GXR-SD/CSD/USD

DIGITAL RADIOGRAPHY SYSTEM

Operation Manual

Digitally signed by Bolea Petru
Date: 2024.10.07 16:14:56 EEST
Reason: MoldSign Signature
Location: Moldova

DRGEM Corporation
7Fl, E-B/D Gwangmyeong Techno-Park, 60 Haan-ro,
Gwangmyeong-si, Gyeonggi-do, 14322, Korea
TEL: +82-2-869-8566, FAX: +82-2-869-8567

D/N: RMD1311-005, Rev.27

CE 2460

(This page intentionally left blank)

REVISION HISTORY

Revision Number	Date	Description
0	NOV 04, 2013	First Edition (New release by combining operation manuals of GXR-S/CS/US, GXR-CS and GXR-US)
1	MAR 25, 2015	Add GXR-C52S
2	JUL 29, 2015	Add TS-CSA
3	JUN 20, 2017	Transition of NB (DNV-GL NB# 0434 -> DNV GL NE MKO PRESAFE AS NB#2460),
4	AUG 21, 2017	Add the collimator (DXC-RM)
5	NOV 10, 2018	Change Standard(EMC 4 , Safety 3.1) Add Tube Stand(TS_CSE) Change name of manufacture for Tube. (TOSHIBA -> CANON, VARIAN -> VAREX)
6	JUL 19, 2019	Add the Ceiling Rail of Option for TS_FM6 Change of Bucky size for Wall bucky Stand.
7	APR 27, 2020	Added Worklist Function. Added Mechanical detent (option)
8	MAY 04, 2020	Apply the tube arm detent for TS_FM6, TS_FC6
9	JUN 25, 2020	Added Handlebar 2 (option)
10	JUL 24, 2020	Change of column rotation assembly for TS_FM6 Change of Table top assembly for Table
11	NOV 6, 2020	The contents of documents for GXR-S,CS,US(RMD1311-005,Rev.10) GXR-S,CS,US Premium (RMD1412-003,Rev.10) GXR-SD,CSD,USD (RMD1311-001,Rev.13) and GXR-SD,CSD,USD Premium (RMD1412-002,Rev.14) are integrated into this document.
12	NOV 20, 2020	Changed section 1.6 for SPECIFICATIONS
13	DEC 24, 2020	Add Membrane design for Arm center detent option Added Hip measurement function Added Auto Stitching function to manual type Added Mano Detector Power off function Grouped image tools

		Changed section 1.6 for SPECIFICATIONS Added section 1.7 APPLICABLE STANDARDS 1) ME Equipment classification Added section 7. MAINTENANCE
14	JAN 29, 2021	Add the Touch Console
15	MAR 30, 2021	Changed section 1.6 Changed section 6.8.3
16	APR 30, 2021	Mars1417X , Mars1717X detector added
17	MAY 31, 2021	Add STITCHING STAND Deleted the ICX1162(ICX1192B) (AEC Ion Chamber)
18	JUN 23, 2021	Add the WSR bucky Tray for PBT-4, PBT-6, WBS, WBS-TM Add the WBS Manual Plus
19	JUN 28, 2021	Change Of Representative Identification Label
20	AUG 27, 2021	Change Desktop Specifications Change Monitor Specifications
21	SEP 24, 2021	Add the Vertical UP/DOWN Hand switch option Changed section 1.2.2 SYMBOL DEFINITIONS, 1.2.10 SAFETY WARNING LABELS Changed section 1.6 SPECIFICATIONS Changed section 6.9.3 WALL BUCKY STAND (WBS-TA) Change of specification form Add to add two programmable positions about P3, P4. Add to show Pop-up if the detent button is pushed when the detent is non-installed. Change about Pop-up Notice on Auto Position Change Remote Control Membrane
22	DEC 02, 2021	Changed from RADMAX version 1.01 to version 1.02 Changed overall GUI for touch environment Add Image Processing Module4 Add the **Imaging Workstation** Add the Dark Skin GUI Add the DICOM TLS
23	DEC 16, 2021	Changed WBS Manual Plus specifications Changed Electrical Rating of R302A, R302MLP/A, R302MFMLP/A

24	JAN 28, 2022	Change of cassette tray handle image Add 230 lpi Grid
25	FEB 25, 2022	Add the SCP(SERVICE CLASS PROVIDER) Changed section 1.6 for SPECIFICATIONS Change form Change of Application Standard Luna1012X detector added Detach GXR-S/CS/US Manual (RMD2202-001)
26	MAR 11, 2022	Add of Live streaming camera
27	APR 28, 2022	Add the Audit Trail Add the Patient movement alarm Lumen 2530W, 4336W, 4343W detector added

ABOUT THESE INSTRUCTIONS FOR USE

The following advisory symbols are used throughout this manual.
Their application and meaning are described below.

"Bold"	Is used for Product's Name.
<*Italic*>	Is used for references and for table or figure titles.
'Button'	Is used for Button's Name.
●	Indicates a list item.
*	Indicates additional explanations.
1. 1) a. i .	Indicates steps within operating sequences.

WARNING	Warning symbol is used to indicate a potential hazard for operators and service personnel that can lead to serious injury, death or radiation exposure.
CAUTION	Caution symbol is used to indicate a potential hazard for operators and service personnel that can lead to injury or damage of equipment.
NOTE	Note symbol is used to indicate important information needed for proper use and correct operation of equipment.

NOTE
Keep this Software Manual with the equipment at all times, and review the important information whenever required. Consult Accompanying Documents - As Applicable

TABLE OF CONTENTS

(This page intentionally left blank)

1. SYSTEM OVERVIEW

1.1 PRODUCT FEATURES

"GXR-SD/CSD/USD" system provides excellent performance and stable operation while state-of-the-art image quality and providing high quality digital radiographic images with reduced dose.

The ***"GXR"***, "***GXR-C"***, ***"GXR-U"*** Series high frequency X-ray generator features excellent accuracy, reproducibility and long-term stability.

Automatic Calibration function of the generator will minimize calibration time and set correct calibration value.
Also the control console of ***"GXR"***, ***"GXR-C"***, ***"GXR-U"*** series offers graphic waveform and data of x-ray exposure.
So, it is not needed to perform the manual calibration procedure with measurement equipment.
Naturally, the generator supports Automatic, Semi-auto and Manual Calibration functions.

Adaptable calibration function keeps up long-term stability and accuracy by trimming calibration data whenever x-ray exposed.

The "***GXR-C***" Series high frequency X-ray generator features excellent accuracy, reproducibility and long-term stability with capacitor assisted general line power supply.
Only 3kVA line power capacity is enough for x-ray generation up to 40kW, and "***GXR-C***" series provides minimum 100mAs output at maximum output rating without mA sliding down.
Also, maximum interval for full charging is 10 seconds after maximum output x-ray generation.

Only 900VA line power capacity is enough for the battery charging, and ***"GXR-U"*** series provides same output rating and performances of line-powered generators.

Remote Diagnosis Software can make report about information of system, user, service and error by transfer report to manufacturer via internet. So this function enables fast and accurate diagnosis on problems and saves service cost and system downtime.

The APR (Anatomical Programming) and the optional AEC (Automatic Exposure Control) features give you controlled exposure factors, automatically optimized for the radiological study selected.

"GXR-SD/CSD/USD" provides state-of-the-art image quality; image processing and user interface; making the system easy to use and reliable while providing high quality digital radiographic images with reduced dose.

"GXR-SD/CSD/USD" incorporates the digital flat panel detector technology.
Direct radiography via flat panel detector improves your workflow, exam speed and comfort with efficiency. Digital flat panel detector provides excellent spatial resolution, MTF, DQE and stability based on fine pixel pitch. Selection of an anatomical study on the imaging software automatically sets up the x-ray generator's pre-programmed exposure technique setting and post image processing for selected study. Also, high resolution grid supplies excellent image quality.

A high performance imaging workstation and ***"RADMAX"*** software serves you a convenient interface and easy operation. Anatomical view-based digital image processing automatically optimizes and enhances the quality of the captured images. Automatic image storage and print with DICOM 3.0 networking capability increases exam throughput and decreases examination time. Remote diagnosis function enables fast and accurate diagnosis on problems and saves service cost and system downtime.

- Excellent Performance and Stability
- Real-time monitoring self-diagnosis function and Error code display
- Overload & HU protection and error message display
- Automatic calibration without measurement equipment.
- Adaptable calibration keeps up accuracy through long-term usage
- Smaller, lighter and convenient modular design and user-friendly system configuration
- Constant dose output due to kV and mA regulation during exposures.
- Time and mA / mAs selections are based on R'10 rule of ISO 497.
- Remote diagnosis software for system diagnosis via internet.
- Easy parameter setting and Firmware upgrade
- System diagnosis, Error log and Statistical data display
- Only maximum 3kVA voltage line power is required for operation (Only to GXR-C)
- Maximum charging interval after maximum x-ray output : 10 seconds (Only to GXR-C)
- Only maximum 0.9kVA free-voltage line power is required for charging (Only to GXR-U)
- Sectionalized power part enables uninterruptible operation regardless of line power status (Only to GXR-U)
- Maximum charging time : 6 hours for GXR-U32, 8 hours for GXR-U40 (Only to GXR-U)

NOTE
The following section contains important information. Please read and understand this material before continuing.

1.2 SPECIFICATIONS

The hardware specified for use with the ***"GXR-SD/CSD/USD"*** System has been selected, tested, and verified by DRGEM Corporation to meet the intended applications. All specified hardware meets applicable regulatory agency requirements for those countries where it is offered for sale with respect to its intended applications.

WARNING
Do not operate this system except in accordance with information included in this section, and any additional information provided by the manufacturer and / or competent safety authorities.

1.2.1 DETECTOR

- **Digital flat panel detector (VAREX)**

Model		PaxScan4343R v3		PaxScan4343RC	
Active Pixel Area / Matrix		17 x 17 inch (3,052 x 3,052)		17 x 17 inch (3,052 x 3,052)	
Pixel Pitch		139um			
Limiting Resolution		3.6 lp/mm			
Screen		DRZ+	CsI	DRZ+	CsI
Energy Range		40 – 150kVp			
A/D Conversion		16-bits			
MTF	@ 1 lp/mm	54%	56%	54%	56%
	@ 2 lp/mm	23%	27%	23%	27%
	@ 3 lp/mm	9%	14%	9%	14%
DQE	@ 0 lp/mm	38%	78%	38%	78%
	@ 1 lp/mm	27%	55%	27%	55%
	@ 2 lp/mm	16%	42%	16%	42%
	@ 3 lp/mm	7%	28%	7%	28%
Interface		Gigabit Ethernet		Gigabit Ethernet	
Weight		6.1 kg (13.4 lbs.)	6.2 kg (13.6 lbs.)	3.5 kg (7.7 lbs.)	3.76 kg (8.2 lbs.)

Model		PaxScan4336W v4		PaxScan4343W		
Active Pixel Area / Matrix		17 x 14 inch 3,052 x 2,456	17 x 14 inch 3,032 x 2,436	17 x 17 inch 3,062 x 3,062	17 x 17 inch 3,052 x 3,052	
Pixel Pitch		139um				
Limiting Resolution		3.6 lp/mm				
Screen		DRZ+	CsI	DRZ+	Standard CsI	Premium CsI
Energy Range		40 – 150kVp				
A/D Conversion		16-bits				
MTF	@ 1 lp/mm	56%	57%	56%	61%	57%
	@ 2 lp/mm	24%	28%	24%	32%	28%
	@ 3 lp/mm	12%	16%	10%	17%	14%
DQE	@ 0 lp/mm	39%	78%	39%	64%	79%
	@ 1 lp/mm	28%	58%	28%	54%	63%
	@ 2 lp/mm	18%	42%	18%	42%	48%
	@ 3 lp/mm	8%	24%	9%	29%	33%
Interface		WiFi(802.11 a/g/n/ac)		WiFi(802.11 n/ac)		
Weight		2.9 kg (6.3 lbs.)	3.0 kg (6.6 lbs.)	3.1 kg (6.8 lbs.)	3.3 kg (7.3 lbs.)	

Model		XRpad2 3025 HWC-M	XRpad2 4336 HWC-M	XRpad2 4343 HWC-M
Active Pixel Area / Matrix		12 x 10 inch (3,004 x 2,508)	17 x 14 inch (4,288 x 3,524)	17 x 17 inch (4,288 x 4,288)
Pixel Pitch		100um		
Limiting Resolution		5 cy/mm		
Screen		CsI,		
Energy Range		40 – 150kVp		
A/D Conversion		16-bits		
MTF	@ 1 lp/mm	70%	70%	70%
	@ 2 lp/mm	40%	40%	40%
	@ 4 lp/mm	15%	15%	15%
DQE	@ 0 lp/mm	75%	75%	75%
	@ 1 lp/mm	60%	60%	60%
	@ 3 lp/mm	40%	40%	40%
Interface		Ethernet / WIFI(802.11n)		
Weight		1.8kg (4.0 lbs.)	3.2kg (7.0 lbs.)	3.8kg (8.4 lbs.)

Model		LUMEN2530W		LUMEN4336W		LUMEN4343W	
Active Pixel Area / Matrix		12 x 10 inch (2,264 x 1,860)		17 x 14 inch (3,032 x 2,436)		17 x 17 inch (3,032 x 3,032)	
Pixel Pitch		131 um		139 um			
Limiting Resolution		3.8 cy/mm		3.6 cy/mm			
Screen		DRZ+	Csl(Std/Pre)	DRZ+	Csl(Std/Pre)	DRZ+,	Csl(Std/Pre)
Energy Range		40 – 150kVp					
A/D Conversion		16-bits					
MTF	@ 1 lp/mm	57%	63%/59%	57%	63%/59%	57%	63%/59%
	@ 2 lp/mm	24%	34%/29%	24%	34%/29%	24%	34%/29%
	@ 4 lp/mm	6%	12%/9%	6%	12%/9%	6%	12%/9%
DQE	@ 0 lp/mm	38%	65%/75%	38%	65%/75%	38%	65%/75%
	@ 1 lp/mm	28%	52%/57%	28%	52%/57%	28%	52%/57%
	@ 3 lp/mm	9%	28%/32%	9%	28%/32%	9%	28%/32%
Interface		Ethernet / WIFI(802.11 n/ac)					
Weight		1.56kg (3.4 lbs.)		2.8kg (6.2 lbs.)		3.2kg (7.1 lbs.)	

- **Digital flat panel detector (iRay)**

Model		Mano4343T	Mano4343X	Mano4343W	Mano4336W
Active Pixel Area / Matrix		17 x 17 inch (3,072 x 3,072)			17 x 14 inch (2,800 x 2,304)
Pixel Pitch		139um			150um
Limiting Resolution		3.6 lp/mm			3.3 lp/mm
Screen		CsI			
Energy Range		40 – 150kVp			
A/D Conversion		16-bits			
MTF	@ 1 lp/mm	70%	75%	71%	75%
	@ 2 lp/mm	45%	50%	44%	49%
	@ 3 lp/mm	26%	30%	26%	29%
DQE	@ 0 lp/mm	65%	56%	65%	63%
	@ 1 lp/mm	47%	40%	47%	48%
	@ 2 lp/mm	35%	30%	35%	37%
Interface		Gigabit Ethernet		Gigabit Ethernet / WiFi(802.11ac)	
Weight		Approx. 4kg(Without Cable) (8.8lbs)		4.6kg (10.1lbs.)	3.6kg (7.9lbs.)

Model		Mars1417X	Mars1717X	Luna1012X
Active Pixel Area / Matrix		14 x 17 inch (3,500 x 4,300)	17 x 17 inch (4,267 x 4,267)	10 x 12 inch (2,505 x 3,152)
Pixel Pitch		100um		
Limiting Resolution		4.3 lp/mm		
Screen		CsI		
Energy Range		40 – 150kVp		
A/D Conversion		16-bits		
MTF	@ 1 lp/mm	65%		60%
	@ 2 lp/mm	35%		30%
	@ 3 lp/mm	19%		14%
DQE	@ 0 lp/mm	68%		60%
	@ 1 lp/mm	54%		43%
	@ 2 lp/mm	38%		27%
Interface		Gigabit Ethernet / WiFi(802.11ac)		
Weight		3.0kg (6.6 lbs.)	3.4kg (7.5 lbs.)	2.2kg (4.9 lbs.)

NOTE

Depending on the country, there are detectors that cannot be installed and used. Please refer to the table below.

Nation	List of detectors that cannot be installed
Brazil	PaxScan4343W, XRpad2 series (XRpad2 3025 HWC-M, XRpad2 4336 HWC-M, XRpad2 4343 HWC-M), Mano series (Mano4343W, Mano4336W), Mars1417X, Mars1717X, Luna1012X

NOTE

Luna1012X detector is not applied CE, FDA and NRTL (CSA mark) Certificate.

1.2.2 WORKSTATION

CPU	Intel Core i5-10500 3.2GHz(up to 4.5GHz) or higher
Memory	8GB (1x8GB) DDR4 2400Mhz or higher
Display	Intel® HD Graphics 630 or Higher
Storage	256GB SSD, 1TB 7200RPM SATA HDD
Monitor	23 inch Color LED or Higher, Display resolution: 1920 x 1080 pixels (16:9)
Maker	Desktop: HP, Monitor: HP or Samsung

- **AP (Access Point) for Wireless Detector.**

Model	RT-AC68U (AC 1900)
Product Picture	
Manufacturer	ASUS
Standards	IEEE 802.11n, IEEE 802.11ac
Frequency	5GHz / 2.4GHz
Wireless LAN (max.)	1.3Gbps(5GHz)/600Mbps (2.4GHz)
Weight Antennas Type	3 external antennas
AC Power Adapter	19V / 1.75A
Regulatory Compliance	CE, FCC, RoHS, KCC

1.2.3 X-RAY GENERATORS

System Model	**GXR-32SD**	**GXR-40SD**	**GXR-52SD#**	**GXR-68SD#**	**GXR-82SD#**
Generator Model	**GXR-32**	**GXR-40**	**GXR-52**	**GXR-68**	**GXR-82**
Output Rating	32kW	40kW	52kW	68kW	82kW
Line Nominal, Phase	220~230V~, 380/400/480V3~		380/400/480V3~		
Line Voltage Range	±10% (Frequency: 50/60Hz)				
kV Range	40~125kV, 1kV step 40~150kV for 3 phase line power		40~150kV, 1kV step		
mA Range	10 to 400mA	10 to 500mA	10 to 640mA	10 to 800mA	10 to 1,000mA
Timer Range	0.001 to 10 sec, 38 steps				
mAs Range	0.1 to 500mAs (Optional up to 1,000mAs)				
AEC Shortest Irradiation Time	1ms				
Max. Power Output	400mA@80kV 320mA@100kV 250mA@125kV 200mA@150kV(3 Φ)	500mA@80kV 400mA@100kV 320mA@125kV 250mA@150kV(3 Φ)	640mA@81kV 500mA@104kV 400mA@130kV 320mA@150kV	800mA@85kV 640mA@106kV 500mA@136kV 400mA@150kV	1,000mA@82kV 800mA@102kV 640mA@128kV 500mA@150kV
Power Requirement	Minimum 125% of output rating				
Minimum Breaker Rating	75A(220-230Vac,1Φ) 50A(380Vac,3Φ) 50A(400Vac,3Φ) 40A(480Vac,3Φ)	100A(220-230Vac,1Φ) 65A(380Vac,3Φ) 65A(400Vac,3Φ) 50A(480Vac,3Φ)	75A(380Vac,3Φ) 75A(400Vac,3Φ) 65A(480Vac,3Φ)	75A(380Vac,3Φ) 90A(400Vac,3Φ) 75A(480Vac,3Φ)	100A(380Vac,3Φ) 100A(400Vac,3Φ) 90A(480Vac,3Φ)
Rotor Supply	Low Speed (Option: LSS Brake, Dual Speed for 3Φ)		Low Speed (Option: LSS Brake, Dual Speed)	Dual Speed	
Technique Selection	4 point display(kV, mA, Time, mAs): kV/mAs, kV/mA/Time, kV/AEC option				
Image Receptors	2 Bucky + 1 Non-Bucky				
Auxiliary Power Supply	External System Power		230VAC, 1A, 230W (PBT-4) 230VAC, 2A, 460W (PBT-6)		
			110VAC, 1A, 110W		
	Magnetic Lock(Brake) Power		28VDC, 6.3A, 176W		
	Collimator Lamp Power		24VAC, 6.3A, 150W		
Reproducibility	Coefficient of Variation: kV < 0.005, Time < 0.005, mAs < 0.01				
Accuracy	kV < ±(1%+1kV), mA < ±(3%+1mA), Time < ±(1%+0.5ms), mAs < ±(3%+0.1mAs)				
Linearity	Coefficient of Linearity < 0.01 : CL = (X1-X2)/(X1+X2), where X is mR/mAs				
Dimension / Weight	650(W) x 655(H) x 405(D) mm / 100kg(220lbs)				

* #: It can be combined with TS-CSP.

System Model	**GXR-C32SD**	**GXR-C40SD**	**GXR-C52SD#**
Generator Model	**GXR-C32**	**GXR-C40**	**GXR-C52**
Power Rating	32kW	40kW	52kW
Line Nominal, Phase	110-120, 220-230V~		
Line Voltage Range	±10% (Frequency: 50*/60Hz), * : Outside North America		
kV Range	40~125kV, 1kV step (Optional 40~150kV)		
mA Range	10 to 400mA	10 to 500mA	10 to 640mA
Timer Range	0.001 to 10 sec, 38 steps		
mAs Range	0.1 to 500mAs		
AEC Shortest Irradiation Time	1ms		
Max. Power Output	400mA@80kV 320mA@100kV 250mA@125kV 200mA@150kV(optional)	500mA@80kV 400mA@100kV 320mA@125kV 250mA@150kV(optional)	640mA@81kV, 500mA@104kV, 400mA@130kV 320mA@150kV(optional)
Rotor Supply	Low Speed		
Technique Selection	point display(kV, mA, Time, mAs): kV/mAs, kV/mA/Time, kV/AEC option		
Image Receptors	2 Bucky + 1 Non-Bucky		
Auxiliary Power Supply	External System Power	230VAC, 1A, 230W (PBT-4) 230VAC, 2A, 460W (PBT-6)	
		110VAC, 1A, 110W	
	Magnetic Lock Power	28VDC, 6.3A, 176W	
	Collimator Lamp Power	24VAC, 6.3A, 150W	
Reproducibility	Coefficient of Variation: kV < 0.005, Time < 0.005, mAs < 0.01		
Accuracy	kV < ±(1%+1kV), mA < ±(3%+1mA), Time < ±(1%+0.5ms), mAs < ±(3%+0.1mAs)		
Linearity	Coefficient of Linearity < 0.01 : CL = (X1-X2)/(X1+X2), where X is mR/mAs		
Dimension / Weight	628(W) x 978(H) x 460(D) mm / 146kg(321lbs)		

* #: It can be combined with TS-CSP.

System Model	**GXR-U32SD**	**GXR-U40SD**
Generator model	**GXR-U32**	**GXR-U40**
Power Rating	32kW	40kW
Line Nominal, Phase	100-240V~	
Line Voltage Range	±10% (Frequency: 50/60Hz)	
kV Range	40~125Kv(optional 150kV), 1kV step	
mA Range	10 to 400mA	10 to 500mA
Timer Range	0.001 to 10 sec, 38 steps	
mAs Range	0.1 to 500mAs(Optional up to 1,000mAs)	
AEC Shortest Irradiation Time	1ms	
Max. Power Output	400mA@80kV 320mA@100kV 250mA@125kV Optional 200mA@150kV	500mA@80kV 400mA@100kV 320mA@125kV Optional 250mA@150kV
Power Requirement	900VA	
Rotor Supply	Low Speed (Optional LSS Brake)	
Technique Selection	4 point display(kV, mA, Time, mAs): kV/mAs, kV/mA/Time, kV/AEC option	
Image Receptors	2 Bucky + 1 Non-Bucky	
Auxiliary Power Supply	External System Power	230VAC, 1A, 230W (PBT-4) 230VAC, 2A, 460W (PBT-6)
		110VAC, 1A, 110W
	Magnetic Lock Power	28VDC, 6.3A, 176W
	Collimator Lamp Power	24VAC, 6.3A, 150W
Reproducibility	Coefficient of Variation: kV < 0.005, Time < 0.005, mAs < 0.01	
Accuracy	kV < ±(1%+1kV), mA < ±(3%+1mA), Time < ±(1%+0.5ms), mAs < ±(3%+0.1mAs)	
Linearity	Coefficient of Linearity < 0.01 : CL = (X1-X2)/(X1+X2), where X is mR/mAs	
Dimension / Weight	628(W) x 1075(H) x 460(D) mm / 203kg (448lbs)	628(W) x 1187(H) x 460(D) mm / 243kg (536lbs)

* #: It can be combined with TS-CSP.

1.2.4 TABLE

<table>
<tr><td colspan="2">Model</td><td colspan="5">PBT-6</td></tr>
<tr><td rowspan="12">Movement</td><td rowspan="7">Tabletop</td><td rowspan="7">Longitudinal</td><td></td><td>Stroke</td><td>Tabletop Size(W)</td></tr>
<tr><td rowspan="3">Standard</td><td>1,000(±500)mm ± 10mm</td><td>Tabletop 2,200mm</td></tr>
<tr><td>800(±400)mm ± 10mm</td><td>Tabletop 2,000mm</td></tr>
<tr><td>600(±300)mm ± 10mm</td><td>Tabletop 1,800mm</td></tr>
<tr><td rowspan="3">Extended#
(Option)</td><td>1100(±550)mm ± 10mm</td><td>Tabletop 2,660mm</td></tr>
<tr><td>840(±420)mm ± 10mm</td><td>Tabletop 2,400mm</td></tr>
<tr><td>640(±320)mm ± 10mm</td><td>Tabletop 2,200mm</td></tr>
<tr><td colspan="2">Transverse (Lateral)</td><td colspan="2">250(±125)mm ± 5mm</td></tr>
<tr><td rowspan="3">Vertical</td><td rowspan="2">Travel</td><td>Standard</td><td colspan="2">285(575~860)mm ± 5mm</td></tr>
<tr><td>Extended#
(Option)</td><td colspan="2">300(560~860)mm ± 5mm</td></tr>
<tr><td colspan="2">Speed</td><td colspan="2">17mm/sec ± 15%</td></tr>
<tr><td colspan="2">Operating</td><td colspan="2">Motorized movement by Foot Switch
DC-motor (Linear Actuator)</td></tr>
<tr><td rowspan="4">Bucky</td><td rowspan="2">Standard</td><td>Mechanical</td><td colspan="2">-350mm ± 10mm with standard tray
-295mm ± 10mm with rotating tray</td></tr>
<tr><td>Table
Tracking</td><td colspan="2">-340mm ± 10mm with standard tray
-290mm ± 10mm with rotating tray</td></tr>
<tr><td rowspan="2">Extended#
(Option)</td><td>Mechanical</td><td colspan="2">-740mm ± 10mm with standard tray
-690mm ± 10mm with rotating tray</td></tr>
<tr><td>Table
Tracking</td><td colspan="2">-730mm ± 10mm with standard tray
-680mm ± 10mm with rotating tray</td></tr>
<tr><td colspan="2" rowspan="4">Tabletop</td><td colspan="2">Inherent Filtration</td><td colspan="2">Laminate : 1.2mmAl at 100kV
Carbon(Option) : 0.5mmAL at 100kV</td></tr>
<tr><td colspan="2">Max. Patient Weight</td><td colspan="2">300kg(660lbs)</td></tr>
<tr><td rowspan="2">Size</td><td>Standard</td><td colspan="2">2,200(W) x 878(D) x 45(H) mm
2,000(W) x 878(D) x 45(H) mm
1,800(W) x 878(D) x 45(H) mm</td></tr>
<tr><td>Extended#
(Option)</td><td colspan="2">2,660(W) x 878(D) x 45(H) mm
2,400(W) x 878(D) x 45(H) mm
2,200(W) x 878(D) x 45(H) mm</td></tr>
<tr><td colspan="2">Bucky Type</td><td colspan="2">Oscillating
(Optional built in charger)</td><td>Fixed
(Optional built in charger)</td></tr>
<tr><td colspan="2">Grid</td><td colspan="2">FD 34~44inch, 103 lpi
ratio 8~12:1</td><td>FD 100cm, 200lpi, 215lpi, 230 lpi,
ratio 8~12:1
(Optional removable grid)</td></tr>
<tr><td colspan="2">Lock(Brake)</td><td colspan="3">EM Lock, Foot Switch on/off</td></tr>
<tr><td colspan="2">Center indication</td><td colspan="3">Transverse center, height center</td></tr>
<tr><td colspan="2">Side Cover</td><td colspan="3">2-story telescopic Cover</td></tr>
<tr><td colspan="2">Electrical Rating</td><td colspan="3">100–240VAC, 400VA, 50/60Hz</td></tr>
</table>

Dimension / Weight	Standard	Laminate	2200(W) x 878(D) x 860(H) mm / 255.2kg(562.6lbs) 2000(W) x 878(D) x 860(H) mm / 252.2kg(556lbs) 1800(W) x 878(D) x 860(H) mm / 248.2kg(547.2lbs)
		Carbon	2200(W) x 878(D) x 860(H) mm / 249.1kg(549.2lbs) 2000(W) x 878(D) x 860(H) mm / 246.9kg(544.3lbs) 1800(W) x 878(D) x 860(H) mm / 243.6kg(537lbs)
	Extended # (Option)	Laminate	2660(W) x 878(D) x 860(H) mm / 310kg(683.4lbs) 2400(W) x 878(D) x 860(H) mm / 306kg(674.6lbs) 2200(W) x 878(D) x 860(H) mm / 303kg(668lbs)
		Carbon	2660(W) x 878(D) x 860(H) mm / 302.2kg(666.2lbs) 2400(W) x 878(D) x 860(H) mm / 299.2kg(659.6lbs) 2200(W) x 878(D) x 860(H) mm / 296.9kg(654.6lbs)

* APPLIED PART, Optional Rotating tray

* #: It can only be combined with TS-CSP.

Model		PBT-4		
Movement	Tabletop	Longitudinal	Stroke	Tabletop Size(W)
			1,000(±500)mm ± 10mm	Tabletop 2,200mm
			800(±400)mm ± 10mm	Tabletop 2,000mm
			600(±300)mm ± 10mm	Tabletop 1,800mm
		Transverse (Lateral)	250(±125)mm ± 5mm	
	Bucky	Longitudinal	350mm ± 10mm with standard tray 295mm ± 10mm with rotating tray	
Tabletop		Inherent Filtration	Laminate : 1.2mmAl at 100kV Carbon(Option) : 0.5mmAL at 100kV	
		Max. Patient Weight	300kg (660lbs)	
		Size	2,200(W) x 818(D) x 45(H) mm 2,000(W) x 818(D) x 45(H) mm 1,800(W) x 818(D) x 45(H) mm	
Bucky Type		Oscillating (Optional built in charger)	Fixed (Optional built in charger)	
Grid		FD 34~44inch, 103 lpi ratio 8~12:1	FD 100cm, 200lpi, 215lpi, 230 lpi, ratio 8~12:1 (Optional removable grid)	
Lock(Brake)		EM Lock, beam sensor on/off		
Center indication		Transverse Buzzer sound and LED		
Electrical Rating		100–240VAC, 200VA, 50/60Hz		
Dimension / Weight		Laminate	2,200(W) x 818(D) x 660(H) mm / 145.7kg(321.2lbs) 2,000(W) x 818(D) x 660(H) mm / 142.7kg(314.6lbs) 1,800(W) x 818(D) x 660(H) mm / 139.7kg(308lbs)	
		Carbon	2,200(W) x 818(D) x 660(H) mm / 140.3kg(309.3lbs) 2,000(W) x 818(D) x 660(H) mm / 137.9kg(304lbs) 1,800(W) x 818(D) x 660(H) mm / 134.6kg(296.7lbs)	

* APPLIED PART, Optional Rotating tray

* PBT-4 cannot be combined with TS-CSP.

Model	PBT-1
Max. Patient Weight	Max. 215kg (474lbs)
Grid	Focal distance 100cm, 103 lpi, ratio 10:1
Inherent Filtration	1.2mmAl at 100kV
Electrical Rating	DC 24V/ 64VA
Caster	Max height 172 mm / Max work load 90 kg (198lb)
Bucky Type	Spring Oscillating
Dimension / Weight	2005(W) x 662(D) x 700(H) mm / 75kg(165lbs)

* APPLIED PART

* PBT-1 cannot be combined with TS-CSP.

Model	PDT-1
Max. Patient Weight	Max. 200kg (441lbs)
Inherent Filtration	1.2mmAl at 100kV
Dimension / Weight	2004(W) x 650(D) X 712(H)mm / 62kg (137lb)

* APPLIED PART

* PDT-1 cannot be combined with TS-CSP.

1.2.5 WALL BUCKY STAND

Model	WBS(Manual)		
Stroke	Vertical	1,070mm (300~1,370mm from floor to Bucky center) ± 10mm 1,220mm (300~1,520mm from floor to Bucky center) ± 10mm 1,390mm (300~1,690mm from floor to Bucky center) ± 10mm 1,640mm (300~1,940mm from floor to Bucky center) ± 10mm	
Vertical Movement	Manual		
Bucky type	Oscillating (Optional built in charger)		Fixed (Optional built in charger)
Grid	FD 40~72inch, 103 lpi, ratio 8~12:1		FD 130,150,180cm, 200, 215lpi, 230 lpi, ratio 8~12:1 (Optional removable grid)
Inherent Filtration	0.5mmAl at 100kV		
Lock(Brake)	EM Lock, Switch on/off		
Vertical Balance	Counter Weight		
Electrical Rating	24VDC, 1A		
Dimension / Weight	1,599(H) x 659(W) x 465(D) mm / 110kg(242lbs) 1,749(H) x 659W) x 465(D) mm / 113kg(249lbs) 1,919(H) x 659(W) x 465(D) mm / 116kg(255lbs) 2,169(H) x 659(W) x 465(D) mm / 120kg(264lbs)		

* APPLIED PART, Optional Rotating tray

* WBS(Manual) cannot be combined with TS-CSP.

Model	WBS-TM(Manual)		
Cassette Stroke	Vertical	1,492mm (286~1,778mm from floor to Bucky center) ± 10mm	
	Tilted 90˚	1,500mm (658~2,158mm from floor to Bucky surface) ± 10mm	
Vertical Movement	Manual		
Bucky type	Oscillating (Optional built in charger)		Fixed (Optional built in charger)
Grid	FD 40~72inch, 103 lpi, ratio 8~12:1		FD 130,150,180cm, 200, 215lpi, 230 lpi, ratio 8~12:1 (Optional removable grid)
Tilting Angle	-30 ~ 90˚		
Tilting Movement	Manual		
Withstanding load (at tilting angle 90°)	20kgf at the point 150mm from the side.		
Inherent Filtration	0.5mmAl at 100kV		
Lock(Brake)	EM Lock, Switch on/off by foot switch(Vertical movement, Tilting)		
Balance	Vertical	Counter Weight	
	Tilting	Spring	
Electrical Rating	24VDC, 2.5A		
Dimension/Weight	2,169(H) x 718(W) x 732(D) mm / 187kg(412lbs)		

* APPLIED PART, Optional Rotating tray

* WBS-TM(Manual) cannot be combined with TS-CSP.

Model	WBS(Manual Plus)	
Cassette stroke	1,220mm (300~1,520mm from floor to Bucky center) ± 10mm 1,390mm (300~1,690mm from floor to Bucky center) ± 10mm 1,640mm (300~1,940mm from floor to Bucky center) ± 10mm	
Vertical Movement	Manual	
Bucky type	Oscillating (Optional built in charger)	Fixed (Optional built in charger)
Grid	FD 40~72inch, 103 lpi, ratio 8~12:1	FD 130,150,180cm, 200, 215lpi, 230 lpi, ratio 8~12:1 (Optional removable grid)
Inherent Filtration	0.5mmAl at 100kV	
Lock(Brake)	EM Lock, Switch on/off	
Balance	Counter Weight	
Electrical Rating	100-240VAC, 160VA, 50/60Hz	
Dimension / Weight	1,749(H) x 659W) x 465(D) mm / 113kg(249lbs) 1,919(H) x 659(W) x 465(D) mm / 116kg(255lbs) 2,169(H) x 659(W) x 465(D) mm / 120kg(264lbs)	

* APPLIED PART, Optional Rotating tray

* WBS(Manual Plus) cannot be combined with TS-CSP.

Model	WBS(Motorized)	
Cassette stroke	Vertical	970mm (300~1,270mm from floor to Bucky center) ± 10mm 1,120mm (300~1,420mm from floor to Bucky center) ± 10mm 1,290mm (300~1,590mm from floor to Bucky center) ± 10mm 1,540mm (300~1,840mm from floor to Bucky center) ± 10mm
Vertical movement	Manual and Motorized movement	
Bucky type	Oscillating (Optional built in charger)	Fixed (Optional built in charger)
Grid	FD 40~72inch, 103 lpi, ratio 8~12:1	FD 130,150,180cm, 200, 215lpi, 230 lpi, ratio 8~12:1 (Optional removable grid)
Inherent Filtration	0.5mmAl at 100kV	
Lock(Brake)	EM Lock, Switch on/off	
Balance	Counter Weight	
Electrical Rating	100-240VAC, 160VA, 50/60Hz	
Vertical Speed	6.2 cm/s ± 15% (Normal up), 5.6cm/s ± 15% (Normal down)	
Dimension / Weight	1,614(H) x 659(W) x 549(D) mm / 126kg(277lbs) 1,764(H) x 659(W) x 549(D) mm / 130kg(286lbs) 1,934(H) x 659(W) x 549(D) mm / 132kg(291lbs) 2,184(H) x 659(W) x 549(D) mm / 135kg(297lbs)	

* APPLIED PART, Optional Rotating tray

* WBS(Motorized) cannot be combined with TS-CSP.

Model	WBS-TM(Motorized)		
Cassette Stroke	Vertical	1,492mm (286~1,778mm from floor to Bucky center) ± 10mm	
	Tilted 90˚	1,517mm (645~2,162mm from floor to Bucky surface) ± 10mm	
Vertical movement	Manual and Motorized		
Bucky type	Oscillating (Optional built in charger)		Fixed (Optional built in charger)
Grid	FD 40~72inch, 103 lpi, ratio 8~12:1		FD 130,150,180cm, 200, 215lpi, 230 lpi, ratio 8~12:1 (Optional removable grid)
Tilting Angle	-30 ~ 90˚		
Tilting Movement	Manual		
Withstanding load (at tilting angle 90°)	20kgf at the point 150mm from the side.		
Inherent Filtration	0.5mmAl at 100kV		
Lock(Brake)	EM Lock, Switch on/off by foot switch(Vertical movement, Tilting)		
Balance	Vertical	Counter Weight	
	Tilting	Spring	
Electrical Rating	100-240VAC, 160VA, 50/60Hz		
Vertical Speed	6.2 cm/s ± 15% (Normal up), 5.6cm/s ± 15% (Normal down)		
Dimension/ Weight	2,184(H) x 824(W) x 831(D) mm / 218kg(480lbs)		

* APPLIED PART, Optional Rotating tray

* WBS-TM(Motorized) cannot be combined with TS-CSP.

Model	WBS-TA(Motor type)		
Cassette stroke	Vertical	1,526mm (326~1,852mm from floor to Bucky center) ± 10mm	
	Tilted 90˚	1,526mm (440~1,966mm from floor to Bucky surface) ± 10mm	
Vertical Movement	Manual and Motorized		
Bucky type	Oscillating (Optional built in charger)		Fixed (Optional built in charger)
Grid	FD 40~72inch, 103 lpi, ratio 8~12:1		FD 130,150,180cm, 200, 215lpi, 230 lpi, ratio 8~12:1 (Optional removable grid)
Tilting Angle	-30˚ ~ 90˚		
Tilting Movement	Motorized		
Inherent Filtration	0.5mmAl at 100kV		
Lock(Brake)	EM Lock, Switch on/off		
Balance	Counter Weight		
Electrical Rating	100–240VAC, 200VA, 50/60Hz		
Vertical Speed	Normal	6.2 cm/s ± 15% (Up), 5.6cm/s ± 15% (Down)	
	Fast	12.1cm/s ± 15% (Up), 11.8cm/s ± 15% (Down)	
Tilting Speed	Tilting up	11.3˚/s	
	Tilting down	11.7˚/s	
Dimension / Weight	2,184(H) x 659(W) x 990(D) mm / 195kg(430lbs)		

* APPLIED PART, Optional Rotating tray

* WBS-TA(Motorized) cannot be combined with TS-CSP.

Model	WBS-TA(Actuator type)#	
Cassette stroke	Vertical	1,526mm (283~1,809mm from floor to Bucky center)±10mm
	Tilted 90˚	1,526mm (450~1,976mm from floor to Bucky surface)±10mm
Vertical movement	Manual and Motorized	
Bucky type	Oscillating (Optional built in charger)	Fixed (Optional built in charger)
Grid	FD 40~72inch, 103 lpi, ratio 8~12:1	FD 130,150,180cm, 200, 215lpi, 230 lpi, ratio 8~12:1 (Optional removable grid)
Tilting range	-20˚ ~ 90˚	
Tilting Movement	Motorized	
Inherent Filtration	0.5mmAl at 100kV	
Lock(Brake)	EM Lock, Switch on/off	
Balance	Counter Weight	
Electrical Rating	100–240VAC, 200VA, 50/60Hz	
Vertical Speed	Normal	6.2 cm/s ± 15% (Up), 5.6cm/s ± 15% (Down)
	Fast	12.1cm/s ± 15% (Up), 11.8cm/s ± 15% (Down)
Tilting Speed	0˚ ~ 90˚	8.2˚/s
	-20˚ ~ 0˚	5.1˚/s
Dimension / Weight	2,184(H) x 659(W) x 893(D) mm / 186kg(410lbs)	

* APPLIED PART, Optional Rotating tray

* #: It can be combined with TS-CSP.

