HF8015 - SERVICE

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1.1 Procedure of adjustment for x-ray tube voltage

Explanation of x-ray tube voltage control circuit

X-ray tube voltage of this device is stabilized by comparing reference voltage of x-ray tube voltage from M3115 PC Board which is placed on reverse side of control panel and voltage (Ep) which is fed back from insert box.

Principle

If feed back voltage is lower than reference voltage, Inverter become ON. If feed back voltage is higher than reference voltage, Inverter become OFF.

Reference voltage can be set by switch on control panel. 4.0V at 80kV and 2.5V at 50kV are generated (1/20000 of each set value of x-ray tube voltage).

Feed back voltage is generated 1/20020 of x-ray tube voltage.

Therefore, reference voltage should be 3.996V to get 80kV of x-ray tube voltage. (About 0.05V of reference voltage should be increased to increase 1kV of x-ray tube voltage.)

Adjustment of reference voltage

Adjustment of reference voltage can be done by VR1 and VR2 on M3115 PC Board which is placed on reverse side of control panel.
Reference voltage can be measured by terminal of M9142 PC Board.
If adjust 50kV (lowest kV) by VR2 and 80kV(highest kV) by VR1, other kV settings (55~75kV) are adjusted automatically.

*VR1 and VR2 are depend on each other. So, even if only one of them have to be adjusted, adjust both of them.
When VR2 (lowest voltage) is adjusted, highest voltage is also changed. So, adjustment of VR1 is necessary.
When VR1 (highest voltage) is adjusted, lowest voltage is also changed. So, adjustment of VR2 is necessary.

Adjustment of x-ray tube voltage

1. Measure x-ray tube voltage at 50kV and 80kV of device which adjustment is necessary
2. Remove 4 screws besides of outer case and expose M3115 PC Board which is placed reverse side of control panel.
   (During the work, disconnect power cord to avoid short circuit.)
3. Set kV to adjustment necessary kV setting (50kV or 80kV), measure reference of M9142 PC Board, and adjust reference voltage by VR1 and VR2.

   (eg.) When measuring value at 80kV setting is only 75kV by Nero and reference voltage is 3.7V, adjustment is necessary.
   (Measuring equipment have deviation of measured value. So, adjust 1~2kV lower.)
   X-ray tube voltage should be increased 4kV, so increase reference voltage for 4×0.05V(0.2V) by VR2.
4. Measure by x-ray tube voltage measuring equipment and continue above procedure if necessary.
5. After one kV setting is adjusted, measure another kV setting (highest or lowest kV). If adjustment is necessary, adjust it.
6. Continue above 3~5 until correct value is obtained.

adjustment range 50kV :49~51kV 80kV:79~81kV (value of AVE. on NERO)

*Concerning place of adjustment and measurement of voltage, refer page of each PC Board.

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11. Procedure of adjustment for x-ray tube current

Explanation of x-ray tube current control circuit

X-ray tube current of this device is stabilized by comparing reference voltage of x-ray tube current from M9141 PC Board which is placed at bottom of main body (under insert box) and voltage (Ip) which is fed back from insert box.

Principle

When feed back voltage is lower than reference voltage, filament circuit become ON. When feed back voltage is higher than reference voltage, filament circuit become OFF.

X-ray tube current is set up at 15 mA unrelated with kV setting and reference voltage is stable.

Adjustment of reference voltage

Adjustment of reference voltage can be done by IP volume on M9141 PC Board.

*Measurement of reference voltage of x-ray tube current is for pre-adjustment for replacement of Inverter PC Board, etc. So, measure and adjust voltage at Ip by oscilloscope directly on usual mA adjustment.

Adjustment of x-ray tube current

1. Remove 4 screws besides of outer case and remove upper outer case.
   (During the work, disconnect power cord to avoid short circuit.)

2. Connect oscilloscope with M9141 PC Board, set timer to around 0.1 sec., make an exposure, and measure voltage at Ip.
   * Concerning connection of oscilloscope, refer page of adjustment measurement of M9141 PC Board.

