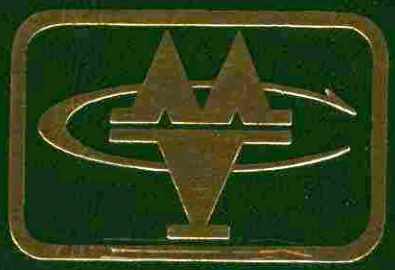
SURVEILLANCE AND MEASUREMENT RECEIVERS



INSTRUCTION MANUAL
for
WR-200 SERIES
WIDE RANGE RECEIVERS

MICRO-TEL CORPORATION
BALTIMORE, MARYLAND

INSTRUCTION MANUAL

for WR-200 SERIES

WIDE RANGE RECEIVERS

Micro-Tel Corporation
1406 Shoemaker Road
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Revision B
June 1967

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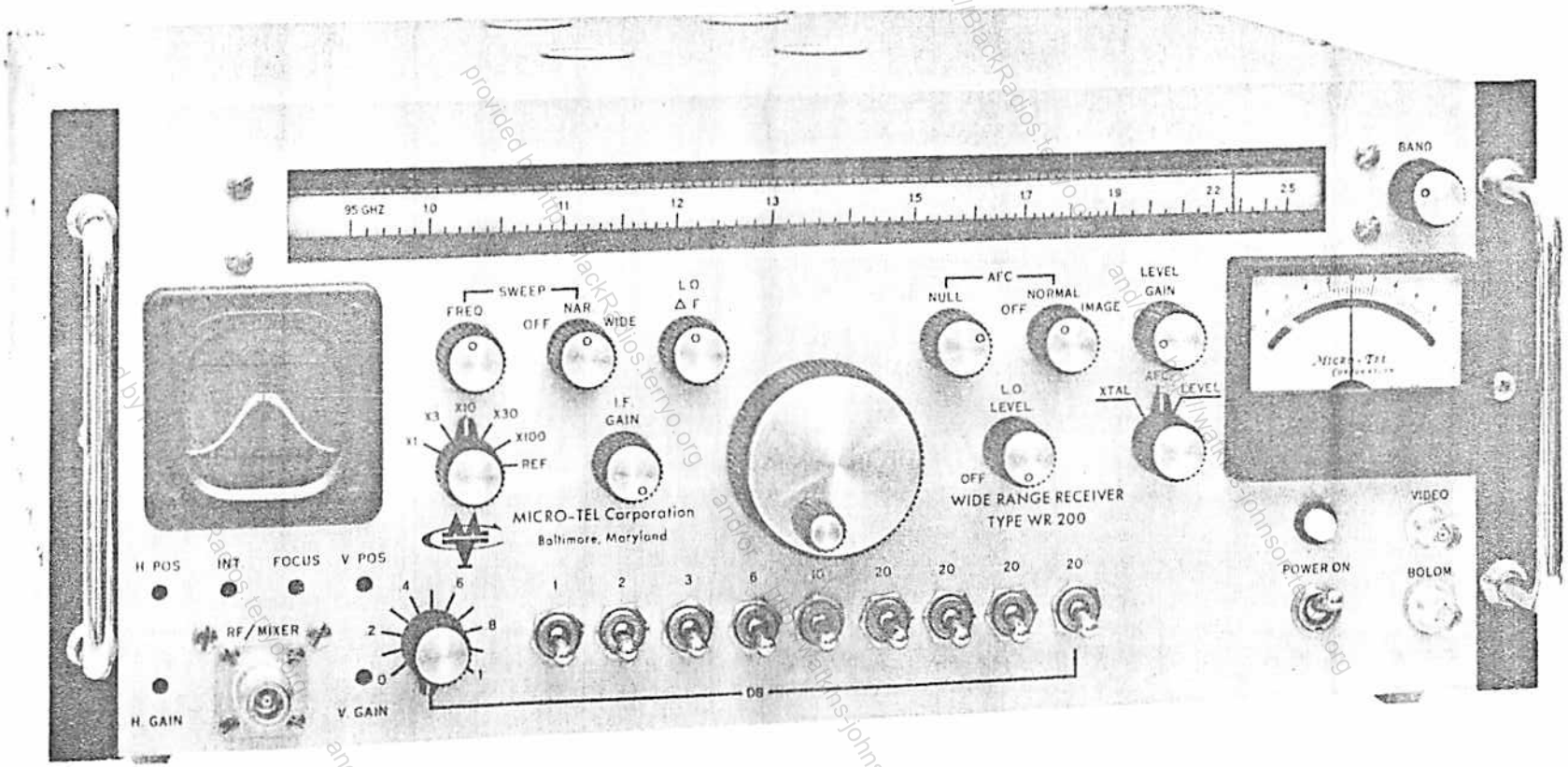


Receiver Front View

Figure 1.1

1.0 GENERAL DESCRIPTION

The Model WR-200 Wide Range Receiver is a versatile laboratory instrument designed for antenna pattern ranges, attenuation measurements, and spectrum surveillance. It is a highly linear receiver which features a square law bolometer output, and audio-video crystal detector, internal attenuator and reference channel for slideback measurements. The receiver covers the frequency range of 20 MHZ to above 100 GHZ, with a slide-rule dial directly calibrated from 20 MHZ to 22.5 GHZ.

All major components are contained in a single case as shown in Figure 1.1. It is a fully solid state receiver except for the cathode ray tuning indicator and the first local oscillator.

At frequencies above 950 MHZ a frequency selective tee and remote mixer permit the use of a single coaxial cable between the receiver and antenna with reduced loss of sensitivity since the cable carries the first local oscillator signal up to the mixer and the first intermediate frequency returns through the cable to the receiver.

The received signal may be CW, pulse or square-wave modulated. An internal modulator provides the 1000 HZ output signal required for antenna pattern recorder use. The bolometer output is linear over a 40-decibel range, and the receiver may be operated over a 100-decibel range as a slideback device with

continuous readout of attenuation. Mechanical and electronic automatic frequency control permits the reception of CW signals from simple signal sources. Frequency preselection is not required below 950 MHZ because of the conversion method. Automatically tracked preselection is available from 1 to 10 Gc as an option.

1.1 PRINCIPLES OF OPERATION

Refer to the block diagram Figure 1.2. For convenience, assume the presence of a 75 MHZ signal at the input to the Step Attenuator. Operation of the First Local Oscillator, mixer, and Low Frequency Converter will be covered later.

The Step Attenuator is a step unit which may be adjusted to atteunate the input signal to the 75 MHZ Preamplifier over a range of 102 db in 1 db steps. In addition, the 0-1 db attenuator control provides finer adjustment, but it actually controls the gain of the IF Amplifier. The Preamplifier has a bandwidth of 8 MHZ and is extremely flat over at least 4 MHZ. The flatness is required so that AFC corrections will not cause a change in the amplitude response of the amplifier. The Preamplifier is highly linear over a 40 db dynamic range to meet the overall linearity specifications of the receiver. The output of the 75 MHZ Preamplifier is fed to the Second Mixer.

The Swept Oscillator provides a heterodyning signal to the second mixer. It may be operated CW or in a swept mode.

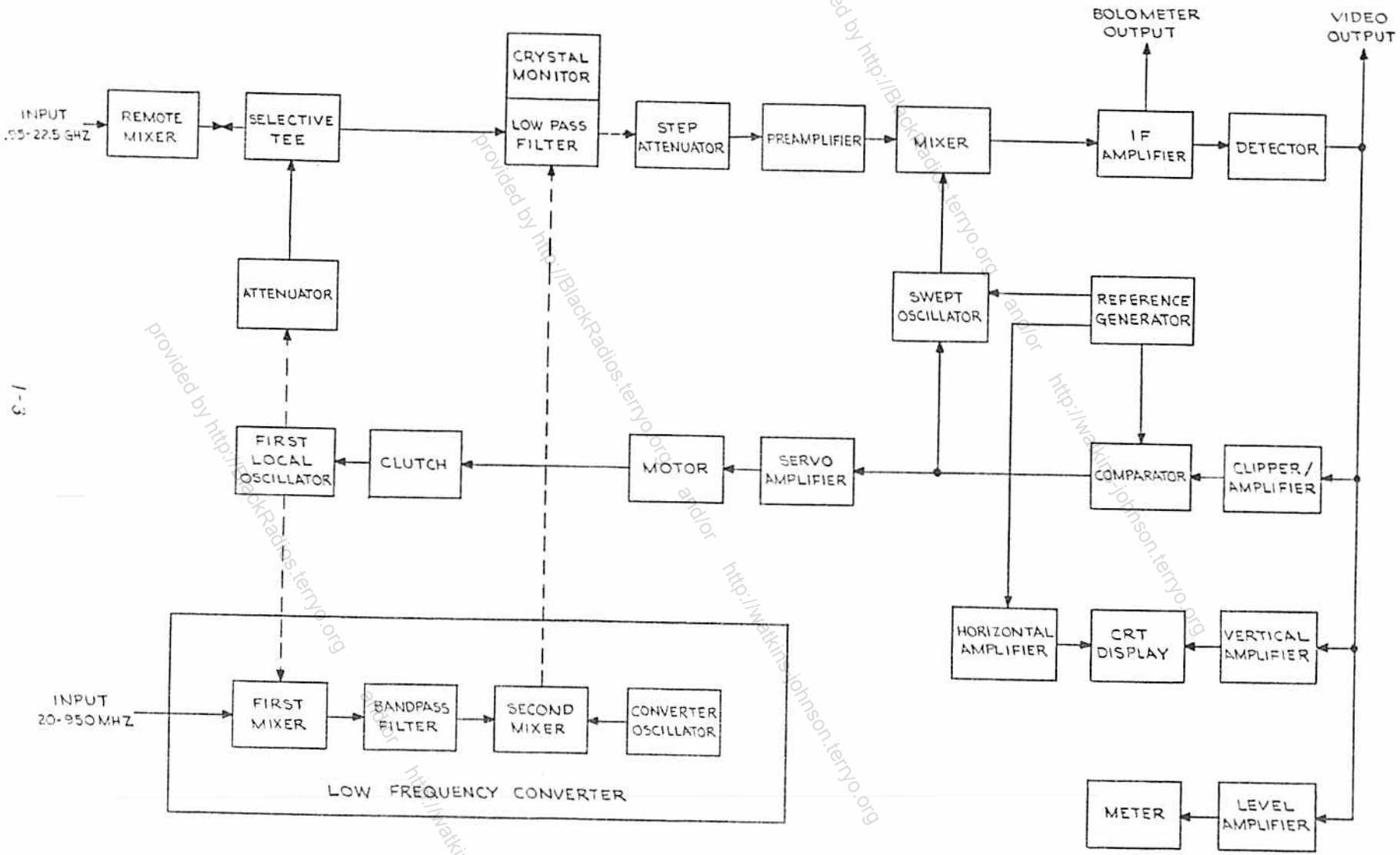


FIGURE 1.2
BLOCK DIAGRAM
RECEIVER AND LOW FREQUENCY CONVERTER

The CW mode is selected when the receiver is used for the detection of pulse signals. For the reception of CW signals, the oscillator is swept about its center frequency at a 1000 HZ rate, adjustable plus and minus 5 percent. The Swept Oscillator operates at a center frequency of 105 MHZ and is swept ± 0.5 or ± 2 MHZ. The oscillator mode is selected by a switch on the front panel. The WIDE sweep is used for convenience in tuning to display the maximum frequency spectrum on the Scope Display. The NARROW sweep insures the maximum transfer of useable energy through the receiver to the VSWR Amplifier or Antenna Pattern Recorder.

The second mixer output, sweeping between 29.5 and 30.5 MHZ (or 28 to 32 MHZ), produces a 1000 cycle AM signal at the output of the linear 30 MHZ IF amplifier. The amplitude of this signal is precisely proportional to the incoming signal level over a 40 db dynamic range.

Two output signals are derived from the IF Amplifier. One is connected to a square law detector (bolometer) and the bolometer output is available at the front panel for direct connection to a VSWR Amplifier, Antenna Pattern Recorder, or other device calibrated for use with square law detectors.

The second output is connected to a crystal diode, and the detected envelope is displayed on the front panel cathode ray tube and also used for the AFC error signal and level signal. The Scope Display shows frequency versus amplitude with the

horizontal axis representing 4 MHZ or 1 MHZ depending on the position of the sweep selector switch.

For AFC operation, a sample of the diode detector output is filtered, amplified, and applied to a phase comparator. The reference generator, which provides the sweep to the Swept Oscillator, also supplies a reference square wave to the phase comparator. A shift in phase balance between these two signals is interpreted as a shift in the incoming 75 MHZ signal. The output of the phase comparator shifts the center frequency of the Swept Oscillator electonically to keep the incoming signal in the center of the receiver passband. The phase comparator output is further amplified and applied to a servo motor which mechanically repositions the first local oscillator to compensate for large frequency shifts in the received signal.

For operation at frequencies above 950 MHZ, the output of the First Local Oscillator is passed to a frequency Selective Tee. This TEE Isolates the local oscillator frequency and the intermediate frequency. Oscillator energy is passed along the coaxial cable to the remote mixer. Fundamental or harmonics of the oscillator heterodyne the incoming RF signal to generate a 75 MHZ signal which is returned to the Selective Tee on the same cable.

For operation between 20 and 950 MHZ, a third local oscillator is introduced as shown on the block diagram. Mixing, in this frequency range is performed internally within the

receiver. The First Local Oscillator is tuned from 1020 to 1950 MHZ to generate a 1000 MHZ heterodyne with an incoming signal from 20 to 950 MHZ. The 1000 MHZ signal is passed through a steep-sided Bandpass Filter to another mixer for heterodyning with the fixed 925 MHZ Converter Oscillator. The resulting 75 MHZ heterodyne is fed to the Preamplifier.

1.2 EQUIPMENT

All of the WR-200 series receivers are supplied with a coaxial mixer which may be mounted at any distance up to 100 feet from the receiver. This mixer is used only above 950 MHZ (refer to Section 3.2) and is rated for operation from 950 MHZ to 15 GHZ.

For short distances between the receiver and the signal source, RG-9B/U coaxial cable (not supplied) may be used between the receiver and the mixer. Where increased sensitivity is required or where longer cable runs are necessary, the coaxial cable should be a low-loss type, and a matching device, such as a double stub tuner, should be inserted between the mixer and the cable. At higher frequencies, waveguide mixers are recommended.

1.3 OPTIONS

The WR-200 Receiver is normally supplied with a Low Frequency Converter as shown in the block diagram Figure 1.2.

Where coverage below 950 MHZ is not required, the receiver may be supplied without the Low Frequency Converter. Other options are described below.

1.3.1 SOURCE LEVEL COMPENSATOR

When amplitude-unstable signal sources are to be employed, the use of the Model SLC-200 Source Level Compensator is recommended. This accessory samples the amplitude of the signal source and varies the gain of the receiver to compensate for changes in the source amplitude. The sample of the transmitter signal must be at a level greater than -35 dbm at the input to the Source Level Compensator.

1.3.2 PRESELECTION

A significant amount of preselection is inherent in the receiver below 950 MHZ because of the method of heterodyning. Above 950 MHZ preselection is not normally required, or may be added externally. However, a wide selection of internal, tracked preselectors is available. These use YIG filters which may be supplied in octave bandwidths up to 12 GHZ, or a single unit is available covering 1 to 10 GHZ.

1.4 SPECIFICATIONS

Frequency Range:	950 MHZ to above 60 GHZ
Input:	CW, Pulse, Squarewave -15 dbm maximum
Dial:	Direct Reading 950 MHZ to 22.5 GHZ Accuracy ±1%
Output:	Bolometer and Xtal (Video)
Dynamic Range:	Bolometer linear to ±0.25 db over 40 db range
IF Attenuation:	102 db in 1 db steps plus 0-1 db continuous Accuracy ±0.25 db per step
Reference Level Meter:	±1 db full scale, zero-center
AFC:	Electronic over 4 MHZ range Mechanical - continous Operable to 10db above noise
Size:	19" x 7" x 15" Rack mount 17" x 7" x 15" Case
Weight:	26 pounds
Power:	117 Volts, 50-60 HZ, 35 watts

1.4.1 SENSITIVITY

The basic system, without the external mixer, consists of a low-noise 75 MHZ receiver and a tuneable oscillator. The oscillator covers the frequency range of 1000 to 2575 MHZ and provides a power output of at least 50 milliwatts at the RF/MIXER connector on the front panel (with the internal oscillator attenuator removed). The receiver noise figure at 75 MHZ is 4 db maximum, giving an equivalent noise input of -117 dbm.

The sensitivity over the receiver frequency range, using an external mixer, will depend on the length of cable. frequency and mixer. Typical sensitivities using a double-stub tuner are listed below for a 3 db signal-to-noise ratio as measured on a typical VSWR meter or antenna pattern recorder connected. Still greater sensitivities, approximately 5 db, may be realized by employing appropriate waveguide mixers.

Frequency	Sensitivity
2 GHZ	-109 DBM
4 GHZ	-105 DBM
7 GHZ	-95 DBM
70 GHZ	-60 DBM

1.4.2 LOW FREQUENCY CONVERTER

Frequency Range:	20 to 950 MHZ
Dial:	Direct Reading
Sensitivity:	-90 dbm minimum

1.4.3 SOURCE LEVEL COMPENSATOR

Input:	-35 dbm minimum
Control Range:	±2 db
Correction:	Within 0.5 db

1.5 FUSE

The power line is protected by a 1-ampere type 3AG fuse which is located on the rear panel of the receiver.

1.6 VACUUM TUBES

The receiver uses only two vacuum tubes. A type 2AP1-A cathode ray tube is the display, and a General Electric type Y1032 planar triode is used in the First Local Oscillator.

1.7 SEMICONDUCTORS

Type	Preamplifier/Swept Osc.	IF Amplifier	AFC				Level Amplifier	Scope Display			Low Voltage Power Supply	Low Frequency Converter	
			Reference Generator	Clipper/Amplifier	Comparator	Servo Amplifier		Horiz. Amp.	Vert. Amp.	Power Supply			
1N21E												2	2
1N82AG	1												1
1N295		1											1
1N456				8		1	4						13
1N3282										4			4
1N4009											2		2
1N4735A											2		2
1N4740A											2		2
1N4744A												1	1
1N4751A						1							1
1N4759A										4			4
2N398B											1		1
2N1613			2										2
2N1671			1										1
2N1701						3							3
2N2195					1								1
2N2108											1		1
2N2270			1	2	1	2					1		7
2N3053						1	1						2
2N3292	1	7											8
2N3293	1												1
2N3391				3		2	4		2				11
2N3440								2	2		1		5
2N3478	2												2
2N3866												1	1
3N126	1												1
CTP-200(1)											2		2
CTN-200(1)											1		1
1N5140A(2)	1												1
RA-1A(3)											1		1
40319(4)											1		1
Total	7	8	4	13	2	10	9	2	4	8	15	4	86

(1) Mallory
(2) Motorola
(3) General Electric
(4) RCA

2.0 INSTALLATION

The receiver should be unpacked and visually inspected for any damage during shipment. Locate the remote mixer and printed circuit extender board. Next remove the top and bottom receiver covers and inspect for loose components. Push all printed circuit cards firmly down into their connectors. Check all coaxial connectors to ensure that they are firmly mated.

The receiver may be mounted in any convenient position or attitude, and no consideration need be given to cooling unless it is operating in a high ambient temperature or is placed next to equipment which radiates excessive heat.

Connect the receiver to a 3-wire grounded 117-volt, 50/60 HZ power source. Current drain is well below one ampere so any conventional power cable or connectors are suitable. Place the bandwidth switch in the correct position; it is located on the rear panel, and should be up for narrow bandwidth and down for wide. If the receiver has not been exposed to a large change in ambient temperature, it will be ready for operation in a few minutes.

For operation below 950 MHZ, connect the signal source to be measured directly to the Type N connector on the front panel marked RF/MIXER. For operation above 950 MHZ, a remote mixer should be used. The female Type N connector on the remote mixer should be connected to the Type N fitting marked RF/Mixer.

The signal to be measured should be applied to the other end of the mixer. Use RG-9B/U coaxial cable for short distances; for distances in excess of 75-100 feet, use 50 ohm cable with lower loss, such as styrofoam.

3.0 OPERATION

WR-200 Series Receivers are available with numerous optional features and accessories. This section describes the Model WR-200-1 which contains the Low Frequency Converter and operates from 20 MHZ to above 60 GHZ. It performs the following basic measurement functions:

Antenna Pattern Recording
Attenuation Measurement
Pulse Detection and Measurement

The Model WR-200-1 operates in two different frequency domains; i.e., 20 MHZ to 950 MHZ, and 950 MHZ to above 60 GHZ. All of the above basic measurement functions can be performed in both frequency domains.

3.1 TURN-ON

Connect the receiver to a source of 115 volt 50/60 HZ power.

Set each control as follows:

SWEEP FREQ.	Centered
SWEEP Width	WIDE
L.O. F	Centered
Scope Gain	X3
I. F. GAIN	Clockwise
A.F.C. NULL	Centered
A.F.C.	OFF
LEVEL GAIN	Centered
L.O. LEVEL	Counterclockwise
Meter Switch	XTAL
BAND	Desired Frequency range
Step Attenuator	0 db

Turn the power switch to POWER ON and, after about 30 seconds, observe a horizontal trace on the cathode ray tube.

If a trace is not visible, use a small screwdriver to manipulate the conventional oscilloscope controls so that the trace fills the lower horizontal line on the tube overlay. A small amount of noise may be observed on the trace.

3.2 ADJUSTMENT FOR FREQUENCY DOMAIN

3.2.1 20 MHZ to 950 MHZ

Turn the BAND knob so that this frequency band appears in the dial window. Observe crystal current on the front panel meter. In low band operation, this meter reads crystal current as generated by the fixed local oscillator. its level is determined by an internal factory adjustment and is not controlled by the front panel LO LEVEL.

Connect a source of CW energy to the connector marked RF/MIXER. Use RG-9A/U or other low-loss 50 ohm cable. Do not use the external mixer. In low band operation, the first mixer is internal to the receiver. Adjust the Main Tuning control until the pip representing the desired incoming signal is centered on the cathode ray tube.

3.2.2 950 MHZ to above 100GHZ

Turn the BAND knob so that the appropriate band appears in the dial window. If operation above 22.5 GHZ (the highest band displayed) is desired, select the lowest convenient submultiple of the operating frequency. For example, if operation at 40 GHZ is desired, use a submultiplier of two and set the tuning dial to 20 GHZ; for 70 GHZ, use 4 and set the dial to 17 GHZ.

For operation between 950 MHZ and 15 GHZ, use the coaxial mixer supplied with the receivers. Consult the factory for waveguide mixers at frequencies to 90 GHZ. Connect the mixer to the receiver via a length of RG-9/U cable. This cable may be as long as 300 feet although, at extreme lengths, it may not be possible to read mixer crystal current. Inability to read crystal current at the receiver does not infer that mixing action will not take place. Since the mixer presents a severe mismatch to the coaxial cable, varying the length of the cable slightly may markedly change the indicated crystal current.

Set the tuning dial to the approximate frequency to be measured and adjust LO LEVEL for approximately 1 ma. of crystal current (or use maximum LO LEVEL if necessary). This is not a critical adjustment.

Now adjust the tuning dial so that the incoming CW signal is centered on the cathode ray tube. At extremely high frequnecies, it will be more convenient to make the final setting using the LO ΔF control.

3.3 AUTOMATIC FREQUENCY CONTROL

This section assumes that a CW signal has been tuned in and that it is properly centered on the cathode ray tube with the sweep width switch set to NAR. Turn the AFC switch from OFF to NORMAL and the meter switch to AFC. Remove or

lower the signal to at least -120 dbm, adjust NULL control for 0 reading on meter. (Note: Another setting of the SWEEP FREQ., LO LEVEL, IF GAIN, LO FREQ. control may require re-setting of the NULL control as above). Check the operation of the AFC by very slightly shifting the incoming signal. The main tuning knob should automatically retune to keep the pip and the meter centered. For frequencies above 950 MHZ, the receiver does not discriminate between upper and lower image. However, the tuning dial is arbitrarily calibrated on the upper image for which the AFC switch should be set to NORMAL. If for some reason, operation on the lower image is desired, this will be found 150 MHZ lower in frequency and the AFC switch should be set to IMAGE.

In LOW BAND operation (below 960 MHZ), the receiver does discriminate against the image frequency and the AFC switch should always be set to NORMAL.

The mechanical AFC is designed to correct only for slow drift of the signal source and it will do this over extremely wide excursions.

3.4 ANTENNA PATTERN MEASUREMENTS

This section assumes that the desired signal is properly tuned, the AFC is now operative, and the maximum signal is being received; i.e., the test and source antenna are pointing directly at each other.

Set the gain control to REF. and adjust the IF Gain so that the pip on the cathode ray tube fills the space between the two scribed horizontal lines. If necessary to achieve this condition, switch in the Step Attenuator.

CAUTION: Consideration should be given to the signal level at the mixer input. The mixer can be expected to be highly linear from, approximately, -15 dbm to the noise level of the receiver which occurs between -85 and -105 dbm depending on frequency. Therefore, the incoming signal should always be less than -15 dbm at the mixer.

Connect the antenna pattern recorder input to the BOLOmeter output of the receiver.

CAUTION: Observe the usual precautions when connecting and disconnecting to the bolometer. The recorder bolometer bias supply should always be turned off when making or breaking the connection.

Adjust the bias supply in the recorder for 8.75 ma. Turn the SWEEP width control to NAR. and adjust the SWEEP FREQ. control for maximum deflection of the recorder pen. Receiver and recorder linearity may be checked by inserting attenuation in the receiver.

The receiver is now ready to record over a 40 db dynamic

range. Greater dynamic ranges may be recorded by IF substitution but the saturation level of the mixer should be observed.

