

AIX 10

X-ray inspection system for PCB multilayers



USER MANUAL

AIX10-MS-1.02-01-UK



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1 INTRODUCTION



This manual was intended to make easy and safe the use of the AIX10 manufactured by Piergiacomini Robotics. For safety reasons the reading and knowledge of this manual by the machine user is compulsory, therefore if not completely read may cause damages.

The AIX10 has been designed only and exclusively for the inspection of PCB and in particular for dimensional and hole eccentricity analysis

The PC runs on Windows 98 (or higher) environment, in order to provide a friendly interface. A keyboard with a trackball is the main machine interface. This keyboard is located underneath the working table and it's easy to slide it out.

The advanced x-ray source, combined with an optimum vision system give to this x-ray system very high performance results.

The PC runs on Windows Xp (or higher) environment, in order to provide a friendly interface.

2 SAFETY REGULATION

This manual was intended to make easy and safe the use of the AIX10 manufactured by Piergiacomini Robotics. For safety reasons the reading and knowledge of this manual by the machine user is compulsory, therefore if not completely read may cause damages and an increased risk. .

Pay particular attention to those parts concerning x-ray.

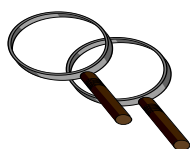
Integrating part of this manual are following documents:

- ELECTRICAL EQUIPMENT
- SOFTWARE MANUAL
- X-RAY CAMERA INSTRUCTION MANUAL
- X-RAY SOURCE AND CONTROL INSTRUCTION MANUAL

2.1 MEANING OF GRAPHIC SYMBOLS LISTED IN THIS MANUAL



The exclamation mark, within the equilateral triangle, indicates the presence of working or maintenance instructions or any situation, which is, or might become, potentially dangerous. It reminds the kind of risk involved and the competence required.





The magnifying lens indicates information or details, which might be useful to the technicians while detecting failures or fixing any machine's fault.

Therefore the comprehension of these parts requires an adequate technical knowledge. This kind of knowledge is not required for the normal use of the machine.

2.2 GENERAL PRESCRIPTIONS

	WARNING !!! The aim of AIX10 is to check the correct location and dimension of pads and reference holes on multi-layer PCB. It is also possible to use the machine for a general PCB inspection. ANY OTHER USE IS FORBIDDEN
	WARNING !!! The use of this machine is strictly forbidden to personnel who have not read and deeply understood all AIX10 manuals
	WARNING !!! It is strictly forbidden to tamper with the security features of this machine. The chassis panels are intended as a permanent protection and therefore they cannot be removed.
	WARNING !!! In order to install and to start-up the machine, it is extremely important to respect and to pay attention to safety and prevention regulations.
	WARNING !!! The installation and maintenance have to be carried out by authorized and appropriately trained personnel only.

	<p>WARNING !!! Before any intervention on electrical or mechanical parts, the power supply disconnection from the machine is compulsory.</p>
	<p>WARNING !!! In order to minimize any risk of fire or electrical discharge avoid any contact between any machine's electrical part and water or other kind of liquids.</p>





2.3 SPECIFIC INDICATIONS RELATED TO X-RAY USE

The **AIX10** uses a device able to generate x-rays.





X-rays are dangerous for the human body

To avoid any kind of problem, Piergiacomini recommends that all following indications are fully respected. Being x-rays quite complex argument, these indications are divided in 3 groups: law regulations; x-ray device; image detector (device which transform the x-rays in images).


2.3.1 LAW REGULATIONS

	<p>WARNING !!! The ownership of this machine must be communicated to the concerned authorities.</p>
	<p>WARNING !!! The use of this machine is subject to a qualified expert supervision that will check the x-ray emissions with the timing prescribed by law and will establish operator's work loads and all the safety precautions.</p>
	<p>WARNING !!! Check the technical relation supplied with the machine. In particular pay attention to those parts concerning frequency evaluations and x-ray protections installed.</p>
	<p>WARNING !!! A doctor will check results of dosimeters.</p>

