SBE LCBS 4 Service Manual

LCBS-4

40 Channel AM/SSB
Base/Mobile Transceiver

SERVICE MANUAL

Land Command
by SBE

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SECTION 1
GENERAL

1.1 CUSTOMER SERVICE

The SBE Technical Service Department functions as a source of information on the application, installation and use of SBE products. In addition, the Technical Service Department provides technical consultation on service problems and availability of local and factory repair facilities.

In any communications to the Technical Service Department, please include a complete description of your problems or needs, including model and serial numbers of the unit or units in question, accessaries being used, any modifications or attachments in use, or any non-standard installation details.

For assistance on any of the above matters, please contact SBE, Incorporated, Technical Service Department, 220 Airport Boulevard, Watsonville, California 95076. Phone: 408/728-2071.

1.2 PARTS ORDERS

SBE original replacement parts are available from the Factory Parts Department at 220 Airport Boulevard, Watosonville, California 95076.

When ordering parts, please supply the following information:

Model number of the unit.
Serial number of the unit.
Part number.
Description of the part.

1.3 FACTORY RETURNS

Repair services are available locally through SBE Certified Service Stations across the country. A list of these Service Stations is available upon request from the Technical Services Department. Do not return any merchandise to the Factory without authorization from the Factory.

SECTION 2
SPECIFICATIONS

2.1 GENERAL

Channels:	40
Frequency Range:	26.965 to 27.405 MHz
Frequency Composition:	PLL Synthesizer Circuitry
Operating Temperature Range:	−20° C to +50° C
Frequency Tolerance:	±0.003%
Operating Humidity Limit:	95%
Input Power Voltage:	117 volts AC, or 13.8 volts DC
Microphone:	Dynamic, 700 ohm, DIN Terminated
Size:	10-7/16" (265 mm)W x 4-59/64" (125 mm)H x 11-27/32" (300 mm)D
Weight:	16.72 lbs (7.6 kg)

2.2 TRANSMITTER

AM RF Power Output:	4 watts
SSB RF Power Output:	12 watts
SSB Carrier Suppression:	40 dB
Harmonic and Suprious Suppression:	60 dB
SSB Composition:	Dual Balanced Modulator

2.3 RECEIVER

AM Heterodyne:	Dual Conversion
SSB Heterodyne:	Single Conversion
AM Intermidiate Frequency:	10.695 MHz, 455 kHz
SSB Intermidiate Frequency:	10.695 MHz
AM Sensitivity at 10 dB S/N:	1 μV
SSB Sensitivity at 10 dB S/N:	0.25 μV

AM Selectivity at 6 dB down:	6 kHz
SSB Selectivity at 6 dB down:	2 kHz
Adjacent Channel Rejection:	70 dB
Clarifier Shift Range:	±800 Hz
Audio Output Power for 8 ohm:	2.7 watts
Squelch Range:	0.7 to 500 μV

SECTION 3
INSTALLATION

GENERAL

This transceiver is a PLL control synthesizing system, 40 channel SSB/AM, BASE/MOBILE CB transceiver. This handsomely styled unit is designed to be used as either a base station or mobile unit.

Advanced Single Sideband operation allows you the use of less crowded AM sidebands, provides great range, and gives you more channel of communications. To provide the crystal controlled, 40 channel operation, SBE utilizes a PLL (Phase Locked Loop) controlled synthesizing circuit. The receiver is a sensitive superheterodyne circuit featuring; Large illuminated exclusive S meter, RF GAIN control, low noise RF stage, adjustable Squelch, Clarifier control, Noise Blanker, Noise Limiter, Channel priority switch, external speaker jack, PA jack and instataneous selection of any of the 40 channels with LED read-out.

The transmitter section is designed around highly reliable silicon transistors and a PLL controlled synthesizing system. This circuit makes use of the output of "3" crystal controlled oscillators which are beat together to produce the desired frequency. The transmitter final is a conservatively rated high gain RF power transistor.

3.1 BASE STATION INSTALLATION

The transceiver is designed to operate directly from a 117V AC power line. The transceiver should be placed in a convenient operating location close to an AC outlet and the antenna lead-in cable.

3.2 POWER CONNECTION

Attach the AC power cable connector to the matching male AC connector at the rear of the unit.

NOTE: Always line up the connector properly before pushing into the connector on the transceiver. Do not attempt to force it onto the pins – when properly lined up, the connector can be inserted easily.
Making sure the transceiver is off, insert the AC plug at the other end and cable into an outlet supplying 117V, 50/60 Hz AC.

For protection, the AC input to the transceiver is fused. As supplied, the transceiver is designed to operate from AC, as state above.

In an emergency, the transceiver may be operated from nominal 12V DC battery. Connect the supplied fused DC power cord to the socket on the rear of the transceiver and to the battery. Be sure to connect the Red cable lead to the positive (+) battery terminal and the Black lead to the negative (–) terminal.

WARNING: If you install the transceiver in an automobile, make sure that the vehicle has the Negative ground system.

