

**FRD-1201U
12 Channel Radio Control System
Instruction Manual**



**LOR Manufacturing Company, INC.
Industrial Radio Control**

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FCC NOTICE

Note: This equipment has been tested and found to comply with the limits of a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiver's antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the distributor or an experienced radio/TV technician for help.

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.

Opening the transmitter or receiver, or attempting to repair or modify the FRD system, may be in violation of law. Changes or modifications to the FRD system not expressly approved by **LOR Manufacturing Company, Inc. ("LOR")** could void the user's authority to operate the system 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 lists 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 FRD system.

The FRD system by itself is not inherently dangerous. **HOWEVER, WHEN THE FRD 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.**

There are virtually unlimited possible applications in which the FRD system may be used. 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 FRD safely in most applications. If you have questions regarding the safety of your specific application, please contact the appropriate people for help. Your LOR sales representative, representatives of the equipment you are controlling, and the Technical Support staff at LOR are among those who can give you assistance with your safety concerns.

The following warnings are addressed in the tables that follow but warrant repetition here:

The FRD system will provide remotely those functions that are typically done at the equipment. All operators must be thoroughly trained in the normal function of that equipment before attempting to control it remotely with the FRD system.

To help ensure safe operation of the equipment, the FRD 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 from the FRD transmitter. 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.

General Precautions

In many applications, the FRD system will enhance safety by allowing the operator to control the equipment from a safer distance or location than would normally be the case. However, this flexibility may also allow the operator to enter areas that are unsafe or to travel beyond the area where the operator can see the equipment well enough to control it properly. This flexibility may also allow the operator to be in a safe position, but one that may distort his perception of normal operation, causing unsafe operation of the equipment being controlled. Be sure that the safe operating area is well defined and tested. Be sure that all users know implemented safety procedures and conform to them.

Four symbols are used in the margin of the following section and throughout the manual to indicate the type 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.

NOTE

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

The safety information below is listed under four categories: operator specific, system specific, transmitter specific, and receiver specific.

Operator



Only authorized and properly trained personnel should be permitted to operate this system and any equipment being controlled with this system. Operators should be able to read and understand the instructions, signs, and dangers associated with its operation.



This system and any equipment being controlled by this system should not be operated by any person with uncorrected vision, hearing deficiencies, or other conditions that may impair the ability to operate the equipment safely.

⚠ WARNING

Do not allow the separation between the operator and the remotely controlled equipment to become so great that the operator cannot monitor completely the operation of the remotely controlled device.

⚠ WARNING

Be sure that the area in which the equipment being controlled is clear of people and obstructions that may interfere with safe operation.

⚠ WARNING

If you have any questions about the FRD system or experience any equipment malfunctions, please contact your equipment manufacturer or LOR immediately. Contact information can be found in the section in this manual titled “How to Get Help”.

⚠ CAUTION

Always keep this manual at a location readily accessible to anyone operating the radio 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 Get Help” for the contact that can supply you with replacement or additional manuals.

System

⚠ DANGER

The FRD 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, without sufficient fail-safe measures that force the equipment being controlled to default to its safest state.

⚠ DANGER

Because any radio signal may be interrupted temporarily by undesired electromagnetic signals or noise, or may cease to function because of battery or other power failure, 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 or critical process (refer to the beginning of the safety section for further explanation).

⚠ WARNING

Be sure to keep all systems and antennas clear of power lines. Severe shock injury or death can occur if the system contacts power lines while being held.

⚠WARNING

Improper installation and/ or operation of the FRD system can cause serious or fatal injuries to the operator or nearby persons and cause damage to the FRD 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.

⚠WARNING

If the transmitter or receiver has been stored in a very hot or cold location 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 the appendix that lists the system specifications for the specific operating temperature range.

⚠WARNING

Do not operate the FRD system in environments where it will be subject to excessive moisture such as rain or water spray since doing so may cause it to malfunction. If it does become wet or contaminated, verify proper operation and have any problems corrected before using it to control other equipment.

⚠WARNING

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

⚠WARNING

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

⚠WARNING

Never exceed the rated load or other operating limits of the remotely controlled equipment.

⚠WARNING

Be certain that all AC power outlets for use with 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.

⚠ CAUTION

If you are using multiple FRD systems, try to maintain a distance of at least six feet horizontal separation or three feet vertical separation between the unmatched system transmitter and receiver antennas. Vertical separation provides greater signal isolation between systems (refer to Figure 0.1).

⚠ CAUTION

The FRD system contains no user serviceable parts other than the transmitter batteries. In the event of problems, contact your distributor or LOR for repair service. Contact information can be found in this manual under the section titled “How To Get Help”.

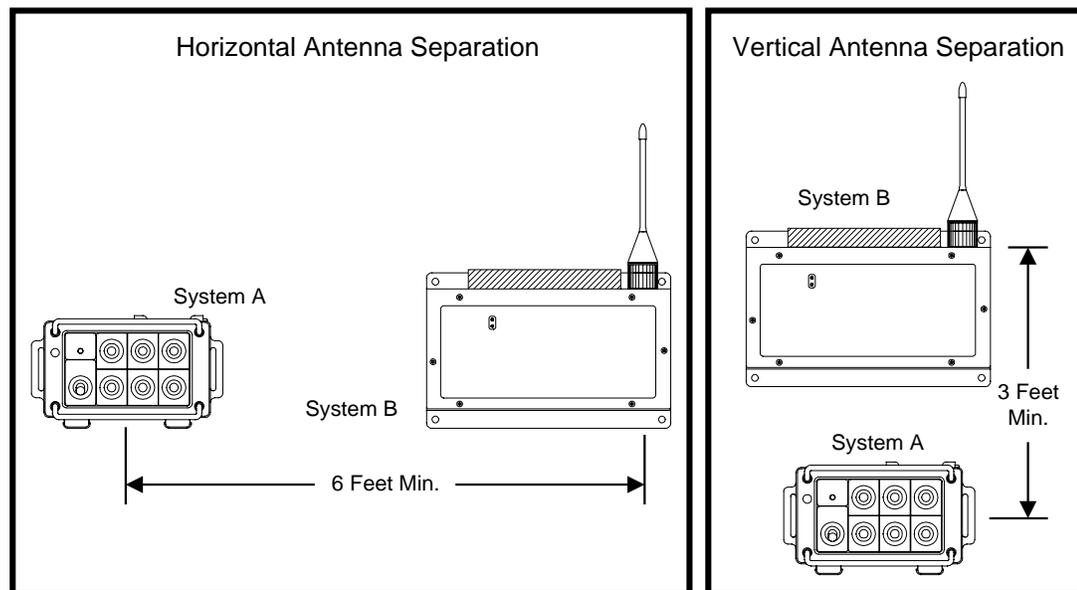


Figure 0.1 Multiple System Separation

Transmitter Handling Precautions

⚠ WARNING

Do not drop the transmitter or subject it to physical shocks. Check the case before each use for any signs of defects or damage. If there is damage, do not use the system until it can be verified to be in good working condition.

