Shure Incorporated
222 Hartrey Avenue
Evanston IL 60202-3696 U.S.A.

T Wireless System

SERVICE MANUAL CHANGE NOTICE

T1/TC1 WIRELESS BODY-PACK TRANSMITTER

Changes and corrections have been made to the Service Manual for the T1 Body-Pack Transmitter. To update your Service Manual, remove the pages identified in the tables below and replace them with the pages attached to this Change Notice. Note that there are no changes to pages not specifically identified in the tables below.

T1 BODY-PACK TRANSMITTER SERVICE MANUAL REVISION HISTORY

Release	Part Number	Date Code	Color
Original	25A1016	QH	White
Revision 1	25B1016	SB	Pink
Revision 2	25C1016	SI	White
Revision 3	25C1016	TL	White
Revision 4	25C1016	AF	White
Revision 5	25C1016	BA	White
Revision 6	25C1016	CC	Red

CHANGES EFFECTIVE MARCH 17, 2003

REMOVE these pages from the T1 Service Manual	**INSERT** these new Revision pages into the T1 Service Manual
Page 22	Page 22

T1/TC1 Body-Pack Transmitters

25C1016 (CC)

Characteristics

General

This section tells how to service and align the T1G, T1, TC1, and the discontinued T1P Body-Pack Transmitters (Figure 1). These single-channel, crystal-controlled units operate in the 169 MHz to 216 MHz VHF Band.

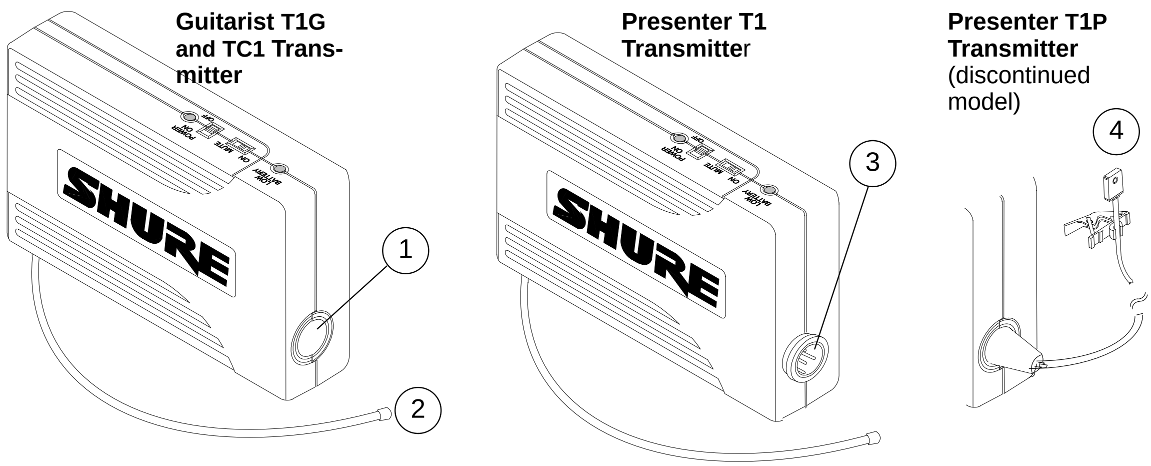


Figure 1.

1. Phone jack $^1/_4$″ (guitar or headset input)
2. Antenna
3. Tini “Q-G” (Lavalier, headset, WA302 input)
4. Lavalier microphone

Service Note: Shure recommends that all service procedures be performed by a factory-authorized service center or returned directly to Shure Brothers Inc.

Licensing: Operation may require a user license. Frequency or power-output modifications may violate this product’s approvals. Contact your country’s communications authorities.

Circuit Description

The T1 transmitter contains one circuit board which comprises an audio and an RFsection. It is intended for use with the matching T3 and T4 receivers.

Audio Section

Input: Audio signals enter via a $^{1}/_{4}$-in. phone jack, with the signal on the tip and the ground on the ring (T1G), an attached microphone (the discontinued model T1P), or a four-pin, Tini Q-G®, connector (T1):

- **Pin 1:** *Ground*
- **Pin 2:** *Supplies regulated 5 Vdc bias for electret condenser microphones*
- **Pin 3:** *Audio input*
- **Pin 4:** *20 kΩ load resistor connected to pin 3 for Shure electret microphones*

Preamplifier Stage: This is centered in one section of the operational amplifier (U102C). An externally accessible potentiometer (R125) adjusts the voltage gain of this stage over a 40 dB range.

Passive Pre-emphasis Network and Compandor: The network (R145, C110, C111, R112, and R115) has a pole at 63 microseconds and a zero at 1 microsecond. The NE571D integrated circuit compandor (U101A) provides a 2:1 logarithmic compression of the audio signal.

Noise and Distortion: U102A lowers the noise floor, and an internal potentiometer (R130) nulls the system audio distortion. Operational amplifier U102B, operating as a two-pole, active, low-pass filter, restricts the bandwidth of the system to audio frequencies.

Limiting: PNP transistors Q103 and Q104 limit the level of the audio signal leaving the audio section via U102B. Beginning in July 1995, this section was removed from the “A,” “B,” and “C” boards but left in a newly designated “T” board.

5 Vdc Bias and LED Drive Circuits: The NE571D’s identical second channel (U101B) supplies regulated, low-noise 5 Vdc bias to various audio and RF circuit points. Transistor Q105 provides “reverse battery protection” to the circuit. Q106 drives LED D101 (“Power On”), and Q107 drives LED D102 (“Low Battery”).

RF Section

Audio Input: Processed audio enters R217, an internal potentiometer that is adjusted for 15 kHz deviation (100% modulation) when the audio section provides a –2.2 dBV, 1 kHz tone.

Oscillation: The audio then goes to varactor diode D201, which is part of the modulated oscillator-tripler stage (Q201). The latter’s base-emitter circuit operates as a crystal-controlled Colpitts oscillator in the 20 MHz region. Fundamental-mode crystal Y201 is tuned 10 kHz below series resonance by the series combination of frequency-netting coil

L209, diode D201, capacitor C214, and capacitor divider C224 and C230.

Frequency and Temperature Stability: To ensure frequency stability despite changes in the battery voltage, regulated 5 Vdc bias is applied to the varactor diode and to the base of Q201. Temperature compensation is provided by C224, C230, and C214.

Tuned Circuits

Stage 1: The collector circuit of Q201 is tuned to the third harmonic of the oscillator frequency (approximately 60 MHz) by L205, C225, C234, L202, C217, and C233. (The latter components also form a capacitively-tapped voltage divider for matching the signal to the base of Q203.) The output is double-tuned to provide high-spectral purity. Regulated dc bias is again employed to minimize changes in loading on the oscillator stage and to stabilize the drive levels.

Stage 2: Q203 operates as a frequency tripler, with its collector circuit tuned to the output frequency (for example, 180 MHz). In this case, L204, C215, C237, C236, L207, C235, and C222 perform tuning and impedance-matching functions. As in the preceding stage, regulated dc bias is applied to the base circuit to stabilize the drive level, and the output is double-tuned to provide spectral purity.

Stage 3: Q204 operates as a tuned amplifier. Resistive loading on the input provides stability. The output circuit consists of a resonant tank circuit (L203 and C213) capacitively coupled to a low-pass filter (C219, L206, and C218). C213 and C219 provide a capacitively tapped voltage divider for matching into the low-pass filter.

Transmitter Output

Transmitter: This can deliver up to +17 dBm (50 mW) to the antenna. No user adjustment permits this value to be exceeded. The unit should be powered exclusively by a 9 Vdc dry battery (an alkaline type, such as a Duracell MN1604, is recommended).

Voltage Measurements: With 9 Vdc applied to the unit, the following voltages should appear at the terminals of the output transistor;

- Vc = 8.88 Vdc
- Vb = .450 Vdc
- Ve = .473 Vdc.
- Base current = .29 mAdc
- Emitter current = 21.5 mAdc
- Collector current = 21.8 mAdc
- Power input = 183 mW

The output power is +16.5 dBm (44.7 mW) into a 50 Ω load, at a frequency of 169.445 MHz. At the minimum acceptable battery voltage of 6 Vdc, the final collector current drops to 15 mAdc and the output power declines to +13.9 dBm (24.4 mW).

