Futaba®

TELECONTROL RADIO EQUIPMENT

FRN-0202U / FRN-0402U / FRN-0602U
2, 4, 6 Channel Radio Control System

Instruction Manual

LOR Manufacturing Company, Inc.
Industrial Radio Control

Futaba®

Revision 050729-01

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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 FRN system, may be in violation of law. Changes or modifications to the FRN 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.

FCC ID: AZP-FRN601U-T

Caution:
Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

NOTICE TO USERS

The information in this manual covers the FRN-0202U, FRN-0402U and FRN-0602U systems. The function of each system is identical with the exception of the number of digital output relays the particular system can control. The FRN-0602U allows control of 6 relay closures. The FRN-0402U allows control of 4 relay closures and the FRN-0202U allows control of 2 relay closures. The FRN receiver offers "dry contacts" outputs, meaning the receiver provides the contacts of SPST relay outputs.

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 FRN system.

The FRN system by itself is not inherently dangerous. **HOWEVER, WHEN THE FRN 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 FRN system may be used in virtually unlimited possible 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 FRN 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 FRN 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 FRN system.

To help ensure safe operation of the equipment, the FRN 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 FRN 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 FRN 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.

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 Precautions

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 which may impair the ability to operate the equipment safely.

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.

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 FRN 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 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 Installation and Handling Precautions

DANGER

The FRN 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 FRN system can cause serious or fatal injuries to the operator or nearby persons and cause damage to the FRN 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 FRN 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 FRN 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 FRN system, verify that both the equipment being controlled and the FRN 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 FRN 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 FRN system contains no user serviceable parts other than the transmitter batteries. In the event of problems, contact LOR for repair service. Contact information can be found in this manual under the section titled “How To Get Help”.

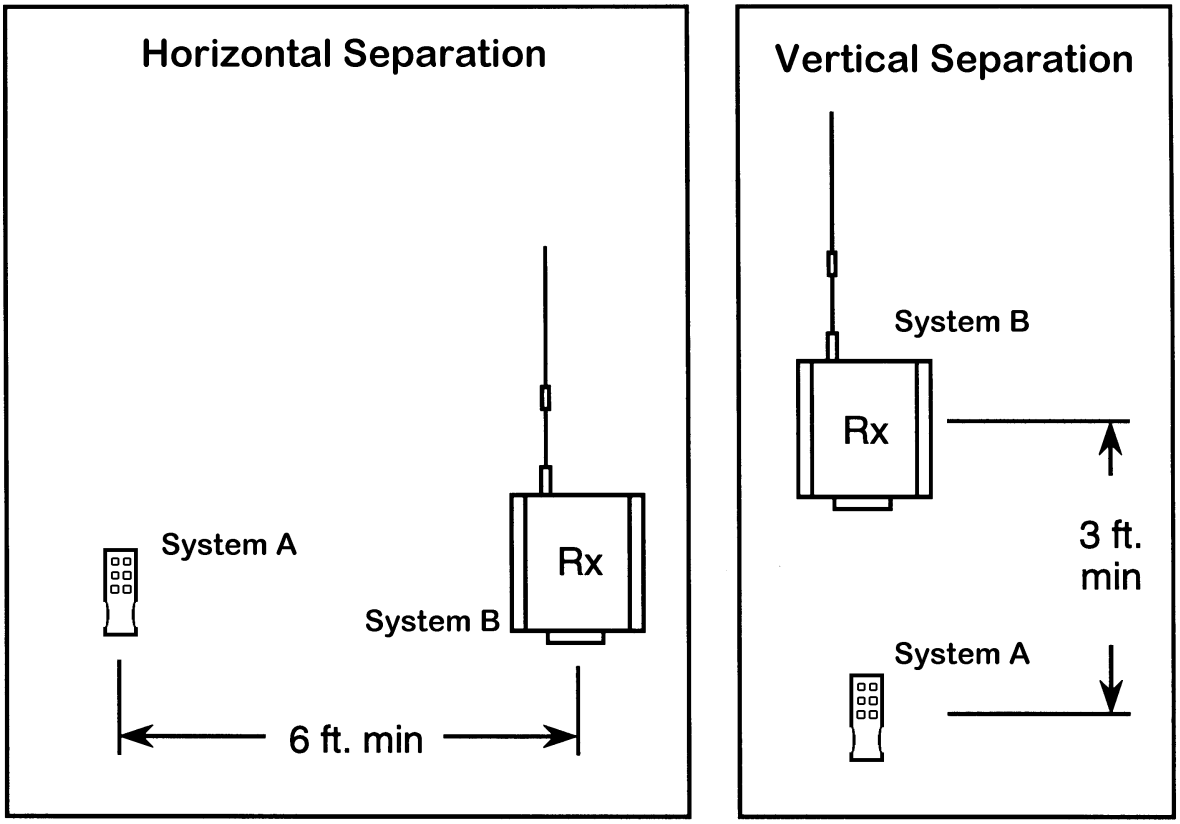

Figure 0.1 Multiple System Separation

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

Receiver Installation Precautions

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 FRN system ever need repair or replacement.

Model Number: FRN-0#02U

Serial Number: _____

ID Code & Frequency #: _____

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.

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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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SECTION 1

BEFORE YOU BEGIN

CONTENTS

1.1 Overview

The FRN radio control system provides economical remote control of up to 6 relay activated functions. The system features an ergonomically designed hand held transmitter with dust and moisture proof membrane switches, small enough to be carried in a shirt pocket. The receiver operates from 12 VDC or 24 VDC power for mobile equipment use. The actual supplied input power can range from 9 to 31 VDC. A user supplied AC adapter may be used to allow operation from AC line power source. Each relay output provides two wire, dry contact connections for controlling user equipment.

Futaba's exclusive direct sequence data encoding coupled with a 16 bit identification code (65,536 unique address codes) provide unmatched security and reliability. Microprocessors and surface mount component technology are used in both transmitter and receiver.

1.1.1 Special Features

- The operating distance is 60 Meters, line of sight, when there are no obstructions.
- Exclusive data encoding techniques coupled with 16 bit identification code provide unmatched security, reliability and exceptional immunity to noise.
- The FRN transmitter and receiver are approved under Part 15 of the FCC Rules. No user license is required to operate the system.
- Small, lightweight, hand-held transmitter with internal antenna. Can be carried in a shirt pocket.
- An automatic power off feature helps prolong transmitter battery life.
- The FRN receiver is factory programmed with momentary outputs. Optional latching outputs of any or all functions may be special ordered.
- Exclusive data encoding techniques provide exceptional immunity to noise.
- Two-wire dry relay outputs.
- Momentary outputs standard. Optional latching outputs available.

1.1.2 How To Get Help

Please contact LOR's technical support at the address shown below for:

- Application information regarding the FRN or other Futaba products.
- Technical Assistance or Training
- Safety Questions
- 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

1.1.3 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. It has incorporated in its design many advanced features both 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.

1.2 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. We recommend that you turn the receiver power on first, followed by the transmitter power.
- The FRN transmitter case is dust and moisture resistant. The receiver case is dust 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.
- It may be a violation of law to open the transmitter or attempt to repair or modify the equipment. Changes or modifications to this equipment not expressly approved by LOR could void the user's authority to operate the equipment.
- The FRN system is factory programmed to one of 32 frequencies and one of 65,536 ID Codes. Frequency and ID Code are documented on each transmitter and receiver by a frequency seal and serial number. Transmitters or receivers with an ID Code different from the original factory programming have special labels noting the new ID Code number. These labels are located near the serial label of the changed transmitter and/or receiver.

