5300 ES Series Mobile Radio Service Manual

VHF

Project 25 Conventional and Trunked
Analog and Digital Conventional
SMARTNET/SmartZone

60 Watt VHF

Part Number 001-5300-00001CD
December 2008

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SECTION

1

General Information

This service manual contains operation, programming, alignment, and service information for the EFJohnson Technologies 5300 ES Series mobile radio. The 53SL and Ascend (Multi-Net) models are similar in appearance and covered by separate manuals. The distinguishing characteristics of the 5300, 53SL, and Ascend models are as follows:

5300 Series Mobile

- Part No. 242-53xx-xxx (see Section 1.2)
- "RS-5300" label on top edge of front panel
- Black front panel bezel

53SL Series Mobile

- Part No. 242-54xx-xxx (see Section 1.2)
- "53SL" label on top edge of front panel
- Black front panel bezel

Ascend Series Mobile

- Part No. 242-5580-xxx (see Section 1.2)
- "ASCEND" label on top edge of front panel
- Black front panel bezel

1.1 Radio Description

The 5300 ES Series mobile radios can operate on various types of channels and with various signaling protocols. Repeater talk-around is also available.

1.1.1 Analog / Digital Operation

The 5300 ES Series mobile radios use a digital signal processor (DSP) to provide IF and audio filtering and signal modulation functions. This allows operation on the following types of channels, backwards compatibility with existing equipment, and also 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.

1.1.2 Operating Protocols

The 5300 ES Series mobile radio can be programmed for all the following operating protocols. The conventional analog protocol is standard and the others are optional (available only if enabled by factory programming).

- APCO Project 25 (digital) conventional
- APCO Project 25 (digital) trunked
- SMARTNET®/SmartZone® trunked analog or digital
- Analog conventional

Note *Multi-Net operation can be programmed with Ascend models only.*

1.1.3 Available Mounting Options

Front Mount - The operating controls are on the front on the radio, so the radio must be mounted within reach of the user.

Remote Mount, Single Control Unit - The operating controls are located on a remote mounted control unit. The radio does not have operating controls.

Remote Mount, Dual Controls - A remote control unit is connected to the front mount radio. This allows control from the front panel and the remote control unit.

Remote Mount, Dual Remote Control Units - Two remote control units are connected to the remote mount radio. This allows control from both remote control units.

1.1.4 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.

1.1.4.1 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 is limited to 864 based on the option enabled. Channels may also be limited by available memory space as described in the following information.

1.1.4.2 Channels

A channel selects a radio channel or talk group in a system 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.

A maximum of up to 864 channels can be programmed. Although it is theoretically possible to program any combination of systems that produces up to 864 total channels, the maximum number may be 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.

1.1.4.3 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 specific geographical area. Up to 54 zones can be programmed depending on the option enabled.

1.1.5 Programming

Radio programming is performed using a PC-compatible computer and an EFJohnson Technologies Remote Programming Interface (RPI) and PC Configure programming software (see Table 1.1). Programming is described in the *PC Configure Programming Manual* included separately.

1.1.5.1 Alignment

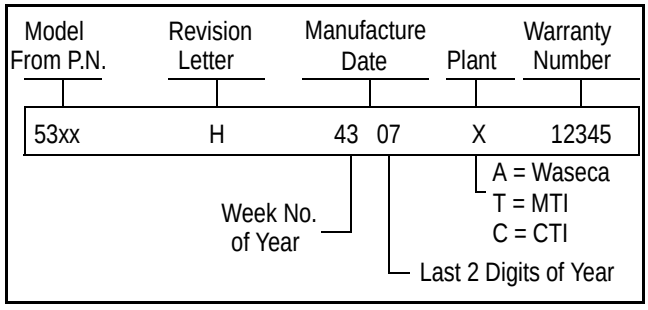
Radio alignment is performed using the same computer and RPI used for programming (see preceding section) and special PC Tune™ software. All adjustments are made electronically using the software (no manual adjustments are required). Alignment is described in Section 6.

