Instruction Manual

This instruction manual contains important notices and how to use this product safely. Please be sure to read this instruction manual before you use this product. Please understand the following symbols that are used in this manual before reading this instruction manual.

The symbols are defined as follows:

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

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

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⚠WARNING

The following eight are extremely important warnings.
1. The user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.
2. This equipment has been tested and found to comply with the limit for a Class B digital device,pursuant to part 15 of the FCC rules.These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates,uses and can radiate radio frequency energy and,if not installed and use in accordance with the instructions,may cause harmful interference to radio communications.However,there is no guarantee that interference will not occur in a particular installation.If this equipment dose cause harmful interference to radio or television reception,which can be determind by turming the equipment off andon,the user is encouraged to try to correct the interference by one or more of the following measure:
    Reorient or relocate the receiving antenna.
    Increase the separation between the equipment and receiver.
    Connect the equipmentinto an outlet on a circuit different from that to which the receiver is connected.
    Consult the dealer or an experienced radio/TV technician for help.
3. Be sure to use this product within its specification; otherwise it may cause failures and malfunctions. Especially, pay great attention to temperature range and power source voltage.
4. Do not install this product to the sites where the product is disposed under the direct sunlight and/or under the high temperature. Prior to use this product, please make sure the temperature around the site where you are planning to use this product, because this product is guaranteed at the limited ranges in operating temperature and storage temperature. Operating the product beyond the guaranteed temperature range may cause failure of this product.
5. Do not install this product in a high humidity area. A drop of water on the circuit inside of this product may cause failure of this product.
6. Avoid this product from being watered. If water enters inside this product, it may cause failure of this product
7. The specification of the external interface of this product is different from ordinary one. Please make sure the wire identifications before connecting external equipment.
8. Be sure to confirm that the power switches are off before connecting or disconnecting connectors. Connecting and disconnecting connectors while any power is on may cause failures and malfunctions.

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⚠CAUTION

The following three are very important cautions in handling this product.

1. This product is designed specially for industrial applications. If you are planning to use this product in the area where the use of electromagnetic wave is restricted because medical equipment and airplanes are used near its area, please confirm that this product does not interfere with those before you use this product. Please do not use this product unless you can confirm that this product does not interfere with those medical equipment and airplanes near the site.

2. Please pay attentions to the electromagnetic conditions around this product. This product uses electromagnetic wave as a communication method. Consequently, if there is a strong source of electromagnetic wave near this product, this product may not able to fully achieve its performance. Please check the electromagnetic conditions around the site where you are planning to use this product prior to use this product.

3. This instruction manual is protected by the law of copyright protects. Futaba Co. is not responsible to any problem and incident that are caused from reprinting this instruction manual by somebody other than Futaba.

Contents

1. INTRODUCTION

1-1. Special Features

1) FDK02TU（mobile station）communicates with the modem FDK01TU（fixed station）through coupler FZE02TJ010 and 200-ohm feeder cable.

2) Communication speed is 100Kbps across the feeder wires.

3) FDK has a function to carry out error correction by the combination of ARQ（Automatic Retransmission Request）and FEC of BCH（15,7）.

4) In this system, multiple mobile stations can be allocated to the single feeder cable. And each mobile station can have individual address that can be set externally. As a result, a single fixed station and multiple mobile stations can establish a communication network.

5) The interface between the external controller and the fixed station or the one between the external controller and the mobile stations is designed to meet RS-422, RS-485 and RS232C.

