



WIRELESS DATA COMMUNICATION MODEM

FDQ02T

Wireless Modem with Serial Interface  
Instruction Manual

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Futaba Corporation  
Industrial Radio Control

## I Notice

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.

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

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

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

## II Important Safety Information

The list of dangers, warnings and cautions in this section contain important information that will help ensure safe operation of the system. Please read carefully and understand all of these items. All installers, operators and maintenance personnel should read and understand this information before installation, use, or maintenance of the FDQ02T system.

The FDQ02T system by itself is not inherently dangerous. **HOWEVER, WHEN THE FDQ02T 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 FDQ02T system may be used in virtually unlimited applications. Many of these associated systems can, by themselves, pose a mechanical, electrical or other hazard to operators and other persons or equipment. To address all possible applications and associated safety hazards in this manual would be impossible. The warnings below and throughout this manual give information that will allow safe installation and use the modem system applications. If you have questions regarding the safety of your specific application, please contact the appropriate people for help. Your Futaba sales representative, representatives of the equipment being controlled, and the technical support staff at local branch of Futaba Corporation are among those who can provide assistance with your safety concerns.

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

In installations where the FDQ02T system is used to control motion or operation of potentially dangerous equipment, it is imperative for safety that all operators and installers be thoroughly trained in the normal function of that equipment before attempting to control it remotely with the FDQ02T system.

To help ensure safe operation of the equipment, the FDQ02T system must be connected so that it will operate in a fail-safe way. In other words, the equipment being controlled should stop or return to its safest state in the absence of a control signal or total loss of RF transmission from the FDQ02T system. Our system uses one of the most reliable methods available to transmit data using radio signals. Many factors can affect a radio signal that may block it or interfere enough to disrupt regular transmission. Because of this, equipment motion or dangerous electrical current, for example, that continues during a loss-of-signal condition could be very dangerous.

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

The symbols are defined as follows:



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



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



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



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

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

## II.1 General Safety Hazards and Notes



Improper installation and/or operation of the FDQ02T system can cause serious or fatal injuries to the operator or nearby persons and cause damage to the FDQ02T system, and any equipment it is used to control. Please read and understand this manual completely and the manual of all equipment being controlled before attempting to operate or install this system.



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



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



The FDQ02T should **NOT** be used in a manner in which failure of the product or loss of the radio signal could cause damage to the

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

**▲ CAUTION**

The FDQ02T contains no user serviceable parts. If the unit requires service, contact your sales representative or local branch of Futaba Corporation per instructions the section titled **How To Obtain Help**. Do not disassemble or attempt to repair the FDQ02T yourself. Doing so could void your warranty and may void the user’s authority to operate the device.

**▲ WARNING**

Contact Futaba before using the FDQ02T in safety critical applications such as medical equipment, aircraft, hazardous materials handling, etc.

## II.II Installation Safety Hazards and Notes

**▲ CAUTION**

When mounting the FDQ02T, use M2.6 (ISO) screws.

**▲ WARNING**

Use only the proper regulated DC voltage supplied to the FDQ02T. Use of any other voltage may permanently damage the modem and/or cause the modem to malfunction and create a shock or fire hazard.

**▲ WARNING**

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

**▲ WARNING**

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

**▲ WARNING**

Ensure that the FDQ02T power and the power to the equipment to be controlled is turned off before connecting or disconnecting the cable between them. This will help prevent accidental damage to the system and unexpected operation and/or injury.

**▲WARNING**

Be sure the FDQ02T power, the power to the equipment that is being connecting to it, and the DC power source are all turned off before wiring and connecting the power cable.

**▲WARNING**

Be sure that the supplied power is within the specified range (3.5 to 7.0 VDC). Voltages outside the specified range may damage the FDQ02T.

**▲WARNING**

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

**▲WARNING**

Securely attach the antenna cable, and serial communication connector to the FDQ02T and equipment/power source to which it is connected. Failure to do so could cause an unexpected system failure.

### II.III Antenna Installation Hazards and Notes

**▲WARNING**

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

**▲WARNING**

This device has been designed to operate with an antenna having a maximum gain of 2.14 dB. Antenna having a higher gain is strictly prohibited for use with this device. The required antenna impedance is 50 ohms.

Contact Futaba before connecting any antenna not provided by Futaba specifically for the FDQ02T. Attaching any non-authorized antenna may be in violation of FCC regulations.

**▲CAUTION**

To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that permitted for successful communication.

**▲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.

**NOTE**

The FDQ02T operates at frequencies in the 2.4 GHz band. These frequencies are more directional than lower frequencies and are easily reflected. If there are metal structures nearby, the effective range may be shortened or the directional properties may be further narrowed. To help avoid this, mount the antenna as far away as possible from surrounding metallic structures.

**NOTE**

Multipath problems occur easily at frequencies in the 2.4 GHz band. When multipath problems are present, moving the antenna as little as 10 cm may result in improved communication or, conversely, worsened or complete loss of communication. Futaba recommends that the mounting position of the antenna be determined *after* testing and verifying optimal communication conditions.

**▲ CAUTION**

When installing multiple FDQ02T systems that will use different frequency pattern number in the same area, these antennas must be mounted at least 6 feet (2 meters) apart. Failure to do so may severely reduce the modem operating range.

**NOTE**

Please contact Futaba for information about antenna separation when using the FDQ02T and other wireless products in the same area.

## II.IV Environmental Safety Hazards and Notes

### **▲WARNING**

If the FDQ02T has been stored at a temperature beyond the specified operating temperature range for the system, it may not function properly. Allow it to return to normal temperatures before use. Refer to **APPENDIX A – TECHNICAL SPECIFICATIONS** for the actual operating temperature range.

### **▲WARNING**

The FDQ02T is a precision electronic device with a rugged design that is intended for industrial applications. However, do not install it where it will encounter excessive vibrations. In some cases, isolation mounts may be used to isolate the modem from the equipment's vibration. Excessive vibration can permanently damage the modem and/or cause it to malfunction.

### **▲WARNING**

Do not operate the FDQ02T in environments where it will be subjected to excessive moisture (such as rain or water spray), dust, oil, or other foreign matter (such as metal particles). Doing so may permanently damage the modem and/or cause it to malfunction. If it does become wet or contaminated, correct the situation, verify proper operation and have any problems corrected before using it to control other equipment. If necessary, the modem can be mounted inside a protective or waterproof enclosure. If the enclosure is metallic, the antenna must be mounted externally or the effective operating range will be severely limited.

### **▲WARNING**

The FDQ02T is designed for indoor use. When using it outdoors, the modem should be mounted in a waterproof enclosure and the ambient temperature range should be checked to insure that it is within the modem's specifications. Always use the modem within its specified environmental ranges.

## II.V Other Notice

### **NOTE**

*Italicized gothic word* used in this manual shows functional and technical term especially important for the FDQ02T.



## Operational Safety Hazards and Notes



Before each use of the FDQ02T, ensure that the area where the equipment will be operated is clear of people or obstacles that may affect its safe operation.



Before each use of the FDQ02T, verify that both the equipment being controlled and the modem are in proper operating condition.



When rewriting the FDQ02T's memory registers, do not turn its power off until it returns a "P0" response. If the power is interrupted before a P0 response is returned, the memory contents may be lost or corrupted and its operation will be unpredictable. If the memory contents are lost or corrupted, they may be restored to original default settings by reinitializing them. (See p.25 **Memory REGISTER INITIALIZATION** for more details.)



Do not attempt to operate remotely controlled equipment outside the communication range of the FDQ02T system. Doing so could cause loss of control of the equipment.



Without implementing proper serial communication flow control settings, the baud rate between the modem and its terminal equipment (wire linked) can exceed the wireless link data rate and cause the modem buffer to overflow. This can result in malfunction of the systems being controlled and/or data corruption. Ensure that the appropriate flow control settings are being used for your upper layer application protocol.

## Exposure to Radio Frequency Radiation



For FCC RF safety requirements a minimum of 20 cm separation distance should be kept between the antenna and the user.

### III System Identification

For future reference, please take a moment to fill in the information below. This information will help us respond as quickly as possible should your FDQ02T modem ever need repair or replacement.

Model Name and Number: FDQ02T

Serial Number: \_\_\_\_\_

Date of Purchase: \_\_\_\_\_

Distributor Name: \_\_\_\_\_

Distributor Address: \_\_\_\_\_

Distributor Phone Number: \_\_\_\_\_

#### IV Limited Warranty

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

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

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

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

## V Returns

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

## VI Patents – Copyrights – Trademarks – Proprietary Rights

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

## VII Limitation of Damages and Action

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

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SECTION

1

**INTRODUCTION**

## 1.1 Special Features

The following list highlights some of the special features of the FDQ02T. For more complete system specifications please refer to p.60 **SPECIFICATIONS**.

- Approved under FCC Part 15.247 rules -- no special user license required
- Operating range greater than 3000 feet, line-of-sight -- configurable as a repeater for extended range of application service area
- 2.4 GHz Direct Sequence Spread Spectrum (DSSS) communication system provides unsurpassed immunity to interference and RF noise
- Fast switching Time-Division-Duplex (TDD) provides virtual full-duplex communication between terminal equipments at rates up to 115.2kbps
- User selectable frequency pattern number
- Supports 1:1, 1:n, and n:m wireless network topology
- Serial communication interface allows direct connection to a micro controller chip. By converting its level by the external interface circuit, conformable to RS232C, RS422 and RS485
- Small size allows easy integration with many systems
- Supply voltage range is DC voltage in 3.5 to 7.0 V DC (modem) / 6.0 to 9.0 V DC (Amp.)



## 1.2 How To Obtain Help

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

- Application information regarding the FDQ02T or other Futaba products
- Technical assistance or training
- Answers to safety questions and issues
- Additional manuals or other documentation
- Repair or service
- Comments regarding the product or this manual

Japan  
Futaba Corporation  
Radio Control Equipment Group  
1080 Yabutsuka, Chosei,  
Chiba, 299-4395 JAPAN  
Tel: +81 (475) 32-6173, Fax: +81(475) 32-6179  
Internet: [www.futaba.co.jp](http://www.futaba.co.jp)

Europe  
PENDING

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

### CAUTION

The FDQ02T contains no user serviceable parts. If the unit requires service, contact your sales representative or local branch of Futaba Corporation as per instructed in this section. Do not disassemble or attempt to repair the modem yourself. Doing so could void your warranty and may void the user's authority to operate the device.

### 1.3 Physical Description

Please review the following section and take a moment to familiarize yourself with the FDQ02T wireless modem.

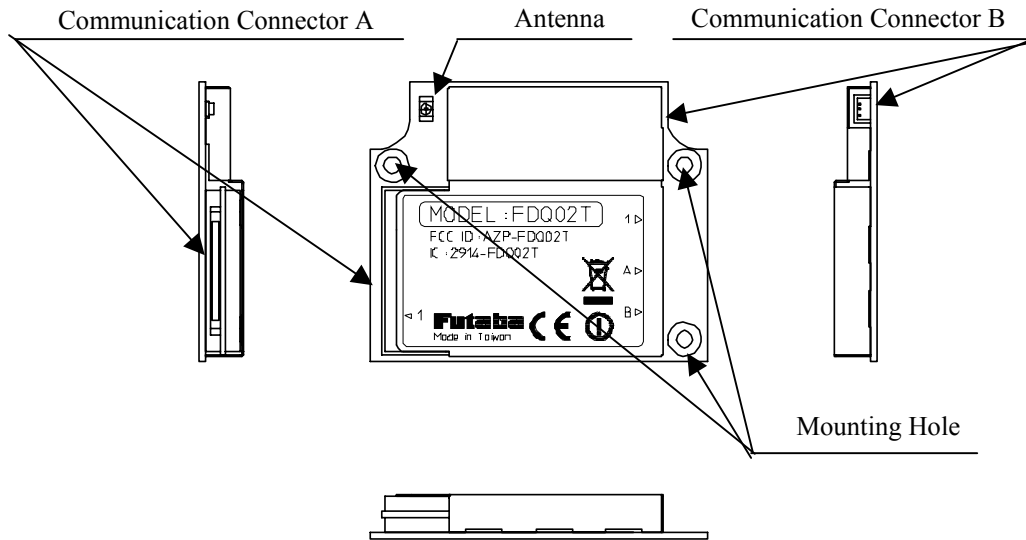


Figure 1–1: Upper View

- (1) Communication Connector A  
Used to connect to the DTE(Data Terminal Equipment) with interface cable. Also controlling functions such as *hardware reset* and *RS232C/RS485 selecting* pins are available. Signal is CMOS level.
- (2) Communication Connector B  
It is a power supply of power amplifier input.  
The control signal is input from the Communication Connector A.
- (3) Antenna Connector  
Used to connect to antennas for transmit and receive functions.
- (4) Mounting Hole  
Used to install a modem from the front surface. It is easy to install a modem, however, only three holes are available.

SECTION

2

**SYSTEM INSTALLATION**

## 2.1 Communication Cable Connection

Use the serial communication cable prepared by Futaba to connect the FDQ02T to the external terminal equipment. For the connection of the modem, see PIN ASSIGNMENT. The signal level of the FDQ02T is CMOS. If the interface of the equipment to be connected is RS232C or RS485, the level conversion circuit is required. Please connect connector A-12pin and B-2pin.