⚠ WARNING

Do not operate the remotely controlled equipment outside the range of the transmitter.

⚠WARNING

Before each use, check all switches for damage, correct spring-return, or any other unusual conditions. If such a condition exists, do not use the system until it is corrected and the system is in good working condition.

⚠WARNING

Turn the transmitter power switch to the OFF position when not in use. This will help prevent accidental or unexpected operation of the equipment and will prolong the life of the batteries.

⚠WARNING

The transmitter should be stored in a locked or secure area to prevent operation by unauthorized persons.

⚠CAUTION

Always start operation with fresh batteries. Using partially discharged batteries will reduce the operating time of the transmitter.

NOTE

You may wish to keep additional fresh batteries on hand to replace exhausted cells.

Receiver Safety**⚠WARNING**

Ensure that the power is disconnected from the receiver and the equipment to be controlled before connecting or disconnecting wires between them. This will help prevent accidental damage to the system, unexpected operation, or injury to the worker by way of electrical shock.

⚠WARNING

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.

⚠CAUTION

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

⚠CAUTION

Whenever possible, the antenna should be mounted in a position that has an unobstructed view of the area in which the transmitter will be operated.

System Identification

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

Model Number: FRD-1201U

Serial Number: _____

ID Code: _____

Date of Purchase: _____

Distributor Name: _____

Distributor Address: _____

Distributor Phone Number: _____

Limited Warranty

LOR 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”). LOR’S LIABILITY, WHETHER BASED ON BREACH OF WARRANTY OR NEGLIGENCE, SHALL BE LIMITED, AT LOR’S ELECTION, TO REPLACEMENT OR REPAIR OF ANY SUCH NONCONFORMING GOODS, F.O.B. LOR’S PLANT, OR, AT LOR’S ELECTION, CREDIT FOR THE NET PURCHASE PRICE OF SUCH GOODS. ALL CLAIMS HEREUNDER MUST BE MADE IN WRITING DURING THE WARRANTY PERIOD, AND LOR 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 LOR’S SOLE WARRANTY. **LOR MAKES NO OTHER WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, AND EXPRESSLY DISCLAIMS ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.** LOR’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 LOR 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 LOR FOR USE WITH OR REPAIR OF THE PRODUCT UNLESS SUCH USE IS AUTHORIZED IN WRITING IN ADVANCE BY LOR.

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 LOR'S PRIOR APPROVAL.**

Returns

LOR's authorization must be obtained prior to return of any item for warranty or other repair or replacement or credit and will reflect LOR's warranty service procedure. Consumer's warranty rights are governed by the terms of LOR'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 LOR shall become the property of LOR. If after inspection LOR determines the defect is not covered by its limited warranty, LOR 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 LOR's standard repair rate then in effect), and other expenses including all shipping charges and insurance. LOR reserves the right to retain possession of any product returned by Consumer because of defects not covered by LOR's warranty until LOR receives Consumer's agreement as above noted or, if Consumer wants the product returned without repair or replacement, Consumer reimburses LOR for all shipping and handling charges incurred by LOR. Issuance of credit for returned items shall be made at LOR'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 LOR, 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 LOR has an interest, nor does it convey rights to trade secrets or any other proprietary information of LOR.

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IN NO EVENT SHALL LOR 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 LOR, 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 LOR's Limited Warranty or any other provision of this paragraph or the above paragraphs shall result from LOR's acknowledgment of any purchase order, shipment of goods, or other affirmative action by LOR 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.

SECTION

1

BEFORE YOU BEGIN

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1.1 Special Features

- The FRD system uses CRC error checking and a 16 bit ID Code (65,536 unique identification codes) for exceptional security and reliability. When “non-identical” codes are selected, a transmitter cannot cause the activation of an unwanted output device.
- The FRD system can operate at distance of more than 330 feet. (Operation 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.)
- The system uses high accuracy PLL (Phase-Locked-Loop) frequency synthesizers and *Channel Watch*[™] carrier sensing technology.
- The FRD transmitter and receivers are approved under Part 15 of the FCC rules. No user license is required to operate the system.
- The FRD receiver offers “dry contacts” for the relay output.
- The transmitter contains a convenient, protected, internal antenna.
- An automatic power off feature helps prolong transmitter battery life.

1.2 How To Get Help

Please contact your local sales representative or LOR at the address shown below for help with the following:

- Application information regarding the FRD-1201U 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

LOR Manufacturing Company, Inc.
7131 West Drew Road, Weidman, MI 48893
Telephone: (866)644-8622, Fax: (888)524-6292, E-mail: info@lormfg.com

1.3 Importance Of Safety

Please take the time now, if you have not already, to read the important safety precautions found at the beginning of this manual. This system was designed with user safety as the foremost consideration and incorporates many advanced features in the hardware and firmware that make it one of the safest, most reliable wireless control systems available. However, because this system can be used to control many types of equipment, incorrect installation or operation of this system may result in property damage or serious or fatal injury to people operating, or in the vicinity of, the equipment being controlled.

1.4 General Care and Handling

- All wiring connections to the receiver should be made with both the receiver power and the connecting equipment power disconnected.
- Before turning the power on, check for safe conditions in the operating area and a normal and safe status of the equipment being operated.
- The transmitter case is dust and moisture resistant. The receiver case is dust and moisture resistant. The transmitter must not be immersed in water or exposed to rain or water spray.
- Do not drop or subject the transmitter or receiver to hard physical shocks. Doing so could cause damage to the case or internal circuitry.
- The receiver should be mounted vertically with the connectors directed downward to achieve the best moisture and dust protection. However, the antenna should be mounted upward for best reception.
- Do not store the transmitter or receiver in direct sunlight, extreme temperatures, or damp/wet areas. Remove the transmitter batteries when storing for long periods of time or at elevated temperatures.
- Opening the transmitter or receiver, or attempting to repair or modify the FRD system may be in violation of law. Changes or modifications to the FRD system not expressly approved by LOR could void the user's authority to operate the system.

