Manual No.: M501-E376
Revision: －

X-Ray High-Voltage Generator

ZUD-P40D/DS **ZUD-L41D/DS**

ZUD-L40D/DS **ZUD-V40D/DS**

ZUD-B40D/DS

INSTALLATION MANUAL

This manual is for professional service engineers.
It bears no relation to the usual operation.

SHIMADZU CORPORATION
KYOTO JAPAN
MEDICAL SYSTEMS DIVISION

Manual No.: M501-E376
Revision: －

NO TEXT

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Introduction

Chapter Contents

1. Introduction

1.1 Introduction

This is the Installation Manual for the ZUD-P40D/DS, ZUD-L41D/DS, ZUD-L40D/DS, ZUD-V40D/DS, and ZUD-B40D/DS X-ray high-voltage generators for the FLEXAVISION X-ray TV system. These units incorporate a controller for the R/F table.

Install and adjust the apparatus in accordance with the steps described in this manual.

Before installing the equipment, check the items described in “2.1 Specifications and Installation Environment.” Then follow the procedures described in “3. Installation and Connection” and “4. Checks and Adjustments.”

NOTE

The tube current is not adjusted at the factory.

Adjust the tube current during installation in accordance with the sections specified above.

Chapter 2

2

Technical Data

Chapter Contents

2. Technical Data

2.1 Specifications and Installation Environment

2.1.1 ZUD-P40D/DS

Equipment Classifications

Type of protection against electric shocks: Class 1 equipment

Degree of protection against electric shocks: Type B

Waterproofing: Standard

Safe operation in air/flammable anesthetic gas or oxygen/nitrous oxide or flammable anesthetic gas atmosphere: Unsuitable

Operation mode: Continuous operation with intermittent load

Rated output (product of max. tube current that can flow in 0.1 sec and tube voltage at 100 kV tube voltage)

20 kW (100 kV, 200 mA)

Short-time rating

125 kV 160 mA, 100 kV 200 mA, 80 kV 250 mA

Long-time rating

125 kV 2.5 mA

Nominal max. tube voltage and maximum current at nominal max. tube voltage

Short-time rating 125 kV 160 mA

Long-time rating 125 kV 2.5 mA

Max. tube current and maximum voltage at max. tube current

Short-time rating 250 mA 80 kV

Long-time rating 2.5 mA 125 kV

Tube voltage and tube current combination at maximum electrical output

Short-time rating 125 kV 160 mA, 100 kV 200 mA, 80 kV 250 mA

Long-time rating 125 kV 2.5 mA

Nominal shortest radiation time (for AEC radiography)

3 ms

Radiography tube voltage

40-125kV

1 kV steps

Radiography tube current

10-250 mA

Any 12 of the following positions that are permitted by the X-ray tube unit can be used:

10, 11, 12, 14, 16, 18, 20, 22, 25, 28, 32, 36, 40, 45, 50, 56, 63, 71, 80, 90, 100, 110, 125, 140, 160, 180, 200, 220, 250 mA

Radiography tube current time product

0.5-320 mAs

Set from the following 57 positions:

0.5, 0.56, 0.63, 0.71, 0.80, 0.90, 1.0, 1.1, 1.25, 1.4, 1.6, 1.8, 2.0, 2.2, 2.5, 2.8, 3.2, 3.6,4.0, 4.5, 5.0, 5.6, 6.3, 7.1, 8.0, 9.0, 10, 11, 12.5, 14, 16, 18, 20, 22, 25, 28, 32, 36, 40, 45, 50, 56, 63, 71, 80, 90, 100, 125, 140, 160, 180, 200, 220, 250, 280, 320 mAs

Radiography time

0.001-10 sec

Set from the following 81 positions. Do not set to a value less than 0.5 mAs or over 320 mAs.

1.0, 1.1, 1.25, 1.4, 1.6, 1.8, 2.0, 2.2, 2.5, 2.8, 3.2, 3.6, 4.0, 4.5, 5.0, 5.6, 6.3, 7.1, 8.0, 9.0, 10, 11, 12.5, 14, 16, 18, 20, 22, 25, 28, 32, 36, 40, 45, 50, 56, 63, 71, 80, 90 ms

0.10, 0.12, 0.14, 0.16, 0.18, 0.20, 0.22, 0.25, 0.28, 0.32, 0.36, 0.40, 0.45, 0.50, 0.56, 0.63, 0.80, 0.90, 1.0, 1.1, 1.25, 1.4, 1.6, 1.8, 2.0, 2.2, 2.5, 2.8, 3.2, 3.6, 4.0, 4.5,5.0, 5.6, 6.3, 7.1, 8.0, 9.0, 10 s

Fluoroscopy tube voltage

50-125 kV

1 kV steps

Fluoroscopy tube current

0.3-2.5mA

Fluoroscopy time

Continuous fluoroscopy time 10 minutes

Applicable Procedures

General radiography, fluoroscopic examinations, direct spot filming, DR radiography, vertical Bucky radiography, horizontal Bucky radiography

Radiography programs

User can create up to 12 radiography conditions per technique

Number of connectable X-ray tube units

1 (2 with 2-tube option)

Starter

Normal rotation

2. Technical Data

ZUD-P40D/DS

Number of connectable AEC detectors

I.I. photocell type: 1

Direct phototimer photo sensor: 3 (SPT-XD only)

Options

2-tube option

Normal rotation starter (starter 4 CE/UL)

Power supply

Type and frequency   AC, 50 or 60 Hz

Phases and nominal voltage   Single-phase, 200/220/240 V

Permitted voltage range and power supply impedance under no-load status

200V-5%,＋10%   0.08 Ω

220V±10%   0.08 Ω

240V±10%   0.08 Ω

Recommended distribution transformer capacity

30kVA

Length and Sectional Area of Lead-in Conductor vs Distribution Transformer Capacity

Length / Transformer capacity	Sectional area of wire (mm^2)									
	10 m max.	20m	30m	40m	50m	60m	70m	80m	90m	100m
30 kVA (single-phase)	22	22	22	38	38	38	38	60	60	60

Safety Devices

	Safety Device		Current rating of recommended fuse or circuit breaker
	Type	Capacity	
Single-phase 200/220/240V	Knife switch or fuse or circuit breaker	100 A min.	60A

If an earth leakage breaker is installed, use an inverter type that does not malfunction at high frequency current.

Earth

Grounding resistance 100 Ω max.

Operating environment

Temperature: 5°C to 35°C

Humidity: 20% to 85%

Atmospheric pressure: 700 hPa to 1060 hPa

No condensation

Provide a dedicated air-conditioning unit if the environmental conditions do not meet the conditions above.

Heat generated by equipment

Control console: 30 kcal/h

Power cabinet: 500 kcal/h (120 kcal/h)

These heat generation values are values from an average operating state. The values may differ due to the operating state.

Values in parentheses ( ) indicate the heat generated by the X-ray tube unit.

1kW=860kcal/h

Power consumption

Standby: 500 VA

Short-time maximum rating: 45 kVA

Transport and storage environment

Temperature: -10°C to 60°C

Humidity: 10% to 95%

Atmospheric pressure: 700 hPa to 1060 hPa

The conditions above are for the transportation and storage of the equipment in its packaging.

Unit configuration

Control cabinet

Cables

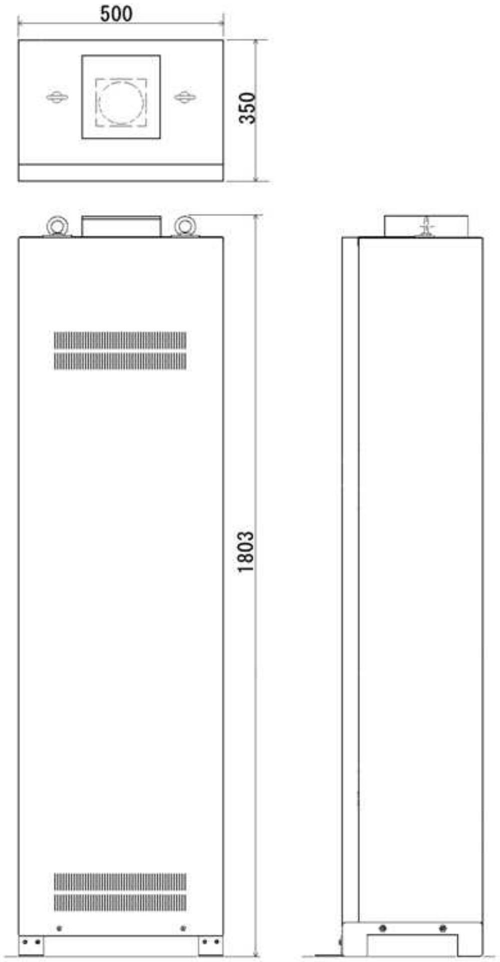
Accessories

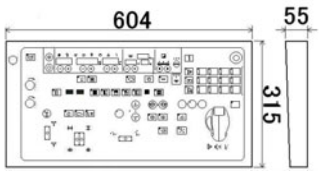
(Operating console：XSC-Z40RA/RB/RC Remote Operating Console)

2. Technical Data

ZUD-P40D/DS

External dimensions and mass





Mass 170 kg

Mass 7 kg

2.1.2 ZUD-L41D/DS , ZUD-L40D/DS

Equipment Classifications

Type of protection against electric shocks: Class 1 equipment

Degree of protection against electric shocks: Type B

Waterproofing: Standard

Safe operation in air/flammable anesthetic gas or oxygen/nitrous oxide or flammable anesthetic gas atmosphere: Unsuitable

Operation mode: Continuous operation with intermittent load

Rated output (product of max. tube current that can flow in 0.1secand tube voltage at 100 kV tube voltage)

Single-phase 200/220/240 V:	32 kW (100 kV, 320 mA)
3-phase 200/220/240 V:	50 kW (100 kV, 500 mA)
3-phase 380/400/415/440 V:	50 kW (100 kV, 500 mA)

Short-time rating

Single-phase 200/220/240 V: 150kV 200 mA, 125kV 250 mA, 100 kV 320 mA, 80 kV 400 mA

3-phase 200/220/240 V: 150 kV 320 mA, 125 kV 400 mA, 100 kV 500 mA, 80 kV 630 mA

3-phase 380/400/415/440 V: 150 kV 320 mA, 125 kV 400 mA, 100 kV 500 mA, 80 kV 630 mA

Long-time rating

125kV 4mA

Nominal max. tube voltage and maximum current at nominal max. tube voltage

Short-time rating	Single-phase 200/220/240 V:	150 kV, 200 mA
	3-phase 200/220/240 V:	150 kV, 320 mA
	3-phase 380/400/415/440 V:	150 kV, 320 mA
Long-time rating	125 kV 4 mA	

Max. tube current and maximum voltage at max. tube current

Short-time rating	Single-phase 200/220/240 V:	400 mA 80 kV
	3-phase 200/220/240 V:	630 mA 80 kV
	3-phase 380/400/415/440 V:	630 mA 80 kV
Long-time rating	4 mA 125 kV	

Tube voltage and tube current combination at maximum electrical output

Short-time rating	Single-phase 200/220/240 V:	100 kV 320 mA, 80 kV 400 mA
	3-phase 200/220/240 V:	80 kV 630 mA
	3-phase 380/400/415/440 V:	80 kV 630 mA
Long-time rating	125 kV 4 mA	

2. Technical Data

ZUD-L41D/DS , ZUD-L40D/DS

Nominal shortest radiation time (for AEC radiography)

3 ms

Radiography tube voltage

40 kV to 150 kV

1 kV steps

Radiography tube current

10 mA to 630 mA

Any 12 of the following positions that are permitted by the X-ray tube unit can be used:

10, 11, 12, 14, 16, 18, 20, 22, 25, 28, 32, 36, 40, 45, 50, 56, 63, 71, 80, 90, 100, 110, 125, 140, 160, 180, 200, 220, 250, 280, 320, 360, 400, 450, 500, 560, 630 mA

Radiography tube current time product

0.5-800 mAs

Set from the following 65 positions:

0.5, 0.56, 0.63, 0.71, 0.80, 0.90, 1.0, 1.1, 1.25, 1.4, 1.6, 1.8, 2.0, 2.2, 2.5, 2.8, 3.2, 3.6, 4.0, 4.5, 5.0, 5.6, 6.3, 7.1, 8.0, 9.0, 10, 11, 12.5, 14, 16, 18, 20, 22, 25, 28, 32, 36, 40, 45, 50, 56, 63, 71, 80, 90, 100, 125, 140, 160, 180, 200, 220, 250, 280, 320, 360, 400, 450, 500, 560, 630, 710, 800 mAs

Radiography time

0.001-10 sec

Set from the following 81 positions. Do not set to a value less than 0.5 mAs or over 800 mAs.

1.0, 1.1, 1.25, 1.4, 1.6, 1.8, 2.0, 2.2, 2.5, 2.8, 3.2, 3.6, 4.0, 4.5, 5.0, 5.6, 6.3, 7.1, 8.0, 9.0, 10, 11, 12.5, 14, 16, 18, 20, 22, 25, 28, 32, 36, 40, 45, 50, 56, 63, 71, 80, 90 ms

0.10, 0.12, 0.14, 0.16, 0.18, 0.20, 0.22, 0.25, 0.28, 0.32, 0.36, 0.40, 0.45, 0.50, 0.56, 0.63, 0.80, 0.90, 1.0, 1.1, 1.25, 1.4, 1.6, 1.8, 2.0, 2.2, 2.5, 2.8, 3.2, 3.6, 4.0, 4.5, 5.0, 5.6, 6.3, 7.1, 8.0, 9.0, 10 s

Fluoroscopy tube voltage

50 kV to 125 kV

1 kV steps

Fluoroscopy tube current

0.3 mA to 4 mA

Fluoroscopy time

Continuous fluoroscopy time 10 minutes

Applicable Procedures

General radiography, fluoroscopic examinations, direct spot filming, DR radiography, vertical Bucky radiography, horizontal Bucky radiography

Radiography Programs

User can create up to 12 radiography conditions per technique

Number of Connectable X-ray Tube Units

ZUD-L41D/DS: 1

ZUD-L40D/DS: 2 with 2-tube option

Starter

High-speed rotation/normal rotation

Number of connectable AEC detectors

I.I. photocell type: 1

Direct phototimer photo sensor: 3 (SPT-XD only)

Options

2-tube option

Auto transformer XAT-2 (3-phase 200/220/240 V required)

High-speed starter (starter SA-42ZUD)

Normal rotation starter (STARTER 4 UL/CE)

Direct phototimer option

Power Supply

Type and frequency	AC, 50 or 60 Hz
Phases and nominal voltage	Single-phase, 200/220/240 V
	3-phase 200/220/240 V
	3-phase 380/400/415/440 V

Permitted voltage range and power supply impedance under no-load status

Single-phase 200/220/240 V	200V-5%,+10%	0.08 Ω
	220V±10%	0.08 Ω
	240V±10%	0.08 Ω
3-phase 200/220/240 V	200V-5%,+10%	0.087 Ω
	220V±10%	0.087 Ω
	240V±10%	0.087 Ω

2. Technical Data

ZUD-L41D/DS , ZUD-L40D/DS

3-phase 380/400/415/440 V	380V±10%	0.16 Ω
	400V±10%	0.17 Ω
	415V±10%	0.19 Ω
	440V±10%	0.21 Ω

Recommended distribution transformer capacity

Single-phase 200/220/240 V: 30 kVA

3-phase 200/220/240 V: 50 kVA

3-phase 380/400/415/440 V: 50 kVA

Length and Sectional Area of Lead-in Conductor vs Distribution Transformer Capacity

Power cable	Distribution transformer capacity kVA	Sectional area of wire (mm^2) (Cu)									
		10m max.	20m max.	30m max.	40m max.	50m max.	60m max.	70m max.	80m max.	90m max.	100m max.
Single-phase, 200 V	30	14	22	38	60	60	100	100	100	100	100
3-phase, 400 V	50	5.5	5.5	5.5	5.5	8	8	8	14	14	14
3-phase, 200 V	50	8	14	14	22	38	38	38	60	60	60

Safety Devices

	Safety Device		Current rating of recommended fuse or circuit breaker
	Type	Capacity	
Single-phase 200/220/240 V	Knife switch or fuse or circuit breaker	100 A min.	100A
3-phase 200/220/240 V	Knife switch or fuse or circuit breaker	100 A min.	100A
3-phase 380/400/415/440V	Circuit breaker	-	50A

If an earth leakage breaker is installed, use an inverter type that does not malfunction at high frequency current.

Earth

Single-phase, 200/220/240 V: Grounding resistance 100 Ω max.

3-phase, 200/220/240 V: Grounding resistance 100 Ω max.

3-phase, 380/400/415/440 V: Grounding resistance 10 Ω max.

Operating environment

Temperature: 5°C to 35°C
Humidity: 20% to 85%
Atmospheric pressure: 700 hPa to 1060 hPa
No condensation
Provide a dedicated air-conditioning unit if the environmental conditions do not meet the conditions above.

Heat generated by equipment

Control console: 30 kcal/h
Power cabinet: 600 kcal/h (170 kcal/h)
These heat generation values are values from an average operating state. The values may differ due to the operating state.
Values in parentheses ( ) indicate the heat generated by the X-ray tube unit.
1 kW = 860 kcal/h

Power consumption

Standby: 500 VA

Short-time maximum rating:	Single-phase 200/220/240 V:	60 kVA
	3-phase 200/220/240 V:	80 kVA
	3-phase 380/400/415/440 V:	80 kVA

Transport and storage environment

Temperature: -10°C to 60°C
Humidity: 10% to 95%
Atmospheric pressure: 700 hPa to 1060 hPa
The conditions above are for the transportation and storage of the equipment in its packaging.

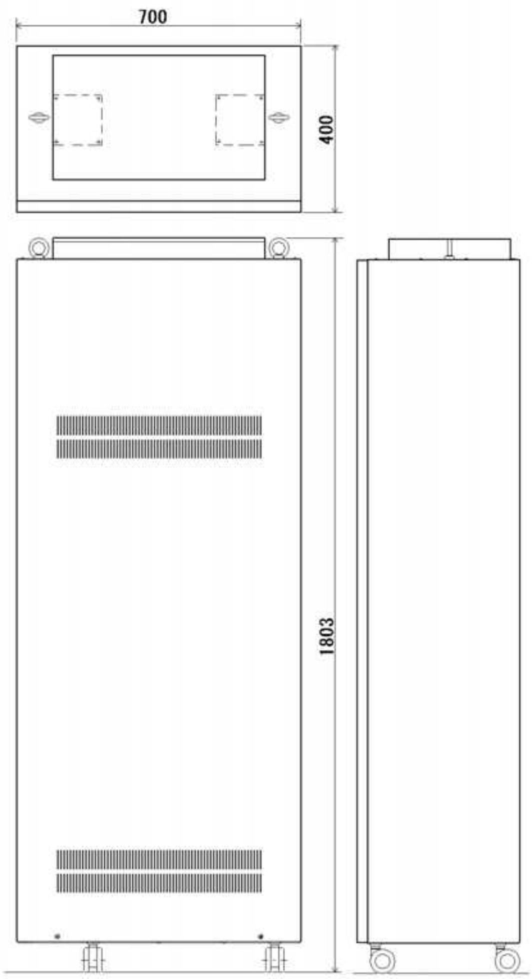
Unit configuration

Control cabinet
Cables
Accessories
(Operating console：XSC-Z40RA/RB/RC Remote Operating Console)

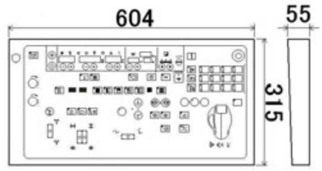
2. Technical Data

ZUD-L41D/DS , ZUD-L40D/DS

External dimensions and weight



Mass 270 kg



Mass 7 kg

2.1.3 ZUD-V40D/DS

Equipment Classifications

Type of protection against electric shocks: Class 1 equipment

Degree of protection against electric shocks: Type B

Waterproofing: Standard

Safe operation in air/flammable anesthetic gas or oxygen/nitrous oxide or flammable anesthetic gas atmosphere: Unsuitable

Operation mode: Continuous operation with intermittent load

Rated output (product of max. tube current that can flow in 0.1 sec and tube voltage at 100 kV tube voltage)

65kW(100kV, 650mA)

Short-time rating

150kV 400mA, 125kV 500mA, 100kV 650mA, 80kV 800mA

Long-time rating

125kV 4mA

Nominal max. tube voltage and maximum current at nominal max. tube voltage

Short-time rating 150 kV 400 mA

Long-time rating 125 kV 4 mA

Max. tube current and maximum voltage at max. tube current

Short-time rating 800 mA 80 kV

Long-time rating 4 mA 125 kV

Tube voltage and tube current combination at maximum electrical output

Short-time rating 100 kV 650 mA

Long-time rating 125 kV 4 mA

Nominal shortest radiation time (for AEC radiography)

3 ms

Radiography tube voltage

40 kV to 150 kV

1 kV steps

2. Technical Data

ZUD-V40D/DS

Radiography tube current

10 mA to 800 mA

Any 12 of the following positions that are permitted by the X-ray tube unit can be used:

10, 11, 12, 14, 16, 18, 20, 22, 25, 28, 32, 36, 40, 45, 50, 56, 63, 71, 80, 90, 100, 110, 125, 140, 160, 180, 200, 220, 250, 280, 320, 360, 400, 450, 500, 560, 630, 710, 800 mA

Radiography tube current time product

0.5 mAs to 800 mAs

Set from the following 65 positions:

0.5, 0.56, 0.63, 0.71, 0.80, 0.90, 1.0, 1.1, 1.25, 1.4, 1.6, 1.8, 2.0, 2.2, 2.5, 2.8, 3.2, 3.6, 4.0, 4.5, 5.0, 5.6, 6.3, 7.1, 8.0, 9.0, 10, 11, 12.5, 14, 16, 18, 20, 22, 25, 28, 32, 36, 40, 45, 50, 56, 63, 71, 80, 90, 100, 125, 140, 160, 180, 200, 220, 250, 280, 320, 360, 400, 450, 500, 560, 630, 710, 800 mAs

Radiography time

0.001 sec to 10 s

Set from the following 81 positions. Do not set to a value less than 0.5 mAs or over 800 mAs.

1.0, 1.1, 1.25, 1.4, 1.6, 1.8, 2.0, 2.2, 2.5, 2.8, 3.2, 3.6, 4.0, 4.5, 5.0, 5.6, 6.3, 7.1, 8.0, 9.0, 10, 11, 12.5, 14, 16, 18, 20, 22, 25, 28, 32, 36, 40, 45, 50, 56, 63, 71, 80, 90ms

0.10, 0.12, 0.14, 0.16, 0.18, 0.20, 0.22, 0.25, 0.28, 0.32, 0.36, 0.40, 0.45, 0.50, 0.56, 0.63, 0.80, 0.90, 1.0, 1.1, 1.25, 1.4, 1.6, 1.8, 2.0, 2.2, 2.5, 2.8, 3.2, 3.6, 4.0, 4.5, 5.0, 5.6, 6.3, 7.1, 8.0, 9.0, 10 s

Fluoroscopy tube voltage

50 kV to 125 kV

1 kV steps

Fluoroscopy tube current

0.3 mA to 4 mA

Fluoroscopy time

Continuous fluoroscopy time 10 minutes

Applicable Procedures

General radiography, fluoroscopic examinations, direct spot filming, DR radiography, vertical Bucky radiography, horizontal Bucky radiography

Radiography Programs

User can create up to 12 radiography conditions per technique

Number of Connectable X-ray Tube Units

2

Starter

High-speed rotation/normal rotation

Number of connectable AEC detectors

I.I. photocell type: 1

Direct phototimer photo sensor: 3 (SPT-XD only)

Options

2-tube option

Auto transformer (3-phase 200/220 V required)

High-speed starter (starter SA-42ZUD)

Normal rotation starter (starter 4 CE/UL)

Direct phototimer option

Power Supply

Type and frequency	AC, 50 Hz or 60 Hz
Phases and nominal voltage	3- phase, 200/220/240 V
	3-phase 380/400/415/440 V

Permitted voltage range and power supply impedance under negative load

3-phase 200/220/240 V	200V±10%	0.054 Ω
	220V±10%	0.054 Ω
	240V±10%	0.054 Ω
3-phase 380/400/415/440 V	380V±10%	0.10 Ω
	400V±10%	0.11 Ω
	415V±10%	0.12 Ω
	440V±10%	0.13 Ω

Recommended distribution transformer capacity

3-phase 200/220/240 V:	75 kVA
3-phase 380/400/415/440 V:	75 kVA

Length and Sectional Area of Lead-in Conductor vs Distribution Transformer Capacity

Power cable	Distribution transformer capacity kVA	Sectional area of wire (mm^2) (Cu)									
		10m max.	20m max.	30m max.	40m max.	50m max.	60m max.	70m max.	80m max.	90m max.	100m max.
3-phase, 200 V	75	14	22	38	38	60	60	60	100	100	100
3-phase, 400 V	75	5.5	8	14	22	22	22	38	38	38	38

2. Technical Data

ZUD-V40D/DS

Safety Devices

	Safety Device		Current rating of recommended fuse or circuit breaker
	Type	Capacity	
3-phase 200/220/240 V	Knife switch or fuse or circuit breaker	100 A min.	100 A
3-phase 380/400/415/440 V	Circuit breaker	-	100 A

If an earth leakage breaker is installed, use an inverter type that does not malfunction at high frequencies.

Earth

3-phase, 200/220/240 V: Grounding resistance 100 Ω max.

3-phase, 380/400/415/440 V: Grounding resistance 10 Ω max.

Operating environment

Temperature: 5 °C to 35 °C

Humidity: 20% to 85%

Atmospheric pressure: 700 hPa to 1060 hPa

No condensation

Provide a dedicated air-conditioning unit if the environmental conditions do not meet the conditions above.

Heat generated by equipment

Control console: 30 kcal/h

Power cabinet: 680 kcal/h (220 kcal/h)

These heat generation values are values from an average operating state. The values may differ due to the operating state.

Values in parentheses ( ) indicate the heat generated by the X-ray tube unit.

1 kW = 860 kcal/h

Power consumption

Standby: 500 VA

Short-time maximum rating: 120 kVA

Transport and storage environment

Temperature: -10 °C to 60 °C

Humidity: 10% to 95%

Atmospheric pressure: 700 hPa to 1060 hPa

The conditions above are for the transportation and storage of the equipment in its packaging.

Unit configuration

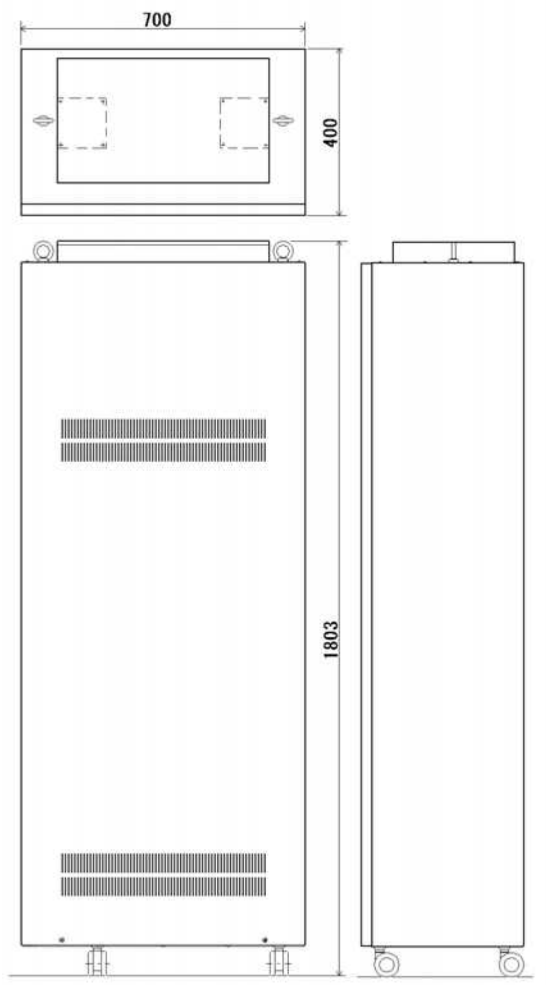
Control cabinet

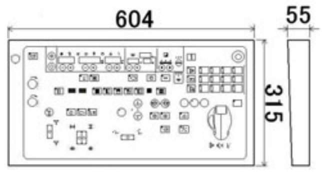
Cables

Accessories

(Operating console: XSC-Z40RA/RB/RC Remote Operating Console)

External dimensions and weight





Mass 270 kg

Mass 7 kg

2.1.4 ZUD-B40D/DS

Equipment Classifications

Type of protection against electric shocks: Class 1 equipment

Degree of protection against electric shocks: Type B

Waterproofing: Standard

Safe operation in air/flammable anesthetic gas or oxygen/nitrous oxide or flammable anesthetic gas atmosphere: Unsuitable

Operation mode: Continuous operation with intermittent load

Rated output (product of max. tube current that can flow in 0.1 sec and tube voltage at 100 kV tube voltage)

80 kW (100 kV, 800 mA)

Short-time rating

150kV 500mA, 125kV 630mA, 100kV 800mA, 80kV 1000mA

Long-time rating

125kV 4mA

Nominal max. tube voltage and maximum current at nominal max. tube voltage

Short-time rating 150 kV 500 mA

Long-time rating 125 kV 4 mA

Max. tube current and maximum voltage at max. tube current

Short-time rating 1000 mA 80 kV

Long-time rating 4 mA 125 kV

Tube voltage and tube current combination at maximum electrical output

Short-time rating 100 kV 800 mA, 80 kV 1000 mA

Long-time rating 125 kV 4 mA

Nominal shortest radiation time (for AEC radiography)

3 ms

Radiography tube voltage

40 kV to 150 kV

1 kV steps

Radiography tube current

10 mA to 1000 mA

Any 12 of the following positions that are permitted by the X-ray tube unit can be used:

10, 11, 12, 14, 16, 18, 20, 22, 25, 28, 32, 36, 40, 45, 50, 56, 63, 71, 80, 90, 100, 110, 125, 140, 160, 180, 200, 220, 250, 280, 320, 360, 400, 450, 500, 560, 630, 710, 800, 900, 1000 mA

Radiography tube current time product

0.5 mAs to 800 mAs

Set from the following 65 positions:

0.5, 0.56, 0.63, 0.71, 0.80, 0.90, 1.0, 1.1, 1.25, 1.4, 1.6, 1.8, 2.0, 2.2, 2.5, 2.8, 3.2, 3.6, 4.0, 4.5, 5.0, 5.6, 6.3, 7.1, 8.0, 9.0, 10, 11, 12.5, 14, 16, 18, 20, 22, 25, 28, 32, 36, 40, 45, 50, 56, 63, 71, 80, 90, 100, 125, 140, 160, 180, 200, 220, 250, 280, 320, 360, 400, 450, 500, 560, 630, 710, 800 mAs

Radiography time

0.001 sec to 10 s

Set from the following 81 positions. Do not set to a value less than 0.5 mAs or over 800 mAs.

1.0, 1.1, 1.25, 1.4, 1.6, 1.8, 2.0, 2.2, 2.5, 2.8, 3.2, 3.6, 4.0, 4.5, 5.0, 5.6, 6.3, 7.1, 8.0, 9.0, 10, 11, 12.5, 14, 16, 18, 20, 22, 25, 28, 32, 36, 40, 45, 50, 56, 63, 71, 80, 90ms

0.10, 0.12, 0.14, 0.16, 0.18, 0.20, 0.22, 0.25, 0.28, 0.32, 0.36, 0.40, 0.45, 0.50, 0.56, 0.63, 0.80, 0.90, 1.0, 1.1, 1.25, 1.4, 1.6, 1.8, 2.0, 2.2, 2.5, 2.8, 3.2, 3.6, 4.0, 4.5, 5.0, 5.6, 6.3, 7.1, 8.0, 9.0, 10 s

Fluoroscopy tube voltage

50 kV to 125 kV

1 kV steps

Fluoroscopy tube current

0.3 mA to 4 mA

Fluoroscopy time

Continuous fluoroscopy time   10 minutes

Applicable Procedures

General radiography, fluoroscopic examinations, direct spot filming, DR radiography, vertical Bucky radiography, horizontal Bucky radiography

Radiography Programs

User can create up to 12 radiography conditions per technique

Number of Connectable X-ray Tube Units

2

Starter

High-speed rotation/normal rotation

Number of connectable AEC detectors

I.I. photocell type: 1

Direct phototimer photo sensor: 3 (SPT-XD only)

Options

2-tube option

Auto transformer (3-phase 200/220/240 V required)

High-speed starter (starter SA-42ZUD)

Normal rotation starter (starter 4 CE/UL)

Direct phototimer option

Power Supply

Type and frequency	AC, 50 Hz or 60 Hz
Phases and nominal voltage	3- phase, 200/220/240 V
	3-phase 380/400/415/440 V

Permitted voltage range and power supply impedance under negative load

3-phase 200/220/240 V	200V±10%	0.054 Ω
	220V±10%	0.054 Ω
	240V±10%	0.054 Ω
3-phase 380/400/415/440 V	380V±10%	0.10 Ω
	400V±10%	0.11 Ω
	415V±10%	0.12 Ω
	440V±10%	0.13 Ω

Recommended distribution transformer capacity

3-phase 200/220/240 V:	75 kVA
3-phase 380/400/415/440 V:	75 kVA

Length and Sectional Area of Lead-in Conductor vs Distribution Transformer Capacity

Power cable	Distribution transformer capacity kVA	Sectional area of wire (mm^2) (Cu)									
		10m max.	20m max.	30m max.	40m max.	50m max.	60m max.	70m max.	80m max.	90m max.	100m max.
3-phase, 400 V	75	5.5	8	14	22	22	22	38	38	38	38
3-phase, 200 V	75	14	22	38	38	60	60	60	100	100	100

Safety Devices

	Safety Device		Current rating of recommended fuse or circuit breaker
	Type	Capacity	
3-phase 200/220/240 V	Knife switch or fuse or circuit breaker	100 A min.	100 A
3-phase 380/400/415/440 V	Circuit breaker	-	100 A

If an earth leakage breaker is installed, use an inverter type that does not malfunction at high frequency current.

Earth

3-phase, 200/220/240 V: Grounding resistance 100 Ω max.

3-phase, 380/400/415/440 V: Grounding resistance 10 Ω max.

Operating environment

Temperature: 5 °C to 35 °C

Humidity: 20% to 85%

Atmospheric pressure: 700 hPa to 1060 hPa

No condensation

Provide a dedicated air-conditioning unit if the environmental conditions do not meet the conditions above.

Heat generated by equipment

Control console: 30 kcal/h

Power cabinet: 680 kcal/h (200 kcal/h)

These heat generation values are values from an average operating state. The values may differ due to the operating state.

Values in parentheses ( ) indicate the heat generated by the X-ray tube unit.

1 kW = 860 kcal/h

Power consumption

Standby: 500 VA

Short-time maximum rating: 130 kVA

Transport and storage environment

Temperature:	-10 °C to 60 °C
Humidity:	10% to 95%
Atmospheric pressure:	700 hPa to 1060 hPa

The conditions above are for the transportation and storage of the equipment in its packaging.

Unit configuration

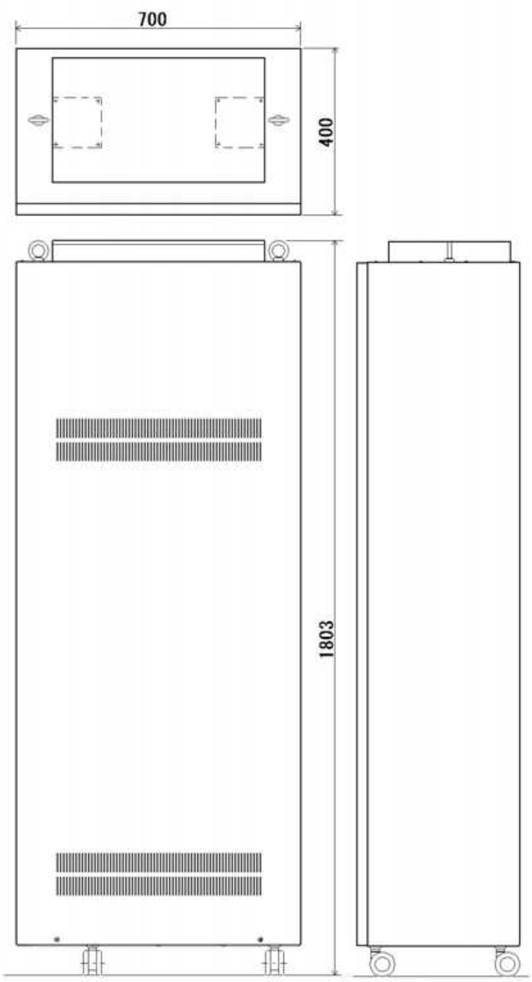
Control cabinet

Cables

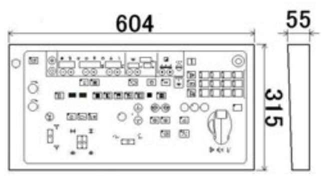
Accessories

(Operating console: XSC-Z40RA/RB/RC Remote Operating Console)

External dimensions and weight



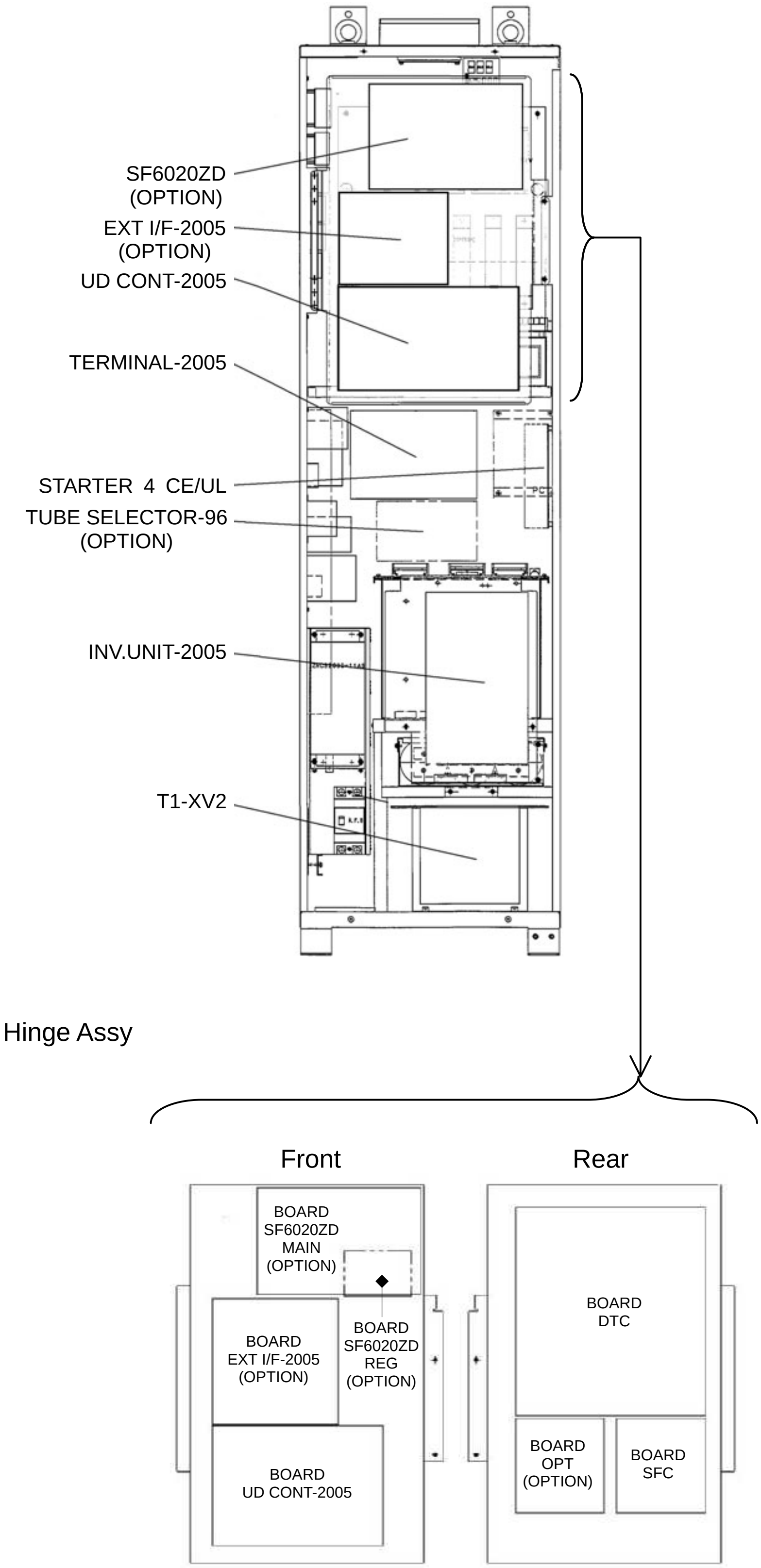
Mass 270 kg



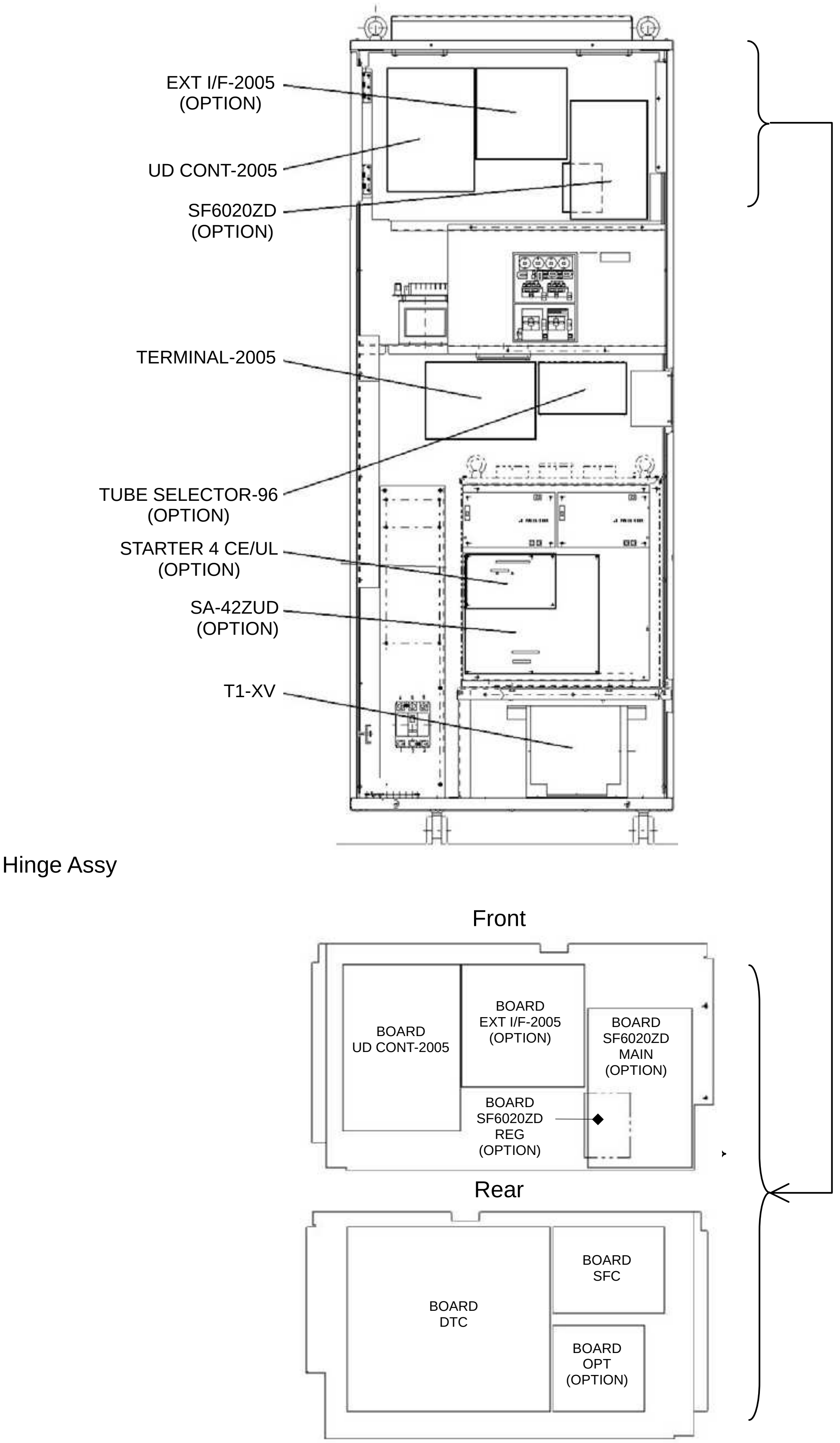
Mass 7 kg

2.2 Internal Structure

2.2.1 ZUD-P40D/DS Cabinet



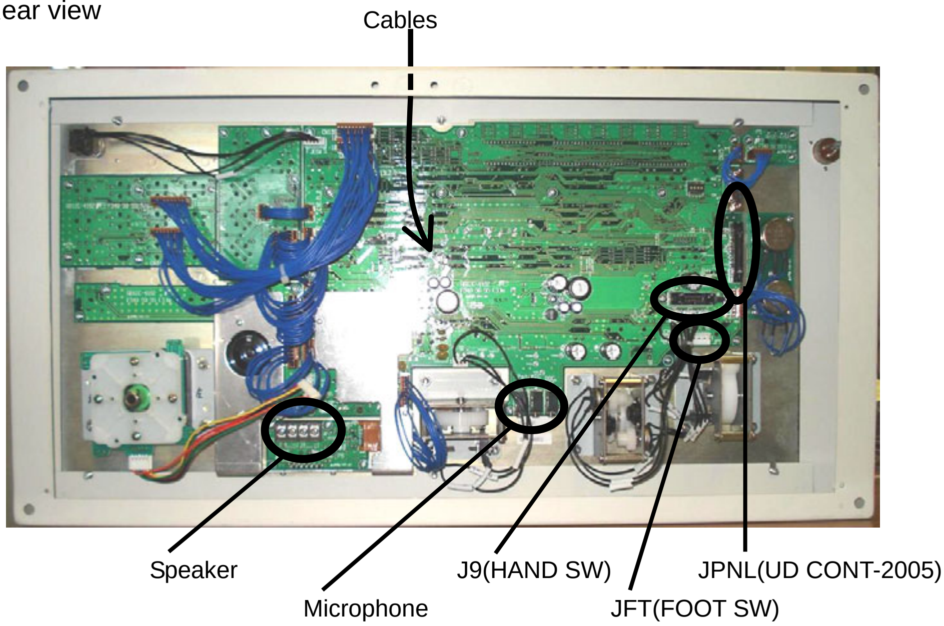
2.2.2 ZUD-L41D/DS, ZUD-L40D/DS, ZUD-V40D/DS, ZUD-B40D/DS Cabinet



2.2.3 XSC-Z40RA/RB/RC Remote Operating Console

Front view

Rear view



Package Remote console type name correlation table

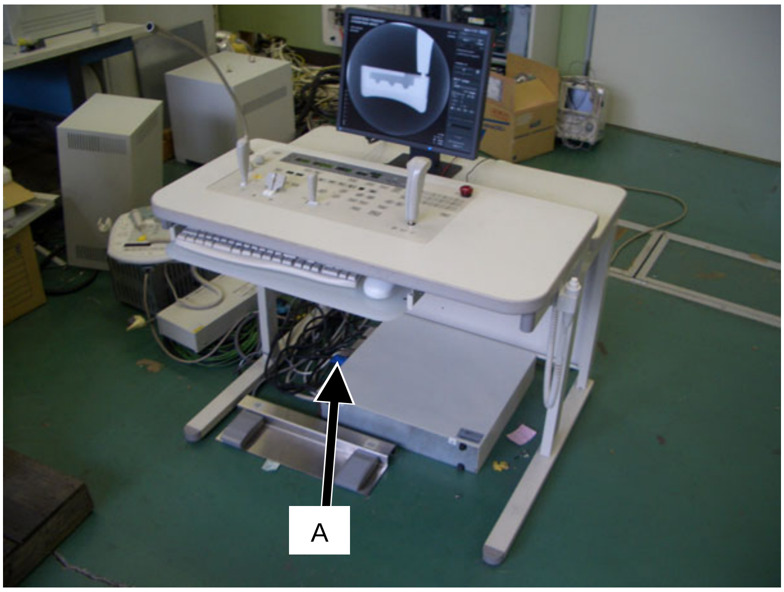
Remote console type name	Package name
XSC-Z40RA	SF Package
XSC-Z40RB	HB Package
XSC-Z40RC	FD Package

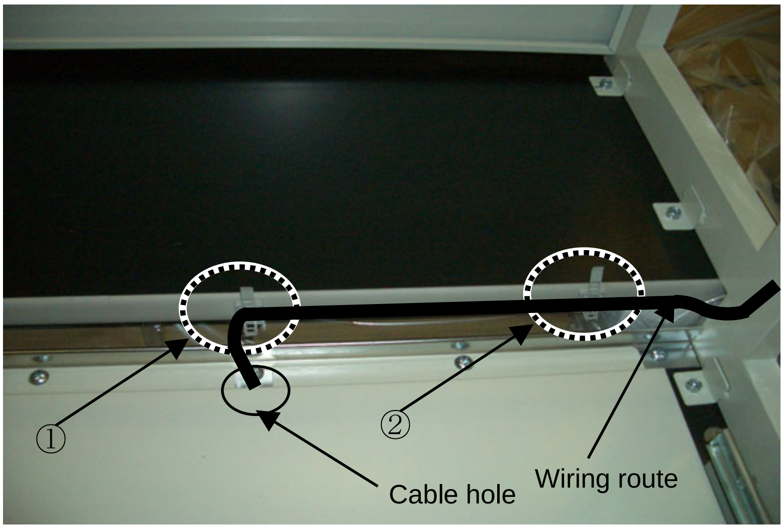
Confirm that DIP Switch SW3 of remote console all turns off.

Wiring fixed method of remote console of desk type

In case of remote console of desk type, fix wire following figure.

Wiring clamp for fixing is supplied with remote console.





A. Arrow diagram

1) Attach wiring clamp to cable hole rear. (①)
2) With layout if combination device such as control cabinet and the like, attach remaining wiring clamp to frame of desk, and wire.

In case of SF package, doctor microphone is equipped with monitor, so microphone on the remote console is not necessary. Blindfold hole for microphone with cover following method.

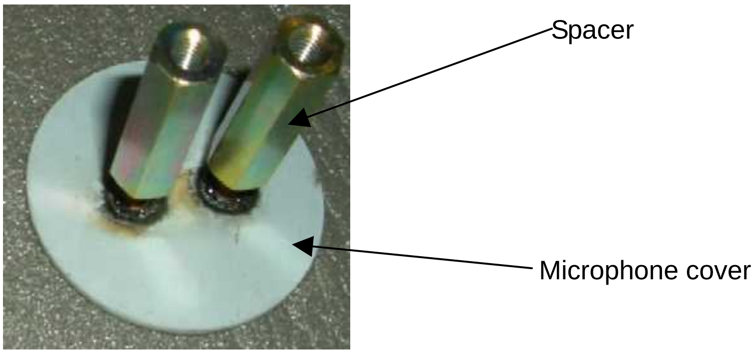
Console comprises the following parts.

- Microphone cover ······1pcs
- Screw plate ······1pcs
- Spacer(M4X25) ······2pcs
- SEMS screw(M4X12) ······2pcs
- Nut(M4) ······2pcs

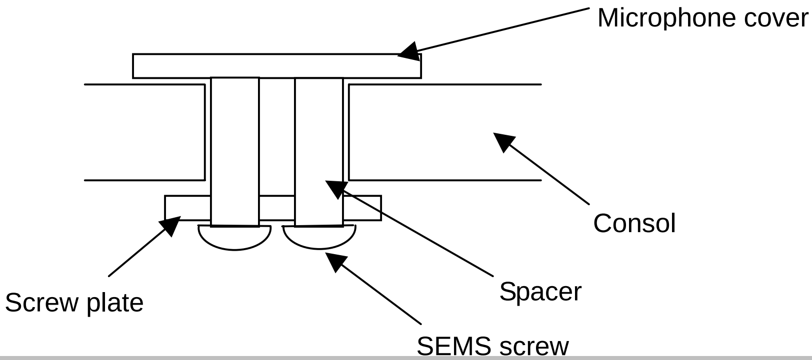
1) In case of desk type console

Desk type console

① Mount spacer(MX25) to microphone cover.



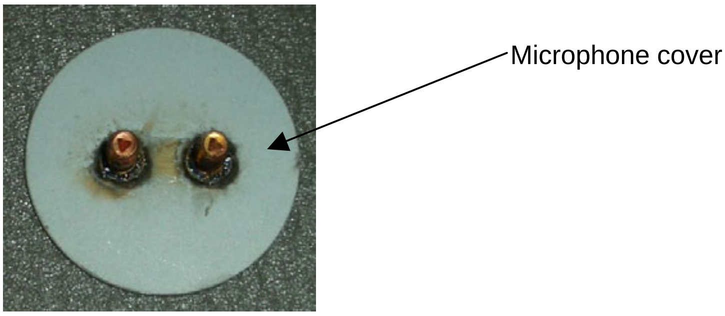
② Microphone cover which made up procedure ① let in hole for microphone of console, fix screw plate by SEMS screw(M4X12) from reverse.



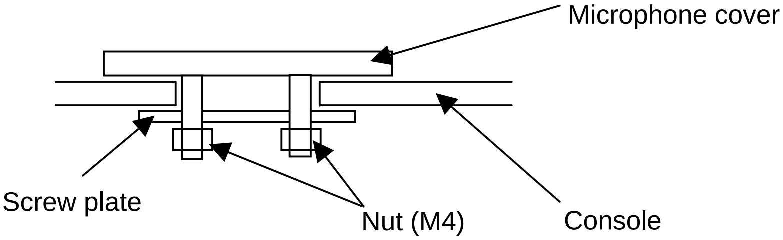
2) In case of desk top type console

Desk top type console

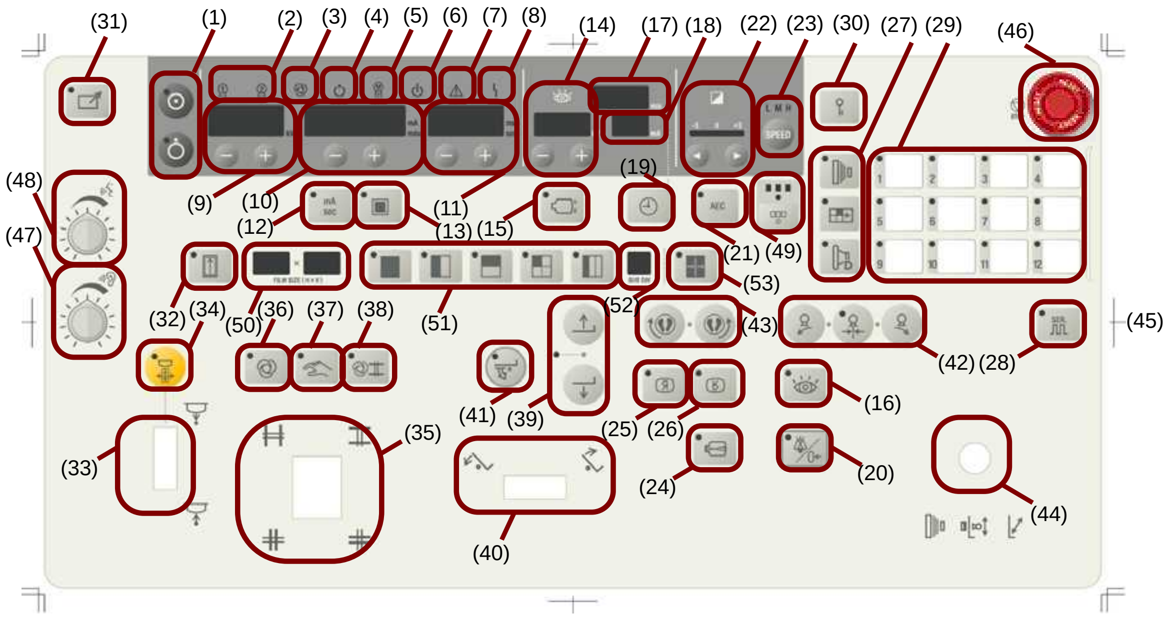
① It use to microphone cover without change.



② Put cover of ① in hole for microphone of console, fix screw plate by nut(M4) from reverse.



Key to the Remote Console



(1) Unit [Power] buttons
Turn the power ON and OFF.

(2) [Selected X-ray tube] indicators
The indicator corresponding to the X-ray tube ready for irradiation lights. As an X-ray tube is assigned to each radiography technique, the tube switches automatically when the radiography technique is changed.

(3) [Memory shot] indicator
When the APR registered for memory shot radiography is selected, the memory shot radiography function turns ON and this [Memory shot selected] indicator lights. When an APR not registered for memory shot radiography is selected, the memory shot radiography function turns OFF and this indicator goes out.

(4) [Radiography Ready Up] indicator
Preparation for X-ray exposure starts when the hand switch is pushed to the first position or the [Spot filming] button is pressed. This indicator lights when X-ray exposure can be conducted immediately. When this indicator is lit, push the hand switch to the second position to start exposure. After the [Spot filming] button was pressed, exposure starts immediately after the system enters the exposure standby status.

(5) [X-ray] indicator
This indicator lights during X-ray exposure.

(6) [Unit standby] indicator

This indicator lights when the unit is in a status permitting X-ray exposure operations. When this indicator is not lit, radiography or fluoroscopy cannot be started by pressing the [Exposure] button or foot switch.

(7) [Unit warning] indicator

This indicator lights if X-ray exposure is disabled due to the door interlock, overheating, or if the radiography X-ray conditions exceed the unit ratings. The error code about the warning is displayed in the [Radiography time] display area.

(8) [Unit fault] indicator

This indicator lights when a problem, such as an tube overvoltage, occurs that suggests a fault in the unit. The error code about the warning for the fault is displayed in the [Radiography time] display area.

(9) [Radiography tube voltage] adjustment keys and display

The display shows the current radiography tube voltage. Pressing the [+] or [–] key increases or decreases the tube voltage in steps of 1KV. Holding down the key for a long time increases the rate at which the setting changes. The setting cannot be changed during radiography or in the exposure standby status.

If [Measured value display] is set ON in the initial settings, the actual measured tube voltage is displayed after radiography. The decimal point at the first digit position lights to indicate a measured value display. The measured value display switches to the set value display in the following situations:

* When the next radiography starts
* When the radiography conditions are changed (tube voltage, tube current, radiography time, 2-control/3-control mode, focus, technique, or APR selection)

(10)[Radiography tube current (mAs)] adjustment keys and display

The display shows the current radiography tube current or radiography mAs. Radiography mAs is displayed in the 2-control mode. The radiography tube current is displayed in the 3-control mode.

Pressing the [+] or [–] key increases or decreases the setting. Holding down the key for a long time increases the rate at which the setting changes. The setting cannot be changed during radiography or in the exposure standby status.

If [Measured value display] is set ON in the initial settings, the actual measured tube current or mAs after radiography is displayed. The decimal point at the first digit position lights to indicate a measured value display. The measured value display switches to the set value display in the following situations:

* When the next radiography starts

* When the radiography conditions are changed (tube voltage, tube current, radiography time, 2-control/3-control mode, focus, technique, or APR selection)

(11) [Radiography time] adjustment keys and display

The display shows the current radiography time. In the 3-control mode, pressing the [+] or [–] key increases or decreases the setting. Holding down the key for a long time increases the rate at which the setting changes. The setting cannot be changed in the 2-control mode, during radiography or in the exposure standby status.

If [Measured value display] is set ON in the initial settings, when phototimer radiography is conducted, the actual measured time is displayed after radiography. The decimal point at the first digit position lights to indicate a measured value display.

The measured value display switches to the set value display in the following situations:

* When the next rdiograpy starts
* When the radiography conditions are changed (tube voltage, tube current, radiography time, 2-control/3-control mode, focus, technique, or APR selection)

(12) [mAs ON/OFF] key and indicator

This key selects whether the radiography conditions are set in the 2-control mode (tube voltage and mAs) or in the 3-control mode (tube voltage, tube current, and radiography time).

The LED indicator in the key lights when the 3-control mode is selected. The setting cannot be changed during radiography or in the exposure standby status.

(13) [Focus selector] key and indicator

This key selects the focus used for radiography. If the radiography conditions are exceeded at the set tube voltage after focus selection, the radiography conditions are changed to become maximum at the set tube voltage.

The LED indicator in the key lights when the small focus is selected. This setting cannot be changed if a fixed-focus X-ray tube is used, during radiography or in the exposure standby status.

(14) [Fluoroscopy tube voltage] adjustment keys and display

When a fluoroscopic technique is selected, the current fluoroscopy tube voltage is displayed. Pressing the [+] or [–] key increases or decreases the setting in steps of 1KV. Holding down the key for a long time increases the rate at which the setting changes. The setting cannot be changed if IBS is ON.

(15) [IBS ON/OFF] key and indicator

This key turns ON/OFF the IBS function that automatically adjusts the fluoroscopy tube voltage to achieve a stable image brightness. The LED indicator in the key lights when IBS is ON.

(16)[Fluoroscopy enabled ON/OFF] adjustment key and indicator

This switch enables or disables fluoroscopy from the foot switch. The indicator lights when fluoroscopy is enabled. It does not light when a non-fluoroscopic technique is selected. This setting is forced OFF when a non-fluoroscopic technique is selected.

(17)[Fluoroscopy tube current] display

When a fluoroscopic technique is selected, the current fluoroscopy tube current is displayed. The mean tube current is displayed for pulsed fluoroscopy.

(18)[Fluoroscopy integration time] display

When a fluoroscopic technique is selected, the current fluoroscopy integration time is displayed.

(19)[Fluoroscopy preset timer] time setting key

When a fluoroscopic technique is selected, this key selects the time setting for the fluoroscopy preset timer. After this key is held down for several seconds, the preset time flashes in the [fluoroscopy integration time] display.

The initial preset time is 4.5 minutes. The setting decreases in 30-second intervals each time the key is pressed and cycles as follows:

4.5 min->4.0 min->3.5 min->3.0 min->2.5 min->2.0 min->1.5 min
->1.0 min->0.5 min->-- min（buzzer sounds during fluoroscopy）->4.5 min

(20)[Fluoroscopy timer buzzer stop] key and [Fluoroscopy integration time reset] key

When the preset fluoroscopy integration time elapses after this key is pressed, the LED indicator in the key flashes and a warning buzzer sounds if fluoroscopy is being conducted.

Press the [fluoroscopy timer buzzer stop] key to reset the timer. This operation resets only the fluoroscopy integration time elapsed since this key was pressed. It does not reset the fluoroscopy integration time displayed on the console.

To reset the fluoroscopy integration time displayed on the console, hold down this key for at least one second while fluoroscopy is not being conducted.

(21)[Phototimer ON/OFF] key and indicator

This switch enables or disables phototimer radiography. The indicator lights when phototimer radiography is enabled.

The alarm C03 is displayed if radiography is not cut off by the phototimer within the set radiography time during phototimer radiography.

(22)[Phototimer density] select keys and display

When phototimer radiography is ON, the current phototimer density is displayed. Pressing the left or right arrow key increases or decreases the setting.

(23)[Phototimer sensitivity] select key and indicator

When phototimer radiography is ON, the current fluoroscopy sensitivity is indicated. Each time the [SPEED] key is pressed. the setting changes, in the sequence L -> M -> H -> L

(24)[Small field] select key and indicator

This key selects the I.I. field size. The LED indicator in the key lights when the small field size is selected.

(25)[Flip horizontal] key and indicator

Flips the displayed image horizontally. The LED indicator in the key lights when the image is flipped horizontally.

(26)[Flip vertical] key and indicator

Flips the displayed image vertically. The LED indicator in the key lights when image is flipped vertically.

(27)[Technique] select keys and indicators

These keys select the radiography technique. When the radiography technique is changed, the default APR set for that technique is selected.

(28)[Digital spot/serial radiography] select key

This key selects digital spot radiography or serial imaging when a digital radiography technique is selected. The LED indicator in the key lights during serial radiography.

(29)[APR (Anatomical Program)] select keys and indicators

These keys allow the following radiography conditions to be registered and called up for radiography techniques:

・Radiography tube voltage
・Radiography tube current
・Radiography mAs
・Radiography time
・2-control/3-control
・Focus size
・IBS ON/OFF
・Phototimer ON/OFF
・Phototimer density
・Phototimer sensitivity
・Selected direct phototimer photo sensor
・I.I. field
・Image flipped horizontally/vertically
・Memory shot ON/OFF and memory shot number

The LED indicator lights in the key corresponding to the selected APR.

(30)[APR setting] key

This key is used to register the currently set conditions to an APR. To register the conditions, press the corresponding APR key while holding down this [Register] key.

(31)[Remote/local console] select key

This key is used to assign or remove user operation rights to the operation console. The operating rights can only be transferred when no controls are being operated, including the foot switch and radiography buttons.

(32)[Cassette feed] key (A/B)

This key moves the spot-film carriage from the cassette unloading position to the radiography standby position. The LED indicator lights when the carriage is at the radiography standby position.

(33)Compression cone operating lever (A. B and C optional)

Push the lever forward to move the compression cone from the standby position to the tabletop. Pull the lever forward to move the compression cone from the tabletop to the standby position.

(34)[Squeeze Compression] key (A. B and C optional)

Use this key to execute Squeeze Compression.

* If this key has been pressed (LED lit), when the tabletop or optical system is moved without operating the compression cone, the compression cone retracts after a 0.5-second delay.
* If this key has been pressed (LED lit), when the tabletop or optical system is moved with the compression cylinder inclined forward, the compression cone does not retract.

(35)Collimator leaf control handle

Adjusts the degree of vertical and horizontal collimator leaf opening.

(36)[Collimator Full-auto mode select] key (A, B)

This key is enabled when a cassette spot-filming technique is selected. The leaf opens to the size set in the selected radiography program, regardless of the X-ray irradiation field size for fluoroscopy.

(37)[Collimator Manual mode select] key (A, B)

This key is enabled when a cassette spot-filming technique is selected. Radiography is conducted with the vertical and horizontal field set for fluoroscopy.

(38)[Collimator Semi-auto mode select] key (A, B)

This key is enabled when a cassette spot-filming technique is selected. The vertical leaf opening is adjusted automatically according to the radiography program but the horizontal opening remains as the field set for fluoroscopy.

(39)[Table up/down] key

This key is enabled only when the table is horizontal. Use this key to raise the entire table. The table moves in the direction indicated by the arrow while the key is pressed. The LED indicator lights when the table height is 850 mm or higher. At this table height, the optical system can move through its full stroke.

(40)[Tabletop tilt] lever

Move the lever to the right to tilt the table toward the vertical. Move the lever to the left to tilt the table to the horizontal. The table tilts at a constant speed.

(41)[Tabletop reverse-tilt] key

Use this key to tilt the tabletop in the reverse direction. To permit the tabletop to tilt in the reverse direction, press this key to light the LED indicator while the tabletop is in the horizontal position.

(42)[Oblique projection] keys (optional for all systems)

Use these keys to tilt the X-ray tube. The X-ray tube moves in the direction indicated by the arrow while the key is pressed.

The X-ray tube moves toward the center position while the middle key is pressed. The LED indicator lights when the X-ray tube reaches the center position.

(43)[Rolling step control] key (optional for all systems)

Use this key to turn the rolling step. The rolling step moves in the direction indicated by the arrow while the key is pressed.

(44)Switch for [Moving Tabletop Laterally, Moving Imaging Longitudinally, radiography start]

* Use this key to move the tabletop laterally. Push the lever to the left to move the tabletop to the left. Push the lever to the right to move the tabletop to the right. (Left = the front-cover side of the R/F table)
* Use this key to move the optical system longitudinally. Push the lever forward to move the optical system toward the head. No speed-adjustment dial is provided.
* Use this key to start radiography X-ray irradiation. It is used for cassette spot-filming and DR radiography techniques.

(45)Hand switch

* Use the hand switch for radiography X-ray irradiation.

(46)[Stop] button

Use this button to stop the R/F table in emergencies. The button lights red while an emergency stop is applied. Turn the button clockwise to release it.

(47)Operation room speaker volume

Use this dial to adjust the speaker volume inside the operation room.

(48)Examination room speaker volume

Use this dial to adjust the speaker volume inside the examination room.

(49)[Direct phototimer photo sensor] select switch

When phototimer radiography is ON, the currently selected direct phototimer photo sensor is indicated. Each time the key is pressed, the currently selected pattern combination changes.

(50)Cassette size and mechanical error display

Displays the size of the cassette loaded in the spot-film carriage or cassette tray.

The display remains blank if no cassette is loaded.

If an error occurs in the R/F table, the error code is shown on this display.

(51)[Multi-division radiography] select keys

Press the key corresponding to the multi-division radiography mode to be used for cassette spot-filming or digital spot radiography techniques. The three vertical multi-division cannot be selected for digital spot radiography.

(52)Number of frames display for multi-division radiography

This display shows the number of remaining frames during multi-division radiography. During digital-spot multi-division radiography, it displays the number of possible frames.

(53)[Seriography ON/OFF] key and indicator

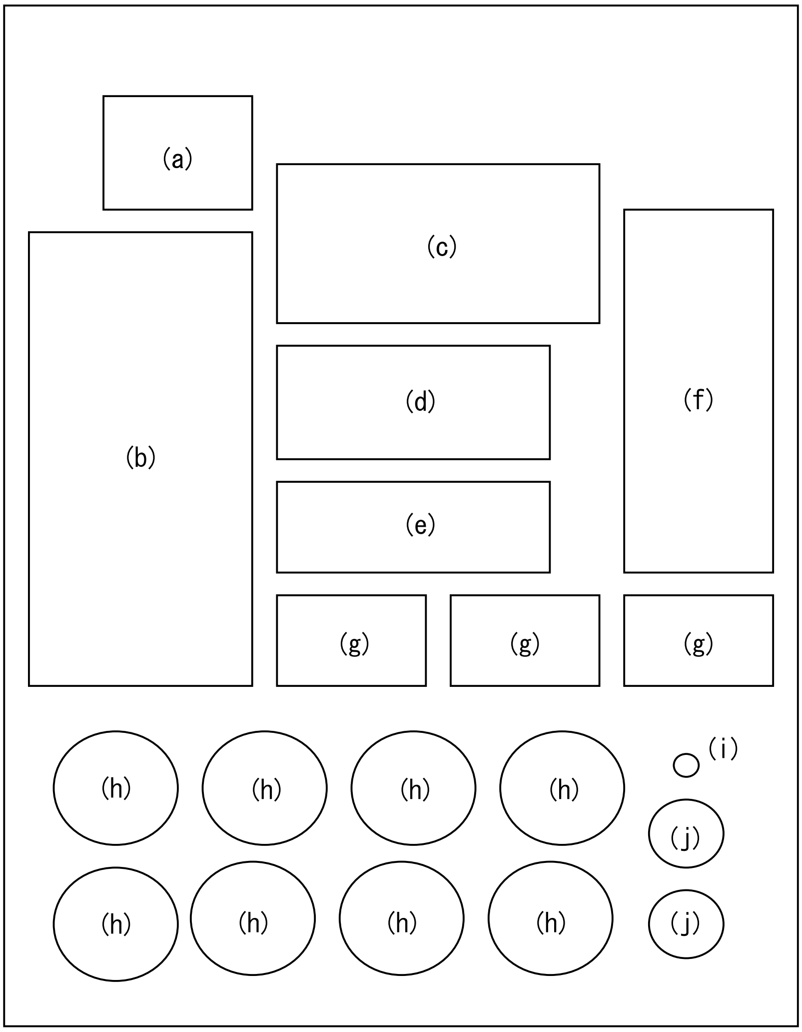
This key turns seriography ON and OFF. It is enabled only during multi-division radiography.

Blindfold sticker for remote console

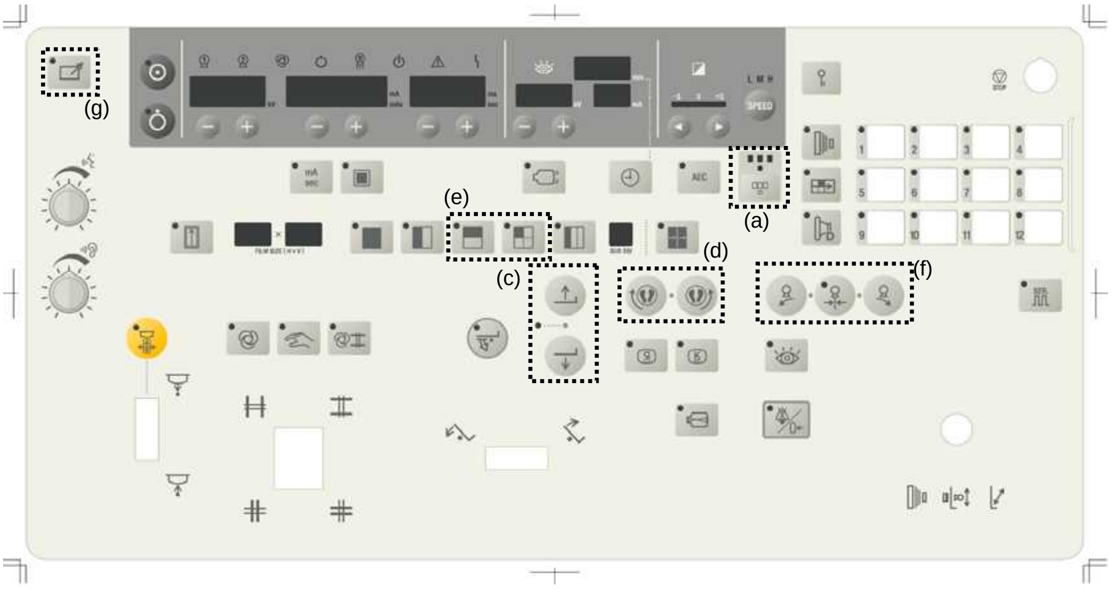
Remote console is equipped with following blindfold sticker.

By the state of use, stick blindfold sticker.

For example, (a) part of remote console sticks sticker(a) for blindfold, stick same symbol sticker.



Blindfold sticker



In case of following situation, stick sticker each symbol.

(a) Stick that when not use direct Phototimer.

(b) To be determined

(c) Stick that when there is no [Table up/down] function.

(d) Stick that when [Rotating foot-stand] is not formed.

(e) Stick that when [Multi-frame imaging] is not formed in SF package.

(f) Stick that when oblique projection is not formed.

(g) Stick that when local console is not formed.

(h) To be determined

(i) To be determined

(j) To be determined

NO TEXT

Chapter 3

Installation and Connection

Chapter Contents

3. Installation and Connection

3.1 Fixing the Cabinet

3.1.1 ZUD-P40D/DS

(1) Attaching the Top Cover

Attach the top cover supplied to the control cabinet using the two eyebolts.

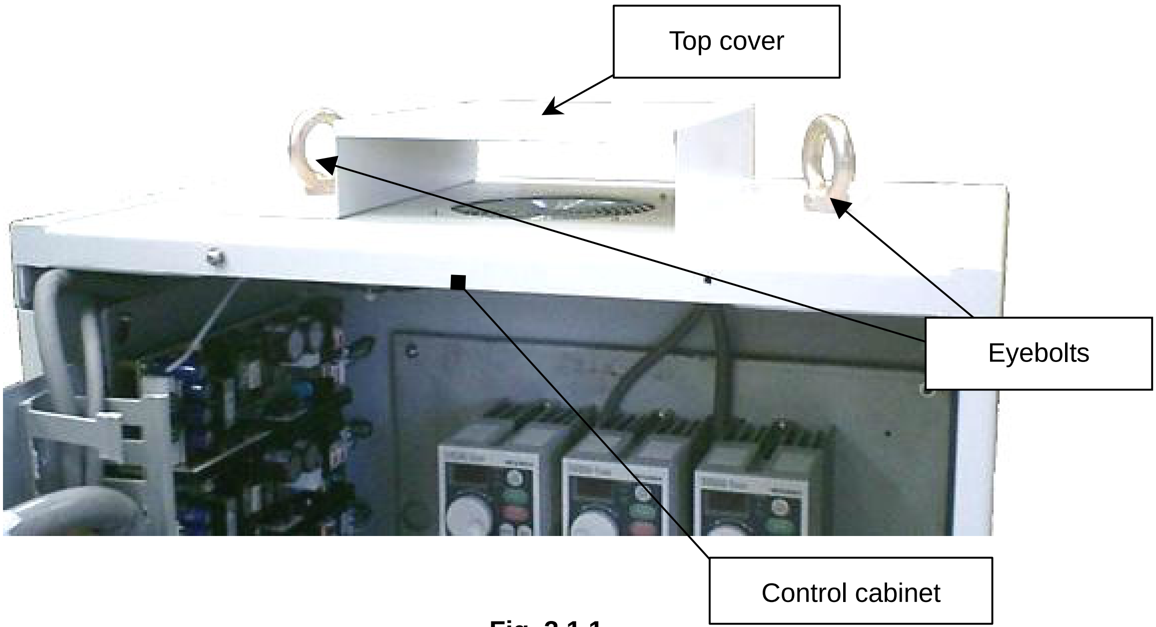


Fig. 3.1.1

(2) Fixing the Cabinet

To prevent the cabinet from tipping over, fix it to a wall using the two retainer brackets (P/N 501-79200) supplied.

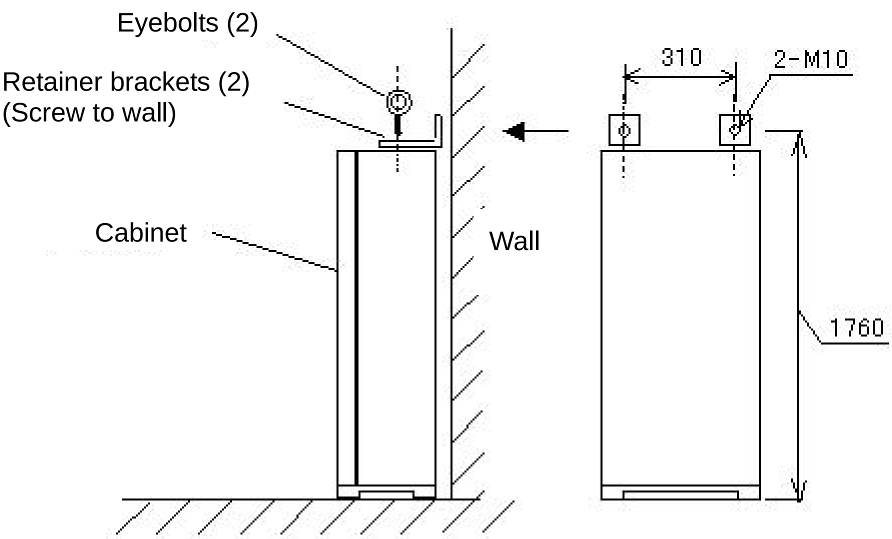


Fig. 3.1.2

3.1.2 ZUD-L41D/DS, ZUD-L40D/DS, ZUD-V40D/DS, ZUD-B40D/DS

(1) Attaching the Top Cover

Attach the top cover supplied to the cabinet using the two eyebolts.

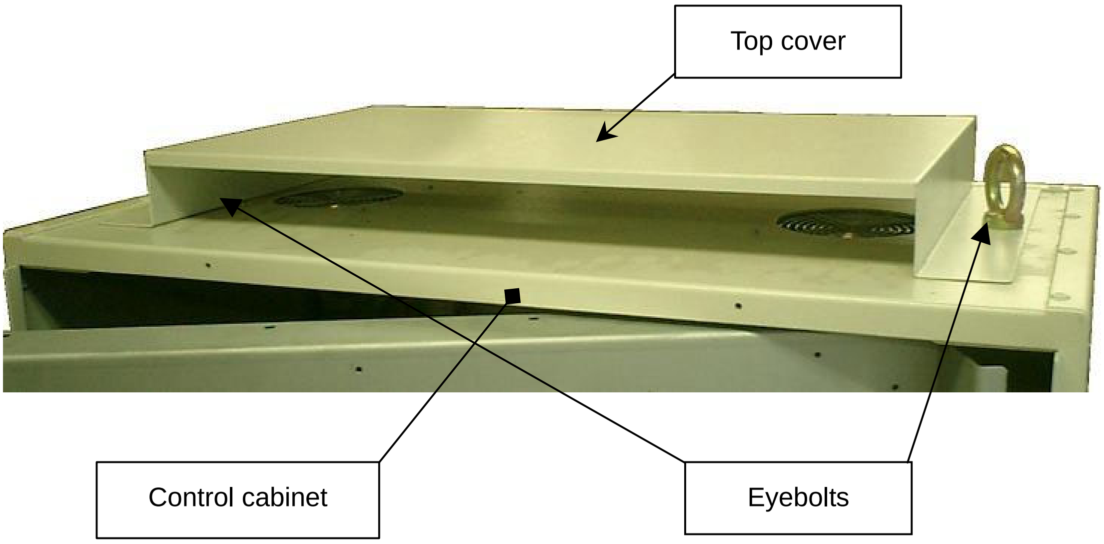


Fig. 3.1.3

(2) Fixing the Cabinet

To prevent the cabinet from tipping over, fix it to a wall using the two retainer brackets (P/N 501-79200) supplied.

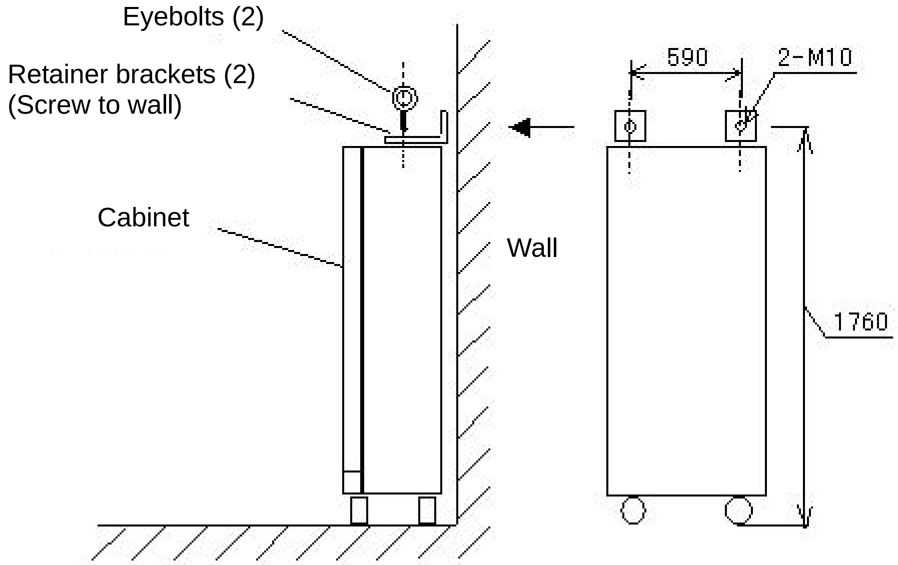


Fig. 3.1.4

3.2 Setting of generator device of each type

Setting of device model type is recognized automatically, by the presence of IC for security, short connecter, and type of high voltage transformer which is connected.

Device model type which is recognized can be confirmed with ZUD-HV Maintenance Tool. “System” → ”System information” → “Model type”. (Refer to 4.19)

	Type of high voltage transformer which is connected	short connecter “ZD-L40” to JINV2	Security key IC “dongle80” to KEY SOCKET M37 of UD CONT-2005 PCB
ZUD-P40	D125PH-C3	○	-
ZUD-L40/L41	D150KH-40/41	○	-
ZUD-V40	D150KH-40	-	×
ZUD-B40		-	○

○：Condition which is necessary to realization (Mount is necessary.)

×：Condition which is necessary to realization (Mount is disapprove.)

－：Condition which is not necessary to realization

3.3 Setting of switch of each PCB・setting jumper pin

3.3.1 Setting of switch of UD CONT-2005 PCB and jumper pin

(1) DIP switch

SW1:CPU, FPGA operation mode setting

		Normal time	Boot mode update time
SW1-1	FPGA operation mode setting	Always ON	
SW1-2		Always OFF	
SW1-3	Not use	Always OFF	
SW1-4	CPU operation mode setting	Always OFF	
SW1-5		Always OFF	
SW1-6		Normal time OFF	Update time ON
SW1-7		Always ON	
SW1-8		Normal time OFF	Update time ON

SW3: S/W operation mode setting

SW3-1	Not use	Always OFF	
SW3-2			
SW3-3			
SW3-4			
SW3-5	Imitation R/F table operation mode ON/OFF	Normal time OFF	When execute fluoroscopy radiography without R/F table is ON
SW3-6	Demonstration mode ON/OFF	Normal time OFF	When execute demonstration mode is ON
SW3-7	Not use	Always ON	
SW3-8	F/W force updating mode ON/OFF	Normal time OFF	When execute force updating is ON

(2) Jumper pin

		1-2 side	1-3 side
JP1	With or without of RTC back up	Not back up	Back up(normal time)
JP2	With or without of termination resistor of CAN	Without termination (normal time)	With termination
JP3	Switching of current loop power of CN9	Use UD CONT built-in ＋15V	Use the power of CN9 connection device
JP4	VP COMP function ON/OFF	VP COMP : OFF (normal time)	VP COMP : ON

3.3.2 Setting of TERMINAL-2005 PCB switch

(1) DIP switch

SW1,2 : Changing of output signal to external device

		SW1 is ON	SW2 is ON
SWxx-1	*1B2-OUT is ON/OFF	Output to CN9(*1B2I)	Output to terminal X1(1B2)
SWxx-2	*2B2-OUT is ON/OFF	Output to CN9(*2B2I)	Output to terminal X1(2B2)
SWxx-3	*KC2-OUT is ON/OFF	Output to CN9(*KC2I)	Output to terminal X1(KC2)
SWxx-4	*KC-OUT is ON/OFF	Output to CN9(*P2I)	Output to terminal X1(KC)
SWxx-5	*XR1M-OUT is ON/OFF	Output to CN9(*1MI)	Output to terminal X1(XR1M)
SWxx-6	*XR2M-OUT is ON/OFF	Output to CN9(*2MI)	Output to terminal X1(XR2M)
SWxx-7	Not use	Always OFF	Always OFF
SWxx-8			

※xx of SWxx show 1 or 2.

