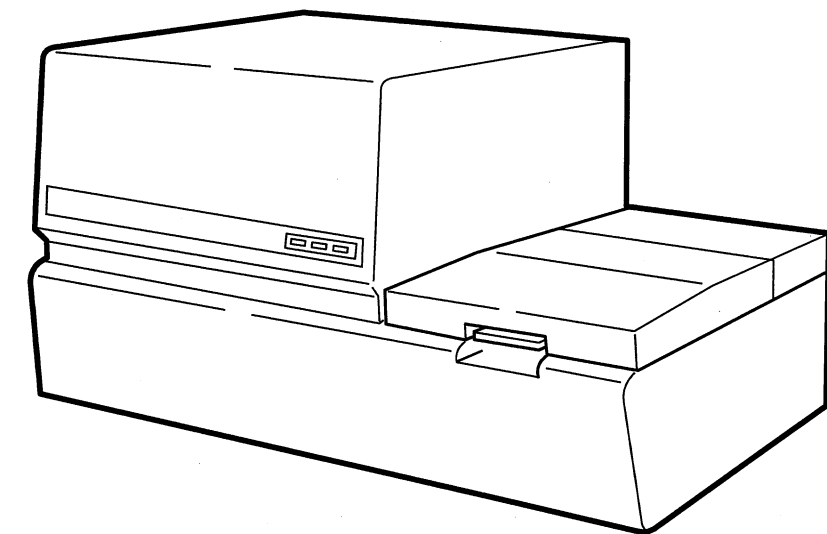


BIO-IMAGING ANALYZER
BAS-1800II
Operation Manual



Read this first:

Thank you for purchasing the FUJIFILM BAS-1800II.

The FUJIFILM BAS-1800II is a bio-imaging analyzer for conducting auto-radiography with an Imaging Plate (IP). Compared to systems using X-ray film, this system permits visualization of electrophoresis in a much shorter time. It is also possible to quantify the radioactivity of the image that has been recorded on an IP.

- This operation manual describes the operation methods, usage precautions and basic technical information for the FUJIFILM bio-imaging analyzer BAS-1800II.
- Please read this manual thoroughly so that you will be able to utilize the BAS-1800II system to the utmost and bring out its full performance.
- Please keep this manual, as you may need to refer to it.

NOTES

- 1) Reproduction of parts or all of the contents of this manual without permission is prohibited.
- 2) The contents of this manual are subject to change without notice.
- 3) This manual has been prepared with utmost care. However, if you have any questions or find errors, omissions, etc., please contact us.
- 4) We will not be liable for any effects incurred from the use of this device.

Copyright Reserved

<Reprints and/or reproduction of parts or all of this manual is prohibited.>

Copyright© 1999 by Fuji Photo Film Co., Ltd.

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without the prior written permission of Fuji Photo Film Co., Ltd. Equipment Product Division, Science Systems.

This equipment cannot be taken to or used in a country or area where power supply specifications differ from those in the country or area where it was originally installed.

Japan

This device is in compliance with the VCCI standards established by the conference on self-imposed control of noise interference caused by information devices for the purpose of preventing interference in commercial and industrial areas caused by Class 1 information devices (information devices to be used in commercial and industrial areas).

If this device is used in residential areas adjacent to them, it may cause radio disturbance.

This device must be handled correctly in accordance with this operation manual.

United States of America

This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instructions manual, may cause interference with radio communications.

It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment.

Operation of this equipment in a residential area is likely to cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

Canada

This digital apparatus does not exceed the Class A limits for radio noise emission from digital apparatus as set out in the radio interference regulations of the Canadian Department of Communications.

“Le présent appareil numérique n’émet pas de bruits radioélectriques dépassant les limites applicable aux appareils numériques de la class A prescrites dans le Règlement sur le brouillage radioélectrique édicté par le ministère des Communications du Canada.”

Germany/Bundes Republik Deutschland

Geräusentwicklung des Geräts: weniger als 70 dB (A).

Part
1

Usage Precautions

This chapter describes items requiring special attention for safe use of the BAS-1800II. Some of the items described in this chapter may also appear in others. This chapter has been provided for the specific purpose of describing the general points to be noted when using the BAS-1800II.



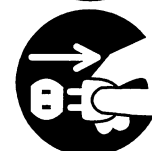
CAUTION

- Do not place on top of the BAS-1800II IP Reader vases, flowerpots, cups or other containers that have water in them. Also, do not place metal objects on top of the BAS-1800II IP Reader. If these items spill or end up inside the BAS-1800II IP Reader, fire and/or electric shock could result.
- Do not place heavy objects on top of the BAS-1800II IP Reader. If such objects are thrown off balance and fall down, injury could result.



WARNING

- To avoid possible fire and electric shock, do not alter the construction of the BAS-1800II IP Reader.
- In the event that a foreign object (such as metal, water or other fluid) enters the BAS-1800II IP Reader, turn off the power. Then, remove the plug from the electrical outlet and contact your sales dealer. If the machinery is used in this condition, fire or electric shock could result.



CAUTION

- If you plan on moving the BAS-1800II IP Reader, please contact your sales dealer first.
- When using the BAS-1800II IP Reader for prolonged periods, make sure to take a 10 to 15 min. break once an hour, for health-related reasons. Rest your eyes and your hands.



WARNING

- Use of controls of adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.



1. Grounding Safety

Reasons for Grounding

Electric and electronic equipment must be grounded, for the following reasons.

- 1 Grounding prevents metal parts of the equipment from being charged when equipment electric circuit insulation has deteriorated or been damaged.
- 2 It prevents electrostatic trouble from occurring when equipment housing is charged with static electricity.
- 3 It is a countermeasure to noise that may be generated when equipment housing potential equals that of the earth.
- 4 It prevents lightning-related trouble.

Grounding

Before use, the BAS-1800II IP Reader must be connected to the protective earth line of the indoor wiring.



WARNING

Make sure to connect the BAS-1800II IP Reader to the earth line.

If it is not connected and there is an electricity leak for some reason, fire and/or electric shock could result.

If it is not possible to connect the earth line, contact your sales dealer.



2. Laser Safety

Safety Regulations

The BAS-1800II IP Reader has safety features that comply with the laser radiation safety requirements of the U.S. Federal Regulations (21 CFR, Chapter 1, Subchapter J).

The BAS-1800II IP Reader also complies with the German IEC825 LASER KLASSE 1.

Laser Unit Specifications

Class	IIIb
Medium	Semi-conductor
Wavelength	635 nm
Maximum Output	6 mW (CW)

Caution on Exposure to Laser Beam

The BAS-1800II IP Reader incorporates one Class IIIb laser unit which delivers a maximum output of 6 mW. To avoid exposure to it's laser beam, observe the following precautions.

- No one should be allowed to uncover the equipment other than the "Lid" except a qualified service personnel.
- If any equipment malfunction occurs, contact a qualified service personnel immediately.



CAUTION : Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

Labels for Laser Safety Requirement

Certification and identification label attached on the BAS-1800II IP Reader.

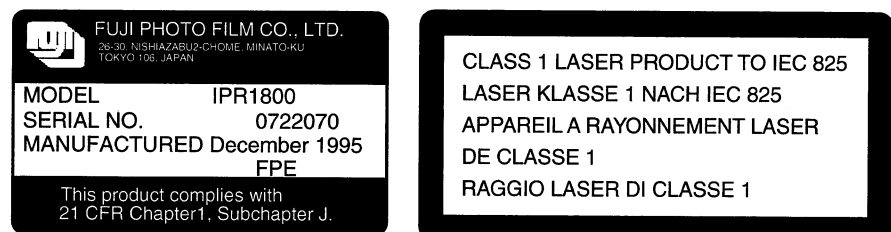


Fig. 1.1

IP Reader (Rear View)

