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T Wireless System

SERVICE MANUAL CHANGE NOTICE

T2 WIRELESS HANDHELD TRANSMITTER

Changes and corrections have been made to the Service Manual for the T2 handheld 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.

T2 HANDHELD TRANSMITTER SERVICE MANUAL REVISION HISTORY

Release	Part Number	Date Code	Color
Original	25A1018	QH	White
Revision 1	25B1018	SB	Pink
Revision 2	25C1018	SI	White
Revision 3	25C1018	TF	White
Revision 4	25C1018	TL	White
Revision 5	25C1018	AF	White
Revision 6	25C1018	BA	White
Revision 7	25C1018	CC	Red

CHANGES EFFECTIVE MARCH 17, 2003

REMOVE **these pages from Revision the** **T2 Service Manual**	**INSERT** **these new Revision pages into the** **T2 Service Manual**
31 & 32	31 & 32

25–1018–1 (CC)
Printed in U.S.A.

SHURE®

T2 Vocal Artist Microphone-Transmitter

Service Manual

25C1018 (CC)

Characteristics

General

This section tells how to service and align the Shure Vocal Artist T2 Microphone-Transmitter (Figure 1). The single-channel, crystal-controlled transmitter operates in the 169 MHz to 216 MHz (FCC-approved models) or 173–240 MHz (ETSI-approved models) VHF band. (The differences between the two versions of this product are explained on the next page.)

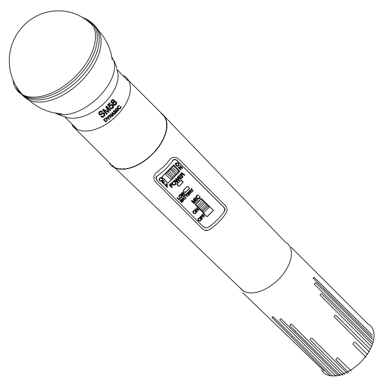


Figure 1.

Service Note: Shure recommends that all service procedures be performed by a factory-authorized service center or that the product be 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

This unit contains two interconnected circuit boards that comprise the audio and RF sections, respectively. It is intended for use with the matching T3 and T4 receivers.

FCC-Approved vs. ETSI-Approved Models: Models approved by the Federal Communications Commission (assembly number 90–8690, with boards marked 34A8494) have different sections from those approved by the European Telecommunications Standards Institute (assembly number 90–8705, with boards marked 34A8538). The FCC-approved version, sold in North America and many other places, uses only the frequencies listed in Table 3 on page 12. The ETSI-approved version, sold in Europe and many other places, uses only the frequencies listed in Table 4 on page 13. Hence, the following circuit descriptions have separate sections for the two RF boards. The audio sections are the same for all T2 models.

Audio Section

Input: The microphone element converts the sound source into an electrical signal, which then enters the audio board through the center contact of the head board (Figure 5, page 16).

Preamplifier Stage: This is centered in one section of operational amplifier U102C. Externally accessible potentiometer R175 adjusts the voltage gain of this stage over a 25 dB range.

Passive Pre-emphasis Network and Compandor: The network (R145, C110, C111, C112, and R115) has a pole at 63 microseconds and a zero at 12 microseconds. The NE571D integrated circuit compander (U101A) provides 2:1 logarithmic compression of the audio signal.

Noise, Distortion, and Limiting: U102A lowers the noise floor, and 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 the audio frequencies. PNP transistors Q103 and Q104 limit the level of the audio signal leaving the audio section via U102B.

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 0n"), and Q107 drives LED D102 ("Low Battery").

RF Section: FCC-Approved Models

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. C224, C230, and C214 provide temperature compensation.

Tuned Circuits (FCC-Approved Models)

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, C237, and C233. (The latter components also form a capacitively tapped voltage divider for matching into 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 the collector circuit tuned to the output frequency (for example, 180 MHz). In this case, L204, C216, C238, C236, L210, 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.

Final Output (FCC-Approved Models)

Transmitter: This can deliver up to +17 dBm (50 milliwatts) to the antenna. No user adjustments permit this value to be exceeded. Test-point I110 provides a termination point for the 50 Ω output. C211 and L207 act as a series resonating network for the battery, which acts as the antenna. The unit should be powered exclusively by a 9 Vdc dry battery (an alkaline type like the 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 = 0.29 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 169.4445 MHz. At the lowest acceptable battery voltage of 6 Vdc, the final collector current drops to 15 mAdc and the output power to +13.9 dBm (24.4 mW).

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 V supply by ferrite chokes, resistors, and bypass capacitors. The base circuits are similarly decoupled except they use resistor-capacitor (R-C) networks, whose higher-impedance levels are more appropriate.

*RF Sectio*n: ETSI-Approved Models

Audio Input: Processed audio enters R201, 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 L201, diode D201, capacitor C203, and capacitor divider C206 and C207.

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. C203, C206, and C207 provide temperature compensation.

Tuned Circuits (ETSI-Approved Models)

Stage 1: The collector circuit of Q201 is tuned to the third harmonic of the oscillator frequency (approximately 60 MHz) by L202, C208, C244, C210, L203, C214, C213, and C215. (The latter components also form a capacitively tapped voltage divider for matching into the base of Q202.) 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: Q202 operates as a buffer, with the collector circuit tuned to the output frequency (for example, 60 MHz). In this case, L204, C216, C245, C218, L205, C222, C221, and C224 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: Q203 operates as a frequency tripler, with the collector circuit tuned to the output frequency (for example, 180 MHz). In this case, L206, C226, C227, C229, L207, C230, and C232 perform tuning and impedance-matching.

Stage 4: 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.

Final Output (ETSI-Approved Models)

Transmitter: This can deliver up to +11.5 dBm (14 milliwatts) to the antenna. No user adjustments permit this value to be exceeded. Test-point TP6 provides a termination point for the 50 Ω output. C243 and L211 act as a series resonating network for the battery, which acts as the antenna. The unit should be powered exclusively by a 9 Vdc dry battery (an alkaline type like the 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 = 8.83 Vdc
- Vb = .097 Vdc
- Ve = .32 Vdc
- Base current = 0.27 μAdc
- Emitter current =9.67 mAdc
- Collector current = 9.67 mAdc
- Power input = 87 mW

The output power is +9.5 dBm (8.9 mW) into a 50 Ω load, at a frequency of 169.4445 MHz. At the lowest acceptable battery voltage of 6 Vdc, the final collector current drops to 8.84 mAdc and the output power to +7.3 dBm (5.4 mW).

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 V supply by ferrite chokes, resistors, and bypass capacitors. The base circuits are similarly decoupled except they use resistor-capacitor (R-C) networks, whose higher-impedance levels are more appropriate.

Notes

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 tests on any reported problem for both listening and functional tests. For example, many complaints are for “short range” and “drop-outs.” In such cases, perform only the RF tests in this section to verify the problem. 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.

Functional Test

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

Note: Most of the following tests can be performed without disassembling the unit.

RF Tests

1. Install a fresh 9 V battery in the T2, mute its audio, and turn it on.
2. Measure 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 (FCC-approved model) or $\geq$3 dBm (ETSI-approved model).

   (If you are unsure of the results you obtained 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 [FCC-approved model] or 10 dBm, $\pm$2 dBm [ETSI-approved model].)
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 T2.

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

Audio Tests

A: Verify the Matching Receiver

1. Make sure that the receiver is turned off. 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. Turn on the receiver.
2. Set the RF signal generator as follows:

   Amplitude: *–50 dBm*
   Modulation: *1 kHz*
   Deviation: *15 kHz*
   Frequency: *T2 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. Engage the 400 Hz and 30 kHz filters on the audio analyzer. Verify the following:
   - For the T3 and T4 the audio level is 400 mVrms (±90 mV)
   - For the T4N the audio level is 626 mVrms (±120 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. Make sure the receiver's *Volume* control is at its maximum setting.
2. Replace the microphone cartridge on the T2 with the test head. Set the unit's *Gain* control to minimum and unmute the audio.
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 –1.0 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 –3.5 dB, ±2 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) boards, disassemble the transmitter (refer to Figures 2 and 3 on pages 9 and 10).

! CAUTION

Observe precautions when handling this static-sensitive device.

Disassembly

1. Turn off the *Power* switch.
2. Unscrew the transmitter battery cup and remove the battery.
3. Unscrew the microphone cartridge.
4. If necessary, remove the microphone-transmitter subassembly:
   (a) Use snap ring pliers to remove the retaining ring from inside the microphone handle.
   (b) Remove the bezel by carefully inserting a small screwdriver into the microphone handle, pressing the blade against the plastic bezel tab, and prying it up (Figure 2). Remove the label plate and switch actuators (Figure 3, page 10).

   Note: Newer bezels have the labeling printed directly on their faces; there are no separate label plates.

   (c) As you slide out the transmitter subassembly (audio, RF, and head circuit boards) from the handle, note how it was positioned in the internal guides.

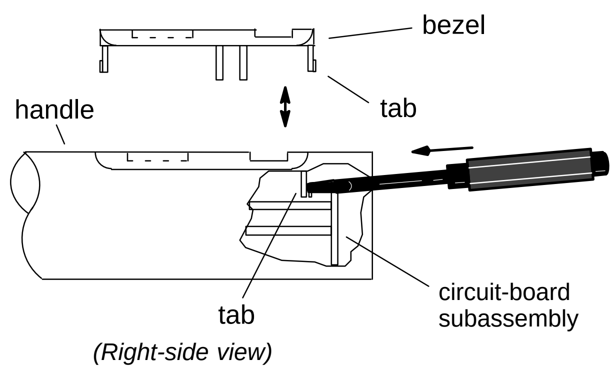


Figure 2. *Removing the Bezel*

Reassembly

1. Insert the transmitter subassembly (audio, RF, and head circuit boards) into the internal guides of the handle (Figure 3).
2. Orient the retaining ring so its gap will fit over the flat edge of the head board (to avoid shorting the board). Use snap-ring pliers to insert the retaining ring into the groove inside the handle.
3. Drop in the switch actuators and position the label plate (older bezels only) over them. Position the bezel over the switches then press until it snaps into place.
4. Screw on the microphone cartridge and ball screen. Install a battery (if desired) and screw on the battery cup.