Antenna: This is a quarter-wavelength, permanently attached, flexible wire. The ground plane of the circuit serves as an untuned counterpoise capacitively coupled to the body of the user.

Spurious Emissions: To minimize the production and radiation of spurious emissions and harmonic energy, and to promote stable operation, the collector of each RF stage is separately decoupled from the 9-volt supply by ferrite chokes, resistors, and bypass capacitors. The base circuits are similarly decoupled except that they use resistor-capacitor (R-C) networks, whose higher-impedance levels are more appropriate.

Preliminary Tests

Listening Tests

Before disassembling the unit, operate it to determine whether it is functioning normally.

Focused Testing: First and most important: Review any customer complaint or request and focus your listening and functional tests on any reported problem. For example, for “short range” and “drop-outs” complaints, perform only the RF tests in this section. If the unit passes these, there is a strong indication that the customer is using the product incorrectly (e.g., not keeping the transmitter in the receiver’s line of sight, not avoiding metal enclosures or TV interference). Return the unit to the customer together with an explanation of the proper set-up procedures.

For complaints of distortion or other audio problems, try a “standard” lavalier or headset microphone (you should have one of each microphone on-hand for testing) and perform the audio tests in this section.

Functional Tests

RF Tests

1. Remove the case top, mute the audio, and apply 9 Vdc to the battery terminals.
2. Measure the current drain: it should not exceed 35 mA.
3. Maximize the signal received on the spectrum analyzer by attaching a telescoping whip antenna to it. Then measure the near-field output power: it should be $\geq$7 dBm.

   (If you are unsure of the results you obtain here, measure the output power conductively by soldering a 50 Ω cable to the output of the transmitter. Verify that the output power is 15 dBm, $\pm$2 dBm.)
4. Verify that the carrier frequency of the transmitter varies from its nominal value by no more than $\pm$6 kHz.
5. Check for an intermittent problem by shaking the transmitter and tapping on it. As you do so, try to keep it at a constant distance from the spectrum analyzer. Verify that the output power on the spectrum analyzer shows no large and sudden drops in power level (it will, however, vary a few dB with hand position).
6. Turn off the transmitter.

If the transmitter passes the above tests, its RF circuits are working as designed.

Audio Tests

A: Verify the Matching Receiver

1. Connect the signal generator to the receiver through a 50 Ω cable. Tack-solder the center conductor to the antenna input and ground the shield of the cable to pcb ground.

2. Set the RF generator as follows:

   Amplitude: *–20 dBm*
   Modulation: *1 kHz*
   Deviation: *15 kHz*
   Frequency: *T1 operating frequency*

3. Connect the audio from the unbalanced output to the audio analyzer with a 3.3 kΩ load. Turn the *Volume* control all the way up.

4. For the associated T3 or T4, verify the following:

   - audio level is 400 mVrms (±90 mV)
   - thd = <0.75%

B: Check the Transmitter

1. Disconnect the signal generator from the receiver. Monitor the receiver's unbalanced audio output with a 3.3 kΩ load and the audio analyzer. Check that the receiver's *Volume* control is still at its maximum setting.

2. Unmute the transmitter and turn its gain to the minimum setting. Connect an input cable as follows:

   T1 and T1G: Use adapter cables to input the audio to the body-pack input.

   T1P: Disassemble the case, remove the microphone, and attach the adapter cable to the four-pin header of the audio input.

3. Inject a 775 mV, 1 kHz signal from the audio analyzer into the adapter cable and verify the following:

   - the amplitude from receiver's unbalanced output equals 400 mVrms (±90 mV)
   - thd = <0.75%

4. Change the frequency of the audio generator to 100 Hz and disengage the 400 Hz high-pass filter from the audio analyzer. Verify that the audio level is –1 dB (±0.7 dB) relative to the level measured in step 3.

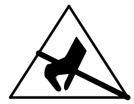
5. Change the frequency of the audio generator to 10 kHz and re-engage the 400 Hz high-pass filter. Verify that the audio level, relative to that measured in step 3, is 0 dB, ±1 dB.

Units That Pass

If the system components pass these tests and the microphone is good, then the system is functioning as expected and shouldn't require tuning and alignment. Inform the customer that the product has retested within specifications.

Disassembly and Assembly

To access the printed circuit (pc) board, disassemble the transmitter.



! CAUTION

Observe precautions when handling this static-sensitive device.

Disassembly

1. Slide open the battery-compartment cover and remove the battery.
2. With a #1 Phillips screwdriver, remove the four screws securing the back of the case, and set them aside.
3. Carefully separate the top and bottom halves of the case to expose and lift out the pc board. (If you have trouble separating the case, carefully slit the label covering the case separation inside the battery compartment.)

Reassembly

Reassemble the T1 Transmitter as follows:

1. *Presenter T1P transmitter only:* Plug the lavalier microphone connector into J104.
2. Place the pc board in the bottom half of the case.
3. Slide the battery-compartment cover into its slot.
4. Align the rubber grommets (antenna, lavalier) while positioning the top half of the case over the bottom half.
5. Make sure the two sections are properly seated before securing them with the four Phillips screws.

Converting a T1P to a T1

Because direct replacements for the lavalier microphones used in the T1P are no longer available, the best way of replacing the microphones in these earlier units is to replace the lavalier header with a male Tini Q-G connector, which will allow the unit to accept a WL93 or other microphone that has a mating connector. Changing the connectors in effect converts the T1P into a T1 unit.

Parts Needed

Microphone with a female Tini Q-G connector (e.g., Shure WL93).

Part order RPW262 for all the following items:

- male Tini Q-G connector with a pcb assembly
- spacer
- nut

Conversion Procedures

1. After separating the two halves of the case, remove the pc board and the microphone. Pull the female connector wired to the microphone from the pcb header, J104.
2. Remove the header by unsoldering its four pins from the bottom of the pcb (the side with fewer components). Make sure the four holes in the pcb are open.
3. Orient the pcb assembly with the top (major-component) side up, the switches and LEDs to the left, and the antenna to the right.
4. Pull off the pre-cut insulation from the ends of the connector assembly's ribbon cable. From the top of the transmitter board, insert the cable wires into the four holes vacated by the header: the black coded lead goes into the hole nearest the right edge of the pcb (towards the pcb number).
5. Solder the wires to the bottom of the pcb and cut off the excessive leads.
6. After replacing the transmitter's pcb in the bottom half of the case, insert the connector into the front slot. Place the spacer and start the nut on the part of the connector that protrudes from the case.
7. After completing the reassembly, tighten the nut on the Tini Q-G connector.

Service Procedures

Reference Material

The *Shure Wireless Systems: T Series User's Guide* provides a description, information on operation and troubleshooting, and technical data.

Special Equipment

The *Wireless Service Equipment* manual covers the standard items needed for servicing the transmitters. If you do not have the modified SC4 receiver described there, you will need an appropriate receiver (usually T3 or T4) to verify that the transmitter is working properly.

System Operating Frequencies

Each transmitter circuit board is marked with a group letter (A, B, C, or T) that identifies the range of frequencies on which the transmitter can operate. Table 1 shows the Group Letter and its associated frequencies. Note that this chart applies only to the T1 series.

Table 1
(90_8552F) Pc Board Groups

Group	Frequency Range
A	169.000–183.975 MHz
B	184.000–198.975 MHz
C	199.000–215.975 MHz
T	"AC," "V," & "W" frequencies

Used with pcb assembly 90_8552F
(pcb marking 34A8459F)

Table 2 provides information for identifying the system frequency. The Crystal Letter Code, when used with the appropriate Shure model number, identifies a specific operating frequency for both transmitters and receivers. Note that, although a Crystal Letter Code always designates a specific frequency, it may be used with different Group Letters on other products.

