SERVICE MANUAL
for
GENERAL PURPOSE RECEIVER
MODEL GPR-110

THE TECHNICAL MATERIEL CORPORATION

MAMARONECK, N.Y. OTTAWA, ONTARIO

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IN 3011-2 ISSUE DATE: Aug. 1975

THE TECHNICAL MATERIEL CORPORATION

COMMUNICATIONS ENGINEERS

700 FENIMORE ROAD MAMARONECK, N. Y.

Warranty

The Technical Materiel Corporation, hereinafter referred to as TMC, warrants the equipment (except electron tubes,*fuses, lamps, batteries and articles made of glass or other fragile or other expendable materials) purchased hereunder to be free from defect in materials and workmanship under normal use and service, when used for the purposes for which the same is designed, for a period of one year from the date of delivery F.O.B. factory. TMC further warrants that the equipment will perform in a manner equal to or better than published technical specifications as amended by any additions or corrections thereto accompanying the formal equipment offer.

TMC will replace or repair any such defective items, F.O.B. factory, which may fail within the stated warranty period, PROVIDED:

1. That any claim of defect under this warranty is made within sixty (60) days after discovery thereof and that inspection by TMC, if required, indicates the validity of such claim to TMC's satisfaction.
2. That the defect is not the result of damage incurred in shipment from or to the factory.
3. That the equipment has not been altered in any way either as to design or use whether by replacement parts not supplied or approved by TMC, or otherwise.
4. That any equipment or accessories furnished but not manufactured by TMC, or not of TMC design shall be subject only to such adjustments as TMC may obtain from the supplier thereof.

Electron tubes*furnished by TMC, but manufactured by others, bear only the warranty given by such other manufacturers. Electron tube warranty claims should be made directly to the manufacturer of such tubes.

TMC's obligation under this warranty is limited to the repair or replacement of defective parts with the exceptions noted above.

At TMC's option any defective part or equipment which fails within the warranty period shall be returned to TMC's factory for inspection, properly packed with shipping charges prepaid. No parts or equipment shall be returned to TMC, unless a return authorization is issued by TMC.

No warranties, express or implied, other than those specifically set forth herein shall be applicable to any equipment manufactured or furnished by TMC and the foregoing warranty shall constitute the Buyers sole right and remedy. In no event does TMC assume any liability for consequential damages, or for loss, damage or expense directly or indirectly arising from the use of TMC Products, or any inability to use them either separately or in combination with other equipment or materials or from any other cause.

*Electron tubes also include semi-conductor devices.

PROCEDURE FOR RETURN OF MATERIAL OR EQUIPMENT

Should it be necessary to return equipment or material for repair or replacement, whether within warranty or otherwise, a return authorization must be obtained from TMC prior to shipment. The request for return authorization should include the following information:

1. Model Number of Equipment.
2. Serial Number of Equipment.
3. TMC Part Number.
4. Nature of defect or cause of failure.
5. The contract or purchase order under which equipment was delivered.

PROCEDURE FOR ORDERING REPLACEMENT PARTS

When ordering replacement parts, the following information must be included in the order as applicable:

1. Quantity Required.
2. TMC Part Number.
3. Equipment in which used by TMC or Military Model Number.
4. Brief Description of the Item.
5. The *Crystal Frequency* if the order includes crystals.

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TMC's Warranty specifically excludes damage incurred in shipment to or from the factory. In the event equipment is received in damaged condition, the carrier should be notified immediately. Claims for such damage should be filed with the carrier involved and not with TMC.

All correspondence pertaining to Warranty Claims, return, repair, or replacement and all material or equipment returned for repair or replacement, within Warranty or otherwise, should be addressed as follows:

THE TECHNICAL MATERIEL CORPORATION
Engineering Services Department
700 Fenimore Road
Mamaroneck, New York

RECORD OF CORRECTIONS MADE

Change No.	Date of Change	Date Entered	Entered By

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SECTION 4

PRINCIPLES OF OPERATION

4-1. GENERAL.

4-2. This section details the principles of operation of General Purpose Receiver GPR-110 as an independently operated communications receiver. The principles of operation of the GPR-110 are presented on three levels. The first level is an overall block diagram discussion where the function of a group of circuits (generally a circuit board) is described, with the emphasis on an overall understanding of the operation of the receiver. The second level is a detailed block diagram discussion, where each circuit board is described on a block diagram level. The third level is a circuit analysis of each circuit board which traces the signal flow through each board.

4-3. The GPR-110 capabilities can be expanded through the addition of certain accessory units. This section does not include the principles of operation of the accessory units; a full description of the accessory units is covered in the applicable system operating manuals.

4-4. BLOCK DIAGRAM DISCUSSION.

4-5. The receiver consists of two basic sections; the signal flow section and the digital logic and control section. The signal flow section contains the r-f, i-f, and audio circuits and the digital logic and control section contains the digital circuits which establish and maintain the receiver at the selected frequency.

4-6. The signal flow section includes the circuits shown in figure 4-1 and the digital logic and control section includes the circuits shown in figure 4-2. Some circuit boards function in both the signal flow and digital logic and control circuits; these circuit boards are shown on both figures to clarify the functioning of each section.

4-7. The signal present at the antenna is routed through J104 to preselector Z120. The preselector contains relays and a bandpass filter. The filter rejects the broadcast frequencies from approximately 500 to 1600 kHz and is inserted by the relays at all frequencies except the broadcast band. The preselector also contains a receiver disable relay which disconnects the receiver antenna and audio when an associated transmitter is enabled. The resultant output of the preselector is applied to rf input mixer assembly Z307.

4-8. The rf input mixer assembly is basically a balanced modulator which receives the preselector output signal, and also receives an oscillator signal in the frequency range from 163.5 to 192.5 mHz from Z304. The output frequency of 163.5-192.5 mHz oscillator assembly Z304 is always 163.5 mHz above the receiver MHz frequency and is mixed in rf input mixer assembly Z307. As a result, the output of Z307 is in the range of 162.5 to 163.5 mHz and is applied to differential amplifier Z306. Differential amplifier Z306 is tuned to 163 ± 0.5 mHz and amplifies the signal.

4-9. The resultant output of the differential amplifier is applied to if output mixer assembly Z305. Also applied to Z305 is a 160.5 mHz signal from oscillator assembly Z302. The two signal frequencies are mixed in Z305 to produce a 3-2 mHz output that is applied to a mixer in tunable if assembly Z301.

4-10. Also applied to the mixer in tunable if assembly Z301 is a 3.25-2.25 mHz signal developed by an oscillator in Z301. Both the 1-mHz range between 3-2 mHz and the 1-mHz range between 3.25-2.25 mHz are divided into 10 bands to obtain the optimum selectivity from the varicap controlled elements, and provide tight tracking. The result of the mixing frequencies yields a difference frequency of 250 kHz.

4-11. The 250-kHz signal from the mixer in the tunable if assembly is the result of the third frequency conversion and this signal is applied to USB filter assembly Z115 (and LSB filter assembly Z116 if this optional assembly is included in the receiver). The filters amplify and detect the 250-kHz signal. If the receiver is set to AM, the signal is detected by the AM detector in the USB assembly. The sideband filter assembly has two outputs. One is a 600-ohm balanced output for upper sideband signals to auxiliary equipment such as

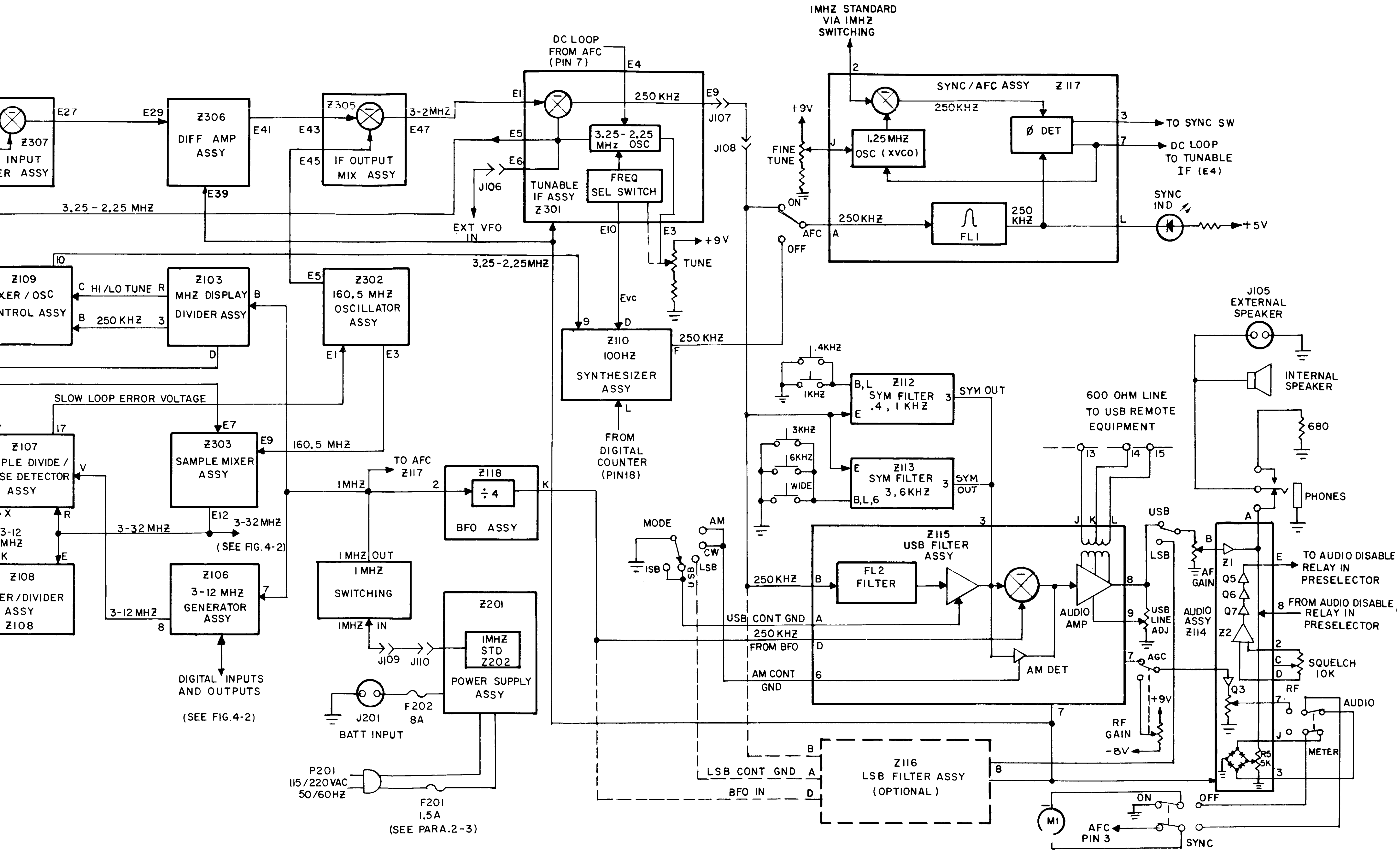

Figure 4-1. Signal Flow Section, Block Diagram

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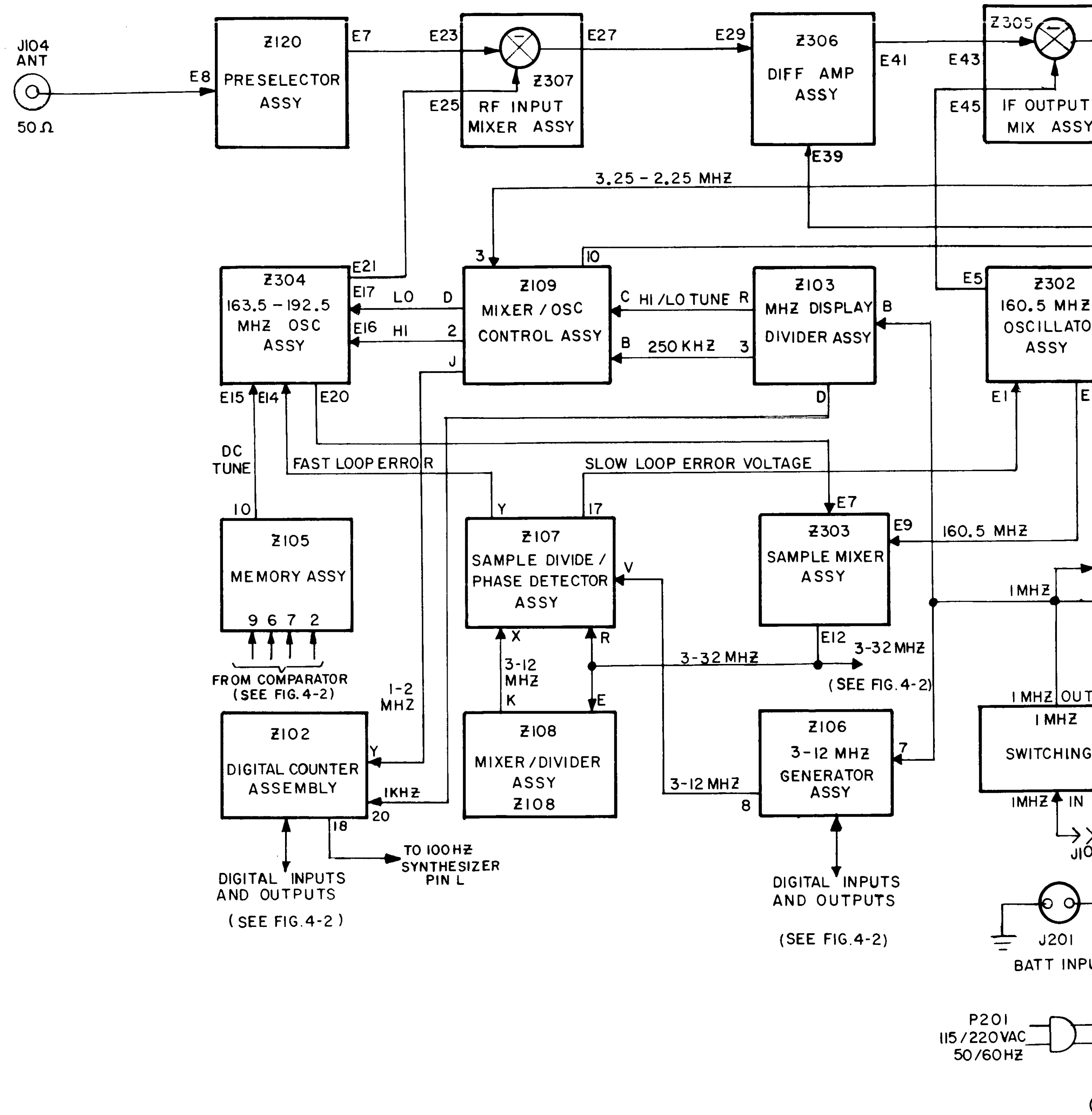

J104
ANT
50 Ω
Z120
PRESELECTOR ASSY
Z307
RF INPUT MIXER ASSY
Z306
DIFF AMP ASSY
Z305
IF OUTPUT MIX ASSY
3.25 - 2.25 MHZ
Z304
163.5 - 192.5 MHZ OSC ASSY
Z109
MIXER / OSC CONTROL ASSY
HI / LO TUNE
250 KHZ
Z103
MHZ DISPLAY DIVIDER ASSY
Z302
160.5 MHZ OSCILLATO ASSY
DC TUNE
FAST LOOP ERROR
SLOW LOOP ERROR VOLTAGE
Z105
MEMORY ASSY
FROM COMPARATOR (SEE FIG. 4-2)
Z107
SAMPLE DIVIDE / PHASE DETECTOR ASSY
Z303
SAMPLE MIXER ASSY
160.5 MHZ
1 MHZ
3-32 MHZ
(SEE FIG. 4-2)
3-12 MHZ
Z102
DIGITAL COUNTER ASSEMBLY
1-2 MHZ
1 KHZ
TO 100 HZ SYNTHESIZER PIN L
DIGITAL INPUTS AND OUTPUTS (SEE FIG. 4-2)
Z108
MIXER / DIVIDER ASSY Z108
Z106
3-12 MHZ GENERATOR ASSY
DIGITAL INPUTS AND OUTPUTS (SEE FIG. 4-2)
1 MHZ OUT
1 MHZ SWITCHING
1 MHZ IN
J201
BATT INPU
P201
115/220 VAC 50/60 HZ

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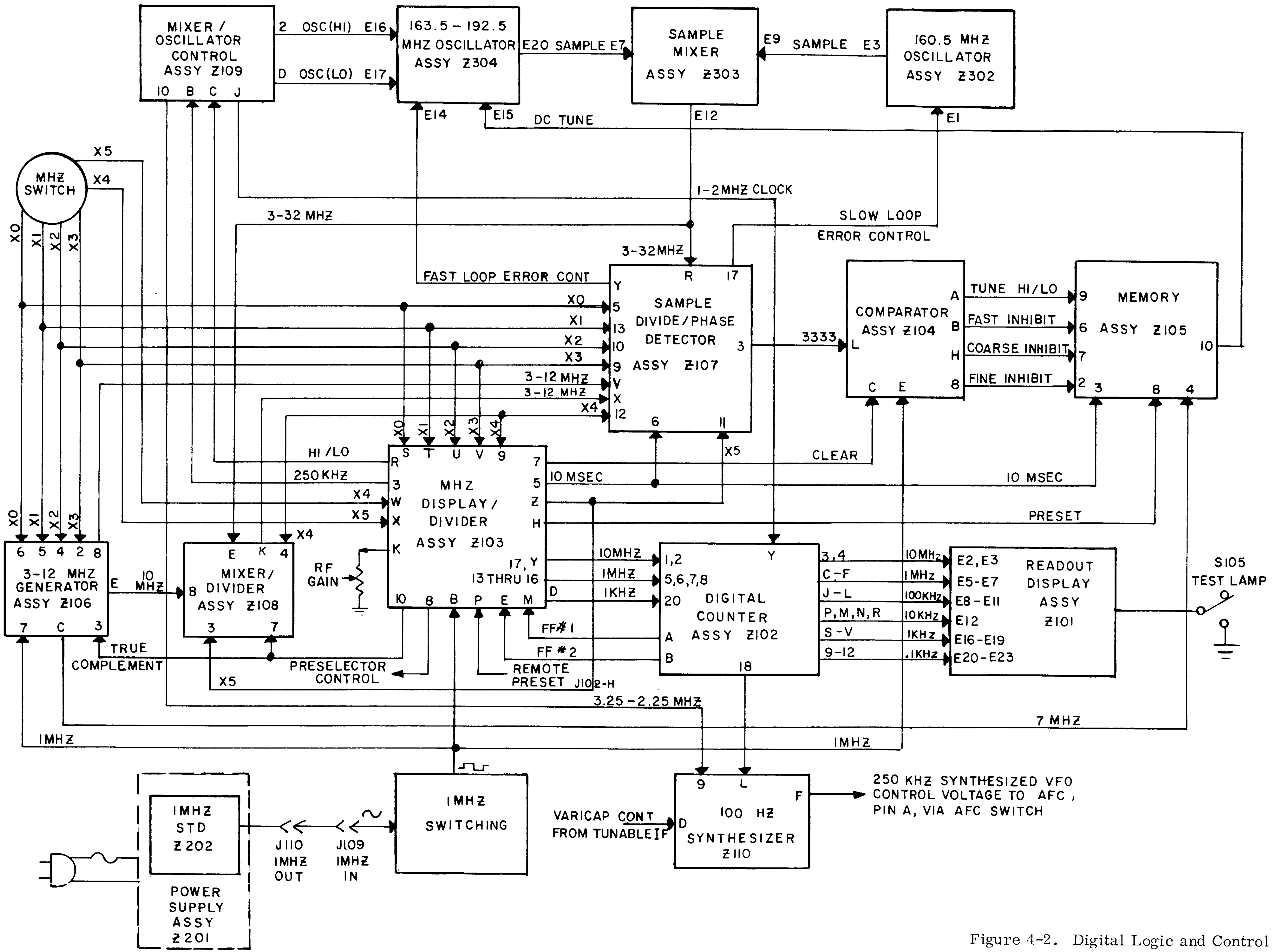

Figure 4-2. Digital Logic and Control Section, Block Diagram

a teletype converter input. The second output is an amplified audio signal which is routed to the AF GAIN control, the USB or LSB line adjustment potentiometer, and the METER USB/LSB pushbutton switch. The signal level derived from the AF GAIN control is applied to audio assembly Z114. The audio assembly amplifies the audio before it is routed to the internal speaker and external speaker jack, the PHONES jack on the front panel, meter adjustment circuitry, audio squelch circuitry tying into an audio disable relay located in the preselector assembly, and a d-c bridge receifier circuit for the front panel meter.

4-12. The preceding signal flow section discussion is fairly straight forward and is a basic triple conversion receiver, with the added feature of a high i-f frequency for good image rejection. The uniqueness of the GPR-110 lies in the digital and control section and the afc circuitry.

4-13. The sync/afc assembly Z117 contains an XVCO tuned to 1.25 mHz whose output is mixed with the 1-mHz standard signal. The resultant 250-kHz signal is applied to a phase detector. Also applied to the phase detector is the 250-kHz output signal from tunable if assembly Z301 via the AFC position of the front panel AFC/SYNTH switch and 50-Hz filter FL1 in sync/afc assembly Z117. The FINE TUNE control is used to adjust the XVCO for the plus and minus 50 Hz of filter FL1. The sync indicator senses the output of FL1; when the frequency is set up within the bandpass of the filter, the sync indicator lights indicating that the signal is through within 50 Hz. Therefore, the sync indicator acts as a carrier indicator in this situation. The phase detector compares the 250-kHz signal output from the XVCO mixer with the 250-kHz output signal of the filter. Any difference in frequency results in a d-c output voltage from the phase detector which is applied to the 3.25-2.25 mHz oscillator in tunable if assembly Z301 and corrects the oscillator output in such a manner as to bring the 250-kHz output signal of the tunable if assembly closer to 250 kHz. A second d-c output of the phase detector is applied to the sync switch which is in a metering circuit. When in sync position, it permits visually monitoring the fine tuning as the FINE TUNE control is varied. When the meter is zeroed, the sync indicator remains lighted on both sides of the bandwidth. This enables tuning while the meter monitors the r-f or audio levels.

4-14. Establishing and maintaining the selected frequency is a function of the digital logic and control section which operates through memory assembly Z105 to apply a 0 to 40 volt d-c tune signal to 163.5-192.5 mHz oscillator Z304. The level of the d-c tune signal voltage determines the frequency output of the oscillator, thereby maintaining the receiver at the selected frequency. In turn, the memory assembly receives various inputs from comparator assembly Z104 which receives tune information via sample divide/phase detector assembly Z107. A number of closed loops are established that set and maintain the selected frequency.

4-15. Sample divide/phase detector assembly Z107 receives a signal in the range of 3-32 mHz from sample mixer assembly Z303. The 3-32 mHz frequency is the result of mixing the 163.5-192.5 mHz oscillator output with the 160.5 mHz oscillator signal. The sample divide circuitry of Z107 utilizes this signal frequency as one input to programmable divider circuits. The divide factor for each programmable divider circuit is controlled by the binary coded signals resulting from the setting of the front panel MHZ switch, indicating the desired operating frequency of the receiver. The sample divide circuitry of Z107 forms a closed loop with comparator assembly Z104, memory assembly Z105, 163.5-192.5 mHz oscillator assembly Z304, and sample mixer assembly Z303.

4-16. The sample divide circuit divides the 3-32 mHz input from the sample mixer by the dividing factor determined by the MHZ switch setting, and is seeking an output of 3333 (3333 pulses in a 10-millisecond gating period). The difference from the desired 3333 output of the sample divide circuit indicates to the comparator assembly the direction and amount of voltage change required of the memory assembly. The d-c tune output of the memory assembly then changes accordingly and varies the frequency of the 163.5-192.5 mHz oscillator output. A sample of the oscillator output is then applied to the sample mixer assembly, resulting in a 3-32 mHz frequency output that is applied back to the sample divide circuit. The process continues until the output of the sample divide circuit is 3333, at which point the frequency is in locking range of the phase detector.

4-17. SIGNAL FLOW CIRCUITS, BLOCK DIAGRAM DISCUSSION.

4-18. PRESELECTOR ASSEMBLY Z120.

4-19. Preselector assembly Z120 receives the antenna signal and controls the insertion of a 500 to 1600 kHz filter in the signal path. Signal routing through the preselector assembly is controlled by relays K1 and K2. In the normally deenergized state, the relays route the antenna signal through the filter and out of the assembly to rf input mixer assembly Z307. When the receiver is operated in the a-m mode of the broadcast band frequency range, relay K2 is energized by a control signal from the front panel MHz switch via mHz display/divider assembly Z103. With K2 energized, the filter is bypassed and the antenna signal is effectively routed through the two relays to Z307. When operated in other than the broadcast band, the relays are deenergized and the filter is inserted in the signal path. Relay K1 is energized by a receiver disable signal when an associated transmitter antenna is used in conjunction with the GPR-110. When energized, K1 grounds the input signal and removes the positive potential from the audio preamplifier.

4-20. 163.5-192.5 MHZ OSCILLATOR ASSEMBLY Z304.

4-21. The 163.5-192.5 mHz oscillator assembly Z304 develops the first mixing frequency which is approximately 163.5 mHz above the receiver MHz frequency. The oscillator output is mixed with the antenna signal output of the preselector assembly to produce the first i-f conversion. The initial frequency output of Z304 is established by a d-c tune signal voltage from memory assembly Z105 and places the oscillator output frequency at approximately the required output. A sample of the oscillator frequency is applied to sample mixer assembly Z303 where it is mixed with the 160.5 mHz output of Z302 to yield a 3-32 mHz output frequency that is applied to sample divide/phase detector assembly Z107. The sample divide/phase detector assembly then produces a fast loop error control signal voltage that corrects and/or maintains the required output frequency of Z304.

4-22. The 163.5-192.5 mHz oscillator assembly Z304 contains two oscillator circuits; one operates in the lower half of the required frequency range of 163.5-175.5 mHz and the second operates in the upper half of the required frequency range of 176.5-192.5 mHz. Oscillator selection is controlled by a low and high signal from mixer/oscillator control assembly Z109 which activates the required oscillator from the information received from the front panel MHZ switch setting via MHz display divider Z103.

4-23. RF INPUT MIXER ASSEMBLY Z307.

4-24. Rf input mixer assembly Z307 receives the preselector output signal, and also receives the oscillator frequency from the 163.5-192.5 mHz oscillator assembly, and mixes the two signals. The resultant difference signals are applied to difference amplifier assembly Z306. The mixing element is a double balanced diode mixer circuit Z1 on the rf input mixer assembly Z307.

4-25. DIFFERENCE AMPLIFIER ASSEMBLY Z306.

4-26. Difference amplifier assembly Z306 receives the difference output signals from rf input mixer assembly Z307, and selects the difference frequency. The difference amplifier assembly contains a three-stage amplifier which is tuned to 163 mHz and has a bandwidth of 0.5 mHz. The resultant amplified 163 ± 0.5 mHz output signal is applied to if output mixer assembly Z305.

4-27. IF OUTPUT MIXER ASSEMBLY Z305.

4-28. If output mixer assembly Z305 receives the 163 ± 0.5 mHz output signal from difference amplifier assembly Z306, mixes the signal with a 160.5 mHz signal from oscillator Z302, and develops a resultant 3-2 mHz signal that is applied to tunable if assembly Z301. The 3-2 mHz i-f signal is the result of the second frequency conversion in the receiver. The exact output frequency in the 1-mHz range from 3-2 mHz is determined by the operating frequency of the receiver. For example, with an incoming signal of 100 kHz, the carrier frequency of the i-f output is 2.900 mHz, with plus and minus 3-kHz sidebands. The mixing element is a double balanced mixer circuit Z1 on the if output mixer assembly Z305.

4-29. 160.5 MHZ OSCILLATOR ASSEMBLY Z302.

4-30. The 160.5 mHz oscillator assembly Z302 develops a 160.5 mHz output that is applied to if output mixer assembly Z305 where it is mixed with the if signal from difference amplifier Z306 to produce a second if conversion frequency.

4-31. TUNABLE IF ASSEMBLY Z301.

4-32. Tunable if assembly Z301 receives the 3-2 mHz signal from if output mixer assembly Z305 and mixes the signal with an internally generated 3.25-2.25 mHz signal to develop the third frequency conversion yielding 250 kHz. The exact frequency output of the internally generated 3.25-2.25 mHz signal is a function of the receiver frequency setting and is configured in such a manner that, when mixed with the incoming 3-2 mHz signal, produces a 250-kHz output signal. The 3.25-2.25 mHz oscillator is voltage controlled and receives a d-c loop signal from sync/afc assembly Z117 that corrects and/or maintains the output of the tunable if assembly at 250 kHz. The 250-kHz output signal is applied to the symmetrical filters Z112, Z113, USB filter assembly Z115, and (optional) LSB filter assembly Z116. The 250-kHz output signal is also applied to sync/afc assembly Z117 via the AFC position of the front panel AFC/SYNTH switch.

4-33. MIXER/OSCILLATOR CONTROL ASSEMBLY Z109.

4-34. Mixer/oscillator control assembly Z109 develops the high and low oscillator voltage control for the 163.5-192.5 mHz oscillator assembly Z304 in response to information received from mHz sidplay divider assembly Z103 to activate the required high or low frequency oscillator assembly in Z304. The mixer/oscillator control assembly also mixes the 3.25-2.25 mHz signal from tunable if assembly Z301 with a 4.25 mHz signal derived from the 17th harmonic of the 250 kHz signal input from display divider assembly Z103. The resultant 1-2 mHz output signal is applied to digital counter assembly Z102 where it is counted and read out as the exact operating frequency of the receiver.

4-35. SYNC/AFC ASSEMBLY Z117.

4-36. Sync/afc assembly Z117 develops a d-c voltage that is used to correct the frequency of the 3.25-2.25 mHz oscillator in the tunable if assembly. A 250-kHz i-f signal is received from the tunable if assembly when the front panel AFC/SYNTH switch is set to the AFC position, and from the 100 Hz synthesizer when the AFC/SYNTH switch is set to SYNTH. The signal passes through a 250-kHz filter with a bandpass characteristic of 50 Hz and is applied to one input of a phase detector circuit. The second input to the phase detector circuit is a 250-kHz signal developed within the sync/afc assembly by mixing a 1-mHz signal from the 1-mHz standard with a 1.25 mHz signal from a crystal controlled oscillator (XVCO) in the assembly. When the phase detector circuit generates a difference voltage, the XVCO oscillator receives a d-c correction voltage, and a d-c error correction voltage is also routed back to the oscillator in the tunable if assembly to correct the 3.25-2.25 mHz oscillator output in such a manner as to result in a 250-kHz output from the tunable if assembly. The frequency of the XVCO oscillator can be shifted slightly by adjusting the front panel fine TUNE control. When a 250-kHz signal from either the 100 Hz synthesizer or the tunable if assembly passes through the bandpass filter in the sync/afc assembly, the SYNC indicator on the front panel lights to indicate that the receiver is tuned within 100 Hz of the incoming signal (in sync).

4-37. 100 HZ SYNTHESIZER ASSEMBLY Z110.

4-38. The 100 Hz synthesizer assembly Z110 provides a 250-kHz signal to the sync/afc assembly when the front panel AFC/SYNTH switch is set to SYNTH, thereby applying the internal synthesizer output to the sync/afc assembly. The 250-kHz signal is derived by mixing the 3.25-2.25 mHz signal from tunable if assembly Z301 (via mixer/oscillator control assembly Z109), with a 2-3 mHz signal derived from a harmonic of the 100-Hz input from digital counter assembly Z102. The resultant 250-kHz output is directly related to the 3.25-2.25 mHz oscillator output and provides a phase detector lock every 100 Hz. In turn, the phase detector in the sync/afc assembly develops a d-c voltage that is applied to the 3.25-2.25 mHz oscillator in the tunable if assembly. Therefore, if the oscillator frequency has an inaccuracy of 100 Hz, the phase detector d-c voltage derived from the 100-Hz synthesizer output signal locks it at that frequency. For frequencies between 100 Hz increments, the front panel FINE TUNE control varies the 1.25 mHz XVCO oscillator in the sync/afc assembly to offset the 1.25 mHz frequency to lock both signals at a 100-Hz incremental lock.

4-39. SAMPLE MIXER ASSEMBLY Z303.

4-40. Sample mixer assembly Z303 receives a sample signal from the 163.5-192.5 and 160.5 mHz oscillators and mixes them to generate an output frequency in the range of 3-32 mHz. Because the frequency of the 163.5-192.5-Hz oscillator varies with the receiver operating frequency, the precise 3-32 mHz output frequency is proportional to the operating frequency. The 3-32 mHz output frequency is applied to the sample divide/phase detector assembly Z107, the mixer/divider assembly Z108, and to the digital logic and control circuits.

4-41. SAMPLE DIVIDE/PHASE DETECTOR ASSEMBLY Z107.

4-42. The sample divide/phase detector assembly Z107 contains a sample divide circuit that functions in the digital logic and control section and a phase detector circuit that functions in the signal flow section. The functional operation of the sample divide circuit of this assembly is described in the functional description of the digital logic circuits. The phase detector circuit of this assembly generates d-c correction voltages for the 163.5-192.5 mHz oscillator assembly and the 160.5 mHz oscillator assembly. A 3-12 mHz signal is received from both the 3-12 mHz generator assembly Z106 and the mixer/divider assembly Z108. Each signal is amplified separately and applied to one of the inputs of a phase detector transformer. The resultant output voltage is the fast loop error signal which is applied to the 163.5-192.5 mHz oscillator assembly. The same output voltage is applied through a delay circuit which reduces the response time, and froms the slow loop error signal which is applied to the 160.5 mHz oscillator assembly.

4-43. MIXER/DIVIDER ASSEMBLY Z108.

4-44. The mixer/divider assembly Z108 receives a 10-mHz input from the 3-12 mHz generator assembly, divides and multiplies the frequency in accordance with binary coded commands received from the mHz display/divider assembly Z103, and mixes the resultant with a 13-32 mHz signal from the sample mixer assembly Z303. The resultant frequency is a signal in the 3-12 mHz range, and is applied to the sample divide/phase detector assembly where it is compared against a 3-12 mHz signal from 3-12 mHz generator assembly Z106 to develop the fast and slow loop error control voltages.

4-45. 1 MHZ STANDARD Z202.

4-46. The 1 mHz standard assembly Z202 provides an extremely stable 1-mHz signal to the 3-12 mHz generator assembly Z106, mHz display/divider assembly Z103, BFO assembly Z118, and to the assemblies of the digital logic and control circuits.

4-47. BFO ASSEMBLY Z118.

4-48. The BFO assembly Z118 receives a 1-mHz square wave, divides it by four, and applies the resultant 250-kHz signal to the USB assembly Z115, and to the LSB assembly Z116 (if used). In the USB and/or LSB assemblies, the 250-kHz signal is mixed with incoming c-w signals to provide an audible tone. A front panel BFO pushbutton switch enables a fixed 250-kHz beat frequency signal, or connecting a BFO control which varies the tone approximately 1000 Hz on either side of zero.

4-49. SYMMETRICAL FILTER ASSEMBLIES Z112 AND Z113.

4-50. The symmetrical filters provide the signal bandwidth selected from front panel pushbuttons. The symmetrical filters receive the 250-kHz i-f signal from tunable if assembly Z301 when operating in the a-m and c-w mode. The signal is then passed through a narrow band filter which is designed to meet the user's requirement. Symmetrical filter Z112 contains two filter and amplifier circuits with a 0.4 and 1 kHz bandpass, respectively, and Z113 contains two filters and amplifiers, with a 3 and 6 kHz bandpass, respectively, in addition to a wideband amplifier with approximately a 12-kHz bandwidth. The desired bandwidth is selected by a pushbutton switch on the front panel.

4-51. USB FILTER ASSEMBLY Z115.

4-52. During USB or ISB operation, the USB filter assembly Z115 receives a 250-kHz i-f signal from the tunable if assembly Z301 (in a-m or c-w operation, the signal is received through one of the narrow band symmetrical filters), and mixes it with a 250-kHz signal from the BFO assembly (derived from the 1 mHz standard), to produce an audio tone. The resultant audio is amplified in the audio circuit of the USB filter assembly and applied to the rear panel output terminals for the USB 600 ohm distribution line. The audio signal is also applied, via the AF GAIN control, to an audio amplifier circuit in audio assembly Z114 where sufficient audio drive is developed for the internal and external speakers.

4-53. LSB FILTER ASSEMBLY Z116.

4-54. The LSB filter assembly Z116 is similar to USB filter assembly Z116 except for the filter bandpass range. During LSB or ISB operation, the LSB filter assembly receives the 250-kHz signals from the tunable if and BFO assemblies and applies the resultant audio to the rear panel terminals of the LSB 600 ohm line.

4-55. AUDIO ASSEMBLY Z114.

4-56. Audio assembly Z114 receives an audio signal from the output of the sideband filter assembly via the METER USB/LSB switch and the AF GAIN control, amplifies it and applies it to the speaker via the PHONES jack. It applies the same signal, after rectification, to the front panel meter, via the sync switch. (The sync switch is set to off when a relative audio reading is desired.) The audio assembly also contains a squelch circuit, controlled by the SQUELCH control on the front panel, which operates in conjunction with the audio disable relay in the preselector assembly.

4-57. DIGITAL LOGIC AND CONTROL CIRCUITS, BLOCK DIAGRAM DISCUSSION.

4-58. MHZ SWITCH S101.

4-59. The MHZ switch controls the tuning of the receiver. The switch wafers are constructed in such a manner as to generate a group of opens and shorts to ground for each band setting (00, 01, etc.). These opens and shorts are excess three binary codes which represent each frequency setting. A total of six binary levels are generated by the MHZ switch, from X0 to X5. Thus, the X0 signal represents a binary 2^0, the X1 signal represents a binary 2^1, ..., and the X5 signal represents a binary 2^5. A group of signals applied simultaneously to an assembly represents a binary code; for example, with X3 open, X2 ground, X1 ground, and X0 open, the group represents a binary code of 1001, or a 9 digit. The codes are applied to the 3-12 mHz generator assembly Z106, the mHz display/divider assembly Z103, and the sample divide/phase detector assembly Z107.

4-60. 3-12 MHZ GENERATOR ASSEMBLY Z106.

4-61. The 3-12 mHz generator assembly Z106 develops: square-wave outputs in 1-mHz increments from 3 to 12 mHz depending on the setting of the front panel MHZ switch; a 7-mHz square-wave output that is applied to memory assembly Z105; and a 10-mHz square-wave output that is applied to mixer/divider assembly Z108. These signals are generated by utilizing the 1-mHz square-wave input which originated in the 1-mHz standard as a sine wave. The 1-mHz square wave input is applied to each of six oscillators through crystal filters (7, 8, 9, 10, 11, or 12 mHz). The output is passed through a second crystal filter tuned to the same frequency. The output of each oscillator is continuously applied to logic gates in the assembly, which are enabled or inhibited by binary coded signals from the front panel MHZ switch. The appropriate oscillator output is gated by the binary coded signals. The resultant output is applied through the enabled logic gates to a programmable divider, which is also controlled by the binary coded signals from the MHZ switch, or directly to the output of the assembly in the case of the 7 through 12 mHz outputs.

4-62. MIXER/DIVIDER ASSEMBLY Z108.

4-63. Mixer/divider assembly Z108 receives a 3-32 mHz signal from the sample mixer assembly Z303 which is the result of mixing the 163.5-192.5 mHz signal with the 160.5 mHz signal. A second input to Z108 is a 10-mHz signal from the 3-12 mHz generator assembly Z106. The 3-12 mHz signals are amplified and passed through the filter. The 10-mHz signal is divided by two and then multiplied by five to obtain 25 mHz which is mixed with 13-22 mHz for a resultant of 12-3 mHz. The frequency from 23-32 mHz is mixed against 35 mHz to obtain 12-3 mHz again. Thus:

Input (MHz)	Mixer (MHz)	Output (MHz)
3-12	None	12-3
13-22	25	12-3
23-32	35	12-3

The resultant 3-12 mHz output is applied to sample divider/phase detector assembly Z107.

4-64. MHZ DISPLAY/DIVIDER ASSEMBLY Z103.

4-65. The mHz display/divider assembly Z103 receives: a 1-mHz signal; a binary coded signal X0 through X5 from the MHZ switch; and two inputs from the flip-flops in the digital counter assembly. The binary coded signals from the MHZ switch program the programmable dividers in the assembly, and generate a 250-kHz signal and a HI/LO signal for the mixer/oscillator control assembly Z109, a 10-millisecond gating pulse for the sample divide/phase detector assembly Z107 and memory assembly Z105, a true complement signal for the mixer/divider and 3-12 mHz generator assemblies, a control signal for the preselector assembly relay, which disables the high pass filter during a-m operation, a preset signal for the memory assembly, and 1-mHz and 10-mHz digital logic outputs for the digital counter assemblies. An input is also provided to receive preset pulses from a remote control installation, and an output of -8 volts dc is provided to the RF GAIN control for distribution to the agc line of the receiver.

4-66. MIXER/OSCILLATOR CONTROL ASSEMBLY Z109.

4-67. The digital portion of the assembly receives a HI and LO tuning signal from the mHz display/divider assembly, and provides a control voltage for the 163.5-192.5 mHz oscillator assembly. The high and low logic levels activate the required oscillator in the 163.5-192.5 mHz oscillator assembly in response to the setting of the front panel MHZ switch.

4-68. SAMPLE MIXER ASSEMBLY Z303.

4-69. Sample mixer assembly Z303 develops the 3-32 mHz variable frequency which is derived by mixing the two frequencies sampled from the 163.5-192.5 mHz oscillator assembly Z304 and the 160.5 mHz oscillator assembly Z302. The 3-32 mHz output is applied to sample divide/phase detector assembly Z107 and mixer/divider assembly Z108.

4-70. SAMPLE DIVIDE/PHASE DETECTOR ASSEMBLY Z107.

4-71. Sample divide/phase detector assembly Z107 receives a signal in the range of 3-32 mHz from sample mixer assembly Z303 and utilizes it as one input to programmable divider circuits. The divide factor of each programmable divider circuit is controlled by the binary coded signals resulting from the setting of the front panel MHZ switch, indicating the desired operating frequency of the receiver. The sample divide circuitry of the Z107 assembly forms a closed loop with comparator assembly Z104, memory assembly Z105, 163.5-192.5 mHz oscillator assembly Z304, and sample mixer assembly Z303. The sample divide circuit divides the 3-32 mHz input from the sample mixer by the dividing factor determined by the MHZ switch setting, and is looking for an output of 3333. The difference from the 3333 output of the sample divide circuit indicates to the comparator assembly the direction and amount of voltage change required of the memory assembly. The d-c tune output of the memory assembly then changes accordingly and varies the frequency of the 163.5-192.5 mHz oscillator output. A sample of the oscillator output is then applied to the sample mixer assembly, resulting in a 3-32 mHz frequency output that is applied back to the sample divide circuit. The process continues until the output of the sample divide circuit is 3333, at which point the memory assembly is locked and the d-c tune output voltage is maintained.

4-72. COMPARATOR ASSEMBLY Z104.

4-73. Comparator assembly Z104 receives a square wave frequency from the sample divide/phase detector assembly which consists of 3333 pulses, during a 10-millisecond gating period, when the receiver operating frequency is exactly the same as that of the incoming signal; that is, the 163.5-192.5 mHz oscillator is tuned to the correct frequency. The circuitry preceding the comparator is arranged so that if the receiver is off tune, the comparator receives less than, or more than, 3333 pulses in the 10-millisecond period. The circuitry within the comparator assembly is designed so that the pulse data input is counted by a 4-bit decade counter and applied to the inputs of four digital comparators which contain previously stored data (3333). When the input data contains more, or less, pulses than the stored data, the comparators activate logic circuits to generate four logic levels for the memory assembly. They are: tune high/low (logic 1 level for determination of the direction of change in oscillator returning); fast tune (logic 1 level) causes the memory to generate a large d-c tune until the oscillator change reflects through the fast loop, causing the first "3" to be impressed on the comparator fast input; coarse tune (logic 1 level) causes a medium magnitude of d-c tune voltage to be generated until the oscillator change produces the second "3" at the comparator coarse input; fine tune (logic 1 level) causes a small magnitude of d-c tune voltage to be generated until the oscillator produces a third and fourth "3" to occur at the fine input of the comparator. When the number of input pulses to the comparators is the same (3333) as the number of stored pulses, the logic circuits are activated to generate the following three logic levels: fast tune inhibit (logic 0 inhibits the fast tune logic circuit of the memory assembly when there is no difference between input and stored pulses); coarse tune inhibit (logic 0 inhibits the coarse tune logic circuitry of the memory assembly when there is no difference in input and stored pulses); fine tune inhibit (logic 0 inhibits the fine tune logic circuitry when there is no difference between the input and stored pulses).

4-74. MEMORY ASSEMBLY Z105.

4-75. Memory assembly Z105 receives four logic levels from the comparator assembly and, depending on whether the levels are high or low, generates a d-c tune voltage for the 163.5-192.5 mHz oscillator. If the oscillator frequency is only slightly different from the frequency set by the MHZ switch, the memory receives fast and coarse inhibit levels (low) from the comparator, and a high enable for the input gates to the fine tune and tune HI/LO circuits. The fine tune circuit generates a relatively small d-c tune signal which is just enough to retune the oscillator assembly. However, if the MHZ switch is set to a new position, the memory assembly receives coarse inhibit and fine input signals (low logic levels) from the comparator assembly which inhibit the input gates for the coarse and fine tune circuits. The fast input receives a high logic level, and the fast tune circuit generates a large d-c tune signal to bring the oscillator frequency within capture range of the coarse tune circuit in the comparator assembly. When this occurs, the fast tune memory input receives an inhibit level and the coarse tune circuit receives an enable level (logic high). The coarse tune circuit then generates a d-c tune signal to bring the oscillator frequency within capture range of the fine tune circuit in the comparator assembly. When this occurs, the memory receives an inhibit signal (logic low) for the coarse tune circuit, and an enable signal (logic high) for the fine tune circuit. The fine tune circuit generates a d-c tune signal to bring the oscillator frequency within capture range of the phase detector and error signal voltage circuits, at which time the memory receives inhibit signals for the fine tune and tune HI/LO circuits. Whenever one of the tune circuits is generating a d-c tune voltage, it is a frequency-to-voltage conversion performed by a discriminator circuit. The discriminator circuits for the three tune circuits are in series, resulting in one averaged output. The memory assembly also receives from the comparator assembly the following signals: a tune HI/LO signal which determines the direction of the change in the d-c tune signal for the oscillator; a 10-millisecond clock pulse and a preset pulse from the mHz display/divider assembly Z103; and a 7-mHz clock pulse from the 3-12 mHz generator assembly Z106 which activates the gates and counters of the memory circuits.

4-76. 1-MHZ STANDARD Z202.

4-77. The 1-mHz standard generates a high-stability sine wave, and distributes it to the mHz display divider assembly, and to digital clock inputs of the comparator, 3-12 mHz generator, and BFO assemblies.

4-78. 100 HZ SYNTHESIZER ASSEMBLY Z110.

4-79. The 100 Hz synthesizer assembly Z110 provides a 250-kHz signal containing 100-Hz increment locks to the sync/afc assembly when the front panel AFC/SYNTH switch is set to SYNTH, thereby applying the internal synthesizer output to the sync/afc assembly. The 100 Hz synthesizer assembly receives a 100-Hz signal from digital counter assembly Z102 (which is derived from the 1-mHz standard), and a 3.25-2.25 mHz signal from mixer/oscillator control assembly Z109. Also applied to the 100 Hz synthesizer is a varicap control voltage from tunable if assembly Z301, which is a function of the setting of the front panel TUNE switch and controls the selection of harmonic derived from the 100-Hz input from the digital counter. When mixed with the 3.25-2.25 mHz signal, the resultant 250-kHz output signal, in 100-Hz increments, is related to the 3.25-2.25 mHz oscillator output and provides a phase detector lock every 100 Hz.

4-80. DIGITAL COUNTER ASSEMBLY Z102.

4-81. Digital counter assembly Z102 receives binary coded 10-mHz and 1-mHz signals from the MHZ switch via the mHz display/divider assembly Z103, and a 1-kHz clock pulse directly from the mHz display/divider assembly. The binary code applied to the 10-mHz input generates outputs to the 10-mHz driver circuit in the readout display assembly, and the binary code applied to the 1-mHz input generates outputs for the 1-mHz driver circuits in the readout display assembly. The 1-kHz clock pulse triggers the operation of some of the decade counters and flip-flops in the digital counter. In addition, a 1 to 2 mHz clipped sine wave signal from the mixer oscillator assembly provides clock pulses for the counting circuits. A 100-Hz signal for the 100 Hz synthesizer assembly is generated by passing the 1-kHz clock pulse through a decade counter circuit. Outputs from FF-1 and FF-2 in the digital counter are applied to the gate circuits of the mHz display divider. The binary coded decimal outputs of the 10 mHz, 1 mHz, 100 kHz, 10 kHz, 1 kHz, and 0.1 kHz circuits are applied to the corresponding inputs of the readout display.

4-82. READOUT DISPLAY ASSEMBLY Z101.

4-83. Readout display assembly Z101 receives binary coded decimal inputs from the 10 mHz, 1 mHz, 100 kHz, 10 kHz, 1 kHz, and 0.1 kHz circuits of the digital counter assembly and applies them to the appropriate decoder-driver circuits 10 mHz, 1 mHz, 100 kHz, 10 kHz, 1 kHz, and 0.1 kHz, respectively. The driver circuits activate the appropriate filament segments of each numeric indicator, thereby displaying the proper numbers for the receiver operating frequency.

4-84. SIGNAL FLOW CIRCUITS, CIRCUIT ANALYSIS.

4-85. PRESELECTOR ASSEMBLY Z120. (See figure 7-39.)

4-86. Preselector assembly Z120 receives the antenna signal via ANT IN terminal E8 and controls the insertion of a 500 to 1600 kHz filter in the signal path. Relays K1 and K2 are in the normally deenergized state. Under these conditions, the antenna input signal is routed through normally closed contacts of relay K1, through the normally closed contacts of relay K2, through the filter, and applied to rf input mixer assembly Z307 via normally closed contacts of relay K2 and RF OUT terminal E7. This signal routing is applicable only in the a-m mode of operation when the receiver is tuned to any frequency not in the broadcast band range. In the broadcast band range, relay K2 is energized with the result that the two sets of contacts of K2 bypass the filter and route the input antenna signal directly through the preselector and out to the rf input mixer assembly. The energizing of relay K2 is controlled by the MHZ switch setting and a signal routed via the mHz display/divider assembly Z103. When operated in c-w mode or any sideband mode, the relays are deenergized and the filter is inserted in the signal path.

4-87. Relay K1 is energized by a receiver disable signal at terminal 2 when an associated transmitter antenna is used in conjunction with the receiver, and grounds the input signal in the preselector assembly.

4-88. 163.5-192.5 MHZ OSCILLATOR ASSEMBLY Z304. (See figure 7-48.)

4-89. The 163.5-192.5 mHz oscillator assembly Z304 develops the first mixing frequency which is approximately 163.5 mHz above the receiver MHz frequency. The initial frequency input to Z304 is established by the oscillator d-c control input at terminal E15 which is derived from memory assembly Z105 and places the oscillator output frequency at approximately the required output.

4-90. The 163.5-192.5 mHz oscillator assembly Z304 contains two oscillator circuits; one operates in the upper half of the required operating range, and the second oscillator operates in the lower half of the range. When the front panel MHZ switch is set to any band which requires an oscillator signal in the range of 163.5-175.5 mHz, low band oscillator circuit Q1, Q2 is activated by +8 volts dc at terminal E17 from the low-band control circuit in mixer/oscillator control assembly Z109. When the MHZ switch is set to a band which requires an oscillator signal in the range of 176.5-192.5 mHz, oscillator circuit Q6, Q7 is activated by +8 volts dc at terminal E16 from the high-band control circuit in the mixer/oscillator control assembly. The output of the selected oscillator is amplified by Q5, Q4 and applied to rf input mixer Z307 via terminal E21.

4-91. A sample of the oscillator output frequency at terminal E20 is applied to sample mixer assembly Z303 where it is mixed with the 160.5 mHz output of Z302 to yield a 3-32 mHz output frequency that is applied to sample divide/phase detector assembly Z107. The sample divide/phase detector assembly then produces the fast loop error control signal voltage that is applied to terminal E14 and corrects and/or maintains the required output frequency of the selected oscillator.

4-92. RF INPUT MIXER ASSEMBLY Z307, DIFFERENCE AMPLIFIER ASSEMBLY Z306, AND IF OUTPUT MIXER ASSEMBLY Z305. (See figure 7-50.)

4-93. Rf input mixer assembly Z307, difference amplifier assembly Z305 are shown on figure 7-50. The rf input mixer assembly receives the output signal of preselector Z120 at pin E23 and applies the received signal to terminal 6 of mixer Z307Z1. Also applied to mixer Z307Z1 is the 163.5 to 192.5 mHz oscillator signal from 163.5-192.5 mHz oscillator assembly Z304 via pin E25 and is applied to terminal 1 of Z307Z1. Mixer Z307Z1 mixes the two input frequencies and applies the resultant sum and difference frequencies across the primary of transformer T2 in difference amplifier assembly Z306.

4-94. Difference amplifier assembly Z306 contains three stages of tuned amplifier circuits centered at 163 mHz and a bandwidth of ±0.5 mHz. The tuned circuits select the difference output signal for rf input mixer assembly Z307. The agc signal from USB and LSB filter assemblies Z115 and Z116, respectively, is applied to pin E39 of Z306 and controls the amplification of Q1, Q2, and Q3. The resultant amplified signal is applied to pin E43 of if output mixer assembly Z305.

4-95. The 163.0 ± 0.5 mHz signal from if amplifier assembly Z306 is received at input terminal E43 and applied to input terminal 6 of mixer Z305Z1. The 169.5-Hz signal from the 160.5 mHz oscillator assembly Z302 is applied to terminal 1 of Z305Z1 via terminal E45. Z303Z1 mixes the two frequencies to obtain the sum and difference frequencies. Tuned circuit L1, C1 passes only the difference frequency in the range of 2 to 3 mHz from output terminal 4 of Z305Z1 to output terminal E47 of the Z305 where it is then connected to the input of the tunable if assembly Z301.

4-96. 160.5 MHZ OSCILLATOR ASSEMBLY Z302. (See figure 7-44.)

4-97. The 160.5 mHz oscillator assembly Z302 develops a 160.5 mHz output that is applied to if output mixer assembly Z305 where it is mixed with the if signal from difference amplifier Z306 to produce a second if conversion frequency. Oscillator circuit Q5, Q4 in this assembly receives a slow loop error signal, via terminal E1, from sample divide/phase detector Z107 which provides a continuously changing bias voltage. The oscillator output is amplified by Q3, Q2, Q1 and routed via terminal E5, to terminal E45 of if output mixer assembly Z305 to provide the second if conversion in the receiver. At the same time, a sample of the amplified oscillator signal is applied, via terminal E3, to terminal E9 of the sample mixer assembly Z303.

4-98. TUNABLE IF ASSEMBLY Z301. (See figure 7-42.)

4-99. Tunable if assembly Z301 mixes the 3-2 mHz input signal from if output mixer assembly Z305 with an internally generated 3.25-2.25 mHz signal to produce the desired 250 kHz i-f output signal. In turn, the internal 3.25-2.25 mHz oscillator frequency is controlled by the front panel TUNE control, is adjusted by a d-c signal returned from the sync/afc assembly Z117, and is divided into 10 bands, as a function of frequency change to optimize the selectivity of the receiver. The resultant exact output frequency of the 3.25-2.25 mHz oscillator controls a number of parameters in the receiver. The output of the 3.25-2.25 mHz oscillator is applied to mixer/oscillator control assembly Z109 where it develops the 1-2 mHz signal frequency for display on the front panel of the exact receiver operating frequency. The frequency is also applied, via Z109, to the 100 Hz synthesizer assembly Z110. The 250-kHz output signal is also applied to sync/afc assembly Z117 via the AFC position of the front panel AFC/SYNTH switch.

4-100. The tunable if assembly receives a 3-2 mHz signal at pin E1 from if output mixer assembly Z305. The input signal is amplified by dual gate field effect transistors (FET's) Q1, Q2, and Q3. Transformers T1, T2, and T3 enable tuning the amplifier circuits to provide a 1-mHz bandwidth for the input signal. The resultant amplified output of Q3 is applied to FET mixer Q6.

4-101. Also applied to FET mixer Q6 is the output of 3.25-2.25 mHz oscillator Q4. The difference frequency is selected by transformer T6 and the resultant 250-kHz output signal is applied to the USB filter Z115, symmetrical filters Z112 and Z113, (optional) LSB filter Z116, and also to the sync/afc assembly Z117 when the front panel AFC switch is set to on (depressed). The 3.25-2.25 mHz oscillator output signal is also made available at pin E5 and is applied to mixer/oscillator control assembly Z109.

4-102. The oscillator control voltage input at pin E4 is a d-c voltage derived from sync/afc assembly Z117 and represents a correction voltage required to close the loop indicating the exact operating frequency of the receiver.

4-103. The sections of TUNE switch divides the tunable if assembly into 10 bands as a function of frequency change to optimize the selectivity of the receiver. Since the amplifier stages are varicap controlled, each band is individually optimized. Similarly, the 3.25-2.25 mHz oscillator is divided into 10 bands. This feature results in extremely tight tracking and minimum tracking error.

4-104. MIXER/OSCILLATOR CONTROL ASSEMBLY Z109. (See figure 7-20.)

4-105. Mixer/oscillator control assembly Z109 contains two discrete circuits. The mixer portion of the assembly mixes the 2.25-3.25 mHz signal from tunable if assembly Z301 with a 4.25 mHz signal derived from the 17th harmonic of the 250 kHz signal input from display divider assembly Z103. The oscillator d-c switching portion of the assembly develops the high and low oscillator voltage signals for the 163.5-192.5 mHz oscillator assembly as a result of receiving the information from display divider assembly Z103.

4-106. The mixer portion of the assembly receives the 2.25-3.25 mHz signal from tunable if assembly Z301. The exact frequency within this received frequency range is determined by the setting of the front panel TUNE control and is corrected by the dc loop signal from the sync/afc assembly Z117. Thus, when the last four digits of the display are set to XX.0000, a 3.25 mHz signal is applied to the mixer portion. When the last four digits are XX.9999, a 2.25 mHz signal is applied to the mixer portion.

4-107. The 250 kHz signal from display divider Z103 is applied to tuned multiplier/amplifier circuit consisting of Q4 and Q5. Tuned circuits, adjustable by L2, L3, and L4 are set for the 17th harmonic of the 250 kHz input signal, resulting in a 4.25 mHz signal. The 4.25 mHz signal is mixed with the 3.25-2.25 mHz signal in Q6, resulting in a 1-2 mHz output signal frequency. The signal is buffered by emitter follower Q7, filtered by L8, L9, L10, C15, C17, C19, and C21, and amplified by Q8 and Q9 and the resultant 1-2 mHz signal is applied to digital counter assembly Z102 where it performs a clocking function to read out the exact operating frequency of the receiver.