3.3.3 Setting EXT I/F-2005 PCB switch

(1) DIP switch

SW1 : FPGA operation mode setting

SW1-1	FGPA operation mode setting	Always ON
SW1-2	FPGA operation mode setting	Always OFF
SW1-3	Not use	Always OFF
SW1-4		
SW1-5		
SW1-6		
SW1-7		
SW1-8		

3.3.4 Set to switch of DTC/SFC/OPT PCB and set to jumper pin

Refer to maintenance chapter 5.1 of ZS-5D/5DS Installation Manual.

3.3.5 Set to switch of Remote console XSC-Z40RA/RB/RC

		Normal time	Boot mode update time
SW3-1	CPU operation mode setting	OFF	ON
SW3-2	Not use	Always OFF	
SW3-3	Not use	Always OFF	
SW3-4	Remote・Local console operation setting	Always OFF	

3.3.6 Set to switch of Local console

		Normal time	Boot mode update time
SW8-1	CPU operation mode setting	OFF	ON
SW8-2	Not use	Always OFF	
SW8-3	Not use	Always OFF	
SW8-4	Remote・Local console operation setting	Always ON	

3.4 Connecting the Power Cable and Cables between Units

DANGER

Before connecting cables, turn off the power supply and open the knife switch or circuit breaker on the power supply unit.

To ensure safety, first connect the grounding cable from the distribution board to the cabinet.
Use spring washers to ensure the terminal does not come loose.

CAUTION

When the hinged unit at the top of the cabinet is open, take care not to bang you head on it when standing up.

WARNING

When attach remote console, be sure to short between 2 and 3 to between 1 and 2 of DTC PCB･JP1 connecter.
When between 2 and 3 is shorted, stop switch of remote console can’t operate.

3.4 Connecting the Power Cable and Cables between Units

3.4.1 ZUD-P40D/DS

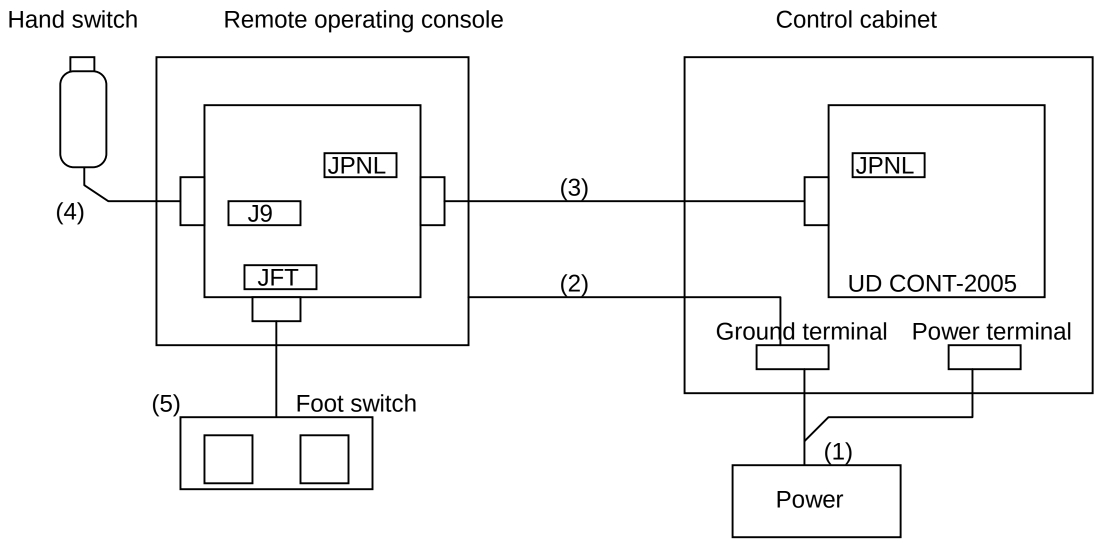


Fig. 3.4.1

(1) Power cable, 25 dia. 14 mm^2, 3-core (502-20669-10), 10 m

Power supply		Cables		Control cabinet	
Single-phase	U V	L1 L2	L1 L2	LU LV	Power terminal block
Ground terminal	⏚	E	E	⏚	Ground terminal block

(2) Control console grounding cable, 3.5 mm^2, green/yellow (502-25685-10), 12 m

Remote operating console		Cables		Control cabinet	
Ground terminal	⏚	E	E	⏚	Ground terminal block

(3) Control console signal cable, AWG#28, 40-core shielded (502-24996-10), 13.7 m

Remote operating console		Cables		Control cabinet	
	JPNL	JPNL	JPNL	JPNL	UD CONT-2005 PCB

(4) Hand switch C2U-23 ASSY (511-64129), 800 mm

Remote operating console		Cables		Hand switch Assy
	J9			

Curled cord, extended length 4500 mm (9.81 N tensile force applied)

(5) Foot switch ASSY (501-78515-01), 2m

Remote operating console		Cables		Foot switch Assy
	JFT			

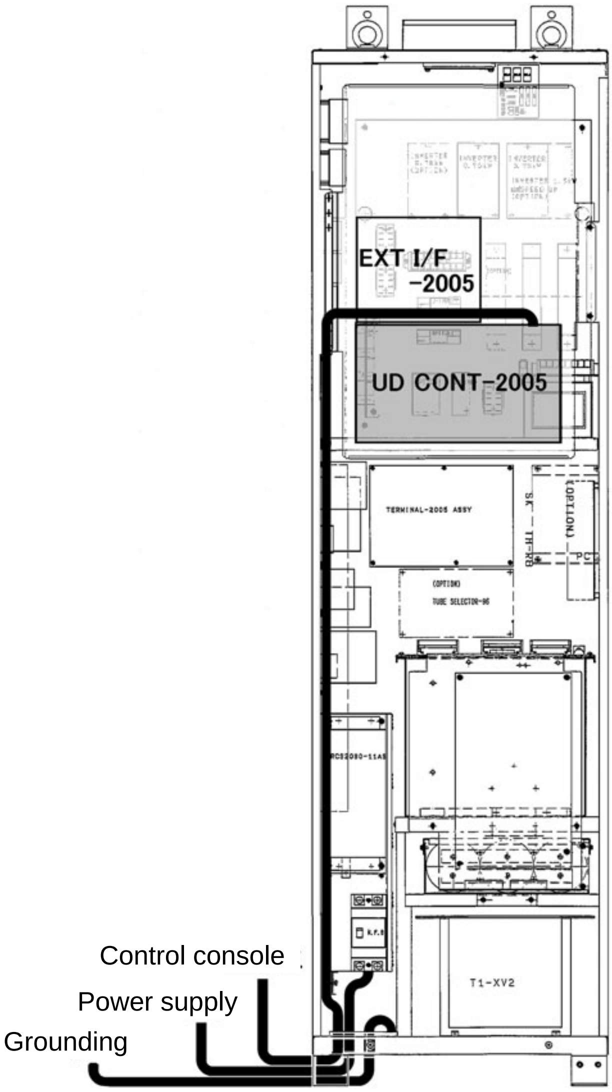


Fig. 3.4.2 Wiring Route

3.4.2 ZUD-L41D/DS, ZUD-L40D/DS, ZUD-V40D/DS, ZUD-B40D/DS

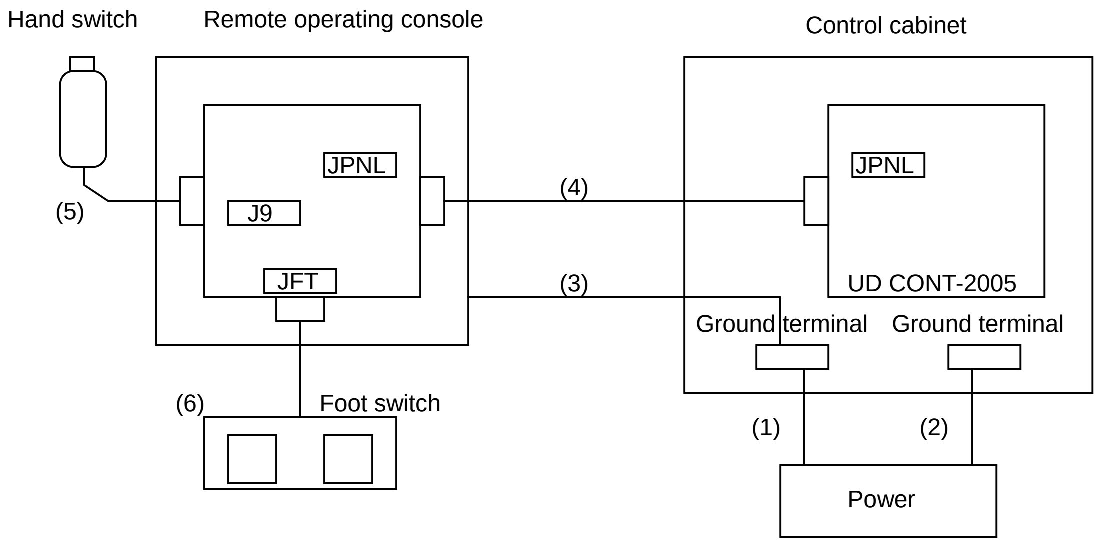


Fig. 3.4.3

(1) Grounding cable, 8 mm dia., 22 mm^2, green/yellow (501-78406-10), 10 m

Power supply		Cables		Control cabinet	
Ground terminal	⏚	E	E	⏚	Ground terminal block

(2) Power cable, 27 mm dia. 22 mm^2, 3-core shielded (501-74885-10), 10 m

Power supply		Cables		Control cabinet	
3-phase power supply	U V W	LU LV LW	LU LV LW	LU LV LW	Power terminal block
			E (shield)	⏚	Ground terminal block

The power cable shield wire must be firmly connected to the ground terminal block in the cabinet.

(3) Control console grounding cable, 3.5 mm^2, green/yellow (502-25685-10), 12 m

Remote operating console		Cables		Control cabinet	
Ground terminal	⏚	E	E	⏚	Ground terminal block

(4) Control console signal cable, AWG#28, 40-core shielded (502-24996-10), 13.7 m

Remote operating console		Cables		Control cabinet	
	JPNL	JPNL	JPNL	JPNL	UD CONT-2005 PCB

(5) Hand switch C2U-23 ASSY (511-64129), 800 mm

Remote operating console		Cables		Hand switch Assy
	J9			

Curled cord, extended length 4500 mm (9.81 N tensile force applied)

(6) Foot switch ASSY (501-78515-01), 2 m

Remote operating console		Cables		Foot switch Assy
	JFT			

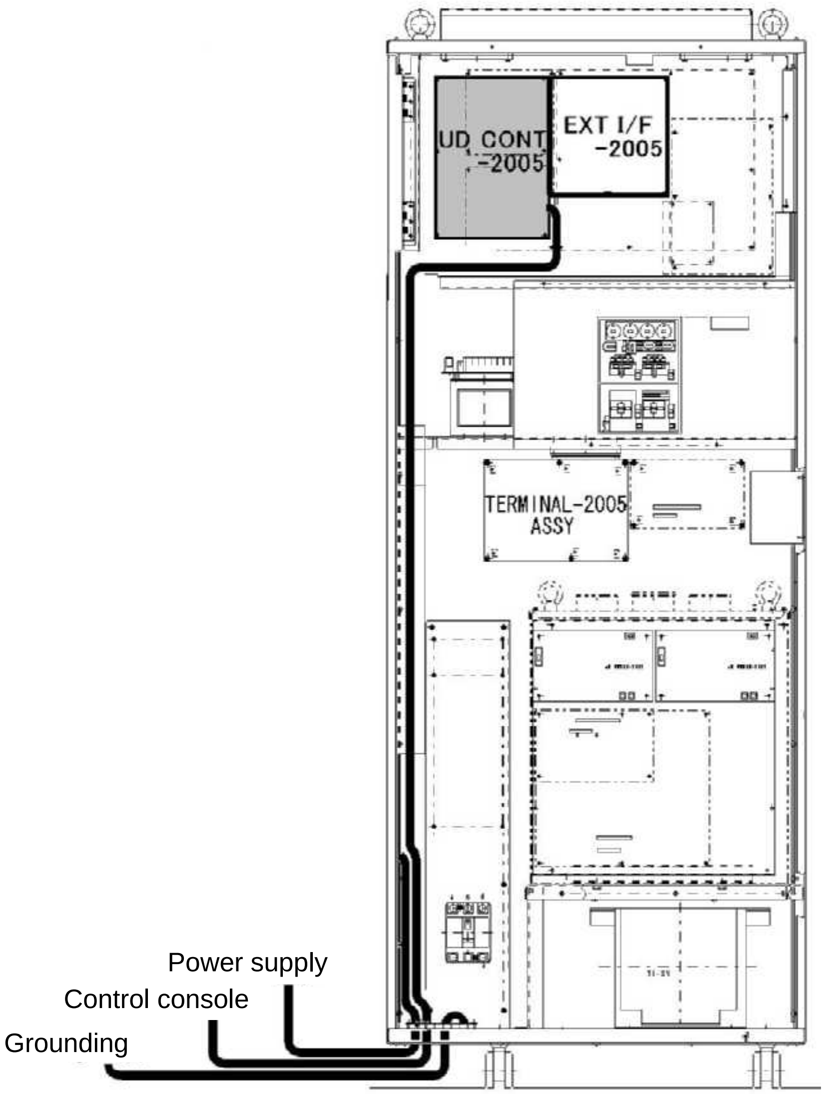


Fig. 3.4.4 Wiring Route

3.5 Changing Connections According to the Power Supply Voltage

DANGER

The connection changes described in this section must be made to suit the supply voltage where the system is installed.

The connections must be changed according to the supply voltage.

The table below lists the changes required for each model and supply voltage.

Model	Supply voltage	Details
ZUD-P40D/DS	Single-phase, 200 V	3.5.1
ZUD-L40D/DS	Three-phase, 400 V	3.5.2
	Three-phase, 200 V	5.1 (Auto Transformer Installation Guide)
	Single-phase, 200 V	3.5.3
ZUD-V40D/DS ZUD-B40D/DS	Three-phase, 400 V	3.5.2
	Three-phase, 200 V	5.1 (Auto Transformer Installation Guide)

3.5.1 ZUD-P40D/DS

(1) Changes to Transformer T1, T2 Connections

Change the input lead connections to transformers T1 and T2 inside the control cabinet according to the supply voltage, as described in the table below.

Supply voltage		T1-XV2		T2-CE	
		AIN-0 terminal	AIN-2 terminal	T2-0 terminal	T2-2 terminal
Single-phase, 200 V	240V ±10%	A0	A240	0	240
	220V ±10%	A0	A220	0	220
	200V -5%,+10%	A0	A200	0	200

DANGER

The default factory connections are made for 200 V.

3.5 Changing Connections According to the Power Supply Voltage

3.5.2 ZUD-L41D/DS, ZUD-L40D/DS, ZUD-V40D/DS, ZUD-B40D/DS Three-phase 400 V System

(1) Changes to Transformer T1, T2 Connections

Change the input lead connections to transformers T1 and T2 inside the control cabinet according to the supply voltage, as described in the table below.

Supply voltage		T1-XV		T2-CE	
		AIN-0 terminal	AIN-2 terminal	T2-0 terminal	T2-2 terminal
Three-phase, 400 V	440V ±10%	-A200	A240	-200	240
	415V ±10%	-A200	A220	-200	220
	400V ±10%	-A200	A200	-200	200
	380V ±10%	-A200	A180	-200	180

DANGER

The default factory connections are made for 400 V.

3.5.3 ZUD-L41D/DS, ZUD-L40D/DS, Single-phase 200 V System

(1) Changes to Transformer T1, T2 Connections

Change the input lead connections to transformers T1 and T2 inside the control cabinet according to the supply voltage, as described in the table below.

Supply voltage		T1-XV		T2-CE	
		AIN-0 terminal	AIN-2 terminal	T2-0 terminal	T2-2 terminal
Single-phase, 200 V	240V ±10%	A0	A240	0	240
	220V ±10%	A0	A220	0	220
	200V -5%,+10%	A0	A200	0	200

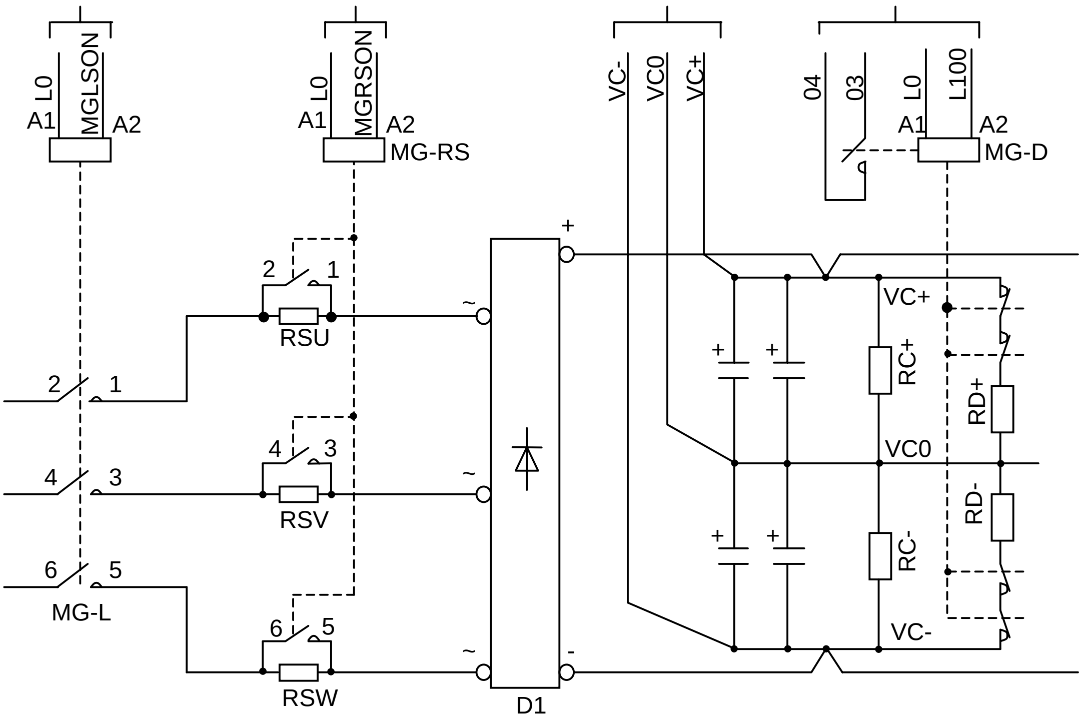
DANGER

The default factory connections are made for 400 V.

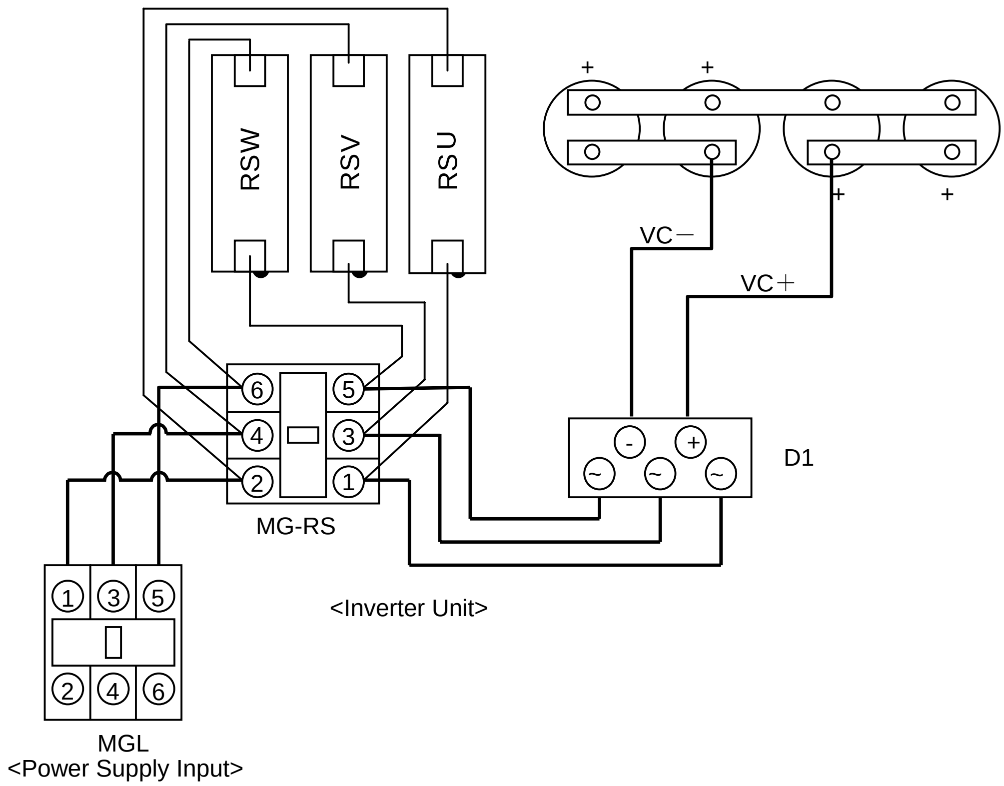
(2) Changing Connections to the Inverter Unit

The inverter unit connections must be changed when a ZUD-L41D/DS or ZUD-L40D/DS cabinet is connected to a single-phase 200 V supply. Refer to Fig. 3.5.2 when connecting the cables. When connecting the cables, use the diode short-circuit plate supplied. In addition, the single-phase 200 V specification must be registered in the initial settings. When making these settings, refer to (4) Option Settings in section 4.4 Initial Settings. As a reference, Fig. 3.5.1 shows the default factory wiring (400 V power supply).

3.5 Changing Connections According to the Power Supply Voltage

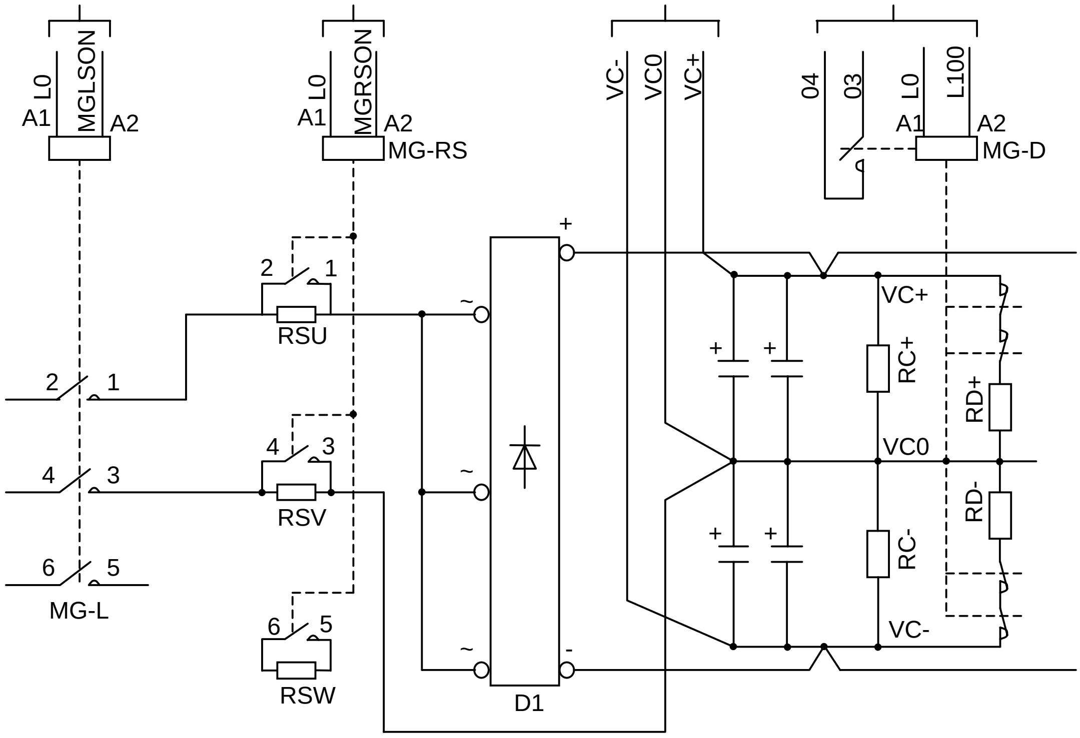


(a) Connection Diagram

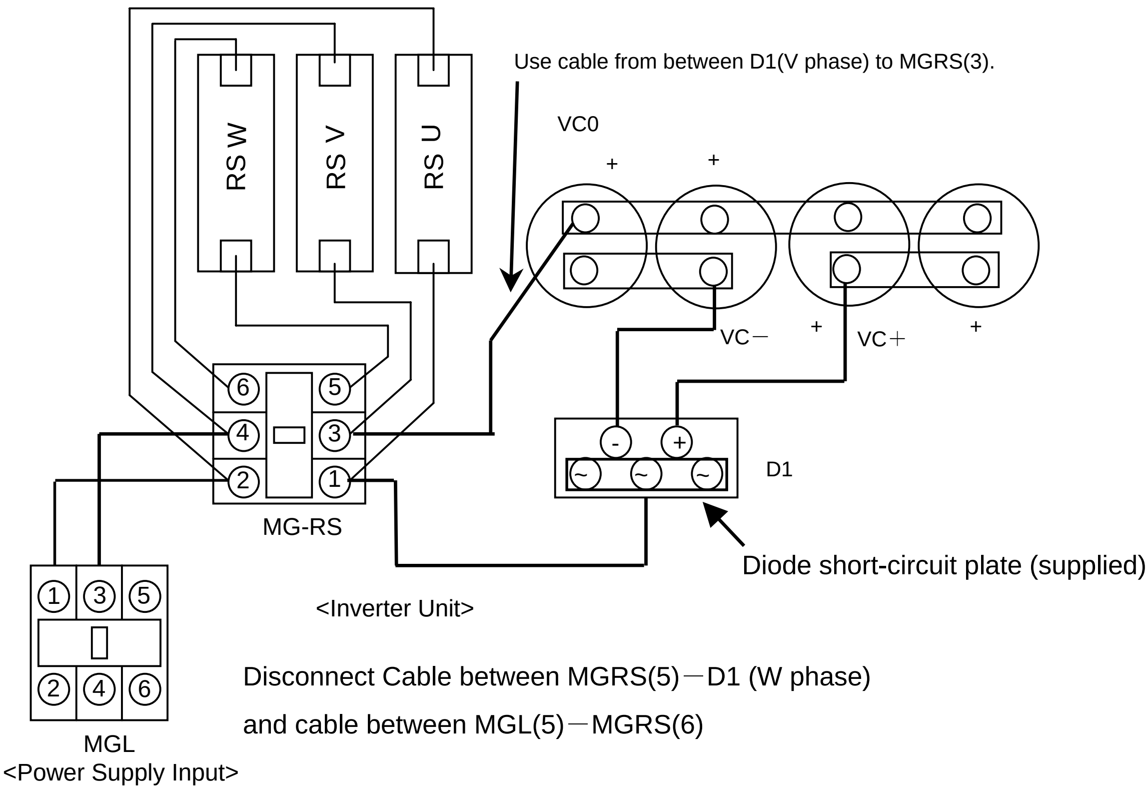


(b) Wiring Diagram

Fig. 3.5.1 Inverter Unit Wiring Connections for 400 V Power Supply (Default Factory Connections)



(a) Connection Diagram



(b) Wiring Diagram

Fig. 3.5.2 Inverter Unit Wiring Connections for 200 V Power Supply

3.6 Starter Connections

Only starter SA-42ZUD or STARTER 4 CE/UL can be connected. Connect the starter as described in section 5.2 or 5.3.

3.7 X-ray High-voltage Cable Connection

Wipe the high-voltage cable clean of dust and connect it as described in the table below.

> **CAUTION**
>
> **Apply the cap to the receptacle if the high-voltage generator is not used.**

Position	Symbol	Symbol and color	Position
High-voltage generator	(1) +	(+) red	X-ray tube unit - 1 (TUBE1)
	(1) -	(-) green	
	(2) +	(+) red	X-ray tube unit -2 (TUBE2)
	(2) -	(-) green	

High-voltage Cable Connection Procedure

(a) Make sure that all power supplies are turned off.

(b) Wipe the cable head and socket with a dry cloth. (Do not use alcohol or other organic solvents.) If insulating grease remains in the socket, wipe it off using grease removal plates (P/N531-93211).

(c) Thinly (0.2 to 0.3 mm) apply insulating grease to the cable head.

(d) Also, thinly (0.2 to 0.3 mm) apply insulating grease to the front and rear surfaces of the packing (drawing name: Packing for high-voltage plug).

(e) Insert the packing into the socket at the end of the cable head, with the holes in the packing aligned with the pins.

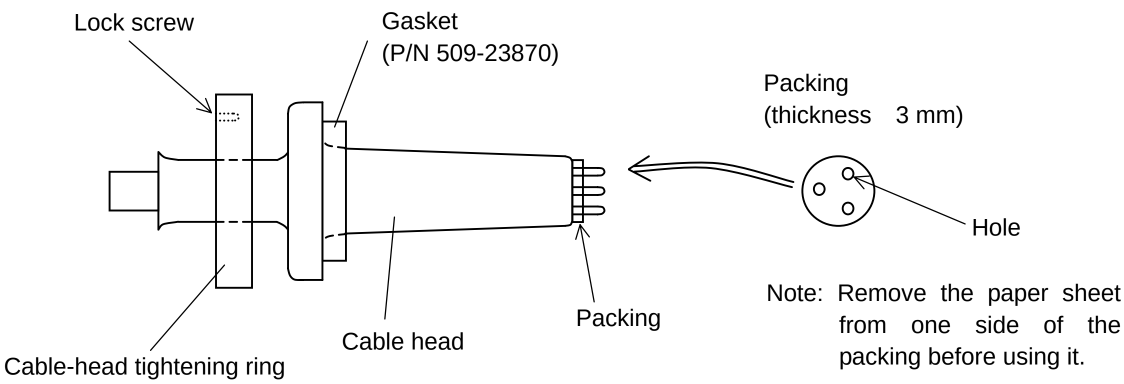


Fig. 3.7.1

(f) Tighten the cable-head tightening ring as far as possible by hand and then fully tighten it with the prescribed tool (Special Pliers, P/N: 531-96584). As a guideline, turn the tightening ring from 1/4 to 1/2 rotation after tightening it by hand.

(g) Tighten the lock screw.

> **CAUTION**
>
> **Replace the packing after one year. However, the packing must be replaced whenever the cable head is disconnected for repair or maintenance.**
>
> **Beware of electric shocks when disconnecting the high-voltage cable.**

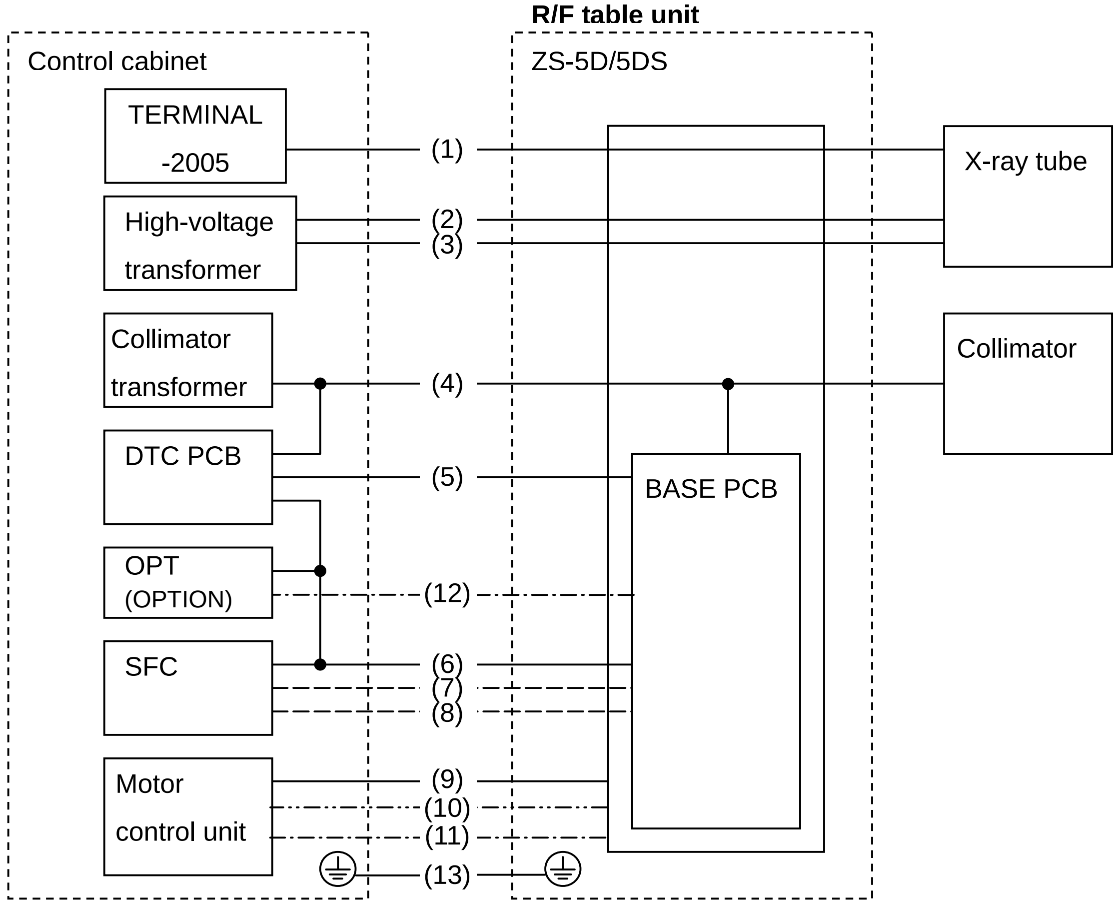
(h) Part names and part number

- Packing for high-voltage plug #1 532-23029 3-core applications
- Packing for high-voltage plug #3 532-23061 For tube voltmeter**

** The packing for 3-core applications (3 mm thick) is replaced with thinner packing (2 mm thick, as the Arco tube voltmeter has little thread engagement with the cable head.

3.8 Connections to External Equipment

3.8.1 R/F Table ZS-5D/5DS



(1) Low-voltage cable

Control cabinet		Cable		X-ray tube	
TERMINAL-2005 PCB terminal block	XA	X	X	X	X-ray tube
	YA	Y	Y	Y	
	ZA	Z	Z	Z	
	L0A	L0	L0	L0	
	L100A	L100	L100	L100	
	THIM	TH(8)	TH(8)	TH(8)	
	THIL	TH(9)	TH(9)	TH(9)	
	E	E	E	E	

(2) High-voltage cable (see section 3.7)

Control cabinet		High-voltage cable		X-ray tube	
High-voltage transformer	(1) +	(+) red	(+) red	+	X-ray tube

(3) High-voltage cable (see section 3.7)

Control cabinet		High-voltage cable		X-ray tube	
High-voltage transformer	(1) -	(–) green	(–) green	-	X-ray tube

(4) Main Body Collimator Cable (P/N:503-65505)

Control cabinet		Cable		Collimator	
Collimator transformer	L0 L12	L0 L12	L0 L12	L0 L12	Collimator
				R/F table unit	
DTC PCB	J4D J5D	J4D J5D	J1B J3B	J1B J3B	BASE PCB

(5) Main Body Signal Cable A (P/N:503-65511)

Control cabinet		Cable		R/F table unit	
DTC PCB	J7D	J7D	J7B	J7B	BASE PCB

(6) Main Body Power Cable B (P/N:503-65507)

Control cabinet		Cable		R/F table unit	
DTC PCB	J5D	J5D	J5B	J5B	BASE PCB
SFC PCB (DS only)	J7S J6S	J7S J6S	J18B J20B	J18B J20B	
OPT PCB (OPTION)	J13P	J13P	J15B	J15B	

(7) Main Body Spot Film Device Cable A (P/N:503-66313)

Control cabinet		Cable		R/F table unit	
SFC PCB (with spot-filming option)	J2S	J2S	J13B	J13B	BASE PCB

(8) Main Body Spot Film Device Cable B (P/N:503-66314)

Control cabinet		Cable		R/F table unit	
SFC CPB (with spot-filming option)	J4S	J4S	J11B	J11B	BASE PCB

(9) Main Body Power Cable A (P/N:503-65506)

Control cabinet		Cable		R/F table unit	
Motor control unit	CN3 CN6	CN3 CN6	CN4 CN7	CN4 CN7	R/F table unit

(10) Main Body Power Cable C (P/N:503-65508)

Control cabinet		Cable		R/F table unit	
Motor control unit	CN1	CN1	CN2	CN2	R/F table unit

(11) Oblique Power Cable (P/N:503-66076)

Control cabinet		Cable		R/F table unit	
Motor control unit (with oblique projection option)	CN9	CN9	-	-	R/F table unit

(12) Main Body Signal Cable B (P/N:503-65512)

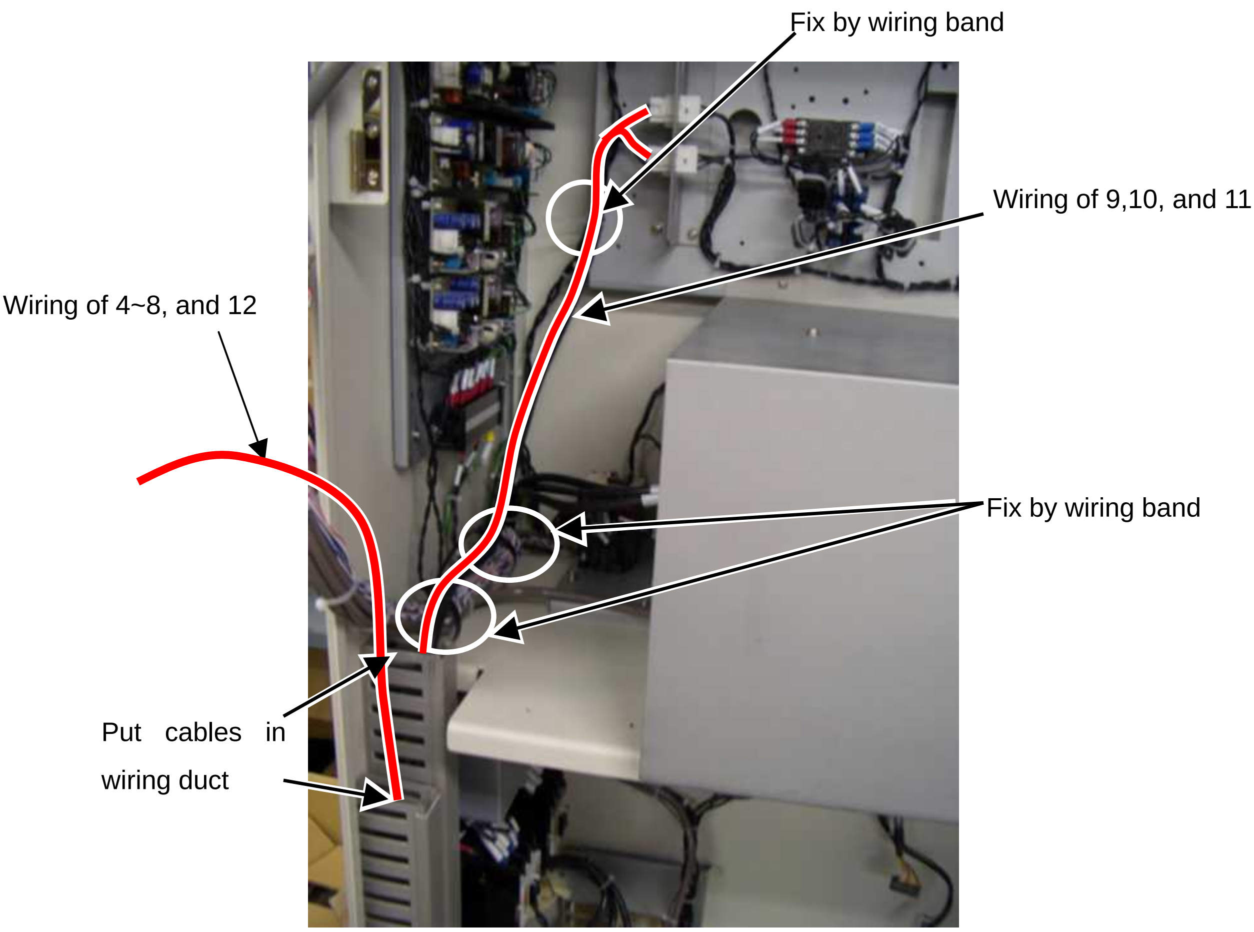
Control cabinet		Cable		R/F table unit	
OPT (with oblique projection option)	J2P	J2P	J17B	J17B	BASE PCB

(13) Grounding Cable (P/N:503-65505)

Control cabinet		Cable		R/F table unit	
Control cabinet	⏚	E	E	⏚	R/F table unit

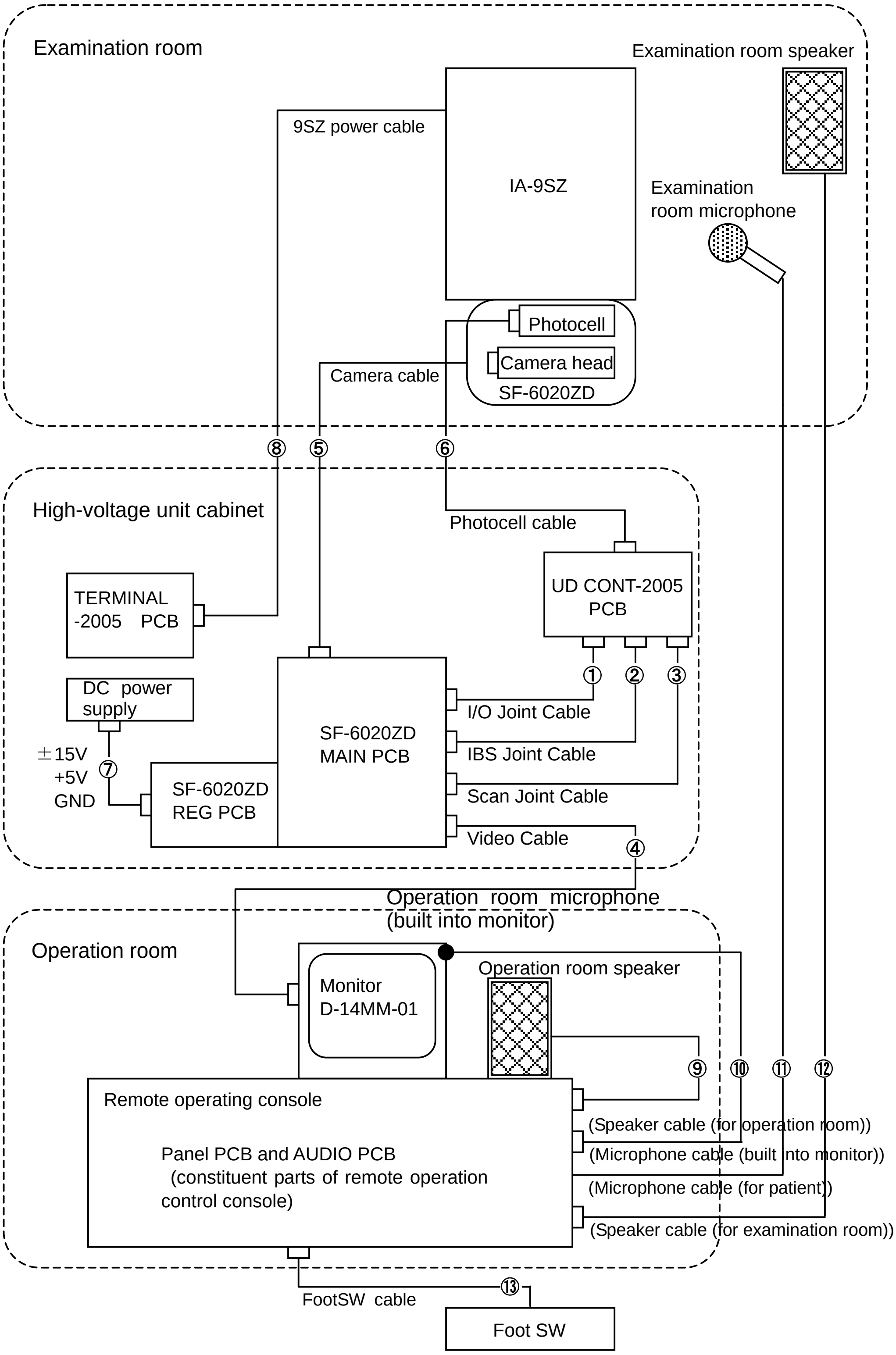
CAUTION

Fix wiring cable, to don't pull when open hinge unit.



3.8.2 I.I. Unit, X-ray TV Unit, Digital Unit

1) IA-9SZ + SF6020 ZD



(1) I/O joint cable

High-voltage control cabinet		Cable		High-voltage control cabinet	
SF-6020ZD MAIN PCB	J2	J2	JC1	JC1	UD CONT-2005 PCB

(2) IBS joint cable

High-voltage control cabinet		Cable		High-voltage control cabinet	
SF-6020ZD MAIN PCB	J31	J31	JIBS	JIBS	UD CONT-2005 PCB

(3) Scan joint cable

High-voltage control cabinet		Cable		High-voltage control cabinet	
SF-6020ZD MAIN PCB	J92	J92	JC2	JC2	UD CONT-2005 PCB

(4) Video cable

High-voltage control cabinet		Cable		Operating console	
SF-6020ZD MAIN PCB	J93	J93	-	-	Operation room monitor

(5) Camera cable

High-voltage control cabinet		Cable		R/F table	
SF-6020ZD MAIN PCB	J1	J1	-	-	Camera head

(6) Photocell cable

R/F table		Cable		High-voltage control cabinet	
Photocell	-	-	JIPT	JIPT	UD CONT-2005 PCB

(7) SF-6020ZD power cable

High-voltage control cabinet		Cable		High-voltage control cabinet	
SF-6020ZD MAIN PCB					DC power supply pack ± 15V +5V

(8) 9SZ power cable

R/F table		Cable		High-voltage control cabinet	
IA-9SZ	L100 L0 GND	L100 L0 GND	L100 L0 GND	L100 L0 GND	TERMINAL-2005 PCB terminal block

(9) Speaker cable (for operation room)

Remote operating console		Cable		Operation room	
Panel PCB	Pat.Out +,-		-	-	Operation room speaker

(10) Microphone cable (built into monitor)

Remote operating console		Cable		Operation room	
Panel PCB	J3 (Doc.Mic)				Operation room monitor

(11) Microphone cable (for patient)

Remote operating console		Cable		Examination room	
Panel PCB	J2 (Pat.Mic. Main)		-	-	Examination room microphone

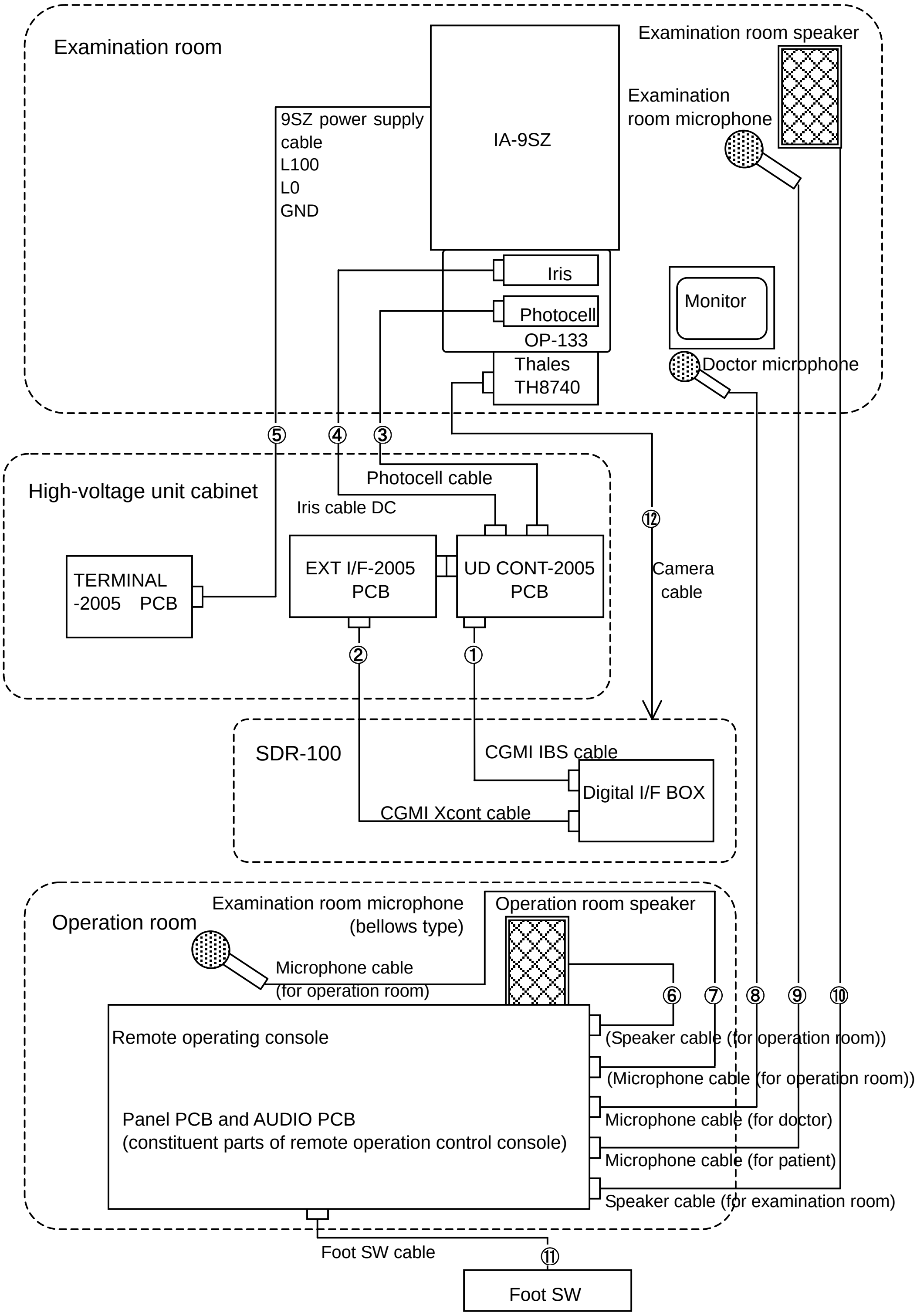
(12) Speaker cable (for examination room)

Remote operating console		Cable		Examination room	
Panel PCB	Doc.Out +,-		-	-	Examination room speaker

(13) Foot switch cable

Remote operating console		Cable		Foot SW	
Panel PCB	JFT	JFT	F-F F-MIC	F-F F-MIC	Foot SW

2) IA-9SZ + SDR-100



(1) CGMI IBS cable

SDR-100		Cable		Operation room monitor	
DIGITAL I/F BOX			JIBS	JIBS	UD CONT-2005 PCB

(2) CGMI Xcont cable

SDR-100		Cable		R/F table	
DIGITAL I/F BOX			JGMI	JGMI	EXT I/F-2005 PCB

(3) Photocell cable

R/F table		Cable		High-voltage control cabinet	
Photocell	-	-	JIPT	JIPT	UD CONT-2005 PCB

(4) Iris cable

R/F table		Cable		High-voltage control cabinet	
Iris			JIRS	JIRS	UD CONT-2005 PCB

(5) 9SZ power cable

R/F table		Cable		High-voltage control cabinet	
IA-9SZ	L100 L0 GND	L100 L0 GND	L100 L0 GND	L100 L0 GND	TERMINAL-2005 PCB terminal block

(6) Speaker cable (for operation room)

Remote operating console		Cable		Operation room	
Panel PCB	Pat.Out +,-		-	-	Operation room speaker

(7) Microphone cable (for operation room)

Remote operating console		Cable		Operation room	
Panel PCB	J3 (Doc.Mic)				Operation room microphone

(8) Microphone cable (for doctor)

Remote operating console		Cable		Examination room	
Panel PCB	J1 (Pat.Mic.Sub)				Doctor microphone

(9) Microphone cable (for patient)

Remote operating console		Cable		Examination room	
Panel PCB	J2 (Pat.Mic.Main)		-	-	Examination room microphone

(10) Speaker cable (for examination room)

Remote operating console		Cable		Examination room	
Panel PCB	Doc.Out +,-		-	-	Examination room speaker

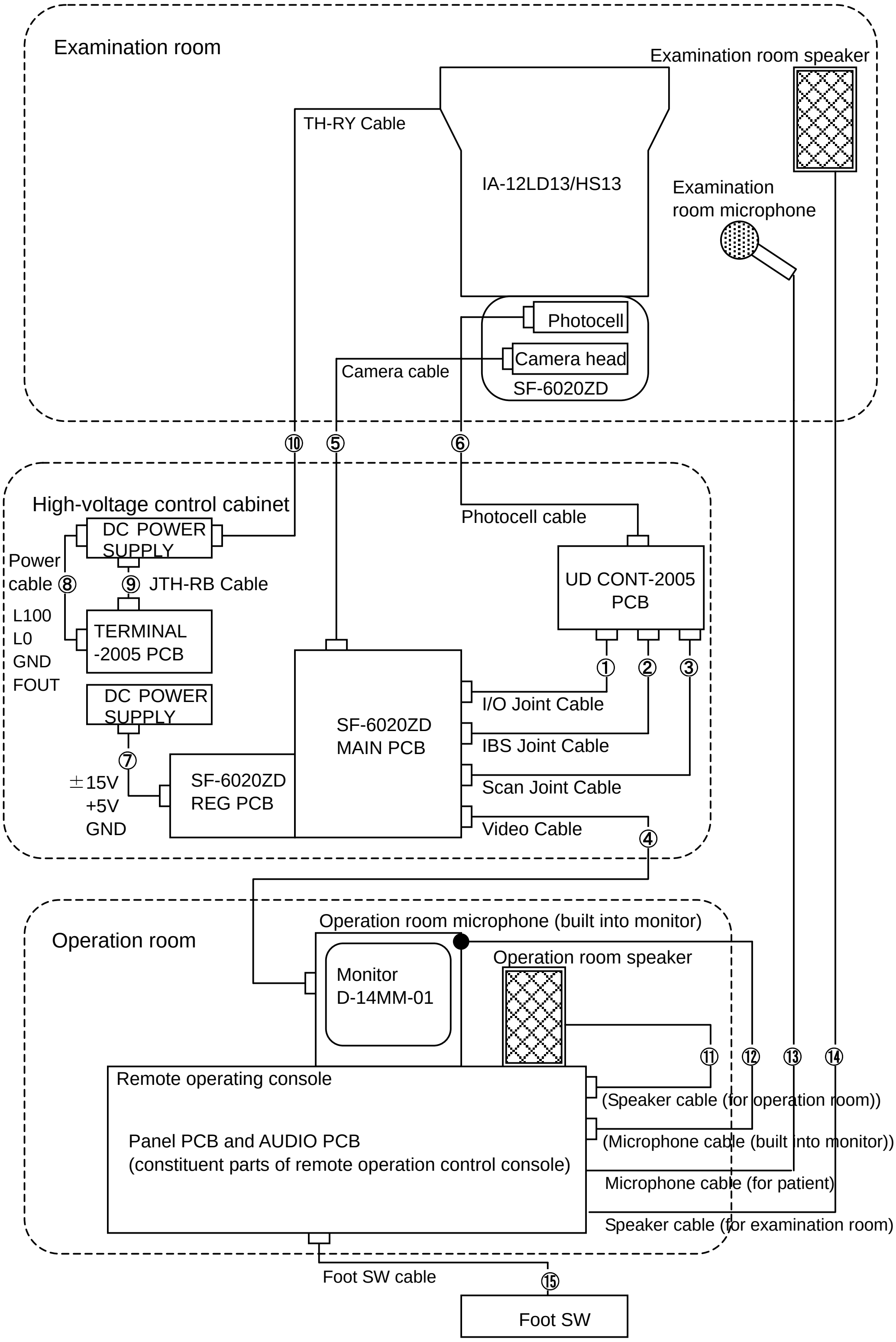
(11) Foot switch cable

Remote operating console		Cable		Foot SW	
Panel PCB	JFT	JFT	F-F F-MIC	F-F F-MIC	Foot SW

(12) Camera cable

SDR-100		Cable		THALES	
DIGITAL I/F BOX					TH8740

3) IA-12LD13 / HS13 + SF6020 ZD



(1) I/O joint cable

High-voltage control cabinet		Cable		High-voltage control cabinet	
SF-6020ZD MAIN PCB	J2	J2	JC1	JC1	UD CONT-2005 PCB

(2) IBS joint cable

High-voltage control cabinet		Cable		High-voltage control cabinet	
SF-6020ZD MAIN PCB	J31	J31	JIBS	JIBS	UD CONT-2005 PCB

(3) Scan joint cable

High-voltage control cabinet		Cable		High-voltage control cabinet	
SF-6020ZD MAIN PCB	J92	J92	JC2	JC2	UD CONT-2005 PCB

(4) Video cable

High-voltage control cabinet		Cable		Operation room monitor	
SF-6020ZD MAIN PCB	J93	J93	-	-	Operation room monitor

(5) Camera cable

High-voltage control cabinet		Cable		R/F table	
SF-6020ZD MAIN PCB	J1	J1	-	-	Camera head

(6) Photocell cable

R/F table		Cable		High-voltage control cabinet	
Photocell	-	-	JIPT	JIPT	UD CONT-2005 PCB

(7) SF6020ZD power cable

High-voltage control cabinet		Cable		High-voltage control cabinet	
SF-6020ZD MAIN PCB					DC power supply pack ± 15V +5V

(8) RB24Y power cable

High-voltage control cabinet		Cable		High-voltage control cabinet	
RB-24Y	L100 L0 GND	L100 L0 GND	L100 L0 GND	L100 L0 GND	TERMINAL-2005 PCB terminal block

(9) JTH-RB cable

High-voltage control cabinet		Cable		R/F table	
RB-24Y			JTH-RB	JTH-RB	TERMINAL-2005 PCB

(10) TH-RY cable

High-voltage control cabinet		Cable		R/F table	
RB-24Y	-	-	-	-	IA-12LD B/HS-B

(11) Speaker cable (for operation room)

Remote operating console		Cable		Operation room	
Panel PCB	Pat.Out +,-		-	-	Operation room speaker

(12) Microphone cable (built into monitor)

Remote operating console		Cable		Operation room	
Panel PCB	J3 (Doc.Mic)				Operation room monitor

(13) Microphone cable (for patient)

Remote operating console		Cable		Examination room	
Panel PCB	J2 (Pat.Mic.Main)		-	-	Examination room microphone

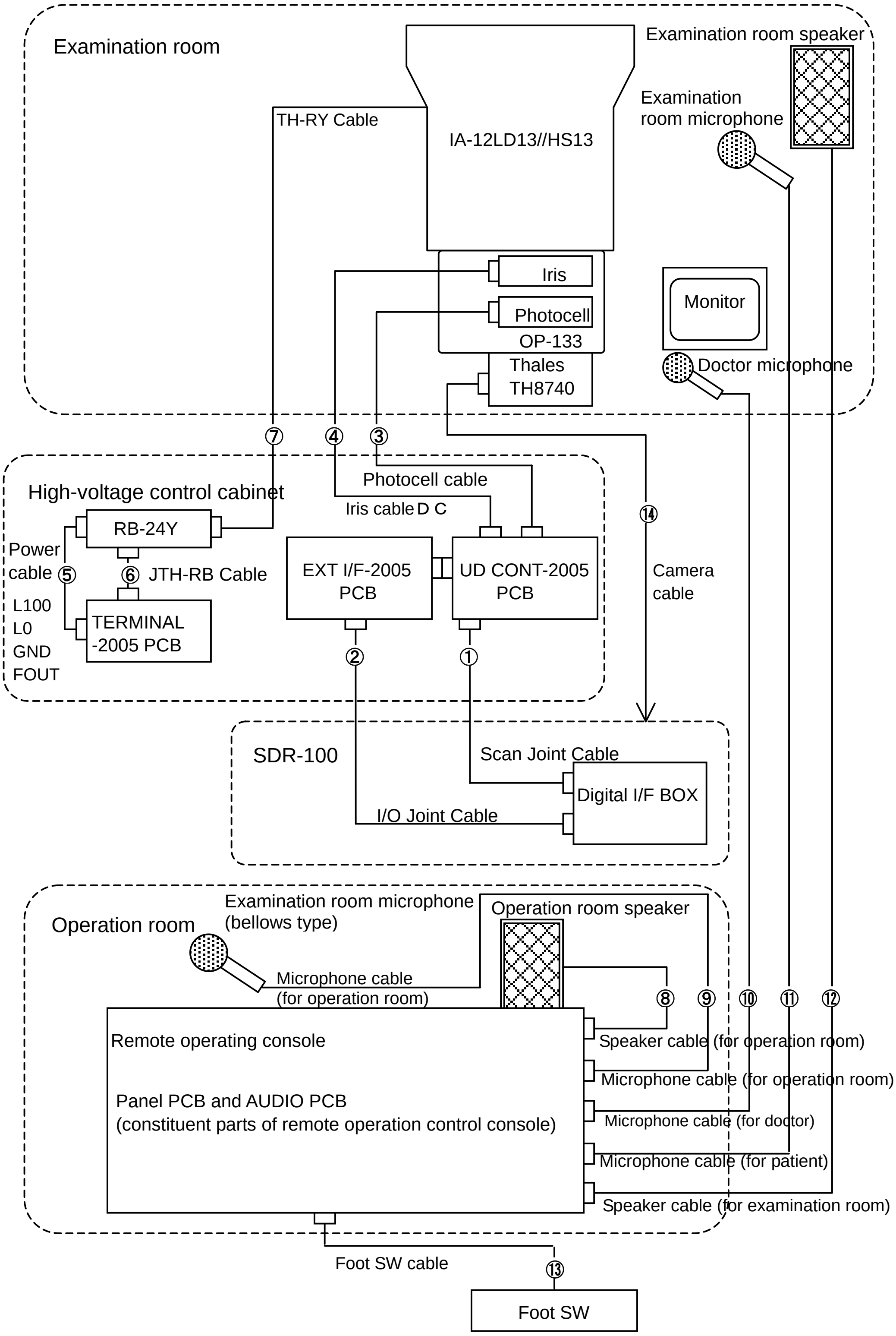
(14) Speaker cable (for examination room)

Remote operating console		Cable		Examination room	
Panel PCB	Doc.Out +,-		-	-	Examination room speaker

(15) Foot switch cable

Remote operating console		Cable		Foot SW	
Panel PCB	JFT	JFT	F-F F-MIC	F-F F-MIC	Foot SW

4) IA-12LD13 / HS13 + SDR-100



(1) CGMI IBS cable

SDR-100		Cable		Operation room monitor	
DIGITAL I/F BOX			JIBS	JIBS	UD CONT-2005 PCB

(2) CGMI Xcont cable

SDR-100		Cable		R/F table	
DIGITAL I/F BOX			JGMI	JGMI	EXT I/F-2005 PCB

(3) Photocell cable

R/F table		Cable		High-voltage control cabinet	
Photocell	-	-	JIPT	JIPT	UD CONT-2005 PCB

(4) Iris cable

R/F table		Cable		High-voltage control cabinet	
Iris			JIRS	JIRS	UD CONT-2005 PCB

(5) RB24Y power cable

High-voltage control cabinet		Cable		High-voltage control cabinet	
RB-24Y	L100 L0 GND	L100 L0 GND	L100 L0 GND	L100 L0 GND	TERMINAL-2005 PCB terminal block

(6) JTH-RB cable

High-voltage control cabinet		Cable		R/F table	
RB-24Y			JTH-RB	JTH-RB	TERMINAL-2005 PCB

(7) TH-RY cable

High-voltage control cabinet		Cable		R/F table	
RB-24Y	-	-	-	-	IA-12LD B/HS-B

(8) Speaker cable (for operation room)

Remote operating console		Cable		Operation room	
Panel PCB	Pat.Out +,-		-	-	Operation room speaker

(9) Microphone cable (for operation room)

Remote operating console		Cable		Operation room	
Panel PCB	J3 (Doc.Mic)				Operation room microphone

(10) Microphone cable (for doctor)

Remote operating console		Cable		Examination room	
Panel PCB	J1 (Pat.Mic.Sub)				Doctor microphone

(11) Microphone cable (for patient)

Remote operating console		Cable		Examination room	
Panel PCB	J2 (Pat.Mic.Main)		-	-	Examination room microphone

(12) Speaker cable (for examination room)

Remote operating console		Cable		Examination room	
Panel PCB	Doc.Out +,-		-	-	Examination room speaker

(13) Foot switch cable

Remote operating console		Cable		Foot SW	
Panel PCB	JFT	JFT	F-F F-MIC	F-F F-MIC	Foot SW

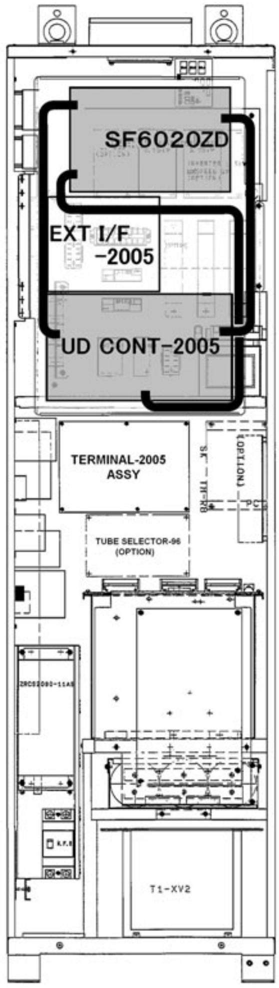
3. Installation and Connection

(14) Camera cable

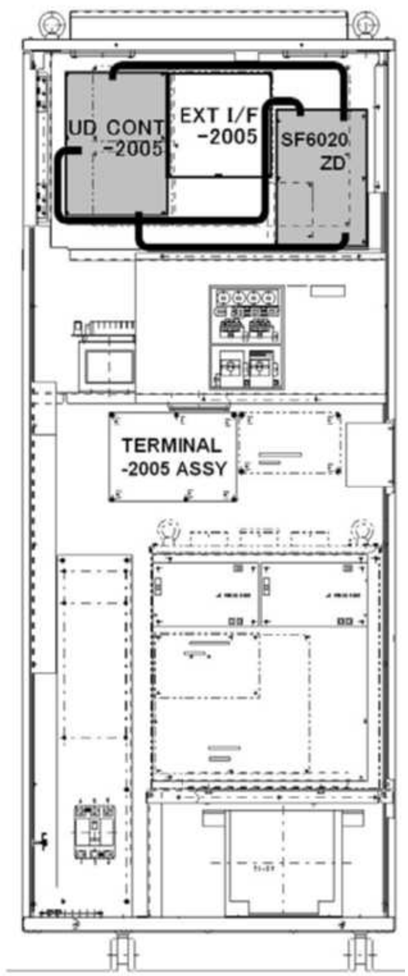
SDR-100		Cable		THALES	
DIGITAL I/F BOX					TH8740

Wiring Route to SF-6020ZD

ZUD-P40D/DS

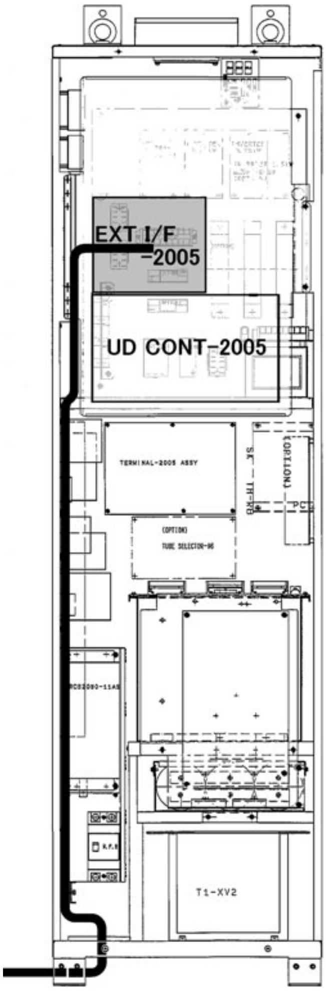


ZUD-L41D/DS , ZUD-L40D/DS ,
ZUD-V40D/DS ,ZUD-B40D/DS

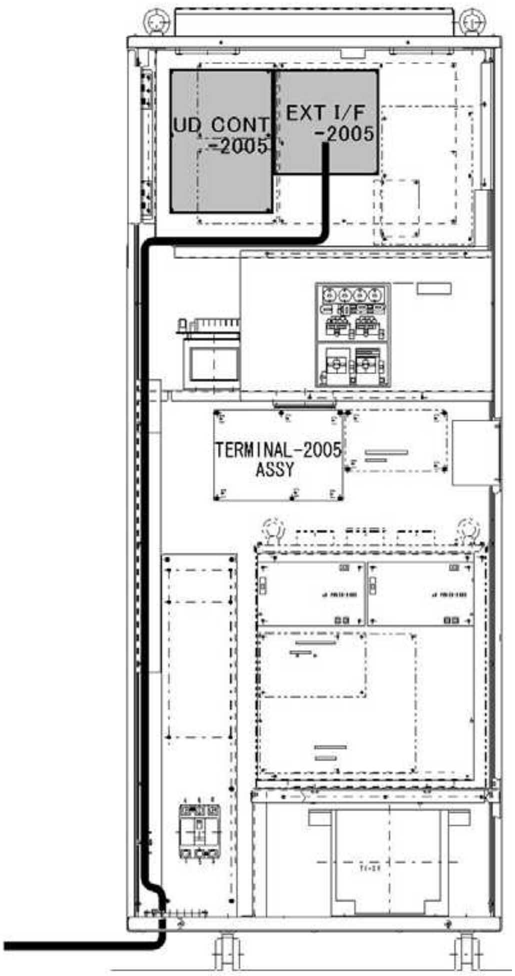


Wiring Route to EXT I/F-2005 PCB

ZUD-P40D/DS



ZUD-L41D/DS , ZUD-L40D/DS ,
ZUD-V40D/DS , ZUD-B40D/DS



3.8.3 Tube Select Signals

The signal corresponding to the selected tube number is obtained.

Signal name	TERMINAL-2005 PCB name	Comments
Tube 1 selected output contacts	XR1MA XR1MB	SW2-(6) must be ON and SW1-(6) must be OFF on TERMINAL-2005 PCB.
Tube 2 selected output contacts	XR2MA XR2MB	SW2-(7) must be ON and SW1-(7) must be OFF on TERMINAL-2005 PCB.

CAUTION

Refer to "4.22 setting of external output signal", set signal correct which you would like to output each output terminal.

3.8.4 Door Open/Closed Confirmation Terminals

To confirm the door open/closed status, connect the contact between the X2 "0V" and "DOOR" terminals on the TERMINAL-2005 PCB.

CAUTION

If these terminals are not used, short the "0V" and "DOOR" terminals.

3.9 Fixing the Cables

Fasten the power cables and signal cables using the wire clamps on the cable-fixing plate in the cabinet.

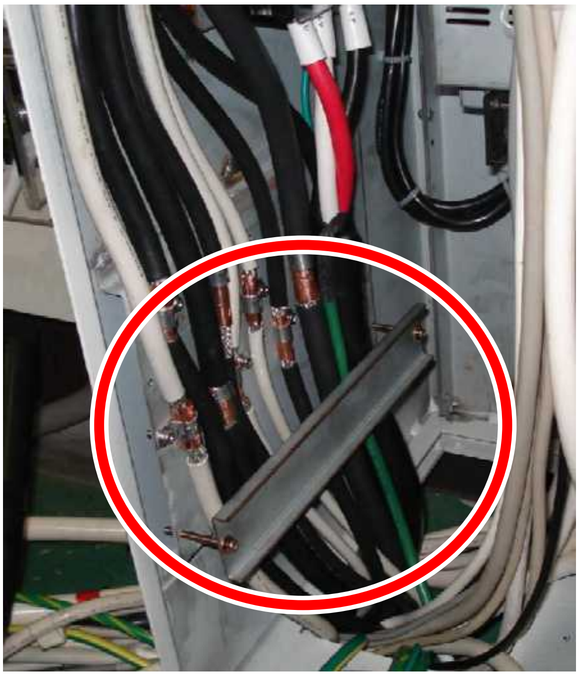


Fig. 3.9.1 ZUD-L41D/DS, ZUD-L40D/DS, ZUD-V40D/DS, ZUD-B40D/DS

Fig. 3.9.2 ZUD-P40D/DS

Chapter 4

Checks and Adjustments

Chapter Contents

4. Checks and Adjustments

This section describes the operation checks and adjustments required during on-site installation. Refer to MAINTENANCE for the readjustment procedures when a PCB or parts are replaced when a fault occurs on-site.

CAUTION

The tube current is not adjusted at the factory. Adjust the tube current during installation.

DANGER

The control cabinet power unit contains electrolytic capacitors that retain their charge after the power is turned off.
Before inspecting the control cabinet after the power has been turned off, wait until the LD2 and LD2 LEDs at the center of the TERMINAL-2005 PCB are turned off. The charge voltage of the main capacitor drops below 5V in about 30 seconds after the power is turned off.
Note that it takes some time for the main capacitor to charge up after the power is turned on.

DANGER

Do not apply a high voltage in the no-load status.
This can damage the unit or cause a major accident.

DANGER

Turn the equipment's power supply OFF prior to performing a check of the high-voltage unit, or connecting or disconnecting the high-voltage power cable.

CAUTION

Calibrate the probe frequency characteristics and voltage range of the oscilloscope before starting the adjustments.

4.1 Preparations

4.1.1 Equipment Required for the Adjustments

(1) Instruments to measure X-ray tube voltage and current	Calibrated within the last year
(2) Oscilloscope with memory function	100MS/S or above
(3) Digital voltmeter	Abbreviated as "D.V.M." or "tester." Preferably, measuring to 3 decimal places. Instrument with 1000V DC range.
(4) DC ammeter	Instrument measuring across the range 0.1 mA to 1 A
(5) PC	With RS-232C serial port or USB port. Windows XP or Windows2000 operating system.
(6) CD-R containing ZUD-HV Maintenance Tool	
(7) RS-232C cable (cross-type) or USB cable	

> **DANGER**
>
> **Do not connect the GND terminal in the power plug on the oscilloscope.**
> **Do not simultaneously measure between CH1 and CH2 with a different reference potential.**

> **CAUTION**
>
> **Turn off the power supply before inserting or removing a PCB or connecting or disconnecting a connector.**

> **DANGER**
>
> **Before connecting cables, turn off the power supply and open the knife switch or circuit breaker on the power supply unit.**
>
> **To ensure safety, first connect the ground cable from the distribution board to the cabinet.**
> **Use spring washers to ensure the terminal does not come loose.**

> **CAUTION**
>
> **When the hinged unit at the top of the cabinet is open, take care not to bang you head on it when standing up.**

4.1.2 Connecting the Adjustment PC

CAUTION

When use ZUD-HV Maintenance Tool, be sure to install of USB driver.(Refer to APPENDIX 2.3-(b).)

(1) Connect the following connectors on the adjustment PC:

For RS-232C

UD CONT-2005 PCB: JMNT

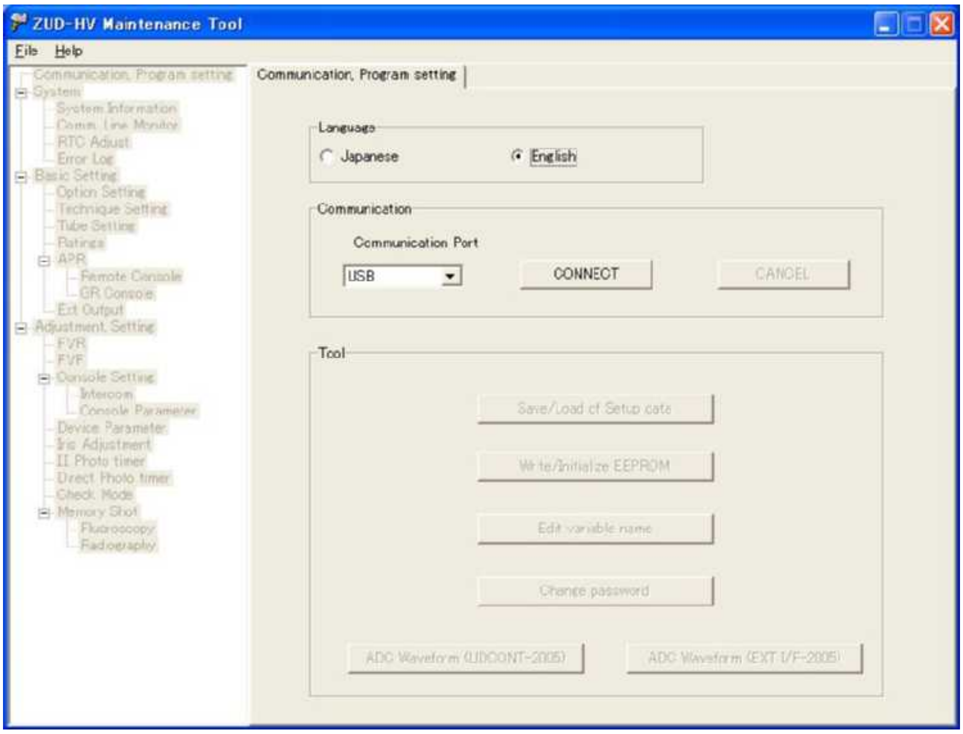
For USB

UD CONT-2005 PCB: JUSB

(2) Start up the ZUD-HV Maintenance Tool.

(3) The following window appears.

Select the appropriate connection port and then click [CONNECT].



(4) The password-input dialog box opens.

Input the password “udcont2005” and click [OK].

(5) The connections to the adjustment PC are now complete.

CAUTION

When use ZUD-HV Maintenance Tool, be sure to connection work every time turn on the power of device.

4.2 Checking the Supply Voltage Detection

(1) Turn on the knife switch or circuit breaker on the power supply unit.

(2) Turn on the knife switch or circuit breaker on the power supply unit. The [Power OFF] button lights on the console.

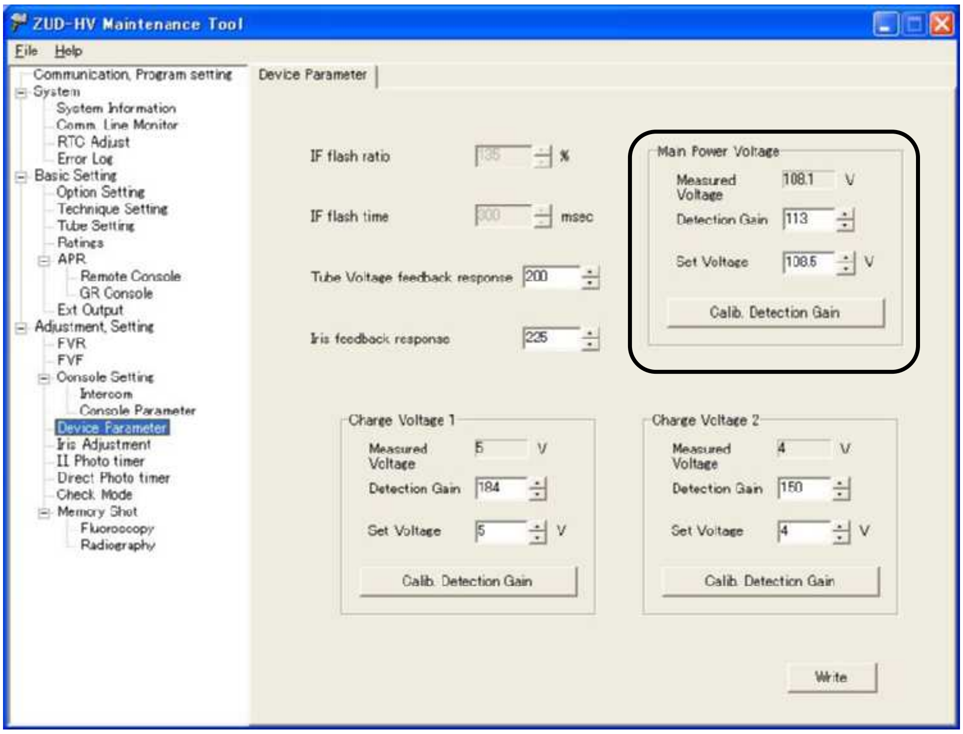
(3) Connect a voltmeter capable of measuring 100V AC to terminals L0 and L100 on the TERMINAL-2005 PCB in the control cabinet.

(4) Press the [Power ON] button on the control console to turn on the power.

(5) Check that the voltmeter indicated value enters the range 105V ± 5V about 20 seconds after the power is turned on.

(6) If the voltmeter indicated value does not enter the range 105V ± 5V, check the connections as described in section 2.5.

(7) Check that the measured voltage displayed as [Main Power Voltage] on the [Adjustment, Setting][Device Parameter] screen is within ±5V of the value indicated on the D.V.M. or voltmeter. Adjust the voltage if it lies outside this range. Refer to MAINTENANCE.

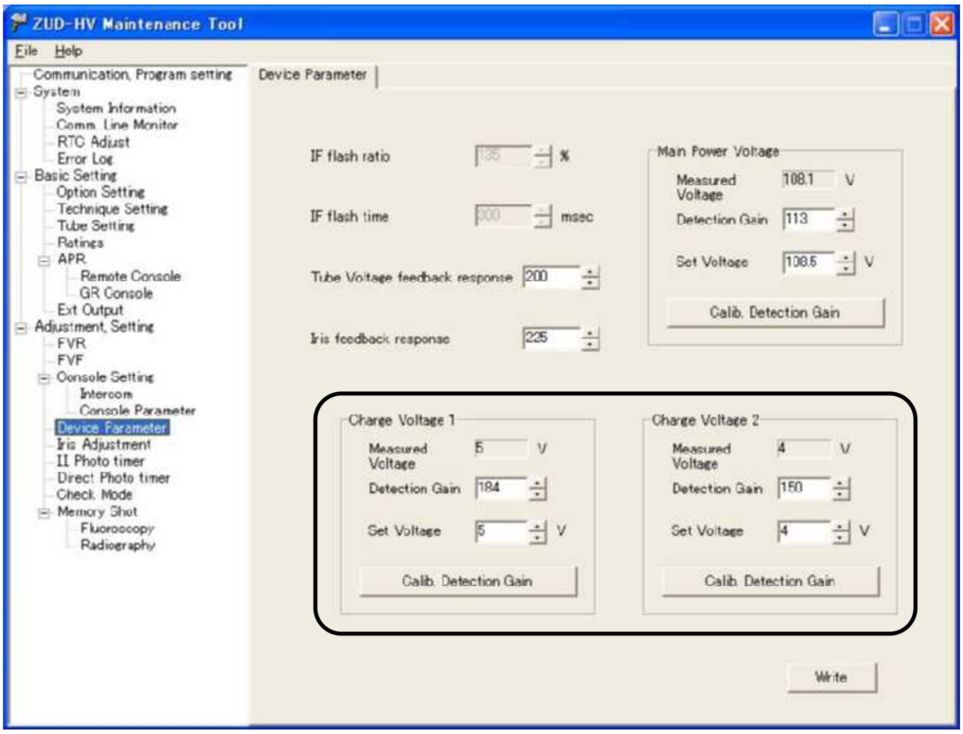


4.3 Checking the Inverter Voltage Detection

CAUTION

*** ZUD-P40 uses a single-phase 200 V supply**
Check only [Charge Voltage 1]. ((1) to (4))
*** ZUD-L41/L40/V40/B40 use three-phase 200 V supply**
Check [Charge Voltage 1] and [Charge Voltage 2]. ((1) to (9))

(1) With the power supply turned off, connect the voltmeter to terminals CP8 VC+ and CP6 VC0 on the TERMINAL-2005 PCB.
(2) Turn on the power and measure voltage with the voltmeter after about 20 seconds.
(3) Start up the ZUD-HV Maintenance Tool on the adjustment PC. Check that the measured voltage displayed as [Charge Voltage 1] on the [Adjustment, Setting][Device Parameter] screen is within ±5 V of the value indicated on the voltmeter. Adjust the voltage if it lies outside this range. Refer to MAINTENANCE.
(4) Turn off the power.
(5) Wait until the capacitor is discharged. (about 30 seconds)
(6) With the power supply turned off, connect the voltmeter to terminals CP9 VC- and CP6 VC0 on the TERMINAL-2005 PCB.
(7) Turn on the power and measure voltage with the voltmeter after about 20 seconds.
(8) Check that the measured voltage displayed as [Charge Voltage 2] on the ZUD-HV Maintenance Tool [Adjustment, Setting][Device Parameter] screen is within ±5V of the value indicated on the voltmeter. Adjust the voltage if it lies outside this range.
(9) Turn off the power. Refer to MAINTENANCE.

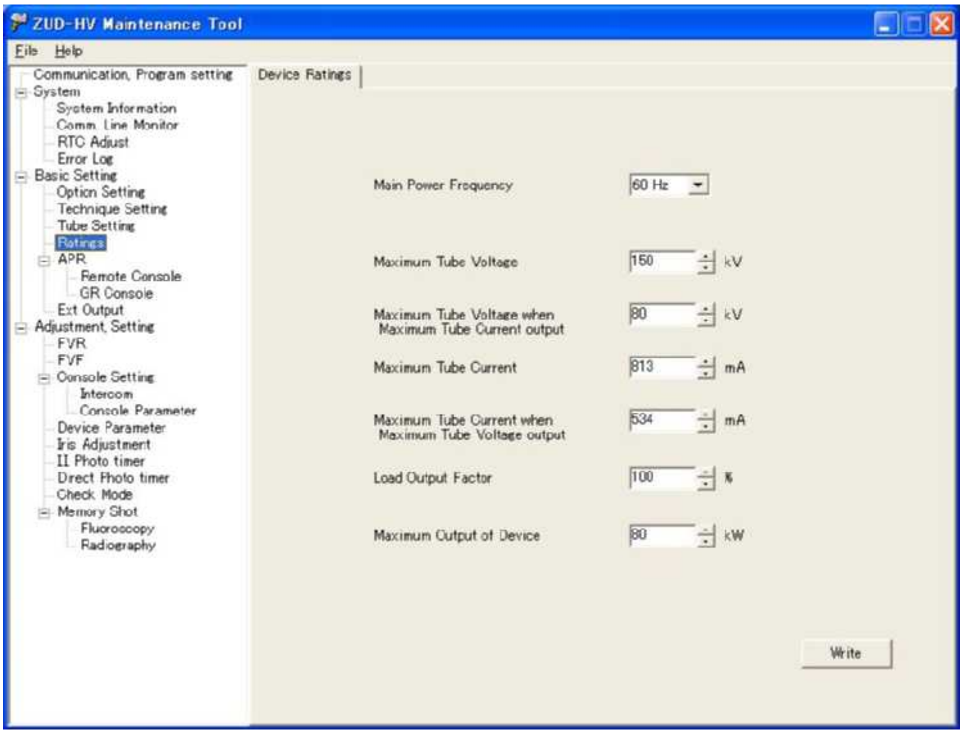


4.4 Initial Settings

Make the settings required for checking the operation during installation.

