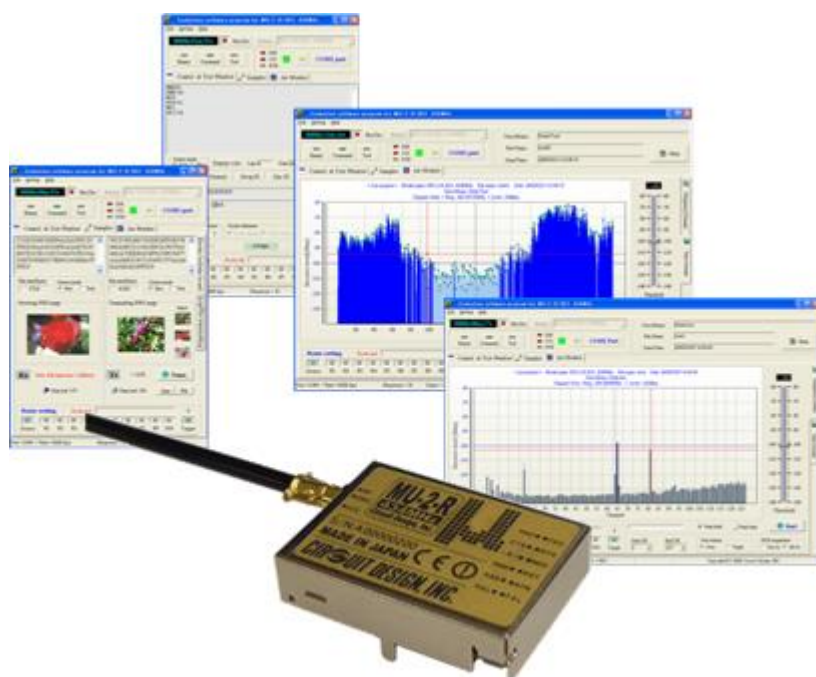


Embedded low power radio modem **MU-2-R**

**MU-2-R Evaluation Software Program  
MU2-ESP**



**Operation Guide**

**Version 1.1 (Sep. 2020)**

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## Contents

Chapter 1 MU2-ESP	3
1.1 Outline	3
1.2 Terminology	3
1.3 Product Name and Part Number	3
1.4 Operating Environment of the Program	3
1.5 Program Development Language	3
1.6 Program Functions	4
Chapter 2 How to Use the Evaluation Software	5
2.1 Basic Operations	5
2.1.1 Basic operations	5
2.1.2 Hex-decimal conversion form	7
2.2 Control and Test Window	8
2.2.1 Control & Test window	8
2.2.2 ID setting panel	10
2.2.3 Command and transmission panel	10
2.2.4 Transmission data auto assignment panel	11
2.2.5 Set route information panel	11
2.2.6 Route setting panel	12
2.2.7 Key input form	12
2.2.8 Transmission data auto assignment form	13
2.2.9 Binary code transmission form	14
2.2.10 Command issue panel	15
2.2.11 Packet success rate test panel	16
2.2.12 Setting value acquisition panel	17
2.2.13 Other functions panel	18
2.3 Sample Window	20
2.3.1 Electronic bulletin board	20
2.3.2 JPEG image/file transmission	21
2.4 Air Monitoring	23
2.4.1 Air monitor (measurement in a frequency domain)	24
2.4.2 Air monitor (measurement in a time domain)	26
2.4.3 Air monitor mouse functions	27
2.4.4 Cautions when using the air monitor	28
2.5 COM Port Setup Dialogue	29
2.6 Image Viewer	30
2.7 Option Dialogue	31
2.8 Files Created by the Program	32

# Chapter 1 MU2-ESP

## 1.1 Outline

The *MU-2-R Evaluation Software Program: MU2-ESP* is a dedicated program for evaluation of the MU-2-R and MU-4 series of products. It includes a control window and test window for issuing commands for evaluation purposes, testing samples, an air monitor function, various test functions and so on. Using the air monitor function during product development allows you to optimize the equipment. In addition, you can create graphical reports when conducting field tests. With the test functions, it is possible to check the field status such as the RSSI level where the equipment is placed, the packet success rate and so on using a local PC. The MU-4 can also use this program.

- ☞ Caution: This program cannot control equipment other than the MU-2-R and MU-4 series of products. This Operation Guide is for the equipment using the MU-2-R 434 MHz and MU-4-434.

## 1.2 Terminology

Terminology used in this Operation Guide and the MU-2-R series product Operation Guides may be written as follows.

1. When referring to products, "MU-2-R" may be used to represent the MU-2-R series of products. This should be understood as referring to the version you own.
2. When using MU-4, it is treated the same as MU-2-R.
3. The "setup file" is the zip file from the web site of the MU-4 that is used for setup.

## 1.3 Product Name and Part Number

Product name: MU-2-R Evaluation Software Program

Part number: MU2-ESP

## 1.4 Operating Environment of the Program

Operating system: Windows 8 and 10

Recommended display: XGA (1024 x 768 pixels) or higher

Pointing device: Mouse etc.

- Some RS232C-USB converters do not work properly due to problems with the virtual COM port driver or for other reasons. In this case, use a conventional COM port.

## 1.5 Program Development Language

Borland Developer Studio 2006, Delphi

Components used: Naichal: PREPRE electronic signboard component

Maker's URL: [http://www.geocities.jp/nai\\_777/free/index.htm](http://www.geocities.jp/nai_777/free/index.htm)

## 1.6 Program Functions

The program has windows with the following functions. Read the MU-2-R Operation Guide and the Operation Guide for the MU-2-R series of products before using the program.

### ◆ Control and test window

The control and test window are for issuing commands to the MU-2-R, and by checking the responses, understanding the operation of the MU-2-R. You can check the operation of the 3 modes (command mode, text mode, and binary mode) provided with the MU-2-R and carry out tests. In addition, you can fix the basic operation parameters in the EEPROM.

With the test functions, it is possible to check the field status where the equipment is placed, the packet success rate and the internal setting values, and to change the channels in the system and so on.

### ◆ Sample window

#### • Sample 1

A sample program for data transmission between PCs using the MU-2-R showing the data on the electronic bulletin board. This is a transmission test using 1 frame (255 bytes). The character string entered in the data input line is shown in the electronic bulletin board window on the destination PC screen.

#### • Sample 2

A sample program for transmitting image data between PCs using the MU-2-R. This is a transmission test using data spread over multiple frames (more than 255 bytes). Binary files such as images and the like can be transmitted.

### ◆ Air monitoring window

A function that uses the RSSI level information acquired from the MU-2-R, monitoring the status of the radio waves in the field and displaying them as a graph. You can also display the field status of the target station using the relay function.

With the air monitor function, the status of the radio waves changing from moment to moment can be displayed as a frequency domain or as a time domain.

- You can display the absolute receive level.
- You can write the measurement data to a file and read it.
- You can print the measurement results.
- You can save the measurement results as image data such as extended metafile (EMF), which is useful for creating reports and the like.
- You can scroll and zoom in on the measurement results to analyse them.
- You can customise the colours of the graphs and display them in 3D.

#### 1. Monitoring by frequency domain

- Since you can measure and display the RSSI level of each channel, you can monitor the status of the radio waves in the field.
- You can hold the peak level of each channel for the period of measurement.
- You can display the field status of the target station.

#### 2. Monitoring by time domain

Since you can monitor the field strength (signal level and noise floor level) of the current channel in real time, you can choose where to locate the radio equipment and assess the status of the antenna. At the source station, you can specify the channel to measure.

- You can carry out continuous measurement and one-shot measurement.
- If you carry out measurement while moving the transmitter around, you can assess the relationship between communication range and receive level.
- You can display the field status of the target station.

### ◆ Image viewer

You can open and view the image files of graphs saved during air monitoring. You can also copy the images to other applications using the clipboard.

## Chapter 2 How to Use the Evaluation Software

### 2.1 Basic Operations

#### 2.1.1 Basic operations

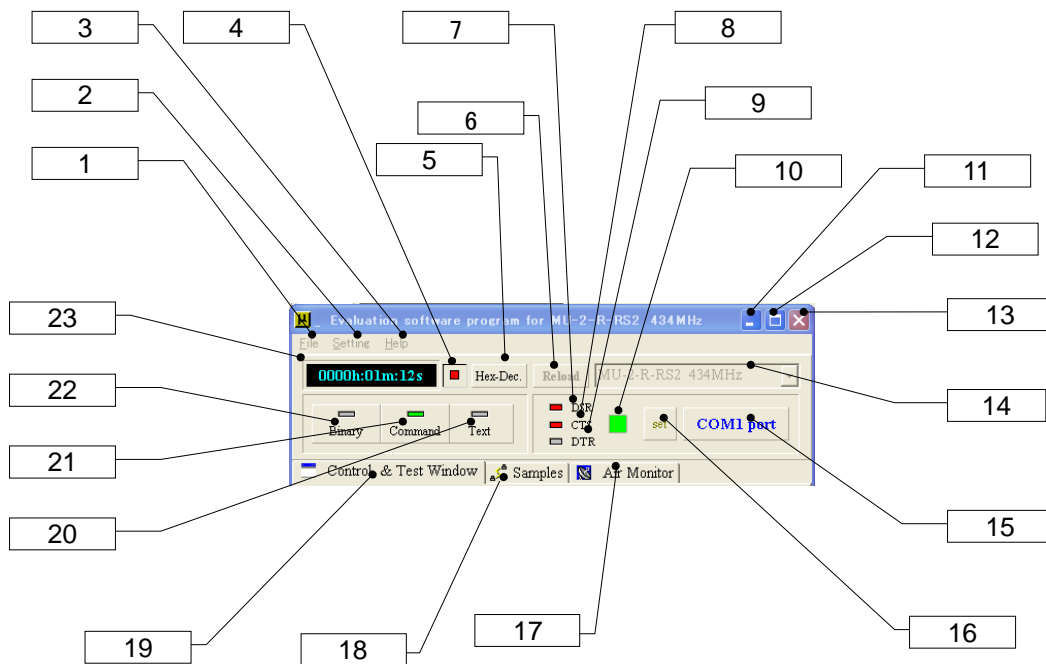
The basic operations include selecting the MU-2-R to use, setting the interface, selecting the mode and function window and so on.

- ◆ The MU-2-R has 3 operation modes (command, text, and binary). The transmission test function and air monitor function operate in the command mode. The buttons for these functions are disabled in modes other than the command mode.
- ◆ Immediately after opening the COM port and when returning from the air monitoring function to the control and test window, the program automatically reads and resets the channel and Equipment ID, and these items are displayed on the control and test window screen. If you perform an unexpected operation, the Equipment ID may change to 'FFh', therefore always check the Equipment ID.



Note

- (1) Always close the COM port before connecting the MU-2-R, changing the equipment, turning the power on and off and so on. If not, not only will the program shut down due to a COM port error, there may be adverse effects to the operation of the OS.
- (2) In the binary mode, characters entered in the input line of the control and test window are sent to the MU-2-R as they are input.
- (3) In order to return from the text mode to the command mode, the program sends the 1-byte ESC code:1Bh.
- (4) An RS232C signal DTR line is used for switching between the binary mode, text mode, and command mode.
- (5) When carrying out the various tests, check the User ID, Group ID, Equipment ID, Destination ID, transmission channel and the routing information in the control and test window. In particular, note that when finishing on the air monitoring function screen, the Equipment ID may be 'FFh' unless the power of the MU-2-R is turned off.



**[1] File menu**

- \* Image Viewer: You can check the air monitor images that you save, or copy them to the clipboard.
- \* Quit: Finishes the program.

**[2] Setting menu**

- \* COM Port: Opens the COM port setup window.
- \* Option: Opens a window for program settings and changing the colour of displays.

