Anexa 3

Unitate de radiografie, mobila (varianta cu masa redusa)

Descriere	Sistem radiografic digital pe consola mobila, destinat pentru investigatii traumatologice , usor transportabil cu masa redusa sub 100kg)			
Parametru	Specificatie	Parametrul solicitat	Parametrul oferit	Referinta manual tehnic /brosura
Dimensiuni	Greutatea maxima acceptata	</= 100 kg	86	OM-0463R3_EN_PRX (220930), 9.3 **DIMENSIONS**, OM-0463R3 pag 127
	Roti	Roți moi, potrivite pentru toate tipurile de teren, oferind conducere agilă atât pe suprafețe netede, cât și pe suprafețe denivelate.	da	OM-0463R3_EN_PRX (220930), 3.9.1.6 **WHEELS**, OM-0463R3 pag 76
	Inaltime maxima (in pozitia verticala de stationare/ deplasare)	145 cm	140.8	OM-0463R3_EN_PRX (220930), **Dimensions** (**Aluminium Column, Standard Wheels**), OM-0463R3 pag 128
	Latime maxima	70 cm	66.9	
Putere generator		>/=4 kW	4 kw	OM-0463R3_EN_PRX (220930), SECTION 9 **TECHNICAL SPECIFICATIONS**, OM-0463R3 pag 123--124
Caracteristici tehnice Tub Raze X	Capacitatea termica HU	minim 40000HU	47215 HU	
	kVp Diapazon	40-125	da	
	mA Diapazon	5-100, in 14 steps	da	
	mAs Diapazon	0,1-250 , in 34 steps	da	
	Pata focala, mm	0,6(±0,1) -1,5(±0,3)mm	0.5 mm - 1.8 mm	
	Timp de expunere	0,001-10 sec , in 41 steps	da	
SID Diapazon, cm		min 180 cm	180	OM-0463R3_EN_PRX (220930), **Table 3-2 Image Size according to the SID and Collimator Opening**, OM-0463R3 pag 67
Caracteristici tehnice Detector Digital	Tip	detector plat	da, iMars 1417x	Q-22865_ProductData_flex_dr, pagina 6
	Rezolutie matrice	minim 2466x3040 mm	3500x4300	
	Pixel	maxim 140 um	100	
	Gradatie	minim 14 biti	16	
	Dimensiune aria activa, cm	minim 35x43	35x43	
	Timp pana la aparitia imaginii	maxim 5 sec	3	
	Tip conectare la unitate	WiFi	da	
	Baterie reincarcabila	da	da	

	Compartiment special dedicat pastrarii in siguranta a detectoului	da	da	OM-0463R3_EN_PRX (220930), 3.4 **DETECTOR BASKET**, OM-0463R3 pag 57--59
	Incarcator baterie	da	da	
DAP-metru		da	da	OM-0463R3_EN_PRX (220930), 3.7.1 **SID GUARD, ALUMINIUM FILTERS AND DOSIMETER**, OM-0463R3 pag 67
Compartiment integrat de depozitare pentru a pastra detectorul şi a-l proteja împotriva şocurilor		da, cu sistem de inchidere	da	OM-0463R3_EN_PRX (220930), 3.4 **DETECTOR BASKET**, OM-0463R3 pag 57--59
Centrare pacient /Lumina colimator		da, LED	da	OM-0463R3_EN_PRX (220930) 9.4 **COLLIMATOR R 72S**, OM-0463R3 131
Loc de lucru integrat in consola mobila cu software dedicat pentru aplicatiile de diagnostic X-ray	Calculator cu accesorii, display touchscreen si software integrat dedicat pentru achizitie si prelucrare/stocare a imaginilor x-ray , interfata de control generator.	da	da	**PC Raybow flex Flex**
	CPU	min 4 nuclee (sau echivalent)	i5	
	Sistem de operare	Windows (sau echivalent)	Windows 10	
	Memorie operativa RAM, GB	minim 4 GB	8 gb	
	Memorie SSD/HDD, GB	minim 500 GB	500 GB	
	Dimensiune display	min 17 inch	17 inch	
	Rezolutie display	minim 1280x1024	1280x1024	
	Baza de date pacienti,posibilitatea de vizualizare si redactare a imaginilor captate de pe detector	da	da	Q-22865_ProductData_flex_dr pagina 7--13
	Managementul dozei acumulate de pacient (legatura cu DAP-metru)	da	da	
	Posibilitatea de conectare printer (DICOM print)	da	da	
	WiFi	da	da	
	Conexiuni disponibile	LAN, HDMI, USB	da	
	Compatibilitate totale cu standartul DICOM 3.0	da	da	

Alimentare electrica		220V, 50 Hz	da	OM-0463R3_EN_PRX (220930), SECTION 9 **TECHNICAL SPECIFICATIONS**, OM-0463R3 pag 124
Instalare/service	Instalare inclusiv raport de evaluare a calitatii(Controlul calitatii sau raport de testare de la producator)	da	da	Declaratie
	Existenta centru de service in RM cu ingineri locali instruiti si autorizati de producatorul dispozitivului care va fi livrat.	da	da	Declaratie
	Posibilitatea de service post garantie (contra cost) pe un termen de minim	7 ani	da	Declaratie
	Termenul de garantie pentru dispozitivul livrat se va calcula din momentul darii in exploatare si inceperii utilizarii si va constitui	minim 12 luni	da	Declaratie
Alte conditii	Certificate CE,ISO	da	da	
	Manual de service in limba engleza	da	da	
	Manual de utilizare in limba engleza/romana	da	da	
	Training utilizatori timp de 2 zile ,la locatia beneficiarului.	da	da	

Digitally signed by Savca Octavian
Date: 2023.11.24 12:32:33 EET
Reason: MoldSign Signature
Location: Moldova

DECLARAȚIE PE PROPRIA RASPUNDERE

Data: 24.11.2023

Către: ***CENTRUL PENTRU ACHIZITII PUBLICE CENTRALIZATE IN SANATATE***

Numărul procedurii de achiziție: ocds-b3wdp1-MD-1695389614853 din 24.11.2023

Vipromed Service SRL declară prin prezenta urmatoarele:

- Asigurarea instalararii inclusiv raport de evaluare a calitatii (Controlul calitatii sau raport de testare de la producator)
- Existenta centru de service in RM cu ingineri locali instruiti si autorizati de producatorul dispozitivului care va fi livrat
- Asigurare service post garantie (contra cost) pe un termen de minim 7 ani
- Termenul de garantie pentru dispozitivul livrat se va calcula din momentul darii in exploatare si inceperii utilizarii si va constitui minim 12 luni, conform cerintelor.

Semnatura: ______________________________
Nume:
Funcţia în cadrul firmei: Director
Denumirea firmei: Vipromed Service SRL

Digitally signed by Savca Octavian
Date: 2023.11.24 12:38:02 EET
Reason: MoldSign Signature
Location: Moldova

Technical Publication
OM-0463R3_EN_PRX

Operation

Portable X-Ray Units
with Digital Detectors

CE 1639

This product bears a CE marking in accordance with the provisions of the 93/42/EEC MDD dated June 14, 1993, as amended by 2007/47/EEC dated September 5, 2007.

Este producto ostenta una marca CE de acuerdo con las disposiciones de la Directiva 93/42/CEE del 14 de junio de 1993 sobre Productos Sanitarios, modificada por la directiva 2007/47/CEE del 5 de septiembre de 2007.

Ce produit porte la marque CE de conformité aux réglements de la Directive 93/42/CEE du 14 juin 1993 relative aux Dispositifs Médicaux, modifiée par la directive 2007/47/CEE du 5 septembre 2007.

Questo prodotto presenta un marchio CE in ottemperanza a quanto disposto nel 93/42/EEC MDD del 14 giugno 1993, rettificato da 2007/47/CEE il 5 settembre 2007.

This manual covers the following equipments / Este manual cubre los siguientes equipos **Ce manuel couvre les équipements suivants / Il presente manuale descrive i seguenti dispositivi**
Portable X-Ray Unit RAYBOW FLEX: **PMLW4** **PMLW8**

RADIOLOGÍA
Pelaya, 13. Polígono Industrial "Río de Janeiro"
28110 Algete, Madrid - España (Spain)
Phone: +34 902 195 770
Fax: +34 902 103 367 www.radiologia-sa.com

Manufactured by RADIOLOGÍA for PRIMAX INTERNATIONAL srl
Via Alessandro Volta 10
24060 Torre de' Roveri (BG) - Italia (Italy)

REVISION HISTORY

REVISION	DATE	REASON FOR CHANGE
0	APR 24 2020	First Edition
1	FEB 18 2021	Sec. 4 Image Acquisition Control Console
2	APR 22 2021	Technical specificatons for 5 kW model and Detector basket update
3	SEP 07 2022	New options added and general update

This Document is the English original version, edited and supplied by the manufacturer.

The Revision state of this Document is indicated in the code number shown at the bottom of this page.

ADVISORY SYMBOLS

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

DANGERS ADVISE OF CONDITIONS OR SITUATIONS THAT IF NOT HEEDED OR AVOIDED WILL CAUSE SERIOUS PERSONAL INJURY OR DEATH.

ADVISE OF CONDITIONS OR SITUATIONS THAT IF NOT HEEDED OR AVOIDED COULD CAUSE SERIOUS PERSONAL INJURY, OR CATASTROPHIC DAMAGE OF EQUIPMENT OR DATA.

Advise of conditions or situations that if not heeded or avoided could cause personal injury or damage to equipment or data.

Note ☞

Alert readers to pertinent facts and conditions. Notes represent information that is important to know but which do not necessarily relate to possible injury or damage to equipment.

IMPORTANT NOTES

AUTOMATIC LINE POWER DETECTION SYSTEM

By means of this System, the Unit detects the maximum operative Power Line adapting the Exposure Parameters to the Power available and avoiding undesired line breakdowns when operating with poor electricity lines. Refer to Section 6.2 for Automatic Line Power Detection Procedure and Section 6.4 if Manual Power Reduction is required.

COLLIMATOR LIGHT THERMAL PROTECTION

Collimator Light is provided with a Thermal Protection that may reduce the lighting time of the Light and even turn the light Off in case it is On for an excessive period of time. Refer to the Service Manual to configure the time that the Collimator Light is light On.

X-RAY TUBE SEASONING AND X-RAY TUBE WARMING-UP

*The **Seasoning** and **Warning-up** procedures assure a correct operation of the X-Ray Tube and must be properly carried out. Otherwise the X-Ray Tube life may be considerably reduced or the X-Ray tube will suffer a permanent damage.*

*The **Seasoning** Procedure (Running) must be performed when the Tube is used for the first time or when it has not been in use for more than one month. This action establishes a favorable distribution of the electrical charges and electrostatic stresses in the insulation system of the Tube and the associated equipment. Not performing the Seasoning Procedure causes loss of the X-Ray Tube Warranty.*

*The **Warming-up** Procedure must be performed at the start of each day or when the unit has been off for more than four hours.*

SEASONING PROCEDURE (RUNNING) *(after one month)*

1. Close Collimator Blades fully and make sure that no one will be exposed.
2. Make sure that X-Ray Tube is fully cold (at least 30 minutes without making exposures).
3. Reduce the power manually to 20% in case of 4 kW or 5 kW units or 10% in case of 8 kW units. On the X-Ray Unit Control Panel, press and hold the “Large Focal Spot” push-button and then press the “kVp Decrease” push-button several times until “P10 or P20” respectively is shown in the kVp display.
4. Select 70 kVp, 10 mAs and Large Focus. Perform one exposure per minute increasing 5 kVp in every exposure up to the maximum Tube voltage.
5. If there are not signs of instability, the tube is ready for normal use.
6. If instability is observed during procedure, reduce 5 kVp of the selected kVp and make two exposures at those KVp, then continue the process.
7. Once the seasoning procedure is completed, set the power at 100% again. On the X-Ray Unit Control Panel, press and hold the “Large Focal Spot” push-button and then press the “kVp Increase” push-button several times until “P– –” is shown in the kVp display.

Note: Check that the Heat Units capacity is above 80% during this process.

WARMING-UP PROCEDURE *(every day)*

1. Close Collimator Blades fully and make sure that no one will be exposed.
2. For 4kW and 8 kW X-Ray Units, select 60 kVp, 40 mAs and Large Focus.
   For 5 kW X-Ray Units, select 70 kVp, 64 mAs and Large Focus.
3. Perform one exposure.
4. Now the Tube is ready for normal use.

TABLE OF CONTENTS

Section **Page**

SECTION 1 INTRODUCTION

This manual contains all the necessary information to understand and operate this **Portable X-Ray Unit with Detector**. It provides a general description, safety and regulatory information, operating instructions and specifications concerning the equipment. It is not intended to teach radiology or to make any type of clinical diagnosis.

This **Portable X-Ray Unit with Detector** operates from single phase power supplies and provides all the advantages of constant potential waveform including lower patient dose and shorter exposure times as well as greater accuracy and consistency.

The Unit is controlled by microprocessors, providing increased exposure consistency, efficient operation and extended Tube life. A high level of self-diagnostics greatly increases serviceability and reduces down time.

All functions, displays and controls are logically arranged, easily accessible and identified to prevent confusion. Radiographic technique factors and functions are selected by touch sensitive buttons and displayed on the Touch Screen Console and Control Panel of the X-Ray Unit.

Illustration 1-1
Portable X-Ray Unit with Detector

1.1 GENERAL FEATURES

This **Portable X-Ray Unit with Detector** consists of:

X-RAY GENERATOR COMPONENTS

- *X-Ray Unit* that comprises:
  - *Power Module* containing control and power components.
  - *High Voltage Transformer.*
  - *Filament Transformer.*
  - *X-Ray Tube.*
  - *Control Panel* for operation and service tasks.
- *Collimator Model* RS72S compatible with the X-Ray source. The Collimator includes controls to limit the X-Ray beam.
- *SID Guard.*
- *Handswitch.*

ACCESSORIES AND SUBASSEMBLIES

Accessories and subassemblies are considered to be the elements that compose the unit.

These components comply with the corresponding safety requirements.

- *Touch Screen Console with embedded PC* or Laptop for radiographic operations.
- *Digital Detector.*
- *Portable Unit* with an *Articulated Arm and* a *Detector Basket.*

The main features of this Portable X-Ray Unit are:

- Safe and easy operation.
- Constant potential high frequency operating on single phase lines.
- Radiographic operation from the Personal Computer Controls or from the X-Ray Unit Control Panel.
- Anatomical Programmer (APR) through *Primo S* Software Application.
- Tube protection circuitry prolongs Tube life and increases system performance.
- Filament Power Down Mode to increase the Tube Filament life.
- Equipped with closed loop control of X-Ray Tube current, kVp and filaments, which minimize potential errors and the need for readjustments.
- Standard electric outlet operation from 100 to 240 V~ for Portable Units of 4 kW, and from 220 to 240 V~ for Portable Units of 5 kW and 8 kW.
- Hibernation mode (only for units with embedded touchscreen computer): allows carrying the Unit between short distances with a later quick powering on.
- Automatic line voltage compensation due to closed loop operation of X-Ray Tube current and kVp.
- Remaining percentage of the Thermal Capacity of the X-Ray Tube and Generator.
- Ready for Cassette Film / CR (Maximum size 430 x 430 mm).

1.1.1 OPTIONS AND ACCESSORIES

In addition to the above mentioned features, this Portable Unit also includes the following options and accessories:

OPTIONS:

- *Collimator with Laser positioner.*
- *Inclinometers.*
- *DVD-RW.*
- *X-Ray Unit Quick Disconnect.*
- *Folding Column for Transport.*
- *Y-Shaped Folding Leg.*
- *All-Terrain Wheels.*
- *Lateral Movement Mechanism.*
- *Wheels for Motion with folded Leg.*
- *Digital Detectors*.

ACCESSORIES:

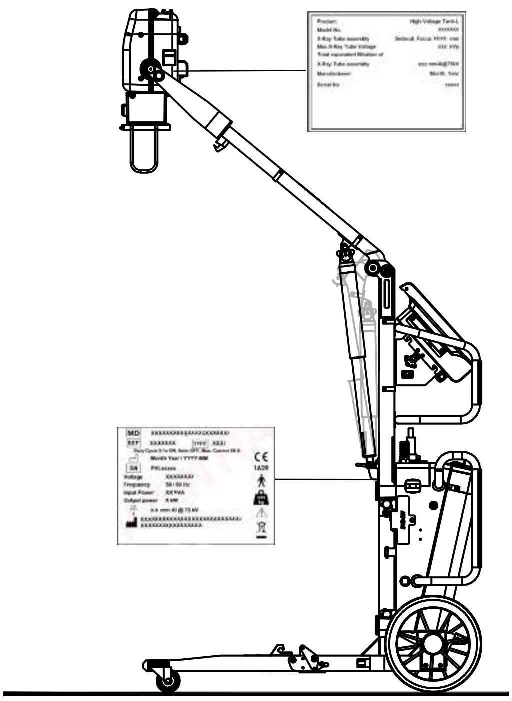
- *Aluminium Filters.*
- *Dosimeter.*
- *Dosimetry Printer.*
- *Removable Protective Frames and Grids.*
- *Transport Boxes.*

Note ☞ *For detailed information on the Options and Accessories of the X-Ray unit, refer to Section 3.9.*

1.2 PRODUCT IDENTIFICATION

Identification labels of the Portable X-Ray Units provide information on:

- Product.
- Model.
- Volts (V), Line Phases, Frequency (Hz), and Power (kVA, kW).
- Date of manufacture.
- Serial number.
- Reference.
- Manufacturer.
- Manufacturing location.
- Certifications.
- Total Filtration.
- Nominal X-Ray Tube Voltage of the X-Ray Source.
- Manufacturer and Focus Size of the X-Ray Tube.



1.3 INDICATIONS FOR USE

1.3.1 INTENDED USE

This equipment is intended for use by qualified personnel only, as radiology technicians and doctors who have licenses in the radiology field.

The **Portable X-Ray Units with Detector** is an equipment designed for general radiography in hospitals, clinics, radiology imaging centers and medical practices. It is suitable for taking diagnostic radiographic exposures of the skull, spinal column, chest, abdomen, extremities, and other body parts in intensive care units, emergency rooms, radiology departments and physicians' offices. Not for mammography.

Applications can be performed with the patient sitting, standing, or lying in the prone or supine position. Examinations can be performed to any kind of patient group. Patients may be physically abled, disabled, immobilized or in a state of shock.

This **Portable X-Ray Units with Detector** contributes to the metrics of imaging performance ensuring the efficient use of radiation. It is designed for multiple uses/cases per day.

The X-Ray image receptors used in this Unit are Digital Detectors.

1.3.2 NORMAL USE

The Normal Use of this equipment is defined as the Intended Use plus the Maintenance and Service tasks.

1.3.3 CONTRAINDICATIONS

Do not use the equipment for any purposes other than those for which it is intended. Operation of the equipment for unintended purposes could lead to fatal or other serious injury.

This equipment is not intended for mammographic applications.

If children are to be examined, they should always be accompanied by an adult.

SECTION 2 SAFETY AND REGULATORY INFORMATION

This section describes the safety considerations, general precautions for patient, operator and equipment in order to perform a safe operation and service tasks.

Regulatory information and symbols used in the equipment are detailed in this section to operate it safely.

2.1 GENERAL

WARNING

FOR CONTINUE SAFE USE OF THIS EQUIPMENT FOLLOW THE INSTRUCTIONS IN THIS OPERATING MANUAL. BOTH OPERATOR AND SERVICE PERSONNEL HAVE TO STUDY THIS MANUAL CAREFULLY, INSTRUCTIONS HEREIN SHOULD BE THOROUGHLY READ AND UNDERSTOOD BEFORE ATTEMPTING TO PLACE THE EQUIPMENT IN OPERATION, ESPECIALLY THE INSTRUCTIONS CONCERNING SAFETY, REGULATIONS, DOSAGE AND RADIATION PROTECTION. KEEP THIS OPERATING MANUAL WITH THE EQUIPMENT AT ALL TIMES AND PERIODICALLY REVIEW THE OPERATING AND SAFETY INSTRUCTIONS.

TECHNICAL INSTRUCTIONS FOR SERVICE PERSONNEL SUCH AS INSTALLATION, CALIBRATION OR MAINTENANCE ARE DESCRIBED IN THE RESPECTIVE CHAPTERS OF THE SERVICE MANUAL PROVIDED WITH THIS EQUIPMENT.

PLEASE STUDY THIS MANUAL AND THE MANUALS FOR EACH SYSTEM COMPONENT TO BE FULLY AWARE OF ALL THE SAFETY AND OPERATIONAL REQUIREMENTS.

WARNING

OPERATOR AND SERVICE PERSONNEL AUTHORIZED TO USE, INSTALL, CALIBRATE AND MAINTAIN THIS EQUIPMENT MUST BE AWARE OF THE DANGER OF EXCESSIVE EXPOSURE TO X-RAY RADIATION. IT IS VITALLY IMPORTANT THAT EVERYONE WORKING WITH X-RAY RADIATION IS PROPERLY TRAINED, INFORMED ON THE HAZARDS OF RADIATION AND TAKE ADEQUATE STEPS TO ENSURE PROTECTION AGAINST INJURY.

WARNING

OPERATOR MUST HAVE SUFFICIENT KNOWLEDGE TO COMPETENTLY PERFORM THE DIFFERENT DIAGNOSTIC IMAGING PROCEDURES WITH X-RAY DEVICES. THIS KNOWLEDGE IS ACQUIRED THROUGH A VARIETY OF EDUCATIONAL METHODS INCLUDING CLINICAL WORKING EXPERIENCE, AND AS PART OF MANY COLLEGE AND UNIVERSITY RADIOLOGIC TECHNOLOGY PROGRAMS IN ACCORDANCE WITH LOCAL LAWS OR REGULATIONS.

WARNING

SERVICE PERSONNEL MUST HAVE SUFFICIENT KNOWLEDGE TO COMPETENTLY PERFORM THE SERVICE TASKS RELATED TO X-RAY DEVICES AND PARTICULARLY TO THE EQUIPMENT DESCRIBED IN THIS MANUAL. THIS KNOWLEDGE IS ACQUIRED THROUGH A VARIETY OF EDUCATIONAL METHODS FOR TECHNICIANS IN ACCORDANCE WITH LOCAL LAWS OR REGULATIONS, INCLUDING SPECIFIC TRAINING ON THIS EQUIPMENT.

WARNING

X-RAY EQUIPMENT IS DANGEROUS TO BOTH PATIENT AND OPERATOR UNLESS PROTECTION MEASURES ARE STRICTLY OBSERVED. IF THE EQUIPMENT IS NOT ACCURATELY USED, IT MAY CAUSE INJURY.

ALTHOUGH X-RADIATION CAN BE HAZARDOUS, X-RAY EQUIPMENT DOES NOT POSE ANY DANGER WHEN IT IS PROPERLY USED.

WARNING

SPECIAL ATTENTION MUST BE GIVEN TO DIAGNOSTIC X-RAY EQUIPMENT SPECIFIED TO BE USED IN COMBINATION WITH ACCESSORIES OR OTHER ITEMS. BE AWARE OF POSSIBLE ADVERSE EFFECT ARISING FROM THESE MATERIALS LOCATED IN THE X-RAY BEAM. (SEE THE TABLE BELOW FOR THE MAXIMUM EQUIVALENT ATTENUATION OF MATERIALS POSSIBLY LOCATED IN THE X-RAY BEAM).

ITEM	MAXIMUM ATTENUATION EQUIVALENT mm AL	
	21 CFR	IEC 60601-2-54:2009 and IEC 60601-2-54:2009+AMD1:2015
Total of all layers composing the front panel of cassette holder	1.2	1.2
Total of all layers composing the front panel of FILM CHANGER	1.2	1.2
Total of all layers, excluding detector itself, composing the front panel of DIGITAL X-RAY IMAGING DEVICE	1.2	1.2
Cradle	2.3	2.3
PATIENT SUPPORT, stationary, without articulated joints	1.2	1.2
PATIENT SUPPORT, movable, without articulated joints (including stationary layers)	1.7	1.7
PATIENT SUPPORT, with radiolucent panel having one articulated joint	1.7	1.7
PATIENT SUPPORT, with radiolucent panel having two or more articulated joints	2.3	2.3
PATIENT SUPPORT, cantilevered	2.3	2.3

Note 1.- Devices such as RADIATION DETECTORS are not included in the item listed in this table.

Note 2.- Requirements concerning the ATTENUATION properties of RADIOGRAPHIC CASSETTES and of INTENSIFYING SCREENS are given in ISO 4090 [3], for ANTI-SCATTER GRIDS in IEC 60627[1].

Note 3.- ATTENUATION caused by table mattresses and similar accessories is not included in the maximum ATTENUATION EQUIVALENT for PATIENT SUPPORT.

Note 4.- Maximum ATTENUATION EQUIVALENT mm Al is only applied to the corresponding item. If several items given in this table are located in the path of the X-RAY BEAM between the PATIENT and the X-RAY IMAGE RECEPTOR, each corresponding maximum ATTENUATION EQUIVALENT mm Al is separately applied to each item.

2.2 RESPONSIBILITIES

WARNING

THIS X-RAY UNIT MAY BE DANGEROUS TO PATIENT AND OPERATOR UNLESS SAFE EXPOSURE FACTORS, OPERATING INSTRUCTIONS AND MAINTENANCE SCHEDULES ARE OBSERVED.

WARNING

THE EQUIPMENT HEREIN DESCRIBED IS SOLD WITH THE UNDERSTANDING THAT THE MANUFACTURER, ITS AGENTS, AND REPRESENTATIVES ARE NOT LIABLE FOR INJURY OR DAMAGE WHICH MAY RESULT FROM OVEREXPOSURE OF PATIENTS OR PERSONNEL TO X-RAY RADIATION.

WARNING

THE MANUFACTURER DOES NOT ACCEPT ANY RESPONSIBILITY FOR OVEREXPOSURE OF PATIENTS OR PERSONNEL TO X-RAY RADIATION GENERATED BY THIS EQUIPMENT WHICH IS A RESULT OF POOR OPERATING TECHNIQUES OR PROCEDURES.

NO RESPONSIBILITY WILL BE ASSUMED FOR ANY EQUIPMENT THAT HAS NOT BEEN SERVICED AND MAINTAINED IN ACCORDANCE WITH THE MANUFACTURER INSTRUCTIONS, OR WHICH HAS BEEN MODIFIED OR TAMPERED WITH IN ANY WAY.

WARNING

IT IS THE RESPONSIBILITY OF THE OPERATOR TO ENSURE THE SAFETY OF THE PATIENT WHILE THE X-RAY EQUIPMENT IS IN OPERATION BY VISUAL OBSERVATION, PROPER PATIENT POSITIONING, AND USE OF THE DEVICES THAT ARE INTENDED TO PREVENT PATIENT INJURY.

ALWAYS WATCH ALL PARTS OF THE SYSTEM TO VERIFY THAT THERE IS NEITHER INTERFERENCE NOR POSSIBILITY OF COLLISION WITH THE PATIENT OR WITH OTHER EQUIPMENTS.

WARNING

IT IS THE RESPONSIBILITY OF THE PURCHASER / CUSTOMER TO PROVIDE THE MEANS FOR AUDIO AND VISUAL COMMUNICATION BETWEEN THE OPERATOR AND THE PATIENT.

WARNING

IT IS THE RESPONSIBILITY OF THE OPERATOR TO ENSURE THAT ALL THE EXPOSURE PARAMETERS ARE CORRECT BEFORE PERFORMING AN EXAM TO THE PATIENT, BY VERIFYING THAT THE PARAMETER SELECTION HAS NOT BEEN MODIFIED UNINTENTIONALLY OR BY THE CONTACT OF EXTERNAL ELEMENTS ON THE CONTROL CONSOLE, IN ORDER TO AVOID THE OVEREXPOSURE OR THE NEED OF PERFORMING A NEW EXAM TO THE PATIENT.

WARNING

MAKE SURE THAT THE X-RAY TUBE IS SET IN WORKING POSITION WITH THE REFERENCE AXIS (X-RAY BEAM) POINTING TO THE RECEPTION AREA.

WARNING

IF ANY SERIOUS INCIDENT INVOLVING THE EQUIPMENT OCCURS, IT MUST BE REPORTED TO THE MANUFACTURER, AS WELL AS TO THE COMPETENT AUTHORITY OF THE COUNTRY/REGION IN WHICH THE USER AND/OR PATIENT IS ESTABLISHED.

2.3 MAXIMUM PERMISSIBLE DOSE (MPD)

Before operation, people qualified and authorized to operate this equipment should be familiar with the Recommendations of the International Commission on Radiological Protection, contained in Annals Number 60 of the ICRP, with applicable National Standards; and should have been trained in use of the equipment.

WARNING

THE OPERATOR SHALL USE THE LARGEST POSSIBLE DISTANCE FROM THE FOCAL SPOT TO SKIN IN ORDER TO KEEP THE ABSORBED DOSE AS LOW AS REASONABLY ACHIEVABLE.

2.4 RADIATION PROTECTION

Although this equipment is built to the highest safety standards and incorporates a high degree of protection against X-radiation other than the useful beam, no practical design of equipment can provide complete protection, nor can any practical design compel the operator to take adequate precautions to prevent the possibility of any persons carelessly, unwisely, or unknowingly exposing themselves or others to X-radiation.

WARNING

IT IS THE RESPONSIBILITY OF THE OPERATOR TO RESTRICT ACCESS TO THE EQUIPMENT IN ACCORDANCE WITH LOCAL REGULATIONS FOR RADIATION PROTECTION.

Because exposure to X-Ray radiation can be damaging to the health, use great care to ensure protection against exposure to the primary beam. Some of the effects of X-Ray radiation are cumulative and may extend over a period of months or years. The best safety rule for an X-Ray operator is *"Avoid exposure to the primary beam at **all times**"*.

Any object in the path of the primary beam produces secondary (scattered) radiation. The intensity of secondary radiation depends on the energy and intensity of the primary beam and the atomic number of the object material struck by the primary beam. Secondary radiation may be of greater intensity than that of the radiation reaching the receptor. Take protective measures to safeguard against it.

An effective protective measure is the use of lead shielding. To minimize dangerous exposure, use such items as lead screens, lead impregnated gloves, aprons, thyroid collars, etc. Lead screens should contain a minimum of 2.0 mm of lead or equivalent and personal protective devices (aprons, gloves, etc.) must contain a minimum of 0.25 mm of lead or equivalent. For confirmation of the local requirements at your site, please refer to your "Local Radiation Protection Rules" as provided by your Radiation Protection Advisor.

CAUTION

Observe the following rules for radiation protection of the personnel in the examination room during X-Ray exposures:

- Wear radiation protective clothing.

- Wear a personal dosemeter.

- Use the different recommended protective materials and devices against radiation.

- While operating or servicing X-Ray equipment, always keep as large a distance as possible from the Focal Spot and X-Ray beam, never shorter than 2 meters, protect body and do not expose hands, wrists, arms or other parts of the body to the primary beam.

- Protect the patient against radiation outside the area of interest by using protection accessories.

- Use the smallest X-Ray field collimation. Make sure that the area of interest will be completely exposed and the X-Ray field does not exceed the area of interest.

- Select a Focal Spot to patient skin distance (SID) as large as possible to keep the absorbed dose for the patient as low as reasonably possible.

The radiation dose decreases or increases according to the Focal Spot to patient skin distance (SID): the greater the SID distance, the lower the radiation dose. The radiation dose is inversely proportional to the distance squared.

- Select as short an examination time as possible. This will reduce total radiation dose considerably.

- Use Grids whenever possible.

- Place the region of interest as close as possible to the image receptor. This will reduce exposure to radiation and optimize the exposure.

- Be sure that audible and visual communication between the patient and operator is established throughout the entire examination.

2.5 MONITORING OF PERSONNEL

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

The most effective method of determining whether or not the existing protective measures are adequate is the use of instruments to measure the exposure. These measurements should be taken at all locations where the operator, or any portion of the body may be exposed. Exposure must never exceed the accepted tolerable dose.

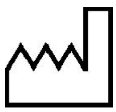
A frequently used, but less accurate, method of determining the amount of exposure is the placement of film at strategic locations. After a specified period of time, develop the film to determine the amount of radiation.

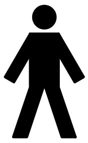
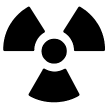
A common method of determining whether personnel have been exposed to excessive radiation is the use of personal radiation dosimeters. These consist of X-Ray sensitive film or thermoluminescent material enclosed within a holder that may be worn on the body. Even though this device only measures the radiation which reaches the area of the body on which they are worn, they do provide a reasonable indication of the amount of radiation received.

