SBE LCM 8 Service Manual

LCM-8

Digital PLL Synthesized Mobile CB Transceiver

SERVICE MANUAL

Land Command by SBE®

TABLE OF CONTENTS

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, Watsonville, 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:	Dual PLL circuitry
Frequency Tolerance:	±0.003%
Operating Temperature Range:	−20° C to +50° C
Operating Humidity Limit:	95%
Input Power Voltage:	10.5 to 16 volts
Microphone:	Dynamic, 700 ohms, DIN terminated
Size:	10-3/64" (225 mm) D x 7-1/64" (178 mm) W x 2-9/16" (65 mm) H
Weight:	3.7 lbs (1.7 kg)

2.2 TRANSMITTER

Power Output:	4 watts maximum
Modulation Level:	95 to 100%
Modulation Response:	300 to 3000 Hz, +3, −10 dB
Output Impedance:	50 ohms, unbalanced
Harmonic and Spurious Suppression:	60 dB

2.3 RECEIVER A AND B

Sensitivity for 10 dB S/N:	0.7 μV
Selectivity at 10 kHz:	60 dB
Intermediate Frequencies:	10.695 MHz, 455 kHz
AGC Range for 10 dB Level Change:	75 dB
Squelch Threshold:	0.7 μV
Scanning Sensitivity Range:	1 to 500 μV

Scanning Rate:	0.75 seconds
Audio Output Power:	2.5 watts at 8 ohms
Image Rejection:	60 dB
Spurious Rejection:	60 dB
IF Rejection:	60 dB

2.4 POWER CONSUMPTION

RX at Stand by:	500 mA
TX at Modulation:	1.8 A

SECTION 3
INSTALLATION

GENERAL

This transceiver is an advanced solid-state 2-way CB radio designed primarily for mobile operation. It employs the very latest technology to provide 40 channels of operation by means of digital frequency synthsis with Phase Locked Loop (PLL) circuitry. The use of PLL circuitry assures a precise on-frequency operation on every channel in both transmit and receive modes that is unmatched by conventional crystal frequency synthesis.

This transceiver also includes many unique features which will provide greater operating convenience and assure optimum communications under a wide range of conditions.

3.1 MOBILE INSTALLATION

Before installing the transceiver in a car, truck, boat, etc., be sure to choose a location which is convenient to the operating controls, and will not interfere with the normal functions of the driver.

The transceiver may be mounted to the underside of the instrument panel or dashboad of a car, truck, etc., by means of the special bracket that is supplied with the transceiver [see Figure 1.].

Two special adhesive-backed protective rubber pads have been supplied for use with the mobile mounting bracket. Remove the paper backing, then attach the exposed adhesive side of each pad to the inside edge on each side of the bracket as shown in Figure 1. Verify that the holes in the bracket and pads are perfectly aligned before attaching them.

The general procedure for mounting is as follows;

Attach the bracket to the underside of the instrument panel of the vehicle using the hardware that has been supplied for this purpose.

Before drilling any holes, however, check the fit and convenience of the unit in the selected location. Also, check behind the dashpanel — wires or vacuum hoses should be moved out of the way. Use the bracket as a template to mark the mounting hole locations. Drill the holes using a bit size that is appropriate for the mounting screws. Secure the bracket firmly in position, then attach the CB unit to the bracket, using the two knurled securing screws at the sides.

Before fully tightening the side screws, tilt the CB unit to the desired angle.

INSTALLATION

First choose a location for mounting. The location should be a place which is convenient to use the transceiver and does not interfere with the driver. Usually the underside of the instrument panel or dashboard of a vehicle will be selected. A special bracket for this purpose is supplied with unit.

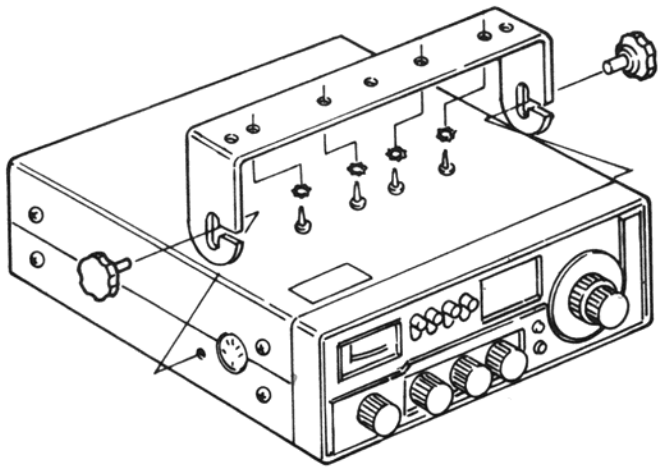


Figure 1.