1.3 Serial Number & Radio Frequency

The serial label contains information about the transmitter and receiver which includes the factories ID Code programming. The transmitter serial number is located inside the battery compartment. The receiver serial number is located on the front panel near the RF connector. Transmitters or receivers with an ID Code different from the original factory programming have a special label noting the new ID Code number. The ID code label is located near the serial label of the changed transmitter and/or receiver.

Figure 1.1 FRN Frequency Seal

The frequency label contains one of thirty-two frequency designation numbers. Please refer to frequency table 1.1 and the frequency label sample in figure 1.1. Our example frequency seal shows frequency number 22 representing 318.05 MHz. The transmitter frequency label is located on the back panel. The receiver frequency label is located on the top panel.

NOTE

New transmitters or receivers can be factory programmed to operate existing receivers or transmitters. Frequency and ID Code are required when requesting programming changes.

	Frequency(MHz)	Indication		Frequency(MHz)	Indication
1	317.350	735	11	317.900	790
2	317.400	740	12	317.950	795
3	317.450	745	13	318.000	800
4	317.500	750	14	318.050	805
5	317.550	755	15	318.100	810
6	317.600	760	16	318.150	815
7	317.650	765	17	318.200	820
8	317.700	770	18	318.250	825
9	317.800	780	19	318.300	830
10	317.850	785	20	318.350	835

Table 1.1 Frequency Designations

1.4 Standard Parts List

A list of parts that are included in your system package is shown below. Please check the contents of your packaging with this list. If you have ordered optional items not in the list below) they may be shipped separately or may be included in the main system packaging. 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.

PART DESCRIPTION	PART NUMBER	Quantity
FRN Instruction Manual	MANUAL	1
FRN 6 Channel Transmitter	01300163-1	1
FRN 4 Channel Transmitter	01300164-1	*
FRN 2 Channel Transmitter	01300165-1	*
FRN 6 Channel Receiver	FRN602R080	1
FRN 4 Channel Receiver	FRN402R140	*
FRN 2 Channel Receiver	FRN202R150	*
Receiver Antenna Extension Cable	1M38A08202	1
Connector and Connector Pins Set	1M38A00201	1
Receiver Antenna	1M38A02501	1
Receiver Antenna Mounting Bracket	1M38A06801	1
Transmitter Safety/ Carrying Strap	1M38A17901	1

1.5 Tools/ Parts Required For Installation

Screwdriver, Standard (-)	(For TX cover, RX antenna mount)
Long Nose Pliers	(For RX connector pins)
Wire Stripper	(For RX connector pins)
Solder Iron	(For RX connector pins)
4 Screws or Bolts	(For RX mounting)
3 “AAA” (LR03) Alkaline Batteries	(For TX operation)

SECTION 2

TRANSMITTER DESCRIPTION

CONTENTS

2.1 Operator Panel Layout

The power and the six function controls are spring-loaded, membrane switches. The status indicator lamp is a bicolor LED in the upper left corner.

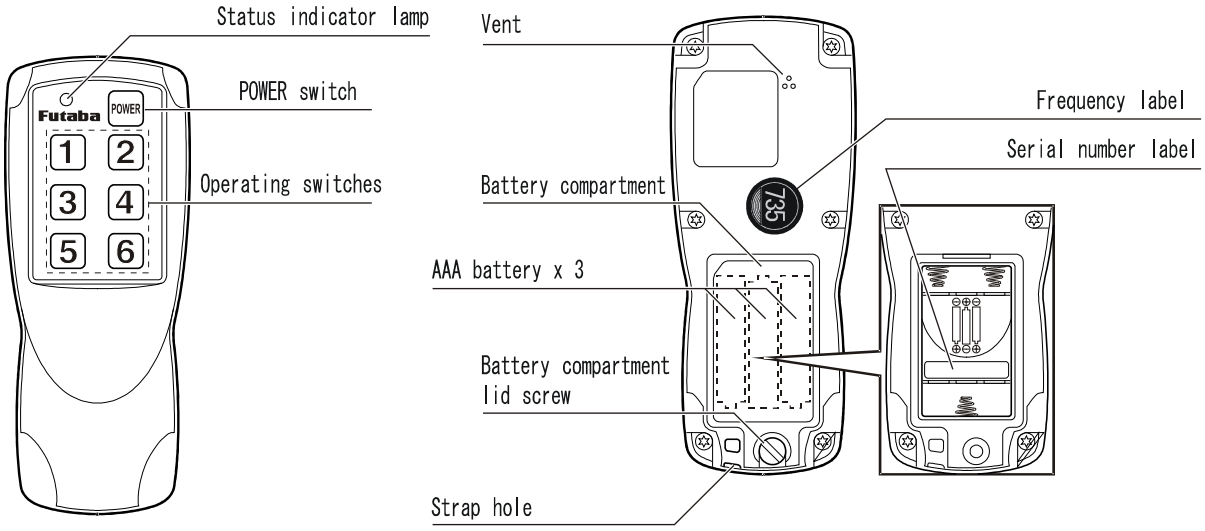


Figure 2.1 Transmitter Front and Rear Panel Layouts

2.2 Transmitter Operation

To turn the transmitter on, depress only the power switch in the upper right corner. The status indicator LED should be slowly flashing as it is in standby mode. Likewise, to turn the transmitter off, depress the power switch, and then the status LED should go off.

To control a function, depress the desired function switch, and the corresponding receiver relay should be closed as long as the switch is depressed (when receiver is in Normal mode.) When any channel function push-button is depressed, the transmitter status indicator LED should be steady on. Refer to the Transmitter Operation Flowchart and LED Status Indicator table on the following pages for status indicator mode of the various operation conditions. Refer to the Operation section for detailed system operation instructions.