4-108. The oscillator d-c switching portion of mixer/oscillator control assembly Z109 receives a HI/LO (logic 1 or logic 0, respectively) signal from display/divider Z103. When the front panel MHZ switch is set between 00 and 12 MHZ, a logic 0 (ground) level is applied at pin C. As a result, Q1 turns on Q3 and +8 volts is applied through Q3 to pin 2 to activate oscillator No. 2 in the 163.5-192.5 mHz oscillator assembly. When the MHZ switch is set between 13 and 29 mHz, a logic 1 (+5 volt) level is applied to pin C, Q1 turns on Q2, and +8 volts is applied through Q2 and pin D to activate oscillator No. 1 in the 163.5-192.5 mHz oscillator assembly.

4-109. SYNC/AFC ASSEMBLY Z117. (See figure 7-32.)

4-110. Sync/afc assembly Z117 develops a d-c voltage that is used to correct the frequency of the 3.25-2.25 mHz oscillator in the tunable if assembly. The sync/afc assembly also provides two outputs that indicate that tuning of the receiver is correct via a visual SYNC indicator lighting and a zero centered indication on the front panel meter when the meter switch is set to SYNC.

4-111. The 250-kHz input to the sync/afc assembly is from tunable if assembly Z301 when the AFC switch is activated or is from 100 Hz synthesizer Z110 when the AFC/SYNTH switch is in the SYNTH position. The 250-kHz input at pin A is amplified by Q1 and applied to filter FL1. The filter is tuned to 250 kHz with a bandpass of ±50 Hz. The resultant output signal is then amplified by Q2, Q3, Q4, Q6, and Q7. The output of Q7 is applied to secondary center tap of transformer T1 which operates in conjunction with Q5 to form a phase detector circuit.

4-112. The second 250-kHz input to the phase detector circuit is derived on the XVCO (voltage controlled crystal oscillator) subassembly of the sync/afc assembly. Crystal Y1 operates in conjunction with Q1 to develop 1.25-mHz signals that are applied to mixer Q2. The fine tune input at pin E2 of the subassembly via terminal J of the sync/afc assembly provides a means of correcting the XVCO oscillator frequency ±50 Hz to coincide with the ±50 Hz band width of filter FL1.

4-113. Fine tuning is provided by the front panel FINE TUNE control. Also applied to the mixer circuit Q2 is a 1-mHz signal at pin E6 of the subassembly via terminal 2 of the sync/afc assembly and is derived from the 1-mHz standard. The resultant 250-kHz output signal of mixer Q2 is the second input to the phase detector circuit and is routed between the subassemblies and applied to the base of Q5.

4-114. The resultant phase detector output is a d-c voltage whose direction indicates the direction the frequency must be changed in the 3.25-2.25 mHz oscillator in tunable if assembly Z301 to return to a 250 kHz output signal. The magnitude of the d-c voltage indicates the amount of frequency correction. The d-c voltage is amplified by integrated circuit Z1 with the resultant output of Z1 applied to the tunable if assembly via pin 7.

4-115. The output of Z1 is also made available at pin 3 via FET Q8 and meter adjust potentiometer R44. The output at pin 3 is applied to the front panel meter via the SYNC position of the meter select switch.

4-116. Two types of visual tuning are made available. One type is via the center-reading meter and is derived from the d-c output at pin 3. However, since the front panel meter is capable of monitoring a number of parameters, a sync indicator lights to indicate tuning within ±20 Hz. This second indication is derived by the 250-kHz output of amplifier Q7 which is further amplified by Q10, Q11, and Q12. The resultant output at pin L is applied to front panel SYNC indicator which lights to indicate that the signal is within ±20 Hz bandpass. The sync indicator circuit is a sensitive LED and can be used in conjunction with the front panel meter, if desired.

4-117. 100 HZ SYNTHESIZER ASSEMBLY Z110. (See figure 7-22.)

4-118. The 100 Hz synthesizer assembly Z110 provides a 250-kHz signal containing 100-Hz increment locks to the sync/afc assembly when the AFC/SYNTH switch is set to SYNTH, thereby applying the internal synthesizer output to the sync/afc assembly. The 100 Hz synthesizer receives the 3.25-2.25 mHz signal at pin 9 which is derived in the tunable if assembly Z301, and also receives a 100 Hz square wave at pin L from digital counter assembly Z102. A third input to the synthesizer at pin D is the varicap input voltage derived from the TUNE selector switch.

4-119. The 100-Hz square wave input at pin L is applied to harmonic generator Q4 which develops a spectrum of 100-Hz signals. The resultant signals are applied through tuned circuits adjusted by T3 and T4 which extracts the 2-3 mHz frequency range of the 100-Hz signals. The varicap input voltage at pin D is derived from a wafer on the TUNE control and is also divided into 10 bands for increased selectivity. A voltage is selected that approximately tunes the tuned circuits in the region required in the 2-3 mHz range.

4-120. The 100-Hz signals in the 2-3 mHz range are then mixed with the 3.25-2.25 mHz signal returned from the tunable if assembly. The 3.25-2.25 mHz input signal is applied to pin 9, is amplified by tuned amplifier Q3, and applied to mixer Q2. The second input to mixer Q2 is the 2-3 mHz signal filled with 100-Hz signals. The difference output frequency of the mixer is selected by T1, T2, and Q1 and is the desired 250-kHz output signal.

4-121. The 250-kHz output signal is applied to the 250-kHz filter in the sync/afc assembly Z117 when the front panel AFC/SYNTH switch is set to SYNTH and the internal 100 Hz synthesizer is selected. The 250-kHz output is directly related to the 3.25-2.25 mHz oscillator and provides a phase detector lock every 100 Hz in that band. The phase detector in the sync/afc assembly develops a d-c voltage that is applied to the 3.25-2.25 mHz oscillator in the tunable if assembly. Therefore, if the oscillator frequency has an inaccuracy of 100 Hz, the phase detector d-c voltage derived from the 100-Hz synthesizer output signal will lock it at that frequency. For frequencies between 100-Hz increments, the front panel FINE TUNE control varies the 1.25-mHz oscillator in the sync/afc assembly sufficiently to offset the 1.25 mHz frequency to lock both signals at a 100-Hz incrementsl lock. The FINE TUNE provides ±50 Hz. This system provides a very accurate means of controlling frequency, because only the 3.25-2.25 mHz oscillator, a low frequency oscillator, is controlled.

4-122. SAMPLE MIXER ASSEMBLY Z303. (See figure 7-46.)

4-123. Sample mixer assembly Z303 compares a sample of the 163.5-192.5 mHz oscillator output against a sample of the 160.5 mHz oscillator frequency and develops a 3.32 mHz output. Pin E7 receives a sample voltage from the 163.5-192.5 mHz oscillator and applies it to one input of amplifier Z1. Pin E9 receives a sample voltage from the 160.5 mHz oscillator assembly and applies it to the other input of amplifier Z1. The two signals are mixed, and their difference frequence in the range of 3-32 mHz is amplified in Z1, Q1, and Q2, and then applied to output pin E12.

4-124. SAMPLE DIVIDE/PHASE DETECTOR ASSEMBLY Z107. (See figure 7-14.)

4-125. The phase detector section of this assembly compares 3-12 mHz sine wave at pin V from the 3-12 mHz generator assembly Z106 with a 3-12 mHz input via pin X from the mixer/divider assembly Z108. The output of the phase detector circuit T1, CR3, CR4 is a d-c correction voltage for the 160.5 mHz oscillator assembly (pin 17 slow loop output), and the 163.5-192.5 mHz oscillator assembly (pin Y fast loop output). The signal from the 3-12 mHz generator assembly is also applied to second phase detector circuit T1, via amplifier Q2, and the signal from the mixer/divider assembly is applied to the same phase detector circuit, via amplifier Q1. The d-c outputs of the phase detector circuit are applied via CR2 and CR3, to amplifier circuit Q3 and Q4, and mixed in the collector circuit to provide a logic 0 level for the inverter in Z8. This circuit inhibits the comparator when the correct d-c tune level is attained.

4-126. MIXER/DIVIDER ASSEMBLY Z108. (See figure 7-17.)

4-127. Mixer/divider assembly Z108 receives two signal inputs and mixes them to produce a 3-12 mHz output for the phase detector/sample divide assembly Z107. Pin B receives a 10-mHz square wave from the 3-12 mHz generator assembly Z106, and routes it to the clock input of Z1. Pin E receives a sine wave from the sample mixer assembly Z303 which is in the range of 3-32 mHz (exact frequency depends upon the receiver operating frequency and is always 3 mHz higher than the receiver frequency). For example, if the receiver is tuned to the 00 band, the frequency at pin E is 3 mHz; on the 01 band, pin E receives 4 mHz, etc.

When the receiver is tuned to 10 to 19 mHz, pin E receives 13-22 mHz. With the receiver tuned to 20 to 29 mHz, pin E receives 23 to 32 mHz.

4-128. Z1 is a dual J-K flip-flop and is controlled by logic levels received from the mHz display/divider via pins 3 and 4. When the X4' input at pin 4 is a logic 1 level, the Z1Q1 output is active and the 10 mHz sine wave at pin B is converted to a 5 mHz square wave. This output is applied to 5X multiplier circuit T4, Q3, T5, Q4, T6. The resultant 25-mHz signal is applied to one input of difference mixer Z2, where it is mixed with the 3-32 mHz signal from the sample mixer assembly via pin E. When the X5' input at pin 3 is a logic 1 level, the Z1Q2 output is active and the 10 mHz sine wave at pin B is converted to a 5-mHz square wave and applied to 7X multiplier circuit T1, Q1, T2, Q2, T3. The resultant 35-mHz signal is applied to difference mixer Z2. At this time, there is no output from Z1Q1, because whenever the X5' input is a logic 1, the X4' input is a logic 0, turning off Z1Q1. When the input signal at pin E from the sample mixer assembly is in the range of 3-12 mHz, the X4' and X5' inputs are both logic 0 levels and both outputs of Z1 are turned off. Therefore, the signal at pin E is routed through amplifier Q6 without any mixing at difference mixer Z2. Amplifier Q6 is gated on by an enabling logic level from the mHz display/divider assembly via pin 7 and amplifier Q8.

4-129. Difference mixer Z2 receives a signal, 25 or 35 mHz, from one of the multiplier circuits and the 3-32 mHz signal from pin E; the resulting frequency is applied to the input gate of FET amplifier Q7. The amplified output is applied through a filter to FET amplifier Q9. The output of Q9 is applied through filter assembly Z3, amplifier Q5, filter assembly Z4, amplifier Q11, and amplifier Q10 to 3-12 mHz output pin K. The following input and output frequencies apply as the receiver is tuned through its range of selected frequencies:

Selected Frequency (MHZ Switch)	Frequency at Pin E (mHz)	Mixing Frequency (mHz)	Output Frequency at Pin K (mHz)
00	3	0	3
01	4	0	4
02	5	0	5

Selected Frequency (MHZ Switch)	Frequency at Pin E (mHz)	Mixing Frequency (mHz)	Output Frequency at Pin K (mHz)
03	6	0	6
04	7	0	7
05	8	0	8
06	9	0	9
07	10	0	10
08	11	0	11
09	12	0	12
10	13	25	12
11	14	25	11
12	15	25	10
13	16	25	9
14	17	25	8
15	18	25	7
16	19	25	6
17	20	25	5
18	21	25	4
19	22	25	3
20	23	35	12
21	24	35	11
22	25	35	10
23	26	35	9
24	27	35	8

Selected Frequency (MHZ Switch)	Frequency at Pin E (mHz)	Mixing Frequency (mHz)	Output Frequency at Pin K (mHz)
25	28	35	7
26	29	35	6
27	30	35	5
28	31	35	4
29	32	35	3

4-130. BFO ASSEMBLY Z118. (See figure 7-35.)

4-131. The BFO assembly Z118 receives the 1-mHz standard input at pin 2 and squares it in Q2. The squared output of Q2 is applied to divide-by-four dual J-K flip-flop Z1. The resultant 250-kHz square wave output is applied through a NAND gate in logic circuit Z2, to pin k, and is routed from there to the USB and LSB assemblies. In all modes except AM, integrated circuit Z1 receives an enabling voltage through BFO control transistor Q4. In AM operation, the base of Q4 receives a fround logic level via pin H from the mode switch and Q4 cuts off, thereby disabling Z1. The 250-kHz BFO signal is modulated by audio oscillator Q1 via amplifier Q3 and the logic gate in Z2. The frequency of the audio modulation is adjusted by the BFO control on the front panel which varies the enabling voltage for Q1 from zero to +9 volts dc. The BFO frequency is fixed at 250 kHz when the BFO pushbutton is set to FXD by applying a ground to logic circuit Z2 via pin D.

4-132. SYMMETRICAL FILTER (0.4 KHZ, 1 KHZ) Z112 AND SYMMETRICAL FILTER (3 KHZ, 6 KHZ, WB) Z113 ASSEMBLIES. (See figure 7-26.)

4-133. Either one, or both, of these filter assemblies may be incorporated in the receiver. If both are installed, internal circuitry and external pin connections are identical, except for narrow band filters FL1 and FL2. In the Z112 assembly, the bandpass of FL1 is 0.4 kHz centered at 250 kHz and the bandpass of FL2 is 1 kHz, centered at 250 kHz. In the Z113 assembly, the bandpass of FL1 is 3 kHz, and the bandpass of FL2 is 6 kHz. Also, in Z113, the wide band amplifier (approximately 12 kHz bandpass) can be used instead of the narrow band filters. Selection of the desired narrow band filter is accomplished by pressing one of the BANDWIDTH pushbuttons on the front panel, which applies a control ground level via pin B or 6 to amplifier Q2, Q4, or Q6, respectively. The ground activates the amplifier, passing the signal applied to that circuit to the SYM OUT line via pin 3. The input to each of the filter section is a 250 kHz sine wave applied to all of the inputs simultaneously from terminal E9 of the tunable if assembly.

4-134. UPPER SIDEBAND FILTER ASSEMBLY Z115. (See figure 7-30.)

4-135. When the receiver MODE switch is set to USB position (or ISB, if this option is incorporated in the receiver), a USB control ground from the MODE switch, via pin A, turns on transistors Q1 and Q2 and applies the 250 kHz signal to FET amplifier Q3. A 3-kHz bandpass filter Z115FL1 establishes the bandwidth and frequency range of the sideband signal while it passes through the Q1, Q2 amplifier. The 250-kHz input at pin 3 is disabled when the MODE switch is set to AM or CW position; the 250-kHz signal then comes from symmetrical filter Z112 or Z113 via pin 3. The specific symmetrical filter required depends on the desired bandwidth.

4-136. Q3 amplifies the signal and clamping diodes CR1, CR2 provide automatic noise limiting when the ANL switch is set to ON and grounds pin 2. The 250-kHz signal is then amplified by Q4 and Q5, and is applied to one of the gates of product detector Q8. A 250-kHz BFO signal at pin D during c-w operation is applied to the second gate of product detector Q8, producing an audio tone. The pitch of the tone is varied by the BFO control on the front panel. The audio is applied to audio output amplifier Z1 which, in turn, drives the 600-ohm audio distribution line connected to pins J, K, and L. A second audio signal from Z1 is applied to pin 8 where it is connected through the audio line adjust potentiometer and back through pin 9 to the feedback input of Z1. The audio signal from pin 8 is also connected through the METER USB pushbutton to pin B of audio assembly Z114 where it is again amplified and connected to the internal speaker and the external speaker terminals on the rear panel.

4-137. The current path for the source of product detector Q8 is provided by Q10; however, during AM operation, the AM control ground from the MODE switch turns off Q10 via pin 6 and disables product detector Q8. The AM control ground from pin 6 also turns on amplifier Q9 during AM operation, providing the 250-kHz signal with a path to a-m detector CR5. The audio signal on the carrier is recovered by CR5 and applied to the input of audio output amplifier Z1 (the audio signal from product detector is now disables and does not interfere). The aduio is applied to the 600-ohm line and the internal speaker and external speaker jack as in c-w operation.

4-138. In all modes of operation, AGC voltage is developed by tapping off the 250-kHz signal at the output of amplifier Q5 through AGC level adjust potentiometer R38, through amplifiers Q6 and Q7, with AGC detector CR3, CR4 providing the d-c voltage for automatic gain control of the various i-f amplifiers. The AGC voltage is connected to the AGC distribution line through pin 7 and the AGC switch on the front panel.

4-139. LOWER SIDEBAND FILTER ASSEMBLY Z116. (See figure 7-30.)

4-140. Functional operation of the lower sideband filter assembly is the same as the upper sideband filter assembly with the following exceptions:

1. Bandpass filter Z116FL1 passes 3 kHz in the lower sideband range instead of the upper sideband range; i.e., the filter passes 247.0 to 249.7 kHz.

2. The ground signal which activates transistors Q1 and Q2 via pin A comes from the LSB control line instead of the USB control line.

3. The 600-ohm line adjustment potentiometer, connected across pins 8 and 9, is the lower sideband line adjust potentiometer instead of the upper sideband adjust potentiometer.

4. The audio signal from pin 8 is connected to pin B through the METER LSB pushbutton instead of the METER USB pushbutton.

4-141. AUDIO ASSEMBLY Z114. (See figure 7-28.)

4-142. The audio signal from pin 8 of USB (or LSB) assembly is applied via the METER USB (or LSB) switch and AF GAIN control to pin B. Pin B is connected to input pin 10 of power driver amplifier Z1. The amplified outputs of Z1 are applied to push-pull transistors Q1 and Q2 which, in turn, drive the internal speaker of the receiver via pin A. The output is also applied through a rectifier bridge, pins 3 and J, and the METER and AFC switches, to the RF/audio/sync meter on the front panel to provide monitoring of the audio signal.

4-143. AGC voltage at pin 9 from the AGC switch is applied to FET amplifier Q3. The amplified output is then applied to the METER switch via pin 7 to provide monitoring of the r-f level of the signal. The AGC voltage at pin 9 is also applied to source follower Q4 which provides regulation and isolation to the AGC voltage.

4-144. Squelching of the audio and rf under excessively strong signal conditions is also accomplished on Z114. The output voltage of source-follower Q4 is applied to the non-inverting input of squelch amplifier Z2, and to one end of the squelch control. The output of the squelch amplifier is connected back to its inputs in a feedback configuration consisting of the squelch control and a network of resistors.

4-145. <u>DIGITAL LOGIC AND CONTROL CIRCUITS, CIRCUIT ANALYSIS</u>.

4-146. 3-12 MHZ GENERATOR ASSEMBLY Z106. (See figure 7-12.)

4-147. The 3-12 mHz generator assembly develops square-wave outputs in 1-mHz increments from 3 to 12 mHz, depending on the setting of the front panel MHZ switch, develops a 7-mHz square-wave output that is applied to memory assembly Z105, and develops a 10-mHz square-wave output that is applied to mixer/divider assembly Z108. The 3-12 mHz generator assembly contains six crystal controlled oscillator circuits (7, 8, 9, 10, 11, and 12 mHz) in addition to logic gating and dividing elements that develop the required output requencies in accordance with the binary coded signals established by the setting of the front panel MHZ switch.

4-148. A 1-mHz input at pin 7 is squared by Q19 and is applied to a NAND gate in Z3. The NAND gate develops sufficient drive for the output signal at pin 6 of Z3 to trigger the inputs of each of the six crystal controlled oscillators. Thus, the output at pin 6 of Z3 is applied to the 7, 8, 9, 10, 11, and 12 mHz oscillator circuits. Each oscillator is resonant at a frequency determined by the input crystal. A second crystal in each oscillator circuit is tuned to the same frequency as the input crystal.

4-149. The output frequency of each oscillator (7, 8, 9, 10, 11, and 12 mHz) is continuously applied to logic gates in the assembly, with the resultant output frequency at pin 8 a function of the frequency setting of the MHZ switch. The X0, X1, X2, and X3 binary signals from the MHZ switch are applied to pins 2, 4, 5, and 6; the true complement signal from the mHz display/divider assembly Z103 is applied to pin 3. The binary coded inputs from the MHZ switch in each of the 30 positions and the corresponding output frequency generated at output pin 8 of the 3-12 mHz generator assembly are indicated in table 4-1.

4-150. The following paragraphs describe the development of a 3-mHz signal at output pin 8 when the front panel MHZ switch is set to 19 mHz. The signal frequencies developed for each of the remaining 29 positions can be traced in a similar manner.

Note

> The 00 and 01 bands are each repeated once, making a total of 32 switch positions, but only 30 listings in table 4-1.

4-151. The four-bit binary code of 1100 is applied to pins 2, 4, 5, and 6, respectively. Also applied is a fifth high level bit at pin 3 which is the true complement signal. The code represents a MHZ switch setting of 19 mHz and is applied to quad 2-input exclusive OR-gate integrated circuit Z1. With this binary coding, and a high level on pin 3, Z1 develops a logic 0 output on pins 3 and 4 and a logic 1 output on pins 10 and 11. The 0011 outputs are applied to Z2, pins 15, 14, 13, and 12, respectively. As a result of receiving a 0011 input, Z2 develops a logic 0 output at pin 1 and logic 1 outputs on pins 2 through 7, 9, 10, and 11. The logic 0 at pin 1 is inverted in Z6 and the resultant logic 1 is applied to one input of a 2-input NAND gate in Z8. The second input to the NAND gate is the continuously applied

TABLE 4-1. BINARY CODES

Operate MHZ Sw. F (mHz)	CODE INPUT X3	X2	X1	X0	True Comp.	3-12 mHz Output (Pin 8) F (mHz)
00	0	0	1	1	0	3
01	0	1	0	0	0	4
02	0	1	0	1	0	5
03	0	1	1	0	0	6
04	0	1	1	1	0	7
05	1	0	0	0	0	8
06	1	0	0	1	0	9
07	1	0	1	0	0	10
08	1	0	1	1	0	11
09	1	1	0	0	0	12
10	0	0	1	1	1	12
11	0	1	0	0	1	11
12	0	1	0	1	1	10
13	0	1	1	0	1	9
14	0	1	1	1	1	8
15	1	0	0	0	1	7
16	1	0	0	1	1	6
17	1	0	1	0	1	5
18	1	0	1	1	1	4
19	1	1	0	0	1	3
20	0	0	1	1	1	12
21	0	1	0	0	1	11
22	0	1	0	1	1	10
23	0	1	1	0	1	9
24	0	1	1	1	1	8
25	1	0	0	0	1	7
26	1	0	0	1	1	6
27	1	0	1	0	1	5
28	1	0	1	1	1	4
29	1	1	0	0	1	3

9-mHz sine wave from the 9-mHz oscillator. The logic 1 gates the 9-mHz signal to pins 1 and 5 of dual flip-flop Z9. The signal at pins 1 and 5 are applied to the clock inputs of each flip-flop in Z9. The two flip-flops are connected in a divide-by-3 configuration, with the resultant 3-mHz output signal at pin 8 of Z9 applied as one input to a NAND gate on Z7 via pin 12 of Z7. The second input to the NAND gate is derived from a four-input NAND gate on Z3. With three of the four inputs to the NAND gate at logic 1 level and one input at a logic 0, the resultant logic 1 output of the NAND gate enables the NAND gate on Z7. As a result, the 3-mHz signal is routed through the NAND gate to a second NAND gate on Z7. Applied to the second NAND gate is a logic 1 from Z10 which enables the NAND gate and routes the resultant 3-mHz signal to pin 8 of the 3-12 mHz generator assembly.

4-152. MHZ DISPLAY/DIVIDER ASSEMBLY Z103. (See figure 7-6.)

4-153. 1-MHZ DIGIT DISPLAY. Z103 receives the excess 3 binary coded signals X0 through X5 from the MHZ switch. Binary signals X0 through X3 are applied via input pins S, T, U, and V directly to the A-inputs of 4-bit binary adder Z14, and to the B-inputs through the inverters of Z11, NAND gates in Z12 and Z6, and an AND gate in Z13. A square wave from flip-flop No. 1 in the digital counter assembly is also applied via pin M, to the B1 input of Z14, and through the gates and inverters of Z9, Z7, Z12, Z13, and Z6 to inputs B2 and B4 of Z14. The B3 input of Z14 is wired to the +5-volt bus, and is therefore always at a logic 1 level. A fixed output from flip-flop No. 2 in the digital counter assembly is applied via pin E and NAND gates in Z6 to the B2 input of Z14, and through NAND gates in Z9, Z12, and Z6 and an inverter in Z7, to the B4 input of Z14. Summing outputs 1 through 4 of Z14 are applied via pins 16, 13, 14, and 15, respectively, to the 1 mHz circuit in the digital counter assembly, causing the correct digit to appear on the digital display. Whenever the last four digits of the digital display are dialed above 9999, the logic inputs of Z14 add one binary digit to its output. The 1-mHz circuit in the digital counter therefore receives a higher binary number and the 1-mHz digit displays the next higher number. Conversely, if the last four digits are dialed below 0000, the 1-mHz digit changes to the next lower number.

4-154. 10-MHZ DIGIT DISPLAY. Binary signals X4 and X5 are applied via input pins W and X, respectively, to the inputs of a 2-bit binary adder consisting of three exclusive-OR gates in Z15, and an AND gate in Z13. Two inverters in Z11 provide binary carry inputs from the 1-mHz adder circuit. Whenever the 1-mHz digit is dialed from 9 up to 0, the binary carry from the 1-mHz logic circuit causes the 10 mHz digit to advance to the next higher number. Conversely, when the 1-mHz digit is dialed from 0 down to 9, the binary carry from the 1-mHz logic causes the 10-mHz digit to decrease to the next lower number.

4-155. SIGNALS GENERATED BY DECADE DIVIDERS. Decade divider Z1 receives a 1-mHz square-wave via pin B and divides it by 10. The resultant 100-kHz output is divided by 10 in Z3 and again by 10 in Z5. The 1-kHz output of Z5 is applied to the digital counter assembly via pin D. The 1-kHz output of Z5 also provides clock inputs for decade divider Z4 and dual J-K flip-flop Z2. The 10-kHz output of Z3 provides a clock input for dual J-K flip-flop Z8, and is also used as an input power source for low-level regulated power supply Q3, Q4, Q5. The -8 volts dc output is applied via pin K to the RF GAIN control and to the sync/afc assembly. The output of Z4 is applied through a NAND gate in Z6 to the K input of dual J-K flip-flop Z2 and is routed via pin 7 to the clear input of the comparator; the output of the NAND gate is inverted in Z7 and applied to the J input of Z2. The output of pin 13 of Z2 is routed via pin 5 as a 10-millisecond positive gating pulse to pin 6 of the sample divide/phase detector assembly and to pins 3 and c of the memory assembly. The output at pin 8 of the second flip-flop in Z2 generates a 250-kHz output by dividing the 500 kHz clock inputs at pin 5 by 2. This signal is routed via pin 3 to pin B of the mixer/oscillator control.

4-156. MEMORY PRESET SIGNAL. The preset pulse circuit consists of two exclusive OR gates in Z9, a dual J-K flip-flop in Z8, three inverters in Z7, and a NAND gate in Z10. It detects any change on the X0 or X4 input lines (pins S and W, respectively) from the MHZ switch. On the next clock pulse, after any change in logic level on the X0 or X4 lines, the appropriate flip-flop in Z8 (inputs connected to the exclusive OR gate in that line) will change state. This change is applied from the Q output of the flip-flop into the gate which carried the level change, and disables the gate and the flip-flop. The result is a narrow, negative-going pulse applied through the inverters in Z7 and the NAND gate in Z10 to pin H, where it is routed to the preset input of the memory assembly.

4-157. REMOTE PRESET INPUT. When the MHZ switch setting is changed at a remote location, pin P of the mHz display/divider receives a ground level via pin H of the remote input jack J102. The ground is applied to one input of a NAND gate in Z10, enabling the gate, even if the other two inputs (from X0 and X4 lines) are logic 1 levels. The output level (logic 1) of the NAND gate is then applied through an inverter in Z7 as a logic 0 level (negative-going) pulse to pin H as in memory preset signal circuitry and activates the preset input of the memory assembly.

4-158. PRESELECTOR CONTROL SIGNAL. When the MHZ switch is set to any position except BCST, it generates two logic 1 levels on the X4 and X5 lines which are received simultaneously via pins W and X, respectively, at the inputs of a 2-input NAND gate in Z6. The gate generates an output which activates Q1 and Q2, developing a logic 0 level output at Q1. This level is routed via pin 8 to terminal E1 on the preselector assembly and applies it to the preselector filter control relay.

4-159. HI/LO SIGNAL TO MIXER/OSCILLATOR CONTROL. The high/low oscillator signal is generated in the NAND gate of Z10 which has its output connected to pin R of the assembly. This NAND gate monitors the binary code lines (X0 through X5) from the MHZ switch via pins S through X, logic gates in Z10, Z13, Z15, and an inverter in Z7, and generates a logic 1 level at its output when any of its inputs are logic 0 levels. This occurs when the MHZ switch is set to any position from 13 through 29 MHZ. The logic 1 level is then applied to pin C of the mixer/oscillator control. When the MHZ switch is set to 00 through 12 MHZ, the NAND gate in Z10 generates a logic 0 level at its output and this level is applied to pin C of the mixer/oscillator control.

4-160. TRUE COMPLEMENT SIGNAL. When binary coded signals X4 and X5 at pins W and X are dissimilar (one is a logic 1 and the other is a logic 0), an exclusive OR gate in Z15 is enabled and the resultant logic 1 output level is applied via pin 10 to the 3-12 mHz generator and mixer/divider assemblies. This occurs when the MHZ switch is set to any position from 10 through 29 MHZ, and causes the 3-12 mHz generator to generate frequency outputs in the order of 12-3 mHz instead of 3-12 mHz.

4-161. MIXER/OSCILLATOR CONTROL ASSEMBLY Z109. (See figure 7-20.)

4-162. The oscillator control portion of Z109 receives a logic 1 or logic 0 level (HI/LO in) at pin C from mHz display/divider assembly Z103. When the MHZ switch is set between 00 and 12 MHZ, a logic 0 level is applied at pin C. As a result, Q1 turns on Q3 and +8 volts is applied through Q3 and pin 2 to activate oscillator No. 2 in the 163.5-192.5 mHz oscillator assembly. When the MHZ switch is set between 13 and 29 mHz, a logic 1 level is applied to pin C, Q1 turns on Q2, and +8 volts is applied through Q2 and pin D to activate oscillator No. 1 in the 163.5-192.5 mHz oscillator assembly.

4-163. SAMPLE MIXER ASSEMBLY Z303. (See figure 7-46.)

4-164. The sample mixer receives a frequency sample at terminal E7 from the 163.5-192.5 mHz oscillator and a frequency sample at terminal E9 from the 160.5 mHz oscillator. The two frequency samples are connected to the inputs of high gain wideband differential amplifier Z1 which mixes the two frequencies and develops a 3-32 mHz output as the frequency. The output of Z1 is amplified by Q1 and Q2 and applied to output terminal E12, where it is routed to the sample divide/phase detector and to the mixer/oscillator control.

4-165. SAMPLE DIVIDE/PHASE DETECTOR ASSEMBLY Z107. (See figure 7-14.)

4-166. The sample divide section of the assembly is used to convert a 3-32 mHz sine wave, generated by the sample mixer assembly to a square wave to be utilized by the comparator assembly. The sine wave is received at pin R from the sample mixer assembly and applied to transistor amplifier Q1. Diode clipper CR1 provides d-c restoration and converts the sine wave to a series of d-c levels. This signal is applied to the input of dual flip-flop Z1, which divides the frequency by 3. Z1 is controlled by a 10-millisecond gating signal at its K inputs from the mHz display/divider assembly via pin 6. Z1 generates pulses during the 10-millisecond gating period and this output is applied to programmable divider Z3 and Z2. Z3 and Z2 function in conjunction with Z4 and Z5 to generate the desired 3333 pulse output at pin 3. Z4 and Z5 receive logic levels X0 through X3 from the MHZ switch via pins 5, 13, 19, and 9, respectively, and X4 and X5 from the mixer/divider assembly via pins 12 and 11, respectively. These are excess 3 inputs; that is, the binary coded inputs are always binary 3 above the actual setting of the front panel frequency controls. Z4 is a 4-bit binary adder and Z5 is a 2-bit binary adder. The carry output from Z4 is applied to Z5 and the combination functions to supply an excess three to binary conversion. Z6 through Z9 function as frequency extenders to enable Z2 and Z3 to operate in the frequency range above their design cutoff frequency of 8 mHz. The output of Z6 is a 3333 (3333 pulses per 10-millisecond gating period), which is applied via output pin 3 to the 3333 input of the comparator assembly.

4-167. COMPARATOR ASSEMBLY Z104. (See figure 7-8.)

4-168. The pulse input (3333 pulses per 10-millisecond period) from the sample divide/ phase detector assembly is applied via pin L to the clock input of 4-bit decade counter Z4. The pulses are divided by 10 in Z4 and 333 pulses are applied to the input of decade counter Z3, where it is divided by 10 again. The 33 pulse output is applied to Z2, where it is divided by 10 again. The 3 pulse output is applied to decade counter Z1. The outputs from Z1 through Z4 are applied to the data inputs of 8-bit bistable latches Z5 and Z6, where the data (3333, 333, etc.) is stored and all conditions are satisfied. A read signal (clock pulse) is received from pin 6 of Z14. Data is stored in Z5 and Z6 when a read signal from Z14 pin 6 is applied to the clock inputs of Z5 and Z6. The stored data is applied to the inputs of comparators Z7 through Z10. When the data being compared is equal, the A = B output, pin 3, of each comparator generates a logic high level at Z7, Z9, and Z1, and applies this level to the appropriate inverters and AND or NAND gates in Z11, Z12, and Z14. Z11 is a hex inverter; Z12 is a triple 3-input positive NAND gate; and Z14 is a quadruple 2-input positive AND gate.

4-169. The A greater than B output of Z7 generates a tune high/low output signal (logic high or low level) and applies it to pin A, where it is routed to the memory assembly. The A = B output, after inversion in Z11, is applied to pin B as a fast inhibit out signal (logic high or low level), and is routed from there to the memory assembly. The A = B output signal from Z9 is routed through an inverter in Z11 and an AND gate in Z14 to generate the coarse inhibit signal for output pin H. This signal is also routed to the memory assembly. The A = B output signal from Z10 is applied, via Z11 and Z14, to output pin 8 as a fine inhibit out signal for the memory assembly. When a phase detector sync signal is received as a high on pin F, the read pulse is disabled and no further changes are made in Z5 and Z6. Z5 and Z6 then stores the 3333 in memory which satisfies the comparator. The 1-mHz input at pin E from the 1-mHz standard provides a stable clock pulse to be used whenever applicable throughout the comparator assembly.

4-170. MEMORY ASSEMBLY Z105. (See figure 7-10.)

4-171. The memory assembly has three basic memory sections that are connected in series to generate a d-c control voltage (d-c tune) for the 163.5-192.5 mHz oscillator assembly. These sections are fast tune, coarse, tune, and fine tune. Each section consists of an input AND gate, two or more up/down counters, two or more programmable counters, a flip-flop, and a discriminator circuit.

4-172. The up/down counters at the input of the memory assembly continuously receive direction control data from the comparator assembly tune high/low circuit via pin 9 and logic signals and clock pulses at appropriate times to enable the gates and initiate counting. Preset pulses are received from the mHz display/divider assembly whenever the MHZ switch setting is changed in order to preset the counters to a setting which is approximately equidistant from all frequencies that can be tuned. The outputs of the up/down counters provide control voltages for the counting of the programmable counters. The programmable counters divide a fixed 7-mHz frequency by the divide-by-N number generated by the up/down counters. The resulting pulses from the programmable counters are then applied to the flip-flops which, in turn, convert the pulses to square waves. The square wave voltages are averaged by the discriminator circuit to provide a d-c tune level for the 163.5-192.5 mHz oscillator assembly.

4-173. FAST, COARSE, AND FINE MEMORY CIRCUIT OPERATION. The direction control inputs (tune high/low) of the up/down counters in the memory assembly Z1 through Z6 and Z16, are received via pin 9 from the comparator assembly. This data represents the frequency position of the oscillator in the 163.5-192.5 mHz oscillator assembly, as compared to the desired frequency. When any one of the inhibit inputs at pin 6, 7, or 2 receives a logic high level from the comparator assembly, the appropriate input AND gate is enabled, and a clock pulse is applied to the first of the up/down counters in the appropriate circuits as soon as a clock pulse arrives from the mHz display/divider assembly via pin 3c. The up/down counter is enabled and begins to count in the proper direction according to the tune high/low input signal. The following events occur when the MHZ switch on the front panel is reset to select a new frequency:

1. A preset pulse is received at pin 8 from the mHz display/divider assembly and applied to the loading input of each up/down counter, Z1 through Z6 and Z16. The outputs of each up/down counter are applied to its respective programmable counter. The up/down counters in each section operate serially, providing binary data for the appropriate programmable counter which, with its respective flip-flop, generates a square-wave output for the amplifiers and discriminator in that section. The discriminator develops a d-c level from the averaged voltages and applies it to output pin 10.

2. The programmable counters in the fast tune section (which is usually activated first), continues to count the last data received from its up/down counters. This data is stored by the up/down counters even after the fast tune inhibit line is disabled by a logic low level from the comparator.

3. The coarse tune inhibit input at pin 7 receives a logic high level which gates the up/down counters data to the respective programmable counters, and a d-c voltage is developed in the coarse tune discriminator circuit. When the coarse tune inhibit input receives a low level from the comparator, the input AND gate is disabled, the up/down counters stop counting up or down, and they continue to store the data for the programmable counters.

4. The fine tune inhibit input receives a logic high level from the comparator, gating its up/down counter data to their respective programmable counters, and a d-c level is developed in the fine tune discriminator circuit. When the fine tune inhibit input receives a logic low level, the input AND gate is disabled, the up/down counters stop, and continue to store the data for the programmable counters.

5. The d-c outputs of the three discriminator circuits add or subtract from each other, resulting in one d-c output at pin 10.

4-174. FAST TUNE MEMORY CIRCUIT. The tune high/low data is continuously applied from the comparator assembly via pin 9 to the down/up inputs of up/down counters Z16, Z1, and Z2. When the MHZ switch setting is changed, a preset pulse is received at pin 8 from the mHz display/divider assembly and applied to the loading inputs of Z16, Z1, and Z2. At the same time, the fast tune inhibit input AND gate A in Z13 receives a logic high level via pin 6; and a 10-millisecond clock pulse received from the mHz display/divider assembly via pins 3, c, enables input gate A so that its output clocks up/down counter Z2. This causes Z2 to count and provide its output pulses to programmable counter Z8. On the next 10-millisecond clock pulse, Z2 begins an up or down count, depending on the data received at its down/up input from the tune high/low line; Z8 begins to count its 7-mHz input by the binary input data from Z2 as memory data. Z1 begins to count in the same direction as Z2. A1 also applies its output to programmable counter Z7 and generates a clock pulse for up/down counter Z16. When further 10-millisecond clock pulses arrive, Z2 continues to count and store data in Z8; Z1 continues to count and store the data in Z7; and Z16 applies its data to programmable counter Z17. Programmable counters Z8, Z7, and Z17 receive a continuous 7 mHz clock pulse from the 3-12 mHz assembly, via pin 4 and input AND gate D of Z13, enabling an output for each of these counters whenever they receive inputs. Their outputs operate serially (first one, then the second, and then the third), and combine to produce a clock pulse for flip-flop A in Z14 which, in turn, generates a square wave for application to amplifiers Q1 and Q2, and discriminator circuit CR1 through CR4. The discriminator circuit produces a d-c level which is filtered and applied to output pin 10 as the d-c tune signal for the 163.5-192.5 mHz oscillator assembly.

4-175. COARSE TUNE MEMORY CIRCUIT. The tune high/low data is continuously applied from the comparator assembly via pin 9 to the down/up inputs of up/down counters Z3 and Z4. When the MHZ switch setting is changed, the preset pulses are also received from pin 8 by the loading inputs of up/down counters Z3 and Z4. At the same time, a 10-millisecond clock pulse is applied to AND gate B and a logic high level from the coarse tune inhibit input at pin 7 enables gate B. The output of the gate provides a clock pulse for up/down counter Z4. This causes Z4 to count and generate an output pulse for programmable counter Z10. When the next 10-millisecond clock pulse arrives from pins 3, c, Z4 begins an up or down count, depending on the tune high/low data at its down/up input; programmable counter Z10 begins to count its 7-mHz input by the binary input data from Z4 as memory data; and up/down counter Z3 begins to count in the same direction as Z4. When further 10-millisecond pulses arrive, Z4 continues to count and store data for programmable counter Z10; Z3 continues to count and now begins to store its output in programmable counter Z9. Programmable counters Z10 and Z9 receive a continuous 7-mHz clock pulse from the 3-12 mHz generator assembly, via pin 4 and gate D of Z13, enabling an output for each of these counters whenever they receive an input. The outputs of Z9 and Z10 operate serially, as the programmable counters in the fast tune circuit, and combine to provide a clock pulse for flip-flop B in Z14 which, in turn, generates a square wave for application to amplifiers Q3 and Q4, and discriminator CR5 through CR8. The discriminator circuit, connected in series with the discriminator of the fast tune circuit, develops a d-c level which adds or subtracts from the d-c level produced by the fast tune discriminator, and the resultant voltage is applied to the d-c tune signal output at pin 10.

4-176. FINE TUNE MEMORY CIRCUIT. The tune high/low data is continuously applied from the comparator assembly via pin 9 to the down/up inputs of up/down counters Z5 and Z6. When the MHZ switch setting is changed, preset pulses are received from pin 8 at the loading inputs of up/down counters Z5 and Z6. At the same time, a 10-millisecond clock pulse is received at input AND gate C in Z13, and a logic high level from the fine tune inhibit input at pin 2 enables gate C. The output of the gate provides a clock pulse for up/down counter Z6. This causes Z6 to count and generate an output pulse for programmable counter Z12. When the next 10-millisecond clock pulse arrives, Z6 begins an up or down count, depending on the tune high/low data at its down/up input; programmable counter Z12 begins to count its 7-mHz input by the binary input data from Z6 as memory data; and up/down counter Z5 begins to count in the same direction as Z6. When further 10-millisecond pulses arrive, Z6 continues to count and apply its output to programmable counter Z16; Z5 continues to count and now begins to store its output in programmable counter Z11.

Programmable counters Z11 and Z12 receive a continuous 7-mHz clock pulse from the 3-12 mHz generator assembly, via pin 4 and input AND gate D of Z13, enabling an output for each of these counters whenever they receive an input. The outputs of programmable counters Z12 and Z11 operate serially (first one output, then the other), and combine to provide a clock pulse for flip-flop A in Z15 which, in turn, generates a square wave for application to amplifiers Q5 and Q6, and discriminator circuit CR9 through CR12. The discriminator circuit, connected in series with the discriminators for the fast and coarse tune circuits, develops a d-c level which adds to, or subtracts from, the levels generated by the other two discriminator circuits, and the resultant d-c voltage is applied to the d-c tune signal line at pin 10.

4-177. 1 MHZ STANDARD.

4-178. The 1-mHz standard is a factory adjusted hermetically sealed unit which contains a high stability, crystal controlled oscillator circuit. The temperature within the unit is stabilized by a filament heated oven, powered by +12 vdc ± 10% at 1.2 amperes maximum current. The oven remains heated even when the receiver is set to STANDBY. The crystal oscillator requires a power input of +9 vdc ±5% at 30 milliamperes and generates a sine wave of 1.0 volt rms +50%, -10% into 50 ohms impedance. The stability of the oscillator reaches one part in 10^7 after a 4-hour warmup, and one part in 10^8 after a 24-hour warmup. The sine wave output is applied to the 3-12 mHz generator, mHz display/divider, comparator, BFO, and AFC assemblies.

4-179. 100 HZ SYNTHESIZER ASSEMBLY Z110. (See figure 7-22.)

4-180. A 100-Hz square wave is received via pin L from pin 18 of the digital counter and applied to the input of amplifier Q4. The output of Q4 contains all harmonics of 100 Hz, including the 30,000 harmonic, or 3 mHz. The secondary of transformer is selectively tuned to any one of the harmonics by a Varicap which is, in turn, controlled by a voltage input via pin D from the MHZ switch. The selected harmonic is applied to amplifier Q5, and the secondary of T4 is selectively tuned to the same harmonic as T3, but the variable capacitance controlled by Varicap CR2, and the same voltage input from the MHZ switch. The amplified harmonic is then applied to pin 2 of mixer Q2. A 2.25 to 3.25 mHz signal received via pin 9, is amplified by Q3 and applied to pin 3 of mixer Q2. The resultant 250-kHz output of the mixer is peaked by coul T2, amplified by Q1, and applied through transformer T1, also tuned to 250 kHz, to pin F of the assembly. Pin F is connected to the AFC switch and, when the receiver is operated in synthesized mode, the 250-kHz signal is routed to pin A of the sync/afc assembly.

4-181. DIGITAL COUNTER ASSEMBLY Z102. (See figure 7-4.)

4-182. The digital counter receives a 1-kHz clock pulse from the mHz display/divider which is divided by 10 in decade counter Z13. The output of Z13 provides a 100 Hz square wave for the 100 Hz synthesizer via pin 18 and a 10-Hz clock pulse for Z14. Decade counter divides the pulse again by 10, providing a 10-Hz clock pulse for flip-flop No. 1 in dual J-K master/slave flip-flop Z12. Flip-flop No. 2 generates counting pulses continuously, and the pulses from pin 12 of Z12 are applied to the clock input of the decade counter Z9 as long as the appropriate NAND gates in Z10 are enabled by a signal in the range of 1-2 mHz from pin Y. This signal (the exact frequency is determined by the operating frequency of the receiver) comes from pin J of the mixer/oscillator control assembly. Z9 provides a 100-kHz clock pulse for the clock pulse cp input of Z8 and, after dividing by 10, the 4-bit binary outputs at pins 12, 9, 8, and 11, are applied to the input pins 22, 16, 15, and 21 of one-half of 8-bit bistable latch Z3. The data is stored at the inputs until a 5-Hz clock pulse arriving at pin 12 from flip-flop No. 1 in Z12, via the gates and inverters of Z10 and Z11, reads them into the outputs at pins 19, 17, 18, and 20. They are then applied via pins 11, 9, 10, and 12 of the assembly to the binary coded decimal (BCD) 1, 2, 4, and 8 inputs of the 0.1 kHz digit on the readout display assembly. Z8 applies the counting during the counting enable time to the clock input pin 14 of Z7, and the same sequence of events occurs as in Z8, except now, the outputs of Z7 are applied to the inputs of the second half of Z3 and its output goes to the 1-kHz digit on the readout display via pins U, S, T, and V. Z7 applies the count to Z6, Z6 to Z5, and Z5 to flip-flop No. FF-1 in Z4, and the identical sequence of events occurs in each case as in Z7, each set of outputs being applied to its appropriate 4-bit bistable latch and to the appropriate digit of the readout display. The binary data for the 10 mHz digit, however, is received via pins 1 and 2 directly from the mHz display/divider assembly to Z1, and the data for the 1 mHz digit is received for Z1 via pins 8, 6, 5, and 7.

4-183. When the TUNE control on the front panel is set above 9999 on the last four digits of the display, Z4 generates a binary carry 1 output, changing the 1 mHz digit to the next higher number. For example, if the display reads 02.9999 and the TUNE control changes the (1's to 0's, the number will change to 03.0000. If the last three digits change from 0000 to 9999, Z4 generates a binary carry which subtracts 1 from the mHz digit.

4-184. READOUT DISPLAY ASSEMBLY Z101. (See figure 7-2.)

4-185. Binary coded decimal inputs representing the operating frequency of the receiver are received by the BCD-to-7 segment decoder/drivers, Z1 through Z6, via their respective input pins, from the digital counter assembly. Four binary bits are received by each decoder/driver corresponding to binary 1, 2, 4, and 8, respectively, except the 10 mHz decoder/driver. Z1 has only two inputs, binary 1 and 2, since the highest number to be displayed on this digit is 3. The outputs of the decoder/driver logic circuits cause the appropriate filament segments of the associated display lamp to glow, and the combination of the glowing segments form a lighted number to be displayed.

SECTION 5

MAINTENANCE

5-1. GENERAL.

5-2. This section contains the procedures required to maintain General Purpose Receiver GPR-110 in satisfactory operating condition. When performing the alignment and checkout procedures, refer to Section 6 for the overall component location diagrams and to the individual component location diagrams for the printed circuit board assemblies.

Note

> Some of the adjustments in the GPR-110 are in high frequency circuits and require the use of suitable test equipment. These adjustments have been performed at the factory and are sealed. It is not recommended that these seals be broken unless it is definitely ascertained that the circuit requires adjustment and the proper test equipment is available.

5-3. PREVENTIVE MAINTENANCE.

5-4. The following paragraphs describe procedures to inspect, check, and clean the components of the GPR-110. In general, preventive maintenance provides a basis for recognizing future probable causes of equipment malfunction in the early stages of deterioration. Many such cases are apparent to the senses of sight, touch, and smell. Therefore, by adhering to a stringent program of preventive maintenance, involving periodic inspection and checks, the most probable causes of equipment malfunction can be avoided, thereby minimizing equipment downtime and the possibility of compromising important schedules.

a. INSPECTION. A most important and least expensive tool in the preventive maintenance program is the sense of sight; a thorough visual inspection of an assembly or component for tell-tale signs of deterioration prior to failure can save hours of test and trouble shooting time after a complete breakdown. Table 5-1 presents a weekly inspection checklist for the GPR-110.

TABLE 5-1. WEEKLY INSPECTION ROUTINE

Assembly or Subassembly	Check
Line Power Cord	Check three-wire line power cord for cracks, nicks, or fraying.
Main Chassis Assemblies	1. Check underside of chassis for dirt and dust. 2. Check all inter-connector wiring for nicks, cracks, or fraying. 3. Check all printed circuit boards for cracks; check components for looseness and evidence of deterioration from possible overheating. 4. Check printed circuit board jacks for tightness against chassis. 5. Check ground connections for security.
Front and Rear Panels	1. Check panel for general cleanliness. 2. Check all control knobs for smooth action from limit-to-limit. Check all switches for positive action. 3. Check meter face for cracks, scratches, etc. 4. Check digital readout face for cracks. 5. Remove line fuses and check for proper a-c 1.5-ampere or 0.75-ampere value and condition (0.75-ampere with 230 vac line). The d-c line fuse should have an 8-ampere rating. 6. Check all input/output jacks for security against panel.

b. CLEANING. In general, the GPR-110 should be cleaned once a month, using a soft camel's hair brush, forced air pressure of not more than 20 psi, and a suitable cleaning agent such as trichloroethylene or methylchloroform.

WARNING

When using toxic solvents, make certain that adequate ventilation is provided; prolonged or repeated breathing of the vapor shall be avoided. Avoid prolonged or repeated contact with skin. Flammable solvents should not be used on energized equipment or near other equipment from which a spark may be received.

CAUTION

Trichloroethylene contains a paint removing solvent; avoid contact with painted surfaces.

Remove dirt or grease from wiring and chassis surfaces using cleaning solvent; dry with compressed air. Remove dust from printed circuit boards using a soft camel's hair brush. Blow out accumulated dust from inaccessible areas of chassis using forced air.

5-5. TROUBLESHOOTING.

5-6. In general, a malfunction of the GPR-110 will usually manifest itself by lack of, or improper reading on the digital readout or front panel meter. If a second GPR-110 is obtainable, or a set of spare PC boards is available, troubleshooting can be facilitated by the board substitution method. In some instances, a particular board may require alignment or adjustment as outlined in paragraph 5-7. Table 5-2 presents a troubleshooting chart for the GPR-110.

5-7. CHECKOUT AND ALIGNMENT.

5-8. The following paragraphs detail the checkout and alignment procedures for the GPR-110. Perform the procedures in the order presented.

TABLE 5-2. TROUBLESHOOTING CHART

Trouble	Probable Cause	Remedy
Receiver inoperative	AF GAIN control is not turned clockwise.	Turn AF GAIN control clockwise until receiver power comes on.
	STBY/REC pushbutton is not released to REC position.	Release STBY/REC pushbutton to REC position by pressing in one of the BANDWIDTH KHZ pushbuttons.
	Power supply assembly Z201 defective.	Check power supply assembly and replace defective component(s).
	External power inoperative.	Check external power.
	Line fuse(s) inoperative.	Check a-c line fuse (1.5 ampere for 115 vac line and 0.75 ampere for 230 vac line) and check d-c line fuse (8 ampere), and replace fuse if defective.
No receiver output on the broadcast band.	MHZ switch in incorrect BDCST position.	Check that MHZ switch is in first BDCST position if frequency of incoming carrier is between 00.0001 and 00.9999 and is in second BDCST position if frequency of incoming carrier is between 01.0000 and 01.9999.
No receiver output on any frequency.	Malfunctioning circuit in signal flow section or digital logic and control section.	1. Check for d-c tune voltage output (0 to 40 volts) at terminal 10 of memory assembly Z105. If d-c tune voltage present, proceed to step 2. If d-c tune voltage not present, proceed to step 3. 2. Insert a 250-kHz signal at approximately 150 millivolts into J107 and check for

TABLE 5-2. TROUBLESHOOTING CHART (Continued)

Trouble	Probable Cause	Remedy
		loudspeaker output. If speaker output is not present, check symmetrical filters Z112 and Z113, audio assembly Z114, and USB filter Z115. If speaker output is present, insert a 3-2 mHz signal at a 0.5 microvolt level into terminal E1 of tunable IF assembly Z301 and check for a 250-kHz output at terminal E9. If 250-kHz output is not present, check tunable IF assembly Z301 and replace defective component(s). If 250-kHz output is present, insert a 0.5 microvolt level signal at the antenna input at the receiver operating frequency and signal trace through preselector Z120, RF input mixer Z307, differential amplifier Z306, and IF output mixer Z305 and replace defective component(s).
		3. The absence of a d-c tune voltage indicates a malfunction in the digital logic and control section. Proceed to check and alignment procedures, paragraph 5-7.

5-9. INITIAL CHECKOUT.

1. Connect a-c power to the GPR-110.

2. Rotate the AF GAIN/AC OFF control clockwise and press any one of the BANDWIDTH KHZ pushbuttons.

3. Press the TEST LAMP pushbutton on the rear panel of the unit. All six digits of the counter display should indicate the number 8.

4. Monitor the +5 and +9 volt terminals on upper mother board A4960 and adjust, if necessary.

5. Monitor the 1-mHz terminal on the upper mother board A4960 for a sine-wave signal that is exactly 1 mHz.

Note

The 1-mHz standard must be on for at least 30 minutes before it stabilizes.

5-10. AUDIO ASSEMBLY Z114.

1. Connect a 3-ohm 5-watt resistor from terminal A to ground (can be inserted into PHONES jack).

2. Connect an audio generator to terminal B with audio gain fully clockwise (USB and LSB removed).

3. Adjust audio level for approximately 5.6 volts peak-to-peak across a 3-ohm load (approximately 1 watt). The input should be approximately 40 millivolts peak-to-peak.

5-11. DIFFERENTIAL AMPLIFIER ASSEMBLY Z306.

1. Adjust signal generator to 163 mHz.

2. Lift coaxial cable on terminal E27 of Z307 and connect signal generator output to coaxial cable.

3. Set RF GAIN control fully clockwise.

4. Adjust capacitors C1, C2, C3, and C4 for maximum gain (approximately 20 dB).

5-12. COMPARATOR ASSEMBLY Z104.

1. Remove the memory assembly from Z105 and insert a variable voltage supply (0 to +40 vdc) to terminal 10 of Z105.

2. Set MHZ switch to 00 and monitor terminal R of Z107.

3. Set the frequency at terminal R of Z107 above 3 mHz using the variable voltage supply.

4. Monitor terminal A of Z104 and observe a high level.

5. Adjust the frequency below 3 mHz and observe a low level on terminal A of Z104.

6. Check fast, coarse, and fine terminals B, H, and 8, respectively. As the frequency is approached, the inhibit lines go low. When a sync condition is attained, lines B, H, and 8 go low. Also, terminal J is low and terminal 2 of Z107 is high. Test points 5, 6, 8, 9, 12, 13, 16, and 17 are high and test points 7, 10, 11, 14, 15, 18, and 19 are low.

7. Insert memory assembly Z105 and monitor terminal R of Z107. Check for sync in all positions (3-32 mHz).

5-13. MIXER/DIVIDER ASSEMBLY Z108.

1. Monitor at the junction of L15 and L3.

2. Set MHZ switch to 10 and adjust the 25 mHz circuits T4, T5, T6, and C40 for 25 mHz.

3. Set MHZ switch to 20 and adjust T1, T2, T3, and C8 for 35 mHz.

4. Set MHZ switch to 00 and monitor terminal K.

5. Vary the power supply output voltage connected to terminal 10 of Z105. The output should be 3-12 mHz at terminal E.

6. Set MHZ switch to 10 and increase the supply voltage. The output should be 13-15 mHz at terminal E and 12-10 mHz at terminal K.

7. Set MHZ switch to 13 and increase the supply voltage. The output should be 16-22 mHz at terminal E and 9-3 mHz at terminal K.

8. Set KHZ switch to 20 and increase the supply voltage. The output should be 23-32 mHz at terminal E and 12-3 mHz at terminal K.

5-14. SAMPLE DIVIDE/PHASE DETECTOR ASSEMBLY Z107.

1. Insert a variable voltage power supply (0 to +40 vdc) in place of memory assembly Z105 at terminal 10.

2. Open terminal 6 of Z107.

3. Monitor terminal R with a high frequency counter and monitor terminal 3 with a scope/counter.

4. Set MHZ switch to 00 and vary power supply voltage until terminal R indicates 3.000 mHz. Terminal 3 should indicate 3.333.

5. Set MHZ switch to 01 and vary power supply voltage until terminal R indicates 4.000 mHz. Terminal 3 should indicate 3.333.

6. Set MHZ switch to 02 and vary power supply voltage until terminal R indicates 5.000 mHz. Terminal 3 should indicate 3.333.

7. Adjust variable supply accordingly. Terminal R reads 3.0 mHz higher than display. Check all MHZ positions (00 through 29). Check terminal 2 for a high when frequency is locked (ex. 3.333).

5-15. 160.5 MHZ OSCILLATOR ASSEMBLY Z302.

1. Place extender card in Z107 and ground pins 17, Y, and Z. The output at terminal E5 of Z302 should be approximately 0.5 to 1.0 volt rms.

2. Connect a high frequency counter to terminal E5 and adjust the oscillator coil for a reading of 160.5 mHz.

5-16. 163.5-192.5 MHZ OSCILLATOR ASSEMBLY Z304.

1. Monitor terminal E21 with a high frequency counter.

2. Connect a variable power supply (0-40 vdc) to terminal 10 of memory assembly Z105.

3. Set MHZ switch to 00 and monitor terminal R of sample divide/phase detector assembly Z107 with an oscilloscope.

4. Adjust power supply for an output of approximately 3.0 vdc and adjust low frequency oscillator to 163.5 mHz.

5. Adjust power supply for an output of approximately 15-20 vdc. The low frequency oscillator output should be 175.5 mHz. The output range at terminal R should be 3-15 mHz.