3.2 DC POWER CONNECTION

This transceiver is designed to be operated from a 12V DC battery in Negative or Positive Ground System.

A. Power Connection for Negative Ground System.

1. Connect Black power lead from the transceiver to the metal chassis ground of the vehicle or minus battery terminal.
2. Connect Red power lead from the transceiver to any convenient hot (positive) side of electrical system or plus (+) battery terminal.

B. Power Connection for Positive Ground System.

1. Connect Red power lead from the transceiver to the metal chassis ground of the vehicle or plus (+) battery terminal.
2. Connect Black power lead from the transceiver to any convenient hot (negative) side of electrical system or minus (—) battery terminal.

3.3 ANTENNA CONNECTION

The antenna is one of the most important factors in the operation of the transceiver. An improper antenna may decrease reception sensitivity and lower the communication range in transmitting. The CB antenna and its mounting method will largely depend upon your type of vehicle, mounting position, etc. Also, the antenna may be different according to your needs — using the transceiver as a mobile or base station transceiver.

We recommend you consult with the dealer from whom you purchased the transceiver or any other CB/Amateur radio equipment supply shop. They should be able to meet your specific needs.

3.4 A QUICK GUIDE TO ANTENNA INSTALLATION

Firstly, the ideal location for a car is in the center of the roof. This gives the best coverage in all directions. Normally it is necessary to drill a hole and remove the roof lining in order to run your cable through. The other alternative is mounting the antenna by means of a strong magnet base and running the cable across the roof.

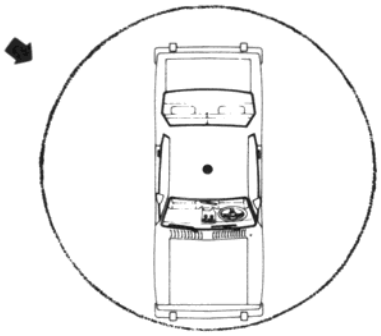


Figure 2.

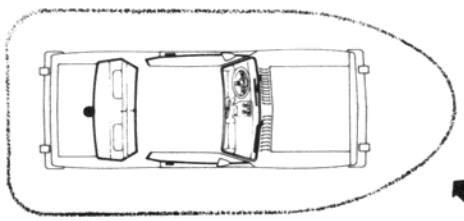


Figure 3.

The next most popular mounting method is on the boot — lid edge.
Signal Strongest Front & Rear of Car.

TERMINATING A PL-259 CONNECTOR

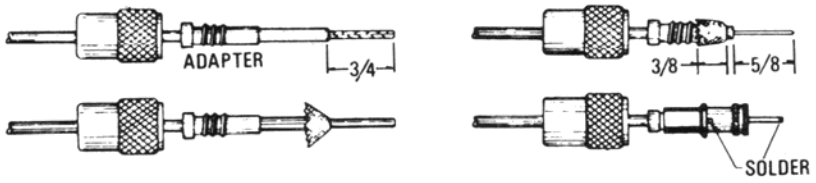


Figure 4.

Another popular method is the gutter grip mount. This is the simplest of all in terms of installation and is very effective. No holes need to be drilled.

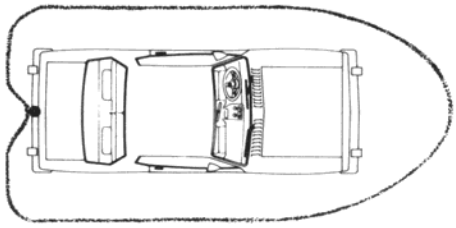


Figure 5.

Next in popularity is the bumper mount. This is very effective when using a full 1/4 wave (108") whip.