1.5 Channel Watch™ Technology and Transmission Frequencies

The FRD transmitter can select from 40 frequencies between 429.25 MHz and 429.7375 MHz to transmit command data. These 40 frequency channels are divided into 4 groups of 10 frequencies each (see table 1.1 below). The transmitter is factory programmed to one of these frequency groups with a starting frequency of the lowest in that group and an ending frequency of the highest in that group. This defines a group of frequencies from which the transmitter can choose. By changing the group selection, the starting frequency, and the ending frequency, precise control of the frequency band is achieved to avoid conflicts with other RF devices operating in the area.

The Channel Watch technology is the process the FRD transmitter performs when choosing a frequency to send command data. From the defined group of frequencies, the transmitter performs a scan to determine a clear frequency in which to transmit. It then locks onto the frequency and sends command data to the receiver. The RF remains active for 4 seconds after all operation switches have been released and then goes into standby mode. The selected frequency is held for an additional 3 minutes after the transmitter goes into standby mode. By holding the selected frequency, the response-time to execute a command is reduced. If a operation switch is not activated within this 3-minute period, the selected frequency is released and a new frequency is chosen when the next operation switch is activated.

NOTE

New transmitters or receivers can be factory programmed to operate existing receivers or transmitters. The ID number from the present system is required when requesting programming changes.

Group 1	Group 2	Group 3	Group 4
429.2500	429.3750	429.5000	429.6250
429.2625	429.3875	429.5125	429.6375
429.2750	429.4000	429.5250	429.6500
429.2875	429.4125	429.5375	429.6625
429.3000	429.4250	429.5500	429.6750
429.3125	429.4375	429.5625	429.6875
429.3250	429.4500	429.5750	429.7000
429.3375	429.4625	429.5875	429.7125
429.3500	429.4750	429.6000	429.7250
429.3625	429.4875	429.6125	429.7375

Table 1.1 Frequency Designations

1.6 Standard Parts List

A list of parts that are included in your system is shown below. Please check the contents of your carton with this list. If you believe that you have ordered but not yet received parts other than those listed below, or if you are missing any of the parts that are listed below, please **contact the sales representative from whom you purchased the system.**

<u>PART DESCRIPTION</u>	<u>PART NUMBER</u>	<u>QUANTITY</u>
FRD Instruction Manual		1
FRD 12 Channel Transmitter	FRDC12T020	1
FRD 12 Channel Receiver	FRDC11R020	1
Transmitter Battery Holder	9M06A08801	1
Transmitter Belt	D70000	1
Transmitter Belt Buckle	S11098	1
Receiver Antenna Extension Cable	1M38A11901	1
Receiver Antenna	1M38A07301	1
Receiver Antenna Mounting Bracket	1M38A06801	1

1.7 Tools/ Parts Required For Installation

No. 2 Phillips (+) Screwdriver	(For RX terminal block)
4 Screws or Bolts	(For RX mounting)
4 "AA" Alkaline Batteries	(For TX operation)

SECTION

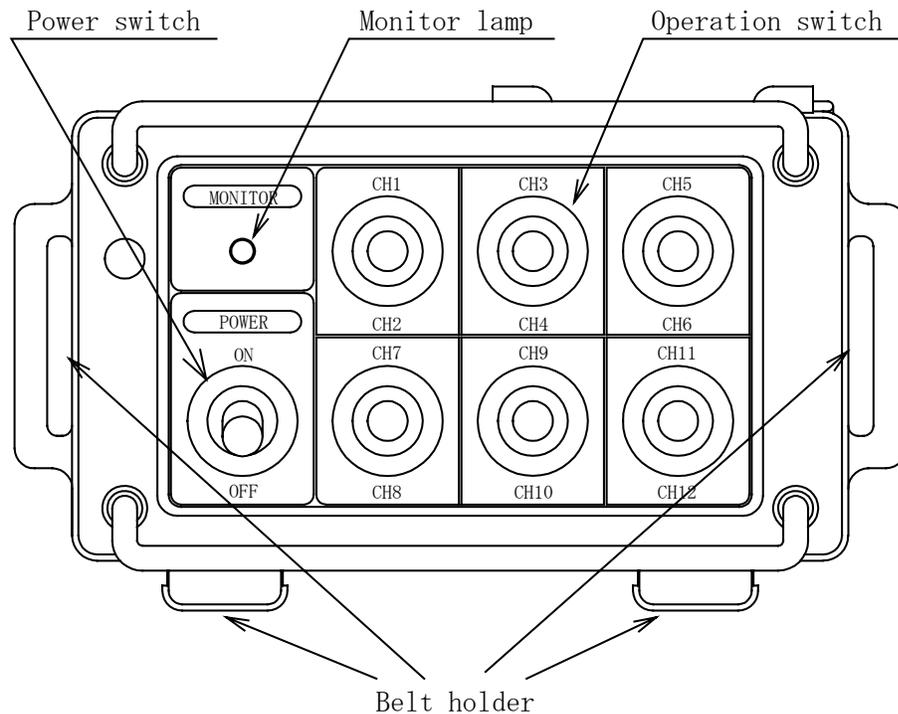
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System Installation

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2.1 Transmitter Installation



The transmitter is designed to be hand held during operation. No installation is required for the transmitter other than inserting the batteries. If a belt is used, you will be able to use both hands freely.

CAUTION

Be sure that someone possessing the necessary electrical skills and competence handles the installation and interface of the FRD system and the equipment that will be controlled.

2.2 Transmitter Battery Installation and Replacement

When changing batteries, always use four new batteries of the same type. Nickel Cadmium batteries are not recommended because of their lower voltage. If used, Nickel Cadmium batteries will reduce operating time to approximately 25% of alkaline batteries. When charging Nickel Cadmium batteries, follow the battery manufacturer's charging instructions.

⚠ WARNING

Do not attempt to charge alkaline or other dry cell batteries. Damage or leakage, as well as personal injury, may result. Dispose of used batteries properly.

NOTE

Observe the battery manufacturer's operating and storage temperature limitations for the batteries.

NOTE

Remove the batteries when storing for long periods of time, or at an elevated temperature.

