Figure 1-1

Figure 1-1. Type 357 VLF Receiver, Front View

SECTION I

GENERAL DESCRIPTION

1.1 ELECTRICAL CHARACTERISTICS

1.1.1 The CEI Type 357 VLF Receiver tunes the frequency range of 1 kHz to 600 kHz in one band. It may be used for the reception of AM, CW, SSB, MCW, or FSK signals. A direct-reading digital readout is used to indicate the frequency to which the receiver is tuned. The frequency is normally displayed with an accuracy of ±100 Hz. A front-panel switch permits expanding the readout by a factor of 10, so that the frequency may be read to an accuracy of 10 Hz. A fine-tuning control is provided so that the receiver can be easily tuned this accurately. Four IF bandwidths are provided: 150 Hz, 1 kHz, 3 kHz, and 6 kHz. Selection of the desired bandwidth is by means of a front-panel switch. The IF frequency is 2 MHz.

1.1.2 A digital automatic frequency control (DAFC) circuit in the 357 permits locking the receiver's local oscillator to the counter for the frequency display. In addition to counteracting local oscillator drift, the DAFC circuit, in effect, acts as a frequency synthesizer to provide the equivalent of 60,000 crystal-controlled frequencies, each separated by 10 Hz, when used in the decimal shift mode. Thus the 357 can be locked to a particular frequency whether or not a signal is present. An extremely effective and fast acting noise canceller circuit is provided which, when used, eliminates all types of impulse noise, such as lightning and ignition, from the receiver's output. The canceller is tunnel-diode triggered to gate off the output for the duration of a noise spike above a preset threshold level. A front-panel control sets the threshold level.

1.1.3 Two audio bandwidths are available: normal, which extends from 100 Hz to 7 kHz, and narrow, which is restricted to 825 to 1175 Hz. Separate audio amplifiers are used to drive the front-panel PHONES jack and 600-ohm balanced output at the rear of the receiver. The front-panel AUDIO GAIN control adjusts only the headphones volume. An internal control is used to adjust the 600-ohm output level. The AM detector, local oscillator, and IF outputs are available at rear-apron BNC connectors. An output is also available for attaching a signal monitor. Other features of the receiver include an adjustable input attenuator to expand the dynamic range of the receiver to permit input signals of up to 1 volt, rms, AGC or manual gain control, switch-selectable antenna input impedances of 50 or 1000 ohms, and an extremely versatile BFO section. There are five separate beat frequency oscillators. One has a variable frequency which may be shifted 7 kHz each side of the 2-MHz IF center frequency. The other four oscillators are crystal controlled and provide outputs which zero beat with the IF frequency, give a 5.5-kHz beat note, and give upper sideband or lower sideband reception of SSB signals (depending on which sideband is transmitted) when used with the 3-kHz IF bandwidth. The desired BFO is selected by means of a front-panel switch. Performance specifications for the receiver are given in Table 1-1.

1.2 MECHANICAL CHARACTERISTICS

1.2.1 The front panel of the receiver mounts all controls normally needed for the operation of the unit. These are the INPUT ATTENUATOR, IF BANDWIDTH, AUDIO BW, and BFO switches, the MAIN and FINE TUNING, AUDIO GAIN, IF GAIN, BFO FREQ, and NOISE CANCELLER THRESHOLD controls, the frequency display MODE switch, and DAFC LAST DIGIT selector switch. The ac power switch is ganged with the AUDIO GAIN control.

1.2.2 Located on the rear apron of the receiver are the RF INPUT jack, A1J1, the DETECTOR LEVEL OUTPUT jack, J1, the BALANCED AUDIO OUTPUT jack, J2, the LO OUTPUT jack, J4, the SM OUTPUT jack, J5, the IF OUTPUT jack, J6, the 115/230-Vac input power selector switch, the input impedance selector switch, and the line fuses. Jacks J1, J4, J5, and J6 are BNC-type connectors; A1J1 and J2 are twinax-type connectors.