Group T: Beginning in July 1995, "V" and "W" frequencies, formerly assigned to the "A" board, were reassigned to a newly designated "T" board (see the "Audio Alignment" subsection in "Service Procedures").

Table 2
T1 Series System Operating Frequencies

Group	Crystal Code	Freq. (MHz)
T	V	169.445
T	AC	170.245
T	W	171.845
A	CA	176.200
A	CC	177.600
A	CE	182.200
A	CF	183.600
B	CG	186.200
B	CL	192.200
C	CQ	202.200
C	CV	208.200

Changing the Frequency

The operating frequency of the T1 transmitter may be changed within a specific group by changing the crystal on the pc board. (For Group information, see the preceding section.) Check the transmitter for proper operation before attempting to change its operating frequency. After installing the new crystal, perform the alignment procedures. Then run an operational test to ensure the transmitter is functioning properly. Finally, update the label to show the new frequency and letter identification code.

Note: To ensure proper operation, obtain the crystal from Shure and verify that it operates within the frequency range of the pc board. Since crystals are marked with their nominal oscillating frequency, not a letter code, you can use the following equation to determine the frequency at which a transmitter will operate with a given crystal:

Carrier Frequency = (9 × nominal crystal freq. in MHz) –.09

Alignment

The RF and audio alignments are generally done together, as a single, continuous procedure. Before beginning, be sure to do the setup described in the following subsection, “Test Conditions.”

Test Conditions

The following test conditions apply unless otherwise specified (see Figure 2):

- An external 9-volt supply is connected to the battery terminals (J101 and J102).
- The *Power On/Off* switch is off.
- The *Mute* switch is set to “Mute.”

- The *Gain* pot (R125) is preset to its midpoint.
- The 400 Hz high-pass and the 30 kHz low-pass filters on the audio analyzer are activated.

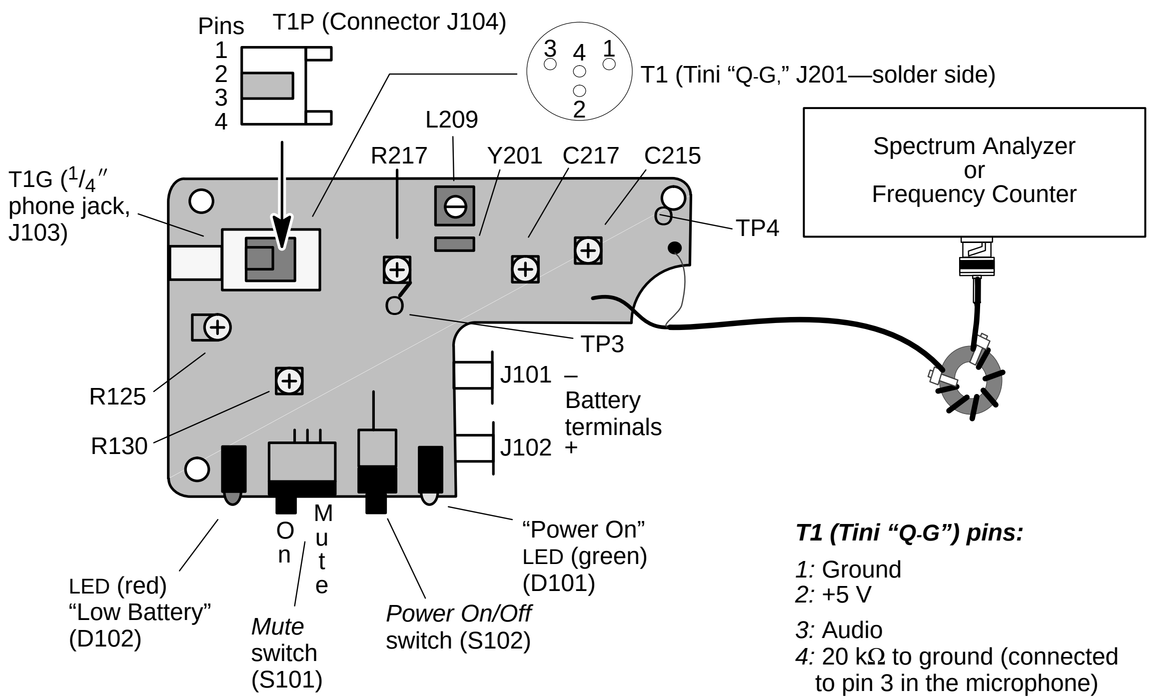
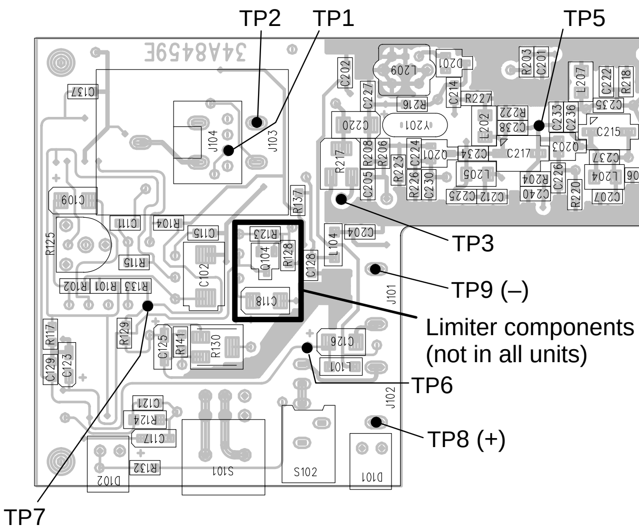


Figure 2. *Pc Board: Key Parts Locations*

Test Cable

Use a 50 Ω coaxial test cable to connect the pc board with various test equipment (see Figure 2). To construct the 50 Ω test cable, see the *Wireless Service Equipment* manual.

1. Unsolder the antenna lead from the pc board.
2. Attach the center conductor of the 50 Ω RG174 cable to the antenna solder pad, and the shield to ground.
3. Turn on the T1.



Test Points

TP1	Audio In, J104, pin 3, Model T1-P.
TP2	Audio In, J103, center conductor of $^1/_4$-in. phone jack, Model T1-G.
TP3	Audio
TP4	Antenna Output
TP5	Intermediate Output
TP6	9 Vdc
TP7	5 Vdc
TP8	(+) Battery
TP9	(–) Battery

Figure 3. *Pcb Side 1*

Display Checks

1. Connect the 9 Vdc power supply: the green LED should glow.
2. Reduce the power supply voltage to 6 Vdc: the red LED should glow.
3. Return the power supply voltage to 9 Vdc.
4. Verify that 9 Vdc 〈±0.35 Vdc) is present at TP6.
5. Verify that 5 Vdc 〈±0.25 Vdc) is present at TP7.

RF Alignment

A: RF Power and Frequency

1. Connect the 50 Ω output cable to the spectrum analyzer. Make sure S101 is in the “Mute” position.
2. Set the spectrum analyzer as follows:
    - **Center Frequency:** *transmitter’s*
    - **Span:** *1 MHz*
    - **Reference Level:** *+20 dBm*
    - **Scale:** *10 dB/div*
3. The output power should measure 15 dBm (±2 dBm) taking into account cable losses. If the power is within specification, skip to step 6.
4. Adjust C217 for maximum (peak) output power on the spectrum analyzer.

    Note: Once the signal is close to its maximum, setting the spectrum analyzer scale (under the amplitude menu) to 2 dB/div may make fine adjustments easier.
5. Adjust C215 for maximum output power on the spectrum analyzer. The output power should measure 15 dBm (±2 dBm) taking into account cable losses.

6. Connect the 50 Ω output cable to the frequency counter. If the frequency is off by more than 5 kHz, adjust L209 to set the carrier frequency to FC ±1 kHz.
7. Reconnect the 50 Ω output cable to the spectrum analyzer. Confirm that the output power remains within specification. If necessary, readjust C217 and C215.

