THEORY OF OPERATION

GENERAL

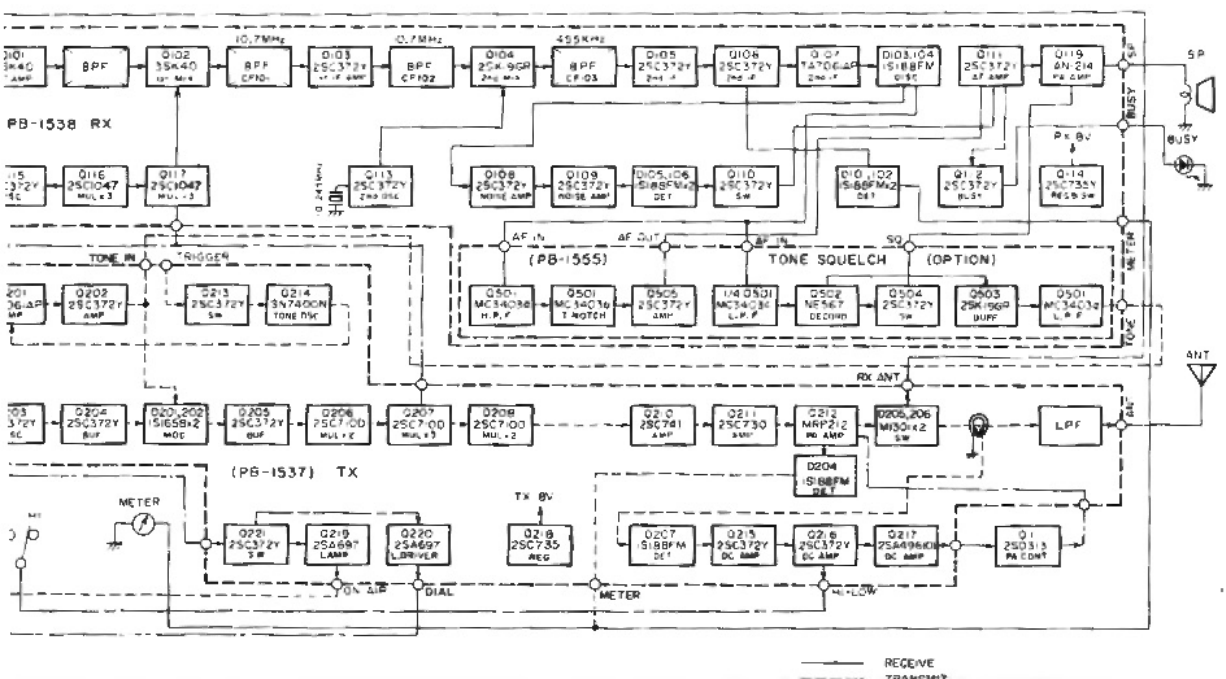
Functional operation of the model FT-223 VHF/FM transceiver is illustrated in the Block Diagram, Figure 6
Refer to the schematic diagram for the circuit description.
The transceiver consists of a crystal controlled transmitter and receiver operating on any of the 23 channels within the frequency range of 144 to 148 MHz. In addition to 22 channels which are selected by the CHANNEL selector switch, one "most-often-used" channel may be preset for ease of operation. Solid state circuitry is employed throughout and the transceiver is designed to operate from a 13.5 Volt ±10% DC negative ground power source.

TRANSMITTER SECTION

The transmitter section produces an FM (phase modulation method) output signal.

The audio signal from the microphone is amplified by an integrated circuit Q201 (TA7061AP) which works as amplifier and an IDC (Instantaneous Deviation Control) circuit. The IDC circuit, clips both positive and negative peaks when they exceed a predetermined level to limit the maximum deviation of the transmitter. The IDC control, VR202, permits the deviation to be adjusted, and is nominally factory set for a deviation of ±5 kHz. When wide band transmission is desired, VR202 must be readjusted to provide a maximum deviation of ±10 kHz.

