

INSTRUCTION MANUAL

FOR

TYPE R-485A-03050

VHF RECEIVER



WATKINS-JOHNSON

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INTRODUCTION

The R-485A-03050 Receiver is similar to the 480A Series VHF Receiver explained in Sections I through VI of this manual. Section VII pertains to the R-485A-03050 and explains the differences between the 480A and the R-485A-03050.

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TCC
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**INSTRUCTION MANUAL
FOR
TYPE 480A VHF
SERIES RECEIVER**

**WATKINS - JOHNSON COMPANY
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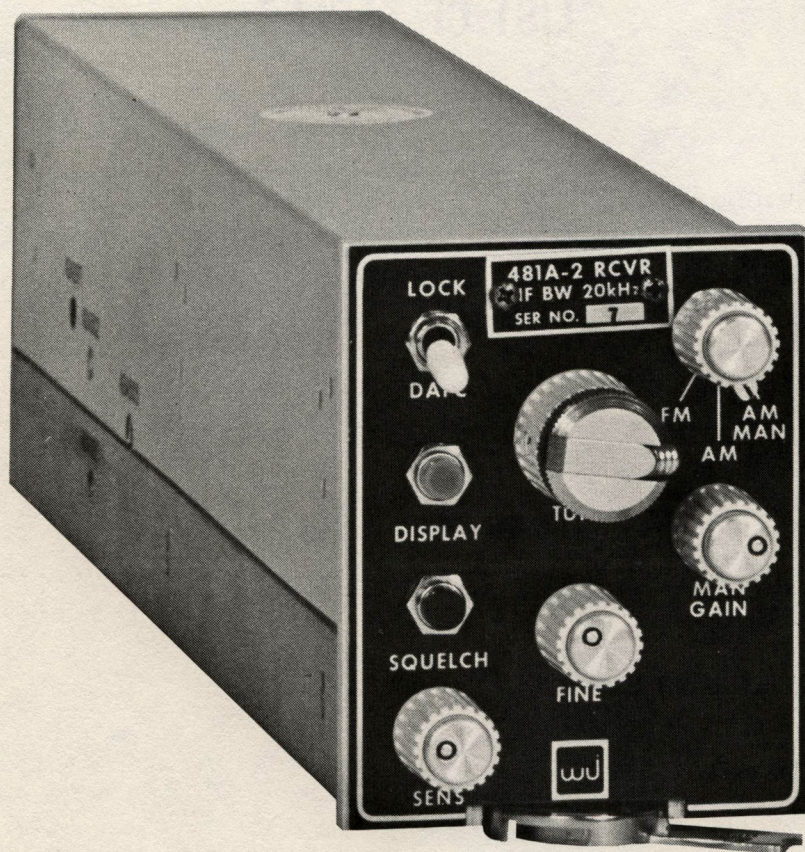


Figure 1-1. Type 480A VHF Receivers, Front View

SECTION I

GENERAL DESCRIPTION

1.1 ELECTRICAL CHARACTERISTICS

1.1.1 The 480A Series Receivers are manually tuned in the frequency range of 30-300 MHz. These receivers are designed to operate as a part of the RS-180A Receiving System. The RS-180A system provides six or twelve independent single-channel receivers, and a time-shared counter with DAFC. Two different equipment frames are available for the RS-180A system, the Type EF-180A or EF-182A. All operating voltages and interface connections are provided by the equipment frame.

1.1.2 The 480A Series Receivers are course tuned by an inductive tuning assembly and fine tuned by a voltage applied from the front panel tuning potentiometer to a varactor diode in the local oscillator circuit. DAFC (digital automatic frequency control) is supplied by the DRO-280A Frequency Counter to lock the local oscillator of each receiver to the desired frequency. The DAFC holds the receiver within ± 1 kHz of any frequency within its tuning range.

1.1.3 These receivers are designed for narrowband AM or FM reception in the 30-300 MHz range. The receivers are also available with a BFO for CW reception as an option. IF bandwidths of 10, 20, 40, 50 and 100 kHz are available. Crystal filters are used to establish these bandwidths. A 500 kHz IF bandwidth is also available. This filter consists of discrete components.

1.1.4 The 480A Series Receivers operate in three manually selected modes. These are FM, AM, and AM MAN. When the BFO option is used the modes are FM, AM, and CW. In addition a BFO pitch control is added to the front panel.