6. Set MHZ switch to 13, adjust power supply for an output of 3.0 vdc, and adjust high frequency oscillator to 176.5 mHz.

7. Adjust power supply for an output of approximately 15-20 vdc. The high frequency oscillator output should be 192.5 mHz. The output range at terminal R should be 16-32 mHz.

Note

If the high end adjustments of the low and high frequency oscillators cannot be made with 20 vdc maximum, shift the low frequency end with less than 3.0 vdc.

5-17. 100 HZ SYNTHESIZER ASSEMBLY Z110.

1. Lift terminals 9 and L on the extender card.

2. Set bandswitch to band 1.

3. Measure the d-c voltage on terminal D. The voltage should increase as the bandswitch is turned clockwise. Return bandswitch to full counterclockwise position.

4. Apply 250 kHz to terminal 9.

5. Connect oscilloscope to R3 and adjust T5 and T6 for 250 kHz (minimum level).

6. Connect signal generator (250 kHz) to R7 and connect oscilloscope to pin F. Adjust T1 and T2 for maximum output.

7. Connect signal generator to terminal L and adjust R26 and R28 to mid range.

8. Set signal generator to 2.060 mHz.

9. Connect oscilloscope to R7 and adjust T3 and T4 for maximum output.

10. Set bandswitch fully clockwise, set signal generator to 2.9 mHz, and adjust R26 and R28 for maximum output.

11. Check for approximately 8 vdc at terminal D.

12. Repeat steps 8 through 11 until no further improvement can be obtained.

13. Reconnect terminals 9 and L.

5-18. PRESELECTOR ASSEMBLY Z120.

1. Remove preselector assembly and connect output of an r-f signal generator to the ANT input connector.

2. Set signal generator to 880 kHz at an output level of approximately 1 volt rms.

3. Monitor the junction of L5 and C5 on the preselector assembly. Adjust C5 for maximum signal. Reduce the signal generator output level and tune C5 for maximum signal using a minimum input signal.

4. Monitor the preselector assembly output.

5. Sweep the signal generator frequency from 100 kHz to 2 mHz. The filter in the preselector assembly should cut off all frequencies from 500 kHz to 1.5 mHz.

6. Replace the preselector assembly.

5-19. DIGITAL COUNTER ASSEMBLY Z102.

1. Press the WIDE BANDWIDTH KHZ pushbutton.

2. Monitor terminal 18 of Z102 for a 100-Hz square-wave signal at approximately +4 volts.

3. Rotate the MHZ switch clockwise until the counter display indicates the <u>SECOND</u> 00MHZ position.

4. If necessary, adjust the MHZ knob so that the white dot on the knob indicates the first broadcast band position as the counter display is indicating the SECOND 00MHZ.

5. Rotate the MHZ control through all of the positions. The MHZ display should indicate the following positions in order:

00MHZ, 00MHZ, 01MHZ, 01MHZ thru 29MHZ
└BDCST┘

6. Set the tunable IF to band 1. Adjust the frequency control fully clockwise. The MHZ display should indicate the following positions in order:

01MHZ, 01MHZ, 02MHZ, 02MHZ thru 30MHZ
└BDCST┘

7. Set the tunable IF to band 10. Adjust the frequency control fully counterclockwise. The MHZ display should indicate the following positions in order:

39MHZ, 39MHZ, 00MHZ, 00MHZ thru 28MHZ
└BDCST┘

8. Check of the display digits (100 kHz, 10 kHz, 1 kHz, and 0.1 kHz) and verify each digit from 0 through 9.

9. Press the STBY pushbutton and remove extender card A5601 from Z102 and insert A4955 into Z102.

5-20. MHZ DISPLAY/DIVIDER ASSEMBLY Z103.

1. Extend Z103 and press the WIDE BANDWIDTH KHZ pushbutton.

2. Monitor the signal at terminal D. A 1-kHz square wave signal at approximately +4 volts should be present.

3. Monitor the signal at terminal 3. A 250-kHz square-wave signal at approximately +4 volts should be present.

4. Monitor the signal at terminals 5 and 7. A 11-millisecond period square wave (10-millisecond positive excursion and 1-millisecond negative excursion) at approximately +4 volts should be observed.

5. Monitor the voltage at terminal K. The voltage should be -8 volts.

6. Monitor the signal at terminal 8. With the MHZ switch in the BDCST position, a low level should be observed (semiconductor virtual ground). All other positions of the MHZ switch result in a high level of approximately +20 volts.

7. Monitor the signal at terminal R. A low level (semiconductor virtual ground) should be observed for positions 00 MHZ through 12 MHZ. Positions 13 MHZ through 29 MHZ result in a high level of approximately +4 volts.

8. Monitor the signal at terminal 10. A low level should be observed for positions 00 MHZ through 09 MHZ. Positions 10 MHZ through 29 MHZ result in a high level of approximately +4 volts.

9. Monitor the signal at terminal H. A negative going pulse (positive voltage to ground) should be observed every time the MHZ switch is changed in either direction.

10. Rotate the MHZ switch through all of its positions in a clockwise direction and then all positions in a counterclockwise direction.

11. Ground terminal P. The level at terminal H should go from a high to a low.

12. Press the STBY pushbutton, remove extender card A5601 from Z103, and insert A4958 into Z103.

5-21. MIXER/OSCILLATOR ASSEMBLY Z109.

1. Extend A4957 from Z109 and press the WIDE BANDWIDTH KHZ pushbutton.

2. Monitor TP5 and adjust L2, L3, and L4 for a maximum signal at 4.25 mHz.

3. Monitor terminal J using a frequency counter. The frequency on the external counter should agree with the frequency displayed on the receiver.

Note

The MHZ digits will not agree.

4. Monitor the signal at terminal 2. A level of +8 volts should be observed for MHZ switch positions 00MHZ through 12MHZ.

5. Monitor the signal at terminal D. A level of +8 volts should be observed for MHZ switch positions 13MHZ through 29MHZ.

6. Press the STBY pushbutton, remove extender card A4984 from Z109, and insert A4957 into Z109.

5-22. 3-12 MHZ GENERATOR ASSEMBLY Z106.

1. Extend A4952 from Z106 and depress the WIDE pushbutton.

2. Monitor the signal at terminal C. A 7-mHz square-wave signal at approximately +4 volts should be observed.

3. Monitor the signal at terminal E. A 10-mHz square-wave signal at approximately +4 volts should be observed.

4. Monitor the signal at terminal 8 for the following frequencies:

MHZ Switch Position	Frequency at Terminal 8 (mHz)
00	3
BDCST 00	3
BDCST 01	4
01	4
02	5
03	6
04	7
05	8
06	9
07	10
08	11
09	12
10	12
11	11

MHZ Switch Position	Frequency at Terminal 8 (mHz)
12	10
13	9
14	8
15	7
16	6
17	5
18	4
19	3
20	12
21	11
22	10
23	9
24	8
25	7
26	6
27	5
28	4
29	3

5. Press the STBY pushbutton, remove extender card A4952 from Z106, and insert A4952 into Z106.

5-23 MEMORY ASSEMBLY Z105.

1. Extend A4951 from Z105.

2. Press the WIDE pushbutton.

3. It may be necessary to check the +5-volt line because of the amount of power used by A4951. Retest if necessary.

4. Set MHZ switch to 00MHZ.

5. Monitor the signal at terminal R of Z107 for exactly 3 mHz.

6. Step the MHZ switch through each position and observe a corresponding sync frequency for each position.

Note

> Because of frequency limitation of the test equipment used and also the availability of test equipment, terminal R may be difficult to observe at the higher frequencies. In this case, terminal X may be used as a monitor point instead of terminal R. However, the sync frequencies observed will be the same as shown in paragraph 5-22. For each of the frequencies checked, terminal 3 will indicate a frequency of 333.3 kHz.

7. A d-c tuning voltage should be observed at terminal 10 of Z105.

8. Press the STBY pushbutton and remove extender card. Insert A4951 into Z105.

5-24. SYNC/AFC ASSEMBLY Z117.

1. Remove Y1 (1.25 mHz crystal) and adjust R10 fully clockwise

2. Connect a signal generator set at 250-kHz with no modulation on FL1 output. Adjust signal generator for a 2-millivolt (lowest) output possible.

3. Connect oscilloscope to junction of C12 and R15 and adjust L4 for maximum output, keeping signal as low as possible (150 millivolts).

4. Connect oscilloscope to junction of C17 and R17 and adjust L5 input as low as possible. Input should be approximately 220 microvolts for 150 millivolt output.

5. Connect oscilloscope to junction of C26 and R31. Keeping input as low as possible, tune L6 to maximum. Input should be approximately 12 microvolts for 150 millivolt output.

6. Connect oscilloscope to C27. Keeping input as low as possible, tune L10 to maximum. Input should be approximately 2 microvolts for 150 millivolt output.

7. Connect oscilloscope to C31. Input should be 15 microvolts for 1.5 volt output.

8. Carrier indicator on readout assembly should be lit with approximately 10 microvolt input.

9. With 10 microvolt input, pin 1 of Q10 should be approximately 0.6 volt. Collector of Q11 should be 5 volts peak-to-peak. The base of Q12 should be +0.7 volt and the collector should be low.

10. Adjust R10 1/4 turn from full counterclockwise position. Reconnect oscilloscope to C31 and connect 250-kHz input at 150 microvolts to pin A. Output should be approximately

1.2 volts peak-to-peak. (Readjust R10 for 1.2 volts peak-to-peak, if necessary. Check filter FL1 for proper ±40 Hz bandwidth.)

11. Insert 1.25-mHz crystal. Remove wire going to E MOD terminal on oscillator assembly, and ground E MOD to PC712. Set FINE TUNE to center and check output frequency of XVCO (set to 250 kHz). Also check range of FINE TUNE with oscilloscope on C31. Oscillator leakage should be no greater than 0.2 volt with 250 kHz disconnected. Connect Hewlett-Packard 410B to P7 (1 volt scale, 0 center) and adjust R29 (BAL) to 0 volt and adjust front panel meter (in SYNC position) to center scale with R44. If zero cannot be attained, check at cathode of CR9 for balance.

12. Recheck that carrier indicator is off until 150 microvolt input 250 kHz ± 40 Hz is inserted. Check XVCO output which should be 150 millivolts peak-to-peak.

13. The AFC should now be operating. Check by varying 250-kHz input with FINE TUNE control in center carrier. Light should stay lit for full range of AFC. Set front panel meter to 0 center frequency and turn FINE TUNE control to both extremes. The SYNC meter should follow. Also, the carrier indicator should stay lit.

14. Connect signal generator to REC INPUT and reconnect 250-kHz to REC. Set signal generator to 2.3 mHz and tune receiver on CW to light carrier indicator. The AFC loop should now have control of VFO oscillator and lock in signal. A slight adjustment of R10 may be necessary.

5-25. XVCO ASSEMBLY.

1. Adjust C5 and R1 to mid range.

2. Measure level and frequency of oscillator with oscilloscope at junction of Y1 and C5. Adjust C5 to 1.25000 mHz. The level should be 125 millivolts.

3. Measure level at junction of C6 and R9. The level should be 1.2 volts.

4. Connect oscilloscope to E4. The frequency should be 250 kHz at a 0.9 volt level.

5. Adjust FINE TUNE control from minimum to maximum. The output frequency should change approximately ±40 Hz. A readjustment of C5 may be necessary.

5-26. AUDIO SECTION.

1. Connect a 600-ohm load resistor across pins 13 and 15 of audio mother board. Replace speaker with a 3-ohm 10-watt resistor load. Place MODE switch on USB, BFO on fixed, ANL on off, squelch on off, and RF GAIN switch to AGC. Apply a 250 kHz sine wave at 1 millivolt into rear of unit.

2. Monitor pin j of PC689 and vary input frequency for maximum output. Monitor the following points on PC689 and adjust corresponding resistors for desired voltage:

Pin 1 of Q4	0.5 Vpp	Approximately 250 kHz	Adjust R31
Pin 10 of Z1	0.5 Vpp	Approximately 500 Hz	Adjust R31
Pin J of PC689	8 Vpp	Approximately 500 Hz	USB line adjust
Collector of Q7	8 volt square wave	Approximately 250 kHz	Adjust R38
Pin 7 of PC689	-7 vdc	Approximately 250 kHz	Adjust R38
Pin D of PC689	6 Vpp	250 kHz	Check values
Pin 8 of PC689	0.24 Vpp	500 Hz	Check values

5-27. BFO ASSEMBLY Z118.

1. Monitor pin K. There should be a 250-Hz sine wave at 6 volts peak-to-peak.

2. If the output is not exact, check accuracy of 1-mHz input.

5-28. TUNABLE IF ASSEMBLY Z301.

1. Connect +9 vdc to pin 7 and to one end of frequency control potentiometer. Position selector switch on band 1. Adjust R52 fully clockwise. Monitor pin 5 with oscilloscope and counter. Set frequency control potentiometer fully clockwise (lowest frequency). Adjust T5 until output frequency is 2.248 mHz (0.25 Vpp).

2. Select band 10. With frequency control potentiometer still fully clockwise, adjust C36 until output frequency is 3.062 mHz. Turn frequency control fully counterclockwise. Adjust R42 until output is 3.284 mHz. Select band 1 and return frequency control fully clockwise. Output should return to 2.248 mHz. If frequency does not return, retune T5 and repeat the procedure.

3. Select band 2. Set frequency control fully clockwise (lowest frequency). By adjusting C28, set output frequency to 2.306 mHz. The remaining bands follow the same procedure as band 2.

Band	Adjustment	Osc. Output (MHz)
3	C29	2.388
4	C30	2.462
5	C31	2.548
6	C32	2.629
7	C33	2.739
8	C34	2.822
9	C35	2.989

4. Turn frequency control fully counterclockwise. Keeping control in this position, switch through bands 1 to 9. Record the highest frequency on each band. The outputs for this example which are only approximate values, are:

Band	Highest Osc. Output (MHz)
1	2.328
2	2.289
3	2.482
4	2.564
5	2.667
6	2.754
7	2.892
8	2.992
9	3.195

5. To obtain the midband frequency for each band, take the difference of the highest and lowest frequency, divide by 2, add to the low frequency, and record values. For this example, frequencies are:

Band	Osc. Midband Frequency (MHz)
1	2.288
2	2.348
3	2.434
4	2.513
5	2.608
6	2.692
7	2.816
8	2.907
9	3.092
10	3.173 (Exact Value)

6. To obtain the r-f limits of each band, subtract 250 kHz from the highest, lowest, and midband frequencies of the oscillator bands.

Band	Lowest (MHz) (Exact Values)	Highest (MHz) (Approximate Examples)	Midband (MHz) (Approximate Examples)
1	1.998	2.078	2.038
2	2.056	2.139	2.098
3	2.138	2.232	2.184
4	2.212	2.314	2.263
5	2.298	2.417	2.358
6	2.379	2.504	2.442
7	2.484	2.642	2.566
8	2.572	2.742	2.657
9	2.739	2.945	2.842
10	2.812	3.034 (Exact)	2.923 (Exact)

7. Apply a 2-3 mHz sine wave at 30 millivolts into pin 1. Select band 1. Using frequency control, adjust oscillator to midband frequency (in this case, 2.288 mHz). Monitoring TP1, set r-f input to midband (2.038 mHz). Monitoring TP3, adjust T1 for maximum

output. Monitoring TP2 and TP4, adjust T2 and T3, respectively, for maximum output. Voltage at TP4 should be approximately 1.1 Vpp.

8. Select band 2. Set oscillator frequency to midband (2.348 mHz). Monitoring TP1, set r-f input to midband (2.098). Monitor output at each stage (TP3, TP2, TP4) and peak output by adjusting C1, C10, and C19, respectively. The procedure for the remaining bands is the same as for band 2.

Band	Osc. Midband Frequency	R-f Midband Frequency	TP3	TP2	TP4
3	2.434	2.184	C2	C11	C20
4	2.513	2.263	C3	C12	C21
5	2.608	2.358	C4	C13	C22
6	2.692	2.442	C5	C14	C23
7	2.816	2.566	C6	C15	C24
8	2.907	2.657	C7	C16	C25
9	3.092	2.842	C8	C17	C26
10	3.173 (Exact)	2.923 (Exact)	C9	C18	C27

9. Select band 1. Set oscillator at midband (2.288 mHz) and r-f input at midband (2.038 mHz). Monitor pin 9. Output at this point should be 250 kHz ± 0.1%. At exactly 250 kHz, adjust T4 and T6 for maximum output (1.7 Vpp).

10. Set r-f input to 1.998 mHz. Set frequency control potentiometer fully clockwise. Output at pin 9 should be 250 kHz ± 0.1%.

11. Set r-f input to upper limit of r-f input for band 1 (in this case, 2.078 mHz). Set frequency control potentiometer fully counterclockwise. Output at pin 9 should be 250 kHz ± 0.1%. Repeat this procedure for the remaining 9 bands.

5-29. SAMPLE MIXER ASSEMBLY Z303.

1. Monitor terminal E12.

2. Check for the following output levels at the indicated frequency:

1.5 Vpp at 3 mHz	0.8 Vpp at 25 mHz
1.0 Vpp at 20 mHz	0.5 Vpp at 32 mHz

SECTION 6

PARTS LIST

6-1. GENERAL.

6-2. This section contains the parts list for the GPR-110. The parts list first lists the mechanical assemblies and continues in reference designation order of the assemblies comprising the unit, and follows the same order of arrangement of the schematic and component location diagrams in Section 7.

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.
		FINAL ASSEMBLY AX5184			
	Test Card	A4984		Jumper, Coax. Rear Panel	CA480-3-4 inch
	Power Supply Assembly	BMA513		Marking, Plate Right Side	LD3013
	Main Chassis Assembly	BMA515		1 MHz Standard	NF120
	Front End Assembly	BMA516		Top Cover	MS6499-1
				Bottom Cover	MS6499-2
		FRONT END ASSEMBLY			
Z101	Readout Display Assembly	A4959		Capacitor, Fixed, Ceramic (28)	CC100-28
	Tuning Gear Assembly	AX5186		Handle, Locking	LK108
	Diode, Light Emitting	BI132 (LED 5082-4880)		Marking, Front Panel	LD3014

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.

FRONT END ASSEMBLY (Continued)

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.
	Marking, Escutcheon	LD3020		Resistor, Variable, Composition (AF GAIN)	RV4BTSC502D
	Speaker, Per. Mag.	LS108		Resistor, Variable, Composition (RF GAIN)	RV4BTSC505B
	Knob (5)	MP127-3FB		Resistor, Variable, Composition (FINE TUNE)	RV106UF12 A101A
	Knob, BFO	MP127-5FB		Switch, Slide (SYNC)	SW163
	Knob, TUNE	MP146		Switch, Rotary	SW454
	Knob, SYNC	MP127-2FB		Switch, MHZ, Step	SW548
	Meter, Milliamp	MR236		Switch, Multi, Interlock (MODE)	SW558
	Housing, Readout	MS5694		Switch, Multi, Push Lock (MODE)	SW559
	Cover, Housing	MS6495		Terminal (3)	TE115-1
	Grill, Speaker	MS6504			
	Bracket, Meter	MS6506			
	Spacer, Switch (8)	PX1242-1			
	Spacer, Switch (4)	PX1242-2			
	Window, Display	PX1244			
	Resistor, Variable, Composition (2) (BFO, SQUELCH)	RV4ATSA103A			

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.
MAIN CHASSIS AND REAR PANEL ASSEMBLY					
J102	Connector, Receptacle	JJ319-22D-F-E	Z108	Mixer/Divider Assembly	A4954
J103	Same as J102		Z109	Mixer/Oscillator Control Assembly	A4957
J105	Connector, Receptacle	JJ146	Z110	100 Hz Synthesizer Assembly	A4950
J106 thru J110	Connector	UG625/U	Z111	Digital Logic and Control Mother Board	A4960
R106	Resistor, Variable, Composition	RV4NAYSA502A	Z114	Audio Assembly	A4962
R107	Same as R106		Z117	Sync/AFC Assembly	A4964
Z102	Digital Counter Assembly	A4955	Z118	BFO Assembly	A4965
Z103	MHz Display Divider Assembly	A4958	Z119	Audio Filter Mother Board	A4966
Z104	Comparator Assembly	A4956	Z120	Preselector Assembly	AX5196
Z105	Memory Assembly	A4951		Sync Detector Assembly (p/o Z107)	A4981
Z106	3-12 MHz Generator Assembly	A4952		Multiplier Bandpass Filter Assembly (p/o Z108)	A4980
Z107	Sample Divide/ Phase Detector Assembly	A4953			

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.

MAIN CHASSIS AND REAR PANEL ASSEMBLY (Continued)

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.
	Cable, Coaxial	CA480-178-5		Cable, Main	CA1755
	Cable, Pre-selector Input	CA1778		Cable, Main	CA1756

FRONT END ASSEMBLY

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.
Z301	Tunable IF Assembly	A4977	Z305	IF Output Mixer Assembly	A4973
Z302	160.5 MHz Oscillator Assembly	A4971	Z306	Differential Amplifier Assembly	A4975
Z303	Sample Mixer Assembly	A4979			
Z304	163.5-192.5 MHz Oscillator Assembly	A4976	Z307	RF Input Mixer Assembly	A4974

TUNING GEAR ASSEMBLY

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.
	Bearing, Nylon, Panel	BB117-5		Plate, Switch, Front	MS6527
	Gasket, Neoprene	GA137-2		Shaft, Switch	PM1574
	Gear, Pinion	GR109-2		Resistor, Variable, Composition	RV117-2-102
	Gear, Spur, Hub	GR205-22		Spring	SP103
	Plate, Switch, Rear	MS6526		Spacer, Threaded	TE0440BN58H

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.
		TEST CARD A5601			
	Connector, Receptacle	JJ319-22D-P-E		Terminal Stud (44)	TE127-2
	Test Card, PC	PC718			
		TEST CARD A4984			
	Connector, Receptacle	JJ319-10D-P-E		Terminal Stud (20)	TE127-2
	Test Card, PC	PC708			
		BYPASS FILTER ASSEMBLY A5627			
C1 thru C5	Capacitor, Fixed, Ceramic	CC100-28	L1 thru L5	Coil, RF	CL275-103
		READOUT DISPLAY ASSEMBLY A4959 (Z101)			
C1	Capacitor, Fixed, Ceramic	CC100-43	DS3	Lamp, Digital Display	BI131-2
C2	Capacitor, Fixed, Ceramic	CC100-28	DS4 thru DS6	Same as DS1	
CR1	Semiconductor, Device, Diode	1N3821A	E1 thru E27	Terminal, Miniature	TE168-4-B
DS1	Lamp, Digital Display	BI131	R1	Resistor, Fixed, Composition	RC32GF3R3J
DS2	Same as DS1				

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.
		READOUT DISPLAY ASSEMBLY A4959 (Z101) (Continued)			
XDS1 thru XDS6	Socket, Lamp	TS210	Z1 thru Z6	Microcircuit, Digital	NW211
		DIGITAL COUNTER ASSEMBLY A4955 (Z102)			
C1 thru C4	Capacitor, Fixed, Ceramic	CC100-43	Z3	Same as Z1	
L1	Coil, RF, Fixed	CL275-100	Z4	Microcircuit, Digital	NW207
R1	Resistor, Fixed, Composition	RC07GF102J	Z5 thru Z29	Microcircuit, Digital	NW204
R2	Same as R1		Z10	Microcircuit, Digital	NW206
R3	Resistor, Fixed, Composition	RC07GF182J	Z11	Microcircuit, Digital	NW187
R4	Resistor, Fixed, Composition	RC07GF332J	Z12	Microcircuit, Digital	NW159
Z1	Microcircuit, Digital	NW201	Z13	Same as Z5	
Z2	Same as Z1		Z14	Same as Z5	
		MHz DISPLAY/DIVIDER ASSEMBLY A4958 (Z103)			
C1	Capacitor, Fixed, Electrolytic	CE105-200-16	C2 and C3	Capacitor, Fixed, Ceramic	CC100-41

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.
MHz DISPLAY/DIVIDER ASSEMBLY A4958 (Z103) (Continued)					
C4	Capacitor, Fixed, Electrolytic	CE105-1-16	R6	Resistor, Fixed, Composition	RC07GF390J
C5 and C6	Capacitor, Fixed, Electrolytic	CE105-100-16	R7	Resistor, Fixed, Composition	RC07GF182J
C7	Same as C2		R8 thru R13	Resistor, Fixed, Composition	RC07GF103J
CR1 thru CR3	Semiconductor, Device, Diode	1N914	Z1	Microcircuit, Digital	NW204
CR4	Semiconductor, Device, Diode	1N756	Z2	Microcircuit, Digital	NW207
L1 thru L3	Coil, RF, Fixed	CL275-100	Z3 thru Z5	Same as Z1	
Q1	Transistor	2N697	Z6	Microcircuit, Digital	NW206
Q2 and Q3	Transistor	2N3646	Z7	Microcircuit, Digital	NW205
Q4 and Q5	Transistor	2N1711	Z8	Same as Z2	
R1 thru R3	Resistor, Fixed, Composition	RC07GF472J	Z9	Microcircuit, Digital	NW189
R4	Resistor, Fixed, Composition	RC07GF102J	Z10	Microcircuit, Digital	NW199
R5	Resistor, Fixed, Composition	RC07GF332J	Z11	Same as Z7	
			Z12	Same as Z10	

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.

MHz DISPLAY/DIVIDER ASSEMBLY A4958 (Z103) (Continued)

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.
Z13	Microcircuit, Digital	NW208	Z15	Same as Z9	
Z14	Microcircuit, Digital	NW200	Z16	1 MHz Switching Assembly	A4982

COMPARATOR ASSEMBLY A4956 (Z104)

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.
C1 thru C3	Capacitor, Fixed, Ceramic	CC100-28	Z5 and Z6	Microcircuit, Digital	NW201
C4 and C5	Capacitor, Fixed, Mica	CM111E102J1S	Z7 thru Z10	Microcircuit, Digital	NW209
L1	Coil, RF, Fixed	CL275-100	Z11	Microcircuit, Digital	NW205
R1	Resistor, Fixed, Composition	RC07GF182J	Z12	Microcircuit, Digital	NW210
R2	Resistor, Fixed, Composition	RC07GF332J	Z13	Microcircuit, Digital	NW159
R3 and R4	Resistor, Fixed, Composition	RC07GF102J	Z14	Microcircuit, Digital	NW208
TP1 thru TP22	Terminal, Stud	TE127-2	Z15	1 MHz Switching Assembly	A4982
Z1 thru Z3	Microcircuit, Digital	NW204			
Z4	Microcircuit, Digital	NW190			

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.
		MEMORY ASSEMBLY A4951 (Z105)			
C1 and C2	Capacitor, Fixed, Ceramic	CC100-28	C22	Capacitor, Fixed, Ceramic	CC100-29
C3	Capacitor, Fixed, Mylar	CN112B474K1	C23	Same as C1	
			C24	Not Used	
C4	Capacitor, Fixed, Electrolytic	CE105-50-16	C25 and C26	Same as C1	
C5 thru C8	Same as C1		C27	Capacitor, Fixed, Ceramic	CC100-33
C9	Capacitor, Fixed, Mica	CM112E103J1S	CR1 thru CR12	Semiconductor, Device, Diode	1N463
C10	Same as C1		L1 thru L3	Coil, RF, Fixed	CL275-101
C11 and C12	Capacitor, Fixed, Electrolytic	CE105-2-50	Q1	Transistor	2N3646
			Q2	Transistor	2N1711
C13 thru C15	Same as C1		Q3	Same as Q1	
C16	Same as C9		Q4	Same as Q2	
C17	Not Used		Q5	Same as Q1	
C18 and C19	Same as C11		Q6	Same as Q2	
			R1	Resistor, Fixed, Composition	RC07GF152J
C20	Capacitor, Fixed, Ceramic	CC100-16			
C21	Not Used		R2	Resistor, Fixed, Composition	RC07GF151J

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.
MEMORY ASSEMBLY A4951 (Z105) (Continued)					
R3	Resistor, Fixed, Composition	RC07GF471J	R17	Same as R6	
R4	Resistor, Fixed, Composition	RC07GF332J	R18 and R19	Same as R3	
R5	Same as R2		R20	Resistor, Fixed, Composition	RC07GF102J
R6	Resistor, Fixed, Composition	RC07GF470J	R21	Resistor, Fixed, Composition	RC07GF103J
R7	Resistor, Fixed, Composition	RC07GF151J	R22	Same as R1	
R8 and R9	Resistor, Fixed, Composition	RC07GF123J	R23	Resistor, Fixed, Composition	RC07GF472J
R10	Resistor, Fixed, Composition	RC07GF224J	R24	Same as R3	
R11	Resistor, Fixed, Composition	RC07GF4R7J	R25 and R26	Same as R2	
R12	Same as R1		R27	Same as R6	
R13	Same as R6		R28 and R29	Same as R3	
R14	Same as R3		R30 and R31	Same as R20	
R15 and R16	Same as R2		R32	Same as R3	
			R33	Resistor, Fixed, Composition	RC07GF331J

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.

MEMORY ASSEMBLY A4951 (Z105) (Continued)

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.
T1	Transformer	TF267-4	Z13	Microcircuit, Digital	NW176
Z1 thru Z6	Microcircuit, Digital	NW203	Z14 and Z15	Microcircuit, Digital	NW159
			Z16	Same as Z1	
Z7 thru Z12	Microcircuit, Digital	NW212	Z17	Same as Z7	

3-12 MHz GENERATOR ASSEMBLY A4952 (Z106)

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.
C1 thru C15	Capacitor, Fixed, Ceramic	CC100-29	R1	Resistor, Fixed, Composition	RC07GF392J
C16	Capacitor, Fixed, Mica	CM111E471J1S	R2 thru R6	Resistor, Fixed, Composition	RC07GF102J
C17 thru C20	Same as C1		R7 and R8	Resistor, Fixed, Composition	RC07GF101J
C21 thru C27	Capacitor, Fixed, Ceramic	CC100-43	R9	Same as R1	
C28 and C29	Capacitor, Fixed, Ceramic	CC100-28	R10 thru R14	Same as R2	
C30 thru C37	Same as C21		R15 and R16	Same as R7	
L1	Coil, RF, Fixed	CL275-100	R17	Same as R1	
Q1 thru Q18	Transistor	2N3646	R18 thru R22	Same as R2	

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.
3-12 MHz GENERATOR ASSEMBLY A4952 (Z106) (Continued)					
R23 and R24	Same as R7		R54	Resistor, Fixed, Composition	RC07GF682J
R25	Same as R1		R55	Resistor, Fixed, Composition	RC07GF242J
R26 thru R30	Same as R2		R56	Same as R54	
R31 and R32	Same as R7		R57	Same as R55	
R33	Same as R1		R58	Same as R54	
R34 thru R38	Same as R2		R59	Same as R55	
R39 and R40	Same as R7		R60	Same as R54	
R41	Resistor, Fixed, Composition	RC07GF470J	R61	Same as R55	
R42	Same as R1		R62	Same as R54	
R43 thru R47	Same as R2		R63	Same as R55	
R48 and R49	Same as R7		R64	Same as R54	
R50 and R51	Resistor, Fixed, Composition	RC07GF331J	R65	Same as R55	
R52	Same as R2		TP1 thru TP8	Terminal, Stud	TE127-2
R53	Same as R41		Y1 and Y2	Crystal, Unit	CR119-7R0
			Y3 and Y4	Crystal, Unit	CR119-8R0
			Y5 and Y6	Crystal, Unit	CR119-9R0

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.
		3-12 MHz GENERATOR ASSEMBLY A4952 (Z106) (Continued)			
Y7 and Y8	Crystal, Unit	CR119-10R0	Z4	Microcircuit, Digital	NW187
Y9 and Y10	Crystal, Unit	CR119-11R0	Z5	Microcircuit, Digital	NW176
Y11 and Y12	Crystal, Unit	CR119-12R0	Z6	Same as Z4	
Z1	Microcircuit, Digital	NW189	Z7 and Z8	Microcircuit, Digital	NW167
Z2	Microcircuit, Digital	NW203	Z9	Microcircuit, Digital	NW159
Z3	Microcircuit, Digital	NW166	Z10	Same as Z7	
			Z11	1 MHz Switching Assembly	A4982
		SAMPLE DIVIDE/PHASE DETECTOR ASSEMBLY A4953 (Z107)			
C1 and C2	Capacitor, Fixed, Ceramic	CC100-41	C15 thru C18	Same as C3	
C3 thru C6	Capacitor, Fixed, Ceramic	CC100-28	CR1	Semiconductor, Device, Diode	1N914
C7	Same as C1		CR2	Semiconductor, Device, Diode	1N756
C8	Same as C3		CR3 and CR4	Semiconductor, Device, Diode	1N100
C9	Capacitor, Fixed	CX118E4RSN 30C1	L1	Coil, RF, Fixed	CL275-121
C10 thru C14	Same as C1				

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.
SAMPLE DIVIDE/PHASE DETECTOR ASSEMBLY A4953 (Z107) (Continued)					
L2	Coil, RF, Fixed	CL275-100	R9	Resistor, Fixed, Composition	RC07GF562J
L3	Same as L1		R10	Resistor, Fixed, Composition	RC07GF102J
Q1 thru Q3	Transistor	2N2368	R11	Same as R1	
R1	Resistor, Fixed, Composition	RC07GF562J	R12	Same as R9	
R2	Resistor, Fixed, Composition	RC07GF471J	R13	Same as R3	
R3	Resistor, Fixed, Composition	RC07GF470J	R14	Resistor, Fixed, Composition	RC07GF392J
R4	Resistor, Fixed, Composition	RC07GF100J	R15	Same as R2	
R5	Resistor, Fixed, Composition	RC07GF242J	R16	Resistor, Fixed, Composition	RC07GF103J
R6	Resistor, Fixed, Composition	RC07GF180J	R17	Same as R2	
R7	Resistor, Fixed, Composition	RC07GF104J	R18	Same as R1	
R8	Resistor, Fixed, Composition	RC07GF101J	R19	Same as R3	
			R20	Same as R14	
			T1	Transformer	TR199
			Z1	Microcircuit, Digital	NW198
			Z2 and Z3	Microcircuit, Digital	NW212

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.
SAMPLE DIVIDE/PHASE DETECTOR ASSEMBLY A4953 (Z107) (Continued)					
Z4	Microcircuit, Digital	NW200	Z8	Microcircuit, Digital	NW187
Z5	Microcircuit, Digital	NW197	Z9	Microcircuit, Digital	NW164
Z6 and Z7	Microcircuit, Digital	NW176			
SYNC DETECTOR ASSEMBLY A4981 (P/O Z107)					
C1	Capacitor, Fixed, Ceramic	CC100-28	CR1 thru CR4	Semiconductor, Device, Diode	1N100
C2 and C3	Capacitor, Fixed, Ceramic	CC100-41	L1 and L2	Coil, RF,	CL275-121
C4	Same as C1		Q1 and Q2	Transistor	2N2368
C5	Capacitor, Fixed, Mica	CM111E131J1S	Q3	Transistor	2N3646
C6	Same as C2		Q4	Same as Q1	
C7	Capacitor, Fixed, Electrolytic	CE105-1-16	R1 and R2	Resistor, Fixed, Composition	RC07GF562J
C8 and C9	Same as C2		R3	Resistor, Fixed, Composition	RC07GF392J
C10	Same as C7		R4	Resistor, Fixed, Composition	RC07GF470J
C11	Same as C2				
C12	Same as C1				

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.
		SYNC DETECTOR ASSEMBLY A4981 (P/O Z107) (Continued)			
R5	Resistor, Fixed, Composition	RC07GF820J	R10	Resistor, Fixed, Composition	RC07GF221J
R6	Same as R3		R11	Resistor, Fixed, Composition	RC07GF103J
R7	Same as R4				
R8	Same as R5		R12 and R13	Same as R1	
R9	Resistor, Fixed, Composition	RC07GF151J	R14	Same as R11	
			T1	Transformer	TR198
		MIXER/DIVIDER ASSEMBLY A4954 (Z108)			
C1	Capacitor, Fixed, Mica	CM111E470J1S	C9	Capacitor, Fixed, Ceramic	CC100-28
C2	Capacitor, Fixed, Mica	CM111C100J1S	C10	Same as C4	
			C11	Not Used	
C3	Same as C1		C12 and C13	Same as C4	
C4	Capacitor, Fixed, Ceramic	CC100-43	C14	Not Used	
C5	Capacitor, Fixed, Ceramic	CC100-29	C15	Capacitor, Fixed, Mica	CM111E560J1S
C6	Same as C1		C16	Capacitor, Fixed, Mica	CM111E750J1S
C7	Same as C5				
C8	Capacitor, Variable	CV112-9	C17	Same as C1	

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.
MIXER/DIVIDER ASSEMBLY A4954 (Z108) (Continued)					
C18	Capacitor, Fixed, Mica	CM111E330J1S	C38	Capacitor, Fixed, Mica	CM111E101J1S
C19	Capacitor, Fixed, Mica	CM111E390J1S	C39	Same as C21	
C20	Capacitor, Fixed, Mica	CM111E680J1S	C40	Same as C8	
C21	Capacitor, Fixed, Mica	CM111E221J1S	L1	Coil, RF, Fixed	CL275-100
C22	Same as C9		L2	Coil, RF, Fixed	CL275-101
C23	Same as C5		L3	Coil, RF, Fixed	CL275-1R5
C24	Same as C20		L4 thru L6	Same as L2	
C25	Same as C2		L7	Not Used	
C26	Same as C20		L8 and L9	Coil, RF, Fixed	CL275-680
C27	Same as C5		L10 thru L14	Same as L2	
C28	Same as C20		L15	Same as L3	
C29	Same as C5		Q1 thru Q7	Transistor	40841
C30	Same as C9		Q8	Transistor	2N2368
C31 and C32	Same as C4		Q9	Same as Q1	
C33 thru C35	Same as C9		Q10 and Q11	Same as Q8	
C36	Same as C4				
C37	Same as C9				

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.
MIXER/DIVIDER ASSEMBLY A4954 (Z108) (Continued)					
R1 thru R5	Resistor, Fixed, Composition	RC07GF470J	R21	Same as R11	
			R22	Same as R6	
R6	Resistor, Fixed, Composition	RC07GF102J	R23 thru R26	Same as R1	
R7	Same as R1		R27	Resistor, Fixed, Composition	RC07GF561J
R8	Same as R6		R28	Same as R11	
R9	Resistor, Fixed, Composition	RC07GF391J	R29	Resistor, Fixed, Composition	RC07GF101J
R10	Same as R6		R30	Resistor, Fixed, Composition	RC07GF471J
R11	Resistor, Fixed, Composition	RC07GF103J	R31	Same as R1	
R12	Same as R6		R32	Same as R27	
R13	Same as R11		R33	Resistor, Fixed, Composition	RC07GF182J
R14	Same as R1		R34	Same as R1	
R15	Same as R6		R35	Resistor, Fixed, Composition	RC07GF682J
R16	Same as R11		R36	Resistor, Fixed, Composition	RC07GF331J
R17	Same as R1				
R18	Same as R6				
R19	Same as R1				
R20	Same as R6				

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.
		MIXER/DIVIDER ASSEMBLY A4954 (Z108) (Continued)			
R37 and R38	Same as R1		T4	Transformer, RF, Tuned	TT310-2
R39	Same as R27		T5 and T6	Transformer, RF, Tuned	TT307-18
R40	Resistor, Fixed, Composition	RC07GF392J	Z1	Microcircuit, Digital	NW159
T1	Transformer, RF, Tuned	TT310-1	Z2	Semiconductor, Device, Rectifier	DD148
T2 and T3	Transformer, RF, Tuned	TT307-17	Z3 and Z4	Filter, PC Assembly	A4980
		MULTIPLIER BANDPASS FILTER ASSEMBLY A4980 (P/O Z108)			
C1	Capacitor, Fixed, Mica	CM111E300J1S	C6	Same as C4	
C2	Capacitor, Fixed, Mica	CM111C100J1S	C7	Capacitor, Fixed, Mica	CM111C150J1S
C3	Same as C1		L1	Coil, RF, Fixed	CL275-6R8
C4	Capacitor, Fixed, Mica	CM111E330J1S	L2 and L3	Coil, RF,	CL275-3R3
C5	Capacitor, Fixed, Mica	CM111C240J1S			

REF. SYMBOL	DESCRIPTION	TMC PART NO.
	MIXER/OSCILLATOR CONTROL ASSEMBLY A4957 (Z109)	
C1	Capacitor, Fixed, Ceramic	CC100-41
C2	Capacitor, Fixed, Mica	CM111C100J1S
C3	Capacitor, Fixed, Mica	CM111E391J1S
C4	Capacitor, Fixed, Ceramic	CC100-28
C5	Same as C2	
C6 and C7	Same as C3	
C8	Same as C2	
C9	Same as C4	
C10	Capacitor, Fixed, Electrolytic	CE105-25-16
C11	Same as C4	
C12 and C13	Same as C1	
C14	Same as C4	
C15	Capacitor, Fixed, Mica	CM111E201J1S
C16	Capacitor, Fixed, Mica	CM111C240J1S
C17	Capacitor, Fixed, Mica	CM111E241J1S
C18	Capacitor, Fixed, Mica	CM111E151J1S
C19	Same as C17	
C20	Capacitor, Fixed, Mica	CM111E820J1S
C21	Same as C18	
C22	Same as C1	
C23	Not Used	
C24 and C25	Same as C1	
C26 thru C28	Same as C4	
CR1 and CR2	Semiconductor, Device, Diode	1N914
CR3	Semiconductor, Device, Diode	1N756
CR4	Same as CR1	
L1	Coil, RF, Fixed	CL275-100
L2 thru L4	Transformer	TT307-19
L5	Coil, RF, Fixed	CL275-102

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.
MIXER/OSCILLATOR CONTROL ASSEMBLY A4957 (Z109) (Continued)					
L6 and L7	Same as L1		R7	Resistor, Fixed, Composition	RC07GF100J
L8	Coil, RF, Fixed	CL275-470	R8 and R9	Resistor, Fixed, Composition	RC07GF470J
L9 and L10	Coil, RF, Fixed	CL275-330	R10	Resistor, Fixed, Composition	RC07GF102J
L11	Same as L1		R11	Same as R8	
Q1	Transistor	2N3646	R12	Resistor, Fixed, Composition	RC07GF331J
Q2 and Q3	Transistor	2N3638	R13 and R14	Same as R8	
Q4 thru Q6	Transistor	40841	R15	Same as R12	
Q7 thru Q9	Transistor	2N706	R16	Same as R8	
R1	Resistor, Fixed, Composition	RC07GF472J	R17	Resistor, Fixed, Composition	RC07GF104J
R2	Resistor, Fixed, Composition	RC07GF103J	R18	Same as R8	
R3 and R4	Resistor, Fixed, Composition	RC07GF473J	R19	Same as R2	
R5	Same as R2		R20	Same as R10	
R6	Not Used		R21	Same as R8	
			R22 and R23	Same as R2	

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.
MIXER/OSCILLATOR CONTROL ASSEMBLY A4957 (Z109) (Continued)					
R24	Resistor, Fixed, Composition	RC07GF152J	R29	Same as R10	
R25	Resistor, Fixed, Composition	RC07GF273J	R30	Resistor, Fixed, Composition	RC07GF221J
R26	Resistor, Fixed, Composition	RC07GF562J	R31 thru R38	Not Used	
R27	Same as R10		R39	Same as R10	
R28	Resistor, Fixed, Composition	RC07GF822J	TP1 thru TP6	Terminal, Stud	TE127-2
100-Hz SYNTHESIZER ASSEMBLY A4950 (Z110)					
C1	Capacitor, Fixed, Mica	CM112E272J1S	C7	Capacitor, Fixed, Ceramic	CC100-41
C2	Capacitor, Fixed, Ceramic	CC100-28	C8 thru C10	Same as C2	
C3	Same as C1		C11 and C12	Capacitor, Fixed, Mica	CM111E470J1S
C4	Same as C2		C13 thru C15	Same as C2	
C5	Capacitor, Fixed, Electrolytic	CC105-100-16	C16	Capacitor, Fixed, Mica	CM111E331J1S
C6	Same as C2		C17	Not Used	

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.

100-Hz SYNTHESIZER ASSEMBLY A4950 (Z110) (Continued)

REF. SYMBOL	DESCRIPTION	TMC PART NO.
C18	Capacitor, Fixed, Mica	CM111E910J1S
C19	Same as C5	
C20	Not Used	
C21	Capacitor, Tan, Foil	CX118E10N15C1
C22 and C23	Same as C2	
C24	Same as C7	
C25	Same as C1	
C26	Same as C2	
C27	Same as C1	
C28	Same as C16	
C29	Capacitor, Fixed, Mica	CM111F131J1S
C30	Same as C7	
C31 and C32	Capacitor, Fixed, Mica	CM111E681J1S
C33	Same as C5	
L1 and L2	Coil, RF, Fixed	CL275-103
L3 and L4	Coil, RF, Fixed	CL275-221
L5	Same as L1	
L6	Coil, RF, Fixed	CL275-681
L7	Coil, RF, Fixed	CL275-100
L8 and L9	Same as L1	
Q1 and Q2	Transistor	40841
Q3	Transistor	2N697
Q4 and Q5	Same as Q1	
R1 thru R3	Resistor, Fixed, Composition	RC07GF470J
R4	Resistor, Fixed, Composition	RC07GF221J
R5	Resistor, Fixed, Composition	RC07GF103J
R6	Same as R4	
R7	Same as R5	
R8	Same as R1	
R9	Same as R5	

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.

100-Hz SYNTHESIZER ASSEMBLY A4950 (Z110) (Continued)

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.
R10 and R11	Resistor, Fixed, Composition	RC07GF102J	R23	Same as R10	
			R24	Same as R1	
R12	Same as R1		R25	Same as R5	
R13	Resistor, Fixed, Composition	RC07GF682J	R26	Resistor, Variable	RV124-1-104
			R27	Same as R5	
R14 thru R17	Same as R1		R28	Same as R26	
R18	Resistor, Fixed, Composition	RC07GF561J	R29	Same as R5	
			CR1 and CR2	Semiconductor Device	MV1404
R19	Same as R1		T1 and T2	Transformer, RF, Tuned	TT307-20
R20	Resistor, Fixed, Composition	RC07GF151J	T3 and T4	Transformer, RF Tuned	TT307-25
R21	Same as R1		T5 and T6	Same as T1	
R22	Same as R20				

DIGITAL LOGIC AND CONTROL MOTHER BOARD A4960 (Z111)

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.
XZ102 and XZ103	Connector, Receptacle	JJ319-22DPD	XZ107	Same as XZ102	
XZ104 thru XZ106	Connector, Receptacle	JJ319-10DPD	XZ108 thru XZ110	Same as XZ104	

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.
SYMMETRICAL FILTER ASSEMBLY A4961-1 (Z112)					
C1 thru C13	Capacitor, Fixed, Ceramic	CC100-28	R6	Resistor, Fixed, Composition	RC07GF101J
C14 thru C18	Capacitor, Fixed, Ceramic	CC100-33	R7	Resistor, Fixed, Composition	RC07GF393J
C19 and C20	Same as C1		R8	Same as R2	
FL1	Filter, 0.4 kHz, Symmetrical	FX306	R9	Same as R4	
FL2	Filter, 1 kHz, Symmetrical	FX305	R10	Resistor, Fixed, Composition	RC07GF473J
L1	Coil, RF, Fixed	CL275-103	R11	Same as R6	
Q1 thru Q4	Transistor	2N1711	R12	Same as R2	
R1	Resistor, Fixed, Composition	RC07GF822J	R13 and R14	Same as R6	
R2	Resistor, Fixed, Composition	RC07GF470J	R15	Resistor, Fixed, Composition	RC07GF151J
R3	Resistor, Fixed, Composition	RC07GF102J	R16	Same as R2	
R4	Resistor Fixed, Composition	RC07GF561J	R17	Same as R4	
R5	Same as R2		R18	Same as R2	
			R19	Same as R7	
			R20	Same as R4	
			R21	Same as R10	

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.
SYMMETRICAL FILTER ASSEMBLY A4961-1 (Z112) (Continued)					
R22	Same as R2		R25 thru R34	Not Used	
R23	Same as R6				
R24	Resistor, Fixed, Composition	RC07GF391J	R35	Same as R2	
SYMMETRICAL FILTER ASSEMBLY A4961-2 (Z113)					
C1 thru C20	Capacitor, Fixed, Ceramic	CC100-28	R4	Resistor, Fixed, Composition	RC07GF561J
FL1	Filter, 3 kHz, Symmetrical	FX304	R5	Same as R2	
FL2	Filter, 6 kHz, Symmetrical	FX303	R6	Resistor, Fixed, Composition	RC07GF101J
L1	Coil, RF, Fixed	CL275-103	R7	Resistor, Fixed, Composition	RC07GF393J
Q1 thru Q6	Transistor	2N1711	R8	Same as R2	
R1	Resistor, Fixed, Composition	RC07GF822J	R9	Same as R4	
R2	Resistor, Fixed, Composition	RC07GF470J	R10	Resistor, Fixed, Composition	RC07GF473J
R3	Resistor, Fixed, Composition	RC07GF102J	R11	Same as R6	
			R12	Same as R2	

SYMMETRICAL FILTER ASSEMBLY A4961-2 (Z113) (Continued)

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.
R13 and R14	Same as R6		R24	Resistor, Fixed, Composition	RC07GF391J
R15	Resistor, Fixed, Composition	RC07GF151J	R25	Same as R2	
R16	Same as R2		R26	Same as R4	
R17	Same as R4		R27	Same as R6	
R18	Same as R2		R28	Same as R7	
R19	Same as R7		R29	Same as R6	
R20	Same as R4		R30	Same as R2	
R21	Same as R10		R31	Same as R10	
R22	Same as R2		R32	Same as R2	
R23	Same as R6		R33	Same as R6	
			R34 and R35	Same as R2	

AUDIO ASSEMBLY A4962 (Z114)

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.
C1	Capacitor, Fixed, Electrolytic	CE105-100-16	C4 and C5	Capacitor, Fixed, Ceramic	CC100-33
C2	Capacitor, Fixed, Ceramic	CC100-28	C6	Capacitor, Fixed, Electrolytic	CE105-1-15
C3	Capacitor, Fixed, Ceramic	CC100-43	C7 and C8	Same as C3	

REF. SYMBOL	DESCRIPTION	TMC PART NO.
	AUDIO ASSEMBLY A4962 (Z114) (Continued)	
C9	Same as C1	
C10	Capacitor, Fixed, Electrolytic	CE105-200-15
C11	Capacitor, Fixed, Electrolytic	CE105-25-15
C12	Same as C1	
C13	Same as C2	
C14	Same as C1	
C15 and C16	Same as C2	
C17	Capacitor, Fixed, Ceramic	CC100-40
C18 and C19	Same as C2	
C20	Capacitor, Fixed, Mica	CM111C100D1S
C21	Capacitor, Fixed, Mica	CM111C030D1S
C22	Same as C11	
C23	Same as C1	
C24 and C25	Not Used	
C26 thru C29	Same as C2	
CR1 and CR2	Semiconductor, Device, Diode	1N914
CR3 and CR4	Semiconductor, Device, Diode	1N750
CR5	Semiconductor, Device, Diode	1N757
CR6 thru CR9	Semiconductor, Device, Diode	1N100
L1	Coil, RF, Fixed	CL275-103
Q1 and Q2	Transistor	2N301
Q3	Transistor	2N4352
Q4	Transistor	40841
Q5	Transistor	2N1711
Q6 and Q7	Transistor	2N3646
R1	Resistor, Fixed, Composition	RC07GF474J
R2	Resistor, Fixed, Composition	RC07GF562J

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.
		AUDIO ASSEMBLY A4962 (Z114) (Continued)			
R3	Resistor, Fixed, Composition	RC07GF472J	R16	Resistor, Fixed, Composition	RC07GF252J
R4	Resistor, Fixed, Composition	RC07GF332J	R17	Resistor, Fixed, Composition	RC07GF335J
R5	Resistor, Variable, Composition	RV124-3-502	R18	Resistor, Fixed, Composition	RC07GF104J
R6	Resistor, Fixed, Composition	RC07GF2R7J	R19	Resistor, Fixed, Composition	RC07GF471J
R7 and R8	Resistor, Fixed, Composition	RC07GF221J	R20	Resistor, Fixed, Composition	RC07GF185J
R9	Resistor, Fixed, Composition	RC07GF680J	R21	Resistor, Fixed, Composition	RC07GF182J
R10	Resistor, Fixed, Composition	RC07GF101J	R22	Resistor, Fixed, Composition	RC07GF103J
R11	Resistor, Fixed, Composition	RC07GF4R7J	R23	Resistor, Fixed, Composition	RC07GF825J
R12	Same as R10		R24	Resistor, Fixed, Composition	RC07GF102J
R13	Same as R9				
R14	Same as R11		R25	Same as R3	
R15	Not Used		R26	Same as R22	

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.
		AUDIO ASSEMBLY A4962 (Z114) (Continued)			
R27	Resistor, Fixed, Composition	RC07GF101J	R37	Same as R2	
			R38	Not Used	
R28	Same as R22		R39	Same as R27	
R29	Resistor, Fixed, Composition	RC07GF222J	R40	Same as R18	
R30	Resistor, Fixed, Composition	RC07GF105J	R41	Resistor, Fixed, Composition	RC07GF151J
R31	Same as R22		R42	Resistor, Variable, Composition	RV124-3-103
R32	Resistor, Fixed, Composition	RC07GF223J	R43	Not Used	
R33	Same as R27		R44	Same as R27	
R34	Same as R32		Z1	Microcircuit, Linear	NW193
R35	Same as R4				
R36	Resistor, Fixed, Composition	RC07GF153J	Z2	Microcircuit, Linear	NW156
		USB AND LSB FILTER ASSEMBLIES A4963-1 AND A4963-2 (Z115, Z116)			
C1 thru C6	Capacitor, Fixed, Ceramic	CC100-28	C8 thru C14	Same as C1	
C7	Not Used		C15	Capacitor, Fixed, Electrolytic	CE105-50-16

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.
USB AND LSB FILTER ASSEMBLIES A4963-1 AND A4963-2 (Z115, Z116) (Continued)					
C16 and C17	Same as C1		C40	Capacitor, Fixed, Ceramic	CC100-29
C18	Capacitor, Fixed, Mica	CM111E390J1S	C41	Same as C15	
C19 thru C21	Same as C1		C42 and C43	Same as C1	
C22	Same as C15		C44	Capacitor, Fixed, Mica	CM111E471J1S
C23 thru C26	Same as C1		C45	Capacitor, Fixed, Ceramic	CC100-20
C27	Capacitor, Fixed, Electrolytic	CE105-1-25	C46	Same as C40	
C28	Same as C15		C47	Same as C1	
C29 thru C33	Same as C1		C48	Capacitor, Fixed, Electrolytic	CE105-1-16
C34	Capacitor, Fixed, Electrolytic	CE105-10-16	C49	Not Used	
C35 and C36	Same as C1		C50	Same as C37	
C37	Capacitor, Fixed, Ceramic	CC100-33	C51 thru C59	Same as C1	
C38	Capacitor, Fixed, Ceramic	CC100-19	CR1 and CR2	Semiconductor, Device, Diode	1N100
C39	Capacitor, Fixed, Ceramic	CC100-22	CR3 thru CR5	Semiconductor, Device, Diode	1N914
			CR6	Same as CR1	
			FL1	Filter, Upper Sideband	FX301

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.
USB AND LSB FILTER ASSEMBLIES A4963-1 AND A4963-2 (Z115, Z116) (Continued)					
FL2	Filter, Lower Sideband	FX302	Q8 and Q9	Same as Q3	
L1	Coil, RF, Fixed	CL275-103	Q10	Same as Q1	
L2	Coil, RF, Fixed	CL275-102	R1	Resistor, Fixed, Composition	RC07GF822J
L3	Same as L1		R2	Resistor, Fixed, Composition	RC07GF470J
L4	Same as L2				
L5	Same as L1		R3	Resistor, Fixed, Composition	RC07GF102J
L6	Same as L2				
L7 thru L9	Same as L1		R4	Resistor, Fixed, Composition	RC07GF561J
L10	Coil, RF, Fixed	CL275-104	R5	Resistor, Fixed, Composition	RC07GF101J
L11	Same as L10				
L12 and L13	Same as L2		R6 and R7	Same as R2	
L14 thru L16	Same as L1		R8	Same as R4	
Q1 and Q2	Transistor	2N1711	R9	Resistor, Fixed, Composition	RC07GF273J
Q3 thru Q6	Transistor	40841	R10	Resistor, Fixed, Composition	RC07GF472J
Q7	Same as Q1		R11	Same as R2	

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.
USB AND LSB FILTER ASSEMBLIES A4963-1 AND A4963-2 (Z115, Z116) (Continued)					
R12	Resistor, Fixed, Composition	RC07GF391J	R29	Same as R23	
			R30	Same as R18	
R13 and R14	Same as R5		R31	Resistor, Variable	RV124-3-503
R15	Resistor, Fixed, Composition	RC07GF223J	R32 and R33	Same as R2	
			R34	Same as R10	
R16 and R17	Same as R2		R35	Same as R2	
R18	Resistor, Fixed, Composition	RC07GF151J	R36	Same as R23	
			R37	Same as R18	
R19	Same as R10		R38	Same as R31	
R20	Same as R2		R39 and R40	Same as R2	
R21 and R22	Resistor, Fixed, Composition	RC07GF104J	R41	Resistor, Fixed, Composition	RC07GF333J
R23	Resistor, Fixed, Composition	RC07GF103J	R42	Same as R10	
			R43	Same as R3	
R24	Resistor, Fixed, Composition	RC07GF473J	R44	Same as R5	
			R45	Same as R23	
R25	Same as R2		R46	Resistor, Fixed, Composition	RC07GF105J
R26	Same as R10				
R27 and R28	Same as R2				

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.
USB AND LSB FILTER ASSEMBLIES A4963-1 AND A4963-2 (Z115, Z116) (Continued)					
R47	Resistor, Fixed, Composition	RC07GF125J	R63	Same as R21	
R48	Same as R21		R64 and R65	Same as R2	
R49	Same as R15		R66	Same as R15	
R50 and R51	Same as R2		R67	Same as R21	
R52	Resistor, Fixed, Composition	RC07GF562J	R68	Same as R24	
R53	Resistor, Fixed, Composition	RC07GF331J	R69	Same as R52	
R54	Same as R2		R70	Same as R24	
R55 and R56	Same as R23		R71	Resistor, Fixed, Composition	RC07GF474J
R57	Same as R3		R72	Same as R5	
R58	Same as R23		R73	Resistor, Fixed, Composition	RC07GF470J
R59 and R60	Same as R2		R74	Same as R3	
R61	Same as R15		T1	Transformer, Audio	TF428
R62	Same as R52		Z1	Microcircuit, Linear	NW193

REF. SYMBOL	DESCRIPTION	TMC PART NO.
	SYNC/AFC ASSEMBLY A4964 (Z117)	
C1 thru C3	Capacitor, Fixed, Ceramic	CC100-28
C4 and C5	Capacitor, Fixed, Mica	CM112E272J1S
C6	Same as C1	
C7	Same as C4	
C8 thru C10	Same as C1	
C11 thru C13	Capacitor, Fixed, Ceramic	CC100-29
C14	Capacitor, Fixed, Electrolytic	CE105-200-16
C15 thru C18	Same as C1	
C19	Capacitor, Fixed, Mica	CM111E621J1S
C20	Capacitor, Fixed, Mica	CM112E332J1S
C21	Same as C1	
C22	Same as C4	
C23 thru C25	Same as C1	
C26	Same as C11	
C27 thru C31	Same as C1	
C32	Not Used	
C33 and C34	Same as C1	
C35	Capacitor, Fixed, Mica	CM111E471J1S
C36	Capacitor, Fixed, Mica	CM111C220J1S
C37	Capacitor, Fixed, Ceramic	CC100-41
C38	Same as C1	
C39 and C40	Same as C14	
C41	Not Used	
C42	Same as C14	
C43	Same as C1	
C44 thru C46	Same as C37	
C47 thru C49	Same as C1	
C50	Capacitor	CX118E10N15C1
CR1 thru CR6	Semiconductor, Device, Diode	1N914

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.

