

INSTRUCTION MANUAL

FOR

WJ-8888 HF RECEIVER

**WATKINS-JOHNSON COMPANY
700 QUINCE ORCHARD ROAD
GAITHERSBURG, MARYLAND 20760**

C/WJ/250/7/75

WARNING

The equipment frame associated with this unit employs voltages which are dangerous and may be fatal if contacted. Extreme caution should be exercised when working with the equipment frame with any of the protective covers removed.

TABLE OF CONTENTS

<u>Paragraph</u>		<u>Page</u>
SECTION I GENERAL DESCRIPTION		
1.1	Electrical Characteristics	1-1
1.2	Mechanical Characteristics	1-2
1.3	Equipment Supplied	1-3
1.4	Equipment Required But Not Supplied	1-3
SECTION II INSTALLATION		
2.1	Unpacking and Inspection	2-1
2.2	Installation	2-1
SECTION III OPERATION		
3.1	Introduction	3-1
3.2	Power Switch, Meter, and Audio Controls	3-1
3.3	Local Mode	3-2
3.4	Memory Mode	3-6
3.5	Remote Mode	3-7
SECTION IV CIRCUIT DESCRIPTION		
4.1	General	4-1
4.2	Overall Functional Description	4-1
4.3	Receiver Section	4-2
4.3.1	Functional Block Diagram Description	4-2
4.3.2	Schematic Descriptions	4-3
4.3.2.1	Type 791312 0.5-30 MHz Bandpass Filter (A20)	4-3
4.3.2.2	Type 791199 Input Filter Assembly (A1)	4-4
4.3.2.3	Type 79116 Input Converter (A2)	4-5
4.3.2.4	Type 791198 10.7/455 Converter (A3)	4-9
4.3.2.5	Type 72399-(X) IF Filter Assembly (A4, A6)	4-10
4.3.2.6	Type 72409 455 kHz IF Amplifier (A8)	4-11
4.3.2.7	Type 791113 AM Demodulator (A9)	4-11
4.3.2.8	Type 791162 FM Demodulator (A10)	4-14
4.3.2.9	Type 791180-(X) LSB/USB/CW Demodulator (A11, A12)	4-15
4.3.2.10	Type 7453 Audio Amplifier (A13)	4-17

TABLE OF CONTENTS (CONT)

<u>Paragraph</u>		<u>Page</u>
4.3.2.11	Type 7899 Gain Control (A14)	4-20
4.3.2.12	Type 791275 Phone Jack Assembly (A28)	4-28
4.3.2.13	Optional Type 791451 Logarithmic IF Amplifier Assembly (A7).	4-28
4.4.1	Synthesizers Relationships	4-31
4.4.2	Phaselock Loops	4-33
4.4.3	1st LO Synthesizer	4-34
4.4.4	2nd LO Synthesizer	4-47
4.4.5	3rd LO Synthesizer	4-54
4.4.6	BFO Synthesizer	4-56
4.4.7	Time Base Circuits	4-62
4.4.8	Power Fail Detector	4-63
4.5	Digital Control Section	4-67
4.5.1	Functional Block Diagram and Program Sequencing	4-67
4.5.2	Schematic Descriptions	4-76
4.5.2.1	Type 791124 Program Sequencer Board (A20)	4-76
4.5.2.2	Type 791134 Front Panel Register Board (A22)	4-83
4.5.2.3	Type 791137 Switch Encoder Board (A21)	4-92
4.5.2.4	Type 791140 Receiver Register Board (A17)	4-95
4.5.2.5	Type 791202 Tuning Dial Encoder Assembly (A25)	4-102
4.5.2.6	Type 791276 Optional Tuning Connector Filter (A24)	4-102
4.5.2.7	Type 791126 Numerical Display/Buffer (A23)	4-103
4.5.2.8	Type 791200-1, -2 Synchronous I/O Module (A16)	4-103
4.6	Power Supply Section	4-105
4.6.1	Primary Power	4-105
4.6.2	Power Supply Board Schematic Descriptions	4-105
4.6.2.1	Type 76210-7 ± 15 V Power Supply Board	4-105
4.6.2.2	Type 76209 ± 5 V Power Supply Board	4-106