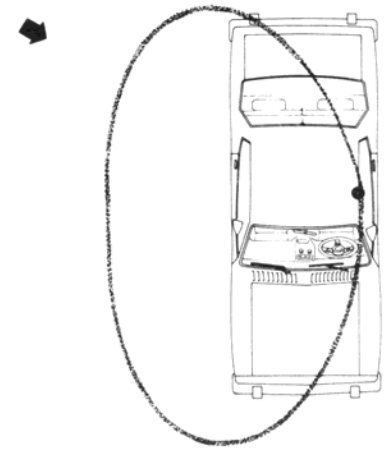


Figure 6.

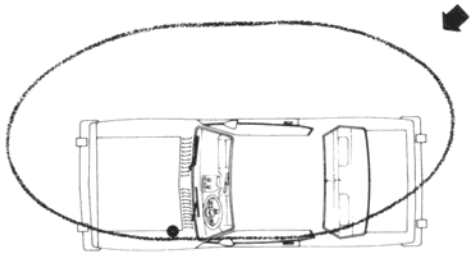


Figure 7.

Finally, another popular idea is the combination AM/FM/CB antenna. This replaces your ordinary car radio antenna. It reduces theft and vandalism and saves having two antennas on your car.
The radiation pattern varies according to the location, however, as a rule-of-thumb the signal will be strongest in the direction of the largest area of nearby horizontal metal.

3.5 ANTENNA TUNING

The final step in installation is to trim the antenna for minimum SWR. The recommended method of antenna tuning is to use an in-line wattmeter or SWR bridge to adjust the antenna for minimum reflected power on channel 19. A properly tuned antenna system will present a suitable load to the transceiver and will insure that maximum power is transfered from the radio to the antenna. If the antenna system in use presents a poor load, as indicated by a high SWR reading, transmitter range will be substantially reduced and damage to the transmitter final amplifier transistor may occur. Poor SWR can usually be corrected by altering the antenna's electrical length in accordance with the manufactures instructions. Extremely high SWR readings may be indicative of a defective transmission line, antenna, or connectors. To determine whether the antenna should be lengthened or shortened, test the SWR on channels 1 and 40. If the SWR is the highest on channel 40, the antenna is too long and if highest on channel 1, the antenna is too short. When the antenna system has been tuned correctly, channel 19 should have the lowest SWR and channel 1 and 40 will be slightly higher.

3.6 NOISE SUPPRESSION

A. TUNE-UP:

In most mobile installations, ignition noise is a problem. Before begining any special noise suppression steps, be sure that the vehicle is well-tuned. Clean and tighten all electrical connections, including alternator, battery, regulator and coil connections. Perform the following maintenance steps as necessary. Solder any crimped spark plug or distributor leads; clean and regap or replace spark plugs and ignition points; and check and clean alternator rings or generator brushes. Retune the engine at the manufacturer's recommended intervals.

B. CORRECTIVE STEPS:

Usually several sources of noise are present in any vehicle, with the strongest covering the others. In order to find and eliminate the maximum number of noise sources, you will have to start with the strong sources and then work back. To be sure the noise you hear comes from your vehicle and not outside it, drive to a relatively quiet location (free of man-made electrical interference such as noisy power lines, industrial noise or other vehicles). Test for noise with a weak signal on the channel and the engine off. Then start the engine. Ignition noise will probably be present at all engine speeds. If it is severe, it may make a normally readable signal unreadable.

To reduce ignition noise, install resistor-type spark plugs if these are not already installed. If non-resistance ignition wiring is used, install a 10 k-ohm suppressor resistor at each spark plug tower of the distributor. Install a coaxial capacitor at the ignition coil primary as close to the coil primary as possible. This capacitor can be purchased from an electronics parts company or an automotive electrical service company.

