1. THEORY OF OPERATION

A. Overall Operation

The KRX 1053 Receiver/Exciter is a component of a KHF 1050 HF Radio Communication system. It receives HF transmissions, provides a low power transmitter drive signal (Exciter signal) to the KPA 1052.

B. Simplified Block Diagram Description

The block diagram description is divided into the follow subdivision:

- KRX 1053 OVERVIEW
- EXCITER OVERVIEW
- RECEIVER OVERVIEW
- POWER SUPPLY OVERVIEW
- OPERATIONAL BLOCK DIAGRAMS

(1) KRX 1053 overview

The KRX 1053's circuitry is divided into three major subdivision:
Exciter, Receiver and Power Supply. Figure x provides an overall block diagram of entire KRX 1053. The blocks within the diagram indicate stage of processing. Figure 1-1 provide an internal frequency diagram of the KRX 1053.

(2) Exciter overview

Figure 1-2 provides a block diagram overview of the exciter stage.
The blocks within the diagram indicate the stages of processing.

(3) Receiver overview

Figure 1-3 provides a block diagram overview of the receive stage.
The blocks within the diagram indicate the stages of processing.

(4) Power Supply overview

Figure 1-4 Power Supply Block Diagram is a block diagram overview of the power supply. The block within blocks the diagram indicate stage of processing.

The high efficiency switching power supply is regulated by controlling the duty cycle of the switching transistors.

Block diagram description of the power supply is divided into the following subdivisions:

- POWER ON/OFF
- COMPARATOR
- RIPPLE REGULATOR

- +15 V REGULATOR
- +9 V REGULATOR
- +3.3 V REGULATOR
- +5 V REGULATOR
- -15 V REGULATOR

(a) POWER ON/OFF

The POWER ON/OFF circuit performs ACTIVATE/DEACTIVATE KRX 1053 POWER SUPPLY.

(b) COMPARATOR

The CPMPARATOR circuit monitors the A/C power line.

When a low voltage condition is detected, a POWER FAIL signal is sent to the CPU.

(c) RIPPLE REGULATOR

The +28 V A/C signal is regulated by a ripple regulator to remove undesired ripple and noise.

(d) +15 V REGULATOR

The ripple regulator output is regulated to produce the +15 V dc supply voltage and filtered.

(e) +9 V REGULATOR

The ripple regulator output is regulated to produce the +9 V dc supply voltage and filtered.

(f) +3.3V REGULATOR

The ripple regulator output is regulated to produce the +3.3 V dc supply voltage and filtered.

(g) +5 V REGULATOR

The ripple regulator output is regulated to produce the +5 V dc supply voltage and filtered.

(h) –15 V REGULATOR

The +5 V DC output is converted to negative voltage from positive voltage, regulated to produce the –15 V dc supply voltage and filtered.