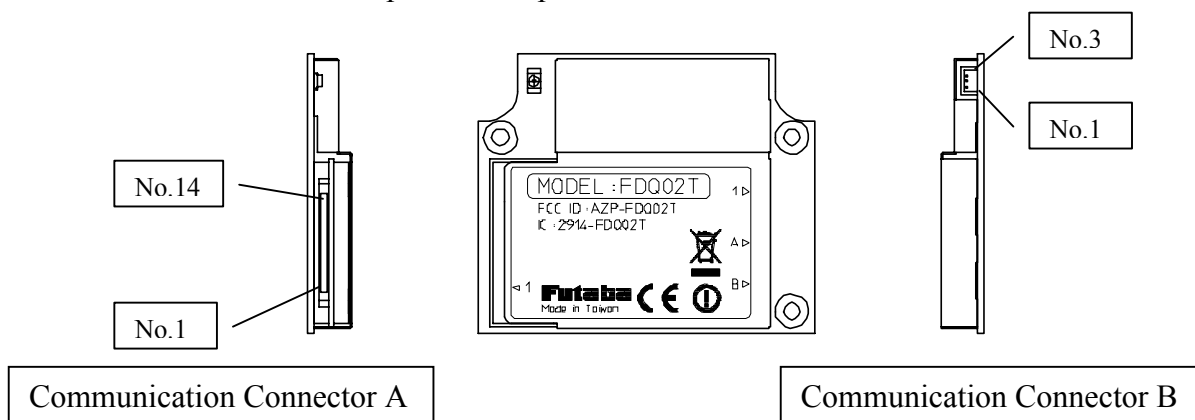


Figure 2-1: PIN ASSIGNMENT

Table 2-1 : PIN ASSIGNMENT ( Communication Connector A )

Pin No.	Name	I/O	Meaning	Terminal treatment
1	STAND-BY	Input	Standby mode transition/return	C-MOS
2	RxD	Output	Output received data	C-MOS
3	TxD	Input	Input transmitted data	47kΩ pull down
4	Reserved	Input	Do not use.	47kΩ pull down
5	GND	-	Signal ground	-
6	DSR	Output	Initialization completed	C-MOS
7	RTS	Input	Flow control	47kΩ pull down
8	CTS	Output	Flow control	C-MOS
9	Reserved	Input	Do not use.	47kΩ pull down
10	VCC	-	3.5V ~ 7.0V	-
11	POWER-ON	Input	Power on/reset	47kΩ pull down
12	RX/TX	Output	Set external amplifier to receiver or transmitter	C-MOS
13	/INIT	Input	Memory register initialization	47kΩ pull up
14	Reserved	Input	Do not use	47kΩ pull up

- (1) The terminals of the radio modem are based on the DCE (Data Communication Equipment) mode. Accordingly, the transmission corresponds to the input, while the reception corresponds to the output.
- (2) Only supplying the power to the number 10-pin does not activate the MODEM. Raise the number 11-pin to the Hi-level to turn on the modem. This operation works as a reset function as well.
- (3) The number 1-pin is used for controlling the standby mode.  
Lo: Communication mode / Hi: Standby mode

- Be sure to add a pull-down circuit externally. (Refer to the Standby mode)
- (4) The level of the number 6-pin turns to Hi-level when the modem gets ready to accept commands after the modem is turned on or reset. To use this function, add a pull-down circuit externally. (Refer to the Standby mode)
  - (5) The number 12-pin is used to control the external amplifier's transmission and reception.  
Lo: Transmission / Hi: Reception
  - (6) If the number 13-pin is at Lo-level when the modem is turned on or reset, the pin initializes the memory register and makes the modem start working.
  - (7) Do not connect anything to the number 14-pin.
  - (8) As the input terminals accept 5V, users can use this interface for 5V-systems.

**Table 2-2 : Signal definition**

Logic	Voltage	Signal
0 ( ON )	Lo	Space
1 ( OFF )	Hi	Mark

**Table 2-3 : PIN ASSIGNMENT ( Communication Connector B )**

Pin No.	Name	I/O	Meaning	Terminal treatment
1	VCC	-	6.0V ~ 9.0V	-
2	RX/TX	Input	Set receiver or transmitter	C-MOS
3	GND	-	Signal ground	-

**⚠WARNING**

Ensure that the FDQ02T modem power and the power to the equipment to be controlled is turned off before connecting or disconnecting the cable between them. This will help prevent accidental damage to the system and unexpected operation and/or injury.

**⚠CAUTION**

In addition to this manual, read the operation manual of a PC (Personal Computer) and PLC (Programmable Logic Controller) to be connected.

## 2.2 Reset signal

The reset signal at the number 11-pin (POWER-ON) is shown in the figure bellow. The reset conducted by the reset signal is equivalent to rebooting the power.

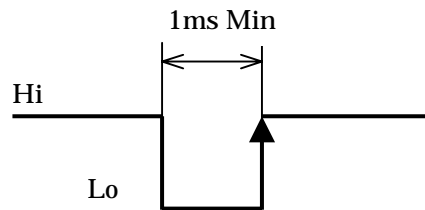
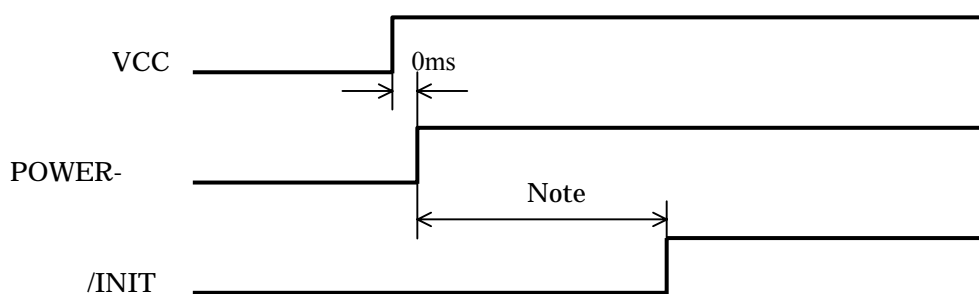


Figure 2-2 : Reset signal

## 2.3 Initialization time

- (1) The initialization time, which is between the time to turn on the modem and the time to accept the first command, is 150ms maximum.
- (2) When using the RST command to carry out the software-reset, it takes 100ms to reset the modem and accept the first command after entering the RST command.  
Note: This is based on the premise that the modem accepts the RST command while it is in the standby mode for reception.
- (3) When using the INT command to initialize the memory register, it takes 150ms or less to reset the modem and accept the first command after entering the INT command.  
Note: This is based on the premise that the modem accepts the INT command while it is in the standby mode for reception.
- (4) When using the /INIT pin to initialize the memory register, it takes 250ms or less to accept the first command after turning on the modem.  
The next figure shows the boot-up sequence to initialize the modem by the /INIT pin.



Note: Min 100ms for initialization (1000ms is recommended. Never use the modem with this level at Lo.)

Max 20ms for no initialization

Figure 2-3 : Initialization sequence

## 2.4 Other Installation Precautions

### 2.4.1 Modem Installation Precautions

#### **WARNING**

Securely attach the antenna cable, and *serial communication connector* to the FDQ02T and equipment/power source to which it is connected. Failure to not do so could cause an unexpected system failure.

#### **WARNING**

The FDQ02T is a precision electronic device. Its rugged design is intended for industrial applications. However, do not install it where it will encounter excessive vibrations. In some cases, isolation mounts may be used to isolate the modem from the equipment vibration. Excessive vibration could permanently damage the modem and/or cause it to malfunction.

#### **WARNING**

If the FDQ02T has been stored at a temperature beyond the specified operating temperature range for the system, it may not function properly. Allow it to return to normal temperatures before use. Refer to p.60 **SPECIFICATION** for the actual operating temperature range.

#### **WARNING**

Do not operate the FDQ02T in environments where it will be subjected to excessive moisture (such as rain or water spray), dust, oil or other foreign matter (such as metal particles). Doing so may permanently damage the modem and/or cause it to malfunction. If it does become wet or contaminated, correct the situation, verify proper operation and have any problems corrected before using it to control other equipment. If necessary, the modem can be mounted inside a protective or waterproof enclosure. If the enclosure is metallic, the antenna must be mounted externally or the effective operating range will be severely limited.

#### **WARNING**

The FDQ02T is designed for indoor use. When using it outdoors, the modem should be mounted in a waterproof enclosure and the ambient temperature range should be checked to insure that it is within the modem's specifications. Always use the modem within its specified environmental ranges.

## 2.4.2 Antenna Installation Precautions

### **⚠ 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.

### **⚠ WARNING**

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

### **⚠ CAUTION**

The FDQ02T operates at frequencies in the 2.4 GHz band. These frequencies are much directional than lower frequencies and are easily reflected. If there are metal structures nearby, the effective range may be shortened or the directional properties may be further narrowed. To help avoid this, mount the antenna as far away as possible from surrounding metallic structures.

### **⚠ CAUTION**

Multipath problems occur easily at 2.4 GHz frequencies. When multipath problems are present, moving the antenna as little as 10 cm may result in improved communication or, conversely, a further diminished or total loss of communication. Futaba recommends that the mounting position of the antenna be determined *after* testing and verifying optimal communication conditions.

### **NOTE**

Please contact Futaba for information about antenna separation when using the FDQ02T and other wireless products in the same area.



SECTION

3

**SYSTEM OPERATION**

### 3.1 Packet transmission mode

#### 3.1.1 Abstract

In the Packet Transmission mode, the communication is carried out by the follows procedure:

- (1) Once the power of the modem is turned on, the modem becomes the State for Reception.
- (2) The transmission command “TXT” or “TBN” makes the MODEM to the State for Transmission.
- (3) One transmission command can send one packet. The maximum length of the user’s message is 255 bytes for a packet.
- (4) Receiving a packet, the destination modem returns an “ACK” to the sender modem. Receiving the “ACK,” the sender modem ends the communication. The sender modem returns its response, which depends on the cause of success or failure in the communication. Meanwhile, the packet of a message that has failed to be transmitted will be destroyed.
- (5) Prior to sending messages consecutively, the modem checks the responses whether the previous transmission has been successful or not.
- (6) The modem returns to the State for Reception after finishing the transmission.

#### 3.1.2 T Transmission command and reception header

The transmission commands used for the Packet Transmission mode are “TXT”, “TXR”, “TBN” or “TBR.” Depending on the transmission commands, there are four different formats that are used to output received data to external equipment. The external equipment can find the data format by its reception header.

The “TXR” and “TBR” commands via repeater are not utilized for the modem, but are explained here for the future upgrade.

Table 3-1 : Transmission command and reception header

Transmission command	Reception header	Function
TXT	RXT	Transmit text data
TXR	RXR	Transmit text data via repeater
TBN	RBN	Transmit binary data
TBR	RBR	Transmit binary data via repeater

The followings are the input format of transmission data from the external equipment to the modem and the reception format from the modem to the external equipment.

#### (1) Text data transmission

Transmission : @TXT[destination address] [message] [CRLF]

Example : @TXT012HELLO [CRLF]

Reception : RXT[sender address] [message] [CRLF]

Example : RXT0015HELLO [CRLF]

(2) Text data transmission via repeater

Transmission : @TXT[repeater address] [destination address][message][CRLF]

Example : @TXT003012HELLO [CRLF]

Reception : RXT[repeater address] [sender address][message][CRLF]

Example : RXT003015HELLO [CRLF]

(3) Binary data transmission

Transmission : @TBN[destination address] [the number of bytes of the message]  
[message] [CRLF]

Example : @TBN012005HELLO [CRLF]

Reception : RBN[sender address] [the number of bytes of the message] [message]  
[CRLF]

Example : RBN015005HELLO [CRLF]

(4) Binary data transmission via repeater

Transmission : @TBN[repeater address] [destination address]  
[the number of bytes of the message] [message] [CRLF]

Example : @TBN003012005HELLO [CRLF]

Reception : RBN[repeater address] [destination address]  
[the number of bytes of the message] [message] [CRLF]

Example : RBN003015005HELLO [CRLF]

### 3.1.3 Broadcast communication

If the destination address is set to 255, the sender modem broadcasts to all the other modems, which is called broadcast communication. In the broadcast communication, the sender modem can transmit its data to multiple modems simultaneously. However, the modem cannot determine whether all the other modems have received the data without a failure because ACK is not returned from any of them in the broadcast communication. In the broadcast communication, the sender modem repeats retransmission inevitably up to the predetermined count and then returns an “end” response to its external equipment. Meanwhile, if the receiver modems have received data properly, the modems output the data to their external equipment. However, the modems do not output the retransmitted data to their external equipment if the data has been once accepted properly.

## 3.2 Header-less Stream mode

### 3.2.1 Abstract

The Header-less Stream mode, a special Packet Transmission mode, does not require the procedures for transmission commands that are necessary in the Packet Transmission mode, but requires only inputting transmission data directly.

- (1) The destination address can be set in memory register or by command.
- (2) The transmission triggers such as terminator, timeout and a specified number of bytes can be set in the memory register.
- (3) The maximum length of the message in a packet is 255 bytes , and the number is including terminator.
- (4) Receiving a packet, the destination modem returns an "ACK" to sender modem. Receiving the "ACK," the sender modem ends the communication.
- (5) The sender modem does not return any response regardless of success or failure in the communication. It is necessary for application software to checking the establishment of the communication.
- (6) Since the modem has a transmission buffer inside, you can enter transmission data consecutively without waiting the end of transmission like in the Packet Transmission mode.
- (7) This mode is compatible and can communicate with the Packet Transmission mode.

### 3.2.2 Format

The Header-less Stream mode does not output the responses such as P1, P0 and N1 in response to transmission commands. In addition, it doesn't output the reception header or CRLF code, which is used in the Packet Transmission mode, but outputs instead special characters (terminators), which are used as packet separators, as part of data.

The followings are the transmission and reception formats in the Header-less Stream mode.

- 1 . Packet Transmission mode ( Reference )  
Transmission : @TXT002HELLO [CRLF]  
Reception : RXT001HELLO [CRLF]
- 2 . Header-less Stream mode (When terminator is CRLF.)  
Transmission : HELLO [CRLF]  
Reception : HELLO [CRLF]
- 3 . Transmission in the Header-less Stream mode, Reception in the Packet Transmission mode ( text mode )  
Transmission : HELLO [CRLF]  
Reception : RXT001HELLO [CRLF] [CRLF]
- 4 . Transmission in the Header-less Stream mode, Reception in the Packet Transmission mode ( binary mode )  
Transmission : HELLO [CRLF]  
Reception : RBN001007HELLO [CRLF] [CRLF]
- 5 . Transmission in the Packet Transmission mode, Reception in the Header-less Stream mode  
Transmission : @TXT002HELLO [CRLF]  
Reception : HELLO

### 3.2.3 Transmission trigger

In the Header-less Stream mode, transmission starts under the following conditions.