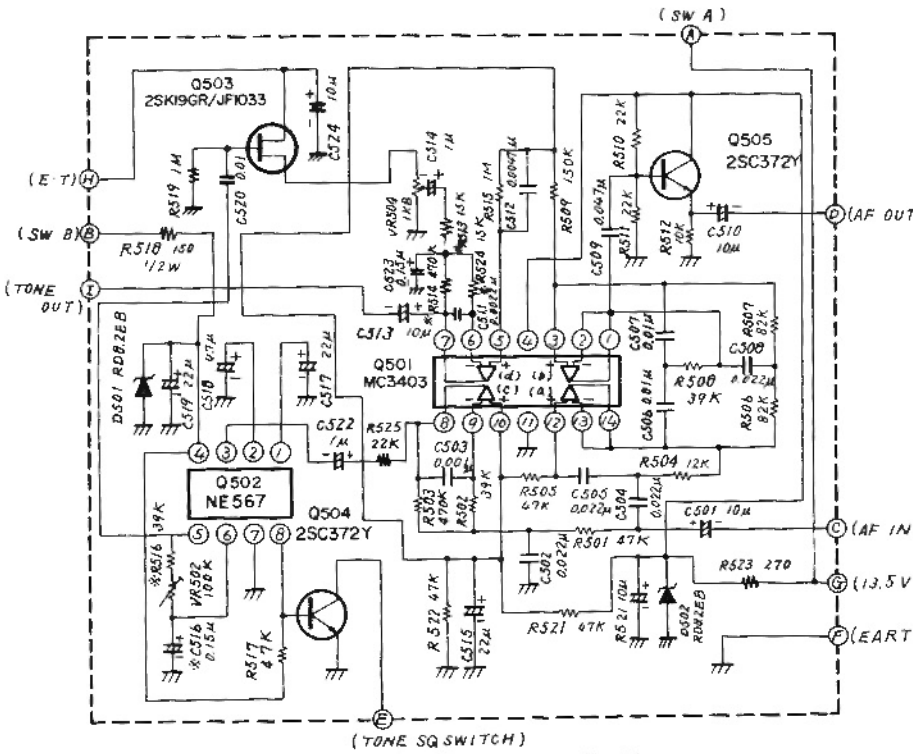
FT-223 BLOCK DIAGRAM



The tone signal passes through a low pass filter by unit "c" c
Q501 and is fed to Q502, NE567. When the tone signal has th
same frequency as preset for transmitting, the voltage of pi
of Q502 becomes low causing Q504, 2SC372Y to "OFF". In t
proper bias voltage is applied to Q119 for normal operation.

Without proper tone signal, Q504 conducts, removing the pro
bias from Q119 to disable the audio circuit.

As the conventional carrier squelch circuit is operative when
the tone squelch is switched in, the busy lamp lights up when
any carrier is received.



TONE SQUELCH (PB-1555A) OPTION

Figure 9

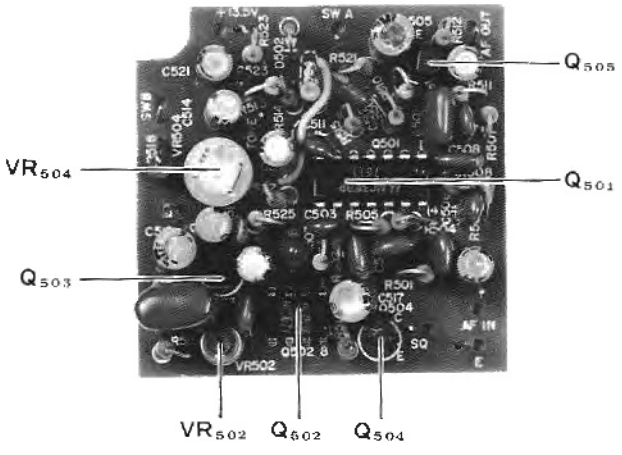


Figure 10

ne frequency modulated 146 to 148 MHz signal is amplified by Q210, SC741, Q211, 2SC730 and Q212, MRF212 and applied through a two age pi-network to the antenna. A diode D204, 1S188FM rectifies small portion of the RF output and applies the resultant DC voltage the meter where is provides an indication of relative power output om the transmitter. The meter sensitivity is adjusted by VR204 d it is set for indication of 8 on the meter scale at 10 watts on a ohm resistive load.

the transmitter is keyed without an antenna connected, or if a high VR exists in the antenna system, the reflected power is detected rough T210 and a diode D207, 1S188FM produces DC voltage. 215, 2SC372Y conducts with the DC voltage applied through VR209 using Q216, 2SC372Y to decrease its collector current. Thus, e emitter voltage of Q217, 2SA496(0) is lowered causing Q1, D313 to decrease current and the supply voltage to the PA amplifier 212 is lowered to prevent damage of the transistor. The protection vel is set by VR209. This circuit is also used to switch the output wer down to 1 watt where the HI/LOW switch is set to LOW position. ne amount of power reduction may be adjusted by VR208.

ne antenna change-over circuit consists of the switching diodes 205 and D206, M1 301.