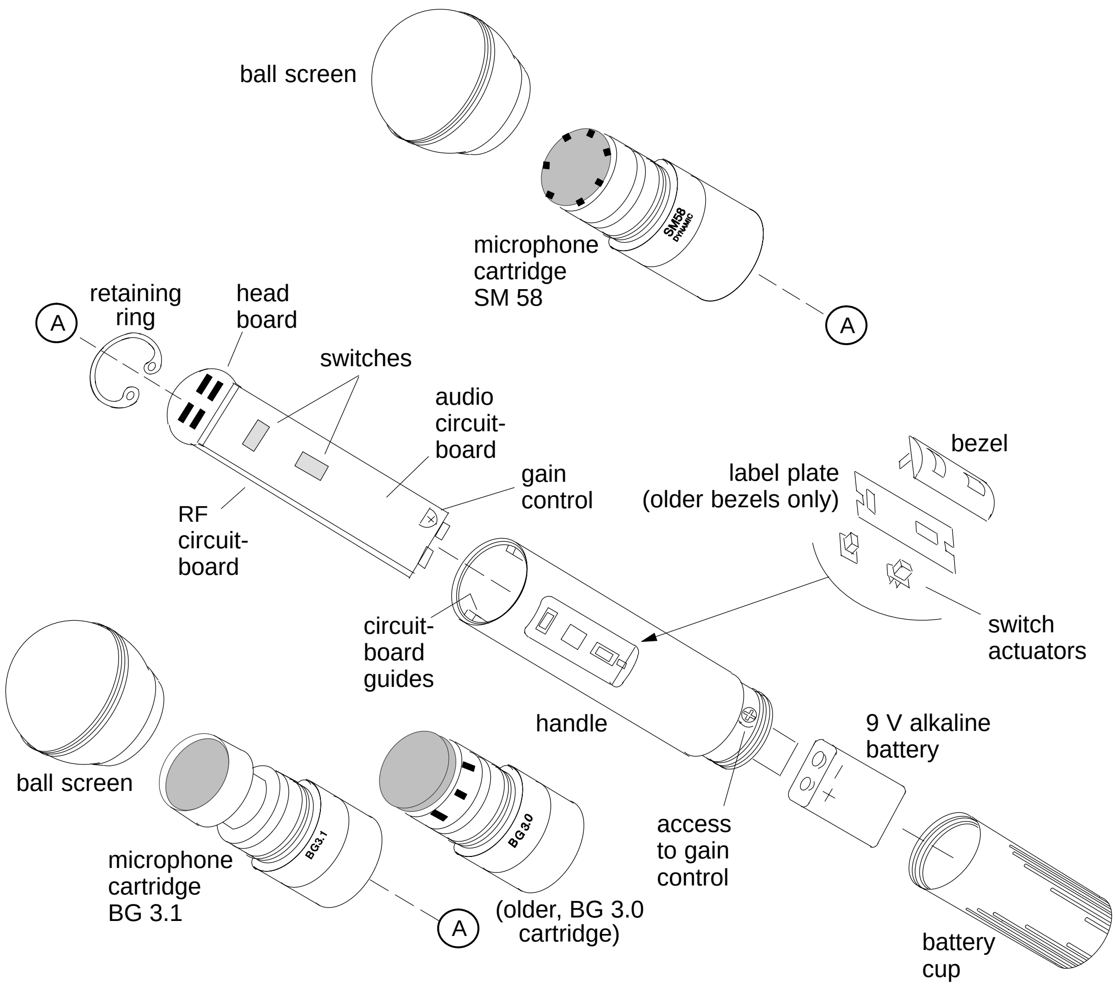


Figure 3.

Service Procedures

Reference Material

The Shure *Wireless System T Series User's Guide* describes the product, tells how to operate it, and provides troubleshooting and technical data.

Special Equipment and Tools

In addition to the standard items described in the *Wireless Service Equipment* manual, you will need:

- to verify that the system is working properly, obtain the receiver with which the transmitter is used (usually a T3 or T4); otherwise, use the modified SC4 receiver described in the equipment manual
- a small flat-blade screwdriver to remove the bezel
- snap-ring pliers to remove and re-insert the retaining ring
- hand-made high-impedance probe (see the Service Equipment manual)

System Operating Frequencies

Each transmitter circuit board is marked with a group letter that identifies the range of frequencies on which the transmitter can operate. Note that Table 1 applies only to T2 transmitters that are FCC-approved, and Table 2 applies only to T2 transmitters that are ETSI-approved.

Frequency Coverage: Earlier models used the same family of RF boards (with Groups A, B, and C) for all the frequencies offered worldwide at that time. Now there are separate board assemblies for units approved by the ETSI. If you have a frequency from Table 4, you have an ETSI-approved model; if you have a frequency from Table 3, you have an FCC-approved model.

Table 1
Pc Board Groups for
FCC-Approved Models

Group	Frequency Range
A	169.000–183.975 MHz
B	184.000–198.975 MHz
C	199.000–215.975 MHz
Used with pcb assembly 90_8690 (pcb marking 34A8494).	

Table 2
Pc Board Groups for
ETSI-Approved Models

Group	Frequency Range
A	169.000–173.975 MHz
B	174.000–180.975 MHz
C	181.000–187.975 MHz
D	188.000–194.975 MHz
E	195.000–201.975 MHz
F	202.000–208.975 MHz
G	209.000–215.975 MHz
H	216.000–222.975 MHz
K	216.000–239.975

Used with pcb assembly 90_8705
(pcb marking 34A8538).

Tables 3 and 4 provide 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.

Table 3
T2 System Operating Frequencies for
FCC-Approved Models

Group	Crystal Code	Operating Freq. (MHz)
A	V	169.445
A	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

Used with pcb assembly 90_8690
(pcb marking 34A8494).

Table 4
T2 System Operating Frequencies for ETSI-Approved Models

Group	Crystal Code	Operating Freq. (MHz)
A	AQ	173.800
B	ZZ	174.500
B	BB	175.000
B	NB	175.000
B	ND	176.600
B	NE	177.600
C	NH	182.000
C	NK	183.600
C	NL	184.600
C	S	184.000
D	NP	189.000
D	NR	190.600
E	NX	197.600
E	NY	198.600
E	NZ	200.350
E	PU	201.650
F	PB	203.000
F	PD	204.600
H	PP	217.000
H	PR	218.600
H	PS	219.600
K	PV	232.825
K	PX	233.125
K	PY	234.625
K	PZ	237.325

Used with pcb assembly 90_8705 (pcb marking 34A8538).

Changing the Frequency

The operating frequency of the T2 transmitter may be changed within a specific Group by changing the crystal on the pc board. (For Group information, see the preceding subsection). Check the transmitter for proper operation before changing its operating frequency. After installing the new crystal, perform the alignment procedures. Then run an operational test to ensure that 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 the nominal oscillating frequency, not with 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 x nominal crystal freq. in MHz) – .09

FCC- and ETSI-Approved Models

To accommodate the different frequencies and requirements, Shure supplies the T2 with different RF boards for FCC-approved models (used in North America and other places) and ETSI-approved models (used in Europe and other places). Although the RF alignment procedures are similar for the two boards, there are some differences, especially in the number of tuning stages and in the numbering of components and test points. The audio-alignment procedures are the same for both versions of the T2.

Note: Before the introduction of a distinct RF board for ETSI 300 922 requirements, all units shared the same RF and audio boards.

Drawings for Different Versions

At the back of this manual are diagrams of the circuit boards and schematics for the original versions of the audio and RF boards as well as for the current versions of the audio board, FCC-approved RF board, and ETSI-approved RF board. Refer to the circuit-board diagrams for the test points.

Alignment

The RF and audio alignments are generally done together, as a single, continuous procedure. Before beginning, do the setup described in the following subsection, "Test Conditions." Unless specified for FCC- or ETSI-approved models, the alignment procedures apply to all models.

Test Conditions

The following test conditions apply to all versions unless otherwise specified:

- An external 9-volt supply is connected to the battery terminals (J101 and J102).
- The *Gain* pot (R125) is set to its mid-range position.
- The audio analyzer's 400 Hz high-pass and 30 kHz low-pass filters are pressed in.

FCC-Approved Units

1. Obtain a 50 Ω test cable for connecting the circuit boards to various test equipment. (To construct this cable, see "50 Ω Test Cable Assembly" in the *Wireless Service Equipment* manual.)

2. Tack-solder the cable to side 1 of the RF circuit board as follows:
   - Center conductor to the 50 Ω solder pad, I210
   - Shielding to I2GN (on older versions, IGND)

ETSI-Approved Units

1. Obtain a 50 Ω coaxial test cable for connecting the circuit boards to various test equipment. (To construct this cable, see “50 Ω Test Cable Assembly” in the *Wireless Service Equipment* manual.)
2. Tack-solder the cable to the bottom of the RF circuit board as follows:
   - Center conductor to the 50 Ω solder pad, TP6
   - Shielding to TP7 (ground)

High-Impedance Probe for TP5: When measuring test point 5, fashion a high-impedance probe on the end of the test cable by connecting a 50 Ω resistor between the center conductor and the shield, and a 0.5 pF capacitor to the end of the center conductor (see the following illustration).

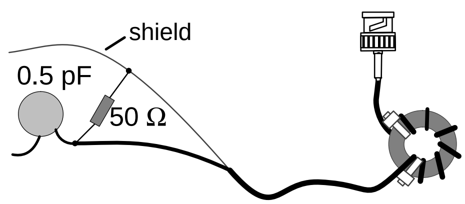


Figure 4. *High-Impedance Probe for ETSI-Approved Models*

All Units

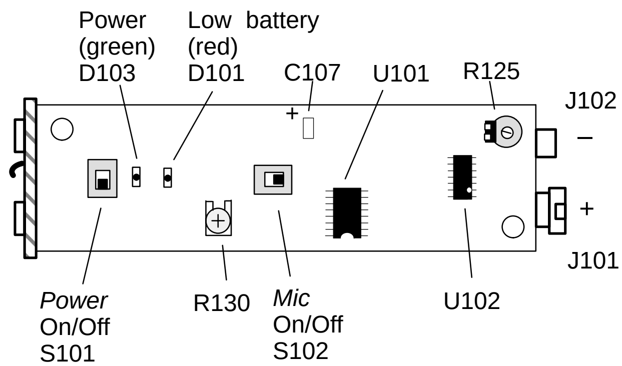
3. Carefully remove C240 (domestic units) or C242 (ETSI units) from the RF board.

   Note: This disconnects the battery antenna to allow accurate conductive-power measurements.

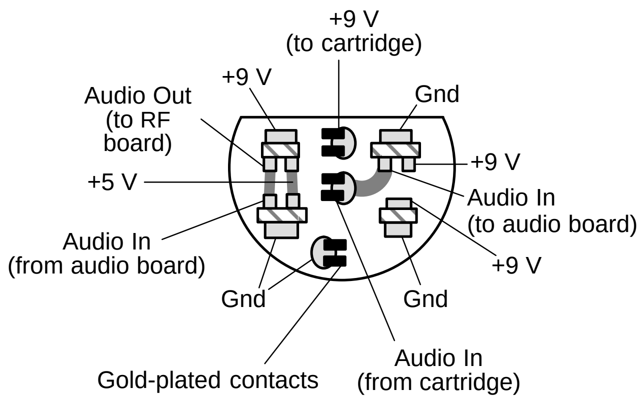
Display Checks

1. Connect the 9 Vdc power supply to the audio board: the positive lead to I140 (the positive battery terminal), and the negative lead to I145 (ground).
2. Slide S101 (*Power*) to “On” (toward the board number), and S102 (*Mic*) to “Off” (away from S101): the green LED should glow. If it doesn’t, there is a circuit malfunction.
3. Reduce the power-supply voltage to 6 Vdc: the red LED should glow.
4. Return the power supply voltage to 9 Vdc.