1.2.6 TUBE STAND (WITH TUBE & COLLIMATOR)

- **Tube Stand**

Model	TS-FM6(Motorized)	
Tube Rotation Angle	Horizontal axis	±135°
	Vertical axis	±180° (mechanical detents at every 90°)
Tube stroke	Longitudinal	2,100mm ± 10mm (Optional 2,900mm and 3,600mm) ± 10mm
	Lateral	250mm ± 5mm
	Vertical	1,526mm (420~1,946mm from floor to focus) ± 10mm
Vertical Movement	Manual and Motorized Optional vertical synchronization with wall stand and table	
Tube Rotation	Manual or Motorized(Option) Motorized option supports the source tilting type image stitching operation	
Lock(Brake)	EM Lock, Switch on/off	
Balance	Counter Weight	
Column Rotation	EM lock, Switch on/off	
Tube OP	7 inch Touch screen	
Electrical Rating	100–240VAC, 160VA, 50/60Hz	
Dimension / Weight	2,327(H) x 3,006(W) x 1,458(D) mm / 255kg(562lbs) 2,327(H) x 3,806(W) x 1,458(D) mm / 268kg(591lbs) 2,327(H) x 4,506(W) x 1,458(D) mm / 278kg(613lbs) Option(Tube Head Motorized Rotation): 2,327(H) x 3,006(W) x 1,458(D) mm / 265kg(584lbs) 2,327(H) x 3,806(W) x 1,458(D) mm / 278kg(613lbs) 2,327(H) x 4,506(W) x 1,458(D) mm / 288kg(635lbs)	

Model	TS-FC6 (Motorized)	
Tube Rotation Angle	±135°	
Tube stroke	Longitudinal	2,500mm ± 10mm
	Lateral	250mm ± 5mm
	Vertical	1,330mm (430~1,760mm from floor to focus) ± 10mm Optional 1,580mm (430~2,010mm from floor to focus) ± 10mm
Vertical Movement	Manual and Motorized Optional vertical synchronization with wall stand and table	
Lock(Brake)	EM Lock, Switch on/off	
Balance	Counter Weight	
Column Rotation	90° step, Foot Lock	
Options	Line laser, Column rotation by electrical release	
Electrical Rating	100~240VAC, 160VA, 50/60Hz	
Dimension / Weight	2,070(H) x 3600(W) x 1,458(D) mm / 220kg(485lbs) 2,320(H) x 3600(W) x 1,458(D) mm / 227kg(500lbs)	

Model	TS-FC4 (Motorized)	
Tube Rotation Angle	±135°	
Tube stroke	Longitudinal	2,536mm ± 10mm
	Lateral	N/A
	Vertical	1,410mm (420~1,830mm from floor to focus) ± 10mm Optional 1,660mm (420~2,080mm from floor to focus) ± 10mm
Vertical Movement	Manual and Motorized Optional vertical synchronization with wall stand and table	
Lock(Brake)	EM Lock, Switch on/off	
Balance	Counter Weight	
Electrical Rating	100~240VAC, 160VA, 50/60Hz	
Dimension / Weight	2,048(H) x 3,600(W) x 830(D)mm / 190kg(419lbs) 2,298(H) x 3,600(W) x 830(D)mm / 200kg(441lbs)	

Model	TS-FC2 (Motorized)	
Tube Direction	Right-angle or Straight	
Tube Rotation Angle	N/A	
Tube stroke	Longitudinal	N/A
	Lateral	N/A
	Vertical	1,080mm(324mm~1,404mm from floor to focus) ± 10mm 1,230mm(324mm~1,554mm from floor to focus) ± 10mm 1,400mm(324mm~1,724mm from floor to focus) ± 10mm 1,650mm(324mm~1,974mm from floor to focus) ± 10mm
Vertical Movement	Motorized Optional vertical synchronization with wall stand	
Lock(Brake)	EM Lock, Switch on/off	
Balance	Counter Weight	
Electrical Rating	100~240VAC, 160VA, 50/60Hz	
Dimension / Weight	1) Right-angle type: 1,614(H) x 659 (W) x 770(D) mm / 162kg(357lbs) Straight type: 1,614(H) x 659 (W) x 859(D) mm / 162kg(357lbs) 2) Right-angle type: 1,764(H) x 659 (W) x 770(D) mm / 165kg(363lbs) Straight type: 1,764(H) x 659 (W) x 859(D) mm / 165kg(363lbs) 3) Right-angle type: 1,934(H) x 659(W) x 770(D) mm / 168kg(370lbs) Straight type: 1,934(H) x 659(W) x 859(D) mm / 168kg(370lbs) 4) Right-angle type: 2,184(H) x 659(W) x 770(D) mm / 171kg(377lbs) Straight type: 2,184(H) x 659(W) x 859(D) mm / 171kg(377lbs)	

Model	TS-FM6	
Tube Rotation Angle	±135°	
Tube stroke	Longitudinal	2,200mm ± 10mm (Optional 3,000mm and 3,700mm) ± 10mm
	Lateral	220mm ± 5mm (Optional 250mm) ± 5mm
	Vertical	1,330mm (440~1,770mm from floor to focus) ± 10mm Optional 1,580mm (440~2,020mm from floor to focus) ± 10mm
Lock(Brake)	EM Lock, Switch on/off	
Balance	Counter Weight	
Column Rotation	90° step, Foot Lock	
Options	Line laser, Column rotation by electrical release	
Electrical Rating	24VDC, 3A	
Dimension / Weight	2,067(H) x 3,006(W) x 1,388(D) mm / 217kg(478lbs) 2,067(H) x 3,006(W) x 1,418(D) mm / 217kg(478lbs) 2,067(H) x 3,806(W) x 1,388(D) mm / 230kg(507lbs) 2,067(H) x 3,806(W) x 1,418(D) mm / 230kg(507lbs) 2,067(H) x 4,506(W) x 1,388(D) mm / 240kg(529lbs) 2,067(H) x 4,506(W) x 1,418(D) mm / 240kg(529lbs) 2,317(H) x 3,006(W) x 1,388(D) mm / 225kg(496lbs) 2,317(H) x 3,006(W) x 1,418(D) mm / 225kg(496lbs) 2,317(H) x 3,806(W) x 1,388(D) mm / 238kg(525lbs) 2,317(H) x 3,806(W) x 1,418(D) mm / 238kg(525lbs) 2,317(H) x 4,506(W) x 1,388(D) mm / 248kg(547lbs) 2,317(H) x 4,506(W) x 1,418(D) mm / 248kg(547lbs)	

Model	TS-FC6	
Tube Rotation Angle	±135°	
Tube stroke	Longitudinal	2,000mm ± 10mm (Optional 2,500mm) ± 10mm
	Lateral	220mm± 5mm (Optional 250mm) ± 5mm
	Vertical	1,330mm (430~1,760mm from floor to focus) ± 10mm Optional 1,580mm (430~2,010mm from floor to focus) ± 10mm
Lock(Brake)	EM Lock, Switch on/off	
Balance	Counter Weight	
Column Rotation	90° step, Foot Lock	
Options	Line laser, Column rotation by electrical release	
Electrical Rating	24VDC, 3A	
Dimension / Weight	2,056(H) x 3,080(W) x 1,388(D) mm / 182kg(401lbs) 2,056(H) x 3,080(W) x 1,418(D) mm / 182kg(401lbs) 2,056(H) x 3,600(W) x 1,388(D) mm / 186kg(410lbs) 2,056(H) x 3,600(W) x 1,418(D) mm / 186kg(410lbs) 2,306(H) x 3,080(W) x 1,388(D) mm / 190kg(419lbs) 2,306(H) x 3,080(W) x 1,418(D) mm / 190kg(419lbs) 2,306(H) x 3,600(W) x 1,388(D) mm / 194kg(428lbs) 2,306(H) x 3,600(W) x 1,418(D) mm / 194kg(428lbs)	

Model	TS-FC4	
Tube Rotation Angle	±135°	
Tube stroke	Longitudinal	2,000mm ± 10mm (Option: 2,536mm ± 10mm)
	Lateral	N/A
	Vertical	1,410mm (420~1,830mm from floor to focus) ± 10mm Optional 1,660mm (420~2,080mm from floor to focus) ± 10mm
Lock(Brake)	EM Lock, Switch on/off	
Balance	Counter Weight	
Column Rotation	N/A	
Options	Line laser	
Electrical Rating	24VDC, 3A	
Dimension / Weight	2,048(H) x 3,040(W) x 778(D) mm / 187kg(412lbs) 2,298(H) x 3,040(W) x778(D) mm / 195kg(430lbs) 2,048(H) x 3,600(W) x 778(D) mm / 191kg(421lbs) 2,298(H) x 3,600(W) x778(D) mm / 199kg(439lbs)	

Model	TS-FC2	
Tube Rotation Angle	±135°	
Tube stroke	Longitudinal	N/A
	Lateral	N/A
	Vertical	1,243mm (294mm~1,537mm from floor to focus) ± 10mm 1,413mm (294mm~1,707mm from floor to focus) ± 10mm 1,663mm (294mm~1,957mm from floor to focus) ± 10mm
Lock(Brake)	EM Lock, Switch on/off	
Balance	Counter Weight	
Column Rotation	N/A	
Options	Line laser	
Electrical Rating	24VDC, 3A	
Dimension / Weight	1,749(H) x 659(W) x 790(D) mm / 145kg(320lbs) 1,919(H) x 659(W) x 790(D) mm / 150kg(331lbs) 2,169(H) x 659(W) x 790(D) mm / 158kg(348lbs)	

Model	TS-CSA	
Tube Rotation Angle	Horizontal axis	±180° (LCD display)
	Vertical axis	±180° (mechanical detents at every 90°)
Tube stroke (with 3x4m rails - Transverse x Longitudinal)	Longitudinal	3,280mm(with 4m rail), 4,280mm(with 5m rail) ± 10mm
	Lateral	2,200mm(with 3m rail), 3,200mm(with 4m rail) ± 10mm
	Vertical	1,500mm or 1,600mm ± 10mm (1,500mm is possible up to the weight of E7252X plus R108)
Lock(Brake)	EM Lock, Switch on/off	
Balance	Spring	
Vertical Movement	Manual or Motorized(Option) Motorized option supports vertical sync with table and wall stand	
Tube Rotation	Manual or Motorized(Option) Motorized option supports the source tilting type image stitching operation	
Option	Auto Collimation, Mechanical detent function	
SID Indication	7inch Touch Screen LCD with control buttons	
Electrical Rating	220–230VAC, 200VA, 50/60Hz	
Dimension	2,866(H) x 3,022(D) x 4,010(W) mm when vertical direction is fully extended with 1,600mm stroke and 3x4m rails	
Weight	Main body(Vertical movement Manual): 160kg(353lbs) Main body(Vertical movement Motorized): 170kg(375lbs) except tube and collimator Rails: 115kg(254lbs, 3x4m rails)	

Model	TS-CSP	
Tube Rotation Angle	Horizontal axis	±180° (LCD display)
	Vertical axis	±180° (mechanical detents at every 90°)
Tube stroke (with 3x4m rails - Transverse x Longitudinal)	Longitudinal	3,280mm ± 10mm
	Lateral	2,200mm ± 10mm
	Vertical	1,600mm ± 10mm
Lock(Brake)	EM Lock, Switch on/off	
Balance	Spring	
Operation	Manual and Vertical Motorized Vertical synchronization with Wall stand and Table for motorized stand	
Indication / Control	7inch Touch Screen LCD with control buttons	
Electrical Rating	220-230V~, 500VA, 50/60Hz	
Dimension	2,849(H)x3,182(D)x4,214(W) mm when vertical direction is fully extended with 1,600mm stroke and 3x4m rails	
Weight	Main body: 175kg(386lbs) except tube, Rails: 122kg(269lbs, 3x4m rails)	

Model	TS-CSE	
Tube Rotation Angle	Horizontal axis	±180°
	Vertical axis	±180° (mechanical detents at every 90°)
Tube stroke with 3x4m rails	Longitudinal	3,280mm ± 10mm
	Transverse	2,200mm ± 10mm
	Vertical	1,500mm ± 10mm
Lock(Brake)	EM Lock, Switch on/off	
Vertical Balance	Spring	
Vertical Movement	Manual	
Tube Rotation	Manual	
SID Indication	LED lamp and 7-Segment display	
Electrical Rating	100-240Vac, 150VA, 50/60Hz	
Dimension	2,688(H) x 3,022(D) mm x 4,010(W) mm when vertical direction is extended with 1,500mm stroke and 3x4m rails	
Weight	Main body: 135kg(298lbs) except tube, Rails: 100kg(220lbs)	

- **X-ray Tube**

Tube Model	E7239X	DXT-8M	E7242X	DXT-11M
Manufacturer	CANON	DRGEM	CANON	DRGEM
Focal Spot Size	1.0/2.0mm	1.0/2.0mm	0.6/1.5mm	0.6/1.5mm
Rating(0.1s)	22.5/47kW@60Hz	22.5/47kW@60Hz	18/50kW@60Hz	18/50kW@60Hz
Max. Anode HU	140kHU(100kJ)	140kHU(100kJ)	200kHU(142kJ)	200kHU(142kJ)
Target Angle	16°	16°	14°	14°
Max. kV	125kV	125kV	125kV	125kV
Weight	16kg(35.3lbs)	16kg(35.3lbs)	16kg(35.3lbs)	16kg(35.3lbs)
Inherent Filtration	0.9mmAl/75kV	1.0mmAl/75kV	0.9mmAl/75kV	1.0mmAl/75kV
Half Value Layer	More than 2.9mmAl eq. at 80kVp			
Leakage Radiation	Less than 100mR/hr			

Tube Model	E7843X	DXT-10M	E7876X
Manufacturer	CANON	DRGEM	CANON
Focal Spot Size	0.6/1.2mm	0.6/1.2mm	0.6/1.2mm
Rating(0.1s)	22/50kW@60Hz	17/48kW@60Hz	22/54kW@60Hz
Max. Anode HU	150kHU(111kJ)	150kHU(111kJ)	230kHU(163kJ)
Target Angle	12°	12°	12°
Max. kV	150kV	125kV	150kV
Weight	16kg(35.3lbs)	16kg(35.3lbs)	16kg(35.3lbs)
Inherent Filtration	1.3mmAl/75kV	1.0mmAl/75kV	1.3mmAl/75kV
Half Value Layer	More than 2.9mmAl eq. at 80kVp		
Leakage Radiation	Less than 100mR/hr		

Tube Model	E7884X#	DXT-12M#	E7252X#
Manufacturer	CANON	DRGEM	CANON
Focal Spot Size	0.6/1.2mm	0.6/1.2mm	0.6/1.2mm
Rating(0.1s)	22/54kW@60Hz	22/54kW@60Hz	27/75kW
Max. Anode HU	300kHU(210kJ)	300kHU(210kJ)	300kHU(210kJ)
Target Angle	12°	12°	12°
Max. kV	150kV	150kV	150kV
Weight	16kg(35.3lbs)	16kg(35.3lbs)	18kg(39.7lbs)
Inherent Filtration	0.9mmAl/75kV	1.0mmAl/75kV	0.9mmAl/75kV
Half Value Layer	More than 2.9mmAl eq. at 80kVp		
Leakage Radiation	Less than 100mR/hr		

Tube Model	DXT-14U#	RAD-14#	DXT-15U *#
Manufacturer	DRGEM	VAREX	DRGEM
Focal Spot Size	0.6/1.2mm	0.6/1.2mm	0.6/1.2mm
Rating(0.1s)	27/75kW	32/77kW	32/77kW
Max. Anode HU	300kHU(210kJ)	300kHU(210kJ)	300kHU(210kJ)
Target Angle	12°	12°	12°
Max. kV	150kV	150kV	150kV
Weight	18kg(39.7lbs)	16.4kg(36.2lbs)	16.4kg(36.2lbs)
Inherent Filtration	1.0mmAl/75kV	0.6mmAl/75kV	0.7mmAl/75kV
Additional Filtration		0.5mmAl	0.5mmAl
Half Value Layer	More than 2.9mmAl eq. at 80kVp		
Leakage Radiation	Less than 100mR/hr		

* Including VAREX RAD-14 Insert.

* #: It can be combined with TS-CSP.

Tube Model	RAD-21#	RAD-60#	RAD-92#
Manufacturer	VAREX	VAREX	VAREX
Focal Spot Size	0.6/1.2mm	0.6/1.2mm	0.6/1.2mm
Rating(0.1s)	36/100kW	40/100kW	40/100kW
Max. Anode HU	300kHU(210kJ)	400kHU(285kJ)	600kHU(444kJ)
Target Angle	12°	12°	12°
Max. kV	150kV	150kV	150kV
Weight	18.9kg(41.7lbs)	18.9kg(41.7lbs)	18.9kg(41.7lbs)
Inherent Filtration	0.7mmAl/75kV	0.7mmAl/75kV	0.7mmAl/75kV
Additional Filtration	0.5mmAl		
Half Value Layer	More than 2.9mmAl eq. at 80kVp		
Leakage Radiation	Less than 100mR/hr		

Tube Model	E7255FX#	E7254FX#	E7869X#
Manufacturer	CANON	CANON	CANON
Focal Spot Size	0.6/1.2mm	0.6/1.2mm	0.6/1.2mm
Rating(0.1s)	40/102kW	40/102kW	40/100kW
Max. Anode HU	300kHU(210kJ)	400kHU(285kJ)	600kHU(444kJ)
Target Angle	12°	12°	12°
Max. kV	150kV	150kV	150kV
Weight	20kg(44.1lbs)	25kg(55.1lbs)	24kg(52.9lbs)
Inherent Filtration	0.8mmAl/75kV	0.8mmAl/75kV	1.1mmAl/75kV
Additional Filtration	0.5mmAl	0.5mmAl	
Half Value Layer	More than 2.9mmAl eq. at 80kVp		
Leakage Radiation	Less than 100mR/hr		

* #: It can be combined with TS-CSP.

NOTE
Total filtration including X-ray tube assembly and collimator will be matched by appropriate additional filters to within the range from 2.9 to 3.3mmAl. eq.

NOTE
If the target angle of the applied tube is 12°, the field size (43cm X 43cm) cannot be realized by SID 100cm when combined with a collimator. To use the field size (43cm X 43cm), please use SID 105cm or 110cm.

- **Collimator**

Model	DXC-RML
Manufacturer	DRGEM
Control	Manual with 30sec. lamp timer
Field Shape	Rectangular
Max. Field Size	More than 43x43cm(17x17inch) at 100cm SID
Leakage Radiation	Less than 40 mR/h
Max. kVp shield	150kV
Inherent Filtration	2mmAl eq.
Luminosity	Over 160LUX at 100cm SID
Light source	LED
Standard	Rotating flange with fixing knob
Option	Line laser+shutter, Measure tape Near port moving shutters, Mounting flange mechanical detent Accessory guides spring, Additional filter, DAP rail
Electrical Rating	LED lamp type 12~45V DC 35VA / 20~30VAC 35VA - 50~60Hz
Dimension / Weight	196(W) x 250(D) x 171(H) mm 7.1kg(15.6lb)

Model	R108	R302A, R302MLP/A#, R302MFMLP/A#
Manufacturer	RALCO	
Control	Manual with 30sec. lamp timer	
Field Shape	Rectangular	
Max. Field Size	More than 43x43cm(17x17inch) at 100cm SID	
Leakage Radiation	Less than 100mR/hr	
Max. kVp shield	150kV	150kV
Inherent Filtration	2.0mmAl eq.	2.0mmAl eq.
Luminosity	Over 160LUX at 100cm SID (Typ. 250LUX)	Over 160LUX at 100cm SID (Typ. 200LUX)
Light source	Single LED	HLX64638 100W 24V / OSRAM or LED (Option)
Standard	Tape measure, rotating flange	Auto collimation for R302 MLP/A and R 302 MFMLP/A Auto filter selection for R 302 MFMLP/A
Option	Line laser, near port shutters	Tape measure, line laser, rotating flange LED Type
Electrical Rating	20–30Vac, 30VA, 50/60Hz	Halogen type: 24Vac, 6.5A, 50/60Hz LED Type(Option): 24Vac, 2A, 50/60Hz
Dimension / Weight	223(W) x 246(D) x 140(H) mm / 6.6kg(14.6lb)	195.5(W) x 237(D) x 206.5(H) mm / 9.4kg(20.7lb)

* #: It can be combined with TS-CSP.

1.2.7 OPTION & ACCESSORIES

- **Option**

- AEC Ion Chamber

Model	9890-000-70006 (Amplimat 5-Field)
Manufacturer	Philips
Field	5 Fields (Using 3 Fields)
X-ray Energy Range	40~150kV
Exposure time Range	1ms to 6s
Accuracy	< 5 mV
Inherent Filtration	0.8 mm Al eq.
Weight	1.8kg (4lb)

- Stitching Stand

Model	STITCHING STAND
Dimension / Weight	927.6(W) x 945.9(D) X 2064.7(H)mm / 47.1kg (103.8lb)

- Live stream camera

Model	HU205
Manufacturer	HUENTEK
Display resolution	1920×1080
Max. Image Transfer Rate	30FPS @ FHD
Electrical Rating	5VDC, 210mA

* Only DXC collimator can use a Live Stream Camera.

NOTE
Live stream camera images are used only for reference.

- Pedestal console stand
- Patient Compression Belt
- Patient hand grips (Tabletop, Wall stand – Overhead, Lateral)
- Cassette holders (Lateral, External Wall Bucky)
- Full-spine imaging software
- DC brake for low speed starter of x-ray generator
- Stitching Stand
- Radiation protection
  - ■ Wearing(apron, neck guide, glove), movable x-ray protection wall

- Vertical Up/Down foot switch or hand switch for operation room (Only WBS(Motorized), WBS-TM(Motorized) and WBS-TA)
- Emergency Stop Switch for operation room
- Table Bucky Tracking (Mechanical)
  - Upgrade table bucky tracking for TS-FM6
- Dual Speed Starter (DSS)
  - Up-grade DSS for the dual speed rotating tube under the 3 phase(32/40/52KW)
- LSS Brake for Low speed rotor supply
- Fail- safe switch
- Mechanical detent for TS-CSA
- Ceiling rail for TS-FM6 (3.0m, 3.8m, 4.5m rails)
- Rail length for TS-CSA (transverse x longitudinal: 3x5m, 4x4m, 4x5m)
- Floor rail of TS-FM6 (3.8m, 4.5m) (recommend for WBS-TM or WBS-TA)
- Cable chain for TS-FM6 (3.0m, 3.8m, 4.5m rails)
- Cable chain for TS-CSA (3x4m, 3x5m, 4x4m, 4x5m)
- Extend HV cable length for TS-CSA

From	To
8m	10m, 15m, 18m, 20m, 25m
10m	15m, 18m, 20m, 25m
15m	18m, 20m, 25m
18m	20m, 25m
20m	25m

- Extend HV cable length for TS-FM6

From	To
8m	10m, 15m
10m	18m

- Remote controller for WBS-TA
- LED light upgrade from Hallogen lamp for R302MFMLP/A
- Built-in laser of R302 Series collimators
- Rotating flange of R302 Series collimators
- Right side drawer tray for WBS/WBS-TM/WBS-TA

- **Accessory**

- DAP (Dose Area Product) meter

Model	120-131HS (RS485)
Manufacturer	IBA
DAP Resolution	0.01 μGym²
Interface	RS485
Active area	115 x 115mm / 146 x 146mm
Display	Integrated or separate display (single or dual line)
Dimension	158 x 134.5 x 17mm / 180 x 156 x 17mm
Inherent Filtration	0.5 mm Al
Power input	12 – 29 VDC,100mA
Measurement Uncertainty	±25%

- Detachable High Resolution Grid

Model	Grid 1000
Manufacturer	JPI
Focal distance	100, 130, 150, 180cm
Line number	103 lpi, 200 lpi, 215 lpi, 230 lpi
Reason	8:1 ~ 12:1

- DAP (Dose Area Product) meter with display
  - ■ Upgrade DAP kit, Stand-alone Display type
  - ■ Upgrade DAP kit, for DR system
- Detachable High Resolution Grid and Holder

WARNING
Maximum force of Overhead grip is 10kgf.

WARNING
Bucky tilting and Auto positioning is not available with Overhead grip.

1.2.8 SOFTWARE FIRMWARE INFORMATION

- **Software Version**

1) RADMAX

Software/Firmware	Version	Description
RADMAX	1.02	RADMAX is the main software provides top level graphics user interface on whole system control and imaging process. RADMAX consists of System Control Module, Imaging Module, DICOM Module, Database Module, System Diagnosis Module and Display Module.

2) X-ray Generators

Software/Firmware	Version	Description
GXR SDK	1.06	GXR SDK is the software provides user interface on generator control. GXR SDK consists of generator control Module and Display Module.
GXR Remote Diagnosis	1.03	GXR Remote Diagnosis is the software provides remote diagnosis function through Membrane Console and Touch Console
GXR HT Control Board(GXR)	1.5a	GXR HT Control Board at x-ray generator controls whole x-ray generation process by the control of System Control Module in GXR SDK. This module controls x-ray parameters such as kV, mA and exposure time, and controls the filament and rotor driving and detector interfacing.
GXR DSS Board (GXR)	1.00	GXR DSS board at x-ray generator controls starter operation which drives tube's anode rotation by the control of GXR DSS board at x-ray generator.

3) GXR-C X-ray Generators

Software/Firmware	Version	Description
GXR SDK	1.06	GXR SDK is the software provides user interface on generator control. GXR SDK consists of generator control Module and Display Module.
GXR Remote Diagnosis	1.03	GXR Remote Diagnosis is the software provides remote diagnosis function through Membrane Console and Touch Console
GXR HT Control Board(GXR-C)	1.2a	GXR HT Control Board at x-ray generator controls whole x-ray generation process by the control of System Control Module in GXR SDK. This module controls x-ray parameters such as kV, mA and exposure time, and controls the filament and rotor driving and detector interfacing.
GXR Capacitor Monitor Board (GXR-C)	1.00	Capacitor monitor board is a board that measures the voltage of the capacitor module and provides danger and warning signals to HT control board and GXR charger board.
GXR Charger board (GXR-C)	1.00	GXR Charger board is X-ray generator charges the capacitor modules in the power stack of the generator to save the energy for X-ray exposure. This module detects voltage and current of capacitor modules to protect capacitor modules.

4) GXR-U X-ray Generators

Software/Firmware	Version	Description
GXR SDK	1.06	GXR SDK is the software provides user interface on generator control. GXR SDK consists of generator control Module and Display Module.
GXR Remote Diagnosis	1.03	GXR Remote Diagnosis is the software provides remote diagnosis function through Membrane Console and Touch Console
GXR HT Control Board(GXR-U)	1.6a	GXR HT Control Board at x-ray generator controls whole x-ray generation process by the control of System Control Module in GXR SDK. This module controls x-ray parameters such as kV, mA and exposure time, and controls the filament and rotor driving and detector interfacing.
GXR Inverter board (GXR-U)	1.01	GXR Charger board is X-ray generator charges the capacitor modules in the power stack of the generator to save the energy for X-ray exposure. This module detects voltage and current of capacitor modules to protect capacitor modules.

5) Patient Table

Software/Firmware	Version	Description
PBT-6 auto control	1.00	PBT-6 auto control at integrated control board controls the Tabletop table and Vertical movement of patient table.
Auto tracking	1.00	Module for motorized or manual tracking rail movement control of Auto tracking.
PBT-4 auto control	1.00	PBT-4 auto control at integrated control board controls the Tabletop table.

6) Wall Bucky stand Manual

Software/Firmware	Version	Description
PBT-4 Control Board	1.00	PBT-4 Control Board at integrated control board in Wall Bucky Stand controls the each lock

7) Wall Bucky stand Motorized

Software/Firmware	Version	Description
WBS MOTORIZED CONTROL BOARD	1.00	WBS MOTORIZED CONTROL BOARD at integrated control board in Wall Bucky Stand controls the each lock and DC Motors.
WBS PANEL BOARD	1.00	WBS PANEL BOARD at integrated control board in Wall Bucky Stand controls the each switch and Display the information of Vertical movement and Tilting Angles.
COMMUNICATION BOARD	1.00	COMMUNICATION BOARD at integrated control board in Wall Bucky Stand controls the communication of GXR, PC interface module and Tube stand.

8) Tube stand Manual

Software/Firmware	Version	Description
Tube Stand Control Board	1.00	Tube stand board controls the position of the tube.

9) Tube stand Motorized

Software/Firmware	Version	Description
Tube Stand Control Board	1.00	Tube Stand Control Board is motorized radiographic stand controls the motorized radiographic stand, controls the motorized x-ray collimator by the control THU or RADMAX.
LS210 Board	1.00	LS210 Board is system status display and collimator control signal transfer to Tube Stand Control Board and x-ray control signal transfer to generator.
OP Switch Control Board	1.00	OP Switch Control Board is switch signal transfer to Tube Stand Control Board and receive remote control signal.
Angle Board (Stitch system option)	1.00	Angle Board uses Tube Rotation signal received from OP Switch board to rotate the tube in CW or CCW direction.

10) TS-CSP

Software/Firmware	Version	Description
Ceiling main control	1.00	Ceiling main control at integrated control board in the TS-CSP measures the angle of TS-CSP OP control
TS-CSP OP control	1.00	TS-CSP OP control at integrated control board displays the information of conventional stand, generator and image.
TS-CSP Switch control	1.00	TS-CSP Switch control at integrated control board control the lock switch and measures the angle of tube head.
TS-CSP Sensor Board	1.00	Control to the sensor station for preventing the collision.
TS-CSP Head Unit	1.00	TS-CSP Head Unit is displayed for system's information that SID, Tube angle, Detector state etc.

11) TS-CSA

Software/Firmware	Version	Description
Ceiling main control	1.00	Ceiling main control at integrated control board in the TS-CSA measures the angle of TS-CSA OP control
TS-CSA OP control	1.00	TS-CSA OP control at integrated control board displays the information of conventional stand, generator and image.
TS-CSA Switch control	1.00	TS-CSA Switch control at integrated control board control the lock switch and measures the angle of tube head.
TS-CSA Head Unit	1.00	TS-CSA Head Unit is displayed for system's information that SID, Tube angle, Detector state etc.

12) TS-CSE

Software/Firmware	Version	Description
TS-CSE Main Board	1.00	Ceiling main control at integrated control board in the TS-CSE measures the angle of TS-CSE OP control
TS-CSE Display Board	1.00	TS-CSE Display Board transmits the switch status to the Main Board and displays the Vertical height information.

1.3 ENVIRONMENT OF USE

OPERATING ENVIRONMENT

Ambient temperature range	10 °C to 35°C (50 °F to 95 °F)
Relative humidity range	30% to 75%, non-condensing
Atmospheric pressure range	700 hPa to 1060 hPa
Altitude Limit	This product is rated to operate at an altitude ≤3000m

TRANSPORT AND STORAGE

Ambient temperature range	-10 °C to 70 °C (14 °F to 158 °F).
Relative humidity range	10% to 90%, non-condensing.
Atmospheric pressure range	500 hPa to 1060 hPa

2 SAFETY INFORMATION

The policy of Manufacturer is to manufacture X-ray equipment that meets high standards of performance and reliability. We enforce strict quality control techniques to eliminate the potential for defects and hazards in our products. The intended use of this equipment is to acquire the purpose of acquiring X-ray images of the desired parts of a patient's anatomy. Use of this equipment in any other fashion may lead to serious personal injury. The safety guidelines provided in this section of the manual are intended to educate the operator on all safety issues in order to operate and maintain ***"GXR-SD/CSD/USD"*** System in a safe manner.
The following warnings and cautions are specific to ***"GXR-SD/CSD/USD"*** System. Read them carefully - some of them are not obvious to typical use.

NOTE
According to Medical Devices Regulation (EU) 2017/745, any serious incident that has occurred in relation to the device should be reported to the manufacturer and the competent authority of the EU Member State in which the user and/or patient is established.

NOTE
This manual contains important safety information. An understanding of this information is critical to the safe operation of your equipment. Please ensure that you read the warning notices before using the equipment.

2.1 SAFETY GUIDELINE

The following are general safety precautions:

- Only qualified personnel may use this software.
- Do not defeat or bypass built-in equipment safety features.
- Observe all warnings and cautions, stated or implied, in the procedures.
- Pediatric patients are more radiosensitive than adults (i.e., the cancer risk per unit dose of ionizing radiation is higher). Use of equipment and exposure settings designed for adults may result in excessive radiation exposure if used on smaller patients. Pediatric patients have a longer expected lifetime, putting them at higher risk of cancer from the effects of radiation exposure.
- To protect the system and data from Virus, Spam, spoofing, Phishing, Pharming, Spyware, Keylogging, Adware, Botnets, Worms, Trojan, Denial-Of-Service such as online attack and etc., it is important to install the proper Anti-Virus software in the workstation.

No practical design can incorporate complete protection for operators or service personnel who do not take adequate safety precautions. Only authorized and properly trained service and operating personnel should be allowed to work with this X-ray generator equipment. The appropriate personnel must be made aware of the inherent dangers associated with the servicing of high voltage equipment and the danger of excessive exposure to X-ray radiation during system operation.

WARNING
This x-ray unit may be dangerous to patient and operator unless safe exposure factors and operating instructions are observed.

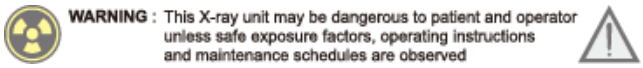
CAUTION
Observe all safety precautions recommended by the accessory equipment manufacturer in the user documentation provided with the equipment.

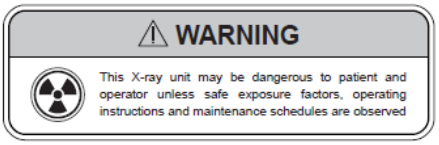
WARNING
Do not install components or accessories that were not intend for use by the system. Failure to comply could result in damage to the equipment or injury to personnel.

2.2 SYMBOL DEFINITIONS

The table below defines the meaning of various symbols used on labels on the machine.

Radiation exposure symbol used on operator console. Lights to indicate that an exposure is in progress. This is accompanied by an audible tone from the console.





Radiation warning message on console.
Never allow unqualified personnel to operate the X-ray generator.

Sitting at the end of tabletop is prohibited.

Consult accompanying documents (Required to consult for Safety)

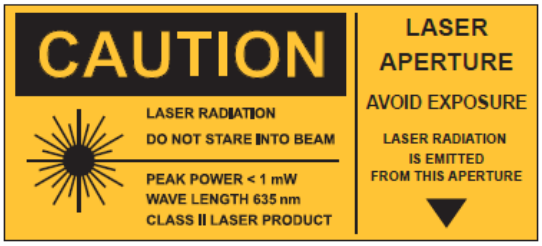
Emergency Stop

Caution for trapping zone of hand

This symbol means that the product and battery should be recycled separately from household waste. When this product reaches its end of life, follow the local laws and regulations of disposal. The improper disposal of waste electronic equipment from the consumer may be subject to fines.

Caution for overhead grips

Maximum allowable load of overhead grips



Caution of laser radiation.

Staring into beam is never allowed.

High voltage symbol used to indicate the presence of high voltage.

Warning symbol used to indicate a potential hazard to operators, service personnel or to the equipment. It indicates a requirement to refer to the accompanying documentation for details.

Protection earth symbol

PC Install Warning sticker

Stitching Stand Lock/Unlock sticker

L Live line among the single phase line powers.

N Neutral line among the single phase line powers.

L1 First phase line power among the three phase line powers.

L2 Second phase line power among the three phase line powers.

L3 Third phase line power among the three phase line powers.

V~	Single phase AC voltage
V3~	Three phase AC voltage
V⎓	DC voltage

This subsection defines the safety labels used inside and outside the generator cabinet.

NOTE
These labels and warnings are provided to alert service personnel that serious injury will result if the hazard identified is ignored.

This information is provided to help you establish safe operating conditions for both you and your X-ray generator. Do not operate this X-ray generator except in accordance with these instructions, and any additional information provided by the X-ray generator manufacturer and / or competent safety authorities.

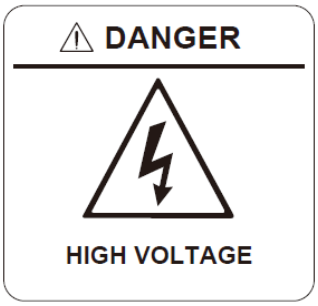
HEAVY WEIGHT WARNING LABEL

This label is attached to the outside of the radiographic stand and generator cabinet. This label states the approximate weight.
Do not attempt to lift this unit without proper assistance.
(Example)

HV 3 MINUTES WARNING LABEL

This label is attached to the outside of the generator cabinet. The DC bus capacitors (approximately 310-325/565/680 VDC with line voltage at 220-230/400/480VAC) will remain charged for up to 3 minutes after the AC mains is disconnected or the console is switched off.

DANGER HIGH VOLTAGE LABEL



This label is attached to the main fuse cover, main noise filter cover and power stack cover.

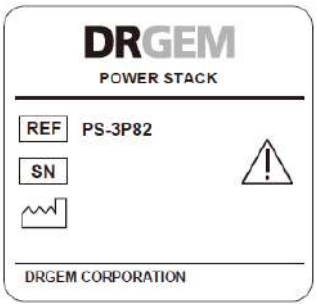
Mains voltage is present inside the generator cabinet whenever the main disconnect is switched on. Additionally, the DC bus capacitors will remain charged for up to 3 minutes after the AC mains is disconnected or the console is switched off.

IDENTIFICATION LABEL – HIGH TENSION TANK

This label is attached to side of the High Tension Tank inside of the generator main cabinet.

(Example)

IDENTIFICATION LABEL – POWER STACK



This label is attached to side of the POWER STACK inside of the generator main cabinet.

(Example)

WARNING
Wait a minimum of 3 minutes after the input mains power has been removed before removing any covers. Once the cover(s) are removed, check that the voltage across the dc bus capacitors is near zero before servicing.

WARNING
High voltage is present on all components connected to the AC mains (line fuses, main power contactor, auxiliary transformer, etc) whenever the AC mains is switched on. Additionally, DC bus voltage will remain on certain components (mains rectifier assembly, DC bus capacitors, Power-Stack, HT tank, etc) for up to 3 minutes after the console is switched off or the AC mains is switched off or disconnected. Be certain that you are aware of all potential high voltage locations and hazards as detailed in this section before removing any covers, or attempting any service on this X-ray generator.

WARNING
High voltage (approximately 565/680VDC with line voltage at /480VAC) is present on the power stack (inverter assembly) and associated components whenever the ac mains is energized and the console is switched on, and for up to 3 minutes after the console is switched off or the ac mains is disconnected. **This combination of high voltage and high current is potentially lethal.** **Use extreme caution when servicing this unit.**

2.3 RADIATION SAFETY

Everyone associated with X-ray work must be familiar with the recommendations of the Center for Devices and Radiological Health (CDRH), the National Institute for Standards and Technology (NIST), the National Council on Radiation Protection (NCRP), and the International Committee on Radiation Protection (ICRP).

Be sure that all personnel authorized to operate the X-ray system are familiar with the established regulations of the authorities named above. All personnel should be monitored to ensure compliance with recommended procedures.

Current sources of information include:

- National Council on Radiation Protection Report No. 33
  ("Medical X-ray and gamma ray Protection for Energies up to 10 MEV-Equipment Design and Use").
- National Bureau of Standards Handbook No. 76 ("Medical X-ray Protection up to Three Million Volts"). Refer to NCRP Report No. 33.
- Current recommendations of the International Committee on Radiation Protection.

Although X-radiation is hazardous, X-ray equipment does not pose any danger when properly used. Be certain all operating personnel are properly educated concerning the hazards of radiation. Persons responsible for the system must understand the safety requirements and special warnings for X-ray operation. Review this manual and the manuals for each component in the system to become aware of all safety and operational requirements.

WARNING
Ensure exposure parameters are properly adjusted within safety limits.

CAUTION
Incorrectly positioning the X-ray tube and Collimator could cause the X-ray field to be misaligned with the Bucky, resulting in unacceptable images.

2.3.1 RADIATION SAFETY NOTICE

X-ray radiation exposure may be damaging to health, with some effects being cumulative and extending over periods of many months or even years. **X-ray operators should avoid any exposure to the primary beam** and take protective measures to safeguard against scatter radiation. Scatter radiation is caused by any object in the path of the primary beam and may be of equal or less intensity than the primary beam that exposes the film.

WARNING
X-rays generate a potential risk for both patients and operators. For this reason, the application of X-rays for a given medical purpose must aim at the minimization of radiation exposition to any persons. Those persons responsible for the application must have the specific knowledge according to legal requirements and regulations and must establish safe exposure procedures for this kind of systems. Those persons responsible for the planning and installation of this equipment must observe the national regulations.

2.3.2 X-RAY PROTECTION

X-ray equipment may cause injury if used improperly. The instructions contained in this manual must be read and followed when operating the ***"GXR-SD/CSD/USD"*** System. No practical design can provide complete protection nor prevent operators from exposing themselves or others to unnecessary radiation. Personal radiation monitoring and protective devices are available. You are urged to use them to protect against unnecessary radiation exposure.

Serious unfavorable health effects can result from short term exposure to high levels of ionizing radiation (such as X-rays) as well as from long term exposure to low levels. Personnel who operate the ***"GXR-SD/CSD/USD"*** System should familiarize themselves with both the short term and the long term effects of radiation exposure and take appropriate measures to minimize the amount of radiation to which they are exposed while performing their duties. Some effects of X-radiation are cumulative, and may extend over a period of months or years. The best safety rule for X-ray operators is to avoid exposure to the primary beam at all times.

Ionizing radiation occurs naturally in the environment. It is generated by astronomical radiation sources such as the sun and the stars, and by the soil under our feet. The atmosphere filters radiation from astronomical sources. As a result, the radiation level from these sources is much lower at sea level than on the summit of high mountains. Radiation generated in the soil varies greatly from place to place depending on the composition of the soil. For example, areas rich in granite rock have a higher level of radiation than other areas.

Any materials placed in the path of the beam absorb natural as well as man-made radiation, such as the X-rays used in the ***"GXR-SD/CSD/USD"*** System.
Materials with a high atomic number, such as tungsten, lead, and uranium, absorb X-rays much more effectively than materials with a low atomic number such as hydrogen, aluminum, or beryllium. Therefore, lead is used for shielding the radiologist's workstation in most X-ray facilities, including ones using the ***"GXR-SD/CSD/USD"*** System.
If there are windows in the partition separating the operator from the patient, these windows are typically glazed with lead glass and provide effective protection against ionizing radiation.

To minimize dangerous exposure, use movable lead screens, lead-impregnated gloves, and lead-impregnated aprons. These protective devices must contain 0.35 millimeter thickness of lead or the equivalent.
Use such protective devices for all operators, observers, and/or servicing personnel exposed to radiation fields of five or more milli-Roentgens per hour.

- Wear protective clothing. Protective aprons with an equivalent of a minimum of 1/64" (0.35 mm) of lead are recommended.

- To protect the patient against radiation, always use radiation protection accessories in addition to devices which are fitted to the X-ray equipment.
- Keep as large a distance as possible away from the object being exposed and the X-ray tube assembly.

The shielding provided for a typical X-ray facility's operator workstation is generally quite effective and reduces the residual radiation from diagnostic X-rays to a level that is comparable to or lowers than natural background radiation. If the operator abandons the protected environment of the workstation, he or she may be exposed to a significantly higher level of radiation. For a single exposure this may still not lead to serious health effects, but repeated carelessness in this regard may lead to serious consequences.

Any object in the path of the primary beam produces scattered radiation. In the absence of proper precautions, scattered radiation can result in a substantial radiation dose to the operator or any other personnel in the facility. Moveable screens may be used to shield occupied areas from scattered radiation.

The X-ray Generator/host system used to power the ***"GXR-SD/CSD/USD"*** System only produces X-rays when high voltage is applied to the X-ray tube. When the high voltage is removed, X-ray emission ceases without delay.

WARNING
Proper use and safe operating practices with respect to ***"GXR-SD/CSD/USD"*** system are the responsibility of users. DRGEM corporation provides information on its products and associated hazards, but assumes no responsibilities for after-sale operating and safety practices.

WARNING
The manufacturer accepts no responsibility for any ***"GXR-SD/CSD/USD"*** system not maintained or serviced according to this manual, or for any ***"GXR-SD/CSD/USD"*** system that has been modified in any way.

WARNING
Keep as large a distance as possible away from the object being exposed and x-ray tube assembly.

2.3.3 MONITORING PERSONNEL

Monitoring personnel to determine the amount of radiation to which they have been exposed provides a valuable crosscheck to determine whether or not safety measures are adequate. This crosscheck may reveal inadequate or improper radiation protection practices and/or serious radiation exposure situations.

The most effective method of determining whether the existing protective measures are adequate is the use of instruments to measure the exposure (in rads). This measurement should be taken at all locations where the operator, or any portion of the operator's body, may be inadequately shielded during exposure. Exposure must never exceed the accepted tolerable dose.

A frequently used, but less accurate, method of determining the amount of exposure is placement of film at strategic locations. After a specified period of time, develop the film to determine the amount of radiation. Fluorescent screens (used in a darkened room) may also be used to detect excessive radiation.

A common method of determining whether personnel have been exposed to excessive radiation is the use of film badges. These are X-ray sensitive film enclosed in a badge that incorporates metal filters of varying degrees of transparency to X-ray radiation. Even though this device only measures the radiation reaching the area of the body on which it is worn, it does provide an indication of the amount of radiation received.

2.3.4 RADIATION PROTECTION SURVEY

A radiation protection survey must be made by a qualified expert after every change in equipment or change in operating conditions which might significantly increase the probability of personnel receiving more than the maximum permissible dose equivalent.

2.4 EQUIPMENT SAFETY

- Never operate this X-ray equipment in areas where there is a risk of explosion. Detergents and disinfectants, including those used on patients, may create explosive mixtures of gases. Please observe the relevant regulations.
- The operator console, or anything electrically connected to it, must never be used within 6 ft (1.8 m) of the patient environment.
- Do not place liquids (coffee, beverages, flowers, etc) on the control console or generator main cabinet.
- Always ensure adequate ventilation around the control console and generator main cabinet. Do not operate the equipment near curtains, drapes, etc which may block the ventilation slots.
- Do not operate the console or generator main cabinet in direct sunlight or near any heat sources.
- Do not operate the console near strong magnetic fields (microwave ovens, speakers, etc.), and avoid routing the console cables near these devices.
- The console and generator main cabinet must be operated in locations that are clean (free of excess dust, dirt, debris, etc.), stable (free of vibration), and secure such that the console cannot slip or tip.
- Only trained maintenance staff may remove the covers of the generator cabinet and the control console.
- Don't connect more than one multiple socket-outlet.
- Do not hang on the overhead handgrip and the chest handgrips of Wall Stand.
- Also, instruct patient not to hang on the overhead handgrip.
- Be careful not to catch hand(s) holding the chest handgrips while rotating the cassette tray.
- Make sure to fix the overhead handgrip tightly to prevent it from rotating.

The user is responsible for ensuring that the application and use of the ***"GXR-SD/CSD/USD"*** System does not compromise the patient contact rating of any equipment used in the vicinity of, or in conjunction with, the system.