**[3] Help menu**

- \* Open Help Folder: Opens the folder containing the Help file.
- \* Version: Opens the version information window.

**[4] Time counter start/stop button**

Starts and stops time measurement with the time counter

**[5] Hex conversion button**

Clicking this button opens the hex-decimal conversion form. For details of conversion, refer to the conversion form item.

**[6] Reload button**

Reloads the model name to enable measurement with the equipment actually connected to the COM port. When existing saved air monitor data is opened in the air monitor window, the colour of the button changes to flashing red when the data is displayed. Clicking the button enables measurement with the equipment that is actually connected.

**[7] DSR indicator**

An indicator that displays the status of the COM port DSR signal. On when the level is High.

**[8] CTS indicator**

An indicator that displays the status of the COM port CTS signal. On when the level is High.

**[9] DTR indicator**

An indicator that displays the status of the COM port DTR signal. On when the level is High. The DTR signal is connected to the MODE terminal of the MU-2-R via the RS232C transceiver. Since the MU-2-R is normally used in the command mode, the DTR indicator is off. It turns on when changing to the binary mode or text mode.

**[10] COM port indicator**

On when the COM port is opened.

**[11] Minimize button**

**[12] Maximize button (do not use this)**

**[13] Close Program button**

Closes the program.

**[14] Model type designation box**

Specifies the MU-2-R to use.

**[15] COM port button**

Opens and closes the COM port.

If commands and so on are not sent normally when you click the “Trans.1” and “Trans.2” buttons, click the **COM port button** again.

**[16] COM port Set button**

Displays the COM port setup dialogue. Enter the same communication parameters as for the MU-2-R.

**[17] Air monitor window button**

**[18] Sample window button**

**[19] Control and test window button**

**[20] Text mode button**

Sets the MU-2-R to the text mode.

**[21] Command mode button**

Sets the MU-2-R to the command mode. Normally you should use this mode.

**[22] Binary mode button**

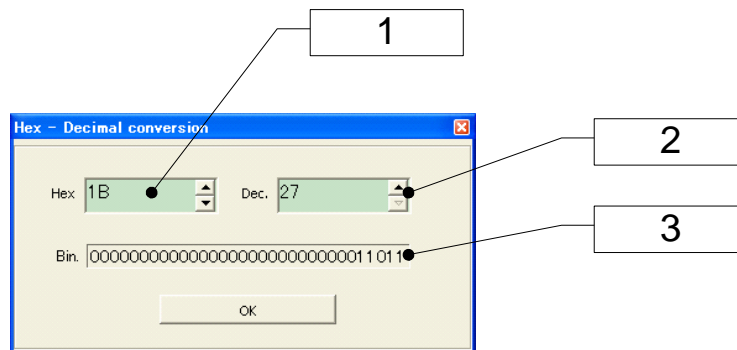
Sets the MU-2-R to the binary mode.

**[23] Time counter**

A time measurement counter. This is stopped with a left mouse click.

**2.1.2 Hex-decimal conversion form**

Converts hexadecimal numbers to decimals, and vice versa. The numerical values that can be converted are from 0h to FFFFFFFh for hexadecimal, and 0 to 268435455 for decimals. After double clicking the value, enter a numerical value to make the setting. It is not possible to enter a binary number.



**[1] Hexadecimal number input**

**[2] Decimal number input**

**[3] Binary display**

Shows the setting value as a binary number.

## 2.2 Control and Test Window

You can perform the following tasks from the control and test window.

1. Issue a variety of commands, 2. Fix the parameters in the EEPROM, 3. Packet success rate test, 4. Change the system channels, 5. Issue continuous test data, 6. Check the MU-2-R internal setting values of each station, 7. Other tasks.

### 2.2.1 Control & test window

#### Data input lines

In the command mode you can issue commands to the MU-2-R from the data input line 1 and data input line 2. In the text mode, enter a character string to transmit to the data input line and click the “Trans.” button or push the “Enter” key. In the binary mode, characters entered in the input line are transmitted to the MU-2-R as soon as the key is released. In the text mode and binary mode, make the size of data sent at one time less than 255 bytes.

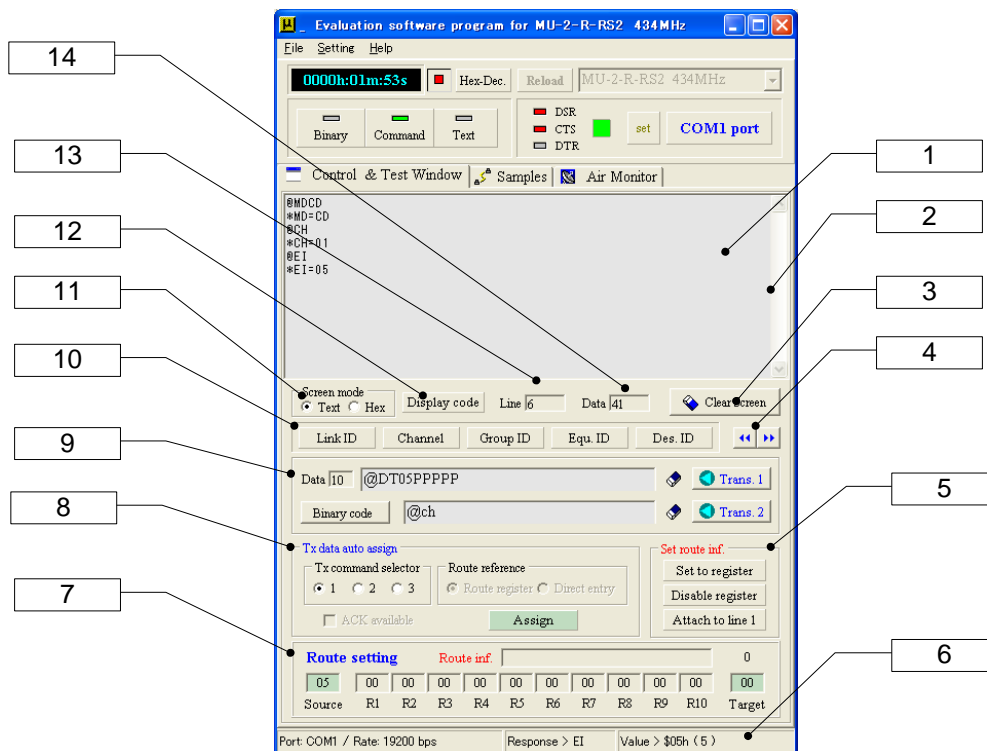
#### Screen

The screen displays the commands and data sent from the data input lines and displays the command response and receive response returned from the MU-2-R. You can copy character strings selected on the screen to the clipboard. However, commands cannot be issued, nor can data be edited, printed or saved from the screen. You can check the number of characters displayed on the screen with the “Screen data counter”.

⚠ Caution: Note that the screen is cleared automatically if the amount of data reaches 30,000 bytes.

#### Issuing commands

The data transmission command '@DT' requires data and the size of the data. You can easily make the basic '@DT' command using the transmission data auto assignment panel. Attach the route information to the basic command with the “Attach to line1” button on the Set route information panel. You can also enter the route information directly.





**[1] Screen**

Displays commands issued to the MU-2-R, and command responses and receive responses from the MU-2-R.

\* The data displayed cannot be edited, saved, printed or copied, although character strings can be copied to the clipboard.

**[2] Screen scroll button**

Scrolls the screen.

**[3] Clear screen/F7 button**

Clears the screen. The F7 function key has the same function.

**[4] Extend function button**

Opens and closes the extend function panel for the packet success rate test, internal setting value check and so on.

**[5] Set route information panel**

You can write the route information set with the route setting panel in the route register or attach it to the data transmit command. For details, refer to the page of 'Set route information panel'.

**[6] Status bar**

Indicates the status of various items during operation.

**[7] Route setting panel**

You can set route information using only the mouse. For details, refer to the page of route setting panel.

**[8] Transmission data auto assignment panel**

You can automatically make the template data transmit command (@DT) using this panel. The transmission data assigned is shown in the data input line 1.

The format of the data transmit command is different depending on whether the relay function is used or the Destination ID is used.

In other words, there are three methods; sending in accordance with the content of the Destination ID or the content of the route register, and directly entering the information in the command.

You can also request an ACK response. For details, refer to the page of 'Transmission data auto assignment panel'.

**[9] Command and data transmission panel**

You can transmit the commands and data entered in the data input lines. It is convenient to use the data input line 1 for the data transmit command and the data input line 2 for other commands. Clicking the binary code button opens a form to send binary code. For details, refer to the page of 'Command and data transmission panel'.

**[10] Link ID setting panel**

You can issue the commands to change the channel and frequently used IDs such as the Equipment ID with only a mouse click. For details, refer to the page of 'Link ID setting panel'.

**[11] Screen mode panel**

Switches between screen display modes.

This displays ASCII characters when set to "Text". It displays control code as garbled characters.

It displays hexadecimal code from 00h to FFh when set to "Hex".

**[12] Display code button**

A button for checking the character code. While this button is pressed, the characters appearing on the screen are displayed as hexadecimal code.

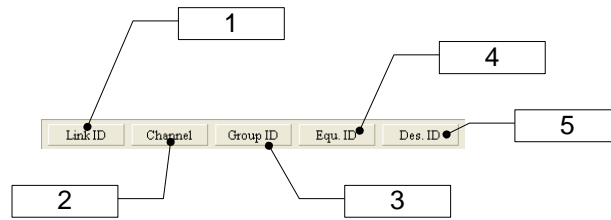
**[13] Screen line counter**

The number of lines on the screen.

**[14] Screen data counter**

Shows the amount of data displayed on the screen. Note that the screen is cleared automatically if the amount of data exceeds 30,000 bytes.

**2.2.2 ID setting panel**



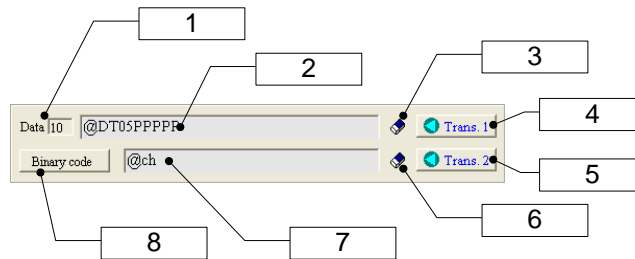
**[1] Link ID check button**

Clicking this button issues link related commands, making it possible to check the internal setting values.

**[2] Channel, [3] Group ID, [4] Equipment ID, [5] Destination ID**

You can change the link related IDs without writing the commands.

**2.2.3 Command and data transmission panel**



**[1] Data input line 1 counter**

Indicates the amount of data (single byte) entered in the data input line 1.

**[2] Data input line 1**

Enter commands or data, and press the Enter key or click the “Trans.1” button to send the data to the MU-2-R. Mainly used to enter the data transmit commands. The content is cleared with a double mouse click.

In the command mode: Enter commands.

In the text mode and binary mode: Enter transmission data.

**[3] Clear data input line 1 button**

Clears the content of the data input line 1. The SHIFT+F8 function key has the same function.

**[4] Transmit 1 button**

Transmits the content of the data input line 1 to the MU-2-R. The F8 function key has the same function.

If commands and so on are not sent normally when you click the “Trans. 1” button, click the **COM port button** again.

**[5] Transmit 2 button**

Transmits the content of the data input line 2 to the MU-2-R. The F9 function key has the same function.

If commands and so on are not sent normally when you click the “Trans. 2” button, click the **COM port button** again.

**[6] Clear data input line 2 button**

Clears the content of the data input line 2. The SHIFT+F9 function key has the same function.

**[7] Data input line 2**

Enter commands or data, and press the Enter key or click the “Trans. 2” button to send the data to the MU-2-R.

The content is cleared with a double mouse click.

