

OPERATION MANUAL  
FOR  
X-RAY HIGH POTENTIAL GENERATOR  
TYPE ED125L

SHIMADZU CORPORATION  
KYOTO JAPAN

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For  
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for  
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Type ED125L

1. Introduction

Thank you for purchasing the SHIMADZU ED125L X-ray High Tension Unit. This X-ray high tension unit reflects the skill, and long experience of SHIMADZU engineers and we are, therefore, confident that it will give continued satisfaction.

However please read this manual carefully before using the unit so that you may effectively utilize its full potential.

2. General Description of the Unit

2.1 Uses

The type ED125L is a diagnostic X-ray high tension unit having a radiographic capacity of 125 kV at 300 mA and 100 kV at 500 mA. This capacity fulfills all necessary routine X-ray requirement. This technical capacity of the unit is as follows.

- (1) General Radiography
- (2) Fluoroscopy
- (3) Spot Filming
- (4) Bucky Radiography
- (5) Planigraphy

2.2 Features

- (1) High output

The high output of the ED125L permits efficient use of all standard type CIRCLEX rotating-anode tubes.

A built-in high tension change-over switch provides for connection of two double-focus rotating anode tubes.

(2) Simple operation

All controls are logically arranged within natural reach on control desk. The ED125L can be operated easily even by new staff or emergency helper.

(3) SCR primary switching

Primary energy to the high tension transformer is switched by silicon controlled rectifiers (SCR). It provides synchronous contacting for elimination of high-voltage transients and accurate timing. Because SCR has no inherent failure mechanism, it has a long operating life.

(4) One pulse exposure

Because of accurate timing of SCR timer, short time exposure of one pulse is possible.

(5) Tube protector with a load factor meter

A percentage of set tube load to rated tube load is indicated on a load factor meter. If combination of kV , mA and second exceed rating of X-ray tube, protector prevents exposure.

(6) Electric mAs meter

An mAs value is held even after exposure for accurate and easy reading.

(7) Fluoroscopic timer

The timer permits a doctor to limit fluoroscopic examination of any integrated time up to 5 minutes (60 Hz) or 6 minutes (50 Hz). Approximately 30 seconds before termination of preselected time, the buzzer will buzz. At the end of preselected time, exposure will terminate.

(8) Tube current stabilization

Filament voltage stabilizer prevents fluctuation of X-ray tube filament voltage. And space charge compensator corrects tube current as a function of tube voltage.

(9) High tension silicone rectifier

Since it employs a silicone rectifier for high tension rectification,

the high tension generator is allowed to have semi-permanent life and large capacity in spite of its compactness.

- (10) As the rating is 125 kV at 300 mA, 100 kV 500 mA, good results will be assured in any heavy load radiography such as serial angio-cardiography.
- (11) In the control the tube voltage and tube current for fluoroscopy and radiography can be adjusted separately. So fluoroscopic images and spot films of an excellent diagnostic value are obtained.
- (12) On the specially developed pre-reading kV meter system, the radiographic voltage can be exactly indicated, and the exact fluoroscopic voltage is obtainable by adjustment on the graduation of the voltage regulator.
- (13) Since for radiography a pair of tube voltage regulators (a coarse and fine) are provided, the voltage can be adjusted minutely per 1 kV .  
Since unique circuit is applied, a step voltage is always consistent no matter what mA is selected.
- (14) As the breaker is included in the line switch, there is no need for changing fuses in case of short-circuit or overloading of the main circuit. Small capacity fuses are provided for each auxiliary circuit in order not to damage the component unit.
- (15) In the case of radiography, if the anode does not rotate at a regular speed, high tension will not be applied thus preventing X-ray tube overload.
- (16) A change over time from fluoroscopy to spot-filming decreases to 0.8 seconds by the use of a rapid CIRCLEX starter and preheating within emission of large focus during fluoroscopy.

## 2.3 Specifications

Type in JIS regulation : RF-500-125

### (1) Ratings

Single-phase full-wave rectified type		
Radiographic ratings	125kV	300mA
	100kV	500mA
Fluoroscopic rating	120kV	4mA continuously

The above is the rating of the high tension unit and when it is used in combination with an X-ray tube, it should be used within the specified limits, according to the regulations for use accompanying each X-ray tube.