3. When voltage of Ip is 1.46V, x-ray tube current of 15mA can be obtained.
   (Measuring equipment have deviation of measured value. So, adjust about 1.45V lower at adjustment of highest x-ray tube voltage.)

   adjustment range Ip at 15mA : 1.43~21.46V (value of oscilloscope)

* Concerning place of adjustment and measurement, refer page of each PC Board.

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1.3 Procedure of adjustment for pre-heat time (x-ray tube current starting time)

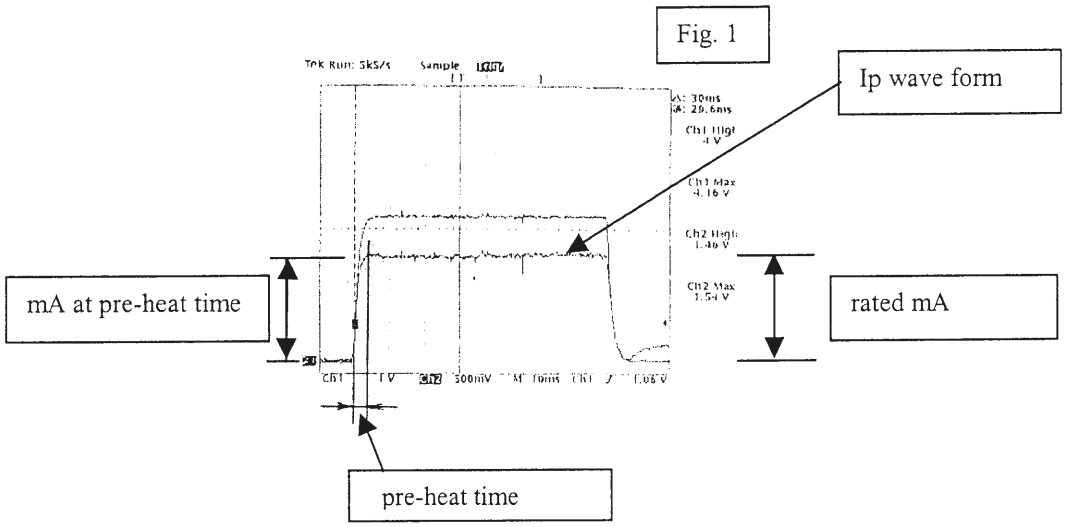
Explanation of pre-heat time

This device is pre-heat system. So, when first stage of exposure switch is pressed, filament is pre-heated for 1.5 sec. After that, x-ray is generated as soon as second stage is pressed.

As soon as x-ray is generated, filament is heated until x-ray tube current become rated mA. The time is called as pre-heat time.

The pre-heat time become shorter by increasing of pre-heat voltage and become longer by decreasing of pre-heat voltage.

Fig. 1



During pre-heat time, x-ray is not generated. So, x-ray tube current is not passed but electric current is passed through filament. If the current become over rated value for filament, filament might be burnt or life of filament might become shorter.

To avoid electrical surge current, adjust electrical current to filament during pre-heat time lower than rated value.

Adjustment of pre-heat time

Adjustment of pre-heat time can be done by PRE VR on M9142 PC Board.

Measurement of pre-heat voltage can be done by PRE terminal on M9142 PC Board.

*Measurement of pre-heat voltage is for pre-adjustment for replacement of Inverter PC Board or Insert etc. So, measure and adjust voltage at pre-heat time by oscilloscope directly on usual pre-heat time adjustment.

1. **Adjustment of x-ray tube current**
   1. Remove 4 screws besides of outer case and remove upper outer case.
      Remove 4 screws fixing chassis.
      (During the work, disconnect power cord to avoid short circuit.)

   2. Connect oscilloscope with M9142 PC Board, set timer to around 0.1 sec., make an exposure, and measure voltage at Ip.
      * Concerning connection of oscilloscope, refer page of adjustment measurement of M9142 PC Board.

adjustment range pre-heat time : 0 ~ 5msec (value of oscilloscope)

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* Concerning place of adjustment and measurement, refer page of each PC Board.

1.4 Procedure of adjustment for exposure time

Explanation of exposure time control circuit

Exposure time circuit of this device is put in M3115 PC Board which is placed on reverse side of control panel. The time can be adjusted by VR3 on M3115 PC Board.

