

E-H Automatic Tuning System

Plat series

Operations Manual

Ver.L

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1. Safety instructions and directions to use

To secure the safety of personnel and equipment itself, refer to and observe the descriptions and instructions given below and through this operations manual.

 DANGER	The sign shows that the description under the sign gives the description which may imminently result in loss of human lives or in serious wound in case of improper operation or handling disregarding the descriptions under the sign.
 WARNING	The sign shows that the description under the sign gives the description which may possibly result in loss of human lives or in serious wound in case of improper operation or handling disregarding the descriptions under the sign.
 CAUTION	The sign shows that the description under the sign gives the description which may possibly result in human injury or in material damage in case of improper operation or handling disregarding the descriptions under the sign.



- ◆ Never operate the tuner under the environment which has igniting gases, explosive gases or conductive dusts. Otherwise, it may possibly result in explosion or fire.



- ◆ Use or operate the tuner in conformity with the applicable laws and regulations.
- ◆ When installing the tuner to the waveguide circuit, securely tighten all of the bolts for waveguide flanges on both ends. Loose fastening or lack of bolt(s) may result in human injury or even death due to the leakage of microwave and its heating effects.
- ◆ Observe the regulations on the microwave leakage power. Excessive leakage may result in malfunction of surrounding equipments or communication obstructions and also in human injury or even death due to the electromagnetic injury and the heating effects.

- ◆ While applying the microwave power, do not dismount the tuner from the waveguide circuit. The excessive microwave leakage may result in human injury or even death due to the electromagnetic injury and the heating effects.
- ◆ Grounding is required. Firstly connect the protective earth terminal of the tuner or Piat-PS-CE to an external protective earthing conductor. An electric fault without protective earth may result in human injury or even death due to the electric shock.

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CAUTION

- ◆ The tuner is designed and manufactured on the premise that it is operated by a professional person or a person under the guidance of the professional person who has the knowledge of the field.
- ◆ Read and understand this document and the relevant documents attached to the tuner before operating it.
- ◆ Do not operate or store the tuner under the environment of direct sunlight or ultraviolet rays.
- ◆ Do not step on the tuner. The tuner will be damaged or broken.
- ◆ Do not disassemble or alter the tuner. The tuner may change or degrade in electric performance. The manufacturer will not bear any responsibility for the case.
- ◆ Waveguide components and units including the tuner have considerable weight. Support the waveguide circuit at appropriate positions to avoid their damage due to the weight and force by it.
- ◆ Install the tuner in right direction so that the “INPUT” port faces to microwave power source and “OUTPUT” port faces to the load. Mistaking in opposite direction will cause malfunction of the tuner and/or surrounding units.
- ◆ The source side equipment viewed at the input port of the tuner should have VSWR of less than 1.2. Otherwise, it may cause the malfunction of the tuner.

- ◆ Do not operate the tuner in the environment which has or produces dusts. The dusts entered into the waveguide may cause temperature rise, operational trouble or electric discharge.
- ◆ Do not operate the tuner in the environment where it may possibly be exposed to water. Water penetration may result in malfunction of the tuner.
- ◆ Install the tuner not to obstruct the cooling air flow to/from its air intake and/or exhaust holes. The heat accumulation may result in malfunction of the tuner.
- ◆ Securely tighten the screws of the connector for “remote cable” (cable for remote control signal). Loose connection of the connector may result in malfunction or operational trouble.
- ◆ While applying power, do not plug in or out the connector for “remote cable”. Accidental short-circuiting of the power line may possibly result in malfunction or operational trouble.
- ◆ Do not use the tuner in a place with vibration. It may result in malfunction or operational trouble of the tuner.
- ◆ In case of fuse blow, contact the manufacturer. It is required to investigate the cause.
- ◆ In case to check the fuse, check it after turning off the power switch of the tuner.
- ◆ In case of any foreign sound or smell, turn off the microwave power immediately and investigate the cause.
- ◆ In case of unusual temperature rise or electric discharge (dielectric breakdown), turn off the microwave power immediately and investigate the cause.
- ◆ In case of any alarm indication on the tuner, turn off the microwave power immediately and investigate the cause.
- ◆ Check periodically that there is no slack of bolts in the microwave path, and that the microwave leakage is under the specified value in the regulation.
- ◆ Do not apply microwave power higher than the specified, and also, do not try to match a load having higher reflection than the specified. Those may result in high temperature rise, malfunction or electric discharge in the tuner.

- ◆ All the data for recipe number, recipe parameters and control parameters are stored in a non-volatile memory and will be kept as they are even when turning off the Piat tuner. Note that the non-volatile memory may reach its life in shorter period in case of rewriting it at short intervals. The non-volatile memory manufacturer warrants 100,000 erase cycles per sector.

- ◆ The data for recipe number and recipe parameters are stored in one sector of the non-volatile memory. The Piat tuner firmware of V6.00 or later version reserves 10 sectors for storing the data and changes the sector at every rewriting. The lifetime of the non-volatile memory may result in 10 times longer than previous lifetime.
The data for control parameters are stored in one sector of the non-volatile memory. The Piat tuner firmware of V6.00 or later version reserves 2 sectors for storing the data and change the sector at every rewriting.

- ◆ It is recommended that the Piat tuner be in the RAM mode if you change the recipe number frequently at short intervals through PC or I/O. In the RAM mode, the data for recipe number are stored only in volatile memory and the data stored in the non-volatile memory will not be modified. In the ROM mode, the data for recipe number are stored in the non-volatile memory. In either mode, the data for recipe parameters and control parameters are stored in a non-volatile memory.
For detail, refer to the “Instruction Manual for Maintenance/Control Software”.

- ◆ In the factory default setting, the Piat tuner is in the RAM mode. If necessary, select the ROM mode through PC.

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2. Outline

Piat series automatic tuner (hereinafter referred to as Piat auto-tuner, Piat tuner or the tuner) is a unit which is designed to automatically match the impedance of the load, such as plasma discharge load, to that of microwave source to effectively transmit the microwave power at 2.45 GHz. The tuner detects the standing wave by the built-in detector and calculates the unmatched load impedance, and then, performs auto-matching operation by moving the motorized short-circuiting plungers in the E- and H-branch waveguides to positions suitable to cancel out the load mismatch.

Piat tuner can perform auto-matching operation by itself. When equipped with Piat-RM-CE unit, its operation is remotely controllable by PC or Input/Output System (your unit), and further, advanced operation can be achieved such as operation through pre-determined variety of recipe, etc.

Piat series auto-tuner has two types, Piat-XX-CE and Piat-XX-2PM-CE. Piat-XX-2PM-CE has two built-in sets of power monitoring units, each for forward power and reverse power, while Piat-XX-CE does not. The power monitoring unit consists of a directional coupler and a diode detector to give a DC monitoring output for forward power or reverse power.

The tuner has flanges of TBR-2A2 type for flat waveguide (96mm x 27mm).

The following Fig.1 through Fig.3 show the outline dimensions of Piat-XX-2PM, Piat-XX-2PM-CE with Piat-PS-CE, and, Piat-RM-CE respectively. Piat-60-2PM-CE, Piat-30-2PM-CE, Piat-15-2PM-CE and Piat-03-2PM-CE have the same outline dimensions.

