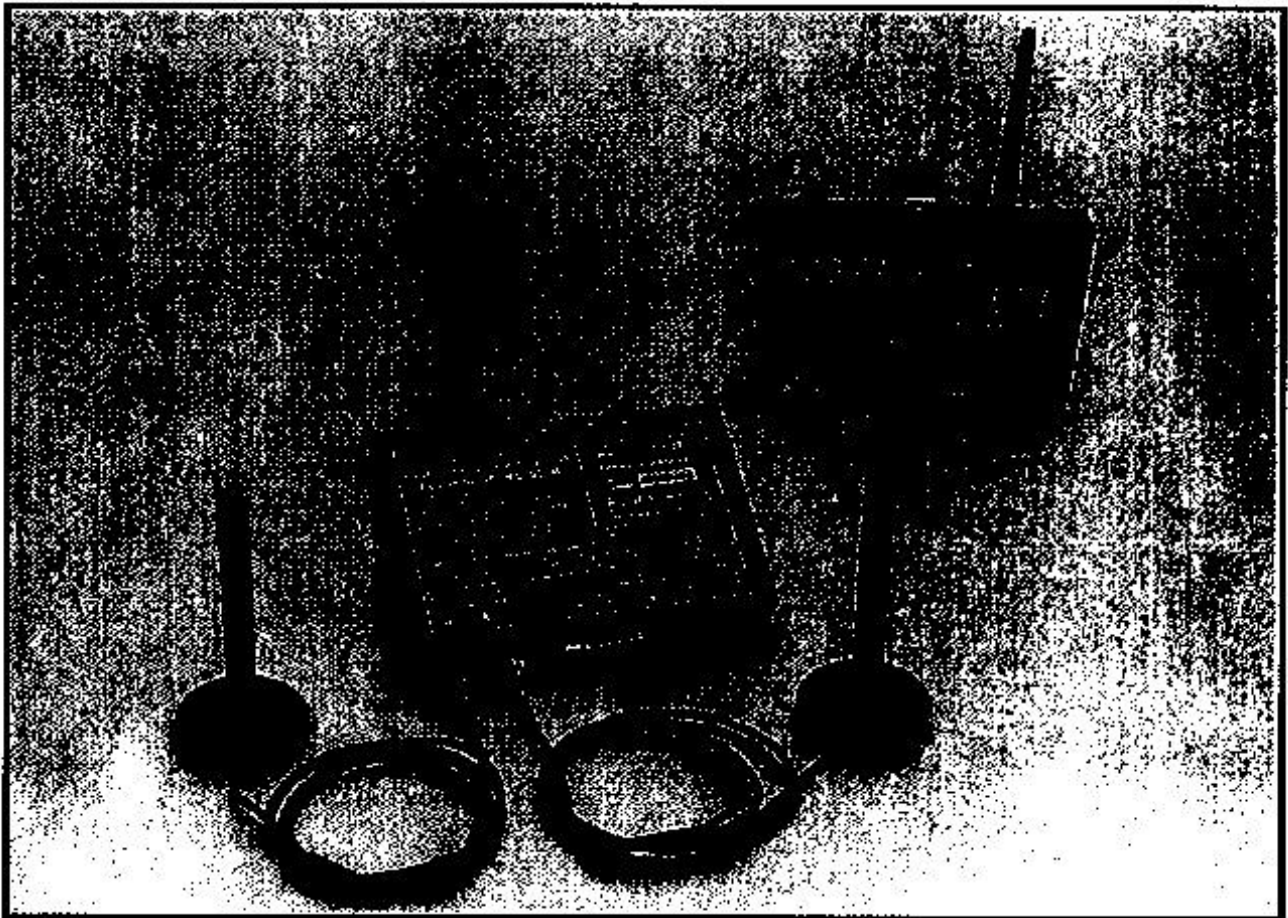


FRH-SD03TU
Wireless Data Communication System
Instruction Manual



Futaba Corporation of America
Industrial Radio Control

FCC Notice

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Any unauthorized changes or modifications to this device not expressly approved by Futaba Corporation of America could void the user's authority to operate the device and possibly result in damage to the equipment and/or cause serious or fatal injuries to the operator or nearby personnel.

This device is intended to be installed and used in accordance with the instructions contained in this manual. Failure to comply with these instructions could void the user's authority to operate the device and possibly result in damage to the equipment and/or cause serious or fatal injuries to the operator or nearby personnel.

Important Safety Information

The list of dangers, warnings and cautions in this section contain important information that will help ensure safe operation of the system. Please read carefully and understand all of these items. All installers, operators and maintenance personnel should read and understand this information before installation, use, or maintenance of the FRH system.

The FRH system by itself is not inherently dangerous. **HOWEVER, WHEN THE FRH SYSTEM IS CONNECTED TO OTHER EQUIPMENT FOR THE PURPOSE OF CONTROL, SAFETY AND ALL POSSIBLE ASSOCIATED DANGERS MUST ALWAYS BE GIVEN THE UTMOST CONSIDERATION DURING SYSTEM INTEGRATION, DESIGN, INSTALLATION, AND USE.**

The FRH system may be used in virtually unlimited applications. Many of these associated systems can, by themselves, pose a mechanical, electrical or other hazard to operators and other persons or equipment. To address all possible applications and associated safety hazards in this manual would be impossible. The warnings below and throughout this manual give you information that will allow you to install and use the FRH system safely in most applications. If you have questions regarding the safety of your specific application, please contact the appropriate people for help. Your Futaba sales representative, representatives of the equipment you are controlling, and the technical support staff at Futaba Corporation of America are among those who can give you assistance with your safety concerns.

The following warnings are included in the lists that follow but warrant repetition here:

In installations where the FRH system is used to control motion or operation of potentially dangerous equipment, it is imperative for safety that all operators and installers be thoroughly trained in the normal function of that equipment before attempting to control it remotely with the FRH system.

To help ensure safe operation of the equipment, the FRH system must be connected so that it will operate in a fail-safe way. In other words, the equipment being controlled should stop or return to its safest state in the absence of a control signal or total loss of RF transmission from the FRH modem. Our system uses one of the most reliable methods available to transmit data using radio signals. Many factors can affect a radio signal that may block it or interfere enough to disrupt regular transmission. Because of this, equipment motion or dangerous electrical current, for example, that continues during a loss-of-signal condition could be very dangerous.

Four symbols are used in the margin of the following section and throughout the manual to indicate the level of hazard or information listed.

The symbols are defined as follows:



Indicates a hazard that *will* cause severe personal injury, death, or substantial property damage if the warning is ignored.



Indicates a hazard that *can* cause severe personal injury, death, or substantial property damage if the warning is ignored.