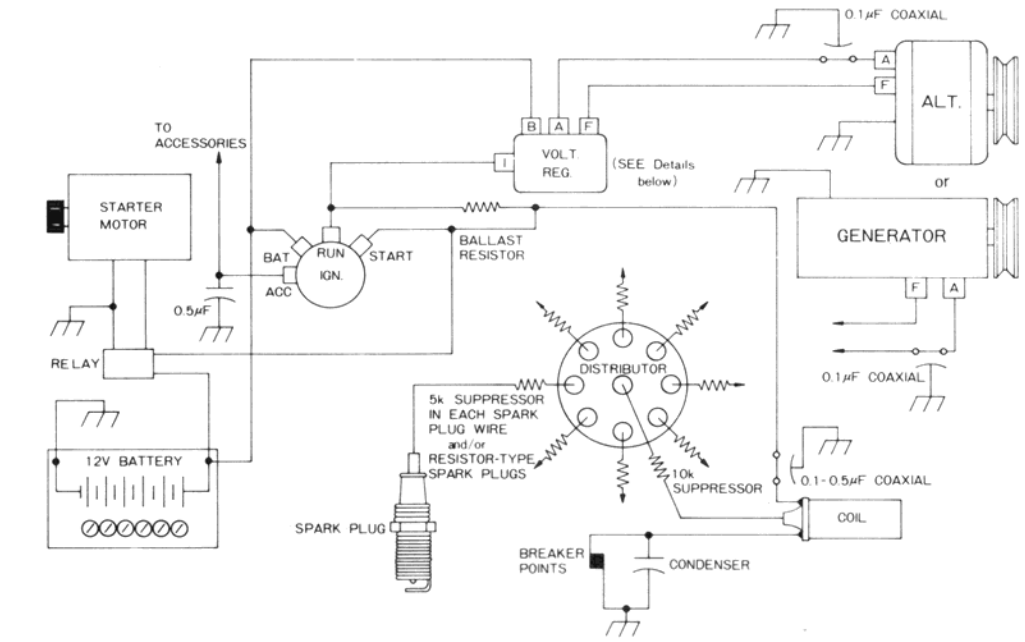
A "whining" noise which varies with engine speed and continues with the ignition turned off and the vehicle coasting in gear is characteristic of the alternator. Check and clean it and install an alternator filter (same sources as above).

An irregular, clicking sound which disappears at a slow idle characterizes the voltage regulator. Install a 4-ohm carbon resistor as close to the field terminal of the regulator as possible, then a .002 μF capacitor in series with and as close to the resistor as possible. Connect the capacitor to ground.

See the detail drawings under Noise Suppression Diagram.

Irregular popping noises which vary with road surfaces indicate static discharge at any of several locations in the vehicle. Tighten loose nuts and bolts and bond large areas such as the fenders, exhaust pipe, firewall, etc. to the frame with lengths of heavy wire braid.

NOISE SUPPRESSION DIAGRAM



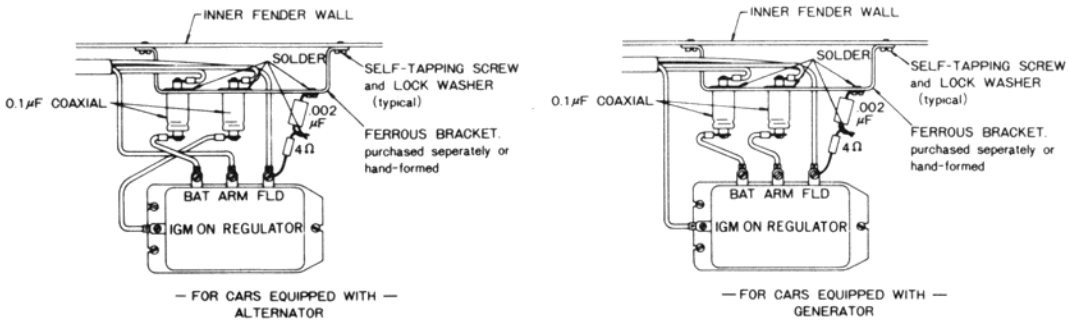


Figure 8.

SECTION 4
CIRCUIT DESCRIPTION
OPERATION THEORY OF THE PLL FREQUENCY SYNTHESIZING AM CB TRANSCEIVER

4.1 FUNDAMENTAL THEORY OF PLL CIRCUITRY

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

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

The PLL circuitry consists of the three main units in simple form as shown in Fig. 9.