3.5 ATTENUATOR CALIBRATION

In this mode of operation, the receiver functions as an IF substitution device and is limited only by the saturation level of the mixer, receiver noise level, and accuracy of the Step Attenuator supplied in the receiver. Where greater accuracy is desired, other types of attenuators are available. Contact the factory for details.

Apply a CW signal whose level is not greater than -20 dbm to the mixer. Turn the meter selector switch to LEVEL. By a combination of IF GAIN, LEVEL GAIN and the attenuator, set the meter to zero. Note the amount of attenuation inserted including the 0-1 db control. Now insert the attenuator to be measured between the mixer and signal source. Note the usual precautions involved in attenuation measurement; i.e., mismatch and the necessity for padding.

Re-adjust the Step Attenuator and 0-1 db control to again establish zero on the meter. The difference between the first and second setting of attenuation represent the value of the unknown attenuator to an accuracy of ± 0.25 db per tap provided the precautions concerning mixer saturation and VSWR error have been taken.

3.6 MODULATED SIGNALS

The receiver will operate properly with most modulated signals. However, the SWEEP FREQ. control should be adjusted to ensure that a zero beat does not occur between the external modulating frequency and the internal sweep.

3.7 PULSE OPERATION

The receiver has an internal filter whose bandwidth is approximately 400 KHZ. This will pass pulses of 5 microseconds width, or greater, with reasonable fidelity. The Selectivity switch on the rear of the receiver increases this bandwidth to 5 mc when placed in the down position. The SWEEP control should be turned to the OFF position and an appropriate oscilloscope connected to the VIDEO output on the front panel. Care should be taken to ensure that the receiver is tuned to the frequency of the RF pulse.

AFC is not available in this mode of operation. However, an option is available, and the factory should be contacted for details.

3.8 EXTERNAL FIRST LOCAL OSCILLATOR

The receiver may be used with an external first local oscillator by turning the LO LEVEL control fully counterclockwise to the off position. The receiver will then operate with any oscillator-mixer combination having an output frequency

of 75 MHZ. No modifications to the receiver are necessary, and the mixer output is connected directly to the RF/MIXER connector on the receiver front panel.

4.0 THEORY OF OPERATION

This section explains in detail the circuits and components of the Wide Range Receiver. Reference should be made to the corresponding schematics contained in Section 7 when reading the following sections. It is recommended that the functional description and principles of operation contained in Section 1.1 be read beforehand.

4.1 SELECTIVE TEE

The Selective Tee permits the use of a remote mixer which can be connected to the receiver by only one coaxial cable. The tee is a three-port device which directs the First Local Oscillator energy up to the mixer, and directs the returned heterodyned signal to the Preamplifier.

The First Local Oscillator is connected to J3, and its output passes through J1 to the remote Mixer because a built-in capacity offers a low impedance at the relatively high frequency (1-2.5 GHZ). An inductor in series with J3 attenuates the oscillator energy entering the preamplifier. The heterodyne output from the remote mixer is 75 MHZ. At this comparatively low frequency, the inductor is a low impedance, so the 75 MHZ entering J1 is directed to the Preamplifier and isolated from the First Local Oscillator.

4.2 FIRST LOCAL OSCILLATOR

The first Local Oscillator is tunable over the range of 1025 to 2575 MHZ, and consists of a General Electric Type Y1032 planar triode, tuned by two concentric coaxial type cavities. The oscillator output, and therefore crystal current, is varied by adjustment of the plate voltage. The LO LEVEL control thus varies the output by approximately 10 db. The L.O. ΔF control fine tunes the oscillator by small variation of plate voltage.

4.3 OSCILLATOR ATTENUATOR

A 3 db fixed attenuator pads the oscillator output. If additional oscillator power is required for long cable lengths, this attenuator may be removed. The cable length then supplies the necessary padding.

4.4 CRYSTAL MONITOR

The Crystal Monitor provides the direct current path for the crystal in the remote mixer, and the means for metering crystal current for presentation on the front panel meter. The monitor is packaged with the Low Pass Filter, and is itself a low pass filter which must pass only direct current.

4.5 LOW PASS FILTER

The Low Pass Filter is a lumped constant device with a cutoff frequency in the vicinity of 90 MHZ. Its purpose

is to eliminate any possible overloading of the IF amplifier by the local oscillator.

4.6 STEP ATTENUATOR

The Step Attenuator is a conventional ladder-type resistive network with toggle switch selection. It provides a total attenuation of 102 db in 1 db steps.

4.7 PREAMPLIFIER/SWEPT OSCILLATOR

The Preamplifier/Swept Oscillator amplifies the 75 MHZ output of the first mixer and converts it to the second intermediate frequency of 30 MHZ for further amplification. The swept oscillator is the second local oscillator. When swept by the reference generator, this oscillator converts the incoming signal into a swept signal at the second intermediate frequency and, due to the IF Amplifier selectivity, amplitude modulates an incoming CW signal at the sweep frequency (1000 HZ).

The input stages Q801 and Q802 accept the 75 MHZ signal output from the first mixer and Selective Tee. They are low noise, common-emitter amplifiers using silicon NPN transistors. The input circuit is a single-tuned bifilar transformer.

The next stage (Q803) at 75 MHZ uses a dual-gate field effect transistor in the common source configuration. Gain control is applied to both gates. The signal is then fed to the crystal mixer in series with the swept second local oscil-

lator output. Oscillator center frequency is 105 MHZ so the mixer output is tuned to 30 MHZ, the IF amplifier frequency. A stage of amplification at 30 MHZ is included in this module. The amplifier Q804 is a common emitter amplifier.

The Swept Oscillator Q805 (second local oscillator) is a Colpitts circuit with a grounded base. A varactor is connected across the oscillator resonant circuit. This varactor is AC coupled to the output of the Reference Generator and is therefore swept at 1000 HZ. Automatic frequency control is obtained by DC coupling of the varactor to the output of the AFC Comparator.

4.8 30 MHZ FILTER

The receiver may be operated in either a narrowband or wideband mode. Selection is made by a switch on the rear panel.

In the narrowband mode (switch up), the receiver selectivity is essentially obtained by the double tuned resonant circuit within the filter assembly. The two resonant circuits have a high Q, are lightly loaded, and are coupled by a common inductance. Input and output are transformer coupled. Both resonant circuits are tuned by variable air capacitors. The narrow bandwidth is approximately 400 KHZ.

In the wideband mode (switch down), the filter assembly contributes no selectivity. It only attenuates the signal by an amount equal to the insertion loss of the narrowband filter

in order to keep the overall receiver gain constant in both modes. The selectivity in the wideband mode is about 5 MHZ and is obtained by the synchronously tuned circuits coupling the 30 MHZ IF Amplifier stages.

Normally the wideband mode is used only for reception of pulse signals. For attenuation measurements and antenna pattern recording, the narrowband position is used.

4.9 IF AMPLIFIER

The Intermediate Frequency amplifier follows the 30 MHZ Filter and further amplifies the signal to the appropriate levels for the bolometer and crystal detectors, both of which are packaged within the amplifier case.

The input amplifier stage Q901 is a grounded base stage and presents a low impedance match to the output of the 30 MHZ Filter. The collector circuits of all stages are synchronously tuned.

The second and third amplifier stages Q902 and Q903 are identical common emitter amplifiers, except for the bypassed emitter resistor of Q902 which is varied to produce the continuous one-decibel receiver gain variation. The variable resistor in the emitter circuit is R1001, the front panel one-decibel attenuator level control.

The bolometer is transformer coupled to the next common emitter amplifier Q904. The bolometer directly shunts the

transformer at 30 MHZ because of bypass capacitor C918, but this capacitor has negligible effect on the detected 1000 HZ signal. The bolometer 1000 HZ signal path and the direct current bias path are kept above chassis ground to prevent unwanted ground currents from introducing spurious noise.

The remaining three common emitter amplifier stages Q905, Q906 and Q907 are isolated from the preceding stages by the resistive attenuator network consisting of R921 and R922. This prevents interaction between the non-linear crystal detector and the bolometer.

The diode detector D901 is coupled to the final amplifier through C932. Choke L915 provides the direct current return for the detector, and the network C934, L916, C935 filters the 30 MHZ from the detector output.

4.10 AFC

The receiver has both electronic and mechanical automatic frequency control. The electronic AFC is applied to the second local oscillator (Swept Oscillator) and compensates for fast small changes in center frequency. The mechanical AFC drives the tuning shaft of the First Local Oscillator through the AFC clutch and will follow slow drifts of the signal source over the entire dial range.

4.10.1 REFERENCE GENERATOR

The Reference Generator located on printed circuit board 3 generates the 1000 HZ sawtooth and square wave signal which (1) drives the Swept Oscillator (2) supplies the reference signal to the AFC Comparator and (3) is amplified to form the horizontal trace on the cathode ray tube display.

The 1000 HZ sawtooth waveform is generated by the unijunction transistor Q301. The capacitor C303 and C304 charge through resistances R1010, R302, R303 and R304 until the emitter voltage reaches its peak point voltage and discharges the capacitors. The frequency is dependent on the time constant of the resistors and capacitors in the emitter circuit. R302 is a coarse frequency adjustment which compensates for circuit tolerances, and R1010 is located on the front panel as the fine frequency or SWEEP FREQ. control. The components C301 and R305 increase the sweep linearity. The sawtooth waveform is fed to the base of amplifier Q302. The output to the Swept Oscillator is taken from the unbypassed emitter resistors of this stage. Potentiometer R306 sets the amplitude of the narrow sweep and R307 sets the amplitude of the wide sweep. Selection is made by the NAR.-WIDE SWEEP control on the front panel.

The emitter of Q302 also drives the horizontal amplifier of the Scope Display through the H. GAIN control which is

a screwdriver adjustment available at the front panel.

Output from the collector of Q302 drives the flip-flop Q303-Q304. The common charging capacitor C306 maintains a symmetrical square wave output as the frequency is varied. The output taken from the collector of Q304 is the reference input to the AFC Comparator.

4.10.2 CLIPPER/AMPLIFIER

The Clipper/Amplifier amplifies, filters, and clips the video detector output, and supplies the signal which is compared with the AFC reference signal to generate the tuning error signal. The Clipper/Amplifier is located on the same printed circuit board as the AFC Comparator (board 4).

The base of the first amplifier stage Q401 is capacitively coupled to the detector output. This common emitter stage has a resonant collector circuit (the inductor L1001 is located on the chassis) which reduces the noise bandwidth and thereby increases the output signal-to-noise ratio of the AFC subsystem.

The following three amplifier stages Q402, Q403, Q404 are essentially identical. Each is a common emitter amplifier with diode clipping in the input circuit. The output at the collector of Q404 is a clipped 1000 HZ square wave which is synchronously detected by the Comparator Q407. The output at the emitter of Q404 drives the AFC relay rectifier to actuate

the clutch when the signal level is sufficient to produce an AFC signal.

4.10.3 COMPARATOR

The Comparator on board 4 is a chopper switch Q407 which is driven by the square wave from the Reference Amplifier. Transistor Q406 is an emitter follower which provides a low impedance driving source for the chopper. The synchronous detection produces a DC voltage at the base of Q405 which is proportional in amplitude to the phase difference between the 1000 HZ output of Q404 and the 1000 HZ output of the reference generator. The polarity of the DC signal depends on the polarity of the phase difference. The reference of "zero-error" voltage of the AFC is varied by the AFC NULL control on the front panel. This control varies the DC level at the collector of the chopper transistor Q407.

Transistor Q405 is a direct current emitter follower which drives the AFC Servo Amplifier and supplies the DC bias for center frequency correction of the Swept Oscillator. The emitter resistor of Q405 is returned to the negative 20-volt supply.

4.10.4 SERVO AMPLIFIER

The Servo Amplifier is located on board 5. It increases the DC output of the Comparator to a power level suf-

ficient to drive the direct current motor which tunes the First Local Oscillator. Direction of motor rotation is determined by the polarity of the DC input voltage, and may be reversed by changing the AFC switch from NORMAL to IMAGE or vice versa. See Section 3.3. The rectifier and voltage regulator for the Servo Amplifier are described in Section 4.13.4.

The DC input drives the base of Q503 which is connected with Q504 to form a differential amplifier having a balanced output. The common emitter resistor is returned to the negative 20-volt supply. Potentiometer R511 is the balance control. The balanced output is DC coupled to emitter followers Q505 and Q508 which in turn are DC coupled to the power amplifier Q506 and Q507. The motor is connected between the emitters of the power amplifier, in series with the polarity reversing switch functions.

4.10.5 CLUTCH

The 1000 HZ output from the AFC Clipper/Amplifier is rectified by diode D502, and the DC output is amplified by Q502 and Q509 to operate relay K1003 which energizes the Clutch when the receiver input signal is sufficient to generate an adequate signal-to-noise ratio in the AFC channel. The relay is the collector load of Q502 and completes the mechanical link between the motor and the First Local Oscillator tuning shaft. If the Clutch did not disengage the motor when the signal level dropped out, residual noise might detune the receiver, or drive the tuning shaft against the mechanical stops.

4.10.6 MOTOR

The motor is a DC current type, and direction of rotation is determined by the polarity of the voltage across its terminals. The overall sense of the AFC system is changed when the AFC switch is changed between NORMAL and IMAGE. This is done by interchanging the input leads to the Motor.

4.11 LEVEL AMPLIFIER

The LEVEL Amplifier amplifies the 1000 HZ output of the crystal detector to drive the reference level metering circuit. It operates only when the meter switch is set to LEVEL. The amplified signal is rectified and compared against a predetermined DC level, using a differential amplifier to drive the zero center meter.

The LEVEL GAIN control R1003 is connected across the output of the video detector. The arm of the gain control drives the base of Q701 which is a common emitter amplifier. The collector load is a resonant filter L1002 which is tuned to 1000 HZ and establishes a narrow noise bandwidth for the amplifier. Q701 is directly coupled to the next stage Q702 which is an emitter follower and therefore presents a minimum load on the resonant circuit. The DC negative feedback from the emitter of Q702 to the base of Q701 provides bias stabilization. Q702 is also directly coupled to the next stage Q703, a common emitter amplifier. The unbypassed variable resistor in the emitter of Q703 compensates for gain variation due to component tolerances.

The final 1000 HZ amplifier Q704 is transformer coupled to the full wave rectifier which drives one input of the differential amplifier Q705-Q706. This input is proportional to the 1000 HZ signal level. The other input to the differential amplifier is the DC reference level established by the voltage divider R718, R719, R720.

The zero center meter is connected between the emitters of the differential amplifier. Resistor R721 sets the meter sensitivity at the mid-point range, and the combination of diodes CR703-CR704 with R722 establishes the rate of reduction in meter sensitivity away from the midpoint. This facilitates zeroing the meter and prevents damage to the meter movement.

4.12 SCOPE DISPLAY

The Scope Display circuits present a cathode ray tube presentation of the received signal. The horizontal trace is swept by the Sweep voltage applied to the Swept Oscillator, and the vertical trace is the amplified video detector output. In the presence of a CW signal, the scope pattern is the receiver response function. The height is proportional to received signal strength and may be changed by the I.F. Gain control, the scope gain control, or the Step Attenuator. The incoming signal is centered in the receiver pass band when the display is centered on the cathode ray tube. The width of the displayed response function decreases as the sweep width is increased.

4.12.1 HORIZONTAL AMPLIFIER

The horizontal amplifier of the scope display is located on board 3 with the AFC Reference Generator and the Sweep Generator. Its input is connected to the latter. The amplifier consists of two transistors Q305 and Q306 connected as an emitter-coupled phase splitter which provides an amplified balanced output from the unbalanced input. The control R321 balances the push-pull output to the vertical plates of the cathode ray tube. The input is connected to the base of Q305 through the H. GAIN control, a screwdriver adjustment located below the cathode ray tube bezel.

4.12.2 VERTICAL AMPLIFIER

The vertical amplifier is located on board 6.

The video detector output is connected to the base of the first vertical amplifier stage Q602 through the continuously variable V. GAIN control (the screwdriver adjustment located below the cathode ray tube bezel) and the rotary switch gain control located just to the right of the bezel. The first two stages Q602, Q603 are common emitter amplifiers. Q602 and Q603 are directly coupled with DC feedback for bias stabilization. The output of Q603 is capacitively coupled to Q604, which combines with Q605 to form an emitter coupled phase splitter. The unbalanced input to Q604 is amplified and converted to a balanced output which drives the vertical plates of the cathode ray tube.

4.12.3 POWER SUPPLY

The low-level stages of the scope amplifiers are connected to the common +20-volt supply. The scope power supply located on board 2 provides the potentials needed by the cathode ray tube and the collectors of the transistors which drive the horizontal and vertical deflection plates.

The power transformer T1002 has a 6.3-volt winding for the cathode ray tube filament. This winding is at a high DC potential. The high voltage secondary winding has a grounded center tap. A full wave rectifier, D201 and D202, feeds a capacitor input filter and zener regulator to generate +248 volts for the collectors of the deflection driver stages. The zeners regulate this voltage and further reduce the ripple. One side of the high voltage secondary is connected to a voltage doubler, D203 and D204, to provide a negative potential of -700 volts. The cathode ray tube is connected between the +248 and the -700 volts for maximum brightness.

The focus, intensity, and centering controls are connected in the conventional configuration. Diodes D205 and D206 clamp the base line of the trace at a fixed spot as the vertical amplitude changes. The controls are screwdriver adjustments available at the front panel below the scope bezel.

4.13 LOW VOLTAGE POWER SUPPLY

The Low Voltage Power Supply provides power to the

entire receiver except for portions of the scope display circuits as noted in Section 4.12. The following outputs are available from the Low Voltage Power Supply.

6.3 VAC
-20 VDC
-10 VDC
+20 VDC
+50 VDC

The 6.3 VAC supply is a winding on the power transformer T1001 and goes only to the filament of the tube in the First Local Oscillator. In addition to this filament winding, the power transformer has two other secondary windings, one of which is center tapped and has two voltage ranges; this winding supplies all DC voltages except the +30 VDC for the Servo Amplifier.

4.13.1 NEGATIVE SUPPLY

The full wave rectifier SR103 uses the low voltage taps of the center-tapped winding and is connected to the capacitor input filter C108 through the peak current limiting resistor R119. Zener diodes D105 and D106 regulate the voltage and further reduce the ripple. Both zeners are 10-volt units, so both -20 and -10 volts are available from the negative supply.

4.13.2 +20 VDC

The full wave rectifier SR102 uses the low voltage taps of the center-tapped winding and is connected to the

capacitor input filter C105 through the peak current limiting resistor R117.

The series transistor Q105 regulates the DC output voltage and further reduces the ripple. It is a conventional series regulator. Reference amplifier Q106 is connected across the supply output terminals. It compares the output to its internal zener reference, and amplifies the error signal and feeds it to the base of Q105 with the correct polarity to oppose the error.

Zener diode D103 and transistor Q104 normally provide a constant current source for the reference amplifier Q106. However, when the current through R111 increases to the point where the voltage drop across R111 exceeds the zener voltage of D103, diode D104 conducts and decreases the current through Q104. Consequently, the current available at the base of Q105 is limited, and protective current limiting of the supply occurs.

4.13.3 <u>+50 VDC</u>

The +50 VDC supply is essentially a duplicate of the +20 VDC supply except for two minor differences. The full wave rectifier is connected to the high voltage taps in order to get the higher voltage. Also the +20 volt supply is used as the voltage reference, so a transistor Q103 is used as the error amplifier. A combined amplifier-zener is not required for both supplies.

4.13.4 +30 VDC

The +30 volt supply is located on board 5 with the AFC Servo Amplifier. It powers the AFC drive motor, clutch and relay. The full wave bridge rectifier SR501 is connected to a separate secondary winding on the power transformer. The rectifier output is connected to the capacitor input filter through the peak current limiting resistor R501. Transistor Q501 is a series regulator and further reduces the ripple. Zener diode D501 regulates the output voltage by maintaining the base of Q501 at a constant potential.

4.14 LOW FREQUENCY CONVERTER

The Low Frequency Converter extends the operating range of the receiver down to 20 MHZ by the addition of a third frequency conversion. The elements of the Low Frequency Converter are shown in Figure 1.2. The converter is automatically switched into the system by coaxial relays actuated through the bandswitch. The bandswitch also applies power to the Converter Oscillator.

4.14.1 FIRST MIXER

The first Mixer is a crystal diode in a standard mixer mount. The injection signal is fed to the mixer through a resistive coupler which reduces the shunting effect of the injection source. An incoming signal from 20 to 950 MHZ is

mixed with 1020 to 1950 MHZ from the cavity oscillator to produce 1000 MHZ at the mixer output.

4.14.2 BANDPASS FILTER

The Bandpass Filter is a multi-section coaxial filter having steep sides and a passband centered at 1000 MHZ. It eliminates spurious mixer products and restricts the receiver input bandwidth.

4.14.3 SECOND MIXER

The Second Mixer is identical to the First Mixer, and heterodynes the 1000 MHZ output from the Bandpass Filter down to 75 MHZ. The injection frequency is 925 MHZ.

4.14.4 CONVERTER OSCILLATOR

The Converter Oscillator is an integrally packaged transistor LC oscillator. A fine tuning adjustment is available for alignment exactly to the operating frequency of 925MHZ.

5. MAINTENANCE

This section describes the maintenance procedures for the Wide Range Receiver. Periodic adjustments are not normally required. Familiarization with the previous sections of this manual is recommended before attempting any of the steps described herein.

CAUTION: Most components and circuits operate at low potentials. However, the power supply and scope display circuits contain high voltages which are dangerous to personnel. Become familiar with the circuit operation and component locations before servicing. Disconnect the power cord before installing or removing components and assemblies.

Most diagnoses, adjustments and repairs can be made on a modular basis. Printed circuit cards may be operated on the extender board supplied, without deteriorating performance. Remove the polarizing key from the card connector before inserting the extender board, and replace the key after servicing.

The tables giving typical values of voltages at transistor and tube terminals are measured using a voltmeter having a sensitivity of 20,000 ohms per volt DC and 1,000 ohms per volt AC. Readings are referred to chassis ground unless otherwise indicated. Care must be taken to avoid shorting adjacent terminals when making measurements. When soldering small components, particularly semiconductors, clamp pliers on the leads between the component and solder joint in order to minimize heating of the component.

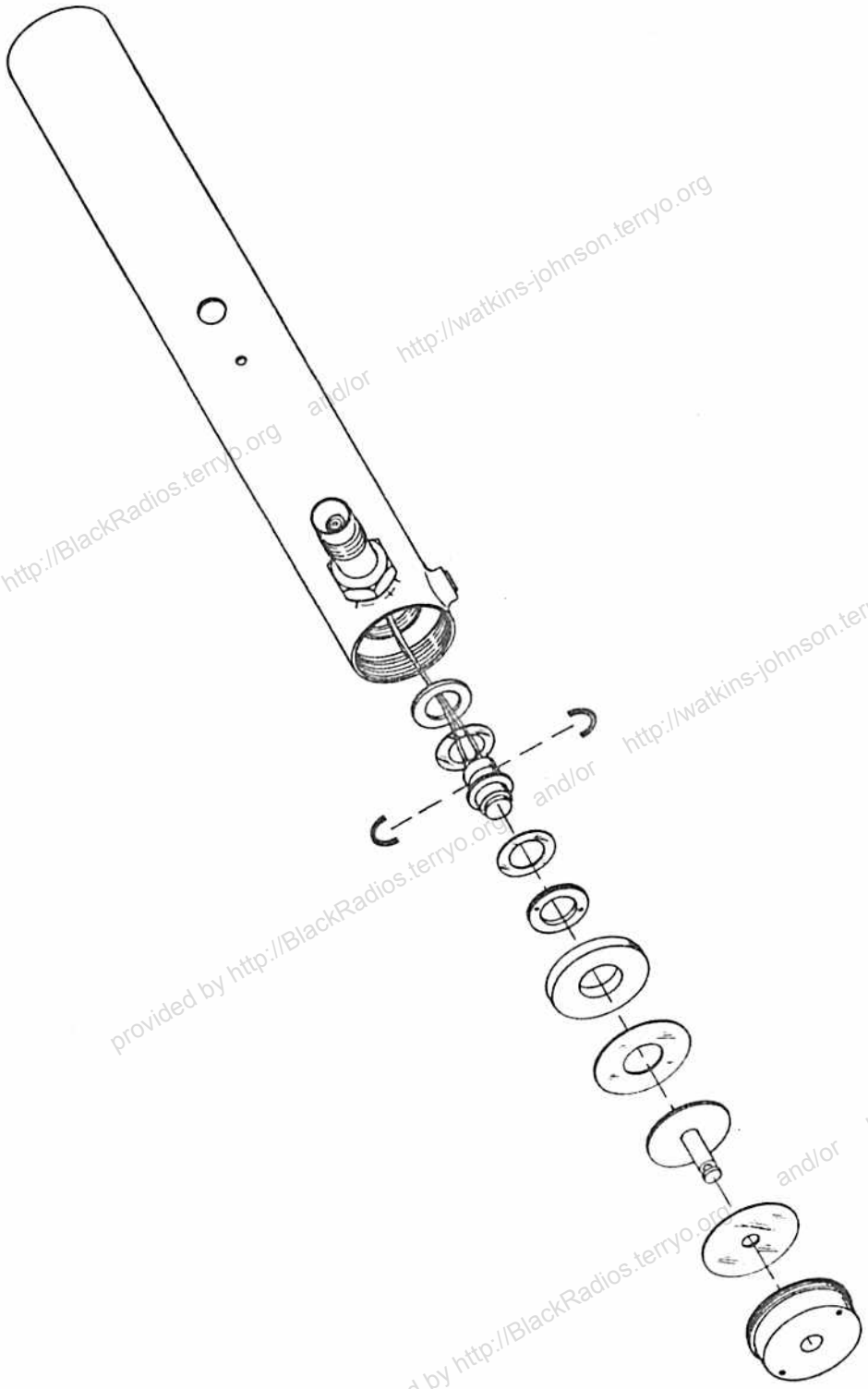
5.1 FIRST LOCAL OSCILLATOR

The First Local Oscillator is a triode vacuum tube oscillator, tuned by two concentric cavities which are ganged together and connected to the tuning shaft by a non-translating lead screw mechanism. The tuning shaft rotates 58 turns between mechanical stops, and the oscillator has lower and upper frequency limits of at least 1000 and 2575 MHZ respectively. Use extreme care in servicing the cavity, and particularly avoid damage to the spring contacts which wipe against the cavity walls.