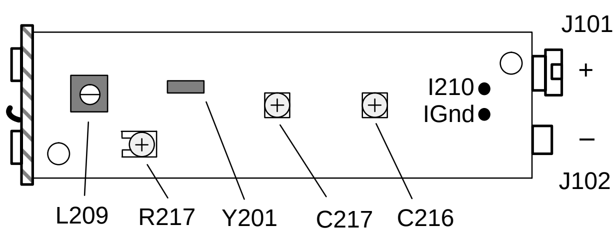
Audio Board (top)



Head Board (front view)



FCC-Approved Model RF Board (top)



ETSI-Approved Model RF Board (top)

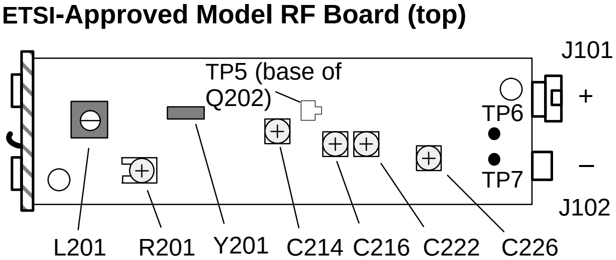


Figure 5. *Major Components Referred to in the Alignment Procedures*

RF Alignment: FCC-Approved Models

Do not apply modulation during the following RF alignment procedures.

Note: If you cannot achieve any of the settings described in these procedures, see “Bench Checks,” starting on page 23.

1. Make sure that the *Mic* switch (S102) is turned to ”Off.”
2. On the spectrum analyzer, set the center frequency to the frequency of the T2. Then make the following settings:
   - **Span:** *1 MHz*
   - **Reference level:** *+20 dBm*
   - **Scale:** *10 dB/div.*
3. Connect the 50 Ω output cable to the spectrum analyzer.

A: Output Power (FCC-Approved Models)

1. With a yellow Toray non-conductive tuning tool, adjust C217 and C216 for maximum (peak) output power on the spectrum analyzer. If the signal is very near the top of the screen, switch the scale to 2 dB/div.
2. The output power should be 15 dBm, ±2 dBm (compensate for cable losses in this calculation).

B: Frequency Adjustment (FCC-Approved Models))

1. Connect the 50 Ω output cable to the frequency counter through the 20 dB attenuator. With a pink Toray driver, adjust L209 to set the RF carrier frequency to the operating frequency (±1 kHz—see Table 3 on page 12).
2. Reconnect the 50 Ω output cable to the spectrum analyzer. Confirm that the output power remains within specification. If not, readjust C217 and C216 as described in the preceding “Output Power” subsection.

C: Spurious Emissions (FCC-Approved Models)

1. Set the spectrum analyzer as follows:
   - **Scale:** *10 dB/div*
   - **Start Frequency:** *10 MHz*
   - **Stop Frequency:***1 GHz*
   - **Reference level:** *20 dBm*
2. Check the level of spurious emissions: **All must** be at least 30 dB below the carrier level. If necessary, retune C217 and C216.

D: Current Drain (FCC-Approved Models)

1. With a digital multimeter, measure the current drain of the transmitter: it should be less than 35 mA. If it is too high, try detuning C216, but make sure that the power and spurious response remain within specification.
2. Check for 9 Vdc (±0.35 Vdc) at +9 V on the head board (I133 on the audio board).

RF Alignment: ETSI-Approved Models

Do not apply modulation during the RF alignment procedures.

Note: If you cannot achieve any of the settings described in these procedures, see “Bench Checks,” starting on page 23.

1. Slide the *Mic* switch (S102) to the ”Off” position.
2. On the spectrum analyzer, set the center frequency to *one-third* the frequency of the T2. Then make the following settings:
   - **Span:** *30 MHz*
   - **Reference level:** *+20 dBm*
   - **Scale:** *10 dB/div.*
3. Connect the high-impedance probe to the spectrum analyzer.

A: Output Power (ETSI-Approved Models)

1. Connect the high-impedance probe to TP5 (the base of Q202).
2. With a yellow Toray non-conductive screwdriver, adjust C214 for maximum (peak) output power on the spectrum analyzer. For better resolution while tuning, switch the scale to 2 dB/div and adjust the reference level to the center of the screen.
3. Remove the high-impedance probe. Connect the standard 50 Ω output cable to TP6 (before antenna-matching).
4. Plug the BNC end of the 50 Ω cable into the spectrum analyzer.
5. Set the center frequency to the frequency of the T2.
6. Adjust C216 and C222 for maximum (peak) output power on the spectrum analyzer.

   Note: C216 is not tuneable on earlier ETSI-approved units.

B: Frequency and Final Output Power (ETSI-Approved Models)

1. Connect the 50 Ω output cable to the frequency counter. With a pink Toray driver, adjust L201 to set the RF carrier frequency to within ±1 kHz of the operating frequency (see Table 4, page 13).
2. Reconnect the 50 Ω output cable to the spectrum analyzer. Peak C226 for maximum output power on the spectrum analyzer.
3. Confirm that the output power is 9.5 dBm (±2 dBm).

C: Spurious Emissions (ETSI-Approved Models)

1. Set the spectrum analyzer as follows:
   - **Scale:** *10 dB/div*
   - **Start Frequency:** *10 MHz*
   - **Stop Frequency:***1 GHz*
   - **Reference level:** *20 dBm*
2. Check the level of spurious emissions: **All must** be at least 44 dB below the carrier level. If necessary, retune C226.

D: Current Drain (ETSI-Approved Models)

1. With a digital multimeter, measure the current drain of the transmitter: it should be less than 35 mA. If it is too high, try detuning C226, but make sure that the power and spurious response remain within specification.
2. Check that 9 Vdc (±0.35 Vdc) is present at the head board +9 V location (I133 on the audio board).

Audio Alignment (Both Models)

The audio boards on the FCC-approved and ETSI-approved models are identical except for the pcb number printed on the board. (These numbers differ because the boards are made as parts of larger assemblies for the two different models.)

The audio board has changed relatively little in the history of the T2. Two examples of changes are the renumbering of the LEDs (the green used to be D101, and the red, D102) and some slightly different designations (e.g., I1GN used to be IGND).

E: Setup

1. Disconnect the power supply from the T2.
2. Unsolder the test cable.
3. Replace C240 (domestic units) or C242 (ETSI units) on the RF board.
4. Slide the board assembly, battery terminals first, into the test handle: be sure to align the sides of the assembly with the handle's inner tracks. Alternatively, slide the assembly through the test ring.
5. Screw the audio test head into the handle or ring. Connect a BNC-to-BNC cable between the audio analyzer and the test head.
6. Reconnect the 9 V power supply to the battery terminals of the T2.
7. Place the *Mic* switch in the "On" position. Verify that the green power LED (D103) lights steadily.

F: Modulation Calibration

1. Set the output of the audio analyzer as follows:
   - **Frequency:** *1 kHz*
   - **Amplitude:** *230 mV*
   - **Measurement:** *Ac Level*
   - **Filters:** *400 Hz and 30 kHz on*
2. Adjust the *Gain* (R125) so the output at the positive side of C107 is 0 dBu, ±0.1 dB (775 mV, ±50 mV). See Figure 5, page 16.

   Note: At this point you may want to press the *Log/Lin* button on the audio analyzer (to measure in dBm) and then press the *Ratio* button to perform the relative measurement for frequency response.

G: Frequency Response

1. Set the audio analyzer as follows:
   - **Frequency:** *100 Hz*
   - **400 Hz High-Pass filter:** *Disengaged*
2. Verify that the audio level at the positive side of C107 is –0.5 dB, ±0.5 dB, relative to the level you set in Step 2 of subsection F.
3. Reset the audio analyzer as follows:
   - **400 Hz High-Pass filter:** *Engaged*
   - **Frequency:** *10 kHz*
4. Check that the audio level at the positive side of C107 is equal to 3 dB, ±0.5 dB, relative to the level you set in Step 2 of subsection F.

H: Deviation Reference Voltage

1. Turn off the T2 *Power* switch.
2. Obtain a receiver set to the same frequency as the T2 (this will probably be the T3 or T4 that came with the T2).

   Note: Alternatively, use a modified SC4 receiver for any transmitter. Instructions for modifying and using an SC4 are in the *Wireless Service Equipment* manual.
3. Attach an antenna or an unshielded cable to the RF signal generator. Set the RF signal generator as follows;
   - **Frequency:** *Carrier*
   - **Modulation:** *FM*
   - **Modulation source:** *Int 1 kHz*
   - **FM Deviation:** ±*15 kHz*
   - **Amplitude:** –38 dBm

4. Make sure that the receiver's yellow RF LED lights.

5. Set the receiver's *Volume* control to the maximum position (full clockwise rotation) and apply power to the receiver. On the T4, set the *Squelch* control to its midpoint.

6. Measure the rms voltage developed across the unbalanced output of the receiver. The reading should be approximately 0 dBu (775 mV), which 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 *Log/Lin* button on the audio analyzer (to measure in dBm) and then press the *Ratio* button to perform the relative measurement in the next section.

7. Turn off the RF output from the signal generator.

I: Deviation Adjustment

1. Make sure that C240 is on the RF board, so that the antenna is connected).

2. Remove the power-supply leads and attach a new 9 V battery.

3. Connect the output of the audio analyzer to the test head.

4. Set the frequency of the audio analyzer to 1 kHz. Make sure that 0 dBu (775 mV) is present at the positive side of C107.

5. Measure the rms voltage at the unbalanced output of the receiver. Adjust R217 to obtain voltage within ±1 dB of the deviation reference voltage that you recorded earlier (see the end of the preceding subsection).

J: Distortion Adjustment

1. Set the audio analyzer for "Distn" (total harmonic distortion).

2. Adjust R130 for minimum distortion out of the receiver (it should measure less than 1%).

Note: This completes the alignment procedures. Refer to the "Reassembly" instructions earlier in this manual.

Notes

Bench Checks

The tests for power and audio apply to all T2 units. Those involving the RF board differ for FCC-approved and ETSI-approved units; hence this section includes two separate sets of procedures for RF testing.

Dc Power

- ✓ Verify that 9 Vdc (±0.35 Vdc) is present at I+9.0 (on the bottom of the audio board—see Figure 6, page 33). If this voltage is low, check it at I133. 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 I147. If the correct voltage is not present, check I+5 (pin 7 of U101). Then check:
  - pin 13 of U101 for 9 V
  - values of R133, R135, and R137

  Note: If you are measuring dc voltages at points where RF signals are present, use a 10 kΩ resistor *at the probe* to prevent loading the circuit. To remove the RF signal, remove the crystal.

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 open vias (through-hole connections between board layers), 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 *Mic* 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.

Distortion

- Make sure the analyzer's 400 Hz high-pass and 30 kHz low-pass filters are pressed in.
- Pin 9 of U101 should read ≅1.8 Vdc.
- As you turn R130, the dc level on its wiper should change from ≅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.