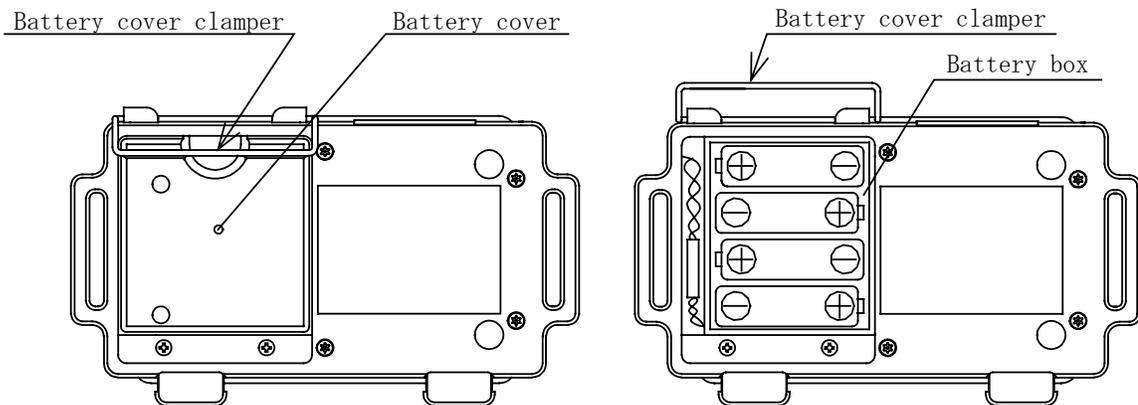


Figure 2.1 Transmitter Battery Installation

2.3 Receiver Installation

The installer of the FRD system should read this manual in its entirety. The section describing the operation of the FRD system may have information that will aid in the installation. There are four mounting holes located on the molded receiver case. Use the receiver as a template for marking the hole locations on the mounting surface. Drill appropriately sized holes and use screws or bolts to secure the receiver to the surface.

⚠ CAUTION

Be sure that someone possessing the necessary electrical skills and competence handles the installation and interface of the FRD system and the equipment that will be controlled.

⚠ CAUTION

If the surface upon which the receiver is mounted is subject to vibration, use vibration damping mounts to protect the receiver from the vibrational forces.

When properly mounted the receiver is dust resistant. The receiver must not be immersed in water or be subjected to excessive moisture. For installations in these wet environments, the receiver should be mounted inside a waterproof enclosure properly rated for the application. The antenna should be mounted outside the enclosure with the supplied coaxial cable and antenna bracket.

2.4 Receiver Power Connections

Verify that the receiver supply voltage is within the range of 9 ~ 31 VDC. Use a low noise power supply and verify low electrical noise on the power bus. Observe polarity of power wires when connecting to a power source.

NOTE

It is recommended to install a fuse in the power wire. Selecting a “fast-blow” fuse of 2-ampere rating will minimize the chance of blowing the internal 3-ampere fuse.

2.5 Receiver Antenna Installation

If the antenna extension cable will not be used, simply screw the antenna to the antenna connector on the bottom of the receiver.

For installations where the antenna will be remotely mounted, use the supplied antenna cable assembly and mounting bracket. Refer to the diagram below for mounting examples. After mounting the antenna bracket and receiver in their respective locations, mount the antenna to the bracket and then connect the cable between the antenna and receiver. Secure any loose antenna cable with suitable wall brackets or tie wraps.

NOTE

For best operating range, mount the antenna at a high location, such as on top of the cab for truck installations. Avoid mounting the antenna and cable close to sources of electrical noise.

When mounting the antenna directly to a surface (instead of using the supplied bracket), pick an area with the largest available metal ground plane such as the center of the cab roof on a truck. This will provide the best operating range for the system. If there is no available metal surface (ex. a truck cab using fiberglass or other nonmetallic material), a ground plane should be added (as a minimum, a metal plate one foot square, with a thickness of one millimeter or greater). With a larger ground plane, the receiver will have better sensitivity and provide a more uniform coverage area.

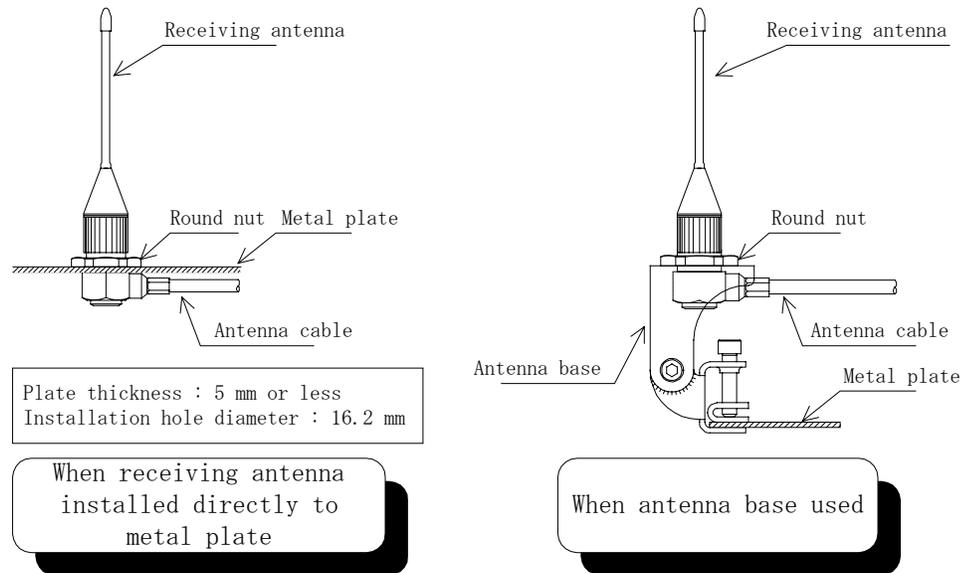


Figure 2.2 Remote Antenna Mounting Examples

⚠WARNING

Be sure to keep all antennas clear of power lines.

⚠WARNING

Before each use, verify that the antenna is securely attached and in good condition. Verify that the antenna cable, if used, is also secure and in good condition.