3.3 ANTENNA CONNECTION

For best reception and transmission, your CB transceiver should use an antenna designed for a frequency of 27 MHz. Antennas are purchased separately and include installation instructions.

Numerous types of CB antennas are available that range from emphasis on ease of installation to emphasis on performance. Often the difference in performance between many CB antennas is modest. This transceiver has a standard antenna connector, type SO-239 (located on rear panel), for easy connection to a standard PL-259 coax plug. The antenna matching circuit in this model requires no adjustment if the antenna load is between 35 and 100 ohms. If the coax antenna cable must be made longer, use coax cable with impedance and frequency ratings for 27 MHz, and use only enough cable to suit your needs. This will insure a proper impedance match and maximum power from the transmitter to the antenna.

BASE STATION ANTENNAS: When using this CB transceiver as a Base Station, any Citizen Band ground plane, beam, dipole or vertical antenna may be used. The range of the transceiver depends basically on the height of the antenna. Whenever possible, select the highest location within the FCC limits. The Ground Plane antenna provides greater coverage and is nondirectional. Ideal for base-to-mobile (or to base) operation. It is designed for medium-long range communication. The Beam antenna is a highly directional type antenna and must be used with a rotor unless you are communicating with another Base Station. It is designed for long-range selective communication, and not usually selected for mobile use. Follow all safety instructions when installing base station antenna. Use coaxial cable rated for the 27 MHz frequency when connecting your Base Station antenna to the transceiver. Use 27 MHz connectors and terminate them well when installing the antenna system. Usually RG-58/U cable is adequate up to 50 ft. of cable, use RG-8u type to reduce any in-line signal loss. Antenna cable can also act as the antenna, so keeping length to minimum not only reduces signal loss from cable but also pick up of static signals.

3.4 ANTENNA TUNING

The output circuit of this model, LCBS-4 has been factory adjusted to operate into any good 50 ohm antenna. No attempt should be made to tune the transmitter to the antenna. Instead, the antenna should be adjusted to present the lowest possible SWR (Standing Wave Ratio). A very low SWR means that the antenna is operating at maximum efficiency and will also mean that it is adjusted 50 ohms. An improperly adjusted antenna causes standing waves to appear on the feed line. Since this feed line is fixed at 50 ohms, and cannot be adjusted, this mismatch appears at the transmitter. If the transmitter is adjusted to compensate for this mismtach, both it and the antenna will no longer be operating at peak efficiency. Since the transmitter has already been adjusted to 50 ohms output and the coaxial feed line has a fixed 50 ohm value, the only remaining element to be adjusted to this value is the antenna itself. When received, the antenna is probably cut as near as is possible to this value.

The mounting location on the vehicle or building and surrounding objects affect the antenna however and requires that it be adjusted to compensate for them.

Many of the newer Citizen Band antennas provide means of adjusting them for lowest SWR. Instructions for doing so are included with the antenna. For such antennas as the full quarter wave length whip, it is necessary to carefully vary the length until the lowest SWR is obtained. For all adjustments to the antenna, connect an SWR meter in the feed line to the antenna.

The transceiver will work into an antenna system having on SWR as high as 3 : 1. For best communications, you will want this figure as near 1 : 1 as possible so that the antenna will be operating at its best efficiency.

3.5 PUBLIC ADDRESS

An external 8 ohm 4 watts speaker may be connected to the PA jack located on the rear panel of the unit when it is to be used as a public address system. The speaker should be directed away from the microphone to prevent acoustical feedback.

3.6 FINAL CHECKOUT

Make an operational checkout of the transceiver to insure operation of it and all accessories installed. Contact other stations and inquire about their location and their reception of your signal. If an omnidirectional antenna is used, the distance to other stations contacted should be about the same in all directions. A directional antenna should reach more distant stations in the direction in which it is beamed. Also inquire whether the stations contacted are omnidirectional and if directional which way they are beamed.

SECTION 4
OPERATION THEORY OF PLL FREQUENCY SYNTHESIZING AM/SSB CB TRANSCEIVER

4.1 FUNDAMENTAL THEORY OF PLL CIRCUITRY

The word PLL is an abbreviation of the "Phase Locked Loop" in which a given signal is processed to track the frequency and phase of reference signal.

In other word, the PLL is an automatic frequency control loop or automatic phase control.

The PLL circuitry consists of the three main units in simple form as shown in Figure 1.