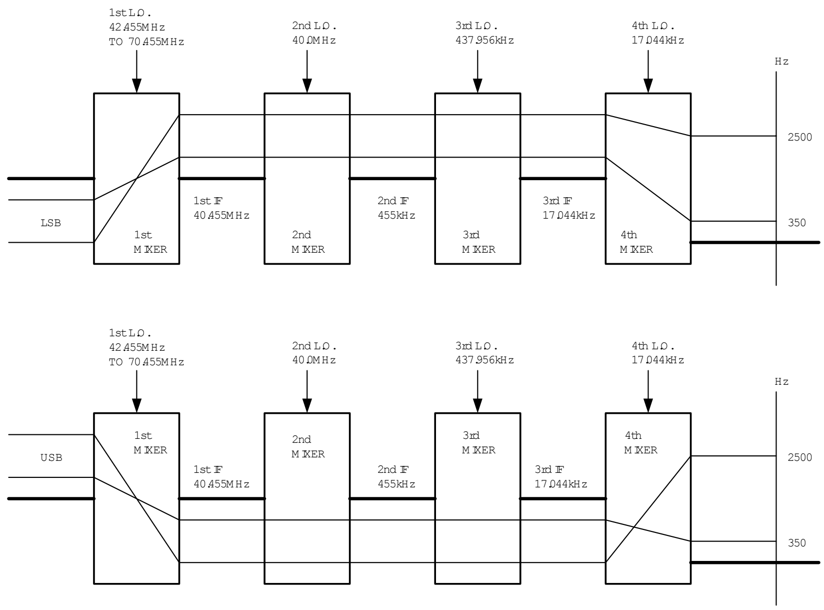

Figure 1-1 KRX 1053 Internal Frequency Diagram

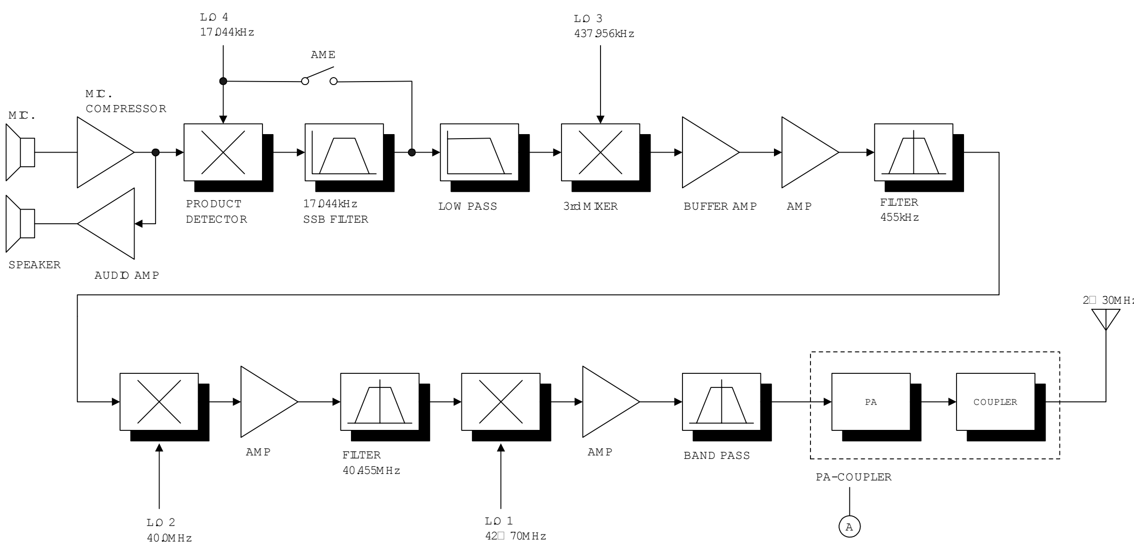

Figure 1-2 Exciter Block Diagram

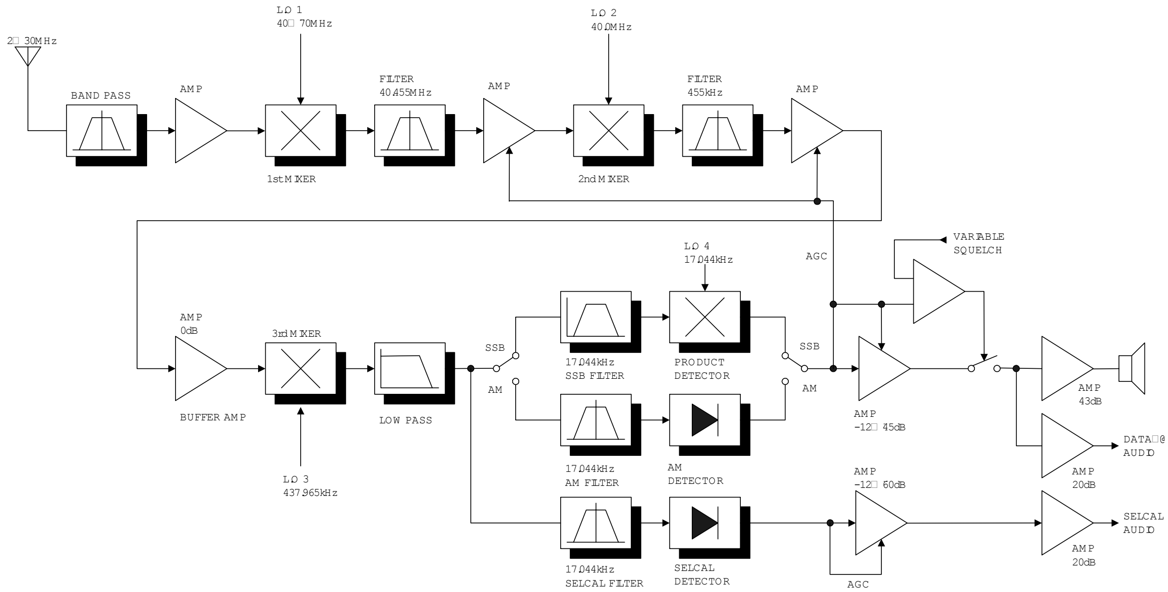

Figure 1-3 Receiver Block Diagram

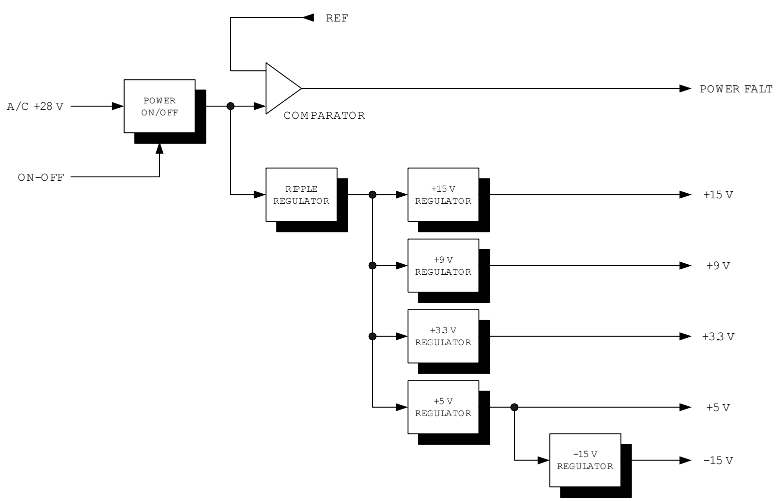

Figure 1-4 Power Supply Block Diagram

(5) Operational block diagrams

The signal flow within the KRX 1053 is mode dependent. Simplified flow diagrams are provided for the following modes of operation:

- AM RECEIVE