2.6 SAFETY SYMBOLS

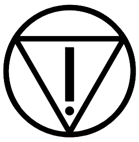
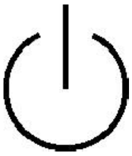
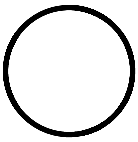
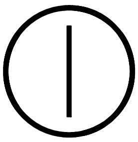
The following safety symbols may appear in the equipment.

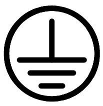
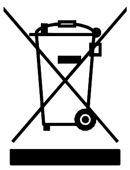
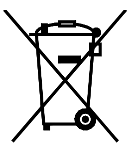
Their meaning are described below.

	**Caution. Consult accompanying documents.**
	**Safety Symbol. Follow instructions for use, especially those instructions identified with Advisory Symbols to avoid any risk for the Patient or Operator.** *(Only applies to Standard IEC 60601-1:2005 and IEC 60601-1:2005+AMD1:2012)*
	**Manufacturer.**
	**Date of Manufacture.**
MD	**Medical Device.**
REF	**Catalogue Number (Model reference).**
SN	**Serial Number.**
TYPE	**Model Configuration.**
UDI	**Unique Device Identifier.**

	**General Mandatory action.**
	**Type B applied part.**
IPx0	**Protection against harmful ingress of water or particulate matter.** **IP Classification: Ordinary.**
	**Ionizing radiation.**
	**Non-ionizing electromagnetic radiation.**
	**Radiation of Laser apparatus.** Do not stare into beam. *(Only applicable to equipment with Laser Pointer)*
	**Dangerous voltage.**
	**General warning, caution, risk of danger.**
	**Warning: Ionizing radiation.**

	**Warning: Non-ionizing radiation.**
	**Warning: Laser beam.**
	**Warning: Electricity.**
	**Warning: Do not place fingers between mobile and fixed parts of the equipment, it may cause serious injuries to patient or operator. As well, make sure the patient extremities are correctly positioned into limit areas during operation, movement of parts may cause serious damages to patient.**
	**Warning: Electrostatic sensitive devices.**
	**No pushing.**
	**No sitting. Surface unsuitable to sit on.**
	**No stepping on surface.**
	**Do not handle.**

	**Emergency stop.**
	**“Stand-by” power.** *(Only applies to IEC 60601-1:2005 and IEC 60601-1:2005+AMD1:2012)*
	“ON” power.
	**“OFF” power.**
	**“ON” / “OFF” (push-push).** *Each position, “ON” or “OFF”, is a stable position.*
~	**Alternating current.**
3~	**Three-phase alternating current.**
3N~	**Three-phase alternating current with neutral conductor.**
N	**Connection point for the neutral conductor on Permanently Installed equipment.**

	**Direct current.**
	**Both direct and alternating current.**
	**Protective Earth (Ground).**
	**Earth (Ground).**
	**This symbol according to the European Directive indicates that the Waste of Electrical and Electronic Equipment (WEEE) must not be disposed of as unsorted municipal waste and must be collected separately. Please contact an authorized representative of the manufacturer or an authorized waste management company for information concerning the decommissioning of your equipment.**
 **Li/Pb/Cd/Hg**	**This separate collection symbol is affixed to a battery or its packing, to advise that the battery must be recycled or disposed of in accordance with local or country laws. The letters below the symbol indicate whether certain elements (Li=Lithium, PB=Lead, CD=Cadmium, Hg=Mercury) are contained in the battery. All batteries removed from the equipment must be properly recycled or disposed. Please contact an authorized representative of the manufacturer or an authorized waste management company for information concerning the decommissioning of your equipment.**
	**Pollution Control.** *(Only applicable to People's Republic of China (PRC)).* **This symbol indicates the product contains hazardous materials in excess of the limits established by the Chinese Standards. It must not be disposed of as unsorted municipal waste and must be collected separately. Please contact an authorized representative of the manufacturer or an authorized waste management company for information concerning the decommissioning of your equipment.**

2.7 REGULATORY INFORMATION

2.7.1 CERTIFICATIONS

The **Portable X-Ray Unit** covered by this Operation Manual is authorized to be marked with **CE MARKING** in accordance with the provisions of the Council Directive 93 / 42 / EEC as amended by 2007/47/EEC concerning Medical Devices.

Statement of Compliance with IEC 60601-1-3: ***Portable X-Ray Unit*** *with radiation protection in accordance with IEC 60601-1-3: 1994, IEC 60601-1-3:2008 and IEC 60601-1-3:2008+AMD1:2013.*

Statement of Compliance with IEC 601-2-28: *X-Ray source assembly* ***Portable X-Ray Unit*** *in accordance with IEC 601-2-28:1993.*

Statement of Compliance with IEC 60601-2-28: *X-Ray Tube assembly* ***Portable X-Ray Unit*** *in accordance with IEC 60601-2-28:2010.*

Statement of Compliance with IEC 60601-2-54: ***Portable X-Ray Unit*** *for Radiography and/or Radioscopy in accordance with IEC 60601-2-54:2009 and IEC 60601-2-54:2009+AMD1:2015.*

Statement of Compliance with 21CFR Subchapter J: *This* ***Portable X-Ray Unit*** *conforms to DHHS radiation Standards of 21CFR subchapter J as of the date of manufacture.*

Note ☞ ***Portable X-Ray Unit*** *model or type references are stated at the back of the cover page of this document.*

2.7.2 ENVIRONMENTAL STATEMENT ON THE LIFE CYCLE OF THE EQUIPMENT OR SYSTEM

This equipment or system contains environmentally dangerous components and materials (such as PCBs, electronic components, used dielectric oil, lead, batteries etc.) which, once the life-cycle of the equipment or system comes to an end, becomes dangerous and need to be considered as harmful waste according to the international, domestic and local regulations.

The manufacturer recommends to contact an authorized representative of the manufacturer or an authorized waste management company once the life-cycle of the equipment or system comes to an end to remove this equipment or system.

2.7.3 MODE OF OPERATION

- *Continuous operation with intermittent loading,* in accordance with Standard IEC 60601-1:1988, IEC 60601-1:2005 and IEC 60601-1:2005+AMD1:2012.
- *Non-continuous with Duty Cycle of 0.1 seconds (ON) and 5 minutes (OFF)*, in accordance with Standard IEC 60601-1:2005 and IEC 60601-1:2005+AMD1:2012.

2.7.4 PROTECTION AGAINST ELECTRIC SHOCK HAZARDS

Protection against electric shock hazards in accordance with Standards: IEC 60601-1:1988, IEC 60601-1:2005 and IEC 60601-1:2005+AMD1:2012, IEC 60601-2-54:2009 and IEC 60601-2-54:2009+AMD1:2015.

This equipment has been classified as a *type-B () device,* in accordance with Standard IEC 60601-1 requirements: *Class I - Type B applied parts.*

DANGER !

TO AVOID THE RISK OF ELECTRIC SHOCK, THIS EQUIPMENT MUST ONLY BE CONNECTED TO A SUPPLY MAINS WITH PROTECTIVE EARTH.

THIS PORTABLE X-RAY UNIT IS EQUIPPED WITH EMC FILTERS. THE LACK OF PROPER GROUNDING MAY PRODUCE ELECTRICAL SHOCK TO THE USER.

2.7.5 PROTECTION AGAINST HARMFUL INGRESS OF WATER OR PARTICULATE MATTER

Protection against harmful ingress of water or particulate matter: *Ordinary (IPx0)*, in accordance with Standard IEC 60601-1:1988, IEC 60601-1:2005 and IEC 60601-1:2005+AMD1:2012.

2.7.6 PROTECTION AGAINST HAZARDS OF IGNITION OF FLAMMABLE ANAESTHETIC MIXTURES

Degree of Safety in the presence of Flammable Anesthetics Mixture with air or with oxygen or with nitrous oxide: *Not suitable for use in the presence of Flammable Anesthetics Mixture with air or with oxygen or with nitrous oxide*, in accordance with Standard IEC 60601-1:1988, IEC 60601-1:2005 and IEC 60601-1:2005+AMD1:2012.

2.7.7 PROTECTION AGAINST HAZARDS FROM UNWANTED OR EXCESSIVE RADIATION

Protection against hazards from unwanted or excessive radiation in accordance with Standards IEC 60601-1:1988, IEC 60601-1:2005 and IEC 60601-1:2005+AMD1:2012, and IEC 60601-1-3:1994, IEC 60601-1-3:2008 and IEC 60601-1-3:2008+AMD1:2013.

2.7.8 DESIGNATED SIGNIFICANT ZONES OF OCCUPANCY

X-Ray equipment specified for any radiological examination that requires the operator or staff to be close to the patient during normal use (e.g. some pediatric examinations or other types of examinations for patients that may require assistance), shall have at least one *"Significant Zone of Occupancy"* for the use of the operator and staff, designated as follows:

Illustration 2-1
Radiographic Examination on a Chest Unit or Front Panel

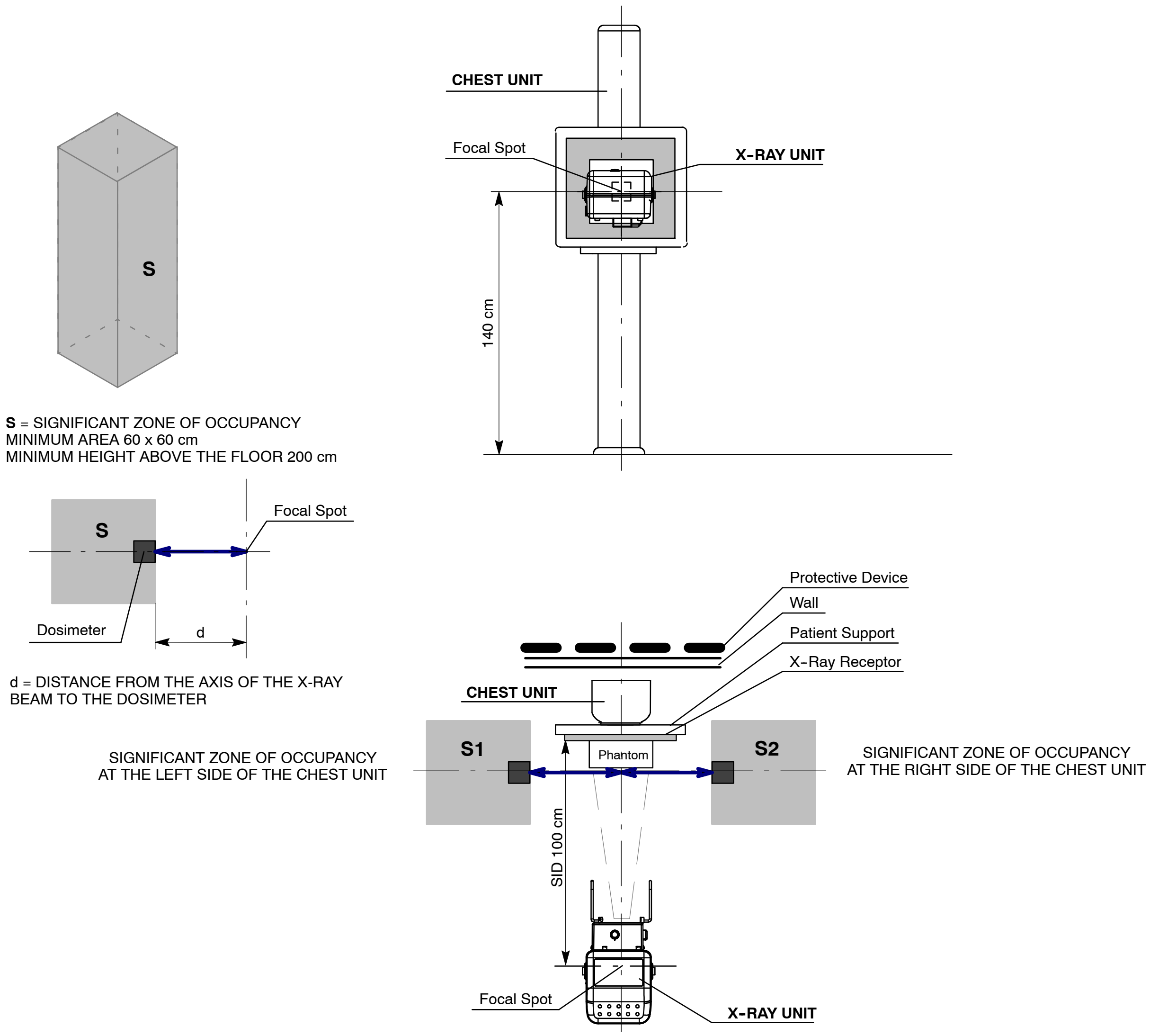
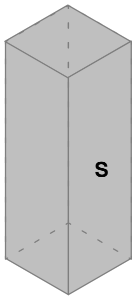
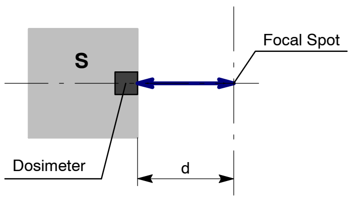


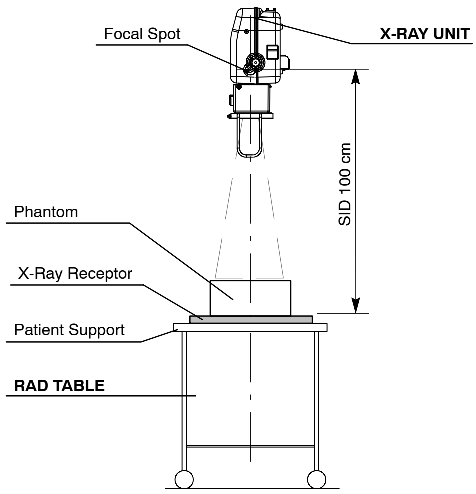
Illustration 2-2
Radiographic Examination on any Patient Support or Table

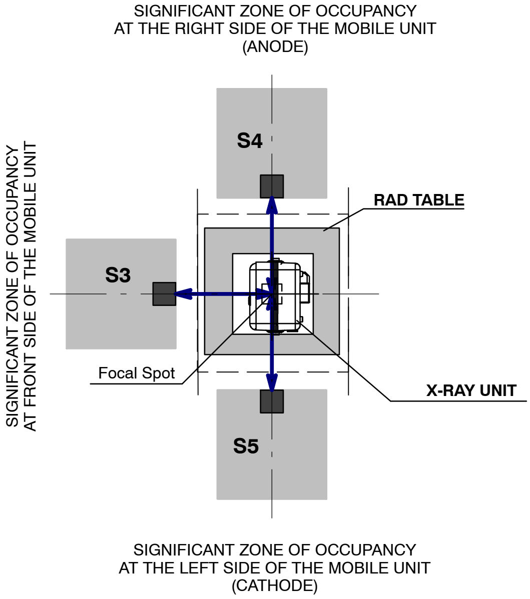


S = SIGNIFICANT ZONE OF OCCUPANCY
MINIMUM AREA 60 x 60 cm
MINIMUM HEIGHT ABOVE THE FLOOR 200 cm



d = DISTANCE FROM THE AXIS OF THE X-RAY BEAM TO THE DOSIMETER





2.7.9 DISTRIBUTION OF STRAY RADIATION

Measurement conditions to determine the distribution of Stray Radiation in the Significant Zone of Occupancy are in accordance with IEC 60601-1-3:1994, IEC 60601-1-3:2008 and IEC 60601-1-3:2008+AMD1:2013.

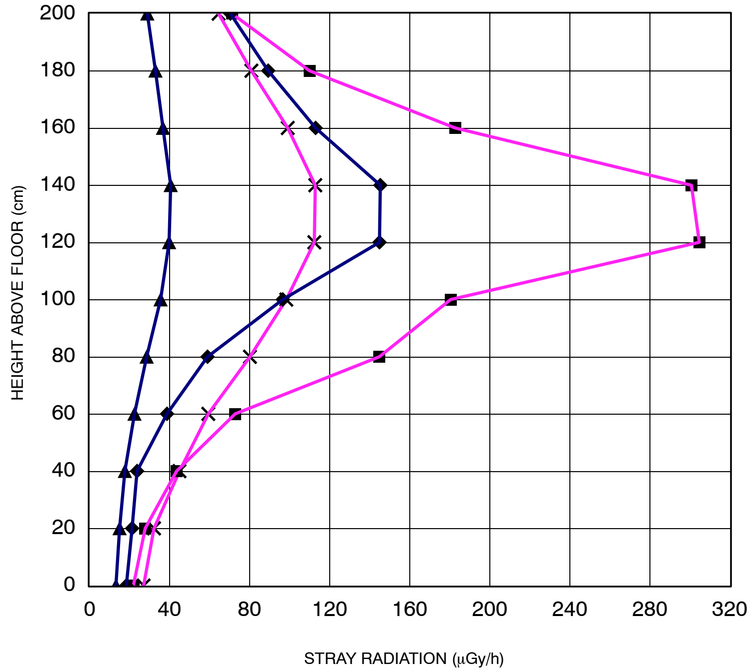
- Exposure Parameters: RAD mode, 125 kVp, 10 mAs, large focus.
- Collimator opening for Field Size 18 x 18 cm, SID 100 cm.
- Phantom: Rectangular water phantom of 25 x 25 x 15 cm, or a material having a similar X-Ray attenuation coefficient.
- Radiation measuring instrument: Low Radiation Dosimeter.

Note ☞ *The results have been obtained with a configuration that is representative of the worst case within the different configurations of the unit.*

Refer to Illustration 2-1 for position of the X-Ray Unit during radiographic examination on the Chest Unit or Front Panel, and refer to Illustration 2-2 for position of the X-Ray Unit during radiographic examination on any Patient Support or Table.

The following illustrations show the Distribution of Stray Radiation in each examination position.

Illustration 2-3
Distribution of Stray Radiation on the Chest Unit or Front Panel



$S1_1$	d = 50 cm	—◆—
$S1_2$	d = 100 cm	—▲—
$S2_1$	d = 50 cm	—■—
$S2_2$	d = 100 cm	—×—

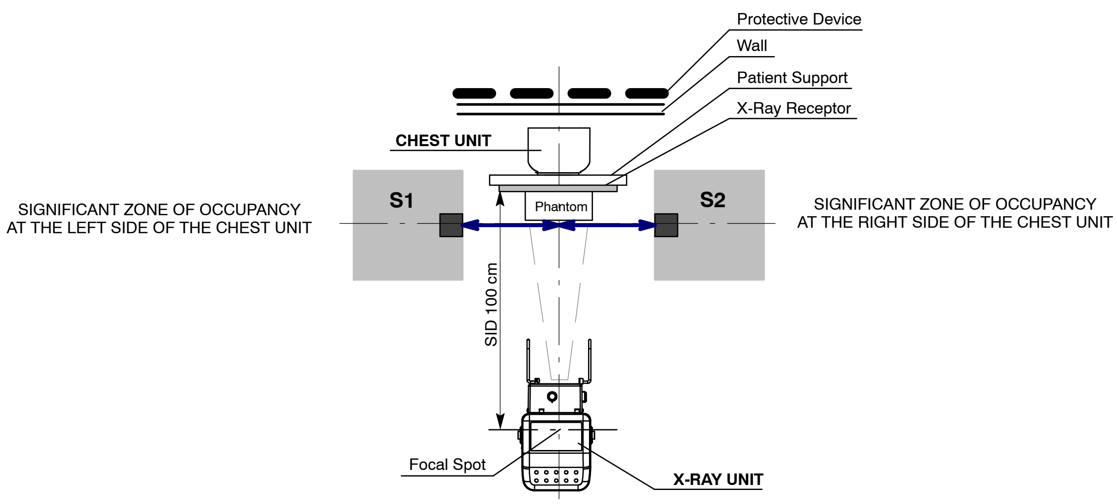
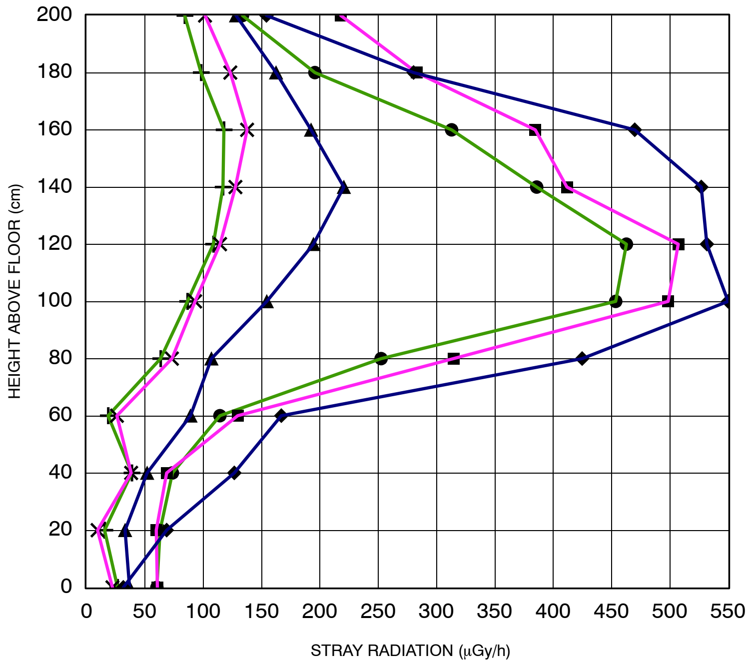
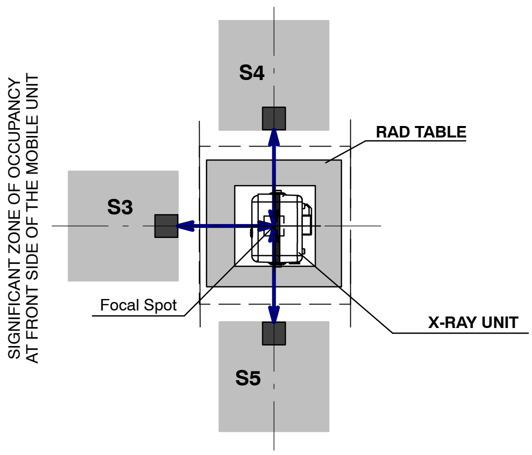


Illustration 2-4
Distribution of Stray Radiation on any Patient Support or any Table



S3$_1$	d = 50 cm	◆
S3$_2$	d = 100 cm	▲
S4$_1$	d = 50 cm	■
S4$_2$	d = 100 cm	×
S5$_1$	d = 50 cm	●
S5$_2$	d = 100 cm	+



2.8 ELECTROMAGNETIC COMPATIBILITY (EMC)

This equipment generates, uses, and can radiate radio frequency energy.

CAUTION

The equipment may cause radio frequency interference to other medical or non medical devices and to radio communications.

To provide reasonable protection against such interference, this equipment complies with emissions limits for a Group 1 – Class A Medical Devices Directive as stated in IEC 60601–1–2:2007 and IEC 60601-1-2:2014. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment is found to cause interference (which may be determined by turning the equipment on and off), the operator (or qualified service personnel) should attempt to correct the problem by one or more of the following measures:

- reorient or relocate the affected device,
- increase the separation between the equipment and the affected device,
- power the equipment from a source different from that of the affected device,
- consult the service engineers for further suggestions.

To comply with the regulations applicable to an electromagnetic interference for a Group 1 – Class A Medical Device, all interconnect cables to peripheral devices must be shielded and properly grounded. Use of cables not properly shielded and grounded may result in the equipment causing radio frequency interference in violation of the European Union Medical Device Directive and of Federal Communications Commission regulations.

CAUTION

Before using this equipment make sure that all requirements about EMC included in this manual are accomplished.

CAUTION

Should any interference (EMC) be detected with other equipment, please position other equipment away from this one.

CAUTION

It is customer responsibility to assure that this equipment and vicinity equipment complies the value of radio frequency interferences shown in General Regulation for safety according to IEC 60601-1-2:2007 and IEC 60601-1-2014 Tables as described in this section.

CAUTION

The manufacturer is not responsible for any interference caused by using other than recommended interconnect cables or by unauthorized changes or modifications to this equipment.

ESSENTIAL PERFORMANCE

The system (e.g. Genarator, Patient Support, Tube, Detector, etc.) is designed to use X-rays for diagnostic purposes according to international standards, to prevent patient, user, and others from electrical and mechanical hazards by using adequate EMC measures like using filters, screened cables or housings.

EMC-COMPLIANCE CRITERIA DUE TO THE ESSENTIAL PERFORMANCE

- No unintended X-radiation
- No unintended change of generator parameters (kV, mAs)

<table>
<tr><th colspan="3">GUIDANCE AND MANUFACTURER’S DECLARATION – ELECTROMAGNETIC EMISSIONS
(IEC 60601-1-2:2007 AND IEC 60601-1-2:2014)</th></tr>
<tr><td colspan="3">This Portable X-Ray Unit is intended for use in the electromagnetic environment specified below.
The customer or the user of this Portable X-Ray Unit should assure that it is used in such an environment.</td></tr>
<tr><th>Emissions test</th><th>Compliance</th><th>Electromagnetic environment – guidance</th></tr>
<tr><td>RF emissions
CISPR 11</td><td>Group 1</td><td>This Portable X-Ray Unit 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.</td></tr>
<tr><td>RF emissions
CISPR 11</td><td>Class A</td><td rowspan="3">This Portable X-Ray Unit 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 purposes.</td></tr>
<tr><td>Harmonic emissions
IEC 61000–3–2</td><td>Class A</td></tr>
<tr><td>Voltage fluctuations/flicker emissions
IEC 61000–3–3</td><td>Complies</td></tr>
<tr><td colspan="3">NOTE - In accordance with Standard IEC 61601-1-2:2014, the emissions characteristics of this equipment make it suitable for use in industrial areas and hospitals (CISPR 11 Class A). If it is used in a residential environment (for which CISPR 11 Class B is normally required) this equipment might not offer adequate protection to radio-frequency communication services. The user might need to take mitigation measures, such as relocating or re-orientating the equipment.</td></tr>
</table>

GUIDANCE AND MANUFACTURER'S DECLARATION – ELECTROMAGNETIC IMMUNITY (IEC 60601-1-2:2007)			
This Portable X-Ray Unit is intended for use in the electromagnetic environment specified below. The customer or the user of this Portable X-Ray Unit should assure that it is used in such an environment.			
Immunity test	**IEC 60601-1-2:2007 Test Level**	**Compliance level**	**Electromagnetic environment – guidance**
Electrostatic discharge (ESD) IEC 61000-4-2	± 6 kV contact ± 8 kV air	± 6 kV maximum ± 8 kV maximum	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	Mains power quality should be that of a typical commercial or hospital environment.
Surge IEC 61000–4–5	± 1 kV line(s) to line(s) ± 2 kV line(s) to earth	± 1 kV ± 2 kV	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 40% U_T (60% dip in U_T) for 5 cycles 70% U_T (30% dip in U_T) for 25 cycles < 5% U_T (>95% dip in U_T) for 5s	30% for 0.5 periods 60% for 5 periods 100% for 250 periods	Mains power quality should be that of a typical commercial or hospital environment. If the user of the Portable X-Ray Unit requires continued operation during power mains interruptions, it is recommended that the Portable X-Ray Unit be powered from a uninterruptible power supply or a battery
Power frequency (50/60 Hz) magnetic field IEC 61000–4–8	3 A/m	3 A/m	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.
NOTE – U_T is the a.c. mains voltage prior to application of the test level.			

GUIDANCE AND MANUFACTURER'S DECLARATION – ELECTROMAGNETIC IMMUNITY
(IEC 60601-1-2:2007)

This Portable X-Ray Unit is intended for use in the electromagnetic environment specified below.
The customer or the user of this Portable X-Ray Unit should assure that it is used in such an environment.

Immunity test	IEC 60601-1-2:2007 Test Level	Compliance level	Electromagnetic environment – guidance
			Portable and mobile RF communications equipment should be used no closer to any part of this Portable X-Ray Unit including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter. Recommended separation distance
Conducted RF IEC 61000-4-6	3 Vrms 150 kHz to 80 MHz	3 Vrms 150 kHz to 80 MHz	$d = 1.2\sqrt{P}$
Radiated RF IEC 61000-4-3	3 V/m 80 MHz to 2.5 GHz	3 V/m 80 MHz to 2.5 GHz	$d = 1.2\sqrt{P}$, 80 MHz to 800 MHz $d = 2.3\sqrt{P}$, 800 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 less than the compliance level in each frequency 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 is 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 this Portable X-Ray Unit is used exceeds the applicable RF compliance level above, this Portable X-Ray Unit should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as re-orienting or relocating this Portable X-Ray Unit.*

[b]) *Over the frequency range 150 kHz to 80 MHz, field strengths should be less than 3 V/m.*

RECOMMENDED SEPARATION DISTANCES BETWEEN PORTABLE AND MOBILE RF COMMUNICATIONS EQUIPMENT AND THE PORTABLE X-RAY UNIT (IEC 60601-1-2:2007)			
This Portable X-Ray Unit is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of this Portable X-Ray Unit can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and this Portable X-Ray Unit 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 m**		
	150 KHz to 80 MHz $d = 1.2\sqrt{P}$	**80 MHz to 800 MHz** $d = 1.2\sqrt{P}$	**800 MHz to 2.5 GHz** $d = 2.3\sqrt{P}$
0.01	0.12	0.12	0.23
0.1	0.38	0.38	0.73
1	1.2	1.2	2.3
10	3.8	3.8	7.3
100	12	12	23

TYPICAL RF DEVICES (Worst-Case scenario)	
Device: Power @ Frequency	**Recommended distance(m)**
GMRS device (Professional Walkie-Talkie): 5 W @ 462-467 MHz	2.7
GSM / UMTS cell phone: 2 W @ 850/1700/1900 MHz	3.3
FRS device (Amateur Walkie-Talkie): 500 mW @ 462-467 MHz	0.9
WiFi / Bluetooth devices: 100 mW @ 2400-2500 MHz	0.8
DECT devices (modern cordless phones): 100mW @ 1880-1900 MHz	0.8
RFID reader (3): 10 mW @ 125-150 KHz / 13.56 MHz	0.12
RFID reader (3): 10 mW @ 902-928 MHz / 2400-2500 MHz	0.23
Station transmitter ATSC TV broadcasting: 100 kW @ 54-800 MHz	380
Station transmitter ATSC TV broadcasting: 100 kW @ 800-890 MHz	730
Station transmitter FM radio broadcasting: 100 kW @ 87.5-108 MHz	380

For transmitters rated at a maximum output power not listed above, the recommended separation distance "d" in metres (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.

NOTE 3 - RFID chips are typically powered from the electromagnetic field, and therefore only the reader can be regarded as an RF transmitter.

GUIDANCE AND MANUFACTURER'S DECLARATION - ELECTROMAGNETIC IMMUNITY (IEC 60601-1-2:2014)			
This X-Ray Unit is intended for use in the electromagnetic environment specified below. The customer or user of this X-Ray Unit should assure that it is used in such an environment.			
Immunity Test	**IEC 60601-1-2:2014 Test Level**	**Compliance Level**	**Electromagnetic environment - guidance**
Electrostatic discharge (ESD) IEC 61000-4-2	± 8 kV contact ± 2 kV, ± 4 kV, ± 8 kV, ± 15 kV air	± 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 (100 kHz repetition frequency)	± 2 kV for power supply lines ± 1 kV for input/output lines (100 kHz repetition frequency)	Mains power quality should be that of a typical commercial or hospital environment.
Surge IEC 61000-4-5	± 0.5 kV, ± 1 kV line(s) to line(s) ± 0.5 kV, ± 1 kV, ± 2 kV line(s) to earth	± 0.5 kV, ± 1 kV line(s) to line(s) ± 0.5 kV, ± 1 kV, ± 2 kV line(s) to earth	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	0% U_T for 0.5 cycle at 0°, 45°, 90°,135°, 180°, 225°, 270° and 315° 0 % U_T for 1 cycle at 0° 70 % U_T for 25/30 cycles at 0° 0% U_T 250/300 cycles	0% U_T for 0.5 cycle at 0°, 45°, 90°,135°, 180°, 225°, 270° and 315° 0 % U_T for 1 cycle at 0° 70 % U_T for 25/30 cycles at 0° 0% U_T 250/300 cycles	Mains power quality should be that of a typical commercial or hospital environment. If the user of the This X-Ray Unit requires continued operation during power mains interruptions, it is recommended that this X-Ray Unit is powered from an Uninterruptible Power Supply or a battery.
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.
NOTE - U_T is the a.c. mains voltage prior to application of the test level.			

