Section 2 Theory of Operation

2.1 General

The standard RT-138F and narrow banded RT-138F are identical except for the following items:

- A Daughter board has been added to the Audio board for gain switching purposes.
- One wire that is normally tied back (mem discrete #2) is now soldered to 'Y' on the Audio board connector A3J3.
- IF filters FL1 and FL2 (20 Mhz filters) were changed to provide a steeper roll-off and narrower bandwidth. The Guard receiver will have its 16.9 MHz IF filters changed to steeper roll-off and narrower bandwidth characteristics as well.
- Some parts were changed in the 4 Section 3 kHz Low Pass Filter on the Audio board to provide a narrower response.

The theory of operation in this document covers only those parts of the Audio board that have been affected by the narrow band modification. The remaining operations are covered in the original Theory of Operation in the RT-138F Maintenance Manual.

2.2 Operational Block Diagram

Figure 2-1 is a block diagram illustrating the operation of the '-050' Audio board used in the RT-138F with the narrow band Daughter board installed.

2.3 Narrow Banded Audio Board Circuit Theory

A3U1A, the Main Receiver inverting buffer no longer drives the main squelch circuitry in the narrow banded Audio board. The signal for the main squelch circuitry is now taken directly from pin A3P3-21 and input to the isolated leg of C4. The reason for this change is because the gain of A3U1A is now switchable to double the amplitude of the incoming audio when in the narrow band mode. Since the gain is doubled in the narrow band mode, the noise is also doubled. The squelch circuitry therefore would sense the extra noise and squelch accordingly. This would create one squelch point for narrow and a different point for wide band depending on which is selected on the C-1000 control head. By picking off the signal before it gets to A3U1A, the squelch remains consistent regardless of the gain selected for the buffer and independent of whether the incoming signal is narrow or wide band.

The Guard Audio Buffers' gain is also switchable for the purpose of doubling the amplitude of an incoming narrow band signal. The squelch circuitry however, is contained in the Guard so the signal received by the Audio board from the Guard has already been screened for squelch.

A3U9B, the Modulation Summing Buffer, also has switchable gain. It's gain however, is cut in half by the gain switch in the narrow band mode in order to keep the modulation within narrow band specs during transmit.