SECTION V MAINTENANCE

5.1	General	5-1
5.2	Cleaning and Lubrication	5-1
5.3	Inspection for Damage or Wear.	5-1
5.4	Test Equipment Required.	5-1
5.5	Troubleshooting Procedure	5-1
5.5.1	Localizing Troubles	5-1
5.5.2	Repair	5-2
5.6	Performance Tests	5-5
5.6.1	General	5-5
5.6.2	Power Supply Test	5-5

TABLE OF CONTENTS (CONT)

<u>Paragraph</u>		<u>Page</u>
5.6.3	Sensitivity Tests	5-6
5.6.4	Unwanted Sideband Rejection Test	5-8
5.6.5	IF Rejection Test	5-9
5.6.6	RF Image Rejection Test	5-9
5.6.7	IF Gain and AGC Tests	5-10
5.6.8	Time Base Performance Tests	5-11
5.6.9	Synthesizers Overall Performance Tests	5-13
5.6.10	1st LO Performance Test	5-14
5.6.11	2nd LO Performance Test	5-16
5.6.12	3rd LO Performance Test	5-18
5.6.13	BFO Performance Test	5-19
5.7	Alignment and Adjustment	5-20
5.7.1	General	5-20
5.7.2	Power Supply Voltage Adjustments	5-20
5.7.3	Power Down Adjustment	5-21
5.7.4	Tuning Circuitry Alignment	5-22
5.7.5	Input Converter Alignment	5-23
5.7.5.1	First LO Test	5-23
5.7.5.2	Second LO Alignment	5-24
5.7.5.3	RF/IF Alignment	5-25
5.7.5.4	Input Converter Gain Test	5-26
5.7.6	10.7/455 Converter Alignment	5-28
5.7.7	455 kHz IF Amplifier Alignment	5-29
5.7.8	IF Gain Adjustments	5-31
5.7.9	FM Discriminator Alignment	5-32
5.7.10	LSB/USB/CW Demodulator Adjustment	5-33
5.7.11	1st LO Alignment	5-34
5.7.12	2nd LO Alignment	5-39
5.7.13	3rd LO Alignment	5-43
5.7.14	BFO Alignment	5-45

SECTION VI REPLACEMENT PARTS LIST

6.1	Unit Numbering Method	6-1
6.2	Reference Designation Prefix	6-1
6.3	List of Manufacturers	6-1
6.4	Parts List	6-6

SECTION VII SCHEMATIC DIAGRAMS

LIST OF ILLUSTRATIONS

<u>Figure</u>		<u>Page</u>
1-1	WJ-8888 Receiver.	1-0
2-1	WJ-8888 Receiver, Critical Dimensions.	2-2
3-1	Serial Synchronous Data Word Format.	3-8
4-1	WJ-8888, Simplified Overall Block Diagram	4-0a
4-2	Receiver Section, Simplified Functional Block Diagram.	4-0b
4-3	Simplified Schematic Diagram of Attenuator Shaper.	4-9
4-4	Noise Limiter, Simplified Diagram	4-13
4-5	Functional Block Diagram, Gain Control (A14)	4-22
4-6	Simplified Functional Block Diagram of A14U1A and A14U1B.	4-26
4-7	Frequency Synthesizers, Functional Relationships	4-30
4-8	Basic Phase Lock Loop.	4-33
4-9	1st LO Functional Block Diagram	4-35
4-10	1st LO Divide-By-N Range	4-36
4-11	1st LO Divide-By-N Integrated Circuits	4-38
4-12	1st LO NAND Terminal Count Sequence	4-42
4-13	1st LO VCO Functional Block Diagram	4-45
4-14	1st LO VCO Tank Circuit Simplified Schematic	4-46
4-15	2nd LO Functional Diagram.	4-48
4-16	2nd LO Divide-By-N Integrated Circuits.	4-49
4-17	2nd LO Divide-By-N Range.	4-50
4-18	2nd LO Flip-Flop Terminal Count Completion.	4-52
4-19	2nd LO VCO Conversion to 72.105(±) MHz.	4-54
4-20	3rd LO Simplified Schematic	4-55
4-21	3rd LO Digital Mixing	4-56
4-22	BFO Functional Diagram	4-57
4-23	BFO Divide-By-N Integrated Circuits	4-58
4-24	BFO Divide-By-N Range	4-58
4-25	BFO VCO Conversion to 455 kHz.	4-62
4-26	Digital Control Section, Simplified Functional Block Diagram	4-66
4-27	Digital Control Section, WJ-8888, Overall Timing Diagram	4-68
4-28	Serial Synchronous I/O Timing Diagram.	4-75
5-1	Receiver Section Functional Dependency Diagram.	5-0
5-2	High Frequency High Impedance Detector	5-4
5-3	Low Frequency High Impedance Detector	5-5
5-4	Test Setup, Sensitivity Tests	5-7
5-5	Test Setup, IF/Image Rejection Tests	5-9
5-6	Test Setup, IF Gain and AGC Tests	5-10
5-7	Test Setup, Time Base Stages	5-12
5-8	Test Setup, 1st LO Performance Test	5-14
5-9	Test Setup, 2nd LO Performance Test.	5-16
5-10	Test Setup, 3rd LO Performance Test.	5-18