WARNING
If any covers must be removed for service, take all required precautions with respect to the hazard(s) and immediately replace the covers when the need for removal is completed.

CAUTION
Incorrect connections or use of unapproved equipment may result in injury or equipment damage.

WARNING

Do not remove flexible high tension cables from X-ray tube housing or X-ray generator and/or access covers from X-ray generator until the main and auxiliary power supplies have been disconnected and allowed to discharge for at least 3 minutes. You can be fatally shocked if you do not.

Voltage as high as 100,000 volts may be present in the ***"GXR-SD/CSD/USD"*** system circuitry for a few minutes after it has been turned off.

WARNING

All of the movable assemblies and parts of this equipment should be operated with care and routinely inspected in accordance with the manufacturer's recommendations contained in this manual. Only properly trained and qualified personnel should be permitted access to any internal parts. Live electrical terminals are deadly; be sure line disconnect switches are opened and other appropriate precautions are taken before opening access doors, removing enclosure panels, or attaching accessories. For all components of the equipment, protective earthing means must be provided in compliance with the national regulations.

WARNING

The ***"GXR-SD/CSD/USD"*** system includes no user serviceable parts. For service assistance, contact DRGEM Corporation or service provider.

WARNING

The ***"GXR-SD/CSD/USD"*** system and associated cables must not be operated in the presence of moisture.

WARNING

Ensure that the earth grounding connections between the ***"GXR-SD/CSD/USD"*** system and its power source is maintained at all times.

WARNING

The ***"GXR-SD/CSD/USD"*** system is not suitable for operation in the presence of a flammable anesthetic mixture with air, oxygen, or nitrous oxide.

WARNING

Disconnect electrical power from the ***"GXR-SD/CSD/USD"*** system before servicing. Use care not to drop tools or other objects into the ***"GXR-SD/CSD/USD"*** system when working on or around the unit. Electrical shock could result.

WARNING
Table top moves for correct position of patient by operator's continuous operation. When it moves for examination it accompany hole under side that can cause serious damage to your hand. Be careful not to insert your hand in this hole.

WARNING
Use of this equipment adjacent to or stacked with other equipment should be avoided because it could result in improper operation. If such use is necessary, this equipment and the other equipment should be observed to verify that they are operating normally.

CAUTION
When using motorized moving functions (Auto Parking, Auto Position, Vertical motorized Up/Down, Motorized tube rotation), be careful of collisions with your device.

CAUTION
Do not directly touch the Tube Stand (Manual and Motorized type of TS-FM6, TS-FC6/4/2). Refer to the enclosed tube manual to check the normal operating range of the tube housing temperature.

2.4.1 ME EQUIPMENT CLASSIFICATION

The main components of ***"GXR-SD/CSD/USD"*** System comply with the regulatory requirements and design standards in this section as follows:

- Degree of protection against electric shock: Type B
- Operation Mode: Non-continuous
- Type of protection against electric shock: Class 1
- Degree of protection against liquid penetration: IPX0
  (Foot switch (patient table): IPX1)
  - Detector

IPX1	IPX4	IP54
Mano4336W Mano4343W	XRpad2 3025 HWC-M XRpad2 4336 HWC-M XRpad2 4343 HWC-M	PaxScan 4336W v4
IP56	IP67	IP68
Mars1717X Mars1417X	Luna1012X	PaxScan 4343W LUMEN2530W LUMEN4336W LUMEN4343W

- Method of sterilization: Not applicable
- Suitability for use in an OXYGEN RICH ENVIRONMENT: Not applicable

■ **GXR (Single phase)**

Model name	Generator Model name	Output rating	Output specification of the X-ray tube voltage	Mode of operation (Non-continuous operation mode)
GXR-32SD	GXR-32	32kW	400mA/80kV, 320mA/100kV, 250mA/125kV Option: 125mA/150kV	1 times exposure after reset time 1 minute (1 times exposure: 100kV, 320mA, 100ms)
GXR-40SD	GXR-40	40kW	500mA/80kV, 400mA/100kV, 320mA/125kV Option: 160mA/150kV	1 times exposure after reset time 1 minute (1 times exposure: 100kV, 400mA, 100ms)

■ **GXR (3-phase)**

Model name	Generator Model name	Output rating	Output specification of the X-ray tube voltage	Mode of operation (Non-continuous operation mode)
GXR-32SD	GXR-32	32kW	400mA/80kV, 320mA/100kV, 250mA/125kV 200mA/150kV	1 times exposure after reset time 1 minute (1 times exposure: 100kV, 320mA, 100ms)
GXR-40SD	GXR-40	40kW	500mA/80kV, 400mA/100kV, 320mA/125kV 250mA/150kV	1 times exposure after reset time 1 minute (1 times exposure: 100kV, 400mA, 100ms)
GXR-52SD	GXR-52	52kW	640mA/81kV, 500mA/104kV, 400mA/130kV, 320mA/150kV	1 times exposure after reset time 1 minute (1 times exposure: 104kV, 500mA, 100ms)
GXR-68SD	GXR-68	68kW	800mA/85kV, 640mA/106kV, 500mA/136kV, 400mA/150kV	1 times exposure after reset time 1 minute (1 times exposure: 106kV, 640mA, 100ms)
GXR-82SD	GXR-82	82kW	1000mA/82kV, 800mA/102kV, 640mA/128kV, 500mA/150kV	1 times exposure after reset time 1 minute (1 times exposure: 102kV, 800mA, 100ms)

- For LSS, up to Output rating 52kW is supported.

■ **GXR-C, GXR-U (Single phase)**

Model name	Generator Model name	Output rating	Output specification of the X-ray tube voltage	Mode of operation (Non-continuous operation mode)
GXR-C32SD GXR-U32SD	GXR-C32 GXR-U32	32kW	400mA/80kV, 320mA/100kV, 250mA/125kV Option: 200mA/150kV	1 times exposure after reset time 1 minute (1 times exposure: 100kV, 320mA, 100ms)
GXR-C40SD GXR-U40SD	GXR-C40 GXR-U40	40kW	500mA/80kV, 400mA/100kV, 320mA/125kV Option: 250mA/150kV	1 times exposure after reset time 1 minute (1 times exposure: 100kV, 400mA, 100ms)
GXR-C52SD	GXR-C52	52kW	640mA/81kV, 500mA/104kV, 400mA/130kV Option: 320mA/150kV	1 times exposure after reset time 1 minute (1 times exposure: 104kV, 500mA, 100ms)

2.4.2 GENERATOR DUTY CYCLE LIMIT

NOTE
The following section contains important information. Please read and understand this material before continuing.

Internal X-ray generator components will heat up during normal use of the generator. This is similar to X-ray tube heating during normal generator operation. The amount of heat produced is proportional to the product of kV, mA, and time.

Modern X-ray generators are designed to operate with the majority of X-ray tubes over their rated power ranges. They are designed for operating duty cycles **consistent with practical patient examination routines that allow for reasonable cooling intervals between X-ray exposures**. Insufficient cooling time between exposures may lead to excessive heat build - up in the generator, which may cause serious generator damage.

CAUTION
This x-ray generator has temperature monitoring of power-stack to protect the excessive heat build-up. If the generator detects the over-heat of power-stack, an error code “e04” or “e05” will be displayed. Exposure will be inhibited when this message is displayed, and it should be understood that continuing to make exposures might cause generator damage due to overheating. The gnenrator should be allowed to cool sufficiently such that this message is no longer displayed.

2.5 LIABILITY

2.5.1 STATEMENT OF LIABILITY

To prevent excess radiation exposure to patient and operator from either primary or secondary radiation, this ***"GXR-SD/CSD/USD"*** System must be operated and serviced by trained personnel who are familiar with the safety precautions required. While this ***"GXR-SD/CSD/USD"*** System has been designed for safe operation, improper operation or carelessness may result in serious injury or damage to equipment. The manufacturer or its agents and representatives assume no responsibility for the following:

- Injury or danger to any person from x-ray exposure.
- Overexposure due to poor technique selection.
- Injury or danger from improper use of the function.
- Problems or hazards resulting from failure to maintain the equipment as specified in the Installation chapter.
- Equipment which has been tampered with or modified. DRGEM Corporation is not liable for any damage or injury arising from failure to follow the instructions and procedures provided within the manuals or associated informational material, or from user failure to use caution when installing, operating, adjusting, or servicing this equipment. DRGEM Corporation is not liable for damage or injury arising from the use of this product for any other use than that intended by the manufacturer.

2.5.2 MANUFACTURER'S RESPONSIBILITY

Although this equipment incorporates protection against X-radiation other than the useful beam, practical design does not provide complete protection. Equipment design does not compel the operator or assistants to take the necessary precautions; nor does it prevent the possibility of improper use (authorized or unauthorized persons carelessly, unwisely, or unknowingly exposing themselves or others to direct or secondary radiation). Allow only authorized, properly trained personnel to operate this equipment.

Be certain that all individuals authorized to use the equipment are aware of the danger of excessive exposure to X-radiation.

This equipment is sold with the understanding that the manufacturer, its agents, and representatives, do not accept any responsibility for overexposure of patients or personnel to X-radiation.

Furthermore, the manufacturer does not accept any responsibility for overexposure of patients or personnel to X-radiation generated by the equipment used in conjunction with the ***"GXR-SD/CSD/USD"*** System as a result of poor operating techniques or procedures.

No responsibility is assumed for any unit that has not been serviced and maintained in accordance with the Manual, or which has been modified or tampered with in any way.

WARNING
Proper use and safe operating practices with respect to x-ray generators are the responsibility of the users of such generators. Manufacturer provides information on its products and associated hazards, but assumes no responsibilities for after-sale operating and safety practices. Manufacturer accepts no responsibility for any generator not maintained or serviced according to the service manual or any generator that has been modified in any way. Manufacturer also assumes no responsibility for x-ray radiation overexposure of patients or personnel resulting from poor operating techniques or procedures.

2.6 IT NETWORK CHARACTERISTICS

"GXR-SD/CSD/USD" System may only be run in an environment approved or authorized by the manufacturer.

The manufacturer requests a firewall and an antivirus program preinstalled in user's workstation according to the institution's regulation.

"GXR-SD/CSD/USD" system provides the user interface for user access that the user can be authorized by entering valid User Name and/or Password.

DICOM communication for receiving/ sending data is made through the Ethernet port on a workstation. Optionally WIFI network can be used.

2.7 WARNING & ERROR MESSAGES AND STATUS INDICATORS

The system displays warnings and error messages status on the system.

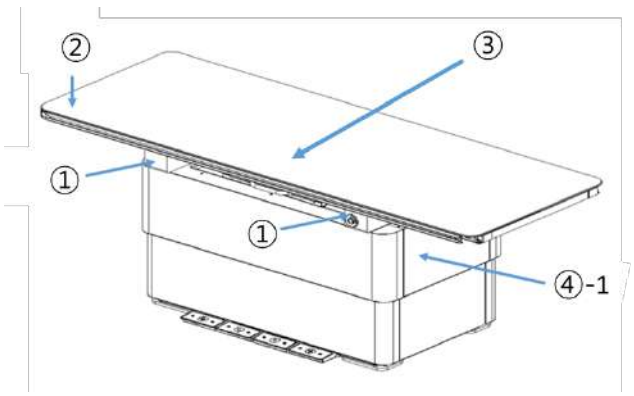
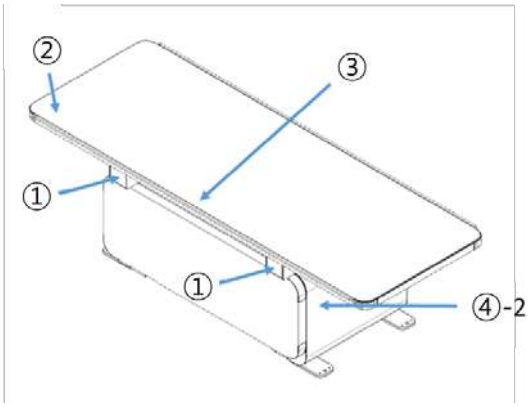
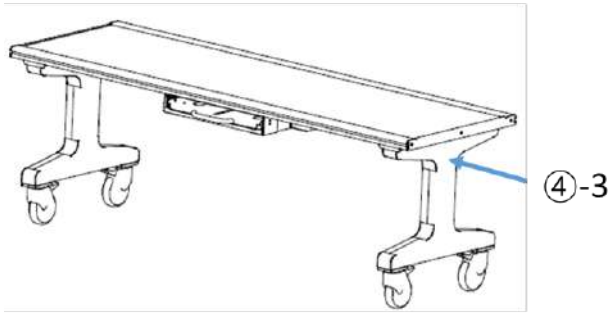
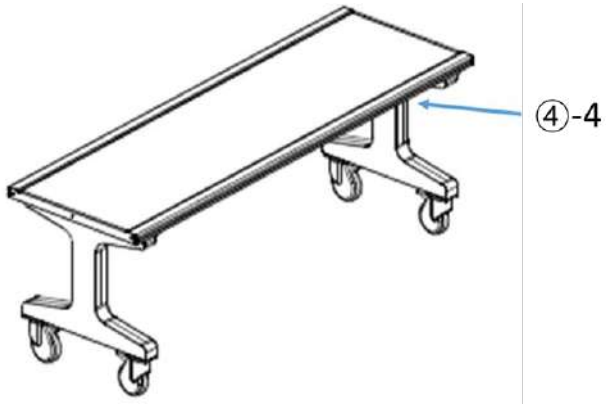
NOTE
Warnings and error messages status are displayed in RADMAX Software, Touch Screen LCD of the Tube Stand (In case of TS-CSP, TS-CSA, TS-FM6 Motorized, TS-FC6/4 Motorized), Vertical SID Display at handlebar (In case of TS-CSE), and WBS-TA Control Panel.

It gives information on what to problem.

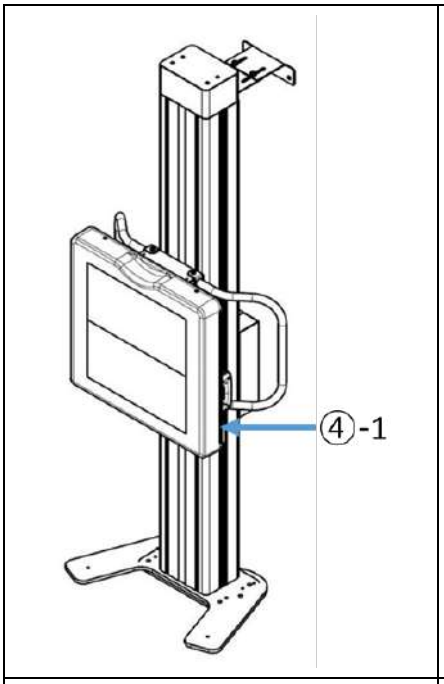
For further details refer to the Service Manual of the ***"GXR-SD/CSD/USD"*** system.

2.8 LABEL ATTACHMENT LOCATION

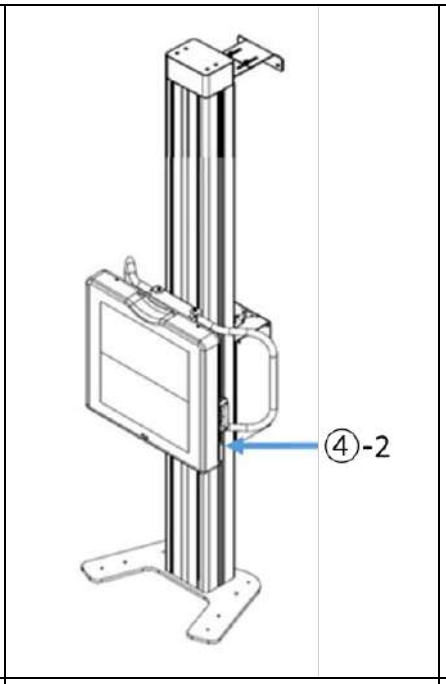
Label Attachment Location

<table>
<tr><td> 
</td><td> 
</td></tr>
<tr><td><PBT-6></td><td><PBT-4></td></tr>
<tr><td> 
</td><td> 
</td></tr>
<tr><td><PBT-1></td><td><PDT-1></td></tr>
</table>

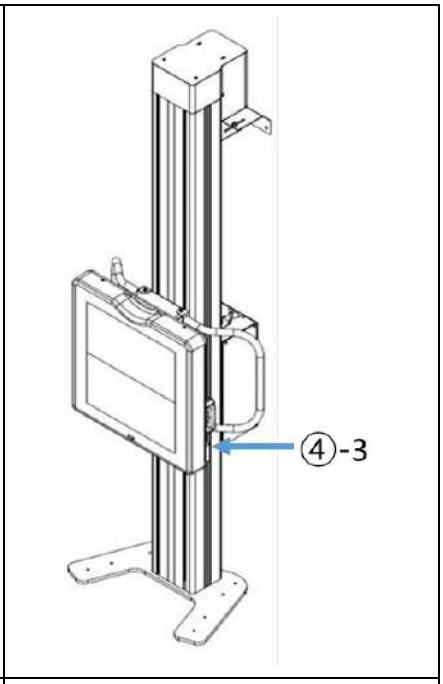
①		Caution for trapping zone of hand
②		Sitting at the end of tabletop is prohibited.
③		Caution for trapping zone of hand
④-1		ID LABEL (PBT-6) The contents may vary depending on the tabletop option.
④-2		ID LABEL (PBT-4) The contents may vary depending on the tabletop option.
④-3		ID LABEL (PBT-1)
④-4		ID LABEL (PDT-1)



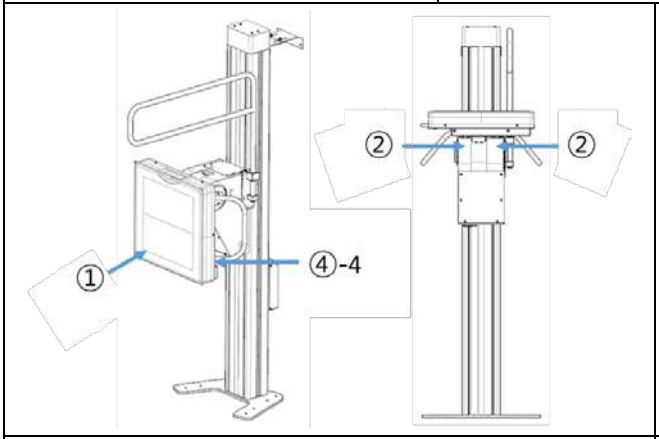
<WBS Manual>



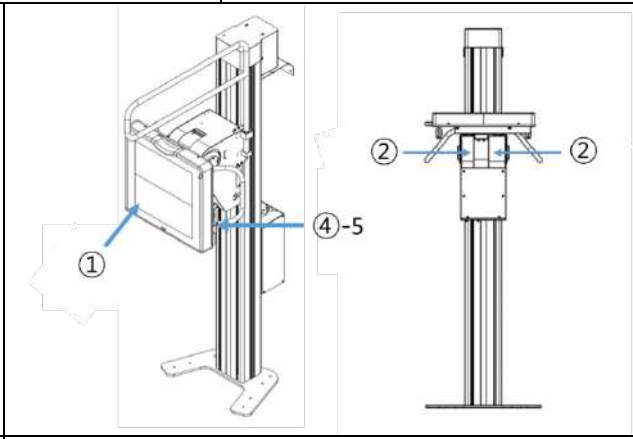
<WBS Manual Plus>



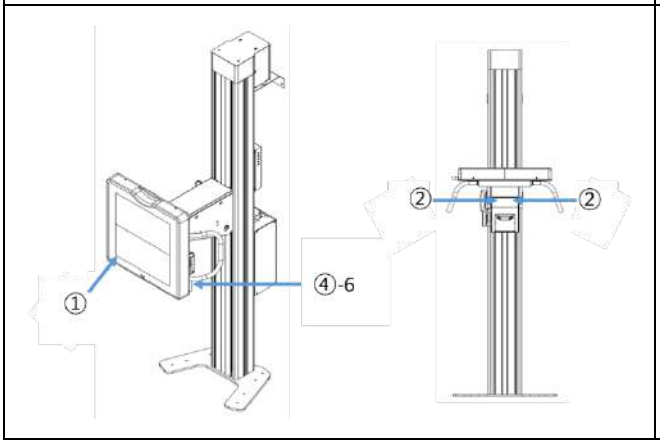
<WBS Motorized>



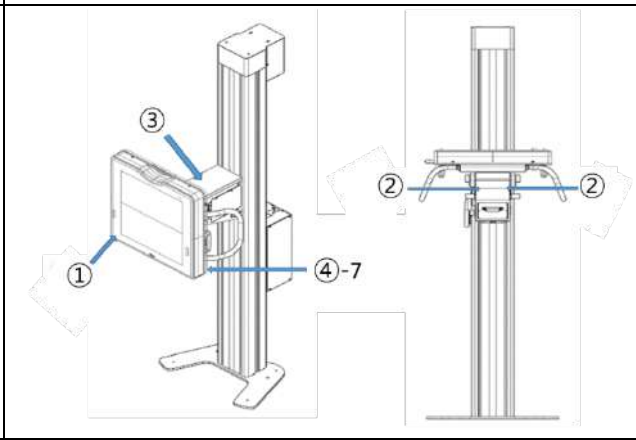
<WBS-TM Manual>



< WBS-TM Motorized>

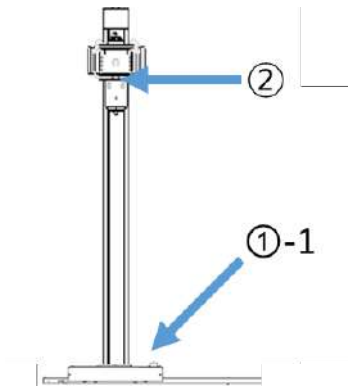
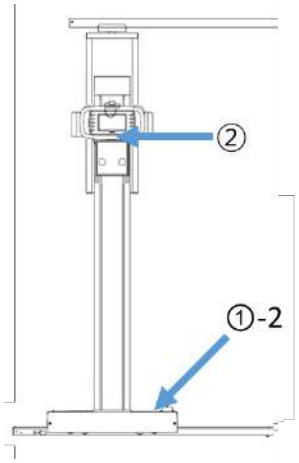
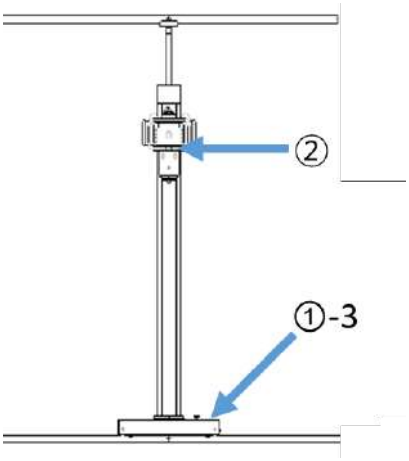
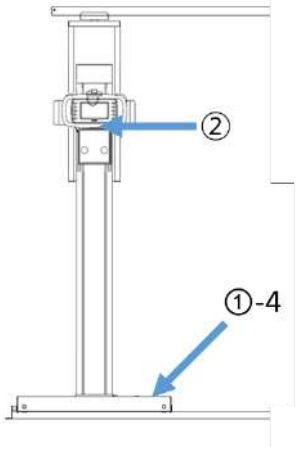
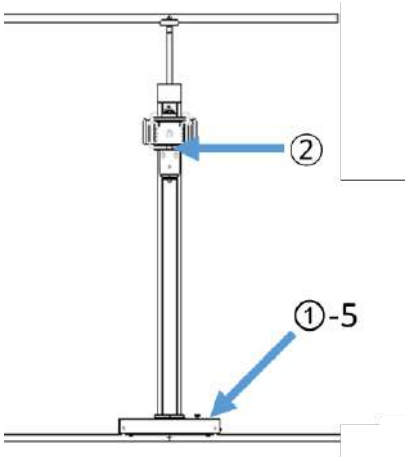
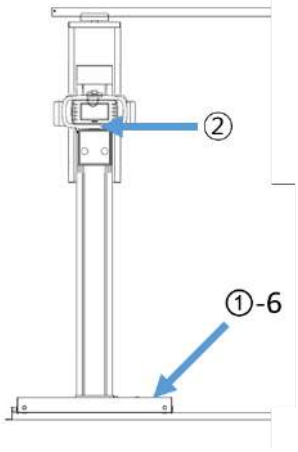


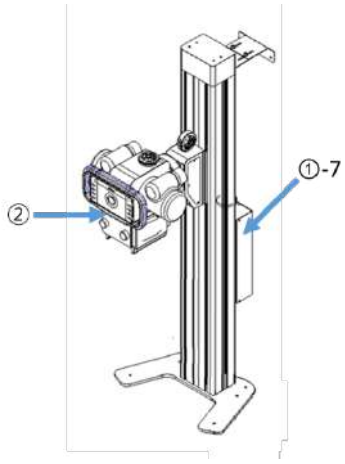
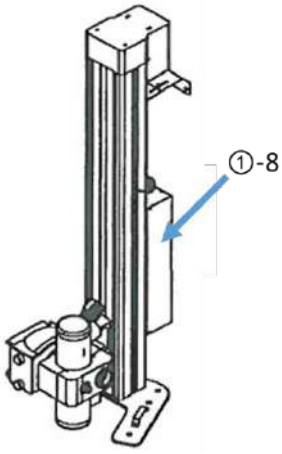
<WBS-TA (Motorized)>



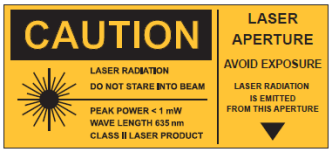
< WBS-TA (Actuator)>

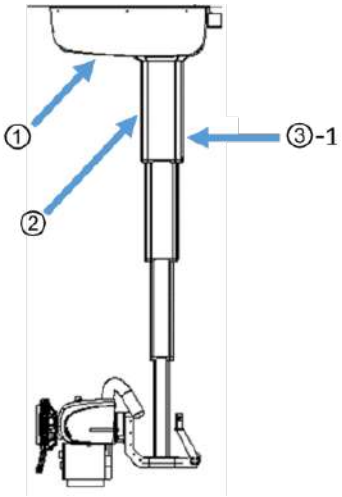
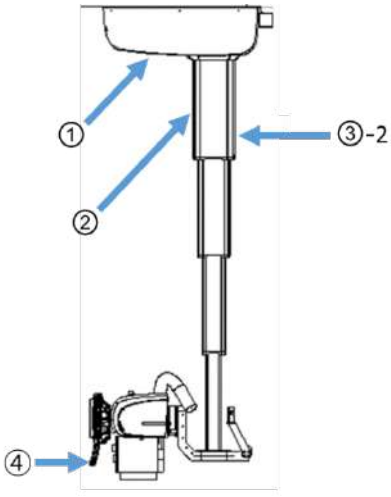
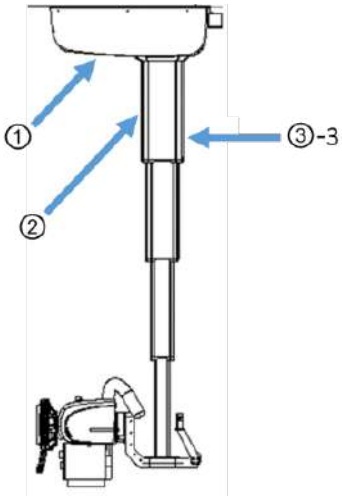
①		Sitting at the end of tabletop is prohibited.
②		Caution for trapping zone of hand
③		Caution for overhead grips Maximum allowable load of overhead grips
④-1		ID LABEL (WBS Manual)
④-2		ID LABEL (WBS Manual Plus)
④-3		ID LABEL (WBS Motorized)
④-4		ID LABEL (WBS-TM Manual)
④-5		ID LABEL (WBS-TM Motorized)
④-6		ID LABEL (WBS-TA (Motorized))
④-7		ID LABEL (WBS-TA (Actuator))

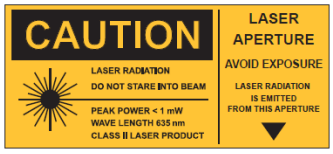
	
<TS-FM6 (Manual)>	*< TS-FM6 (Motorized)>*
	
<TS-FC6 (Manual)>	*< TS-FC6 (Motorized)>*
	
<TS-FC4 (Manual)>	*< TS-FC4 (Motorized)>*

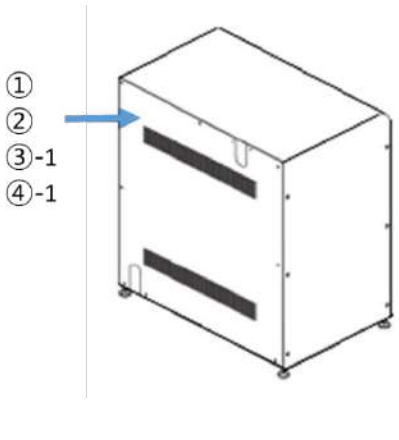
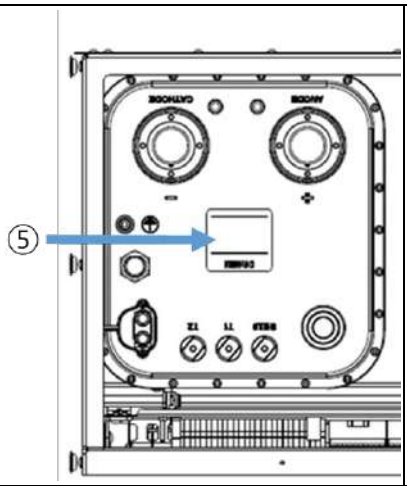
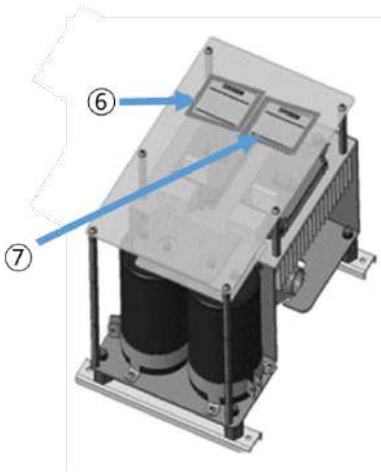
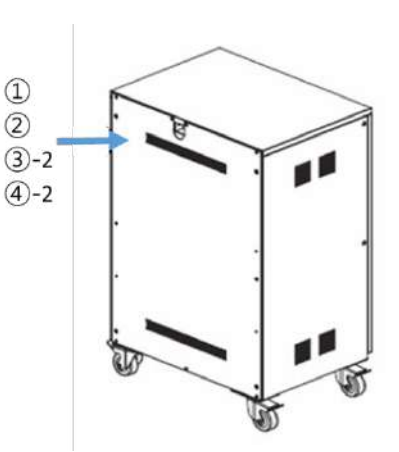
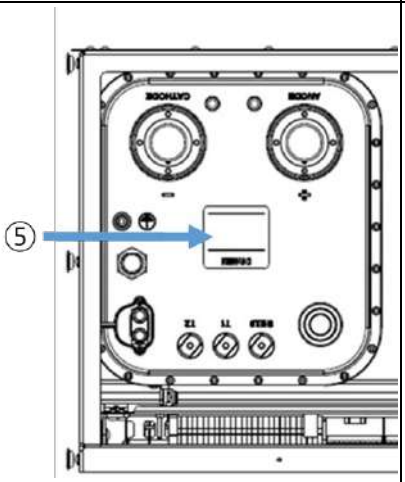
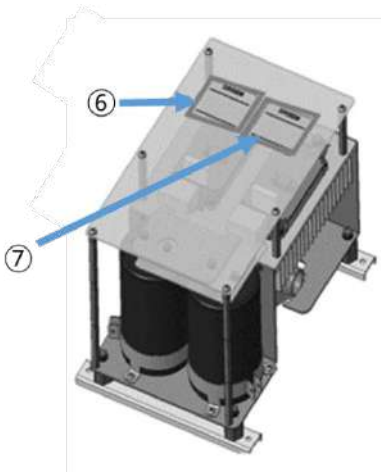
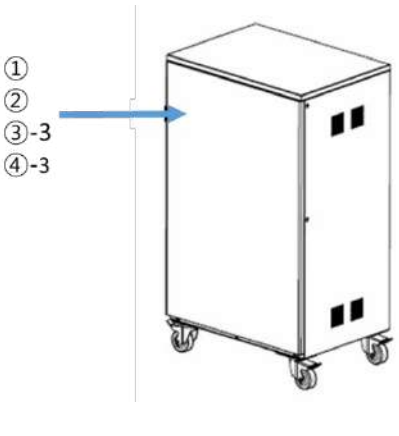
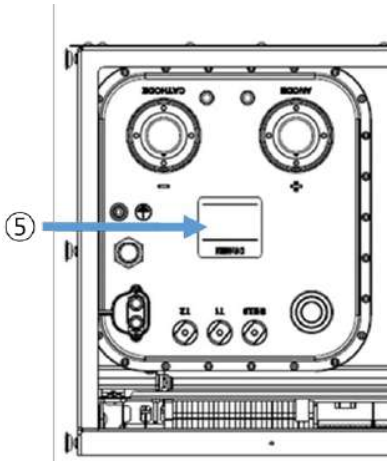
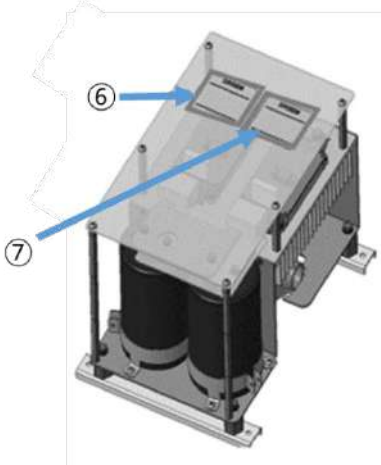
	
<TS-FC2 (Manual)>	*< TS-FC2 (Motorized)>*

①-1		ID LABEL (TS-FM6 (Manual))
①-2		ID LABEL (TS-FM6 (Motorized))
①-3		ID LABEL (TS-FC6 (Manual))
①-4		ID LABEL (TS-FC6 (Motorized))
①-5		ID LABEL (TS-FC4 (Manual))
①-6		ID LABEL (TS-FC4 (Motorized))

①-7		ID LABEL (TS-FC2 (Manual))
①-8		ID LABEL (TS-FC2 (Motorized))
②		Caution of laser radiation. Staring into beam is never allowed. (Attach only when handlebar laser option is applied)

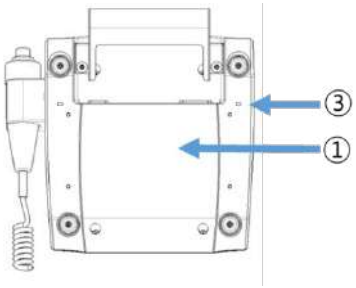
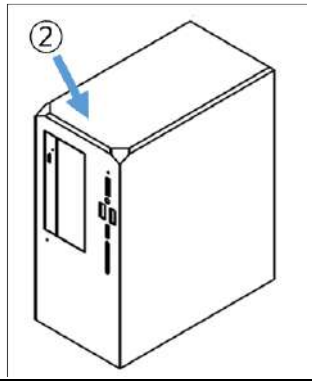
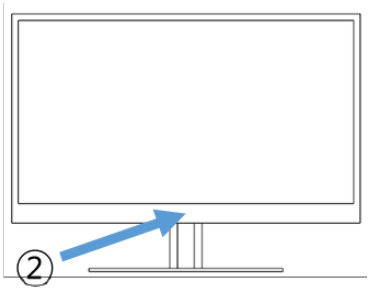
		
<TS-CSP>	*<TS-CSA>*	*<TS-CSE>*

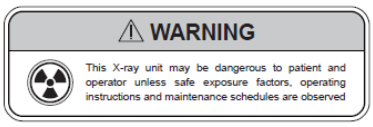
①		Control position color
②		Control position color (Vertical)
③-1		ID LABEL (TS-CSP)
③-2		ID LABEL (TS-CSA)
③-3		ID LABEL (TS-CSE)
④		Caution of laser radiation. Staring into beam is never allowed. (Attaches only when the handlebar laser option is applied on the TS-CSA.)

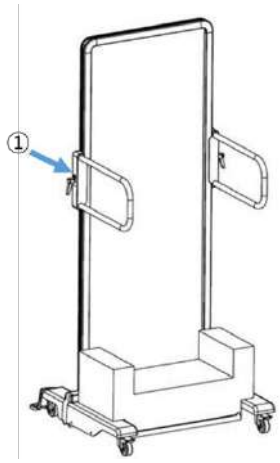
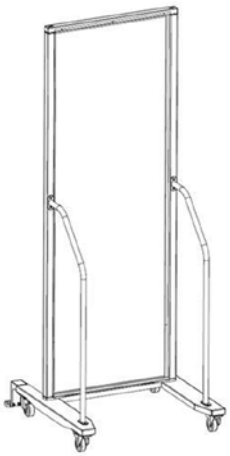
		
<GXR>	*<GXR HV TANK>*	*<GXR POWER STACK>*
		
<GXR-C>	*<GXR-C HV TANK>*	*<GXR-C POWER STACK>*
		
<GXR-U>	*<GXR-U HV TANK>*	*<GXR-U POWER STACK>*

①		HV 3 MINUTES WARNING LABEL
②		HEAVY WEIGHT WARNING LABEL
③-1		ID LABEL (GXR) (Example of GXR-82)
③-2		ID LABEL (GXR-C) (Example of GXR-C52)
③-3		ID LABEL (GXR-U) (Example of GXR-U40)
④-1		SYSTEM LABEL (GXR-SD) (Example of GXR-82SD)

④-2		SYSTEM LABEL (GXR-CSD) (Example of GXR-C52SD)
④-3		SYSTEM LABEL (GXR-USD) (Example of GXR-U40SD)
⑤		ID LABEL (HIGH TENSION TANK)
⑥		DANGER HIGH VOLTAGE LABEL
⑦		ID LABEL (POWER STACK) (Example of PS-3P82)

		
<PC INTERFACE MODULE>	*<WORKSTATION>*	*<MONITOR>*

①		ID LABEL (PC INTERFACE MODULE)
②		PC INSTALL WARNING STICKER
③		RADIATION WARNING MESSAGE STICKER

	
<Stitching Stand>	*<Stitching Stand>*

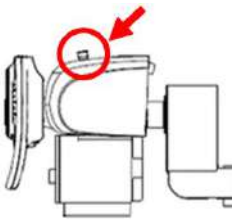
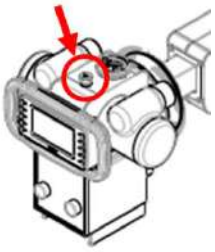
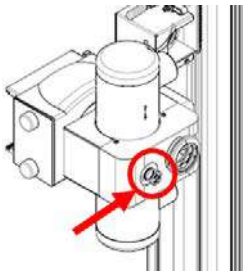
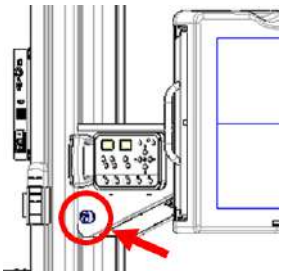
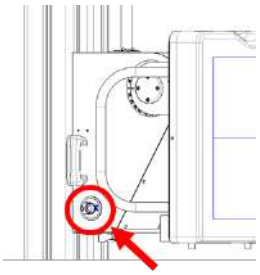
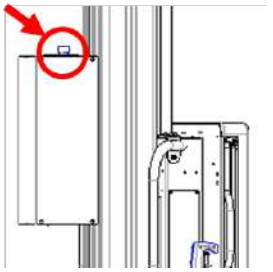
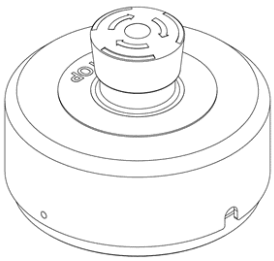
①		Stitching Stand Lock/Unlock sticker

2.9 EMERGENCY PROCEDURE

Press the **'Emergency Stop Switch'** immediately if the device does not operate as intended and risk of collision, injury to the patient or operator, or risk of damage to the system.
(The **'Emergency Stop Switch'** is only available on Motorized equipment.)
All system drives are shut down and movements are stopped immediately.
If necessary, turn off the room's main power switch or the generator's main switch.
Only when the cause of the danger has been unequivocally identified and remedied, should the **"Emergency STOP button"** be disengaged.
Turn the **'Emergency Stop Switch'** clockwise to release.
If the main power switch of the room or the main switch of the generator is turned off, turn on the switch.

CAUTION

The location of the Emergency Stop Switch is as follows.

		
TS-CSP, TS-CSA	*TS-FM6 (Motorized),* *TS-FC6 (Motorized)* *TS-FC4 (Motorized)*	*TS-FC2 (Motorized)*
		
WBS-TA(Motor type), *WBS-TA(Actuator type)*	*WBS-TM(Motorized)*	*WBS(Motorized)*
		
PBT-6	*Emergency Stop Switch* *for operation room* *(Optional)*	

WARNING

Before operating ***"GXR-SD/CSD/USD"*** System, operators must familiarize themselves with the location of the room's main power switch or the generator's main switch in order to enable immediate shutdown of the x-ray tube in the event of unintended motion or other catastrophic equipment failure.

3. INTRODUCTION

This manual contains the necessary instructions for proper operation of ***"GXR-SD/CSD/USD"*** System. All persons operating this equipment need to have read this manual beforehand. You must have a thorough understanding in the proper use of this product before you make any radiographic exposures.
The ***"GXR-SD/CSD/USD"*** Series Digital Diagnostic X-Ray System, is a stationary X-ray imaging system, for the purpose of acquiring X-ray images of the desired parts of a patient's anatomy.

3.1 USE OF THE PRODUCT

This digital diagnostic x-ray system is designed to diagnose human body by providing radiographic x-ray image with anatomical structure.
This ***"GXR-SD/CSD/USD"*** "is for use by medical professionals"

3.1.1 INTENDED USE

The ***"GXR-SD/CSD/USD"*** is intended for use in generating radiographic images of human anatomy. The Diagnostic X-ray System consisting of a high voltage (HV) generator, a tube support unit, an X-ray beam limiting device, patient table, wall Bucky stand, Flat Panel Detector, Workstation, and a tube, operates on a high-frequency inverter method, and is primarily used in a hospital for diagnosis of diseases in skeletal, respiratory and urinary systems. Such as the skull, spinal column, chest, abdomen, extremities, and other body parts. Applications can be performed with the patient sitting, standing, or lying in the prone or supine position.

3.1.2 INTENDED PATIENT POPULATION

Age	Available all people, but is not intended to use for dedicated pediatric application
Weight	Not relevant
Height	Not relevant
Nationality	Multiple
Patient state	PATIENT is not USER

3.1.3 INTENDED USER PROFILE

- Operator

Considerations		Requirement description
Education	Minimum	• Qualified person (He/she must have license for radiologist or have to meet local regulation) • Educated person by manufacturer
	Maximum	• N/A
Knowledge	Minimum	• Qualified person (He/she must have license for radiologist or have to meet local regulation)
	Maximum	• N/A
Language understanding	Minimum	• Local language
	Maximum	• Understanding of manual that is writing in English
Experience	Minimum	• He/she must have license for radiologist or have to meet local regulation • He/she have to be educated by manufacturer or local distributor
	Maximum	• N/A
Permissible impairments	• N/A	

- Service engineer

Considerations		Requirement description
Education	Minimum	• Qualified person by manufacturer or local distributer regarding installation, maintenance and service. • Educated person by manufacturer
	Maximum	• N/A
Knowledge	Minimum	• Qualified person (He/she must have knowledge of electrical engineering and/or radiology procedure)
	Maximum	• N/A
Language understanding	Minimum	• Local language
	Maximum	• English
Experience	Minimum	• He/she have to be educated by manufacturer or local distributor
	Maximum	• N/A
Permissible impairments	• N/A	

WARNING
The ***"GXR-SD/CSD/USD"*** system produces ionizing radiation. Operators must meet all state and local requirements and regulations.

WARNING
Only qualified personnel may operate ***"GXR-SD/CSD/USD"*** System. Operation of the equipment by persons who have not been trained or who are unfamiliar with ***"GXR-SD/CSD/USD"*** System may cause serious injury to the patient, serious injury to the operator, or equipment damage.

3.1.4 CONTRAINDICATION

There are no medical conditions that would make having an X-Ray unsuitable. However, for women who are or might be pregnant, it is advised that certain X-Rays are not undertaken other than in emergency situations.

This System is not intended to use of fluoroscopy, angiography, mammography and bone density

This System is not suitable for operation in the presence of a flammable anesthetic mixture with air, oxygen, or nitrous oxide.

3.1.5 PEDIATRIC USE

General Information: Special care should be exercised when imaging patients outside the typical adult size range, especially smaller pediatric patients whose size does not overlap the adult size range (e.g., patients less than 50 kg (110 lb.) in weight and 150 cm (59 in) in height, measurements, which approximately correspond to that of an average 12-year-old or a 5th percentile U.S. adult female).