- AM TRANSMIT (AM EQUIVALENT)
- SSB RECEIVE
- SSB TRANSMIT
- CW RECEIVE
- CW TRANSMIT
- TUNE
- SELCAL RECEIVE

(a) AM Receive

Refer to Figure 1-5 while reading this subdivision.

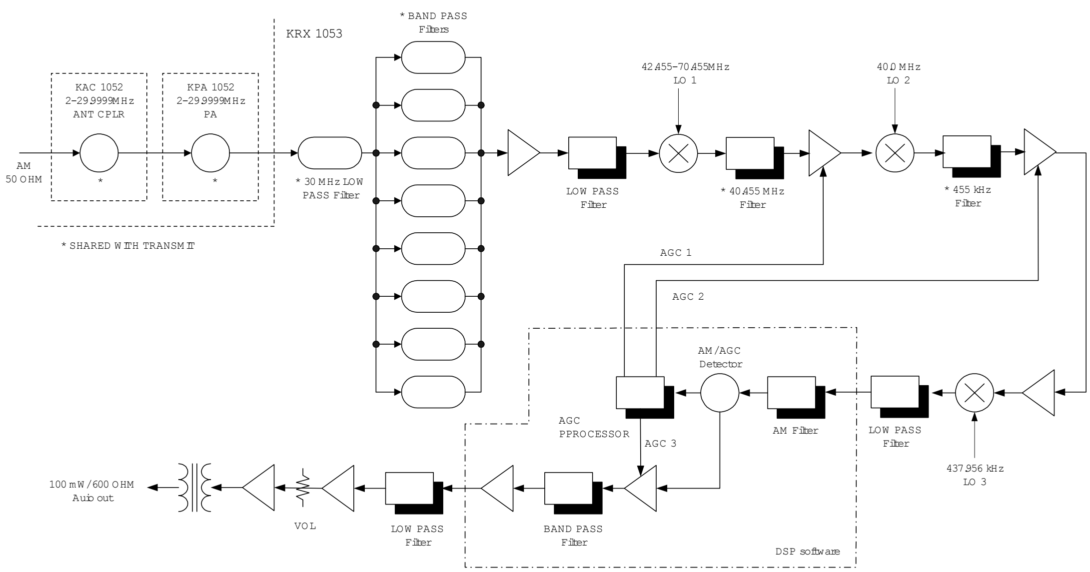

Figure 1-5 AM Receive Mode Block Diagram

The RF signal received by the antenna is coupled to the KAC 1052. This RF signal is coupled to the KPA 1052 through the matching circuit or the bridge amplifier in the KAC 1052.
After that, the RF signal is coupled to the KRX 1053.