Principle

Exposure time is controlled by base clock of time IC. So, if one of time setting is adjusted, all settings of 0.01 ~ 1.99 sec. can be adjusted.

Adjustment of exposure time

Adjustment of exposure time can be done by VR3 on M3115 PC Board.
Time can be measured at Ep terminal on M9142 PC Board by oscilloscope.

Adjustment of exposure time

1. Remove 4 screws besides of outer case and expose M3115 PC Board that is placed on reveres side of control panel.
   (During the work, disconnect power cord to avoid short circuit.)
2. Connect oscilloscope with M9142 PC Board, set timer to 0.1 sec., make an exposure, and measure time during Ep get voltage.
   * Concerning connection of oscilloscope, refer pages of adjustment and measurement of M9142 PC Board.
3. If adjustment of timer is necessary, adjust by turning of VR3 on M3115 PC Board.
   * Confirm at 0.01 sec. and 0.5 sec. surely.

range of adjustment at 0.01sec. : 0.02sec. ~0.03sec. (value of oscilloscope)

range of adjustment at 0.5sec. : 0.510sec. ~0.525sec. (value of oscilloscope)

* Concerning place of adjustment and measurement, refer page of each PC Board.

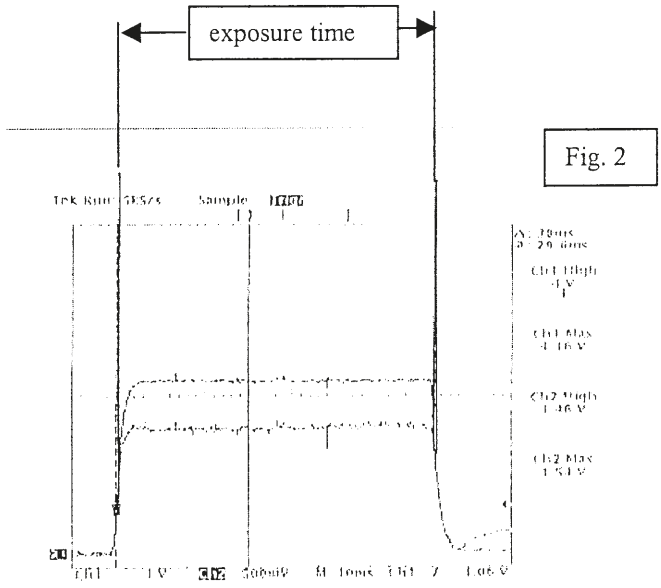

Fig. 2

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If adjustment of timer is necessary, use timer measuring equipment of non-contact type like NERO.

range of adjustment at 0.01sec : 0.005sec~0.015sec. (value of NERO)

range of adjustment at 0.5sec. :0.495sec~ 0.510sec. (value of NERO)

When non-contact measuring equipment like NERO is used, the value will be around 0.015 sec. shorter than the value of oscilloscope.

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Pre-adjustment of M9141 PC Board

