G-ROBOTS

RPU-11

Robot Processing Unit

User's Manual Ver.1.0

Instruction Manual

Cautions

- Please read this instruction manual before use.
- Please keep this manual handy for immediate use.

For Models

CONTENTS

1. Safety

In order to use this product safely, please read this manual carefully before use.

Warning Signs

Be aware of parts or areas with either of the following signs as they require special attention for safety reasons.

Signs	Meaning
⚠ **DANGER**	Procedures which may have a high risk of death or serious injury to the user if not carried out properly, or procedures in which the probability of superficial injury or physical damage is high.
⚠ **WARNING**	Procedures that may lead to dangerous conditions or cause death or serious injury to the user if not carried out properly or procedures in which the probability of superficial injury or physical damage is high.
⚠ **CAUTION**	Procedures in which the possibility of serious injury to the user is small, but there is a danger of injury, or physical damage, if not carried out properly.

Symbols： ⃠ **：Prohibited** ❗ **：Mandatory**

Precautions for Use

⚠ CAUTIONS

⃠ Do not use this product except as indoor hobby-robots.

We assume no responsibility whatsoever for any damage resulting from the use of this product except for the above purpose.

⃠ Control System

This product is a control unit for Command Type Servo controlled by the communication of RS485. Be aware that this product cannot be used for the conventional radio-controlled servos.

⃠ Do not disassemble or modify this product.

This product is precisely assembled. We assume no responsibility whatsoever for any damage if this product is disassembled or modified in a way other than specified by us.

⃠ Supply power only by designated batteries.

Please use a 7.4V lithium polymer battery designed for our RPU series. Be sure to set the positive and negative electrodes of the battery correctly. Misplacement may cause smoking, a fire or damage.

Keep this product free from dust and water.

This product is not waterproof. Any contact with water may cause power short circuit or malfunction.

When the connector is inserted or removed

Please make sure to hold the connector firmly when inserting or removing the cable. All connectors must be all the way seated in the product.

Operation environment for software

Even if your computer is equipped with the operation environment required for the operation, it is not guaranteed that all of the operations on the computer are performed without problems.

Cautions for Storage

Cautions

Please do not store RPU-11 in the following conditions.

- Places where the temperature is over 60℃ or below －20℃.
- Under direct sunlight.
- Places that have a lot of moisture.
- Places with thumping vibrations.
- Dusty places.
- Places that easily generate static electricity.
- Places that are easily reached by children.

*Storing the product in the places shown above may cause the deformation and failure of the product, or cause accidents.

2. Product Outline

2.1. Features

This product is the control unit for our Command Type Servos controlled by the communication of RS485 or TTL. Be aware that this product cannot be used with the conventional radio-controlled servos, PWM-type of servos for robots, or Command Type Servos made by other companies.

Motions of the robot and setting data can be registered in RPU-11.
RPU-11 in which data is registered can direct servos by the instruction given through either PC or the radio controller, or by invoking data automatically.

By flipping the rotary switch located in the middle of the back of RPU-11, motions (modes) such as "connect the robot and PC", "move itself automatically" and "operate with the controller" can be set. Please refer to page 8 about the numbers and the motions.

It is necessary to use the main switch of the robot in order to change modes or turn the robot off. However, the robot can be deactivated or restarted simply by using the Start/Stop switch on RPU-11. (Refer to page7.)

The cable connecting RPU-11 and PC must be seated all the way when used.

If the connector (RS232C Connector) that connects RPU-11 and PC is not seated all the way when used, the product may not function properly.
If the buzzer sounds irregularly when the system is started or the robot does not receive any command after the system is started, switch the robot off and check if the connector is firmly inserted.

Do not unplug the cable connecting PC and RPU-11 or cut the power supply during data transfer from PC to RPU-11 with the Motion Editor.