1.2 Model Number Breakdown

The radio model number is located on the radio identification label attached to the side of the radio.

1.3 Serial Number Breakdown

The radio serial number is located on the radio identification label attached to the side of the radio. The following is a breakdown of this number:



1.4 Accessories

The accessories available for this radio are listed in Table 1.1. A brief description of some of these accessories follows:

Key Cap Kit - The key cap kit includes key caps labeled for various functions and five plugs that can be inserted in the front panel if a key is not used. Refer to the *5300 ES Series Mobile Installation Manual* for more information.

Mounting Hardware - The mounting hardware and DC power cable for standard models are shown in Figures 2.1 and 2.2 in Section 2. The mounting hardware and DC power cable for 100-watt models are shown in the *5300 Series Mobile Installation Manual.* A 22-foot DC power cable is used for both front and remote mount applications. The cable is cut to the required length at installation and any excess discarded.

The accessory cable plugs into the accessory pigtail of the radio, and is used to connect such things as an external speaker, ignition sense input, and a horn alert. It includes two 22-foot and three 2-foot wires that are connected as required to external points. The adapter cable is used to connect a 86xx-series power cable to these radios.

Lockable Mounting Tray - This bracket allows the radio to be locked in place to guard against theft. In addition, it allows it to be easily unlocked and removed from the vehicle. This bracket is intended for use with standard models only (not 100W). Refer to the *5300 ES Series Mobile Installation Manual* for installation information.

Microphones and Speaker - The microphones in Table 1.1 have an impedance of 620 ohms. All DTMF microphones are backlighted. The environmentally sealed microphone is sealed against such things as rain, sand, and dust. The desk microphone can be used for control station applications.

The external 15-watt speaker can be used in place of the internal 5-watt speaker. It is non-amplified and weatherproof. This speaker is connected to pins 1 and 2 of the accessory connector pigtail on the back of the radio. Audio power output is 12 watts with this external speaker or 5 watts with the internal speaker.

Control Station Power Supply - With the -4001- medium-duty power supplies, the radio slides into the power supply housing and receives power from banana jacks on the back of the power supply. The standard power cable is used for connecting power, and the internal radio speaker provides speaker audio. The -004 adapter cable is used to connect the radio DC and accessory pigtail cables to the power supply power cable and speaker. The radio internal speaker can also be used if desired.

Programming Hardware and Software - The RPI provides the interface between the programming computer and radio. The cables from the RPI to computer and radio are not included with the RPI and must be ordered separately. The radio programming software is available only for computers running Windows® 98/NT/2000/XP.

Table 1.1 5300 ES Accessories

Accessory	Part No.
Key Cap Kit	587-5300-001
Mounting Accessories	
Mounting bracket and hardware kit (standard)	023-9750-012
Mounting bracket (100W/bottom radio only)	017-9700-009
Mounting bracket (100W/bottom-top radio)	017-9700-008
DC power cable and hardware, 22 foot (standard)	023-9750-010
DC power cable and hardware, 22 foot (100W)	023-5315-100
Accessory wire kit	023-9750-011
Lockable Mounting Tray (standard models only)	585-7000-185
Microphones	
Standard amplified dynamic	250-0740-310
DTMF without memory, commercial	589-0016-028
DTMF without memory, env seal WR805	587-9650-015
Noise canceling, weather resistant	589-0016-592
Desk microphone	589-0012-021
Speakers	
External, 5 inch 15W 3.2 ohm environmental sealed with plug for HHC	250-0151-005
External, 5 inch 15W 3.2 ohm environmental sealed with terminals for accessory cable	250-0151-006
External, 5 inch, 15W 3.2 ohm motorcycle with mute software	250-0151-015
Handheld Control Unit and Siren Controller	
Handheld control unit with junction box and 17 foot control cable	250-5300-101
Handheld control unit junction box only	250-5300-102
Siren controller kit (without loudspeaker)	250-5300-100
Siren loudspeaker, model TS100 for light bar installation	585-5300-007
Siren loudspeaker, model MS100 compact for behind grill installation	585-5300-009
Remote Control Conversion Kit	
Dual control kit (convert front mount to remote or dual controls)	250-5300-001
Control station power supplies	
15 amp, 117 VAC, 60 Hz (medium duty)	585-4001-202
15 amp, 230 VAC, 50 Hz (medium duty)	585-4001-204
30 amp, heavy duty for 100W models	250-5300-212
DC and speaker cable adapter for -0226- supply	023-9650-004
Programming Accessories	
Remote programming interface (RPI)	023-5300-001