(2a) Power supply (Standard power source unit)

Type	single phase
Frequency	50 or 60 Hz
Standard Voltage	200 V
Allowable Maximum Voltage	260 V
Allowable Minimum Voltage	180 V
Electric Source Impedance below	0.07Ω

Relation between the length and sectional area of the electric wire and the capacity of the pole transformer is as follows.

Standard Voltage	200 V
Frequency	50 or 60 Hz
Switch Capacity	more than 100A, Fuse 100A.

Sectional area of electric wire in mm<sup>2</sup>

Pole Transformer \ Length	10m	20m	30m	40m	50m	60m	70m	80m	90m	100m
30kVA	14	30	50	60	80	80	100	—	—	—
50kVA	8	14	30	38	38	50	60	60	80	80

(2b) Power supply (400V Power source unit)

Type	single phase
Frequency	50 or 60 Hz
Standard Voltage	400 V
Allowable Maximum Voltage	420 V
Allowable Minimum Voltage	360 V
Electric Source Impedance below	0.22 Ω

Relation between the length and sectional area of the electric wire and the capacity of the pole transformer is as follows.

Standard Voltage 400 V  
 Frequency 50 or 60 Hz  
 Switch Capacity more than 100A, Fuse 75A.

Sectional area of electric wire in mm<sup>2</sup>

Length Pole Transformer	10 m	20 m	30 m	40 m	50 m	70 m
30 kVA	8	14	30			
50 kVA	8	8	14	14	22	

(3) Radiographic tube voltage regulator

Major settings 16 kV step

Minor settings 1 kV step

40 ~ 125 kV

(4) Radiographic mA selector

30, 50, 70, 100, 150, 200, 300, 400, 500 mA

(5) Radiographic timer

1, 2, 3, 4, 5, 6, impulses 0.07(8/120), 0.08(10/120), 0.1, 0.12, 0.15, 0.2, 0.25, 0.3, 0.4, 0.5, 0.6, 0.8, 1.0, 1.5, 2, 3, 5 seconds

Mechanism to prevent core saturation.

Maximum repeating cycle is 12 exposures per second. Parenthesized figures are actual time at 60 Hz operation.

(6) Fluoroscopic tube voltage regulator

From 50 kV to 120 kV continuously

(7) Fluoroscopic mA regulator

From approximately 0.5 mA to 2 mA continuously

(Fluoroscopic mA is limited to 2 mA from a standpoint of the radiation protection.)

(8) Fluoroscopic timer

Any integrated time up to 5 minutes (60 Hz) or 6 minutes (50 Hz)

Approximately 30 seconds before termination of preselected time,

timer will initiate a buzzer. At end of preselected time, exposure will terminate.

(9) Technique and tube selector

Six positions of "General", "Bucky-1", "Bucky-2", "Fluo.-Spot", "Plani" and "Spare". Each technique selects an X-ray tube.

(10) Dimensions and Weight

	High Tension Generator	Control
Width x depth x height in cm	about 49 x 49 x 75	about 80 x 35 x 100
Weight in kg	about 210	about 120 (180)

Parenthesized figure is weight of 400V power source unit.

2.4 Safety items

(1) Fuse position

Frontal left side in the X-ray control FUSE UNIT-10.

Fuse type

Glass cartridge fuse

Fuse capacity












10A (<F-L28H> <F-L100H> <F-L125H>)

5A (<F-L100S> <F-C> <F-CP>)

3A (<F-L100E> <F-100P>)



The marks and symbols using in this generator has the following meaning.

	: 1st X-ray Tube		: Large focus of X-ray Tube
	: 2nd X-ray Tube		: Small focus of X-ray Tube
	: 3rd X-ray Tube		: High-speed anode rotating of X-ray Tube
READY	: Ready condition for X-ray exposure		
X-RAY	: X-ray exposure		
OVER	: Over load		
	: Fluoroscopy and Spot Filming		: General Radiography
SP	: Spare		: Bucky Radiography 1
	: Bucky Radiography 2		: Planigraphy
kV	: X-ray tube voltage	sec	: Exposure time
mA	: X-ray tube current		


### 3. Operation





Before setting the apparatus in operation confirm that the line switch "LINE" is set at "OFF" and each regulator is at its lowest position. Close the safety switch of the power supply.

#### 3.1 Energizing the control


- (1) When the line switch "LINE" is changed to "ON", the indication lamps light and the LV meter begins to indicate.
- (2) Turn the line voltage regulator "LINE V" so that the line voltage meter points at the triangle mark.