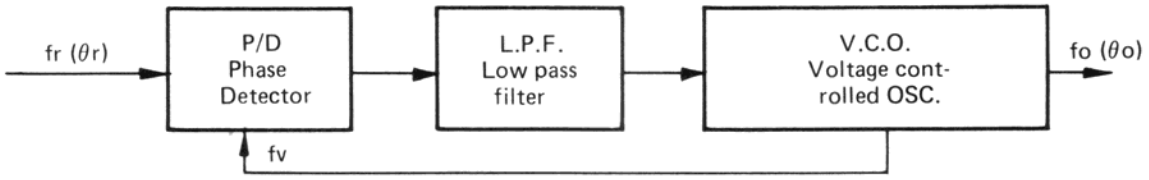

Figure 1. Fundamental Block Diagram of PLL Circuitry

In the above block diagram, when the reference frequency fr and the VCO output frequency fv to be compared are applied to the Phase Detector P/D, fv is compared with fr in terms of Phase lag and lead. Then the resulting output (Phase difference) is converted into the DC output voltage corresponding to the phase difference. Since the phase comparison is made at every cycle, the DC output is, then, fed to the low pass filter (L.P.F.) and integrated or smoothed to continuous DC voltage in propotion to the phase difference.

The frequency of voltage controlled oscillator (V.C.O.) is controlle by the L.P.F. output voltage. Thus controlled VCO output is, then, split into two: One used as an operating frequency of the unit and another will be returned to the P/D, making a closed loop. The closed loop will continue to operate until the following condition is met:

$$\theta r\,(t) = \theta o\,(t)$$

This condition is called locked.

Employing the PLL system into a CB transceiver requires some modifications so that the VCO generates specific frequency corresponding to each channel frequency (1 – 40) according to the channel selection. Figure 2 is the new block diagram made with this modification. As you can see, a programmable divider, Mixer and Offset oscillator are newly added.

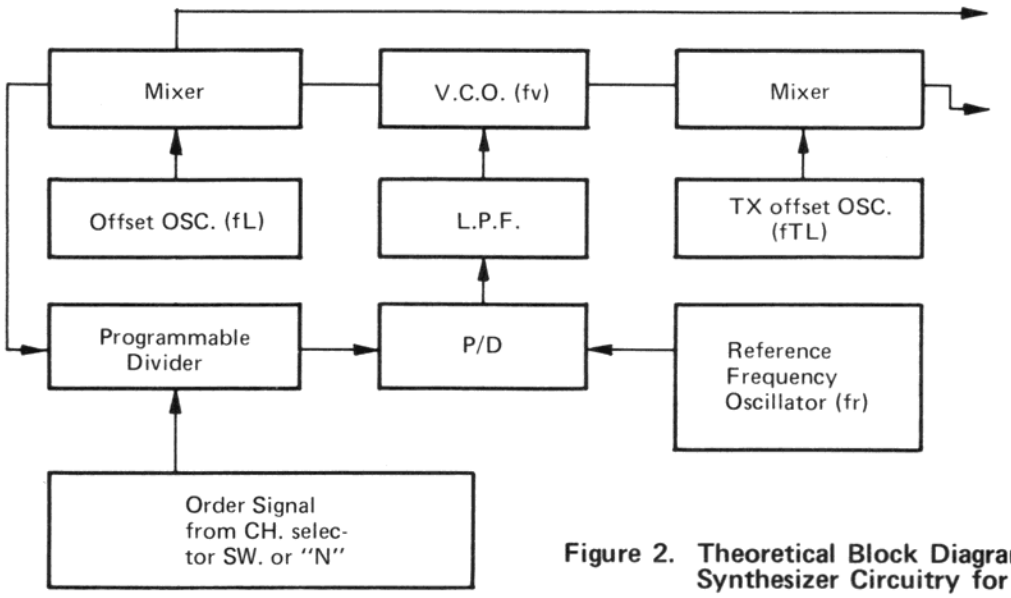

Figure 2. Theoretical Block Diagram of PLL Frequency Synthesizer Circuitry for CB Transceiver

In Figure 2, the first local oscillator frequency for reception fRL is given below

$$fRL = fL + fv \quad \ldots\ldots (1)$$
$$fv = fL - (N \times fr) \quad \ldots\ldots (2)$$

The transmit frequency fT is

$$fT = fRL - fTL \quad \ldots\ldots (3)$$
$$= fL + fv - fTL \quad \ldots\ldots (4)$$

Where "N" is an order signal from the channel selector switch. When using the system in the transceiver, fr should have the same frequency as the channel spacing, namely, fr = 10 kHz. When receiving channel No. 1, 26.965 MHz, the first local frequency fRL should be

$$fRL = 26.965 + 10.695 = 37.660 \text{ MHz}$$

The VCO frequency fv is

$$fv = fRL - fL = 37.660 - 20.105 = 17.555 \text{ MHz}$$

Then, N code will be obtained by using equation 2

$$N = \frac{fL - fv}{fr} = \frac{20.105 - 17.555}{0.01} = 255$$

This means that selecting the channel No. 1 is to select one of "N" codes (ie 255) instead of selecting a proper crystals in a conventional CB transceiver. Thus varying "N" numbers and selecting one of them, any channel can be selected. This is the major difference between a conventional crystal type and PLL Frequency Synthesizer type transceiver.

Figure 3 is a practical operation block diagram of PLL section.