(1) Setting the Unit Ratings

Input the unit ratings below on the ZUD-HV Maintenance Tool [Basic Setting][Device Ratings] screen.

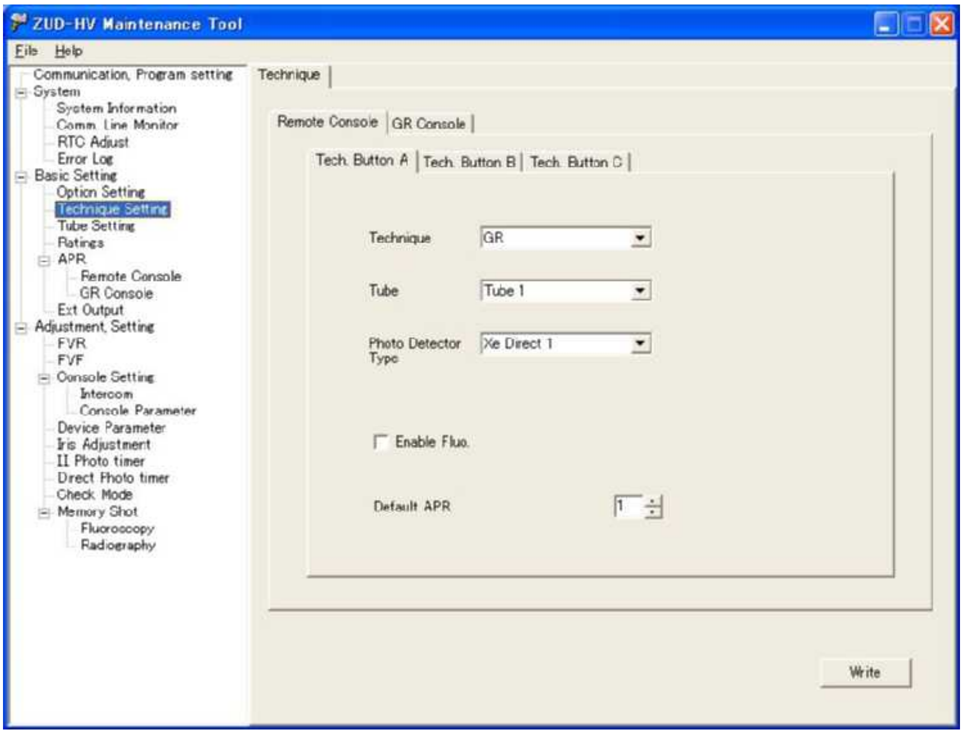


Unit Ratings

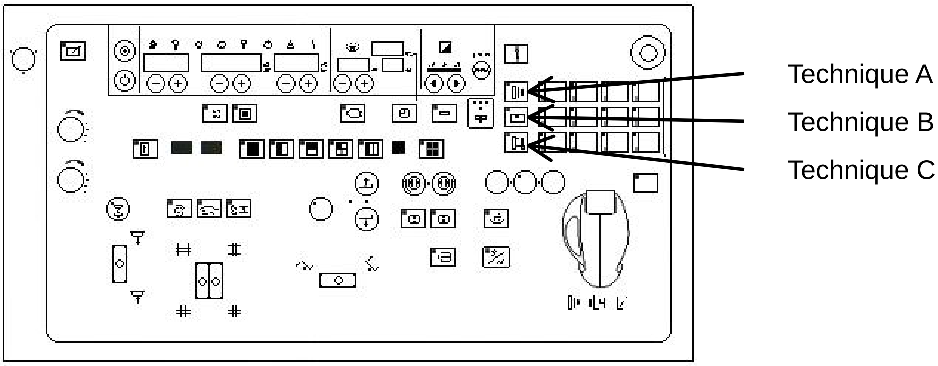
	ZUD-P40	ZUD-L41/L40		ZUD-V40	ZUD-B40
Main Power Frequency	60Hz	60Hz	60Hz	60Hz	60Hz
Maximum Tube Voltage	125kV	150kV	150kV	150kV	150kV
Maximum Tube Voltage when Maximum Tube Current output	80kV	80kV	80kV	80kV	80kV
Maximum Tube Current	250mA	400mA	630mA	813mA	1000mA
Maximum Tube Current when Maximum Tube Voltage output	161	214	334	434	534
Load Output Factor	100	100	100	100	100
Maximum Output of Device	20kW	32kW	50kW	65kW	80kW

(2) Setting the Techniques

ZUD-HV Maintenance Tool [Basic Setting][Technique Setting] screen sets the techniques assigned to the technique buttons on the remote console or the GSC-2002S(Z) Remote Operating Console using the 2-tube option.



(a) The relationship between techniques A, B, and C on the [Technique Setting] screen and the remote operating console is shown below.



The unit initial settings are as follows.

Item	Technique A	Technique B	Technique C
Technique	General radiography	Fluoroscopy spot filming	Digital radiography (DR)
Tube used	Tube 1	Tube 1	Tube 1
Photo Detector Type	None	I.I. indirect phototimer	I.I. indirect phototimer
Enable Fluo	No check	Check	Check
Default APR when technique selected	1	1	1

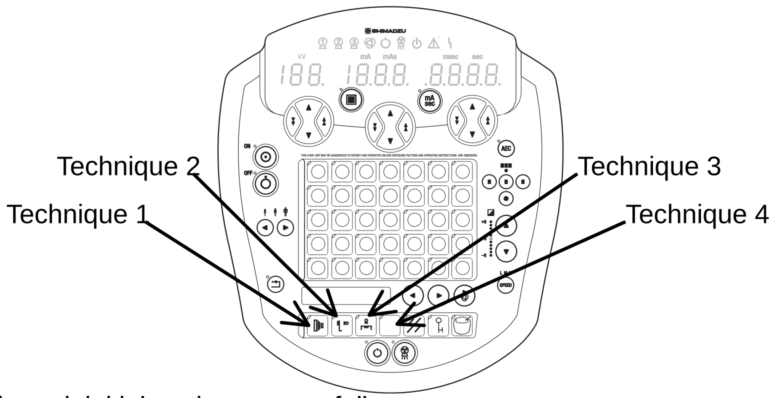
The items must be changed as appropriate according to the combination of R/F table and options. For the FLEXAVISION FD system configuration, change Technique B as follows.

Item	Technique B
Technique	Cassette tray radiography
Tube used	Tube 1
Photo Detector Type	I.I. indirect phototimer
Enable Fluo	No check
Default APR	1

When the direct phototimer option is used, set the photodetector for the techniques using the direct phototimer between “Xe direct phototimer 1” and “Xe direct phototimer 3.”
The table below shows the relationship between the photo sensor and the “Xe direct phototimer 1” to “Xe direct phototimer 3” setting.

Item	Corresponding photo sensor
Xe direct phototimer 1	Connected to JDT1 on the EXT I/F-2005 PCB
Xe direct phototimer 2	Connected to JDT2 on the EXT I/F-2005 PCB
Xe direct phototimer 3	Connected to JDT3 on the EXT I/F-2005 PCB

(b) The diagram below shows the relationship between techniques 1,2,3 and 4 on the [Technique Setting] screen when the GSC-2002S(Z) Remote Operating Console is connected with the 2-tube option.



The unit initial settings are as follows.

Item	Technique 1	Technique 2	Technique 3	Technique 4
Technique	General radiography	Bucky 1	Bucky 2	Not used
Tube	Tube 2	Tube 2	Tube 2	Tube 2
Photo Detector Type	None	None	None	None

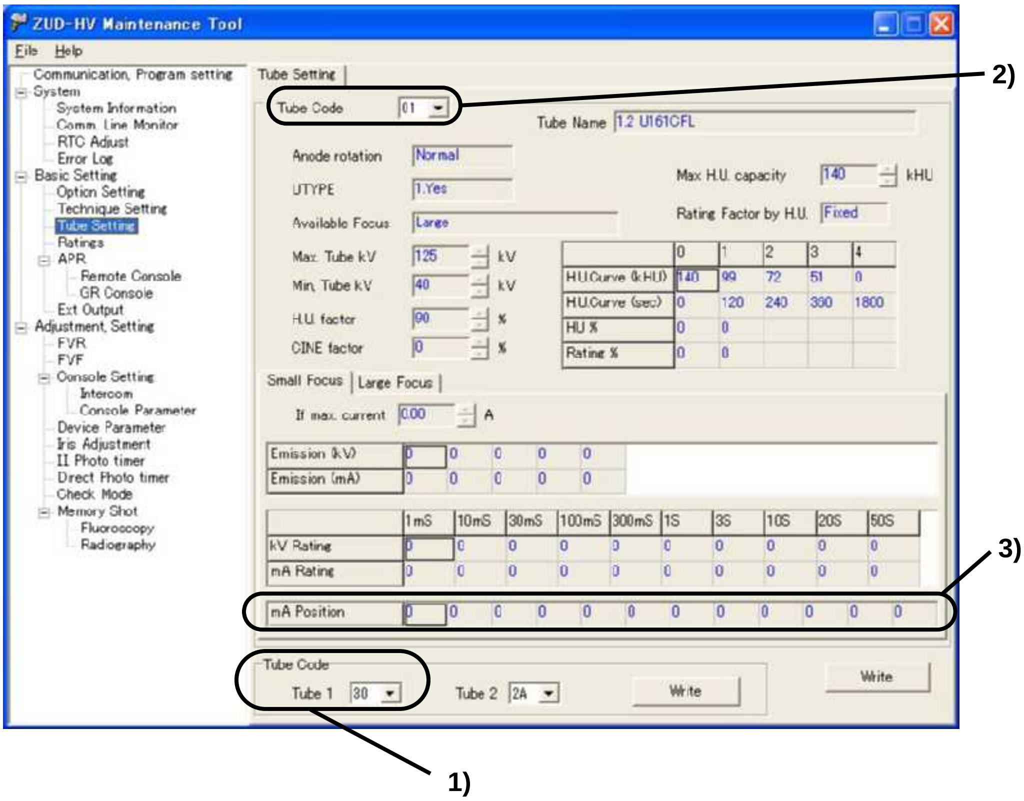
When the direct phototimer option is used, set the photodetector for the techniques using the direct phototimer between “Xe direct phototimer 1” and “Xe direct phototimer 3.”

The table below shows the relationship between the photo sensor and the “Xe direct phototimer 1” to “Xe direct phototimer 3” setting.

Item	Corresponding photo sensor
Xe direct phototimer 1	Connected to JDT1 on the EXT I/F-2005 PCB
Xe direct phototimer 2	Connected to JDT2 on the EXT I/F-2005 PCB
Xe direct phototimer 3	Connected to JDT3 on the EXT I/F-2005 PCB

(3) Tube Settings

The Maintenance Tool [Basic Setting][Tube Setting] screen displays and sets the tube specifications used for Tube 1 and Tube 2.



1) Tube Code Set the tube codes for the Tube 1 and Tube 2 combination.

1.2U161CFL	: 01
0.3/0.8P18DK	: 27
0.6/1.2P18DE	: 29
0.6/1.2P38DE	: 2A
0.3/0.8P323DK	: 1D

Refer to MAINTENANCE 2.1 for tube codes not listed above.

2) Select a tube code here to display the corresponding tube specification.

3) Tube current position setting

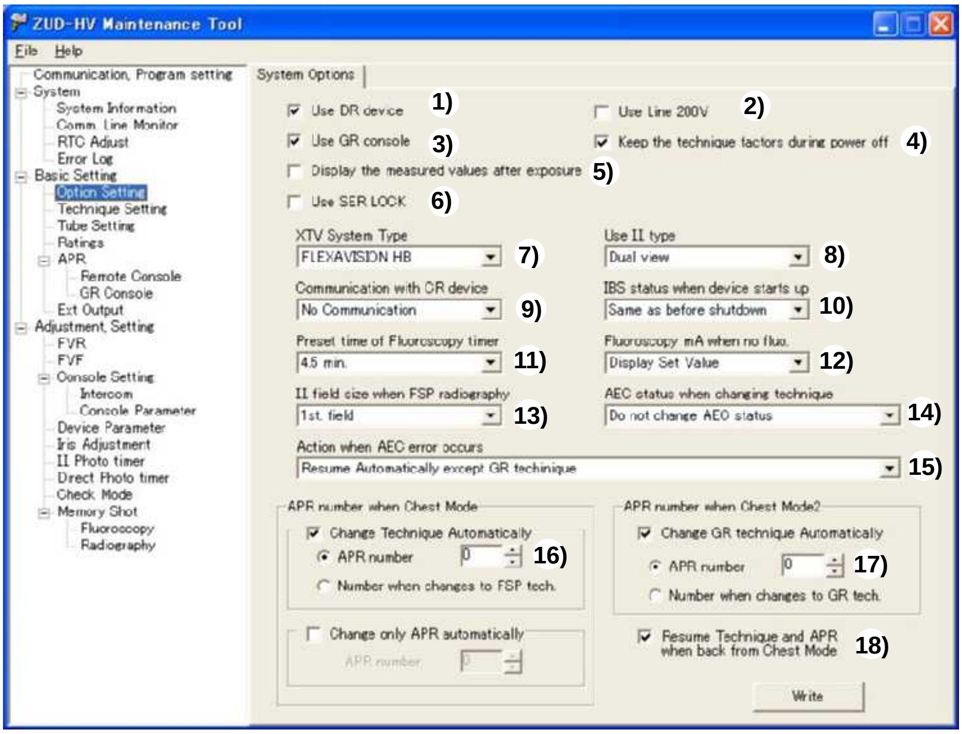
Set the 12 positions required for each tube and focus.

CAUTION

Changes to radiography tube settings are only enabled after turning the unit power off and back on.

(4) Option Settings

ZUD-HV Maintenance Tool [Basic Setting][Option Setting] screen sets the unit options.



1) Use DR device:

Check this checkbox if the system incorporates the SDR-100

2) Use Line 200 V:

Check this checkbox if single-phase 200 V power is supplied to the ZUD-L41/L40.

3) Use GR console:

Check this checkbox if the system incorporates the 2-tube option.

4) Keep the technique factors during power off:

Check this checkbox to save the set conditions when the power is turned off.

-> Set radiography tube voltage, set radiography tube current, set time, set tube-current time product, set fluoroscopy tube voltage, and X-ray tube focus setting

5) Display the measured values after exposure:

Check this checkbox to display the measured tube voltage, tube current, tube current time product on the settings part of the X-ray output remote console.

6) Use SER LOCK:

If you use phototimer at DR serial radiography, when this checkbox is checked, the condition after 2nd radiography is the same as 1st.

When it is not checked, radiography after 2nd use phototimer.

Check this checkbox standard.

7) XTV System Type:

Select the system type

* Cassette spot-filming + XTV SF6020ZD	→	FLEXAVISION SF
* Cassette spot-filming + DR	→	FLEXAVISION HB
* Cassette tray radiography + DR	→	FLEXAVISION FD

8) Use I.I. Type:

* IA-9SZ	→	Select “Single view”.
* IA-12LD	→	Select “Dual view”.

9) Communication with CR device:

Sets details of the communication of X-ray details with the CR.

Select “No Communication” if CR device is not connected.

10)IBS status when device starts up:

Select IBS ON/OFF status when starting device.

Select “Same as before shutdown” as standard.

11)Preset time of Fluoroscopy timer:

Set to 4.5 min. as standard.

12)Fluoroscopy mA when no fluo.:

“Display Set Value”

13)I.I. field size when FSP radiography:

Selects the I.I. field size for cassette spot-filming.

14)AEC status when changing technique

Select AEC ON/OFF operation, when change to technique of available phototimer.

- [Do not change AEC status]
  Keep the same status as before change technique.
- [Always ON]
  After changing technique, AEC is always ON.
- [Always OFF]
  After changing technique, AEC is always OFF.
- [Using the setting of APR]
  AEC ON/OFF depends on APR setting.
  Select “Using the setting of APR” standard.

15)Action when AEC error occurs:

Selects the operation up to the backup time during phototimer radiography.

* Resume Automatically except GR technique

  Check if the backup time has elapsed and display a warning for GR techniques only.

* Do not resume until the user requests error reset action

  Check if the backup time has elapsed and display a warning for all techniques.

* Always resume automatically

  Do not check if the backup time has elapsed for all techniques.

16)APR number when Chest Mode

* When the tube is extended, put a checkmark in the [Change Technique Automatically] to automatically change the technique. To change to a designated APR number, select the upper [APR No.] checkbox and set the APR number to use. Select the lower [Number when changes to FSP tech] checkbox to use the default APR for the FSP technique.
* To automatically change the APR number without changing the technique, select the [Change only APR automatically] checkbox and set the APR number.

17)APR number when Chest Mode2

When the tube is swiveled, do not put a checkmark in the [Change GR Technique Automatically] in order not to automatically change the technique to general radiography. Put a checkmark in the checkbox to automatically change the technique to general radiography. To change to a designated APR number, select the upper [APR No.] checkbox and set the APR number to use.

Select the lower [Number when changes to GR tech] checkbox to use the default APR for the GR technique.

	General radiography	Film spot filming	Cassette tray radiography	Digital radiography (DR)	Fluoroscopy
Tube extended 1.5 m	Select	Select	Select	Select	Select
Tube extended 1.8/2.0 m option	Select	Not select	Not select	Not select	Not select
Tube swiveled	Select	Not select	Not select	Not select	Not select

18)Resume Technique and APR when back from Chest Mode

Put a checkmark in this checkbox to revert to the original technique and APR after retracting a tube extension or swiveling.

4.5 Checking Starter Operation

4.5.1 STARTER 4 CE/UL

Check that the cables are connected as described in section 5.2.

Check and adjust the startup time.

4.5.2 Starter SA-42ZUD

Check that the cables are connected as described in section 5.3.

Adjust the rotation.

4.6 Connecting the Tube Voltage/Tube Current Measuring Instruments

(1) Connecting the high-voltage cable

Connect the high-voltage cable, referring to section 3.7. At this time, also connect the X-ray tube-voltage measuring instrument.

(2) Connecting the tube voltage/tube current measuring instruments

Connect the X-ray tube-voltage measuring instrument to the high-voltage circuit. For details about the connection method, see the instruction manual for the measuring instrument.

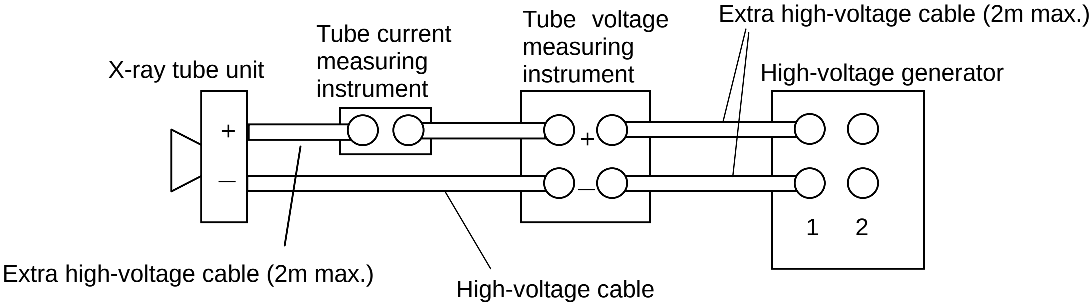


Fig. 4.6.1

CAUTION

Use extra high-voltage cables up to 2m long.

CAUTION

A measuring instrument capable of measuring the X-ray tube current on the high-voltage (secondary) side is required to measure the X-ray tube current for this unit.

Accurate readings may not be obtained due to tube voltage ripples if the measuring instrument is not connected to the X-ray tube side or if the high-voltage cable is too short.

4.6 Connecting the Tube Voltage/Tube Current Measuring Instruments

Use the connection method below if only one tube is used with ZUD-L40/V40/B40.

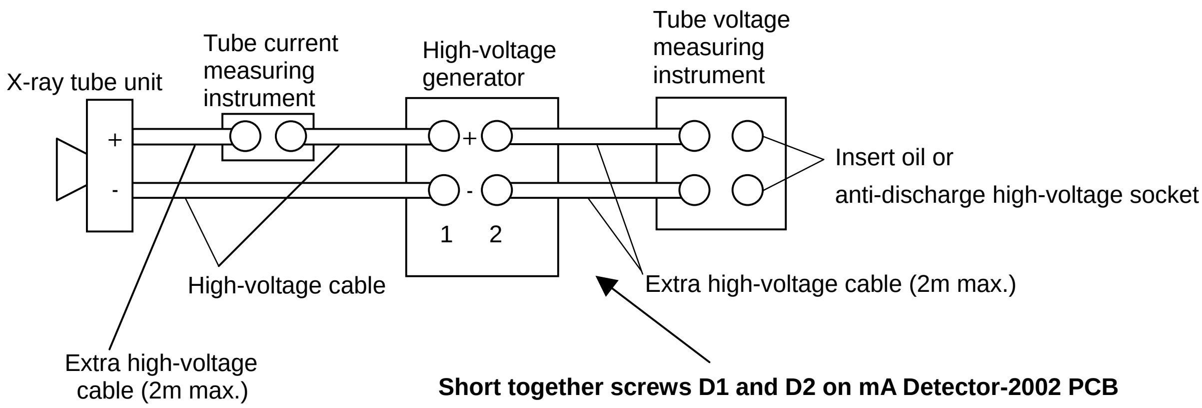


Fig. 4.6.2

With the high-voltage cable from the X-ray tube unit connected as normal to the high-voltage generator, connect the high-voltage cable from the X-ray tube-voltage measuring instrument to the empty receptacle on the high-voltage generator.
Short together screws D1 and D2 on the mA Detector-2002 PCB at the top of the high-voltage generator.

DANGER

Insert insulating oil into empty receptacles on the X-ray high-voltage generator or take other measures to prevent electrical discharge. Cap the free high-voltage receptacles for safety.
This connection cannot be used if the measuring instrument is also used to measure the tube current.

DANGER

After use, remove the shorting between screws D1 and D2 on the mA DETECTOR-2002 PCB.

(3) Connecting the oscilloscope

Connect an oscilloscope to the output terminals of the measuring instruments.

The oscilloscope must have a memory function.

> **CAUTION**
>
> **Do not connect the GND terminal in the power plug on the oscilloscope.**

(4) Checks using the X-ray high-voltage generator measurement circuit

> **CAUTION**
>
> **The method described below is a supplementary measurement method. It does not accurately measure the tube voltage or tube current. Therefore, these measured values are no more than guidelines.**

(a) Measuring the radiography tube voltage

Use the 5V/100kV scale to observe the measured X-ray tube-voltage waveform between the CP81 TkV and GND check terminals on the UD CONT-2005 PCB in the rack inside the control cabinet.

To independently check the X-ray tube anode (+) and cathode (–), use the 5V/100kV scale to observe the measured X-ray tube-voltage waveform across the GND check terminal and the CP90 kV+ or CP83 kV– terminal, respectively, on the UD CONT-2005 PCB in the rack inside the control cabinet.

(b) Measuring the radiography tube current

Connect the oscilloscope to CP48 TMA on the UD CONT-2005 PCB. TMA outputs the measured tube-current waveform using a 1V/200mA scale. (Correct values are not output for approximately the first 5 ms.)

Fig. 4.6.3 shows an example of a measured tube-current waveform measured at CP48 TMA

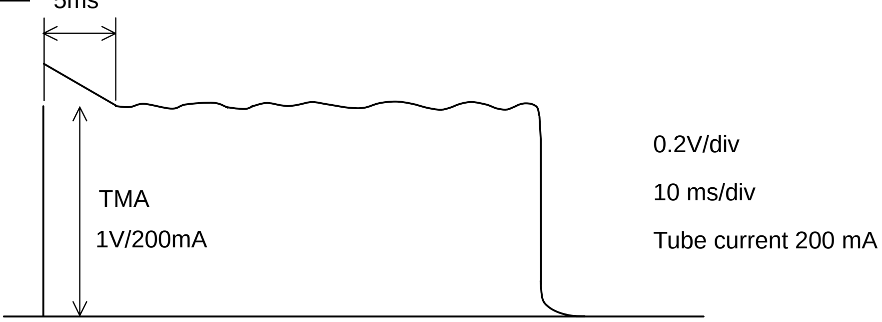


Fig. 4.6.3 TMA

4.6 Connecting the Tube Voltage/Tube Current Measuring Instruments

(c) Measuring the radiography time

Measure the radiography time from the tube-voltage waveform described in (a).

(d) Measured value display mode

This unit incorporates a function to measure the tube current flowing at the neutral point and display the value on the console. This display can be used as a simple tube-current meter if a reading is needed urgently. Select “Display the measured values after exposure in the ZUD-HV Maintenance Tool.

To display the measured values, select the measured value display mode and set the X-ray exposure time to at least 32 ms.

4.7 X-ray Tube Aging

CAUTION

Execute X-ray tube aging according to the following procedure when it is first used after the X-ray unit is installed or after the unit has been unused for one month or more.

A general example is described below. For details, refer to instruction manual for the X-ray tube.

Radiography

(1) Select the large focus and set the following radiography conditions:

Tube voltage	50 kV
Tube current	Minimum position
Radiography time	0.1 s

(2) Increase the tube voltage in 10kV steps up to the maximum operating tube voltage (but not exceeding the maximum operating tube voltage of the X-ray high-voltage generator used), making two X-ray exposures at each tube voltage at a rate of one exposure per minute.
Refer to section 4.8 for details about the adjustment method for the radiography tube current.

(3) If an error code is displayed on the console during aging, reduce the X-ray tube voltage until it stabilizes. Make X-ray exposures for a while at this tube voltage before increasing the tube voltage once more.

Fluoroscopy

(1) Select the fluoroscopy tube current adjustment mode (FVF, refer to section 4.9) and select a technique that includes fluoroscopy.

(2) Set the fluoroscopy tube voltage to 50kV and apply the high voltage. Adjust the FVF value setting at the console to bring the displayed tube current to 1mA ± 0.2mA.

(3) Gradually increase the X-ray tube voltage at a rate of 10kV/minute to one of the following voltages, and then conduct X-ray exposure for ten minutes. If the tube current fluctuates during this process, readjust the FVF value.
   (A) If the maximum continuous voltage of the of the X-ray high-voltage generator used is higher than the maximum operating tube voltage of the X-ray tube, readjust the maximum operating tube voltage.
   (B) If not, readjust the maximum continuous voltage of the of the X-ray high-voltage generator.

4.8 Adjusting the Radiography Tube Current

This system uses the constant-current heating method. Beware of the following points when adjusting the tube current. For details about the X-ray tube unit, see the instruction manual for the X-ray tube used.

(1) Use a tube current measuring instrument (milliammeter) that was calibrated within the last year.
(2) Adjust the current 2 or 3 minutes after turning on the power.
(3) Do not exceed the maximum filament current (normally 5.2 A) of the tube used.
(4) Set the adjustment interval at 1 minute minimum, depending on the tube load. Do not start adjustments from a tube current and tube voltage that create a large tube load.
(5) Adjust all measured tube currents to within ±5% of the set tube current or ±20 mA, whichever is smaller.
(6) An error code (E23) is displayed on the remote console if the tube current exceeds the set tube current value by 200mA or more.
(7) If the tube current is significantly smaller than the set tube current value, the tube voltage tends to overshoot at startup, such that the tube voltage over circuit actuates and an error code (E19, E20, E21, E22) is displayed.

4.8.1 Preparations

(1) This unit adjusts the tube voltage – filament current characteristic for each X-ray tube focus setting and tube current position.
(2) The tube voltage is adjusted at 6 points: 40kV, 60kV, 80kV, 100kV, 125kV, and 150kV. However, if the maximum tube voltage for the tube used is 125kV, the tube voltage is adjusted at five points from 40kV to 125kV. Similarly, if the maximum tube voltage is 100kV, it is adjusted at four points from 40kV to 100kV. The unit conducts linear interpolation to determine the tube voltage between the adjustment points.
(3) The milliammeter is set to 20 ms delay time and 10 ms measurement time.

CAUTION

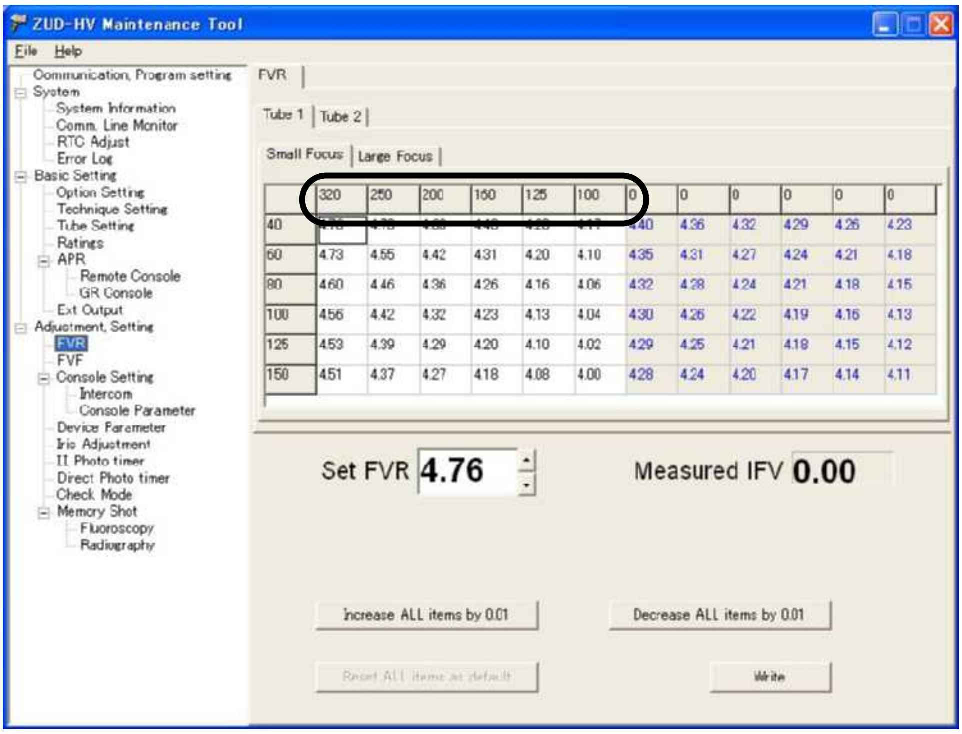
Always make the tube code and other initial settings (refer to section 4.4) before adjusting the radiography tube current.

4.8.2 Adjusting the Radiography Tube Current

The radiography tube current is adjusted by the adjustment PC.

After the adjustment is completed, press [Write] to register the adjusted FVR values.

(1) Start up the ZUD-HV Maintenance Toll and select [Adjustment, Setting][FVR].



(2) Make sure that the technique is General Radiography.

(3) Select the [Tube 1] tab. (The [Tube 2] tab shows Tube 2 when the 2-tube option is installed.)

(4) Select the [Large Focus] tab.

The horizontal axis represents the tube current (mA) and the vertical axis represents the tube voltage (kV).

(5) Select the filament heating set value (A) in the table for the kV and mA values to be adjusted.

(6) The current FVR setting is displayed in the [Set FVR] box. The set value can be changed using the up and down arrow buttons.

(7) Conduct a radiography operation and check TMA peak value on the oscilloscope.

The measurement point is CP48 TMA (200 mA/V) on the UD CONT-2005 PCB.

(8) When all required setting changes have been made, press the [Write] button.

Normally set the radiography time to 40 ms.

(9) For units other than ZUD-P40D/DS, next select [Small Focus] tab and make similar adjustments. Press [Write] when the adjustments are completed. To increase or decrease all filament heating set values in the table in 0.01 increments, click the [Increase ALL items by 0.01] or [Decrease ALL items by 0.01] button, respectively. Press [Write] to save the settings.

CAUTION

If an error code such as L01 (Generator Load Over) or L02 (Emission Over) is displayed, radiography is not possible with the set tube voltage and tube current. Set the filament heating set value (FVR) to the estimated value.

4.9 Adjusting the Fluoroscopy Tube Current

This system uses the constant-current heating method. Beware of the following points when adjusting the tube current. For details about the X-ray tube unit, see the operation manual for the X-ray tube.

(1) Use a tube current measuring instrument (milliammeter) that was calibrated within the last year.

(2) Adjust the current 2 or 3 minutes after turning on the power.

(3) Do not exceed the maximum filament current (normally 5.2 A) of the tube used.

4.9.1 Preparations

(1) This unit adjusts the tube voltage – filament current characteristic for each X-ray tube focus setting and tube current position.

(2) The tube voltage is adjusted at 6 points: 50kV, 60kV, 80kV, 90kV, 100kV, and 115kV. However, if the maximum tube voltage for the tube used is 125kV, the tube voltage is adjusted at 6 points from 50kV to 125kV. The unit conducts linear interpolation to determine the tube voltage between the adjustment points.

(3) The milliammeter is set to 20 ms delay time and 10 ms measurement time.

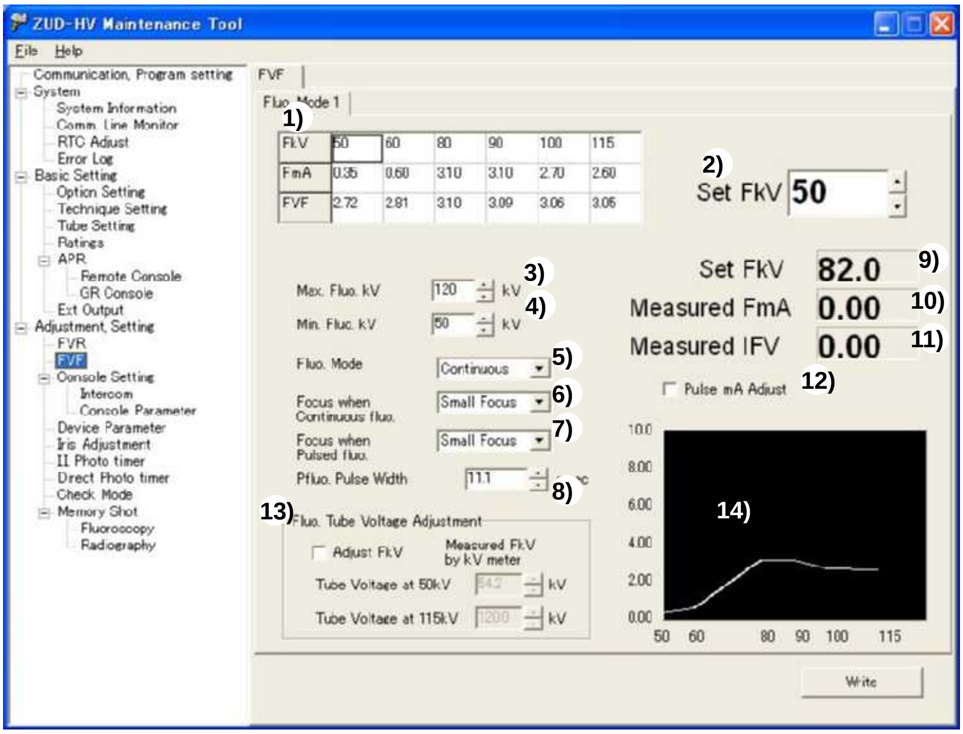
4.9.2 Adjusting the Continuous Fluoroscopy Tube Current

The fluoroscopy tube current is adjusted by the maintenance.

After the adjustment is complete, press [Write] to register the adjusted FVF values.

> **CAUTION**
>
> **Errors occur when adjusting the fluoroscopy tube voltage if the tube-voltage measuring instrument is connected.**
>
> **Disconnect the tube-voltage measuring instrument.**

(1) Start up the ZUD-HV Maintenance Toll and select [Adjustment, Setting][FVF].



(2) Make sure that the [Fluo. Mode] is set to [Continuous]. [5)]

If it appears as [Pulsed], set continuous fluoroscopy at the DR unit.

(3) Set [Focus when Continuous fluo.] to [Large Focus] or [Small Focus]. [6)]

(4) The [Max. fluo. kV] or [Min. Fluo. kV] set value can be changed using the up and down arrow buttons at the right. [3), 4)]

(5) Fluoroscopy tube voltage – fluoroscopy tube current curve settings

* The first row of Table 1) shows the set fluoroscopy tube voltage (FkV). When a value is selected in this row, the name of the box 2) changes to [Set FkV]. The set value can be changed using the up and down arrow buttons.

The second row shows the set fluoroscopy tube current (FmA). An FmA value can be changed when it is selected in this table.

Category fluoroscopy tube current position is shown below.(SDR-100 and SF6020ZD are common.)

Fluoroscopy tube voltage [kV]	50kV	60kV	90kV	100kV	115kV	120kV
200kHU type	0.3mA	0.5mA	2.5mA	2.5mA	2.3mA	2.2mA
300kHU type	0.3mA	0.5mA	2.5mA	2.5mA	2.3mA	2.2mA
400kHU type	0.35mA	0.6mA	3.1mA	3.1mA	2.7mA	2.6mA

Fluoroscopy tube voltage [kV]	50kV	60kV	70kV	85kV	100kV	120kV
140kHU type (1.2U161CFL-31)	0.3mA	0.5mA	1.5mA	2.0mA	1.7mA	1.5mA

* If measurement dose of fluoroscopy exceeds regulation (50 mGy/min(5.75 R/min)), adjust get down fluoroscopy tube current of 120kV point. After adjustment, confirm that dose doesn't exceed regulation by every fluoroscopy tube voltage.

(6) Select the filament heating set value (FVF) in the table for the kV and mA values to be adjusted. The tube voltage setting on the console also changes.

(7) The current FVF setting is displayed in the 2) [Set FVF] box. The set value can be changed using the up and down arrow buttons.

(8) Conduct a fluoroscopy operation and check the value displayed on the tube-current meter. Adjust the FVF value for the set tube current until the selected set

CAUTION

The UD CONT-2005 CP TMA peak value is not the measured fluoroscopy tube current value, due to the high proportion of the current value (0.16 mA to 0.42 mA) flowing in the tube-voltage detection resistance on the high-voltage transformer during fluoroscopy.
Always check the value indicated on the tube-current meter.
The measured value displayed on the console by the ZUD-HV Maintenance Tool has been corrected by subtracting the resistance current above.

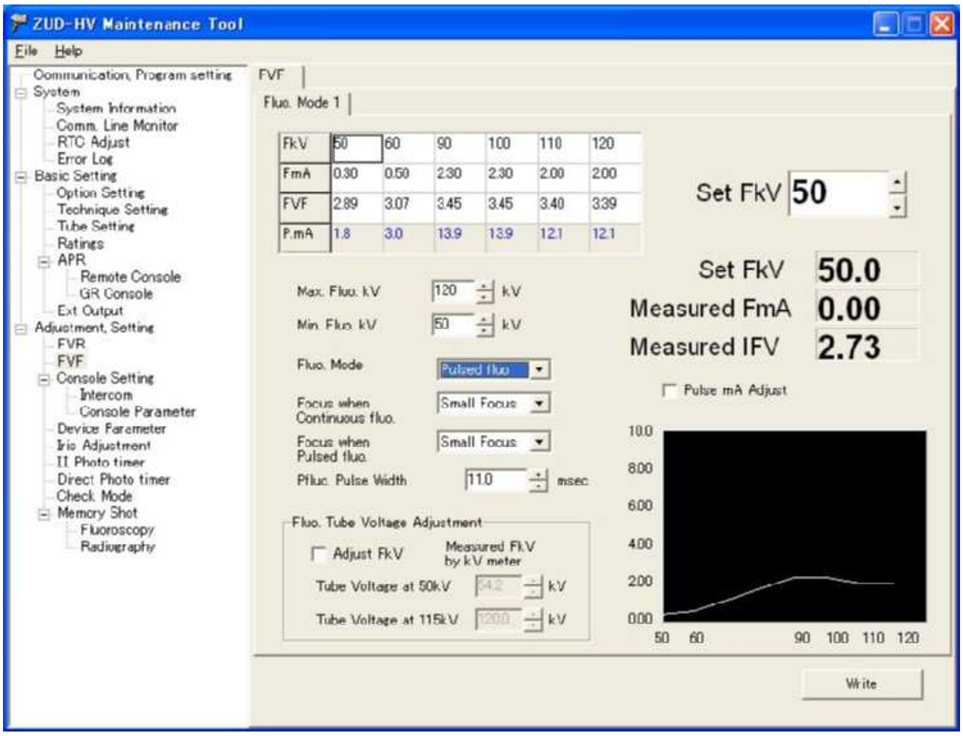
(9) When all required FkV position adjustments have been made, press the [Write] button.

4.9.3 Pulse fluoroscopy tube current adjustment

To adjust pulse fluoroscopy tube current, use adjustment PC.

Afterwards, to save adjusted FVF value and setting, press the “write” button.

(1) Start up the ZUD-HV Maintenance Tool and select [Adjustment, Setting][FVF].



(2) Start up the DR device, setting fluoroscopy condition to pulse fluoroscopy 3.75fps.

(Setting of fluoroscopy condition can execute in “APR temporary compilation” of radiography condition in the DR monitor.)

Set pulse rate to 3.75fps absolutely, to reduce load of tube while adjusting it.

(3) Determine peak value (P.mA) of pulse fluoroscopy tube current which is adjusted.

Be sure to input following parameter.

Reconfirm parameter in “FLEXAVISION Image Adjustment Manual”.

i) Set pulse width to 11msec.

ii) Input setting pulse fluoroscopy average tube current (FmA) at 15fps against each setting fluoroscopy tube voltage (FkV).

It depends on kind of tube, recommendation fluoroscopy curve is different so refer to “FLEXAVISION Image Adjustment Manual”.

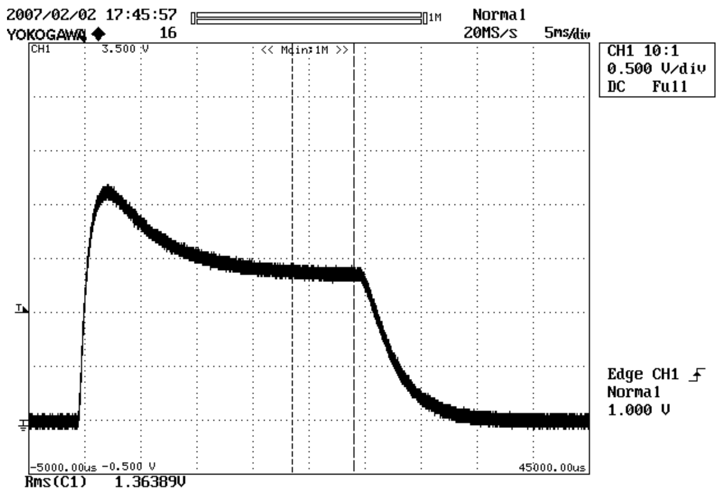
(4) Confirm that “fluoroscopy mode “ is “pulse fluoroscopy”.

(5) Check “pulse mA adjustment mode” checkbox.

Pulse width becomes 25msec fixed for adjustment.

(6) Adjust peak value(P.mA) of pulse fluoroscopy tube current against each setting fluoroscopy tube voltage(FkV).

- i) Confirm tube voltage waveform by output waveform of milliammeter.
- ii) Supplementary method can use TMA waveform of check pin on UD CONT-2005 PCB or “ADC waveform indication” of ZUD-HV Maintenance Tool.



- iii) Execute pulse fluoroscopy, change FVF value to above waveform becomes peak value(P.mA) of pulse fluoroscopy tube current in table.
- iv) When pulse fluoroscopy tube current is steady, adjust peak value (PMA) to 20~25msec.
- v) Adjust waveform value(P.mA) of pulse fluoroscopy tube current against every setting fluoroscopy tube voltage(FkV).

(7) Remove check of “pulse mA adjustment mode” checkbox.

(8) Press “write” button.

CAUTION

FmA and P.mA as pulse fluoroscopy is related to following diagram.

P.mA:
pulse current per pulse

Pulse width

FMA: Average tube current decided by PMA and pulse width, when 15fps pulse fluoroscopy.

4.10 Checking and Adjusting the Tube Voltage

Checking the X-ray Tube Voltage Waveform

The X-ray tube voltage is normally adjusted before dispatch from the factory. No adjustment is required during installation. Follow the procedure below to check that the tube voltage values and waveform are adjusted correctly.

> **CAUTION**
>
> **Fully age the X-ray tube before making this adjustment.**
>
> **Age the tube as described in section 4.7.**

(1) Connecting the Measuring Instrument

Check that the X-ray tube-voltage measuring instrument, tube-current measuring instrument, and oscilloscope are connected as described in section 4.6.

(2) Setting the Radiography Conditions

kV:	Minimum settable tube voltage to 100 kV (maximum settable value if setting is not possible)
mA:	100 mA or 500 mA (or the closest value if setting is not possible)
sec:	0.1 sec (or the closest value if setting is not possible)
Technique:	General technique (any technique is OK that permits a single X-ray exposure)

(3) Checking the X-ray Tube Voltage and Waveform

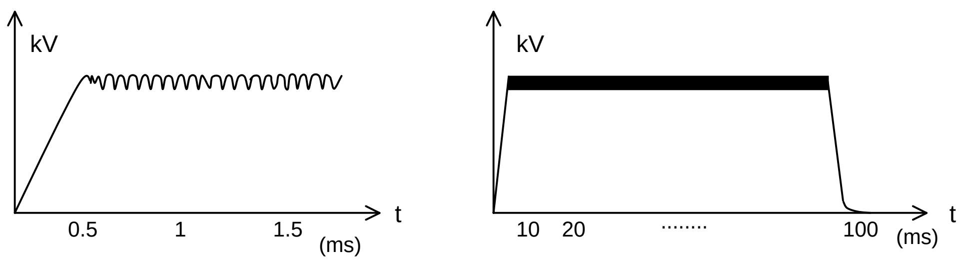


Fig. 4.10.1 A - K Outputs of the Tube-voltage Measuring Instrument

Conduct X-ray exposures while increasing the tube voltage in 10 kV to 20 kV steps from the minimum settable tube voltage up to 100 kV. Switch the oscilloscope sweep time and check that the high-voltage waveform appears as shown in Fig. 4.10.1 above. Also check the X-ray tube voltage value.

The rise time of the tube-voltage waveform and the size of the ripple differs a little due to the length of the high-voltage cable.

If the correct result cannot be obtained when checking the X-ray tub voltage value, readjust the tube voltage according to sections 1.10 “Adjusting the Tube Voltage” and 1.11 “Adjusting the Radiography Tube Voltage Feedback Sensitivity” in the MAINTENANCE.

(4) If No X-ray Tube-voltage Measuring Instrument is Available

CAUTION

The method described below is a supplementary measurement method. It does not accurately measure the tube voltage or tube current. Therefore, these measured values are no more than guidelines.

A simple measurement of the tube voltage value is possible using the method described below.
Measure the voltage between CP81 TKV and GND on the UD CONT-2005 PCB with a correctly calibrated oscilloscope. The value obtained has a relationship of approximately 1 V / 20 kV with the tube voltage.

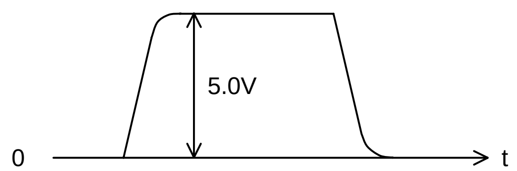


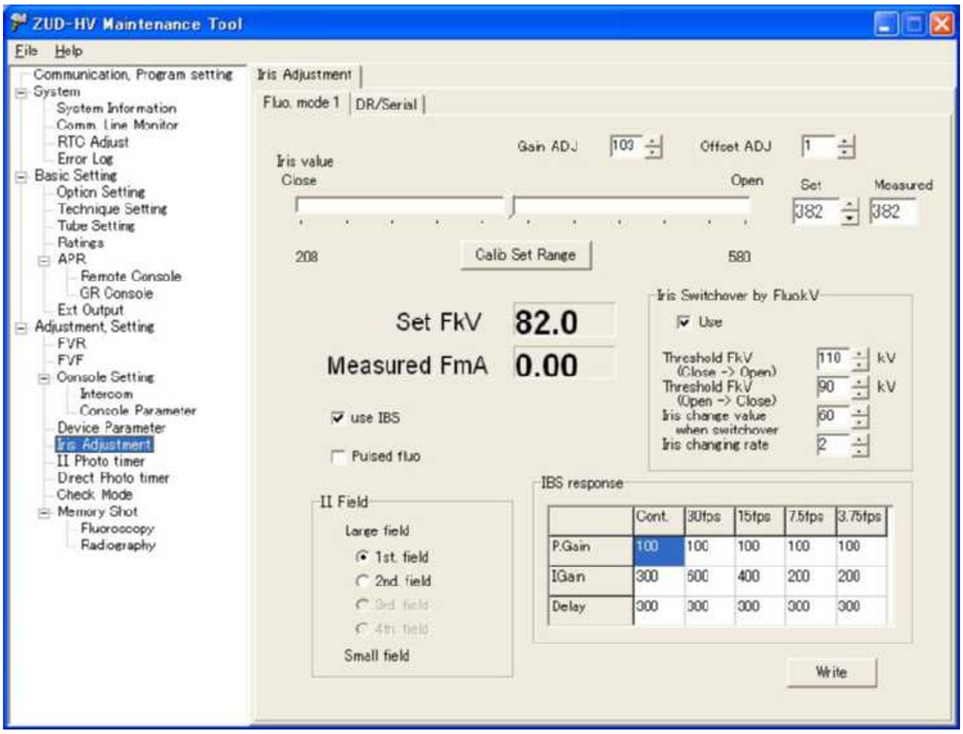
Fig. 4.10.2 TKV Waveform

Fig. 4.10.2 TkV Waveform shows an example of the waveform at the check pin CP81 TKV at 100 kV X-ray tube voltage.

4.11 Adjustment Iris and IBS response

Start up XUD-HV Maintenance Tool, open “Iris Adjustment” window in “Adjustment, Setting” and adjust following.

- Iris value at the time of fluoroscopy and DR radiography
- IBS Response value of each pulse rate



4.11.1 Adjusting the Iris

(1) Iris calibration

Before Iris adjustment, press “Calib Set Range” button and execute following iris calibration.

- Correction of error of measurement value and iris setting value of Iris control circuit.

  (Adjustment of detection gain and offset of when iris measurement value A/D is changed.)

- Detection of iris setting possible area.

  After calibration is finished, confirm that difference of iris setting value and measurement value is max ±10.

  To change gain correction value and offset correction value which are calculated after calibration, it can fine adjust difference of iris setting value and measurement value.

(2) Adjusting the Iris of Fluoroscopy

Select “Fluo mode 1” tab.

It can change iris value to move “iris value” slider. When iris value makes large, iris is open.

Execute fluoroscopy with IBS, and adjust Iris value in order to IBS balance kV reaches specified value.

ON/OFF of IBS and state of continuous fluoroscopy/pulse fluoroscopy are displayed check boxes. To change each state, switch over fluoroscopy mode by SDR-100 and IBS button on the remote console.

Adjust Iris value in each continuous fluoroscopy/pulse fluoroscopy and I.I. field size. Details of IBS balance value and the like of each condition refers to Image Adjustment Manual.

(3) Adjusting the Iris of Radiography

Select “Spot/serial radiography” tab.

It can change iris value to move “iris value” slider. When Iris value makes large, iris is open.

At specified radiography condition, adjust Iris value to become pertinent digital value of SDR-100.

Adjust Iris value in each I.I. field size. Details of radiography conditions when Iris adjusting refers to Image Adjustment Manual.

In addition, Iris value of FSP radiography operates same value of adjustment value of DR radiography.

Input data of Iris value

	Standard Volue			Input Data		
	continuous fluo.	pulse fluo.	DR radiography	continuous fluo.	pulse fluo.	DR radiography
1st. field	300	250	200			
2st. field	320	260	220			
3st. field	340	270	240			
4st. field	360	280	260			

4.11.2 Adjusting the IBS response

After adjust Iris value, to change following parameter, it can possible to adjust IBS response. Following parameters can set each sequence pulse fluoroscopy and pulse rate.

- Proportion gain
  It need not change in principle.
- Integral gain
  To make value large, response of IBS operation becomes fast. When value is too large, hunting of brightness and vibration are shown, reduce the value.
  Pulse rate is low, it tend to happen hunting.
- Delay time of IBS
  Set delay time(ms) to start to fluoroscopy until start to IBS control.
  When hunting when start to radiography is large, increase value large.

4.11.3 Setting of Iris kV interlock function

To use Iris Switchover by Fluo.kV, to open iris when balance kV is high because body thickness is large, it can increase advancement of fluoroscopy image and fluoroscopy possible body thickness.

Iris kV interlock function is availableness when check “apply”, following parameter setting is enabled.

- Threshold FKV (Close -> Open)
  Set fluoroscopy tube voltage of to open iris
- Threshold FKV (Open -> Close)
  Set fluoroscopy tube voltage of to close iris
- Iris change value when switchover
  Set variation to open iris from normal iris setting value.
- Iris changing rate
  Set variation speed of iris.

CAUTION

- **When difference of Threshold FKV (Close -> Open) and Threshold FKV (Open -> Close) is small and iris variation is large, it tends to take place hunting. When the hunting happens, to make Iris switching voltage large or to make Iris variation small.**
- **Iris Switchover by Fluo.kV is availableness when fluoroscopy. It has not an effect on radiography.**

Input data of Iris Switchover by Fluo.kV

	Standard Volue	Input Data
Iris Switchover by Fluo. KV	Use	
Threshold FKV (Close -> Open)	110	
Threshold FKV (Open -> Close)	90	
Iris change value when switchover	60	
Iris changing rate	2	

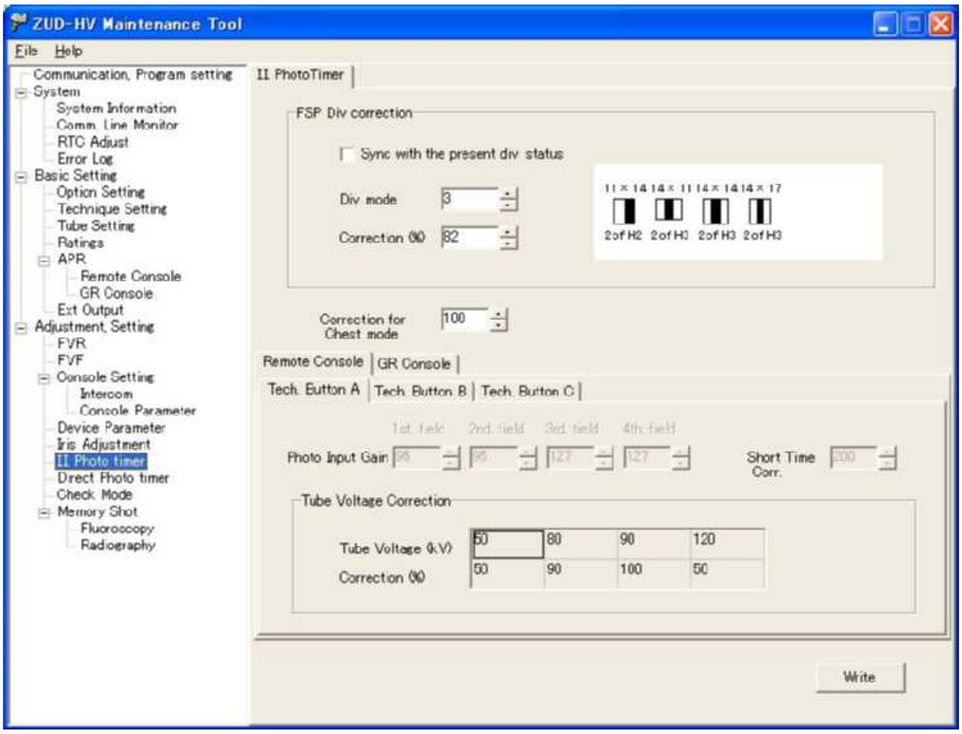
4.12 Adjusting the I.I Phototimer

4.12.1 Preparations

No additional components are required, as the UD CONT-2005 PCB incorporates an automated phototimer control circuit of I.I. photo-pickup type as standard.

(1) Check that the photocell cable connects the I.I. to the UD CONT-2005 PCB, as described in section 3.8.

(2) For techniques using I.I. indirect phototimer radiography, ensure that [I.I. Indirect] is selected on the ZUD-HV Maintenance Tool [Basic Setting][Technique Setting] screen.



4.12.2 Density Adjustment

Conduct phototimer radiography and determine the tube current and radiography time for optimal exposure.

As an I.I. phototimer is used across a wide range of conditions from low to high tube voltage, density adjustment is required in addition to adjustment for tube-voltage dependency. If the actual tube voltage used is relatively constant, set the actual tube voltage used.
Confirm that the value of [Short Time Correction] is "127".
(Range:0<max. correction> to 255<min. correction>)

4.12.2.1 Checking the Optimal Exposure Conditions

Before conducting phototimer density adjustments, use an acrylic phantom with the actual imaging system to determine the most suitable exposure conditions (density 1.3 or user’s preferred value) for radiography (tube voltage, radiography time).

In addition, in case of add tube voltage correction, obtain tube current and radiography time which are optimal exposure when tube voltage is 90kV point, 50kV point, 80kV point and 120kV point.

Radiography tube voltage is 90kV, acrylic phantom is 19cm.
Radiography tube voltage is 80kV, acrylic phantom is 15cm.
Radiography tube voltage is 50kV, acrylic phantom is 3cm.
Radiography tube voltage is 120kV, acrylic phantom is 24cm.

Above as a standard, execute manual radiography and obtain tube current and radiography time each optimal exposure.

4.12.2.2 Adjusting the Photo Input Gain

Start up the ZUD-HV Maintenance Toll and select [Adjustment, Setting][I.I. Photo Timer].

(1) Set the [Tube Voltage Correction] for 90 kV radiography tube voltage to the values below. In default, it has not 90kV position, so use 100kV position as 90kV.

Lead-free cassettes	250
Cassette containing lead	100 (*)
CR Cassette	250

* Gain adjustment is easier for a cassette containing lead, as little light enters the I.I. photocell. Set the correction values for other radiography tube voltages to half the preset values.

(2) On the remote console, set the tube voltage to 90 kV and the tube current to the same value as the radiography conditions investigated in (1).
Set the radiography time longer than the time in the radiography conditions investigated in (1).

(3) Conduct fluoroscopy. Change the Photo Input Gain value with the ZUD-HV Maintenance Tool until the measured value becomes the same as the radiography time investigated in (1).

Execute following setting, after X-ray exposure, cassette is not remove, it is possible double X-ray exposure so you can reduce time spent on phototimer adjustment.

- Setting DTC PCB DIP switch 1-2: ON
- Specification
  1) In case of spot filming: Putting cassette in and out becomes possible by cassette carrier key on remote console.
  2) Cassette tray radiography: double x-ray exposure is enabled without change cassette radiography position.
- To press reset button after DTC PCB setting, it is reflected.

CAUTION

Input and adjust photo input gain value select field size which is selected console by ZUD-HV Maintenance Tool without relation to “I.I. field size when FSP radiography” of “Option Setting” window.
After adjustment, imput same value as all the field sizes ecept the adjusted field.
After adjustment of phototimer is completed, turn off DIP switch 1-2 of DTC PCB.

4.12.2.3 Adjustment for Tube-Voltage Dependency

At the radiography conditions investigated in 4.12.2.1, adjust the tube voltage correction value to achieve the appropriate exposure. Make this adjustment after adjusting the density at 90 kV tube voltage, as described in section 4.12.2.2.

(1) Set the radiography conditions determined in section 4.12.2.1.

(2) Conduct phototimer radiography and check the measured radiography time. Adjust the correction value for the radiography tube voltage position in [Tube Voltage Correction] until the time becomes the same as the measured radiography time investigated in 4.12.2.1. (Range: 0 to 500%) The larger the value, the shorter the radiography time.

	50	60	100	140
Fuji FCR5000plus	11	41	312	397
Fuji CAPSULA	19	55	304	248

	50	70	100	120
Konica REGIUS190	12	87	317	385

(3) Repeat steps (1) and (2) for all tube voltage positions.

(4) After the adjustment is complete, press [Write].

Tube voltage position (KV)	50	60	100	140
Correction value	19	55	304	248

4.12.2.4 Adjusting the Short-Time Characteristic Correction Circuit

Adjust the [Short time correction] value if the object is thin and the density increases as the radiography time becomes shorter. The larger the value, the shorter the radiography time. (The density decreases.)

Setting possible area is 0(max. correction) ~255(min.correction).

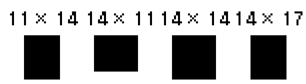
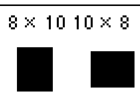
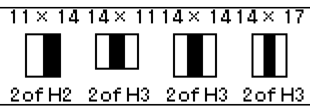
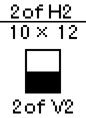
After the adjustment is complete, press [Write].

4.12.2.5 Division Correction

(1) If the technique is FSP, select [Division Mode] 1 and set the correction value to 100 for the entire area for cassette sizes 11 x 14, 14 x 14, and 14 x 17. Conduct phototimer radiography with a 14 x 14 cassette and change the photo timer gain value.

(2) Enter the appropriate correction value for the film size and division size. The preset values are shown in the table below.

Check the [Sync with the present div. status] checkbox to link the division mode in the Maintenance Tool to the division mode selected at the console.

Division mode	Film size	Correction value (%) (Preset value)
1		100
2		83
3		82
4		70

5	14 × 11 14 × 14 14 × 17 3of H3 3of H3 3of H3	70
6	14 × 11 14 × 14 14 × 17 1of H3 1of H3 1of H3	39
7	10 × 12 1of H2	51
8	10 × 12 1of 4	46
9	10 × 12 2of 4	73
10	10 × 12 3of 4	35
11	10 × 12 4of 4	46
12	10 × 8 1of H2	46
13	10 × 8 2of H2	71
14	11 × 14 1of 2	65
15	10 × 12 12 × 10	93
16	10 × 12 1of V2	80
17	10 × 12 2of H2	80

4.13 Adjusting the Direct Phototimer

4.13.1 Configuration

The phototimer option for this ZUD Series comprises a direct phototimer control PCB, a phototimer photo sensor, and accessories.

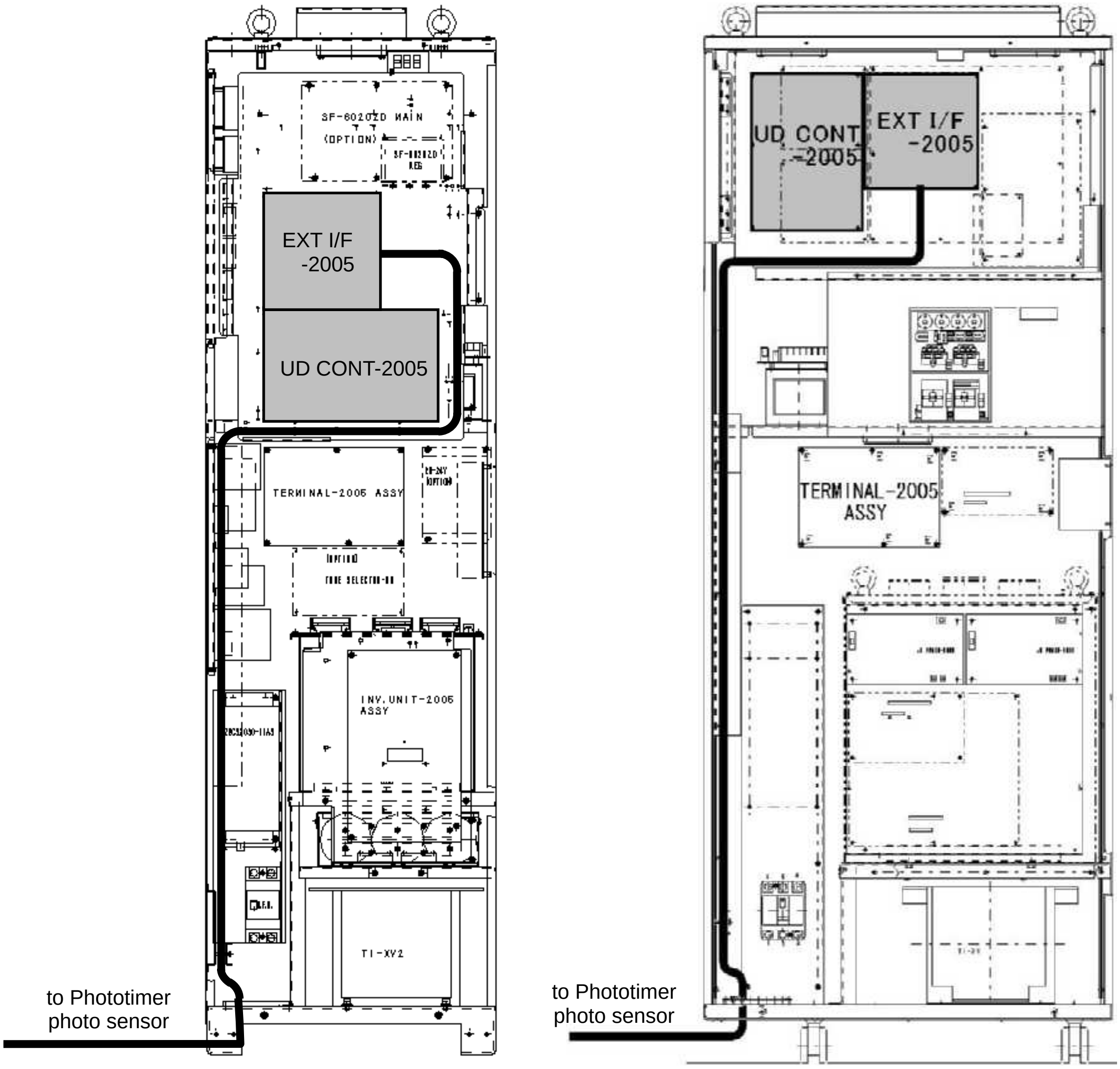
Table Phototimer Option for ZUD40 Series

Name	Direct phototimer for SF system	Direct phototimer for HB, FD systems
Configuration	1. Phototimer photo sensor SPT-XD-A4A (502-22087-01) 2. EXT I/F-2005 PCB (502-25068) 101. Spacer, BSF-415 4 101. Screw, SUS SEMS P3 M4×10 4	1. Phototimer photo sensor SPT-XD-A4A (502-22087-01)

Maximum 3 direct phototimer can be connected.

4.13.2 Installation

Install the unit and connect the wiring as shown in the diagram below.



4.13 3 Adjustment

4.13.3.1Connecting the phototimer photo sensor

Photo sensor No.	Connected to EXT I/F-2005 PCB connector
No.1 photo sensor	JDT1 [DET1]
No.2 photo sensor	JDT2 [DET2]
No.3 photo sensor	JDT3 [DET3]

CAUTION

*** Be sure to connect the shield wire to the EXT I/F-2005 PCB GND terminal.**

*** Clamp the cable along its length to prevent high loads on the cable which can cause discontinuities or other problems.**

*** Put the label of the photo-sensor cable of the attachment.**

Phototimer photo sensor

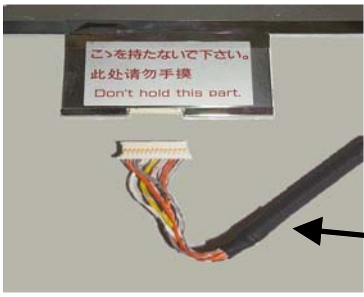
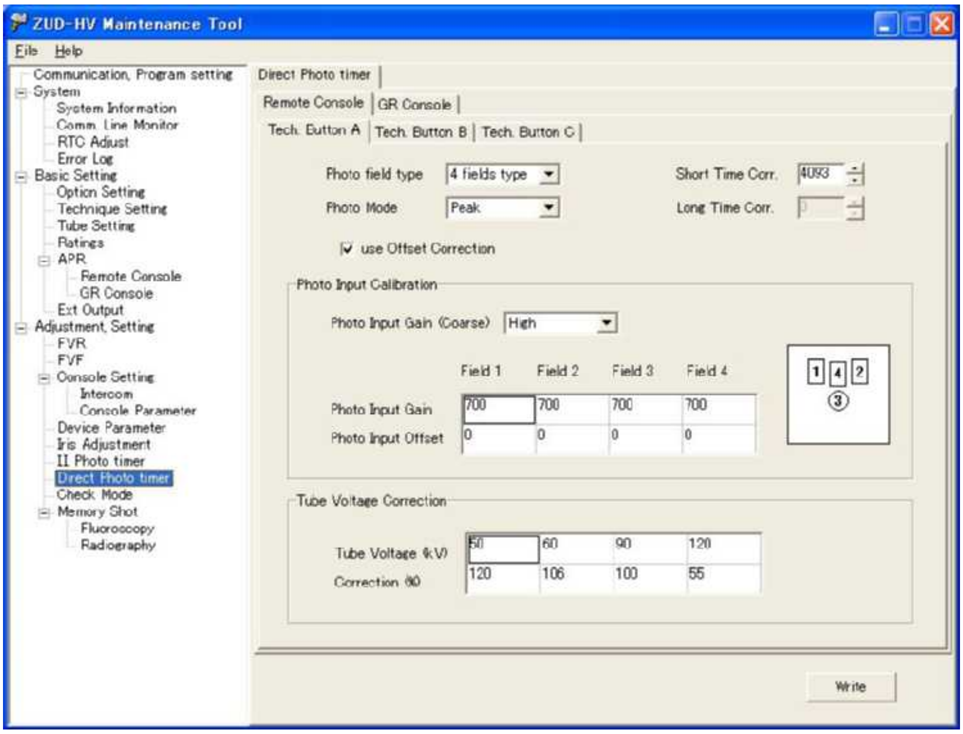


Photo-sensor cable

4.13.3.2 Initial Settings

Referring to (2) Setting the Techniques in 4.4 Initial Settings, allocate the phototimer photo sensors for the techniques using the direct phototimer.

Next, make the following initial settings related to the direct phototimer for each technique on the adjustment software [Basic Setting][Direct Photo Timer] screen. This can be selected only if the photodetector setting is "Xe direct phototimer 1" to "Xe direct phototimer 3" on ZUD-HV Maintenance Tool [Basic Setting][Technique Setting] screen.



・ Photo Field Type

Select the type of photo sensor detected. The table below shows the SPT-XD Series photo sensor corresponding to the set items.

Set item	Corresponding photo sensor
Field 1	SPT-XD-A1A
Field 2	None
Field 3	SPT-XD-A3B
Field 4	SPT-XD-A4A

・ Photo Mode

Sets the phototimer operation mode. Select one of the modes shown below. The Peak mode is normally selected.

Operation mode	
Peak	Photo shutoff when any one selected photo pickup field meets the photo shutoff conditions.
Average	Photo shutoff when average of all selected photo pickup fields meet the photo shutoff conditions.
AND	Photo shutoff when all selected photo pickup fields meet the photo shutoff conditions.

・ Use Offset Correction

Put a checkmark in this checkbox to operate the input offset cancelling circuit for the direct phototimer. Normally check this checkbox.

CAUTION

Large discrepancies may occur in the density if the offset correction function is not operating.

4.13.4 Density Adjustment

4.13.4.1 Checking the Optimal Exposure Conditions

Before conducting phototimer density adjustments, use a phantom with the actual imaging system to determine the most suitable exposure conditions (density 1.3 or user’s preferred value) for radiography (tube voltage, tube current, radiography time).

To apply tube voltage correction, also determine the tube current and radiography time for optimal exposure at the 90 kV, 50 kV, 80 kV, and 120 kV points.

19 cm acrylic phantom at 90 kV radiography tube voltage
15 cm acrylic phantom at 80 kV radiography tube voltage
3 cm acrylic phantom at 50 kV radiography tube voltage
24 cm acrylic phantom at 120 kV radiography tube voltage

Using these phantom sizes as guidelines, manually conduct phototimer radiography and determine the tube current and radiography time for each optimal exposure.

Confirm that the value of [Short Time Correction] is "4093".

(Range:4090<max. correction> to 4095<min. correction>)

4.13.4.2 Adjusting the Photo Timer Gains

Adjust the photo input gain for each photo pickup field at the remote console to achieve the appropriate exposure at the radiography conditions investigated in 4.13.4.1.

(1) Set the Photo Input Gain (Coarse) to [High]. Set all the Photo Input Offset values to 0.
(2) Set the radiography conditions determined in section 4.13.4.1 for 90 kV radiography tube voltage.
(3) Turn ON AEC and select one photo pickup field to be adjusted.
(4) Select some photo pickup fields with ZUD-HV Maintenance Tool.
(5) Conduct phototimer radiography and check the measured radiography time. Adjust the photo input gain of the photo pickup field selected in (4) until the time becomes the same as the measured radiography time investigated in 4.13.4.1. (Range: 0 to 4095) The larger the value, the shorter the radiography time.
(6) Repeat steps (3) and (5) for all photo pickup fields.
(7) After the adjustment is complete, press [Write].

4.13.4.3 Adjustment for Tube-Voltage Dependency Correction Value

At the radiography conditions investigated in 4.13.4.1, adjust the tube voltage correction value to achieve the appropriate exposure. Make this adjustment after adjusting the density at 90 kV tube voltage, as described in section 4.13.4.2.

(1) Set the radiography conditions determined in section 4.13.4.1.
(2) Conduct phototimer radiography and check the measured radiography time. Adjust the correction value for the radiography tube voltage position in [Tube Voltage Correction] until the time becomes the same as the measured radiography time investigated in 4.13.4.1. (Range: 0 to 500%) The larger the value, the shorter the radiography time.
(3) Repeat steps (1) and (2) for all tube voltage positions.
(4) After the adjustment is complete, press [Write].

4.13.4.4 Adjusting the Short-Time Characteristic Correction Circuit

Adjust the [Short time correction] value if the object is thin and the density increases as the radiography time becomes shorter. The larger the value, the shorter the radiography time. (The density decreases.)

After the adjustment is complete, press [Write].

Short Time Correction can be adjusted between from 0<max. correction> to 4095<min. correction>.

4.13.4.5 Default Values for Direct Phototimer Settings

The table below lists the default values for the direct phototimer settings.

Photo field type		4 Photo field			
Photo Mode		Peak			
Use Offset Correction		Yes			
Photo Input Gain (Coarse)		High			
Field		1	2	3	4
	Photo Input Gain	250	275	320	360
	Photo Input Offset	0	0	0	0
Tube Voltage Correction (kV)		60	80	90	120
Tube Voltage Correction (%)		186	105	100	65
Short Time Correction		4093			

4.14 Setting the Realtime Clock

The following settings can be made for the realtime clock. After the adjustment is complete, press [Write] to register the adjusted values.

(1) Setting the time and date

Set the date and time for the realtime clock on UDCONT-2005 PCB.

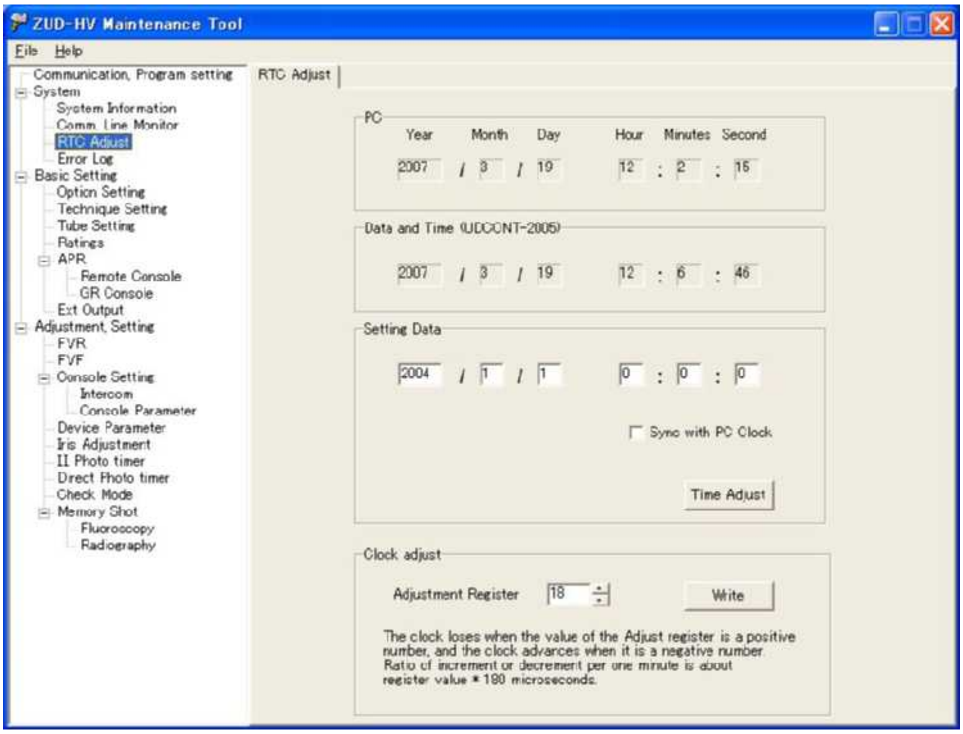
Enter the time and date in the [Setting Data] area and click the [Time Adjust] button to change the time and date setting for the realtime clock.

Check [Sync with PC Clock] to automatically synchronize the data values in the [Setting Data] area to the PC time.

(2) Adjusting the Clock

Change the value of the [Adjustment Register] to delay or advance the realtime clock. The larger the value, the greater the delay of the realtime clock. Each change of 1 to the [Adjustment Register] delays or advances the realtime clock by about 0.26 seconds per day.

Normally set this value to 18.


ZUD-HV Maintenance Tool
File Help
Communication, Program setting
System
System Information
Comm. Line Monitor
RTC Adjust
Error Log
Basic Setting
Option Setting
Technique Setting
Tube Setting
Ratings
APR
Remote Console
GR Console
Ext Output
Adjustment Setting
FVR
FVF
Console Setting
Intercom
Console Parameter
Device Parameter
Iris Adjustment
II Photo timer
Direct Photo timer
Check Mode
Memory Shot
Fluoroscopy
Radiography
RTC Adjust
PC
Year Month Day Hour Minutes Second
2007 / 3 / 19 12 : 2 : 15
Data and Time (UDCONT-2005)
2007 / 3 / 19 12 : 6 : 46
Setting Data
2004 / 1 / 1 0 : 0 : 0
Sync with PC Clock
Time Adjust
Clock adjust
Adjustment Register 18
Write
The clock loses when the value of the Adjust register is a positive number, and the clock advances when it is a negative number.
Ratio of increment or decrement per one minute is about register value * 180 microseconds.

4.15 Setting the Intercom

The following settings can be made for the intercom systems from operation room microphone to examination room speaker (Doctor -> Patient) and from examination room microphone to operation room speaker (Patient -> Doctor).

Adjust the following settings as required for the environments in the rooms. No other items can be changed.

(1) Sound settings (Bass, Mid, Treble)

Change the [Bass], [Mid], and [Treble] set values to adjust the corresponding bass, mid, and treble ranges. (0 db: standard setting. Increasing the value increases the intensity in the corresponding range.) If howling occurs, it can sometimes be prevented by reducing the intensity in the region corresponding to the howling.

(2) Volume

Sets the intercom volume. (Console VR: set from remote console. Other: Use fixed volume. The larger the value, the higher the volume.)

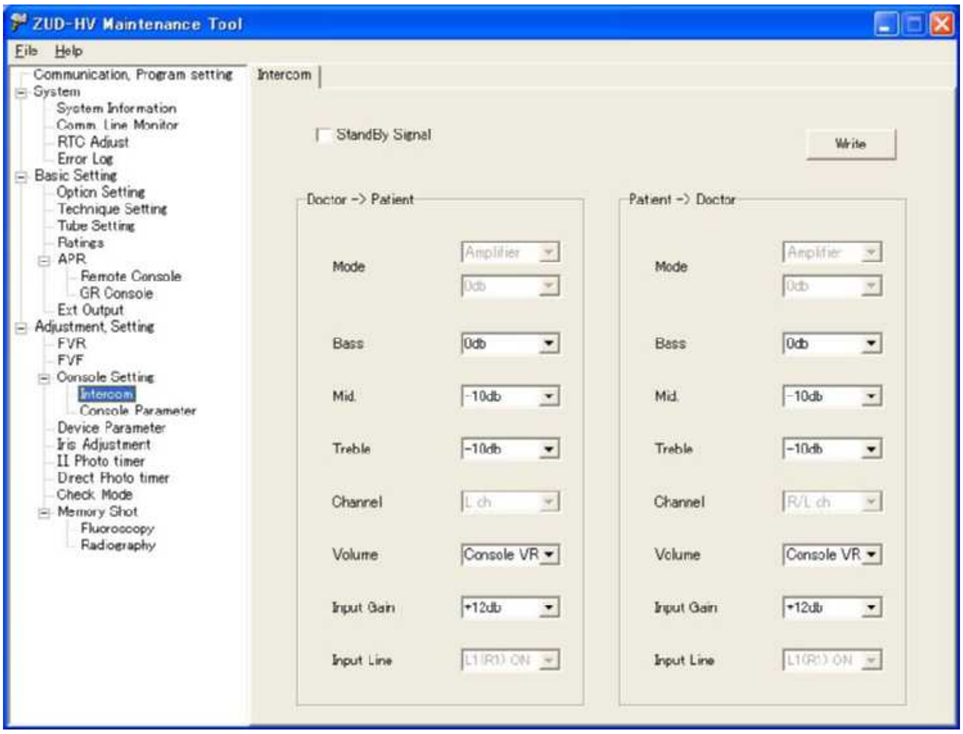
(3) Input Gain

Sets the sensitivity of each microphone connected to the intercom. (The larger the value, the higher the sensitivity.) Howling may occur if this value is too high.

(4) StandBy Signal

Check this checkbox to temporarily mute the intercom.

After the intercom adjustment is complete, press [Write] to register the settings.



		Preset	Data
Doctor	Bass	0dB	
↓	Mid.	-10dB	
Patient	Treble	-10dB	
(Talk)	Volume	Console VR	
	Input Gain	+12dB	
Patient	Bass	0dB	
↓	Mid.	-10dB	
Doctor	Treble	-10dB	
(Hear)	Volume	Console VR	
	Input Gain	+12dB	

4.16 Console Settings

The following settings can be made for the operating consoles. (The settings apply to the remote console and local console.) No other items can be changed. After the console adjustment is complete, press [Write] to register the settings.

(1) Buzzer Frequency

Sets the frequencies for Buzzer 1 (Fluoroscopy timer warning buzzer) and Buzzer 2 (fluoroscopy warning sound, key click sound).

Press the [One Shot] button to sound the buzzer during the One Shot duration time.

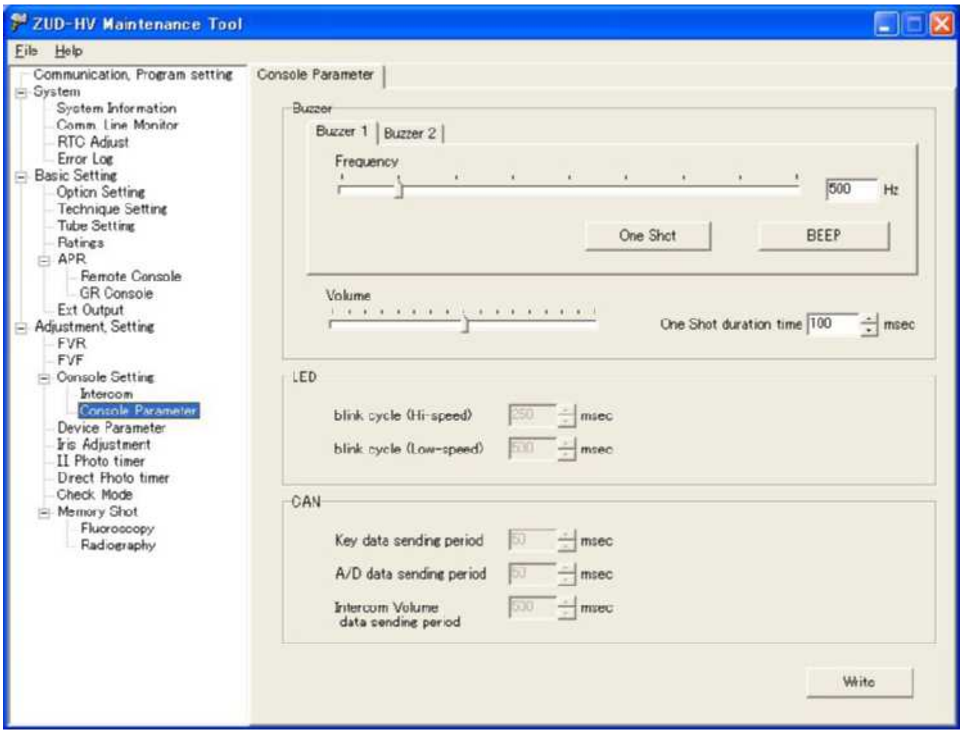
Press the [BEEP] button to turn the buzzer on or off.

(2) Buzzer Volume

Adjusts the buzzer volume.

(3) One Shot duration time

Adjusts the time that the One Shot buzzer sounds (click sound, etc.).



	Preset	Data
Buzzer1	500	
Buzzer2	1000	
One Shot duration time	100	

4.17 APR Settings

4.17.1 Setting of remote console APR

Start up ZUD-HV Maintenance Tool, the following settings can be made for each [APR] button on the remote operating console. Select the tab for the technique button for which the APR is to be set. Change the [APR No.] value to display the contents of the APR to be set.
After the APR settings are complete, press [Write] to register the settings.

(1) Radio. Technique Factors

Selects the conditions for radiography when the [APR] button is pressed (radiography tube voltage, current, time, mAs, focus size, 2 control/3 control). If the [use 2 Control] checkbox is checked, mAs control is conducted and the radiography tube current and radiography time cannot be selected. If this checkbox is unchecked, mA/sec control is conducted and radiography mAs cannot be selected.

* This section is availableness when “(5) memory shot” is not checked.

(2) Fluo. Technique Factors

Selects the conditions for fluoroscopy when the [APR] button is pressed (fluoroscopy starting voltage, enable/disable IBS).

Put a checkmark in the [enable IBS] checkbox to enable IBS.

(3) Phototimer

Selects the conditions for the phototimer when the [APR] button is pressed (use/not use phototimer, phototimer sensitivity, phototimer density, photo pickup field).

The photo pickup field setting ([PT Field] is ignored for techniques for which the direct phototimer is not selected.