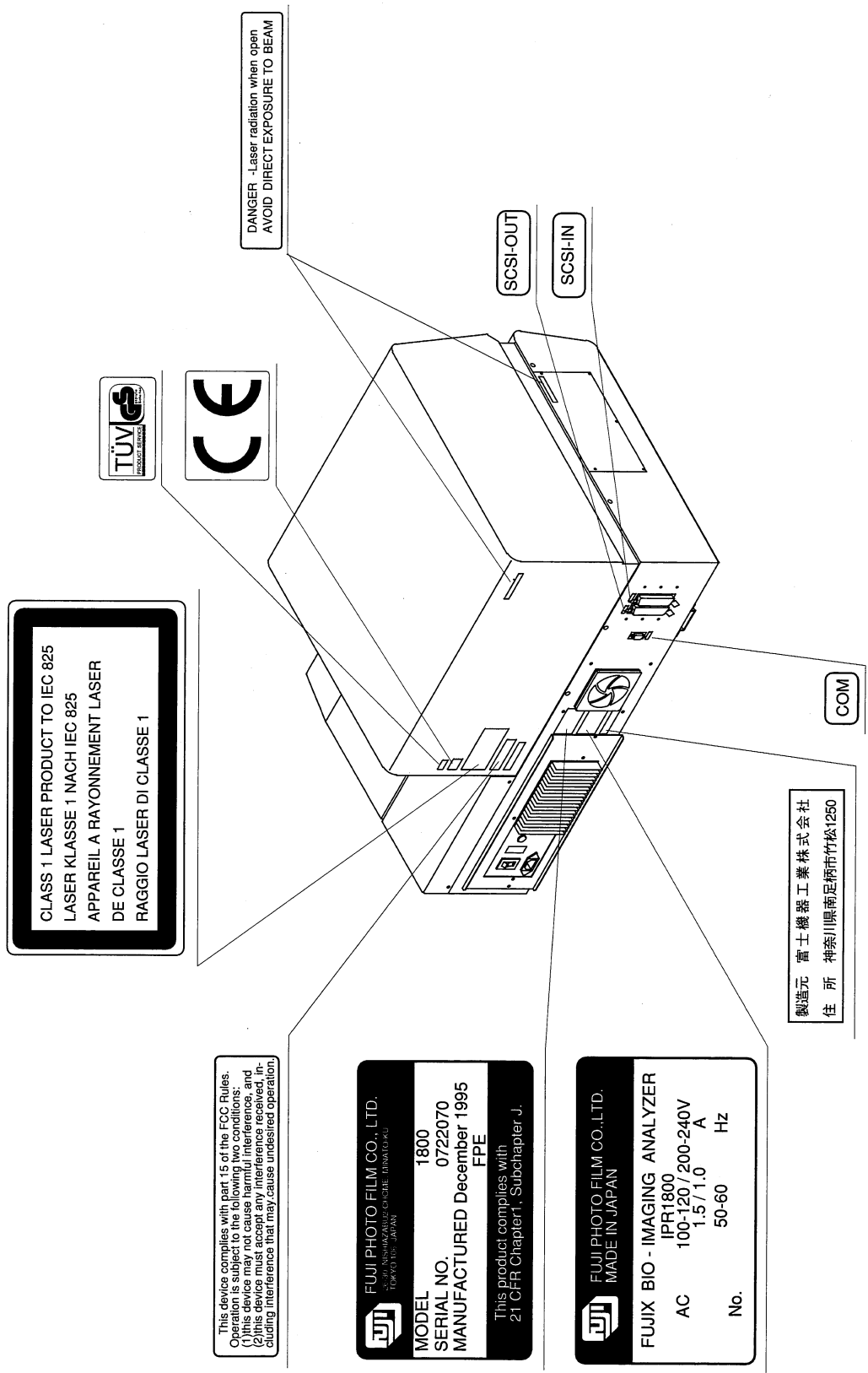
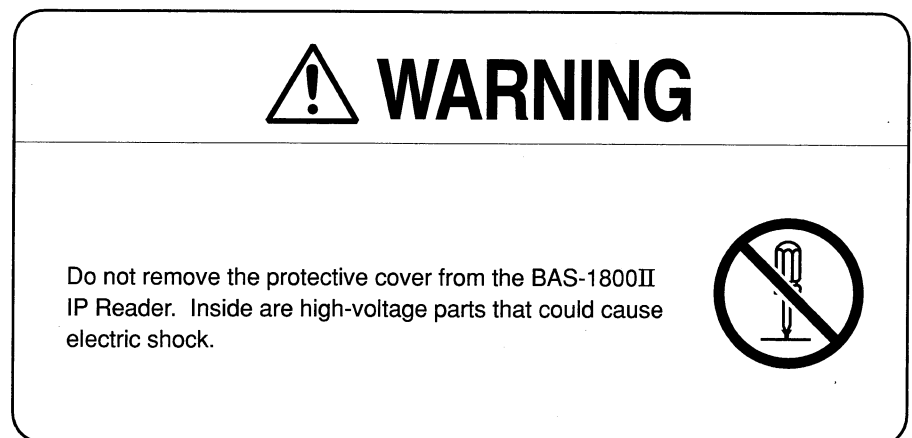


Fig. 1.2

3. Safety at High Voltages

The BAS-1800II IP Reader uses a high-tension power supply for the laser and photomultiplier tube (PMT).

However, the user will not run the risk of being exposed to this supply if the proper equipment operating procedures are observed (including during the time of user maintenance).



4. Various Regulations and Standard

The BAS-1800II IP Reader complies with each of the following regulations and standards.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:
(1) this device may not cause harmful interference, and
(2) this device must accept any interference received, including interference that may cause undesired operation.



This Class A digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.
Cet appareil numérique de la classe: A respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

Fig. 1.3

5. Safety from Radiation

CAUTION

If contamination by radioisotopes occurs, follow the instructions of personnel qualified to deal with radiation.



Related Overseas Radiation Regulations

The BAS-1800II IP Reader is neither loaded with radioisotopes nor equipped with a radiation-generating unit. Thus, none of the radiation regulations apply.

Contamination by Radioisotopes

The BAS-1800II IP Reader can read an IP for ^3H -labeled samples. In this case, the sample is exposed in direct contact with the IP surface. Thus, depending on sample condition, the IP surface may be contaminated by radioisotopes.

Such contamination varies widely with sample condition. Although it is thus extremely difficult to predict the degree of contamination, it is generally higher for wet samples than for dry.

As described in "Exposure Area of IP for ^3H -labeled samples," this area excludes the 15mm margin that runs along both the top and bottom and right and left of the phosphor surface. If exposure is done outside the proper region, radioisotope contamination may spread to the IP Reader and progress to the magazine. Equipment performance will not deteriorate even if the IP Reader is contaminated. However, it is very difficult to determine the degree of contamination that may eventually result to those sections of the unit, as mentioned above.

In der Bundesrepublik Deutschland ist die Strahlenschutzverordnung (StrlSchV) gültig. Nach §3 StrlSchV ist der Umgang mit radioaktiven Stoffen anzuzeigen, wenn nicht die in Anl. III StrlSchV genannten Kriterien für den genehmigungs- und anzeigefreien Umgang zutreffen. Eine Anzeigepflicht besteht z. B. nicht, wenn der Umgang sich auf weniger als 5 MBq Tritium bzw. eine Freigrenze gemäß Anl. IV StrlSchV beschränkt.

Nach §77 StrlSchV muß der Absender, wenn eine Ansammlung von über obiges Maß hinaus radioaktiv kontaminierten Präparaten möglich ist, sicherstellen, daß der Empfänger im Besitz einer Genehmigung ist bzw. Anzeige erstatten. Dadurch ist sichergestellt, daß eine Anlieferung unzulässig hoch radioaktiv kontaminierter Bildplatten ausgeschlossen ist.

Ist ein Umgang mit mehr als einer Freigrenze nicht ausgeschlossen, so besteht eine Anzeige- oder Genehmigungspflicht. In diesem Fall bestehen auch Grenzwerte für die Oberflächenkontamination, die in der Anl. IX StrlSchV genannt sind. Wir empfehlen die Aufstellung des Gerätes in einem Kontroll- oder Überwachungsbereich gemäß §58 oder §60 StrlSchV und regelmäßige Kontaminationskontrollen gemäß §64 StrlSchV.

6. Installation Site

Place of BAS-1800II Installation

As described previously, in autoradiography experiments done with the ^3H -labeled samples, the sample is exposed in direct contact with the IP surface for ^3H -labeled samples. Thus, depending on sample condition, the IP surface may be contaminated by radioisotopes.

Generally, the quantity of radioisotopes contained in a sample for creating an autoradiogram is quite small. However, the degree of IP surface contamination is greatly affected by sample dryness and radioisotope dose during the experiment. In some cases, IP surface contamination may exceed the limit specified in each country's regulations.

Furthermore, the inside of the IP Reader may be contaminated if the IP Reader reads a contaminated IP outside the exposure area. Degree of surface contamination varies widely with system operating conditions and may exceed the limit specified in each country's regulations.

For the aforementioned reasons, **the BAS-1800II IP Reader must be installed within a controlled area when ^3H -labeled samples are used.**

Transporting the BAS-1800II IP Reader Outside Controlled Areas

Before transporting outside controlled areas the BAS-1800II IP Reader and/or its accessories when they have been installed and used within such areas, confirm that surface contamination is below the limits specified in the regulations of the appropriate country.

CAUTION : Make sure to confirm the radiation regulations of the country in which the BAS-1800II IP Reader is used. Installation site must be considered in keeping with these regulations. Observe these regulations when transporting the BAS-1800II IP Reader outside controlled areas.

7. Contamination by Radioisotopes



CAUTION

If contamination by radioisotopes occurs, follow the instructions of personnel qualified to deal with radiation.



IP Contamination

The BAS-1800II system can read, an IP for ^3H -labeled samples. In this case, the sample is exposed in direct contact with the IP surface. Thus, depending on sample condition, IP surface (surface of the phosphor) may be contaminated. If the surface of the phosphor is contaminated by radioisotopes, it cannot be decontaminated. **The IP for ^3H -labeled samples must be disposed of after each use.**

An IP for ^3H -labeled samples contaminated by radioisotopes must be disposed of as incombustible radioactive waste.

Do not store IP for ^3H -labeled samples contaminated by radioisotopes together with clean IPs.

The general isotope-use IP (BAS-SR and the like) can be used repeatedly. It is therefore necessary to avoid contamination by radioisotopes. When samples labeled by radioisotopes are exposed with the general isotope-used IP, wrap the samples with SaranWrap™ or the like so that they do not come in direct contact with the IP surface.

If the general isotope-use IP surface is contaminated by radioisotopes, it will be difficult to completely decontaminate it. Thus, thorough care must be taken.

IP for ^3H -labeled Samples Exposure Area

When exposing a sample on the IP for ^3H -labeled samples, the exposure area (region of sample contact and exposure) must be the area calculated by excluding the 15mm margin that runs along both the top and bottom and right and left of the phosphor surface, as shown in Fig. 1.4.