LIST OF ILLUSTRATIONS (CONT)

<u>Figure</u>		<u>Page</u>
5-11	Test Setup, BFO Performance Test	5-19
5-12	Test Setup, 1st LO Amplifier Test	5-23
5-13	Test Setup, Second LO Alignment	5-24
5-14	Test Setup, Second LO Alignment	5-25
5-15	Test Setup, RF/IF Alignment	5-25
5-16	Test Setup, RF/IF Alignment	5-26
5-17	Typical A2FL1 Response	5-27
5-18	Typical A2A2FL1 Response	5-27
5-19	Test Setup, Overall Final Gain Test	5-27
5-20	Test Setup, Third LO Amplifier Alignment	5-28
5-21	Test Setup, 10.7/455 Converter Alignment	5-29
5-22	10.7/455 Converter Overall Response	5-29
5-23	Test Setup, 455 kHz IF Alignment	5-30
5-24	Typical Response, 455 kHz Amplifier (Narrow Band)	5-30
5-25	Typical Response, 455 kHz Amplifier (Wide Band)	5-30
5-26	Test Setup, FM Discriminator Alignment	5-32
5-27	Typical Response, FM Discriminator	5-33
5-28	Test Setup, LSB/USB/CW Demodulator Adjustments	5-33
5-29	Test Setup, 1st LO Alignment	5-34
5-30	1st LO Prealignment Adjustments	5-36
5-31	Test Setup, 1st LO Step Frequency Response	5-36
5-32	Typical Response, 1st LO Step Voltage	5-37
5-33	Test Setup, 1st LO Alignment	5-37
5-34	Typical Response, 1st LO Narrow Band Spurious Products	5-38
5-35	Typical Response, 1st LO Wide Band Spurious Products	5-38
5-36	Test Setup, 2nd LO Alignment	5-39
5-37	Typical Response, 2nd LO Step Voltage	5-40
5-38	Test Setup, 2nd LO Alignment	5-40
5-39	Typical Response, 2nd LO Step Voltage	5-41
5-40	Test Setup, 2nd LO Alignment	5-41
5-41	Typical Response, 2nd LO Narrow Band Spurious Products	5-43
5-42	Typical Response, 2nd LO Wide Band Spurious Products	5-43
5-43	Test Setup, 3rd LO Alignment	5-43
5-44	Typical Response, 3rd LO Output Spectrum	5-44
5-45	Typical Response, 3rd LO Output Spectrum	5-44
5-46	Test Setup, BFO Alignment	5-45
5-47	Typical Response, BFO Step Voltage	5-46
5-48	Typical Response, BFO Wide Band Spurious Products	5-48
6-1	Type WJ-8888 Receiver, Front View, Location of Components	6-8
6-2	Type WJ-8888 Receiver, Rear View, Location of Components	6-8
6-3	Type WJ-8888 Receiver, Top View, Location of Components	6-10

LIST OF ILLUSTRATIONS (CONT)