At the KRX 1053, the received signal couples through a one of eight-band pass filter. The effects of the band pass filtering establish the spurious response characteristics of the transceiver.

After band pass filter, the filtered signal is amplified by a broadband amplifier and mixed with Local Oscillator (LO) 1 in a double balanced first mixer. This produces a difference frequency of 40.455 MHz (First IF signal).

The first IF signal is filtered by a selective IF monolithic filter to establish the cross modulation rejection characteristics of the transceiver.

The filtered first IF signal is passed through an Auto Gain Controlled IF amplifier stage and mixed with LO2 (40.0 MHz) at the second mixer. This produces a difference frequency of 455 kHz (Second IF signal).

The second IF signal is filtered by a selective IF ceramic filter and passed through an Auto Gain Controlled IF amplifier stages.

The Auto Gain Controlled IF amplifier output signal is passed through a Buffer amplifier stage and mixed with LO3 (437.956 kHz) at the third mixer. This produces a difference frequency of 17.044 kHz (Third IF signal).

The third IF signal is filtered by an active low pass filter and converted form single ended signal to deferential signal.

The deferential signal is converted from analog signal to digital signal by a CODEC and passed to a Digital Signal Processor (DSP).

At the DSP, The digital signal is filtered by an AM filter to establish the AM selectivity characteristics of the transceiver.

The filtered digital signal detected by an envelope detector to produce an envelope signal. This signal is filtered by a band pass filter to produce an AM digital audio signal and filtered by a low pass filter to produce an AGC voltage. The AGC voltage controls the gain of the Digital audio, 455 kHz 2^{nd} IF and 40.455 MHz 1^{st} IF stages.

The AM digital audio signal is passed through an Auto Gain Controlled audio amplifier stage and passed through an Auto Level Controlled amplifier stage to an automatically controlled level.

The Auto Level Controlled amplifier output signal is converted from digital signal to analog signal by a CODEC and filtered by an active low pass filter to produce an AM audio signal.

The AM audio signal is passed through a buffer amplifier stage and amplified by an Audio amplifier.
The audio signal is transformed to 600-ohm output impedance by a transformer.

The synthesizer provides the LO injection signal for 1st mixer stage. It is controlled by CPU on CPU/DSP board.

(b) AM Transmit (AM Equivalent – AME mode)
Refer to Figure 1-6 while reading this subdivision.