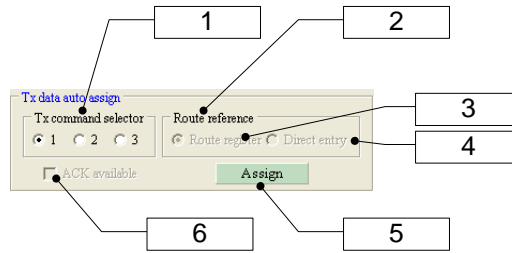
In the command mode: Enter commands.

In the text mode and binary mode: Enter transmission data.

**[8] Binary code transmission button**

Opens a binary code transmission form to send binary codes. For details, refer to the explanation of the binary code transmission form.

**2.2.4 Transmission data auto assignment panel**



**[1] Transmit command selector**

Selects one of the transmit commands the MU-2-R has. The data transmit command 1 uses a format where the transmit command refer to the Destination ID before sending data. With the data transmit command 1, the relay function can not be used nor can the ACK response be returned.

The data transmit command 3 attaches the RSSI level of the receive signal to the response returned.

**[2] Route reference**

Determines the way to make the transmit command reference the route information.

**[3] Refer to route register**

Checking this item and clicking the “Assign” button [5] makes the transmit command reference the content of the route register before being sent. The DT command option character is ‘/R’.

**[4] Directly enter route information**

Checking this item and clicking the “Assign” button [5] attaches the route information set with the route setting panel to the transmit command.

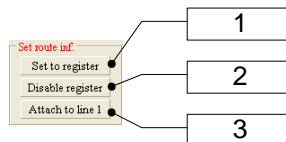
**[5] Transmission data assignment button**

Clicking this button opens the transmission data auto assignment form. The assigned data is displayed in the data input line 1.

**[6] Use ACK response checkbox**

Uses a format where the transmit command requires an ACK response from the target station when a data packet is transmitted. The DT command option character is ‘/A’.

**2.2.5 Set route information panel**



**[1] Set to route register button**

Writes route information set with the route setting panel in the route register. Transmission is based on the content of the route register and does not depend on the Destination ID.

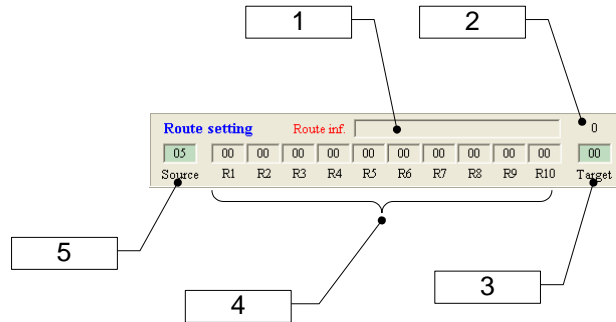
**[2] Disable route register button**

Disables the route register (set to NA). Clears the content of the route register and ensures that data is transmitted based on the Destination ID.

**[3] Attach to the data input line 1 button**

You can attach the route information set with the route setting panel to the command entered in the data input line 1.

**2.2.6 Route setting panel**



**[1] Route information**

The route information set. The character string shown here may be used as the route information in various cases.

**[2] Number of relay stations**

This is the number of relay stations specified.

**[3] Target station**

Specifies the equipment number of the station to which data will be sent. Clicking this opens a key input form for entering the equipment number.

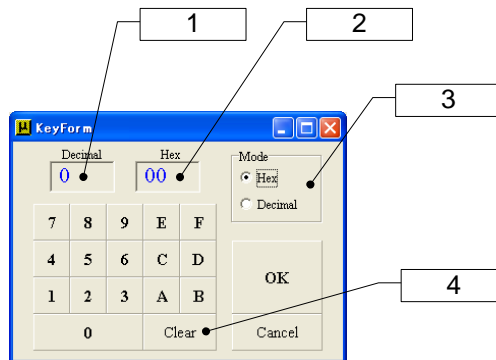
**[4] Relay stations**

Enter the equipment numbers of the relay stations. The equipment numbers are shown in hexadecimal. Clicking them opens a key input form for entering the equipment number. When specifying multiple relay stations, start from the left side.

**[5] Source station**

Specify the equipment number of the station from which data will be sent. Clicking this displays the equipment number currently set in the MU-2-R.

**2.2.7 Key input form**



**[1] Decimal value**

Shows the value set as a decimal.

**[2] Hexadecimal value**

Shows the value set as a hexadecimal.

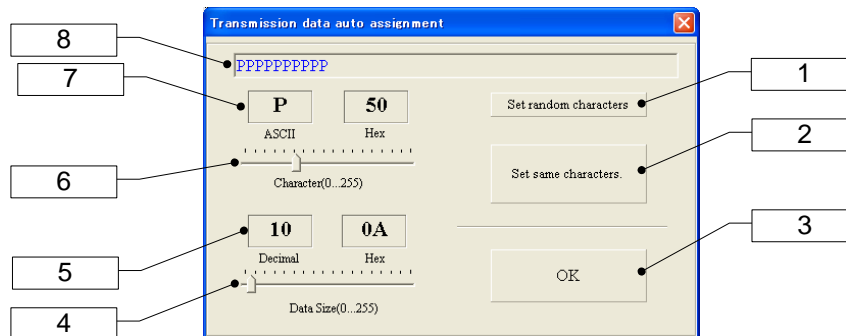
**[3] Mode**

Select whether to input the value as a decimal or hexadecimal. With decimal input the A to F keys cannot be used.

**[4] Clear button**

Clears the value entered.

## 2.2.8 Transmission data auto assignment form



### [1] Character setting (random characters)

Generates a template character string for the data transmit command with a length specified with data size [4]. Characters are selected randomly.

### [2] Character setting (same characters)

Generates a template character string for the data transmit command with a length specified with data size [4]. The characters are selected with the character selector [6].

### [3] OK button

Confirms the character string for data transmission. The created data is displayed in the data input line 1.

### [4] Data size

Specifies the data size. The range that can be specified is 0 to 255 bytes.

### [5] Data size indicator

Indicates the data size as a decimal and a hexadecimal.

### [6] Character selection

Selects the characters for the data transmit command. Data between 0 to 255 can be created, however the control code is not shown. When sending a control code, it is possible to set the screen mode of the target station to Hex and check the code.

### [7] Character display

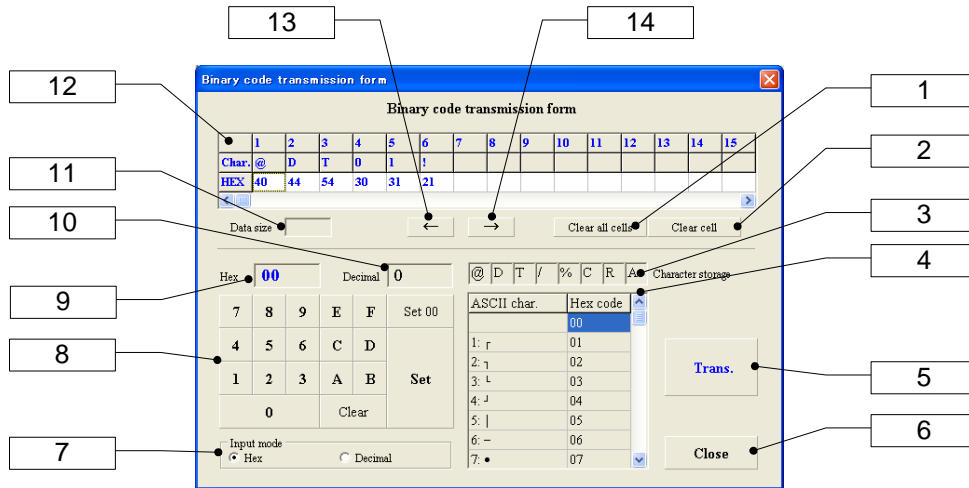
The characters and codes for the transmit command.

### [8] Transmission character display

Shows the character sequence for the transmit command.

**2.2.9 Binary code transmission form**

Generally communication programs can not directly transmit binary codes (hexadecimal data from 00h to FFh). By using this form, it is possible to insert binary codes including control codes into the data transmit command of the MU-2-R and transmit it. You can also issue the commands other than the data transmit commands, which can be used as reference when you create a control program for the MU-2-R. The status of transmission can be checked on the control and test window screen.



**[1] Clear all cells button**

Clears all contents in the transmission data cells [12].

**[2] Clear cell button**

Clears the content in the active cell of the transmission data cells [12].

**[3] Store characters cell**

You can store frequently used characters in these cells. The stored character is set in the active cell of the transmit data cells [12] with a left mouse click. To store characters in these cells, press a right mouse button on the cell and enter a character from the keyboard.

**[4] ASCII code list**

**[5] Transmit data button**

Transmits the command assigned in the transmission data cells [12].

**[6] Close button**

Closes this window.

**[7] Input mode**

Select whether to input the value as a decimal or hexadecimal.

**[8] Hexadecimal key**

Assigns byte data to set in the transmission data cells [12].

**[9] Hex: hexadecimal value display**

Shows the byte data set as a hexadecimal.

**[10] Decimal: Decimal value display**

Shows the byte data set as a decimal.

**[11] Data size**

Displays the size of the data set in the transmission data cells [12].

**[12] Transmission data cells**

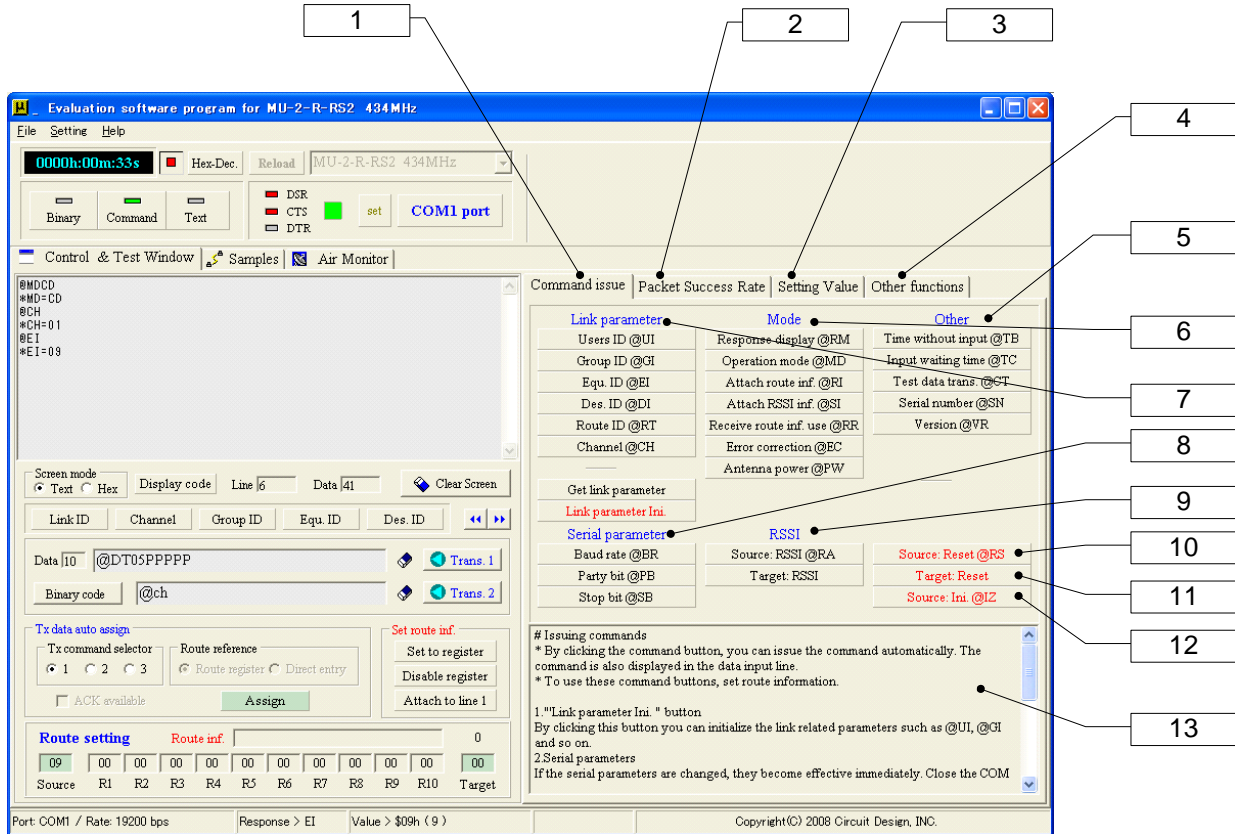
Assigns transmission data in each cell. In the command mode, creating data using commands other than those specifically for the MU-2-R will result in errors. The created data will be sent by clicking the transmit data button.