2.2. Part Names/Handling Instructions

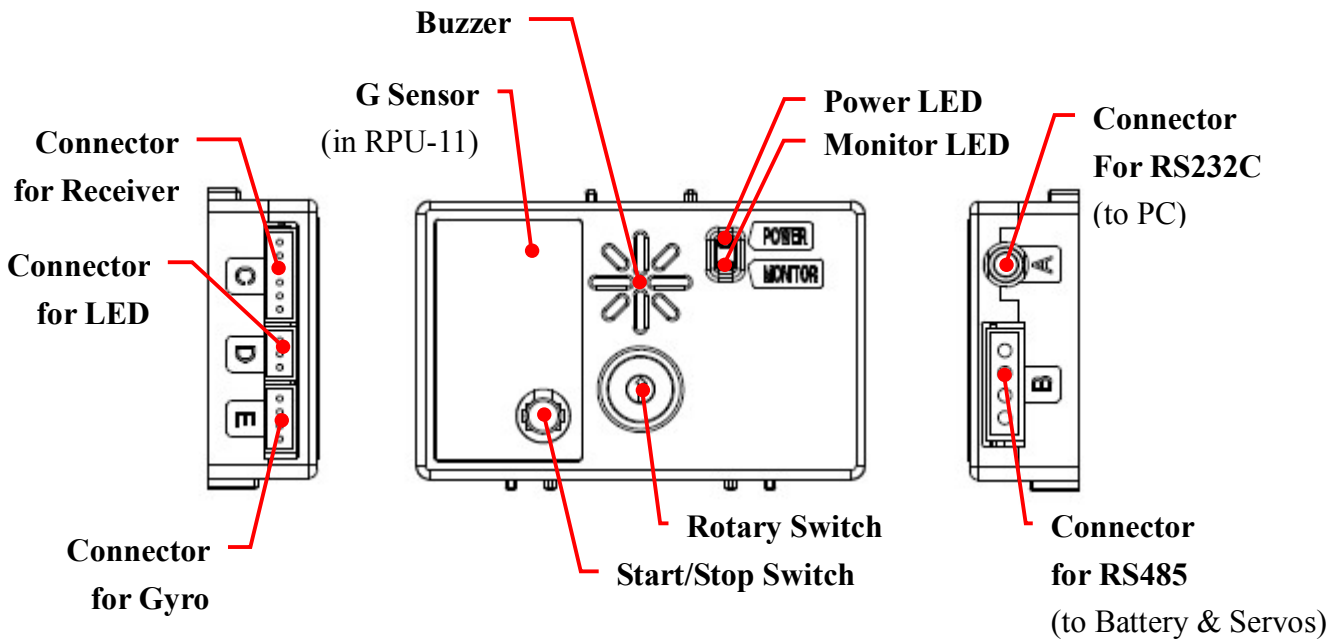

Fig. 2.2.1 RPU-11 Part Names

【Connector for RS232C】

This connector is used to connect PC and RPU-11 with the original connection cable.

【Connector for RS485】

This connector is used to connect servos for the robot and RPU-11.

The power to RPU-11 is also supplied through this connector.

【Connector for Receiver】

This connector is used to connect the original receiver RRC-R11 of RPU-11.

【Connector for LED】

This connector is used to connect the original LED unit.

【Connector for Gyro】

This connector is used to connect the original biaxial gyro of RPU-11(To be sold separately/Under development).

【Power / Monitor LED】

When power is supplied to RPU-11, the Power LED glows green.

Either when RPU-11 starts or the Start/Stop switch is pressed, the Monitor LED glows.

【Buzzer】

The buzzer sounds when RPU-11 starts or the Start/Stop switch is pressed.

When you make motions with Motion Editor, you can also preprogram the buzzer to sound while the robot is in motion by specifying the timing of sounding.

【G Sensor】

A triaxial gravity sensor is mounted on the board of RPU-11.

The direction of each axis is shown in the diagram below.

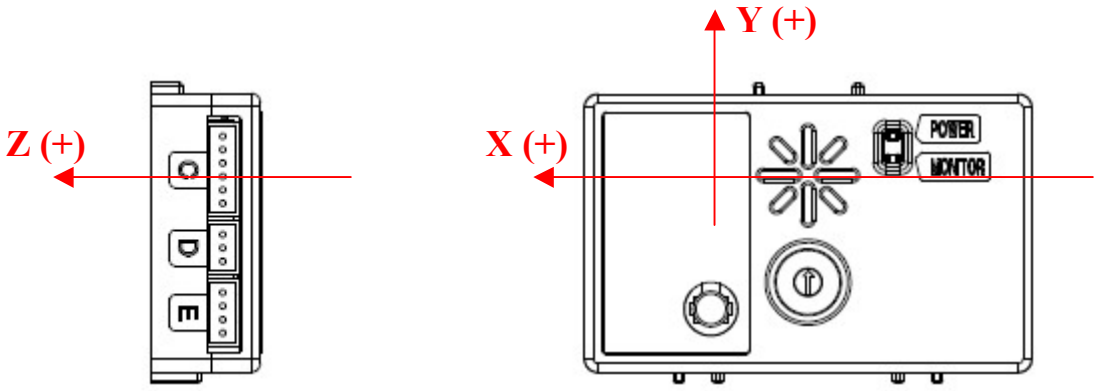

Fig. 2.2G Sensor on RPU-11

Regarding how to use the G Sensor, please refer to the instruction manual for Motion Editor.

【Start / Stop Switch】

If you press this switch, the torque for all servos is set to “OFF” instantly.

RPU-11 will restart if you hold down the switch for about three seconds with the robot inactivated.

Caution

Do not power on/off the robot while holding down Start / Stop switch.

If you turn RPU-11 on while holding down the Start/Stop switch, it starts in the Firmware-Writing mode, regardless of the number for the rotary switch. As the robot does not accept any command, you need to turn it on again.

【Rotary Switch】

This switch is used to set up the modes of RPU-11.

You can change the mode of RPU-11 by turning the power on after adjusting the number for the mode you desire.

The mode does not change until you turn the power on again even if you change the switch when RPU-11 is in motion. The mode does not change either, even if you restart RPU-11 by keeping the Start / Stop switch pressed. If you want to change the mode, restart RPU-11 using the main switch of the robot body.

The relation between the switch number and the mode of RPU-11 is as follows.