CIRCUIT DESCRIPTION OF AM/SSB TRANSCEIVER

PLL CIRCUIT

The offset frequency oscillator Q203 is being oscillates at a frequency of 10.0525 MHz for AM and USB mode of operation (10.05175 MHz for LSB operation). This frequency output is, then, doubled in passing B.P.F. (T201) and applied to the IC201, PIN No. 4 terminal to mix with the VCO output frequency being applied to the IC201, PIN No. 2 terminal. The resultant sum frequency is obtained from IC201, PIN No. 6 terminal and used as a first local frequency (37 MHz band). T202 and T203 are band pass filter for this frequency. While the difference frequency is amplified/buffered inside the IC201 and the resultant frequency output (2.55 – 2.11 MHz) is led to the PLL IC203 through IC201, PIN No. 9.

Q204 is the switching circuit to shift the oscillating frequency of Q203 by 1.5 kHz for LSB operation. In terms of first local frequency 3 kHz will be shifted toward minus direction.

Q202 is the standard reference oscillator (10.240 MHz).

Q201 is a switching transistor (unlock detector) provided to cut off the RF Pre-amp, Q206, when the PLL is out of locked, thus avoiding frequencies other than predetermined are amplified and radiated.

D225 is the diode through which DC voltage, which is supplied when the channel selector is placed between channels, is spplied to the IC202 to disable the mixing operation inside the IC202. Thus no frequency will be generated even though the channel selector is placed in a correct position.

For clearer understanding, please refer to the schematic diagram and the Block Diagram shown in Figure 4.