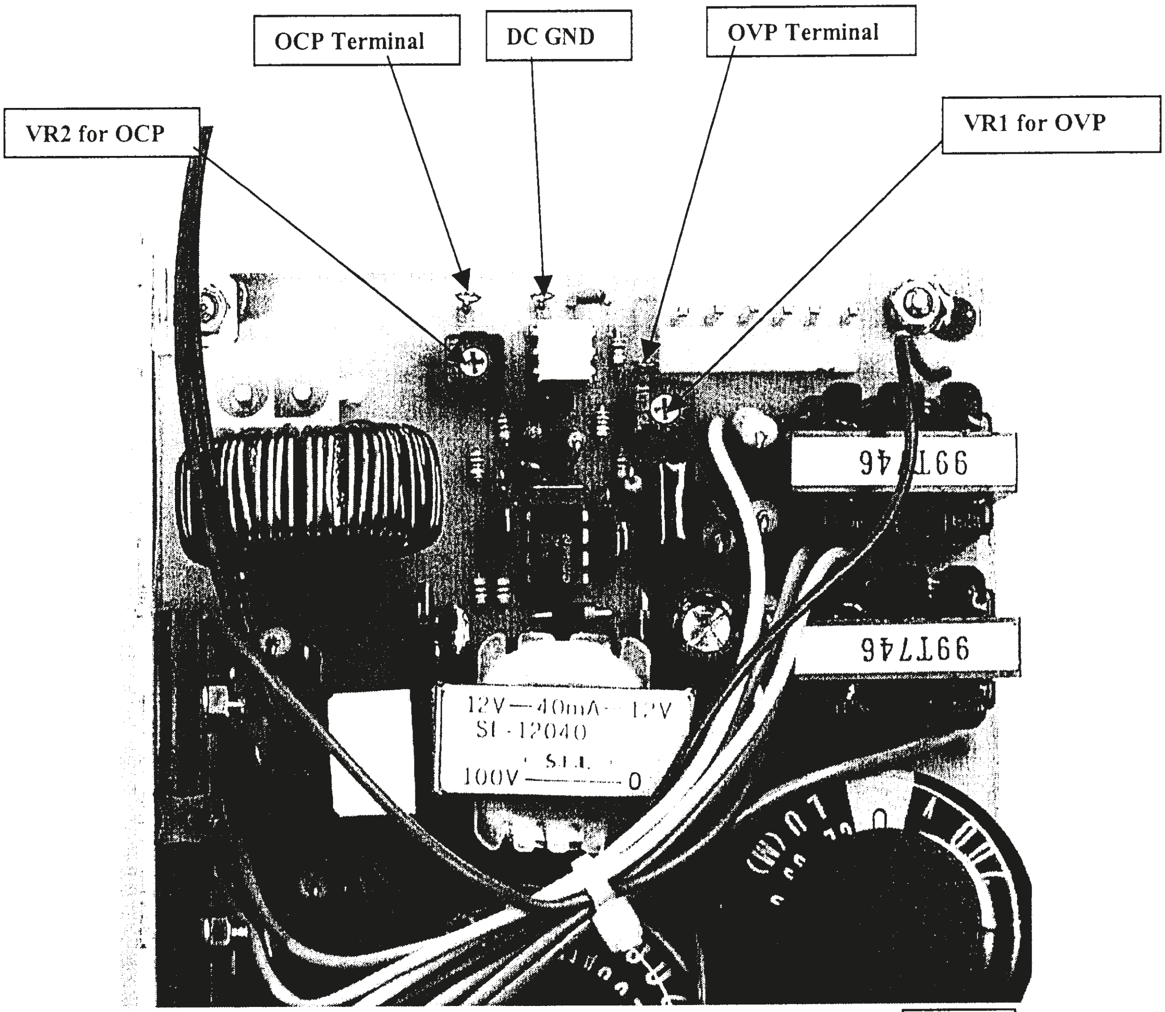

Fig. 3

<u>This adjustment has to be done after connect all connectors completely. But actual exposure is not necessary.</u>

***PC Boards delivered from Mikasa have been already adjusted.**

1. Adjustment of OVP (Over Voltage Protection circuit)
Adjust voltage between OVP(+) and DC GND(-) by turning VR1 for OVP to become DC1.9V(± 0.05V).

2. Adjustment of OCP (Over Current Protection circuit)
Adjust voltage between OCP(+) and DC GND(-) by turning VR2 for OCP to become DC0.8V(± 0.05V).

