug on the cable into the receptacle on the adaptor.

NOTE: The adaptor is wired for a 105- to 115-volt, 50- to 60-cycle, single-phase, alternating current power source. Make certain that this power is available before connecting. If the power source is 230 volts, refer to paragraph 27.

9. OPERATION.

a. Turn on the receiver and check its operation.

NOTE: The antenna should remain connected to the receiver in the normal manner.

b. Turn on the adaptor by throwing the POWER ON-OFF switch (fig. 1) to ON. After approximately $\frac{1}{2}$ minute, a horizontal baseline (sweep) should appear on the screen of the cathode-ray tube. This line should be slightly longer than the calibrated scale. With the GAIN control (fig. 1) in its maximum counterclockwise position, the baseline should be clear and clean from one end to the other.

c. Turn the GAIN control up about half way and rotate the receiver dial. As the receiver dial is slowly tuned, one or more vertical deflections (signals) will be observed along the baseline.

d. Tune in any station on the receiver using phones or speaker. The signal should appear on the screen of the cathode-ray tube *directly* over the zero (0) line, that is, exactly in the center of the scale. For best results it is advisable to adjust the mean frequency of the panoramic adaptor oscillator to give a signal which remains in the center of the screen regardless of the position of the SWEEP control¹ (fig. 1). This adjustment should be made after the adaptor has been allowed to warm up (par. 28b).

10. FUNCTIONING OF CONTROLS.

The following controls are found on models BC-1031-A and BC-1032-A. (Refer to paragraphs 21 and 33 for the other models.)

a. Operating Controls.

(1) SWEEP. The SWEEP¹ control governs the sweepwidth, or bandwidth.

(a) When this control is turned fully clockwise, the maximum band for which the adaptor is designed can be seen on the screen,

¹ This control is labelled SWEEP WIDTH FACTOR on adaptors delivered on Order No. 639-Phila-45.

and the position of the signals with respect to the calibrated scale may be used as a method of estimating the frequency of signals.

(b) As this control is turned from its maximum clockwise position, the band of frequencies observed on the screen is made narrower, but the portion which can be seen is expanded or magnified since the horizontal sweep line remains constant in length.

(c) This control is very useful when two or more signals are so close together that they seem to merge into each other. When the SWEEP control is rotated in a counterclockwise direction, the signals seem to separate.

(2) **HOR. POSITION.** The HOR. POSITION (horizontal positioning) control governs the position of the baseline. It is used to bring the signal heard on the receiver exactly in line with the zero (0) mark on the scale at full sweep. This control does not require frequent adjustment. When necessary, however, it does permit rapid correction of slight center frequency drift while the receiver or adaptor is cold.

(3) **GAIN.** This control governs the height of the signal peaks on the adaptor screen. For best operation, it is recommended that the gain be held to as low a level as possible. Keeping the gain low keeps the noise level and the spurious signal level down and makes it easier to interpret the traces on the screen. The best rule to follow is to keep the gain at the lowest possible level that will still permit observation of the weakest signal that can be heard on the radio receiver. It is important to remember that keeping the gain low will make it much easier to visually compare weak signals that are close to strong signals.

b. Semiaadjustable Controls. On the left side of the panel, there are seven snap covers (fig. 1(A)) under each of which is a control. (In some models the snap covers are replaced by a sliding plate behind the panel.) These controls have slotted shafts and can be adjusted with a screwdriver. Ordinarily these controls are never used, but occasionally they are necessary in adjusting or servicing the equipment. The name of each control is plainly marked on the panel. Some are marked in white and some in red.

CAUTION: Don't move the red controls. These controls are only used when the equipment is serviced by an experienced technician.

(1) The purpose of the three white (seldom used) controls is as follows:

(a) The VERT. POS. (vertical positioning) control adjusts the vertical position of the baseline which should be very close to the calibration line of the screen scale.

(b) The INT. (intensity) control¹ governs the brightness of the pattern on the screen.

(c) The FOCUS control allows the trace or pattern on the screen to be made clear and sharp.

(2) The purpose of the four red (*don't touch*) controls is as follows:

(a) The SWEEP LIM. control¹ limits the width of the band which is observed on the screen.

(b) The HOR. SIZE (horizontal size) control¹ governs the length of the baseline on the screen, which should be slightly longer than the calibrated scale.

(c) The SYNCH control governs the speed with which the "spot" or stream of electrons inside the cathode-ray tube sweeps across the screen in synchronism with the a-c power source. The sweep frequency is normally adjusted for 30 cycles per second when operating from a 60-cycle source of power, and 25 cycles when operating from a 50-cycle power source.

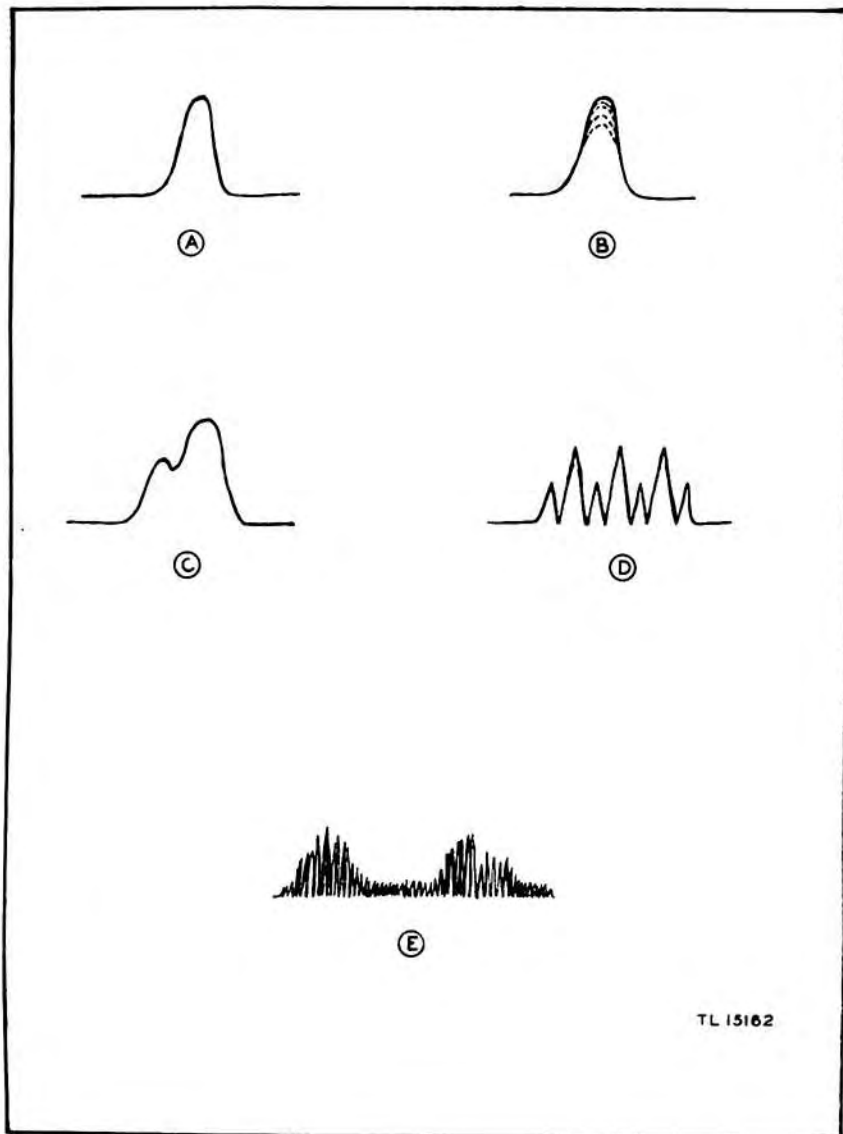
(d) The I.F. GAIN or input gain control varies the amplification in the intermediate-frequency stage of the adaptor.

11. INTERPRETATION OF SIGNALS.

The appearance of signal peaks on the screen, when properly interpreted, allows the operator to recognize the type of signals

¹ For adaptors delivered on Order No. 639-Phila-45, the INT. control is labelled BRILLIANCE, the SWEEP LIM. control is labelled SWEEP WIDTH LIMIT, and the HOR. SIZE control is labelled BASELINE SIZE.

received without the need of listening to them. The various types of signals which appear are described below :



- (A) Constant carrier.
- (B) Amplitude modulated carrier.
- (C) Single side-band modulation.
- (D) Pure tone frequency modulation.
- (E) Noise pattern.

Figure 6. Typical screen patterns.

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a. Constant Carrier (fig. 6 (A)). A constant carrier appears on the screen as a peak of fixed height. The louder the received signal, the higher the peak.

b. Amplitude-modulated Carrier (fig. 6 (B)). An amplitude-modulated carrier appears as a peak of variable height. Voice or music modulation causes the carrier to vary irregularly. A constant tone modulation of low frequency will produce a series of peaks varying in height, their number being determined by the modulation frequency. As the modulation frequency increases, the peaks move toward the two sides of the deflection, as side bands tend to become visible. When the modulation frequency is increased, it becomes possible to separate the two side bands by reducing the sweep-width of the adaptor. The higher the frequency of modulation, the farther away these side bands will move from the center deflection which represents the carrier. However, possible nonlinear amplification of either the receiver or the adaptor, or both, over a wide band, may cause the side bands to appear unequal in height even though they are of even strength. Their relative heights may vary as the receiver is tuned and as the deflection moves from one end of the screen to the other.

c. Single Side-band Modulation (fig. 6 (C)). Single side-band modulation appears as two carriers of slightly different frequency (subpar. g below).

d. Frequency-modulated Signal (fig. 6 (D)). A frequency-modulated (f-m) signal appears as a carrier having a wider baseline size with auxiliary peaks surrounding the central carrier peak.

e. Continuous-wave Signal. A continuous-wave (c-w) signal appears and disappears in step with the keying of the transmitter. During the moments when the signal is off, the frequency sweep axis (baseline) closes at the base of the signal. An operator who is able to read c-w signals on phones can, with practice, read some signals directly off the screen. In very rapidly keyed signals, the deflection and the baseline are seen simultaneously.

f. Modulated-continuous-wave Signal. A modulated-continuous-wave (m-c-w) signal appears like a c-w signal of periodically varying height. If the modulation rate is high, side bands will appear as explained above.

g. Signal Interference. Two signals which are so close in frequency as to cause interference when heard on speaker or phones may appear on the screen as a single peak varying in height and similar to a modulated signal. As the frequency separation between the interfering stations increases, the peak appears as if modulated on one side only. Further increase of frequency will cause a break at the peak of the deflection. By reducing the sweepwidth of the adaptor, the two peaks will gradually separate.

h. Transient Disturbances. These disturbances, generally received as noises (fig. 6(E)) in the receiver, are of two types: periodic and aperiodic transients. Periodic transients, such as disturbances made by automobile ignition systems, motors, vibrators, buzzers, etc., appear as signals moving along the baseline in one direction or another. Thus an automobile which is accelerating will produce a set of deflections which may first move in one direction, slow down, stop, and then move in an opposite direction. This is caused by the adaptor sweeping at a fixed rate (approximately 30 times per second), whereas the transient occurs at a variable rate. The images stand still on the screen when there is synchronism between the two. If a transient disturbance is synchronized with the 60-cycle power source, the noise appears as a fixed signal which does not move on the screen when the receiver is tuned, but varies only in height. Such deflections may appear like amplitude-modulated signals or like steady carriers (subpar. m below). Aperiodic transients, such as static, appear as irregular deflections and flashes along the entire baseline.

i. Tube Noise. Tube noise, observed when too great an amplification of the receiver or adaptor, or both, is used, appears as varying irregularities along the baseline. Proper adjustment of the gain controls should reduce or eliminate this disturbance.

j. Images. If the receiver allows images to pass because of poor image rejection in the r-f circuits, these images will be distinguishable from normal signals by their movement in an opposite direction with respect to normal signals along the baseline, when the

receiver is being tuned. Such images are likely to appear on the higher frequency ranges of the receiver.

k. Harmonics. Harmonics, produced in the receiver by the beat of very strong signals with harmonics of the oscillator, are distinguishable from other signals by the fact that they move across the screen more rapidly with tuning than normal signals. For example, a second harmonic spurious signal will move twice as fast as a normal one. In general, a reduction in the gain of the receiver will eliminate this type of signal.

l. Diathermy Apparatus. Diathermy apparatus using an unfiltered or a-c power supply will produce a periodic disturbance which will cause a deflection to appear on certain portions of the screen and to disappear on other portions. This is due to the fact that such equipment emits a signal which pulsates in synchronism with the power source. The adaptor also is sweeping the spectrum in synchronism with the power source but at a lower frequency (30 cycles for a 60-cycle power source) and when a certain phase relationship exists, it is possible for the adaptor to receive these periodic pulses.

m. Effect of Signal Strength. When the signal strength exceeds a certain value, the deflection caused by any signal breaks up into a series of parallel deflections, somewhat similar to side bands. A slight reduction in the gain of the adaptor will eliminate this type of distortion.

n. Use of Automatic Volume Control in Receiver. When the receiver is using automatic volume control (avc), the signal appearing in the center of the screen will control the height of all other signals. If the receiver is tuned to a strong signal, the weaker adjacent signals will be reduced in height or may not appear at all. It may be found best, in most applications, to operate the receiver with the avc off.

REMEMBER THESE POINTS

1. Make certain that a 105/115-volt, 50/60-cycle power source is available *before* plugging in the adaptor. If it is more than 115 volts, change the primary connections of the power transformer before plugging in (figs. 24 and 25).
2. If the adaptor is on top of the radio, make sure the ventilation holes are not blocked.
3. Remember that the station the radio receiver is tuned to is seen in the center of the adaptor screen if the equipment is properly adjusted.
4. Don't compete with sunlight. Shade the screen.
5. Keep the GAIN control at the lowest setting where it is possible to see a peak on the screen for the weakest signal that can be heard.
6. Don't touch the four *red* semiadjustable controls while operating. These controls are used only when the equipment is being serviced by an experienced technician.
7. Don't let rain or water get into the set. Keep it dry. Moisture may ruin it.
8. *Use extreme care when servicing the equipment. Extremely high voltages (1,000 volts) are exposed on the inside of the adaptor when power is applied.*

SECTION III

FUNCTIONING OF PARTS

12. GENERAL DESCRIPTION.

a. Introduction. The panoramic adaptor, used in conjunction with a superheterodyne receiver, is a visual indicator of received signals. Each signal picked up on the receiving antenna, over a definite range of frequencies, places a corresponding mark or peak on the calibrated scale of an oscilloscope. Panoramic Adaptors BC-1031-A and -B show a frequency band extending 100 kc on each side of the frequency tuned in; Panoramic Adaptors BC-1032-A and -B show a frequency band extending 500 kc on each side. The entire system consists of three major parts: a conventional superheterodyne (companion receiver), the superheterodyne section of the adaptor which receives its signal from the mixer output of the conventional receiver (fig. 7), and the oscilloscope circuits. The features of the panoramic adaptor which distinguish it from the conventional superheterodyne are as follows:

(1) The special band-pass amplifier in the BC-1031-A or BC-1031-B passes a wide band of frequencies ($455 \text{ kc} \pm 100 \text{ kc}$) in comparison to the sharply selective i-f amplifier of the conventional companion receiver. Therefore, signals which beat with the h-f oscillator of the companion receiver to produce difference frequencies separated as much as 100 kc from the 455-kc i-f frequency, pass into the panoramic i-f system with signal strengths equal to a 455-kc difference signal. However, these same signals do not appear in the audio output of the companion receiver, as its i-f system is sharply tuned to 455 kc and only receives signals which produce a 455-kc intermediate frequency.

(2) The h-f oscillator of the panoramic superheterodyne is frequency-modulated instead of set on a fixed frequency. The oscillator is tuned over a band of frequencies at a fixed rapid rate. Therefore, during one sweep cycle it will be beat progressively

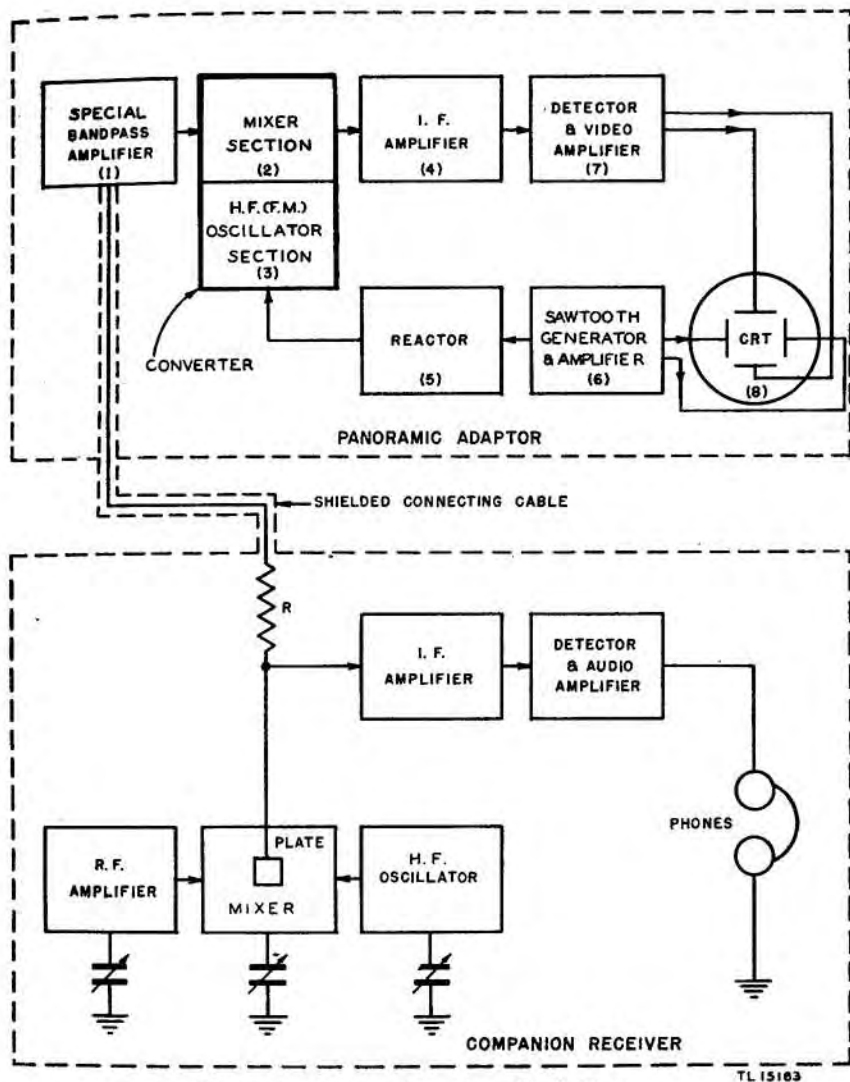


Figure 7. Panoramic system, block diagram.

with each signal in the output of the special band-pass amplifier to produce the 226-kc intermediate frequency.

(3) A direct-coupled video amplifier which has a wide frequency response is used in the output stage. Each rectified signal will therefore deflect the cathode-ray beam only on one side of the baseline on the oscilloscope screen.

b. Panoramic General Theory. (1) The panoramic receiver, as

shown on the block diagram in figure 7, consists first of the special band-pass amplifier which passes a wide band of frequencies. In the case of Panoramic Adaptor BC-1031-A, if the companion receiver is tuned to 3,000 kc, all signals received from 2,900 to 3,100 kc appear in the output of the band-pass amplifier as frequencies covering a range from 355 to 555 kc. Furthermore, the amplification factor from the antenna to the output of the band-pass amplifier is reasonably constant over this 200-kc range of frequencies.

(2) The signals are coupled to the mixer section of the converter where they are mixed with the output of the h-f oscillator section to produce the 226-kc difference frequency of the sharply tuned panoramic i-f amplifier.

(3) If the h-f oscillator of the panoramic superheterodyne were set on a fixed frequency, it would only beat with one frequency to produce the 226-kc i-f difference frequency. Since it is necessary to detect all signals from 555 to 355 kc, the h-f oscillator is frequency modulated. The h-f oscillator frequency is varied from 781 to 581 kc 30 times per second. Thus, in progression, during each sweep cycle, every signal on the frequency band from 555 to 355 kc mixes with the h-f oscillator frequency to produce a 226-kc intermediate frequency.

(4) The signal present in the i-f system consists, therefore, of a series of short "bursts" of signal as the h-f oscillator is swept over its range and beats with the various signals in the output of the special band-pass amplifier. This same series of signal bursts or pulses is repeated 30 times per second with individual pulses each of which represents a particular station always occurring at the same instant during the sweep cycle.

(5) The series of pulses, each representing a particular station, are detected and direct-coupled to the video amplifiers. From the video amplifier the detected pulses are applied to the vertical deflection circuit of the oscilloscope.

(6) Frequency modulation of the panoramic h-f oscillator is accomplished by a reactance modulator and a blocking tube oscillator. The blocking tube oscillator generates a saw tooth voltage to modulate the grid of the reactance modulator, which in turn, varies the frequency of the h-f oscillator. Since a saw tooth voltage represents a linear change in voltage with respect to time plus a rapid snap-back to the same level, the frequency of the h-f oscillator is varied from 781 to 581 kc at a fixed rate and then is quickly returned to 781 kc to begin another cycle.

(7) The cathode-ray tube visually reproduces the received signals in the form of triangular pulses. Each pulse represents a definite station, transmitting on a frequency that is a definite number of kilocycles above or below the frequency to which the companion receiver is tuned. The same blocking oscillator also generates an

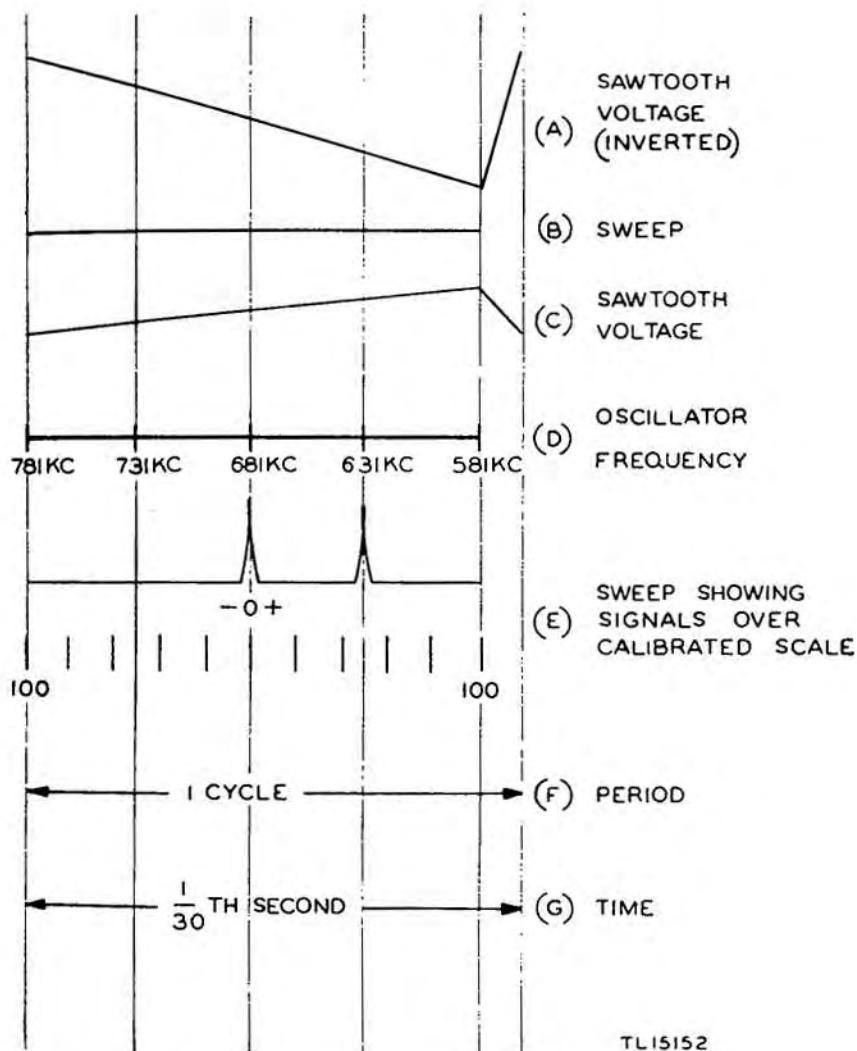


Figure 8. Time, voltage, and frequency relationships.

inverted saw tooth to be applied to the horizontal deflection circuit of the oscilloscope. Thus, at the same instant that the saw tooth (fig. 8(C)) is changing the oscillator frequency from 781 to 581 kc (fig. 8(D)), the inverted saw tooth (fig. 8(A)) steadily moves the oscilloscope electron beam from left to right across the screen tracing a straight line (fig. 8(B)). Since this trace line is thereby synchronized with the oscillator frequency sweep, any position on the line indicates the oscillator is tuned to a definite frequency (fig. 8(D)). When the oscillator is tuned to 681 kc (middle of its frequency sweep), it means the oscilloscope beam has also reached the middle of its horizontal trace.

(8) Assume now that the companion receiver is tuned to a 3,000-kc signal. This signal is mixed with the 3,455-kc signal from the h-f oscillator of the companion receiver to produce the 455-kc intermediate frequency. This latter frequency will pass through the companion receiver to the loudspeaker. It is also fed through the band-pass amplifier to the panoramic mixer. When the h-f oscillator reaches the 681-kc point of its cycle, it mixes with this 455-kc signal to produce the 226-kc intermediate frequency of the panoramic receiver. This burst of signal in the i-f system is detected and applied to the oscilloscope vertical deflection plates producing the peak at the center of the scale (fig. 8(E)). Thus the center (- 0 +) mark on the scale always represents the frequency to which the receiver is tuned, and the calibrations (± 100 kc) above and below this point indicate signals which are present on the antenna but are not being reproduced through the loudspeaker. Now, if at the same time the 3,000-kc signal is received, another signal is present on 3,050 kc, this frequency mixes with the h-f oscillator of the companion receiver to produce a 405-kc i-f. Since the companion receiver i.f. is sharply tuned to 455 kc, this signal never reaches the loudspeaker. However, it passes through the special band-pass amplifier to the panoramic mixer. When the h-f oscillator reaches the 631-kc point (fig. 8(D)) of its cycle, it beats with the 405-kc signal to produce the 226-kc frequency of the panoramic i-f system. This burst of i-f energy is detected and causes a peak to appear on the screen at the +50-kc point (fig. 8(E)), the electron beam having reached in this time a point midway between the center and the right side of the screen. The 3,050-kc signal, therefore, is not heard but its presence is indicated on the panoramic screen.

