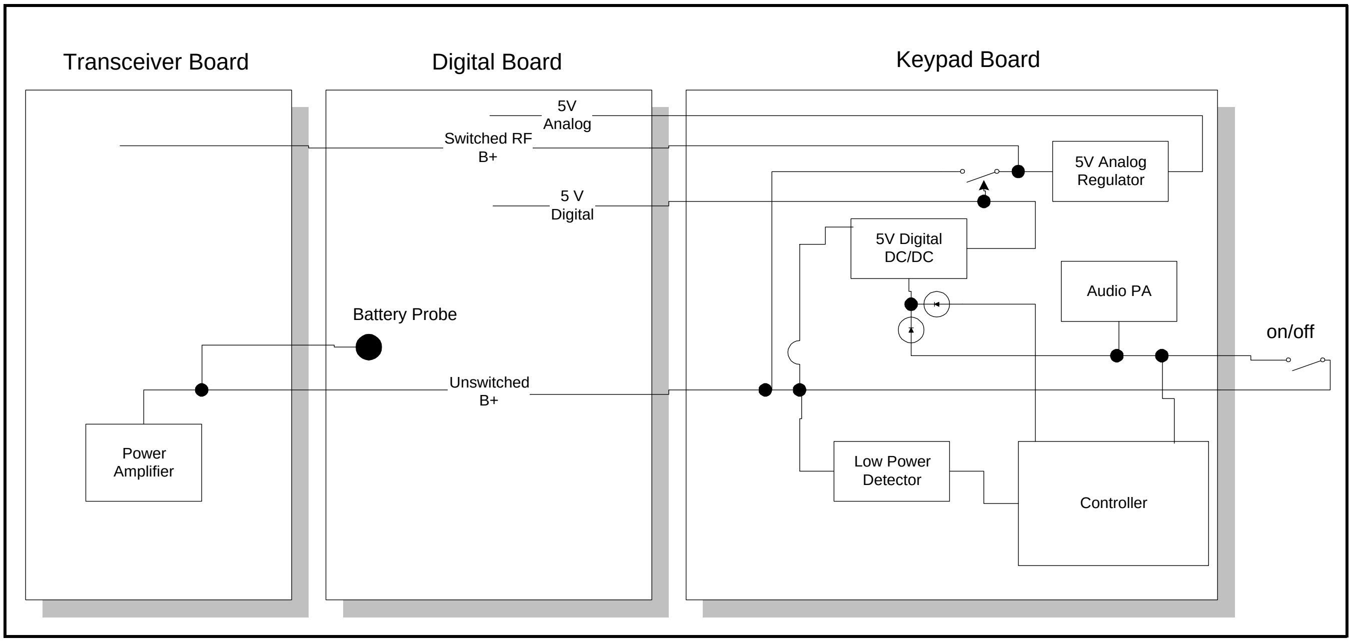

Figure 4-1 Power Supply Diagram

The receiver back end consists of a two-pole crystal filter, IF amplifier, a second two-pole crystal filter, and the ABACUS digital back-end IC. The two pole filters are wide enough to accommodate 5 kHz modulation. Final IF filtering is done digitally in the ADSIC.

The ABACUS digital back-end chip consists of an amplifier, second mixer, IF analog-to-digital converter, a baseband down-converter, and a 2.4 MHz synthesis circuit to provide a clock to the ADSIC on the Digital Board. The second LO is generated by discrete components external to the ABACUS. The output of the ABACUS is a digital bit stream that is current driven on a differential pair to reduce noise generation.

The transmitter consists of an RF power amplifier IC that amplifies an injection signal from the VCO. Transmit power is controlled by two custom ICs that monitor the output of a directional coupler and adjust the power amplifier control voltages correspondingly. The signal passes through a Rx/Tx switch that uses PIN diodes to automatically provide an appropriate interface to transmit or receive signals.