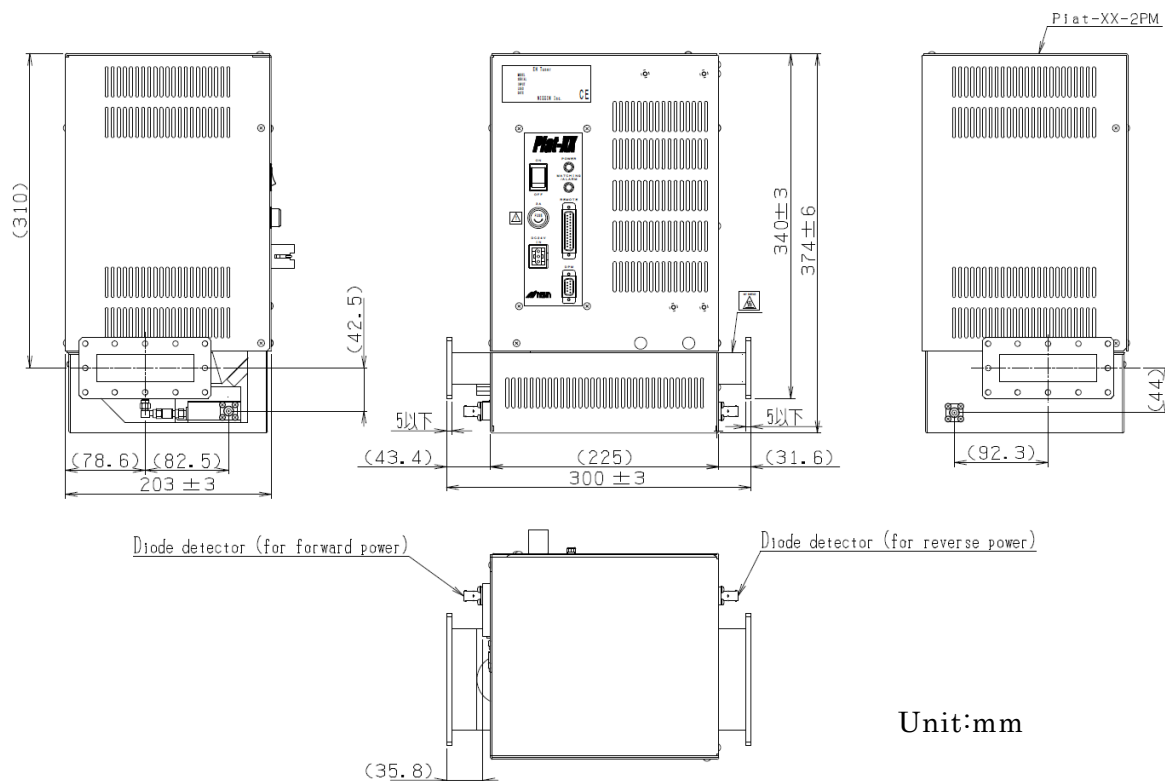


Fig.1 : Piat-XX-2PM-CE Outline dimensional drawing

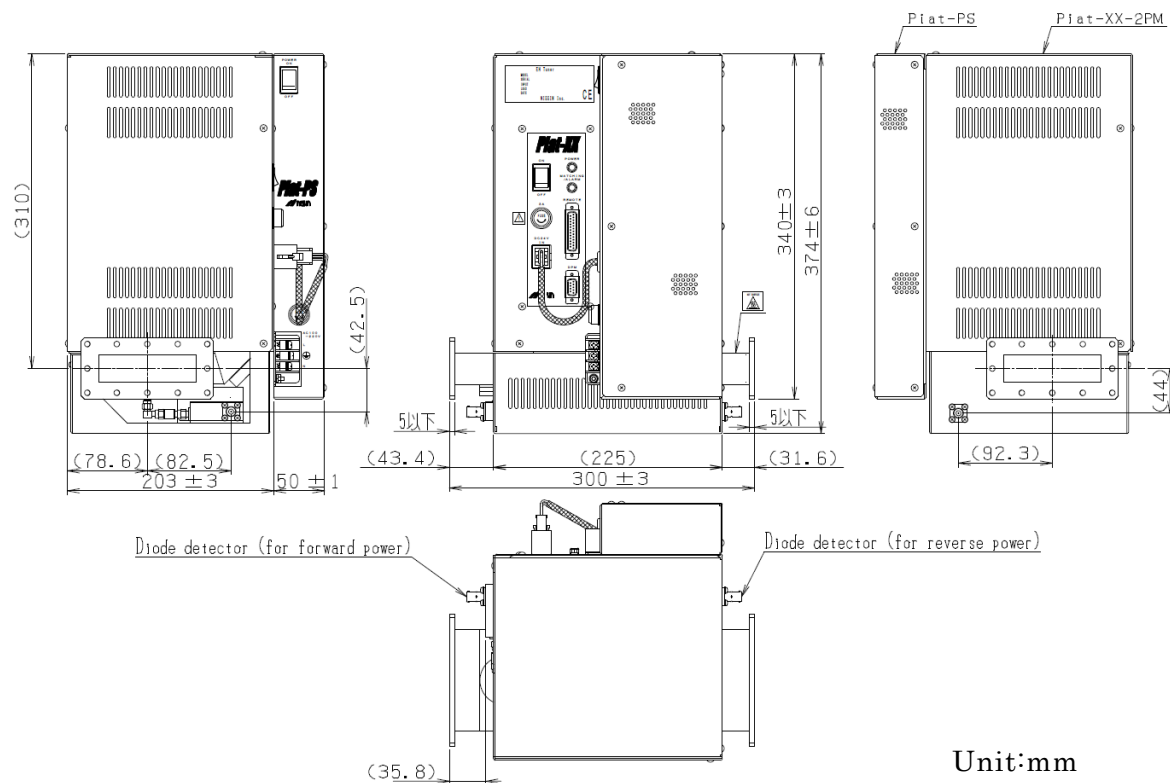


Fig.2 : Piat-XX-2PM-CE with Piat-PS-CE Outline dimensional drawing

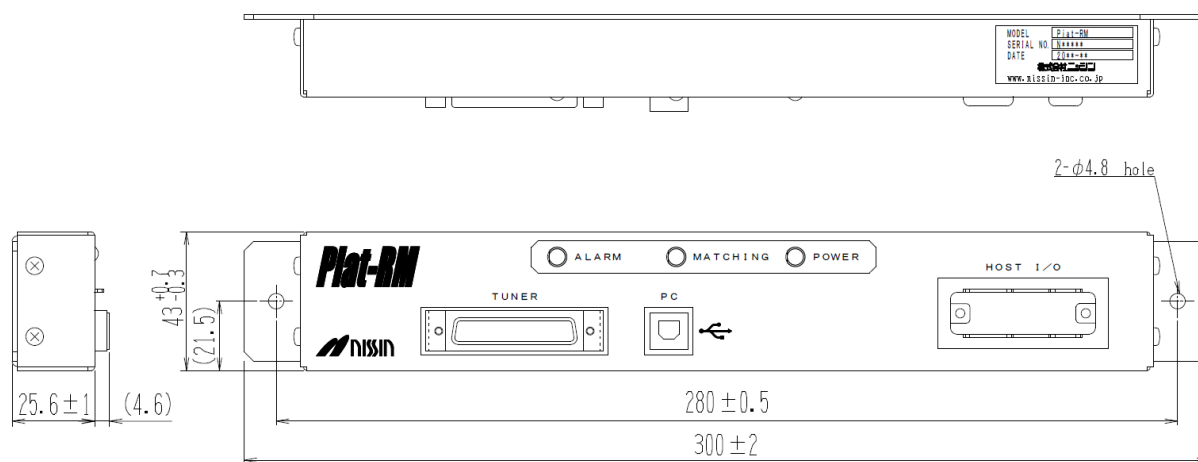


Fig.3 : Piat-RM-CE Outline dimensional drawing

3. Type and description

Type	Class	Description
Piat-60-2PM-CE	Standard	E-H automatic tuner with directional coupler, up to 6kW.
Piat-30-2PM-CE	Standard	E-H automatic tuner with directional coupler, up to 3kW.
Piat-15-2PM-CE	Semi-Standard	E-H automatic tuner with directional coupler, up to 1.5kW.
Piat-03-2PM-CE	Semi-Standard	E-H automatic tuner with directional coupler, up to 0.3kW.
Piat-60-CE	Semi-Standard	E-H automatic tuner, up to 6kW.
Piat-30-CE	Semi-Standard	E-H automatic tuner, up to 3kW.
Piat-15-CE	Semi-Standard	E-H automatic tuner, up to 1.5kW.
Piat-03-CE	Semi-Standard	E-H automatic tuner, up to 0.3kW.
Piat-RM-CE	Standard	Remote control interface unit for Piat-XX-CE or -2PM-CE.
Piat-PS-CE	Standard	Power supply unit for Piat-XX-CE or -2PM-CE.

4. Components

No.	Type	Description	Component	Quantity
1	Piat-XX-2PM-CE 6kW:Piat-60-2PM-CE 3kW:Piat-30-2PM-CE 1.5kW:Piat-15-2PM-CE 0.3kW:Piat-03-2PM-CE	E-H automatic tuner with directional coupler	Piat-XX-2PM-CE	1
			Manual(this document)	1 ¹
			Spare fuse(SHV12-DC400V-3A)	2
			Input connector for DC24V (SMS3P1) ₃	1
			Contact (RC16M-SCD28) _{2,3}	3
			Inspection report	2
2	Piat-XX-CE 6kW:Piat-60-CE 3kW:Piat-30-CE 1.5kW:Piat-15-CE 0.3kW:Piat-03-CE	E-H automatic tuner	Piat-XX-CE	1
			Manual(this document)	1 ¹
			Spare fuse(SHV12-DC400V-3A)	2
			Input connector for DC24V (SMS3P1) ₃	1
			Contact(RC16M-SCD28) _{2,3}	3
			Inspection report	2
3	Piat-RM-CE ※option	Remote Unit	Piat-RM-CE	1
			Remote cable(3m)	1
			USB cable (2m)	1
			CD-ROM (Maintenance software)	1
			Connector for I/O P-1634-BA(09) ₂ ,P-1634A-CA(50)	1 (each)
			Software manual	1 ¹
			Inspection report	2
4	Piat-PS-CE ※option	Power Supply Unit	Piat-PS-CE	1
			AC cable for AC300V (3m) or AC cable for AC300V (3m) with a 3-prong plug (Japan only) ₄	1
			Inspection report	2

¹: Unless otherwise agreed.

²: The contact is of soldering type.

³: Only for the Piat tuner without Piat-PS-CE. (The Piat tuner with Piat-PS-CE includes these connectors and pins as part of Piat-PS-CE.)

⁴: The attached AC cable for AC300V with a 3-prong plug can be used only in Japan. The attached AC cable for AC300V without a 3-prong plug conforms to the EC Low Voltage Directive. You can use this cable (without 3-prong plug) according to the national or local standards.

5. Description on automatic tuner

5.1. Automatic tuner block diagram

The block diagram of the automatic tuner is shown in Fig.4.