**[13][14] ←/→ buttons**

Shifts the active cell of the transmission data cells [12] to right and left. You can also directly select the cell with a mouse click.

2.2.10 Command issue panel

On this panel it is possible to check and set the internal settings of the various parameters. To set the parameters, attach the setting parameter to the command displayed in the data input line 2 and press the transmission button.



- [1] Button for switching to the command issue panel
- [2] Button for switching to the packet success rate test panel
- [3] Button for switching to the setting value acquisition panel
- [4] Button for switching to the other functions panel
- [5] Other

- [6] Mode
- [7] Link parameter

You can issue the communication link related commands and check the internal states. Pressing the “Get link parameter” button acquires multiple parameters. Pressing the “Link parameter Ini.” button initializes the link parameters on the work memory. The content of the EEPROM will be retained.

- [8] Serial parameter

You can issue the serial communication related commands and check the internal states.

- [9] Issue RSSI related parameter

You can issue the RSSI related commands and check the parameters.

- [10] Reset the source station [11] Reset the target station

Resets the source station and target station to the same status as when the power is turned on.

- [12] Initialize the source station

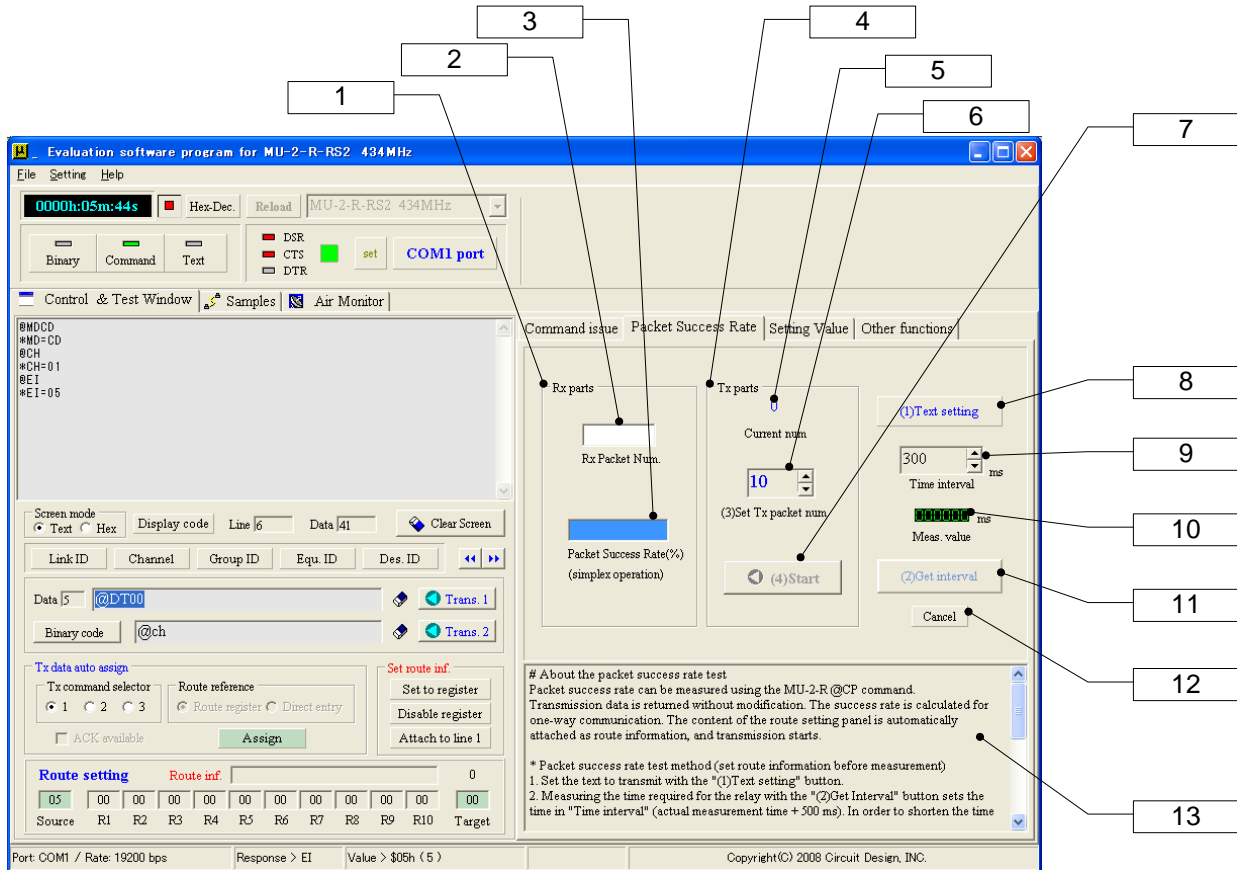
Clicking this button returns the source station to the factory default values. Note that the content of the EEPROM is also rewritten.

- [13] Help

Help for the command issue panel.

**2.2.11 Packet success rate test panel**

The packet test command '@CP' is used for calculating the packet success rate. Packets sent from the source station are returned without modification from the target station, which is displayed as the success rate for one-way.



**[1] Received parts**

Calculates the packet success rate based on the number of packets that succeeded.

**[2] Received packet counter**

The number of packets received.

**[3] Packet success rate indicator**

Shows the packet success rate calculated with one-way communication.

**[4] Sent parts**

Transmits packets for calculating the packet success rate using the '@CP' command.

**[5] Current number sent**

Shows the current value of packets being sent.

**[6] Number of packets setting (3)**

Sets the number of packets to send. To improve the accuracy of success rate measurement, it is necessary to set 100 or more.

**[7] Start/stop button (4)**

Starts and stops measurement of success rate.

**[8] Transmission text setting button (1)**

Opens the transmission data assignment form used for calculating the packet success rate. It is possible to specify characters and data size.

**[9] Time interval**

For the packet success rate test, the sent data being returned is used. For this reason, it is necessary to take into consideration the timing by which packets are forwarded according to the number of relay stations. The time shown here is actually used in the test and acquired by pressing the Get interval button [11]. The acquired value is adjustable. This time interval is Interval actual time displayed in [10] with 500 ms added.



**[10] Interval actual time**

The time until all sent packet data returns.

**[11] Get interval button (2)**

By clicking this button you can acquire the packet transmission timing of the current system.

**[12] Reset button**

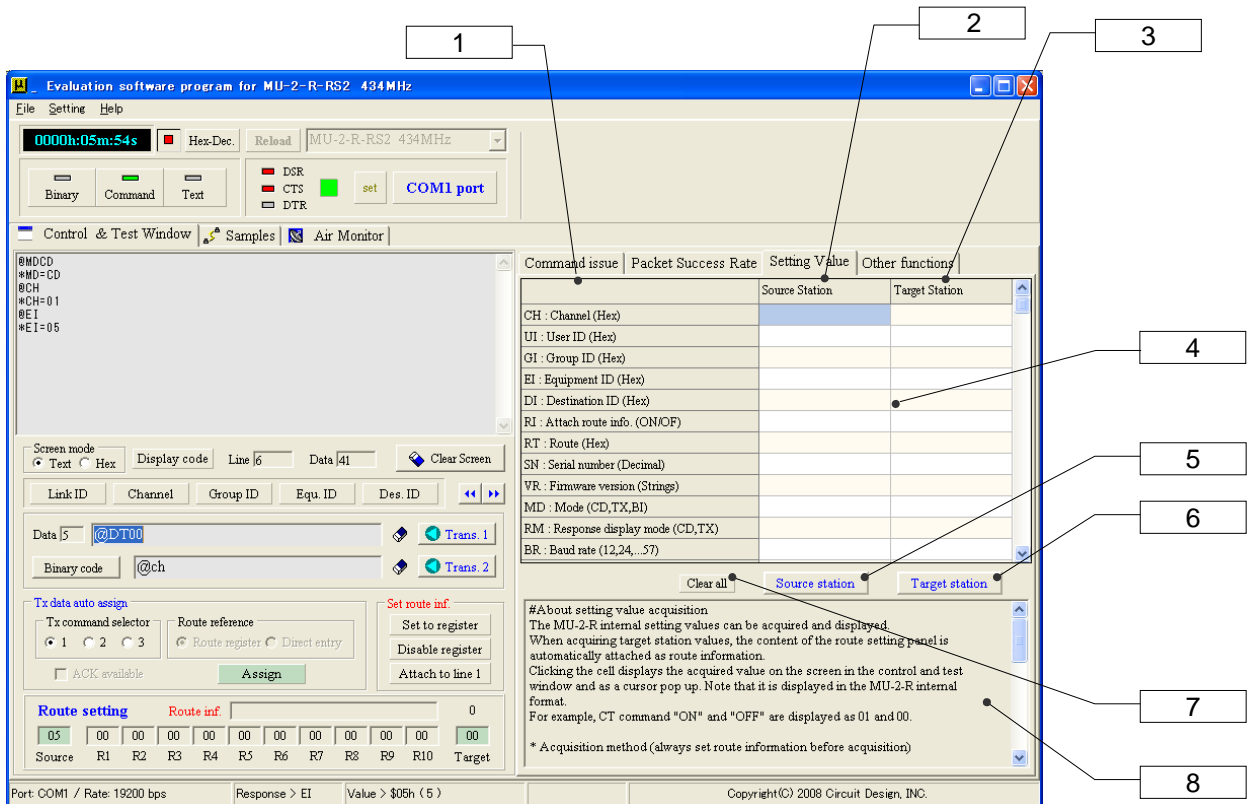
Reset if the interval cannot be acquired. Check the settings of the relay stations and so on.

**[13] Help**

Help for the packet success rate test method of measurement.

**2.2.12 Setting value acquisition panel**

On the setting value acquisition panel it is possible to acquire the internal setting values of the source station, relay station, and target station units. Before acquiring the settings, specify the route information on the route setting panel. If the route information is not set, the setting of the Destination ID will be acquired.



**[1] Display area for internal setting values**

Acquires and shows the various parameters of the MU-2-R units.

**[2] Source station part**

The source station internal setting values field.

**[3] Target station part**

The target station internal setting values field.

**[4] Internal setting values**

The display area for internal setting values. Clicking this displays the content in a cursor pop up.

**[5] Button for acquiring source station values**

Acquires the source station internal setting values.

**[6] Button for acquiring target station values**

Acquires the target station internal setting values.