4.1.5 DIGITAL BOARD

The Digital Board contains the ADSIC, DSP (TMS320C50), static RAM, FLASH memory, and a programmable logic IC. The RF Board and Keypad/ Display Board are connected to the Digital Board. The ADSIC performs the Frequency Discrimination and receiver filtering functions. It also performs analog-to-digital (A/D) and digital-to-analog (D/A) conversion. The DSP performs demodulation and modulation, voice encoding and decoding, audio filtering, and squelch signaling. The software for the radio is stored in FLASH memory that is loaded in to static RAM at turn-on. The programmable logic IC controls which device (Flash, SRAM, or UART) is connected to the DSP address and data bus.

4.1.6 KEYPAD/DISPLAY BOARD

The Keypad Board contains the microcontroller (HC08), audio circuits, front LCD display assembly, display driver, and 5V analog and 5V digital regulators. All interfaces to the side connector and the switches are on this board. The microcontroller determines transmit/receive frequencies, power levels, and display content. It communicates with the DSP via a serial interface.

4.2 POWER SUPPLY

4.2.1 GENERAL

The radio is typically powered by a battery which is fastened at the back of the radio. The electrical contact between the battery and the radio occurs on probes located on the Digital board (see Figure 4-1). However the positive battery voltage (UNSWB+) is directly routed through a small flex circuit (Power Flex) to contacts located on the bottom of the RF Board.

The UNSWB+ signal is then routed to the RF power amplifier module and ALC IC on the RF Board. It also passes through a fuse and is then routed to the Digital Board.

The UNSWB+ signal passes through the Digital Board without being used and is transferred to the Keypad Board. On the keypad board, the UNSWB+ signal is routed as follows:

- Input of the 5V digital regulator
- Electronic switch which controls the input of the 5V analog regulator and the “switched RF B+”
- “On/off switch” located on the top of the radio
- Low voltage detector
- Audio amplifier power FET

4.2.2 POWER ON OPERATION

When the user turns the radio on using the top panel “on/off switch”, the following sequence of events occur:

1. Power is applied to the shutdown pin of the 5V digital regulator.

2. The 5-volt digital supply is created.

3. The appearance of the 5V digital supply turns on the electronic switch which applies the battery voltage to the “Switched RF B+” line and to the input of the 5V analog regulator.

4. The 5-volt analog supply is created.

5. If the battery voltage is high enough, the low voltage detector output goes high.

6. The controller sets the control line to the shutdown pin of the DC/DC converter to a high level.

7. The controller sets the radio in an operational mode.

4.2.3 POWER OFF OPERATION

When the user turns the radio off using the top panel “on/off switch”, the following sequence of events occur:

1. The “on/off switch” opens.

2. Power is removed from the shutdown pin of the 5V DC/DC converter.

3. The controller detects that the power is off through the pin connected to Switched B+.

4. The controller performs all required save operations.

5. The controller resets the control line to the shutdown pin of the DC/DC converter.

6. The 5-volt Digital source disappears.

7. The electronic switch opens.

8. The switched RF B+ and 5V analog sources disappear.

4.2.4 LOW VOLTAGE DETECT

Low battery voltage is detected by a comparator chip. When a low voltage condition is detected (less than 6.3V), the following actions occur:

1. The low voltage detector output goes low which alerts the controller.

2. The controller prevents any action which could have a damaging effect (like writing in flash memory).

3. The controller releases its control of the shutdown pin of the DC/DC converter.

4. The transmitter switches to the low power mode.

RF BOARD

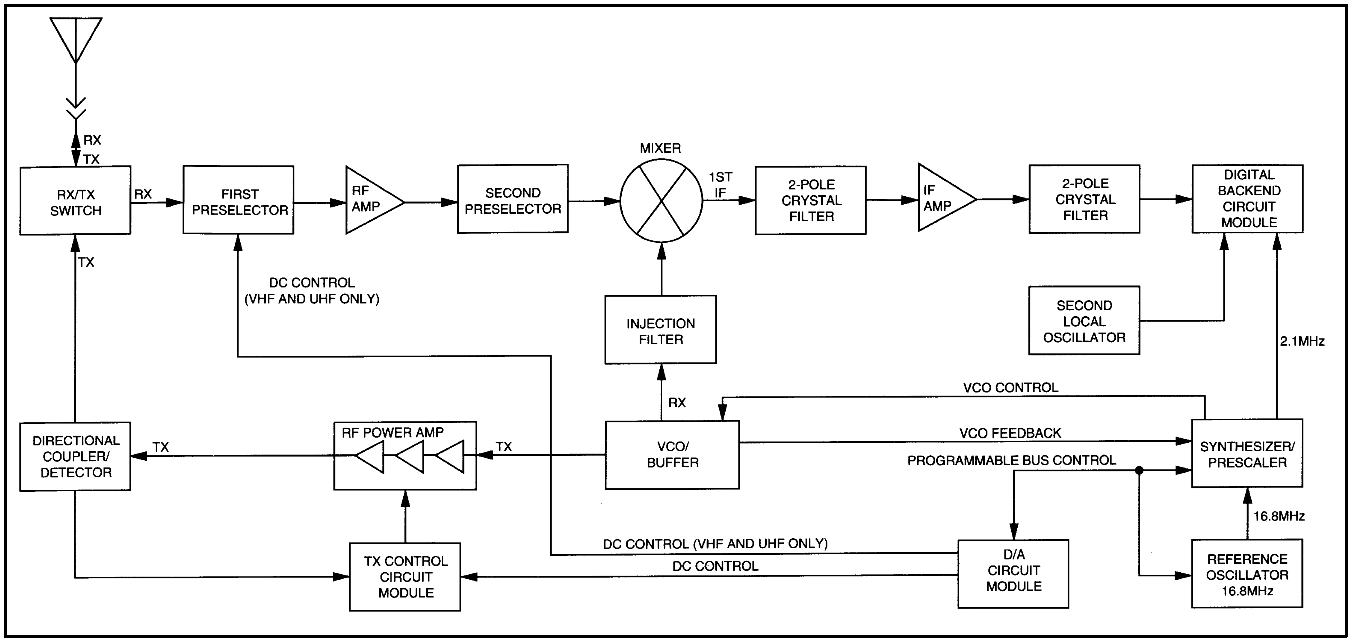

Figure 4-2 RF Board Block Diagram

5. When the voltage gets really low, the 5 volt DC/DC converter automatically shuts down.

6. The 5-volt analog and switched RF B+ sources turn off.

4.3 RF BOARD CIRCUIT DESCRIPTION

4.3.1 FREQUENCY GENERATION UNIT

The Frequency Generation Unit (FGU) consists of these three major sections: (1) high stability reference oscillator, (2) fractional-N synthesizer, and (3) VCO buffer. A 5-volt regulator supplies power to the FGU. The regulator output voltage is filtered and then distributed to the transmit and receive VCOs and the VCO buffer IC. The mixer LO injection signal and transmit frequency are generated by the receive VCO and transmit VCO, respectively. The receive VCO uses an external active device, and the transmit VCO active device is a transistor inside the VCO buffer.

The receive VCO is a Colpitts-type oscillator. The receive VCO signal is received by the VCO buffer where it is amplified by a buffer inside the IC. The amplified signal is routed through a low-pass filter and injected as the first LO signal into the mixer. In the VCO buffer, the receive VCO signal is also routed to an internal prescaler buffer. The buffered output is applied to a low-pass filter. After filtering, the signal is routed to a prescaler divider in the synthesizer.

The divide ratios for the prescaler circuits are determined from information stored in an EEPROM. The microprocessor extracts data for the division ratio as determined by the position of the channel-select switch and routes the signal to a comparator in the synthesizer. A 16.8 MHz reference oscillator applies the 16.8 MHz signal to the synthesizer. The oscillator signal is divided into one of three pre-determined frequencies. A time-based algorithm is used to generate the fractional-N ratio.

If the two frequencies in the synthesizer's comparator differ, an error voltage is produced. The phase detector error voltage is applied to the loop filter. The filtered voltage alters the VCO frequency until the correct frequency is synthesized.

In the transmit mode, the modulation of the carrier is achieved by using a two-port modulation technique. The modulation for low frequency tones, such as CTCSS and DCS, is achieved by injecting the tones into the A/D section of the fractional-N divider, generating the required deviation. Modulation of the high frequency audio signals is achieved by modulating the varactor through a frequency compensation network.