<table>
<tr><th colspan="4">GUIDANCE AND MANUFACTURER'S DECLARATION - ELECTROMAGNETIC IMMUNITY
(IEC 60601-1-2:2014)</th></tr>
<tr><td colspan="4">This X-Ray Unit is intended for use in an electromagnetic environment specified below.
The customer or user of this X-Ray Unit should assure that it is used in such an environment.</td></tr>
<tr><th>Immunity Test</th><th>IEC 60601-1-2:2014
Test Level</th><th>Compliance Level</th><th>Electromagnetic
environment - guidance</th></tr>
<tr><td>Radiated RF EM fields
IEC 61000-4-3

Proximity fields from RF wireless Communications equipment
IEC 61000-4-3

Conducted disturbances induced by RF fields
IEC 61000-4-6</td><td>3 Vrms
from 80 MHz to 2.7 GHz
(80% AM at 1 kHz)

Refer to next table "IMMUNITY REQUIREMENTS FOR RF WIRELESS COMMUNICATIONS EQUIPMENT"

3 Vrms
from 150 kHz to 80 Mhz

6 Vrms in ISM bands
from 150 kHz to 80 MHz

(80% AM at 1 kHz)</td><td>3 Vrms
from 80 MHz to 2.7 GHz
(80% AM at 1 kHz)

Refer to next table "IMMUNITY REQUIREMENTS FOR RF WIRELESS COMMUNICATIONS EQUIPMENT"

3 Vrms
from 150 kHz to 80 Mhz

6 Vrms in ISM bands
from 150 kHz to 80 MHz

(80% AM at 1 kHz)</td><td>Portable RF communications equipment (including peripherals such as antenna cables and external antennas) should be used no closer than 30 cm to any part of the equipment, including cables specified by manufacturer. Otherwise, degradation of the performance of this equipment could result.</td></tr>
<tr><td colspan="4">NOTE – The ISM (Industrial, Scientific and Medical) bands between 0.15 MHz and 80 MHz are 6.765 MHz to 6.795 MHz; 13.553 MHz to 13.567 MHz; 26.957 MHz to 27.283 MHz; and 40.66 MHz to 40.70 MHz.
The amateur radio bands between 0.15 MHz and 80 MHz are 1.8 MHz to 2.0 MHz; 3.5 MHz to 4.0 MHz; 5.3 MHz to 5.4 MHz; 7 MHz to 7.3 MHz; 10.1 MHz to 10.15 MHz; 14 MHz to 14.2 MHz; 18.07 MHz to 18.17 MHz; 21.0 MHz to 21.4 MHz; 24.89 MHz to 24.99 MHz; 28.0 MHz to 29.7 MHz; and 50.0 MHz to 54.0 MHz.</td></tr>
</table>

IMMUNITY REQUIREMENTS TO RF WIRELESS COMMUNICATIONS EQUIPMENT (IEC 60601-1-2:2014)			
This X-Ray Unit is intended for use in an electromagnetic environment specified below. The customer or User of this X-Ray Unit should assure that it is used in such an environment.			
Band [a] **(MHz)**	**Modulation** [b]	**Distance (m)**	**Immunity Test Level (V/m)**
380 – 390	Pulse modulation [b] 18 Hz	0.3	27
430 – 470	FM [c] ±5 kHz deviation 1 kHz sine		28
704 – 787	Pulse modulation [b] 217Hz		9
800 – 960	Pulse modulation [b] 18Hz		28
1700 – 1990	Pulse modulation [b] 217Hz		28
2400 – 2570	Pulse modulation [b] 217Hz		28
5100 – 5800	Pulse modulation [b] 217Hz		9

[a] *For some services, only the uplink frequencies are included.*

[b] *The carrier shall be modulated using a 50 % duty cycle square wave signal.*

[c] *As an alternative to FM modulation, 50 % pulse modulation at 18 Hz may be used because while it does not represent actual modulation, it would be worst case.*

2.9 QUANTITATIVE INFORMATION

Note ☞ *The following tables show the Quantitative Information associated to this equipment according to the Standard IEC 60601-1-3:2008 and IEC 60601-1-3:2008+AMD1:2013. These tables illustrate loading factors for image performance and supply Dose indication examples. Therefore, these tables are an instance of the adjustment of Loading Factors, Focal Spot Selection, SID and Collimator opening, which affect to the radiation quality or to the radiation dose rate applied in normal use.*

2.9.1 FUNCTIONAL TESTS PERFORMED TO OBTAIN THE QUANTITATIVE INFORMATION

Equipment:

- Portable X-Ray Unit with Ralco Collimator R72s.

Instrumentation used:

- Dosimeter 1 (for Collimator Output Dose): Vacudap Compact.
- Dosimeter 2 (for Phantom Input Dose): Unfors Xi R/F.
- Thermohygrometer Testo 608-H2.
- Rectangular water Phantom made of Polymethyl-methacrylate (PMMA) layers of 25 cm x 25 cm x 15 cm.

Test Details:

- Environmental Test Conditions:
  - Temperature: 23º C ± 2º C
  - Relative Humidity: 38% - 42%
- SID distance from Table:100 cm.
- Open Collimator size: 24 cm x 30 cm (min.), 35 cm x 43 cm (max.)
- The measurements were made with the exposure parameters (kVp and mAs) shown on the results table, using the most common examinations performed with this Unit.
- Performed measurements:
  - Collimator Output doses
  - Patient (Phantom) Entrance doses

Quantitative Information											
	Loading Factors				Parameter Selection			Filtrat.	Measured Doses		
Patient Examination	KVp	mA	Time (s)	mAs	Focal Spot Selection	SID Source-Image Distance (cm)	Collimator blades opening (cm)	HVL (min. value allowed) (mmAl)	Collimator Output Dose (µGy*m2)	Phantom Input Dose Rate (µGy/s)	Phantom Input Dose Rate (µGy/mAs)
Skull	70	6.4	1.6	10	Small	100	24x30	2.96	23.4	270.81	43.33
Chest	90	6.4	0.32	2	Small		35x43	3.86	15.2	452.81	72.45
Cervical	65	50	0.125	6.4	Large		24x30	2.71	11.8	1755.20	34.28
Elbow	50	80	0.025	4	Large		24x30	2.13	63.4	2686.00	16.79
Hand	45	80	0.040	3.2	Large		24x30	1.95	1.9	952.25	11.90
Ribs	65	50	0.250	12.5	Large		35x43	2.69	37.5	1424.00	28.48
Thorax	75	50	0.200	10	Large		35x43	3.10	52.3	2470.00	49.41
Pelvis	70	50	0.320	16	Large		35x43	2.91	71.8	2121.88	42.43
Knee	60	64	0.080	5	Large		24x30	2.50	7.8	1843.75	29.50
Abdominal	70	40	0.640	25	Large		35x43	2.90	115.6	1709.38	45.58
Hip	65	50	0.320	16	Large		35x43	2.69	60.1	1786.56	35.73
Lumbar	75	40	0.400	16	Large		35x43	3.11	84.3	1991.50	49.79
Femur	65	8	1	8	Small		24x30	2.76	15.3	282.00	35.25
Ankle	52	64	0.064	4	Large		24x30	2.26	4.0	1231.09	19.70
Foot	50	80	0.025	2	Large		24x30	2.19	1.6	1299.60	16.25
Shoulder	60	64	0.160	10	Large		24x30	2.51	15.8	1850.00	29.60

Note ☞

Combined standard uncertainty is ±35% (IEC 60580 : 2000 / IEC 60601-2-54 : 2009 and IEC 60601-2-54:2009+AMD1:2015).

2.10 DETERMINISTIC EFFECTS

Deterministic effects may occur when the Radiation dose to a certain organ or tissue exceeds a specific threshold. Particular organs or tissues of such concern in diagnostic Radiology are the skin and the eye lens. The numerical value of the threshold dose is in the range between 1 Gy and 3 Gy.

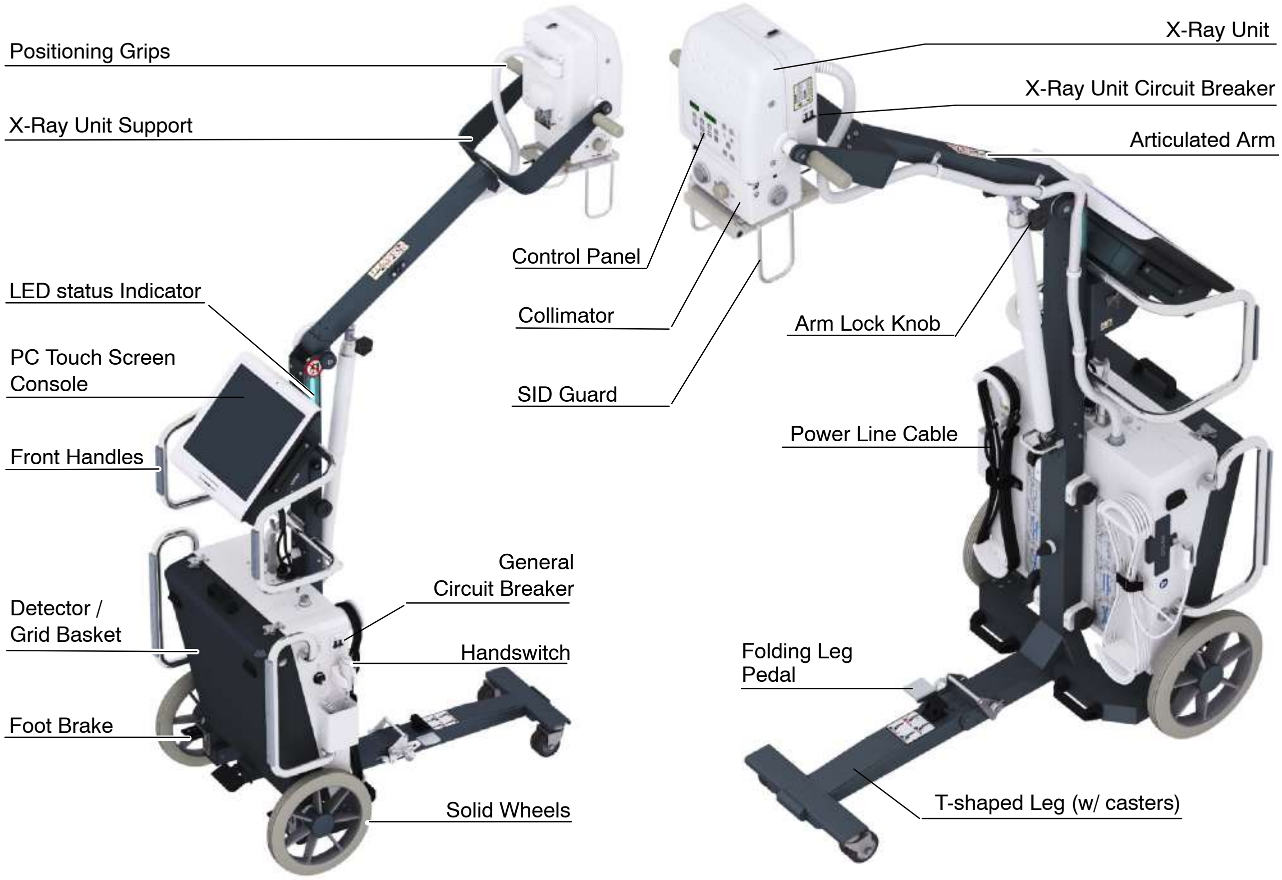
As shown in the Quantitative Information Tables, the radiation dose effects measured in this equipment are below the threshold in which the severity of certain effects would take place on human skin or eyes lens.

This mentioned threshold was established by the International Commission on Radiological Protection (ICRP Publication No 60).

Quantitative Information tables (*refer to Section 2.9*) illustrate examples of available loading factors for image performance and supply Dose indication, which affect to the radiation quality or to the radiation dose rate applied in normal use.

As indicated in the Quantitative Information Tables, the number of exposures needed to reach the previously described maximum radiation values will depend on the selected techniques for each radiographic study.

SECTION 3 OPERATING CONTROLS



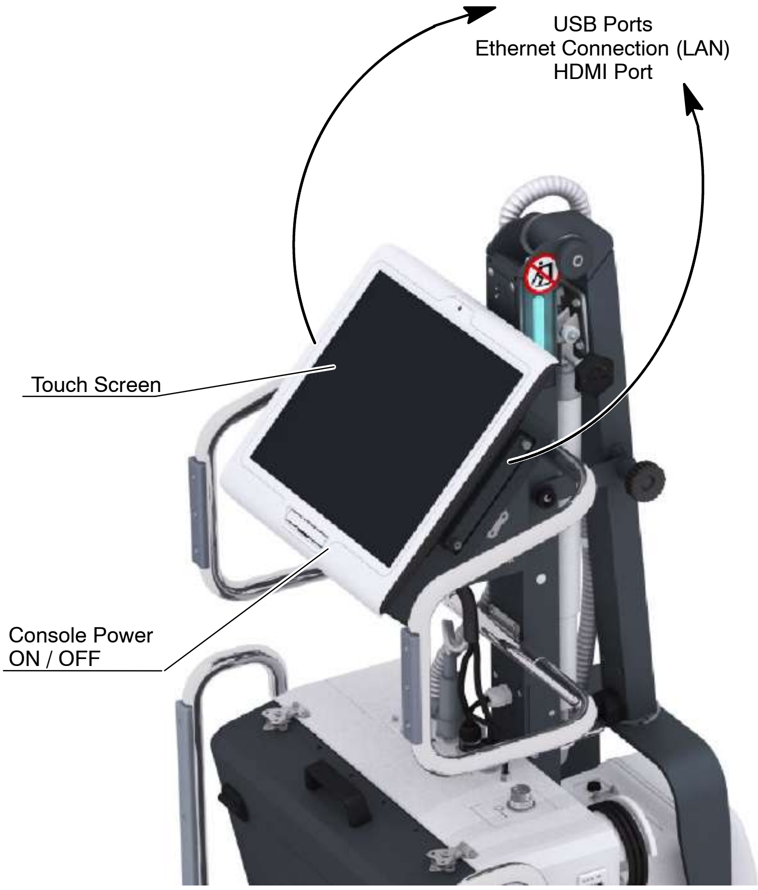
Operation is carried out with the following controls:

- General movements for travelling are controlled with the Front Handles which allow movements in all directions.
- Power ON / OFF controls: General Circuit Breaker, X-Ray Unit Circuit Breaker and PC Switch ON / OFF.
- Control Panel of the X-Ray Unit.
- Touch Screen Console with *Primo S* application and X-Ray Control application for Radiography and General Operation.
- Handswitch.
- Panel of the Manual Collimator, with the controls for opening or closing the Collimator Blades and to switch ON the Collimator Light.

3.1 COMPUTER OPTIONS

3.1.1 EMBEDDED TOUCH SCREEN COMPUTER

The unit is equipped with a PC Touch Screen Console, a Wi-Fi connection (only for WI-FI Digital Detectors), two USB Ports, an Ethernet Connection (LAN), and a HDMI Port.



3.1.2 LAPTOP

The X-Ray Unit is equipped with a Laptop Computer for image acquisition. This is provided with WiFi connection (only for WiFi digital detectors), four USB ports, Ethernet (LAN) connection and a VGA port.

The laptop computer is placed on a protective tray that includes a key lock.

WARNING

KEEP THE TRAY CLOSED DURING TRANSPORT IN DAILY USE.

The operating application for image acquisition and processing is displayed on the laptop computer with the controls, indicators and displays necessary for performing radiographic examinations.

Note ☞

For more information about the notebook computer, refer to its manual and the Section 4.

3.2 COLUMN OPTIONS

The Column of portable X-Ray Units can be made of aluminum or steel.

3.2.1 FOLDING COLUMN

This Column is made of steel and includes options for quick disconnection and disassembly of the system for transport.

Note ☞ The folding steel Column is only compatible with touchscreen embedded computer.

3.2.1.1 X-RAY UNIT QUICK DISCONNECT

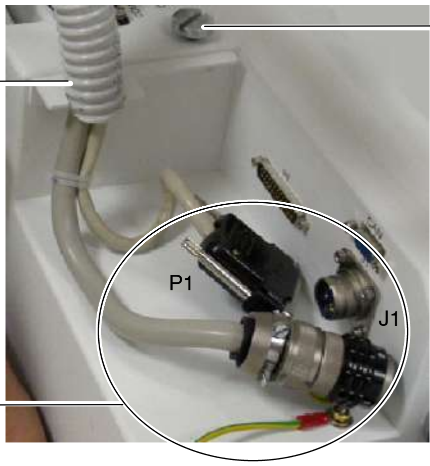
By means of this tool free disconnect feature, the user can disconnect and dismount the X-Ray Unit from the Arm.

1. With the Unit OFF, place it in Parking position, that is, with the Arm locked in the parking detent and the Safety Knob installed to prevent the Arm from springing out when removing the weight of the X-Ray Unit.

DANGER !

THE ARM MUST BE LOCKED WITH THE SAFETY KNOB WHEN THE X-RAY UNIT IS DISASSEMBLED FROM THE ARM.

2. Open the Coin Screw Lock located at the top of the Detector Assembly in order to access to the X-Ray Unit connector plate and disconnect P1 and J1.

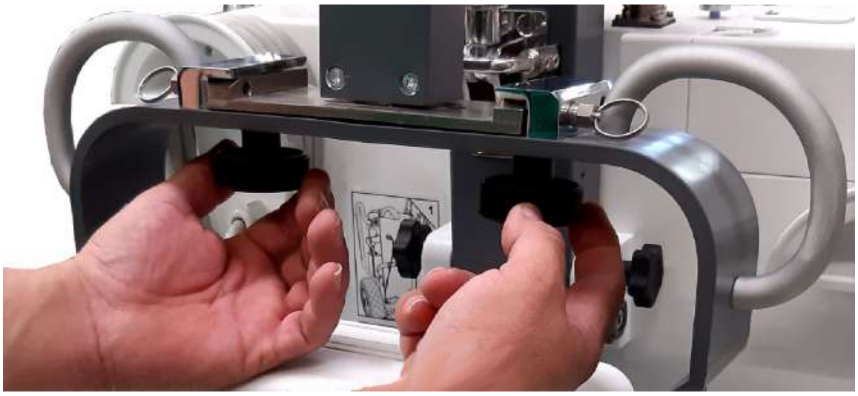


3. Carefully take out the Cable Hose from its entry.

4. Dismount the Cable Hose from the Flexible Cable Hooks. Grab the cable Hose (that goes to the X-Ray Unit) and leave it aside.

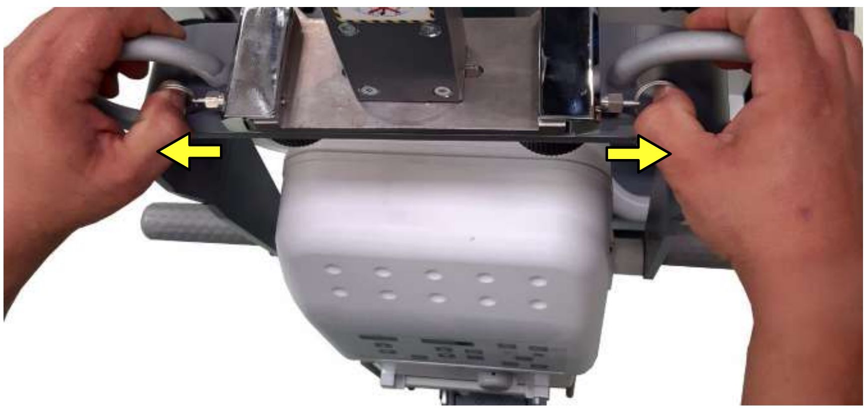
Flexible Cable Hooks

5. Unscrew both Quick Disconnect Knobs.

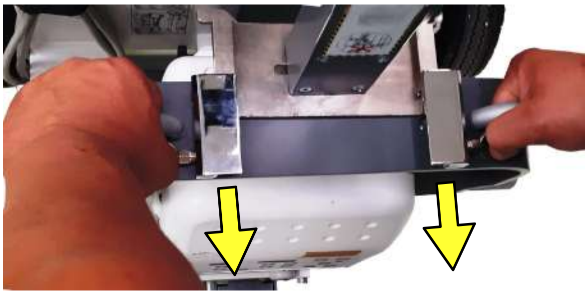


6. Grab and hold with both hands the Support Handles.

7. Pull both pin locks with both thumbs inserted in the rings in order to unlock the X-Ray Unit.



8. Carefully slide backwards the X-Ray Unit. Place it on a safe place. Keep in mind that the flexible cable is part of the X-Ray Unit.



DANGER !

THE UNIT IS COMPLETELY RELEASED AND ITS WEIGHT IS NOW IN YOUR ARMS. LET IT REST IN A SAFE AREA.

3.2.1.2 SYSTEM DISASSEMBLY FOR TRANSPORT

WARNING

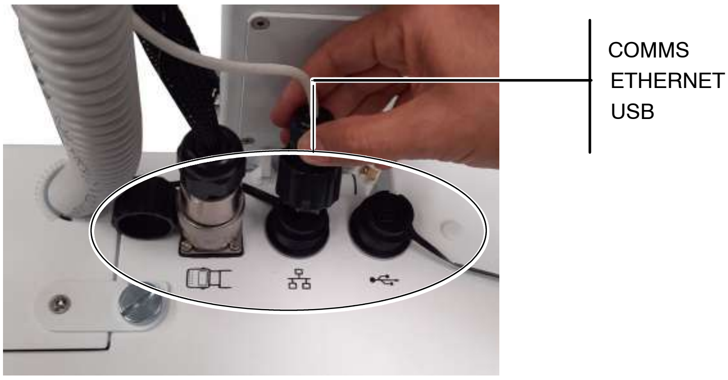
AT LEAST TWO PEOPLE ARE NEEDED TO CARRY OUT THE FOLLOWING INSTRUCTIONS.

Component disassembly is not recommended unless absolutely necessary. The Unit has been designed for transport and maximum spatial efficiency. Follow the steps below to remove the main components from the Frame.

Follow the steps to disassemble the main column elements:

- Portable X-Ray generator with handles
- Foldable column
- Detector basket
- Touch screen computer

1. Once the X-Ray Unit is dismounted as described in *Section 3.2.1.1*, disconnect the three (3) round connectors located at the top of the Detector Assembly COMMS - Ethernet - USB.



2. Dismount the PC Touch Screen. Follow the steps below:

   a. Unlock and open both hinges that attach the Touch Screen to the frame.

   b. Grab the Touch Screen with both hands and move the Touch screen upwards to the limit.

   c. Pull it in order to release it from its bracket.

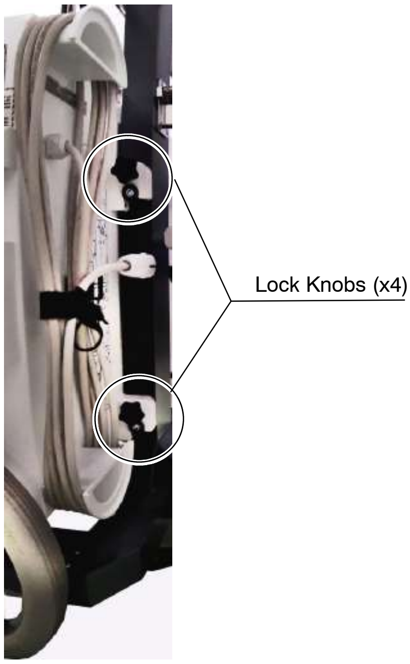
   d. Place the Touch Screen on a safe place. Do not forget that some cables are still attached to the touch screen.

a

b

c

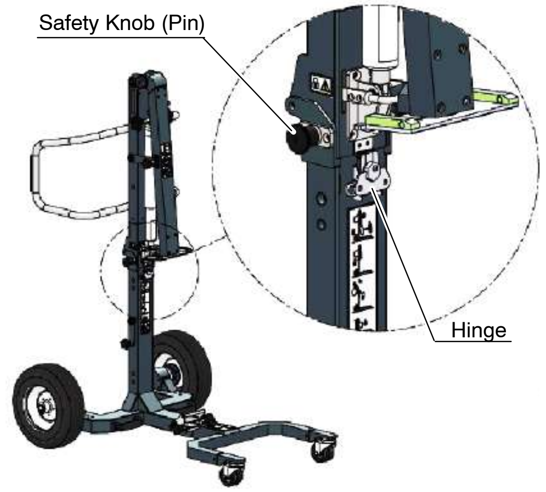
3. Dismount the Detector Basket. Unscrew the four (4) lock knobs located at both sides of the column that attach the Column of the Trolley to the Detector Basket.



4. Grab the Detector Basket with both hands from the Front Handles, lift it, and carefully carry it to a safe place.

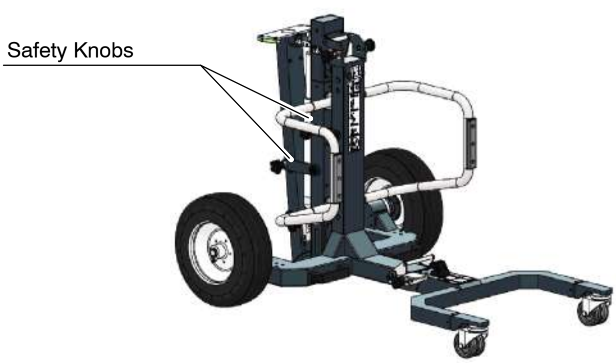
5. Fold the Column as describe below.

   a. Open the hinge and extract the safety knob pins located at both sides of the Column.



   b. Carefully fold the Column backwards.

   c. Lock the folded column with the two (2) Safety Knobs.



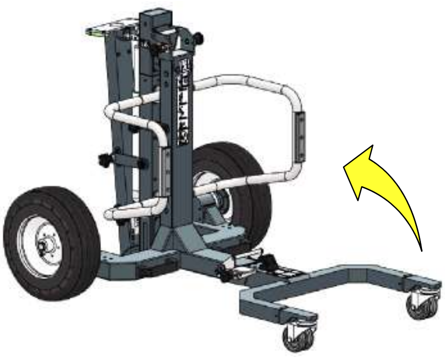
6. Fold the Leg as described below.

   a. Extract the Safety Knob (Pin).

   b. Holding the Unit from the Handle, step on the pedal. Hard the Leg falls down.

   c. Fold the Leg until it is locked in vertical position.

   d. Insert the Safety Knob (Pin).



Note ☞ *Refer to Section 3.3.3 for more details.*

7. Once the Unit is dismounted and folded, it is ready to be transported in the Double Transport Box.

3.3 MOTION AND POSITIONING

WARNING

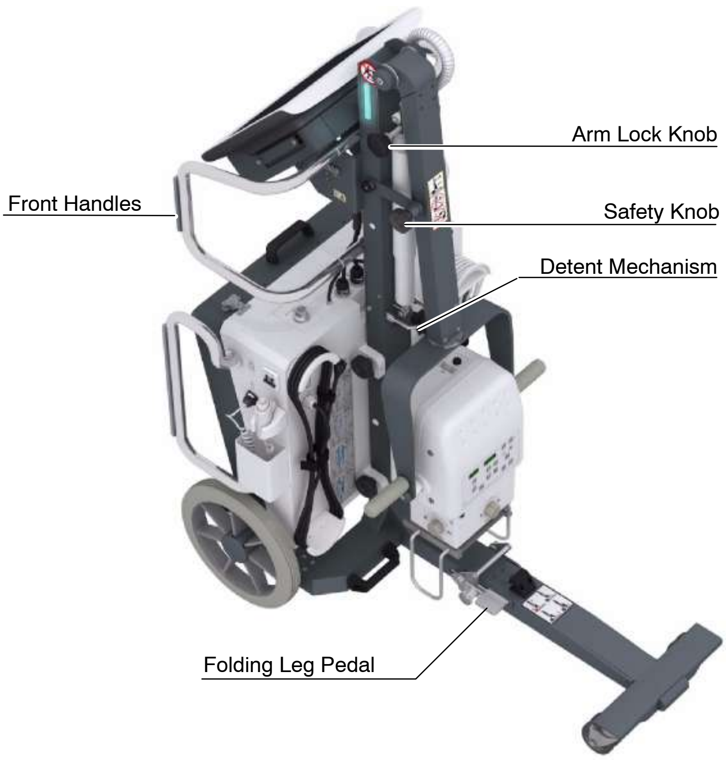
TRAVELLING MUST BE PERFORMED IN PARKING POSITION. FOR SAFETY REASONS, TRAVELLING SURFACES MUST NOT EXCEED 5º INCLINATION (RAMPS).

MONITOR ALL SYSTEM MOVEMENTS & AVOID COLLISION WITH ELEMENTS THAT MAY CAUSE EQUIPMENT DAMAGE.

MONITOR PATIENTS OR OTHER PEOPLE NEARBY TO PREVENT MOVEMENT-CAUSED INJURY. INTRAVENOUS TUBING, CATHETERS AND PATIENT CONNECTED LINES SHOULD BE ROUTED AWAY FROM MOVING EQUIPMENT.

The Front Handles are designed to facilitate sliding the Unit during vehicle loading / unloading as well as to drive the Unit on the front Casters and Main Wheels. The Brakes block the Main Wheels motion once positioned.

Position the Arm with the Positioning Grips. The Detent Mechanism and Safety Knob maintain the Arm in Parking Position while the Arm Lock Knob maintains the Arm steady during radiographic examinations.



NEVER PUSH THE UNIT LATERALLY FROM THE ARM ELBOW, IT MAY FALL DOWN AND MAY CAUSE INJURIES TO PATIENTS OR PEOPLE AROUND THE UNIT.

3.3.1 BRAKES

Both wheels include a brake. Pull the Pedals to prevent the Main Wheels movement.

Push the Pedals to release the wheels.

Push the Pedal

Pull the Pedal

3.3.2 MOVEMENTS

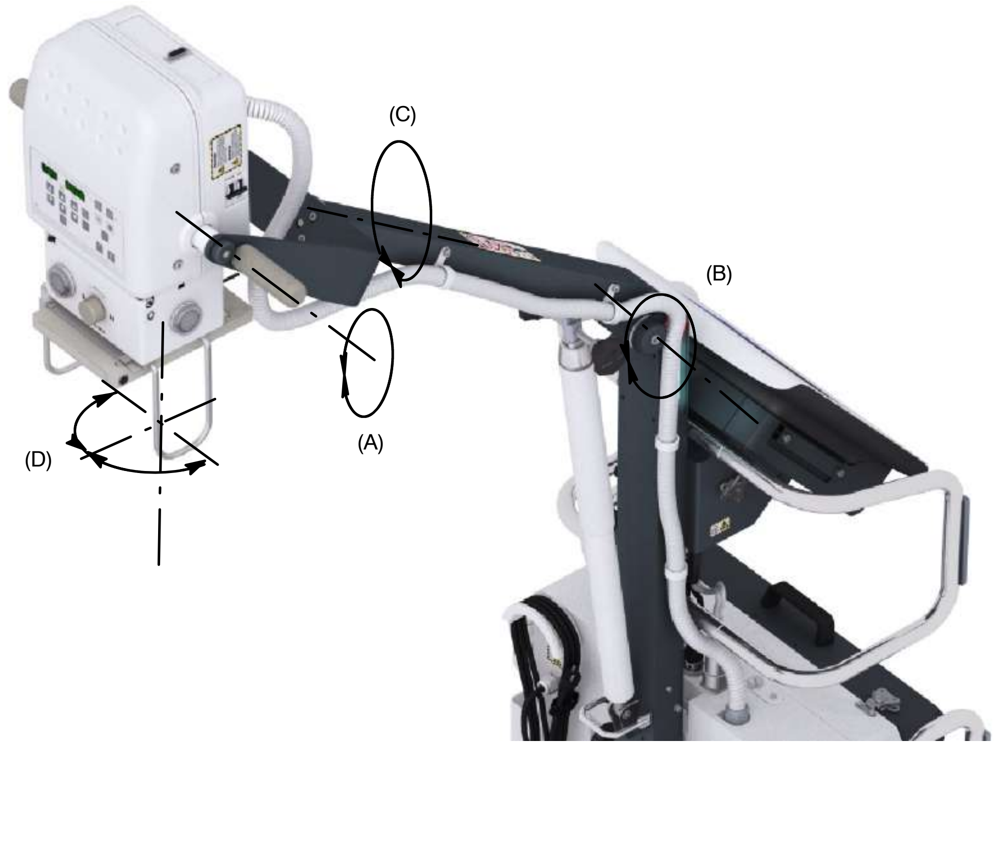
The Mobile Arm allows the following movements:

- (A) Rotation of the X-Ray Unit with reference to its Support (360º that can be limited by the SID Guard and Harness).