1.1.5 Located on the front panel is a DAFC switch, coarse and fine tuning control, squelch control, and the mode selector switch. There are two indicator lights on the front panel. One operates when the squelch is disabled and the other operates in conjunction with the selector switch on the DRO-280A Frequency Counter to indicate which receiver frequency is being displayed on the counter.

1.2 MECHANICAL CHARACTERISTICS

1.2.1 Manual tuning is accomplished by the two front panel tuning controls, coarse and fine tuning. An inductuner is used to coarse tune the receivers and a linear potentiometer provides the fine tuning by applying a voltage to the varactor diode in the local oscillator. The 480A Series Receivers are designed to plug into and operate in the EF-180A or EF-182A Equipment Frames. All

input and output connections are made on the rear panel of the receiver using plug-in connectors

1.2.2 A frontal view of one of the 480A Series Receivers is shown in Figure 1-1. Additional views are shown in Figures 5-1 through 5-4.

1.3 FREQUENCY, BANDWIDTH, CW SPECIFICATIONS AND DESIGNATIONS

For dimensions and weight see Table 1-4.

1.3.1 The suffix for the module type number is the same as that of the receiver, i.e., for the 481A-21, the A1 subassembly is a type 71356-21 and the A2 subassembly is a type 71341-21. The suffix for the A3 module for the example above is a type 7898-1. The Type 7898-1 AGC, COS, Squelch and Video Amplifier is used on all the VHF 480A Receivers.

1.4 EQUIPMENT SUPPLIED

1.4.1 This equipment consists of the 480A-(X) Receiver only.

1.5 EQUIPMENT REQUIRED BUT NOT SUPPLIED

1.5.1 The 480A-(X) Series Receiver requires either the EF-180A or EF-182A Equipment Frame, a DRO-280A Frequency Counter for DAFC operation and the EC-180 Extender Cable for servicing. Provisions are also made for use of a signal monitor.

Table 1-1. Type Number Designations

BASIC TYPE	FREQUENCY RANGE	DASH NUMBER SUFFIX	IF BANDWIDTH
481A-(X)	30-60 MHz	-1	10 kHz
482A-(X)	60-120 MHz	-11	10 kHz and CW Option
483A-(X)	100-180 MHz	-2	20 kHz
484A-(X)	180-300 MHz	-21	20 kHz and CW Option
485A-(X)	30-90 MHz	-3	50 kHz
486A-(X)	90-250 MHz	-31	50 kHz and CW Option
		-4	100 kHz
		-41	100 kHz and CW Option
		-5	500 kHz
		-51	500 kHz and CW Option
		-8	40 kHz
		-81	40 kHz and CW Option

Type 480A VHF Series Receiver

Table 1-2. Receiver Type Number and Tuner (A1) Type Number Correlation.

RECEIVER	TUNER A1
481A-(X)	71356
482A-(X)	71359
483A-(X)	71352
484A-(X)	71353
485A-(X)	71362
486A-(X)	71360

Table 1-3. Receiver Dash Number Suffix, IF Amplifier Type, AGC, COS, Squelch and Video Amplifier Type Correlation.

RECEIVER DASH NUMBER	IF AMPLIFIER (A2)	AGC, COR, SQUELCH AND AUDIO AMPLIFIER (A3)
48(X)A-(1)	72432-1 (10 kHz)	7898-1
48(X)A-(11)	72432-11 (10 kHz) (CW Option)	
48(X)A-(2)	72432-2 (20 kHz)	
48(X)A-(21)	72432-21 (20 kHz) (CW Option)	
48(X)A-(3)	72432-3 (50 kHz)	
48(X)A-(31)	72432-31 (50 kHz) (CW Option)	
48(X)A-4	72432-4 (100 kHz)	
48(X)A-41	72432-41 (100 kHz) (CW Option)	
48(X)A-5	72410-3 (500 kHz)	
48(X)A-51	72410-31 (500 kHz) (CW Option)	
48(X)A-8	72432-8 (40 kHz)	
48(X)A-81	72432-81 (40 kHz) (CW Option)	