(1) Terminator mode

A designated terminator or data of 255 bytes or larger is entered.

(2) Timeout mode

No data has been entered for more than the specified time or data of 255 or larger is entered.

### 3.3 Extended Reception mode

Extended Reception is a function to avoid transmission errors and response delays due to repetition of retransmissions when multiple modems transmit messages at the same time accidentally like contention mode in the Packet Transmission or Header-less Stream mode.

#### 3.3.1 Operations in the Extended Reception mode

In the Extended Reception mode, once a modem has started receiving data during retransmission (during ACK-wait, Random-wait and Carrier-sense), the modem will fully complete the data reception, return its "ACK" and then resume the retransmission. The following figure shows steps of operations in Extended Reception while the two modems transmit messages at the same time.

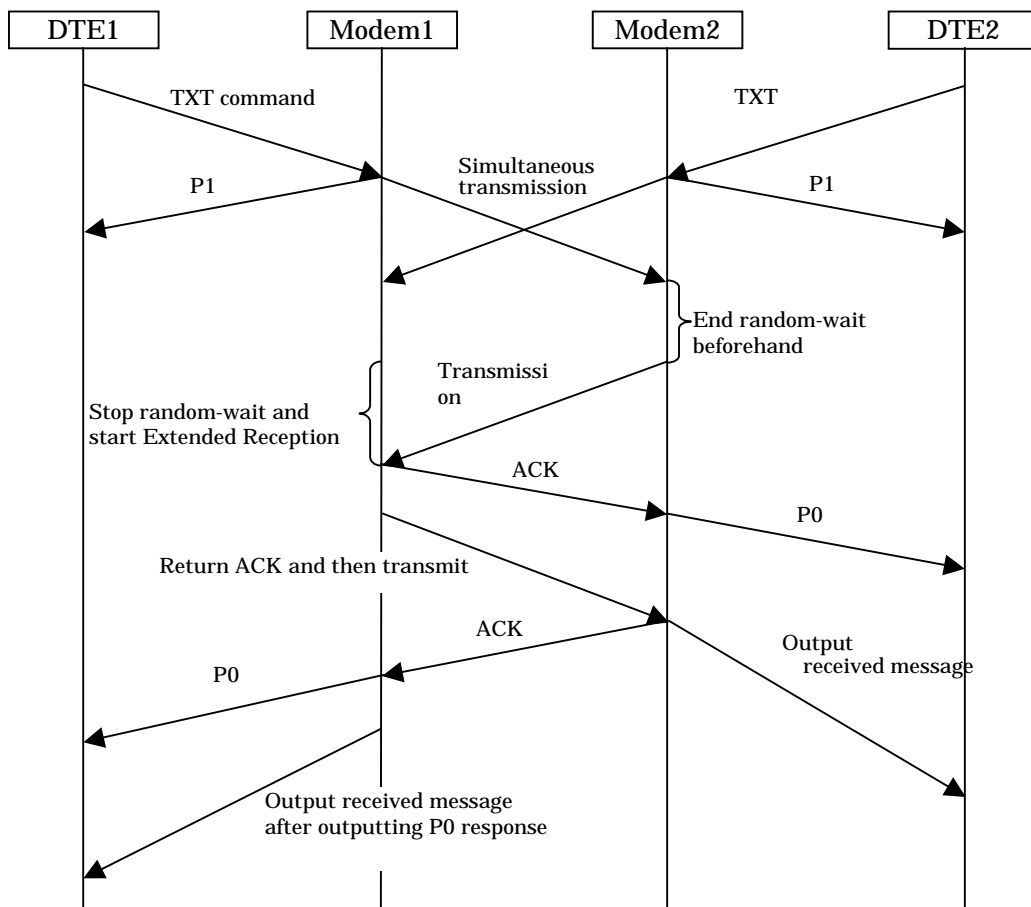


Figure 3-1 : Operations in the Extended Reception mode

- (1) The modem1 and 2 transmit messages at the same time.
- (2) Both modems wait for "ACK", but they time-out.
- (3) Of the two modems, the one that has finished the random-time earlier (modem2 in this case) retransmits its message.
- (4) Receiving a message retransmitted during the random-wait, the modem1 receives the whole message and then returns "ACK".
- (5) The modem1 does not output but keep its received message and transmits its own message.
- (6) The modem2 returns "ACK."
- (7) Receiving "ACK," the modem1 outputs P0 response and the received message.

### 3.3.2 Contention between transmission and reception

If a modem receives a transmission command during reception, the modem completes the reception, returns ACK and then starts processing the transmission command. Like the Extended Reception mode, the modem outputs the received message only after completing its transmission and outputting P0 response.

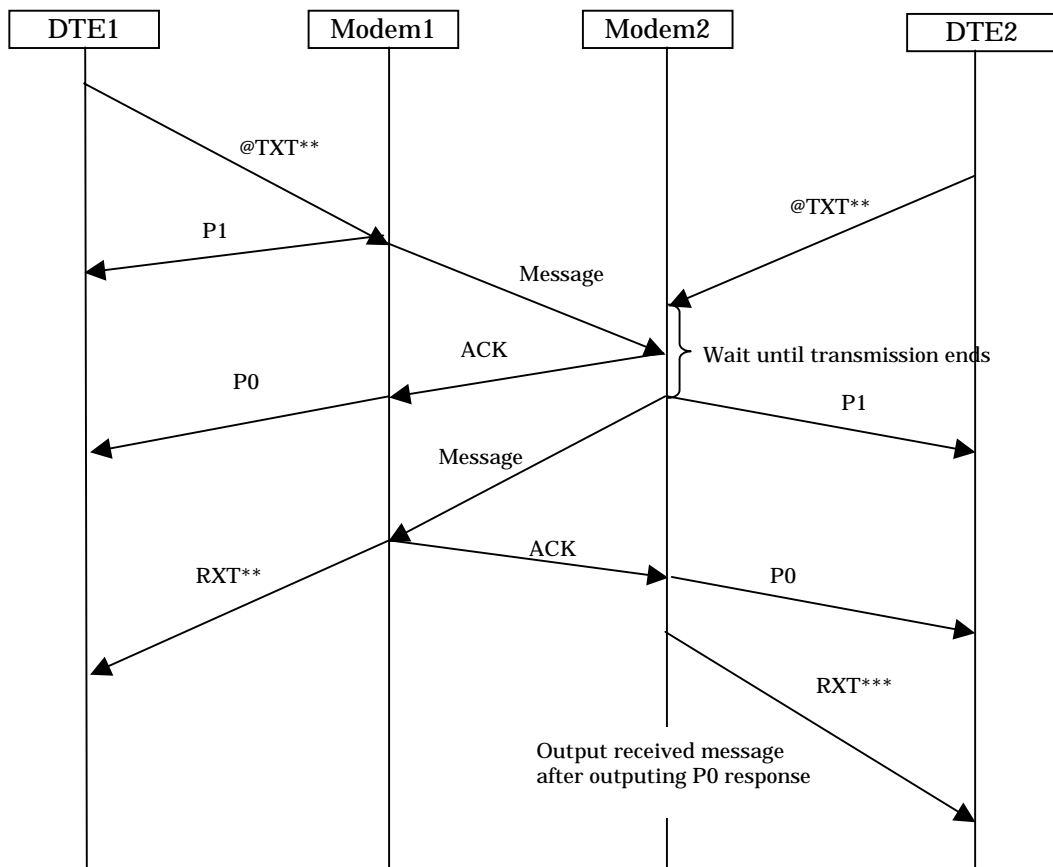


Figure3-2 : Contention between reception and transmission

### 3.4 Communication time

The time consumed for each communication sequence in the Packet Transmission mode is as follows.

#### (1) Time for entering a transmission command

The time consumed for entering a transmission command to the modem from its terminal depends on the communication parameters between them.

Parameters are:

- 1 . Transmission rate (300ps to 115.2kbps)
- 2 . Data length (7 or 8 bits)
- 3 . Parity bit (yes or none)
- 4 . Stop-bit length (one or two bits)
- 5 . Start-bit length (one bit)

For example, in the case of 9600bps for transmission rate, 8 bits for data length, no parity, one stop bit and one start bit, the time consumed for sending one bit will be 104 $\mu$ s. And the time for sending the data of a byte that consists of 10 bits will be 1.04ms.

In the case of sending a message data of ten bytes by “TXT” command, the time consumed for sending the message will be 19.8ms because the transmission format becomes “@TXT001ABCDEFGHJI [CRLF]”, which is 19 bytes.

#### (2) Time to generate a transmission packet

The internal processing time to generate a transmission packet after accepting a command is 1ms or less even though the length of the message data varies from 1 to 255 bytes.

In the Header-less Stream mode, it takes 2ms or less.

#### (3) Time for carrier sense

Prior to transmission, the modem checks SS correlation. If any SS correlation is detected within 0.1ms, the modem does not transmit any data.

#### (4) Time to switch between transmission and reception

The internal processing time consumed for switching transmission to reception or vice versa is approximately 0.07ms.

#### (5) Transmission time via radio

Depending on the number of bytes of a message data (1 to 255), the time consumed to transmit the message is obtained from the following calculation.

$$1.74\text{ms} + (\text{the number of bytes in the message}) \times 0.06\text{ms}$$

#### (6) Waiting time for “ACK”

This is the time consumed for waiting for “ACK” after completing transmission via radio. The waiting time is 2ms.

The modem determines that the transmission has failed if it could not receive “ACK” packet in that period of time. Then the modem waits for the random-wait time and then repeats the above steps starting from the carrier sense if the number of retransmissions has not reached the predetermined number. If there is no remaining number of retransmissions, the modem ends its transmission, outputting the response of “transmission failure”.

#### (7) Time to transmit “ACK” or “NAK”

The time consumed for transmitting “ACK” or “NAK” is 1.74ms.

#### (8) Time for random-wait

When SS correlation has been detected by carrier sense, or when retransmission is required due to the transmission failure, carrier sense will start only after waiting for the random time in order to avoid collisions between packets. The time for random-wait is from 1ms to 7ms.

(9) Time for reception process

Approximately 0.2ms is consumed for the receiver modem to check the address in the data and other information sent from the sender modem. The receiver modem recognizes the data having passed the check and outputs it to its terminal.

The next example shows an approximate time necessary for sending a message of 10 bytes when the parameters are 9600bps for transmission rate, 8 bits for data length, no parity, one stop bit and one start bit.

In this example that includes one retransmission, the modem1 enters into the Retransmission Routine because of no response from the modem2 after waiting for "ACK". In Retransmission Routine, the modem1 does a random-wait of 1ms to 7ms in order to avoid collisions between packets, and then restarts transmission.

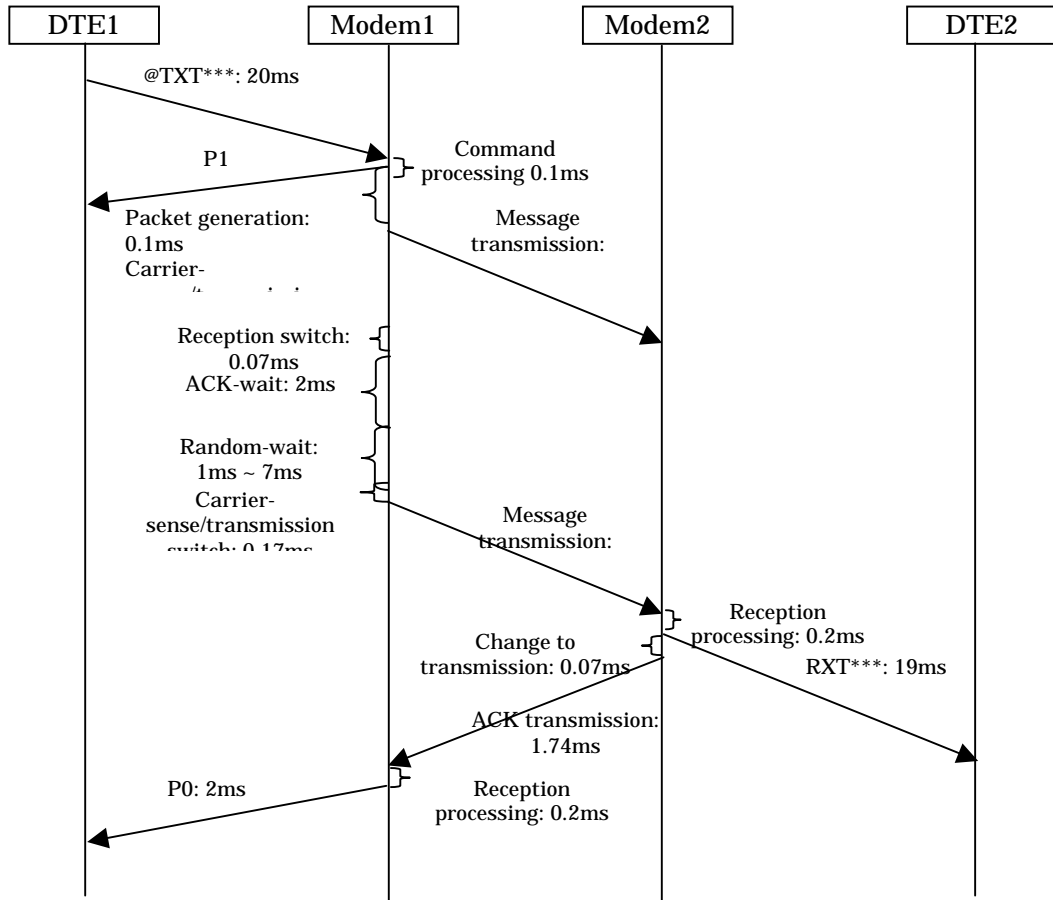


Figure 3-3 : Communication time in the Packet Transmission mode (an example)



### 3.5 Repeater function

This function is not installed in the modem at present. This section is only for explanation for the future upgrade.