5.1.1 TUBE REPLACEMENT

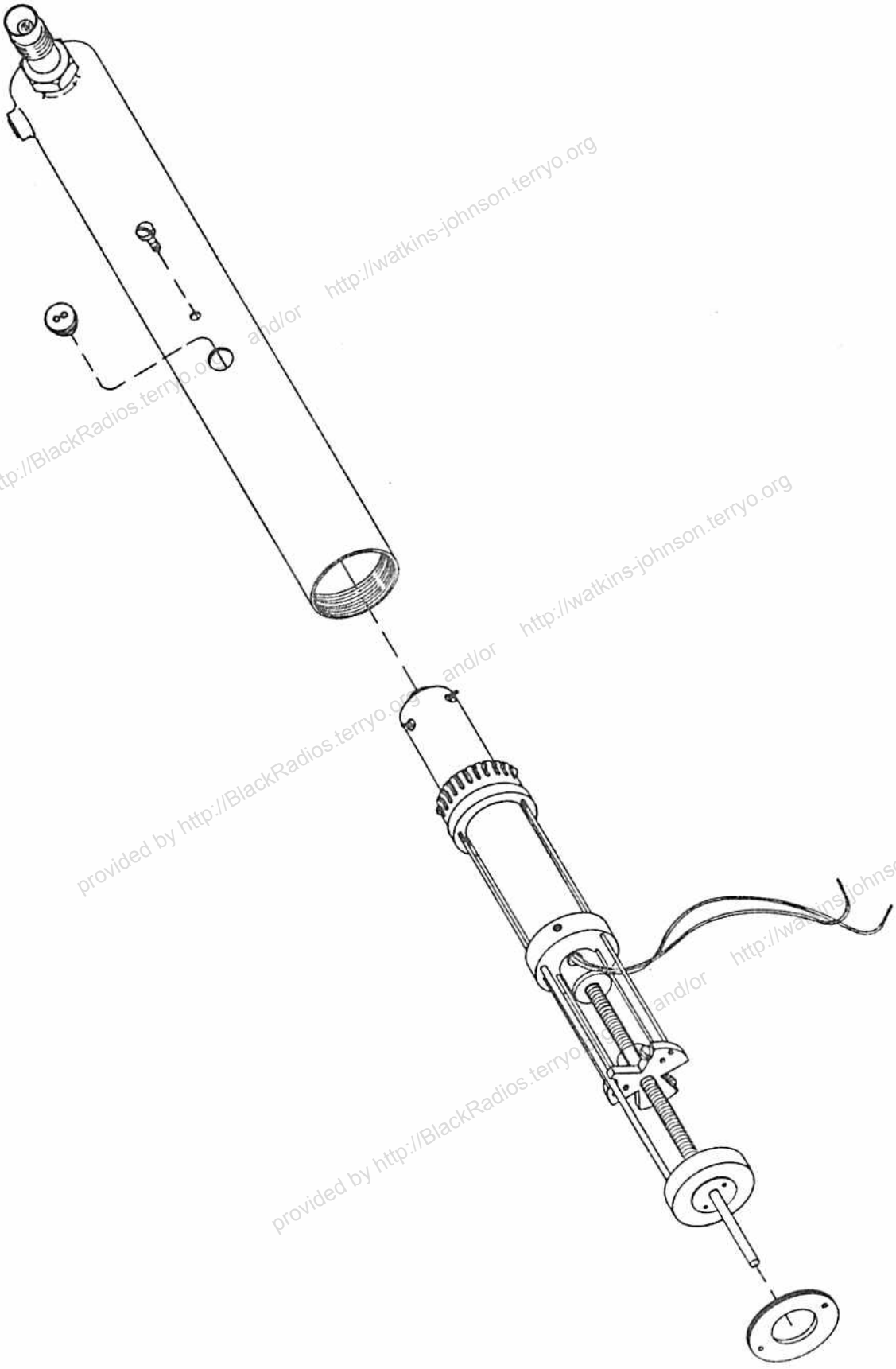
Refer to Figures 5.1 and 5.2 during the following steps. First remove the anode retaining nut, the anode line assembly, anode stop and the grid retainer nut. Then pull the tube straight out until it is loosened from the cathode stem. Remove the filament wire feed-thru and push the filament wires into the cavity as the tube is pulled on out. All parts are reuseable except the mica washers.

Before installing a new tube, solder the filament wires to the tubes. Do not allow the soldering iron to remain on the filament pins longer than necessary, but the pins should be completely covered with solder to insure good bonding. Also paint the grid-to-cathode resistance on the tube using a resistive type paint such as TV Tube Coat. The paint must extend



FIRST LOCAL OSCILLATOR ASSEMBLY

FIGURE 5.1



FIRST LOCAL OSCILLATOR ASSEMBLY

FIGURE 5.2

over the edge of the ceramic so that the cathode rings make good contact. The resistance should measure between 200 to 500 ohms. Replace the tube, pushing it into the cathode stem so the cathode rings make good contact.

Reassemble the remaining parts. The oscillator should be checked for power output and frequency coverage. Minimum power should exceed 50 MW. If the oscillator does not perform satisfactorily, realign as indicated in Section 5.1.2.

5.1.2 ALIGNMENT

Note the oscillator frequency coverage and power output over the band. If unsatisfactory, the grid and cathode fingers must be repositioned. The outside rods control frequency coverage, and the inside rods maintain the power over the band. The main subassembly must be removed from the housing. Remove the anode retainer nut, the anode line assembly, the anode stop, and the rear plug. Tune the oscillator to the low end (full CCW) and feed the filament leads completely inside the housing. Push the main assembly out of the housing through the rear end. Use extreme caution to insure the grid fingers and feedback probes are not damaged. Remove the tuning shaft subassembly. Unscrew the three screws in the tuning nut, holding the pushrods. Loosen the rods so they slide easily in the tuning nut. If excess power is available at the high end, pull the inside rod backwards a slight amount. This will aid the lower end of the tuning range.

After proper positioning of the rods at the high end, slide the tuning nut forward until it rests against the phenolic insert in the rear of the main assembly. Tighten the retaining screws so the push rods can not move in the tuning nut.

Check the oscillator over the complete tuning range. If operation is unsatisfactory at any point in the frequency range, it may be due to improper positioning of the pushrods or feedback probes. To adjust feedback, reposition probes until best operation over complete range is obtained. If this does not correct the problem, re-align the pushrods as before.

Once operation over the complete frequency range is satisfactory, use some type of loctite to insure pushrods will not slip.

Insert main assembly into housing from the front, pushing it down until the retaining screw holes in the support block line up with the holes in the housing. Insert screws and tighten. Feed the filament leads back through housing and filament feed-thru. Replace the front end assembly, using new mica washers. Insert the tuning shaft into the oscillator; push forward until front end of shaft rests in the phenolic insert. Replace and tighten the rear plug. Check oscillator for proper operation.

5.2 PREAMPLIFIER/SWEPT OSCILLATOR

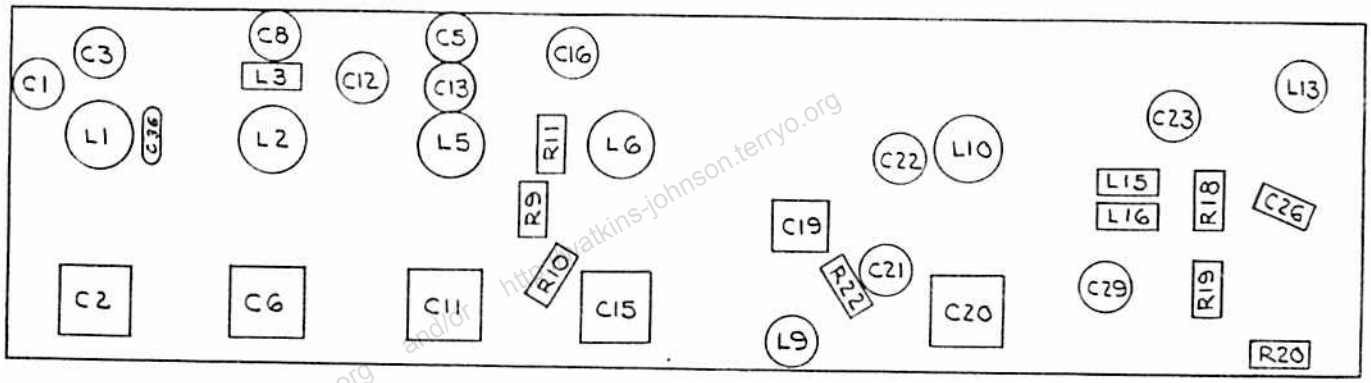
The Preamplifier/Swept Oscillator is located in a

shielded enclosure under the chassis. The oscillator center frequency control is accessible without removing the unit. All other tuning adjustments and tie points can be reached by removing the cover. The cover is held on by the same screws that mount the unit to the receiver chassis.

5.2.1 ALIGNMENT

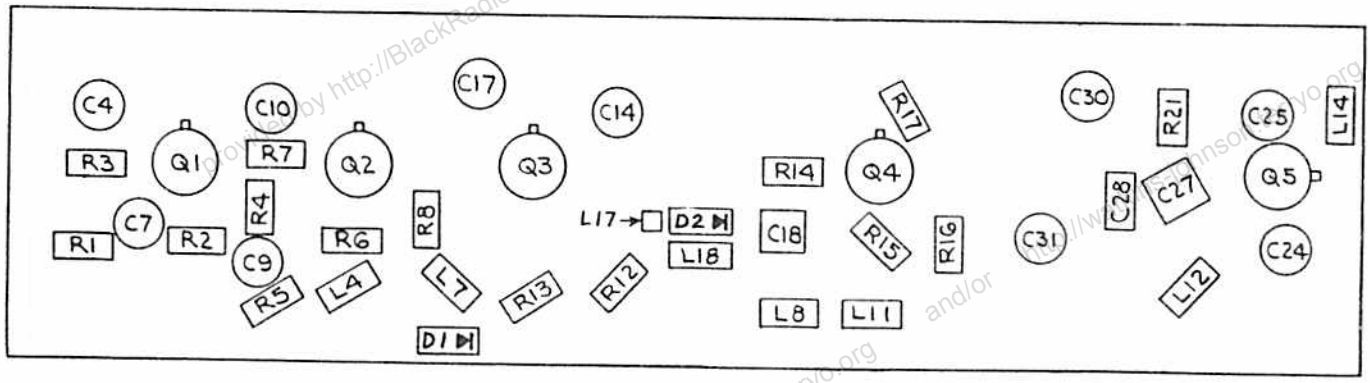
The input to the Preamplifier/Swept Oscillator is 75 MHZ; the output is 30 MHZ. The center frequency of the swept oscillator is 105 MHZ and is set by the variable inductor L813. This control is available with the unit mounted to the receiver chassis. The oscillator is aligned by connecting the receiver or preamplifier input to an accurate 75 MHZ signal generator and adjusting L813 to center the response pattern on the scope display. This should be done only after the 30 MHZ Filter and IF Amplifier have been aligned.

All other tuning adjustments are peaked for maximum response on the scope display with a 75 MHZ signal fed to the receiver input or to the input jack of the Preamplifier/Swept Oscillator. Maintain the input signal level low enough to prevent overload.



PARTS LOCATION – TOP
PREAMPLIFIER / SWEEP OSCILLATOR
FIGURE 5.3

REV. B THRU CO 78 6-20-67 FM



PARTS LOCATION – BOTTOM
PREAMPLIFIER / SWEEP OSCILLATOR
FIGURE 5.4

5.2.2 MEASUREMENTS

The following measurements are made with the SWEEP control set to OFF and the IF GAIN control fully CCW.

	Emitter	Base	Collector
Q801	.85V	1.35V	10V
Q802	2.3 V	3.0 V	10V
Q804	5.3 V	6.0 V	20V
Q805	2.6 V	2.7 V	20V

	Source	Gate 1	Gate 2	Drain
Q803	0	0	0	20V

5.3 30 MHZ FILTER

The 30 MHZ filter is located on the rear of the receiver. The slideswitch, which selects the wideband or narrowband response, is available at the outside rear panel. The switch is placed in the up position for narrowband operation and in the down position for wideband operation.

5.3.1 ALIGNMENT

The trimmer capacitors C9 and C10 which tune the 30 MHZ Filter are accessible after removing the top panel of the case. Normally the filter may be peaked by adjusting these capacitors for maximum output as observed on the scope display. The receiver should be tuned to a CW signal and the SWEEP control set to NAR. Set the filter slideswitch to the up position.

For more precise alignment, disconnect J6 which connects the filter to the Preamplifier, and connect J6 to a sweep or regular signal generator having a center frequency of 30 MHZ. Tune C9 and C10 for maximum response at 30 MHZ, measuring the output at the front panel VIDEO connector, using an oscilloscope or voltmeter.

5.3.2 RESISTANCE MEASUREMENTS

Resistance measurements are made between the center pin and outer ring of connectors J6 and J7. With the slide-switch in the up position (away from where the cables enter the filter) the resistance reading should be zero. With the slideswitch in the down position, the resistance readings should be approximately 70 ohms.

5.4 IF AMPLIFIER

All components and adjustments of the IF amplifier are accessible after removing the bottom cover of the amplifier assembly. Do not remove or loosen the printed circuit board from its case during alignment. The emitter of Q902 is grounded through the 1 db attenuator control on the front panel. If the amplifier is operated from an external cable harness, pin H of the connector must be grounded.

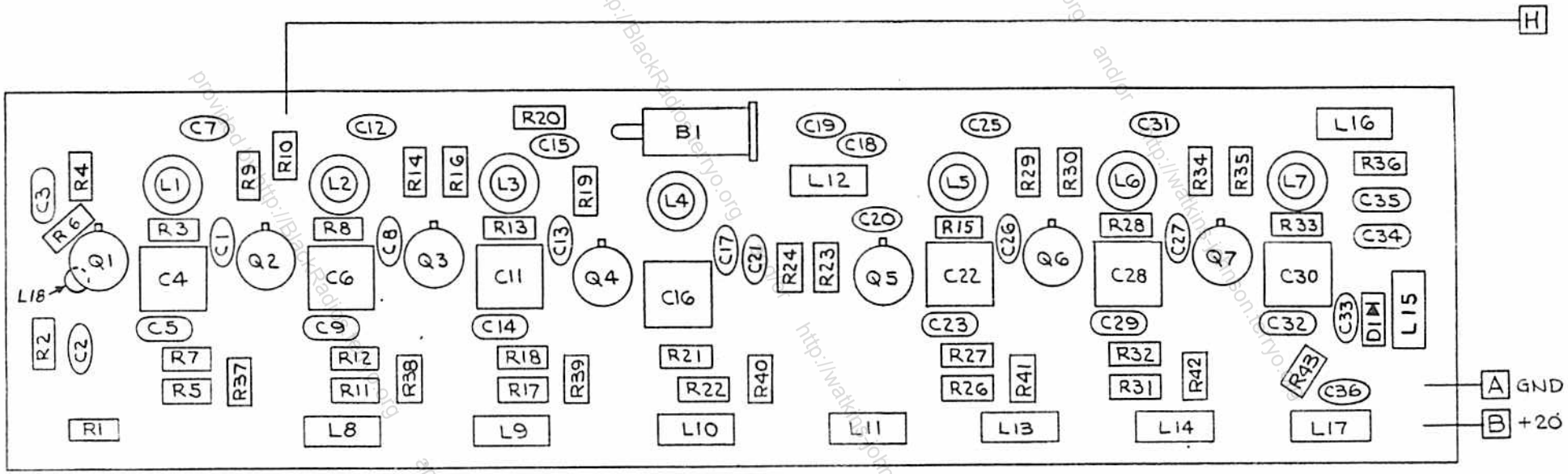
5.4.1 BOLOMETER REPLACEMENT

One common fault is the destruction of the bolometer element by transients in conventional VSWR meters and pattern recorders, particularly when it is connected with the bias supply on. A good operating practice is to turn off the bias supply in the external recorder before connecting or disconnecting the cable to the bolometer output of the receiver. The bolometer may be checked by measuring the resistance between the shell (not ground) and center conductor of the BOLOM output jack. The resistance value should read 200 ohms or less. An open circuit indicates a burnt out bolometer.

The bolometer is located in the IF Amplifier as shown in Figure 5.5 and is held in place by the snap-in clips only. Do not solder.

5.4.2 ALIGNMENT

All circuits in the IF Amplifier are synchronously tuned to 30.0 MHZ. The signal generator is connected to J901, and the voltmeter connected to J903 or the VIDEO output on the front panel. The signal generator may be modulated or CW, using an AC or DC voltmeter respectively as the output indicator. Align all capacitors for maximum output at 30 MHZ. The bolometer may or may not be connected to a load. Maintain the generator at the minimum level consistent with a useable indication on a sensitive voltmeter. The output should be kept below 100 millivolts.



ADD 900 TO REFERENCE NUMBERS

PARTS LOCATION

IF AMPLIFIER

FIGURE 5.5

REV. B THRU C078 6-20-67 FM
REV. A THRU C031 6-16-66

5.4.3 MEASUREMENTS

The following readings may vary by 20 percent and are taken with no signal input.

	Emitter	Base	Collector
Q901	9.2	9.7	+20
Q902	9.2	9.7	+20
Q903	9.2	9.7	+20
Q904	7.8	8.4	+20
Q905	9.2	9.7	+20
Q906	9.2	9.7	+20
Q907	7.8	8.4	+20

5.5 AFC REFERENCE GENERATOR

The Reference Generator generates the 1000 HZ signal which modulates the incoming signal by sweeping the second local oscillator. This 1000 HZ signal is the reference phase of the AFC Comparator and also sweeps the horizontal trace of the Scope Display.

5.5.1 ALIGNMENT

It is most convenient to align the Reference Generator if the bolometer output is connected to a pattern recorder or VSWR meter. Set the SWEEP FREQ control on the front panel to its center position and the SWEEP control to NARrow. Connect

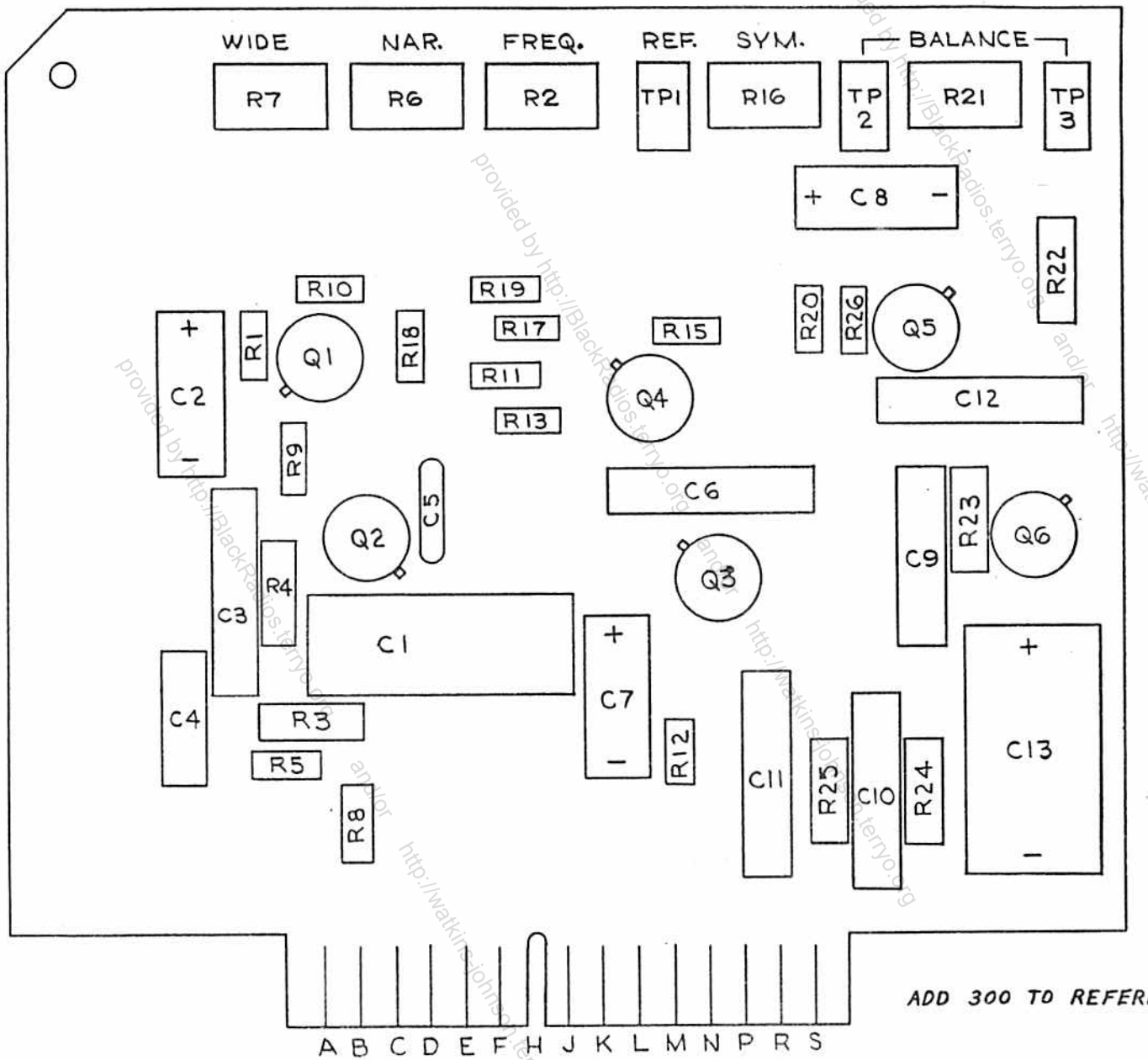
the receiver to a CW signal source and increase the input level until there is a reading on the indicating device. Adjust R302, the coarse frequency potentiometer, and R306, the narrow sweep width adjustment, for maximum output. Then, observing the Scope Display, adjust the signal input level for a clear pattern on the display. Switch the SWEEP control between NARrow and WIDE, and adjust R307, the wide sweep width adjustment, until the display is approximately one-fourth as wide in the WIDE position as it is in the NARrow position.

Connect an oscilloscope to observe the waveform at the collector of Q304. This is available at TP301, the blue test point near middle of board 3. Adjust R316 for best symmetry of the waveform.

5.5.2 MEASUREMENTS

	Emitter	Base 1	Base 2
Q301	5.6	0	17

	Emitter	Base	Collector
Q302	5.0	5.6	15
Q303	6.9	6.4	8.4
Q304	9.0	8.4	13.5



BOARD 3 PARTS LOCATION

REFERENCE GENERATOR and HORIZONTAL SCOPE AMPLIFIER

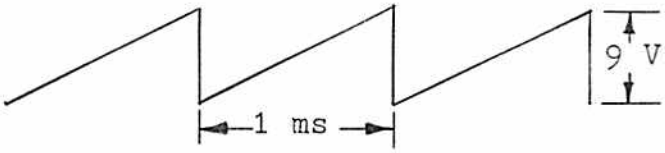
REV. B THRU CO 78 6-20-67 FM
REV. A THRU CO 31 6-16-66

FIGURE 5.6

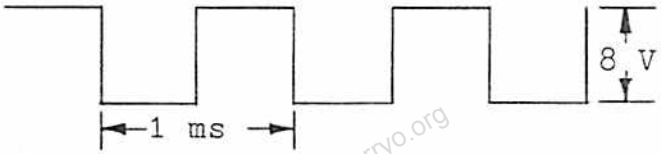
5.5.3 WAVEFORMS

The following waveforms are taken with the SWEEP control in the NARrow position.