Exposure to ionizing radiation is of particular concern in pediatric patients because:

- For certain organs and tumor types, younger patients are more radiosensitive than adults (i.e., the cancer risk per unit dose of ionizing radiation is higher for younger patients);
- Use of equipment and exposure settings designed for adults of average size can result in excessive and unnecessary radiation exposure of smaller patients; and
- Younger patients have a longer expected lifetime over which the effects of radiation exposure may manifest as cancer.

References for pediatric dose optimization: The following resources provide information about pediatric imaging radiation safety and/or radiation safety for general radiography devices:

- FDA's website provides radiation safety information references from a variety of groups including the Image Gently Alliance: Pediatric X-ray Imaging;http://www.fda.gov/Radiation mittingProducts/RadiationEmittingProductsandProcedures/ucm298899.htm
- And Medical X-ray Imaging (http://www.fda.gov/Radiation-EmittingProducts/RadiationEmittingProductsandProcedures/MedicalImaging/MedicalX-Rays/default.htm).
- In addition, FDA's Pediatric X-ray Imaging Website (https://www.fda.gov/radiation-emittingproducts/radiationemittingproductsandprocedures/medicalimaging/ucm298899.htm)

WARNING
Use special care when imaging patients outside the typical adult size range.

3.1.6 CLINICAL BENEFITS

X-ray imaging exams are recognized as a valuable medical tool for a wide variety of examinations and procedures. The Digital Diagnostic X-ray System is primarily used in a hospital for diagnosis of diseases in skeletal, respiratory and urinary systems, such as the skull, spinal column, chest, abdomen, extremities, and other body parts. Generic clinical benefits of radiographic examinations within the intended use are applicable for this system.

3.1.7 SIDE EFFECTS

Most diagnostic X-rays will not have an adverse effect. Procedures with higher doses such as CT, interventional procedures or multiple exposures could lead to biological effects in some cases. A higher absorbed dose means a higher risk for adverse effects – the relationship is almost linear. Adverse effects could include skin redness, infertility, cataracts and hair loss. There are no reports of radiation exposure in diagnostic and interventional procedures causing infertility or cataracts. Patients undergoing interventional procedures that require fluoroscopy that lasts one hour or more could in very rare cases experience radiation induced skin injuries (erythema). Diagnostic X-rays and nuclear medicine examinations lead to a slightly increased risk of cancer. This risk increases with the magnitude of the dose and with the number of procedures.

3.1.8 RESIDUAL RISKS

The overall residual risk was reviewed and assessed. And Despite the overall acceptable residual risk, we have provided information such as NOTE, CAUTION and WARNING in the operating to reduce the risk of patients and operators.

3.2 INFORMATION ABOUT THIS OPERATOR MANUAL

Operation manual of this system has been broken down into several individual operation manual with thematically distinct content.

"GXR-SD/CSD/USD" Operation Manual
"RADMAX" Operation Manual

NOTE
Consult Accompanying Documents - As Applicable

3.3 CUSTOMER SUPPORT

Address any questions regarding ***"GXR-SD/CSD/USD"*** System to:

DRGEM Corporation
7Fl, E-B/D Gwangmyeong Techno-Park, 60 Haan-ro,
Gwangmyeong-si, Gyeonggi-do, 14322, Korea
TEL: +82-2-869-8566, FAX: +82-2-869-8567
E-mail: cs@drgem.co.kr
Web-site: **http://www.drgem.co.kr**

EC REP

Obelis s.a.,
Bd.Général Wahis 53,1030 Brussels, Belgium
Tel) +32.2.732.59.54, Fax) +32.2.732.60.03

4. SYSTEM OPERATION

WARNING
No foreign objects which can attenuate or scatter the X-ray beam are allowed between x-ray tube and tabletop during exposure. Failure to follow this may result in serious injury.

WARNING
The tube stand and patient table is intended to be used as part of a system for the intended generation of X-rays for diagnostic use. X-rays generate a potential risk for both patients and operators. For this reason, the application of X-rays for a given purpose must aim at the minimization of radiation exposure to any persons. Those persons responsible for the application must have the specific knowledge according to legal requirements and regulations and must establish safe exposure procedures for this kind of systems. Those persons responsible for the planning and installation of this equipment must observe the national regulations.

4.1 PRE-PREPARE FOR OPERATION

For stable equipment operation, perform the following procedures before using the equipment every day. Refer to the maintenance section for detailed preparation methods.

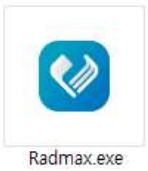
What to Do	Who to Do It	Related Section
DAILY X-RAY TUBE WARM-UP PROCEDURE	Operator	5.1.1
Test of Emergency Stop Switch	Operator	5.1.2
Checking the visible damaged of DAP	Operator	5.1.8

4.2 WORKFLOW OF SYSTEM

1. Turn on the monitor and Imaging Workstation.

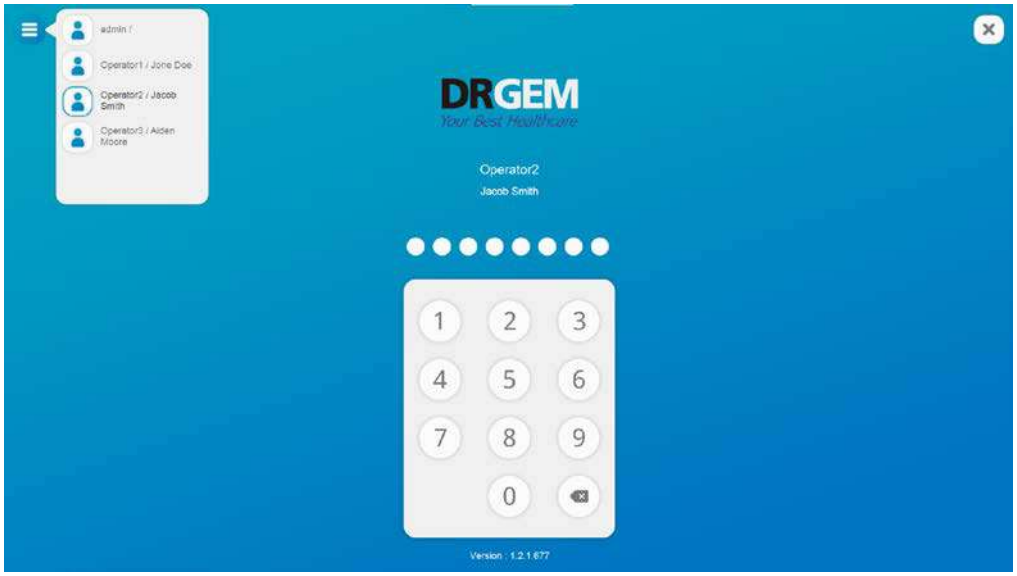
2. Press ON  of PC interface module to turn on the ***"GXR-SD/CSD/USD"*** System.
   (Refer to RADMAX Operation Manual)

3. Run the RADMAX software.



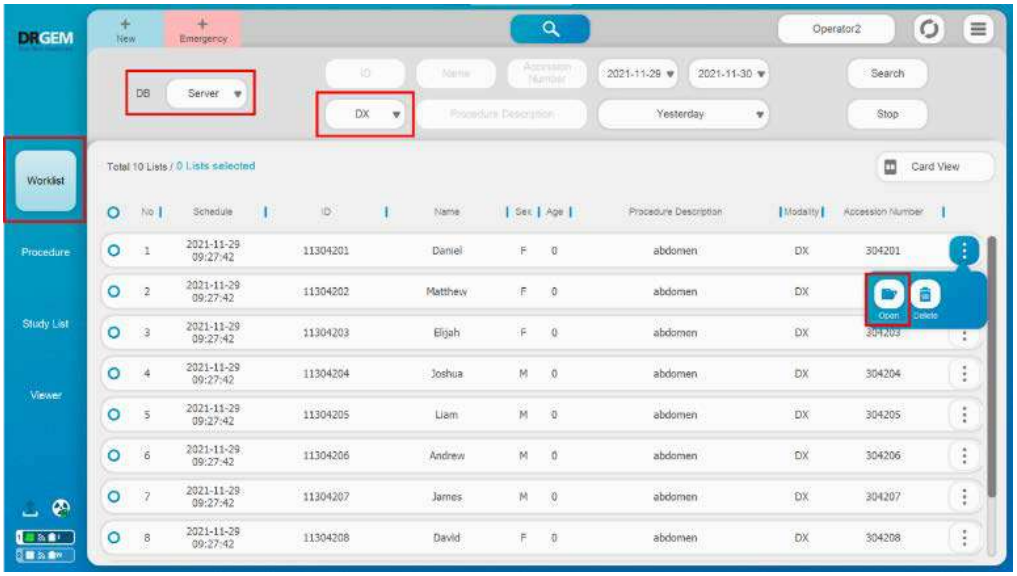
4. Wait until generator and detector booting sequences are finished.

5. Select the account and Log on



6. Check the generator interlock and detector communication status.

7. Press WORKLIST to select the patient to be taken and press open. (Check DB and MODALITY)
   (Refer to RADMAX operation manual.)



8. The user registers the patient.
   (Refer to RADMAX operation manual.)

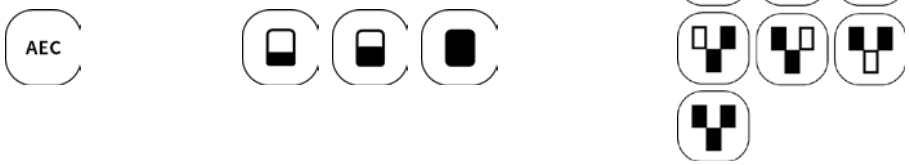
9. Set up the program and equipment according to the patient's examination method.
   Adjust if necessary. (Refer to RADMAX operation manual.)

10. Select the bucky you want to examination in the Bucky selection & indicator.

    Select button  when examining at the patient table.

    Select button  when examining at the wall bucky stand..

11. when using AEC mode , select sensitivity and field



12. X-ray exposure conditions and sizes are determined according to the size and condition of the patient.

13. Position the patient and match the detector center of the table with the collimation center of the tube. (Refer to the section 4.5 APPARATUS OPERATION)

14. Make the exposure. Press the exposure hand switch halfway and keep it pressed halfway, the X-ray tube will enter the prep mode. When the X-ray tube is ready and the patient is in correct position, press the switch all the way to make the exposure.

15. Adjust the contrast and density by dragging up, down, left and right with the right mouse on the acquired image after make the exposure

- Left-right drag: Contrast adjustment
- Top-down drag: Concentration adjustment

16. You can change the marker on the image or adjust the ROI size using the tool box, and also the image direction change.

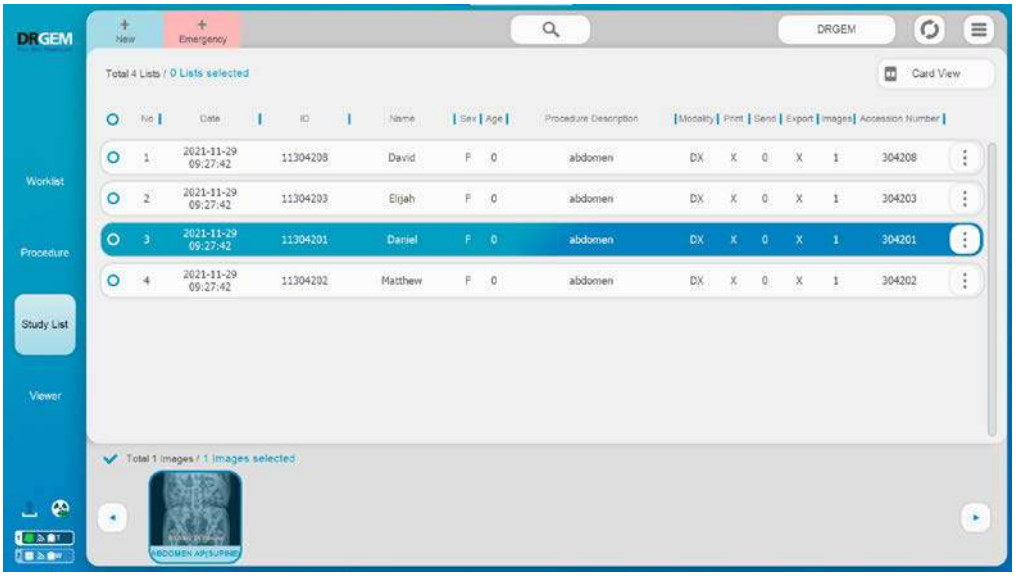
		Select ROI SIZE.
		Select the registered marker
		direction switching
		Return to the initial image
		Fine rotation

17. Make sure that the ROI and marker are correctly entered before image transmission.

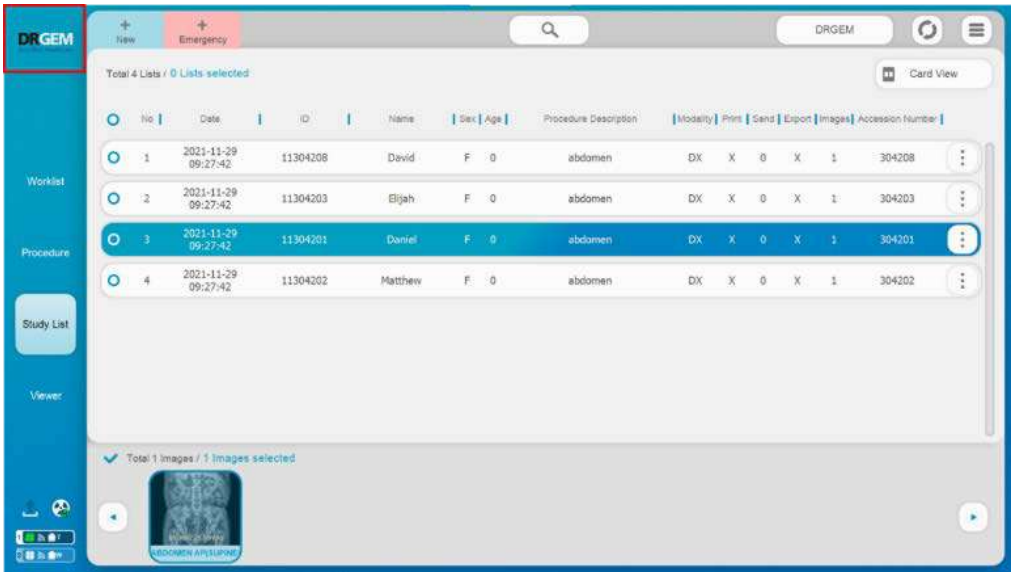
18. Press the send button to send the image to PACS.

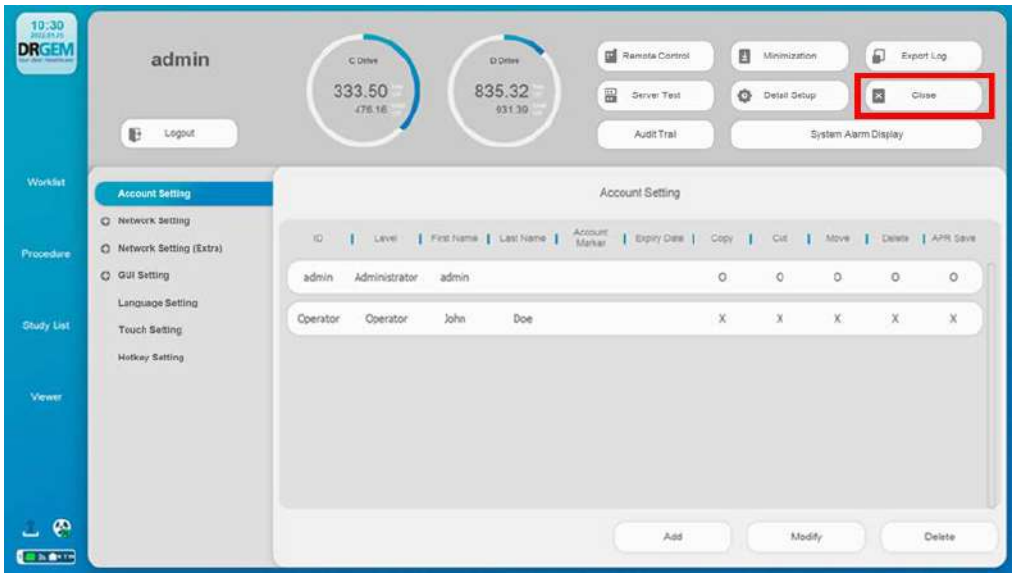
19. Recorded images can be checked in the STUDY LIST.

20. If additional tests are taken for a patient who has already been exposure, select the patient again and open to enter test mode.



21. When make the exposure is complete, click the DRGEM button in the upper left and click the exit button in the upper right to exit the RADMAX program.





22. Press OFF  of PC interface module to turn off the GXR-SD/CSD/UCS System.

23. Click on the **'Exit'** menu on the RADMAX software.

24. Shutdown the Imaging Workstation.

4.3 FREQUENTLY OCCURRING MALFUNCTIONS

The following problems can be solved by simple confirmation.

Please contact the service engineer if the following does not solve the problem.

Problem	Possible Cause	Remedy
Motorized device does not drive.	No power.	Check that the device is powered on.
	Emergency stop switch is pressed	Check the emergency stop switch is pressed.
The lock is not locked.	No power.	Check that the device is powered on.

4.4 RADMAX SOFTWARE

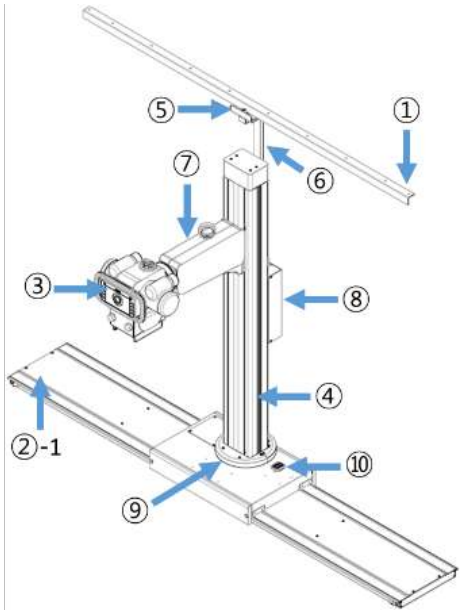
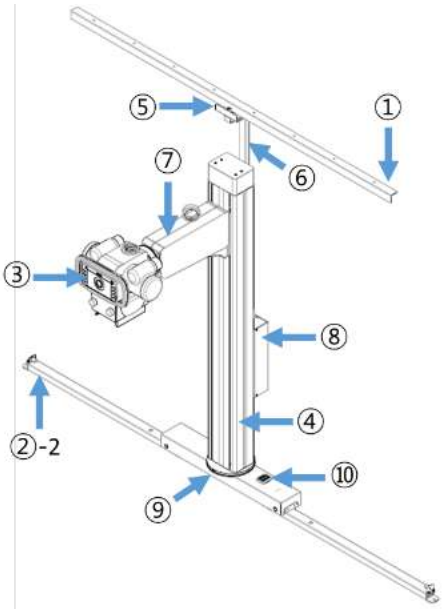
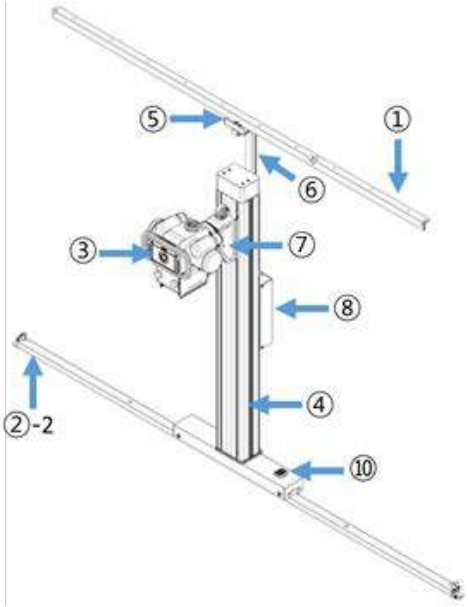
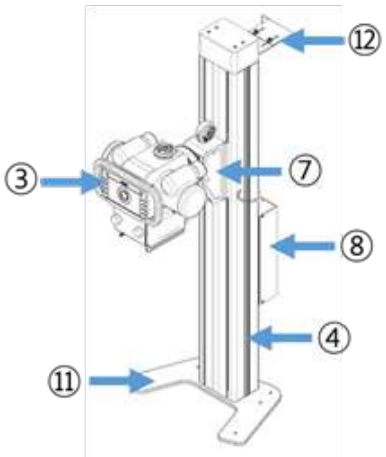
For user instructions on RADMAX, refer to the RADMAX Operation Manual

4.5 APPARATUS OPERATION

4.5.1 TUBE STAND

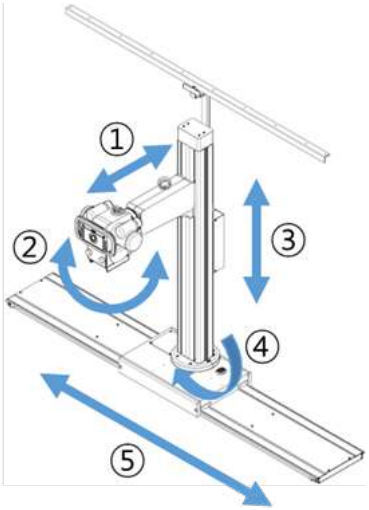
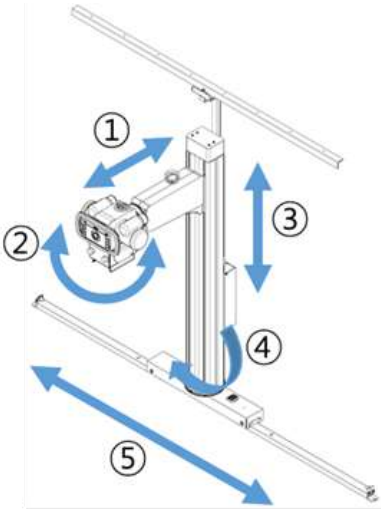
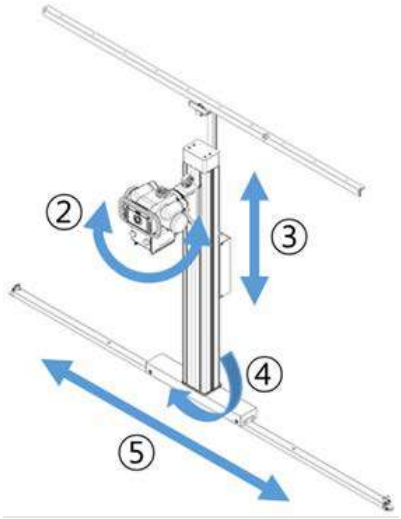
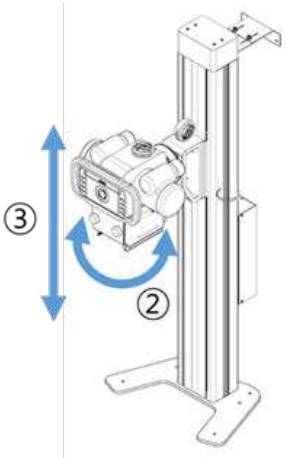
4.5.1.1 TUBE STAND (VERTICAL MANUAL MOVEMENT)

- Parts Description

<table>
<tr><td> 
</td><td> 
</td></tr>
<tr><td><TS-FM6></td><td><TS-FC6></td></tr>
<tr><td> 
</td><td> 
</td></tr>
<tr><td><TS-FC4></td><td><TS-FC2></td></tr>
</table>

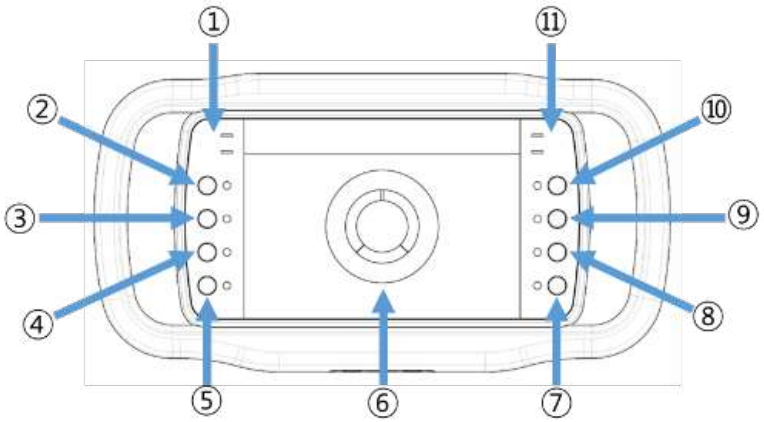
①	Ceiling Rail (TS-FM6 is optional)	②-1	Floor mounted rail
②-2	Floor Rail with stopper rubber	③	Stand console
④	Vertical stand column	⑤	Ceiling rail holder (TS-FM6 is optional)
⑥	Ceiling support (TS-FM6 is optional)	⑦	Arm
⑧	Control box	⑨	Stand rotation part
⑩	Stand rotation lock pedal	⑪	Stand base
⑫	Rear wall support location		

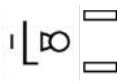
- Movement direction

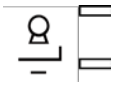
	
<TS-FM6>	*<TS-FC6>*
	
<TS-FC4>	*<TS-FC2>*

①	Lateral movement	Move while pressing the Lateral lock button.
②	Tube rotation movement	Rotate while pressing the Tube rotation lock button
③	Vertical movement	Move while pressing the Vertical lock button.
④	Column rotation movement	Press the Stand rotation lock pedal or Column rotation lock control button to rotate the column. (It stops every 90 degrees.)
⑤	Longitudinal movement	Move while pressing the Longitudinal Lock button.

- Stand Console Membrane



①		Horizontal SID indicator	The LED lights up when the distance between Wall Bucky and the tube focus is 100cm and 180cm. (In Germany, 100cm and 115cm.)
②		Longitudinal lock control button	Manually movement the Longitudinal rail by pressing the Longitudinal lock control button. (Not applicable to TS-FC2)
③		Lateral center lock control button	Turn it on or off by pressing the Lateral center lock control button. (Default) (Not applicable to TS-FC4, TS-FC2)
		Lateral lock control button	Manually movement the Lateral by pressing the Lateral lock control button. (Optional) (Not applicable to TS-FC4, TS-FC2)
④		Tube rotation lock control button	Manually movement the tube rotation by pressing the Tube rotation lock control button.
⑤		Laser control button	Turn it on or off by pressing the Laser control button.
⑥		Tube rotation angle indicator	Displays the rotation angle of the tube.
⑦		N/A	If the Column rotation by Electric Release or Table Bucky Auto Tracking option is not applied, it is blank. (Default)
		Column rotation lock control button	Manually movement the column axis by pressing the Tube Rotation by Column rotation lock control button. (Optional) (Not applicable to TS-FC2)
		Table Bucky Auto Tracking button	Unlock the Tracking Lock when the Bucky Auto Tracking option is applied. (Optional) (Not applicable to TS-FC2)
⑧		All lock control button	Manually movement the Vertical, Lateral and Longitudinal rail by pressing the All lock control button.
⑨		Lateral lock control button	Manually movement the Transverse rail by pressing the Lateral lock control button. (Not applicable to TS-FC4, TS-FC2)

⑩		Vertical lock control button	Manually movement the vertical by pressing the vertical lock release button.
⑪		Vertical SID indicator	The LED lights up when the distance between Tabletop or Table Bucky and the focus of the tube is 100cm. (In Germany Tabletop: 100cm, Table bucky: 115cm)

*: The applicable options change the button configuration and drive of the Stand Console Membrane.

- How to use
  1. Press the **'Tube rotation lock control button'** and rotate the tube in the desired direction.
  2. Use the "Stand Console Membrane" button in Section 4.5.1.1 to align the center with Bucky.
  3. Use the collimator knob to adjust the field size and expose X-ray.

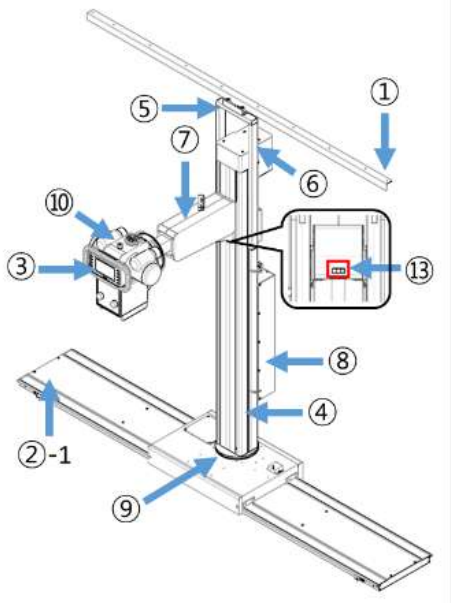
- Table Bucky Tracking (Mechanical) Function

If tracking module at tube stand base and tracking holder at Bucky is not matched, Bucky position will be fixed by brake, but if the position of tracking module and tracking holder is matched, the brake of Bucky will be released and move follow the tube column position.
If the tube stand column is moves even though Bucky is reaches at each limit position of Bucky stroke, tracking will be released and Bucky will be fixed by brake.
If the table Bucky tracking (mechanical) option is applied, follow the ways below for its operation.

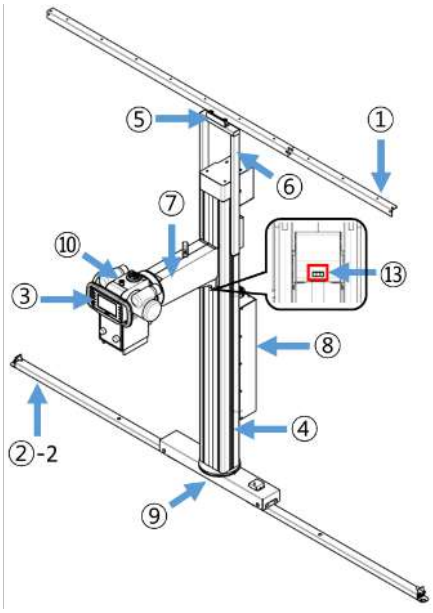
Activating the tracking	While pushing button  or  and moving the tube stand until the tracking module and the tracking bar are assembled.
Release the tracking	• While pushing button  or  and move the tube stand until the tracking module and the tracking bar are disassembled. (If the Bucky position is leaches at the each end of its stroke while tube stand is longitudinally moving with the tracking function, the tracking will be released.) • Draw out the tray and move the Bucky until the tracking module and the tracking bar are disassembled. • If the electric column rotation option is applied, rotate the tube stand column while pressing  button.

4.5.1.2 TUBE STAND (VERTICAL MOTORIZED MOVEMENT)

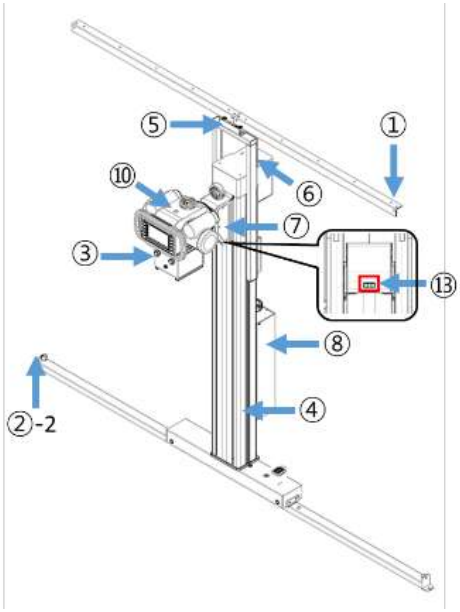
- Parts Description



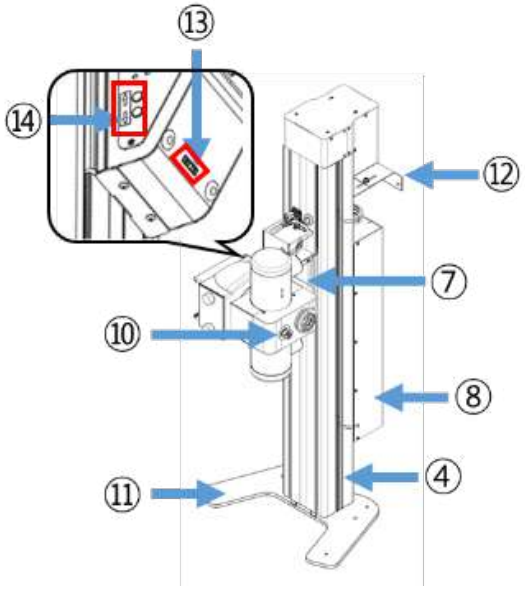
<TS-FM6 (Motorized)>



<TS-FC6 (Motorized)>



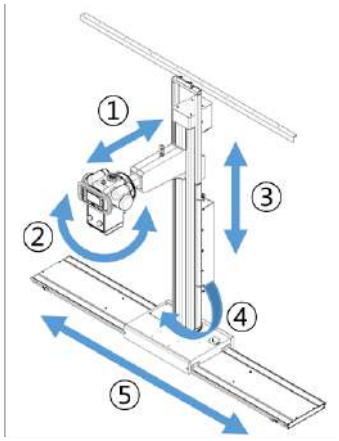
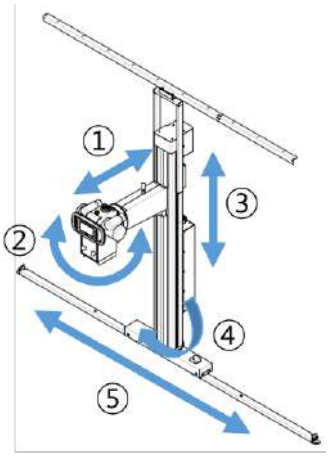
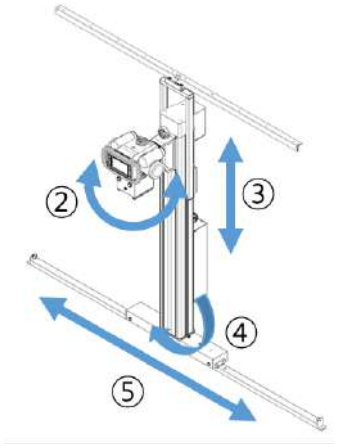
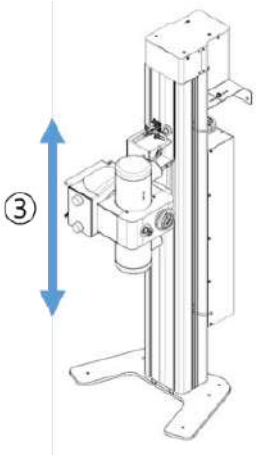
<TS-FC4 (Motorized)>



<TS-FC2 (Motorized)>

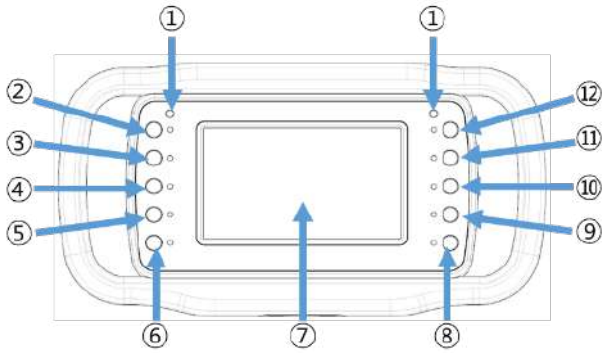
①	Ceiling Rail (TS-FM6 (Motorized) is optional)	②-1	Floor mounted rail
②-2	Floor Rail with stopper rubber	③	Stand console
④	Vertical stand column	⑤	Ceiling rail holder (TS-FM6 (Motorized)is optional)
⑥	Ceiling support (TS-FM6 (Motorized) is optional)	⑦	Arm
⑧	Control box	⑨	Stand rotation part
⑩	Emergency Stop Switch	⑪	Stand base
⑫	Rear wall support location	⑬	Safety Sensor
⑭	Vertical Up/Down Buttton (Only TS-FC2)		

- Movement direction

	
<TS-FM6 (Motorized)>	*<TS-FC6 (Motorized)>*
	
<TS-FC4 (Motorized)>	*<TS-FC2 (Motorized)>*

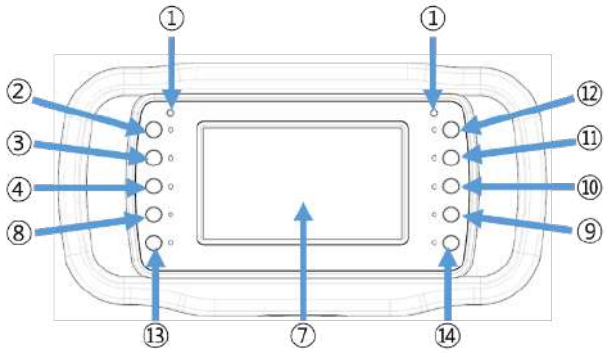
①	Lateral movement	Move while pressing the Lateral lock button.
②	Tube rotation movement	Rotate while pressing the Tube rotation lock button. The Tube Head with Motorized Tube Rotation Type is rotated in that direction by pressing the Motorized Tube Rotation Button.
③	Vertical movement	Move while pressing the Vertical lock button. Press the Vertical Motorized Down Button or Vertical Motorized Up Button to move in that direction.
④	Column rotation movement	Press the Column rotation lock control button to rotate the column. (It stops every 90 degrees.)
⑤	Longitudinal movement	Move while pressing the Longitudinal Lock button.

- Stand Console Membrane (Not applicable to TS-FC2)



Stand Control Button

(Tube head with manual tube rotation Type)



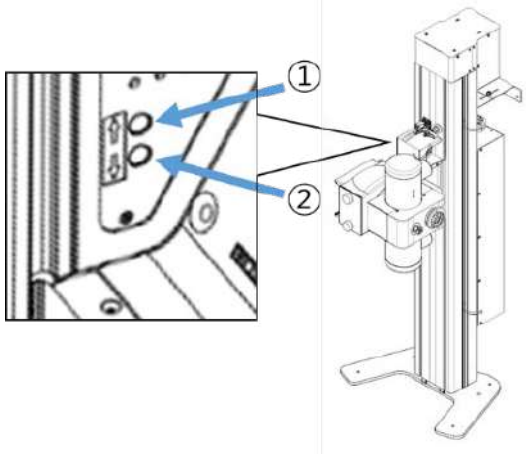
Stand Control Button

(Tube head with motorized tube rotation Type)

①	○	Remote control sensor	Receives signals from the remote control.
②		Longitudinal lock control button	Manually movement the Longitudinal rail by pressing the Longitudinal lock control button.
③		Lateral lock control button	Manually movement the Lateral by pressing the Lateral lock control button. (Not applicable to TS-FC4)
④		Lateral center lock control button	Turn it on or off by pressing the Lateral center lock control button. (Not applicable to TS-FC4)
⑤		Tube rotation lock control button	Manually movement the tube rotation by pressing the Tube rotation lock control button.
⑥		Laser control button	Turn it on or off by pressing the Laser control button.
⑦		Touch Screen LCD	Displays the control manu and status of the system.

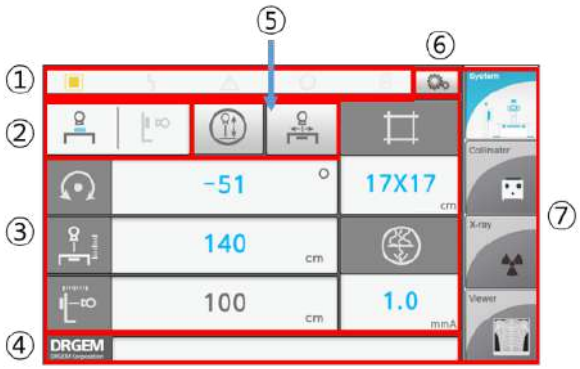
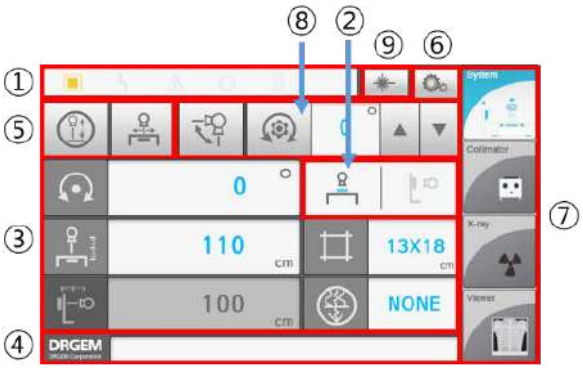
⑧		Column rotation lock control button	Manually movement the column axis by pressing the Tube Rotation by Column rotation lock control button.
⑨		All lock control button	Manually movement the Vertical, Lateral and Longitudinal rail by pressing the All lock control button.
⑩		Vertical motorized down button	Press the Vertical Motorized Down button to operate the Automatic down movement.
⑪		Vertical motorized up button	Press the Vertical Motorized Up button to operate the Automatic up movement.
⑫		Vertical lock control button	Manually movement the vertical by pressing the Vertical lock control button.
⑬		Motorized tube rotation button (CW)	Press the Motorized Tube Rotation (CW) button to automatically turn clockwise.
⑭		Motorized tube rotation button (CCW)	Press the Motorized Tube Rotation (CCW) button to automatically turn counterclockwise.

- Stand Control (TS-FC2)

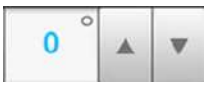


①		Vertical motorized up button	Press the Vertical Motorized Up button to operate the Automatic up movement.
②		Vertical motorized down button	Press the Vertical Motorized Down button to operate the Automatic down movement.

- System Control Menu

	
<Tube head with manual tube rotation Type>	*<Tube head with motorized tube rotation Type>*

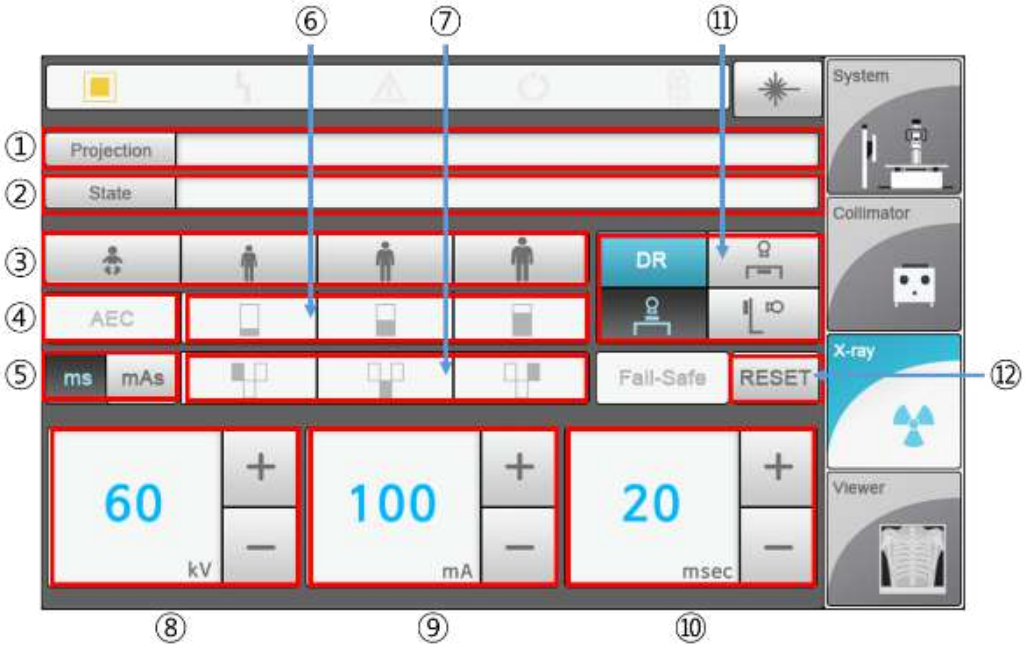
①	Generator status indicator		X-ray large focus Status display
			X-ray small focus Status display
			Error Status display
			Warning Status display
			X-Ray Prep Status display
			X-Ray Exposure Status display
②	Bucky status indicator		Non-Bucky Status display
			Table Bucky Status display
			Stand Bucky Status display
③	Position information		Table SID Indicator
			Wall stand SID Indicator
			Tube rotation angle indicator
			Auto collimation size indicator

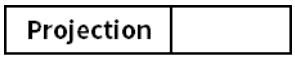
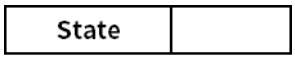
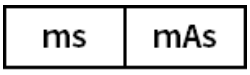
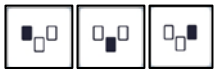
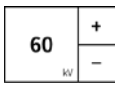
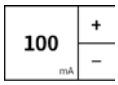
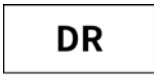
			Auto filter selection indicator Selection filter display (None or 1.0mmAl or 0.1mmCu or 0.2mmCu)
④	Message Box		Informs the operation status of system.
⑤	Vertical sync & table tracking function		Vertical Sync Select the vertical synchronization function of the Motorized Tube Stand. As the wall bucky stand or PBT-6 moves up and down, the tube stand follows the vertical position of the wall bucky stand or PBT-6.
			Table Bucky Tracking Select the table bucky tracking function of the Motorized Tube Stand. Move the motorized tube stand to the left or right, or tilt it, and the table bucky follows to the center of the tube.
⑥	Configuration		Configuration provides an operation window that can adjust the setting of System.
⑦	Menu		Display the system control menu.
			Display the auto filter selection & indicator menu.
			Display the X-ray generator selection & indicator menu.
			Display the acquisition image display.
⑧	Motorized tube rotation function		Auto tube rotation (90° or 0°)
			Press the up or down button to set the angle to rotate.
			Rotation to the set angle.
⑨	Laser control button		Line laser On/Off button.