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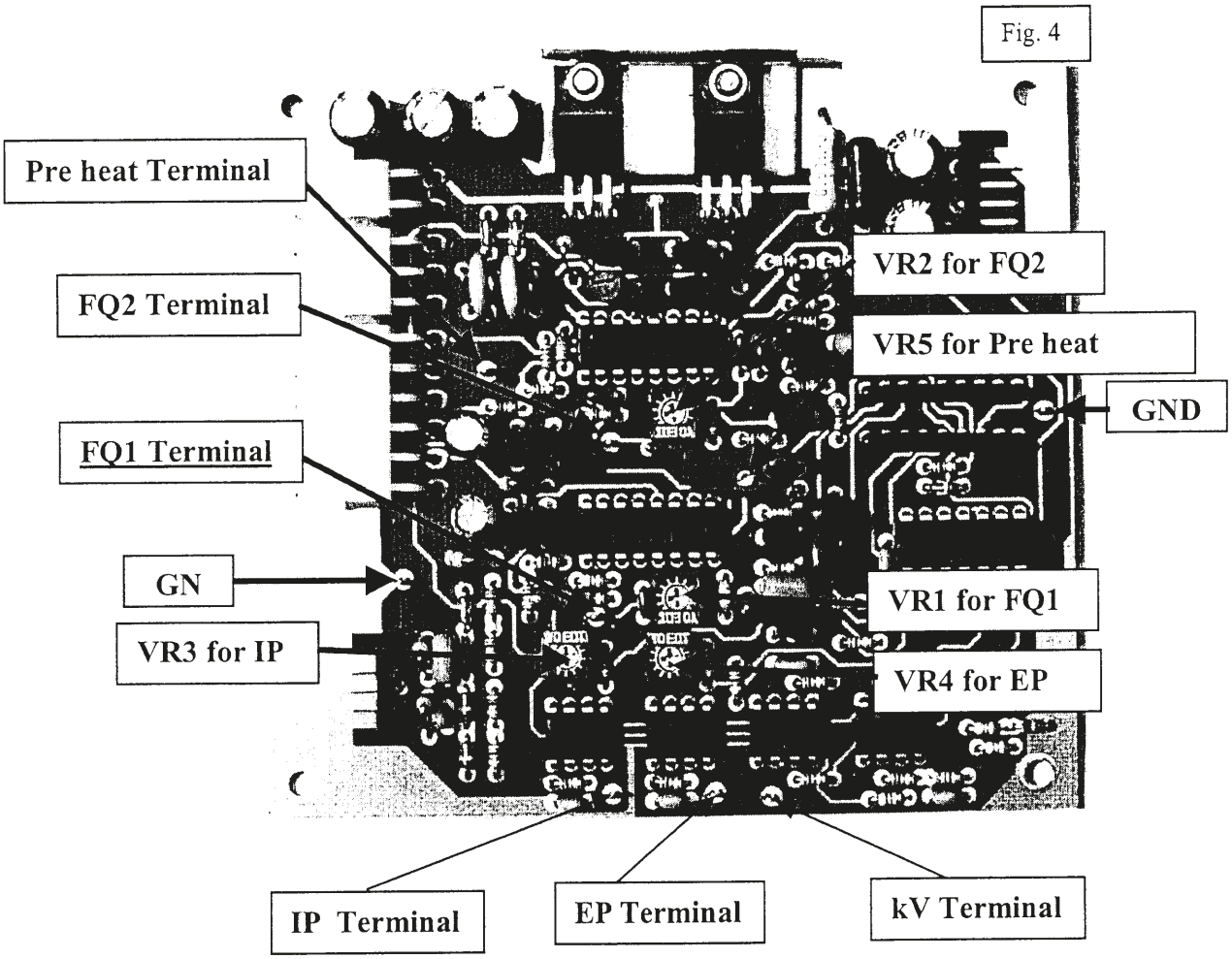
Fig. 4



This adjustment has to be done after connect all connectors completely. But actual exposure is not necessary.
***PC Boards delivered from Mikasa have been already adjusted.**

1. Adjustment of FQ1 (Frequency of inverter)
Adjust frequency between FQ1 Terminal(+) and DC GND(-) to be 120kHz by turning VR1 for FQ1.

2. Adjustment of FQ2 (Frequency of inverter)
Adjust frequency between FQ2 Terminal(+) and DC GND(-) to be 80kHz by turning VR2 for FQ2.

3. Adjustment of Pre heat
Adjust voltage between Pre heat Terminal(+)and DC GND(-) to be 0.36V by turning VR5 for Pre heat.
For re-adjustment of Pre heat, please refer to page 10 .

