INSTRUCTION MANUAL

FT-2A UTO

YAESU MUSEN CO., LTD.

TOKYO JAPAN

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FT-2 AUTO VHF TRANSCEIVER

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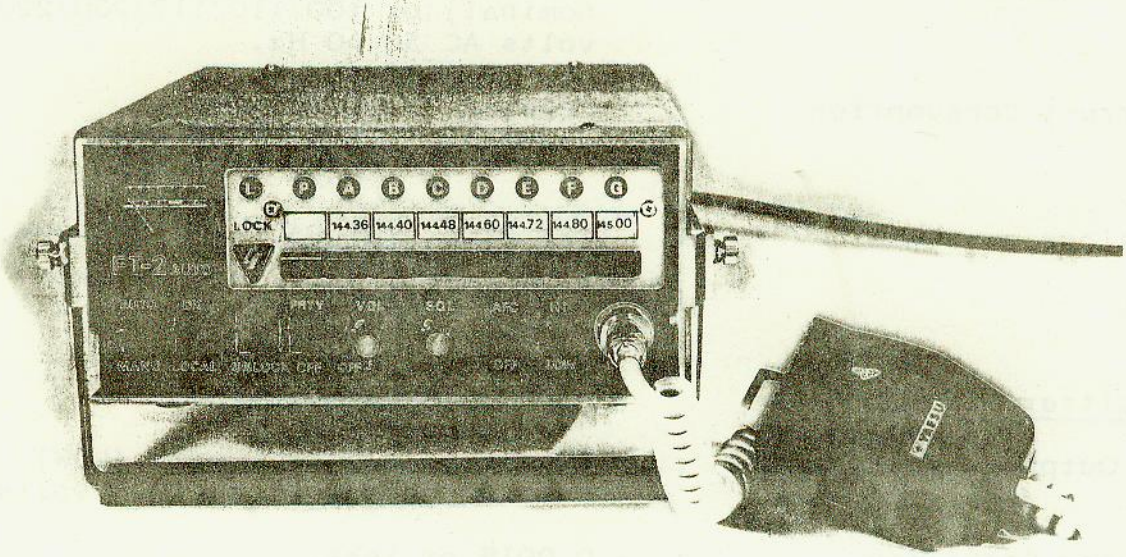


GENERAL DESCRIPTION

The FT-2 Auto Transceiver is a precisely built, compact, high performance FM transceiver designed for 2 meter amateur FM service. The FT-2 Auto is completely transistorized and has a feature of "Electronic Scanning" of up to eight crystal controlled simplex or duplex channels between 144-146 MHz or 146-148 MHz, with provision for sampling a "priority channel" while another channel is locked on. Other design features instant "lock on" by PTT button, tone burst signal generator for repeater actuation, and circuitry to prevent damage to final transistors in case of high antenna VSWR, or reversed DC power supply polarity.

The FT-2 Auto is self-contained, and it may be operated from 100/110/117/200/220/234 volts AC (normally supplied with wired 117 volts AC) or 13.5 volts DC. Two power cables are supplied with the transceiver and selection of AC or DC power source is automatic when the proper power cable is connected to the transceiver.

SPECIFICATIONS

General

Frequency Coverage	:	144-146 MHz or 146-148 MHz.
Number of Channels	:	8 (Crystals are supplied for 3 channels.)
Scanning Speed	:	20 channels/sec. approx.

Delay	:	0.3 second approx. after transmission.
Priority Channel Check	:	Every 2 sec. approx.
Power Requirement	:	12 to 14 volts DC (13.5 volts DC nominal) or 100/110/117/200/220/234 volts AC 50/60 Hz.
DC Current Consumption	:	Receive 0.53 Amp. Transmit Low 0.92 Amp. High 2.1 Amp.
Dimensions	:	(W) 210, (H) 95, (D) 270 m/m.
Weight	:	4.2 Kg approx.

Transmitter

Power Output	:	10 watts (HI) or 1 watt (LOW) into 50 ohms load at 13.5 volts DC.
Frequency Stability	:	0.001% or less.
Crystal Frequency	:	1/8 of transmitting frequency.
Deviation	:	Up to ±15 KHz max.
Spurious Radiation	:	60 db below carrier.
Tone Burst	:	Nominal 1800 Hz (adjustable between 1300-3000 Hz)

Receiver

Circuit	:	Crystal controlled double conversior superheterodyne.
Intermediate Frequency	:	10.7 MHz for first IF. 455 KHz for second IF.
Selectivity	:	±15 KHz at 6 db. ±25 KHz at 60 db.
Sensitivity	:	1 uV for 20 db quieting.
Audio Output	:	2 watts at 10% distortion.

INSTALLATION

GENERAL

The FT-2 Auto Transceiver is a precisely built VHF communication device and designed for both mobile and base operation. The transceiver has been factory pre-tuned and requires no adjustment for normal operation into a 50 ohms load. To prevent damage to the transceiver during installation and use, care should be taken to observe the following precautions.

* Do not attempt to connect the power cord to a power source with power switch ON.

* Do not connect or disconnect antenna with the power switch ON.

* Do not connect the power cord to the primary power source until polarity and voltage are determined.

* Do not use a mismatched antenna.

* Do not key the transmitter unless an antenna or dummy load is connected to the antenna coax connector.

ANTENNA

The antenna system is the most important consideration in either base or mobile installation, as effective communication range is directly related to antenna height. The antenna should always be as high and in the clear as possible. In mobile installation, it is advisable to locate the antenna as far from the engine as practical to minimize ignition noise pick up. In all installations, ensure that the antenna VSWR is less than 1.5:1.

For mobile installation, the most popular antennas are vertical types, either a ¼ wave length whip with unity gain, or a 5/8 wave length affording 3.5 db gain. Suitable mobile antennas are available from the most dealers in two-way mobile radio equipment.

To minimize losses in the antenna system, use the shortest length of coaxial cable that is practical, avoiding any sharp angles or kinks.

MOBILE INSTALLATION

In mobile service, the FT-2 Auto should be installed where the controls and indicators are easily visible during operation. The transceiver may be mounted in any position without degrading performance. Suitable locations are under the dash. A mounting bracket is available for this purpose. When the transceiver is mounted under the dash of a vehicle. keep the air path free from the vehicle's heater duct. Mount the transceiver away from the vehicle's heater system to prevent the damage to the components.

The mounting bracket should be fastened to the mounting surface with the screws, washers and nuts supplied.

Open the locking latch and remove the bottom part of the bracket. Position the transceiver so the slotted side rails on the case engage the flange on both sides of the bracket. Slide the transceiver into the bracket until it is positioned properly then replace the bottom part of the bracket and secure the locking latch.

The transceiver can be tilted within the mounting bracket if desired. Loosen the two knurled knobs on the bracket, tilt the transceiver to the proper angle, then tighten the knobs to secure it in position.

The DC power cable supplied may be plugged directly into the vehicle's cigar lighter receptacle. For a permanent installation, the lighter plug may be removed and the leads routed directly to the battery (red positive, black negative), or to the nearest termination of the battery If it is necessary to extend the power leads use #16 AWG insulated copper wire and do not make the leads any longer than required, otherwise excessive voltage drop may occur.

C A U T I O N

BEFORE CONNECTING THE POWER CABLE TO THE TRANSCEIVER, CHECK THE BATTERY CHARGING SYSTEM. IF THE VOLTAGE EXCEEDS 14.5 VOLTS DC, THE REGULATOR SHOULD BE READJUSTED SO THAT THE HIGHEST CHARGING VOLTAGE DOES NOT EXCEED 14.5 VOLTS. ALSO BE SURE TO OBSERVE PROPER POLARITY WHEN MAKING BATTERY CONNECTIONS. WITH REVERSED POLARITY THE TRANSCEIVER WILL NOT OPERATE.

Connect the DC power cable to the power receptacle on the rear panel. Connect the 50 ohms antenna cable to the ANT receptacle on the rear panel. Connect the microphone cable to the 4-pin microphone receptacle on the front panel.

An external 4 ohms speaker may be connected at the SP receptacle on the rear panel if desired. Use the external speaker plug supplied.

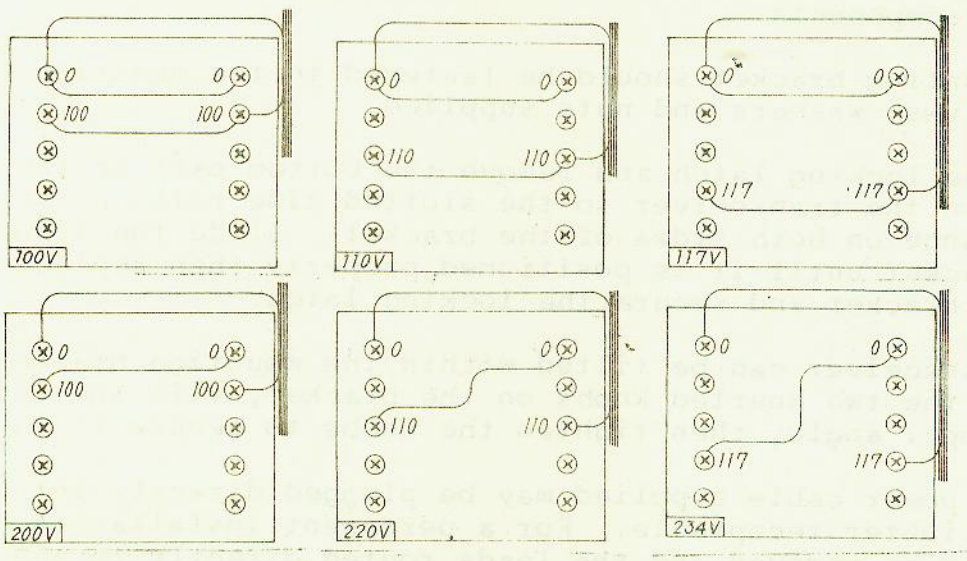
BASE STATION INSTALLATION

C A U T I O N

THE FT-2 AUTO WILL OPERATE FROM A 50/60 HZ SOURCE OF 100, 110, 117, 200 220 OR 234 VOLTS. CHECK THAT THE TRANSCEIVER IS PROPERLY WIRED FOR THE SOURCE TO BE USED, AS LABELLED ON THE REAR PANEL, PRIOR TO CONNECTING POWER CORD TO AN AC SOURCE. IF NOT, REFER TO CHANGING AC VOLTAGES HEREUNDER.

Connect the AC power cable to the power receptacle on the rear panel. Connect the 50 ohms antenna cable to the ANT receptacle on the rear panel. Connect the microphone cable to the 4-pin microphone receptacle on the front panel.

An external 4 ohms speaker may be connected at the SP receptacle on the rear panel if desired. Use the external speaker plug supplied.



Transformer Rewiring

OPERATION

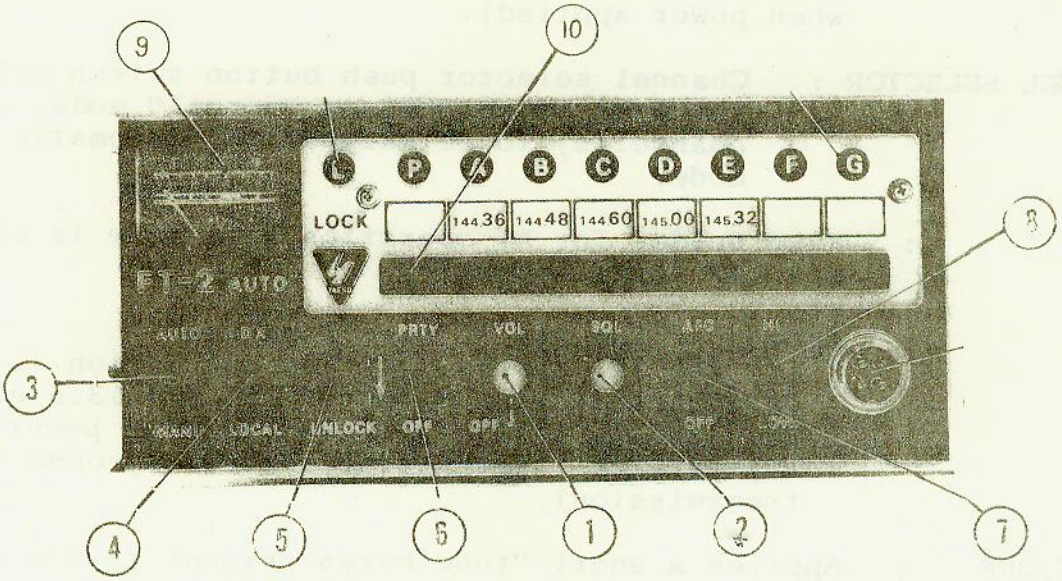
GENERAL

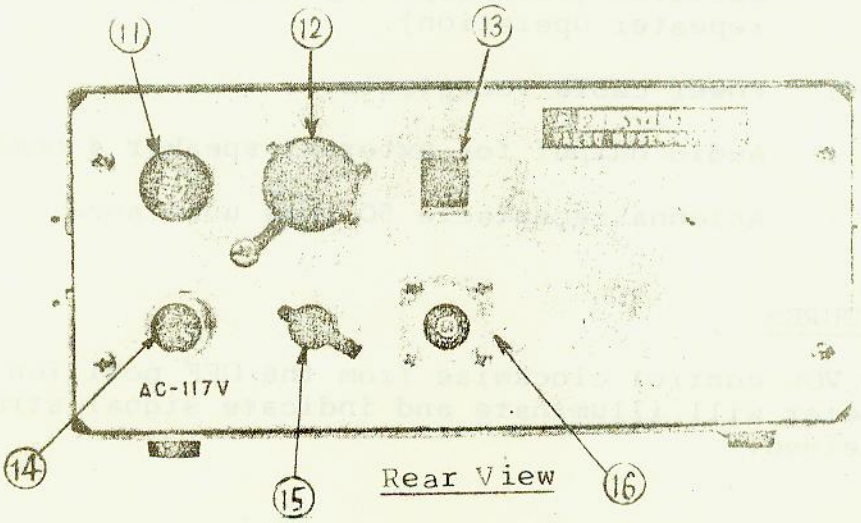
The FT-2 Auto Transceiver operates in two modes, "Automatic Scan" or "Manual". In the "automatic scan" mode, the transceiver will continually scan all 8 channels at a rate of 20 channels per second, and scan will stop on receipt of a signal, remaining on that channel until the received signal disappears. Immediately after the received signal disappears, the scan will resume unless a "lock" is established, holding it on that channel until it is unlocked. Provision is made to skip over selected channels if desired during the scanning process, and also to check a priority channel every 2 seconds while locked on another channel. If a signal appears on the priority channel, the receiver will automatically switch to that channel, locking on till the received signal disappears, then return to scanning.