Table 1.1 5300 ES Accessories (Continued)

Accessory	Part No.
Cable, RPI to transceiver	023-5300-005
Cable, RPI to computer DB9M-DB9F 6 foot	597-5900-002
PC Configure programming software, CD	023-9998-488
PC Tune software, CD (current logic boards)	023-9998-499
Programming Kit, includes -488 software, -005 cable, RPI, CD programming manual	250-5000-004
Handheld control unit programming cable adapter	023-5300-140
Encryption Keyloader and Accessories	
SMA (PDA) keyloader	250-5000-945
SMA keyloader to 5100 radio cable	023-5000-940
SMA keyloader to 5300 radio cable	023-5000-950
Accessory Pigtail Cables	

Encryption Options - In radios that require encryption, the radio is ordered with the EFJohnson Technologies SEM module. Contact Customer Service for more information on the availability of encryption modules.

A key loader and an adapter cable are required to load encryption keys. The EFJohnson Technologies SMA (Subscriber Management Assistant) key loader part number is listed in Table 1.1. With OTAR, the key loader is required to perform the initial load of keys and after that the keys are loaded over the air. The adapter cable connects the key loader to the radio microphone jack. Special programming using PC Configure is also required as described in Section 2.

1.5 Secure Communication

Note *Refer to the 5300 ES Mobile Radio Operating Manual for more information on secure communication.*

SecureNet™ and AES voice encryption are used to provide secure communication with this radio. These protocols digitize the voice and then encrypt it using a DES or AES algorithm. The following types of encryption are available on analog and digital channels:

Analog Conventional and SMARTNET/SmartZone Analog Channels
- DES

Digital Project 25 and SMARTNET/SmartZone Channels
- DES-OFB (Output Feedback)
- AES (Advanced Encryption Standard). Refer to Section 11 of the Operating Manual for your radio for more information.

1.5.1 FIPS 140-2 Approved Encryption

All encrypted 5300 ES Series mobile radio models are FIPS certified for the DES-OFB and AES encryption modes. Encryption on analog channels is not FIPS certified. FIPS 140-02 is a Federal Information Processing Standard recently approved by the United States Secretary of Commerce. This standard specifies Federal security requirements for cryptographic modules for a wide range of applications and environments.

1.5.2 Over-the-Air-Rekeying (OTAR)

Encryption keys are loaded into the radio by OTAR (Over-the-Air-Rekeying) using a Key Management Facility (KMF) and/or a handheld keyloader such as the EFJohnson Technologies Subscriber Management Assistant (SMA) or Motorola KVL 3000 Plus with the AES option.

The keyloader is connected directly to the radio using an interconnect cable, and it loads DES, DES-OFB, and AES keys. Currently, OTAR can be used to load DES-OFB keys on Project 25 conventional channels. Refer to Section 10 of the Operating Manual for your radio for more OTAR information.

1.5.3 Key Retention

Note *The 5300 ES Series mobile radio has a security feature (push-button switch S1 on the logic board) that automatically erases the encryption keys when the bottom cover is removed (except when Infinite Key Retention is programmed as follows).*

If Infinite Key Retention Infinite Key Retention is programmed, the keys are maintained in memory indefinitely, even without power applied. If it is not programmed, the radio must be connected to an unswitched power source to preserve the encryption keys in memory. However, a storage capacitor (C173, 0.22 F) maintains the 5-volt supply (and the encryption keys) for approximately eight hours if power is temporarily lost.