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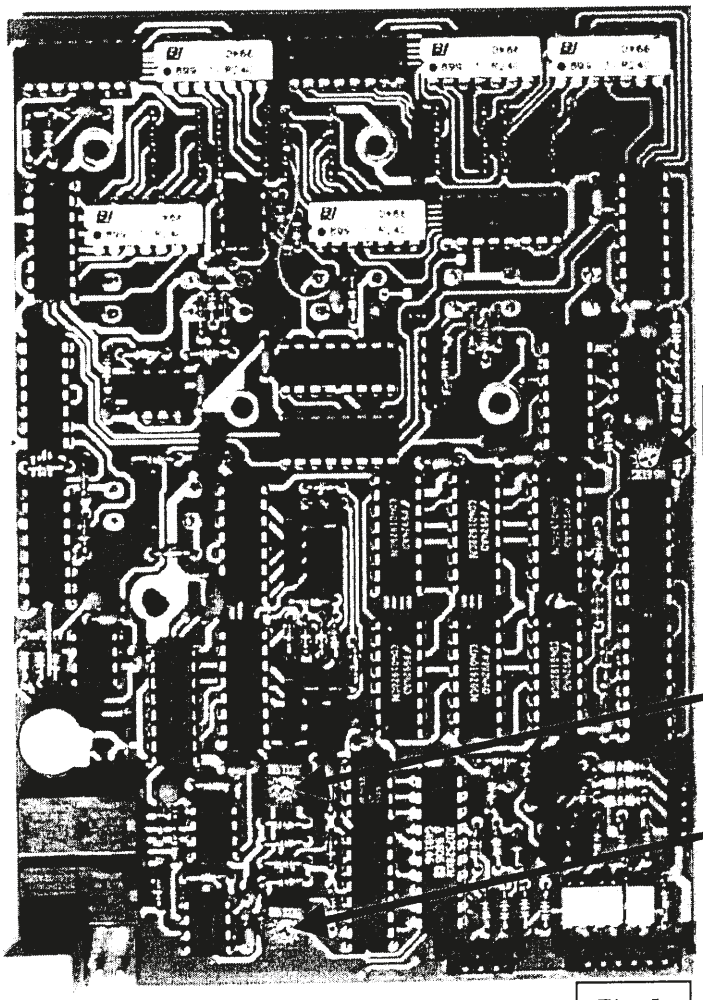

Fig. 5

All of wiring should be connected during adjustment of FQ, but actual exposure is not necessary.
***PC Boards for replacement from Mikasa have been already adjusted as following data.**

1. Adjustment of kV

Connect Digital tester with GND(-) of M9142 and kV Terminal(+) of M9142.

Set the kV to 80, and adjust by VR1 for 80kV at 4.00V.
Set the kV to 50, and adjust by VR2 for 50kV at 2.60V.
Repeat above procedure, and finally confirm that the voltages are above correct values (4.00V, 2.60V).

For re-adjustment of kV, refer to page 12.

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This adjustment has to be done after connect all connectors completely.
Actual exposure is necessary.

This adjustment should be done whenever Inset Box or Inverter PC Board is replaced.

Measure by Oscilloscope
Adjustment of mA
Adjustment of Pre heat time
Adjustment of exposure time
Pre -adjustment of kV

Firstly, check and confirm that filament is lighting by your eyes, when you pushed first button of 2 steps x-ray exposure switch. Connect probe of oscilloscope with EP terminal(+)&GND terminal(-), and IP terminal(+)&GND terminal(-). Set kV to 50kV and set timer to 0.08sec.

Measure by NERO
Adjustment of kV

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Adjustment of mA & Pre heat time

This adjustment has to be done after connect all connectors completely.
Actual exposure is necessary.

50kV at 0.08sec.

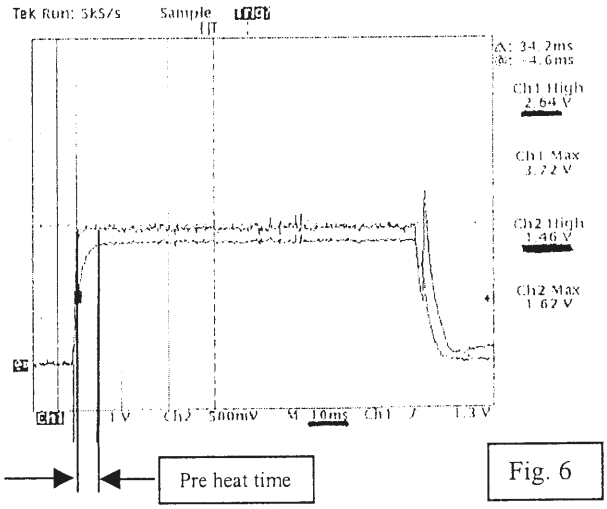

Fig. 6

Adjustment of mA

Adjust mA by turning VR3 for IP on the PCB M9142.