Frequency Problem: FCC-Approved Units

- 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 I218 to I230).
- Look for shorts and opens.

Low Output Power: FCC-Approved Units

For these checks, terminate the transmitter's output with a 50 Ω load between I210 and ground. If you have interconnected the audio and RF boards for testing, temporarily remove C240 to disconnect the battery antenna.

- Check the carrier output power after the oscillator stage (I230). 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:

- Make sure the Board Group is the correct one for the desired frequency.
- *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 C216 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 C216 and the values of L204, C238, L210, 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 I210. Lastly, replace Q204.
- If the power is slightly low and the spurious level is high, check for wrong or open coils at L202, L210, and L206.
- Check the emitter bypass capacitors (C226 and C223) and the collector bypass capacitors (C207 and C208), which can also affect the tuning and power gain of the RF stages. If RF level is not the same on both sides of one of these capacitors, that part is probably defective.

Excessive Current Drain: FCC-Approved Units

- Try readjusting C216 for lower current drain while maintaining output power to specification. If the current drain is still excessive (the factory setting is $\leq$35 mA), check for the following:
    - short
    - wrong resistor value
    - defective capacitor
    - correct value of R219 for the frequency group
- As a last resort, try changing Q204.

Deviation: FCC-Approved Units

- If R217 on the RF board cannot be adjusted to obtain a $\pm$15 kHz deviation, try to isolate the problem to the audio or RF section by doing the following:
    - If I218 on the RF board does not measure –2.2 dBV (775 mV), refer to the “Audio” section, page 23.
    - If I218 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.

Frequency Problem: ETSI-Approved Units

- Make sure the RF carrier is at least 10 dB higher than the spurious emissions, to allow the frequency counter to lock on.
- Check L201 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:

  V_C = 8.83 V
  V_B = 0.97 V
  V_E = 0.32 V

- Make sure that D201 is the correct varactor and has 5 Vdc on its cathode.
- Check the parts and values of the oscillator circuit.
- Look for shorts and opens.

Low Output Power: ETSI-Approved Units

For these checks, terminate the transmitter's output with a 50 Ω load between TP6 and ground. If you have interconnected the audio and RF boards for testing, temporarily remove C242 to disconnect the battery antenna.

- 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 four RF stages:

- Make sure the Board Group is the correct one for the desired frequency.
- *Stage 1:* Make sure that rotating C214 360 degrees in either direction produces two separate peaks in the carrier output amplitude. If there is only one peak, check the values of C214, L202, C208, C244, C210, L203, C213, and C215. Check the bias on Q201. Lastly, replace Q201.
- *Stage 2:* Make sure that rotating C222 360 degrees in either direction produces two separate peaks in the carrier output amplitude. If there is only one peak, check the values of C222, L204, C216, C245, C219, L205, C221, and C224, Check the bias on Q202. Lastly, replace Q202.
- *Stage 3:* Make sure that rotating C226 360 degrees in either direction produces two separate peaks in the carrier output amplitude. If there is only one peak, check the values of C226, L206, C227, C229, L207, C230, and C232. Check the bias on Q203. Lastly, replace Q203.
- *Stage 4:* Check the dc bias on Q204 and the values of all the parts from the base of Q204 to TP6. Lastly, replace Q204.

- If the power is slightly low and the spurious level is high, check for wrong or open coils at L205, L207, and L210.
- Check the collector bypass capacitors for the RF stages (C220, C227, and C234) and the collector bypass capacitor for Q203 (C228), which can also affect the tuning and power gain of the RF stages:
  - If RF level is not the same on both sides of one of these capacitors, that part is probably defective.
  - The RF level between the collector of one transistor and the base of the next should drop approximately 10 dB. Check any stage that drops more than 12 dB.

Excessive Current Drain: ETSI-Approved Units

- Try readjusting C226 for lower current drain while maintaining output power to specification. If the current drain is still excessive (the factory setting is $\leq$35 mA), check for the following:
  - short
  - wrong resistor value
  - defective capacitor
  - value of R218 (that it is correct for the frequency group)
- As a last resort, try changing Q204.

Deviation: ETSI-Approved Units

- If R201 cannot be adjusted to obtain a $\pm$15 kHz deviation, try to isolate the problem to the audio or RF section by doing the following:
  - If TP1 on the RF board (or I109 on the audio board) does not measure –2.2 dBV (775 mV), refer to the “Audio” section, page 23.
  - If the preceding level is correct, check R201, C201, C202, R202, R203, D201, L201, and C203. Also make sure that the cathode of D201 is being supplied with a 5 Vdc bias from the 5 V line through R202 and R203.
- As a last resort, try replacing D201 and Y201.
- Make sure the carrier is good: you need that to get any deviation.

Distortion: ETSI-Approved Units

- Make sure the analyzer's 400 Hz high-pass and 30 kHz low-pass filters are pressed in.
- Pin 9 of U101 should read about 1.8 Vdc.
- As you turn R139, the dc level on its wiper should change from about 1.5 V to 3.5 V. If it does not, check R139, C1, R141, R140, R114, and the parts tied to pin 9 of U101.
- Check the audio level.
- Lastly, replace D201 and Y201.

Replacement Parts and Drawings

On the next page, the parts are listed according to the reference designations from the pc boards and schematics. Parts shown on the circuit diagram and not listed below are available at most electronic parts distributors.

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

Product Changes

This section briefly describes significant changes as of this writing to the T2.

RF Boards: The original RF board supported both North American and a limited number of European frequencies. There are now two RF boards. A slightly revised version of the original board, with a new layout, supports only the frequencies for FCC-approved units, and a new board supports a greatly expanded list of frequencies for ETSI-approved units.

RF Tuning on ETSI-Approved Units: C216 has been changed to a variable capacitor, adding a stage in the tuning. Associated capacitor C245 has also been changed. See the schematic for the frequency-dependent values of this capacitor.

Combined RF and Audio Board Numbers: Because the factory now assembles the two boards as a single panel before separating them, there is now a single part number for each combination: 90_8690 for the RF and audio boards on FCC-approved units, and 90_8705 for the RF and audio boards on ETSI-approved units. When ordering, use the appropriate assembly number but specify whether you want just the RF board, just the audio board, or both. Note further that the audio boards from the two assemblies are identical except for the part number printed on the bottom.

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

LEDs and Layout: The LEDs were rearranged and renumbered, and transistor Q108 and associated circuits were added. In addition, the audio layout was changed. These changes do not greatly affect the audio alignment.

BG 3.1 Microphone: The earlier T230 models were supplied with BG 3.0 microphone cartridges. The newer T231 models are supplied with BG 3.1 cartridges. The earlier models will accept the new cartridges.

ID Resistors: To help assemblers identify the RF board used on ETSI-approved units, the factory has added resistors R259 and R261. They are not functional.

Frequency Changes: The “C” and “D” revisions to the ETSI RF boards primarily consist of minor corrections to the drawings, adding the “S” frequency and “K” group, and redesignating the “J” frequency “BB.”

Parts Designations

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

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

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

Temperature-Compensating Capacitors (N750 designation):

FCC-Approved RF Boards: C214, C224, C230.

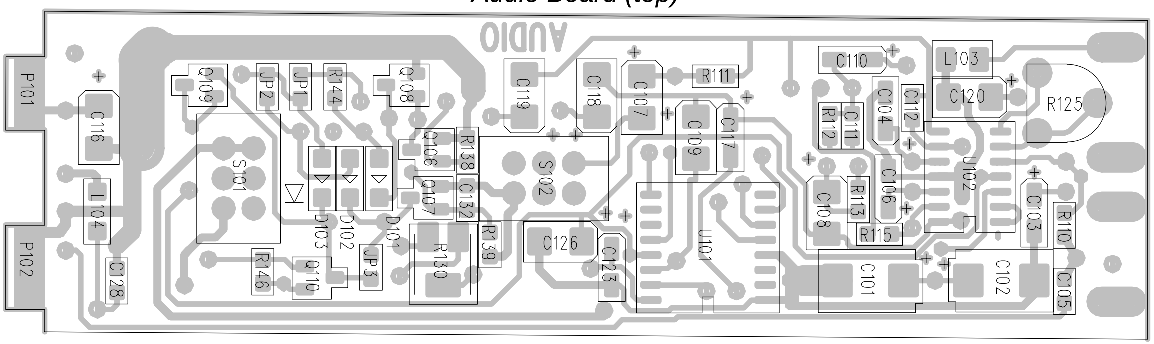
ETSI-Approved RF Boards: C203, C206, C207.

Table 1
T2 Replacement Parts

Reference Designation	Description	Shure Part No.
A1	FCC-approved RF/Audio programmed circuit board assembly	T90__8690 [in the underlined space, insert the proper frequency code-letters from Table 3 page 12, —e.g., T90CA8690]
A2	ETSI-approved RF/Audio programmed circuit board assembly	T90__8705 [in the underlined space, insert the proper frequency code-letters from Table 4 page 13, —e.g., T90NE8705]
A3	Head pcb assembly	34A1090D
MP1	Gold-plated spring contacts	53F2039A
MP2	Actuators *old type*	65A8225
MP3	Actuator *current oval type*	65C8298
MP4	Battery cup	65A8206A
MP5	Bezel * for older version handle *	65B8207A no longer available
MP6	Bezel *current oval type*	65B8299
MP7	Handle *** Old version ***	65A8220A not available
MP8	Handle * Current type.* Uses oval Bezel and Actuators. *** Must replace Actuators and Bezel if replacing from Old version handle	65C8427A
MP9	Kit contains: (2)Current type Actuators, clip ring and (3)gold mic contacts	RPW614
MP10	Retaining Clip ring	30A1314
MP11	Compression disk	38A180
J101	Battery snap (positive)	56A317
J102	Battery snap (negative)	56A318
Y201	Crystal	40_8006A [in the underlined space, insert the crystal-code from Table 3, page 12 (FCC) or Table 4, page 13 (ETSI)]

Reference Designation	Description	Shure Part No.
Audio Circuit Board (both models)		
D101	LED, red (low battery)	184A18
D103	LED, green (power)	184D18
Q103, Q104	PNP transistor, MMBT5087L	183A01
Q105	PNP transistor, 2SA1252	183A07
Q106, Q107, Q108	NPN transistor, MMBT5089L	183A38
R125	Potentiometer, 20 kΩ (log taper)	46B8049
R130	Potentiometer, 20 kΩ, SMD	146F02
S101	Slide switch, *Power* (SPDT)	55A178
S102	Slide switch, *Mic* (SPDT)	55A178
U101	Integrated circuit, compandor	188A01
U102	Integrated circuit, quad op amp	188A49
North American RF Circuit Board		
C216	Capacitor, variable 3–10 pF, 100 V	152C02
D201	Diode, varactor	184A22
L104	Ferrite bead	162A03
Q201, Q203, Q204	NPN transistor	183A03
R217	Potentiometer, 10 kΩ	146E02
European RF Circuit Board		
C214, C222	Trimmer capacitor, 5–20 pF	152D03
C216	Trimmer capacitor, 3–10 pF, 1%	152A03
D201	Diode, varactor	184A22
L201	Netting coil	82_8015 [in the underlined space, insert the proper group-letter from your frequency dependent components list on your RF schematic]
LF208	Ferrite bead	162A12
Q201, Q202, Q203, Q204	NPN transistor	183A03
R201	Potentiometer, 10 kΩ, 1%	146E02