B: Spurious Emissions

1. Set the scale on the spectrum analyzer back to 10 dB/div.
2. Check the level of spurious emissions up to 1 GHz. Set the start frequency of the spectrum analyzer to 10 MHz and the stop frequency to 1 GHz. **All spurs must** be at least 35 dB below the carrier level. If necessary, adjust C217 and C215 until the power and spurious response are both within specification.

C: Current Drain

1. Using a milliammeter, make sure that the transmitter's current drain is less than 35 mA. If it is too high, try detuning C215, taking care that the power and spurious response remain within specification.
2. Disconnect the power supply from the T1.
3. Unsolder the 50 Ω RG174/U test cable, and resolder the antenna lead to the RF board.

Audio Alignment

This section continues the procedures of the preceding subsections.

D: Gain

1. Reconnect the power supply to the T1, and set its *Mute* switch to "On."

   Set the audio analyzer output as follows:

   Frequency: *1 kHz*
   Amplitude: *70 mV*

2. Connect the audio analyzer's output to the transmitter's microphone input. Select the cable with the proper termination:

   (a) **T1:** Tini Q-G (quick-ground) connector

   (b) **T1G:** $^{1}/_{4}$-in. phone plug

   (c) **T1P:** cable's unterminated center conductor to pin 3 of J104; shield to ground

3. Adjust the *Gain* pot (R125) for 775 mVac, ±10 mVac (0 dB, ±0.1 dBu) at TP3 (turning counterclockwise increases the gain). Record the voltage at this setting.

   Note: At this point you may want to press the audio analyzer's *Log/Lin* button (to measure logarithmically) and activate the *Ra-*

tio button to perform the relative measurement in the next subsection.

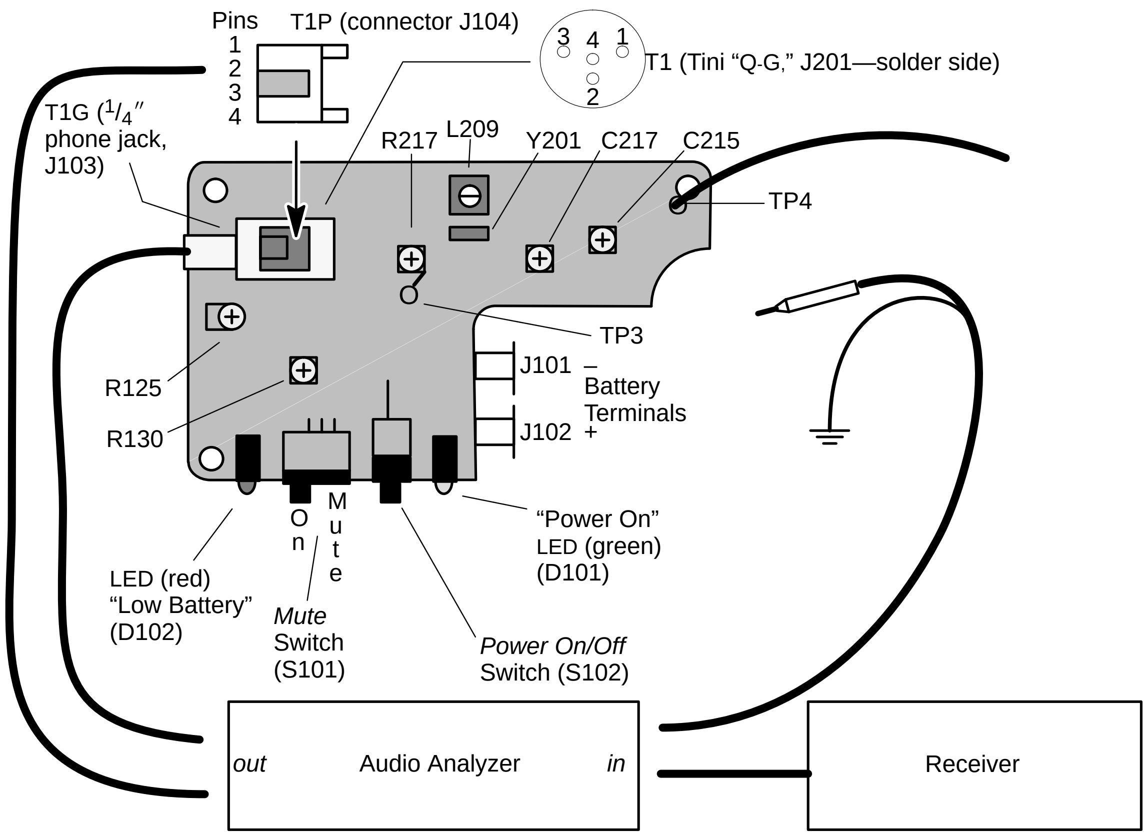


Figure 4. *Audio Test Configuration for T1*

E: Audio Frequency Response

1. Change the frequency of the audio analyzer to 100 Hz.
2. Deactivate the audio analyzer's *400 Hz high pass* filter.
3. Check that the audio level is equal to –1 dB (±0.5 dB) relative to the level measured at TP3 in step 3 of subsection D ("Gain").
4. Activate the *400 Hz high pass* filter on the audio analyzer.
5. Change the frequency of the audio analyzer to 10 kHz. Because the limiter circuitry was removed from most units made after June 1995, the audio level will vary with the unit you have:
   - *All "V" And "W"* frequency units: +3.1 dB (±0.5 dB)
   - *All units made through 6/95*: +3.1 dB (±0.5 dB)
   - *All **non-**"V" and "W" units made after 6/95*: +4.85 dB (±0.5 dB)

   Note: pc boards with the limiter components (see Figure 3) should have the lower (+3.1 dB) audio output level.
6. Disengage the ratio function.

F: Deviation Reference Voltage

1. Turn off the transmitter.
2. Set the RF signal generator as follows:
   (a) Enter the carrier frequency.
   (b) Select FM modulation and enter the following:

   Modulation Source: *Int 1 kHz*
   FM Deviation: *±15 kHz*
   Amplitude: *–38 dBm*
3. Select a receiver for the T1, making sure it is set to the same frequency as the transmitter. Disconnect the receiver's antenna (non-diversity) or antennas (diversity).
4. Solder the 50 Ω cable to the receiver's antenna pads:

   T3: Center conductor to TP1, and shield to TP2

   T4: Center conductor to TPA1, and shield to TPA2
5. Connect the BNC end of this cable to the output of the RF signal generator.
6. Set the *Volume* control on the front panel of the receiver to its maximum position (fully clockwise). Then turn on the receiver and set its *Squelch* control to the midpoint position.
7. Measure the rms voltage developed across the unbalanced output of the receiver. You should find approximately 775 mVac. This is the audio output voltage that corresponds to a deviation level of 15 kHz.

   Record this voltage as the deviation reference voltage.

   Note: At this point you may want to press the audio analyzer's *Log/Lin* button (to measure in dBm) and activate the *Ratio* button to perform the relative measurement in the next subsection.

G: Deviation Adjustment

1. Turn off the RF switch on the RF signal generator.
2. Remove the test cable from the receiver and reconnect the antenna(s) to the receiver board.
3. Turn on the T1 and set its *Mute* switch to "On."
4. Reconnect the output of the audio analyzer to the input of the T1.
5. Reset the frequency of the audio analyzer to 1 kHz. Make sure that 775 mV is still present at TP3.
6. Measure the voltage at the unbalanced output of the receiver. Adjust R217 for 0 dB (±1 dB) relative to the deviation reference voltage measured in step 7 of the preceding subsection.

7. Set the audio analyzer to measure distortion. Verify that the audio distortion at the unbalanced output of the matching receiver is less than 0.5%. If necessary, adjust R130 to obtain minimum distortion.

   Note: *For T1G transmitters Only:* After completing the alignment, turn the audio *Gain* potentiometer (R125) all the way down (fully clockwise as viewed from the top side of the circuit board).