<u>Figure</u>		<u>Page</u>
6-4a	Type WJ-8888 Receiver, Bottom View, Location of Components	6-12
6-4b	Type WJ-8888 Receiver, Bottom View, Location of Components	6-13
6-5	Type 791199 Input Filter Assembly (A1), Location of Components	6-18
6-6	Part 23490 Filter Mother Board (A1A1), Location of Components	6-19
6-7	Type 791247 10-18/18-30 MHz Filter (A1A1A1), Location of Components	6-22
6-8	Type 791250 3.4/6-10 MHz Filter (A1A1A2), Location of Components	6-25
6-9	Type 791249 1.2-2.0/2.0-3.4 MHz Filter (A1A1A3), Location of Components	6-28
6-10	Type 791248 0.5-0.8/0.8-1.2 MHz Filter (A1A1A4), Location of Components	6-31
6-11	Type 791166 Input Converter, Top View (A2), Location of Components	6-37
6-12a	Type 791166 Input Converter, (A2), Bottom View, Location of Components	6-38
6-12b	Type 791166 Input Converter, (A2), Bottom View, Location of Components	6-39
6-13	Part 17059 Attenuator Shaper (A2A1), Location of Components .	6-41
6-14	Part 17600 Filter Board (A2A2), Location of Components . . .	6-41
6-15	Part 17397 LO Amplifier (A2A3), Location of Components . . .	6-42
6-16	Type 791198 10.7/455 kHz Converter (A3), Location of Components	6-45
6-17	Type 72399-X IF Filter Assembly (A4, A6), Location of Components	6-49
6-18	Type 791451 IF Log Amplifier (A7), Location of Components . .	6-52
6-19	Type 72409 455 kHz IF Amplifier (A8), Location of Components	6-55
6-20	Type 791113 AM Demodulator (A9), Location of Components . . .	6-59
6-21	Type 791162 FM demodulator (A10), Location of Components	6-59
6-22	Types 791180-1 and -2 SSB Demodulators (A11, A12), Location of Components	6-65
6-23	Type 7453 Audio Amplifier (A13), Location of Components . . .	6-72
6-24	Type 7899 Gain Control Amplifier (A14), Location of Components	6-76
6-25	Type 791271 Voltage Controlled Oscillator (A15), Location of Components	6-78

LIST OF ILLUSTRATIONS (CONT)

<u>Figure</u>		<u>Page</u>
6-26a	Part 17414 VCO Assembly (A15A1), Location of Components	6-82
6-26b	Part 17414 VCO Assembly (A15A1), Location of Components	6-83
6-27	Type 791200 Synchronous I/O (A16), Location of Components. .	6-85
6-28	Type 791140 Receiver Register (A17), Location of Components	6-89
6-29	Type 791109 First LO, Third LO, and Time Base (A18), Location of Components	6-89
6-30	Type 791117 2nd LO and BFO (A19), Location of Components. .	6-103
6-31	Type 791124 Program Sequencer (A20), Location of Components	6-103
6-32	Type 791137 Switch Encoder (A21), Location of Components . .	6-109
6-33	Type 791134 Front Panel Register (A22), Location of Components	6-115
6-34	Type 791126 Display Buffer (A23), Location of Components . .	6-117
6-35	Part 23458 Digital Display (A23A1), Location of Components. .	6-118
6-36	Part 17543 Optical Transmitter (A25A1), Location of Components	6-121
6-37	Part 17544 Optical Receiver (A25A2), Location of Components. .	6-122
6-38	Type 76210-7 Power Supply (A26), Location of Components. . .	6-123
6-39	Type 76209 Switching Regulator (A27), Location of Components	6-125
6-40	Type 791203 Light Board (A29), Location of Components	6-126
6-41	Type 791312 0.5-30 MHz Bandpass Filter Assembly (A30), Location of Components	6-127
7-1	Type 791199 Input Filter Assembly (A1), Schematic Diagram. .	7-3
7-2	Type 791247 10-18/18-30 MHz Filter(A1A1A1), Schematic Diagram	7-5
7-3	Type 791250 3.4-6.0/6-10 MHz Filter (A1A1A2), Schematic Diagram	7-7
7-4	Type 791249 1.2-2.0/2.0-3.4 MHz Filter (A1A1A3), Schematic Diagram	7-9
7-5	Type 791248 0.5-0.8/0.8-1.2 MHz Filter (A1A1A4), Schematic Diagram	7-11
7-6	Type 791166 Input Converter (A2), Schematic Diagram	7-13
7-7	Part 17059 Attenuator Shaper (A2A1), Schematic Diagram . . .	7-15
7-8	Type 791198 10.7/455 Converter (A3), Schematic Diagram . .	7-17
7-9	Type 72399-(X) IF Filter Assembly (A4, A6), Schematic Diagram	7-19
7-10	Type 791451 Log IF Amplifier (A7), Schematic Diagram	7-21