In "manual" mode, any one of the 3 channels may be selected at a time by a front panel switch.

CONTROLS

The FT-2 Auto has been designed for many advanced design features. Be sure you throughly understand the function of each control before operating the equipment.





Rear View

1. VOL : Adjusts the receiver audio output level and turn on power when rotated clockwise from OFF position.

2. SQL : Adjusts the receiver squelch threshold level.

3. AUTO-MANU : Selects the mode of operation, automatic scan or manual.

4. DX-LOCAL : Receiver operates at full sensitivity in DX position to respond to weak signals. In LOCAL position, the receiver requires a stronger signal to open the squelch and stop the scan.

5. UNLOCK : Releases "lock" condition when pressed.

6. PRTY-OFF : In OFF position priority channel checking is disabled.

7. AFC-OFF : In AFC position "automatic frequency control" voltage is applied to receiver first local-oscillator to correct for "off frequency" station.

8. HI-LOW : Selects RF power output, 10 watts in HI, or 1 watt in LOW position when pressed.

9. "S" METER : Indicates signal strength on "receive" and relative power output on "transmit" (illuminated when power applied).

10. CHANNEL SELECTOR : Channel selector push button switch selects the desired channel in "manual" mode, or channel(s) to be skipped in "automatic scan" mode.

11. FUSE : Fuse holder for AC operation. 1A fuse is used for 117 volts operation.

12. ACC : Accessory socket. Connections are
(1) (4) (5) ground, (2) no connection
(3) discriminator output, (6) (7) 13.5 volts(+)
(8) 13.5 volts(+) connected through power switch
(9) external transmitter control (ground for transmission).

13. BURST-OFF : Applies a short "tone burst" signal to the carrier at the start of each transmission in burst position (normally only used with tone access repeater operation).

14. POWER : Power cable receptacle.

15. EXT SP : Audio output for external speaker 4 ohms.

16. ANT : Antenna receptacle 50 ohms unbalance.

OPERATING PROCEDURES

(1) Rotate the VOL control clockwise from the OFF position to apply power, then S-meter will illuminate and indicate signal strength when a signal is received.

(2) Set the controls as follows:

AUTO/MANU	MANU
DX/LOCAL	DX
AFC	OFF
SQL	Fully counter-clockwise
HI/LOW	Desired power output

(3) Press one of the channel selector push buttons and adjust the VOL control for a normal listening level. The channel indicator lamp will illuminate.

(4) When the channel is clear (no signal), rotate the SQL control clockwise until the receiver noise is just silenced. Do not rotate the control beyond the threshold point or the receiver will not respond to weak signals.

(5) When ready to transmit hold the microphone close to your lips, press the push-to-talk switch and speak into the microphone. Check the LOCK indicator lamp (L) illuminates and the meter moves upward indicating power output.

(6) If operating on a repeater channel requiring "tone signal", set the BURST switch on the rear panel to the "BURST" position, then "tone burst" will be applied to the carrier each time the push-to-talk switch is pressed.

(7) To operate in the "manual" mode, press the appropriate channel selector push button for the desired channel. Be sure only one button at a time.

(8) To operate in the "automatic scan" mode, set the AUTO-MANU switch to the AUTO position. The channel indicator lamps will illuminate momentarily as the scan checks each channel in turn. If it is desired to "lock out" a particular channel (or channels) press the appropriate push button (when locking out more than one channel, press the button simultaneously).

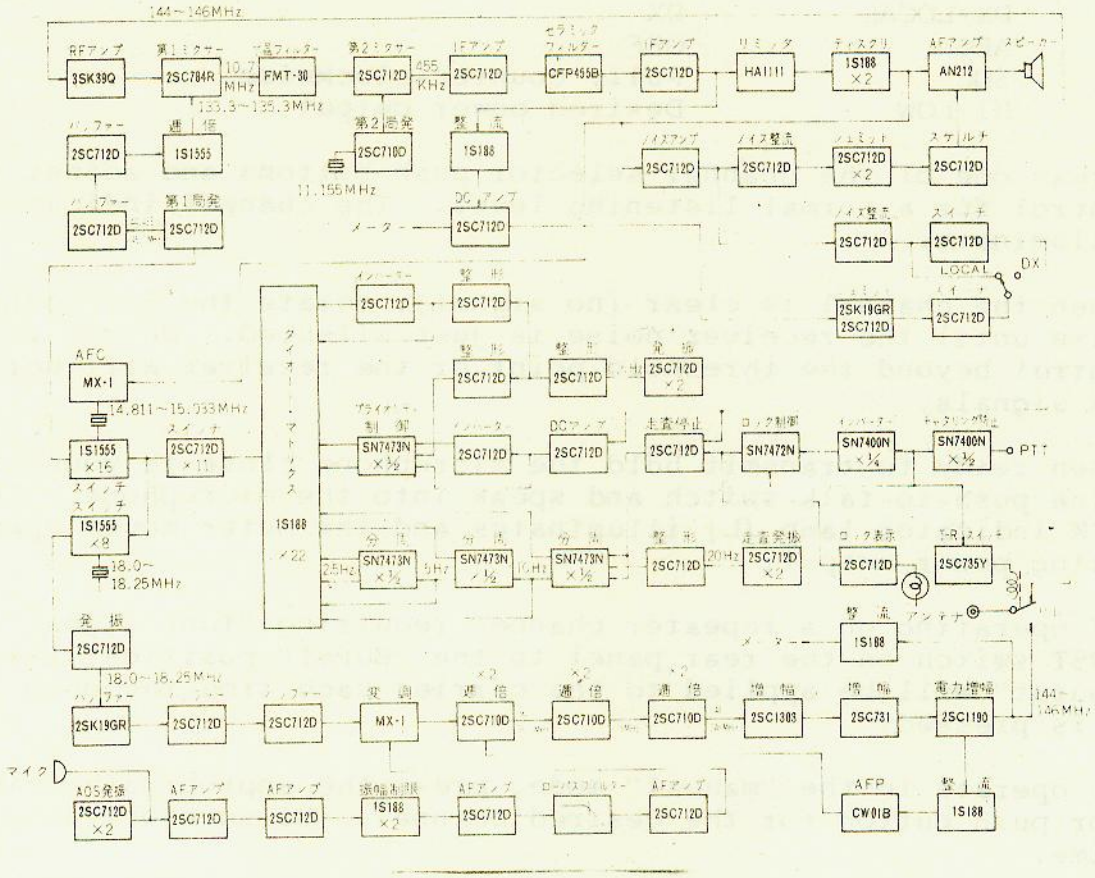
(9) When the scan stops on a signal the appropriate channel indicator lamp illuminates. If it is desired to "lock on" this channel, momentarily press and release the push-to-talk switch then LOCK indicator lamp (L) will illuminate.

(10) To "unlcok", momentarily press and release the push-to-talk switch a second time, or press the UNLOCK switch. The lock lamp will go out and the scan will resume until another signal is received.

Note : Normal push-to-talk operation during transmit will not affect the "lock" condition.

(11) If priority channel check is desired, set the PRTY-OFF switch to the PRTY position. If only strong signals are desired, set the DX-LOCAL switch to the LOCAL position.

THEORY OF OPERATION



Block Diagram

The block diagram will provide you with a better understanding of this transceiver. The transceiver consists of crystal controlled transmitter, receiver and scanning unit, operating on any of 8 channels within the frequency range of 144-146 MHz or 146-148 MHz. Solid state circuit is employed throughout, and the transceiver is designed to operate from a 12 to 14 volts DC (negative ground), or 100, 110, 117,200, 220 or 234 volts 50/60 Hz AC power source.

TRANSMITTER CIRCUIT

The speech signal from the microphone is amplified in two stage mic amplifiers, Q201 and Q202, 2SC712D, and applied to an IDC (instantaneous deviation control) circuit which consists of two diodes D201 and D202 where both positive and negative peaks are clipped when they exceed a predetermined level to limit the maximum deviation of the transmitter. The IDC control VR202 sets the maximum deviation and is normally factory set for a deviation of ±15 KHz (7.5 KHz for U.S.).

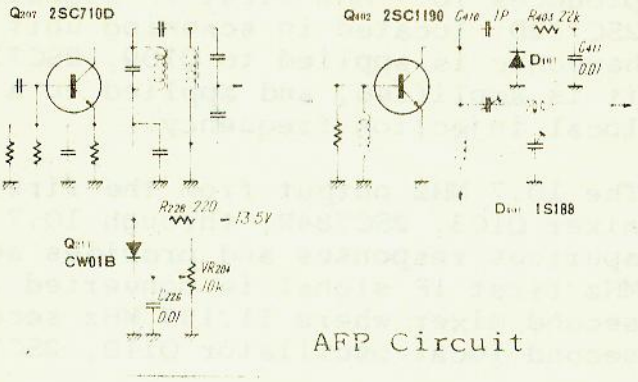
The limited audio signal is amplified by Q203, 2SC712D, and applied to Q204, 2SC712D, through the low pass filter which passes the audio less than 2500 Hz. The output from Q204 is applied to the phase modulator D204.

An oscillator stage Q328, 2SC712D, located in the scanner unit, oscillates at the fundamental crystal frequency which is multiplied 8 times in the following multiplier stages to produce the desired transmitting frequency. The 18 MHz output from the oscillator is applied to Q206 where it is amplified and applied across transformer L203.

The modulated output is relatively small in deviation. Therefore, it is applied to the succeeding frequency multiplier stages to obtain the necessary frequency deviation at the transmitting frequency.

These doubler stages, Q207 through Q209, 2SC710D x 3, provide 8 times frequency multiplication and the multiplied output signal is amplified by the buffer stage, Q210, 2SC1303, and then coupled class C amplifier stages which consist of driver Q401, 2SC731, and final amplifier, Q402, 2SC1190. 10 watts of RF output power is delivered into a 50 ohms load through the pi-network low pass filter. When HI-LOW switch is set to the LOW position, a resistance is placed in series with the 13.5 volts DC applied to Q401 and Q402, reducing the power output to approximately 1 watt.

AFP (automatic final protection) circuit is provided to protect the final transistor against over-load conditions, which may occur if the transmitter is keyed without an antenna or with a high VSWR antenna system. When high VSWR exists, L2 picks up a RF energy which is rectified by D4, 1S188FM.

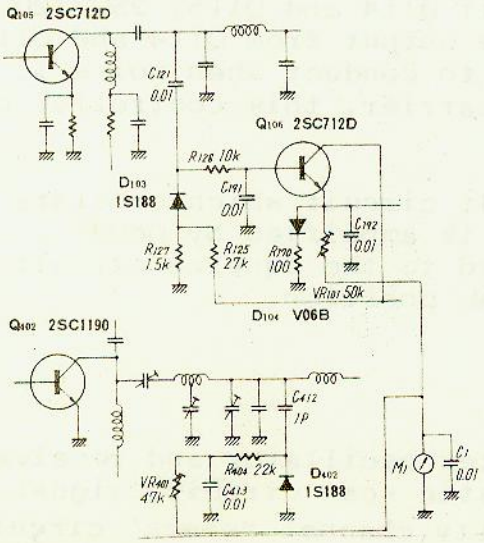


AFP Circuit

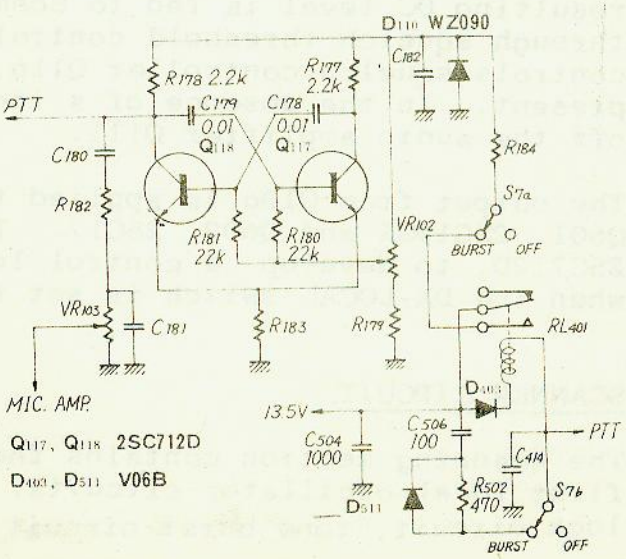
The rectified DC voltage is applied as a control voltage to an SCR Q211, CW01B, through threshold control VR204. Q211 is triggered by the DC voltage into conduction and decreases the voltage supplied to Q207, in turn removing the drive to the following stages to protect Q402.

Diode D402 rectifies a small portion of the RF output and applies the resulting DC level to the meter where it provides an indication of relative power output from the transmitter. The PO ADJ potentiometer VR401 is used to adjust meter sensitivity.

The tone burst circuit consists of a timing generator and a gated multivibration. When the BURST switch is set to the BURST position, and the transmitter keyed, +13.5 volts DC is applied to trigger the timing generator Q121. The timing generator produces an output pulse applied to Q122. Transistor Q122 gates Q117 and Q118 for the duration of the pulse from Q122 to produce a tone output that is applied to the microphone input. The tone frequency is adjustable between 1300 and 2000 Hz by VR102, while the output level is adjusted by VR103, and the burst duration by VR105.



Meter Circuit



Burst Circuit

RECEIVER CIRCUIT

The receiver is double conversion superheterodyne system using 10.7 MHz first IF and 455 KHz second IF.

The input signal from the antenna is amplified by MOSFET, Q101, 3SK39Q, and applied through five hi-Q slot coupled resonators to the first mixer Q102, 2SC784R. The use of a MOSFET RF amplifier, together with the slot resonators, combines to minimize cross modulation and spurious responses, while providing a low noise figure for the receiver front end.

The incoming signal is mixed with the output of the first local oscillator of which frequency is 10.7 MHz below the input signal, and produces 10.7 MHz first IF signal. The first local oscillator Q329, 2SC712D, located in scanning unit oscillates 15 MHz and its third harmonic is applied to Q109, 2SC712D, through Q330, 2SC712D, where it is amplified, and applied to a diode tripler to provide the first local injection frequency.