Audio Board (top)



Audio Board (bottom)

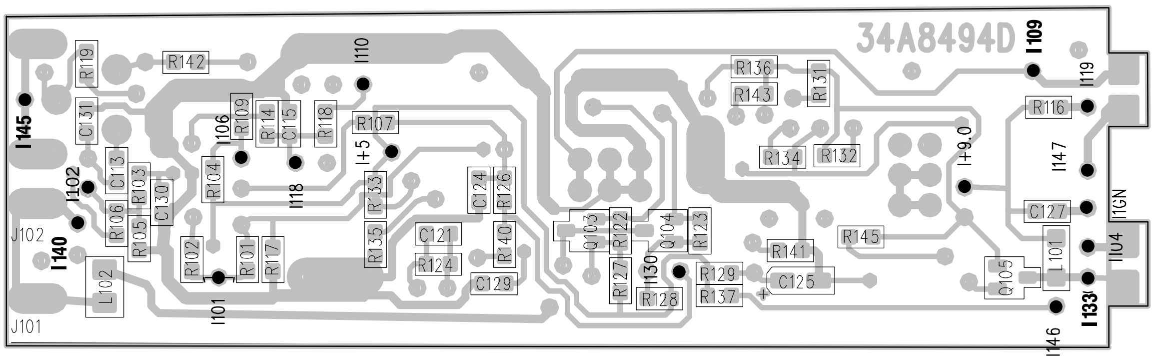
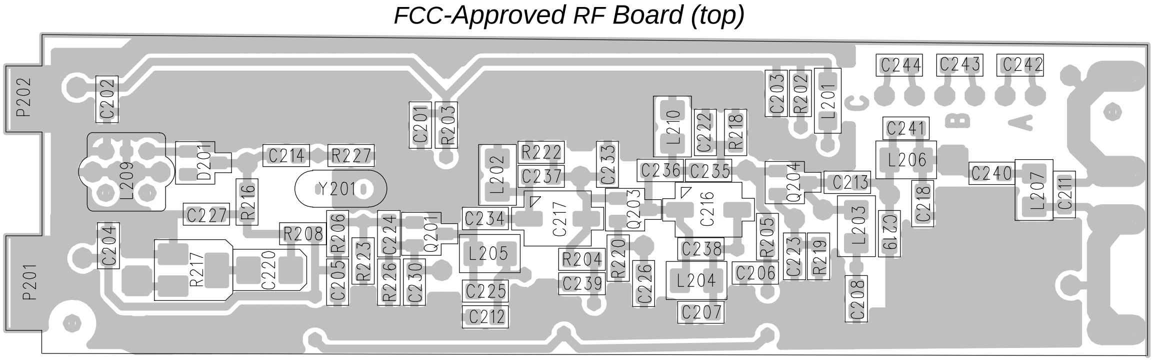


Figure 6. *T2 Audio Board*

FCC-Approved RF Board (top)



FCC-Approved RF Board (bottom)

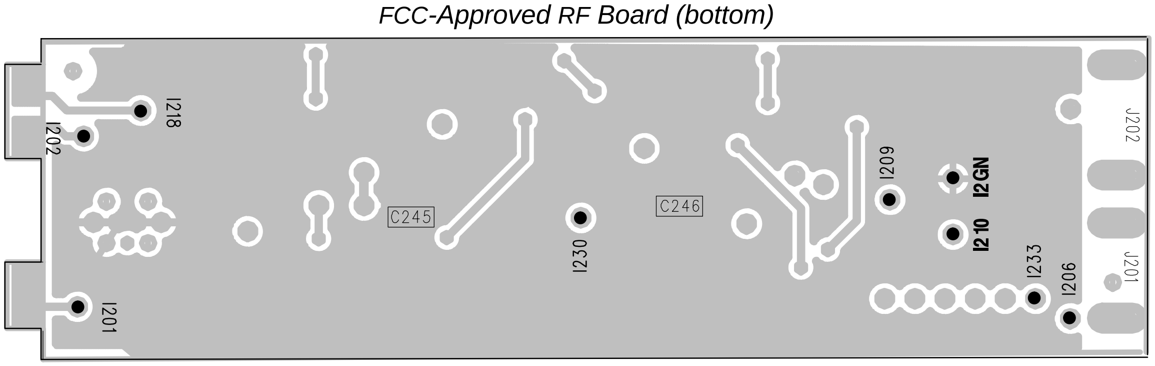
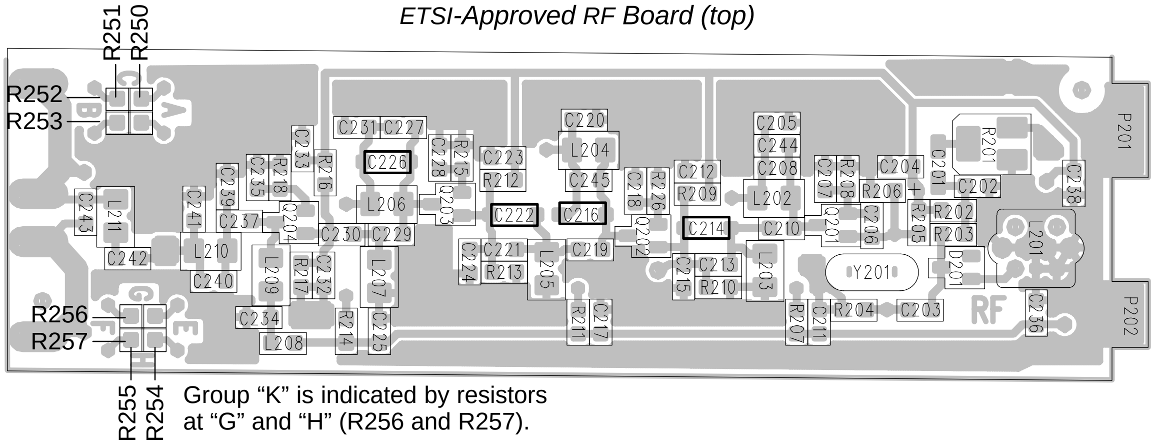


Figure 7. *T2 FCC-Approved RF Board*

ETSI-Approved RF Board (top)



ETSI-Approved RF Board (bottom)

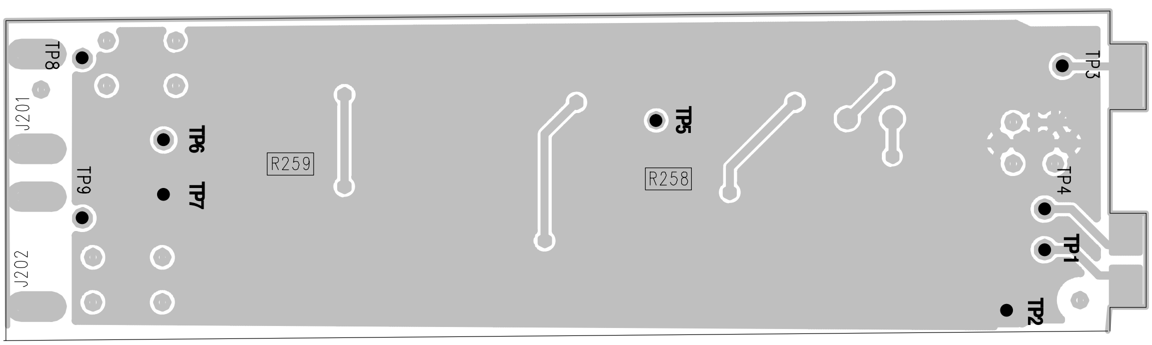
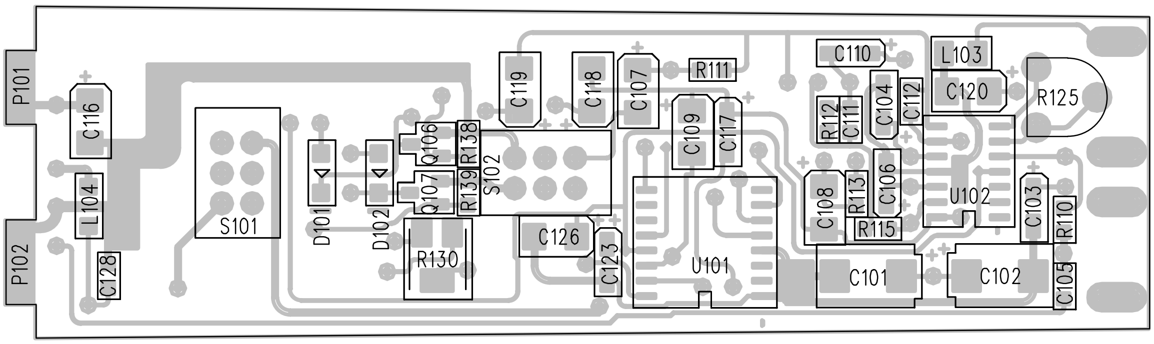
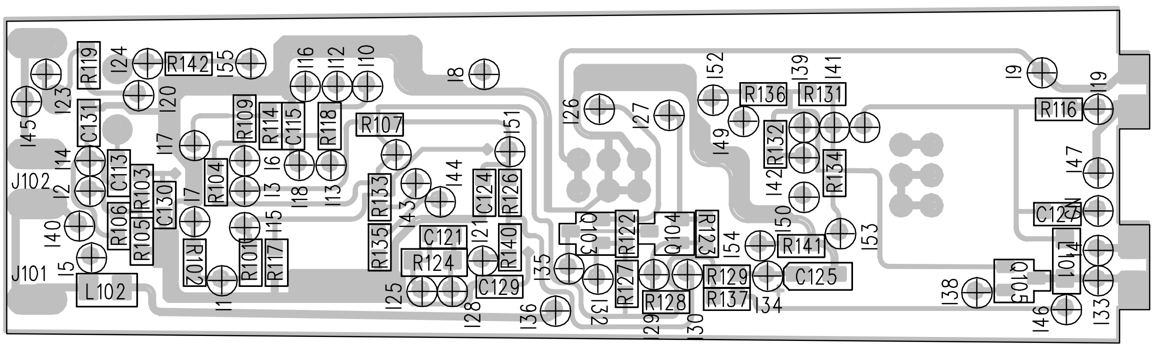