Emitter Q301



Collector Q304



5.6 AFC CLIPPER/AMPLIFIER

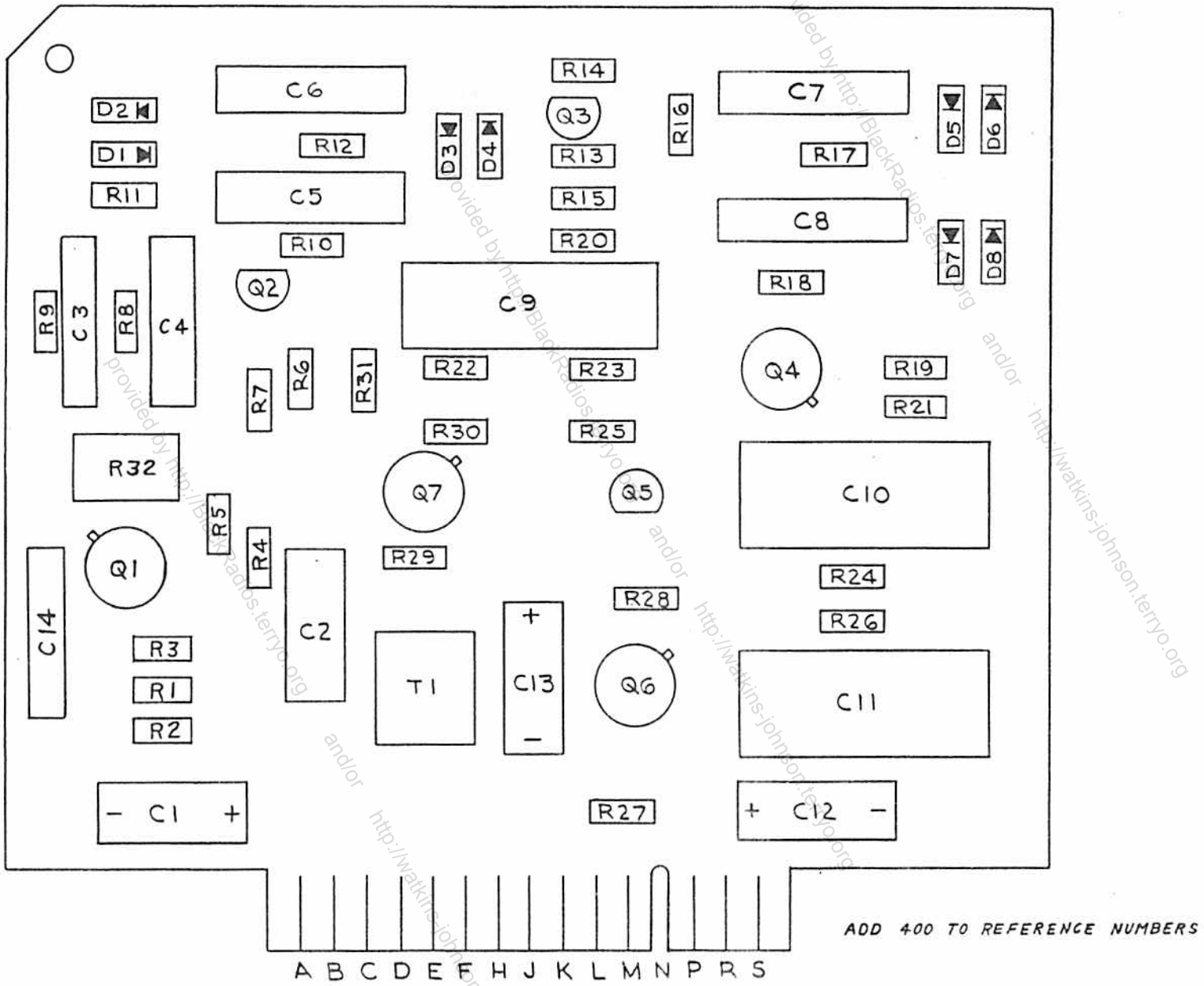
All measurements and waveforms are taken with the front panel controls set as follows;

SWEEP NAR
AFC NORMAL
AFC NULL centered

Set the input signal level to the REF. level. Refer to Section 3.4.

5.6.1 MEASUREMENTS

	Emitter	Base	Collector
Q401	1.3	0.6	18
Q402	0.4	0.2	11
Q403	0.6	0.6	9.6
Q404	0.4	0.6	14
Q405	-0.4	0.2	3.2
Q406	13	13	18
Q407	0.5	-0.4	0.7



ADD 400 TO REFERENCE NUMBERS

BOARD 4 PARTS LOCATION

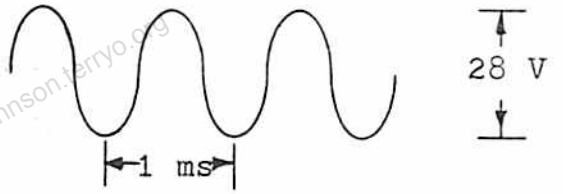
CLIPPER AMPLIFIER and COMPARATOR

FIGURE 5.7

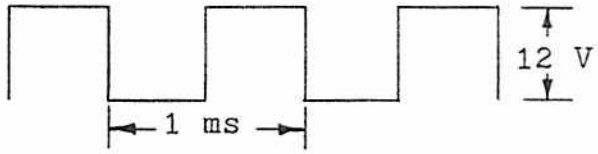
REV. B THRU CO 78 6-20-67 FM
REV. A THRU CO 31 6-16-66

5.6.2 WAVEFORMS

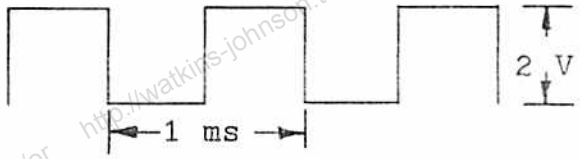
Collector Q401



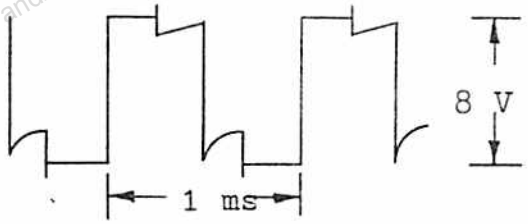
Collector Q403



Base Q404



Collector Q404



5.7 AFC SERVO AMPLIFIER

The Servo Amplifier is located on board 5 along with the 30 volt power supply and clutch driver. When aligning the Servo Amplifier or making measurements, ground pin F of the circuit board connector to the chassis.

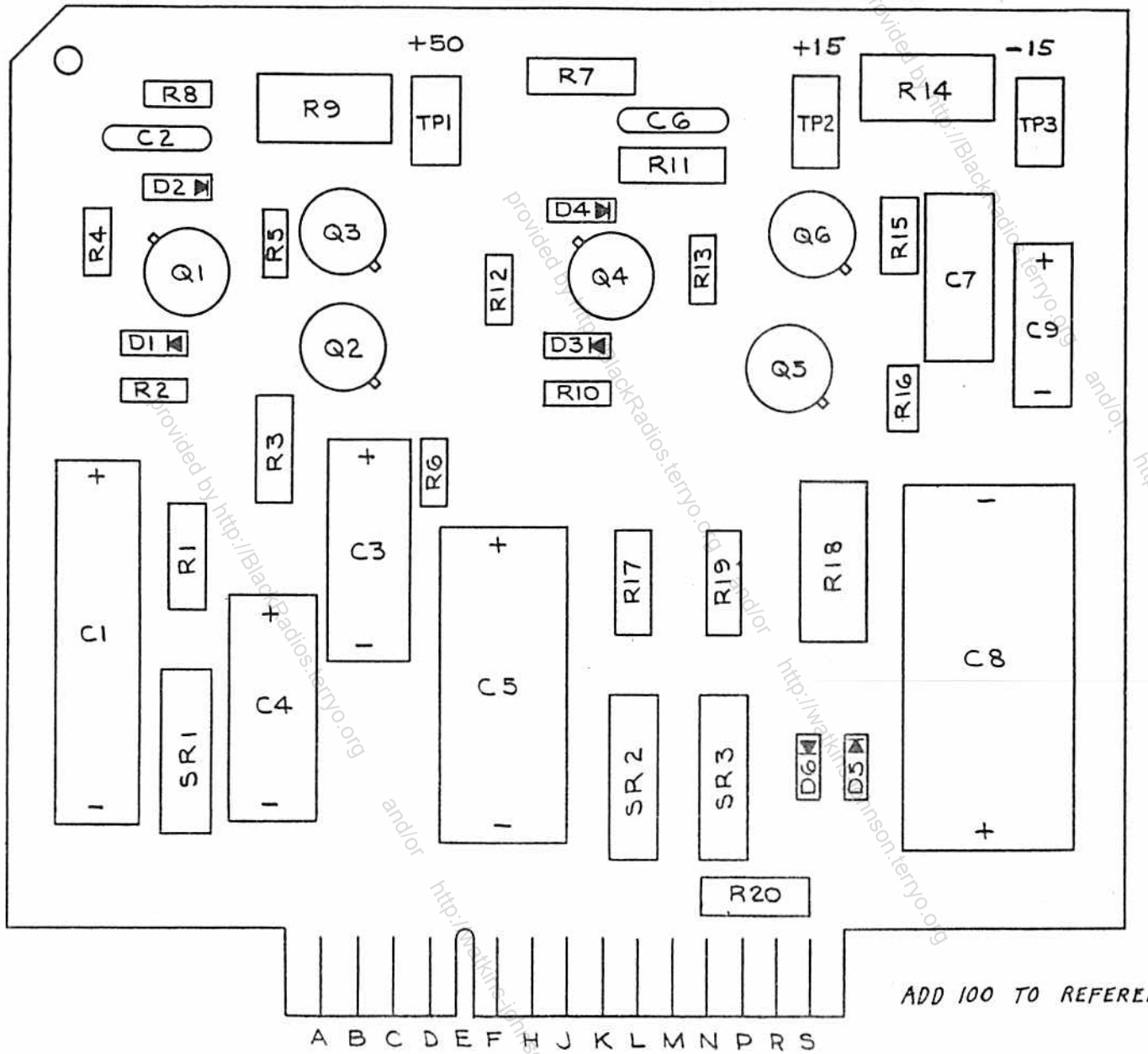
CAUTION: Grounding of other connector pins may cause damage to other circuits.

5.7.1 ALIGNMENT

With pin F of the connector grounded, adjust the balance control R511 for equal DC voltages at the blue test points.

5.7.2 MEASUREMENTS

	Emitter	Base	Collector
Q501	+29.5	+30	+38
Q503	-0.6	-0.1	+10
Q504	-0.6	-0.1	+10
Q505	+10	+10	+15
Q507	+9.5	+10	+15
Q508	+10	+10	+15



ADD 100 TO REFERENCE NUMBERS

BOARD 1 PARTS LOCATION

LOW VOLTAGE POWER SUPPLY

FIGURE 5.3

REV. B THRU CO 79 6-21-67 FM
REV. A THRU CO. 31 6-16-66

	Emitter	Base	Collector
Q101	+67	+67	+53
Q102	+50	+50	+75
Q103	+21	+22	+50
Q104	+25	+25	+22
Q105	+20	+20	+27
Q106	+ 6.0	+ 6.6	+20

5.10 SCOPE DISPLAY

The alignment and maintenance of all circuits of the Scope Display are covered in this section. The cathode ray tube and its associated controls are located on the chassis, along with the power transformer for the scope power supply. The other components of the scope power supply are located on board 2. The horizontal scope amplifier is on board 3, and the vertical scope amplifier is on board 6. Faults in the scope display can usually be isolated by observing the cathode ray tube display itself; i.e., no horizontal sweep indicates a fault in the Horizontal Scope Amplifier. Exercise extreme caution. Potentials in these circuits are dangerous.

5.10.1 POWER SUPPLY

Measurements are taken at the chassis connector of board 2.

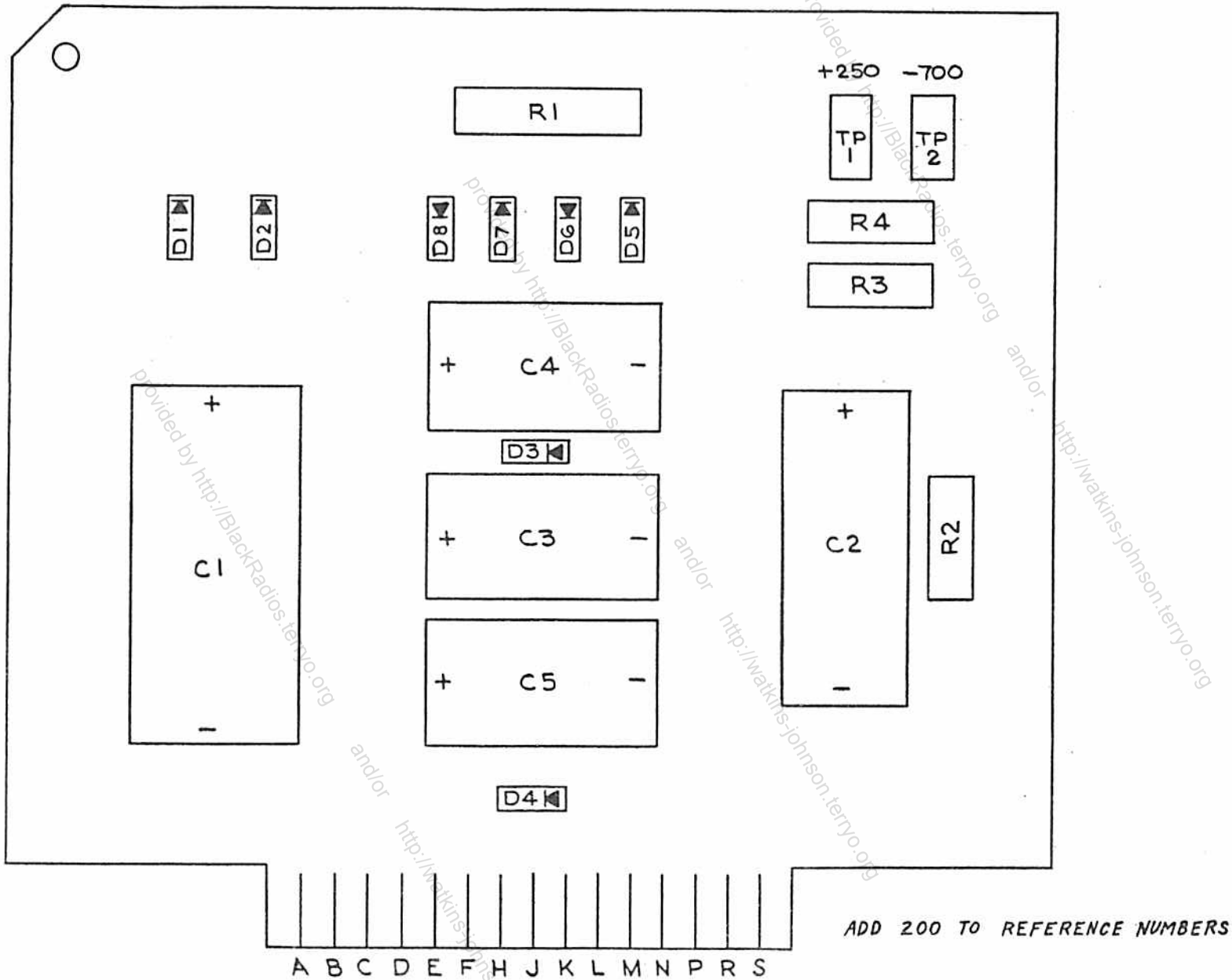
Connector Pin	Volts
C	250 VAC
E	250 VAC
J	+250
L	-700

5.10.2 HORIZONTAL AMPLIFIER

The horizontal amplifier is located on board 3. The balance control R321 is adjusted for equal DC voltages at the collectors of Q305 and Q306.

5.10.2.1 MEASUREMENTS

	Emitter	Base	Collector
Q305	17	18	125
Q306	17	18	125



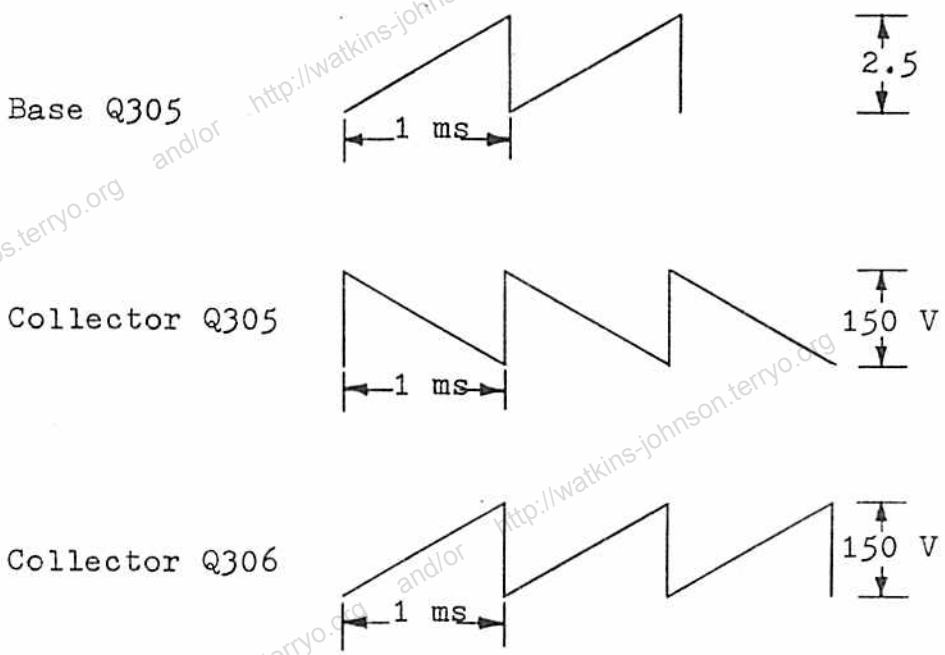
BOARD 2 PARTS LOCATION

SCOPE VOLTAGE POWER SUPPLY

FIGURE 5.10

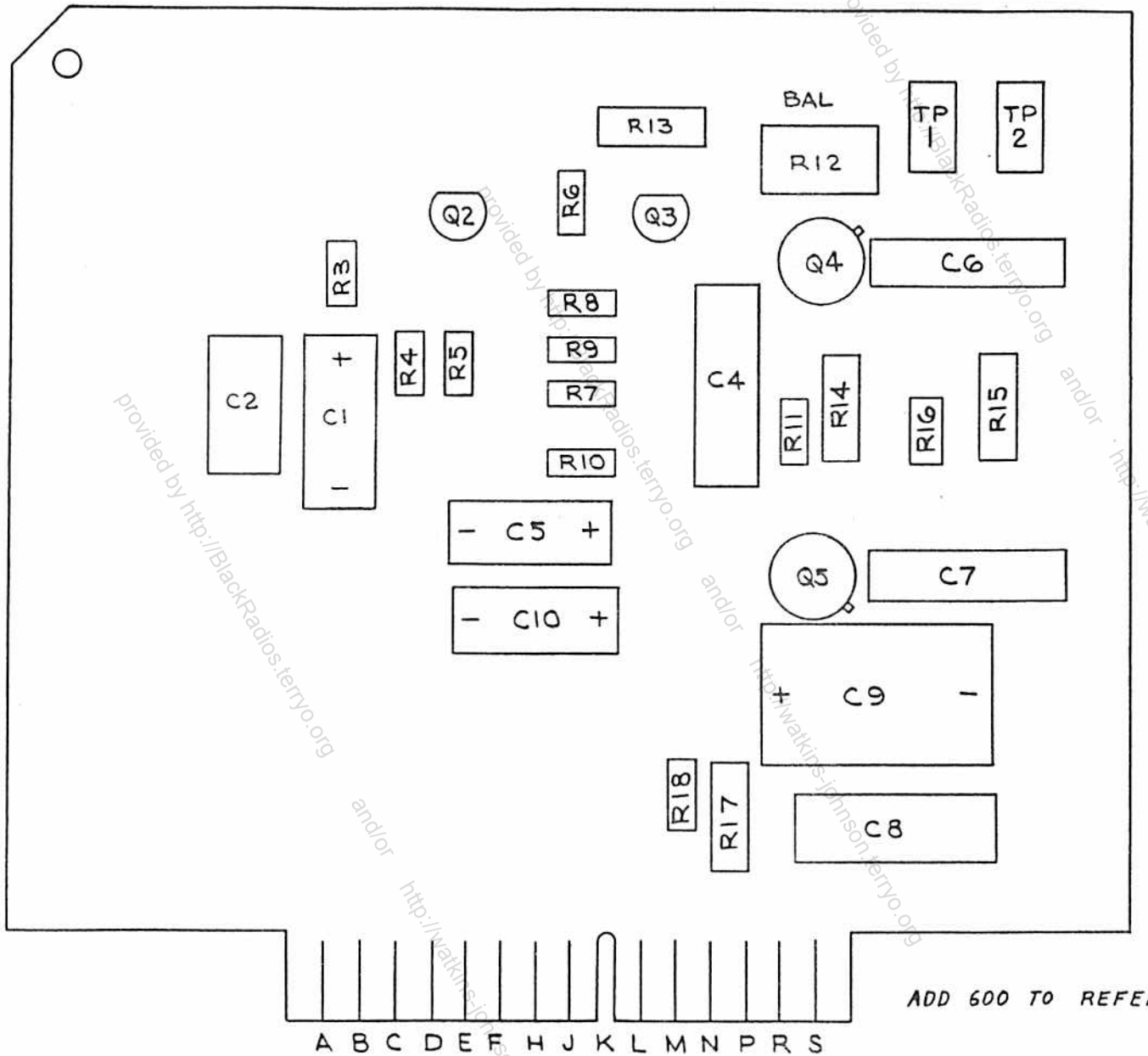
REV. B THRU CO 78 6-20-67 FM
REV. A THRU CO31 6-16-66

5.10.2.2 WAVEFORMS



5.10.3 VERTICAL AMPLIFIER

The Vertical Amplifier is located on board 6. The balance control R612 is adjusted for equal voltages at the collectors of Q604 and Q605.



BOARD 6 PARTS LOCATION

VERTICAL SCOPE AMPLIFIER

FIGURE 5.11

REV. B THRU CO 78 6-20-67 FM
REV. A THRU CO 31 6-16-66

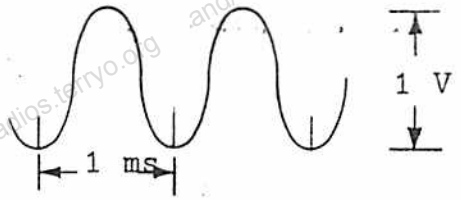
5.10.3.1 MEASUREMENTS

	Emitter	Base	Collector
Q602	0.6		3.0
Q603	2.6	3.0	10
Q604	16	16	150
Q605	16	16	150

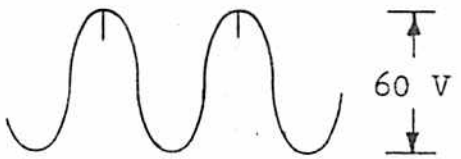
5.10.3.2 WAVEFORMS

Set a 75 MHZ input to the REF. level; see Section 3.4. Turn the LO LEVEL control fully CCW to the off position.

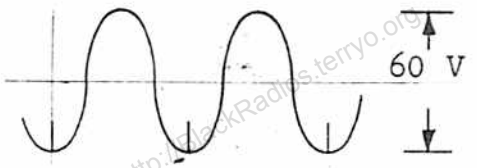
Collector Q603



Collector Q604



Collector Q605



5.10.4 CATHODE RAY TUBE

The cathode ray tube is a type 2AP1-A. All associated controls are available at the front panel below the bezel.

5.10.4.1 REPLACEMENT

Remove the two screws holding the bezel to the front panel. The cathode ray tube is then removed through the front panel. It is not necessary to remove the tube shield. When installing a new tube it may be necessary, because of variations in tube length, to loosen the screws holding the socket bracket to the chassis and adjust the position of this bracket until the new tube fits firmly against the bezel.

5.10.4.2 MEASUREMENTS

The following measurements are made at the cathode ray tube socket with respect to chassis ground.

Socket Pin	Volts
1	-640
2	-640
3	+50
4	-470
6	+50
7	+50
8	+50
9	+50
10	-660
11	-640

Measure the AC voltage between pins 1 and 11. It should read 6.3 volts. Caution! Both of these pins are at dangerous potentials above ground.

5.11 LEVEL AMPLIFIER

Connect the receiver input to a 75 MHZ signal generator. Turn the LO LEVEL control fully CCW to its off position. Set the IF gain control fully CCW, and the LEVEL GAIN fully CCW.

5.11.1 ALIGNMENT

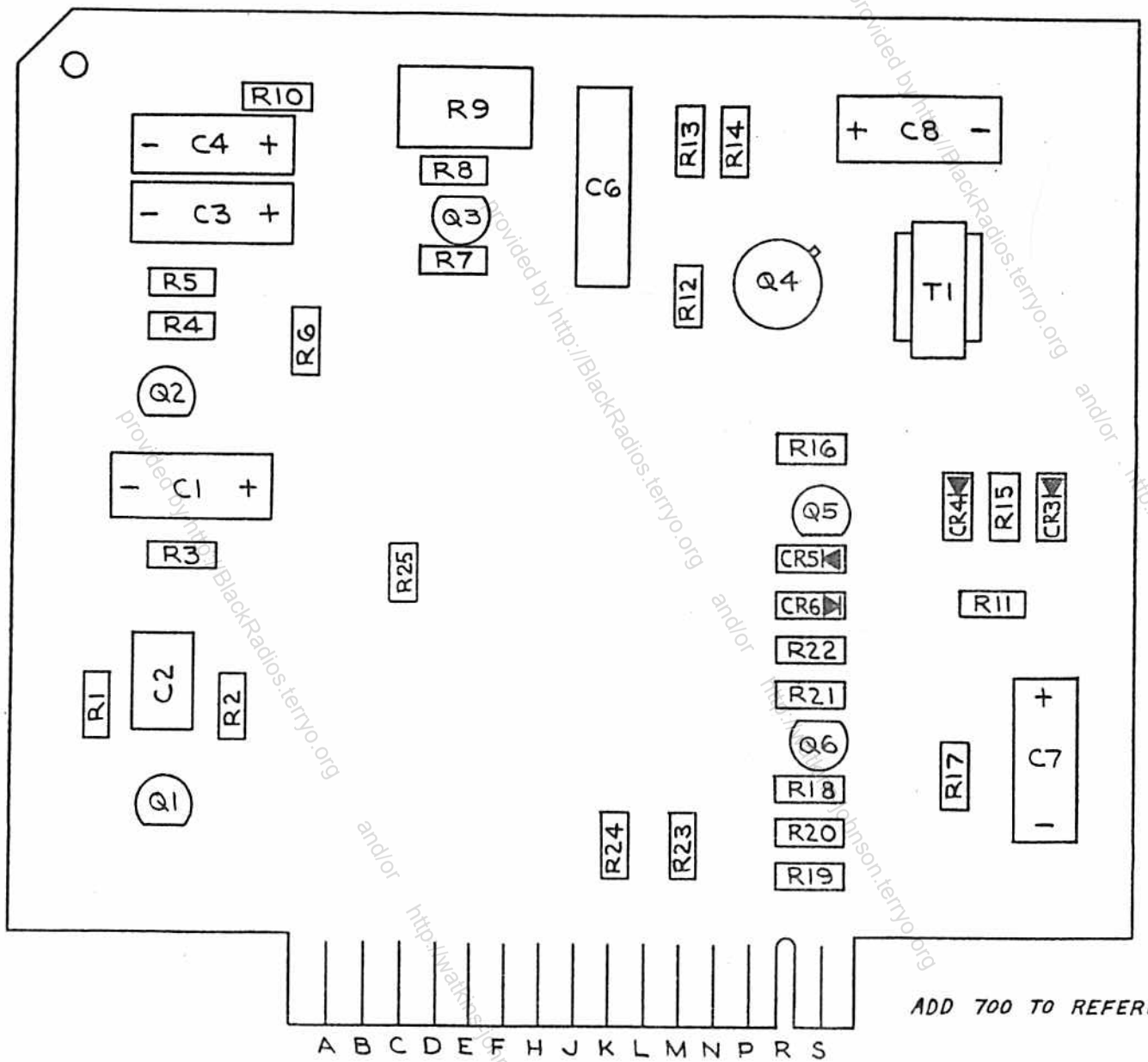
Set the meter switch to LEVEL and increase the input signal until the meter is centered. Adjust L1002 until the

meter reads near its center position with the minimum input signal level.