Indicates a hazard that will or can cause minor personal injury, or property damage if the warning is ignored.



Indicates installation, operation, or maintenance information that is important but not hazard-related.

Please read the following safety information carefully. Some of these notices are duplicated throughout the manual, in areas of associated content, for your benefit.

General Safety Hazards and Notes



Improper installation and/or operation of the FRH system can cause serious or fatal injuries to the operator or nearby persons and cause damage to the FRH system, and any equipment it is used to control. Please read and understand this manual completely and the manual of all equipment being controlled before attempting to operate or install this system.



Always keep this manual at a location readily accessible to anyone operating the system and related equipment. Ensure that all operators have read and understood this manual, especially all safety and operation procedures contained in it. Please refer to the section in this manual titled *How to Obtain Help* for the contact that can supply you with additional manuals or for questions not covered in this manual. If this product is passed on to a different user, be sure that this manual accompanies the product.



Be certain that the installer of this equipment reads and understands the instruction manual of *the equipment that you are connecting to* before attempting this installation.

⚠ DANGER

The FRH system should **NOT** be used in a manner in which failure of the product or loss of the radio signal could cause damage to the equipment being controlled, or to anything in the area in which such equipment is located. All integrated control systems should be designed for “fail-safe” operation so that a temporary or permanent loss of signal will not endanger any person, critical process, or equipment (refer to the beginning of the safety section for further explanation). The system design should ensure that the equipment being controlled will default to its safest state in the event of signal loss.

⚠ CAUTION

The FRH system contains no user serviceable parts. If the unit requires service, contact your sales representative or Futaba Corporation of America for repair service. Contact information can be found in this manual under the section titled *How To Obtain Help*. Do not disassemble or attempt to repair the FRH yourself. Doing so could void your warranty and may void the user’s authority to operate the device.

! WARNING

Contact Futaba before using the FRH in safety critical applications such as medical equipment, aircraft, hazardous materials handling, etc.

Installation Safety Hazards and Notes**⚠ CAUTION**

When mounting the FRH modem, use M3 (ISO) screws that project no more than 3 to 7 mm into the modem. Screws that project further into the modem may permanently damage the internal components and/or cause the FRH modem to malfunction.

⚠ CAUTION

Some equipment applies voltage between Signal Ground and Frame Ground. If this is the case with your equipment, **DO NOT** connect the FRH Frame Ground to your equipment. Doing so could allow current surges to damage the FRH modem. (Standard RS-232C cannot be used with this type of equipment.)

! WARNING

Use only the AC adapter supplied with the FRH system. Use of any other adapter may permanently damage the FRH modem and/or cause the modem to malfunction and create a shock or fire hazard.

! WARNING

Be certain that all AC power outlets used the power adapters have been properly installed, grounded, and fused. An electrical shock hazard may exist if this unit is powered by a faulty power outlet or

source. If you discover such a situation, immediately discontinue use until the power source and outlet have been properly installed, grounded, and fused by an electrician or other authorized person.



Exercise care when using the AC adapter. Do not plug or unplug the AC adapter with wet hands or while standing in water. Do not touch or let any object come into contact with the adapter prongs at any time while they are in contact with the AC outlet.



Be sure to wire the power and serial connections correctly. Incorrect wiring can damage the system, cause it to malfunction and/or create a shock and fire hazard.



Ensure that the FRH modem power and the power to the equipment to be controlled is turned off before connecting or disconnecting the cable between them. This will help prevent accidental damage to the system and unexpected operation and/or injury.



Be sure the FRH modem power, the power to the equipment that you are connecting to it, and the DC power source are all turned off before wiring and connecting the power cable.



Be sure that the supplied power is within the specified range (5 to 31 VDC). Voltages outside the specified range may damage the FRH modem.



Be sure that the power source supplies sufficient current capacity. Insufficient current may cause the unit to malfunction.



DO NOT use the DC power cable and the AC adapter at the same time. Doing so may permanently damage the FRH modem and/or cause the modem to malfunction.



Securely attach the power cable, antenna cable, and serial connector to the FRH modem and equipment/power source to which it is connected. Use the attachment screws on the serial connector, tighten the antenna connector to the recommended torque and secure the power cable as necessary to ensure that they cannot be inadvertently disconnected by any means. Failure to do so could cause an unexpected system failure.

Antenna Installation Hazards and Notes



Be sure to keep all systems and antennas clear of power lines. Permanent equipment damage and severe shock injury or death can occur if the system contacts power lines.



Contact Futaba before connecting any antenna not provided by Futaba specifically for the FRH system. Attaching any non-authorized antenna may be in violation of FCC regulations.



The recommended antenna connector tightening torque is between 8 and 11.5 kg-cm. Exceeding the recommended torque may damage the FRH modem and/or antenna connector. A connector that is insufficiently tightened may become disconnected during operation and cause a severe reduction in operating range.



When using two pedestal antennas with a single FRH for diversity reception, mount the antennas as far apart as possible (30 cm minimum). If the antennas are too close, the diversity advantage will not be achieved.



Do not use two pencil antennas connected directly to the modem antenna connectors for diversity reception, doing so will not allow the diversity advantage to be achieved. If two pencil antennas will be used, remotely mount at least one antenna using an antenna extension cable to facilitate sufficient separation between the two antennas.



Before each use, verify that the antenna (and antenna cable, if used) is securely attached and in good condition. A loose antenna or cable may severely reduce the operating range of the system.



When installing the FRH in a mobile unit such as an Automatic Guided Vehicle (AGV), Futaba recommends using the diversity reception feature as a remedy for multipath fading problems. For diversity reception, install the two antennas as far apart as possible in order to gain maximum benefit (30 mm minimum).



The pedestal antenna is designed for indoor use. When using it outdoors, enclose it in a non-metallic, waterproof case or take other steps to protect it from humidity and other corrosive environments.

CAUTION

Though the outside of the pedestal antenna is made of silicone rubber, the inside is metallic. The metallic components can be bent or broken if enough force is applied. Mount the antenna in a location where it will be least likely to be damaged by contact with other objects or equipment.

CAUTION

The FRH-SD03TU operates at frequencies in the 2.4 GHz band. These frequencies are more directional than lower frequencies and are easily reflected. If there are metal structures nearby, the effective range may be shortened or the directional properties may be further narrowed. To help avoid this, mount the antenna as far away as possible from surrounding metallic structures.

CAUTION

Multipath problems occur easily at 2.4 GHz frequencies. When multipath problems are present, moving the antenna as little as 10 cm may result in improved communication or, conversely, a further diminished or total loss of communication. Futaba recommends that the mounting position of the antenna be determined *after* testing and verifying optimal communication conditions. Negative multipath effects can also be overcome with antenna diversity. See the section in this manual titled *Diversity Antenna Setup* and the related register settings for more details regarding antenna diversity.