1-2. Names and functions of parts of the mobile station

Indicators of signal reception level

Indicator of signal transmission

Switches to set address

Switches to set communication parameters

Switches to set transfer speed

Switches to set parameters for RS-422/RS-485 terminators

Indicator of power switch
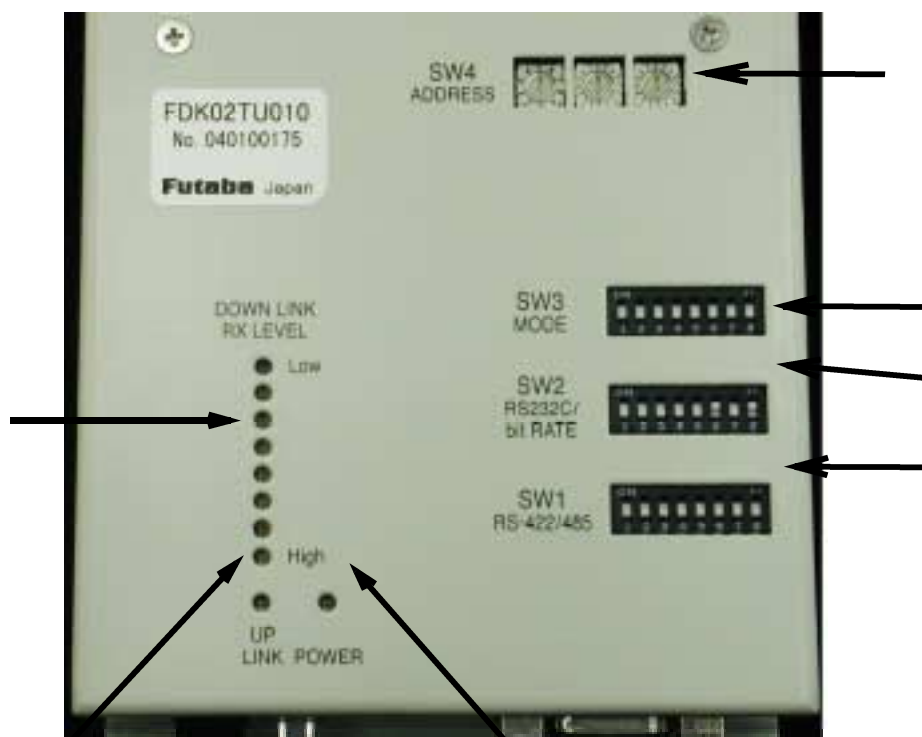
Power switch
Connector to the 24V DC power
Connector to the external reset
Interface connector to RS-232C/RS422/RS485 (specially defined pin assignment)

R2 : Connector for receiving signal from coupler unit 2
R1 : Connector for receiving signal from coupler unit 1
T2 : Connector for sending signal to coupler unit 2
T1 : Connector for sending signal to coupler unit 1

R2   R1   T2   T1

1-3. Names and functions of parts of the coupler unit

Connect this terminal to the mobile station's R1 or R2.
This surface to face the feeder cable
Holes for screws to hold this coupler unit
Connect this terminal to the mobile station's T1 or T2.

2. Power

2-1. Before turning on the power

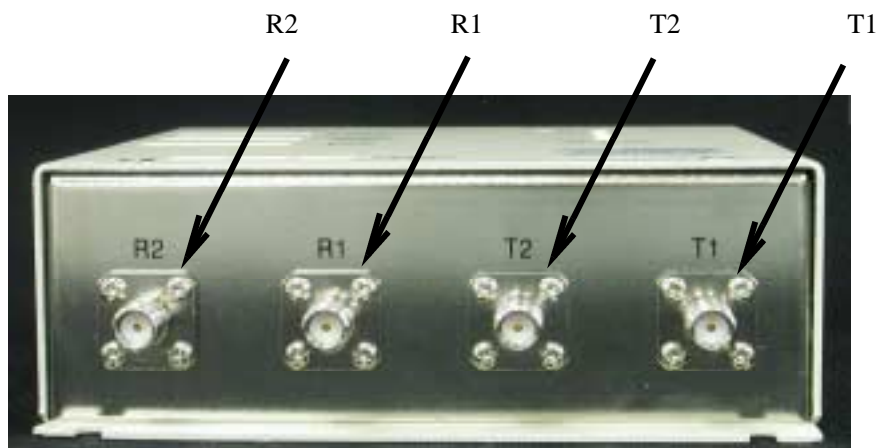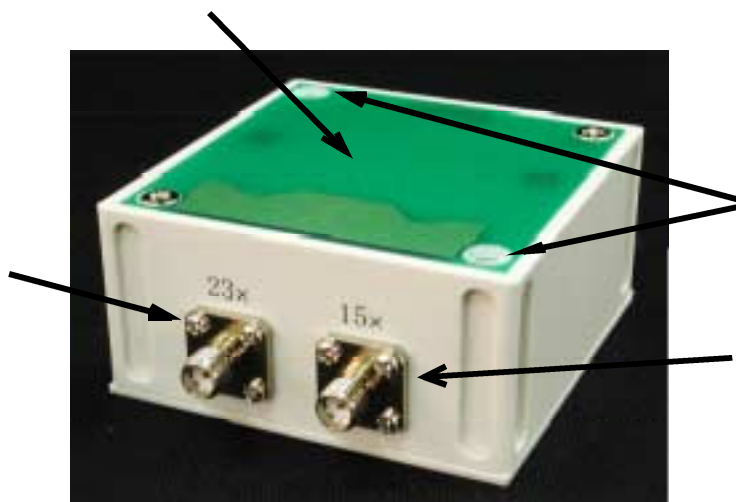Be sure to read this instruction manual prior to turning on the power of the modems.