Table 2.1 Rotary Switches and Modes

Switch Number	Mode	Actions
No.0	Motion Editor Mode	the robot moves by the commands through PC.
No.1	Scenario Mode 1	RPU-11 executes registered motions automatically.
No.2	Scenario Mode 2	ditto
No.3	Scenario Mode 3	ditto
No.4	Scenario Mode 4	ditto
No.5	Scenario Mode 5	ditto
No.6	Scenario Mode 6	ditto
No.7	Scenario Mode 7	ditto
No.8	Scenario Mode 8	ditto
No.9	Scenario Mode 9	ditto
No.10 (A)	Scenario Mode 10	ditto
No.11 (B)	Sensor Output Mode	the sensor value is displayed on PC.
No.12 (C)	(No function is set.)	(No function is set.)
No.13 (D)	(No function is set.)	(No function is set.)
No.14 (E)	Self-Diagnostic Mode	Functions of RPU-11 can be checked on PC.
No.15 (F)	Operation Mode	the robot is controlled with the original controller.

3. System Configuration

Please refer to the diagram below for the connection between RPU-11, PC, servos and battery.

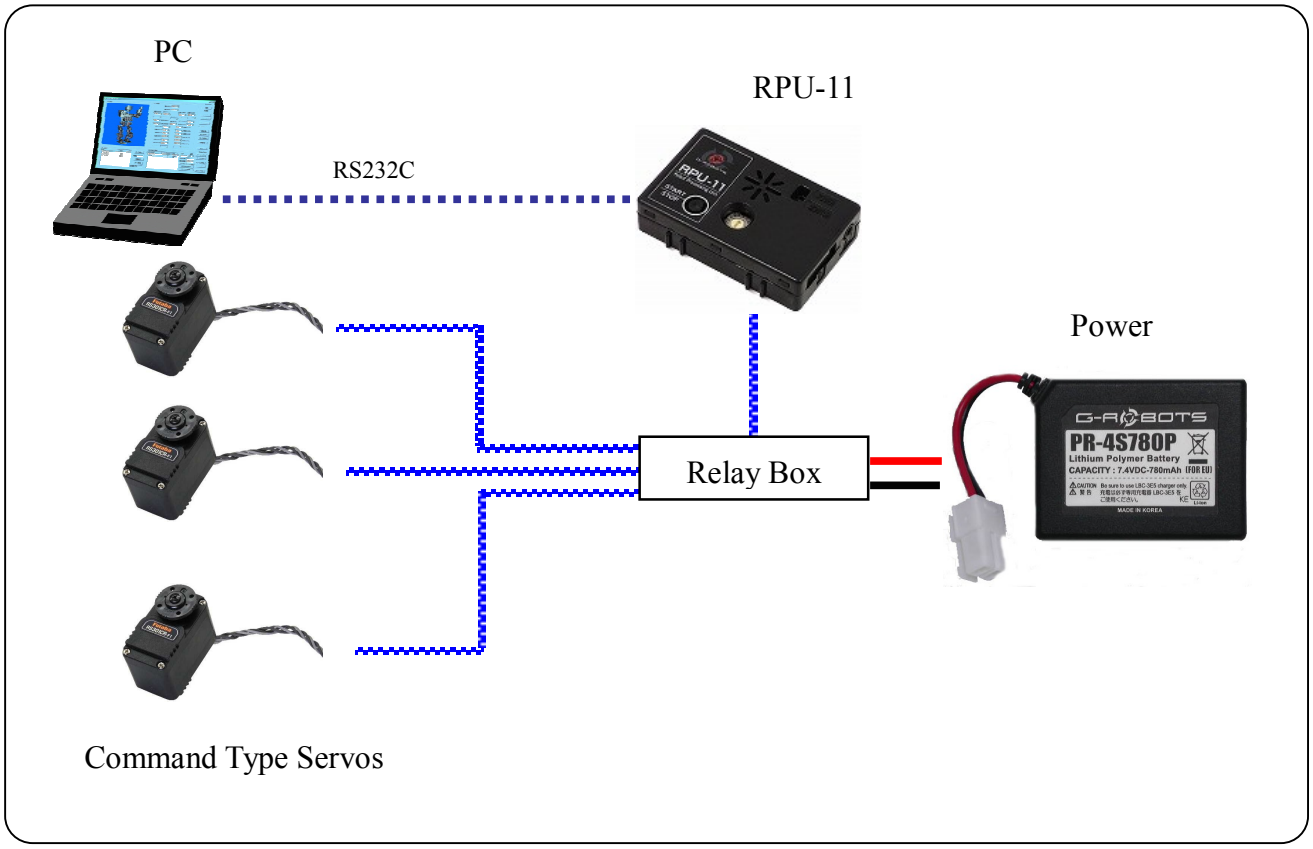

Fig. 3.1Sample of System Configuration

● **Power On/Off**

RPU-11 does not have a power switch. Therefore, it is necessary to power on/off by connecting it to either a relay box equipped with a power switch or a battery.

● **Movements of the Robot when Power is On.**

When data is transferred from PC to RPU-11, a number called “Project ID” for the robot structure and for its motion is transferred. If the both Project IDs do not match (there is a case that the robot registered is different from the one you want.), servos do not receive any signals and the torque remains OFF when RPU-11 is activated.

If you format RPU-11 with the Project you use and transfer the motion data prepared with the Project, the torque will turn “ON” automatically when RPU-11 is activated, and the robot stands at a default position.

For details about Project ID and the format of RPU-11, please refer to the operation manual of Motion Editor RPU-11.

4.The Mode of RPU-11

4.1. Motion Editor Mode

This mode is used for operating RPU-11 with the software (Motion Editor) installed in PC and setting up its autonomous working and operations by connecting RPU-11 and PC.