NOTE: The saw-tooth voltage waveforms shown in figure 8(A) and 8(C) are theoretical representations. The linearity (rate of change) of actual saw-tooth voltages used in practice only approaches these ideal wave-forms. The amplitudes of the two saw-tooth voltages shown in figure 8 have a ratio of 2 to 1. Actually, the amplitude of the saw-tooth voltage applied to the horizontal plates of the cathode-ray tube in the adaptor is approximately 20 times as great as the saw-tooth voltage applied to the grid circuit of the reactance modulator.

(9) By similar reasoning it will be seen that any signal within the 200-kc bandwidth of the special band-pass amplifier will pass through the i-f amplifier of the adaptor at the correct time to appear on the screen in its proper relationship to other signals.

(10) Figure 8 shows one complete cycle of operation. This cycle is periodic and repeats approximately 30 times a second.

c. Panoramic Adaptor BC-1032-A. The general description of the functioning of the BC-1031-A, as explained in this paragraph, may also be used to explain the general functioning of the BC-1032-A. It is necessary, however, to make allowances for the difference in the band of frequencies covered by the BC-1032-A (par. 7).

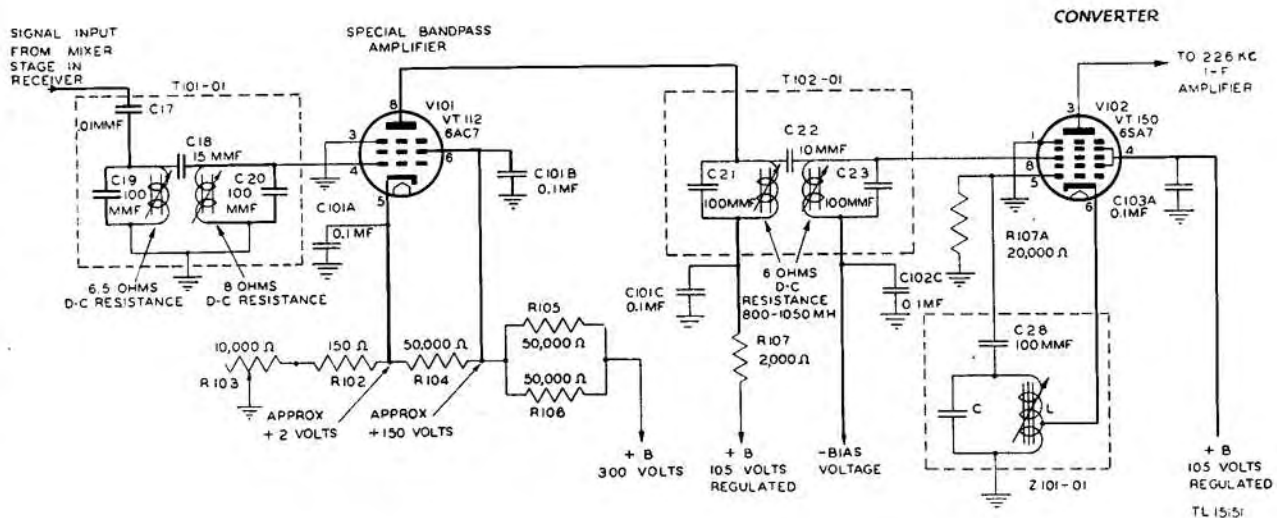
13. CIRCUIT DETAILS.

A general description of how the panoramic adaptor operates, in conjunction with a companion receiver, to make possible the observation of signals on the adaptor's screen is presented in paragraph 12. The results produced by the various stages are given but no explanation is made as to how these results are obtained in terms of capacitors, resistors, inductors, etc. The following paragraphs give this explanation. The material is presented using Panoramic Adaptors BC-1031-A and BC-1032-A as the basic adaptors. Section IV explains the differences between these models and models BC-1031-B and BC-1032-B.

14. BAND-PASS AMPLIFIER AND CONVERTER STAGES.

Figure 9 shows a simplified schematic diagram of the special band-pass amplifier and converter (mixer and oscillator) stages of Panoramic Adaptor BC-1031-A. In order to simplify the explanation of the oscillator circuit at this time, the phase-shifting, resistance-capacitance network (R8, C31, R11, C32) and other parts and connections of the reactance modulator are not consid-

Figure 9. Simplified schematic diagram of special band-pass amplifier and converter stages.



ered and are not shown in the diagram. A simple inductance-capacitance tank circuit (LC) with its coupling capacitor C28 is substituted for the composite oscillator coil Z101-01. The band-pass amplifier and converter circuits in Panoramic Adaptor BC-1032-A are the same as in BC-1031-A except for the design of the transformers.

a. Band-pass Amplifier. The special band-pass amplifier receives the signal input from the receiver. This amplifier is fundamentally an intermediate-frequency amplifier using specially designed input and output transformers.

(1) **FUNCTIONING.** Since the adaptor is designed to show all signals receivable over a continuous 200-kc band, this amplifier must be capable of passing a band of frequencies 200 kc wide. In addition, it must be able to provide greater gain in the outer portions of the band than at the center in order to compensate for the selectivity of the r-f amplifier and mixer stages in the companion receiver. The selectivity of an r-f amplifier is greater at low frequencies than it is at high frequencies. Figure 10 shows the selectivity of a typical r-f amplifier to be greater at a frequency of 1,500 kc than at 4,000 kc. This makes it impractical to compensate exactly over the entire frequency range of the receiver. At one frequency, however, exact compensation is obtained.

(a) At lower input frequencies, the selectivity of the r-f and mixer stages of the receiver increases and the over-all gain at the output of the mixer stage of the adaptor is greater at the center of the 200-kc band pass than at either end. (The amplification characteristics of the special band-pass amplifier remain constant.)

(b) At higher input frequencies, the selectivity of the input circuits of the receiver decreases and the special band-pass amplifier in the adaptor overcompensates with the result that the outer portions of the band have slightly greater gain than the center.

(c) The over-all characteristics of the band-pass amplifier are shown in figure 12.

(2) **SIGNAL INPUT.** The signal input is passed from the plate of the mixer stage in the receiver through an isolating resistor (not shown in fig. 9), coupling capacitor C17, and enters the L-C resonant tank circuit which makes up the primary of transformer T101-01 (T101-02 in BC-1032-A).

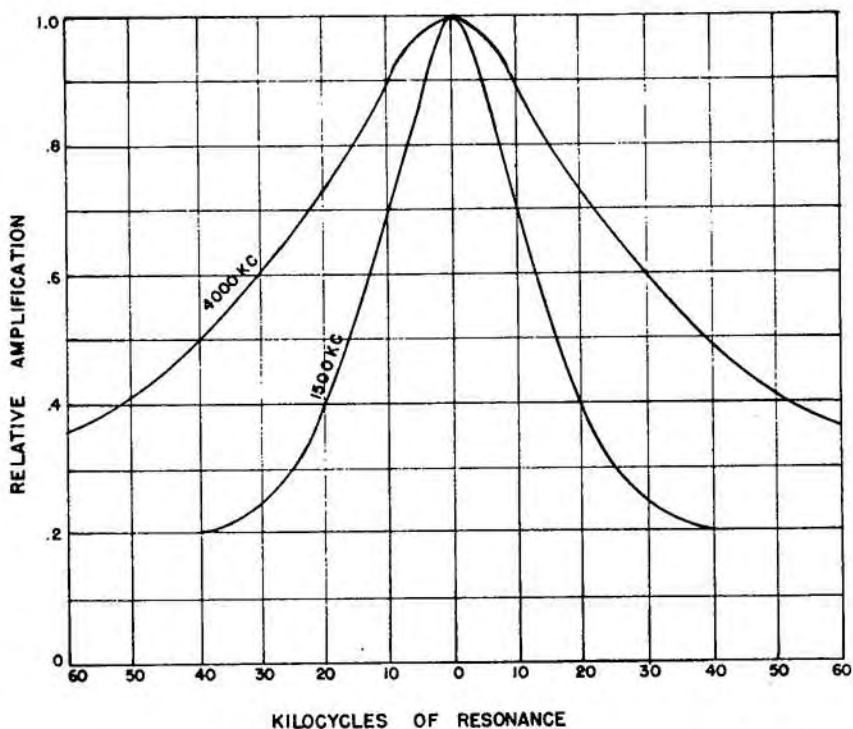
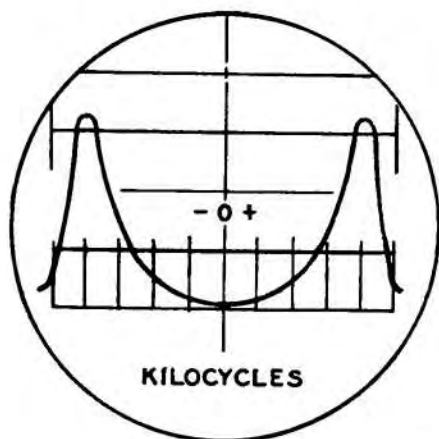


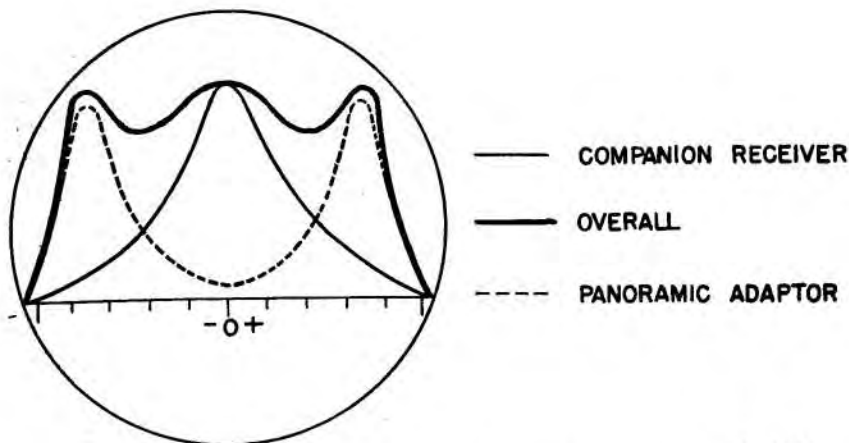
Figure 10. Gain versus frequency curves of typical r-f amplifier in a conventional receiver.

TL 15164



TL15165

Figure 11. Gain versus frequency curve of special band-pass amplifier.



TL 1516a

Figure 12. Over-all gain versus frequency curve of panoramic adaptor.

(a) The isolating resistor prevents undesirable interaction, such as detuning of the receiver, when the adaptor is connected or operated.

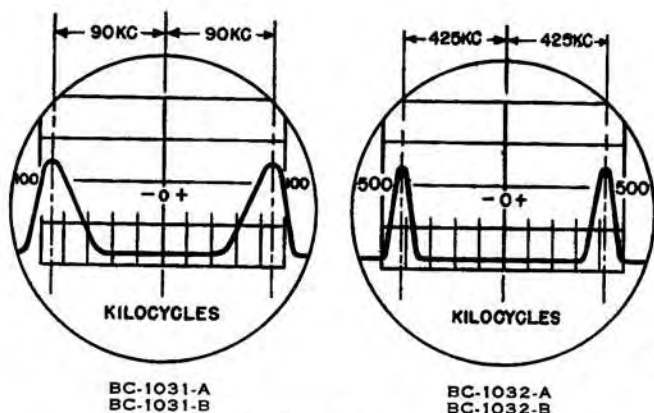
(b) The .01-microfarad (mf) coupling capacitor C17 allows the input signals to enter the transformer primary while blocking any d-c voltage applied to the plate of the mixer tube of the receiver.

(3) INPUT BANDPASS TRANSFORMER T101-01 IN PANORAMIC ADAPTOR BC-1031-A. The L-C combination (primary) of transformer T101-01 in the BC-1031-A is a parallel resonant circuit. The primary is inductively and capacitively coupled (overcoupled) to the secondary, which consists of another L-C parallel resonant circuit. Both primary and secondary are permeability-tuned by means of iron cores. The voltage appearing across the secondary is fed into the grid of Tube JAN-6AC7 (V101), a high-gain pentode.

(a) This transformer is called the input band-pass transformer. Its design and the manner in which it is adjusted are responsible for the unusual gain versus frequency characteristics of the amplifier.

(b) During adjustment, the primary is peaked at a frequency 90 kc *higher* than the mean or center frequency of the band pass. The secondary, on the other hand, is peaked at a frequency 90 kc

lower than the center frequency. For example, if the intermediate frequency of the companion receiver is 455 kc, this frequency will become the center frequency of the band pass. In this case, the primary of T101-01 will be adjusted to peak at 545 kc and the secondary at 365 kc. Figure 13 illustrates the band-pass characteristics of the amplifier when properly adjusted. Refer to paragraph 28c for the step-by-step procedure used in making these adjustments.



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Figure 13. Properly aligned band-pass characteristics.

(4) INPUT BAND-PASS TRANSFORMER T101-02. Transformer T101-02 is the input band-pass transformer for Panoramic Adaptor BC-1032-A (fig. 28). It contains a tertiary winding, a choke coil, and two resistors not found in T101-01. The addition of these parts has been necessary because of the wider sweep-width (1,000 kc) for model BC-1032-A.

(a) The function of both transformers is the same, namely, to provide a band-pass characteristic which amplifies the edges of the band more than the center (fig. 13), thus partly compensating for the input selectivity of the companion receiver which amplifies the center of the band more than the edges. The over-all result is thus an approximately uniform response over the desired band (fig. 12).

(b) The primary of transformer T101-02, during adjustment, is peaked to a frequency of 5.68 mc, which is 430 kc higher than the center frequency (5.25 mc or 5,250 kc) of the band pass. The secondary is peaked to a frequency of 4.83 mc which is 420 kc

lower than the center frequency of the band pass. (Refer to paragraph 28c for adjustment procedure.)

(5) **VOLTAGE DIVIDER.** The d-c operating potentials for the cathode and screen grid of V101 are tapped off a voltage divider which consists of resistors R102, R104, R105, and R106, and potentiometer R103 (GAIN control). This combination of resistances is connected between the positive voltage (+300 volts) and ground.

(6) **GAIN CONTROL.** Potentiometer R103, through which the cathode current flows, controls the transconductance of the tube and in this way serves as a gain control for the adaptor.

(7) **BYPASS CAPACITORS.** Capacitor C101A bypasses the r-f component of cathode current around resistors R102 and R103 to prevent degeneration with its accompanying loss of gain. Capacitor C101B bypasses the rf to ground, placing the screen at ground potential to rf and permitting the screen grid to act as a shield.

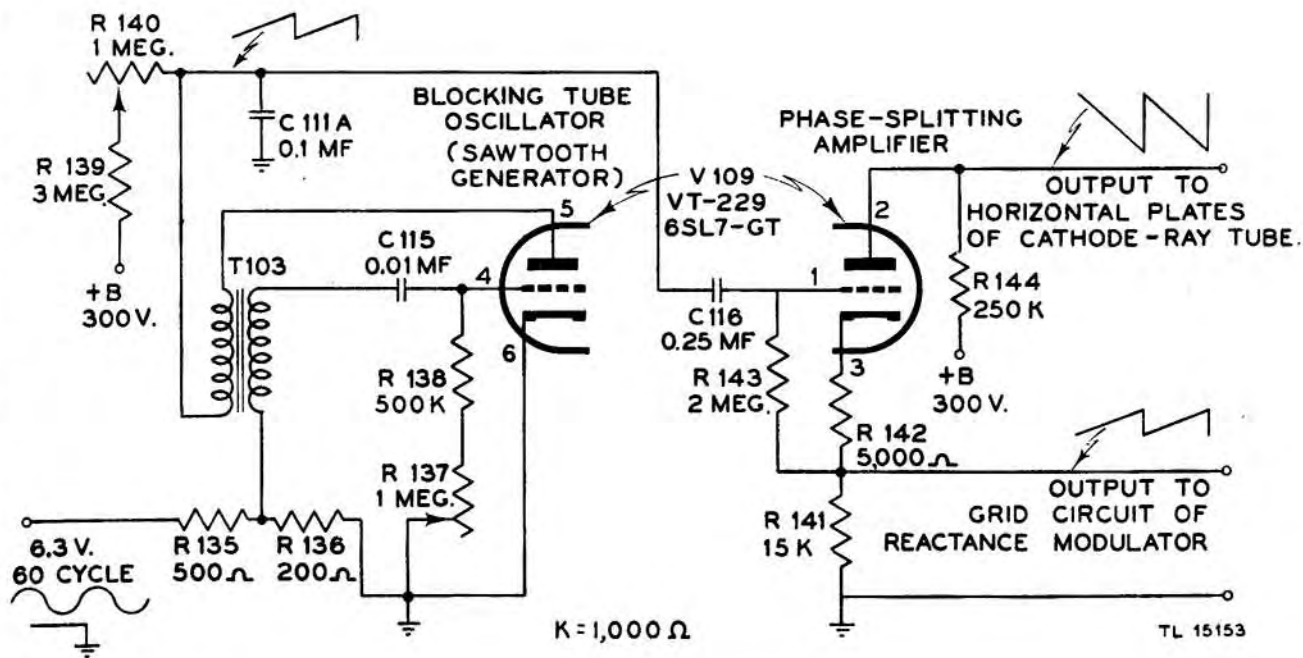
(8) **AMPLIFIER OUTPUT.** The output voltages of the band-pass amplifier appear across the L-C resonant tank (primary of transformer T102-01 or T102-02), which is the impedance in the plate circuit of tube V101.

b. Converter. Tube JAN-6SA7 (V102) serves as the h-f (high-frequency) oscillator tube and at the same time acts as a mixer to combine the output of this oscillator with the output of the band-pass amplifier, thereby producing a resultant difference frequency of 226 kc (5.25 mc for the BC-1032-A) which will pass through the i-f amplifier stage V103 of the adaptor.

(1) **OSCILLATOR SECTION.** The h-f oscillator section of the converter tube employs an electron-coupled series-fed Hartley circuit. The cathode, control grid, and screen-grid operate as a triode, with LC as the oscillatory circuit. Paragraph 16 explains how the frequency of this oscillator is varied by means of a reactance modulator to produce the same effect as if the inductance value of the oscillator coil were continuously varied.

(a) A single coil L is used, part of which is in the screen grid circuit and part in the grid circuit. The screen grid acts as the plate of the triode. Capacitor C is connected across the entire coil. The resonant frequency is determined by the values of L and C. The positive feedback which causes oscillation is due to inductive

Figure 14. Simplified schematic diagram of blocking oscillator and amplifier.



coupling between the part of the coil in the grid circuit and the part in the screen grid circuit. Capacitor C103A bypasses the r-f current around the power supply and places the screen at r-f ground potential to make the return circuit for r-f energy from the screen to the LC oscillatory circuit.

(b) Grid leak resistor R107A provides proper bias for operation.

(c) The oscillator output is taken from the plate of tube V102, the electron stream acting as the coupling medium between the oscillator and the plate output.

(2) MIXER SECTION. The electron stream traveling from the cathode to plate of V102 is affected not only by oscillator action but also by potentials placed on its No. 3 grid. This grid may be considered as a second control grid for the tube. The output voltage of the special band-pass amplifier is passed through transformer T102-01 and is applied to the No. 3 grid of V102. The output of the mixer stage is coupled to the 226-kc i-f amplifier of the adaptor.

(a) Transformer T102-01 in Panoramic Adaptor BC-1031-A is almost identical to transformer T101-01. It is called the output band-pass transformer. Just as in the case of the input band-pass transformer, the design and adjustment of this output transformer causes the edges of the band to be amplified more than the center thus assisting in the compensating effect. Its primary circuit is also adjusted at a peak 90 kc *higher* than the center frequency and its secondary is peaked 90 kc *lower* than the center frequency. Permeability tuning is used.

(b) Transformer T102-02 serves the same function in the BC-1032-A as transformer T102-01 serves in the BC-1031-A. During adjustment, its primary is peaked at a frequency 430 kc *higher* than the center frequency of 5.25 mc and its secondary is peaked at a frequency 420 kc *lower* than the center frequency.

15. BLOCKING OSCILLATOR AND AMPLIFIER.

Figure 14 shows a simplified schematic diagram of the saw-tooth generator which consists of a blocking oscillator and a phase-splitting amplifier. Waveforms of voltages resembling those obtainable by the use of a test oscilloscope are shown at various

points on the diagram. Two outputs are taken from the amplifier: a cathode output which is a saw-tooth voltage of low amplitude (applied to the grid circuit of the reactance modulator), and a plate output which is an inverted saw-tooth voltage of greater amplitude (applied to the horizontal deflection plates of the cathode-ray tube).

a. Blocking Oscillator. A blocking oscillator is one which cuts itself off after one or more cycles because of the accumulation of a negative charge on the grid capacitor. When the grid swings positive with respect to the cathode, electrons are attracted to the grid and accumulate on the side of the grid capacitor nearest the grid. Since these electrons cannot return to the cathode through the tube, they must return through the grid-to-cathode resistor. If this resistor is sufficiently large, electrons will accumulate on the capacitor faster than the resistor is able to return them. In this manner, a negative charge is built up at the grid which will bias the tube beyond cut-off. After the tube is cut off, it provides no additional electrons to the grid capacitor. However, the capacitor continues to discharge through the resistor, and a point is reached eventually where the tube again conducts. Then the process repeats and the tube becomes an intermittent oscillator. The frequency of the oscillations is determined by the inductance, capacitance, and resistance constants in the circuit. The rate of recurrence of operating conditions (recurrence frequency) is determined primarily by the RC time constant of the grid circuit.

(1) The saw-tooth generator of the adaptor uses a single-swing blocking oscillator whose output is taken off across a capacitor C111A in the plate circuit. An external 60-cycle, a-c voltage is injected into the grid circuit to synchronize the recurrence frequency at a submultiple of the frequency of the power source. This type of oscillator is known as a single-swing oscillator because the plate current of the tube is cut off at the completion of one cycle of oscillation.

(2) Theoretical curves of voltage and current (theoretical representations) are shown in figure 15 to help clarify the operation of the oscillator circuit shown in figure 14. The circuit consists of a transformer-coupled feedback oscillator, with capacitor C115 in series with one of the grids of V109. This tube is a dual triode. *Disregarding the 6.3-volt, a-c synchronizing voltage for the time*

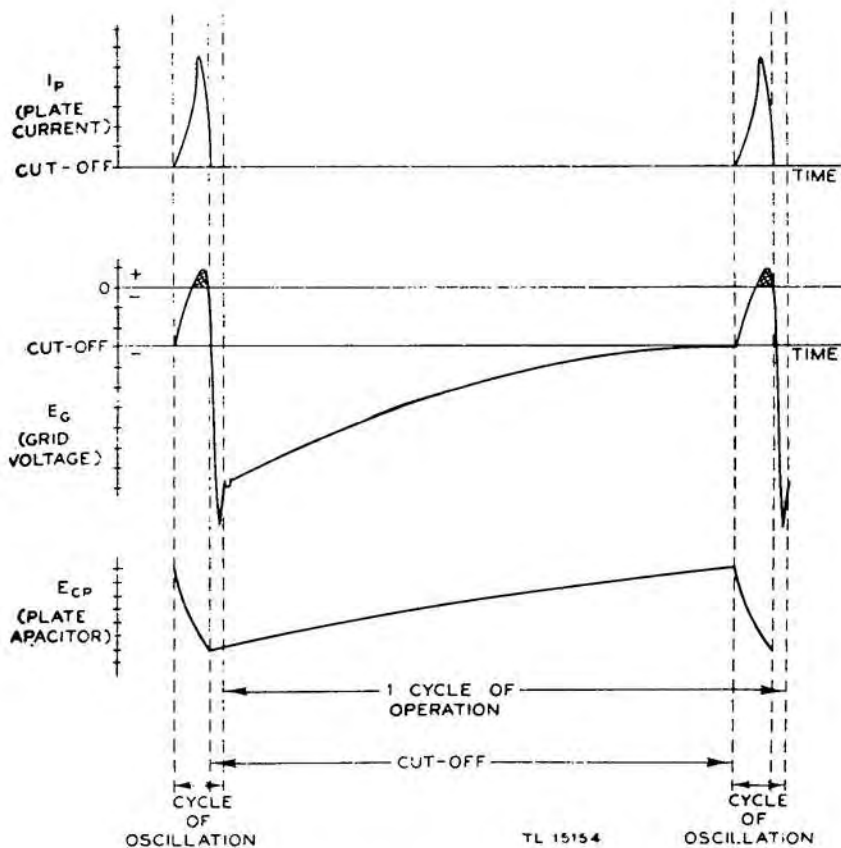


Figure 15. Theoretical current and voltage waveforms of blocking oscillator.

being, assume that grid capacitor C115 has been negatively charged by a preceding cycle. The tube, therefore, is biased well below cut-off. As the charge on the grid capacitor leaks off through grid resistors R138 and R137, the biasing voltage is reduced to the point where the tube begins to conduct.