Improper operations of the FDK modem may not only cause failures of communication but also cause malfunctions and/or damages of this modem and the external equipment connected to this modem.

In order to establish proper communication between this modem and the fixed station, communication parameters should be set by switches, which should be set before turning on the power switch.

In addition, since Futaba has specially defined the pin-assignment of interface connector for RS-232C/RS-422/RS-485; please carefully confirm the wire identifications of the interface cable and pin layout.

2-2. Voltage of the power source

The input voltage to this modem should be within the range of 20Vdc and 29Vdc. Otherwise, this modem and the external equipment connected to this modem may cause damages or malfunctions.

2-3. Connector for the power source

The type of the connector used for this modem is S2P-VH made by J.S.T. Mfg Co., Ltd. Supply the voltage anywhere between 20Vdc and 29Vdc to the "+" marked terminal and connect the ground wire to the "-"marked terminal.

Connector for the power source
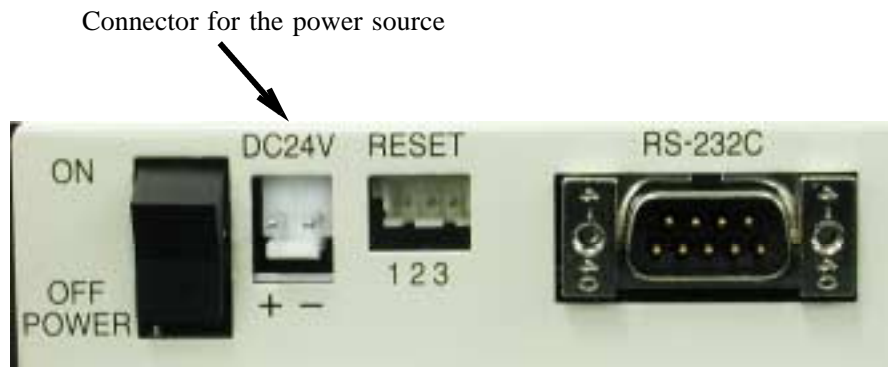
picture 2-3

2-4. Power switch

The label "POWER" is printed beside the power switch of this modem. (See picture 2-4)

Pushing this switch toward "ON" will turn on the power switch and the LED indicator of the power on top of the unit turns on green. On the other hand pushing the switch toward "OFF" will turn off the power. The picture 2-4 shows "OFF" state.

Power switch

picture 2-4

3. Coupler unit

3-1. Connecting the mobile station and the coupler unit

A mobile station has four 50-ohm impedance SMA connectors. The connector type used here is;

Connector : MKT TAISEI CO., LTD. CON1718-BN 4 pieces

Two connecters are for transmission and the other two are for reception.

Connections between a mobile station and the two units of couplers are shown in figure 3-1. T1 and R1 of a mobile station should be connected to one unit of two couplers. T2 and R2 of the mobile station should be connected to the other like figure 3-1.