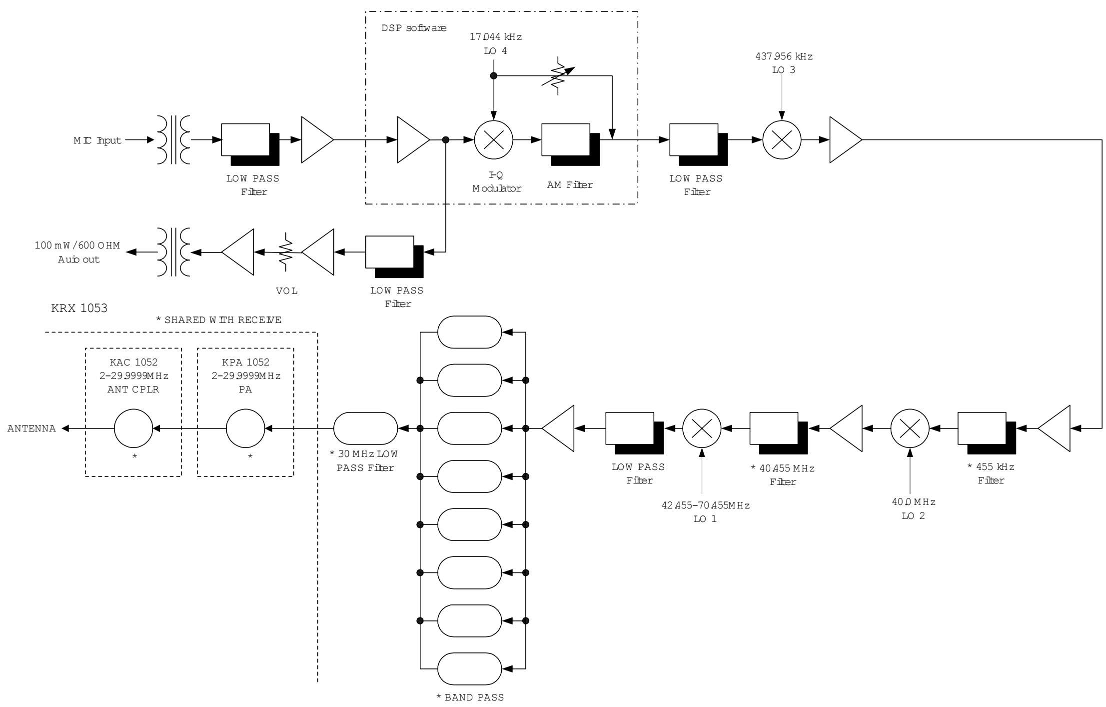

Figure 1-6 AM Transmit (AM Equivalent –AME mode) Block Diagram

The microphone audio is converted from deferential signal to single ended signal by a transformer and filtered by an active low pass filter.

The filtered microphone audio signal is converted for single ended signal to deferential signal and converted from analog signal to digital signal by a CODEC. The microphone digital audio signal passed to a Digital Signal Processor (DSP).

At the DSP, The microphone digital audio signal passes through an audio compressor to an automatically controlled level. This compressed audio is switched to the audio amplifier for sidetone output. It is also mixed in an I-Q modulator 17.044 kHz (LO4) signal to form a 17.044kHz upper sideband suppressed carrier signal.

The I-Q modulator output signal is filtered by 17.044 kHz upper sideband digital filter.

A portion of the 17.044 kHz LO4 signal is level controlled with respect to the SSB signal. This level controlled 17.044 kHz signal is summed with the upper sideband after the digital filter to reinsert the 170.044 kHz carrier.

The upper sideband with carrier signal is converted from digital signal to analog signal by a CODEC and filtered by an active low pass filter to produce a 4th IF signal.

The 4th IF signal is mixed with LO3 (437.956 kHz) at the third mixer. This produces a difference frequency of 455 kHz (3rd IF signal).

The 3rd IF signal is passed through a buffer amplifier, amplified by the 455 kHz IF amplifier and filtered by the 455 kHz ceramic filter.

The filtered 3rd IF signal is mixed with LO2 (40.0 MHz) at the second mixer and filtered by the 40.455 MHz monolithic filter to produce a 2nd IF signal.

The 2nd IF signal is mixed with LO1 signal at the first mixer.
The first mixer output is filtered by a low pass filter, broadband amplified and filtered in the band pass filter to remove the higher frequencies producing an excitation signal at the operating frequency. This signal is sent to the KPA 1052.

(c) SSB Receive

Refer to Figure 1-7 while reading this subdivision.