The 10.7 MHz output from the first mixer Q102 is applied to the second mixer Q103, 2SC784R, through 10.7 MHz crystal filter which reduces spurious responses and provides adjacent channel rejection. The 10.7 MHz first IF signal is converted into 455 KHz second IF signal by the second mixer where 11.155 MHz second local signal is applied from the second local oscillator Q110, 2SC710D.

The 455 KHz second IF signal is amplified by Q104, 2SC712D, then fed to IF amplifier Q105, 2SC712D, through a ceramic-mechanical filter which determines the band width and selectivity of the receiver.

A portion of the 455 KHz output from Q105 is rectified by D103, 1S188, and the resulting DC voltage is amplified by DC amplifier Q106, 2SC712D, and applied to the meter M1, where it provides an indication of relative received signal strength.

The 455 KHz signal is then applied to a limiter amplifier Q107, HA1111, integrated circuit. The limiter is so designed that input signal variations in amplitude produce no change in the output signal. The output from the limiter is fed to the discriminator where the FM signal is converted to the audio signal which is then fed to the audio amplifier Q111, AN-212, integrated circuit through volume control VR1. The audio amplifier delivers 2.5 watts audio output to the speaker.

The squelch circuit consists of Q112 through Q116, 2SC712D x 4. When no signal is present in the 455 KHz IF, the discriminator output noise is amplified by Q112. The output from Q112 is rectified by Q113 and resulting DC level is fed to Schmidt circuit Q114 and Q115, 2SC712D x 2, through squelch threshold control VR2. The output from Q114 and Q115 controls squelch controller Q116, 2SC712D, to conduct when noise is present. In the absence of a incoming RF carrier, this controller cuts off the audio amplifier Q111.

The output from Q106 is applied to a Schmidt circuit which consists of Q601, 2SC19GR and Q602, 2SC17. The output is amplified by Q603, 2SC712D, to develop a control level applied to the squelch circuit when the DX-LOCAL switch is set to the LOCAL position.

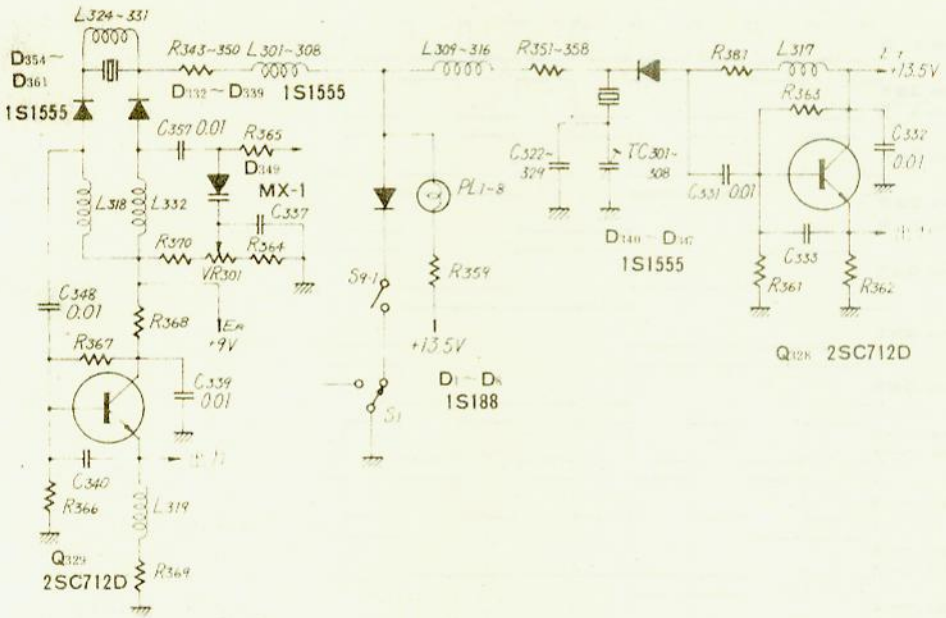
SCANNER CIRCUIT

The scanning section contains the transmitter oscillator and receiver first local oscillator circuits, the automatic scan circuit, signal lock circuit, tone burst circuit and priority channel "check" circuit.

MANUAL OPERATION

When AUTO-MANU switch is set to MANU position, the desired channel is selected by pressing the appropriate push button. It supplies a ground return for the appropriate crystals (TX and RX) and the channel indicator lamp.

The transmitter crystals, X309 through X316 are connected to the transmitter oscillator Q328. The receiver crystals X301 through X309 are connected to the receiver first local oscillator Q329. In the AFC position of the AFC-OFF switch, the receiver discriminator output is applied to a varactor diode D349, MX-1. An off frequency carrier will produce either a positive or negative output from the discriminator. This voltage varies the bias applied to D349, in turn causing the frequency change. As the diode is connected to the crystals, any change of its capacitance will shift the frequency of the crystals sufficiently to "lock on" to the carrier frequency. The FREQ ADJ control VR301 sets the bias level applied to D349.



Manual Channel Select Circuit

AUTOMATIC SCAN OPERATION

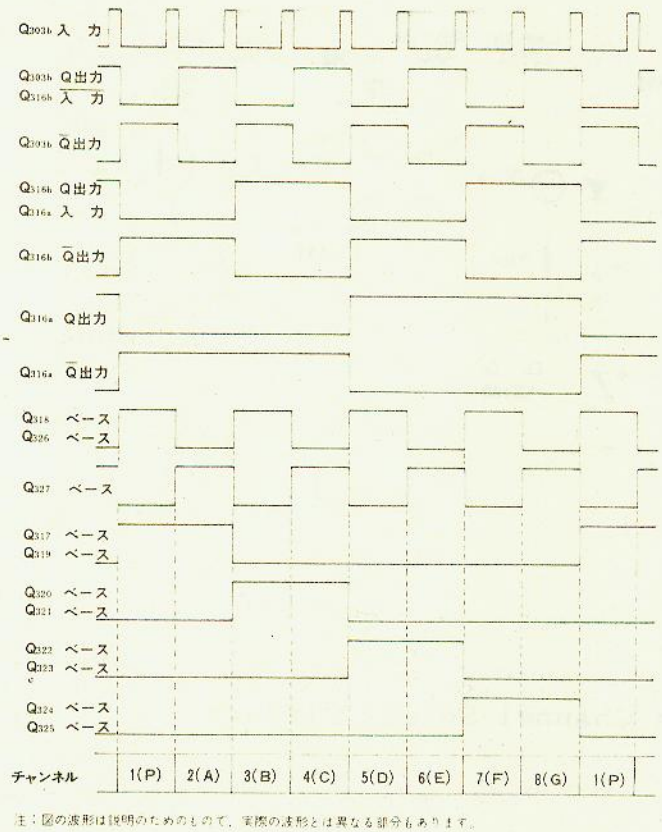
When the AUTO-MANU switch is set to AUTO position, the receiver will scan continuously all 8 channels at a rate of approximately 20 channels/second. When a carrier exists at one of the channels, the scan will stop and the receiver will stay on that channel until the carrier disappears, at which time the scan will resume.

The transmit and receive crystals for each channel are selected by the switching action of Q317 through Q327, 2SC712D, where two transistors are connected in series. The relation between conducting transistors and switched channels are shown on table 1.

Conducting Transistor	Receive Crystal	Transmit Crystal	Channel
Q317, Q318	X-301	X-309	P
Q319, Q327	X-302	X-310	A
Q320, Q326	X-303	X-311	B
Q321, Q327	X-304	X-312	C
Q322, Q326	X-305	X-313	D
Q323, Q327	X-306	X-314	E
Q324, Q326	X-307	X-315	F
Q325, Q327	X-308	X-316	G

Table 1

Automatic scanning circuit consists of the clock pulse generator, three flip-flop circuits and diode matrix circuit.



注：図の波形は説明のためのもので、実際の波形とは異なる部分もあります。

Automatic Scan Clock Pulse

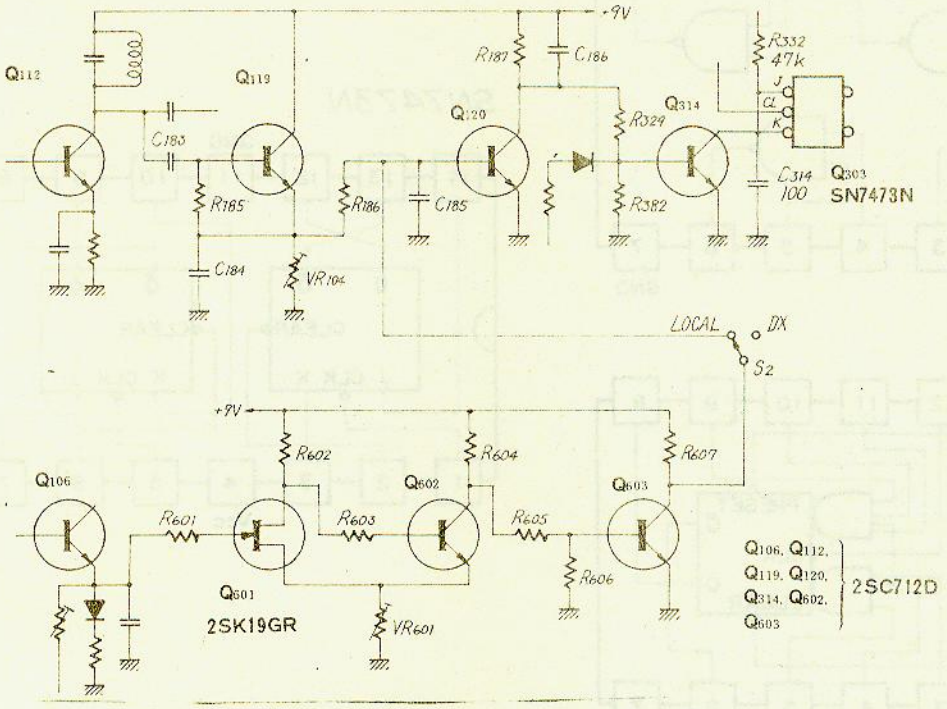
Transistors Q311, Q312, 2SC712D x 2, generate clock pulse of 20 Hz which is shaped by Q313, 2SC712D, and fed to the clock terminal of J-K flip-flop Q303b, SN7473N, providing two outputs Q and $\bar{Q}$. The Q output of Q303b in turn clocks flip-flop Q316b, SN7473N, and the output of Q316b clocks a third flip-flop Q316a, SN7473N. The Q and $\bar{Q}$ output of these three flip-flops are applied to Q317 and Q319 - Q325 through diode matrix circuit to produce the scan as illustrated in Table 1.

If a carrier is present during any 20 Hz sample, the squelch output from Q120, 2SC712D, causes Q314, 2SC712D, to conduct. This inhibits the J and K input of Q303b, the flip-flop will not change state with

a clock pulse and the receiver locks on that channel until the carrier disappears removing the inhibited level at Q303b. The delay time is determined by the time constant which consists of R332 and C314 and selected to 0.3 sec. The signal level is adjusted by VR104 to lock the scan with the signal less than 1 uV.

The circuit is provided to lock the scan with the signal stronger than predetermined level. DC output from Q106 is fed to the Schmidt circuit Q601, 2SK19GR, and Q602, 2SC712D. Q603, 2SC712D is OFF condition until this voltage reaches the trigger level predetermined by VR601. When DX-LOCAL switch is set to LOCAL position, Q120 is conducting while Q603 is OFF without noise input to Q119, in another word, the scan will not lock with weaker signal and lock with the stronger signal which delivers DC output from Q106 to exceed threshold level predetermined by VR601 and cause Q120 to conduct.

One or more channels may be "locked out" if desired by pressing the appropriate channel push buttons. This applies a ground return at the base of Q314 during that 50 ms sample and prevents the squelch output from inhibiting Q303b.

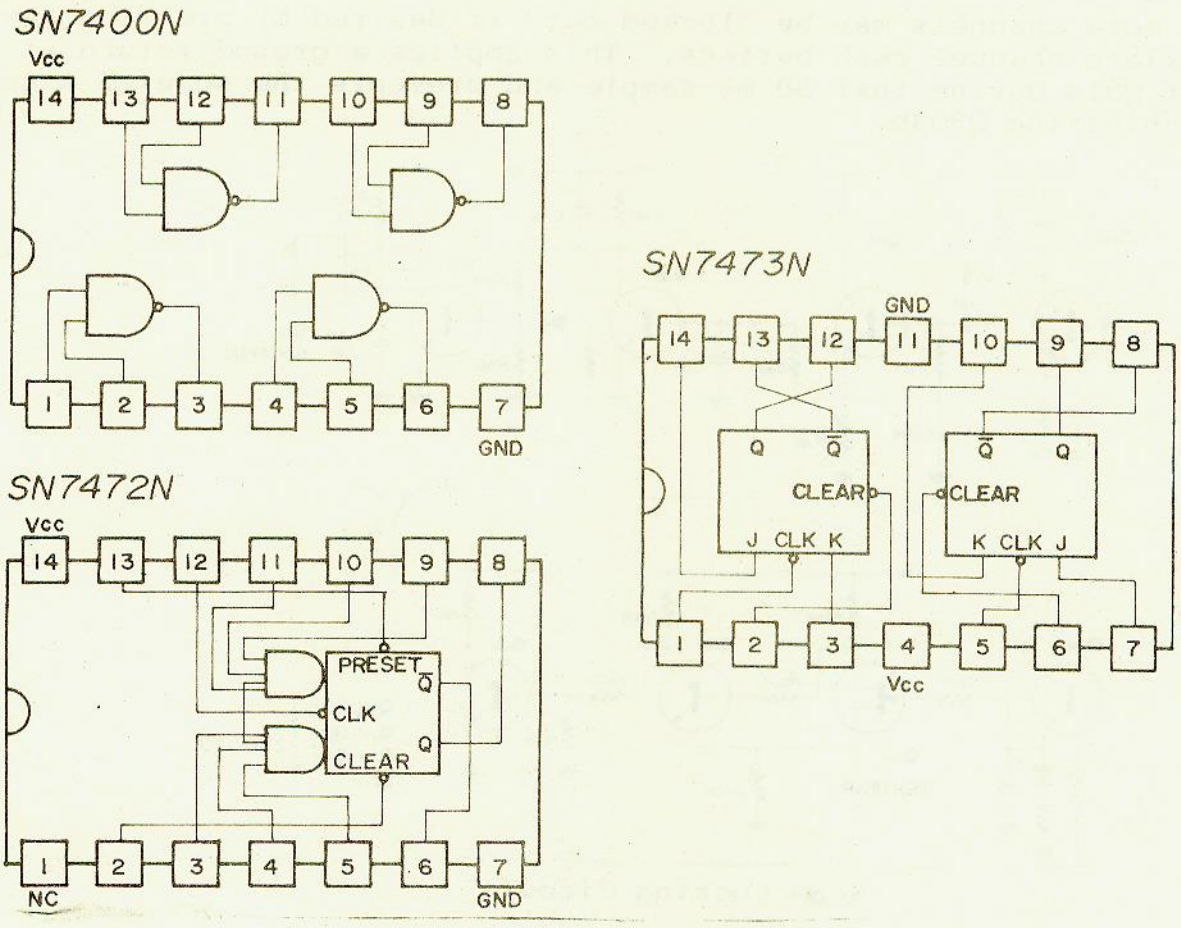


Scan Locking Circuit

Once the scan has stopped on a signal the transceiver may be locked on that channel by momentarily pressing and releasing the push-to-talk switch on the microphone. This removes the ground at the input at Q701, SN-7400N, and applies a ground to the input of Q701b, causing the flip-flop to change state. The output of Q701b in turn triggers Q702, SN7472N, causing it to change the state, and also turns Q703, 2SC735Y, "ON" momentarily, energizing the relay RL401. The $\overline{Q}$ output of Q702 is high and in turn enables Q314 and Q315. The output of Q314 then inhibits the J-K input of Q303b to lock the scan, while the output of Q315 illuminates the LOCK (L) lamp.