1.6 Typical Performance Specifications.

This section contains specifications intended for use in testing and servicing this mobile radio. For current advertised specifications, refer to the specification sheet available from your sales representative. Values are typical and are subject to change without notice.

Table 1.2 contains general specifications for the ES Series Mobile radios.

Table 1.2 5300 ES Mobile Radio General Specifications

Parameter	VHF
Frequency Range	138-174 MHz
Channel Spacing	30 KhZ, 15 kHz
Maximum Frequency Separation	Full Bandsplit

Table 1.3 contains transmitter specifications for the ES Series mobile radios.

Table 1.3 5300 ES Mobile Radio Transmitter Specifications

Parameter	VHF
RF Output Power	15 to 60 Watts
Frequency Stability	± 1.5 ppm
Modulation Limiting	±5 kHz w/ 25 and 30 kHz channels ±2.5kHz w/ 12.5 and 15 kHz channels
Emissions (Conducted & Radiated)	-75 dBc
Audio Response	+1, -3dB
FM Hum and Noise	45 dB
Audio Distortion	2%

Table 1.4 contains receiver specifications for the ES Series mobile radios.

Table 1.4 5300 ES Mobile Radio Receiver Specifications

Parameter	V+HF
Audio Output Power	12 Watts
Frequency Stability	± 1.5 ppm
Sensitivity - Analog (12 dB SINAD)	-119 dBm
Sensitivity - Digital (5% BER)	-119 dBm
Selectivity	70 dB w/25 and 30 kHz channels 60 dB w/12.5 and 15 kHz Project 25
Intermodulation	70 dB
Spurious Rejection	75 dB
FM Hum and Noise	45 dB @ 25 kHz 39 dB @ 25 kHz
Audio Distortion	2%

1.7 Operation

The operation of the 5300 ES Series mobile radio is described in the *5300 ES Series Mobile Radio Operating Manual*. Operation of the 53SL ES and Ascend ES mobile radios are described in the *53SL ES Series Mobile Radio Operation Manual* and the *Ascend ES Series Mobile Radio Operating Manual* respectively. These manuals are available from your EFJohnson Technologies dealer.

SECTION

2

Radio Programming

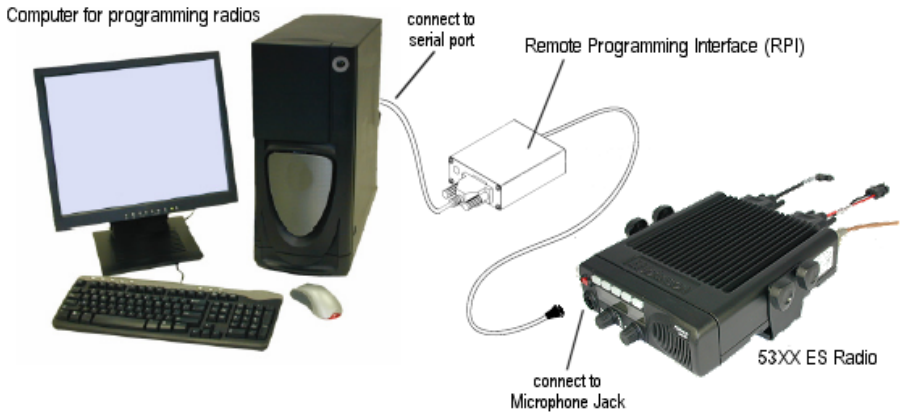
2.1 Programming Setup

The following items are required to program the radio. The part numbers of this equipment are shown in Table 1.1.

- A Windows®-based computer (see next section)
- Remote Programming Interface (RPI), Part No. 023-5300-001
- Programming cable from RPI to radio (see Section 2.1.2 for more information).
- EFJohnson PC Configure programming software, Part No. 023-9998-488.

Figure 2.1 shows the programming setup.