Table 1-4. Type 480A VHF Receiver, Specifications

Tuning Range:	
481A.....	30-60 MHz
482A.....	60-120 MHz
483A.....	100-180 MHz
484A.....	180-300 MHz
485A.....	30-90 MHz
486A.....	80-250 MHz
Type of Reception	FM, AM AGC, or AM MAN; When the BFO option is selected FM, AM AGC or CW.
Noise Figure:	
481A.....	6 dB, maximum
482A.....	6 dB, maximum
483A.....	7 dB, maximum
484A.....	8 dB, maximum
485A.....	6 dB, maximum
486A.....	8 dB, maximum
Image Rejection:	
484A and 486A	50 dB, minimum
481A-483A and 485A.....	60 dB, minimum
IF Rejection:	
481A.....	57 dB, minimum
482A-486A	60 dB, minimum
Antenna Conducted LO Radiation:	
481A.....	-93 dBm, maximum
482A.....	-87 dBm, maximum
483A.....	-84 dBm, maximum
484A.....	-84 dBm, maximum
485A.....	-87 dBm, maximum
486A.....	-84 dBm, maximum
Local Oscillator Output Level.....	20 mV rms into 50 Ω , minimum
IF Bandwidth.....	Customer's option: 10, 20, 40, 50, 100, or 500 kHz.

Table 1-4. Type 480A VHF Receivers, Specifications (Continued)

Video Output Level.....	1.5 V peak to peak across 100 Ω
Output Amplifier Frequency Response....	200 Hz to 25 kHz
Dimensions*	2.5 inches wide, 3.1 inches high, and 14.5 inches deep
Weight.....	4 pounds, approximately

* Measured from back of front panel to rear panel

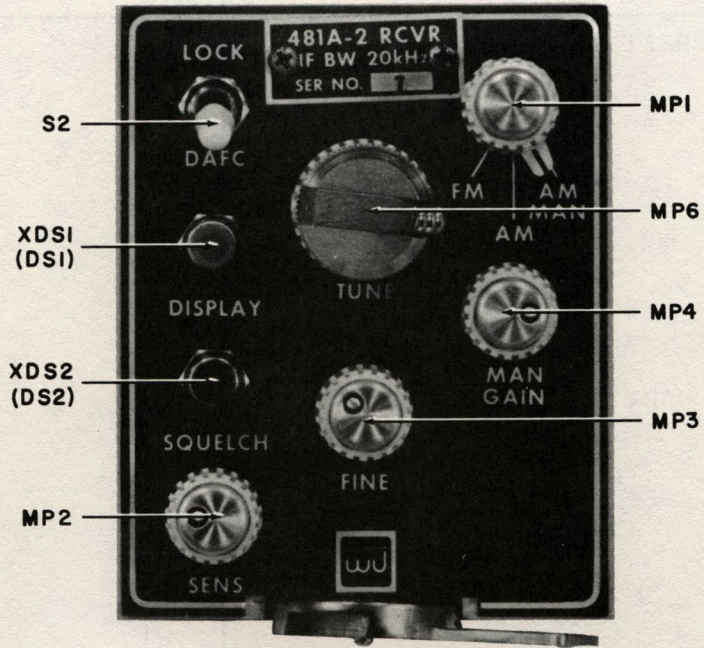


Figure 5-1. Type 480A-(X) Receiver, Front View, Location of Components

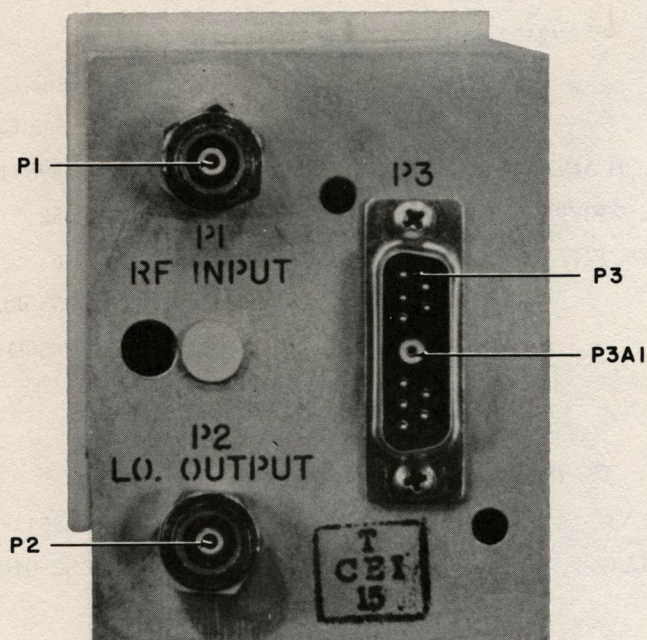


Figure 5-2. Type 480A-(X) Receiver, Rear View, Location of Components

SECTION III

CIRCUIT DESCRIPTION

3.1 GENERAL

The operation of the various circuits in the 480A-(X) Series Receivers is described in the following paragraphs using the functional block diagram, Figure 3-1, and schematic diagrams in Section VI. The 480A-(X) Series Receivers operate in conjunction with the EF-180A or EF-182A Equipment Frame and a DRO-280A Frequency Counter as a part of the RS-180A Receiving System. A signal monitor output is also provided. Notice that the unit numbering system is used to designate electrical components. This means that parts of subassemblies and modules have a prefix before the usual class letter and number of the item, i.e., A1Q1 or A3R9. These subassembly prefixes are omitted on figures and in the text, except where confusion might occur.

