APPENDIX C: USER MANUAL

Please refer to the following pages, specifically pages 8 and 9, that include the new, optional antenna.

5100 Series

SERVICE MANUAL

DIGITAL/ANALOG PORTABLE RADIO

5100 Series Portable Radio

VHF
Project 25 Conventional
SMARTNET®/SmartZone®

7.2 VDC,
1 and 5 Watts (VHF);
Part No. 242-51xx-xxx

EFJohnson®

Part Number: 001-5100-0012CD
November 2002
Supersedes: 001-5100-0011CD; 6/02

51xx SERIES PORTABLE

VHF
PROJECT 25 (DIGITAL) AND ANALOG
SMARTNET®/SmartZone®

7.5 VDC
5 & 1 W (VHF)
Part No. 242-51xx-xx0

The E.F. Johnson Company, which was founded in 1923, provides wireless communication systems solutions for public safety, government, and commercial customers. The company designs, manufactures, and markets conventional and trunked radio systems, mobile and portable subscriber radios, repeaters, and Project 25 digital radio products. E.F. Johnson is a wholly owned subsidiary of EFJ, Inc., formerly Transcrypt International, Inc.

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SECTION 1 GENERAL INFORMATION

1.1 SCOPE OF MANUAL

This service manual contains operation, programming, alignment, and service information for the EFJohnson 5100-Series portable digital transceivers.

1.2 TRANSCEIVER DESCRIPTION

1.2.1 GENERAL

The 5100-series portable digital transceivers have multiple system programming capability to allow operation in various types of radio systems as described in the information which follows.

Models are available for operation in the following frequency ranges. Repeater talk-around, which allows transmitting on the receive frequency, is also available with all bands.

VHF: 136-174 MHz

Power output is user switchable for low and high levels as follows:

VHF - 1 and 5 watts

1.2.2 ANALOG/DIGITAL OPERATION

The 5100-series transceiver uses a digital signal processor (DSP) to provide IF and audio filtering and modulation functions. This allows operation on the various types of channels (see following), backward compatibility with existing equipment, and the ability to operate on various types of radio systems.

Narrow Band Analog - FM modulation is used with a maximum deviation of 2.5 kHz. This mode is usually used in systems with a channel spacing of 12.5 or 15 kHz.

Wideband Analog - FM modulation is used with a maximum deviation of 5 kHz. This mode is usually used in systems where the channel spacing is 25 kHz or 30 kHz.

Project 25 Digital - Operates on Project 25 compatible systems. The voice is digitized, error corrected, optionally encrypted, and then transmitted using C4FM modulation according to the Project 25 standard. This mode uses a channel spacing of 12.5 kHz.

1.2.3 OPERATING PROTOCOLS

Standard 5100-series transceivers can be programmed for any or all the following operating protocols. The conventional analog protocol is standard and the others are optional and therefore are available only if enabled by factory programming. Refer to Section 3 for more operation information.

- Conventional analog
- Conventional Project 25 (digital)
- SMARTNET™/SmartZone® analog or digital
- Trunked Project 25 (digital)

NOTE: Some of the above protocols are not available with early units.

Multi-Net® versions of this radio are planned for future release. These versions will be programmable for Multi-Net and conventional analog operation. However, future migration to any of the other protocols listed above will be possible by reflashing the operating software. This manual does not include Multi-Net operation information.

1.2.4 FULL AND LIMITED KEYPAD MODELS

Both DTMF (18-key) and limited (6-key) models are available. The DTMF keypad version includes the 0-9, *, and # keys for making telephone calls, entering unit or group ID numbers, and keypad programming.

Both models have programmable F1-F4 option keys and the Up/Down switch on the front panel. In addition, both models have a push-button and a rotary switch on the top panel and three push-buttons on the side panel that are programmable. A menu mode can also be programmed with both models to select functions that are selectable by the option buttons. Refer to

Section 3 for more information on transceiver operation.

1.2.5 SYSTEMS, CHANNELS, AND ZONES

A zone and channel are selected to place and receive calls. The following describes the relationship between systems, channels, and zones.

Systems

A system is a collection of channels or talk groups belonging to the same repeater site. It defines all the parameters and protocol information required to access a site. Up to 16 systems of any type can be programmed. The maximum number of channels assignable to a system is limited to approximately 256 with standard models or approximately 500 with the 512-channel option (or the available memory space as described in the following information).

Channels

A channel selects a radio (RF) channel or talk group as follows:

Conventional Analog Mode - A channel selects a specific radio channel, Call Guard (CTCSS/DCS) squelch coding, and other parameters unique to that channel.