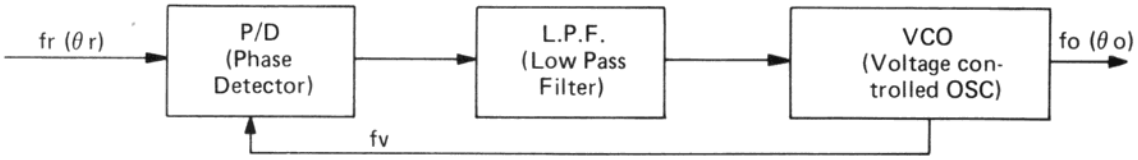


Figure 9. Fundamental Block Diagram of PLL Circuitry

In the above block diagram, 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 may include unnecessary harmonics and noises. The DC output is, therefore, fed to a low pass filter (L.P.F.) and integrated or smoothed to continuous DC voltage in proportion to the phase difference. The frequency of voltage controlled oscillator (V.C.O.) is controlled by the L.P.F. output voltage.

Thus controlled VCO output is, then, split into two:

One used as a 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 called locked.

Employing the PLL circuitry in a CB transceiver requires some modifications so that the VCO (voltage controlled oscillator) generates specific frequency corresponding to each channel frequency (1 through 40, 26.965 to 27.405 MHz, respectively) according to the channel selection. Also, VCO frequency is different according to the operation mode in which the circuit is operated — receive or transmit.

Figure 10 is the new block diagram made with this modification. As you can see, a programmable divider, Mixer and Doubler are newly added.

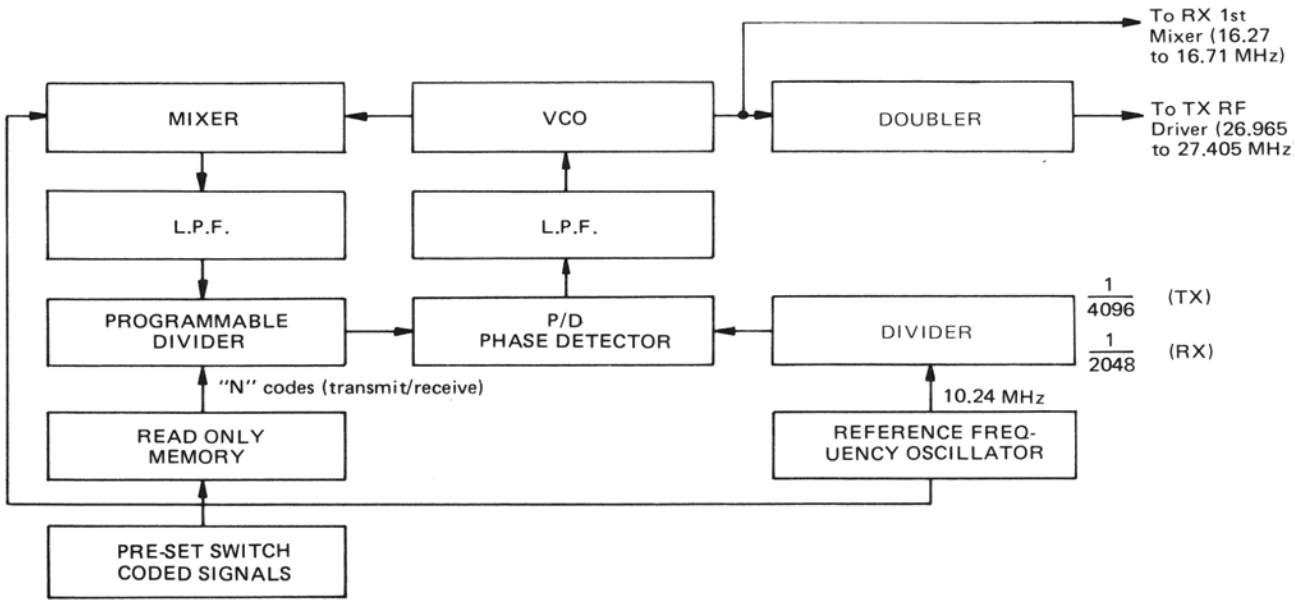


Figure 10. Theoretical Block Diagram of PLL Frequency Synthesizer Circuitry for CB Transceiver

Where Fr (VCO) is VCO frequency in receive mode, In receive mode, the first local oscillator frequency, F (loc) is as;

$$F\ (loc) = Fr\ (VCO) \quad \ldots \quad (1)$$

VCO frequency in receive mode is given below;

$$Fr\ (VCO) = F\ (ref)\ (1 + \frac{Nr}{2048}) \quad \ldots \quad (2)$$

Where F (ref) means reference oscillator frequency, namely, 10.240 MHz Nr is an order signal from the channel selector switch in receive mode. When using the PLL system in the CB transceiver, N code should have the same frequency spacing, as the each channel spacing, namely, 10 kHz.

