

**INSTRUCTION MANUAL
FOR
TYPE 357 VLF RECEIVER**

**WATKINS—JOHNSON COMPANY
700 Quince Orchard Road
Gaithersburg, Maryland 20760**

C/200/9/8/70/BK

WARNING

This equipment employs voltages which are dangerous and may be fatal if contacted. Extreme caution should be exercised in working with the equipment with any of the protective covers removed.

TABLE OF CONTENTS

Paragraph		Page
SECTION I GENERAL DESCRIPTION		
1.1	Electrical Characteristics	1-1
1.2	Mechanical Characteristics	1-1
SECTION II CIRCUIT DESCRIPTION		
2.1	General	2-1
2.2	Functional Analysis, Receiver	2-1
2.3	Functional Analysis, Frequency Display and DAFC	2-3
2.4	Input Transformer and Filter Assembly	2-4
2.5	Input Attenuator	2-4
2.6	Input Amplifier and Balanced Mixer	2-4
2.7	Noise IF Amplifier and Gate	2-5
2.8	IF and BFO Assembly	2-7
2.9	Local Oscillator	2-8
2.10	AGC Amplifier and +200V Power Supply	2-9
2.11	Audio Amplifier	2-9
2.12	Counter Assembly	2-10
2.13	Power Supplies	2-13
2.14	Fine Tuning Regulator	2-15
SECTION III INSTALLATION AND OPERATION		
3.1	Installation	3-1
3.2	Operation	3-1
SECTION IV MAINTENANCE		
4.1	General	4-1
4.2	Plug-In Module Removal	4-1
4.3	Troubleshooting, Receiver Section	4-1
4.4	Troubleshooting, Counter Assembly	4-1
4.5	Alignment Procedures	4-1
SECTION V REPLACEMENT PARTS LIST		
5.1	Unit Numbering Method	5-1
5.2	Reference Designation Prefix	5-1
5.3	List of Manufacturers	5-1
5.4	Parts List	5-3
SECTION VI SCHEMATIC DIAGRAMS		