Conventional Project 25 Mode - A channel selects a specific radio channel, NAC squelch coding, talk group ID, and other parameters unique to that channel.

Trunked Project 25 Mode - A channel selects a specific talk group ID and other parameters unique to that talk group.

SMARTNET/SmartZone and Project 25 Trunked Operation - A channel selects a specific talk group, announcement group, emergency group, and other parameters unique to that talk group.

As described in the preceding “Systems” description, a maximum of up to 256 or approximately 500 channels can be programmed. Although it is theoretically possible to program any combination of systems that produces up to 500 total channels, the maximum number is also limited by the available memory. For example, since more memory is required to program a SMARTNET system than a conventional system, the total number of channels decreases as the number of SMARTNET systems increases. The programming software displays a bar graph which shows the amount of available memory space that is used by the current data. Refer to Section 4 for more information.

Zones

A zone is a collection of up to 16 channels of any type. For example, a zone could include 12 conventional channels and 4 SMARTNET channels. One use of zones may be to program the channels used for operation in a different geographical areas. Up to 16 zones can be programmed with standard models and up to 32 can be programmed if the 512-channel option is enabled.

1.2.6 SECURE COMMUNICATION

SecureNet™ voice encryption is used to provide secure communication with this transceiver. SecureNet is a proprietary Motorola protocol that digitizes the voice and then encrypts it using a DES algorithm. The following types of SecureNet encryption are available:

Analog Conventional and SMARTNET/SmartZone Channels

- DES (DES-XL is not available)

Digital SMARTNET/SmartZone and Project 25 Channels

- DES-OFB (Output Feedback)

1.2.7 PROGRAMMING

Transceiver programming is performed using a PC-compatible computer, the EFJohnson 5100 Programming Cable, and PCConfigure programming software (see Table 1-1). Programming is described in Section 4.

1.2.8 ALIGNMENT

Transceiver alignment is performed using EFJohnson PCTune software and 5100 test box, and the same computer used for programming (see preceding section). All adjustments are made electron-

ically using the software (no manual adjustments are required). Refer to Section 6 for alignment information.

1.3 PRODUCT WARRANTY

The warranty statement for this transceiver is available from your product supplier or from the Warranty Department, E.F. Johnson Company, 299 Johnson Avenue, P.O. Box 1249, Waseca, MN 56093-0514. This information may also be requested from the Warranty Department by phone as described in Section 1.7. The Warranty Department may also be contacted for Warranty Service Reports, claim forms, or any other questions concerning warranties or warranty service.

1.4 PART NUMBER BREAKDOWN

The following is a breakdown of the part number used to identify this transceiver. Some combinations are not available.

242-51FK-ABC-Dx

F (Frequency Band)
- 1 - VHF (136-174 MHz)
- 3 - UHF (403-470 MHz)
- 4 - UHF (450-512 MHz)
- 8 - 800 MHz
- 9 - 900 MHz

K (Keypad)*
- 2 - Standard, Limited keypad
- 3 - Standard, DTMF keypad
- 6 - Intrin Safe, Limited keypad
- 7 - Intrin Safe, DTMF keypad

A (Antenna)
- 0 - No antenna
- 1 - VHF 136-151 MHz
- 2 - VHF 151-162 MHz
- 3 - VHF 162-174 MHz
- 4 - UHF 403-520 MHz
- 8 - 800 MHz

B (Battery)
- 0 - No battery
- 1 - Ultra high capacity, NiMH
- 6 - Intrin Safe, ultra high cap NiMH

C (Reserved for future use)

D Primary Operating Protocol
- A - Analog Conventional
- B - P25 Conventional
- C - P25 Trunking
- D - SMARTNET Analog
- E - SMARTNET Digital
- F - SmartZone Analog
- G - SmartZone Digital
- H - STAR Trunking Analog
- J - STAR Trunking Digital
- K - Multi-Net Analog

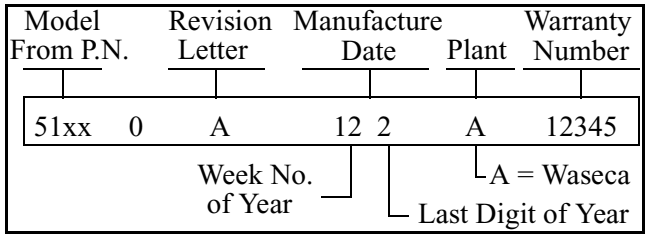
NOTE: The above "D" character indicates only the primary protocol. Other protocols (and options) may also be included and are indicated by the next "E" letter.