SYNC/AFC ASSEMBLY A4964 (Z117) (Continued)

REF. SYMBOL	DESCRIPTION	TMC PART NO.
CR7	Semiconductor, Device, Diode	1N756
CR8	Same as CR1	
CR9 and CR10	Semiconductor, Device, Diode	1N100
CR11 and CR12	Same as CR1	
FL1	Filter	FX300
L1 thru L3	Coil, RF, Fixed	CL275-102
L4 thru L6	Transformer, RF, Adjustable	TT307-20
L7 thru L9	Same as L1	
L10	Same as L4	
L11	Coil, RF, Fixed	CL275-472
L12 and L13	Same as L1	
Q1	Transistor	2N706
Q2 thru Q4	Transistor	2N4221
Q5	Same as Q1	
Q6	Same as Q2	
Q7	Same as Q1	
Q8	Transistor	3N128
Q9	Not Used	
Q10	Transistor	40841
Q11 and Q12	Transistor	2N2368
R1	Resistor, Fixed, Composition	RC07GF822J
R2	Resistor, Fixed, Composition	RC07GF561J
R3	Resistor, Fixed, Composition	RC07GF474J
R4	Resistor, Fixed, Composition	RC07GF473J
R5	Same as R3	
R6	Same as R4	
R7	Same as R3	
R8	Same as R4	
R9	Resistor, Fixed, Composition	RC07GF470J

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.
		SYNC/AFC ASSEMBLY A4964 (Z117) (Continued)			
R10	Resistor, Variable	RV124-3-501	R26	Resistor, Fixed, Composition	RC07GF103J
R11	Resistor, Fixed, Composition	RC07GF102J	R27	Same as R26	
R12	Same as R9		R28	Same as R9	
R13	Resistor, Fixed, Composition	RC07GF154J	R29	Resistor, Variable	RV124-3-103
R14	Same as R9		R30	Not Used	
R15	Same as R13		R31	Same as R13	
R16	Same as R9		R32	Same as R9	
R17	Same as R13		R33	Resistor, Fixed, Composition	RC07GF221J
R18	Same as R9		R34 thru R36	Same as R19	
R19 thru R22	Resistor, Fixed, Composition	RC07GF472J	R37	Same as R26	
R23	Same as R3		R38	Resistor, Fixed, Composition	RC07GF152J
R24	Resistor, Fixed, Composition	RC07GF223J	R39	Same as R26	
R25	Resistor, Fixed, Composition	RC07GF471J	R40 and R41	Resistor, Fixed, Composition	RC07GF390J
			R42	Same as R19	

SYNC/AFC ASSEMBLY A4964 (Z117) (Continued)

REF. SYMBOL	DESCRIPTION	TMC PART NO.
R43	Same as R26	
R44	Same as R10	
R45	Same as R25	
R46	Same as R26	
R47 and R48	Same as R1	
R49	Same as R11	
R50	Resistor, Fixed, Composition	RC07GF222J
R51	Resistor, Fixed, Composition	RC07GF823J
T1	Transformer, RF, Adjustable	TT300
Z1	Microcircuit, Linear	NW156

XVCO ASSEMBLY A4994 (P/O Z117)

REF. SYMBOL	DESCRIPTION	TMC PART NO.
C1	Capacitor, Fixed, Ceramic	CC100-41
C2	Capacitor, Fixed, Ceramic	CC100-28
C3	Capacitor, Fixed, Mica	CM111E221J1S
C4	Capacitor, Fixed, Mica	CM111E331J1S
C5	Capacitor, Variable	CV112-4
C6 and C7	Same as C1	
C8	Same as C2	
C9	Capacitor, Fixed, Mica	CM111E122J1S
C10	Same as C2	
C11 and C12	Capacitor, Fixed, Mica	CM111E470J1S
C13	Same as C2	
CR1	Semiconductor, Device, Diode	MV1404
L1	Coil, RF, Fixed	CL275-102
L2 and L3	Coil, RF, Fixed	CL275-103

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.
SYNC/AFC ASSEMBLY A4964 (Z117) (Continued)					
R10	Resistor, Variable	RV124-3-501	R26	Resistor, Fixed, Composition	RC07GF103J
R11	Resistor, Fixed, Composition	RC07GF102J	R27	Same as R26	
R12	Same as R9		R28	Same as R9	
R13	Resistor, Fixed, Composition	RC07GF154J	R29	Resistor, Variable	RV124-3-103
R14	Same as R9		R30	Not Used	
R15	Same as R13		R31	Same as R13	
R16	Same as R9		R32	Same as R9	
R17	Same as R13		R33	Resistor, Fixed, Composition	RC07GF221J
R18	Same as R9		R34 thru R36	Same as R19	
R19 thru R22	Resistor, Fixed, Composition	RC07GF472J	R37	Same as R26	
R23	Same as R3		R38	Resistor, Fixed, Composition	RC07GF152J
R24	Resistor, Fixed, Composition	RC07GF223J	R39	Same as R26	
R25	Resistor, Fixed, Composition	RC07GF471J	R40 and R41	Resistor, Fixed, Composition	RC07GF390J
			R42	Same as R19	

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.
		SYNC/AFC ASSEMBLY A4964 (Z117) (Continued)			
R43	Same as R26		R50	Resistor, Fixed, Composition	RC07GF222J
R44	Same as R10		R51	Resistor, Fixed, Composition	RC07GF823J
R45	Same as R25		T1	Transformer, RF, Adjustable	TT300
R46	Same as R26		Z1	Microcircuit, Linear	NW156
R47 and R48	Same as R1				
R49	Same as R11				
		XVCO ASSEMBLY A4994 (P/O Z117)			
C1	Capacitor, Fixed, Ceramic	CC100-41	C9	Capacitor, Fixed, Mica	CM111E122J1S
C2	Capacitor, Fixed, Ceramic	CC100-28	C10	Same as C2	
C3	Capacitor, Fixed, Mica	CM111E221J1S	C11 and C12	Capacitor, Fixed, Mica	CM111E470J1S
C4	Capacitor, Fixed, Mica	CM111E331J1S	C13	Same as C2	
C5	Capacitor, Variable	CV112-4	CR1	Semiconductor, Device, Diode	MV1404
C6 and C7	Same as C1		L1	Coil, RF, Fixed	CL275-102
C8	Same as C2		L2 and L3	Coil, RF, Fixed	CL275-103

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.
XVCO ASSEMBLY A4994 (P/O Z117) (Continued)					
L4	Coil, RF, Fixed	CL275-331	R6	Resistor, Fixed, Composition	RC07GF470J
Q1	Transistor	2N706	R7	Resistor, Fixed, Composition	RC07GF101J
Q2	Transistor	40841	R8	Resistor Fixed, Composition	RC07GF472J
R1	Resistor, Fixed, Composition	RC07GF224J	R9	Resistor, Fixed, Composition	RC07GF103J
R2	Resistor, Fixed, Composition	RC07GF393J	R10	Resistor, Fixed, Composition	RC07GF273J
R3	Resistor Fixed, Composition	RC07GF104J	R11 and R12	Same as R6	
R4	Resistor, Fixed, Composition	RC07GF223J	R13 and R14	Resistor, Fixed, Composition	RC07GF102J
R5	Resistor, Fixed, Composition	RC07GF333J	Y1	Crystal, Quartz	CR27/U1.250000
BFO ASSEMBLY A4965 (Z118)					
C1 and C2	Capacitor, Fixed, Ceramic	CC100-28	C4	Same as C1	
C3	Capacitor, Fixed, Electrolytic	CE105-50-16	C5	Capacitor, Fixed, Ceramic	CC100-43

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.
		BFO ASSEMBLY A4965 (Z118) (Continued)			
C6 thru C9	Same as C1		L6	Coil, RF, Fixed	CL275-682
C10	Same as C3		Q1	Transistor	40841
C11 and C12	Same as C1		Q2	Transistor	2N3646
C13	Capacitor, Fixed, Mica	CM112E202J1S	Q3	Same as Q1	
			Q4	Transistor	2N697
C14 thru C16	Same as C1		R1	Resistor, Fixed, Composition	RC07GF220J
C17	Capacitor, Fixed, Mica	CM111E470J1S	R2	Resistor, Fixed, Composition	RC07GF101J
C18 thru C20	Same as C1				
CR1	Semiconductor, Device, Diode	1N756	R3	Resistor, Fixed, Composition	RC07GF272J
CR2	Capacitor, Variable	CX106-16	R4	Resistor, Fixed, Composition	RC07GF102J
CR3	Semiconductor, Device, Diode	1N3826	R5	Resistor, Fixed, Composition	RC07GF470J
CR4	Semiconductor, Device, Diode	1N914			
L1 and L2	Coil, RF, Fixed	CL275-103	R6	Resistor, Fixed, Composition	RC07GF621J
L3 thru L5	Coil, RF, Fixed	CL275-102	R7	Resistor, Fixed, Composition	RC07GF103J

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.

BFO ASSEMBLY A4965 (Z118) (Continued)

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.
R8	Resistor, Fixed, Composition	RC07GF104J	R16 and R17	Resistor, Fixed, Composition	RC07GF121J
R9	Same as R5		R18	Resistor, Fixed, Composition	RC07GF182J
R10	Resistor, Fixed, Composition	RC07GF820J	R19	Same as R7	
R11	Same as R4		T1	Transformer, Adjustable	TT307-20
R12	Same as R5		Z1	Microcircuit, Digital	NW159
R13	Same as R4		Z2	Microcircuit, Digital	NW176
R14	Same as R7				
R15	Same as R4				

AUDIO FILTER MOTHER BOARD A4966 (Z119)

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.
C1 thru C6	Capacitor, Fixed, Ceramic	CC100-28	CR1 and CR2	Semiconductor, Device, Diode	1N914
C7 thru C17	Capacitor, Fixed, Electrolytic	CE105-100-16	XZ1 thru XZ11	Not Used	
			XZ12 thru XZ18	Connector, Receptacle	JJ319-10DPD

PRESELECTOR ASSEMBLY A5628 (Z120)

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.
C1 thru C4	Capacitor, Fixed, Ceramic	CC100-28	C5	Capacitor, Variable	CV112-9

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.
PRESELECTOR ASSEMBLY A5628 (Z120) (Continued)					
C6	Capacitor, Fixed, Mica	CM112E432J1S	K1 and K2	Relay (26.5 vdc)	RL160-3
C7	Capacitor, Fixed, Mica	CM112E512J1S	L1 thru L4	Coil, RF, Fixed	CL275-103
C8	Capacitor, Fixed, Mica	CM112E752J1S	L5	Coil, RF, Fixed	CL275-681
C9 and C10	Capacitor, Fixed, Mica	CM112E622J1S	L6	Coil, RF, Fixed	CL275-8R2
C11	Capacitor, Fixed, Ceramic	CC100-43	L7	Coil, RF, Fixed	CL275-4R7
C12	Capacitor, Fixed, Mica	CM112E222J1S	L8	Coil, RF, Fixed	CL275-6R8
C13	Same as C11		L9	Coil, RF, Fixed	CL275-5R6
C14	Capacitor, Fixed, Mica	CM112E562J1S	L10	Coil, RF, Fixed	CL275-2R7
C15	Capacitor, Fixed, Ceramic	CC100-13	L11 thru L13	Same as L9	
C16	Capacitor, Fixed, Ceramic	CC100-6	L14	Coil, RF, Fixed	CL275-100
POWER SUPPLY ASSEMBLY BMA513					
C1	Capacitor, Fixed, Electrolytic	CE112-3	C2	Capacitor, Fixed, Ceramic	CC100-37

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.

POWER SUPPLY ASSEMBLY BMA513 (Continued)

REF. SYMBOL	DESCRIPTION	TMC PART NO.
C3	Capacitor, Fixed, Electrolytic	CE116-5V
C4 and C5	Same as C2	
C6	Capacitor, Fixed, Metallized	CN112A105K2
CR1	Semiconductor, Device, Rectifier	RX108-2
CR2 and CR3	Semiconductor, Device, Rectifier	RX108-2
F1	Fuse, Cartridge	FU102-1.5
F2	Fuse, Cartridge	FU102-8
J1	Connector, Receptacle	JJ146
L1	Coil, Fixed	CL485
P1	Cord, Line, A-c	CA1754
Q1 and Q2	Transistor	2N3447
R1	Resistor, Fixed, Wire Wound	RW110-1
R2	Resistor, Fixed, Wire Wound	RW109-1
R3	Resistor, Fixed, Composition	RC42GF151J
R4 and R5	Resistor, Fixed, Wire Wound	RW109-5
R6	Same as R1	
R7 and R8	Resistor, Fixed, Wire Wound	RW110-2
R9	Same as R4	
R10 thru R12	Resistor, Fixed, Composition	RC07GF470J
R13	Resistor, Fixed, Composition	RC07GF103J
T1	Transformer, Power	TF427
TB1	Terminal, Barrier	TM117-35
XF1 and XF2	Holder, Fuse	FH100-1

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.

POWER SUPPLY ASSEMBLY BMA513 (Continued)

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.
XQ1 and XQ2	Socket, Semiconductor Device	TS166-1	XZ2	Socket, Electron Tube	TS165-P01
XZ1	Not Used		Z201	Power Supply Board Assembly	A4970

POWER SUPPLY BOARD ASSEMBLY A4970 (Z201)

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.
C1 and C2	Capacitor, Fixed, Electrolytic	CE105-200-16	CR10	Semiconductor Device, Diode	1N754A
C3	Capacitor, Fixed, Electrolytic	CE105-10-25	CR11 and CR12	Same as CR3	
C4	Capacitor, Fixed, Ceramic	CC100-28	E1 thru E11	Terminal, Stud	TE127-2
C5 and C6	Same as C1		Q1	Transistor	2N4036
C7	Same as C3		Q2	Transistor	2N2631
C8	Same as C4		Q3 and Q4	Transistor	2N706
C9 and C10	Same as C1		Q5	Same as Q1	
CR1 and CR2	Semiconductor Device, Diode	1N4370A	Q6	Same as Q2	
CR3 thru CR8	Semiconductor Device, Diode	1N914	Q7 and Q8	Same as Q3	
CR9	Same as CR1		R1	Resistor, Fixed, Composition	RC07GF152J

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.
POWER SUPPLY BOARD ASSEMBLY A4970 (Z201) (Continued)					
R2	Resistor, Fixed, Composition	RC07GF151J	R9	Same as R1	
			R10	Same as R2	
R3	Resistor, Fixed, Composition	RC07GF101J	R11	Same as R3	
			R12	Resistor, Variable	RV111U102A
R4	Resistor, Variable	RV111U101A	R13	Same as R4	
R5	Resistor, Fixed, Composition	RC07GF560J	R14	Resistor, Fixed, Composition	RC07GF181J
R6	Same as R3		R15	Same as R3	
R7	Same as R4		R16	Resistor, Fixed, Composition	RC07GF102J
R8	Resistor, Fixed, Composition	RC07GF2R7J			
TUNABLE IF ASSEMBLY A4977 (Z301)					
C1 thru C35	Capacitor, Variable	CV112-9	C39	Capacitor, Fixed, Mica	CM111E181J1S
C36	Capacitor, Variable	CV112-4	C40	Capacitor, Fixed, Mica	CM111E151J1S
C37	Capacitor, Fixed, Mica	CM111E271J1S	C41	Capacitor, Fixed, Mica	CM111E121J1S
C38	Capacitor, Fixed, Mica	CM111E221J1S	C42	Capacitor, Fixed, Mica	CM111E820J1S

TUNABLE IF ASSEMBLY A4977 (Z301) (Continued)

REF. SYMBOL	DESCRIPTION	TMC PART NO.
C43	Capacitor, Fixed, Mica	CM111E560J1S
C44	Capacitor, Fixed, Mica	CM111E201J1S
C45	Capacitor Fixed, Mica	CM111E241J1S
C46	Capacitor, Fixed, Mica	CM111E681J1S
C47	Capacitor, Fixed, Ceramic	CC100-28
C48	Capacitor, Fixed, Mica	CM111E331J1S
C49 thru C52	Capacitor, Fixed, Ceramic	CC100-43
C53	Same as C44	
C54 thru C57	Same as C49	
C58	Capacitor, Fixed, Mica	CM111E131J1S
C59	Capacitor, Fixed, Mica	CM111E301J1S
C60	Same as C49	
C61	Same as C44	
C62	Capacitor, Fixed, Mica	CM111E431J1S
C63	Same as C49	
C64	Same as C47	
C65	Capacitor, Fixed, Mica	CM112E272J1S
C66 and C67	Same as C49	
C68	Same as C65	
C69	Capacitor, Fixed, Mica	CM111E391J1S
C70	Capacitor, Fixed, Mica	CM111C240J1S
C71	Capacitor, Fixed, Mica	CM111C050J1S
C72	Same as C47	
C73	Same as C71	
C74 and C75	Same as C49	
C76	Same as C47	
C77	Capacitor, Fixed, Mica	CM112E332J1S
C78	Same as C41	
C79	Same as C38	
C80	Capacitor, Fixed, Mica	CM111C150J1S

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.
TUNABLE IF ASSEMBLY A4977 (Z301) (Continued)					
C81	Same as C48		C100	Capacitor, Fixed, Mica	CM111C270J1S
C82	Same as C43		C101	Same as C37	
C83	Same as C47		C102	Same as C44	
C84	Capacitor, Fixed, Mica	CM111E361J1S	C103	Capacitor, Fixed, Mica	CM111E161J1S
C85	Same as C37		C104	Same as C58	
C86	Same as C38		C105	Capacitor, Fixed, Mica	CM111E750J1S
C87	Same as C39		C106 thru C108	Same as C49	
C88	Same as C40		C109	Capacitor, Fixed, Mica	CM111E511J1S
C89	Same as C41		C110	Same as C47	
C90	Same as C42		C111 thru C113	Capacitor, Fixed, Mica	CM111E120J1S
C91	Same as C43		C114	Same as C47	
C92	Same as C48		C115	Same as C49	
C93	Same as C37		C116	Same as C47	
C94	Same as C38		C117	Not Used	
C95	Same as C39		C118 and C119	Same as C47	
C96	Same as C40				
C97	Same as C41				
C98	Same as C42				
C99	Same as C43				

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.
		TUNABLE IF ASSEMBLY A4977 (Z301) (Continued)			
CR1 thru CR4	Capacitor, Voltage Variable	CX106-14	R4	Resistor, Fixed, Composition	RC07GF223J
CR5	Semiconductor Device, Diode	1N756	R5	Resistor, Fixed, Composition	RC07GF475J
CR6	Capacitor, Voltage Variable	CX106-5	R6	Same as R1	
L1 and L2	Coil, RF, Fixed	CL275-121	R7	Resistor, Fixed, Composition	RC07GF151J
L3	Coil, RF, Fixed	CL275-221	R8	Resistor, Fixed, Composition	RC07GF106J
L4 thru L8	Coil, RF,	CL275-102	R9	Resistor, Fixed, Composition	RC07GF102J
L9	Coil, RF, Fixed	CL275-103	R10	Same as R1	
Q1 thru Q6	Transistor	40841	R11	Resistor, Fixed, Composition	RC07GF334J
R1	Resistor, Fixed, Composition	RC07GF103J	R12	Same as R2	
R2	Resistor, Fixed, Composition	RC07GF101J	R13	Same as R3	
R3	Resistor, Fixed, Composition	RC07GF105J	R14	Same as R8	
			R15	Same as R1	
			R16	Same as R5	
			R17	Same as R1	

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.
TUNABLE IF ASSEMBLY A4977 (Z301) (Continued)					
R18	Same as R9		R38	Same as R2	
R19	Same as R7		R39	Same as R9	
R20	Same as R11		R40	Same as R11	
R21	Same as R3		R41	Same as R2	
R22	Same as R2		R42	Resistor, Variable	RV124-1-104
R23	Resistor, Fixed, Composition	RC07GF822J	R43	Same as R11	
R24	Same as R9		R44	Same as R2	
R25	Same as R2		R45	Same as R4	
R26	Same as R2		R46	Same as R2	
R27	Same as R9		R47	Same as R30	
R28	Same as R2		R48	Same as R1	
R29	Same as R1		R49	Same as R9	
R30 thru R32	Resistor, Fixed, Composition	RC07GF470J	S1	Switch, Detent	DT110
R33 thru R35	Resistor, Fixed, Composition	RC07GF104J	T1	Transformer, Tunable	TT307-21
R36	Resistor, Fixed, Composition	RC07GF471J	T2 and T3	Transformer,	TT307-22
R37	Same as R33		T4	Transformer, Tunable	TT307-24
			T5	Transformer, Tunable	TT307-23

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.
		TUNABLE IF ASSEMBLY A4977 (Z301) (Continued)			
T6	Same as T4		TP1 thru TP6	Terminal, Stud	TE127-2
		VOLTAGE DIVIDER ASSEMBLY A4999 (P/O Z301)			
C1 and C2	Capacitor, Fixed, Ceramic	CC100-28	R5	Resistor, Fixed, Composition	RC07GF122J
L1	Coil, RF, Fixed	CL275-102	R6 and R7	Resistor, Fixed, Composition	RC07GF331J
R1	Resistor, Fixed, Composition	RC07GF102J	R8	Resistor, Fixed, Composition	RC07GF271J
R2	Resistor, Fixed, Composition	RC07GF222J	R9 thru R11	Resistor, Fixed, Composition	RC07GF820J
R3 and R4	Resistor, Fixed, Composition	RC07GF182J			
		DECOUPLING ASSEMBLY A5623 (P/O Z301)			
L1	Coil, RF, Fixed	CL275-103	L3 thru L5	Same as L1	
L2	Coil, RF, Fixed	CL275-102			

REF. SYMBOL	DESCRIPTION	TMC PART NO.
	160.5 MHz OSCILLATOR ASSEMBLY A4971 (Z302)	
C1	Capacitor, Fixed, Mica	CM111E101J1S
C2	Capacitor, Fixed, Mica	CM111C050J1S
C3 and C4	Same as C1	
C5	Capacitor, Fixed, Mica	CM111E0271J1S
C6	Capacitor, Fixed, Mica	CM111C030J1S
C7 thru C11	Same as C1	
C12 thru C15	Capacitor, Fixed, Ceramic	CC100-29
CR1	Capacitor, Vairable	CX106-5
CR2	Semiconductor Device, Diode	1N756
E1 thru E6	Terminal, Stud	TE127-2
L1	Coil, RF	CL275-0R82
L2	Coil, HFO Assembly	A4983-2
L3	Same as L1	
L4	Coil, RF	CL486-5
L5	Same as L1	
L6	Coil, RF	CL486-4
Q1	Transistor	MPS918
Q2	Transistor	2N2368
Q3	Not Used	
Q4	Transistor	3N128
Q5	Transistor	2N3819
R1	Resistor, Fixed, Composition	RC07GF100J
R2	Resistor, Fixed, Composition	RC07GF270J
R3	Resistor, Fixed, Composition	RC07GF104J
R4	Resistor Fixed, Composition	RC07GF565J
R5	Resistor, Fixed, Composition	RC07GF682J
R6	Resistor, Fixed, Composition	RC07GF821J
R7	Same as R4	

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.

160.5 MHz OSCILLATOR ASSEMBLY A4971 (Z302) (Continued)

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.
R8 and R9	Not Used		R14	Resistor, Fixed, Composition	RC07GF154J
R10	Resistor, Fixed, Composition	RC07GF103J	R15	Resistor, Fixed, Composition	RC07GF474J
R11	Resistor, Fixed, Composition	RC07GF680J	R16	Resistor, Fixed, Composition	RC07GF684J
R12	Resistor, Fixed, Composition	RC07GF562J	R17	Resistor, Fixed, Composition	RC07GF151J
R13	Resistor Fixed, Composition	RC07GF121J	R18	Resistor, Fixed, Composition	RC07GF470J

SAMPLE MIXER ASSEMBLY A4979 (Z303)

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.
C1 thru C3	Capacitor, Fixed, Ceramic	CC100-43	C12	Capacitor, Fixed, Ceramic	CC100-29
C4	Not Used		C13	Same as C1	
C5 thru C8	Capacitor, Fixed, Mica	CM111E101J1S	C14 and C15	Capacitor, Fixed, Mica	CM111E470J1S
C9	Same as C1		L1 and L2	Coil, RF	CL275-101
C10	Same as C5		L3	Coil, RF	CL275-150
C11	Not Used		L4	Coil, RF	CL275-102

SAMPLE MIXER ASSEMBLY A4979 (Z303) (Continued)

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.
L5	Coil, RF	CL275-0R47	R6 and R7	Same as R4	
L6	Coil, RF	CL275-0R22	R8 thru R10	Resistor, Fixed, Composition	RC07GF470J
Q1 and Q2	Transistor	2N2368	R11 and R12	Same as R4	
R1	Resistor, Fixed, Composition	RC07GF221J	R13	Same as R14	
R2	Resistor, Fixed, Composition	RC07GF681J	R14	Same as R5	
R3	Resistor, Fixed, Composition	RC07GF562J	R15	Same as R4	
R4	Resistor, Fixed, Composition	RC07GF471J	R16	Same as R5	
			R17	Same as R1	
R5	Resistor, Fixed, Composition	RC07GF682J	Z1	Microcircuit, Linear	NW195

163.5-192.5 MHz OSCILLATOR ASSEMBLY A4976 (Z304)

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.
C1 and C2	Capacitor, Fixed, Mica	CM111E101J1S	C8	Capacitor, Fixed, Mica	CM111C030J1S
C3	Capacitor, Fixed, Mica	CM111C050J1S	C9 and C10	Same as C1	
C4 thru C7	Capacitor, Fixed, Ceramic	CC100-29	C11	Capacitor, Fixed, Mica	CM111C330J1S

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.
163.5-192.5 MHz OSCILLATOR ASSEMBLY A4976 (Z304) (Continued)					
C12	Same as C1		Q1	Transistor	2N3819
C13	Capacitor, Fixed, Mica	CM111C150J1S	Q2	Transistor	3N128
C14 thru C18	Same as C1		Q3	Not Used	
C19	Same as C3		Q4 and Q5	Transistor	2N2368
C20	Same as C8		Q6	Same as Q1	
C21 thru C23	Same as C1		Q7	Same as Q1	
C24 and C25	Same as C4		R1	Resistor, Fixed, Composition	RC07GF100J
C26	Capacitor, Fixed, Ceramic	CC100-41	R2 and R3	Resistor, Fixed, Composition	RC07GF270J
CR1 and CR2	Capacitor, Voltage Variable	CX106-17	R4	Resistor, Fixed, Composition	RC07GF104J
L1	Coil, RF	CL275-0R82	R5	Resistor, Fixed, Composition	RC07GF154J
L2	Coil, HFO	CL486-2	R6	Same as R4	
L3	Coil, HFO	CL484-2	R7	Resistor, Fixed, Composition	RC07GF682J
L4 and L5	Same as L1		R8	Resistor, Fixed, Composition	RC07GF221J
L6	Coil, HFO	CL484-1			
L7 and L8	Same as L1				
L9	Coil, HFO	CL486-3			

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.
		163.5-192.5 MHz OSCILLATOR ASSEMBLY A4976 (Z304) (Continued)			
R9	Resistor, Fixed, Composition	RC07GF103J	R13	Resistor, Fixed, Composition	RC07GF121J
R10	Resistor, Fixed, Composition	RC07GF562J	R14 and R15	Same as R9	
			R16	Same as R1	
R11	Resistor, Fixed, Composition	RC07GF101J	R17	Same as R4	
			R18	Same as R5	
R12	Resistor, Fixed, Composition	RC07GF680J	R19 and R20	Same as R9	
			R21 thru R23	Same as R4	
		IF OUTPUT MIXER ASSEMBLY A4974 (Z305)			
C1	Capacitor, Fixed, Mica	CM111E360D1S	L1	Coil, RF, Fixed	CL275-0R18
C2 and C3	Capacitor, Fixed, Mica	CM111E181J1S	Z1	Rectifier	DD148
		DIFFERENTIAL AMPLIFIER ASSEMBLY A4973 (Z306)			
C1 thru C4	Capacitor, Variable	CV112-7	C11	Capacitor, Fixed, Mica	CM111C220J1S
C5 thru C10	Capacitor, Fixed, Mica	CM111E101J1S	C12 and C13	Same as C5	

REF. SYMBOL	DESCRIPTION	TMC PART NO.
DIFFERENTIAL AMPLIFIER ASSEMBLY A4973 (Z306) (Continued)		
C14	Same as C11	
C15	Same as C5	
C16 thru C22	Not Used	
C23 thru C25	Capacitor, Fixed, Mica	CM111E111J1S
C26 thru C30	Capacitor, Fixed, Ceramic	CC100-29
C31 and C32	Not Used	
C33	Same as C26	
L1	Not Used	
L2	Coil, RF	CL486
L3 and L4	Coil, RF	CL275-1R0
L5 and L6	Coil, RF	CL275-103
Q1 thru Q3	Transistor	40841
R1	Resistor, Fixed, Composition	RC07GF104J
R2	Resistor, Fixed, Composition	RC07GF475J
R3 thru R6	Resistor, Fixed, Composition	RC07GF102J
R7	Not Used	
R8	Same as R3	
R9	Resistor, Fixed, Composition	RC07GF331J
R10	Resistor, Fixed, Composition	RC07GF106J
R11 thru R15	Resistor, Fixed, Composition	RC07GF100J
R16	Resistor, Fixed, Composition	RC07GF151J
R17	Same as R1	
R18	Same as R16	
R19	Same as R1	
R20	Same as R16	
R21	Same as R11	
T1	Transformer, RF	TZ234-1
T2	Transformer, RF	TZ234-2
T3	Transformer, RF	TZ234-3

REF. SYMBOL	DESCRIPTION	TMC PART NO.	REF. SYMBOL	DESCRIPTION	TMC PART NO.
		RF INPUT MIXER ASSEMBLY A4975 (Z307)			
C1	Capacitor, Fixed, Mica	CM111E911J1S	L1	Coil, RF, Fixed	CL275-1R5
C2 and C3	Capacitor, Fixed, Mica	CM112E162J1S	Z1	Rectifier	DD148
		1-MHz SWITCHING ASSEMBLY A4982			
C1	Capacitor, Fixed, Ceramic	CC100-28	R1	Resistor, Fixed, Composition	RC07GF272J
C2	Capacitor, Fixed, Ceramic	CC100-29	R2	Resistor, Fixed, Composition	RC07GF331J
CR1	Semiconductor Device, Diode	1N914	R3	Resistor, Fixed, Composition	RC07GF470J
L1	Coil, RF, Fixed	CL275-103	R4	Resistor, Fixed, Composition	RC07GF152J
Q1	Transistor	2N3646			

RETURN THIS REQUEST TO YOUR T.M.C. DISTRIBUTOR OR SEND TO:

The Technical Materiel Corporation
700 Fenimore Road
Mamaroneck, New York 10543

Date ____________

ORGANIZATION/NAME ____________

ADDRESS ____________

____

LOCATION ____________ COUNTRY ____________

Instructions:

Use the TMC Technical Manual to identify the spare parts required. List these parts with quantities in the spaces provided below. TMC will return the list to you within 30 days of receipt with both prices and delivery quoted. If you do not have a technical manual and need a current spare parts list, use this form to request one.

TMC EQUIPMENT MODEL ____________ Serial/Mfgr No ____________

Quantity	TMC Part Number	Description	Unit Price	Ext Price	Delivery

Shaded Area for TMC Use

Shipping Charges	
TOTAL QUOTATION	

Requested Delivery ____________(Days)

Quantity	TMC Part Number	Description	Unit Price	Ext Price	Delivery

Shipping Charges	
TOTAL QUOTATION	

Shaded Area for TMC Use

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Mamaroneck, New York 10543

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ORGANIZATION/NAME ______________________________

ADDRESS ______________________________

____

LOCATION ______________________ COUNTRY ______________

Instructions:

Use the TMC Technical Manual to identify the spare parts required. List these parts with quantities in the spaces provided below. TMC will return the list to you within 30 days of receipt with both prices and delivery quoted. If you do not have a technical manual and need a current spare parts list, use this form to request one.

TMC EQUIPMENT MODEL ______________________ Serial/Mfgr No ______________

Quantity	TMC Part Number	Description	Unit Price	Ext Price	Delivery

Shaded Area for TMC Use

Shipping Charges	
TOTAL QUOTATION	

Requested Delivery ______________ (Days)

Quantity	TMC Part Number	Description	Unit Price	Ext Price	Delivery

Shipping Charges	
TOTAL QUOTATION	

Shaded Area for TMC Use

SECTION 7

DIAGRAMS

7-1. GENERAL.

7-2. This section contains the schematic and component location diagrams of the GPR-110. The overall schematic diagram of the unit is first presented, followed by the schematic, interconnection, and component location diagrams of the assemblies. The diagrams are arranged in reference designation order.

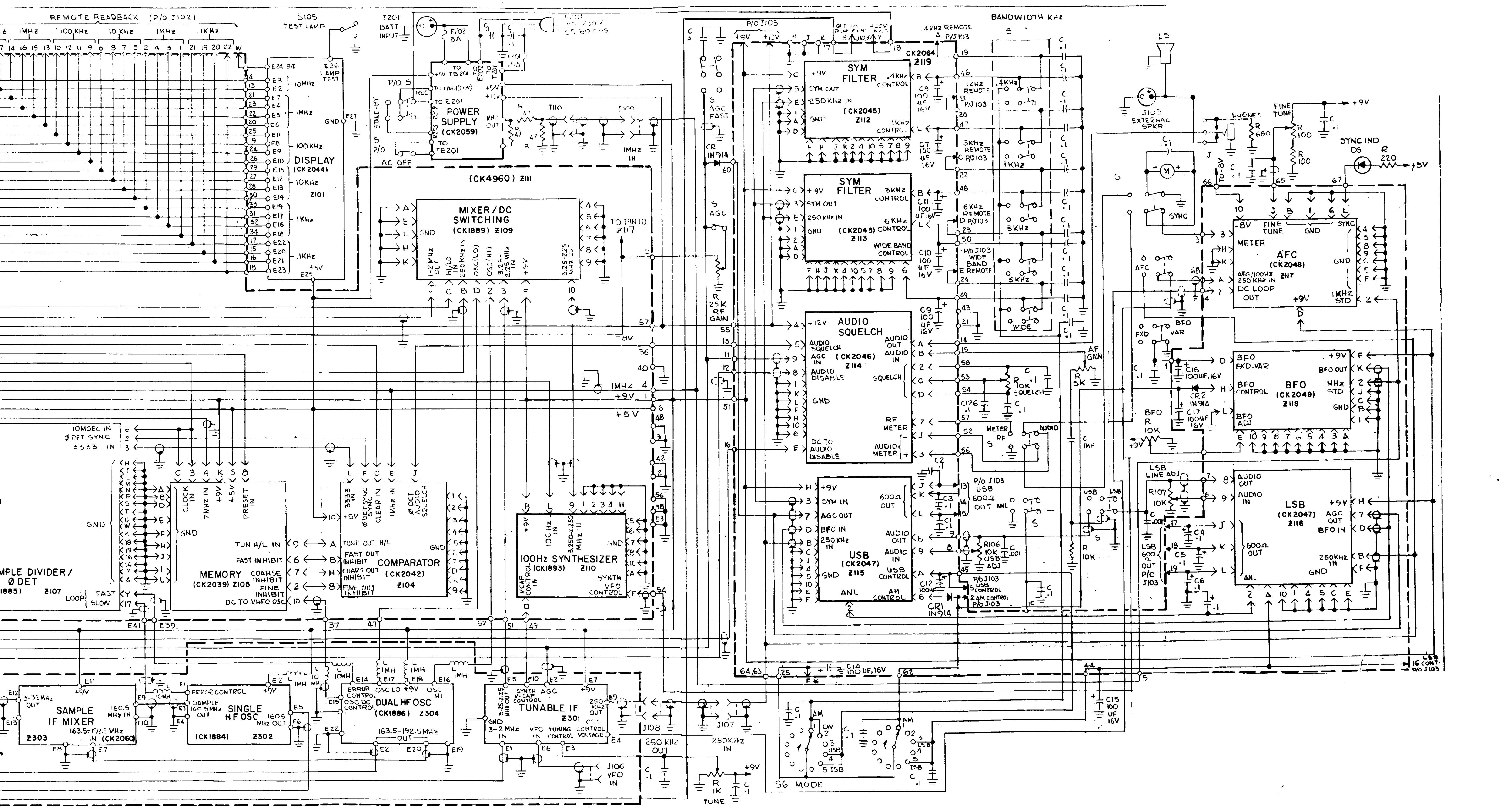

Figure 7-1. General Purpose Receiver GPR-110, Overall Schematic Diagram

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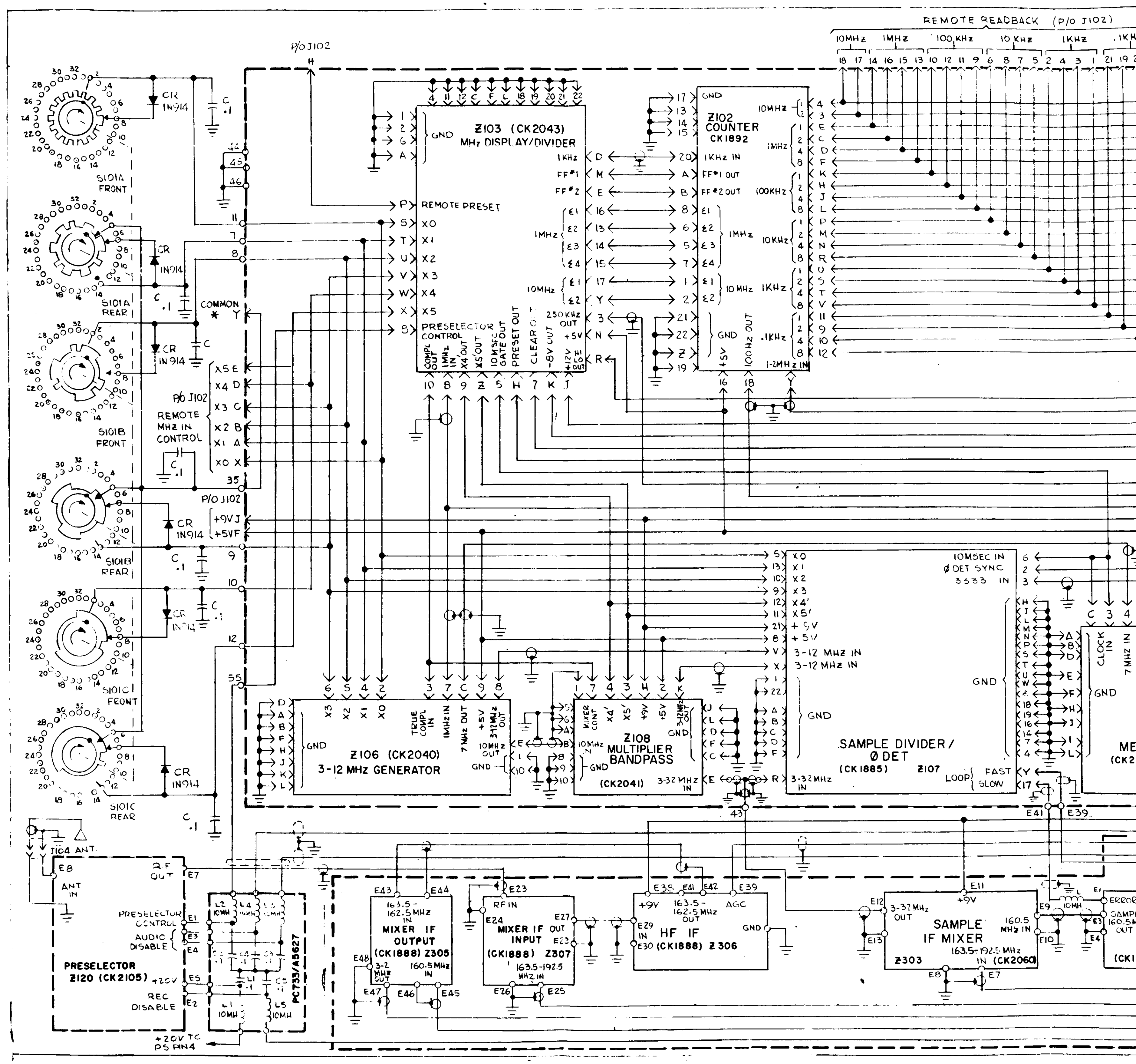
CK1891-X6

NOTES:
UNLESSE OTHERWISE SPECIFIED
1 - ALL RESISTANCE VALUES ARE IN OHMS.
2 - ALL DECIMALS CAPACITANCE VALUES ARE IN MICROFARADS
* CONNECT TO GND FOR LOCAL



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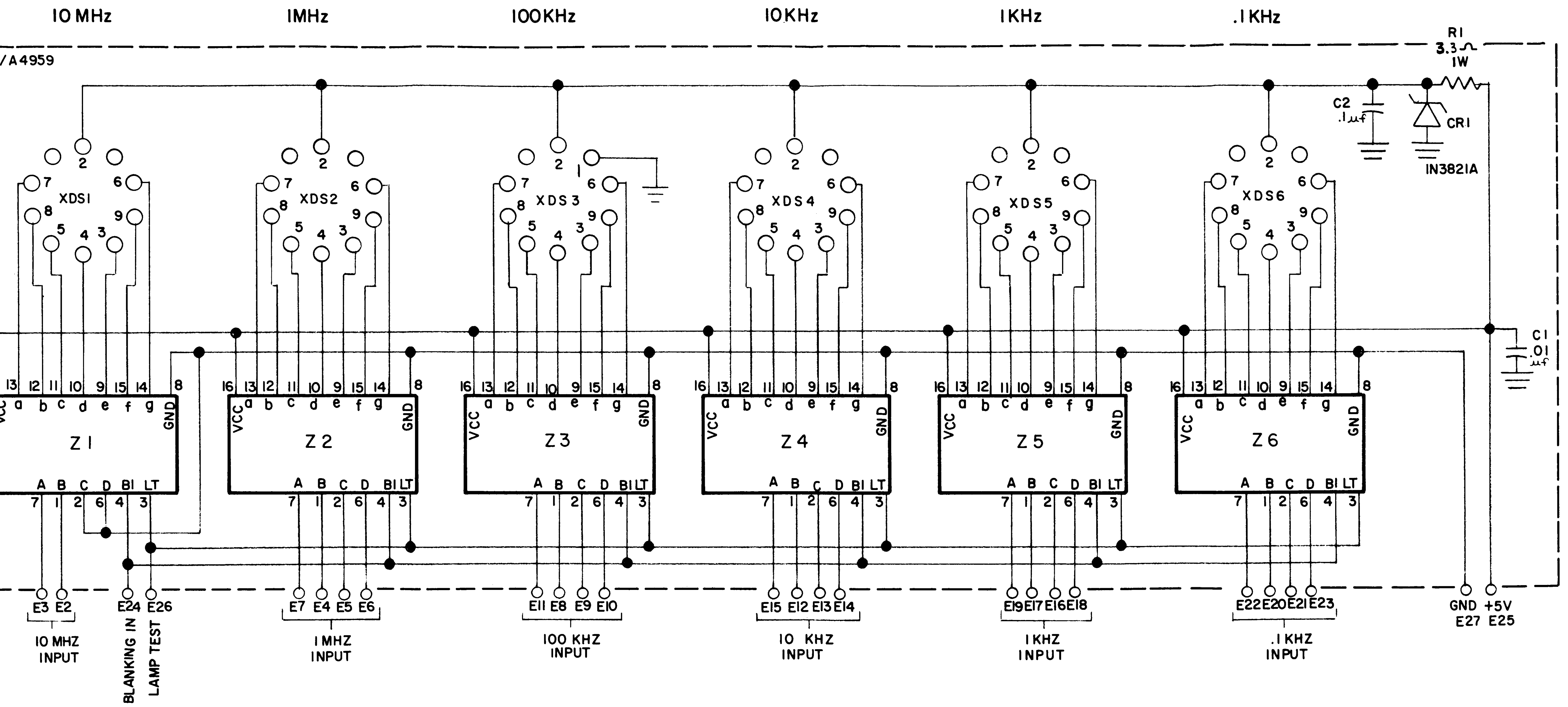

Figure 7-2. Readout Display Assembly Z101, Schematic Diagram

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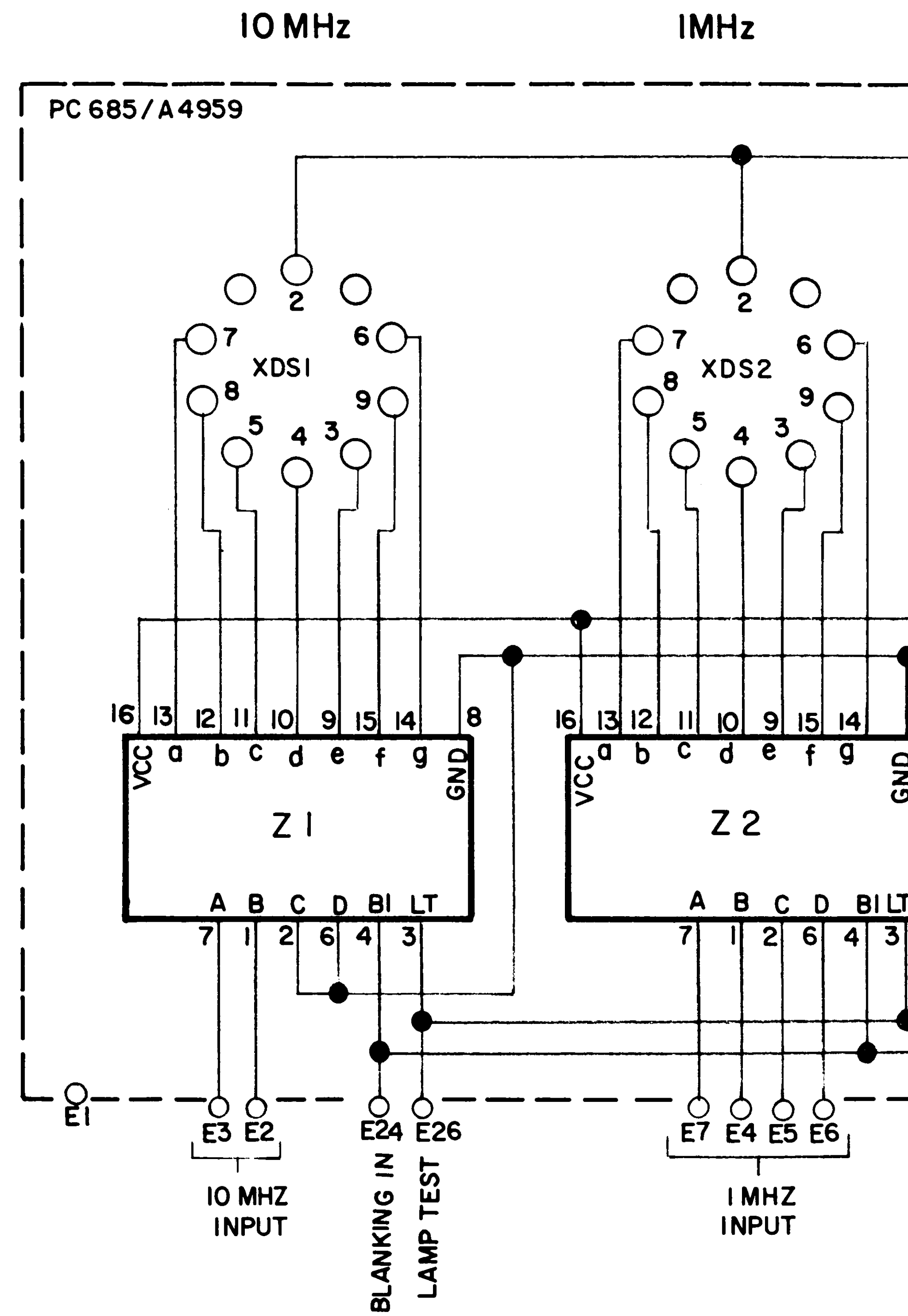

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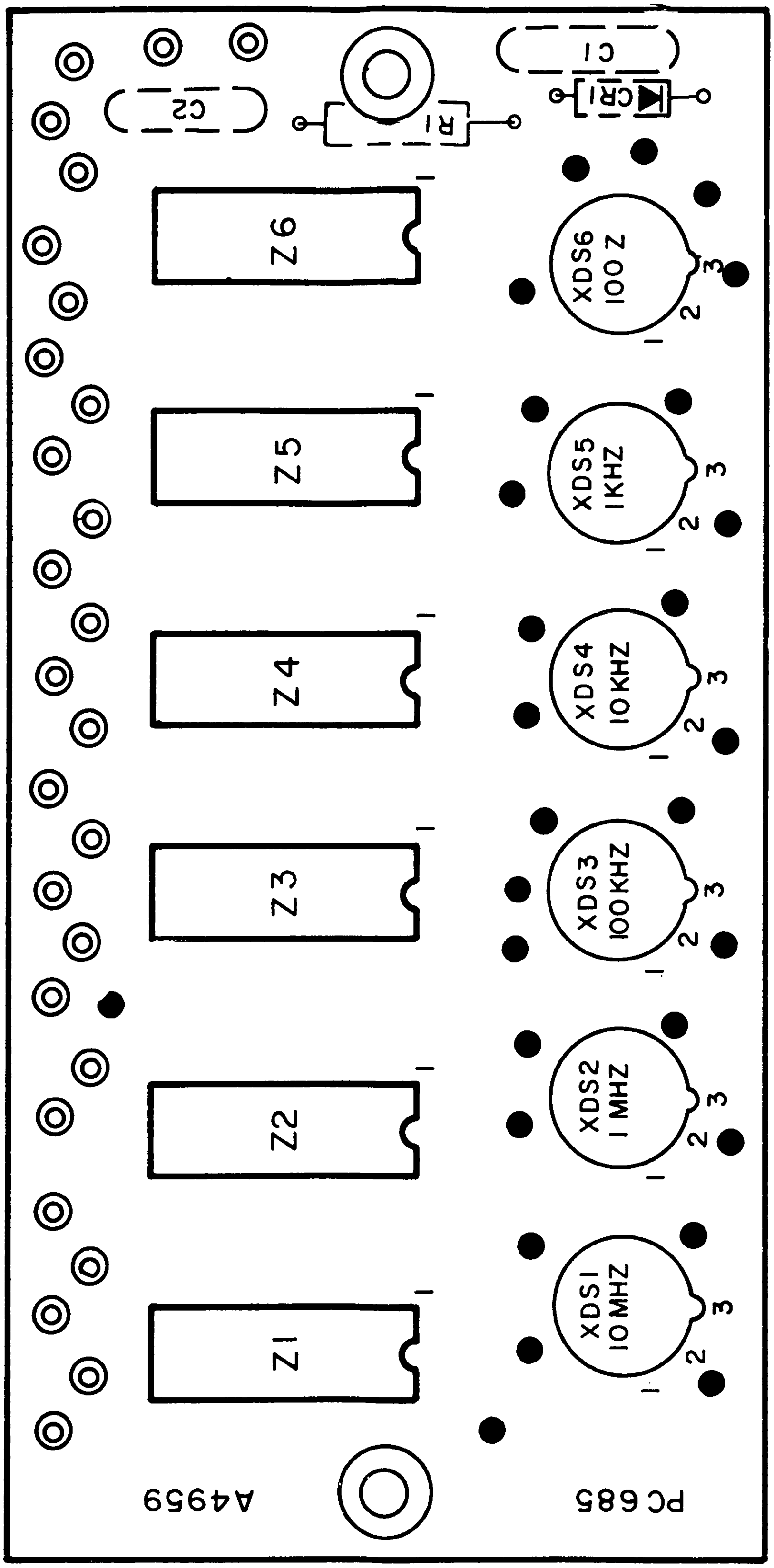
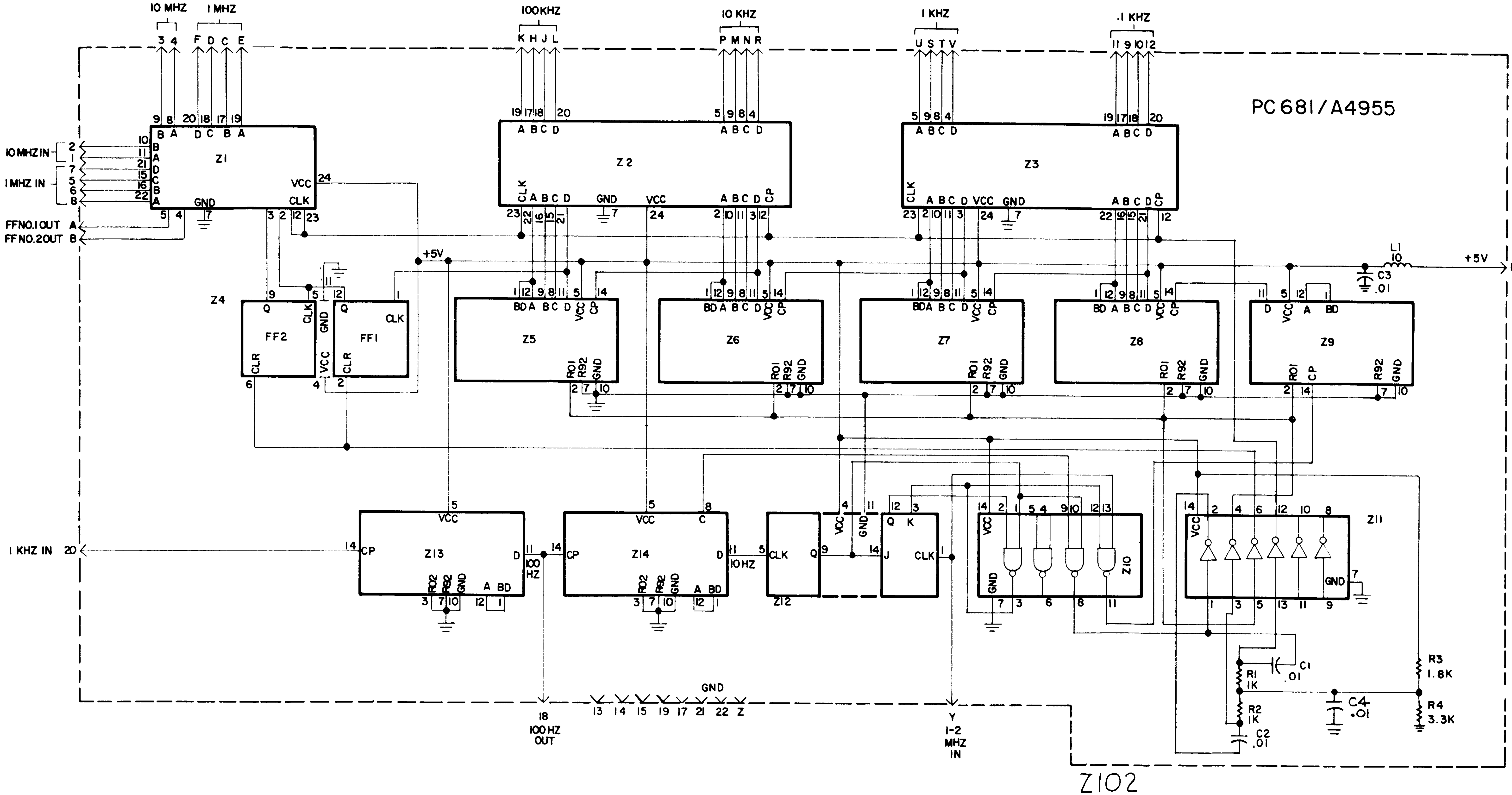


Figure 7-3. Readout Display Assembly, Location of Components



UNLESS OTHERWISE SPECIFIED

1. ALL RESISTANCE VALUES ARE IN OHMS, 1/4 W.
2. ALL DECIMAL CAPACITANCE VALUES ARE IN MICROFARADS.
3. ALL WHOLE NUMBER VALUES ARE IN PICOFARADS.
4. ALL INDUCTANCE VALUES ARE IN MICROHENRIES.