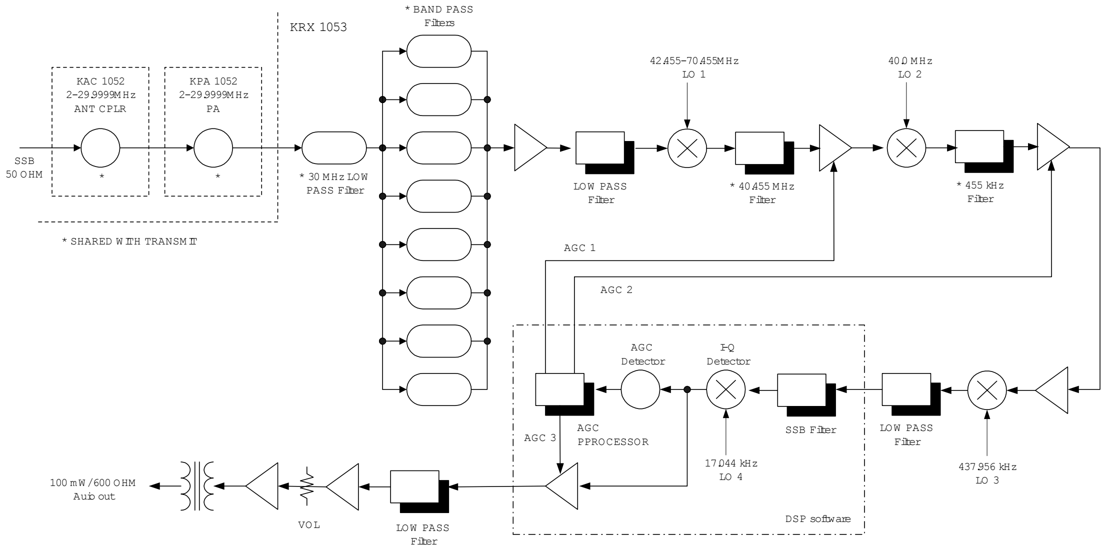

Figure 1-7 SSB Receive Mode Block Diagram

SSB reception is the same as AM reception with the following exception:

- The output of the sideband digital filter is applied as one input of a I-Q detector. In the I-Q detector it is mixed with LO 4 (17.044 kHz) and the resultant audio signal is selected for audio amplification.
- The Audio band pass filter and Auto Level Controlled amplifier is bypassed.
- Only mode where the clarifier can be enabled. The clarifier fine tunes LO injection to improve audio clarity resulting in the most natural voice from the transceiver.

(d) SSB Transmit

Refer to Figure 1-8 while reading this subdivision.

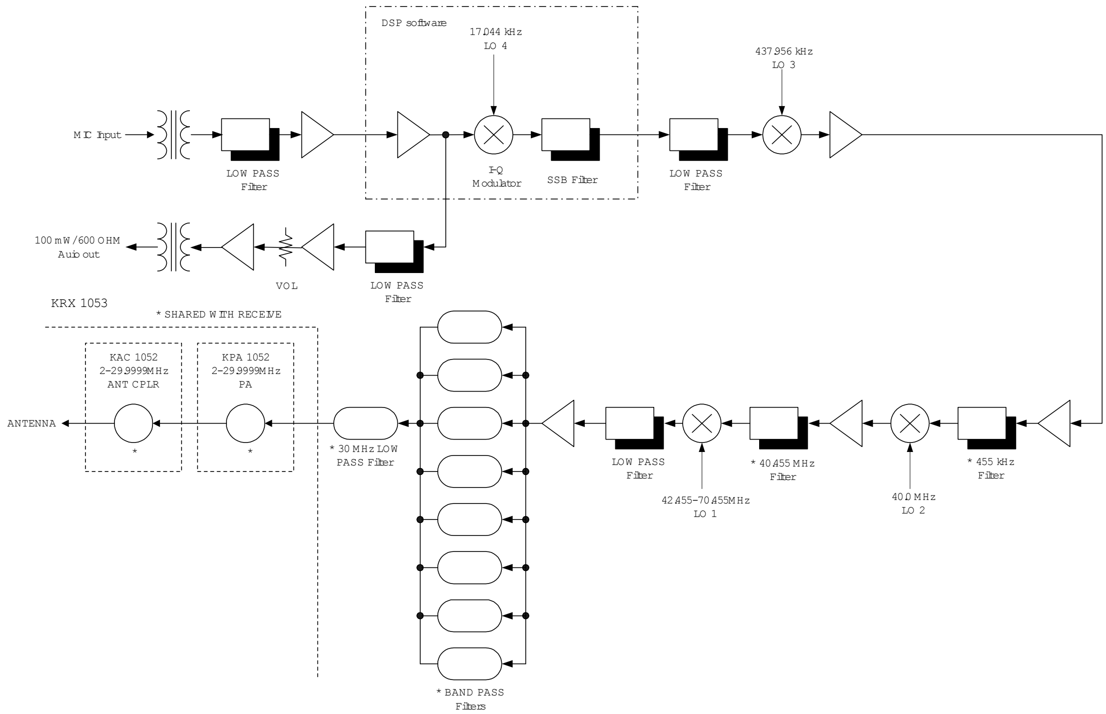

Figure 1-8 SSB Transmit Mode Block Diagram

SSB Transmit is the same as AM Transmit with the following exceptions:

- The 17.044 kHz carrier is not reinserted (LO 4) prior to the first mixer.