(3) As plate current starts to flow, a magnetic field is set up around the plate winding of transformer T103. This field builds up from zero to a maximum in direct proportion to the plate current, and therefore induces a voltage in the grid winding of T103. This voltage is impressed upon the grid of the tube through grid capacitor C115 with a polarity that drives the grid more and more positive, as the field in the plate winding is building up. The tube and circuit constants have been chosen so that the grid of the tube

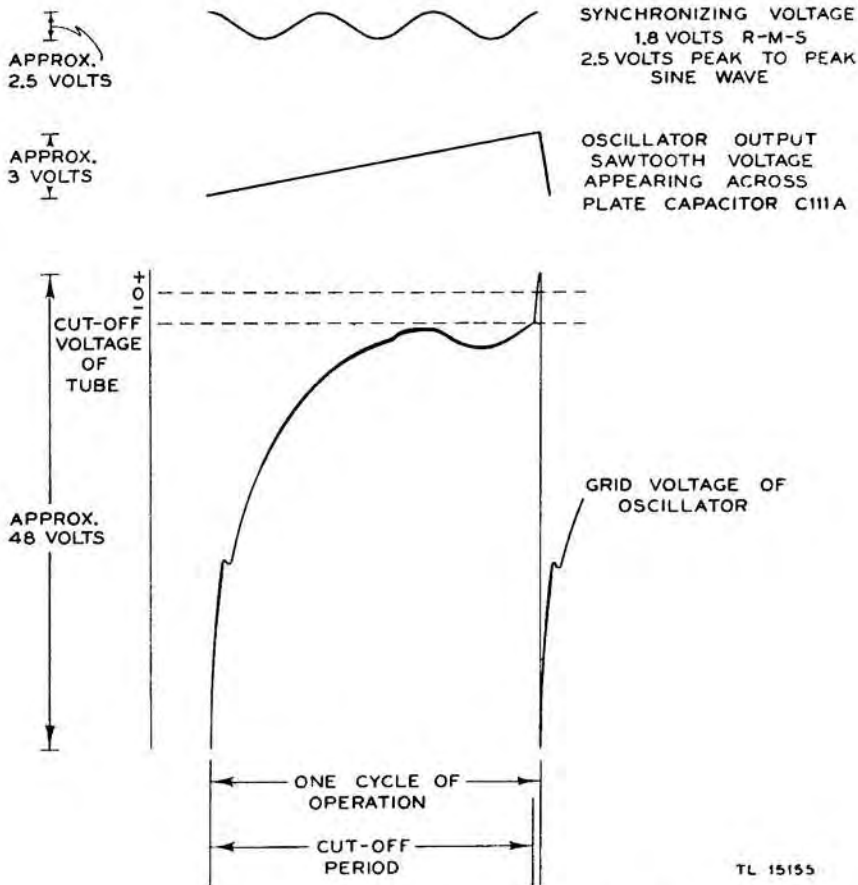


Figure 16. Actual current and voltage waveforms of blocking oscillator.

is driven positive by the induced secondary voltage. The grid, when driven positive with respect to the cathode, draws current, and electrons accumulate on the plate of the grid capacitor nearest the grid. As plate current reaches saturation or a point where there can be no further increase in plate current, the field in the plate winding also ceases to increase.

(4) For an instant there is no induced voltage in the grid winding and because no charging potential is applied, the capacitor begins to discharge through resistors R137 and R138. This discharge causes the positive potential on the grid to become less positive, causing less plate current to flow in the plate winding, and the field around the plate coil starts to collapse. This collapsing field, in

turn, induces a voltage in the grid winding in the reverse direction, causing the grid to become more and more negative. This process continues until the grid is driven beyond cut-off, thus completing a cycle of operation. Oscillation does not start again immediately, however, because the grid-current flow, when the grid is positive, builds up enough charge on the grid capacitor to maintain cut-off until a large portion of the charge leaks off through the grid resistor.

(5) Capacitor C111A in the plate circuit receives a charge through resistors R139 and R140 during cut-off. It only receives approximately 30 percent of its full charge, however, because the RC time constant of capacitor C111A and resistors R139 and R140 is very long (approximately $2/5$ second) in comparison with the recurrence frequency of the oscillator (approximately $1/30$ second). When plate current flows during the cycle of operation, the charging voltage on this capacitor is suddenly driven more negative due to the voltage drop caused by high current through resistors R139 and R140 and the capacitor quickly discharges through the low impedance presented by the plate winding of T103 and tube V109. An advantage is gained by restricting the charge of capacitor C111A to 30 percent of maximum since any capacitor will increase its charge more linearly during the early part of its charging period. In this way a more linear saw-tooth voltage is developed. The voltage across capacitor C111A is capacitively coupled to the grid of the amplifier stage.

(6) Since the recurrence frequency of the oscillator is dependent on the value of the grid resistor, R137 (SYNCH. control) is made variable and may be used as a means of regulating this recurrence frequency.

(7) Potentiometer R140 (HOR. SIZE control) affects the amplitude of the generated saw-tooth voltage by controlling the plate voltage applied to the oscillator. In addition, it also affects the time constant of the RC combination of capacitor C111A and resistors R139 and R140.

(8) Resistors R135 and R136 form a voltage divider to lower the a-c synchronizing voltage injected in the grid circuit to approximately 1.8 volts (rms). This voltage, which is a sine wave, has the same frequency as the power source. Its injection into the grid circuit causes the tube to conduct periodically at a submultiple

frequency of the power source. R137 is usually adjusted so that conduction takes place at a frequency one half or one third that of the power source. For example, if the power source is 60 cycles per second the frequency of conduction may be adjusted to 20 cycles per second. If so, three cycles of the synchronizing voltage will occur during each complete cycle of operation (fig. 16). Without an applied synchronizing voltage during the cut-off period, the voltage on the grid of the tube will increase approximately 48 volts from its most negative point before plate current flows. The application of the small amount of a-c synchronizing voltage superimposed on the normal grid voltage forms a resultant grid voltage equal to the algebraic sum of the two voltages. When the synchronizing voltage is passing through its three negative half-cycles, the rate of increase of grid voltage is slowed down. When the synchronizing voltage is passing through its positive half-cycles, the rate of increase of grid voltage is speeded up. While the synchronizing voltage is passing through its first two cycles, it will not cause plate current flow since the resultant grid voltage is still below cut-off. During the positive swing of its third cycle, however, the resultant voltage is sufficient to start the flow of plate current. In this way, the superimposition of the synchronizing voltage on the normal grid voltage causes the plate current to flow periodically in synchronism with a submultiple of the frequency of the power source. This action of the synchronizing voltage is called "triggering".

(9) Actual waveforms are shown in figure 16. The time consumed by the rise and fall of plate current is determined by the inductance and resistance of the transformer. The time between pulses is determined primarily by the value of resistance and to some extent by the capacitance in the grid circuit. When these RC grid circuit constants are correct, the synchronizing voltage will cause periodic recurrence at the desired frequency. The superimposition of the synchronizing voltage can be observed in the grid voltage waveform shown in figure 16. Note the rises and dip in grid voltage just before the time of plate current flow.

b. Phase-splitting Amplifier. The output saw-tooth voltage of the oscillator is coupled to the grid of the amplifier through capacitor C116. This amplifier has two output voltages as illustrated in figure 14.

(1) Any ordinary vacuum tube used as a conventional amplifier has an output of opposite polarity to the input. In other words, a positive-going voltage on the grid produces a negative-going voltage at the plate, and vice versa. However, in most applications of the vacuum tube, the output voltage at the plate has an amplitude greater than that of the input voltage.

(2) The phase-splitting amplifier used in the panoramic adaptor employs a circuit which converts a single input voltage to a double output; one output being the normally amplified and inverted voltage at the plate, and the other output being a voltage of the same polarity and waveshape, but having slightly less amplitude than the input voltage. This output is taken from a tap on the cathode resistor and is developed in the following manner:

(a) As the input voltage on the grid of the tube increases from negative to positive, the current flowing through the cathode and plate circuits increases. This increase of current flow through the cathode resistance (R141, R142), which has no bypass capacitor, causes an increasing voltage drop across each of the two resistors. The output voltage across resistor R141 therefore follows the grid voltage input. The term "cathode follower" is often used to describe this circuit.

(b) The operating bias for class A amplification is obtained by the voltage developed across resistor R142.

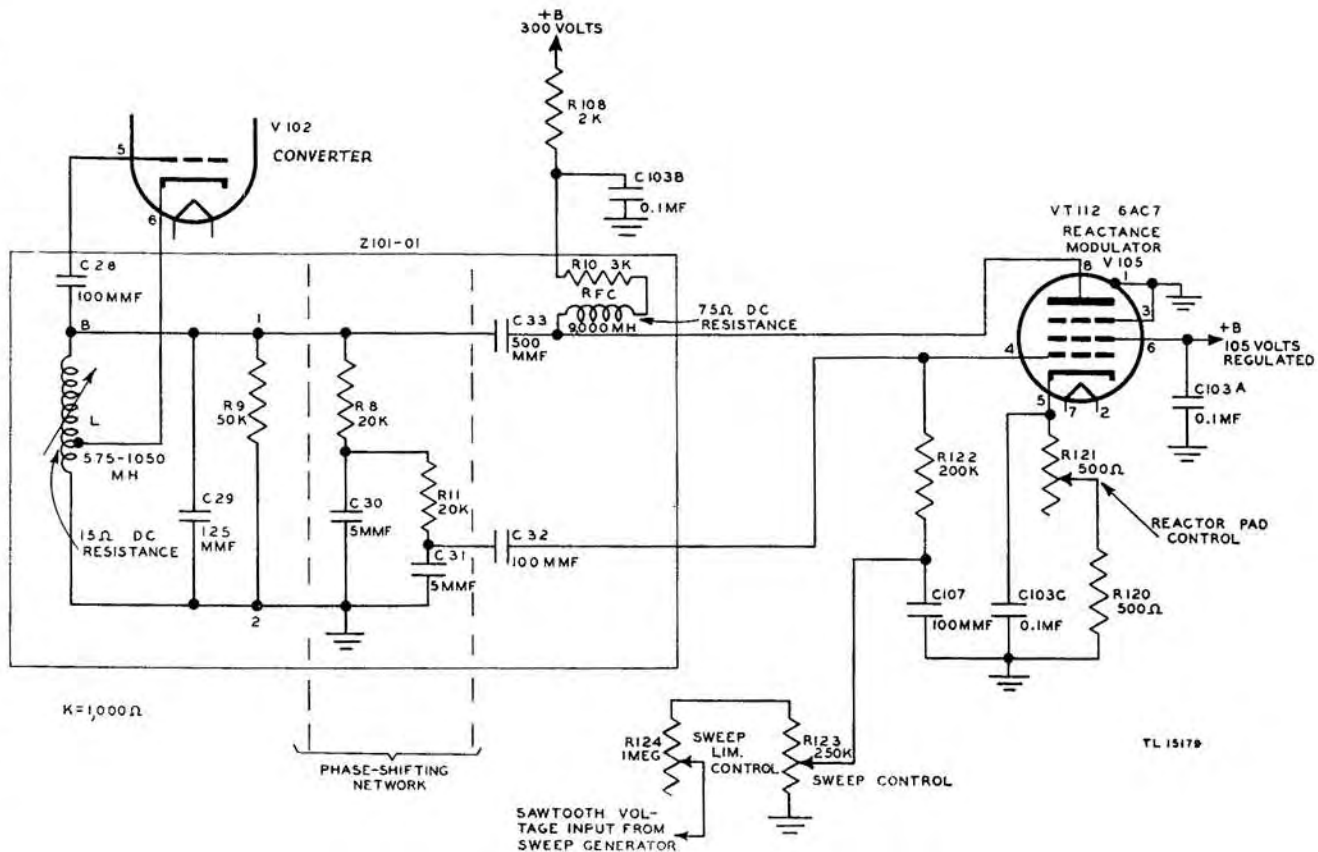
(3) Resistor R143 is the grid resistor and R144 is the plate load resistance.

(4) The plate output is coupled to the horizontal deflection plates of the cathode-ray tube and produces the horizontal sweep. The cathode output is coupled to the grid circuit of the reactance modulator tube V105 where it makes possible frequency modulation of the high-frequency oscillator in synchronism with the horizontal sweep voltage.

16. REACTANCE MODULATOR (fig. 17).

a. **General.** The reactance modulator or reactor tube, JAN-6AC7 (V105), under control of the saw-tooth voltage from the blocking oscillator, varies the h-f oscillator frequency linearly and periodically from 781 to 581 kc. Frequency of oscillation of the panoramic

Figure 17. Simplified schematic diagram of reactance modulator.



h-f oscillator is varied by shunting the tuned circuit (C29 and L) with *effective* inductance. This effective inductance is applied to the tuned circuit by the reactor. The value of the effective inductance is proportional to the instantaneous potential on the grid of the reactor. When a saw-tooth voltage is applied to the grid of the reactor, the instantaneous grid potential is varied at a linear rate, which, in turn, varies the effective inductance shunted across the tuned circuit. Consequently the frequency of the local oscillator is varied at a linear rate.

b. Reactance and Frequency. The effect of inductive and capacitive reactance on current and voltage is of importance in understanding the operation of the reactance modulator.

(1) Inductive reactance in addition to increasing as the frequency is increased has another effect: it not only opposes the flow of alternating current, but also causes the current to *lag* a fraction of a cycle (90°) behind the applied voltage.

(2) Capacitive reactance has just the opposite effect: it causes the current to lead the voltage by a fraction of a cycle (90°).

(3) At the resonant frequency of any L-C combination, the lagging current of the inductor and the leading current of the capacitor cancel out, because the reactance value of the inductor and capacitor are equal, the rate of current flow through each element is the same, and the voltage drop across each element is identical.

(4) In a frequency-determining L-C tank circuit, such as used in the high-frequency oscillator of the adaptor, one important property of the inductor is its ability to affect the current flow, as explained above. A reactance modulator circuit is so designed that it may also be used to affect the current flow in an L-C circuit, giving the same effect as if the inductance value were changed. For example, a lagging current at the resonant frequency of the L-C circuit is developed in the reactance modulator. This *lagging* current is injected into the L-C tank circuit where it is superimposed on the normal tank current. In this way the total lagging or inductive current in the L-C circuit will not equal the leading capacitor current at the original resonant frequency of the L-C combination, but instead will cause the tank circuit to resonate at another

frequency where the lagging and leading currents are again equal. The frequency change caused by the injected current is dependent on the *amount* of injected current. Thus by controlling the amount of injected current produced by the reactance modulator, the frequency at which the L-C circuit resonates can also be controlled; and since the oscillator frequency is, in turn, dependent on the resonant frequency of the L-C combination, the oscillator frequency is likewise governed. The methods used in developing, injecting, and controlling this lagging current are explained in subparagraph **c** below.

c. Circuit of Reactance Modulator. Figure 17 shows a simplified schematic diagram of the reactance modulator used in Panoramic Adaptor BC-1031-A. All other models of adaptors use a similar circuit.

(1) The reactance modulator tube (V105) operates as a class A amplifier and is so biased by the voltage drop across the cathode resistors R121 and R120. Capacitor C103C is a cathode bypass capacitor.

(a) The screen grid of this tube operates at ground potential for ac, capacitor C103A being the screen grid bypass capacitor.

(b) The plate of tube V105 receives voltage from the +300-volt power supply through resistors R108 and R10, and the radio-frequency choke (rfc) coil. Resistor R108 and capacitor C103B form a decoupling network to isolate the circuit from the power supply.

(2) The control grid receives two a-c voltage inputs. One input is a high-frequency voltage from the composite coil Z101-01 which is coupled through capacitor C32. The other input is the saw-tooth voltage from the sweep generator. For the time being, assume that potentiometer R123 is turned completely counterclockwise so that no saw-tooth voltage input is impressed on the control grid.

(3) Coil L and capacitor C29 can also be assumed to be the basic tank circuit of the high-frequency oscillator tube V102, corresponding to L and C in figure 9. The shunt resistor R9 lowers the Q of the tank circuit and has very little influence on the resonant frequency.

(4) Tank voltage across points 1 and 2 in figure 17 causes a cor-

responding current flow in the series-parallel combination of resistors R8 and R11 and capacitors C30 and C31 (phase-shifting network). This current, because of the capacitance in the circuit, is out of phase with the tank voltage. Part of the total current in this combination flows through the R11, C31 branch and has a phase relationship which causes the voltage across C31 to lag the voltage across the tank circuit. This lagging voltage is coupled through capacitor C32 to the grid of the reactance modulator tube V105 and will be called the r-f component on the grid. The frequency of the r-f component will, of course, be the same as the resonant frequency of the tank but will *always* lag the tank voltage.

(5) Since in any vacuum tube amplifier, the plate current is in phase with the grid voltage, the plate current flow of V105 will also lag the tank voltage. This lagging plate current is then coupled back through capacitor C33, a blocking capacitor, and causes a *lagging* current to be injected into the tank circuit. The injection of this lagging current, as explained in paragraph 16b(4), causes the resonant frequency of the tank circuit to change, and the high-frequency oscillator to operate at a new frequency.

(6) As also stated in paragraph 16b(4), the *amount* of injected current determines at what frequency the oscillator will operate. Since plate current in any class A amplifier may be increased or decreased, within limits, by variation of the grid bias voltage, it follows that a variable grid bias voltage will also cause a variable plate current. The voltage used in the reactance modulator tube for this purpose is the saw-tooth voltage from the sweep generator. This voltage, which varies linearly with time (fig. 8), is impressed on the grid and causes a corresponding linear variation in the amount of plate current flow. In this way the amount of plate current injected into the tank circuit varies to produce a linear change in the frequency of the high-frequency oscillator.

(7) The amount of reactance modulation is thus controlled by the voltage on the grid of the tube. The sweepwidth of the oscillator, therefore, is controlled by the amplitude of the saw-tooth voltage. Resistances R124 and R123 are potentiometers which act as a voltage divider, by means of which the amplitude of the saw-tooth voltage may be adjusted.

(8) Coil L is permeability-tuned and is adjusted so that the desired mean or center frequency of the oscillator may be obtained. For example, the mean frequency of the oscillator in Panoramic Adaptor BC-1031-A is 681 kc, assuming a center frequency of 455 kc as the input to the band-pass amplifier from the companion receiver. The oscillator, when the amplitude of the saw-tooth voltage is correctly adjusted, will sweep 100 kc above and below this mean frequency. Since potentiometer R121 also controls the bias on the grid, it may also be adjusted to control the mean frequency of the oscillator within small limits.

(9) The adjustable controls on models BC-1031-A and BC-1032-A are as follows:

- (a) Potentiometer R121.....REACTOR PAD.
- (b) Potentiometer R123.....SWEEP.
- (c) Potentiometer R124.....SWEEP LIM.

17. I-F AMPLIFIER, DETECTOR, AND VIDEO AMPLIFIER.

a. I-f Amplifier (fig. 27). The i-f amplifier selects the 226-kc (912 kc for BC-1032-A) mixer output and increases its amplitude. A Tube JAN 6SG7 (VT-211), remote cut-off r-f pentode is used. The mixer stage i-f signal appearing across the primary of transformer Z102-01 (Z102-02 in BC-1032-B) is resonated by capacitor C24 and inductively coupled to the secondary winding where the signal is again resonated by capacitor C25. Capacitor C103B and resistor R108 form a plate load decoupling network for tube V102 while capacitor C104C and resistor R113 serve the same purpose for tube V103. Cathode bias is provided by resistor R109. C104A is the cathode bypass capacitor and capacitor C104B is the screen grid bypass capacitor for tube V103. Resistors R111 and R112 in series with potentiometer R110 serve as the screen grid voltage-dropping resistance. Potentiometer R110 is the I.F. GAIN control for the adaptor. The primary and secondary of transformer Z102-01 (Z102-02 in BC-1032-A) are permeability-tuned by means of adjustable iron cores. The output of the i-f amplifier is coupled to the detector by means of transformer Z103-01 (Z103-02 in BC-1032-A), which is identical to the i-f input transformer.

b. Detector. The detector uses one diode section of tube V104 which is a JAN 6SQ7 (VT103) duplex diode, high- μ triode. The diode rectification of the 226-kc signal appearing across the secondary of transformer Z103-01 (Z103-02 in BC-1032-A) causes the video component of this signal to appear across the diode load resistor R114 with capacitor C105 bypassing the i-f component to the chassis ground. The video signal voltage across the load resistor is direct-coupled to the triode section of V104 which operates as a straight amplifier. Direct coupling allows the control grid of the triode section of the tube to be biased by the d-c component across the diode load resistor R114. It is often called a diode-biased system. In addition, the elimination of a coupling capacitor by the use of direct coupling prevents loss of gain at low modulation frequencies and in this way prevents a shift in average bias with changes in average signal content.

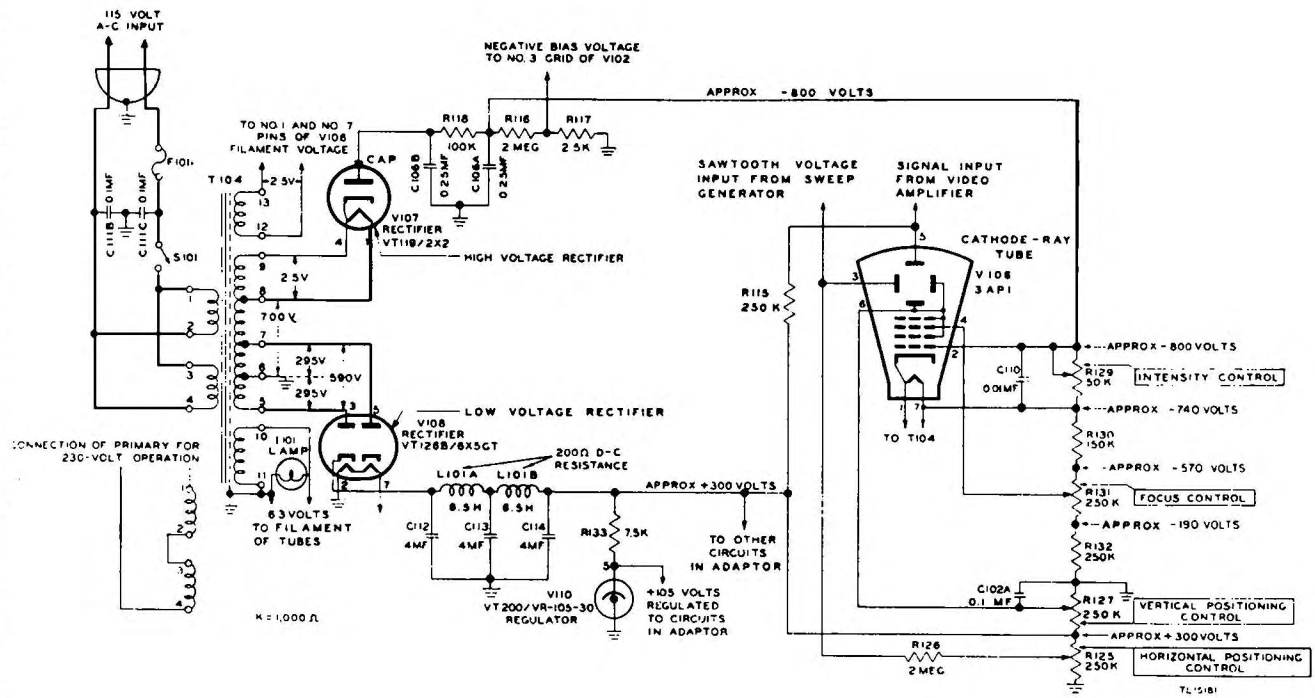
c. Video Amplifier. The rectified video component of the signal voltage which appears at the grid of this amplifier is a negative-going voltage which is inverted and amplified by the triode section. Resistor R115 is the plate load resistance and resistor R145 limits the voltage gain of the amplifier stage to a desired value. The positive-going signal voltage at the plate of V104 is direct-coupled to the upper vertical deflection plate of the cathode-ray tube and attracts the negative stream of electrons, causing a vertical deflection to appear above the baseline or horizontal sweep on the fluorescent screen. This amplifier, called a video amplifier, has a wide frequency response. Good low-frequency response allows the signals to deflect the electron beam vertically, only on one side of the baseline; high-frequency response insures a well-defined separation (resolution) between stations appearing on the screen.

18. OSCILLOSCOPE CIRCUIT.

Visual indications of stations picked up on the antenna appear on the fluorescent screen of the oscilloscope as triangular marks.

a. The cathode-ray tube consists of a number of elements operating at high d-c potentials. When these steady d-c potentials are applied in a proper ratio, they cause the electrons emitted from the cathode to be accelerated to a high velocity and focused into a sharp beam. This high velocity electron beam continues toward

Figure 18. Simplified schematic diagram of rectifier power supplies and cathode-ray tube.



the face of the tube and strikes a phosphorescent coating, causing a green glow to appear as a single bright spot on the screen of the tube. In the cathode-ray tube are two sets of parallel plates through which the electron beam passes; one set, called the vertical deflection plates, causes the spot to be deflected up and down on the screen when an external a-c voltage is applied to the vertical plates. The other set of parallel plates, called the horizontal deflection plates, causes the spot to be deflected from side to side when an external a-c voltage is applied to these plates. When the movement of the spot is rapid enough and repeats itself often enough, it appears to be a continuous line or pattern on the screen.

b. In the panoramic adaptors, the horizontal movement of the electron beam is controlled by the voltage output of a saw-tooth generator. Figure 8(A) shows an inverted saw-tooth voltage waveform. The application of this voltage to the horizontal deflection plates causes the electron beam to move steadily from the left to the right side, across the face of the tube, and then return almost instantly to its starting position. The frequency of the saw-tooth voltage developed in the adaptor is usually adjusted to 30 cycles per second and at this speed the bright spot appears as a luminous horizontal line (fig. 8(B)). This line is called the baseline. The length of the line is adjusted by varying the amplitude of the saw-tooth voltage which is applied to the plates.

c. The output of the saw-tooth generator also controls the frequency sweep of the panoramic oscillator. Thus, the frequency sweep and the horizontal trace line are in synchronism. Any signal which is received when the oscillator frequency passes a *particular point*, appears as a vertical mark on the horizontal trace line at the corresponding point of the horizontal sweep.

d. In addition to the saw-tooth voltage and signal voltages which are applied to the deflection plates of the cathode-ray tube, several fixed d-c potentials are necessary for the proper operation of this tube (fig. 18). D-c potentials must be impressed on the cathode, intensity or control grid, and the focusing and accelerating anodes, in order to concentrate the electrons into a sharp beam which will pass through the deflection plates and strike the fluorescent screen. Positioning voltage is also necessary on both the vertical and horizontal deflection plates so that the beam or pattern on the screen may be properly centered.