Figure 7-4. Digital Counter Assembly Z102, Schematic Diagram

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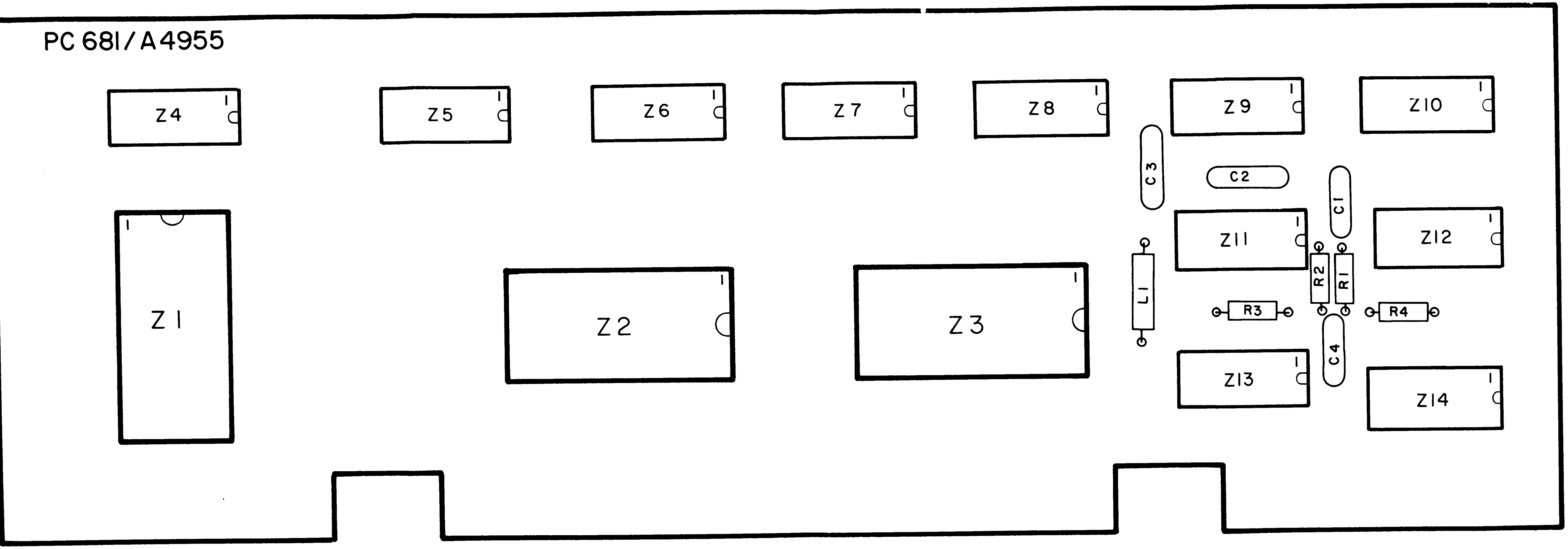
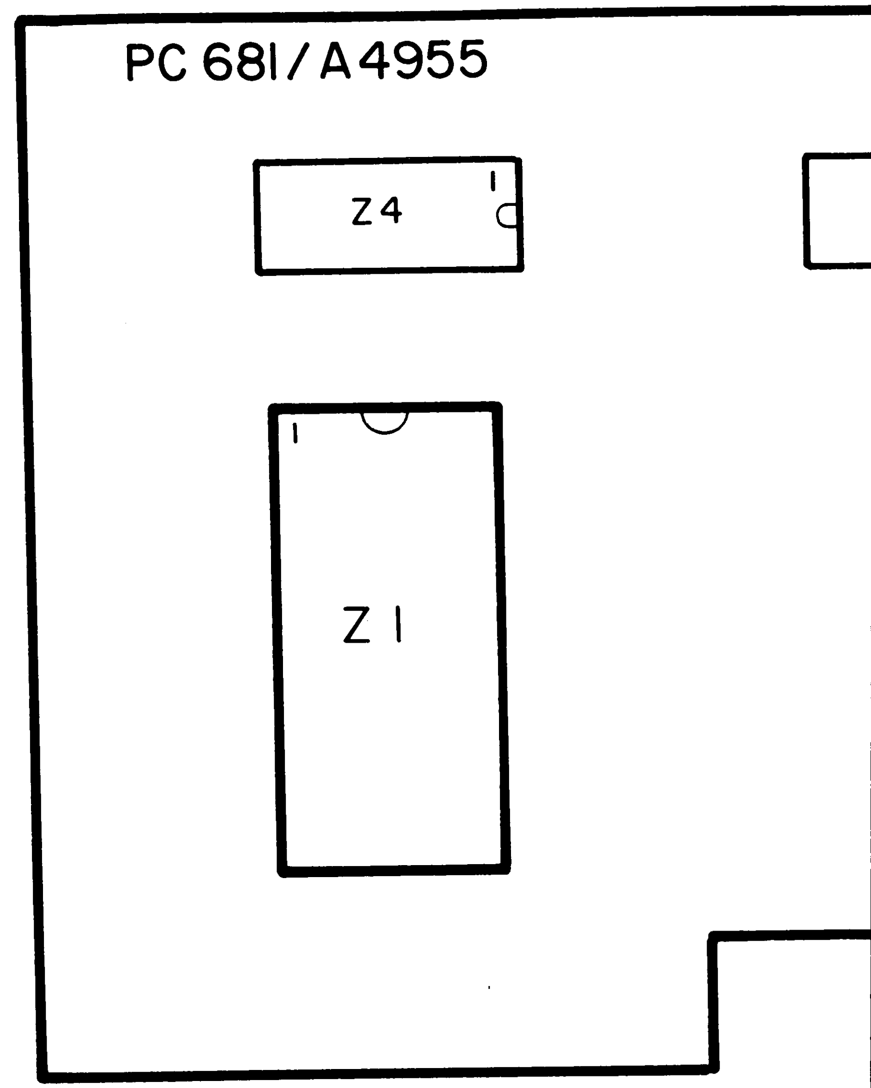


Figure 7-5. Digital Counter Assembly Z102, Location of Components



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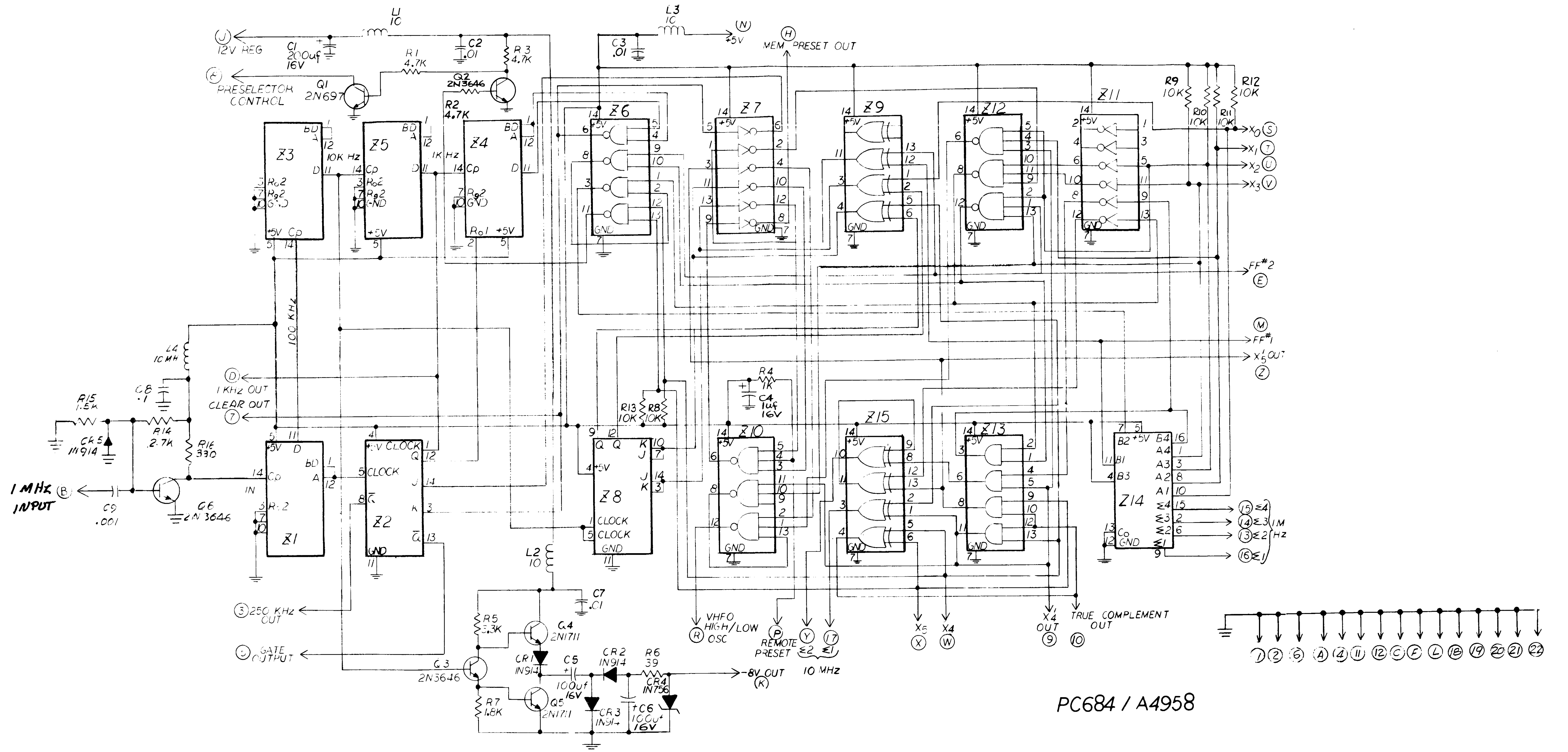
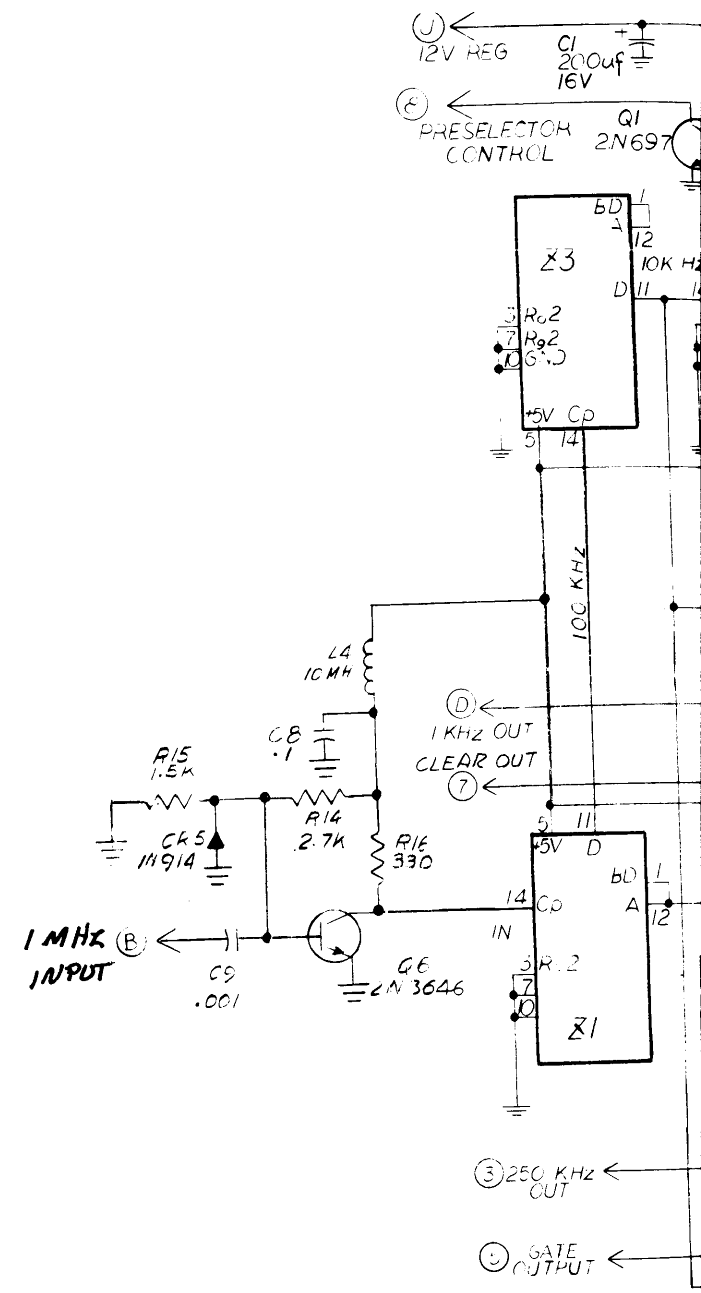


UNLESS OTHERWISE SPECIFIED

1. ALL RESISTANCE VALUES ARE IN OHMS, 1/4W.
2. ALL DECIMAL CAPACITANCE VALUES ARE IN MICROFARADS.
3. ——
4. ALL INDUCTANCE VALUES ARE IN MICROHENRIES.

Figure 7-6. MHz Display/Divider Assembly Z103, Schematic Diagram



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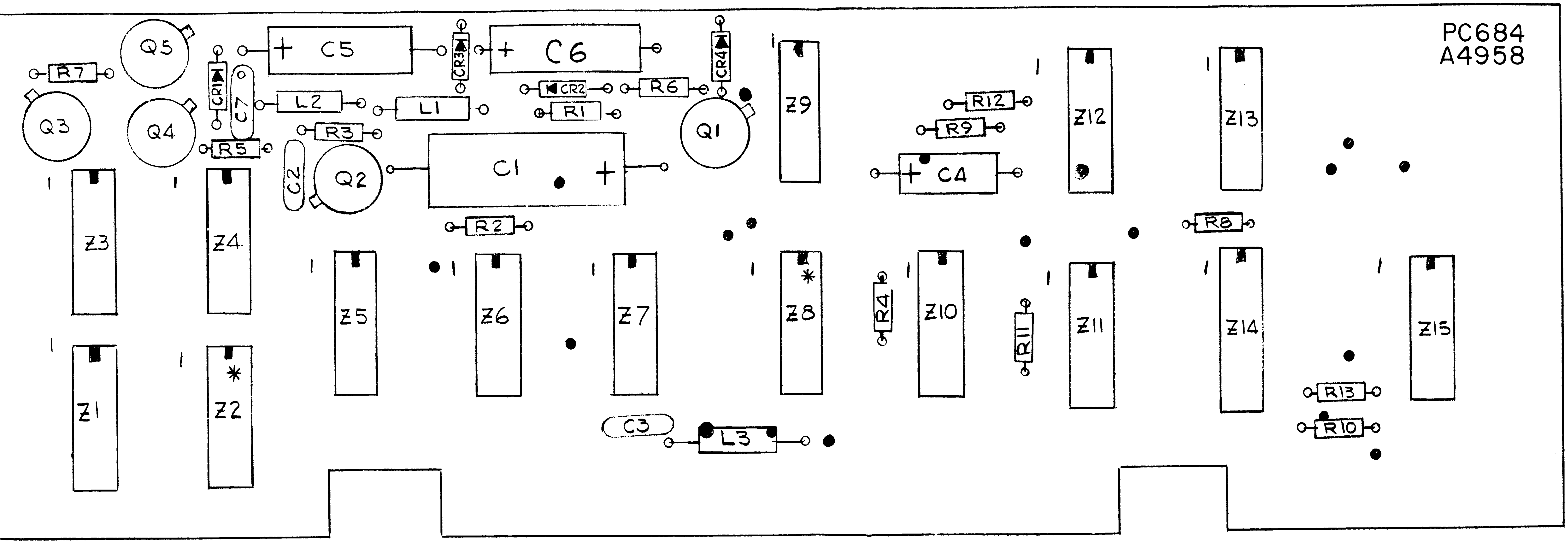

Figure 7-7. MHz Display/Divider Assembly Z103, Location of Components

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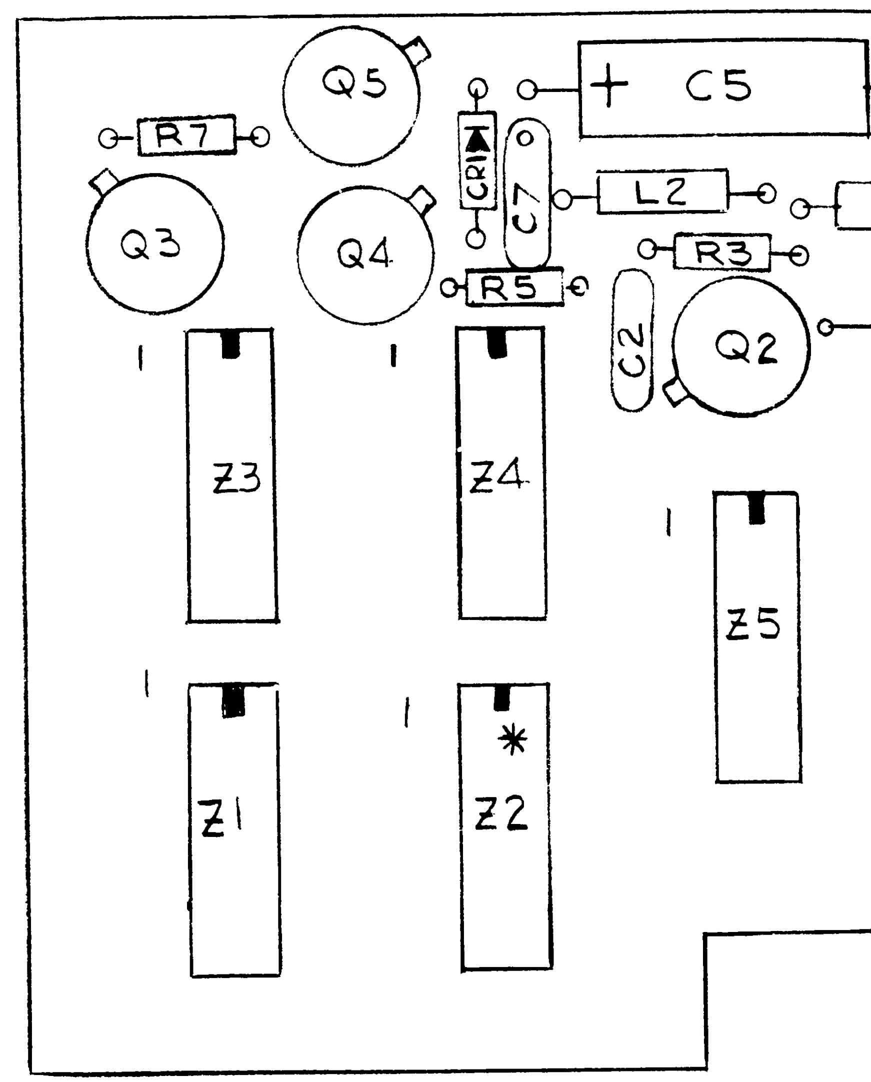

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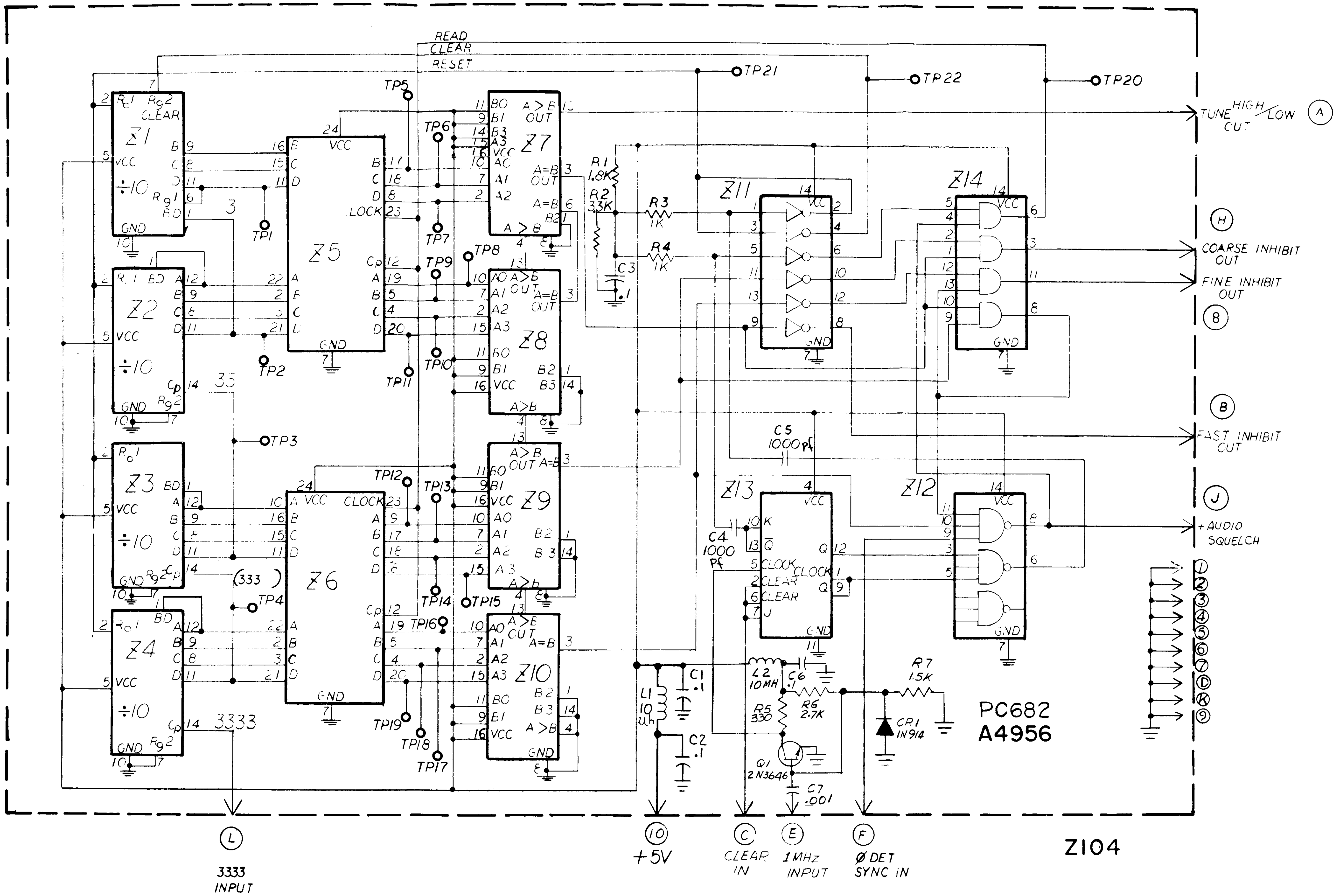


UNLESS OTHERWISE SPECIFIED

1. ALL RESISTANCE VALUES ARE IN OHMS, 1/4W.
2. ALL DECIMAL CAPACITANCE VALUES ARE IN MICROFARADS.

Figure 7-8. Comparator Assembly Z104, Schematic Diagram

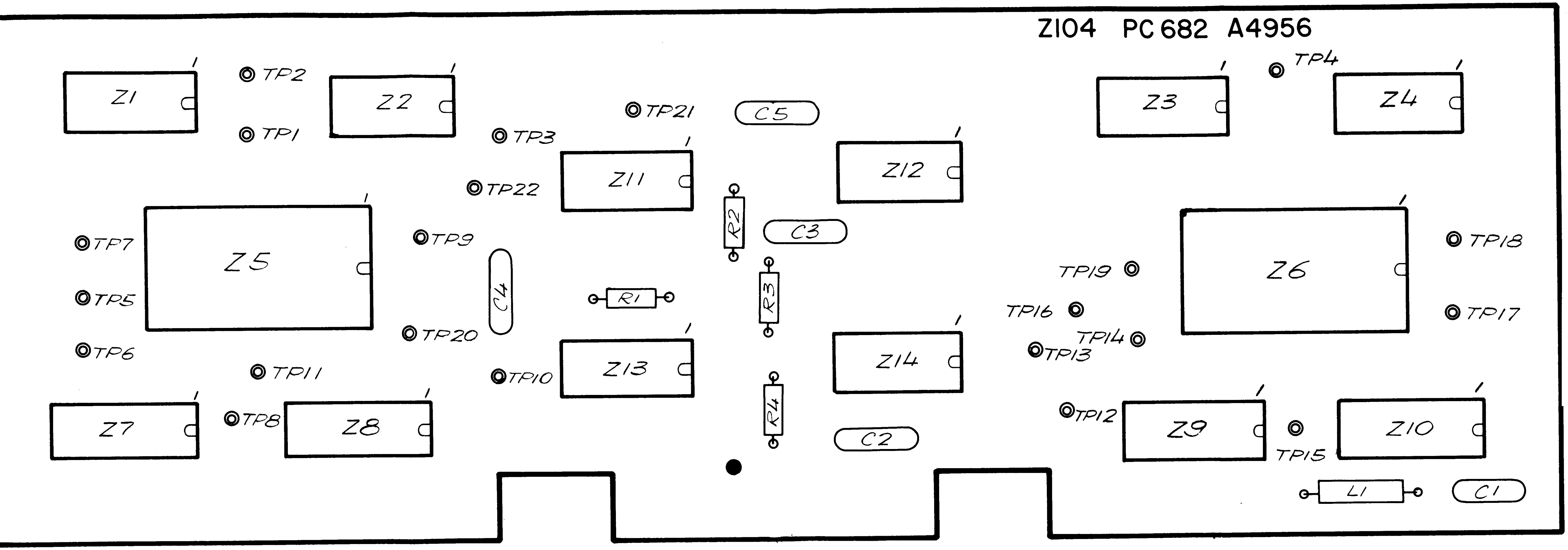
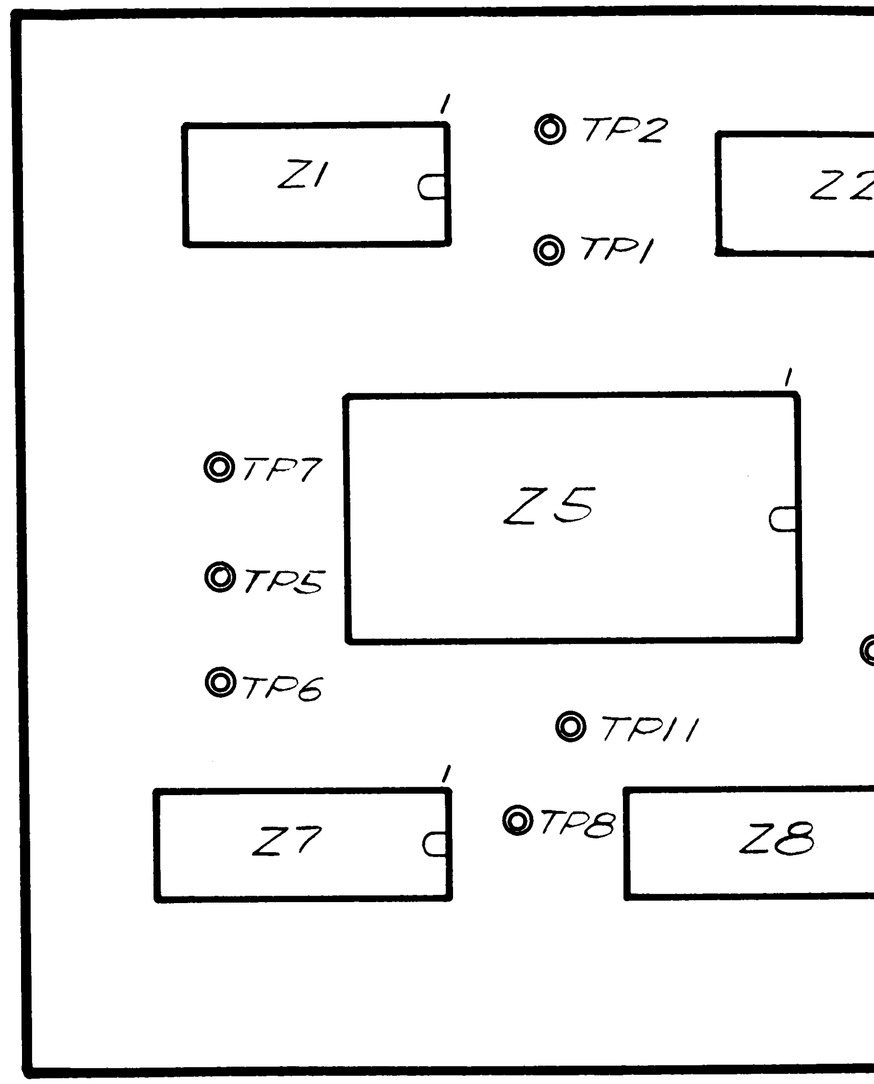


Figure 7-9. Comparator Assembly Z104, Location of Components



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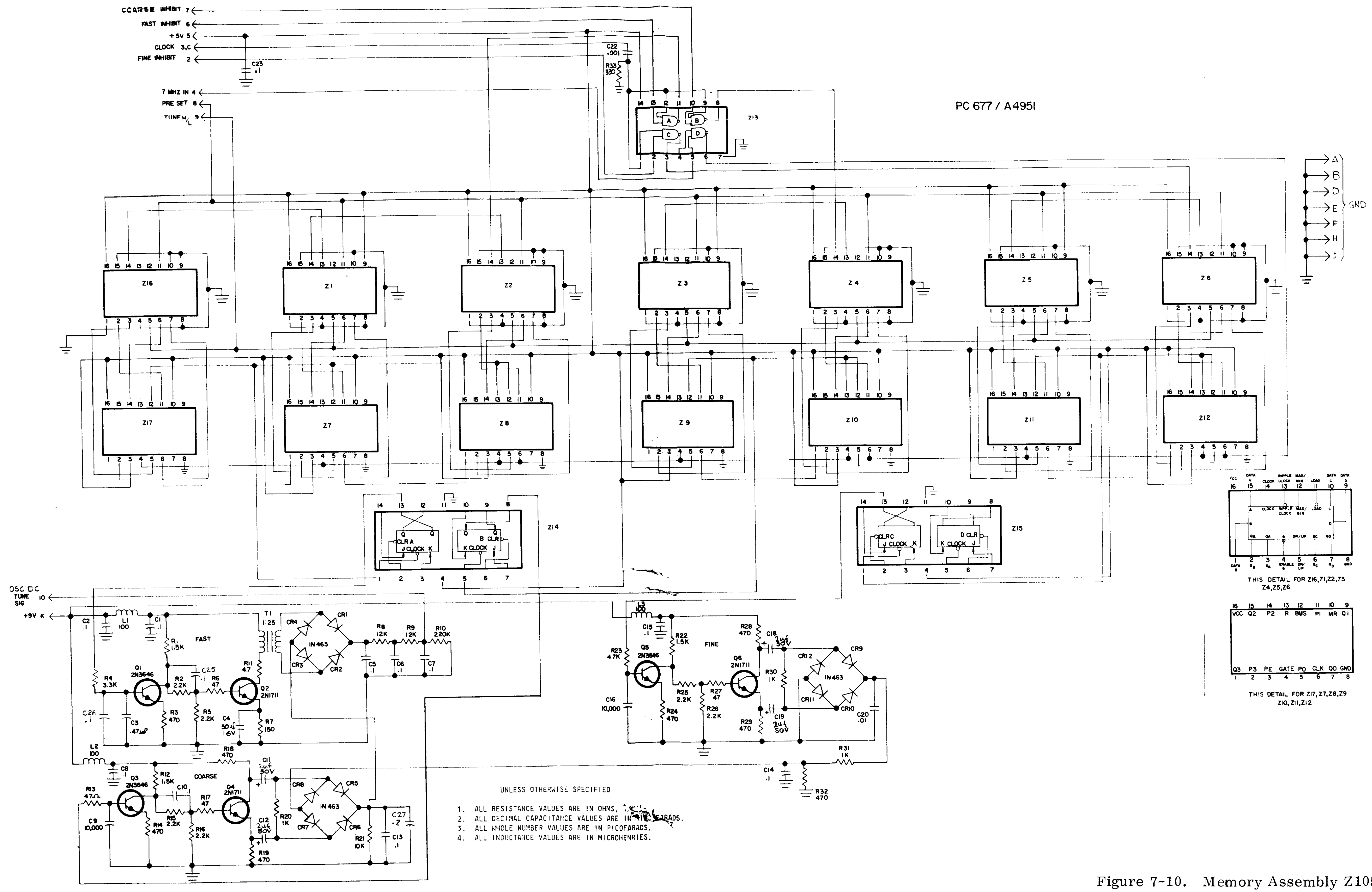

Figure 7-10. Memory Assembly Z105, Schematic Diagram

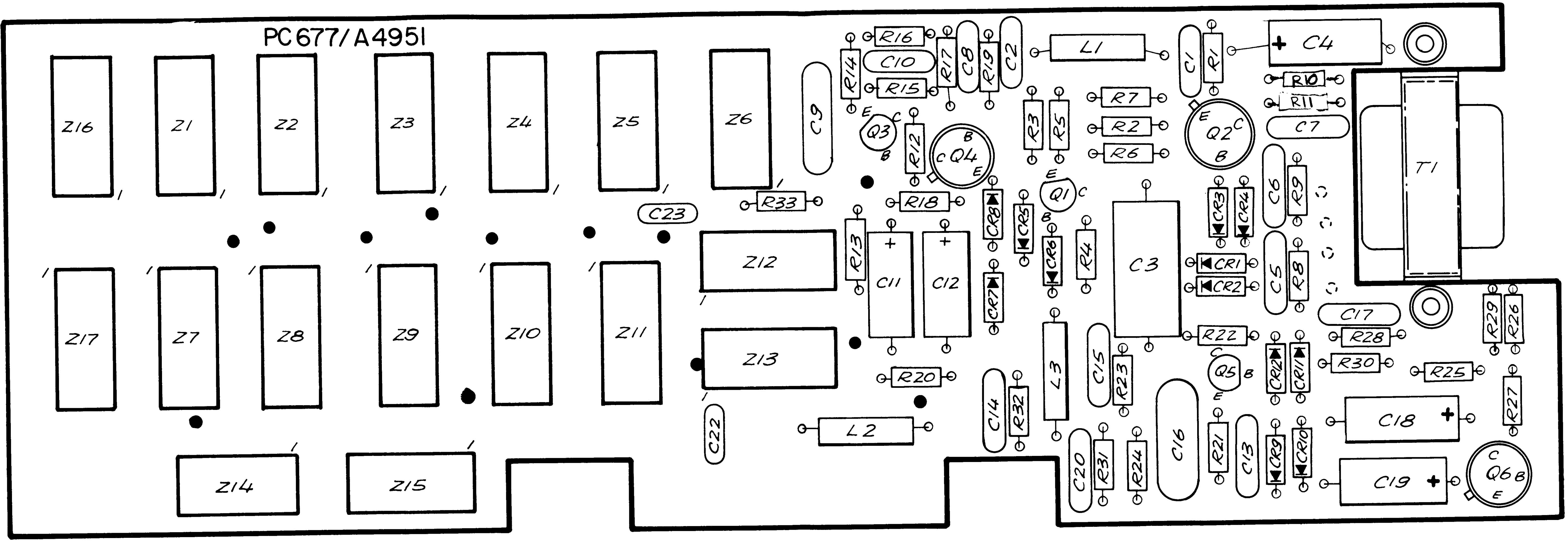

Figure 7-11. Memory Assembly Z105, Location of Components

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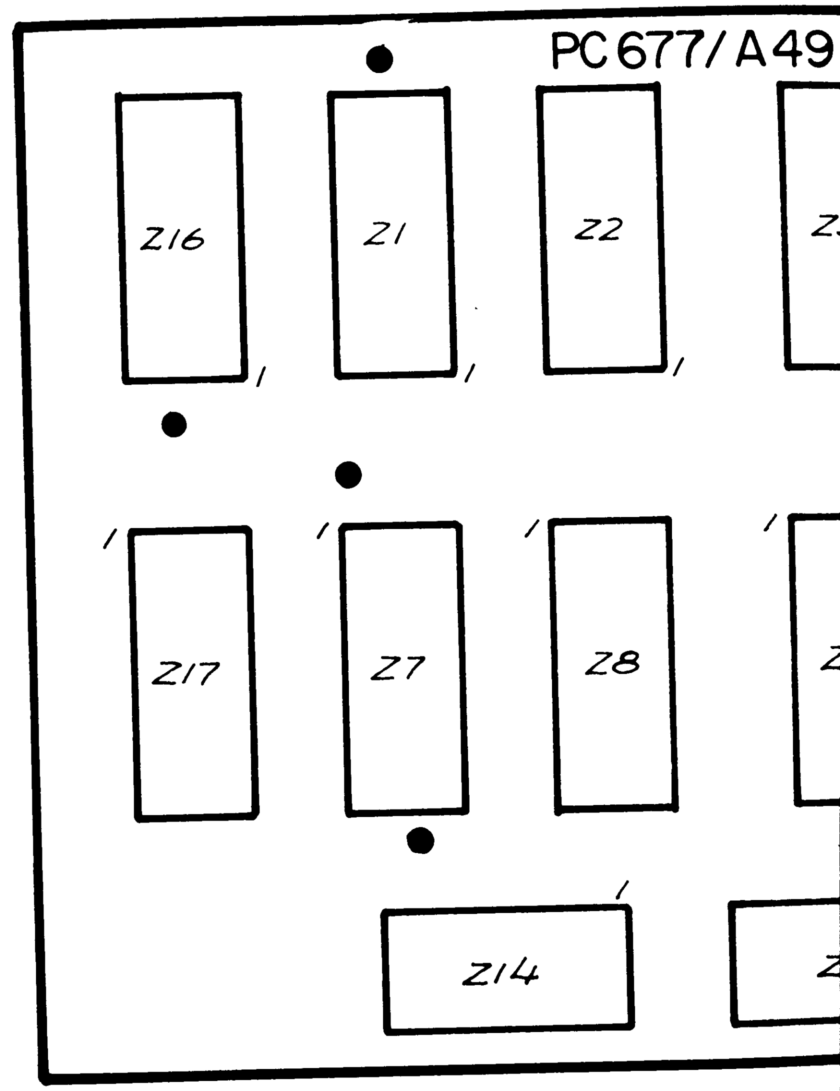

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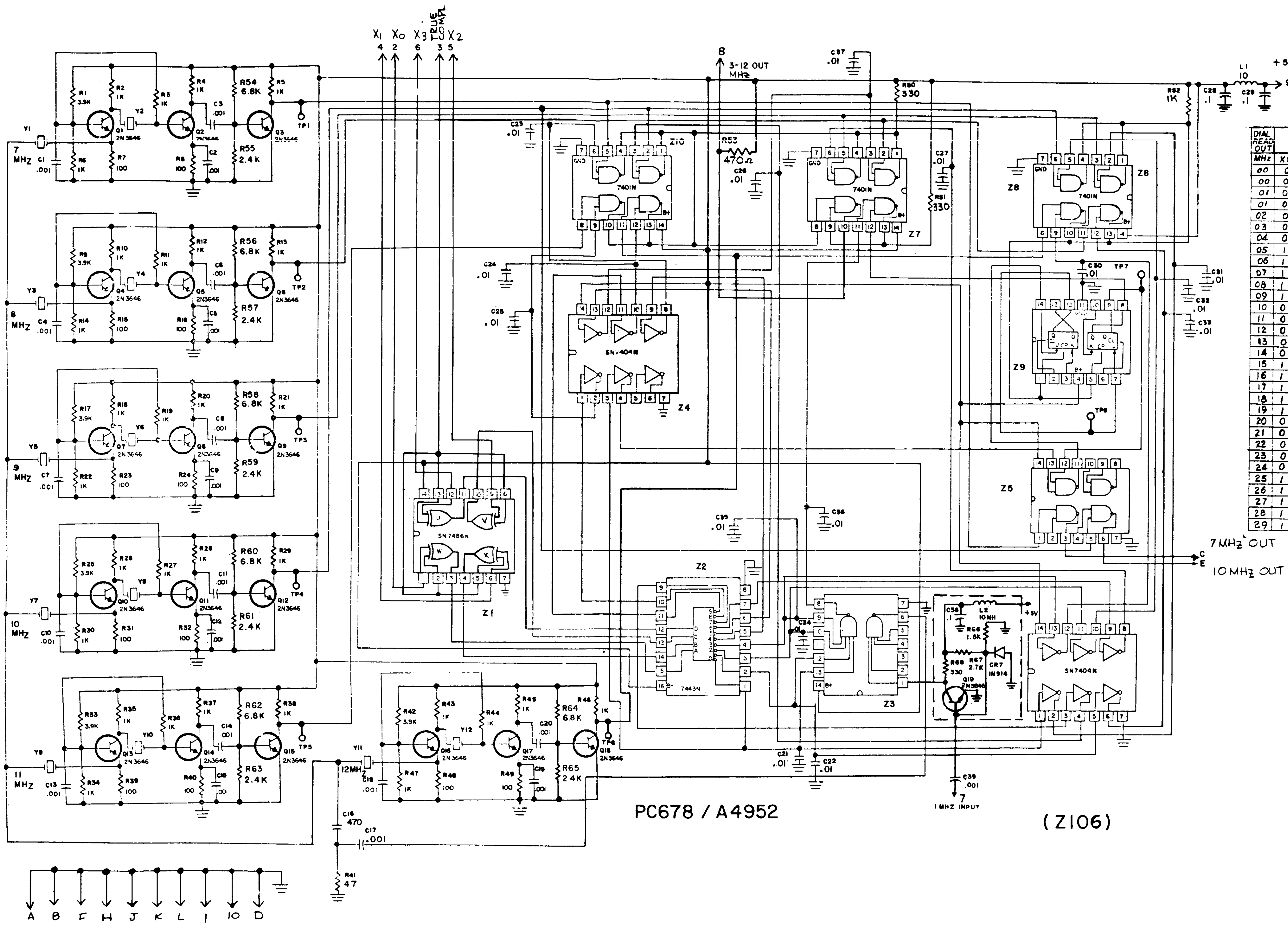

DIAL READ OUT	CODE INPUT					OUTPUT AT PIN 8
MHz	X3	X2	X1	X0	C	MHz
00	0	0	1	1	0	3
00	0	0	1	1	0	3
01	0	1	0	0	0	4
01	0	1	0	0	0	4
02	0	1	0	1	0	5
03	0	1	1	0	0	6
04	0	1	1	1	0	7
05	1	0	0	0	0	8
06	1	0	0	1	0	9
07	1	0	1	0	0	10
08	1	0	1	1	0	11
09	1	1	0	0	0	12
10	0	0	1	1	1	12
11	0	1	0	0	1	11
12	0	1	0	1	1	10
13	0	1	1	0	1	9
14	0	1	1	1	1	8
15	1	0	0	0	1	7
16	1	0	0	1	1	6
17	1	0	1	0	1	5
18	1	0	1	1	1	4
19	1	1	0	0	1	3
20	0	0	1	1	1	12
21	0	1	0	0	1	11
22	0	1	0	1	1	10
23	0	1	1	0	1	9
24	0	1	1	1	1	8
25	1	0	0	0	1	7
26	1	0	0	1	1	6
27	1	0	1	0	1	5
28	1	0	1	1	1	4
29	1	1	0	0	1	3

Figure 7-12. 3-12 MHz Generator Assembly Z106, Schematic Diagram

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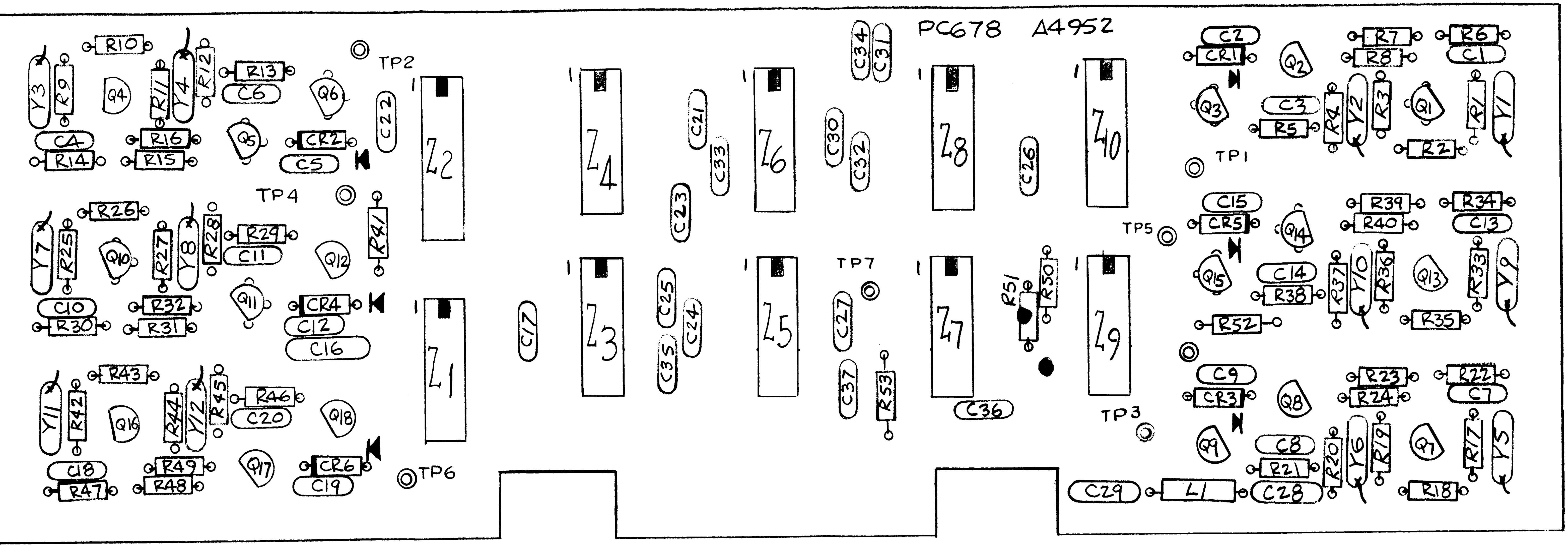
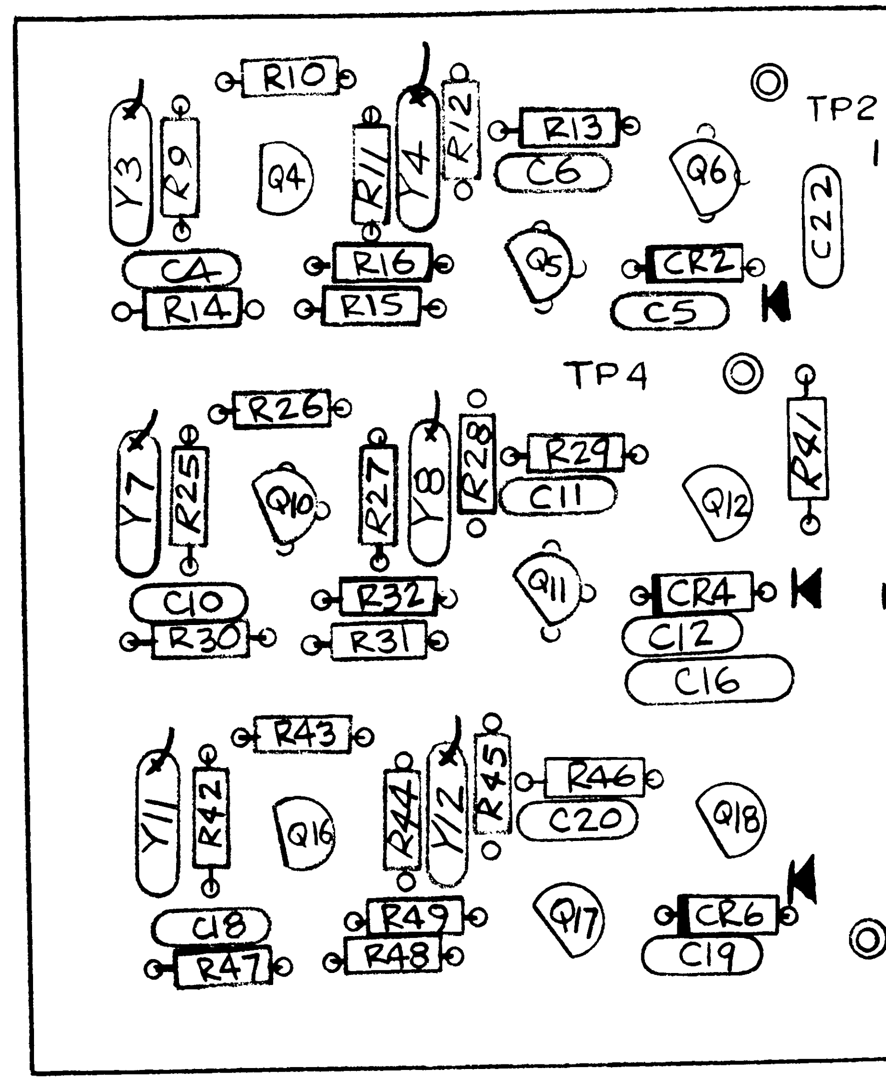


Figure 7-13. 3-12 MHz Generator Assembly Z106, Location of Components



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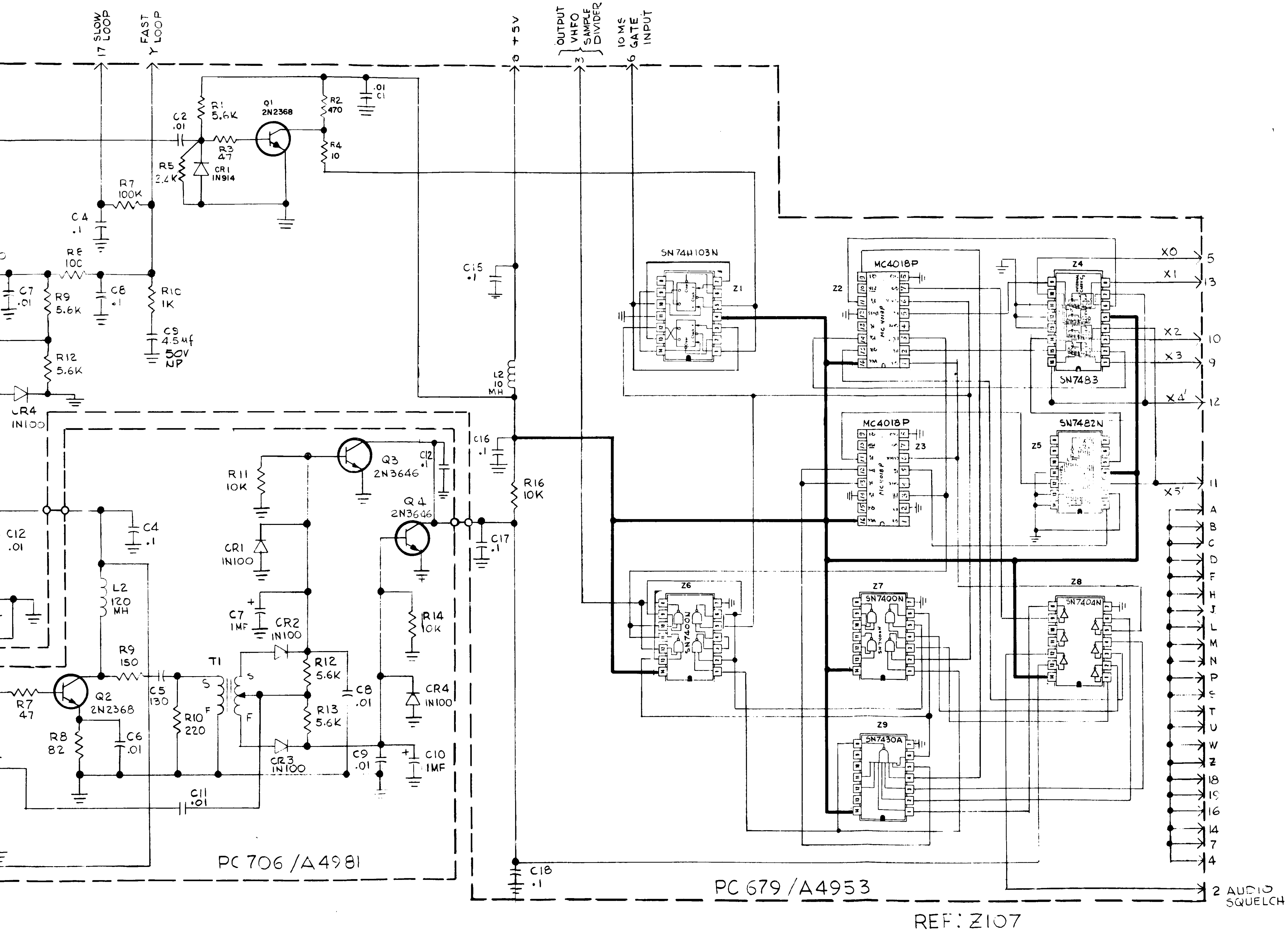

Figure 7-14. Sample Divide/Phase Detector Assembly Z107, Schematic Diagram

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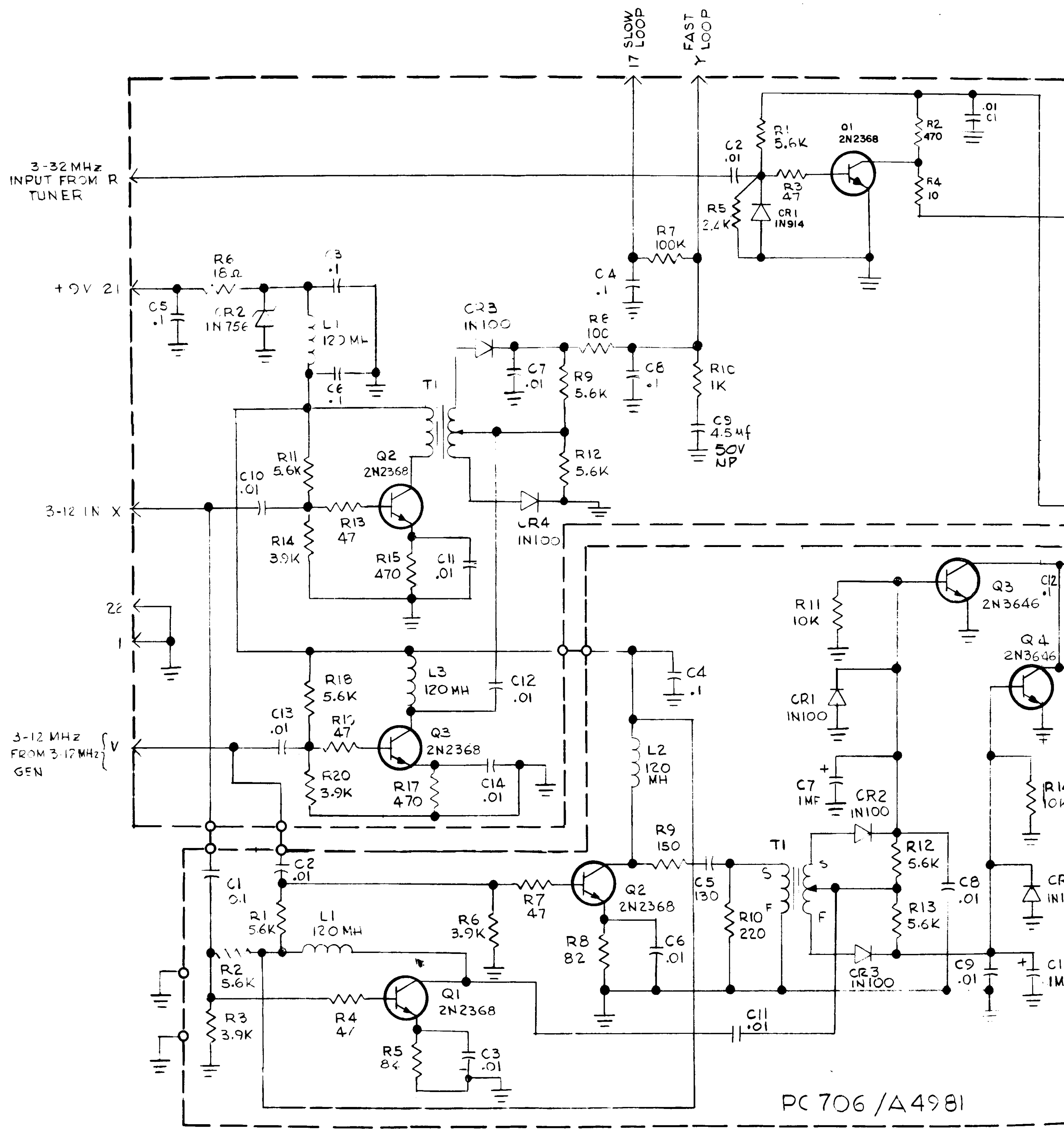
CK1885-X1



UNLESS OTHERWISE SPECIFIED
1- ALL RESISTANCE VALUES ARE IN OHMS 1/4W
2- ALL CAPACITACE VALUES ARE IN MICROFARADS

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CK1885-X1

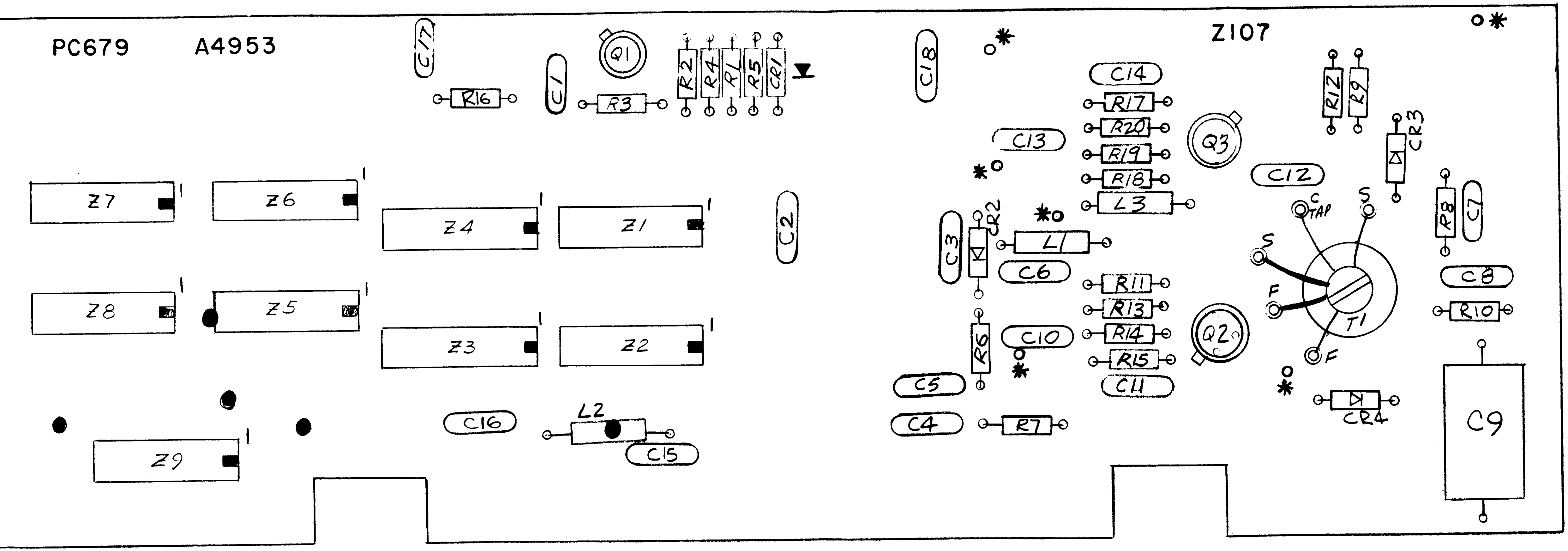
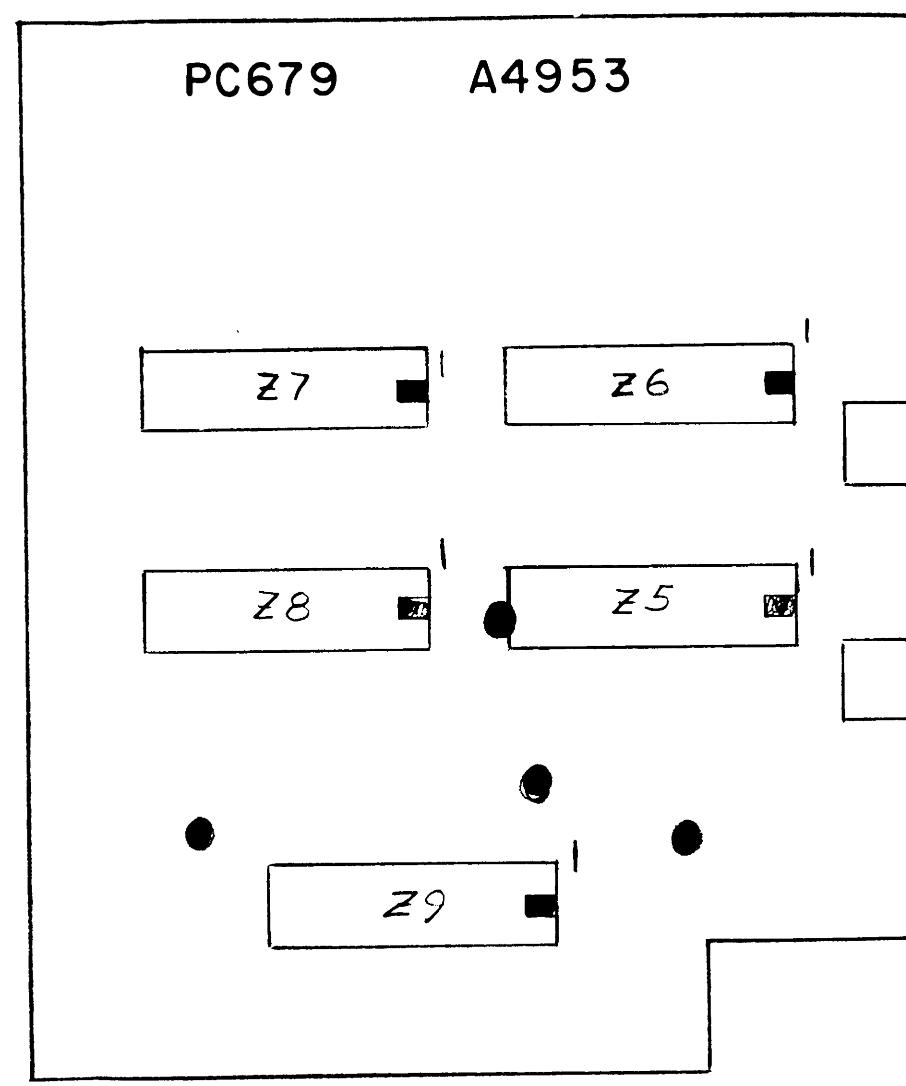