(e) CW Receive

Refer to Figure 1-9 while reading this subdivision.

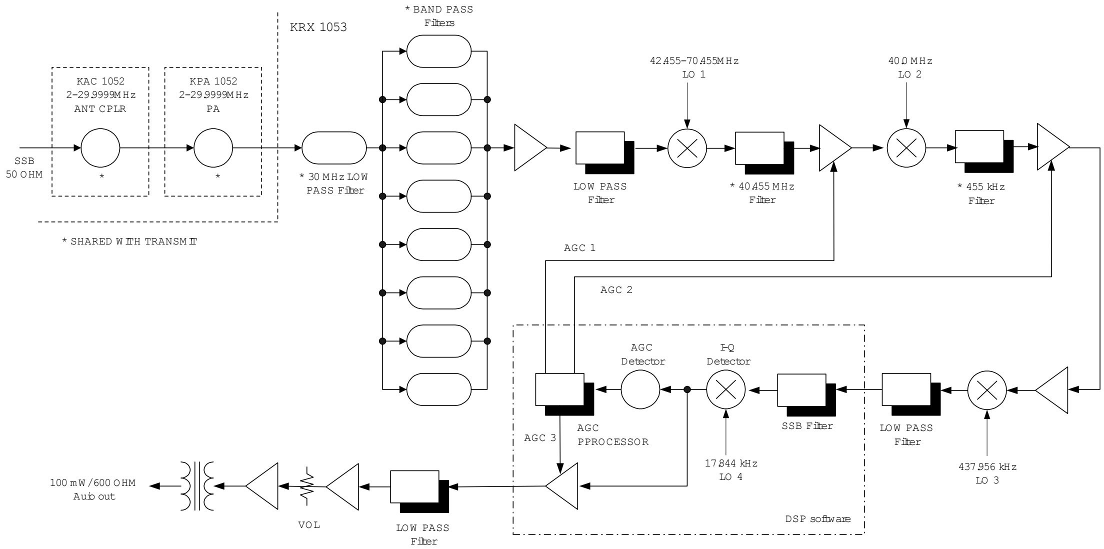

Figure 1-9 CW Receive Mode Block Diagram

CW reception is the same as SSB reception with the following exception:

- Local oscillator injection for the I-Q detector is 17.844 kHz.

(f) CW Transmit

Refer to Figure 1-10 while reading this subdivision.