**[7] Clear all button**

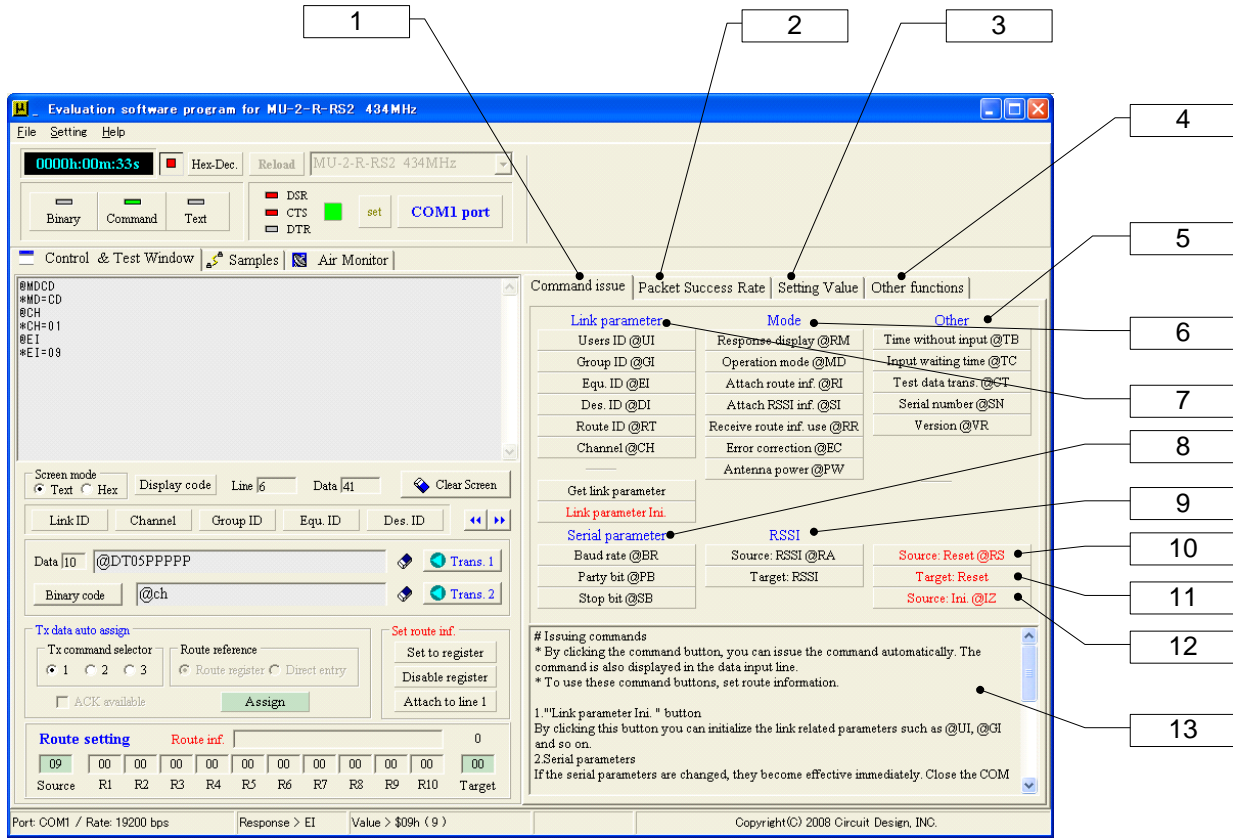
Clears the internal setting values display area.

**[8] Help**

Help for acquiring internal setting values.

**2.2.13 Other functions panel**

On this panel it is possible to change the channels within the system and transmit test data.



**[1] Channel changing panel**

It is possible to change the channels of MU-2-R units in the system at the same time. Before changing the channels, set the routing information on the route setting panel. This function is not guaranteed to change the channels without fail. Exercise prudence when changing channels. For example, if changing channels fails when changing all channels at the same time, first check which stations you can communicate with, then set the route information again and change the channels.

**[2] Changed channel**

Sets the channel to change.

**[3] Fix in EEPROM**

Check this to fix the changed channel in the EEPROM.

**[4] Route test button**

Tests whether the current system is linked normally before changing the channels.

**[5] Result**

Shows the result of the route test. If the route is normal, the channel changing buttons are enabled for 3 seconds only. Change the channels within this time.

**[6] Button for changing all station channels**

Changes the channels of all stations in the system.

**[7] Button for changing the target station channel**

Changes the channel of the target station.

**[8] Button for changing the source station channel**

Changes the channel of the source station.

**[9] Help**

Help for the other functions panel.

**[10] Start/stop button**

Starts/stops transmission of the command string.

**[11] Interval setting**

Approximate transmission time  $t$  with the standard protocol can be calculated using the following formula in accordance with the number of transmission characters;

$$t=2.08ms*n+100ms$$

**[12] Number of transmitted packets**

Shows the number of packets transmitted

**[13] Continuous command transmission panel**

By pressing the 'Start' button, the command character string entered in the data input line 1 is continuously transmitted for the time specified with the 'Interval'.

**[14] Issue target station test data**

Pressing this button issues test data from the target station specified with the route information on the route setting panel for only the time specified.

**[15] Issue source station test data**

Pressing this button issues test data from the source station for only the time specified.

**[16] Start/stop button****[17] Set data button****[18] Packet transmission interval****[19] Number of packets****[20] Transmission of packets with serial numbers**

You can assign a serial number to each of packets to send. The serial number is a hexadecimal integer. The transmission time 't' with standard protocols can be calculated depending on the number of transmission characters 'n' as follows;

$$t=2.08\text{ms}\cdot n+100\text{ms}$$

Set the transmission data using the "Set data" button [13]. 8 characters are used for a serial number, therefore ensure that the number of transmission characters is less than 247.

**[21] Time for issuing test data**

Specifies the time for issuing test data in 10-second units.

**[22] Test data transmission panel**

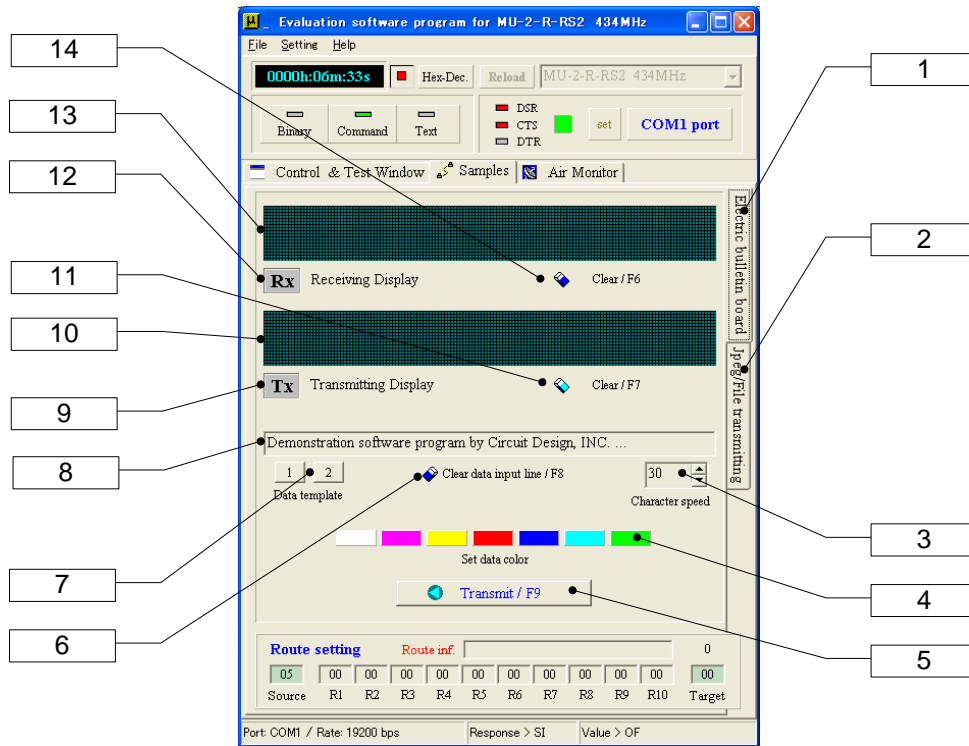
Transmits test data from the source station or target station for the time specified.

## 2.3 Sample Window

### 2.3.1 Electronic bulletin board

The electronic bulletin board sample is a one-way communication sample, with only one transmission packet of up to 255 bytes of data.

Before transmitting data, set the route information on the route setting panel.



**[1] Button for switching to the electronic bulletin board panel**

**[2] Button for switching to the JPEG image/file transmission panel**

**[3] Character speed control**

Controls the speed at which characters are shown on the transmitting display. A higher value makes the display slower.

This is the speed at which characters are shown on the receiving display of the target station.

**[4] Data setting button**

The character string shown in the data input line is shown on the transmitting display in the colour of the button.

**[5] Transmit/F9 button**

The character string shown in the transmitting display is transmitted from the MU-2-R. Transmission is also possible with the F9 function key.

**[6] Clear data input line button (F8)**

**[7] Transmission data template** A template for transmission data.

**[8] Data input line**

Enter transmission data. Pressing the Enter key displays it in the transmitting display. You can input data.

**[9] Transmission indicator** Displayed in red when data is being transmitted.

**[10] Transmitting display** Displays the transmission data.

**[11] Clear transmitting display button (F7)**

**[12] Receiving indicator** Shown in green when data is being received.

**[13] Receiving display** Displays the receiving data.

**[14] Clear receiving display button (F6)**

**2.3.2 JPEG image/file transmission**

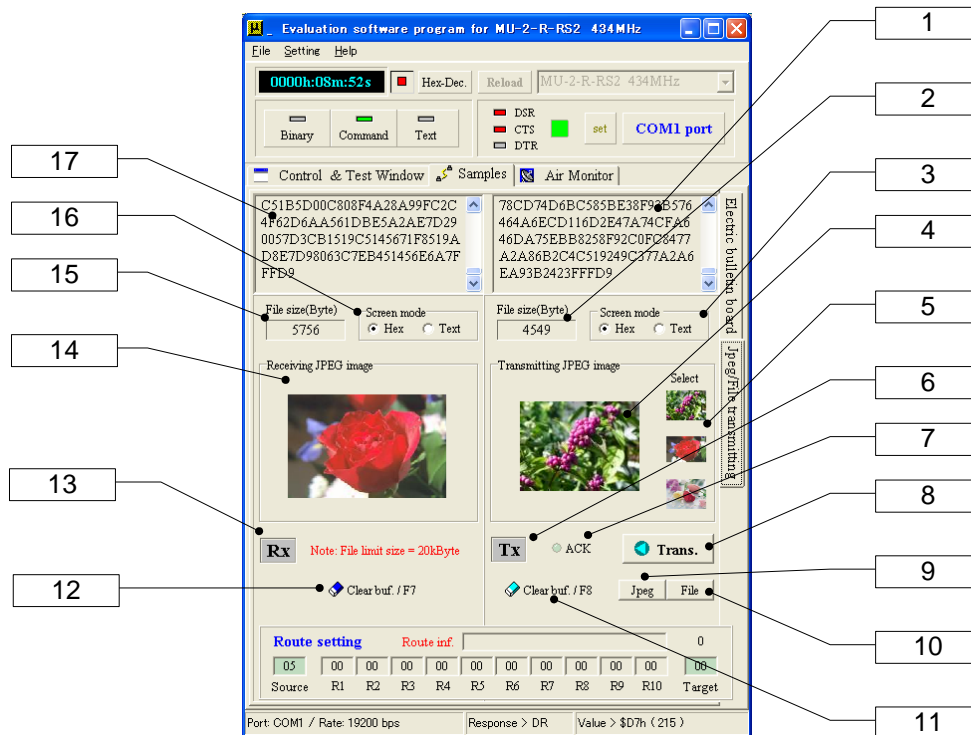
A JPEG image and file transmission sample that exceeds one packet.

The MU-2-R can send up to 255 bytes of user data at one time, but to send larger amounts of data, it is necessary to make a file transfer protocol in the user program.

This program uses a data transmit command with an ACK response.

However, since the program does not perform ACK response detection using ARQ (resend request), files may not be transmitted normally due to radio transmission errors.