ECEIVER SECTION

ne 146 to 148 MHz input signal from the antenna is amplified by ET Q101, 3SK40Mon RF board, and applied through five hi-Q ot-coupled resonators to the first mixer, Q102, 3SK40M.

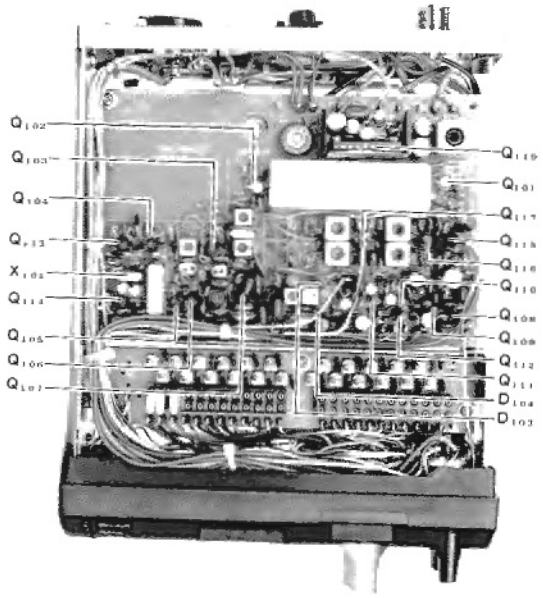


Figure 8 Top View

The limited audio signal is applied through a low-pass filter to Q202, 2SC372Y where it is amplified and applied to the phase modulator varactor diode D201, 1S1658. The low-pass filter limits the transmitte modulation spectrum by attenuating frequencies above the speech range.

The oscillator, Q203, 2SC372Y, operates on the crystal frequency to generate the initial RF signal. The crystal frequency is in the 12 MH range, and is determined as follows:

$$\text{Crystal Frequency (MHz)} = \frac{\text{Output Frequency (MHz)}}{12}$$

Trimmer capacitors TC401 through TC423 permit each of the 23 crystals to be individually set to frequency. Output from Q203 is amplified by Q204, 2SC372Y, and applied across transformer L203.

The audio signal from Q202 varies the bias applied to D201 and D202, in turn causing the capacity of the diodes to vary in accordance with the audio voltage. As D201 and T201 and D202 and T202 are in series, the capacity change in the diode effectively changes the resonant frequency to produce a phase shift at an audio rate in the input of Q205, 2SC372Y in the exciter stage.

The angular phase shift from the modulator is relatively small, therefore the crystal frequency is multiplied twelve times to obtain the desired deviation at the output frequency of 144 to 148 MHz. The modulated 12 MHz signal is applied through the buffer amplifier Q205, 2SC372Y to the multiplier chain consisting of a doubler Q206, 2SC710D, a tripler Q207, 2SC710D, and a doubler Q208, 2SC710D where the necessary frequency multiplication is provided.