### 3.2 General radiography




- (1) Change over the technique selector "TECHNIQUE" to "  ".

With this operation, the X-ray tube to be used are automatically selected and they are recognizable by lighting-up of indication lamp "  " or "  " or "  ". When the high-speed rotating anode X-ray tube is used the indicator "  " lights up.

- (2) Determine the exposure time.

Set the exposure timer "  sec." to the desired time. The timer is adjustable in 23 steps from 0.01 second (one pulse) to 5 seconds.

- (3) Setting of tube current

Change over the tube current selector "  mA" to the desired mA. Appropriate focus is automatically selected according to mA value. The selected focus is indicated by indicator "  " or "  ".

- (4) mA meter and mAs meter



In order to read the X-ray tube current, mA meter and mAs meter are provided. The former can be changed over through three kinds of sensitivities, namely 6, 60 and 600 mA, and indicates the X-ray tube current accurately for over 0.8 second of exposure. The latter, on the other hand, is designed to read the product of X-ray tube current and exposure time and also can be used as the load factor meter. Thereby the load factor is being indicated until the "READY" operation is performed. Moreover, when radiographed, the mAs value at this time is indicated and the indication is kept on the meter after the completion of radiography until the switch "READY" is released. The changeover of the above-mentioned meters and sensitivity are automatically done by the aforementioned exposure timer and tube current selector as follows.

Timer	Meter	Tube current selector	Multipli- cation
Less than 0.3 sec.	mAs	Entire range	X1
More than 0.4 sec.	mA	10 ~ 50 mA	X10
		70 ~ 500 mA	X100

Examples:

- (a) When radiography is done at 400 mA, 0.1 second;  
It is changed over to mAs meter and indicates 40 mAs.
- (b) When radiography is done at 100 mA, 1 second;  
It is changed to 600 mA meter (100 times of graduation of mA meter) and indicates 100 mA.

(5) Adjustment of tube voltage

The adjustment of tube voltage is done by two regulators, namely "MAJOR  " and "MINOR  ". The former changes by 16 kV with the shift of one tap, the latter by 1 kV. The radiographic voltage at the time is indicated by kV meter. When the aforementioned tube current adjustment is done after the completion of tube voltage adjustment, the indication of kV meter, that is, radiographic voltage may vary. So due care must be taken. The graduations of less than 40 kV on the kV meter are marked in red. It is provided for mammography. When radiographic voltage decreases to this extent, it is impossible to flow a large current in general X-ray tube.




(6) Load factor meter and indication lamp "OVER"


The rate of the set load over the maximum tolerable load of X-ray tube is indicated on the load factor meter. When this indication exceeds the tolerable value or the voltage is adjusted to the level above the maximum tolerable tube voltage, the indication lamp "OVER" is lit and radiography becomes impossible.

In such a case, set the tube current selector to the lower side or the timer to the shorter exposure time. Also make the tube voltage to be lower than the tolerable value.

The relation between the indication of load factor meter and the rate against the X-ray tube short-time rating and the lighting conditions of the indication lamp "OVER" under various technique are as follows:

Indication of load factor meter, %	100	84	74
Rate against the short-time rating, %	Less than 95	Less than 80	Less than 70
Lighting-up of "OVER" lamp	*A	*B	*C

When the operation selector "TECHNIQUE" is changed over to " , " , or " , the indication lamp "OVER" lights up at the (\*A) in the table above.

In case of "SERIAL" it lights up at the(\*B;)"  " at(\*C).

By the way the load factor meter is also used as mAs meter, therefore after the "READY" operation, the load factor is not indicated until the completion of radiography.

(7a) Pull the trigger switch of the hand switch. (Standard type)

When it is pulled , the X-ray tube filament becomes heated to get ready for radiography. At the same time the anode of X-ray tube begins to rotate. And when heating of filament and rotation of anode reach at their respective normal states (about 1.6 seconds after pulling ), the indication lamp "READY" will light up.

(7b) Depress the "READY, X-RAY" pushbutton to primary step.  
(Pushbutton type)

When it is depressed, the X-ray tube filament becomes heated to get ready for radiography. At the same time the anode of X-ray tube begins to rotate. And when heating of filament and rotation of anode reach, at their respective normal states (about 1.6 seconds after depressing), the indication lamp "READY" will light up.