* This section is availableness when “(5) memory shot” is not checked.

(4) I.I. Field Size

Selects the I.I. field size when the [APR] button is pressed.

When use DR, this setting is ignored.

(5) Memory Shot

Selects the conditions for the memory shot when the [APR] button is pressed (use/not use memory shot, memory shot number used).

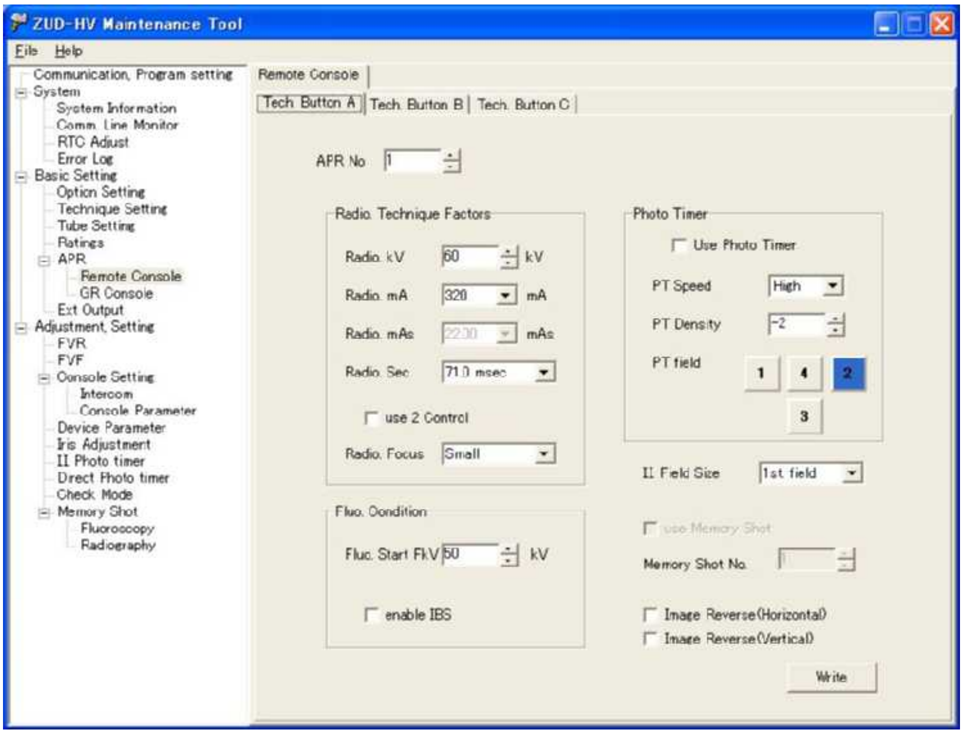
Refer to 4.18 for the content of each memory shot number.

This setting is ignored for techniques which do not use fluoroscopy.

* This section can only set when “(3) phototimer” is availableness.

(6) Image reverse setting

Select On/Off of image horizontal/vertical reverse. When check box is selected, image reverse becomes ON. When using DR, this setting is ignored.


ZUD-HV Maintenance Tool
File Help
Communication, Program setting
System
System Information
Comm. Line Monitor
RTC Adjust
Error Log
Basic Setting
Option Setting
Technique Setting
Tube Setting
Ratings
APR
Remote Console
GR Console
Ext Output
Adjustment Setting
FVR
FVF
Console Setting
Intercom
Console Parameter
Device Parameter
Iris Adjustment
II Photo timer
Direct Photo timer
Check Mode
Memory Shot
Fluoroscopy
Radiography
Remote Console
Tech. Button A
Tech. Button B
Tech. Button C
APR No
Radio. Technique Factors
Radio. kV 60 kV
Radio. mA 320 mA
Radio. mAs mAs
Radio. Sec 71.0 msec
use 2 Control
Radio. Focus Small
Photo Timer
Use Photo Timer
PT Speed High
PT Density -2
PT field
II Field Size 1st field
Fluo. Condition
Fluo. Start FkV 50 kV
enable IBS
use Memory Shot
Memory Shot No.
Image Reverse(Horizontal)
Image Reverse(Vertical)
Write

4.17.2 Setting the APR of general radiography console

Run the ZUD-HV Maintenance Tool, open “APR” and “GR console” window in “Basic Setting”.

It can set in each APR button of general radiography console by following procedure.

Complete setting, press “update” button and register setting.

(1) Select APR button

To press any button in “APR select key” which you would like to setting, display current setting of selected APR button.

(2) Setting Technique

To press each technique button in “APR Key”. set lay out technique to APR button.

- No Tech.

Select when APR key when selected is not use.

- Tech. button 1~4

Open “APR“ window in “ Basic Setting”. And each Technique set to “Technique Setting” window is displayed.

Each APR button in “APR Key” is displayed color which is suitable to technique which is set.

(3) Radiography setting condition

Set following radiography setting condition to APR button which is selected.

- Radio. kV :Radiography tube voltage
- Radio. mA :Radiography tube current (only at the time of 3 control can set)
- Radio. mAs :Radiography mAs (only at the time of 3 control can set)
- Radio. Sec :Radiography time (only at the time of 3 control can set)
- Switching 2 control and 3 control

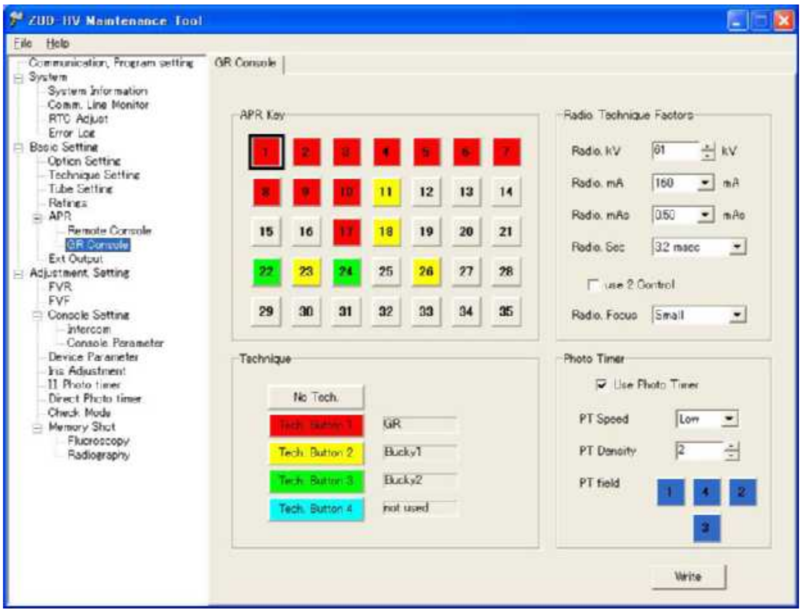
  When “use 2 Control“ is checked, you can not select radiography tube current・radiography time.

  When it isn’t checked, you can not select radiography mAs.

(4) Phototimer

Select condition about phototimer which is set when APR button select(on/off of phototimer, phototimer speed, phototimer density and phototimer field).

When technique which direct phototimer is not selected, ignore setting of photo field.


ZUD-HV Maintenance Tool
File Help
GR Console
APR Key
Radio Technique Factors
Radio. kV
Radio. mA
Radio. mAs
Radio. Sec
use 2 Control
Radio. Focus
Technique
No Tech.
Tech. Button 1
Tech. Button 2
Tech. Button 3
Tech. Button 4
GR
Bucky1
Bucky2
not used
Photo Timer
Use Photo Timer
PT Speed
PT Density
PT field
Write

4.18 Adjusting the Memory Shot

4.18.1 Preparations before Adjusting the Memory Shot

Adjust the memory shot after the adjustments of the unit as a general X-ray high-voltage generator are complete.

Also, adjust the I.I. unit and TV unit before adjusting the memory shot.

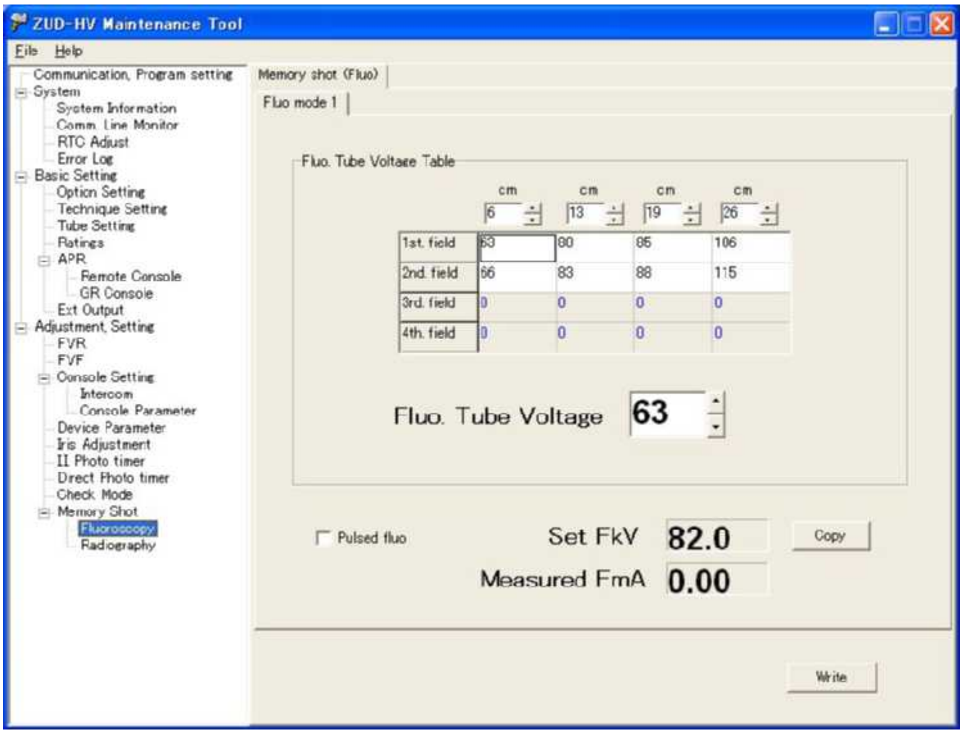
Also check the IBS area and the photo signal pickup position.

Acrylic phantoms are needed to make this adjustment. Use water phantoms if no acrylic phantoms are available. The phantom size must prevent X-rays from directly entering the I.I.

> ⚠ CAUTION
>
> **The initial radiography conditions for the adjustment in this manual are only examples. Consult the user to determine the optimal radiography conditions.**

4.18.2 Setting the Fluoroscopy Conditions for Different Image Fields

Use the ZUD-HV Maintenance Tool to set the fluoroscopy conditions for each image field. After making all the settings, press [Write].



(1) Position a 9 cm acrylic phantom.

(2) Press the [IBS] button on the remote console to turn on IBS.

(3) Start up the ZUD-HV Maintenance Tool and select [Adjustment, Setting][Memory Shot][Fluoroscopy].

(4) Enter the acrylic thickness 9 cm in the left-hand [cm] box on the [Memory Shot] Maintenance Tool screen.

(5) Change the value for the acrylic phantom with the up and down arrow buttons or by directly entering the value.

(6) On the [Memory Shot] Maintenance Tool screen, set the I.I. field size corresponding to the acrylic thickness.

(7) Conduct fluoroscopy. The measured fluoroscopy tube voltage is displayed by [Measured FkV] at the bottom of the [Memory Shot] Maintenance Tool screen. When the displayed value stabilizes, click the [Copy] button at the right.

(8) Check that the measured fluoroscopy tube voltage for the I.I. field size corresponding to the acrylic thickness is set in the table.

(9) Repeat steps (2) to (8) for an 18 cm acrylic phantom (75 kV tube voltage) and a 23 cm acrylic phantom (90 kV tube voltage), by entering the acrylic thickness in the second and subsequent [cm] boxes on the [Memory Shot] Maintenance Tool screen. The fluoroscopy tube voltage can be adjusted using the up and down arrow buttons.
(Only enter this value for detailed settings for the fourth position.
When not use the fourth position, input 0cm.)

(10) Register the measured fluoroscopy tube voltage for each field size in the table on the [Memory Shot] Maintenance Tool screen.

(11) When all adjustments are complete, press [Write] to save the settings.

(12) When pulse fluoroscopy option is combined, after select pulse fluoroscopy by DR operation, once again, return to “Memory shot fluoroscopy screen” and confirm that “Pulse fluoroscopy” is checked.

(13) Input data procedure (6)~(11) and save that.

4.18.3 Checking the Radiography Conditions

4.18.3.1 Checking the Initial Radiography Conditions (Direct Spot Filming)

The initial radiography conditions are preset at the factory as Shimadzu standard specifications. Conduct the check below to determine whether the entered radiography conditions are appropriate.

Conduct radiography without the phototimer and determine whether the film density obtained is suitable as a backup.

The initial radiography conditions for direct spot filming are shown below.

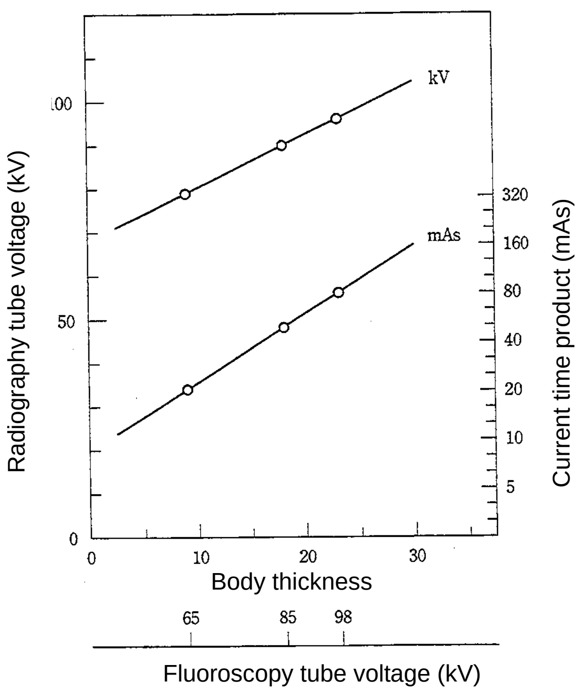


Fig. 4.18.1 Memory Shot Initial Conditions (Direct Radiography)

Focus: Large

Photo speed: M

Photo density: 0

Body thickness	Radiography tube voltage	Radiography mAs
9cm	70kV	6.3mAs
18cm	82kV	32mAs
23cm	88kV	80mAs

(1) Position an 18 cm acrylic phantom.
(2) Select a APR of fluoroscopy spot filming for which memory shot is not registered. (Set manual radiography.)
(3) Manually set the initial conditions 82 kV and 32 mAs for 18 cm thickness from Fig. 4.18.1.
(4) At the remote console, select film full-area radiography and auto-focus collimator.
(5) Conduct fluoroscopy spot filming. Measure and record the film density.
Film density ______________________
(6) If the film density is within the range +0.4 to 0.5 of the appropriate film density, the density is appropriate for a backup film and no adjustment of the memory shot radiography conditions is required.
Otherwise, change the mAs set value, as follows.

Appropriate density	–0.3 to –0.1	Increase mAs value by 6 steps.
	–0.1 to +0.1	Increase mAs value by 4 steps.
	+0.1 to +0.3	Increase mAs value by 2 steps.
	+0.5 to +0.7	Decrease mAs value by 2 steps.
	+0.7 to +0.9	Decrease mAs value by 4 steps.

Example
If the film density is appropriate density – 0.3, make the following changes to the mAs values from Fig. 4.18.1.

9cm: 6.3mAs → 12.5mAs
18cm: 32mAs → 63mAs
23cm: 80mAs → 160mAs

(7) The fluoroscopy conditions may drop too low for lung and other techniques where X-rays directly enter the I.I. In this case, the backup time may be inappropriate for the entered mAs. Change the mAs value for low body thicknesses, as follows:
Example
Make the following changes to the data in Fig. 4.18.1.

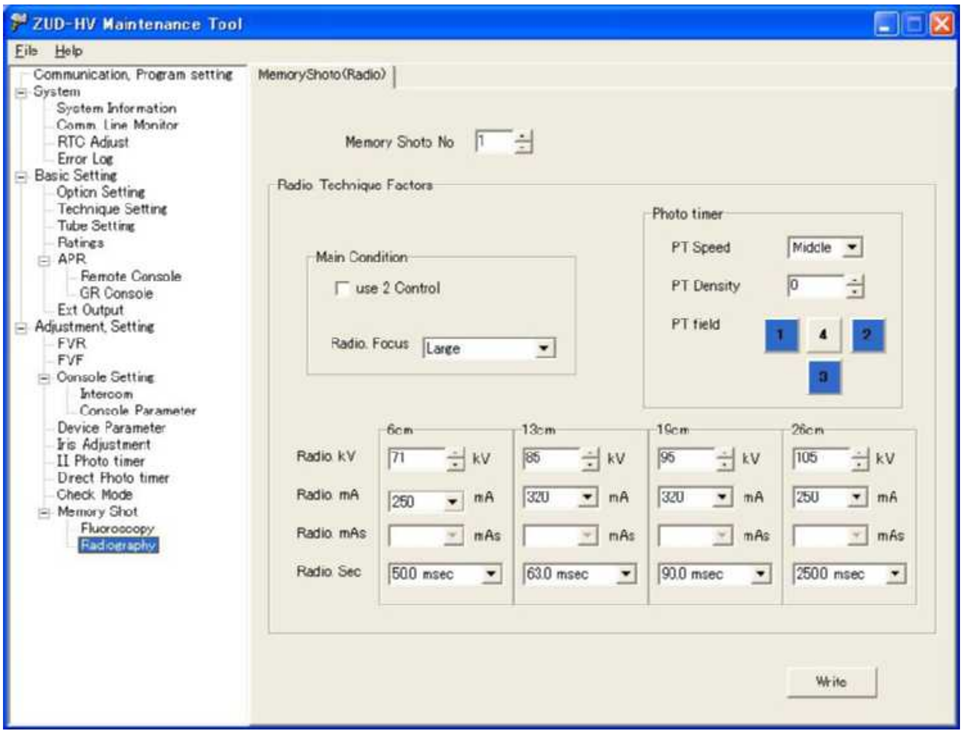
9 cm: 6.3 mAs → approx. 10 mAs
18 cm: 32 mAs → approx. 50 mAs

4.18.3.2 Checking the Initial Radiography Conditions (DR Radiography)

Refer to the SDR-100 Image Quality Adjustment Manual for details about the radiography condition data for DR radiography.

4.18.4 Changing the Radiography Memory Shot Data

Modify the initial radiography data for direct spot filming and enter the DR radiography on the adjustment software [Adjustment, Setting][Memory Shot][Radiography] screen.



(1) In [Memory Shot No.] select the memory shot number to modify or create. (Range: 1 to 16) As the value is changed, the radiography conditions for the memory shot number are displayed.

(2) Modify or enter the following radiography condition data for each memory shot number.

Use 2 control	Select this checkbox to operate in 2-control mode.
Radiography focus	Select the radiography focus.
Phototimer	Select the phototimer sensitivity, density, and field.
Radiography tube voltage	Set the radiography tube voltage for each body thickness.
Radiography tube current	Set the radiography tube current for each body thickness. The radiography tube current can be set if 2-control mode is not selected.
Radiography mAs	Set the radiography mAs for each body thickness. The radiography mAs can be set when 2-control mode is selected.
Radiography time	Set the radiography time for each body thickness. The radiography time can be set if 2-control mode is not selected.

(3) After the radiography conditions have been modified or entered, press [Write].

4.18.5 Registering Memory Shot to APR

This section describes how to register the memory shot conditions that were modified or entered above to APR. Referring to (5) Memory Shot in 4.17 [APR], set the APR to allocate the Memory shot number corresponding the modified or created memory shot conditions.

4.18.6 Checking the Backup (Direct Spot Filming)

Check the memory operation in combination with the phototimer. Check whether the X-ray exposure time is appropriate.

(1) Position an 19 cm acrylic phantom. Put the test film into the film magazine.

(2) Conduct fluoroscopy using IBS. Approximately 0.4 sec after starting fluoroscopy, the radiography conditions are automatically calculated and set from the fluoroscopy conditions.

(3) Conduct spot-filming after IBS stabilizes. After radiography, the measured X-ray exposure time appears in the [sec] display. Check that the set sec value and measured sec value are appropriate.

(4) Change the acrylic thickness and check the measured time. Check that the set sec value is at least 1.4 times the measured sec value.

4.18.7 Precautions when Changing the Direct Spot Filming Conditions

Follow the procedure below when changing the direct spot filming conditions adjusted above. Appropriate radiography conditions are tube voltage from 70 kV to 110 kV and radiography time from 10 ms to 0.2 sec (backup values). The entered mAs value is separated into mA and sec value according to the X-ray tube and load factor combination, and these values are displayed. Check that the radiography time is not too short or too long.

Confirm the radiography conditions change correctly in all fluoroscopy conditions when two controls is not selected.

If an appropriate condition is not registered, radiography conditions don’t change correctly because.

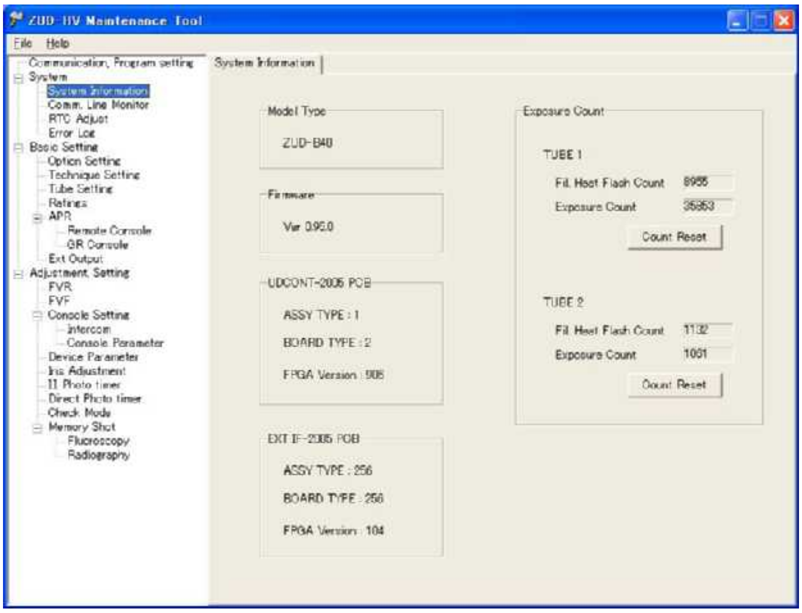
(1) Changing the [Phototimer Sensitivity Speed]

Select H, M, or L according to the intensifying screen used.

(2) Changing the density setting

If the phototimer setting is increased or decreased by two or more steps to obtain images with a higher or lower film density, increase or decrease the mAs value by one step.

4.19 System information



You can confirm the system information of X-ray high voltage generator.

- Model type

  Display model of X-ray high voltage generator.

- Firmware

  Display version of firmware of X-ray high voltage generator.

- UD CONT-2005 PCB

  Display ASSY, PCB and FPGA revision of UD CONT-2005 PCB.

  (This ASSY and PCB revision is different from those which are inscribed on PCB).

- EXT I/F-2005 PCB

  Display ASSY, PCB and FPGA revision of EXT I/F PCB.

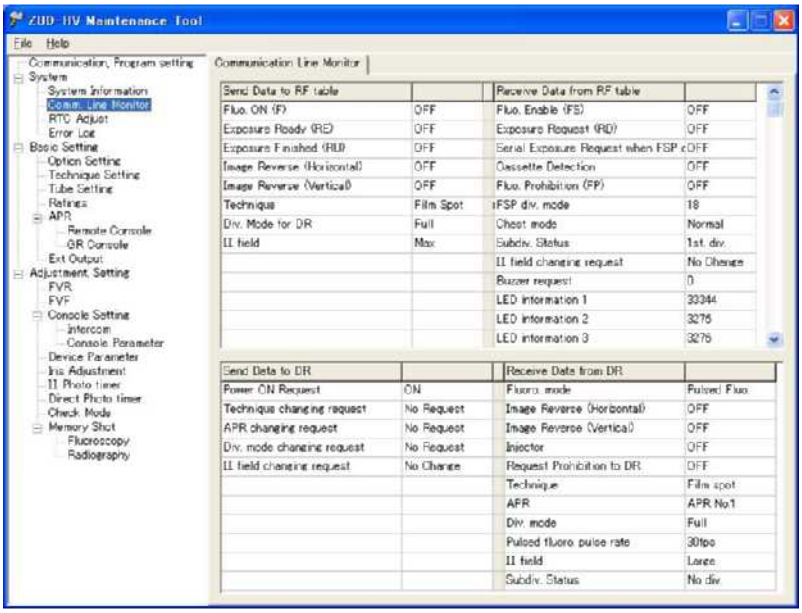
  (This ASSY and PCB revision is different from those which are inscribed on PCB).

- Exposure Count

  Display heat flash times and exposure times of each tube.

  (Reset to press [Count Reset] button.)

4.20 Communication Line Monitor



Display sent and received information of X-ray high voltage generator to R/F table and DR device.

Communication contents of X-ray generator to R/F table (CAN communication)

Item	Mean
Fluo. ON (F)	It becomes ON during generator is fluoroscopy (It is equivalent to former F signal)
Exposure Ready (RE)	It becomes ON when generator completes radiography ready up (It is equivalent to former RE signal)
Exposure Finished (RU)	It becomes ON when generator completes radiography (It is equivalent to former RU signal)
Image Reverse (Horizontal)	When image is horizontal reverse, it becomes ON
Image Reverse (Vertical)	When image is vertical reverse, it becomes ON
Technique	Generator displays technique
Div. Mode for DR	Display Div. Mode for DR
I.I. field	Display information of I.I. field

Receive Data from RF table (CAN)

Item	Mean
Fluo. Enable (FS)	When fluoroscopy or radiography is permitted, it becomes ON.
Exposure Request (RD)	When radiography preparation of the R/F table is completed, it becomes ON. (It corresponds to the RD signal of the past.)
Serial Exposure Request when FSP of Div. mode (FSE)	When Serial Exposure is permitted, it becomes ON. (It corresponds to the FSE signal of the past.)
Cassette Detection	When cassette is set in cassetteholder, it becomes ON. (only FLEXAVISION FD)
Fluo. Prohibition (FD)	When fluoroscopy is prohibited, it becomes ON.
FSP div. mode	Display the FSP Div. mode for spot filming.
Chest mode	Display chest mode status.
Subdiv. Status	Display the subdiv status.
I.I. field changing request	Display the value of requested I.I. field from R/F table.

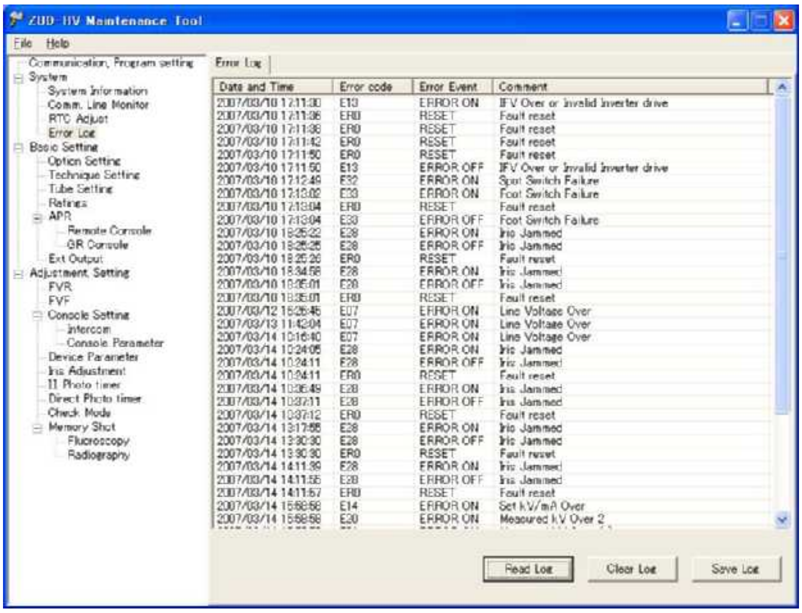
Send Data to DR (Current loop)

Item	Mean	EXT I/F-2005 PCB LED
Power ON Request	When power supply ON to the DR device is demanded, it becomes ON.	LD37
Technique changing request	Display the value of requested technique to DR.	LD9,LD45,LD46
APR changing request	Display the value of requested APR to DR.	LD11,LD12, LD47,LD48
Div. mode changing request	Display the value of requested Div. mode to DR.	LD7,LD43,LD44
I.I. field changing request	Display the value of requested I.I. field to DR.	LD5,LD41

Receive Data from DR (Current loop)

Item	Mean	EXT I/F-2005 PCB LED
Fluoro. mode	Display status of continuous fluo. or pulse fluo..	LD33
Image Reverse (Horizontal)	When image is horizontal reverse, it becomes ON	LD28
Image Reverse (Vertical)	When image is vertical reverse, it becomes ON	LD27
Injector	When injector-on is requested from DR, it becomes ON.	LD14
Request Prohibition to DR	When the change request is prohibited to DR, it becomes ON.	LD19
Technique	Display the content of the technique notification from DR device.	LD34～LD36
APR	Display the content of APR notification from DR device.	LD29～LD32
Div. mode	Display the content of Div. mode notification from DR device.	LD24～LD26
Pulsed fluoro. pulse rate	Display the content of pulse fluo. pulse rate notification from DR device.	LD22,LD23
I.I. field	Display the content of I.I. field notification from DR device.	LD20,LD21
Subdiv. Status	Display the content of subdiv status notification from DR device.	LD16～LD18

4.21 Error log



Display error log, which is generated by X-ray high voltage generator.

- Acquisition of log

  Display error log to presently.

  Date : date when error occurred and returned

  Error No. : error number of error generation and returning.
  "ERO" is meant fault reset requiring.

  Event : Error generation(ERROR ON), returning(ERROR OFF) are indicated reset requiring(RESET).

  Comment : Display meaning of error generation and returning.

- Delete of error log

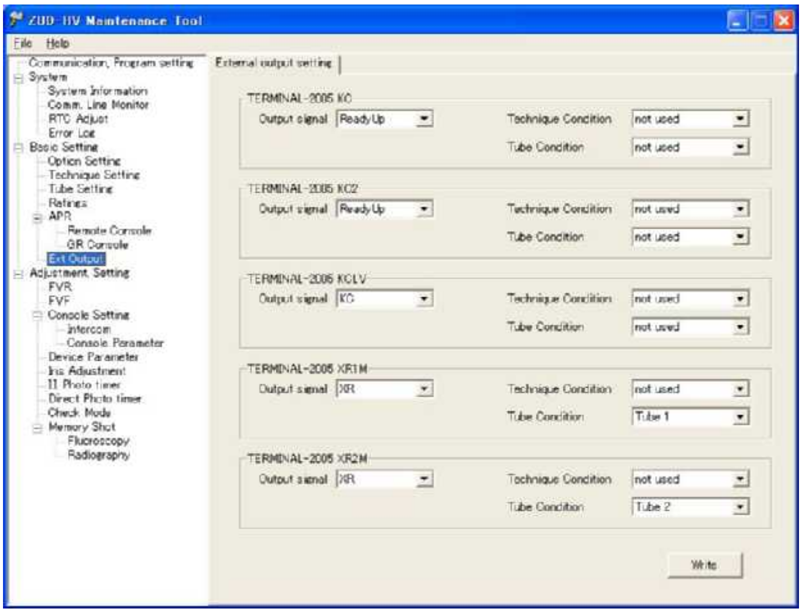
  Delete error log.

- Save log

  Save error log CSV format.

4.22 Setting of external output signal

Start up ZUD-HV Maintenance Tool and open [Ext Output] window of [Basic Setting], setting signal type and condition which is output following output terminal on TERMINAL-2005 PCB. Each output terminal is ON when every output signal, technique and tube condition are filled.



- Output terminal

Output Terminal	Output Signal Type
KC KC2 XR1M XR2M	Relay contact terminal Short circuit by output ON
KCLV	15V current loop Suction by output ON

- Output signal

Output Signal	Output Condition
KC	When KC, it is ON
Ready Up	When Ready Up, it is ON
XR	It becomes ON while 100ms during radiography and after radiography
XR100ms	From start radiography to 100ms is ON
F	When fluoroscopy, it is on.

- Technique Condition

Technique Condition	Output Condition
not used	Output condition none by technique
GR	Output permission at GR
Bucky 1	Output permission at Bucky 1
Bucky 2	Output permission at Bucky 2
Film Spot	Output permission at Film Spot
DR	Output permission at DR radiography
GR by RF table	Output permission at GR by RF table
Bucky 1 or 2	Output permission at Bucky 1 or 2

- Output tube condition

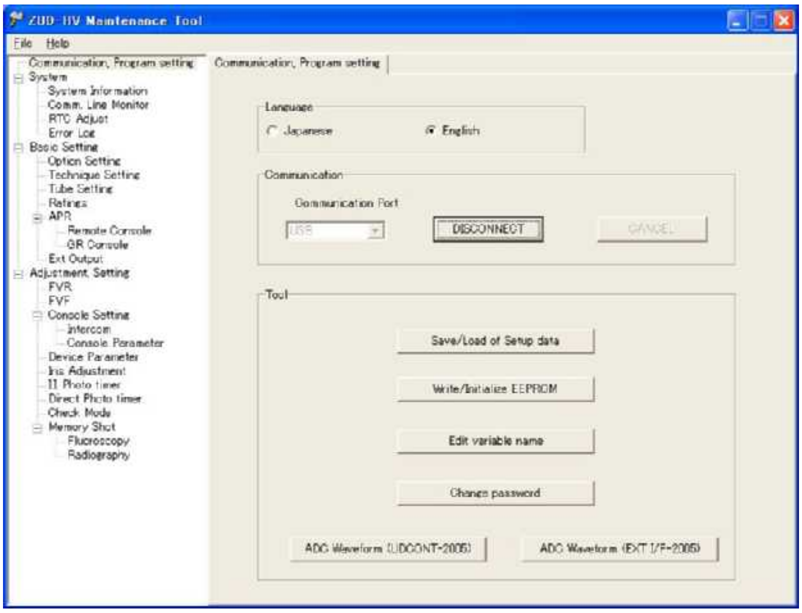
Tube Condition	Output Condition
not used	Output condition none by selected tube
Tube 1	Output permission at Tube 1
Tube 2	Output permission at Tube 2

- preset value

Output Terminal	Signal	Technique	Tube Condition
KC	KC	not used	not used
KC2	KC	Bucky 1	not used
KCLV	KC	not used	not used
XR1M	XR	not used	Tube 1
XR2M	XR	not used	Tube 2

4.23 Save setting data, and load.

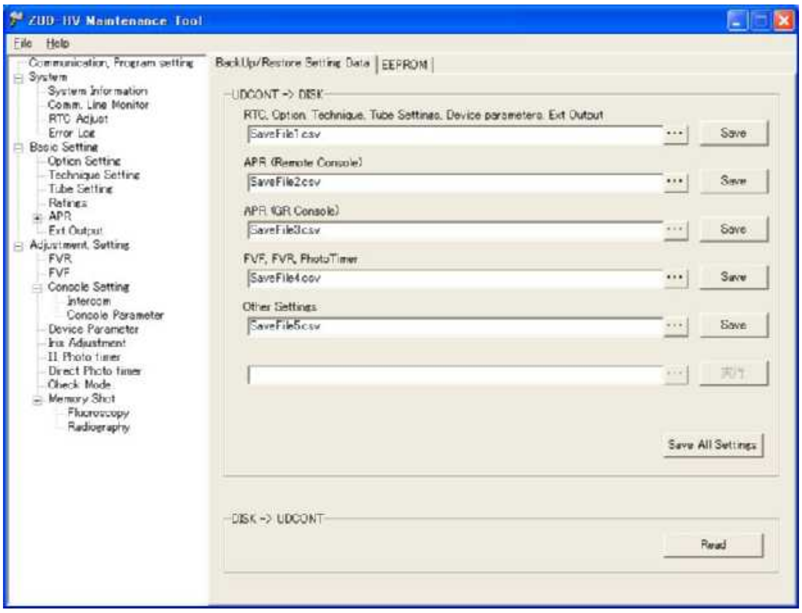
It enables to save and load setting data of ZUD X-ray high voltage generator by CSV format.



4.23.1 Procedure of saving and loading of setting data

Start up ZUD-HV Maintenance Tool and press “Save/Load of Setup data” button by “Communication, Program setting” window, “data file” window is displayed.

4.23.2 Save setting data

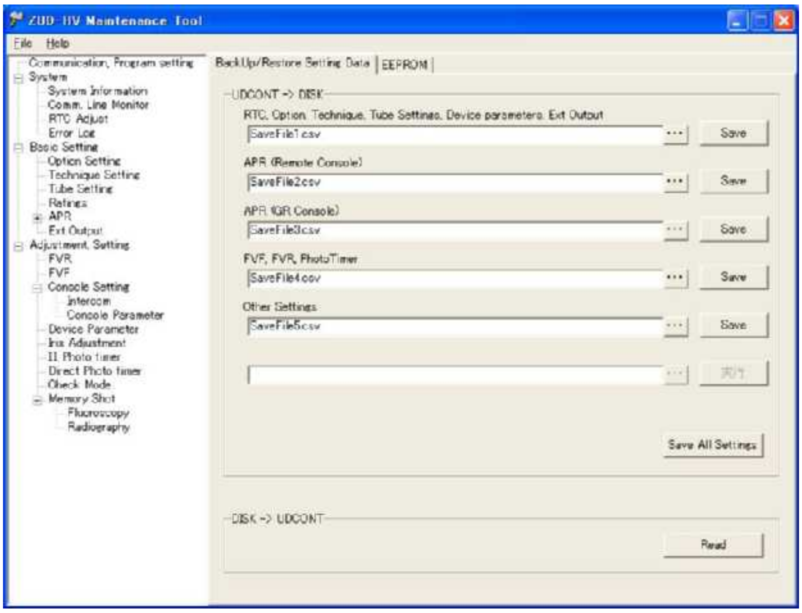


(1) Select “UD-CONT-> disk” tab in “data file” window.

(2) Select data file concern contents which you would like to save and click “execution” button.

(3) Repeat (2) every items which you would like to save.

4.23.3 Loading setting data



(1) Select “disk-> UD-CONT” tab in “data file” window.

(2) Set data file concern contents which you would like to load and click “execution” button.

(3) Repeat (2) every items which you would like to load.

(4) Confirm loading item is updated by each setting window and click “write“ button of each setting window.

CAUTION

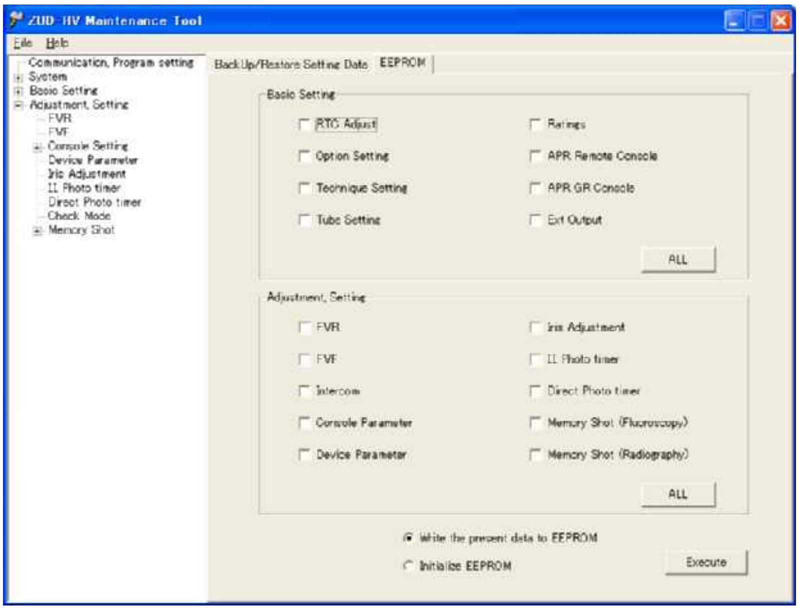
After display “data file” screen, it can not X-ray exposure until restarting the device.

CAUTION

At each setting screen, until click “Write” button, setting data is not save EEPROM so setting is not reflected until restarting the device.

4.24 Writing the present data to the EEPROM

It enables to save the present setting data to the EEPROM.



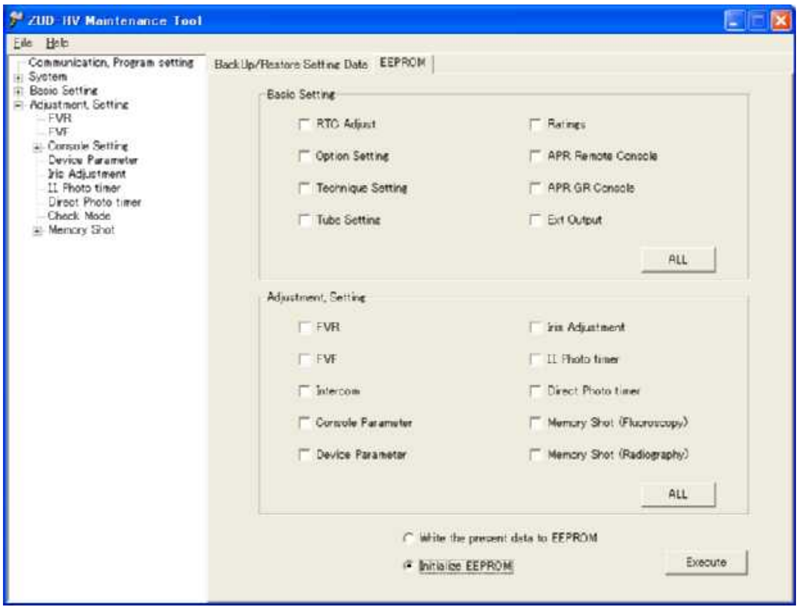
(1) Press “Write / Initialize EEPROM” button in the “Communication, Program setting” window. Then, “EEPROM” tab is displayed.

(2) For every items to be written to the EEPROM, check the corresponding checkboxes. Pressing “ALL” button, all checkboxes in the field are checked/unchecked simultaneously.

(3) Confirm “Write the present data to EEPROM” is selected, press “Execute” button.

4.25 Initializing the EEPROM

It enables to initialize the device by writing to the initial data to the EEPROM.



(1) Press “Write / Initialize EEPROM” button in the “Communication, Program setting” window. Then, “EEPROM” tab is displayed.

(2) For every items to be initialized, check the corresponding checkboxes. Pressing “ALL” button, all checkboxes in the field are checked/unchecked simultaneously.

(3) Confirm “Initialize EEPROM” is selected, press “Execute” button.

Chapter 5

5

Options

Chapter Contents

5 Options

5.1 Installing the Optional Auto Transformer (Option)

5.1.1 Outline

This option is required to use ZUD-L41, L40, V40, or B40 with a 3-phase 200 V power supply.

The Auto Transformer is installed between the power supply and control cabinet to boost 3-phase 200 V to 3-phase 400 V.

5.1.2 Configuration

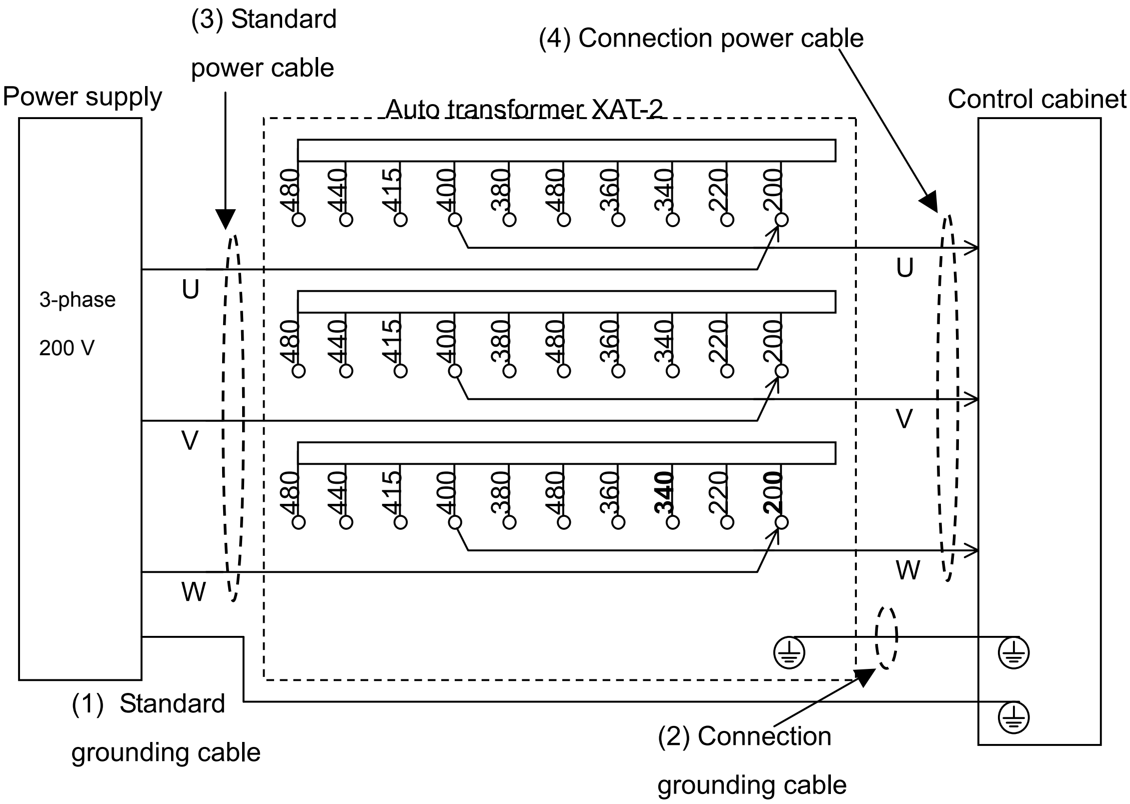
(1) Transformer BOX XAT-2 ASSY •••502-25847

(2) Output power cable (3 m)

(3) Grounding cable (3 m)

(4) Accessories

5.1.3 Connections



(1) Connect the standard grounding cable to the power supply earth terminal and the ZUD earth terminal in the control cabinet.

(2) Connect the grounding cable (3 m) supplied with this option to the transformer box earth terminal and the earth terminal in the control cabinet.

(3) Connect the auto transformer to the power unit with the standard power cable.

Power supply		Cable		Transformer box	
3-phase 200 V	U V W	LU LV LW	LU LV LW	*LU *LV *LW	Terminal block
			E (shield)	⏚	Ground terminal block

* Change the auto transformer terminal connections according to the supply voltage, as shown in the table below.

Supply voltage	Connected Auto Transformer terminals
3-phase 240 V ± 10 %	U240,V240,W240
3-phase 220 V ± 10 %	U220,V220,W220
3-phase 200 V ± 10 %	U200,V200,W200

DANGER

The default factory connections are made for 200 V.

(4) Connect the connection cable supplied with this option to the auto transformer and the control cabinet power terminals.

Irrespective of the supply voltage, connect to the Auto Transformer U415, V415, and W415 terminals.

Auto Transformer		Cable (3 m)		Control cabinet	
Terminal block	U415 V415 W415	U415 V415 W415	LU LV LW	LU LV LW	Power terminals

(5) Changes to Transformer T1, T2 Connections

Irrespective of the 3-phase 200 V supply voltage, make the following connections for 400 V.

T1-XV		T2-CE	
AIN-0 terminal	AIN-2 terminal	T2-0 terminal	T2-2 terminal
-A200	A220	-200	220

5.2 Installing the Starter 4CE/UL (Option)

5.2.1 Outline

Starter 4CE/UL is a device that rotates the anode in the Shimadzu rotating anode X-ray tube up to its normal speed.

5.2.2 Specifications

(1) Power Supply

Phases	Single
Frequency	50/60 Hz
Voltage	125 V AC ± 10% (to start Shimadzu X-ray tubes)
	50 V AC ± 10% (constant-speed operation)
Current	10 A min. (for all starting voltages)

(2) Output

(a) During starting	125 V AC (Shimadzu X-ray tubes)
(b) Constant-speed operation	50 V AC continuous

(3) Starting Time

Adjustable range	1 to 2 seconds (general techniques)
	0.5 to 1.5 seconds (fluoroscopy spot filming)

Set the following values for Shimadzu X-ray tubes.

General radiography 1.6 s   Fluoroscopy spot filming 1.2 s

Turn off(SHIMADZU side) all DIP switches of S1.

(4) Phase-advance Capacitor

30 μF/350 V

(5) External Dimensions

120 mm (D) × 200 mm(W) × 45 mm (H)

0.8 kg

5.2.3 Configuration

Starter 4CE/UL comprises the following parts:

(a) STARTER 4CE/UL (502-24498)

(b) Power cable, 4UD<JS2> (501-77695-01)

(c) DC signal cable, 4UD<JS1> (501-77736-01)

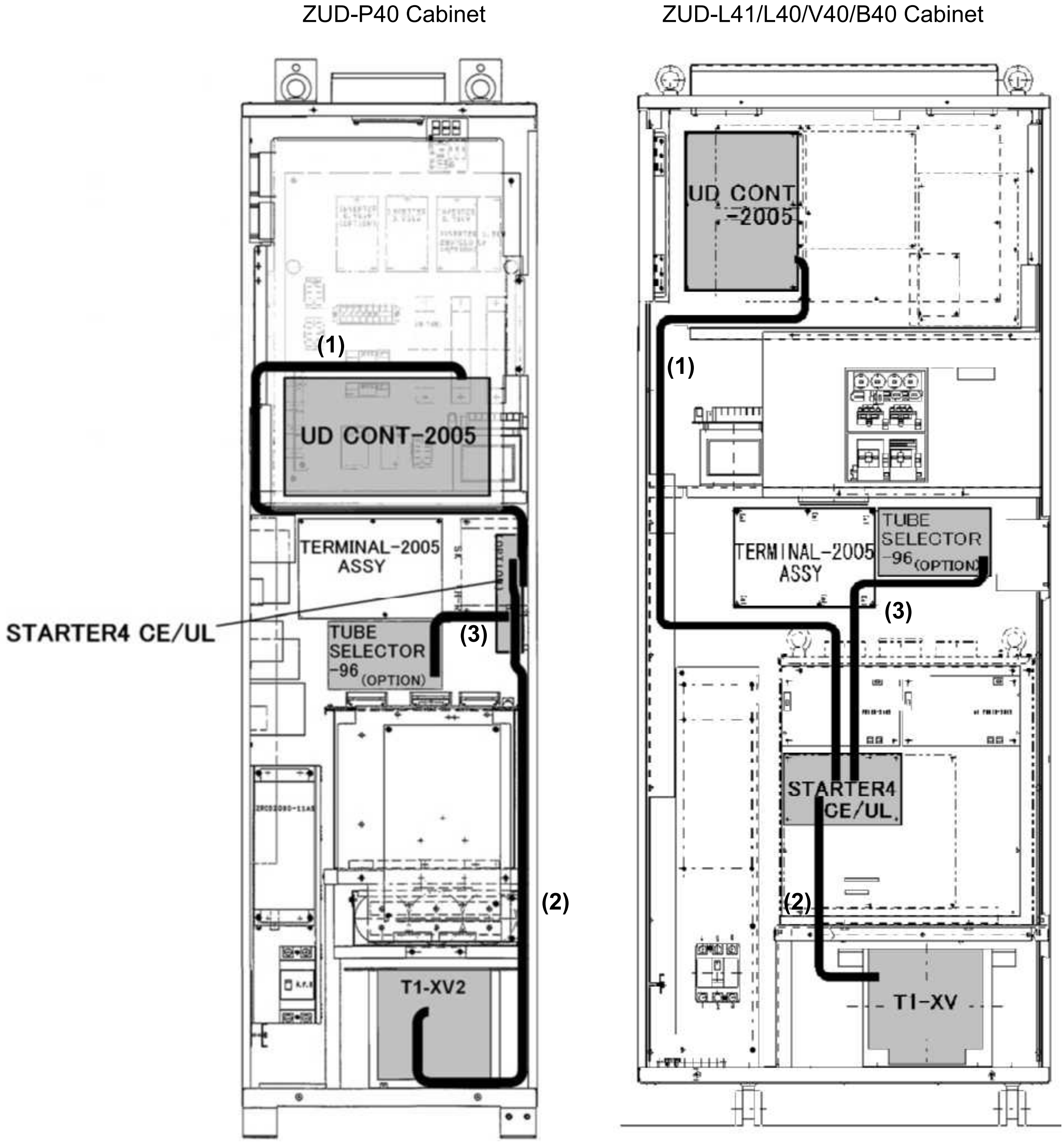
(d) Output cable, 4UD<JH4> (501-77727-01)

(e) Accessories (spacers, screws, etc.)

5.2.4 Installation

5.2.4.1 Installation

Install the two supports, two spacers, and the STARTER 4CE/UL PCB into the control cabinet. Install them at the positions shown in the diagram below.



5.2.4.2 Cable Connections

(1) DC Signal Cable

UD CONT-2005	Cable		STARTER-4 CE / UL	Comments
Connector JS1	JS1	JS1	Connector JS1	DC power supply (+15 V) control signal

(2) Power Cable

Transformer T1-XV	Cable		STARTER-4 CE / UL	Comments
Fuse holder terminal *A200 A125 A50 A0	 AX A125 A50 A0	JS2	 Connector JS2 Pin No.3 1 4 7	 Starting power supply Constant-speed operation

* Connect the cable AX terminal to A200

(3) Output Cable

STARTER 4 CE / UL	Cable		TUBE SELECTOR-96	Comments
Connector JH4 Pin No.1 2 4	JH4	JH4	Connector JH4 Pin No.1 2 4	X-ray tube starter X Y Z

5.2.4.3 Adjusting the STARTER-4 CE / UL PCB

(1) Switch Settings (Setting the Starter Voltage)
Set TUBE1 to TUBE3 as follows for each X-ray tube.

Shimadzu X-ray tube	OFF
(Other X-ray tube	ON)

(2) Adjusting the Start Times
Connect oscilloscope probes across check pins CP3 TIMER and CP1 GND and adjust the start times using trimmer VR1 (general radiography) or VR2 (fluoroscopy spot filming).
Set the start times to suit the X-ray tube used that requires the longest start time.

Set the following start times for Shimadzu X-ray tubes.

General radiography 1.6 sec Fluoroscopy spot filming 1.2 sec

For X-ray tube other than made by Shimadzu, refer to specifications for the start times for these tubes.
(The default factory settings for the start time are made for Shimadzu X-ray tubes.)

5.3 Installing Starter SA-42UD (Option)

5.3.1 Outline

Starter SA-42UD is a device that rotates the anode in the Shimadzu rotating anode X-ray tube in high-speed. The power input from the X-ray control unit is rectified and smoothed, and passed through a 60 Hz or 180 Hz inverter to supply power to the starter coil in the X-ray tube vessel. The same starter is used for normal and high-speed operations. The frequency for normal rotations is constant (60 Hz) regardless of the power supply frequency.

> ⚠ CAUTION
>
> **Starter SA-42UD cannot be installed in the ZUD-P40.**
> **It is compatible with ZUD-L41/L40/V40/B40.**

5.3.2 Specifications

(1) Power Supply

Phases	Single
Frequency	50/60 Hz
Voltage	220 V AC ± 10%
Current	20 A min.

(2) Output

(a) During starting

High-speed rotation

Approx. 280 V (effective value) Approx. 8 A (effective value) 180 Hz

2.5 sec (General radiography P-type X-ray tube 0 → 9000 rpm min.)

2 to 1.3 sec (Fluoroscopy spot filming P-type X-ray tube 3200 → 9000 rpm min.)

Normal rotation

Approx. 190 V (effective value) Approx. 9 A (effective value) 60 Hz

1.4 sec (P, U-type X-ray tube 0 → 3200 rpm min.)

(b) Constant-speed operation

The voltage and current in (a) above are applied intermittently.

High-speed rotation Repeated cycles of 1 sec ON and 25 sec OFF

Normal rotation Repeated cycles of 0.3 sec ON and 10 sec (or 6.8 sec) OFF

(c) Braking

Approx. 190 V (effective value) Approx. 9 A (effective value) 60 Hz

1.8 sec (P-type X-ray tube 9000 → 3600rpm min.)

(3) Phase-advance Capacitor

High-speed rotation 4 μF/1600 V DC

Normal rotation 29μF/300 V DC

(4) Weight and External Dimensions

275mm (D) × 330mm(W) × 100mm (H)

2.5 kg

5.3.3 Configuration

Starter SA-42UD (502-23498) comprises the following parts:

(a) SA CONT-2002 ASSY (502-22520)

(b) Power cable, SA42UD (502-23550)

(c) DC signal cable <JS1,JS2> (502-23549)

(d) Output cable <JH4> (502-23548)

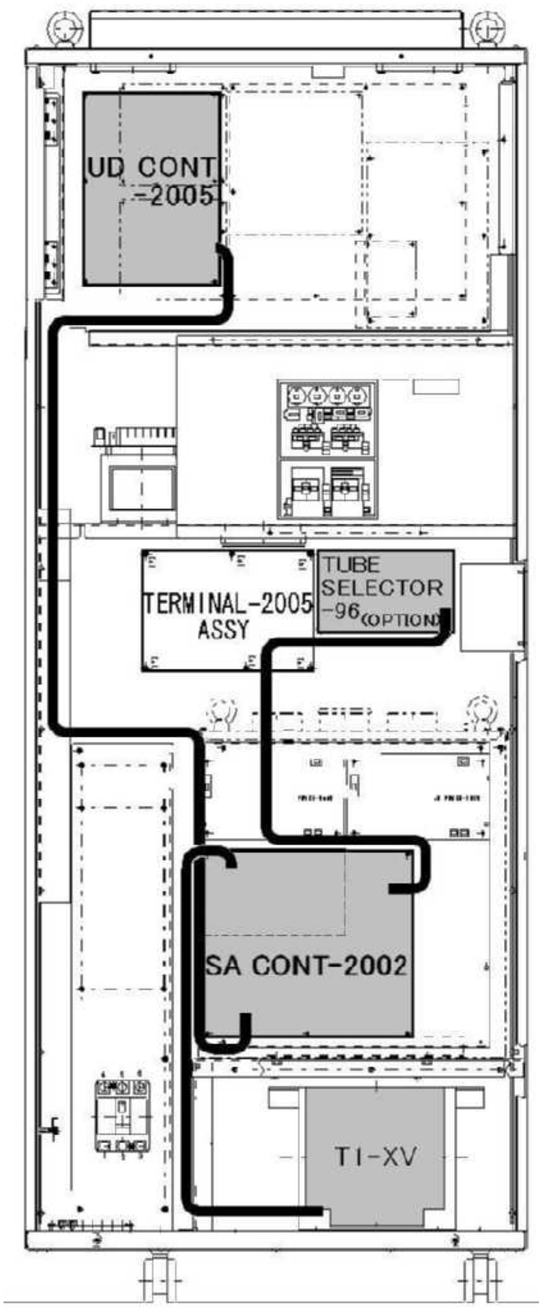
(e) Accessories

5.3.4 Installation

5.3.4.1 Installation

Install the SA CONT-2002 PCB into the control cabinet. Install it at the position shown in the diagram below.

ZUD-L41/L40/V40/B40 cabinet



5.3.4.2 Cable Connections

(1) DC Signal Cable

UD CONT-2005	Cable		SA CONT-2002	Comments
Connector JS1	JS1	JS1	Connector JS1	DC power supply (+15 V) control signal

(2) Power Cable

Transformer T1-XV	Cable		SA CONT2002	Comments
Fuse holder terminal A220 A0	A220 A0	A220 A0	Terminal block X1 A220 A0	Power supply

(3) Output Cable

SA CONT-2002	Cable		TUBE SELECTOR-96	Comments
Connector JH4 Pin No.1 2 4	JH4	JH4	Connector JH4 Pin No.1 2 4	X-ray tube starter X Y Z

5.3.4.3 DIP Switch Settings

SW1

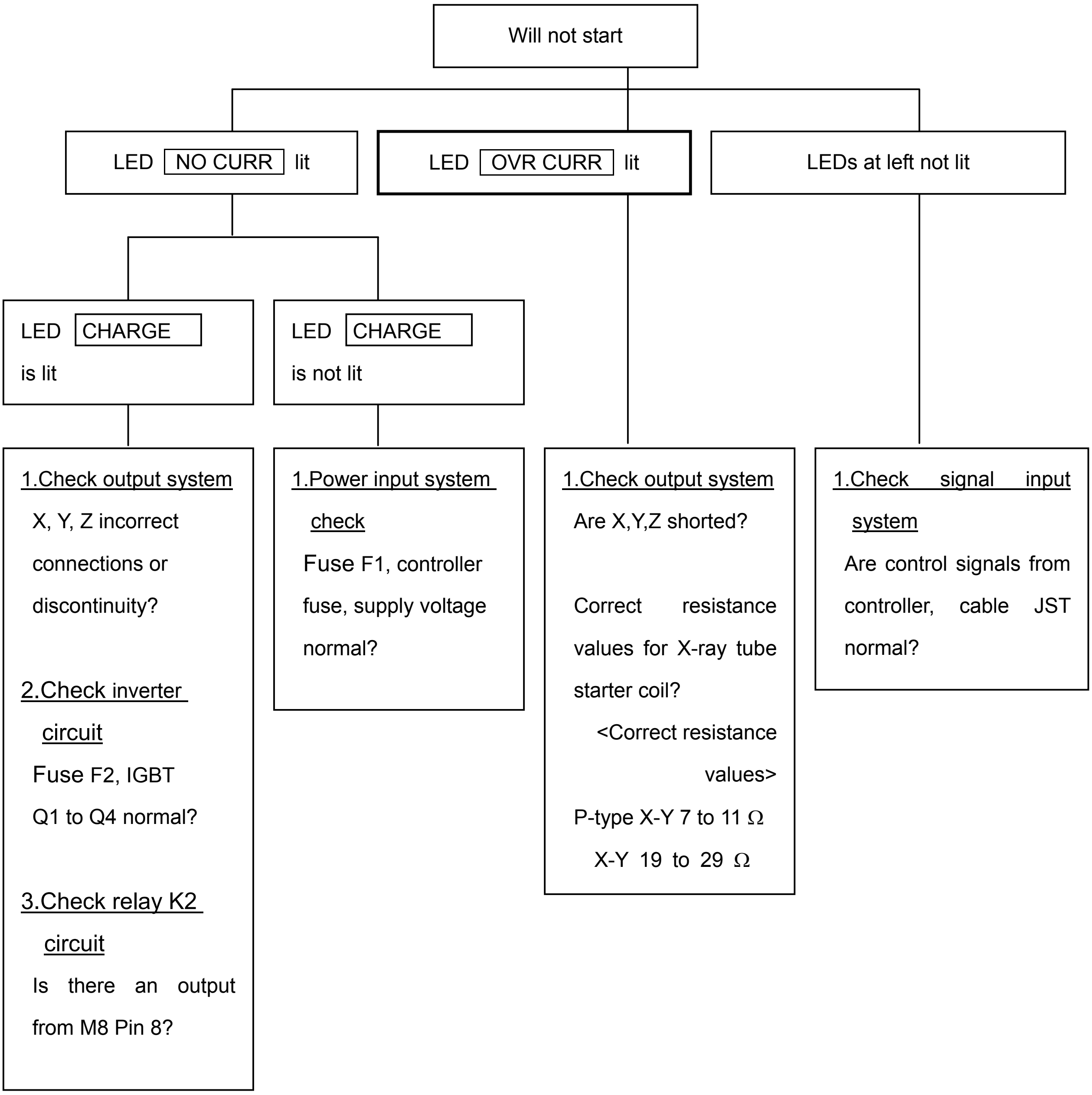
Pin No.	Name	Description
1	*SA-41	Switches 2, 5, and 6 of SW1 are enabled only if this switch is ON. Normally turn ON this switch.
2	*CHECK	Turn ON to cancel the discontinuity detection during the check. Normally turn ON this switch.
3	-	Not used at present.
4	-	Not used at present.
5	*NS_5M_ON	Turn ON to continue normal rotation for 5 minutes after radiography or fluoroscopy when performing fluoroscopy spot filming. If this switch is ON and normal rotational speed reached, the start time for spot-filming is reduced. Turn ON this switch for a P-type X-ray tube.
6	*T1_3S_ON	Turn ON this switch to set the radiography time for fluoroscopy spot filming to 1.3 sec. Turn OFF this switch to set the radiography time for fluoroscopy spot filming to 1.2 sec. Normally turn ON this switch.
7	-	Not used at present.
8	-	Not used at present.

SW2

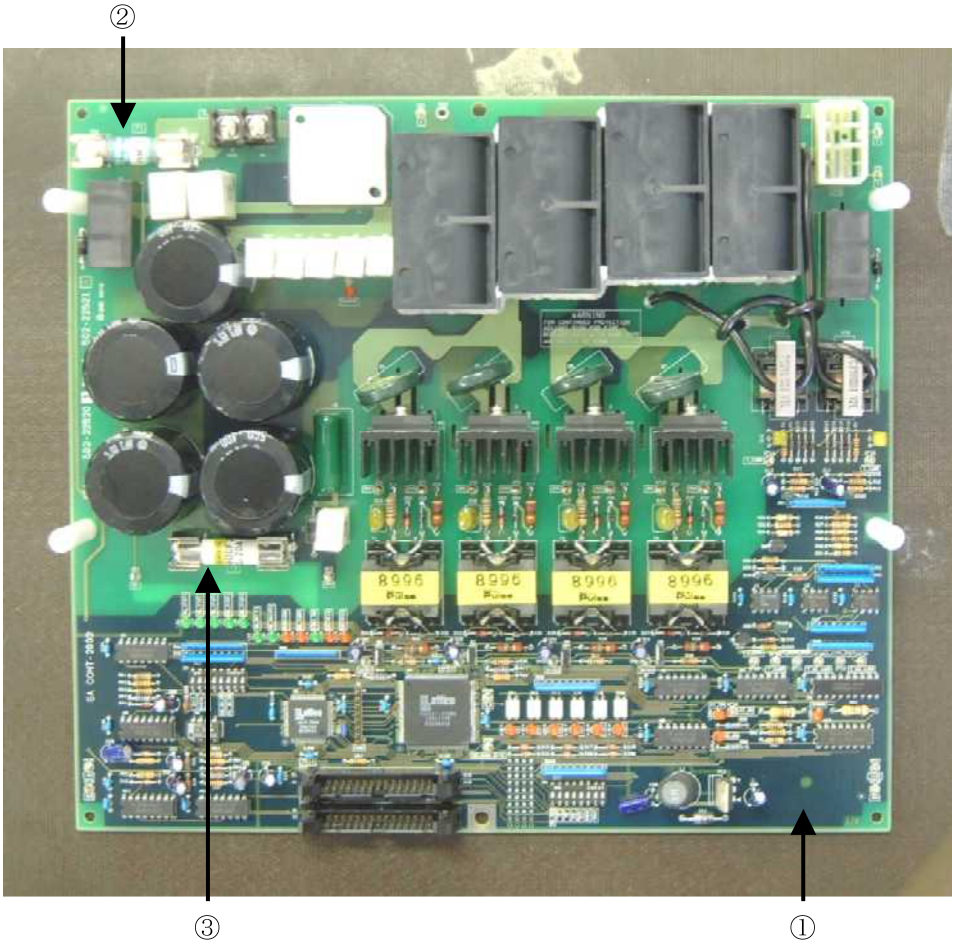
Pin No.	Name	Description
1	[NO_CLK]	Turn ON to stop operation of the oscillator (EXC-2C16MHz). This is used for conducting the check. Normally turn OFF this switch.
2	*2[*NS_*BK]	Normal-speed operation signal from controller: While this signal is input, the 60 Hz start/control inverter operates. Turn ON to check the normal-speed rotation of the rotating anode for 60 Hz drive operation. This is used for conducting the check. Normally turn OFF this switch.
3	*H2[*HS]	High-speed operation signal from controller: While this signal is input, the 180 Hz start/speed-maintenance inverter operates. Turn ON to check the rotation of the rotating anode for 180 Hz drive operation. This is used for conducting the check. Normally turn OFF this switch.
4	*H11	Drive power stop signal from X-ray controller: Stops the inverter drive. It is input from the X-ray controller when the radiography X-rays are on. Turn ON to confirm that the inverter drive is stopped. This is used for conducting the check. Normally turn OFF this switch.
5	*H12	Start-time switching signal: Input from the X-ray controller to reduce the start time when a fluoroscopy technique is selected. Turn ON to confirm that the start time is reduced. This is used for conducting the check. Normally turn OFF this switch.
6	*FRSTS	Fault reset signal from the X-ray controller. Turn ON to confirm that the fault reset signal was input and the starter brake released. This is used for conducting the check. Normally turn OFF this switch.
7	*TRST	Starter timer reset signal from the X-ray controller. Turn ON to confirm that the timer reset signal was input and the normal speed maintenance cancelled. This is used for conducting the check. Normally turn OFF this switch.
8	*STBRK	Starter error signal: Output when a starter error occurs (overcurrent, discontinuity detected). Turn ON to confirm that the signal is output and LED indicator lights when a starter error occurs (overcurrent, discontinuity detected). This is used for conducting the check. Normally turn OFF this switch.

5.3.5 Maintenance

5.3.5.1 Troubleshooting



5.3.5.2 Parts List



REF No.	P/N	DESCRIPTION	RECO.
1	502-22520	SA CONT-2002 ASSY	1
2	072-01659-86	FUSE FLM20 <F1>	1
3	072-06035-24	FUSE 660CF-20 <F2>	1
K1	065-60047-04	RELLAY ALFP12	1
K2	065-60047-04	RELLAY ALFP12	1
Q1	060-39931	IGBT 1MBH60D-100	1
Q2	060-39931	IGBT 1MBH60D-100	1
Q3	060-39931	IGBT 1MBH60D-100	1
Q4	060-39931	IGBT 1MBH60D-100	1

5.3.6 Precautions

(1) The voltage across the terminals of capacitors C1 to C5 in the power circuit does not drop immediately after the power is turned off. Take due care when replacing a fuse or conducting other maintenance.

(2) The power circuit is not insulated from the power line. When observing the voltages at the check pins CP1 to CP13 (pins with the signal surrounded by [ ]), ensure that the probe common and the oscilloscope chassis are not earthed.

5.4 Installing 2-tube Unit (Option)

5.4.1. Outline

This option can be connected to ZUD-P40/L40/V40/B40.

This option is not supported by ZUD-L41.

5.4.1.1 Configuration

The 2-tube Unit comprises the following parts:

(1) GSC-2002S(Z) Remote Operating Console for general radiography （502-23589-20）

(2) Connection cable for remote operating console to control cabinet 16 m (up to 32 m supported)

- Console signal cable-40 （502-23224-01）
- Console signal cable, CE （501-79903-16）

CAUTION

The unit operation and ratings cannot be guaranteed if the cable length exceeds these values.

(3) TUBE SELECTOR-96	（501-79038）	
(4) Wire harness	（502-25336）	
(5) High-voltage switchgear HC-150-2-88	（501-72688）	ZUD-P40D/DS only
(6) FSC cable 2.5 m	（509-41980-19）	ZUD-P40D/DS only
(7) Connection cable	（501-79047）	ZUD-P40D/DS only
(8) Fasteners 1 set		
(9) Accessories 1 set		
(10)Short circuit wire (D2-D3)	(501-75087)	not used

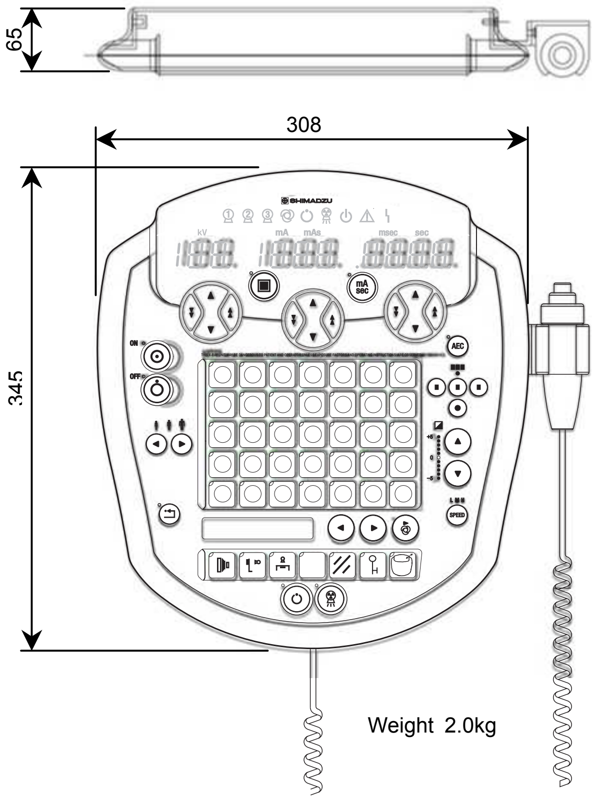


Fig. 5.4.1 Remote Operating Console for General Radiography

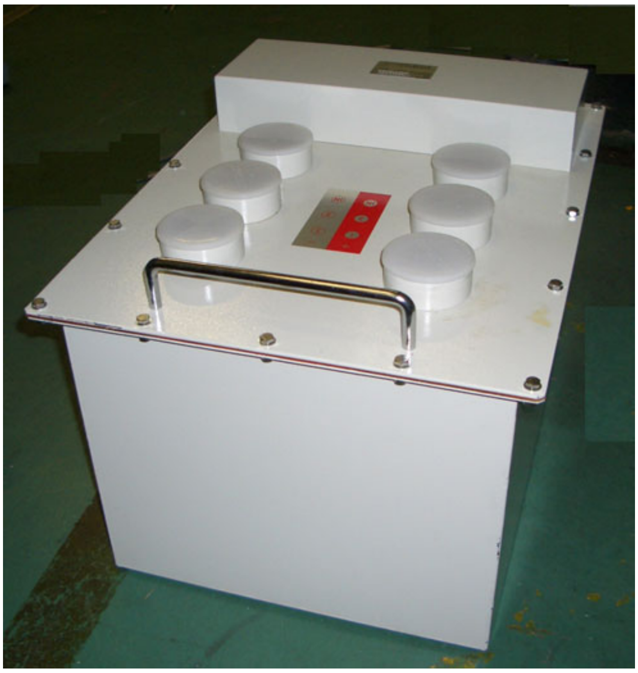


Fig. 5.4.2 High-voltage Switchgear

5.4.1.2 Heat Generated by Remote Operating Console for General Radiography

The heat generated by the remote operating console for general radiography is shown below.

50 kcal/h

CAUTION

These heat generation values are values from an average operating state.
The values may differ due to the operating state.
1 kW = 860 kcal/h

5.4.2 Installation Procedure

Follow the procedure below to install the 2-tube unit option.

5.4.3 GSC-2002S(Z) Installation and Wiring

↓

5.4.4 Connecting Two Tubes

↓

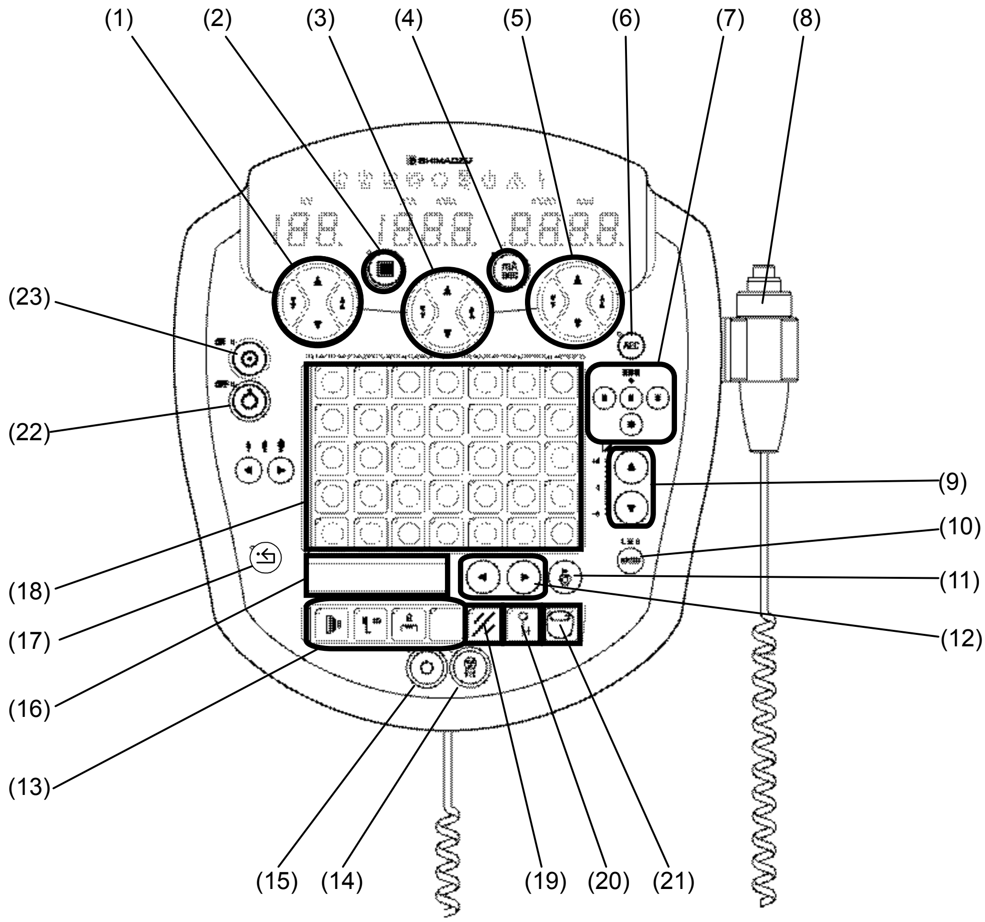
5.4.5 Changing the Wiring Connections for One Tube

↓

5.4.6 Connecting the Attachments

5.4.3 GSC-2002S(Z) Installation and Wiring

5.4.3.1 Internal Structure of GSC-2002S(Z) Remote Operating Console for General Radiography



(1) kV setting	(2) Focus Switch
(3) mA/mAs setting	(4) mA/mAs Switch
(5) sec setting	(6) AEC
(7) Photo Pickup Field	(8) Hand switch
(9) Density-up/down	(10) Speed
(11) Auto-step	(12) Exposure step Change
(13) Technique	(14) X-Ray Switch
(15) Ready Switch	(16) Sub-display
(17) Reset	(18) Anatomical Program
(19) APR Delete	(20) APR Save
(21) User Operation Right Switch	(22) ON
(23) OFF	

Fig. 5.4.3

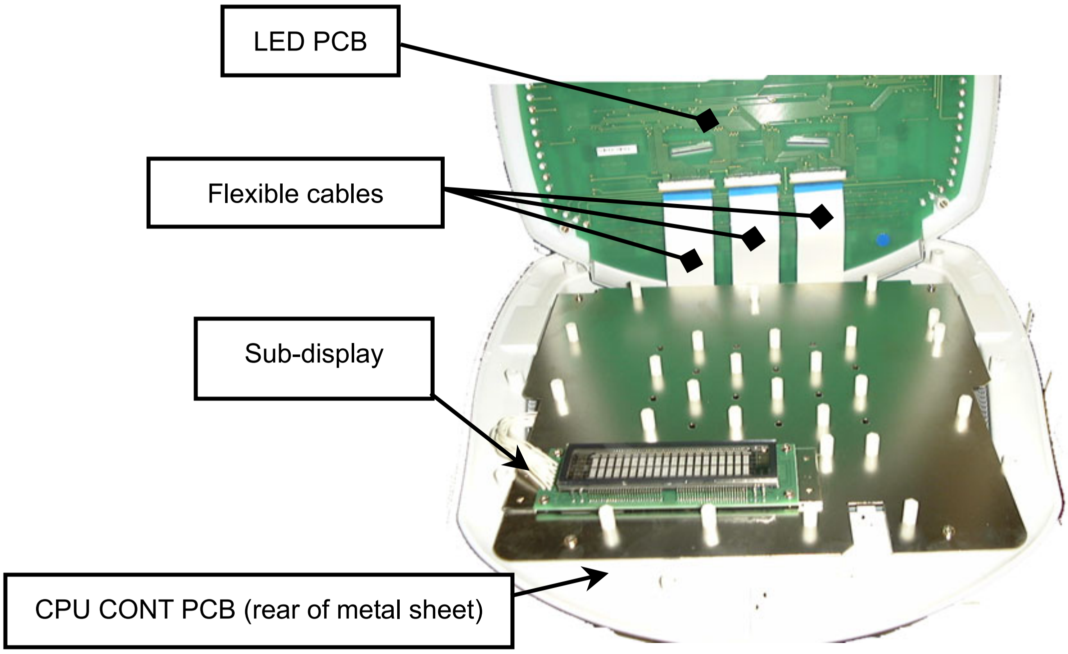


Fig. 5.4.4 View Disassembled

5.4.3.2 PCB Switch Settings in GSC-2002S(Z) Control Console for General Radiography

1) CPU CONT PCB

SW2-1 : ON Write to CPU internal flash memory.

Normally set OFF.

SW2-2 : ON

Normally set ON.

SW2-3 and SW2-4 Not used

SW3 : Switch sound.

SW3 1－2 Not used

SW3 2－3 Sound

Normally set to 2-3.

JP1

JP1 Setting	GSC-2002S(Z) backup battery operation
1-2	Backup used **(normal setting)**
2-3	Backup not used

JP2

JP2 Setting	GSC-2002S(Z) external connector (J2) power supply
1-2	Supply power
2-3	Cut-off power **(normal setting)**

JP3

JP3 Setting	GSC-2002S(Z) external connector (J1) power supply
1-2	Supply power
2-3	Cut-off power **(normal setting)**

5.4.3.3 Connecting Cables to Control Cabinet

Connect the cables as shown in Fig. 5.4.7

> **DANGER**
>
> **Before connecting cables, turn off the power supply and open the knife switch or circuit breaker on the power supply unit.**

Precautions When Connecting Cables

(1) Fasten the signal cables using the wire clamps on the cable-fixing plate in the cabinet. (See Fig. 5.4.5 and 5.4.6)

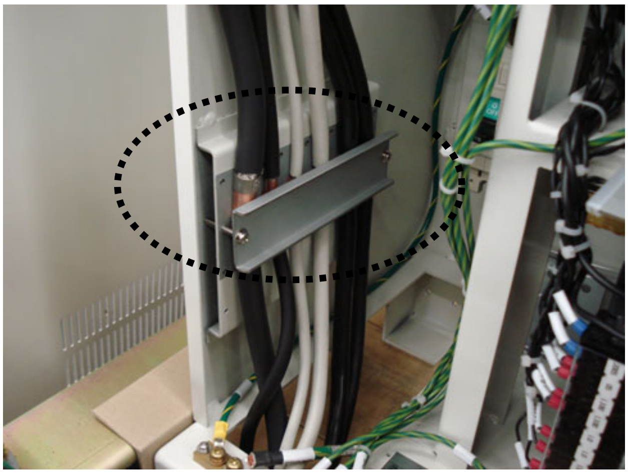


Fig. 5.4.5 ZUD-P40 Series

Fig. 5.4.6 ZUD-L40/V40/B40 Series

CAUTION

When the hinged unit at the top of the control cabinet is open, take care not to bang you head on it when standing up.

(2) Pass the display cables through the side of the control cabinet and connect them to UD CONT-2005 PCB. (See 2.15 External Cable Wiring Route.)

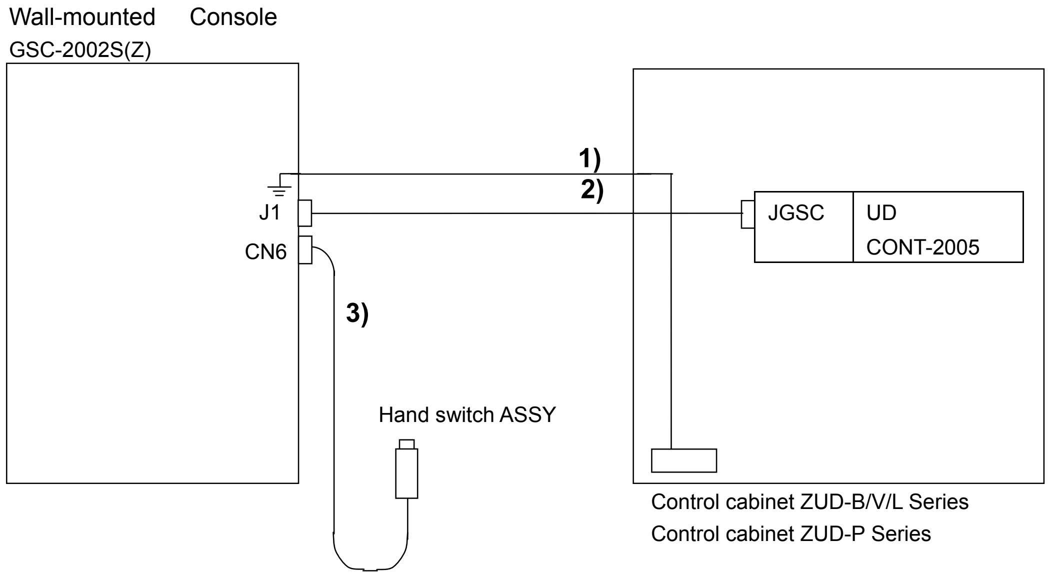


Fig.5.4.7 Connecting Cables to the Control Cabinet

1) Control console grounding cable, 3.5 mm^2, green/yellow (501-79903-16)

GSC-2002S(Z) Wall-mounted Console		Cable		Control cabinet	
Wall-mounting ASSY	⏚	E	E	⏚	Ground terminal block

2) Control console signal cable, AWG#28, 25-core shielded (502-23224-01)

GSC-2002S(Z) Wall-mounted Console		Cable		Control cabinet	
Wall-mounting ASSY	J1	J1	J13	JGSC	UD CONT-2005 ASSY

3) Hand switch C2U-24 ASSY (511-64136)

GSC-2002S(Z) Wall-mounted Console		Cable		Hand switch Assy
Wall-mounting ASSY	CN6			

Total length 800 mm

Curled cord, extended length 4500 mm (9.81 N tensile force applied)

5.4.3.4 GSC2002S(Z) Installation Method

(1) Installation

* Wall-mounted operation

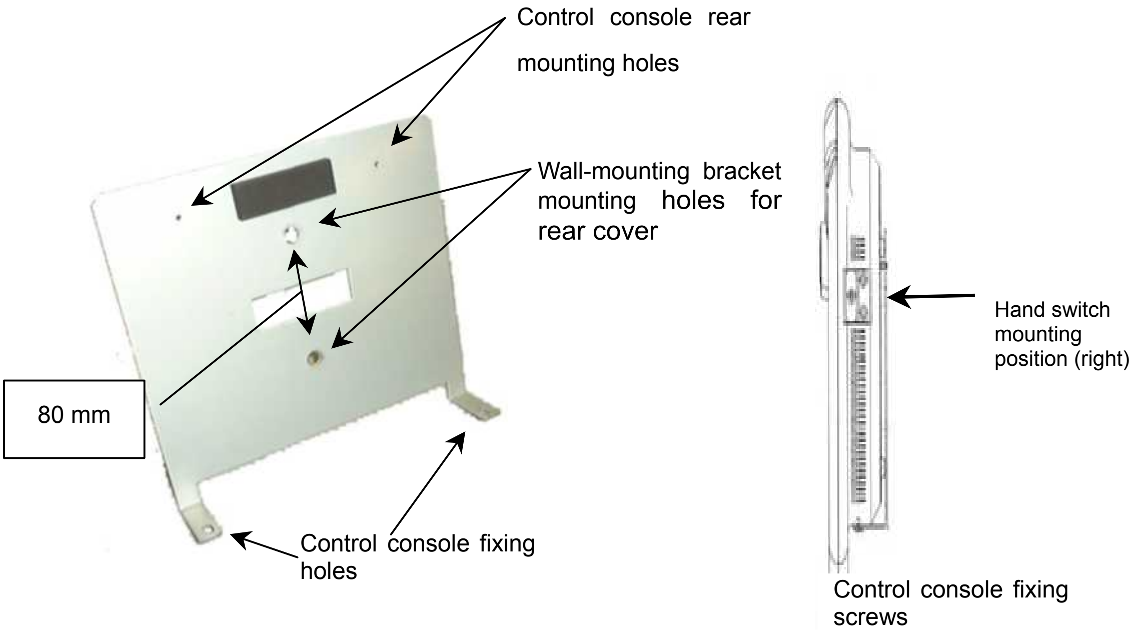


Fig. 5.4.8

The hole pattern for the console rear cover is shown below.