Figure 8. *T2 ETSI-Approved RF Board*

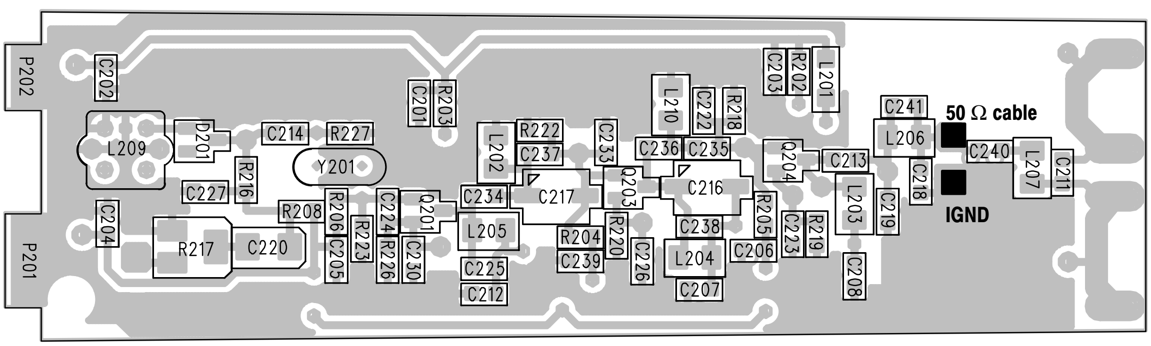
Older Version Audio Board (top)



Older Version Audio Board (bottom)



Older Version RF Board (bottom)



Older Version RF Board (bottom)

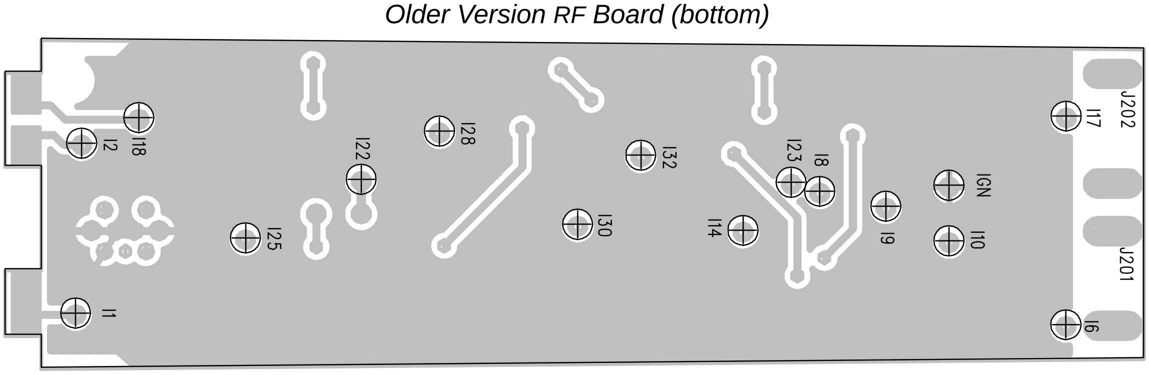


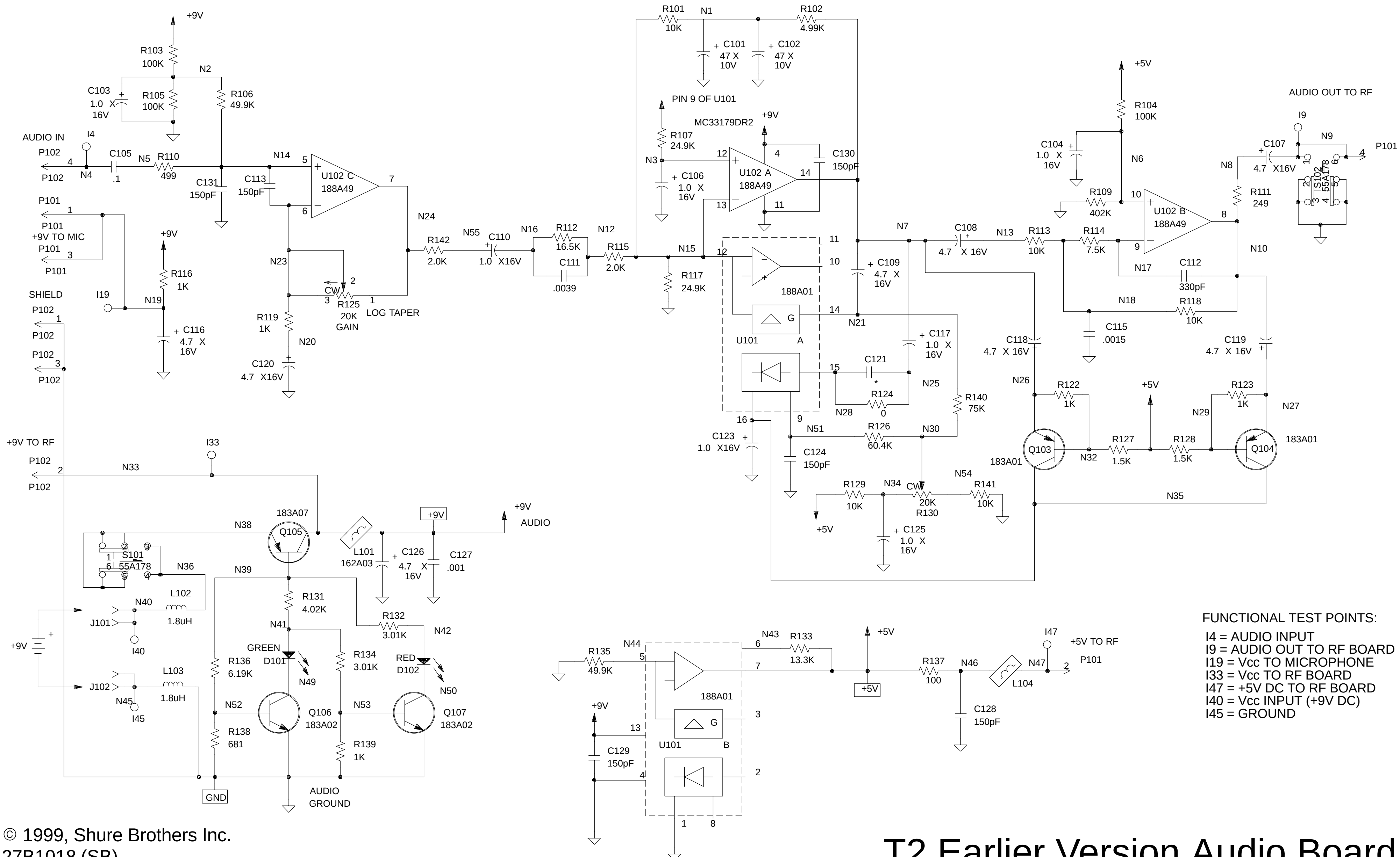
Figure 9. *T2 Older Version Boards*

Schematics

(Note to Printer: do not print this page)

Please print the attached schematics in the order they are listed:

- T2 Earlier Version Audio Board (letter size)
- T2 Earlier Version RF Board (letter size)
- T2 Audio Board (ledger size)
- T2 FCC–approved RF Board (ledger size)
- T2 ETSI-approved RF Board (ledger size)

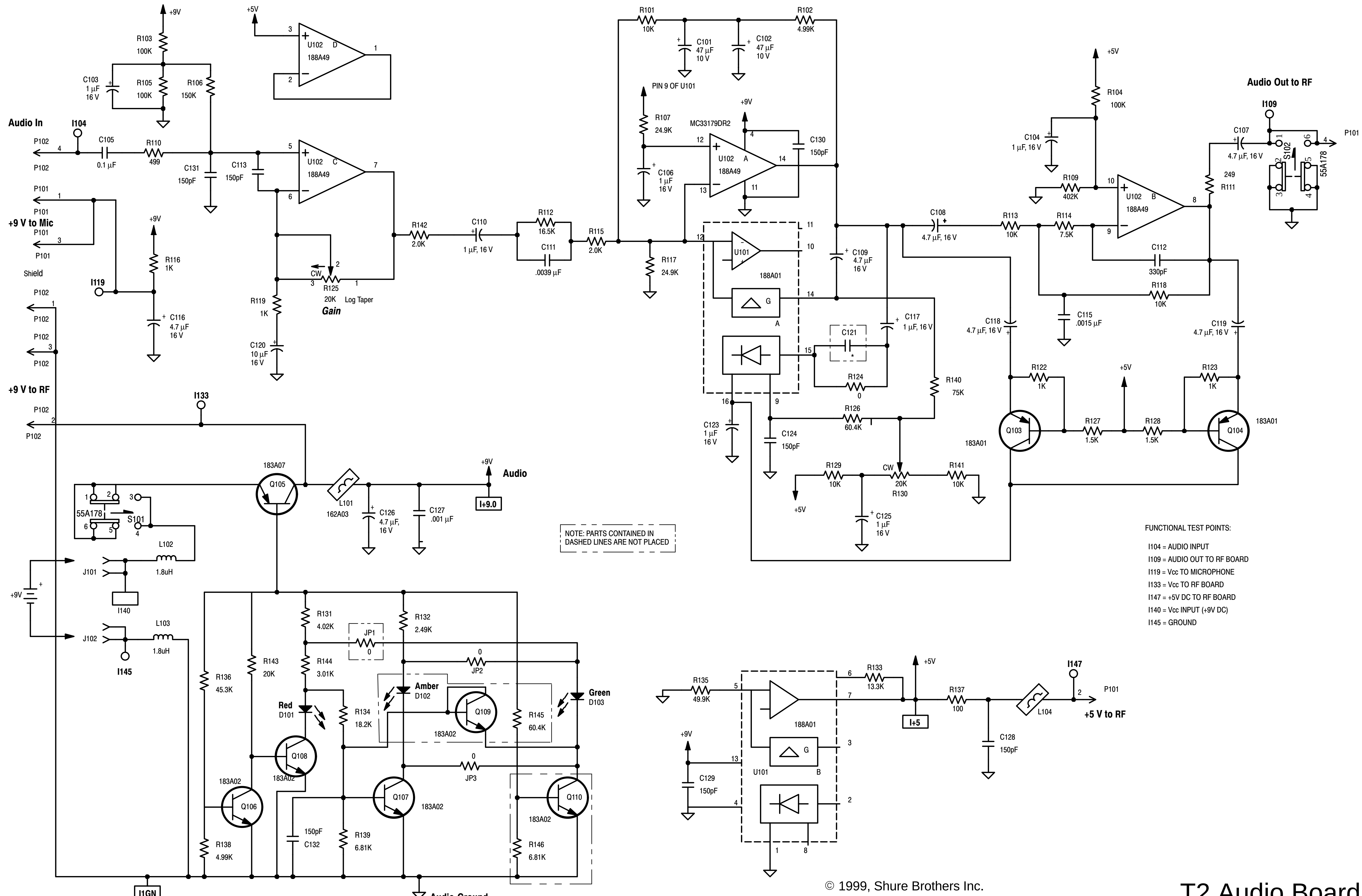


FUNCTIONAL TEST POINTS:

I4 = AUDIO INPUT
I9 = AUDIO OUT TO RF BOARD
I19 = Vcc TO MICROPHONE
I33 = Vcc TO RF BOARD
I47 = +5V DC TO RF BOARD
I40 = Vcc INPUT (+9V DC)
I45 = GROUND

27B1018 (SB)

T2 Earlier Version Audio Board

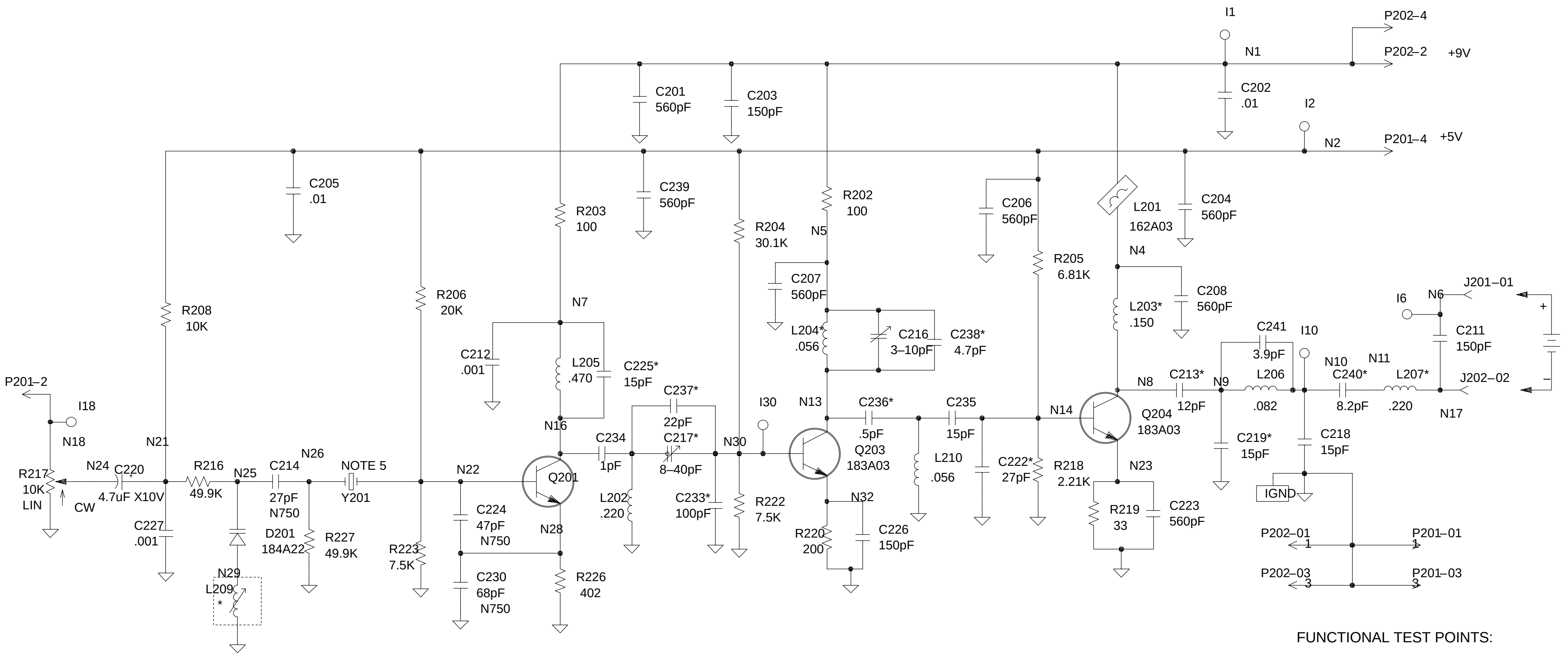


FUNCTIONAL TEST POINTS:

I104 = AUDIO INPUT
I109 = AUDIO OUT TO RF BOARD
I119 = Vcc TO MICROPHONE
I133 = Vcc TO RF BOARD
I147 = +5V DC TO RF BOARD
I140 = Vcc INPUT (+9V DC)
I145 = GROUND

27B1018 (SB)

T2 Audio Board



FREQUENCY DEPENDENT PARTS BY GROUP AND COMPONENT NO.

VARIABLE COMPONENTS	FREQUENCY RANGE	L204		L203		L207		L209	C213		C233		C222	
		PART NO.	uH	PART NO.	uH	PART NO.	uH	SHURE PART NO.	PART NO.	pF	PART NO.	pF	PART NO.	pF
GROUP A	169.000 – 184.000 MHz	162G06	.056	162E06	.150	162C06	.220	82A8015	150DA120JA	12	150DA101KA	100	150DA270JA	27
GROUP B	184.000 – 199.000 MHz	162G06	.056	162B06	.100	162D06	.180	82B8015	150DA120JA	12	150DA101KA	100	150DA220JA	22
GROUP C	199.000 – 216.000 MHz	162H06	.047	162B06	.100	162D06	.180	82C8015	150DA100CA	10	150DA820JA	82	150DA180KA	18

VARIABLE COMPONENTS	FREQUENCY RANGE	C217		C219		C237		C236		C240		C238		C225	
		PART NO.	pF	PART NO.	pF	PART NO.	pF	PART NO.	pF	PART NO.	pF	PART NO.	pF	PART NO.	pF
GROUP A	169.000 – 184.000 MHz	152F01	8–40	150DA150JA	15	150DA220JA	22	150DA509CA	0.5	150DA828CA	8.2	150DA478CA	4.7	150DA150JA	15
GROUP B	184.000 – 199.000 MHz	152D01	4–20	150DA150JA	15	150DA220JA	22	150DA509CA	0.5	150DA100CA	10	N/A	—	150DA120JA	12
GROUP C	199.000 – 216.000 MHz	152D01	4–20	150DA120JA	12	150DA180KA	18	150DA108CA	1.0	150DA688CA	6.8	N/A	—	150DA828CA	8.2

LAST USED: N33
C240
R227
L210

FUNCTIONAL TEST POINTS:

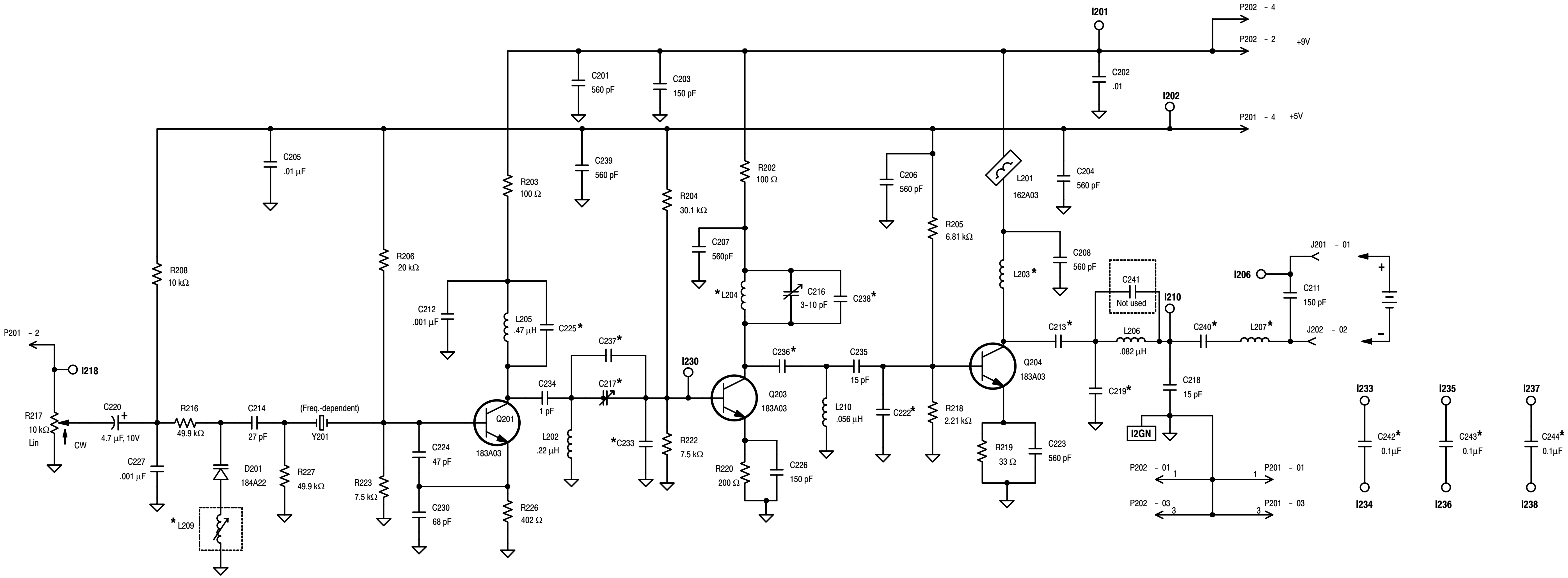
I1 = +9 VDC
I2 = +5 VDC
I18 = AUDIO INPUT
I10 = RF OUTPUT (50 OHMS)
I6 = RF OUTPUT (ANTENNA)

* FIRST AND SECOND PRODUCTION UNITS WERE ASSEMBLED WITHOUT C241 AND R227

LAST REVISION: 01/31/94

27B1018 (SB)

T2 Earlier Version RF Board



* FREQUENCY DEPENDENT PARTS BY GROUP AND COMPONENT NO.

VARIABLE COMPONENTS	FREQUENCY RANGE	L204		L203		L207		L209	C213		C233		C222		FREQ. DESIGNATOR	
		PART NO.	µH	PART NO.	µH	PART NO.	µH	SHURE PART NO.	PART NO.	pF	PART NO.	pF	PART NO.	pF	P/N 150DA104KB	
GROUP A	169.000–183.975 MHz	162G06	.056	162E06	.150	162C06	.220	82A8015	150DB120JA	12	150DB101JA	100	150DB270JA	27	C242	0.1µF
GROUP B	184.000–198.975 MHz	162G06	.056	162B06	.100	162D06	.180	82B8015	150DB120JA	12	150DB101JA	100	150DB220JA	22	C243	0.1µF
GROUP C	199.000–215.975 MHz	162H06	.047	162B06	.100	162D06	.180	82C8015	150DB100CA	10	150DB820JA	82	150DB180JA	18	C244	0.1µF

VARIABLE COMPONENTS	FREQUENCY RANGE	C217		C219		C237		C236		C240		C238		C225	
		PART NO.	pF	PART NO.	pF	PART NO.	pF	PART NO.	pF	PART NO.	pF	PART NO.	pF	PART NO.	pF
GROUP A	169.000–183.975 MHz	152F02	8–40	150DB150JA	15	150DB220JA	22	150DB509BA	0.5	150DB828CA	8.2	150DB478CA	4.7	150DB150JA	15
GROUP B	184.000–198.975 MHz	152D02	4–20	150DB150JA	15	150DB220JA	22	150DB509BA	0.5	150DB100JA	10	N/A	--	150DB120JA	12
GROUP C	199.000–215.975 MHz	152D02	4–20	150DB120JA	12	150DB180JA	18	150DB108BA	1.0	150DB688CA	6.8	N/A	--	150DB828CA	8.2