(8a) Irradiation of X-ray (Standard type)

When the indication lamp "READY" is lit, give notice to the patient and depress the pushbutton of the hand switch.

With this maneuver, X-ray is irradiated for the period set by the timer. When the set time is over 0.4 second at the time, X-ray tube current can be read on mA meter; when below 0.3 second, the product of X-ray tube current and exposure time can be read on mAs meter. The "X-RAY" pushbutton should be kept depressed until the completion of radiography.


When radiography is over, the indication lamp "READY" goes off.

If you want another radiography, first pull the "READY" trigger switch again and depress the "X-RAY" pushbutton.

(8b) Irradiation of X-ray (Pushbutton type)

When the indication lamp "READY" is lit, give notice to the patient and depress the "READY, X-RAY" pushbutton to secondary step. With this maneuver, X-ray is irradiated for the period set by the timer. When the set time is over 0.4 second at the time, X-ray tube current can be read on mA meter; when below 0.3 second, the product of X-ray tube current and exposure time can be read on mAs meter. The "READY, X-RAY" pushbutton should be kept depressed until the completion of radiography. When radiography is over, the indication lamp "READY" goes off. If you want another radiography, first depress the "READY, X-RAY" pushbutton to primary step again and depress to secondary step.

3.3 Fluoroscopy and spot filming


(1) Set the technique selector "TECHNIQUE" to "".

(2) Setting of conditions for spot filming

Adjust the exposure time, tube current and tube voltage to the desired level. (Refer to Paragraph 3.2.)

(3) With the above procedure, the sensitivity of mA meter that reads X-ray tube current is automatically switched to 6 mA and the X-ray tube filament is heated at the same time.

(4) Determine the fluoroscopic time.


Determine the fluoroscopic time beforehand by adjusting the fluoroscopic timer " time".

When fluoroscopy is performed for the set time, the timer turns off and irradiation of X-ray is cut off. Since the buzzer rings before the timer turns off, set the fluoroscopic time again if continuous fluoroscopy is to be performed.


(5) Irradiate X-ray .

Conduct fluoroscopy on the X-ray diagnostic table or by depressing the foot switch. With this operation, X-ray is irradiated. The X-ray tube current at this time can be read by mA meter. As for the operations on the X-ray diagnostic table, please refer to the Instruction Manual for each operation.

(6) Regulation of tube current

By turning the handle of tube current regulation for fluoroscopy "  mA", regulate the tube current so that it normally registers around 2 mA.



(7) Regulation of tube voltage




By turning the tube voltage regulator for fluoroscopy "  kV ", give appropriate contrast to fluoroscopic image.  
At this time tube voltage can be known by the figures described on the name plate.

(8) Spot filming

Spot filming is conducted on the X-ray diagnostic table and in this case fluoroscopy is stopped and radiography is carried out.


### 3.4 Bucky radiography


- (1) Change over the technique selector to "  " or "  ".

With this operation, the X-ray tube to be used are automatically selected and they are recognizable by lighting-up of indication lamp "  " or "  " or "  ".

- (2) After the completion of the above, perform radiography in the procedure described in the items from (2) to (8) Paragraph 3.2.  
For further operations of bucky radiography, please refer to the Instruction Manuals of each operation.

### 3.5 Planigraphy

- (1) Change over the technique selector to "  ".

- (2) The procedure for planigraphy is the same as in the case of bucky radiography. The exposure time, however, is set by the time regulator of planigraphic apparatus, therefore set the timer "  sec." to its maximum (5 seconds).  
For further details, please refer to the instruction manual for planigraphic apparatus.

### 3.6 Procedure after use

When finishing the operation, be sure to proceed to the following.

- (1) Turn off the line switch "LINE".
- (2) Return each regulator to its lowest level.
- (3) To further safety, turn off the safety switch at the wall.