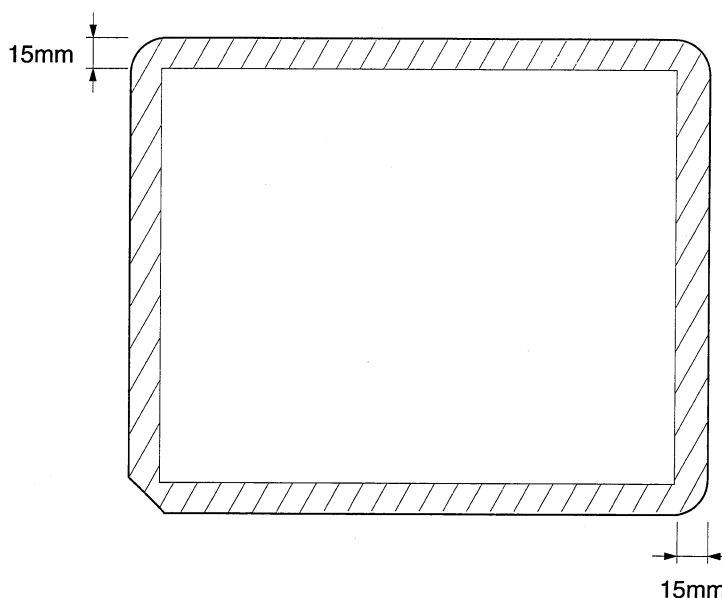


Fig. 1.4

IP Reader Contamination

If the sample is contacted and exposed outside this region, IP surface contamination may spread to the IP Reader and adhere to the IP conveyance path inside the IP Reader.

Radioisotope contamination adhering to the IP conveyance path may be transferred to other IPs during reading.

Thorough care must be taken so that contamination by radioisotopes does not ruin experiments.

As described in "IP for ^3H -labeled samples Exposure Area," the phosphor surface of the IP for ^3H -label samples may be contaminated by radioisotopes. If exposure is done outside the exposure area, contamination by radioisotopes may spread to the inside of the IP Reader (but will be limited to the IP conveyance path).

Equipment performance will not deteriorate even if the IP Reader is contaminated. However, correct operating procedures must be observed to prevent contamination by radioisotopes from spreading in the equipment.

Part **2**

System Overview

1. Features of the BAS-1800II

The FUJIFILM Bio-imaging Analyzer BAS-1800II applies Fuji Film Imaging Plate (IP) technology as a radioactive energy sensor to record images. The BAS-1800II is designed with compact size and ease of operation in mind. Because the IP can be used repeatedly by uniformly exposing it to the light and erasing images after they have been read using the IP Eraser, the cost is low. With this system, nucleic acid and protein analysis or metabolism studies, to name just a few of the possible applications, can be performed significantly faster than the conventional X-ray film methods allow.

The advantages of the BAS-1800II can be summarized as follows:

- Ultra-high resolution comparing to X-ray film image.
- Proprietary reusable imaging plate (excluding the IP for ^3H -labeled samples) featuring high sensitivity, wide dynamic range, excellent linearity and high resolution.
- High throughput (because the instrument is not occupied during exposure) and reading accomplished in under 3 min. and 30 sec.
- High resolution and sharpness compared with other filmless systems.
- Linearity superior to any similar system.
- Ease of installation and operation; no darkroom, film processor, chemicals or plumbing required.

2. System Overview

The BAS-1800II is composed of the following units:

1 BAS-1800II IP Reader (hereinafter, IP Reader)

The high-resolution IP Reader can scan the IP in less than 3 min. and 30 sec. and transfer the data to the Analyzing Unit for analysis.

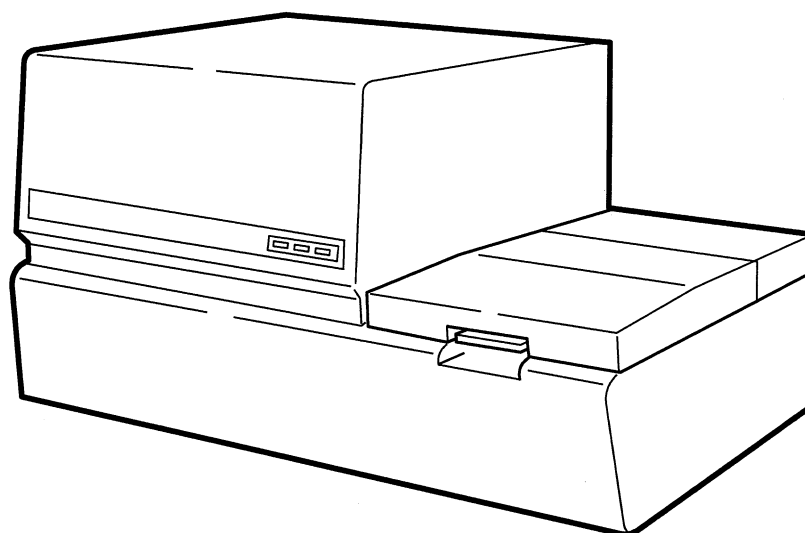


Fig. 2.1 IP Reader

2 Power Cable

The power cable is for the IP Reader.

3 FD Unique to the Machine No.

For each IP Reader, there is a floppy diskette to which the specific parameters for that particular IP Reader have been saved.

4 Active Terminator

SCSI Terminator

5 Imaging Plate (IP)

Fuji's Imaging Plate consists of a radiosensitive layer of phosphor crystals on a polyester backing plate. The unique design makes it reusable and easy to handle.

Exposing IPs evenly to the light within the IP Eraser will make it possible to reuse IPs repeatedly. (However, the IPs for ^3H -labeled samples are not reversible.)

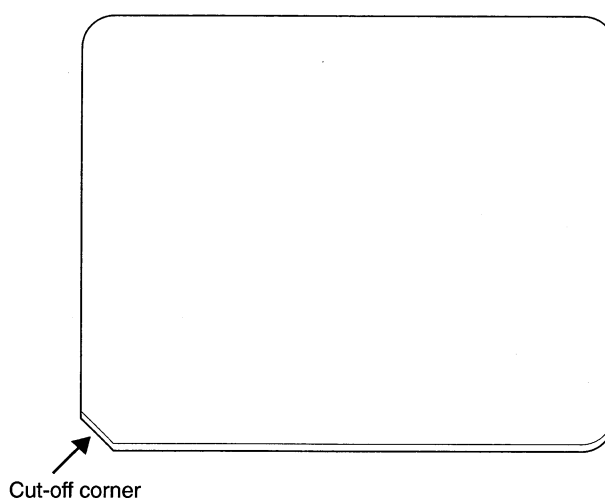
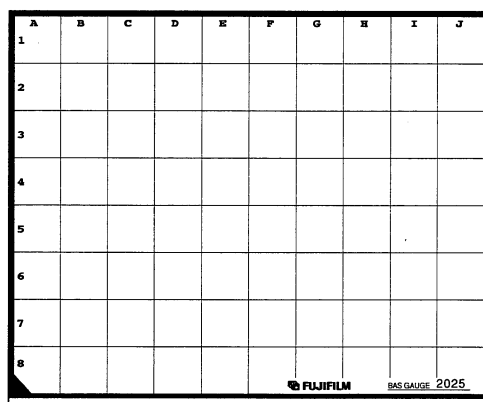


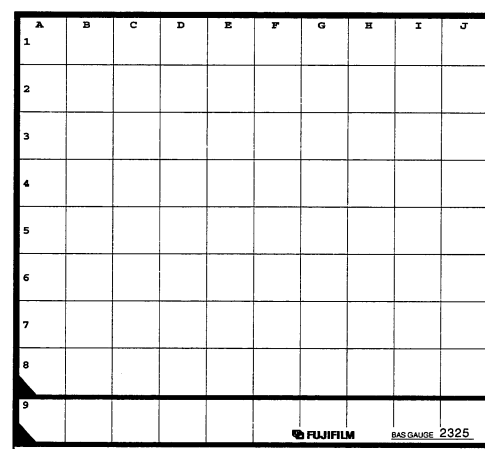
Fig. 2.2 IP

6 BAS Gauge

The BAS-1800II system can read not only the whole IP but also specified parts of it alone. The BAS Gauge is used for specifying which parts to read.



(for 20 × 25cm IP)



(for 23 × 25cm IP)

Fig. 2.3 BAS Gauge

7 BAS Cassette

The BAS cassette is used when an IP is exposed.

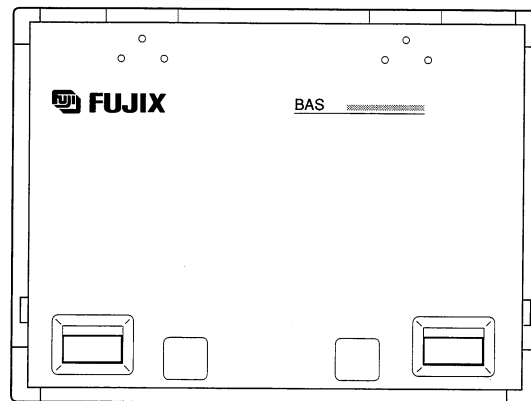


Fig. 2.4

8 Suction Pad

The suction pad is used to suction the IP inside the cassette to remove it from the cassette and transfer it to the IP Reader.

9 Operation Manual

This document.

10 The software for IP Reading (Image Reader for Macintosh / for Windows®)

3. Hardware

WARNING

Use only the indicated voltage.
Also, make sure not to have too many plugs in one outlet or fire and electric shock could result.



IP Reader

The IP Reader unit is used to read the image from the IP and transfer the data to the analyzing unit. Important parts of the unit are shown in the following three figures.