#### 3.5.1 Abstract

Using repeaters is useful in extending communication area and eliminating dead-point area where radio signal intensity is insufficient.

The repeater function can coexist with the modem function. If a modem receives a packet whose “destination address” matches with the modem’s address, the modem outputs the received data to its external equipment. (Modem operation) If a modem receives a packet whose “repeater address” matches with the modem’s address, the modem transfers the packet. (Repeater operation)

If a modem is used as a repeater, there is no need for the modem to have its external equipment. When a conflict occurs between a transmission command and a transfer operation, the priority will be given to the one that emerged first. If a transfer request occurred afterward, the transfer is carried out after transmission. In contrast, if a transmission request occurred afterward, the transmission is carried out after transmission.

A repeater station, for its installation purpose, should be used as a master station. (Not mandatory)

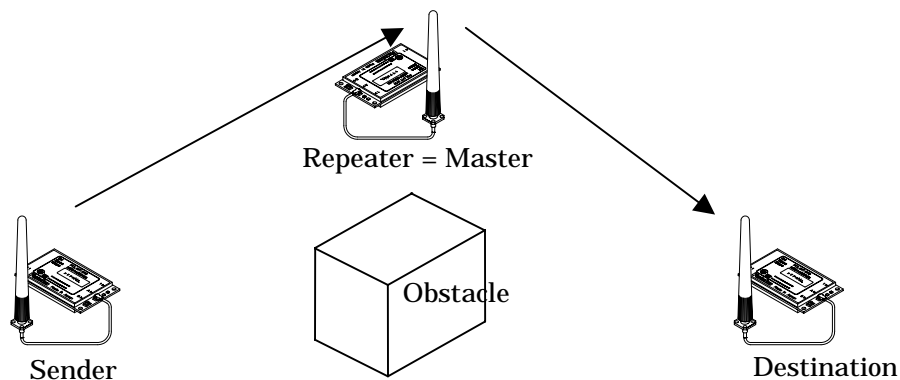


Figure 3-4: Repeater

#### 3.5.2 Repeater address

In the Packet Transmission mode, the repeater address is set by transmission command.

In the Header-less Stream mode, there are two ways bellow:

- (1) Setting by memory register
- (2) Setting by PAS command

#### 3.5.3 Communication time via repeater

The communication time through a repeater is about twice as long as the time consumed in the direct communication.

### 3.6 Frequency Channel

The FDQ02T can operate on 22 available frequencies between 2405.376 MHz and 2448.384 MHz with 2.048 MHz separation between each frequency.

See the table below for the exact frequency assignments.

Table 3-2 : Frequency Channel

Channel	Frequency(MHz)	Channel	Frequency (MHz)
2	2405.376	24	2427.904
4	2407.424	26	2429.952
6	2409.472	28	2432.000
8	2411.520	30	2434.048
10	2413.568	32	2436.096
12	2415.616	34	2438.144
14	2417.664	36	2440.192
16	2419.712	38	2442.240
18	2421.760	40	2444.288
20	2423.808	42	2446.336
22	2425.856	44	2448.384

SECTION

4

**FUNCTION CONTROL METHODS**

## 4.1 Interface

### 4.1.1 Pin Assignment

The figure below shows the pin location of the *serial communication connector*, following the DCE (Data Communication Equipment) specification.

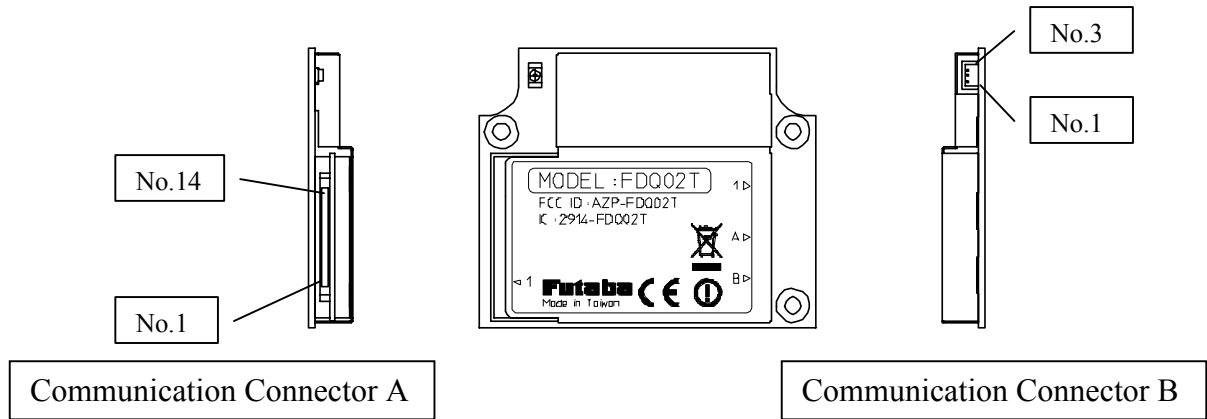


Figure 4–1: Serial Communication Connector Location

Pin No.	Name	I/O	Meaning	Terminal treatment
1	STAND-BY	Input	Standby mode transition/return	C-MOS
2	RxD	Output	Output received data	C-MOS
3	TxD	Input	Input transmitted data	47kΩ pull down
4	Reserved	Input	Do not use.	47kΩ pull down
5	GND	-	Signal ground	-
6	DSR	Output	Initialization completed	C-MOS
7	RTS	Input	Flow control	47kΩ pull down
8	CTS	Output	Flow control	C-MOS
9	Reserved	Input	Do not use.	47kΩ pull down
10	VCC	-	3.5V ~ 7.0V	-
11	POWER-ON	Input	Power on/reset	47kΩ pull down
12	RX/TX	Output	Set external amplifier to receiver or transmitter	C-MOS
13	/INIT	Input	Memory register initialization	47kΩ pull up
14	Reserved	Input	Do not use	47kΩ pull up

Table 4–1: Pin Descriptions

- (1) The terminals of the radio modem are based on the DCE (Data Communication Equipment) mode. Accordingly, the transmission corresponds to the input, while the reception corresponds to the output.
- (2) Only supplying the power to the number 10-pin does not activate the MODEM. Raise the number 11-pin to the Hi-level to turn on the modem. This operation works as a reset function as well.

- (3) The number 1-pin is used for controlling the standby mode.  
Lo: Communication mode / Hi: Standby mode  
Be sure to add a pull-down circuit externally. (Refer to the Standby mode)
- (4) The level of the number 6-pin turns to Hi-level when the modem gets ready to accept commands after the modem is turned on or reset. To use this function, add a pull-down circuit externally. (Refer to the Standby mode)
- (5) The number 12-pin is used to control the external amplifier's transmission and reception.  
Lo: Transmission / Hi: Reception
- (6) If the number 13-pin is at Lo-level when the modem is turned on or reset, the pin initializes the memory register and makes the modem start working.
- (7) Do not connect anything to the number 14-pin.
- (8) As the input terminals accept 5V, users can use this interface for 5V-systems.

**Table 2-2 : Signal definition**

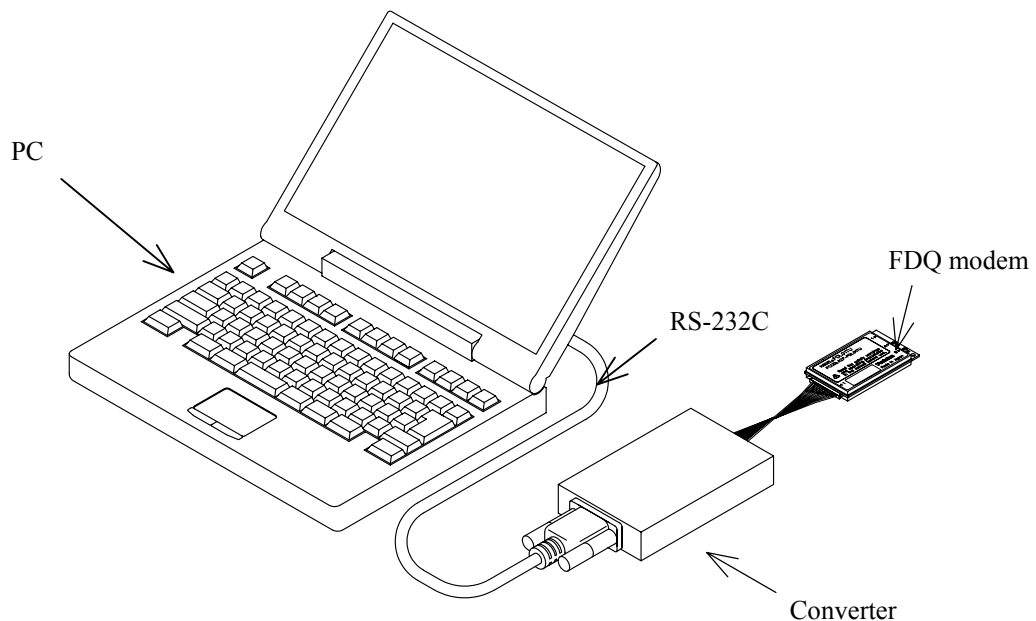
Logic	Voltage	Signal
0 ( ON )	Lo	Space
1 ( OFF )	Hi	Mark

## 4.2 Serial Interface Setting

For connecting the FDQ02T modem with an external terminal equipment, RS232C is appropriate for 1 to 1 topology. And set the *RS485 mode* to make RS485 multi-dropping topology for multiple equipment connection. Interface configuration can be made with Pin 12 (*RS485ENB*) of the *serial communication connector*.

To configure the *RS485 mode*, pull down Pin 12 with 10k ohm register. In this case, do NOT connect this pin DIRECTLY to the GND. This is because in *RS485 mode*, this pin will be as an output pin, after the initialization completes, to control the output buffer of the RS485 driver IC chip. As for the RS232C interface, no connection is required because it is pulled up inside.

Since the interface level of the FDQ02T modem is CMOS, the level conversion circuit must be provided outside for connecting it with the RS232C or RS485 interface.



**Figure 4-1: Connection Example to PC**

### 4.3 Terminal Software Setup for Memory Register Control

Communication or terminal software is necessary to set the *memory registers*. Nearly any PC communication software can be used. Launch the communication software and set the terminal's communication parameters as shown below. Refer to your specific communication software instructions how to set these parameters.

bit rate: 9600 bps  
data length: 8 bits  
stop bits: 1 bit  
parity bit: none  
flow control: none  
local echo: yes  
terminator: carriage return + line feed

### 4.4 Memory Register Setting

*Memory registers* set the operation mode and communication parameters of the modem and retain them in memory. All of the settings of the modem are made by these *memory registers*.

Since the *memory register* is based on rewritable non volatile memories, these memories can be readily rewritten by external terminal equipment such as PC and their contents will be kept even after the power is turned off. This non volatile memory can be rewritten about 1 million times.

#### 4.4.1 Memory Register Referencing and Setting

*Memory registers* are referenced and set with the REG command. (For more information, refer to REG section at p.39 **COMMAND SET DESCRIPTION**)

Example procedure:

1. To view the current value of register 00, enter: @REG00 CR/LF
2. Modem responds with 00H CR/LF (REG00 is assumed to be 00H in this case and varies in each setting case)
3. To set register REG00 to 0FH, enter: @REG00:0FH CR/LF
4. Modem responds with "P0" CR/LF
5. Enter "@RST CR/LF" or cycle the modem power, to activate new values

@ = command header (specify following characters are command)  
CR/LF = Terminator (carriage return + line feed)

#### CAUTION

When rewriting the modem's *memory registers*, do not turn the modem's power off until the modem returns "P0" response. If the power is interrupted before "P0" is returned, the memory contents may be lost or corrupted and the modem operation will be unpredictable.

**⚠ CAUTION**

If the memory contents are lost or corrupted, they can be restored to original default settings by reinitializing them. (See the section below titled p.25 **MEMORY REGISTER INITIALIZATION**)

**NOTE**

Input character arrays of commands quickly and sequentially. Too slow input (taking more than 5 seconds in the initial setting) results in *command error*.

#### 4.4.2 Memory Register Initialization

The *memory registers* can be restored to the *factory default* values at any time by using one of the following two methods.

##### 1) Memory Register Initialization by hardware:

Use either methods stated below, in which the modem attempts to read Pin 13 (/DefParam) of the *serial communication connector* at the startup and starts initializing the *memory registers* when it is “L”.

Method 1. Set “L” level to Pin 13 (/INIT) of the *serial communication connector* with the power turned off. When the power is re-supplied, the *memory registers* are initialized and the modem starts operation in the *factory default* state.

Method 2. Set “L” level to Pin 13 (/INIT) of the *serial communication connector* while the power turned on. In this state, force “L” to Pin 11 (POWER ON) of the *serial communication connector* more than 1ms, then return the level to “H”. The modem once becomes the *Shutdown mode* and returns to *Active mode*. Since this sequence is the same as the *reset*, the *memory registers* are initialized and the modem starts operation in the *factory default* state.

##### 2) Memory Register Initialization by Command:

1. With the modem power is on and the communication software running, enter “@INI CR/LF ” at the terminal prompt.
2. The modem responds with “P0” *response* and immediately begins to operate using the initialized *factory default* state.

**⚠ CAUTION**

While initializing the *memory registers*, do not turn the modem’s power off. It take about 1 sec. to initialize the *memory registers*.

## 4.5 Command Control

Some FDQ02T parameters can be changed by issuing commands from the terminal equipment. Various applications can be supported with the flexibility that command control offers.