Bench Checks

Dc Power

- ✓ Verify that 9 Vdc (±0.35 Vdc) is present at TP6. If this voltage is low, trace the circuitry back to the power supply to see where the loss occurs. Check:
  - power switch
  - bias on Q105
  - L101
  - circuit-board ground for 0 V
- ✓ If you have a short to ground from 9 V, try isolating different parts of the circuit. Narrow it down to the RF or audio section. Look for foil shorts, solder bridges, and capacitors that have been installed backwards.
- ✓ Check for 5 Vdc (±0.25 Vdc) at TP7 (pin 7 of U101). If the correct voltage is not present, check:
  - pin 13 of U101 for 9 V
  - values of R133, R135, and R137

Audio

All the steps in this section comprise a methodical way of determining where the audio signal is being interrupted:

- ✓ Check for audio at pin 7 of U102. If it is not present, check that the dc bias at pins 5, 6, and 7 of U102 is ≅4.5 Vdc (half the level of the supply voltage). If the correct voltage is not present:
  - Trace the circuitry: this bias derives from the 9 V line through voltage divider R103 and R105, then through R106 to pin 5.
  - Look for foil shorts, incorrect parts, and bad connections.
- ✓ If there is audio at pin 7 of U102 but not at pin 14, check the dc bias at pins 12 and 13 (≅1.8 Vdc) and pin 1 (≅3.7 Vdc). If the correct voltage is not present:
  - Trace the circuitry: this dc bias proceeds from pin 9 of U101 through R107 to pin 12 of U102.
  - Check **(a)** the parts in the feedback path from pin 14 to pin 13, **(b)** the parts connected to pin 7, and **(c)** the connections from U102 to U101.
- ✓ Check the connections from pin 14 of U102 to the next stage, to the limiter (Q103), and to pin 15 of U101.

- Check the bias voltage (≅4 Vdc) on pins 8, 9, and 10 of U102. If the correct voltage is not present:
  - Make sure the *Mute* switch is set to "On."
  - Trace the bias circuit from the 5 V line through R104 to pin 10 of U102.
  - Check the values in the feedback path from pin 8 to pin 9 of U102, and the path to Q104 and pin 16 of U101.

Frequency Problem

- Make sure the RF carrier is at least 10 dB higher than the spurious emissions, to allow the frequency counter to lock on.
- Check L209 for the proper group and make sure its core is not cracked.
- Make sure the crystal (Y201) has the correct frequency.
- Check the dc bias for Q201 against the readings of a unit known to be operating correctly.
- Make sure that D201 is the correct varactor and has 5 Vdc on its cathode.
- Check the parts and values of the oscillator circuit (from TP3 to TP5).
- Look for shorts and opens.

Low Output Power

- Check the carrier output power after the oscillator stage (TP5). If there is no signal, refer to the preceding subsection, "Frequency Problem."

The remaining steps perform basically similar diagnostics for each of the three RF stages:

- *Stage 1:* Make sure that rotating C217 360 degrees in either direction produces two separate peaks in the carrier output amplitude. If there is only one peak, check the color (value) of C217 and the values of L205, C225, C234, L202, and C233. Check the bias on Q201. Lastly, replace Q201.
- *Stage 2:* Make sure that rotating C215 360 degrees in either direction produces two separate peaks in the carrier output amplitude. If there is only one peak, check the color (value) of C215 and the values of L204, C237, C236, L207, C235, C222, and C226. Check the bias on Q203. Lastly, replace Q203.
- *Stage 3:* Check the dc bias on Q204 and the values of all the parts from the base of Q204 to TP4. Lastly, replace Q204.
- If the power is slightly low and the spurious levels are high, check for wrong or open coils at L202, L207, and L206.

Excessive Current Drain

- Try readjusting C215 for lower current drain while maintaining output power to specification. If the current drain is still excessive, check for the following:
  - short
  - wrong resistor value
  - shorted capacitor
- As a last resort, try changing Q204.

Deviation

- If R217 cannot be adjusted to obtain a ±15 kHz deviation, try to isolate the problem to the audio or RF section by doing the following:
  - If TP3 does not measure –2.2 dBV (775 mV), refer to the "Audio" subsection, above.
  - If TP3 has the right level, check R217, C220, C227, R208, R216, D201, R209, L209, and C214. Also make sure that the cathode of D201 is being supplied with a 5 Vdc bias from the 5 V Line through R216 and R208. The value of C214 is critical to the deviation sensitivity.
- As a last resort, try replacing D201 and Y201.
- Make sure the carrier is good: you need that to get any deviation.

Distortion

- Make sure the analyzer's 400 Hz high-pass and 30 kHz low-pass filters are "In."
- Pin 9 of U101 should read about 1.8 Vdc.
- As you turn R130, the dc level on its wiper should change from about 1.5 V to 3.5 V. If it does not, check R129, C125, R130, R141, R140, R126, and the parts tied to pin 9 of U101.
- Check the audio level.
- Lastly, replace D201 and Y201.

Notes:

Replacement Parts and Drawings

On the next page, the parts are listed according to the designations from the pc board and schematic (see Figures 5 and 6, and the schematic). Parts shown on the circuit diagram and not listed below are available through electronic-parts distributors.

On the pages following the parts list are the drawings of the printed circuit boards and the schematics.

Product Changes

This section briefly describes significant changes to the T1.

Limiter Circuitry and "V" and "W" Frequencies: The limiter circuitry was removed from Group A, B, and C boards (see Figure 3 and the schematic). The older "A" board with the limiter circuitry (now designated as the "T" board) handles just the "V" and "W" "traveler" frequencies.

T1 and T1P: The Model T1P (with a permanently attached lavalier microphone) was replaced by the model T1 (with a Tini Q-G connector instead of an attached microphone).

Belt Clip: The older metal-plate clip was replaced by a wire-and-plastic, spring-loaded clip. A new case bottom accommodates the new clip.

Quad Op Amp: The older part (manufactured by Raytheon) was replaced; the former value of associated resistor R107 was 100 kΩ.

"F" Assembly: This update added Group T, enlarged the hole for the antenna bracket, and changed the following parts from the earlier numbers or values given in parentheses: Q106 and Q107 (183A02)), R228 (0 Ω), S101 (55A8020), and S102 (55B8020).

Parts Designations

The following comments apply to the parts lists and the schematic:

Resistors: All resistors are surface-mount with $^1/_{10}$ W rating and 1% tolerance.

Capacitors: Unless otherwise noted, non-polarized capacitors are surface-mount NPO dielectric types with a 100 V capacity and a 5% tolerance, and polarized capacitors are tantalum types.

Temperature-Compensating Capacitors (N750): C214, C224, C230.

Coils: These parts are rated in microhenries.

Table 1
T1 Replacement Parts

Drawing Designation	Description	Source: Shure Part No. (Commercial Alternate)
A1	Printed circuit board assembly **T1G:** (Order the antenna, and $^1/_4$-in phone jack separately) Printed circuit board assembly **T1P**: (Discontinued, for modification see pg. 8) Printed circuit board assembly **T1**: (Order the antenna, and pcb with Tini "Q-G" connector seperately)	Shure T90__8552 [See Table 2, to determine the Frequency Code in the underlined space. e.g. T90CF8552].
A2	Wireless miniature omnidirectional lavalier microphone	Shure 98A195 (no longer available) To adapt a T1P transmitter to work with other microphones, see "Converting a T1P to a T1) on page 8.
C215	Capacitor, variable 3–10 pF	Shure 152C02
D101	Light-emitting diode, green (power)	Shure 86A8959
D102	Light-emitting diode, red (low battery)	Shure 86B8959
D103	Dual diode	Shure 184A08 (MMBD7000L)
E1	Antenna	Shure 70C8007
J101, J102	Battery terminals	Shure 56A8043
J103	Phone jack, $^1/_4$-in (mounted on T1G)	Shure 95A8535
J104	Side entry shrouded header (mounted on T1P)	Shure 95C8545 (no longer available)see "Converting a T1P to a T1) on page 8.
J201	Mic Pcb and microphone receptacle ass'y	Shure 95A8823
MP1	Battery door	Shure 65A8352
MP2	Compression pad, battery	Shure 38A185
MP3	Case (top, T1/T1G)	Shure 65B8203
MP4	Case (bottom, T1/T1G)	Shure 90A8706
MP5	Belt clip	Shure 90A4392
MP6	Phillips pan-head hi-lo screw #4 x $^5/_8$″	Shure 30E1245
MP7	Nut for QG mic connector	Shure 31A8140A
MP8	Spacer	Shure 31A8039A
MP9	Case (top, TC1)	Shure 65B8203B
MP10	Case (bottom, TC1)	Shure 65A8270B
MP11	Contains: MP1, MP2, MP5, MP6, MP7, MP8	RPW616
MP12	Mic connector / PCB assembly	RPW262
MP13	Battery polarity label	39A8092
Q103, Q104	PNP transistor (Group T only)	Shure 183A01