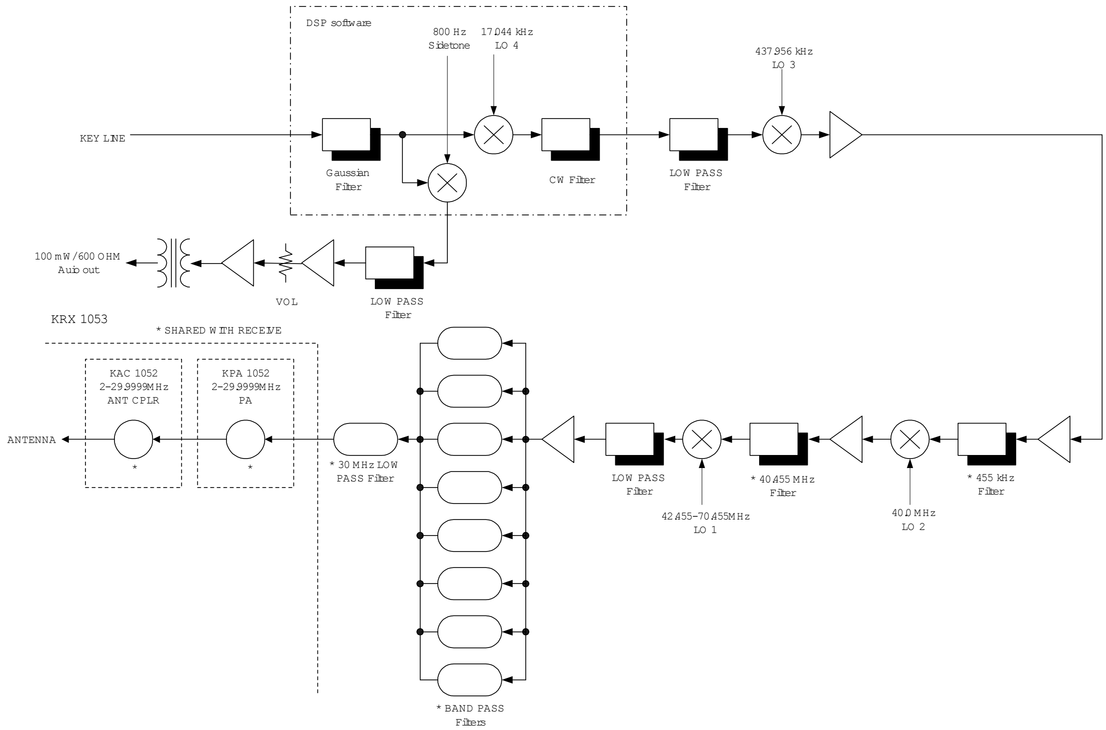

Figure 1-10 CW Transmit Mode Block Diagram

CW Transmit is the same as AM Transmit with the following exception:

- The MIC audio is disabled.
- The KEY LINE signal passes through the Gausian filter to a spectrum controlled. The output signal of the Gausian filter is multiplied with 800 Hz sidetone oscillator and switched to the audio amplifier for a sidetone output. It is also multiplied with 17.044 kHz LO4 for a 4th IF signal.

(g) Tune

Refer to Figure 1-11 while reading this subdivision.

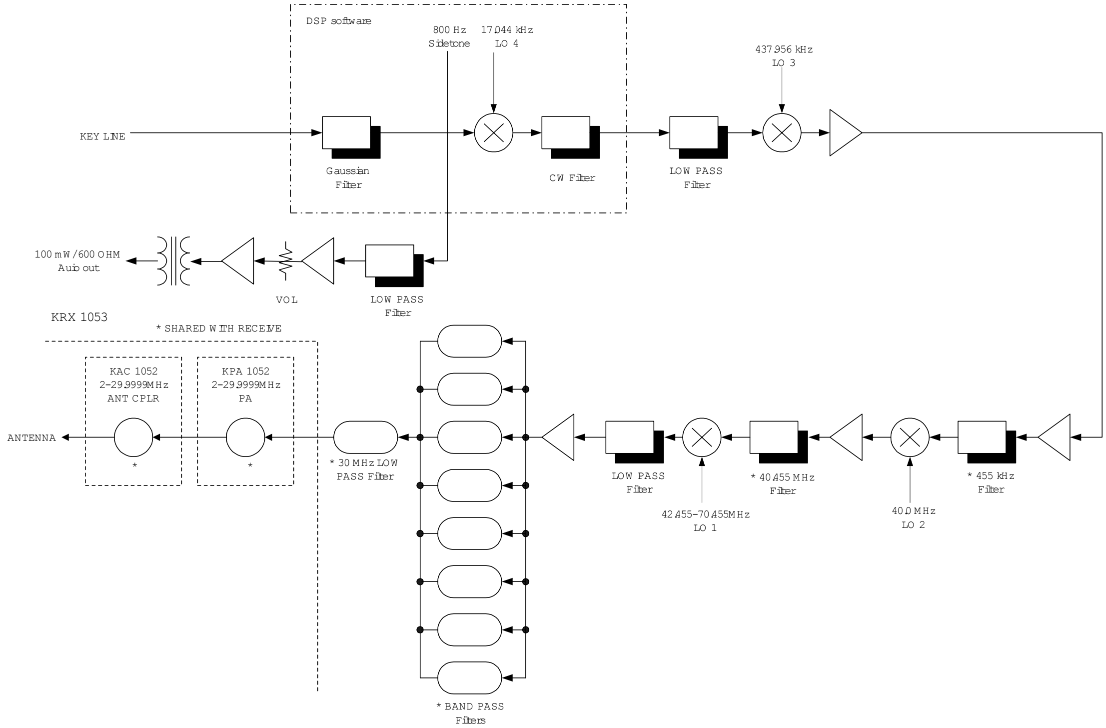

Figure 1-11 TUNE mode Block Diagram

Tune mode is the same as CW transmit with the following exception:

- The sidetone signal is outputted during the tuning process no relation with KEY LINE.

The tune mode provides a continuous carrier to KAC 1052 passed through KPA 1052 which allows it's discriminators to operate during the tuning process.