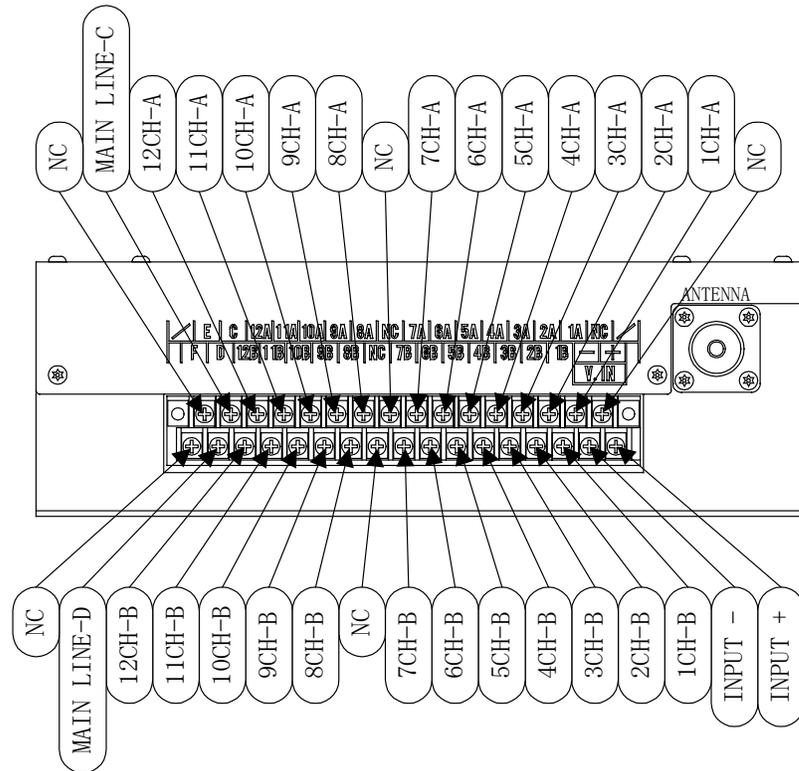
⚠CAUTION

Avoid mounting the antenna near large metallic objects or inside metal enclosures. Such objects can drastically reduce the sensitivity of the receiver.

⚠CAUTION

Whenever possible, the antenna should be mounted in a position that has an unobstructed view of the area in which the transmitter will be operated.

2.6 Receiver Connections

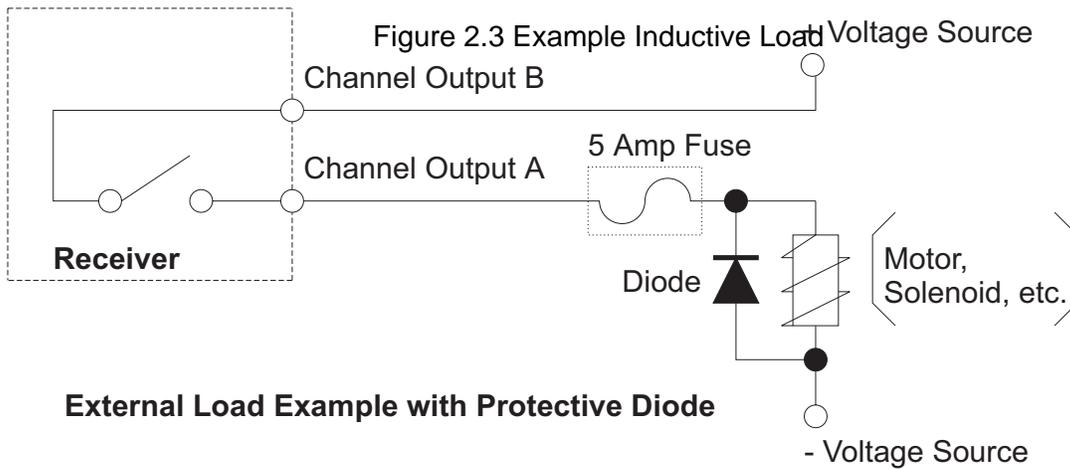


<< Figure 1 Receiver Terminals layout >>

When directly connecting a motor, solenoid, or other inductive loads, it is recommended that a protective diode be installed across the load. The diode rating should be at least ten times the rated load voltage and capable of handling the maximum DC load current.

CAUTION

Choose electrical wire with the correct capacity for the load to be controlled.



External Load Example with Protective Diode

As an example, to protect an inductive load drawing 2 amps at 24 V, the diode reverse voltage breakdown rating should be at least 240V. The 1N5404 series diode has a 3 amp average forward current, a 400V reverse voltage breakdown rating. It is axial lead type, and is readily available.

⚠WARNING

Do not exceed the voltage and current ratings for the relay outputs.

SECTION

3

SYSTEM DESCRIPTION

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The FRD-1201U 12 channel radio control systems provide economical, reliable radio frequency remote control of 12 relays. The user interface consists of six manually operated operation switches, hand held transmitter. The transmitter is small and light enough to be carried.

The receiver is powered by an external voltage ranging from 9 to 31 VDC (convenient for mobile equipment use). This voltage range allows the receiver to operate normally when an odd power source is used.

Futaba's data encoding coupled with a 16 bit identification code (over 65,000 unique address codes) and CRC error checking provide unmatched security and reliability. Microprocessors and surface mount component technology are used in both the transmitter and receiver.

The transmitter encodes and transmits the status of the six manual switches and a unique system ID code that is recognized only by a receiver using the identical ID code setting. When the receiver recognizes the unique system ID code coming from the transmitter, it receives and decodes the transmitted data. The decoded data controls the status of the relays.