- (B) Vertical Movement of the Arm to lower or raise the X-Ray Unit which is used to adjust the Vertical SID.

- (C) Rotation of the X-Ray Unit Support (360º that can be limited by the Harness). This movement has detents at 0º, +90º and –90º.

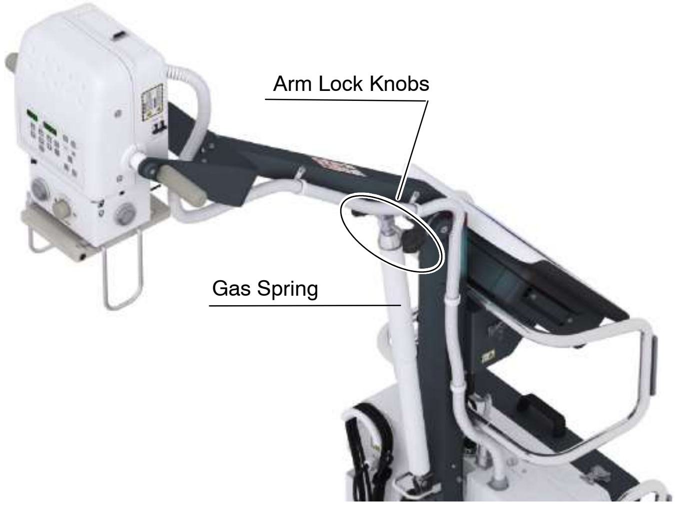
- (D) Rotation of the Collimator with reference to the X-Ray Unit (± 90º). This movement has a detent every 90º.



3.3.2.1 ARM LOCK KNOBS

The vertical movement of the Arm is locked / unlocked with the manual Arm Lock Knobs. This manual lock provides the Unit with an extra protective measure to prevent unwanted or unintended movements during examinations.

To lower or raise the Arm, turn the Arm Lock Knob to the unlock position. When the Arm has been properly positioned, place the knob in lock position (the line between the arrows in vertical position). Locking and Unlocking is as shown in the photo below.



WARNING

NEVER ATTEMPT TO UNFOLD THE UNIT IN LAYING POSITION. UNFOLD ONLY IN VERTICAL POSITION.

3.3.2.2 SAFETY KNOB

The Safety Knob is used to secure the Arm in Parking Position (coupling the Arm to the Chassis for transportation and storage).

Turning the Knob clockwise into the Arm Catch secures the Arm to the Chassis; counterclockwise releases the Arm. Whenever releasing the Safety Knob, the Arm Lock Knob must be engaged, thus preventing a springback.

Parking Position

Locked

Unlocked

3.3.2.3 PARKING DETENT MECHANISM

The Parking Detent Mechanism is designed to maintain the Arm in Parking Position and comprises the Hook and U-support.

To place the Arm into the Parking Detent Mechanism:

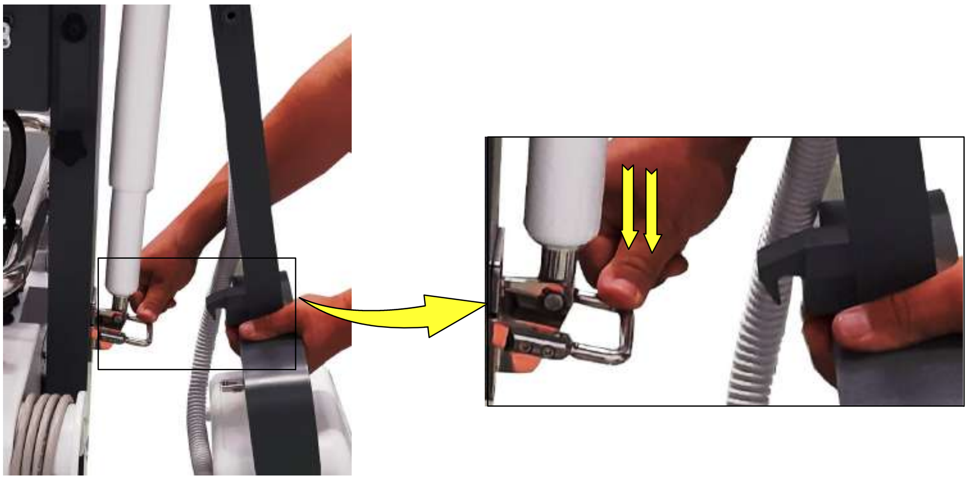
- Unlock the Gas Spring with the Arm Lock Knob.
- Push the X-Ray Unit downwards (using Grips) with both hands until the Hook grabs the U-support.

CAUTION

Control arm movements at all times when releasing the Arm Lock Knob and Parking Detent Mechanism.

To release the Arm from the Parking Position:

- The Safety Lock knob should be unlocked.
- Unlock the Gas Spring with the Arm Lock Knob.
- Push the U-support downwards with one hand while the other supports the X-Ray Unit Support.



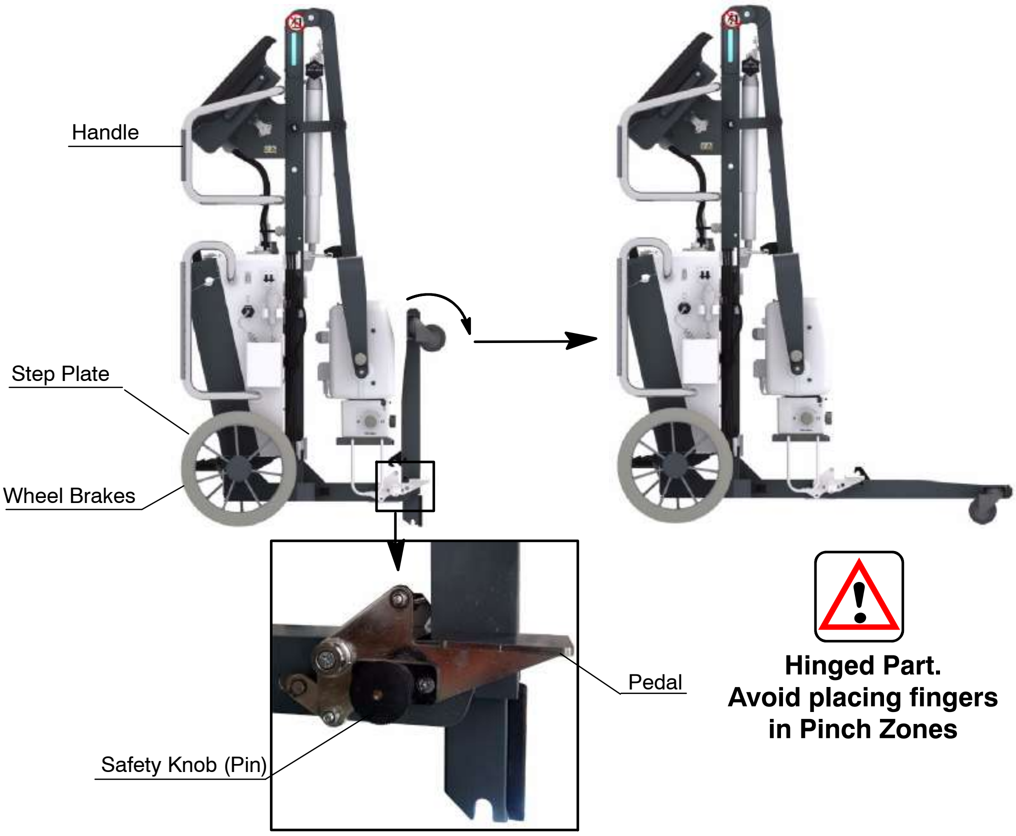
Note *To avoid damaging the Unit when travelling, always keep the Arm in the Parking Position.*

Note *Never push the unit laterally from the arm elbow, it may fall down and may cause injuries to patients or people around the Unit.*

3.3.3 UNFOLDING / FOLDING THE UNIT

UNFOLDING THE UNIT

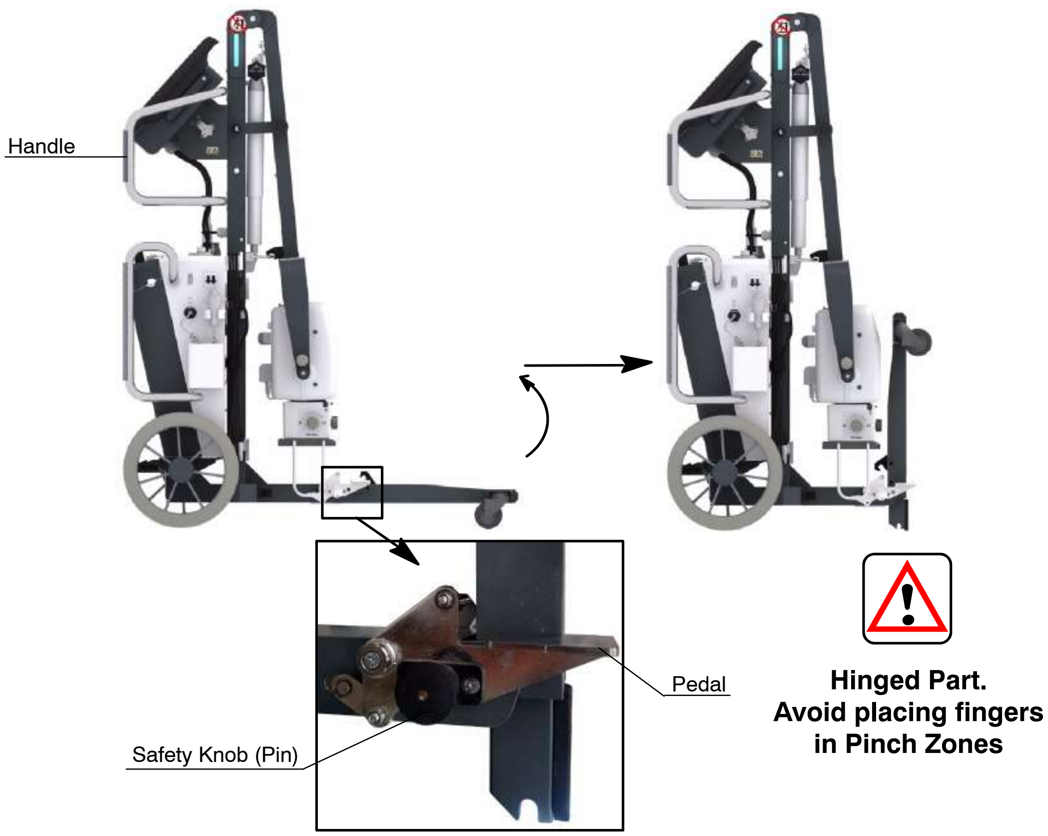
1. Unfold the Leg:
   a. Check the Arm is in Parking Position (*refer to Section 3.3.2.3*) and the wheels are locked.
   b. Extract the Safety Knob (Pin).
   c. Holding the Unit laterally from the Handle, step on the pedal.
   d. Extend the leg.
   e. Holding the Handles with both hands and stepping on the step plate, lean back the Unit slightly. The Leg automatically locks in horizontal position.
   f. Insert the Safety Knob (Pin).



2. Unfold the Arm:
   a. Unscrew the Safety Knob from the Arm (*refer to Section 3.3.2.2*).
   b. Release U-Support from Parking Detent (*refer to Section 3.3.2.3*).
   c. Hold the Positioning Grips to prevent spring back.
   d. Turn the Gas Spring Knob and position the Arm.

FOLDING THE UNIT

1. Place the Unit in Parking Position (*refer to Section 3.3.2.3*) and lock both wheels with the Brakes.
2. Extract the Safety Knob (Pin).
3. Holding the Unit from the Handle, step on the pedal. Hard the Leg falls down.
4. Fold the Leg until it is locked in vertical position.
5. Insert the Safety Knob (Pin).



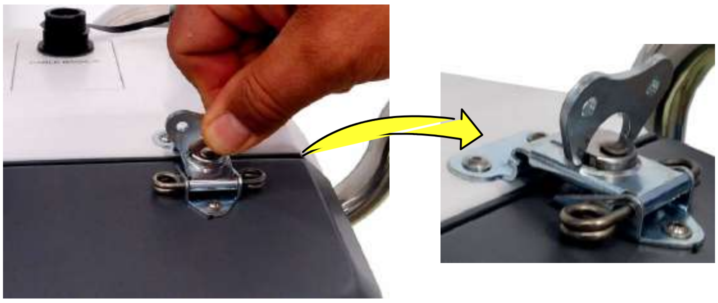
3.4 DETECTOR BASKET

The Detector Basket safely houses the Digital Detector and the antiscattering Grid (if applicable).

The Hatch should be locked for a safe transport. To remove or insert the Detector/Grid from the Basket, follow the instructions below and learn how to unlock the Hinge Lock and open the Hatch.

1. Place the Hinge Lock Key vertical.
2. Turn the Key counterclockwise to open the catch.
3. Lift the Hinge Lock and repeat the steps 1 and 2 for the other Hinge Lock.
4. Open the Hatch of the Detector Basket.

1



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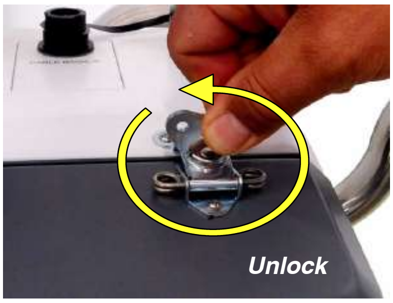

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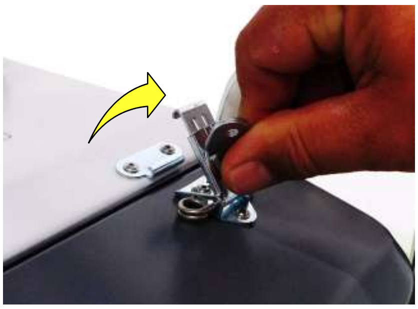
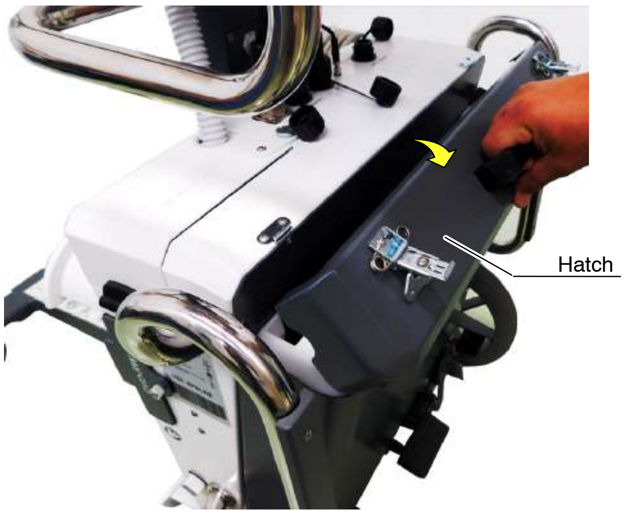


4



The Detector Basket may be optionally provided with a Detector Charger Connector.

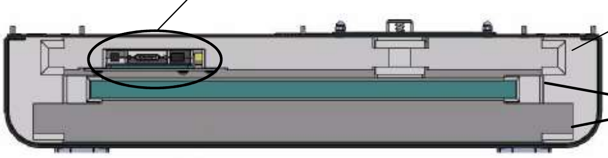
Example of Detector basket with Detector Charger

Two types of detector baskets are available:

- **Charging Panel**

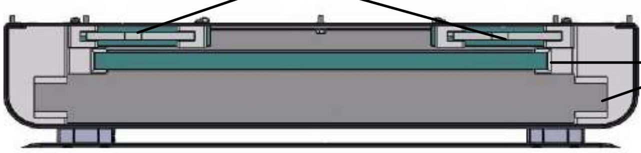
1. Slot for panels storage 43 x 43 cm (17'' x 17'') or 35 x 43 cm (14'' x 17'').

2. Slot for charging both panels.



Note ☞ *Detectors must be removed from the charging slot and place them in the storage slots to close the detector basket.*

- **No Charging Panel**
  - Slots for panels storage 43 x 43 cm (17'' x 17'') or 35 x 43 cm (14'' x 17'').



Detector Basket Hatch is available with an opening to allow the internal storage of the Detector Frame with Handle in case of large panels of 43 x 43 cm (17” x 17”).

Illustration 3-1
Detector Baskets Types

Detector Basket with standard Hatch — Detector Basket with opening Hatch

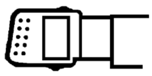
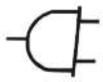
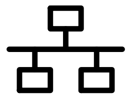
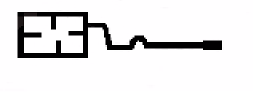
DANGER !

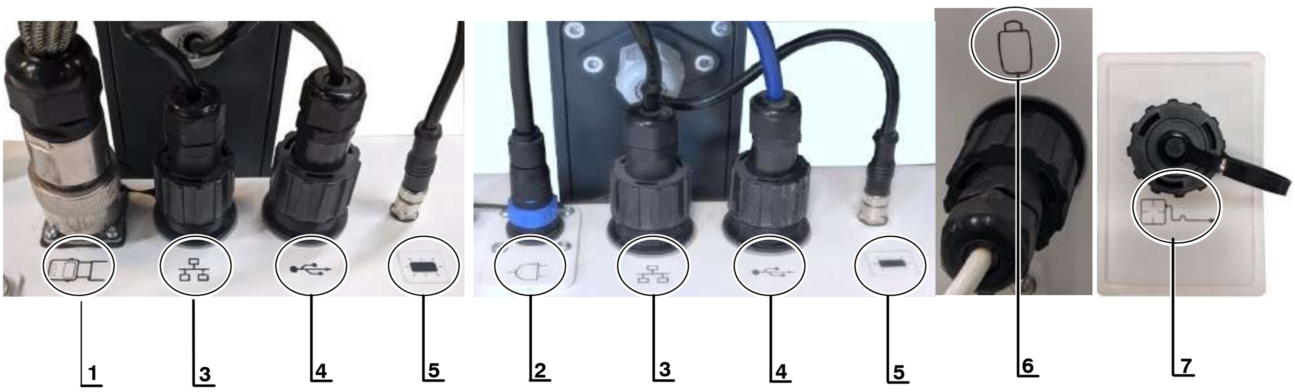
WHEN THE DETECTOR BATTERY IS BEING CHARGED INSIDE THE DETECTOR BASKET, PART OF THE DETECTOR IS OUTSIDE IT. DO NOT TRY TO CLOSE THE DETECTOR BASKET HATCH OR THE DETECTOR COULD BE SERIOUSLY DAMAGED.

3.4.1 CABLE CONNECTORS SYMBOLS

These symbols, which correspond to the connector of each cable, are located on the top and side of the detector drawer of the X-Ray Unit.

Table 3-1
Cable Connectors Symbols

	SYMBOL	DESCRIPTION
1		COMMS - COMMUNICACIONES
2		POWER SUPPLY
3		ETHERNET
4		USB
5		BEACON LIGHT
5		BACKUP CABLE
6		HANDSWITCH



3.5 POWER ON / OFF

The Unit should be plugged into a wall socket that accomplishes local regulations and electrical requirements of the equipment (*refer to Section 9 for Technical Specifications*). The Power Line Cable can only be replaced by the Service Personnel. The plug is the device used as a means of disconnecting the Unit from mains. Position the Unit so that the plug can be easily disconnected.

WARNING

FOR SAFETY REASONS AND FOR PROPER FUNCTIONING, MAKE SURE THAT THE UNIT IS CONNECTED TO A STANDARD OUTLET WITH GND.

3.5.1 POWER ON ROUTINE

Illustration 3-2
Power ON routine

1

Plug in the unit.

2

Switch on the general circuit breaker.

3

Switch on the X-Ray Unit. If the unit is not activated, a beep will be emitted when the X-Ray unit is turned on.

4


Turn on the touch screen computer or laptop.

5


When the computer is switched on, a start-up routine takes place until the *Primo S* application login screen appears. Enter the user name and password to start the application.

3.5.2 POWER OFF ROUTINE

Illustration 3-3
Power OFF routine

1

Switch OFF the X-Ray Unit Circuit Breaker

2

Press the Shutdown button of *Primo S* in the Login screen, confirm the action in the dialog box and wait for the Console to turn off.

3

Switch OFF the General Circuit Breaker.

4

Unplug the Unit.

3.5.3 HIBERNATION MODE (ONLY FOR UNITS WITH EMBEDDED COMPUTER WITH TOUCHSCREEN)

Hibernation mode of the PC Touch Screen means that the PC Touch Screen uses almost 0% power and the later powering on will take less.

When the Unit stops receiving electricity (e.g. it is unplugged from mains, failure of mains supply, etc.), a warning informing about the hibernation of the PC will be displayed:

WHENEVER THE X-RAY UNIT IS BEING USED, KEEP IT CONNECTED TO MAINS. IN CASE IT IS NECESSARY TO UNPLUG THE UNIT, PREVIOUSLY SAVE AND EXIT THE X-RAY STUDY.

When the PC is in Hibernation mode, switch OFF the Circuit Breakers before unplugging the Unit for a safe use of the X-Ray Unit.

To power on the Unit after hibernation mode:

1. Connect the Unit to Mains.
2. Switch ON the General Circuit Breaker.
3. Switch ON the X-Ray Unit Circuit Breaker.
4. Press the ON/OFF button located at the bottom of the PC Touch Screen.

5. Wait a moment. The Unit will be operative quickly.

3.5.4 AUTOMATIC LINE POWER DETECTION SYSTEM

By means of this System, the Unit detects the maximum operative Power Line adapting the Exposure Parameters to the Power available and avoiding undesired line breakdowns when operating with poor electricity lines.

Note ☞ *This procedure is performed using the Control Panel of the X-Ray Unit. For more information refer to Section 6.2.*

3.5.5 MANUAL POWER REDUCTION

The operator may select the maximum Power percentage used by the Unit in order to avoid blown fuses or Circuit Breakers jumping in insufficient or poor electricity lines.

Note ☞ *This procedure is performed using the Control Panel of the X-Ray Unit. For more information refer to Section 6.4.*

3.6 RADIOGRAPHIC CONTROL

This equipment includes a embedded touch screen computer or laptop computer with *Primo S* and a X-Ray Control applications. (*Refer to Section 4* more information).

The X-Ray Unit also includes a Control Panel with controls, indicators and displays needed to perform radiographic exams and service tasks. (*Refer to Section 6 for description*).

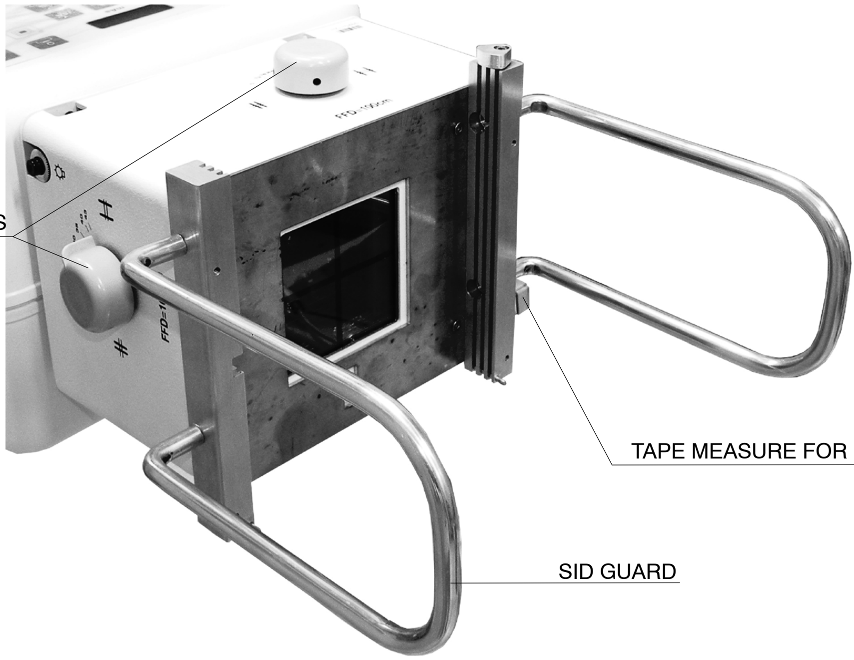
3.7 COLLIMATOR

Collimator controls consist of a push-button to switch ON / OFF the Collimator Light (located on the Control Panel and on the Collimator Assembly) and two knobs to open or close the internal blades of the Collimator.

The Collimator is supplied with a SID Guard, Aluminium Filters and DAP Rails. *(Refer to Section 3.7.1)*

The retractable Collimator Tape Measure indicates the distance from the Focal Spot (X-Ray Source) to the Reception Area (SID).

Illustration 3-4
Collimator Controls



COLLIMATOR LIGHT: After pressing this push-button on the Control Panel of the X-Ray Unit, the Collimator Light remains ON for 30 seconds before the light switches OFF automatically. The operator can turn it OFF at any moment within this lapse by pressing the *“Collimator Light”* push-button again. The ON time may also be configured between 10 and 50 seconds by the engineer during the installation.

Collimator Light may also be switched ON / OFF by pressing the Handswitch *“Collimator Light”* button.

COLLIMATOR LIGHT WITH LASER POSITIONER (OPTIONAL): After pressing the Collimator Light push-button, a cross-shaped Laser light points at the patient in the middle of the Collimator Light field. They remain lighting for 30 seconds before they switch OFF automatically. The ON time may also be configured between 10 and 50 seconds by the engineer during the installation.

The Laser pointer also lights when the Handswitch *“Collimator Light”* button is pressed.

COLLIMATOR CONTROL KNOBS: These knobs are used to open or close the Collimator blades in order to limit the X-Ray beam. The final image field may be checked switching on the Collimator Light.

The numbers located around these knobs show the Collimator opening to be set to open the blades according to the SID (Source-Image Distance) and image size to be used.

CAUTION

In order to apply the lowest Dose to patient, it is recommended to use the larger SID that image size allows.

Table 3-2
Image Size according to the SID and Collimator Opening

COLLIMATOR OPENING	SID		
	90 cm (36")	**100 cm (40")**	**180 cm (72")**
13	11.5 cm (4.5")	13 cm (5")	23.5 cm (9.5")
18	16 cm (6.5")	18 cm (7")	32.5 cm (13")
24	21.5 cm (8.5")	24 cm (10")	43 cm (17")
30	27 cm (11")	30 cm (12")	54 cm (21.5")
35	31.5 cm (12.5")	35 cm (14") *	63 cm (25")
40	36 cm (14.5") *	40 cm (16") *	72 cm (29")
43	38.5 cm (15.5") *	43 cm (17") *	77.5 cm (31")

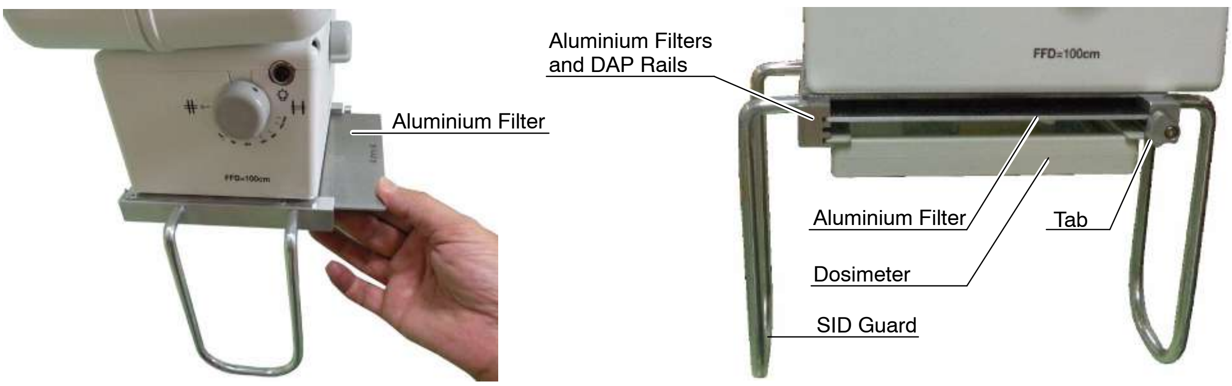
IMAGE AREA: The Collimator projects a lighted area with reference axis on the image reception area that coincides with X-Ray projection area.

3.7.1 SID GUARD, ALUMINIUM FILTERS AND DOSIMETER

The Unit is supplied with a SID Guard with rails for accessories (Dosimeter and Aluminium Filters).

To place the Aluminium Filter and the Dosimeter, insert them in the rails and lock them with the tab as shown in the illustration below.

Illustration 3-5
Aluminium Filters and Dosimeter



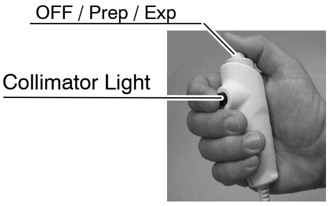
Note ☞ *For more information on Dosimeter and Aluminium Filters, refer to Section 3.10.1.*

3.8 RADIOGRAPHIC EXPOSURES

Radiographic exposures can be made with the X-Ray handswitch or the X-Ray footswitch, which are connected to the side of the X-Ray unit detector.

As an option, it can be equipped with an infrared remote control.

3.8.1 X-RAY HANDSWITCH



Radiographic exposures may also be initiated with the X-Ray handswitch which is connected to the Control Panel.

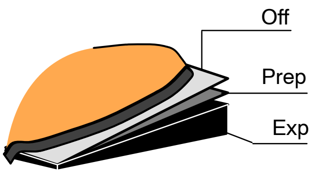
PREP: Press the Handswitch button half-way (*"Prep"* position) to prepare the X-Ray Tube for exposure.

EXP: After the "*Ready*" indicator is illuminated, fully press the Handswitch button to start an X-Ray exposure.

The "*X-Ray ON*" indicator remains illuminated and a sound is emitted during the length of the exposure.

COLLIMATOR LIGHT: This X-Ray Handswitch includes an extra *"Collimator Light"* button that helps patient positioning. Pushing this button will turn ON the Collimator Light.

3.8.2 X-RAY FOOTSWITCH



Radiographic exposures may also be initiated with the X-Ray footswitch which is connected to the Control Panel.

PREP: Press the footswitch button half-way (*"Prep"* position) to prepare the X-Ray Tube for exposure.

EXP: After the "*Ready*" indicator is illuminated, fully press the footswitch button to start an X-Ray exposure.

The "*X-Ray ON*" indicator remains illuminated and a sound is emitted during the length of the exposure.

3.8.3 INFRARED REMOTE CONTROL

CAUTION

Before starting the exposure, make sure that there is no other equipment operating with an IR remote control at the same time either near it or behind leaded glass windows or partitions. Before making an exposure with this device, turn off any other portable X-ray unit operating with infrared remote control that could be affected by this exposure control.

Note ☞

In case of having more than one portable X-ray unit, the service personnel shall ensure that the infrared remote controls are coded to control only the corresponding X-ray unit.

The infrared remote control allows the operator to perform long-distance exposures, which helps to protect the operator from radiation.

WARNING

DURING AN EXPOSURE, THE IR REMOTE CONTROL MUST BE POINTED DIRECTLY AT THE PORTABLE X-RAY UNIT AT ALL TIMES.

The IR receiver sensor is located on the top of the detector drawer.

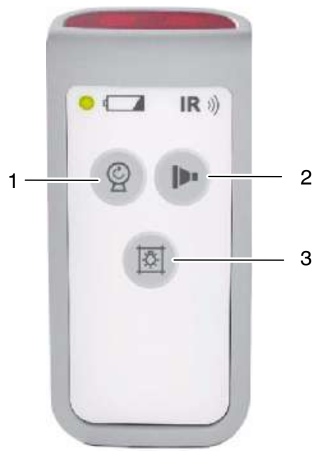
The battery indicator lights up when the battery power is low and needs to be replaced (2 AAA batteries). The batteries can be replaced by the user.

When the infrared remote control is not in use, it must be placed in its cradle.

If the infrared remote control is not returned to its cradle within three (3) minutes of its removal from the cradle, the remote control locator function will be activated and the portable X-Ray unit will beep. The infrared remote control will beep continuously until it is placed back in its holder.

COLLIMATOR LIGHT BUTTON

Press this button (3) to turn on the collimator light..



1 “Prep” button

2 “Exp” button

3 Collimator light button

OPERATION

Follow the steps below to make an exposure with the infrared remote control:

1. Remove the remote control from its cradle.

2. Aim the remote control at the IR receiver sensor on the portable X-ray unit from a maximum distance of 10 meters.

3. Press the "Prep" button (1 in the previous illustration). The "Prep" status is maintained for 15 seconds until the "Exp" button is pressed.