Figure 7-15. Sample Divide/Phase Detector Assembly Z107, Location of Components



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A4953-Ø

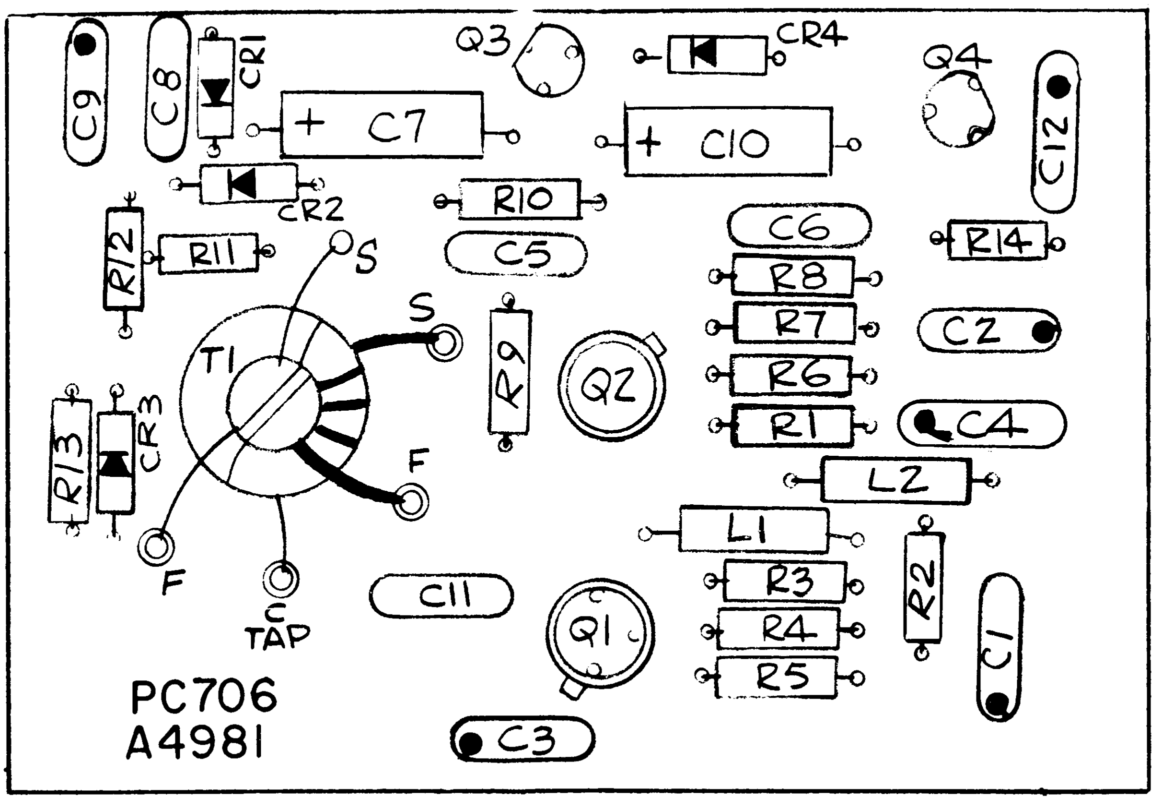
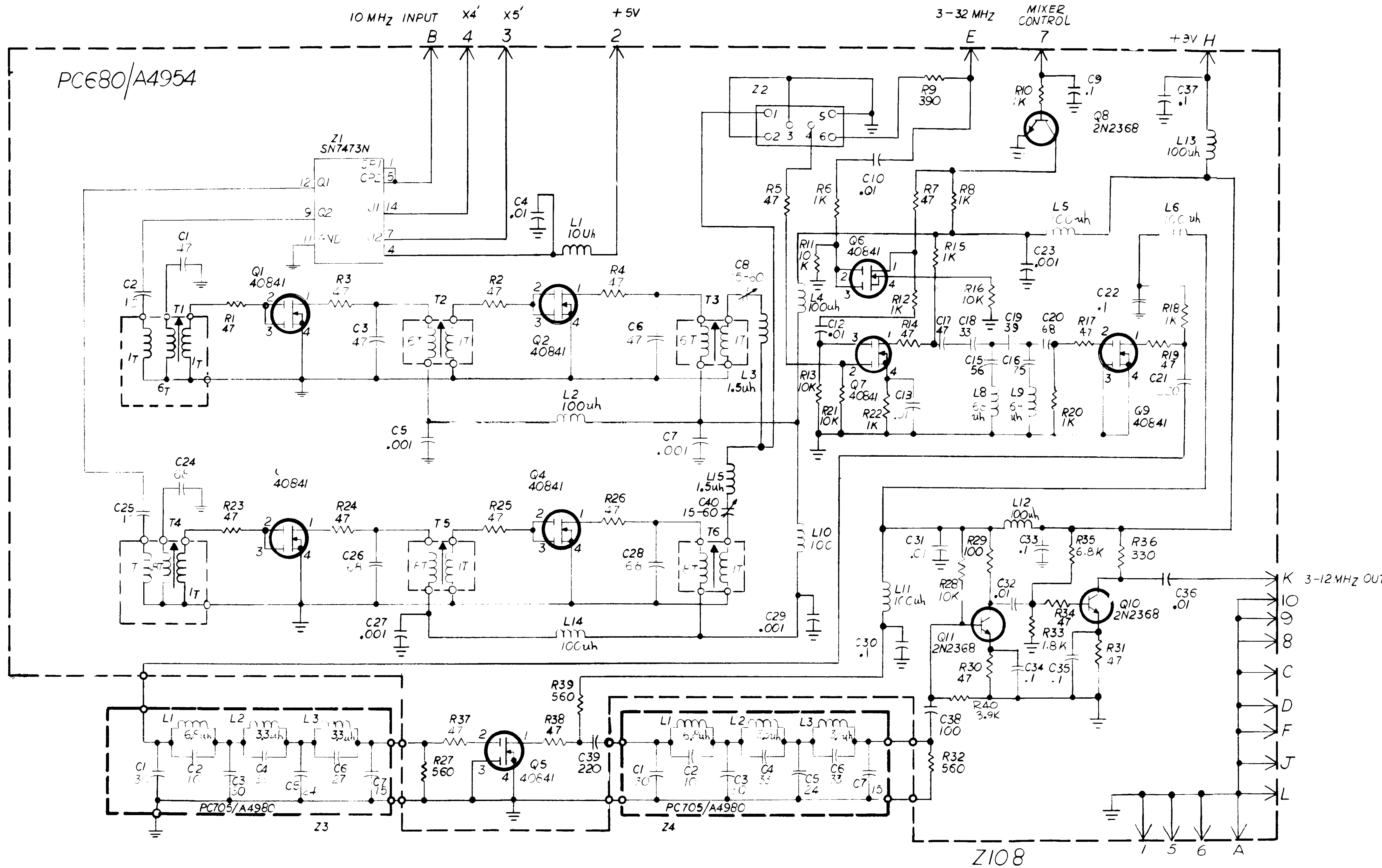


Figure 7-16. Sync Detector Assembly (P/O Z107), Location of Components



UNLESS OTHERWISE SPECIFIED

1. ALL RESISTANCE VALUES ARE IN OHMS, 1/4 W.
2. ALL DECIMAL CAPACITANCE VALUES ARE IN MICROFARADS.
3. ALL WHOLE NUMBER VALUES ARE IN PICOFARADS.
4. ALL INDUCTANCE VALUES ARE IN MICROHENRIES.

Figure 7-17. Mixer/Divider Assembly Z108, Schematic Diagram

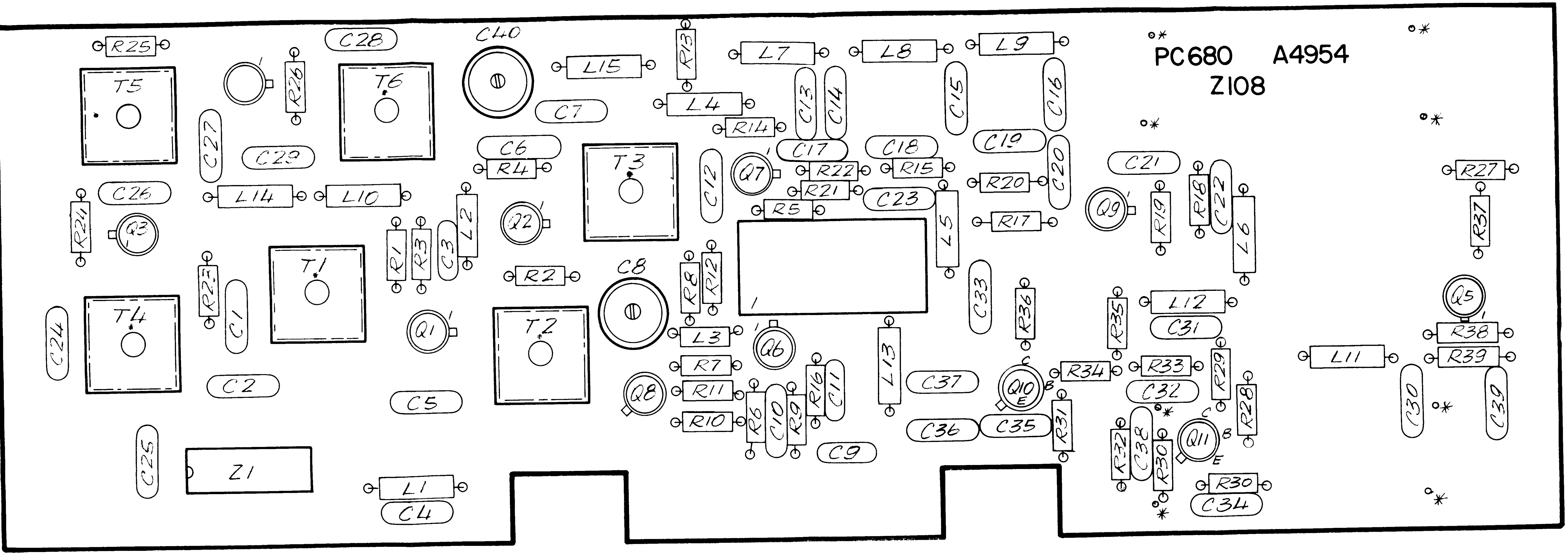
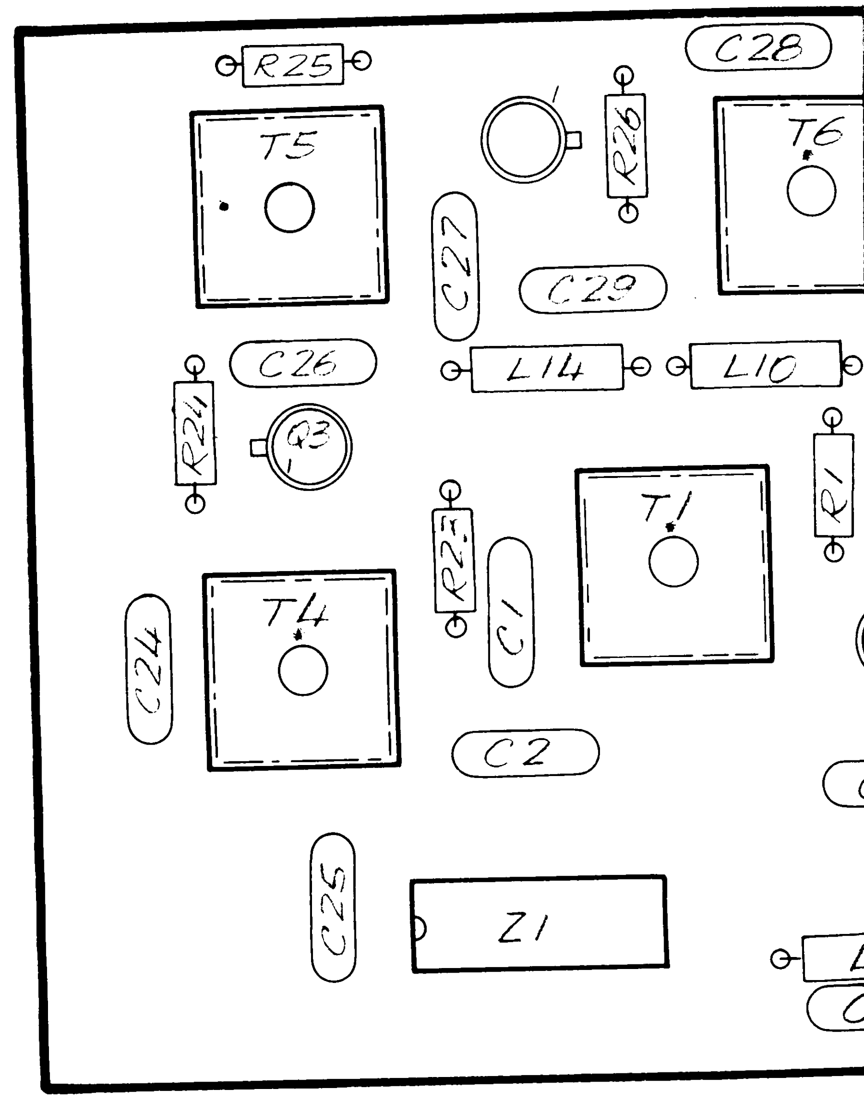


Figure 7-18. Mixer/Divider Assembly Z108, Location of Components



008753011
A4954-Ø

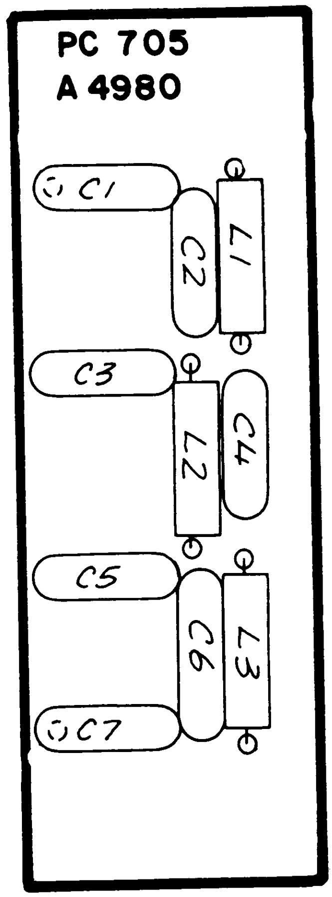
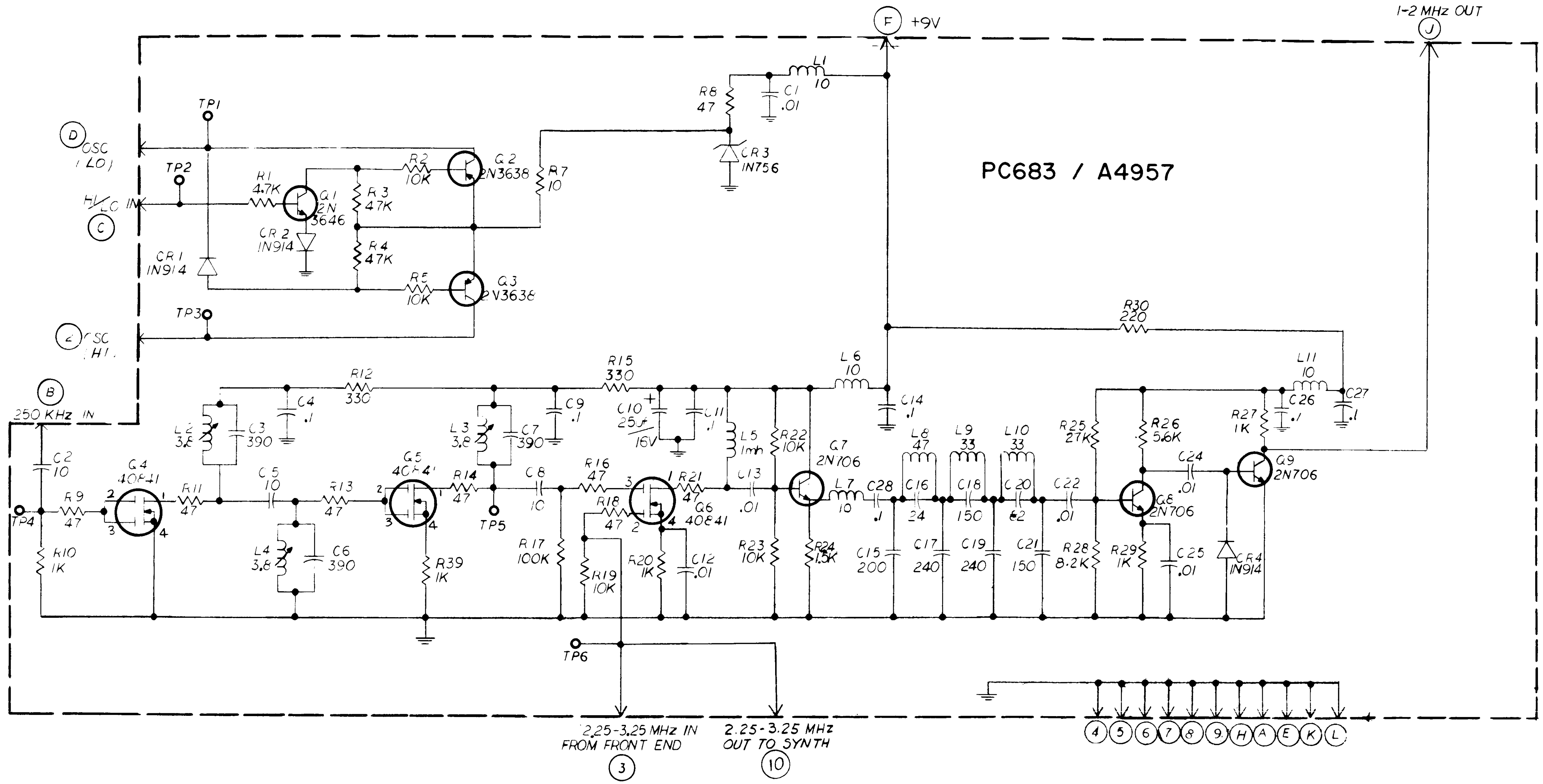


Figure 7-19. Multiplier Bandpass Filter Assembly (P/O Z108), Location of Components



UNLESS OTHERWISE SPECIFIED

1. ALL RESISTANCE VALUES ARE IN OHMS, 1/4W.
2. ALL DECIMAL CAPACITANCE VALUES ARE IN MICROFARADS.
3. ALL WHOLE NUMBER VALUES ARE IN PICOFARADS.

Figure 7-20. Mixer/Oscillator Control Assembly Z109, Schematic Diagram

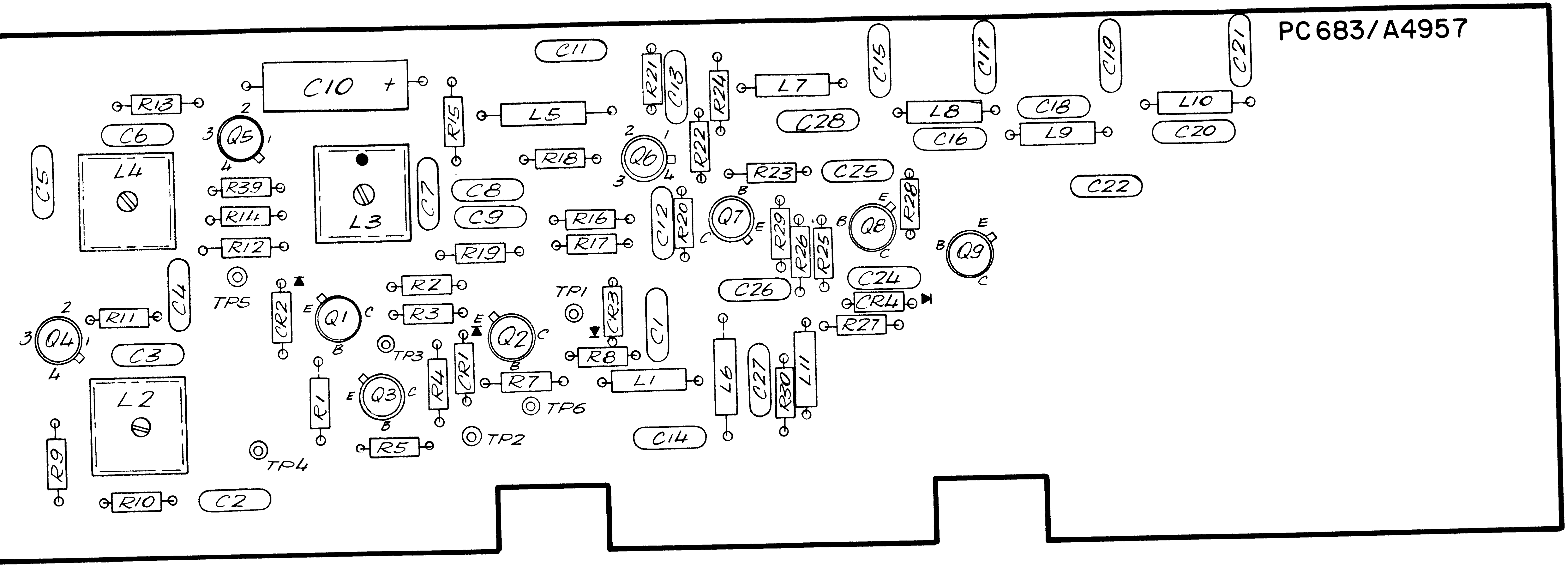
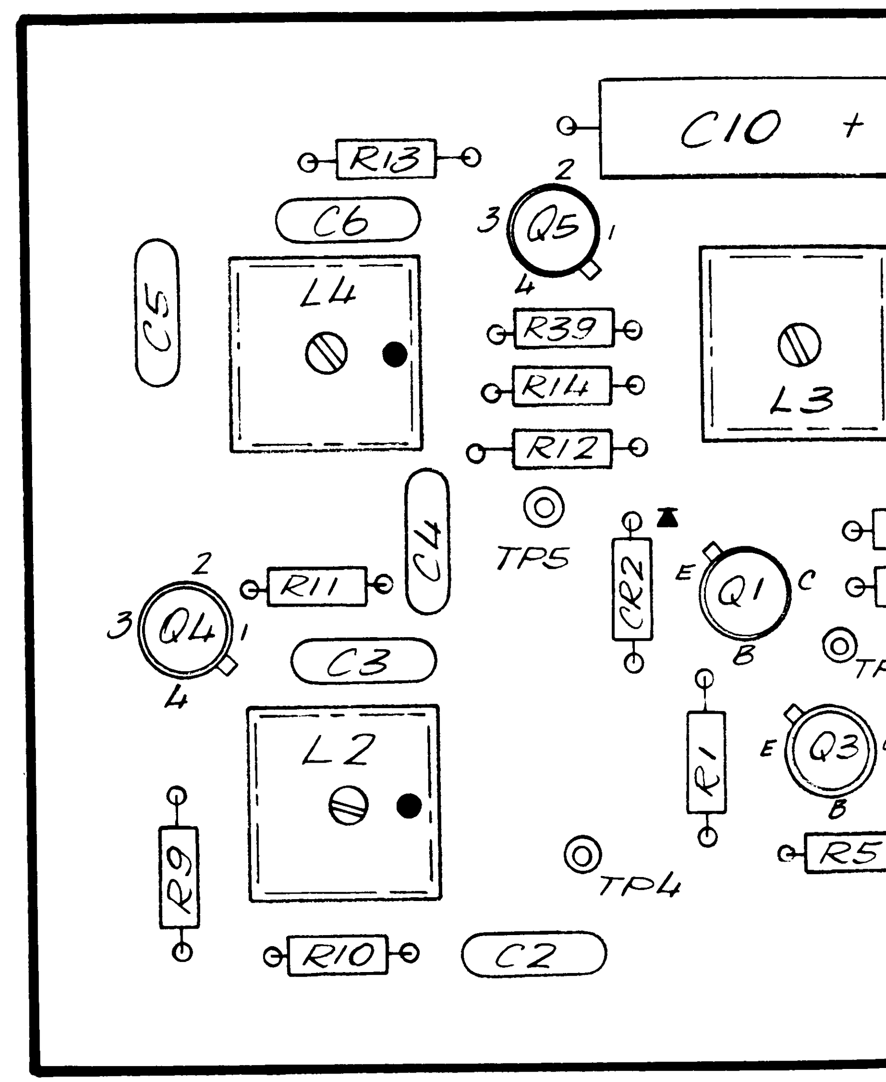


Figure 7-21. Mixer/Oscillator Control Assembly Z109, Location of Components

008753011
A4957-Ø



008753011
A4957-Ø

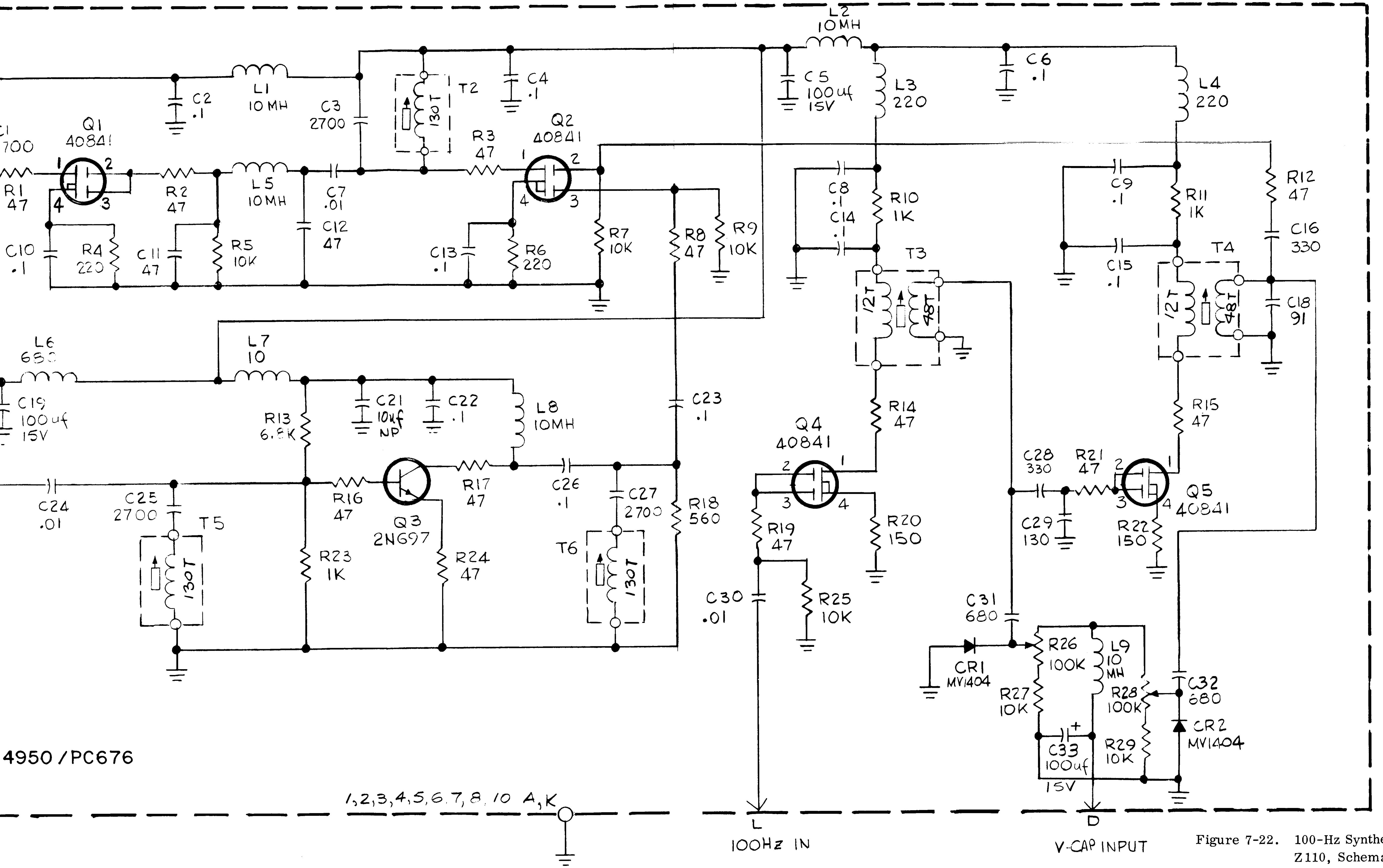
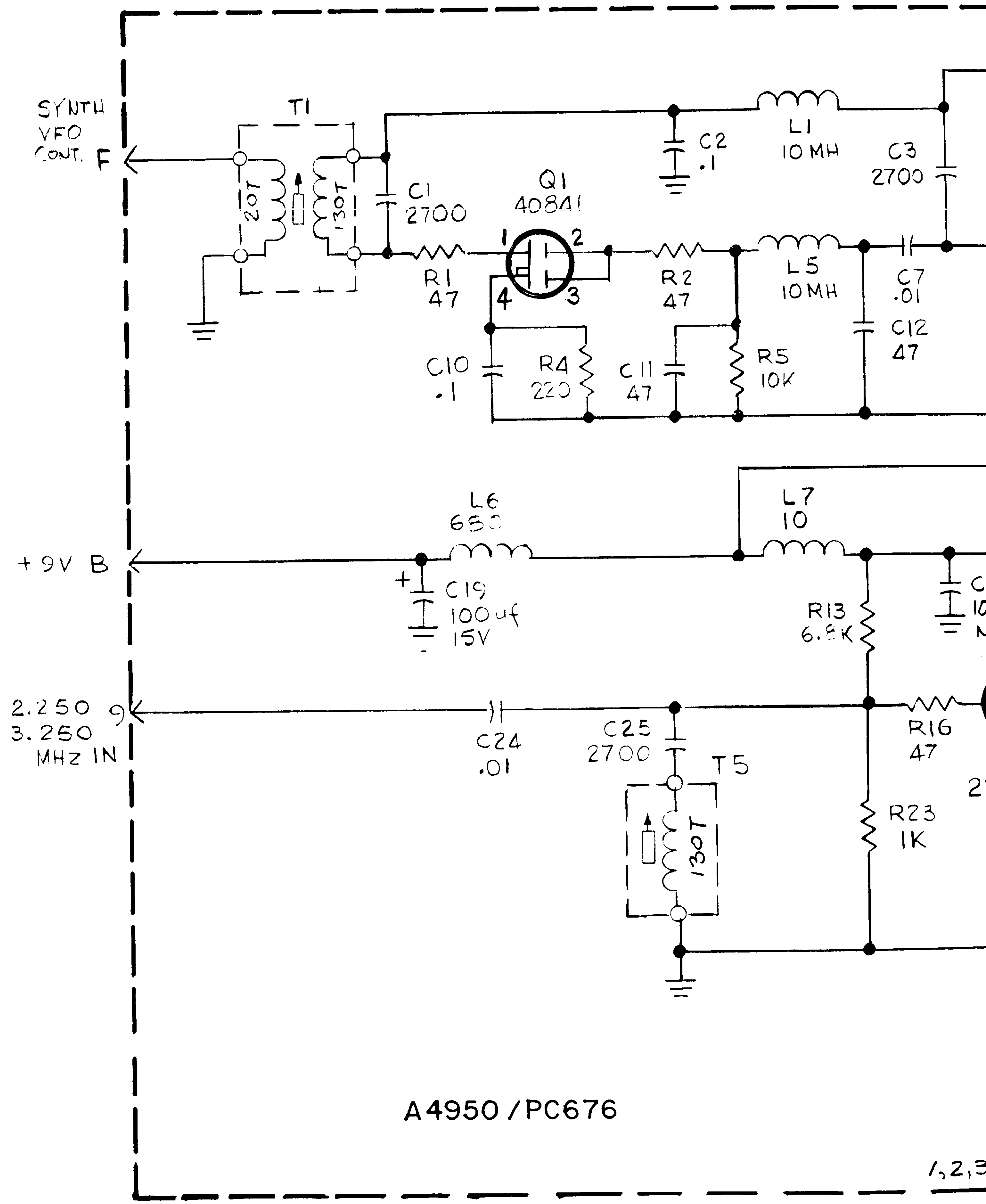


Figure 7-22. 100-Hz Synthesizer Assembly Z110, Schematic Diagram

008753011
CK1893-X1



008753011
CK1893-X1

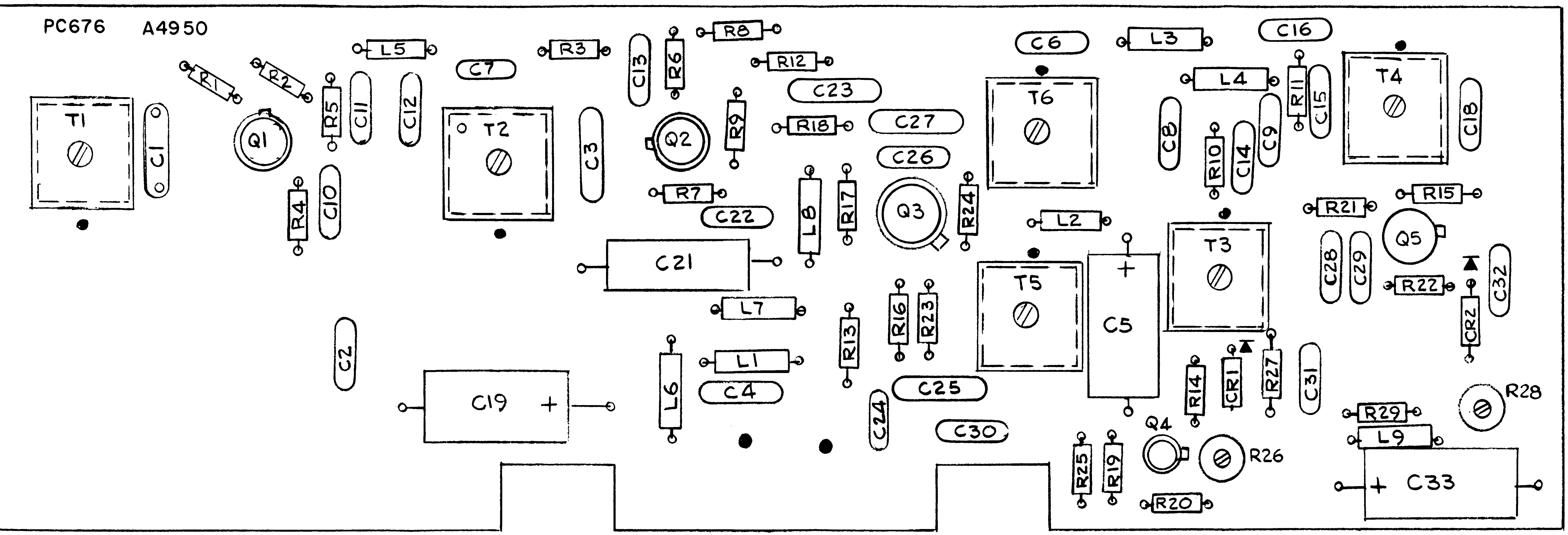
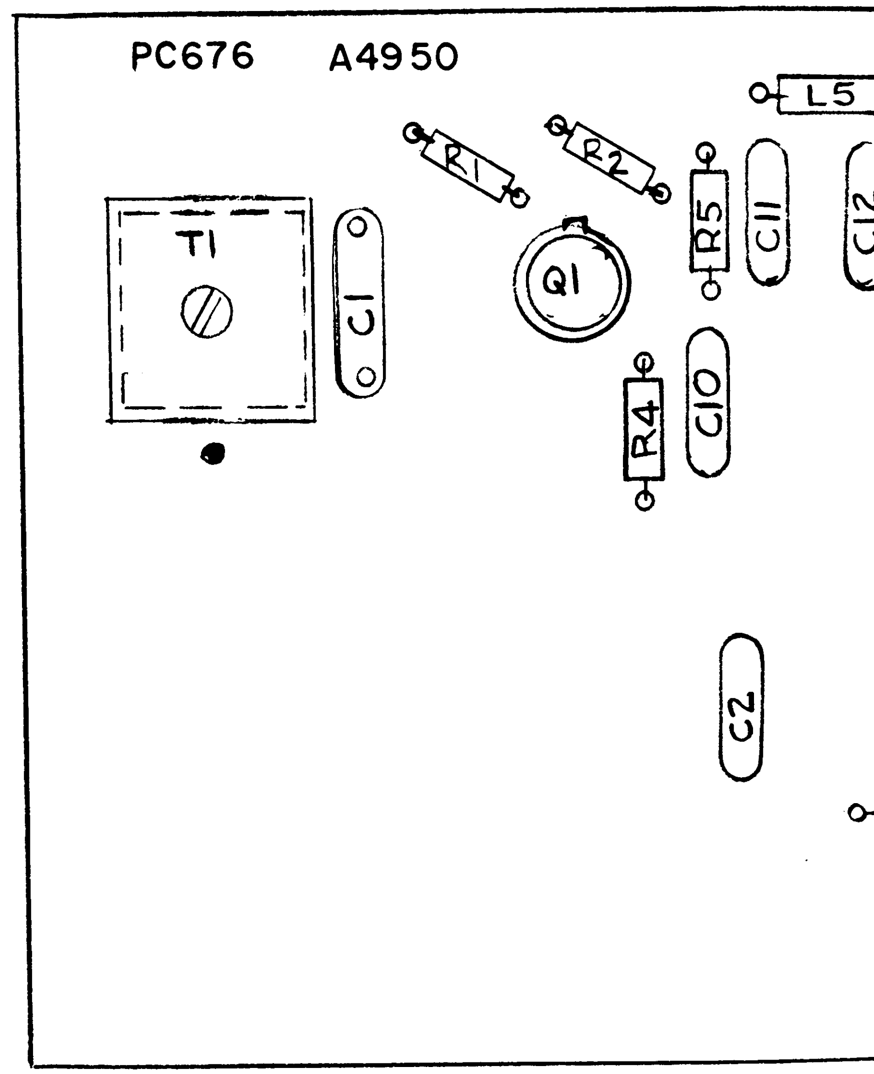


Figure 7-23. 100-Hz Synthesizer Assembly Z110, Location of Components



008753011
A4950-Ø

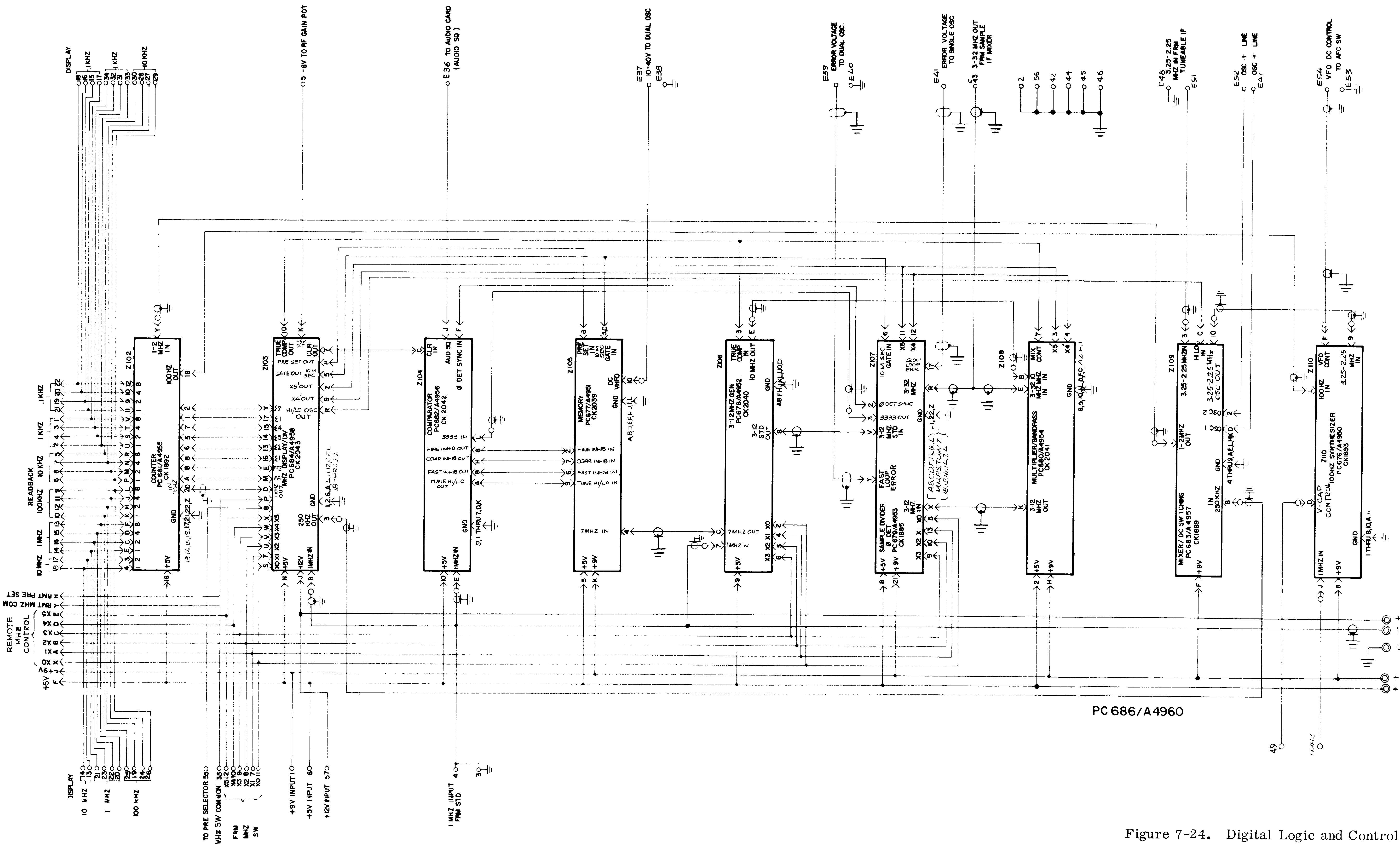


Figure 7-24. Digital Logic and Control Mother Board Z111, Interconnection Diagram

008753011
CK2065-Ø

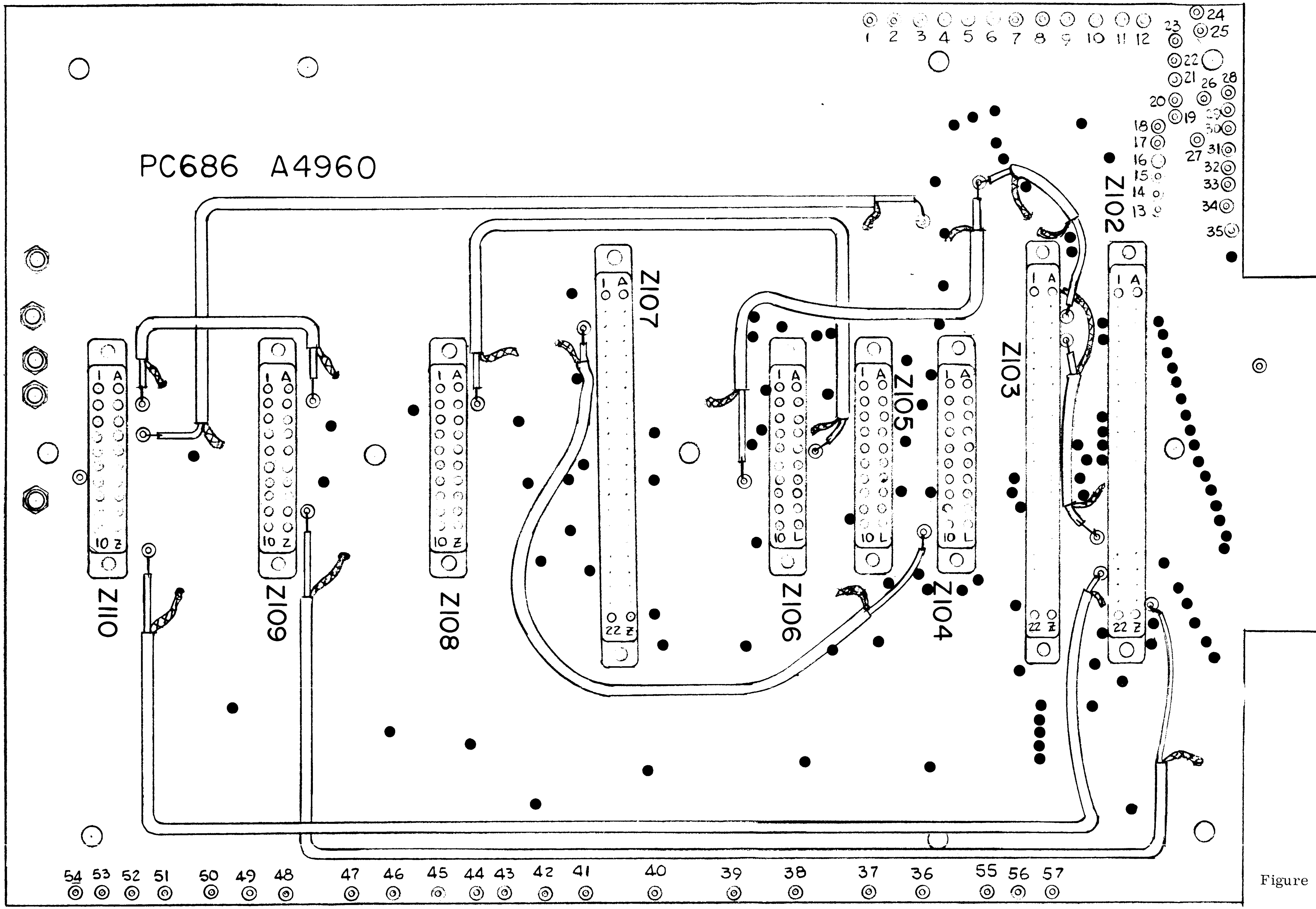
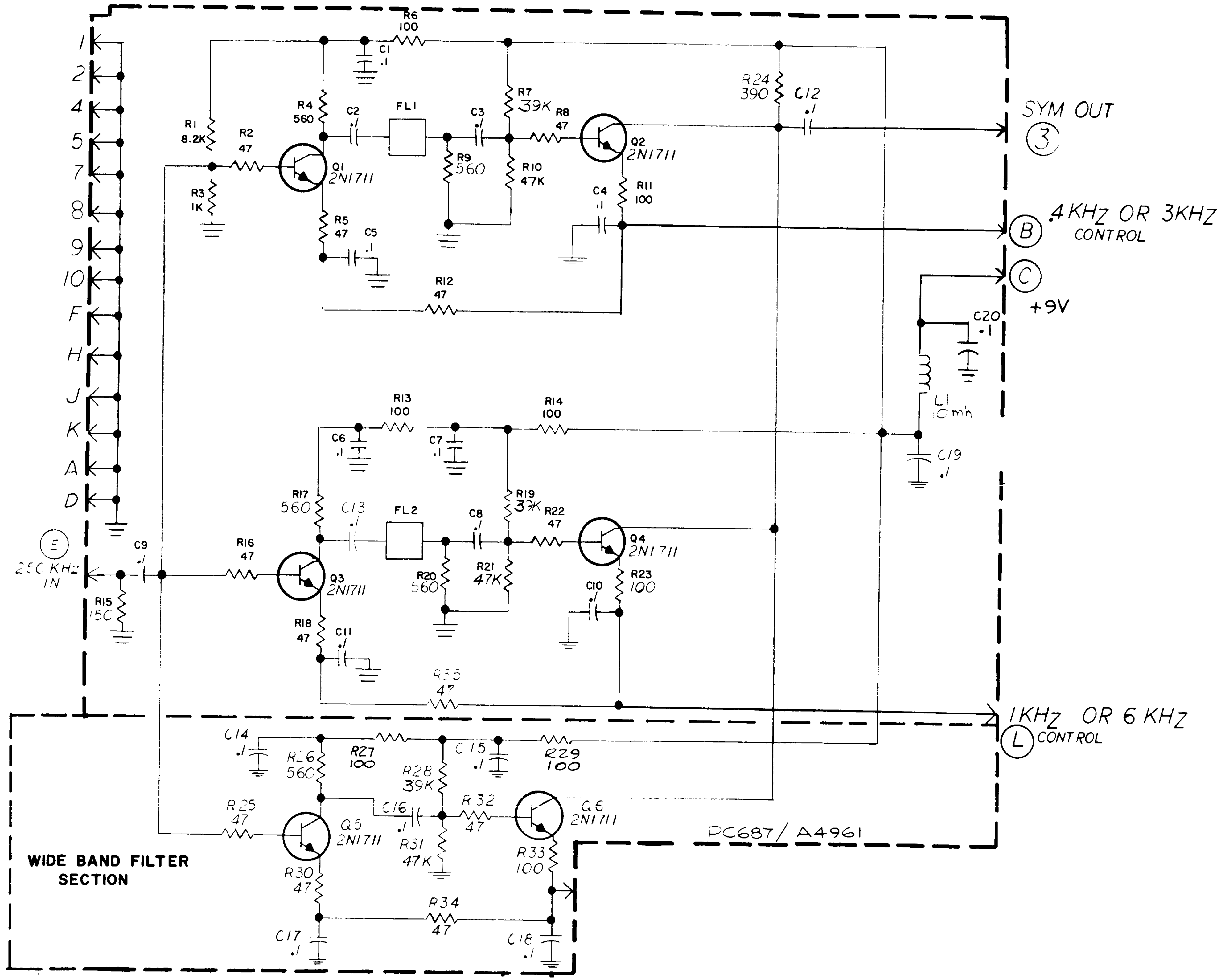


Figure 7-25. Digital Logic and Control Mother Board Z111, Location of Components

008753011
A4960-Ø



UNLESS OTHERWISE SPECIFIED

1. ALL RESISTANCE VALUES ARE IN OHMS, 1/4W.
2. ALL DECIMAL CAPACITANCE VALUES ARE IN MICROFARADS.

Figure 7-26. Symmetrical Filter Assemblies Z112 and Z113, Schematic Diagram

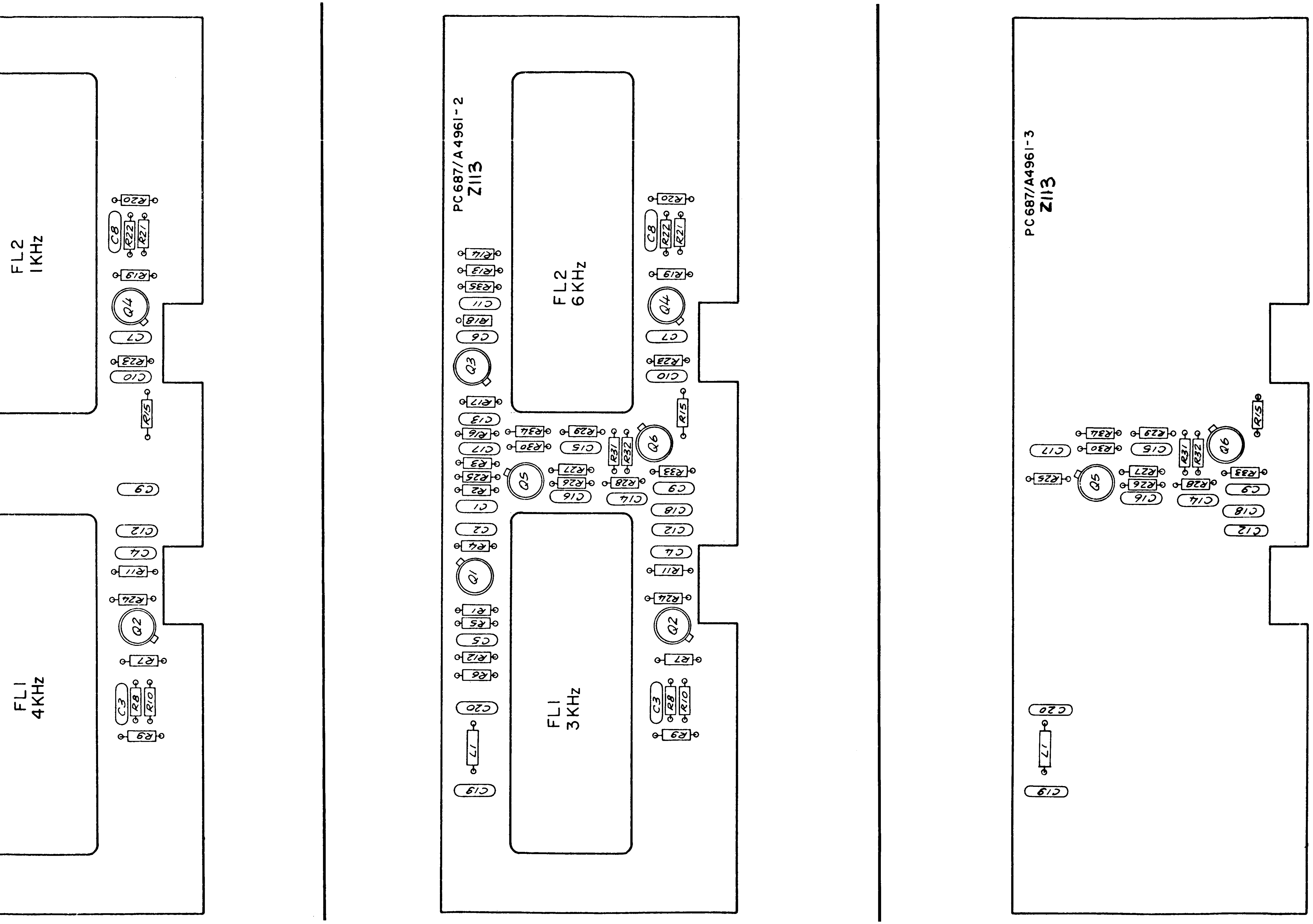
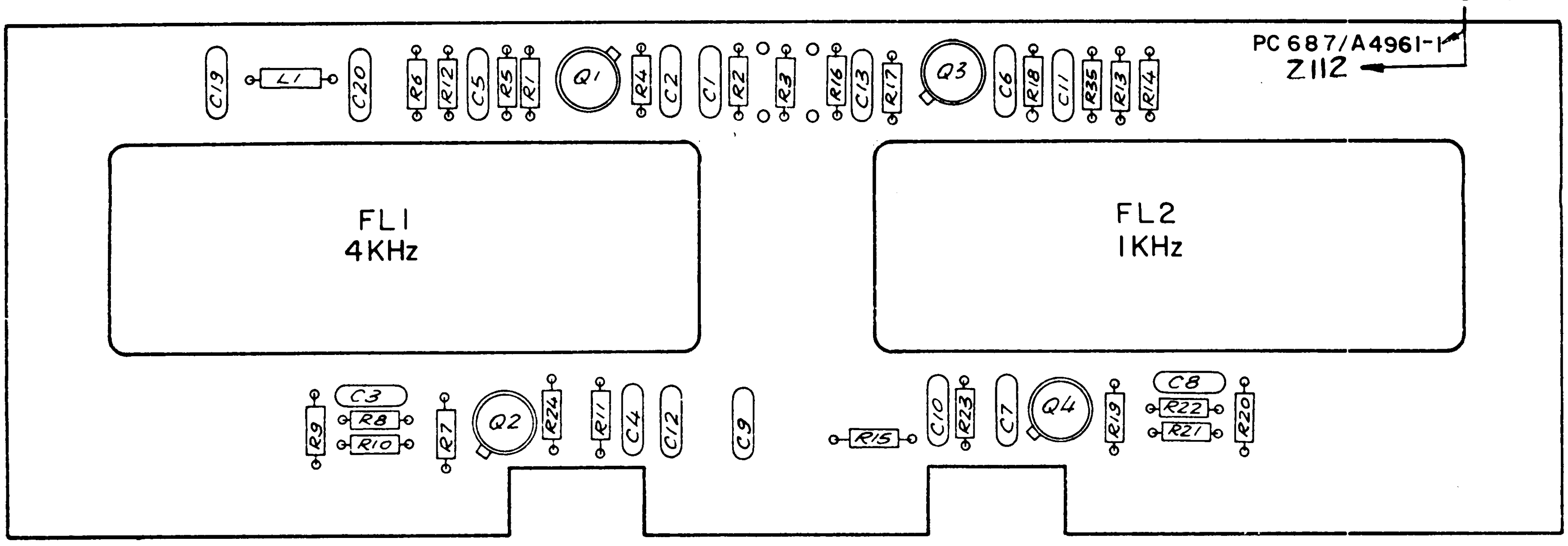
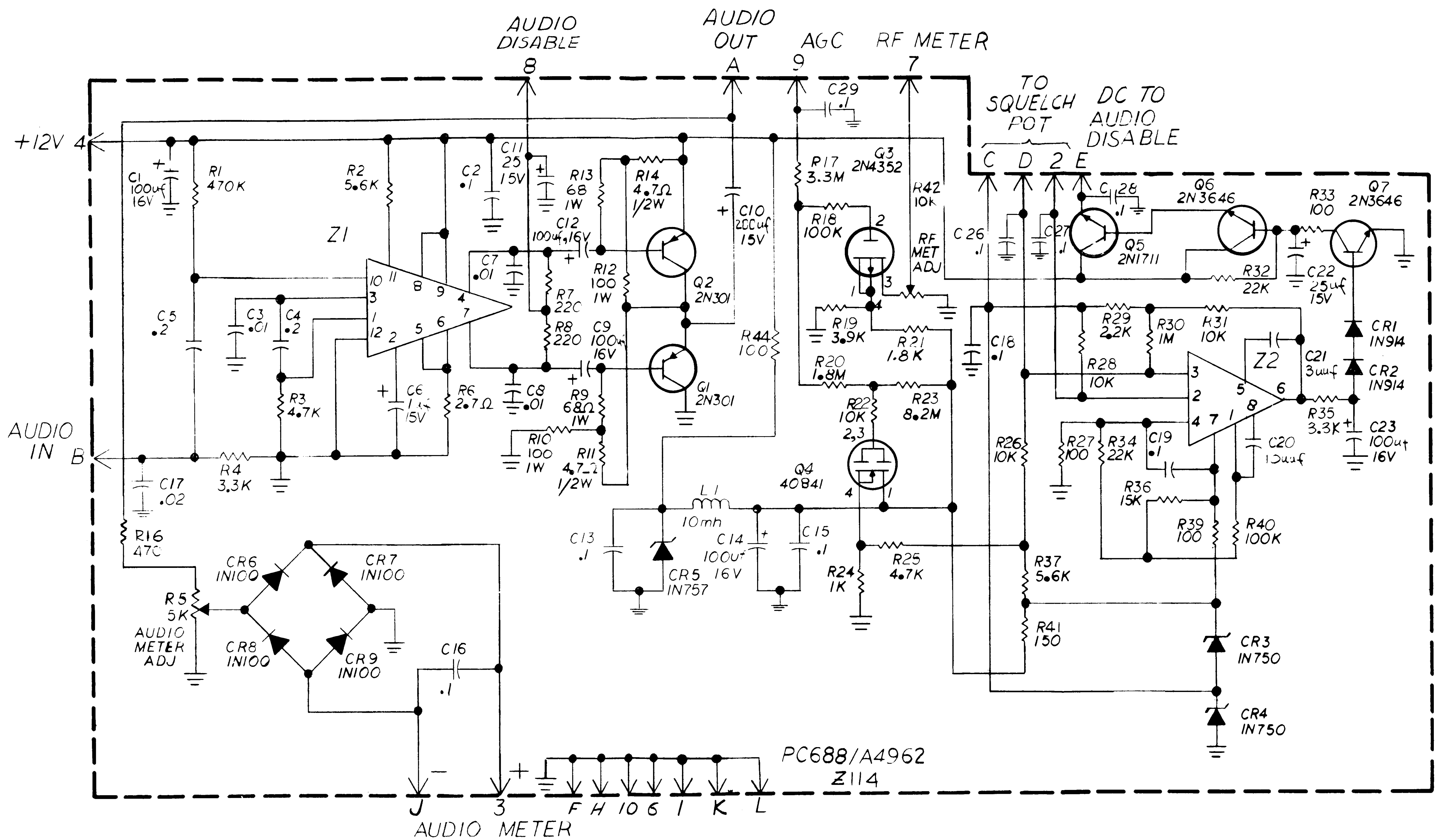