CAUTION

When installing multiple FRH modem systems that will use different frequency groups in the same area, modem antennas of different frequency groups must be mounted at least 6 feet (2 meters) apart. Failure to do so may severely reduce the FRH operating range.

NOTE

Please contact Futaba before attempting to install any third party antenna equipment.

NOTE

Please contact Futaba for information about antenna separation when using the FRH-SD03TU and other wireless products in the same area.

NOTE

The diversity reception function is not available in Mode 1. (See the section titled *Operation Modes* for more details)

Environmental Safety Hazards and Notes**WARNING**

If the FRH system has been stored at a temperature beyond the specified operating temperature range for the system, it may not function properly. Allow it to return to normal temperatures before

use. Refer to *Appendix A – Technical Specifications* for the actual operating temperature range.



The FRH modem is a precision electronic device. Its rugged design is intended for industrial applications. However, do not install it where it will encounter excessive vibrations. In some cases, isolation mounts may be used to isolate the FRH modem from the equipment vibration. Excessive vibration can permanently damage the FRH modem and/or cause it to malfunction.



Do not operate the FRH system in environments where it will be subjected to excessive moisture (such as rain or water spray), dust, oil, or other foreign matter (such as metal particles). Doing so may permanently damage the FRH modem and/or cause it to malfunction. If it does become wet or contaminated, correct the situation, verify proper operation and have any problems corrected before using it to control other equipment. If necessary, the modem can be mounted inside a protective or waterproof enclosure. If the enclosure is metallic, the antenna must be mounted externally or the effective operating range will be severely limited.



The FRH-SD03TU is designed for indoor use. When using it outdoors, the modem should be mounted in a waterproof enclosure and the ambient temperature range should be checked to insure that it is within the modem's specifications. Always use the FRH modem within its specified environmental ranges.

Operational Safety Hazards and Notes



Before each use of the FRH system, ensure that the area where the equipment will be operated is clear of people or obstacles that may affect its safe operation.



Before each use of the FRH system, verify that both the equipment being controlled and the FRH system are in proper operating condition.



Turn the FRH power off before changing the rotary switch setting. Failure to do so may cause the modem to malfunction.



Except when initializing the memory registers, always turn the FRH modem power off before changing any dip switch settings.

CAUTION

Do not use rotary switch positions 8 to F. Doing so may cause the modem to malfunction. See the sections in this manual titled *Rotary Switch Setting* and *Frequency Grouping* for a more detailed description of the rotary switch settings.

CAUTION

When rewriting the FRH modem's memory registers, do not turn the FRH modem's power off until the FRH modem returns a P0. If the power is interrupted before a P0 is returned the memory contents may be lost or corrupted and the FRH operation will be unpredictable. If the memory contents are lost or corrupted, they may be restored to original default settings by reinitializing them. (See the section in this manual titled *Memory Register Initialization* for more details.)

CAUTION

When initializing the memory registers, do not turn the FRH modem's power off until the PW LED flashes green. If the power is interrupted before the LED flashes green, the registers will not be written correctly and the FRH operation will be unpredictable. If a power interruption does occur, restart the initialization procedure from the beginning.

WARNING

Do not attempt to operate remotely controlled equipment outside the communication range of the FRH system. Doing so could cause loss of equipment control.

WARNING

Without implementing proper flow control settings, the data rate between the FRH modem and its terminal (wired link) can exceed the wireless link data rate and cause the modem buffer to overflow. This can result in malfunction of the systems being controlled and/or data corruption. Ensure that you are using appropriate flow control settings for your application.

System Identification

For future reference, please take a moment to fill in the information below. This information will help us respond as quickly as possible should your FRH system ever need repair or replacement.

Model Name and Number: FRH-SD03TU

Serial Number: _____

ID Code: _____

Date of Purchase: _____

Distributor Name: _____

Distributor Address: _____

Distributor Phone Number: _____

Limited Warranty

FUTABA WARRANTS ONLY THAT THE INDUSTRIAL RADIO CONTROL SYSTEM GOODS OR PRODUCTS FURNISHED HEREWITH SHALL BE FREE FROM DEFECTS IN MATERIAL AND WORKMANSHIP UNDER NORMAL CONDITIONS OF USE AND SERVICE FOR A PERIOD OF ONE (1) YEAR FROM THE DATE OF SALE TO THE PURCHASER WHO IS THE FIRST BUYER OF THE GOODS FOR USE OR CONSUMPTION AND NOT FOR RESALE OTHER THAN AS A COMPONENT OF ANOTHER PRODUCT MANUFACTURED FOR SALE BY SUCH PURCHASER ("CONSUMER"). FUTABA'S LIABILITY, WHETHER BASED ON BREACH OF WARRANTY OR NEGLIGENCE, SHALL BE LIMITED, AT FUTABA'S ELECTION, TO REPLACEMENT OR REPAIR OF ANY SUCH NONCONFORMING GOODS, F.O.B. FUTABA'S U.S.A. PLANT, OR, AT FUTABA'S ELECTION, CREDIT FOR THE NET PURCHASE PRICE OF SUCH GOODS. ALL CLAIMS HEREUNDER MUST BE MADE IN WRITING DURING THE WARRANTY PERIOD, AND FUTABA SHALL HAVE THE RIGHT PRIOR TO ANY RETURN OF GOODS TO INSPECT ANY GOODS CLAIMED TO BE NONCONFORMING, AND IN ANY EVENT RESERVES THE RIGHT TO REJECT CLAIMS NOT COVERED BY WARRANTY. THIS LIMITED WARRANTY CONSTITUTES FUTABA'S SOLE WARRANTY. **FUTABA MAKES NO OTHER WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, AND EXPRESSLY DISCLAIMS ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.** FUTABA'S WARRANTY SHALL NOT APPLY IF, AMONG OTHER LIMITATIONS CONTAINED HEREIN OR FURNISHED WITH THE PRODUCT, BUYER, OR CONSUMER, OR ANY USER OF THE PRODUCT (A) ALTERS SUCH PRODUCT, OR (B) REPLACES ANY PART OF SUCH PRODUCT WITH ANY PART OR PARTS NOT FURNISHED BY FUTABA FOR THAT PURPOSE, OR IF, AMONG SUCH OTHER LIMITATIONS, PRODUCT FAILS TO OPERATE PROPERLY OR IS DAMAGED DUE TO ATTACHMENTS OR COMPONENTS THAT ARE NOT FURNISHED BY FUTABA FOR USE WITH OR REPAIR OF THE PRODUCT UNLESS SUCH USE IS AUTHORIZED IN WRITING IN ADVANCE BY FUTABA.