Figure 2.1 Programming Setup (Standard Front/Remote Models)



Note *The -005 cable, the -488 software, RPI, and a CD manual are included in the 5300 Series Programming Kit, Part No. 250-5000-004.*

2.1.1 Computer Description

The computer used to program this radio should meet the following minimum requirements:

- Windows 95/98/NT/2000/Vista (3.1 cannot be used)
- Pentium® processor or equivalent
- 16 MB of RAM
- A hard disk drive with at least 5 MB of free space
- A CD-ROM drive
- An available serial port

2.1.2 Connecting Computer to Radio

Note *RPI, Part Number 023-5300-001, should be used to program the 5300 ES Series mobile radio. Other RPIs such as 023-9800-000 and 023-9750-000 are not compatible with this radio.*

2.1.2.1 Connecting RPI To Computer

The Radio Programming Interface (RPI) provides the required logic interface between the computer and radio. The cable from the RPI to computer is not included with the RPI. The RPI has a female DB9 connector, and most computer serial ports have a male DB9 or DB25 connector. Therefore, a male DB9 to female DB9 or DB25 is usually required. This is a standard cable available at most computer supply stores or order 6 foot. DB9M to DB9F cable, Part Number 597-5900-002.

2.1.2.2 Connecting RPI To Radio

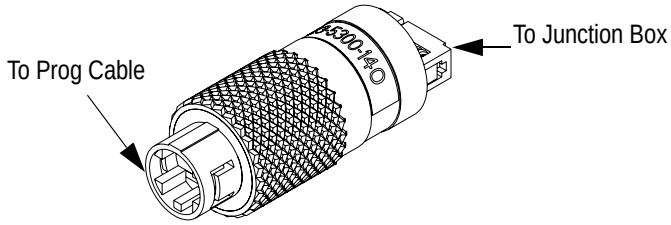
The programming setup for a front mount radio is shown in Figure 2.1. With radios that use the standard front or remote control unit, the cable from the RPI plugs into the microphone jack of the radio or control unit. This cable is Part Number 023-5300-005, and it is not included with the RPI. Connecting the programming setup to the handheld controller is described in the next section.

2.1.3 Handheld Controller Programming Setup

When the Handheld Control Unit is used, the same computer, RPI, and programming cable are used as with the standard front and remote models. In addition, the following components are required:

- The junction box, Part Number 023-5300-130, is required to provide a connection point for the RPI since the control unit does not have a programming jack. This box may not be included with some handheld control units.
- Adapter Plug, Part Number 023-5300-140, is required to plug the 5300 programming cable into the rectangular 10-pin programming connector on the junction box, as shown in Figure 2.2.

Figure 2.2 Programming Adapter Plug



Only one radio programming parameter must be changed when the Handheld Control Unit is used. Set the “Controller Type” parameter on the **Global** tab of the PC Configure programming software for “Handheld” instead of “Normal”.

2.1.4 Siren Programming

When the optional siren feature is installed (see the *5300 Series Mobile Installation Manual*), one radio programming parameter may need to be changed for proper operation of the siren controller backlight. On the **Global** tab of the PC Configure programming software, set the “Auxiliary B Toggle” parameter for “Backlight”. The Siren Control Head backlight then turns on and off with the radio control unit backlight.

2.2 Using PC Configure Software

The PC Configure software is described in a separate CD-based manual included on the CD-ROM with the programming software.

SECTION

5

Troubleshooting

5.1 User Troubleshooting

When approaching the limits of radio range, the other party may not be able to hear your transmissions and there may be an increase in background noise when messages are received.

You may still be out of range even though you can hear a message.

- The reason for this is that the signal you are receiving is usually transmitted at a higher power level than the one transmitted by your transceiver.
- Communication may be improved by moving to higher ground or away from shielding objects such as tall buildings or hills.

5.2 5300 Battery Discharge

In the standby mode (power on, not transmitting), transceiver power consumption is relatively low. Therefore, you can probably leave the transceiver on for one or two days without operating the vehicle and the battery should not become seriously discharged.

However, if the outdoor temperature is low enough to significantly decrease battery capacity, the transceiver should be turned off when not in use. Since power consumption is significantly higher when transmitting, it is good practice to have the vehicle running while transmitting. This ensures that optimum power is being delivered to the transceiver and that the battery does not become discharged.