- \* Ensure that the file size is less than 20 KB.
- \* Do not specify images other than JPEG images.



**[1] Transmitting box**

Shows the contents of the file for transmission (including the JPEG image file).

**[2] Data size of the file for transmission (JPEG image)**

Indicates the data size of the file for transmission in bytes.

**[3] Transmit screen mode switcher**

Switches the display mode of the transmitting box between Hex and Text.

In the text mode, text files are displayed normally, but binary files cannot be displayed.

Binary files should be displayed as Hex.

**[4] JPEG image for transmission**

The selected JPEG image is displayed.

**[5] JPEG image samples**

JPEG samples for image transmission. Clicking with the mouse selects the image to transmit. The data size of the files is 4.5, 5.7, and 8.3 KB from the top. Displaying and transmitting the image takes some time.

**[6] Transmit indicator**

Shown in red when data is being transmitted.

**[7] ACK indicator**

Displays the ACK response from the target station.

**[8] Transmit button (F9)**

The contents shown in the transmitting box (JPEG image and file) are transmitted.

**[9] Open JPEG file button**

Clicking this button opens the open JPEG image file dialogue. You cannot test transmission with an image bigger than 20 KB. Processing files with a larger data size takes some time.

**[10] Open file button**

Clicking this button opens the open file dialogue. You cannot test transmission with a file bigger than 20 KB. Processing files with a larger data size takes some time.

**[11] Clear transmit buffer button**

Clears the internal transmit buffer of the program.

**[12] Clear receive buffer button**

Clears the internal receive buffer of the program.

**[13] Receive indicator**

Shown in green when data is being received.

**[14] Received JPEG image**

Displays the received JPEG image.

**[15] Data size of the received file (JPEG image)**

Indicates the data size of the received file in bytes.

**[16] Receive screen mode switcher**

Switches the display mode of the receiving box between Hex and Text.

In the text mode, text files are displayed normally, but binary files cannot be displayed.

Binary files should be displayed as Hex.

**[17] Receiving box**

Displays the contents of the received file (including the JPEG image file).

## 2.4 Air Monitor

The air monitor uses the MU-2-R @RA and @CA commands for reading the RSSI level, displaying the levels as a graph. You can measure any of the channels of the MU-2-R units you are using. It is possible to save, view, analyse, and print out the measurement result on a PC. The RSSI level and channel frequencies can be analysed, by scrolling around and zooming in on the graph.

The acquired RSSI absolute level is based on the signal level of a reference signal generator, but there is an error of several percent.

### Checking the functions of the air monitor

When the MU-2-R '@CT' command is used, test waves are emitted continuously in the designated channel allowing you to check the air monitor.

Specify the channel of the MU-2-R, and issue the command '@CTON'. To stop, use '@CTOF'. By issuing the option '/W' command, you can make the MU-2-R emit test waves continuously as long as the power is turned on.

### Peak hold

The peak is the RSSI level of each channel during the period of measurement, and you can hold this value. By conducting monitoring over a long time, you can assess which channels in the field are being used frequently.

### Using the graphs as data

Using the save and load file functions, you can reuse the measurement results. If you customise the colours of the graph, the graph retains the customised colours when you load the data.

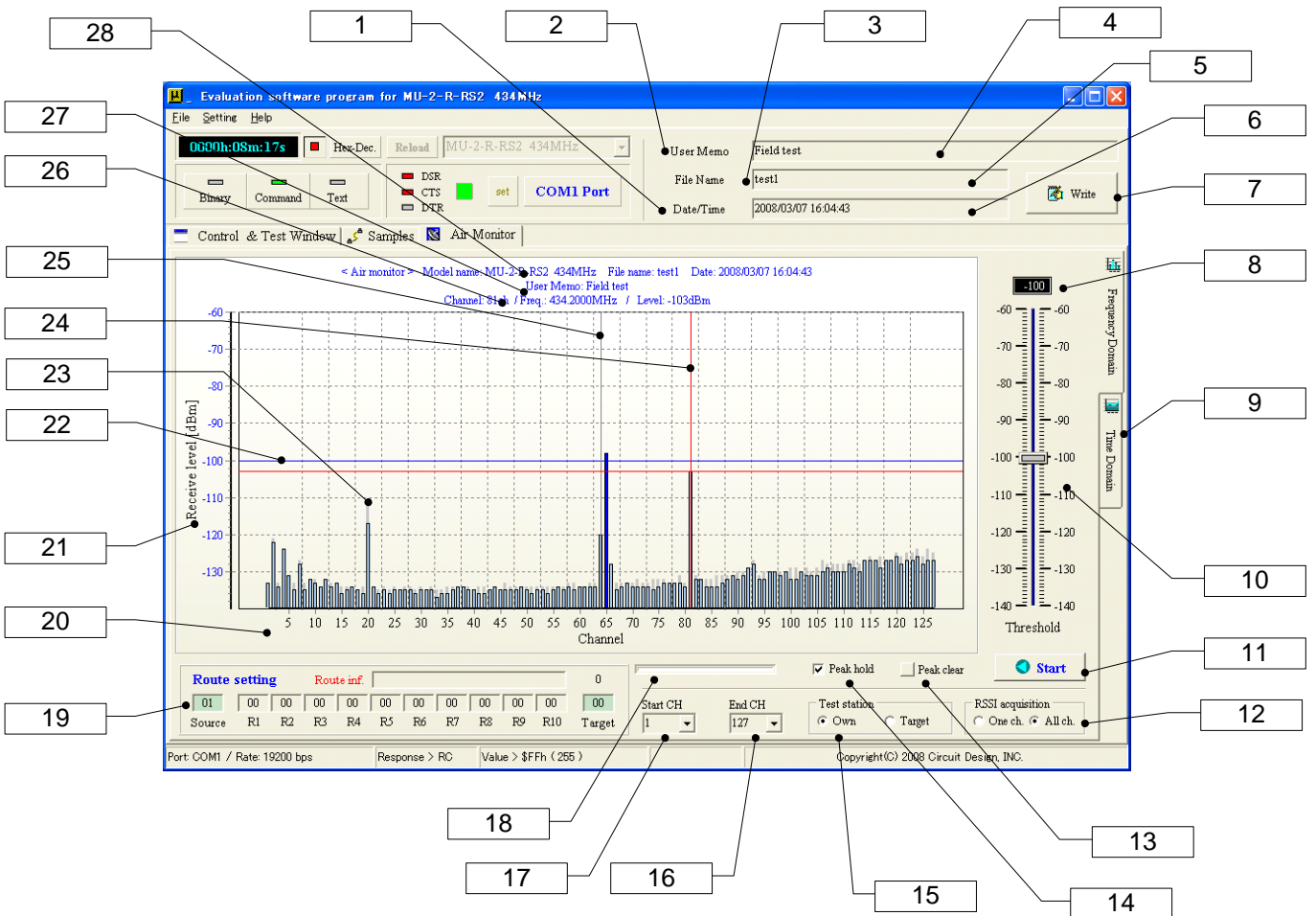
### Using the graphs as images

With this program you can save the graphs as Windows extended metafiles (EMF), WMF, BMP and JPEG, and use them in MS-Word and so on. If you customise the colours of a graph, it is saved in those colours.

In addition, you can also copy graphs to the clipboard in the EMF, WMF, and BMP formats.

👉 Hint: The air monitor scans the RSSI level of many channels so it takes some time. Setting the bit rate of the COM port to 38,400 bps or higher improves the response.

**2.4.1 Air monitor (measurement in a frequency domain)**



- [1] Date and time button**  
Sets the date and time in the date/time line.
- [2] Clear user memo line button**
- [3] Clear file name line button**
- [4] User memo input line**  
Enter character strings shown in the graph. Clear the text with a double mouse click.
- [5] File name line**  
A file name used when pressing the save menu on the pop-up menu displayed with a right mouse click. Do not add a file extension. One is added automatically. Clear the text with a double mouse click. The file extension is '.AMF' for a frequency domain, and '.AMT' for a time domain.
- [6] Date and time line**  
Sets the date and current time shown in the graph. The current time is updated with a left mouse click. It is cleared with a double click.
- [7] Write button**  
Displays the contents of the user memo input line, the date and time line, and file name line in the user memo section at the top of the graph. The contents shown in the graph can be printed out or output as an EMF file.
- [8] Threshold value**
- [9] Button for switching to the time domain measurement panel**
- [10] Threshold value adjustment**  
Sets the threshold for the RSSI level. Levels that exceed this value change colour. When the control is active, you can make fine adjustments with the centre wheel of the mouse or the keyboard up and down arrow keys.
- [11] Start/stop button**  
Starts and stops measurement. During measurement, do not switch to other functions.



**[12] RSSI acquisition method button**

Select the RSSI acquisition method for each channel to perform the air monitor function.  
Selecting 'One ch' acquires the RSSI by channel and display it using the @RA command.  
Selecting 'All ch' acquires the RSSI of all channels at once and display it using the @RC command.

**[13] Clear peak button**

Clears the peak hold value.

**[14] Display peak value**

Checking this displays the peak value within the measurement period.

**[15] Test station selector**

Source: Measures the source station. Target: Measures the target station.

**[16], [17] Scan end channel, scan start channel**

By setting the start channel and end channel, you can collect data between any channels.  
\* Always set the end channel higher than the start channel.

**[18] Progress bar**

Displays the progress of data acquisition for each channel.

**[19] Route setting panel**

Sets the routing information to the station to be measured.

**[20] Measurement channel axis (horizontal axis)****[21] RSSI absolute level axis (vertical axis)**

The axis for RSSI absolute level inducted through the antenna of the measured MU-2-R.

**[22] Threshold line****[23] Peak marker**

Displays and holds the peak value for each channel during the measurement period.

**[24] Analyse line**

Clicking the graph displays the channel frequency and RSSI absolute level are displayed at the top of the graph and as a cursor pop up.