### Command Entry

- When a command is issued to the modem from the terminal equipment, a *command header* (one byte character) should be used the modem to acknowledge the command from ordinary data. The *command header* is initially set to “@” (40H) but can be changed to another character by changing the value stored in the *memory register* REG10.
- Commands must use all upper case letters (A to Z). The modem does not recognize lower case letters (a to z) in commands.
- A two byte terminator (carriage return (0DH) + line feed (0AH)) is used to terminate a command. “CR/LF” shows the terminator in this manual. PC can send this two byte character with pressing ENTER key once using a communication software. But some setting is necessary in the software.
- The modem immediately executes a command once it’s recognized. If the command requires a *response*, the modem returns the *response* to the terminal equipment when its internal processing is completed.

The following is an example of a command entry and *response*:

```
@BCL CR/LF :command issued from the terminal equipment  
P0 CR/LF   : successive completion response is returned
```



SECTION

5

## MEMORY REGISTER DESCRIPTION

## 5.1 Memory Register Description

The FDQ02T modem contains 28 *memory registers* which are used to control and store communication parameters and operation mode settings. After rewriting new register settings, the power must be cycled, a hardware reset asserted, or a software RST command is issued to validate the new settings.

The following table briefly lists each register, register function and default value:

Register	Function	Default Value	Meaning
REG00	Own (sender) address	00H	Address 0
REG01	Reserved	F0H	-
REG02	Destination address	00H	Address 0
REG03	Special mode	F0H	Communication mode
REG04	ID code 1 ( low-order digits )	00H	Refer to REG04
REG05	ID code 2 (high-order digits)	00H	Refer to REG05
REG06	Frequency Pattern	00H	Pattern 0
REG07	Reserved	05H	-
REG08	Repeater address	FFH	Repeater invalid
REG09	Reserved	13H	-
REG10	Command header	40H	'@'
REG11	Retransmission count	32H	50 times
REG12	Reserved	B4H	-
REG13	Buffer data timeout	1EH	30 seconds
REG14	Command input timeout	32H	5 seconds
REG15	Command recognition interval	00H	0 second
REG16	Terminator 1	0DH	C R
REG17	Terminator 2	0AH	L F
REG18	Radio communication setting 1	8CH	Refer to REG18
REG19	Radio communication setting 2	00H	Refer to REG19
REG20	Wired communication setting 1	05H	Refer to REG20
REG21	Wired communication setting 2	09H	Refer to REG21
REG22	Wired communication setting 3	00H	Refer to REG22
REG23	Wired communication setting 4	00H	Refer to REG23
REG24	Special communication setting 1	C0H	Refer to REG24
REG25	Special communication setting 2	40H	Refer to REG25
REG26	Data input timeout	00H	Terminator valid
REG27	reserved	00H	-

Table 5–1: Memory Registers

Suffix 'H' of each default value denotes HEX radix expression in the value.

**REG00: Own (sender) address** **[default value: 000]**

---

- This register is used to set the address of a modem. Valid values are from 000 to 254.
- The value in this register is used as a sender address in every data packet being sent.
- When the address-check function is used, it is possible to receive a packet if the packet contains such value as a destination address.

**REG01: Reserved** **[default value: 240]**

---

- The FDQ02T does not use this register. Keep the default value as it is.

**REG02: Destination Address** **[default value: 000]**

---

- In the Header-less Stream mode, this register is used to set the address of a destination modem. Valid values are from 000 to 255.
- This destination address is attached to every data packet to be sent.
- When using the address-check function, set the destination address in this register. When using the “DAS” command, however, the address defined by the “DAS” command is always prioritized.
- The destination address 255 represents the broadcast communication.

**REG03: Special mode** **[default value: F0H]**

---

- This register is used to set a special operating mode. The default is the Communication mode.

**REG04: ID Code 1** **[default value: 00H]**

---

- Used with ID code 2 (REG05), set the ID code. Valid values are 000 to 255. Together with ID code 2, up to 65535 ID codes can be set.
- The ID code identifies the group of the modems works in the same group. The ID code is used to prevent erroneous connection with other systems and for communication security.
- Before transmission, *radio data packets* are scrambled using a pseudo-random data sequence generated with this ID code as the seed. During reception, the original data is restored by de-scrambling it with the pseudo-random data sequence. The modems with different ID codes cannot communicate with each other.

**REG05: ID Code 2** **[default value: 00H]**

---

- Used with ID code 1 (REG04), set the ID code. Valid values are 000 to 255. Together with ID code 1, up to 65535 ID codes can be set.
- In case plural modems are used as a single system, always set the same ID code for all modems and *repeaters*.

**REG06: Frequency pattern** **[default value:00H]**

---

- This register is used to set a frequency pattern. The valid values are from 00H to 15H.
- To establish communication in a system, the same frequency pattern should be used. In contrast, to let multiple systems operate in the same area, each system should have different frequency patterns.
- When using multiple systems in the same area, frequencies may periodically match and interfere with each other even if the systems are using different frequency patterns.

**REG07: Reserved** **[default value: 05H]**

---

- The FDQ02T does not use this register. Keep the default value as it is.

**REG08: Repeater Address** **[default value: FFH]**

---

- This register is used to set repeater address when using repeater in the Header-less Stream mode.
- When not using repeater, set “FFH” at this register, making the communication direct.

**REG09: Reserved** **[default value: 13H]**

---

- The FDQ02T does not use this register. Keep the default value as it is.

**REG10: Command Header** **[default value: 40H]**

---

- Sets the character that identifies the start of a command.
- The default is character “@” (40H).
- When this character is input from the terminal equipment after no character is received for the *command recognition interval* (REG15) or longer, subsequent input character is recognized as a command for the modem.

**REG11: Retransmission Count** **[default value: 32H]**

---

- Sets the maximum *number of packet retransmission* attempts. Valid values are 000 to 255.
- When retransmission exceeds the *retransmission count* (*retransmission count* plus one), the modem outputs an *error response* to the terminal equipment.

**REG12: Reserved** **[default value: B4H]**

---

- The FDQ02T does not use this register. Keep the default value as it is.

**REG13: Buffer Data Timeout****[default value: 1EH]**

- This register is used to set the waiting time to clear the content of the buffer after the last change in the buffer.
- Valid values are from 000 to 255 seconds with an increment of 1 second. The default value is 30 seconds.
- If the Buffer Data Timeout is not necessary, set it at “0.”
- This value should be longer than the Data Input timeout (REG26).

**REG14: Command Input Timeout****[default value: 32H]**

- Sets the character *input timeout interval for command input*. It is used as the *timeout* between the *command header* and the character following it and between each character of the command.
- At the timeout, the modem operation transits from *command-input-state* to *data-wait-state*.
- Valid values are 000 to 255, representing tenths of seconds in 0.1 second increments. (Set an integer value equal to ten times the number of seconds desired.)
- A setting of 000 disables this *timeout function*

**REG15: Command Recognition Interval****[default value: 00H]**

- When a message data contains a *command header* character (in case of binary data or data in two-byte Chinese characters), data following the *command header* character will be interpreted as a command, the message does not transmit properly.
- Sets the necessary vacant duration *time interval* to discriminate between ordinary data character and a *command header* character. Input a command after a longer interval than *time interval* setting.
- Valid values are 0.1 to 25.4 sec., representing tenths of seconds in 0.1 second increments. (Set an integer value equal to ten times the number of seconds desired.)
- When set to 000, the *command header* is recognized at any time, and when set to 255, all *command header* character are ignored.

**REG16: Terminator 1****[default value: 0DH]**

- Set an arbitrary 1 byte *terminator*. In case of a *2-byte terminator*, set the first byte character of the *terminator*.

**REG17: Terminator 2****[default value: 0AH]**

- Set another arbitrary 1 byte *terminator*. In case of a *2-byte terminator*, set the last character of the *terminator*.

**Bits 7 – 6: Protocol**

bit 7	bit 6	Setting
0	0	Data transparent mode
0	1	Reserved
1	0	Packet transmission mode
1	1	Headerless stream mode

Table 5–7: Protocol

**Bits 5: Reserved**

- The FDQ02T does not use this register. Keep the default value as it is.

**Bit 4 Transmission format**

0	transmit in the text form (default value)
1	transmit in the binary form

Table 7–4 Transmission format

- Selects the *transmission format*. When data are transmitted to the *destination station* which is set to the normal *packet transmission mode*, output text format (RXT, RBN) from the receiver modem (*destination station*) differs depend on this setting.
- This setting does not effect in the receiver modem set as *headerless stream mode*.

**Bits 3 – 2 Terminator Setting**

bit 3	bit 2	setting
0	0	two kinds of arbitrary 1 byte code (REG16, REG17)
0	1	arbitrary 1 byte code (REG16) + a wild card (any character)
1	0	arbitrary 2 byte code (REG16 + REG17)
1	1	carriage return (CR) + line feed (LF) (default value)

Table 7–5 Terminator setting

- Sets the *terminator* to identify the breakpoint of a packet. The modem transmits data considering this character as the breakpoint of a packet.
- In case of using an arbitrary terminator, set it to REG16 and 17.

**Bit 1: Source address check**

0	Inhibit source address checking (default value)
1	Activate source address checking

Table 5–4: Source Address Check Settings

- When the *source address checking* is active and the *source address* in the received *packet header* does not match the *destination address setting* (REG02), the data is discarded (data cannot be received).

**Bit 0: Destination address check**

0	Inhibit destination address checking on receipt (default)
1	Activate destination address checking on receipt

Table 5–5: Destination address check

- When the *destination address checking* is active and the *destination address* in the received *packet header* does not match the received modem’s *local station address* (REG00), the data is discarded (data cannot be received).

**REG19: Communication Setting 2**

**[default value: 00H]**

**Bit 7 - 6: Reserved**

- The FDQ02T does not use this register. Keep the default value as it is.

**Bit 5: Broadcast Reception**

0	Enable broadcast transmission reception (default value)
1	Disable broadcast transmission reception

Table 5–7: Broadcast Reception Settings

- Enable/disable reception of *broadcast transmission* in *packet transmission mode* (Mode 3 and 5).

**Bit 4 - 2: Reserved**

- The FDQ02T does not use this register. Keep the default value as it is.

**Bit 1: Master/Slave**

0	Slave station (default)
1	Master station

Table 5–11: Master/Slave

- There should be no more or no less than one master station among a group of modems that communicate each other. The number of slave stations can be up to the number defined by the REG00. (253 Max)
- The master station transmits beacon as a reference.

**Bit 0: Reserved**

- The FDQ02T does not use this register. Keep the default value as it is.

**Bit 7: Data Length**

0	8 bit data bytes (default value)
1	7 bit data bytes

Table 5–13: Data Length Settings

**Bit 6: Parity Bit**

0	No parity bit (default value)
1	Parity bit

Table 5–14: Parity Settings

**Bit 5: Even/Odd Parity**

0	Even parity (default value)
1	Odd parity

Table 5–15: Odd/Even Parity Settings

- Invalid when bit 6 is set to 0, without parity.

**Bit 4: Stop Bit**

0	1 stop bit (default value)
1	2 stop bits

Table 5–16: Stop Bit Settings

**Bits 3 – 0: Baud rate setting**

Bit 3	Bit 2	Bit 1	Bit 0	Setting
0	0	0	0	300 bps
0	0	0	1	600 bps
0	0	1	0	1200 bps
0	0	1	1	2400 bps
0	1	0	0	4800 bps
0	1	0	1	9600 bps (default)
0	1	1	0	19200 bps
0	1	1	1	38400 bps
1	0	0	0	Reserved
1	0	0	1	Reserved
1	0	1	0	Reserved
1	0	1	1	Reserved
1	1	0	0	57600 bps
1	1	0	1	115200 bps
1	1	1	0	Reserved
1	1	1	1	Reserved

Table 5–17: Baud Rate



**REG21: Wired communication Setting 2****[default value: 09H]****Bits 7 – 5: Reserved**

- The FDQ02T does not use this register. Keep the default value as it is.

**Bit 4: Command Header**

0	Use REG 10 character
1	Use Break signal

Table 5–16: Command Header

**Bit 3 - 2: Reserved**

- The FDQ02T does not use this register. Keep the default value as it is.

**Bit 1: Flow Control**

0	Software flow control (default value)
1	Hardware flow control

Table 5–18 Software/Hardware Flow Control Settings

- Selects the flow control method. This setting must match the connected terminal equipment's setting.
- *Hardware flow control* uses the two *control lines RTS* and *CTS*. When using with the RS485 interface, be sure to set to 0.
- *Software flow control* uses XON and XOFF codes.

**Bit 0: Reserved**

- The FDQ02T does not use this register. Keep the default value as it is.

**REG22: Wired communication Setting 3****[default value: 00H]****Bit 7: Enable and Disable Reception**

0	Enable reception at the initial state (default value)
1	Disable reception at the initial state

Table 5–19: Enable/Disable Reception

- The initial state is in *reception enable*. Depending on an usage of the modem, the initial state of the modem may be better in the *reception disable* state. In such a case, use this setting.
- Issue the REN command to enable reception.

**Bit 6 - 0: Reserved**

- The FDQ02T does not use this register. Keep the default value as it is.

**Bit 7 - 5: Reserved**

- The FDQ02T does not use this register. Keep the default value as it is.

**Bit 4 : CR/LF addition/deletion**

## (1) Setting at the headerless stream mode

0	does not add CR/LF code to the received data (default value)
1	adds CR/LF code to the received data

Table 7–6: Addition of CR/LF code

- In the *headerless stream mode*, setting is made whether the CR/LF character is added to the received data or not.
- In the communication between the modems set to the *headerless packet mode*, this setting is invalid because the *terminator* is originally added to the transmit data. However, when a packet is received from the modem in the *packet transmission mode*, there is no addition of the CR/LF *terminator*. In this case, set this bit to 1. Then the received packet is output with the CR/LF character is added.

## (2) Setting at the packet transmission mode

0	adds the CR/LF to the received data (default value)
1	does not add the CR/LF to the received data

Table 7–7: Deletion of CR/LF character

- In the *packet transmission mode*, setting is made whether the CR/LF character is added to the received data or not.
- At the receiver modem (set to the *packet transmission mode*), the sender (set to the *headerless stream mode*) side *terminator* (CR/LF character as default) plus *packet transmission mode terminator* (CR/LF) are output. To avoid such redundant outputs, set this bit of the modem in the normal *packet transmission mode* to 1.