5.3 5300 Viewing Angle

If no characters or all characters appear in the display, the viewing angle may be improperly adjusted. If the display is difficult to read from the angle you normally view it, the viewing angle can be adjusted as follows: Press and hold the last option switch above the display and then press the first option switch above the display. Release both switches and turn the Select switch until the best contrast is obtained. This function times out in three to five seconds.

5.4 5300 User Troubleshooting

If some other problem is occurring, turn power off and then on again to reset the control logic. Also make sure that the controls are properly set and that the power, external speaker, and accessory cables (if used) are securely plugged into the back of the transceiver.

If the transceiver is completely inoperative, check the power cable fuse that is usually located near the vehicle battery. If it is blown, remedy the cause if possible and replace it with the same type (15A). If the transceiver still does not operate properly, return it to your system operator for service.

5.5 User Troubleshooting

If UNPROGRAMD" is displayed, the cause could be any of the following:

- An unprogrammed channel is selected. Select a programmed channel.
- The selected channel is programmed for an option that is not installed or an error in programming was detected. The radio needs to be reprogrammed.

5.6 Additional Information

Please refer to the *5300 ES Series Mobile Installation Manual* for installation instructions and information (Part Number 004-5300-011).

SECTION

6

Service Information

This section describes how to obtain authorized service for the 5300 Series mobile radio.

6.1 Product Warranty

The warranty statement for this equipment is available from your product supplier or from:

Warranty Department
EFJohnson Technologies
8050 Jetstar # 175
Irving, TX 75063

This information may also be requested from the Warranty Department by phone at the numbers listed in Section 6.4. The Warranty Department may also be contacted for warranty service reports, claim forms, or any other questions concerning warranties or warranty service.

6.2 Online Registration

EFJohnson Technologies offers greater convenience through online product warranty registration. Registering EFJohnson Technologies products online allows customers to receive warranty service and field service notices more quickly.

To register EFJohnson Technologies products online, visit *www.EFJohnsonTechnologies.com*. Click the link for *Service & Support*, then follow the instructions for Warranty Registration.

6.3 Telephone Technical Support

Technical support personnel can help resolve many issues over the telephone, such as display, volume, software, programming. Please refer to Section 6.4 for information to contact the Customer Service Department.

6.4 Factory Customer Service

The EFJohnson Technologies Customer Service Department provides customer assistance on technical problems and the availability of local and factory repair facilities. Regular customer service hours are 8:00 a.m. - 5:00 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 (all except Multi-Net)
	(800) 295-1773 (Multi-Net only)
Fax:	(972) 819-0639
E-Mail:	customerservice@efji.com

You can also e-mail a person directly if you know their first initial/last name. For example, if John Smith is an EFJohnson Technologies employee, then his e-mail address is probably jsmith@efji.com.

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

When your call is answered at EFJohnson Technologies, 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:

Customer Service Department
EFJohnson Technologies
8050 Jetstar # 175
Irving, TX 75063

6.5 Returns for Repairs

Before returning equipment for repair, contact the EFJohnson Technologies Customer Service Department as described in the preceding section. They may be able to suggest a solution to the problem, making return of the equipment unnecessary.

Repair service is normally available through local authorized EFJohnson Technologies land mobile radio service centers. If local service is not available, the equipment can be returned to the EFJohnson Technologies repair depot for repair. However, before returning equipment, contact the Customer Service Department Repair Depot for the correct Ship To" address.

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. You can obtain it in any of three ways:

- Download it from the EFJohnson Technologies Web site's Service & Support" section.
- Call the EFJohnson Technologies Customer Service Department and request it. See Section 6.4.
- Request it 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 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@efji.com

6.6 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 6.4. When ordering, please supply the part number and quantity of each part ordered. EFJohnson Technologies 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 6.4.

Service Parts Department
EFJohnson Technologies
8050 Jetstar # 175
Irving, TX 75063

6.7 Internet Home Page

EFJohnson Technologies 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.EFJohnsonTechnologies.com