1 Power Switch

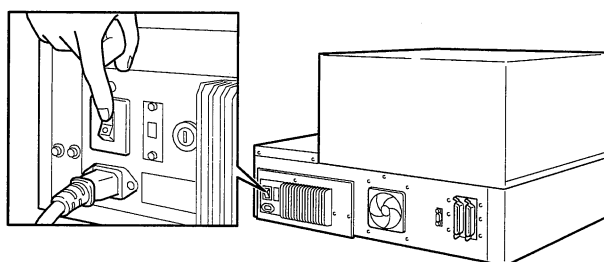


Fig. 2.5 IP Reader Power ON

2 IP Loading Section

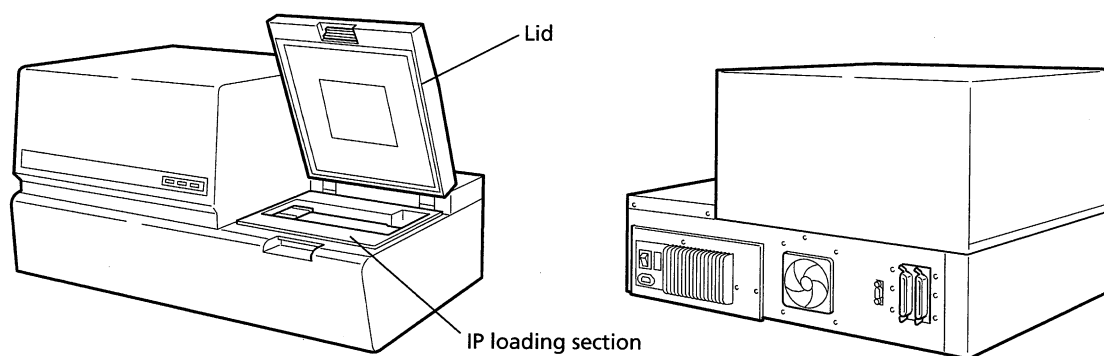


Fig. 2.6 IP Loading Section

3 Indicator Lamp

IP Reader condition and errors are indicated by combinations of ON/OFF/blink of these three indicator lamps.

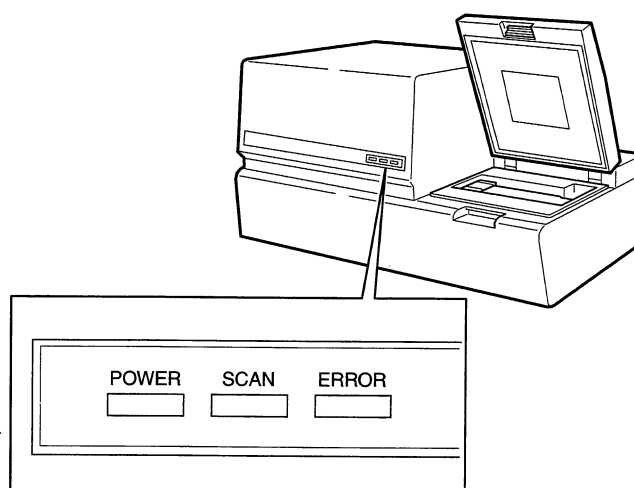


Fig. 2.7 Indicator Lamps

4 SCSI ID Selection Switch and PSL Adjustor

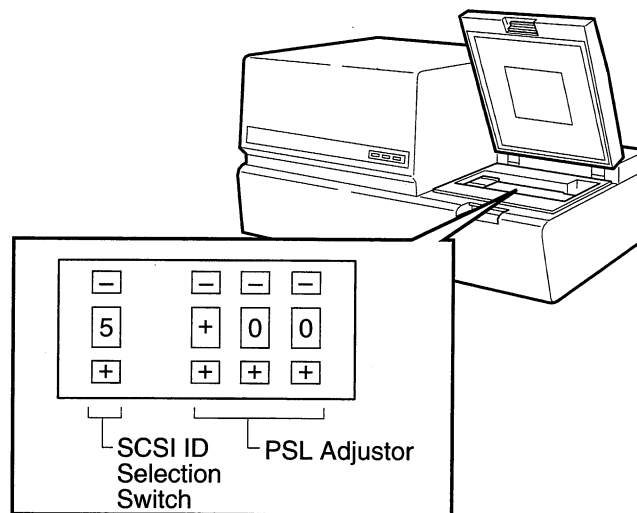


Fig. 2.8 ID Switch and PSL Adjustor

SCSI ID Switch:

Switches IP Reader SCSI ID.

Note 1:

When changing the SCSI ID, be sure to turn off the power of such peripheral devices as the IP Reader or analyzing unit.

Note 2:

Changing the SCSI ID may cause system malfunction if the change does not comply with the analyzing unit (computer) settings or duplicates those of the peripheral devices.

Note 3:

Do not select SCSI ID 8, 9.
Error will occur on the IP Reader.

PSL Adjustor:

Changes the PSL value of the image read by the IP Reader within the range of $\pm 10\%$.

This PSL Adjustor absorbs BAS series device differentials. For example, when a BAS-2000 system user uses the BAS-1800II IP Reader, PSL values obtained from the same sample may not be equal because of the IP or IP Reader differentials.

In such case, the PSL Adjustor can correct the device differentials with BAS-2000.

Be well informed of the above when using the PSL Adjustor.

PSL Adjustor is set at +00(%) at the factory.

Note 1:

Do not set the PSL Adjustor value over +11(%) or under -11(%). Error will occur in the IP Reader.

Note 2:

Be sure to turn OFF the IP Reader when changing the PSL Adjustor value. If the PSL Adjustor value is changed while the IP Reader is ON, the change will not take effect.

4. IP Reader Power ON/OFF

Power ON Sequence

Perform the following steps to turn IP Reader power ON.

Note:

Before turning power ON, open the lid and make sure there are no IPs remaining in the IP loading area. Then, close the lid.

1 IP Reader

Place the IP Reader power switch (located on the right-hand side of the rear panel) in the ON (I) position. (For a detailed diagram of the rear panel, see Fig. 2.5 on page 18.)

2 Once the power switch has been turned ON, the indicator lamps should change as shown next.

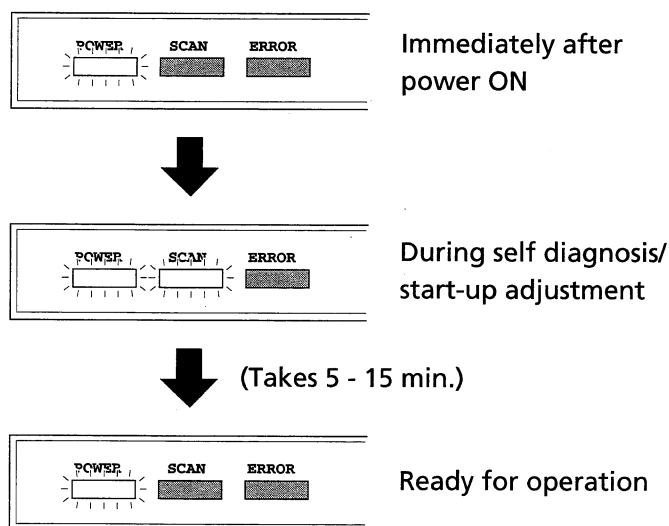


Fig. 2.9

Note:

It is possible that the IP Reader will not be ready for operation if the analyzing unit has not been turned OFF. Turn ON the power for the analyzing unit and the IP Reader at the same time.

Power OFF Sequence

Turn the power switch on the rear to the O side before reading the IP. (See Fig. 2.5 on page 18 to confirm the location of the power switch.)

Part **3**

IP Handling

1. IP Overview

The Fuji Imaging Plate (IP) is an innovative, memory-type, two-dimensional sensor of radioactive energy. The IP consists of an image-sensing layer composed of fine photostimulable phosphor crystals (BaFBr:Eu^{2+}) bonded to a special backing material.

The general isotope-use IP can be used repeatedly after recorded image data have been erased. However, the tritium-dedicated IP should be disposed of.

IP type is distinguishable by the package or the back label.

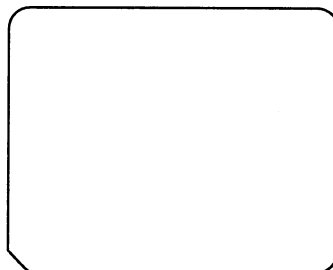
- **Exposure**
When exposed, the IP accumulates and stores the irradiated radioactive energy. Exposure of the IP is accomplished by close contact with a radioisotope-labeled sample in a cassette, similar to the conventional X-ray film methods.
- **Reading**
When the exposed IP is inserted into the IP Reader and then scanned with a semi-conductor laser beam, it emits luminescence in proportion to the recorded radiation intensity. This luminescence is detected by a photomultiplier tube (PMT) and converted into electrical signals. Image data are recorded as digital values on the hard disk inside the analyzing unit for further analysis. The image recorded on the IP is read as high-resolution digital data at up to 50 μm per pixel (20 pixels/mm).
- **Erasing**
After being scanned by the IP Reader, by erasing all the image data recorded on the IP, the general isotope-use IP can be re-used.

2. IP Sensitive-Surface Identification

The imaging plate's sensitive surface can be easily identified by its all-blue-white or all-white appearance. The sample should be placed on this surface. The backing side is black.

IP Sensitive Side:

All-blue-white or all-white



IP Backing Side: Black



Fig. 3.1 IP Surfaces

3. IP Routine Handling

- **Handling the IP**
To maintain the quality of the IP, wear gloves when handling the IP. Take care not to bend, scratch, or soil the IP. Also avoid allowing dust to build up on the IP.
- **Cleaning the IP**
For the general isotope-use IP:
We recommend that you use a dry non-woven cotton cloth, gauze or eyeglass cleaner to clean the IP. To clean dirt that is hard to remove, use either of these cleaning materials slightly dampened with ethanol anhydride (1st-grade or superior). Because ethanol anhydride stored under poor conditions may change IP yellowish, be sure to use ethanol anhydride packed in a brown reagent bottle or observe the usage instructions specified by the maker.

CAUTION :

For the IP for ^3H -labeled samples:

Never wipe dust off. Use an air blower and carefully blow any dust off.