**Bit 3 - 0: Reserved**

- The FDQ02T does not use this register. Keep the default value as it is.

**REG24: Reserved** **[default value: C0H]**

---

- The FDQ02T does not use this register. Keep the default value as it is.

**REG25: Reserved** **[default value: 40H]**

---

- The FDQ02T does not use this register. Keep the default value as it is.

**REG26: Data input timeout** **[default value: 00H]**

---

- Sets the vacant duration time interval to recognize as the end of the message data input in the headerless stream mode.

**REG27: Reserved** **[default value: 00H]**

---

- The FDQ02T does not use this register. Keep the default value as it is.



SECTION

6

**COMMAND SET DESCRIPTION**

## 6.1 Command Set Description

This section provides a description of each command available in the FDL command set. The table below lists each command and its applicability in each operation mode.

	Command	Function
1	ARG	Reference All Memory Registers
2	BCL	Clear Transmit and Receive Buffers
3	DAS	Reference and Set the Destination Address
4	DBM	Read Signal Strength
5	HOP	Refer to or set frequency pattern
6	INI	Initialize All Memory Registers
7	ODA	Disable Received Data Output
8	OEN	Enable Received Data Output
9	PAS	Reference and Set Repeater Address
10	RDA	Disable Wireless Reception
11	REG	Reference and Set Memory Registers
12	REN	Enable Wireless Reception
13	RID	Display Received Serial ID
14	RNO	Reference and Set Retransmission Count
15	ROF	RF Circuit Block Power Down
16	RON	RF Circuit Block Power Up
17	RST	Reset
18	SAS	Reference and Set Local Station Address
19	STS	Read Status
20	TBN	Transmit Binary Data
21	TBR	Transmit Binary Data Through Repeater
22	TID	Display Local Station Serial ID
23	TS2	Test radio link
24	TXR	Transmit Text Data Through Repeater
25	TXT	Transmit Text Data
26	VER	Reference Version Information

Table 6–1: Command to Mode Availability

The symbols used in this section have the following meaning:

- > : Input character from the terminal equipment to the modem
- < : Output from the modem to the terminal equipment
- @ : *Command header*
- CR/LF : *Terminator* (carriage return + line feed)
- [ ] : Required input parameter/s Be sure to input.
- ( ) : Optional input parameter/s May be omitted
- { } : *485 mode local station address (REG00)*. Be sure to input at *485 mode*

In the *Syntax* and *Response* segments of the following command descriptions the *terminator* symbol (CR/LF) has been omitted for clarity.

**Syntax**

ARG{Local Station Address}

Local Station Address : *local station address* for *485 mode* (000 to 999).

**Response**

All settings are indicated (REG00 to REG27)

N0: *command error* (Except *485 mode*)

**Function**

Recalls the contents of all 28 *memory registers*.

**Example**

>@ARG CR/LF : Recall the contents of all the *memory registers*

<REG00 : 001 CR/LF : Consecutive output of register contents

<REG01 : 240 CR/LF : Register values output in hexadecimal codes

<REG02 : 002 CR/LF

<REG03 : F0H CR/LF

|

<REG26 : 00H CR/LF

<REG27 : 00H CR/LF

**Syntax**

BCL{Local Station Address}

Local Station Address : *local station address* for *485 mode* (000 to A22).

**Response**

P0 : command accepted

N0 : *command error* (Except *485 mode*)

**Function**

On *headerless stream mode*, clears the contents of the transmit and receive buffers of the modem.

**Example**

>@BCL CR/LF : clear the buffer contents

<P0 CR/LF : command accepted

**Example**

>@BIV025 CR/LF : Set the *receiving (transmission) interval* at 250 ms

<P0 CR/LF : command accepted

>@BIV CR/LF : Refer the current value

<025 CR/LF : 025 (25 0ms) returns

**Notes**

Values set by the BIV command will be lost by turning the power on or resetting.

Generally, this parameter is no need to modifying. Use with the default value.

**Syntax**

DAS(set destination address)

set destination address : the desired *destination address* (000 to A23)

**Response**

xxx : current value (reference)  
 P0 : command accepted (setting)  
 N0 : *command error*

**Function**

References or sets the *destination address* of the modem connection established with in the *data transparent mode* and *headerless stream mode*

The current DAS value can be referenced by entering the command with no parameter.

The DAS command is used for temporary modifying *destination address*. Change the value of REG02 to change the default value.

**Example**

```
>@DAS002 CR/LF      : set the destination address to 002
<P0 CR/LF          : command accepted
>@DAS CR/LF        : reference the destination address
<002 CR/LF         : current value output (002)
```

**Notes**

This command cannot be used in *packet transmission mode*.

The *local station address* (REG00) must be set to communicate with the remote modem. Communication cannot be established unless the *addresses* coincide with each other.

This command is not allowed to use in *485 mode*.

**Syntax**

DBM{Local Station Address}

Local Station Address : *local station address* for *485 mode* (000 to 999).

**Response**

-xxxdBm : signal strength  
 N0 : *command error* (Except *485 mode*)

**Function**

Reads the *received signal strength* and outputs the value in dBm.

Higher values represent stronger *signal strength* and better receiving conditions.

**Example**

```
>@DBM CR/LF          : read signal strength
<-78dBm CR/LF       : signal strength is -78dBm.
```



## Notes

The range available for measurement is –40 dBm to –100 dBm. Since the *signal strength* indication has a slight error in its value, use this result for your ‘rule of a thumb’ reference.

This command outputs the *strength* of last *received packet*.

## HOP

## Refer to or set frequency pattern

---

### Syntax

HOP  
HOP(:pattern number)  
Pattern number : 00 ~ 21

### Response

xx : when referring  
P0 : normal end (when setting)  
N0 : command error

### Function

This command refers to or sets frequency pattern.

To refer to the current setting, enter this command alone. To set a pattern number, enter this command with the pattern number.

Setting frequency pattern once releases synchronization.

The setting by this command is temporarily effective. It returns to the value defined by the REG06 after resetting.

### Example

>@HOP CR/LF : reference the *pattern number*  
<00 CR/LF : output value (*pattern number* 00)  
>@HOP:21 CR/LF : set *pattern number* to 21.  
<21 CR/LF : output value (*pattern number* 21)

## INI

## Initialize All Memory Registers

---

### Syntax

INI{Local Station Address}

Local Station Address : *local station address* for *485 mode* (000 to A22).

### Response

P0 : command accepted  
N0 : *command error* (Except *485 mode*)

### Function

Sets the all contents of the *memory registers* to the factory default values.

### Example

>@INI CR/LF : initialize all memory registers  
<P0 CR/LF : command accepted

## Notes

Custom settings of all *memory registers* are lost when this command is executed.

If the *group address* (REG01) is designated while RS485 multi-drop connection is being made in the *RS485 mode*, the *local station address* of all modems will be initialized to 000. Exercise care when issuing this command.

For a list of the *factory default values*, see the section titled p.27 **MEMORY REGISTER DESCRIPTION**.

## ODA

## Disable Received Data Output

---

### Syntax

ODA{Local Station Address}

Local Station Address : *local station address* for *485 mode* (000 to A22).

### Response

P0 : command accepted

N0 : *command error* (Except *485 mode*)

### Function

*Disables output* of any data received via the wireless link to the terminal equipment.

Data received, while output is disabled, is stored in the receive buffer.

When the modem's power is turned on (or a reset), the modem is in the state to *enable the received data output*.

### Example

>@ODA CR/LF : *disable* the output of received wireless data  
<P0 CR/LF : command accepted

(Data is not output during this period even if received.)

>@OEN CR/LF : *enable* the output of received wireless data.  
<P0 CR/LF : command accepted  
<RXT002HELLO CR/LF : outputs data stored in the receive buffer  
<RXT003MAIL CR/LF :

## OEN

## Enable Received Data Output

---

### Syntax

OEN{Local Station Address}

Local Station Address : *local station address* for *485 mode* (000 to A22).

### Response

P0 : command accepted

N0 : *command error* (Except 485 mode)

### Function

*Enables output* of any data received via the wireless link to the terminal equipment.

This command enables serial data output after it has been disabled with the ODA command.

When the modem's power is turned on (or a reset), the modem is in the state to *enable* the *received data output*.

### Example

>@ODA CR/LF : *disable* serial output of received wireless data  
<P0 CR/LF : command accepted

(Data is not output during this period even if received.)

>@OEN CR/LF : *enable* serial output of received wireless data.  
<P0 CR/LF : command accepted  
<RXT002HELLO CR/LF : outputs data stored in receive buffer  
<RXT003MAIL CR/LF : and any new data received

## PAS

## Reference and Set Repeater Address

---

### Syntax

PAS (:Repeater Address1 :Repeater Address2)

Repeater Address : *repeater address* to pass through

### Response

xxx : xxx : current address (reference)  
P0 : command accepted (setting)  
N0 : *command error*

### Function

In the *headerless stream mode*, references and sets the *repeater address* to pass through

When no *repeater address* is set, the current setting can be referenced.

This command is used to temporarily change *repeater address*. To change the default value, change REG13.

### Example

>@PAS CR/LF : references the current *repeater address*  
<004 : A00 CR/LF : current *repeater address* is 004  
<P0 CR/LF : command accepted  
< @PAS:002:A00 CR/LF : sets the *repeater address* to 002  
<P0 CR/LF : command accepted

### Notes

This command is not allowed to be used in *485 mode*.

**Syntax**

RDA{Local Station Address}

Local Station Address : *local station address* for 485 mode (000 to A22).

**Response**

P0 : command accepted  
 N0 : *command error* (Except 485 mode)

**Function**

*Disables wireless reception in the packet transmission mode.*

The status when the modem is powered ON or reset follows bit 7 of REG22.

**Example**

```
>@RDA CR/LF      : disable wireless reception
<P0 CR/LF       : command accepted

>@REN CR/LF     : enable wireless reception
<P0 CR/LF       : command accepted
```

**REG****Reference and Set Memory Register****Syntax**

REG[register number]( : value) {;Local Station Address}

register number : *register* number to be set (00 to 27)  
 value : value to be set. Input 2 hexadecimal digits (0 through 9 and A through F) followed by the number radix designator H.  
 Local Station Address : *local station address* for 485 mode (000 to A22 ).

**Response**

xxx : current value (reference)  
 P0 : command accepted (setting)  
 N0 : *command error* (Except 485 mode)  
 N6 : memory register write error

**Function**

References or sets *memory registers*.

The current *register* value is referenced by omitting the “value” parameter.

**Example**

```
>@REG00 CR/LF    : reference the contents of register 00
<01H CR/LF      : displays current value
>@REG00 : 023 CR/LF : set value of memory register 00 to 023 (decimal)
<P0 CR/LF       : command accepted
```

**Notes**

The *register* can be rewritten sequentially. However, to make its parameter valid after rewriting it, re-supply the power, reset the modem or use RST command.

While rewriting the *memory register*, do not turn off the power until *response* is output. Otherwise, the *memory registers* content may be collapsed.

When the *response* of the *memory register write error* is output, set the values after initializing the *memory register*.

## REN

## Reception Enable

---

### Syntax

REN{Local Station Address}

Local Station Address : *local station address* for *485 mode* (000 to A22).

### Response

P0 : command accepted

N0 : *command error* (Except *485 mode*)

### Function

*Enables* wireless reception in the *packet transmission mode*.

The status when the modem is powered ON or reset follows bit 7 of REG22.

Use this command to *enable wireless reception* after reception is disabled with the RDA command.

### Example

>@RDA CR/LF : *disable wireless reception*

<P0 CR/LF : command accepted

>@REN CR/LF : *enable wireless reception.*

<P0 CR/LF : command accepted

## RID

## Display Received Serial ID

---

### Syntax

RID{Local Station Address}

Local Station Address : *local station address* for *485 mode* (000 to 999).

### Response

XXXXXXXXXXXX : displays the received *serial ID code* ( 12 digits )

N0 : *command error* (Except *485 mode*)

### Function

Outputs the *serial ID code* in the received packet and displays it.

The *serial ID code* consists of 12 digits; upper three digits are 0 and the lower 9 digits are the *product serial number* of the transmitted-end modem.

Be noted that the *serial ID code* of the packet received last is displayed. When packets are received from multiple stations and their data are stored in the receiving buffer, those data may not be correspond to the *serial ID code* readout with RID command.

To use it more securely, it is recommended to readout the *local serial ID code* with TID command and pad it (either all or a part of it) in the transmitting packet.

When no packet is received, “All Zero” is displayed as the result of this command execution.

The *serial ID code* is no relation with *ID code* setting of REG04 and 05.

### Example

>@RID CR/LF : requests the received remote station's *serial ID code*  
<XXXXXXXXXXXXX CR/LF : outputs the received remote station's *serial ID code*

---

## RNO Reference and Set Retransmission Count

### Syntax

RNO (:Retransmission count) {; Local Station Address}

Retransmission count : maximum *number of retransmissions* (000 to 255)

Local Station Address : *local station address* for 485 mode (000 to A22).

### Response

xxx : current set value  
P0 : command accepted  
N0 : *command error* (Except 485 mode)

### Function

This command references or sets the *number of retransmissions (retransmission count)* to attempt before making decision as transmission failure.

The current value can be referenced by issuing the command with no parameter.

RNO command is used to temporarily change the *retransmission count*. To change the default value, change the setting of REG11.

### Example

>@RNO CR/LF : reference the *retransmission count*  
<050 CR/LF : output the current set value (50 times)  
>@RNO010 CR/LF : set the *retransmission count* to 10 times  
<P0 CR/LF : command accepted

---

## ROF RF Circuit Block Power Down

### Syntax

ROF {Local Station Address}

Local Station Address : *local station address* for 485 mode (000 to A22).