E Options

This letter indicates other operating protocols and options that are enabled by factory programming. Options may include encryption, OTAR, 512 Talk Groups, Digital SMARTNET/SmartZone, and others. Some combinations are currently be undefined, so use the **Transfer > Read Options From Radio** menu function of PCConfigure to determine which protocols and options are enabled in your radio (see Section 4).

1.5 TRANSCEIVER IDENTIFICATION

The transceiver identification number is printed on a label that is attached to the chassis. The following information is contained in the identification number:



1.6 ACCESSORIES

The accessories available for this transceiver are listed in Table 1-1.

Table 1-1 Accessories

Accessory	Part No.
Batteries	
2200 mAH NiCd	587-5100-220
3600 mAH NiMH standard	587-5100-360
Battery Chargers	
Single-unit rapid chgr, w/o power supply	585-5100-210
Single-unit rapid chgr/cond w/o pwr sup	585-5100-215
Pwr supply, switching 120/230 VAC 1.3A	585-5100-230
Docking station, 4-unit for -210 (-250 power supply included)	585-5100-240
Wall mount kit for docking station	585-5100-245
Power supply, switching 120/230 VAC 4.5A for docking station	585-5100-250
Charger kit, -210 chgr, -230 PS, US cord	250-5100-210
Charger kit, -215 chgr, -230 PS, US cord	250-5100-215
Charger kit, -210 chgr, -230 PS, Eur cord	250-5100-220
Charger kit, -215 chgr, -230 PS, Eur cord	250-5100-225
Antennas	
136-151 MHz helical (yellow core)	501-0017-101
151-166 MHz helical (black core)	501-0017-103
166-174 MHz helical (blue core)	501-0017-105
136-174 MHz wideband	501-0017-108
Carrying Accessories	
Belt clip, 2-1/2" std spring loaded	585-5100-128
Speaker/Microphones and Earphones	
Spkr/mic, coil cord w/2.5mm earphone jk	589-0015-057
Replacement coil cord for above spkr/mic	597-2002-101
Earphone kit, coil cord w/2.5mm rt angle plug, for -057 spkr/mic	589-5100-057
Earphone kit, coil cord w/2.5mm straight plug, for -057 spkr/mic	589-5100-059
Earphone adapter, w/3.5 mm thrd jack	589-5100-051
Lightwght headset w/inline PTT for -051	589-0015-059
1-wire earphone kit, for -051 adapter	589-5100-053
2-wire palm mic kit, for -051 adapter	589-5100-055
Programming Accessories	
5100 Programming Kit (-488 software, -920 cable, CD manual)	250-5100-003
5100 Programming Cable	023-5100-920
5100 Cloning Cable	023-5100-930
PCConfigure programming software, CD	023-9998-488
Adapter, DB9M-DB25F	515-9000-015

Table 1-1 Accessories (Continued)

Accessory	Part No.
Test Cables and Accessories	
PCTune radio tuning software	023-9998-499
Radio test and Ethernet box	023-5100-900
Cable, -900 test box to radio	023-5100-910
DB9 M-F cable, 6 ft. (-900 to cmptr)	597-5900-002
DB25M-DB9F cable, 6 ft (-900 to cmptr)	597-0005-057
SMA F to BNC F adapter	515-3102-050
SMA M to BNC F adapter	515-3102-060
DES Encryption Keyloader	
DES Key Variable Loader (KVL)	585-5000-930
Key loader to radio cable	585-5000-932
Key loader charger (NLN8858)	585-5000-934
Key loader spare battery (NLN9998)	585-5000-936

1.7 FACTORY CUSTOMER SERVICE

The Customer Service Department of the E.F. Johnson Company provides customer assistance on technical problems and the availability of local and factory repair facilities. Regular Customer Service hours are 7:30 a.m. - 5:30 p.m. Central Time, Monday-Friday. A technical support subscription service is available or support can be purchased on an as-needed basis. The Customer Service Department can be reached using the following telephone numbers:

Toll-Free: (800) 328-3911
FAX: (507) 835-6969
E-Mail: customerservice@efjohnson.com You can also e-mail a person directly if you know their first initial/last name (example: jsmith@efjohnson.com).

NOTE: Emergency 24-hour technical support is also available at the 800 and preceding numbers during off hours, holidays, and weekends.

When your call is answered at the E.F. Johnson Company, you will hear a brief message informing you of numbers that can be entered to reach various departments. This number may be entered during or after the message using a tone-type telephone. If you have a pulse-type telephone, wait until the message is finished and an operator will come on the line to assist you. When you enter some numbers, another number is requested to further categorize the type of information you need.