In the transmit mode, transmit frequency into RF driver, F (tr) is given as;

$$F\ (tr) = 2\ Ft\ (VCO)$$

Where, Ft (VCO) is VCO frequency in transmit mode, and is;

$$Ft\ (VCO) = F\ (ref)\ (1 + \frac{Nt}{4096})$$

Nt is an order signal from the channel selector switch in the transmit mode.

When receiving channel number 1, 26.965 MHz, the first local frequency F (loc) will be obtained from the equation (1) and (2).

$$F\ (loc) = Fr\ (VCO) = 16.27\ MHz$$

Then "N" code in reception of channel 1 will be obtained by using the equation (2) as;

$$Nr = 2F\ (ref)\ (\frac{Fr\ (VCO)}{F\ (ref)} - 1)$$

When transmitting on channel 1, 26.965 MHz, Doubler output signal frequency into transmitter RF driver, F (tr), should be;

$$F\ (tr) = 2\ Ft\ (VCO)$$

VCO frequency in transmit mode, Ft (VCO) will be;

$$Ft\ (VCO) = 2F\ (ref)\ (1 + \frac{Nt}{4096})$$

N code in transmit mode Nt will be;[4]

$$Nt = 4096\ (\frac{F\ (tr)}{2F\ (ref)} - 1)$$

This means that selecting channel 1 is to select one of the "N" codes (i.e. "1206" in receive and "1297" in transmit mode) instead of selecting proper crystals in a conventional CB transceiver. Thus by 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.