(1) Potentiometers R129 and R131 in series with resistors R130 and R132 act as a voltage divider between the -800 -volt high-voltage rectifier output and the chassis ground. Potentiometers R127 and R125 across each of which is impressed a $+300$ -volt potential, serve as positioning controls.

(2) The electron emitter, or cathode, of V106 is impressed with a high negative voltage between approximately -740 volts and -800 volts, the exact voltage depending on the setting of the intensity control R129. In addition to affecting this voltage, potentiometer R129 also controls the potential difference between the cathode and the intensity grid. By making this difference of potential greater, the grid becomes more negative than the cathode and reduces the amount of electron flow, and thus the amount of illumination on the fluorescent screen. Conversely, when the potential difference is decreased, the grid becomes less negative in respect to the cathode and a greater number of electrons pass through the tube to the screen.

(3) The electrons, after leaving the cathode and passing through the intensity grid, are greatly accelerated by the high positive potentials impressed on the focusing and accelerating anodes.

(a) The focusing anode is operated at a potential approximately 400 volts more positive than the cathode. The exact impress voltage necessary for normal focusing of the electron beam may be obtained by adjustment of potentiometer R131, the FOCUS control.

(b) The accelerating anode is operated at a d-c potential which is approximately $1,000$ volts more positive than the cathode. Since the cathode in the adaptor is impressed with a voltage of approximately -800 volts negative with respect to the chassis ground and the accelerating anode is impressed with a voltage of approximately $+200$ volts with respect to the chassis ground, the difference between the two voltages is about $1,000$ volts.

(4) The vertical positioning (and horizontal positioning) of the electron beam or pattern on the screen of the cathode-ray tube is made possible by adjustment of the applied d-c potential on these plates. Potentiometer R127, the VERT. POS. control, is made variable to serve this purpose.

(5) Horizontal positioning is likewise controlled by means of potentiometer R125, the HOR. POSITION control.

(6) C110 and C102A are decoupling capacitors.

19. POWER SUPPLY.

The adaptor is designed to operate from 115- or 230-volt, 50/60-cycle alternating current. The a-c power source is applied to the primaries of transformer T104 through fuse F101 and switch S101, the POWER ON-OFF switch of the adaptor (fig. 1). Capacitors C111B and C111C act as line filters to prevent interference from entering the adaptor through the power connections. The transformer primaries are connected in series (fig. 18) when the power source is 230 volts and are connected in shunt (fig. 18) when the power source is 115 volts. The secondary windings of transformer T104 supply the a-c voltages for the high and low voltage rectifiers, as well as the filament voltages for the various tubes in the adaptor. The circuit shown in figure 18 is a simplified schematic diagram of the power supply and cathode-ray tube in Panoramic Adaptor BC-1031-A or BC-1032-A. Section IV explains the differences between these models and Panoramic Adaptors BC-1031-B and BC-1032-B.

a. High-voltage Rectifier. Rectifier Tube JAN 2X2 (VT-119), V107, is used as a half-wave rectifier for the high-voltage supply, which furnishes the necessary operating potentials for the cathode-ray tube. In addition, this rectifier supplies a low value of negative bias voltage for the No. 3 grid of the mixer tube, V102.

(1) The filament of the tube is heated by application of 2.5 volts from a low-voltage secondary winding on transformer T104.

(2) Another secondary winding on T104 provides a source of 700 volts and is connected between the filament of tube V107 and the chassis ground. On the negative half-cycles of this a-c voltage, tube V107 conducts, the circuit being completed through resistors R118, R116, and R117.

(3) Capacitors C106B and C106A together with resistor R118 form an R-C filter which eliminates much of the ripple voltage from the output of the rectifier.

NOTE: Extremely low current drain permits use of this R-C filter which has a sufficiently high time constant to hold a charge almost in its entirety during the negative alternation of the input cycle.

(4) The two output voltages are tapped off the voltage divider R118, R116, and R117.

(5) The output power of this rectifier is characterized by high voltage and low current.

b. Low-voltage Rectifier (fig. 18). Tube JAN 6X5GT (VT-126B), V108, is a full-wave rectifier tube employed in the low-voltage power supply. This rectifier furnishes a +300-volt d-c potential to various circuits in the adaptor as well as horizontal and vertical positioning voltages for the cathode-ray tube. In addition, it supplies regulated +105-volt, d-c potential for the plate of V101 and the screen grids of V102 and V105.

(1) The anodes of tube V108 are connected across a 590-volt winding of transformer T104, the center-tap connection on this winding being grounded.

(2) The output voltage of the rectifier is well filtered by an L-C capacitor-input network, consisting of capacitors C112, C113, C114, and choke coils L101A and L101B.

(3) The output power of this rectifier is characterized by low ripple voltage and good regulation.

(4) The +300-volt output is impressed across resistor R133 and tube V110, a gas regulator Tube JAN 0C3/VR-105 (VT-200). This tube maintains a constant voltage drop of 105 volts across its terminals. The operation of the tube is relatively simple. As the voltage across the tube tends to increase, the internal resistance of the tube decreases; thus more current is drawn through the series resistor R133, and the voltage across the tube is maintained at a constant level. Conversely, if the voltage across the tube tends to decrease, the internal resistance increases, less current is drawn through the series limiting resistor, and again the voltage across the tube remains constant. The starting voltage necessary to bring the tube to the point of conduction is somewhat higher than the operating voltage. The tube has upper and lower limits of current flow through it, namely, 30 milliamperes and 5 milliamperes.

SECTION IV

PANORAMIC ADAPTORS BC-1031-B AND BC-1032-B

20. GENERAL.

Basically, Panoramic Adaptor BC-1031-B has the same characteristics as model BC-1031-A, and model BC-1032-B has the same characteristics as model BC-1032-A. Panoramic Adaptors BC-1031-B and BC-1032-B are more recent models and contain modifications not found on models BC-1031-A and BC-1032-A. This section explains these modifications.

21. OPERATING CONTROLS.

The operating controls of the B models are slightly different from the A models. See note.

a. I-f Gain Control. The i-f gain control on the B models cannot be adjusted from the front panel since it is located on the chassis directly in front of the reactor pad control. (Refer to figure 21; the i-f gain control is marked R110 and the reactor pad is marked R119.)

b. Location of Horizontal Positioning Control. On the B models, the HOR. POSITION control is located behind one of the snap covers on the front panel (fig. 1 (B)) and is adjusted by means of a screwdriver.

NOTE: The front panel controls for adaptors delivered on Order No. 639-Phila-45 are labelled differently although their functions remain unchanged. The main differences are: SWEEP control changed to SWEEP WIDTH FACTOR control. SWEEP LIMIT control changed to SWEEP WIDTH LIMIT control. HOR. SIZE control changed to BASELINE SIZE control. INTENSITY control changed to BRILLIANCE control.

c. Center-frequency Control. The addition of the CENTER FREQ. control (fig. 1 (B)) permits fine adjustment of the signal trace at center frequency as observed on the screen of the adaptor. This control R123 (fig. 30) acts as a vernier for the reactor pad control R119 (fig. 30). It allows accurate adjustment of the cathode bias voltage for reactor tube V107. The method of adjusting the adaptor for center frequency is detailed in section V.

d. Horizontal Size Control. This control (HOR. SIZE) performs the same function on all models of adaptors. On the B models, however, this control R152 (fig. 30) has a different resistance value and is connected into the circuit differently. The HOR. SIZE control, R140, on the A models (fig. 27) regulates the plate voltage applied to the blocking oscillator tube V109. On the B models, the value of resistor R150 (fig. 30), a fixed resistor, permits the proper plate voltage to be applied to the blocking oscillator tube V111. The fixed grid resistor R143 (fig. 27) of the A models has been replaced by a potentiometer, R152, in the B models (fig. 30). This potentiometer permits the horizontal size of the baseline on the screen of the cathode-ray tube to be adjusted by controlling the amplitude of the saw-tooth voltage applied to the grid of the phase-splitting amplifier tube V111 (fig. 30).

22. CATHODE-RAY TUBE, PHASE INVERTER, AND AUTOMATIC AMPLITUDE CONTROL.

a. Cathode-ray Tube. Panoramic Adaptors BC-1031-A and BC-1032-A use a type 3AP1 cathode-ray tube, whereas models BC-1031-B and BC-1032-B use a type 3BP1 tube. The difference between the two types of cathode-ray tubes lies in the method of connecting the deflection plates. Figures 27 and 30 illustrate these differences. The common connection between one vertical plate, one horizontal plate, and the accelerating anode for type 3AP1 makes it necessary to use nonsymmetrical (single-ended) deflection for both vertical and horizontal plates. This results in a certain amount of distortion, which can be avoided by applying equal and opposite deflecting voltage to each plate of a given pair of plates, or in other words, through the use of push-pull balanced deflection. In the 3BP1 tube, each deflecting plate has a separate lead coming through the envelope which permits this balanced deflection.

b. Phase Inverter. An additional tube, V108, is added in the B models to provide the balanced deflection voltage. This tube (V108) is a twin triode, high μ amplifier type JAN 6SL7GT (VT-229). The

value of circuit constants and the circuits used (figs. 19, 29, and 30) allow the two triode sections of the tube to function as phase inverters. One triode section supplies balanced deflecting voltage for the vertical deflecting plates, while the other supplies balance deflecting voltage for the horizontal plates. These phase-inverters do not increase the gain. Their only function is to provide the two deflecting voltages, simultaneously, that are equal in value but opposite in phase. In other words, they permit push-pull action on oscilloscope plates. The potential on one plate decreases as the potential on the other plate increases.

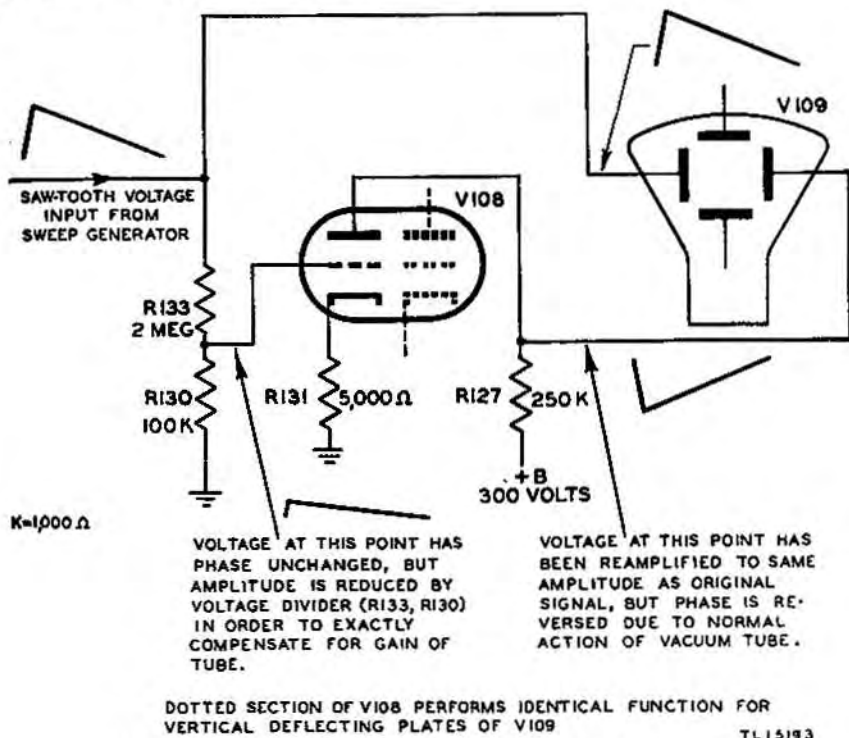


Figure 19. Simplified schematic diagram of phase-inverter.

(1) Resistors R133 and R130 act as a voltage divider to lower the amplitude of the saw-tooth voltage input to the grid to approximately one twentieth of its normal value. This lowering of the input voltage compensates for the actual gain of the amplifier stage. R130 also serves as a grid resistance. Resistor R131 provides self-bias and R127 is the plate load resistance.

(2) Resistors R134 and R135 act as another voltage divider to

lower the signal voltages to approximately three eightieths of their normal value in order to compensate for the actual gain of the amplifier (2d triode section). R135 also serves as a grid resistance. Resistor R132 provides self-bias and R126 is the plate load resistance. A different arrangement is used on the B models to obtain positioning of the pattern on the screen of the cathode-ray tube. See figure 30. Potentiometer R124 (VERT. POS. control) and potentiometer R128 (HOR. POSITION control) are used to regulate the steady d-c bias applied to the cathodes of amplifier Tube JAN 6SL7GT (VT-229), V108. The control of this bias in turn regulates the average plate voltage on the plates of the triode sections of the tube and thus the average d-c potential applied to one of the horizontal and one of the vertical deflection plates. The adjustment of these potentials, with respect to the average d-c potentials applied to the other two deflection plates, allows proper positioning.

c. AAC Circuit. Panoramic Adaptors (BC-1031-B) delivered on Order No. 639-Phila-45 contain changes which are listed in paragraph 33 and shown in figures 30 and 31. These changes do not affect the functioning of the adaptor except for an automatic amplitude control (AAC) circuit. The purpose of this additional circuit is to preserve a smaller ratio between the amplitudes of signals which differ considerably in strength.

(1) The secondary of the i-f transformer Z102-01 is not connected directly to ground (fig. 30). Instead, 250,000-ohm resistor R5 is connected in series with 500 mmf capacitor C104; this combination is shunted across the diode load resistor R114. The transformer secondary is then connected to the common terminals of resistor R5 and capacitor C104 (fig. 30).

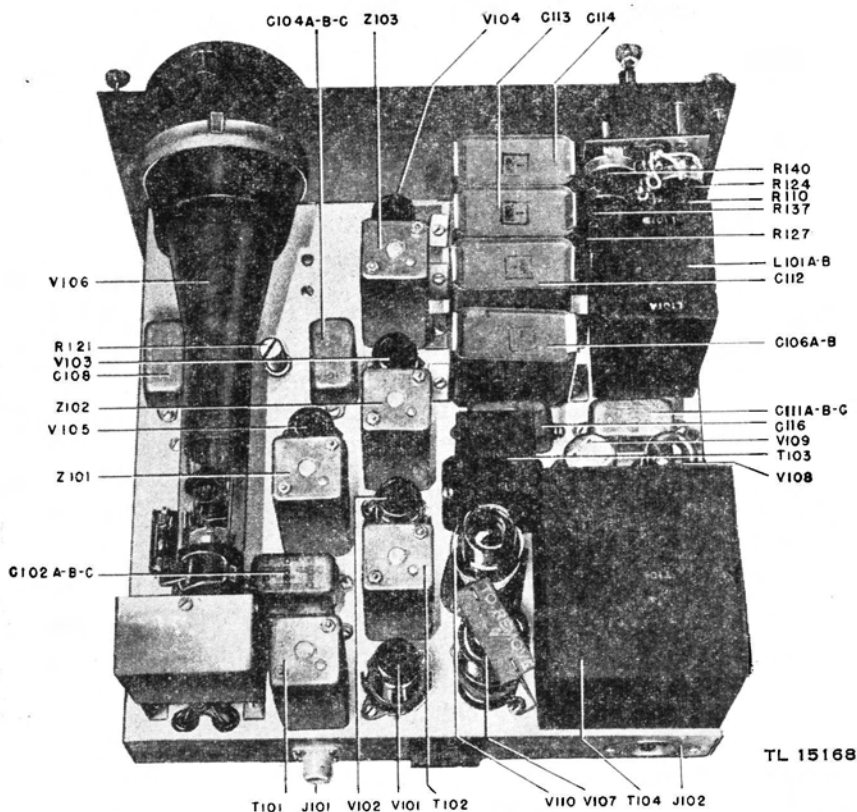
(2) In operation, the voltage drop across resistor R114 produced by the signal is impressed as a variable negative bias on the grid of i-f amplifier tube V103. The magnitude of the bias depends upon the strength of the signal.

(3) The circuit is somewhat similar to an ordinary automatic volume control (a-v-c) circuit. The values of resistor R5 (250,000 ohms) and capacitor C104 (500 mmf) have been selected to give a resistance-capacitance time constant of 125 microseconds which is very short in comparison with the usual a-v-c circuit. This short time constant permits rapid recovery so the large bias voltages developed by strong signals will not be applied during the period when weaker signals are being passed through the i-f amplifier.

SECTION V

MAINTENANCE

NOTE: Failure or unsatisfactory performance of equipment used by Army Ground Forces and Army Service Forces will be reported on W.D., A.G.O. Form No. 468 (Unsatisfactory Equipment Report). If Form No. 468 is not available, see TM 38-250. Failure or unsatisfactory performance of equipment used by Army Air Forces will be reported on Army Air Forces Form No. 54 (unsatisfactory report).



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Figure 20. Panoramic Adaptor BC-1031-A, top view.

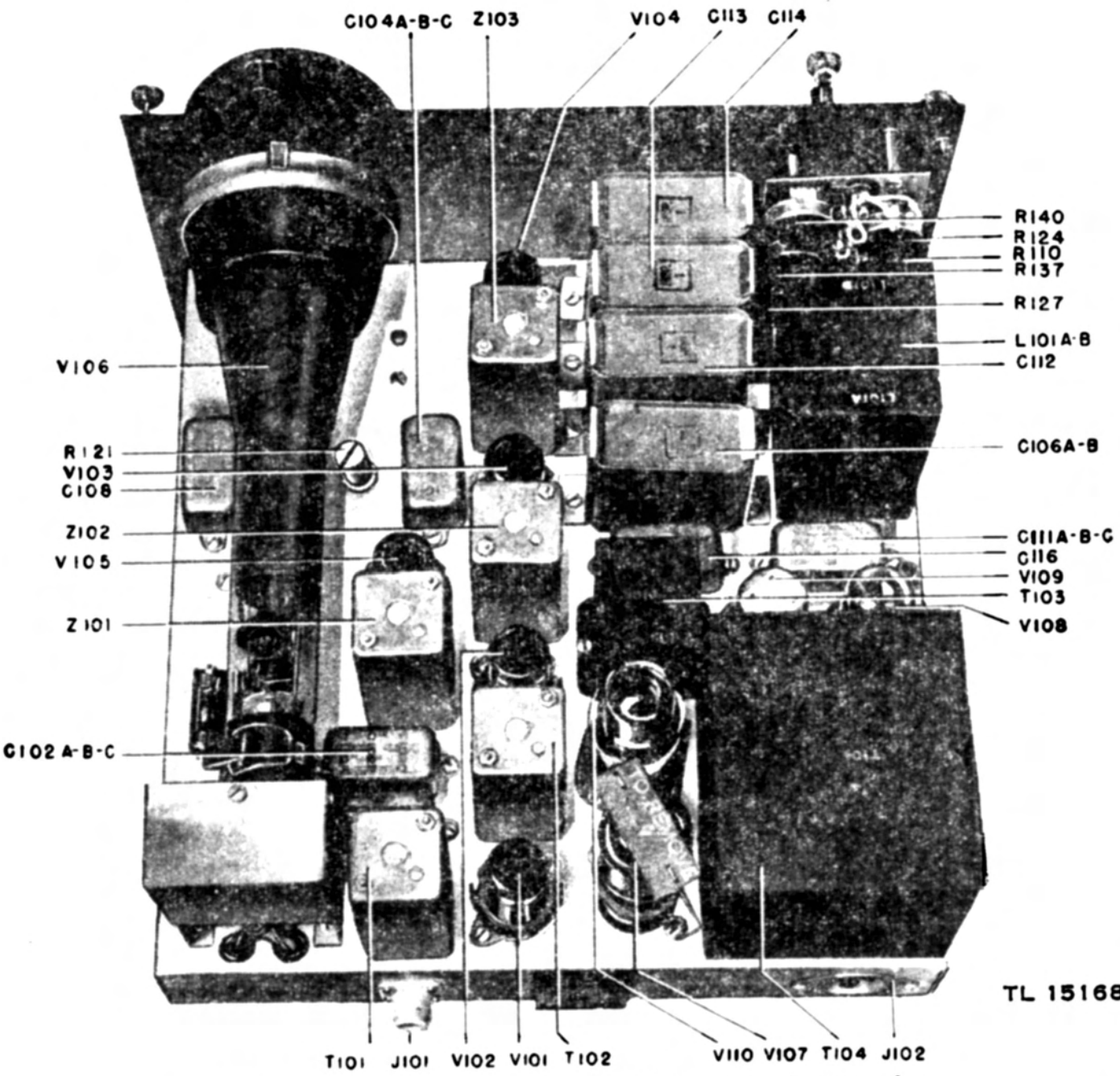


Figure 20. Panoramic Adaptor BC-1031-A, top view.

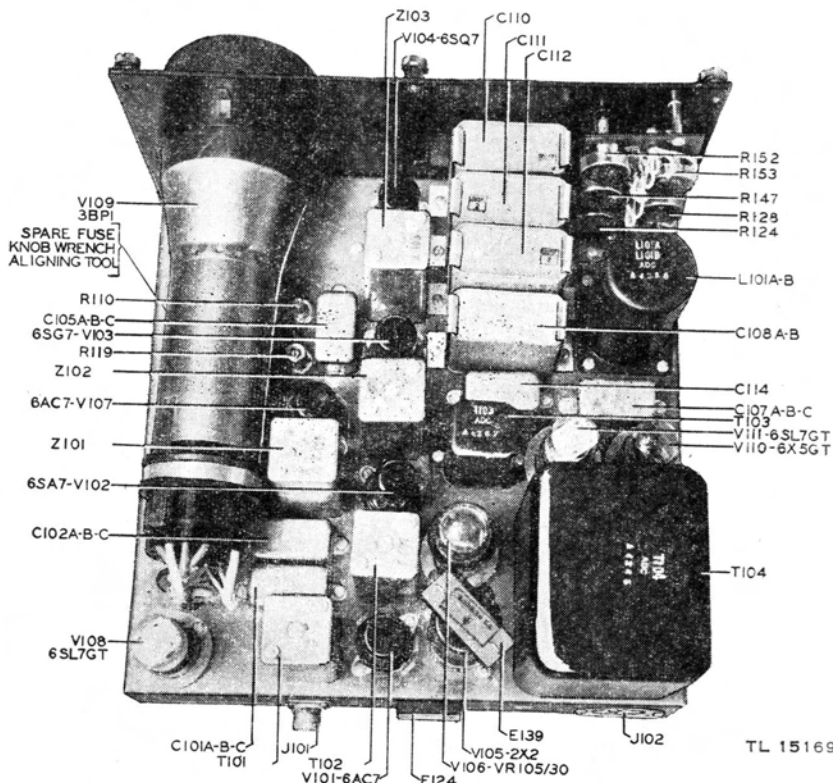


Figure 21. Panoramic Adaptor BC-1032-B, top view.¹

CAUTION: High voltage (1,000 volts) exists in certain points inside the adaptor when power is on. When working on equipment, avoid actual contact with high-voltage points. When alone do not work inside the equipment with power applied.

23. INSPECTION AND REPLACEMENTS BY OPERATING PERSONNEL.

a. Inspection. All components of the adaptor should be given a thorough inspection upon issue and at regular intervals thereafter. Keep the equipment dry. Moisture, even in a completely tropicalized unit, may cause deterioration of material and produce generally unsatisfactory operation. Dust and dirt materially affect both electrical and mechanical operation. Keep the various parts clean. Check accessible connections and tubes regularly to make sure that

¹ The arrangement and reference symbol markings of parts are slightly different on adaptors delivered on Order No. 639-Phila-45. Refer to figure 31.