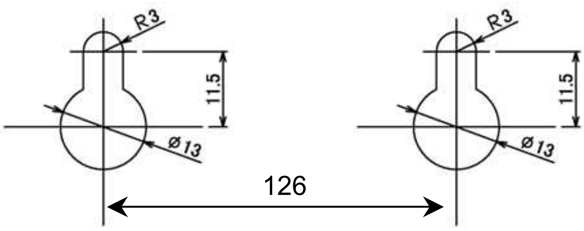


Fig. 5.4.9

To mount the GSC-2002S(Z) on a wall or other vertical surface, attach the wall-mounting bracket onto the wall and then mount the GSC-2002S(Z) unit to it as shown in Fig. 5.4.8 (Rear-surface mounting.)

* Using a Commercial Wall-mounting Bracket

Mounting with a commercial angle-adjustable VESA-standard (75 mm x 75 mm pitch) allows adjustment of the console while it is mounted on the wall. See Fig. 5.4.10

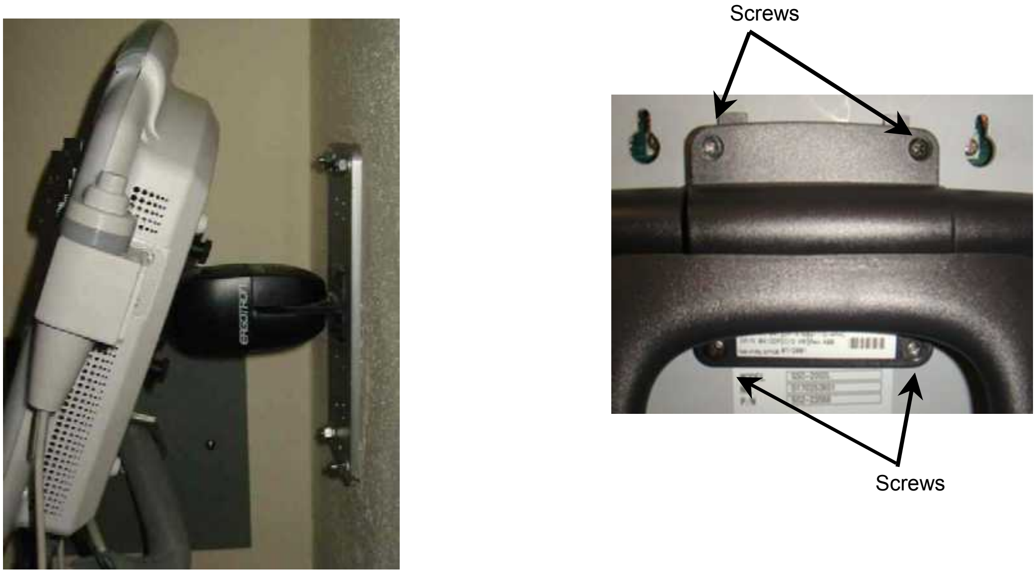


Fig. 5.4.10

* Desktop operation

The console can be mounted to a commercial VESA-standard arm (75 mm x 75 mm pitch). See Fig. 5.4.11.

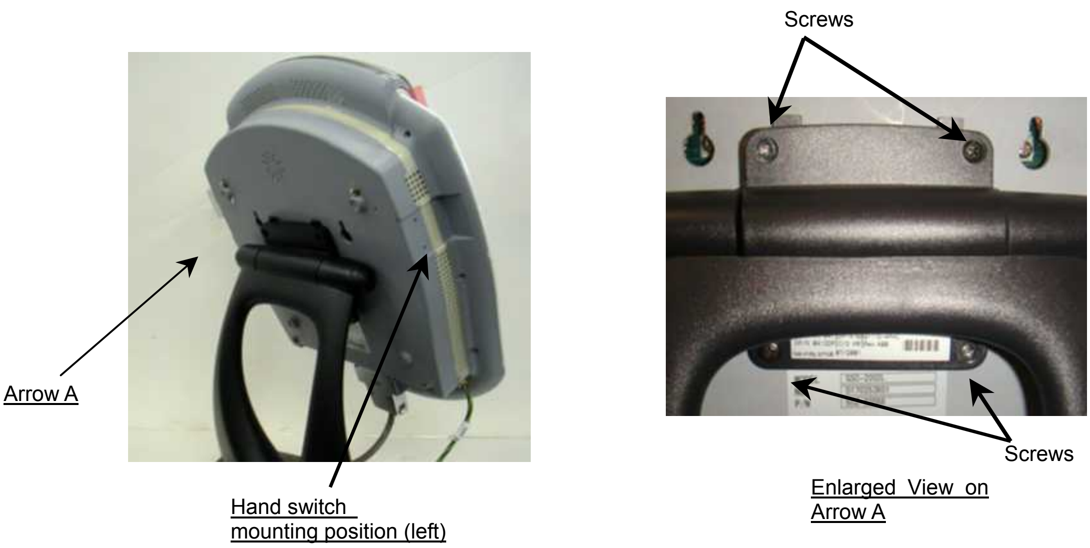


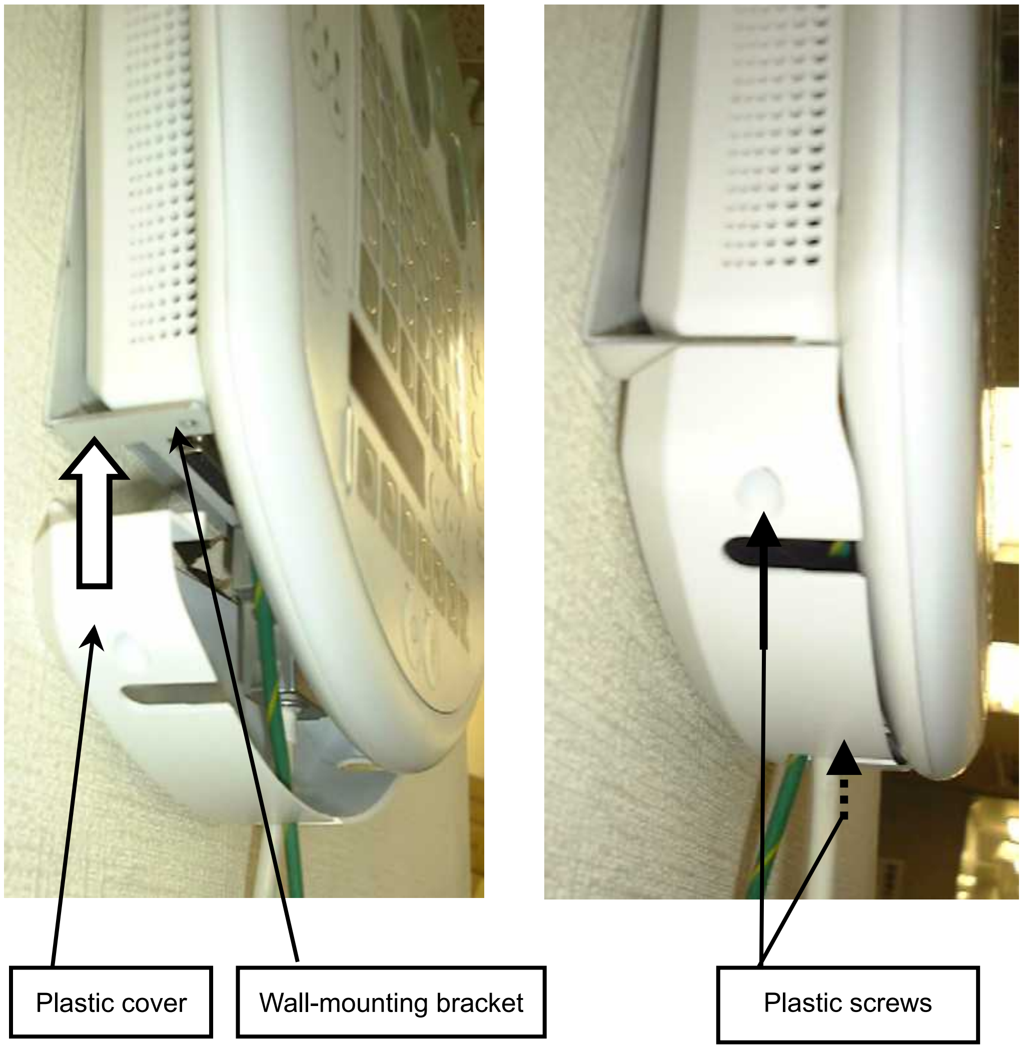
Fig. 5.4.11

(2) Attaching the Plastic Cover

* Temporarily position the control console on the wall-mounting bracket. Connect the ground wire and console signal cable in advance to the terminal screws. As shown in the diagram, attach the plastic cover in the direction of the arrow from below to cover the connectors. Pass the cable and wire through the slot.
* Fasten the plastic cover using the two plastic screws supplied.

CAUTION

Overtightening the plastic screws may damage their threads.



5.4.3.5 Assembling the Hand Switch Bracket Assembly

Check that the parts listed below are supplied.

1. Hand-switch bracket (A)
2. Hand-switch bracket (B)
3. Screw M4 x 5 (1 pcs)
4. Screw M4 x 10 (2 pcs)
5. Screw M3 x 8 (2 pcs)

Assemble the parts as shown in Fig. 5.4.12 See Fig. 5.4.8 (right-side mounting) or Fig. 5.4.11(left-side mounting).

CAUTION

First, mount the and-switch bracket (A) to the control console using the screws (4).

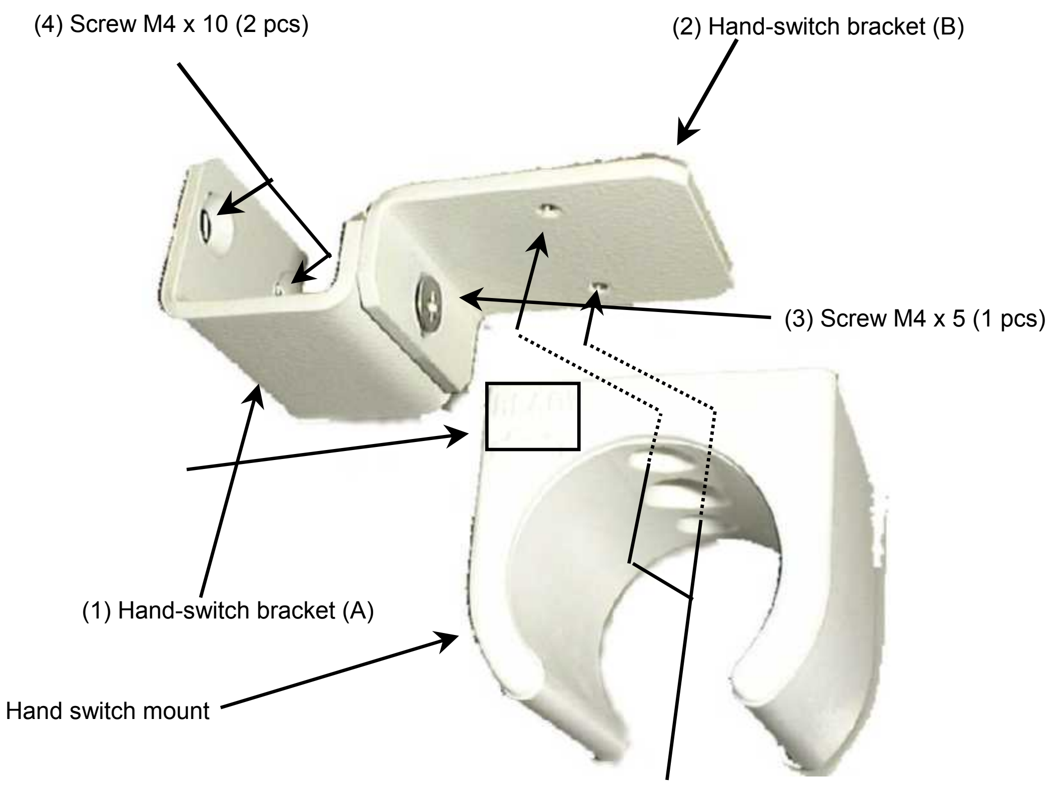


Fig. 5.4.12Hand Switch Bracket Assembly

5.4.3.6 Wiring the GSC-2002S(Z) Control Console

Pull the wires to connect to the GSC-2002S(Z) through the bottom of the console. The cable connection positions are shown in Fig. 5.4.13. The console signal cable ground connection in the control cabinet is shown in Fig. 5.4.14.

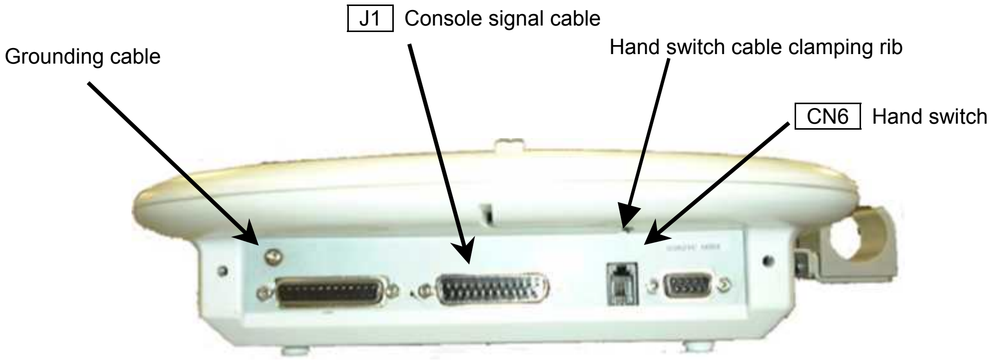


Fig. 5.4.13 GSC-2002S(Z) Cable Connection Positions

> **CAUTION**
>
> **Fully fasten the hand switch cable in the clamping rib shown above.**

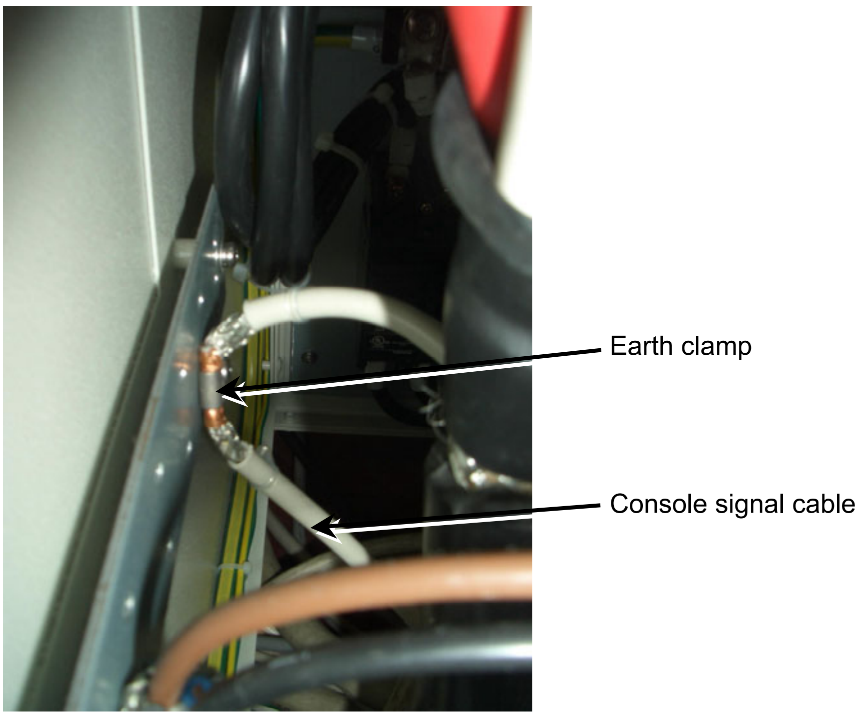
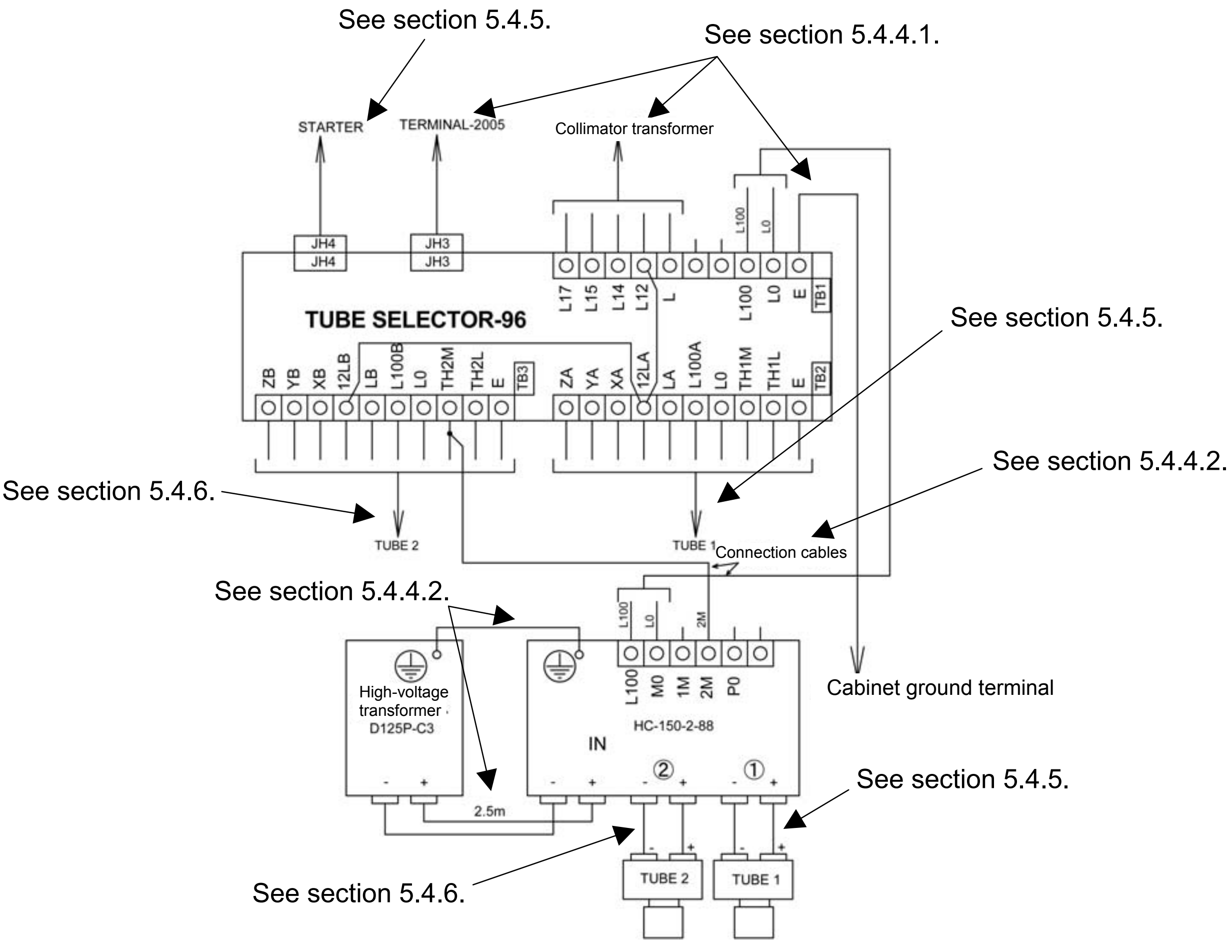


Fig. 5.4.14 GND Connection in Control Cabinet

5.4.4 Connecting Two Tubes

Connect the two X-ray tubes as shown in the diagram below.



5.4.15Two X-ray tubes Connected to ZUD-P40 Series

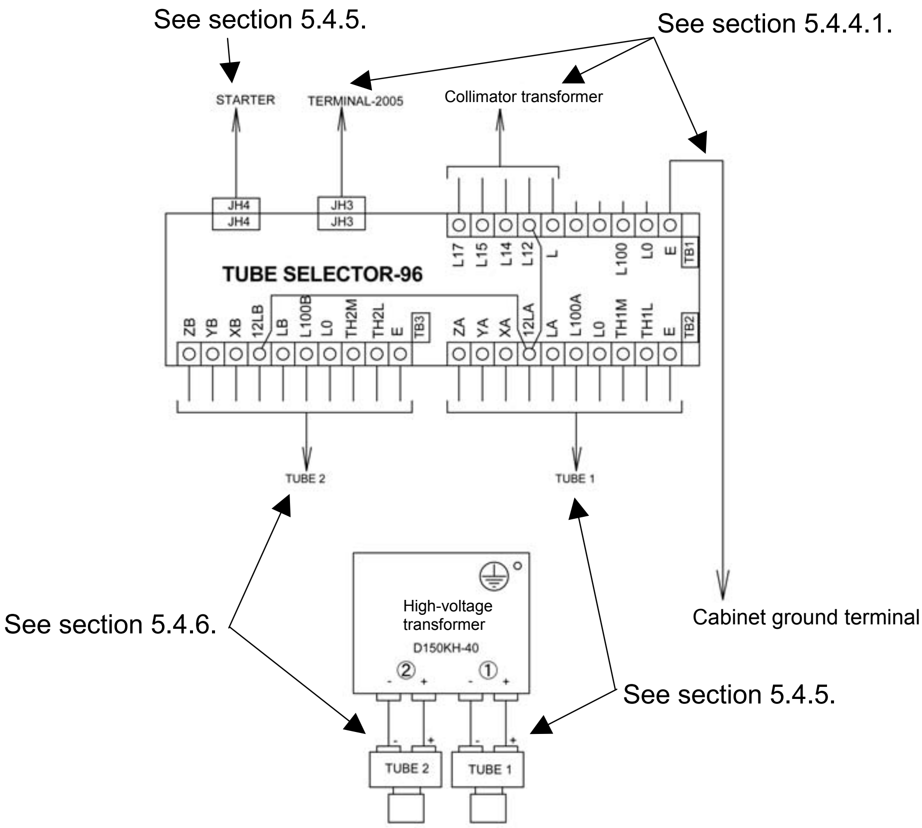


Fig. 5.4.16 Two X-ray tubes Connected to ZUD-L40/V40/B40 Series

Connect the X-ray tube high-voltage cables according to the tables below.

ZUD-P40 Series

Tube	
Tube 1	High-voltage switchgear HC150－2－88, socket (1)
Tube 2	High-voltage switchgear HC150－2－88, socket (2)

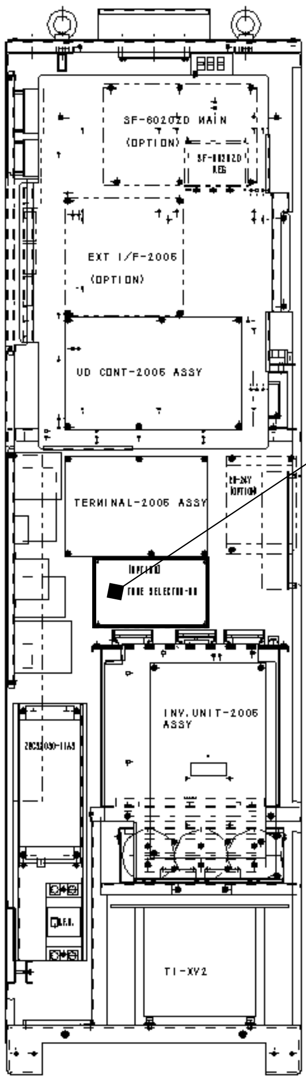
ZUD-L40/V40/B40 Series

Tube	
Tube 1	High-voltage generator in cabinet, tube socket 1
Tube 2	High-voltage generator in cabinet, tube socket 2

5.4.4.1 Installing and Connecting the TUBE SELECTOR-96 PCB

(1) Installation

Install and Connect the TUBE SELECTOR-96 PCB as shown in the diagram below.

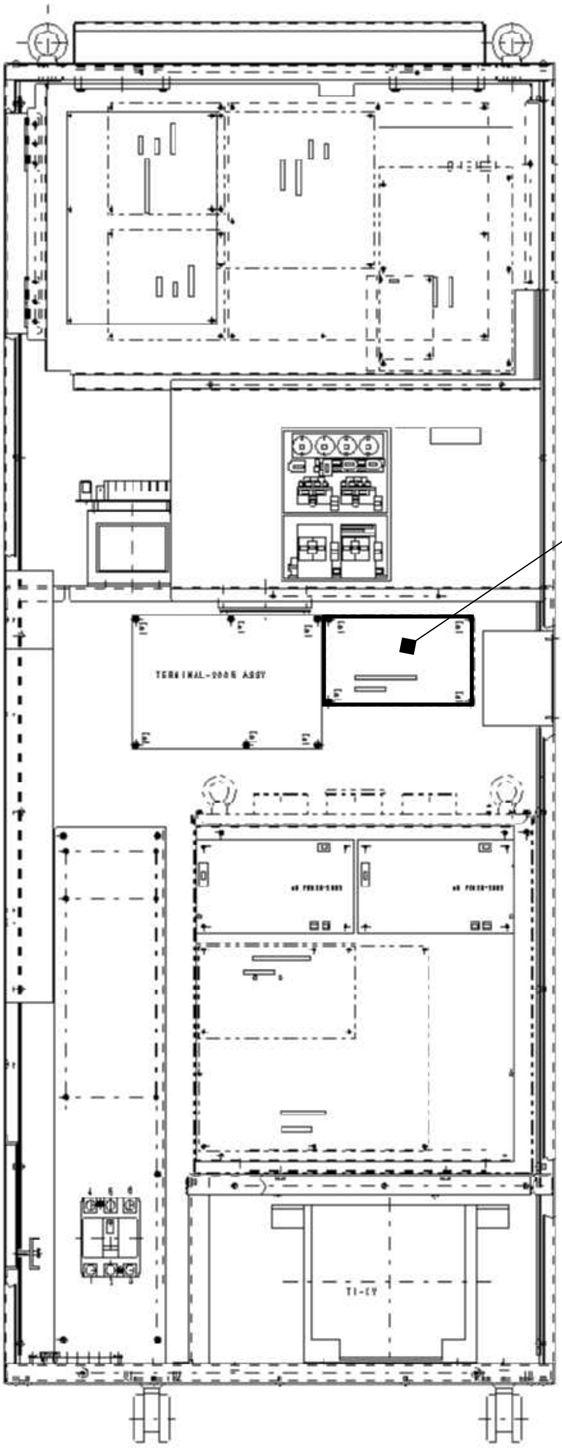


TUBE SELECTOR-96
（501-79038）

Use the following screws to install the PCB.

101. Screw, SUS SEMS P3 M4 x 10 (4 pcs)

Fig. 5.4.17 ZUD-P40 Series



TUBE SELECTOR-96
(501-79038)

Use the following screws to install the PCB.

101.
Screw, SUS SEMS P3 M4 x 10 (4 pcs)

Fig. 5.4.18 ZUD-L40/V40/B40 Series

(2) Wiring Route

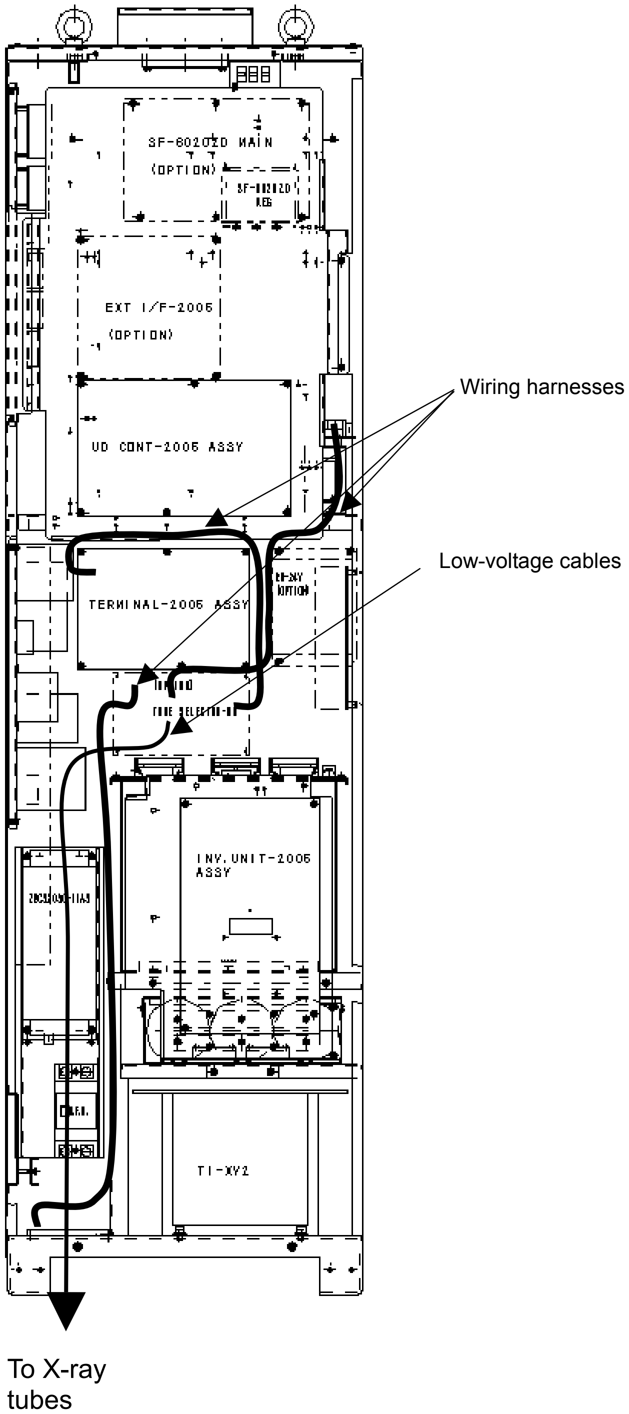


Fig. 5.4.19 ZUD-P40 Series

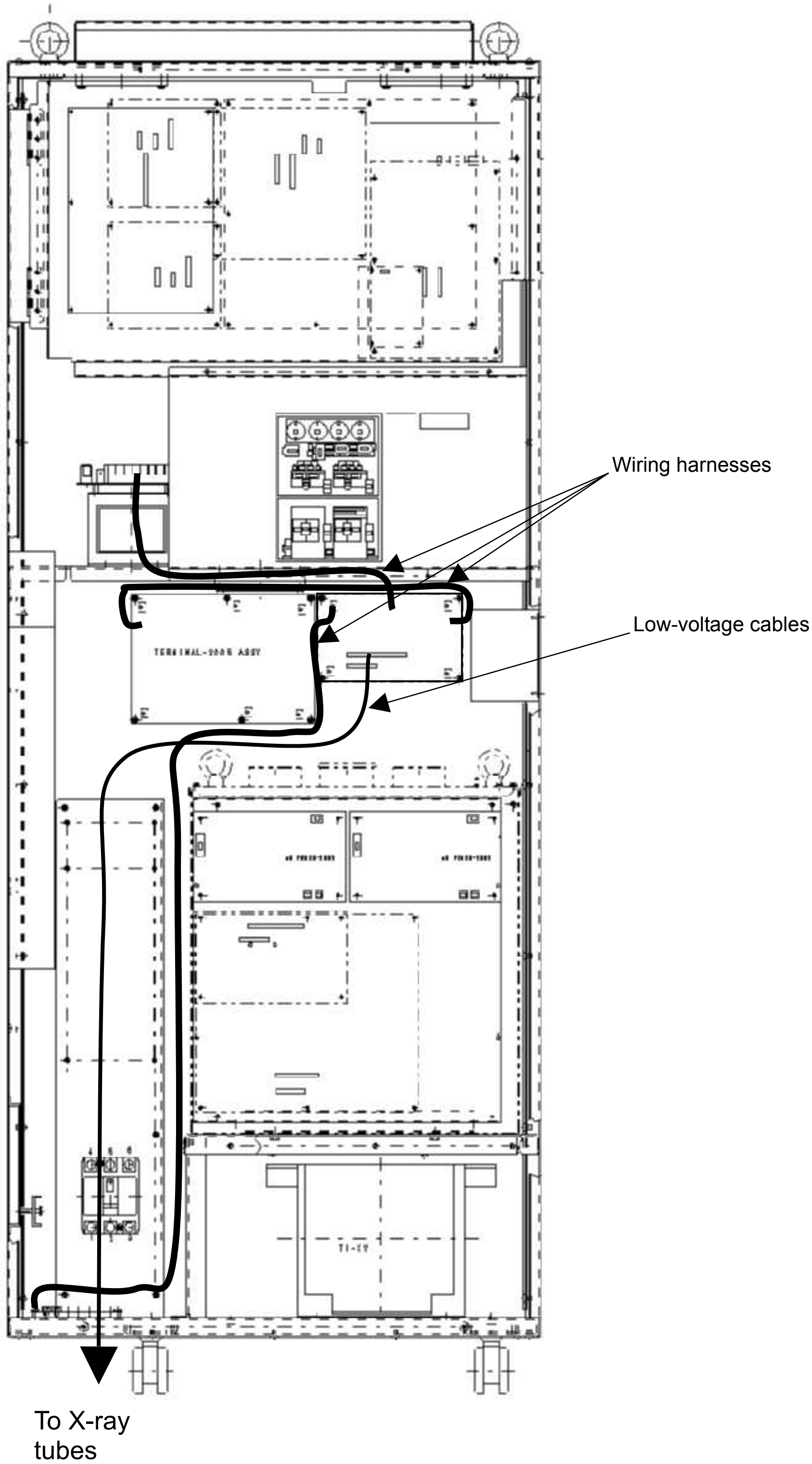


Fig. 5.4.20 ZUD-L40/V40/B40 Series

5.4.4.2 Connecting the High-voltage Switchgear HC-150-2-88 (ZUD-P40 Series only)

Connect the high-voltage (tube) switchgear as shown in Fig. 5.4.15.

(Remarks) Not use the short-wire(D2-D3).

5.4.5 Changing the Wiring Connections for One Tube

Change the current wiring connections. (See Fig. 5.4.4.1 and 5.4.4.2.)

(1) Starter wiring

Move the JH4 cable from the TERMINAL-2005 PCB JH4 terminal to the TUBE SELECTOR-96 PCB JH4 terminal.

(2) Collimator wiring

Move the collimator cable terminals (L0, L12) from the collimator transformer to TB2 (L12A LA) on the TUBE SELECTOR-96 PCB.

Connect the jumper wire across TB1 and TB2 on the TUBE SELECTOR-96 PCB to TB1 for the optimal voltage.

(3) Low-voltage cable connection

Move the low-voltage cable connected from the X-ray tube to the TERMINAL-2005 PCB to the TUBE SELECTOR-96 PCB TB2 terminal.

(4) High-voltage cable (ZUD-P40 Series only)

Move the high-voltage cable connected from the X-ray tube to the high-voltage transformer to Tube 1 on the high-voltage switchgear.

5.4.6 Connecting the Attachments

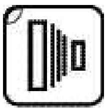
(1) Applicable Techniques

The applicable techniques are shown in the table below.

Technique		ZUD-B/V/L/P40(D/DS)
General radiography	GR	Available
Bucky table radiography	BU1	Available
Bucky stand radiography	BU2	Available

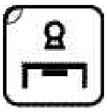
Up to two R/F tables can be attached.

The following techniques are preset at the factory. See 4.4 Initial Settings for the method of changing the set techniques.



General radiography

Bucky stand radiography



Bucky table radiography

(2) Connecting the Attachments

Connect each attachment to the terminals listed below. The positions of these terminals are shown in section 2.10. The applicable power supplies are also shown below.

1) Terminal block X2 (front panel of Transformer T1)

L_0 - L_{100}	100V AC	5 A max.
A_0 - A_{200}	200V AC	10 A max.

2) Fuse holder (front panel of Transformer T1)

A_0 - A_{220}	220V AC	20 A max.
A_0 - A_{200}	200V AC	20 A max.
A_0 - A_{125}	125V AC	10 A max.
A_0 - A_{50}	50V AC	10 A max.
L_0 - L_{40}	40V AC	5 A max.

Total 20 A max. (for starter)

Total 2 kVA max. (for continuous load)

CAUTION

Do not apply continuous loads exceeding the supply capacity.

(3) X-ray Tube Unit and Variable Aperture

(a) When the X-ray tube is used as Tube 2.

TUBE SELECTOR-96 terminal block TB3	X-ray tube unit	Variable aperture R-10	Variable aperture R-20
X_B	X		
Y_B	Y		
Z_B	Z		
L_B		L	L
L_0B	L_0, (1)		
$L_{12}B$		L_{12}	L_{12}
$L_{100}B$	L_{100}, (2)	L_{100}	
TH2M	TH, (8)		
TH2L	TH, (9)		
E	E	E	E

(b) Variable aperture transformer

TUBE SELECTOR-96 PCB, terminal block	Transformer for R-10	Transformer for R-20
L_0	L_0 (L)	L_0
L_{100}	L_{100}	L_{100}
L		L
$L_{12}A$	L_{12}	L_{12}, L_{14}, L_{15-3},
$L_{12}B$		L_{16-7}
$L_{12}C$		
E	E	E

R-10 Wiring Example

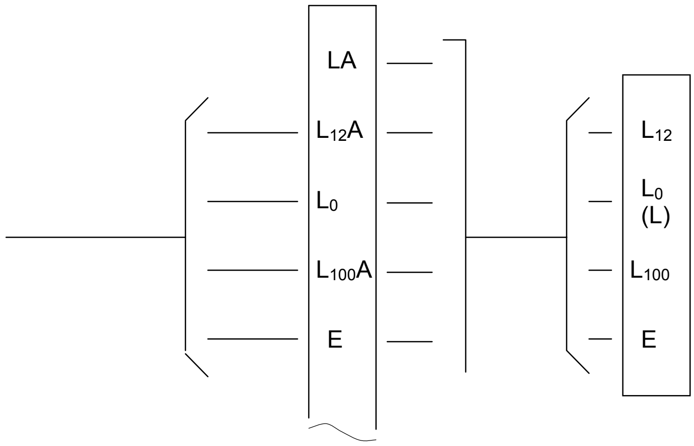


Fig. 5.4.16

CAUTION

variable-aperture transformer can be shared when the 2-tube option is installed.

1) **If both R-10 and R-20 are available, use the variable-aperture transformer for R-20. In this case, short together the L and L_0 terminals on the variable-aperture transformer.**
2) **If the R-20 variable aperture is used, connect the L_{12}A, L_{12}B, and L_{12}C terminals on the terminal block on the high-voltage generator to the L_{12}, L_{14}, L_{15-3}, or L_{16-7} terminal. For details, refer to R-20 operation manual.**
3) **For the R-10 variable aperture, connect the L12A, L12B, and L12C terminals to the L12 terminal.**

(4) Bucky Radiography Unit

Up to two radiography units can be connected.

Use the ZUD-HV Maintenance Tool to set the techniques to the GSC-2002S(Z) technique keys.

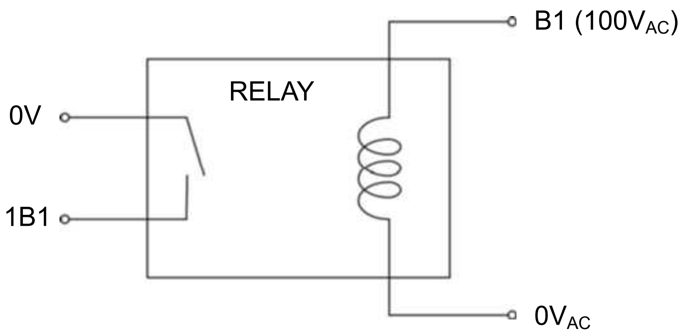
(a) Connections to set the technique to Bucky 1

Control cabinet			Bucky Radiography Unit	
Terminal block		I/O status	BK-1, -12, BKZ-10, BR Series, etc.	BR-1H, BK-12H
Transformer T1	L0	0V AC →	L_0	L_0
	L100	100V AC →	L_{100}	L_{100}
	L125	125V AC →	L_{125}	
TERMINAL-2005	1B2	X-RAY operation output contacts	Note2) Shorting B_2	B_{22}
	1B2			B_2
	0V	X-RAY OK (0V) input contacts		B_{11}
	1B1		(B_1) Note3)	B_1
	Ground terminal	→	E	

Note1) On the TERMINAL-2005 PCB, turn ON SW2-(1)(3) and turn OFF SW1-(1)(3).

Note2) If the unit uses a 100 V AC motor, short together L100 and 1B2.

Note3) If the unit uses a 100VAC output signal (X-ray OK), make it the relay point of contact output (normal open), according to the circuit example to show in below.



(b) Connections to set the technique to Bucky 2

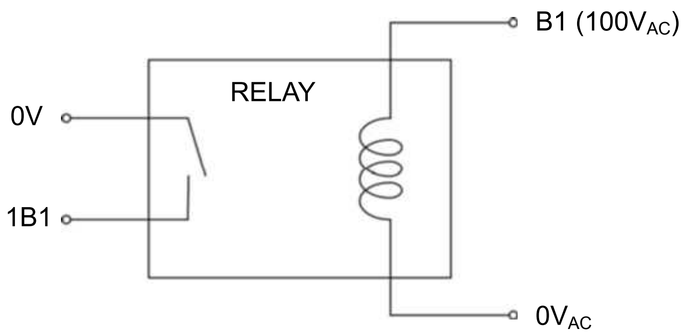
Control cabinet			Bucky Radiography Unit (Note 3)	
Terminal block		I/O status	BK-1, -12, BKZ-10, BR Series, etc.	BR-1H, BK-12H
Transformer T1	L0	0V AC →	L_0	L_0
	L100	100V AC →	L_{100}	L_{100}
	L125	125V AC →	L_{125}	
TERMINAL-2005	2B2	X-RAY operation output contacts	Note2) Shorting wire B_2	B_{22}
	2B2			B_2
	0V	X-RAY OK (0V) input contacts		B_{11}
	2B1		(B_1) Note4)	B_1
	Ground terminal	→	E	

Note 1) On the TERMINAL-2005 PCB, turn ON SW2-(2) and turn OFF SW1-(2).

Note 2) If the unit uses a 100 V AC motor, short together L100 and 2B2.

Note 3) Refer to the I/O status in the table above when connecting a unit not listed above.

Note4) If the unit uses a 100VAC output signal (X-ray OK), make it the relay point of contact output (normal open), according to the circuit example to show in below.



(5) Integrated Bucky Radiography Unit

Use the ZUD-HV Maintenance Tool to set the techniques to the GSC-2002S(Z) technique keys.

(a) Connections when the technique is Bucky 1

Control cabinet				Integrated Bucky Radiography Unit	
Terminal block		I/O status		BR-100 alone	BR-100 + CH30GX-30
Transformer T1	A0	Single-phase 200V	→		L_1
	A220		→		L_2
	L0	0V AC	→	L_0	L_0
	L100	100V AC	→	L_{100}	L_{100}
TERMINAL-2005 (Note)	1B2	X-RAY operation output contacts		B_{22}	Connector CN9
	1B2			B_2	
	1B1	X-RAY OK (L_{100}) input contacts ( )		B_{11}	
	1B1			B_1	
	Ground terminal	→		E	

Note) If CN9 is not used with BR-100 alone, turn ON SW2-(1) and turn OFF SW1-(1) on the TERMINAL-2005 PCB.

To use connector CN9, turn OFF SW2-(1) and turn ON SW1-(1) on the TERMINAL-2005 PCB.

To use connector CN9 and use tube number 1 for CH, turn OFF SW2-(5) and turn ON SW1-(5). To use tube number 2 for CH, turn OFF SW2-(6) and turn ON SW1-(6).

(b) Connections to set the technique to Bucky 2

Control cabinet			Integrated Bucky Radiography Unit	
Terminal block		I/O status	BR-100 alone	BR-100 + (BH-100 / CH30GX-30)
Transformer T1	A0	Single-phase 200V →		L_1
	A200	→		L_2
	L0	AC. 0V →	L_0	L_0
	L100	AC. 100V →	L_{100}	L_{100}
TERMINAL-2005 (Note)	2B2	X-RAY operation output contacts	B_{22}	Connector CN9
	2B2		B_2	
	2B1	X-RAY OK (L_{100}) input contacts (-□-)	B_{11}	
	2B1		B_1	
	Ground terminal	→	E	

Note) If CN9 is not used with BR-100 alone, turn ON SW2-(2) and turn OFF SW1-(2) on the TERMINAL-2005 PCB.

To use connector CN9, turn OFF SW2-(2) and turn ON SW1-(2) on the TERMINAL-2005 PCB.

To use connector CN9 and use tube number 1 for CH, turn OFF SW2-(5) and turn ON SW1-(5). To use tube number 2 for CH, turn OFF SW2-(6) and turn ON SW1-(6).

(6) Tube Select Signals

The signal corresponding to the selected tube number is obtained.

TERMINAL-2005	Tube 1 selected	XR1M	Tube 1 select output contacts	SW2-(5) must be ON and SW1-(5) must be OFF on TERMINAL-2005 PCB.
	Tube 2 selected	XR2M	Tube 2 select output contacts	SW2-(6) must be ON and SW1-(6) must be OFF on TERMINAL-2005 PCB.

CAUTION

Refer to "4.22 External Output Setting" and set the correct signal to each output terminal.

5.5 Installation of connection unit ZUD (Option)

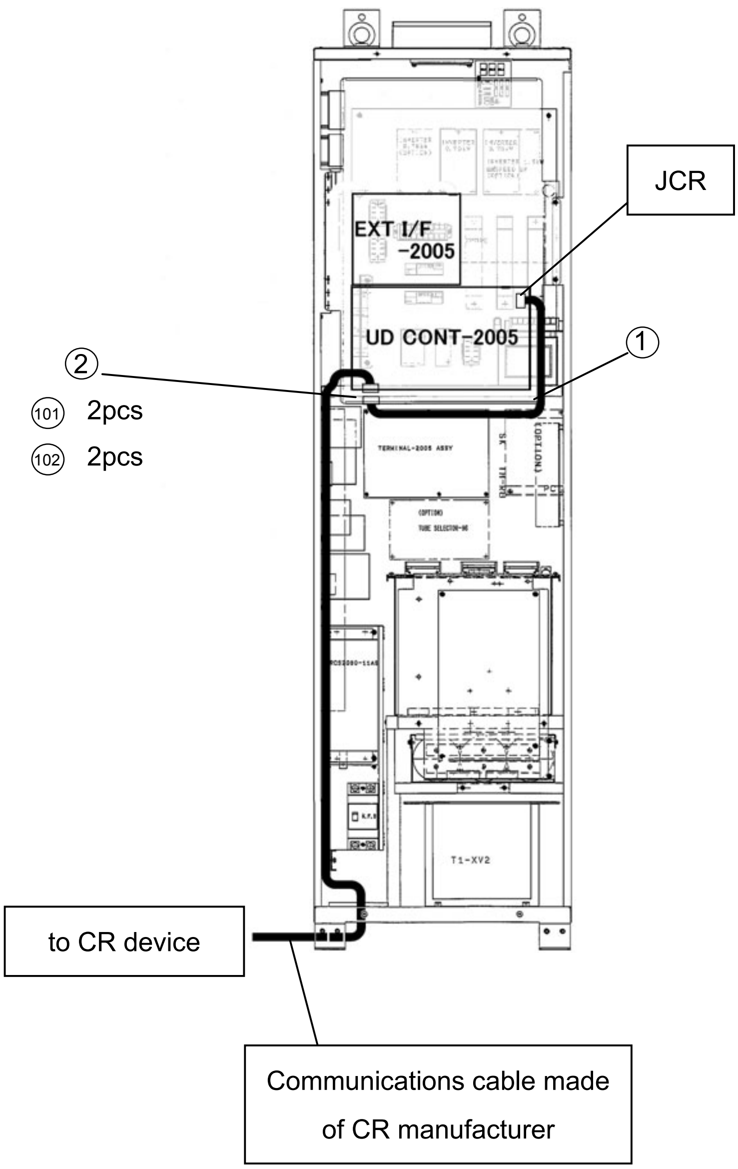
5.5.1 Configuration

Inscribe the configuration of connection unit ZUD (503-67777).

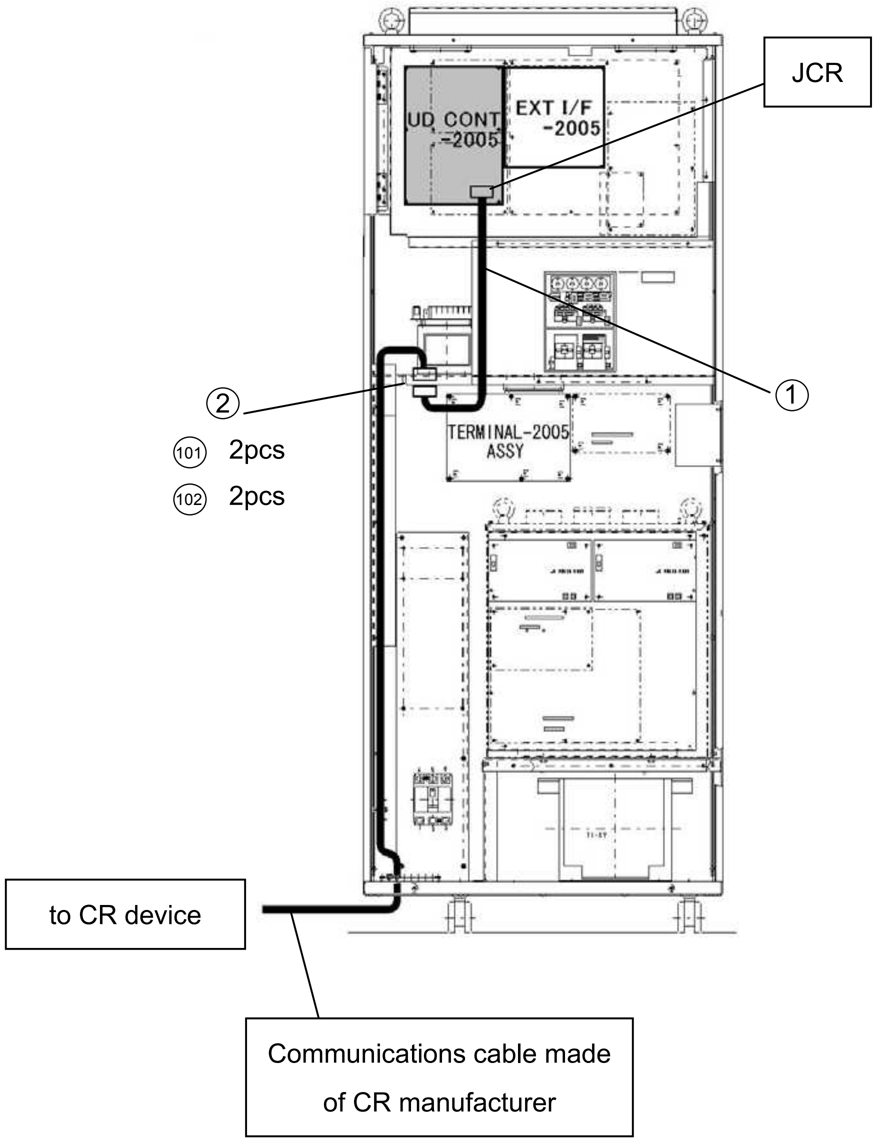
Configuration parts	1. 25-9CR conversion cable	(502-25890-03)
	2. Signal cable mount sheet	(502-25989)
	3. Wiring band CV-100N 4pcs	(072-60321-02)
	4. Conversion cable	(502-23733)
	101.Screw,SUS SEMS P3 M4×10 2pcs	(020-46548)
	102.Screw,SUS SEMS P4 M2.5×6 2pcs	(020-46602)

5.5.2 Connecting the cables

5.5.2.1 In case of ZUD-P40



5.5.2.2 In case of ZUD-L41/L40/V40/B40



5.5.3 Initial Setting

(1) Initial setting to use the connections unit

Start up ZUD-HV Maintenance Tool open [Basic setting] [Option setting] of [Interlock function setting of CR] in [Basic Setting] window, select the method of interlock to CR.

Do not interlock	Do not connect to the CR. When it does not interlock to CR, select it.
FCR mode	Select that when it received radiography conditional interlock to CR with the radiography conditional.
FCR APR mode	Select that when it received program number interlock to CR with the radiography conditional.

5.5.4 Operation Check

(1) Check that the printed circuit board is mounted in the equipment, and then turn on the power.

(2) Check that the X-ray controller display changes according to the control commands when control data is transmitted to the X-ray controller. (Control data: See section 5.5.11.)

(3) Check at the receiving device that the X-ray controller transmits radiography data when X-ray exposure is conducted.

(4) Check that the X-ray controller LCD displays "C05" or “CR invalid Parameter” when control data outside the permitted condition range is transmitted to the X-ray controller.

Also, ensure that X-ray exposure is not possible in this state.

5.5.5 Communications Specification

The communications protocol is described below.

(1) The master station requests establishment of a data link.

① The master station generates an "ENQ" message to request establishment of the data link.

② The slave station sends "ACK" to permit establishment of the data link. If the data link cannot be established, the slave station sends "NAK".

③ If the slave station does not return "ACK" within 2 seconds, IDT retransmits "ENQ" (up to three retransmissions).

(2) The master station transmits the required message.

① The master station sends a message starting with "STX".

② The slave station checks the message. If the message is evaluated to be correct, the slave station transmits "ACK", otherwise it transmits "NAK".

③ If the master station receives "NAK", it retransmits the same message (“NAK”). (up to three retransmissions)

(3) The master station closes the data link.

① The master station generates an "EOT" message to close the data link.

5.5.6 Message Formation

(1) Format

Supports a text block from STX to BCC of variable length up to 127 bytes.

Command form appears below.

S T X	Application Message	E T X	B C C

← MAX.127 byte →

STX : 0X02

ETX : 0X03

BCC : Horizontal parity

Excluding the STX, the exclusive OR to EXT.

Error process

It is due to the parity check of every error detection data.

(Evenness parity check of message unit)

5.5.7 Physical Layer

(1) Electrical specifications RS-232C

(2) Transmission mode: half duplex, asynchronous

Start bit ················ 1 bit

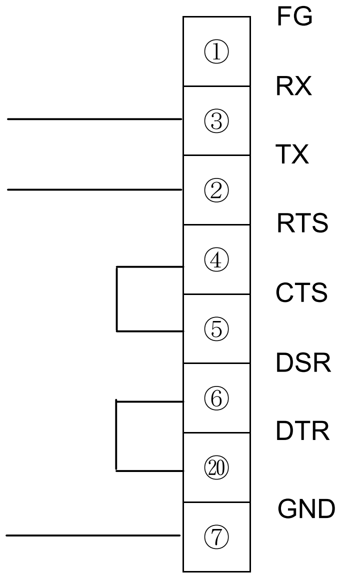
Data ···················· 8 bit

Parity ·················· 1 bit (even)

Stop bit ················ 1 bit

(3) Transmission rate 4800bps

(4) Connection cable Specification



D-SUB25P(male)

5.5.8 Data Link Layer

(1) Protocol conforms to JISX5002

Transmission code	8-bit code prescribed in JIS-X-0201
	(Not including ‘ * ’ ‘ @ ’ ‘ ? ‘codes)
Response method	Alternateness response method (ACK, NAK)
Error check protocol.	BCC(text block horizontal parity)
	XOR from character after STX to ETX
Error correcting method	Automatic retransmission
Transmission rate	4800 bps

(2) Basic transmission control protocol

The communications protocol is executed following procedure.

1) The master station requests establishment of a data link

- The master station generates an “ENQ” message to request establishment of the data link.
- The slave station sends “ACK” to permits establishment of the data link. If the data link cannot be established, the slave station sends “NAK”.

- If the slave station does not return “ACK” within the specified time (RT1 in table 2), the master station retransmits “ENQ”. (For maximum number of retransmission is RT1 in Table 2)

2) The master station transmits the required message.
   - The master station sends a message starting with “STX”.
   - The slave station checks the message and if the message is evaluated to be correct, the slave station transmits “ACK” ,otherwise it transmits “NAK”.
   - If the master station receives “NAK”, it retransmits the same message. (For maximum number of retransmission is RT2 in Table 2)

3) The master station closes the data link.
   - The master station generates an “EOT” message to close the data link.

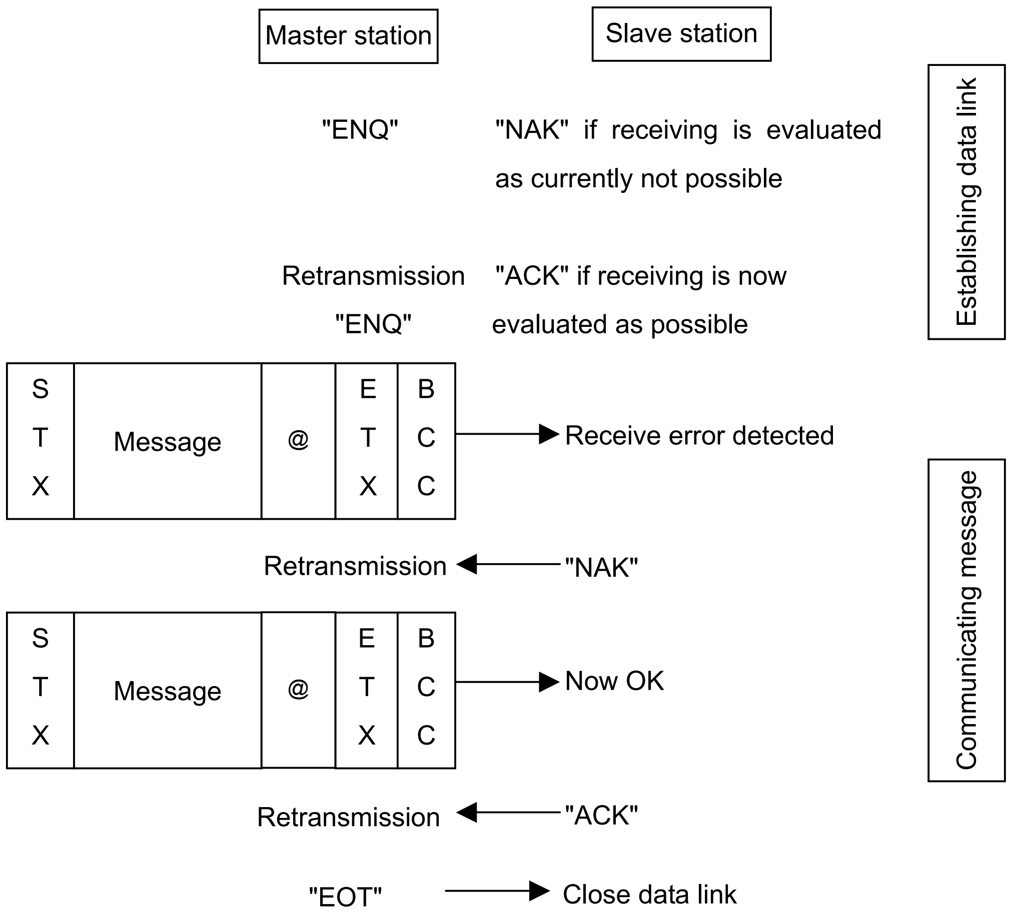


Fig.5.5.1 Transmission control protocol

- Details comply with implementation specification. (Z30N0161)
- Maximum text block length up to 127 bytes.

(1) Parameter

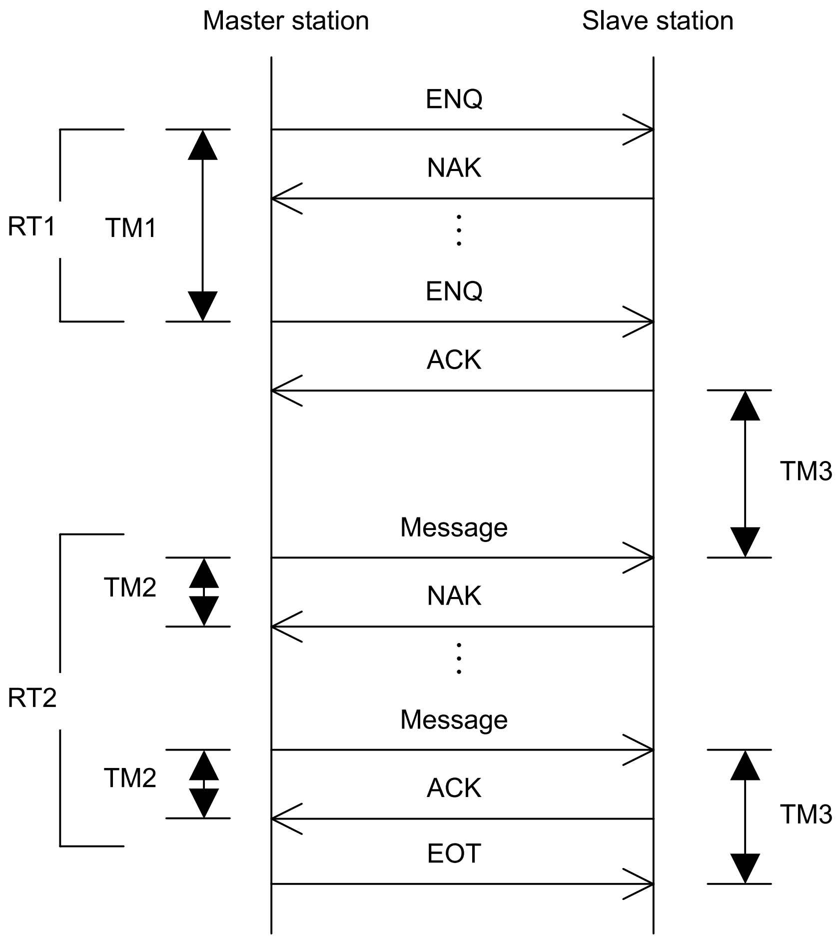


Fig.5.5.2 Control protocol and parameters

Table 2 Parameters

	Items	Communicated unit	UD
TM1	Pause time before ENQ retransmission when establishing data link	2.0 sec	3.0 sec
RT1	Number of ENQ retransmissions when establishing data link	3 times	3 times
RT2	Number of retransmissions when sending message	3 times	3 times
	Maximum text length (excluding STX, ETX, ETB, and BCC)	124 byte	124 byte
TM2	Response monitoring time	2.0 sec	2.0 sec
TM3	Receiving timeout time	2.0 sec	2.0 sec

5.5.9 Application Layer

(1) Message format

Supports a text block from STX to BCC of variable length up to 127 bytes.

However, details of the actual text used is described in section 5.5.11 Details of Transmitted Text.

STX	Header (2 bytes)	Application message	@	ETX	BCC

MAX.127 byte

STX : 0×02

ETX : 0×03

BCC : horizontal parity

Exclusive OR to ETX (excluding STX)

A command contains the following three fields:

- Header
  The header is represented as a 2-byte code.
- Message
  Expressed in JIS 8-bit code.
- Terminator
  One-byte field indicating the end of the message.

Error Processing

Parity check on each error detected data

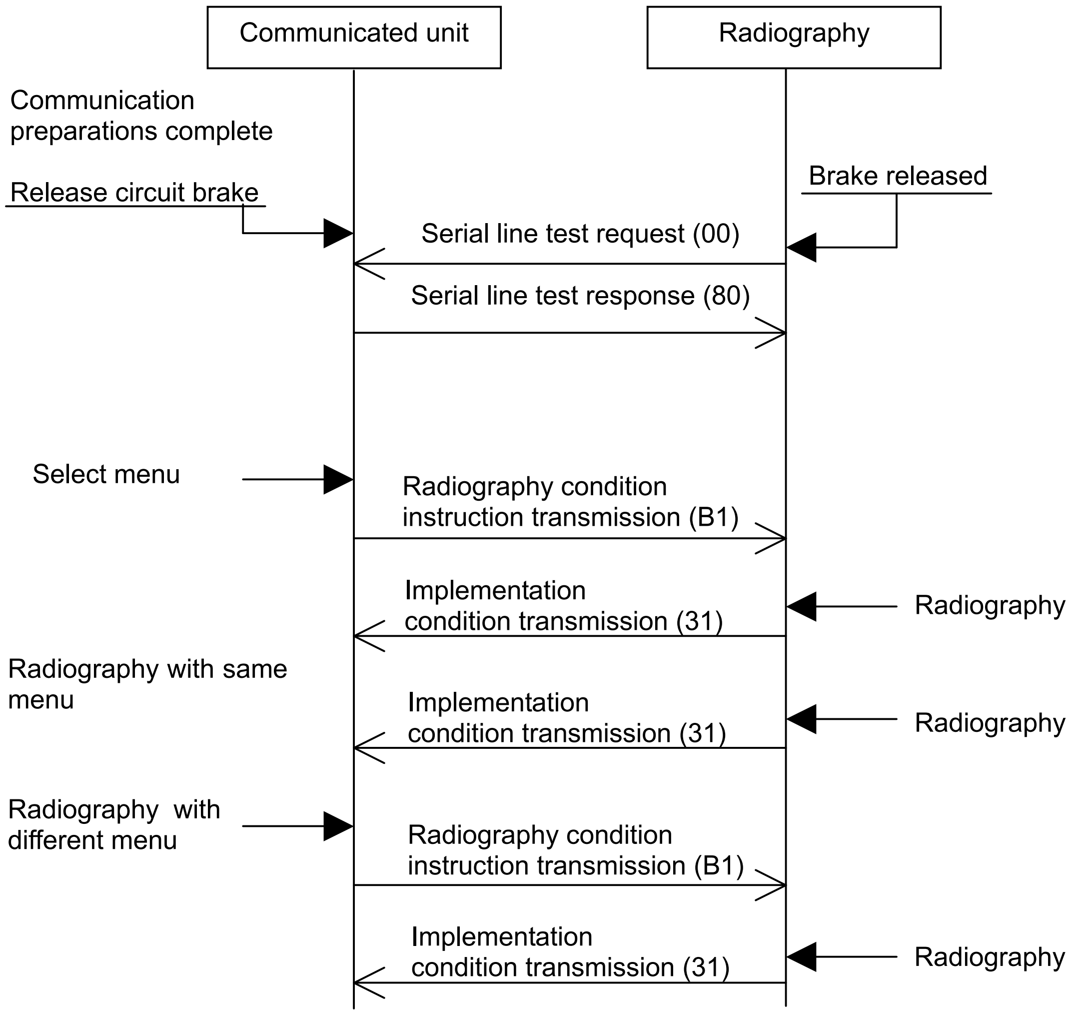
(Horizontal parity checks on each message unit.)

(2) Header Table

Table 4 Header Table

Communicated unit→ X-ray unit		X-ray unit → Communicated unit	
Header	Message contents	Header	
80	Serial line test response	00	Serial line test request
B1	Radiography condition instruction transmission	31	Implementation condition transmission

5.5.10 Communication Sequence



Communication sequence

5.5.11 Details of Transmitted Text

(1) Circuit test request (X-ray unit → Communicated unit)

Test data to test the serial circuit from the X-ray unit to the communicated unit.

STX	Header	Message	@	ETX	BCC
	“00”	Test data (any character codes)			

MAX.127 byte

The test data can include any characters between "STX" and "BCC", up to a length of 127 bytes. After the IDT circuit brake release is detected, the X-ray unit waits at least one second before transmitting ENQ for the 00 command.

(2) Line test response (Communicated unit → X-ray unit)

This is the response to the line test request in (1) above.

STX	Header	Message	@	ETX	BCC
	"80"	Test data			

MAX.127 byte

The communicated unit returns the data sent by the X-ray unit unchanged. The X-ray unit compares the returned data to the data sent in the line test request; if the data matches, the circuit is established. If the data does not match, the circuit test request is repeated. The communicated unit waits up to 5 seconds from receiving the "00" command (i.e. , receiving "EOT") before transmitting ENQ for the "80" command.

(3) Radiography condition instruction transmission (Communicated unit)

The communicated unit makes settings for the X-ray unit, including radiographic conditions and automatic exposure conditions.

STX	Header	Message	@	ETX	BCC
	"B1"	Detailed message			

Total 39 bytes

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)
2B	1B	2B	8B	4B	4B	4B	4B	4B	2B	4B

* Message details

Item	Bytes	Description
(a)	2B	Manufacturer/model code for connected instrument
(b)	1B	Radiography/Fluoroscopy flag

(c)	2B	Tube/Technique code
(d)	8B	Film-related code (disabled)
(e)	4B	Tube voltage
(f)	4B	Tube current
(g)	4B	Exposure time
(h)	4B	Spare 1 (fixed as "0000") Note*
(i)	4B	Automatic exposure control
(j)	2B	ID code (fixed as "00")
(k)	4B	Focus code

NOTE The value range and steps for the tube voltage, tube current, and exposure time depend on the system composition. However, if an illegal value is sent to the X-ray unit, the X-ray unit ignores it. In this case, the user is notified by some means, such as displaying an error on the X-ray unit, to prevent exposure with incorrect radiographic conditions, even if a new menu is selected.

* If the X-ray unit ignores received data:
  1) an error is displayed; and
  2) exposure is prohibited.

This status is maintained until:

a) It is reset at the X-ray unit; or
b) Legal data is received.

NOTE The data sent to the X-ray unit is ignored in the following cases:
  1) An illegal value is received;
  2) During exposure or during exposure operation.

NOTE Spare 1 becomes the Protocol Number if FCR APR was selected in the initial setup.

Implementation condition transmission (Communicated unit)

Data for actual radiography.

STX	Header	Message	@	ETX	BCC
	"31"	Detailed message			

Total 39 bytes

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)
2B	1B	2B	8B	4B	4B	4B	4B	4B	2B	4B

The implementation data transmits the radiography setting or measured value corresponding to each radiographic condition instruction, as shown in the table below.

Item	Description
(a) Manufacturer/model code for connected instrument	"01"
(b) Radiography/Fluoroscopy flag	Fixed as "0"
(c) Tube code Technique code	Tube code for the selected technique Actual code used for radiography
(d) Film-related code	Disabled * Note 1
(e) Tube voltage	Actual condition used for radiography
(f) Tube current	Actual condition used for radiography
(g) Exposure time	Actual condition used for radiography
(h) Spare 1	Fixed as "0000" Note 2*
(i) Automatic exposure control	Actual code used for radiography
(j) ID code	Disabled
(k) Focus code	Tube focus used for radiography

(a) Manufacturer/model code for connected instrument
Fixed as "01"

(b) Radiography/Fluoroscopy flag
Fixed as "0" because fluoroscopy is not applicable

(c) Tube code/Technique code

X — Selected tube		X — Selected technique	
0:	Tube 1	1:	Spot (or DR)
1:	Tube 2	2:	Bucky 1
2:	Tube 3	3:	Bucky 2
		4:	Radiography
		5:	Tomography
		6:	Autochanger
		7:	Direct spot filming

(d) Film-related code
Fixed as "00000000"

(e) Tube voltage
Indicates the tube voltage used for radiography in 1 kV steps between 0040 and 0150 kV. Illegal transmitted values are ignored.

(f) Tube current
Indicates the tube current used for radiography as 4 digits between 0010 and 1000 mA. Steps are:
10,12,16,20,25,32,40,50,63,80,100,125,160,200,250,320,400,500,630,800,1000 mA.
The settable values may vary according to the system composition. Transmitted illegal values are ignored.

(g) Exposure time

Indicates the exposure time used for radiography between 0001 and 8000 ms.

The exposure time steps are:

1,1.2,1.6,2,2.5,3.2,4,5,6.3,8,10,12,15,20,25,32,40,50,63,80,100,125,160,
200,250,320,400,500,630,800,1000,1250,1600,2000,2500,3200,4000,
5000,6300,8000,10000ms.

However, only 1, 2, 4, 5, and 8 ms are valid below 10 ms. Transmitted illegal values are ignored.

(h) Spare 1 See Note 2* (Program Code)

Fixed as "0000"

However, Spare 1 becomes the Program Code if FCR APR was selected in the initial setup.

Remote console: 3 techniques

APR -> 12 kinds

3 x 12 = 36 kinds

In this case, when program code is beyond the pale(for example 0), radiography condition which is sent to general radiography option console : 35 kinds 36+35=71 kinds becomes availableness, but, if it is in range(1~71), it becomes radiography condition which is preset beforehand by protocol number, so all other radiography conditions are ignored.
(Operation and tube code are also ignored.)

(i) Automatic exposure control (phototimer)

Selects the phototimer (ON/OFF), film sensitivity, film density, and phototimer detection field.

× × × ×

Selects the phototimer (ON/OFF)

0, 1
0: phototimer OFF
1: phototimer ON

film sensitivity

0 to 2
0: standard
1: low sensitivity
2: high sensitivity

film density

1 to 7
1:−3
2:−2
3:−1
4: 0
5:+1
6:+2
7:+3

phototimer detection field

1 - 4, 8

Code	■ □ □	□ ■ □	□ □ ■	□■□ ○
1	○	×	×	×
2	×	○	×	×
3	○	○	×	×
4	×	×	○	×
8	×	×	×	○

The film sensitivity, film density, and phototimer detection field are ignored if the phototimer is set OFF.
If the detection field is set to 1, the detection field is ignored, even if the phototimer is set ON.

(j) ID code

Fixed as "00"

(k) Focus code

Designates the tube focus size.
0000: small focus
1000: large focus

Reference Material (If Fuji IDT is used)

Data set in IDT

××0××00000000××××××××××××0000××××00××××

(1) ×× (2) × (3) × (4) ×××× (5) ×××× (6) ×××× (7) ×××× (8) ××××

(1) Manufacturer/model code set in IDT

Fixed as "01"

(2) Relationship between tube codes set in IDT and ZUD

ZUD requires both the tube code and technique to be set in IDT.

For Tube 1, set the IDT tube code to 0

For Tube 2, set the IDT tube code to 1

(3) Relationship between technique codes set in IDT and ZUD

IDT code	Corresponding ZUD technique	
” 1 ”	DR	(XDR)
” 2 ”	Horizontal Bucky 1	(BU1)
” 3 ”	Vertical Bucky 2	(BU2)
” 4 ”	Radiography	(GR)
” 7 ”	Direct spot filming	(FSP)

Example

If the technique code and tube code in the ZUD initial setup was Horizontal Bucky with Tube 2, then set technique code = 2 and tube code = 1 for the IDT.

(4) Tube voltage

(5) Tube current

Tube current data for each focus in the initial settings must be set correctly in IDT.

(6) Exposure time

(7) Relationship between IDT phototimer-related settings and ZUD

IDT code (4 digits)			
×	×	×	×
1) Phototimer (ON/OFF)	2) Film sensitivity	3) Film density	4) Phototimer detection field
0 : OFF	0 : M	1 : -3	1 : top-left
1 : ON	1 : L	2 : -2	2 : top-right
	2 : H	3 : -1	3 : top-left & top-right
		4 : 0	4 : bottom-center
		5 : +1	8 : top-center
		6 : +2	
		7 : +3	

(8) IDT focus code ZUD

“ 0000 “ small focus

“ 1000 “ large focus

NOTE

FUJI personnel entering data into the IDT have no knowledge of the tube current positions for the equipment used on-site, or the radiographic equipment (techniques) that can be used. Ensure a satisfactory exchange of information with FUJI personnel when they enter the data.

Registering Protocols (Part 2)

If FCR APR was set ON during initial setup, the radiographic conditions are transmitted and received as a Program Code

The relationship between the Program Codes and protocol keys is shown below.

When the protocol key 1 is selected

Protocol key 1		1	2	3	4
Protocol key 2		5	6	7	8
Protocol key 3		9	10	11	12

When the protocol key 2 is selected

Protocol key 1		13	14	15	16
Protocol key 2		17	18	19	20
Protocol key 3		21	22	23	24

When the protocol key 3 is selected

Protocol key 1		25	26	27	28
Protocol key 2		29	30	31	32
Protocol key 3		33	34	35	36

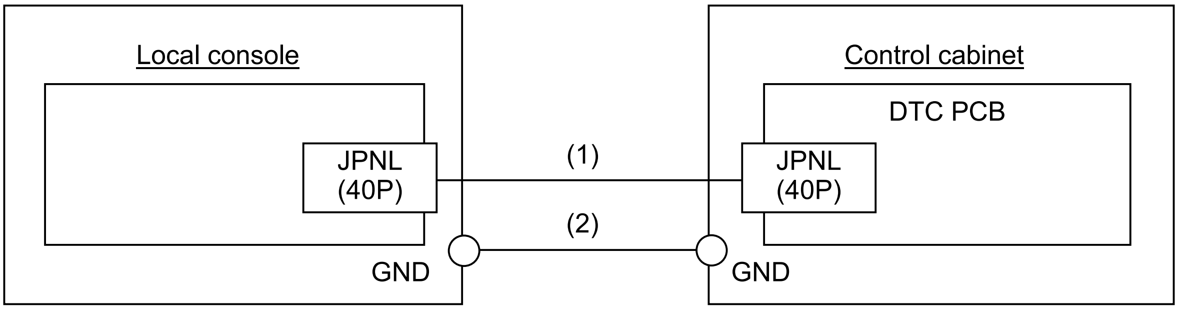
General radiography optional console

37	38	39	40	41	42	43
44	45	46	47	48	49	50
51	52	53	54	55	56	57
58	59	60	61	62	63	64
65	66	67	68	69	70	71

5.6 Installation of Local Console (Option)

5.6.1 Connection

Connect the accessory cable between the local console and the control cable.



(1) Control console signal cable AWG#28 40core shielded (502-24996-10) 10m

Remote console		Cable		Control cabinet	
	JPNL	JPNL	J10D	J10D	UD CONT-2005 PCB

(2) Control console grounding cable 3.5mm^2 Green / Yellow (502-25685-10) 10m

Remote console		Cable		Control cabinet	
Ground terminal	⏚	E	E	⏚	Ground terminal board

5.6.2 Setting

After local console is installed, execute the three modifications of setting below.

1) Bypass setting of safety circuit

   In order to function the stop switch circuit of local console, DTC witch insides the control cabinet short together JP2 connector 1 and 2.

<JP2>

1-2	Enabled: Stop switch does function
2-3	Disabled: Stop switch does not function

WARNING

When local console is installed, be sure to shorted together JP2 connector 1 and 2 of the DTC inside the control cabinet. When JP2 connector 2 and 3 are shorted, stop switch of local console does not function.

2) System optional setting

   With the DTC is set initial setting mode and turn on the power, setting of the local console turn on.

   Concerning the details, refer to the ZS-5D/DS Installation Manual section 2 Maintenance “3.1.1 System Optional Setting”.

3) Potentiometer registration of collimator handle

   DTC start up as a initial setting mode, execute the potentiometer registration of collimator handle.

   Concerning the details, refer to the ZS-5D/DS Installation Manual section 2 Maintenance “2.8.1 Potentiometer adjustment”.

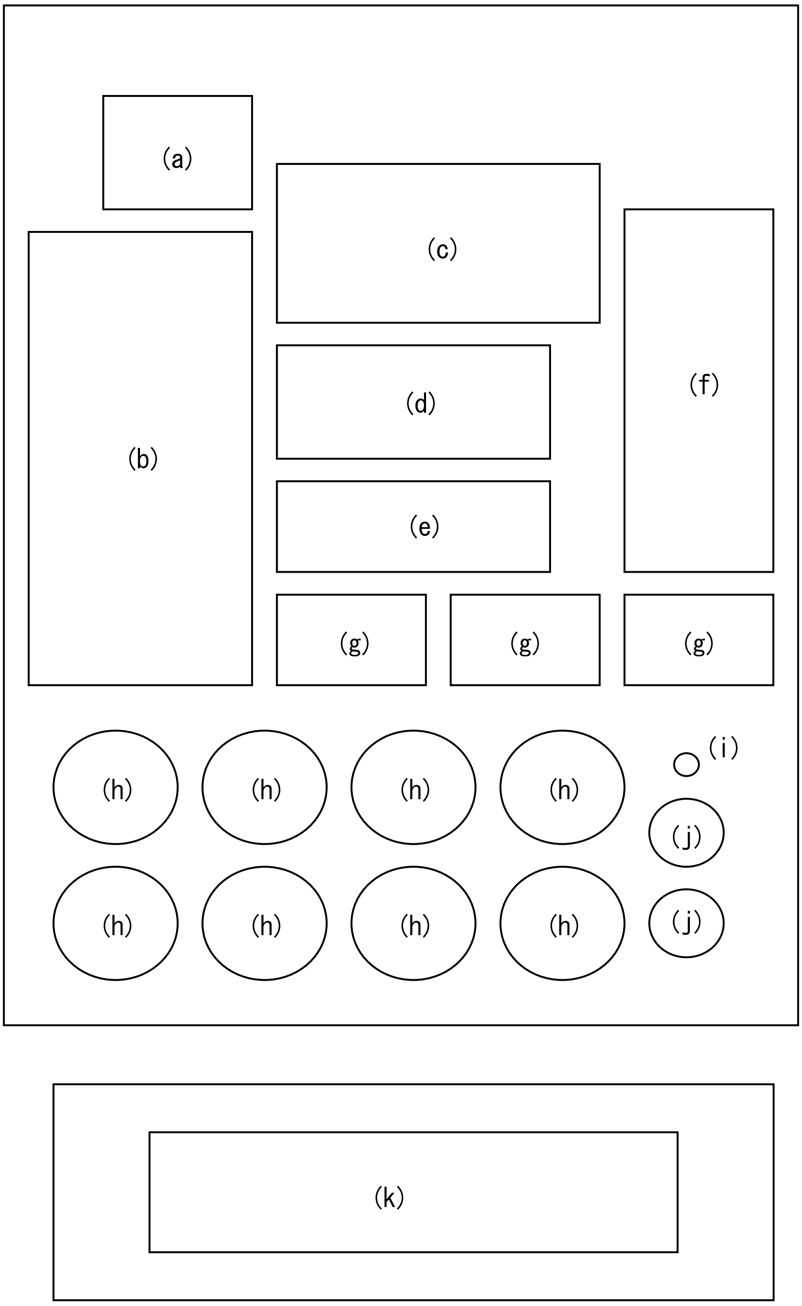
Confirm that the switch 1, 2, 3 of SW8 are OFF, and switch 4 is ON.

Blindfold sticker for local console

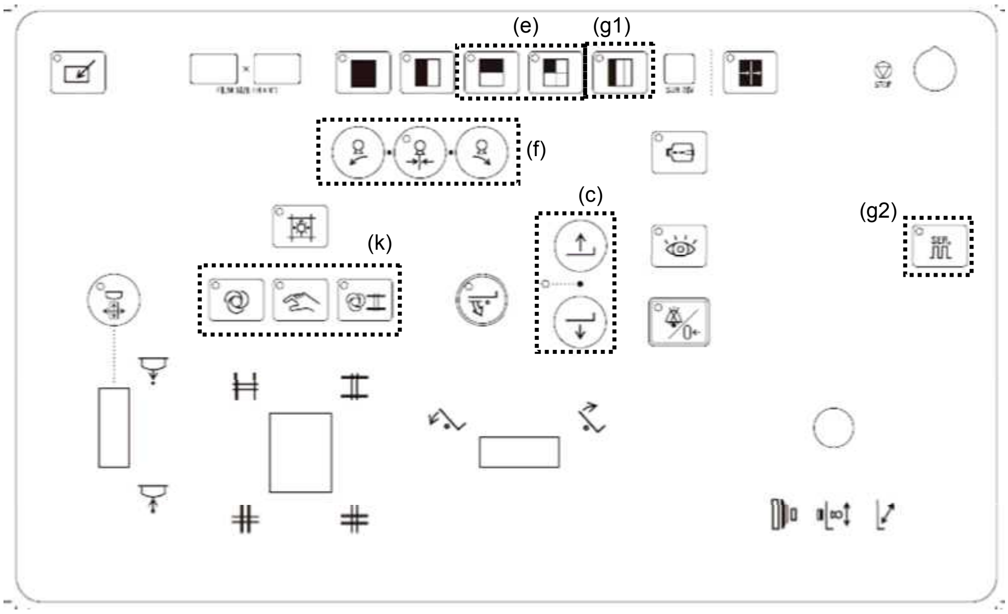
Local console is equipped with following blindfold sticker.

By the state of use, stick blindfold sticker.

For example, (a) part of remote console sticks sticker (a) for blindfold, stick same symbol sticker.



Blindfold sticker



In case of following situation, stick sticker each symbol.

(c) Stick that when there is no [Table up/down] function.

(e) Stick that when [Multi-frame imaging] is not formed in SF package.

(f) Stick that when oblique projection is not formed.

(g1) Stick (g) , in case of FD Package.

(g2) Stick (g) , in case of SF Package.

(k) Stick that when [Select the X-Ray irradiation field size] function is not formed in FD package.

NO TEXT

Chapter 6

R/F Table System Option

Chapter Contents

6. R/F Table System Option

6.1 Installation control cabinet parts for Spot Film Device.

6.1.1 Outline

Install There Parts in the control cabinet when the cassette Spot Film device is combined with R/F Table ZS-5D/5DS.