Note ☞ *Before making an exposure with the infrared remote control, make sure that the system is "Ready" for exposure.*

4. Press and hold the "Exp" button (2) until the portable X-ray unit completes the exposure.

Note ☞ *If this button is released while an exposure is being made, the exposure is automatically aborted.*

5. Return the remote control to its holder on the portable X-ray unit.

Note ☞ *For more information about the exposure process, refer to Section 3.8.*

Note ☞ *If the unit has the beacon LED illumination option, the light will indicate the status of the system. For more information, refer to Section 3.10.1.*

3.9 OPTIONS AND ACCESSORIES

3.9.1 OPTIONS

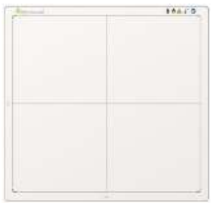
3.9.1.1 COMPATIBLE DIGITAL DETECTORS

Wireless Detectors available: AR-A3543W, AR-A4343W, Mars1417V, Mars1717V, Mars 1417X, Mars 1717X and FDX2530RPW.

AR-A3543W

AR-A4343W

Mars 1417V



Mars 1717V

Mars 1417X

Mars 1717X

3543EZ

3543DR

FDX2530RPW

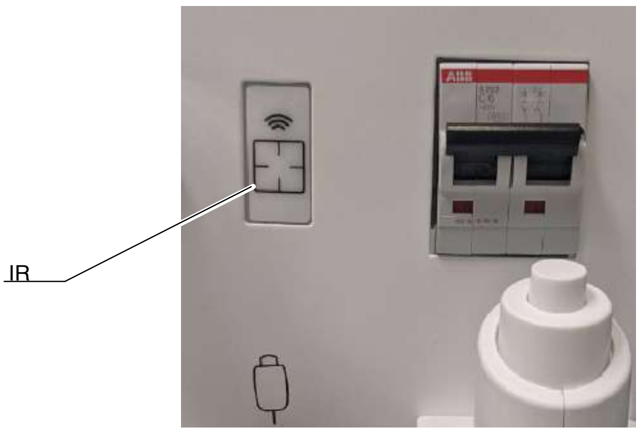
Generally, Digital Detectors are wireless devices that communicate with the Portable X-Ray Unit via an internal wireless Access Point. Some Digital Detectors are already provided with their own Access Point and do not need an internal Access Point.

As an option, the Unit can be provided with a detector communications cable (**Cable Backup**).

Illustration 3-6
Optional Backup Cable

The Portable X-Ray Unit is equipped with an IR Data Communication unit, used to register the Detector to the Portable unit by infrared communication.

Illustration 3-7
IR Data Communication Unit



USING AND MAINTAINING THE DIGITAL DETECTOR

Before Exposure, check the equipment daily and confirm that it works properly.

The action of the Air-Conditioning or Heating may produce condensation in the equipment, wait until the condensation evaporates before performing an exposure. As a general rule, raise or lower the room temperature gradually to avoid condensation.

During exposure, do not use the Detector near devices generating a strong magnetic field.

For Wireless Detectors, do not cover the IR Data Port with hands or other parts of the body and do not use the selected frequency channel (2.4 GHz band) for other wireless devices.

After every examination, wipe with a cloth slightly damped the patient contact surfaces as well as the handle and Grid with disinfectants such as ethanol. For cleaning, wipe with a cloth damped in neutral detergent.

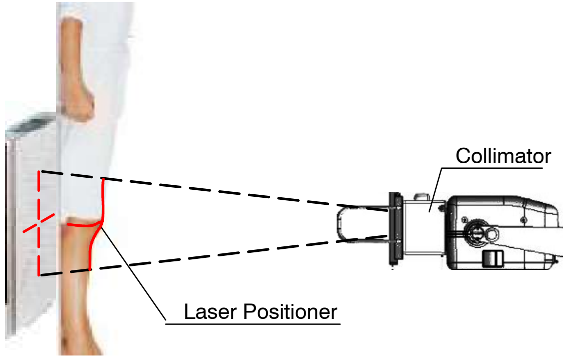
Note ☞ *For further information on the Digital Detector Handling and Maintenance, refer to the Digital Detector manuals.*

3.9.1.2 DVD-RW

This device allows the operator to record a radiographic study in a DVD.

3.9.1.3 COLLIMATOR WITH LASER POSITIONER

The Laser Positioner, a cross-shaped Laser light, is a Collimator option that helps the operator accurately center the collimator with respect to the receptor and correctly position the patient.



The Laser Positioner can be activated by pressing the *"Collimator Light"* push-button. It remains lighting for 30 seconds before it switches off automatically (lighting time can be configured from 10 to 50 seconds during installation by the Service Engineer).

The Laser Positioner also lights when the Handswitch *"Collimator Light"* button is pressed.

3.9.1.4 INCLINOMETERS

Three Inclinometers are optionally added to the X-Ray Unit: one Inclinometer is located on the front side and one Inclinometer at every lateral sides.

They show the angle inclination of every side, helping the operator position the X-Ray Unit.

3.9.1.5 Y-SHAPED OR T-SHAPED FOLDING LEG WITH CASTERS

Designed for improved Undertable positioning, the Y-shaped Folding Leg works best when performing studies with single leg radiographic tables while the T-Shaped folding leg fits the rest of radiographic tables.

T-Shaped folding leg

Y-Shaped folding leg

3.9.1.6 WHEELS

There are two types of Wheels:

- **STANDARD**
- **ALL-TERRAIN**

Standard Wheel

All-Terrain Wheel (Flat-free)

Table 3-3
Wheels Specifications

Type	Diameter	Width	Weight
Standard	315 mm (12.4”)	42 mm (1.65”)	1.5 kg (3.30 lbs)
All-Terrain (Flat-Free)	315 mm (12.4”)	100 mm (3.9”)	3.5 kg (7.71 lbs)

3.9.1.7 LATERAL MOVEMENT MECHANISM

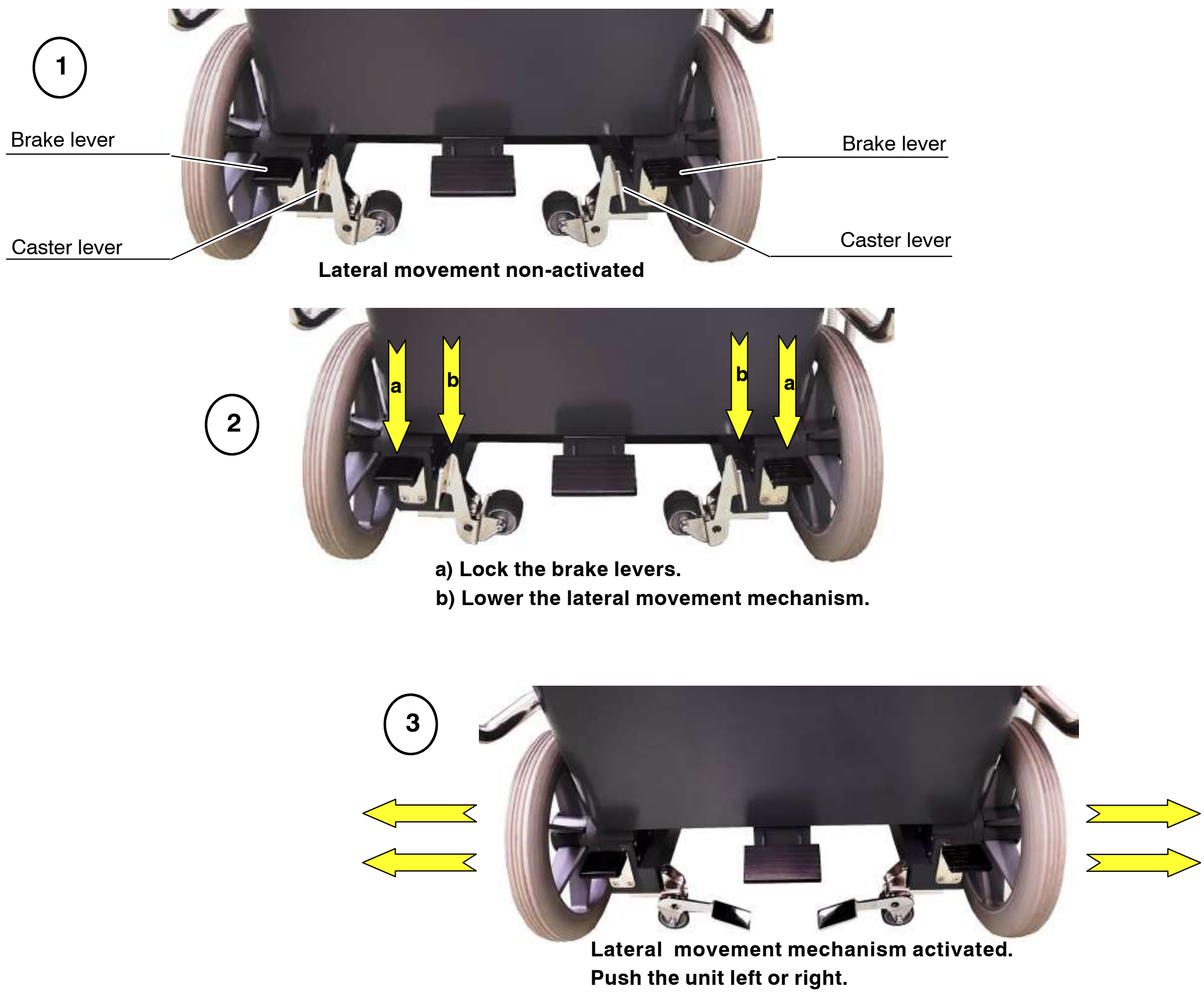
This option has been designed to permit storage and precise lateral movements. The pictures below illustrate the lowering and raising of the casters.

WARNING

LOCK THE BRAKES BEFORE LOWERING THE LATERAL MOVEMENT MECHANISM, OTHERWISE, UNWANTED MOVEMENT COULD OCCUR.

Pressing down forcefully on the levers will lower the casters, lifting the regular wheels off the ground. To raise the casters (returning the regular wheels to the ground), lift the levers upward.

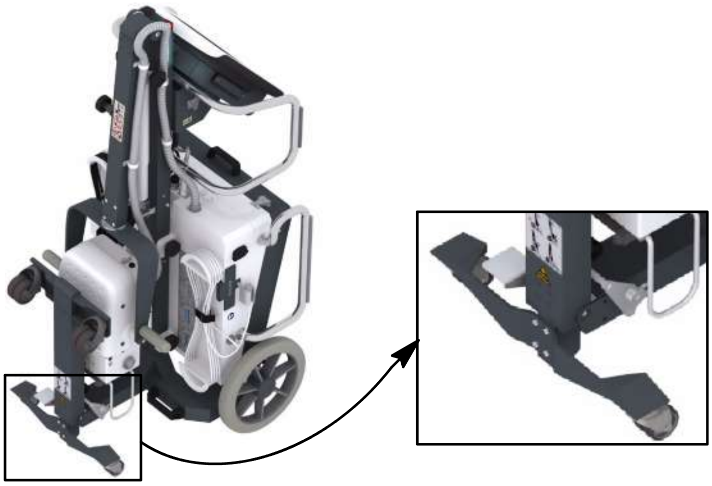
Illustration 3-8
Lateral Movement Mechanism activation



3.9.1.8 WHEELS FOR MOTION WITH FOLDED LEG

The Wheels for Motion with folded Leg are designed to facilitate motion of the Unit in narrow spaces, thus avoiding bumps with the extended Leg in furniture or corners.

Refer to Section 3.3.3 on how to fold the Leg.



3.10 LED BEACON LIGHTS (OPTION)

The unit with Wireless Detectors can be provided with LED Beacon Lights, placed under the Control Console frame, indicating different status.

LIGHTS OFF → SYSTEM NOT PREPARED.
The LED Beacon lights are OFF when the Detector and/or the Generator are not prepared.

BLUE → SYSTEM PREPARED.
It lights when the Detector is ready, the RAD technique is correctly set and there is not Error or Interlock condition in the system.

GREEN → READY STATE.
It lights when the System is ready for exposure. One single action initiates the exposure (loading state).

YELLOW → EXPOSURE (LOADING STATE).
It lights during the X-Ray Exposure.

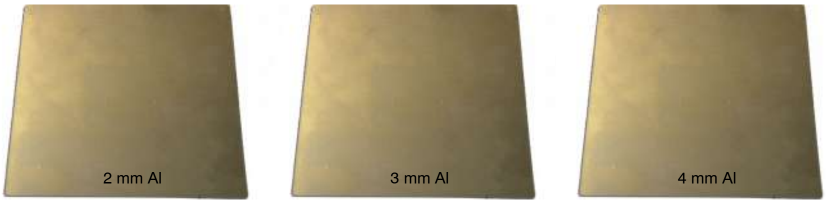
MAGENTA (BLINKING)→ ERROR / INTERLOCK (ER/IL).
It lights during an Error or an Interlock (ER/IL) condition.
The exposure is not allowed until the Error or Interlock condition disappears.

Note ☞ *For further information, refer to Section 5 about Generator and System Messages.*

3.10.1 ACCESSORIES

3.10.1.1 ALUMINIUM FILTERS

A kit comprising 2 mm, 3 mm and 4 mm Aluminium Filters may additionally be supplied with the Portable X-Ray Units.



INHERENT FILTRATION OF EXTERNAL ADDED FILTERS	
Filter	**Quality equivalent Filtration**
2.0 mm Al.	2.0 mm Al. 75 kV / HVL 2.9 mm Al.
3.0 mm Al.	2.9 mm Al. 75 kV / HVL 2.9 mm Al.
4.0 mm Al.	3.8 mm Al. 75 kV / HVL 2.9 mm Al.

3.10.1.2 DOSIMETER: VACUDAP OEM

VacuTec VacuDAP OEM

The VacuDAP OEM is a Dosimeter device related to the Collimator installed in the X-Ray Unit. It comprises a transparent square Ionization Chamber.

VacuDAP OEM is compatible with the portable X-Ray units in this manual. The dose values are displayed on the computer screen (see Section 6.8.1).

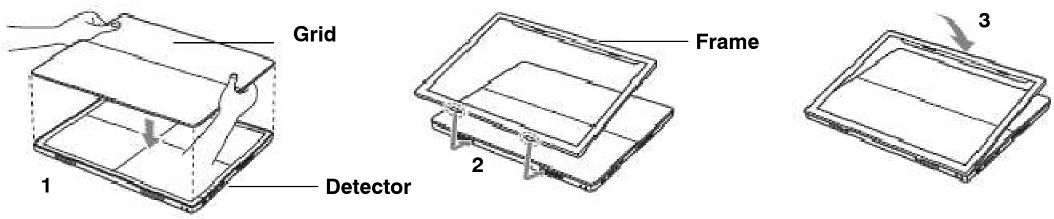
Note ☞ *Refer to the corresponding Dosimeter Manual for extended information about operation or technical description.*

3.10.1.3 REMOVABLE PROTECTIVE FRAMES AND GRIDS

Grids are intended to reduce scattered radiation and significantly enhance image quality.

Before using the Grid, clean the front and back sides with a dry cloth to remove dust and dirt.

Removable Protective Frames are prepared to hold a Grid and the Digital Detector. The following illustration is an example of Grid installation.



CAUTION

Handle the Grid with care and put it in a safe place when not in use. Dropping the Grid could cause damage and reduced image quality.

3.10.1.4 TRANSPORT BOXES

P-BOX-A

Aluminium Transport Box
with wheels and ramp

Dimensions
Length: 1710 mm
Width: 900 mm
Height: 1030 mm

P-BOX-M

Transport Box
with wheels

Dimensions
Length: 1540 mm
Width: 930 mm
Height: 960 mm

LWM-BOX-M2

Transport Boxes
with wheels

Dimensions A
Length: 1117 mm
Width: 1117 mm
Height: 901 mm

Dimensions B
Length: 939 mm
Width: 774 mm
Height: 513 mm

A

B

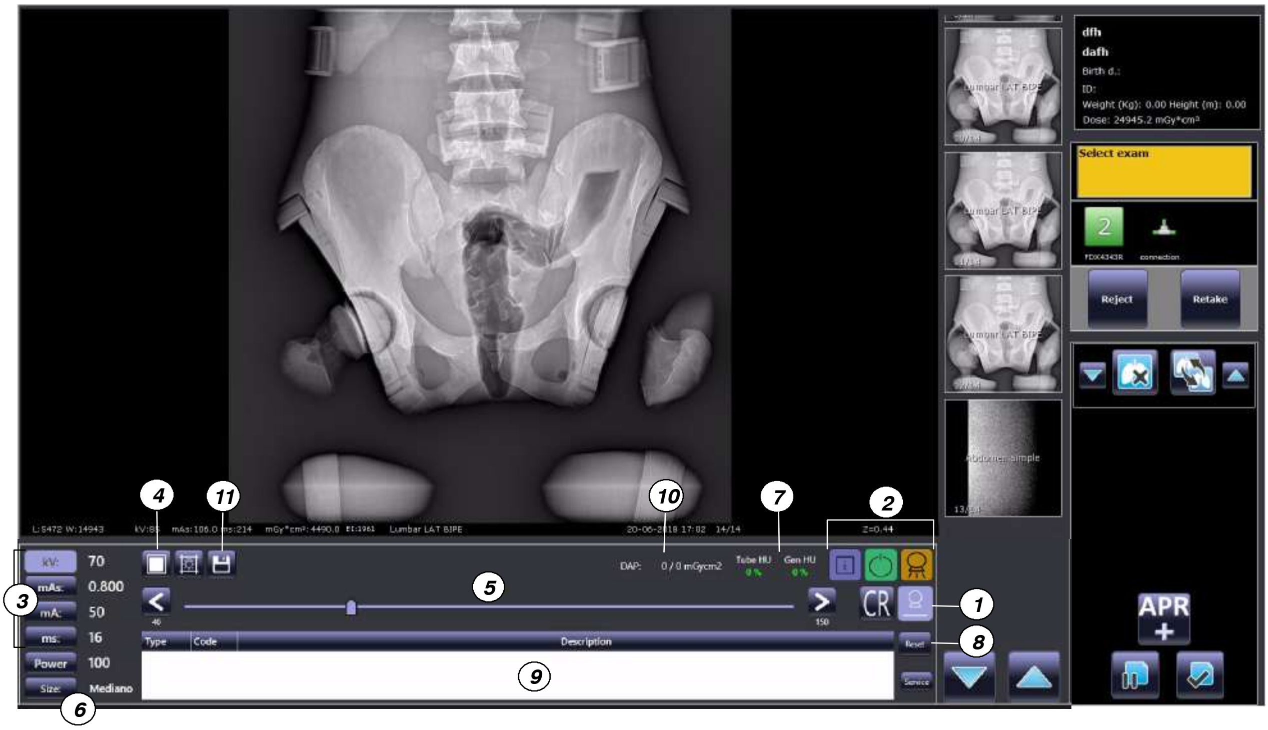
SECTION 4 IMAGE ACQUISITION CONTROL CONSOLE

All controls, indicators and displays located on the Image Acquisition Control Console are positioned depending upon their functions.

Note ☞ *Use the operating controls as described in this manual. Any other non-indicated combination may cause an incorrect operation.*

Note ☞ *For further details about operation with controls of PrimoS software, refer to PrimoS User Manual.*

Illustration 4-1
X-Ray Generator Console

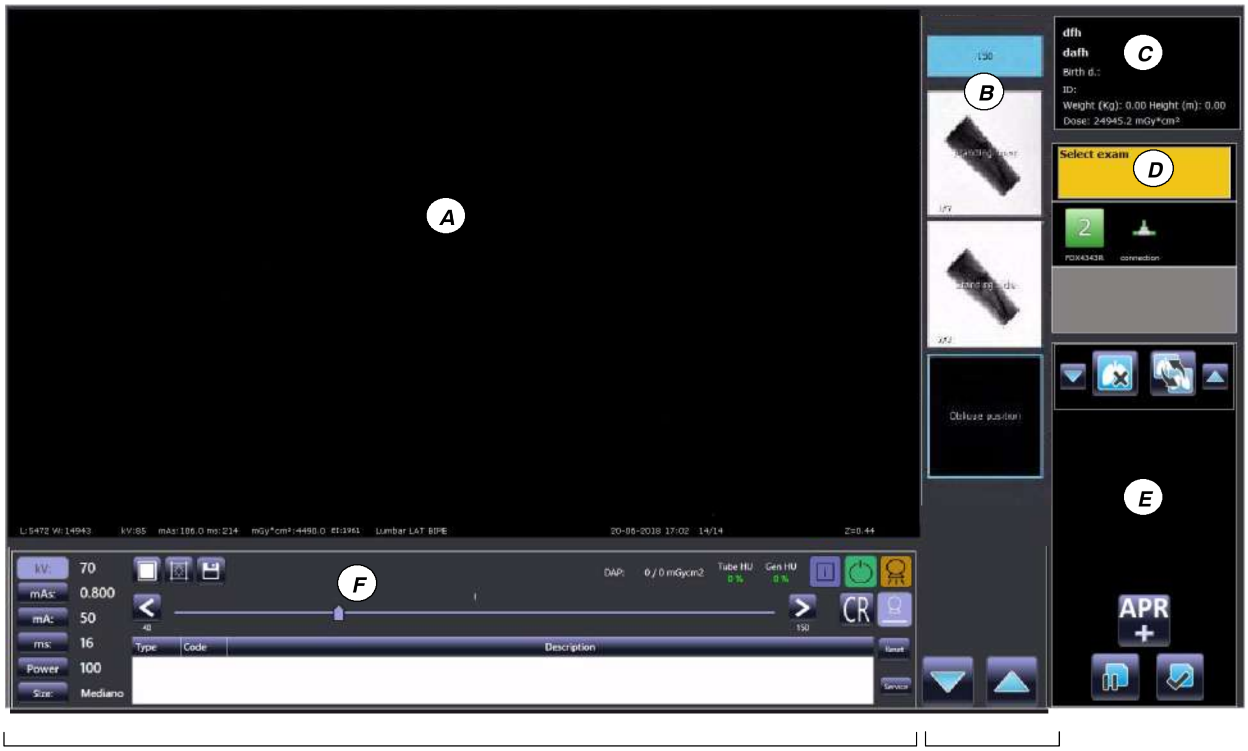


1. Workstation Selection
2. Operation Status and Exposure Indicators
3. Radiographic Parameters
4. Focal Spot
5. Radiographic Parameters Slider
6. Patient Size / Type
7. Heat Units
8. Reset Error and Details
9. Message Area
10. Dosimetry
11. Save Button

4.1 WORKING FRAME

The working frame is split into the following sections:

A. Image Area
B. Exam List / Preview List
C. Patient Data
D. Messages Area
E. Exam Management Area
F. X-Ray Generator Console



X-Ray Generator Console **Exam List**

A. IMAGE AREA

This area shows the image of the exam selected in the preview list.

B. EXAM LIST / PREVIEW LIST

When a new exam is added to the study, a black box with the name of the procedure chosen is created. When the image associated to a certain procedure is acquired, a preview of the acquired image will be displayed in the black box.

C. PATIENT DATA

This section shows the patient's personal data: patient's name (or emergency number is the emergency mode is being used), birth date, patient ID, weight (kg), height (m), and dose.

D. MESSAGES AREA

This area provides information about the status of the equipment and alarm messages, the connection status of the detector and the amount of free storage space on the archive disk.

E. EXAM MANAGEMENT AREA

This area contains keys to delete, move or add procedure to the study and to suspend or close the study.

F. X-RAY GENERATOR CONSOLE

The X-Ray Generator parameters are already set by the manufacturer for each kind of exam. The parameters can be adjusted during the installation.

4.2 X-RAY GENERATOR CONSOLE

4.2.1 OPERATING STATUS

Exposure indicators and the "*Status*" icon of the *"Generator Summary Panel"* icon can vary according to the operating status, as described below.

COLOR AND ICON	DESCRIPTION
 BLUE	**Normal status.** Communication is correct and Generator is operational. This icon also appears with information messages.
 ORANGE	**Warning Messages.** A warning notification is displayed in the Message Area.
 ORANGE	**Error.** A System failure or a Generator error / interlock is present.

When a Generator or System Message (Error, Interlock, Warning and Informational) occurs, it is shown in the "Message Area" at the bottom end of the console with the type and description of the message (*for further information about Generator and System Messages refer to Section 6.9).*

The *Reset* button, located at the right end of the Console, can be used to unlock the inhibit status of the system when an error is detected and displayed in the Message Area.

4.2.2 EXPOSURE INDICATORS

READY: Indicates that the technique selected is properly set, there are no interlock failures nor system faults, the anode is rotating and the X-Ray Tube is ready for exposure.

X-RAY ON: Indicates that the X-Ray exposure is in progress. It remains illuminated during the length of exposure. At the same time that radiographic exposure is being made, an audible signal sounds.

BEFORE PERFORMING AN EXPOSURE, IT IS THE RESPONSIBILITY OF THE OPERATOR TO CHECK THAT THE RADIOGRAPHIC PARAMETERS AND SELECTIONS ARE APPROPRIATED FOR EACH EXAM.

BE SURE THAT NO LIQUID DROPS NOR OBJECTS ON THE IMAGE ACQUISITION CONTROL CONSOLE HAVE MODIFIED THE RADIOGRAPHIC PARAMETERS / SELECTIONS.

4.2.3 WORKSTATION INDICATORS

Digital Detector | Direct CR/Film

The Workstations are configured according to the customer preferences during the installation procedure (Icon, X-Ray, Tube, Device, etc.).

Each icon corresponds to its related workstation and remains highlighted on the Generator Console when selected.

- **Digital Detector:** when selected, it is possible to make an exposure on the Detector assigned to this Workstation.
- **Direct CR / Film:** press to select direct exposure in cassette modality.

4.2.4 RADIOGRAPHIC PARAMETERS

Radiographic Parameters are divided into kV, mAs, mA, and Time (milliseconds “ms”).

kV shows:

- The radiographic kV value selected for the technique.

mAs can show:

- The radiographic mAs value selected for the technique.
- If an exposure is aborted by releasing the Handswitch button, the actual Time (ms) value flashes for two seconds, the message “*ER Exposure interrupted by the operator*” (ER50) appears in the Information Area and an alarm sounds, until the “*Reset*” control is pressed to reset the error condition.

mA shows:

- The radiographic mA value selected for the technique.

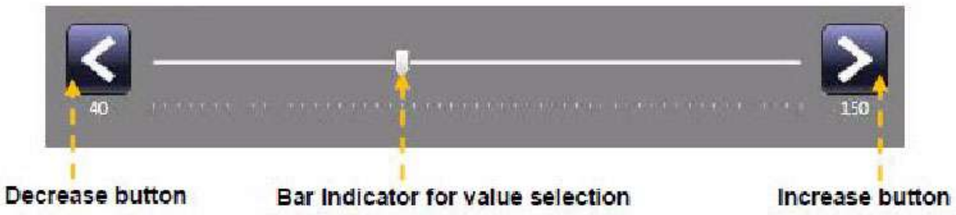
Time (ms) can show:

- The Time value (in milliseconds) selected for the radiographic technique.
- If an exposure is aborted by releasing the Handswitch button, the actual Time (ms) value flashes for two seconds, the message “*ER Exposure interrupted by the operator*” (ER50) appears in the Information Area and an alarm sounds, until the “*Reset*” control is pressed to reset the error condition.

INCREASE / **DECREASE**: Radiographic technique values are increased or decreased by selecting their respective RAD Display and changing the value with the "*Increase*" or "*Decrease*" buttons or moving the "*Slider*" position.

The value increases or decreases step-by-step each time the corresponding button is pressed, and changes faster when either of them is pressed and held.

Also, the values can be directly selected by clicking on its position on the bar. When this indicator is positioned over a value not allowed, its pointer comes back to the previous position and the parameter value does not change.



- **kV**: Selects the X-Ray Tube voltage.
- **mA**: Selects the X-Ray Tube current, changing the mAs value and keeping constant the selected Exposure Time, whenever possible.
- **mAs**: Selects the exposure in mAs, setting the maximum mA available for the selected Focal Spot and the respective Exposure Time.
- **ms**: Selects the Exposure Time in milliseconds, changing the mAs value and keeping constant the selected mA value, whenever possible.

(*Refer to Section 9 for Factor ranges*)

Note ☞

If after pressing any of these buttons, the technique value is blocked, it could mean the following:

***Radiographic Parameters Blockage**: any of the maximum or minimum radiographic parameter limits are reached.*

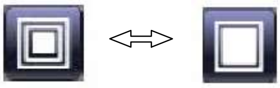
***Generator Power Limit:** generator power limit (kV x mA) is reached.*

***Space Charge:** if a variation of the kV or mA values means that the space charge limit will be reached in the selected Tube, the parameters are blocked.*

***Tube Power Limit:** if a technique reaches the power limit of the X-Ray Tube (ratings limit or the X-Ray Tube is momentarily overheated), some techniques cannot be selected.*

For further information about Generator and System Messages, refer to Section 6.9.

4.2.5 FOCAL SPOT



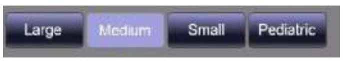
This indicator shows the selected Focal Spot of the X-Ray Tube: "*Small*" or "*Large*". The Focal Spot is changed by pressing on this indicator or selecting an mA station of the other Focal Spot. It keeps kVp and constant mAs, whenever it is possible.

Note ☞ *The Focal Spot can be changed whenever the present conditions of the X-Ray Tube allow it. The mA station set for the Focal Spot change is configured by the field engineer during the installation.*

When a Focal Spot is selected, it sets the highest mA value available for the selected Focal Spot and the respective Exposure Time in order to keep constant mAs.

The mA value available is set according to the maximum power, instantaneous power, percentage limit configured for the X-Ray Tube power, space charge, etc.

4.2.6 PATIENT SIZE / TYPE



The patient size can be selected by pressing the Size button, which will show the four available patient sizes: three for Adult (small, medium and large) and one for Pediatric. The selected size is shown on the display.

Patient size selection includes the values of pre-programmed technique parameters in the APR.

4.2.7 HEAT UNITS

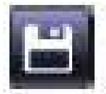
The percentage of the remaining Thermal Capacity of the X-Ray Tube and Generator are both calculated and totalled during exposures.

Gen HU: This Display shows the percentage of used Thermal Capacity of the Generator. For example, a display of *"32%"* would indicate that 32% of the Generator capacity is used. *"0%"* indicates that full capacity remains.

Tube HU: This Display shows the percentage of used Thermal Capacity of the X-Ray Tube. For example, a display of *"25%"* would indicate that 25% of the X-Ray Tube capacity is used. *"0% "* indicates that full capacity remains.

If the Unit detects that the new selection of parameters overpass the remaining Thermal Capacity, exposure is inhibited and an error *108 IL Tube Overload* appears in display accompanied by an alarm. Reduce parameter values or wait for the unit to cool.

4.2.8 SAVE BUTTON



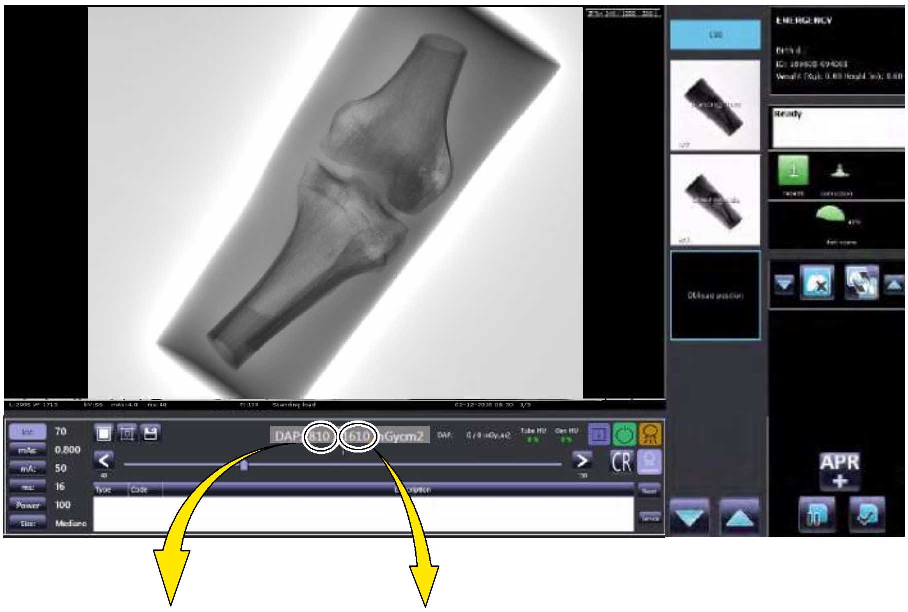
The *Save* button is only available to *Administrator* user.