5.11.2 MEASUREMENTS

Adjust the input signal to the REF level. See Section 3.4.

	Emitter	Base	Connector
Q701	0.2		18
Q702	8.0		18
Q703	7.5	8.0	15
Q704	0.4	0.7	19
Q705	0.8	0.5	19
Q706	4.1	4.0	19



BOARD 7 PARTS LOCATION

LEVEL AMPLIFIER

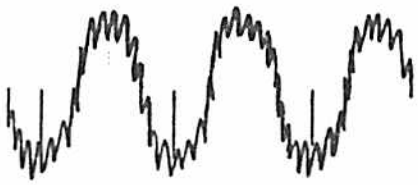
REV. B THRU CO 78 6-20-67 FM
REV. A THRU CO 31 6-16-66

FIGURE 5.12

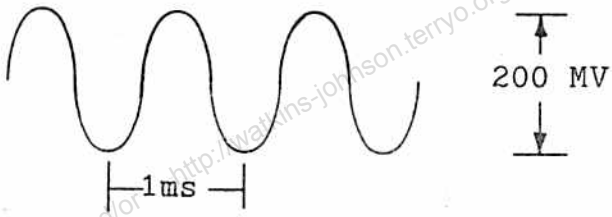
5.11.3 WAVEFORMS

Adjust the input signal to the REF level. See Section 3.4.

Base Q701



Collector Q701



Collector Q704

6. PARTS LIST

This section contains a listing of the replacement parts. For convenience and clarity, blocks of numbers have been assigned to components making up each major subassembly, but only the significant digits within this block are shown on the schematic drawings. The assignments are listed below.

1-99	Components of small assemblies (30 MHZ Filter, Low Frequency Converter, etc.)	
101-199	Board 1.	Low Voltage Power Supply
201-299	Board 2.	Scope Power Supply
301-399	Board 3.	Reference Generator. Horizontal Scope Amplifier
401-499	Board 4.	AFC Clipper/Amplifier. AFC Comparator
501-599	Board 5.	AFC Servo Amplifier and Power Supply
601-699	Board 6.	Vertical Scope Amplifier
701-700	Board 7.	Level Amplifier
801-899	Preamplifier/Swept Oscillator	
901-999	IF Amplifier	
1001-1099	Miscellaneous Components on Panel and Chassis	
1100-	Options and Accessories	

Certain standard components may differ from the exact type specified in the following parts lists. This is due to availability at the time of manufacture, and the use of the most advanced components. Either of the component types may be used for replacement.

Parts List

MISCELLANEOUS SUBASSEMBLIES

Ref.	Description	Mfg./Type	Figure
C1	Capacitor 33 pf 5% 500 WVDC	DM15-330J	7.2
C2	Capacitor 68 pf 5% 500 WVDC	DM15-680J	7.2
C3	Capacitor 68 pf 5% 500 WVDC	DM15-680J	7.2
C4	Capacitor 33 pf 5% 500 WVDC	DM15-330J	7.2
C5	Capacitor 470 pf 5% 500 WVDC	DM15-471J	7.2
C6	Capacitor 470 pf 5% 500 WVDC	DM15-471J	7.2
C7	Capacitor 470 pf 5% 500 WVDC	DM15-471J	7.2
C8	Capacitor 20 pf 5% 500 WVDC	DM15-200J	7.6
C9	Capacitor, variable 2-14 pf	E.F. Johnson 160-107	7.6
C10	Capacitor, variable 2-14 pf	E.F. Johnson 160-107	7.6
C11	Capacitor 20 pf 5% 500 WVDC	DM15-200J	7.6
FL1	Filter, 1000 MHZ	Telonic TBA-1000-20-4CD	7.1
C12	Filter	Erie 1201-051	7.2
C13	Capacitor .01 uf 50 WVDC	Sprague TG-S10	7.2
J1	Connector	p/o Z9	7.1
J2	Connector	p/o Z9	7.1
J3	Connector	p/o Z9	7.1
J4	Connector	Dage 8016-1	7.3
J5	Connector	Dage 8016-1	7.3
P1	Connector	Dage 8000-1	7.6
P2	Connector	Dage 8000-1	7.6
L1	Not used		
L2	Inductor	Micro-Tel	7.2
L3	Inductor	Micro-Tel	7.2
L4	Inductor	Micro-Tel	7.2
L5	Inductor 4.7 uh	J.W. Miller 9310-28	7.2
L6	Inductor 4.7 uh	J.W. Miller 9310-28	7.2
L7	Inductor 4.7 uh	J.W. Miller 9310-28	7.2
L8	Inductor 4.7 uh	J.W. Miller 9310-28	7.2
R1	Resistor 120 ohms 5% 1/4 watt	RC07GF121J	7.6
R2	Resistor 51 ohms 5% 1/4 watt	RC07GF510J	7.6
R3	Resistor 120 ohms 5% 1/4 watt	RC07GF121J	7.6
S1	Switch, slide DPDT	Stackpole SS-50	7.6
T1	Transformer	Micro-Tel 25-020-1	7.6
T2	Transformer	Micro-Tel 25-020-2	7.6
Z1	Mixer	Sage 1262L	7.1
Z2	Mixer	Sage 1262K	7.1
Z3	Attenuator 3-db	Emco A-303T	7.1
Z4	Attenuator 0-102 db	Telonic TG-950	7.1
Z5	Coupler	Micro-Tel	7.1
Z6	Coupler	Micro-Tel	7.1
Z7	Filter, low pass	Emco 1-1075 TF	7.1
Z8	Attenuator 3-db	Microlab AA-03T	7.1
Z9	Tee	Nurad 17T3	7.1
--	Oscillator 1-2.5 GHZ	RFDLS5106	7.1
--	Oscillator 925 MHZ		7.1

Parts List

LOW VOLTAGE POWER SUPPLY

Ref.	Description	Mfg./Type
C101	Capacitor 20 uf 100 WVDC	Sprague TE1409
C102	Capacitor .0047 uf 10% 200 WVDC	Sprague 192P47292
C103	Capacitor 10 uf 25 WVDC	Sprague TE1204
C104	Capacitor 10 uf 100 WVDC	Sprague TE1407
C105	Capacitor 250 uf 50 WVDC	Cornell-Dublilier BR250-50
C106	Capacitor .0047 uf 10% 200 WVDC	Sprague 192P47292
C107	Capacitor 20 uf 50 WVDC	Sprague TE1305
C108	Capacitor 250 uf 50 WVDC	Cornell-Dublier BR250-50
C109	Capacitor 20 uf 50 WVDC	Sprague TE1305
D101	Diode, zener	1N4735A
D102	Diode	1N4009
D103	Diode, zener	1N4735A
D104	Diode	1N4009
D105	Diode, zener	1N4740A
D106	Diode, zener	1N4740A
Q101	Transistor	2N398B
Q102	Transistor	2N3440
Q103	Transistor	2N2270
Q104	Transistor	RCA 40319
Q105	Transistor	2N2108
Q106	Reference Amplifier	GE RA1A
R101	Resistor 10 ohms 5% 1/2 Watt	RC20GF100J
R102	Resistor 15,000 ohms 5% 1/4 Watt	RC07GF153J
R103	Resistor 150 ohms 5% 1/2 Watt	RC20GF151J
R104	Resistor 3,000 ohms 5% 1/4 Watt	RC07GF302J
R105	Resistor 2,000 ohms 5% 1/4 Watt	RC07GF202J
R106	Resistor 1,000 ohms 5% 1/4 Watt	RC07GF102J
R107	Resistor 5,000 ohms 5% 3 Watts	Ohmite 995-3A
R108	Resistor 3,000 ohms 5% 1.5 Watts	Ohmite 995-1A
R109	Resistor 5,000 ohms 5% 1 Watt	IRC 106-2
R110	Resistor 4,700 ohms 5% 1/4 Watt	RC07GF472J
R111	Resistor 40 ohms 5% 1.5 Watts	Ohmite 995-1A
R112	Resistor 3,000 ohms 5% 1/4 Watt	RC07GF302J
R113	Resistor 1,000 ohms 5% 1/4 Watt	RC07GF102J
R114	Resistor 1,000 ohms 5% 1 Watt	IRC 106-2
R115	Resistor 1,500 ohms 5% 1.5 Watts	Ohmite 995-1A
R116	Resistor 1,000 ohms 5% 1.5 Watts	Ohmite 995-1A
R117	Resistor 10 ohms 5% 1/2 Watt	RC20GF100J
R118	Resistor 300 ohms 5% 2 Watts	RC42GF301J
R119	Resistor 10 ohms 5% 1/2 Watt	RC20GF100J
R120	Resistor 22,000 ohms 5% 1/4 Watt	RC07GF223J
SR101	Rectifier 200 PRV 1.5 A	Mallory CTP-200
SR102	Rectifier 200 PRV 1.5 A	Mallory CTP-200
SR103	Rectifier 200 PRV 1.5 A	Mallory CTN-200

Parts List

SCOPE POWER SUPPLY

Ref.	Description	Mfg/Type
C201	Capacitor 16 uf 450 WVDC	Cornell-Dubilier BR16-450
C202	Capacitor 8 uf 350 WVDC	Cornell-Dubilier BR8-350
C203	Capacitor 4 uf 450 WVDC	Cornell-Dubilier BR4-450
C204	Capacitor 4 uf 450 WVDC	Cornell-Dubilier BR4-450
C205	Capacitor 4 uf 450 WVDC	Cornell-Dubilier BR4-450
D201	Diode	1N3282
D202	Diode	1N3282
D203	Diode	1N3282
D204	Diode	1N3282
D205	Diode, zener	1N4759A
D206	Diode, zener	1N4759A
D207	Diode, zener	1N4759A
D208	Diode, zener	1N4759A
R201	Resistor 8,000 ohms 5% 5 Watts	Sprague 243-E
R202	Resistor 1 megohm 5% 1 Watt	RC32GF105J
R203	Resistor .47 megohm 5% 1 Watt	RC32GF474J
R204	Resistor .47 megohm 5% 1 Watt	RC32GF474J

Parts List

REFERENCE GENERATOR AND HORIZONTAL SWEEP AMPLIFIER

Ref.	Description	Mfg/Type
C301	Capacitor 1.0 uf 10% 50 WVDC	GE 75F7R5A105
C302	Capacitor 10 uf 25 WVDC	Sprague TE1204
C303	Capacitor 0.1 uf 10% 50 WVDC	GE 75F2R5A104
C304	Capacitor .056 uf 10%	Sprague225P56391
C305	Capacitor 470 pf 10% 200 WVDC	Sprague 192P47192
C306	Capacitor 0.1 uf 10% 50 WVDC	GE 75F2R5A104
C307	Capacitor 10 uf 25 WVDC	Sprague TE1204
C308	Capacitor 10 uf 25 WVDC	Sprague TE1204
C309	Capacitor .022 uf 10% 400 WVDC	GE 75F3R4A223
C310	Capacitor .022 uf 10% 400 WVDC	GE 75F3R4A223
C311	Capacitor .22 uf 10% 50 WVDC	GE 75F3R5A224
C312	Capacitor .22 uf 10% 50 WVDC	GE 75F3R5A224
C313	Capacitor 4 uf 350 WVDC	Cornell-Dubilier BR4-350
Q301	Transistor	2N1671
Q302	Transistor	2N2270
Q303	Transistor	2N1613
Q304	Transistor	2N1613
Q305	Transistor	2N3440
Q306	Transistor	2N3440
R301	Resistor 330 ohms 5% 1/4 Watt	RC07GF331J
R302	Resistor 10,000 ohms 5% 1 Watt	IRC 106-2
R303	Resistor 10,000 ohms 1% 1/2 Watt	IRC CEC T-0
R304	Resistor 22,600 ohms 1% 1/2 Watt	IRC CEC T-0
R305	Resistor 15,000 ohms 5% 1/3 Watt	RC07GF153J
R306	Resistor 1,000 ohms 5% 1 Watt	IRC 106-2
R307	Resistor 1,000 ohms 5% 1 Watt	IRC 106-2
R308	Resistor 1,000 ohms 5% 1/4 Watt	RC07GF102J
R309	Resistor 1,000 ohms 5% 1/4 Watt	RC07GF102J
R310	Resistor 100 ohms 5% 1/4 Watt	RC07GF101J
R311	Resistor 15,000 ohms 5% 1/4 Watt	RC07GF153J
R312	Resistor 10,000 ohms 5% 1/4 Watt	RC07GF103J
R313	Resistor 10,000 ohms 5% 1/4 Watt	RC07GF103J
R314	Resistor 6,800 ohms 5% 1/4 Watt	RC07GF682J
R315	Resistor 6,800 ohms 5% 1/4 Watt	RC07GF682J
R316	Resistor 5,000 ohms 5% 1 Watt	IRC 106-2
R317	Resistor 4,700 ohms 5% 1/4 Watt	RC07GF472J
R318	Resistor 1,000 ohms 5% 1/4 Watt	RC07GF102J
R319	Resistor 1,000 ohms 5% 1/4 Watt	RC07GF102J
R320	Resistor 47,000 ohms 5% 1/4 Watt	RC07GF473J
R321	Resistor 1,000 ohms 5% 1 Watt	IRC 106-2
R322	Resistor 4,700 ohms 5% 1/2 Watt	RC20GF472J
R323	Resistor 56,000 ohms 5% 1/2 Watt	RC20GF563J
R324	Resistor 56,000 ohms 5% 1/2 Watt	RC20GF563J
R325	Resistor 1,000 ohms 5% 1/2 Watt	RC20GF102J
R326	Resistor 47,000 ohms 5% 1/4 Watt	RC07GF473J

Parts List

AFC CLIPPER/AMPLIFIER AND COMPARATOR

Ref.	Description				Mfg/Type
C401	Capacitor	10 uf		25 WVDC	Sprague TE1204
C402	Capacitor	.005 uf	5%	500 WVDC	Mallory SX250
C403	Capacitor	0.1 uf	10%	50 WVDC	GE 75F2R5A104
C404	Capacitor	.22 uf	10%	50 WVDC	GE 75F3R5A224
C405	Capacitor	0.1 uf	10%	50 WVDC	GE 75F2R5A104
C406	Capacitor	.22 uf	10%	50 WVDC	GE 75F3R5A224
C407	Capacitor	0.1 uf	10%	50 WVDC	GE 75F2R5A104
C408	Capacitor	.22 uf	10%	50 WVDC	GE 75F3R5A224
C409	Capacitor	.47 uf	10%	50 WVDC	GE 75F6R5A474
C410	Capacitor	1.0 uf	10%	50 WVDC	GE 75F7R5A105
C411	Capacitor	1.0 uf	10%	50 WVDC	GE 75F7R5A105
C412	Capacitor	10 uf		25 WVDC	Sprague TE1204
C413	Capacitor	10 uf		25 WVDC	Sprague TE1204
C414	Capacitor	0.1 uf	10%	50 WVDC	GE 75F2R5A104
D401	Diode				1N456
D402	Diode				1N456
D403	Diode				1N456
D404	Diode				1N456
D405	Diode				1N456
D406	Diode				1N456
D407	Diode				1N456
D408	Diode				1N456
Q401	Transistor				2N2270
Q402	Transistor				2N3391
Q403	Transistor				2N3391
Q404	Transistor				2N2270
Q405	Transistor				2N3391
Q406	Transistor				2N2270
Q407	Transistor				2N2195
R401	Resistor	1 megohm	5%	1/4 Watt	RC07GF105J
R402	Resistor	.15 megohm	5%	1/4 Watt	RC07GF154J
R403	Resistor	4,700 ohms	5%	1/4 Watt	RC07GF472J
R404	Resistor	.2 megohm	5%	1/4 Watt	RC07GF204J
R405	Resistor	1,000 ohms	5%	1/4 Watt	RC07GF102J
R406	Resistor	.1 megohm	5%	1/4 Watt	RC07GF104J
R407	Resistor	.15 meghom	5%	1/4 Watt	RC07GF154J
R408	Resistor	1 meghom	5%	1/4 Watt	RC07GF105J
R409	Resistor	27,000 ohms	5%	1/4 Watt	RC07GF273J
R410	Resistor	15,000 ohms	5%	1/4 Watt	RC07GF153J
R411	Resistor	1,000 ohms	5%	1/4 Watt	RC07GF102J
R412	Resistor	68,000 ohms	5%	1/4 Watt	RC07GF683J
R413	Resistor	1 megohm	5%	1/4 Watt	RC07GF105J
R414	Resistor	.15 megohm	5%	1/4 Watt	RC07GF154J

Parts List
AFC Clipper/Amplifier and Comparator (continued)

Ref.	Description				Mfg/Type
R415	Resistor	15,000 ohms	5%	1/4 Watt	RC07GF153J
R416	Resistor	1,000 ohms	5%	1/4 Watt	RC07GF102J
R417	Resistor	68,000 ohms	5%	1/4 Watt	RC07GF683J
R418	Resistor	.33 megohm	5%	1/4 Watt	RC07GF334J
R419	Resistor	.15 megohm	5%	1/4 Watt	RC07GF154J
R420	Resistor	10,000 ohms	5%	1/4 Watt	RC07GF103J
R421	Resistor	1,000 ohms	5%	1/4 Watt	RC07GF102J
R422	Resistor	10,000 ohms	5%	1/4 Watt	RC07GF103J
R423	Resistor	10,000 ohms	5%	1/4 Watt	RC07GF103J
R424	Resistor	.1 megohm	5%	1/4 Watt	RC07GF104J
R425	Resistor	27,000 ohms	5%	1/4 Watt	RC07GF273J
R426	Resistor	36,000 ohms	5%	1/4 Watt	RC07GF363J
R427	Resistor	220 ohms	5%	1/4 Watt	RC07GF221J
R428	Resistor	4,700 ohms	5%	1/4 Watt	RC07GF472J
R429	Resistor	10,000 ohms	5%	1/4 Watt	Rc07GF103J
R430	Resistor	10,000 ohms	5%	1/4 Watt	RC07GF103J
R431	Resistor	6,800 ohms	5%	1/4 watt	RC07GF682J
R432	Resistor	.5 megohm	5%	1 Watt	IRC 106-2
T401	Transformer	10,000:10,000 ohms			Triad SP-66

Parts List

SERVO AMPLIFIER

Ref.	Description	Mfg/Type
C501	Capacitor 250 uf 50 WVDC	Cornell-Dubilier BR250-50
C502	Capacitor .47 uf 10% 50 WVDC	GE 75F6R5A474
C503	Capacitor 10 uf 25 WVDC	Sprague TE1204
D501	Diode, zener	1N4751A
D502	Diode	1N456
Q501	Transistor	2N1701
Q502	Transistor	2N3053
Q503	Transistor	2N2270
Q504	Transistor	2N2270
Q505	Transistor	2N3391
Q506	Transistor	2N1701
Q507	Transistor	2N1701
Q508	Transistor	2N3391
Q509	Transistor	2N3391
R501	Resistor 2,700 ohms 5% 1/2 Watt	RC20GF272J
R502	Resistor 680 ohms 5% 1/2 Watt	RC20GF681J
R503	Resistor .1 meghom 5% 1/4 Watt	RC07GF104J
R504	Resistor 3,900 ohms 5% 1/4 Watt	RC07GF392J
R505	Resistor 10 ohms 5% 1/4 Watt	RC07GF100J
R506	Resistor 20,000 ohms 5% 1/4 Watt	RC07GF203J
R507	Resistor 20,000 ohms 5% 1/4 Watt	RC07GF203J
R508	Resistor 22,000 ohms 5% 1/4 Watt	RC07GF223J
R509	Resistor 22,000 ohms 5% 1/4 Watt	RC07GF223J
R510	Resistor 22,000 ohms 5% 1/4 Watt	RC07GF223J
R511	Resistor 100 ohms 5% 1 Watt	IRC 106-2
R512	Resistor 10,000 ohms 5% 1/4 Watt	RC07GF103J
R513	Resistor 100 ohms 5% 5 Watts	Sprague 243E
R514	Resistor 2,200 ohms 5% 1/4 Watt	RC07GF222J
R515	Resistor 150 ohms 5% 5 Watts	Sprague 243E
R516	Resistor 150 ohms 5% 5 Watts	Sprague 243E
R517	Resistor 2,200 ohms 5% 1/4 Watt	RC07GF222J
R518	Resistor .1 megohm 5% 1/4 Watt	RC07GF104J
SR501	Rectifier	Mallory FW-200

Parts List

SCOPE VERTICAL AMPLIFIER

Ref.	Description	Mfg/Type
C601	Capacitor 10 uf 25 WVDC	Sprague TE1204
C602	Capacitor .022 uf 10% 50 WVDC	GE 75F1R5A223
C604	Capacitor .22 uf 10% 50 WVDC	GE 75F3R5A224
C605	Capacitor 50 uf 6 WVDC	Sprague TE110
C606	Capacitor .022 uf 10% 400 WVDC	GE 75F3R4A223
C607	Capacitor .022 uf 10% 400 WVDC	GE 75F3R4A223
C608	Capacitor .22 uf 10% 50 WVDC	GE 75F3R5A224
C609	Capacitor 4 uf 350 WVDC	Cornell-Dubilier BR4-350
C610	Capacitor 10 uf 25 WVDC	Sprague TE1204
Q602	Transistor	2N3391
Q603	Transistor	2N3391
Q604	Transistor	2N3340
Q605	Transistor	2N3340
R603	Resistor .1 megohm 5% 1/4 Watt	RC07GF104J
R604	Resistor 1 megohm 5% 1/4 Watt	RC07GF105J
R605	Resistor 51,000 ohms 5% 1/4 Watt	RC07GF513J
R606	Resistor 2,200 ohms 5% 1/4 Watt	RC07GF222J
R607	Resistor 2,200 ohms 5% 1/4 Watt	RC07GF222J
R608	Resistor 10,000 ohms 5% 1/4 Watt	RC07GF103J
R609	Resistor 330 ohms 5% 1/4 Watt	RC07GF331J
R610	Resistor 3,000 ohms 5% 1/4 Watt	RC07GF302J
R611	Resistor 47,000 ohms 5% 1/4 Watt	RC07GF473J
R612	Resistor 1,000 ohms 5% 1 Watt	IRC 106-2
R613	Resistor 4,700 ohms 5% 1/2 Watt	RC20GF472J
R614	Resistor 56,000 ohms 5% 1/2 Watt	RC20GF563J
R615	Resistor 56,000 ohms 5% 1/2 Watt	RC20GF563J
R616	Resistor 47,000 ohms 5% 1/4 Watt	RC07GF473J
R617	Resistor 1,000 ohms 5% 1/2 Watt	RC20GF102J
R618	Resistor 1,000 ohms 5% 1/4 Watt	RC07GF102J

Parts List

LEVEL AMPLIFIER

Ref.	Description	Mfg/Type
C701	Capacitor 10 uf 25 WVDC	Sprague TE1204
C702	Capacitor .005 uf 5% 500 WVDC	Mallory SX250
C703	Capacitor 50 uf 6 WVDC	Sprague TE1100
C704	Capacitor 10 uf 25 WVDC	Sprague TE1204
C705	Not used	
C706	Capacitor 0.1 uf 10% 50 WVDC	GE 75F2R5A104
C707	Capacitor 10 uf 25 WVDC	Sprague TE1204
C708	Capacitor 10 uf 25 WVDC	Sprague TE1204
CR701	Diode	1N456
CR702	Diode	1N456
CR703	Diode	1N456
CR704	Diode	1N456
Q701	Transistor	2N3391
Q702	Transistor	2N3391
Q703	Transistor	2N3391
Q704	Transistor	2N3053
Q705	Transistor	2N3391
Q706	Transistor	2N3391
R701	Resistor 4,700 ohms 5% 1/4 Watt	RC07GF472J
R702	Resistor .33 megohm 5% 1/4 Watt	RC07GF334J
R703	Resistor .33 megohm 5% 1/4 Watt	RC07GF334J
R704	Resistor 10,000 ohms 5% 1/4 Watt	RC07GF103J
R705	Resistor 1,000 ohms 5% 1/4 Watt	RC07GF102J
R706	Resistor 1,000 ohms 5% 1/4 Watt	RC07GF102J
R707	Resistor 5,600 ohms 5% 1/4 Watt	RC07GF562J
R708	Resistor 330 ohms 5% 1/4 Watt	RC07GF331J
R709	Resistor, variable 5,000 ohms 1 Watt	IRC 106-2
R710	Resistor 10,000 ohms 5% 1/4 Watt	RC07GF103J
R711	Resistor 33,000 ohms 5% 1/4 Watt	RC07GF333J
R712	Resistor .33 megohm 5% 1/4 Watt	RC07GF334J
R713	Resistor 22,000 ohms 5% 1/4 Watt	RC07GF223J
R714	Resistor 330 ohms 5% 1/4 Watt	RC07GF331J
R715	Resistor .1 megohm 5% 1/4 Watt	RC07GF104J
R716	Resistor 10,000 ohms 5% 1/4 Watt	RC07GF103J
R717	Resistor 10,000 ohms 5% 1/4 Watt	RC07GF103J
R718	Resistor .15 megohm 5% 1/4 Watt	RC07GF154J
R719	Resistor .1 megohm 5% 1/4 Watt	RC07GF104J
R720	Resistor .1 megohm 5% 1/4 Watt	RC07GF104J
R721	Resistor 10,000 ohms 5% 1/4 Watt	RC07GF103J
R722	Resistor 1,000 ohms 5% 1/4 Watt	RC07GF102J
R723	Resistor 20,000 ohms 5% 1/4 Watt	RC07GF203J
R724	Resistor 330 ohms 5% 1/4 Watt	RC07GF331J
R725	Resistor 2,000 ohms 5% 1/4 Watt	RC07GF202J
T701	Transformer 1,200:20,000 ohms	Stancor TA-27