### Response

P0 : command accepted  
N0 : *command error* (Except 485 mode)

### Function

Turn off the power of *RF circuit block* and stops RF operation.

This function is used to save the current consumption when no transmit/receive are required.

### Example

```
>@ROF CR/LF      : turn off RF circuit block
<P0 CR/LF        : command accepted

>@RON CR/LF      : turn on RF circuit block
<P0 CR/LF        : command accepted
```

## RON

## RF Circuit Block Power Up

---

### Syntax

ROF {Local Station Address}

Local Station Address : *local station address* for *485 mode* (000 to A22).

### Response

```
P0      : command accepted
N0      : command error (Except 485 mode)
```

### Function

Turn on the power of *RF circuit block* and activates RF operation.

Use this command to activate *RF circuit block* after its *power down state* set by the ROF command.

The status when the modem is powered ON or reset, the *RF circuit block* is in the operation state.

### Example

```
>@ROF CR/LF      : turn off RF circuit block
<P0 CR/LF        : command accepted

>@RON CR/LF      : turn on RF circuit block
<P0 CR/LF        : command accepted
```

## RST

## Reset

---

### Syntax

RST {Local Station Address}

Local Station Address : *local station address* for *485 mode* (000 to A22).

### Response

```
P0      : command accepted
N0      : command error (Except 485 mode)
```

### Function

Resets the modem to restore the power on state.

When any *memory register* is rewritten with REG command before issuing this command, the value rewritten becomes valid and active. Temporary settings like DAS and FRQ command become invalid and the *memory register* settings is loaded.

## Example

>@RST CR/LF : reset the modem  
<P0 CR/LF : command accepted

## Note

When a serial communication parameter in *memory register* is changed with REG command, the *response* of “P0” returns according to the changed setting parameter, which may cause communication error. In such a case, set the communication parameter of the terminal equipment in correspondence with the new setting immediately after the issuance of RST command.

## SAS

## Reference and Set Local Station Address

---

### Syntax

SAS (:set value){Local Station Address}

set value : new local station address (000 to 999)  
Local Station Address : *local station address* for *485 mode* (000 to 999).

### Response

xxx : current value (reference)  
P0 : connection established (setting)  
N0 : command error

### Function

References or sets the local station address.

The current value can be referenced by entering this command with no parameter. For setting, input the desired value to set.

The SAS command is for temporary local address and setting. To more permanently change the local station address value, use REG00.

## Example

>@SAS001 ↵ : set the station address to 001  
<P0 ↵ : connection established  
>@SAS ↵ : reference the local station address  
<001 ↵ : output the current value (001)

## STS

## Read Status

---

### Syntax

STS{Local Station Address}

Local Station Address : *local station address* for *485 mode* (000 to 999).

### Response

xxxxxxxx : modem's current status (x = 0 or 1)  
N0 : *command error* (Except *485 mode*)

### Function

Reads the modem *status register*. (Represented with an 8-bit binary number.)



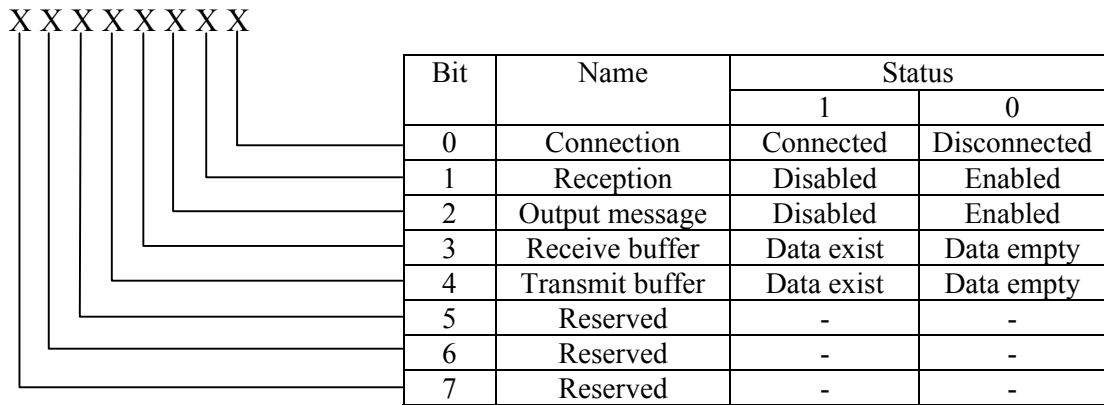


Figure 6–2: Modem Status Bit Description

**Example**

```
>@STS CR/LF : read the current status
<00001010 CR/LF : Received data exist, Output message enabled,
Reception disabled ,Disconnected.
```

**TBN**

**Transmit Binary Data**

**Syntax**

```
TBN[destination address][message byte length]{Local Station Address}[message]
Destination address : address of the transmission (000 to A23)
Message byte length : message length (001 to 255)
Local Station Address : local station address for 485 mode (000 to A22).
Message byte : arbitrary binary data (255 or less)
```

**Response**

```
P0 : data transmission succeeded
P1 : command accepted, data being transmitted
N0 : command error (Except 485 mode)
N1 : data transmission failed -- no response from destination station
N2 : data transmission failed -- destination station is in the reception disabled state
N3 : data transmission failed -- destination station cannot receive because its receive
buffer is full
```

**Function**

Transmits binary data in the *packet transmission mode*.

Any *message length* between 1 to 255 bytes is accepted.

The modem counts the number of message characters and transmits the message.

For *broadcasting* messages to multiple modems, set the *destination address* to 255. In this case, the modem *retransmits* the message the number of times of the *Retransmission count* plus 1, and then it will return “P0”.

In case the *global addressing command* is issued to plural modems connected by RS485 multi-dropping interface, the transmission stops when any modem outputs “P0”, “N2” or “N3” *response* to the RS485 line.

**Example**

```
>TBN002005HELLO CR/LF : transmit “HELLO” from station 001 to station 002
<P1 CR/LF : data being transmitted
<P0 CR/LF : data transmission succeeded.
>@TBN003004MAIL CR/LF : retransmit “MAIL” from station 001 to station 003
```

<P1 CR/LF : data being transmitted  
<N1 CR/LF : transmission failed, no *response* from *destination station*

## Notes

Set the *message length* to 255 byte or less. The *message length* exceeding 255 byte will be *command error*.

Message must be terminated with 2 byte (CR/LF) character, others will be *command error*.

In *broadcast transmission*, the receiving result of the *destination station* cannot be confirmed at the sender side.

## TBR

## Transmit Binary Data through Repeater

---

### Syntax

TBR [repeater address] [destination address] [message byte length]{Local Station Address}[message]

Repeater address : *repeater* address to pass through (000 to 999)  
Destination address : address of *destination station* (000 to A23)  
Message byte length : message byte length (001 to 255)  
Local Station Address : *local station address* for *485 mode* (000 to A22).  
Message byte : arbitrary binary data (255 or less)

### Response

P0 : data transmission succeeded  
P1 : command accepted, data being transmitted  
P2 : data packet reached to *repeater*  
N0 : *command error* (Except *485 mode*)  
N1 : data transmission failed -- no *response* from *destination station*  
N2 : data transmission failed -- *destination station* is in the *reception disabled state*  
N3 : data transmission failed -- *destination station* cannot receive because its receive buffer is full

### Function

In the *packet transmission mode*, transmits binary data through *repeater*.

Any *message length* between 1 to 255 bytes is accepted.

The modem counts the number of message characters and transmits the message.

For *broadcasting* messages to multiple modems, set the *destination address* to 255. In this case, the modem *retransmits* the message the number of times of the *Retransmission count* plus 1, and then it will return "P0".

In case the *global addressing command* is issued to plural modems connected by RS485 multi-dropping interface, the transmission stops when any modem outputs "P0", "N2" or "N3" *response* to the RS485 line.

### Example

```
>TBR100002005HELLO CR/LF : transmit "HELLO" from station 001 to station 002  
<P1 CR/LF : data being transmitted  
<P2 CR/LF : data packet reached to repeater  
<P0 CR/LF : data transmission succeeded
```

### Notes

Set the *message length* to 255 byte or less. The *message length* exceeding 255 byte will be *command error*.

Message must be terminated with 2 byte (CR/LF) character, others will be *command error*.

In *broadcast transmission*, the receiving result of the *destination station* cannot be confirmed at the sender side.

**Syntax**

TID{Local Station Address}

Local Station Address : *local station address* for *485 mode* (000 to 999).

**Response**

XXXXXXXXXXXX : displays the *local serial ID code* (12 digits)

N0 : *command error* (Except *485 mode*)

**Function**

Readout the *local serial ID code* of the modem and display it. This command corresponds to RID command.

The *local serial ID code* consists of 12 digits; upper three digits are 0 and the lower 9 digits are the *product serial number* of the modem.

Be noted the usage of RID command, the *serial ID code* of the packet received last is displayed. When packets are received from multiple stations and their data are stored in the receiving buffer, those data may not correspond to the *serial ID code* readout with the RID command.

To use it more securely, it is recommended to readout the *local serial ID code* with the TID command and pad it (either all or a part of it) in the transmitting packet.

The *serial ID code* is no relation with *ID code* setting of REG04 and 05.

**Example**

>@TID CR/LF : requests the modem's *local serial ID code*

<XXXXXXXXXXXX CR/LF : outputs the modem's *local serial ID code*

**TS2****Test radio link****Syntax**

TID{Local Station Address}

Local Station Address : *local station address* for *254mode* (000 to 254).

**Response**

P0 : command accepted

Connect : connect link, start measurement

oo

BER=0.0E-3 PER=0.00 PWR=-060dBm : read out

Disconnect : disconnect link

N0 : *command error*

N2 : destination modem rejects reception

N7 : the modem is trying to establish synchronization and cannot start the test

**Function**

To help evaluate the radio link condition, this command measures and outputs the "Bit Error Rate," "Packet Error Rate" and "Signal Intensity."

The command accompanying a destination address requests a connection to the destination address. The command without a destination address requests a connection to the address defined by the DAS command. The modem that has received a connection request starts actions of the TS2 immediately.

The modem to which the command is entered is called "TS2 master." The destination modem is called "TS2 slave." The TS2 slave does not output any measurement results.

Ten-consecutive failures in reception disconnect the radio link. Meanwhile, the TS2 master keeps outputting connection request.

The TS2 master modem renews the measurement result approximately every 0.27second and continues outputting the measurement results until the TS2 command is terminated. To stop measurement, enter the command "RST" or turn off the modem.

The radio modem, being turned into a special mode by this TS2 command, may output command error or irrelevant responses against all commands except RST command.

The TS2 command always conducts "address check."

## TXR

## Transmit Text Data through Repeater

---

### Syntax

TXR [repeater address] [destination address] {Local Station Address} [message]  
repeater address : address of *repeater* to pass through (000 to 999)  
destination address : address of *destination station* (000 to A23)  
Local Station Address : *local station address* for *485 mode* (000 to A22).  
message : any text data (255 or less)

### Response

P0 : data transmission succeeded  
P1 : command accepted, data being transmitted  
P2 : data packet reached to *repeater*  
N0 : *command error* (Except *485 mode*)  
N1 : data transmission failed -- no *response* from the *destination station*  
N2 : data transmission failed -- *destination station* is in the *reception disabled state*  
N3 : data transmission failed -- *destination station* cannot receive because its receive buffer is full.

### Function

Transmits text data in the *packet transmission mode* through *repeater*.

Any *message length* between 1 to 255 bytes is accepted. The completion of data input is recognized by the *terminator*.

For *broadcasting* messages to multiple modems, set the *destination address* to 255. In this case, the modem *retransmits* the message the number of times of the *Retransmission count* plus 1, and then it will return "P0".

In case the *global addressing command* is issued to plural modems connected by RS485 multi-dropping interface, the transmission stops when any modem outputs "P0", "N2" or "N3" *response* to the RS485 line.

### Example

```
>@TXR100002HELLO CR/LF : transmits HELLO from station 001 to station 002 through  
                        repeater 100  
<P1 CR/LF : data being transmitted
```

<P2 CR/LF : data packet reached to *repeater*  
<P0 CR/LF : data transmission succeeded

## Notes

Set the *message length* to 255 byte or less. The *message length* exceeding 255 byte will be *command error*.

When the same character as the *terminator* (CR/LF) is contained in a message, the modem distinguishes it as the end of a command and ignore the subsequent data. In such a case, use TBR command.

In *broadcast transmission*, the receiving result of the *destination station* cannot be confirmed at the sender side.

## TXT

## Transmit Text Data

---

### Syntax

TXT [destination address]{Local Station Address}[message]  
destination address : address of *destination station* (000 to A23)  
Local Station Address : *local station address* for *485 mode* (000 to A22).  
message : any text data (255 or less)

### Response

P0 : data transmission succeeded  
P1 : command accepted, data being transmitted  
N0 : *command error* (Except *485 mode*)  
N1 : data transmission failed - no *response* from the *destination station*  
N2 : data transmission failed - *destination station* is in the *reception disabled state*  
N3 : data transmission failed - *destination station* cannot receive because its receive buffer is full.

### Function

Transmits text data in the *packet transmission mode*.

Any message length between 1 to 255 bytes is accepted. The completion of data input is recognized by the *terminator* (CR/LF).

For *broadcasting* messages to multiple modems, set the *destination address* to 255. In this case, the modem will *retransmit* the message the number of times of the *Retransmission count* plus 1, and then it will return "P0".

In case the *global addressing command* is issued to plural modems connected by RS485 multi-dropping interface, the transmission stops when any modem outputs "P0", "N2" or "N3" *response* to the RS485 line.

### Example

>@TXT002HELLO CR/LF : transmits HELLO from station 001 to station 002  
<P1 CR/LF : data being transmitted  
<P0 CR/LF : data transmission succeeded  
>@TXT003MAIL CR/LF : transmits MAIL from station 001 to station 003  
<P1 CR/LF : data being transmitted  
<N1 CR/LF : transmission failed. no *response* from *destination station*

## Notes

Set the *message length* to 255 byte or less. The *message length* exceeding 255 byte will be *command error*.