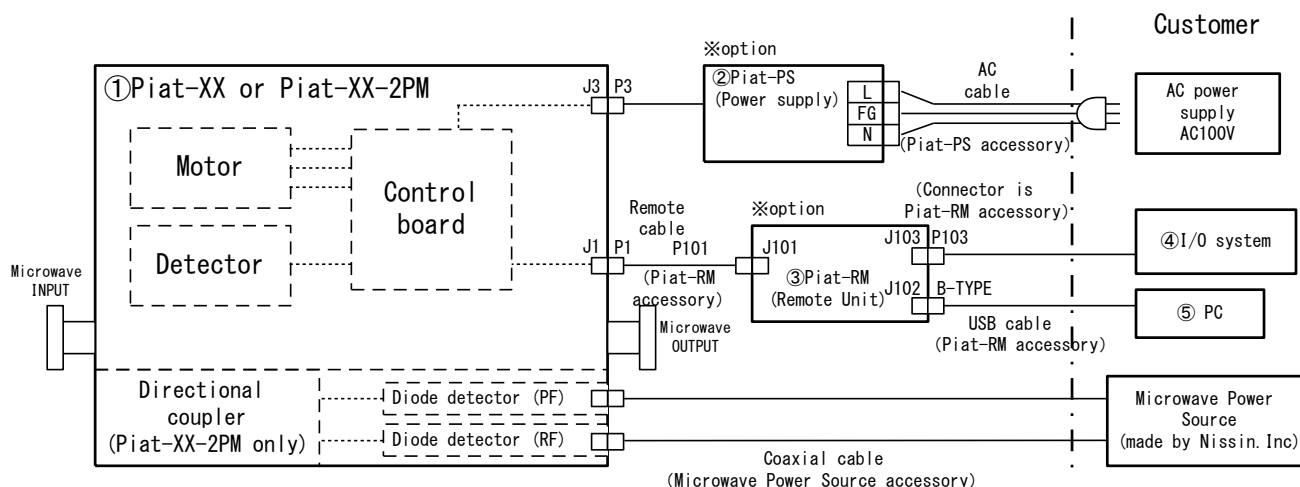


Fig.4 : Automatic tuner block diagram

No.	Type	Description
①	Piat-XX-2PM-CE Piat-XX-CE (Automatic tuner unit)	- The automatic tuner performs auto-matching operation by adjusting motorized variable short-circuiting plungers in both E and H branch waveguides. - The tuner can be operated alone without optional units. - Operating voltage is DC24V. - The DC output voltage of the diode detector is used as a measure of incident and reflected power. (Piat-XX-2PM-CE only)
②	Piat-PS-CE (Power supply unit) ※option	- Input AC100-220V is rectified to produce DC24V (3A). - The attached AC cable has a rated voltage of AC300V. - AC cable with a 3-prong plug can be used only in Japan.
③	Piat-RM-CE (Remote unit) ※option	- Piat-RM-CE is a remote control interface unit, and can be connected to a PC or an Input/Output system (I/O system) . - Refer to Chap.8.3 for signal timing chart for input and output signals.
④	I/O system ※your equipment	- The connectors for connecting I/O system are attached to Piat-RM-CE. - Through contact signals, you can remotely monitor the state of Piat tuner (matching, alarm etc.), manually operate the plunger positions and set up the recipe number.

⑤	PC ※your equipment	• The software for Piat operation is equipped in Piat-RM-CE. • PC is connected to Piat-RM-CE with a USB cable. • In remote mode, you can monitor the operational state of the tuner such as matching, alarm etc. , manually operate the plunger positions, and modify the recipe parameters and the control parameters etc.
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5.2. Piat-XX-2PM-CE with Piat-PS-CE

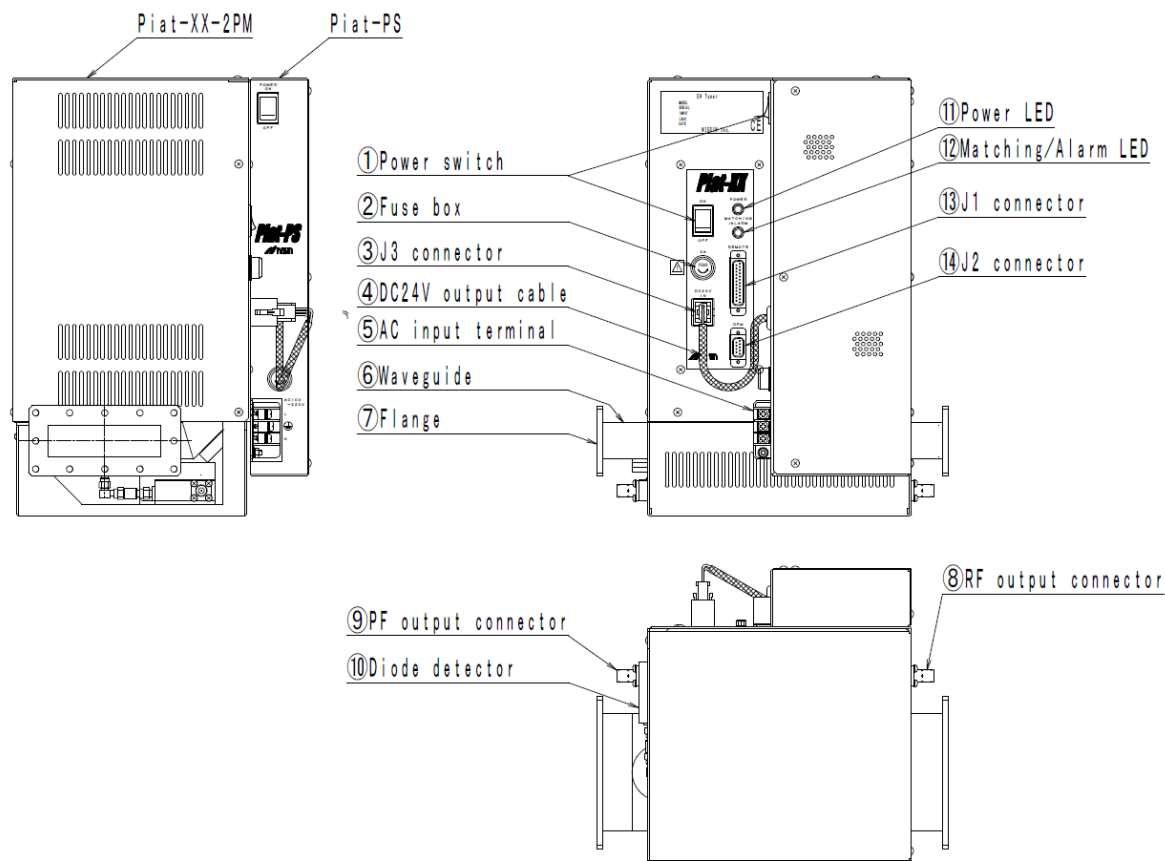


Fig.5 : Piat-XX-2PM-CE with Piat-PS-CE

No.	Description	Function
①	Power switch	Power on/off switch for Piat-XX-2PM-CE or Piat-PS-CE.
②	Fuse box	To protect the circuit, 3A fuse inside.
③	J3 connector	Operating power supplying port (supply DC24V here). Refer to Chap.6.3 for pin assignment.
④	DC24V output cable	Output cable for DC24V. Connect it to J3 connector.
⑤	AC input terminal	Use input voltage within AC100V-AC220V.
⑥	Waveguide	The waveguide is a hollow metallic square pipe for microwave transmission. The waveguide is flat waveguide (96mmx27mm) which meets TOSHIBA standard.
⑦	flange	Flange is used to connect waveguides each other with bolts.

⑧	RF output connector	Output DC voltage corresponding to the reflected power in the waveguide.
⑨	PF output connector	Output DC voltage corresponding to the incident power in the waveguide.
⑩	Diode detector	Diode detector converts microwave into DC voltage.
⑪	Power LED	The “Power” LED (yellow) lights up when the power switch turned on.
⑫	Matching/Alarm LED (green/ red)	The “Matching/Alarm” LED (green) lights up during matched state and flashes during unmatched state. The “Matching/Alarm” LED (red) flashes when an alarm is activated. Refer to Chap.8.2.4 for alarm state.
⑬	J1 connector	The interface connector to be connected with Piat-RM-CE through attached remote cable.
⑭	J2 connector	Expansion interface.

5.3. Piat-RM-CE

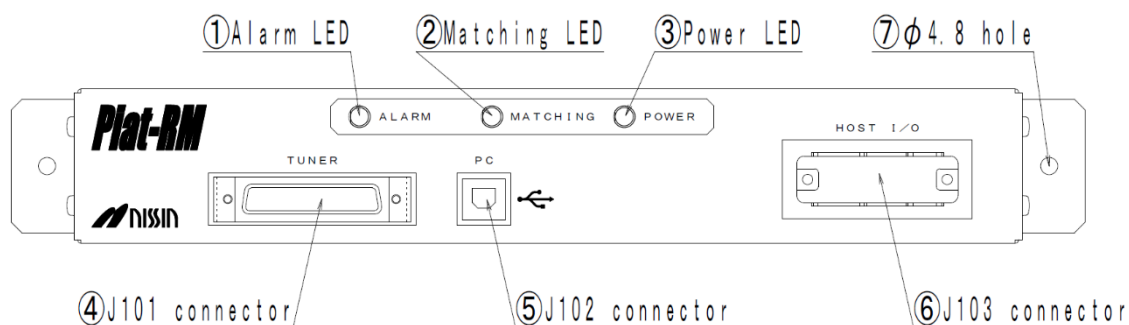


Fig.6 : Piat-RM-CE

No.	Description	Function
①	Alarm LED	The red LED lights up when the alarm is activated. Refer to Chap.8. 2 for alarm state.
②	Matching LED	The green LED lights up during matched state and flashes during unmatched state or alarm state.
③	Power LED	The yellow LED lights up when the power switch turned on.
④	J101 connector	The interface connector to be connected with Piat tuner through attached remote cable.
⑤	J102 connector	The interface connector to be connected with your PC through attached USB cable.
⑥	J103 connector	The interface connector to be connected with your I/O system through a cable which you are requested to make using attached connector.
⑦	φ4.8 hole	Mounting hole for mounting to your system.

6. Installation and connection

Before starting the following installation and connection works, turn off the primary power to all of the related equipment and check that the works can be performed safely. After the works done, make sure that the works are performed correctly and suitably observing the instructions and descriptions, and then, turn on the equipment to operate.

6.1. Installation and connection

Install the Piat auto-tuner unit firmly to your waveguide circuit. It is recommended to install it as close as to the load. Connect each flange by tightening all of twelve bolts of M5 size. Attach the flange marked “INPUT” to microwave source (magnetron) side waveguide and the other flange marked “OUTPUT” to the load side.

 DANGER	• Never operate the tuner under the environment which has igniting gases, explosive gases or conductive dusts. Otherwise, it may possibly result in explosion or fire.
 WARNING	• When installing the tuner to the waveguide circuit, securely tighten all of the bolts for waveguide flanges on both ends. Loose fastening or lack of bolt(s) may result in human injury or even death due to the leakage of microwave and its heating effects.
 CAUTION	• Waveguide components and units including the tuner have considerable weight. Support the waveguide circuit at appropriate positions to avoid their damage due to the weight and force by it. • Install the tuner in right direction so that the “INPUT” port faces to microwave power source and “OUTPUT” port faces to the load. Mistaking in opposite direction will cause malfunction of the tuner and/or surrounding units. • The source side equipment viewed at the input port of the tuner should have VSWR of less than 1.2. Otherwise, it may cause the malfunction of the tuner. • Do not use the tuner in a place with vibration. It may result in malfunction or operational trouble of the tuner.