LIST OF ILLUSTRATIONS

Illustration		Page
Table 1-1	Type 357 VLF Receiver, Specifications	vi
Table 4-1	Typical Transistor Element Voltages.	4-6
Figure 1-1	Type 357 VLF Receiver, Front View.	1-0
Figure 2-1	Type 357 VLF Receiver, Simplified Functional Block Diagram.	2-0a
Figure 2-2	VLF Counter Assembly, Simplified Functional Block Diagram.	2-0b
Figure 2-3	Gate Generator Timing Chart.	2-12
Figure 3-1	Type 357 VLF Receiver, Critical Dimensions.	3-3
Figure 4-1	Equipment Setup, IF Alignment	4-2
Figure 4-2	Equipment Setup, BFO Alignment	4-3
Figure 4-3	Equipment Setup, Audio Output Adjustment.	4-5
Figure 5-1	Type 357 VLF Receiver, Front View, Component Locations	5-4
Figure 5-2	Type 357 VLF Receiver, Rear View, Component Locations.	5-5
Figure 5-3	Type 357 VLF Receiver, Top View, Component Locations.	5-6
Figure 5-4	Type 357 VLF Receiver, Bottom View, Component Locations.	5-7
Figure 5-5	Type 79224 Input Transformer and Filter Assembly, Component Locations	5-12
Figure 5-6	Part 11922/1 Filter Board, Component Locations.	5-13
Figure 5-7	Type 79223 Input Attenuator, Component Locations	5-14
Figure 5-8	Type 79222 Input Amplifier and Balanced Mixer, Component Locations	5-15
Figure 5-9	Part 12876 Input Amplifier and Balanced Mixer, Component Locations.	5-16
Figure 5-10	Type 71202 Tuning Assembly, Component Locations.	5-19
Figure 5-11	Type 7727 Local Oscillator Assembly, Component Locations.	5-20
Figure 5-12	Type 79283 Local Oscillator Board, Component Locations.	5-22
Figure 5-13	Part 12654 Inductor Board, Component Locations.	5-24
Figure 5-14	Type 8525 Gear Train Assembly, Exploded View.	5-25
Figure 5-15	Type 72134 IF and BFO Assembly, Component Locations.	5-27
Figure 5-16	Part 12868 IF BW Switching Amplifier "A", Component Locations.	5-31
Figure 5-17	Part 12865 IF BW Switching Amplifier "B", Component Locations	5-33
Figure 5-18	Part 11937 IF Amplifier and AM Detector, Component Locations	5-35
Figure 5-19	Part 12879 BFO and Product Detector, Component Locations	5-39
Figure 5-20	Type 79219/1 AGC Amplifier/Power Supply, Component Locations	5-43
Figure 5-21	Type 7411 Audio Amplifier, Component Locations	5-45
Figure 5-22	Type 76133 +12V Regulated Power Supply, Component Locations.	5-47
Figure 5-23	Type 7680 -12V Regulated Power Supply, Component Locations	5-49
Figure 5-24	Type 79206 Fine Tuning Regulator, Component Locations	5-50
Figure 5-25	Type 79189 VLF Counter Assembly, Component Locations	5-51
Figure 5-26	Type 79184 Oscillator/Divider, Component Locations.	5-53
Figure 5-27	Type 79186 Amplifier and Gate, Component Locations	5-55
Figure 5-28	Type 79247A Readout Scaler and Nixie Driver, Component Locations	5-59
Figure 5-29	Type 79220 Noise IF and Gate, Component Locations	5-60
Figure 5-30	Part 13262 50 kHz Noise IF Amplifier, Component Locations.	5-63
Figure 5-31	Part 13635 20 kHz IF Amplifier and Noise Gate, Component Locations.	5-65
Figure 5-32	Type 76101 Compensated $\pm 4.5V$ Power Supply, Component Locations.	5-68
Figure 6-1	Type 79224 Input Transformer and Filter Assembly, Schematic Diagram.	6-3
Figure 6-2	Type 79223 Input Attenuator, Schematic Diagram.	6-5
Figure 6-3	Type 79222 Input Amplifier and Balanced Mixer, Schematic Diagram.	6-7
Figure 6-4	Type 7727 Local Oscillator Assembly, Schematic Diagram	6-9
Figure 6-5	Part 12868 IF BW Switching Amplifier "A", Schematic Diagram	6-11
Figure 6-6	Part 12865 IF BW Switching Amplifier "B", Schematic Diagram	6-13
Figure 6-7	Part 11937 IF Amplifier and AM Detector, Schematic Diagram.	6-15
Figure 6-8	Part 12879 BFO and Product Detector, Schematic Diagram.	6-17
Figure 6-9	Type 79219/1 AGC Amplifier/Power Supply, Schematic Diagram	6-19

LIST OF ILLUSTRATIONS

Illustration		Page
Figure 6-10	Type 7411 Audio Amplifier, Schematic Diagram	6-21
Figure 6-11	Type 76113 +12V Regulated Power Supply, Schematic Diagram	6-23
Figure 6-12	Type 7680 -12V Regulated Power Supply, Schematic Diagram	6-25
Figure 6-13	Type 79206 Fine Tuning Regulator, Schematic Diagram	6-27
Figure 6-14	Type 79189 VLF Counter Assembly, Schematic Diagram	6-29
Figure 6-15	Type 79184 Oscillator/Divider, Schematic Diagram	6-31
Figure 6-16	Type 79186 Amplifier and Gate, Schematic Diagram	6-33
Figure 6-17	Type 79247A Readout Scaler and Nixie Driver, Schematic Diagram	6-35
Figure 6-18	Type 79220 Noise IF Amplifier and Noise Gate, Schematic Diagram	6-37
Figure 6-19	Type 76101 $\pm 4.5V$ Compensated Power Supply, Schematic Diagram	6-39
Figure 6-20	Type 357 VLF Receiver, Main Chassis Schematic Diagram	6-41