To unlock, the push-to-talk switch is momentarily pressed and released a second time, again causing Q701a and Q701b to trigger Q702 or the UNLOCK switch can be pressed, applying a ground to the "present" input to Q702. Either of these conditions causes Q702 to change state and inhibit Q314 and Q315.

When the PRTY-OFF switch is set to the PRTY position, Q305 through Q307 generate clock pulse 2 seconds apart and these clocks J-K flip-flop Q303a providing two outputs Q and $\overline{Q}$. The Q output is applied as input to both Q317 and Q318, while the $\overline{Q}$ output is applied to both Q326 and Q327. When the Q output is high Q317 and Q318 are enabled, while the low $\overline{Q}$ output inhibits Q326 and Q327. This causes the receiver to switch to channel P. If no carrier is present during the "check", the receiver will revert to the previous channel. However, if a carrier is present, the squelch output is inverted by Q301 and applied to the K-input of Q303a, and inverted again by Q302 and applied to the J-input. This inhibits Q303a and the flip-flop will not change state with the next clock pulse, keeping the receiver locked to P channel until the carrier disappears.



Internal Block Diagram of I.C.

POWER SUPPLY

AC Operation

When the AC power cable is connected, the AC power is applied between pin 1 and pin 2 of J2. The input is applied to the transformer through the fuse F1 and power switch S8A. Power transformer has two multi-tap primary windings. These may be connected in parallel for 100, 110, or 117 volts and in series for 200, 220 or 234 volts operation.

The output voltage AC 16 volts from the transformer is rectified by a diodes bridge connected D501 through D508, V06B x 8, filtered, and applied to the regulator Q1, 2SD114Y. The regulator Q1 regulates DC output to 13.5 volts DC with the base referenced by D509, 1N4744.

DC Operation

When the DC power cable is connected, the DC voltage (13.5 volts) is applied between pin 3 and pin 4 (ground). Diodes D403, D404 and D540 are used to protect the circuit if the power cable is accidentally connected with the polarity reversed.

Note : The DC input is fused at 3 amp in the DC power cable.

ALIGNMENT

The model FT-2 Auto VHF Transceiver has been carefully designed and tested prior to shipment from the factory. The reliability of the solid-state devices used in FT-2 Auto should provide years of trouble free service.

C A U T I O N

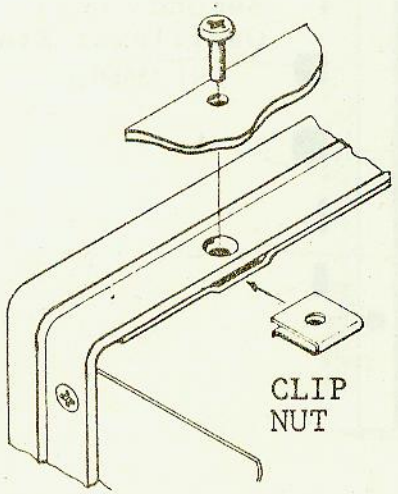
DO NOT EXCEED 14.0 VOLTS AT THE POWER RECEPTACLE.

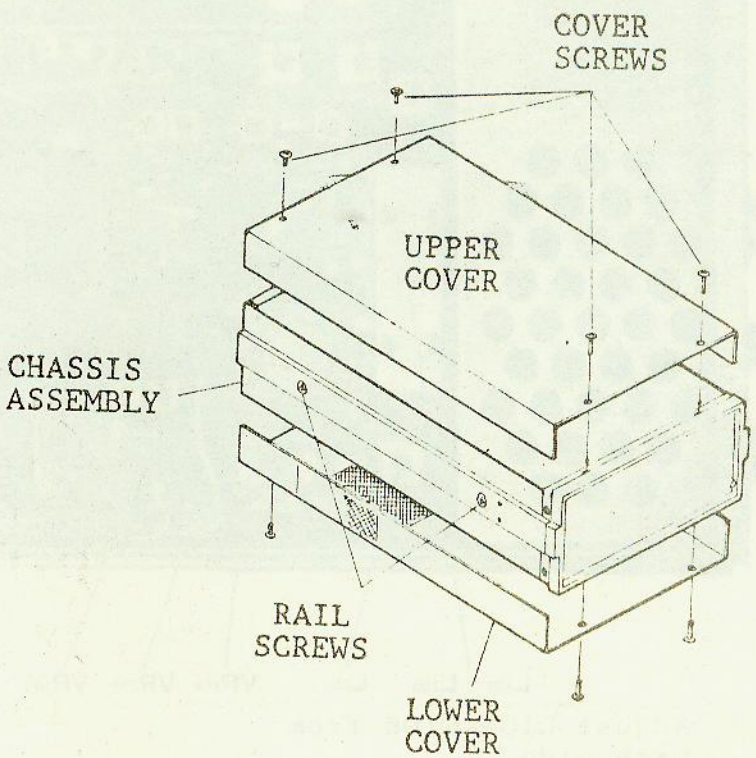
DISASSEMBLY

(1) Loosen the 4 screws securing the slotted side rails to the chassis.

(2) Remove the 8 screws on the top and bottom covers and remove the covers.

(3) To check scanning unit, remove two screws marked # and wires marked * and pull the printed board.





RECEIVER ADJUSTMENT

(1) Pull out second local oscillator crystal 11.155 MHz from the socket.

(2) Connect signal generator output exactly set to 455 KHz to the base of Q104.

(3) Connect VTVM (DC range) between pin 3 of accessory socket and ground.

(4) Turn L116 fully clockwise direction.

(5) Peak L115 for maximum VTVM reading.

(6) Carefully adjust L116 for zero VTVM reading.

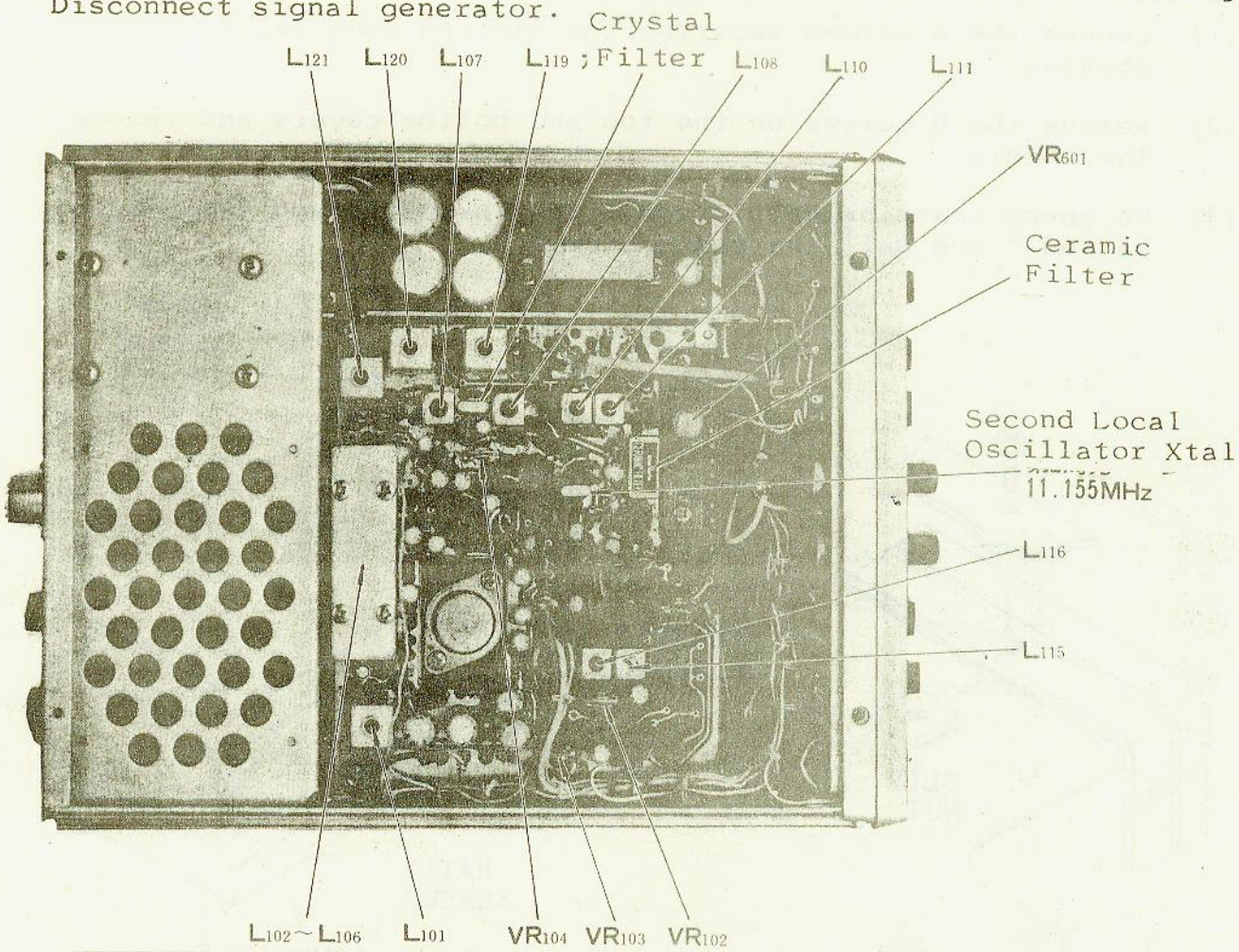
(7) Disconnect signal generator from Q104, and connect to the base of Q103. Disconnect VTVM.

(8) Adjust L110 and L111 for maximum S-meter reading.

(9) Reinstall the 11.155 MHz crystal.

(10) Disconnect the coax input of the first local oscillator.

(11) Connect signal generator output exactly set to 10.7 MHz to the base of Q102 and adjust L107 and L108 for maximum S-meter reading. Disconnect signal generator.



Adjust L102-L106 from back side.

Bottom View

(12) Connect the output of a sweep generator set to the center frequency of 2 meter band (i.e. 147 MHz for 146-148 MHz band and 145 MHz for 144-146 MHz band).

(13) Connect temporary 0.01 uf capacitor between the collector of Q102 and ground.

(14) Connect oscilloscope to TP101.

(15) Adjust L101-L106 for maximum gain and unity characteristics over the band.

(16) Disconnect sweep generator, capacitor and scope.

(17) Connect the coax input from the first local oscillator to the pin.

(18) Connect RF probe of VTVM to TP102 and adjust L320, L321 and L119 for maximum VTVM reading.

(19) Disconnect VTVM.

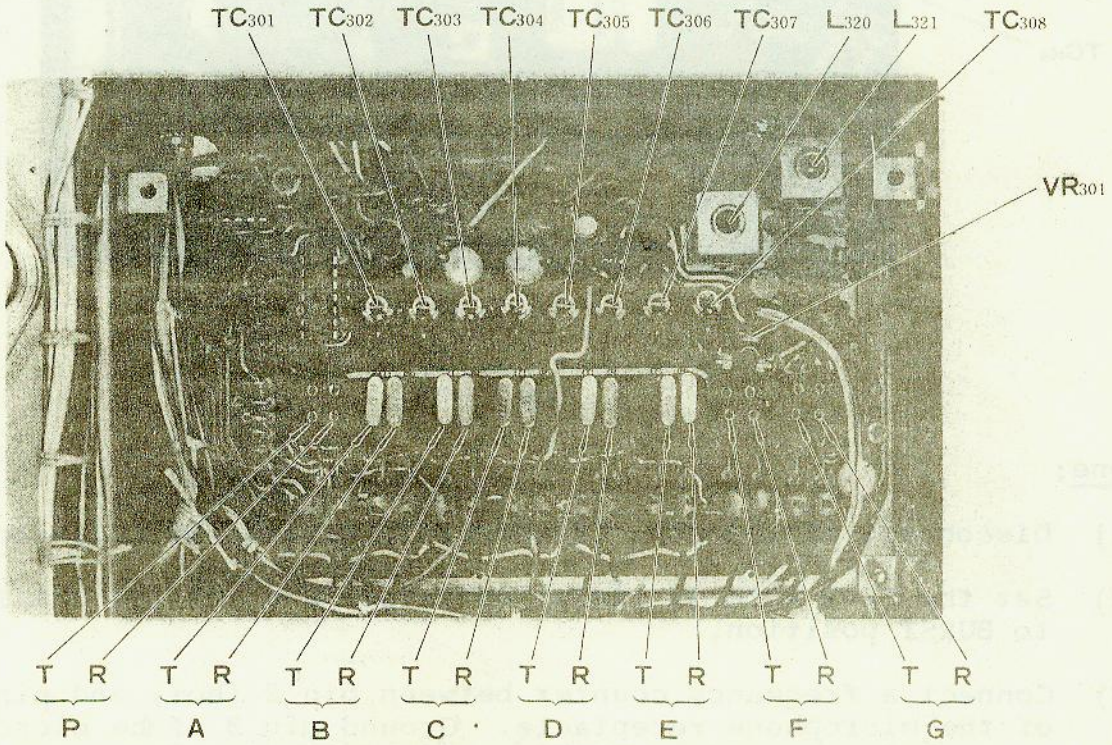
(20) Connect an antenna and receive the signal. Peak L120 and L121 for maximum S-meter reading.