If, after modifying any of the Radiographic Parameters, Focus, etc., it is necessary to save these settings so that they remain associated with the selected technique, press the *Save* button.

Note ☞ *Once the Save button is pressed, the values of the selected technique will be overwritten in the APR.*

4.2.9 DOSIMETRY (OPTION)

The Dose shows the radiation value received by the patient. Radiation measure is read as DAP value (Dose Area Product) in mGy*cm^2.



Last exposure dose   Cumulative dose

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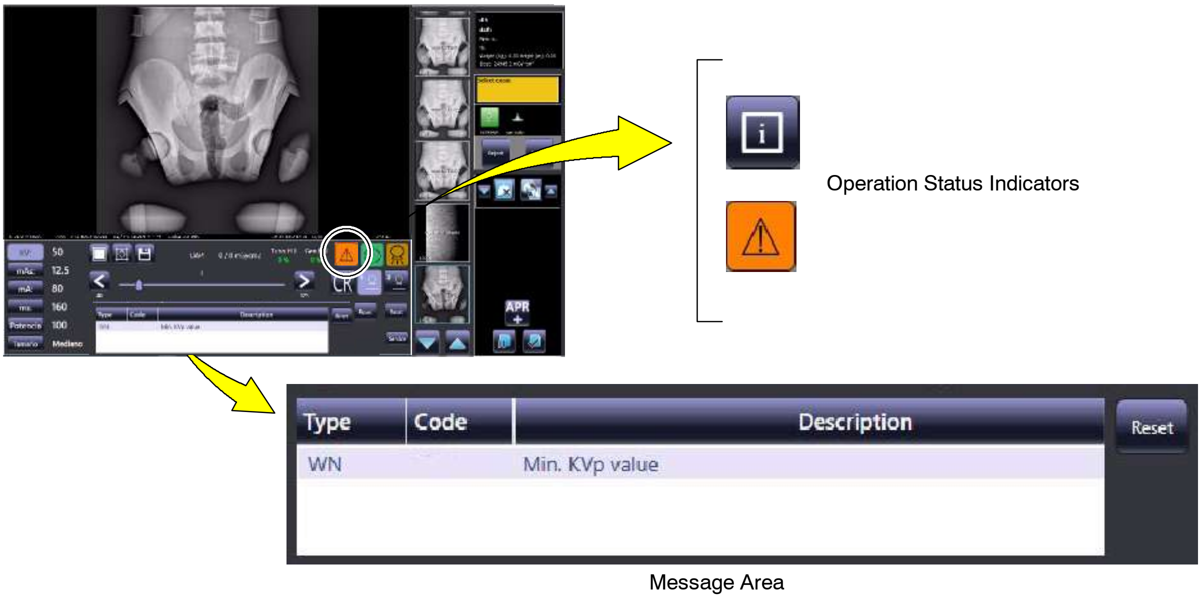
SECTION 5 GENERATOR AND SYSTEM MESSAGES

Generator and System Messages are displayed in the "*Message Area*" at the bottom of the screen, indicating the type of message and a brief description next to the "*Reset*" button.

Illustration 5-1



Generator and System Messages indicate the potential cause of an Error, a Warning condition or an Information:

BLUE

- **NORMAL STATUS**. The communication is correct and Generator is operational. By pressing this control, "Message Area" is empty showing no Error, Warning or Interlock message.

ORANGE

- **WARNING (WN-WNC):** Warning messages indicate a limit or an inhibit. The warning condition for "*WN*" codes disappears after a few seconds, whilst for "*WNC*" codes it is required in general to press the "*Reset*" control.

ORANGE

- **ERROR (ER)**: Error messages indicate the potential cause of a failure. In general, to remove the error indication, the "*Reset*" control have to be pressed.

ORANGE

- **INTERLOCK (IL)**: Interlock messages indicate a transitory situation that prevents the use of the system. This condition disappears when the cause of the inhibition expires. It is not required any user confirmation.

5.1 GENERATOR MESSAGES

Generator messages indicate the potential cause of an Error, a Warning condition or an Information, related to the Generator.

5.1.1 ERROR MESSAGES

Error messages indicate the potential cause of a failure. They are shown on the "*Information Area*" of the RAD Screen while an alarm sounds. In general, to remove the error indication on the Console press the "*Reset*" control, then the alarm goes off.

Table 5-1
Error Messages

ERROR	MESSAGE / DESCRIPTION	WHAT TO DO
No Error Code	System does not Start-up (No indication of Activity)	Ensure that the unit is connected to mains. If the problem persists, turn the Unit OFF and ON. If the equipment remains inoperative, turn it OFF and call Field Service.
ER01	Backup Timer communications error	Press the "*Reset*" push-button. If the error code persists, turn the Unit OFF and ON. If the equipment remains inoperative, turn it OFF and call Field Service.
ER02	Wrong Workstations configuration	Turn the Unit OFF and call Field Service.
ER03	No Workstation configured	Turn the Unit OFF and call Field Service.
ER04	Fluoro Signals Active during Power Up	Turn the Unit OFF and call Field Service.
ER05	Exposure Signals Active during Power Up	Release all the controls. Turn the Unit OFF and ON. If the equipment remains inoperative, turn it OFF and call Field Service.
ER06	Preparation Signals Active during Power Up	Release all the controls. Turn the Unit OFF and ON. If the equipment remains inoperative, turn it OFF and call Field Service.
ER08	Wrong tube index for X-Ray Tube 1	Turn the Unit OFF and call Field Service.
ER10	EEPROM corrupted or not initialized	Turn the Unit OFF and call Field Service.
ER11	No voltage detection in the main storage capacitors during Power Up	Turn the Unit OFF and ON. If the equipment remains inoperative, turn it OFF and call Field Service.
ER12	Tube current out of range during Power Up mA Range Error	Press the "*Reset*" push-button. Repeat exposure with same technique values, If the error code persists try exposure with another combination of technique values. If the equipment remains inoperative, turn it OFF and call Field Service.
ER13	Tube voltage out of range during Power Up kVp Range Error	Press the "*Reset*" push-button. Repeat exposure with same technique values, If the error code persists try exposure with another combination of technique values. If the equipment remains inoperative, turn it OFF and call Field Service.
ER14	Tube voltage out of range during rising time kVp Ramp Error	Press the "*Reset*" push-button. Repeat exposure with same technique values, If the error code persists try exposure with another combination of technique values. If the equipment remains inoperative, turn it OFF and call Field Service.
ER15	Large Filament Current out of range	Press the "*Reset*" push-button. If the error code persists, turn the Unit OFF and ON. If the equipment remains inoperative, turn it OFF and call Field Service.
ER16	Small Filament Current out of range	Press the "*Reset*" push-button. If the error code persists, turn the Unit OFF and ON. If the equipment remains inoperative, turn it OFF and call Field Service.
ER17	DC BUS Voltage out of range	Press the "*Reset*" push-button. If the error code persists, turn the Unit OFF and ON. If the equipment remains inoperative, turn it OFF and call Field Service.
ER19	mA detected without exposure command	Press the "*Reset*" push-button. If the error code persists, turn the Unit OFF and ON. If the equipment remains inoperative, turn it OFF and call Field Service.
ER20	kV detected without exposure command	Press the "*Reset*" push-button. If the error code persists, turn the Unit OFF and ON. If the equipment remains inoperative, turn it OFF and call Field Service.

Table 5-1 (cont.)
Error Messages

ERROR	DESCRIPTION	WHAT TO DO
ER23	EEPROM error access	Turn the Unit OFF and ON. If the equipment remains inoperative, turn it OFF and call Field Service.
ER24	Detector or bucky not ready	Press the "*Reset*" push-button. If the error code persists, turn the Unit OFF. Check cable connections of Image Receptor and turn the Unit ON. If the equipment remains inoperative, turn it OFF and call Field Service.
ER25	Large Filament current demand error	Press the "*Reset*" push-button. If the error code persists, turn the Unit OFF and ON. If the equipment remains inoperative, turn it OFF and call Field Service.
ER26	Small Filament current demand error	
ER27	Collimator light current out of range	
ER28	Collimator Light without order	
ER30	Real time Clock corrupted Wrong date/time at the RTC (Real Time Clock).	Press the "*Reset*" push-button. If the error code persists, turn the Unit OFF and ON. If the equipment remains inoperative, turn it OFF and call Field Service.
ER31	Corrupted time stamp	
ER32	Real Time Clock access error Bus I2C error while accessing the RTC.	
ER33	Communications Error Serial Communication error	
ER34	Main exposure Timer error If it activates during exposure it means that the exposure has been interrupted by the "Security Timer" because of a system failure	Turn the Unit OFF and ON. If the equipment remains inoperative, turn it OFF and call Field Service.
ER35	Bucky Motion Error The acknowledge for X-Rays from the Bucky or Flat Panel Detector has been lost before the end of the exposure	Press the "*Reset*" push-button. If the error code persists, turn the Unit OFF. Check cable connections of Image Receptor and turn the Unit ON. If the equipment remains inoperative, turn it OFF and call Field Service.
ER36	Thermal switch	This error does not require to press the "*Reset*" push-button, the signal indicator disappears automatically. Wait for the X-Ray Unit to cool. If the error code persists, turn the Unit OFF and ON. If the equipment remains inoperative, turn it OFF and call Field Service.
ER38	Chopper Error	Press the "*Reset*" push-button. If the error code persists, turn the Unit OFF and ON. If the equipment remains inoperative, turn it OFF and call Field Service.
ER39	Power supply error	
ER40	Imbalanced kVp error	
ER41	Imbalanced mA error	
ER42	Corrupted counters	
ER43	Corrupted error Log	

Table 5-1 (cont.)
Error Messages

ERROR	MESSAGE / DESCRIPTION	WHAT TO DO
ER44	Digital Potentiometer access error	Press the “*Reset*” push-button. If the error code persists, turn the Unit OFF and ON. If the equipment remains inoperative, turn it OFF and call Field Service.
ER45	Multiplexer access error	
ER46	I2C Bus error	
ER47	Corrupted APR Lite	Press the “*Reset*” push-button. If the error code persists, turn the Unit OFF and ON. If the equipment remains inoperative, turn it OFF and call Field Service.
ER48	Bucky or detector interface not available	
ER49	Exposure Timeout Error mAs-Meter Error	Press the “*Reset*” push-button. Check the selected parameters and modify them. In case of poor electricity line reduce the mAs (mA / exposure time) or connect the Unit to a better power line (*refer to Section 6.3*). Try a new exposure. If the error code persists, turn the Unit OFF and ON. If the equipment remains inoperative, turn it OFF and call Field Service.
ER50	Exposure interrupted	Press the “*Reset*” push-button. If the error code persists, turn the Unit OFF and ON. If the equipment remains inoperative, turn it OFF and call Field Service.
ER51	Exposure time unreachable	Press the “*Reset*” push-button. Change the exposure parameters. If the error code persists, turn the Unit OFF and ON. If the equipment remains inoperative, turn it OFF and call Field Service.
ER53	Fluoro Sync Error The timeout for receiving the Fluoro synchronism pulse has elapsed	Press the “*Reset*” push-button. If the error code persists, turn the Unit OFF and ON. If the equipment remains inoperative, turn it OFF and call Field Service.
ER60	Autocalibration error The preprogrammed Exposures for Autocalibration have finished without finding the corresponding Stations.	This Error only affects Service Engineer during Autocalibration Process. *Refer to Service Manual.*
ER95	Line impedance test fails	Perform the Automatic Line Power Detection procedure if it has not been done previously. If the error persists, turn the Unit OFF, change the Unit plug to another socket line and try again the Automatic Line Power Detection procedure. If the Error persists turn it OFF and call Field Service.
ER117	Error opening Com Port	This Error only affects Service Engineer during software update.

5.1.2 INTERLOCK MESSAGES

Interlock messages indicate a transitory situation that prevents the use of the system.

This condition disappears when the cause of the inhibition expires.

Table 5-2
Interlock Messages

CODE	MESSAGE / DESCRIPTION	ACTION
IL103	**Generator Overload**	If the message persists, turn the Generator OFF and ON. If the equipment remains inoperative, turn it OFF and call Field Service.
IL106	**Thermal Switch**.	If the housing is too hot, wait for the housing to cool. If the housing is cool, call Field Service.
IL108	**Tube overload.** Indicates that either the technique selected is beyond the X-Ray Tube ratings or the present conditions of the X-Ray Tube inhibit the exposure (anode overheated). Parameters for the next exposure may be temporally limited by the Generator (change the exposure values or wait for the X-Ray Tube to cool).	Check that heat units available are lower than those calculated for the next exposure (heat units close to zero). Reduce exposure factors or wait for the X-Ray Tube to cool.
IL115	**X-Ray Disabled**	Check that the X-Ray Inhibition Key is in ON position; if not, turn the key to ON position in order to enable X-Ray. If the message persists, reduce exposure factors in order to reduce the Energy, or wait for the X-Ray Tube to cool. If the message persists, turn the Generator OFF and ON. If the equipment remains inoperative, turn it OFF and call Field Service.

5.1.3 WARNING MESSAGES

The Warning messages described in this section indicate a limit or an inhibit during the parameter selection, e.g. while increasing or decreasing kVp, when the value reaches the limits, the message *"Maximum/Minimun kVp Value"* is shown and the variation above or below limits inhibited.

Warnings show a condition that inhibits exposures temporarily, when the warning source disappears, the warning message disappears.

Table 5-3
Warning Messages (WN)

CODE	INFORMATION MESSAGE	DESCRIPTION
WN01	Generator Power Limit	The selected power exceeds the maximum Generator Power or the maximum Generator Power limit configured by the operator.
WN02	Tube Power Limit	The selected power exceeds the X-Ray Tube Power limit due to Anode temperature (remaining Heat Units). Wait for X-Ray Tube cool. The selected power exceeds the maximum X-Ray Tube Power or the maximum Tube Power limit configured in the Unit.
WN03	Space Charge Limit	Filament emission limit for a combination of kVp and mA in a selected Focal Spot.
WN04	kVp Range Limit	Maximum or minimum kVp (Generator limit).
WN05	mAs Range Limit	Maximum or minimum mAs (Generator limit).
WN06	mA Range Limit	Maximum or minimum mA (Generator limit configured for each Focal Spot).
WN07	ms Range Limit	Maximum or minimum Exposure Time (ms) (Generator limit).
WN08	Focus Change Inhibit	Present conditions of X-Ray Tube unable the change (remaining Heat Units, power limit for selected mAs, space charge).
WN09	Wrong APR Technique	Values of the selected APR Technique exceed the Generator range limits, Generator Power limit, X-Ray Tube Power limits or values are limited by the present conditions of X-Ray Tube.
WN10	Generator Load Limit	Inverter Overheating error. Refer to Error Code OL.
WN11	Line impedance too high	Power Line not good enough for operation. Refer to Error Code E95.
WN12	Wrong APR Workstation	Values of the selected APR Workstation exceed the Generator range limits, Generator Power limit, X-Ray Tube Power limits or values are limited by the present conditions of X-Ray Tube.
WN13	PPS Range Limit	Maximum or minimum PPS (Generator limit).
WN113	Generator Power ON	
WN114	Generator Power OFF	

SECTION 6 X-RAY UNIT

This Section describes the controls, indicators and displays of the X-Ray Unit. Although the routine operations are performed from the Touch Screen Console, the Control Panel offers some operative functions.

Note ☞ *Use the operating controls as described in this manual, any other non-indicated combination may cause an incorrect operation of the equipment.*

Illustration 6-1
Portable X-Ray Unit

6.1 POWER ON / OFF

Note ☞

Refer to Section 3.5 for a General Power ON / OFF. The X-Ray Unit can be Turned ON alone for some Service Tasks and to perform the Automatic Line Power Detection or the Manual Power Reduction procedures explained in next Sections.

For safety reasons and for proper functioning make sure that the Unit is connected to a standard outlet with GND.

Plug the Unit to a wall socket and turn On the X-Ray Unit Circuit Breaker. It is not necessary to Turn ON the General Circuit Breaker. After the generator is turned ON a power-up routine is shown on the Control Panel displaying:

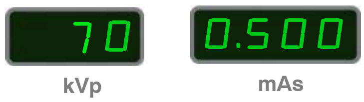
1. Lines (- - -   - - - -).

2. The software version (e.g. P01   01.03 = Vers.01 R01.03).

3. The selected Power percentage (e.g. Po= 100).

4. Scrolling dash (- - -   - - - -).

5. And finally the Technique Parameters, e.g.:



6.2 AUTOMATIC LINE POWER DETECTION SYSTEM

By means of this System, the Unit detects the maximum operative Power Line adapting the Exposure Parameters to the Power available and avoiding undesired line breakdowns when operating with poor electricity lines.

1. Press and hold the *“Collimator Light”* push-button and then turn the Unit *“ON”*. The Display shows *“LPd ACT”* (Line Power Detection Active).

2. Release the *“Collimator Light”* push-button, the Display shows *“LPd P-E”* (Line Power Detection Preparation-Exposition).

3. Press “Prep”, then press and hold *“X-Ray ON”* to perform consecutive exposures. After each exposure, the display will show “LPd StP” for a few seconds. In case the X-ray tube is too hot, the display will show “LPd StP” for a while until the tube cools down; when the display shows “LPd P-E” the procedure can be continued.

4. The Display shows "*LPd End*" when the procedure has finished (approximately ten (10) exposures). Release *"X-Ray ON"* button, then the Display shows normal parameters. Now the Unit has detected the Maximum Power Line that can be used during normal operation.

   If error code *"E95"* appears at this moment, it means that the line is not good enough and exposures will not be allowed, if possible, change the Unit Plug to another socket (line).

   If error code *"E96"* appears during the procedure at any mA station, it means that the corresponding station is not calibrated and power is limited to the previous mA station. The procedure ends and the Unit should be calibrated again.

Note ☞ *If any error code appears on Display during procedure, press "Reset" push-button.*

Once the Line Power Detection Procedure is performed:

- It is **necessary** to perform the Warm Up procedure.
- Perform the procedure every time the Unit is plugged into a different socket as the Unit **applies the data of the last Power Line acknowledged.**
- After finishing the procedure, the remaining thermal capacity (%) is **reduced and certain techniques could be temporarily inhibited.** Wait a few minutes for the Tube to cool.
- This procedure does not take into account the limitations of the **Circuit Breaker (Thermomagnetic Switch) installed at site.** If the Circuit Breaker (Thermomagnetic Switch) installed at site still goes down, perform the Manual Power Reduction procedure below.

To restore default values (which means that no restrictions will be set due to the Line Power Detection System):

1. Press and hold the *"Collimator Light"* push-button and turn the Unit *"ON"*. After a few seconds, the Display will show *"LPd ACT"* (Line Power Detection Active).
2. At this point press and hold the *"Reset"* push-button.
3. Release the *"Collimator Light"* push-button.
4. Release the *"Reset"* push-button. The values will be set to the maximum range available (no restrictions due to the line) and the *"LPd rSt"* (Line Power Detection Reset) message will be shown on the displays. When the kVp and mAs parameters are displayed, the X-Ray Unit will be ready for operation.

6.3 mAs-METER MODE

This automatic mode allows the generator to adapt the Exposure Parameters in order to avoid interrupted exposures due to poor electricity lines.

If the Unit detects undesired voltage drops when operating with poor electricity lines, mA are automatically reduced, Exposure Time is increased and the exposure finishes once the mAs selected by the operator are reached.

Note ☞ *Exposure Parameters values selected by the operator may vary when this mode is enabled. In order to visualize time, mA average during exposure and mAs actual values, press the "Reset" button and they will be shown on the displays for a while.*

Note ☞ *If the electricity line is so poor that the exposure cannot be completed (e.g. generator time-out (10 seconds) or receptor time-out (2.5), if applicable), E17 or E49 may occur.*

Note ☞ *The mAs-Meter Mode is factory set and it can only be disabled by a Service Engineer. The minimum Exposure Time in mAs-Meter Mode is 0.01 seconds.*

6.4 MANUAL POWER REDUCTION

The operator may reduce the Unit maximum Power in order to avoid blown fuses or Circuit Breakers down in poor electricity lines. For that, press and hold any *"Focal Spot"* push-button and increase or decrease the percentage by pressing the *"kVp Increase o Decrease"* push-buttons respectively.

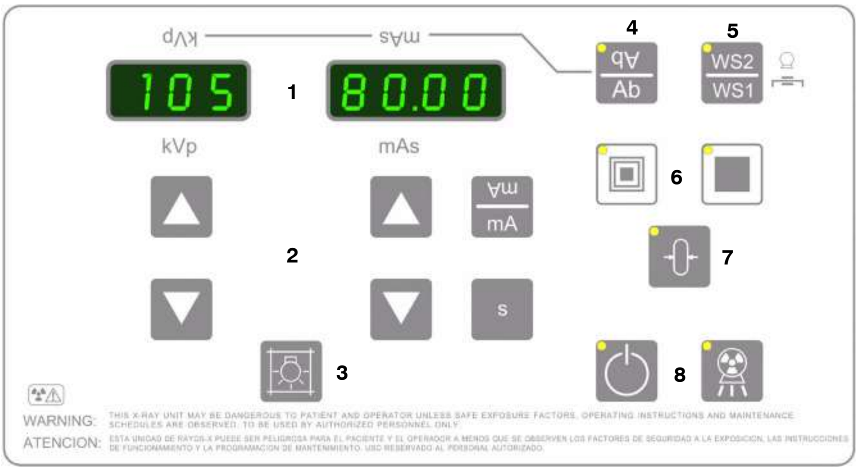
The kVp Display shows the selected Power Percentage in 10% steps, preceded by the letter "*P*", from 10% up to 100%. For example, a display of *"P80"* would indicate that the Power of the Unit will be limited to a maximum of 80%. *"P - - "* indicates that the Unit will operate at full Power (100% - factory set).

In case a technique exceeds the power required, the kVp and mAs displays will blink, modify the technique or modify Power percentage.

Note ☞ *The Power Percentage selected by the Operator is stored in memory and applied each time the Unit is turned ON.*

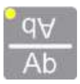
6.5 CONTROL PANEL

All controls and displays on the Control Panel are positioned according to their function.



1. Radiographic Displays
2. RAD parameters
3. Collimator Light
4. Rotation of the Control Panel
5. Workstations
6. Focal Spots
7. Reset
8. Exposure Controls

6.5.1 ROTATION OF THE CONTROL PANEL



The readout of the Radiographic displays and the function of the increase/decrease RAD parameters (kVp and mAs) and APR buttons can be inverted (180°) by pressing the button "*Rotation of the Control Panel*". Two beeps and the light on the button indicate that the Control Panel is now inverted.

To rotate the Control Panel to the 0° position again, press the "*Rotation of the Control Panel*" button.

6.5.2 WORKSTATIONS

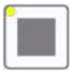
The Workstations are configured according to the customer preferences during the installation procedure (X-Ray Tube, Device, etc.).

This button selects the Workstation "*Direct*" (WS1) or "*Receptor*" (WS2).

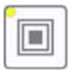
The *"Direct"* (WS1) Workstation is automatically selected after turning ON the Unit. The button is not illuminated.

The *"Receptor"* (WS2) Workstation (Bucky, Digital Detector) is selected when the button is illuminated.

6.5.3 FOCAL SPOT INDICATORS



LARGE FOCAL SPOT: Selects the "*Large Focal Spot*" of the X-Ray Tube.



SMALL FOCAL SPOT: Selects the "*Small Focal Spot*" of the X-Ray Tube.

The Led of a Focal Spot turns ON when selected.

The Focal Spot change keeps constant kVp and mAs, whenever it is possible according to maximum power, space charge, etc.

When a Focal Spot is selected, it sets the highest mA value available for the selected Focal Spot and the respective Exposure Time in order to keep constant mAs.

Note ☞ *The Focal Spot change is related to the mA stations configured by the field engineer during installation.*

Note ☞ *The Focal Spot change can be done whenever the present conditions of the X-Ray Tube allow it. A blinking light on the push-button and an audible alarm will alert the operator if present conditions of X-Ray Tube unable the change.*

Focal Spot Buttons can also enable the Filament Power Down Mode (*Refer to Section 6.6).*

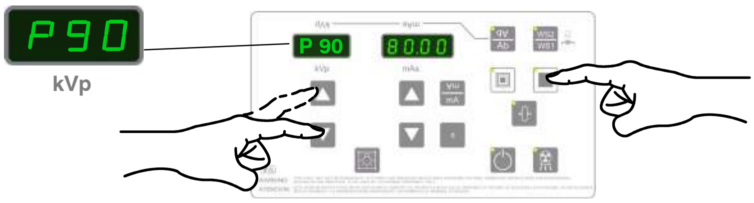
6.5.4 RADIOGRAPHIC PARAMETERS

Note ☞ *Refer to Section 9 for parameter ranges with reference to equipment model.*

kVp DISPLAY can show:

- The radiographic **kVp value** selected for the technique.

- The **Power percentage** after pressing at the same time any *"Focal Spot"* and *"kVp Increase or Decrease"* push-buttons *(refer to Section 6.4)*.



- The **Error messages** during a system fault, preceded by the letter "E" (e.g., E03) (*refer to Section 6.9*).

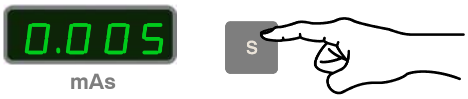
mAs DISPLAY can show:

- The radiographic **mAs value** selected for the technique, keeping the maximum mA and minimum exposure time values according to the Tube power percentage adjusted by the field engineer (factory set at 100%), to the Manual Power Reduction, the mAs-Meter Mode, the Line Power Detection, the remaining Thermal Capacity (%) of the X-Ray Tube and Generator.

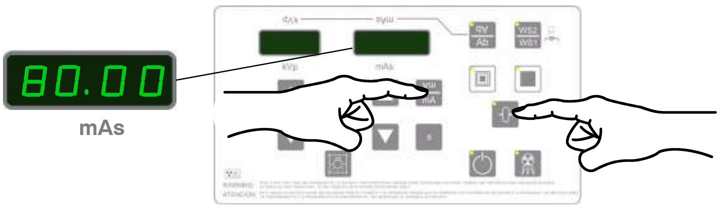
- If an exposure is aborted when releasing the *"Exp"* or *"Prep"* push-buttons, or because of a system failure, an alarm sounds until the error condition is reset. The **actual mAs value** of the exposure is shown for a while when the Error condition is produced, and again when the *"Reset"* push-button is pressed.

- **mA:** Pressing *"mA"* push-button, the mAs display shows the mA value selected. This parameter can not be modified by the operator because it relies on the mAs value.

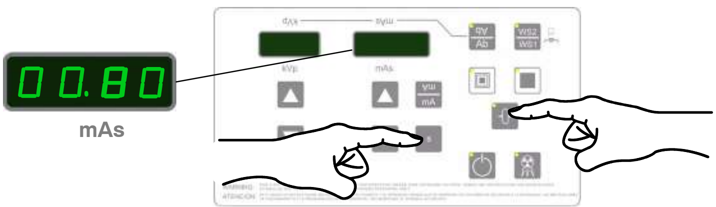
- **s (Exposure Time in seconds)**: Pressing *"s"* push-button, the mAs display shows the selected Exposure Time in seconds. This parameter can not be modified by the operator because it relies on the mAs value.



- **mA of the last exposure**, by pressing *"Reset"* plus *"mA"* push-button.



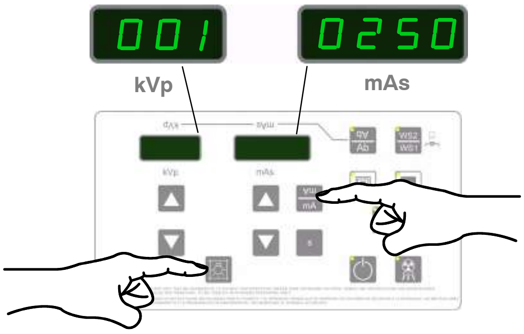
- **s (Exposure Time in seconds) of the last exposure**, by pressing *"Reset"* plus *"s"* push-button.



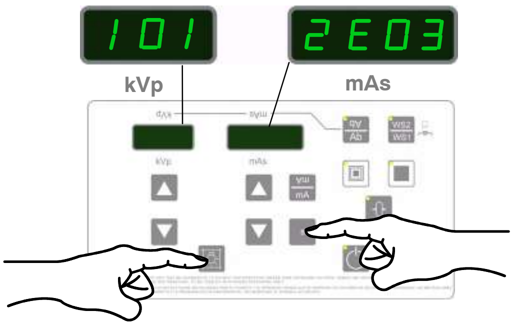
***"kVp"* Display in combination with *"mAs"* Display** can also show:

- **kVp and mAs from the last exposure** after pressing *"Reset"* push-button, whenever an error condition is not present.

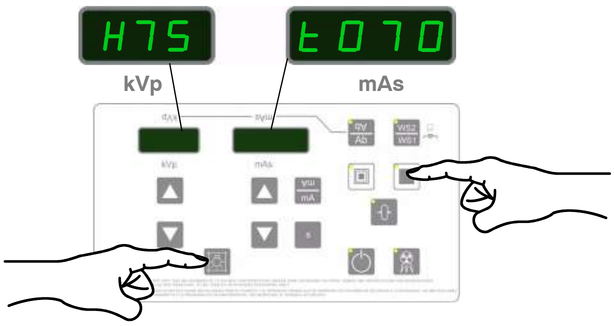
- **Exposures Counter** (only in Service Mode), of the selected Focal Spot, while pressing simultaneously *"Collimator Light"* and *"mA"* push-buttons, e.g. (001) (0250) = 10.250 exposures (*refer to Section 6.7.1.*)



- **Energy Counter** (only in Service Mode), that is, the cumulative Energy of all the exposures of the selected Focal Spot expressed in Joules (J) while pressing simultaneously *"Collimator Light"* and *"s"* push-buttons, e.g. (1.01) (2E03) = 1.012 * 10^3 (*refer to Section 6.7.2*) .



- **Remaining Thermal Capacity (%) of the X-Ray Tube and Generator**, by pressing simultaneously *"Collimator Light"* and any *"Focal Spot"* push-buttons (*refer to Section 6.8*).



INCREASE / DECREASE: Radiographic technique values increase or decrease step-by-step each time its related push-button is pressed, and changes faster when either of them is pressed and held.

- **kVp:** Selects the X-Ray Tube voltage.
- **mAs**: Selects the mAs exposure (X-Ray Tube current * exposure time).

Note ☞

If after pressing any of these push-buttons, the technique value is blocked and an acoustic signal is emitted it could mean that:

Radiographic Parameters Blockage. *When any of the maximum or minimum radiographic parameter limit is reached, its related display begins flashing accompanied of an acoustic signal.*

Generator Power Limit. *If the power limit (kV x mA) is reached by increasing the kVp or mAs up to a maximum possible value, the mAs value is blocked. Flashing values on kV and mAs displays and an audible signal will alert operator about the situation.*

If required, kV could be increased up to its maximum value while mA value may automatically decrease, as long as mAs value is kept the same.

Space Charge*. If a variation of the kV or mAs induces to reach space charge limit, the parameter is blocked, and a flashing value on the kV display and an acoustic signal will alert operator about the situation.*

X-Ray Tube Ratings or X-Ray Tube Overheating*. If a technique reaches the X-Ray Tube ratings limit or the X-Ray Tube is momentarily overheated, some technique could not be selected. Flashing values on the kV / mAs displays and an acoustic signal will alert operator about the situation.*

Cold X-Ray Tube Protection*. If trying to select a greater kVp value than 100 kVp when the Tube is cold after powering ON the Unit (if the Unit has been off for more than 4 hours, the Tube will be completely cold), the kVp parameter is blocked. Flashing values on the kV / mAs displays and an acoustic signal will alert operator about the situation. (Refer to Section 6.8.1)*

mA: Pressing this push-button, the mAs display shows the selected X-Ray Tube current. This parameter can not be modified by the operator because it relies on the mAs value.

Exposure Time (s): Pressing this push-button, the mAs display shows the selected Exposure Time in seconds. This parameter can not be modified by the operator because it relies on the mAs value.

6.5.5 EXPOSURE CONTROLS

Radiographic exposures can be performed with the Exposure Controls placed on the Control Panel or with the Handswitch. The status of the exposure is shown by the "*Ready*" and "*X-Ray ON*" light indicators (located on the respective push-buttons) for the duration of the exposure.