For the setting and the adjustment refer to “ZS-5D/5DS Installation Manual”.

6.1.2 Configuration

The Spot Film Device kit for Cabinet (502-25691) consists of the following parts.

(a) SFC PCB	(502-25325)
(b) POWER SUPPLY,VS150B-24	(074-80654-95)
(c) WIRE HARNESS, SPOT FILM DEVICE	(502-25341)
(d) MAIN BODY SPOT FILM CABLE A2	(503-66313)
(e) MAIN BODY SPOT FILM CABLE B	(503-66314)
(f) CABLE TIE, CV-150N (5 Pieces)	(072-60321-03)
(g) CLAMP, AL-4	(072-60376-03)
(h) CLAMP, AL-6	(072-60376-05)
(i) Mounting Parts	

① WIRE HARNESS , SPOT FILM DEVICE (P/N:502-25341)

<table>
<tr><td colspan="2">DC POWER SUPPLY UNIT</td><td colspan="2">WIRE HARNESS</td><td colspan="2">HINGE UNIT</td></tr>
<tr><td>DC POWER SUPPLY PS6</td><td>CN2
CN3</td><td>CN2
CN3</td><td>J5S</td><td>J5S</td><td>SFC PCB</td></tr>
<tr><td colspan="2">HINGE UNIT</td><td rowspan="2">L100
L0</td><td rowspan="2">L100
L0</td><td rowspan="2">L100
L0</td><td rowspan="2">SFC PCB
TRMINAL BLOCK</td></tr>
<tr><td>DTC PCB TERMINAL BLOCK</td><td>L100
L0</td></tr>
</table>

② MAIN BODY SOPT FILM CABLE A2（P/N:503-66313）

CONTROL CABINET		CABLE		R/F Table Unit	
SFC PCB	J2S	J2S	J13B	J13B	BASE PCB

③ MAIN BODY SPOT FILM CABLE B（P/N:503-66314）

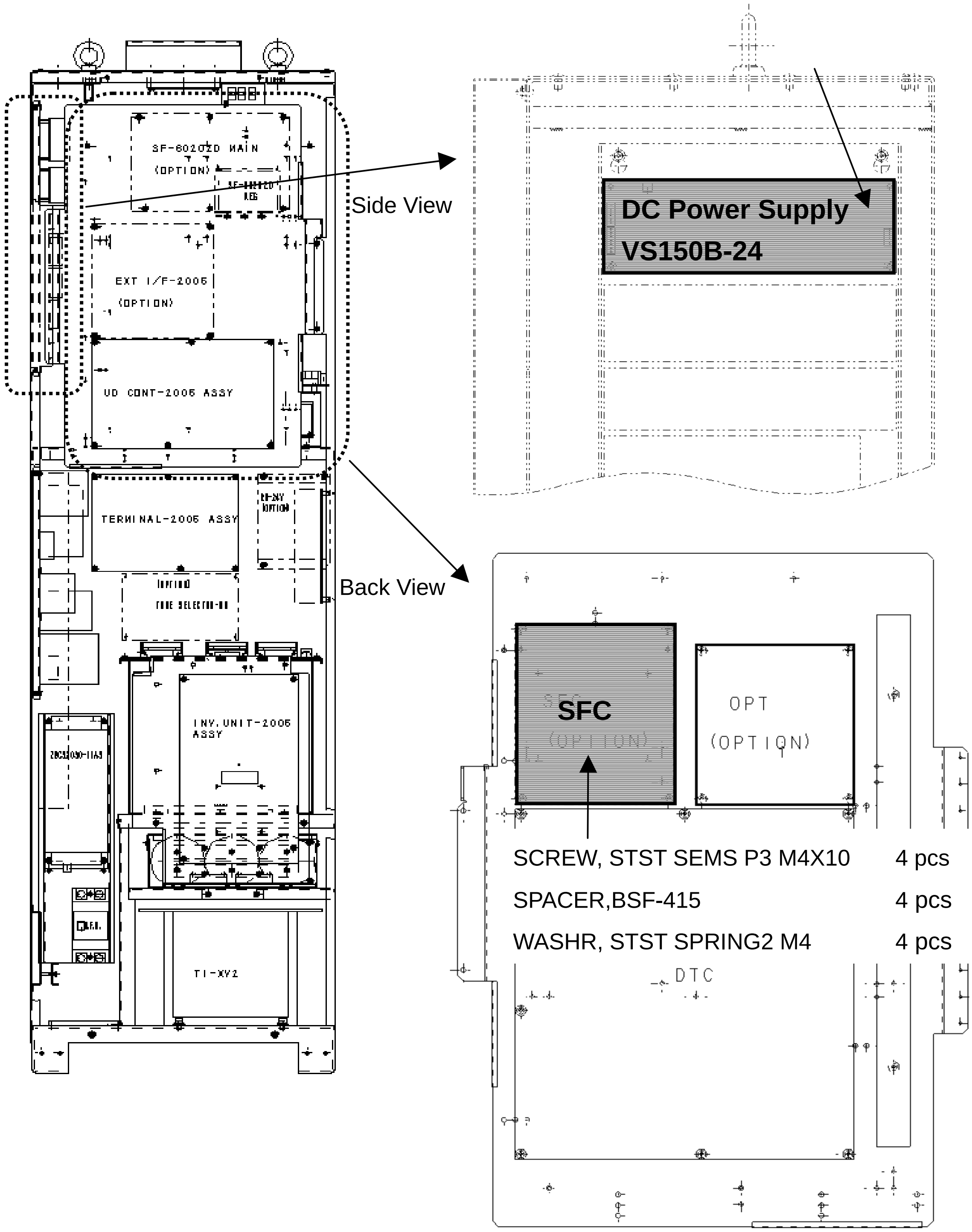
CONTROL CABINET		CABLE		R/F Table Unit	
SFC PCB	J4S	J4S	J11B	J11B	BASE PCB

6.1.3 Parts Installation

It installs it with a screw of the attachment in each part control cabinet.

In case of ZUD-P40

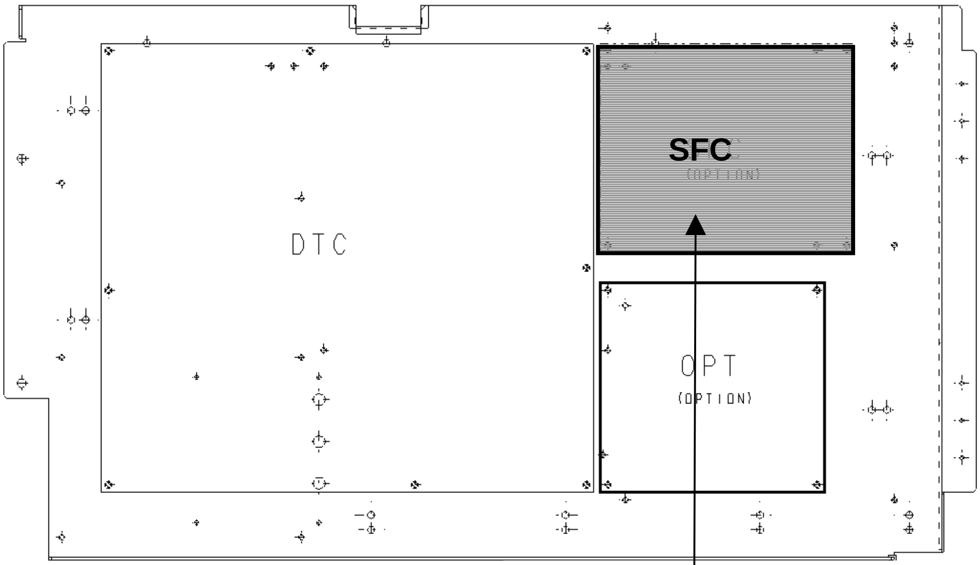
SCREW, STST SEMS P3 M3X8	1 pcs
SPACER, SBB-315(E)	1 pcs
WASHER, STST SPRING 2 M3	1 pcs
SPACER, MSPLS-10U	4 pcs



SCREW, STST SEMS P3 M4X10	4 pcs
SPACER,BSF-415	4 pcs
WASHR, STST SPRING2 M4	4 pcs

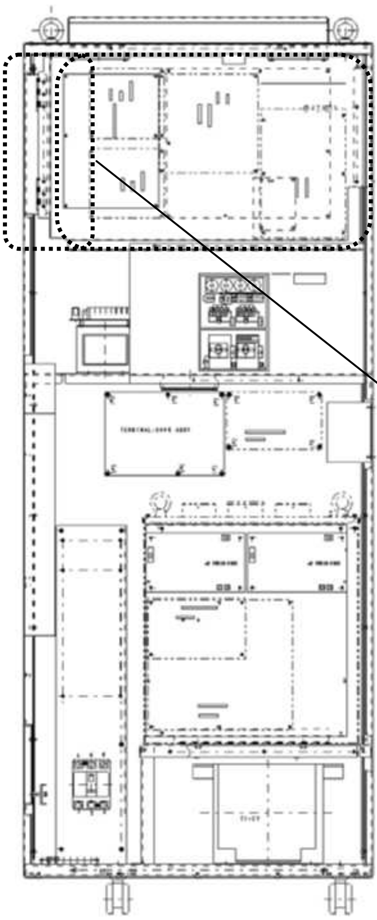
6. R/F Table System Option

In case of ZUD-L41/L40/V40/B40

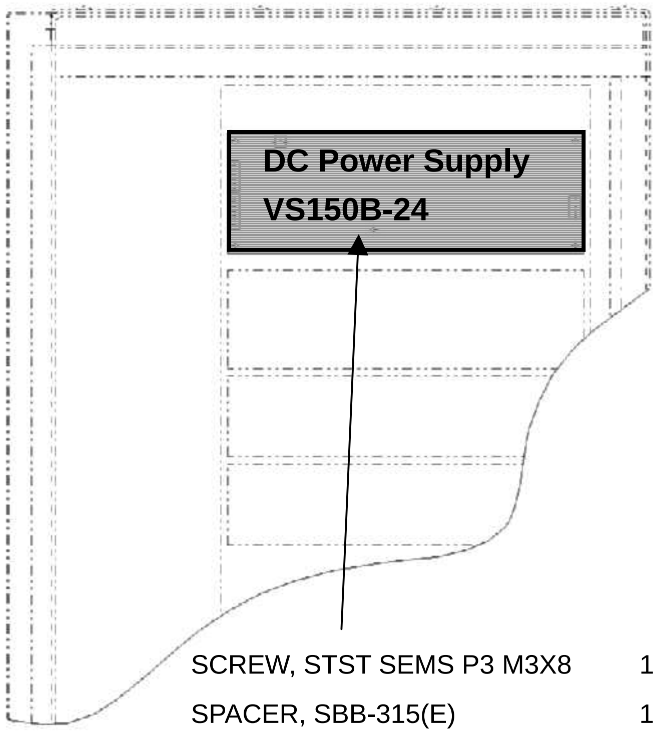


Back View

SCREW, STST SEMS P3 M4X10	4 pcs
SPACER,BSF-415	4 pcs
WASHR, STST SPRING2 M4	4 pcs



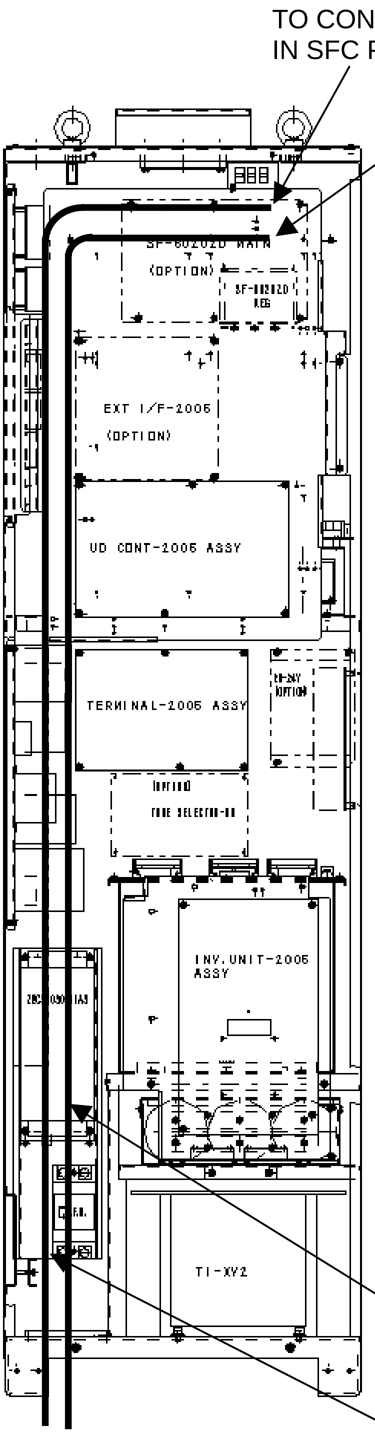
Side View

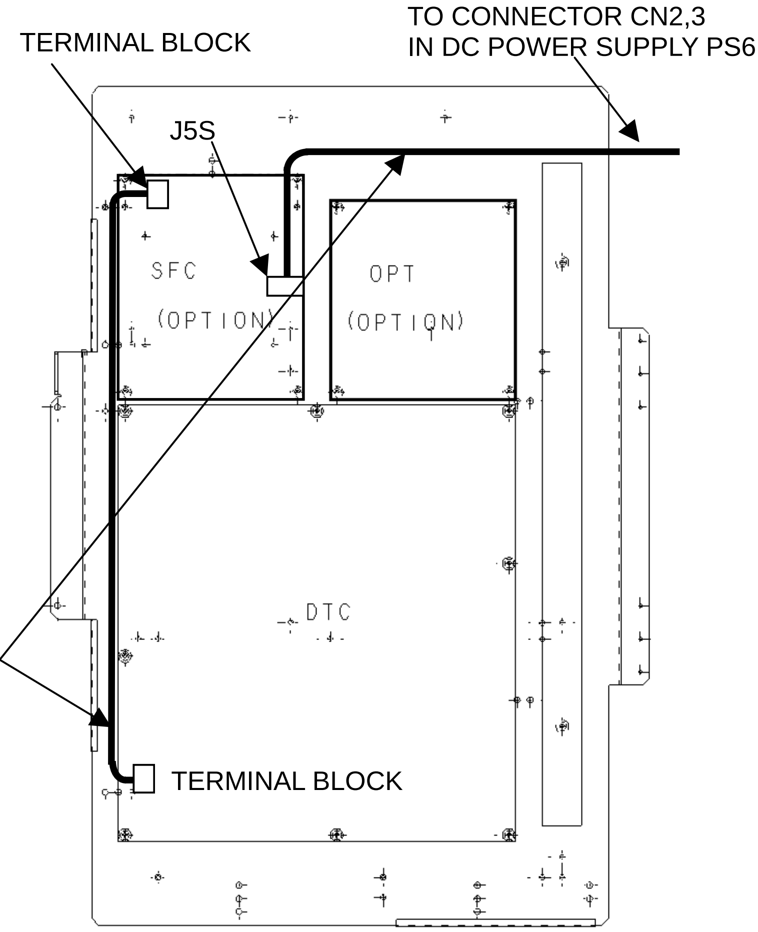


SCREW, STST SEMS P3 M3X8	1 pcs
SPACER, SBB-315(E)	1 pcs
WASHER, STST SPRING 2 M3	1 pcs
SPACER, MSPLS-10U	4 pcs

6.1.4 Parts Wiring

In Case of ZUD-P40



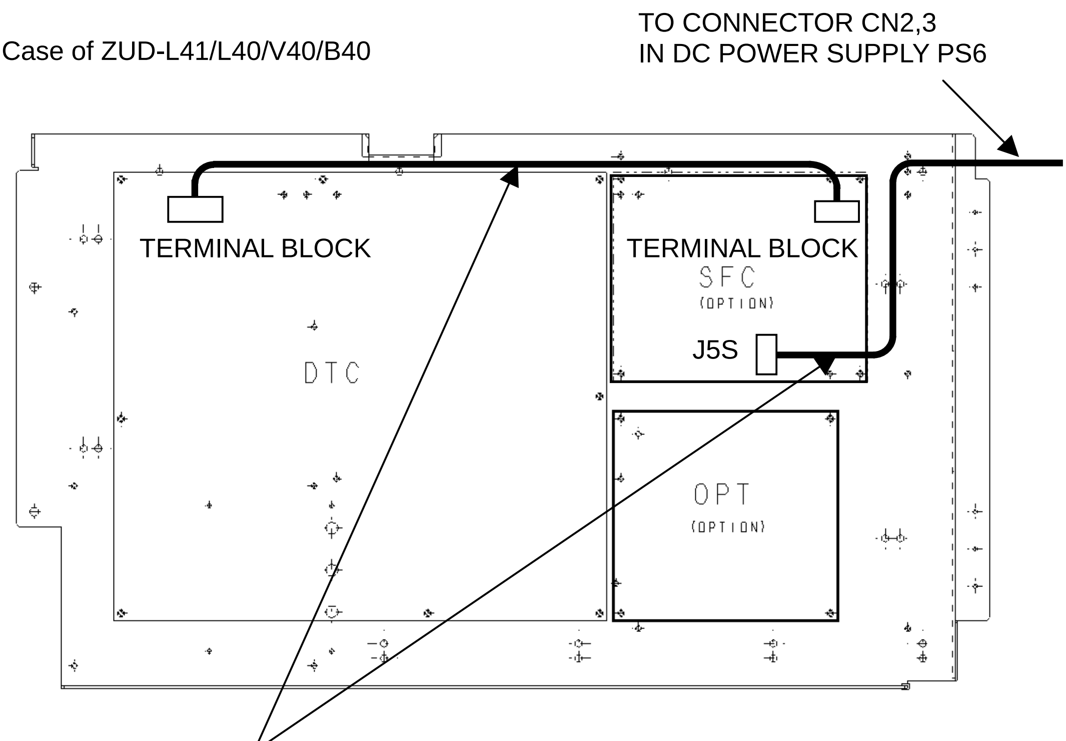


Wiring of product number ① WIRE HARNESS SPOT FILM DEVICE (502-25341).

Please fix by the right place by using the CABLE TIE CV-150N.

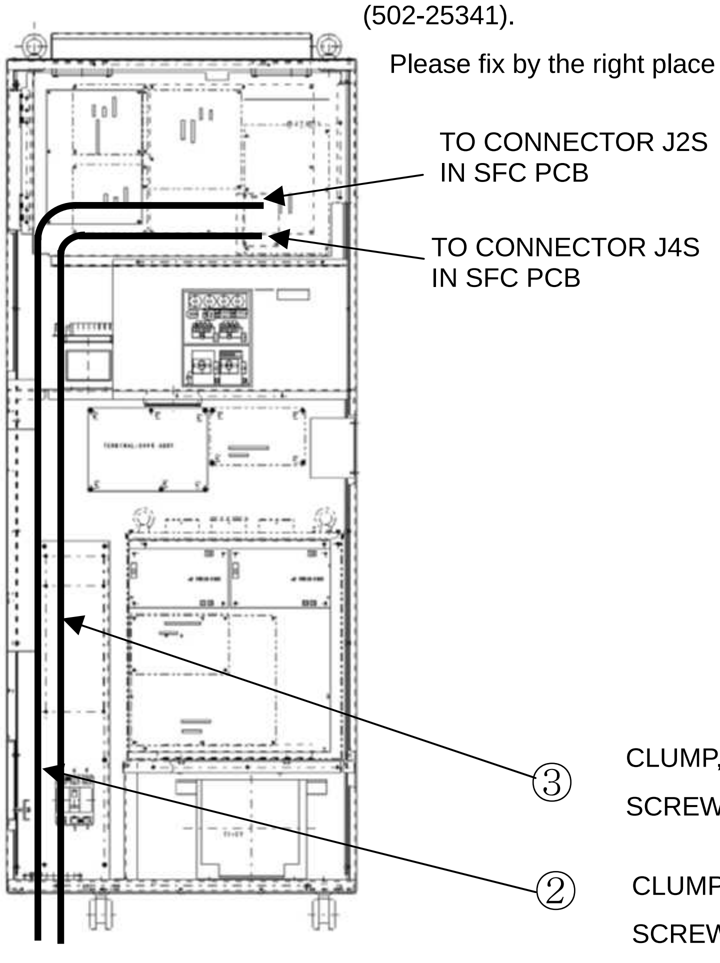
③	CLUMP,AL-6	1 pcs
	SCREW, STST SEMS P3 M4X10	1 pcs
②	CLUMP,AL-4	1 pcs
	SCREW, STST SEMS P3 M4X10	1 pcs

In Case of ZUD-L41/L40/V40/B40



① Wiring of product number ① WIRE HARNESS SPOT FILM DEVICE (502-25341).

Please fix by the right place by using the CABLE TIE CV-150N.



③ CLUMP,AL-6	1 pcs
SCREW, STST SEMS P3 M4X10	1 pcs
② CLUMP,AL-4	1 pcs
SCREW, STST SEMS P3 M4X10	1 pcs

To R/F Table

6.2 Installation control cabinet parts for Oblique radiography unit. (Option)

6.2.1 Outline

Install this Parts in the control cabinet when the Oblique radiography unit is combined with R/F Table System ZS-5D/5DS.

For the setting and the adjustment refer to “ZS-5D/5DS Installation Manual”.

6.2.2 Configuration

The Oblique option for Cabinet (502-25690) consists of the following parts.

(a) OPT Kit for Cabinet(Include OPT PCB and Wire Harness)	(502-25694)
(b) RELAY, MY4 DC24V	(065-60823-11)
(c) CLUMP, PYC-A1	(070-73091-01)
(d) RELAY, TRONH/3/0.64A/UL	(065-45180-36)
(e) WIRE HARNESS, OBLIQUE	(502-25344)
(g) MAIN BODY SIGNAL CABLE B	(503-65512)
(h) OBLIQUE POWER CABLE	(503-66076)
(i) CABLE TIE, CV-150 (5Peace)	(072-60321-03)
(j) CLUMP, AL-4	(072-60376-03)
(k) CLUMP, AL-6	(072-60376-05)
(l) Mounting Parts	

NOTE

Refer to the installation of “6.3 Installation control cabinet parts for OPT Kit. (Option)”for the method of installing OPT Kit For Cabinet.

6. R/F Table System Option

① WIRE HARNESS,OBLIQUE (P/N:502-25344)

<table>
<tr><th colspan="2">MOTOR CONTROL UNIT</th><th colspan="2">WIRE HARNESS</th><th colspan="2">MOTOR CONTROL UNIT</th></tr>
<tr><td>Relay Robi</td><td>10
11
12</td><td>ROBI-10
ROBI-11
ROBI-12</td><td>RTH-5
RTH-3
RTH-1</td><td>5
3
1</td><td>Thermal Relay
Rth</td></tr>
<tr><td>Thermal Relay
Rth</td><td>2
4
6</td><td>RTH-2
RTH-4
RTH-6</td><td>CN9</td><td>CN9</td><td>Relay Connector</td></tr>
<tr><td rowspan="2">RELAY Robi</td><td rowspan="2">13
14</td><td rowspan="2">ROBI-13
ROBI-14</td><td rowspan="2">J4P</td><td colspan="2">HINGE UNIT</td></tr>
<tr><td>J4P</td><td>OPT PCB</td></tr>
</table>

② MAIN BODY SIGNAL CABLE B (P/N:503-65512)

CONTROL CABINET		CABLE		R/F Table Unit	
OPT PCB	J2P	J2P	J17B	J17B	BASE PCB

③ OBLIQUE POWER CABLE (P/N:503-66076)

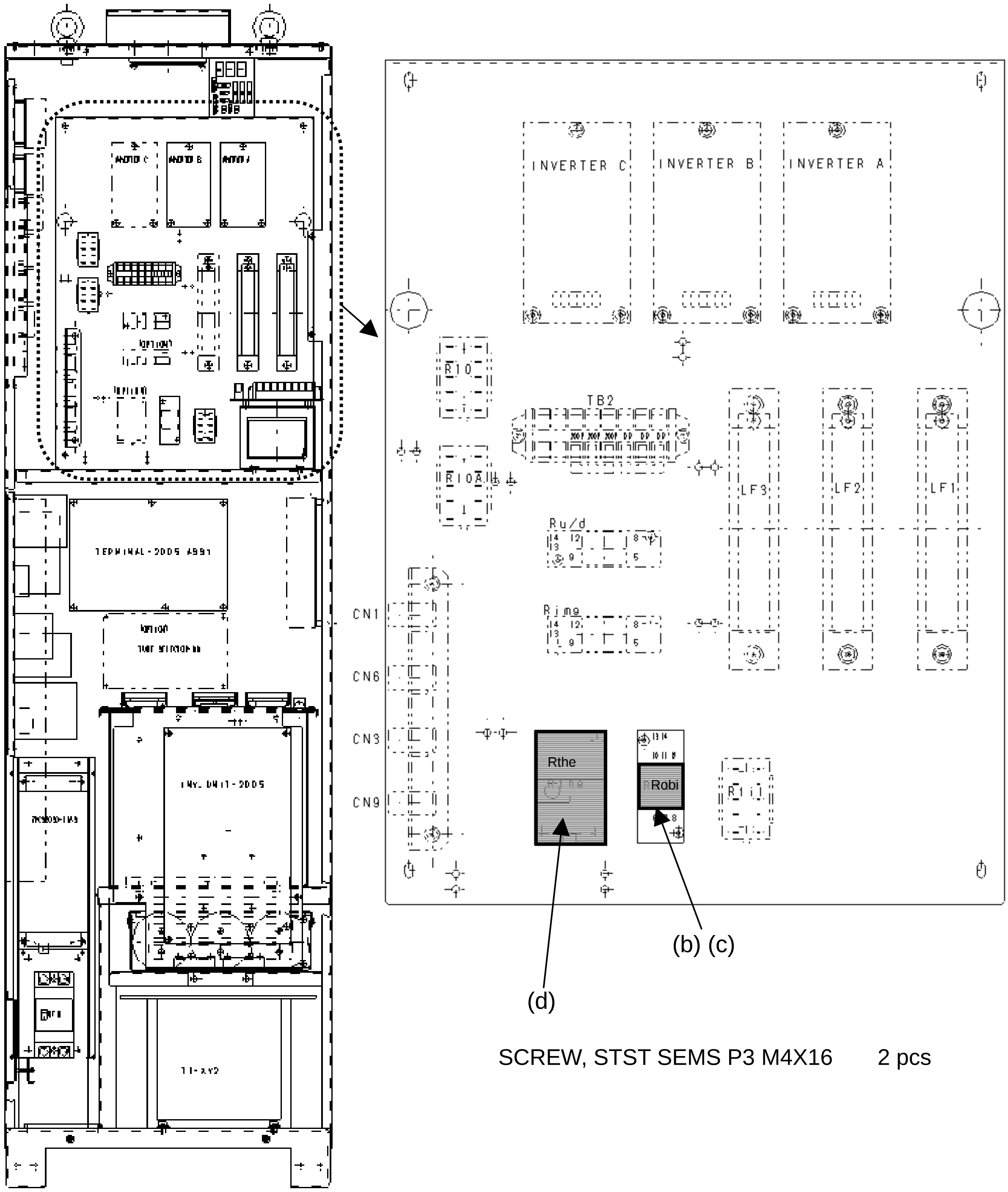
Control Cabinet		CABLE		R/F Table Unit	
MOTOR CONTROL UNIT	CN9	CN9	CN10	CN10	R/F Table Unit

6.2 Installation control cabinet parts for Oblique radiography unit. (Option)

6.2.3 Parts Installation

It installs it with a screw of the attachment in each part control cabinet.

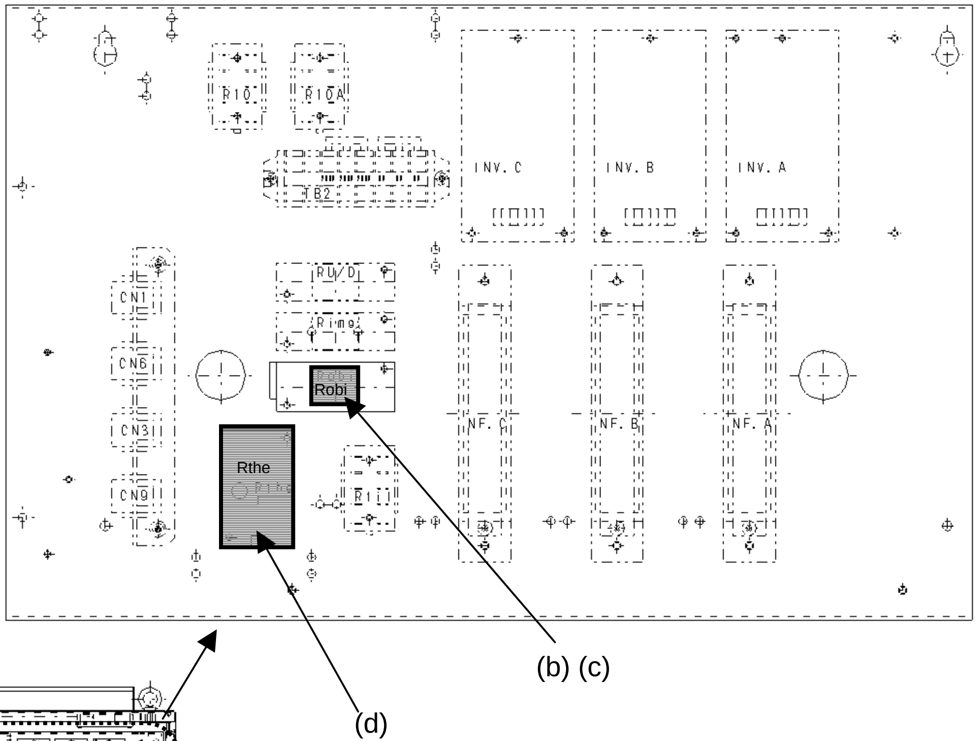
In case of ZUD-P40

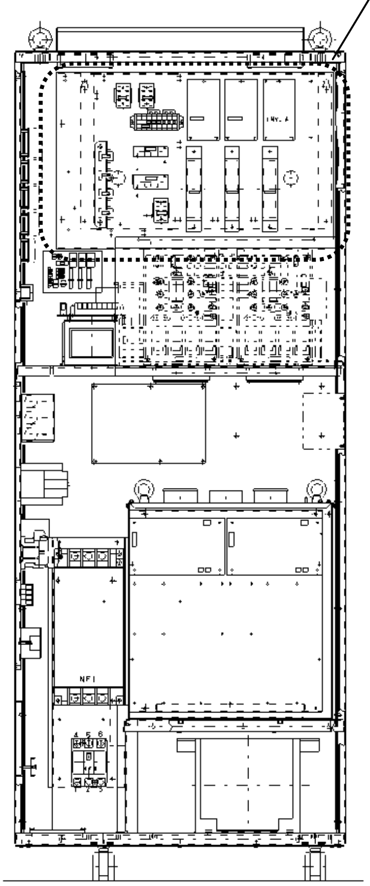


SCREW, STST SEMS P3 M4X16 2 pcs

6. R/F Table System Option

In case of ZUD-L41/L40/V40/B40



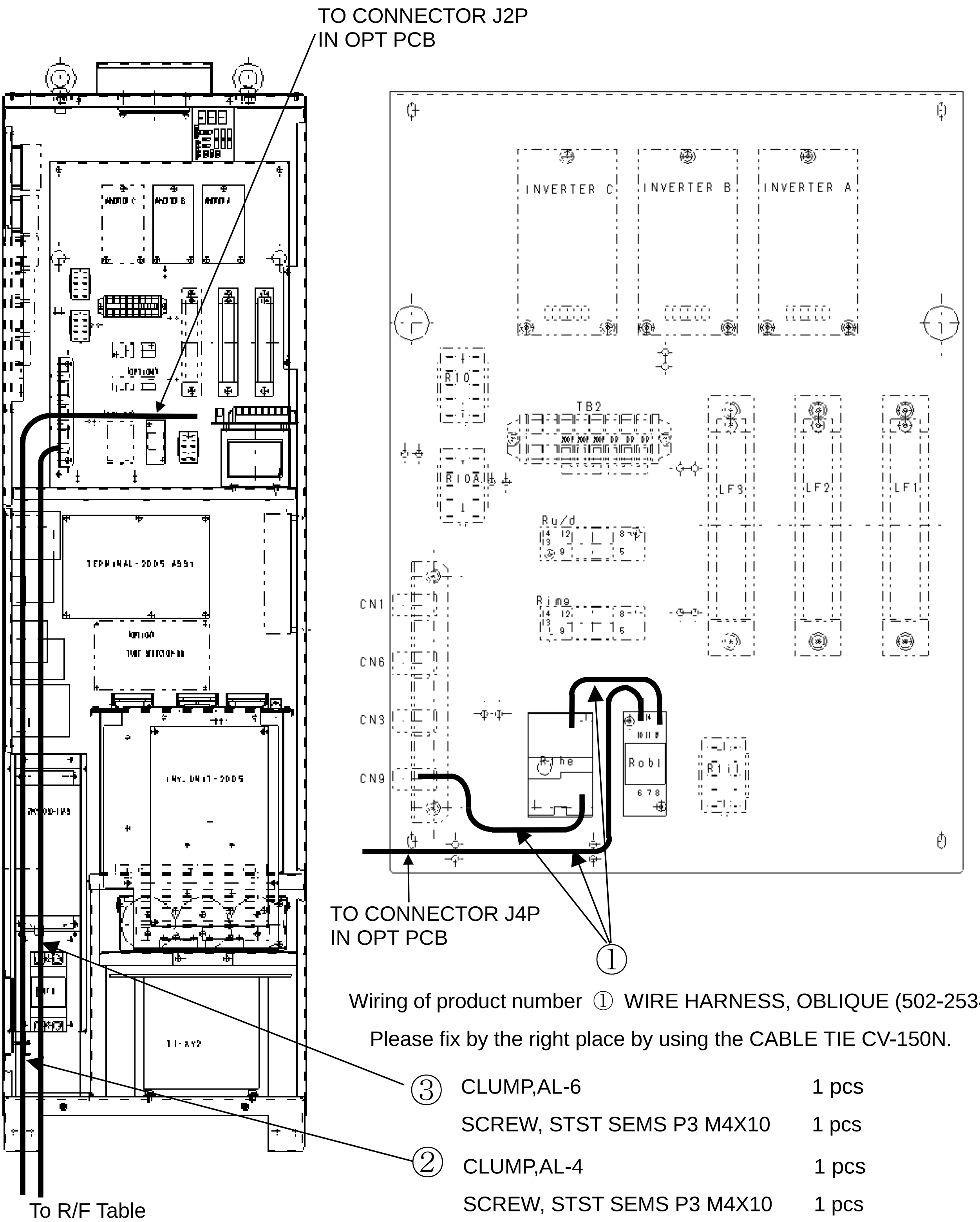


SCREW, STST SEMS P3 M4X16 2 pcs

6.2 Installation control cabinet parts for Oblique radiography unit. (Option)

6.2.4 Parts Wiring

In case of ZUD-P40



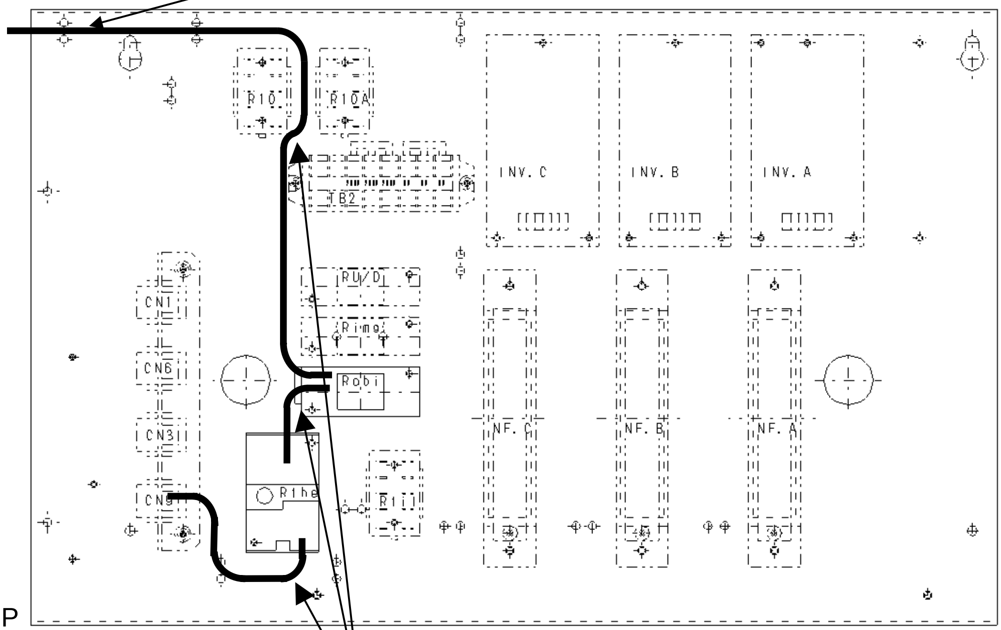
Wiring of product number ① WIRE HARNESS, OBLIQUE (502-25344).

Please fix by the right place by using the CABLE TIE CV-150N.

③	CLUMP,AL-6	1 pcs
	SCREW, STST SEMS P3 M4X10	1 pcs
②	CLUMP,AL-4	1 pcs
	SCREW, STST SEMS P3 M4X10	1 pcs

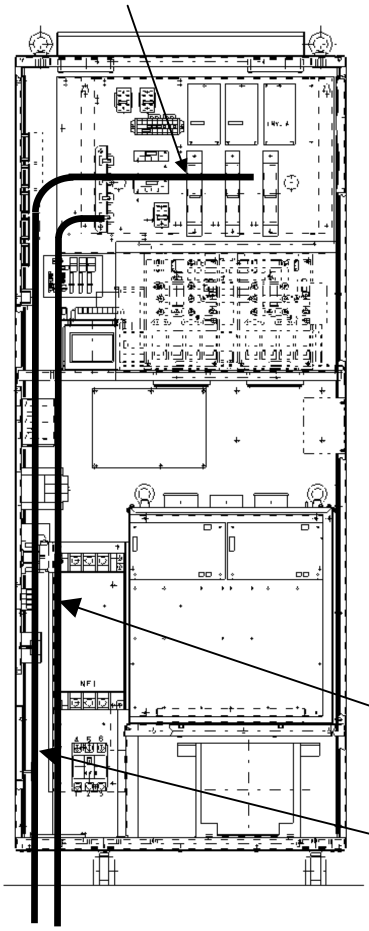
In case of ZUD-L41/L40/V40/B40

TO CONNECTOR J4P
IN OPT PCB



TO CONNECTOR J2P
IN OPT PCB

①



Wiring of product number ① WIRE HARNESS, OBLIQUE (502-25344).

Please fix by the right place by using the CABLE TIE CV-150N.

③	CLUMP,AL-6	1 pcs
	SCREW, STST SEMS P3 M4X10	1 pcs
②	CLUMP,AL-4	1 pcs
	SCREW, STST SEMS P3 M4X10	1 pcs

To R/F Table

6.3 Installation control cabinet parts for OPT Kit. (Option)

6.3.1 Outline

Install This Parts in the control cabinet when the Each Option is combined with R/F Table System ZS-5D/5DS.

・Image Speed UP Option

・Oblique Radiography Unit Option

・Rotation step Option

For the setting and the adjustment refer to “ZS-5D/5DS Installation Manual”.

6.3.2 Configuration

The OPT kit for Cabinet (502-25694) consists of the following parts.

(a) OPT PCB (502-25367)

(b) WIRE HARNESS,OPT (502-25693)

(c) CABLE TIE, CV-150N (3Peace) (072-60321-03)

(d) Mounting Parts

① WIRE HARNESS, OPT (P/N:502-25693)

In Case of SFC PCB Mounting.

HINGE UNIT		WIRE HARNESS		HINGE UNIT	
DTC PCB TERMINAL BLOCK	L100 L0	L100 L0	L100 L0	L100 L0	OPT PCB TRMINAL BLOCK

In Case of SFC PCB Not Mounting.

HINGE UNIT		WIRE HARNESS		HINGE UNIT	
SFC PCB TERMINAL BLOCK	L100 L0	L100 L0	L100 L0	L100 L0	OPT PCB TRMINAL BLOCK

NOTE

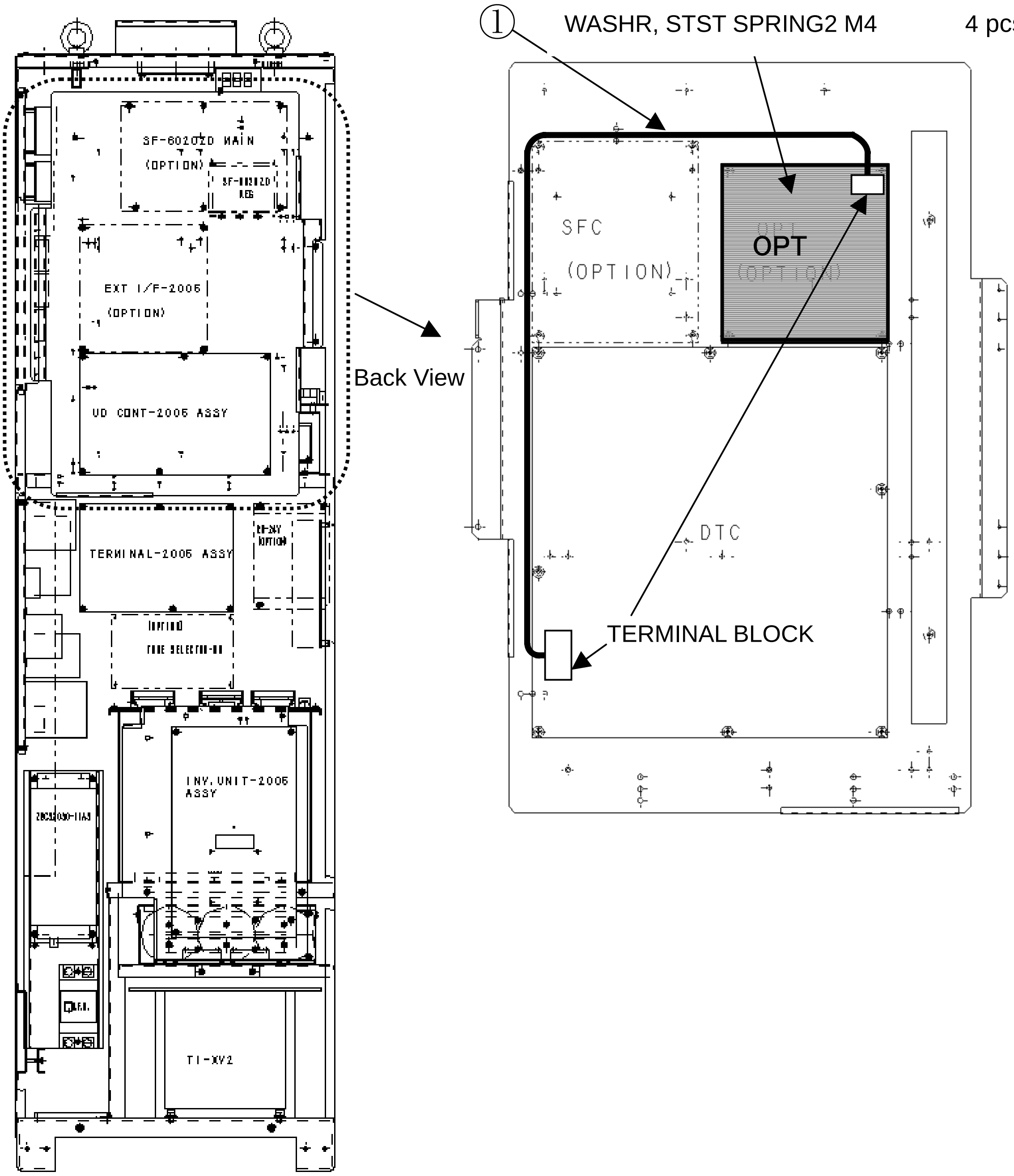
Wiring for 100V to the OPT PCB from the terminal board of the SFC PCB when the SFC PCB is installed.

6.3.3 Board OPT Installation and wiring

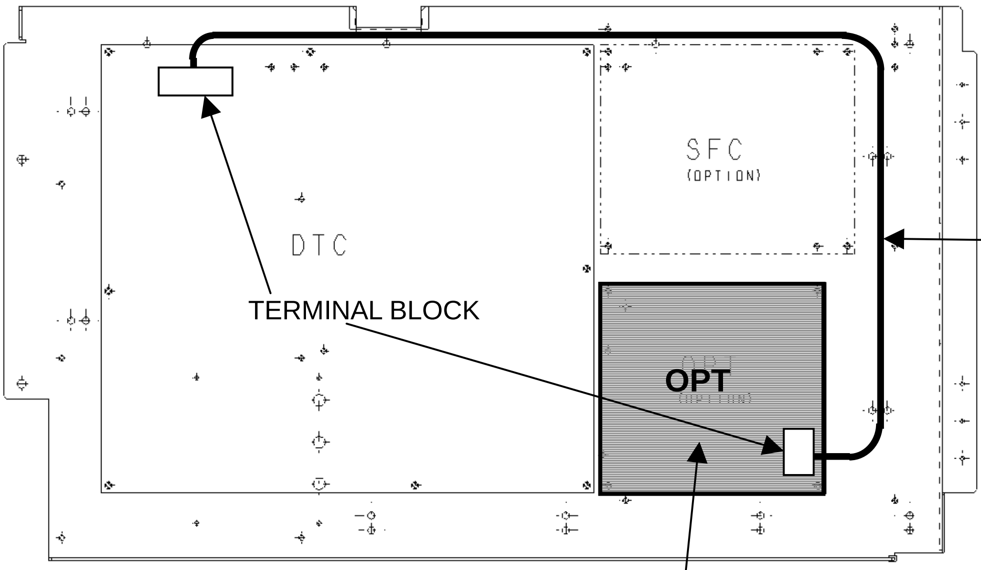
It installs it with a screw of the attachment in each part control cabinet.

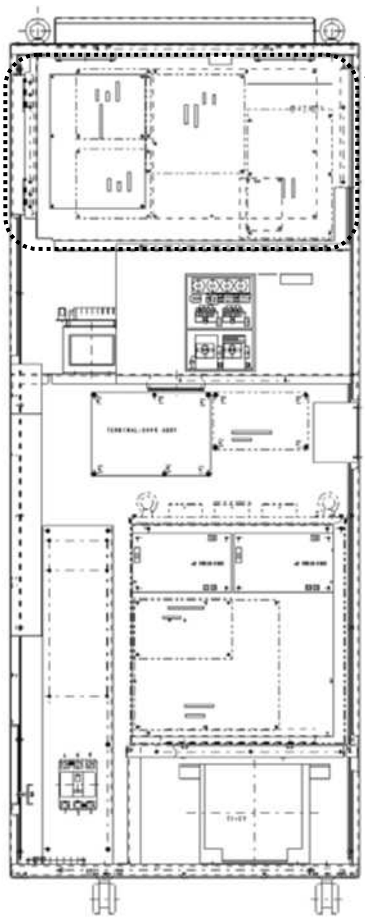
In case of ZUD-P40

SCREW, STST SEMS P3 M4X10	4 pcs
SPACER,BSF-415	4 pcs
① WASHR, STST SPRING2 M4	4 pcs



In case of ZUD-L41/L40/V40/B40





BACK VIEW

SCREW, STST SEMS P3 M4X10	4 pcs
SPACER,BSF-415	4 pcs
WASHR, STST SPRING2 M4	4 pcs

6.4 Installation control cabinet parts for Image Speed Up unit. (Option)

6.4.1 Outline

Install There Parts in the control cabinet when the Image Speed Up Option is combined with R/F Table System ZS-5D/5DS.

For the setting and the adjustment refer to “ZS-5D/5DS Installation Manual”.

6.4.2 Configuration

The IMAGE SPEED UP for Cabinet (502-25692) consists of the following parts.

(a) OPT Kit for Cabinet(Include OPT PCB and Wire Harness)	(502-25694)
(b) RELAY, MY2 DC24V	(065-60633-02)
(c) SOCKET, PYF08A	(070-73013-01)
(d) CLUMP, PYC-A1	(070-73091-01)
(e) WIRE HARNESS, IMAGE UP	(502-25342)
(f) CABEL TIE, CV-150N (5 pcs)	(072-60321-03)
(g) IMAGE SPEED UP NAME PLATE	(503-68598)
(h) Mounting Parts	

NOTE

Please refer to the installation of “6.3 Installation control cabinet parts for OPT Kit. (Option)”for the method of installing OPT Kit For Cabinet.

① WIRE HARNESS, IMAGE UP (P/N:502-25342)

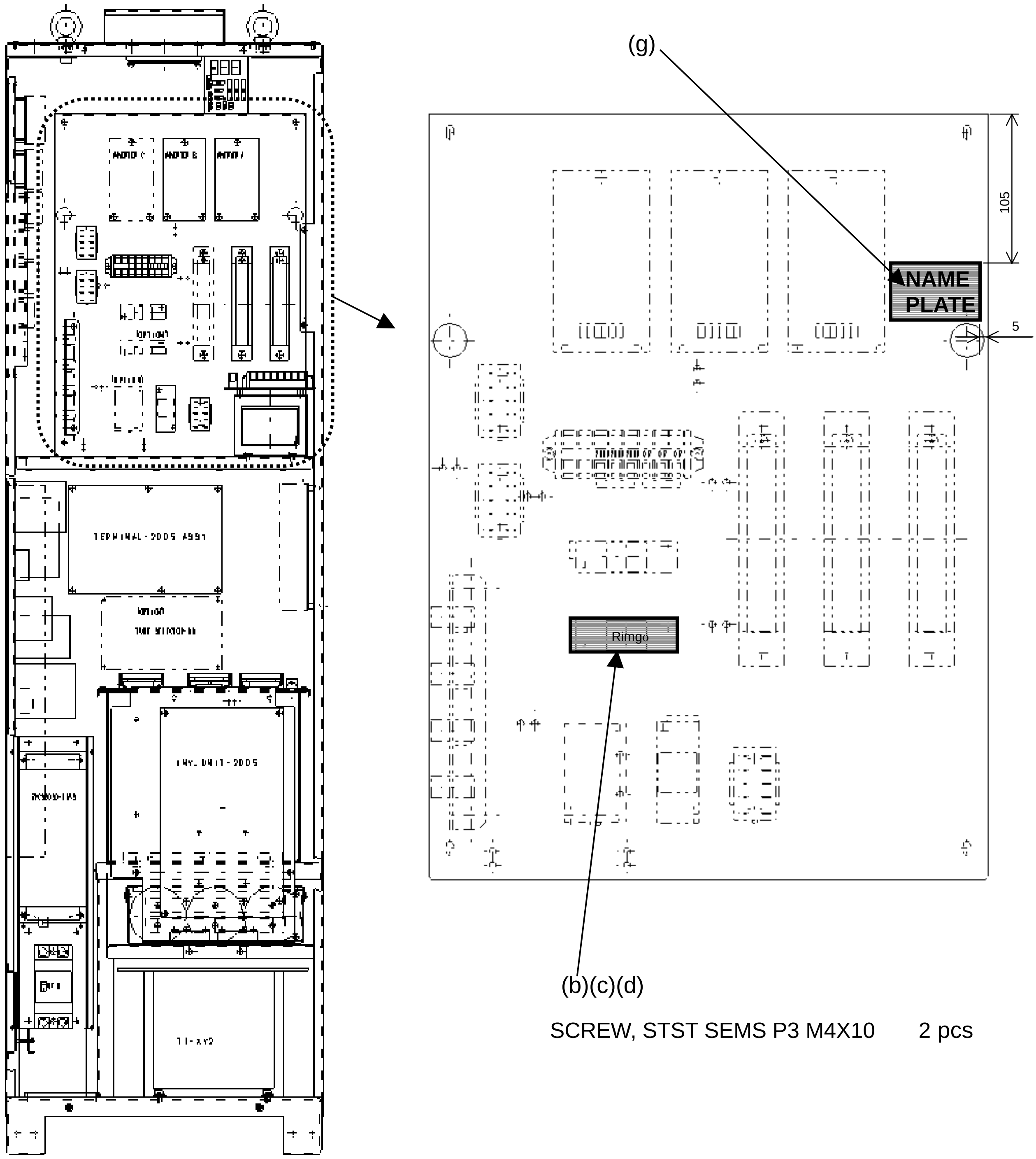
<table>
<tr><th colspan="2">MOTOR CONTROL UNIT</th><th colspan="2">WIRE HARNESS</th><th colspan="2">MOTOR CONTROL UNIT</th></tr>
<tr><td>TERMINAL BLOCK
TB2</td><td>200R
0R</td><td>200R
0R</td><td>RIMG-8
RIMG-5</td><td>8
5</td><td>RELAY
R-img</td></tr>
<tr><td>RELAY
R-img</td><td>9
12</td><td>RIMG-9
RIMG-12</td><td>CN6-5
CN6-4</td><td>5
4</td><td>RELAY
CONNECTOR</td></tr>
<tr><td rowspan="2">RELAY
R-img</td><td rowspan="2">13
14</td><td rowspan="2">RIMG-13
RIMG-14</td><td rowspan="2">J5P</td><td colspan="2">HINGE UNIT</td></tr>
<tr><td>J5P</td><td>OPT PCB</td></tr>
</table>

6.4 Installation control cabinet parts for Image Speed Up unit. (Optional)

6.4.3 Parts Installation

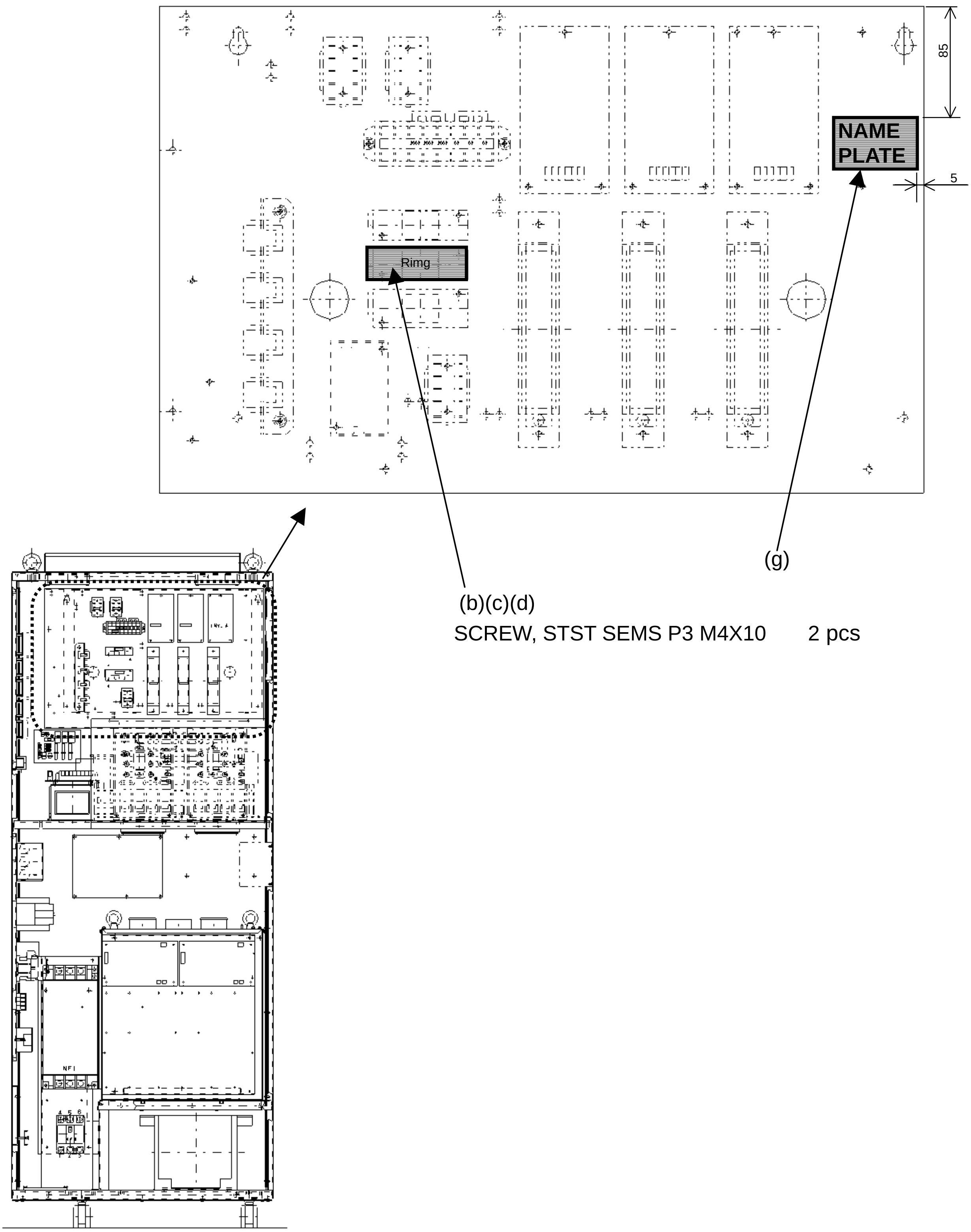
It installs it with a screw of the attachment in each part control cabinet.

In case of ZUD-P40



SCREW, STST SEMS P3 M4X10 2 pcs

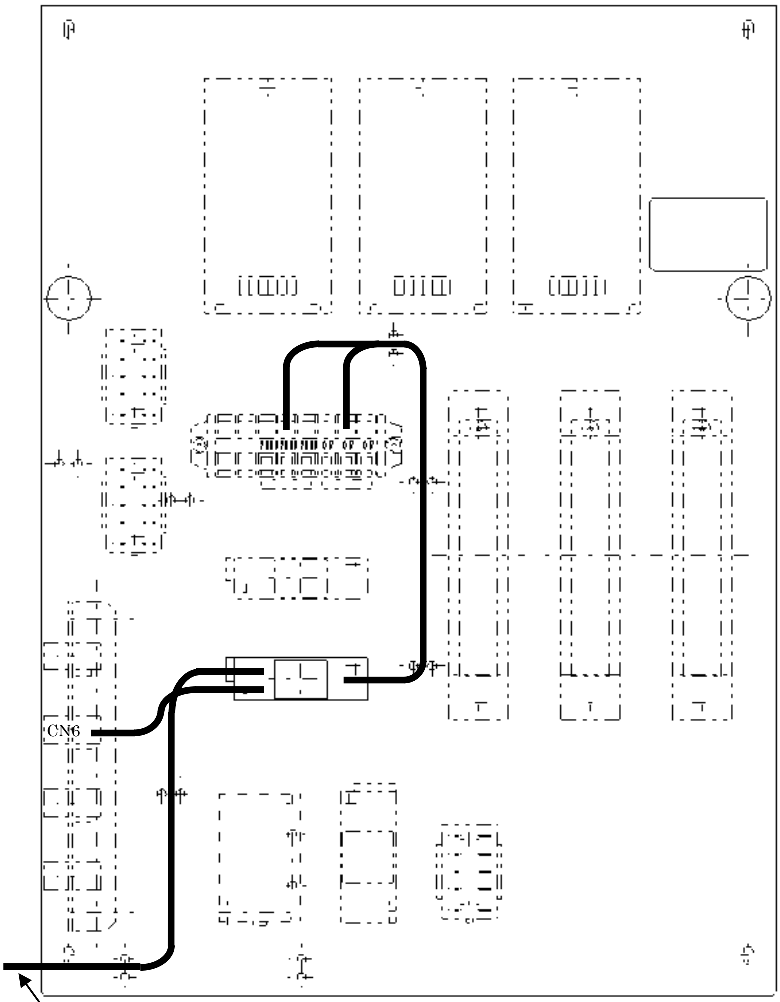
In case of ZUD-L41/L40/V40/B40



6.4 Installation control cabinet parts for Image Speed Up unit. (Optional)

6.4.4 Parts Wiring

In case of ZUD-P40



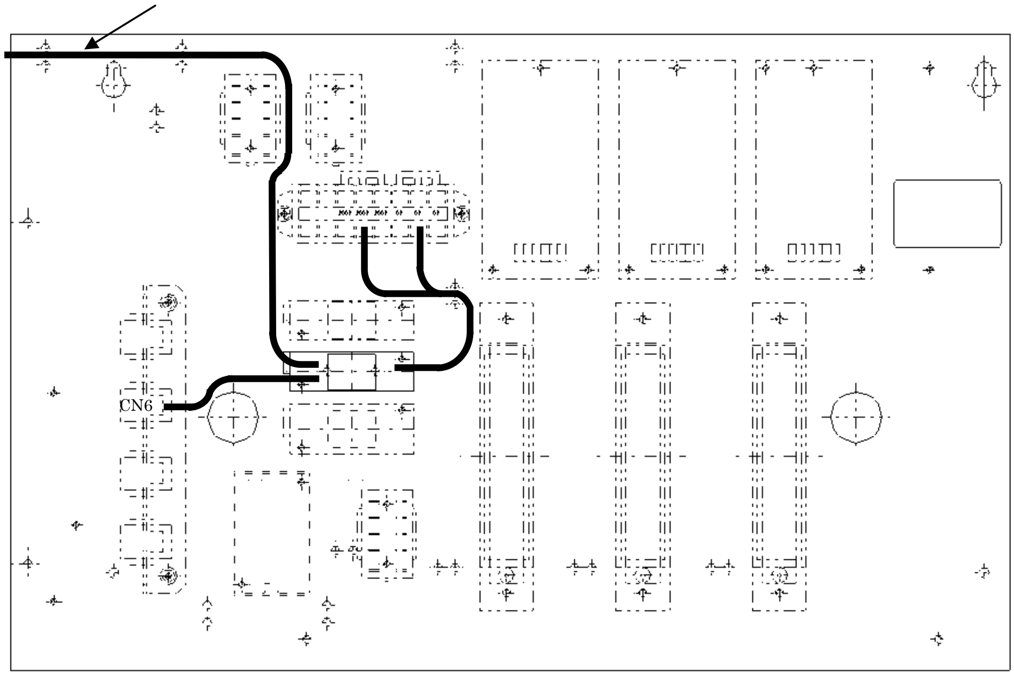
TO CONNECTOR J5P
IN OPT PCB

Wiring of product number ① WIRE HARNESS, IMAGE UP (502-25342).

Please fix by the right place by using the CABLE TIE CV-150N.

In case of ZUD-L41/L40/V40/B40

TO CONNECTOR J5P
IN OPT PCB



Wiring of product number ① WIRE HARNESS, IMAGE UP (502-25342).

Please fix by the right place by using the CABLE TIE CV-150N.

MAINTENANCE Chapter 1

M1

Detailed Adjustment Procedures

Chapter Contents

1. Detailed Adjustment Procedures

1.1 Precautions

1.1.1 Introduction

This section describes the detailed adjustment procedures for maintenance.

1.1.2 Equipment Required for the Adjustments

(1)	X-ray tube-voltage measuring instrument	(KV meter) (Calibrated within the last year)
(2)	X-ray tube-current measuring instrument	(mA mrter) (Calibrated within the last year)
(3)	Oscilloscope	(with memory function) (100MS/S, or above)
(4)	Digital voltmeter	(Abbreviated as “D.V.M.” or “tester”) (Preferably, measuring to 3 decimal places.) (with 1000V DC range)
(5)	DC ammeter	(Instrument measuring across the range 0.1mA to 1A)
(6)	Current transformer for current detection	
(7)	PC	(With RS-232C serial port or USB port.)

CAUTION

Windows XP or Windows2000 operating system.

(8)	CD-R containing adjustment software	(The adjustment software is called “ZUD-HV Maintenance Tool” below.)
(9)	RS-232C cable (cross-type) or USB cable	

1.1.3 Precautions during Adjustments

DANGER

Always turn off the unit power supply before checking or connecting the high-voltage generator or connecting or disconnecting high-voltage cables.

Calibrate the probe frequency characteristics and voltage range of the oscilloscope before starting the adjustments.

DANGER

Do not connect the GND terminal in the power plug on the oscilloscope.
Do not simultaneously measure between CH1 and CH2 with a different reference potential.

CAUTION

Turn off the power supply before inserting or removing a PCB or connecting or disconnecting a connector.

1.1.4 Connecting the Power Cable and Cables between Units

DANGER

Before connecting cables, turn off the power supply and open the knife switch or circuit breaker on the power supply unit.

To ensure safety, first connect the ground cable from the distribution board to the cabinet.
Use spring washers to ensure the terminal does not come loose.

CAUTION

When the hinged unit at the top of the cabinet is open, take care not to bang you head on it when standing up.

1.1.5 Connecting the Adjustment PC

(1) Connect the following connectors on the adjustment PC:

For RS-232C

UD CONT-2005 PCB: JMNT - PC RS-232C serial port

For USB

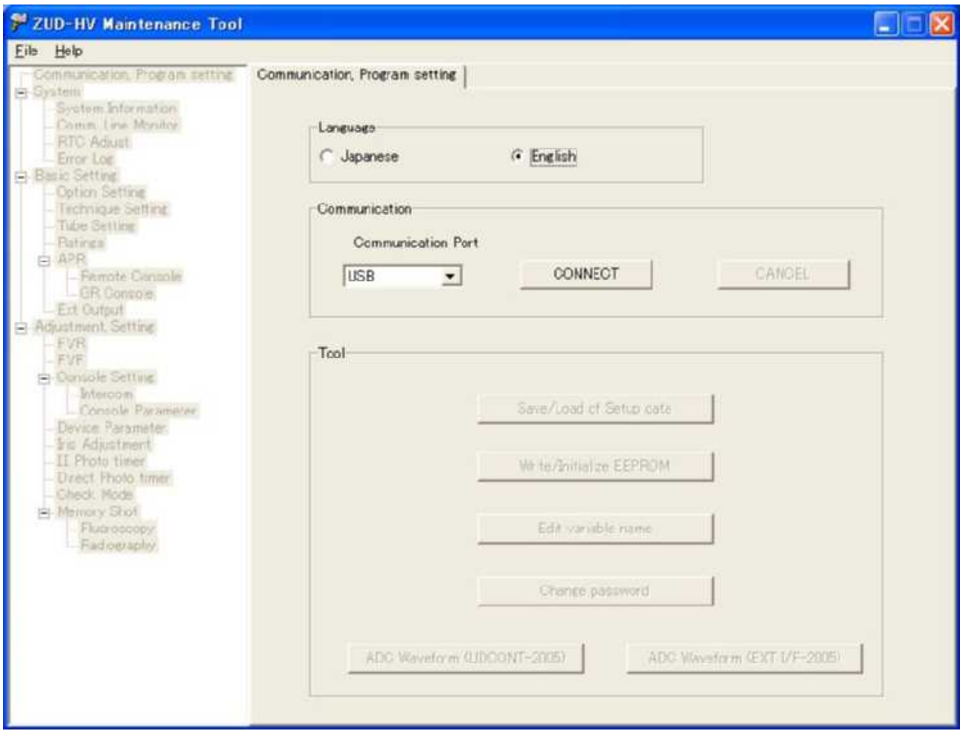
UD CONT-2005 PCB: JUSB - PC USB port

(2) Start up the ZUD-HV Maintenance Tool.

(3) The following window appears.

(4) Turn on the power.

(5) Select the appropriate connection port and then click [CONNECT].



(6) The password-entry dialog box opens.

(7) Enter the password “udcont2005” and click [OK].

(8) The connections to the adjustment PC are now complete.

CAUTION

Repeat steps (4) to (6) after turning off the system power.

Refer to installation section 4.1.2.

1.2 Turning ON Power and Checking Voltage

1.2.1 Preparations Before Turning ON the Power

1.2.1.1 ZUD-P40

(1) Make sure that the main circuit breaker is OFF.

(2) Disconnect the following connectors before turning on the power.

UD CONT-2005: JPW, JI24, JPW2
INV.UNIT-2005: JM2
TERMINAL-2005: J2 J-MGL,J9 JH3 (2-tube option only)
J11 JTH-RB, J14 JH4-1M

1.2.1.2 ZUD-L41/L40/V40/B40

(1) Make sure that the main circuit breaker is OFF.

(2) Disconnect the following connectors before turning on the power.

UD CONT-2005: JPW, JI24, JPW2
mA POWER-2002: J1, J2
TERMINAL-2005: J2 J-MGL, J8 J-MGF,
J9 JH3 (2-tube option only)
J11 JTH-RB, J14 JH4-1M

DANGER

Disconnect connector J2 J-MGL on the TERMINAL-2005 PCB in the cabinet to prevent charging of the electrolytic capacitors in the inverter unit.

This measure is important to ensure safety.

1.2.2 Turning ON Power

(1) Measure the power supply unit voltage with a circuit tester.

(2) Make the following connections according to the supply voltage.

Supply voltage		Transformer T1-XV AIN-0 terminal	Transformer T1-XV AIN-2 terminal	Transformer T2－CE T2-0 terminal	Transformer T2－CE T2-2 terminal
Three-phase, 400 V	440V ±10%	-A200	A240	-200	240
	415V ±10%	-A200	A220	-200	220
	400V ±10%	-A200	A200	-200	200
	380V ±10%	-A200	A180	-200	180

Supply voltage		Transformer T1-XV AIN-0 terminal	Transformer T1-XV AIN-2 terminal	Transformer T2－CE T2-0 terminal	Transformer T2－CE T2-2 terminal
Single-phase, 200 V	240V ±10%	A0	A240	0	240
	220V ±10%	A0	A220	0	220
	200V -5%,+10%	A0	A200	0	200

(3) Connect the D.V.M. to terminals L0 and L100 on the TERMINAL-2005 PCB.

CAUTION

The displays and LED indicators on the console do not light at this time.
Except for the [ON] lamp and [OFF] lamp.

(4) Turn on the main circuit breaker. The [OFF] lamp lights on the console.

(5) Press the [ON] button on the console. The unit power turns on. Check externally that no heating or abnormal noises are generated.

(6) Ensure that the D.V.M. connected at step (3) reads 105 V ± 5 V max. If the reading is out of range, refer to the tables above and change the T1-XV connection.

1.2.3 Voltage Check

(1) Check the voltages at the positions in the table below.

ZUD-P40

Name	Measured terminals	Voltage	Comments
TERMINAL-2005	J7 J-T2 1-2	10.5V±1V	
	J7 J-T2 4-6	105V±10V	
	J13 J-T1 5-6	18V AC±2V	
Transformer T1-XV2	L100-L0	105V AC±5V	No-load status
	135C-0C	135V AC±10V	
	A50-A0	50V AC±5V	
	A125-A0	125V AC±5V	
	200S-0S	200V AC±15V	
INV.UNIT-2005	JM2 1-3	135V AC±10V	
DC power supply UD CONT-2005	JPW 1-2 (GND)	+5V DC±50mV	PS4
	JPW 3-4 (GND)	+15V DC±400mV	PS3
	JPW 6-5 (GND)	-15V DC±400mV	PS1
	JI24 1-2 (GND)	+24V DC±600mV	PS2

ZUD-L41/L40/V40/B40

Name	Measured terminals	Voltage	Comments
TERMINAL-2005	J7 J-T2 1-2	10.5V±1V	
	J7 J-T2 4-6	105V±10V	
	J13 J-T1 5-6	18V AC±2V	
Transformer T1-XV	L100-L0	105V AC±5V	No-load status
	135C-0C	135V AC±10V	
	A50-A0	50V AC±5V	
	A125-A0	125V AC±5V	
	200S-0S	200V AC±15V	
mA POWER-2002	J1 1-3	135V AC±10V	
DC power supply UD CONT-2005	JPW 1-2 (GND)	+5V DC±50mV	PS4
	JPW 3-4 (GND)	+15V DC±400mV	PS3
	JPW 6-5 (GND)	-15V DC±400mV	PS1
	JI24 1-2 (GND)	+24V DC±600mV	PS2

DANGER

Output of the Transformer T2 voltage continues when the power is turned off at the console. When measuring the voltage, be sure to turn off the power supply and control cabinet circuit breakers before connecting a D.V.M..

(2) Turn off the power.

1.2.4 Connecting the Connectors

(1) With the power supply turned off, use a tester to confirm that ±15 V, ±24 V, and +5 V on the UD CONT-2005 PCB are not shorted to GND.

+24V - GND	JPW2 Pin (1) +24V - CP19 GND
+15V - GND	CP80 +15V - CP94 GND
-15V - GND	CP93 -15V - CP94 GND
+5V - GND	CP72 +5V - CP94 GND

(2) After these checks, connect the following connectors.

UD CONT-2005: JPW, JPW2, JI24
TERMINAL-2005: J8 J-MGF (not required for ZUD-P40)
J9 JH3
J11 JTH-RB, J14 JH4-1M

DANGER

Do not connect connector J2 J-MGL on the TERMINAL-2005 PCB.

1.2.5 Checking the Supply Voltage Detection

1.2.5.1 Connecting the D.V.M.

(1) Turn on the main circuit breaker. The [OFF] lamp lights on the console.

(2) Connect a digital voltmeter capable of measuring 100V AC to terminals L0 and L100 on the TERMINAL-2005 PCB in the control cabinet.

1.2.5.2 Measuring the Voltage

(1) Press the [ON] button on the control console to turn on the power.

(2) Check that the voltmeter indicated value enters the range 105V ± 5V about 2 seconds after the power is turned on.

(3) If the D.V.M. indicated value does not enter the range 105V ± 5V, check the connections as described in section 1.2.2.

1.2.5.3 Adjusting the Detected Voltage

(1) Start up the ZUD-HV Maintenance Tool and select [Adjustment, Setting][Device Parameter].

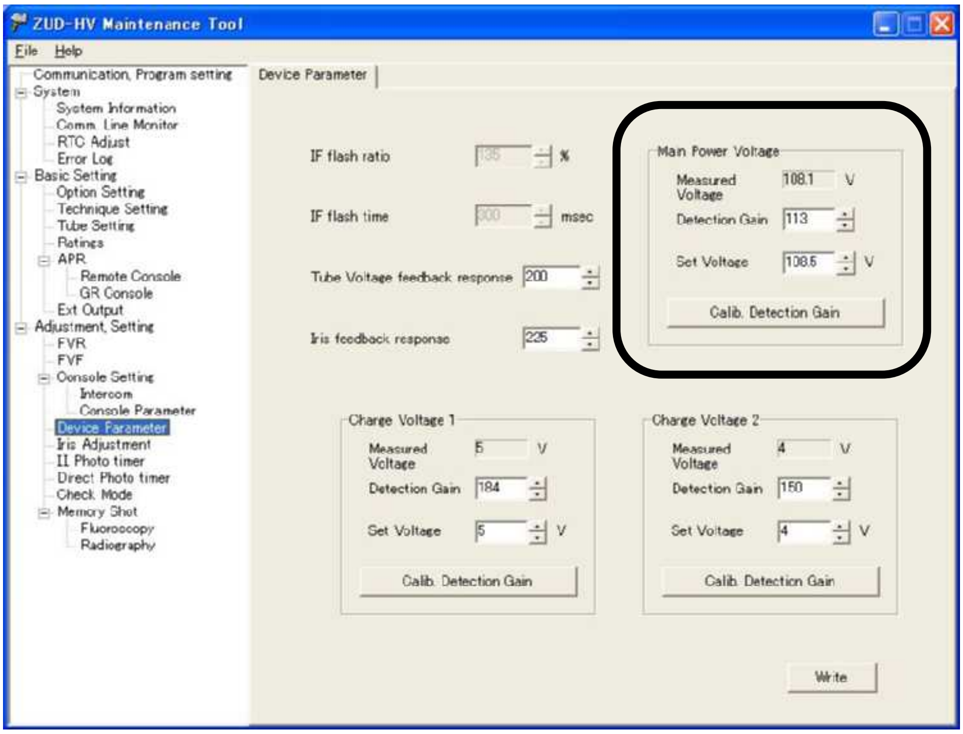
(2) Input the voltage measured at L100 with the D.V.M. in the [Set Voltage] box in the [Main Power Voltage] section.

(3) Click [Calib Detection Gain].
The [Detection Gain] value changes automatically.

(4) Check that the voltage measured at L100 is within ±5V of the [Measured voltage].

(5) Adjust the [Detection Gain] if the measured voltage does not lie in this range.

(6) Click [Write].



1. Detailed Adjustment Procedures

CAUTION

When change setting of L100 voltage, be sure to restart the device. If you don't turn off the power, setting of L100 voltage is not reflected.

1.3 Checking the Inverter Voltage Detection

1.3.1 ZUD-P40

1.3.1.1 Measuring the Charge Voltage

(1) Turn off the power and connect J2 J-MGL on the TERMINAL-2005 PCB.

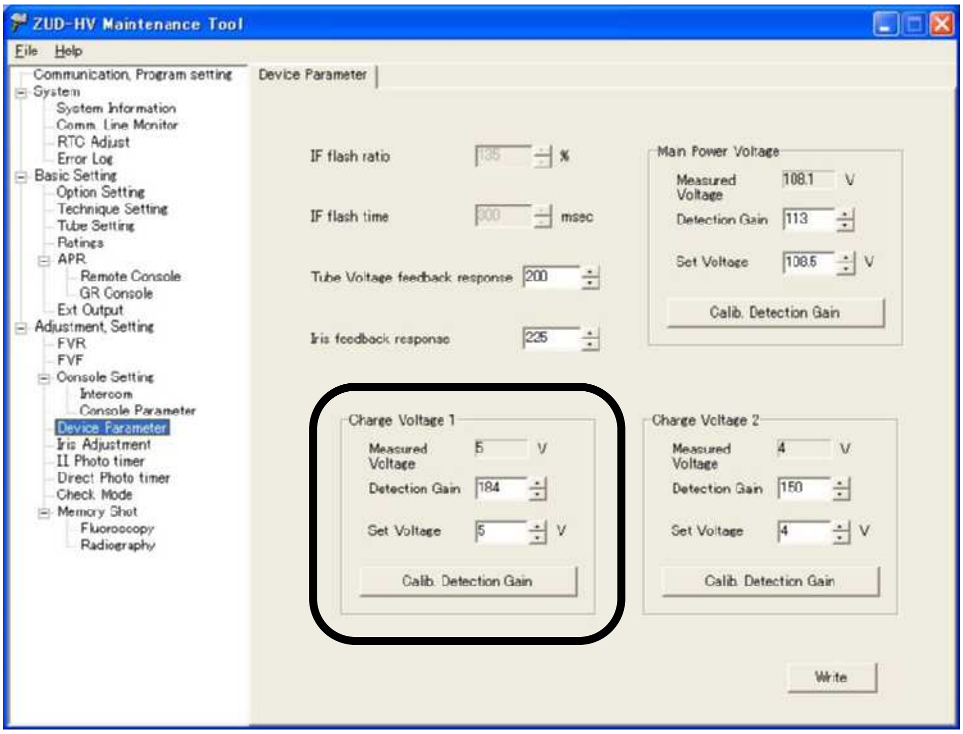
(2) Remove the protective plate from the TERMINAL-2005 PCB.

(3) Connect the D.V.M. between CP8 VC+ and CP6 VC0 on the TERMINAL-2005 PCB.

(4) Turn on the power and measure voltage with the digital voltmeter after about 20 seconds.

1.3.1.2 Adjusting the Detected Voltage

(1) Start up the ZUD-HV Maintenance Tool and select [Adjustment, Setting][Device Parameter].



(2) Input the voltage measured with the D.V.M. in the [Set Voltage] box in the [Charge Voltage 1] section.

(3) Click [Calib Detection Gain].

The [Detection Gain] value changes automatically.

(4) Check that the voltage measured with the D.V.M. is within ±5V of the [Measured voltage]

(5) Adjust the [Detection Gain] if the measured voltage does not lie in this range.

(6) Click [Write].

(7) Turn off the power.

(8) Attach the protective plate from the TERMINAL-2005 PCB.

DANGER

Do not attach the protective plate to the TERMINAL-2005 PCB until the [LD2] LED is fully turned off.

CAUTION

Only the [Charge Voltage 1] adjustment is required for ZUD-P40. Adjustment of [Charge Voltage 2] is not necessary.

1.3.2 ZUD-L41/L40/V40/B40 Series

1.3.2.1 Measuring the Charge Voltage (Positive)

(1) Turn off the power and connect J2 J-MGL on the TERMINAL-2005 PCB.

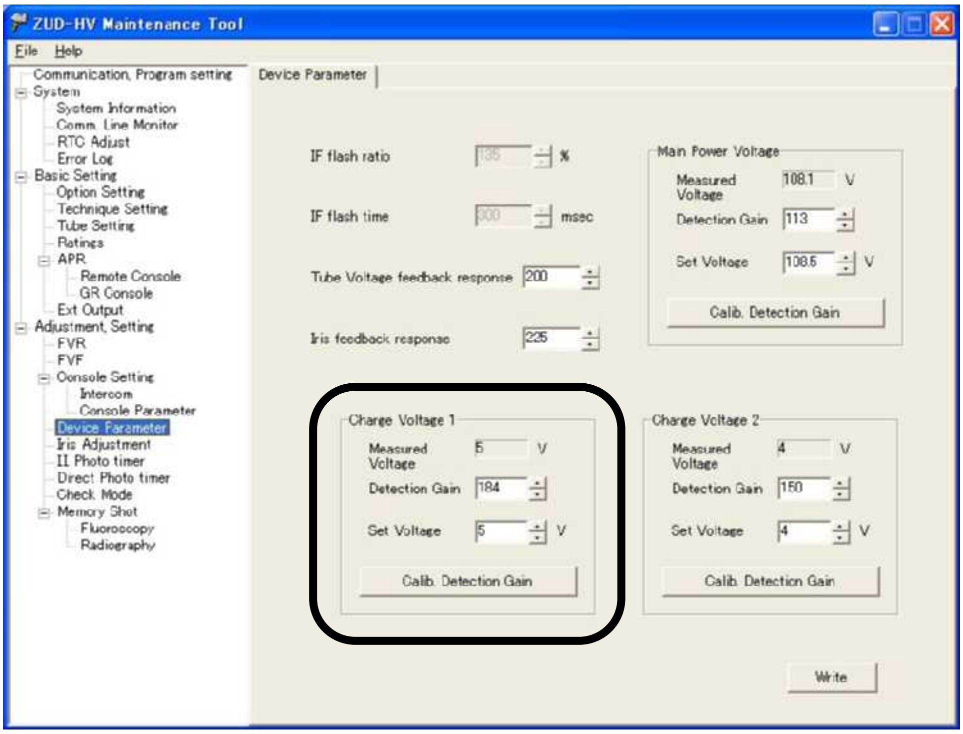
(2) Remove the protective plate from the TERMINAL-2005 PCB.

(3) Connect the D.V.M between CP8 VC+ and CP6 VC0 on the TERMINAL-2005 PCB.

(4) Turn on the power and measure voltage with the D.V.M. after about 5 seconds.

1.3.2.2 Adjusting the Detected Voltage (Positive)

(1) Start up the ZUD-HV Maintenance Tool and select [Adjustment, Setting][Device Parameter].



(2) Input the voltage measured with the D.V.M. in the [Set Voltage] box in the [Charge Voltage 1] section.

(3) Click [Calib Detection Gain].

The [Detection Gain] value changes automatically.

(4) Check that the voltage measured with the D.V.M. is within ±5V of the [Measured voltage]

(5) Adjust the [Detection Gain] if the measured voltage does not lie in this range.

(6) Click [Write].

(7) Turn off the power.

1.3.2.3 Measuring the Charge Voltage (Negative)

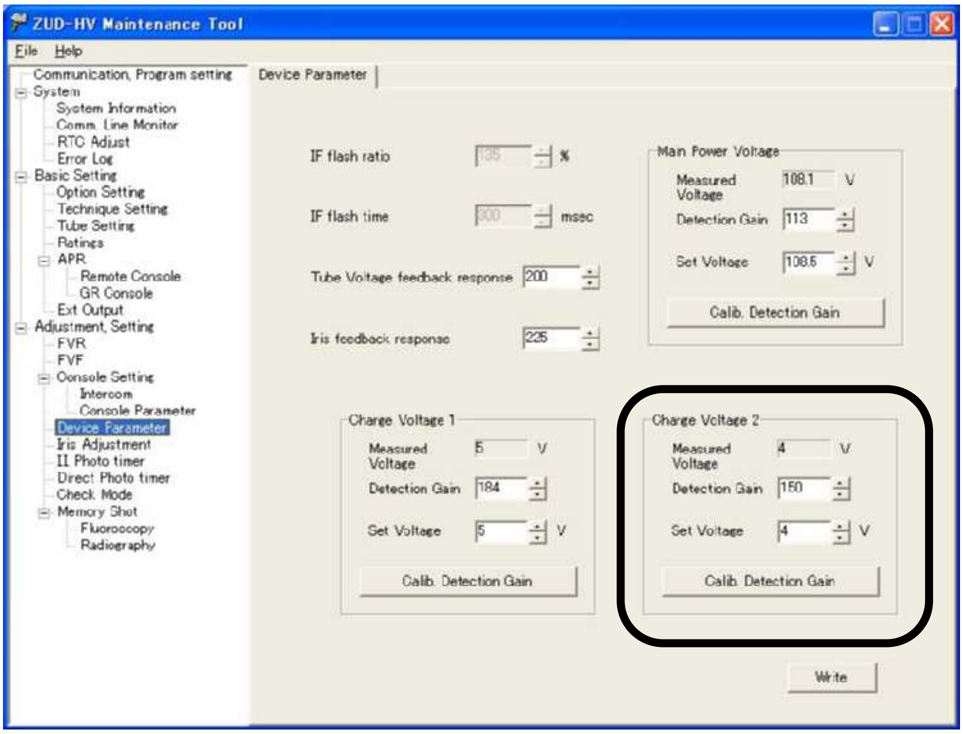
(1) With the power supply turned off, connect the D.V.M. between CP9 VC- and CP6

VC0 on the TERMINAL-2005 PCB.

(2) Turn on the power and measure voltage with the D.V.M. after about 5 seconds.

1.3.2.4 Adjusting the Detected Voltage (Negative)

(1) Start up the ZUD-HV Maintenance Tool and select [Adjustment, Setting][Device Parameter].



(2) Input the voltage measured with the D.V.M. in the [Set Voltage] box in the [Charge Voltage 2] section.

(3) Click [Calib Detection Gain].
The [Detection Gain] value changes automatically.

(4) Check that the voltage measured with the D.V.M. is within ±5V of the [Measured voltage].

(5) Adjust the [Detection Gain] if the measured voltage does not lie in this range.