1.2.3 The main chassis, the front panel and the top and bottom dust covers are constructed of aluminum. The IF and BFO assembly, the counter assembly, the noise IF and gate, and the input amplifier and balanced mixer are enclosed in silver-plated brass chassis which have been gold-flashed to prevent tarnishing. The audio and AGC amplifiers, and the power supply regulators are built on etched circuit boards which plug into the main chassis. All the digital circuitry within the counter assembly is also built on plug-in etched circuit cards.

Figure 2-1

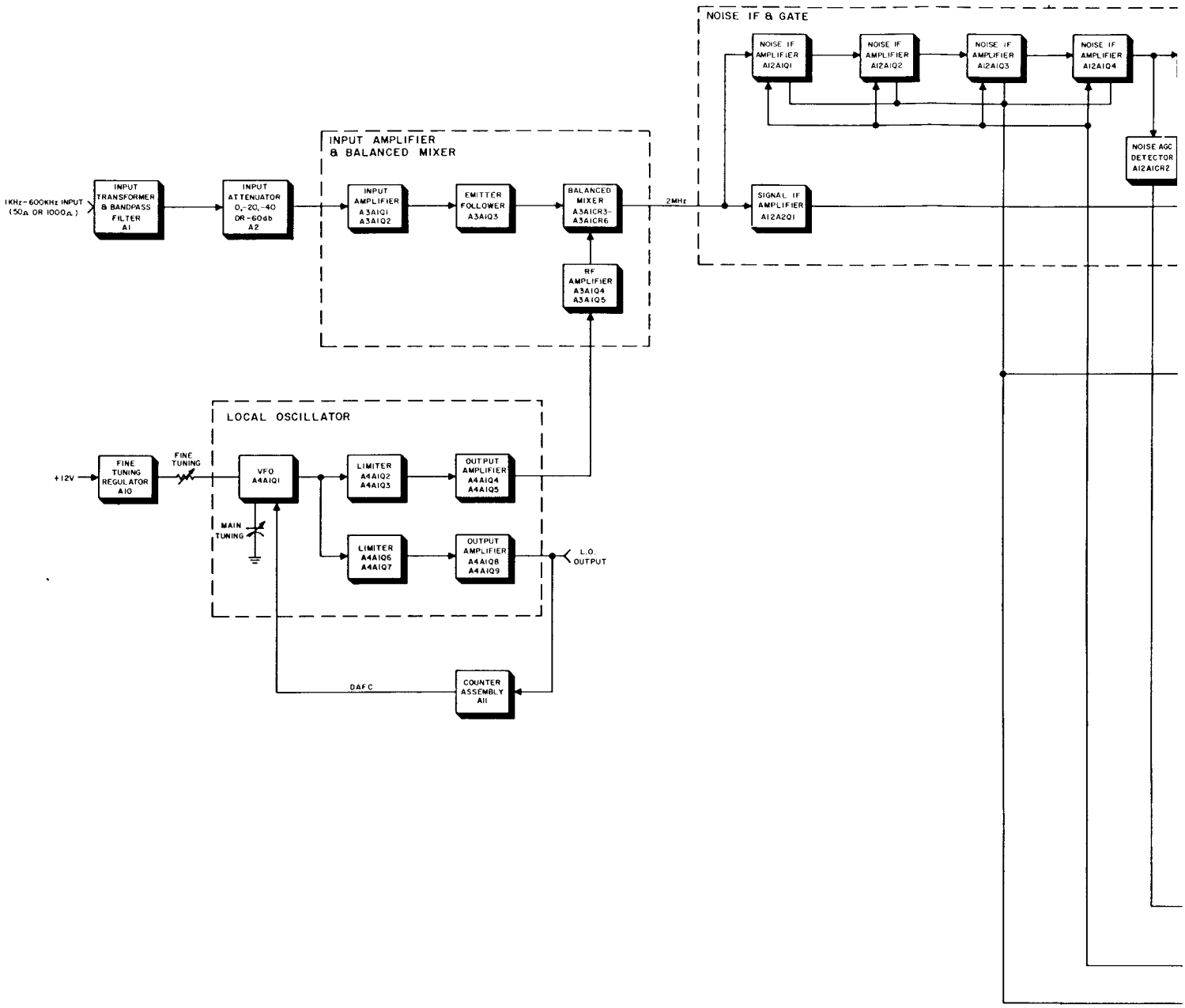
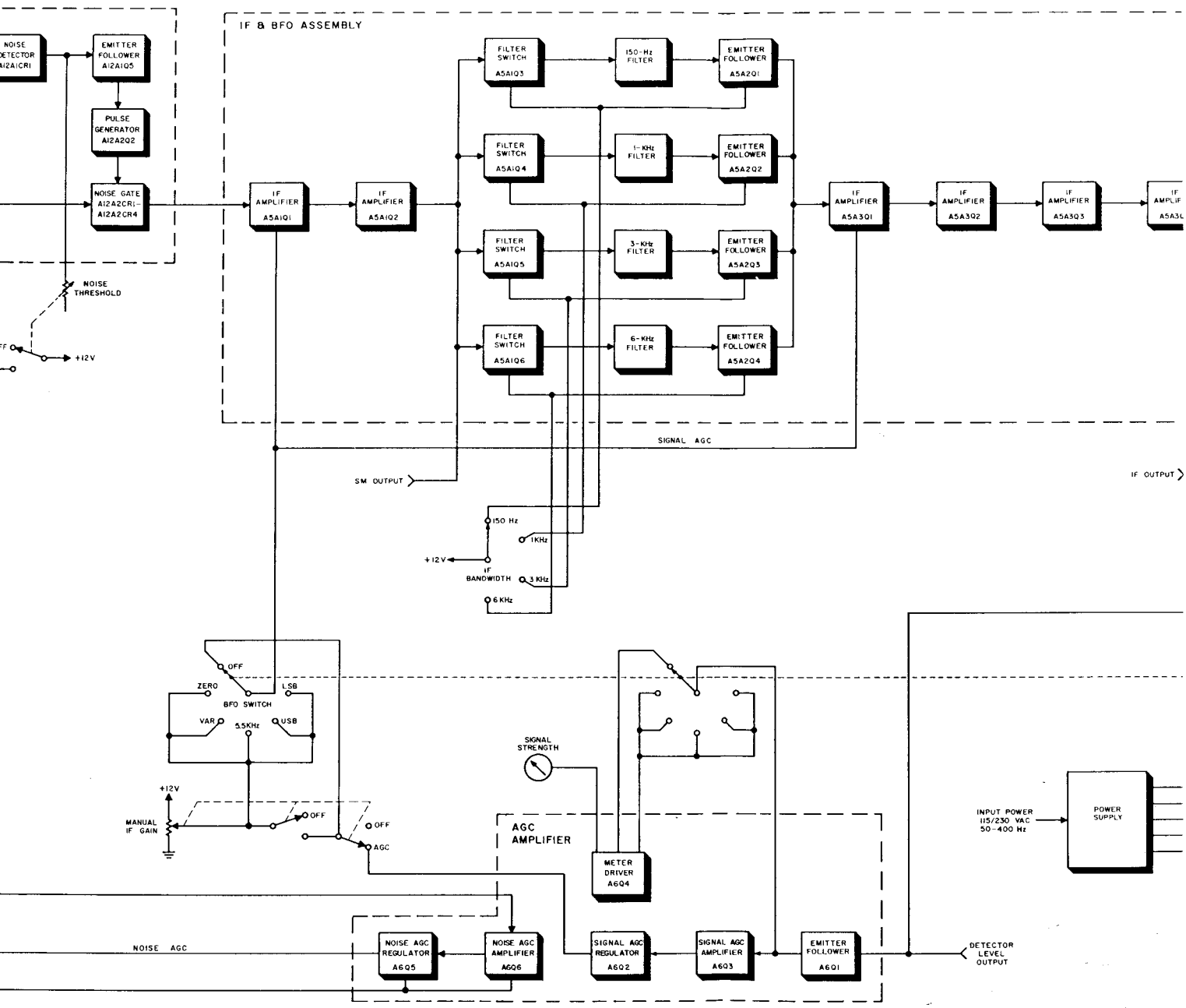
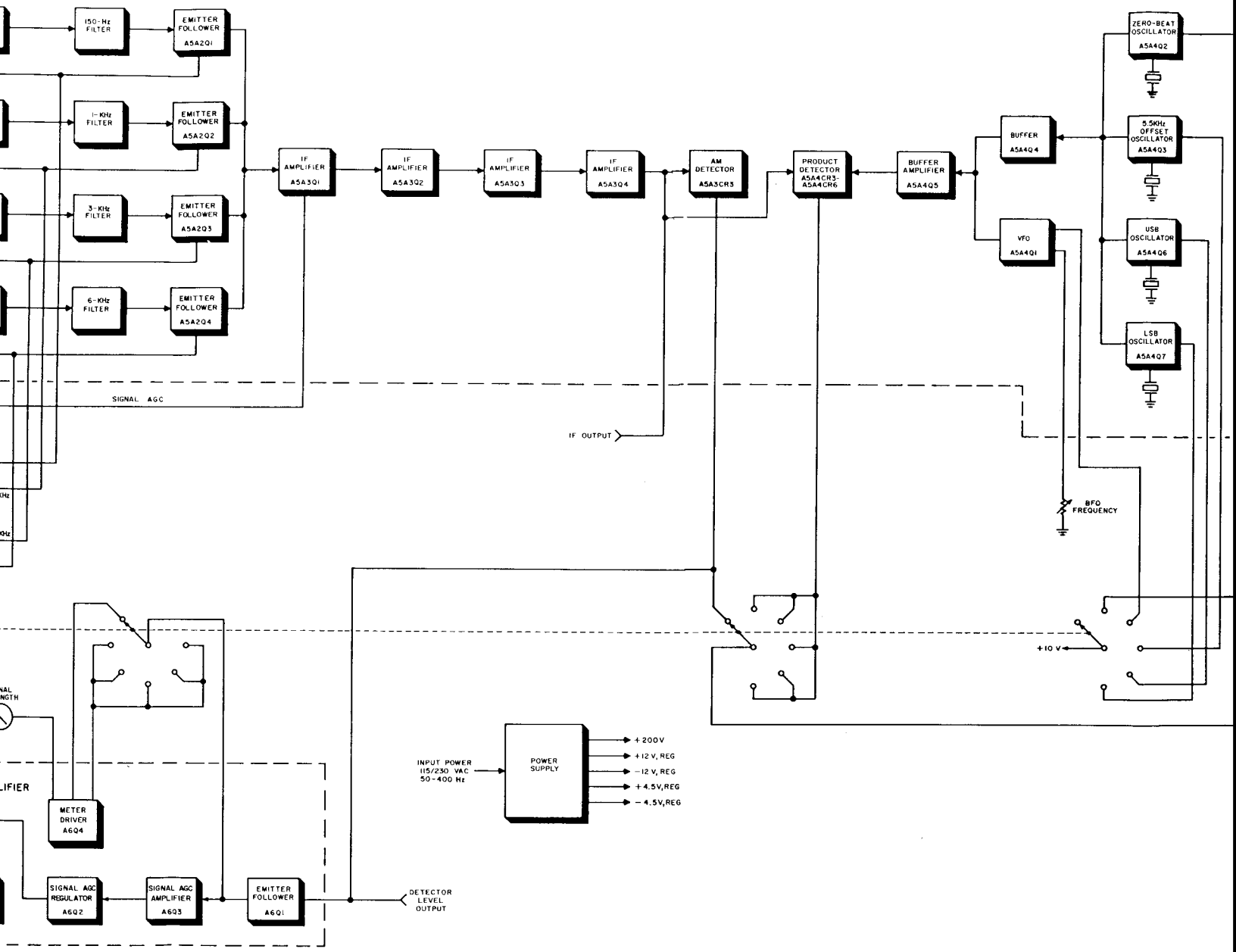