LIST OF ILLUSTRATIONS (CONT)

<u>Figure</u>		<u>Page</u>
7-11	Type 72409 455 kHz IF Amplifier (A8), Schematic Diagram . . .	7-23
7-12	Type 791113 AM Demodulator (A9), Schematic Diagram	7-25
7-13	Type 791162 FM Demodulator (A10), Schematic Diagram	7-27
7-14	Type 791180-(X) LSB/USB/CW Demodulator (A11, A12), Schematic Diagram	7-29
7-15	Type 7453 Audio Amplifier (A13), Schematic Diagram	7-31
7-16	Type 7899 Gain Control Amplifier (A14), Schematic Diagram . . .	7-33
7-17	Type 791271 VCO (A15), Schematic Diagram	7-35
7-18	Type 791200 Synchronous Remote I/O (A16), Schematic Diagram	7-37
7-19	Type 791140 Receiver Register (A17), Schematic Diagram	7-39
7-20	Type 791109 1st LO/3rd LO/Time Base (A18), Schematic Diagram	7-41
7-21	Type 791117 2nd LO/BFO (A19), Schematic Diagram	7-43
7-22	Type 791124 Program Sequencer (A20), Schematic Diagram	7-45
7-23	Type 791137 Switch Encoder (A21), Schematic Diagram	7-47
7-24	Type 791134 Front Panel Register (A22), Schematic Diagram, Sheet 1 of 2	7-49
7-25	Type 791134 Front Panel Register (A22), Schematic Diagram, Sheet 2 of 2	7-51
7-26	Type 791126 Display Buffer (A23), Schematic Diagram	7-53
7-27	Type 791276 Optional Tuning Connector Filter (A24), Schematic Diagram	7-55
7-28	Type 791202 Encoder Assembly (A25), Schematic Diagram	7-57
7-29	Type 76210-1 ± 15 V Power Supply (A26), Schematic Diagram . . .	7-59
7-30	Type 76209 ± 5 V Switching Regulator (A27), Schematic Diagram	7-61
7-31	Type 791275 Phone Jack Assembly (A28), Schematic Diagram . . .	7-63
7-32	Type 791312 0.5-30 MHz Bandpass Filter (A30), Schematic Diagram	7-65
7-33	WJ-8888 HF Receiver, Schematic Diagram	7-67

LIST OF TABLES

<u>Table</u>		<u>Page</u>
1-1	WJ-8888 Receiver, Specifications	1-4
1-2	Sensitivity	1-7
2-1	Mating Connector Types	2-3
2-2	Synchronous/Asynchronous I/O Connector (J1) Pin Designations	2-7
4-1	Truth Tables for Input Filter Logic Elements	4-6
4-2	1st and 2nd LO 10 kHz Tuning Increment	4-32
4-3	1st and 2nd LO Frequencies Versus Tuned Frequency	4-32
4-4	1st LO Decrement to Terminal Count	4-37
4-5	2nd LO Counter Range Restriction	4-51
4-6	BFO Binary/Decimal Equivalents	4-59
4-7	Operation Modes	4-70
4-8	Preselector Code	4-99
5-1	Test Instruments Required	5-3
5-2	Power Supply Voltages, Measurement Points and Adjustments	5-6
5-3	Corresponding IF Bandwidths, Signal Levels, and Modulation Frequencies for Sensitivity Tests	5-7
5-4	1st LO Test Frequencies	5-15
5-5	2nd LO Test Frequencies	5-17
5-6	BFO Test Frequencies	5-47