Table 1-1. Type 357 VLF Receiver, Specifications

Frequency Range	1 kHz to 600 kHz (Lower Band limit 500 Hz)
Types of Reception	AM, SSB, CW, MCW, and FSK
Noise Figure	Less than 5 dB
Sensitivity (at 50-ohm input impedance and 1-kHz IF bandwidth)	CW and FSK, 1 kHz to 10 kHz: 5 microvolts for 20 dB (s plus n)/n CW and FSK, 10 kHz to 600 kHz: 0.5 microvolt for 20 dB (s plus n)/n MCW and AM, 50 kHz to 600 kHz: 1 microvolt for 10 dB (s plus n)/n
Input Impedance	50 ohms or 1000 ohms, selectable by rear-panel switch
Input Attenuator	0 dB, -20 dB, -40 dB, or -60 dB, selectable by front-panel switch
Maximum Input Level	1 volt, rms, with input attenuator in -60 dB position
IF Bandwidths	150 Hz, 1 kHz, 3 kHz, or 6 kHz, selectable by front-panel switch
Image Rejection	70 dB, minimum
IF Rejection	60 dB, minimum
Dynamic Range	AGC or Manual: 55 dB, minimum
Digital AFC	Holds receiver tuning with ± 100 Hz of the indicated frequency in the normal AFC mode, and within ± 10 Hz in the decimal shift AFC mode
Noise Canceller	Attenuates receiver output approximately 40 dB for duration of impulse-type noise spikes. Threshold of canceller adjustable by front-panel control
BFO	Five separate BFO's: One variable ± 7 kHz by front-panel control and four crystal controlled: (1) to provide zero beat with IF frequency; (2) a 5.5-kHz beat note; and (3) upper or (4) lower sideband reception of SSB signals
Incidental FM	Less than 10 Hz peak deviation
Outputs	Six: front-panel phone jack (2000 ohms, nominal); rear-apron audio, 6 milliwatts (600 ohms, balanced); local oscillator output; IF output; AM detector output; and signal monitor output
Audio Bandwidths	Normal (100 Hz to 7 kHz) or narrow (825 to 1175 Hz), selectable by front-panel switch
Input Power	115/230 Vac, 50-400 Hz
Power Consumption	Approximately 25 watts
Size	19-inches wide, 3.5-inches high, and 19.5-inches deep
Weight	20 lbs., approximately

ADDENDA

The following changes are required in the parts lists and schematic diagrams for the 357 receiver:

Type 79283 Local Oscillator Board, A4A1:

Change C3 and C4 from 510 pF to 390 pF (5%, 500V, CM05F391J03)
 Change C5 from 39 pF to 33 pF (5%, 500V, CM05E330J03)

Type 12654 Inductor Board, A4A2:

Change L1 from 30312-52 to 30312-58

Type 72134 IF & BFO Assembly, A5

Change Y3 to 2001.650 kHz (91804-04)
 Change Y4 to 1998.350 kHz (91804-03)

Type 79189 Counter Assembly, A11

Add C6 .01 μ F (20%, 50V, 19C214A6, 56289) between E9 and E24.
 Change S1 to 265757-A2, 76854
 Change S2 to 263283-BA2, 76854

Type 79184 Oscillator/Divider, A11A1

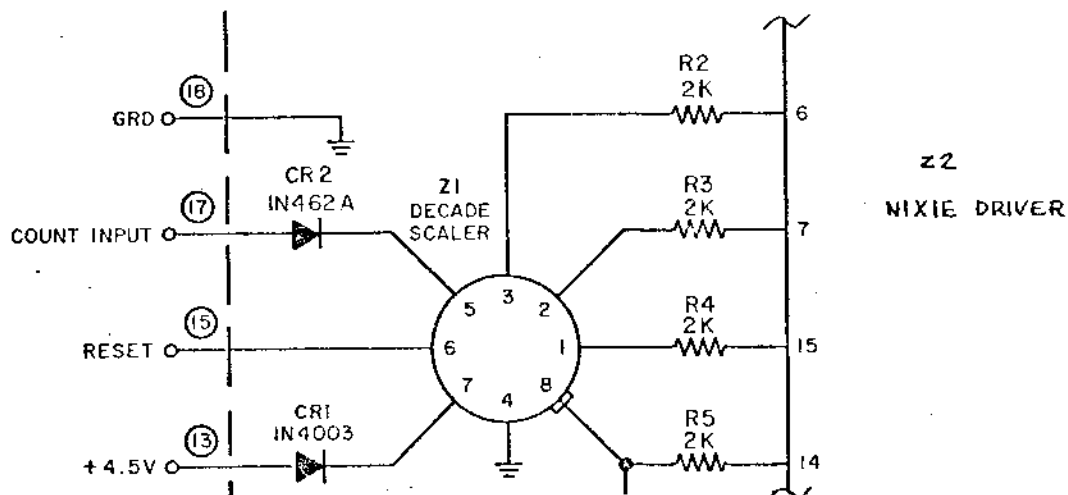
Change Z1 through Z5 to U5B995879X, 07263

Type 79186 Amplifier and Gate, A11A2

Change R32 to 3.9k, (5%, 1/4W, CB3925, 01121)
 Delete C14

Type 79247 Readout Scaler and Nixie Driver, A11A3 through A11A6

Change Z1 to U5B995879X, 07263
 Change Z2 to U6B996079X, 07263
 Add R2 through R5, (2k, 1/4W, 5%, CB2025, 01121)
 and CR2 (1N462A, 07688) as shown in the diagram below.