- Auto Filter Selection & Indicator Menu

①	Auto filter selection & indicator	Choice the filter on the GUI. The filter is rotated to the selected position.
②	Auto collimation size selection & indicator	Choice the light field size of the collimator. The knob is automatically adjusted to the size you select. The indicator shows the light field size of the collimator.

- X-Ray Generator Selection & Indicator



①	Projection		This menu shows patient information.
②	Generator state		This menu informs the operation status of the generator.
③	Patient Body Size selection & indicator		This menu allows you to adjust the dose of the X-ray by selecting the size of the patient.
④	AEC selection & indicator		This menu allows you to control on/off operation of AEC.
⑤	Time/mAs selection & indicator		Select time or mAs of X-ray from this menu.
⑥	Screen selection & indicator		This menu control density of X-ray.
⑦	AEC field selection & indicator		This menu allows you to specify where the AEC will be applied.
⑧	KV set & indicator		Select the value of kV from this menu.
⑨	mA set & indicator		Select the value of mA from this menu.
⑩	Exposure. Time set & indicator		Select exposure time from this menu.
⑪	Bucky selection & indicator		Indicates that the external device of the selected bucky is digital radiography. It is only possible if the generator has a DR option.
			Non-Bucky Status display
			Table Bucky Status display
			Stand Bucky Status display
⑫	Error reset button		Use this menu to initialize the error.

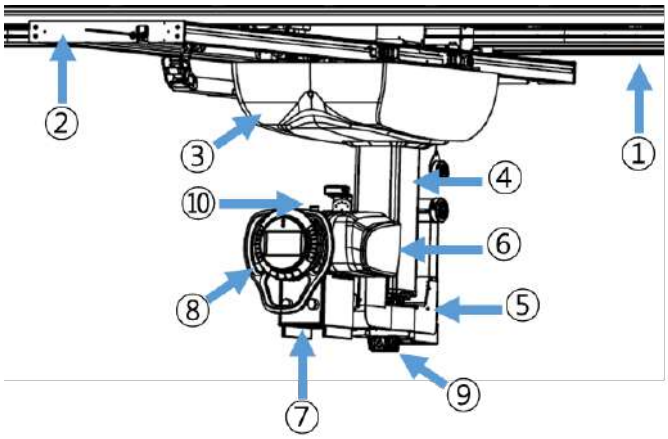
- Acquisition Image Display

①	DR Image Viewer menu	Display DR Image.

- How to use
  1. Press the **'Tube rotation lock control button'** and rotate the tube in the desired direction. (Excluding TS-FC2 (Motorized).)
     (For Tube Head with Motorized Tube Rotation Type, you can use the **'Motorized Tube Rotation Button'** or  button to rotate.)
  2. Use the "Stand Console Membrane" and "System Control Menu" button in Section 4.5.1.2 to align the center with Bucky.
     (For TS-FC2 motorized, refer to Stand Control (TS-FC2) in Section 4.5.1.2)
  3. Use the collimator knob to adjust the field size. And if necessary, set the collimator and X-ray parameter and expose X-ray.
     (When applying the Auto collimator option, it can be set on the touch screen LCD. Refer to Auto Filter Selection & Indicator Menu, X-ray Generator Selection & Indicator in Section 4.5.1.2.)

4.5.1.3 TUBE STAND (TS-CSP)

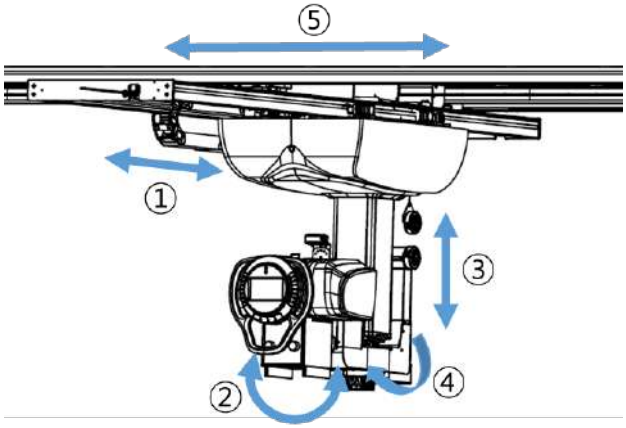
- Parts Description



①	Longitudinal rail	②	Transverse rail & Transverse bridge
③	Main Body & Transverse carriage	④	Telescoping tube arm
⑤	Tube support arm(Tube arm rotation part)	⑥	X-ray Tube
⑦	Collimator	⑧	Operation panel with handle
⑨	Safety Sensor	⑩	Emergency Stop Switch

NOTE
Three safety sensors are located at the bottom of tube arm support. If any obstacles are detected by these sensors, the motorized movement will be stopped.

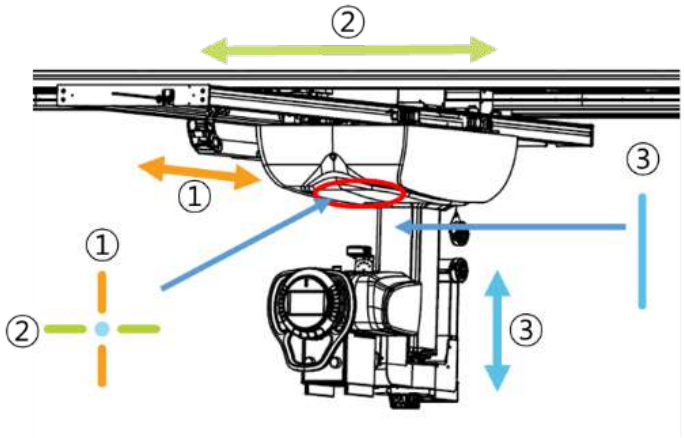
- Movement direction



①	Transverse movement	Move while pressing the Transverse lock control button.
②	Tube rotation movement	Rotate while pressing the Tube rotation lock control button.
③	Vertical movement	Move while pressing the Vertical lock control button. Press the Vertical Motorized Down Button or Vertical Motorized Up Button to move in that direction.
④	Column rotation movement	Press the Column rotation lock control button to rotate the column. (It stops every 90 degrees.)
⑤	Longitudinal movement	Move while pressing the Longitudinal lock control button.

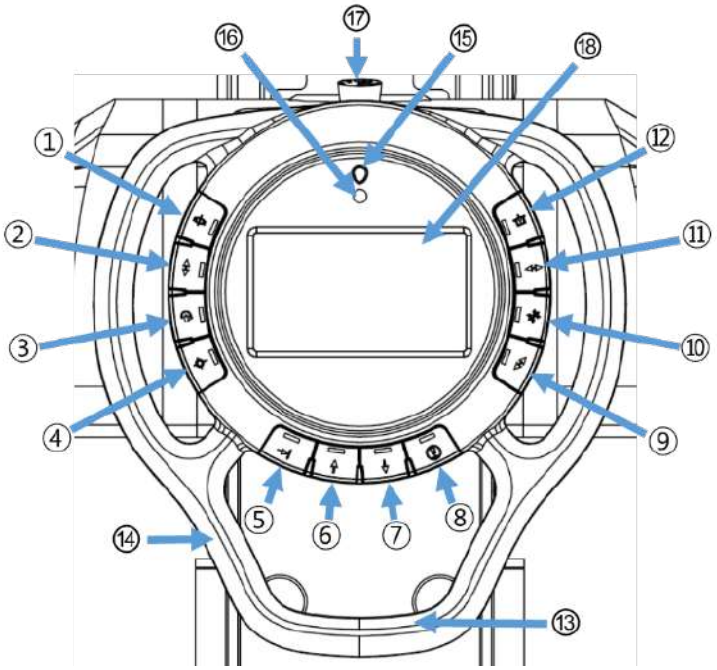
NOTE

Control position color and Switch LED color is same.



No	Direction of movement	Color	Symbol	button
①	Transverse movement	Orange		
②	Longitudinal movement	Green		
③	Vertical movement	Blue		, ,

- Handlebar Control

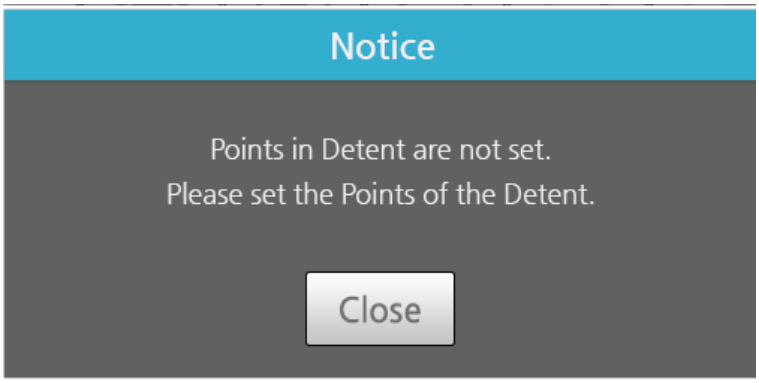


①		Column rotation lock control button	Manually movement the column axis by pressing the Tube Rotation by Column rotation lock control button.
②		Vertical lock control button	Manually movement the vertical by pressing the Vertical lock control button.
③		Tube rotation lock control button	Manually movement the tube rotation by pressing the Tube rotation lock control button.
④		Laser control button	Turn it on or off by pressing the Laser control button.
⑤		Auto Parking button	Press the Auto parking button to automatically move to the stored highest position of the tube stand.
⑥		Vertical motorized up button	Press the Vertical Motorized Up button to operate the Automatic up movement.
⑦		Vertical motorized down button	Press the Vertical Motorized Down button to operate the Automatic down movement.
⑧		Vertical Sync. Selection & indicator	Press Vertical Sync Button to perform vertical sync operation. The button lights when sync is in operation.
⑨		Transverse lock control button	Manually movement the Transverse rail by pressing the Transverse lock control button.
⑩		All lock control button	Manually movement the Vertical, Transverse rail and Longitudinal rail by pressing the All lock control button.

⑪		Longitudinal lock control button	Manually movement the Longitudinal rail by pressing the Longitudinal lock control button.
⑫		Auto Detent control button	Turn it on or off by pressing the Auto Detent control button.
⑬		All lock control button	Manually movement the Vertical, Transverse rail and Longitudinal rail by pressing the All lock control button.
⑭		Handle bar	Handlebar for Tube Stand driving.
⑮		System State LED	The color of the indicator changes according to the system state.
⑯		Remote control sensor	Receives signals from the remote control.
⑰		Emergency Stop Switch	When the Emergency Stop Switch is pressed, the system stops running immediately.
⑱		Touch Screen LCD	Displays the control manu and status of the system.

NOTE

Show the Pop-up if the detent button is pushed when the detent is non-installed.



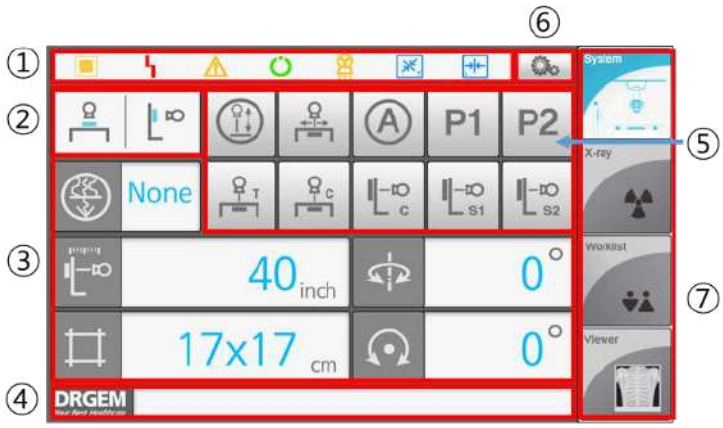
NOTE

The status of the System state LED for each color is as follows.

- BLUE: Normal State
- RED: Error or Warning State
- GREEN: Exposure Ready State
- GREEN(Blink): Auto Positioning in operation
- YELLOW: Exposure Complete State

NOTE
When applying Auto Detent function, it operates as follows. • If the moving speed is less than 4cm/s, the unit will be stopped by one time brake. • If the moving speed is between 4cm/s and 30cm/s, the unit will be stopped one time to reduce • The moving speed and then be stopped by next brake. • If the moving speed is too fast over 30cm/s, the unit will pass by the detent position. • If the stopped position is over the range of +/-5mm from the target position, brake will be released and additional trial is needed.

- System Control Menu



①	Generator status indicator		X-ray large focus Status display
			X-ray small focus Status display
			Error Status display
			Warning Status display
			X-Ray Prep Status display
			X-Ray Exposure Status display
			Transverse Detent Status display
			Longitudinal Detent Status display

②	Bucky status indicator		Table Rotate Bucky Status display (17’ X 14’)
			Table Rotate Bucky Status display (14’ X 17’)
			Stand Rotate Bucky Status display (14’ X 17’, Center)
			Stand Rotate Bucky Status display (17’ X 14’, Center)
			Stand Rotate Bucky Status display (17’ X 14’, Upper)
③	Position information		Table SID Indicator
			Wall stand SID Indicator
			Column rotation angle indicator
			Tube rotation angle indicator
			Auto collimation size indicator
			Auto filter selection indicator Selection filter display (None or 1.0mmAl or 0.1mmCu or 0.2mmCu)
④	Message Box		Informs the operation status of system.
⑤	Vertical sync & table tracking function		Vertical Sync Select the vertical synchronization function of the TS-CSP. As the wall bucky stand or PBT-6 moves up and down, the tube stand follows the vertical position of the wall bucky stand or PBT-6.
			Table Bucky Tracking Select the table bucky tracking function of the TS-CSP. Move the motorized tube stand to the left or right, or tilt it, and the table bucky follows to the center of the tube.
			Automatic Positioning This menu allows you to activate the Automatic Positioning operation of the TS-CSP.

		P1 P2 P3 P4	Programmable Mode 1~4 This menu allows you to activate the Programmable Mode operation of the TS-CSP. Press the button you want to save in P1~4 for about 2 seconds to save the location.
			Table Mode TS-CSP and PBT-6 moves to set position and Table Bucky follows to TS-CSP center.
			Table Bucky centering TS-CSP follows to Table Bucky center when Table Bucky moves.
			Stand Bucky centering TS-CSP follows to WBS Bucky center when WBS bucky position moves.
			Stand Mode 1 TS-CSP moves vertical position to WBS-TA center while keeping SID 100cm.
			Stand Mode 2 TS-CSP moves vertical position to WBS-TA center while keeping SID 180cm.
⑥	Configuration		Configuration provides an operation window that can adjust the setting of System.
⑦	Menu		Display the system control menu, and the auto filter selection & indicator menu.
			Display the X-ray generator selection & indicator menu.
			Display the Worklist. (Activation when used with RADMAX.)
			Display the acquisition image display. (Activation when used with RADMAX.)

NOTE

Programmable Mode can store current position of TS-CSP, WBS-TA, PBT-6.

Bucky Mode	TS-CSP	WBS-TA	PBT-6
Non-Bucky	Save	Not	Not.
PBT Bucky	Save	Not	Save
WBS Bucky	Save	Save	Not

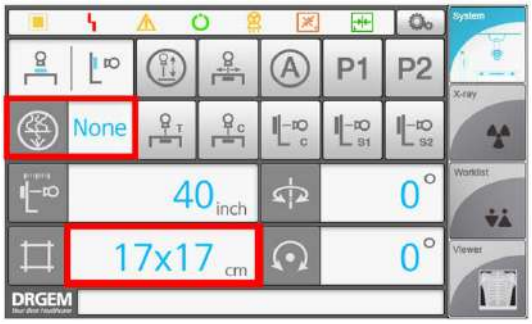
NOTE

Pop-up Notice on Auto Position

Please follow the instructions if warning message occurs like below during the auto position.

- Auto Filter Selection & Indicator Menu

If you touch ‘Auto collimation size indicator’ or ‘Auto filter selection indicator’ from the System Control Menu, you enter Auto Filter Selection & Indicator Menu.

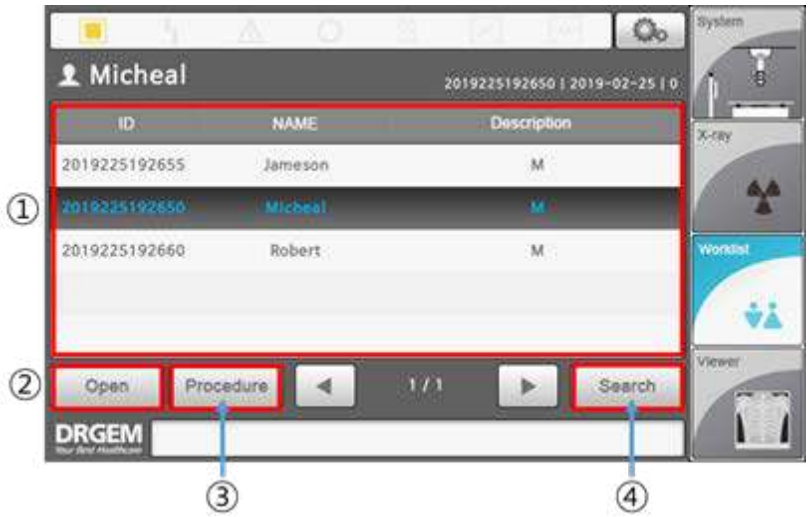


Refer to the Auto Filter Selection & Indicator Menu in Section 4.5.1.2.

- X-Ray Generator Selection & Indicator

Refer to the X-Ray Generator Selection & Indicator in Section 4.5.1.2.

- Worklist



①	Patient ID, NAME, Description	Display Patient ID, NAME, Description.
②	Open	Go to Procedure and display study list and step list.
③	Procedure	Go to previous Procedure.
④	Search	Load Latest patient.
⑤	Study List	Select Study List.
⑥	Step List	Select Step List.

⑦	Display kV, mA, msec	Display kV, mA, msec exposure condition.
⑧	Operate Auto Position Function	Move position to selected Step position.
⑨	Worklist	Go back to Worklist.

- Acquisition Image Display

Refer to the Acquisition Image Display in Section 4.5.1.2.

- How to use

1. Press  button when exposing to a table. When the TS-CSP is completely driven, move Bucky to the desired position.

   (If exposing to the wall bucky stand, Press  button when SID 100 or  button when SID 180.)

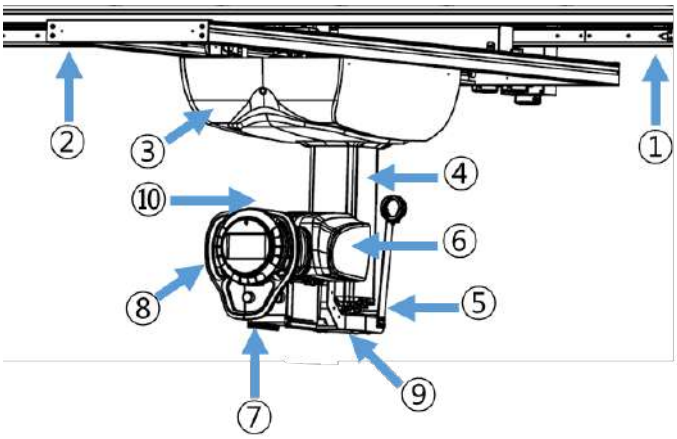
   (You can also operate it manually using the button on the Handlebar Control.)

2. If necessary, set the collimator and X-ray parameter.
   (When applying the Auto collimator option, it can be set on the touch screen LCD. Refer to Auto Filter Selection & Indicator Menu, X-ray Generator Selection & Indicator in Section 4.5.1.2.)

3. Expose X-ray. And check acquired images on DR Image Viewer menu.

4.5.1.4 TUBE STAND (TS-CSA)

- Parts Description



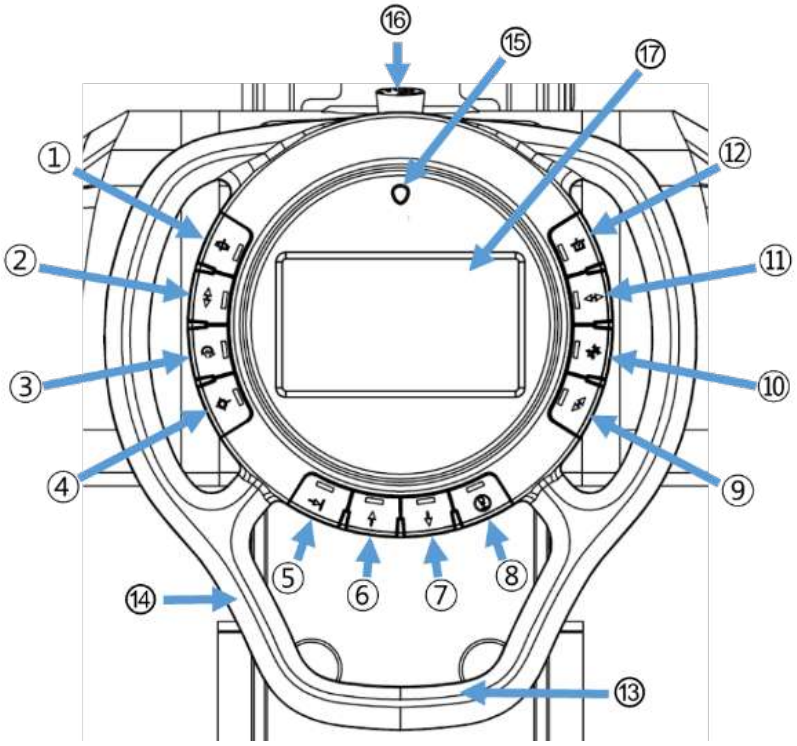
①	Longitudinal rail	②	Transverse rail & Transverse bridge
③	Main Body & Transverse carriage	④	Telescoping tube arm
⑤	Tube support arm(Tube arm rotation part)	⑥	X-ray Tube
⑦	Collimator	⑧	Operation panel with handle
⑨	Safety Sensor	⑩	Emergency Stop Switch

NOTE
Three safety sensors are located at the bottom of tube arm support. If any obstacles are detected by these sensors, the motorized movement will be stopped.

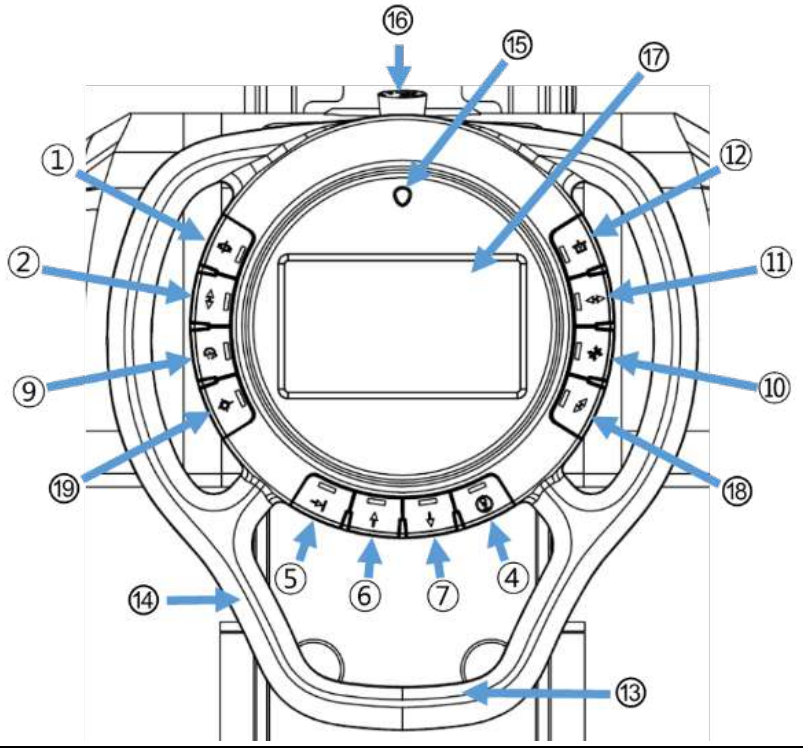
- Movement direction

Refer to the Movement direction in Section 4.5.1.3.

- Handlebar Control



<Tube head with manual tube rotation Type>

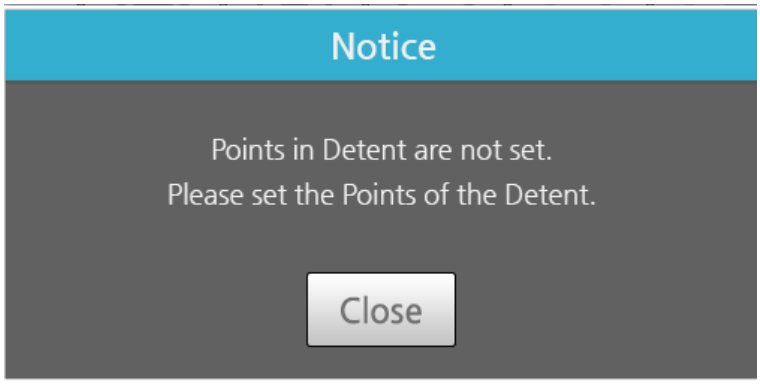


<Tube head with motorized tube rotation Type>

①		Column rotation lock control button	Manually movement the column axis by pressing the Tube Rotation by Column rotation lock control button.
②		Vertical lock control button	Manually movement the vertical by pressing the Vertical lock control button.
③		Tube rotation lock control button	Manually movement the tube rotation by pressing the Tube rotation lock control button.
④		Laser control button	Turn it on or off by pressing the Laser control button.
⑤		Auto Parking button	Press the Auto parking button to automatically move to the stored highest position of the tube stand.
⑥		Vertical motorized up button	Press the Vertical Motorized Up button to operate the Automatic up movement.
⑦		Vertical motorized down button	Press the Vertical Motorized Down button to operate the Automatic down movement.
⑧		Vertical Sync. Selection & indicator	Press Vertical Sync Button to perform vertical sync operation. The button lights when sync is in operation.
⑨		Transverse lock control button	Manually movement the Transverse rail by pressing the Transverse lock control button.
⑩		All lock control button	Manually movement the Vertical, Transverse rail and Longitudinal rail by pressing the All lock control button.
⑪		Longitudinal lock control button	Manually movement the Longitudinal rail by pressing the Longitudinal lock control button.
⑫		Auto Detent control button	Turn it on or off by pressing the Auto Detent control button.
⑬		All lock control button	Manually movement the Vertical, Transverse rail and Longitudinal rail by pressing the All lock control button.
⑭		Handle bar	Handlebar for Tube Stand driving.
⑮		System State LED	The color of the indicator changes according to the system state.
⑯		Emergency Stop Switch	When the Emergency Stop Switch is pressed, the system stops running immediately.
⑰		Touch Screen LCD	Displays the control manu and status of the system.
⑱		Motorized Tube Rotation (CCW) button	Press the Motorized Tube Rotation (CCW) button to automatically turn counterclockwise.
⑲		Motorized Tube Rotation(CW) button	Press the Motorized Tube Rotation (CW) button to automatically turn clockwise.

NOTE

Show the Pop-up if the detent button is pushed when the detent is non-installed.



NOTE

The status of the System state LED for each color is as follows.

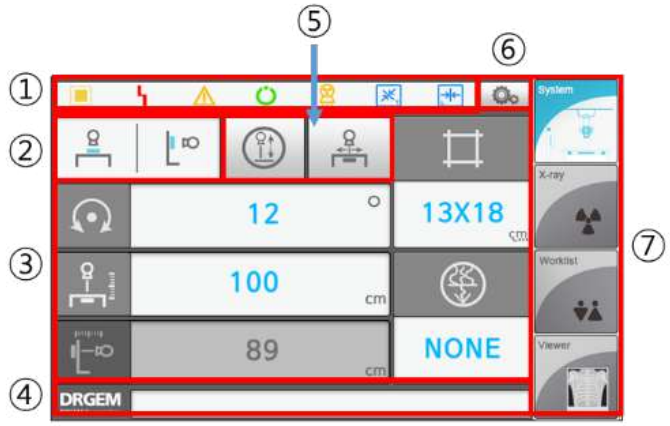
- BLUE: Normal State
- RED: Error or Warning State
- GREEN: Exposure Ready State
- GREEN(Blink): Auto Positioning in operation
- YELLOW: Exposure Complete State

NOTE

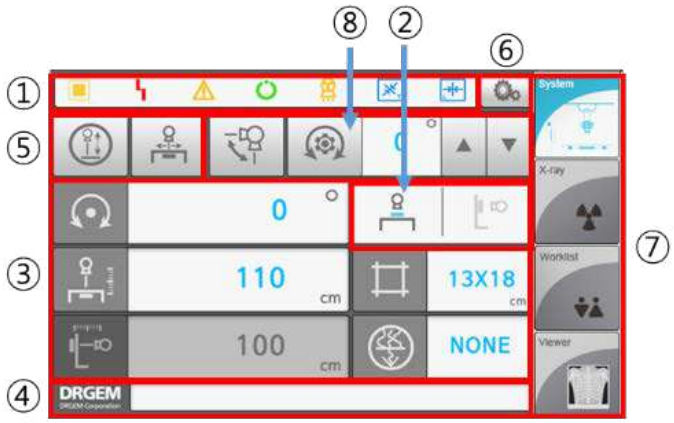
When applying Auto Detent function, it operates as follows.

- If the moving speed is less than 4cm/s, the unit will be stopped by one time brake.
- If the moving speed is between 4cm/s and 30cm/s, the unit will be stopped one time to reduce
- The moving speed and then be stopped by next brake.
- If the moving speed is too fast over 30cm/s, the unit will pass by the detent position.
- If the stopped position is over the range of +/-5mm from the target position, brake will be released and additional trial is needed.

- System Control Menu

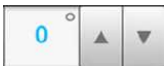


<Tube head with manual tube rotation Type>



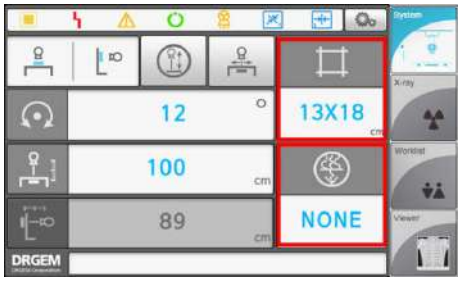
<Tube head with motorized tube rotation Type>

①	Generator status indicator		X-ray large focus Status display
			X-ray small focus Status display
			Error Status display
			Warning Status display
			X-Ray Prep Status display
			X-Ray Exposure Status display
			Transverse Detent State display
			Longitudinal Detent State display
②	Bucky status indicator		Non-Bucky Status display
			Table Bucky Status display
			Stand Bucky Status display
③	Position information		Table SID Indicator
			Wall stand SID Indicator
			Tube rotation angle indicator
			Auto collimation size indicator
			Auto filter selection indicator Selection filter display (None or 1.0mmAl or 0.1mmCu or 0.2mmCu)

④	Message Box		Informs the operation status of system.
⑤	Vertical sync & table tracking function		Vertical Sync Select the vertical synchronization function of the Motorized Tube Stand. As the wall bucky stand or PBT-6 moves up and down, the tube stand follows the vertical position of the wall bucky stand or PBT-6.
			Table Bucky Tracking Select the table bucky tracking function of the Motorized Tube Stand. Move the motorized tube stand to the left or right, or tilt it, and the table bucky follows to the center of the tube.
⑥	Configuration		Configuration provides an operation window that can adjust the setting of System.
⑦	Menu		Display the system control menu, and the auto filter selection & indicator menu.
			Display the X-ray generator selection & indicator menu.
			Display the Worklist. (Activation when used with RADMAX.)
			Display the acquisition image display. (Activation when used with RADMAX.)
⑧	Motorized tube rotation function		Auto tube rotation (90° or 0°)
			Press the up or down button to set the angle to rotate.
			Rotation to the set angle.

- Auto Filter Selection & Indicator Menu

If you touch **'Auto collimation size indicator'** or **'Auto filter selection indicator'** from the System Control Menu, you enter Auto Filter Selection & Indicator Menu.

	
<Tube head with manual tube rotation Type>	*<Tube head with motorized tube rotation Type>*

Refer to the Auto Filter Selection & Indicator Menu in Section 4.5.1.2.

- X-Ray Generator Selection & Indicator

Refer to the X-Ray Generator Selection & Indicator in Section 4.5.1.2.

- Worklist

Refer to the Worklist in Section 4.5.1.3.

- Acquisition Image Display

Refer to the Acquisition Image Display in Section 4.5.1.2.

- How to use

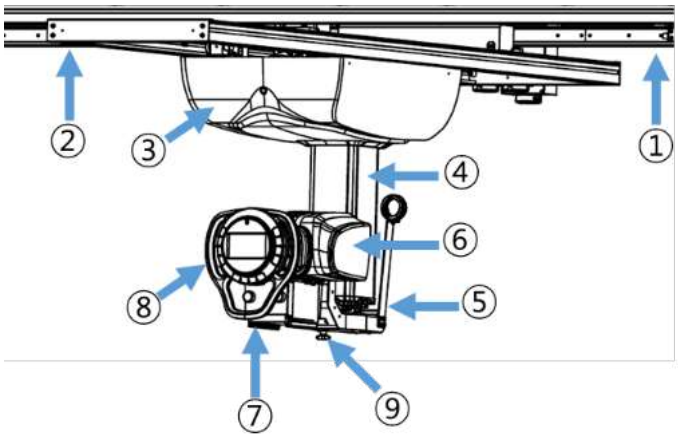
1. Press the **'Tube rotation lock control button'** and rotate the tube in the desired direction.
   (For Tube Head with Motorized Tube Rotation Type, you can use the **'Motorized Tube Rotation Button'** or  button to rotate.)

2. Use the Handlebar control and System Control Menu button in Section 4.5.1.4 to align the center with Bucky.

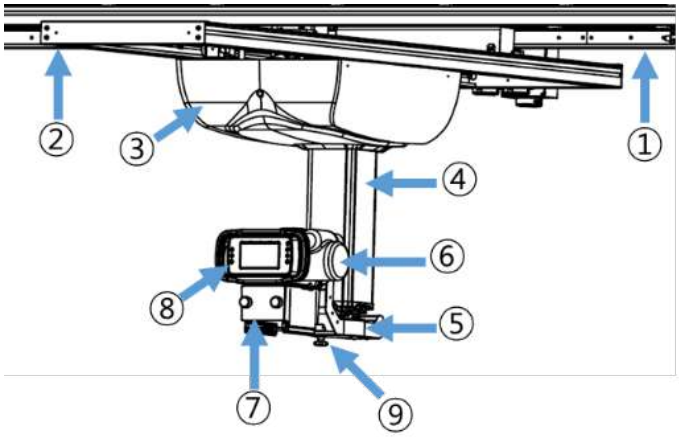
3. Use the collimator knob to adjust the field size. And if necessary, set the collimator and X-ray parameter and expose X-ray.
   (When applying the Auto collimator option, it can be set on the touch screen LCD. Refer to Auto Filter Selection & Indicator Menu, X-ray Generator Selection & Indicator in Section 4.5.1.2.)

4.5.1.5 TUBE STAND (TS-CSE)

- Parts Description



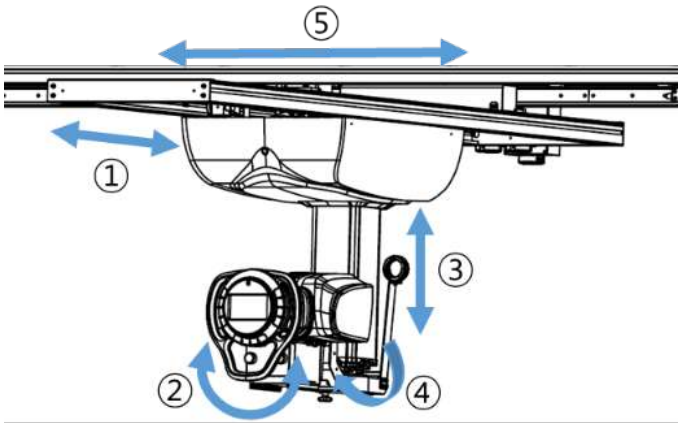
<Handle bar 1>



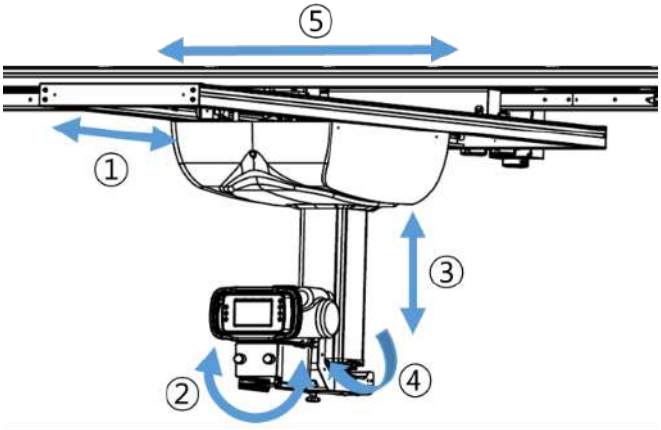
<Handle bar 2>

①	Longitudinal rail	②	Transverse rail & Transverse bridge
③	Main Body & Transverse carriage	④	Telescoping tube arm
⑤	Tube support arm(Tube arm rotation part)	⑥	X-ray Tube
⑦	Collimator	⑧	Operation panel with handle
⑨	Column rotation lock Lever		

- Movement direction



<Handle bar 1>

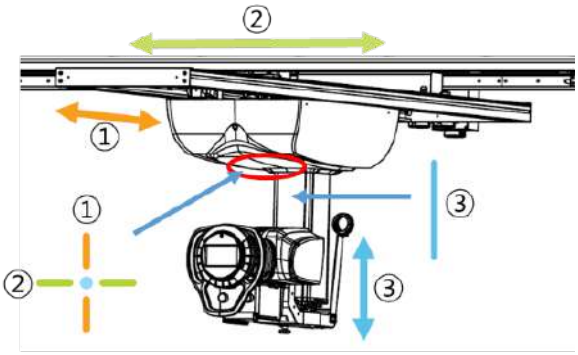


<Handle bar 2>

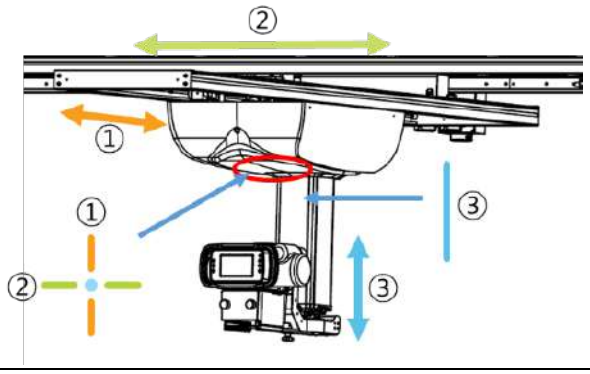
①	Transverse movement	Move while pressing the Transverse lock control button.
②	Tube rotation movement	Rotate while pressing the Tube rotation lock control button.
③	Vertical movement	Move while pressing the Vertical lock control button.
④	Column rotation movement	Pull the column rotation lock lever and rotate the column. (It stops every 90 degrees.)
⑤	Longitudinal movement	Move while pressing the Longitudinal lock control button.

NOTE

Control position color and Switch LED color is same.



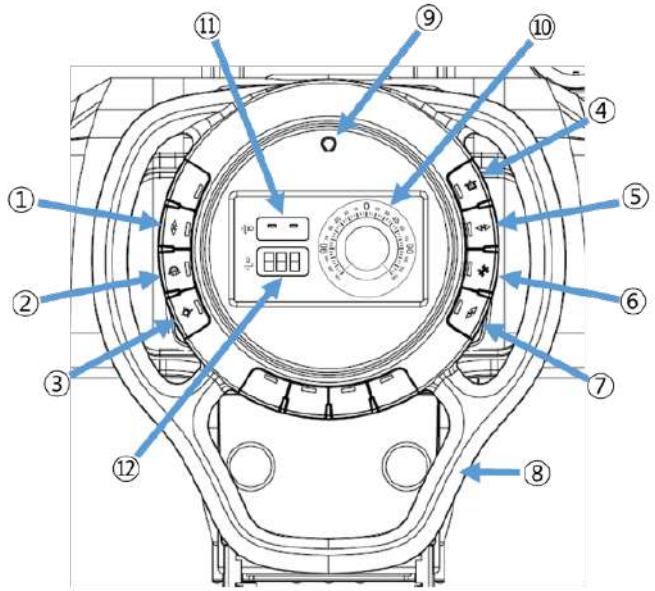
<Handle bar 1>



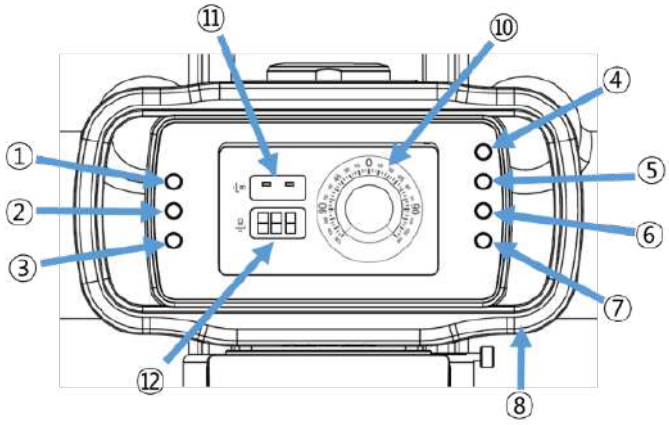
<Handle bar 2>

No	Direction of movement	Color	Symbol	button
①	Transverse movement	Orange		
②	Longitudinal movement	Green		
③	Vertical movement	Blue		

- Handlebar Control



<Handle bar 1>



<Handle bar 2>

①		Vertical lock control button	Manually movement the vertical by pressing the Vertical lock control button.
②		All lock control button	Manually movement the Vertical, Transverse rail and Longitudinal rail by pressing the All lock control button.
③		Transverse lock control button	Manually movement the Transverse rail by pressing the Transverse lock control button.
④		Auto Detent control button	Turn it on or off by pressing the Auto Detent control button.
⑤		Longitudinal lock control button	Manually movement the Longitudinal rail by pressing the Longitudinal lock control button.

⑥		Tube rotation lock control button	Manually movement the tube rotation by pressing the Tube rotation lock control button.
⑦		All lock control button	Manually movement the Vertical, Transverse rail and Longitudinal rail by pressing the All lock control button.
⑧		Handle bar	Handlebar for Tube Stand driving.
⑨		System State LED	The color of the indicator changes according to the system state.
⑩		Tube rotation angle indicator	Displays the rotation angle of the tube.
⑪		Horizontal SID indicator	The LED lights up when the distance between Wall Bucky and the tube focus is 100cm and 180cm.
⑫		Vertical SID indicator	display the distance between Tabletop and the focus of the tube.

NOTE
The status of the System state LED for each color is as follows. (Handle bar 1) • BLUE: Normal State • RED: Error or Warning State • GREEN: Exposure Ready State • GREEN(Blink): Auto Positioning in operation • YELLOW: Exposure Complete State

- How to use
  1. Press the **'Tube rotation lock control button'** and rotate the tube in the desired direction.
  2. Use the "Handlebar control" button in Section 4.5.1.5 to align the center with Bucky.
  3. Use the collimator knob to adjust the field size. And if necessary, set X-ray parameter
  4. Expose X-ray.