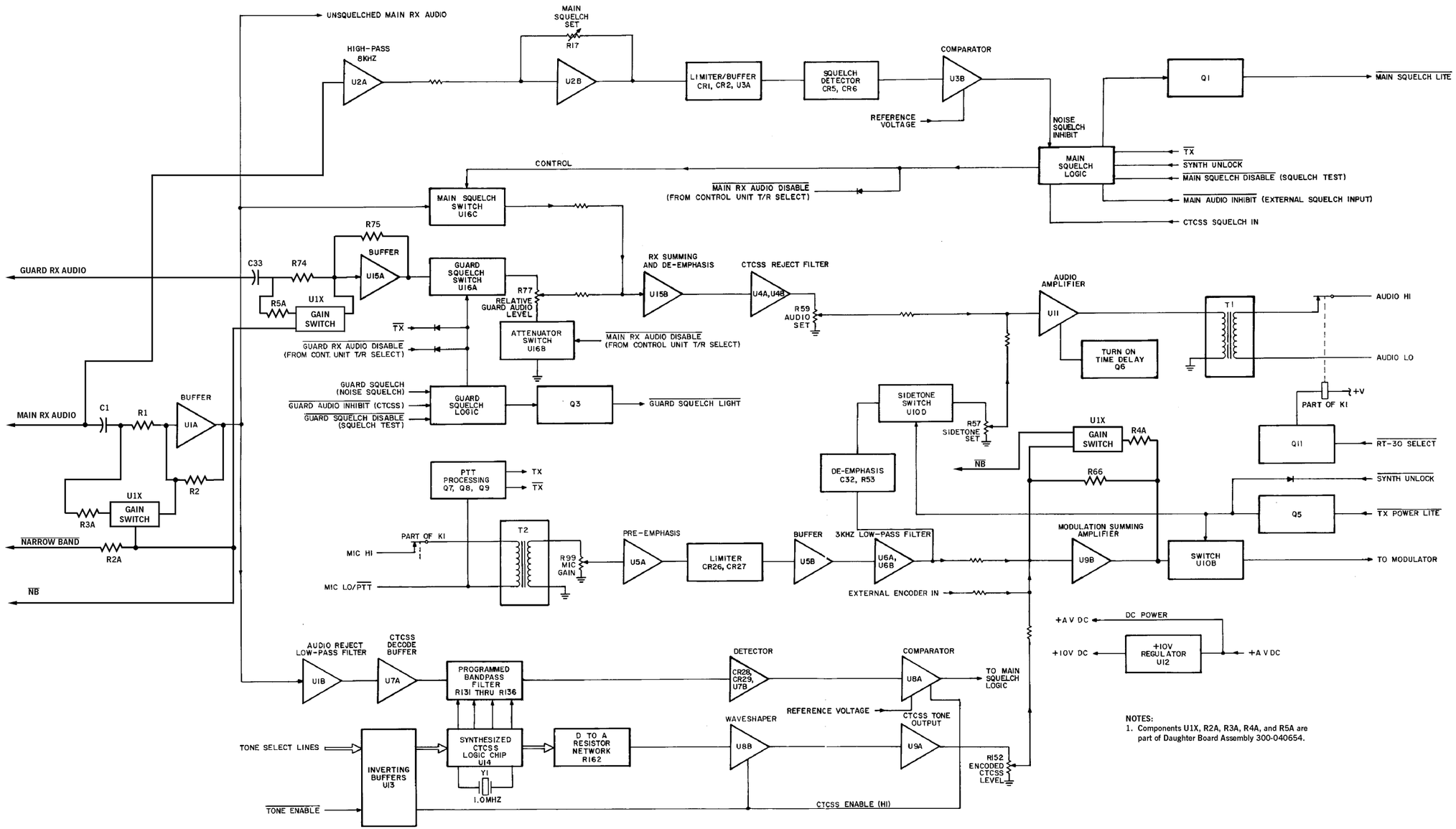

Figure 2-1. RT-138F Narrow-Band Audio Board Block Diagram

2.3.1 Narrow Band Gain Boost

When the radio incorporates a narrow band system, the received audio is reduced by a factor of two due to the reduced modulation deviation. To compensate for this reduction, a times-two audio boost circuit is supplied for the Main and Guard receive audio paths and is controlled by the $\overline{\text{Narrow Band}}$ control signal.

The Main Receiver audio is buffered by amplifier A3U1A. The gain of this stage will be 1.18 with a high signal (+10 Vdc) applied to U1X pin 1. A low signal applied to this pin will double the gain to 2.36.

The Guard Receiver audio is buffered by amplifier A3U15A. This is a switchable gain stage that is unity when a high signal (+10 Vdc) is applied to U1X pin 9. A low signal applied to this pin gives it a gain of two.

2.3.2 Narrow Band Gain Reduction

Another aspect of a radio that incorporates a narrow band system is that when transmitting in narrow band, the modulated audio and CTCSS tone deviation are reduced by a factor of two. This reduction is created by making the Modulation Summing Buffer a switchable gain stage controlled by the narrow band control signal.

The Modulation Summing Buffer A3U9B is a switchable gain stage that is unity when a high signal (+10 Vdc) is applied to U1X pin 8. A low signal applied to this pin cuts the gain in half reducing the deviation by a factor of two when in narrow band.

2.3.3 4 Section 3kHz Low Pass Filter

The audio response needs to be shaped to fit a certain modulation response curve in the narrow band mode as well as the standard band. This is more difficult in the narrow band mode because the sidebands created by the modulated audio need to be suppressed considerably at 12.5 kHz from center whereas in the standard mode we're concerned with 25 kHz and beyond where the sidebands are already attenuated sufficiently.

The response is measured using a modulation frequency of 300 Hz to 5 kHz. Over this range, the output can't be over-modulated or under-modulated as defined by the TIA/EIA Standard. The changes made to the 3 kHz Low Pass Filter are there to keep the modulation response within the specified limits.

R108 has been reduced to increase the gain of this stage.

C51 was increased to provide additional filtering and R119 was decreased to reduce the gain of the final stage of the filter. R118 was decreased primarily to affect the filter roll-off characteristics and R117 was increased mainly to affect the overall shape of the response curve.