Drawing Designation	Description	Source: Shure Part No. (Commercial Alternate)
Q105	PNP transistor	Shure 183A07 (MMBT404AL)
Q106, Q107	NPN transistor	Shure 183A38 (MMBT5089LT1)
Q201, Q203, Q204	NPN transistor	Shure 183A03 (MMBTH10)
R125	Potentiometer, trim, 100 kΩ	Shure 46D8049
R130	Potentiometer, trim, 20 kΩ	Shure 146F02
R217	Potentiometer, trim, 10 kΩ	Shure 146E02
S101	Switch, *Mute*	Shure 55C8020
S102	Switch, *Power*	Shure 55C8055
U101	Integrated circuit, compandor	Shure 188A01 (Signetics NE571D)
U102	Quad op amp	Shure 188A49 (MC33179DR2)
Y201	Crystal	Shure 40_8006A (SeeTable 2, p. 10 in “Service Procedures” to determine the letter in the blank space.)

Table 2
Frequency-Dependent Parts

Grp	A	B	C	T
Freq.	169.000–183.975	184.000–198.975	199.000–215.975	169.000–173.975
C118	Not used	Not used	Not used	4.7 µF, 16 V
C119	Not used	Not used	Not used	4.7 µF, 16 V
C217	8.5–40 pF	4.5–20 (±0.1) pF	4.5–20 pF	8.5–40 (±0.1) pF
C222	27 pF	22 pF	18 pF	27 pF
C225	15 pF	12 pF	8.2 pF	15 pF
C233	100 pF	100 pF	82 pF	100 pF
C237	4.7 pF	3.3 pF	2.2 pF	4.7 pF
C238	22 pF	22 pF	18 pF	22 pF
C239	3.9 pF	2.7 pF	2.2 pF	3.9 pF
L203	162D06	162D06	162E06	162D06
L209	82A8015	82B8015	82C8015	82A8015
R122	Not used	Not used	Not used	1 kΩ, 1%
R123	Not used	Not used	Not used	1 kΩ, 1%
R127	Not used	Not used	Not used	1.5 kΩ, 1%
R128	Not used	Not used	Not used	1.5 kΩ, 1%
Q103	Not used	Not used	Not used	183A01
Q104	Not used	Not used	Not used	183A01

Note: See Tables 1 and 2 for information on the crystal.

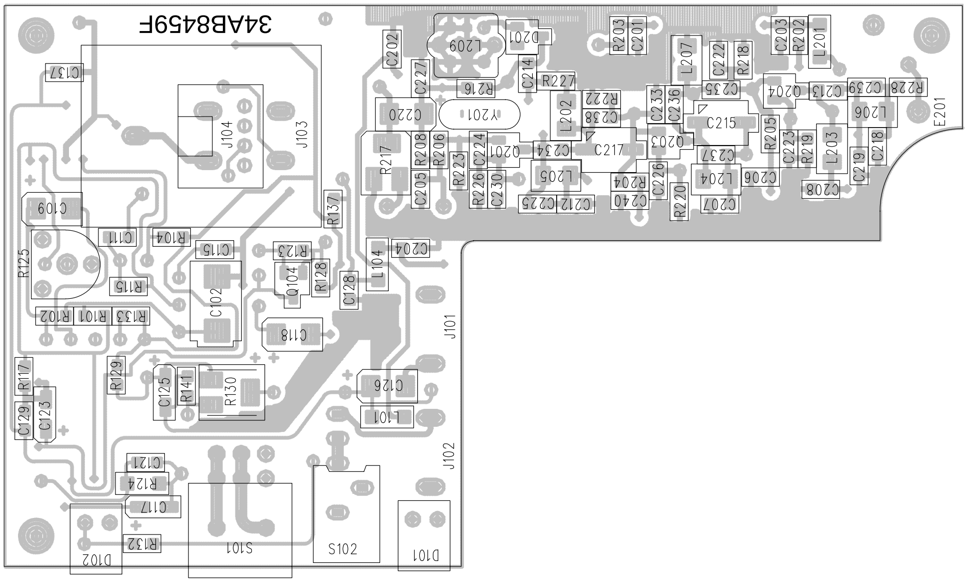


Figure 5. *Pcb Side 1*

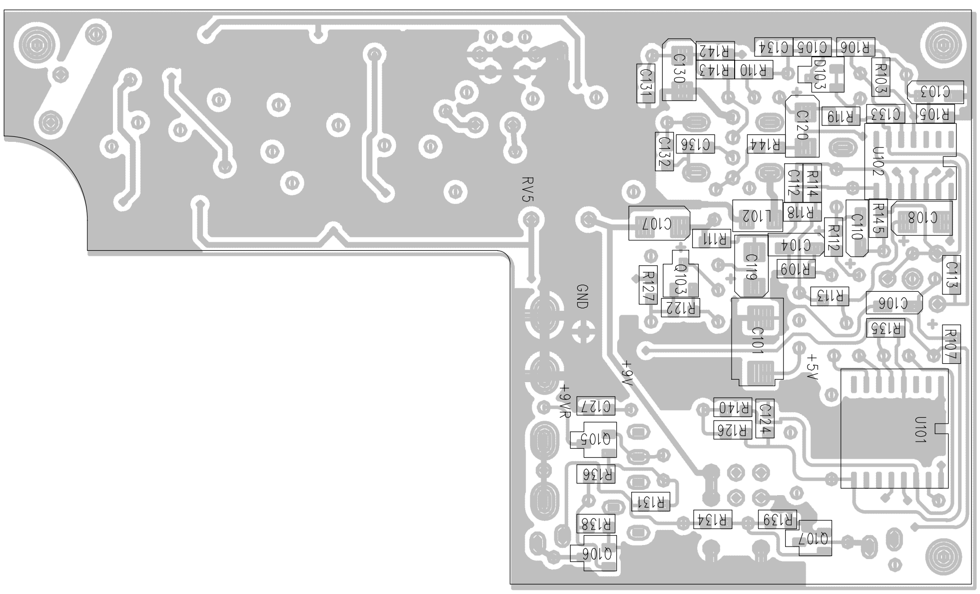
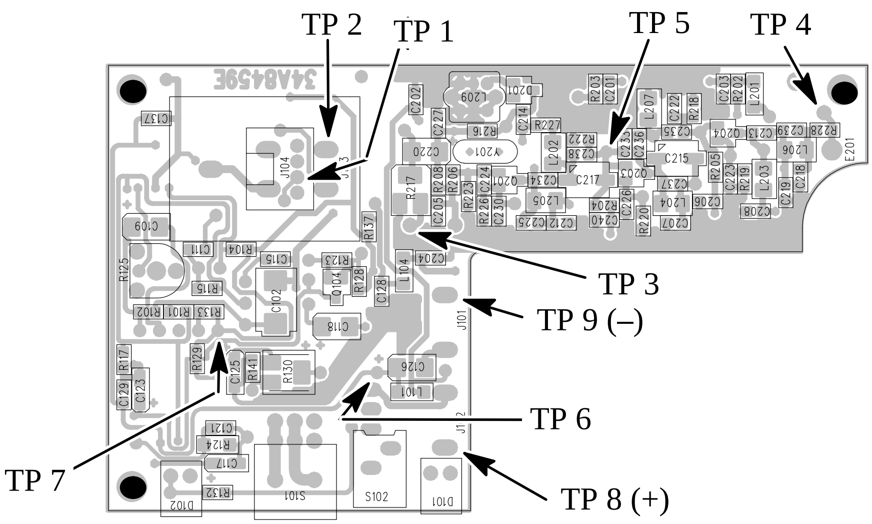