3.1 Overview

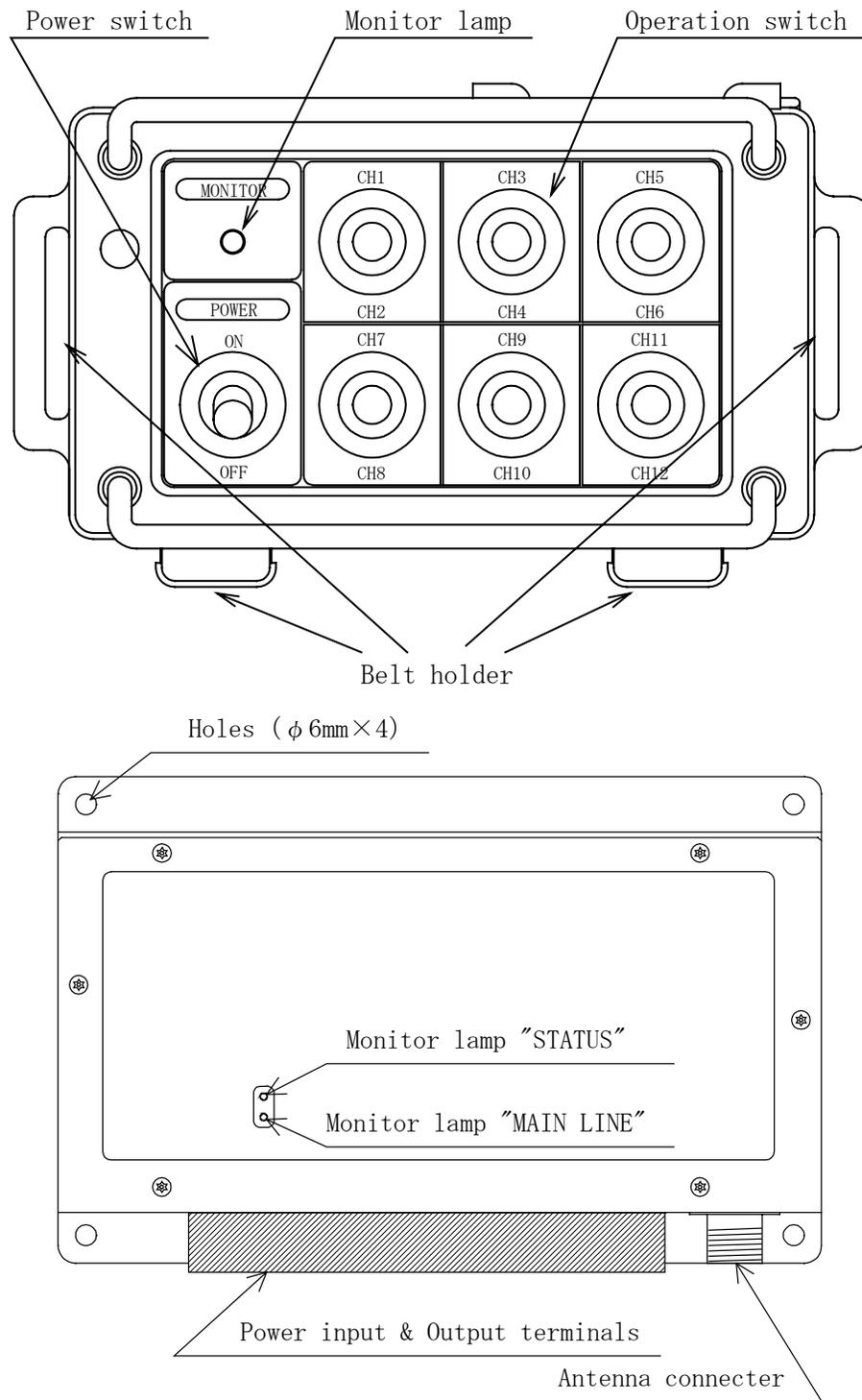


Figure 3.1 FRD-1201U System Components

3.2 Error Checking

Even when the transmitter and receiver are synchronized, a small percentage of the transmitted data may be received erroneously. In other words, the data sent by the transmitter does not exactly match the data received by the receiver. The FRD system uses a powerful error checking technique called Cyclic Redundancy Check (CRC). The transmitter appends an extra n-bit sequence to every frame. This is called the Frame Check Sequence (FCS). The FCS holds redundant information about the frame that helps the receiver detect errors in the frame. When an error is detected, the frame is ignored. The receiver then looks for the next error free frame.

3.3 Transmitter Description

The transmitter user interface consists of six switches labeled CH1, CH2, ..., and CH12. Each switch controls the corresponding receiver relay one through twelve. A status monitor LED is located just above the power switch on the face of the transmitter.

3.4 Transmitter Status LED

When the power switch is first turned on, the monitor LED should be steady green for approximately three seconds, followed by a fast blinking green at two blinks per second. When the LED changes to red the batteries are weak. With alkaline batteries, about one hour of continuous operation time remains after the LED first changes to red. If the LED stays off, the batteries are dead and must be replaced before operating the system. With good batteries installed, the monitor LED will be flashing green during idle periods and steady green when any function switch is activated.

LED Indication of Operating Modes	
Steady Green	Power Up, and Function Switch Active
Fast Blink Green (2 per second)	Standby, RF Off, Channel Selected
Slow Blink Green (1 per second)	Standby, RF Off, No Channel Selected
Red (steady or blinking, as noted above)	Batteries Weak - Replace

Table 3.1 Transmitter LED Indication Chart

3.5 Transmitter operation features

3.5.1 Auto-Standby Feature

With the transmitter power switch on, if no function switches are activated for approximately eight minutes, the power is automatically shut off to conserve battery life. The LED will change from a slow blink rate of one blink per second to off.

Once the power-off feature is activated, the power switch must be cycled to off and then back on to resume operation.

In the auto-power-off mode, some battery power is still being used by the microprocessor. The power switch should be turned off when the system is not being used.

3.5.2 Frequency Hold Time

The transmitter and receiver will not release the frequency channel immediately after the transmitter enters standby mode. Both transmitter and receiver will instead hold the frequency channel for an additional 3 minutes. The frequency hold feature allows a faster response after the transmitter has entered standby mode.

3.5.3 Auto Power-Off Feature

If a function switch is not activated for a 30-minute period, the transmitter automatically powers off to conserve battery life. The status indicator LED will be off. To resume control, cycle the power switch, and then activate the desired function switches.

3.5.4 Battery Status Indicator

The status indicator light will be green when the battery charge is OK. If the battery condition is low, then the light will be red. With alkaline batteries, about one hour of continuous operation time remains after the LED first changes to red. If the batteries are bad, the transmitter will not turn on, and the indicator light will be off. Replace the batteries.

3.6 Receiver Description

When the FRD receiver is installed properly and powered, it will constantly monitor the area for the presence of a valid signal from its matched transmitter. The data signal from the transmitter will cause the twelve receiver relays to open and close depending upon which transmitter control switch is depressed and the relay mode setting at the receiver.

3.7 Receiver STATUS / MAINLINE LED

The LEDs are located on the front of the receiver. Under normal power on conditions, the STATUS LED will be on and the MAINLINE LED will be off when the receiver is waiting for a signal from the transmitter. The STATUS LED will turn off and the MAINLINE LED will turn on when it is receiving a valid transmitter signal.

3.8 Relay Output Description

The FRD receiver provides 12 output relays. All relays are single-pole, single throw (SPST), normally open type.

APPENDIX

A

SYSTEM SPECIFICATIONS

GENERAL SPECIFICATIONS

frequency	429.2500 – 429.7375 MHz
frequency control	PLL synthesizer, 40 frequency channels, 12.5 kHz spacing
modulation	FM-FSK
baseband data format	NRZ bi-phase
communication mode	simplex
error checking	CRC technique
data channels	12 discrete, 1 main-line
security	16 bit ID code (65,536 unique codes)
operating range	> 330 ft (100 m) [†]
response time	130 ms average
operating temperature	+14 to +122 °F (–10 to +50 °C)
storage temperature	–4 to +140 °F (–20 to +60 °C)
humidity	up to 90% RH, non-condensing
shock	20 G (JIS C0912-1984 T2, see next page)
vibration	4.4 G (JIS D1601-1977 3-A-4, see next page)

TRANSMITTER SPECIFICATIONS

supply voltage	4.8 to 6.0 VDC (4 AA alkaline batteries)
maximum current consumption	60 mA (RF active), 30 mA (idle mode)
transmission power	< 10797 μ V/m at 3 m
operating temperature	+14 to +122 °F (–10 to +50 °C)
battery life	continuous operation: \approx 25 hours (alkaline batteries)
antenna	internal
case	water resistant (JIS D0203-1976 R1) and dustproof high-impact black resin
dimensions	7.01 x 4.11 x 3.19 in (178 x 105 x 81 mm)
weight	22.6 oz (640 g) excluding batteries