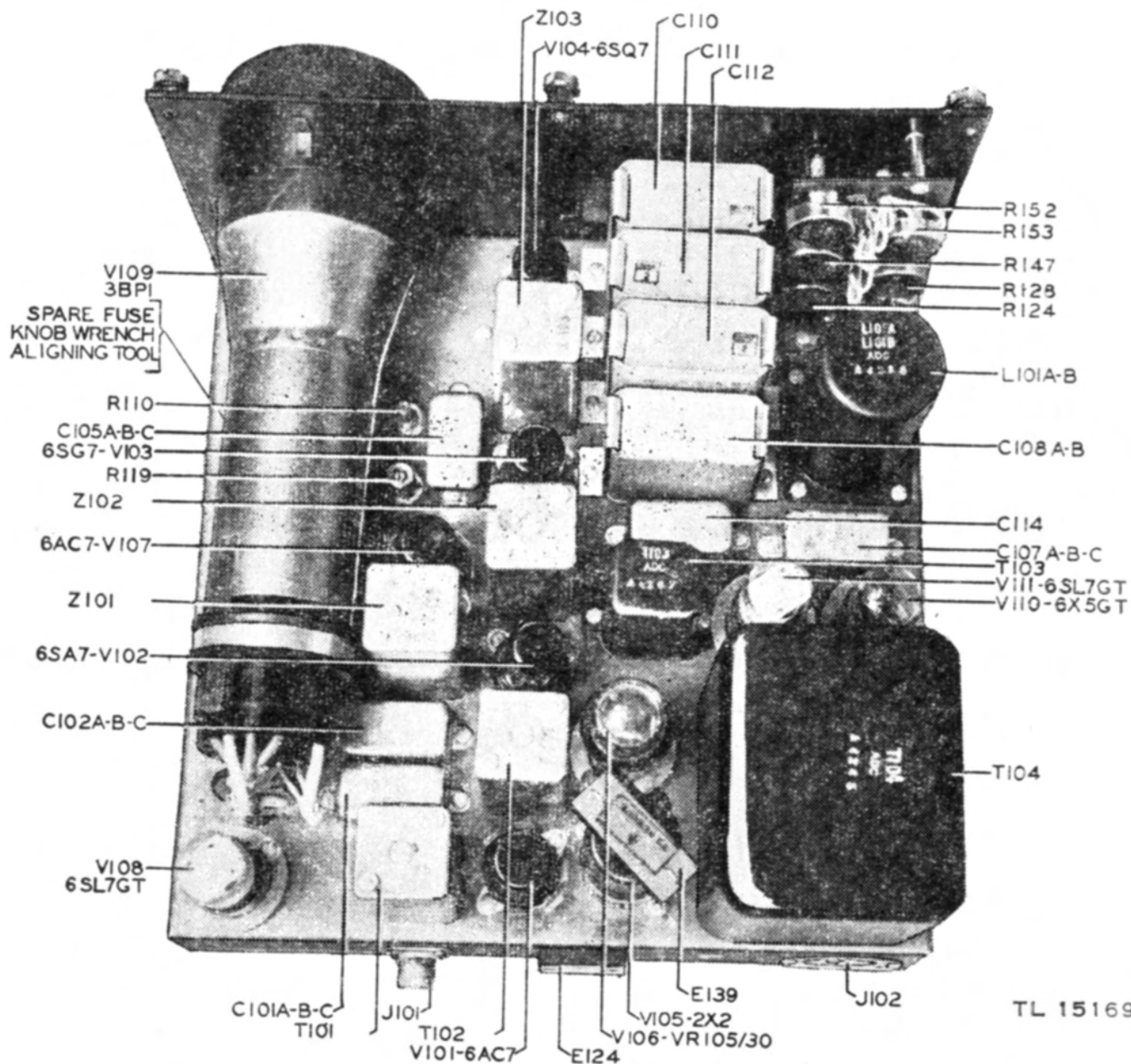
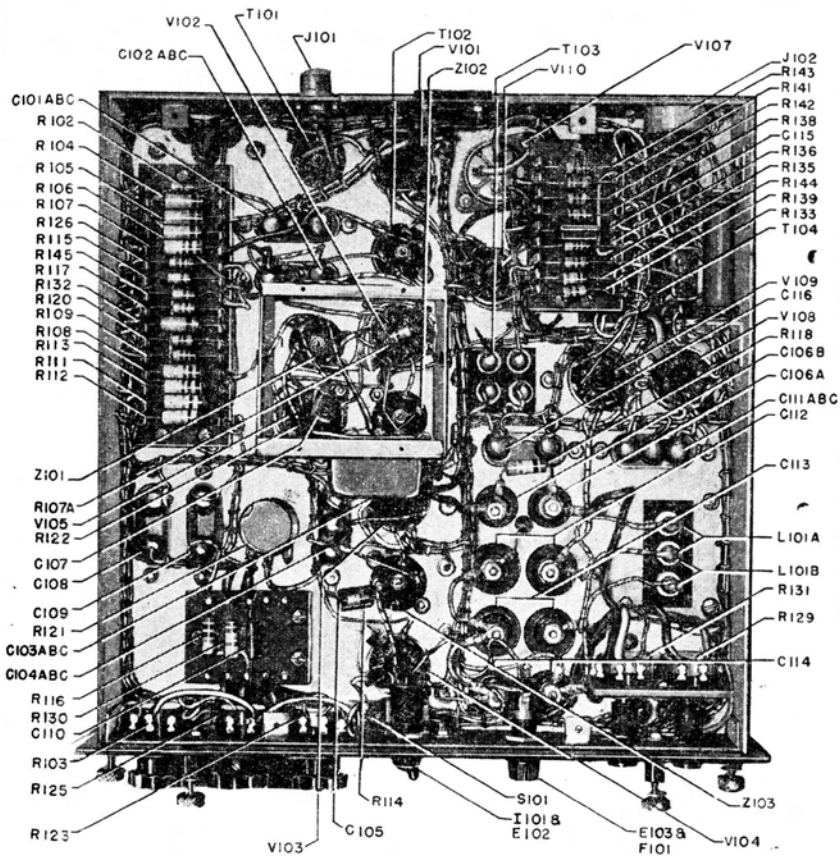


Figure 21. Panoramic Adaptor BC-1032-B, top view.¹



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Figure 22. Panoramic Adaptor BC-1031-A, bottom view.

all contacts are clean and tight and that tubes are held securely in their sockets.

b. Replacement. All tubes are accessible at the top of the chassis. The pilot light lamp I101 is located behind the green indicator on the front panel. This lamp is of the bayonet type and is removed by pressing down slightly in the socket and turning counterclockwise. The fuse is replaceable from the front panel. It is removed by pushing in the fuse holder cap and turning it approximately $\frac{1}{8}$ inch counterclockwise.

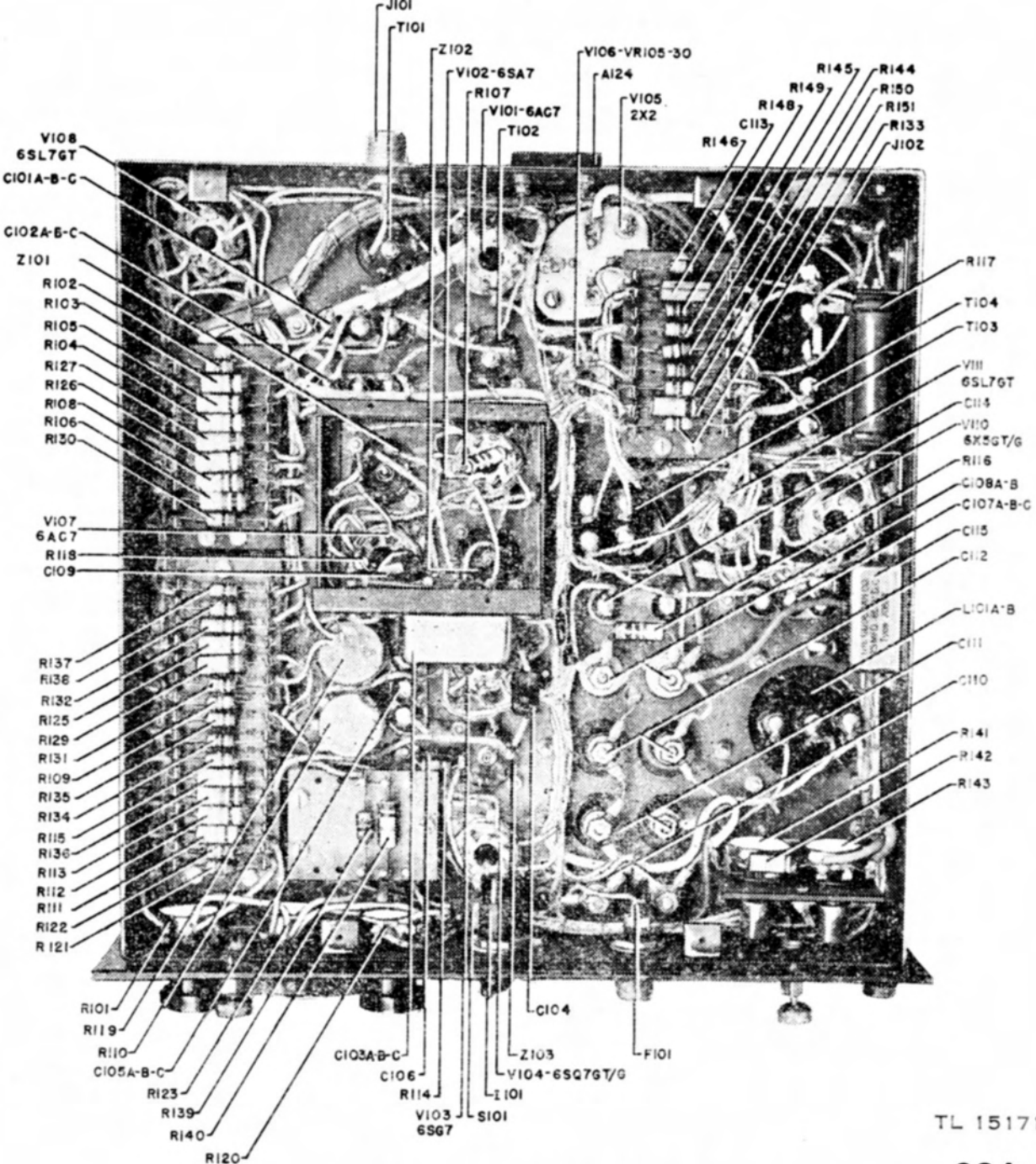


Figure 23. Panoramic Adaptor BC-1032-B, bottom view.¹

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25. TROUBLE-SHOOTING CHART.

a. Pilot light does not light and no illumination is observed on screen when POWER ON-OFF switch is turned to the ON position.

<i>Probable causes</i>	<i>Tests</i>
(1) Burned out pilot light I101.	(1) Replace.
(2) Burned out fuse F101.	(2) Replace.
(3) Power cord not plugged into "hot" socket.	(3) Check.
(4) Primary circuit of power transformer T104 open or shorted.	(4) Check parts and connections.
(5) Defective Transformer T104.	(5) Check.
(6) Defective socket of pilot light I101.	(6) Check.

b. The pilot light does not light but the adaptor otherwise operates normally.

<i>Probable causes</i>	<i>Tests</i>
(1) Burned out pilot light I101.	(1) Replace.
(2) Defective socket of pilot light I101.	(2) Check.
(3) Broken connection in pilot light circuit.	(3) Repair.

c. The pilot light glows but no illumination is observed on screen.

<i>Probable causes</i>	<i>Tests</i>
(1) Improper adjustment of INT. ¹ or FOCUS controls.	(1) Adjust these controls.
(2) Defective rectifier tube V107 or V108 in BC-1031-A or BC-1032-A (V105 or V110 in BC-1031-B or BC-1032-B).	(2) Replace.

¹This control is labelled BRILLIANCE on adaptors delivered on Order No. 639-Phila-45.

CAUTION: Turn off power before touching these tubes.

- | | |
|---|---|
| (3) Improper adjustment of HOR. POSITION or VERT. POS. controls. | (3) Adjust these controls. |
| (4) Abnormal socket voltage or resistance measurement on tube V107, V108 or V106 in models BC-1031-A or BC-1032-A (V105, V110 or V109 in BC-1031-B or BC-1032-B). | (4) Make measurements. See voltage and resistance charts. |
| (5) Defective cathode-ray tube. | (5) Replace. |
-

d. With GAIN control turned counterclockwise, illumination is observed on screen but no horizontal baseline (horizontal sweep) is obtained.

<i>Probable causes</i>	<i>Tests</i>
(1) Defective tube V108 or V109 in model BC-1031-A or BC-1032-A (V111, V110, or V108 in model BC-1031-B or BC-1032-B).	(1) Replace.
(2) On model BC-1031-B or BC-1032-B, improper adjustment of HOR. SIZE control. ¹	(2) Adjust control.
(3) Abnormal socket voltage or resistance measurement on tube V109 or V108 in model BC-1031-A or BC-1032-A (tubes V111, V110, or V108 in model BC-1031-B or BC-1032-B).	(3) Make measurements. See voltage and resistance charts.

¹ This control is labelled BASELINE SIZE on adaptors delivered on Order No. 639-Phila-45.

e. With GAIN control turned counterclockwise, the horizontal baseline is obtained but it is unstable.

<i>Probable causes</i>	<i>Tests</i>
(1) Blocking oscillator circuit not synchronized, usually caused by improper adjustment of SYNCH. or HOR. SIZE ¹ controls on models BC-1031-A or BC-1032-A. On model BC-1031-B or BC-1032-B, improper adjustment of SYNCH. control.	(1) Make adjustment of proper controls (par. 28d). <i>Do not disturb these controls unless functioning of adaptor is thoroughly understood.</i>
(2) Abnormal application of horizontal positioning voltage.	(2) Check potentiometers R125 and R127 in models BC-1031-A or BC-1032-A (R124 and R128 in BC-1031-B or BC-1032-B).
(3) Defective tube V109 in model BC-1031-A or BC-1032-A (V108 or V111 in model BC-1031-B or BC-1032-B).	(3) Try replacing.
(4) Abnormal socket voltage or resistance measurement on tube V109 in model BC-1031-A or BC-1032-A (V111 and V108 in model BC-1031-B or BC-1032-B).	(4) Make measurements. See voltage and resistance charts.

¹ This control is labelled BASELINE SIZE on adaptors delivered on Order No. 639-Phila-45.

f. Horizontal baseline normal but no vertical deflection (signals) observed when GAIN control is turned clockwise although a signal is heard on the loudspeaker or phones of the receiver.

<i>Probable causes</i>	<i>Tests</i>
(1) Signal input Cord CD-806 not properly connected between receiver and adaptor.	(1) Check.
(2) I-f gain control of adaptor or r-f gain control of receiver not adjusted properly.	(2) Adjust as explained in par. 28c .
(3) Defective tube V101, V102, V103, or V104.	(3) Replace.
(4) Abnormal socket voltage or resistance measurement on tube V101, V102, V103, or V104.	(4) Make measurements. See voltage and resistance charts.
(5) Defective resistor or connection between plate of mixer tube in receiver and panoramic adaptor.	(5) Check.
(6) Improper alignment of signal channels of adaptor.	(6) Realign (pars. 28a , c , and e).

g. With SWEEP control¹ turned completely clockwise, the vertical deflection, representing the signal being heard on the loudspeaker of the receiver or phones, does not appear on the horizontal baseline at the zero (0) line of the calibrated scale.

<i>Probable cause</i>	<i>Test</i>
(1) Improper adjustment of center frequency.	(1) Make adjustment (par. 28b).

¹ This control is labelled SWEEP WIDTH FACTOR on adaptors delivered on Order No. 639-Phila-46.

h. The frequencies of signals, as determined by their position on the horizontal baseline in reference to the calibrated scale, are not indicated accurately.

<i>Probable causes</i>	<i>Tests</i>
(1) Defective tube V105 or V110 in models BC-1031-A or BC-1032-A (V107 or V106 in models BC-1031-B or BC-1032-B).	(1) Replace.
(2) Improper adjustment of adaptor.	(2) Make adjustments (par. 28).

i. The amplitude of a signal which is moving across the length of the horizontal baseline as the receiver dial is rotated, varies abnormally. See normal ratio of peak to center amplitude in paragraph 30.

<i>Probable cause</i>	<i>Test</i>
(1) Improper adjustment of band-pass amplifier.	(1) Make adjustment (par. 28c).

j. With SWEEP control¹ set at maximum, the vertical deflection (representing a signal) does not appear as a peak, but rather as a shift in the baseline. This is caused by the reactance modulator not affecting the frequency of the h-f oscillator.

<i>Probable causes</i>	<i>Tests</i>
(1) Defective tube V105 in model BC-1031-A or BC-1032-A (V107 in model BC-1031-B or BC-1032-B).	(1) Replace.
(2) Abnormal socket voltage or resistance measurement on tube V105 in model BC-1031-A or BC-1032-A (V107 in model BC-1031-B or BC-1032-B).	(2) Make measurements. See voltage and resistance charts.

¹This control is labelled SWEEP WIDTH FACTOR on adaptors delivered on Order No. 639-Phila-45.

- (3) Defective composite coil Z101-01 in model BC-1031-A, Z101-02 in BC-1032-A, Z101-01 in BC-1031-B, or Z101-02 in BC-1032-B. (3) Check.
-

k. The length of the horizontal baseline does not cover the diameter of the screen although the controls are adjusted properly.

<i>Probable causes</i>	<i>Tests</i>
(1) Defective tube V109, or V108 in model BC-1031-A or BC-1032-A (V111, V110, or V108 in model BC-1031-B or BC-1032-B).	(1) Replace.
(2) Abnormal socket voltage or resistance measurement for tube V109 or V108 in model BC-1031-A or BC-1032-A (V111, V110, or V108 in model BC-1031-B or BC-1032-B).	(2) Make measurements. See voltage and resistance charts.

l. The amplitude of the signals on the screen is low with the GAIN control of the adaptor turned clockwise.

<i>Probable causes</i>	<i>Tests</i>
(1) R-f gain control on receiver turned too low.	(1) Turn r-f control on receiver to maximum and adjust receiver with i-f gain or a-f gain control.
(2) Improper adjustment of i-f gain control of adaptor.	(2) Adjust as explained in par. 28e.
(3) Follow probable causes and tests in subparagraph f above.	

m. The screen of the cathode-ray tube contains burned spots or owl's eyes (unwarranted spots of illumination).

(1) Burned spots occur through normal usage. The life of the tube can be prolonged by keeping the illumination at as low an intensity as practicable. Slight adjustment of the vertical positioning control (VERT. POS.) may allow the illumination to be observed in a screen area free of burned spots. If this is not possible or practicable, the tube must be replaced.

(2) Owl's eyes are a defect of the tube itself. If their presence interferes with normal operation, replace the tube.

n. Distortion of signals and screen pattern occurs when GAIN control is advanced, although the aural output of the receiver is normal. With GAIN control turned counterclockwise, a stable horizontal sweep is obtained.

<i>Probable causes</i>	<i>Tests</i>
(1) Defective tube V101, V102, V103, V104, V108 in any model. In addition, tube V110 in models BC-1031-B or BC-1032-B may be defective.	(1) Replace.
(2) Defective GAIN control (R103 in model BC-1031-A or BC-1032-A; R101 in model BC-1031-B or BC-1032-B).	(2) Check.
(3) Loose connection or poor tube socket contact.	(3) Check.
(4) Improper adjustment of i-f gain control of adaptor.	(4) Adjust as explained in par. 28e.
(5) Other abnormal condition in signal channel or signal input connection between receiver and adaptor.	(5) Check.

o. Adaptor operates normally except that some vertical peaks are present along baseline which do not move as receiver dial is rotated. This is caused by electrical interference whose frequency is synchronized with the sweep frequency of the adaptor. In many cases, the trouble may be traced to a nearby electrical appliance connected to the same power source as the adaptor or the trouble may be in the power source itself. Corrective filters may be used in the event of interference caused by the appliances. If the power source is the cause and a motor generator set is being used, the same remedy is required. If commercial or similar centralized power is being used, the necessary complaint must be made through regular channels.

26. EQUIPMENT REQUIRED FOR ALIGNMENT AND SERVICING.

In order to align and service the adaptor, the following equipment should be available:

a. Voltohmmeter (at least 1,000 ohms per volt), such as Weston #772 Analyzer, S. C. Stock No. 3F1772.

b. Signal generator to cover a range of 200 kc to 6,000 kc, such as S. C. Signal Generator Type I-72-().

c. 100-kc crystal oscillator and 50-kc multivibrator, such as General Radio Co. Class C-10-H Secondary Frequency Standard.

d. Cathode-ray test oscilloscope, such as DuMont Oscilloscope Type 224, S. C. Stock No. 3F3640-134.

27. MISCELLANEOUS DATA.

a. Removal of Chassis from the Cabinet.

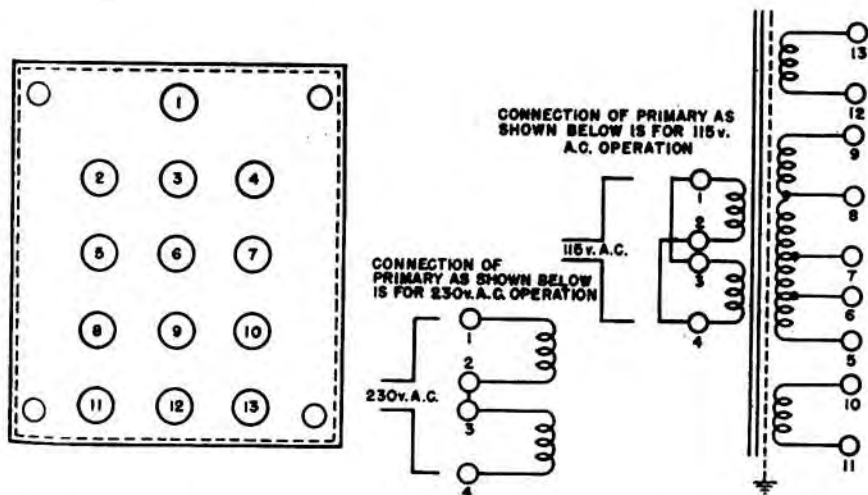
- (1) Disconnect the power cable.
- (2) Disconnect the input cable.
- (3) Remove the knurled screw from the back of the cabinet.
- (4) Loosen the eight knurled screws mounted along the edges of the front panel.
- (5) Remove the chassis from the cabinet.

b. Removal of Cathode-ray Tube.

- (1) Follow procedure for removal of chassis from cabinet (sub-par. a above).
- (2) Loosen the tube clamp and lift shield fingers.
- (3) Grasping the tube at its base, ease it out through the metal hood or shield which forms part of the front panel. Note that the cathode-ray tube is protected by a sponge rubber boot which will come out with the tube when it is removed.
- (4) This boot also serves to hold in place the calibrated green filter screen.
- (5) Remove boot by pulling it off the cathode-ray tube.

c. **Operation of Panoramic Adaptor BC-1031-A or BC-1032-A at 230-volt AC Instead of 115-volt AC.** The primary connections of the power transformer must be changed (fig. 24).

d. **Operation of Panoramic Adaptor BC-1031-B or BC-1032-B at 230-volt AC Instead of 115-volt AC.** The primary connections of the power transformer must be changed (fig. 25).



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Figure 24. Power transformer connections for BC-1031-A and BC-1032-A.

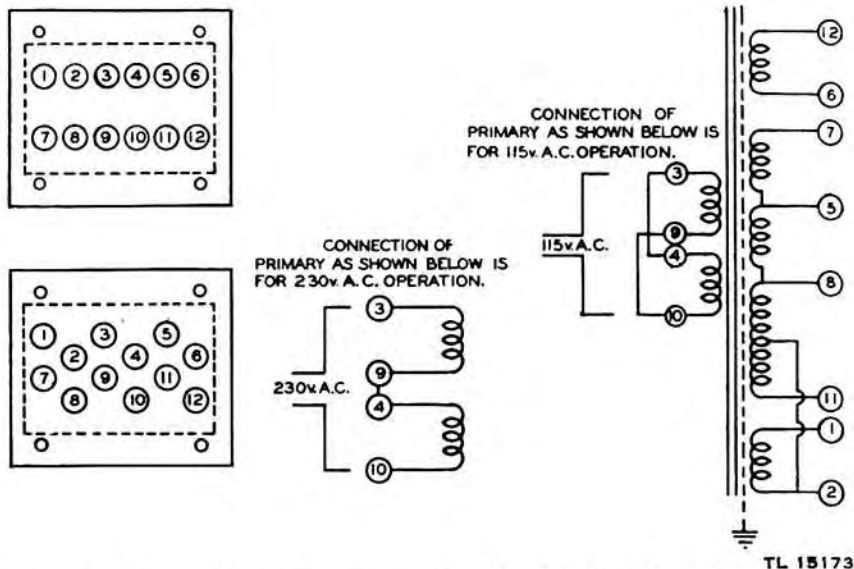


Figure 25. Power transformer connections for BC-1031-B and BC-1032-B.

e. Tuning the R-f, I-f, and F-m Oscillator Coils. Transformers T101-01, T102-01, Z101-01, Z102-01, Z103-01 in BC-1031-A or BC-1031-B (T101-02, T102-02, Z101-02, Z102-02, Z103-02 in BC-1032-A or BC-1032-B) are tuned by means of movable iron cores. A tuning tool is supplied with the adaptor. It will be found clamped in the spare fuse holder which is mounted on the chassis. This tuning tool is made of bakelite. One end is tapered to form a screwdriver and the other end has a pin passing through at right angles. Windings marked A on BC-1031-A and BC-1032-A (T on BC-1031-B and BC-1032-B) on the circuit diagrams can be tuned from the top of each transformer with the *pin end* of the tuning tool. Windings B can be tuned from either the top or the bottom of each transformer with the *screwdriver end* of the tuning tool.

28. ALIGNMENT PROCEDURE.

Allow the equipment to warm up for approximately 1/2 hour before making adjustments.

NOTE: When the adaptor is used in conjunction with a companion receiver, the (+) sign on the calibration screen indicates high frequency, and the (—) sign on the calibration screen indicates low frequency; but when the signals are fed directly into the adaptor (as from a signal generator), the (+) sign indicates low frequency and the (—) sign indicates high frequency.

a. I-f Amplifier Alignment. The i-f amplifier frequency for BC-1031-A and BC-1031-B is 226 kc (912 kc for BC-1032-A and BC-1032-B). Using the signal generator:

(1) The signal of the proper intermediate frequency is fed into the grid of tube V103, JAN 6SG7 (VT-211). The grid of this tube is pin 4.

(2) Adjust the cores of the second i-f transformer Z103-01 in BC-1031-A and BC-1031-B (Z103-02 in BC-1032-A and BC-1032-B) for greatest vertical deflection on the screen of the cathode-ray tube.

(3) The signal is now fed into the grid of tube V102, JAN-6SA7 (VT-150). The grid of this tube is pin 8.

(4) Adjust the cores of the first i-f transformer Z102-01 in BC-1031-A and BC-1031-B (Z102-02 in BC-1032-A and BC-1032-B) for greatest vertical deflection attainable on the screen of the cathode-ray tube.

b. Frequency-modulated h-f Oscillator Alignment. The following adjustments are a series of approximations which are gradually narrowed down until the desired results are obtained. During the entire procedure the signals are fed into the input of the adaptor through a resistor of 50,000 ohms for BC-1031-A and BC-1031-B (25,000 ohms for BC-1032-A and BC-1032-B).

(1) To obtain *center-frequency alignment* for BC-1031-A and BC-1032-A, proceed as follows:

(a) A 455-kc signal for BC-1031-A (5.25 mc for BC-1032-A) is used.

(b) Set SWEEP¹ control R123 at maximum.

(c) Adjust the ZERO on transformer Z101-01 for BC-1031-A (Z101-02 for BC-1032-A) so that the deflection on the screen of the cathode-ray tube is centered. In order to achieve centering, it also may be necessary to adjust the reactor cathode pad (semi-adjustable control R121).

¹This control is labelled SWEEP WIDTH FACTOR on adaptors delivered on Order No. 639-Phila-45.