mobile station
rear panel

T1		15x
T2		23x	coupler
R1		15x
R2		23x	coupler

ferrite core   NEC TOKIN CO.   ESD-SR-12   100-ohm
                                              (100MHz)
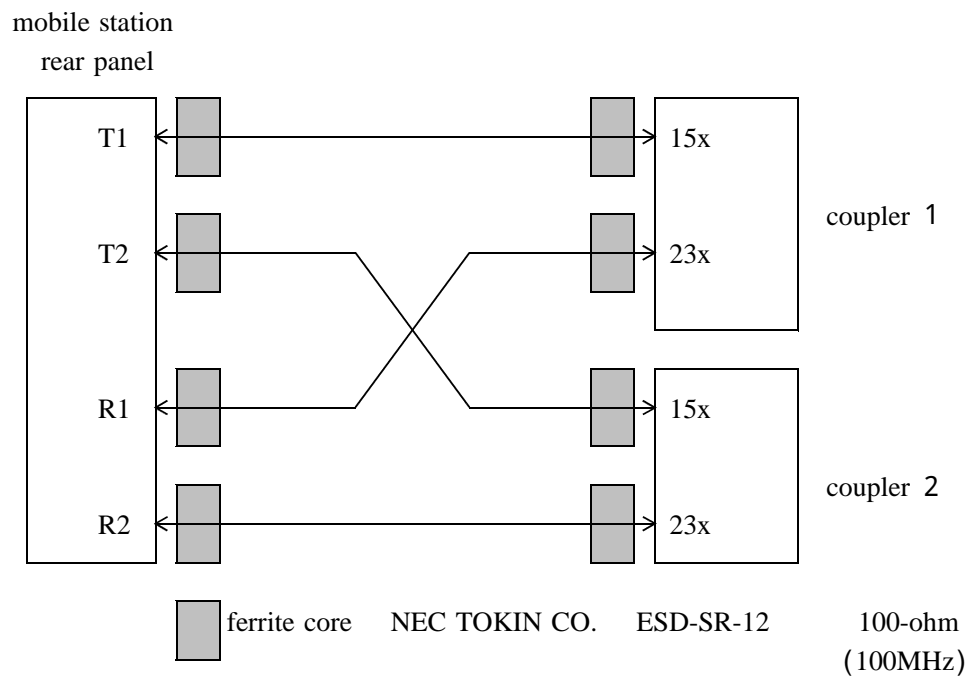
3-2. Installment of coupler unit

Holes for screws to hold this coupler unit
Use two ISO M3 screws to hold the unit.
This surface to face the feeder cable
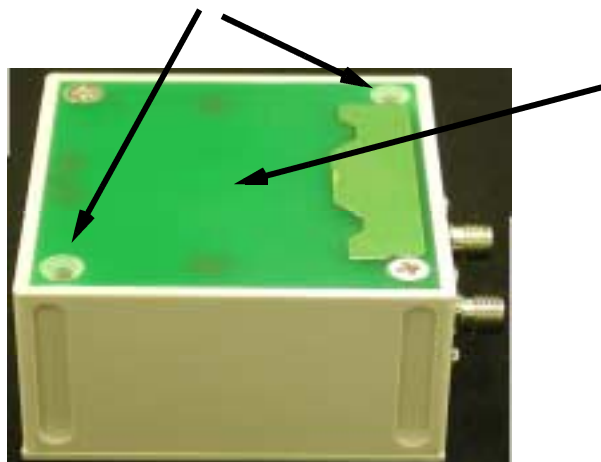
3-3. Distance between the coupler unit and feeder cable

Install coupler units and feeder cables in the shadowed area in the figure 3-3, otherwise communication cannot be carried out.
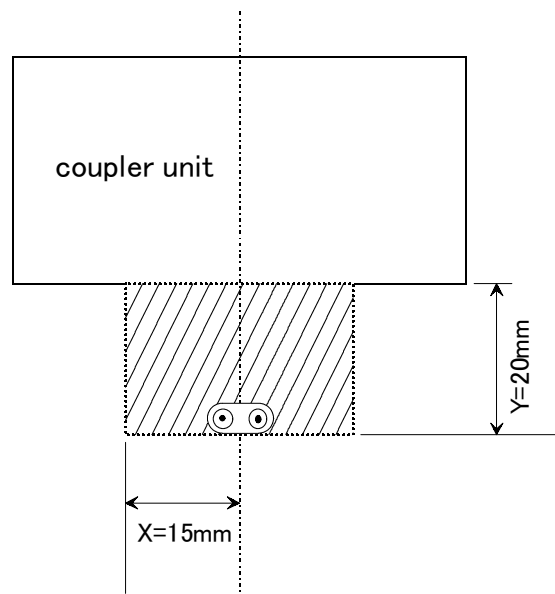
Figure 3-3

4. Connecting communication cable

4-1. Connector for RS-232C/RS-422/RS-485

Connector model: Hirose Electric Co., Ltd. RDED-9P-LN (4-40) (50)

Please select one out of RS-232C, RS-422 and RS-485.

```
      1   2   3   4   5
     ┌─────────────────┐
      O   O   O   O   O
        O   O   O   O
        6   7   8   9
        D－sub 9PIN
```
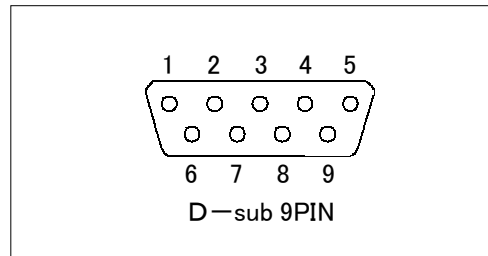
PIN No.	Signal name	note
	NC	
	TD	RS-232C transfer data
	RD	RS-232C recieve data
	NC	
	GND	Signal ground.
	RD+	RS422 RS485
	RD-	
	TD+	↓
	TD-	

RS-232C uses the pins 2, 3 and 5.