2.3.2 OPERATIONAL PRECAUTIONS RELATED TO THE X-RAY SOURCE

	<p>WARNING !!! Do not tamper, remove, change or leave open panels or doors. They are fundamental to reduce to the minimum the quantity of x-ray emissions in the surrounding environment.</p>
	<p>WARNING!!! <u>Do not</u> TAMPER or MODIFY x-ray devices. <u>Do not</u> EXCLUDE safety locks.</p>
	<p>WARNING!!! Do not install in environment with excessive dust, humidity, corrosive gas which could cause electrical discharge or fire.</p>
	<p>WARNING!!! AVOID SHOCKS OR EXCESSIVE VIBRATIONS.</p>

2.3.3 OPERATIONAL PRECAUTIONS RELATED TO THE X-RAY CAMERA


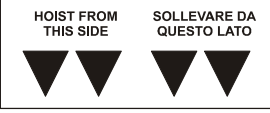
	<p>WARNING!!! AVOID SHOCKS OR EXCESSIVE VIBRATIONS.</p>
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2.4 MACHINE GROUNDING

This product has to be grounded. In case of false contacts or loss of insulation, the machine grounding ensures a low resistance path to avoid any risk of electrical discharge. The machine is provided with a grounding system which works only if connected to the factory plant's grounding system by means of a wire between the machine's main terminal block and the power supply system (see installation options of the machine). The supply system has to follow the law prescriptions.

WARNING!!! An incorrect grounding procedure may cause electrical discharge. Qualified personnel must check the method used to ground the machine

2.5 MEANING OF WARNING SIGNS ON THE MACHINE

	<p>The lightning symbol within an equilateral triangle is used to make the operator aware of “dangerous voltage” presence within the product. This might be a cause of harm in case of contact</p>
	<p>This sign shows the exact location where to position the lifting arms to perform any machine loading and movement operation</p>

3 SECURITY FEATURES IN THE MACHINE CONSTRUCTION

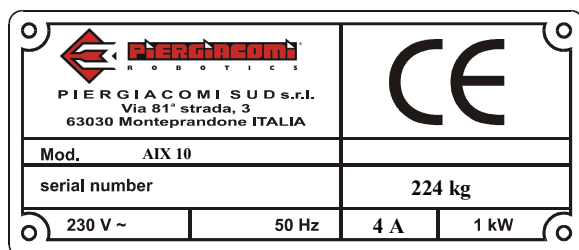
The machine has been built following the security regulations in force.

The complete analysis of these aspects is contained within the “**Fascicolo Tecnico**” (compulsory document required by the EEC directive 89/392 “*enclosure V, Machine Directive*”, necessary to have the conformity certificate to be released). This documentation is available to the authority but not to the machine buyer.

The producer gives the buyer the conformity certificate, which contains all the regulations the project and the construction of the machine are based on.

This machine mounts x-ray devices and maximum care has been used on the design and implementation of shielding structure to reduce to minimum x-ray emissions in the environment.

3.1 IDENTIFICATION PLATES APPLIED ON THE MACHINE



MACHINE PLATE:

This is the machine identification plate, which reports the main characteristics and the registration number. It is located on the machine’s structure.

X-RAY TUBE	
Model:	IS601.5
S/N:	-----
High Voltage range min.:	22kV
High Voltage range max.:	65 kV
Current range min.:	0,12 mA
Current range max.:	1,5 mA

X-RAY PLATE:

This is the x-ray device plate. It is located inside the machine.

4 MACHINE DESCRIPTION

The AIX10 manufactured by Piergiacomini ROBOTICS is only and exclusively an x-ray inspection system for multi-layer PCBs.