 CAUTION	Do not operate the tuner in the environment which has or produces dusts. The dusts entered into the waveguide may cause temperature rise, operational trouble or electric discharge.
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It is recommended to mount the tuner unit in either direction instructed in Fig. 8. In case of mounting the tuner unit in other directions, you are requested to provide the tuner unit with protective covers at 5cm or more away over or under the body. The cover under the body protects the tuner against fire, and the cover over the body protects against exposure to water. Do not mount the tuner with Piat-PS-CE in the direction that Piat-PS-CE is under the tuner as shown the right figure in Fig.8.

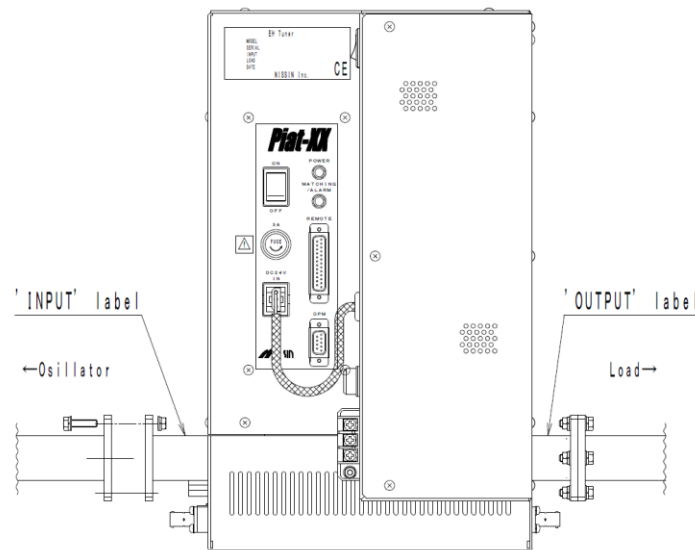


Fig.7 : Connection to waveguide

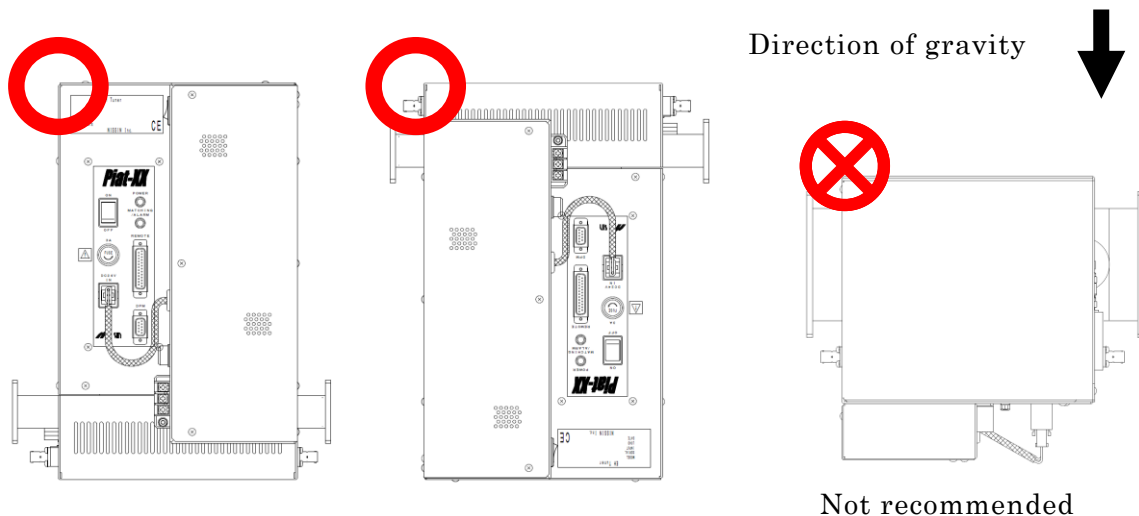


Fig.8 : Recommended mounting direction

6.2. Primary power connection to the tuner with Piat-PS-CE

In case of the tuner with Piat-PS-CE, the primary power of AC 100 V or AC 200 V is to be supplied to AC input terminal on the Piat-PS-CE. Connect the terminal marked “L” to the line side, the terminal marked “N” to the neutral side and the terminal marked “PE” to the external protective conductor. Connect the protective earth at first. The screw holes of AC input terminal are of M4 size.

In case that your primary power is AC 100 V in Japan, you can use the attached cable with 3-prong plug. When AC 200 V is the case, you can use the attached cable without 3-prong plug. In case you make AC cable, prepare a toroidal core (TFT-152613N or equivalent) and make one-turn link by the cable through the hole of the core at the position close to Piat-PS-CE. Make sure to equip your primary power with circuit breaker (3A) conforming to IEC60947-1.

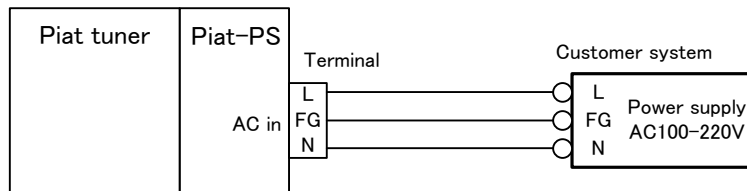


Fig.9 : Primary power connection to the tuner with Piat-PS-CE

 WARNING	Grounding is required. Firstly connect the protective earth terminal of the tuner or Piat-PS-CE to an external protective earthing conductor. An electric fault without protective earth may result in human injury or even death due to the electric shock.
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6.3. Primary power connection to the tuner without Piat-PS-CE

In case of the tuner without Piat-PS-CE, the primary power of DC 24 V is to be supplied to the connector J3 of the tuner. The connector P3 and the contacts which mate with J3 are attached to the tuner. You are requested to make a cable using these connector and contacts. The contacts are of soldering type. Use wires of AWG 18-20. Check the cable and pin assignment.

Table 1:P3 connector pin assignment (for DC24V)

No.	Signal Name	Note
1	+	DC24V line
2	—	DC24V return
3	PE	Protective earth

Connector type : SMS3P1 manufactured by SOURIAU

Contact type : RC16M-SCD28 manufactured by SOURIAU

Using this cable, connect the primary power of DC 24 V (3A or more) to J3 connector marked “DC 24 V IN” of the tuner after turning off the power switches of your primary power of DC24V and of the tuner. Connect the protective earth firstly.

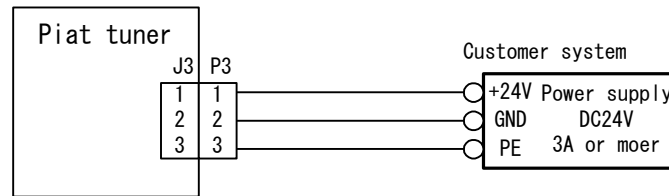


Fig.10 : Primary power connection to the tuner without Piat-PS-CE

6.4. Connection of Piat-RM-CE

6.4.1. Connection of Piat-RM-CE to Piat tuner

Turn off the Piat tuner. Connect the Piat-RM-CE to Piat tuner using “remote cable” which is attached to Piat-RM-CE. Tighten the screws of the connector. The cable is bi-lateral and can be used in either direction. Turn on the Piat tuner to operate.

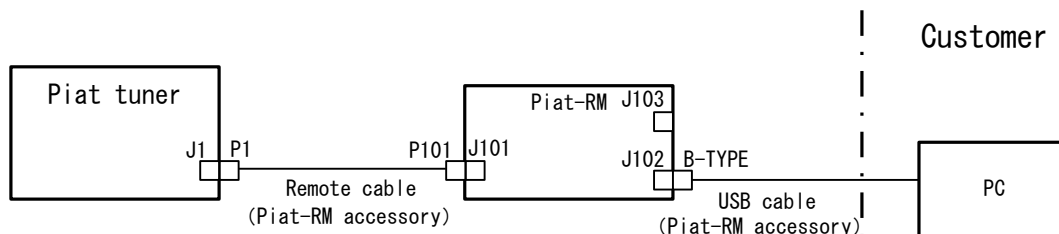


Fig.11 : Connection of Piat-RM-CE to Piat tuner and PC to Piat-RM-CE

 CAUTION	- Securely tighten the screws of the connector for “remote cable” (cable for remote control signal). Loose connection of the connector may result in malfunction or operational trouble. - While applying power, do not plug in or out the connector for “remote cable”. Accidental short-circuiting of the power line may possibly result in malfunction or operational trouble.
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6.4.2. Connection of PC to Piat-RM-CE

Connect the PC (your equipment) to Piat-RM-CE using USB cable which is attached to Piat-RM-CE. This connection can be done without turning off the Piat tuner.

6.4.3. Connection of I/O system to Piat-RM-CE

The signals to and from the I/O system (your equipment) are to be connected to J103 connector of the Piat-RM-CE. You are requested to make a cable for this connection using the mating connector which is attached to Piat-RM-CE. The contact is of soldering type. Use wires of AWG20 or less. See the pin assignment table below for signals and pin numbers.

Connect dry contact (that is, either open or close) to each of the input terminals through the cable. The input terminals produce the voltage of about DC12V when opened, and carry the current of about 2mA when closed. The maximum allowable voltage and current of the output terminals are DC30V and 0.2A. Refer to Chap.8.3.3 for signal interface schematic.