Type 79219/1 AGC AMP/Power Supply, Ref Desig Prefix A6: (Serial No. 117 and above)

Change C1 to 47 μ F, 20%, 10V, 109D476X0010C2, 56289

Main Chassis Parts List and Schematic Diagram

Change P8 to part No. 44950

Add C10, 22 μ F, 10%, 35V (150D226X9035R2, 56289) from A6 pin 10 to ground (negative terminal to ground).

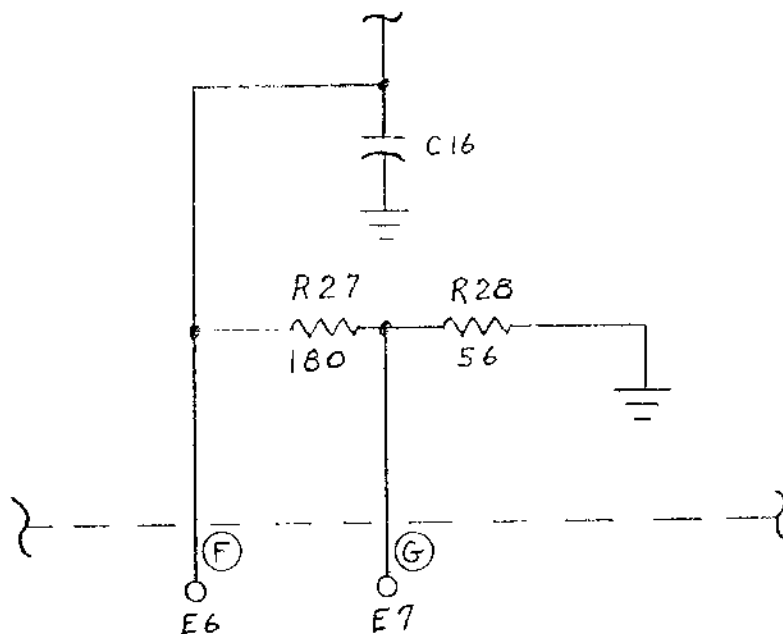
Part 12876 Input Amplifier and Balanced Mixer, Ref., A3A1 (Serial numbers 177 and above)

Change R16, R23, R26, and R28 to 750 Ω , 5%, 1/4 W (CB7515, 01121)

Change R19 and R27 to 200 Ω , 10%, 3/4W (150, 200 Ω , 10%, 75042)

Part 11937 IF Amplifier and AM Detector, A5A3 (Serial Number 177 and above)

Add R27, 180 Ω , 1/4W, 5% (CB1815, 01121) and R28, 56 Ω , 1/4W, 5% (CB5605, 01121) as shown in the sketch below.



Type 76101 Compensated ± 4.5 V Power Supply, (Serial Number 297 and above)

Change CR1, CR2 to 1N4998, 07688

Part 12879/1 BFO and Product Detector, (Serial Number 60 and above)

Change R8 to 10 Ω , 5%, 1/4W. (CB1005, 01121)

Part 12654 Inductor Board (A4A1A2) Change L2 from 9220-28; 76493 to 2500-28; 99800

Part 11937/3 IF Amplifier and AM Detector (A5A3) Change C4 from 0.1 μ F to 150 pF,

5%, 500V; CM05FE151J03 on the parts list and schematic, Figure 6-7. Add at C4 an asterisk (*), add as final entry of the parts list: *Nominal value, final value factory selected. Add to Figure 6-7 at C4: (NOTE 3). Add NOTE 3 as follows: Nominal value, final value factory selected.

Type 76101 Compensated \pm 4.5V Power Supply (A13) Change R12 from 500 Ω to 1 k Ω

(10%, 1/2W; 3067P-1-102) on the parts list and schematic Figure 6-19.