TRANSMITTER ADJUSTMENT

C A U T I O N

FOR THE TRANSMITTER ADJUSTMENT ALWAYS CONNECT 50 OHMS DUMMY LOAD TO THE ANT RECEPTACLE.

Crystal Trimmer;



Scanner Board

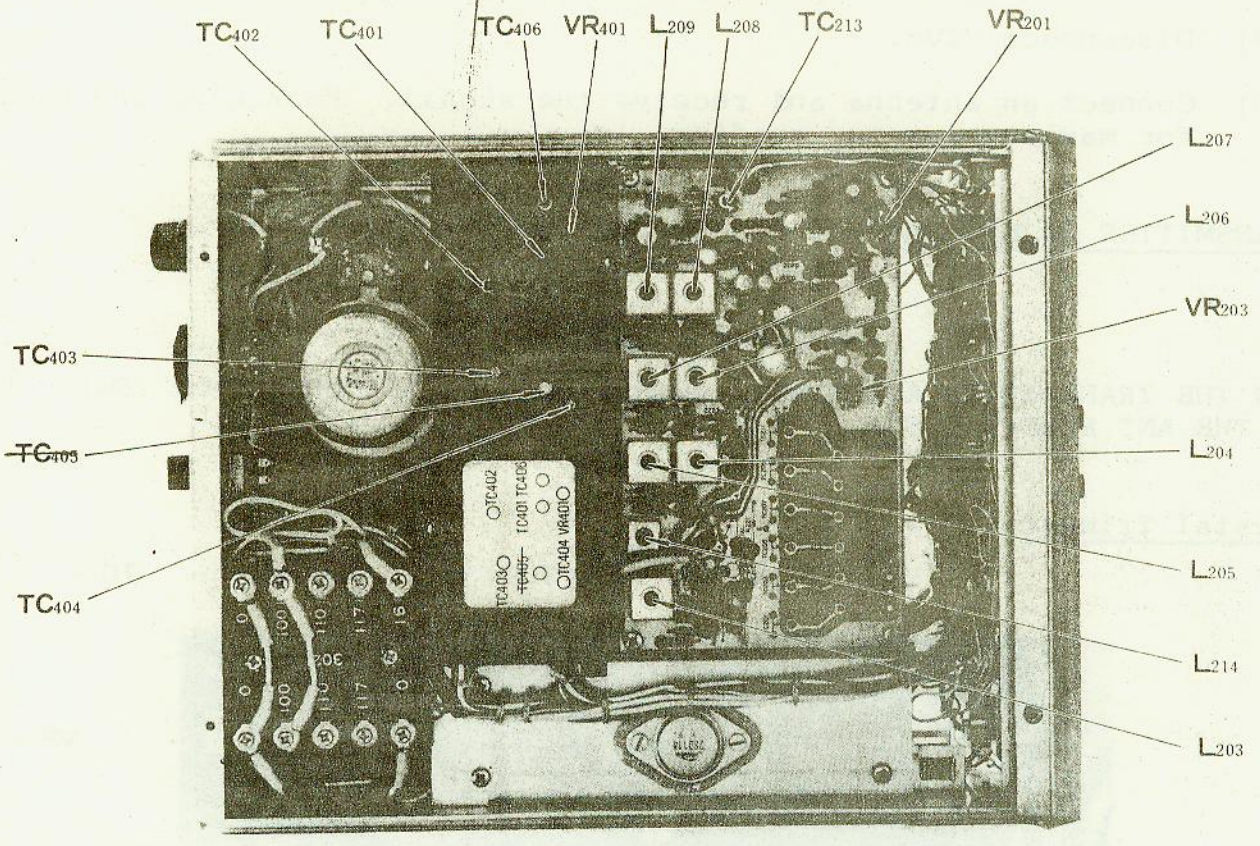
(1) Disconnect the coaxial oscillator input and exciter output cables and green AFP cable from the transmitter exciter unit.

(2) Remove the 2 screws on the exciter unit adjacent to shielded PA compartment and swing the hinged exciter unit upward to adjust the scanner unit.

(3) Connect the frequency counter to the coaxial oscillator input cable and set the FT-2 Auto for manual operation.

(4) Key the transmitter and adjust the appropriate trimmer capacitor TC301 through TC308 for correct frequency and repeat this procedure for each channel.

(5) Replace the exciter unit, securing with the 2 screws and reconnect the all cables.



Top View

Tone;

(1) Disconnect microphone. Temporarily ground the collector of Q122.

(2) Set the FT-2 Auto in manual operation and set the BURST-OFF switch to BURST position.

(3) Connect a frequency counter between pin 2 (hot) and pin 1 (ground) of the microphone receptacle. Ground pin 3 of the microphone receptacle and adjust VR102 until counter reads the exact tone frequency desired.

(4) Remove the temporary ground at the collector of Q122.

(5) Key the transmitter and adjust VR105 for the desired tone burst length (one second max.)

(6) Adjust VR103 for ±7.5 KHz for U.S. or 15 KHz deviation (a deviation meter should be used).

Deviation;

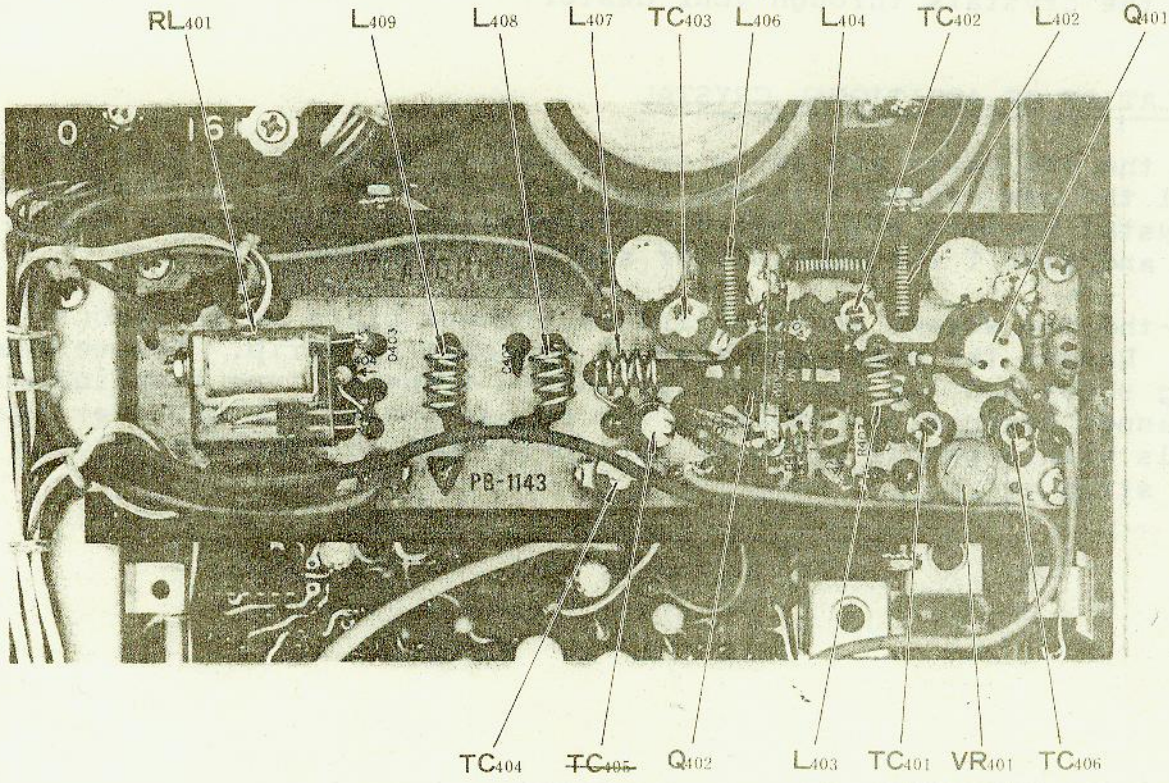
(1) Disconnect microphone. Set BURST switch to OFF position.

(2) Connect the output of an audio oscillator between pin 2 (hot) pin 1 (ground) of the microphone receptacle. Set oscillator output to 80 mili volt at 2500 Hz.

(3) Set the FM deviation meter and key the transmitter by grounding pin 3 of the microphone receptacle and adjust IDC potentiometer VR102 for a deviation desired (normally ±7.5 KHz in U.S. and ±15 KHz in other countries).

(4) Set the audio oscillator to 25 mili volt at 10 KHz and key the transmitter. Adjust potentiometer VR201 for deviation of ±10 KHz for (±15 KHz) wideband operation or ±3 KHz for (±7.5 KHz) narrowband.

(5) Disconnect the audio oscillator and set the BURST switch to BURST position. Key the transmitter and adjust VR101 for same deviation as step 3.



Final Power Amplifier

Meter & AFP;

(1) Set the FT-2 Auto for normal HI power operation. Key the transmitter and check the S-meter. Adjust VR401 until the meter shows 5 with approximately 10 watts output.

(2) Disconnect the dummy load from the ANT receptacle and momentarily key the transmitter. Adjust VR204 until S-meter indicates between 1 and 2.

(3) Connect the RF output of signal generator to the ANT receptacle and set the FT-2 Auto to normal operation in manual mode.

(4) Set the signal generator to the receiving frequency and its output to 5 micro volt. Adjust VR101 until S-meter reads 10.

I M P O R T A N T

Your FT-2 Auto VHF FM Transceiver is supplied with the crystal for 3 channels specified by your dealer when it is ordered. You may add up to five more sets of crystal to provide with operation on repeater or simplex frequencies used in your area.

ORDERING CRYSTAL

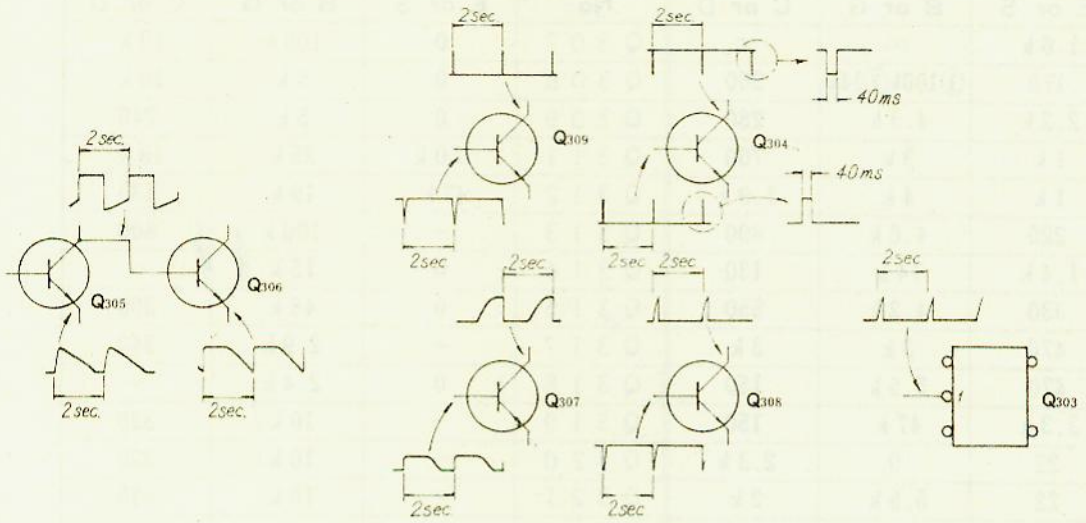
The crystals used in FT-2 Auto are manufactured to extremely close tolerance to match the oscillator circuit. It is recommended to obtain the crystals through your dealer.

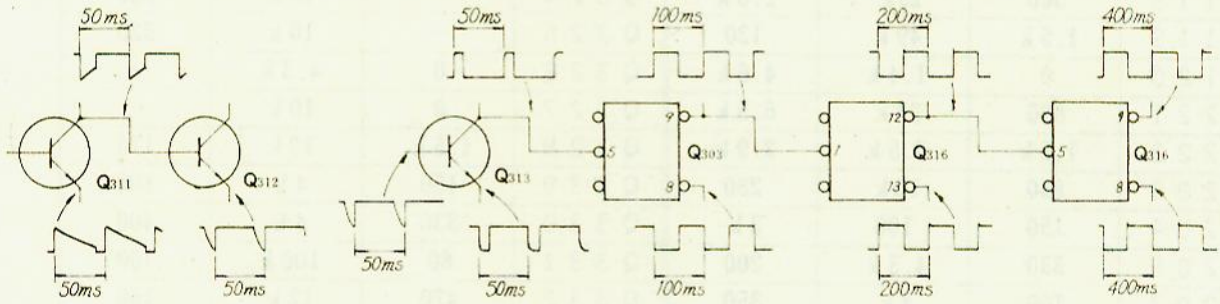
INSTALLATION OF ADDITIONAL CRYSTAL

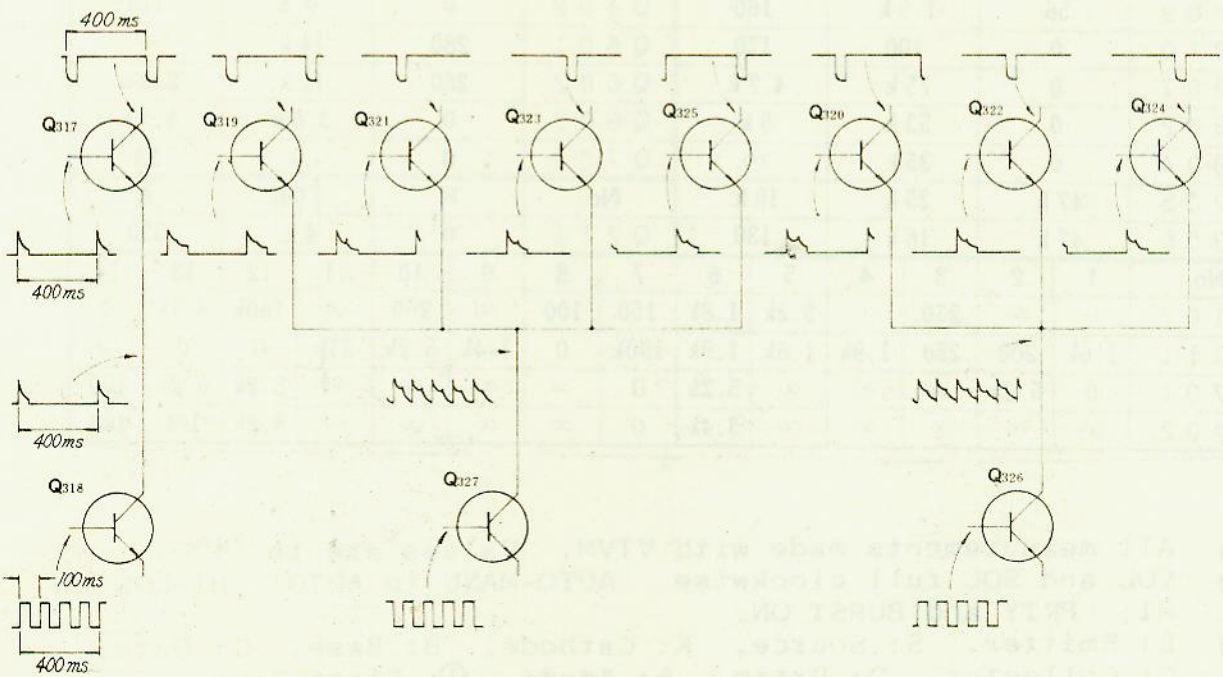
Remove the top cover and swing up the hinged transmitter unit and install the new crystals in the appropriate socket on the scanner unit. The crystal sockets are labeled corresponding to the channel designation and also T for transmitter and R for receiver.