- **Environment**
Keep the IP away from direct sunlight. Do not position the IP in places where large amounts of ultraviolet or radioactive rays exist. Also avoid high temperatures and high humidity.
- **Storage**
To avoid curling and possible jamming in the IP Reader, the IP should be stored horizontally. As a general rule, an IP should not be used if when placed on a flat surface one end curls up more than 4mm above it.

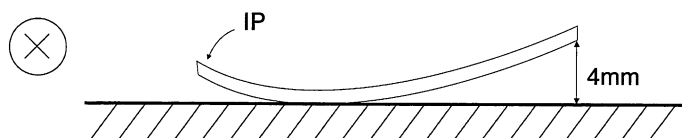


Fig. 3.2

To maintain dry conditions, a desiccator should be used if the IP is to be stored for a long period of time.

Do not take the IP for ^3H -labeled samples out of the bag when storing it. IP performance may be deteriorated by moisture in the air.

Warning

IPs may be deteriorated by water. Make sure not to get them wet.

The IP may curl if it comes in contact with certain organic solvents. Assume that samples containing organic solvents will have come in contact with the IP inside the cassette. As organic solvents are generally flammable, if a sample was wrapped with wrapping film, for example, expect that the vapor from it will have filled the interior of the cassette. In keeping, make sure that the thin-layer chromatography plate has been fully dried before it comes in contact with the IP.

- Examples of solvents that have a high possibility of causing curling : Dichloromethane, chloroform, acetone, acetic acid and its derivatives

4. Precautions Prior to Exposure

Items Necessary for Exposure

To expose an IP, you will need the following items:

- IP
- BAS cassette
- BAS Gauge
- Sample labeled with radioisotopes
- Gloves (to be worn while handling the IP)
- SaranWrap™ or a similar wrapping film (to wrap the sample)
- Kimwipe® and ethanol (to wipe clean the IP and cassette interior)

Suggested Lighting Conditions

Conventional X-ray film is very sensitive to visible light. Although the IP has over 100 times the sensitivity to radioactivity of the conventional X-ray film, handling of the IP prior to exposure and after reading may be done under normal room light conditions. However, between the time the IP is removed from the cassette after exposure and loaded into the IP Reader, subdued lighting should be used to avoid erasing the image on the IP .

- Subdued Lighting
Subdued lighting means that if the working room has outside windows, the curtains should be drawn and the main overhead lights turned off. An illumination level of 20 lux or less is sufficient for most common measurements.

Table 3-1 Suggested Lighting Conditions

IP Procedure	Suggested Lighting
IP handling prior to exposure	No special considerations.
Loading IP and sample into cassette	No special considerations.
During IP exposure	IP should be placed in cassette or other light-tight container.
After IP exposure and when transferring IP from cassette to IP Reader	Subdued light, i.e., less than 20 lux.
IP handling after removal from IP Reader	No special considerations.

**Exposure Time
Calculation**

To achieve optimum results, in general the IP should be read as soon as possible after exposure. Therefore, it is best for exposure to be timed so that it ends immediately prior to IP scanning.

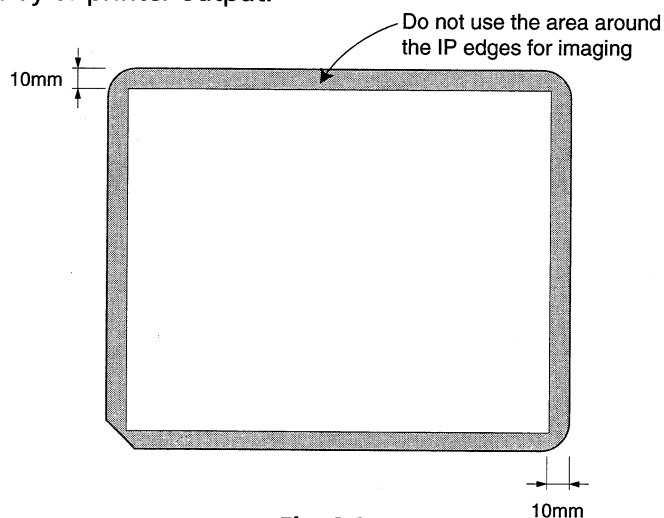
The usual recommended exposure time is one-twentieth of X-ray film exposure time.

**IP, Cassette and
BAS Gauge Cleaning**

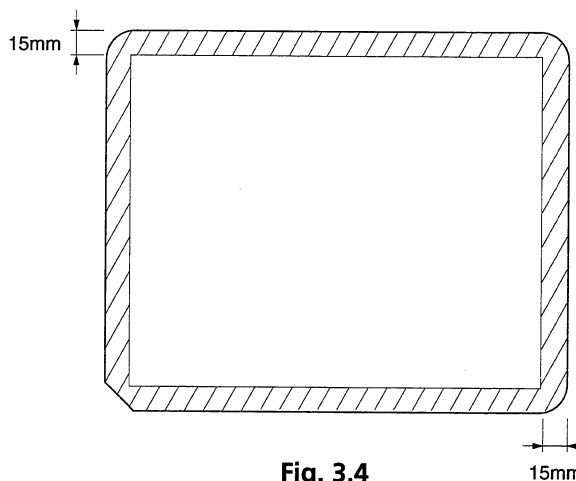
Prior to exposure, be sure to use a Kimwipe® or lintfree tissue and wipe clean the surface of the IP, the cassette interior, and the both sides of BAS Gauge.

Cautions

- 1 Before making any exposures, be sure to erase the IP.
(Erase any noise from radioactive rays.)
- 2 For best results, IP reading should be conducted promptly after completion of exposure.
- 3 The IP is very sensitive to small amounts of radioactive rays. To maintain a low background image on the IP, avoid placing the IP near strong background radiation sources, such as concrete block walls, during exposure.
- 4 Do not use the space at the extreme outer edges of the IP for image recording, as a border of approximately 10mm will not be shown on the display or printer output.

**Fig. 3.3**

- 5 Never use the space at the extreme outer edges of the IP for ^3H -labeled samples (shown in the figure below) for conducting ^3H -labeled sample contact exposure.

**Fig. 3.4**

5. IP Erasure

It is necessary to erase the IP before it can be exposed.

Note:

If the IP was overexposed the last time, the stored image may not have been completely erased. In this case, read the IP again to confirm that the previous image has been completely erased.

■ Using the IP Eraser

Refer to "IP Eraser Operation Manual" for detailed usage.

When the IP Eraser is used, satisfactory erasure can be done in 14 min., provided that the IP has not been overexposed.

For usage procedure, refer to the accompanying IP Eraser Manual.

■ Using the BAS Filter

IP erasure is possible by placing the dedicated BAS filter on the IP to cut off the ultraviolet rays, using the light source such as the view box. Because the IP erasure level will depend on the amount of the light source, determine the appropriate erasure time before using the BAS filter.

Part
4

IP Exposure and Reading

1. IP Exposure

Items to be prepared:

- Sample
- SaranWrap™
- BAS Cassette
- BAS Gauge
- IP

IP exposure procedure is as follows.

- 1 Wrap the sample in SaranWrap™ or like material.
(Do not wrap samples labeled with ^3H . However, be careful not to contaminate the inside of the cassette.)

Note:

Smooth out any wrinkles in the SaranWrap™ or like film to ensure close contact with the IP.

- 2 Set the BAS Gauge in the cassette, referring to the following illustration.

Note:

Pay attention to the direction in which the BAS Gauge faces. Without the BAS Gauge, the IP partial reading cannot be done.

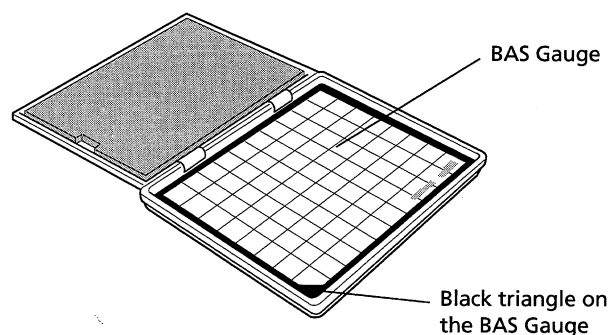


Fig. 4.1

- 3 Place the sample on the BAS Gauge set inside the cassette.
Jot down the area where the sample covers on the BAS Gauge (ex. from B2 to G6, etc.).
This area will be used in procedure 1) in "2. IP Reading, 3 IP Reading."

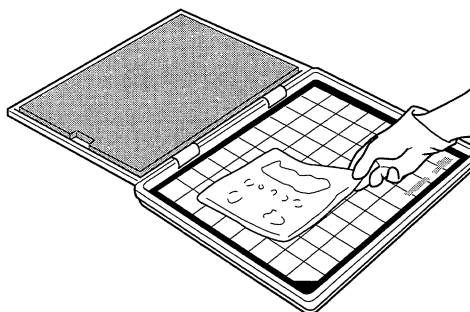


Fig. 4.2

User Tip:

When the sample is smaller than IP, place the sample on the A side of the BAS Gauge (left side in the above illustration) and expose it. Partial reading will shorten the reading time.

- 4 Referring to the following illustration, set the IP in the cassette so that the IP's sensitive side and the sample meet and the IP's cut-off corner and the black triangle of the BAS Gauge meet.