Table 2:P103 connector pin assignment (for I/O control)

Pin No	Signal (input) I/O system →Piat tuner	Pin No	Signal (output) Piat tuner →I/O system
1	NOT USED	23	READY
2	NOT USED	24	
3	NOT USED	25	WARNING
4	NOT USED	26	
5	AUTOTUNING	27	BUSY AUTOTUNING
6	GND	28	
7	MOVE STUB	29	BUSY MOVE STUB
8	GND	30	
9	REMOTE	31	MICROWAVE ON
10	GND	32	
11	WR STUB POSITION	33	ALARM
12	GND	34	
13	MEM NO2 ³	—	
14	GND	—	
15	MEM NO2 ²	—	
16	GND	—	
17	MEM NO2 ¹	—	
18	GND	—	
19	MEM NO2 ⁰	—	
20	GND	—	
21	RESET	—	
22	GND	—	

Connector type : P-1634-BA(09) manufactured by HRS

Connector accessory type : P-1634A-CA(50) manufactured by HRS

Turn off the Piat tuner and connect the I/O system to Piat-RM-CE using above-prepared cable. Tighten screws of the connector. Turn on the Piat tuner to operate.

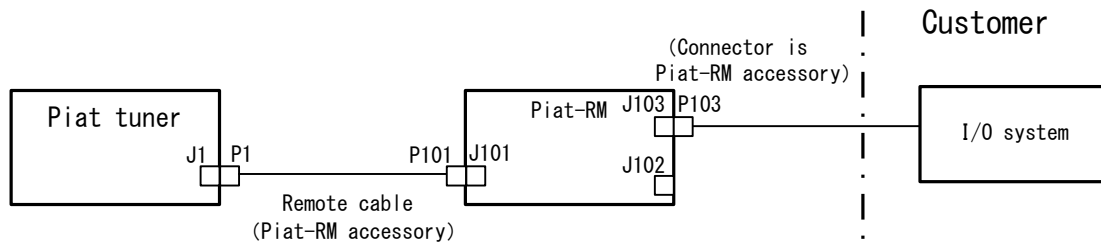


Fig.12 : Connection of I/O system to Piat-RM-CE

6.5. Connection of power monitoring outputs

Piat-XX-2PM-CE has two power monitoring outputs each for forward power and reverse power. Connect the outputs (BNC connector) to the external signal input terminals (BNC connector) of the microwave power source or of the external power meter unit (EX-MU), both manufactured by Nissin Inc. The BNC cables for this connection are attached to the microwave power source or EX-MU.

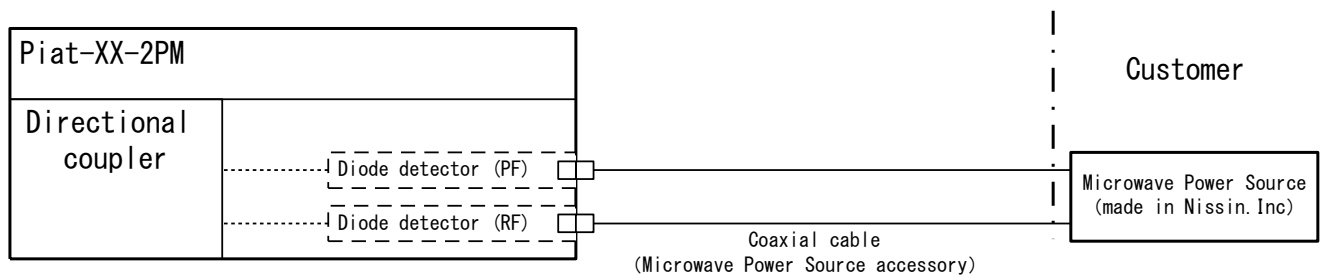


Fig.13 : Connection of power monitoring outputs

6.6. Check after installation

Before applying microwave power, check that there is no loose bolt, especially for the bolts connecting the waveguide flanges. Check that the microwave leakage is less than 1 mW/cm² at 5 cm away from the system by a microwave leakage detector.

 WARNING	• Observe the regulations on the microwave leakage power. Excessive leakage may result in malfunction of surrounding equipments or communication obstructions and also in human injury or even death due to the electromagnetic injury and the heating effects. • While applying the microwave power, do not dismount the tuner from the waveguide circuit. The excessive microwave leakage may result in human injury or even death due to the electromagnetic injury and the heating effects.
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**CAUTION**

- In case of any foreign sound or smell, turn off the microwave power immediately and investigate the cause.
- In case of unusual temperature rise or electric discharge (dielectric breakdown), turn off the microwave power immediately and investigate the cause.
- Check periodically that there is no slack of bolts in the microwave path, and that the microwave leakage is under the specified value in the regulation.
- Do not apply microwave power higher than the specified, and also, do not try to match a load having higher reflection than the specified. Those may result in high temperature rise, malfunction or electric discharge in the tuner.

7. Installing and setting of the software

7.1. Installing the "Maintenance" software (For Windows 2000/XP/7/10)

- (a) To install the "Maintenance" software, double-click on the icon of "MaintePC.exe" in the equipped CD-ROM.



Fig.14 : Icon of "MaintePC.exe"

- (b) To run the "Maintenance" software, double-click on the icon of "MaintetanceVXXXX.exe" in the "EHMaintenancePC" folder. ("XXXX" is version number.) If necessary, place a shortcut button on your desktop.



Fig.15 : Icon of "MaintetanceVXXXX.exe"

7.2. Installing and Setting of the USB driver (For Windows 2000/XP/7/10)

7.2.1. Installing the USB driver (Example: Windows XP)

- (a) Switch on your computer (PC).
- (b) To install the USB driver, double-click on the icon of “CP210xVCPInstaller_x86.exe” (for 32-bit versions of Windows XP/7) in the “USB_drivers¥win_XP,server2003,vista,7,8,8.1(v6.7)” folder of the equipped CD-ROM.



Fig.16 : Icon of “CP210xVCPInstaller_x86.exe”

- (c) Connect Piat-RM and PC with attached USB cable. Make sure that the driver is detected. (Refer to Fig.21.)

(A type connector : PC side、B type connector : Piat-RM-CE side)

7.2.2. Setting of the COM port

- (a) After installing USB driver, click on [Control Panel] in the [Start] menu.
(Leave the USB cable connected.)
- (b) Click on [System] in the Control Panel.

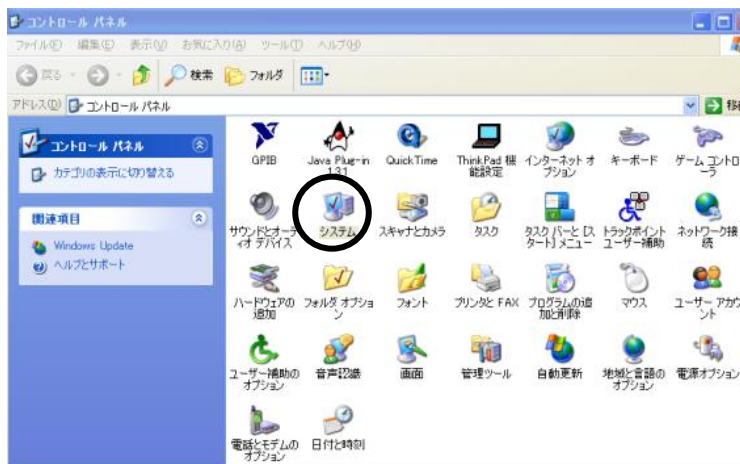


Fig.18 : Control Panel

- (c) In the “System Properties” dialog box, click on the [Hardware] tab.



Fig.17 : Start menu



Fig.19 : System Properties1

(d) Click on the [Device Manager] button in the “Hardware” dialog box.

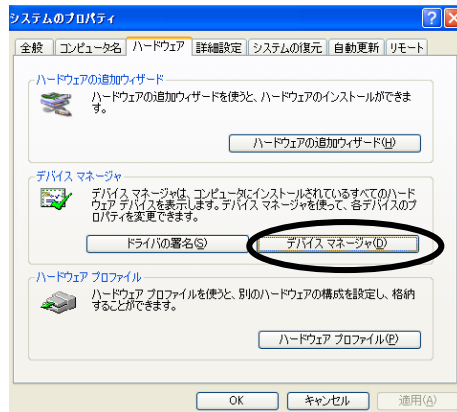


Fig.20 : System Properties2

(e) In the Device Manager screen, double-click on [USB Controller]. Its details will be displayed. Check that “Silicon Labs CP210x USB to UART Bridge” is displayed.

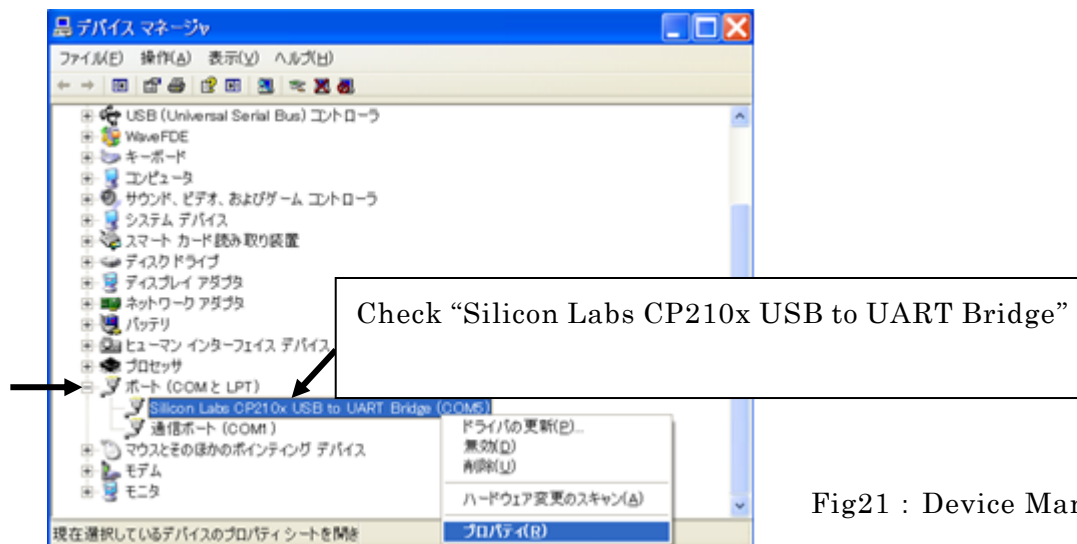


Fig21 : Device Manager

(f) After checking the above, double-click on [Silicon Labs CP210x USB to UART Bridge] in “Ports (COM and LPT)”, and click on the [Properties]. The screen below will appear. Click on the [Port Settings] in the screen.