Figure 2-1. Type 357 VLF Receiver, Simplified Functional Block Diagram


IF & BFO ASSEMBLY
NOISE DETECTOR A12A1CR1
EMITTER FOLLOWER A12A1Q5
PULSE GENERATOR A12A2Q2
NOISE GATE A12A2CR1-A12A2CR4
NOISE THRESHOLD
+12V
IF AMPLIFIER A5A1Q1
IF AMPLIFIER A5A1Q2
FILTER SWITCH A5A1Q3
FILTER SWITCH A5A1Q4
FILTER SWITCH A5A1Q5
FILTER SWITCH A5A1Q6
150-Hz FILTER
1-KHz FILTER
3-KHz FILTER
6-KHz FILTER
EMITTER FOLLOWER A5A2Q1
EMITTER FOLLOWER A5A2Q2
EMITTER FOLLOWER A5A2Q3
EMITTER FOLLOWER A5A2Q4
IF AMPLIFIER A5A3Q1
IF AMPLIFIER A5A3Q2
IF AMPLIFIER A5A3Q3
SIGNAL AGC
SM OUTPUT
IF OUTPUT
150 Hz
1KHz
+12V
IF BANDWIDTH
3 KHz
6 KHz
OFF
ZERO
LSB
BFO SWITCH
VAR
5.5KHz
USB
+12V
MANUAL IF GAIN
OFF
OFF
AGC
SIGNAL STRENGTH
AGC AMPLIFIER
METER DRIVER A6Q4
INPUT POWER 115/230 VAC 50-400 Hz
POWER SUPPLY
NOISE AGC
NOISE AGC REGULATOR A6Q5
NOISE AGC AMPLIFIER A6Q6
SIGNAL AGC REGULATOR A6Q2
SIGNAL AGC AMPLIFIER A6Q3
EMITTER FOLLOWER A6Q1
DETECTOR LEVEL OUTPUT


150-Hz FILTER
EMITTER FOLLOWER A5A2Q1
1-KHz FILTER
EMITTER FOLLOWER A5A2Q2
3-KHz FILTER
EMITTER FOLLOWER A5A2Q3
6-KHz FILTER
EMITTER FOLLOWER A5A2Q4
IF AMPLIFIER A5A3Q1
IF AMPLIFIER A5A3Q2
IF AMPLIFIER A5A3Q3
IF AMPLIFIER A5A3Q4
AM DETECTOR A5A3CR3
PRODUCT DETECTOR A5A4CR3-A5A4CR6
BUFFER AMPLIFIER A5A4Q5
BUFFER A5A4Q4
VFO A5A4Q1
ZERO-BEAT OSCILLATOR A5A4Q2
8.5KHz OFFSET OSCILLATOR A5A4Q3
USB OSCILLATOR A5A4Q6
LSB OSCILLATOR A5A4Q7
SIGNAL AGC
IF OUTPUT
BFO FREQUENCY
+10 V
METER DRIVER A6Q4
SIGNAL AGC REGULATOR A6Q2
SIGNAL AGC AMPLIFIER A6Q3
EMITTER FOLLOWER A6Q1
DETECTOR LEVEL OUTPUT
INPUT POWER 115/230 VAC 50-400 Hz
POWER SUPPLY
+200V
+12 V, REG
-12 V, REG
+4.5V, REG
-4.5V, REG