When the same character as the *terminator* (CR/LF) is contained in a message, the modem distinguishes it as the end of a command and ignores the subsequent data.

In such a case, use TBN command.

In *broadcast transmission*, the receiving result of the *destination station* cannot be confirmed at the sender side.

## VER

## Reference Version Information

---

### Syntax

VER {Local Station Address}

Local Station Address : *local station address* for 485 mode (000 to 999).

### Response

Program Version x.xxx : Hardware system version

N0 : *command error* (Except *485 mode*)

### Function

Reads the modem's hardware system version.

### Example

>@VER CR/LF : read the version information

<Ver 1.000 CR/LF : this modem firmware is version 1.000

SECTION

7

**APPENDIX**

## 7.1 Conversion Circuit

Examples of the level conversion circuit are shown as a reference, which is just for the confirmation of system operation. This example does not guarantee the operation under users' actual operation environment.

### 7.1.1 RS-232C Level Converter

Wire the *control line* when necessary. Tie down unused input pin(s) to GND and leave the 485ENB pin open.

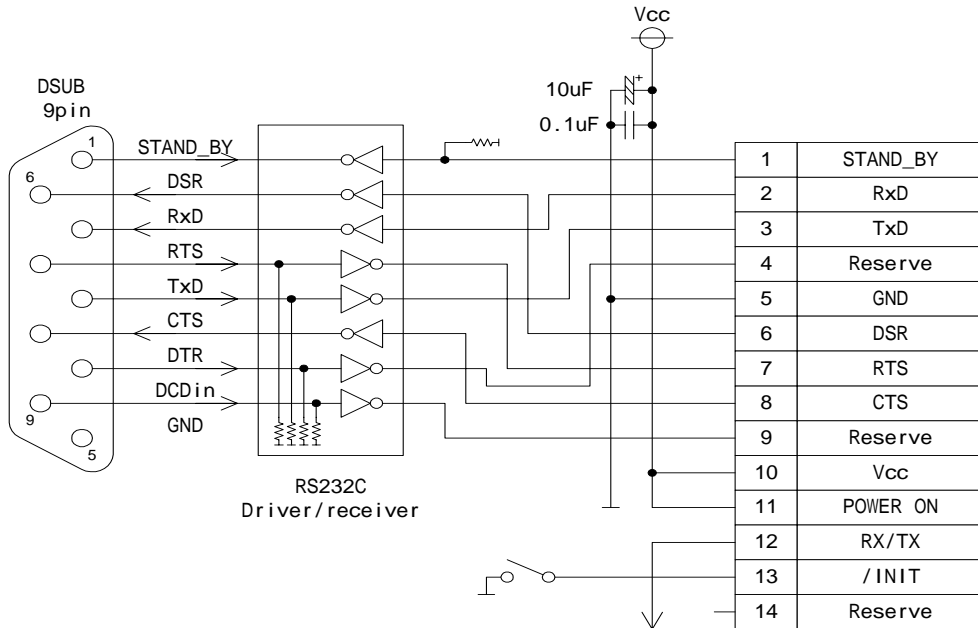


Figure B-1: RS-232C Level Conversion Circuit

### 7.1.2 RS422 Level Converter

Wire the output terminator (100 ohm) of the RS422 line driver, the input terminator (100 ohm) of the receiver, the input pull-up (1k ohm) and the input pull-down (1k ohm), when necessary.

Provide a surge absorber (e.g. Z2012 made by Ishizuka Denshi) when long RS422 line is used or there is much noisy environment, etc.

### 7.1.3 RS485 Level Converter

Wire the terminator of the RS485 bus (100 ohm), the input pull-up (1k ohm) and the input pull-down (1k ohm), when necessary.

When long RS485 line is used or there is much noise, provide the surge absorber (e.g. Z2012 made by Ishizuka Denshi) according to the situation.



## 7.2 Specification of the Connectors

(1) Serial Communication connector A

Connector: MOLEX 53780-1490 (14 pins)

(2) Serial Communication connector B

Connector: JST SM03B-SRSS-TB(LF)(SN) (3pin)

(2) Antenna connector

RF connector: HIROSE U.FL-R-SMT



The antenna connector is guaranteed for 30 times of plugging in/out.



When plugging out the antenna connector, use the specially prepared tool of E.FL-LP-N, provided by HIROSE (HIROSE Product No. CL331-0441-9).

## 7.3 Specification

### 7.3.1 Radio Characteristics

Engineering standard	FCC Part 15.247 (no user license required) >FCC ID : AZP-FDQ02T RSS-210 ISSUE6 (no user license required) >CERTIFICATION NO 2914D-FDQ02T
RF power output	71.8mW max.
Modulation	Direct sequence spread spectrum
Communication scheme	Single communication
Frequency band	2405.376 to 2448.384 MHz
Frequency channel	22 channels
Data barer rate	134 kbps
Oscillation	PLL synthesizer
Service area	In an outdoor environment: more than 3000 feet (line-of-sight)
RF connector	Hirose U.FL-R-SMT
In/out of connector	30 times max. using E.FL-LP-N extractor (for exclusive use)

### 7.3.2 Communication Control

Radio link control	Command control
Error checking	CRC-CCITT (16 bit)
Error handling	ARQ (Automatic Retransmission Request)
Multi-access function	Connect on clearest channel from selected frequency group

### 7.3.3 Data Terminal Interface

Physical interface	Molex 53780-1470 (14 pins) JST SM03B-SRSS-TB(LF)(SN) (3pin)
Interface specification	Serial communication Input CMOS level (5V tolerant with hysteresis) Output CMOS level
Communication	Full-duplex or half-duplex system
Synchronization	Asynchronous
Transmit/receive buffer	Approx. 3 k bytes in total
Baud rate	300 / 600 / 1200 / 2400 / 4800 / 9600 / 19200 / 38400 / 57600 / 115200 bps
Flow control	Hardware flow / Software flow
Data length	7 or 8 bit
Stop bit	1 or 2 bit
Parity	Even, odd, or none

### 7.3.4 Power Supplying

#### 7.3.4.1 Modem (Connector A)

Supply voltage	3.5 to 7.0 V DC
Current consumption	110 mA or less in the active mode 35 mA or less in the RF stop mode 1mA or less in the stanby mode

#### 7.3.4.2 Power Amp. (Connector B)

Supply voltage	6.0 to 9.0 V DC
Current consumption	150 mA or less in the transmitter mode 5 mA or less in the receiver mode

### 7.3.5 Environmental

Operating temperature	-20 to +50
Storage temperature	-30 to +60
Operating humidity	90%RH max. (no condensation)
Storage humidity	90%RH max. (no condensation)
Vibration resistance	JIS-C-60068-2-6:1999 (50m/s <sup>2</sup> , 10 to 150 Hz, 15 cycles)
Shock resistance	JIS-C-60068-2-27:1995 (500m/s <sup>2</sup> ) (JIS specification is Japanese Industry Standard)

### 7.3.6 Miscellaneous

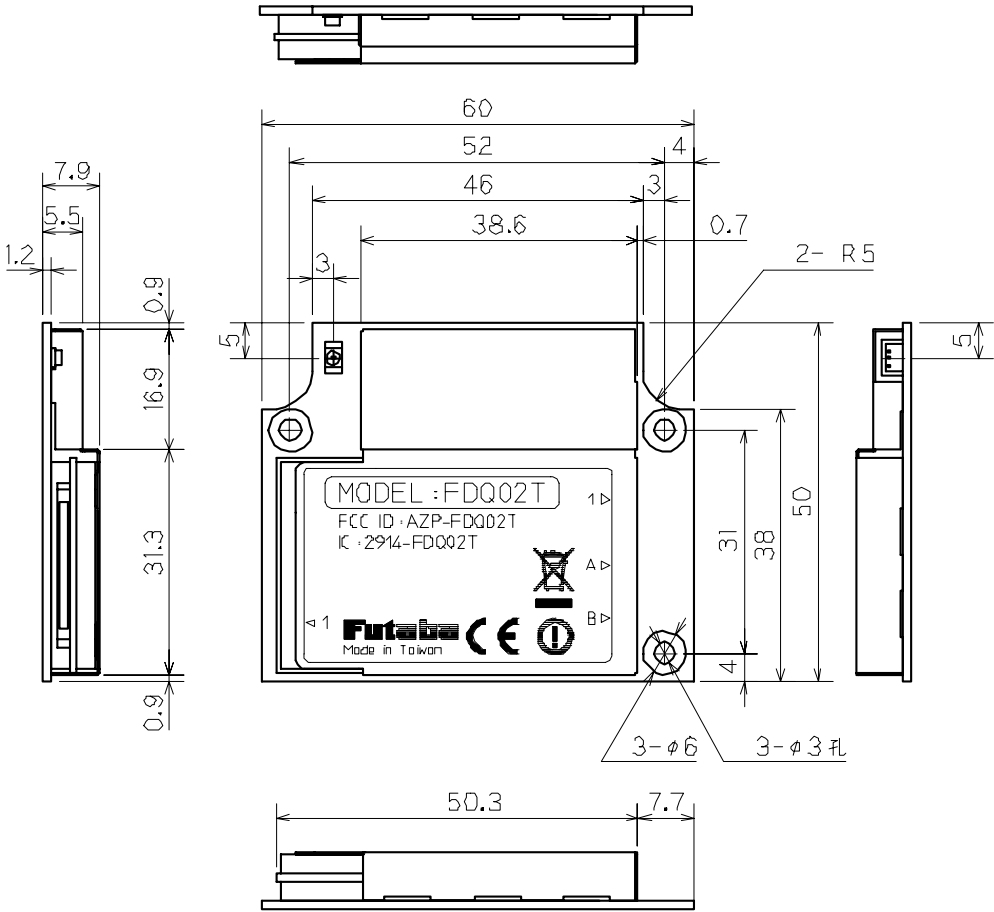
Memory register	Rewritable times: approx. 1 million times
Case	Ni plated steel plate
Outer dimensions	60 (W) × 50(D) × 8(H)mm
Weight	Aprox. 30g

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

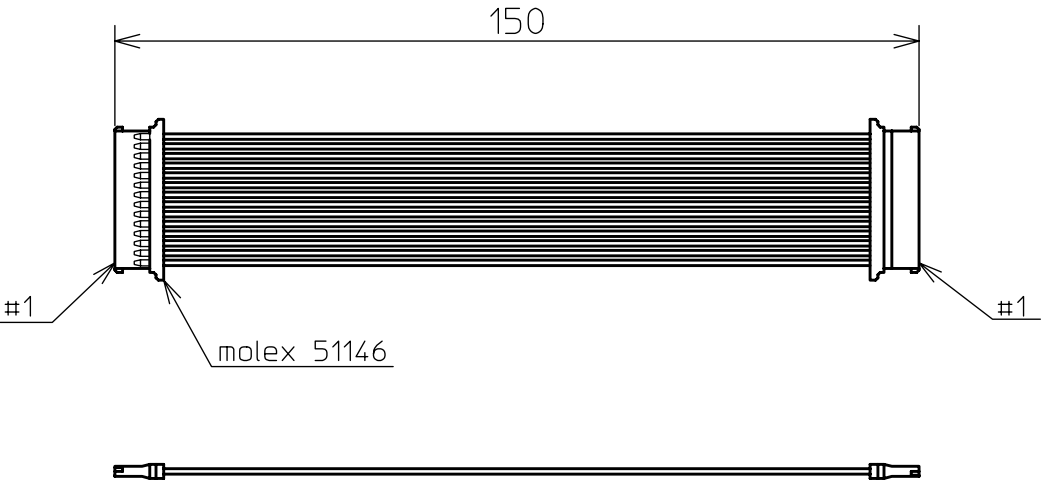
\* Specifications and appearance are subject to change without prior notice.

7.4 Dimensions

7.4.1 FDQ02T



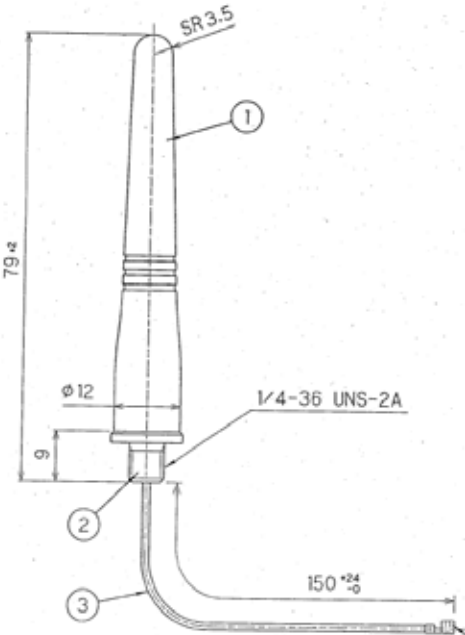
7.4.2 Communication Cable A



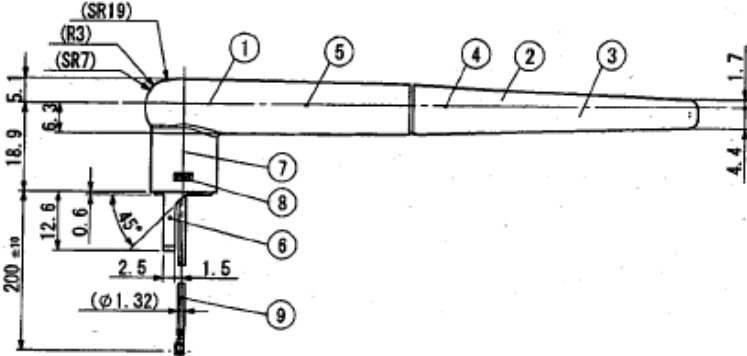
7.4.3 Communication Cable B

( TBD )

7.4.4 Antenna Type A



7.4.5 Antenna Type B



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