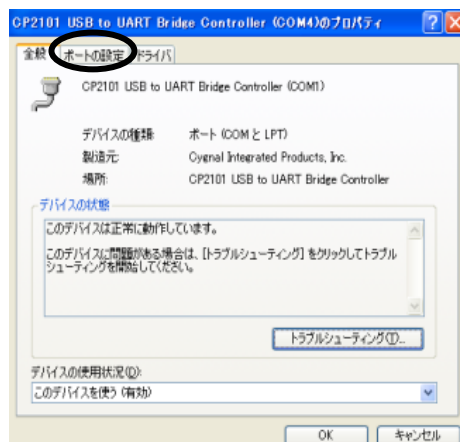
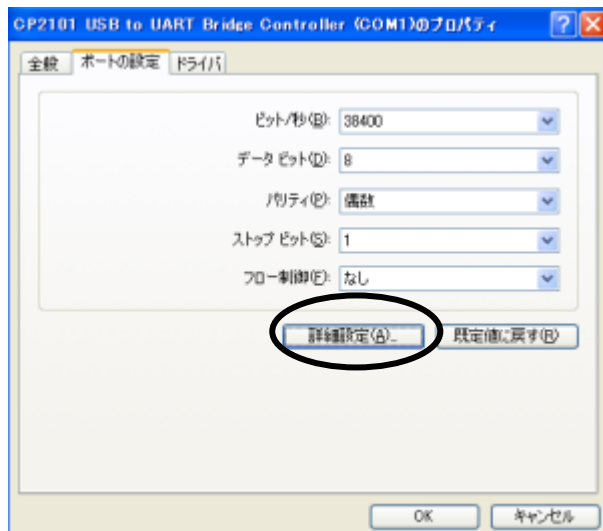


Fig.22 : Com Property1

- (g) In “Port Settings” screen, check that each parameter has the value in the right table.
If not, correct it. After correction, click on the [Advanced Settings] button.

Table 3: Port settings



Bit per second	: 38400/19200※
Data bits	: 8
Parity	: even
Stop bits	: 1
Flow control	: None

※When No.8 of the switch (refer to Chap8.1.6) is “ON”, select “19200” in the Bit per second.

Fig.23 : Com Property2

- (h) In the “Advanced Settings” screen, check the “COM port number”.
When to use the ”Maintenance” software, this number will be required.

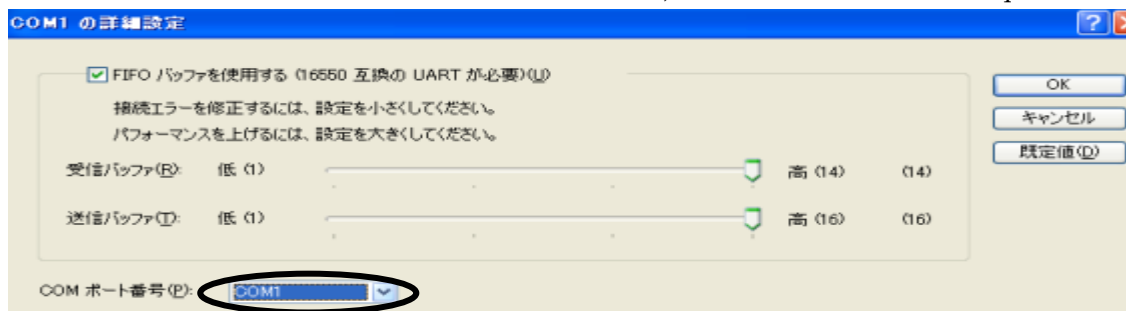


Fig.24 : Setting for COM

8. Operation instructions

8.1. Operation of Piat tuner

8.1.1. Power on

Turn on the power switch to operate the Piat tuner after turning on the power switch of Piat-PS-CE or the primary power of DC 24 V. The “Power” LED (yellow) lights up. At first, the Piat tuner initializes its two plungers. The initializing process requires 5-10 seconds. After initialization, when the microwave power is applied, the Piat tuner starts auto-matching operation.

In case that the microwave power is applied during the initializing process, the Piat tuner will not start the auto-matching operation and wait till completion of the initialization.

All operational parameters of the Piat tuner are initially set to factory default value. In this condition, the Piat tuner can perform auto-matching operation.

8.1.2. Matching

When microwave power is applied, Piat tuner starts matching operation automatically. The “Matching/Alarm” LED flashes in green while matching operation is in process and lights up in green after matching is completed.

8.1.3. Alarm

The “Matching/Alarm” LED flashes in red when an alarm is activated. You can reset the activated alarm by any of the following actions.

- Click on alarm reset [アラームリセット] button at PC (in software “Maintenance”),
- Reset by I/O system,
- Restart Piat tuner.

Note that if the causes of the alarm are left not fixed, the alarm will be activated again.

 CAUTION	• In case of any alarm indication on the tuner, turn off the microwave power immediately and investigate the cause.
--	---

8.1.4. Position of plunger

The moving ranges of the plungers are 0-80.4 mm. After the initializing process, each plunger moves to the positions which are specified by “Stop” parameters in the effective recipe. (In the factory default value, E plunger position is around 47 mm and H is around 31 mm. This set of positions is non-reflective position.)

It is recommended that Piat tuner starts auto-matching process from the non-reflective position. You can change the initial position through PC.

8.1.5. Fuse

In case of fuse blow, contact the manufacturer. It is required to investigate the cause.

Contact address (phone number)

Nissin Inc. Sales Department : +81-797-72-1903

 CAUTION	• In case to check the fuse, check it after turning off the power switch of the tuner. • In case of fuse blow, contact the manufacturer. It is required to investigate the cause.
--	---

8.1.6. Setting of operational parameters

The selection of values or valid/invalid selections can be set up at the switch (DIP style switch, see Figs. 31 and 32).

The initial settings at the time of delivery from the manufacturer are all “OFF”.

Table 4: Switch settings

Switch No.	Initial setting	Function	Description
1	OFF	—	Reserved for system
2	OFF	Disables plunger initialization process (except at initial run or at alarm)	ON : Initialization invalid OFF : Initialization valid
3	OFF	—	Reserved for system
4	OFF	—	Reserved for system
5	OFF	—	Reserved for system
6	OFF	—	Reserved for system
7	OFF	—	Reserved for system
8	OFF	Selects communication speed	ON : 19200bps OFF : 38400bps

Note: Specify the same communication speed for both Piat tuner and PC (USB driver).

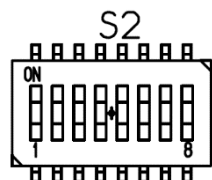


Fig.25 : Switch

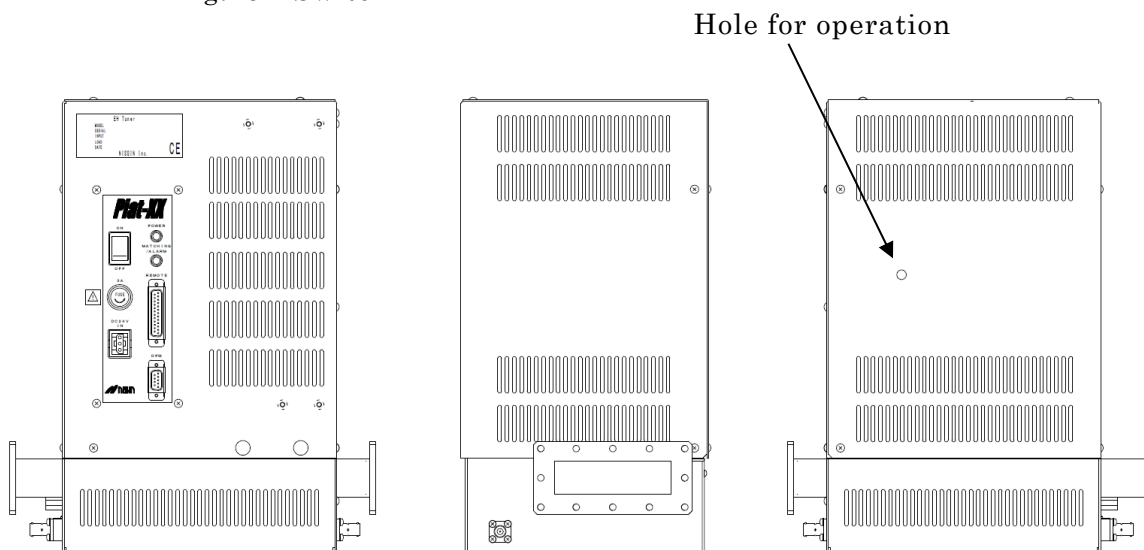


Fig.26 : Hole for operation

8.1.7. Power off

Turn off the power switch of the Piat tuner to shutdown. If necessary, turn off the power switches of Piat-PS-CE and your primary power.

8.2. Operation through PC

8.2.1. Connection of PC and running the PC

Connect PC with Piat tuner through Piat-RM-CE. Run the attached “Maintenance/Control” software for Piat operation, and Piat tuner can be operated and monitored from PC.

With regard to the connection, see “6.4 Connection of Piat-RM-CE” in this manual.

At the time of running the software, specify the COM Port number and communication speed.

Note that the communication speed of the tuner can be selected at the parameter switch (DIP style switch). Initial setting is 38400 bps. See “8.6.1 Setting of operational parameters”.