Range of adjustment IP at 15mA : 1.43 V – 1.46V (Value of Oscilloscope)

Adjustment of Pre heat time

Adjust pre heat time by turning VR5 for pre heat time on PCB M9142.

Range of adjustment Pre heat time : 0 - 5msec. (Value of Oscilloscope)

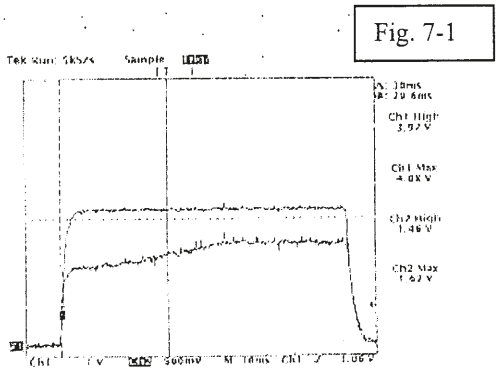

Fig. 7-1

Abnormal wave form

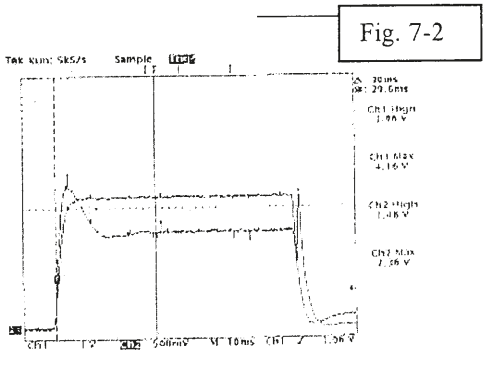

Fig. 7-2

Abnormal wave form

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(Pre heat voltage is too low.) (Pre heat voltage is too high)

Adjustment of exposure timer

This adjustment has to be done after connect all connectors completely.
Actual exposure is necessary.

50kV at 0.08sec.

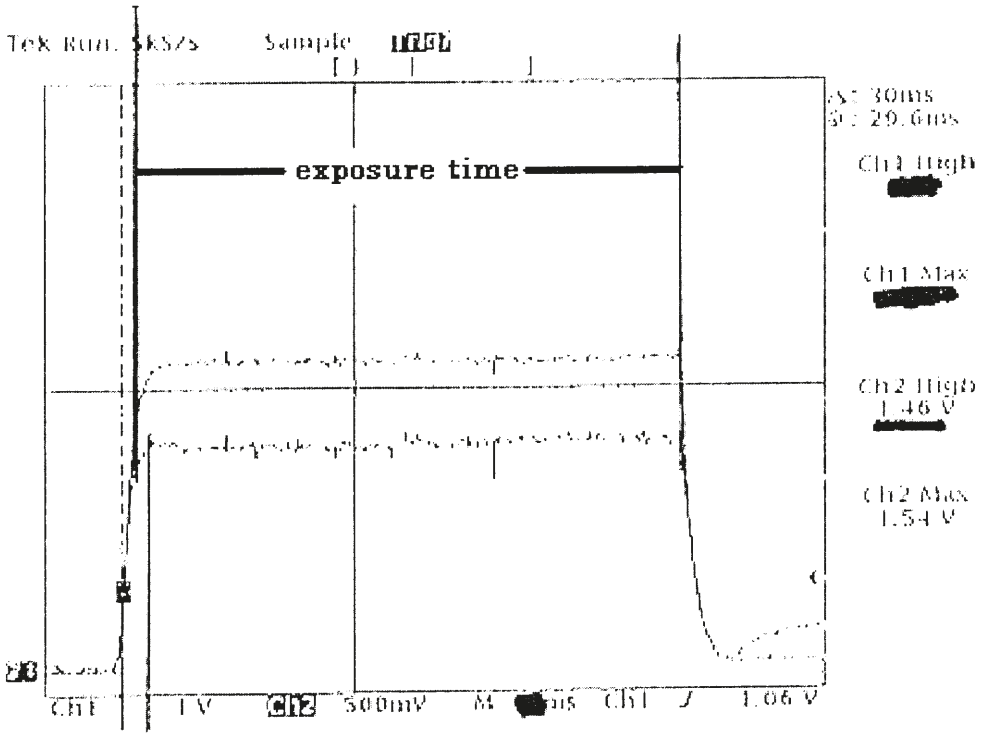

Fig. 8

Adjust exposure time by turning VR3 for timer on the PCB M3115.