(d) Now gradually rotate SWEEP control towards its minimum position. At the same time keep readjusting the ZERO control for a centered deflection.

(e) The adaptor is properly adjusted for center frequency when, with SWEEP control set just above its minimum position, a symmetrically centered curve appears on the screen (fig. 26). This symmetrical curve is one that is equally balanced to the right and left of the center line of the screen.

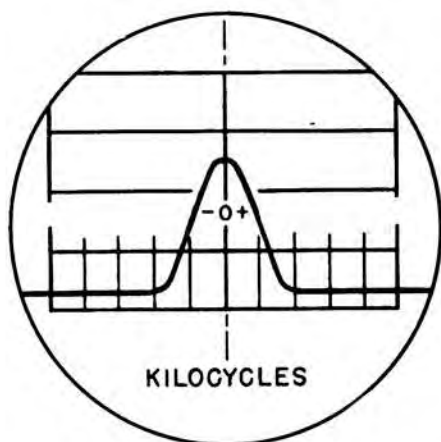


Figure 26. Symmetrically centered curve.

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(2) To obtain *high-frequency alignment* for BC-1031-A and BC-1032-A, proceed as follows:

(a) A 555-kc signal for BC-1031-A (5.75 mc for BC-1032-A) is used.

(b) Set SWEEP control R123 at maximum.

(c) Adjust the reactor cathode pad control R121 until the deflection appears on the screen at -100 kc for BC-1031-A (-500 kc for BC-1032-A).

(3) Now repeat the procedure as outlined in subparagraph b(1) above.

(4) To obtain *low-frequency alignment* for BC-1031-A and BC-1032-A, proceed as follows:

(a) A 355-kc signal for BC-1031-A (4.75 mc for BC-1032-A) is used.

(b) Set SWEEP control R123 at maximum.

(c) Adjust SWEEP LIM.¹ control R124 until the deflection appears on the screen at +100 kc for BC-1031-A (+500 kc for BC-1032-A).

(5) Again repeat procedure as outlined in subparagraph **b(1)** above.

(6) Now repeat procedure as outlined in subparagraph **b(2)** above.

(7) Now repeat the procedure outlined in subparagraphs **b(1)**, **(2)**, and **(4)** above until the desired results are obtained simultaneously.

(8) Finally repeat procedure as outlined in subparagraph **b(1)**,

(9) To obtain *center-frequency alignment* for BC-1031-B and BC-1032-B, the adjustment of the ZERO control is generally sufficient. If, however, all controls are out of adjustment, proceed as follows:

(a) A 455-kc signal for BC-1031-B (5.25 mc for BC-1032-B) is used.

(b) Set the SWEEP control R120 at maximum.

(c) Set the CENTER FREQ. control R123 at the panel marker. If knob set screws have been disturbed, reset knob pointer to panel marker when potentiometer is in middle of rotational range 135°.

(d) Adjust the zero on transformer Z101-01 for BC-1031-B (Z101-02 for BC-1032-B) so that the deflection on the screen of the cathode-ray tube is centered. In order to achieve centering, it may also be necessary to adjust the reactor cathode pad control R119 until the deflection appears on the screen at -100 kc for BC-1031-B (-500 kc for BC-1032-B). Make this adjustment as a last resort. Some adjustment of SWEEP LIM. control R153 may be necessary.

¹ For adaptors delivered on Order No. 639-Phila-45, the SWEEP LIM. control is labelled SWEEP WIDTH LIMIT.

(e) Now gradually rotate the SWEEP control R120 counter-clockwise towards its minimum position. At the same time continue readjusting ZERO control for a centered deflection.

(f) The adaptor is properly adjusted for center frequency when, with SWEEP control R120 set just above its minimum position, a symmetrically centered curve appears on the screen.

(g) Rotate SWEEP control R120 to maximum. If the deflection fails to remain centered, the HOR. POSITION control R128 should be used.

(h) In order to achieve a symmetrical curve, it may be necessary to readjust the i-f alignment slightly.

(10) To obtain *high-frequency alignment* for BC-1031-B and BC-1032-B, proceed as follows:

(a) A 555-kc signal for BC-1031-B (5.75 mc for BC-1032-B) is used.

(b) Set SWEEP control R120 at maximum.

(c) Readjust the reactor pad control R119 until the deflection appears on the screen at -100kc for BC-1031-B (-500 kc for BC-1032-B). Some adjustment of SWEEP LIM. control R153 may be necessary.

(11) Now repeat procedure as outlined in subparagraph b(9) above.

(12) To obtain *low-frequency alignment* for BC-1031-B and BC-1032-B, proceed as follows:

(a) A 355-kc signal for BC-1031-B (4.75 mc for BC-1032-B) is used.

(b) Set SWEEP control R120 at maximum.

(c) Adjust SWEEP LIM. control R153 until the deflection appears on the screen at +100 kc for BC-1031-B (+500 kc for BC-1032-B).

(13) Again repeat procedure as outlined in subparagraph b(9) above.

(14) Now repeat the procedure as outlined in subparagraph b(10) above.

(15) Now repeat procedures outlined in subparagraphs **b(9)**, (10), and (12) above.

(16) Finally, repeat the procedure as outlined in subparagraph **b(9)** above.

NOTE: For the h-f oscillator alignment as given above, only a signal generator is required. This alignment procedure is greatly simplified, if a multivibrator is used in conjunction with the signal generator, because the signals can be seen simultaneously on the high and low frequencies as well as at the center. The multivibrator is a 50-kc oscillator, preferably accurately controlled by a 100-kc crystal oscillator. Since the multivibrator is very rich in harmonics, it supplies a multitude of signals every 50 or 100 kc. When the f-m oscillator is correctly aligned, 50-kc signals will show five deflections at intervals of two and one half divisions on BC-1031-A and BC-1031-B (100-kc signals will show 11 deflections at intervals of one division on BC-1032-A and BC-1032-B).

c. R-f Alignment. For this alignment, another series of approximations is used until the desired results are obtained. Figure 13 illustrates properly aligned band pass. The use of a multivibrator having any frequency between 1 kc and 10 kc greatly simplifies alignment, making it possible to view as one complete picture the entire band-pass characteristics of the r-f amplifier. It is possible to align the r-f amplifier stage using only a signal generator. In order to obtain the trace illustrated in figure 13, the frequency of the signal generator is varied so that the peaks of the deflection on the screen move from one end to the other to produce this trace.

(1) Procedure for alignment of the r-f band-pass transformers with the use of the multivibrator.

(a) Feed the multivibrator to the input of the adaptor through a 50,000-ohm resistor for BC-1031-A and BC-1031-B (25,000 ohms for BC-1032-A and BC-1032-B).

(b) Adjust the cores of the r-f transformers T101-01 and T102-01 for BC-1031-A and BC-1031-B (T101-02 and T102-02 for BC-1032-A and BC-1032-B) until the trace approximates that shown in figure 13.

(2) Procedure for alignment of the r-f band-pass transformers with the use of the signal generator.

(a) Align *first* the interstage transformer T102-01 for BC-1031-A and BC-1031-B (T102-02 for BC-1032-A and BC-1032-B).

1. Feed a 455-kc signal BC-1031-A and BC-1031-B (5.25 mc for BC-1032-A and BC-1032-B) to the plate (pin 8) of the r-f amplifier tube V101 (VT 112/6AC7) *through a 0.01-mf coupling capacitor*. Adjust the secondary B of the transformer for peak deflection at the center of the screen.
2. Now feed a 545-kc signal for BC-1031-A and BC-1031-B (5.68 mc for BC-1032-A and BC-1032-B) to the grid (pin 4) of the r-f amplifier tube V101. Adjust the primary A or T for peak deflection at the left of the screen.
3. With the signal generator still being fed in the grid (pin 4) of the r-f amplifier tube V101, readjust the secondary B at a frequency of 365 kc for BC-1031-A and BC-1031-B (4.83 mc for BC-1032-A and BC-1032-B) for peak deflection at the right side of the screen.

(b) Align next the input band-pass transformer T101-01 for BC-1031-A and BC-1031-B (T101-02 for BC-1032-A and BC-1032-B).

1. Feed a 455-kc signal for BC-1031-A and BC-1031-B (5.25 mc for BC-1032-A and BC-1032-B) through the 50,000-ohm resistor for BC-1031-A and BC-1031-B (25,000 ohms for BC-1032-A and BC-1032-B) to the input cable of the adaptor. Adjust the secondary B for peak deflection at the center of the screen.
2. Now feed a 545-kc signal for BC-1031-A and BC-1031-B (5.68 mc for BC-1032-A and BC-1032-B) through the isolating resistor to the input cable of the adaptor. Adjust the primary A or T for peak deflection at the left side of the screen.

NOTE: The capacity of the input cable is part of the primary circuit.

3. With the signal generator still being fed to the input cable of the adaptor, readjust the secondary B at a frequency of 365 kc for BC-1031-A and BC-1031-B (4.83 mc for BC-1032-A and BC-1032-B) for peak deflection at the right side of the screen.
4. Now trim the primaries and secondaries of both r-f transformers until the desired peak deflections are nearly of equal amplitude and appear between 80 and 100 kc from the center mark for BC-1031-A and BC-1031-B (at approximately 400 kc from the center mark for BC-1032-A and BC-1032-B).

d. Synchronization of Sweep Frequency. The frequency of the saw-tooth voltage is adjusted by a semiadjustable control to a sub-multiple of the a-c line frequency. The standard frequency of the adaptor is 30 cycles when used with a 60-cycle line, and 25 cycles when used with a 50-cycle line. In order to check this adjustment, connect a 0.005-mf coupling capacitor between pins No. 7 and No. 6 of tube V104. Two peaks will appear on the screen if the sweep frequency is correct. The sweep frequency is now one half of the a-c line frequency.

e. I-f Gain Limiter Adjustment.

NOTE: This adjustment is made only by experienced personnel.

(1) The GAIN and SWEEP¹ controls should be placed at maximum.

(2) An 800-microvolt signal of 455 kc for BC-1031-A and BC-1031-B (5.25 mc for BC-1032-A and BC-1032-B) is fed through the isolating resistor of 50,000 ohms for BC-1031-A and BC-1031-B (25,000 ohms for BC-1032-A and BC-1032-B) to the input cable of the adaptor.

(3) The semiadjustable control R110 marked I.F. GAIN for BC-1031-A and BC-1032-A or the limiter control R110 marked I.F. PAD for BC-1031-B and BC-1032-B is adjusted so that at least a one-inch deflection is obtained at the center of the screen.

NOTE: Under certain conditions, i-f regeneration or oscillation may take place, because of the extra high transconductance of the i-f amplifier tube. This condition may be remedied by reducing the setting of the i-f control. The reserve i-f gain present in the equipment may then be employed as the tubes weaken in use.

29. MOISTUREPROOFING AND FUNGIPROOFING.

a. General. The operation of Signal Corps equipment in tropical areas where temperature and relative humidity are extremely high requires special attention. The following items represent problems which may be encountered in operation:

(1) Resistors, capacitors, coils, chokes, transformer windings, etc., fail.

¹This control is labelled SWEEP WIDTH FACTOR on adaptors delivered on Order No. 639-Phil-a-45.

(2) Electrolytic action takes place in resistors, coils, chokes, transformer windings, etc., causing eventual break-down.

(3) Hook-up wire and cable insulation break down. Fungus growth accelerates deterioration.

(4) Moisture forms electrical leakage paths on terminal boards and insulating strips, causing flash-overs.

b. Treatment. A moistureproofing and fungiproofing treatment has been devised which, if properly applied, provides a reasonable degree of protection against fungus growth, insects, corrosion, salt-spray, and moisture. The treatment involves the use of a moisture- and fungi-resistant varnish applied with a spray gun or brush. Refer to TB SIG 13, Moistureproofing and Fungiproofing Signal Corps Equipment, for a detailed description of the varnish-spray method of moistureproofing and fungiproofing.

CAUTION: Varnish spray may have toxic effects if inhaled. To avoid inhaling spray, use respirator if available; otherwise, fasten cheesecloth or other cloth material over nose and mouth.

c. Step-by-step Instructions for Treating Panoramic Adaptor.

(1) PREPARATION. Make all repairs and adjustments necessary for proper operation of the equipment.

(2) DISASSEMBLY.

(a) Remove chassis from cabinet in the following manner:

1. Disconnect power cable.
2. Disconnect input cable.
3. Remove knurled screw from back of cabinet.
4. Loosen eight captive knurled screws mounted along edges of front panel.
5. Pull chassis from cabinet.

(b) Remove all vacuum tubes from sockets on top of chassis.

(c) Remove cathode-ray tube from chassis in the following manner:

1. Loosen clamp on the fiber tube base.
2. Grasp tube at its base and slide it out through metal hood or shield which forms part of front panel.

(d) Remove bottom cover plate.

(e) Remove shield from rear of cathode-ray tube socket.

(f) Remove shield on center bottom of chassis that covers f-m oscillator components. This shield is removed by loosening four screws on bottom surface.

(g) Remove the three mounting screws from each of the two large terminal strips on bottom of chassis. One terminal strip contains nine pairs of terminals; the other contains 16 pairs of terminals. Pull terminal strips away from mounting studs exposing their underside and components mounted beneath them.

(h) Clean all dirt, dust, rust, fungus, oil, grease, etc., from the equipment to be processed.

(3) MASKING.

(a) Mask the underside of each of the nine tube sockets with tape as illustrated in the instructions furnished with the kit. The tube socket for the cathode-ray tube need not be masked.

(b) Mask the four angle brackets riveted to front and back of chassis and the flanges on the sides of the chassis to which the bottom cover plate is attached. Completely cover these surfaces with tape.

(c) Mask two flat surfaces on sides of f-m oscillator shield to which cover plate attaches with strips of masking tape.

(4) DRYING. Bake chassis per instructions furnished with kit.

(5) VARNISHING.

(a) Spray bottom of chassis only per instructions furnished with kit.

(b) Apply one coat of Lacquer, Fungus-resistant, Spec No. 71-2202 (stock No. 6G1005.3) or equal, with brush to all exposed wires and potentiometers on top of chassis.

(c) Bake and then repeat spraying, brushing, and baking operations two times per instructions furnished with kit.

(6) REASSEMBLY.

(a) Remove all masking tape. Where more than one inch of unlacquered wire is present, apply one coat of lacquer with brush. Baking after this operation is not necessary.

(b) Clean all contacts with varnish remover, and burnish the contacts.

(c) Reassemble the set and test its operation.

NOTE: The alignment of the set may be affected by this process. Check the operation carefully; if realignment is necessary, follow procedure indicated in this section.

(7) MARKING. Mark the set with "MFP" and the date of treatment.

Example: MFP—8 June 1944.

SECTION VI

SUPPLEMENTARY DATA

30. ELECTRICAL CHARACTERISTICS.

	Panoramic Adaptor BC-1031-A or BC-1031-B	Panoramic Adaptor BC-1032-A or BC-1032-B
Maximum sweepwidth	200 kc	1,000 kc
Input frequency	450 to 470 kc	5.25 mc
Isolating resistor used in companion receiver	50,000 ohms	25,000 ohms
Power source required	115/230 volts 50/60 cycles Single phase	115/230 volts 50/60 cycles Single phase
Peak frequencies (+ or -5%)	365 kc and 545 kc (at 455-kc center)	4.83 mc and 5.67 mc (at 5.25-mc center)
Peak to center ampli- tude ratio greater than:	12:1	6:1
Sensitivity: c-r deflec- tion from a 200-micro- volt signal applied to the input cable through the isolating resistor	More than 1/4-inch deflection	More than 1/4-inch deflection
I-f transformers tuned to:	226 kc	912 kc
I-f oscillator mean fre- quency (F)	681 kc	6.162 mc
I-f oscillator excursion	±100 kc	±500 kc
Sweep frequency	30 cycles (approx)	30 cycles (approx)
Waveform of saw-tooth voltage	Linear saw tooth	Linear saw tooth

31. TUBE SOCKET VOLTAGES AND RESISTANCES FOR PANORAMIC ADAPTORS BC-1031-A AND BC-1032-A.

a. Table of Tube Socket Voltages.

Readings taken with voltmeter (5,000-ohms per volt) using lowest suitable range.

GAIN and SWEEP controls set at max; FOCUS and INTENSITY controls set for normal operation.

All readings taken from indicated pin to ground (chassis).

All voltages are + direct current unless otherwise indicated.

All readings taken with tubes in sockets.

Line voltage equals 115 volts alternating current.

Ref symbol	Tube type	Function	Pin							
			1	2	3	4	5	6	7	8
V101	JAN-6AC7	1st r-f amplr					2.2	150	6.3(ac)	100
V102	JAN-6SA7	F-m osc and 1st det			290	105			6.3(ac)	
V103	JAN-6SG7	1st i-f amplr			1		1	90	6.3(ac)	250
V104	JAN-68Q7	2d det and video-amplr					-0.2	90	6.3(ac)	
V105	JAN-6AC7	Reactance-modulator					3	105	6.3(ac)	280
V106	JAN-3AP1	Deflection screen	-800	-800	50	-400	80	120	-800	
V107	JAN-2X2	High-voltage rect	700(ac)			700(ac)	(Read at plate cap -800)			
V108	JAN-6X5GT/G	Low-voltage rect			290(ac)		290(ac)		6.3(ac)	320
V109	JAN-6SL7GT/G	Saw-tooth gen and amplr		170	6.5	-8.5	20		6.3(ac)	
V110	JAN-0C3/VR-105	Voltage regulator			300		105		300	

b. Table of Tube Socket Resistances.

Readings taken with ohmmeter.

GAIN and SWEEP set at max. All other controls set for normal operation.

All readings taken from indicated pin to ground (chassis).

All readings taken with tubes in sockets and power disconnected.

Readings may vary by $\pm 20\%$.

Ref symbol	Tube type	Function	Pin							
			1	2	3	4	5	6	7	8
V101	JAN-6AC7	1st r-f amplr	0	0	0	6	110	32k	0.5	42k
V102	JAN-68A7	F-m osc and 1st deteccr	0.5	0.5	35k	40k	22k	2	0.5	2k
V103	JAN-6SG7	1st i-f amplr	0	0	150	34	125	21.5k	0	35k
V104	JAN-6SQ7	2d deteccr & video-amplr	0.5	140k	0.5		140k	190k	0.5	0.5
V105	JAN-6AC7	Reactance-modulator	0	0.5	0.5	500k	460	40k	0.5	37.5k
V106	JAN-3AP1	Deflection screen	475k	500k	1,750k	365k	180k	85k	480k	
V107	JAN 2X2	High-voltage rect			1,100	1,100	Cap:	580k		
V108	JAN 6X5GT/G	Low-voltage rect	0	0	175		175		0.5	33k
V109	JAN-6SL7GT/G	Saw-tooth gen and amplr	1,700k	280k	22k	750k	2,500k	0	0	0
V110	JAN-0C3/VR-105	Voltage regulator	0.5	0.5	32k	32k	40k	40k	34k	

32. TUBE SOCKET VOLTAGES AND RESISTANCES FOR PANORAMIC ADAPTORS BC-1031-B AND BC-1032-B.

a. Table of Tube Socket Voltages.

Ref symbol	Tube type	Function	Pin																
			1		2		3		4		5		6		7		8		
V101	JAN-6AC7	1st r-f amplr																	
V102	JAN-6SA7	F-m osc and 1st detecr																	
V103	JAN-6SG7	1st i-f amplr																	
V104	JAN-6SQ7	2d detecr and video amplr																	
V105	JAN-2X2	High-voltage rect	820(ac)						820(ac)		(read at plate cap		-950)						
V106	JAN-0C3/VR-105	Voltage regulator																	
V107	JAN-6AC7	Reactance-modulator																	
V108	JAN-6SL7GT/G	Horizontal amplr & video amplr	3																
V110	JAN-6X5GT/G	Low-voltage rect																	
V111	JAN-6SL7GT/G	Saw-tooth gen & horizontal amplr	(c)																
V109	JAN-3BP1	Deflection screen																	
			1	2	3	4	5	6	7	8	9	10	11	12	13	14			
			-920	-920	-950(f)	nc	-640(g)	nc	170	170	170	155	100	nc	nc	-920			

Readings taken with voltmeter (5,000 ohms per volt) using the lowest suitable range.

GAIN and **SWEEP** control set at max; **FOCUS**, **INTENSITY**, **HOR. SIZE**, and **POSITION** controls set for normal operation.

All readings taken from indicated pin to ground (chassis).

Voltage readings will vary according to the type of meter used.

All voltages are + direct current unless otherwise marked.

All readings taken with tubes in sockets.

Line voltage equals 115 volts alternating current.

NOTES:

- (a) Depends upon setting of R110, i-f PAD.
- (b) Depends upon settings of R119, REACTOR PAD, and R123, CENTER FREQ control.
- (c) Depends upon setting of R152, HOR. SIZE potentiometer.
- (d) Depends upon setting of R124, V POSITION control.
- (e) Depends upon setting of R128, H POSITION control.
- (f) Depends upon setting of R143, INTENSITY control.
- (g) Depends upon setting of R141, FOCUS control.

b. Table of Tube Socket Resistances.

Ref symbol	Tube type	Function	Pin														
			1		2		3		4		5		6		7		8
V101	JAN-6AC7	1st r-f amplr	0	0	0	2	150	30k	0.1	0							
V102	JAN-6SA7	F-m osc and 1st detecr	0	0	32k	37k	50k	0.2	0.1	300k							
V103	JAN-6SG7	1st i-f amplr	0	0	150	2.5 ¹	150	25k(a)	0.1	32k							
V104	JAN-6SQ7	2d detecr & video amplr	0	150k	0		150k	130k	0.1	0							
V105	JAN-2X2	High-voltage rect	1.6k			1.6k	Cap: 900k										
V106	JAN-0C3/VR-105	Voltage regulator	0	0	30k	30k	37k	37k	30k								
V107	JAN-6AC7	Reactance modulator	0	0	0	450k	350k(b)	37k	0.1	34k							
V108	JAN-6SL7GT/G	Horizontal amplr & video amplr	75k	180k	3.3k	100k	300k	5.5k	0.1	0							
V110	JAN-6X5GT/G	Low-voltage rect	0	0	200	0.1	200		0.1	30.5k							
V111	JAN-6SL7GT/G	Saw-tooth gen & horizontal amplr	700k(c)	240k	30k	850k	3,000k	0	0.1	0							
V109	JAN-3BP1	Deflection screen	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
			850k.....	350k.....	850k(d)...	.....	600k(e)...	.....	240k.....	300k.....	85k.....	180k.....	130k.....	.....	.....	.....	850k.....

¹ Approximately 400,000 ohms on adaptors delivered on Order No. 639-Phila-45.

Readings taken with ohmmeter.

GAIN and SWEEP set at max. All other controls set for normal operation.

All readings taken from indicated pin to ground (chassis).

All readings taken with tubes in sockets and power disconnected.

Readings may vary by $\pm 20\%$.

NOTES:

Depends upon setting of potentiometers indicated:

- (a) I-f pad.
- (b) C-f pad and CENTER FREQ control.
- (c) Baseline size.
- (d) Brilliance.
- (e) Focus.

33. MODIFICATIONS IN EQUIPMENTS DELIVERED ON ORDER NO. 639-PHILA-45.

a. Automatic Amplitude Control. An automatic amplitude control circuit is incorporated on the adaptors delivered on this order. Paragraph 22c explains this modification.

b. Controls. The front panel controls, although functioning the same as on other Panoramic Adaptors BC-1031-B, are labelled differently.

(1) The SWEEP control with graduations of 0-100-200 is labelled SWEEP WIDTH FACTOR with graduations of 0-.2-.5-.8-1.0.

(2) The SWEEP LIM. control is labelled SWEEP WIDTH LIMIT.

(3) The HOR. SIZE control is labelled BASELINE SIZE.

(4) The INT. control is labelled BRILLIANCE.

(5) The HOR. POSITION and VERT. POSITION controls are labelled HORIZONTAL and VERTICAL with the word POSITION located to apply to either control.

(6) The ON marking for the POWER ON-OFF switch is removed.

(7) A slide panel, instead of the snap covers, is used to gain access to the semiadjustable controls.

(8) The SWEEP WIDTH FACTOR and GAIN controls have a white indicating line on the control knobs instead of white pointers.

c. Physical Changes on Bottom of Chassis. Reference to subparagraph e below and a comparison of figures 23 and 31 will clarify these changes.

d. Physical Changes on Top of Chassis.

(1) Stamping C115 replaces C114.

(2) Stamping C108 A-B-C replaces C107 A-B-C.

(3) Tube V104 is at the left side of transformer Z103-01A.

(4) Capacitors C108 A-B, C110, C111, and C112 are replaced by round capacitors.

e. Circuit and Symbol Changes (fig. 30).

- (1) A 250,000, 1/2-watt resistor is shunted between terminals Nos. 3 and 5 of transformer Z103-01A. This is the AAC filter resistor (par. 22c).
- (2) The plate limiting resistor (R115) of tube V104 is changed from a 500,000, 1/2-watt to a 750,000, 1/2-watt resistor.
- (3) The cathode bias resistor (R131) of tube V108 is changed from a 5,000, 1/2-watt to a 5,750 ($\pm 10\%$), 1/2-watt resistor.
- (4) The GAIN control (R101) of tube V101 is changed from a 10,000, V-taper to a 3,000, linear-taper potentiometer.
- (5) The following table lists parts whose symbols have been changed but whose functions and values, unless otherwise specified, remain unchanged.