TRANSCEIVER PLL CIRCUIT

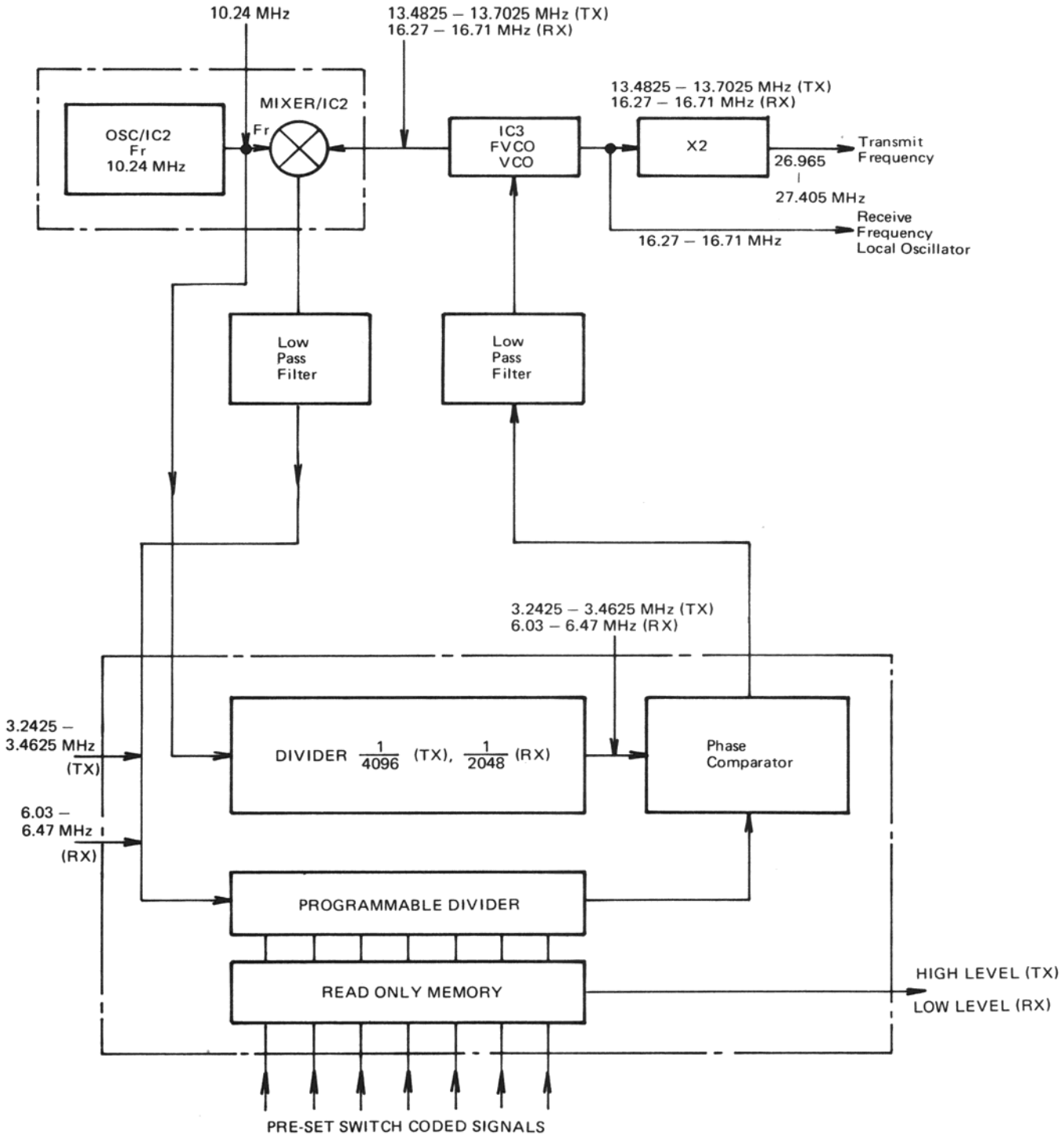


Figure 11.