RS-422 and RS-485 use the pins 5 through 9.

SW 1 on top of the unit can select either RS-422 or RS-485 and can either connect the termination resisters or disconnect them.

SW2 is the common switch for RS-232C, RS-422 and RS485 to set parameters of communication speed and so on.

Please refer to the next section for further detail.

5. Setting switches

The functions of the dipswitches and a rotary switch are follows:

SW1	8bit DIP-SW	Set parameters of RS-422/485
SW2	8bit DIP-SW	Set transfer speed
SW3	8bit DIP-SW	Set communication parameters
SW4	3 sets of 16-step rotary switch	Own station address

table 5-1

Table 5-2　SW1（DIP-8）

Item	bit		ON	OFF
Set D-sub connector Set termination resisters（RS-422/485）	1	Connect/disconnect TD+ and RD+	connected	open
	2	Connect/disconnect TD- and RD-	connected	open
	3	Connect/disconnect the resister between TD+ and TD-	connected	open
	4	Connect/disconnect the resister between RD+ and RD-	connected	open
	5	Connect/disconnect the pull-up resister to RD+	connected	open
	6	Connect/disconnect the pull-down resister to RD-	connected	open
	7	Set parameters of RS-422/485 reception driverRS-422/485	OFF during transmission	Normally ON
	8	Reserved		

The shadowed indicates the Ex-factory conditions

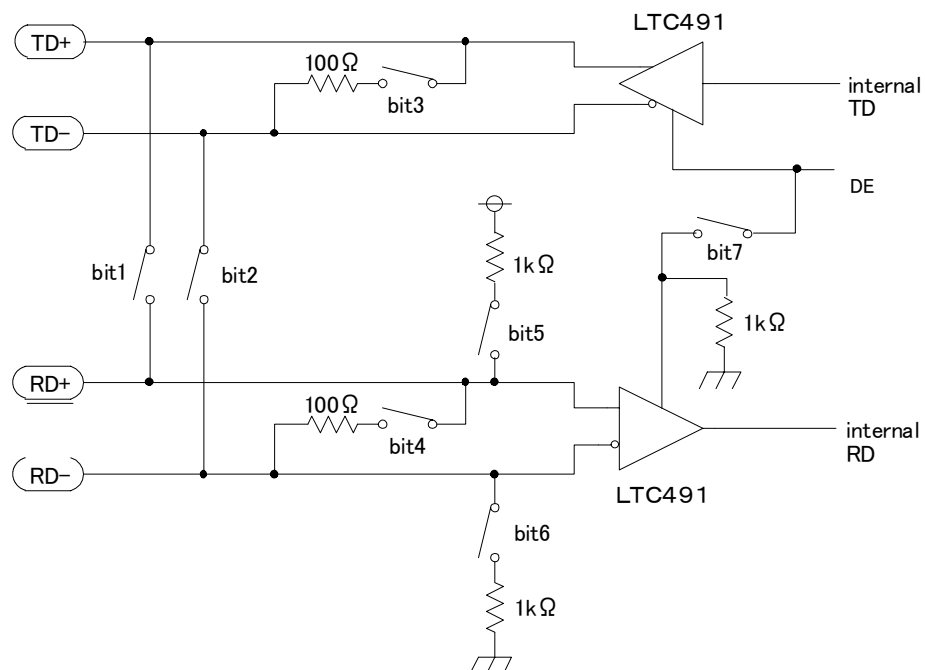Figure 5-1 RS-422/485 interface circuitry

Table 5-3 SW2（DIP-8）

Item	bit		ON	OFF
Set D-sub connector (wiring of RS-232C)	1	Select RS-232C or RS-422/485	RS-422/485	RS-232C
	2	packet user data length	Refer to table 4-4	
	3			
	4	Reserved		
Common for RS-422/485/232C	5	Transfer speed	Refer to table 4-5.	
	6	↓		
	7			
	8	Reserved		

The shadowed indicates the Ex-factory conditions.

Table 5-4 Setting of 1 packet user data length

No.	SW2		Number of user data bytes
	bit3	bit2	[BYTE]
1	OFF	OFF	8
2	OFF	ON	16
3	ON	OFF	32
4	ON	ON	64

The shadowed indicates the Ex-factory conditions.