You may also contact the Customer Service Department by mail. Please include all information that may be helpful in solving your problem. The mailing address is as follows:

E.F. Johnson Company
Customer Service Department
299 Johnson Avenue
P.O. Box 1249
Waseca, MN 56093-0514

1.8 FACTORY RETURNS

Repair service is normally available through local authorized E.F. Johnson Land Mobile Radio Service Centers. If local service is not available, the equipment can be returned to the factory for repair. However, it is recommended that you contact the Customer Service Department before returning equipment. A service representative may be able to suggest a solution to the problem making return of the equipment unnecessary.

Be sure to fill out a Factory Repair Request Form #271 for each unit to be repaired, whether it is in or out of warranty. These forms are available free of charge by calling Customer Service (see Section 1.7) or by requesting them when you send a unit in for repair. Clearly describe the difficulty experienced in the space provided and also note any prior physical damage to the equipment. Include this form in the shipping container with each unit. Your telephone number and contact name are important as there are times when the technicians may have specific questions that need to be answered in order to completely identify and repair a problem.

When returning equipment for repair, it is also recommended that you use a PO number or some other reference number on your paperwork in case you need to call the repair lab about your unit. These numbers are referenced on the repair order and make it easier and faster to locate your unit in the lab.

Return Authorization (RA) numbers are not necessary unless you have been given one by the Field Service Department. RA numbers are required for exchange units or if the Field Service Department wants to be aware of a specific problem. If you have been given an RA number, reference this number on the Factory Repair Request Form sent with the unit. The repair lab will then contact the Field Service Department when the unit arrives.

For additional information on factory service, the Depot Service Department can be contacted at the following E-mail address:

depotrepair@efjohnson.com

1.9 REPLACEMENT PARTS

Replacement parts can be ordered directly from the Service Parts Department. To order parts by phone, dial the toll-free number as described in Section 1.7. When ordering, please supply the part number and quantity of each part ordered. E.F. Johnson dealers also need to give their account number. If there is uncertainty about the part number, include the designator (C512, for example) and the model number of the equipment the part is from.

You may also send your order by mail or FAX. The mailing address is as follows and the FAX number is shown in Section 1.7.

E.F. Johnson Company
Service Parts Department
299 Johnson Avenue
P.O. Box 1249
Waseca, MN 56093-0514

1.10 INTERNET HOME PAGE

The E.F. Johnson Company has a site on the World Wide Web that can be accessed for information on the company about such things as products, systems, and regulations. The address is http://www.efjohnson.com.

5100 SERIES PORTABLE SPECIFICATIONS

The following are general specifications intended for use in testing and servicing this transceiver. For current advertised specifications, refer to the specification sheet available from your sales representative. Values are typical and are subject to change without notice.

GENERAL

Frequency Range	VHF: 136-174 MHz
Available Operating Modes	Conventional analog, Project 25 conv. and trunked, SMARTNET/SmartZone analog and digital, Multi-Net (Multi-Net available with future release)
Talk Groups	256 standard, up to 500 optional (dependent on available memory)
Transmit/Receive Separation	Any frequency within the range
Channel Spacing	VHF: 12.5, 25, and 30 kHz
Maximum Deviation	25 kHz analog - 5 kHz 12.5 kHz analog - 2.5 kHz 12.5 kHz analog NPSPAC - 4.0 kHz
Frequency Stability	VHF - 2.0 PPM (–22 to +140° F or –30 to +60° C)
Dimensions (w/o antenna)	6.7” H x 2.52” W x 1.9” D (17.0 cm x 6.4 cm x 4.8 cm)
Weight (w/std battery)	24 oz. (675 g)
Supply Voltage	7.2 volts DC nominal
Battery Life	13 hours typical w/std 3600 mAH battery
Current Drain (maximum w/backlight, w/o backlight subtract 100 mA)	Standby - 350 mA Receive (rated audio out) - 500 mA Low Tx Power - 1.0 A High Tx Power - 2.0 A

RECEIVER

Sensitivity	0.25 µV (analog mode 12 dB SINAD), 0.25 µV (digital mode 5% BER)
Selectivity	–75 dB
Spurious and Image Rejection	–75 dB
Intermodulation	–78 dB (VHF)
Maximum Frequency Spread	Any spread within the range
Audio Power Output	500 mW
Audio Distortion	Less than 2% at 1 kHz

TRANSMITTER

RF Power Output	VHF: 5W (high), 1W (low)
Spurious and Harmonic Emissions	–70 dB (VHF)
FM Hum and Noise	–45 dB at 25 kHz bandwidth
Audio Modulation	16K0F3E, 8K10F1E, 11K0F3E VHF
Audio Distortion	Less than 2% at 1 kHz
Maximum Frequency Spread	Any spread within the band