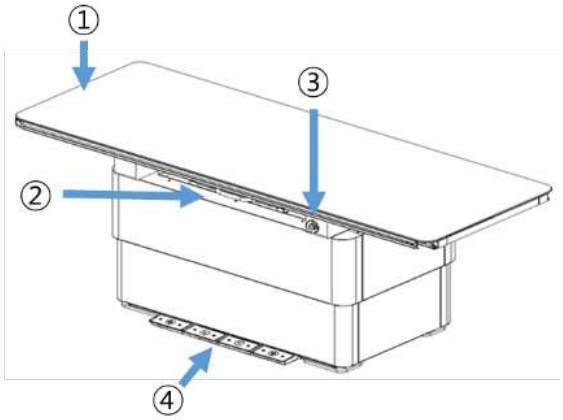
4.5.2 PATIENT TABLE

NOTE
If Fail-Safe option is applied, X-ray exposure will be prohibited and FAIL-SAFE warning will be displayed on control console if the panel is not inserted in the selected Bucky.

NOTE
Drawing out the cassette tray will enable the longitudinal movement of Bucky. And this will turn on the laser transverse center line if the laser option is applied. The laser will keep turn on if the tray is drawn out. Full drawing in the cassette tray will lock the movement of Bucky and turn off the laser. While the tray is drawn in the Bucky, the laser can be controlled by the laser button on the tube head controller.

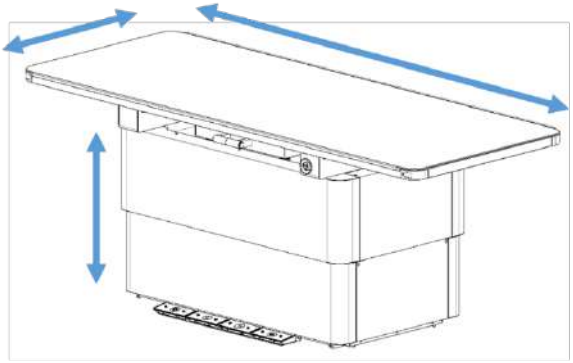
4.5.2.1 PATIENT TABLE (PBT-6)

- Parts Description

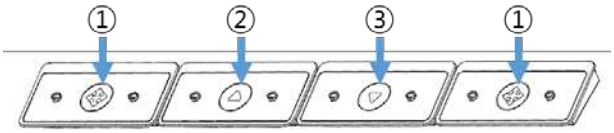


①	Tabletop	②	Bucky Tray (Drawing out tray off the tray lock)
③	Emergency stop switch	④	Foot pedal Switch

- Movement direction



- Foot pedal switch



< Foot pedal Switch>

①		Table Top Lock Pedal:	Pressing the table lock pedal unlocks the table top lock to move the top of the table.
②		Elevating Up Pedal:	Press the Elevating Up pedal to move the table up
③		Elevating Down Pedal:	Press the Elevating Down pedal to move the table Down

- How to use

1. Use the **'Foot pedal switch'** to move table top plate for positioning.

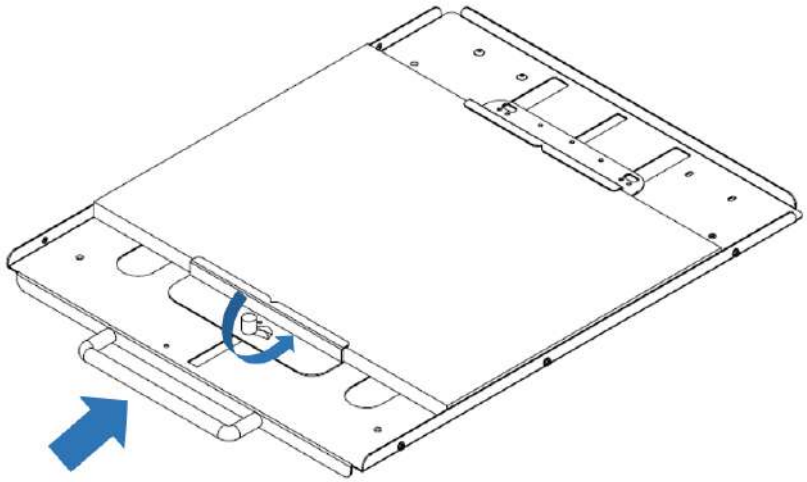
NOTE
For the safety, all pedals will works when pushed twice in 2 seconds. After table start works by pedals, operator can operate table by only one pushing pedals within 5 seconds. If the pedal operation is stopped over 5 seconds, double stepping is required for pedal operation. This mechanism or interval can be adjusted by firmware upgrading based on customer's request.

2. Insert the detector into the bucky tray and place the bucky in the desired position.
   (If you use Fixed Type Bucky, you do not need to insert a detector.)

NOTE
Used the Auto tracking board (Optional) Table Bucky is Motorized Operation for synchro and tracking according to tube stand operation.

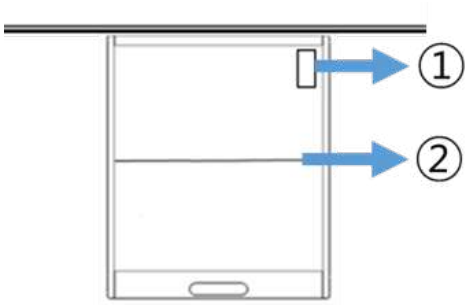
- When using Cassette type Bucky Tray

1) Pull out the Bucky Tray and insert the image receptor.



   a. Widen the space between holders and place on the panel.
   b. Push the holder into the center position until the panel is fixed and then rotate the lever to CCW direction in order to hold the position.

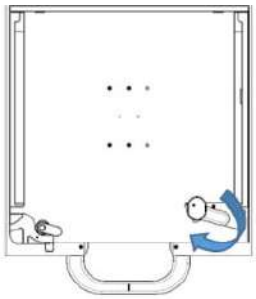
2) Manually move the bucky to the left or right while pulling the cassette tray forward.
3) When inserting the bucky tray, push it all the way to the stop position.
   (If there is a line laser option, the line laser is automatically activated when the cassette is pulled forward)
4) When inserting the removable grid, install it with the centerline or label facing upward, and push it all the way to the stop position.

	①	Grid Label
	②	Grid Center Line

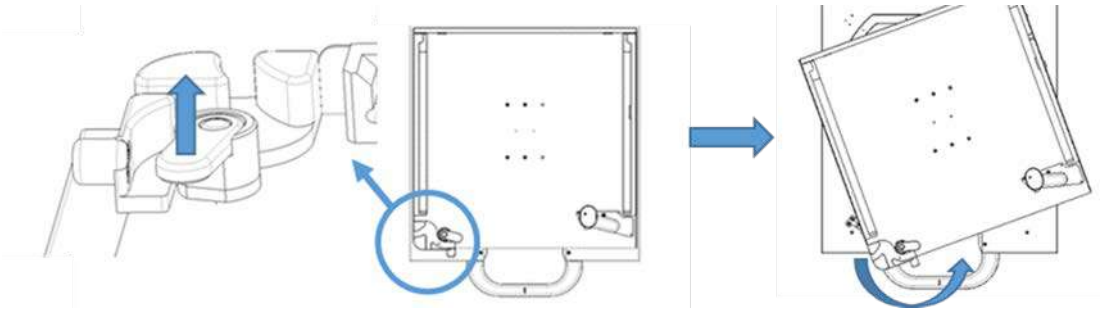
CAUTION
Install with centerline or label facing up when inserting grid. Check grid focal length. Improper grid usage can affect image quality

- When using Rotating type Bucky Tray

a. Pull out the Bucky Tray and insert the image receptor. And fix the image receptor using a image receptor holder.



b. Rotate bucky tray and shoot according to patient's body type when use 14x17 image receptor.



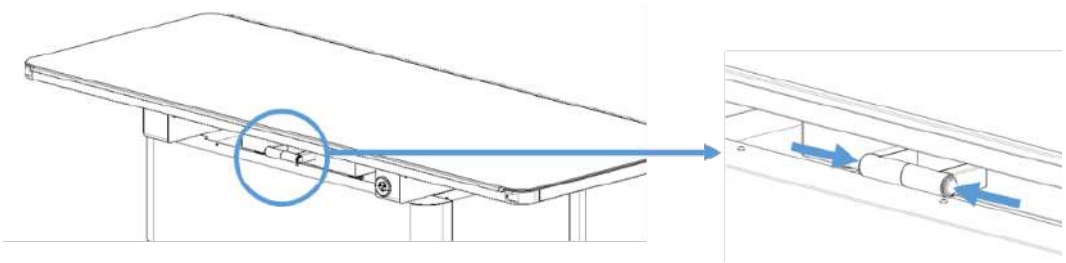
NOTE
When using the Rotating Tray type BUCKY, the tray must be completely discharged and rotated.

CAUTION
Regarding the rotating tray, make sure that the tray is set in the correct position before insert the tray into Bucky.

c. Refer to 2) to 4) in ‘When using Cassette type Bucky Tray’ in step 2.

- When using Fixed type Bucky Tray

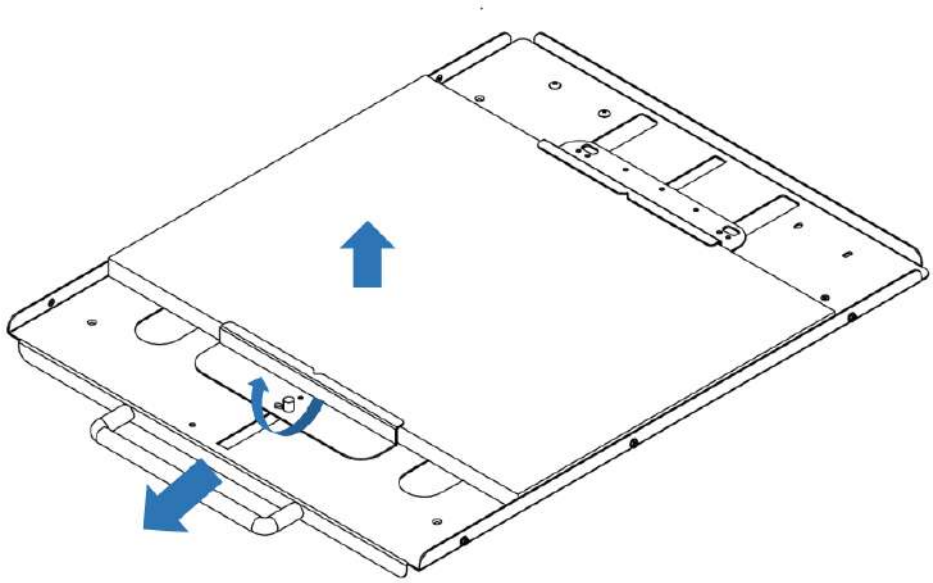
1) Manual move the Bucky left or right by push the bucky tray switch.



2) Refer to 4) in ‘When using Cassette type Bucky Tray’ in step 2

3. When the exposure is complete, press **‘Elevating Down Pedal’** to lower the tabletop to make it easier for the patient to come down. After the patient gets off, pull the Bucky Tray and remove the detector. (Fixed type bucky tray does not require detector removal.)

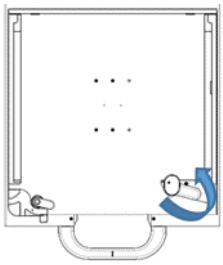
- When using Cassette type Bucky Tray



1) Rotate the lever to CW direction in order to release the holders and then widen the space between holders.

2) Draw out the panel.

- When using Rotating type Bucky Tray

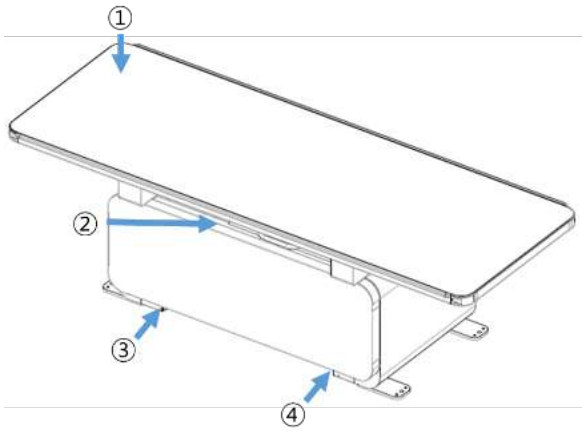


1) Rotate the image receiver holder counterclockwise..
2) Lift up and draw out the panel

CAUTION
Do not pull the tray roughly with the image receptor inserted.

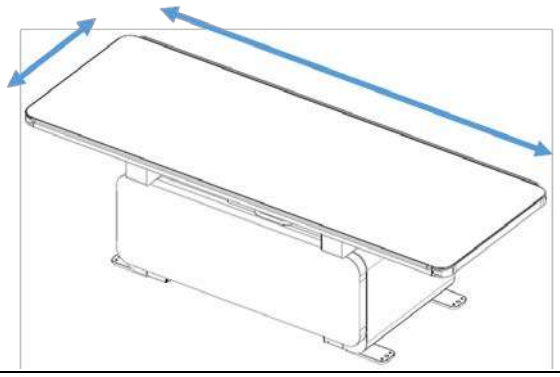
4.5.2.2 PATIENT TABLE (PBT-4)

- Parts Description

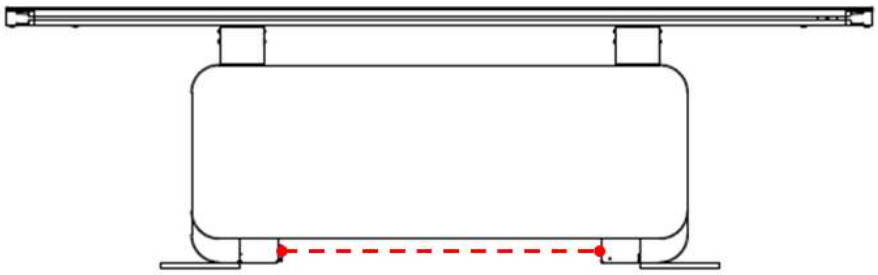


①	Tabletop	②	Bucky Tray (Drawing out tray off the tray lock)
③	Lock control foot sensor(beam)	④	Reflection mirror for Photo sensor

- Movement direction



- How to use
  1. Inserting the foot inside the bottom of the table will release the electromagnetic brakes of tabletop so the tabletop can be moved by hand.
     Release table top lock to move the top of the table.



<Foot sensor location>

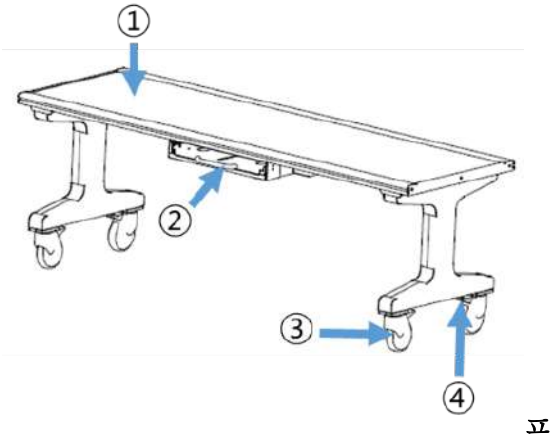
  2. Refer to Step 2 of how to use in Section 4.5.2.1.

  3. When the exposure is complete, after the patient gets off, pull the Bucky Tray and remove the detector.
     (For instructions on how to remove the image receiver, refer to step 3 of How to use in Section 4.5.2.1.)

CAUTION
Do not pull the tray roughly with the detector inserted.

4.5.2.3 PATIENT TABLE (PBT-1)

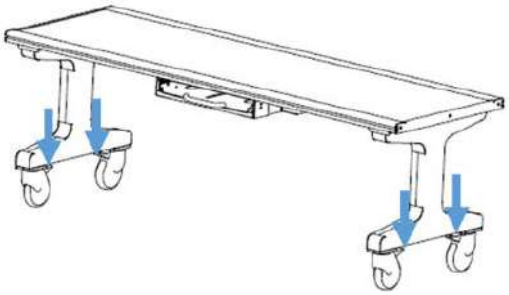
- Parts Description



①	Tabletop	②	Bucky Tray
③	Caster	④	Caster Lock Pedal

- How to use

1. Move the table to the desired position and fix it using the Caster Lock Pedal.



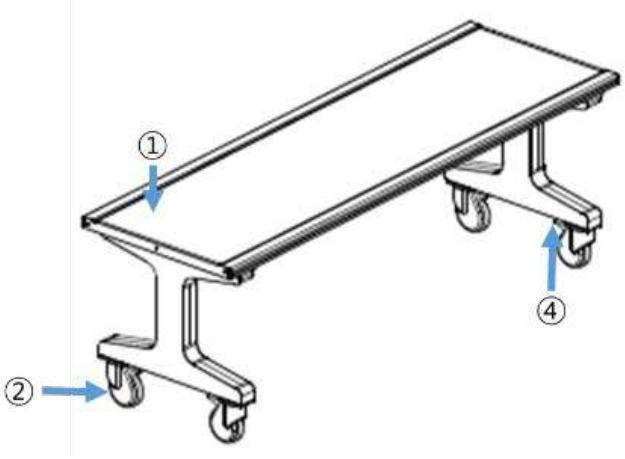
2. Pull out the Bucky Tray and insert the detector. And push it all the way to the stop position.

3. When the exposure is complete, after the patient gets off, pull the Bucky Tray and remove the detector. And Unlock using Caster Lock Pedal to move the table.

CAUTION
Do not pull the tray roughly with the detector inserted.

4.5.2.4 PATIENT TABLE (PDT-1)

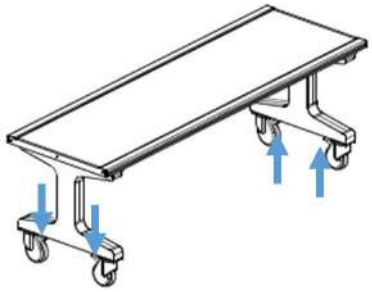
- Parts Description



①	Tabletop	②	Caster
③	Caster Lock Pedal		

- How to use

1. Move the table to the desired position and fix it using the Caster Lock Pedal.



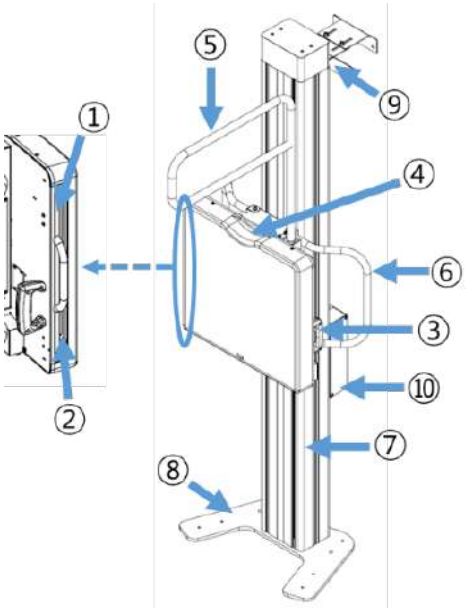
2. When the exposure is complete, after the patient gets off, Unlock using Caster Lock Pedal to move the table.

4.5.3 WALL BUCKY STAND

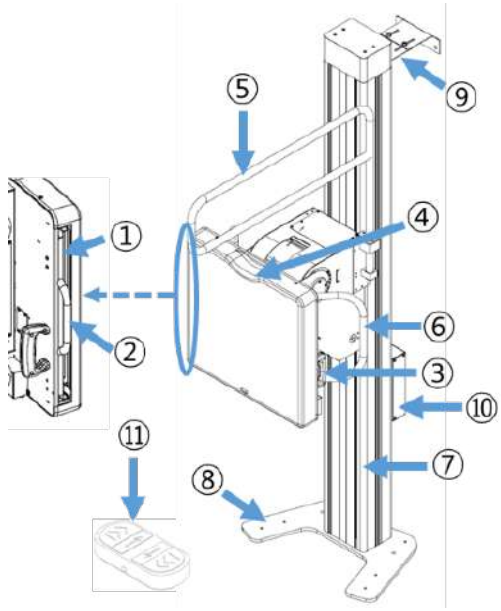
NOTE
If Fail-Safe option is applied, X-ray exposure will be prohibited and FAIL-SAFE warning will be displayed on control console if the panel is not inserted in the selected Bucky.

4.5.3.1 WALL BUCKY STAND (VERTICAL MANUAL MOVEMENT)

- Parts Description



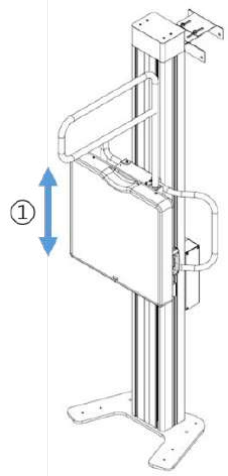
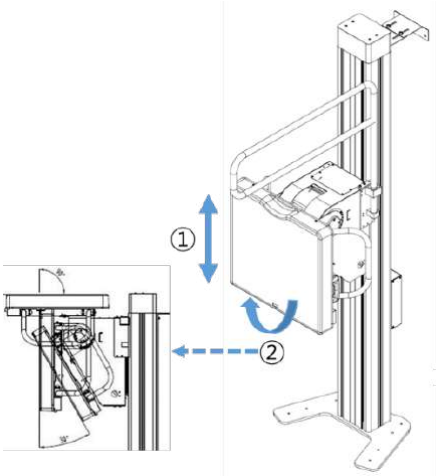
<WBS(Manual) & WBS(Manual Plus) >



<WBS-TM(Manual)>

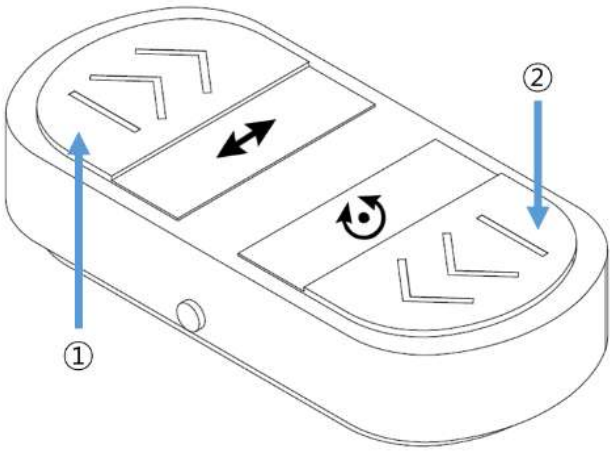
①	Bucky Tray	②	Bucky Tray handle
③	Handle switch	④	Mandible rest
⑤	Overhead handgrip (Optional)	⑥	Chest handgrip (Optional for WBS and default for WBS-TM)
⑦	Vertical stand column	⑧	Stand base
⑨	Rear wall support location	⑩	Control box
⑪	Foot Pedal Switch		

- Movement direction

	
<WBS(Manual) & WBS(Manual Plus) >	*<WBS-TM(Manual)>*

①	Vertical movement	Move while pressing the handle switch. (The WBS-TM can also be moved while pressing the **'Vertical lock control button'** on the Foot Pedal Switch.)
②	Bucky Tilting movement	Manually movement the Bucky Tilting by pressing the **'Bucky tilting lock button'** in Foot Pedal Switch. (Tilting Angel: -30 ~ 90 degrees)

- Foot Pedal Switch



< Foot Pedal Switch>

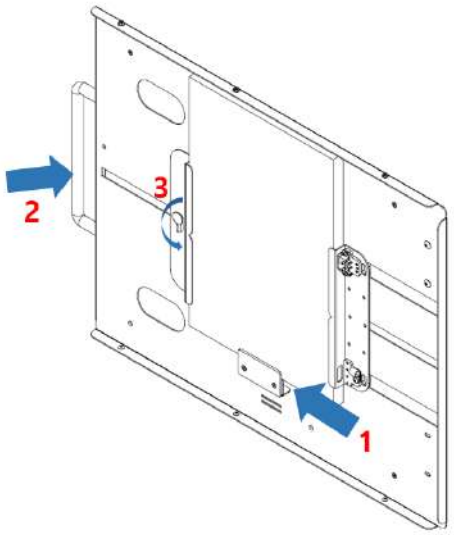
①	Vertical lock control button	②	Bucky tilting lock button

- How to use

1. Insert the image receptor into the bucky tray and place the bucky in the desired position.

- When using Cassette type Bucky Tray

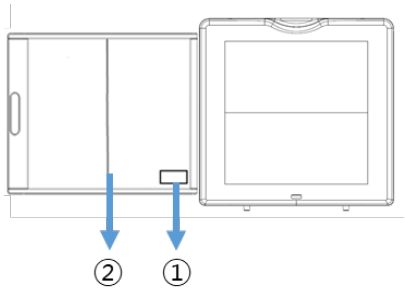
1) Pull out the Bucky Tray and insert the detector.



a. Place the bottom support(1) on tray.
b. Widen the space between holders and place on the panel.
c. Push the holder into the center position until the panel is fixed and then rotate the lever(3) to CCW direction in order to hold the position.

2) Insert the tray all the way to the stop position, and manually move the bucky to the up or down while pressing the **'Handle switch'**.
(The WBS-TM can also be moved while pressing the **'Vertical lock control button'** on the **'Foot Pedal Switch'**.)

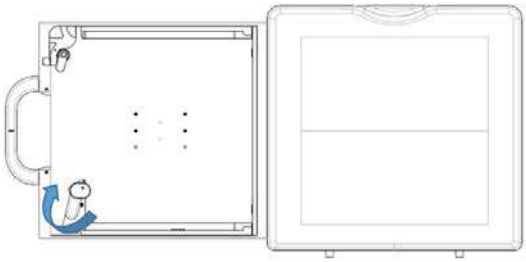
3) When inserting the removable grid, install it with the centerline or label facing front, and push it all the way to the stop position.

	①	Grid Label
	②	Grid Center Line

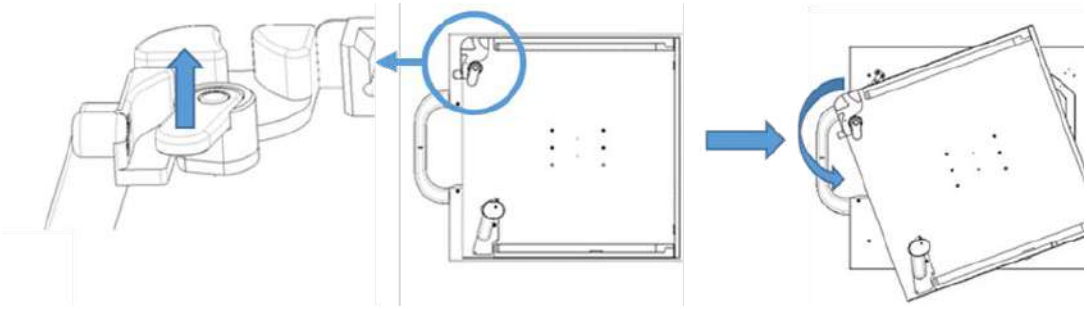
CAUTION
Install with centerline or label facing up when inserting grid. Check grid focal length. Improper grid usage can affect image quality

- When using Rotating type Bucky Tray

1) Pull out the Bucky Tray and insert the image receptor. And fix the image receptor using a image receptor holder.



2) Rotate bucky tray and shoot according to patient's body type when use 14x17 image receptor.



3) Refer to 2) to 3) in 'When using Cassette type Bucky Tray' in step 1.

NOTE
When using the Rotating Tray type BUCKY, the tray must be completely discharged and rotated.

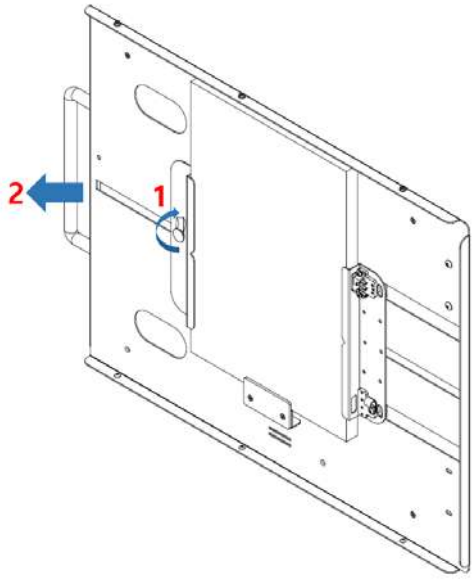
CAUTION
Regarding the rotating tray, make sure that the tray is set in the correct position before insert the tray into Bucky.

- When using Fixed type Bucky Tray

1) Manual move the Bucky up or down by push the **'Handle switch'**.
   (The WBS-TM can also be moved while pressing the **'Vertical lock control button'** on the **'Foot Pedal Switch'**.)
2) Refer to 3) in 'When using Cassette type Bucky Tray' in step 1.

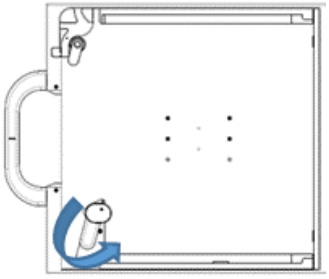
2. When the exposure is complete, Pull the Bucky Tray and remove the detector.
   (Fixed type bucky tray does not require detector removal.)

- When using Cassette type Bucky Tray



1) Rotate the lever to CW direction in order to release the holders and then widen the space between holders.
2) Draw out the panel.

- When using Rotating type Bucky Tray



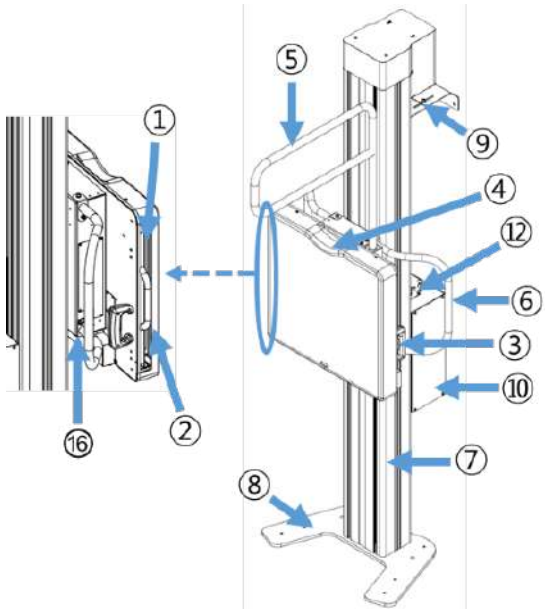
1) Rotate the image receiver holder counterclockwise..

2) Lift up and draw out the panel

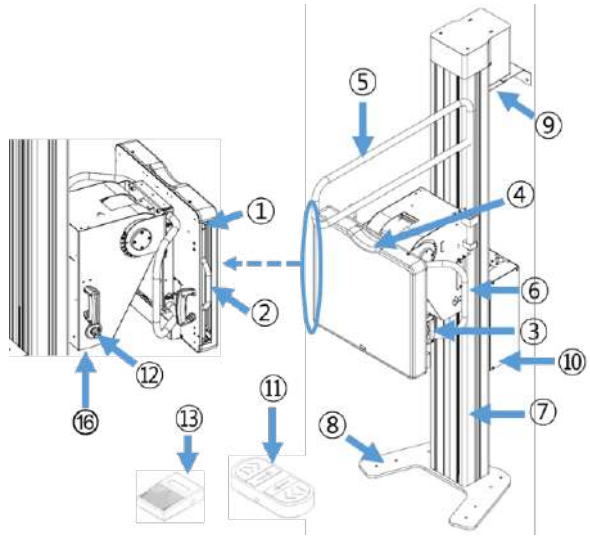
CAUTION
Do not pull the tray roughly with the image receptor inserted.

4.5.3.2 WALL BUCKY STAND (VERTICAL MOTORIZED MOVEMENT)

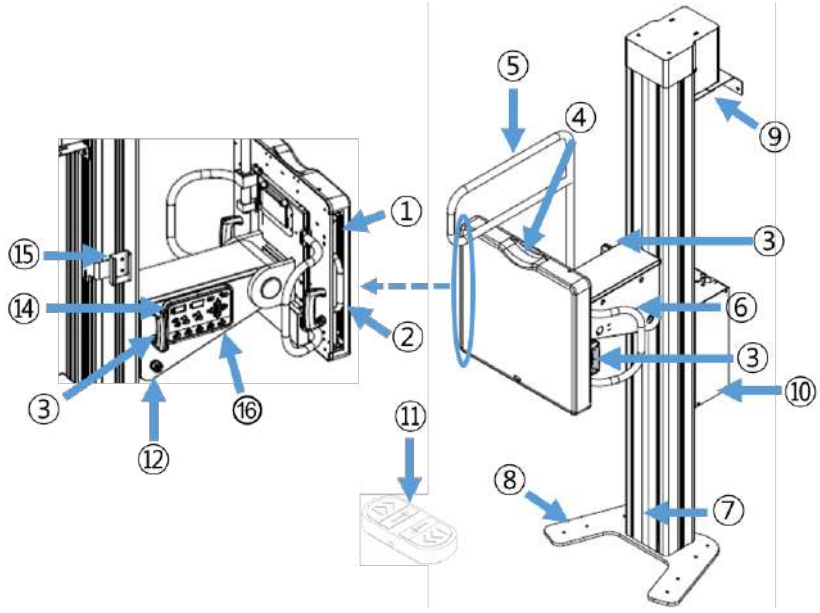
- Parts Description



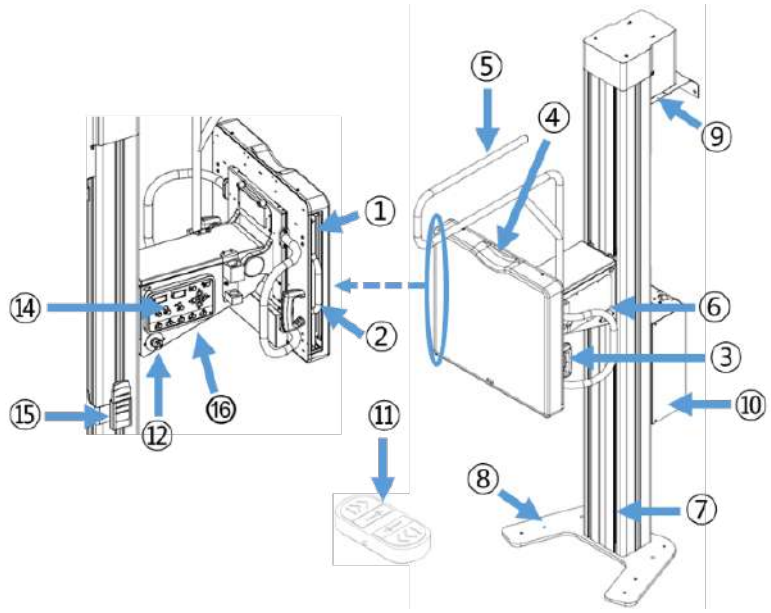
<WBS(Motorized)>



<WBS-TM(Motorized)>



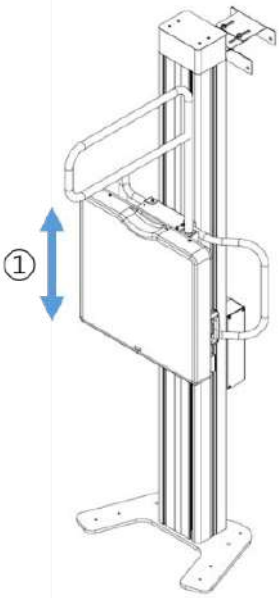
<WBS-TA(Motor type)>



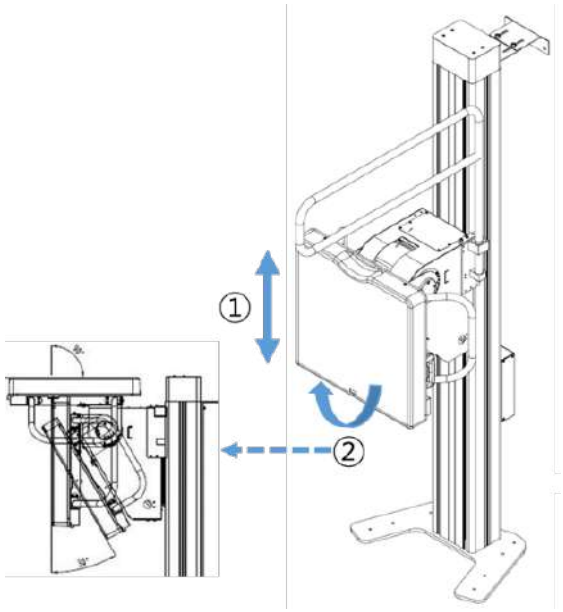
<WBS-TA(Actuator type)>

①	Bucky Tray	②	Bucky Tray handle
③	Handle switch	④	Mandible rest
⑤	Overhead handgrip	⑥	Chest handgrip (In WBS-TM, this is the default and the others are optional.)
⑦	Vertical stand column	⑧	Stand base
⑨	Rear wall support location	⑩	Control box
⑪	Foot Pedal Switch (WBS(Motorized), WBS-TA are optional.)	⑫	Emergency stop switch
⑬	Foot Switch (Only WBS-TM(Motorized)	⑭	WBS-TA Control Panel
⑮	Remote controller	⑯	Safety Sensor

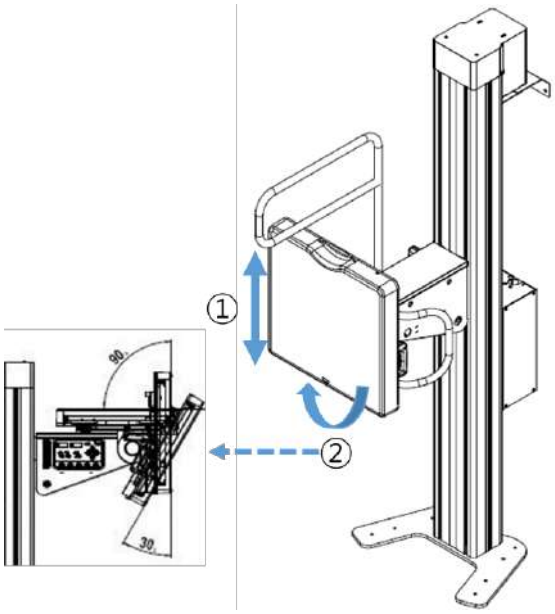
- Movement direction



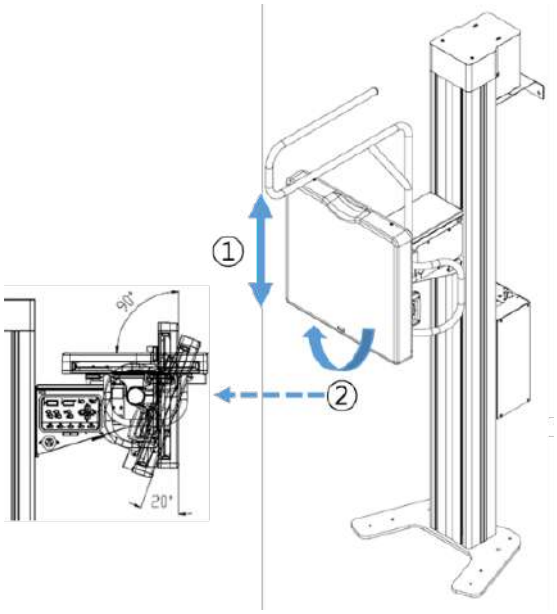
<WBS(Motorized)>



<WBS-TM(Motorized)>



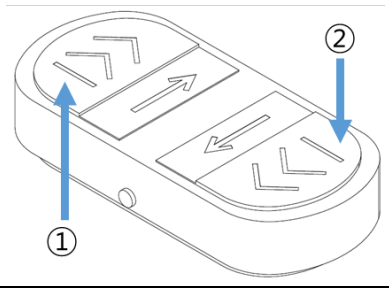
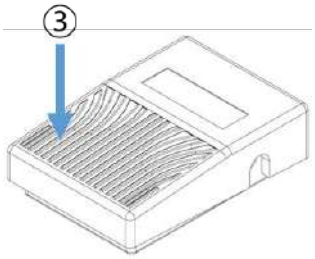
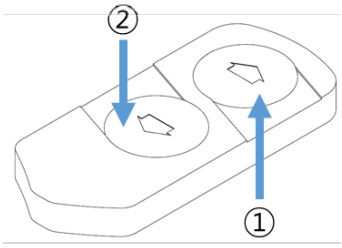
<WBS-TA(Motor type)>



<WBS-TA(Actuator)>

①	Vertical movement	Move while pressing the handle switch. (Motorized drive is also possible using 'Foot Pedal & Hand Switch' or 'Remote control & WBS-TA Control Panel'.)
②	Bucky Tilting movement	WBS-TM will manually tilt the bucky by pressing the Foot Switch. WBS-TA presses the Tilting Motorized Control button to tilt bucky with a motor. (Tilting Angel: -30 ~ 90 degrees) (However, WBS-TA (Actuator type) is -20~90 degrees.)

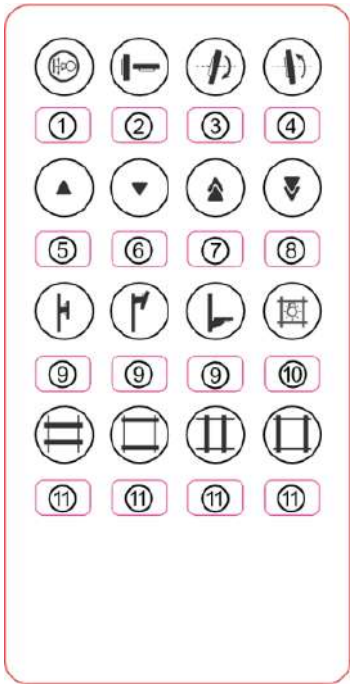
- Foot Pedal & Hand Switch

		
<Foot Pedal Switch>	*<Foot Switch>*	*<Hand Switch>*

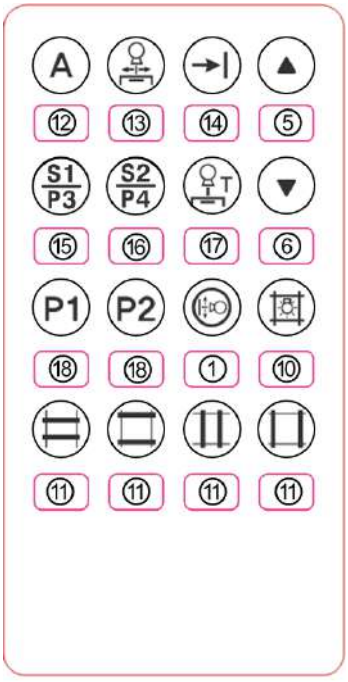
①	Vertical motorized up button	②	Vertical motorized down button
③	Bucky tilting lock Switch		

NOTE
You can choose between **'Foot Pedal Switch'** and **'Hand Switch'**.

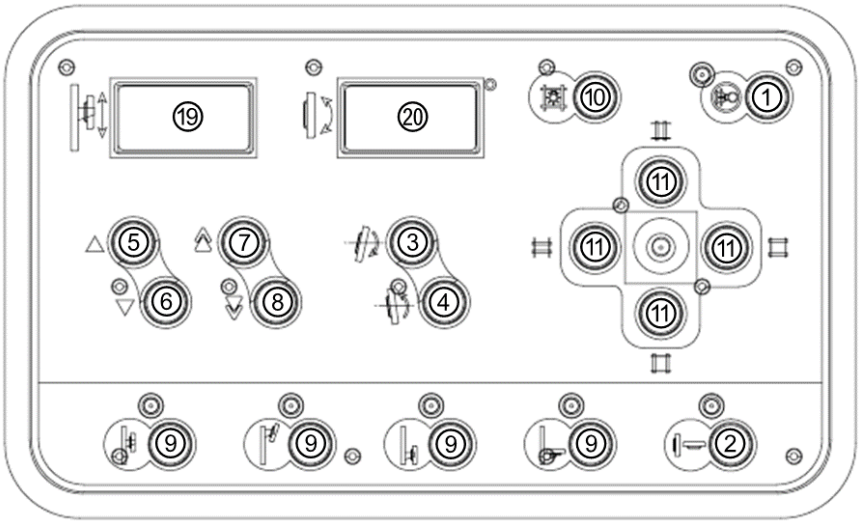
- Remote control & WBS-TA Control Panel



Remote controller (Model: WBS-TA (Motor Type))



Remote controller (Model: WBS-TA (Actuator Type))



< WBS-TA Control Panel>

①	Vertical Sync.	②	Auto Tilting Control
③	Tilting Motorized Control (CW)	④	Tilting Motorized Control (CCW)
⑤	Vertical motorized up	⑥	Vertical motorized down
⑦	Vertical motorized up (Fast)	⑧	Vertical motorized down (Fast)
⑨	Auto Positioning Control	⑩	Collimator Lamp On/Off Control
⑪	Motorized Collimator Control	⑫	Automatic Positioning
⑬	Table Bucky Tracking	⑭	Auto Parking
⑮	Stand Mode 1 (SID 100)	⑯	Stand Mode 2 (SID 180)
⑰	Table Mode	⑱	Programmable Mode 1, 2
⑲	Vertical height indicator	⑳	Tilting angle indicator

NOTE

'Tilting motorized control buttons' will work as follows when the safety sensor has detected the obstacle.