Table 5-5 Setting of transfer speed

No.	SW2			Transfer speed
	bit7	bit6	bit5	[bps]
1	OFF	OFF	OFF	4800
2	OFF	OFF	ON	9600
3	OFF	ON	OFF	19200
4	OFF	ON	ON	38400
5	ON	OFF	OFF	57600
6	ON	OFF	ON	reserve
7	ON	ON	OFF	115200
8	ON	ON	ON	115200

The shadowed indicates the Ex-factory conditions.

Table 5-6 SW3（DIP-8）

Item	bit	content	ON	OFF
Communication parameters	1	Data length	7	8
	2	Stop bit	2	1
	3	Parity	yes	none
	4	Parity even or odd	even	odd
	5	Software flow control	valid	Not valid
	6	Multi-connection or single connection with RS-422/485	multi	single
	7	Add "CR" and "LF" to reception data and output it to the external I/F	add	Not add
	8	Output packets to all mobile stations and the host computer	output	Not output

The shadowed indicates the Ex-factory conditions.

Table 5-7 SW4（3 sets of 16-step rotary switch）

Item	Effective value	note
Own address	400h to 9FFh	Default value is 400h 000h through 3FFh are prohibited.

6. Communication command

Input and output between external control equipment and mobile stations are carried out by packet method.

The data format of the packet method is either in the sequence of "@TXT（address）（user data）[CR][LF]" or in the sequence of "@TBN（address）（data length）（user data）"

Binary data method is useful to avoid communication errors when a control code matches exactly a part of user data.

Text data   @TXT（address）（user data）[CR][LF]
___

        Address   : ASCII code, hexadecimal 3-digits
                        （For instance, 4 is "34h" in ASCII.）
        Data   : ASCII code, hexadecimal
        The data length : Arbitrary but no more than 1024 bytes.
        [CR]   : 0Dh in hexadecimal
        [LF]   : 0Ah in hexadecimal

        Example   : Sending "ABCDEFG" to a mobile station whose address is 400.

                        @TXT400ABCDEFG[CR][LF]

Binary data   @TBN（address）（data length）（user data）
___

        Address   : ASCII code, hexadecimal 3-digits
        Data length   : "001" to "400"   （0 to 1024 bytes）
                        The number of bytes should be expressed by hexadecimal 3-digits in
                         ASCII code.
        [CR][LF]   : not necessary

        If data length is longer than predetermined data length, the surplus of the data will slide in
        front of the next instruction. Therefore "NG[CR][LF]" may be returned to the data
        sender.

        Example   : Sending 7 bytes of binary data to a mobile station whose address is 400.

                        @TBN400007（7 bytes of binary data）

Taking into consideration the manual input through terminal software, the text data method can delete a character by recognizing backspace key while the binary data method treats backspace key as data.

In the communication between the feeder cable and mobile stations, a packet is defined and transmitted as the number of user bytes that are set by bit2 and bit3 of the DIP SW2.

In the case that transmission and reception of all the data is completed properly, the sender will output the

message "OK [CR] [LF]" after receiving ACK of the last packet.

On the other hand, the receiver will output the same character string that was sent from the sender from the headfirst. In case of @TBN command, the receiver will output the data that is within the range determined by the user data length, otherwise surplus of the data will not be outputted.

In case of communication error, if ACK is not returned from the destination after repeating retransmission up to the preset number, the sender will stop sending data and output "NG [CR] [LF]" immediately after detection of the end of input data.

In case of failure while sending a packet due to communication error, the sender will output the partial data that the sender could properly receive from the external interface of the receiver.

7. Control command

Control commands are used for controlling the fixed station.

Command table

No.	Command string	content
	FRQ	Write or read frequency channel number
	PNG	Request response & read the reception intensity of the destination
	SWR	Read switch information
	RST	Reset software
	COP	Setting of the coupler or readout

@FRQ　　　　: Write or read frequency channel number

1) Input　　　: @FRQpp [CR] [LF]

pp : Input a number between 1 and 50 (ASCII code) or input nothing for pp.

(note)

Inputting a single digit is allowed for 1 through 9.

Do not input space between "FRQ" and "pp".

2) Processing : If there is no input for "pp", the current frequency channel number will be outputted.
Response message

FRQ = pp [CR] [LF]

(note)

pp : 01 to 50 (ASCII code)

Spaces are necessary in front of and afterwards of "=".