This mode is also used for changing the servo's ID.
Regarding how to use the Motion Editor, please refer to the attached instruction manual of Motion Editor RPU-11.

4.2. Scenario Mode

Scenarios can be executed automatically with this mode by transferring motions and scenarios made by Motion Editor to RPU-11 with the RPU-11 and PC disconnected.
There are two ways to automatically play scenarios: The one is to execute scenarios with the robot itself. The other is to execute them by setting the timing of the play, using the original controller.

5.2.1 Independent Performance

When power is supplied to the robot after adjusting the rotary switch of RPU-11 to the number for the scenario slot in which a scenario to be performed is registered, the robot executes the scenario automatically after it is activated.(The scenario slot 10 is【A】on the rotary switch.)

When the scenario finishes, the robot stops and keeps the same posture as it stops. If the **【Repeat Count】** for the scenario slot on the data transfer window is set, the robot repeats the scenario according to the number set.
When you want to stop the robot in automatic execution, press **【START/STOP】** of RPU-11 and deactivate the robot. If you hold down the **【START/STOP】** for about three seconds after deactivation, RPU-11 restarts and the scenario is executed again.

5.2.2 Performance with Controller

If RPU-11 is activated in Scenario Mode with the original controller turned on after RPU-11 is connected to the original receiver, you can set the starting time of the automatic execution with the controller.
When RPU-11 is activated, the green LED of the receiver glows. If the controller is turned off, the buzzer of RPU-11 sounds.
When the connection to the controller is confirmed, the robot stands still in the default position after activated. By pressing the **【START】** of the controller in this position, scenarios can be executed.
If the **【START】** is pressed again when the scenario is in execution, the robot stops performing the scenario and returns to the default position.

If **【SELECT】** is pressed while the scenario is in execution, the torque of all servos turns off.

If【**START**】is pressed while the torque is off, the servos turn on and the scenario starts.

Please be aware that legs and hands of the robot may get tangled up when the robot returns to the default position with the【**START**】, depending on the posture of the robot.

5.3. Operation Mode

The robot can be operated freely by registering motions and scenarios made by Motion Editor with RPU-11 and setting up the relations with the buttons of the original controller RRC-T10.

5.4. Self-Diagnostic Mode

When power is supplied after adjusting the rotary switch of RPU-11 to【E】, RPU-11 activates in the Self-Diagnostic Mode. In this Mode, you can check whether RPU-11, buzzer, LEDs, G sensor and servos are operating properly, and confirm the results on PC.

5.4.1. Connecting PC and RPU-11 with Communication Software

The personal computer communication software is required to confirm the contents to be checked in the Self-Diagnostic Mode.

In this section, an example using "HyperTerminal" contained as a standard feature in Windows is shown.

Be sure to close Motion Editor down when Self-Diagnostic Mode is executed.

Activate HyperTerminal by selecting the following items from the Start menu of Windows.

Program>Accessory>Communication>HyperTerminal

If the connection settings are saved, you can start by selecting the settings from the second time.
In this case, the selection sequence is as follows.

Program>Accessory>Communication>HyperTerminal>(Connection Name set)

The followings show the steps for making the first connection.

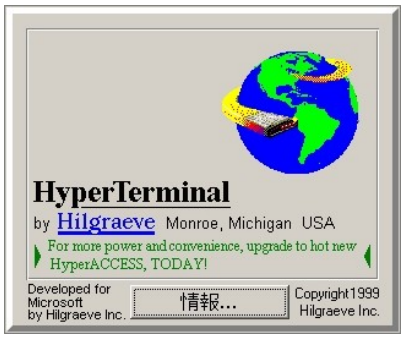

Fig. 4.1 Starting HyperTerminal

Input the name for the connection. (Fig. 4.2)

It doesn't matter whatever the name is. "RPU-11" is used in this example for reference.

Fig. 4.2 Connection Setting 1　Input the Connection Name

Select the port that connects to RPU-11 from【**Connect using**】on the following setting window.

Fig. 4.3 Connection Setting 2　Select the COM Port

Set up the COM port selected.
InputFig.4.4.

bits/second	:	115200
bits of data	:	8
parity	:	none
stop bit	:	1
flow control	:	none

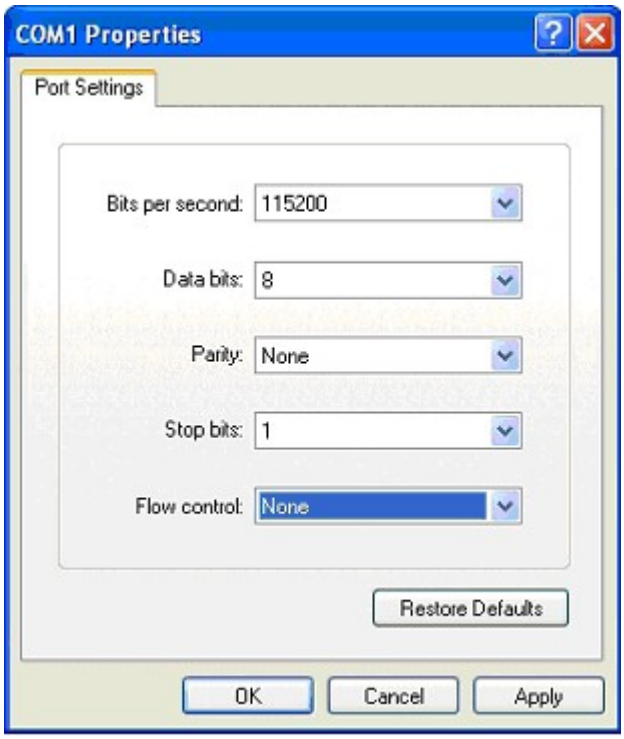

Fig.4.4 Connection Setting 3　Setting of COM Port

When the input is finished and “OK” is clicked, the settings are completed.