Figure 6. *Pcb Side 2*



<u>TP – Test Points</u>

TP 1 Audio In, J104, pin 3, Model T1–P.
TP 2 Audio In, J103, center conductor of 1/4 in. phone jack, Model T1–G.
TP 3 Audio
TP 4 Antenna Output
TP 5 Carrier Output
TP 6 9.0 Vdc
TP 7 5.0 Vdc
TP 8 (+) Battery
TP 9 (–) Battery

Figure 7. *Earlier Version of T1 Pc Board (Side 1)*

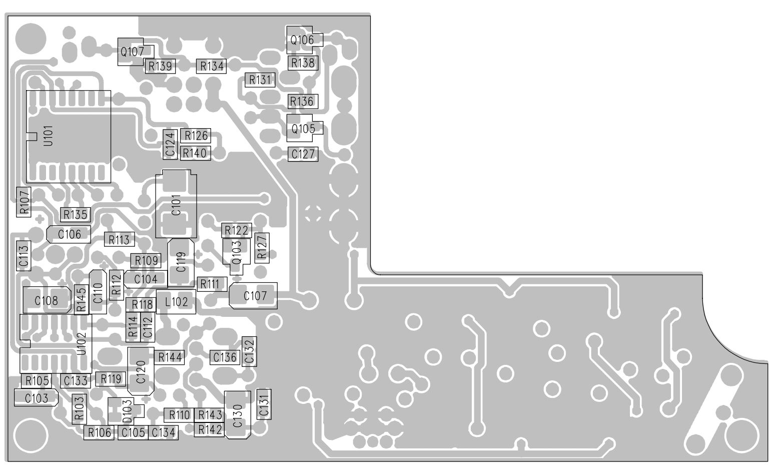


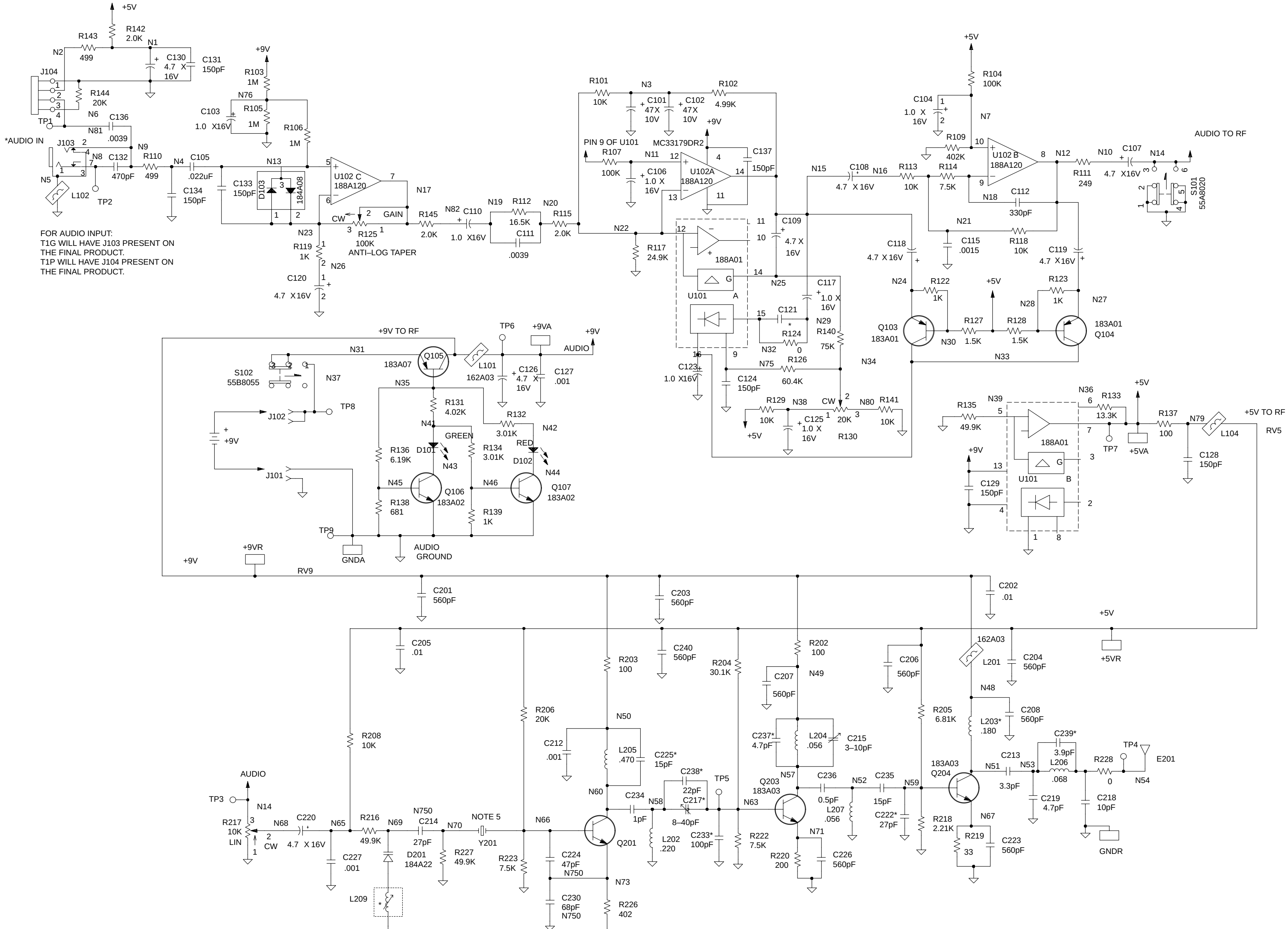
Figure 8. *Earlier Version of T1 Pc Board (Side 2)*

[Insert:

Earlier Version of T1 schematic ($8^1/_2 \times 11$) as p. 26;

Current T1 schematic (11×17) attached]

Do not print this page!



FREQUENCY DEPENDENT PARTS BY GROUP AND COMPONENT NO.