Figure 7-27. Symmetrical Filter Assemblies Z112 and Z113, Location of Components



PC 687/A4961-1
Z112
FL1
4KHz
FL2
1KHz
C19
L1
C20
R6
R12
C5
R5
R1
Q1
R4
C2
C1
R2
R3
R16
C13
R17
Q3
C6
R18
C11
R35
R13
R14
C3
R8
R10
R9
R7
Q2
R24
R11
C4
C12
C9
R15
C10
R23
C7
Q4
R19
C8
R22
R21
R20



UNLESS OTHERWISE SPECIFIED

1. ALL RESISTANCE VALUES ARE IN OHMS, 1/4 W.
2. ALL DECIMAL CAPACITANCE VALUES ARE IN MICROFARADS.

Figure 7-28. Audio Assembly Z114, Schematic Diagram

008753011
CK2046-X3

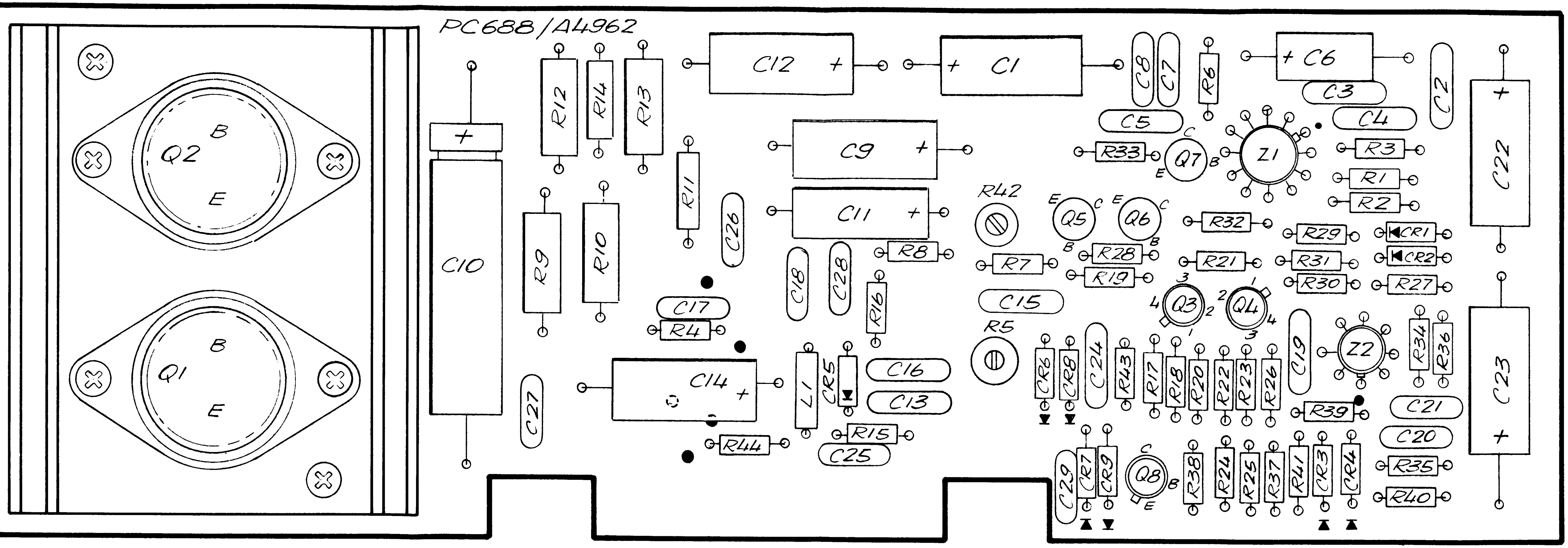
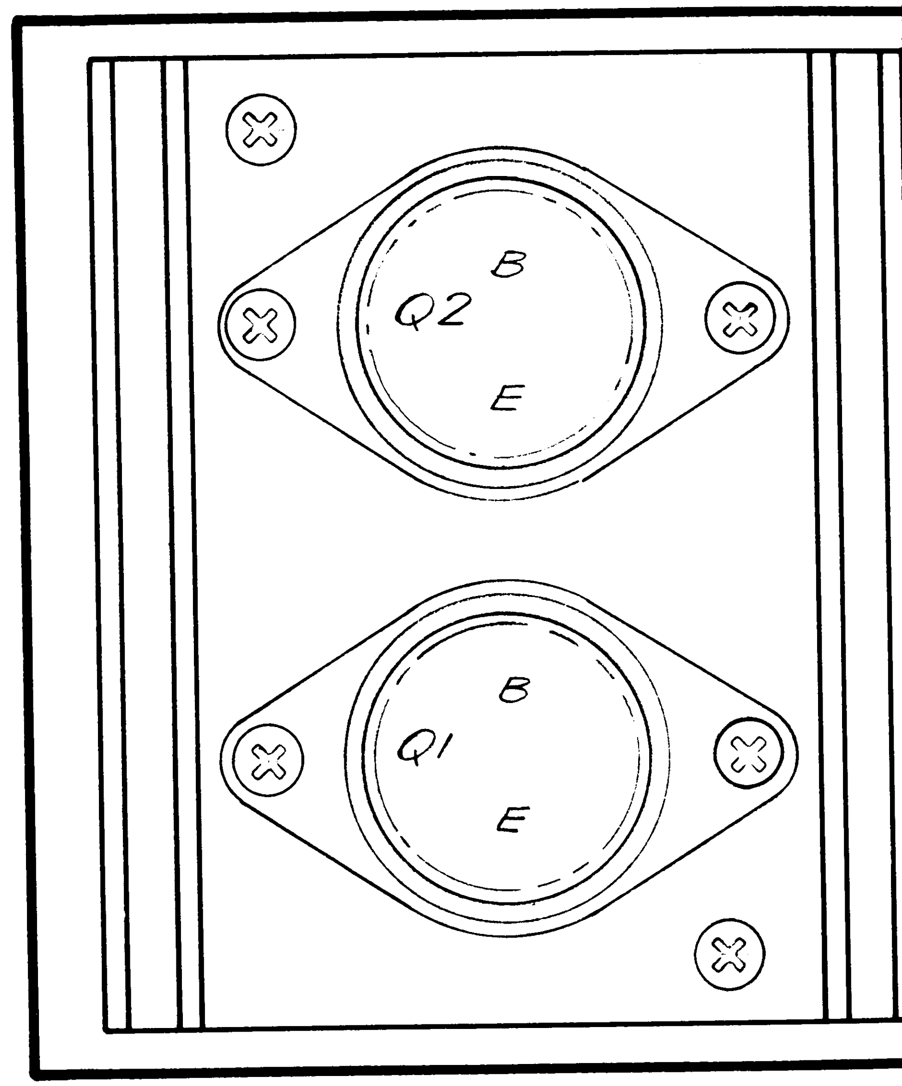
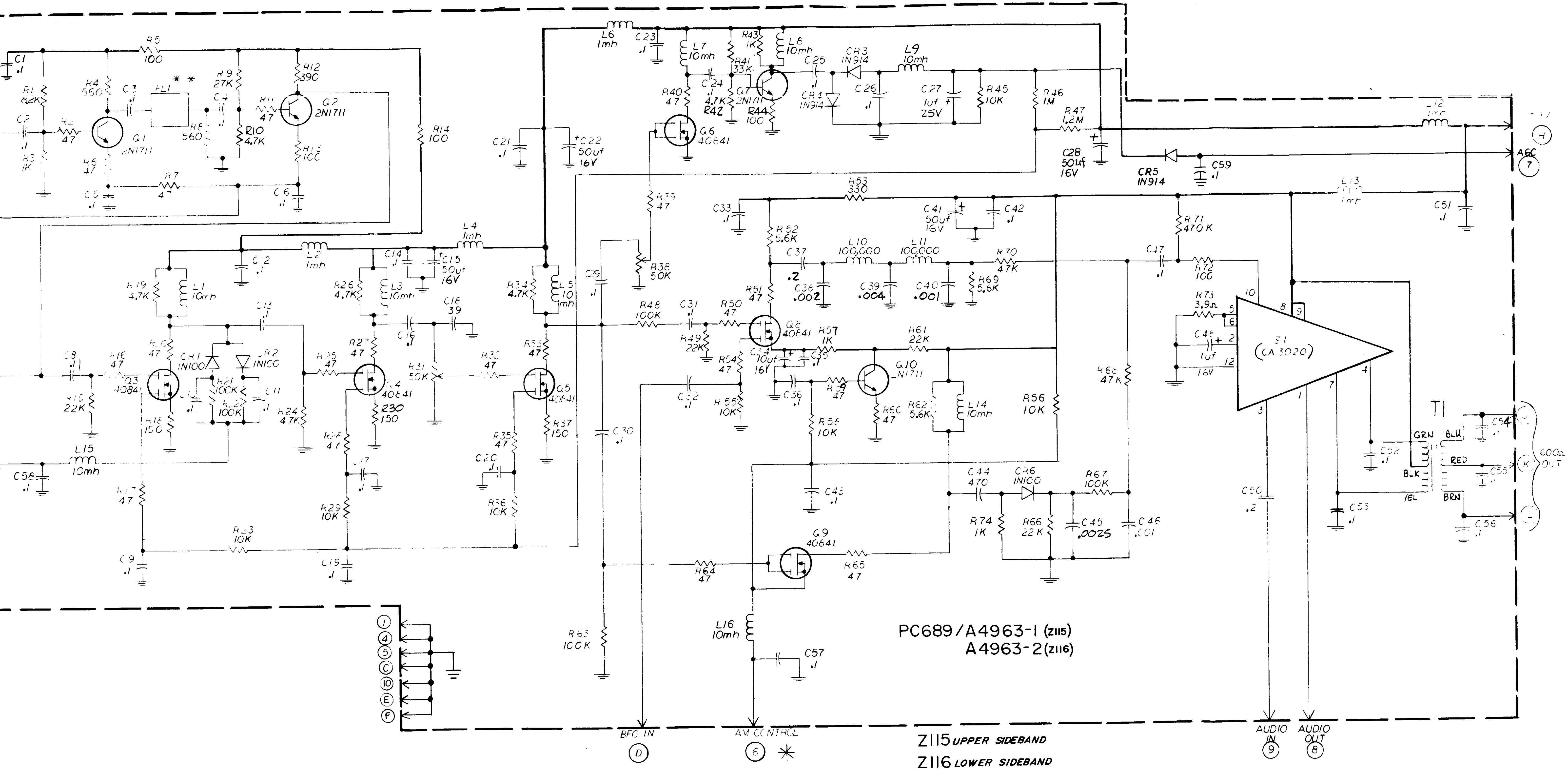


Figure 7-29. Audio Assembly Z114, Location of Components



008753011
A4962-Ø

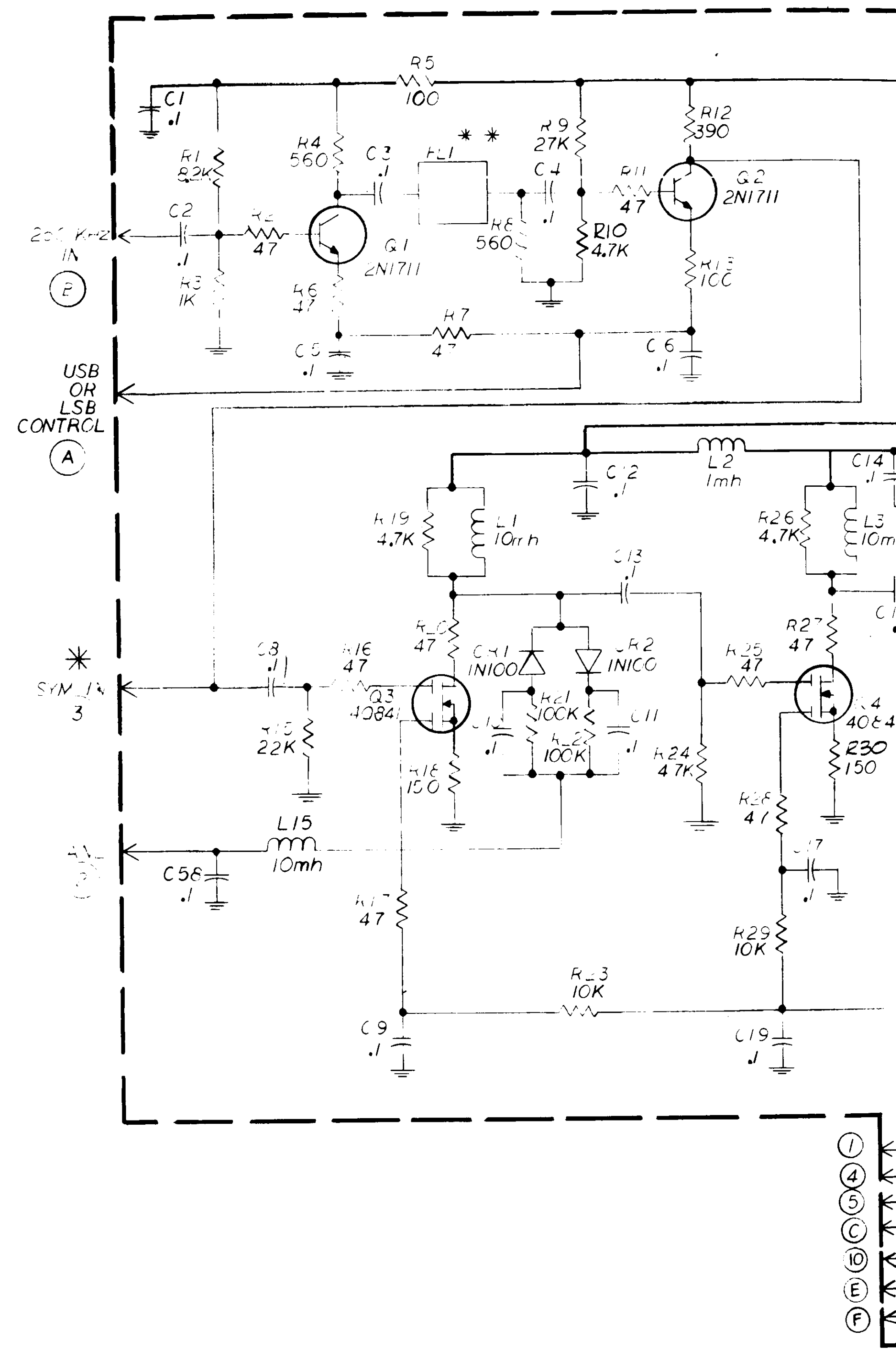


UNLESS OTHERWISE SPECIFIED

1. ALL RESISTANCE VALUES ARE IN OHMS, 1/4W.
2. ALL DECIMAL CAPACITANCE VALUES ARE IN MICROFARADS.
3. ALL WHOLE NUMBER VALUES ARE IN PICOFARADS.
4. ALL INDUCTANCE VALUES ARE IN MICROHENRIES.
5.

Figure 7-30. USB and LSB Filter Assemblies Z115 and Z116, Schematic Diagram

008753011
CK2047-Ø



1.
2.
3.
4.
5.

008753011
CK2047-Ø

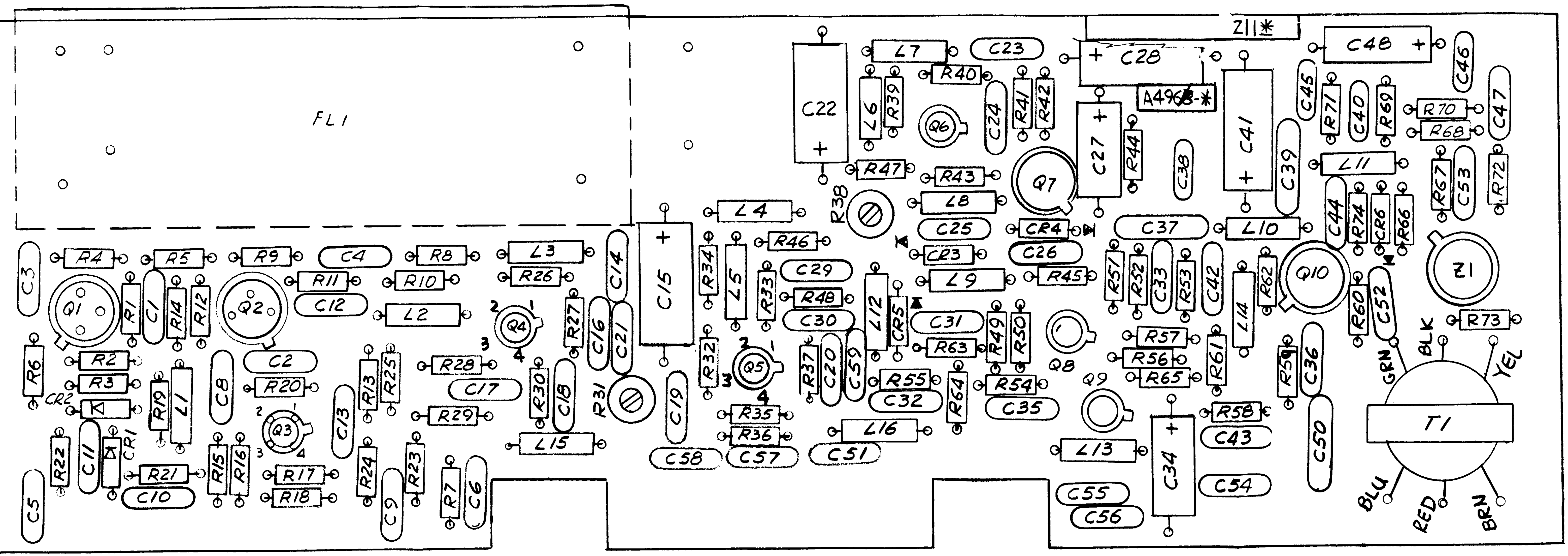
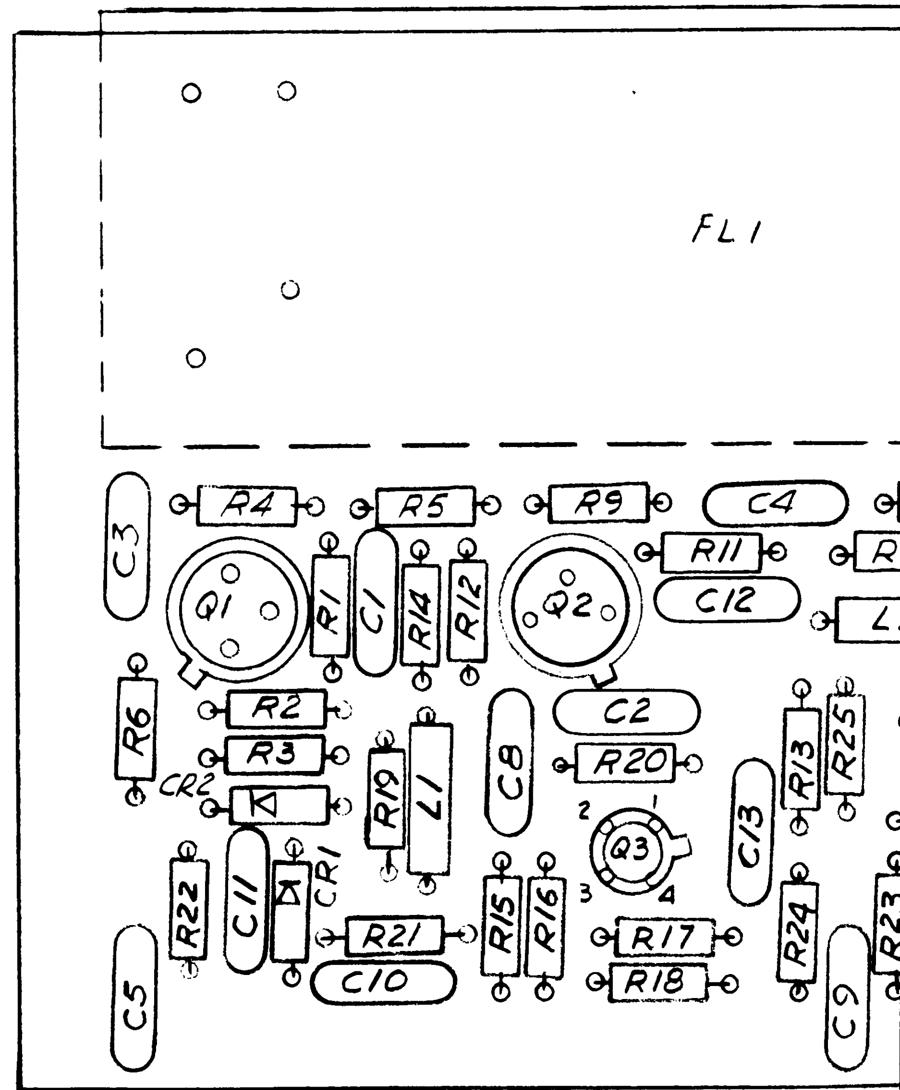
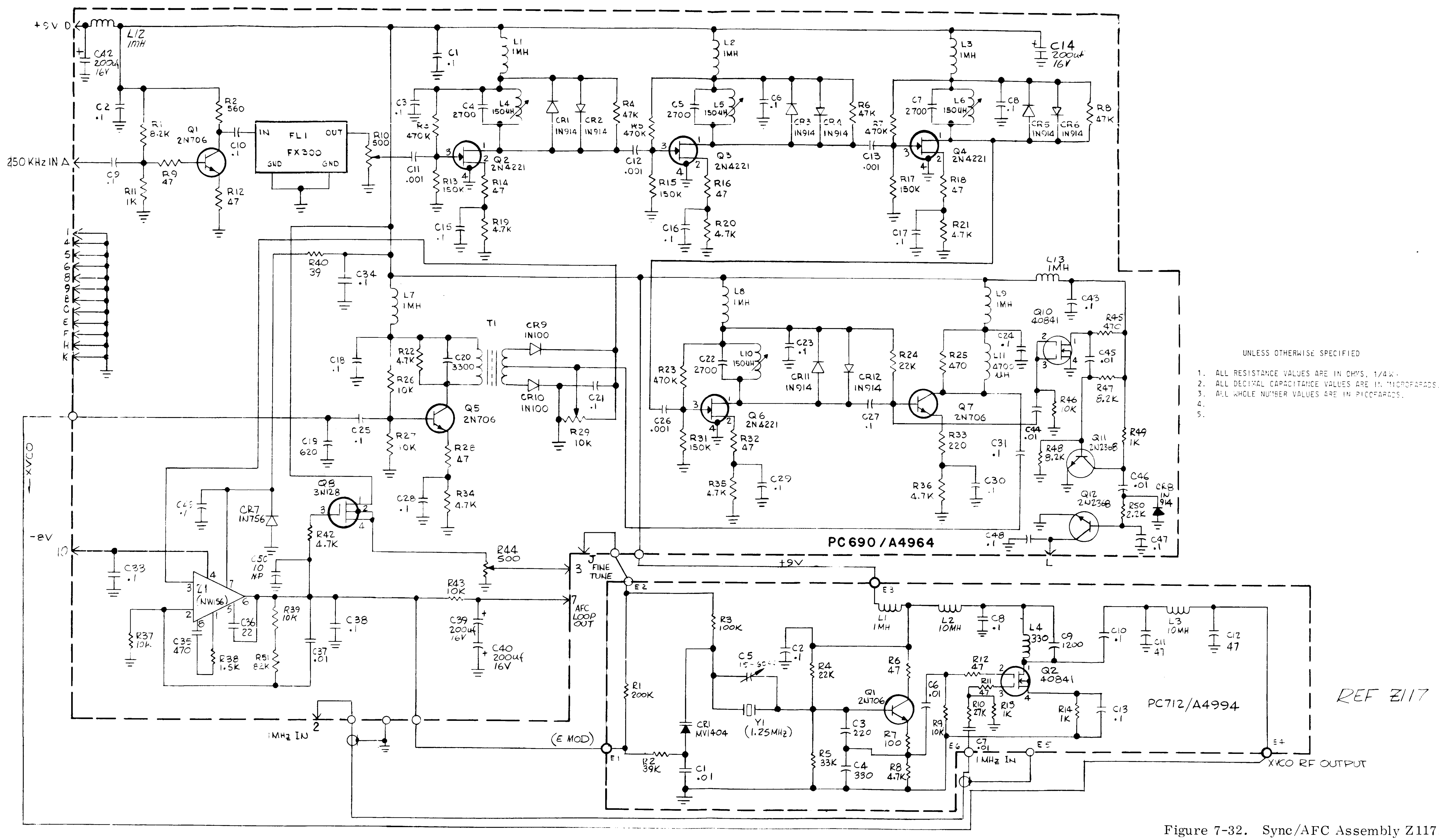


Figure 7-31. USB and LSB Filter Assemblies Z115 and Z116, Location of Components



008753011
A4963-Ø



UNLESS OTHERWISE SPECIFIED

1. ALL RESISTANCE VALUES ARE IN OHMS, 1/4W.
2. ALL DECIMAL CAPACITANCE VALUES ARE IN MICROFARADS.
3. ALL WHOLE NUMBER VALUES ARE IN PICOFARADS.
4.
5.

Figure 7-32. Sync/AFC Assembly Z117, Schematic Diagram

008753011
CK2048-X

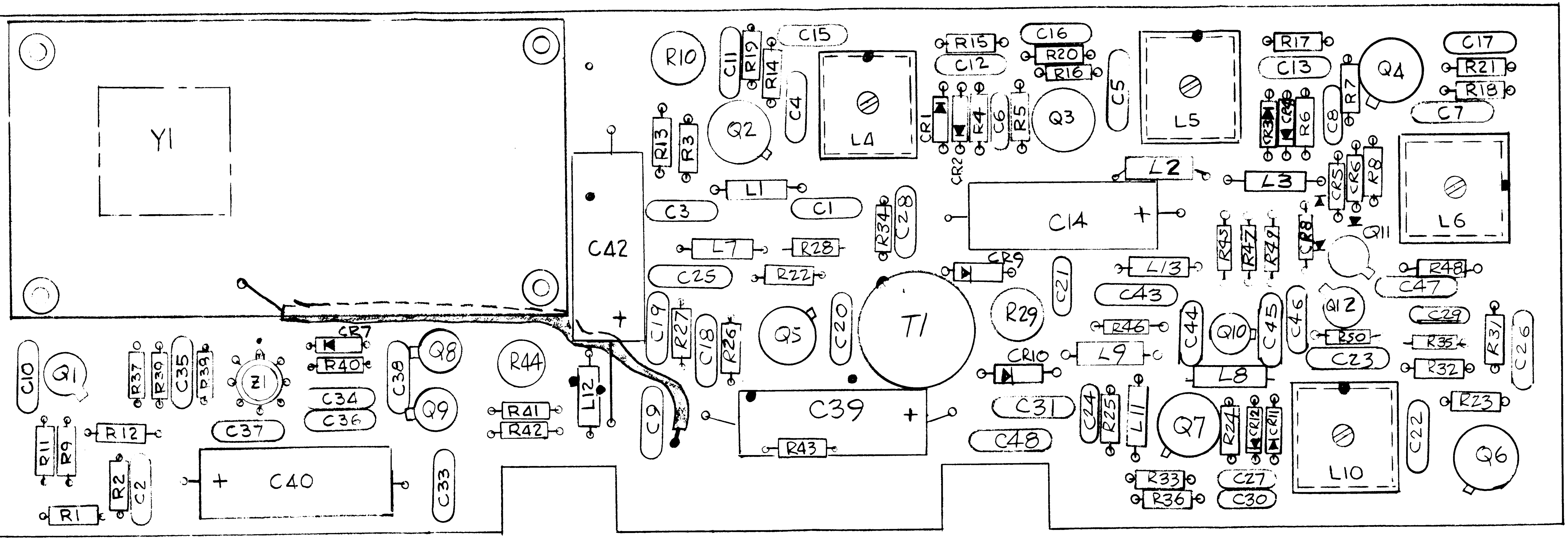
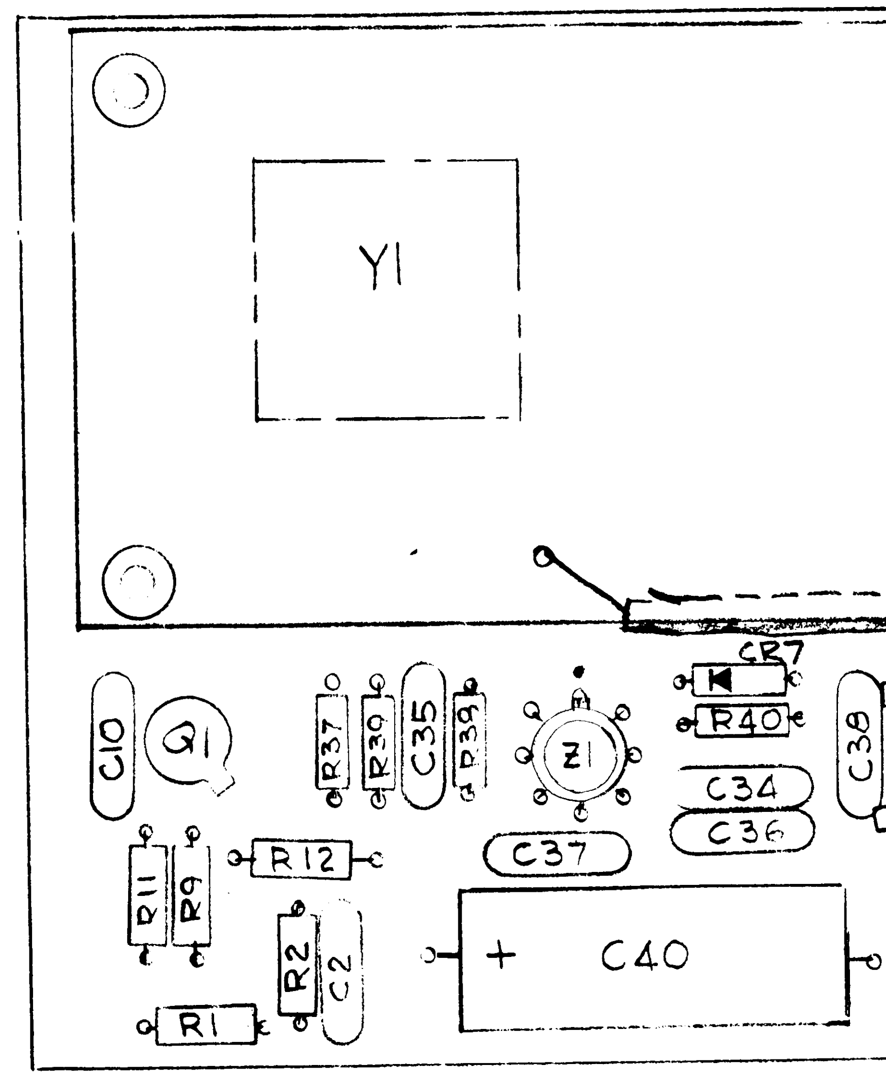


Figure 7-33. Sync/AFC Assembly Z117,
Location of Components

008753011
A4964-Ø

7-67/7-68



008753011
A4964-Ø

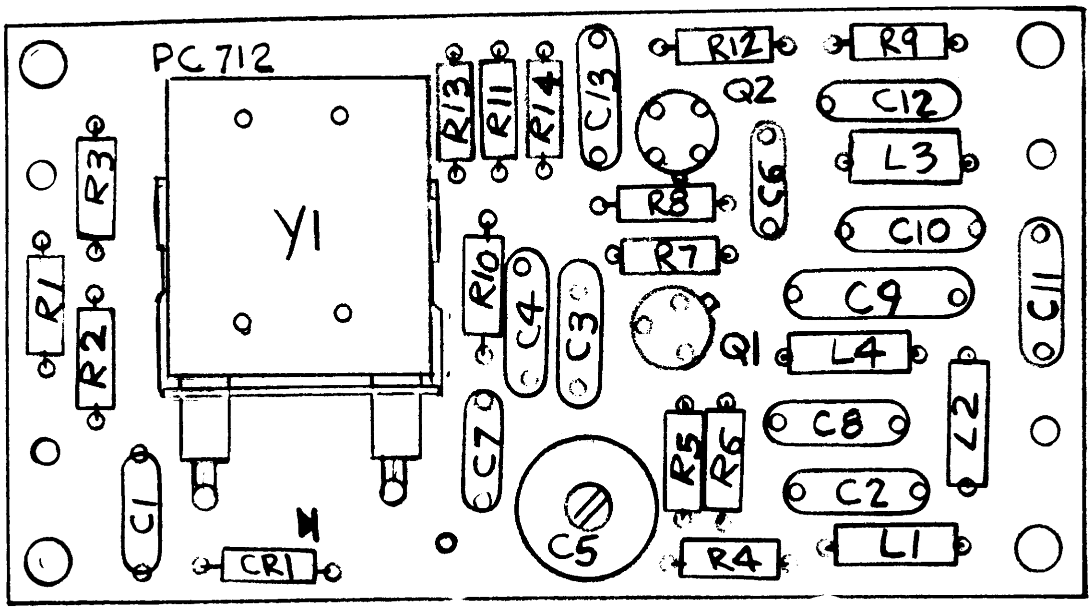
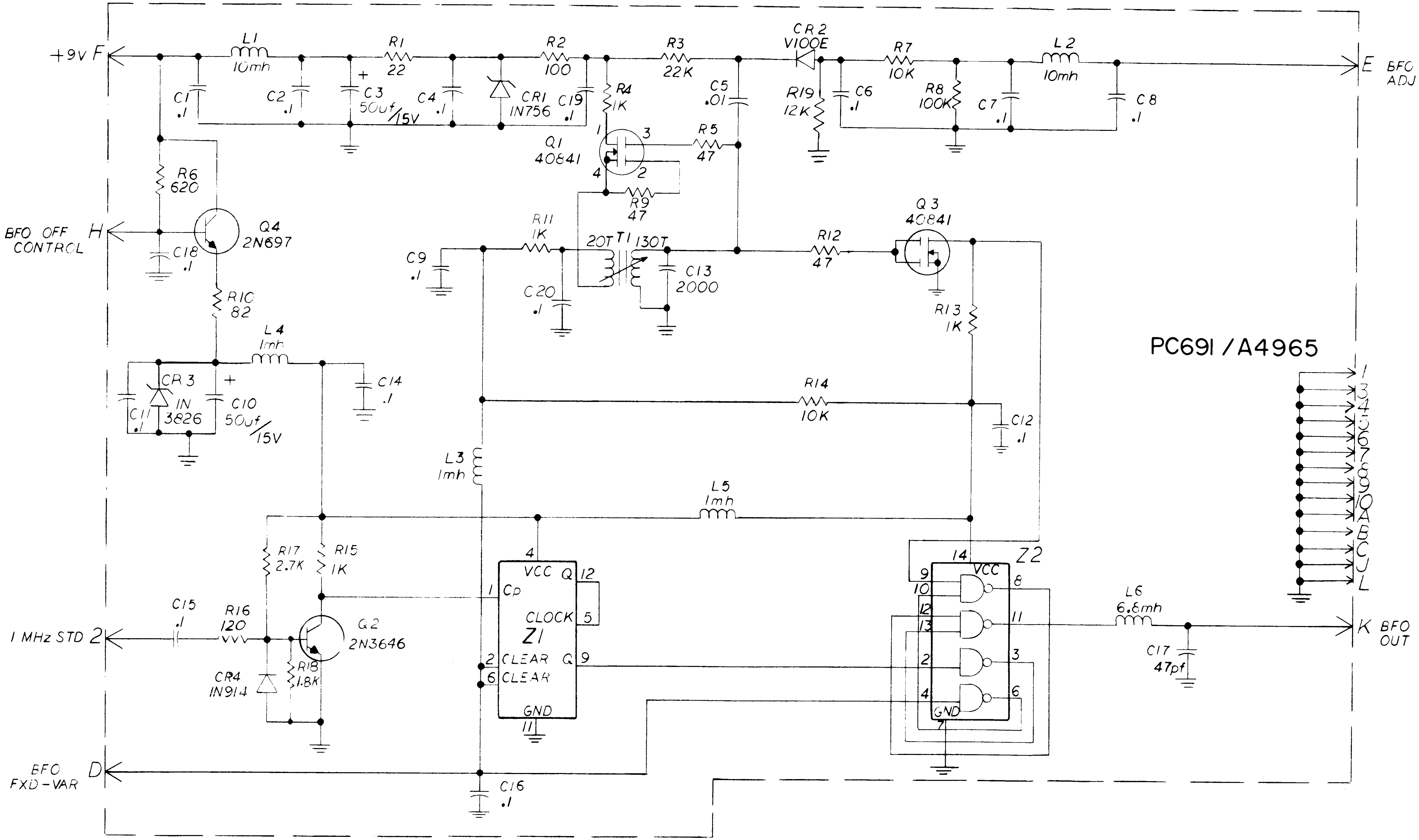


Figure 7-34. XVCO Assembly (P/O Z117), Location of Components



UNLESS OTHERWISE SPECIFIED

1. ALL RESISTANCE VALUES ARE IN OHMS, 1/4W.
2. ALL DECIMAL CAPACITANCE VALUES ARE IN MICROFARADS.
3. ALL WHOLE NUMBER VALUES ARE IN PICOFARADS.

Figure 7-35. BFO Assembly Z118, Schematic Diagram

008753011
CK2049-X1

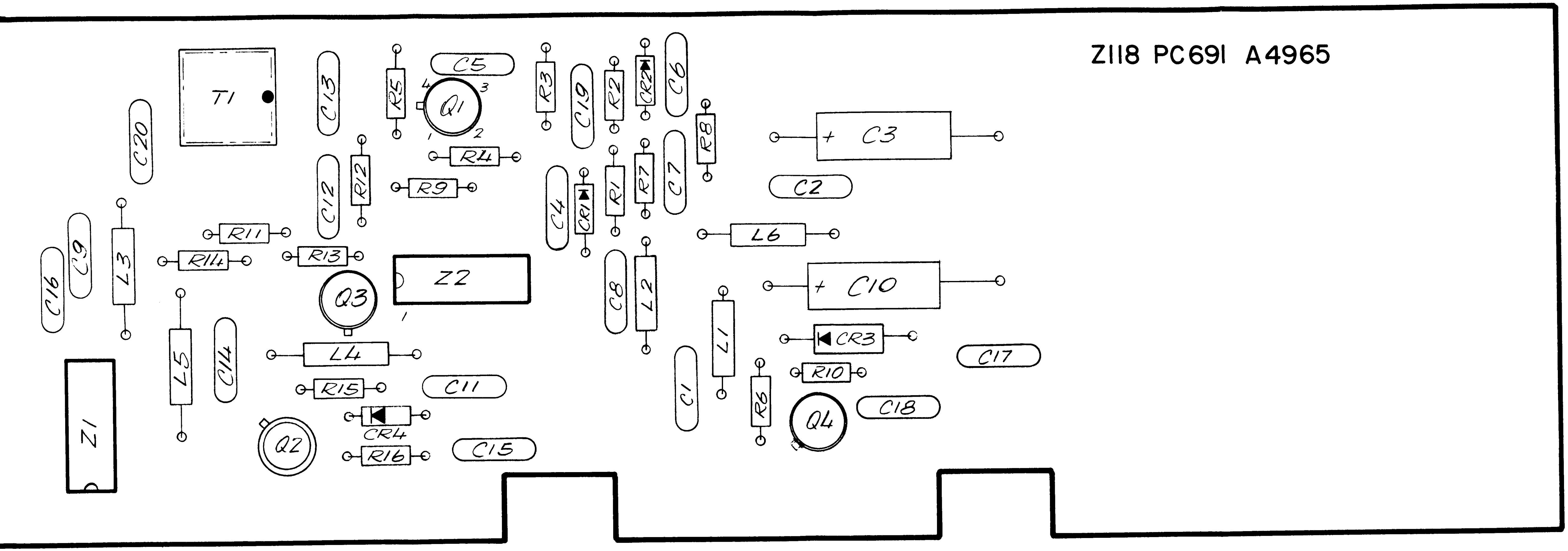
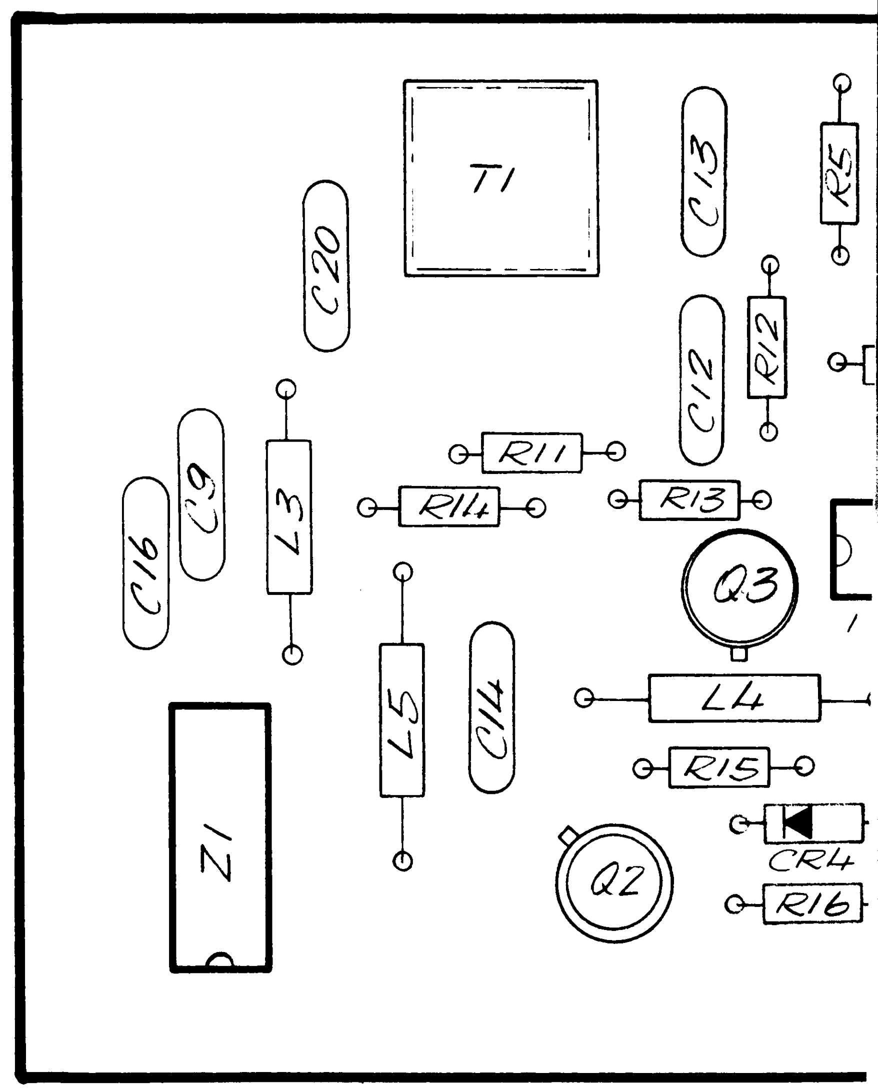


Figure 7-36. BFO Assembly Z118, Location of Components

008753011
A4965-Ø



008753011
A4965-Ø

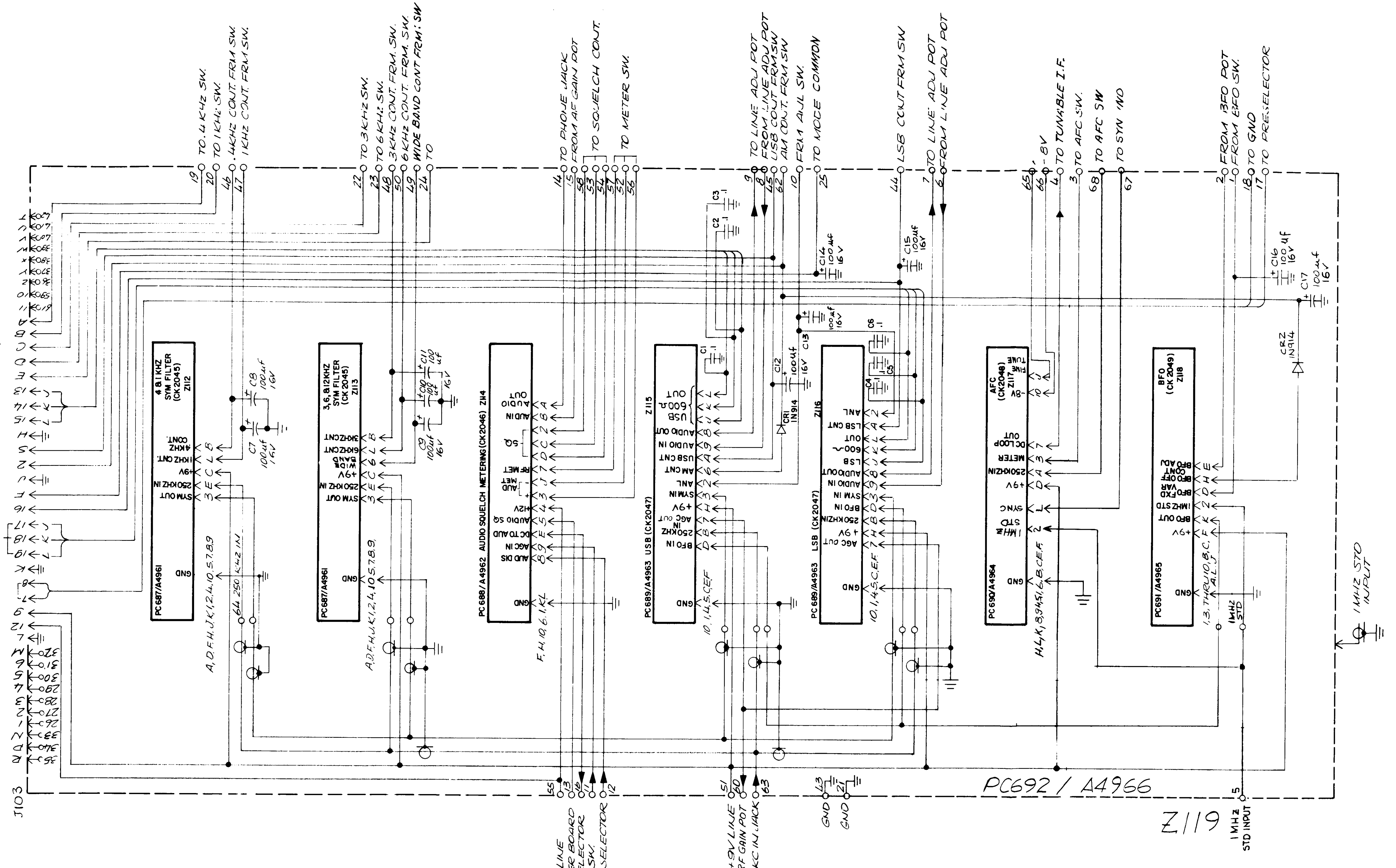
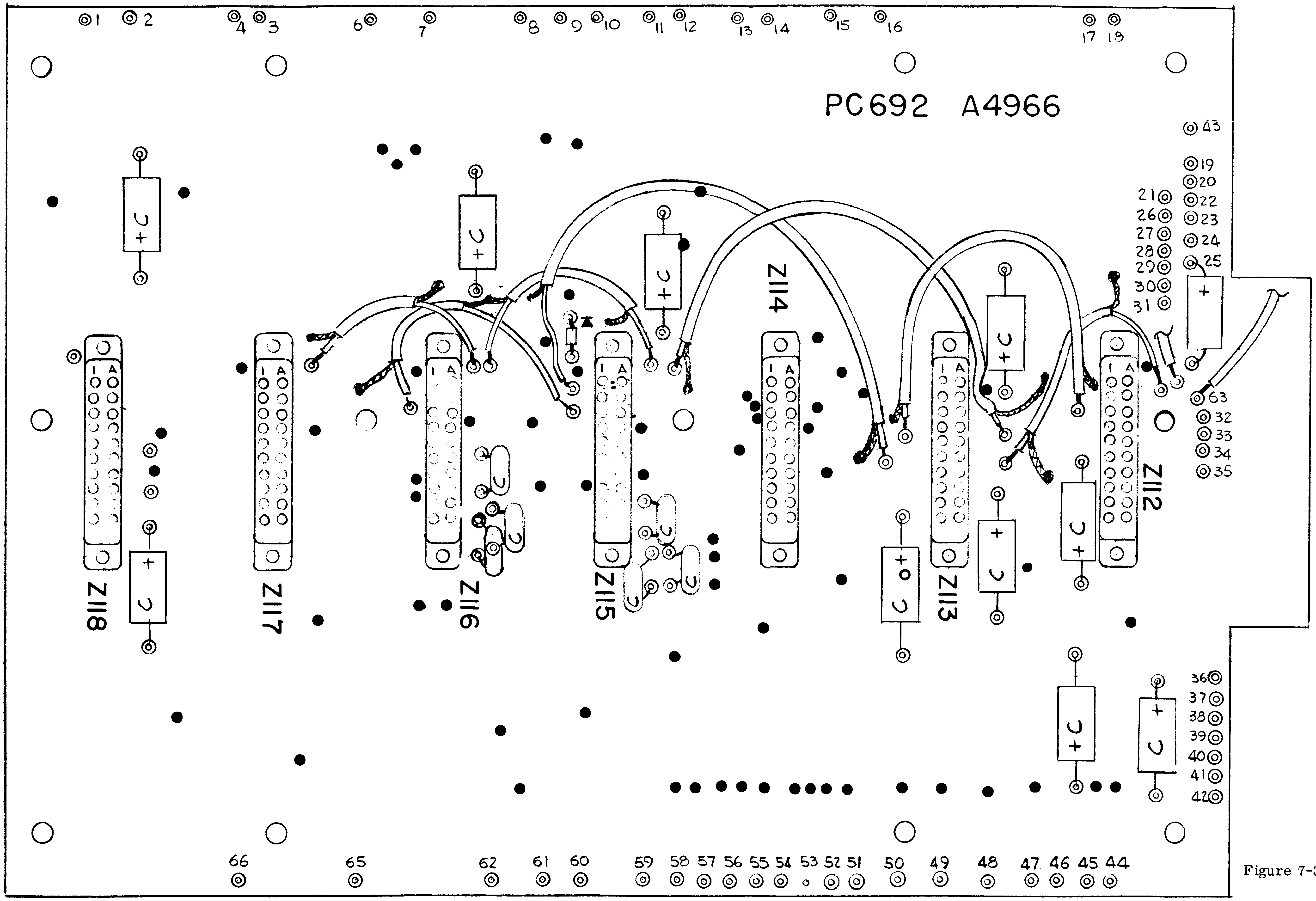


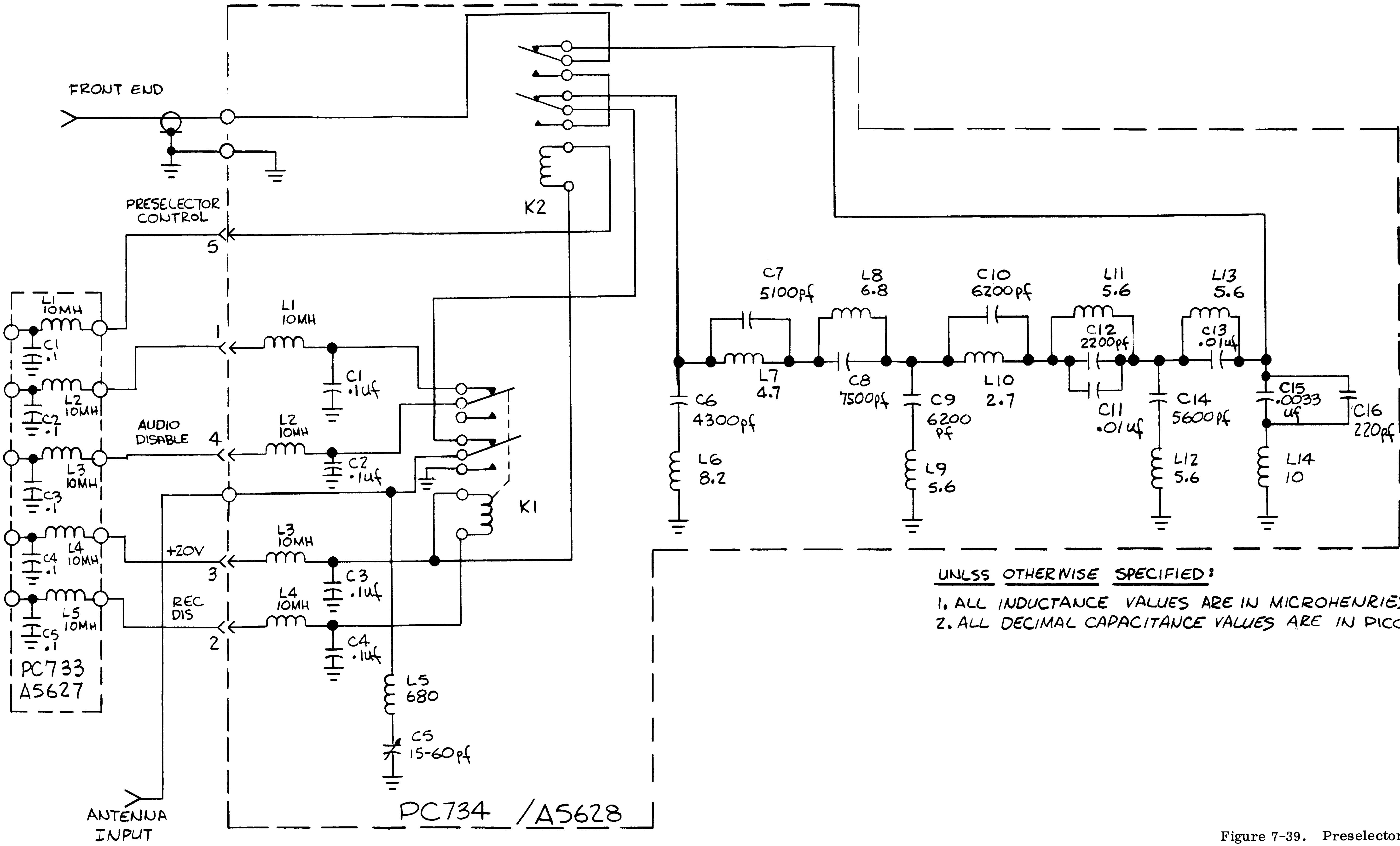
Figure 7-37. Audio Filter Mother Board Z119, Interconnection Diagram

008753011
CK2064-Ø



008753011
A4966-Ø

Figure 7-38. Audio Filter Mother Board Z119, Location of Components

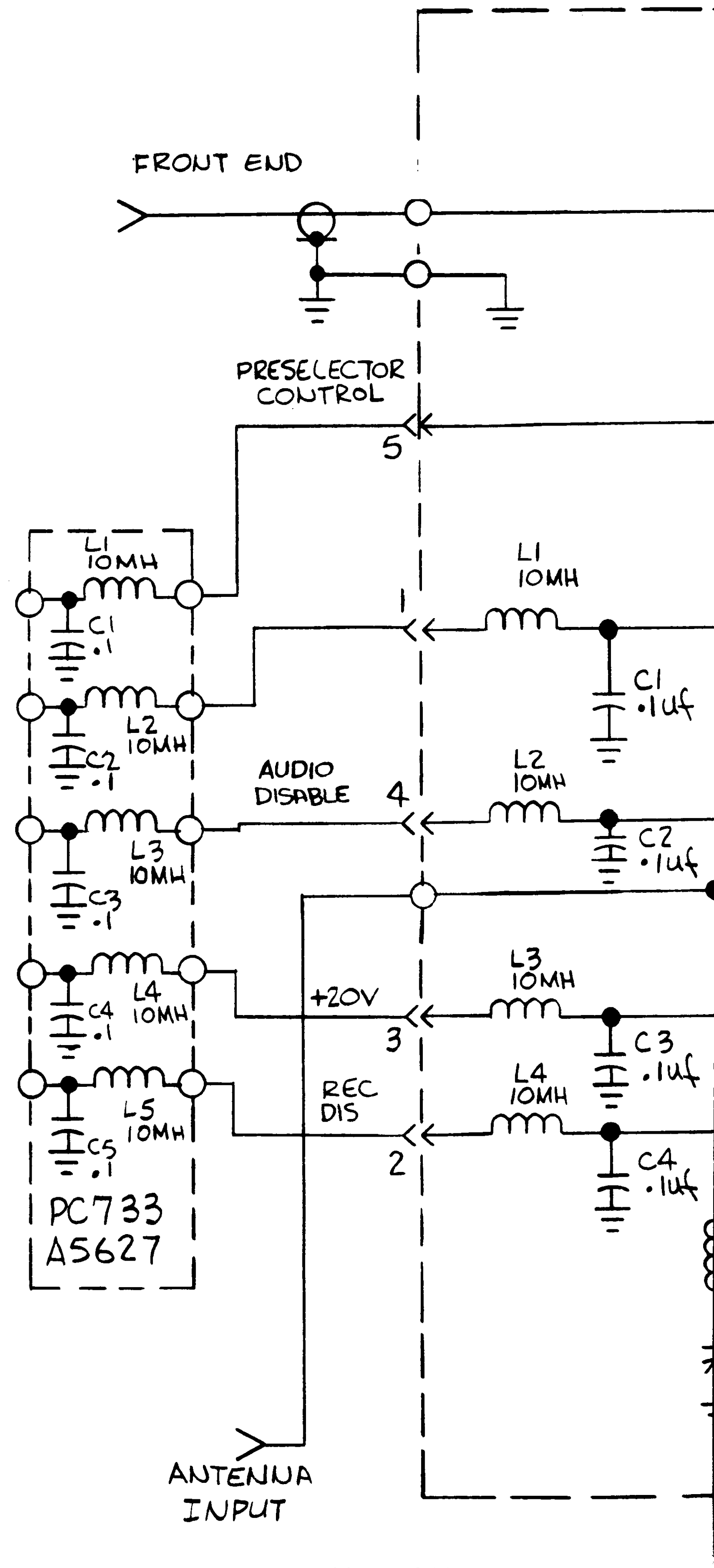


UNLSS OTHERWISE SPECIFIED:

1. ALL INDUCTANCE VALUES ARE IN MICROHENRIES (uh)
2. ALL DECIMAL CAPACITANCE VALUES ARE IN PICOFARADS (pf)

Figure 7-39. Preselector Assembly Z120, Schematic Diagram

008753011
CK2105-Ø



008753011
CK2105-Ø

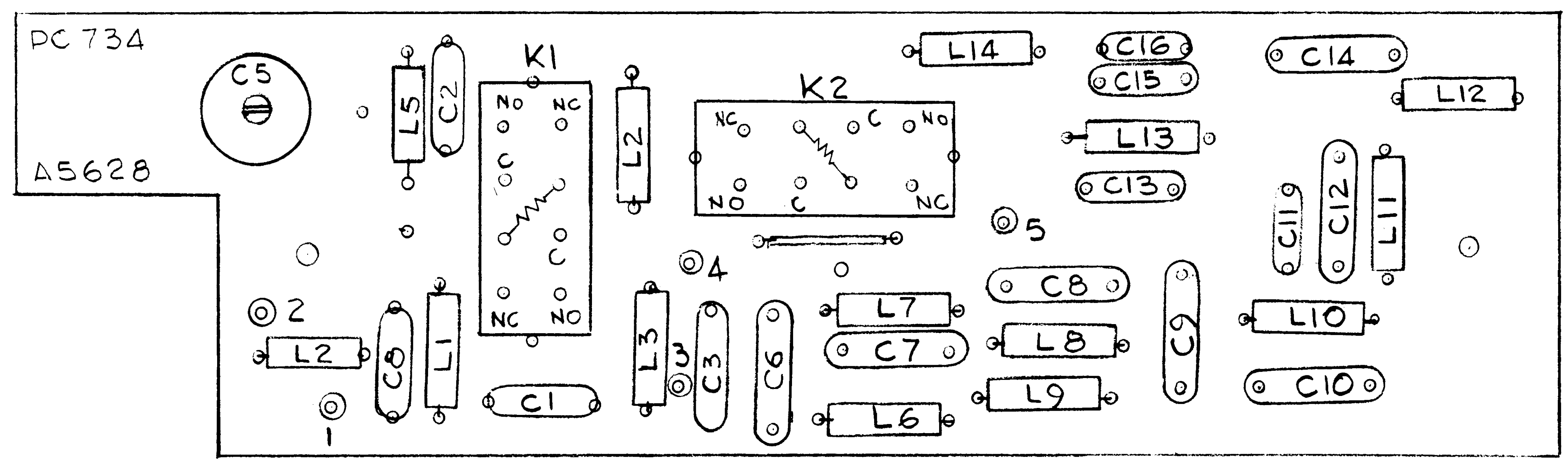
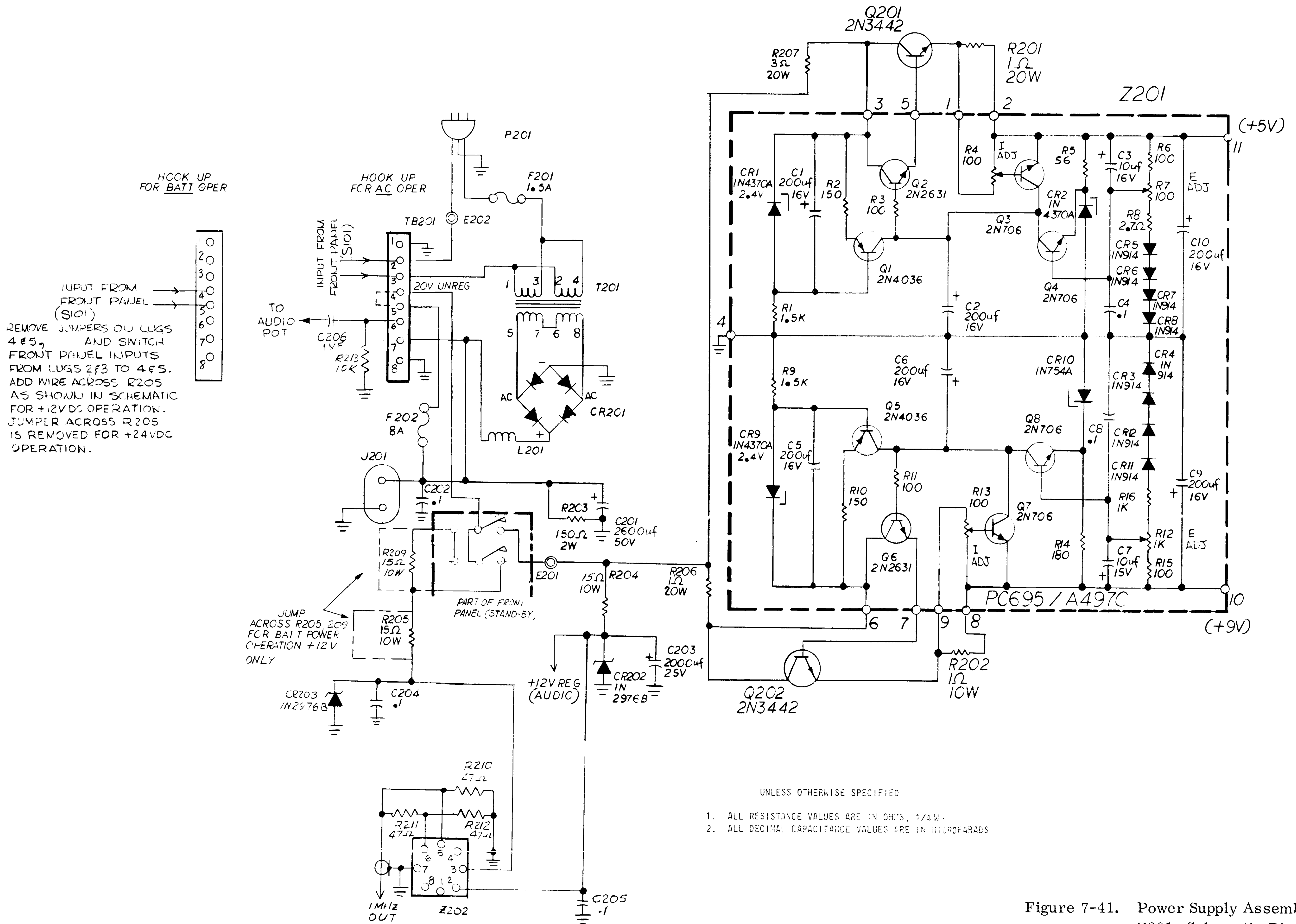


Figure 7-40. Preselector Assembly Z120, Location of Components

008753011
A5628-Ø

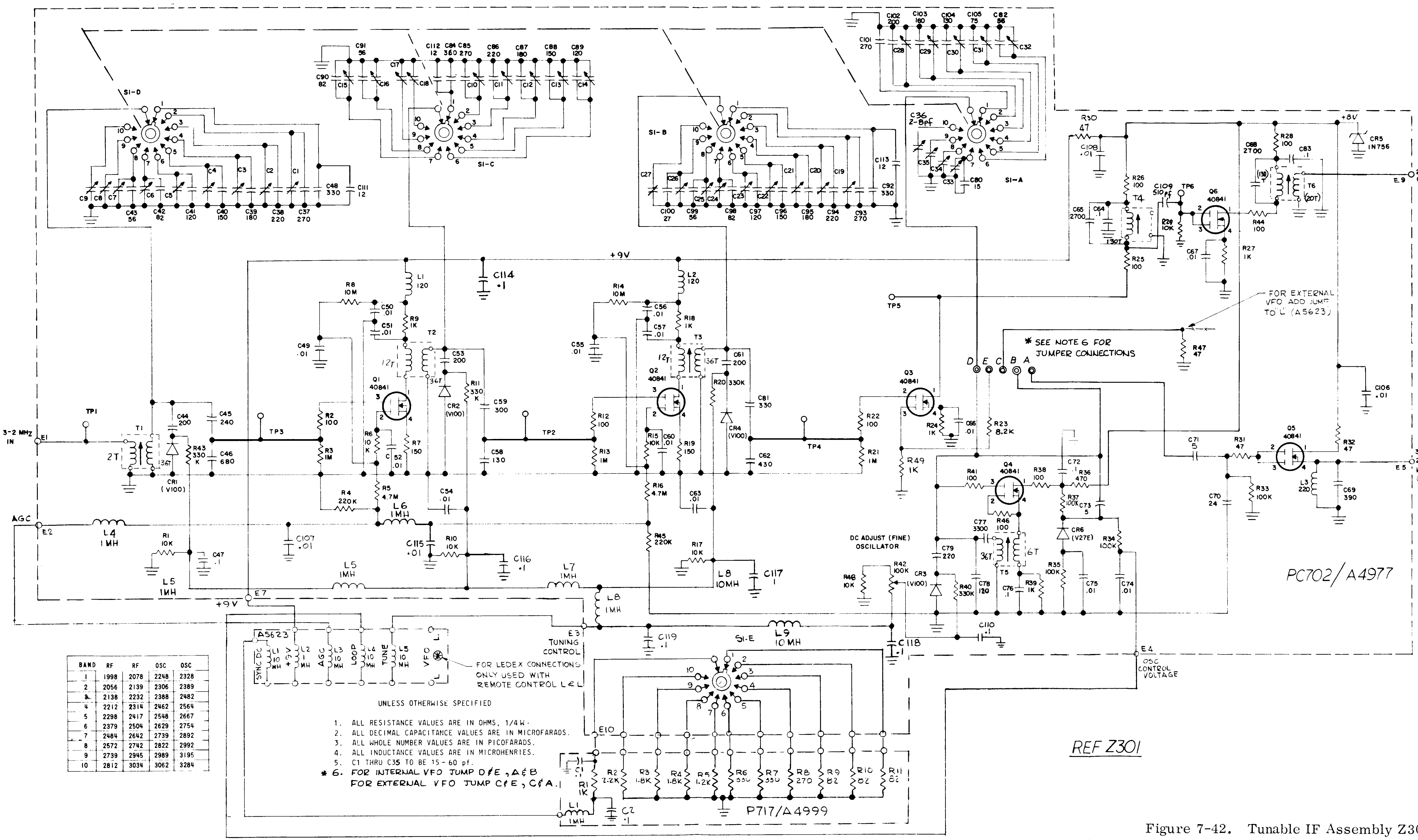


UNLESS OTHERWISE SPECIFIED

1. ALL RESISTANCE VALUES ARE IN OHMS, 1/4W.
2. ALL DECIMAL CAPACITANCE VALUES ARE IN MICROFARADS

Figure 7-41. Power Supply Assembly Z201, Schematic Diagram

008753011
CK2059-D



BAND	RF	RF	OSC	OSC
1	1998	2078	2248	2328
2	2056	2139	2306	2389
3	2138	2232	2388	2482
4	2212	2314	2462	2564
5	2298	2417	2548	2667
6	2379	2504	2629	2754
7	2484	2642	2739	2892
8	2572	2742	2822	2992
9	2739	2945	2989	3195
10	2812	3034	3062	3284

UNLESS OTHERWISE SPECIFIED

1. ALL RESISTANCE VALUES ARE IN OHMS, 1/4 W.
2. ALL DECIMAL CAPACITANCE VALUES ARE IN MICROFARADS.
3. ALL WHOLE NUMBER VALUES ARE IN PICOFARADS.
4. ALL INDUCTANCE VALUES ARE IN MICROHENRIES.
5. C1 THRU C35 TO BE 15 - 60 pf.

* 6. FOR INTERNAL VFO JUMP D & E, A & B
FOR EXTERNAL VFO JUMP C & E, C & A.

Figure 7-42. Tunable IF Assembly Z301, Schematic Diagram

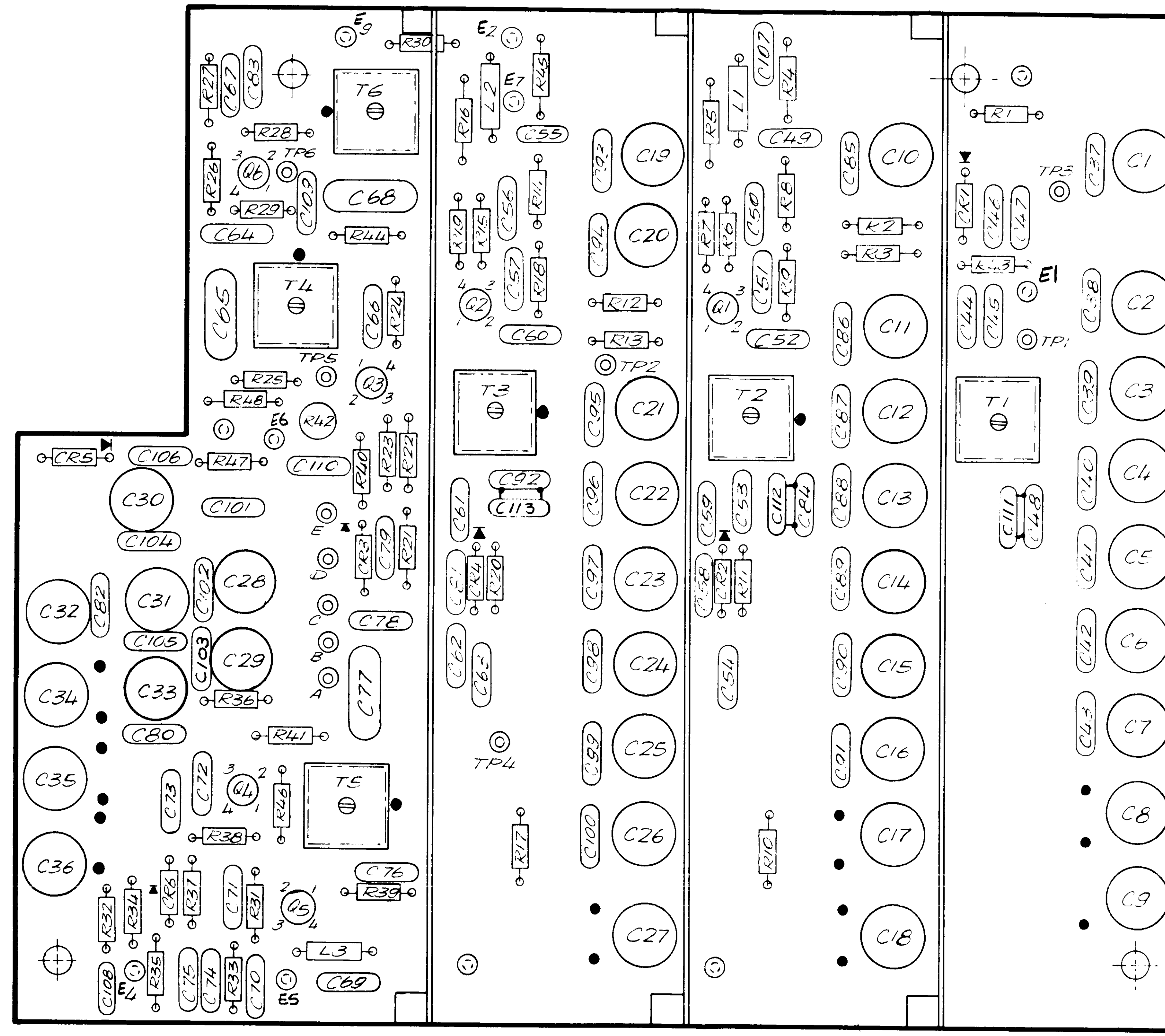


Figure 7-43. Tunable IF Assembly Z301, Location of Components

008753011
A4977-Ø

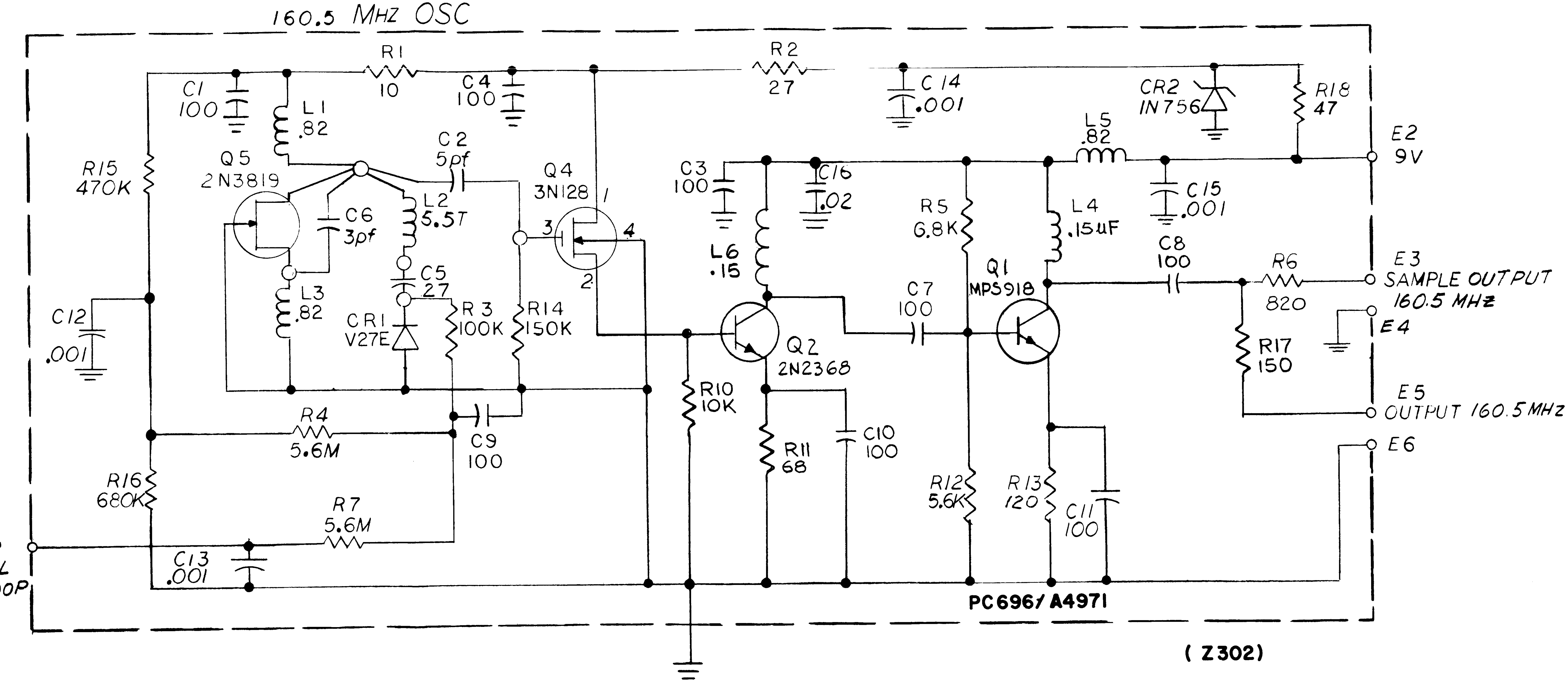
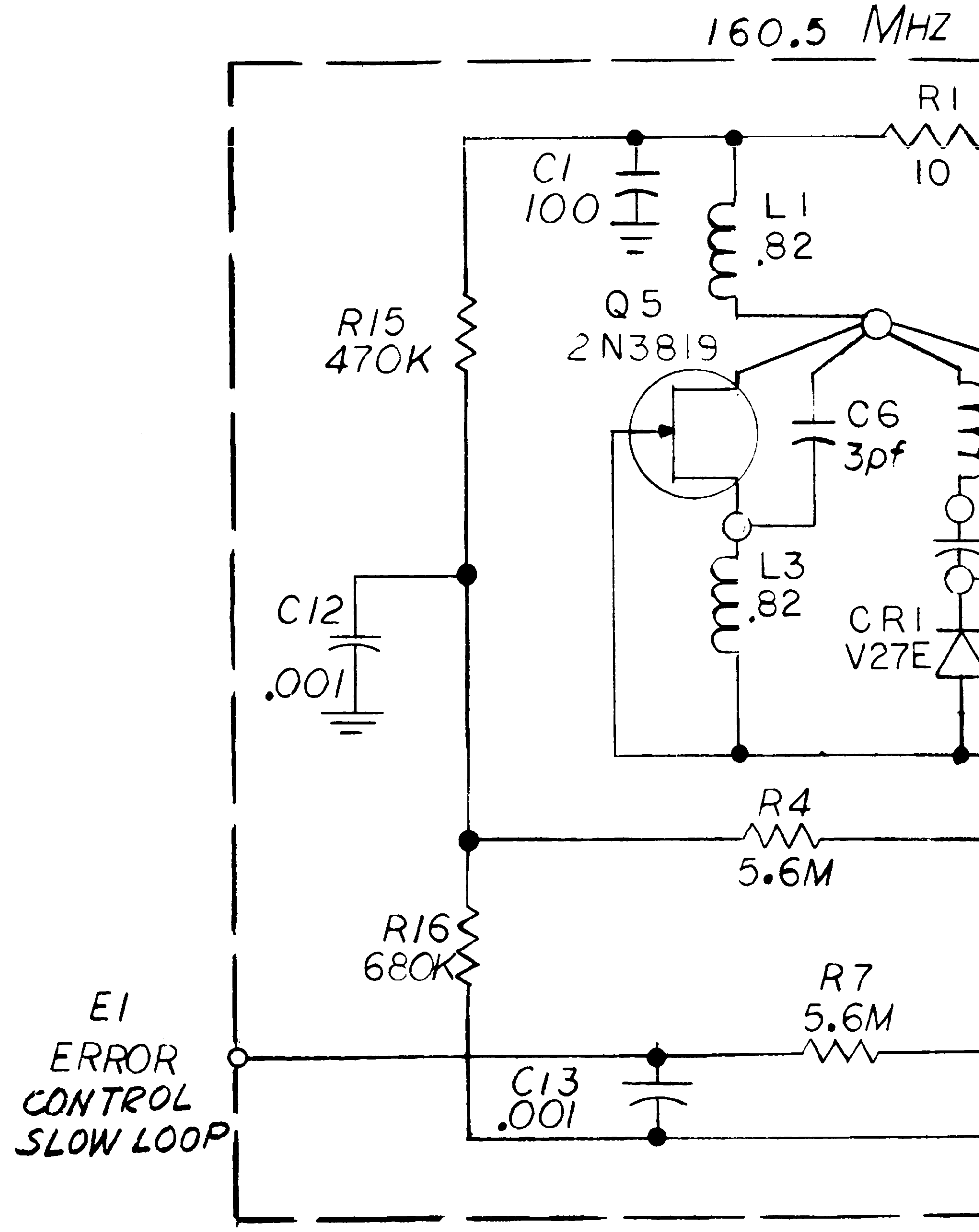


Figure 7-44. 160.5 MHz Oscillator Assembly Z302, Schematic Diagram

008753011
CK1884-X2



008753011
CK1884-X2

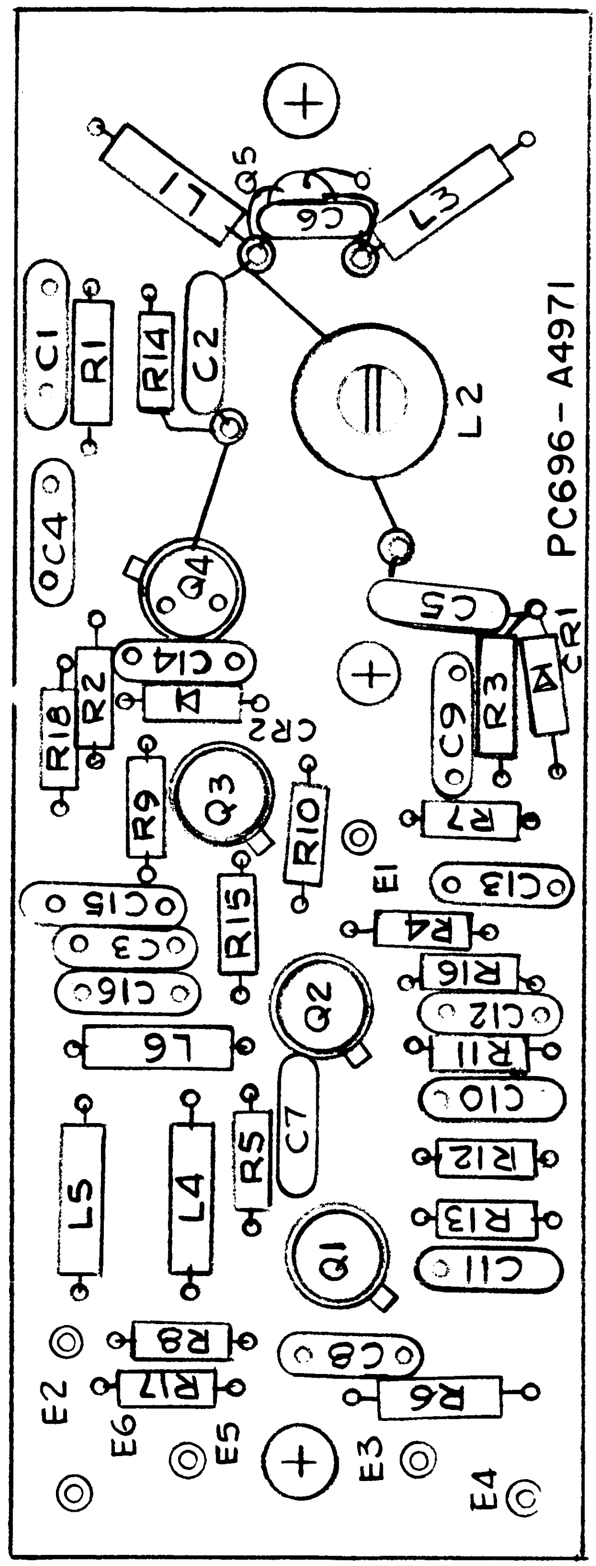
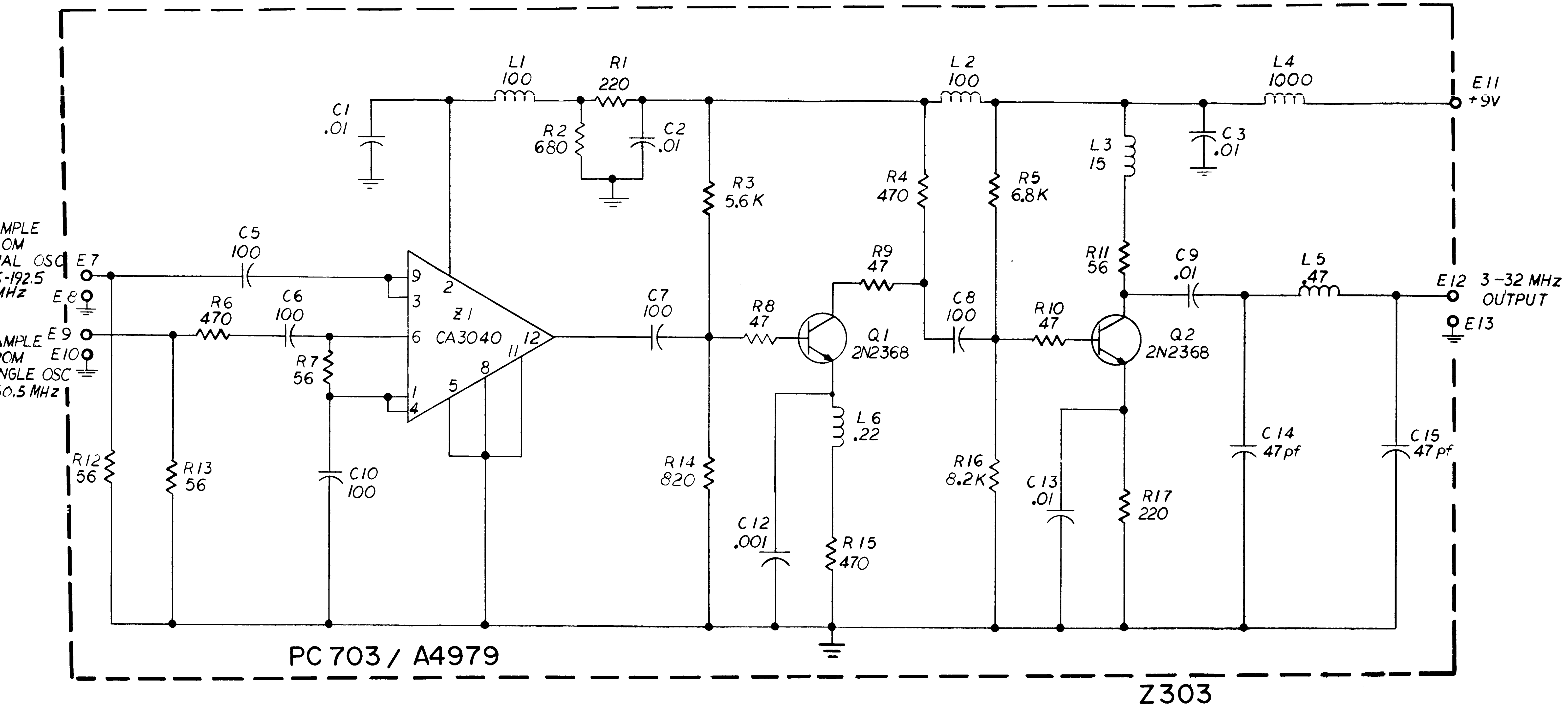


Figure 7-45. 160.5 MHz Oscillator Assembly Z302, Location of Components

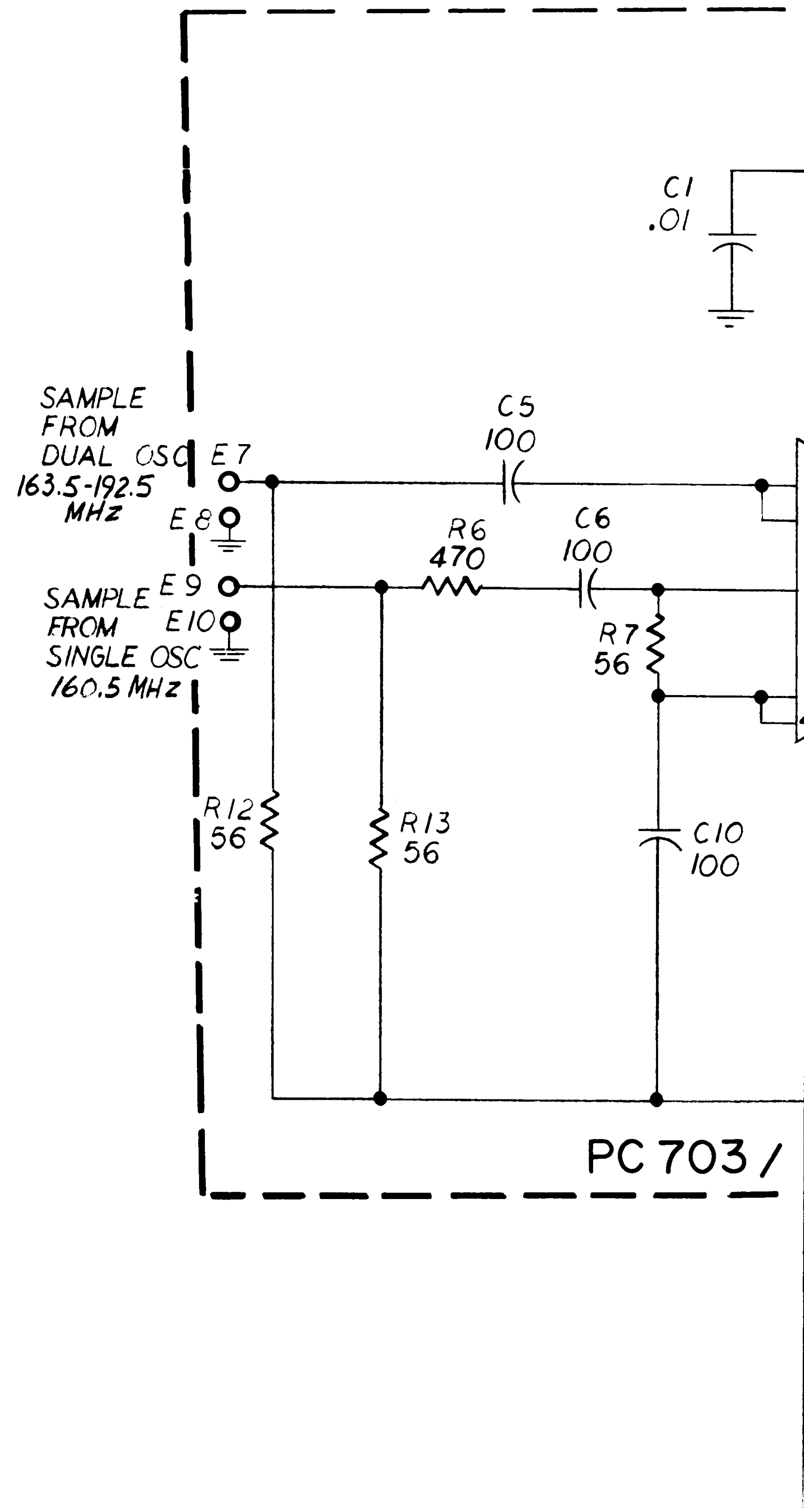


UNLESS OTHERWISE SPECIFIED

1. ALL RESISTANCE VALUES ARE IN OHMS, 1/4W.
2. ALL DECIMAL CAPACITANCE VALUES ARE IN MICROFARADS.
3. ALL WHOLE NUMBER VALUES ARE IN PICOFARADS.
4. ALL INDUCTANCE VALUES ARE IN MICROHENRIES.
5.

Figure 7-46. Sample Mixer Assembly Z303, Schematic Diagram

008753011
CK2060-X2



008753011
CK2060-X2

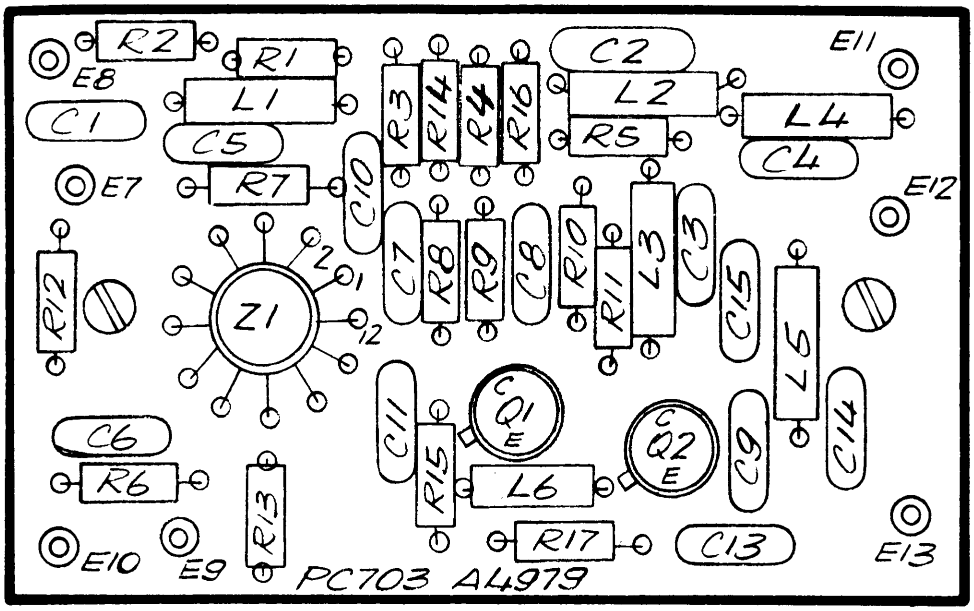
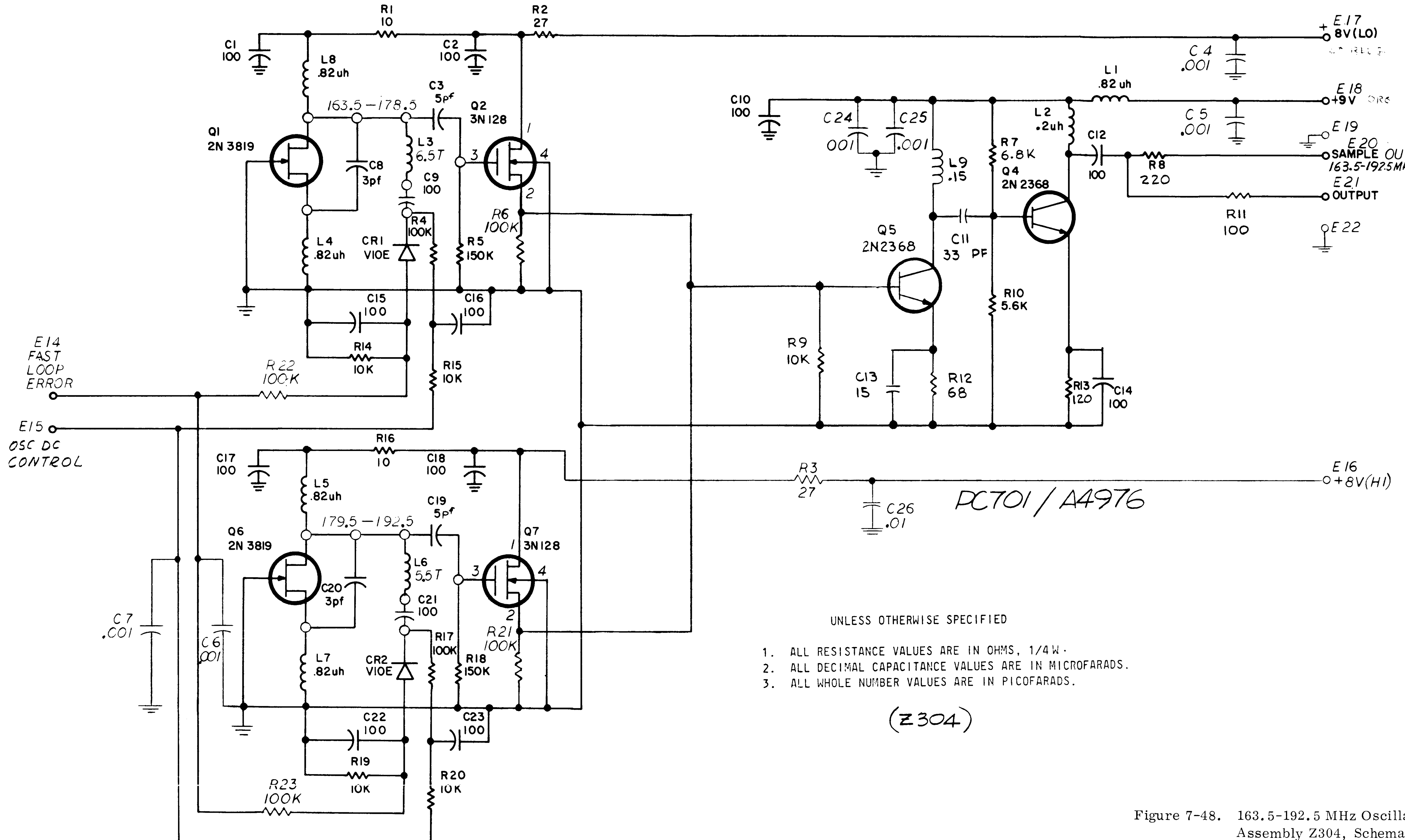


Figure 7-47. Sample Mixer Assembly Z303, Location of Components



UNLESS OTHERWISE SPECIFIED

1. ALL RESISTANCE VALUES ARE IN OHMS, 1/4W.
2. ALL DECIMAL CAPACITANCE VALUES ARE IN MICROFARADS.
3. ALL WHOLE NUMBER VALUES ARE IN PICOFARADS.

(Z304)

Figure 7-48. 163.5-192.5 MHz Oscillator Assembly Z304, Schematic Diagram

008753011
CK1886-X3

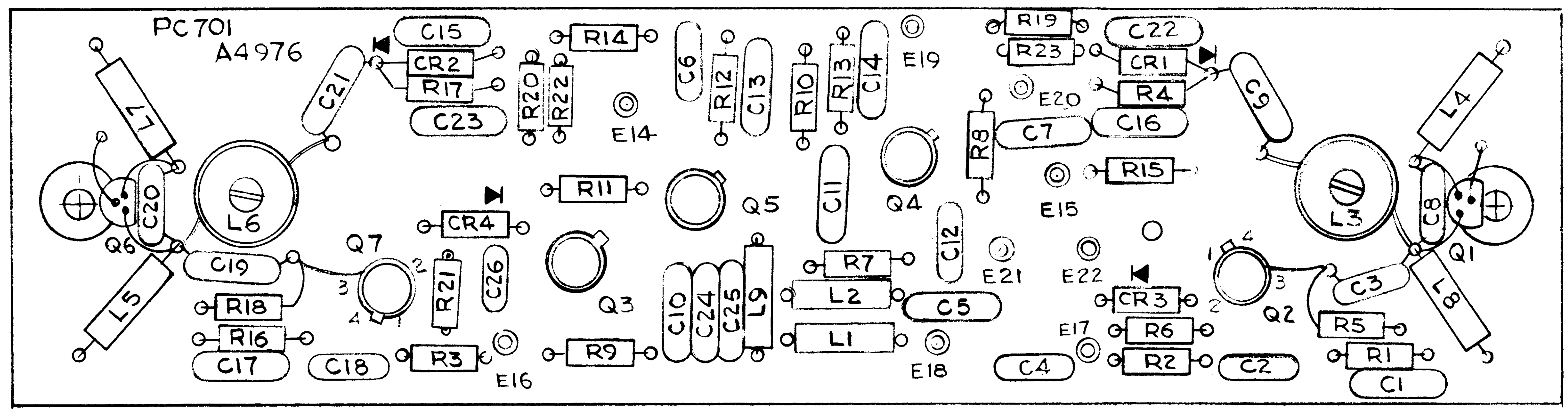
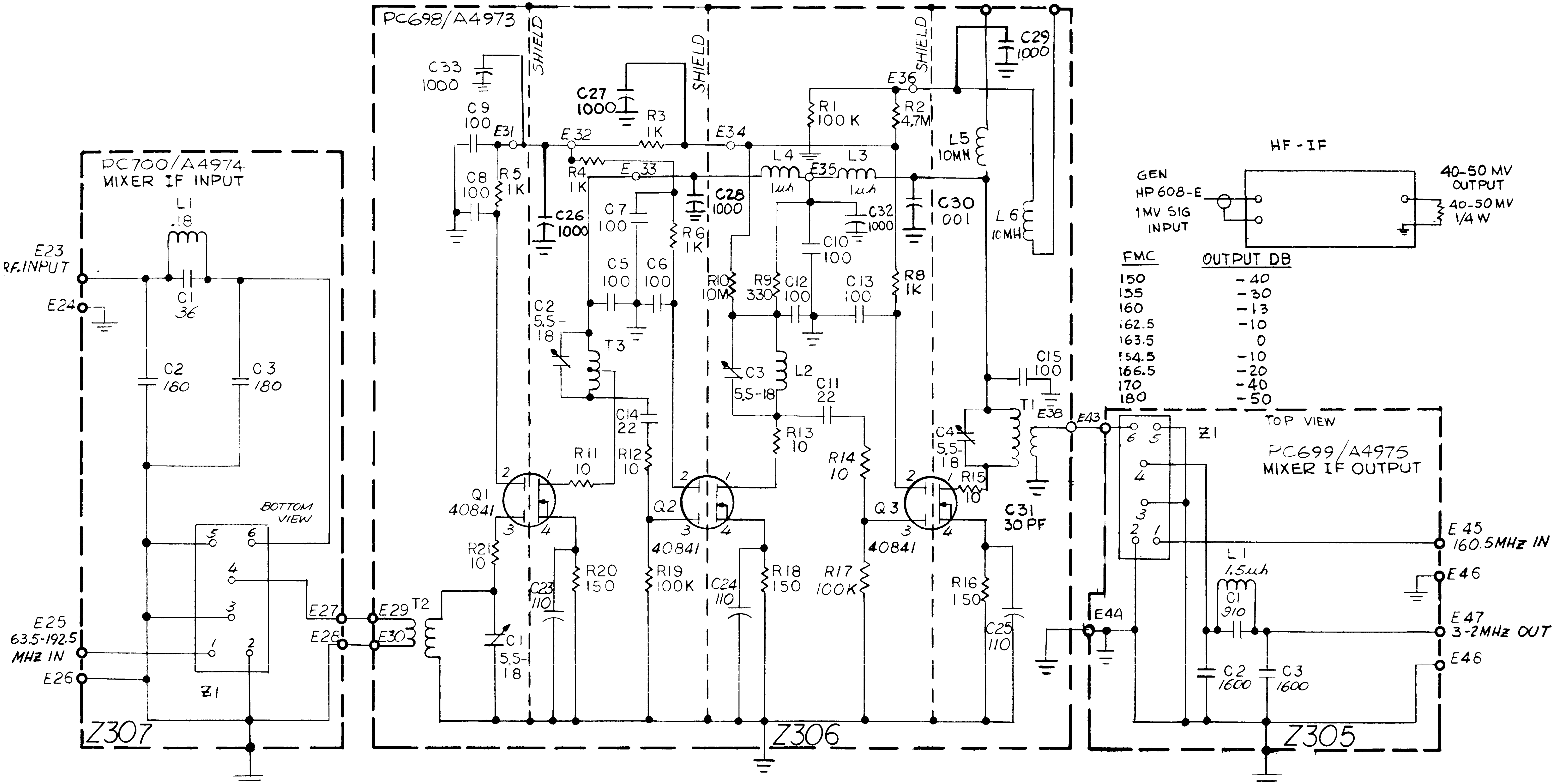


Figure 7-49. 163.5-192.5 MHz Oscillator Assembly Z304, Location of Components

008753011
A4976-Ø



UNLESS OTHERWISE SPECIFIED

1. ALL RESISTANCE VALUES ARE IN OHMS, 1/4 W.
2. ALL DECIMAL CAPACITANCE VALUES ARE IN MICROFARADS.
3. ALL WHOLE NUMBER VALUES ARE IN PICOFARADS.
4. ALL INDUCTANCE VALUES ARE IN MICROHENRIES.

Figure 7-50. RF Input Mixer Assembly Z307, Differential Amplifier Assembly Z306, and IF Output Mixer Assembly Z305, Schematic Diagram

008753011
CK1888-X4

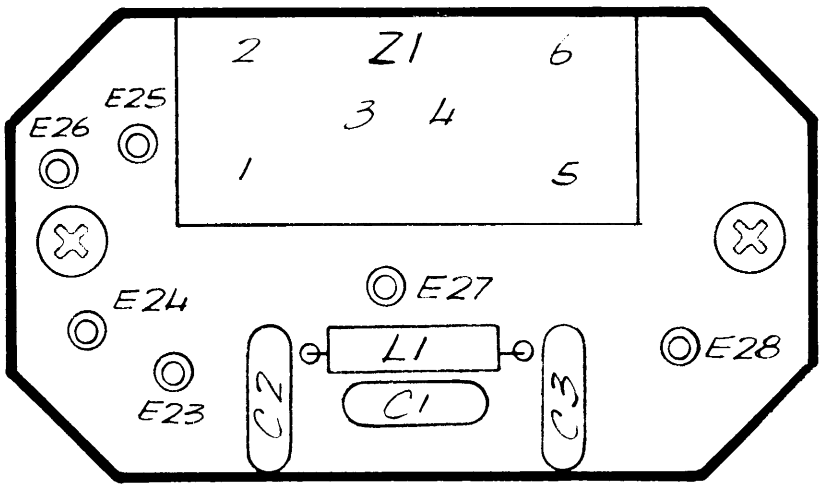


Figure 7-51. IF Output Mixer Assembly Z305, Location of Components

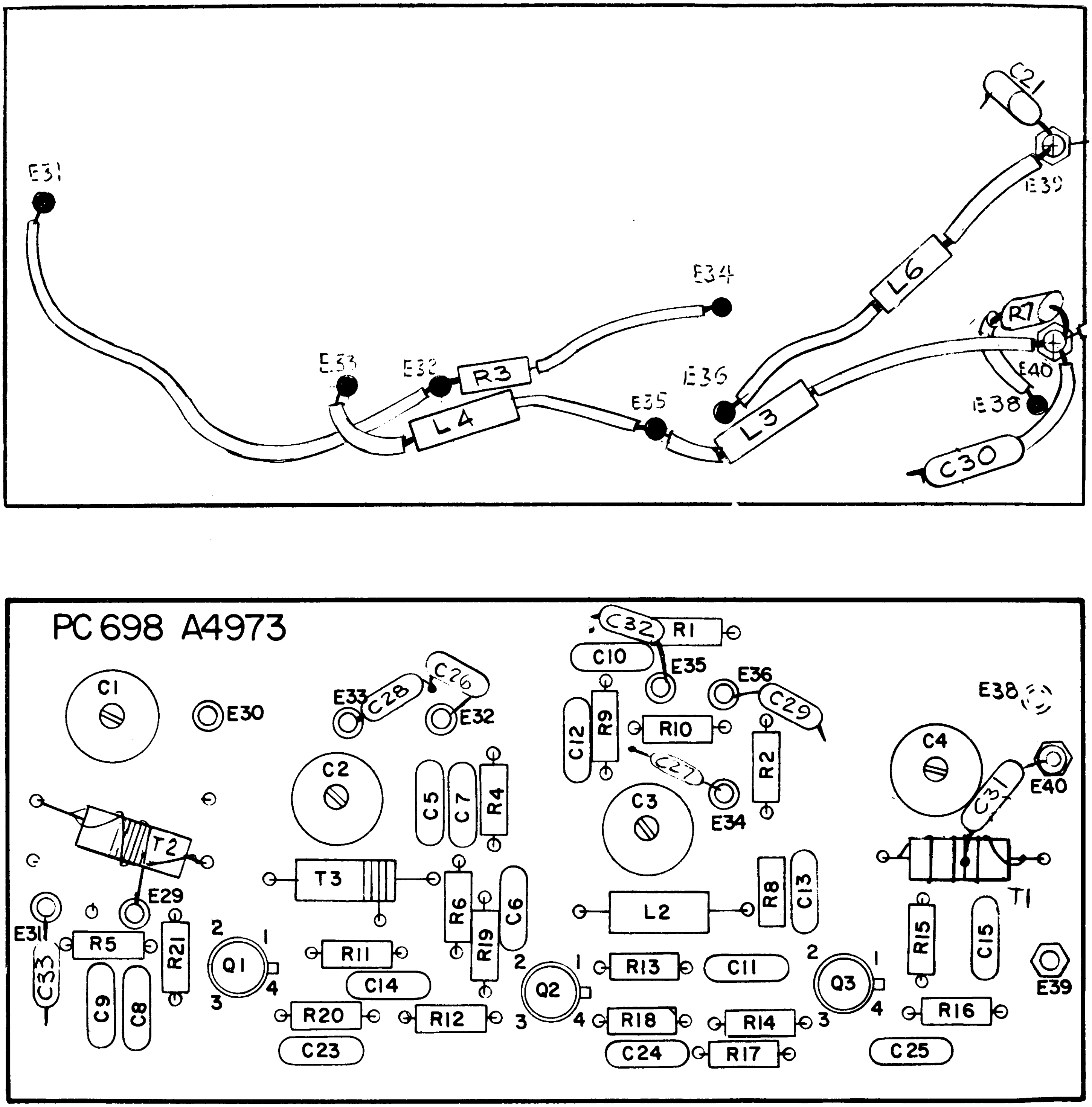


Figure 7-52. Differential Amplifier Assembly Z306, Location of Components

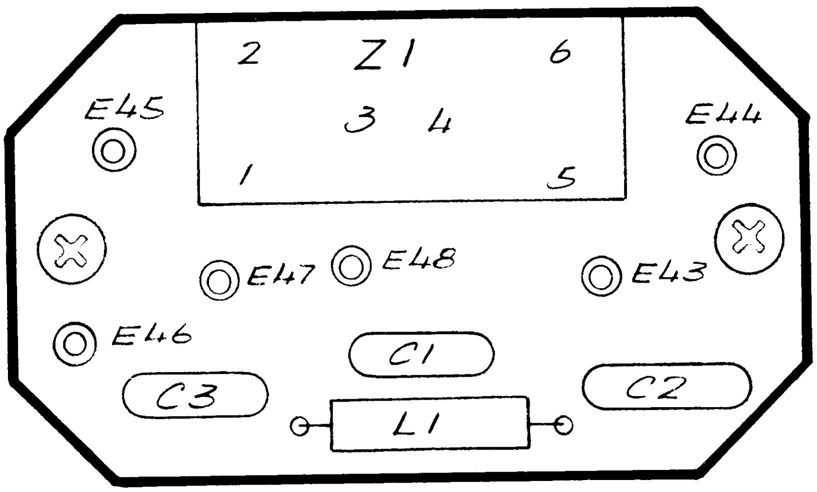


Figure 7-53. RF Input Mixer Assembly Z307, Location of Components

Note

On certain GPR-110 units, the 1-mHz switching assembly is replaced by individual 1-mHz switching assemblies on mHz display divider assembly A4958 (Z103), comparator assembly (Z104), and 3-12 mHz generator assembly Z4952 (Z106).

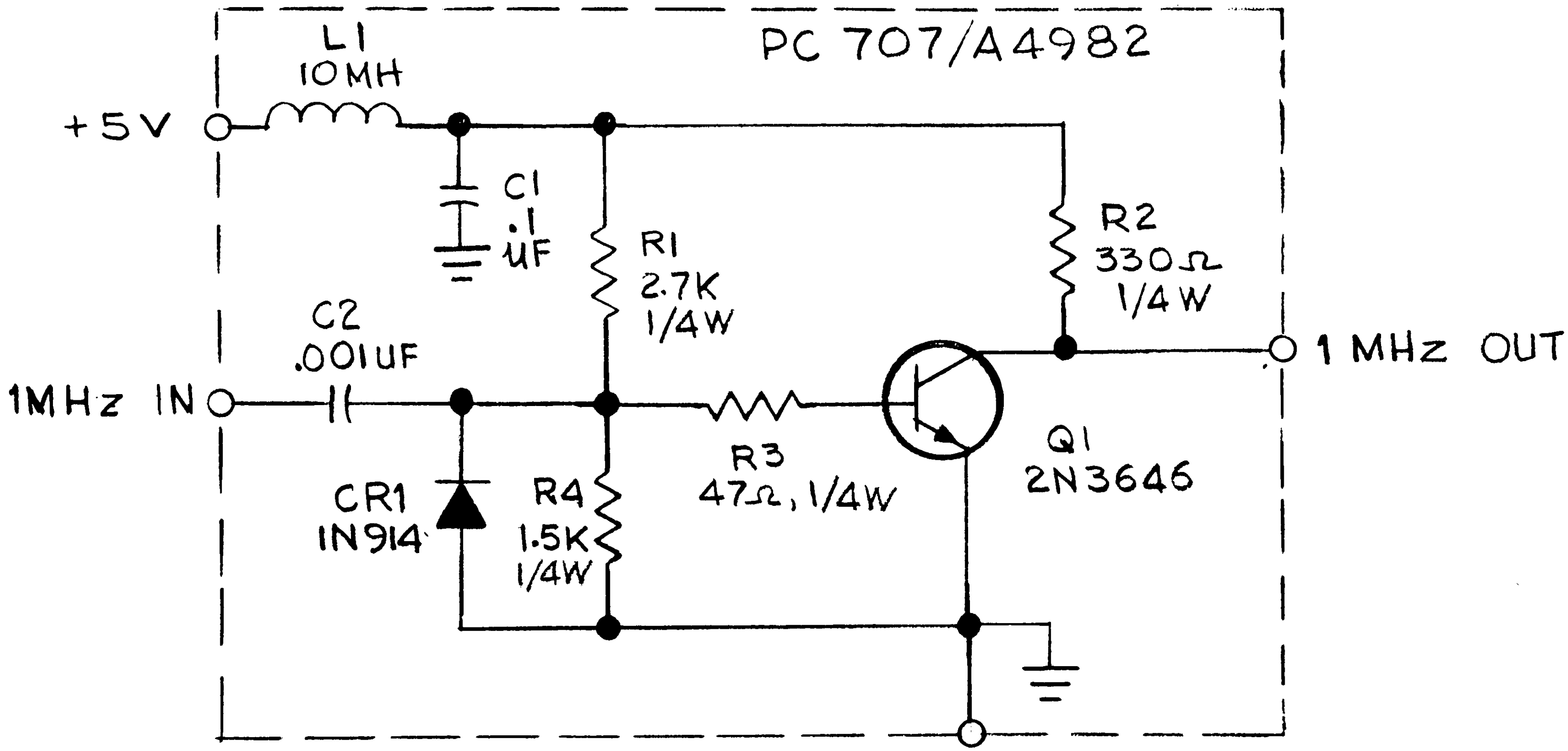
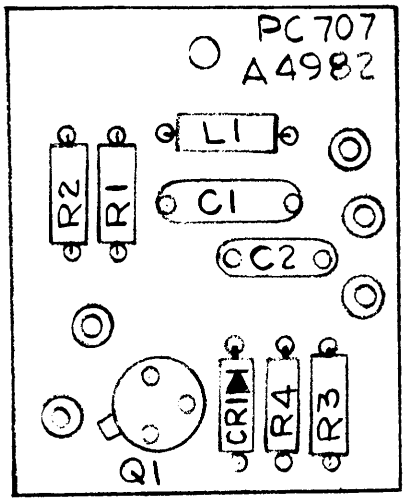


Figure 7-54. 1-MHz Switching Assembly, Schematic Diagram

008753011
CK2069-Ø



Note

On certain GPR-110 units, the 1-mHz switching assembly is replaced by individual 1-mHz switching assemblies on mHz display divider assembly A4958 (Z103), comparator assembly A4956 (Z104), and 3-12 mHz generator assembly A4952 (Z106).

Figure 7-55. 1-MHz Switching Assembly, Location of Components