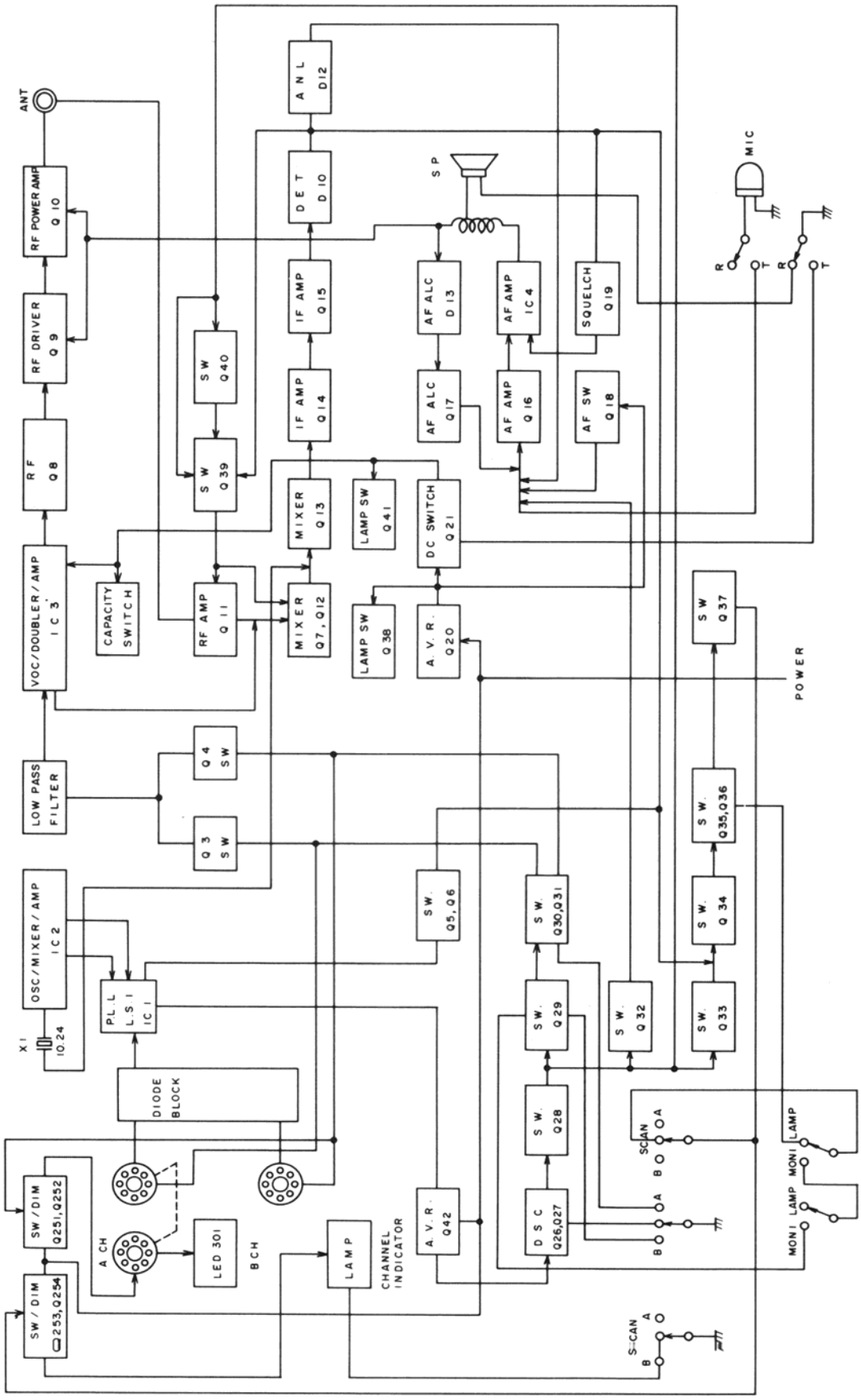


Figure 12. BLOCK DIAGRAM OF LCM-8

4.2 RECEIVER

GENERAL

In the receive mode, Q1 and Q21 are turned off and Q11, Q12, Q7, Q13, Q14, Q16, IC4, Q19 and scan-switching circuits are powered and operate. IC1 (PLL), IC2 (Reference OSC/Mixer) and IC3 (VCO/Mixer) operate in both the receive and transmit modes.

Q11 is a 27 MHz RF amplifier and amplifies the signal from the antenna through L13, L12, L11, C77 & T9. The amplified signal is applied to the base of mixer Q12 & Q7 where it is mixed with the output of IC3.

The resultant is the first IF frequency:

When channel 1 is selected;
1st IF = 26.965 – 16.27 = 10.695 MHz

The 1st IF signal is then applied to the 2nd Mixer (Q13) together with 10.240 MHz from IC2. The resultant is the 2nd IF frequency.

2nd IF = 10.695 – 10.240 = 0.455 MHz = 455 kHz

The 455 kHz signal is fed to the IF amplifiers Q14 and Q15 and finally detected at D10.

The detected audio signal is amplified by IC4.

The output is supplied to the built-in speaker through the audio output transformer T17.

Base bias is supplied to Q19 (squelch circuit) during receive operation only.

AUTOMATIC NOISE LIMITER CIRCUIT

The ANL circuit prevents impulse noise, such as ignition noise, from being amplified. The audio output voltage from the detector diode D10 is attenuated to voltage driver R73 and R74 via R75.

The audio output from the detector is also fed through R75 to C101 where it is filtered and then fed through R76 to the cathode of D12 – the ANL diode. Since the audio signal is positive, the signal at the anode of D10 is normally more positive than the cathode and the diode is forward biased providing a low impedance path for the audio.

When a noise pulse appears in the output of the detector, the anode and cathode of D12 becomes reversed biased by the time constant of R75 and C101 and thus provide signal cut-off.

R72 applies the bias to D12 through the AGC line and operates to prevent the distortion for audio output level.

AUTOMATIC GAIN CONTROL CIRCUIT

The AGC reduces the gain of three stages – RF amp Q11, 1st Mixer Q7 & Q12 and 1st IF amp Q14 in response to a strong signal by lowering bias voltages which are fed through R49 to the base of Q11, R51 to the base of Q7 & Q12 and/or R61 to the base of Q14.

R67 and R71 establishes AGC bias point (about 2V). The rectified output of D10 varies the AGC bias voltage and its controls the bias voltage of the above stages.

SQUELCH CIRCUIT

The squelch circuit shuts the audio off when the received signal is less than the threshold level as determined by the squelch sensitivity control RV1. Since the base bias of Q19 is supplied during receive