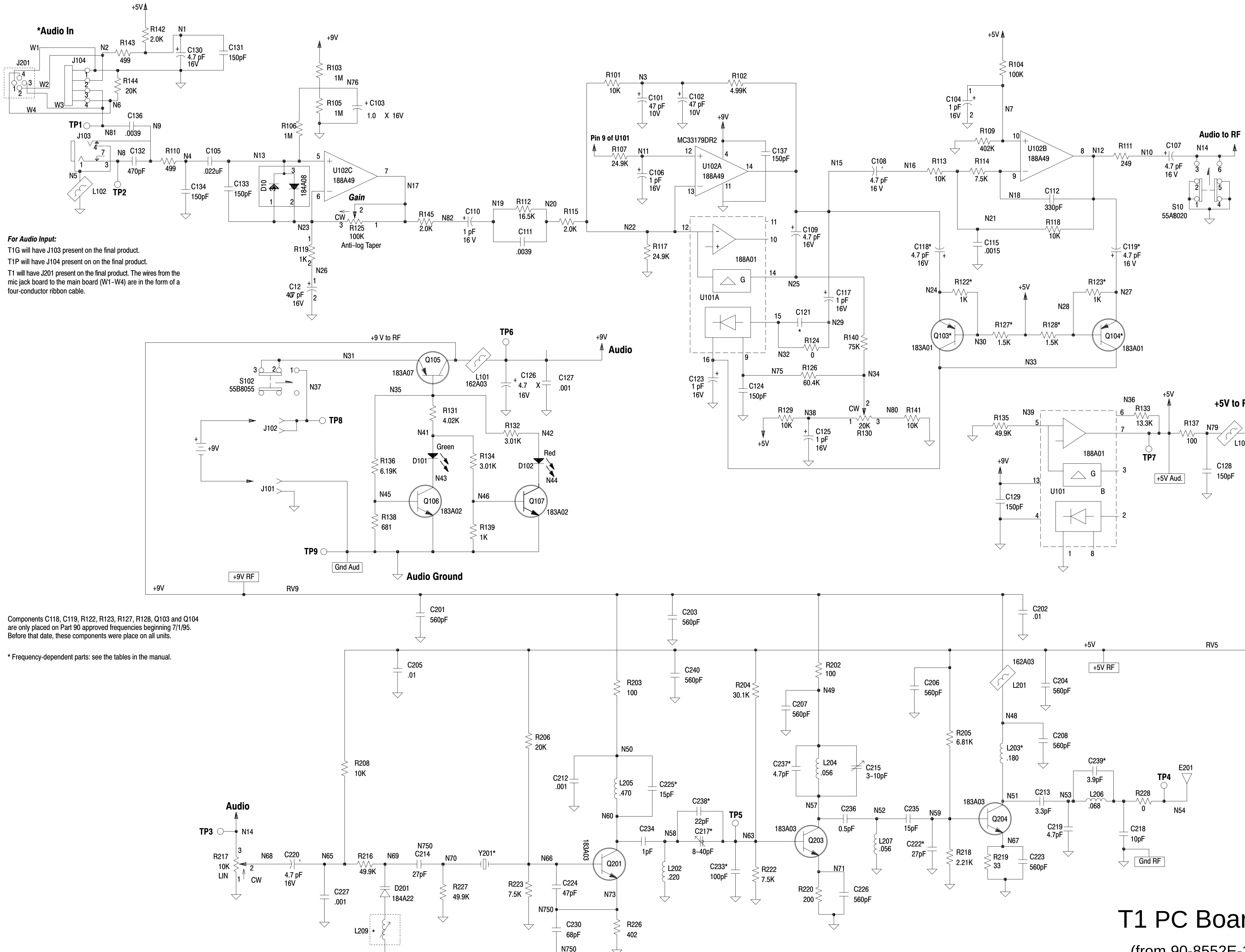
VARIABLE COMPONENTS	FREQUENCY RANGE	C237 PART NO.	pF	C225 PART NO.	pF	C233 PART NO.	pF	C238 PART NO.	pF	C239 PART NO.	pF	L209 PART NO.		L203 PART NO.	µH
GROUP A	169.000 – 184.000 MHz	150DA478CA	4.7	150DA150JA	15	150DA101KA	100	150DA220JA	22	150DA398CA	3.9	82A8015		162D06	.180
GROUP B	184.000 – 199.000 MHz	150DA338CA	3.3	150DA120JA	12	150DA101KA	100	150DA220JA	22	150DA278CA	2.7	82B8015		162D06	.180
GROUP C	199.000 – 216.000 MHz	150DA228CA	2.2	150DA828CA	8.2	150DA820JA	82	150DA180KA	18	150DA228CA	2.2	82C8015		162E06	.150

C222 PART NO.	pF	C217 PART NO.
150DA270JA	27	152F01
150DA220JA	22	152D01
150DA180KA	18	152D01

NOT USED: L208, L102, L103
Q101, Q102, Q202
N5

27B1016 (SB)

T1 Earlier Version



For Audio Input:

T1G will have J103 present on the final product.

T1P will have J104 present on on the final product.

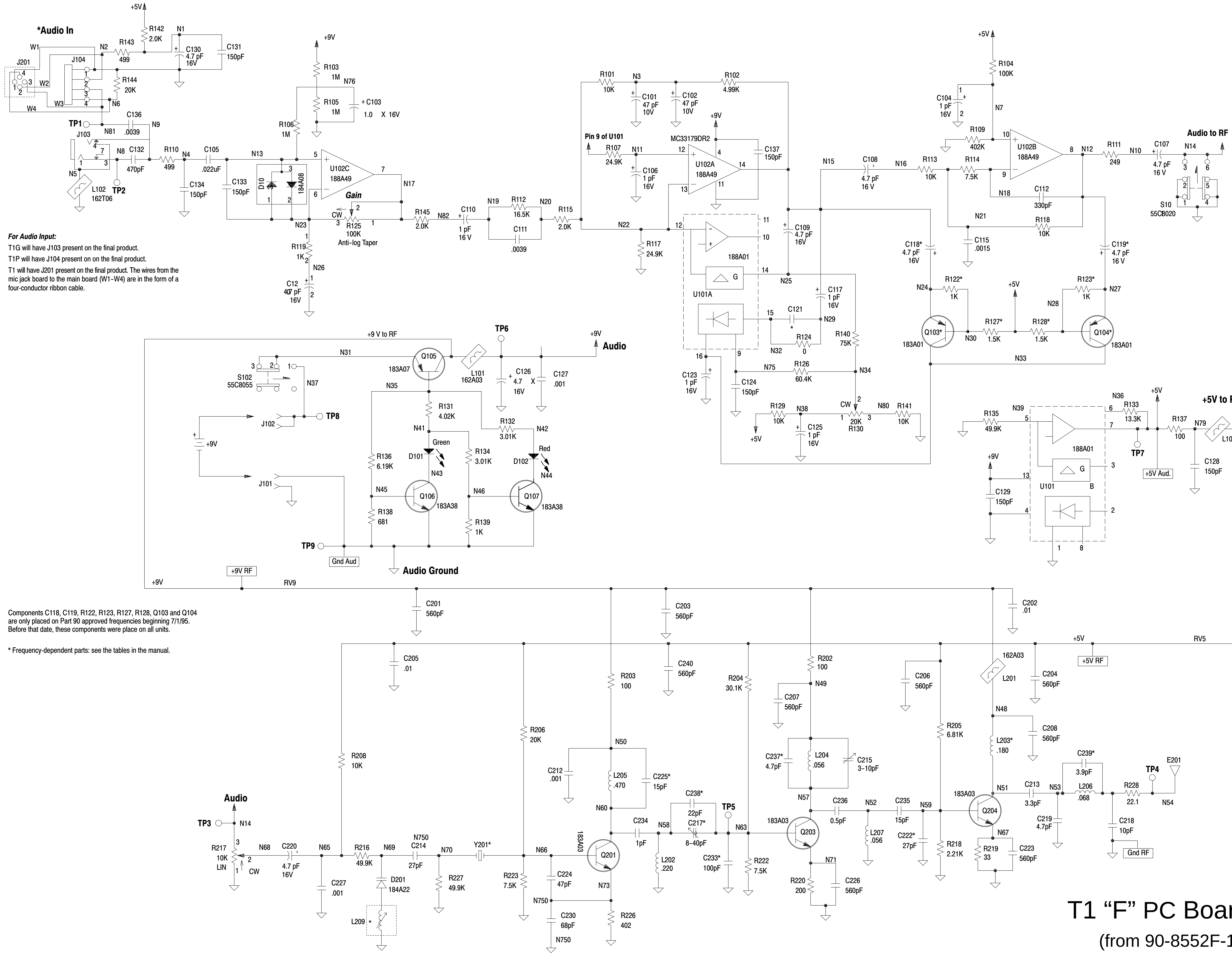
T1 will have J201 present on the final product. The wires from the mic jack board to the main board (W1–W4) are in the form of a four-conductor ribbon cable.

Components C118, C119, R122, R123, R127, R128, Q103 and Q104 are only placed on Part 90 approved frequencies beginning 7/1/95. Before that date, these components were place on all units.

* Frequency-dependent parts: see the tables in the manual.

T1 PC Board

(from 90-8552E-11)



For Audio Input:

T1G will have J103 present on the final product.

T1P will have J104 present on on the final product.

T1 will have J201 present on the final product. The wires from the mic jack board to the main board (W1–W4) are in the form of a four-conductor ribbon cable.

Components C118, C119, R122, R123, R127, R128, Q103 and Q104 are only placed on Part 90 approved frequencies beginning 7/1/95. Before that date, these components were place on all units.

* Frequency-dependent parts: see the tables in the manual.

T1 “F” PC Board

(from 90-8552F-11)