#### 4. General View

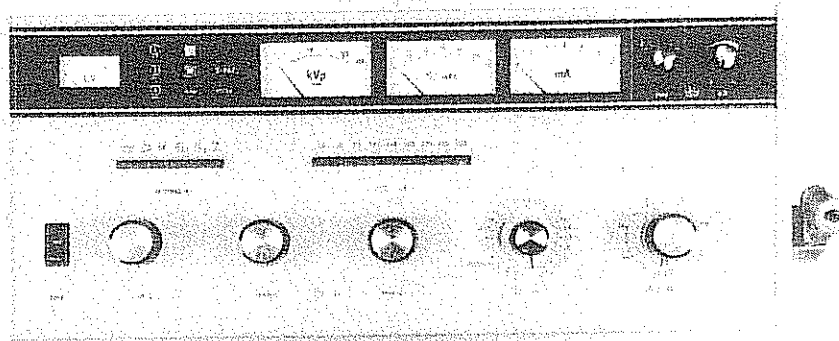


Fig. 1 Control Panel

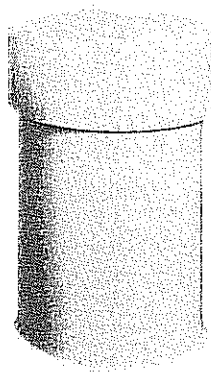


Fig. 2 High Tension Generator (D125LE-12 for two x-ray tubes system (standard).  
D125LE-13 for three x-ray tubes system (Option).)

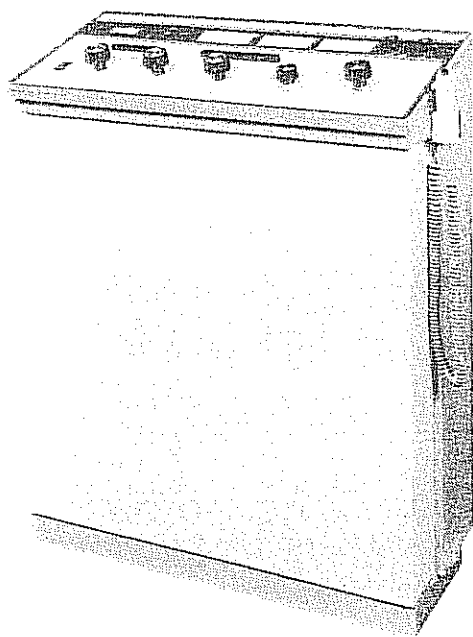


Fig. 3 Control



## Cautions for use

### 1. Cautions for start of use

When using the X-ray tube unit for the first time after its installation or when using it again after its nonuse for more than one month, energize it as follows:

- (1) Gradually rising the X-ray tube voltage from 50 kV at X-ray tube current of 1 mA to the following voltage of either (a) or (b) at the rate of 10 kV per minute, energize the X-ray tube with the final voltage for ten minutes.
  - (a) The maximum working tube voltage of the X-ray tube used if this voltage is lower than the maximum continuous (rated) voltage of the X-ray high tension apparatus to be combined with.
  - (b) The maximum continuous (rated) voltage of the X-ray high tension apparatus if this voltage is lower than the maximum working tube voltage of the X-ray tube used.
- (2) Rising the X-ray tube voltage from 80 kV to the maximum working tube voltage (not exceeding the maximum working voltage of the X-ray high tension apparatus to be combined with) 10 kV at a time, apply the load twice at every voltage at the rate of one per minute.

Energizing time: 0.1 second





X-ray tube current: 30 ~ 50% of short-time rating  
(not exceeding the maximum rating of the X-ray apparatus)

After energizing the X-ray tube for more than the aforementioned requirements, carry out usual way of use.

Should the energization of the foregoing step (1) is found to be impossible, however, start energization with tube voltage of 50 kV.

If there is an abnormality such as unstable tube current during energization, drop the X-ray tube voltage to a level where the tube current become stable, energize the X-ray tube with that dropped voltage for a while, and then rise the tube voltage again.

### 2. General cautions

- (1) In the case where the actual radiographic tube voltage is used within a range near the maximum working tube voltage (  125 ~ 150 kV,  110 ~ 125 kV), practice aging from 80 kV to the usual working voltage 10 kV at a time prior to daily use to check that there is no abnormality in the X-ray tube. For this aging, however, the starting tube voltage and energizing time should be 100 kV and 0.03 second, respectively.
- (2) There might be a case that the X-ray tube will become faulty when the X-ray tube is used in a range near the maximum working tube voltage (  125 ~ 150 kV,  110 ~ 125 kV) all of a sudden after its long use with comparatively low tube voltage of less than 70 ~ 80 kV. This is a trouble resulted from a fact that the X-ray tube has been made aging at a low tube voltage. In that case, practice aging described in the foregoing par. 1 step (2).