: If a channel number is inputted in "pp", this modem will return "OK" message to the host computer after changing the SRAM register and reassign the frequency number,.

3) Frequency channel at the booting

At the booting this modem and resetting the software, the frequency channel is given by the setting by SW5 on the case top.

@PNG   : Request response & read the reception intensity of the destination

1) Input   : @PNG[CR][LF]

2) Processing : Receiving this command, this modem returns as a response message the signal intensity
    of the last packet that this modem has received.

    Response massage
       RSSI = nn[CR][LF]
                    nn : Hexadecimal number of signal intensity in [dBm]

@SWR   : Read switch information

1) Input   : @SWR[CR][LF]

2) Processing : Receiving this command, this modem outputs information related to its switches of SW2
    through SW5. SW1 has no function to send its information.

       SW2   : Binary, 8 digits (0: OFF,   1:ON   BIT8 is in the far left.)
       SW3   : Binary, 8 digits (0: OFF,   1:ON   BIT8 is in the far left.)
       SW4   : Hexadecimal, 2 digits (The lower 2 digits of address)
       SW5   : Hexadecimal, 2 digits
    In case of the fixed station, this figure shows the setting condition of its channel switches.
    The most significant digit of the mobile station address corresponds to the rotary switch in the far right
    of the SW5.

@RST   : Reset software

1) Input   : @RST[CR][LF]

2) Processing : Receiving this command, software will be reset.
       This command restarts the exerciser program from the start address.
       Also the SRAM register will be reset to the condition when this modem was turned on.
       In addition, this command will initialize not only the software but also the hardware of this modem.
       It takes about 300ms.
       After the completion of initialization, a response message of "OK" will be returned to the host
       computer.

@COP   : Setting of the coupler or readout (valid only for mobile stations)

1) Input   : @COPp[CR][LF]
                                 "p" should be 1 or 2 in ASCII code, or enter nothing.
                                 Do not input space between "COP" and "p".

2) Processing : in case of no value for "p";
       The current status of the coupler is read out.

       The message will be;
              COP = p[CR][LF]
                       p= 1 or 2 in ASCII code
       A space code (0x20) will be added to either side of the "=".

: In case that some value is inputted for "p":
   Coupler units will be switched.

3) Default setting
   COP = 1

4) Timing of command execution
   Receiving a command from external I/F, the mobile terminal will carry out the command and return its end message immediately after the disconnection of the coupler is completed. This command will be carried out regardless of the communication status on the feeder.

8. Address

The effective addresses for mobile stations are from 400 trough 9FF.
Use rotary switch SW4 for setting.
Set the address at "001" when sending data to the fixed station from mobile stations.
The address setting of the fixed station is required only for the host computer to send control command to the specific one of the fixed stations that is connected in multi-drop fashion. No specific address is necessary in case sending data from mobile stations, because there exits only one fixed station.

9. Communication with mobile stations

Communication procedure (an example)

Set parameters of fixed station, and make it effective to communicate with mobile stations.
Connect to the power source.
Connect the external interface (One of RS-232C, RS422 and RS485)
Connect to the matching/distributing unit.
   (The order between   and   can be changed freely.)
Turn on the fixed station and mobile stations.
   (The order to turn on the powers is free.)
Wait more than 1 second and then set frequency channel.
   After receiving a response of "OK", forward to the next step.
Send command/data in format of @TXT or @TBN.
   If "OK" is returned, the communication is completed.

If "NG" is returned, possible reasons of the failure are insufficient signal strength and improper settings of communication cable, switches and frequencies.
Send @PNG command and read the value of RSSI. If the value is 57 or lager, please confirm the setting condition again.
If "OK" is returned, it is possible to continue communication by repeating   .

10. Indicators

POWER	When green LED is on, the power is on.
DOWN LINK	When green LED is off, there is no packet.
	When green LED is on, packets have been sent to feeder cables.

UP LINK
RX LEVEL
	Combinations of eight LEDs indicate the levels of the signal intensity.
	    2 Red LEDs ON : < or =-90dBm
	    2 Red and 1 Orange LEDs : < or =-85dBm
	    2 Red and 2 Orange LEDs : < or =-80dBm
	    2 Red, 2 Orange 1 Green LEDs : < or =-75dBm
	    2 Red, 2 Orange 2 Green LEDs : < or =-70dBm
	    2 Red, 2 Orange 3 Green LEDs : < or =-65dBm
	    2 Red, 2 Orange 4 Green LEDs : > -65dBm

11. External Reset

The following connector is equipped with this modem so that the hardware of this modem can be reset externally.