5.4.2. Activation of RPU-11 and Its Connection to PC

Connect RPU-11 and PC with the original cable. There is no problem even if RPU-11 and PC are connected before the communication software is activated.

Turn RPU-11 on after adjusting the rotary switch located on the back of RPU-11 to【E】.
If RPU-11 and PC are properly connected, a message is displayed automatically.(Fig.4.5)
There is a case that a different value from Fig.4.5 **is displayed, depending on versions or settings of RPU-11.**

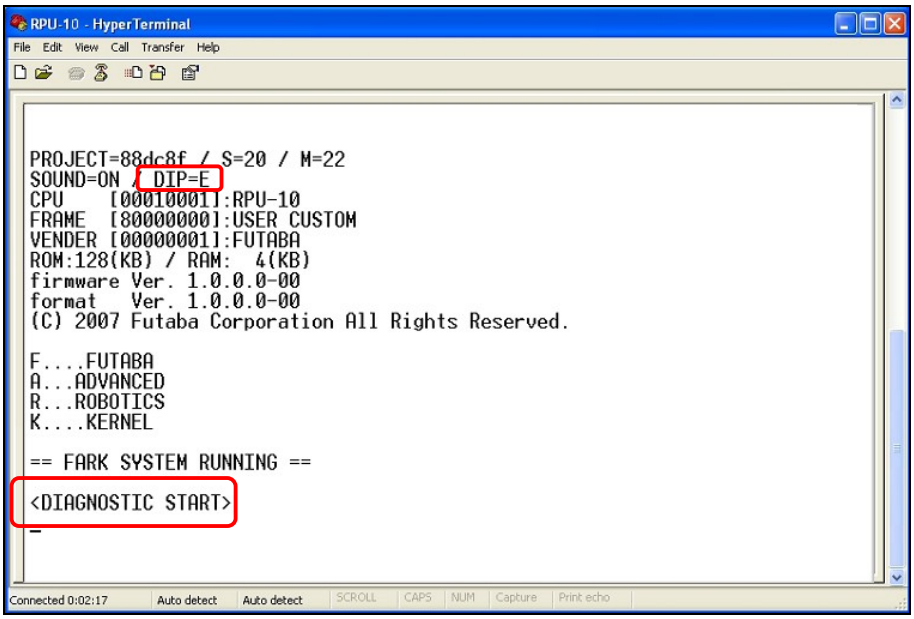

Fig.4.5 Start-up Message of RPU-11

The rotary switch number is displayed in "DIP=" on the first line when RPU-11 is activated.
Make sure that this value is "E".

<DIAGNOSTIC START> is displayed after the start-up message, and self-diagnosis starts automatically. At this time, the buzzer of RPU-11 sounds three times in a high tone.

5.4.3. Inspection Items

● **Check of Buzzer**

The following message is displayed, and the buzzer sounds.
The sound changes from the high tone to the low tone for about five seconds.

```
BEEP TEST (Do you hear the buzzer?)
```

If the buzzer does not sound or the sound interrupts, there is a possibility that the buzzer is malfunctioning.

● **Check of LED**

After checking the buzzer, the following message is displayed, and LEDs glow.
The right and left LEDs alternately blink quickly for about five seconds.

```
LED TEST (Do you see the light of LED?)
```

If the LEDs do not glow or glow irregularly, there is a possibility that something is wrong with the LEDs.

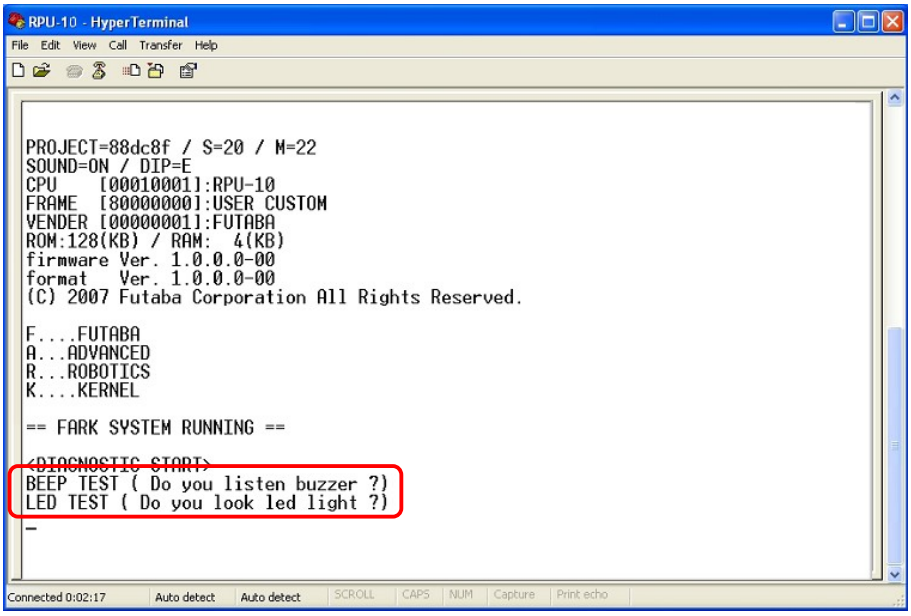

Fig.4.6 Testing of Buzzer and LEDs

● **Connection Check of Servos**

Servos set with Projects registered in RPU-11 are inspected whether they are connected properly.