PREP: Press the *"Prep"* push-button to prepare the X-Ray Tube for exposure. The push-button indicator will light when the X-Ray Tube is prepared, indicating that the technique selected is properly set, there are no interlock failures or system faults and the X-Ray Tube is ready for exposure.

After pressing this push-button filament current switches from stand-by to the mA emission level.

X-RAY ON: When the indicator on the *"Prep"* push-button is illuminated, press this push-button to start a X-Ray exposure.

During the exposure the light indicator of this push-button remains illuminated and a beep sounds.

Note ☞ *If any of these push-buttons are released before the generator completes the selected time, the exposure will be aborted. E50 appears on "kVp" Display with the actual mAs accompanied with an alarm until "Reset" is pressed.*

6.5.6 COLLIMATOR LIGHT

After pressing this push-button, the Collimator Light remains illuminated for 30 seconds.

Refer to Section 3.7 Collimator.

In combination with other push-buttons enables different functions of the Unit.

6.5.7 RESET BUTTON

This push-button resets error messages.

It can also show the last exposure parameters.

Pressing at the same time:

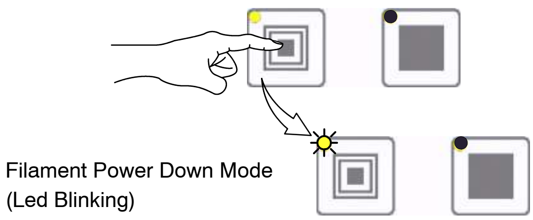
*Rese*t + *Collimator Light* + *mA / s*,

the Exposure counter (totalled number of exposures) and the Energy counter (totalled Energy) of both Focal Spots are reset.

6.6 FILAMENT POWER DOWN MODE

The Filament Power Down Mode preserves the Tube service life.

To enter this mode, press the selected Focal Spot (its Led is already ON), a beep sounds and the Led starts blinking which means that the Filament is powered OFF.



To exit, press once any Focal Spot or press *"Prep".*

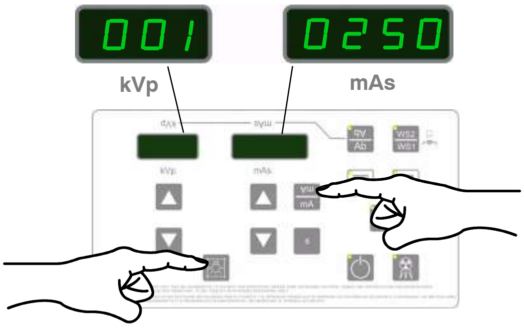
Note ☞ *After exiting Filament Power Down Mode it takes 5 seconds to allow the exposure ("Ready"* Led ON). *It also happens after an Error is "Reset" and when shifting from one Focal Spot to the other.*

6.7 COUNTERS FOR SERVICE PURPOSES

Note ☞ *These counters are only accessible to Service Engineer.*

6.7.1 EXPOSURE COUNTER

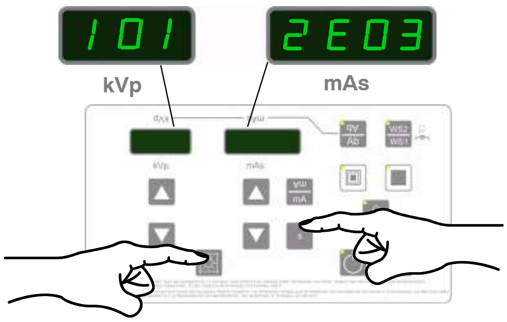
To display the totalled number of performed exposures of the selected Focal Spot, press simultaneously *“Collimator Light”* and *“mA”* push-buttons, e.g. (001) (0250) = 10.250 exposures.



To reset the Exposure Counter value (totalled number of exposures for the selected focal spot), press and hold simultaneously *“Collimator Light”, “mA”* and *“Reset”*.

6.7.2 ENERGY COUNTER

To display the totalled Energy of performed exposures of the selected Focal Spot expressed in Joules (J), press simultaneously *“Collimator Light”* and *“s”* push-buttons, e.g. (1.01) (2E03) = 1.012 * 10^3.



To reset the Energy counter (totalled Energy for the selected focal Spot), press and hold simultaneously *“Collimator Light”, “s”* and *“Reset”*.

6.8 REMAINING THERMAL CAPACITY

The percentage of the remaining Thermal Capacity of the X-Ray Tube and Generator are both calculated and totalled during exposures. They can be displayed on the Unit after pressing the *"Collimator Light"* and any of the *"Focal Spot"* push-buttons.

The kVp Display shows the percentage of remaining Thermal Capacity of the X-Ray Tube, preceded by the letter "*H*". For example, a display of *"H75"* would indicate that 75% of the X-Ray Tube capacity remains. *"H – – "* indicates that full capacity remains (100%).

The mAs Display shows the percentage of remaining Thermal Capacity of the Generator, preceded by the letter *"t"*. For example, a display of *"t032"* would indicate that 32% of the Generator capacity remains. *"t100"* indicates that full capacity remains (100%).

If the Unit detects that the new selection of parameters overpass the remaining Thermal Capacity, exposure is inhibited and values in displays blink accompanied by an alarm. Reduce parameter values or wait for the unit to cool.

Both displays revert to its normal function after releasing any of the push-buttons.

6.8.1 COLD X-RAY TUBE PROTECTION

To protect the X-Ray Tube when it is cold just after powering ON the Unit, high kVp exposures (over 100 kVp) cannot be performed until the Tube Thermal Capacity (HU) used reaches at least 8%. In that case, the kVp Display would show *"H92"*, that is, 92% of the X-Ray Tube capacity remains.

Note ☞

Flashing values on the kV / mAs displays and an acoustic signal will alert operator if trying to select a greater kVp value than 100 kVp when the Tube is cold after powering ON the Unit (if the Unit has been off for more than 4 hours, the Tube will be completely cold). To prevent that situation, a warming-up procedure is recommended (refer to Section 7.2.2).

Once the Tube has been warmed-up, any kVp value could be selected according to the X-Ray Tube condition and kVp limits.

6.9 ERROR CODES

Error codes indicate the potential cause of a system failure. They are intermittently shown on the kV Display at the same time an alarm sounds. In general, to remove the error condition press *“Reset” (Refer to Table 6-1).*

All these error codes are preceded by the letter *“E”* (e.g., E03) and they will enable the operator to indirectly convey the possible source of error to service personnel. This may prevent the need for a service call or enable service personnel to anticipate corrective actions prior to arriving in site.

Table 6-1
Error Codes

<table>
<tr><th>ERROR</th><th>DESCRIPTION</th><th>WHAT TO DO</th></tr>
<tr><td>No Error Code</td><td>System does not Start-up (No indication of Activity).</td><td>Ensure that the unit is connected to mains.
If the problem persists, turn the Unit OFF and ON.
If the equipment remains inoperative, turn it OFF and call Field Service.</td></tr>
<tr><td>E01</td><td>Backup Timer I2C error.</td><td>Press the “Reset” push-button.
If the error code persists, turn the Unit OFF and ON.
If the equipment remains inoperative, turn it OFF and call Field Service.</td></tr>
<tr><td>E02</td><td>Wrong Workstation configuration.</td><td rowspan="3">Turn the Unit OFF and call Field Service.</td></tr>
<tr><td>E03</td><td>No Workstation configured.</td></tr>
<tr><td>E04</td><td>Fluoro Order error.</td></tr>
<tr><td>E05</td><td>“Exposure” order is active during power-up.</td><td rowspan="2">Release all the controls.
Turn the Unit OFF and ON.
If the equipment remains inoperative, turn it OFF and call Field Service.</td></tr>
<tr><td>E06</td><td>“Preparation” order is active during power-up.</td></tr>
<tr><td>E08</td><td>Wrong index configuration for X-Ray Tube 1.</td><td rowspan="2">Turn the Unit OFF and call Field Service.</td></tr>
<tr><td>E10</td><td>Corrupted data in E2PROM.</td></tr>
<tr><td>E11</td><td>Load Capacitor error.</td><td>Turn the Unit OFF and ON.
If the equipment remains inoperative, turn it OFF and call Field Service.</td></tr>
<tr><td>E12</td><td>mA is out of range during exposure.</td><td>Press the “Reset” push-button.
Repeat exposure with same technique values, If the error code persists try exposure with another combination of technique values.
If the equipment remains inoperative, turn it OFF and call Field Service.</td></tr>
</table>

Table 6-1 (cont.)
Error Codes

ERROR	DESCRIPTION	WHAT TO DO
E13	kVp is out of range during exposure.	Press the "*Reset*" push-button. Repeat exposure with same technique values, If the error code persists try exposure with another combination of technique values. If the equipment remains inoperative, turn it OFF and call Field Service.
E14	kVp ramp error.	
E15	Large Filament current is out of range.	Press the "*Reset*" push-button. If the error code persists, turn the Unit OFF and ON. If the equipment remains inoperative, turn it OFF and call Field Service.
E16	Small Filament current is out of range.	
E17	DC BUS is out of range.	
E19	mA without exposure order.	
E20	kVp without exposure order.	
E23	EEPROM error.	Turn the Unit OFF and ON. If the equipment remains inoperative, turn it OFF and call Field Service.
E24	Bucky / Digital Panel error.	Press the "*Reset*" push-button. If the error code persists, turn the Unit OFF. Check cable connections of Image Receptor and turn the Unit ON. If the equipment remains inoperative, turn it OFF and call Field Service.
E25	Large Filament current demand is over the limit.	Press the "*Reset*" push-button. If the error code persists, turn the Unit OFF and ON. If the equipment remains inoperative, turn it OFF and call Field Service.
E26	Small Filament current demand is over the limit.	
E27	Collimator current is out of range.	
E28	Current in the Collimator Light without order.	
E30	Wrong date/time at the RTC (Real Time Clock).	
E31	Wrong TimeStamp.	
E32	Bus I2C error while accessing the RTC.	
E33	Serial Communication error.	
E34	Exposure Timer error. If it activates during exposure it means that the exposure has been interrupted by the "Security Timer" because of a system failure	Turn the Unit OFF and ON. If the equipment remains inoperative, turn it OFF and call Field Service.
E35	The acknowledge for X-Rays from the Bucky or Flat Panel Detector has been lost before the end of the exposure	Press the "*Reset*" push-button. If the error code persists, turn the Unit OFF. Check cable connections of Image Receptor and turn the Unit ON. If the equipment remains inoperative, turn it OFF and call Field Service.

Table 6-1 (cont.)
Error Codes

ERROR	DESCRIPTION	WHAT TO DO
E36	Presostat / Thermostat error.	This error does not require to press the “*Reset*” push-button, the signal indicator disappears automatically. Wait for the X-Ray Unit to cool. If the error code persists, turn the Unit OFF and ON. If the equipment remains inoperative, turn it OFF and call Field Service.
E38	System error – Chopper failure.	Press the “*Reset*” push-button. If the error code persists, turn the Unit OFF and ON. If the equipment remains inoperative, turn it OFF and call Field Service.
E39	System error – Power supply error.	
E40	System error – kV Unbalanced.	
E41	System error – mA Unbalanced.	
E42	Corrupted Counters.	
E43	Corrupted Error Log.	
E44	I2C Bus error while accessing the Potentiometer.	
E45	I2C Bus error while accessing the Multiplexer.	
E46	Busy I2C Bus.	
E47	APR Lite check error.	
E48	Bucky / Digital Interface error.	
E49	Exposure Timeout - mAs-Meter Error	Press the “*Reset*” push-button. Check the selected parameters and modify them. In case of poor electricity line reduce the mAs (mA / exposure time) or connect the Unit to a better power line (*refer to Section 6.3*). Try a new exposure. If the error code persists, turn the Unit OFF and ON. If the equipment remains inoperative, turn it OFF and call Field Service.
E50	Exposure has been aborted by the Operator or defective Handswitch.	Press the “*Reset*” push-button. If the error code persists, turn the Unit OFF and ON. If the equipment remains inoperative, turn it OFF and call Field Service.
E51	Incorrect Exposure Time.	Press the “*Reset*” push-button. Change the exposure parameters. If the error code persists, turn the Unit OFF and ON. If the equipment remains inoperative, turn it OFF and call Field Service.
E53	The timeout for receiving the Fluoro synchronism pulse has elapsed.	Press the “*Reset*” push-button. If the error code persists, turn the Unit OFF and ON. If the equipment remains inoperative, turn it OFF and call Field Service.

Table 6-1 (cont.)
Error Codes

ERROR	DESCRIPTION	WHAT TO DO
E60	The preprogrammed Exposures for Autocalibration have finished without finding the corresponding Stations.	This Error only affects Service Engineer during Autocalibration Process. *Refer to Service Manual.*
E61	There has been an error while trying to access the license data. Default options have been selected.	Press the “*Reset*” push-button. If the error code persists, turn the Unit OFF and ON. If the equipment remains inoperative, turn it OFF and call Field Service.
E74	The generator has been reset because of the COP module.	Call Field Service.
E75	The generator has been reset because of the CLK module.	
E76	The generator has been reset because of an illegal operation code.	
E77	The generator has been reset because of a software interrupt.	
E78	The generator has been reset because of a memory overflow interrupt.	
E95	Power Line not good enough for operation.	Perform the Automatic Line Power Detection procedure if it has not been done previously. If the error persists, turn the Unit OFF, change the Unit plug to another socket line and try again the Automatic Line Power Detection procedure. If the Error persists turn it OFF and call Field Service.
E96	Line Power Non Calibrated Technique.	Press the “*Reset*” push-button. Perform the Automatic Line Power Detection procedure again. If the Error persists, turn the Unit OFF and call Field Service.
E97	License - I2C Error.	Press the “*Reset*” push-button. If the error code persists, turn the Unit OFF and ON. If the equipment remains inoperative, turn it OFF and call Field Service.
Err rAn	Defective RAM memory.	Press the “*Reset*” push-button. If the error code persists, turn the Unit OFF and ON. If the equipment remains inoperative, turn it OFF and call Field Service.
Err nrAn	Defective NVRAM memory.	
OL	Tube or Generator Overload. The selected technique is beyond the X-Ray Tube ratings, the present conditions of the X-Ray Tube/Generator inhibit the exposure (anode/inverter overheated) or the calculated remaining thermal capacity (%) for the next exposure is beyond the Generator capacity. Parameters for next exposure may be temporally limited by the Unit.	This error does not require to press the “*Reset*” push-button, the signal indicator disappears automatically. Change the exposure parameters or wait for the X-Ray Unit to cool. Check that the remaining thermal capacity (%) is lower than the calculated for the next exposure (thermal capacity close to 0%). If the error code persists, turn the Unit OFF and ON. If the equipment remains inoperative, turn it OFF and call Field Service.

SECTION 7 OPERATING SEQUENCES

7.1 POWER-UP SEQUENCE OF THE X-RAY UNIT

After turning the Unit ON, the Unit will go through a power-up sequence conducting an automatic self-test. The Display on the X-Ray Unit will show information usable only by service personnel.

Once the power-up sequence has been completed, the Control Panel should display normal radiographic factors. If a malfunction is found, error messages will be displayed.

Note ☞

Some indicators on the Control Panel are used to provide service information during the power-up sequence. These indicators should be ignored by the operator until the unit has completed its power-up sequence.

7.2 X-RAY TUBE SEASONING AND X-RAY TUBE WARMING-UP

The **Seasoning** and **Warning-up** procedures assure a correct operation of the X-Ray Tube and must be properly carried out. Otherwise the X-Ray Tube life may be considerably reduced or the X-Ray Tube will suffer a permanent damage.

The **Seasoning** Procedure (Running) must be performed when the Tube is used for the first time or when it has not been in use for more than one month. This action establishes a favorable distribution of the electrical charges and electrostatic stresses in the insulation system of the Tube and the associated equipment. Not performing the Seasoning Procedure causes loss of the X-Ray Tube Warranty.

The **Warming-up** Procedure must be performed at the start of each day or when the unit has been off for more than four hours.

CAUTION

Before performing X-Ray exposures ensure that the Tube is properly warmed-up. Make sure that no persons will be inadvertently exposed to unnecessary X-Rays during this procedure.

7.2.1 SEASONING PROCEDURE (RUNNING) (AFTER ONE MONTH)

1. Close Collimator Blades fully and make sure that no one will be exposed.

2. Make sure that X-Ray Tube is fully cold (at least 30 minutes without making exposures).

3. Reduce the power manually to 20% in case of 4 kW or 5 kW units or 10% in case of 8 kW units. On the X-Ray Unit Control Panel, press and hold the “Large Focal Spot” push-button and then press the “kVp Decrease” push-button several times until “P10 or P20” respectively is shown in the kVp display.

4. Select 70 kVp, 10 mAs and Large Focus. Perform one exposure per minute increasing 5 kVp in every exposure up to the maximum Tube voltage.

5. If there are not signs of instability, the tube is ready for normal use.

6. If instability is observed during procedure, reduce 5 kVp of the selected kVp and make two exposures at those KVp, then continue the process.

7. Once the seasoning procedure is completed, set the power at 100% again. On the X-Ray Unit Control Panel, press and hold the “Large Focal Spot” push-button and then press the “kVp Increase” push-button several times until “P--” is shown in the kVp display.

Note ☞ *Check that the remaining Thermal Capacity of the X-Ray Tube is above 80% during this process.*

7.2.2 WARMING-UP PROCEDURE (EVERY DAY)

1. Close Collimator Blades fully and make sure that no one will be exposed.

2. For 4kW and 8 kW X-Ray Units, select 60 kVp, 40 mAs and Large Focus. For 5 kW X-Ray Units, select 70 kVp, 64 mAs and Large Focus.

3. Perform one exposure.

4. Now the Tube is ready for normal use.

CAUTION

Excessive filament evaporation shortens X-Ray Tube life. Minimize evaporation by keeping Exposure “Preparation” time to an absolute minimum.

7.3 RADIOGRAPHIC OPERATION

A typical examination sequence is as indicated below:

1. Make sure that the X-Ray Tube is properly warmed-up.
2. Position the patient for the examination.
3. Select the radiographic technique to be performed.
4. Maintain the patient at the required position. Prepare the X-Ray Tube by pressing the Handswitch button to the "*Prep*" position and maintain it until the "*Ready*" indicator is illuminated.
5. Carry out an X-Ray exposure by pressing the Handswitch button fully to the "*Exp*" position, maintaining it pressed throughout the exposure. The "*X-Ray On*" indicator will light and an audible signal will sound during the exposure.
6. When the exposure is finished, release the push-button.
7. Repeat the procedure if additional exposures are desired.

WARNING

KEEP THE UNIT CONNECTED TO MAINS WITH THE CIRCUIT BREAKER IN ON POSITION TO ENSURE THE MAXIMUM PC TOUCH SCREEN BATTERY CAPACITY AT ALL TIMES.

7.4 X-RAY BEAM ALIGNMENT WITH RESPECT TO PATIENT

After selecting RAD parameters for the technique to be performed:

1. Point the X-Ray Tube-Collimator Assembly to the Image Receptor.
2. Center the Collimator light on the receptor using the centering marks and the laser mark on the receptor handle if applicable.
3. Position the patient for the examination.
4. Turn on the Collimator light and adjust the field size with the Collimator controls.

5. Perform any adjustment on the patient position, receptor or tube collimator assembly to assure that the X-Ray beam is correctly positioned.

WARNING

ALWAYS SELECT THE CORRECT FIELD SIZE TO AVOID EXCESSIVE RADIATION.

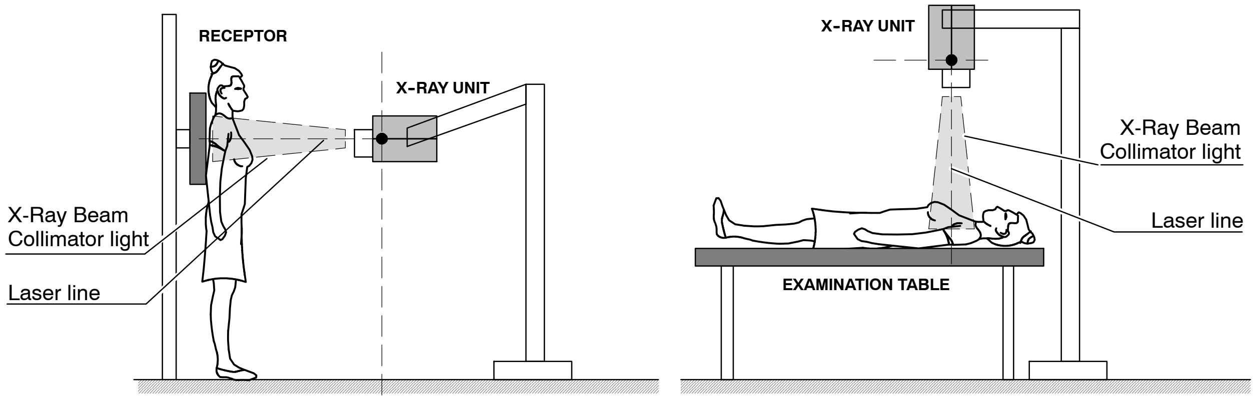
WARNING

THE X-RAY BEAM AXIS AND THE REFERENCE AXIS OF THE PLANE OF INTEREST COINCIDE AND ARE ORTHOGONAL WITH RESPECT TO THE PLANE OF INTEREST, IN EXAMS PERFORMED WITH THE IMAGE RECEPTOR PERPENDICULARLY POSITIONED WITH RESPECT TO THE TUBE-COLLIMATOR ASSEMBLY.

IN CASE OF EXAMS WHERE THE IMAGE RECEPTOR IS NOT PERPENDICULARLY POSITIONED WITH RESPECT TO THE TUBE-COLLIMATOR ASSEMBLY, THE X-RAY BEAM AXIS DOES NOT COINCIDE WITH THE REFERENCE AXIS OF THE PLANE OF INTEREST AND IT IS NOT ORTHOGONAL WITH RESPECT TO THE PLANE OF INTEREST. THEREFORE, THE RESULTING IMAGE WILL BE DEFORMED.

IT IS THE OPERATOR RESPONSIBILITY THE PROPER POSITIONING OF THE PATIENT AND EQUIPMENT BEFORE PERFORMING AN EXAM.

Illustration 7-1
Patient Positioning



SECTION 8 PERIODIC MAINTENANCE

In order to assure continuous safe performance of the X-Ray Unit, a periodic maintenance program must be established. It is the **owner's responsibility** to supply or arrange for this service.

There are two levels of maintenance, the first consists of tasks which are performed by the user/operator, and the second are those tasks to be performed by qualified X-Ray service personnel.

Service tasks here described must be performed exclusively by service personnel specifically trained on medical X-Ray Units. The first periodic maintenance service should be performed six (6) months after installation, and the subsequent services at twelve (12) month intervals.

The manufacturer undertakes to have available spare parts for this equipment at least for ten (10) years after the unit manufacturing.

WARNING

NEVER ATTEMPT TO PERFORM MAINTENANCE TASKS WHILE THE ME EQUIPMENT IS IN USE WITH A PATIENT.

8.1 OPERATOR TASKS

The tasks of this periodic maintenance shall include the following items:

DANGER !

DO NOT REMOVE ANY COVER, DISASSEMBLE OR MANIPULATE INTERNAL COMPONENTS IN THE UNIT. THESE ACTIONS COULD CAUSE SERIOUS PERSONAL INJURIES AND / OR DAMAGE TO EQUIPMENT.

WARNING

NEVER ATTEMPT TO CLEAN ANY PART OF THE UNIT WHEN IT IS SWITCHED ON. ALWAYS SWITCH OFF THE EQUIPMENT AND ISOLATE THE MAINS ELECTRICAL SUPPLY BEFORE CLEANING.

1. Switch the Unit OFF.

2. Externally, check the proper cable connections between each component in the X-Ray system.

3. Clean the equipment frequently, particularly if corroding chemicals are present.

   Clean external covers and surfaces, especially parts which might be in contact with patients, with a cloth moistened in warm water with mild soap. Wipe with a cloth moistened in clean water.

   When it is needed to disinfect the Control Console, clean it with a cloth impregnated with isopropyl alcohol.

   Do not apply directly any liquid on the screen or other surfaces, nor use cleaners containing bleach, ammonia or any other abrasive or solvent liquid, it could cause damage to the equipment.

8.2 SERVICE TASKS

Only service personnel specifically trained on this medical X-Ray equipment should work on service tasks (installation, calibration or maintenance) of the equipment. (*Refer to the respective Sections of the Service Manual provided with this equipment.)*

SECTION 9 TECHNICAL SPECIFICATIONS

9.1 FACTORS

Note ☞ *Specified accuracy does not include test equipment accuracy.*

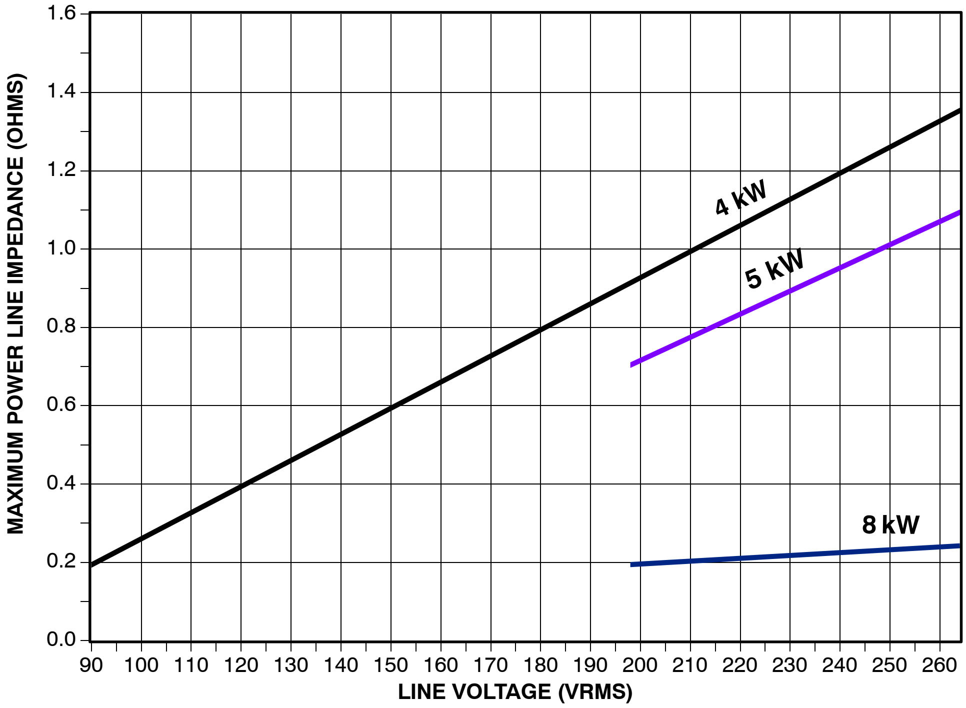
Maximum Power kW	4.0	5.0	8.0
kVp Range and Accuracy	40 to 125 kVp (in 1 kVp steps) ±(3% +1 kVp)		
kVp High Frequency Ripple	300 kHz		
mAs Range and Accuracy	0.1 - 250 mAs (in 25% steps according to R'10 series) ±(5% + 0.1 mAs)		
mA Stations and Accuracy	5, 6.4, 8, 10, 12.5, 16, 20, 25, 32, 40, 50, 64, 80, 100 ±(4% + 1 mA)		
Exposure Time Range and Accuracy	0.001 - 10 seconds (in 25% steps according to R'10 series) ±(2% + 0.1 ms)		
Output Power (@ 0,1s)	121 – 125 kVp @ 20 mA 111 – 120 kVp @ 25 mA 101 – 110 kVp @ 32 mA 100 kVp @ 40 mA 50 kVp @ 80 mA 40 kVp @ 100 mA	121 – 125 kVp @ 25 mA 111 – 120 kVp @ 32 mA 101 – 110 kVp @ 40 mA 100 kVp @ 50 mA 60 kVp @ 80 mA 50 kVp @ 100 mA	121 – 125 kVp @ 40 mA 111 – 120 kVp @ 50 mA 101 – 110 kVp @ 64 mA 100 kVp @ 80 mA 80 kVp @ 100 mA
Input Power	6.6 kVA	7.5 kVA	12.5 kVA
Radiation Output Accuracy *(Reproducibility related to loading factors)*	C.V. (Coefficient of variation) $\leq$ 0.05		
Maximum Specified Energy input in one hour	125 kVp @ 700 mAs		
Equivalent Current	The equivalent current in continuous mode of the maximum specified energy corresponds to 0.194 mA at a nominal voltage of 125 kVp		
Maximum leakage radiation	<0.88 mGy per hour or 100 mR per hour.		

<table>
<tr><th>Maximum Power kW</th><th>4.0</th><th>5.0</th><th>8.0</th></tr>
<tr><td>X-Ray Source Assembly:</td><td colspan="2"></td><td></td></tr>
<tr><td>Anode Type</td><td colspan="2">Stationary</td><td>Stationary</td></tr>
<tr><td>Nominal X-Ray Tube Voltage</td><td colspan="2">125 kV</td><td>125 kV</td></tr>
<tr><td>Two Focal Spots</td><td colspan="2">0.5 mm - 1.8 mm</td><td>0.6 mm - 2.8 mm</td></tr>
<tr><td>Target Angle</td><td colspan="2">16°</td><td>15°</td></tr>
<tr><td>Anode Heat Content</td><td colspan="2">35500 J (47215 HU)</td><td>28000 J (40000 HU)</td></tr>
<tr><td>Nominal Radiographic Anode Input Power (0.1 s per minute)</td><td colspan="2">5.3 kW (Large Focus)
1.1 kW (Small Focus)</td><td>8.0 kW (Large Focus)
0.6 kW (Small Focus)</td></tr>
<tr><td colspan="4">(For extended information about “Heating and Cooling Curves“ and “Loading Ratings”, refer to Appendix AP0074 for 4 kW and 5 kW units or Appendix AP0075 for 8 kW units)</td></tr>
<tr><td>Inherent Filtration:</td><td colspan="3"></td></tr>
<tr><td>Added Filter</td><td colspan="3">0.5 mm Al @ 75 kVp</td></tr>
<tr><td>X-Ray Tube Assembly</td><td colspan="3">1.3 mm Al @ 75 kVp</td></tr>
<tr><td>Collimator Assembly</td><td colspan="3">2.0 mm Al @ 75 kVp</td></tr>
<tr><td>Total Inherent Filtration</td><td colspan="3">3.8 mm Al @ 75 kVp</td></tr>
<tr><td rowspan="3">Power Line Operation</td><td>Single-Phase, 100 - 240 V~ , 50 / 60 Hz.</td><td colspan="2">Single-Phase, 220 - 240 V~ , 50 / 60 Hz.</td></tr>
<tr><td colspan="3">Line voltage automatic compensation: ±10%</td></tr>
<tr><td colspan="3">Power line cable of the Portable Unit: 6 meters.
Connection to standard outlets with GND that accomplishes local regulations.</td></tr>
<tr><td>Maximum Power Line Impedance</td><td colspan="3">Refer to Illustration 9-1</td></tr>
<tr><td rowspan="3">Minimum recommended Thermomagnetic / Circuit Breaker</td><td colspan="3">The General Circuit Breaker installed in the Portable Unit is 32 A (curve type C) with a 30 mA Sensitivity Differential.