(6) Click [Write].

(7) Turn off the power.

(8) Attach the protective plate from the TERMINAL-2005 PCB.

DANGER

Do not attach the protective plate from the TERMINAL-2005 PCB until the [LD2] and the [LD3] LED fully turn off.

1.4 Preparations for Test Operation (1)

With the electrolytic capacitors in the inverter unit uncharged, prepare to test the Ready and X-ray operations.
However, restore these connections if they are not required for subsequent adjustments.

1.4.1 ZUD-P40

(1) Turn off the power.
(2) Disconnect connector J2 J-MGL on the TERMINAL-2005 PCB.
(3) Disconnect JS1 on the UD CONT-2005 PCB.
(4) Disconnect JM2 (135V AC) on the INV.UNIT-2005 PCB.
(5) Turn on the power.
(6) Select general radiography on the console.

1.4.2 ZUD-L41/L40/V40/B40

(1) Turn off the power.
(2) Disconnect connector J2 J-MGL on the TERMINAL-2005 PCB.
(3) Disconnect JS1 on the UD CONT-2005 PCB.
(4) Disconnect J1, J2 (135V AC) on the mA POWER-2002 PCB.
(5) Turn on the power.
(6) Select general radiography on the console.

1.5 Checking the X-ray tube Filament Heating Circuit

1.5.1 Checking the Pulsed Output for the Heating Setting

(1) Make sure that the preparations for test operation (1) have been completed. (refer to section 1.4.)

(2) Make the following connections on the oscilloscope:

CH1: UD CONT-2005 CP24 [Q1-4L] - CP19 [GND]

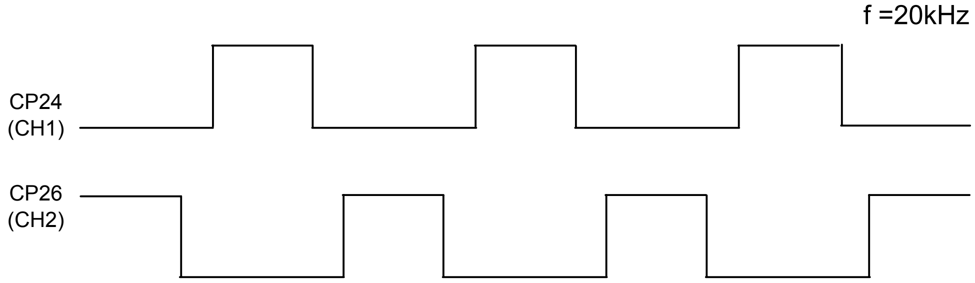
CH2: UD CONT-2005 CP26 [Q2-3L] - CP19 [GND]

(3) Turn on the power.

(4) Select general radiography on the console.

(5) Select the large focus on the console.

(6) Make sure that the pulse outputs at CP24 [Q1-4L] and CP26 [Q2-3L] on the UD CONT-2005 PCB appear as shown below. (Confirm that CP24 and CP26 do not overlap on the high side.)



Oscilloscope setting:
5V/div 20μsec/div

1.5.2 Checking the Power Circuit

1.5.2.1 ZUD-P40

(1) Make sure that the preparations for test operation (1) have been completed. (See section 1.4.)

(2) Provide an imitation filament or a 2Ω to 3Ω resistance (200W min.).

(3) Insert the high-voltage cable into the Tube 1 high-voltage socket (–) on the high-voltage generator.

(4) Connect the imitation filament or resistance between the C and L, or C and S pins at the other end of the high-voltage cable.

(5) Connect [JM2] (135V AC) on the INV.UNIT-2005 PCB.

(6) Make the following connections on the oscilloscope:

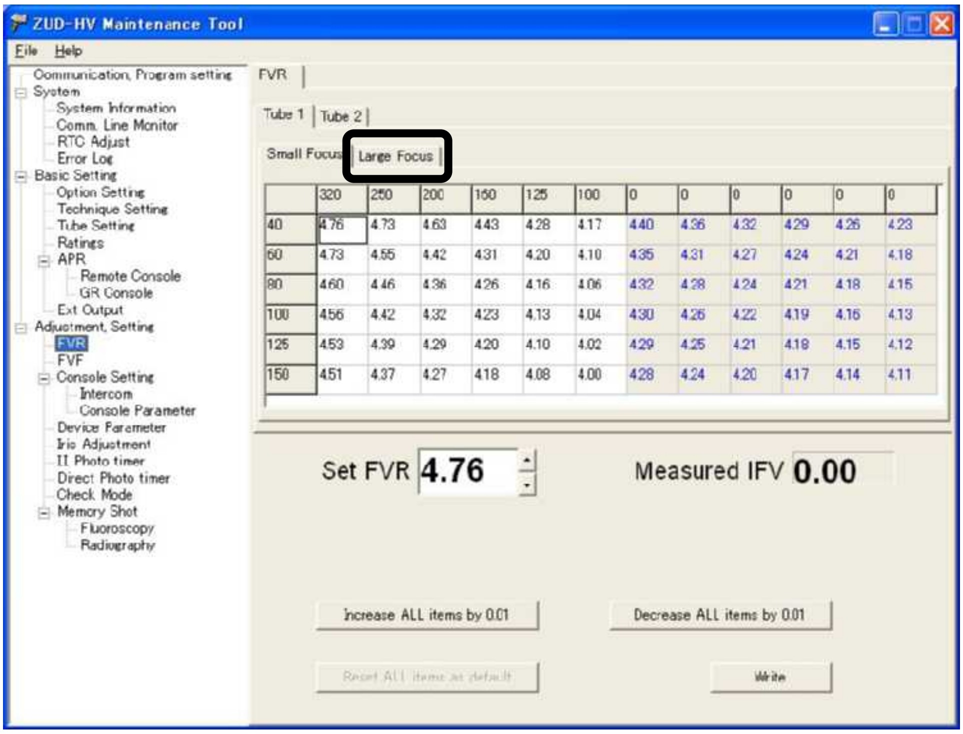
CH1: INV.UNIT-2005 CP9 [CL] - CP10 [CO]

(7) Turn on the power.

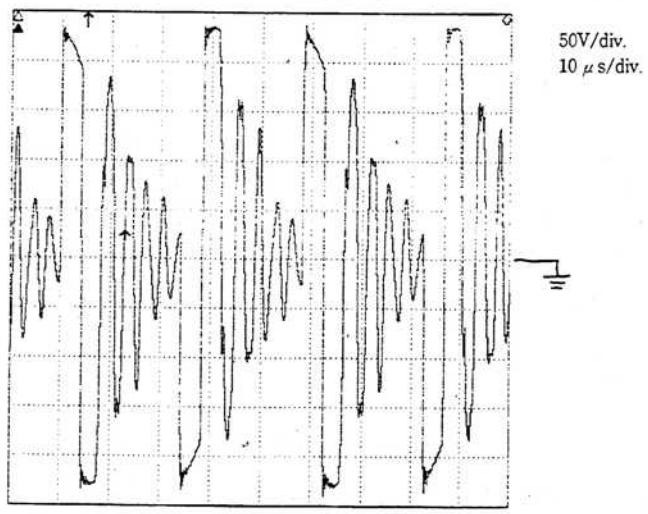
(8) Start up the ZUD-HV Maintenance Tool and select [Adjustment, Setting][FVR].

1.5 Checking the X-ray tube Filament Heating Circuit

(9) Select [Large Focus] tab.



(10) Check that the oscilloscope waveform appears as shown in the diagram below.



(11) Make sure that the UD CONT-2005 CP76 $\boxed{\text{IFV-L}}$ voltage value is approximately 35% the value displayed for [Measured IFV] in the ZUD-HV Maintenance Tool. For example, approximately 1.75 V is indicated if the setting is 5 A.

(12) After the Ready operation, make sure that the UD CONT-2005 CP76 $\boxed{\text{IFV-L}}$ voltage value is approximately equal to the value displayed for [Set FVR] in the ZUD-HV Maintenance Tool.

1.5.2.2 ZUD-L41/L40/V40/B40

(1) Make sure that the preparations for test operation (1) have been completed. (refer to 1.4.)

(2) Provide an imitation filament or a 2Ω to 3Ω resistance (200 W min.).

(3) Insert the high-voltage cable into the Tube 1 high-voltage socket (–) on the high-voltage generator.

(4) Connect the imitation filament or resistance between C and L, or C and S pins at the other end of the high-voltage cable.

(5) Connect J1 (135V AC) on both the mA POWER-2002 PCBs.

(6) Make the following connections on the oscilloscope:

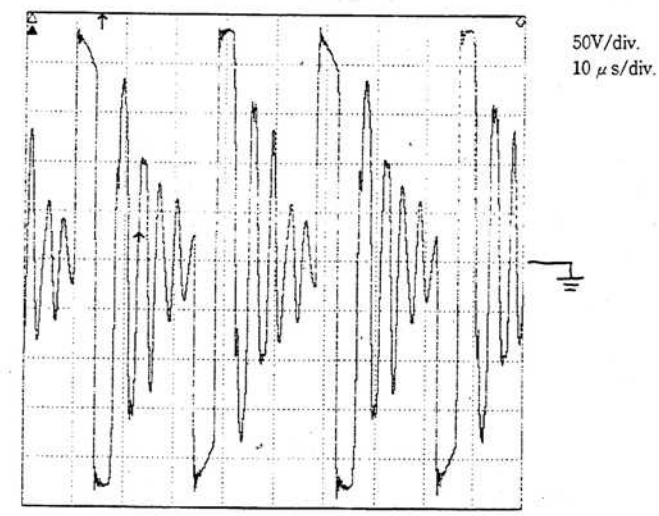
CH1: mA POWER-2002(LARGE) CP9 CL - CP10 CO

(7) Turn on the power.

(8) Start up the ZUD-HV Maintenance Tool and select [Adjustment, Setting][FVR].

(9) Select the [Large Focus] tab.

(10) Check that the oscilloscope waveform appears as shown in the diagram below.



(11) Make sure that the UD CONT-2005 CP76 IFV-L voltage value is about 35% the value displayed for [Measured IFV] in the ZUD-HV Maintenance Tool. For example, approximately 1.75V is indicated if the setting is 5A.

(12) After the Ready operation, make sure that the UD CONT-2005 CP76 IFV-L voltage value is approximately equal to the value displayed for [Set FVR] in the ZUD-HV Maintenance Tool.

(13) Turn off the power.

(14) Make the following connections on the oscilloscope:

CH1: mA POWER-2002(SMALL) CP9 CL - CP10 CO

(15) Turn on the power.

(16) Start up the ZUD-HV Maintenance Tool and select [Adjustment, Setting][FVR].

(17) Select the [Small Focus] tab.

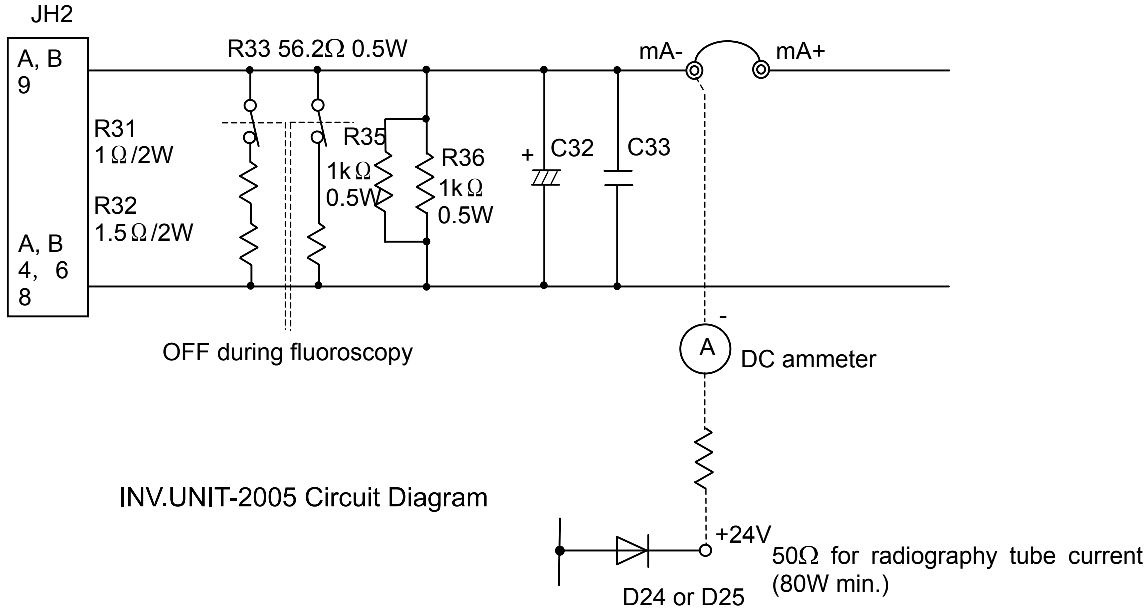
(18) Make the checks described in steps (10) to (12). (However, CP82 IFV-S voltage value should be about 35% the value displayed for [Measured IFV] in the ZUD-HV Maintenance Tool.)

1.5.3 Adjusting the Measured Tube Current System

1.5.3.1 ZUD-P40

(1) Make sure that the preparations for test operation (1) have been completed. (See section 1.4.)

(2) Connect a 50Ω resistance (80W min.) and DC ammeter (1A range) across the cathode of diode D24 or D25 and the terminal mA– on the INV.UNIT-2005 PCB.



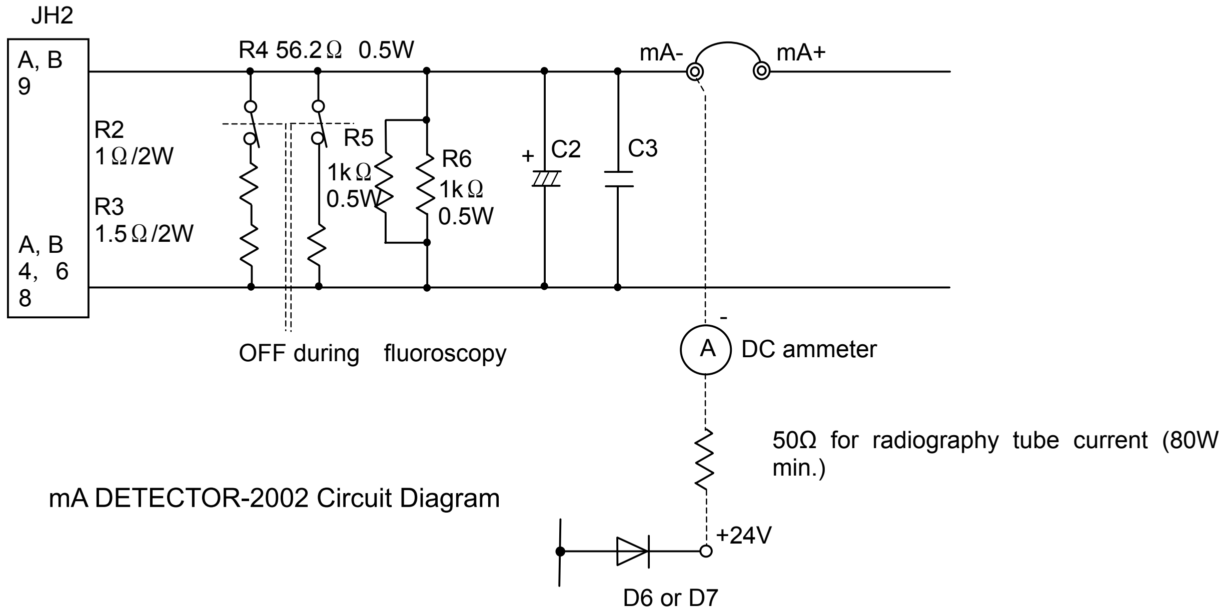
INV.UNIT-2005 Circuit Diagram

(3) Adjust VR1 MAM ADJ so that the voltage at CP48 TMA on the UD CONT-2005 PCB corresponds to the value indicated by the DC ammeter (connected at step 2) at the rate of 5 V/1000 mA. As a current of approximately 480 mA flows under the conditions set at step 2, adjust the voltage at CP48 TMA to 2.4V. (allowable error: ±0.05V)

1.5.3.2 ZUD-L41/L40/V40/B40

(1) Make sure that the preparations for test operation (1) have been completed. (refer to 1.4.)

(2) Connect a 50Ω resistance (80W min.) and DC ammeter (1A range) across the cathode of diode D6 or D7 and the terminal [mA–] on the mA DETECTOR-2002 PCB as shown in the diagram below.



mA DETECTOR-2002 Circuit Diagram

(3) Adjust VR1 [MAM ADJ] so that the voltage at CP48 [TMA] on the UD CONT-2005 PCB corresponds to the value indicated by the DC ammeter (connected at step 2) at the rate of 5V/1000mA. As a current of approximately 480 mA flows under the conditions set at step 2, adjust the voltage at CP48 [TMA] to 2.4V. (allowable error: ±0.05V)

1.6 Checking Main Inverter Operation

CAUTION

The maximum oscillation frequency differs for ZUD-P40 and ZUD-L41/L40/V40/B40.

	ZUD-P40	ZUD-L41 ZUD-L40 ZUD-V40 ZUD-B40
Section of reference	**1.6.1**	**1.6.2**
Maximum oscillation frequency [kHz]	**112**	**90**
Gate pulse amplitude (5V cross) [μs]	**7.9**	**10.0**

Always click [Write] after making adjustments with the ZUD-HV Maintenance Tool.

1.6.1 ZUD-P40

(1) Make sure that the preparations for test operation (1) have been completed. (refer to 1.4.)

(2) Make the following connections on the oscilloscope probe:

CH1: UD CONT-2005 CP25 B/C - CP19 GND

CH2: UD CONT-2005 CP32 A/D - CP19 GND

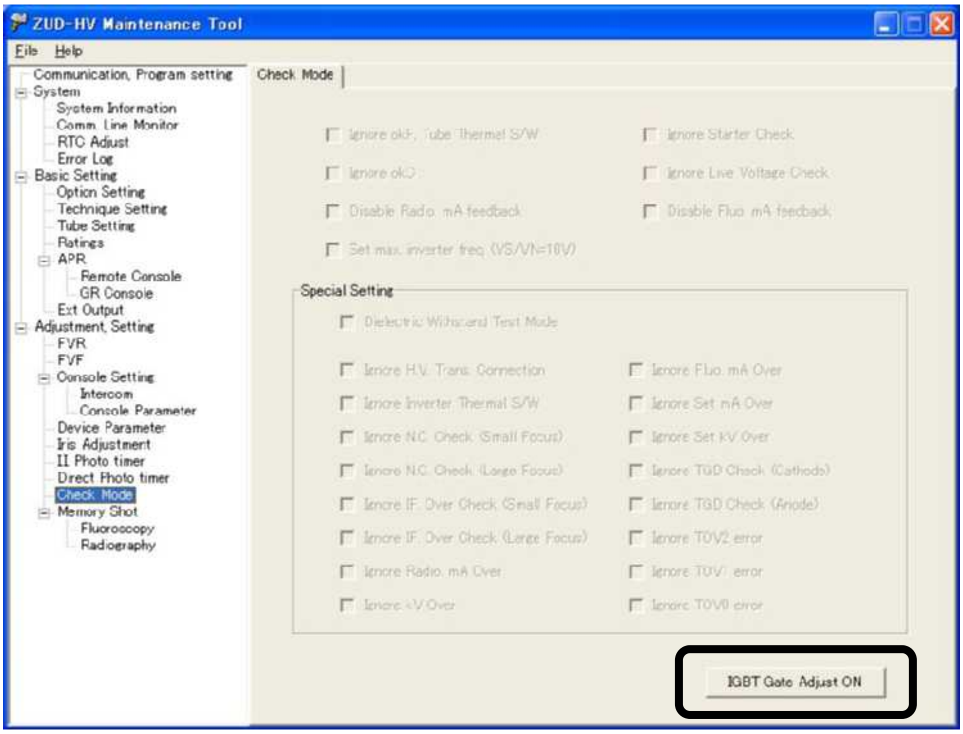
(3) Make sure that J2 JMGL on the TERMINAL-2005 PCB is not connected.

(4) Connect the adjustment PC and turn it on.

If the error occurs, restart ZUD-HV Maintenance Tool.

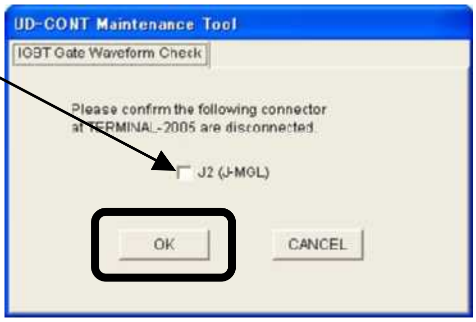
(5) Select general radiography on the console.

(6) Open the ZUD-HV Maintenance Tool [Check Mode] window and click [IGBT Gate Adjust ON].

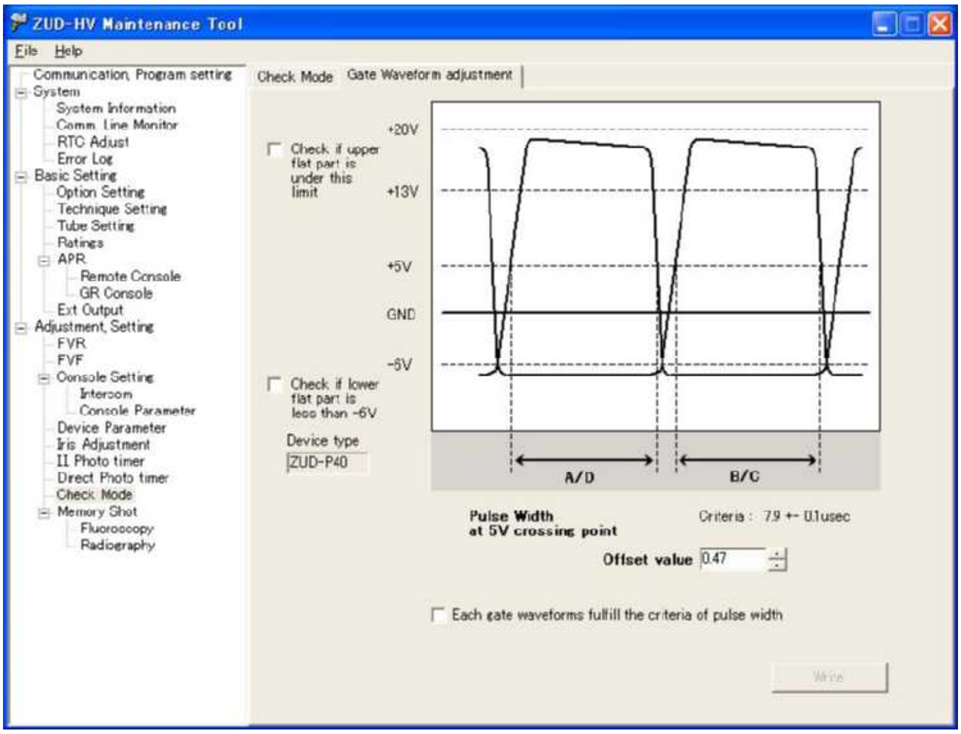


(7) When the following dialog box appears, make sure that the connector J2 [J-MGL] on the TERMINAL-2005 PCB is disconnected, put a check in the checkbox, and click [OK].

Check this box

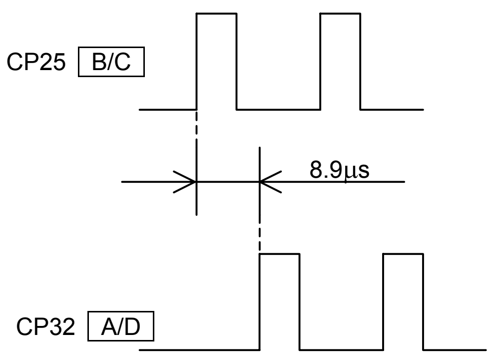


(8) The following screen appears.



(9) Check the frequency.

Conduct the Ready and X-ray operations and confirm that the interval between the CP25 B/C leading edge and CP32 A/D leading edge is 8.9μs(112kHz).



(10) Check that the signals are output alternately, as shown in the diagram above.

(11) Next, adjust the gate waveform.

(12) Turn off the power.

(13) Remove the insulating plate from the INV.UNIT-2005 PCB.

(14) Make the following connections on the oscilloscope:

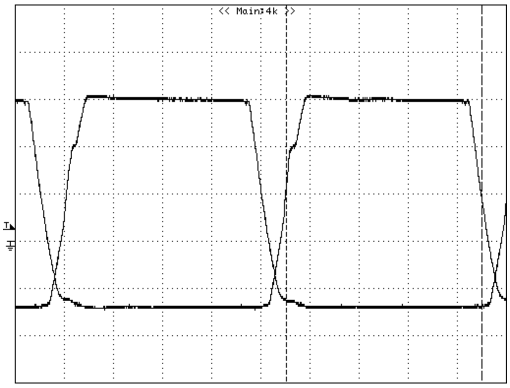
CH1: INV.UNIT-2005 CP3 $\boxed{Gc}$ - CP4 $\boxed{Ec}$ (GND)

CH2: INV.UNIT-2005 CP1 $\boxed{Ga}$ - CP2 $\boxed{Ea}$ (GND)

(15) Turn on the power.

(16) Conduct steps (5) to (8) above.

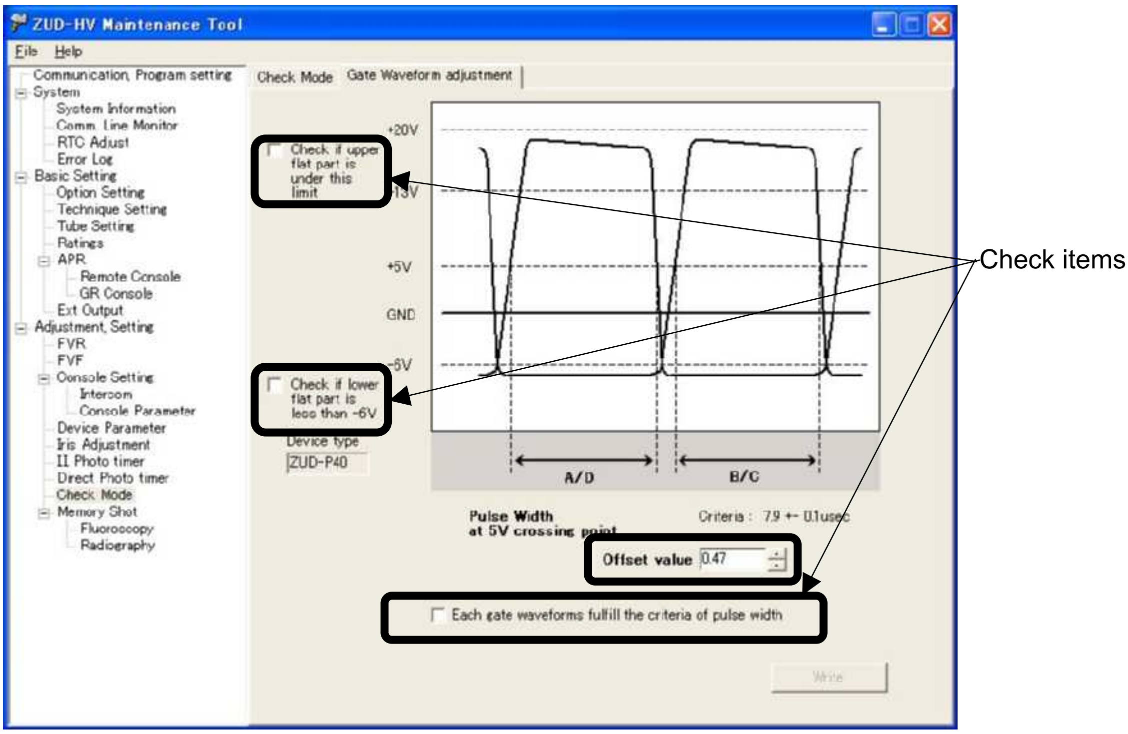
(17) Conduct the Ready and X-ray operations and observe the gate waveform after it reaches steady state. (It reaches steady state 0.1 sec after the X-ray operation.)



Oscilloscope settings	CH1:5V/div CH2:5V/div
	2 µsec/div
	Normal Trigger

(18) Use a imitation exposure (hand switch operation) to measure the width at 5V. Change the [Offset Value] to bring the width to 7.9 ± 0.1µsec.

The larger the [Offset Value], the greater the pulse width.



(19) If the measured results are OK, check that:

the flat sections are in range;

the lower flat parts do not exceed –6 V.

Check all three checkboxes and then click [Write]. The [Write] button becomes enabled when the checkboxes are checked.

(20) Turn off the power.

(21) Make the following connections on the oscilloscope:

CH1:	INV.UNIT-2005	CP7 Gd - CP8 Ed	(GND)
CH2:	INV.UNIT-2005	CP5 Gb - CP6 Eb	(GND)

(22) Conduct steps (15) to (18) and check that the width at 5 V is 7.9 ± 1μs.

1.6.2 ZUD-L41/L40/V40/B40

(1) Make sure that the preparations for test operation (1) have been completed. (See section 1.4.)

(2) Make the following connections on the oscilloscope:

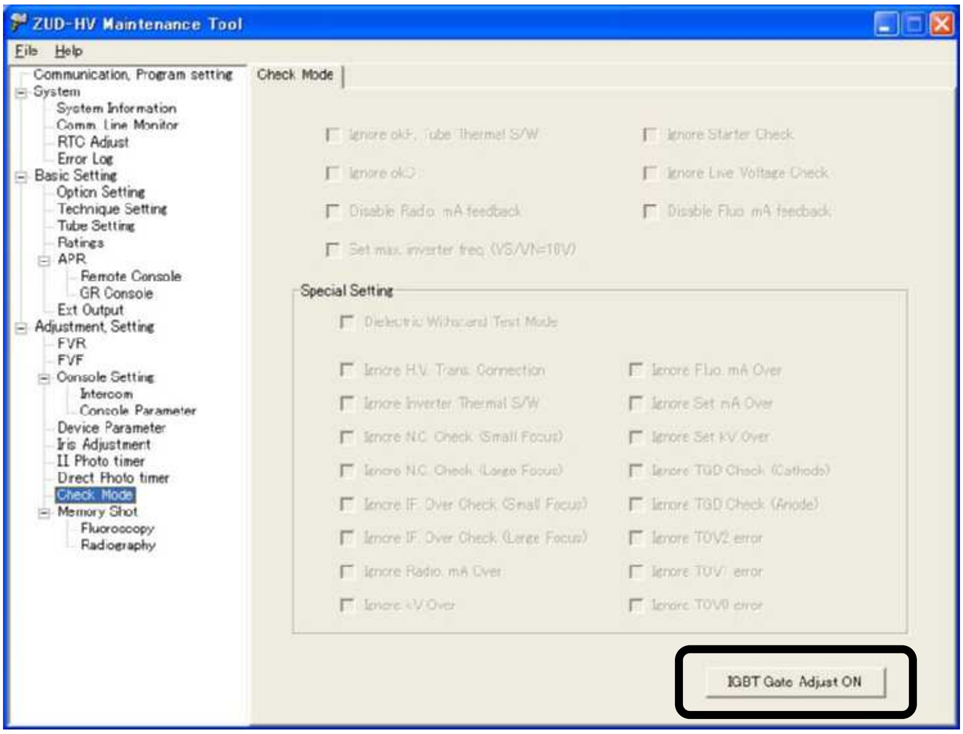
CH1: UD CONT-2005 CP25 B/C - CP19 GND

CH2: UD CONT-2005 CP32 A/D - CP19 GND

(3) Make sure that J2 JMGL on the TERMINAL-2005 PCB is not connected.

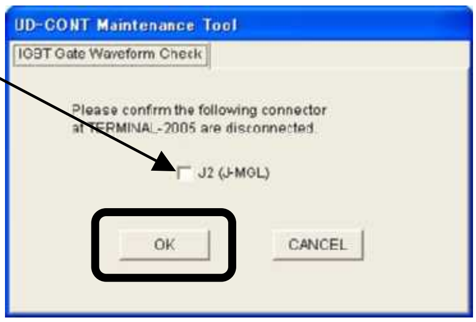
(4) Connect the adjustment PC and turn it on.

(5) Open the ZUD-HV Maintenance Tool [Check Mode] window and click [IGBT Gate Adjust ON].

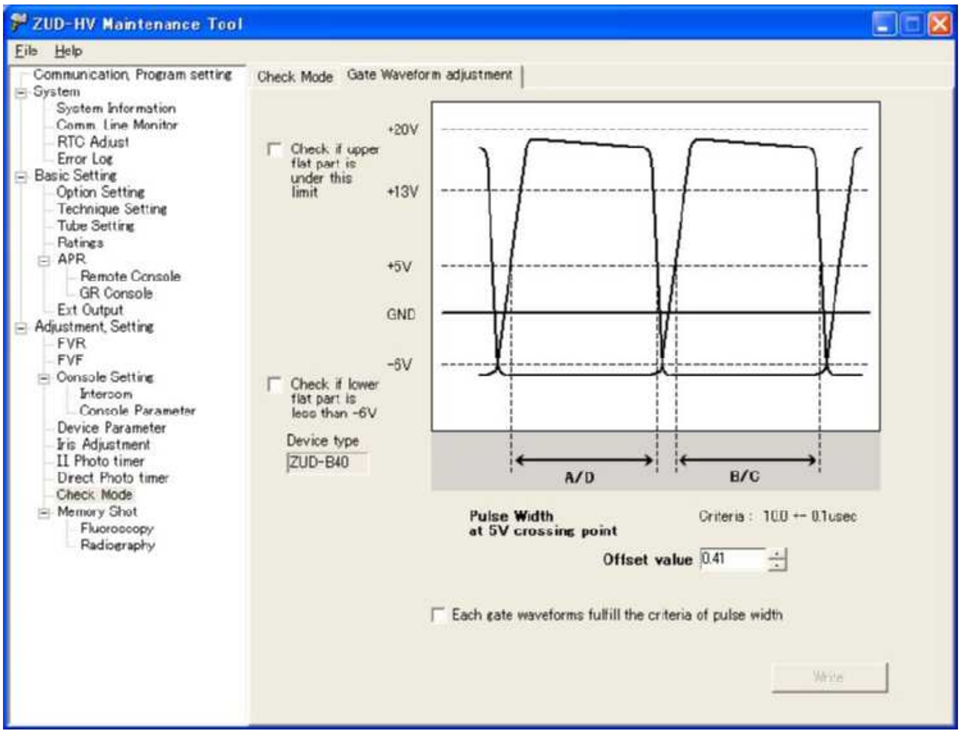


(6) When the following dialog box appears, make sure that the connector J2 J-MGL on the TERMINAL-2005 PCB is disconnected, put a check in the checkbox, and click [OK].

Check this box

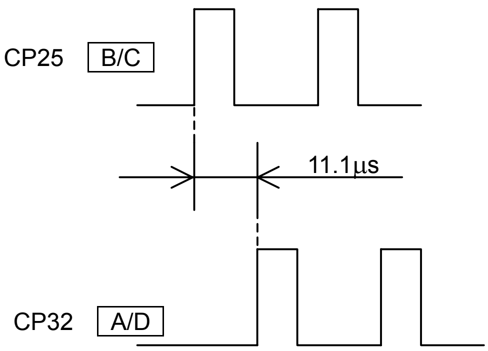


(7) The following screen appears.



(8) Check the frequency.

Conduct the Ready and X-Ray operations and confirm that the interval between the CP25 B/C leading edge and CP32 A/D leading edge is 11.1 μs.



(9) Check that the signals are output alternately, as shown in the diagram above.

(10) Next, adjust the gate waveform.

(11) Turn off the power.

(12) Remove the inverter unit cover.

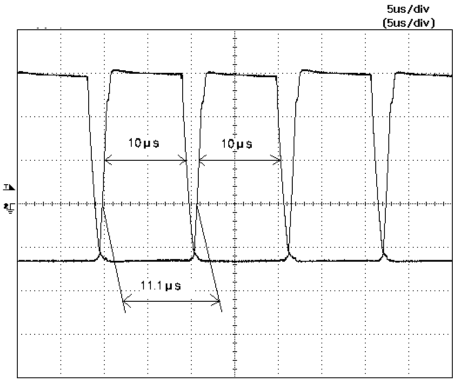
(13) Make the following connections on the oscilloscope:

CH1:	INVERTER-2002	CP1 G - CP2 E	(GND)
CH2:	INVERTER-2002	CP3 G - CP4 E	(GND)

(14) Turn on the power.

(15) Conduct steps (5) to (8) above.

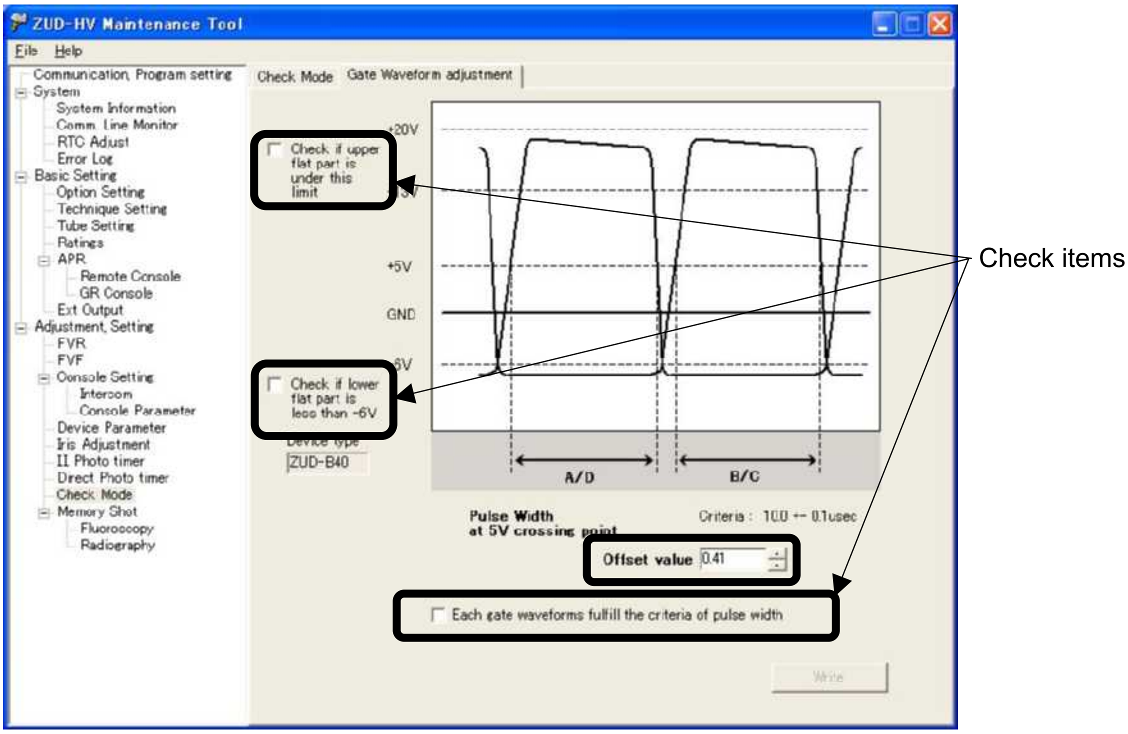
(16) Conduct the Ready and X-ray operations and observe the gate waveform after it reaches steady state. (It reaches steady state 0.1 sec after the X-ray operation.)



Oscilloscope settings	CH1:5V/div CH2:5V/div
	2 μsec/div
	Normal Trigger

(17) Use a imitation exposure (hand switch operation) to measure the width at 5 V. Change the [Offset Value] to bring the width to 10 ± 0.1 μsec.

The larger the [Offset Value], the greater the pulse width.



(18) If the measured results are OK, check that:
the flat sections are in range;
the lower flat parts do not exceed –6V.
Check all three checkboxes and then click [Write]. The [Write] button becomes enabled when the checkboxes are checked.
(19) Turn off the power.
(20) Make the following connections on the oscilloscope:

CH1:	INVERTER-2002	CP7 G - CP8 E (GND)	
CH2:	INVERTER-2002	CP5 G - CP6 E (GND)	

(21) Conduct steps (15) to (18) and check that the amplitude at 5V is 10 ± 1μsec.
(22) Check the gate waveform in the same way on the other INVERTER-2002 PCB. (ZUD-V40/B40 only)

1.7 Checking the Tube Voltage Feedback System

1.7.1 Adjusting kV+ and kV- on KV ADJ-2002 PCB

(1) With the power supply turned off, remove the KV ADJ-2002 PCB from the UD CONT-2005 PCB.
(2) Connect the D.V.M. between Pin (7) and Pin (10) of connector J22 on the KV ADJ-2002 PCB.
(3) Adjust VR3 kV+ADJ on the KV ADJ-2002 PCB to bring the D.V.M. resistance value to 7.5kΩ ± 0.1kΩ.
(4) Connect the D.V.M. between Pin (2) and Pin (5) of connector J23.
(5) Adjust VR3 kV–ADJ on the KV ADJ-2002 PCB to bring the D.V.M. resistance value to 7.5kΩ ± 0.1kΩ.
(6) With the power supply turned off, correctly attach the KV ADJ-2002 PCB to the UD CONT-2005 PCB.

1.8 Adjusting the Tube Voltage

Adjust the kV peak values and waveform for each tube voltage.

Use a connecting cable up to 2m long for the tube-voltage measuring instrument.

The procedures below also age the X-ray tube.

1.8.1 Preparations

(1) Connect the A - K outputs of the KV meter to the oscilloscope.

(2) Set the KV meter delay time to 20ms.

1.8.2 Adjustment

(1) Select the measured value display mode at the console.

(2) Set 80kV, 100mA and 0.1sec at the console.

(3) kV+ : Short CP49 kV CHK1 of the UD CONT-2005 PCB to CP50 kV CHK2.

(4) Apply the high voltage to the X-ray tube and adjust the filament current to bring the measured tube voltage to approximately 100 mA.

(5) Connect CH1 of the oscilloscope to the A – K output terminals of the KV meter and CH2 to CP85 kV+ on the UD CONT-2005 PCB. Adjust VR3 kV + ADJ on the KV ADJ-2002 PCB to bring the KV meter reading across A - K to 80 kV ± 1kV.

(6) Set the KV meter selector dial to A - E and conduct the Ready and X-Ray operations. Check that the kV peak value of the KV meter become same as the one of CP85 kV +.

(7) Adjust VR4 WFADJ+ on the KV ADJ-2002 PCB until the rising edge region of the KV meter output waveform resembles that of the CP85 kV + waveform.

(8) kV - : Remove the shorting on the CP49-CP50 (connected at step (3)). Repeat the adjustments at steps (6) and (7) for the KV meter output waveform across A - K and CP84 kV -.

The trimmers for the adjustment are VR5 kV – ADJ and VR6 WFADJ -. (Set the KV meter selector dial to E - K.)

(9) Adjust the measured value display on the console.

(10) Adjust the tube-voltage measured value display at the operating console.

1.9 Adjusting the Radiography Tube Voltage Feedback Sensitivity

This section describes the rising edge of the tube voltage.

Use a connecting cable up to 2m long for the tube-voltage measuring instrument.

(Refer to “4.6 Connecting the Tube Voltage / Tube Current Measuring Instruments” for connection of KV meter.)

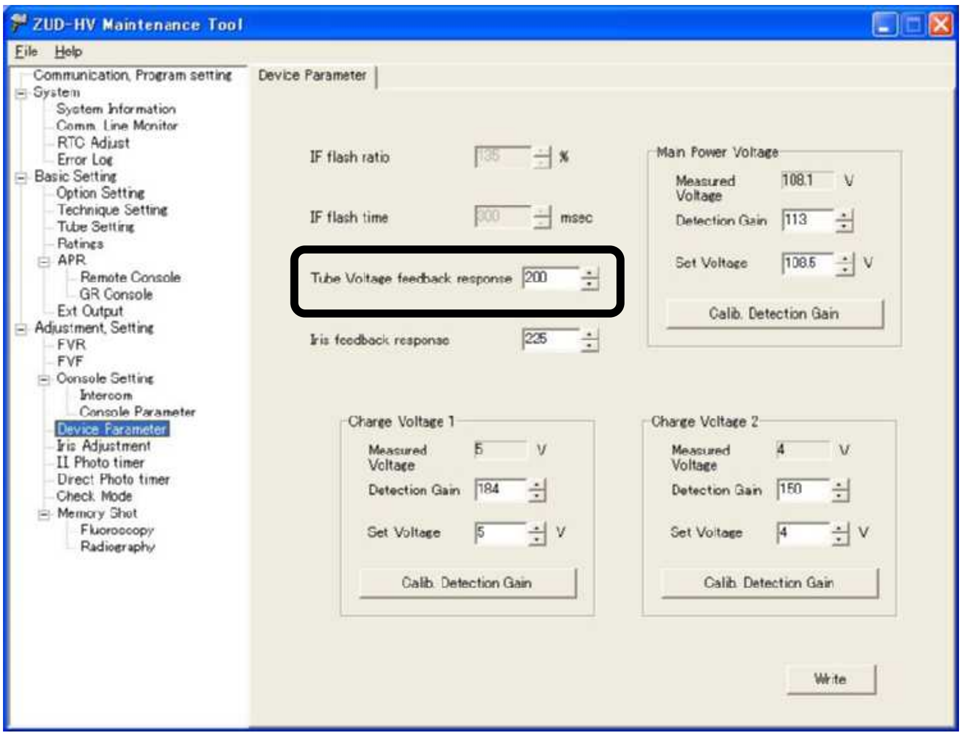
Calibrate the probe frequency characteristics and voltage range of the oscilloscope before starting the adjustments.

> **CAUTION**
>
> **Execute this adjusting after tube aging fully.**

(1) Turn off the power and connect CH1 of the oscilloscope to the A – K output terminal of the KV meter.

(2) Turn on the power.

(3) Start up the ZUD-HV Maintenance Tool and select [Adjustment, Setting][Device Parameter].



(4) Set the radiography conditions as follows:

kV: Minimum settable tube voltage to 100 kV (maximum settable value if setting is not possible)

mA: 400 mA (maximum settable value if setting is not possible)

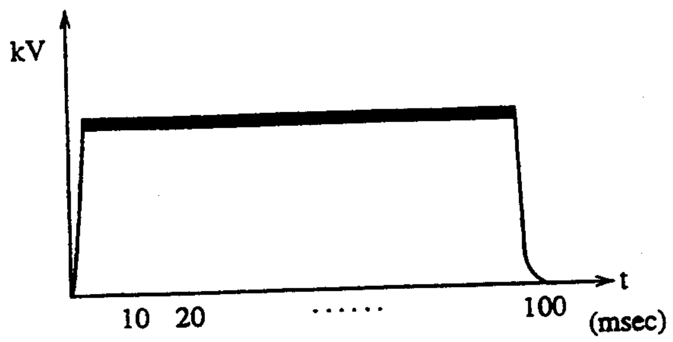
sec: 100 ms (maximum settable value if setting is not possible)

Technique: General radiography

(5) Adjusting Tube Voltage Rising Edge

Conduct X-ray exposures while increasing the tube voltage in 10 kV to 20 kV steps from the minimum settable tube voltage up to the 100 kV. Adjust the [Tube Voltage Feedback Response] value until the CH1 waveform appears as shown in the diagram below. At this time, ensure that the tube-voltage waveform is not vibrating or oscillating.

(The larger the [Tube Voltage Feedback Response] value, the faster response. However, vibration or oscillation of the tube-voltage waveform may occur if the value is set too large.)



1.10 Adjusting the Flash

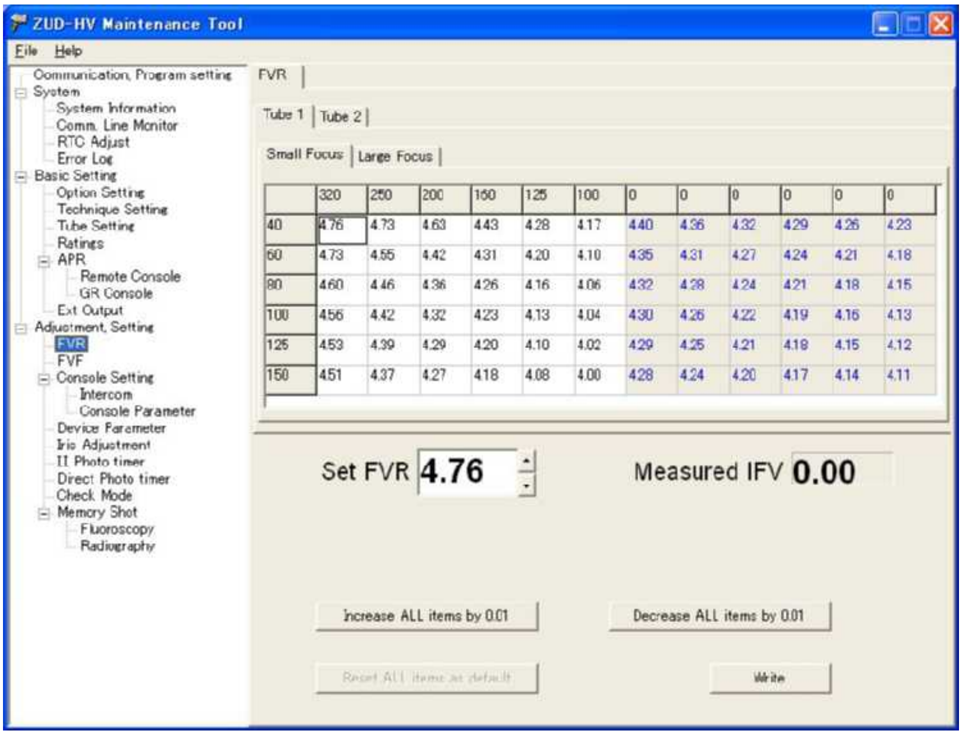
(1) Turn off the power and make the following connections on the oscilloscope:

CH1: UD CONT-2005 CP76 $\boxed{\text{IFV-L}}$ - CP19 $\boxed{\text{GND}}$

(2) Turn on the power.

(3) Select a general radiography technique on the console.

(4) Start up the ZUD-HV Maintenance Tool and select [Adjustment, Setting][FVR].



(5) Select [Large Focus] tab.

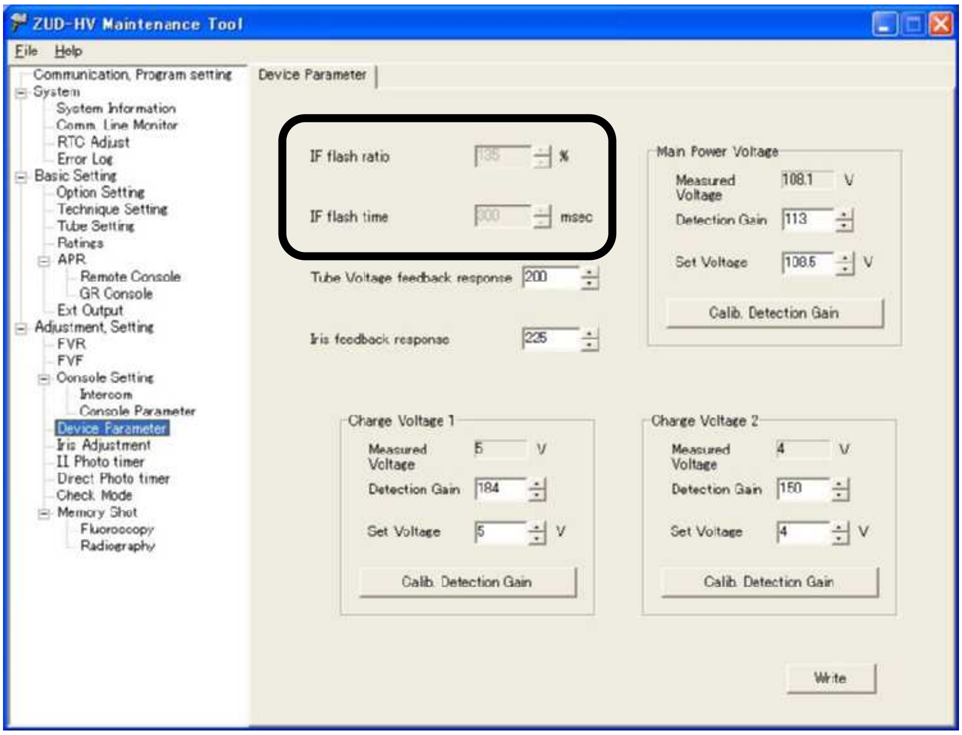
(6) Select the position with the minimum tube voltage and minimum tube current in the selection range.

(7) Note the selected tube voltage, tube current, and [Set FVR] value.

(8) Set the [Set FVR] value to 4.00.

(9) Click [Write].

(10) Start up the ZUD-HV Maintenance Tool and select [Device Parameter].



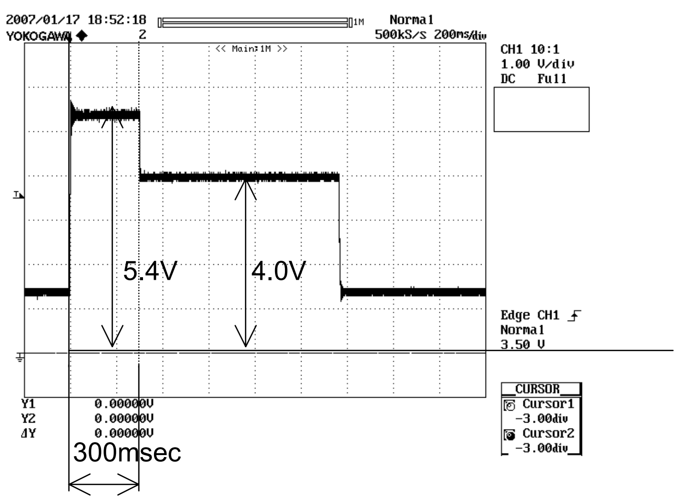
(11) Set the radiography condition which FVR is adjusted with the tube voltage and tube current adjustment buttons on the console (Set the radiography time to any arbitrary value.)

(12) Make sure that the [IF flash ratio] and [IF flash time] values appear as follows in the ZUD-HV Maintenance Tool [Device Parameter] window.

IF Flash Ratio: 135 %

IF Flash Time: 300 msec

(13) Conduct the Ready operation and check that the [IF flash ratio] appears approximately as shown in the following diagram.



(14) If the kV peak value exceeds 5.4 V immediately after the Ready operation, reduce the [IF flash ratio] value. If it is less than 5.4 V, increase the [IF flash ratio] value.

(15) After completing these checks, click [Write].

(16) Open the ZUD-HV Maintenance Tool [FVR] window.

(17) Revert the [Set FVR] set value to the value before it was changed at step (6).

(18) Click [Write].

1.11 Adjusting the Fluoroscopy Tube Voltage

Adjusting the Fluoroscopy Tube Voltage with Maintenance PC.

Use the cable, which is connected to kilovoltmeter is max 2m.

(1) Turn on the power. Start up the ZUD-HV Maintenance Tool and select [Adjustment, Setting][FVF].

(2) Put a checkmark in [Adjust FkV] in [Fluo. Tube Voltage Adjustment].

(3) Conduct fluoroscopy at 50 kV FkV. Input the value displayed on the tube voltage measuring instrument for [Tube Voltage at 50 kV].

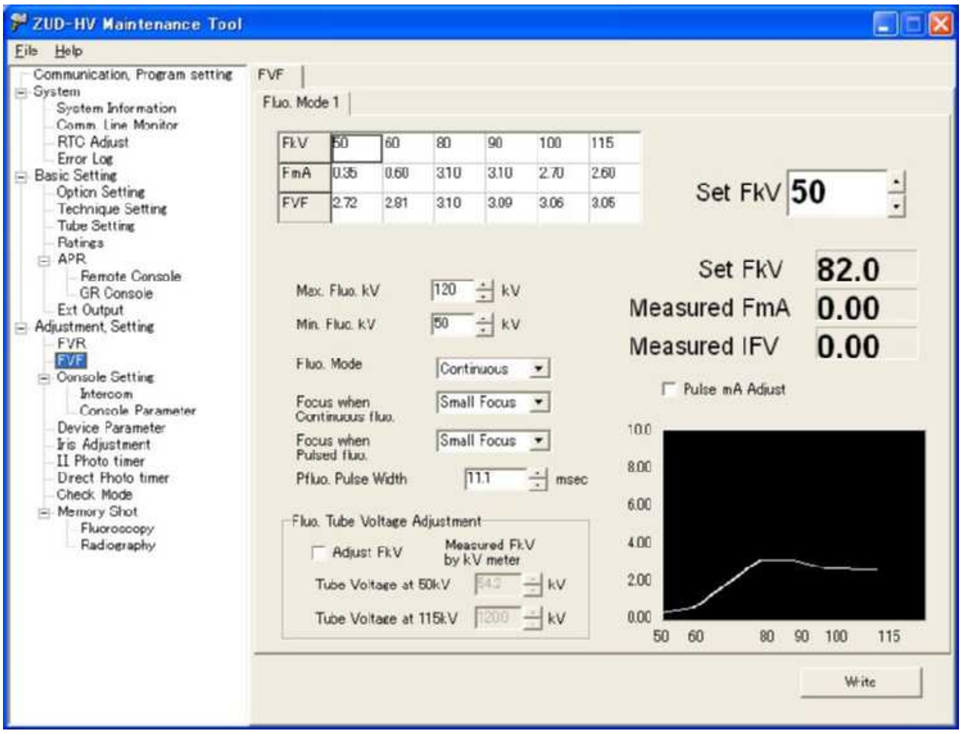
(4) Conduct fluoroscopy at 115 kV FkV. Enter the value displayed on the tube-voltage measuring instrument for [Tube Voltage at 115 kV].

(5) Click [Write].

(6) Remove the checkmark from [Adjust FkV].

(7) Conduct fluoroscopy from 50 kV to 125 kV. Check that the value displayed on the tube voltmeter is within ± 5% of the value.

(8) Turn off the power and disconnect the tube voltmeter.



NO TEXT

MAINTENANCE Chapter 2

Replacing PCBs and Major Components

M2

Chapter Contents

2. Replacing PCBs and Major Components

2.1 Replacing PCBs and Major Components

2.1.1 UD CONT-2005 PCB

(1) Before change the UD CONT-2005 PCB, save setting data.
Refer to installation section 4.23.

(2) Turn off the power.
Remove the UD CONT-2005 PCB on the hinged unit of the cabinet.

(3) Remove the KV ADJ PCB from the UD CONT-2005 PCB.
Attach the KV ADJ PCB to new UD CONT-2005 PCB.

(4) Attach the new UD CONT-2005 PCB on the hinged unit.

(5) Load the setting data of the former UD CONT-2005 PCB.
Refer to installation section 4.23.

(6) Adjusting the measured tube current system. (Refer to MAINTENANCE, section 1.5.3)

(7) Adjusting the gate waveform. (Refer to MAINTENANCE, section 1.6)

CAUTION

- **KV ADJ PCB is adjusted with a high-voltage transformer by a pair.**
- **Connect a connector precisely.**
Do not make in particular a mistake because filament heating control connector JMPL and JMPS

2.1.2 KV ADJ PCB

(1) Turn off the power.
Remove the KV ADJ PCB from the UD CONT-2005 PCB.

(2) If the high-voltage transformer is changed at the same time,
conduct a readjustment of the high-voltage.
Refer to maintenance 1.8.

CAUTION

- **For changing a KV ADJ PCB alone, readjust high-voltage with a KV mater.**
- **It is not a PCB same as a KV ADJ-2002 board (using in the UD150B-40 series).**
For using a KV ADJ-2002 PCB, short-circuit by 1,2 pins of connector J22.are the number of the same pins.

2.1.3 Replacing High-voltage transformer (D150KH-40/41, D125PH-C3)

(1) After turn off, replacing High-voltage transformer.

(2) Readjust the detection constant of tube current. Refer to MAINTENANCE section 1.5.3.

(3) If KV ADJ PCB and High-voltage transformer don't replace simultaneously, readjust tube voltage absolutely. Refer to MAINTENANCE section 1.8

2.1.4 Replacing mA POWER-2002 PCB(only ZUD-L41/L40/V40/B40)

(1) After turn off, replacing mA POWER-2002 PCB.

(2) Confirm the operating of filament. Refer to MAINTENANCE section 1.5.1 and 1.5.2.

CAUTION

- **If mA POWER-2002 PCBs for large focus and small focus simultaneously, don't make a mistake in the connection of JMP connector.**
  The left side is PCB for large focus. (Connector name is "J4 mA POWER L")
  The right side is PCB for small focus. (Connector name is "J4 mA POWER S")

2.1.5 Replacing IGBT unit (ZUD-L41/L40/V40/B40)

(1) Turn off, and confirm that LEDs (LD2, LD3) in TERMINAL-2005 PCB are turned off completely. Then, replace IGBT unit.

(2) Execute a imitation radiography, and readjust the gate waveform. Refer to MAINTENANCE section 1.6.

CAUTION

- **If the exchange only of IGBT is necessary, attach same kind of IGBT.**
  Don't use different kind of IGBT mixing it.

2.1.6 Replacing INV.UNIT-2005 PCB (ZUD-P40)

(1) Turn off, and confirm that LEDs (LD2, LD3) in TERMINAL-2005 PCB are turned off completely. Then, replace INV.UNIT-2005 PCB.

(2) Execute a imitation radiography, and readjust the gate waveform. Refer to MAINTENANCE section 1.6..

(3) Readjust the detection constant of tube current. Refer to MAINTENANCE section 1.5.3.

(4) Confirm the operating of filament. Refer to MAINTENANCE section 1.5.1 and 1.5.2.

CAUTION

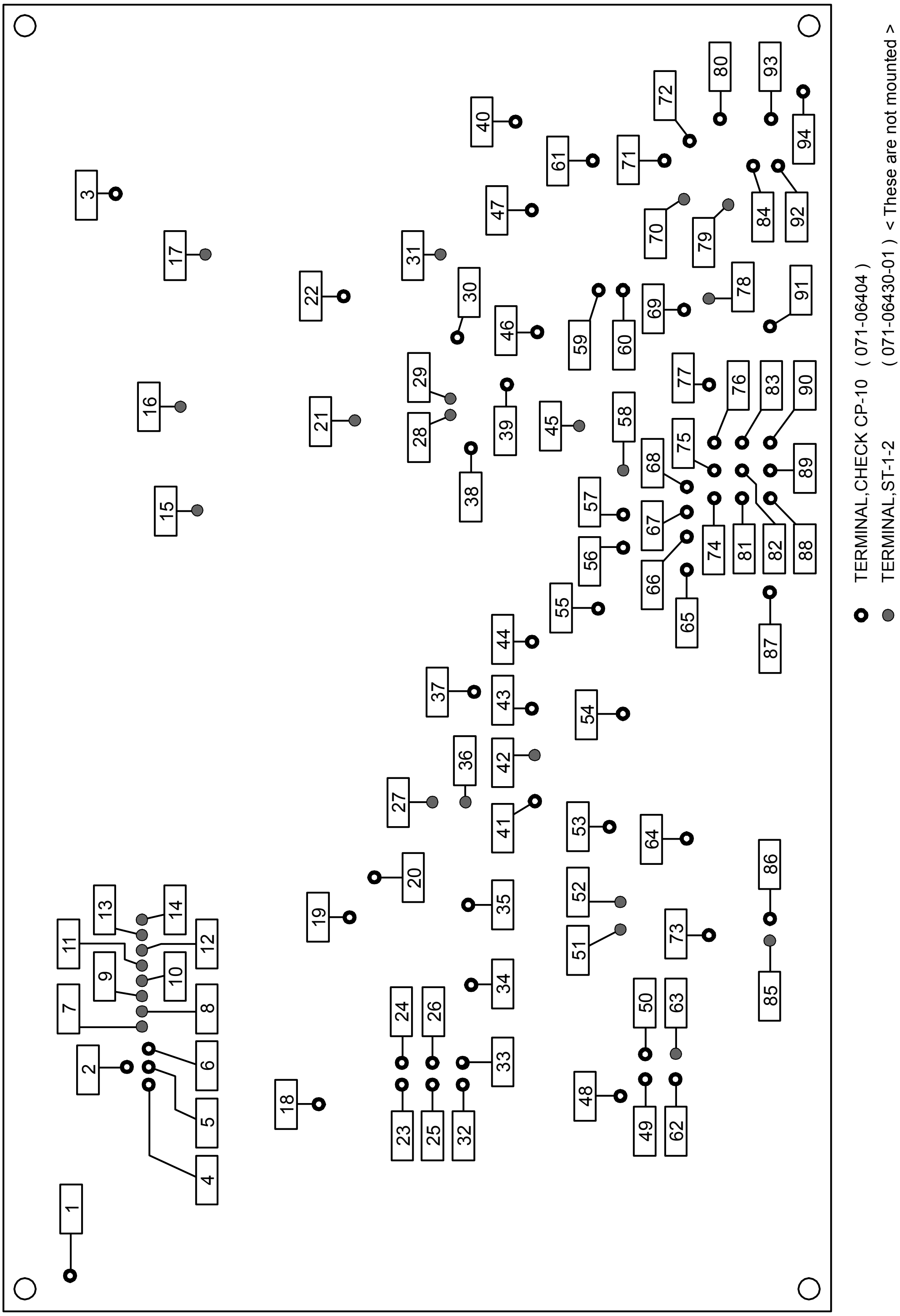
- **If the exchange only of IGBT is necessary, attach same kind of IGBT. Don’t use different kind of IGBT mixing it.**

2.2 Table of X-ray Tube Model Names

Tube Code	X-ray tube unit name
01	1.2 U161CFL
02	0.8 P323DK
03	0.3/0.8 P38C
04	0.6/1.2 P38C
05	1/2 P38C
06	0.3/1 P364DK
07	1/2 P38D
08	0.5/1.0 P33C
09	0.4/0.7 JG326D
0A	1.0 P39AK
0B	0.6/1.2 P18C
0C	1/2 P18C
0D	0.15/0.4 U14Y13E
0F	0.5/1.0 P13C
10	1/2 P13C
11	0.6/1.2 U14VN
12	0.2/1 U14YBE
13	0.2/0.8 P324DK
14	1/2 U13C
15	0.5/1.5 U18CN
16	0.6/1.2 P323DK
17	0.8 P38CS
18	0.3/0.8 P18C
19	0.2/0.8 P38C
1A	0.6/1.2 P37CK
1B	0.6/1.2 P13DK
1C	0.5/1 WP36AK
1D	0.3/0.8 P323DK
1E	0.6/1.2 P33DK
1F	0.2 TPG32AK
20	0.2/0.8 P39C
21	0.3/0.8 P39C
22	0.6/1.2 P17CK
23	1/2 P13DK
24	1/2 P33DK
25	0.6/1.2 P164DK
26	0.6/1.2 P364DK
27	0.3/0.8 P18DK
28	0.3/0.8 P38DK
29	0.6/1.2 P18DE
2A	0.6/1.2 P38DE
2C	0.8 P38DK
2E	1/2 P18DK
2F	1/2 P38DK
30	0.6/1.2 P324DK
31	0.3/0.8 P324DK
32	G292 (0.6/1.2)
33	G1092 (0.6/1.2)
35	0.2/1.0 J326C
36	0.6/1.0 J326C
37	0.2T/0.8 JG346C
38	0.2/0.8T JG346C
39	G-1593
3A	G-1582
3B	PX1483 (0.3/1.0)
3C	PX1482 (0.6/1.0)
3D	PX1486 (0.6/1.2)
3E	0.6/1.0 J327C
40	G-292
41	G-1092
42	G-1592
43	G-1593Bi
44	0.6/1J317C G-1582Bi
45	LX-3081
46	LX-2011
47	0.6/1 J327C
48	0.3/1 J327C
49	0.3/0.6/1 J327C
4A	G1593Tri
4B	G1582Tri
4C	0.6/1.2 P123DK

2.3 UD CONT-2005 Check Pin Arrangement Diagram

The diagram below shows the arrangement of check pins on the UD CONT-2005 PCB.



2.3 UD CONT-2005 Check Pin Arrangement Diagram

CP1	GND	CP41	AGND	CP81	TKV
CP2	RADREQ	CP42	SCLK_ADC	CP82	IFV_S
CP3	RESETIN	CP43	IRIS	CP83	KV-
CP4	RADEXP	CP44	VREF	CP84	-A5V
CP5	FLOEXP	CP45	AD_VIN	CP85	KVFB-
CP6	XRAY	CP46	VP	CP86	KVCK1
CP7	Not used	CP47	VBACK	CP87	mA_VF
CP8	Not used	CP48	TMA	CP88	VP1_AD
CP9	Not used	CP49	FB+	CP89	VP2_AD
CP10	Not used	CP50	MAM	CP90	KV+
CP11	Not used	CP51	TMA_AD	CP91	FBKV
CP12	Not used	CP52	TKV_AD	CP92	AGND
CP13	Not used	CP53	VREF2.5	CP93	-15V
CP14	Not used	CP54	IPOT	CP94	GND
CP15	CLK6M	CP55	IBS		
CP16	XT_BKUP	CP56	PH REF		
CP17	RESET	CP57	VP1_IN		
CP18	+1.2V	CP58	AD_VP		
CP19	GND	CP59	VS/VN		
CP20	MASCLK	CP60	VSIN		
CP21	Not used	CP61	+A5V		
CP22	GND	CP62	FB-		
CP23	Q2_3S	CP63	KVFB+		
CP24	Q1_4L	CP64	KVCK2		
CP25	B/C	CP65	KVOFF		
CP26	Q2_3L	CP66	PKV		
CP27	CLK12M	CP67	VN		
CP28	32KOUT	CP68	VS		
CP29	SDO	CP69	PH-DET		
CP30	FBST	CP70	PH_INTEG		
CP31	SDI	CP71	+3.3V		
CP32	A/D	CP72	+5V		
CP33	Q1_4S	CP73	KVG		
CP34	EXP	CP74	VIN		
CP35	VD_CAM	CP75	LV		
CP36	SCLK_DAC	CP76	IFV_L		
CP37	VFCALIB	CP77	LMT		
CP38	VP2_IN	CP78	IRIS_ERR		
CP39	AGND	CP79	IRIS_MOTOR		
CP40	VCAP	CP80	+15V		

2.4 Fuse Lists

■Cabinet

NFB (for ZUD-B40/V40/L40/L41)	065-91017-01	100A	690V	
NFB (for ZUD-P40)	065-89824-02	75A	600V	
F-T2-0	072-01664-20	1A	250V	Slow Blow
F-T2-1	072-01664-20	1A	250V	Slow Blow
F-10LA	072-01664-15	0.5A	250V	Slow Blow
F-100LB	072-01664-15	0.5A	250V	Slow Blow
F-LPT	072-01664-39	15A	32V	Slow Blow

■T1-XV / XV2

F-A IN2	072-01659-38	30A	500V	Slow Blow
F-A IN0	072-01659-38	30A	500V	Slow Blow
F-200S	072-01659-83	10A	250V	Slow Blow
F-L100	072-01659-84	12A	250V	Slow Blow
F-135C	072-01664-26	2A	250V	Slow Blow
F-18T	072-01664-30	3A	250V	Slow Blow
F-A125	072-01665-34	10A	250V	Slow Blow
F-A50	072-01665-34	10A	250V	Slow Blow
F-A220	072-01659-86	20A	250V	Slow Blow
F-A200	072-01659-86	20A	250V	Slow Blow
F-A0	072-01659-86	20A	250V	Slow Blow

■IGBT UNIT (for ZUD-B40/V40/L40/L41)

F1A	072-06033-08	100A	600V	Fast Acting
F1B (for ZUD-B40/V40 only)	072-06033-08	100A	600V	Fast Acting

■INV.UNIT-2005 (for ZUD-P40)

F1	072-06033-09	125A	600V	Fast Acting

■SA CONT-2002 PCB (Optional)

F1	072-01659-86	20A	250V	Slow Blow
F2	072-06035-24	20A	600V	Fast Acting

2.5 Error Code Lists

2.5.1 Error Messages

2.5.1.1 Messages Related to the X-ray High-voltage Generator

When an error occurs, the error code is displayed in the radiography time display area of the console. If GSC-2002S(Z) is connected, the error code and error message appear on the sub-display.

Error code	Message	Description	Remedy
E01	Board status Error	Indicates abnormal UD CONT-2005 PCB status	Check for poor cable connections.
E02	IGBT 24V Failure	Abnormal 24 V supply voltage for IGBT.	Check for poor cable connections.
E03	-15V Failure	Abnormal -15 V supply voltage.	Check the DC power supply connection (PS1). Check for poor cable connections.
E04	+15V Failure	Abnormal +15 V supply voltage.	Check the DC power supply connection (PS3). Check for poor cable connections.
E05	+24V Failure	Abnormal +24 V supply voltage.	Check the DC power supply connection (PS2). Check for poor cable connections.
E06	HV Trans. No Connect	Abnormal connection to high-voltage transformer.	Check for poor cable connections.
E07	Line Voltage Over	The supply voltage exceeds the permitted range.	Measure L0 - L100. Check the tap connections to T1-XV transformer and T2-CE transformer. Check L100 voltage with the ZUD-HV Maintenance Tool.
E08	Charge Volt Over	Abnormal charging voltage of primary smoothing capacitor.	Check the charging voltage. Check charging capacitor voltage with the ZUD-HV Maintenance Tool.
E09	No Fil. Curr. (L)	Abnormal filament heating current. (Large focus)	Check CP76 IFV_L. Check FVR/FVF adjustment.
E10	No Fil. Curr. (S)	Abnormal filament heating current. (Small focus)	Check CP92 IFV_S. Check FVR/FVF adjustment.
E12	Invalid S/W version	Software and hardware versions do not match.	Match versions
E13	Inverter fault	Set tube voltage is exceeded. IFVO detected or main inverter AD/BC on simultaneously.	Check the set tube voltage.

Error code	Message	Description	Remedy
E14	Set kV/mA Over	Set tube voltage/current is exceeded.	Check the set tube current.
E15	Set IF Over	Incorrect filament heating current setting.	Check FVR/FVF.
E16	Measured I.F. Over (L)	Abnormal filament heating current. (Large focus)	Check CP76 [IFV_L]. Check FVR/FVF adjustment.
E17	Measured I.F. Over (S)	Abnormal filament heating current. (Small focus)	Check CP92 [IFV_S]. Check FVR/FVF value.
E18	Starter Failure	Defective starter.	Check the starter detection sensitivity.
E19	Meas. kV Over	The measured tube voltage exceeds the permitted range.	Check FVR adjustment. Check CP81 [TKV], CP83 [KV+], CP90 [KV-], etc.
E20	Meas. kV Over		
E21	Meas. kV Over (-)		
E22	Meas. kV Over (+)		
E23	Meas. RmA Over	The radiography tube current exceeds the set value.	Check FVR adjustment.
E24	Meas. FmA Over	The fluoroscopy tube current exceeds the set value.	Check FVF adjustment.
E25	Arcing Trouble(-)	Arcing occurred 3 or more times (-).	Check the tube status.
E26	Arcing Trouble(+)	Arcing occurred 3 or more times (+).	
E27	Inverter Temp. High	Abnormal inverter temperature	Check the IGBT installation and gate waveform.
E28	Iris Jammed	Defective iris	Check the adjustment of the iris in the optical system.
E29	Sheet SW. Failure	Defective sheet keys	Do not press a sheet key immediately after resetting a fault.
E30	Hand SW. Failure	Defective hand switch.	Check for poor cable connections.
E31	Hand SW. Failure	Defective hand switch.	
E32	Spot SW. Failure	Defective [Spot filming] button.	
E33	Foot SW. Failure	Defective foot switch.	
E34	Meas. mAs Over	Measured mAs too high.	Check FVR adjustment.
E35	Starter Not Work	Starter did not operate during fluoroscopy.	Check for poor cable connections.

2.5.1.2 Messages Related to Radiography Conditions

When an error occurs, the error code is displayed in the radiography time display area of the console. If GSC-2002S(Z) is connected, the error code and error message appear on the sub-display.

Error code	Message	Description	Remedy
L01	Load Over	Unit ratings were exceeded.	Reduce the radiography tube voltage or radiography tube current.
L02	Emission Over	Emission properties exceed the limit.	Increase the radiography tube voltage or decrease the radiography tube current.
L03	mAs Too Small	mAs value less than 0.5 mAs. Or, tube current less than minimum for mAs setting method.	Change the set value.
L04	mAs Over	mAs value exceeds the unit rating.	
L05	mAs/Sec OVER	mAs too large so that radiography time exceeds 10 sec. Or, radiography time exceeds the permitted range.	Reduce the set value.
L06 to L11	mAs Range Over	Setting out of range for mAs setting method.	

2.5.1.3 Messages Related to the X-ray Tube Accumulated Heat

When an error occurs, the error code is displayed in the radiography time display area of the console. If GSC-2002S(Z) is connected, the error code and error message appear on the sub-display.

Error code	Message	Description	Remedy
H01	HU OVER Predicted	The permitted value would be exceeded if the increase set in the radiography conditions were added to the current accumulated heat.	Change the radiography conditions or stop operation until the accumulated heat decreases.
H02	HU Full Stored	The accumulated heat reached the permitted limit value.	Stop operation until the accumulated heat decreases.
H03	Thermal Over	The X-ray tube housing temperature exceeds the permitted limit.	

2.5.1.4 Messages at Power ON

When an error occurs, the error code is displayed in the radiography time display area of the console. If GSC-2002S(Z) is connected, the error code and error message appear on the sub-display.

Error code	Message	Description	Remedy
C01	Door Open /Interlock	The door is open or the interlock has activated.	Close the door.
C02	-	Timer operated after 10 minutes continuous fluoroscopy operation.	Release and press the foot switch to restart fluoroscopy.
C03	-	The fluoroscopy mode was changed during fluoroscopy operation.	Release and press the foot switch to restart fluoroscopy.
C04	AEC Over	Photo backup operated during phototimer radiography.	-
C05	CR Invalid Parameter	An invalid radiography condition was received from the CR unit.	Change the radiography conditions.
C06	Battery Empty	The GSC-2002S(Z) backup battery is empty.	Replace battery voltage and replace the battery.
C07	Low Battery	The GSC-2002S(Z) backup battery voltage is low.	Replace battery voltage and replace the battery.
C08	RTC Reset	RTC was reset on the UD CONT-2005 PCB.	Set RTC with the ZUD-HV Maintenance Tool.
C09	EEPROM Write Error	Failed to write to EEPROM.	-

2.6 High-voltage Transformer Oil Volumes

2.6.1 ZUD-P40

High-voltage transformer: D125PH-C3

Oil volume: 9L

2.6.2 ZUD-L41

High-voltage transformer: D150-KH41

Oil volume: 41L

2.6.3 ZUD- L40/V40/B40

High-voltage transformer: D150-KH40

Oil volume: 41L

NO TEXT

MAINTENANCE Chapter 3

M3

Inspection and Maintenance

Chapter Contents

3. Inspection and Maintenance

3.1 Periodic Replacement Parts

Consumables

■Batteries

* DTC PCB (in control cabinet)

Part No.	Name	Replacement period
074-73307-02	Battery, CR2450	1 year

■Fuses

* Control cabinet

Model name	Rated current	Rated voltage	Type	Part No.	Name	Replacement period
F-T2-0	1A	250V	SlowBlow	072-01664-20	Fuse, 313 001	1 year
F-T2-1	1A	250V	SlowBlow	072-01664-20	Fuse, 313 001	1 year
F-10LA	0.5A	250V	SlowBlow	072-01664-15	Fuse, 313.500	1 year
F-100LB	0.5A	250V	SlowBlow	072-01664-15	Fuse, 313.500	1 year
F-LPT	15A	32V	SlowBlow	072-01664-39	Fuse, 313 015	1 year

* T1-XV/XV2 Transformer (in control cabinet)

Model name	Rated current	Rated voltage	Type	Part No.	Name	Replacement period
F-AIN2	30A	500V	SlowBlow	072-01659-38	Fuse, FLQ30	1 year
F-AIN0	30A	500V	SlowBlow	072-01659-38	Fuse, FLQ30	1 year
F-200S	10A	250V	SlowBlow	072-01659-83	Fuse, FLM10	1 year
F-L100	12A	250V	SlowBlow	072-01659-84	Fuse, FLM15	1 year
F-135C	2A	250V	SlowBlow	072-01664-26	Fuse, 313 002	1 year
F-18T	3A	250V	SlowBlow	072-01664-30	Fuse, 313 003	1 year
F-A125	10A	250V	SlowBlow	072-01665-34	Fuse, 326010	1 year
F-A50	10A	250V	SlowBlow	072-01665-34	Fuse, 326010	1 year
F-A220	20A	250V	SlowBlow	072-01659-86	Fuse, FLM20	1 year
F-A200	20A	250V	SlowBlow	072-01659-86	Fuse, FLM20	1 year
F-A0	20A	250V	SlowBlow	072-01659-86	Fuse, ,FLM20	1 year

* IGBT Unit (in control cabinet)

Model name	Rated current	Rated voltage	Type	Part No.	Name	Replacement period	Applicable models
F1A	100A	600V	FastActing	072-06033-08	Fuse, 600FH-100	1 year	ZUD-L41 ZUD-L40 ZUD-V40 ZUD-B40
F1B	100A	600V	FastActing	072-06033-08	Fuse, 600FH-100	1 year	ZUD-V40 ZUD-B40

* INV.UNIT-2005 PCB (in control cabinet)

Model name	Rated current	Rated voltage	Type	Part No.	Name	Replacement period	Applicable models
F1	150A	600V	FastActing	072-06033-10	Fuse, 600FH-150	1 year	ZUD-P40

Periodic Replacement Parts

■ Relays (R/F table control unit in control cabinet)

Part No.	Name	Replacement period
065-80874-56	Relay, G7J4A-T-KM-DC24V	2 years

NO TEXT

APPENDIX Chapter 1

A1

ZUD-HV

Maintenance Tool

Waveform Display

Functions

Chapter Contents

1. ZUD-HV Maintenance Tool Waveform Display Functions

1.1 Introduction

This section is described how to use the ZUD-HV Maintenance Tool waveform display functions.

1.2 Equipment Required for the Adjustments

(1) PC (With RS-232C serial port or USB port.)

(2) RS-232C cable (cross-type) or USB cable

(3) USB extension cable. (according to need) USB cable, 10MT (P/N: 511-71053)

1.3 Starting the Waveform Display Functions

(1) Connect the Maintenance PC. (Refer to section 1.1.5 of the Maintenance Manual.)

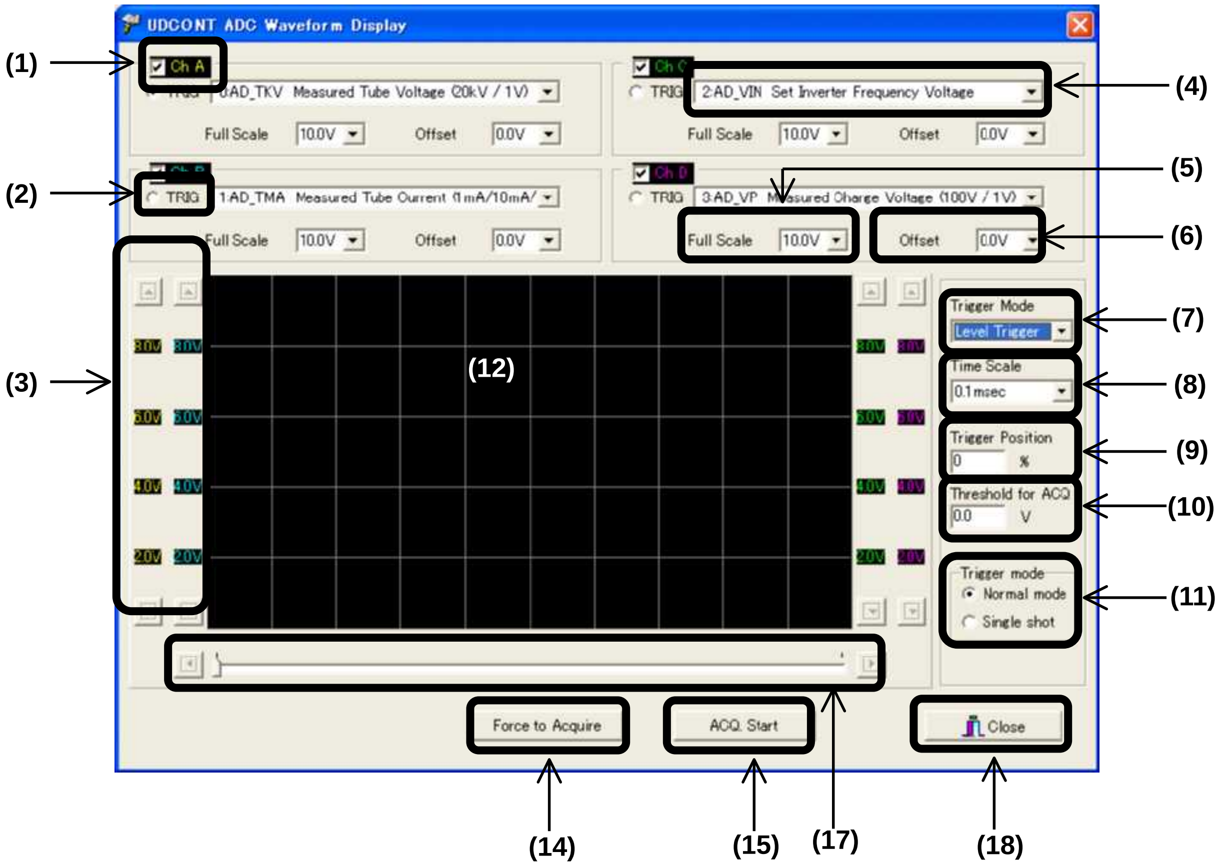
(2) Select [ADC Waveform (UD CONT-2005)] or [ADC Waveform (EXT I/F-2005)] in [Communication, Program setting].

- [ADC Waveform (UDCONT-2005)] displays the waveforms for the values processed in the UDCONT-2005 PCB.
- [ADC Waveform (EXT I/F-2005]] displays the waveforms for the values processed in the EXT I/F-2005 PCB.
- [ADC Waveform (UDCONT-2005)] and [ADC Waveform (EXT I/F-2005)] can be displayed simultaneously.

CAUTION

The ZUD-HV Maintenance Tool cannot be ended while a waveform display function is displayed.
Moreover, the connection cannot disconnect.

(3) [UDCONT ADC Waveform Display] or [EXT I/F ADC Waveform Display] open in separate windows.