TRANSCEIVER PLL CIRCUIT

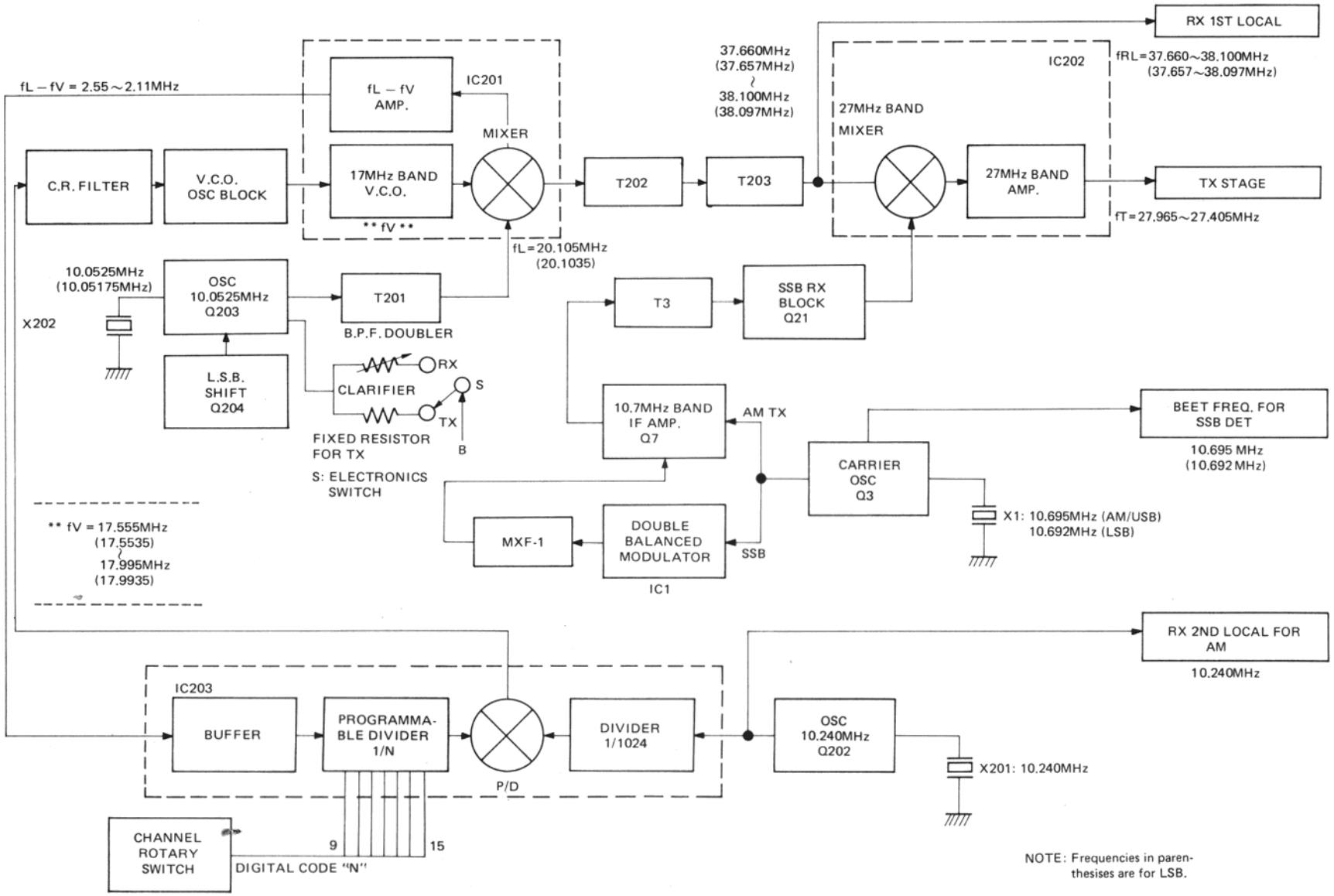

FIGURE 3. BLOCK DIAGRAM FOR PLL CIRCUIT