Parts List

PREAMPLIFIER/SWEPT OSCILLATOR

Ref.	Description	Mfg/Type
C801	Capacitor .005 uf 50 WVDC	Sprague TG-D50
C802	Capacitor, variable 2-11 pf	E.F. Johnson 189-5-1
C803	Capacitor .005 uf 50 WVDC	Sprague TG-D50
C804	Capacitor .005 uf 50 WVDC	Sprague TG-D50
C805	Capacitor .005 uf 50 WVDC	Sprague TG-D50
C806	Capacitor, variable 2-11 pf	E.F. Johnson 189-5-1
C807	Capacitor .005 uf 50 WVDC	Sprague TG-D50
C808	Capacitor .005 uf 50 WVDC	Sprague TG-D50
C809	Capacitor .005 uf 50 WVDC	Sprague TG-D50
C810	Capacitor .005 uf 50 WVDC	Sprague TG-D50
C811	Capacitor, variable 2-11 pf	E.F. Johnson 189-5-1
C812	Capacitor .005 uf 50 WVDC	Sprague TG-D50
C813	Capacitor .005 uf 50 WVDC	Sprague TG-D50
C814	Capacitor .005 uf 50 WVDC	Sprague TG-D50
C815	Capacitor, variable 2-11 pf	E.F. Johnson 189-5-1
C816	Capacitor .005 uf 50 WVDC	Sprague TG-D50
C817	Capacitor .005 uf 50 WVDC	Sprague TG-D50
C818	Capacitor 100 pf 5% 500 WVDC	DM15-101J
C819	Capacitor 100 pf 5% 500 WVDC	DM15-101J
C821	Capacitor .005 uf 50 WVDC	Sprague TG-D50
C820	Capacitor, variable 2-11 pf	E.F. Johnson 189-5-1
C822	Capacitor .005 uf 50 WVDC	Sprague TG-D50
C823	Capacitor .005 uf 50 WVDC	Sprague TG-D50
C824	Capacitor .005 uf 50 WVDC	Sprague TG-D50
C825	Capacitor .005 uf 50 WVDC	Sprague TG-D50
C826	Capacitor 5 pf 10% 500 WVDC	DM15-050K
C827	Capacitor 50 pf 5% 500 WVDC	DM15-500J
C828	Not used	
C829	Capacitor .005 uf 50 WVDC	Sprague TG-D50
C830	Capacitor .005 uf 50 WVDC	Sprague TG-D50
C831	Capacitor .005 uf 50 WVDC	Sprague TG-D50
C832	Filtercon	Erie 1201-051
C833	Filtercon	Erie 1201-051
C834	Filtercon	Erie 1201-051
C835	Filtercon	Erie 1201-051
C836	Capacitor 15 pf 5% 500 WVDC	DM15-150J
D801	Diode, zener 10 VDC 1 Watt	1N4740A
D802	Diode	1N82AG
D803	Diode	Motorola 1N5140A
J801	Connector	Dage 8001-1
J802	Connector	Dage 8016-1

Parts List
PREAMPLIFIER/SWEPT OSCILLATOR (Continued)

Ref.	Description	Mfg/Type
L801	Inductor	Micro-Tel
L802	Inductor	Micro-Tel
L803	Inductor 3.3 uh	J.W. Miller 9310-24
L804	Inductor 3.3 uh	J.W. Miller 9310-24
L805	Inductor	Micro-Tel
L806	Inductor	Micro-Tel
L807	Inductor 3.3 uh	J.W. Miller 9310-24
L808	Inductor 2.2 uh	J.W. Miller 9310-20
L809	Inductor	Micro-Tel
L810	Inductor	Micro-Tel
L811	Inductor 3.3 uh	J.W. Miller 9310-24
L812	Inductor 2.2 uh	J.W. Miller 9310-20
L813	Inductor	Micro-Tel
L814	Inductor 2.2 uh	J.W. Miller 9310-20
L815	Inductor 2.2 uh	J.W. Miller 9310-20
L816	Inductor 2.2 uh	J.W. Miller 9310-20
L817	Ferrite Bead	Ferroxcube 56-590-65B3B
L818	Inductor 3.3 uh	J.W. Miller 9310-24
Q801	Transistor	2N3478 or 40242
Q802	Transistor	2N3478 or 40242
Q803	Transistor	3N126
Q804	Transistor	2N3292
Q805	Transistor	2N3293
R801	Resistor 10,000 ohms 5% 1/4 Watt	RC07GF103J
R802	Resistor 47,000 ohms 5% 1/4 Watt	RC07GF473J
R803	Resistor 680 ohms 5% 1/4 Watt	RC07GF681J
R804	Resistor 470 ohms 5% 1/4 Watt	RC07GF471J
R805	Resistor 4,700 ohms 5% 1/4 Watt	RC07GF472J
R806	Resistor 10,000 ohms 5% 1/4 Watt	RC07GF103J
R807	Resistor 820 ohms 5% 1/4 Watt	RC07GF821J
R808	Resistor 470 ohms 5% 1/4 Watt	RC07GF471J
R809	Resistor 1 megohm 5% 1/4 Watt	RC07GF105J
R810	Resistor 1 megohm 5% 1/4 Watt	RC07GF105J
R811	Resistor 1,000 ohms 5% 1/4 Watt	RC07GF102J
R812	Resistor 51 ohms 5% 1/4 Watt	RC07GF510J
R813	Resistor 470 ohms 5% 1/4 Watt	RC07GF471J
R814	Resistor 4,700 ohms 5% 1/4 Watt	RC07GF472J
R815	Resistor 10,000 ohms 5% 1/4 Watt	RC07GF103J
R816	Resistor 470 ohms 5% 1/4 Watt	RC07GF471J
R817	Resistor 820 ohms 5% 1/4 Watt	RC07GF821J
R818	Resistor 15,000 ohms 5% 1/4 Watt	RC07GF153J
R819	Resistor 3,000 ohms 5% 1/4 Watt	RC07GF302J
R820	Resistor 1,000 ohms 5% 1/4 Watt	RC07GF102J
R821	Resistor 10,000 ohms 5% 1/4 Watt	RC07GF103J
R822	Resistor 18 ohms 5% 1/4 Watt	RC07GF180J

Parts List

IF AMPLIFIER

Ref.	Description	Mfg/Type
B901	Bolometer	Filmohm CWB875-2000
C901	Capacitor .01 uf 50 WVDC	Sprague TG-S10
C902	Capacitor .01 uf 50 WVDC	Sprague TG-S10
C903	Capacitor .01 uf 50 WVDC	Sprague TG-S10
C904	Capacitor, variable 2-11 pf	E.F. Johnson 189-5-1
C905	Capacitor 100 pf 5% 500 WVDC	DM15-101J
C906	Capacitor, variable 2-11 pf	E.F. Johnson 189-5-1
C907	Capacitor .01 uf 50 WVDC	Sprague TG-S10
C908	Capacitor .01 uf 50 WVDC	Sprague TG-S10
C909	Capacitor 100 pf 5% 500 WVDC	DM15-101J
C910	Capacitor .01 uf 50 WVDC	Sprague TG-S10
C911	Capacitor, variable 2-11 pf	E.F. Johnson 189-5-1
C912	Capacitor .01 uf 50 WVDC	Sprague TG-S10
C913	Capacitor .01 uf 50 WVDC	Sprague TG-S10
C914	Capacitor 100 pf 5% 500 WVDC	DM15-101J
C915	Capacitor .01 uf 50 WVDC	Sprague TG-S10
C916	Capacitor, variable 2-11 pf	E.F. Johnson 189-5-1
C917	Capacitor .01 uf 50 WVDC	Sprague TG-S10
C918	Capacitor .01 uf 50 WVDC	Sprague TG-S10
C919	Capacitor .01 uf 50 WVDC	Sprague TG-S10
C920	Capacitor .01 uf 50 WVDC	Sprague TG-S10
C921	Capacitor .01 uf 50 WVDC	Sprague TG-S10
C922	Capacitor, variable 2-11 pf	E.F. Johnson 189-5-1
C923	Capacitor 100 pf 5% 500 WVDC	DM15-101J
C924	Not used	
C925	Capacitor .01 uf 50 WVDC	Sprague TG-S10
C926	Capacitor .01 uf 50 WVDC	Sprague TG-S10
C927	Capacitor .01 uf 50 WVDC	Sprague TG-S10
C928	Capacitor, variable 2-11 pf	E.F. Johnson 189-5-1
C929	Capacitor 100 pf 5% 500 WVDC	DM15-101J
C930	Capacitor, variable 2-11 pf	E.F. Johnson 189-5-1
C931	Capacitor .01 uf 50 WVDC	Sprague TG-S10
C932	Capacitor 100 pf 5% 500 WVDC	DM15-101J
C933	Capacitor .01 uf 50 WVDC	Sprague TG-S10
C934	Capacitor 47 pf 5% 500 WVDC	DM15-470J
C935	Capacitor 47 pf 5% 500 WVDC	DM15-470J
C936	Capacitor .01 uf 50 WVDC	Sprague TG-S10
D901	Diode	1N295
J901	Connector	Dage 8016-1
J902	Connector	Dage 8016-1
J903	Connector	Dage 8016-1

Parts List
IF AMPLIFIER (Continued)

Ref.	Description	Mfg/Type
L901	Coil	Micro-Tel 25-020-4
L902	Coil	Micro-Tel 25-020-4
L903	Coil	Micro-Tel 25-020-4
L904	Coil	Micro-Tel 25-020-6
L905	Coil	Micro-Tel 25-020-3
L906	Coil	Micro-Tel 25-020-4
L907	Coil	Micro-Tel 25-020-5
L908	Coil 6.8 uh	J.W. Miller 9310-32
L909	Coil 6.8 uh	J.W. Miller 9310-32
L910	Coil 6.8 uh	J.W. Miller 9310-32
L911	Coil 6.8 uh	J.W. Miller 9310-32
L912	Coil 6.8 uh	J.W. Miller 9310-32
L913	Coil 6.8 uh	J.W. Miller 9310-32
L914	Coil 6.8 uh	J.W. Miller 9310-32
L915	Coil 6.8 uh	J.W. Miller 9310-32
L916	Coil 6.8 uh	J.W. Miller 9310-32
L917	Coil 6.8 uh	J.W. Miller 9310-32
L918	Ferrite Bead	Ferroxcube 56-590-65B3B
P901	Connector	Amphenol 126-216
Q901	Transistor	2N3292
Q902	Transistor	2N3292
Q903	Transistor	2N3292
Q904	Transistor	2N3292
Q905	Transistor	2N3292
Q906	Transistor	2N3292
Q907	Transistor	2N3292
R901	Resistor 10,000 ohms 10% 1/4 Watt	RC07GF103K
R902	Resistor 10,000 ohms 10% 1/4 Watt	RC07GF103K
R903	Resistor 680 ohms 10% 1/4 Watt	RC07GF681K
R904	Resistor 3,300 ohms 10% 1 4 Watt	RC07GF332K
R905	Resistor 10,000 ohms 10% 1/4 Watt	RC07GF103K
R906	Resistor 47 ohms 10% 1/4 Watt	RC07GF470K
R907	Resistor 10,000 ohms 10% 1/4 Watt	RC07GF103K
R908	Resistor 680 ohms 10% 1/4 Watt	RC07GF681K
R909	Resistor 100 ohms 5% 1/4 Watt	RC07GF101J
R910	Resistor 1,000 ohms 10% 1/4 Watt	RC07GF102K
R911	Resistor 10,000 ohms 10% 1/4 Watt	RC07GF103K
R912	Resistor 10,000 ohms 10% 1/4 Watt	RC07GF103K
R913	Resistor 680 ohms 10% 1/4 Watt	RC07GF681K
R914	Resistor 100 ohms 5% 1/4 Watt	RC07GF101J
R915	Resistor 1,000 ohms 10% 1/4 Watt	RC07GF102K
R916	Resistor 3,300 ohms 10% 1/4 Watt	RC07GF332K
R917	Resistor 10,000 ohms 10% 1/4 Watt	RC07GF103K
R918	Resistor 10,000 ohms 10% 1/4 Watt	RC07GF103K

Parts List
IF AMPLIFIER (Continued)

Ref.	Description				Mfg/Type
R919	Resistor	100 ohms	5%	1/4 Watt	RC07GF101J
R920	Resistor	1,000 ohms	10%	1/4 Watt	RC07GF103K
R921	Resistor	22,000 ohms	10%	1/4 Watt	RC07GF223K
R922	Resistor	10,000 ohms	10%	1/4 Watt	RC07GF103K
R923	Resistor	100 ohms	5%	1/4 Watt	RC07GF101J
R924	Resistor	3,300 ohms	10%	1/4 Watt	RC07GF332K
R925	Not used				
R926	Resistor	10,000 ohms	10%	1/4 Watt	RC07GF103K
R927	Resistor	10,000 ohms	10%	1/4 Watt	RC07GF103K
R928	Resistor	1,000 ohms	10%	1/4 Watt	RC07GF102K
R929	Resistor	100 ohms	5%	1/4 Watt	RC07GF101J
R930	Resistor	3,300 ohms	10%	1/4 Watt	RC07GF332K
R931	Resistor	10,000 ohms	10%	1/4 Watt	RC07GF103K
R932	Resistor	10,000 ohms	10%	1/4 Watt	RC07GF103K
R933	Resistor	2,200 ohms	10%	1/4 Watt	RC07GF222K
R934	Resistor	100 ohms	5%	1/4 Watt	RC07GF101J
R935	Resistor	1,000 ohms	10%	1/4 Watt	RC07GF102K
R936	Resistor	2,200 ohms	10%	1/4 Watt	RC07GF222K
R937	Resistor	10 ohms	10%	1/4 Watt	RC07GF100K
R938	Resistor	10 ohms	10%	1/4 Watt	RC07GF100K
R939	Resistor	10 ohms	10%	1/4 Watt	RC07GF100k
R940	Resistor	10 ohms	10%	1/4 Watt	RC07GF100K
R941	Resistor	10 ohms	10%	1/4 Watt	RC07GF100K
R942	Resistor	10 ohms	10%	1/4 Watt	RC07GF100K
R943	Resistor	10 ohms	10%	1/4 Watt	RC07GF100K

Parts List

MAIN CHASSIS

Ref.	Description	Mfg/Type
B1001	Motor	Hayden K5331-P-1-10
B1002	Clutch	Altair MC545AA28
C1001	Capacitor 1.0 uf 10% 50 WVDC	GE 75F7R5A105
C1002	Capacitor 0.1 uf 10% 50 WVDC	GE 75F2R5A104
C1003	Capacitor 0.1 uf 10% 200 WVDC	Cornell-Dubilier DPMS-2P1
D1001	Diode	1N816
D1002	Diode	1N816
D1003	Diode, zener 15 V 1 Watt	Motorola 1N4744A
F1001	Fuse, 1 ampere slow-blow	3AG
I1001	Lamp, amber	Drake HR118-604
J1001	Connector	UG-556B/U
J1002	Connector	UG-657/U
J1003	Connector	UG-657/U
J1004	Connector	Amphenol 126-221
K1001	Relay, coaxial transfer	Amphenol 360-1189255
K1002	Relay, coaxial SPDT	Amphenol 360-1189248
K1003	Relay SPDT 10,000 ohm coil	Potter & Brumfield RS5D
L1001	Inductor, variable	UTC HVC-8
L1002	Inductor, variable	UTC HVC-8
M1001	Meter	Micro-Tel
P1001	Connector	Dage 8000-1
P1002	Connector	Dage 8000-1
P1003	Connector	Dage 8000-1
P1004	Connector	Dage 8000-1
P1005	Connector	Dage 8000-1
P1006	Connector	Dage 8000-1
P1007	Connector	Dage 8000-1
P1008	Connector	Dage 8000-1
P1009	Connector	Dage 8019-1
P1010	Connector	Dage 8000-1
P1011	Connector	Dage 8000-1
P1012	Connector	Dage 8000-1
P1013	Connector	Dage 8000-1
P1014	Connector	Dage 8000-1
P1015	Connector	Dage 8000-1
P1016	Connector	Dage 8000-1
P1017	Connector	Dage 8005-1
P1018	Connector	Dage 8000-1
P1019	Connector	Dage 8000-1

Parts List
MAIN CHASSIS (Continued)

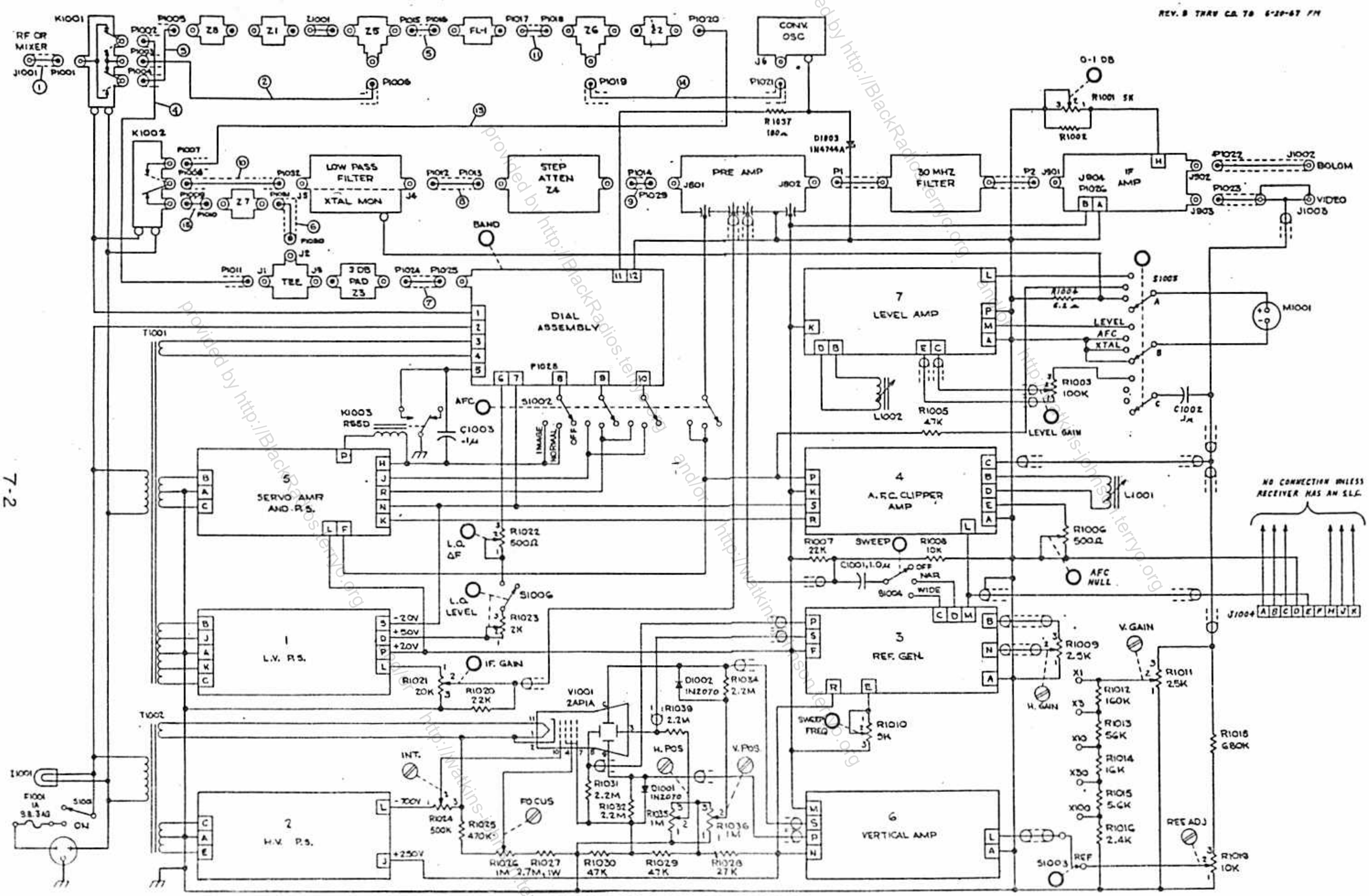
Ref.	Description	Mfg/Type
P1020	Connector	Dage 8019-1
P1021	Connector	Dage 8000-1
P1022	Connector	Dage 8000-1
P1023	Connector	Dage 8000-1
P1024	Connector	Dage 8000-1
P1025	Connector	Dage 8019-1
P1026	Connector	Amphenol 126-223
P1028	Connector	Cinch-Jones DA-15P
P1029	Connector	Dage 8000-1
P1030	Connector	Dage 8000-1
P1031	Connector	Dage 8019-1
P1032	Connector	Dage 8000-1
R1001	Resistor, variable 5,000 ohms 5 Watt	Mallory VW-5K
R1002	Not used	
R1003	Resistor, variable .1 megohm 1/2 Watt	IRC PQ11-128
R1004	Resistor 6.2 ohms 5% 1/2 Watt	RC20GF6R2J
R1005	Resistor 47,000 ohms 5% 1/2 Watt	RC20GF473J
R1006	Resistor, variable 500 ohms 1/2 Watt	IRC PQ11-103
R1007	Resistor 22,000 ohms 5% 1/2 Watt	RC20GF223J
R1008	Resistor 10,000 ohms 5% 1/2 Watt	RC20GF103J
R1009	Resistor, variable 2,500 ohms 1/5 Watt	Centralab JML-252
R1010	Resistor, variable 5,000 ohms 1/2 Watt	IRC PQ11-114
R1011	Resistor, variable 25,000 ohms 1/5 Watt	Centralab JML-253
R1012	Resistor .16 megohm 5% 1/2 Watt	RC20GF164J
R1013	Resistor 56,000 ohms 5% 1/2 Watt	RC20GF563J
R1014	Resistor 16,000 ohms 5% 1/2 Watt	RC20GF163J
R1015	Resistor 5,600 ohms 5% 1/2 Watt	RC20GF562J
R1016	Resistor 2,400 ohms 5% 1/2 Watt	RC20GF242J
R1018	Resistor .68 megohm 5% 1/2 Watt	RC20GF684J
R1019	Resistor, variable 10,000 ohms 1/2 Watt	Bourns 3067S
R1020	Resistor 22,000 ohms 5% 1/2 Watt	RC20GF223J
R1021	Resistor, variable 20,000 ohms 1/2 Watt	IRC PQ11-119
R1022	Resistor, variable 500 ohms 1/2 Watt	IRC PQ11-103
R1023	Resistor, variable 2,000 ohms 1/2 Watt	IRC PQ11-110
R1024	Resistor, variable .15 megohm 1/5 Watt	Centralab JML-504
R1025	Resistor .47 megohm 5% 1/2 Watt	RC20GF474J
R1026	Resistor, variable 1 megohm 1/5 Watt	Centralab JML-105
R1027	Resistor 2.7 megohm 1 Watt	RC32GF275J
R1028	Resistor 27,000 ohms 5% 1/2 Watt	RC20GF273J
R1029	Resistor 47,000 ohms 5% 1/2 Watt	RC20GF473J
R1030	Resistor 47,000 ohms 5% 1/2 Watt	RC20GF473J
R1031	Resistor 2.2 megohm 5% 1/2 Watt	RC20GF225J
R1032	Resistor 2.2 megohm 5% 1/2 Watt	RC20GF225J
R1033	Resistor 2.2 megohm 5% 1/2 Watt	RC20GF225J
R1034	Resistor 2.2 megohm 5% 1/2 Watt	RC20GF225J
R1035	Resistor, variable 1 megohm 1/5 Watt	Centralab JML-105

Part List
MAIN CHASSIS (Continued)

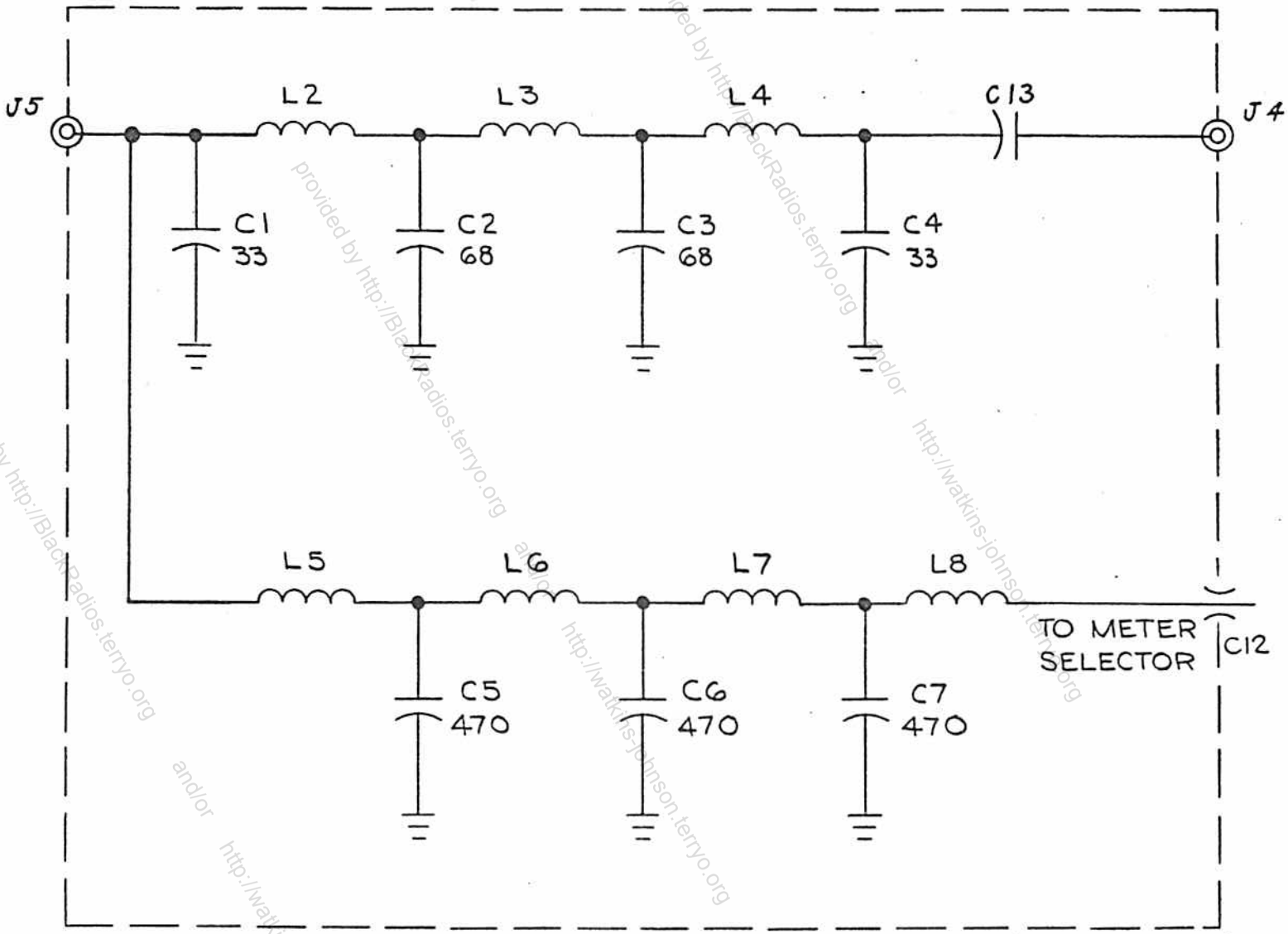
Ref.	Description	Mfg/Type
R1036	Resistor, variable 1 megohm 1.5 Watt	Centralab JML-105
R1037	Resistor 180 ohms 5% 1/2 Watt	RC20GF181J
S1001	Switch, toggle SPST	H.H. Smith 584
S1002	Switch, rotary 4 pole 3 position	Mallory 3243J
S1003	Switch, rotary 2 pole 6 position	Mallory 3226J
S1004	Switch, rotary 2 pole 3 position	Mallory 3223J
S1005	Switch, rotary 4 pole 3 position	Mallory 3243J
S1006	Switch, p/o R1022	IRC 76-1
S1007	Switch	Grayhill 24002-10
T1001	Transformer, power	Micro-Tel
T1002	Transformer, power	Triad R-104A
V1001	Tube, cathode ray	2AP1A
Z1001	Coaxial Adapter	Dage 8014-1

7.0 SCHEMATIC DRAWINGS

The pages of this section contain the schematic diagrams of the entire receiver. Figure 7.1, the overall receiver schematic, has been simplified by the use of blocks for the plug-in and removable subassemblies. The schematic of each block is presented on individual drawings.