- If  button is pressed, tilting will stop and there will be an alarm sound.
- If  button is pressed, tilting will be done and there will be an alarm sound.

CAUTION

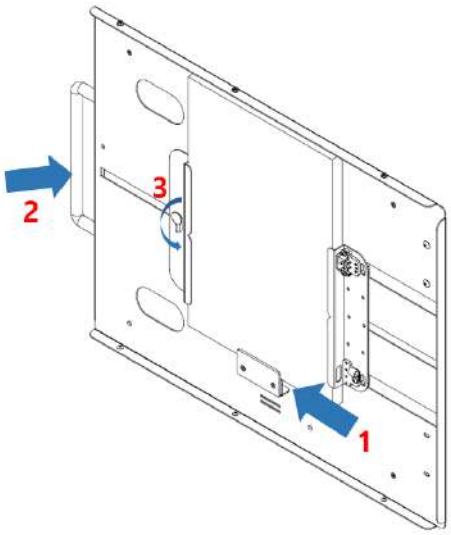
All switches of control panel and remote controller are working by Dead-man type. So the intended operation will be done only while its switch is pushed. If not, the operation will be automatically stopped.

- How to use

1. Insert the image receptor into the bucky tray and place the bucky in the desired position.

- When using Cassette type Bucky Tray

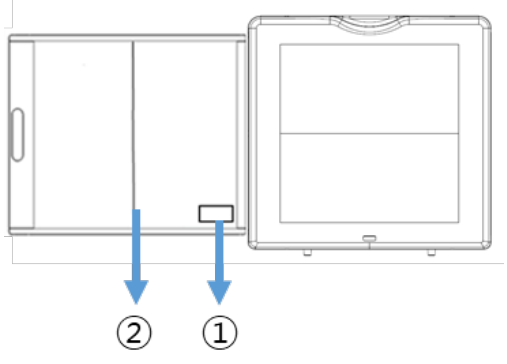
1) Pull out the Bucky Tray and insert the image receptor.



a. Place the bottom support(1) on tray.
b. Widen the space between holders and place on the panel.
c. Push the holder into the center position until the panel is fixed and then rotate the lever(3) to CCW direction in order to hold the position.

2) Insert the tray all the way to the stop position, and manually move the bucky to the up or down while pressing the **'Handle switch'**.
(Motorized drive is also possible using **'Foot Pedal'** & **'Hand Switch'** or Remote control & WBS-TA Control Panel.)

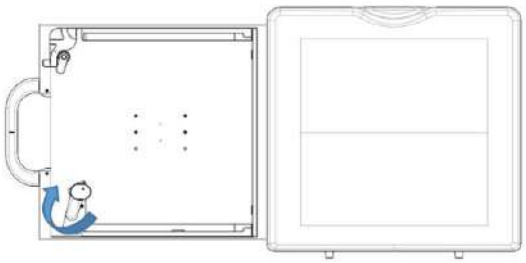
3) When inserting the removable grid, install it with the centerline or label facing front, and push it all the way to the stop position.

	①	Grid Label
	②	Grid Center Line

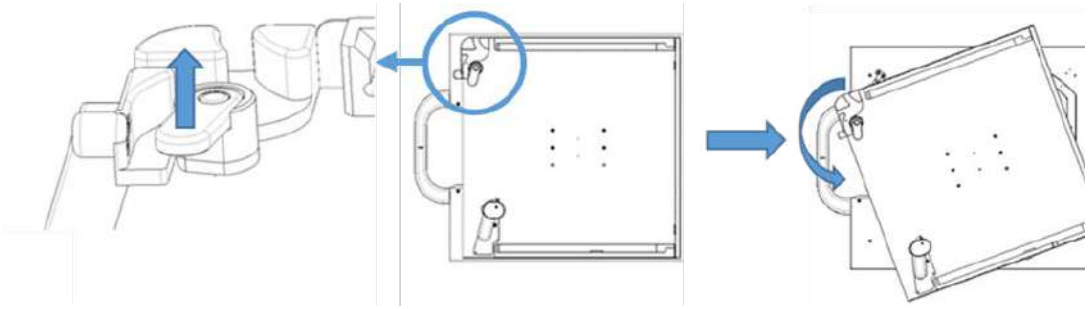
CAUTION
Install with centerline or label facing up when inserting grid. Check grid focal length. Improper grid usage can affect image quality

- When using Rotating type Bucky Tray

1) Pull out the Bucky Tray and insert the image receptor. And fix the image receptor using a image receptor holder.



2) Rotate bucky tray and shoot according to patient's body type when use 14x17 image receptor.



3) Refer to 2) to 3) in 'When using Cassette type Bucky Tray' in step 1.

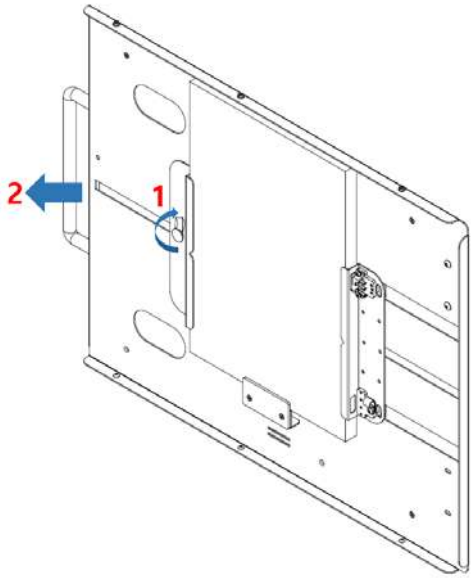
NOTE
When using the Rotating Tray type BUCKY, the tray must be completely discharged and rotated.

CAUTION
Regarding the rotating tray, make sure that the tray is set in the correct position before insert the tray into Bucky.

- When using Fixed type Bucky Tray

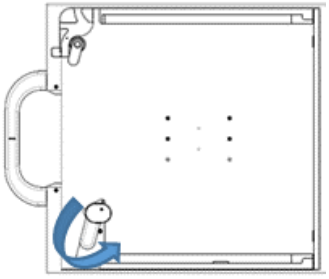
1) Manual move the Bucky up or down by push the **'Handle switch'**.
(Motorized drive is also possible using **'Foot Pedal'** & **'Hand Switch'** or Remote control & WBS-TA Control Panel.)
3) Refer to 3) in 'When using Cassette type Bucky Tray' in step 1.

2. When the exposure is complete, Pull the Bucky Tray and remove the detector.
(Fixed type bucky tray does not require detector removal.)
- When using Cassette type Bucky Tray



1) Rotate the lever to CW direction in order to release the holders and then widen the space between holders.
2) Draw out the panel.

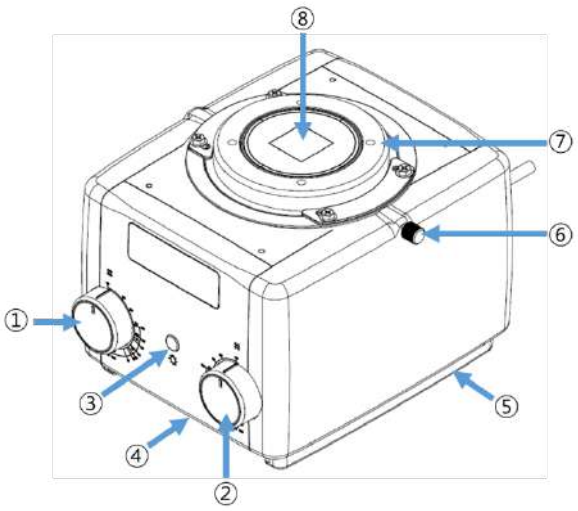
- When using Rotating type Bucky Tray



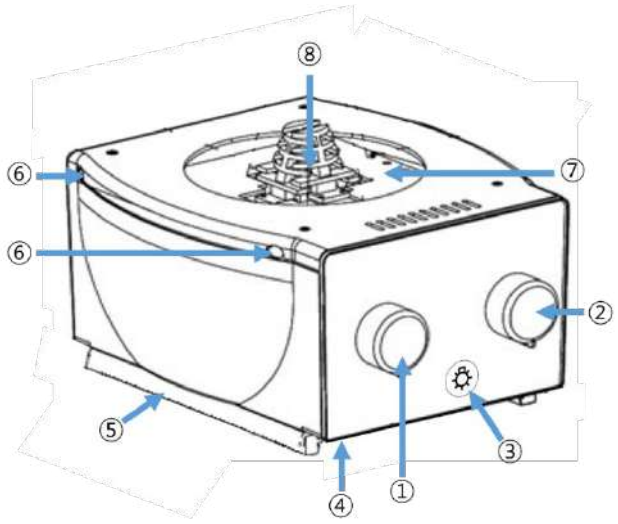
1) Rotate the image receiver holder counterclockwise..
2) Lift up and draw out the panel

CAUTION
Do not pull the tray roughly with the image receptor inserted.

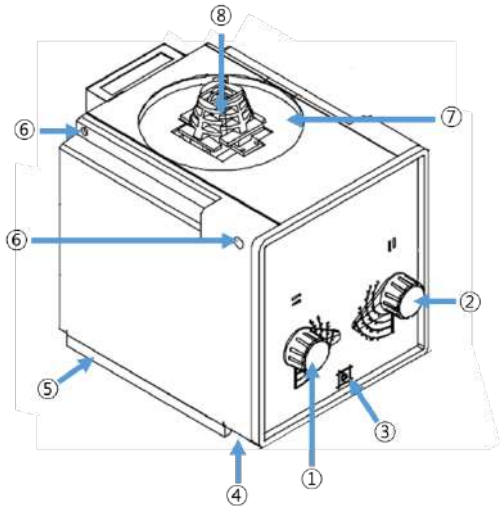
4.5.4 COLLIMATOR



< DXC-RML>



< R108>

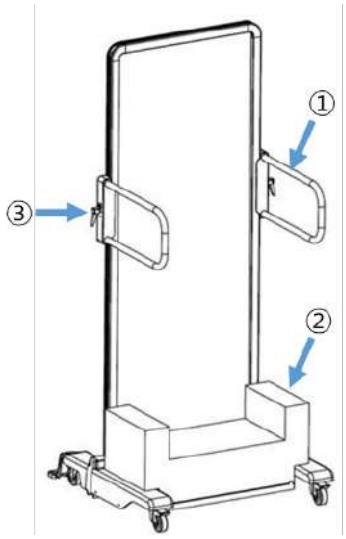


< R302A, R302MLP/A, R302MFMLP/A>

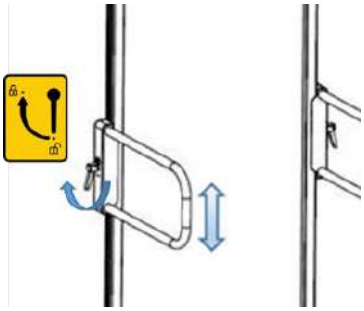
①	Lateral X-ray coverage control knob	②	Longitudinal X-ray coverage control knob
③	Collimation lamp on switch (30sec timer)	④	Beam out port
⑤	Rail for additional filter or beam limiter(cone)	⑥	Rotation fixing Bolt
⑦	Tube assembling area	⑧	Beam in port (optional near port shutters)

4.5.5 STITCHING STAND

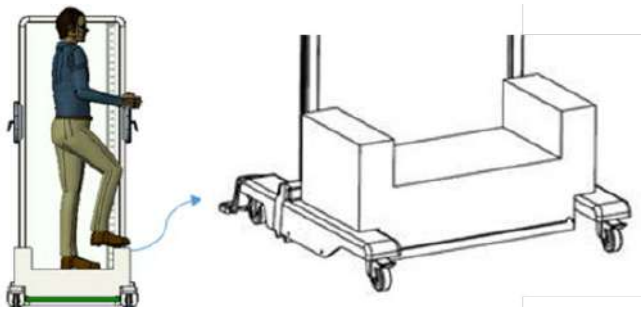
1. Position the patient in front of WBS-TA Stitching Stand

	①	Patient Handle-Bar(Height adjustable)
	②	Patient Foam Step
	③	Patient Handle-Bar Lock Lever

- Patient Handle-Bar (Height adjustable)
  - The handlebar can be height adjusted by operating the lever.



- Patient Foam Step
  - It is available in various direction as below.



5. MAINTENANCE

The user must routinely check the X-ray equipment for apparent defects or damage. Report any apparent defects or irregular operation of any equipment to service personnel immediately, and discontinue use of the suspected faulty equipment until repairs are made. Continuing operation with faulty equipment may present various safety hazards, including risk of increased radiation.

NOTE
Due to varying operating conditions, the maintenance may have to be performed at greater or lesser intervals. it may adjust intervals according to system's performance.

WARNING
Turn off all electrical power to system at it's disconnect switch before servicing unit. Also, make sure that disconnect switch is locked out and tagged "Equipment Being Serviced" before servicing unit.

WARNING
This equipment is NOT classified as anesthetic-proof and may ignite flammable anesthetics. Flammable agents used for skin cleaning or disinfecting may also produce an explosion hazard.

5.1 OPERATOR TASKS

When to Do It	What to Do	Who to Do It	Related Section
Every day or as Required	Daily x-ray tube warm-up procedure	Operator	5.1.1
	Test of emergency stop switch	Operator	5.1.2
	Checking the visible damaged of dap	Operator	5.1.8
Once a month or as Required	Exposed tracks	Operator	5.1.4
Every three months after installation or as Required	Apparatus operation	Operator	4.5
Every 6 months or as Required	Clean external surfaces	Operator	5.1.4
	Clean grid surface	Operator	5.1.5
	AEC functional check	Operator	5.1.3
	Console and miscellaneous generator checks	Operator	5.1.6
Every 1 years or as Required	Checking the visible damaged components	Operator	5.1.6
whenever a related certifiable X-ray component is replaced, when not used for several days	Tube seasoning	Operator	5.1.7

5.1.1 DAILY X-RAY TUBE WARM-UP PROCEDURE

WARNING
The following procedure produces x-rays. Observe all safety precautions to protect personnel.

Use this procedure when the generator has not been used for several days. This procedure provides for exposures at medium power before the tube is used at maximum mA or kV values. This will reduce the possibility of damaging the anode and high voltage components. No test setup is required.

For maximum stability and reliability, use the following techniques at start up:
Select the following:

- Large focal spot.
- 80 kV.
- Normal 50/60 Hz anode rotation.

For a 300 kHU to a 400 kHU tube, use approximately 80 mAs per exposure.
For a 200 kHU to 300 kHU tube, use approximately 64 mAs per exposure.
For a below 200 kHU tube, use approximately 50 mAs per exposure.

Depending on the X-ray tube power rating, select either 100 mA or 200 mA.

Make three to five exposures (depending on tube loading) at 30 second intervals.

5.1.2 TEST OF EMERGENCY STOP SWITCH

'Emergency stop switches' should be checked regularly to prevent the risk of collisions, injury to the patient or operator, or damage to the system.
After pressing the **'Emergency stop switch'**, check that all system drives are shut down and stop moving immediately.
Check the normal operation of the **'Emergency stop switch'** and turn it clockwise to release it.

5.1.3 AEC FUNCTIONAL CHECK

The following procedure may be used to verify that the AEC circuits are functioning on generators equipped with AEC (Automatic Exposure Control).

1. Switch the generator ON, and select an appropriate radiographic image receptor.
2. Align the X-ray tube and the selected image receptor such that the central ray is directly over the center field of the AEC pickup device. Set the focal spot to film plane distance to 40 in. (1 m).
3. Select AEC mode of operation. Select center field.

MINIMUM EXPOSURE TIME:

1. With no object in the radiation field, adjust the collimator or beam limiting device to project a 10 in. X 10 in. (24 cm X 24 cm) field at the image receptor.
2. Select 80 kV and 100 mA.
3. Make an exposure and verify that the Post-mAs reading is ≤ 2 mAs.

MAXIMUM EXPOSURE TIME:

1. Close the collimator or beam limiting device completely. Place a folded lead apron over the image receptor.
2. Select 60 kV and 100 mA.
3. Make an exposure and verify that the error message AEC BUT ERROR or AEC MAS ERROR is indicated in the APR display window after the exposure has terminated. This confirms that the exposure has continued until it was terminated by the AEC backup circuits in the generator.

CAUTION
The AEC verification procedure requires the production of x-rays. Follow proper operating procedures and take appropriate x-ray precautions.

5.1.4 CLEANING EXTERNAL SURFACES

- Tools Required:
  - cleaning wipes
  - non-abrasive, hospital-grade cleaner

Use cleaning wipes and non-abrasive, hospital-grade cleaner to clean external surfaces of the system.

- Ensure the power has been disconnected before starting any cleaning operation.
- Ensure no liquid gets into the unit.
- Do not immerse the equipment, including any components or accessories, in liquid.
- Do not autoclave the equipment, including any component or accessories.
- Do not use water. Water can short-circuit the electrical insulation and cause corrosion to mechanical parts.
- Do not use acid or abrasive products.
- Use only a dry cloth to clean chrome-plated parts.
- Only the surface areas of unit parts, including accessories and connection cables, should be disinfected using a gaseous disinfectant. For safety reasons, do not spray disinfectants.
- Clean painted parts with a cloth and products appropriate for cleaning plastic materials; after cleaning wipe the surfaces with a clean, dry cloth.
- Do not spray cleaning or disinfection solution directly on the equipment. To disinfect, moisten a cloth with a 70% Isopropyl alcohol solution or equivalent and wipe the surface of the equipment.
- When disinfecting the examination room, ensure the unit is covered with plastic sheets.

5.1.5 CLEANING GRID SURFACE

- Tools Required:
  - Dry cloth

Use a cloth to wipe off any dust build-up or any other foreign material.

- Ensure the power has been disconnected before starting any cleaning operation.
- Ensure no liquid gets into the unit.
- Do not immerse the equipment, including any components or accessories, in liquid.
- Do not autoclave the equipment, including any component or accessories.
- Do not use water. Water can short-circuit the electrical insulation and cause corrosion to mechanical parts.
- Do not use acid or abrasive products.
- Use only a dry cloth to clean the receptor.
- For safety reasons, do not spray disinfectants.

5.1.6 CONSOLE AND MISCELLANEOUS GENERATOR CHECKS

The user must routinely check the X-ray equipment for apparent defects or damage. Report any apparent defects or irregular operation of any equipment to service personnel immediately, and discontinue use of the suspected faulty equipment until repairs are made. Continuing operation with faulty equipment may present various safety hazards, including risk of increased radiation.

1. Check all visual displays (warning and status lights, technique displays and indicators, etc) and components for normal operation.
2. Check all audible indicators for normal operation, and check that the loudness settings are adequate for the environment.
3. Check all interconnect cables and connectors for damage.

5.1.7 TUBE SEASONING

Tube “seasoning” is particularly important for new tubes or tubes that have not been used for several days. This should be performed on each X-ray tube before attempting auto calibration, as an unseasoned tube may not operate properly at higher kV values without arcing. Refer to the X-ray tube manufacturer’s instructions, if available, for the tube conditioning or “seasoning” procedure. If the X-ray tube manufacturer’s instructions are not available, the following procedure may be used:

NOTE
The tube manufacturer’s recommended seasoning procedure, if available, must always be used in place of the following procedure.

NOTE
Low speed only exposures are recommended for the seasoning exposures, to prevent excessive heat build-up in the housing from the stator windings or the rotor bearings.

X-ray tubes that have not been used for more than 8 hours may suffer thermal shock if operated at high mA and kV without a warm-up procedure. A cold anode (Molybdenum) is very brittle and when suddenly heated over a small area may experience thermal cracking of the anode surface, eventually leading to permanent tube damage.

The procedure below is intended for seasoning an X-ray tube and, that does not need to be calibrated.

1. Season the tube at 70 kV by taking approximately 10 exposures of 200 mA and 100 ms. These exposures should be taken at the rate of approximately one every 15 seconds.

2. Season the tube at 100 kV by taking approximately 5 exposures of 160 mA and 100 ms. These exposures should be taken at the rate of approximately one every 15 seconds.

3. Season the tube at 120 kV by taking approximately 5 exposures of 100 mA and 100 ms. These exposures should be taken at the rate of approximately one every 15 seconds.

5.1.8 DAP METER

DAP meter has no user serviceable parts which can be classified as replaceable material. The power supply and cables can be changed at any time, since these components do not have any influence on the calibration.

DAP meter was designed to give long and reliable service and does not require special maintenance. In case one of the components becomes defective a repair should not be attempted but the faulty component once identified should be replaced by authorized and qualified service engineers. The respective part numbers are given in the system components section of ***"GXR-SD/CSD/USD"*** service manual.

Daily ensure that it is tightly installed and not damaged mechanically

NOTE
MAINTAINANCE DETAILS Refer to accompanying DAP meter manufacturer's manuals.

5.2 THE END OF PRODUCT LIFE

If the ***"GXR-SD/CSD/USD"*** system has completed its useful service life, local environmental regulations must be complied with in regard to disposal of possible hazardous materials used in the construction of the generator. In order to assist with this determination, the noteworthy materials used in the construction of this generator are itemized below:

ITEM

- Electrical insulating oil in HT tank. This is a mineral oil with trace additives (11 Liter)
- Counter weight in radiographic stand (lead)
- Solder (lead/tin).
- Epoxy fiberglass circuit board materials, tracks are soldering on copper.
- Wire, tinned copper. Insulated with PVC or silicone.
- Steel and / or aluminum (radiographic stand, generator cabinet, etc).
- Plastic (console enclosure and console membrane).
- Electrical and electronic components: IC's, transistors, diodes, resistors, capacitors, etc.

NOTE
Part of the components contains harmful substances which may pollute the ambient environment if disposed carelessly. In particular, lead is contained in concentrations > 0.1 wt% in Wall Bucky Stand, Tube Stand, X-ray tube and collimator. For details on product disposal, contact our official dealer or DRGEM Representative.

(This page intentionally left blank)

APPENDIX A. EXPOSURE TABLE

Table 1, 2 following shows nominal exposure times resulting from pre-selected mAs and mA values.
Discrete values of loading factors were chosen from the series R'10 according to ISO 497.
This table also shows the range and interrelation of these loading factors. For example, if 20 mAs is selected at 200 mA, it can be seen that the exposure time will be approximately 100 ms. This is determined by reading down the 200 mA column to 20 mAs; then by reading the nominal exposure time 100 ms as shown at the left side of the table, along the 20 mAs row.

Table 3, following show the maximum exposure table without mA sliding down for each model.
Within these maximum regions, X-ray generation will be done with its rated levels only using the stored energy in the capacitor bank. The generator will enter the mA sliding down section above these levels and consume the line power in this region. mA level of mA sliding down section will be automatically selected from 10 to 20mA by the generator with referring the charge limit level and input line power status.

Exposure table may be photocopied as required and placed in a suitable location as per local requirements.

(This page intentionally left blank)

GXR Series GENERATOR TECHNIQUE SELECTION

Time (ms)	mA Selected																				
	10	**12.5**	**16**	**20**	**25**	**32**	**40**	**50**	**64**	**80**	**100**	**125**	**160**	**200**	**250**	**320**	**400**	**500**	**640**	**800**	**1000**
1.0											0.1	0.125	0.16	0.2	0.25	0.32	0.4	0.5	0.64	0.8	1.0
1.2										0.1	0.125	0.16	0.2	0.25	0.32	0.4	0.5	0.64	0.8	1.0	1.25
1.6									0.1	0.125	0.16	0.2	0.25	0.32	0.4	0.5	0.64	0.8	1.0	1.25	1.6
2								0.1	0.125	0.16	0.2	0.25	0.32	0.4	0.5	0.64	0.8	1.0	1.25	1.6	2.0
2.5							0.1	0.125	0.16	0.2	0.25	0.32	0.4	0.5	0.64	0.8	1.0	1.25	1.6	2.0	2.5
3.2						0.1	0.125	0.16	0.2	0.25	0.32	0.4	0.5	0.64	0.8	1.0	1.25	1.6	2.0	2.5	3.2
4					0.1	0.125	0.16	0.2	0.25	0.32	0.4	0.5	0.64	0.8	1.0	1.25	1.6	2.0	2.5	3.2	4.0
5				0.1	0.125	0.16	0.2	0.25	0.32	0.4	0.5	0.64	0.8	1.0	1.25	1.6	2.0	2.5	3.2	4.0	5.0
6.4			0.1	0.125	0.16	0.2	0.25	0.32	0.4	0.5	0.64	0.8	1.0	1.25	1.6	2.0	2.5	3.2	4.0	5.0	6.4
8		0.1	0.125	0.16	0.2	0.25	0.32	0.4	0.5	0.64	0.8	1.0	1.25	1.6	2.0	2.5	3.2	4.0	5.0	6.4	8
10	0.1	0.125	0.16	0.2	0.25	0.32	0.4	0.5	0.64	0.8	1.0	1.25	1.6	2.0	2.5	3.2	4.0	5.0	6.4	8	10
12.5	0.125	0.16	0.2	0.25	0.32	0.4	0.5	0.64	0.8	1.0	1.25	1.6	2.0	2.5	3.2	4.0	5.0	6.4	8	10	12.5
16	0.16	0.2	0.25	0.32	0.4	0.5	0.64	0.8	1.0	1.25	1.6	2.0	2.5	3.2	4.0	5.0	6.4	8	10	12.5	16
20	0.2	0.25	0.32	0.4	0.5	0.64	0.8	1.0	1.25	1.6	2.0	2.5	3.2	4.0	5.0	6.4	8	10	12.5	16	20
25	0.25	0.32	0.4	0.5	0.64	0.8	1.0	1.25	1.6	2.0	2.5	3.2	4.0	5.0	6.4	8	10	12.5	16	20	25
32	0.32	0.4	0.5	0.64	0.8	1.0	1.25	1.6	2.0	2.5	3.2	4.0	5.0	6.4	8	10	12.5	16	20	25	32
40	0.4	0.5	0.64	0.8	1.0	1.25	1.6	2.0	2.5	3.2	4.0	5.0	6.4	8	10	12.5	16	20	25	32	40
50	0.5	0.64	0.8	1.0	1.25	1.6	2.0	2.5	3.2	4.0	5.0	6.4	8	10	12.5	16	20	25	32	40	50
64	0.64	0.8	1.0	1.25	1.6	2.0	2.5	3.2	4.0	5.0	6.4	8	10	12.5	16	20	25	32	40	50	64
80	0.8	1.0	1.25	1.6	2.0	2.5	3.2	4.0	5.0	6.4	8	10	12.5	16	20	25	32	40	50	64	80
100	1.0	1.25	1.6	2.0	2.5	3.2	4.0	5.0	6.4	8	10	12.5	16	20	25	32	40	50	64	80	100
125	1.25	1.6	2.0	2.5	3.2	4.0	5.0	6.4	8	10	12.5	16	20	25	32	40	50	64	80	100	125
160	1.6	2.0	2.5	3.2	4.0	5.0	6.4	8	10	12.5	16	20	25	32	40	50	64	80	100	125	160
200	2.0	2.5	3.2	4.0	5.0	6.4	8	10	12.5	16	20	25	32	40	50	64	80	100	125	160	200
250	2.5	3.2	4.0	5.0	6.4	8	10	12.5	16	20	25	32	40	50	64	80	100	125	160	200	250
320	3.2	4.0	5.0	6.4	8	10	12.5	16	20	25	32	40	50	64	80	100	125	160	200	250	320

Table 1: mAs values vs. mA & time selected

Table 1 continued on next page

Time (ms)	mA Selected																				
	10	**12.5**	**16**	**20**	**25**	**32**	**40**	**50**	**64**	**80**	**100**	**125**	**160**	**200**	**250**	**320**	**400**	**500**	**640**	**800**	**1000**
400	4	5	6.4	8	10	12.5	16	20	25	32	40	50	64	80	100	125	160	200	250	320	400
500	5	6.4	8	10	12.5	16	20	25	32	40	50	64	80	100	125	160	200	250	320	400	500
640	6.4	8	10	12.5	16	20	25	32	40	50	64	80	100	125	160	200	250	320	400	500	
800	8	10	12.5	16	20	25	32	40	50	64	80	100	125	160	200	250	320	400	500		
1000	10	12.5	16	20	25	32	40	50	64	80	100	125	160	200	250	320	400	500			
1250	12.5	16	20	25	32	40	50	64	80	100	125	160	200	250	320	400	500				
1600	16	20	25	32	40	50	64	80	100	125	160	200	250	320	400	500					
2000	20	25	32	40	50	64	80	100	125	160	200	250	320	400	500						
2500	25	32	40	50	64	80	100	125	160	200	250	320	400	500							
3200	32	40	50	64	80	100	125	160	200	250	320	400	500								
4000	40	50	64	80	100	125	160	200	250	320	400	500									
5000	50	64	80	100	125	160	200	250	320	400	500										
6400	64	80	100	125	160	200	250	320	400	500											
8000	80	100	125	160	200	250	320	400	500												
10000	100	125	160	200	250	320	400	500													

Table 1 (Cont): mAs values vs. mA & time selected

kV/mA values are generator's output rating dependent.
mA/ms values are tube rating dependent.
For certain tubes, some mA/ms selections are not available at higher kV selections.

640mA is only available for output rating of x-ray generator from 52kW.
800mA is only available for output rating of x-ray generator from 68kW.
1000mA is only available for output rating of x-ray generator from 82kW.

GXR-U Series GENERATOR TECHNIQUE SELECTION

Time (ms)	mA Selected																	
	10	**12.5**	**16**	**20**	**25**	**32**	**40**	**50**	**64**	**80**	**100**	**125**	**160**	**200**	**250**	**320**	**400**	**500**
1.0											0.1	0.125	0.16	0.2	0.25	0.32	0.4	0.5
1.2										0.1	0.125	0.16	0.2	0.25	0.32	0.4	0.5	0.64
1.6									0.1	0.125	0.16	0.2	0.25	0.32	0.4	0.5	0.64	0.8
2								0.1	0.125	0.16	0.2	0.25	0.32	0.4	0.5	0.64	0.8	1.0
2.5							0.1	0.125	0.16	0.2	0.25	0.32	0.4	0.5	0.64	0.8	1.0	1.25
3.2						0.1	0.125	0.16	0.2	0.25	0.32	0.4	0.5	0.64	0.8	1.0	1.25	1.6
4					0.1	0.125	0.16	0.2	0.25	0.32	0.4	0.5	0.64	0.8	1.0	1.25	1.6	2.0
5				0.1	0.125	0.16	0.2	0.25	0.32	0.4	0.5	0.64	0.8	1.0	1.25	1.6	2.0	2.5
6.4			0.1	0.125	0.16	0.2	0.25	0.32	0.4	0.5	0.64	0.8	1.0	1.25	1.6	2.0	2.5	3.2
8		0.1	0.125	0.16	0.2	0.25	0.32	0.4	0.5	0.64	0.8	1.0	1.25	1.6	2.0	2.5	3.2	4.0
10	0.1	0.125	0.16	0.2	0.25	0.32	0.4	0.5	0.64	0.8	1.0	1.25	1.6	2.0	2.5	3.2	4.0	5.0
12.5	0.125	0.16	0.2	0.25	0.32	0.4	0.5	0.64	0.8	1.0	1.25	1.6	2.0	2.5	3.2	4.0	5.0	6.4
16	0.16	0.2	0.25	0.32	0.4	0.5	0.64	0.8	1.0	1.25	1.6	2.0	2.5	3.2	4.0	5.0	6.4	8
20	0.2	0.25	0.32	0.4	0.5	0.64	0.8	1.0	1.25	1.6	2.0	2.5	3.2	4.0	5.0	6.4	8	10
25	0.25	0.32	0.4	0.5	0.64	0.8	1.0	1.25	1.6	2.0	2.5	3.2	4.0	5.0	6.4	8	10	12.5
32	0.32	0.4	0.5	0.64	0.8	1.0	1.25	1.6	2.0	2.5	3.2	4.0	5.0	6.4	8	10	12.5	16
40	0.4	0.5	0.64	0.8	1.0	1.25	1.6	2.0	2.5	3.2	4.0	5.0	6.4	8	10	12.5	16	20
50	0.5	0.64	0.8	1.0	1.25	1.6	2.0	2.5	3.2	4.0	5.0	6.4	8	10	12.5	16	20	25
64	0.64	0.8	1.0	1.25	1.6	2.0	2.5	3.2	4.0	5.0	6.4	8	10	12.5	16	20	25	32
80	0.8	1.0	1.25	1.6	2.0	2.5	3.2	4.0	5.0	6.4	8	10	12.5	16	20	25	32	40
100	1.0	1.25	1.6	2.0	2.5	3.2	4.0	5.0	6.4	8	10	12.5	16	20	25	32	40	50
125	1.25	1.6	2.0	2.5	3.2	4.0	5.0	6.4	8	10	12.5	16	20	25	32	40	50	64
160	1.6	2.0	2.5	3.2	4.0	5.0	6.4	8	10	12.5	16	20	25	32	40	50	64	80
200	2.0	2.5	3.2	4.0	5.0	6.4	8	10	12.5	16	20	25	32	40	50	64	80	100
250	2.5	3.2	4.0	5.0	6.4	8	10	12.5	16	20	25	32	40	50	64	80	100	125
320	3.2	4.0	5.0	6.4	8	10	12.5	16	20	25	32	40	50	64	80	100	125	160

Table 2: mAs values vs. mA & time selected

Table 1 continued on next page

Time (ms)	mA Selected																	
	10	**12.5**	**16**	**20**	**25**	**32**	**40**	**50**	**64**	**80**	**100**	**125**	**160**	**200**	**250**	**320**	**400**	**500**
400	4	5	6.4	8	10	12.5	16	20	25	32	40	50	64	80	100	125	160	200
500	5	6.4	8	10	12.5	16	20	25	32	40	50	64	80	100	125	160	200	250
640	6.4	8	10	12.5	16	20	25	32	40	50	64	80	100	125	160	200	250	320
800	8	10	12.5	16	20	25	32	40	50	64	80	100	125	160	200	250	320	400
1000	10	12.5	16	20	25	32	40	50	64	80	100	125	160	200	250	320	400	500
1250	12.5	16	20	25	32	40	50	64	80	100	125	160	200	250	320	400	500	
1600	16	20	25	32	40	50	64	80	100	125	160	200	250	320	400	500		
2000	20	25	32	40	50	64	80	100	125	160	200	250	320	400	500			
2500	25	32	40	50	64	80	100	125	160	200	250	320	400	500				
3200	32	40	50	64	80	100	125	160	200	250	320	400	500					
4000	40	50	64	80	100	125	160	200	250	320	400	500						
5000	50	64	80	100	125	160	200	250	320	400	500							
6400	64	80	100	125	160	200	250	320	400	500								
8000	80	100	125	160	200	250	320	400	500									
10000	100	125	160	200	250	320	400	500										

Table 1 (Cont): mAs values vs. mA & time selected

kV/mA values are generator's output rating dependent.
mA/ms values are tube rating dependent.
For certain tubes, some mA/ms selections are not available at higher kV selections.

GXR-C Series GENERATOR TECHNIQUE SELECTION (Table 3)

GXR-C32 Maximum Exposure Table without mA sliding down

mA	kV	sec	mAs
10	40	10	100
	125		
	126	10	100
	150		
12.5	40	10	125
	125		
	126	10	125
	150		
16	40	10	160
	125		
	126	6.4	102.4
	150		
20	40	10	200
	100		
	101	8	160
	110		
	111	6.4	128
	125		
	126	5	100
	150		
25	40	10	250
	80		
	81	8	200
	90		
	91	6.4	160
	110		
	111	5	125
	125		
	126	4	100
	150		
32	40	10	320
	60		
	61	8	256
	70		
	71	6.4	204.8
	90		
	91	5	160
	100		
	101	4	128
	110		
	111	3.2	102.4
	125		
	126	2.5	80
	150		

mA	kV	sec	mAs
40	40	10	400
	50		
	51	6.4	256
	70		
	71	5	200
	80		
	81	4	160
	100		
	101	3.2	128
	110		
	111	2.5	100
	125		
	126	2	80
	150		
50	40	6.4	320
	50		
	51	5	250
	60		
	61	4	200
	80		
	81	3.2	160
	90		
	91	2.5	125
	110		
	111	2	100
	125		
	126	1.6	80
	150		
64	40	5	50
	50		
	51	4	40
	60		
	61	3.2	32
	70		
	71	2.5	25
	90		
	91	2	20
	110		
	111	1.6	16
	125		
	126	1.25	12.5
	150		

mA	kV	sec	mAs
80	40	3.2	256
	50		
	51	2.5	200
	70		
	71	2	160
	90		
	91	1.6	128
	100		
	111	1.25	100
	125		
	126	0.8	64
	150		
100	40	2	200
	60		
	61	1.6	160
	80		
	81	1.25	125
	100		
	101	1	100
	110		
	111	0.8	80
	125		
	126	0.64	64
	150		
125	40	2	250
	50		
	51	1.6	200
	60		
	61	1.25	156.25
	80		
	81	1	125
	100		
	101	0.8	100
	110		
	111	0.64	80
	125		
	126	0.5	62.5
	150		
160	40	1.25	200
	60		
	61	1	160
	70		
	71	0.8	128
	90		
	91	0.64	102.4
	110		
	111	0.5	80
	125		

mA	kV	sec	mAs
160	126	0.4	64
	150		
200	40	1	200
	50		
	51	0.8	160
	60		
	61	0.64	128
	90		
	91	0.5	100
	100		
	101	0.4	80
	125		
	126	0.32	64
	150		
250	40	0.8	200
	50		
	51	0.64	160
	60		
	61	0.5	125
	80		
	81	0.4	100
	100		
	101	0.32	80
	110		
	111	0.25	62.5
	125		
	126	0.25	62.5
	128		
320	40	0.5	160
	60		
	61	0.4	128
	70		
	71	0.32	102.4
	90		
	91	0.25	80
	100		
400	40	0.4	160
	50		
	51	0.32	128
	70		
	71	0.25	100
	80		

GXR-C40 Maximum Exposure Table without mA sliding down

mA	kV	sec	mAs
10	40	10	100
	125		
	126	10	100
	150		
12.5	40	10	125
	125		
	126	10	125
	150		
16	40	10	160
	125		
	126	8	128
	150		
20	40	10	200
	110		
	111	8	160
	125		
	126	5	100
	150		
25	40	10	250
	90		
	91	8	200
	100		
	101	6.4	160
	110		
	111	5	125
	125		
	126	4	100
	150		
32	40	10	320
	60		
	61	8	256
	80		
	81	6.4	204.8
	90		
	91	5	160
	100		
	101	4	128
	125		
	126	2.5	80
	150		

mA	kV	sec	mAs
40	40	10	400
	50		
	51	8	320
	60		
	61	6.4	256
	70		
	71	5	200
	90		
	91	4	160
	100		
	101	3.2	128
	110		
	111	2.5	100
	125		
	126	2	80
	150		
50	40	6.4	320
	50		
	51	5	250
	70		
	71	4	200
	80		
	81	3.2	160
	90		
	91	2.5	125
	110		
	111	2	100
	125		
	126	1.6	80
	150		
64	40	5	320
	50		
	51	4	256
	60		
	61	3.2	204.8
	70		
	71	2.5	160
	90		
	91	2	128
	110		
	111	1.6	102.4
	125		
	126	1.25	80
	150		

mA	kV	sec	mAs
80	40	3.2	256
	60		
	61	2.5	200
	70		
	71	2	160
	90		
	91	1.6	128
	110		
	111	1.25	100
	125		
	126	1	80
	150		
100	40	2.5	250
	50		
	51	2	200
	70		
	71	1.6	160
	80		
	81	1.25	125
	100		
	101	1	100
	110		
	111	0.8	80
	125		
	126	0.8	80
	150		
125	40	2	250
	50		
	51	1.6	200
	60		
	61	1.25	156.25
	80		
	81	1	125
	100		
	101	0.8	100
	110		
	111	0.64	80
	125		
	126	0.64	80
	150		
160	40	1.6	256
	50		
	51	1.25	200
	60		
	61	1	160
	80		
	81	0.8	128
	100		

mA	kV	sec	mAs
160	101	0.64	102.4
	110		
	111	0.5	80
	125		
	126	0.4	64
	150		
250	40	0.8	200
	50		
	51	0.64	160
	70		
	71	0.5	125
	80		
	81	0.4	100
	100		
	101	0.32	80
	125		
	126	0.25	62.5
	150		
320	40	0.64	204.8
	50		
	51	0.5	160
	60		
	61	0.4	128
	80		
	81	0.32	102.4
	100		
	101	0.25	80
	110		
	111	0.2	64
	125		
400	40	0.4	160
	50		
	51	0.32	128
	70		
	71	0.25	100
	90		
	91	0.2	80
	100		
500	50	0.25	100
	60		
	61	0.2	80
	80		

GXR-C52 Maximum Exposure Table without mA sliding down

mA	kV	sec	mAs
10	40	10	100
	125		
	126	10	100
	150		
12.5	40	10	125
	125		
	126	10	125
	150		
16	40	10	160
	125		
	126	8	128
	150		
20	40	10	200
	110		
	111	8	160
	125		
	126	5	100
	150		
25	40	10	250
	100		
	101	6.4	160
	125		
	126	4	100
	150		
32	40	10	320
	70		
	71	8	256
	80		
	81	6.4	204.8
	100		
	101	5	160
	110		
	111	4	128
	125		
	126	3.2	102.4
	150		

mA	kV	sec	mAs
40	40	10	400
	60		
	61	8	320
	70		
	71	6.4	256
	80		
	81	5	200
	100		
	101	4	160
	110		
	111	3.2	128
	125		
	126	2.5	100
	150		
50	40	6.4	320
	60		
	61	5	250
	80		
	81	4	200
	90		
	91	3.2	160
	110		
	111	2.5	125
	125		
	126	2	100
	150		
64	40	5	320
	60		
	61	4	256
	70		
	71	3.2	204.8
	90		
	91	2.5	160
	100		
	101	2	128
	125		
	126	1.25	80
	150		

mA	kV	sec	mAs
80	40	4	320
	50		
	51	3.2	256
	70		
	71	2.5	200
	80		
	81	2	160
	100		
	101	1.6	128
	125		
	126	1	80
	150		
100	40	3.2	320
	50		
	51	2.5	250
	70		
	71	2	200
	80		
	81	1.6	160
	100		
	101	1.25	125
	110		
100	40	3.2	320
	50		
	51	2.5	250
	70		
	71	2	200
	80		
	81	1.6	160
	100		
	101	1.25	125
	110		
	111	1	100
	125		
	126	0.8	80
	150		
80	40	4	320
	50		
	51	3.2	256
	70		
	71	2.5	200
	80		
	81	2	160
	100		
	101	1.6	128
	125		
	126	1	80
	150		

mA	kV	sec	mAs
100	40	3.2	320
	50		
	51	2.5	250
	70		
	71	2	200
	80		
	81	1.6	160
	100		
100	101	1.25	125
	110		
	111	1	100
	125		
	126	0.8	80
	150		
125	40	2.5	312.5
	50		
	51	2	250
	70		
	71	1.6	200
	80		
	81	1.25	156.25
	100		
	101	1	125
	110		
	111	0.8	100
	125		
	126	0.64	80
	150		
160	40	2	320
	50		
	51	1.6	256
	60		
	61	1.25	200
	80		
	81	1	160
	100		
	101	0.8	128
	110		
	111	0.64	102.4
	125		
	126	0.5	80
	150		

mA	kV	sec	mAs
200	40	1.25	250
	60		
	61	1	200
	70		
	71	0.8	160
	90		
	91	0.64	128
	110		
	111	0.5	100
	125		
	126	0.4	80
	150		
250	40	1	250
	50		
	51	0.8	200
	70		
	71	0.64	160
	90		
	91	0.5	125
	110		
	111	0.4	100
	125		
	126	0.25	62.5
	150		
320	40	0.8	256
	50		
	51	0.64	204.8
	60		
	61	0.5	160
	80		
	81	0.4	128
	100		
	101	0.32	102.4
	110		
	111	0.25	80
	125		
	126	0.2	64
	150		

mA	kV	sec	mAs
400	40	0.5	200
	60		
	61	0.4	160
	70		
	71	0.32	128
	90		
	91	0.25	100
	110		
	111	0.125	50
	125		
	126	0.08	32
	130		
500	50	0.32	160
	70		
	71	0.25	125
	80		
	81	0.2	100
	90		
	91	0.16	80
	100		
	101	0.125	62.5
	104		
640	50	0.25	160
	60		
	61	0.2	128
	70		
	71	0.16	102.4
	81		

(This page intentionally left blank)

APPENDIX B. EXPOSURE INDEX

The ***"GXR-SD/CSD/USD"*** flat-panel DR system calculates an exposure index (EI) for every image based on international standard IEC 62494-1 (Edition 1.0, 2008-08, Medical electrical equipment – Exposure index of digital X-ray imaging systems).