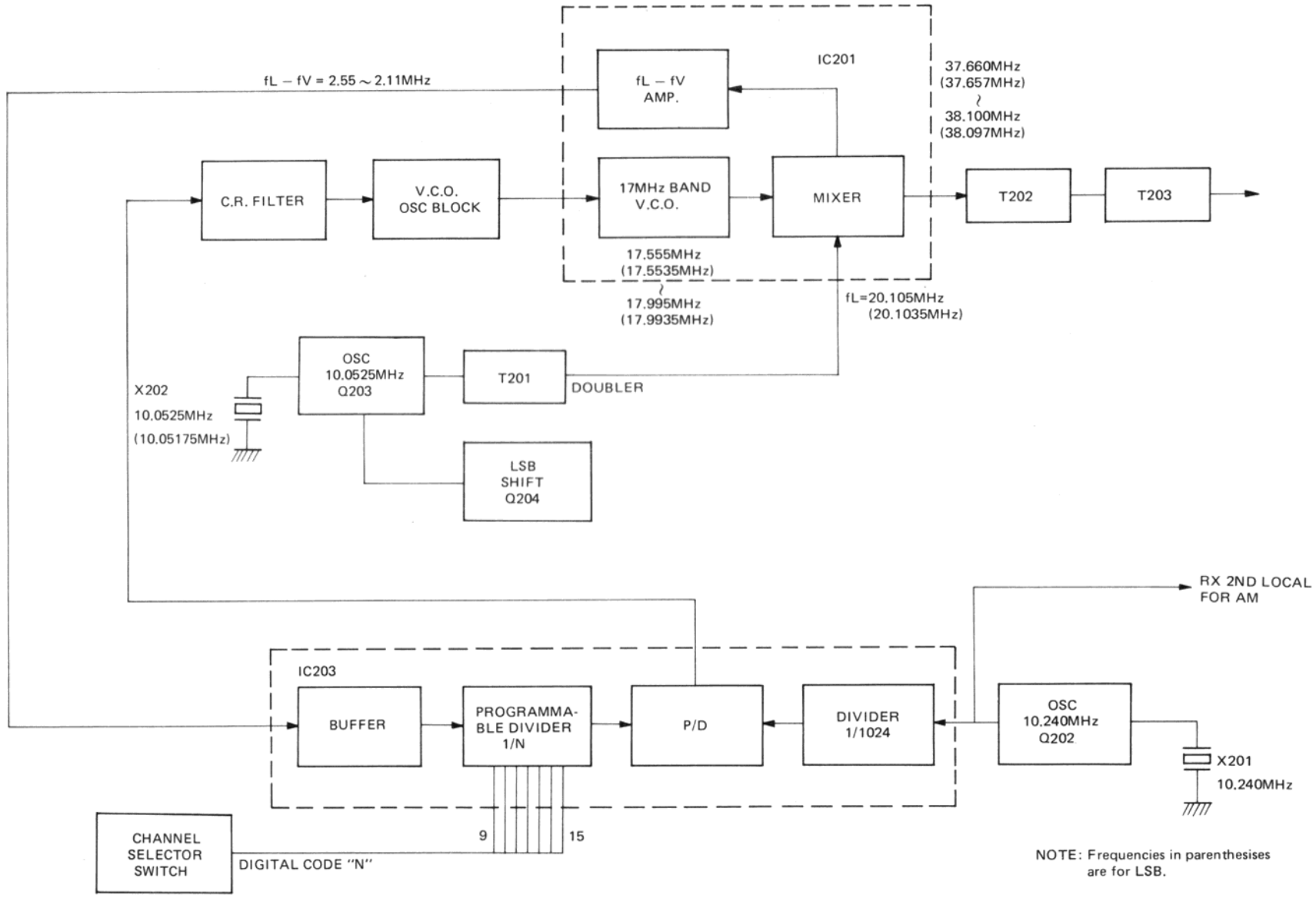

FIGURE 4. PLL CIRCUIT

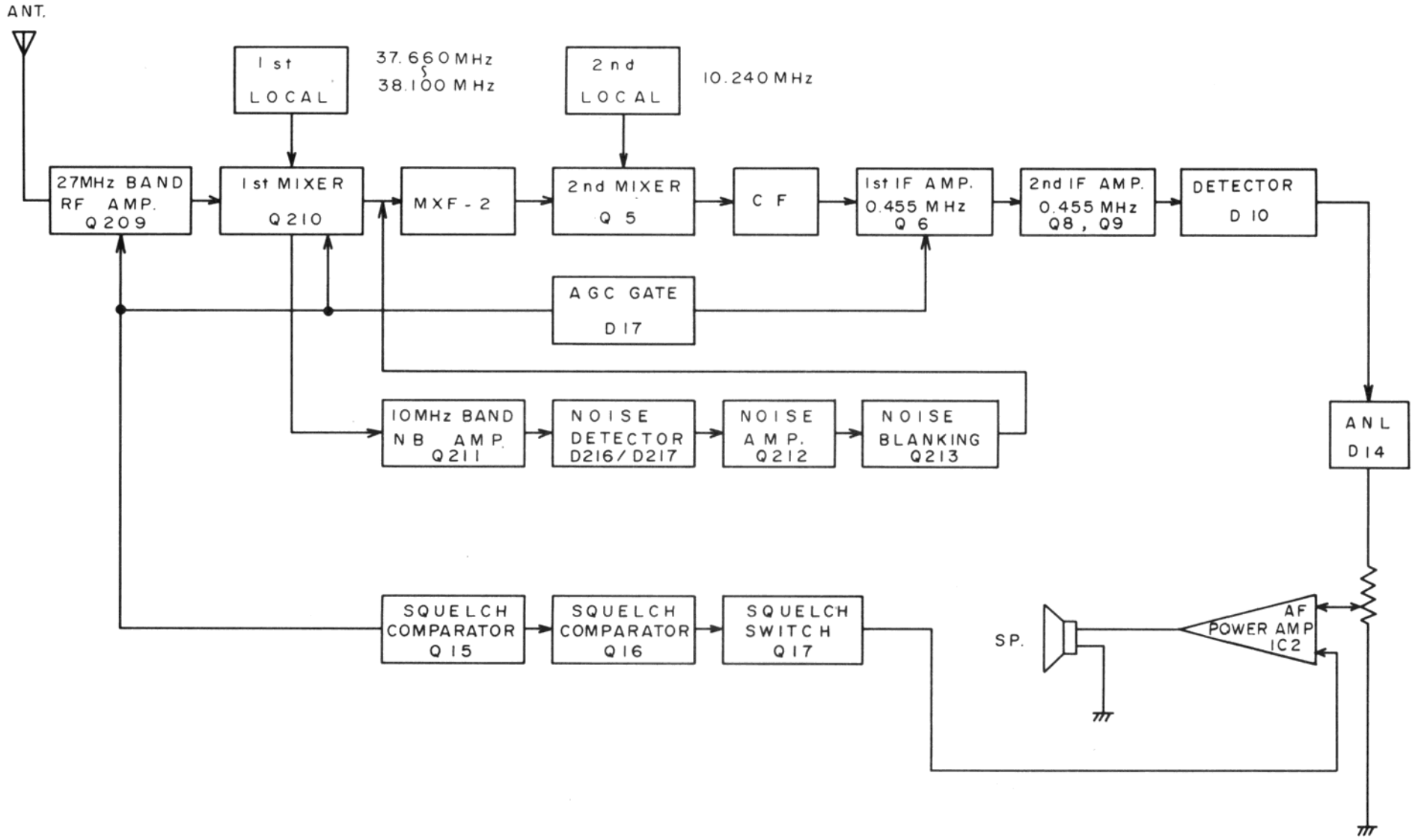