8.2.2. Operation on “Maintenance/Control” software

The descriptions on connection, recipe and initial settings, alarm and warning are given in this manual. For detailed operational procedures, refer to the “Instruction Manual for Maintenance/Control Software” attached to Piat-RM-CE.

Note that Piat tuner is not a measuring instrument. When measured VSWR is larger than 1.2 or the microwave has broader frequency spectrum, the measured values displayed in “Maintenance/Control” software on PC, such as VSWR, reflection coefficient and incident and reflected microwave powers, are not accurate measurements. This does not affect the performance of matching operation.

(When microwave source is a magnetron, the microwave output may possibly have broader spectrum, especially at lower output power than the rated output.)

8.2.3. Recipe setting at the Maintenance/Control Software

Piat tuner performs auto-matching operation according to the parameters set in the recipe. Total of 16 recipes, Recipe 1 through Recipe 16, can be registered. Recipe 1 has base settings which are initially set at the time of delivery from manufacturer and they cannot be modified. Recipes other than Recipe 1 can be modified by you at Maintenance/Control software. The recipe to be executed can be selected through Maintenance/Control software or I/O system. The initial selection is set to Recipe 1.

The descriptions on each setting item of recipe and initial setting values are explained in Table 5.

 CAUTION	• All the data for recipe number, recipe parameters and control parameters are stored in a non-volatile memory and will be kept as they are even when turning off the Piat tuner. Note that the non-volatile memory may reach its life in shorter period in case of rewriting it at short intervals. The non-volatile memory manufacturer warrants 100,000 erase cycles per sector. • The data for recipe number and recipe parameters are stored in one sector of the non-volatile memory. The Piat tuner firmware of V6.00 or later version reserves 10 sectors for storing the data and changes the sector at every rewriting. The lifetime of the non-volatile memory may result in 10 times longer than previous lifetime. The data for control parameters are stored in one sector of the non-volatile memory. The Piat tuner firmware of V6.00 or later version reserves 2 sectors for storing the data and change the sector at every rewriting.
 CAUTION	• It is recommended that the Piat tuner be in the RAM mode if you change the recipe number frequently at short intervals through PC or I/O. In the RAM mode, the data for recipe number are stored only in volatile memory and the data stored in the non-volatile memory will not be modified. In the ROM mode, the data for recipe number are stored in the non-volatile memory. In either mode, the data for recipe parameters and control parameters are stored in a non-volatile memory. For detail, refer to the “Instruction Manual for Maintenance/Control Software”. • In the factory default setting, the Piat tuner is in the RAM mode. If necessary, select the ROM mode through PC.

Table 5: Description on recipe

Item		Initial setting	Description
VSWR		1.2	The threshold value, lower than which it is judged as matched. When the detected VSWR becomes lower than this value, the tuner stops matching operation (ie matched). When it goes over across this value, the tuner starts matching operation again.
Plunger setting	Start,1-4		Plunger preset has a function to locate the E and H plungers to specific positions before performing auto-matching (start position, positions 1 through 4) and after completion of matching session (stop position). Matching operation follows to move plungers to start position, and next, to positions 1 through 4 in this order waiting for wait time at each position, and then, performs normal auto-matching operation. The initially set “Stop” position (around 47mm for E and around 31mm for H) is the non-reflective positions of the tuner.
	E 面(E plunger)	0mm	
	H 面(H plunger)	0mm	
	Wait Time	0sec	
	プリセット動作 (preset operation)	無効 (inactive)	
	Stop		
	E 面(E plunger)	around 47mm	
	H 面(H plunger)	around 31mm	
	Wait Time	0sec	
	プリセット動作 (preset operation)	有効 (active)	
整合マスク時間 (Masking time)		10msec	When larger VSWR than the specified is detected continuously for more than this period after matching is once completed, the tuner starts matching operation again.
マイクロ波 ON Power (Microwave-On power)		300W(Piat-60) 150W(Piat-30) 75W(Piat-15) 15W(Piat-03)	The threshold power level which decides start or stop of matching operation. When incident microwave power becomes more than this value, the tuner starts matching operation. When it becomes lower for more than 1 second, the tuner stops matching, performs initialization and locates the plungers to “Stop” position set in the plunger preset section. In case that “Stop” position is invalid, plungers will be located at 81 mm positions.

Table 5: Description on recipe (continued)

整合エラー タイマー Matching error timer	30sec	Time-limit for auto-matching operation. When VSWR does not once become lower than the specified for more than this duration after the start of matching operation, a warning signal is generated.
Time Delay	0msec	Waiting time before starting the auto-matching. The tuner waits for this duration to start matching operation after incident power grows up across the threshold level set in Microwave-on power section.

8.2.4. Alarm

When an alarm is activated, the “Matching/Alarm” LED (red) on the tuner flashes, “Alarm” LED (red) on Piat-RM-CE lights up, “Matching” LED (green) on Piat-RM-CE flashes(※1) and alarm contact signal is generated at Piat-RM-CE. Messages shown in the table below are also displayed in “Maintenance/Control” software on PC. The alarm once activated is kept active till alarm reset [アラームリセット] button is clicked at “Maintenance/Control” software or till reset signal is made to ON at I/O control in Piat-RM-CE.

Note that even reset action taken, alarm is activated again if the cause of alarm is not rectified.

Table 6: Description on alarm

Displayed Message	Cause and possible trouble
「プランジャが原点復帰できません」 (Failed to locate plungers at home position.)	Cause: Cannot detect home position for plungers. Trouble: Malfunction of position sensor, motor, or control circuit in control board. Operation: Stops matching operation. “Matching/Alarm” LED (red) on the tuner and “Matching” LED (green) on Piat-RM-CE flash 1 time then repeat.(※1)
「検波器データを受信できません」 (No signal from reflection detector.)	Cause: Cannot receive signal from detector. Trouble: No or loose connection of detector cable. Malfunction of detector or interface circuit in control board. Operation: Stops matching operation. The LEDs flash 4 times then repeat.(※1)
「指定時間に整合できませんでした」 (Failed to match within specified time.)	Cause: Matching is not completed within 30 seconds. Trouble: I) Malfunction of control circuit or hardware for matching around motor or plunger. II) Unsuitable load. Reflection coefficient of load is larger than the specified limit or is unstable and varying largely with time. Operation: Continues matching operation. The LEDs flash 6 times then repeat.(※1)
「導波管の温度が 80℃以上です」 (Waveguide temp is higher than 80℃.)	Cause: Sensor on waveguide detected temp more than the specified. Trouble: Reflection by the load exceeds the specified value. Operation: Stops matching operation. The LEDs flash 2 times then repeat.(※1)

「負荷反射係数が 0.9 以上 です」 (Reflection coefficient of load is larger than 0.9.)	Cause: Reflection coefficient of load being larger than 0.9 is kept for 30 seconds during the matching operation. Trouble: Reflection by the load exceeds the specified value. Malfunction of the load. Operation: Stops matching operation. The LEDs flash 5 times then repeat.(※1)
「フラッシュ ROM への書込 みができません」 (Failed to store data in flash ROM.)	Cause : Time out error occurred during storing data in flash ROM (non-volatile memory). Trouble : Malfunction of flash ROM Operation : Stops matching operation. The LEDs flash 3 times then repeat.(※1) (Piat tuner firmware: V6.00 or later version)

For details, see “5.2 Current data screen” in Instruction Manual for Maintenance/Control Software.

※1: This function is applicable for the case of Piat tuner firmware of V6.04 or later version.

 CAUTION	• In case of any alarm indication on the tuner, turn off the microwave power immediately and investigate the cause.
---	---

8.2.5. Warning

Warning is given as I/O signal. When warning signal is given, the tuner continues matching operation and the state of warning is kept as it is even after completion of matching. Upon reset action, warning is released unconditionally.

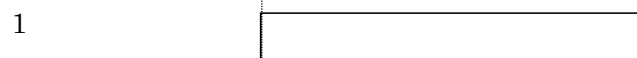
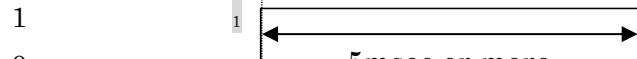
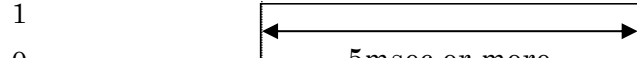
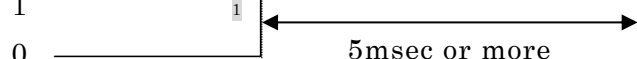
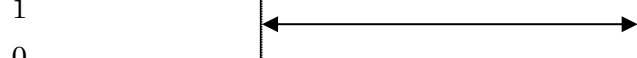
Table 7: Description on warning

Item	Cause and possible trouble
Tuning Time Up	Cause: Cannot complete matching within time-limit specified in recipe. Trouble: I) Malfunction of control circuit or hardware for matching around motor or plunger. II) Unsuitable load. Reflection coefficient of load is larger than the specified limit or is unstable and varying largely with time.

8.3. Operation through I / O

You can monitor and operate Piat tuner by using input contact signals and output contact signals without PC.

8.3.1. Input contact signal and operation

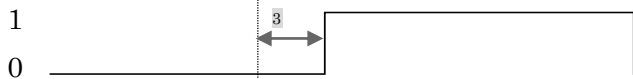
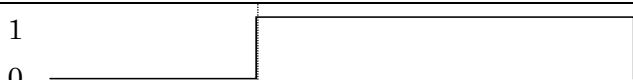
Input signal name	Timing chart and operating state		
REMOTE	1		
	0		
	unavailable	available	unavailable
	All other input contacts become available.		
MOVE STUB	1		
	0		
		5msec or more	
		Move plungers	
Piat tuner moves plungers to "Start" position in the effective recipe.			
AUTO TUNING	1		
	0		
		Auto-matching operation	Stop it
	Piat tuner starts auto-matching operation. Initializing process starts after stopping it.		
RESET	1		
	0		
		5msec or more	
		Reset alarm and warning	
Piat tuner resets alarm and warning.			
Wr STUB POSITION 4	1		
	0		
		5msec or more	
		Record the current plunger position	
Piat tuner records the current plunger position data to the "Start" parameter in the effective recipe.			
MEM No.2 ⁰ -No.2 ³ 4	1		
	0		
	No.2 ^X bit 0	No.2 ^X bit 1	No.2 ^X bit 0
	Recipe Number is defined from 1 to 16 by 4-bit. 2		

- Contact : 1 : CLOSED, 0 : OPEN
- All input contacts become available when the REMOTE input contact is closed.
- When manual mode is active in the "Maintenance" software of PC, I / O operations are unavailable.