Range of adjustment at 0.05 sec. : 0.510sec. – 0.525sec. (Value of Oscilloscope)

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This adjustment has to be done after connect all connectors completely.
Actual exposure is necessary.

Set kV to 50kV and set timer to 0.08sec.
Adjust voltage by turning VR4 for EP on PCB M9142 to be the following range.
Range of adjustment at 50kV : approximately 2.6V (Value of Oscilloscope)

Set kV to 80kV and set timer to 0.08sec.
Adjust voltage by turning VR4 for EP on PCB M9142 to be the following range.
Range of adjustment at 80kV : less than 4.0V (Value of Oscilloscope)

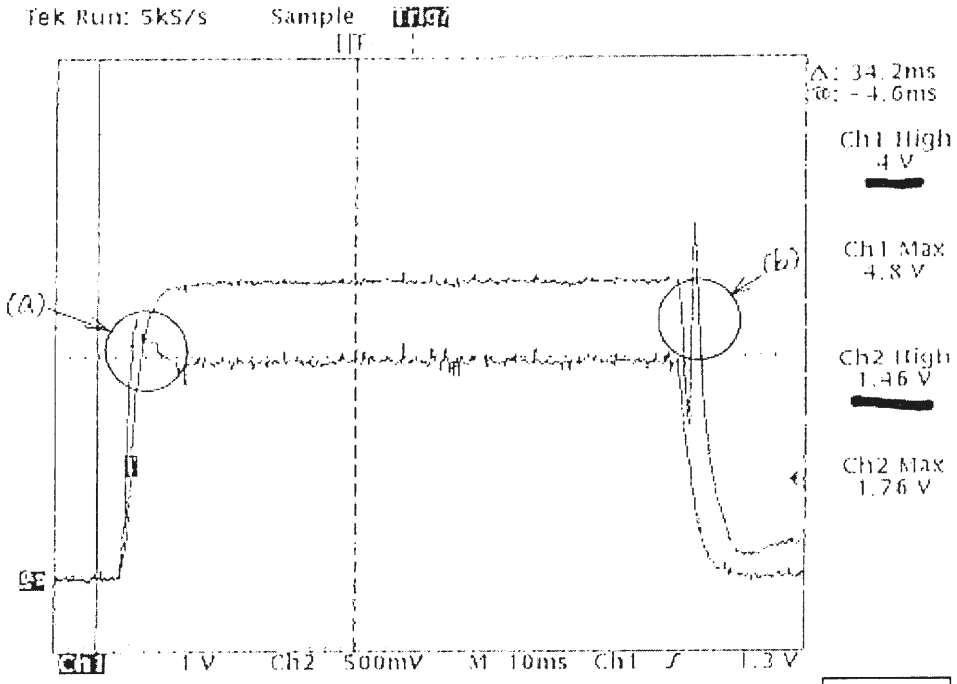

Fig. 9

Although the waveform of above part(Pre heat time) of (a) is low, it is not abnormal wave. In case that Pre heat is high such as fig. 7-2, turn down the voltage a little, and adjust until the voltage to be the part of (a). And then, set kV to 50kV, and confirm the voltage not to be like fig. 7-1.

Although the waveform of above part of (b) is high, it is not abnormal wave.

Final adjustment of kV (by NERO)

Set kV to 80kV and set timer to 0.2sec.
Adjust voltage by turning VR4 for EP on PCB M9142 to be the following range by NERO.
Range of adjustment at 80kV : 79kV – 81 kV (value AVE on NERO)

Range of adjustment at 50kV : 49kV – 51 kV (value AVE on NERO)