3.2 FUNCTIONAL DESCRIPTION

3.2.1 General. - The following description and the associated block diagram, Figure 3-1, applies to all of the 480A Series Receivers. The major differences in the 480A Series Receivers being the tunable frequency range and the IF bandwidths. The frequency range of 30-300 MHz is covered by the six 480A-(X) units. All of the receivers in the 480A Series have an IF bandwidth of 10, 20, 40, 50, 100 or 500 kHz to be determined by the crystal or discrete filters installed in the unit. The 480A Series Receivers are designed for narrowband AM and FM reception and are available with a BFO for CW reception as an option.

3.2.2 VHF Tuner (A1). - RF inputs from the antenna are applied to the tunable preselector network, which is essentially a single-tuned bandpass filter. The output of the pre-selector is then coupled to RF amplifier A1A1Q1, a dual insulated gate field-effect transistor (IGFET). This type of FET is used because of its excellent intermodulation characteristics and the ease with which AGC voltage can be applied to the stage. The output of this IGFET is then capacitively coupled to junction FET (JFET) A1Q1 where the signal is amplified still further before being applied to the double-tuned interstage filtering network. Junction FET A1Q1 was selected because of its low noise, high gain characteristics.

3.2.3 Interstage. - The interstage network is a double-tuned bandpass filter which, in conjunction with the pre-selector network, sets the overall RF bandwidth. The output of this filter is then capacitively coupled to the signal gate of the dual IGFET mixer, A2Q1.

3.2.4 Mixer. - The mixer, A1A2Q1, exhibits good rejection of harmonics and intermodulation characteristics. RF signals from the interstage network are connected to gate #1 of mixer A2Q1, and the local oscillator signal from A3Q1 is buffered by A2Q2 before being connected to gate #2 of the mixer. The 21.4 MHz

IF output from the mixer is filtered through the tuned filter, C16 and L10, before being coupled to IF output J2 and through voltage divider R17 and R18 to SM output jack J4.

3.2.5 Local Oscillator. - Local oscillator, A3Q1, is a modified Colpitts oscillator. It is course tuned by LID and fine tuning by a voltage applied varactor diode CR2 from the front panel fine tuning control and tracks 21.4 MHz above the incoming RF signal. The output frequency from the LO is buffered by A2Q2 before being applied to mixer A2Q1 and is also buffered by A3Q2 and applied to the LO output J3. The function of these buffers, one before the mixer and one before the LO output jack, is to isolate the local oscillator from changes in loading which would load down the oscillator tank circuit causing it to shift frequency.

3.2.6 IF Amplifier (A2). - IF output from J2 of tuner A1 are connected to the IF input J1 of the IF amplifier subassembly. This input signal is applied to one of the gates of the input IF amplifier, A1Q1. Automatic Gain Control voltage is applied to A1Q1 on the second gate. Outputs from transistor Q1 are then applied through emitter follower Q2 to the input of the customer specified filter, FL1. The output of FL1 is coupled to pin 4 of A2U1, the interstage IF amplifier. AGC is applied to A2U1 through the AGC amplifier, A2Q1. Resistor A2A2R7 adjusts the AGC threshold of A2U1. The push-pull output from A2U1 is then coupled to A3U1 where it is amplified further before being demodulated by the AM detector, CR3. The output of A3U1 is also connected to the FM detector, A5U1. The FM signal is demodulated and coupled to FM output amplifier A6U1. The gain of A2A3U1 is adjusted by R2.

3.2.7 BFO Option. - The BFO is used for CW reception and is turned on by the function switch on the front panel. The BFO frequency can be varied ± 8 kHz by the BFO pitch control R5 on the front panel.