THIS LIMITED WARRANTY EXTENDS ONLY TO THE CONSUMER AND IS NOT ASSIGNABLE OR TRANSFERABLE. This limited warranty shall not apply to fuses, lamps, batteries, or other items that are expendable by nature, unless otherwise expressly provided.

This limited warranty does not cover any defect or damage to any of the goods caused by or attributable to force, accident, misuse, abuse, faulty installation, improper maintenance, improper electrical current, failure to install or operate in accordance with Futaba's written instructions, repair or alteration by unauthorized persons, or leaking batteries. **THE GOODS ARE SENSITIVE ELECTRONIC DEVICES REQUIRING SPECIAL HANDLING, AND THIS LIMITED WARRANTY DOES NOT APPLY TO PRODUCTS NOT HANDLED IN ACCORDANCE WITH INSTRUCTIONS SET FORTH IN THE MANUAL.**

THIS LIMITED WARRANTY DOES NOT COVER INDUSTRIAL RADIO CONTROL PRODUCTS PURCHASED OR USED OUTSIDE OF THE UNITED STATES WITHOUT FUTABA'S PRIOR APPROVAL.

Returns

Futaba's authorization must be obtained prior to return of any item for warranty or other repair or replacement or credit and will reflect Futaba's warranty service procedure. Consumer's warranty rights are governed by the terms of Futaba's Limited Warranty, as above described. Products returned for warranty repair or replacement or credit must be carefully and securely packed for return, preferably in the original carton or equivalent. The Consumer must also include in the carton a legible copy of the bill of sale or invoice which shows the date of sale and the original Buyer's and Consumer's names, and also a letter which gives the Consumer's return address and contact telephone number, the model and serial numbers of the product(s) returned, and a brief explanation of the problem or claimed defect. Any returned products that are replaced by Futaba shall become the property of Futaba. If after inspection Futaba determines the defect is not covered by its limited warranty, Futaba will notify Consumer of its determination and will not undertake any repairs or product replacement until Consumer agrees to pay for all necessary parts and materials, labor (to be charged at Futaba's standard repair rate then in effect), and other expenses including all shipping charges and insurance. Futaba reserves the right to retain possession of any product returned by Consumer because of defects not covered by Futaba's warranty until Futaba receives Consumer's agreement as above noted or, if Consumer wants the product returned without repair or replacement, Consumer reimburses Futaba for all shipping and handling charges incurred by Futaba. Issuance of credit for returned items shall be made at Futaba's unfettered discretion. Consumer will not be entitled to return defective goods for cash refunds. Consumer must inspect goods immediately and no rejection or revocation of acceptance shall be permitted more than ten (10) days after delivery to, or first use by, Consumer of the goods, whichever occurs first.

Patents – Copyrights – Trademarks – Proprietary Rights

If this product was manufactured according to designs or processes specified by Consumer, Consumer shall indemnify and save Futaba, its affiliates, officers, agents, and employees, harmless from any expense, loss, attorneys' fees, costs, damages, or liability which may be incurred as a result of actual or alleged infringement of patent, copyright, or trademark rights. Furnishing of these products does not convey a license, implied or otherwise, under any patent, copyright, or trademark right in which Futaba has an interest, nor does it convey rights to trade secrets or any other proprietary information of Futaba.

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IN NO EVENT SHALL FUTABA BE LIABLE TO CONSUMER, OR ANY OTHER PERSON FOR ANY INCIDENTAL, CONSEQUENTIAL, OR SPECIAL DAMAGES RESULTING FROM THE USE OF OR INABILITY TO USE THIS PRODUCT, WHETHER ARISING FROM BREACH OF WARRANTY OR NEGLIGENCE OF FUTABA, OR OTHERWISE. Any action hereunder must be commenced within one (1) year of accrual of cause of action or be barred and forever waived. No modification or alteration of Futaba's Limited Warranty or any other provision of this paragraph or the above paragraphs shall result from Futaba's acknowledgment of any purchase order, shipment of goods, or other affirmative action by Futaba toward performance following receipt of any purchase order, shipping order, or other form containing provisions, terms, or conditions in addition to or in conflict or inconsistent with any such provisions.

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SECTION

1

INTRODUCTION

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1.1 Special Features

The following list highlights some of the special features of the FRH-SD03TU. For more complete system specifications please refer to *Appendix A – Technical Specifications*.

- Approved under FCC Part 15 rules – no special user license required
- Operating ranges greater than 1000 feet, line-of-sight
- Transmission rates up to 38.4 kbps
- 2.4 GHz Direct Sequence Spread Spectrum (DSSS) communication system provides unsurpassed immunity to interference and RF noise
- Diversity receiving system is practically invulnerable to multipath fading
- Fast switching Time-Division-Duplex (TDD) provides virtual full-duplex communication between terminals
- 24 user selectable frequencies allow up to 24 independent systems to operate simultaneously in the same area
- Single fixed frequency communication or multi-access communication (automatic selection of an idle frequency from a defined group of frequencies) allows the user to select the best frequency use for the application
- Supports 1:1, 1:n, and n:m configurations
- Configurable as a repeater for extended range applications
- Data transparency modes allow simple connection and support for a wide range of equipment without the need for applications being aware of the modem
- RS-232C interface allows direct connection to a PC serial port or any other device with RS-232C compatibility
- Small size allows easy integration with many systems (5.70" x 3.70" x 1.06" / 145 x 94 x 27 mm)
- Supports a wide input power supply voltage range through the direct DC voltage connector (5 to 31 VDC) and includes an AC power adapter with separate connector

1.2 How To Obtain Help

Please contact your local sales representative or Futaba Corporation of America at the address shown below for help with the following:

- Application information regarding the FRH-SD03TU or other Futaba products

- Technical assistance or training
- Safety questions and issues
- Additional manuals or other documentation
- Repair or service for your Futaba products
- Comments regarding the product or this manual

Futaba Corporation of America
 Industrial Radio Control Department
 1605 Penny Lane
 Schaumburg, IL 60173

Voice: (847) 884-1444, FAX: (847) 884-1635
 Internet: www.futaba.com

When requesting repairs please provide as much detail as possible regarding the failure and its cause or symptoms. Doing so will help our service department find the problem quickly, resulting in a shorter repair time.

▲ CAUTION

The FRH system contains no user serviceable parts. If the unit requires service, contact your sales representative or Futaba Corporation of America for repair service. Contact information can be found in this manual under the section titled *How To Obtain Help*. Do not disassemble or attempt to repair the FRH yourself. Doing so could void your warranty and may void the user's authority to operate the device.