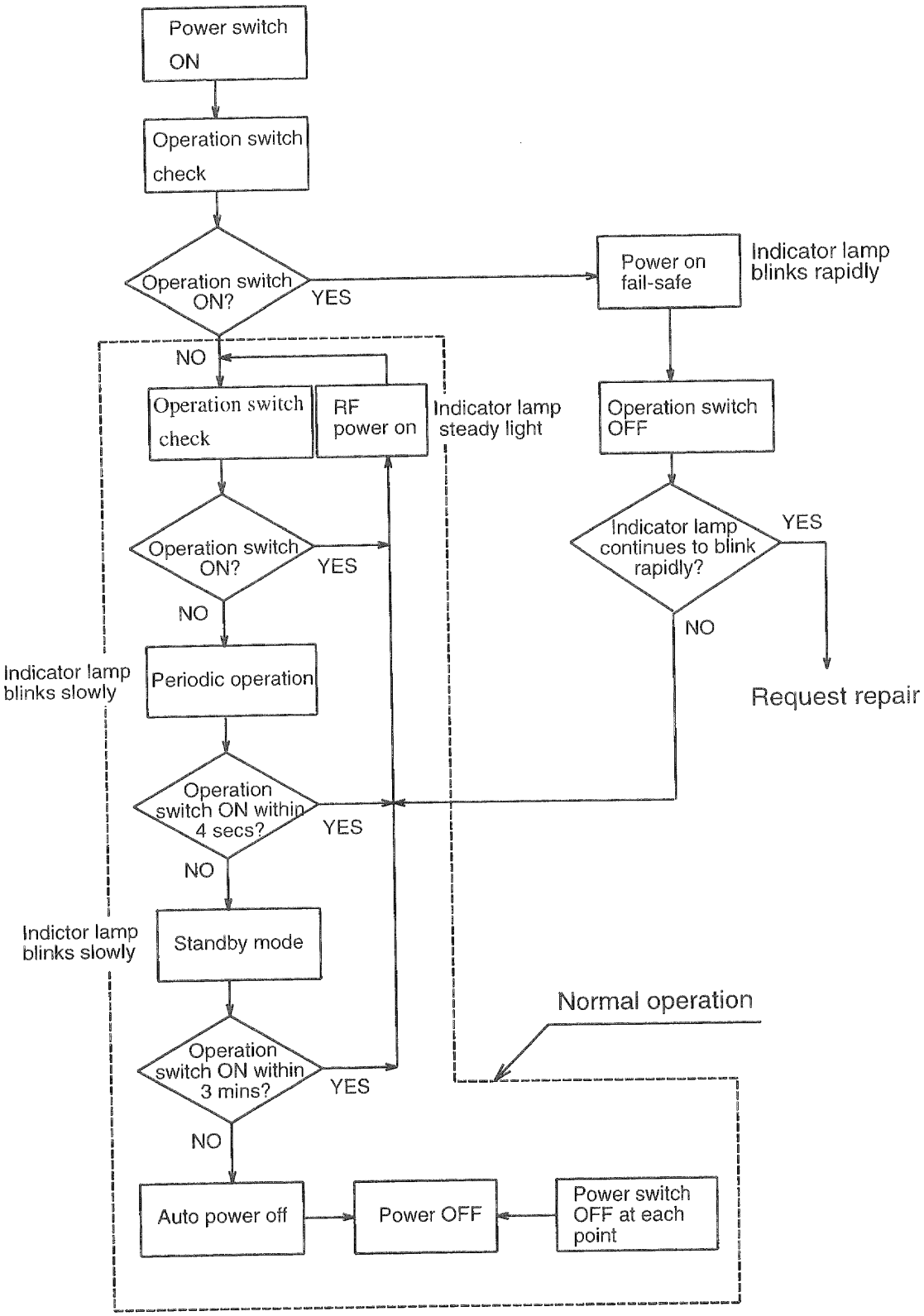


Figure 2.2 Transmitter Operation Flowchart

Transmitter Status Indicator Vs. Operating Mode	
LED Status Indicator	**Transmitter Operation**
No light, Channel button not depressed.	Transmitter power OFF.
Green light on constant, button(s) depressed.	Transmitting command data, battery OK.
Red light on constant, button(s) depressed.	Transmitting command data, battery LOW.
Green light slowly flashing (once/sec), no button depressed.	Standby mode, ready for command, battery OK.
Red light slowly flashing (once/sec), no button depressed.	Standby mode, ready for command, battery LOW.
Light quickly flashing (twice/sec), button depressed.	Fail-safe startup mode, release channel switch; Consult factory for service.
No light, but button(s) depressed.	Transmitter power OFF; Batteries bad, incorrectly installed, or missing; Transmitter error, consult factory for service.

2.2.1 Auto-Standby Feature

After a transmitter command button has been depressed and released, the transmitter will send the release (off) data for 4 seconds, then automatically switch to standby mode to conserve battery life. The status indicator LED will blink slowly after the button is released. To resume control, press one of the six function buttons.

2.2.2 Auto Power-Off Feature

If a function button is not depressed for a 3 min. period, the transmitter automatically powers off to conserve battery life. The status indicator LED will be off. To resume control, depress the power switch, then one or more of the six function switches.

2.2.3 Fail Safe Power Up Feature

If a function switch malfunctions in the on (depressed) position, the power on start-up check will detect this and indicate a fault condition. The transmitter status indicator LED will flash quickly. All command functions are disabled until the fault is removed. Consult factory for service in this case. However, if a function button is depressed during the power on sequence, the status indicator LED will also flash quickly, indicating a fault condition. To resume control, release the function switch, and the transmitter will convert to standby mode, (the status LED will slowly flash) then depress the desired function switch.

2.2.4 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.

2.3 Changing Transmitter Batteries

Removing a screw on the rear panel accesses the battery compartment. Three "**AAA**" type (LR03) alkaline batteries are recommended. Observe the indicated battery polarity when replacing the batteries. Always use three 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.

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

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

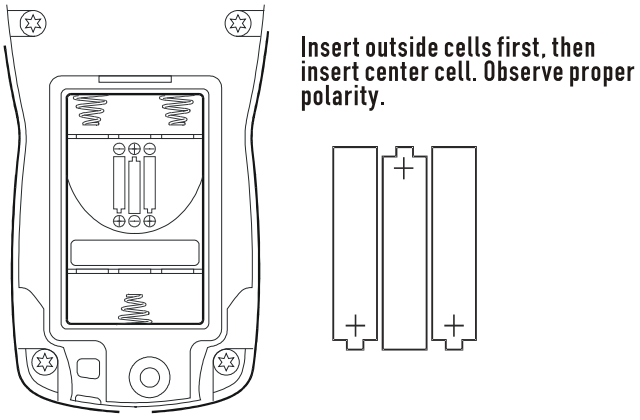


Figure 2.3 Transmitter Battery Compartment

2.4 Using the Carrying Strap

The carrying strap should be used to tether the FRN transmitter to the operator. As with all electronic devices, repeated hard shocks can cause the transmitter to cease operation. Using the carrying strap as shown below will help prevent accidentally dropping the transmitter.

Figure 2.4 Carrying Strap Examples

The carrying strap can be easily adjusted to a desired length. To adjust the carrying strap length, slide the strap through the buckle until the desired length is achieved. The excess strap should be removed with side cutters or scissors.

SECTION 3

RECEIVER DESCRIPTION

CONTENTS

3.1 Receiver Installation

Select an appropriate location near the equipment to be controlled for mounting the receiver. The receiver should be installed as far from any source of electrical noise as possible. Whenever possible, the receiver should be mounted in a readily accessible area to allow easy access to LED display.

There are four mounting holes located on the side flanges for mounting. Use the receiver as a template for marking the hole locations on the surface to be mounted. Use screws or bolts to secure the receiver to the surface. Always mount the receiver to a flat surface. Forcibly installing the receiver to a curved surface will cause damage to the receiver. If the surface upon which the receiver is mounted is subject to vibration, use vibration-damping mounts to protect the receiver from the vibration force.

⚠CAUTION To avoid damaging the receiver case never apply more than 350 oz. inches of torque to the plastic mounting tabs.

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.

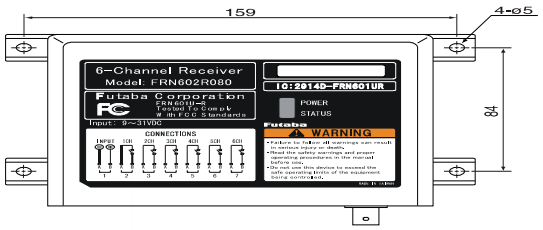


Figure 3.1 Receiver Mounting View

3.1.1 Receiver Connector Pin Attachment

To properly assemble the wiring harness follow the procedure in figure 3.2 or crimp the contact pins to the electric wire with an AMP crimping tool (Amp crimping tool No. 919602-

1 or 914596-3). The contact is designed to attach to 20 to 16 AWG wire with an insulation diameter of 0.071 to 0.110 in. After attaching wires to the contacts, insert the connector pins into the connector housing gently, observing polarity, until the pin clicks or reaches the end of the housing.