Panoramic Adaptors BC-1031-B delivered on prior orders	Panoramic Adaptors BC-1031-B delivered on Order No. 639-Phila-45
C108 A-B: <i>flat</i> ; 2,000-v; 2/0.25 mf; paper.	C109, C110: <i>round</i> ; 2,500-v; 0.25-mf; paper.
C110, C111, and C112: <i>flat</i> ; 4-mf; 600-v; paper.	C111, C112, and C113: <i>round</i> ; 4-mf; 600-v; paper.
C107 A-B-C.	C108 A-B-C.
C113.	C114.
C114.	C115.
C115.	C116.
C109.	C117.
C104.	C106.
C106.	C107.
None.	C104.
None.	C118.
Z103-01	Z103-01A

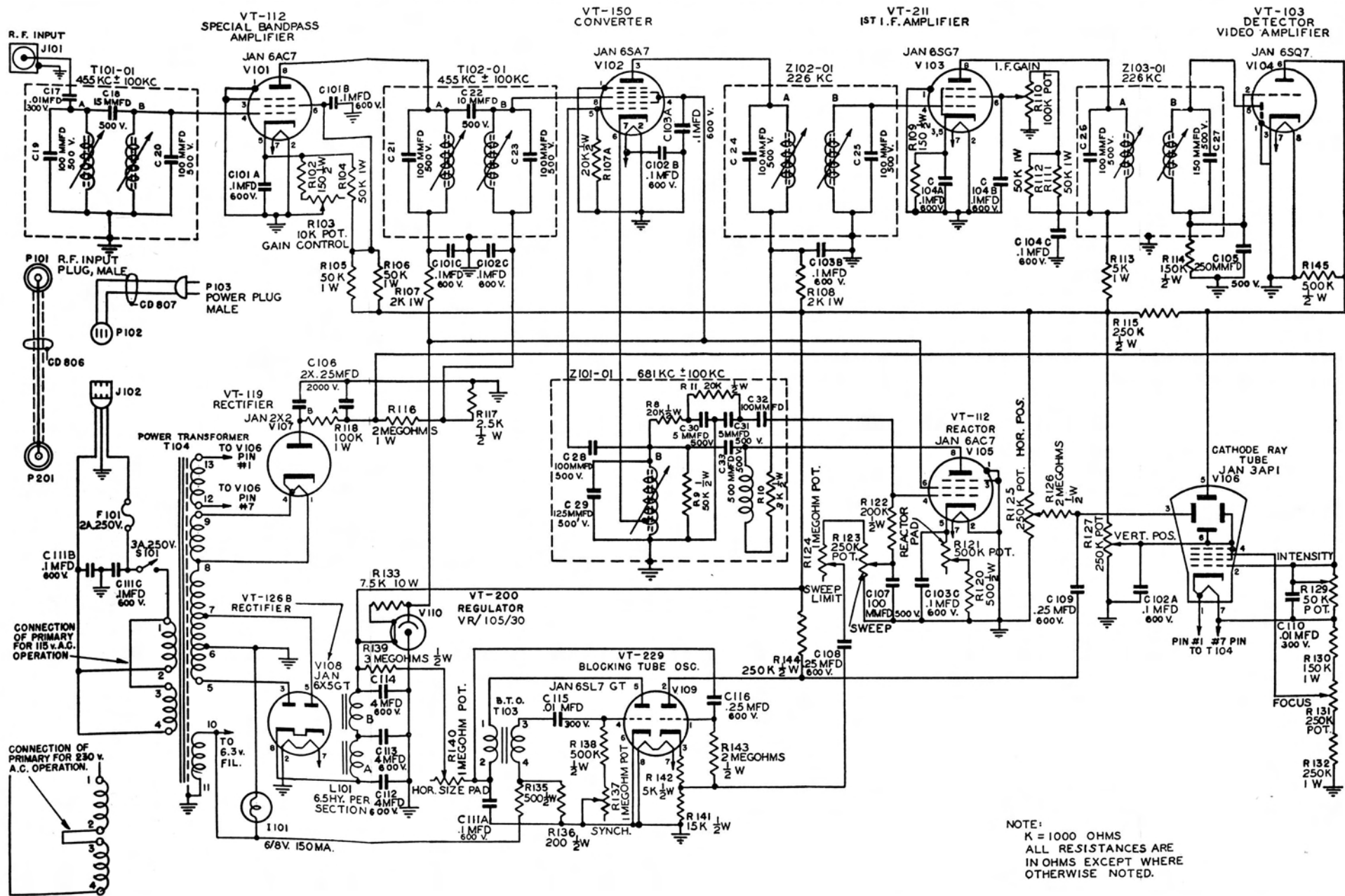


Figure 27. Panoramic Adapter BC-1031-A, circuit diagram.

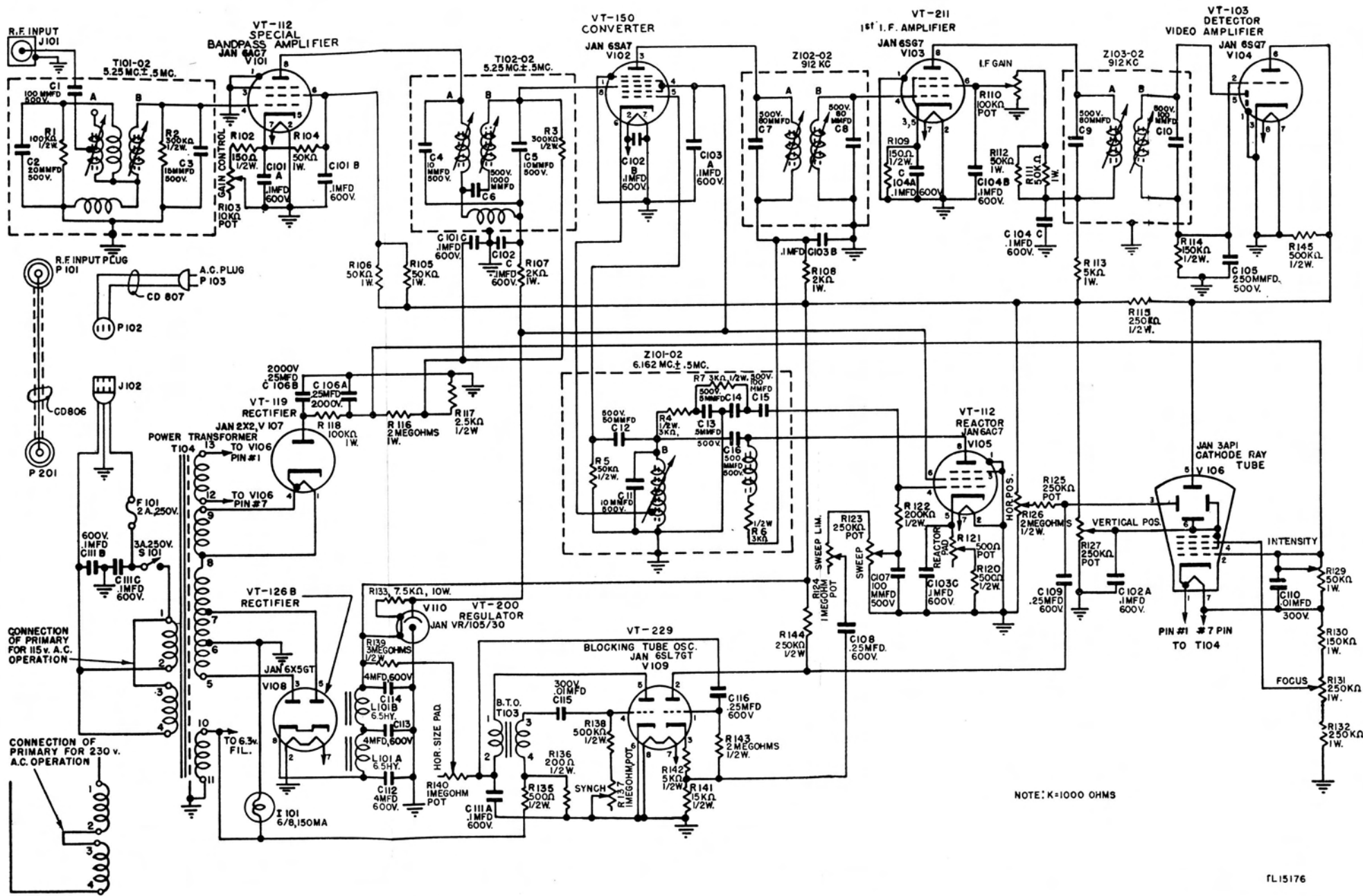


Figure 28. Panoramic Adaptor BC-1032-A, circuit diagram.

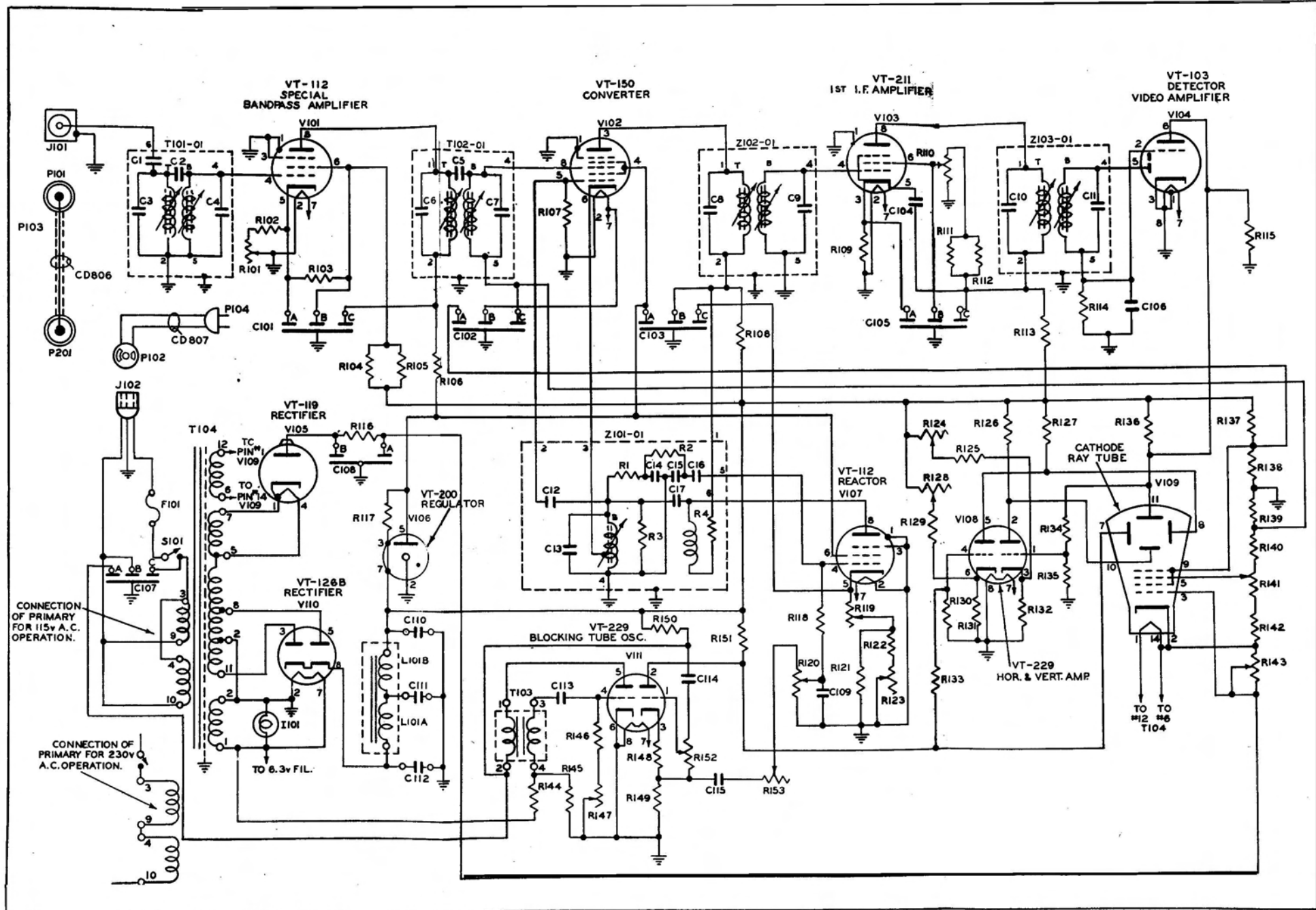


Figure 29. Panoramic Adaptor BC-1031-B, circuit diagram.
(See also figure 30.)

FOR COIL COMPONENTS SEE PARTS LIST.			C102AC	R.F. BYPASS-V102, V109	3X.1MFD. 600V.
			C101AC	R.F. BYPASS-V101	3X.1MFD. 600V.
			R201	OMITTED	
			R153	SWEEP LIMITER	1 MEGOHM POT.
			R152	HOR. SIZE CONTROL	2 MEGOHM POT.
			R151	PLATE LOAD - VIII B	250,000 OHMS 1 W
			R150	SAW. GENERATOR-VIII A	3 MEGOHMS 1/2W.
			R149	SWEEP NET	25,000 OHMS 1/2W.
			R148	BIAS-VIII B	5,000 OHMS 1/2W.
			R147	SYNCH. CONTROL	1 MEGOHM POT.
			R146	GRID RESISTOR-VIII A	500,000 OHMS 1/2W.
			R145	SAME AS R144	200 OHMS 1/2W.
			R144	SYNCH. NET	500 OHMS 1/2 W.
			R143	INTENSITY CONTROL	50,000 OHMS POT.
			R142	H.V. BLEEDER	150,000 OHMS 1W.
			R141	FOCUS CONTROL	250,000 OHMS POT.
			R140	H.V. BLEEDER	500,000 OHMS 1W.
			R139	BIAS-V102	1,000 OHMS 1/2 W.
			R138	SAME AS R137	200,000 OHMS 1/2W.
			R137	2ND ANODE NET-V109	100,000 OHMS 1/2W.
			R136	PLATE LOAD-V104	150,000 OHMS 1 W.
			R135	GRID RETURN-V108B	75,000 OHMS 1/2W.
			R134	COUPLING - V108B	2 MEGOHMS 1/2W.
			R133	COUPLING - V108A	2 MEGOHMS 1/2W.
			R132	BIAS-V108B	3,500 OHMS 1/2 W.
			R131	BIAS-V108A	6,000 OHMS 1/2 W.
			R130	GRID RETURN-V108A	100,000 OHMS 1/2W.
			R129	BIAS NET-V108A	150,000 OHMS 1 W.
			R128	HOR. POSITION	500,000 OHMS POT.
			R127	PLATE LOAD-V108A	250,000 OHMS 1W.
			R126	PLATE LOAD-V108B	150,000 OHMS 1W.
			R125	BIAS NET-V108B	150,000 OHMS 1W.
			R124	VERTICAL POSITION	500,000 OHMS POT.
			R123	CENTER FREQUENCY ADJ.	500 OHMS POT.
			R122	SAME AS R121	200 OHMS 1/2 W.
			R121	CENTER FREQUENCY NET	500 OHMS 1/2W.
			R120	SWEEP	250,000 OHMS POT.
			R119	REACTOR PAD	1,000 OHMS POT.
			R118	GRID RETURN-V107	200,000 OHMS 1/2W.
			R117	REGULATOR DROP-V106	7,500 OHMS 10W.
			R116	H.V. FILTER	25,000 OHMS 1 W.
			R115	PLATE LIMITING - V104	500,000 OHMS 1/2W.
			R114	DIODE LOAD, BIAS-V104	150,000 OHMS 1/2W.
			R113	PLATE ISOLATION-V103	5,000 OHMS 1 W.
			R112	SAME AS R111	50,000 OHMS 1W.
			R111	SCREEN DROP-V103	50,000 OHMS 1 W.
			R110	I.F. PAD-V103	100,000 OHMS POT.
			R109	GRID BIAS-V103	150 OHMS 1/2 W.
			R108	PLATE ISOLATION-V102	2,000 OHMS 1W.
			R107	OSCILLATOR GRID-V102	20,000 OHMS 1/2W.
			R106	PLATE ISOLATION-V101	2,000 OHMS 1 W.
			R105	SAME AS R103	50,000 OHMS 1W.
			R104	SAME AS R103	50,000 OHMS 1W.
			R103	SCREEN BLEEDER-V101	50,000 OHMS 1W.
			R102	GRID BIAS-V101	150 OHMS 1/2 W.
			R101	GAIN CONTROL	10,000 OHMS POT.
SYM.	FUNCTION	VALUE	SYM.	FUNCTION	VALUE
CD807	A.C. LINE CORD				
CD806	SHIELDED CABLE				
P104	A.C. PLUG	7545			
Z103-O1	I.F. OUTPUT TRANS.	226KC.			
Z102-O1	I.F. INPUT TRANS.	226KC.			
Z101-O1	OSC. REACTOR COMPOSITE	681 KC. ± 100 KC.			
V111	SAW.GEN. & HOR. AMP	6SL7-(GT)VT-229			
V110	LOW VOLT. RECTIFIER	6X5-(GT/G)VT-126B			
V109	PANORAMIC INDICATOR	3BP1			
V108	HOR. & VERT. AMP.	6SL7-(GT)VT-229			
V107	REACTOR	6AC7 VT-112			
V106	REGULATOR	VR105/30 VT-200			
V105	HIGH VOLT. RECTIFIER	2X2 VT-119			
V104	DETECTOR & VIDEO AMP	6SQ7(GT/G)VT-103			
V103	I.F. AMPLIFIER	6SG7 VT-211			
V102	OSCILLATOR MIXER	6SA7 VT-150			
V101	R.F. INPUT AMPLIFIER	6AC7 VT-112			
T104	POWER TRANSFORMER				
T103	B.T.O. TRANSFORMER				
T102-O1	R.F. OUTPUT TRANS.	455KC. ± 100 KC.			
T101-O1	R.F. INPUT TRANS.	455KC. ± 100 KC.			
S101	POWER SWITCH	250V. 3AMP.			
P201	R.F. CONNECTOR PLUG	PL-259			
P103	R.F. INPUT ANGLE PLUG	M-359			
P102	FEMALE PLUG CONN.	250V. 10 AMP.			
P101	R.F. COAX. PLUG	PL-259			
L101AB	L.V. FILTER CHOKES	6.5H. PER SECTION			
J201	OMITTED				
J102	RECESSED MALE CONN.	250V. 10 AMP.			
J101	PANORAMIC ADAPTOR INPUT	50-239			
I101	PILOT LIGHT	6-BV. .15 AMP.			
F101	FUSE	250V. 2 AMP.			
C115	SWEEP COUPLING	.25MFD. 600V.			
C114	SAWTOOTH COUPLING	.25MFD. 600V.			
C113	SAWTOOTH GRID-VIII	.01MFD. 300V. MICA			
C112	SAME AS C110	4MFD. 600V.			
C111	SAME AS C110	4MFD. 600V.			
C110	L.V. FILTER	4MFD. 600V.			
C109	R.F. BYPASS-V107	100MMFD. 500V. MICA			
C108AB	H.V. FILTER	2X.25 MFD. 2p00V.			
C107AC	LINE FILTER-SAWGEN-VIII	3X.1MFD. 600V.			
C106	DIODE LOAD-V104	250MMFD. 500V. MICA			
C105AC	R.F. BYPASS-V103	3X.1MFD. 600V.			
C104	R.F. BYPASS CATHODE-V103	250MMFD. 500V. MICA			
C103AC	R.F. BYPASS-V102, V107	3X.1MFD. 600V.			

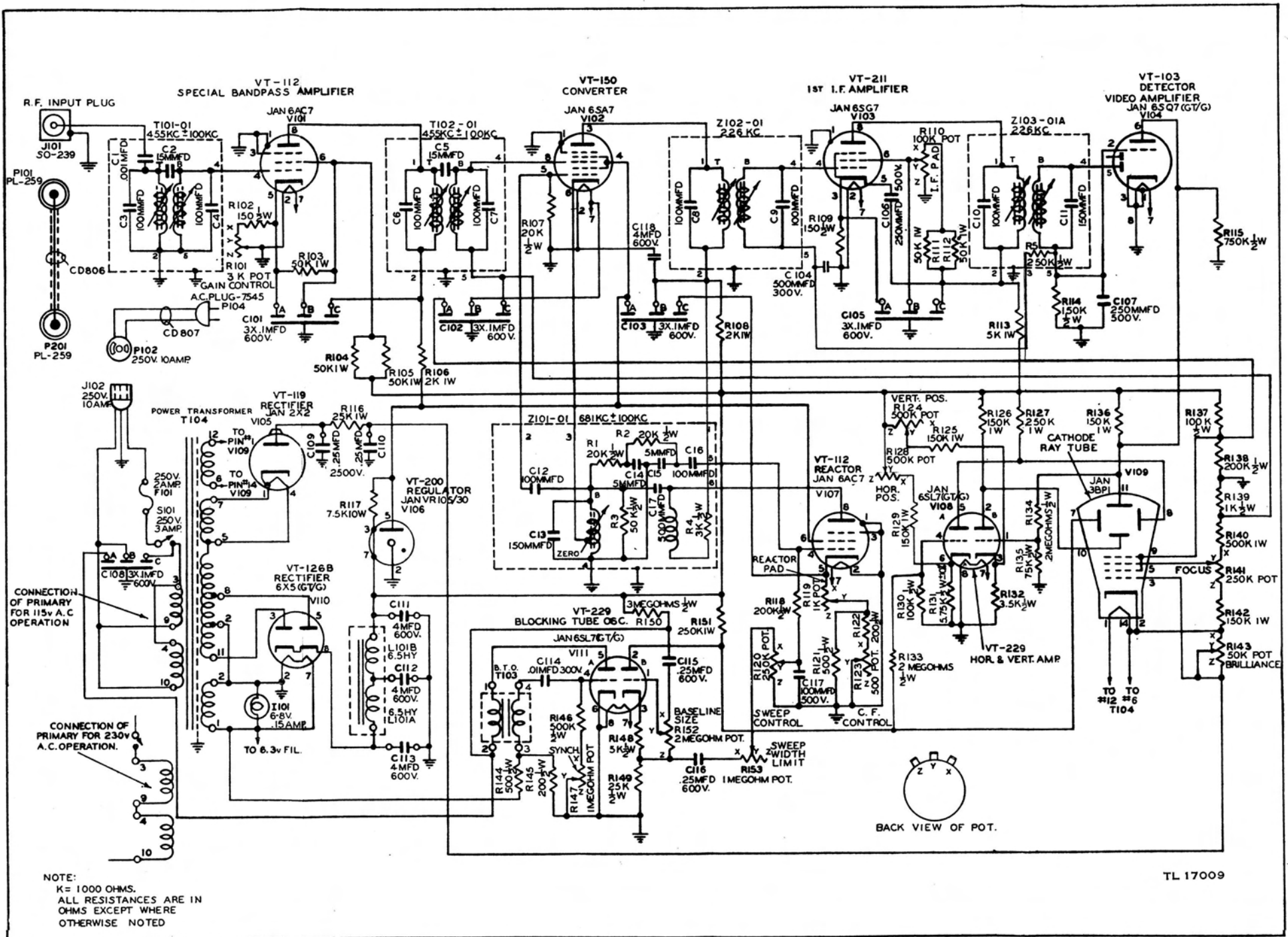
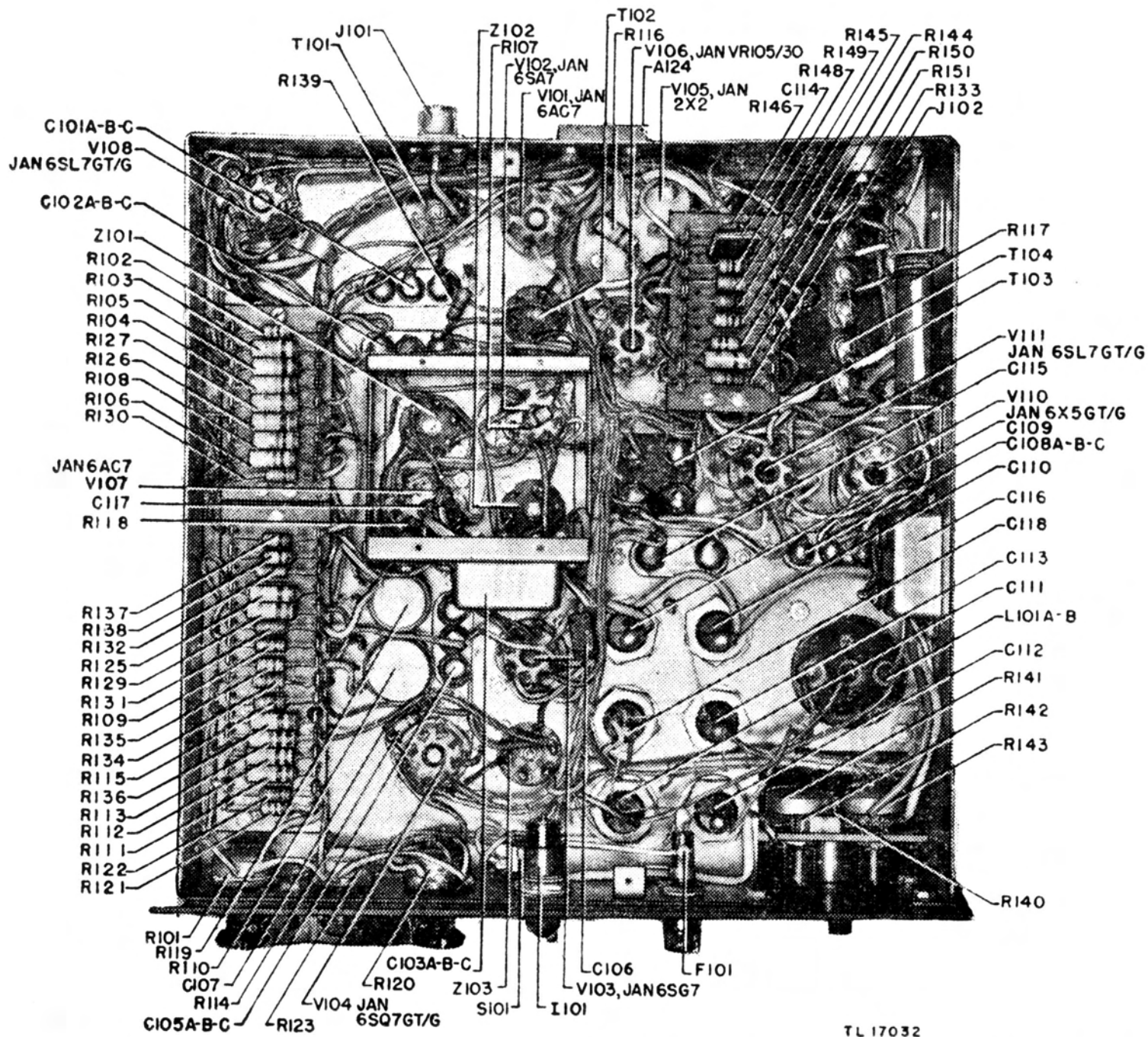


Figure 30. Panoramic Adaptor BC-1031-B, circuit diagram (equipment delivered on Order No. 639-Phila-45-07).