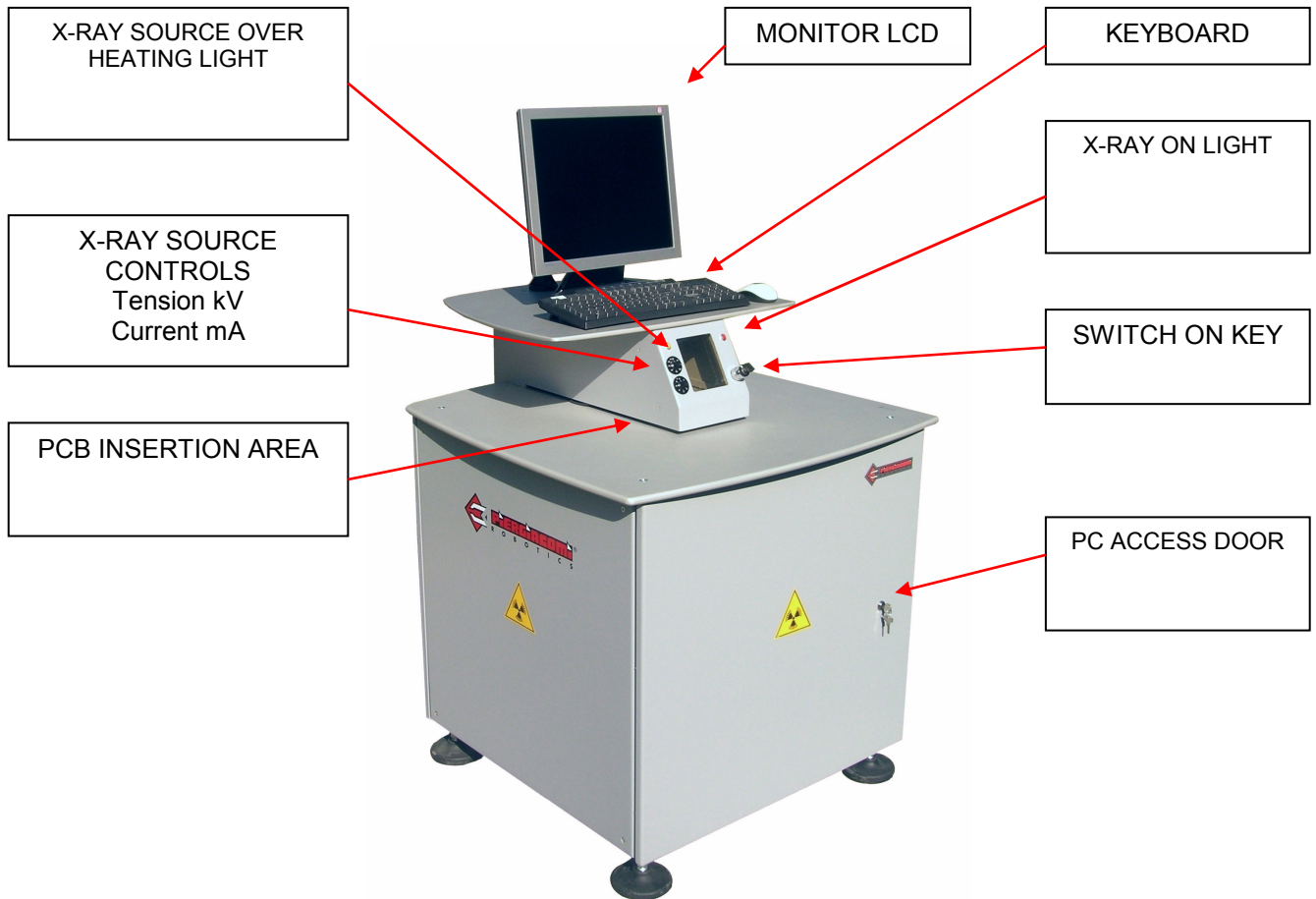




Fig.4.1

5 ELECTRICAL EQUIPMENT

For what concerns electrical system connections and schemas, see “Electrical Equipment” document. The electrical equipment, apart from electro mechanic components, includes also electronic sub systems:

- X-ray devices
- Control system

When any action on the machine is needed please pay attention to the following warnings:

	<p>WARNING !!! Installation and maintenance operations must be performed by authorized trained personnel only.</p>
	<p>WARNING !!! Before any operation on electrical and/or mechanical parts, it is mandatory to disconnect the machine from the electrical power supply.</p>



6 X-RAY DEVICES

In the following scheme all x-ray devices and their main connections are shown:

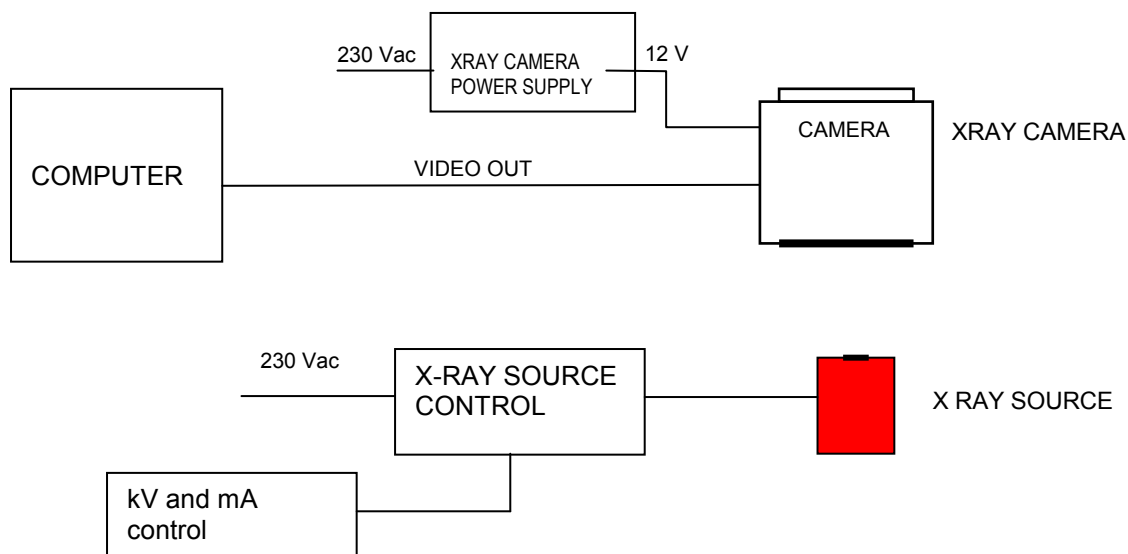


Fig. 6

- X-Ray Camera
- X-Ray camera power supply
- X-Ray source
- X-Ray source control
- kV and mA control

6.1 XRAY CAMERA

The X-RAY Camera mounted on the AIX10 it is an high level performance device, which apart from an excellent quality of its images, it has an extremely high sensitivity which allows a minimum amount of x-ray emissions to be used. The camera is 12V power supplied by its own feeder. The video output is connected at the computer video input. This device has to be managed with extreme care being very fragile.

Cameras are composed by an image intensifier which translate the x-ray energy into light quantum and by optic fibers which transmit the light to a CCD. Then, an electronic circuit system, produce an analogical standard video format. High quality cameras gives high resolution, high sensitivity and optimum contrast level..

6.2 X-RAY CAMERA FEEDER

The power supply feeder, it is connected to the network at 230V a.c. with a 12V c.c. output. The red light indicates output tension presence.

6.3 X-RAY SOURCE

The x-ray source is located inside the machine and it is easily recognizable thanks to a label indicating it. The x-ray source it is connected to its control through a cable. No adjustments or other operations are needed.

6.4 CONTROL PANEL

The control panel manages the c-ray sources and X,Y,Z axes movement:

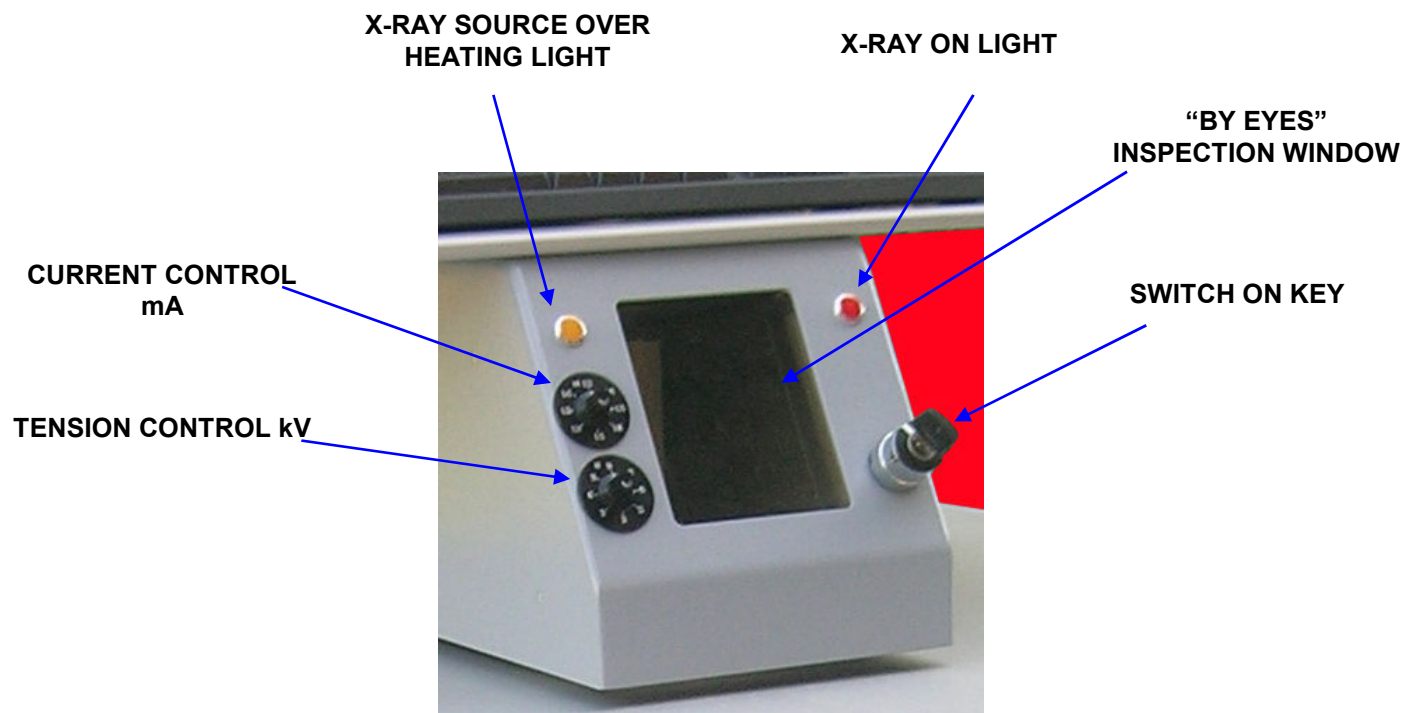




Fig. 6.4A

For what concerns x-ray, main elements to be considered are:

- **X-RAY ON AND OFF KEY** Turning this key x-ray are switched on or off.
- **X-RAY SOURCE OVER HEATING LIGHT** this light turns on when there is an over heating of the x-ray source. Therefore it should be always turned off. In case of over heating switch off x-ray and switch them on after few minutes.
- **X-RAY ON LIGHT** this light is turned on when x-ray are switched on
- **CURRENT AND TENSION CONTROLS** using the appropriate knobs, located on the control panel, it is possible to adjust current from 0,12 to 1,5 mA and x-ray tension from 0 to 65 kV

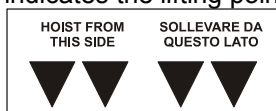
7 TRANSPORT AND STORING

	<p>WARNING !!! All transport operations require a great care and should be performed by trained personnel only.</p>
	<p>WARNING !!! THE XRAY CAMERA CANNOT BE EXPONED TO SCHOCK OR EXCESSIVE VIBRATIONS THEREFORE IT IS NECESSARY TO DEEPLY EVALUATE THE NEED TO REMOVE IT FROM ITS LOCATION.</p>

7.1 MACHINE TRANSPORT

In order to safely perform all transport operations, the machine is set on a pallet whose dimension, together with the center position, is reported in the scheme below.

The following plate indicates the lifting points:



In this drawing the machine center position is reported:

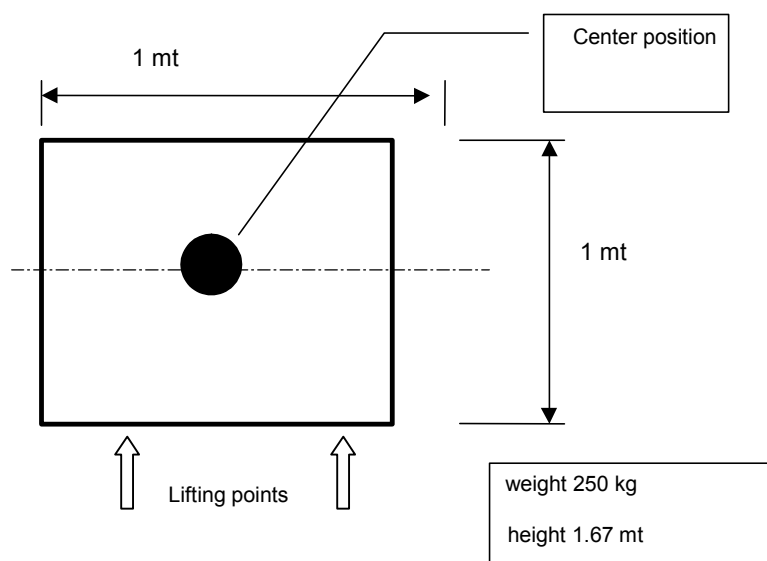


Fig. 8.1

7.2 STORING CONDITIONS

If a certain amount of time will pass between the transportation and the installation of the XDM30, the machine has to be stored following the following conditions and leaving it in the original packaging:

- **Temperature while not working 0°C ÷ +50°C**
- **Humidity lower than 80% and without condensation**

8 INSTALLATION



WARNING !!! The installation of the AIX10 requires a deep knowledge of the machine and therefore it has to be carried out by specifically trained personnel only.

8.1 WORKING AREA

The Picture below shows the minimum area dimensions required to correctly work with the AIX10 and to keep it in good functioning conditions.

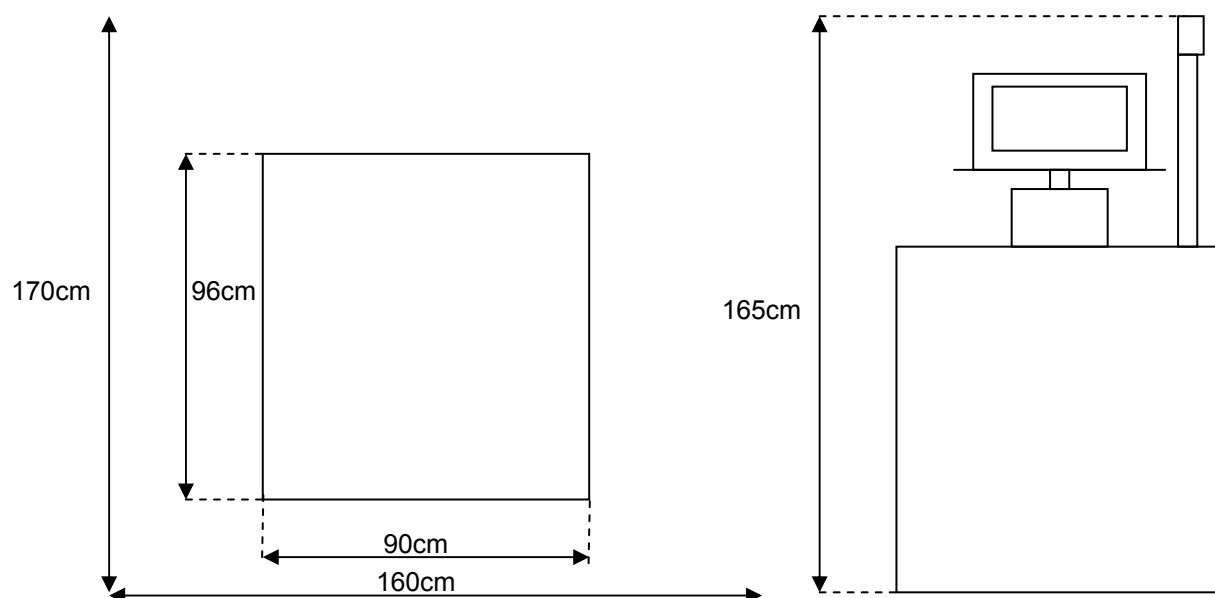


Fig. 8.1

8.2 WORKING CONDITIONS

The section below list working conditions needed in terms of factory's installations and environment.

ENVIROMENT CONDITIONS

- *Temperature while working* : +15 °C ÷ + 35 °C
- *Temperature while not working* : 0 °C ÷ + 50 °C
- *Humidity* : lower than 70% and without condensation

Do not install the machine in dusty environment.

8.3 PREPARING THE MACHINE

To prepare the machine, first prepare an appropriate area as indicated in previous paragraph.