FIGURE 5. AM RECEIVER

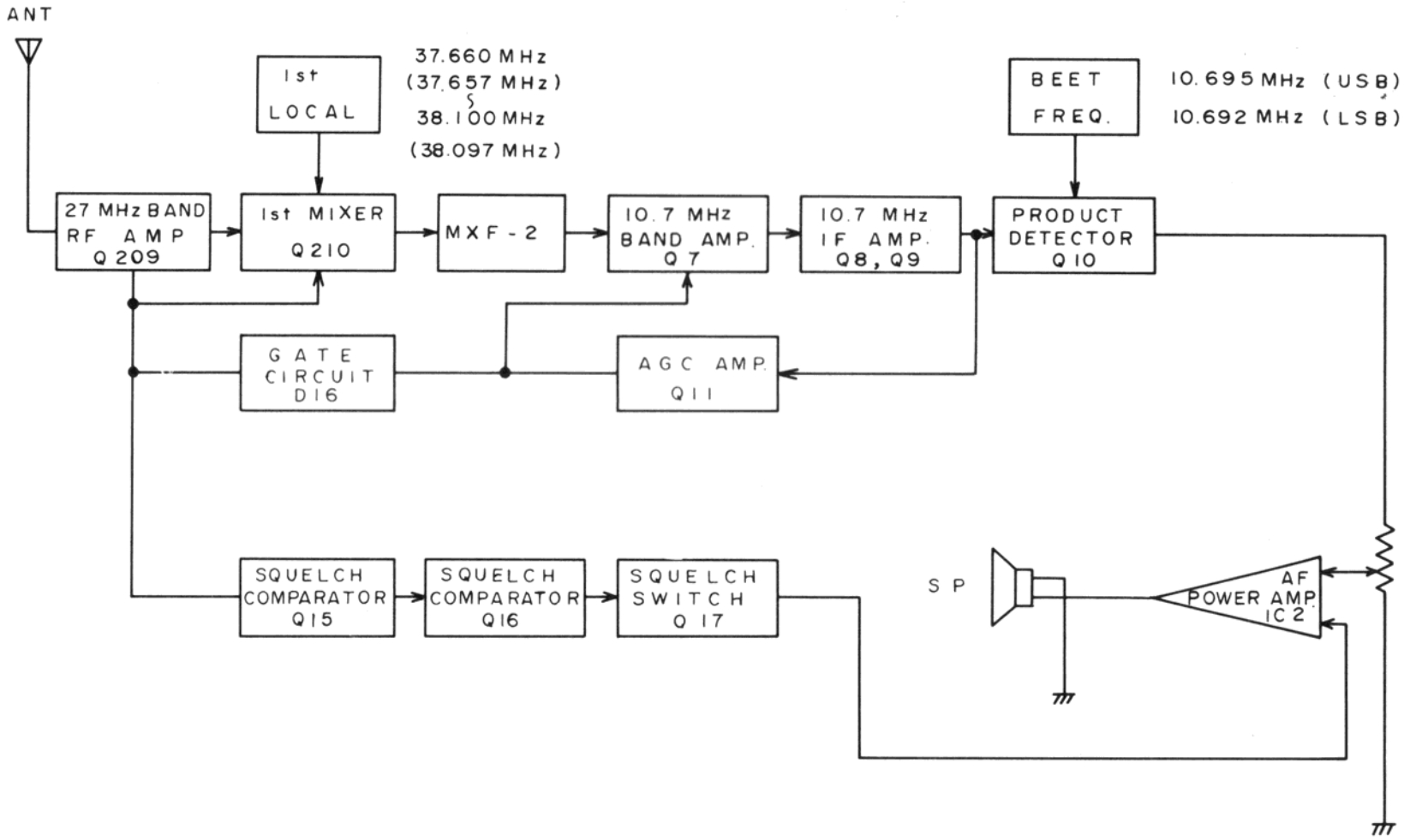

FIGURE 6. SSB RECEIVER

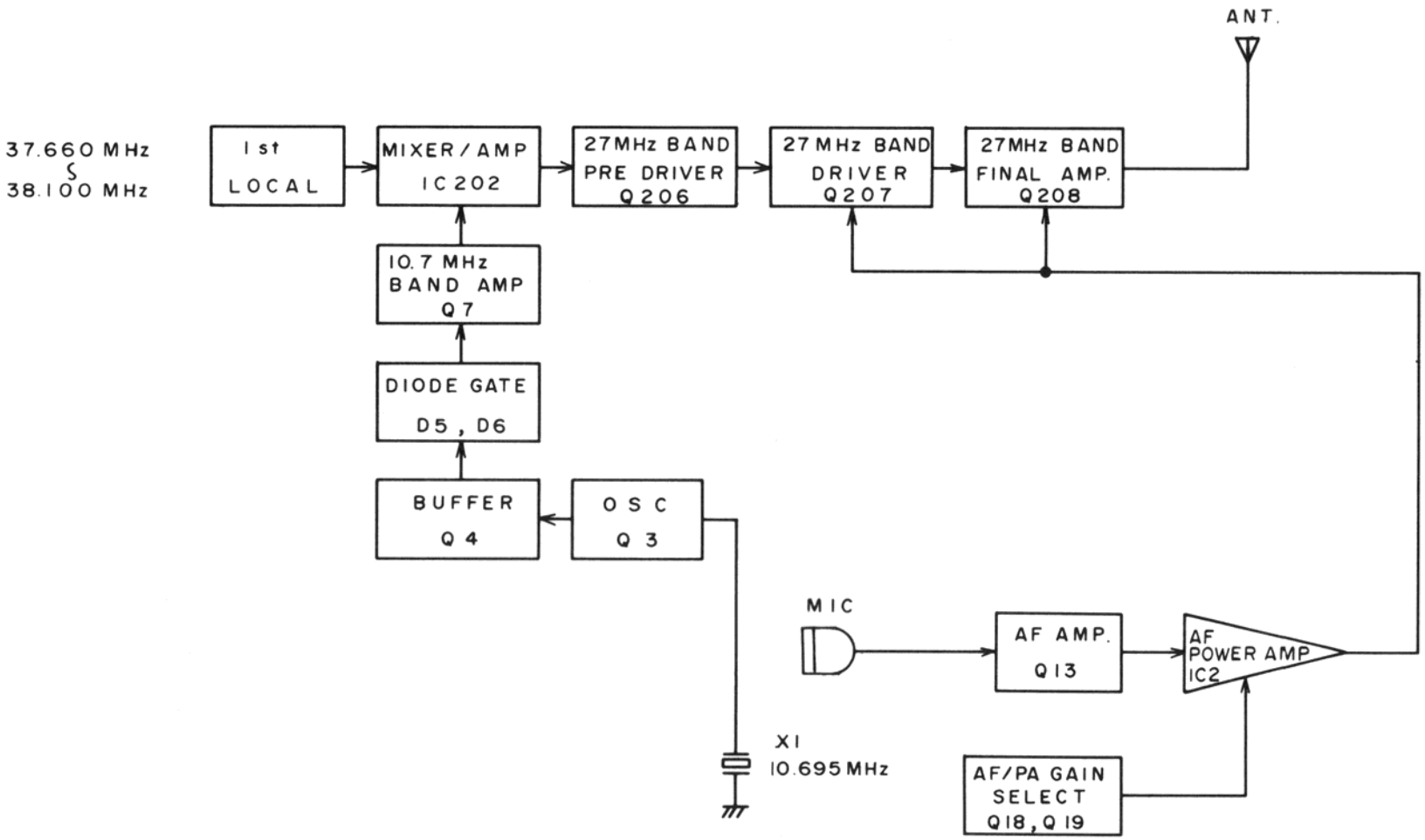