1.3 Standard Parts List

A list of parts that are included in your system is shown below. Please check the contents of your shipment with this list. If you believe that you are missing any of these parts, or other options that you may have ordered, please contact Futaba Corporation of America or the distributor from whom you purchased the system.

Part Description	Part Number	Quantity
FRH-SD03TU Wireless Modem	FRHSD03T02	1
AC Adapter	9M20A00501	1
Modem Mounting Brackets	1M32A02001	2
Rubber Pads	1M38A01001	4
Instruction Manual		1

1.4 Additional Parts

In addition to the basic system, you should have ordered an antenna and any other necessary options from the following list:

<u>Description</u>	<u>Part Number</u>
Pedestal Antenna Set (1m cable and bracket)	01300050
Pencil Antenna Set (90 degree or straight)	01300069
Flat Diversity Antenna Set (1m cables)	01300078
Flat Antenna Set (1m cable)	01300087
Antenna Extension Cable (1m)	1M38A01201
Antenna Extension Cable (2m)	1M38A01301
SMA Conversion Adapter (F-F)	1M10A01101
SMA Conversion Adapter (M-M)	1M10A01201
DC Power Cable	9M04A00701
Remote Reset/Monitor Cable	9M04A00801

Contact Futaba Corporation of America or the distributor from whom you purchased this system for information on obtaining spare parts or accessories.

1.5 Physical Description

Please review the following section and take a moment to familiarize yourself with the FRH wireless modem.

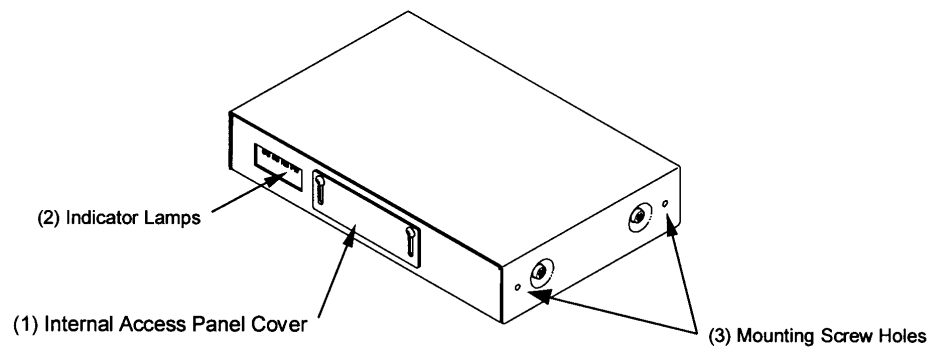


Figure 1-1: FRH Indicator Side View

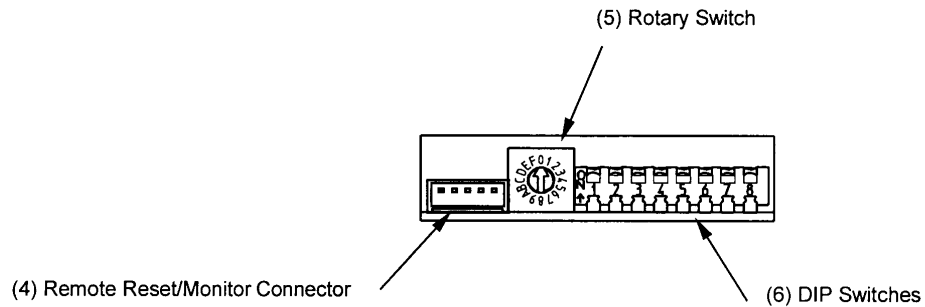


Figure 1-2: Switch and Connector Access View

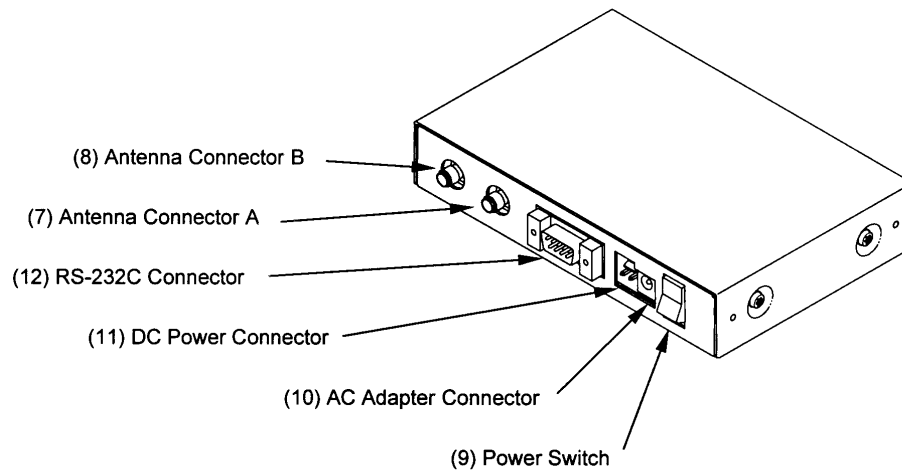


Figure 1-3: FRH Connector Side View

The following numbered list describes the corresponding features indicated in Figures 1-1 through 1-3.

- (1) Internal Access Panel Cover
Covers and protects the connector for remote reset/monitor functions, and the switches used for setting the operation mode and selecting the frequency group

- (2) Indicator Lamps
Four LEDs indicate the states of the following (with green, red, or flashing lights):
CO – connection, SD – send, RD – receive, and PW – power. For more information, refer to *Appendix A – Indicator Lamps*.
- (3) Mounting Screw Holes
Used for mounting the FRH using the supplied brackets or directly to a surface.
- (4) Remote Reset/Monitor Connector
Used with a mating connector and wiring to remotely assert a hardware-reset, or to remotely display the PW and CO indicator lamps.
- (5) Rotary Switch
Used to set the operating frequency group when the modem is in *Mode 1*. Use positions 0 to 7 only (positions 8 through F are invalid).
- (6) DIP Switches
Used to set the RS-232C communication parameters and the basic FRH communication mode.
- (7) Antenna Connector A
Primary antenna connector for transmit and receive functions. This connector must always be used (Antenna Connector B is never used alone).
- (8) Antenna Connector B
Secondary antenna connector for attaching a second antenna when the diversity receive function is enabled.
- (9) Power Switch
Controls the FRH main power state.
- (10) AC Power Adapter Connector
Used to connect to the supplied AC power adapter.
- (11) DC Power Connector
Used to directly connect DC power from any appropriate DC voltage source.
- (12) RS-232C Connector
DB-9 male connector for connecting to an RS-232C compatible serial device.