1 : Set the MEM No.2⁰-No.2³ before 1second of the other I/O operations.

2 , 4 : Refer to p37.

8.3.2. Output contact signal and operation

Output signal name	Timing chart and operating state		
READY	1 		
	0 _____		
	Power supply OFF	Power supply ON	Power supply OFF
	After initialization, this signal output turns on.		
WARNING	1 		
	0 _____		
	Normal	Warning	Reset warning
	The warning once activated is kept active till alarm reset.		
BUSY AUTOTUNING	1 		
	0 _____		
	Matched or stop	Auto tuning	Matched or stop
	During auto tuning, this signal is activated.		
BUSY MOVE STUB	1 		
	0 _____		
	Stop Plungers	Move Plungers	Stop Plungers
	During the plungers moving, this signal is activated.		
MICROWAVE ON	1 		
	0 _____		
	Microwave Off	Microwave On	Microwave Off
	During microwave on , this signal is activated..		
ALARM	1 		
	0 _____		
	Normal	Alarm	Reset alarm
	Until the alarm is reset, this signal is activated (turn off).		

- Contact : 1 : Closed and On, 0 : Open and Off
- These output contact signals are available at all times .
- 3 : The initializing process requires 30 seconds or less.

2 : Refer to the table below about the each bit corresponding to recipe number.

Recipe number \ bit	2 ³	2 ²	2 ¹	2 ⁰	Recipe number \ bit	2 ³	2 ²	2 ¹	2 ⁰
1	0	0	0	0	9	1	0	0	0
2	0	0	0	1	10	1	0	0	1
3	0	0	1	0	11	1	0	1	0
4	0	0	1	1	12	1	0	1	1
5	0	1	0	0	13	1	1	0	0
6	0	1	0	1	14	1	1	0	1
7	0	1	1	0	15	1	1	1	0
8	0	1	1	1	16	1	1	1	1

• 4 :

 CAUTION	• All the data for recipe number, recipe parameters and control parameters are stored in a non-volatile memory and will be kept as they are even when turning off the Piat tuner. Note that the non-volatile memory may reach its life in shorter period in case of rewriting it at short intervals. The non-volatile memory manufacturer warrants 100,000 erase cycles per sector. • The data for recipe number and recipe parameters are stored in one sector of the non-volatile memory. The Piat tuner firmware of V6.00 or later version reserves 10 sectors for storing the data and changes the sector at every rewriting. The lifetime of the non-volatile memory may result in 10 times longer than previous lifetime. The data for control parameters are stored in one sector of the non-volatile memory. The Piat tuner firmware of V6.00 or later version reserves 2 sectors for storing the data and change the sector at every rewriting.
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 CAUTION	• It is recommended that the Piat tuner be in the RAM mode if you change the recipe number frequently at short intervals through PC or I/O. In the RAM mode, the data for recipe number are stored only in volatile memory and the data stored in the non-volatile memory will not be modified. In the ROM mode, the data for recipe number are stored in the non-volatile memory. In either mode, the data for recipe parameters and control parameters are stored in a non-volatile memory. For detail, refer to the “Instruction Manual for Maintenance/Control Software”. • In the factory default setting, the Piat tuner is in the RAM mode. If necessary, select the ROM mode through PC.
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8.3.3. Interface schematic

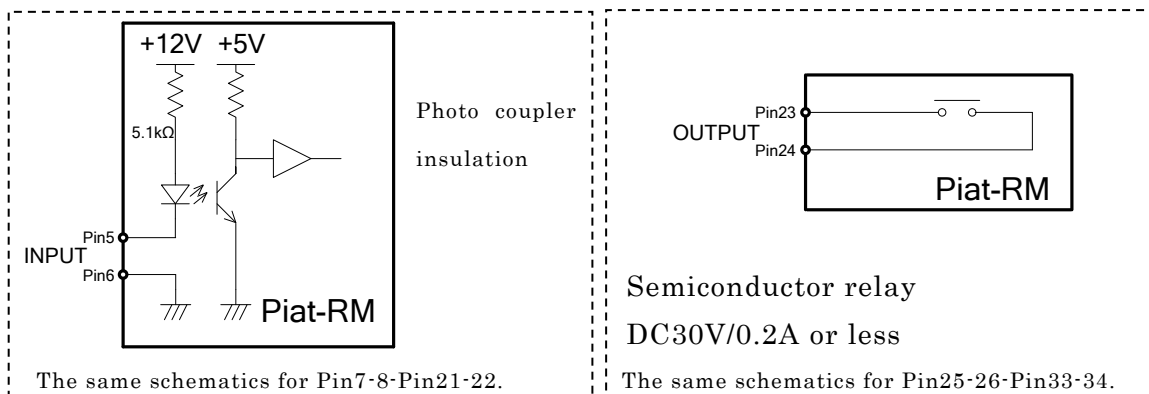


Fig.27 : Input interface schematic
(Example:Pin5,Pin6)

Fig.28 : Output interface schematic
(Example:Pin23,Pin24)

9. Periodic maintenance

Case : Impedance matching work once every two minutes in clean room.

Every 2.5 years after beginning of operation ① Grease up of ball screws

5 years after beginning of operation ① Exchange of Teflon sliding plates

② Exchange of timing belts

③ Readjustment

If you have a greater frequency of use than above case, calculate the maintenance period proportionally. You are requested to send back to the manufacture for the maintenance (charges required). Useful life of Piat tuner is 8 years. It excludes the erase endurance of the non-volatile memory.

10. Specifications

10.1. Piat-XX-2PM-CE

10.1.1. Structural characteristics

Items	Specifications
Outline dimension	300mm(W)x203mm(D)x374mm(H) (without swelling)
Weight	7.5kg or less
Material (waveguide)	Aluminum alloy
Surface treatment (cover)	Trivalent chromium process
Waveguide	WST-AD (inside dimension of 96×27mm)
Flange	TBR-2A2 (outside dimension of 130×60mm)
Cooling system	Natural air cooling

10.1.2. Electrical characteristics

Items		Specifications
Frequency range		2.455GHz±15MHz
Maximum allowable load		VSWR 10
Matching time		2sec or less（for fixed load）
Maximum working power		▪ Piat-60: 0.5 - 6.0kW CW（when VSWR 5 or less） 0.5 - 3.0kW CW（when VSWR 10 or less） ▪ Piat-30: 0.25 - 3.0kW CW（when VSWR 10 or less） ▪ Piat-15: 0.125 - 1.5kW CW（when VSWR 10 or less） ▪ Piat-03: 0.025 - 0.3kW CW（when VSWR 10 or less）
Input power requirement		DC24V±5%、3A or more
Waveguide temperature sensor		Detection temperature 80℃
PF monitor accuracy		±5%（When VSWR 1.2 or less、Ripple 0.5dB or less）
Microwave leakage power		1mW/cm² or less（at 5cm away from the body）
Directional coupler	Directivity	28dB or more
	Coupling	55 - 57dB

10.1.3. Environmental conditions

Items	Specifications
Operational environment temperature	10-40°C on condition of no condensation and No corrosive gas
Operational environment humidity	35-80% RH
Altitude	Less than 1,000 meters above sea level.
Pollution degree	2 or less

10.1.4. Storage conditions

Items	Specifications
temperature	0 to 50 °C (without condensation and corrosive gas)
humidity	35 to 80% of relative humidity

10.2. Piat-RM-CE

10.2.1. Structural characteristics

Items	Specifications
Outline dimension	300mm(W)x25.6mm(D)x43mm(H) (without swelling)
Weight	0.5kg or less
Material (cover)	Aluminum alloy
Surface treatment (cover)	Trivalent chromium process

10.2.2. Electrical characteristics

Items	Specifications
Contact input	Dry contact
Contact	Solid-state relay
output	
Voltage	DC30V or less
Current	0.2A or less

10.2.3. Environmental conditions

Items	Specifications
Operational environment temperature	10-40°C on condition of no condensation and no corrosive gas
Operational environment humidity	35-80% RH
Altitude	Less than 1,000 meters above sea level.
Pollution degree	2 or less

10.2.4. Storage conditions

Items	Specifications
temperature	0 to 50 °C (without condensation and corrosive gas)
humidity	35 to 80% of relative humidity

10.3. Piat-PS-CE

10.3.1. Structural characteristics

Items	Specifications
Outline dimension	50mm(W)x120mm(D)x340mm(H) (without swelling)
Weight	1.5kg or less
Material (cover)	Aluminum alloy
Surface treatment (cover)	Trivalent chromium process

10.3.2. Electrical characteristics

Items	Specifications
Input voltage	AC100-220V $\pm 10\%$
Input current (average)	1A(at AC100V input DC24-3A output)
Frequency range	47-63Hz
Output voltage	DC24V $\pm 5\%$
Output current	3A
Measurement category	CAT II

10.3.3. Environmental conditions

Items	Specifications
Operational environment temperature	10-40°C on condition of no condensation and No corrosive gas
Operational environment humidity	35-80% RH
Altitude	Less than 1,000 meters above sea level.
Pollution degree	2 or less

10.3.4. Storage conditions

Items	Specifications
temperature	0 to 50 °C (without condensation and corrosive gas)
humidity	35 to 80% of relative humidity

Nissin Inc.

VER.L: December 2020 Edition

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