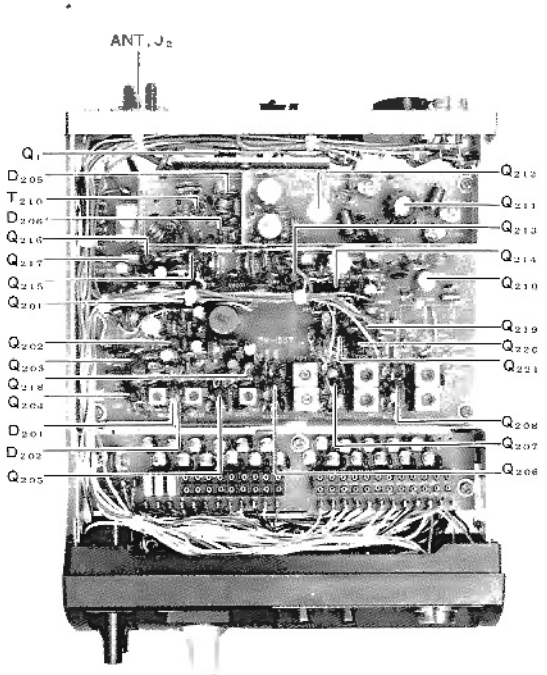
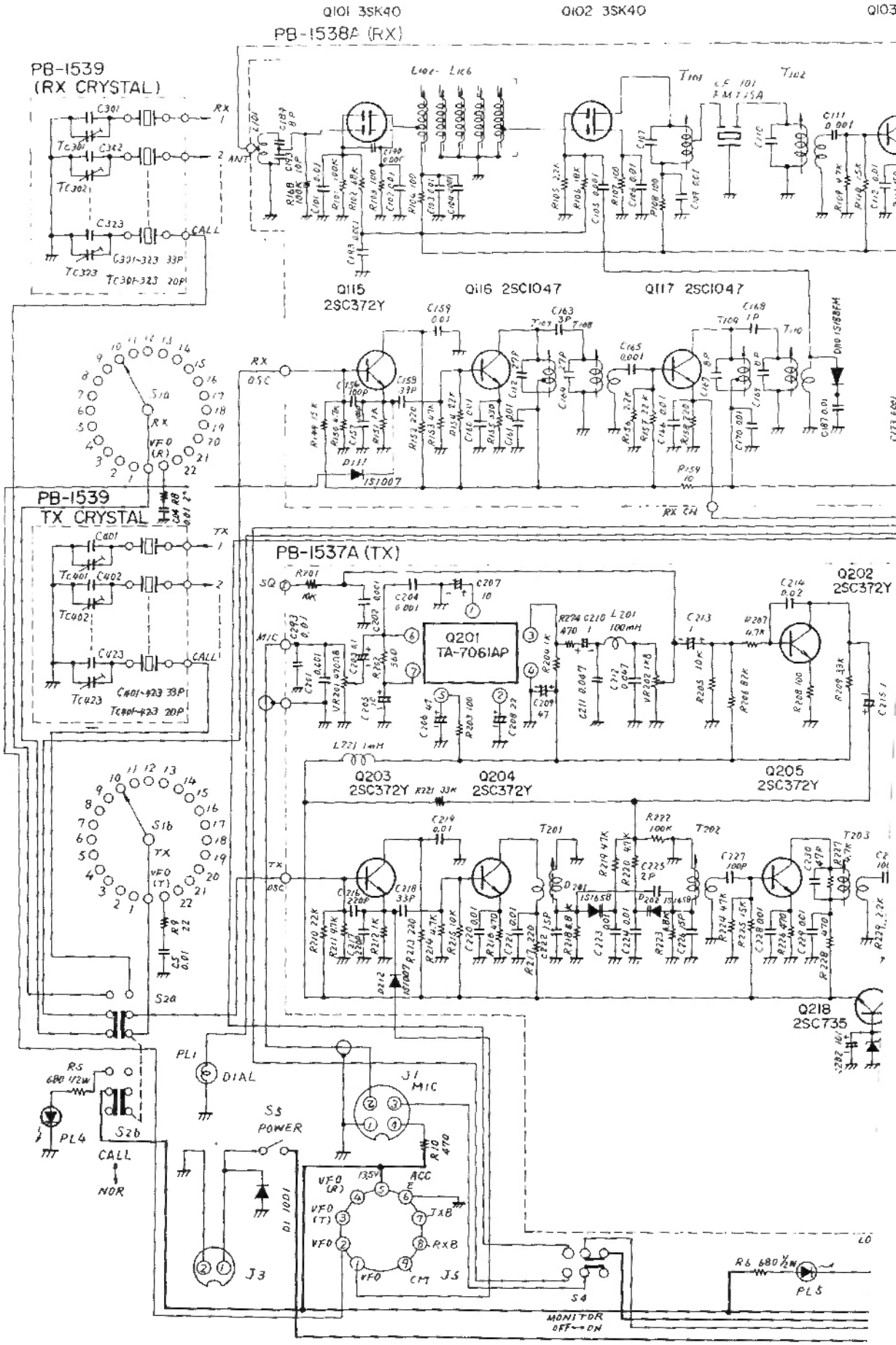
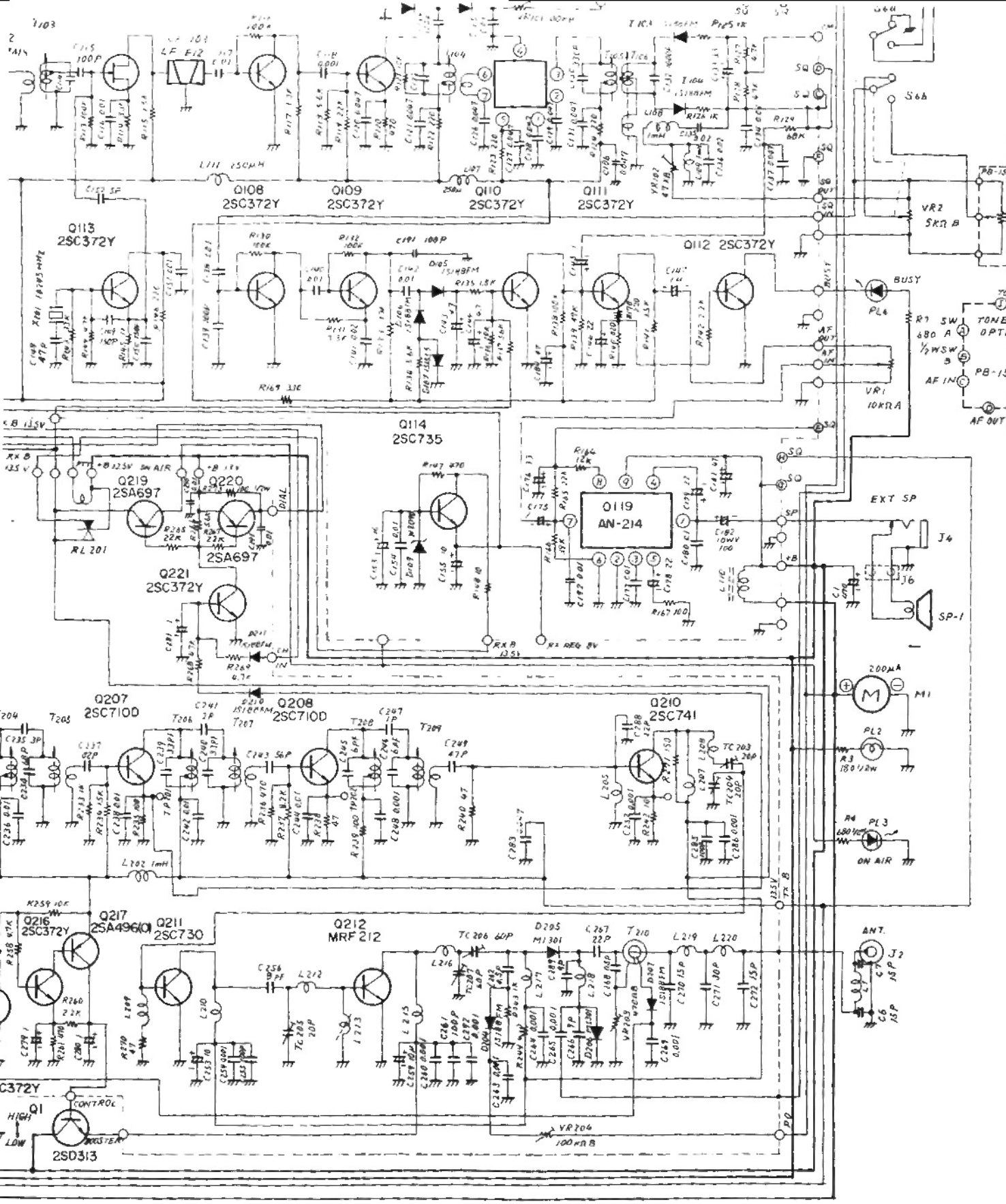


Figure 7. Bottom View





NOTES.

1 ALL RESISTORS IN Ω 1/4W ±10%
UNLESS OTHERWISE NOTED.

2 ALL CAPACITORS IN μF
UNLESS OTHERWISE NOTED
+ ⊣⊢ − 16WV

FT-223
CIRCUIT DIAGRAM