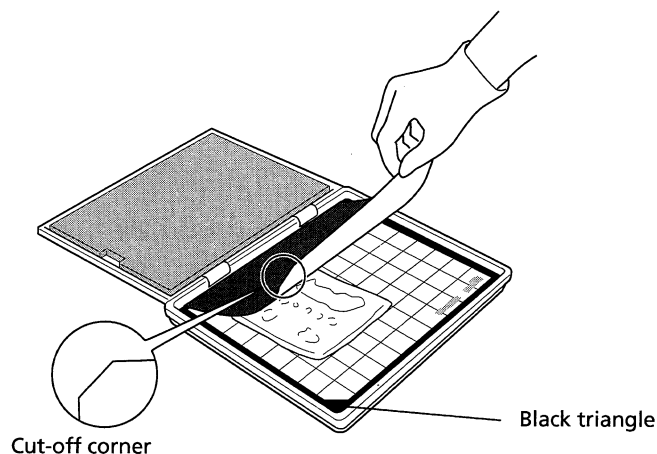


Fig. 4.3

- 5 Ensure that the IP and sample are properly housed within the cassette.
- 6 Close the cassette cover to start exposure.
(Close the cover firmly until you hear a click.)

CAUTION :

- 1 Be careful not to shut the edge of the IP in the cover of the cassette when closing.
- 2 Take care to avoid impact during exposure that would displace the sample and IP.
- 3 Be sure that the cassette is kept away from places where large amounts of background radioactivity exist during IP exposure. (This precaution should be observed to keep IP background noise low.)

Warning

After exposure, it is important to keep the IP away from light until after it has been read by the IP Reader. If the IP is subjected to light before being scanned, the image data will be erased.

- 7 After exposure is completed, open the cassette under subdued lighting (described on page 26) and take out the sample.

The IP should be read by the IP Reader as soon as possible. If reading cannot take place immediately, the IP should be kept in the cassette with the cassette cover closed until it is time to proceed.

2. IP Reading

To read IPs with the BAS-1800II IP Reader, an analyzing unit (computer) is necessary that is connected to the BAS-1800II via SCSI interface and to which the software for each BAS-1800II IP Reader has been installed.

- 1 Turn the IP Reader and each analyzing unit ON, and then start up the software for IP reading.
Refer to the manual for the analyzing unit you are using for the procedure for starting up the analyzing unit.
- 2 Set the IP in the IP Reader
 - 1) Dim the lighting of the room in which the IP Reader is located.
 - 2) Confirm that the indicator lamps on the IP Reader are as follows.

Only the POWER lamp is lit.

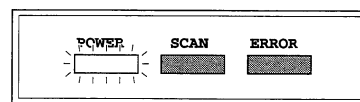


Fig. 4.4

- 3) Open the lid of the IP Reader upward and confirm that the previous IP is not still inside.
- 4) Remove the IP from the cassette using the suction pad and set the IP in the IP loading section, referring to the following illustration. Be careful with the IP orientation.
For the 20×25cm IP, set it in the IP loading section while pressing it toward you (to the front).

Note:

Refrain from touching the exposed surface of the IP, as much as possible.

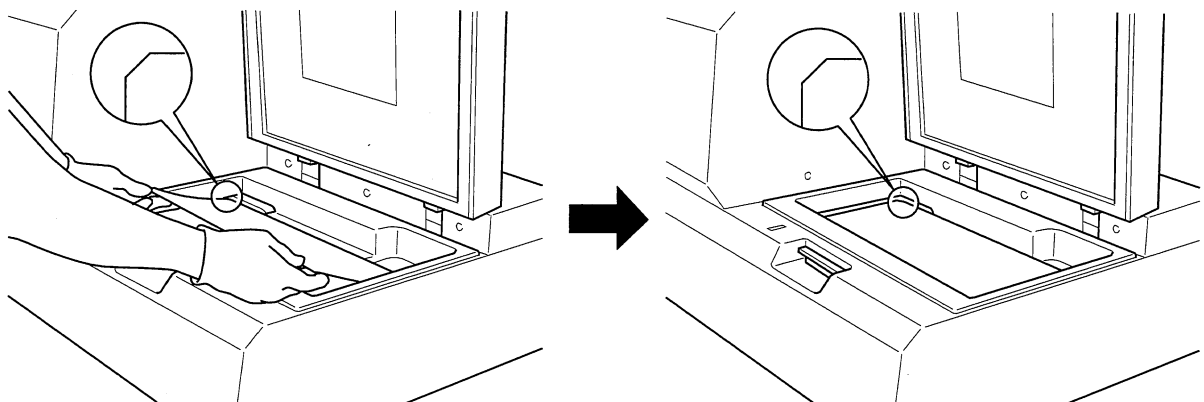


Fig. 4.5

- 5) Confirm that the sample has not adhered to the IP and then close the lid.

Note:

Only one IP can be inserted. If two or more IPs are inserted and reading is started, severe damage may result.

Note:

If the IP reading is done with the sample adhering to the IP, the IP Reader will incur severe damage.

The process from inserting the IP to closing the lid should be done quickly.

- 6) Confirm that the indicator lamps on the IP Reader are as follows.

Only the POWER lamp is lit.

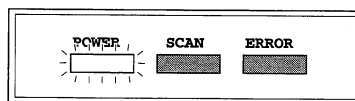


Fig. 4.6

If the lid is not closed correctly, the SCAN lamp will blink. In this case, close the lid tightly.

- 7) After the lid has been closed, room lighting may be restored to normal.

Usage Precaution

When reading a 20×25cm IP, make sure to set it in the IP Reader while pressing it toward you (to the front). Pixels will be read from the side that faces you (from the front) to the bottom, allowing an area 20cm from the front to be converted to image data.

3 IP Reading

After the IP has been set, the operation procedure at the analyzing unit will differ according to the type of analyzing unit.

For details, refer to the manual for the IP Reader software that corresponds to the analyzing unit you are using.

- 1) Start up the software for the IP Reader and then specify the image file name, reading sensitivity, gradation, resolution, latitude and reading area.

User Tip:

When you specify the reading area, use the area that you jotted down in step 3 of "1. IP Exposure."

- 2) Give the IP reading command from the analyzing unit, software for the IP Reader.
- 3) Wait about 3 min. and 30 sec., maximum, until IP reading is completed.

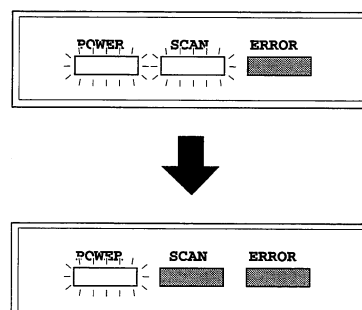


Fig. 4.7

Note:

1. During reading, DO NOT open the lid.
 - If the lid is opened and then closed again within approximately 1 sec., reading will be continued but the image quality and quantification characteristics of the obtained image data cannot be guaranteed.
 - If the lid is left open for more than 1 sec., reading will be interrupted and the IP returned to the IP loading section. In this case, depending on the type of analyzing unit, image data for the read portion can be obtained but the image quality and quantification characteristics cannot be guaranteed.
2. During reading, never subject the IP Reader to vibration by touching it or the like. Doing so could cause lines to appear on the image.
3. Image data cannot be captured entirely if background processing, such as network communication, etc., occurs in the analyzing unit while image data is being read. In this case, connecting an optional image buffer unit (IB-200) will make it possible to cope with computer networking.

When IP reading is completed, make sure to remove the IP and close the lid.

Part **5**

Troubleshooting



WARNING

Do not remove the protective cover that is retained by screws inside the BAS-1800II IP Reader. Doing so will create the danger of exposure to hazardous laser radiation.



WARNING

- Do not remove the protective cover from the BAS-1800II IP Reader. Inside are high-voltage parts that could cause electric shock.
- To avoid possible fire and electric shock, do not alter the construction of the BAS-1800II IP Reader.



WARNING

- In the unlikely event that the BAS-1800II IP Reader generates heat, smoke, strange odors, etc., and use is continued in this condition, fire and/or electric shock could result.
Turn OFF the power immediately and then pull the plug out of the electrical outlet.
- In the event that a foreign object (such as metal, water or other fluid) enter the BAS-1800II IP Reader, turn OFF the power. Then, remove the plug from the electrical outlet and contact your sales dealer.
If the machinery is used in this condition, fire or electric shock could result.



When the Trouble Occurs

When any trouble occurs with the IP Reader, the indicator lamp will change to one of following (warning or error).

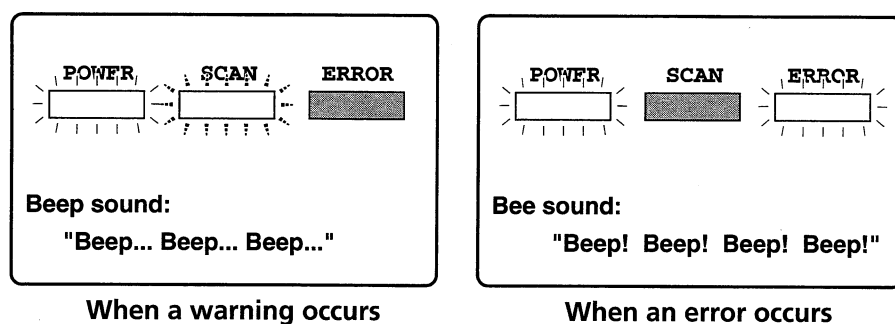


Fig. 5.1 Trouble

■ When a Warning Occurs

This is not a fatal error. The user can remedy the trouble very easily.