RECEIVER SPECIFICATIONS

design type	double-conversion super-heterodyne
receiver sensitivity	< –110 dBm
discrete channel outputs	12 electromechanical relays, plus one main-line relay, SPST normally open
relay configuration	relays provide dry contacts
relay ratings	resistive load : 5 A, 31 VDC/120 VAC maximum ($\cos \phi = 1.0$) inductive load: 2.5 A, 31 VDC/120 VAC maximum ($\cos \phi = 0.4$)
main-line relay ratings	resistive load: 2.5 A, 31 VDC/120 VAC maximum ($\cos \phi = 1.0$) inductive load: 1 A, 31 VDC/120 VAC maximum ($\cos \phi = 0.4$)
supply voltage	9 to 31 VDC
maximum current consumption	1.2 A (all relays activated), 75 mA (idle mode)
RF connector	UHF metric female

antenna	external $\frac{1}{4} \lambda$ flexible, 5.85 in (148.5 mm), UHF metric male
antenna cable	RG-58/U coaxial, 13.1 ft. (4 m), UHF metric male to UHF metric female
operating temperature	+14 to +140 °F (–10 to +60 °C)
case	dustproof (JIS D0207-1976 F2), aluminum
dimensions	5.51 x 8.66 x 2.87 in (140 x 220 x 73 mm) excluding antenna
weight	31.0 oz (880 g) excluding antenna

† 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.

Vibration Test Specifications

Testing Method

- A vibration is applied to the testing unit on 3 axis (up/ down, left/ right, back/ forth).
- Acceleration is constant.
- Vibration frequency is valid from 33 to 67 Hz.
- Testing Time:
 - Up and Down – 4 Hours
 - Left and Right – 2 Hours
 - Back and Forth – 2 Hours
- Standard acceleration is 4.4 G for TX, 6.8 G for RX.

Judgement

- No failure occurred in electrical specifications after applying vibration.
- No failure occurred in components after applying vibration.

Test Results

<u>Applied Acceleration</u>	<u>Results</u>	<u>Quantity Tested</u>
4.4 G	passed	3 units

Shock Test Specifications

Testing Method

- The shock is applied to the unit on 3 axes, applied 3 times on each axis.
- Time applied is from 0.015 to 0.019 second.
- Standard shock rating is 20 G.

Judgement

- No failure occurred in electrical specifications after applied vibration.
- No failure occurred in components after applied vibration.

Test Results

<u>Applied Acceleration</u>	<u>Results</u>	<u>Quantity Tested</u>
20 G	passed	3 units