3.2.8 AGC, COS, Squelch and Video Amplifier (A3). - The AGC voltage is developed in module A2A3 through the negative detector A2A3CR3. Changes in carrier level are detected as increased signal voltage in A2A3T1. This level is then applied to pin A1 of the AGC module A3. The RC time constant formed by R5 and C1 filters the AM portion of the detected signal leaving just the dc component proportional to the average level of the input carrier. Transistor Q2 of module A3 then amplifies this dc level and couples it to the base of U1Q3 where it is further amplified and applied to the IF amplifier as IF AGC. The start of tuner AGC is delayed by U1Q4. Tuner AGC is delayed until the input signal has increased by about 30 to 40 dB above the point at which the IF AGC begins. RF AGC amplifier A3U1Q4 is turned on by the increasing current through R9, the emitter resistor of U1Q3. As the current through R9 increases, U1Q4 conducts more, thus applying more AGC voltage to the tuner.

3.2.9 Squelch and Video Amplifier Circuits. The front panel squelch sense adjust R10, which is connected thru A3R34 and R11 to ± 15 V dc, adjust the

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SECTION VII
SUPPLEMENT
FOR THE
R-485A-03050 VHF RECEIVER

Table 7-1. Type R-485A-03050 VHF Receiver, Table of Specifications

Tuning Range	30-90 MHz
Types of Reception	AM, FM and AM MAN
IF Bandwidth	50 kHz
Intercept Point Inband (@ -35 dBm In). $\Delta f = 250$ kHz	-10 dBm. minimum
Receiver Noise Figure (Max.)	8 dB
Image Rejection (Min.)	60 dB
IF Rejection (Min.)	60 dB
Antenna Conducted LO Radiation (Max.)	15 μ V
AM (S+N)/N	10 dB. minimum, for an input signal modulated 50% at 400 Hz, -100 dBm input level.
FM (S+N)/N	17 dBm, minimum, for a -100 dBm input signal with 15 kHz peak deviation at 1 kHz rate.
Intermediate Frequency	21.4 MHz
Signal Monitor Output	21.4 MHz
LO Output Level	20 mV rms, minimum; 100 mV rms, maximum (into 50 ohm load).
Fine Tuning Range	0.05% of tuned frequency
DAFC Range	0.1% of Tuned Frequency
Manual Gain Control Range	60 dB above AGC Threshold
Squelch Range	50 dB above AGC Threshold
Logic Output	Logic Level Shift: 0 V dc = signal absence +10 V dc = signal presence 1 mA = current sink
Audio/Video Output Level	0.6 volt rms, minimum, into a 160 Ω load for -100 dBm RF input.