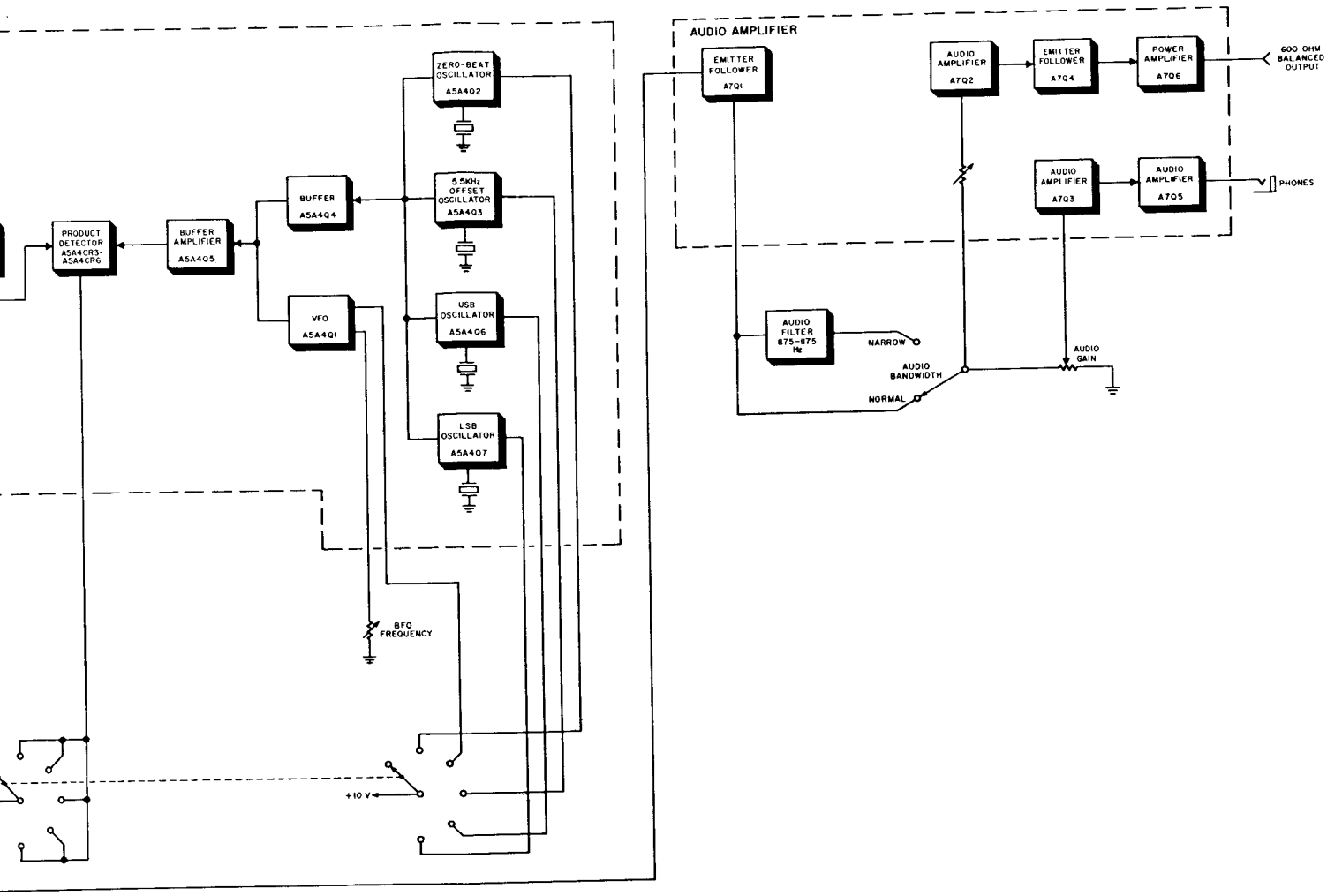

ZERO-BEAT OSCILLATOR A5A4Q2
5.5KHz OFFSET OSCILLATOR A5A4Q3
BUFFER A5A4Q4
VFO A5A4Q1
USB OSCILLATOR A5A4Q6
LSB OSCILLATOR A5A4Q7
BUFFER AMPLIFIER A5A4Q5
PRODUCT DETECTOR A5A4CR3-A5A4CR6
BFO FREQUENCY
+10 V
AUDIO AMPLIFIER
EMITTER FOLLOWER A7Q1
AUDIO AMPLIFIER A7Q2
EMITTER FOLLOWER A7Q4
POWER AMPLIFIER A7Q6
600 OHM BALANCED OUTPUT
AUDIO AMPLIFIER A7Q3
AUDIO AMPLIFIER A7Q5
PHONES
AUDIO FILTER 875-1175 Hz
NARROW
AUDIO BANDWIDTH
NORMAL
AUDIO GAIN