Remove the two screws securing the escutcheon plate to the front panel. Remove the plate and channel designation strip. Remove the backing sheet and lay the sheet of rub-on transfer type supplied over the channel designation strip in the proper position. Rub over the numerals with a pencil point or ball-point pen to transfer through to the strip.

SCAN WAVEFORMS







RESISTANCE MEASUREMENTS

No.	E or S	B or G	C or D	No.	E or S	B or G	C or D
Q 1	1.6 k	∞	∞	Q 3 0 7	0	100 k	10 k
Q 1 0 1	170	①100k②14k	260	Q 3 0 8	0	5 k	10 k
Q 1 0 2	2.2 k	4.3 k	280	Q 3 0 9	0	5 k	240
Q 1 0 3	1 k	3 k	700	Q 3 1 1	150 k	25 k	19 k
Q 1 0 4	1 k	4 k	1.9 k	Q 3 1 2	47 k	19 k	130
Q 1 0 5	220	4.6 k	800	Q 3 1 3	—	100 k	800
Q 1 0 6	1.4 k	14 k	130	Q 3 1 4	0	15 k	—
Q 1 0 9	330	4.2 k	550	Q 3 1 5	0	48 k	300
Q 1 1 0	470	3 k	3 k	Q 3 1 7	—	2.9 k	340
Q 1 1 2	470	5.5 k	150	Q 3 1 8	0	2.4 k	—
Q 1 1 3	3.3 k	47 k	150	Q 3 1 9	—	10 k	320
Q 1 1 4	22	0	2.3 k	Q 3 2 0	—	10 k	320
Q 1 1 5	22	5.5 k	.2 k	Q 3 2 1	—	10 k	320
Q 1 1 6	0	5.5 k	7.5 k	Q 3 2 2	—	10 k	320
Q 1 1 7	560	29 k	2.6 k	Q 3 2 3	—	10 k	320
Q 1 1 8	560	29k	2.6 k	Q 3 2 4	—	10 k	320
Q 1 1 9	1.5 k	49 k	130	Q 3 2 5	—	10 k	320
Q 1 2 0	0	1.4 k	4.6 k	Q 3 2 6	0	4.3 k	—
Q 2 2 1	680	23 k	6.5 k	Q 3 2 7	0	10 k	—
Q 2 2 2	1.5 k	6.5 k	2.9 k	Q 3 2 8	1.5 k	12 k	170
Q 2 0 3	850	13 k	280	Q 3 3 9	150	4 k	400
Q 2 0 4	150	180	3 k	Q 3 3 0	330	4 k	400
Q 2 0 6	330	4.3 k	200	Q 3 3 1	80	100 k	160
Q 2 0 7	100	4 k	350	Q 3 3 2	470	12 k	160
Q 2 0 8	56	1.5 k	380	Q 4 0 1	0	0.5	170
Q 2 0 9	56	1.5 k	160	Q 4 0 2	0	0.5	170
Q 2 1 0	0	100	170	Q 6 0 1	280	14 k	—
Q 3 0 1	0	75 k	4.7 k	Q 6 0 2	280	11 k	2.2 k
Q 3 0 2	0	53 k	5 k	Q 6 0 3	0	3.6 k	5.1 k
Q 3 0 4	0	35 k	∞	Q 7 0 3	0	0	13
Q 3 0 5	47 k	25 k	16 k	No.	K	G	A
Q 3 0 6	47 k	16 k	130	Q 2 1 1	0	4 k	350

No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Q 1 0 7	—	∞	230	∞	5.2k	1.8k	150	100	∞	260	∞	160k	3.9k	0
Q 1 1 1	1.6k	200	250	1.9k	1.6k	1.9k	190k	0	3.4k	5.2k	31k	0	0	∞
Q 7 0 1	0	5.2k	∞	∞	∞	5.2k	0	∞	∞	∞	∞	5.2k	5.2k	160
Q 7 0 2	∞	∞	∞	∞	∞	3.4k	0	∞	∞	∞	∞	5.2k	10k	160

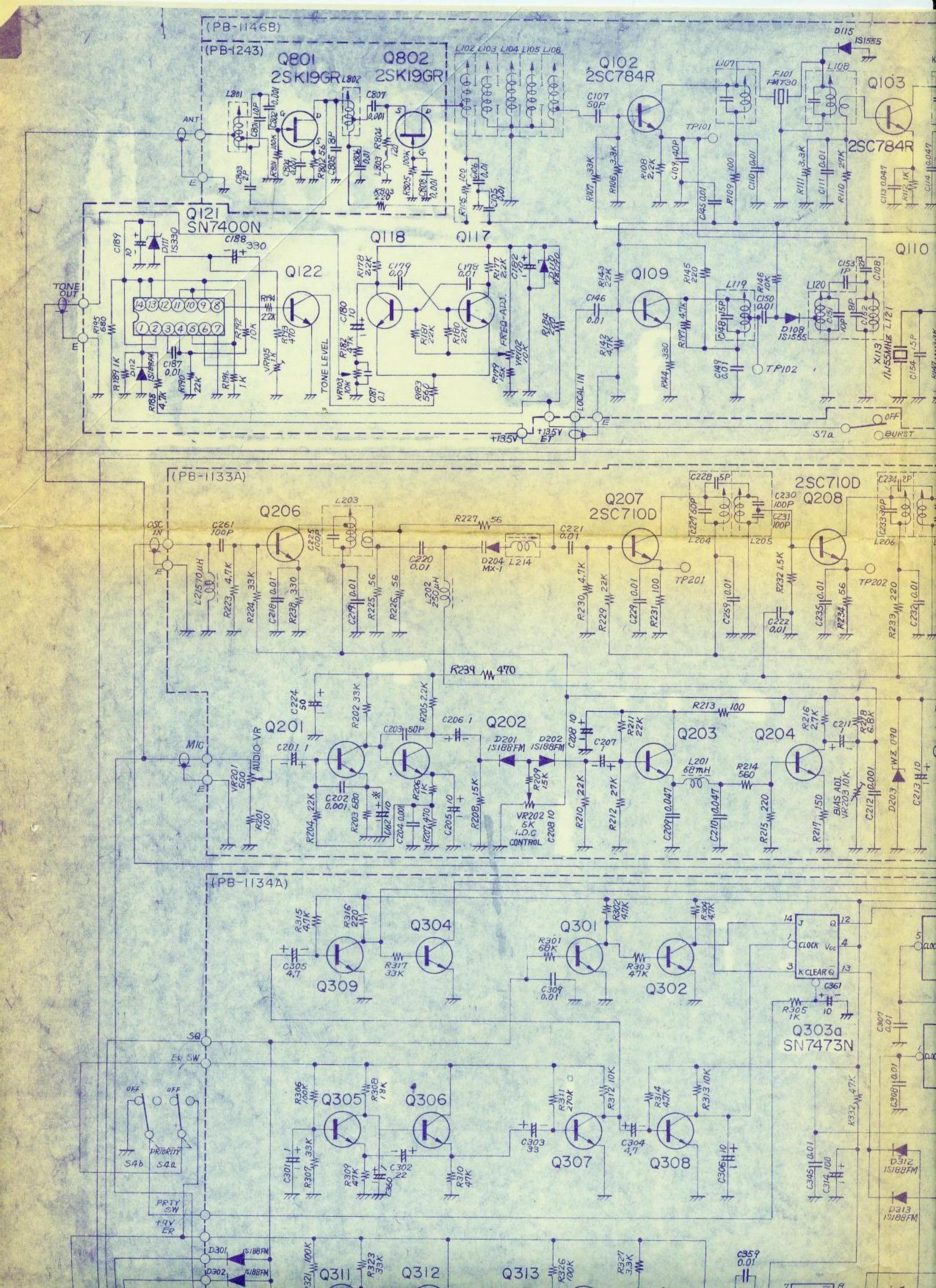
(1) All measurements made with VTVM. Values are in OHM.
(2) VOL and SQL full clockwise AUTO-MANU in AUTO. HI-LOW on HI; PRTY and BURST ON.
(3) E: Emitter, S: Source, K: Cathode, B: Base, G: Gate, C: Collector, D: Drain, A: Anode, ①: First Gate, ②: Second Gate.

VOLTAGE MEASUREMENTS

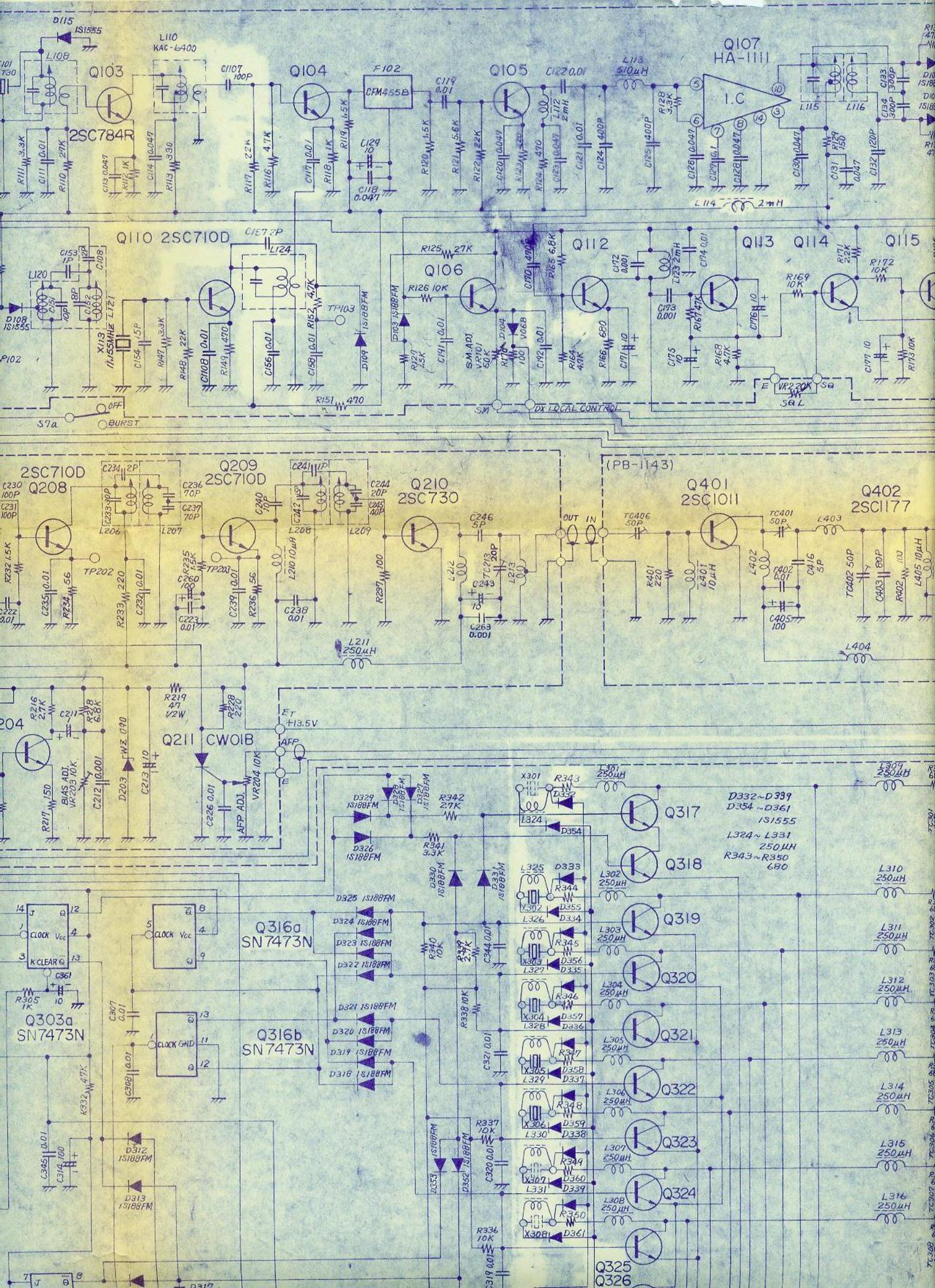
No.	E or S	B or G	C or D	No.	E or S	B or G	C or D
Q 1 Ⓡ	13.8	14.5	22.0	Q 2 0 3 Ⓣ	3.8	4.5	9.0
Q 1 0 1 Ⓡ	0.3	①0 ②3.7	9.0	Q 2 0 4 Ⓣ	0.3	1.0	4.2
Q 1 0 2 Ⓡ	0.5	1.1	9.0	Q 2 0 6 Ⓣ	3.2	0.4	9.5
Q 1 0 3 Ⓡ	0.4	1.0	8.8	Q 2 0 7 Ⓣ	1.3	1.5	10.5
Q 1 0 4 Ⓡ	0.9	1.5	7.5	Q 2 0 8 Ⓣ	0.7	−0.7	10.7
Q 1 0 5 Ⓡ	0.9	1.6	6.9	Q 2 0 9 Ⓣ	1.2	−1.0	13.3
Q 1 0 6 Ⓡ	0	0.5	9.1	Q 2 1 0 Ⓣ	0	−0.2	13.0
Q 1 0 9 Ⓡ	0.6	1.0	8.5	Q 3 2 8 Ⓣ	6.5	6.7	13.3
Q 1 1 0 Ⓡ	0.7	1.0	5.0	Q 3 2 9 Ⓡ	0.9	1.1	7.6
Q 1 1 2 Ⓡ	1.5	2.2	9.1	Q 3 3 0 Ⓡ	1.0	1.4	8.5
Q 1 1 3 Ⓡ	2.7	2.3	9.2	Q 3 3 1 Ⓣ	0.6	0	13.3
Q 1 1 4 Ⓡ	0.1	0	7.6	Q 3 3 2 Ⓣ	6.7	7.0	13.3
Q 1 1 5 Ⓡ	0.1	0.8	0.2	Q 4 0 1 Ⓣ	0	0	13.0
Q 1 1 6 Ⓡ	0	0.1	0	Q 4 0 2 Ⓣ	0	0	13.0
Q 1 1 7 ※	2.0	1.4	5.3	Q 6 0 1 Ⓡ	1.6	0	4.7
Q 1 1 8 ※	2.0	1.4	5.2	Q 6 0 2 Ⓡ	1.6	2.3	1.8
Q 1 1 9 Ⓡ	1.3	0.6	9.2	Q 6 0 3 Ⓡ	0	0.6	0.7
Q 1 2 0 Ⓡ	0	0.7	0	Q 7 0 3 Ⓡ	0	0	13.0
Q 2 0 1 Ⓣ	0.2	0.8	3.3	No.	K	G	A
Q 2 0 2 Ⓣ	2.7	3.3	8.6	Q 2 1 1 Ⓣ	0	0.4	10.5