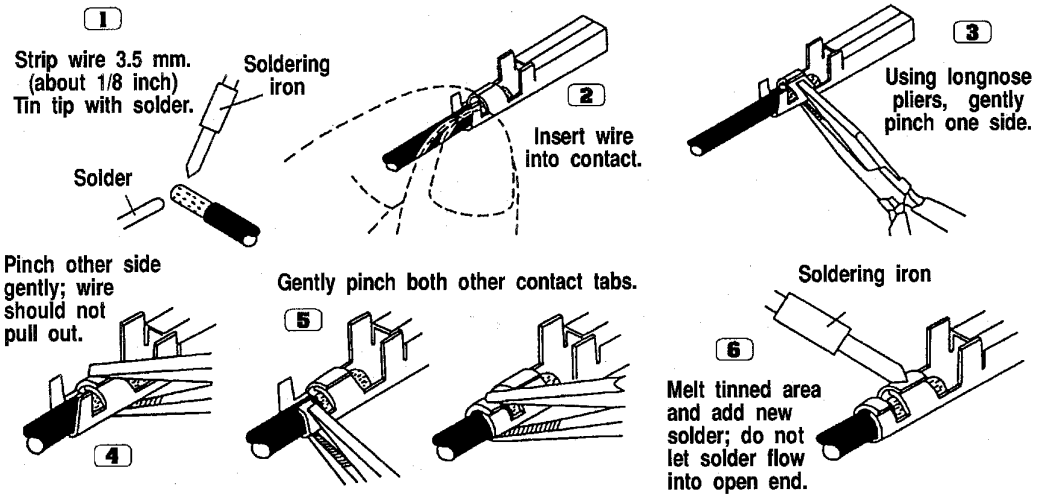


Figure 3.2 Connector Pin to Wire Assembly Method

3.1.2 Output Wire Connections

When directly connecting 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.

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

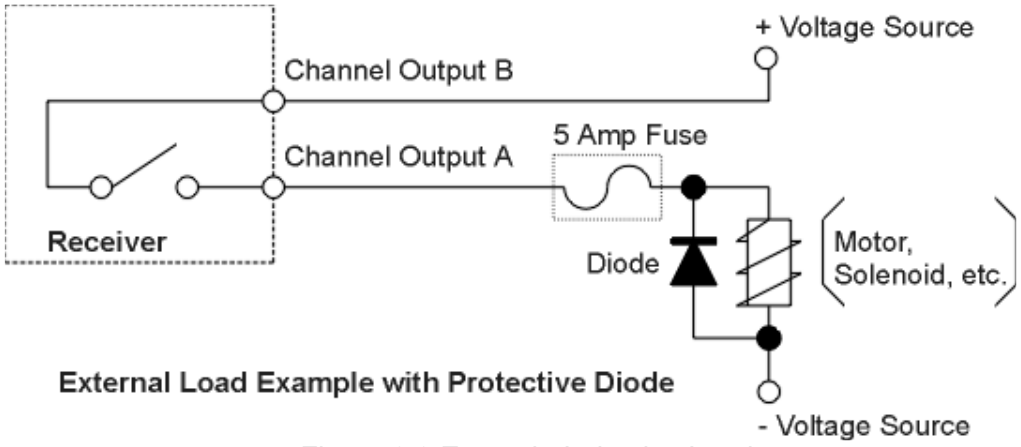


Figure 3.3 Example Inductive Load

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.

3.1.3 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. Connector pin 1B is the source positive line. Connector pin 1A is the source negative line.

NOTE

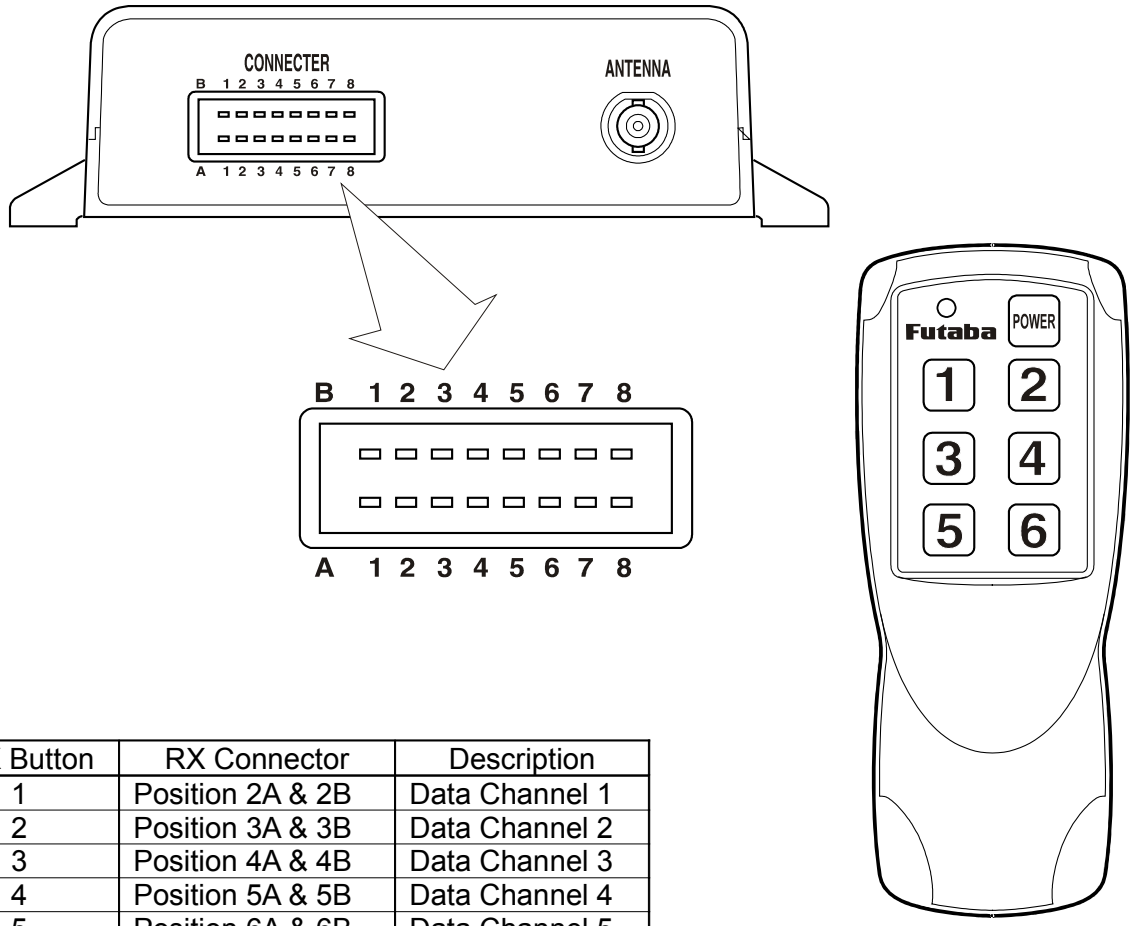
It is recommended to install a fuse in the power wire. Selecting a "fast-blow" fuse of 1 ampere rating will minimize the chance of blowing the internal 3 ampere fuse.