FUNCTIONAL TEST POINTS:

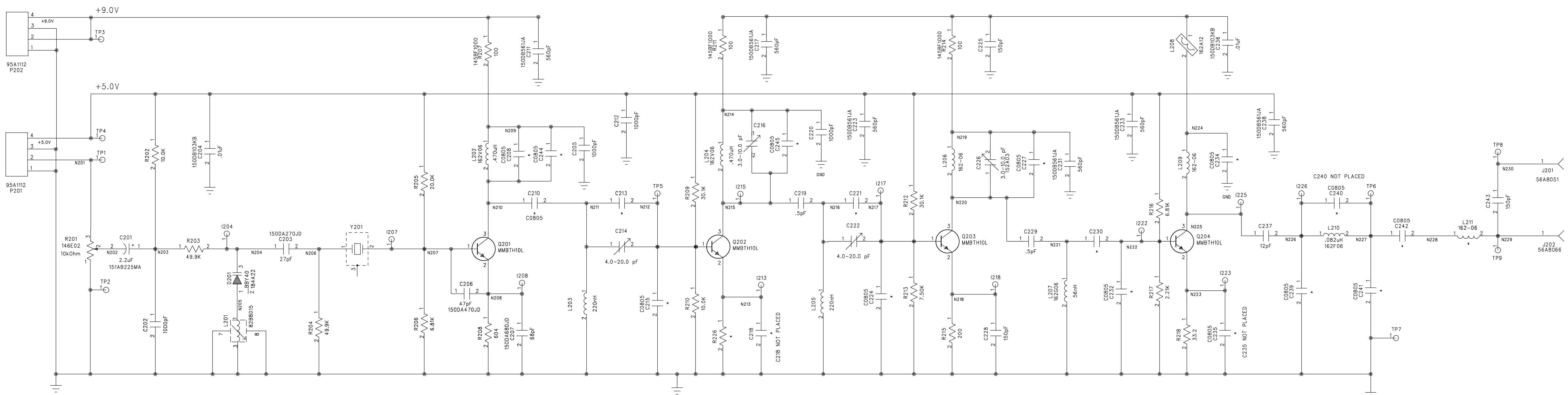
I201 = +9 VDC
I202 = +5 VDC
I218 = AUDIO INPUT
I210 = RF OUTPUT (50 OHMS)
I206 = RF OUTPUT (ANTENNA)

LAST REVISION: 9/23/98

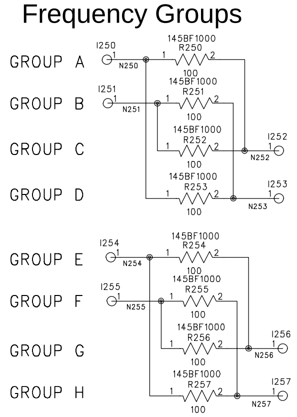
T2 FCC-Approved RF Board

(from 90_8690D-11)

27B1018 (SB)



Frequency Groups



FREQUENCY DEPENDENT PARTS BY GROUP AND COMPONENT NO.

VARIABLE COMPONENTS	FREQUENCY RANGE	C208 pF	C244 pF	C210 pF	C213 pF	C215 pF		C245 pF	C221 pF	C224 pF	C227 pF	C230 pF	C232 pF	C234 pF	C239 pF	C241 pF	C242 pF	R226 OHMS	L206 PART NO.	L206 uH	L209 PART NO.	L209 uH	L211 PART NO.	L211 uH	L201 SHURE PART NO.	GROUP 145BF1000
GROUP A	169.000 – 173.975 MHz	15	--	1.0	33	100	--	8.2	33	100	4.7	27	27	15	27	22	12	750	162G06	.056	162E06	.150	162C06	.220	82A8015	R250
GROUP B	174.000 – 180.975 MHz	12	1.0	1.0	33	100	--	6.8	33	100	4.7	18	27	22	22	33	8.2	1000	162G06	.056	162E06	.150	162C06	.220	82A8015	R251
GROUP C	181.000 – 187.975 MHz	12	--	1.0	27	100	--	6.8	27	100	4.7	15	27	22	18	33	6.8	1000	162G06	.056	162E06	.150	162C06	.220	82A8015	R252
GROUP D	188.000 – 194.975 MHz	12	--	1.0	22	100	--	5.6	22	100	--	15	22	18	15	6.8	3.3	1210	162G06	.056	162E06	.150	162C06	.220	82B8015	R253
GROUP E	195.000 – 201.975 MHz	10	0.5	0.5	22	100	--	5.6	22	100	--	12	22	8.2	15	10	6.8	1000	162G06	.056	162E06	.150	162D06	.180	82B8015	R254
GROUP F	202.000 – 208.975 MHz	8.2	1.0	1.0	22	100	--	3.3	22	100	--	12	22	27	18	18	5.6	1330	162G06	.056	162B06	.100	162D06	.180	82B8015	R255
GROUP G	209.000 – 215.975 MHz	6.8	1.5	0.5	18	82	--	3.3	18	82	--	12	18	15	18	18	4.7	1330	162H06	.047	162B06	.100	162D06	.180	82C8015	R256
GROUP H	216.000 – 222.975 MHz	6.8	1.0	0.5	18	82	--	1.0	18	82	--	12	18	15	15	15	4.7	1000	162H06	.047	162B06	.100	162D06	.180	82C8015	R257

NOTES:

1. All resistors 1/10 Watt, 1%, 0805 unless otherwise specified.

2. Electrolytic capacitors shown in uF x Volts. All non-polar capacitors in uF, tolerance 10% and 50V or more unless otherwise specified.

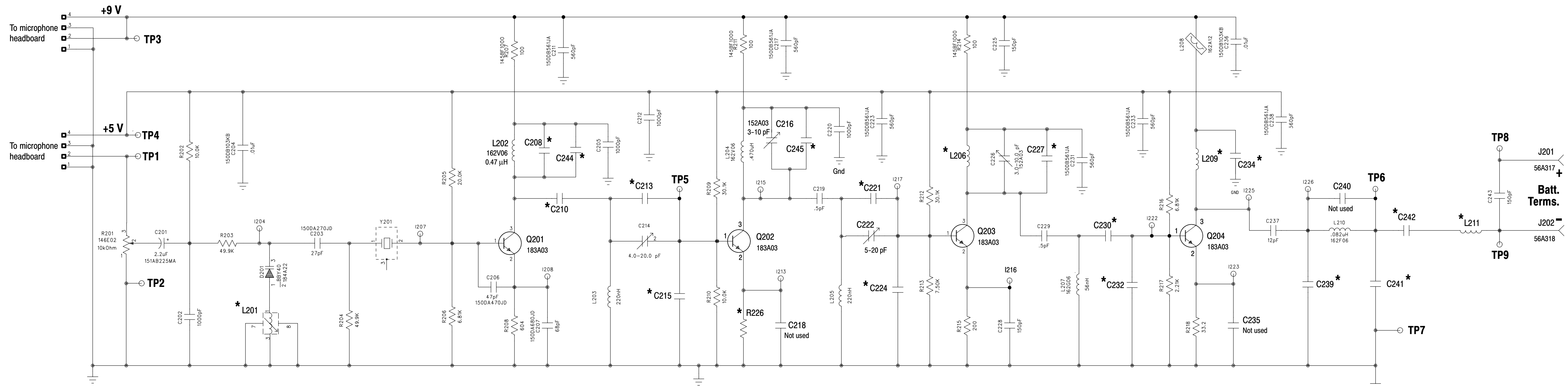
NOTICE

4. The following symbols denote:

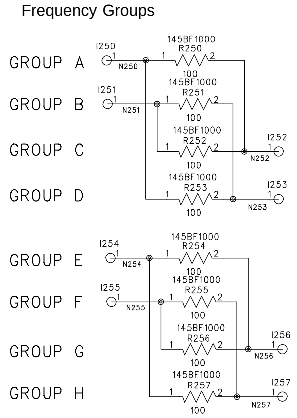
15mV	A.C. Voltage		P.C. ground
15mV	D.C. Voltage		Case ground

27B1018 (SB)

T2 ETSI-Approved RF Board



Frequency Groups



Frequency-Dependent Parts

Group	Frequency Range (MHz)	C208 pF	C210 pF	C213 pF	C215 pF	C221 pF	C224 pF	C227 pF	C230 pF	C232 pF	C234 pF	C239 pF	C241 pF	C242 pF	C244 pF	C245 pF	L201	L206 Shure Part No. (μH)	L209 Shure Part No. (μH)	L211 Shure Part No. (μH)	R226 Ω
A	169.000–173.975	15	1	33	100	33	100	4.7	27	27	15	27	22	12	not used	8.2	82A8015	162G06 (0.56)	162E06 (0.15)	162C06 (0.22)	750
B	174.000–180.975	12	1	33	100	33	010	4.7	18	27	22	22	33	8.2	1	6.8	82A8015	162G06 (0.56)	162E06 (0.15)	162C06 (0.22)	1000
C	181.000–187.975	12	1	27	100	27	100	4.7	15	27	22	18	33	6.8	not used	6.8	82A8015	162G06 (0.56)	162E06 (0.15)	162C06 (0.22)	1000
D	188.000–194.975	12	1	22	100	22	100	not used	15	22	18	15	6.8	3.3	not used	5.6	82B8015	162G06 (0.56)	162E06 (0.15)	162C06 (0.22)	1210
E	195.000–201.975	10	0.5	22	100	22	100	not used	12	22	8.2	15	10	6.8	0.5	5.6	82B8015	162G06 (0.56)	162E06 (0.15)	162D06 (0.18)	1000
F	202.000–208.975	8.2	1	22	100	22	100	not used	12	22	27	18	18	5.6	1	3.3	82B8015	162G06 (0.56)	162B06 (0.1)	162D06 (0.18)	1330
G	209.000–215.975	6.8	0.5	18	82	18	82	not used	12	18	15	18	22	4.7	1.5	3.3	82C8015	162H06 (.047)	162B06 (0.1)	162D06 (0.18)	1330
H	216.000–222.975	6.8	0.5	18	82	18	82	not used	10	27	15	15	22	4.7	1	1	82C8015	162H06 (.047)	162B06 (0.1)	162D06 (0.18)	1000
K	230.975–235.975	6.8	0.5	15	82	15	82	not used	10	15	15	12	12	3.3	not used	not used	82C8015	162H06 (.047)	162B06 (0.1)	162D06 (0.18)	1000

Notes:

1. All resistors are $^1/_{10}$ W, 1% tolerance, 0805 unless otherwise specified.
2. Electrolytic capacitors are shown in μF × volts unless otherwise specified.
3. All voltages shown are dc. Rf ground is indicated by the symbol ⏚ .
4. The “K” Group is marked by R256 and R257 (“G” and “H” resistors).

T2 ETSI-Approved RF Board

(from 90_8705D-11)

27B1018 (SB)