FIGURE 7 AM TRANSMITTER

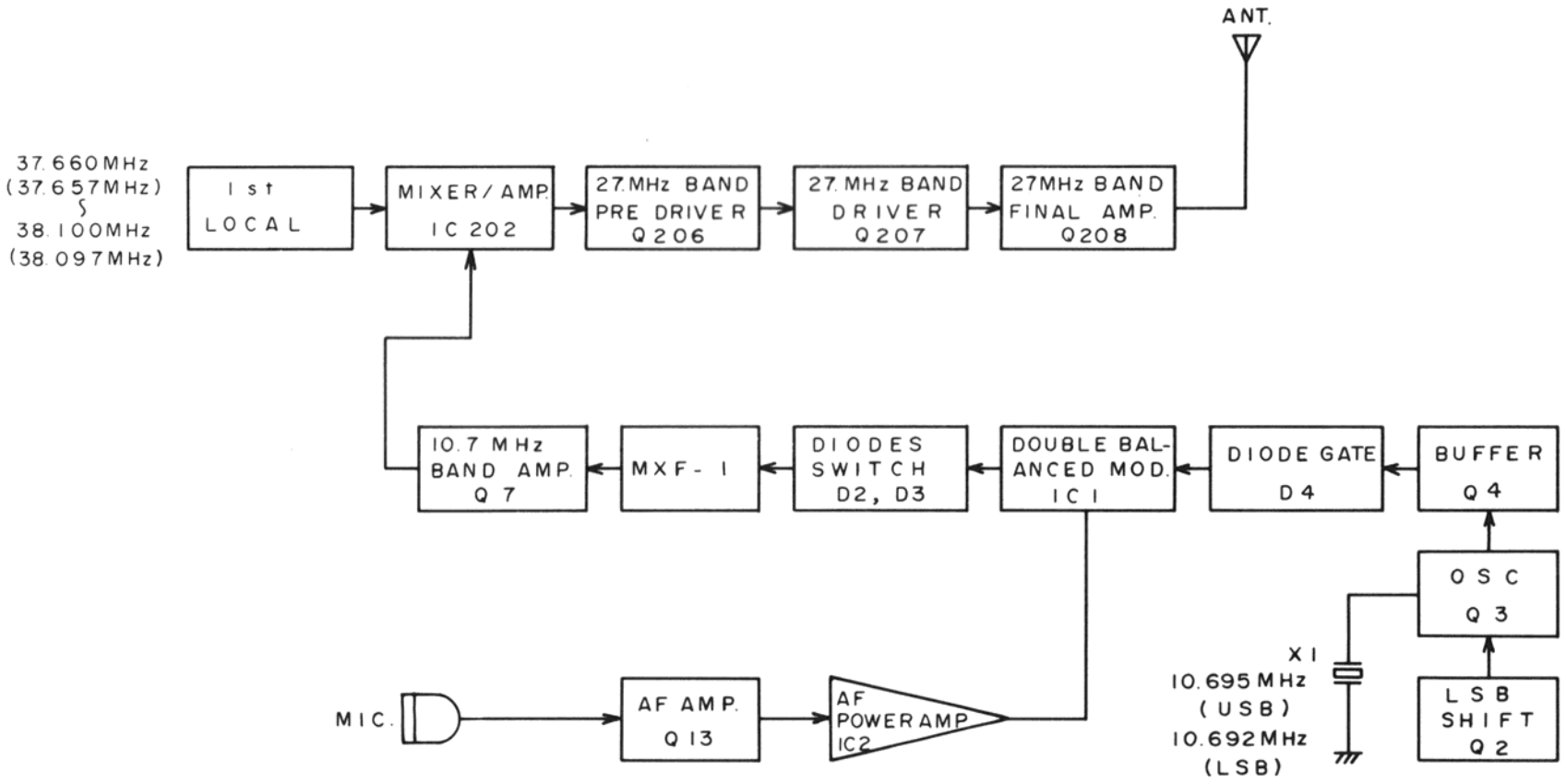

FIGURE 8. SSB TRANSMITTER