As a result of checking, “OK” is displayed for servos whose connection is confirmed.

When the connection for all servos is confirmed, the buzzer sounds twice in a high tone after the checking.

Please be aware that the number for the servo displayed here is different from ID. It is a serial number called “Index” displayed on the Project setting window.

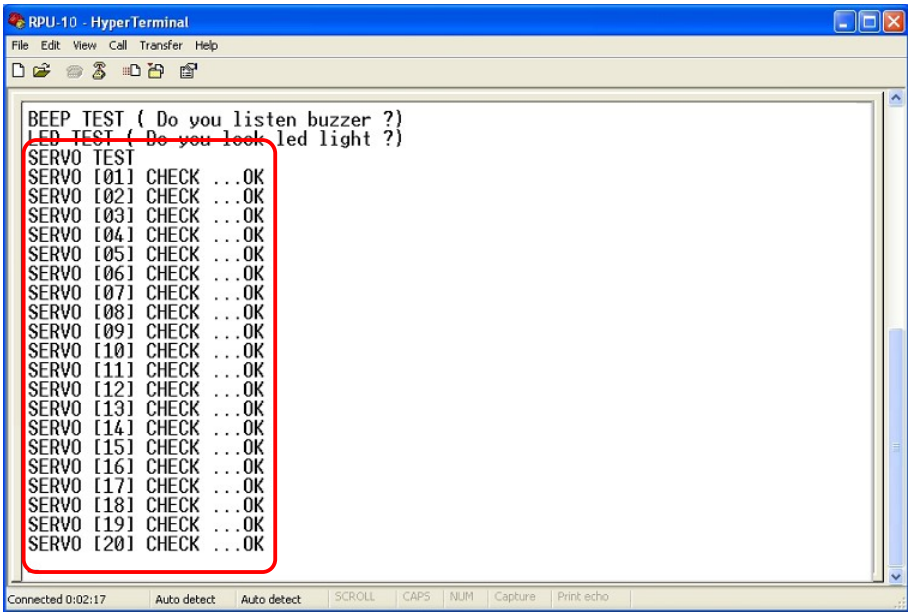

Fig. 4.7 Servo Checking(Connection of all servos is OK)

On the other hand, “NG” is displayed if servos are not connected properly.

Even if there is only one servo whose connection is not confirmed, the buzzer sounds twice in a low tone after the checking.

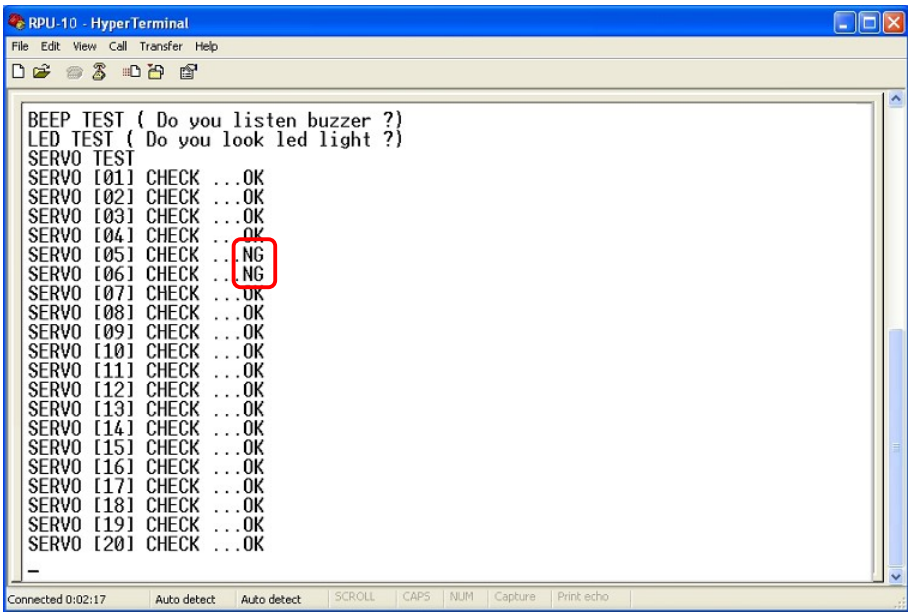

Fig.4.8 Window of Servo Checking(Sample of Connect Failure)

The items to be checked here are just the connection and communication of servos. Mechanical breakdown (gear damage, etc) cannot be checked.

● EEPROM TEST

This test is to check the function of memories inside RPU-11. The robot and RPU-11 do not move.