**[25] Center line**

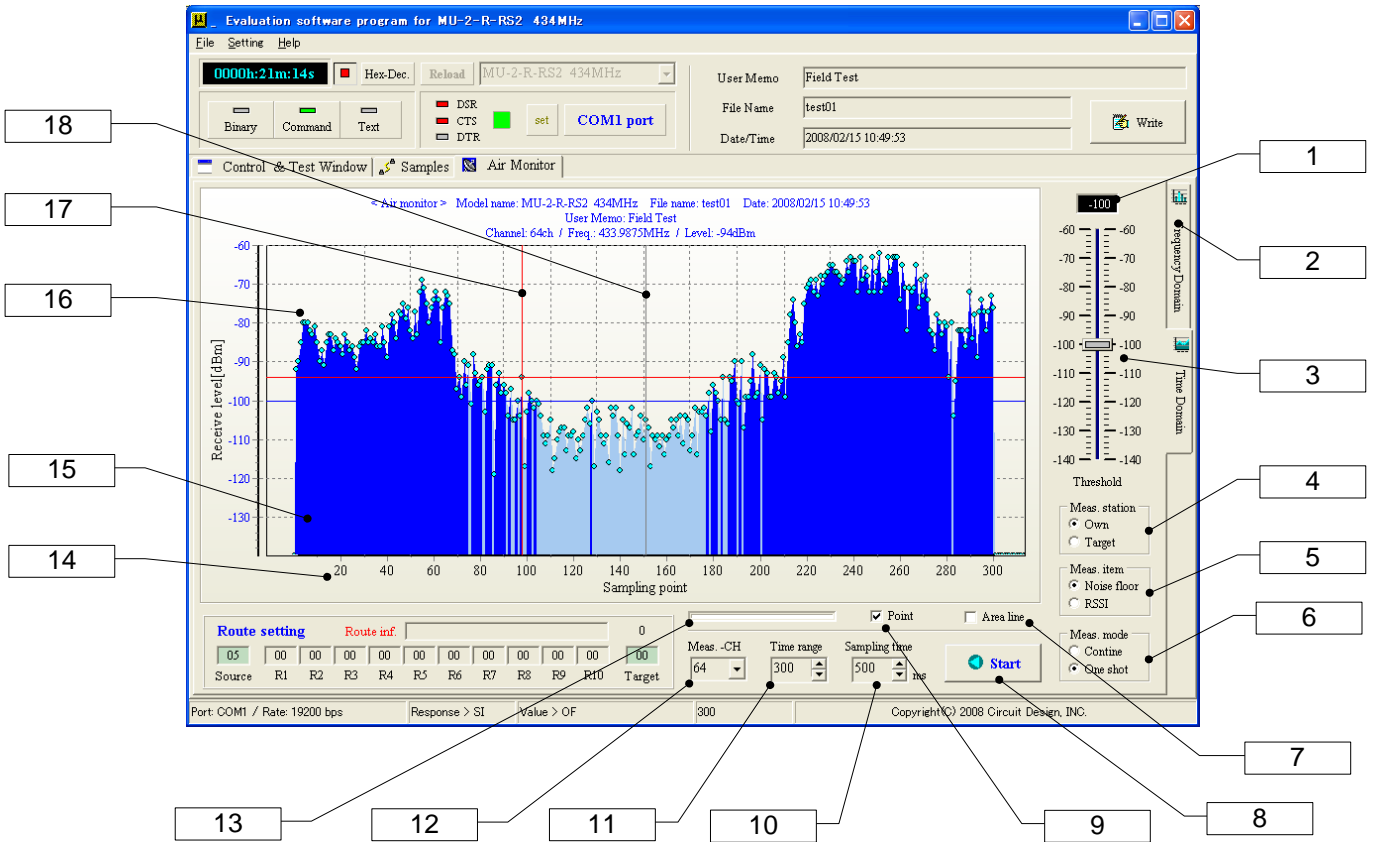
A line that expresses the center of the graph. This can be hidden with the F7 function key.

**[26] Frequency and level of analysed channel**

Displays the frequency and RSSI level of the analysed channel.

**[27] User memo****[28] Unit name and date**

**2.4.2 Air monitor (measurement in a time domain)**



- [1] Threshold value**
- [2] Button for switching to the frequency domain measurement panel**
- [3] Threshold value adjustment**  
Sets the threshold for the RSSI absolute level. Levels that exceed this value change colour. When the control is active, you can make fine adjustments with the centre wheel of the mouse or the keyboard up and down arrow keys.
- [4] Station to measure**  
Specify the station to measure.
- [5] Measurement item**  
Select which to measure between the floor noise level and received signal level. To measure the received signal level of the source station, the matching station (target station) is necessary.
- [6] Measurement mode**  
\* Repeat: The repeat measurement mode. When the set number of samples are gathered, the program goes back to the start and continues with measurement. The measurement time interval is set with the sampling time control.  
\* One shot: Measurement stops when the number of samples set with the sampling number control is reached. The measurement time interval is set with the sample time control.
- [7] Enable area line function**  
Selects whether to show area lines on the graph.
- [8] Start/stop button**  
Starts and stops measurement. You can stop during measurement in all modes.
- [9] Enable point function**  
Selects whether to show points on the graph.
- [10] Sampling time control**  
Sets the sampling time for the timer measurement mode. The unit is ms, and the minimum value is 100 ms. You can set steps of 100 ms with the up and down buttons, and you can also enter a value directly from the keyboard. In this case, double click the field and enter a value. The colour changes when a value is entered. Press the Enter key and check the value. To measure the received signal level at the target station and the source station, it is required to set the sampling time to a proper value, especially for using relay stations, ensure that radio wave collisions are avoided. This evaluation program automatically adds a minimum of 260 ms for a 1:1 system and pluses another 260 ms per relay station when route information is set with the route setting panel.

**[11] Sampling number control**

The number of samples can be adjusted up or down in steps of 10, from 10 to 5000.

To enter a value from the keyboard, double click the field and enter a value. The colour changes when a value is entered. Press the Enter key and check the value.

**[12] Measurement channel control**

Selects a channel to measure.

**[13] Progress bar**

Displays the progress of data acquisition for the measured channel.

**[14] Sampling point axis (horizontal axis)**

**[15] Graph area lines**

**[16] Graph point**

**[17] Analyse line**

Clicking the graph displays the RSSI absolute level at the top of the graph and as a cursor pop up.

**[18] Center line**

A line that expresses the center of the graph. This can be hidden with the F7 function key.

**2.4.3 Air monitor mouse functions**

**1. Analyse function**

When measurement is stopped, you can click on the graph of each channel, and display the RSSI absolute level and frequency of each channel.

**2. Graph scrolling function**

When measurement is stopped, you can scroll the graph left and right by pressing the left mouse button.

**3. Graph zooming function**

When measurement is stopped, you can zoom in on the graph by pressing the Shift key and left mouse button.

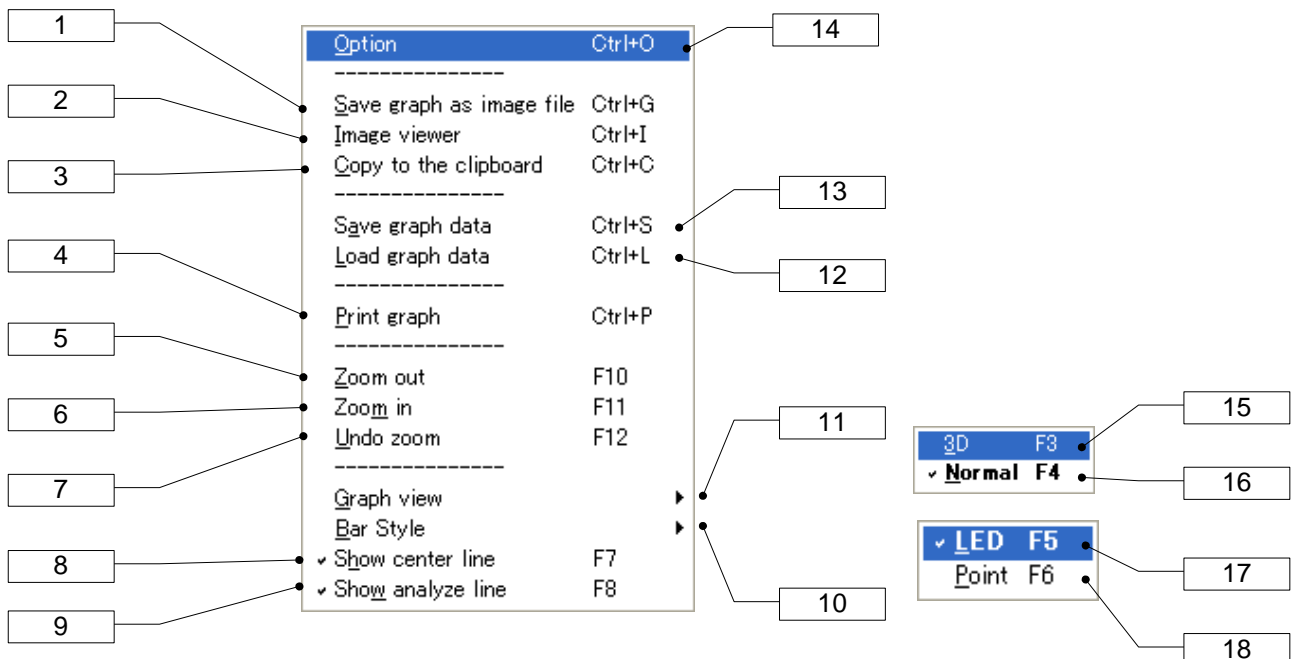
Dragging from upper left to lower right defines an area to zoom in.

Dragging from upper right to lower left defines an area to undo zoom (you can also use the pop-up menu or function keys).

\* When starting to scroll or zoom, start with the cursor at a point outside the measurement data.

**4. Pop-up menu function**

The pop-up menu displayed with a right mouse click.



The keyboard shortcuts are shown at right.

**[1] Save graph as image file (Ctrl+G)**

Saves the measurement results as Windows extended metafiles (EMF), metafiles (WMF), bitmaps (BMP) and JPEG (JPG).

**[2] Image viewer (Ctrl+I)**

Starts up the image viewer.

**[3] Copy to the clipboard (Ctrl+C)**

Copies the graph to the clipboard as image data. Specify the format of copied images in the Option dialogue. You can copy in the EMF, WMF, and BMP formats.

**[4] Print graph (Ctrl+P)**

Prints the measurement results. The range printed is the area of the graph.

**[5], [6], [7] Zoom out (F10), Zoom in (F11), Undo zoom (F12)****[8] Show the center line (F7)**

Selects whether to show the center line.

**[9] Show analyse line (F8)**

Selects whether to show the analyse line.

**[11], [18], [19] Bar style**

Changes the style of the progress bar.

LED: Shows the progress bar as LEDs. (F5)

Point: Shows the progress bar as points. (F6)

**[12], [16], [17] Graph view**

Changes the appearance of the graph.

3D: Shows the graph in 3D. (F3)

Normal: Shows the graph normally (2D). (F4)

**[13] Load graph data (Ctrl+L)**

Loads saved graph data. Do NOT load files with a file extension other than '.AMF' or '.AMT'.

**[14] Save graph data (Ctrl+S)**

Saves graph data as a file. Do not change the file extension.

The file extension is '.AMF' for the frequency domain mode, and '.AMT' for the time domain mode.

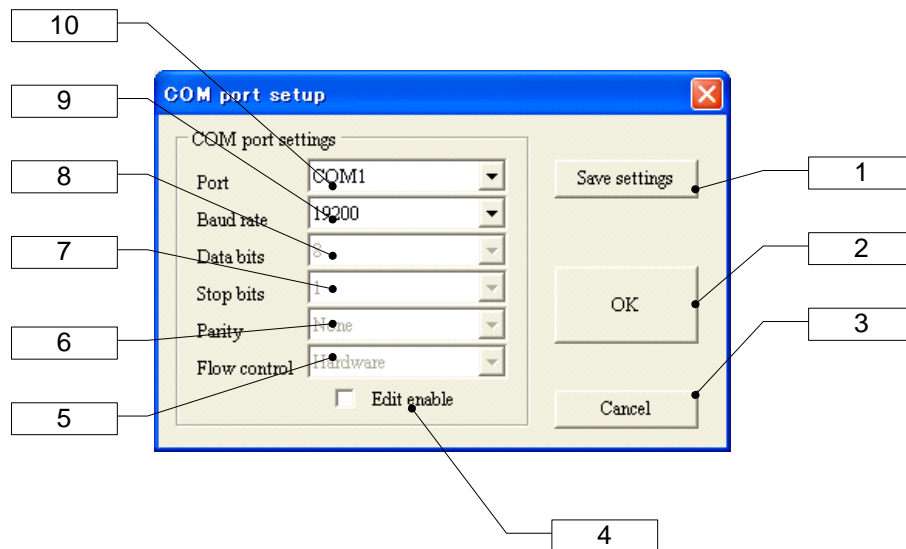
**[15] Option (Ctrl+O)**

Shows the Option dialogue.

**2.4.4 Cautions when using the air monitor**

- ◆ The air monitor function operates with the Equipment ID EI = FFh.  
When using the control and test window or communication test functions, always check the Equipment ID and so on again. Communication is not possible if the Destination ID and Equipment ID do not match. In addition, check the channel again.
- ◆ Do not change to the control and test window or communication test window during measurement with the air monitor. Doing so changes the Equipment ID and channel number. In this case, reset the ID and channel.
- ◆ When finishing on the air monitoring function screen, the Equipment ID will be 'FFh' unless the power of the MU-2-R is turned off. In addition, the channel number stays same when the function finishes. Check them before using the equipment again.