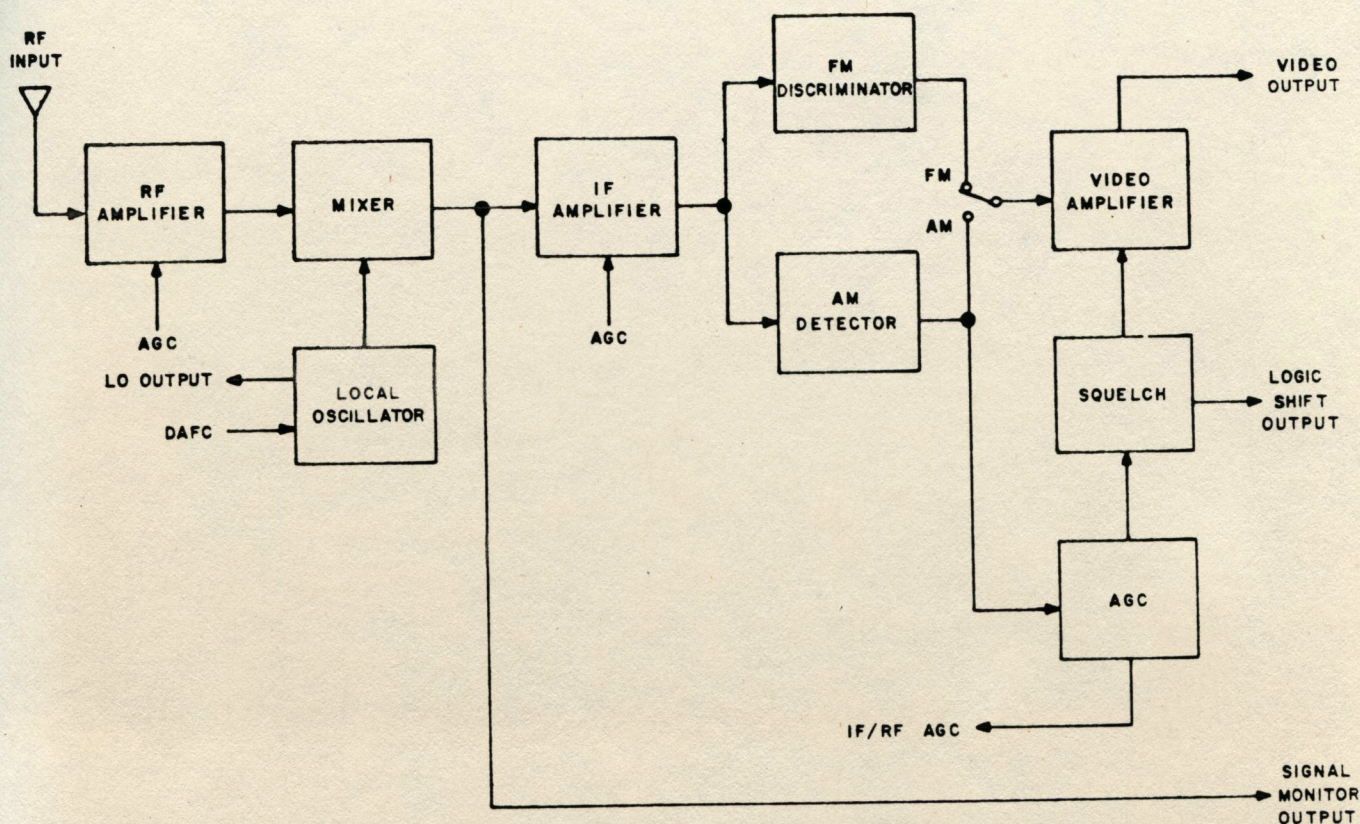


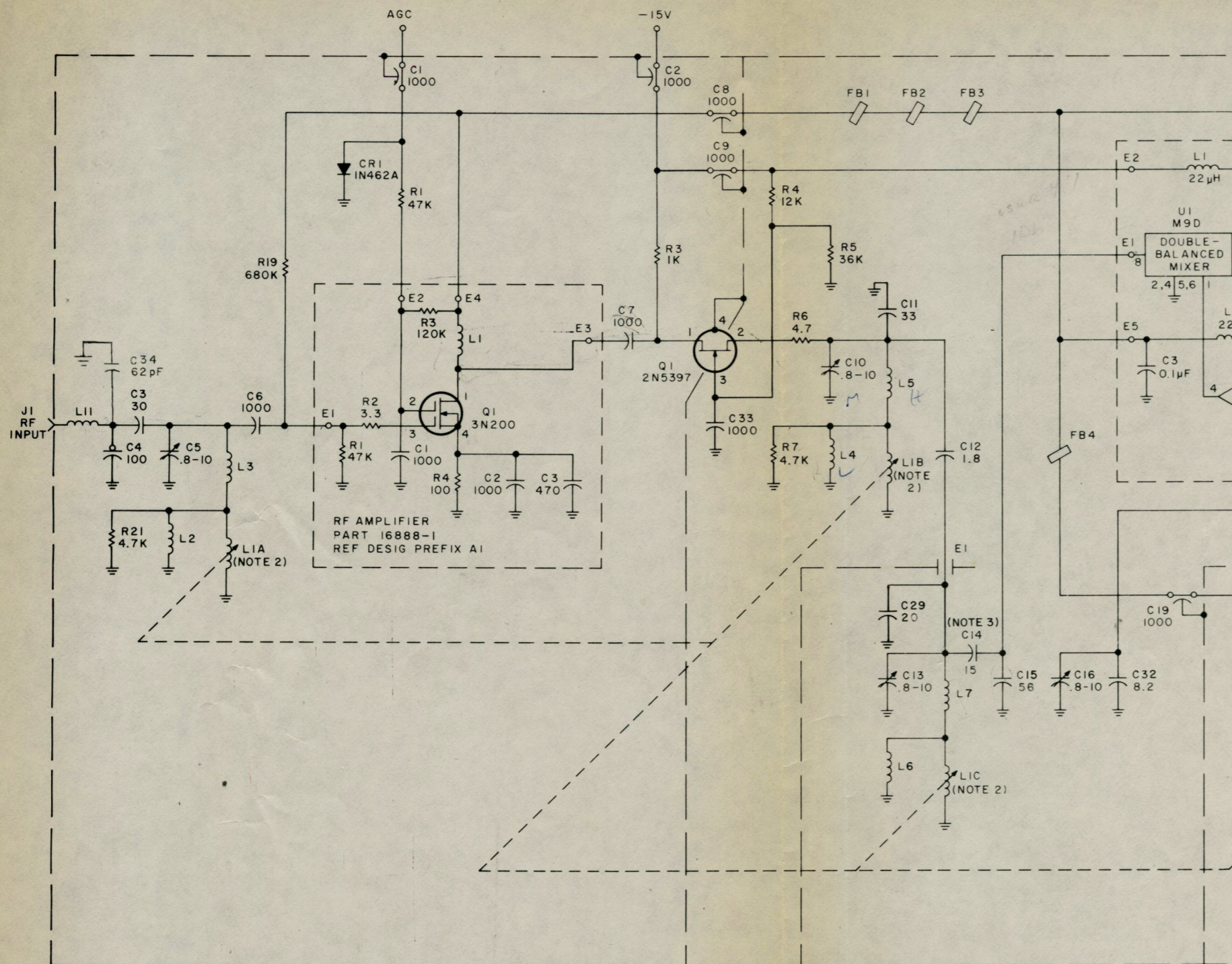
Figure 7-1. Simplified Block Diagram of R-485A-03050 VHF Receiver