TL 17032

Figure 31. Panoramic Adaptor BC-1031-B, bottom view (equipment delivered on Order No. 639-Phila-45-07).

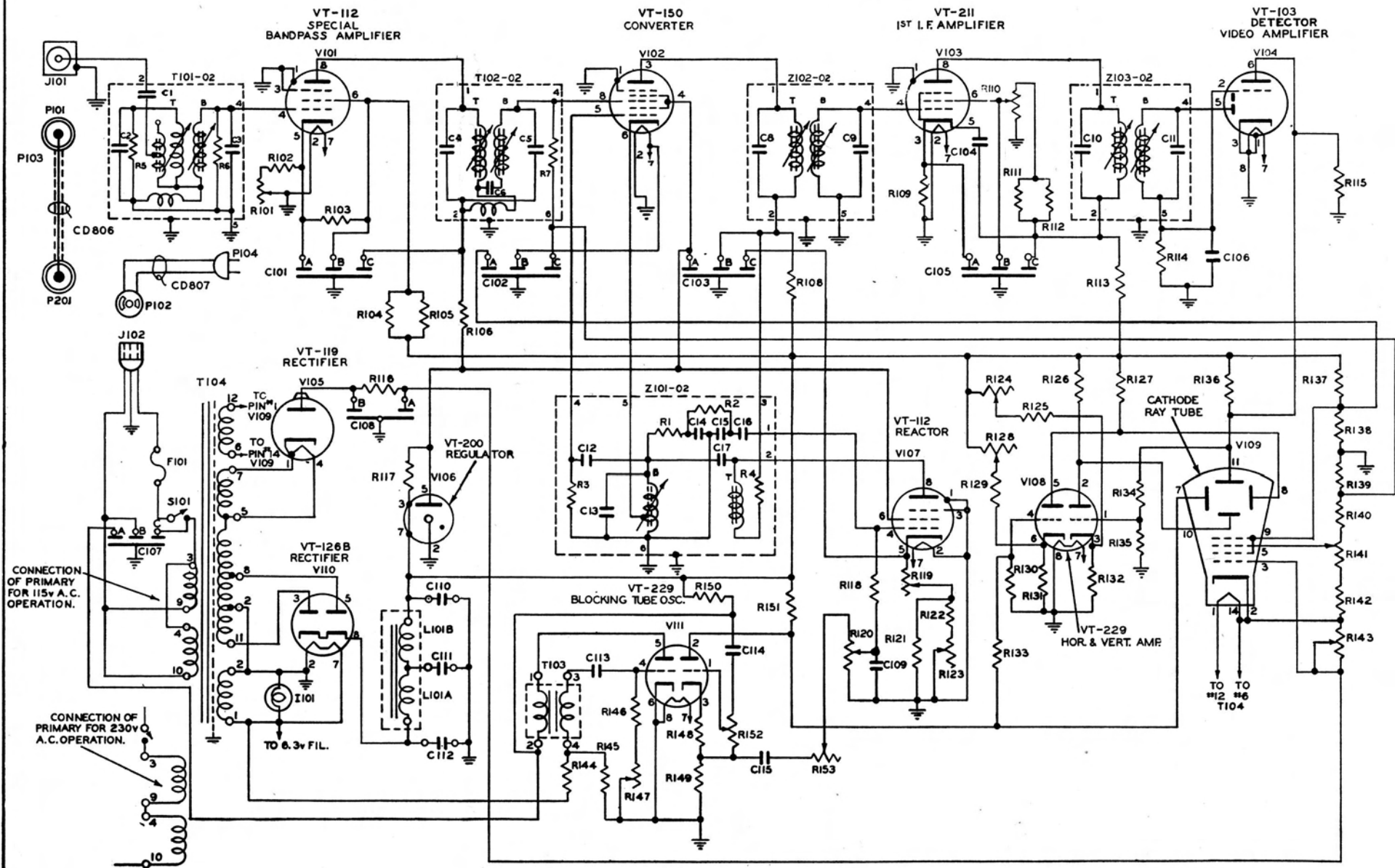


Figure 32. Panoramic Adaptor BC-1032-B, circuit diagram.

FOR COIL COMPONENTS SEE PARTS LIST.					
SYM.	FUNCTION	VALUE	SYM.	FUNCTION	VALUE
			C102AC	R.F. BYPASS-V102,V109	3X.1MFD. 600V.
			C104AC	R.F. BYPASS-V101	3X.1MFD. 600V.
			R201	OMITTED	
			R153	SWEEP LIMITER	1 MEGOHM POT.
			R152	HOR. SIZE CONTROL	2 MEGOHM POT.
			R151	PLATE LOAD - VIII B	250,000 OHMS 1 W
			R150	SAW GENERATOR-VIII A	3 MEGOHMS 1/2 W.
			R149	SWEEP NET	25,000 OHMS 1/2 W.
			R148	BIAS-VIII B	5,000 OHMS 1/2 W.
			R147	SYNCH. CONTROL	1 MEGOHM POT.
			R146	GRID RESISTOR-VIII A	500,000 OHMS 1/2 W.
CD807	A.C. LINE CORD		R145	SAME AS R144	200 OHMS 1/2 W.
CD806	SHIELDED CABLE		R144	SYNCH. NET	500 OHMS 1/2 W.
PI04	A.C. PLUG	7545	R143	INTENSITY CONTROL	50,000 OHMS POT.
Z10302	I.F. OUTPUT TRANS.	912 KC.	R142	H.V. BLEED	150,000 OHMS 1 W.
Z10202	I.F. INPUT TRANS.	912 KC.	R141	FOCUS CONTROL	250,000 OHMS POT.
Z10102	OSC. REACTOR COMPOSITE	6.162 MC. \pm .5 MC.	R140	H.V. BLEED	500,000 OHMS 1 W.
VIII	SAW GEN. & HOR. AMP.	6SL7-(GT) VT-229	R139	BIAS-V102	1,000 OHMS 1/2 W.
VI10	LOW VOLT. RECTIFIER	6X5-(GT/G) VT-126B	R138	SAME AS R137	200,000 OHMS 1/2 W.
VI09	PANORAMIC INDICATOR	3 BP1	R137	2ND ANODE NET-V109	100,000 OHMS 1/2 W.
VI08	HOR. & VERT. AMP.	6SL7-(GT) VT-229	R136	PLATE LOAD-V104	150,000 OHMS 1 W.
VI07	REACTOR	6AC7 VT-112	R135	GRID RETURN-V108B	75,000 OHMS 1/2 W.
VI06	REGULATOR	VR105/30 VT-200	R134	COUPLING-V108B	2 MEGOHMS 1/2 W.
VI05	HIGH VOLT. RECTIFIER	2X2 VT-119	R133	COUPLING-V108A	2 MEGOHMS 1/2 W.
VI04	DETECTOR & VIDEO AMP.	6SQ7-(GT/G) VT-103	R132	BIAS-V108B	3,500 OHMS 1/2 W.
VI03	I.F. AMPLIFIER	6SG7 VT-211	R131	BIAS-V108A	5,500 OHMS 1/2 W.
VI02	OSCILLATOR MIXER	6SA7 VT-150	R130	GRID RETURN-V108A	100,000 OHMS 1/2 W.
VI01	R.F. INPUT AMPLIFIER	6AC7 VT-112	R129	BIAS NET-V108A	150,000 OHMS 1 W.
TI04	POWER TRANSFORMER		R128	HOR. POSITION	500,000 OHMS POT.
TI03	B.T.O. TRANSFORMER		R127	PLATE LOAD-V108A	250,000 OHMS 1 W.
TI0202	R.F. OUTPUT TRANS.	5.25 MC. \pm .5 MC	R126	PLATE LOAD-V108B	150,000 OHMS 1 W.
TI0102	R.F. INPUT TRANS.	5.25 MC. \pm .5 MC	R125	BIAS NET-V108B	150,000 OHMS 1 W.
SI01	POWER SWITCH	250V. 3 AMP	R124	VERTICAL POSITION	500,000 OHMS POT.
P201	R.F. CONNECTOR PLUG	PL-259	R123	CENTER FREQUENCY ADJ.	500 OHMS POT.
PI03	R.F. INPUT ANGLE PLUG	M-359	R122	SAME AS R121	200 OHMS 1/2 W.
PI02	FEMALE PLUG CONN.	250V. 10 AMP.	R121	CENTER FREQUENCY NET	500 OHMS 1/2 W.
PI01	R.F. COAX. PLUG	PL-259	R120	SWEEP	250,000 OHMS POT.
LI01AB	L.V. FILTER CHOKES	6.5 HY. PER SECTION	R119	REACTOR PAD	1,000 OHMS POT.
J201	OMITTED		R118	GRID RETURN-V107	200,000 OHMS 1/2 W.
J102	RECESSED MALE CONN.	250V. 10 AMP.	R117	REGULATOR DROP-V108	7,500 OHMS 10 W.
J101	PANORAMIC ADAPTOR INPUT	50-239	R116	H.V. FILTER	25,000 OHMS 1 W.
II01	PILOT LIGHT	6-BV. .15 AMP.	R115	PLATE LIMITING -V104	500,000 OHMS 1/2 W.
FI01	FUSE	250V. 2 AMP.	R114	DIODE LOAD, BIAS-V104	150,000 OHMS 1/2 W.
CI15	SWEEP COUPLING	.25 MFD. 600V.	R113	PLATE ISOLATION-V103	5,000 OHMS 1 W.
CI14	SAW TOOTH COUPLING	.25 MFD. 600V.	R112	SAME AS R111	50,000 OHMS 1 W.
CI13	SAW TOOTH GRID-VIII	.01 MFD. 300V. MICA	R111	SCREEN DROP-V103	50,000 OHMS 1 W.
CI12	SAME AS CI10	4 MFD. 600V.	R110	I.F. PAD-V103	100,000 OHMS POT.
CI11	SAME AS CI10	4 MFD. 600V.	R109	GRID BIAS-V103	150 OHMS 1/2 W.
CI10	L.V. FILTER	4 MFD. 600 V.	R108	PLATE ISOLATION-V102	2,000 OHMS 1 W.
CI09	R.F. BYPASS-V107	100 MMFD. 500V. MICA	R107	OMITTED	
CI08AB	H.V. FILTER	2X.25 MFD. 2000V.	R106	PLATE ISOLATION-V101	2,000 OHMS 1 W.
CI07AC	LINE FILTER-SAW GEN-VIII	3X.1 MFD. 600V.	R105	SAME AS R103	50,000 OHMS 1 W.
CI06	DIODE LOAD-V104	250 MMFD. 500V. MICA	R104	SAME AS R103	50,000 OHMS 1 W.
CI05AC	R.F. BYPASS-V103	3X.1 MFD. 600V.	R103	SCREEN BLEEDER-V101	50,000 OHMS 1 W.
CI04	R.F. BYPASS CATHODE-V103	250 MMFD. 500V. MICA	R102	GRID BIAS-V101	150 OHMS 1/2 W.
CI03AC	R.F. BYPASS-V102,V107	3X.1 MFD. 600V.	R101	GAIN CONTROL	10,000 OHMS POT.

RESTRICTED

SUPPLEMENT

28 December 1944

TM 11-446

SUPPLEMENT

to

TECHNICAL MANUAL

**PANORAMIC ADAPTORS BC-1031-A,
BC-1032-A, BC-1031-B, AND BC-1032-B**

28 DECEMBER 1944

The following information, published on Order No. 639-Phila-45-07, supplements TM 11-446, 28 December 1944. Personnel using the equipment and having custody of this technical manual will attach this supplement securely inside the front cover of the TM. This supplement will remain in effect only until the information is published in an official War Department publication.

APPENDIX I

1. MAINTENANCE PARTS LIST FOR PANORAMIC ADAPTOR BC-1031-B.

This maintenance parts list is used for Panoramic Adaptors BC-1031-B which bear Order No. 639-Phila-45-07.

MAINTENANCE PARTS LIST FOR PANORAMIC ADAPTOR BC-1031-B.

Ref symbol	Signal Corps stock No.	Name of part and description	Quan per unit	Mfrs part and code No.	†Station stock	†Region stock
C101, 102, 103,105,108	3DA100-126.2	CAPACITOR: paper; oil; 3 x 0.1-mf; 600 v dc (working).	5	6BAB111 (I8)	*	*
C107, 106	3D9250-9	CAPACITOR: mica; 250-mmf; 500 v dc (working).	2	5WLS (C15)	*	*
C104	3K2051132	CAPACITOR: mica; 500-mmf; 500 v dc (working).	1	CM20C511-J	*	*
C109, 110	3DA250-176	CAPACITOR: paper; oil; 0.25-mf; 2,500 v dc (working).	2	256A25 (I-8)	*	*
C117	3K2010121	CAPACITOR: mica; 100-mmf; 500 v dc (working).	1	OXM (C15)	*	*
C111, 112, 113, 118	3DB4-83.1	CAPACITOR: paper; oil; 4-mf; 600 v dc (working).	4	66A400 (I-8)	*	*
C114	3DA10-44	CAPACITOR: mica; 0.01-mf; 300 v dc (working).	1	3W (C15)	*	*
C115	3DA250-63.1	CAPACITOR: paper; oil; 0.25-mf; 600 v dc (working).	1	6BAT25 (I8)	*	*
C116	3DA250-63	CAPACITOR: paper; oil; 0.25-mf; 600 v dc (working).	1	6BAB25 (I8)	*	*

* Indicates stock available.

† Parts not stocked in station or region stock are carried in depot stock.

MAINTENANCE PARTS LIST FOR PANORAMIC ADAPTOR BC-1031-B (contd).

Ref symbol	Signal Corps stock No.	Name of part and description	Quan per unit	Mfrs part and code No.	†Station stock	†Region stock
L-101	3C323-6B	CHOKE FILTER: double inductance of each choke: 6.5 h. -10% measured at 40 ma dc; 5-v, 60-c operation current 55 ma dc; d-c resistance: 200-ohms +10% (special).	1	H1 1B152 (G19) H2 A4266 (A20)		*
Z101-01	2C2831B/C3	**COIL ASSEMBLY: oscillator reactor; permeability tuned; includes h-f choke; inductance of osc: 575 mh ±5%; distributed capacitance less than 5 mmf; 195 turns tapped at 30 turns of No. 36 S.S.E.; d-c resistance, 75 ohms.	1	P2-766b (P30)		*
CD806	3E1806	CORD: low loss; h-f; copolene; transmission line.	1	RG-11U (A13)		*
CD807	3E1807	CORD: power; rubber-covered; 2-conductor.	1	O-SJ (B4)		*
F101	3Z1927	FUSE: cartridge; 2-amp; type 3AG.	2	1042 (L3)	*	*
I101	2Z5952	LAMP: pilot light; bayonet base; 6-8-v; 150 ma.	1	N-47 (G3)	*	*
E103	3Z3275	POST: extractor; fuse.	1	1075 (L3)	*	*
	3RC21BE513J	RESISTOR: 50,000-ohm; 1/2-w; carbon (coupling from receiver to panoramic adaptor).	1	BT-1/2 (I2)	*	*

* Indicates stock available.

** Contains various resistors and capacitors.

† Parts not stocked in station or region stock are carried in depot stock.

4 **MAINTENANCE PARTS LIST FOR PANORAMIC ADAPTOR BC-1031-B (contd).**

Ref symbol	Signal Corps stock No.	Name of part and description	Quan per unit	Mfrs part and code No.	†Station stock	†Region stock
R101	3Z7269.158	RESISTOR: potentiometer; 3,000-ohm; 1-w. carbon.	1	F-37W (C10)		*
R102, 109	3RC20AE151K	RESISTOR: 150-ohm; 1/2-w; carbon.	2	A504 (E3)	*	*
R103, 104, 105, 111, 112	3RC31AE513J	RESISTOR: 50,000-ohm; 1-w; carbon.	5	A-518 (E3)	*	*
R106, 108	3RC31AE202J	RESISTOR: 2,000-ohm; 1-w; carbon.	2	A-518 (E3)	*	*
R107	3RC20AE203J	RESISTOR: 20,000-ohm; 1/2-w; carbon.	1	A504 (E3)	*	*
R110	2Z7271-17	RESISTOR: potentiometer; 100,000-ohm; 1-w.	1	C-S37-W (C10)		*
R113	3RC31AE(512J)	RESISTOR: 5,000-ohm; 1-w; carbon.	1	A-518 (E3)	*	*
R114	3RC20BE154K	RESISTOR: 150,000-ohm; 1/2-w; carbon.	1	A-504 (E3)	*	*
R115	3RC20BE754J	RESISTOR: 750,000-ohm; 1/2-w; carbon.	1	A-504 (E3)	*	*
R116	3RC31AE243J	RESISTOR: 25,000-ohm; 1-w; carbon.	1	A-518 (E3)	*	*

* Indicates stock available.

†Parts not stocked in station or region stock are carried in depot stock.

MAINTENANCE PARTS LIST FOR PANORAMIC ADAPTOR BC-1031-B (contd).

Ref symbol	Signal Corps stock No.	Name of part and description	Quan per unit	Mfrs part and code No.	†Station stock	†Region stock
R117	3Z6575-44	RESISTOR: 7,500-ohm; 10-w; wire-wound.	1	B-DH (I2)	*	*
R118, 138	3Z6720-15	RESISTOR: 200,000-ohm; 1/2-w; carbon.	2	A-504 (E3)	*	*
R119	2Z7268.20	RESISTOR: potentiometer; 1,000-ohm; 1-w.	1	C-S37-W (C10)		*
R120, 141	2Z7272-19	RESISTOR: potentiometer; 250,000-ohm; 1-w.	2	C-S37-W (C10)		*
R121, 144	3RC20AE511J	RESISTOR: 500-ohm; 1/2-w; carbon.	2	A-504 (E3)	*	*
R122, 145	3RC20AE201J	RESISTOR: 200-ohm; 1/2-w; carbon.	2	A-504 (E3)	*	*
R123	2Z7267.6	RESISTOR: potentiometer; 500-ohm; 1-w.	1	C-S37-W (C10)		*
R124, 128	2Z7272-42	RESISTOR: potentiometer; 500,000-ohm; 1-w.	2	C-S37-W (C10)		*
R125, 126, 129, 136, 142	3RC31AE154K	RESISTOR: 150,000-ohm; 1-w; carbon.	5	A518 (E3)	*	*
R127, 151	3Z6725-43	RESISTOR: 250,000-ohm; 1-w; carbon.	2	A-518 (E3)	*	*

* Indicates stock available.

† Parts not stocked in station or region stock are carried in depot stock.

MAINTENANCE PARTS LIST FOR PANORAMIC ADAPTOR BC-1031-B (contd).

Ref symbol	Signal Corps stock No.	Name of part and description	Quan per unit	Mfrs part and code No.	†Station stock	†Region stock
R130, 137	3Z6700-54	RESISTOR: 100,000-ohm; 1/2-w; carbon.	2	A-504 (E3)	*	*
R131	3Z6560-14	RESISTOR: 6,000-ohm; 1/2-w; carbon.	1	BT 1/2 (I2)	*	*
R132	3Z6350-11	RESISTOR: 3,500-ohm; 1/2-w; carbon.	1	710 (C4)	*	*
R133, 134	3RC20AE205J	RESISTOR: 2-meg; 1/2-w; carbon.	2	A504 (E3)	*	*
R135	3Z6675-20	RESISTOR: 75,000-ohm; 1/2-w; carbon.	1	A504 (E3)	*	*
R139	3Z6100-64	RESISTOR: 1,000-ohm; 1/2-w; carbon.	1	A-504 (E3)	*	*
R140	3RC31AE514J	RESISTOR: 500,000-ohm; 1-w; carbon.	1	A518 (E3)	*	*
R143	2Z7270.10	RESISTOR: potentiometer; 50,000-ohm; 1-w.	1	C-S37-W (C10)		*
R147, 153	2Z7273-6	RESISTOR: potentiometer; 1-meg; 1-w.	2	C-S37-W (C10)		*
R148	3RC20AE512J	RESISTOR: 5,000-ohm; 1/2-w; carbon.	2	A504 (E3)	*	*
R149	3RC20AE243J	RESISTOR: 25,000-ohm; 1/2-w; carbon.	1	A-504 (E3)		*
R150	3RC20AE305J	RESISTOR: 3-meg; 1/2-w; carbon.	1	A-504 (E3)	*	*

* Indicates stock available.

† Parts not stocked in station or region stock are carried in depot stock.

MAINTENANCE PARTS LIST FOR PANORAMIC ADAPTOR BC-1031-B (contd).

Ref symbol	Signal Corps stock No.	Name of part and description	Quan per unit	Mfrs part and code No.	†Station stock	†Region stock
R152	2Z7274-12	RESISTOR: potentiometer; 2-meg; 1-w.	1	C-S37-W (C10)		*
I126	2Z4376.4	SCREEN: Lumarith; filter; 3" diam; green.	1	#04650 (P30)		*
S101	3Z9847-3	SWITCH: toggle; SPST; 3-amp; 125 v.	1	K-24000 (A17)		*
T101-01	2C2831B/C1	TRANSFORMER ASSEMBLY: band-pass; 455 ± 100 kc; permeability tuned; inductance of pri, without iron core 600 mh; sec, 900 mh; pri d-c resistance, 6.5 ohms; sec d-c resistance, 8 ohms.	1	P2-762b (P30)		*
T102-01	2C2831B/C2	**TRANSFORMER ASSEMBLY: band-pass; 455 ± 100 kc; permeability tuned; inductance of pri and sec, 800 mh ea.	1	P2-763b (P30)		*
T103	2Z9638-8	TRANSFORMER: audio; 2/1 ratio.	1	H2-4267 (A20) H1-2A137 (G19)		*
T104	2Z9608-11	TRANSFORMER: power; two primary windings for series or parallel operation on 50-70 cycles; 115 v or 230 v; 5 sec windings; (1 tap); 6.4 v at 3 amp; 590 v center tapped at 55 ma; 525 v at 1.5 ma; 2.5 v at 1.75 amp; 6.4 v at 0.6 amp (special).	1	H1 5J13 (G19) H2 A4265 (A20)		*

* Indicates stock available.

** Contains various resistors and capacitors.

† Parts not stocked in station or region stock are carried in depot stock.

MAINTENANCE PARTS LIST FOR PANORAMIC ADAPTOR BC-1031-B (contd).

Ref symbol	Signal Corps stock No.	Name of part and description	Quan per unit	Mfrs part and code No.	†Station stock	†Region stock
Z102-01	2Z9642.33	**TRANSFORMER ASSEMBLY: permeability tuned; pri and sec identical; two pies of 250 turns each; d-c resistance, 40 ohms; Form 7/16" OD XXX bakelite tubing; wax impregnated; zinc alloy can: 1 3/8" x 1 3/8" x 3 1/2"; terminals: silver-plated lugs.	1	P2-764b (P30)		*
Z103-01A	2Z9642.32	**TRANSFORMER ASSEMBLY: permeability tuned; pri has two pies of 250 turns each; sec has two pies of 175 turn each; pr; d-c resistance 40 ohms, sec 34 ohms. Form 7/16" OD XXX bakelite tubing; wax impregnated; zinc alloy can: 1 3/8" x 1 3/8" x 3 1/2"; terminals: silver-plated lugs.	1	P2-765b (P30)		*
V101, 107	2J6AC7	TUBE: JAN-6AC7	2	6AC7 (R2)	*	*
V102	2J6SA7	TUBE: JAN-6SA7	1	6SA7 (R2)	*	*
V103	2J6SG7	TUBE: JAN-6SG7	1	6SG7 (R2)	*	*
V104	2J6SQ7	TUBE: JAN-6SQ7	1	6SQ7 (R2)	*	*
V105	2J2X2	TUBE: JAN-2X2	1	2X2 (R2)	*	*

* Indicates stock available.

**Contains various resistors and capacitors.

† Parts not stocked in station or region stock are carried in depot stock.

MAINTENANCE PARTS LIST FOR PANORAMIC ADAPTOR BC-1031-B (contd).

Ref symbol	Signal Corps stock No.	Name of part and description	Quan per unit	Mfrs part and code No.	†Station stock	†Region stock
V106	2JOC3/VR105	TUBE TUBE: JAN-OC3/VR-105.	1	VR105 (R2)	*	*
V108, V111	2J6SL7GT	TUBE: JAN-6SL7GT.	2	6SL7GT (R2)	*	*
V109	2J3BP1	TUBE: JAN-3BP1.	1	3BP1 (R2)	*	*
V110	2J6X5GT/G	TUBE: JAN-6X5GT/G.	1	6X5GT/G (R2)	*	*

* Indicates stock available.

† Parts not stocked in station or region stock are carried in depot stock.

LIST OF MANUFACTURERS

<i>Code</i>	<i>Name</i>
A52	Aladdin Radio Industries
A13	American Phenolic Corporation
A17	Arrow-Hart and Hegeman Company
A20	Audio Development Company
B4	Birnbach Radio Company
C4	Centralab
C10	Clarostat Manufacturing Company
C15	Cornell-Dubilier Electric Corporation
E3	Erie Resistor Corporation
F16	Freed Transformer Company
G3	General Electric Company
G19	General Transformer Corporation
I2	International Resistance Company
I8	Industrial Condenser Corporation
L3	Littlefuse Laboratory
P30	Panoramic Corporation of America
R2	RCA Manufacturing Company
R3	Repath, P. R. Company
S5	Solar Manufacturing Corporation