(1) Channel display ON/OFF

Put a checkmark in the checkbox for channels to display.

Four channels are available: [Ch A] to [Ch D].

(2) Trigger Channel Selection

Only enabled when [Trigger Mode] is set to [Level Trigger].

Check the channels to apply the trigger.

(3) Waveform Scale

Displays the scale corresponding to the full-scale range of each channel.

[Ch A] to [Ch D] are displayed from the left of the screen.

In the range zoom display, press the buttons at the top and bottom to change the displayed position.

(4) Select Displayed Waveform

Select the displayed waveform from the table below. (for UDCONT ADC waveform display)

0	AD_TKV	Measured Tube Voltage	1V/20kV
1	AD_TMA	Measured Tube Current	1V/1mA, 1V/10mA, 1V/200mA
2	AD_VIN	Set Inverter Frequency Voltage	
3	AD_VP	Measured Charge Voltage	1V/100V
4	AD_PHCEL	I.I. photo signal	1V/1V
5	AD_IFVS	Measured IF value (small focus)	1V/1A
6	AD_IFVL	Measured IF value (large focus)	1V/1A
7	AD_IBS	Measured IBS value	1V/1V
8	AD_TMA_PF	Measured TmA (Pulse Fluo.)	1V/10mA
9	AD_IBS_PF	Measured IBS value (Pulse Fluo.)	1V/1V
10	AD_TKV_PF	Measured TKV (Pulse Fluo.)	1v/20kV
11	CNT_TX	Exposure counter	
12	XC_STAT	Not use	
13	CALIB_FMA	Fluoroscopy current after bleeder resistance correction	1V/1mA
14	KV_HP_CALC	Not use	
15	MAS_COUNT	mAs counter value	
16	IFST_CALC	Filament heating current setting value	1V/1A
17	FLT_STAT	Not use	
18	TGD_CNT	Not use	
19	DA_PKV	Set Tube Voltage (DA output)	1V/20kV
20	DA_VN	Set VN Voltage (DA output)	1V/1V
21	DA_VS	Set VS Voltage (DA output)	1V/1V
22	DA_PHREF	I.I. photoTimer Ref. Voltage (DA output)	1V/1V
23	DA_IRIS	Set IRIS value	
24	DA_VREF	Not use	
25	DA_VFCALIB	Not use	
26	DA_LMT	IFVO limit (DA output)	1V/1V
27	XC	Not use	
28	SET_KV	Set Tube Voltage	1V/20kV
29	SET_MA	Set Tube current	1V/1mA, 1V/10mA, 1V/200mA
30	IFST_L	Set If value (Large Focus)	1V/1A
31	IFST_S	Set If value (Small Focus)	1V/1A

Select the displayed waveform from the table below. (for EXT I/F ADC waveform display)

0	AD_CH1	ADC photo value (Field1)	1V/1V
1	AD_CH2	ADC photo value (Field2)	1V/1V
2	AD_CH3	ADC photo value (Field3)	1V/1V
3	AD_CH4	ADC photo value (Field4)	1V/1V
4	CALIB1	Calibrated photo value (Field1)	
5	CALIB2	Calibrated photo value (Field2)	
6	CALIB3	Calibrated photo value (Field3)	
7	CALIB4	Calibrated photo value (Field4)	
8	INT_CH1	Integration of photo value (Field1)	
9	INT_CH2	Integration of photo value (Field2)	
10	INT_CH3	Integration of photo value (Field3)	
11	INT_CH4	Integration of photo value (Field4)	
12	PHREF1	Photo Reference value (Field1)	
13	PHREF2	Photo Reference value (Field2)	
14	PHREF3	Photo Reference value (Field3)	
15	PHREF4	Photo Reference value (Field4)	
16	INT_AVE	Integration photo value (Average)	
17	PHREF_AVE	Photo Reference value (Average)	
18	No use	Not use	
19	No use	Not use	
20	EXP1	Correction Factor of STC1	
21	EXP2	Correction Factor of STC2	
22	EXP3	Correction Factor of STC3	
23	EXP4	Correction Factor of STC4	
24	COR_SIG	VFC Standard Voltage for KVCLK	
25	Not use	Not use	
26	Not use	Not use	
27	Not use	Not use	
28	No use	Not use	
29	No use	Not use	
30	No use	Not use	
31	No use	Not use	

(5) Select Voltage Scale

Select the voltage scale for the displayed waveform.

Select from the values below.

- 10.0V
- 5.0V
- 2.0V
- 1.0V
- 0.5V

Changing the voltage scale after acquiring the waveform selects the voltage zoom mode which zooms in on the voltage axis.

(6) Select Offset Value

Select the offset value for the displayed waveform.

(7) Select Trigger Mode

Select the trigger to acquire the waveform.

Select from the items below.

- Level Trigger
- XRAY ON
- Fault

(8) Select Time Scale

Select the time per scale.

Select from the values below.

・0.1msec	・4msec	・200msec
・0.2msec	・10msec	・400msec
・0.4msec	・20msec	・1sec
・1msec	・40msec	・2sec
・2msec	・100msec	・3sec

Changing the time scale after acquiring the waveform selects the time zoom mode which zooms in on the time axis.

(9) Trigger Position Input

Input the trigger position.

The left edge of the waveform display area is 0% and the right edge is 100%.

(10) Input Threshold Value

Only enabled when [Trigger Mode] is set to [Level Trigger].

Input the threshold Voltage (0V to 10V) to apply the trigger.

(11) Select the Waveform Acquisition Mode

Select the waveform acquisition mode.

- Normal mode
  Waveform is updated while the trigger conditions are met.
- Single shot
  Waveform is acquired and displayed when the trigger conditions are first met.

(12) Waveform Display Area

Displays the acquired waveform

(14) [Force to Acpuire] Button

Click this button to acquire the waveform regardless of the trigger mode.

(15) [ACQ. START]/[ACQ. STOP] Button

Click [ACQ. START]/[ACQ. STOP] button to start/stop waveform acquisition.

After [ACQ. START] button is pressed the waveform is acquired using the trigger timing and displayed.

(17) Time Position Slider

Changes the displayed position of the waveform in time zoom mode.

(18) [Close] Button

Press to close [UDCONT ADC Waveform Display] or [EXT I/F ADC Waveform Display].

NO TEXT

APPENDIX Chapter 2

A2

UDCONT-2005 Firmware Update Procedure Manual

Chapter Contents

2. UDCONT-2005 Firmware Update Procedure Manual

2.1 Introduction

This document is described the procedure for updating of the firmware of UDCONT-2005 PCB inside ZUD-P/L/V/B-40 cabinet.

2.2 Equipment Required for Firmware Updating

In order to update the firmware, following articles are required.

a) Serial cross-cable (Dsub 9pin-Dsub 9pin) or USB cable

b) PC (Installed Windows 2000 or Windows XP)

c) S/W for the firmware updating

   Use ZUD-HV Flash ROM Writer as the firmware updating S/W. It is necessary for the PC which execute updating has been installed this S/W, in advance.

d) Firmware data for updating

   FLEXAud2k5-Vx_xx.s is included inside the maintenance CD. (x_xx means the version of the firmware.)

2.3 Firmware updating procedure

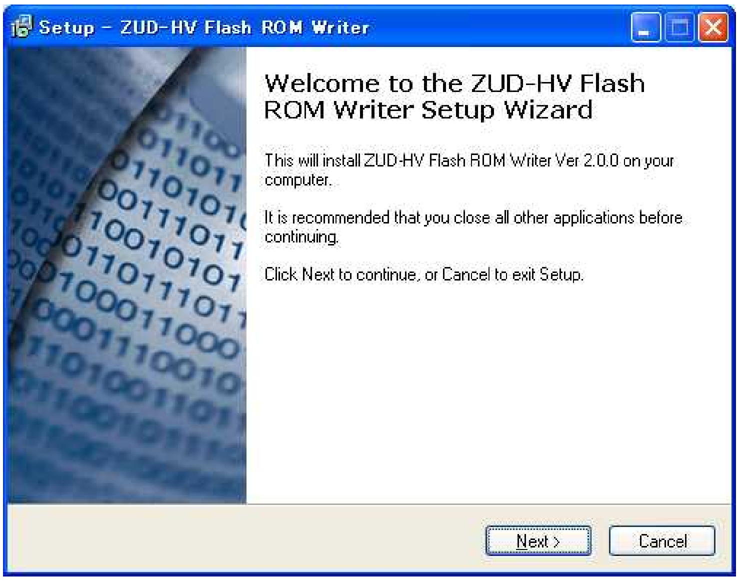
Firmware updating is executed following procedure.

a) Installation of ZUD-HV Flash ROM Writer

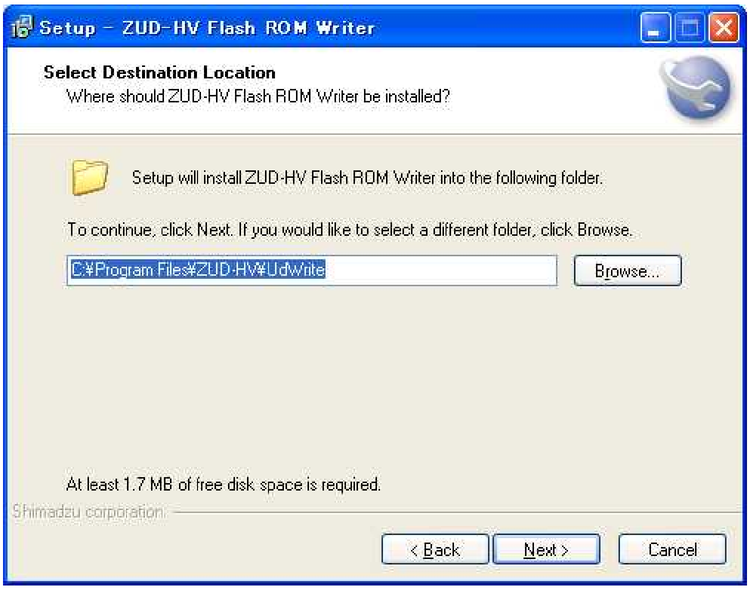
   Install ZUD-HV Flash ROM Writer to the PC which is used for installation. When it has been already installed, following work is not necessary.

   1) Execute the file UdWrt xxx.exe inside the maintenance CD of the folder UdWrite. (xxx means the version of the S/W.)
   2) Start up the installer for ZUD-HV Flash ROM Writer.
   3) Select English and click “OK”.

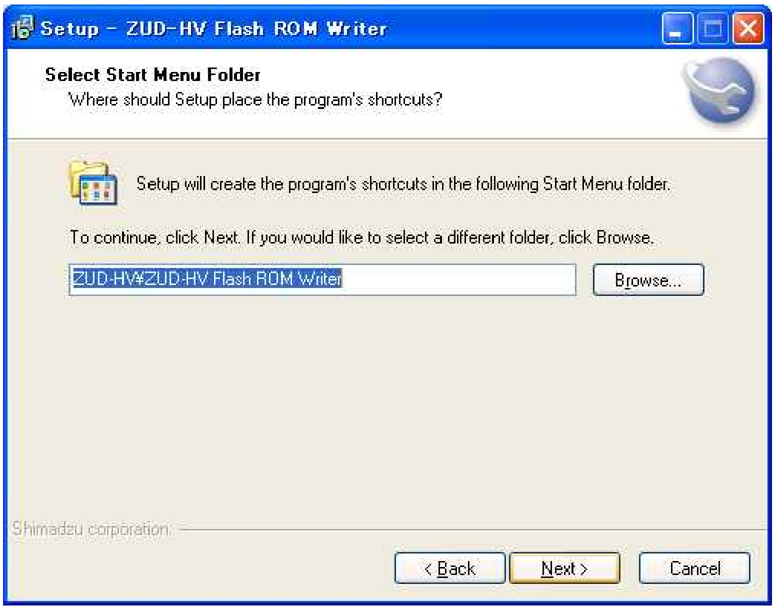
4) Setup screen is displayed and if you prepared, click “NEXT”.



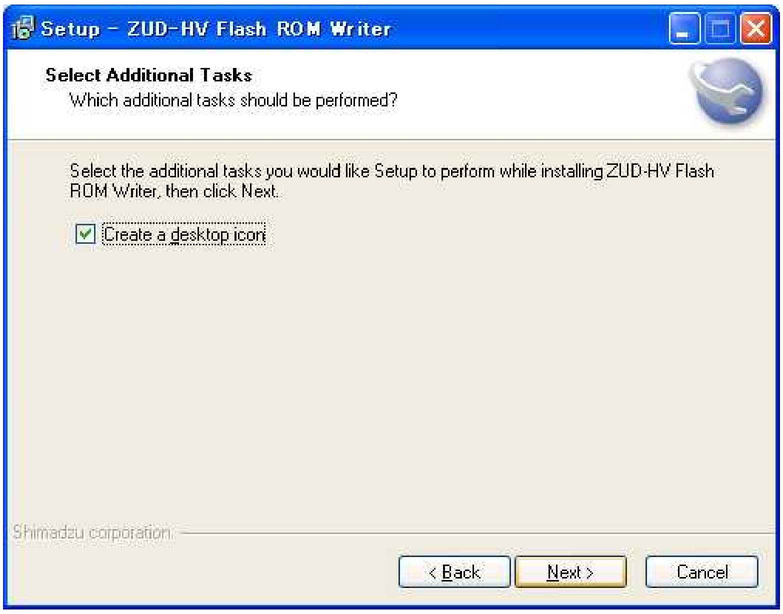
5) Specify the installation destination of ZUD-HV Flash ROM Writer.



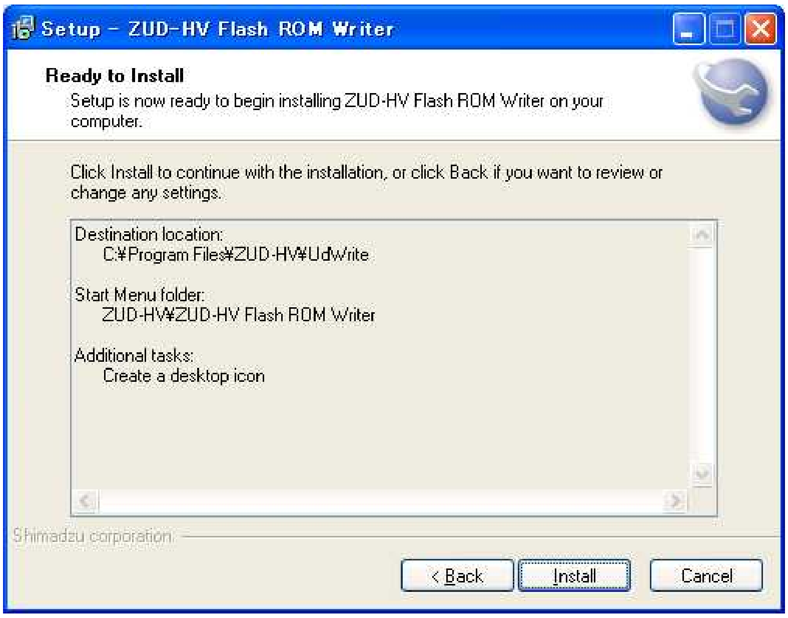
6) Specify the program group of ZUD-HV Flash ROM Writer.



7) Specify “Create the short-cut icon of ZUD-HV Flash Writer” on the desktop.



8) Confirmation screen of installation is displayed, if you prepared, click “Install”.



9) When installation is completed, following screen is displayed. Click “Finish” with the check box of “Launch ZUD-HV Flash ROM Writer” is off.

2. UDCONT-2005 Firmware Update Procedure Manual

b) Installation of USB Driver

Install ZUD-HV Flash ROM Writer to the PC which is used for installation.

When it has been already installed, following work is not necessary.

(1) In case of Windows 2000

1) Connect the PC and UDCONT-2005 PCB with USB cable and turn on the power of the system.
2) Windows detects the new USB device and starts up “Found New Hardware Wizard” and click “Next”.
3) Select “Search for a suitable driver for my device (recommended)” and click “Next”.
4) In the “Optional search locations”, just check “Specify a location” and click “Next”.
5) In the combo-box “Copy manufacturer’s files from:” specify the “Driver” folder inside the folder that is installed “ZUD-HV Flash ROM Writer” S/W. The default folder is “C:¥Program Files¥ZUD-HV¥Driver”. Then click “OK”.
6) After specify the file “ftd2xx.inf”, click “Next”.
7) After completing the driver installation, click “Finish”.

(2) In case of Windows XP

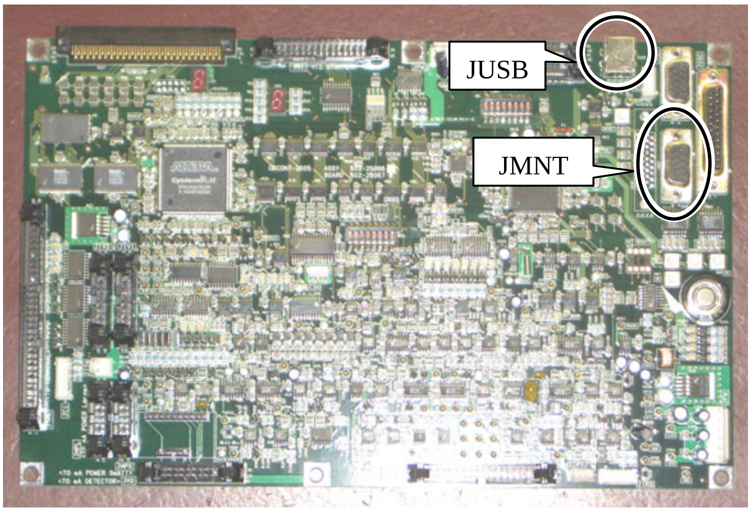
1) Connect the PC and UDCONT-2005 PCB with USB cable and turn on the power of the system.
2) Windows detects the new USB device and starts up the “Found New Hardware Wizard”. Displayed the selection of the software search, but select “No, not this time” and click “Next”.
3) Select “Install from a list or specified location (Advanced)” and click “Next”.
4) In the “Please choose your search and installation options”, just check the “Include this location in the search” and specify the “Driver” folder inside the folder that is installed “ZUD-HV Flash ROM Writer” S/W. The default folder is “C:¥Program Files¥ZUD-HV¥Driver”. Then click “Next”.
5) The warning window that the non-WHQL certified driver is about to be installed will be displayed, click “Continue Anyway”.
6) After completing the driver installation, click “Finish”.

c) Connection of the cable

Connect the PC and the communication port of the device which upgrades the firmware by the serial cable or USB cable.

The position of the communication port of the device is either below.

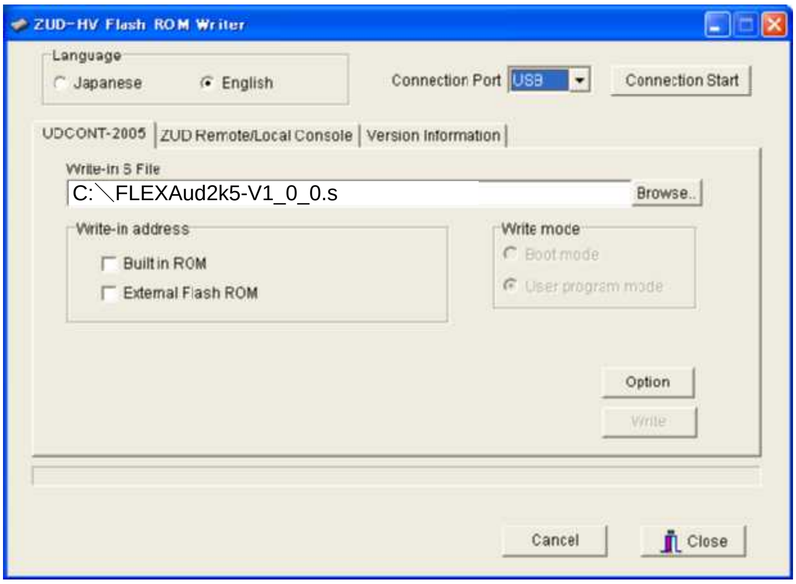
- Dsub 9pin connector JMNT on UD COUNT-2005 PCB (Serial port)
- USB connecter JUSB on UD CONT-2005 PCB (USB port)



d) Turn on the power of the device.

e) Start up ZUD-HV Flash ROM Writer.

f) Select the tab “UDCONT-2005” and then select the connection port which uses and select the radio button ”User program mode”.

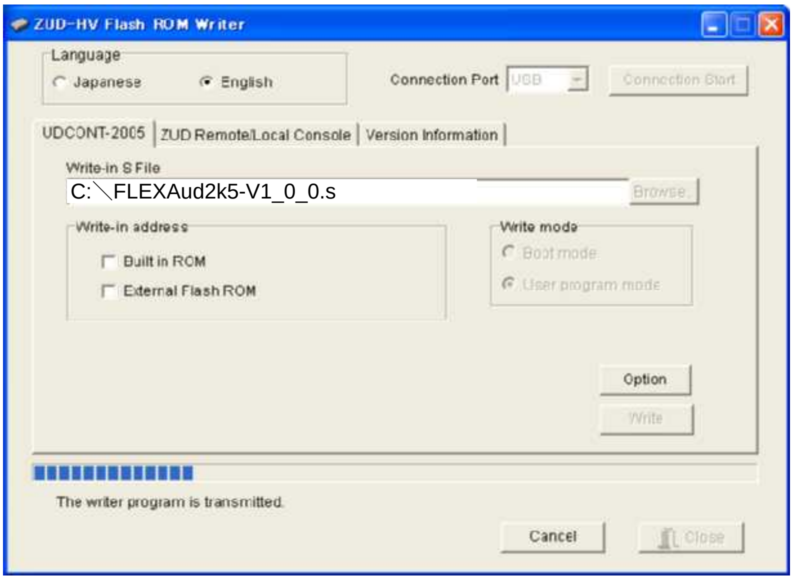


NOTE

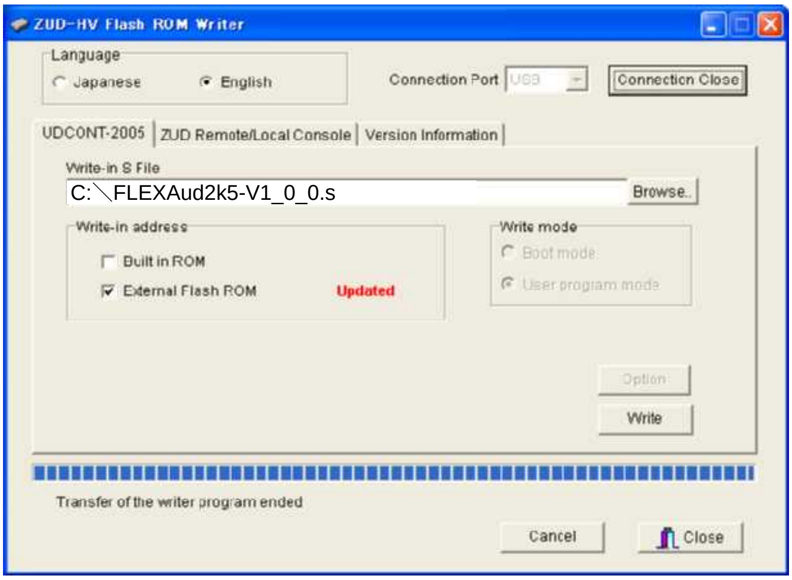
When communication port is selected for USB, it becomes user program mode, automatically.

g) Click “Browse..” button and open the firmware data for update.

h) Click “Connection start” button, transmits the firmware updating program to UDCONT-2005 PCB.



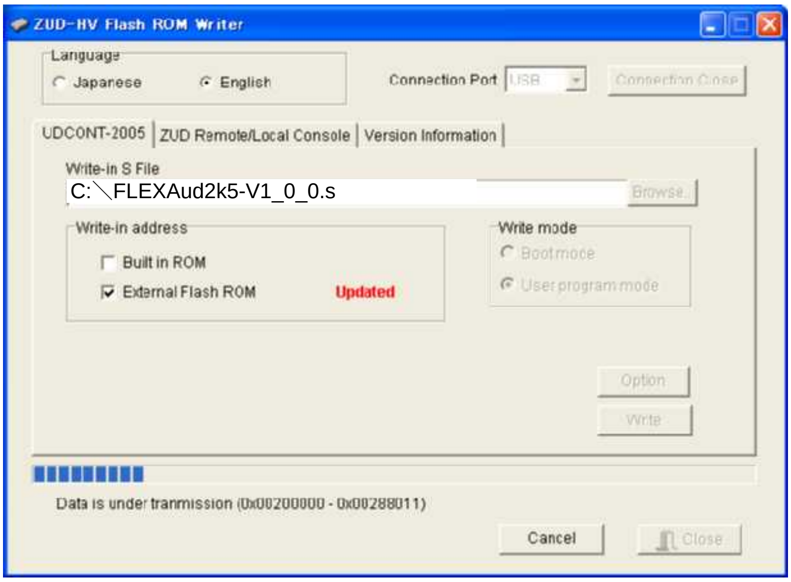
Though click “Connection start”, the transfer of the updating program does not start, (When the progress bar of ZUD-HV Flash ROM Writer of the bottom part does not proceed.) execute “Force updating of UDCONT-2005 PCB” of section 2.4.



i) When the transfer of the firmware updating program is completed, compares the current firmware with updating firmware, and displays “Updated” of the address area where is updated. Address area where is displayed “Updated” is the part where firmware update is necessary.

Check the check box of address area where updates firmware. After that, click “Write” button.

j) After click "Write" button, start updating of the firmware. Until updating of the firmware is completed, do not turn off the power of the device, absolutely.



k) When the updating of firmware is completed, following dialog box is displayed.

Click "OK" to close the dialog, then, click "Close" button of "ZUD-HV Flash ROM Writer" and finish "ZUD-HV Flash ROM Writer" S/W.

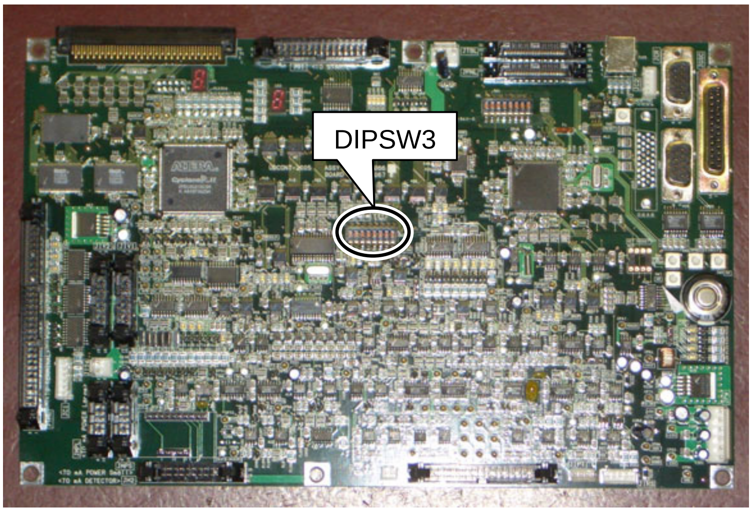
l) Turn off the unit power and then turn on the power once again. Confirm that the device operates normally, and confirm that the version of the firmware has been updated by ZUD-HV Maintenance Tool.

2.4 Force updating procedure of UDCONT-2005 PCB

During the firmware updating, if the power is shut off and the like, when updating of the firmware does not execute completely, updating procedure of section 2.3 cannot be uses.

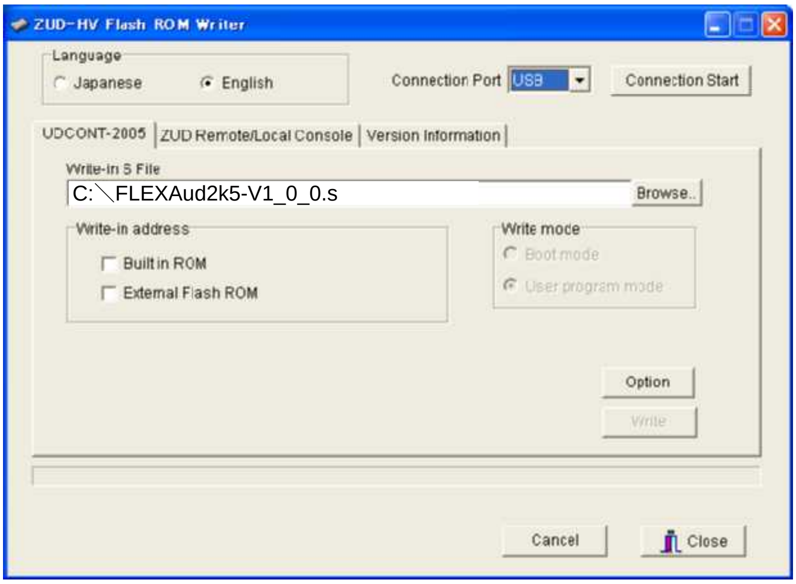
When firmware update of section 2.3 was done normally, following work is not necessary.

a) Turn on DIPSW3-8 of UDCONT-2005 PCB. After that, turn on the power of the unit.



b) Start up ZUD-HV Flash ROM Writer.

c) First, select the tab “UDCONT-2005” and then select the connection port which uses and select the radio button ”User program mode”.

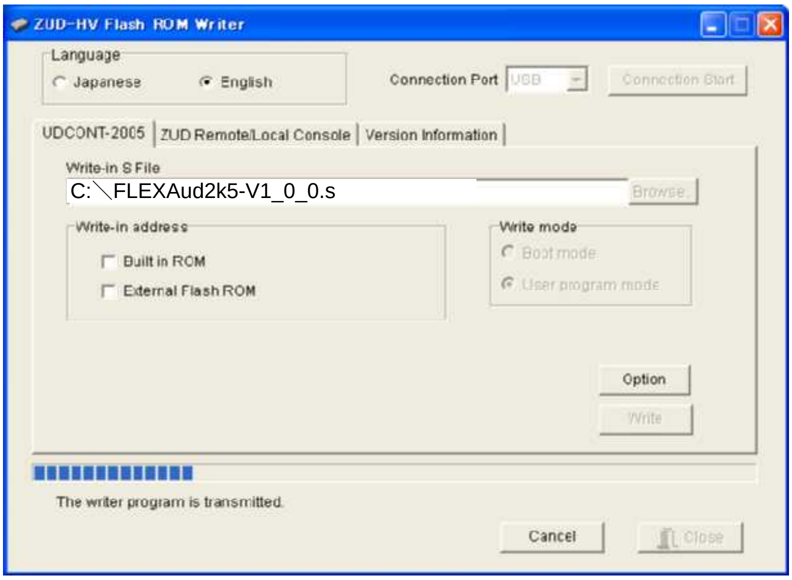


NOTE

When communication port is selected for USB, it becomes user program mode, automatically.

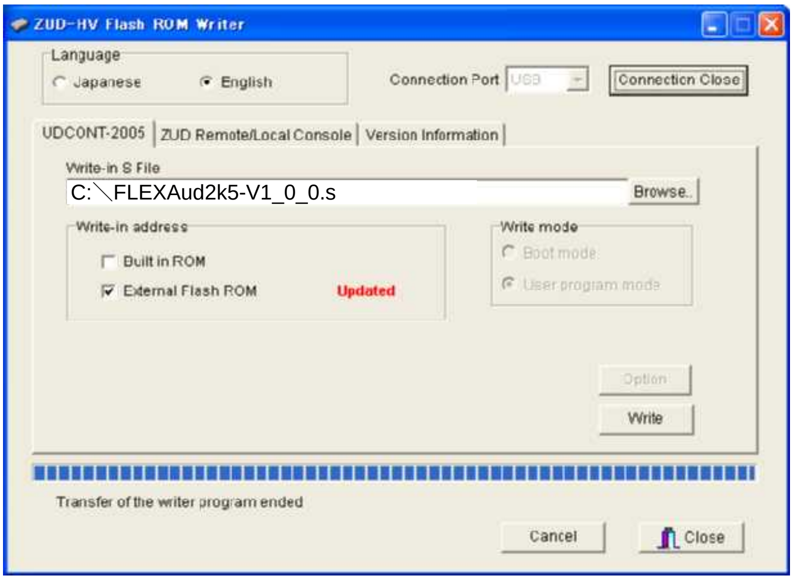
d) Click “Browse..” button and open the firmware data for update.
Open “FLEXud2k5-Vx_x_x.s” in maintenance CD.
(Vx_x_x means the version of firmware.)

e) Click “Connection start” button, transmits the firmware updating program to UDCONT-2005 PCB.



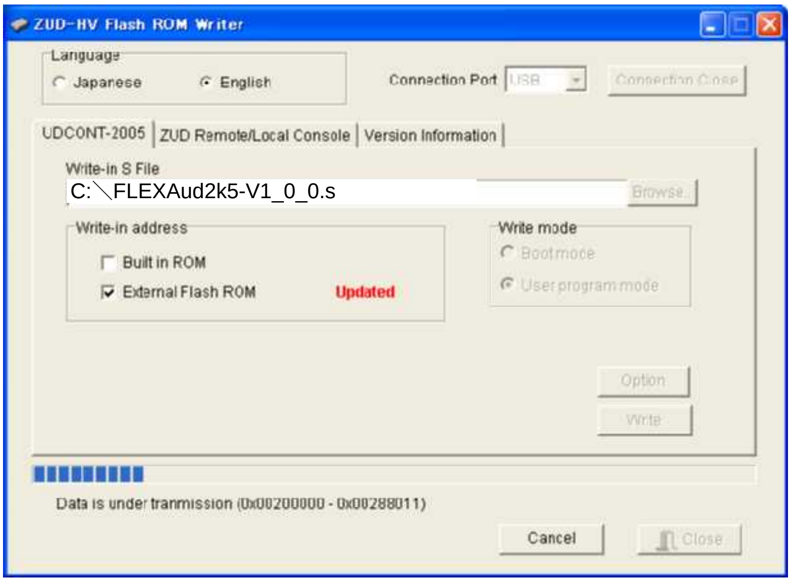
Though click “Connection start”, the transfer of the updating program does not start, (When the progress bar of ZUD-HV Flash ROM Writer of the bottom part does not proceed.) execute “Procedure of Initialization of UDCONT-2005 built-in flash ROM” of section 2.5.

f) When the transfer of the firmware updating program is completed, compares the current firmware with updating firmware, and displays “Updated” of the address area where is updated. Address area where is displayed “Updated” is the part where firmware update is necessary.



Check the check box of address area where updates firmware. After that, click “Write” button.

g) When click “Write” button, start updating of the firmware. Until updating of the firmware is completed, do not turn off the power of the device, absolutely.



h) When the updating of firmware is completed, following dialog box is displayed.

First, click “OK” to close the dialog, then, click “Close” button of “ZUD-HV Flash ROM Writer” and “ZUD-HV Flash ROM Writer” S/W.

i) Turn off the power of the device, and turn off DIPSW 3-8 on UDCONT-2005 PCB.

j) Turn on the power once again. Confirm that the device operates normally, and confirm that the version of the firmware has been updated by ZUD-HV Maintenance Tool.

2.5 Procedure of initialization of UDCONT-2005 built-in flash ROM

Because it is new PCB and the like, when CPU built-in flash ROM does not be initialized, execute the initialization of CPU built-in flash ROM following procedure below.

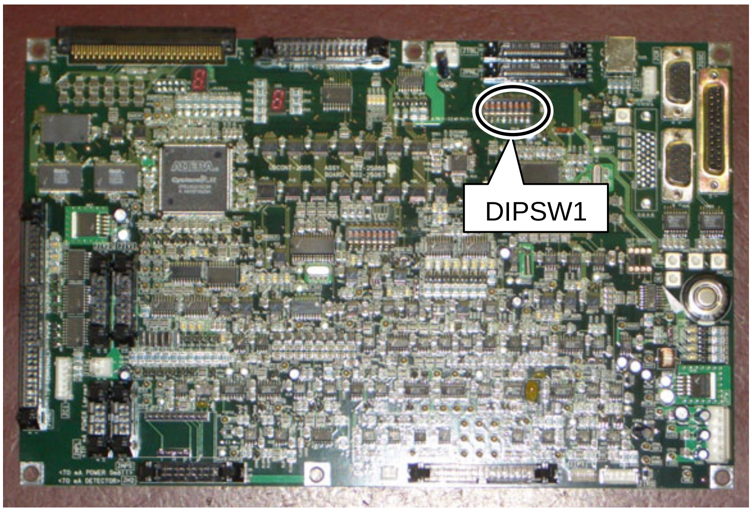
When firmware update of section 2.3 or 2.4 was done normally, following work is not necessary.

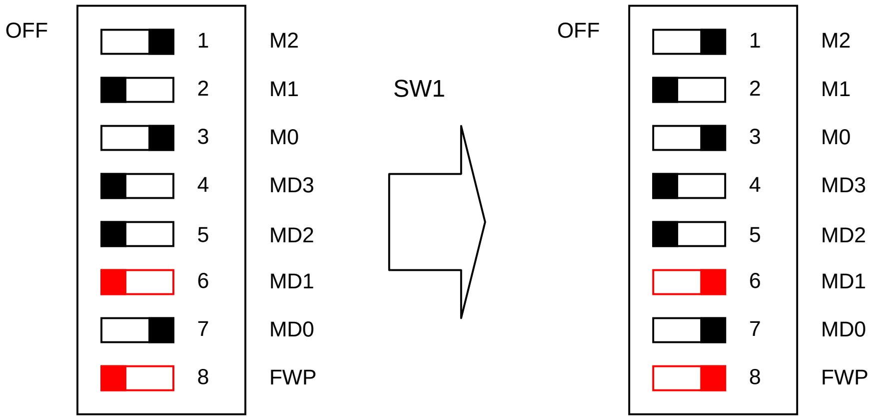
NOTE

This updating cannot do by USB port.

PC which attached the serial port is necessary.

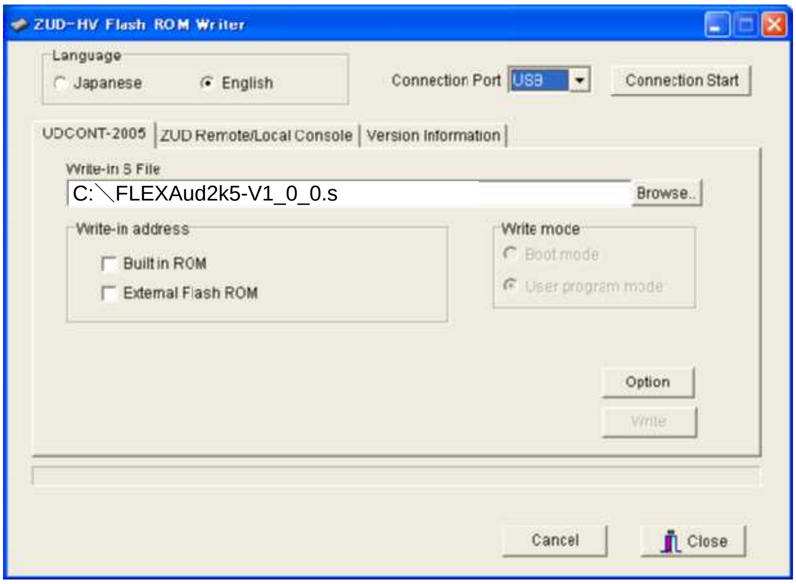
a) Turn on DIPSW1-6 and 1-8 on UDCONT-2005 PCB. After that, turn on the power of the device.





b) Start up ZUD-HV Flash ROM Writer.

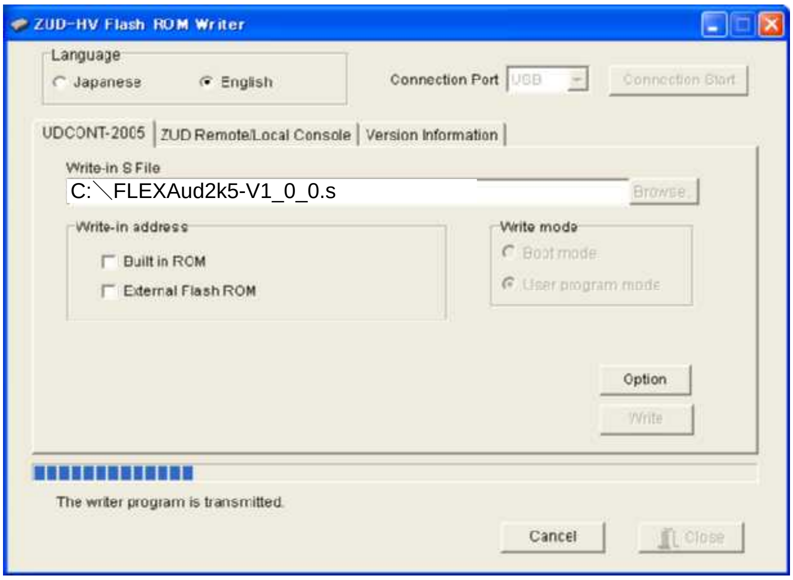
c) Select the tab “UDCONT-2005” and then select the connection port which uses and select the radio button “Boot mode”.



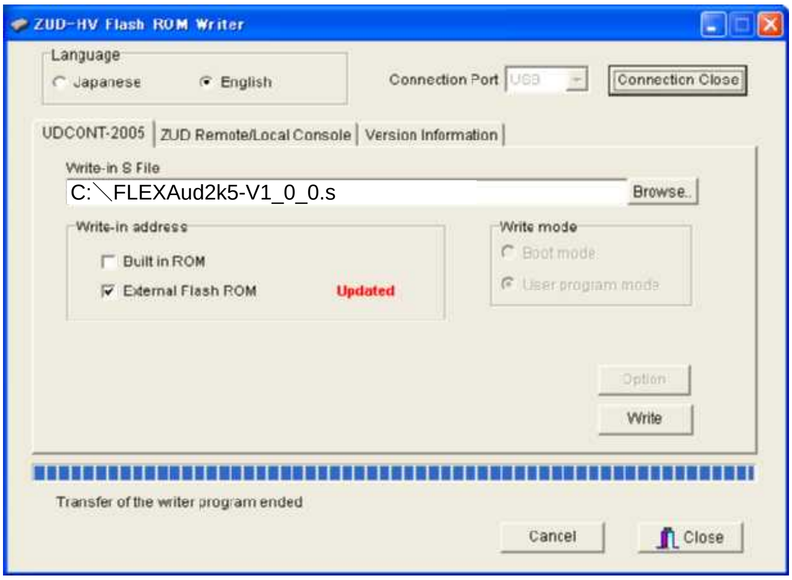
d) Click “Browse..” button and open the firmware data for update.
Open “FLEXAud2k5-Vx_x_x.s” in maintenance CD.
(Vx_x_x.s means the version of firmware.)

2.5 Procedure of initialization of UDCONT-2005 built-in flash ROM

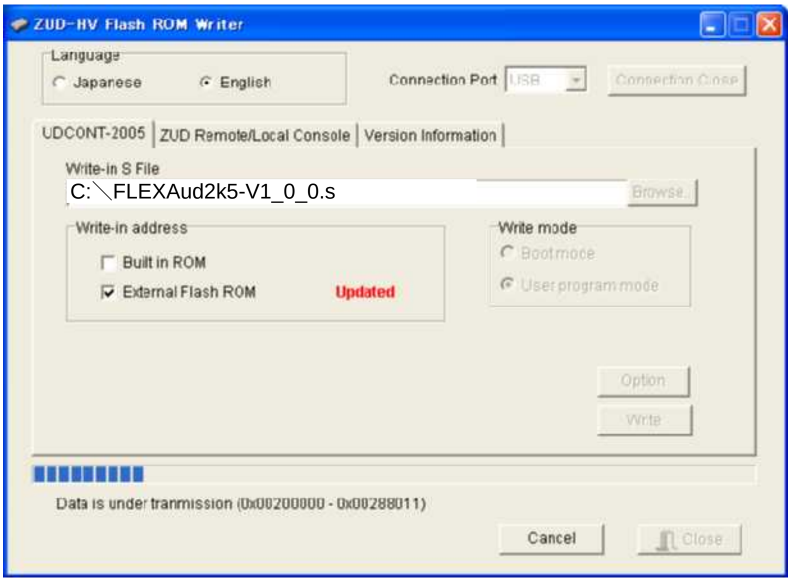
e) Click “Connection start” button, transmits the firmware updating program to UDCONT-2005 PCB.



f) When the transfer of the firmware updating program is completed, indicate “Updated” in the all area.



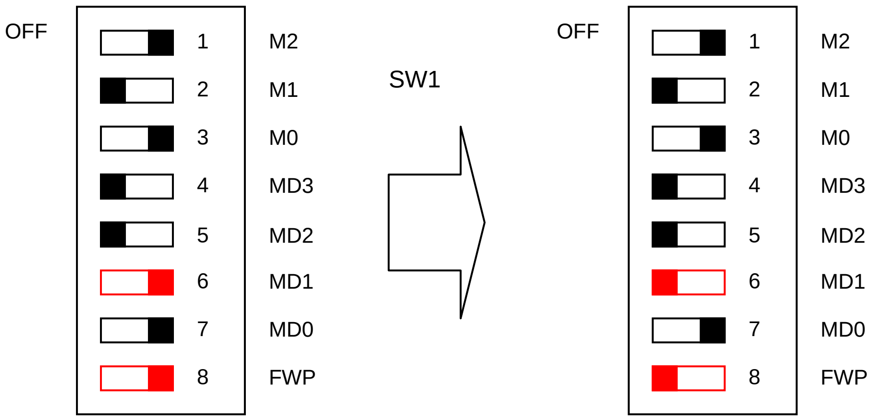
g) When click “Write” button, start updating of the firmware. Until the updating of the firmware is completed, do not turn off the power of the device, absolutely.



h) When the updating of firmware is completed, following dialog box is displayed.

First, click “OK” to close the dialog, then, click “Close” button of “ZUD-HV Flash ROM Writer” and finish “ZUD-HV Flash ROM Writer” S/W.

i) Turn off the power of the device and turn off DIPSW1-6 and 1-8 on UDCONT-2005 PCB.



j) Confirm that the device operates normally.

APPENDIX Chapter 3

A3

FLEXAVISION Remote / Local Console Firmware Update procedure

Chapter Contents

3. FLEXAVISION Remote / Local Console Firmware Update procedure

3.1 Introduction

This section is described the procedure of update of remote / local console firmware which uses for FLEXAVISION.

3.2 Equipment Required for Firmware updating

In order to update the firmware, following articles are required.

a) Serial cross-cable (Dsub 9pin-Dsub 9pin) or USB cable

b) PC (Installed Windows 2000 or Windows XP)

c) S/W for the firmware updating

Use ZUD-HV Flash ROM Writer as the firmware updating S/W. It is necessary for the PC which execute updating has been installed this S/W, in advance.

d) Firmware data for updating

FLEXApanel-Vx_xx.s is included inside the maintenance CD. (x_xx means the version of the firmware.)

3.3 Firmware updating procedure

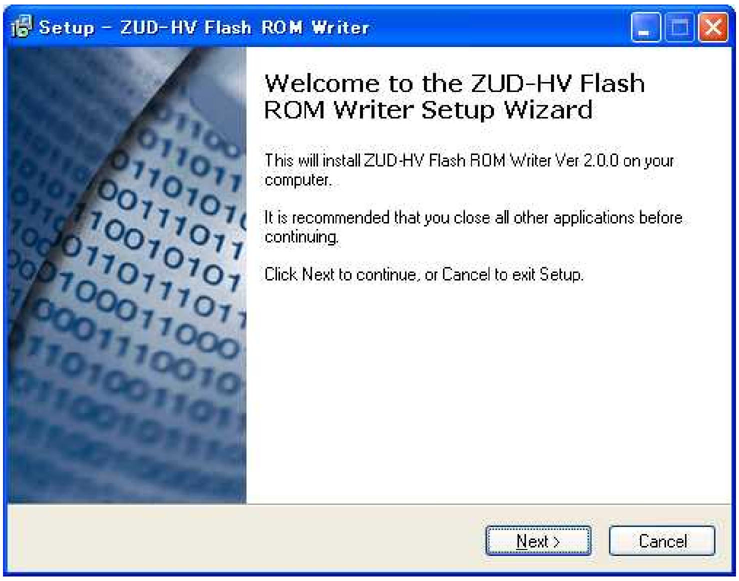
Firmware updating is executed following procedure.

a) Installation of ZUD-HV Flash ROM Writer

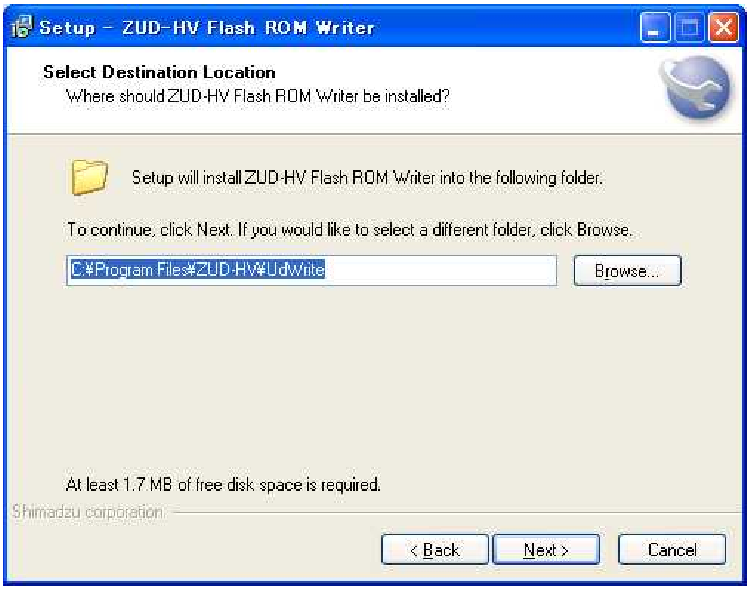
Install ZUD-HV Flash ROM Writer to the PC which is used for installation. When it has been already installed, following work is not necessary.

1) Execute the file UdWrt xxx.exe inside the maintenance CD of the folder UdWrite. (xxx means the version of the S/W.)
2) Start up the installer for ZUD-HV Flash ROM Writer.
3) Select English and click “OK”.

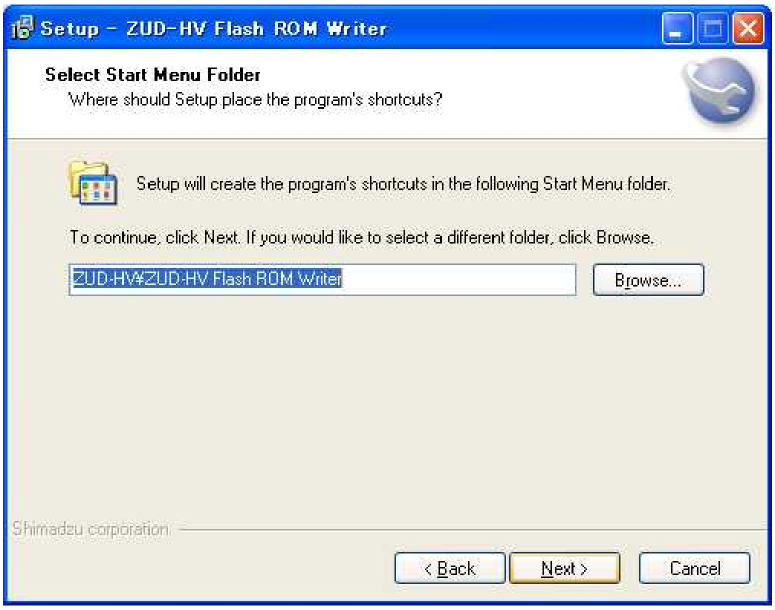
4) Setup screen is displayed and if you prepared, click “NEXT”.



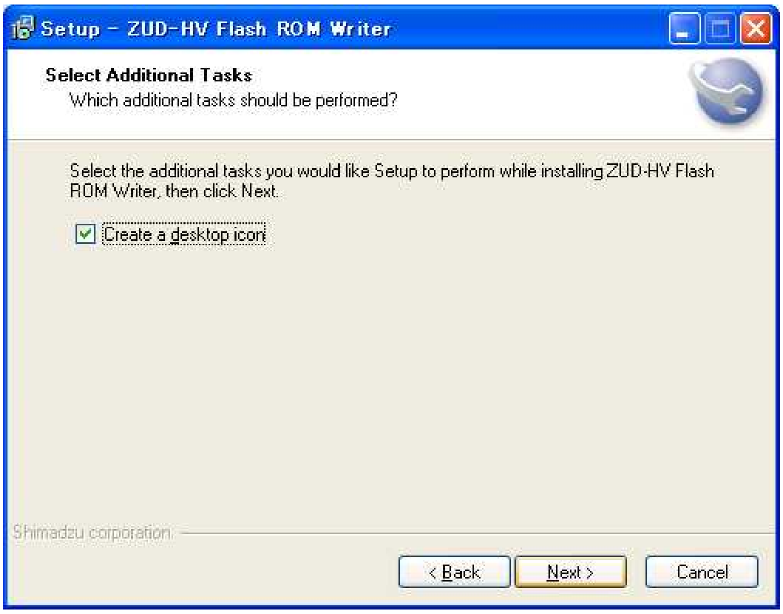
5) Specify the installation destination of ZUD-HV Flash ROM Writer.



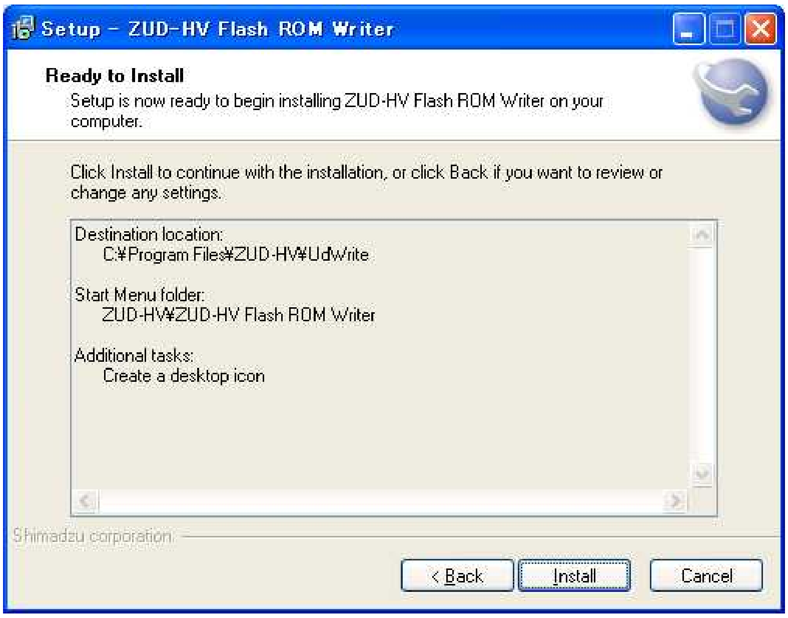
6) Specify the program group of ZUD-HV Flash ROM Writer.



7) Specify “Create the short-cut icon of ZUD-HV Flash Writer” on the desktop.



8) Confirmation screen of installation is displayed, if you prepared, click “Install”.



9) After installation is completed, following screen is displayed. Click “Finish” with the check box of “Launch ZUD-HV Flash ROM Writer” is off.

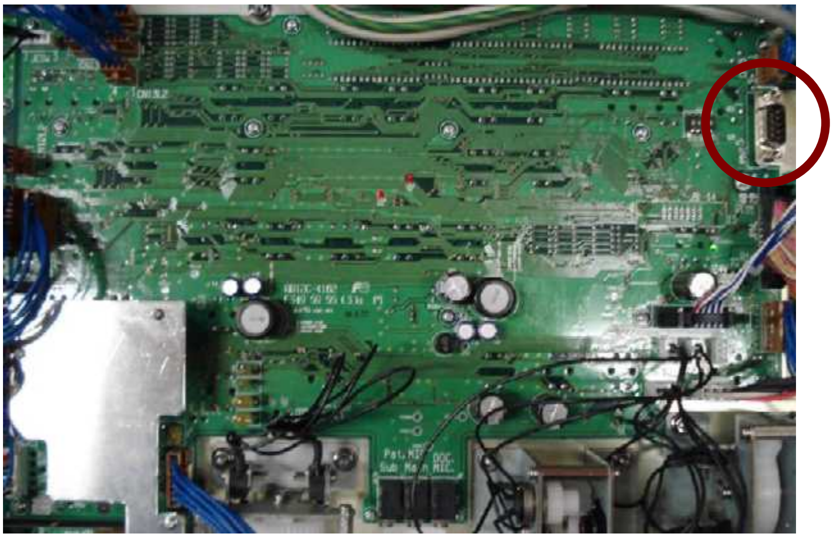
3. FLEXAVISION Remote / Local Console Firmware Update procedure

b) Connection of updating cable

Connect the PC and the communication port of the device which upgrades the firmware by the serial cable.

The position of the communication port of the device is either below.

- Dsub 9pin connecter JMNT on Remote Console PCB (Serial port)
- Dsub 9pin connecter JMNT on Local Console PCB (Serial port)



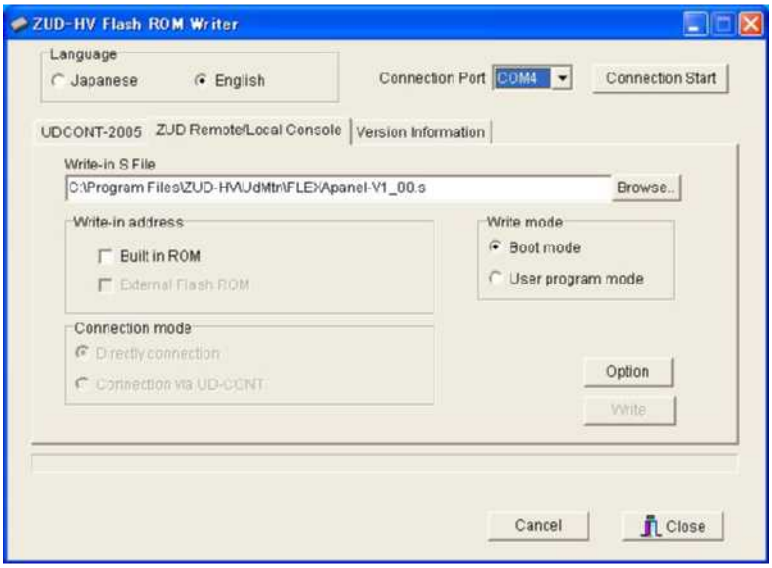
Remote Console PCB (Bottom View)

Local Console PCB (Bottom View)

c) Turn on power of the device.

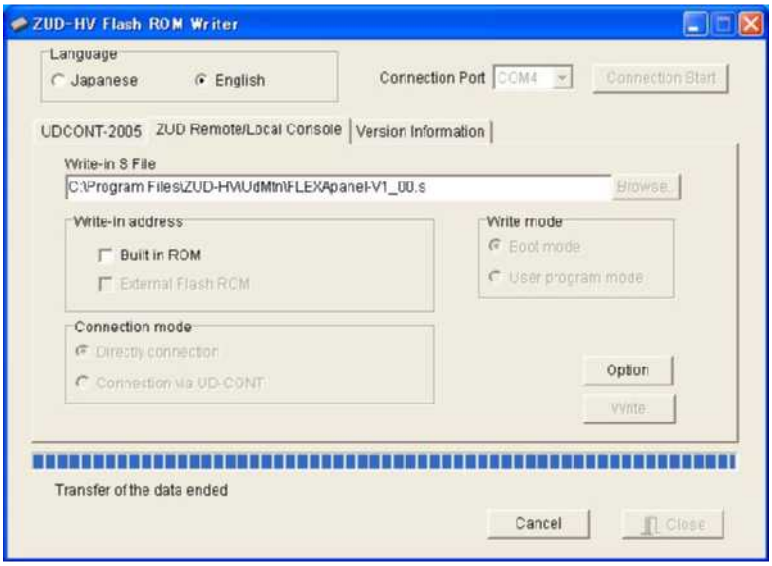
d) Start up ZUD-HV Flash ROM Writer.

e) First, select the tab “ZUD Remote/Local Console” and then select the connection port which uses and select the radio button “User program mode”.



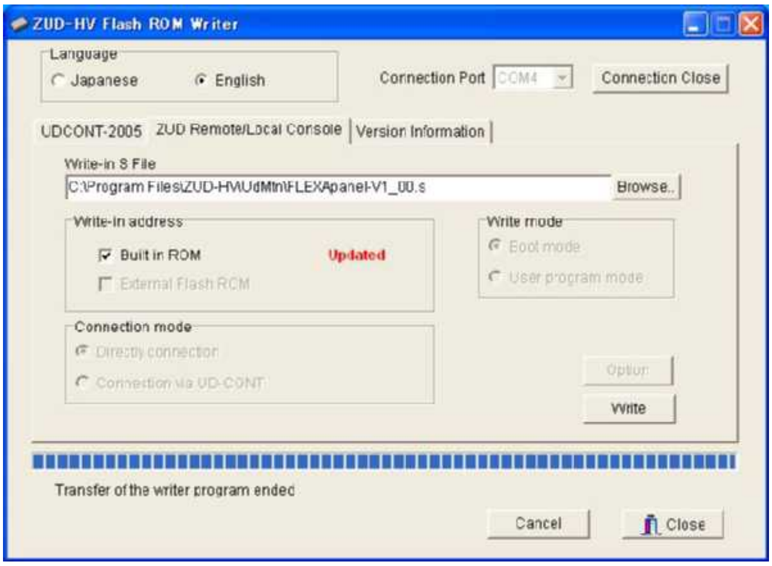
f) Click “Browse..” button and open the firmware data for update.
Open “FLEXApanel-Vx_xx.s” in maintenance CD.
(Vx_xx means the version of firmware.)

g) Click “Connection start” button, transmits the firmware updating program to Remote/Local Console PCB.



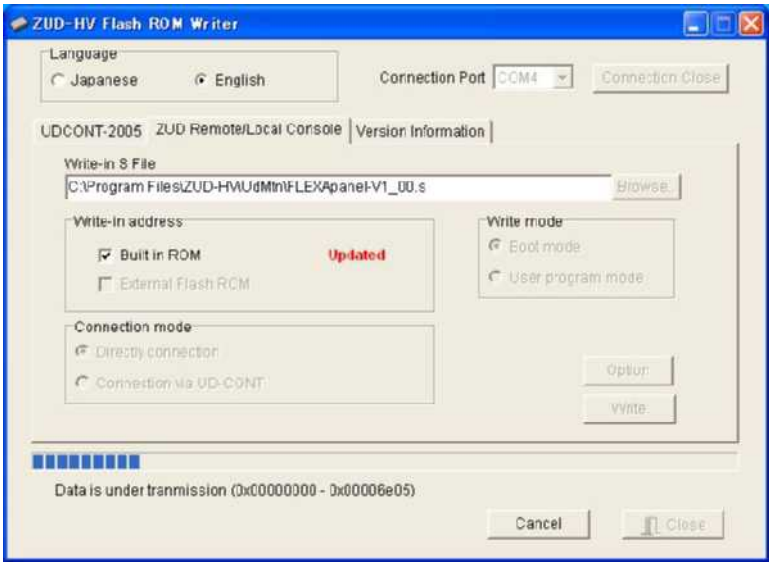
Though click “Connection start”, the transfer of the updating program does not start, (When the progress bar of ZUD-HV Flash ROM Writer of the bottom part does not proceed.) execute “Force updating of Remote/Local Console” of section 3.4.

h) When the transfer of the firmware updating program is completed, compares the current firmware with updating firmware, and displays “Updated” of the address area where is updated. Address area where is displayed “Updated” is the part where firmware update is necessary.



Check the check box of address area where updates firmware. After that, click “Write” button.

i) After click "Write" button, start updating of the firmware. Until updating of the firmware is completed, do not turn off the power of the device, absolutely.



j) When the updating of firmware is completed, following dialog box is displayed.

First, click "OK" to close the dialog, then, click "Close" button of "ZUD-HV Flash ROM Writer" and terminate "ZUD-HV Flash ROM Writer" S/W.

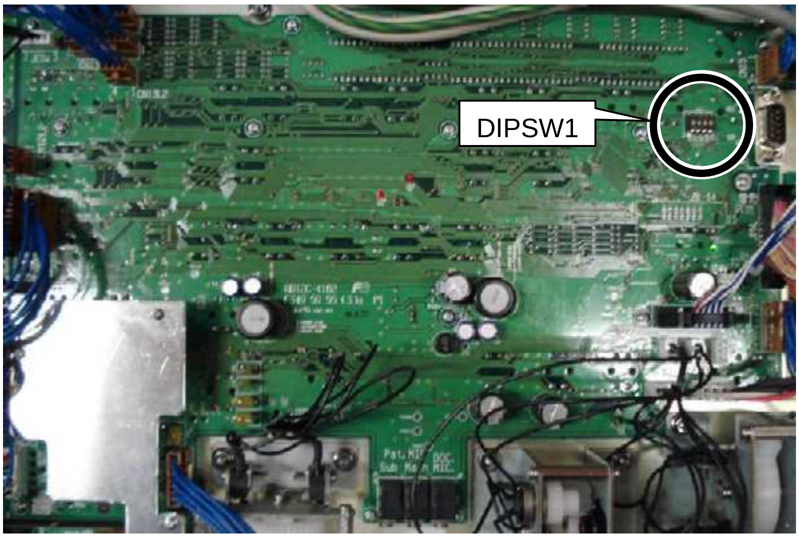
k) Turn off the power of the system and turn on the power once again. Confirm that the device operates normally.

3.4 Force Update Procedure of Remote/Local Console

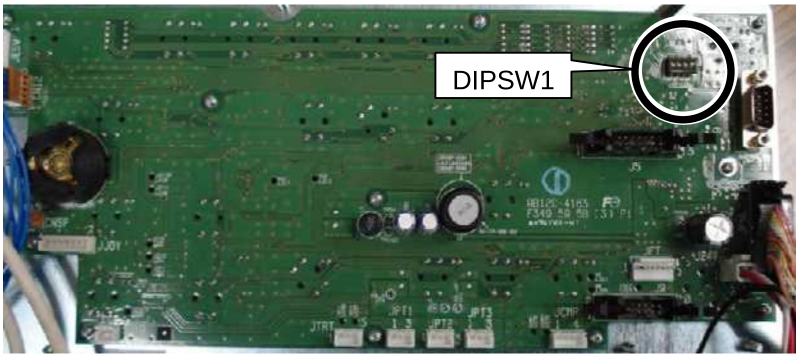
During the firmware updating, if the power is shut off and the like, when updating of the firmware does not execute completely, updating procedure of section 3.3 cannot be uses.

And, because it is new PCB and the like, when CPU built-in flash ROM cannot be updated the firmware, update the firmware to the CPU built-in flash ROM following procedure below.

a) Turn on DIPSW1-1 on the remote/local console. After that, turn on the power of the device.



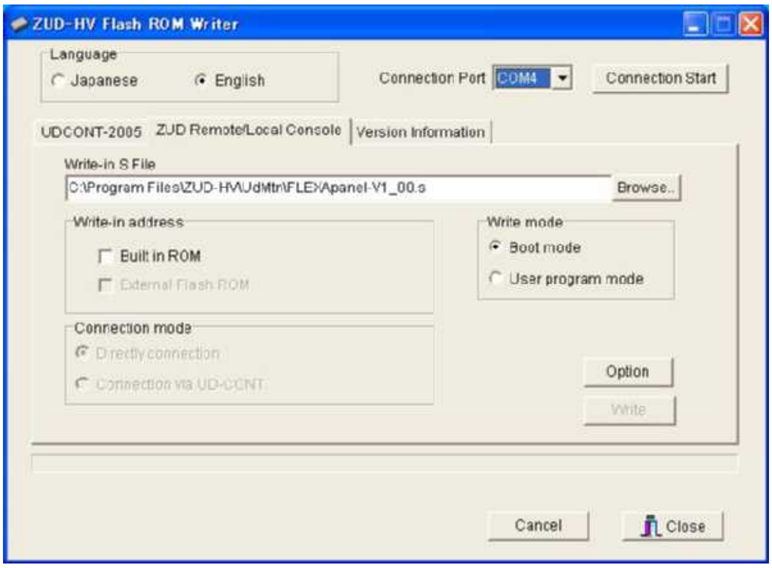
Remote Console PCB (Bottom View)



Local Console PCB (Bottom View)

b) Start up ZUD-HV Flash ROM Writer.

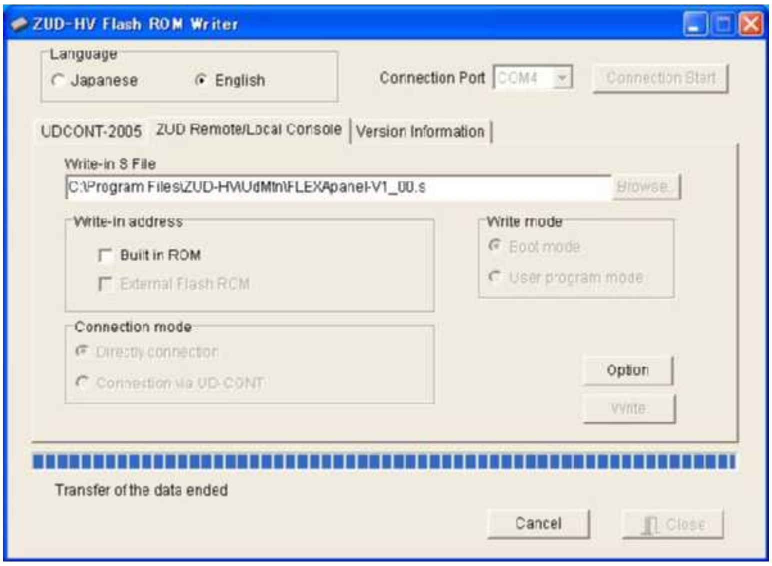
c) Select the tab “ZUD Remote/Local Console” and then select the connection port which uses and select the radio button “Boot mode”.



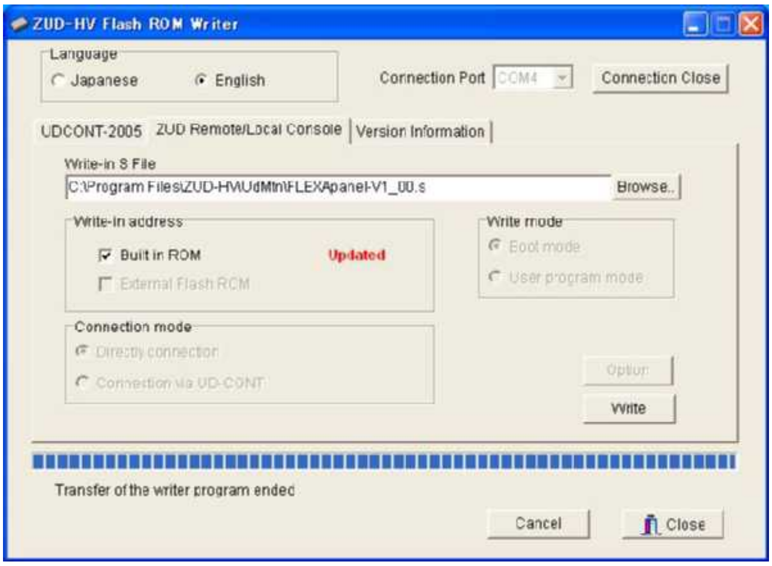
d) Click “Browse..” button and open the firmware data for update.
Open “FLEXApanel-Vx_xx.s” in maintenance CD.
(Vx_xx means the version of firmware.)

3. FLEXAVISION Remote / Local Console Firmware Update procedure

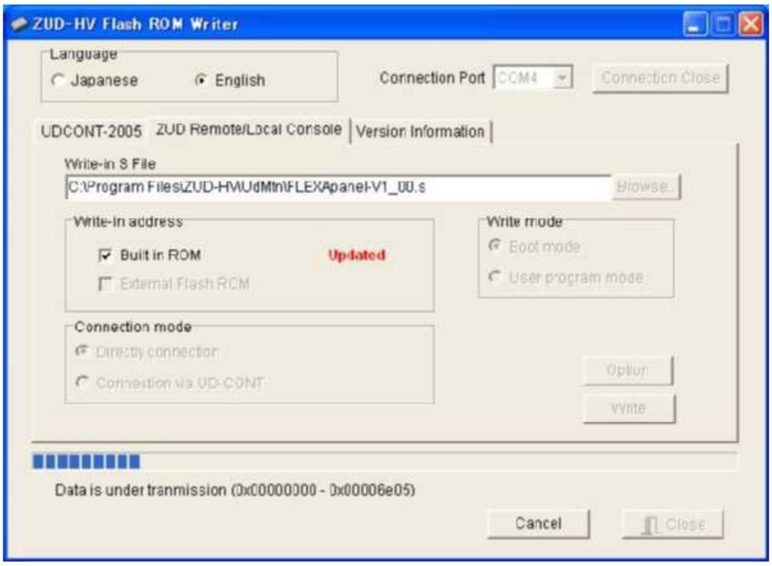
e) Click “Connection start” button, transmits the firmware updating program to Remote/Local Console PCB.



f) When the transfer of the firmware updating program is completed, indicate “Updated” in the all area.



g) When click “Write” button, start updating of the firmware. Until the updating of the firmware is completed, do not turn off the power of the device, absolutely.



h) When the updating of firmware is completed, following dialog box is displayed.

First, click “OK” to close the dialog, then, click “Close” button of “ZUD-HV Flash ROM Writer” and terminate “ZUD-HV Flash ROM Writer” S/W.

i) Turn off the power of the system, turn off DIP S/W 1-1 on the remote/local console.

j) Confirm that the system operates normally.

NO TEXT

APPENDIX Chapter 4

A4

GSC-2002S(Z) for the

2-Tubes Option FLASH

S/W Updating Procedure

Chapter Contents

4. GSC-2002S(Z) for the 2-Tubes Option FLASH S/W Updating Procedure

4.1 Introduction

Inscribe the procedure of execute the upgrade of Flash ROM S/W inside the control panel.

4.2 Parts required and S/W

S/W for FLEXAVISION 2 tubes option installs Flash ROM of GSC-2002S(Z) CPU which is required following parts.

(1) Maintenance CD which includes the updating S/W of GSX-2002S(Z).

(2) PC which is installed Windows 2000 or Windows XP.

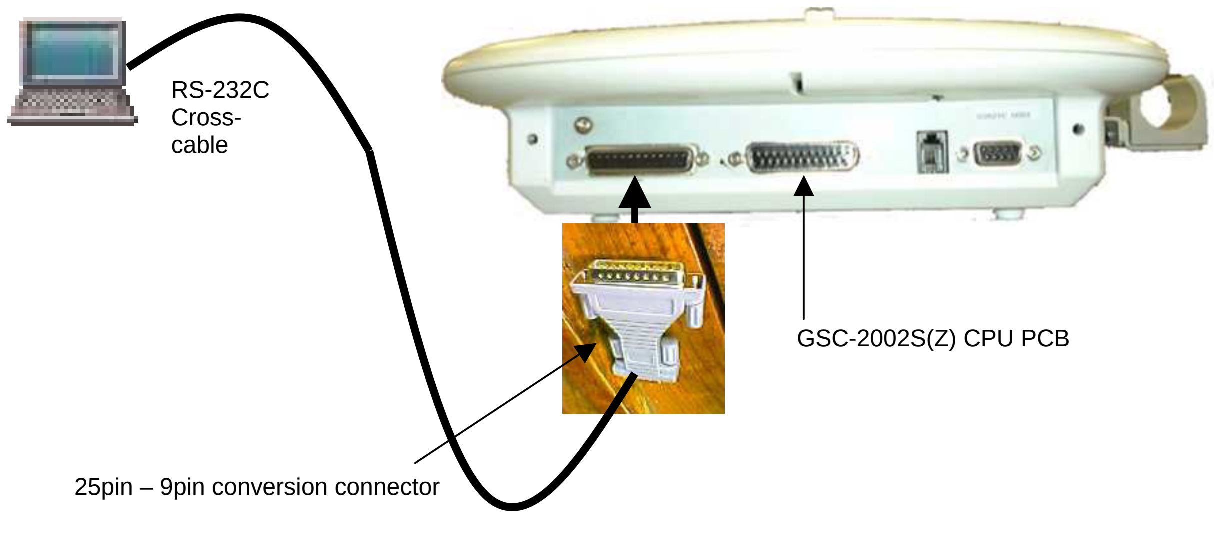
(3) RS-232C crossing cable of 9pin -9pin which connects PC and GSC-2002S(Z).

(4) The conversion connector which converts D-Sub 25 pin male to D-Sub 9 pin male.

4.3 Preparation

4.3.1 Connection

Connect the PC as the following figure.



4.3.2 Setting of PC and Turn on the Power

Turn on the power of the PC and insert the maintenance CD to the drive of the PC.

4.4 Update of S/W

4.4.1 Transfer of S/W

(1) Preparations

While the power of the device has not been turned on, turn on the power of UD with every reset keys and radiography density keys (▲, ▼ key)of the control table pressed. (There is no display on the sheet panel.)

(2) Run "MaxSpeed.ini" file (Serial communication setting file for TeraTermPro.) in maintenance CD.

(3) Following dialog box is displayed.

Select "Open".

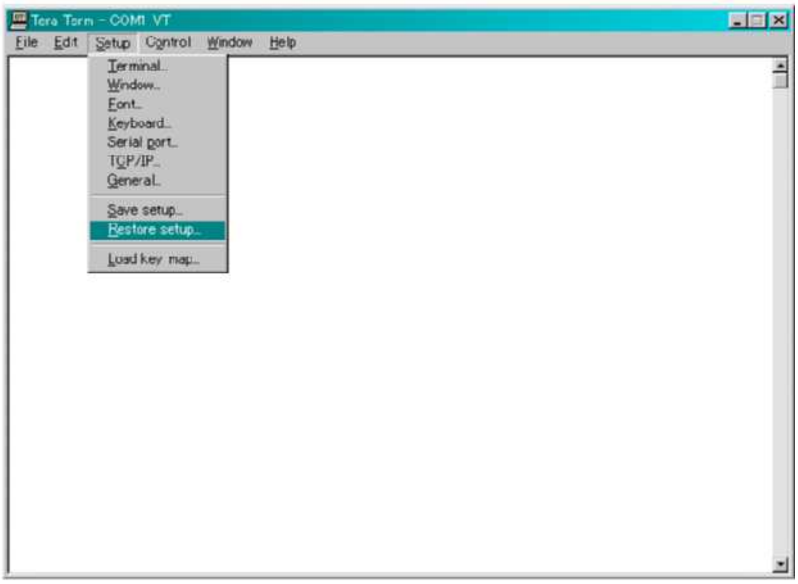
(4) Start up Terminal program (Tera-Term) on the PC.

(5) After start up, setting communication port and serial port.

Select the "Restore setup" from task bar.

Read the "MaxSpeed.ini" file which includes the maintenance CD.

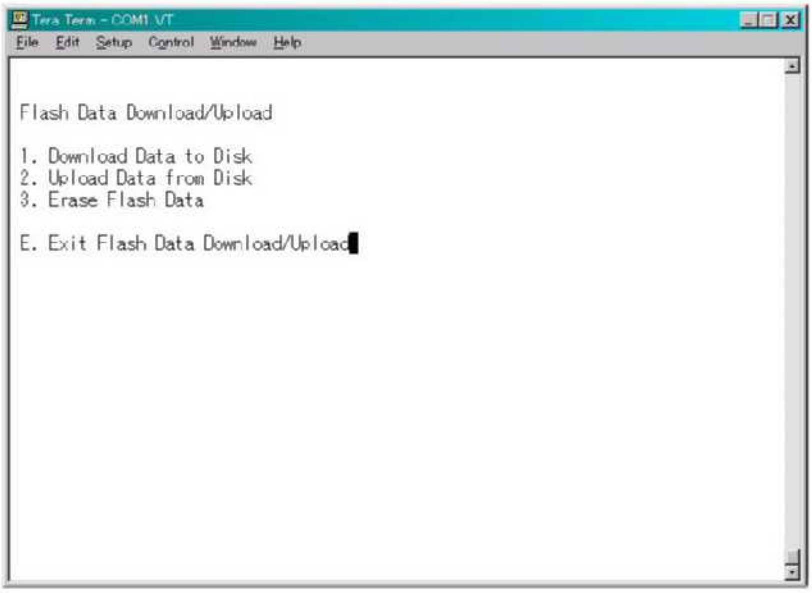
When click "OK" button, install of the setting file is completed.



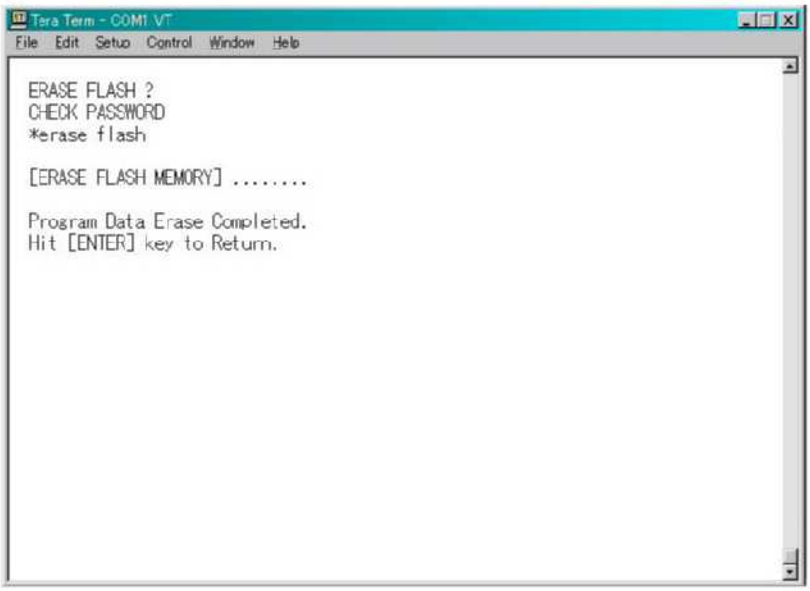
(6) Press "Enter" key of PC.

Confirm that ">T" is displayed.

(7) Input the command “flash” from the PC.
Following menu is displayed.
Input “3” from the PC.

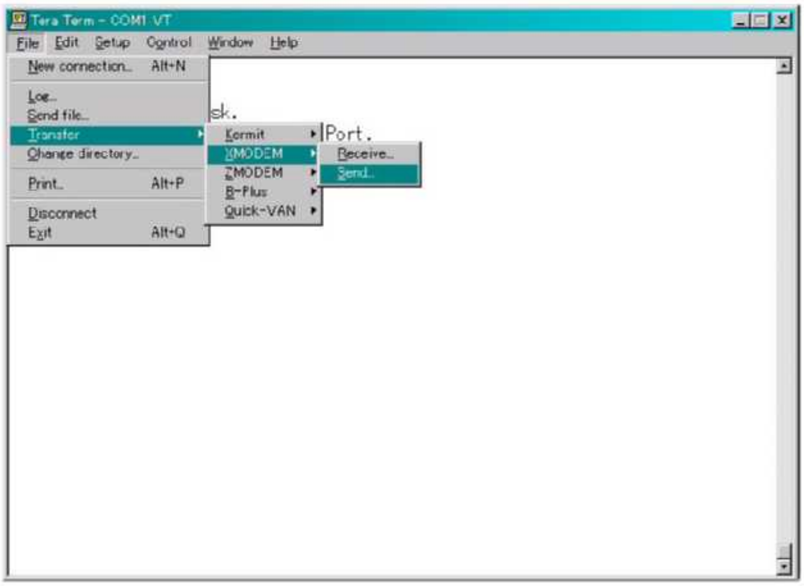


(8) Displayed the screen which is required a password. Input “erase flash” from the PC. Erase of the program is executed.



(9) When completed erase of the program, return to the menu of section (5).
This time, input “2”.

(10)Select “File→Transfer→XMODEM→Send” from the task bar.



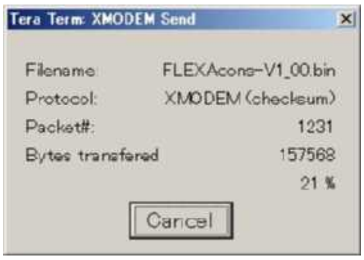
(11)Inquire the file name which installs.

Select the file of “FLEXAcons-Vx_xx.bin” in the maintenance CD.

(Vx_xx means the version)

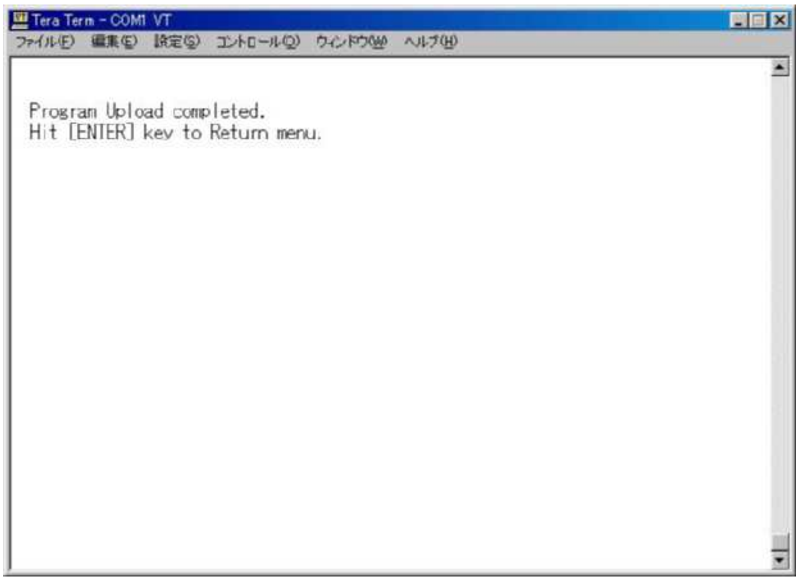
After transfer starts, following screen is displayed.

It is necessary for transfer for about 3minutes and 30 seconds.



(12)When following screen is displayed, transfer is completed.

Turn off the power of ZUD.



4.4 Confirmation Operation

Turn on the power of ZUD.

Confirm that following items.

(1) Display of the sheet panel is normal. (The Sub-display indicate without blurring.)
(2) All kind of LED display states is normal.
(3) The sheet keys operating are normal.
(4) Each KV+-, mA+-, sec+- keys operating normal.
(5) Each APR keys operating normal.
(6) Each operation keys operating normal.
(7) Reset key, AEC keys operating normal.
(8) When execute the radiography, it can be operated normal.

4. GSC-2002S(Z) for the 2-Tubes Option FLASH S/W Updating Procedure

NO TEXT