3.1.4 Relay Output Description

The FRN system provides up to 6 output relays. All relays are SPST, normally open, type. Do not exceed voltage and current ratings at relay output connections. Please refer to receiver specifications in Appendix A for relay electrical limits.

Normal mode: The individual channel relays will close any time their corresponding function switch is held on at the transmitter, and will release as soon as the transmitter switch is released.

Latching mode: Any transmitter button, programmed to latching mode, can activate and latch a receiver relay. Pressing the corresponding transmitter button once will latch the relay. Pressing the transmitter button a second time will release the relay. The latching mode is a factory programmable option.



TX Button	RX Connector	Description
1	Position 2A & 2B	Data Channel 1
2	Position 3A & 3B	Data Channel 2
3	Position 4A & 4B	Data Channel 3
4	Position 5A & 5B	Data Channel 4
5	Position 6A & 6B	Data Channel 5
6	Position 7A & 7B	Data Channel 6

Figure 3.4 Receiver Channel Output and Transmitter Correspondence

3.1.5 Receiver Antenna Mounting

For best operating range, mount the receiving antenna in a location that is as high as possible and with a clear view of the area in which the transmitter will be operated. Avoid mounting the antenna and cable close to sources of electrical noise, such as motor brushes, computer, etc.

The supplied antenna bracket is an edge mounting type. To install the antenna bracket, secure the base, then position and secure the cable mounting plate. Insert the antenna cable connector into the antenna bracket and secure it with the mounting nut, then attach the antenna. When the antenna is not attached, place the plastic cover over the connector to protect it from dust and water.

When mounting the antenna directly to a surface, pick an area with the largest available ground plane (metal surface), such as the center of the cab roof on a truck. This will provide

the best operating range for the system. Remove any insulation from the surface of the metal plane where the antenna cable is mounted. Be sure the base of the antenna has a good electrical connection to the metal surface. If a metal surface is not available, then a ground plane (metal surface) should be added. As a minimum, a metal plate, 300mm by 300mm, with a thickness of one millimeter or greater should be used. With a larger ground plane, the receiver will have better sensitivity and provide a more uniform coverage area.

⚠CAUTION Confirm the antenna and antenna mount is tight. A loose antenna or antenna mount can shorten the operating distance and cause interference.

⚠CAUTION When the antenna is mounted in a location exposed to environmental conditions, be sure to insulate the antenna connector to prevent moisture and corrosion from accumulating.

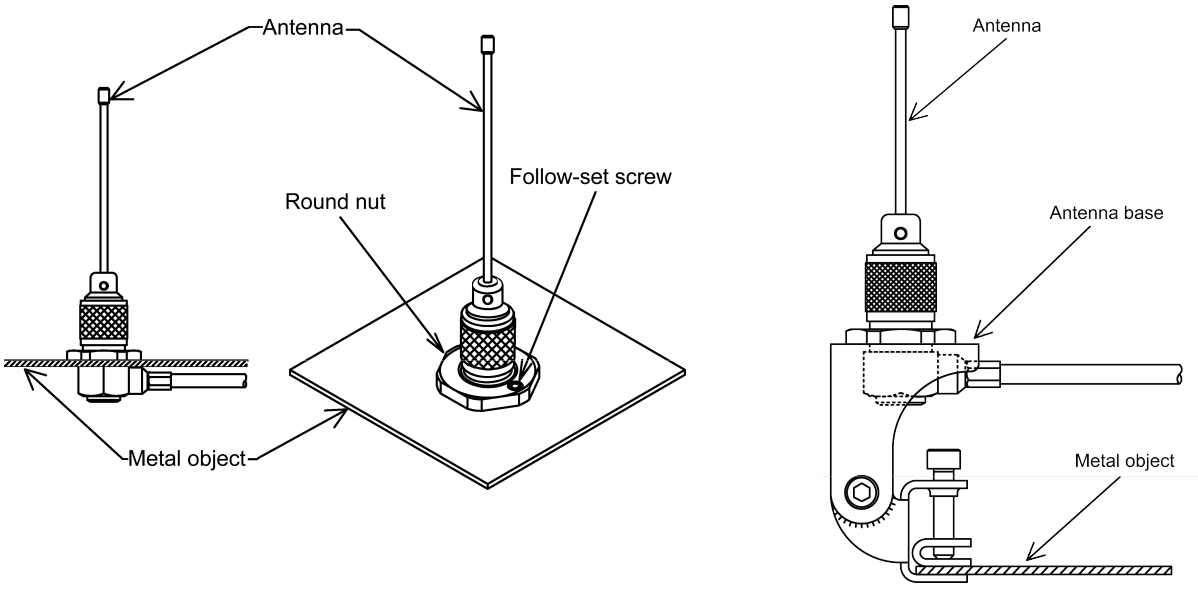


Figure 3.4 Antenna Mounting Examples

3.1.6 Receiver Status Indicator Lights

The Power LED will be red whenever the receiver is connected to a power source.

The STATAS LED will be on whenever the receiver is acquiring valid data from the transmitter. The STATAS LED will be off when there is no signal present, the transmitter is out of range, or there is radio signal interference present in the area.

APPENDIX A

SYSTEM SPECIFICATIONS

General Specifications

frequency range	317.350 to 318.350 MHz
frequency control	PLL synthesizer, 20 frequency channels
modulation	FM-FSK
baseband data format	direct sequence encoded
communication mode	simplex
error checking	CRC technique
data channels	2, 4, or 6 discrete
security	16 bit ID code (65,536 unique codes)
operating range	> 200 ft (60 m)†
response time	200 ms average (from standby mode) 150 ms average (re-operated within 4 s)
operating temperature	–4 to +140 °F (–20 to +60 °C)
storage temperature	–4 to +158 °F (–20 to +70 °C)
humidity	up to 90% RH, non-condensing
shock	Peak acceleration of 500 m/s^2 and action time of 11ms when not communicating (JIS C0041-1995 , see next page)
vibration	Tx: 4.4 G (JIS D1601-1995 3-B-45, see next page) Rx: 6.8 G (JIS D1601-1995 3-B-70, see next page)

Transmitter Specifications

supply voltage	3.6 to 4.5 VDC (3 AAA alkaline batteries)
maximum current consumption	26 mA (RF active), 10 mA (idle mode)
transmission power	< 6000 µV/m at 3 m
battery life	continuous operation: ≈ 30 hrs (alkaline batteries)
power saving features	RF emissions off delay: 4 s auto power off delay: 3 min
antenna	internal
case	water resistant (JIS D0203-1994 R1) and dustproof, high-impact black resin
dimensions	5.79 x 2.32 x 0.94 in (147 x 59 x 24 mm)
weight	3.5 oz (100 g) excluding batteries

Receiver Specifications

design type	double-conversion super-heterodyne with convolutional decoding
receiver sensitivity	< – 110 dBm
discrete channel outputs	2, 4, or 6 electromechanical relays, SPST normally open
relay configuration	FRN-02/04/0601U: relays provide switched supply voltage FRN-02/04/0602U: relays provide dry contacts
relay ratings	resistive load: 5 A, 31 VDC/120 VAC maximum (cos ϕ = 1.0) inductive load: 2 A, 31 VDC/120 VAC maximum (cos ϕ = 0.4) (total combined current for FRN-02/04/0601U relays: 8 A)
supply voltage	9 to 31 VDC
maximum current consumption	0.8 A (6 relays activated), 60 mA (idle mode)

RF connector	BNC female
antenna	external 1/4 λ whip, 10.24 in (260 mm), UHF metric male
antenna cable	RG-58/U coaxial, 13.1 ft (4 m), BNC male to UHF metric female
case	splash resistant and dust proof (JIS D0207-1977 F2), high impact black resin
dimensions	6.77 x 4.61 x 1.81 in (172 x 117 x 46 mm), excluding antenna
weight	approximately 13.1 oz (370 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

	Applied Acceleration	Results	Quantity Tested
Transmitter	4.4 G	passed	3 units
Receiver	6.8 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 0.011 second.
- Standard shock rating is 500 m/s^2.