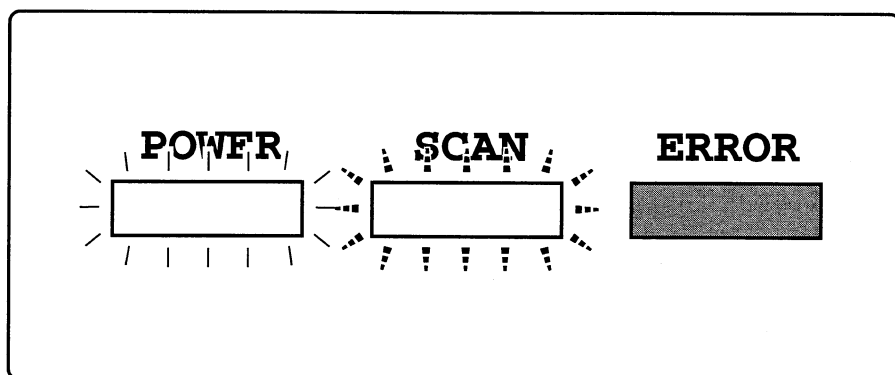


Fig. 5.2 Warning

Probable Cause and Remedies

CASE 1

Cause

The lid was opened during the IP Reader's self-diagnosis or start-up adjustment (within roughly 15 min. after powering ON).



Remedy

Close the lid.

CASE 2

Cause

The IP Reader was turned ON with the IP still remaining it that was being read the last time when the power was turned OFF.



Remedy

Remove the remaining IP and then close the lid.

CASE 3

Cause

The lid was opened during IP reading.



Remedy

Close the lid immediately.

If the lid is closed within 1 sec., reading will be continued but the image quality and quantification characteristics obtained at this time cannot be guaranteed.

If the lid remains open for more than 1 sec., reading will be interrupted at that point and the IP returned to the IP loading section.

In this case, depending on the type of analyzing unit, image data up to the point reading was interrupted can be obtained, but the image quality and quantification characteristics of that image data cannot be guaranteed.

Note:

Never open the lid during IP reading.

■ When Error Occurs

An error related to the IP Reader itself has occurred.

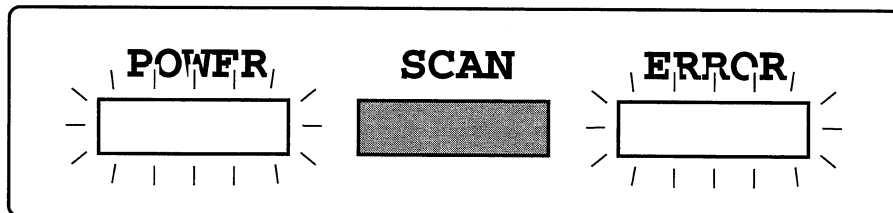


Fig. 5.3 When an Error Occurs

(1) Error occurring during self-diagnosis or start-up adjustment (Within about 15 minutes of powering ON)

Probable Cause and Remedies

CASE 1

Cause

- An abnormality has been detected during self-diagnosis.
- Start-up adjustment has failed.
- An IP remains inside the IP Reader.



Remedy

STEP 1

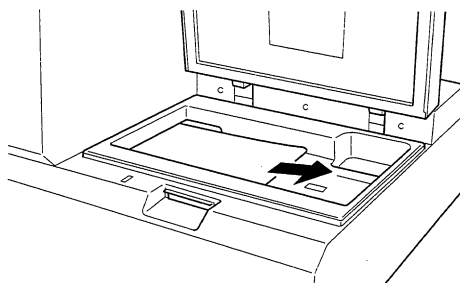
- 1 Turn the IP Reader OFF.
- 2 Confirm that the SCSI ID Selection Switch has been set from 0 - 7. If the SCSI ID setting is incorrect, reset the IP Reader's SCSI ID. (The default SCSI ID is 5.)
- 3 After a few seconds, turn the IP Reader ON.

If the IP Reader boots up normally, the error has been rectified.

If the error recurs, proceed to the **STEP 2**.

STEP 2

- 1 Turn the IP Reader OFF.
- 2 Open the lid. When the IP is on IP loading section, remove it.



Continued

- 3 After the IP is removed, close the lid correctly and then turn the IP Reader ON.

If the IP Reader boots up normally, the error has been rectified.

*If the error recurs, proceed to **STEP 3**.*

NOTE:

If the IP remains stuck deep in the bottom, the assistance of service personnel will be necessary. Contact your sales agent.

STEP 3

- 1 Boot up the analyzing unit.
- 2 Start up the software for the IP Reader and then conduct routine IP reading. (Refer to the manual that corresponds to the analyzing unit that you are using.)
- 3 Any error messages and error codes will be displayed on the monitor of the analyzing unit.
Jot them down and then apply the appropriate countermeasures, referring to "Countermeasures for Each Error Message."

(2) Error occurring after starting IP reading

(Time from when the analyzing unit issues the start IP reading command to any time during reading.)

Probable Causes and Countermeasures**CASE 1****Cause**

- IP reading conditions specified with the software for the IP Reader at the analyzing unit have not been accepted.
- Some part(s) inside the IP Reader has not functioned correctly during IP reading.
- An IP has jammed inside the IP Reader.

**Remedy****STEP 1**

Jot down the error message and error code displayed on the monitor of the analyzing unit.

STEP 2

- 1 Turn the IP Reader OFF.
- 2 Dim the lights of the room the IP Reader is in.
- 3 Open the lid and confirm that if the IP is in the IP setting unit.
- 4 If an IP remains in the IP loading section, store it in an empty cassette, avoiding exposure to light, and then restore room lighting to normal.

User Tip:

The above procedures are necessary to avoid exposing an exposed IP to light.

When an IP is read within 1 hour of exposure, the image can be obtained but the image quantification cannot be guaranteed.

*If there is no IP in the loading section, proceed to **STEP 3**.*

STEP 3

- 1 Turn the IP Reader ON.
- 2 Confirm that the indicator lamp has changed to indicate a warning or error.
- 3 If there is a warning, rectify it by referring to "When a Warning Occurs." If there is an error rectify it by referring to "(1) Error occurring during self-diagnosis or start-up adjustment."

(3) Error occurring after completing IP reading

(When IP reading has been completed, errors will not be displayed on the monitor of the analyzing unit but as occurring at the IP Reader.)

Probable Causes and Countermeasures

CASE 1

Cause

An IP has jammed inside the IP Reader.



Countermeasure

STEP 1

- 1 Start up the software for the IP Reader and then conduct routine IP reading. (For the detailed operation procedure, refer to the manual that corresponds to the analyzing unit that you are using.)

NOTE:

IP Reader power should be left ON.

- 2 Jot down the error message and error code displayed on the monitor of the analyzing unit.
- 3 Turn the IP Reader OFF and turn it ON after a few seconds.
- 4 Confirm that the indicator lamp has changed to indicate a warning or error.
- 5 If there is a warning, rectify it by referring to "When a Warning Occurs."
If an error occurs, rectify it by referring to "(1) Error occurring during self-diagnosis or start-up adjustment."

■ Countermeasures for Each Error Message

Explained below are the countermeasures for errors that occur. Error messages will be displayed on the monitor of the analyzing unit. Refer to the previous item for the method for displaying error messages on the analyzing unit.

EXPLANATION OF TERMS

Restart the IP Reader:

Turn the IP Reader OFF once and after a few seconds turn it on again. Contact your dealer or service engineer and inform them of the following.

Contact your dealer or service engineer:

- 1 There is a problem related to the BAS-1800II IP Reader.
- 2 The type of analyzing unit (ex.: Power Macintosh 7600/200) and the name and version of the software for the IP Reader.
- 3 The details of the situation at the time the error occurred, the error message, the error key and the error code. (Ex.: Approximately 2 min. after turning the IP Reader ON, the error occurred. The error message was "Self diagnosis: Connector connection error." Key: 4H, Code: B1H, etc.)

Error Message	Error Key	Error Code	Cause of Error	Countermeasure
Selected sensitivity is not available now. Try lower one or try again after restarting the IP Reader.			Sensitivity adjustment immediately preceeding IP Reading failed.	1) Lower the reading sensitivity and then retry reading. Or, restart the IP Reader. 2) If the same error recurs even after repeating the above few times, contact your dealer or service engineer.
Self diagnosis: Connector connection error	4H	B1H	An abnormality in the wiring inside the IP Reader has occurred.	1) Restart the IP Reader. 2) If the same error recurs even after repeating the above few times, contact your dealer or service engineer.
Self diagnosis: DRAM R/W operation error	4H	B2H	An abnormality in the DRAM built into the IP Reader has occurred.	1) Restart the IP Reader. 2) If the same error recurs even after repeating the above few times, contact your dealer or service engineer.
Self diagnosis: EEPROM error	4H	B3H	An abnormality in the EEPROM built into the IP Reader has occurred.	1) Restart the IP Reader. 2) If the same error recurs even after repeating the above few times, contact your dealer or service engineer.
Self diagnosis: Lamp ON error	4H	B4H	An abnormality in the standard light source has occurred.	1) Restart the IP Reader. 2) If the same error recurs even after repeating the above few times, contact your dealer or service engineer.
Self diagnosis: Sub-scanning motor operation error	4H	B5H	An abnormality in the sub-scanning motor has occurred.	1) Restart the IP Reader. 2) If the same error recurs even after repeating the above few times, contact your dealer or service engineer.
Self diagnosis: Main scanning motor operation error	4H	B6H	An abnormality in the main-scanning motor has occurred.	1) Restart the IP Reader. 2) If the same error recurs even after repeating the above few times, contact your dealer or service engineer.