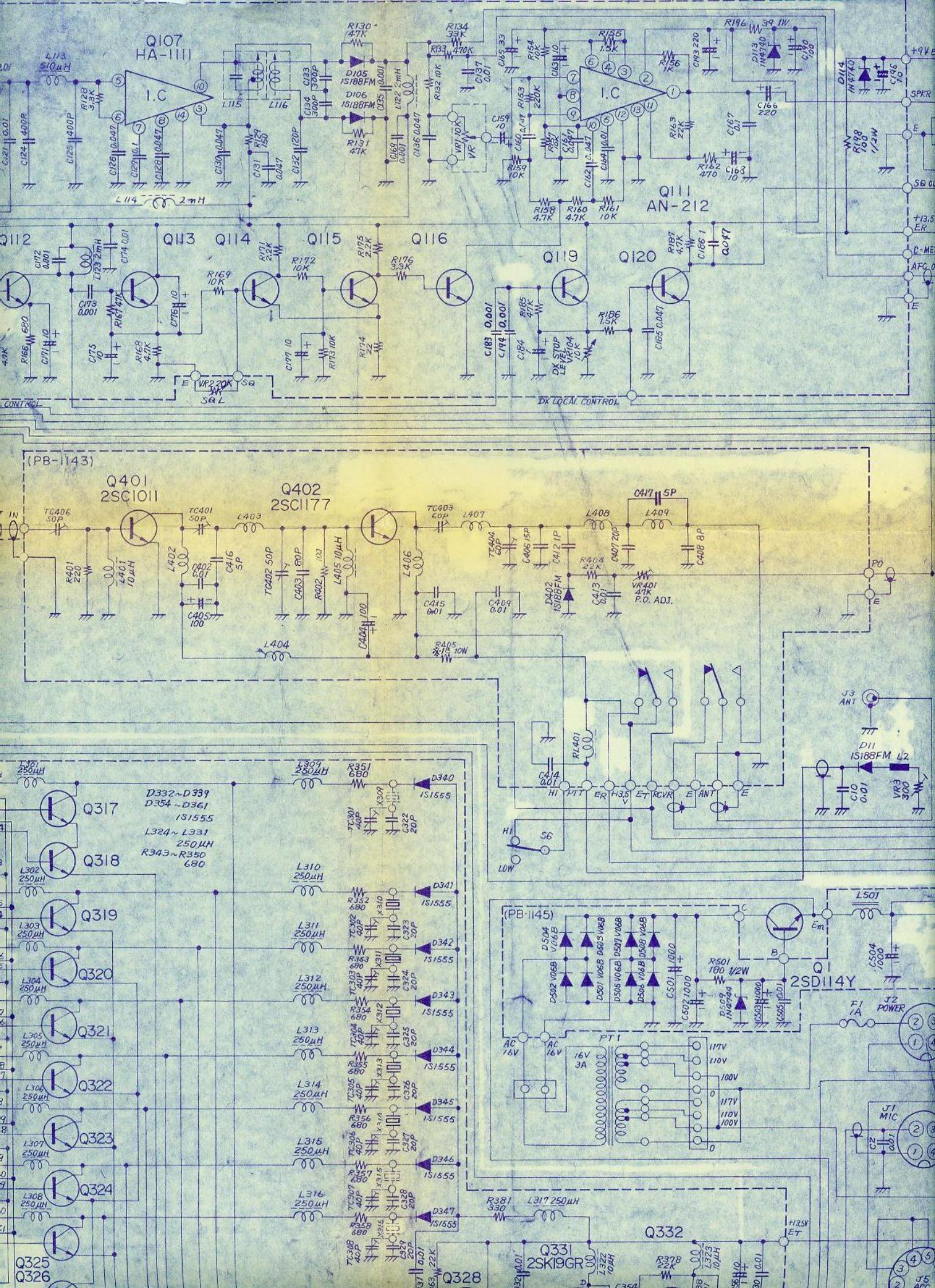
No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Q 1 0 7 Ⓡ	0	0	7.0	0	2.1	2.2	2.1	2.2	0	7.0	0	0	0	0
Q 1 1 1 Ⓡ	5.8	12.7	11.6	6.1	7.3	9.0	0.9	0	3.2	5.8	5.8	0	0	0
Q 7 0 1 Ⓡ	0	0	3.5	3.5	1.5	0	0	0	1.5	1.5	3.5	0	0	4.7
Q 7 0 2 Ⓡ	0	3.5	0	0	0	0	0	3.5	0	0	0	0	2.4	4.7

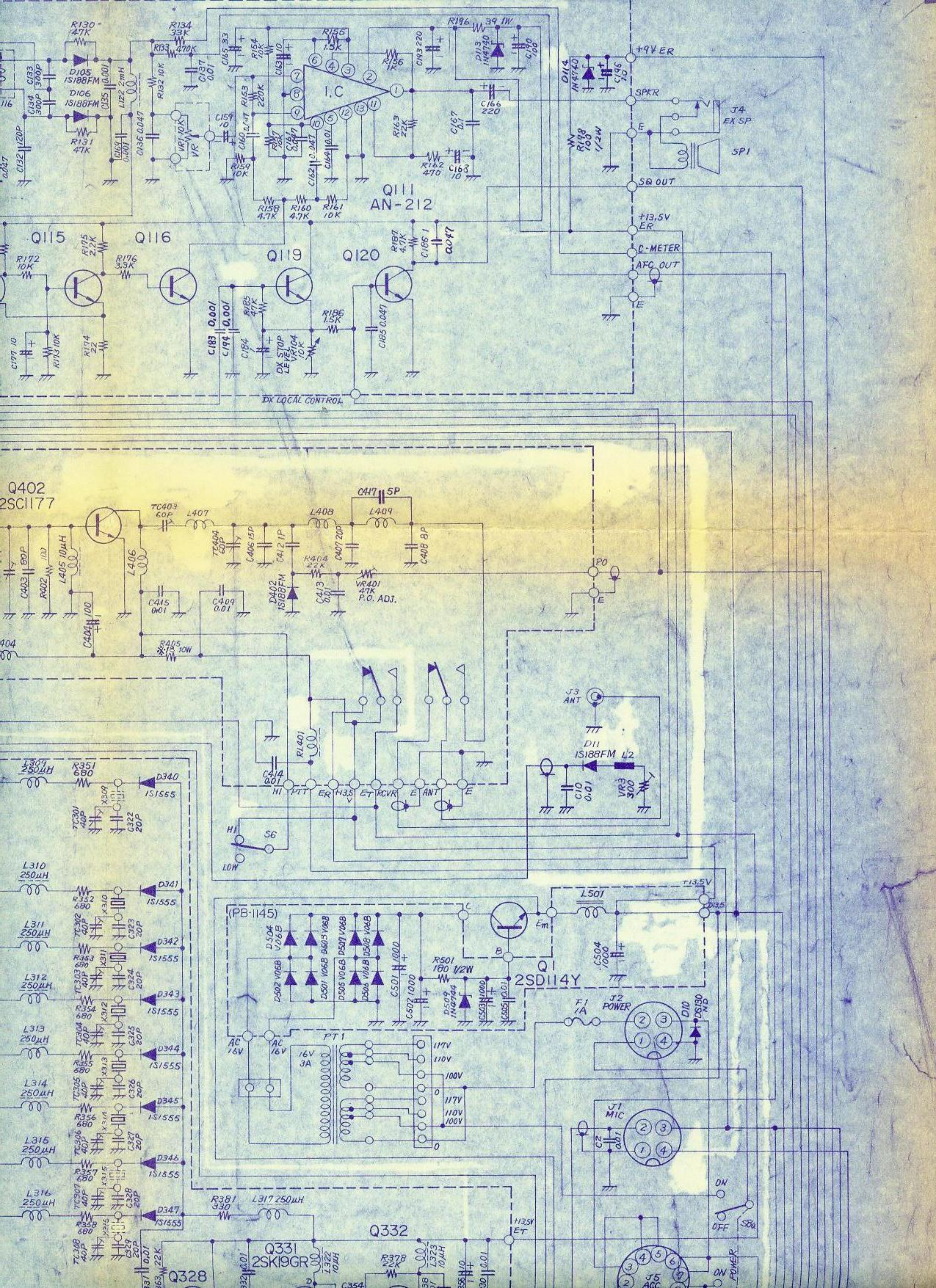
(1) All measurements made with VTVM. Values are in VOLT.
(2) VOL and SQL full clockwise; AUTO-MANU in AUTO; HI-LOW on HI; PRTY and BURST ON.
(3) E: Emitter, S: Source, K: Cathode, B: Base, G: Gate, C: Collector, D: Drain, A: Anode, ①: First Gate, ②: Second Gate.



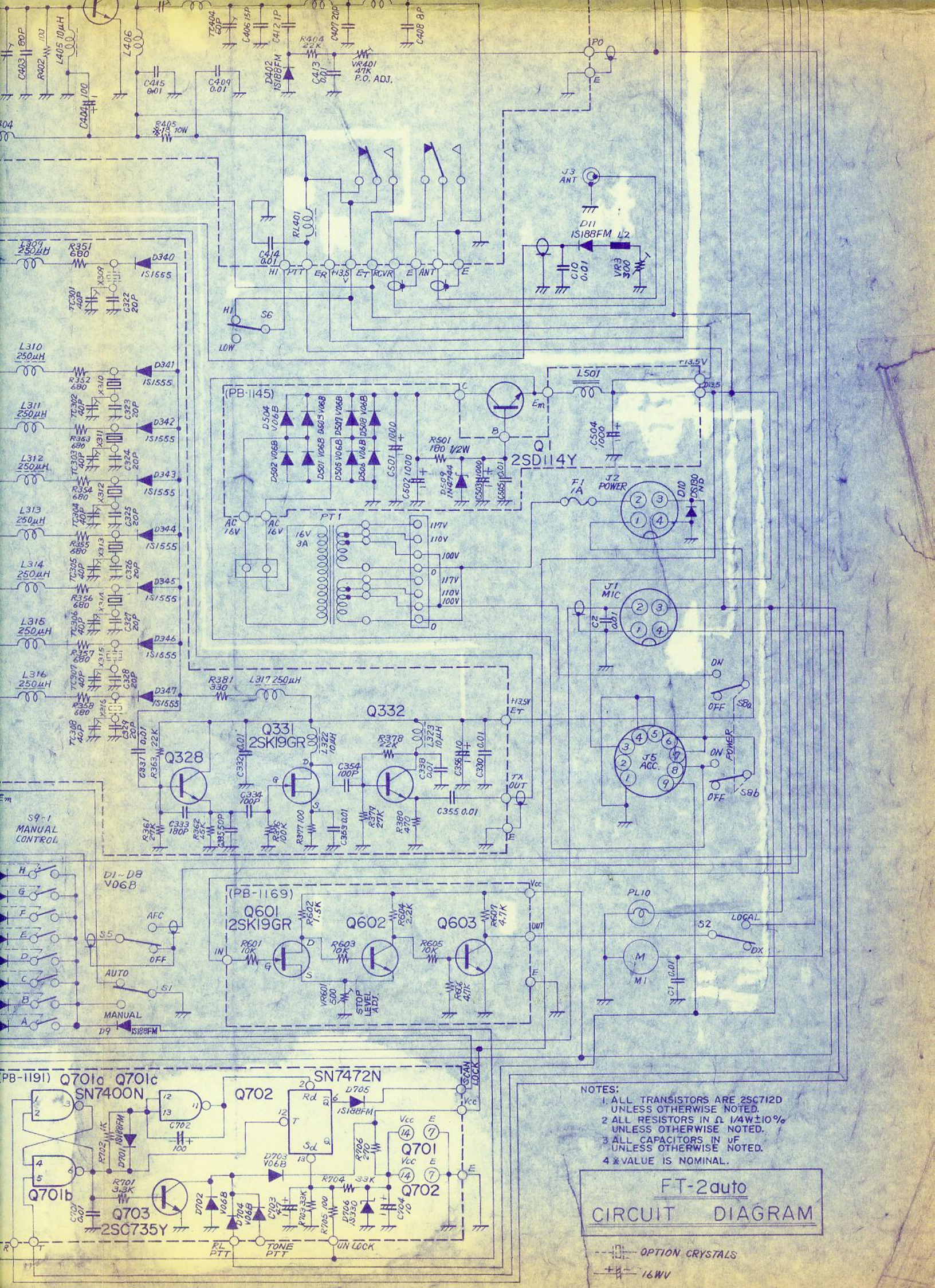
(PB-1146B)
(PB-1243)
Q801
2SK19GR
Q802
2SK19GR
L801
L802
C807
ANT
E
Q102
2SC784R
C107
50P
L102 L103 L104 L105 L106
L107
F101
FM730
D115
1S1555
L108
Q103
2SC784R
TP101
Q121
SN7400N
C189
D111
1S330
C188
330
Q122
Q118
Q117
C179
0.01
C178
0.01
R194
22K
C180
10
R182
47K
R181
22K
R180
22K
FREQ-ADJ.
VR102
10K
TONE LEVEL
VR103
10K
C181
0.1
R183
560
TONE OUT
E
C187
0.01
D112
Q110
Q109
C146
0.01
R143
22K
R142
4.7K
R144
330
R145
220
R146
10K
L119
C150
0.01
D108
1S1555
L120
C153
1P
C154
15P
TP102
X113
11.155MHz
LOCAL IN
+13.5V
+13.5V
ET
E
S7a
OFF
BURST
(PB-1133A)
OSC IN
E
Q206
L203
R227
56
C261
100P
L215
R223
4.7K
R224
33K
C218
0.01
R238
330
C219
0.01
R225
56
R226
56
C220
0.01
L202
250μH
D204
MX-1
L214
C221
0.01
Q207
2SC710D
L204
C228
5P
L205
C230
100P
C231
100P
2SC710D
Q208
C234
2P
L206
R230
4.7K
R229
22K
C229
0.01
R231
100
TP201
C269
0.01
R232
1.5K
C222
0.01
C235
0.01
R234
56
TP202
R233
220
C232
0.01
R239
470
C224
50
Q201
R202
33K
C203
50P
C206
1
R205
2.2K
Q202
D201
1S188FM
D202
1S188FM
C208
10
C207
R211
22K
R213
100
Q203
Q204
R216
2.7K
C211
R218
6.8K
MIC
E
VR201
500
AUDIO VR
C201
1
R201
100
C202
0.001
R203
680
R204
22K
C204
0.001
R206
1K
R207
470
C205
10
R208
15K
R209
15K
VR202
5K
I.D.C
CONTROL
C208 10
R210
22K
R212
27K
L201
68mH
C209
0.047
R214
560
C210
0.047
R215
220
R217
150
BIAS ADJ
VR203 10K
C212
0.001
D203
C213
10
(PB-1134A)
R315
4.7K
R316
220
Q304
C305
4.7
R317
33K
Q309
Q301
R302
47K
R304
47K
R301
68K
C309
0.01
R303
47K
Q302
J
CLOCK
Vcc
K
CLEAR
C361
10
R305
1K
Q303a
SN7473N
C307
0.01
C308
0.01
R332
47K
SQ
ER SW
OFF
OFF
PRIORITY
S4b
S4a
Q305
Q306
R306
100K
R308
18K
C301
R307
33K
R309
47K
C302
22
R310
47K
C303
33
R311
270K
R312
10K
Q307
C304
4.7
R314
47K
R313
10K
Q308
C306
10
C345
0.01
C314
100
D312
1S188FM
D313
1S188FM
PRTY SW
+9V
ER
D301
1S188FM
D302
1S188FM
Q311
R323
33K
Q312
Q313
R326
100K
R327
3.3K
C359
0.01