Step sequence is the following:

- REMOVE THE MACHINE FROM PALLET AND PACKAGING
- PLACE THE MACHINE IN THE CHOSEN AREA
- BE SURE THAT THE MACHINE IS HORIZONTAL
- MOUNT THE SUPPORT HARM FOR THE MONITOR AND PLACE CABLES
- INSTALL THE LCD MONITOR
- CONNECT IT TO THE POWER SUPPLY


8.3.1 HORIZONTAL POSITIONING OF THE MACHINE

8.3.1.1 HORIZONTAL POSITIONING OF THE MACHINE	
Steps	Description
1	Adjust the four anti vibrating feet
2	Tighten the locking nuts on the feet.

8.3.2 CONNECTION TO THE POWER SUPPLY

The machine connection to the power supply can be done simply connecting the power supply cable to a 230V grounded plug.

Set the connection using all protections needed for a maximum load of 1 kW.

	<p>WARNING!! An improper grounding procedure might expose people to the risk of electrical discharge. Ask qualified personnel to check the grounding method used.</p>
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9 MACHINE USE

Here below all main operative steps are listed:

- SWITCH ON (AND OFF) THE MACHINE
- SET UP X-RAY DEVICES
- X-RAY SOURCE PRE-HEATING
- INSPECTION

When the upper red light is on, it means that the x-ray is on

9.1 SWITCHING ON AND OFF THE MACHINE

To switch on the machine, press the [ON] button located in the machine's back. The red light on means that the machine is connected and the power supply is working. Afterwards turn on the start key in the front panel.

Before switching off the machine execute the function <END> from the application program (see Software manual) and wait for the computer to turn off. Afterwards turn anticlockwise the start key.



WARNING !!! To avoid functioning errors switch off the machine only after stopping the job selecting the software option <END> from the main menu.

9.2 X-RAY SOURCE PRE-HEATING

After the machine and the x-ray source are switched on, this last one needs 1 or 2 seconds of pre-heating. The operation comes in automatic.

9.3 X-RAY TENSION AND CURRENT ADJUSTMENT

To perform an optimal inspection it is necessary to adjust the x-ray source current μA and tension kV . The needed values depend on the kind of circuit and on the distance between x-ray source and x-ray camera. To adjust these parameters, turn the apposite knobs on the main control mask located on the machine's front side.

9.4 INSPECTION

After all adjustments have been made, it is possible to start the inspection.

INSPECTION PROCEDURE		
1	Be sure that x-ray source is switched off	
2	Insert the circuit that has to be inspected under the camera (inserting it inside the proper window)	
3	Switch on the x-ray source using the starting key	
4	Set the camera in "Live" status using the appropriate button	
5	Adjust the x-ray source current μA and tension kV .	
6	Move manually the circuit to search for areas to be inspected and measured	



7	Adjust brightness and contrast levels	
8	Execute measuring steps	
9	Check results on monitor	

Other operative steps

The AIX10 gives also the following options:

- Save and recall images previously saved
- Use filters to improve image vision.

9.5 SAFETY AND PROTECTION RULES

Main safety and protection rules concerning the machine's use (extracted from the technical report on the PHYSICAL SURVEILLANCE ON IONIZING RADIATION PROTECTION), are listed below:

- 1 The x-ray inspection is allowed in the case it is not possible to use alternative way of inspection able to give same information on the circuit status
- 2 The use of the system is allowed only to authorized personnel.
- 3 Before switching on the x-ray be sure of the correct set up of radiation data
- 4 Limit operations to a strictly needed number.
- 5 Pregnant women operating on the system must communicate their condition as soon as they know it.
- 6 Any situation which involves a serious and immediate danger must communicated immediately to the Responsible Qualified Expert.
- 7 Once the inspection is ended, the x-ray emission must be stopped.





10 IMPACT ON THE ENVIRONMENT

The AIX 10 has a minimum impact on the environment. Main information is listed below:

- **Dust pollution:**
none.
- **Oil pollution:**
none.
- **Acoustic pollution:**
none.
- **Heating pollution:**
This machine doesn't use heating sources.
The average consumption is less than 1 KW.
- **X-ray emissions:**
Aix 10 uses x-ray.
The best equipment and devices have been used to reduce to minimum x-ray emissions to the environment. Furthermore, an extremely efficient shielding system have been designed, realized and mounted to assure maximum safety for operators

11 PREVENTIVE MAINTENANCE

	<p>WARNING!! All maintenance operations have to be performed while the machine is shut down and not connected to the power supply.</p>
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	<p>WARNING!! All maintenance operations have to be performed by specifically trained and authorized personnel only</p>
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In order to keep the machine in a good state it is advisable to follow a preventive maintenance program.