If it is confirmed that the movement is executed properly, the following message is displayed and the buzzer sounds twice in a high tone.

```
EEPROM TEST .....OK
```

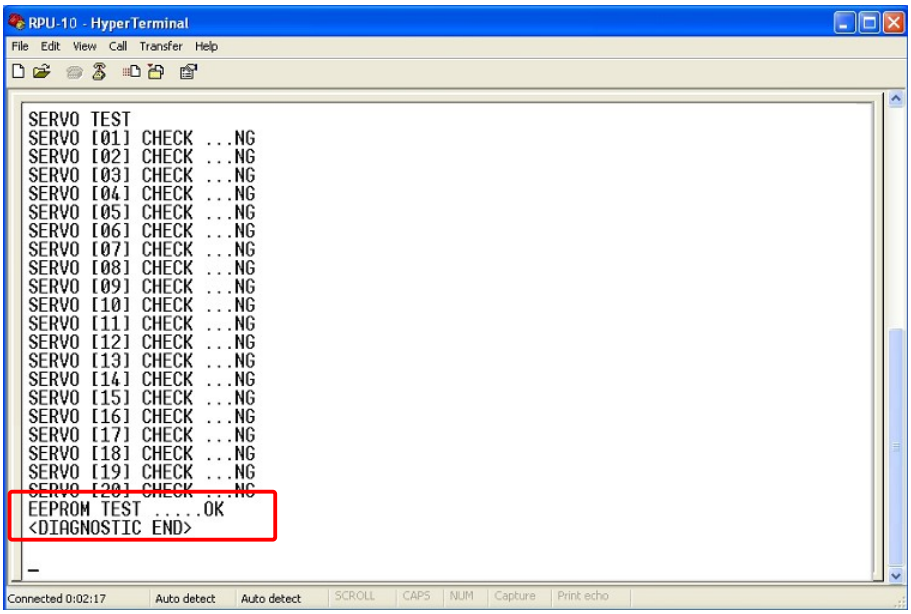

Fig. 4.9 Termination of EEPROM TEST and Self-Diagnosis

When EEPROM TEST finishes, the following message is displayed and the buzzer sounds three times in a high tone.

```
<DIAGNOSTIC END>
```

After the test, the detection value of the sensor is displayed.
If the confirmation of the detection value is not needed, just switch RPU-11 off.

5.4.4. Confirmation of Sensor Output Value

After self-diagnosis finishes, information on the sensors of RPU-11 is displayed every second. (Fig. 4.10)

If you press the **START/STOP** button located on the back of RPU-11, the display stops.

If you want to terminate the display, just turn the power off.