The EI is proportional to the detector Air Kerma, K , and is derived from a Value of Interest (VOI , pixel value) of the original image.

The scaling of EI is defined in a way of IEC 62494-1.

$$EI = 100 \times K$$

where K is the Air Kerma in μGy at the detector entrance.

The Air Kerma K is obtained from the VOI and the EI calibration factor CF of the detector, expressed in digital numbers per μGy :

$$K = VOI / CF$$

The sensitivity of the flat-panel detector after applying the standard detector-specific corrections is $CF = 126.7 \mu Gy^{-1}$, for a beam quality corresponding to RQA5 according to IEC 61267 (70 kV, 21 mm Al added filtration, HVL 6.8 mm Al).

The exposure index for ***"GXR-SD/CSD/USD"*** follow the IEC 62494-1 and have units of 100.

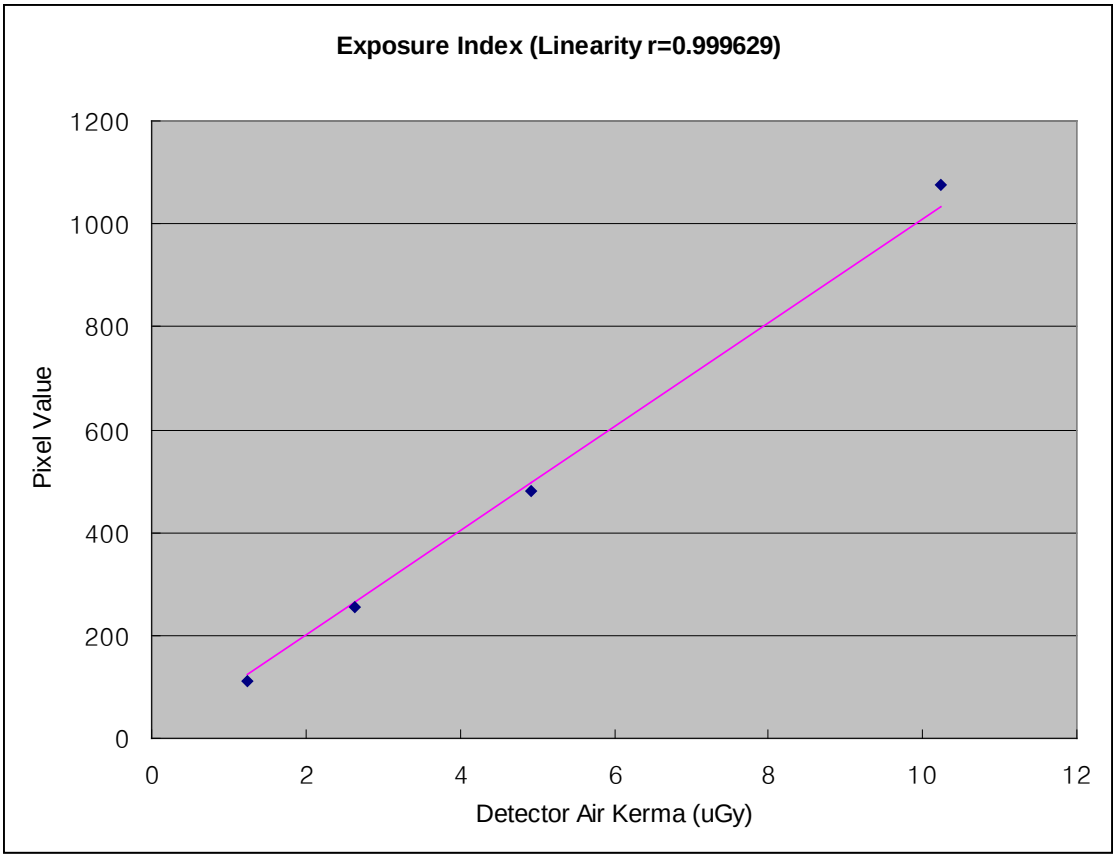
The EI numbers calculated are thus rounded to the values …,200,300,400,500,600,… (Refer to table below).

Calculated EI	EI Display
0~50	0
51~150	100
151~250	200
~	~
351~450	400
~	~
4951~5050	5000
5051~	OVER

Relationship between Detector Exposure (Air Kerma), VOI (Pixel Value), and Exposure Index (EI) for beam quality RQA5 in ***"GXR-SD/CSD/USD"*** flat-panel detector is like below.

Detector Air Kerma (uGy)	Pixel Value	EI
45	5700	4500
35	4435	3500
20	2534	2000
10	1267	1000
7	887	700
5	634	500
4	507	400
3	380	300
2	253	200
1	127	100

Linearity of the exposure index is shown below as a function of dose and its corresponding pixel value.



Determination of VOI

An x-ray image usually contains a wide range of pixel values. An important step in the calculation of the exposure index is to determine a value of interest VOI, i.e., a pixel value that corresponds to the average detector signal representing the target area of the examination.

This process usually comprises two steps:

• The determination of a subarea (ROI) of the full image, containing the target area;

• The determination of the pixel value in this ROI. This can be the average or the median pixel in this subarea; however other, more sophisticated algorithms involving the pixel histogram may also be used.

RADMAX software detects the exposed area and finds specific pixel values from the (cumulative) histogram.

Deviation Index

The look-up table (LUT, Target Exposure Index) will be applied dependent on the selected image type (examination/anatomy), so the Deviation Index (DI) depend on the type of examination, even for similar histograms.

$$DI = 10 \times \log_{10}(EI / \text{Target } EI)$$

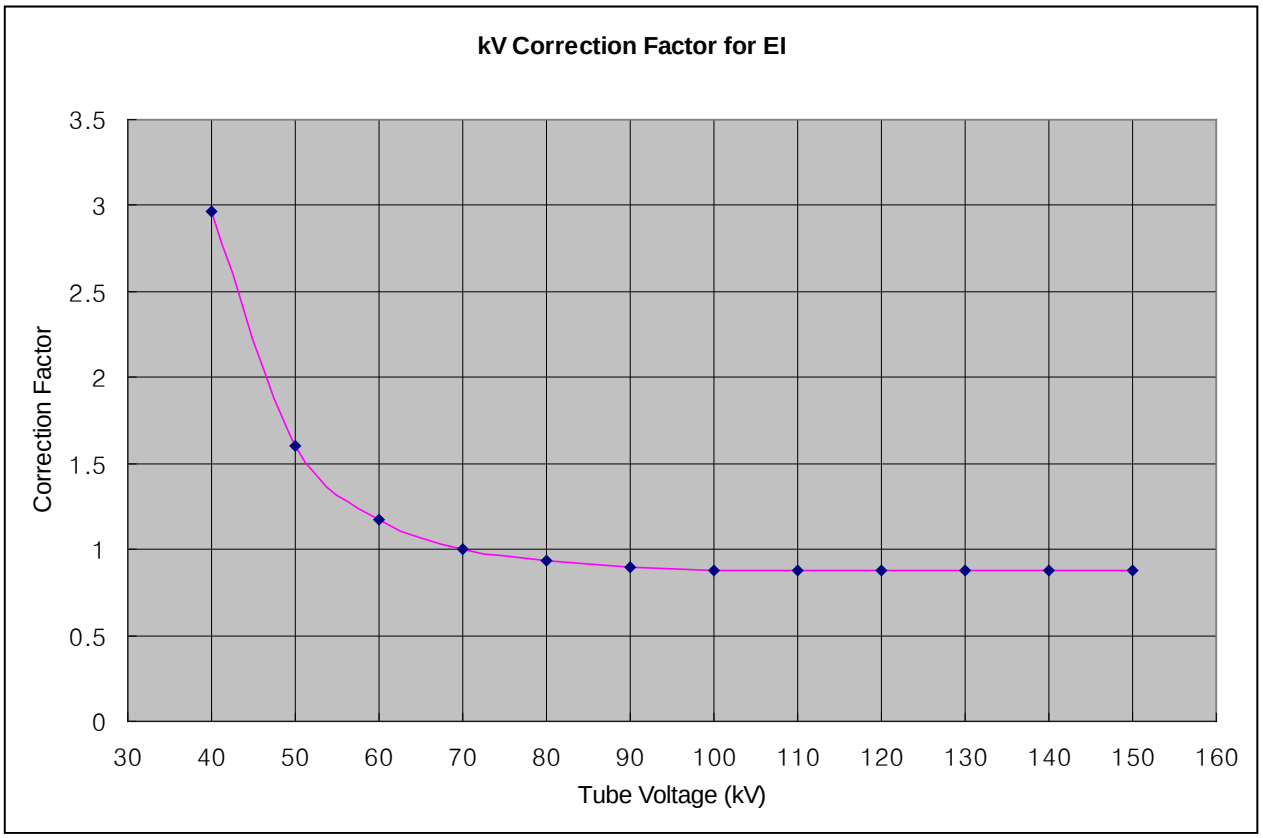
Variation of DI with +/-1 means +25%/-20% change of the EI from the $\text{Target } EI$.

kV Correction

As the EI calibration factor of the detector changes with x-ray photon energy, the relation between pixel value and incident Air Kerma is not fixed for different beam qualities. Consequently, a given EI will correspond to different exposure values (Air Kerma values) for different tube voltages.

This effect is most pronounced for low kVP, where the EI calibration factor (pixel value/μGy) may be only 30% of that at 70 kV. To mitigate this effect, a kV correction factor is applied in the EI calculation, which compensates for changes in the sensitivity for tube voltages.

Refer to graph below about kV correction factor for the EI of RADMAX software.



APPENDIX C. MATTERS REQUIRING ATTENTION FOR SAFETY

C1. APPLICABLE STANDARDS

The main components of ***"GXR-SD/CSD/USD"*** System comply with the regulatory requirements and design standards in this section as follows:

1) SAFETY

- EN60601-1:2006+A1:2013
  Medical electrical equipment -- Part 1: General requirements for basic safety and essential performance
  IEC60601-1:2005+A1:2012

- EN 60601-1-3:2008+A1:2013
  Medical electrical equipment -- Part 1-3: General requirements for basic safety and essential performance - Collateral Standard: Radiation protection in diagnostic X-ray equipment
  IEC 60601-1-3:2008+A1:2013

- EN60601-1-6:2010+A1:2015
  Medical electrical equipment -- Part 1-6: General requirements for basic safety and essential performance - Collateral standard: Usability
  IEC60601-1-6:2010+A1:2013

- EN60601-2-28:2010
  Medical electrical equipment -- Part 2-28: Particular requirements for the basic safety and essential performance of X-ray tube assemblies for medical diagnosis
  IEC60601-2-28:2010

- EN60601-2-54:2009+A1:2015
  Medical electrical equipment -- Part 2-54: Particular requirements for the basic safety and essential performance of X-ray equipment for radiography and radioscopy
  IEC60601-2-54:2009+A1:2015

2) EMC

- EN60601-1-2:2015
  Medical electrical equipment - Part 1-2: General requirements for safety - Collateral standard: Electromagnetic compatibility - Requirements and tests
  IEC 60601-1-2:2014
- EN 55011:2016
- CISPR11:2015
- EN61000-3-2:2014
- EN61000-3-3:2013
- EN61000-4-2:2009
- EN61000-4-3:2006+A1:2008+A2:2010
- EN61000-4-4:2012
- EN61000-4-5:2014
- EN61000-4-6:2014
- EN61000-4-8:2010
- EN61000-4-11:2004

3) CLINICAL EVALUATION

- MEDDEV 2.7/1 Rev.4
  EVALUATION OF CLINICAL DATA:
  A GUIDE FOR MANUFACTURERS AND NOTIFIED BODIES

4) OTHERS

- EN ISO 15223-1:2021
  Medical devices - Symbols to be used with medical device labels, labelling and information to be supplied - Part 1: General requirements
  ISO 15223-1:2021

- IEC TR60878:2015
  Graphical Symbols for electrical equipment in medical practice

- IEC60417:2002DB
  Graphical Symbols for use on equipment-part1: overview and application

- EN ISO14971:2019
  Medical devices - Application of risk management to medical devices
  ISO 14971:2019

- EN ISO13485:2016
  Medical devices - Quality management systems - Requirements for regulatory purposes
  ISO13485:2016

- Regulation (EU) 2017/745
  Medical Devices Regulation

- EN ISO 20417:2021
  Information supplied by the manufacturer with medical devices
  ISO 20417:2021

- EN 62304:2006+A1:2015
  Medical device software — Software lifecycle processes
  IEC 62304:2006+A1:2015

- EN 62366-1:2015+A1:2020
  Medical devices - Application of usability engineering to medical devices
  IEC 62366-1:2015+A1:2020

C2. RADIATION

Radiation Effects

Acute Effects: Short term effects
Very large radiation exposures can kill humans. The lethal dose (LD) for half the population (50%) within 60 days is termed the $LD_{50/60d}$. The $LD_{50/60d}$ in humans from acute, whole body radiation exposure is approximately 400 to 500 rads (4-5 Gy). The temperature elevation in tissue caused by the energy imparted is much less than 1° C. The severe biological response is due to ionizing nature of X-ray radiation, causing the removal of electrons, and thereby chemical changes in molecular structures.

Deterministic Radiation Effects

A number of ionizing radiation effects occur at high doses. These all seem to appear only above a **threshold** dose. While the threshold may vary from one person to another, these effects can be eliminated by keeping doses below 100 rad. The severity of these effects increases with increasing dose above the threshold. These

so-called deterministic (non-stochastic) effects are usually divided into tissue-specific local changes and whole body effects, which lead to acute radiation syndrome (Table below)

Acute Whole Body Radiation Effects

Table: Acute Radiation Syndrome Sorenson, 2000

Syndrome	Symptoms	Dose (rad)
Radiation sickness	Nausea, vomiting	> 100 rad
Hemopoietic	Significant disruption of ability to produce blood products)	> 250 rad
$LD_{50/60d}$	Death in half the population	> 250 - 450 rad
GI	Failure of GI tract lining, loss of fluids, infections	> 500 rad
CNS	Brain death	> 2,000 rad

These whole body (to entire body) doses are very unlikely for patients and staff from fluoroscopy or any diagnostic radiology study.
Several factors, such as total dose, dose rate, fractionation scheme, volume of irradiated tissue and radiation sensitivity all affect a given organ's response to radiation. Radiation is more effective at causing damage when the dose is higher and delivered over a short period of time. Fractionating the dose (i.e. spreading the dose out over time) reduces the total damage since it allows the body time for repair. Patient exposures are higher than attending staff but they occur over short periods of time whereas staff exposures are normally low and occur over several years.

***Deterministic effects*.**

These effects are observed after large absorbed doses of radiation and are mainly a consequence of radiation induced cellular death. They occur only if a large proportion of cells in an irradiated tissue have been killed by radiation, and the loss cannot be compensated by increased cellular proliferation. The ensuing tissue loss is further complicated by inflammatory 4processes and, if the damage is sufficiently extensive, also by secondary phenomena at the systemic level (e.g. fever, dehydration, bacteremia etc.). In addition, eventual effects of healing processes, e.g. fibrosis, may contribute to additional damage and loss of function of a tissue or an organ.
Clinical examples of such effects are: necrotic changes in skin, necrosis and fibrotic changes in internal organs, acute radiation sickness after whole body irradiation, cataract, and sterility (table below).
Doses required to produce deterministic changes are in most cases large (usually in excess of 1-2 Gy). Some of those occur in a small proportion of patients as side effects of radiotherapy. They can also be found after complex interventional investigations (such as vascular stenting) when long fluoroscopy times have been

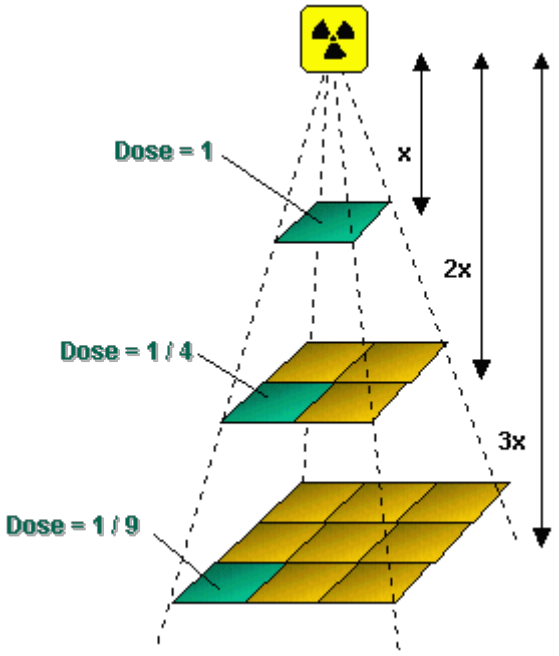
used.

Table: Deterministic effects after whole-body and localized irradiation by X and gamma rays; approximate absorbed threshold doses for single (short-term) and fractionated or low dose-rate (long-term) exposures [5, 6]

Organ/tissue	Effect	Threshold absorbed dose Gy	
		Short-term exposure (single doses)	Long-term exposure (Yearly - repeated for many years)
Testicles	Temporal sterility permanent sterility	0.15 3.5 - 6.0	0.4 2.0
Ovaries	Sterility	2.5 - 6.0	> 0.2
Ocular lens Detectable	opacities Visual impairment (cataract)	0.5 - 2.0 5.0	> 0.1 > 0.15
Bone marrow	Haemopoiesis impairment	0.5	> 0.4
Skin	1. Erythema (dry desquamation). 2. Moist desquamation. 3. Epidermal and deep skin necrosis 4. Skin atrophy with Complications and telangiectasia	2 18 25 10-12	- - - 1.0
Whole body	Acute radiation sickness (mild)	1.0	-

Inverse square law

A bundle of X-rays corresponds to the shape of a cone, with the tube at its tip. The intensity or dose of the radiation emitted from the source of the X-ray beam diminishes with the square of its distance from the source. If you double the distance x, the dose changes by a factor of $1/(2^2)$, and if you triple it, the dose changes by a factor of $1/(3^2)$.



Distance	Relative dose
50	4.00
60	2.78
70	2.04
80	1.56
90	1.23
100	1.00
110	0.83
120	0.69
130	0.59
140	0.51
150	0.44
160	0.39
170	0.35
180	0.31
190	0.28
200	0.25

Fig: Inverse square law

In general, the dose amounts to $1/x^2$. Therefore, if you double the film-to-target distance, you will need four times as much radiation to achieve the same image blackening. If you did not change the patient's position, this would lead to radiation stress in the patient; thus, increasing the distance between X-ray tube and patient helps to reduce the dose.

C3. ELECTROMAGNETIC COMPATIBILITY (EMC)

The ***"GXR-SD/CSD/USD"*** System complies with the requirements of IEC 60601-1-2:2014 regarding electromagnetic compatibility. Surrounding equipment shall follow the standard IEC 60601-1-2:2014.

CAUTION
Mobile telephones or other radiating equipment can interfere with the function of the ***"GXR-SD/CSD/USD"*** System and can therefore cause safety hazards.

Guidance and manufacturer´s declaration - electromagnetic emissions		
The ***"GXR-SD/CSD/USD"*** System is intended for use in the electromagnetic environment specified below. The customer or the user of the ***"GXR-SD/CSD/USD"*** System should assure that it is used in such an environment		
Emissions test	**Compliance**	**Electromagnetic environment - guidance**
RF emissions CISPR 11	Group 1	The ***"GXR-SD/CSD/USD"*** System uses RF energy only for its internal function. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment.
RF emissions CISPR 11	Class A	The ***"GXR-SD/CSD/USD"*** System is suitable for use in all establishments, other than domestic and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purpose. For information purpose the system complies with IEC61000-3-11 and is suitable for connection to public mains network if the impedance is 0,32 Ohm or lower
Harmonic emissions	Not applicable	
Voltage fluctuations/ Flicker emissions IEC 61000-3-3	Not applicable	

Guidance and manufacturer´s declaration - electromagnetic immunity

The ***"GXR-SD/CSD/USD"*** System is intended for use in the electromagnetic environment specified below. The customer or the user of the ***"GXR-SD/CSD/USD"*** System should assure that it is used in such an environment.

Immunity test	IEC 60601 test level	Compliance level	Electromagnetic environment - guidance
Electrostatic discharge (ESD) IEC 61000-4-2	± 2 kV, ± 4 kV, ± 6 kV, ± 8 kV contact ± 2 kV, ± 4 kV, ± 8 kV, ± 15 kV air	± 2 kV, ± 4 kV, ± 6 kV, ± 8 kV contact ± 2 kV, ± 4 kV, ± 8 kV, ± 15 kV air	Floors should be wood, concrete or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.
Electrical fast transient/burst IEC 61000-4-4	± 2 kV for power supply lines ± 1 kV for input/ output lines	± 2 kV for power supply lines n/a. for input/output lines	Mains power quality should be that of a typical commercial or hospital environment.
Surge IEC 61000-4-5	± 0.5 kV , ± 1 kV Line to Earth ± 0.5 kV, ± 1 kV, ± 2 kV Line to Line	± 0.5 kV , ± 1 kV Line to Earth ± 0.5 kV, ± 1 kV, ± 2 kV Line to Line	Mains power quality should be that of a typical commercial or hospital environment.
Voltage dips, short interruptions and voltage variations on power supply input lines. IEC 61000-4-11	<5 % U_T (>95 % dip in U_T) for 0, 5 cycle at 0, 45, 90, 135, 180, 225, 270, 315 deg. <5 % U_T (>95 % dip in U_T) for 1 cycle at 0 deg. 30 % U_T (70 % dip in U_T) for 25/30 cycles at 0 deg. <5 % U_T (>95 % dip in U_T) for 250(50Hz)/300(60Hz) cycles at 0 deg.	<5 % U_T (>95 % dip in U_T) for 0, 5 cycle at 0, 45, 90, 135, 180, 225, 270, 315 deg. <5 % U_T (>95 % dip in U_T) for 1 cycle at 0 deg. 30 % U_T (70 % dip in U_T) for 25/30 cycles at 0 deg. <5 % U_T (>95 % dip in U_T) for 250(50Hz)/300(60Hz) cycles at 0 deg.	Mains power quality should be that of a typical commercial or hospital environment. If the user of the DR- XD 200 requires continued operation during power mains interruptions, it is recommended that the ***"GXR-SD/CSD/USD"*** System be powered from an uninterruptible power supply or battery.

NOTE: U_T is the A.C. mains voltage prior to application of the test level.

Guidance and manufacturer´s declaration - electromagnetic immunity

The ***"GXR-SD/CSD/USD"*** System is intended for use in the electromagnetic environment specified below.

The customer or the user of the ***"GXR-SD/CSD/USD"*** System should assure that it is used in such an environment.

Immunity test	**IEC 60601 test level**	**Compliance level**	**Electromagnetic environment – guidance**
Power frequency (50/60 Hz) magnetic field IEC 61000-4-8	30 A/m	30 A/m	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.
Conducted RF IEC 61000-4-6	3 Vrms 150 kHz to 80 MHz	3 Vrms 150 kHz to 80 MHz	Portable and mobile RF communications equipment should be used no closer to any part of the ***"GXR-SD/CSD/USD"*** System, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter. Recommended separation distance $d = 1,2\sqrt{p}$ $d = 1,2\sqrt{p}$ 80 MHz to 800 MHz $d = 2,3\sqrt{p}$ 800 MHz to 2,5 GHz
Radiated RF IEC 61000-4-3	3 V/m 80 MHz to 2,5 GHz	3 V/m 80 MHz to 2,5 GHz	Where *p* is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and *d* is the recommended separation distance in meters (m). Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey, [a] should be range. [b] Interference may occur in the vicinity of equipment marked with the following symbol: 

NOTE 1: At 80 Mhz and 800 MHz, the higher frequency range applies.

NOTE 2: These guidelines may not apply in all situations. Electromagnetic propagation i affected by absorption and reflection from structures, objects and people.

[a] Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the ***"GXR-SD/CSD/USD"*** System is used exceeds the applicable RF compliance level above, the ***"GXR-SD/CSD/USD"*** System should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as reorienting or relocating the ***"GXR-SD/CSD/USD"*** System.

[b] Over the frequency range 150 kHz to 80 MHz, field strengths should be less than 10 V/m.

Recommended separation distances between portable and mobile RF communications equipment and *"GXR-SD/CSD/USD"* System

The ***"GXR-SD/CSD/USD"*** System is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of the ***"GXR-SD/CSD/USD"*** System can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the ***"GXR-SD/CSD/USD"*** System as recommended below, according to the maximum output power of the communications equipment.

Rated maximum output power of transmitter W	**Separation distance according to frequency of transmitter**		
	150 kHz to 80 MHz $d = 1,17\sqrt{p}$	80 MHz to 800 MHz $d = 0,35\sqrt{p}$	800 MHz to 2,5 GHz $d = 0,7\sqrt{p}$
0,01	0,12	0,04	0,07
0,1	0,37	0,11	0,22
1	1,17	0,35	0,7
10	3,69	1,11	2,21
100	11,67	3,5	7

For transmitters rated at a maximum output power not listed above, the recommended separation distance *d* in meters (m) can be estimated using the equation applicable to the frequency of the transmitter, where *p* is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer.

NOTE 1: At 80 MHz and 800 MHz, the separation distance for the higher frequency range applies.

NOTE 2: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

APPENDIX D. AUTO STITCH

TS-CSP, TS-CSA and TS-FM6 Motorized tube stand provides support for scoliosis and long bone imaging by a fully automatic stitching process. Both tilting method and translation method are supported. An image stitching tool is also provided enabling the user to make modifications for accurate scoliosis or long bone images.

Refer to the RADMAX Operation manual for instructions on how to use and details.

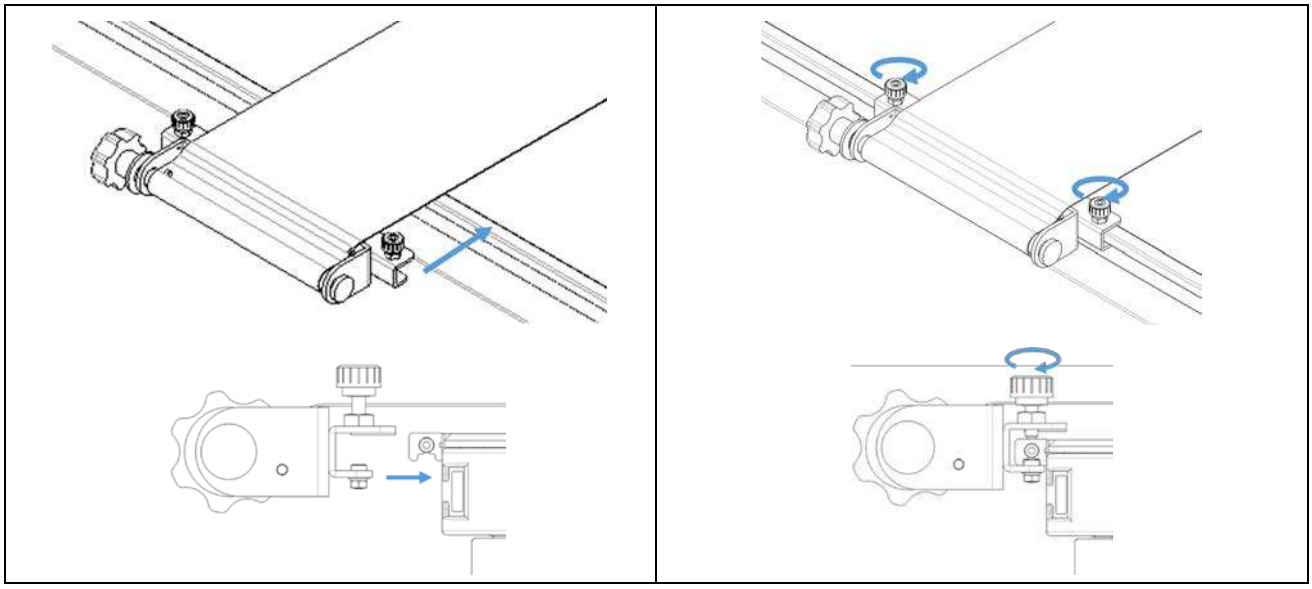
(This page intentionally left blank)

APPENDIX E. HOW TO USE OPTION & ACCESSORIES

E1. PATIENT COMPRESSION BELT

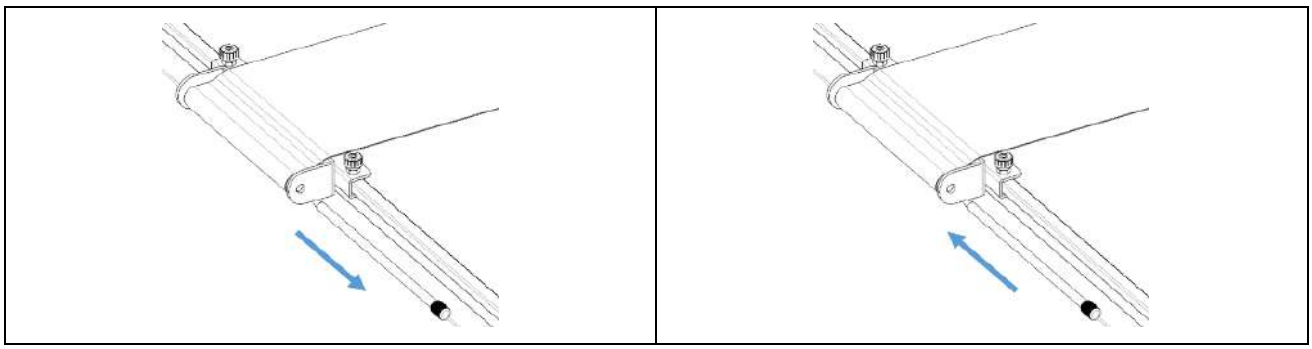
- Install

1. Place it on the guide rail on the side of the table.
2. Turn the lock knob clockwise to fix it.
3. Install the other side in the same way.

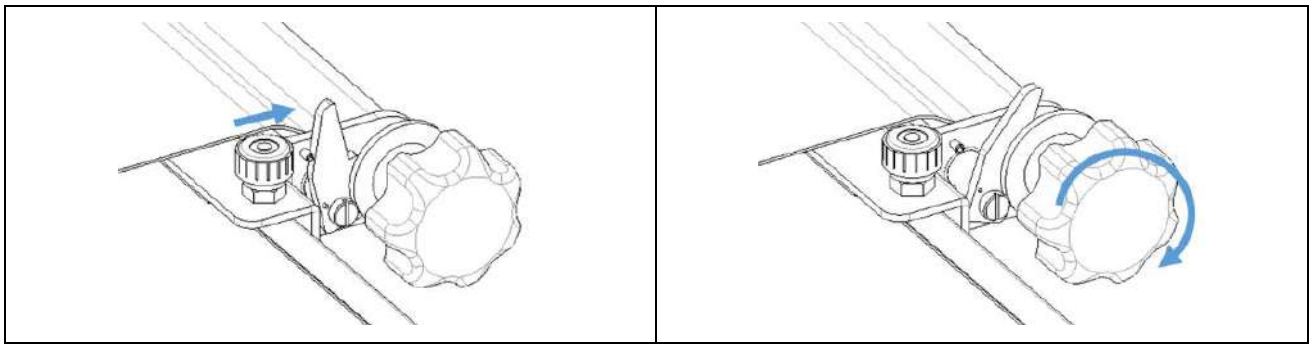


- HOW TO USE

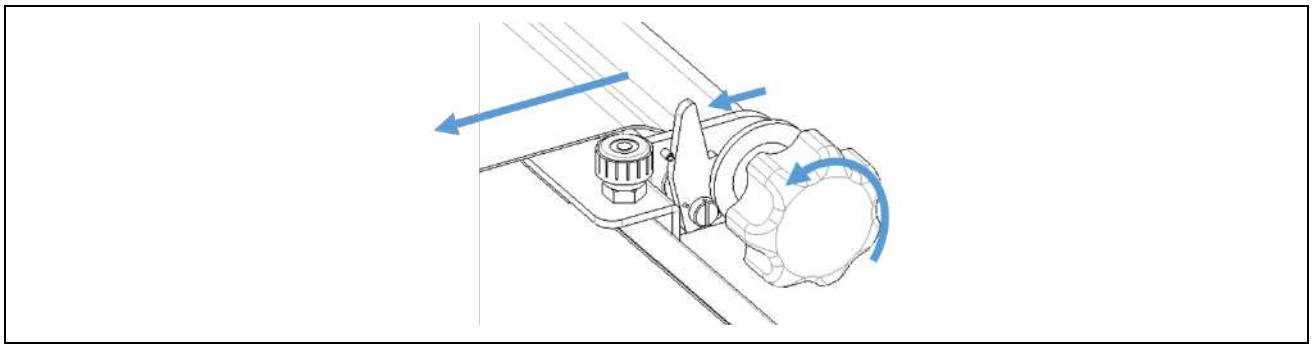
1. Remove the PRESURE CLOTH SUPPORTS PIN. Cover the patient's compression with the pressure cloth and reassemble the PRESSURE CLOTH SUPPORTS PIN.



2. Close the PRESSURE RETAINING CLIP in the handle direction and rotate the handle clockwise until the pressure belt is tight.



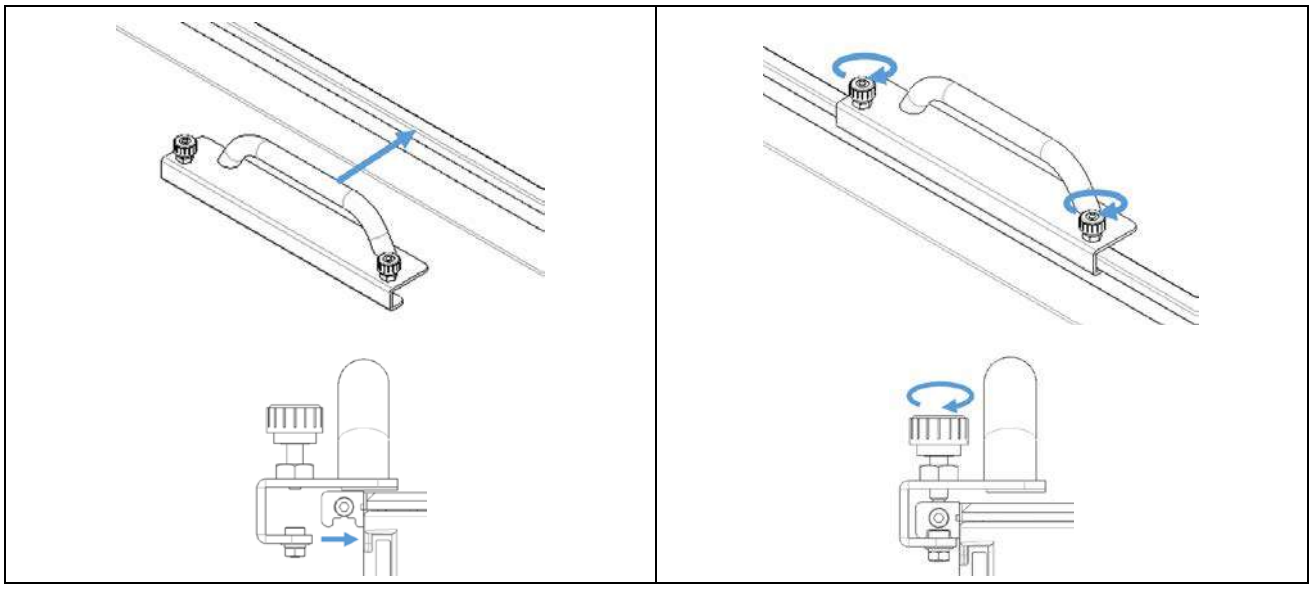
3. To loosen the pressure belt, release the Pressure Retaining clip and turn the handle counterclockwise.



E2. PATIENT HAND GRIP (TABLE TOP)

- Install

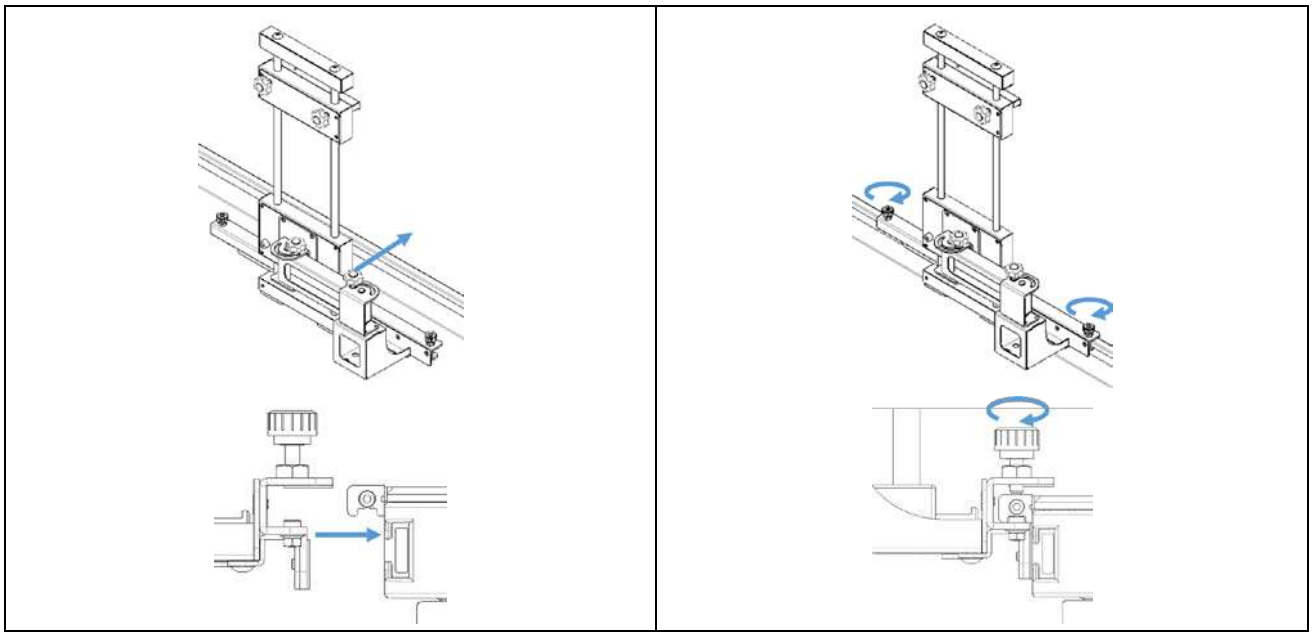
Install it by referring to the ‘Install’ of E1 in Appendix E.



E3. LATERAL CASSETTE HOLDERS

- Install

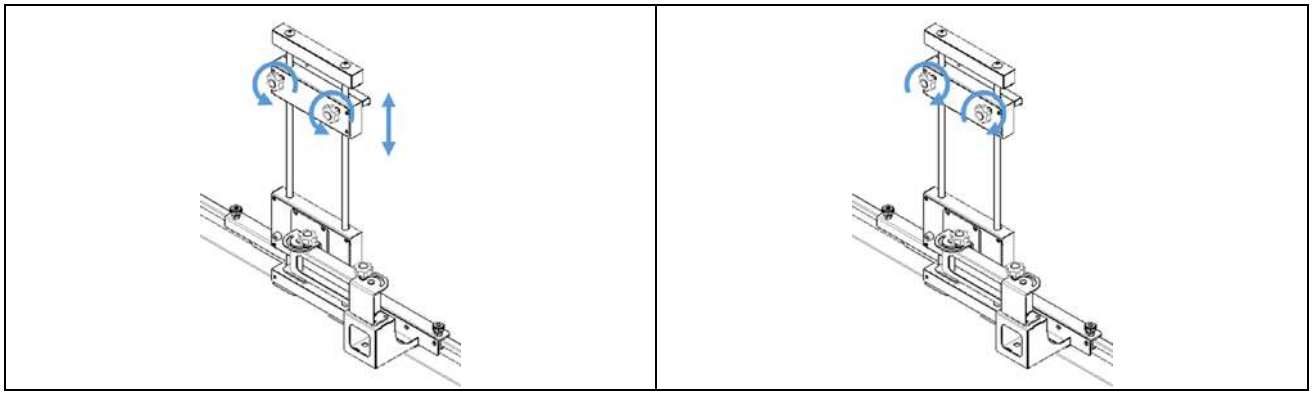
Install it by referring to the ‘Install’ of E1 in Appendix E.



- HOW TO USE

1. Rotate the chest holder knob counterclockwise and move it up and down to fit the detector or image receptor.

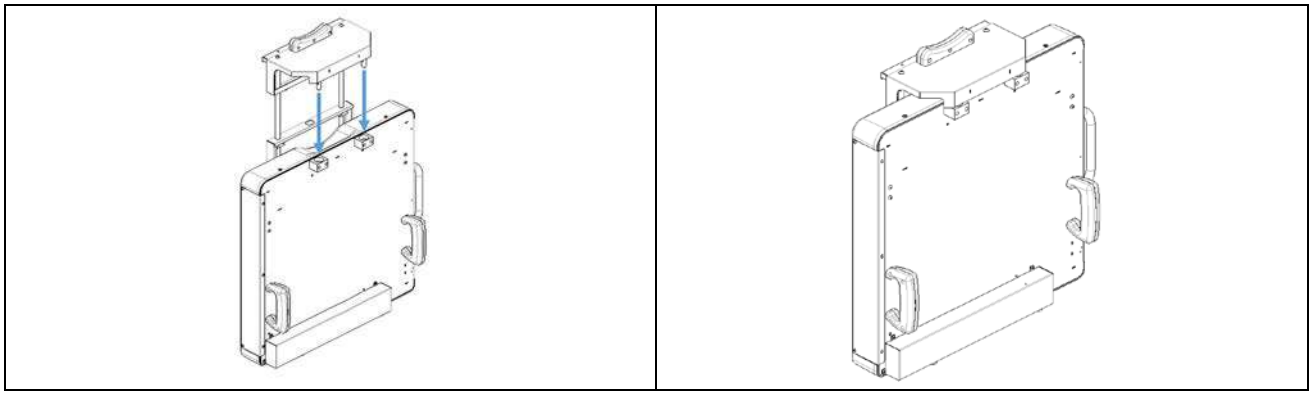
2. Fix the chest holder by rotating the chest holder knob clockwise.



E4. EXTERNAL WALL BUCKY CASSETTE HOLDERS

- Install

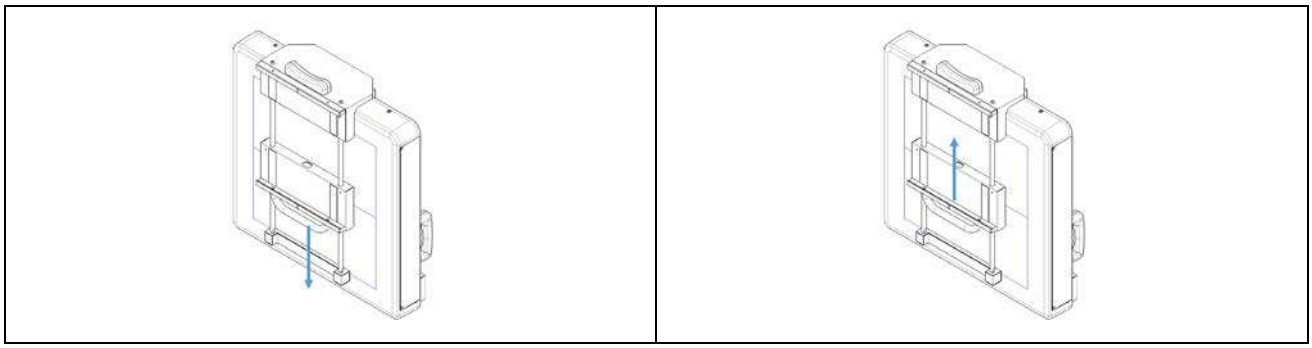
1. Attach the EXTERNAL WALL BUCKY CASSETTE HOLDERS to the bracket hole on the back of the wall bucky.



- HOW TO USE

1. Hold the handle of the chest holder and pull it down to mount the detector or image receptor.

2. Slowly move the handle up to fix the detector or image receptor.



(This page intentionally left blank)

DRGEM Corporation
7Fl, E-B/D Gwangmyeong Techno-Park, 60 Haan-ro,
Gwangmyeong-si, Gyeonggi-do, 14322, Korea
TEL: +82-2-869-8566, FAX: +82-2-869-8567, E-MAIL: drgem@drgem.co.kr