11.1 ELECTRIC SYSTEM MAINTANANCE

ACTION	FREQUENCY
Check the grounding connections.	Monthly
Check the fuses status on the electrical panel	Monthly

11.2 X-RAY DEVICES MAINTANANCE

Both cameras and x-ray sources do not need maintenance.

12 MAINTENANCE AND FAILURES SEARCH



WARNING!! The fault searching procedure requires a machine deep knowledge, therefore has to be carried out by specifically trained personnel only.



WARNING!!! If any problem persists call the Technical Assistance Service.

In case of faulty situation on the machine, in order to restore the normal working conditions as soon as possible, it is important to hold on the following prescriptions avoiding any further or possible damage.

If no evident mechanical damages can be seen it is possible to start with the fault searching.

Failures may belong to one of the following three categories:

- **ELECTRICAL**
- **MECHANICAL**
- **SOFTWARE ERRORS**



WARNING!!! Any operation on the machine for which it is necessary to act in the inside of the machine, needs to remove external panels. Before doing so it is mandatory to disconnect the machine from the power supply. Furthermore, if x-ray is on while the panels are not at their place (removed), this would expose the operator to emissions dangerous for their health. When maintenance operation is finished mount back exactly in the same way has been founded any panel previously removed using all screws available

12.1 ELECTRICAL FAILURES

1 None of the system lights is on.

- Check that the general interrupter is on
- Check that the power supply cable is connected.
- Check that the power supply corresponds to 230V AC 50Hz.
- Check fuses in the electric panel.

2 The computer doesn't start

- Check that the power supply cables are properly connected
- Check that the video signal wire is properly connected.
- For any other kind of errors refer to the PC's user manual.

3 There is no image on the monitor

- If there is no image on the monitor, it could be due to software problems, x-ray camera problems or x-ray emissions absence.
- If there is a problem with the camera, a red cross should be displayed on the part of the video dedicated to images.
- Check that the system is in Live mode
- Check that the camera is 12V power supplied.



Check the cable connected to the frame grabber
Check fuses on the x-ray power supply

12.2 MECHANICAL FAILURES

1 Mechanical failures are easily detected

If there are evident breaks, broken parts should be replaced

If there is components misalignment or misplacement the original situation should be restored.

These misalignment are evident if one axis movement tends to block when it is close to extremities

12.3 SOFTWARE ERRORS CONDITIONS

Di seguito vengono riportati gli errori gestiti dal software con le possibili cause e rimedi.

N. ERR.	PROBLEM	CHECK
125	Image not loadable !	Check that the image file exists and that the memory support is not damaged.
126	Impossible to save file of image !	Check that the memory support is not damaged or full.



WARNING !!! If problems continue, please call Piergiacomini Technical Service

13 TECHNICAL FEATURES

MACHINE TECHNICAL FEATURES		
Maximum panel dimensions	There are no limits to the movement along the x axis. Y AXIS 800	mm
Circuit thickness	From 1 to 8	mm
LCD Monitor	17	"

X-RAY DEVICES FEATURES		
Front window in shielding material	100 x 120	mm.
X-ray tube tension	60	kV.
X-ray tube current	1.3	mA.
View area	1.3	"
CCD camera	Ø 25mm or 8.4x6.3 mm	
Resolution	9,6 pair of lines/mm.	
Safety	<1	uSvh

GENERAL FEATURES		
Dimensions	96 x 90 x 154	cm.
Functioning temperature	+15°C ÷ +35°C	
Not functioning temperature	0°C ÷ +50°C	
Humidity	< 70% e senza condensa	
Power supply	230V ac 50Hz	
Power consumption	1kW	
Marchio	CE	

IMPORTANT NOTICE

Piergiacomini Robotics would like to thank in advance all users that will point out defects or send us advises in order to help us to improve working and safety features of the AIX10.