Error Message	Error Key	Error Code	Cause of Error	Countermeasure
Self diagnosis: User's sensitivity correction-ratio setting error	4H	B9H	The PSL adjustor value on the IP Reader has been set to ">+10" or "<-10."	1) Turn the IP Reader OFF. 2) Reset the PSL adjustor to the normal range (between -10 and +10). 3) Turn the IP Reader ON.
Self diagnosis: DCM operation error	4H	BAH	An abnormality in the DCM has occurred.	1) Restart the IP Reader. 2) If the same error recurs even after repeating the above few times, contact your dealer or service engineer.
Self diagnosis: Sub-scanning motor drive transmission error	4H	BBH	An abnormality in the sub-scanning motor drive transmission has occurred.	1) Restart the IP Reader. 2) If the same error recurs even after repeating the above few times, contact your dealer or service engineer.
Self diagnosis: Laser power error	4H	BCH	An abnormality in the laser has occurred.	1) Restart the IP Reader. 2) If the same error recurs, wait a few hours and then restart the IP Reader. 3) If the same error recurs even after repeating the above few times, contact your dealer or service engineer.
Self diagnosis: Shutter operation error	4H	BDH	Shutter movement error.	1) Restart the IP Reader. 2) If the same error recurs even after repeating the above few times, contact your dealer or service engineer.
Start-up adjustment: Laser power error (at fine pixel size setting)	4H	C1H	Laser power cannot be stabilized.	1) Restart the IP Reader. 2) If the same error recurs, wait 1 hour and then restart the IP Reader. 3) If the same error recurs even after doing the above, contact your dealer or service engineer.
Start-up adjustment: Laser power error (at coarse pixel size setting)	4H	C2H	Laser power is outside the standard value.	1) Restart the IP Reader. 2) If the same error recurs, wait 1 hour and then restart the IP Reader. 3) If the same error recurs even after doing the above, contact your dealer or service engineer.
Start-up adjustment: Dark noise error 1	4H	C5H	Dark noise exceeds the standard value.	1) Confirm that the lid has been closed correctly. 2) Confirm that the connectors on the back of the IP Reader have been connected correctly. 3) Restart the IP Reader. 4) If the same error recurs, wait a few hours and then restart the IP Reader. 5) If the same error recurs even after doing the above, contact your dealer or service engineer.

Error Message	Error Key	Error Code	Cause of Error	Countermeasure
Start-up adjustment: Log-amp offset rough adjustment error	4H	C6H	Log amplifier simple adjustment has failed.	1) Restart the IP Reader. 2) If the same error recurs, wait a few hours and then restart the IP Reader. 3) If the same error recurs even after doing the above, contact your dealer or service engineer.
Start-up adjustment: Log-amp offset fine adjustment error	4H	C7H	Log amplifier fine adjustment has failed.	1) Restart the IP Reader. 2) If the same error recurs, wait a few hours and then restart the IP Reader. 3) If the same error recurs even after doing the above, contact your dealer or service engineer.
Start-up adjustment: Rough adjustment error of high voltage applied to PMT	4H	C8H	Simple adjustment of voltage applied to the PMT has failed.	1) Restart the IP Reader. 2) If the same error recurs, wait a few hours and then restart the IP Reader. 3) If the same error recurs even after doing the above, contact your dealer or service engineer.
Start-up adjustment: Fine adjustment error of high voltage applied to PMT	4H	C9H	Fine adjustment of voltage applied to the PMT has failed.	1) Restart the IP Reader. 2) If the same error recurs, wait a few hours and then restart the IP Reader. 3) If the same error recurs even after doing the above, contact your dealer or service engineer.
Start-up adjustment: Dark noise error 2	4H	CAH	Dark noise exceeds the standard value.	1) Confirm that the lid has been closed correctly. 2) Confirm that the connectors on the back of the IP Reader have been connected correctly. 3) Restart the IP Reader. 4) If the same error recurs, wait a few hours and then restart the IP Reader. 5) If the same error recurs even after doing the above, contact your dealer or service engineer.
Adjustment before reading: Laser power error	4H	D1H	Laser power exceeds the standard value.	1) Correct error in keeping with (2) Error occurring after starting IP reading, in this chapter. 2) If this error occurs frequently, contact your dealer or service engineer.
Adjustment before reading: Log-amp offset rough adjustment error	4H	D5H	Simple log amplifier adjustment has failed.	1) Correct error in keeping with (2) Error occurring after starting IP reading, in this chapter. 2) If this error occurs frequently, contact your dealer or service engineer.
Adjustment before reading: Log-amp offset fine adjustment error	4H	D6H	Fine log amplifier adjustment has failed.	1) Correct error in keeping with (2) Error occurring after starting IP reading, in this chapter. 2) If this error occurs frequently, contact your dealer or service engineer.

Error Message	Error Key	Error Code	Cause of Error	Countermeasure
Adjustment before reading: Rough adjustment error of high voltage applied to PMT	4H	D7H	Simple adjustment of voltage applied to the PMT has failed.	1) Correct error in keeping with (2) Error occurring after starting IP reading, in this chapter. 2) If this error occurs frequently, contact your dealer or service engineer.
Adjustment before reading: Fine adjustment error of high voltage applied to PMT	4H	D8H	Coarse adjustment of voltage applied to the PMT has failed.	1) Correct error in keeping with (2) Error occurring after starting IP reading, in this chapter. 2) If this error occurs frequently, contact your dealer or service engineer.
Sub-scanning motor timeout error	BH	A3H	Sub-scanning motor movement failure.	1) Corresponding to the timing under which the error occurred, refer to (1) Error occurring during self-diagnosis or start-up adjustment, (2) Error occurring after starting IP reading, (3) Error occurring after completing IP reading, in this chapter. 2) If this error occurs frequently, contact your dealer or service engineer.
DCM timeout error	BH	A4H	DCM movement failure.	1) Corresponding to the timing under which the error occurred, refer to (1) Error occurring during self-diagnosis or start-up adjustment, (2) Error occurring after starting IP reading, (3) Error occurring after completing IP reading, in this chapter. 2) If this error occurs frequently, contact your dealer or service engineer.
Main scanning turning error	BH	E1H	Main-scanning motor movement error.	1) Corresponding to the timing under which the error occurred, refer to (1) Error occurring during self-diagnosis or start-up adjustment, (2) Error occurring after starting IP reading, (3) Error occurring after completing IP reading, in this chapter. 2) If this error occurs frequently, contact your dealer or service engineer.
PMT error	BH	E2H	PMT movement error.	1) Corresponding to the timing under which the error occurred, refer to (1) Error occurring during self-diagnosis or start-up adjustment, (2) Error occurring after starting IP reading, (3) Error occurring after completing IP reading, in this chapter. 2) If this error occurs frequently, contact your dealer or service engineer.

Error Message	Error Key	Error Code	Cause of Error	Countermeasure
Line-interrupt generation error	BH	E5H	An abnormal interrupt has generated.	1) Corresponding to the timing under which the error occurred, refer to (1) Error occurring during self-diagnosis or start-up adjustment, (2) Error occurring after starting IP reading, (3) Error occurring after completing IP reading, in this chapter. 2) If this error occurs frequently, contact your dealer or service engineer.
Sub-scanning motor turning error	BH	E6H	Sub-scanning motor movement error	1) Corresponding to the timing under which the error occurred, refer to (1) Error occurring during self-diagnosis or start-up adjustment, (2) Error occurring after starting IP reading, (3) Error occurring after completing IP reading, in this chapter. 2) If this error occurs frequently, contact your dealer or service engineer.
Jamming error	BH	F1H	An IP jam has been detected inside the IP Reader.	1) Corresponding to the timing under which the error occurred, refer to (1) Error occurring during self-diagnosis or start-up adjustment, (2) Error occurring after starting IP reading, (3) Error occurring after completing IP reading, in this chapter. 2) If this error occurs frequently, contact your dealer or service engineer.

Warning!

Curled IPs are a known cause of jamming.

As a rule, do not use any IP that has curled 4mm or more.

(See p. 25, IP Routine Handling.)

Important!

If an IP to which samples, etc., still adhere is loaded into the IP Reader and IP jamming results from reading, there is the danger that the IP Reader will be contaminated by radioisotopes.

When this danger exists, use the radioactivity measurement jig or the like and make sure that the count is normal.

Make sure not to use contaminated IPs.

Other Problems

CASE 1

Type of Error

- The IP Reader will not turn ON.



Countermeasure

- Confirm that the outlet and the IP Reader are connected properly with the power cable.

CASE 2

Type of Error

- After the IP Reader power has been turned ON, system status remains in self-diagnosis/startup adjustments, even though 25 minutes have elapsed, and does not become ready for operation.



Countermeasure

- Turn the analyzing unit power ON.

CASE 3

Type of Error

- An abnormal image appears.
- An image that originally should not have appeared appears.
- An image is not displayed in the position it originally should have been.



Countermeasure

- 1)Vibration was applied to the IP Reader during reading.
If the IP Reader is touched during reading and vibration is applied to it, lines may appear on the image.
* During reading, make sure not to touch the IP Reader or the table on which the IP Reader and IP Eraser have been placed.
- 2)An exposed IP shows scratches or deterioration.
Check the appropriate IP. If abnormality can be confirmed, do not use that IP.
- 3)There is the danger that the IP has been contaminated.

Main Specifications

Dimensions (W × D × H) : 830 × 590 × 450mm

Weight : 65kg

Power Supply Conditions : AC100V±10% (50/60 Hz)
AC115V±10% (50/60 Hz)
AC240V±10% (50/60 Hz)

Power Supply Capacity : 1.2A (100V)
0.6A (200V)

Temperature Conditions : During operation 15°C - 30°C
During storage -25°C - 60°C

Humidity : During operation 35% - 70 (RH)
(Non-condensing)
During storage Non-condensing

Image Reading Specifications

Dedicated Isotopes : ^{14}C , ^{32}P , ^{35}S , etc.
Also, ^3H (the ^3H -dedicated IP must be used)

Reading Size of IP: 20 × 25cm, 23 × 25cm

Pixel Size : 50μm/100μm (select)

Maximum image Capacity : 47MB (50μm) / 12MB (100μm)

Number of Gradations: 65,536

Reading Time : 3min. and 30sec.(for reading at 50μm)
2min. (for reading at 100μm)