Judgement

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

Test Results

	Applied Acceleration	Results	Quantity Tested
Transmitter	20 G	passed	3 units
Receiver	20 G	passed	3 units

Dimensional Drawings

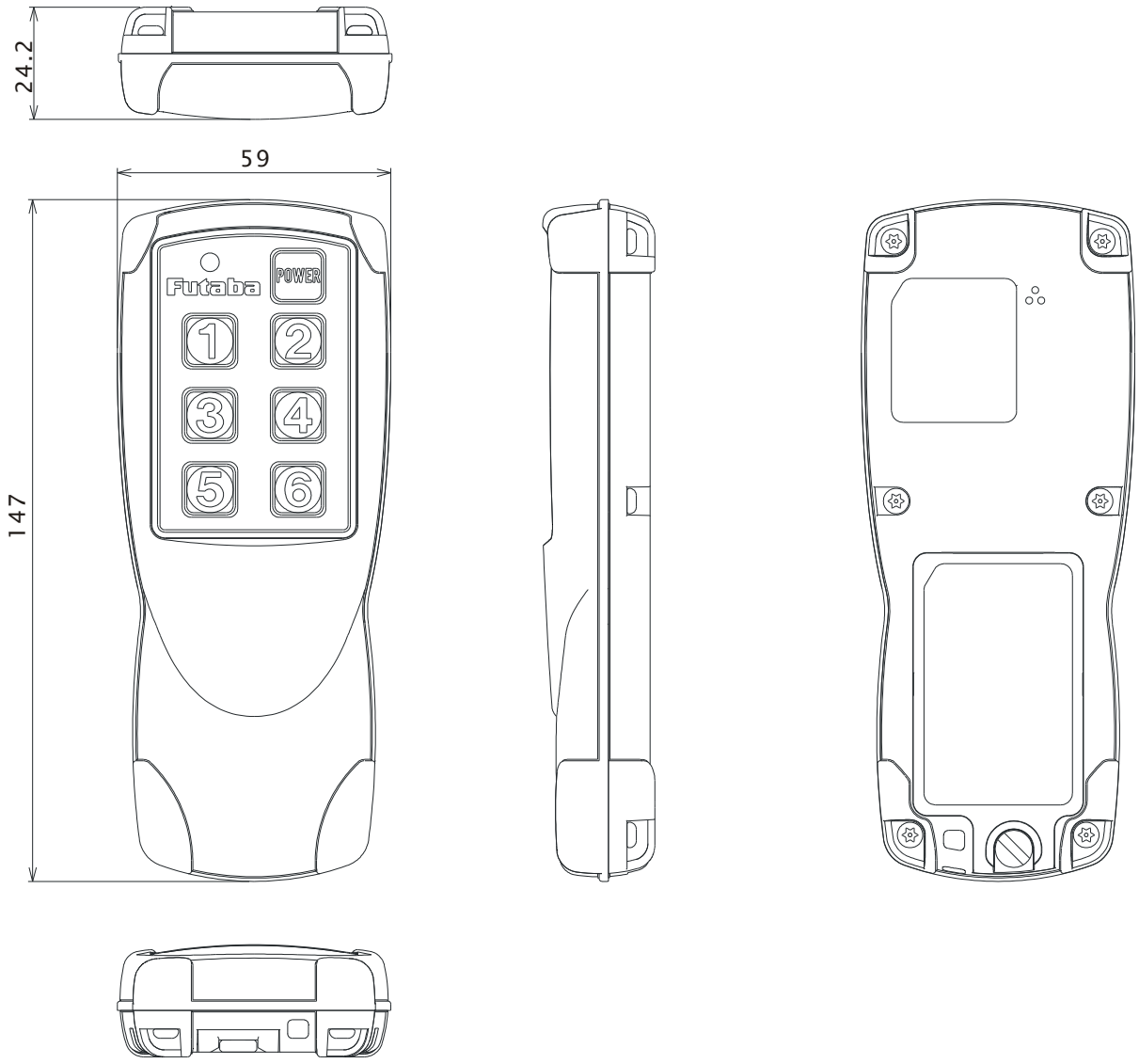


Figure A.1 FRN Transmitter, Exterior View

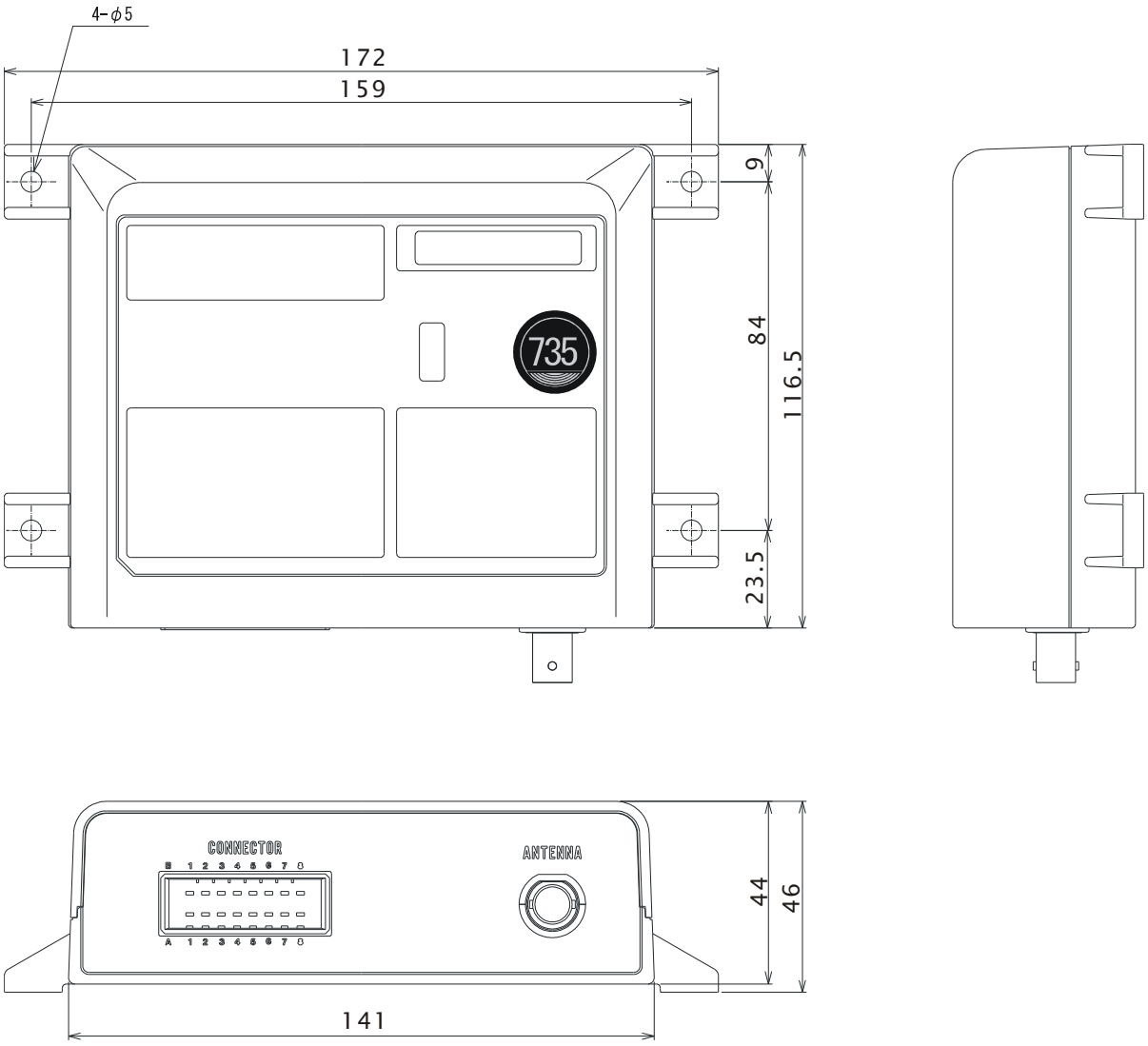


Figure A.2 FRN Receiver, Exterior View

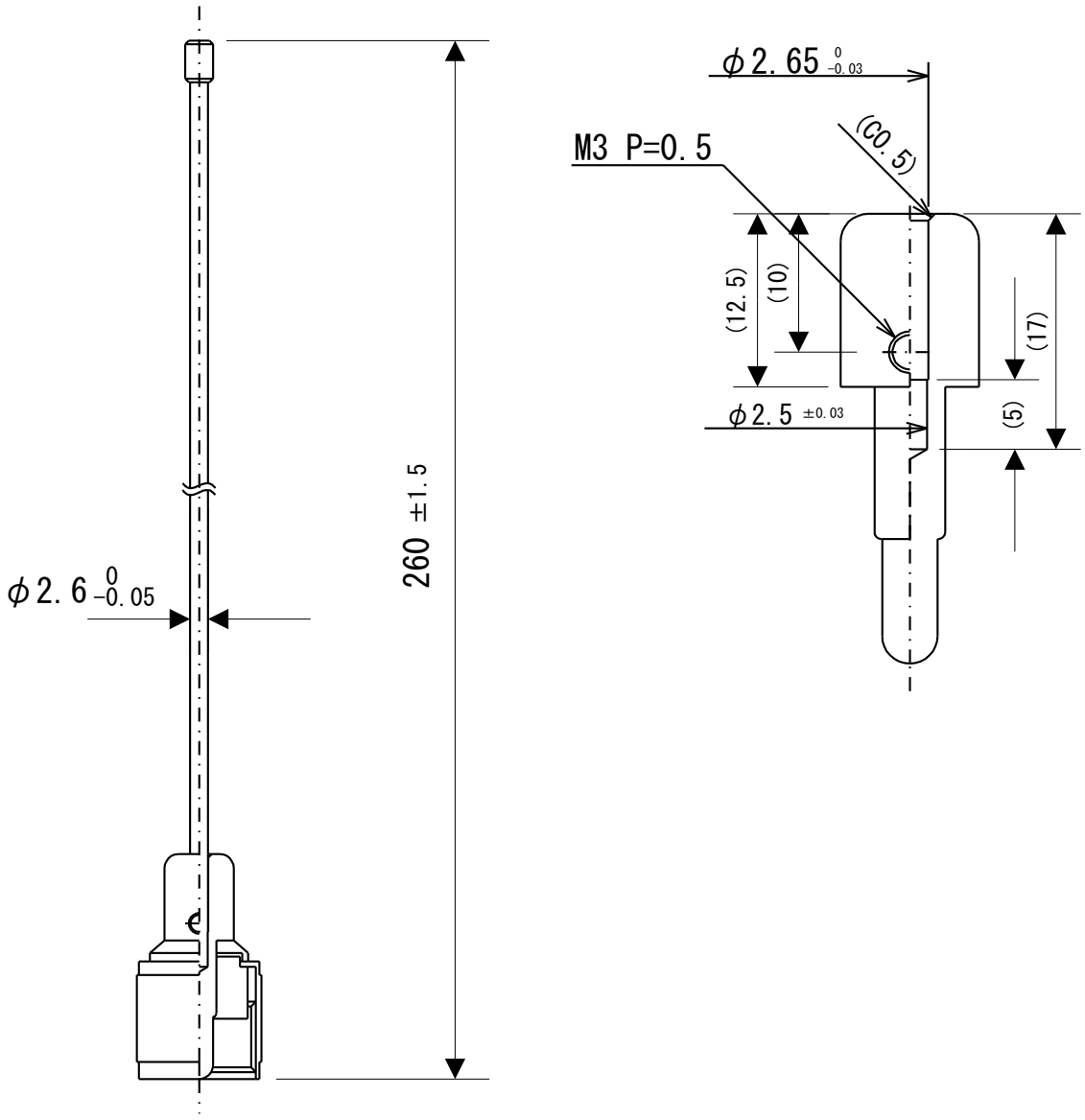


Figure A.3 Receiver Antenna

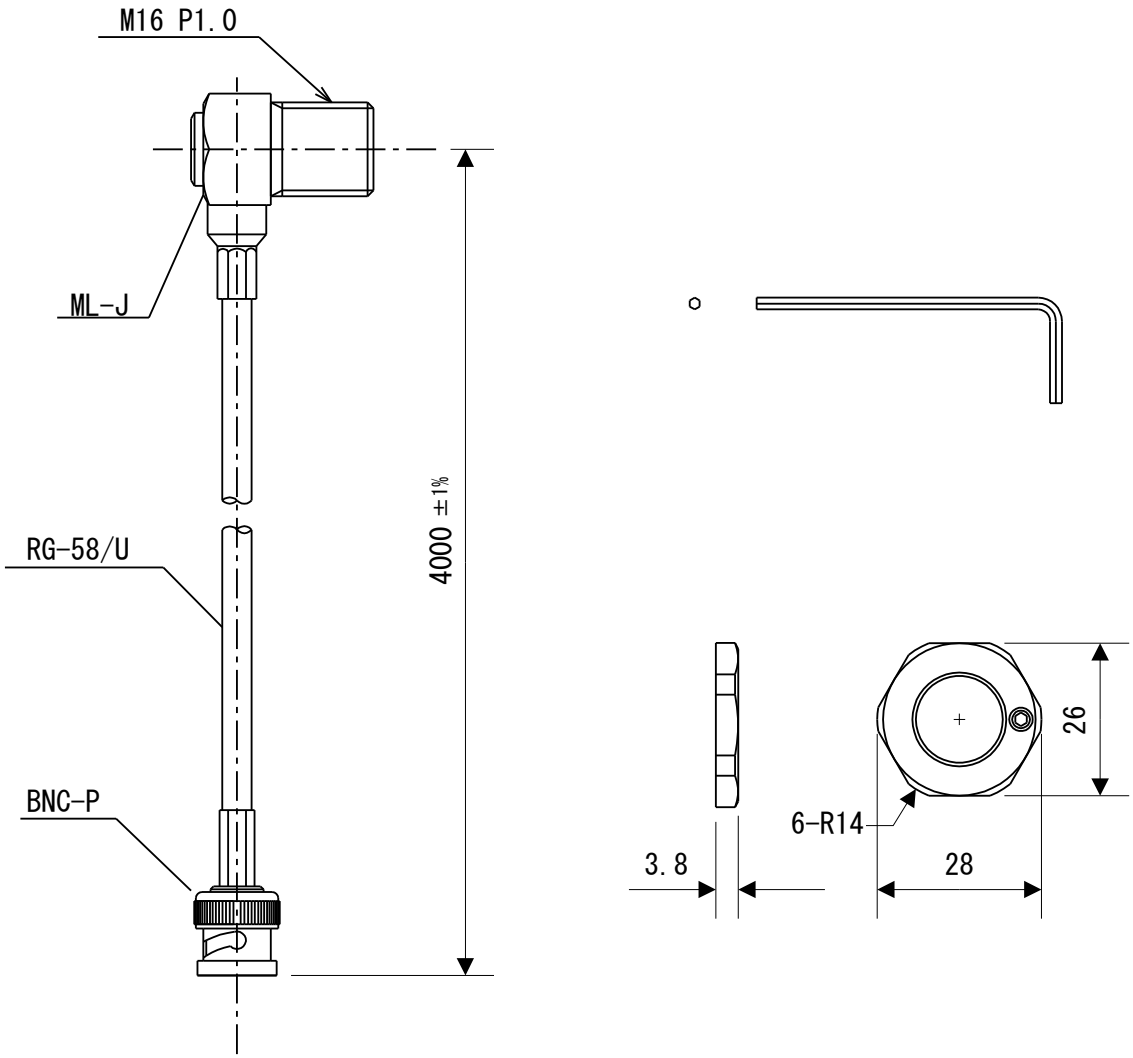


Figure A.4 Receiver Antenna Cable

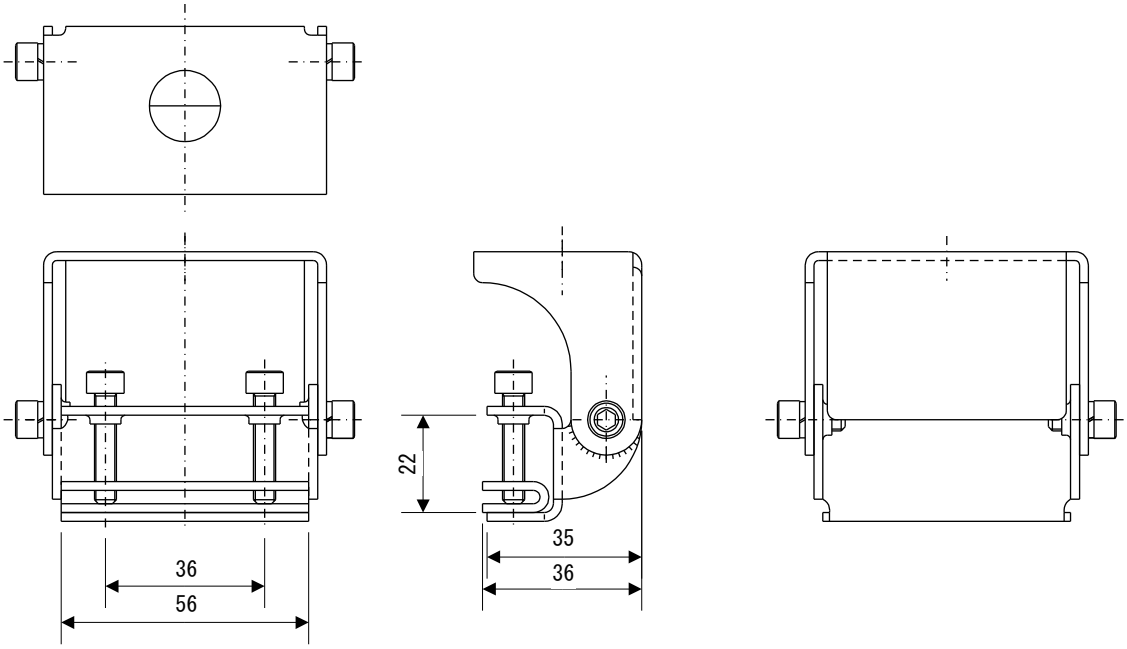


Figure A.5 Receiver Antenna Mounting Bracket

APPENDIX B

OPERATION AND TROUBLESHOOTING GUIDES

Installation Check

	STEP	CHECK
1	Install receiver and matching transmitter	Proper installation. Transmitter and receiver frequency and ID Code match.
2	Apply operating voltage to the receiver.	Check to be sure the power LED is “ON”.
3	Install fresh batteries in the transmitter.	Observe marked polarity.
4	Depress transmitter “ON” push-button.	Receiver STATAS LED should turn “ON” briefly.
5	To control a function, depress the desired transmitter function switch.	The matching receiver relay should turn on. Check for proper operation of equipment.

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. In the normal mode, the relays are momentary operation only. They will remain activated for as long as the switch is held at the transmitter.