    Connector type   : J.S.T. Mfg Co., Ltd   S3B-XH-SM3-TB

In order to reset this modem externally, short #2 and #3 pins of the RESET connector in the picture 11-1 more than 10ms: then disconnect them.
One of the terminals is connected to the internal power source and the other is to the ground line through 560ohm resister respectively.

12. Product specification
 12-1. communication characteristics of feeder cable

Up link frequency band (transmitter)	151 MHz 156 MHz
Down link frequency band (receiver)	230 MHz 235 MHz
Frequency band per channel	100 kHz
Interval between frequency channels	100 kHz
Number of frequency channels	50
Emission power	FCC part15 ClassB 43.5dB μ V/m at 3m
Reception signal intensity	-87dBm (at 100kbs, BER 10⁻)
Addresses for mobile modems (own address)	400h 9FFh(1536 addresses
Communication speed	100 kbps
Communication mode	Full-Duplex Packet mode
Error detection/correction	Combination of ARQ and BCH

12-2. external I/F specification

Item	Notes
Connector	D-sub 9 pins
Communication standards	RS-232C, RS-422, RS-485(Specially defined pin assignments are used for this product.)
Communication speed	4800bps to 115.2kbps
Communication method	RS-232C,RS-422 Full-Duplex Packet mode
	RS-485 Full-Duplex Packet mode
others	Connect/disconnect signal linesConnect/disconnect terminator resistance for RS-422 and RS485

12-3. mobile station's general specification

Item	Notes
Voltage of the power source	DC 20V to 29V
Consumption power	
Outer dimensions	102(D) x 116(W) x 35(H) mm
Weight	550g
Material of the chassis	Iron (1 mm thickness)
Surface treatment of the chassis and color	Surface treatment : Coating on bonded steelColor : DIC 546 1/2 (Dainippon Ink)
Operating temperature range	-10C to +50C
Storage temperature range	-20C to +70C
Operating humidity rage	35%RH to 95%RH (under no condensation)
Storage humidity range	35%RH to 95%RH (under no condensation)

Anti-vibration	The product should survive the following vibration test;
	   Vibration amplitude : 3.5mm
	   Frequency : 10Hz
	   2 hours for back and forth
	   2 hours for left and right
	   4 hours for up and down

Anti-shock	The product should survive the following shock test;
	   Acceleration : 500 m/s^2
	   3 times along with 3 axis,
	   total 9 times500 m/s^2

Anti-electro static	Apply following high voltageInput/output terminals
	    : ± 1kV (contact discharge) Chassis
	    : ± 5kV (non-contact discharge)
	  There should be no malfunction after test.
	  Chassis
	    : ± 10kV (non-contact discharge)
	  There should be no damage after test.The test follows JASO-D-001-94 5.8 (A-2,B-2,C-2)

13. Frequency channel

Channel No.	Frequency		Channel No.	Frequency	
	Down-link [MHz]	Up-link [MHz]		Down-link [MHz]	Up-link [MHz]
1	230.05	151.05	26	232.55	153.55
2	230.15	151.15	27	232.65	153.65
3	230.25	151.25	28	232.75	153.75
4	230.35	151.35	29	232.85	153.85
5	230.45	151.45	30	232.95	153.95
6	230.55	151.55	31	233.05	154.05
7	230.65	151.65	32	233.15	154.15
8	230.75	151.75	33	233.25	154.25
9	230.85	151.85	34	233.35	154.35
10	230.95	151.95	35	233.45	154.45
11	231.05	152.05	36	233.55	154.55
12	231.15	152.15	37	233.65	154.65
13	231.25	152.25	38	233.75	154.75
14	231.35	152.35	39	233.85	154.85
15	231.45	152.45	40	233.95	154.95
16	231.55	152.55	41	234.05	155.05
17	231.65	152.65	42	234.15	155.15
18	231.75	152.75	43	234.25	155.25
19	231.85	152.85	44	234.35	155.35
20	231.95	152.95	45	234.45	155.45
21	232.05	153.05	46	234.55	155.55
22	232.15	153.15	47	234.65	155.65
23	232.25	153.25	48	234.75	155.75
24	232.35	153.35	49	234.85	155.85
25	232.45	153.45	50	234.95	155.95