Dimensional Drawings

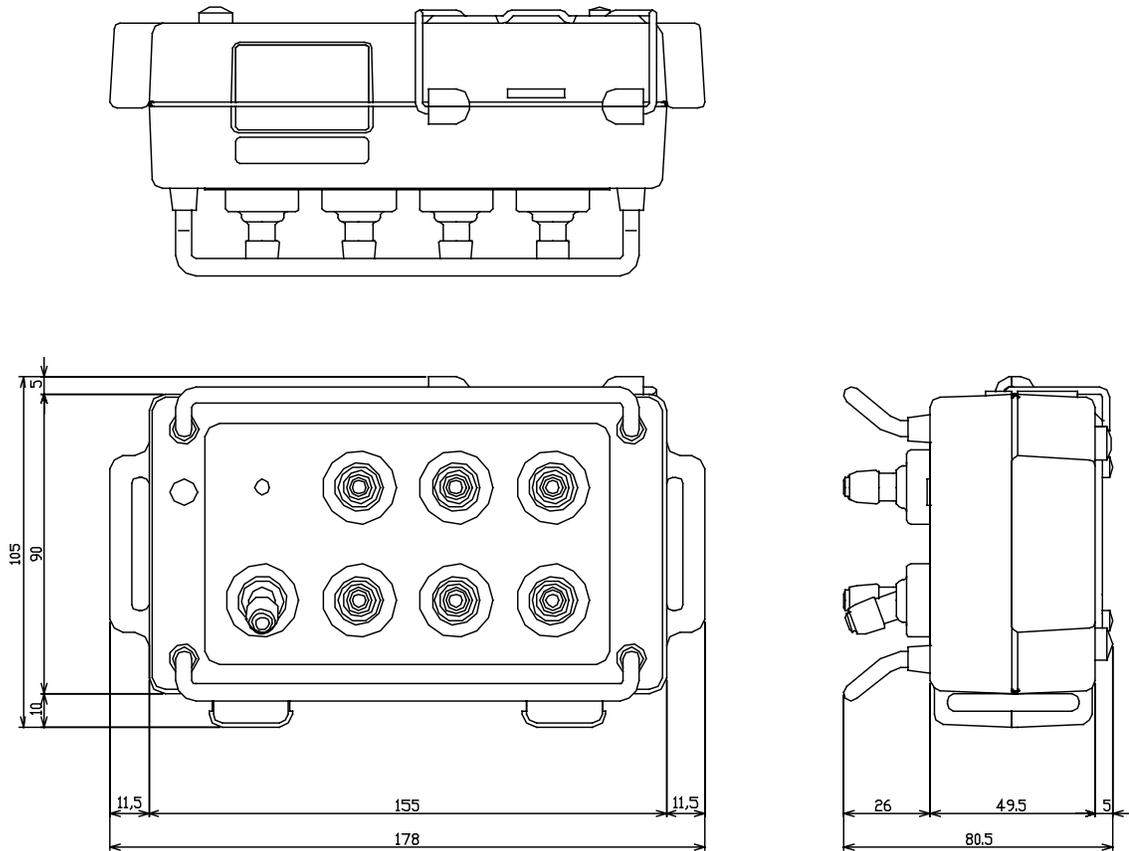


Figure A.1 FRD Transmitter, Exterior View

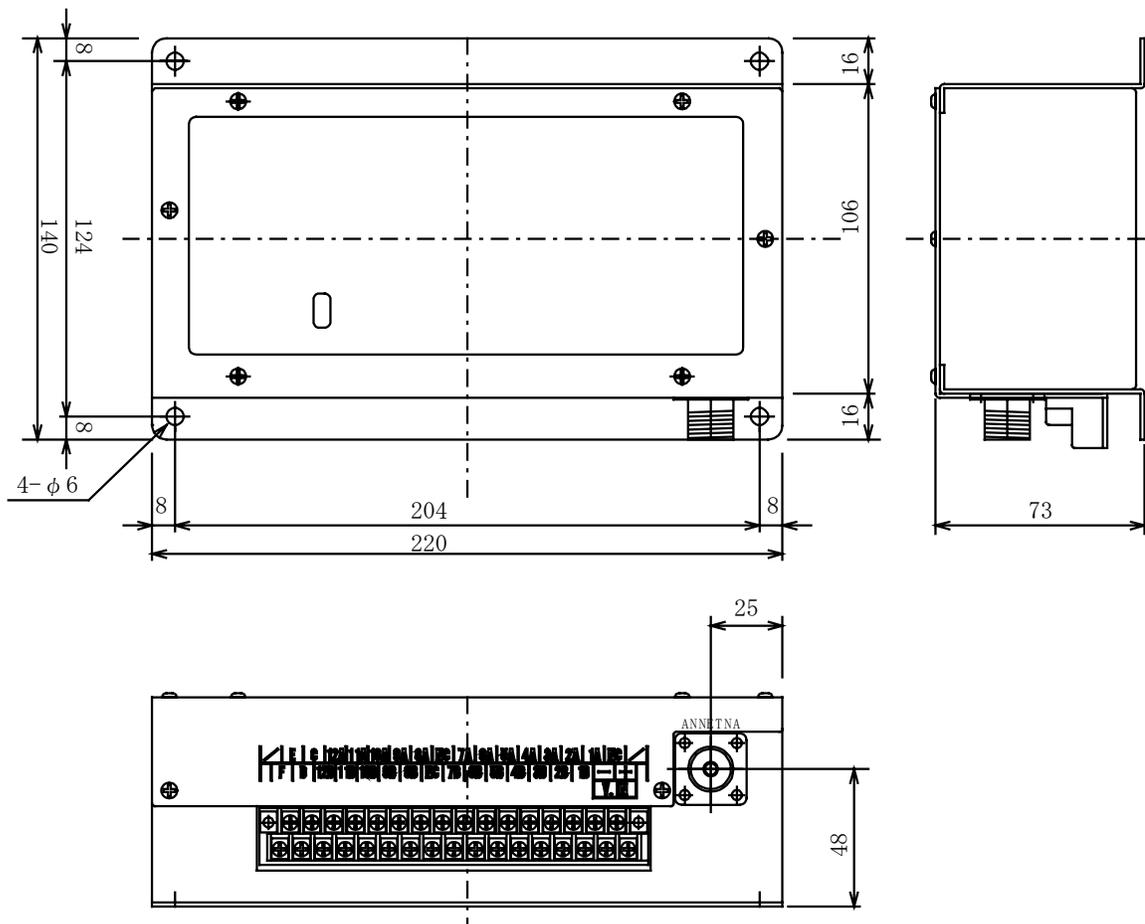


Figure A.2 FRD Receiver, Exterior View

APPENDIX

B

OPERATION AND TROUBLESHOOTING GUIDES

Operation Check

STEP	CHECK
1. Turn Receiver power on	Check to be sure the transmitter is off
2. Turn Transmitter power switch on	Make sure all function switches are off
3. Start operating the system	Observe safe operating procedures!
4. Finish system operation	
5. Turn Transmitter power switch off	Do not turn the receiver off first
6. Turn Receiver power off.	

After power has been applied to the system as outlined above, operating the function switches on the transmitter will cause the corresponding relay to activate at the receiver. The relays are momentary operation only. They will remain activated for as long as the switch is held at the transmitter.

At power-up, the receiver is scanning all available channels. When the transmitter is first turned on, the **Channel Watch™** circuitry scans for, and selects, the first available clear channel. The receiver then locks onto that channel for operation. If no function switch is activated on the transmitter for three minutes, the channel is released and the receiver returns to scan mode. The next time a function switch is activated, **Channel Watch™** repeats the search and lock process.

In the event of radio interference disrupting operations, there are two methods to solve the problem:

1. If the receiver is accessible, turn the power switch to off for a few seconds and back on, then turn the transmitter power switch off and back on. A new channel will be selected
2. If the receiver is not accessible, wait three to four minutes without activating a function switch on the transmitter. The monitor LED will change from a fast blink to a slow blink, indicating the channel has been dropped. Activating a function switch at this time will cause a new channel to be selected.

Troubleshooting Guide

Installation

SYMPTOM	CHECK	CORRECTIONS
Turn transmitter on, nothing happens	Monitor LED not on? Is the power switch on? Are the batteries OK? Batteries correctly installed? Auto-power-off feature active?	Be sure power switch is on. Check that batteries are good. Check that batteries are installed properly. Cycle the power switch off and back to on.
No receiver pilot lamp	Is receiver power wiring properly connected? Is the polarity correct? Is the proper voltage and current being supplied to the receiver? Is the receiver power fuse good?	Check for proper wiring Check wiring polarity Check power source Check fuse, replace with a fuse of the correct rating.
STATUS LED on, no channel activity when transmit functions are operated.	Is the receive antenna properly connected? Is the receiver in a wet location or outside of proper operating temperatures? Has the receiver been subjected to a high voltage source (i.e.: welding currents, etc.)? Has the transmitter been dropped or subjected to severe shock?	Check antenna connection. Check for correct installation environment. If an over-voltage condition has occurred, contact service personnel for repair. If dropped, the transmitter may be damaged. Contact service personnel for repair.

Operation

SYMPTOM	CHECK	CORRECTIONS
Nothing happens when transmitter is turned on	Power switch turned on? Monitor lamp on? Batteries OK? Is auto-power-off active?	Turn on power switch Check batteries Replace batteries if bad Cycle power switch off and on.
System operates, but range is limited or operation is intermittent.	Receive antenna broken? Strong radio frequency interference in the area? Electrical noise sources close to receiver or antenna? Reinforced concrete or metal obstructions between transmitter and receiver antenna? Transmitter monitor LED showing proper indications? Receiver subjected to high voltage spikes or transients?	Repair or replace antenna or connections if necessary Receiver will not operate correctly in the presence of strong interference or a local on-channel signal. Powering the system down and back on will allow the carrier sense circuits to find a clear channel. Removing the interference source is the best cure. Electrical noise (i.e.: motor brushes, spark gap ignition, computer generated noise) may interfere with receiver operation. Remove interference source. Specified operating ranges are based upon line-of-sight conditions. Physical obstructions, especially those with high metal content, may reduce operating range. Avoid obstructions or relocate receiver antenna. Check transmitter operation per previous sections. Voltage spikes or transients may damage receiver circuits. If this is the case, contact service personnel.