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

1. Change the relative positions of the transmitter and of the receiving antenna. Try to decrease the distance between them. Sometimes a longer antenna cable will allow closer spacing.

2. In extreme interference conditions, use of a “unidirectional gain antenna” will provide an additional boost to the desired signal and greater rejection to an interfering signal. Consult the service center for help with installation of gain antenna systems.

Installation Troubleshooting Guide

SYMPTOM	CHECK	CORRECTIONS
Transmitter button depressed, but nothing happens.	Receiver relays on?	Check that TX batteries are installed properly.
	Is the receiver power on?	Supply receiver power.
No receiver power LED when transmitter is on or off.	Is receiver power wiring properly connected?	Connect proper wiring and an active power source.
	Is the polarity correct?	Wire correct polarity.
	Is the proper voltage and current being supplied to the receiver?	Correct power source.
Other incorrect operation.	Is the receive antenna properly connected?	Properly connect antenna and check antenna cable.
	Is the receiver in a wet location or outside of proper operating temperatures?	Correct receiver environment. (Consult factory)
	Has the receiver been subjected to a high voltage source (i.e.: welding currents, etc.)?	If an over-voltage condition has occurred, contact service personnel for repair.
	Has the transmitter or receiver been dropped or subjected to severe shock?	If dropped, it may be damaged. Contact service personnel for repair.

Operational Troubleshooting Guide

SYMPTOM	CHECK	CORRECTIONS
Nothing happens when transmitter is activated.	Power/ transmit LED on?	Turn transmitter ON.
	Batteries OK?	Replace batteries if bad.
	Receiver Power “ON”?	Turn Rx ON, check power source.
System operates, but range is limited or operation is intermittent.	Receive antenna broken?	Repair or replace antenna, connections or cable if necessary.
	Strong radio frequency interference in the area?	Receiver will not operate correctly in the presence of strong interference or a local on-channel signal. Removing the interference source is the best cure. Consult an expert.
	Electrical noise sources close to receiver or antenna?	Electrical noise (i.e.: motor brushes, spark gap ignition, computer generated noise) may interfere with receiver operation. Remove interference source.
	Reinforced concrete or metal obstructions between transmitter and receiver antenna?	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.
	Transmitter LED showing proper indications?	Check transmitter operation per previous sections.
	Receiver subjected to high voltage spikes or transients?	Voltage spikes or transients may damage receiver circuits. If this is the case, contact service personnel.