7.1 GENERAL

The R-485A-03050 VHF Receiver operates in the 30-90 MHz frequency range and provides AM and FM detection modes.

Compared to the R-480A Series Receivers, the R-485A-03050 provides a higher intercept point of -10 dBm. This higher intercept point enables greater capability of detecting low level signals in the presence of high level signals on adjacent channels. The R-485A-03050 is designed to mount in the EF-168/12A-1 Equipment Frame. The R-485A-03050 Receiver is also compatible with the EF-168/6A, EF-168/6B, EF-168/12A, EF-168-12B, EF-180A, and the EF-182A. These Equipment Frames provide all necessary operating voltages for the R-485A-03050 VHF Receiver.

7.1.1 The modifications of the R-485A-03050 Receiver that allow a higher intercept point are as follows: the 30-90 MHz Tuner (A1), the IF Amplifier Assembly, which incorporates a 50 kHz bandwidth (A2), the AGC/COS Squelch and Video Amplifier (A3) and the Attenuator Shaper (A4). Differentiating parts of the R-485A-03050 Receiver and the 480 Series Receiver are in Section 7.2 of this manual.



- NOTES:
- UNLESS OTHERWISE SPECIFIED:
 - CAPACITANCE IS IN pF.
 - RESISTANCE IS IN OHMS, $\pm 5\%$, 1/4W.
 - L1A THRU L1D ARE GANGED SECTIONS OF INDUCTNER L1.
 - NOMINAL VALUE; FINAL VALUE FACTORY SELECTED.
 - TRANSISTOR 3N200 IS PROVISIONED AS P/N 841001-2.