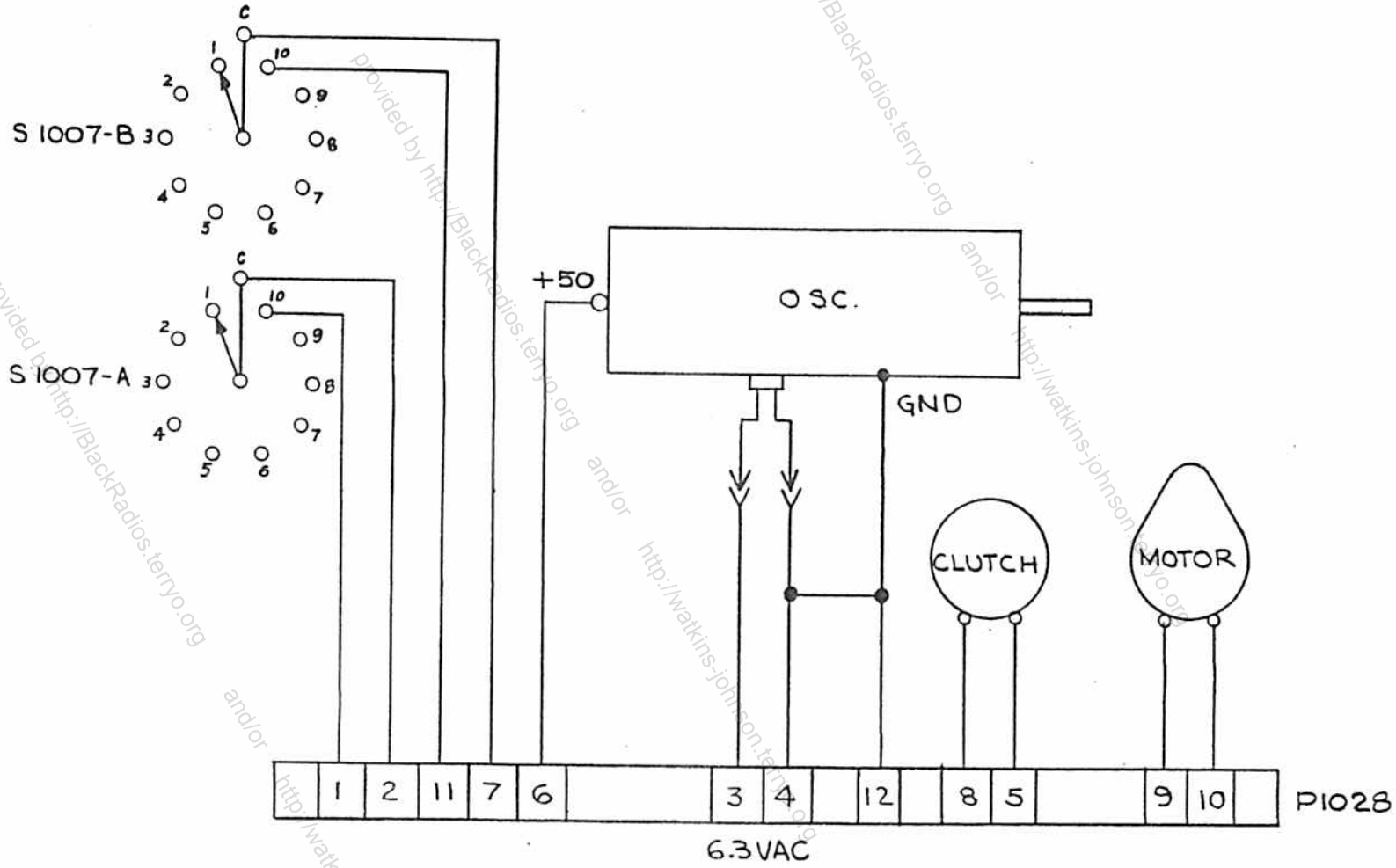


SCHEMATIC DIAGRAM - RECEIVER
FIGURE 7.1



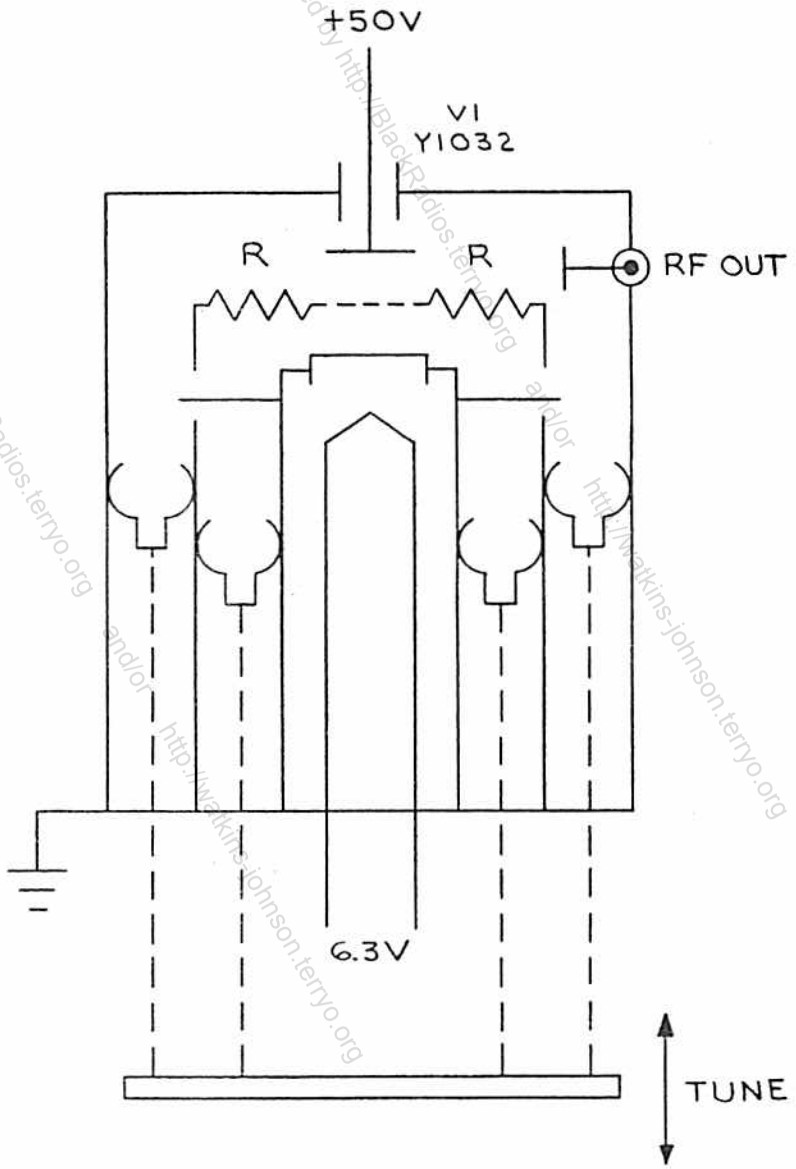
LOW PASS FILTER
AND CRYSTAL MONITOR
FIGURE 7.2

REV. B THRU CO 78 6-21-67 FM
REV. A THRU CO31 6-16-66

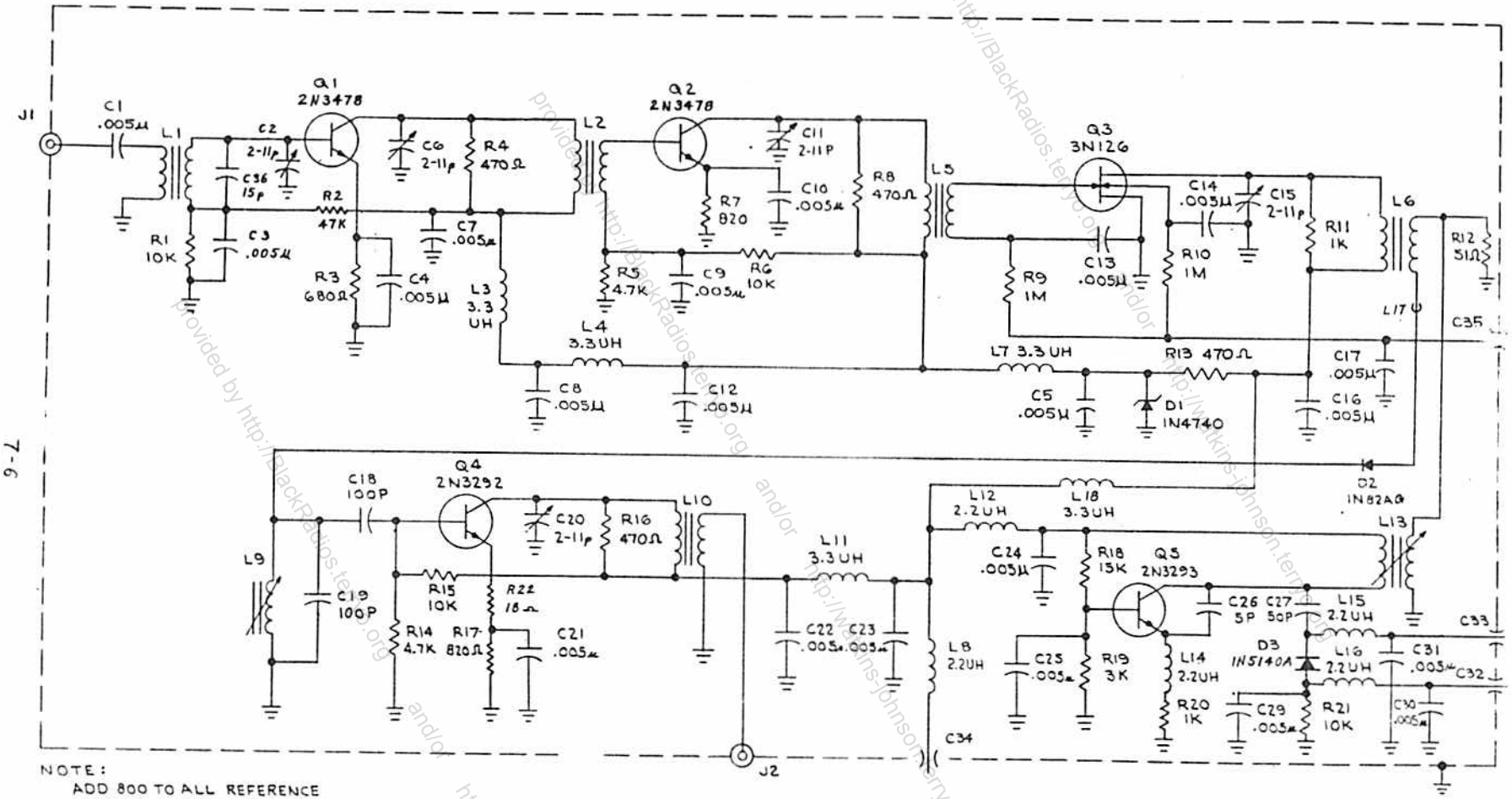


SCHEMATIC DIAGRAM
DIAL ASSEMBLY

FIGURE 7.3



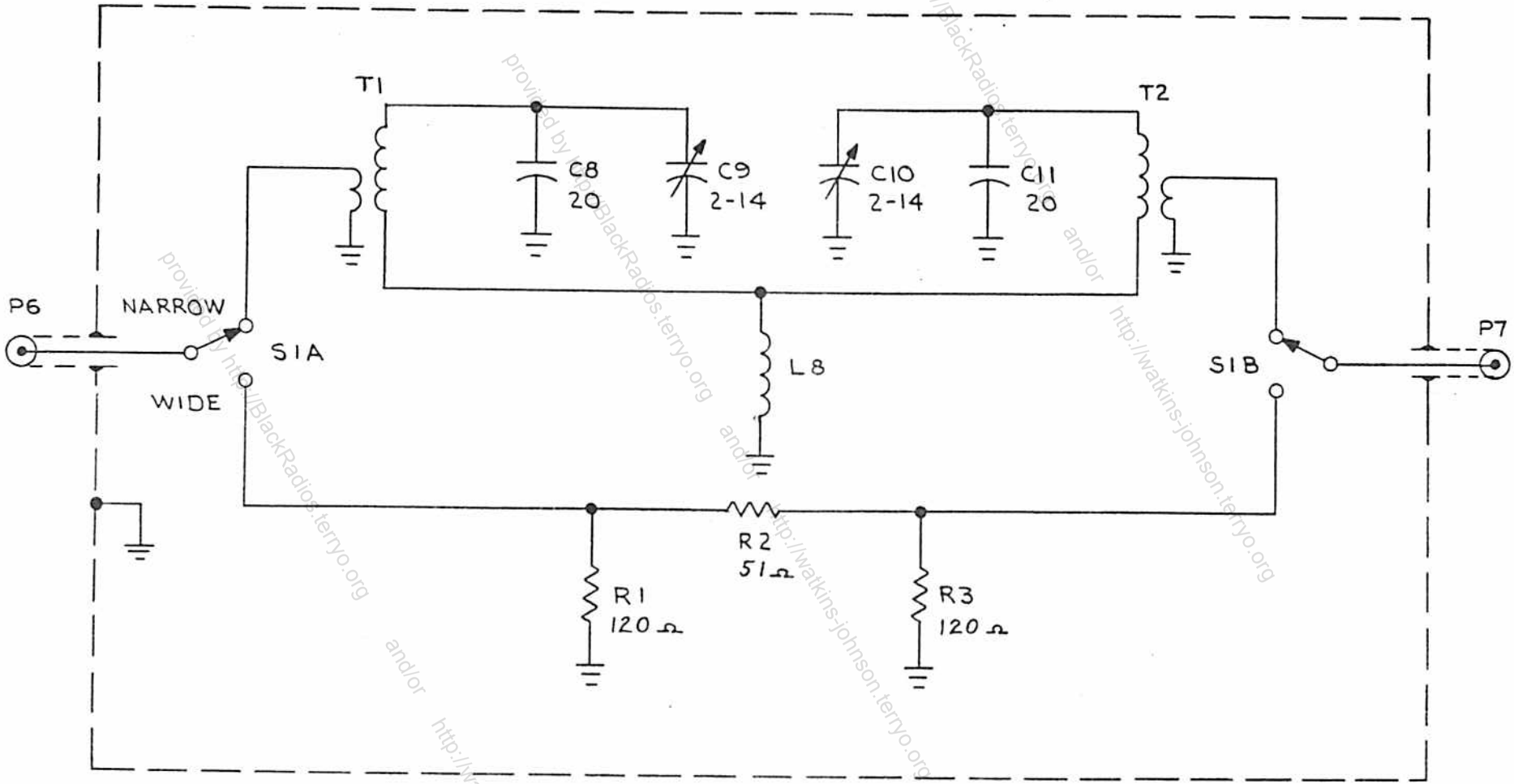
SCHEMATIC DIAGRAM – FIRST LOCAL OSCILLATOR
FIGURE 7.4



NOTE:
ADD 800 TO ALL REFERENCE NUMBERS OF COMPONENTS.

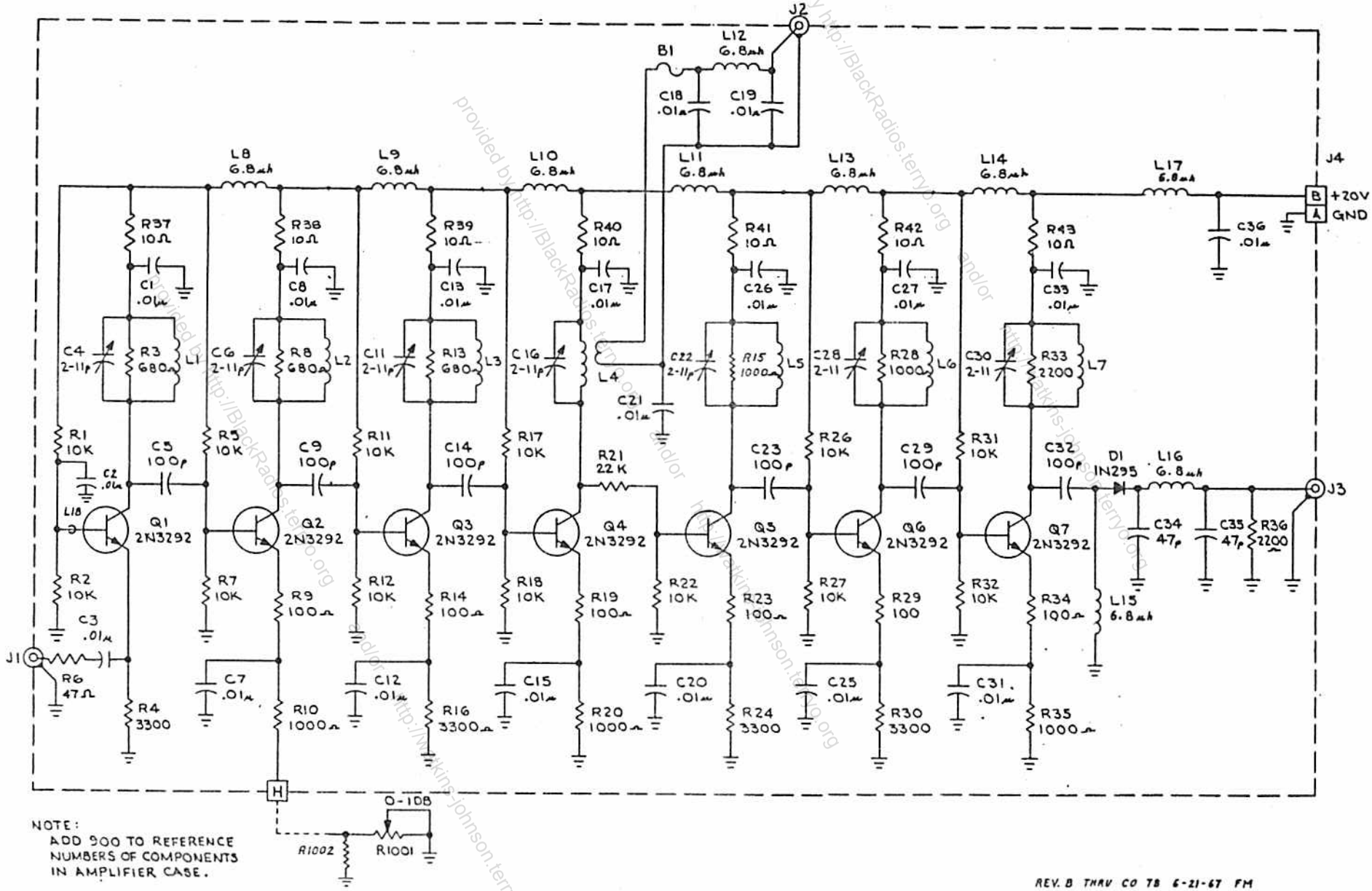
REV. B THRU CO 78 6-21-67 FM
REV. A THRU CO 32 6-17-66

PREAMPLIFIER / SWEPT OSCILLATOR
FIGURE 7.5



30 MHZ FILTER
FIGURE 7.6

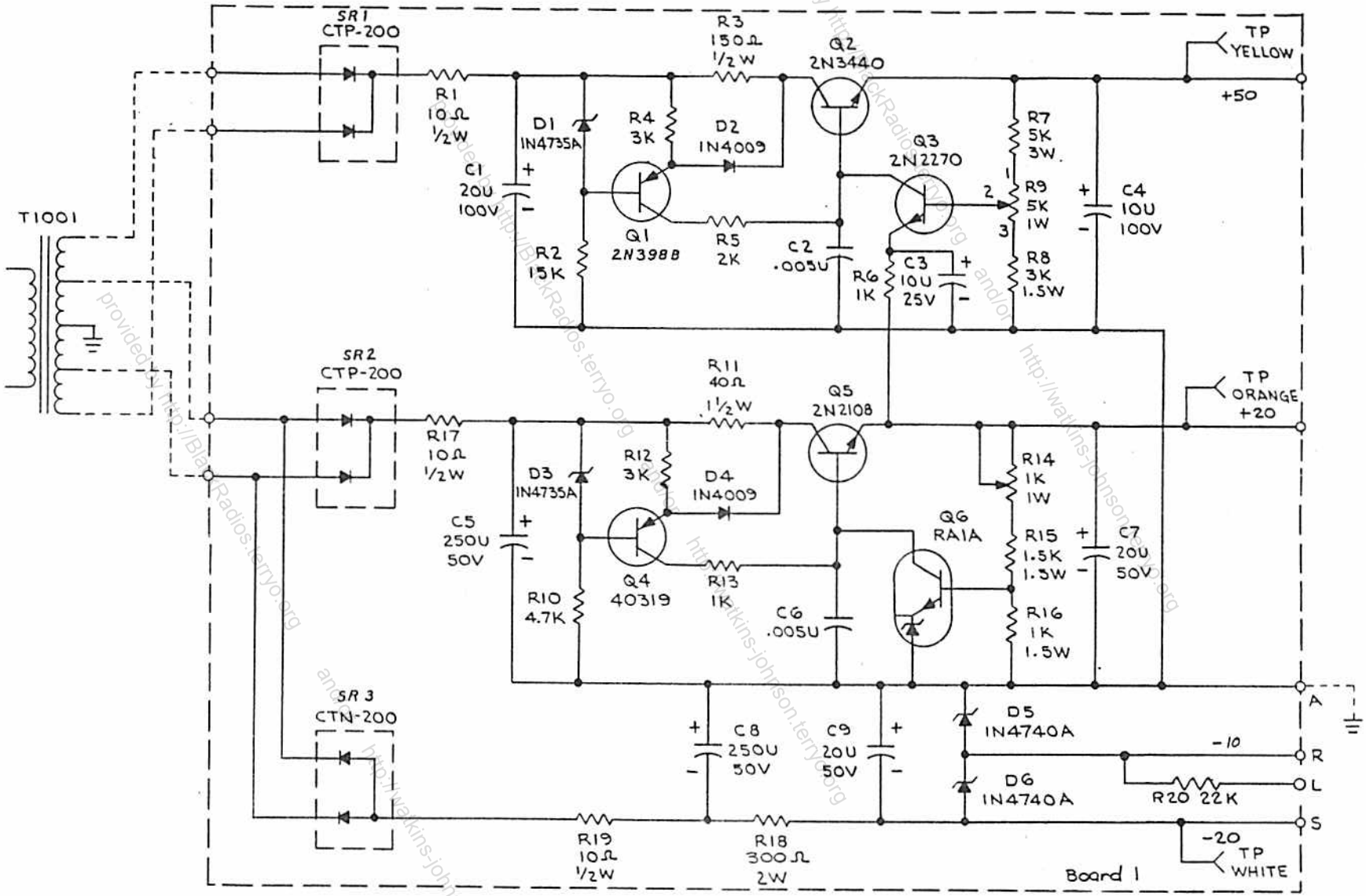
REV B THRU CO 76 6-21-67 FM
REV.A THRU CO 31 6-16-66



NOTE:
ADD 900 TO REFERENCE NUMBERS OF COMPONENTS IN AMPLIFIER CASE.