Figure 2-2

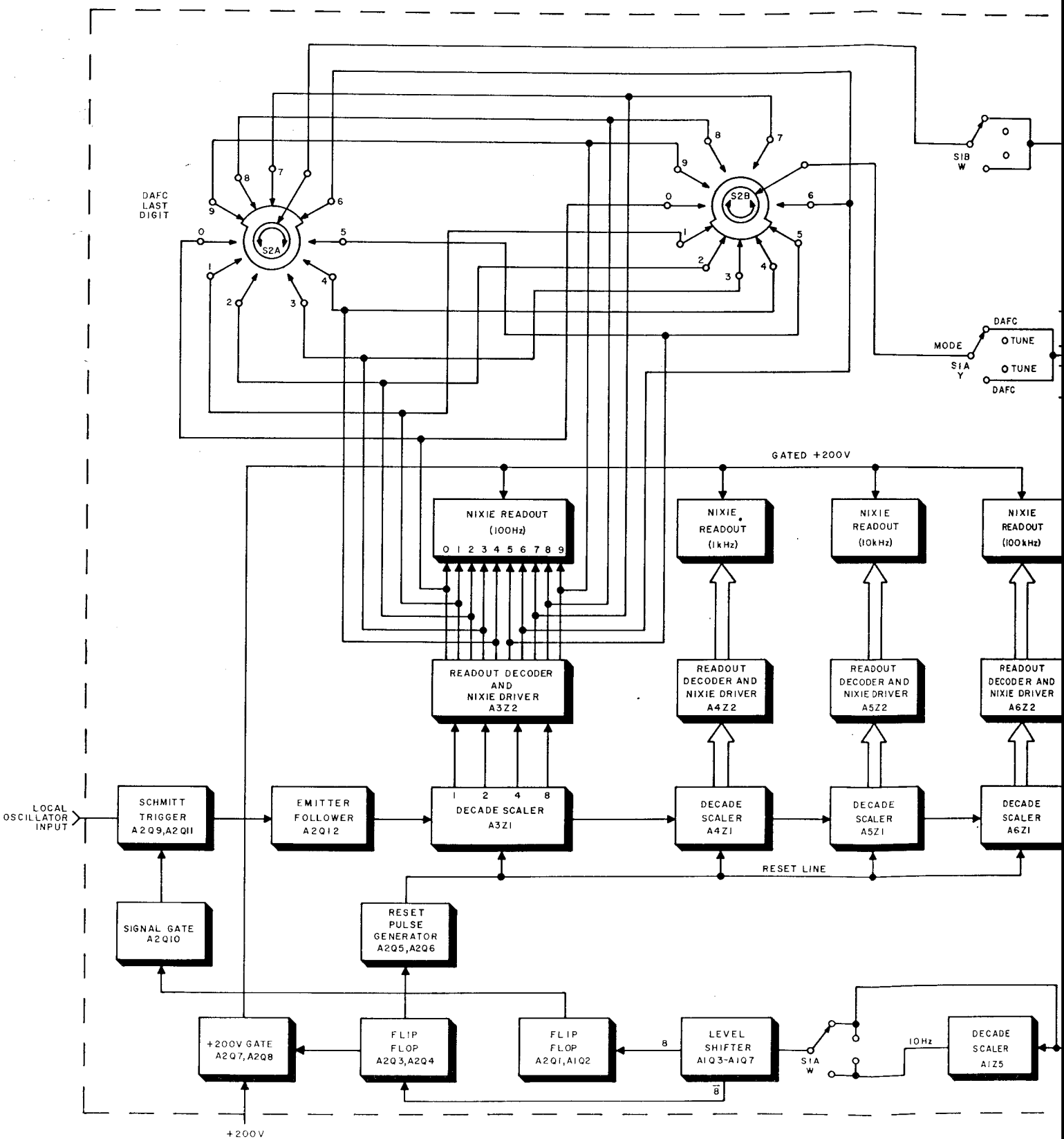
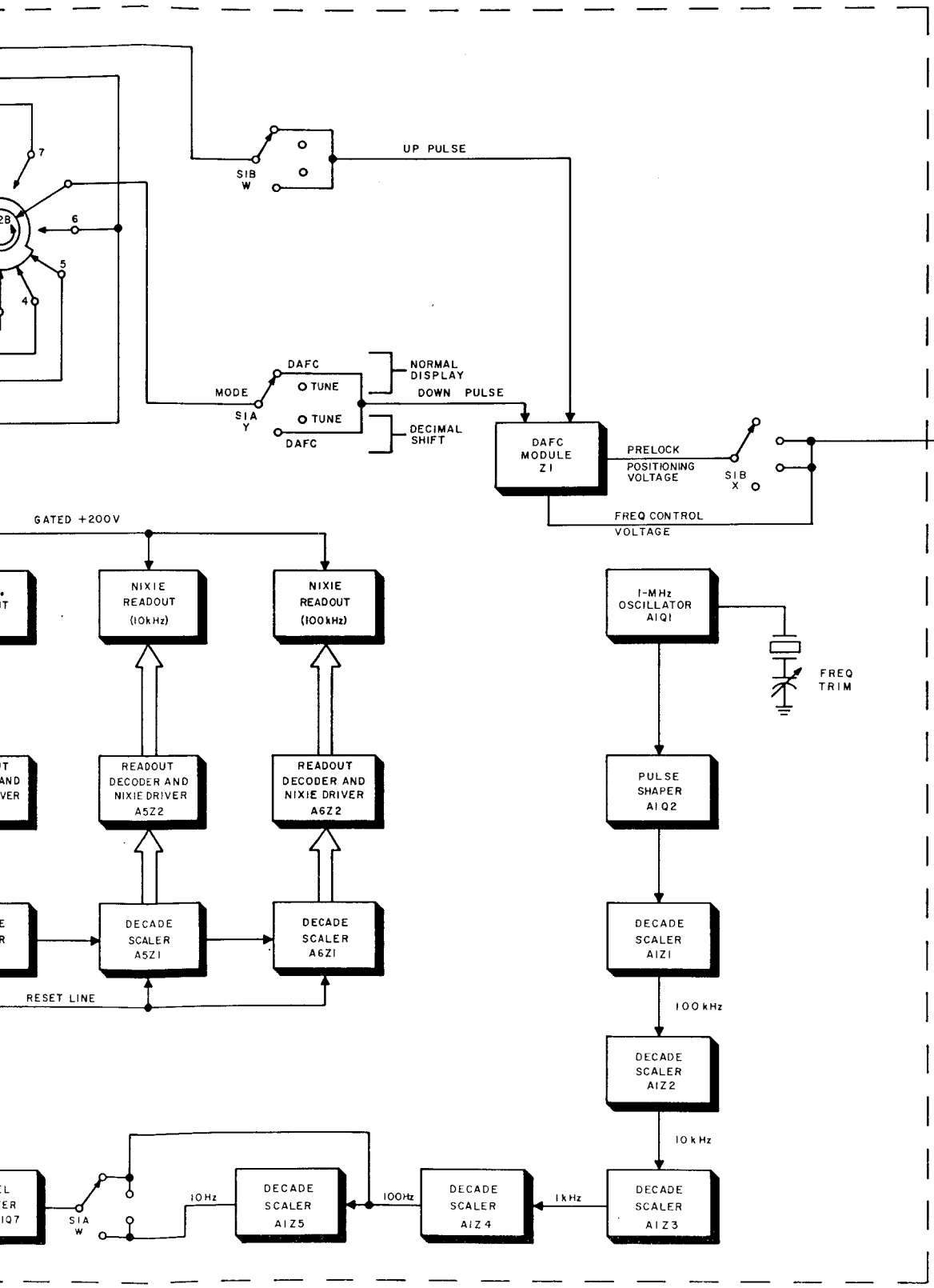


Figure 2-2. VLF Counter Assembly, Simplified Functional Block Diagram


7
6
5
4
SIB
W
UP PULSE
MODE
SIA
Y
DAFC
TUNE
TUNE
DAFC
NORMAL
DISPLAY
DOWN PULSE
DECIMAL
SHIFT
DAFC
MODULE
Z1
PRELOCK
POSITIONING
VOLTAGE
SIB
X
DAFC
OUTPUT
FREQ CONTROL
VOLTAGE
GATED +200V
NIXIE
READOUT
(10kHz)
NIXIE
READOUT
(100kHz)
1-MHz
OSCILLATOR
AIQ1
FREQ
TRIM
READOUT
DECODER AND
NIXIE DRIVER
A5Z2
READOUT
DECODER AND
NIXIE DRIVER
A6Z2
PULSE
SHAPER
AIQ2
DECADE
SCALER
A5Z1
DECADE
SCALER
A6Z1
DECADE
SCALER
AIZ1
RESET LINE
100 kHz
DECADE
SCALER
AIZ2
10 kHz
SIA
W
10Hz
DECADE
SCALER
AIZ5
100Hz
DECADE
SCALER
AIZ4
1kHz
DECADE
SCALER
AIZ3