SECTION

2

SYSTEM INSTALLATION

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2.1 FRH Wireless Modem Installation

The FRH modem was designed to be mounted in one of three ways: placed a flat, horizontal surface; mounted to a surface using the mounting brackets and mounting holes on the sides of the modem case; or directly mounted to a surface using just the holes in the side(s) of the modem case. Please refer to the appropriate diagrams and instructions below for details about each mounting method.

2.1.1 Installation of Rubber Pads for Horizontal Placement

When the FRH wireless modem will be placed on a horizontal surface, apply the self adhesive rubber pads with the hole centered on each projection on the bottom of the case to help prevent the modem from sliding easily on the surface and to protect the surface from scratches.

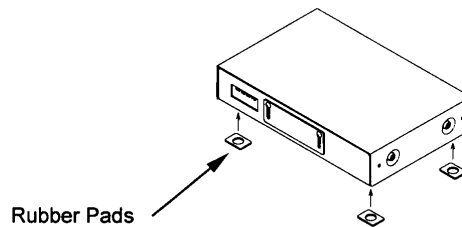


Figure 2-1: Rubber Pad Placement

2.1.2 Mounting the FRH With Brackets

The FRH modem can be securely mounted on a flat surface using the mounting brackets provided. Attach the brackets to the modem as shown in the diagram below.

CAUTION

When mounting the FRH modem, use M3 (ISO) screws that project no more than 3 to 7 mm into the modem. Screws that project further into the modem may permanently damage the internal components and/or cause the FRH modem to malfunction.

Using the modem with the brackets attached as a template, mark the position of the four mounting holes on the desired mounting surface. Drill or prepare the holes as necessary for the hardware you will use (wood screws, bolts, sheet metal screws, etc.) and mount the modem securely to the surface.

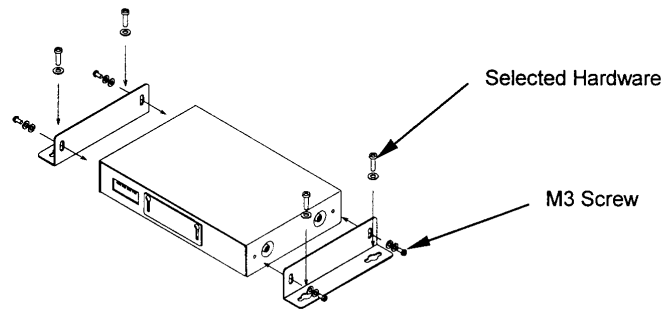


Figure 2-2: Mounting the FRH with Brackets

2.1.3 Mounting the FRH Without Brackets

The FRH modem can be directly mounted without the brackets as shown below (the modem can be oriented horizontally or vertically). Measure and mark the location of the two mounting holes. Drill clearance holes for M3 screws and mount the modem securely.



When mounting the FRH modem, use M3 (ISO) screws that project no more than 3 to 7 mm into the modem. Screws that project further into the modem may permanently damage the internal components and/or cause the FRH modem to malfunction.

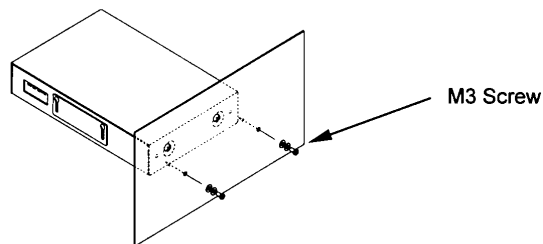


Figure 2-3: Mounting the FRH without Brackets

2.2 RS-232C Cable Connection

Securely connect an appropriate serial cable to the serial connector of the communication equipment (PC, PLC, etc.) and to the RS-232C connector on the FRH modem.



Be certain that the installer of this equipment reads and understands the instruction manual of *the equipment that you are connecting to* before attempting this installation.



Be sure to wire the power and serial connections correctly. Incorrect wiring can damage the system, cause it to malfunction and/or create a shock and fire hazard.



Some equipment applies voltage between Signal Ground and Frame Ground. If this is the case with your equipment, DO NOT connect the FRH Frame Ground to your equipment. Doing so could allow current surges to damage the FRH modem. (A standard RS-232C cable cannot be used with this type of equipment.)



Ensure that the FRH modem power and the power to the equipment to be controlled is turned off before connecting or disconnecting the cable between them. This will help prevent accidental damage to the system and unexpected operation and/or injury.

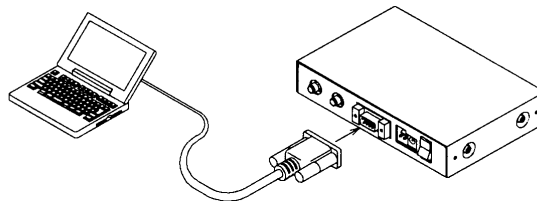


Figure 2-4: Serial Cable Connection

2.3 Antenna Connection

Several antenna options are available from Futaba for the FRH system. At least one antenna must be connected to Antenna Connector A on each FRH modem in use. In areas where multipath fading interferes with reliable communications, a second antenna can be connected to Antenna Connector B and the diversity receive function enabled to improve reception.



Be sure to keep all systems and antennas clear of power lines. Permanent equipment damage and severe shock injury or death can occur if the system contacts power lines.

Directional antennas may also be used to increase the range of the FRH system.

NOTE

Please contact Futaba before attempting to install any third party antenna equipment.

NOTE

Please contact Futaba for information about antenna separation when using the FRH-SD03TU and other wireless products in the same area.

2.3.1 Single Antenna Setup

Always use Antenna Connector A when attaching a single antenna. Antenna Connector B cannot be used to transmit and is only used to attach a second receive antenna when the antenna diversity function is enabled.

CAUTION

The recommended antenna connector tightening torque is between 8 and 11.5 kg-cm. Exceeding the recommended torque may damage the FRH modem and/or antenna connector. A connector that is insufficiently tightened may become disconnected during operation and cause a severe reduction in operating range.

Refer to the figures below for details about the actual mounting and connecting methods.

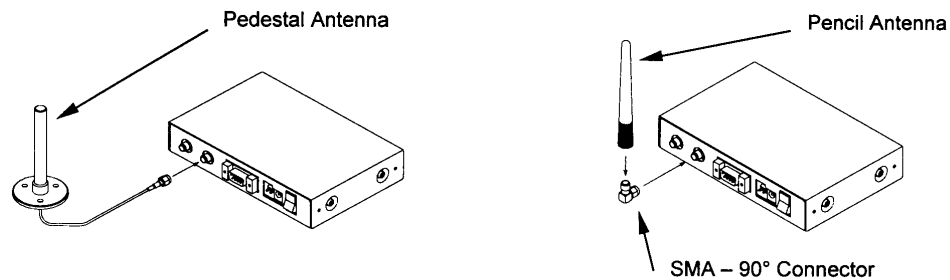


Figure 2-5: Connecting the Pedestal and Pencil Antennas

2.3.2 Diversity Antenna Setup

In certain situations, reception can be improved by using the built-in antenna diversity capability. This is accomplished by using two separate antennas (or one flat diversity antenna) and enabling the diversity function in REG19. (See the section titled *Memory Register Description*.) Diversity reception cannot be used when the FRH modem is set to Mode 1. (See the section titled *Operation Modes*.)