REV. B THRU CO 78 6-21-67 FM

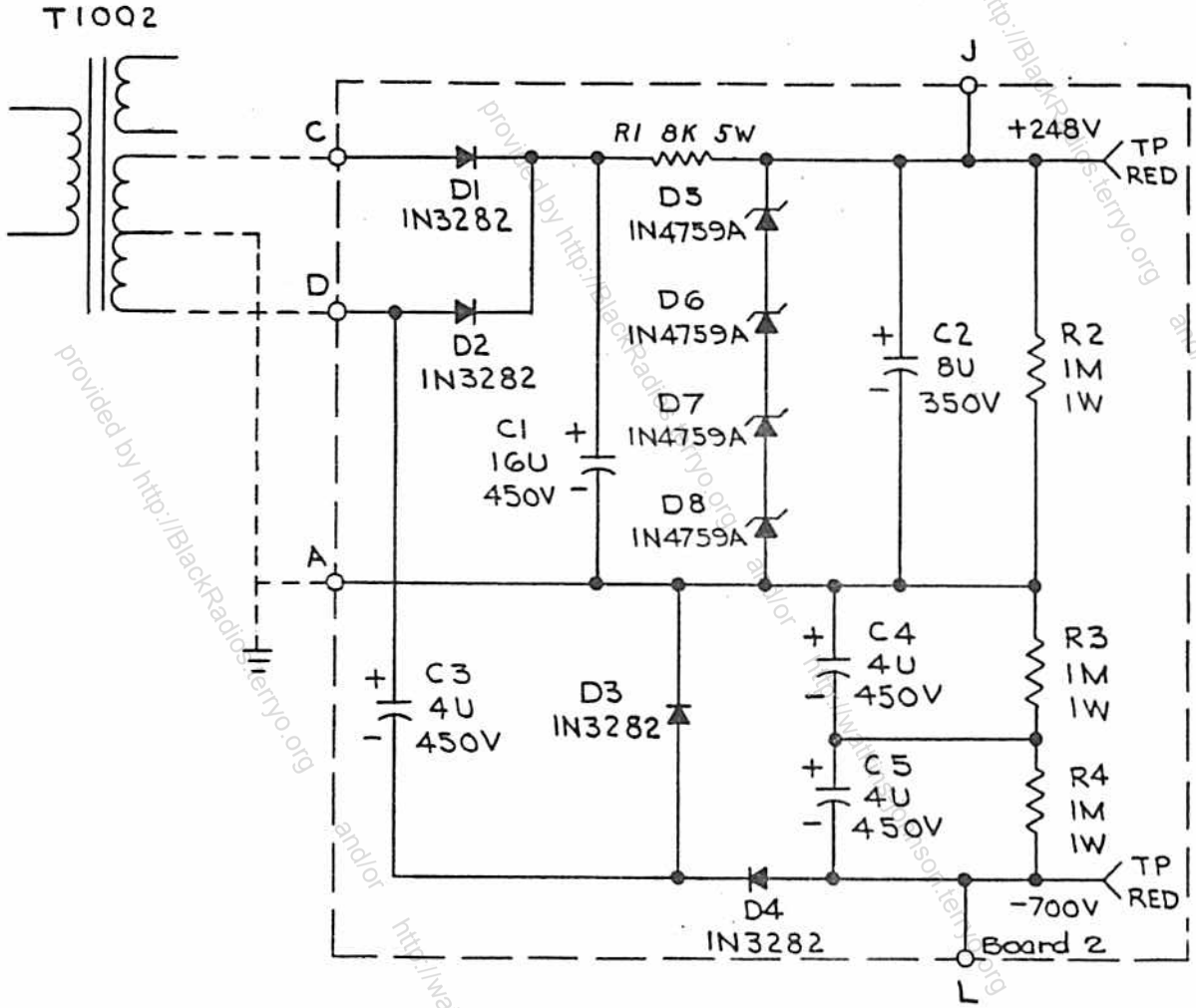
SCHEMATIC DIAGRAM - IF AMPLIFIER
FIGURE 7.7



NOTE:
ADD 100 TO REFERENCE NUMBERS OF COMPONENTS ON BOARD.

LOW VOLTAGE POWER SUPPLY
FIGURE 7.8

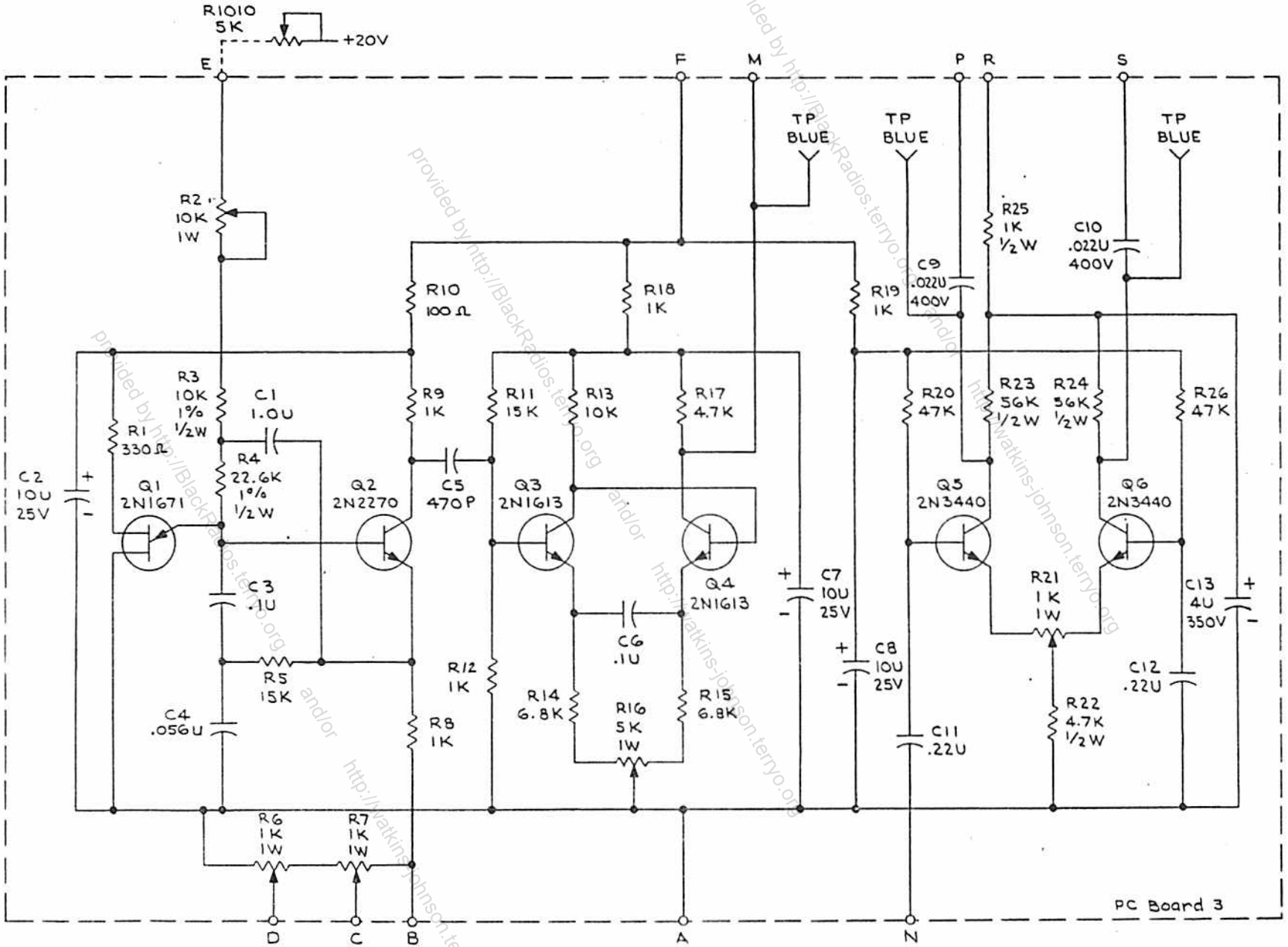
REV. B THRU CO 78 6-21-67 FM
REV. A THRU CO 32 6-16-66



NOTE:
ADD 200 TO REFERENCE NUMBERS OF COMPONENTS ON BOARD.

HIGH VOLTAGE POWER SUPPLY
FIGURE 7.9

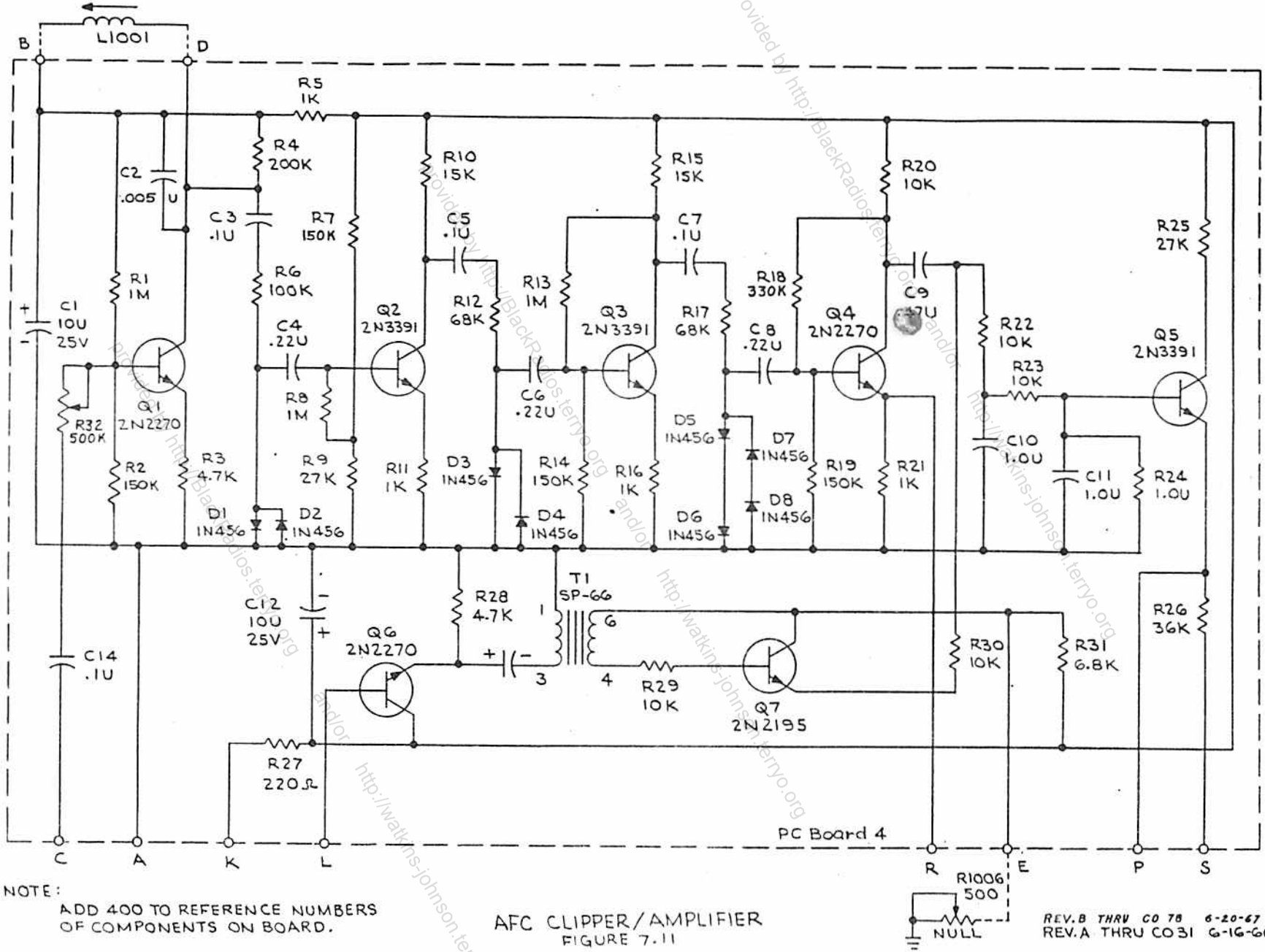
REV. B THRU CO 78 6-21-67 FM
REV. A THRU CO 31 6-16-66



NOTE:
ADD 300 TO REFERENCE NUMBERS OF COMPONENTS ON BOARD.

AFC REFERENCE GENERATOR
AND HORIZONTAL SCOPE AMPLIFIER
FIGURE 7.10

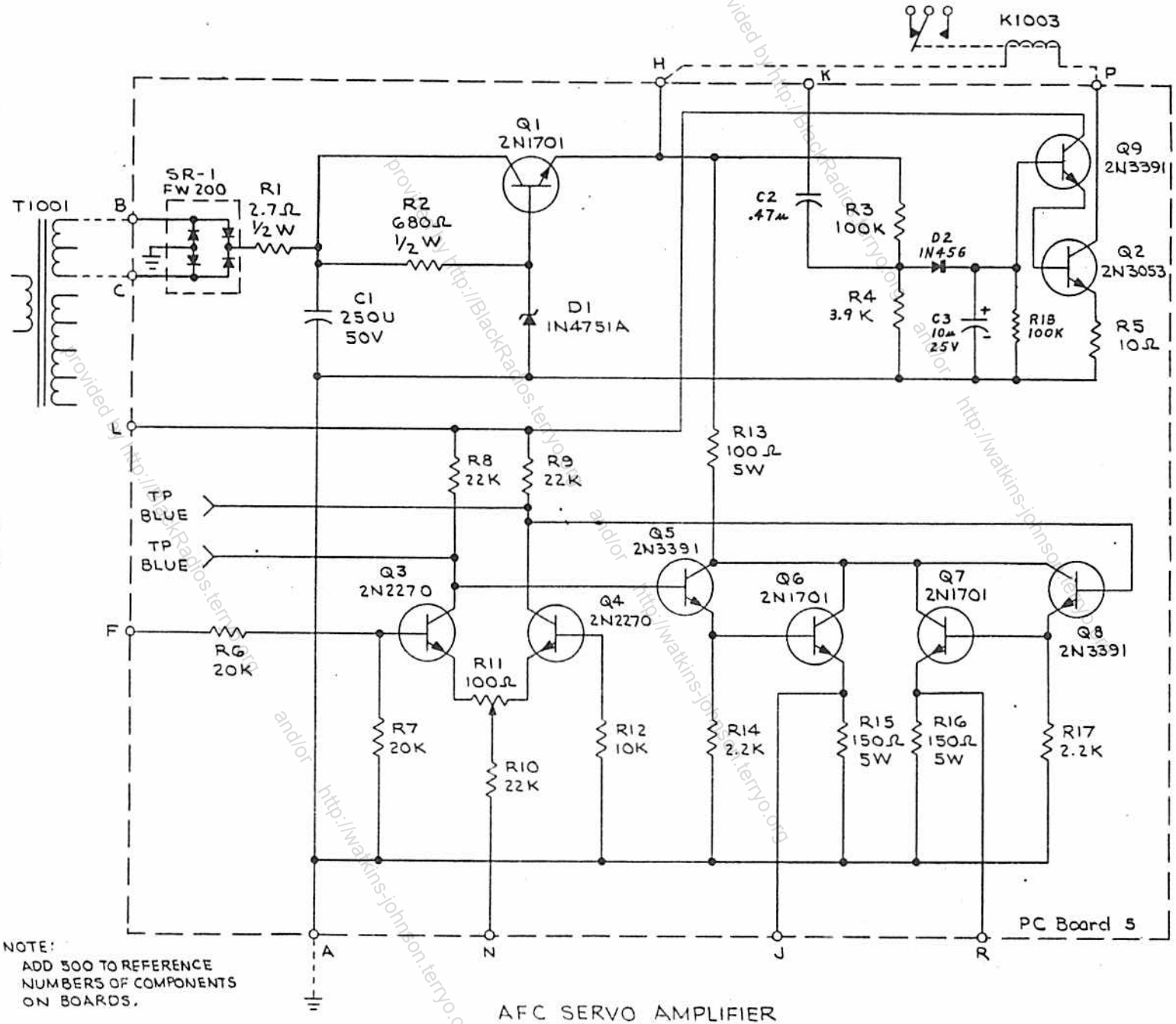
REV. B THRU CO 78 6-27-67 FM
REV. A THRU CO 31 6-16-66



NOTE:
ADD 400 TO REFERENCE NUMBERS OF COMPONENTS ON BOARD.

AFC CLIPPER/AMPLIFIER
FIGURE 7.11

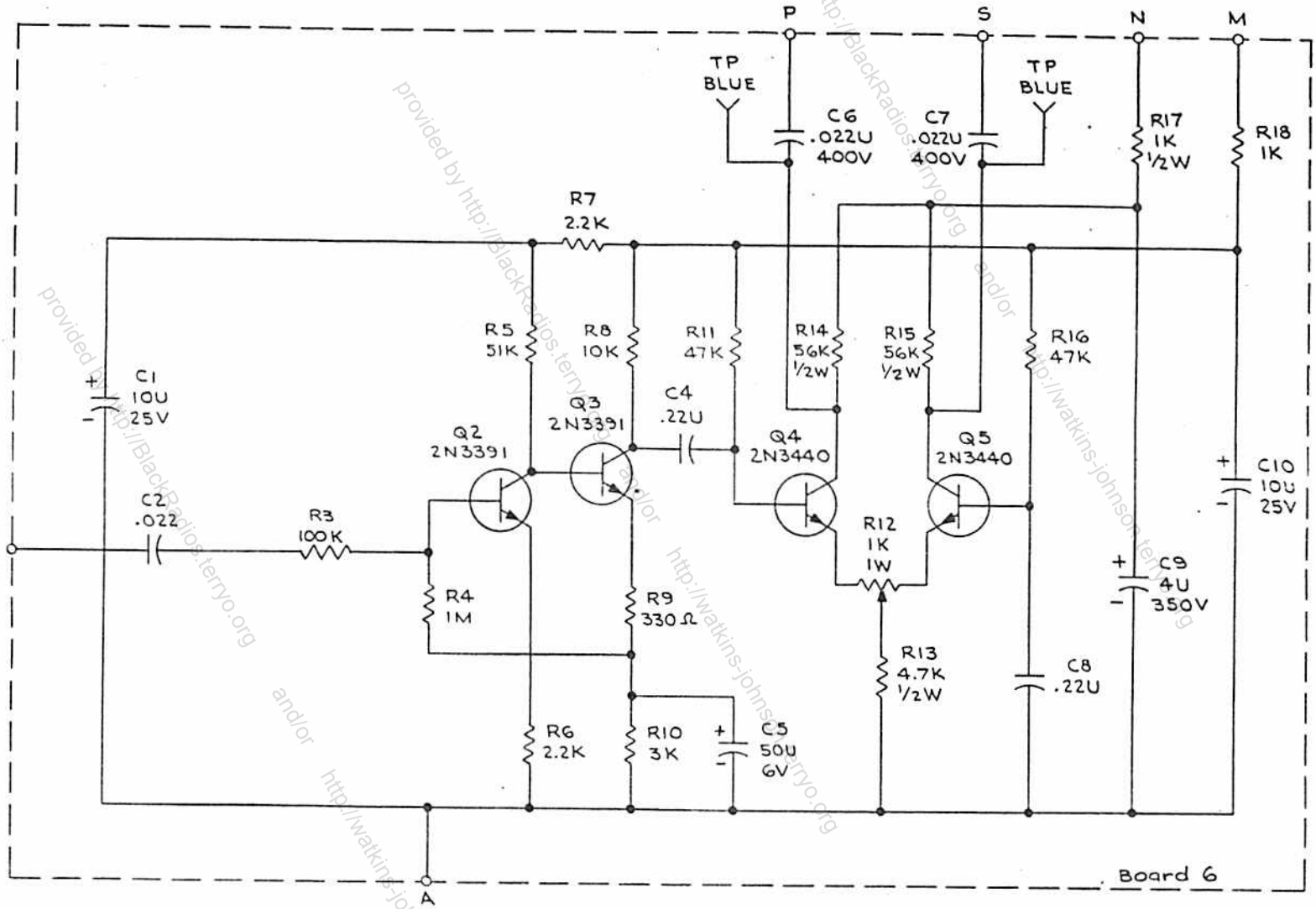
REV.B THRU CO 78 6-20-67 FM
REV.A THRU CO 31 6-16-66



NOTE:
ADD 500 TO REFERENCE NUMBERS OF COMPONENTS ON BOARDS.

AFC SERVO AMPLIFIER AND POWER SUPPLY
FIGURE 7.12

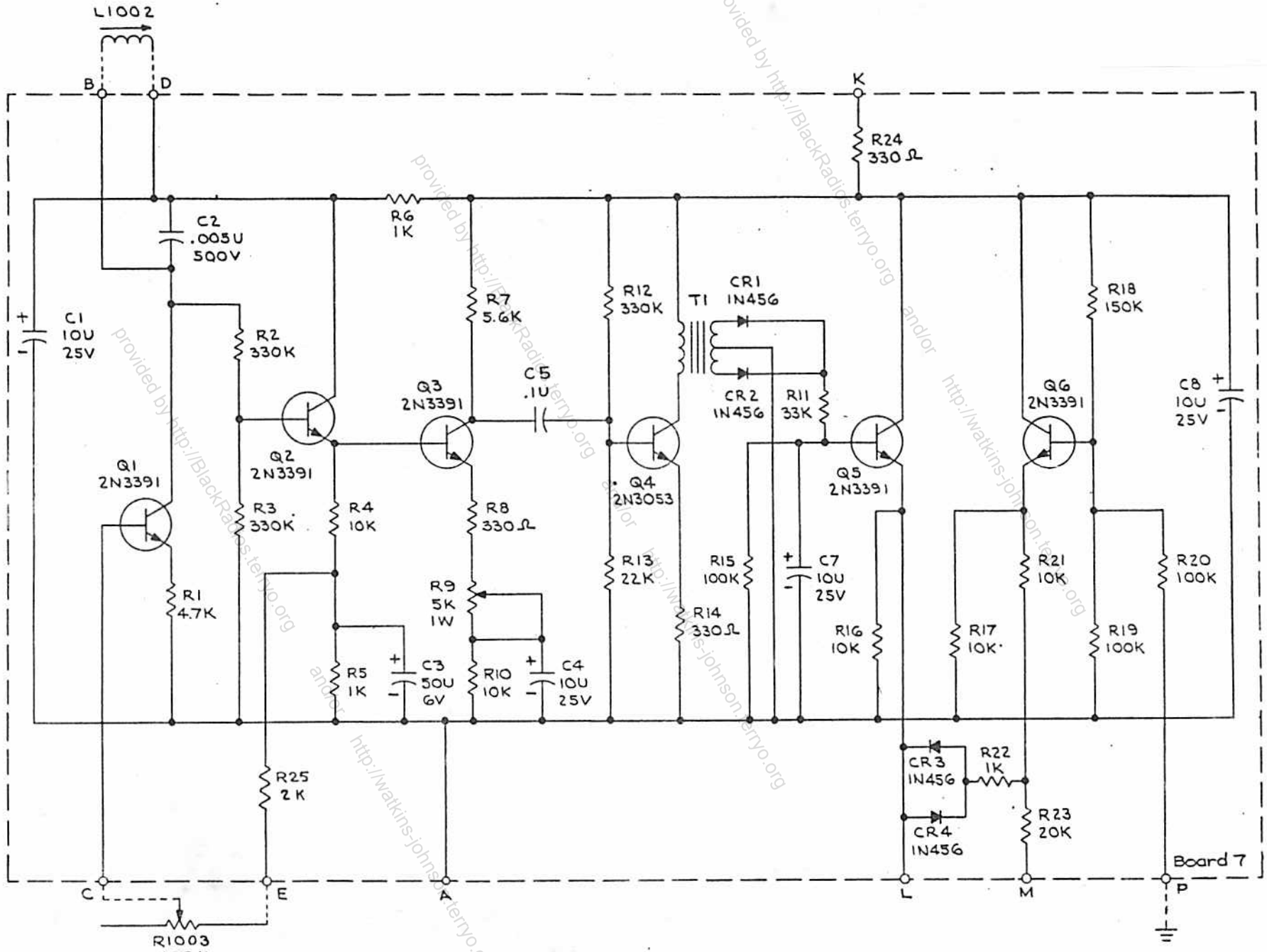
REV. B THRU CO 78 6-27-67 FM
REV. A THRU CO 31 6-16-66



NOTE:
ADD 600 TO ALL REFERENCE NUMBERS OF COMPONENTS ON BOARD.

VERTICAL SCOPE AMPLIFIER
FIGURE 7.13

REV. B THRU CO 78 6-27-67. FM
REV. A. THRU CO 31 6-16-66



NOTE:
ADD 700 TO REFERENCE NUMBERS OF COMPONENTS ON BOARD.

LEVEL AMPLIFIER
FIGURE 7.14

REV. B THRU CO 78 6-27-67 FM
REV. A THRU CO 31 6-16-66