Q103
2SC784R
Q104
Q105
Q107
HA-1111
I.C
F102
CFM455B
Q110 2SC710D
Q106
Q112
Q113
Q114
Q115
Q208
2SC710D
Q209
2SC710D
Q210
2SC730
(PB-1143)
Q401
2SC1011
Q402
2SC1177
Q211 CW01B
Q316a
SN7473N
Q316b
SN7473N
Q303a
SN7473N
Q317
Q318
Q319
Q320
Q321
Q322
Q323
Q324
Q325
Q326
D332~D339
D354~D361
1S1555
L324~L331
250μH
R343~R350
680
OFF
BURST
S7a
DX LOCAL CONTROL
SQL


Q107
HA-1111
I.C
Q111
AN-212
Q112
Q113
Q114
Q115
Q116
Q119
Q120
DX LOCAL CONTROL
(PB-1143)
Q401
2SC1011
Q402
2SC1177
(PB-1145)
Q1
2SD114Y
Q317
Q318
Q319
Q320
Q321
Q322
Q323
Q324
Q325
Q326
Q328
Q331
2SK19GR
Q332
D332~D339
D354~D361
1S1555
L324~L331
250μH
R343~R350
680
PT1
16V
3A
117V
110V
100V
HI
LOW
S6
J1 MIC
J2 POWER
J3 ANT
F1 1A

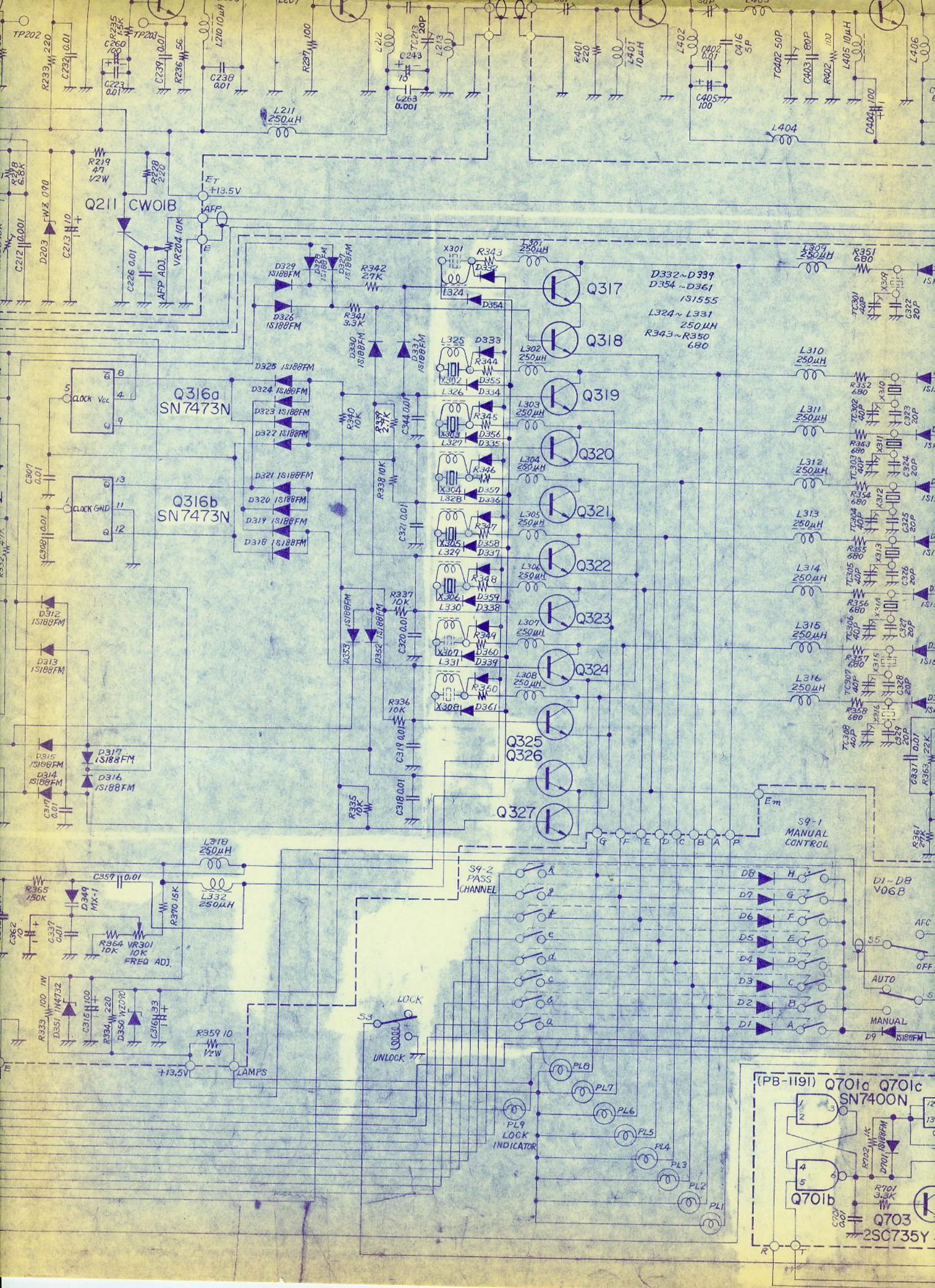


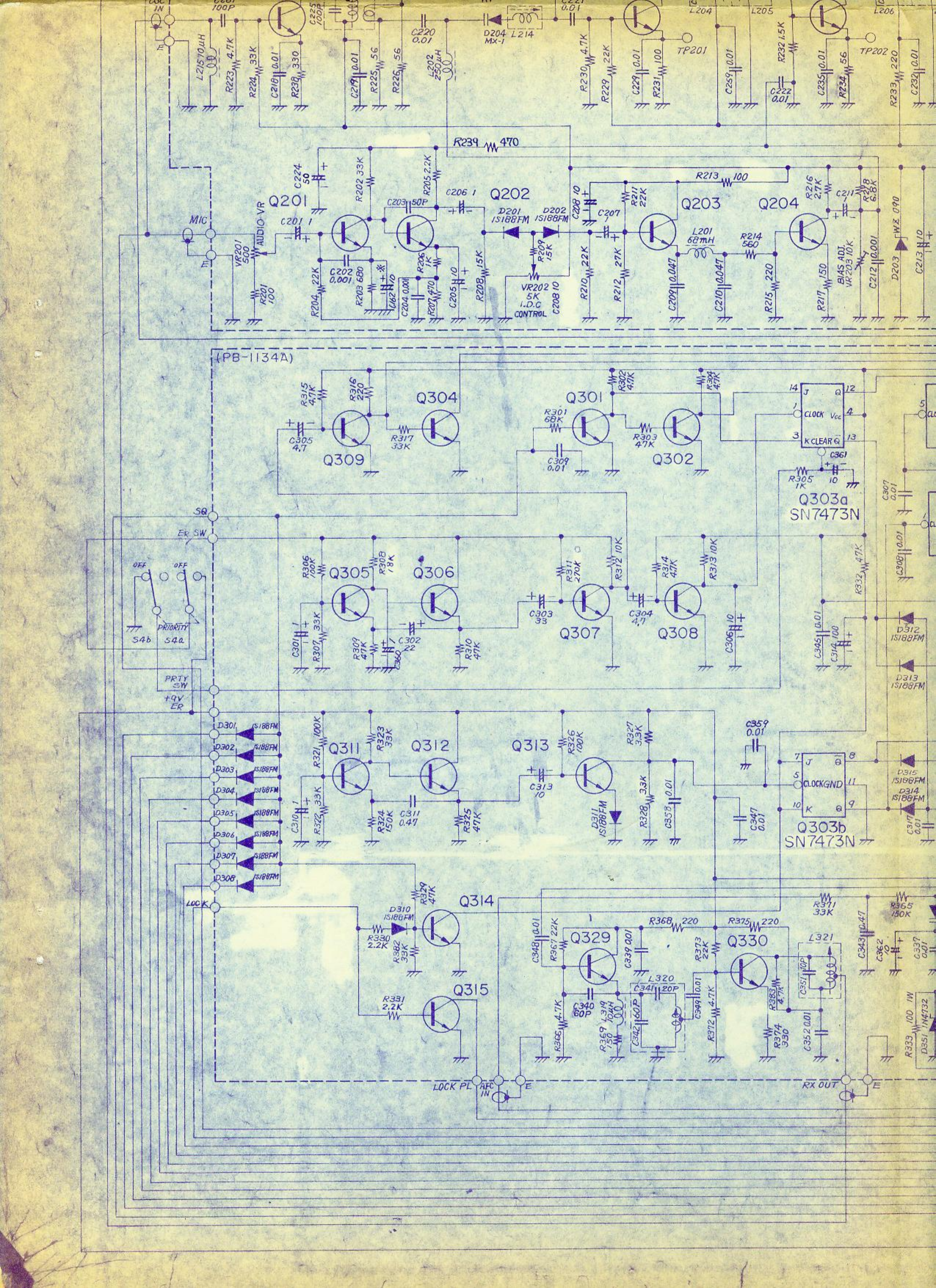
Q111
AN-212
Q115
Q116
Q119
Q120
I.C
+9V ER
SPKR
J4 EX SP
SP1
SQ OUT
+13.5V ER
C-METER
AFC OUT
DX LOCAL CONTROL
DX STOP LEVEL
Q402
2SC1177
P.O. ADJ.
J3 ANT
D11 1S188FM
HI
PTT
ER
+13.5V
ET
RCVR
ANT
S6
LOW
(PB-1145)
Q1
2SD114Y
PT1
F1 1A
J2 POWER
J1 MIC
Q331
2SK19GR
Q332
Q328
ON
OFF
S8a
J5
POWER



NOTES:
1. ALL TRANSISTORS ARE 2SC712D UNLESS OTHERWISE NOTED.
2. ALL RESISTORS IN Ω 1/4W ±10% UNLESS OTHERWISE NOTED.
3. ALL CAPACITORS IN uF UNLESS OTHERWISE NOTED.
4. * VALUE IS NOMINAL.

FT-2auto
CIRCUIT DIAGRAM


Q211 CW01B
Q316a SN7473N
Q316b SN7473N
Q317
Q318
Q319
Q320
Q321
Q322
Q323
Q324
Q325
Q326
Q327
D332~D339
D354~D361
1S1555
L324~L331
250μH
R343~R350
680
S9-1 MANUAL CONTROL
S9-2 PASS CHANNEL
D1~D8
V06B
LOCK
UNLOCK
LAMPS
+13.5V
AFC
AUTO
MANUAL
OFF
(PB-1191) Q701a Q701c SN7400N
Q701b
Q703
2SC735Y
PL1
PL2
PL3
PL4
PL5
PL6
PL7
PL8
PL9 LOCK INDICATOR
VR204 10K
AFP ADJ.
VR301 10K FREQ ADJ.



(PB-1134A)
Q201
Q202
Q203
Q204
Q301
Q302
Q303a
SN7473N
Q303b
SN7473N
Q304
Q305
Q306
Q307
Q308
Q309
Q311
Q312
Q313
Q314
Q315
Q329
Q330
MIC
AUDIO VR
I.D.C CONTROL
BIAS ADJ.
PRIORITY
LOCK PL
RX OUT
TP201
TP202