CAUTION

When using two pedestal antennas with a single FRH for diversity reception, mount the antennas as far apart as possible (30 cm

minimum). If the antennas are too close, the diversity advantage will not be achieved.

CAUTION

Do not use two pencil antennas connected directly to the modem antenna connectors for diversity reception. Doing so will not allow the diversity advantage to be achieved. If two pencil antennas will be used, remotely mount at least one antenna using an antenna extension cable to facilitate sufficient separation between the two antennas.

NOTE

The diversity reception function is not available in Mode 1. (See the section titled *Operation Modes* for more details)

Refer to the figures below for details about the actual mounting and connecting methods.

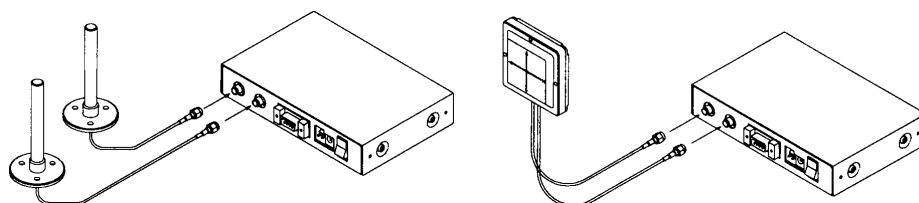


Figure 2-6: Connecting Two Pedestal Diversity and Flat Diversity Antennas

2.3.3 Pedestal and Flat Antenna Mounting

The figures below show typical methods for mounting the pedestal and flat antennas.

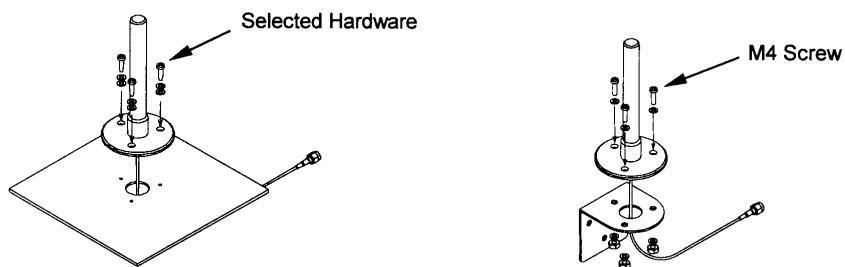


Figure 2-7: Pedestal Antenna Mounting Examples

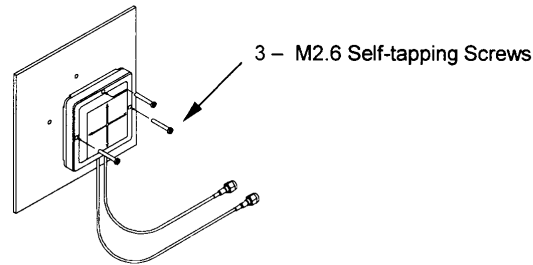


Figure 2-8: Mounting the Flat Diversity Antenna

2.4 Power Connection

The FRH-SD03TU can be powered using the supplied AC adapter or by directly supplying DC voltage through the alternate power connector.



DO NOT use the DC power cable and the AC adapter at the same time. Doing so may permanently damage the FRH modem and/or cause the modem to malfunction.



Be sure to wire the power and serial connections correctly. Incorrect wiring can damage the system, cause it to malfunction and/or create a shock and fire hazard.

2.4.1 AC Adapter Connection

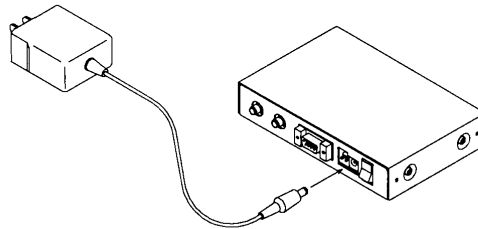


Figure 2-9: AC Power Adapter Connection



Use only the AC adapter supplied with the FRH system. Use of any other adapter may permanently damage the FRH modem and/or cause the modem to malfunction and create a shock or fire hazard.



Be certain that all AC power outlets for use with the power adapters have been properly installed, grounded, and fused. An electrical shock hazard may exist if this unit is powered by a faulty power outlet or source. If you discover such a situation, immediately discontinue use until the power source and outlet have been properly installed, grounded, and fused by an electrician or other authorized person.



Exercise care when using the AC adapter. Do not plug or unplug the AC adapter with wet hands or while standing in water. Do not touch or let any object come into contact with the adapter prongs at any time while they are in contact with the AC outlet.



DO NOT use the DC power cable and the AC adapter at the same time. Doing so may permanently damage the FRH modem and/or cause the modem to malfunction.

2.4.2 Direct DC Power Connection

The figure below shows the connection of the optional DC Power Connector/Cable.

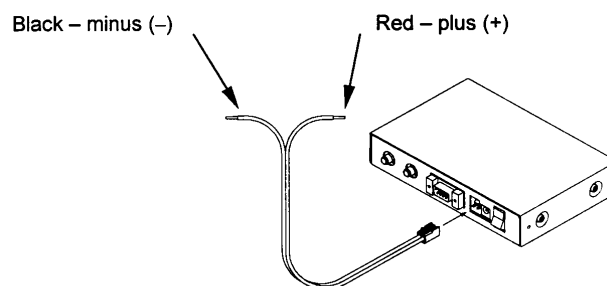


Figure 2-10: Direct DC Power Connection



Be sure that the FRH modem's power switch, the power to any equipment connected to the FRH, and the DC power source are all turned off before wiring and connecting the DC Power Connector/Cable.



Be sure that the supplied power is within the specified range (5 to 31 VDC). Voltages outside the specified range may damage the FRH modem.



Be sure that the power source supplies sufficient current capacity. Insufficient current may cause the unit to malfunction.



DO NOT use the DC power cable and the AC adapter at the same time. Doing so may permanently damage the FRH modem and/or cause the modem to malfunction.

2.5 Other Installation Precautions

2.5.1 Modem Installation Precautions



Securely attach the power cable, antenna cable, and serial connector to the FRH modem and equipment/power source to which it is connected. Use the attachment screws on the serial connector, tighten the antenna connector to the recommended torque and secure the power cable as necessary to ensure that they cannot be inadvertently disconnected by any means. Failure to do so could cause an unexpected system failure.