## 2.5 COM Port Setup Dialogue



### [1] Save settings button

Saves the settings as an initialization file. The settings are used when you next start up the program.

### [2] OK button

Applies the changed parameters. The changes are not saved in the initialization file.

### [3] Cancel button

### [4] Edit enable checkbox

The MU-2-R normally operates with just the port and baud rate specified, but you can change the other parameters for testing and the like.

### [5] to [10] COM port parameter input fields

The initial values (MU-2-R specification) are as follows.

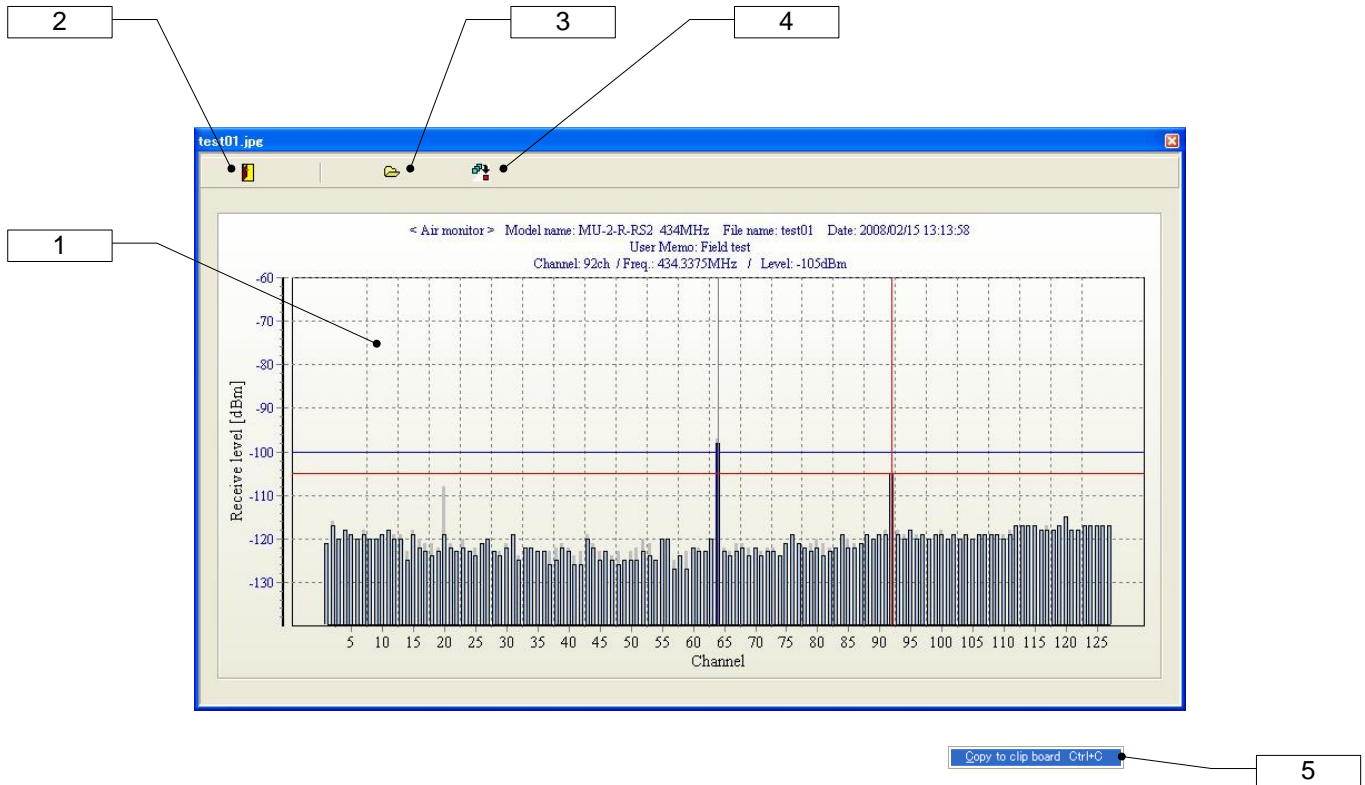
Port: COM1, baud rate = 19,200 bps, data bit = 8, stop bit = 1,  
parity bit = None, flow control: Hardware



Note

Keep the settings within the specifications of the MU-2-R.

**2.6 Image Viewer**



**[1] Image display screen**

Shows images read from files. The load image file dialogue is displayed with a left mouse click. In addition, a pop-up menu is displayed with a right mouse click.

**[2] Quit button**

Quits the image viewer.

**[3] Load image button**

Displays the load image file dialogue.

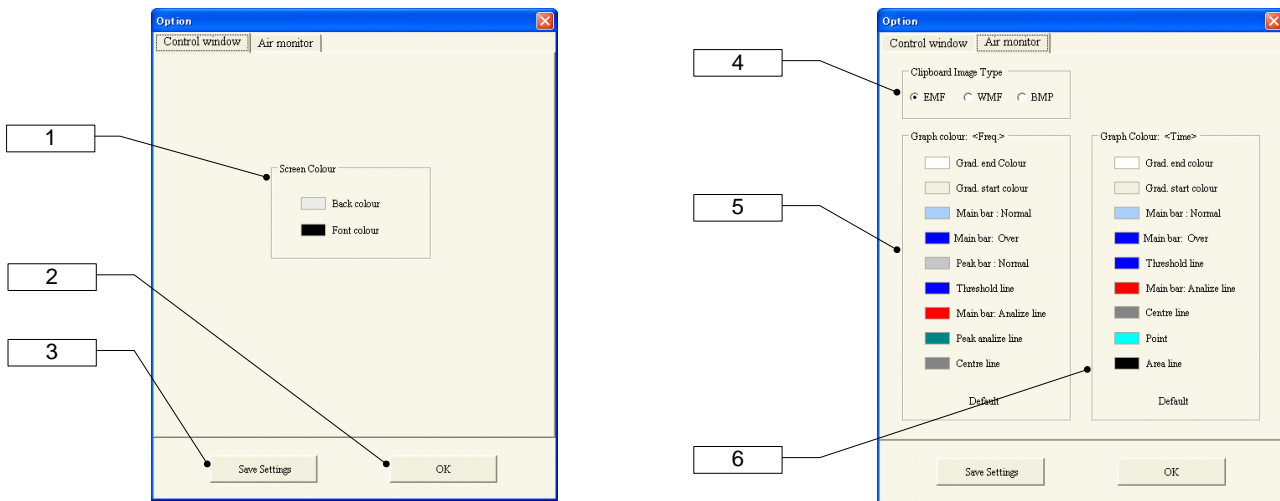
**[4] Copy to the clipboard button**

Copies images to the clipboard. Specify the type of images copied to the clipboard in the Option dialogue. The default is EMF format.

**[5] Pop-up menu**

\* Copy to the clipboard: Copies the image to the clipboard.

**2.7 Option Dialogue**



**[1] Screen colour**

- \* Back colour: Changes the background colour of the screen.
- \* Font colour: Changes the colour of the screen font.

**[2] OK button**

Values set in the Option dialogue are applied immediately, but the default settings file of the program is not changed.

**[3] Save settings button**

- Values set in the Option dialogue are saved in the default settings file of the program, and are applied immediately.
- The settings are also applied when you next start up the program.

**[4] Clipboard image type setting**

Specifies the type of image copied to the clipboard.

**[5] Graph colour setting (frequency domain measurement)**

- \* Gradation end : Changes the end colour of the gradation.
- \* Gradation start : Changes the start colour of the gradation.
- \* Main bar Normal : Changes the colour of the main bar.
- \* Main bar Over : Changes the colour of the main bar when it exceeds the threshold.
- \* Peak bar Normal : Changes the colour of the peak value bar.
- \* Threshold line : Changes the colour of the threshold line.
- \* Main bar Analyse line : Changes the colour of the analyse line of the main bar.
- \* Peak bar Analyse line : Changes the colour of the analyse line of the peak bar.
- \* Centre line : Changes the colour of the centre line.
- \* Default : Sets the colours to their defaults.

**[6] Graph colour setting (time domain measurement)**

- \* Gradation end : Changes the end colour of the gradation.
- \* Gradation start : Changes the start colour of the gradation.
- \* Main bar Normal : Changes the colour of the main bar.
- \* Main bar Over : Changes the colour of the main bar when it exceeds the threshold.
- \* Threshold line : Changes the colour of the threshold line.
- \* Main bar Analyse line : Changes the colour of the analyse line of the main bar.
- \* Centre line : Changes the colour of the centre line.
- \* Point : Changes the colour of the graph points.
- \* Area line : Changes the colour of the area line.
- \* Default : Sets the colours to their defaults.

## 2.8 Files Created by the Program

When the MU-2-R evaluation program is run, the following user data files are created in the Circuit Design\MU2\_ESP folder.

When uninstalling the program, first move important files to another location.

*.AMF	Air monitor data (frequency domain)
*.AMT	Air monitor data (time domain)

test.jpg	Temporary image data (can be deleted)
img0.jpg	Temporary image data (can be deleted)
test.temp	Temporary image data (can be deleted)



## Important notice

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- Circuit Design products are neither designed nor intended for use in life support applications where malfunction can reasonably be expected to result in significant personal injury to the user. Any use of Circuit Design products in such safety-critical applications is understood to be fully at the risk of the customer and the customer must fully indemnify Circuit Design, Inc for any damages resulting from any improper use.
- As the radio module communicates using electronic radio waves, there are cases where transmission will be temporarily cut off due to the surrounding environment and method of usage. The manufacturer is exempt from all responsibility relating to resulting harm to personnel or equipment and other secondary damage.
- The manufacturer is exempt from all responsibility relating to secondary damage resulting from the operation, performance and reliability of equipment connected to the radio module.

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## Cautions

- Do not use the equipment within the vicinity of devices that may malfunction as a result of electronic radio waves from the radio module.
- Communication performance will be affected by the surrounding environment, so communication tests should be carried out before actual use.
- Ensure that the power supply for the radio module is within the specified rating. Short circuits and reverse connections may result in overheating and damage and must be avoided at all costs.
- Ensure that the power supply has been switched off before attempting any wiring work.
- The case is connected to the GND terminal of the internal circuit, so do not make contact between the '+' side of the power supply terminal and the case.
- When batteries are used as the power source, avoid short circuits, recharging, dismantling, and pressure. Failure to observe this caution may result in the outbreak of fire, overheating and damage to the equipment. Remove the batteries when the equipment is not to be used for a long period of time. Failure to observe this caution may result in battery leaks and damage to the equipment.
- Do not use this equipment in vehicles with the windows closed, in locations where it is subject to direct sunlight, or in locations with extremely high humidity.
- The radio module is neither waterproof nor splash proof. Ensure that it is not splashed with soot or water. Do not use the equipment if water or other foreign matter has entered the case.
- Do not drop the radio module or otherwise subject it to strong shocks.
- Do not subject the equipment to condensation (including moving it from cold locations to locations with a significant increase in temperature.)
- Do not use the equipment in locations where it is likely to be affected by acid, alkalis, organic agents or corrosive gas.
- Do not bend or break the antenna. Metallic objects placed in the vicinity of the antenna will have a great effect on communication performance. As far as possible, ensure that the equipment is placed well away from metallic objects.
- The GND for the radio module will also affect communication performance. If possible, ensure that the case GND and the circuit GND are connected to a large GND pattern.

## Warnings

- Do not take a part or modify the equipment.
- Do not remove the product label (the label attached to the upper surface of the module.) Using a module from which the label has been removed is prohibited.

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**REVISION HISTORY**

Version	Date	Description	Remark
1.0	Mar. 2009	MU2-ESP The first issue	
1.1	Sep. 2020	Added MU4-RS2 and MU4-USB information	