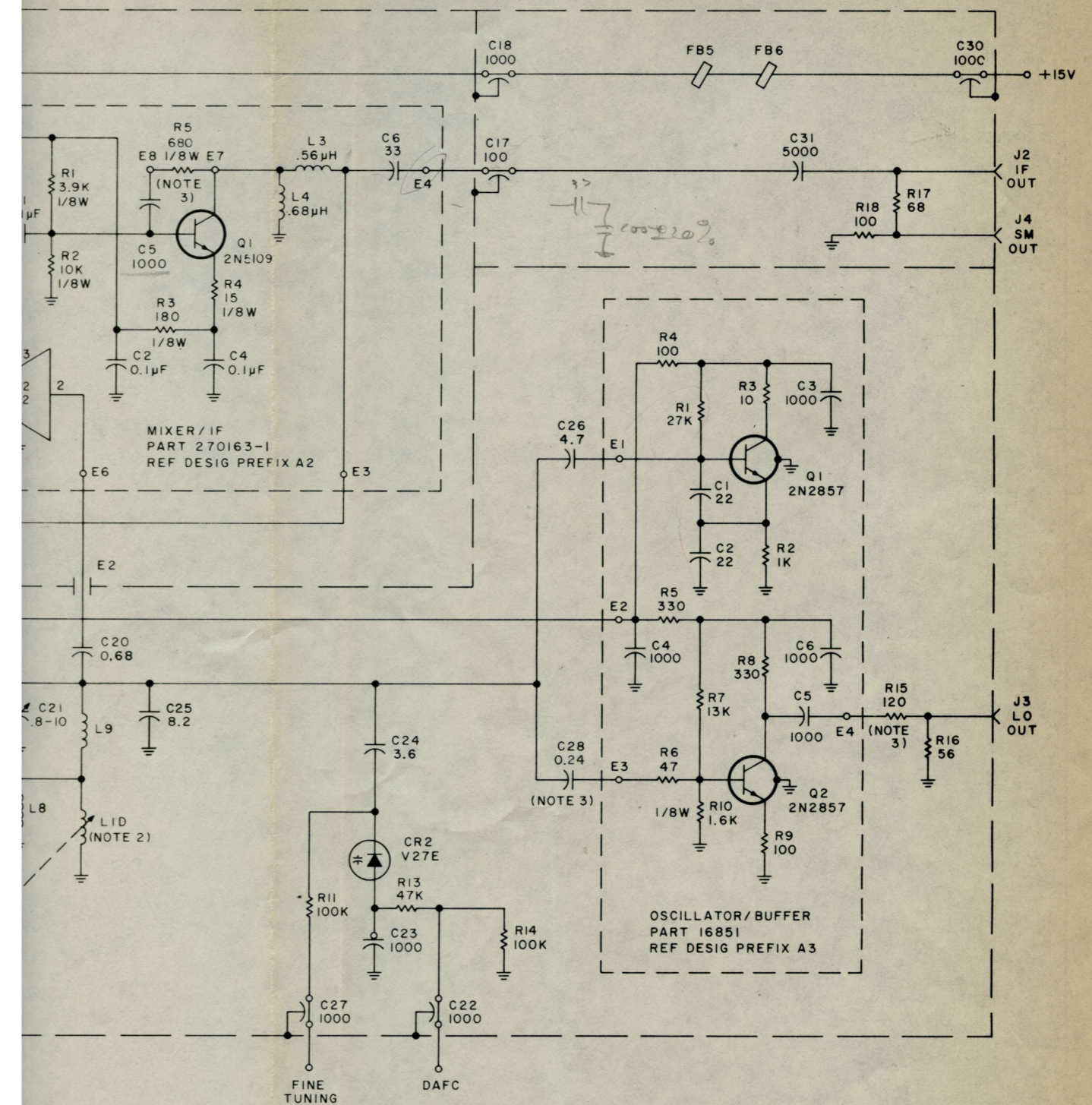


Figure 7-2. Type 714014-1, RF Tuner, (30-90 MHz), (A1) Schematic Diagram 570170

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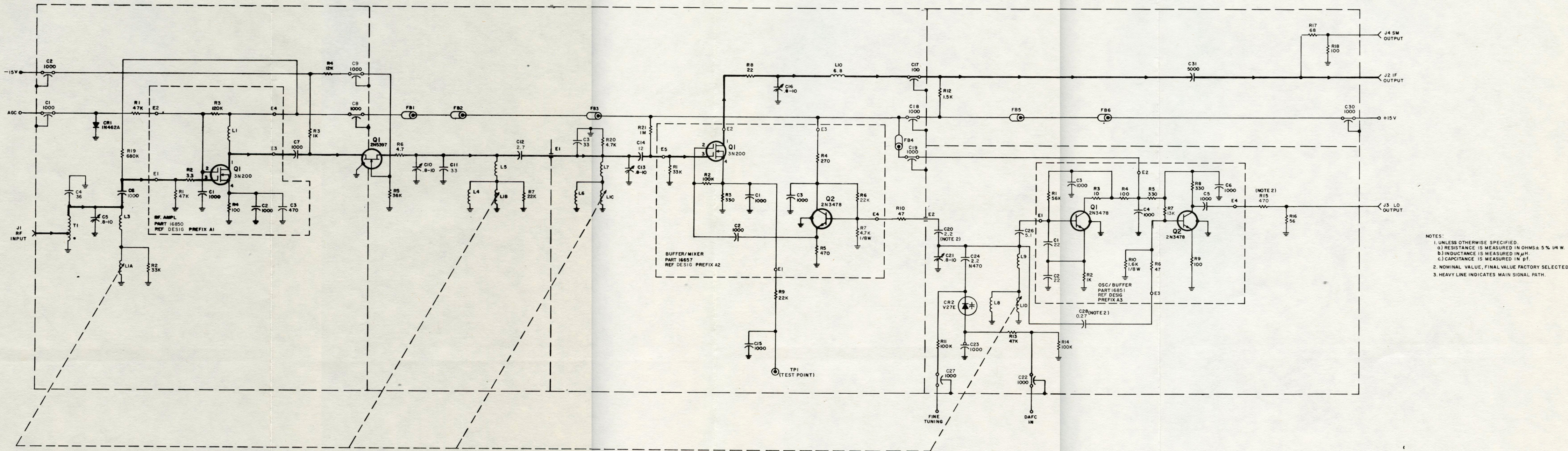


Figure 6-1. Type 71356-2 (30-60 MHz) Tuner (A1), Schematic Diagram