The FRH modem is a precision electronic device. Its rugged design is intended for industrial applications. However, do not install it where it will encounter excessive vibrations. In some cases, isolation mounts may be used to isolate the FRH modem from the equipment vibration. Excessive vibration could permanently damage the FRH modem and/or cause it to malfunction.



If the FRH system has been stored at a temperature beyond the specified operating temperature range for the system, it may not function properly. Allow it to return to normal temperatures before use. Refer to *Appendix A – Technical Specifications* for the actual operating temperature range.



Do not operate the FRH system in environments where it will be subjected to excessive moisture (such as rain or water spray), dust, oil or other foreign matter (such as metal particles). Doing so may permanently damage the FRH modem and/or cause it to malfunction. If it does become wet or contaminated, correct the situation, verify proper operation and have any problems corrected before using it to control other equipment. If necessary, the modem can be mounted inside a protective or waterproof enclosure. If the enclosure is

metallic, the antenna must be mounted externally or the effective operating range will be severely limited.



The FRH-SD03TU is designed for indoor use. When using it outdoors, the modem should be mounted in a waterproof enclosure and the ambient temperature range should be checked to insure that it is within the modem's specifications. Always use the FRH modem within its specified environmental ranges.

2.5.2 Antenna Installation Precautions



Before each use, verify that the antenna (and antenna cable, if used) is securely attached and in good condition. A loose antenna or cable may severely reduce the operating range of the system.



Avoid mounting the antenna near large metallic objects or inside metal enclosures. Such objects can severely reduce the operating range of the system.

NOTE

When installing the FRH in a mobile unit such as an Automatic Guided Vehicle (AGV), Futaba recommends using the diversity reception feature as a remedy for to multipath fading problems. For diversity reception, install the two antennas as far apart as possible in order to gain maximum benefit (30 mm minimum).



The pedestal antenna is designed for indoor use. When using it outdoors, enclose it in a non-metallic, waterproof case or take other steps to protect it from humidity and other corrosive environments.



Though the outside of the pedestal antenna is made of silicone rubber, the inside is metallic. The metallic components can be bent or broken if enough force is applied. Mount the antenna in a location where it will be least likely to be damaged by contact with other objects or equipment.



The FRH-SD03TU operates at frequencies in the 2.4 GHz band. These frequencies are more directional than lower frequencies and are easily reflected. If there are metal structures nearby, the effective range may be shortened or the directional properties may be further narrowed. To help avoid this, mount the antenna as far away as possible from surrounding metallic structures.

▲CAUTION

Multipath problems occur easily at 2.4 GHz frequencies. When multipath problems are present, moving the antenna as little as 10 cm may result in improved communication or, conversely, a further diminished or total loss of communication. Futaba recommends that the mounting position of the antenna be determined *after* testing and verifying optimal communication conditions. Negative multipath effects can also be overcome with antenna diversity. See the section in this manual titled *Diversity Antenna Setup* and the related register settings for more details regarding antenna diversity.

2.5.3 Multiple FRH Modems Installation Precautions**▲CAUTION**

When installing multiple FRH modem systems that will use different frequency groups in the same area, modem antennas of different frequency groups must be mounted at least 6 feet (2 meters) apart. Failure to do so may severely reduce the FRH operating range.

NOTE

Please contact Futaba for information about antenna separation when using the FRH-SD03TU and other wireless products in the same area.

APPENDIX

A

TECHNICAL SPECIFICATIONS

General

power source	5 ~ 31 VDC, or included 120 VAC UL listed adapter						
power consumption	<table> <tr> <td>≤ 1150 mA @ 5 VDC</td> <td>≤ 390 mA @ 12 VDC</td> </tr> <tr> <td>≤ 660 mA @ 7 VDC</td> <td>≤ 200 mA @ 24 VDC</td> </tr> <tr> <td>≤ 480 mA @ 10 VDC</td> <td>≤ 160 mA @ 31 VDC</td> </tr> </table>	≤ 1150 mA @ 5 VDC	≤ 390 mA @ 12 VDC	≤ 660 mA @ 7 VDC	≤ 200 mA @ 24 VDC	≤ 480 mA @ 10 VDC	≤ 160 mA @ 31 VDC
≤ 1150 mA @ 5 VDC	≤ 390 mA @ 12 VDC						
≤ 660 mA @ 7 VDC	≤ 200 mA @ 24 VDC						
≤ 480 mA @ 10 VDC	≤ 160 mA @ 31 VDC						
operating temperature	+14 °F to +122 °F (-10 °C to +50 °C)						
storage temperature	-4 °F to +140 °F (-20 °C to +60 °C)						
humidity	up to 90% RH, non-condensing						
dust resistance	JIS-D-0207-1977 F2						
vibration resistance	JIS-D-1601 Class 3 type A stage 4 (4.4 G)						
shock resistance	JIS-C-0912 (50 G)						
indicators	four bi-color LEDs (connect, send, receive, and power)						
antenna	diversity capable; multiple antenna options are available						
case	black anodized aluminum						
dimensions	5.70" x 3.70" x 1.06" (145 x 94 x 27 mm) ant. excluded						
weight	8.8 oz. (249 grams)						

Radio Characteristics

engineering standard	FCC Part 15.247 approved (no user license required)
transmission power	< 10 mW/MHz
operating distance	> 1000 feet line-of-sight †
modulation	direct sequence spread spectrum (DSSS)
modulation rate	51.9 kbps
communication mode	Time-Division-Duplex (TDD)
frequency range	2433.0 MHz – 2479.0 MHz
RF channels	24 (simultaneous, common area 24 channel usage is possible)
frequency usage	fixed frequency or grouped frequency modes
frequency control	PLL synthesizer
baseband data format	FM-FSK

Communication Control

error checking	CRC-CCITT (16 bit)
error handling	ARQ (Automatic Retransmission Request)
multi-access function	connect on clearest channel from selected frequency group
unit addressing	240 possible station addresses and multicast mode

Data Terminal Interface

data interface	EIA-232E (RS-232C serial, DCE)
physical interface	DB-9 (M) (ANSI thread)
synchronization	asynchronous
data buffers	Tx and Rx (total 3kb)
data rate	300 ~ 38400 bps
data flow control	XON/XOFF, RTS/CTS
data length	7 or 8 bit
stop bit	1 or 2
parity bit	odd, even, or none

† Operating distances are dependent on local conditions such as obstructions and electrical interference. Under ideal, line-of-sight conditions, reliable operating distances greater than specified may be achieved. Optional, directional antennas can significantly increase the operating range.

* Specifications and appearance are subject to change without prior notice.