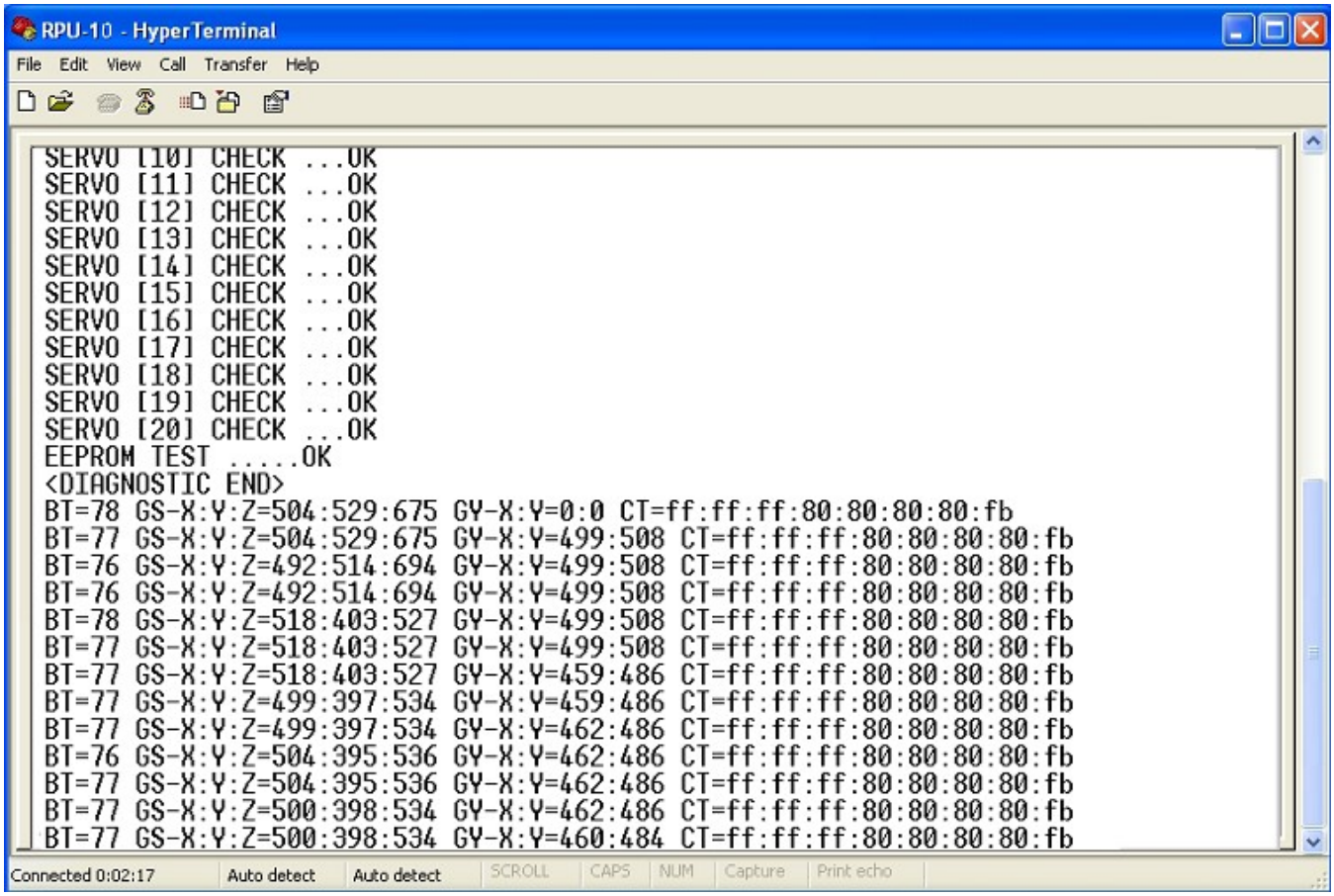

Fig. 4.10 Sensor Output

● **BT(Battery)**

The remaining battery level (%) is displayed.

● **GS-X:Y:Z(G Sensor)**

The detection value of G Sensor built into RPU-11 is displayed.

If the sensor functions normally, the value between 0 and 1023 is displayed.

GS-X:Y:Z=xxx:yyy:zzz

xxx, yyy and zzz show the detection value of X-axis, Y-axis and Z-axis respectively.

If you tilt RPU-11 by hand, you can check how the detection value changes.

This helps you to decide the setting value on the event window of Motion Editor.

● **GY-X:Y(Gyro)**

If an original biaxial gyro is connected to RPU-11, the detection value is displayed.

GY-X:Y=xxxx:yyyy

● **CT(Controller)**

The operation status of the button or the stick of the controller is displayed.

If you manipulate the button or stick of the controller with the controller switched on after the connection to RPU-11 is confirmed(The green LED of the receiver RRC-R11 glows.), you can check how the value of CT changes.

5.5. Sensor Output Mode

When RPU-11 is activated in the same way as the Self-Diagnostic Mode after adjusting the rotary switch of RPU-11 to【B】, the sensor output value is displayed, which is the same way as the sensor value is displayed in Self-Diagnosis Mode. If you want to confirm the setting value of G Sensor, etc, you can check only the sensor value with this mode.

5.Reference

Specifications

Outline Specifications	Major Application	Robots
	Feature	RS485 Communication Command Method
	Others	Motor Control by Software
Dimensions(L×W×H)：		50.2 × 31.2 × 12.1［㎜］
Weight ：		14 ［g］
Consumption Current ：		70 ［mA］(Without Options,Only Main Body)
I/F		RS485 (For Connection to Servos) x1
		RS232C(For Connection to PC) x1
		For Gyro x1
		For Receiver x1
		For External LED x1
CPU		ATmega128
Internal LED		For Status Indication x1
		For Power Indication x1
Built-in Buzzer		Piezoelectric Buzzer x1
Working Voltage ：		7.4[V]
Operating Temperature Limits		0 ~ +40 [℃]
Storage Temperature Range		-20 ~ +60 [℃]
Power Source ：		Lithium Polymer Battery
Transmission Speed ：		RS485 Communication Maximum 460 kbps (Depending on communication environment)
Protocol ：		8bit , 1 Stop bit , None Parity , Asynchronous Communication

Dimensions

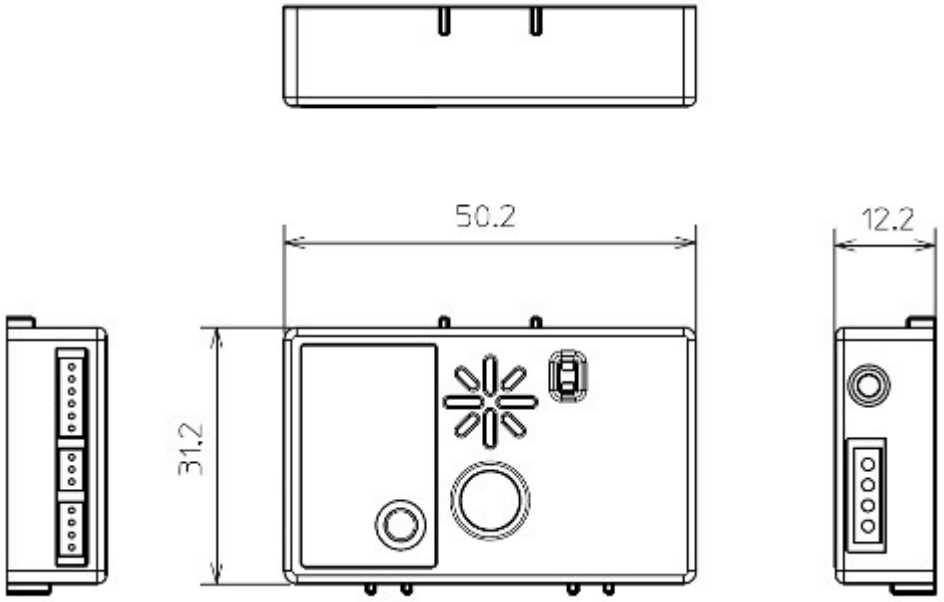

Fig. 5.1 Dimensions of RPU-11 (Unit: mm)