The Power Line Installation should be provided with a 30 mA Sensitivity Differential and with a Thermomagnetic Interruptor / Circuit Breaker of at least:</td></tr>
<tr><td>≥30 A (curve type C) or
≥16 A (curve type D)
for 100 - 120 V~

≥16 A (curve type C) or
≥10 A (curve type D)
for 220 - 240 V~</td><td>≥20 A (curve type C) or
≥13 A (curve type D)
for 220 - 240 V~</td><td>≥30 A (curve type C) or
≥16 A (curve type D)
for 220 - 240 V~</td></tr>
<tr><td colspan="3">Momentary Line Current based on 100 ms X-Ray exposure (RMS)</td></tr>
</table>

Illustration 9-1
Maximum Power Line Impedance



9.2 ENVIRONMENTAL REQUIREMENTS

Note ☞ *STORAGE values only refer to equipment that is still in shipping containers. If the equipment is partially or completely installed, refer to IN USE values.*

Note ☞ *The following tables refer only to the environmental requirements of the X-Ray Unit, they do not include the environmental requirements of the Detectors (refer to the Detector's manuals for further information).*

9.2.1 RELATIVE HUMIDITY AND TEMPERATURE

RELATIVE HUMIDITY (Non-Condensing)				TEMPERATURE			
IN USE		STORAGE		IN USE		STORAGE	
MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.
30%	75%	10%	80%	10 ºC (50 ºF)	35 ºC (95 ºF)	−10 ºC (14 ºF)	50 ºC (122 ºF)

9.2.2 ATMOSPHERIC PRESSURE

ATMOSPHERIC PRESSURE			
IN USE		STORAGE	
MIN.	MAX.	MIN.	MAX.
700 hPa (units without Dosimeter)	1060 hPa	500 hPa	1060 hPa
* 800 hPa (units with Dosimeter)			
**Note: The default Dosimeter calibration is valid up to a minimum atmospheric pressure of 800 hPa. In order to operate at 700 hPa, the Dosimeter must be recalibrated at the installation site.*			

9.3 DIMENSIONS

Dimensions	Length	Width		Height
		Standard Wheels	All-Terrain Wheels	
	1664 mm (max) (65.5”) (max)	669 mm (26.3”)	759 mm (29.8”)	2228 mm (max) (87.7”) (max)

Weight	Aluminium Column		Steel Column	
	Minimum Weight	Maximum Weight	Minimum Weight	Maximum Weight
	73.5 kg (162 lbs)	80 kg (176.3 lbs)	79.5 kg (175.2 lbs)	86 kg (189.5 lbs)
	Note: Weight varies depending on the options added to the Unit			

Illustration 9-2
Dimensions (X-Ray Unit)

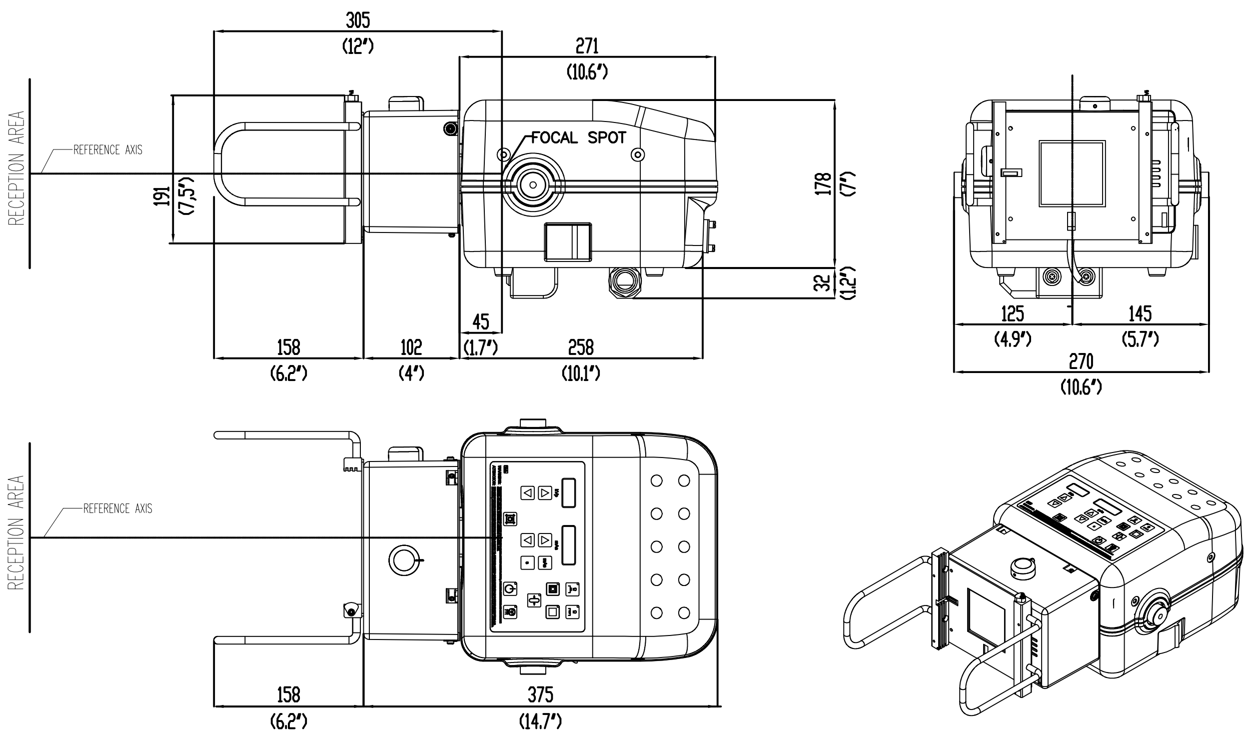


Illustration 9-3
Dimensions (Aluminium Column, Standard Wheels)

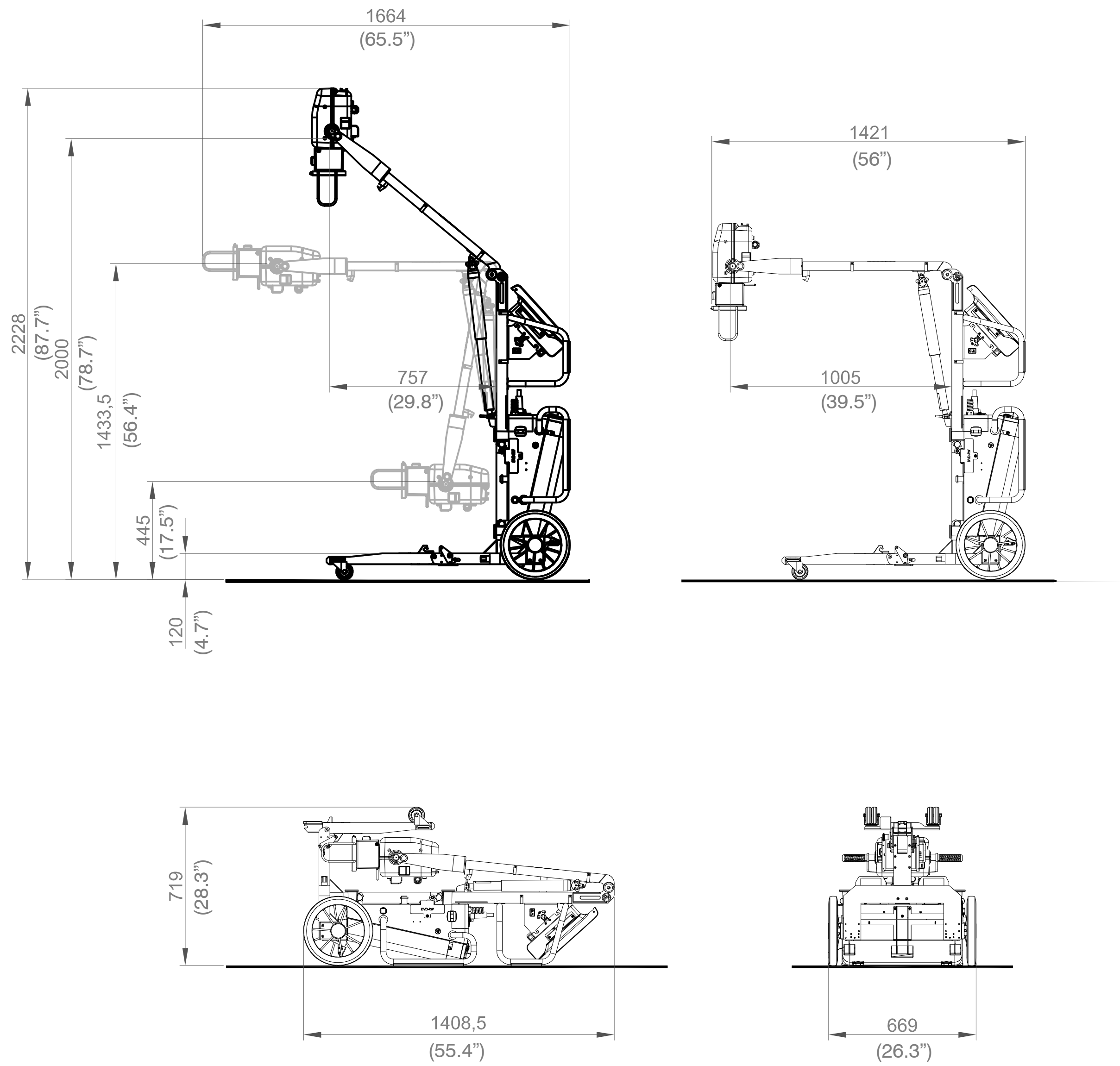


Illustration 9-4
Dimensions (Steel Column, All-Terrain Wheels)

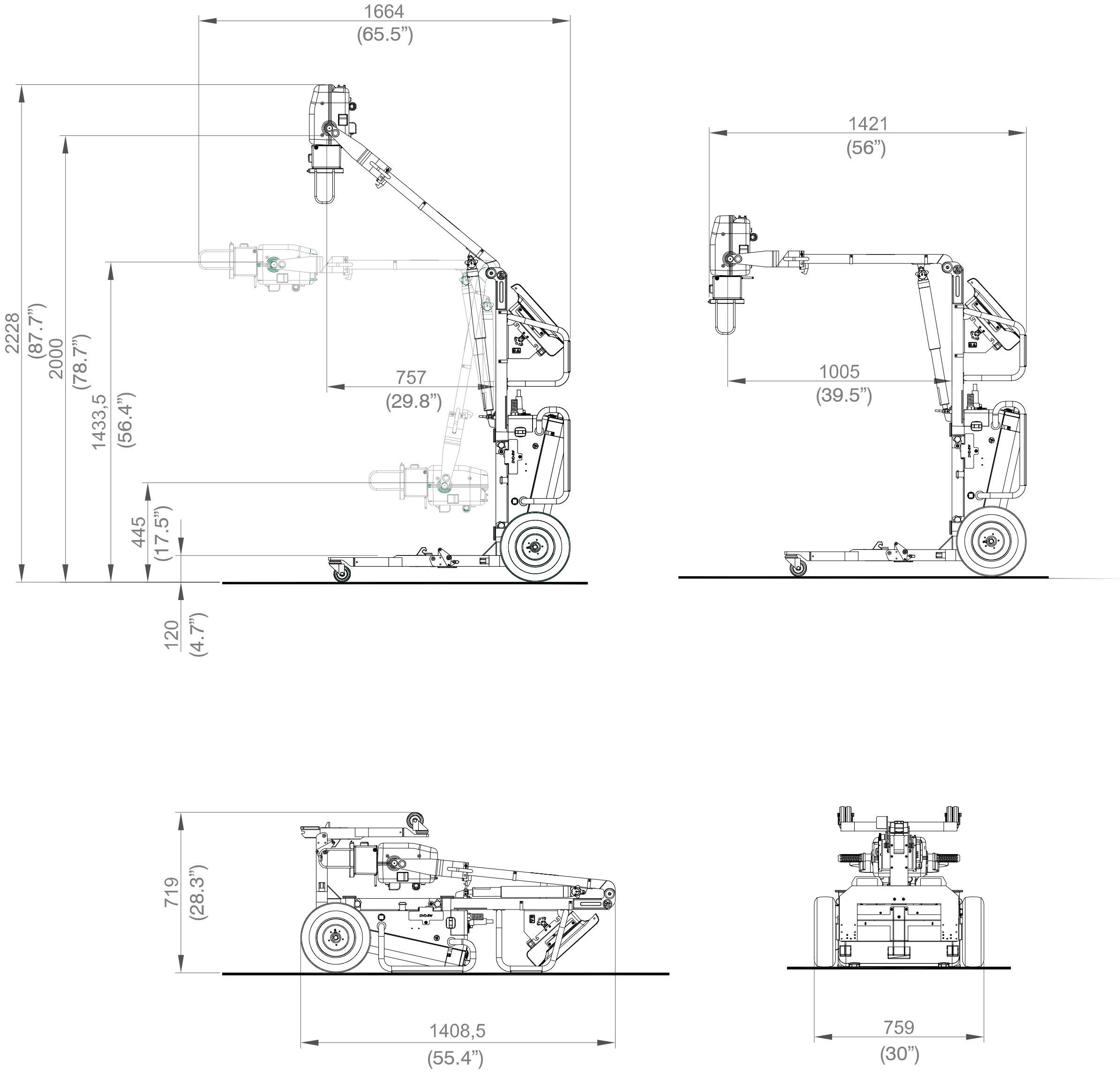
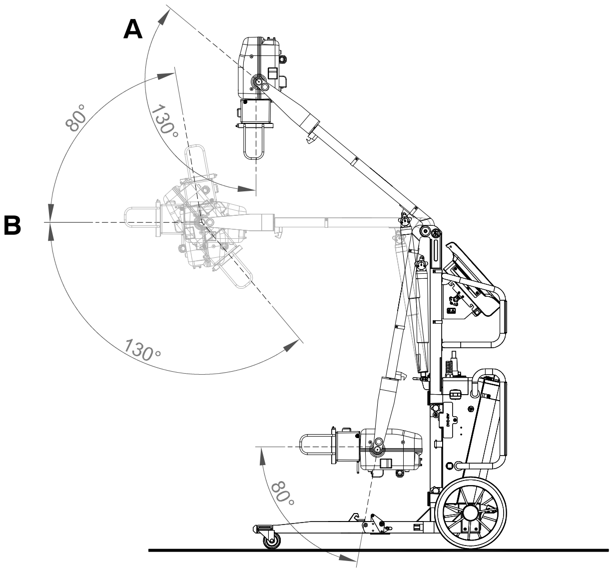
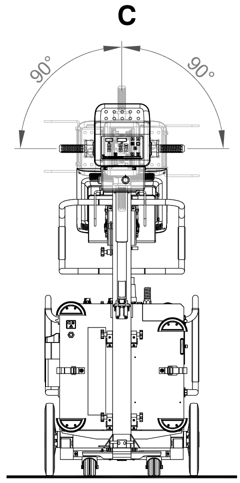


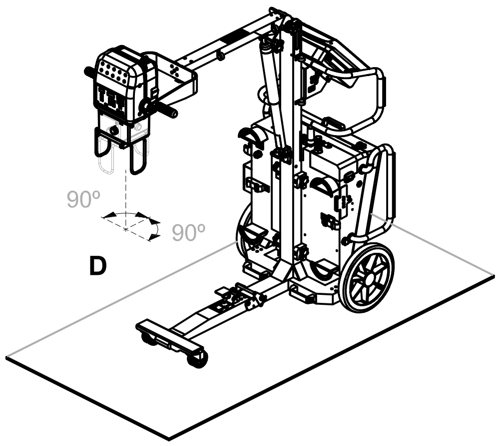
Illustration 9-5
Movements





A. Rotation of the X-Ray Unit with reference to its Support
B. Vertical Movement of the Arm to adjust Vertical SID

C. Rotation of the X-Ray Unit Support

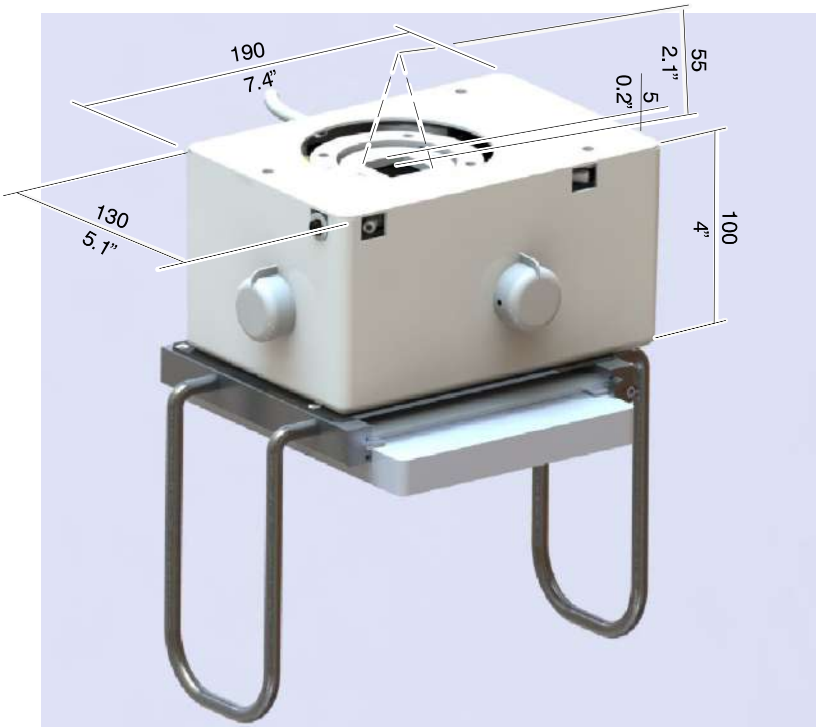


D. Rotation of the Collimator

9.4 COLLIMATOR R 72S

Model		R 72S
Field	Shape	Square
	Filed Size	Continuous film coverage from 00 x 00 to 43 x 43 at 100 cm FFD (SID).
Light field	Average illumination	> 160 lx
	Edge contrast ratio	> 3:1
	Accuracy	< 2% SID
	Display of center	Cross lines
	Inherent filtration	Min. 2.0 mm. Al.
	Type of lamp	CLUSTER LED – Power Supply 1A
Drive of leaves		Manual
External dimensions (W x D x H) and weight		190 x 130 x 100 mm (7.4” x 5.1” x 4”) – 2.9 kg (6.4 lb)
** Note: For more detailed information, please refer to the Collimator manual.*		

Illustration 9-6
Dimensions (Collimator)



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APPENDIX A GUIDELINES FOR PEDIATRIC APPLICATIONS

WARNING

THE PRACTITIONER WILL BE THE ULTIMATE RESPONSIBLE OF APPLYING THE PROPER DOSE TO THE PATIENT FOR RADIOGRAPHIC PROCEDURES. THE PURPOSE OF THESE GUIDELINES IS TO HELP THE PRACTITIONER TO MINIMIZE POTENTIAL RISKS.

CAUTION

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

CAUTION

Children are more radiosensitive than adults. Adopting the Image Gently campaign guidelines and reducing dose for radiographic procedures while maintaining acceptable clinical image quality will benefit patients.

Please review the following link and reduce pediatric technique factors accordingly: *http://www.pedrad.org/associations/5364/ig/*

As a general rule, next recommendations shall be observed in pediatrics:

- X-Ray Generator must have short exposures times.
- AEC must be used carefully, preferably use manual technique setting, applying lower doses.
- If possible, use high kVp techniques.
- As the use of Grids requires higher doses, **never use Grids in pediatric exams**. Remove the Grid from the receptor assembly and select the lower possible doses. If the Grid can not be detached, pediatric exams can not be performed using this device.

Positioning the pediatric patient:

Pediatric patients are not as likely as adults to understand the need to remain still during the procedure. Therefore it makes sense to provide aids to maintaining stable positioning. It is strongly recommended the use **of immobilizing devices** such as bean bags and restraint systems (foam wedges, adhesive tapes, etc.) to avoid the need of repeating exposures due to the movement of the pediatric patients. Whenever possible use techniques based on the lowest exposure times.

Shielding:

We recommend you provide extra **shielding of radiosensitive organs or tissues such as eyes, gonads and thyroid glands.** Applying a correct collimation will help to protect the patient against excessive radiation as well. Please review the following scientific literature regarding pediatric radiosensitivity: *GROSSMAN, Herman. "Radiation Protection in Diagnostic Radiography of Children". Pediatric Radiology, Vol. 51, (No. 1): 141-144, January, 1973: http://pediatrics.aappublications.org/cgi/reprint/51/1/141*.

Technique factors:

You should take steps to reduce technique factors to the lowest possible levels consistent with good image acquisition.

For example if your adult abdomen settings are: 70-85 kVp, 200-400 mA, 15-80 mAs, consider starting at 65-75 kVp, 100-160 mA, 2.5-10 mAs for a pediatric patient. Whenever possible use high kVp techniques and large SID (Source Image Distance).

Summary:

- Image only when there is a clear medical benefit.
- Image only the indicated area.
- Use the lowest amount of radiation for adequate imaging based on size of the child (reducing tube output - kVp and mAs).
- Try to use always short exposure times, large SID values and immobilizing devices.
- Avoid multiple scans and use alternative diagnostic studies (such as ultrasound or MRI) when possible.

APPENDIX B PROTECT YOUR IMAGING SYSTEM FROM CYBERSECURITY THREATS

Because Digital Radiography Systems may be connected by Wi-Fi or Ethernet to the Host Computer containing the Software, and the Host Computer may in turn be connected to the hospital information system, and ultimately the Internet, cybersecurity may become an issue for you. Here are some tips to keep your system and your medical images secure.

CAUTION

The medical devices security is a shared responsibility between manufacturer and responsible organization.

CAUTION

Use only materials supplied by Official Support/Technical Service for your Image Management software updates.

REQUIRED STRATEGIES BY THE OWNER / OPERATOR

Antivirus protection:

Use antivirus programs such as:

- Total AV
- ScanGuard Security Suite
- Norton by Symantec
- PC Protect
- Mcafee Antivirus Plus.
- Microsoft Security Essentials.
- Microsoft Windows Defender.

Keep these products up to date.

Limit access to trusted users only:

Limit access to devices through the authentication of users (e.g. user ID and password or smart card).

<u>Ensure trusted content:</u>

Restrict software or firmware updates to authenticated code.

<u>Detect, respond, recover</u>:

- Watch for on-screen warnings of possible virus infections.
- Respond by scanning for and removing possible virus infections.
- Recover from possible virus infections by having up to date backups of your host computer.

REQUIRED STRATEGIES BY THE MEDICAL DEVICE MANUFACTURER / SOFTWARE MANUFACTURER

We affirm our commitment to providing you with validated software updates and patches as needed throughout the life cycle of the medical device to continue to assure its continued safety and effectiveness.

Please promptly apply software updates and patches provided by us and never use image management software supplied by anyone else. Our development process utilizes the CISCO AMP protection. We are constantly scanning our development computers for malware. We hope you are doing the same.

A summary of our integrity controls:

- Our development computers are constantly being scanned for malware, and our supplier for anti-virus software automatically updates the software continuously as new threats are revealed.
- We perform daily backups to our external hard drives. The backups are in other place.
- During software development we disconnect from the Internet to prevent external attacks.
- Our development process utilizes the CISCO AMP protection.
- Copies of software updates we will be sending you are individually scanned for malware.

CONCLUSION

It is our JOINT responsibility to ensure your medical image software and image collection is safe and secure. We must both do our parts.

PC WITH TOUCH SCREEN MONITOR

LWALLINONE

The State-of-the-art 17” color touch screen monitor provides immediate interactivity, greater comfort and speed without the need for additional keyboards and cables, enhancing the efficiency of the workflow.

PC equipped with the following rear connections:

- Wi-Fi connection.
- Ethernet Port.
- One USB Port.

PC	INTEGRATED TOUCH SCREEN MONITOR
Operating System: Windows 10	LCD size 17”.
CPU: Onboard Intel® i5-4030U	Resolution/color: 1,280 x 1,024 XGA TFT, 16.7M
Memory: 8GB DDR3L 1600 SDRAM SODIMM	Luminance: 350cd/m^2
Hard Drive: 500Gb SSHD	Contrast Ratio 800:1
Long Life Battery (CR2477)	Viewing angle: 140 (L/R) 160(U/D).
	LED blacklight

The 500GB built-in hard disk can storage more than 25,600 images (20 Mb per image).

INTERNATIONAL

RAYBOW FLEX DR

PLASTIC WHEELS

PW

Plastic wheels offer agile handling and easy positioning on smooth surfaces.
No punctures during use thanks to *Flat Free* structure.

Tire Type	Flat Free
Tire Diameter	31.7 cm (12.5")
Tire Width	5.7 cm (2.25")
Tire Material	Micro-Cellular Polyurethane
Weight	1.5Kg (3.30lbs)

T-SHAPE FOLDING LEGS

FLT-AL

Designed for improved undertable positioning. This T-shaped folding leg works perfectly when performing studies with any radiographic table.

IRAY MARS1417X DETECTOR

LWD-MARS1417X

Designed to provide the highest quality of X-Ray images with an active matrix of 2,304×2,800 pixels and **100µm pitch** (CSI).
With a Gigabit Ethernet connection for high data transfer rates and equipped with the possibility of query/upload images from detector to workstation, enable easy interchangeability between different X-Ray modalities (X-Ray mobile and fix ones).
It is the optimal choice for both retrofit and new DR System solutions, offering an effective and fast work flow.

- Wireless cassette detector. ISO 4090, fits in any bucky.
- Software with Auto-Exposure Detection.
- Best-in-class 100 µm pixel pitch with 16-bit ADC for more image details.
- Large capacity battery design, with **8+ hours battery life.**
- Lightweight design with IP56 ingress water protection.
- Supports a fast workflow for a better user experience.
- **With 200 images internal storage**
- Direct deposition CsI, with excellent DQE at all frequencies **.**

Very High trigger Sensitivity even with the thickest patients. Equipped with **internal X-ray sensors** which automatically detect the X-ray and synchronize image acquisition.

drop monitoring

Equipped with a unique drop monitoring system which serves as a real time tracker of panel dropping and shocking.

back up power cable, online charging solution

With its Charging connector is easy to keep the panel continuously charging without needing to replace the battery. The additional ethernet interface makes extremely easy to switch between wireless and wired mode.

long lasting battery

Faster operation, at least 500 exposures and **8,5 hours of continuous operation** before to recharge the battery. A few seconds to replace and restart the detector.

dual battery charger

Battery charger with capacity of charging two batteries simultaneously for a non-interrupted workflow.
With Battery charging capacity indicator.
Pack of **two batteries included**.

robust wifi signals

Both 2.4G and 5G wireless mode is supported. With higher speed and stability under 5G modes.

IGZO

Faster readout speed reaching the smallest pixels for better resolution and lower noise for improved low-dose DQE and less leakage for higher dynamic range.

TECHNICAL DATA – MAIN CHARACTERISTICS	
Detector Technology	Amorphous Silicon (a-Si) TFT
Scintillator	CsI (Cesium Iodide)
Active Area	350 x430mm
Pixel Matrix	3.500 x 4300
Pixel Pitch	100 μm
Gray Scale	16bit
Spartial Resolution	4.3 lp/mm
AD Conversion	16bit
Battery Autonomy	8.5h
WiFi	2.4G and 5G
Trigger Mode	• Software (with Auto-Exposure Detection). • AED (Optional).
Full Image Time	Typ. 3.5s
Dimensions	460x384x15mm
Weight with battery	3.0 kg
Drop Monitoring	70cm @3mm PVC
Static Loading	300Kg (over the surface)
Protection Index	IP56
MTF	70% (1.0 lp/mm) 40.4% (2.0 lp/mm) 22.8% (3.0 lp/mm)
DQE	73.4% (0 lp/mm) @RQA5 55.9% (1.0 lp/mm) @RQA5 40.4% (2.0 lp/mm) @RQA5 28% (3.0 lp/mm) @RQA5
Operating Temperature	10-40 °C
Image Acquisition Time	3 sec
BATTERIES	
Rated Capacity	Min. 4,700mAh, Typ. 4,900mAh @ Discharge 0.2C
Nominal Voltage	11.55V
BATTERY CHARGER	
Simultaneous Charging	Pack of 2 batteries
Full charging time	3 hours
Rated power supply	24V(DC)
COMPONENTS	
Components included	1 Adapter for detector and battery charger 2 Batteries (Pack) 1 Gigabit Ethernet cable 1 AC Power Cable 1 DC Power Cable

PRIMO ACQUISITION SOFTWARE

Primo is a complete innovative and technological advanced digital DR system with multi-detector operations

- Professional acquisition software for X-ray images from flat panel systems (DR)
- The software controls X-ray generator, providing a smooth and systematic workflow.
- The professional image processing can be adapted to individual user needs and provides a complete control of all image capture
- functions within the examination room, enhancing the entire workflow by delivering diagnostic images instantly, and allowing users to move X-ray images electronically to remote workstations, image archives, and printers.
- Integrated functions and intuitive operation greatly simplify daily routine tasks.

PATIENT CREATION FRAME

Possibility of Creating manually a new study:

- Last Name and First Name
- Patient ID
- Date of birth
- Weight & Height, sex
- Accession Number
- Technician and doctor
- Patient´s notes, study description

ACCESSING THE STUDY LIST (WORKLIST)

- Possibility of Creating a new study from the Worklist.
- Possibility of requesting the Worklist from the RIS.
- Transfer one or more selected studies to the Study List.
- Associate the selected study with a previous study.
- Delete one or more selected studies.
- Delete the entire list of studies received from the RIS.
- On the right-hand side of the study list frame, you find the following keys:
- DICOM Store.
- Export studies to CD/DVD or USB.
- Report Tools.
- Patient´s data Edit.
- Rejected images (statistics).
- RDSR (Radiation Dose Structured Report):
- dose report of the selected study.
- DICOM SPOOLER shows the queue for DICOM store and print services.
- Browse the list, if there is more than one page.

WORKING FRAME AND IMAGE ACQUISITION

To start the radiographic exam the Working Frame lead you to the exam selection window to choose the anatomical region required, then the anatomical part and finally the right exam:

- Head
- Chest
- Abdomen
- Cervical spine
- Pelvic measurement
- Humerus
- Femur
- AEC adjustment

Disposition of the Working Frame Information:

- Image area
- Exam List / Preview List
- Patient Data
- Messages Area:

This area contains indications of the detector connection status, the battery charge level, the amount of free space (%) on the archive disk and equipment status warnings and alarms.

- **Generator Console** (X-ray parameters): Information about X-ray generator controls and parameters is shown in this area whenever the generator communicates directly with application. If this is not the case, information on the techniques to be selected in the generator can be displayed in this area.
- **Exam Management Area**: contains keys to delete, move or add procedure to your study, and to suspend or close the study.
- **Anatomical Region and exam selection.**

PROCEDURES TECHNIQUE

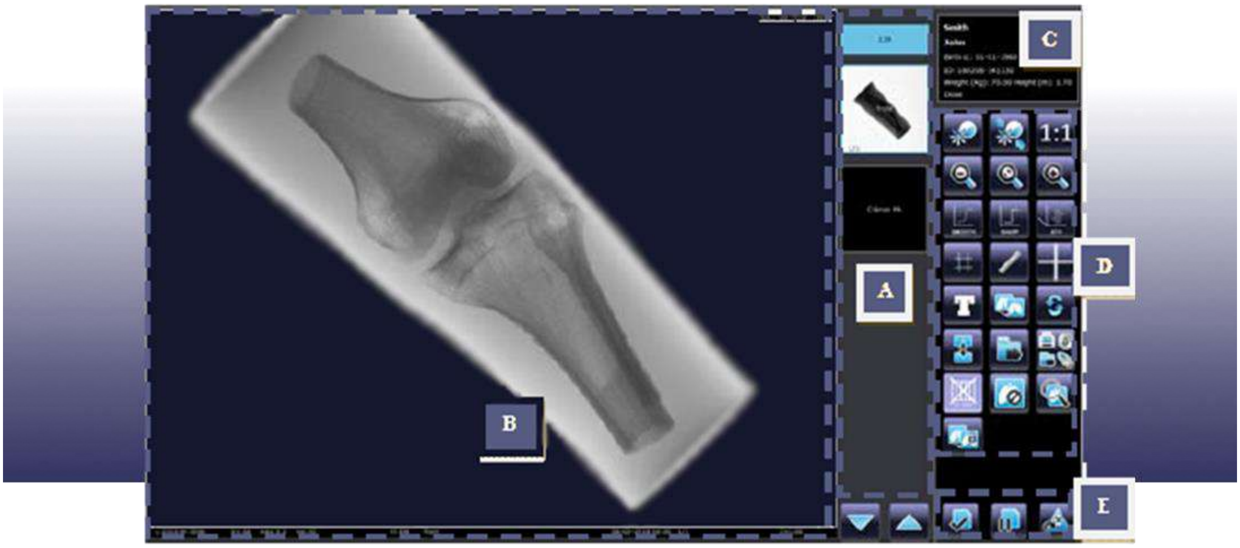
For an easy use is possible to set a Procedure to guide you through the performance of the exposures required for a study. Procedures define the exam/projection types needed for the study.

- Procedures are defined during installation of the system, in accordance with the operators and depending on the type of work required in the radiology theatre.
- A procedure can be associated to:
  - A single exam (projection) (e.g.: Std Thorax with just the PA projection of the thorax).
  - Several exams (projections) (e.g.: Full Thorax with both PA and LAT projections).
- You can either receive the Procedure from RIS via the Worklist function or chose it manually, e.g. when creating a new study manually.
- If a procedure is associated to a study, the system guides you during image acquisition and automatically presents the exams required.
- Otherwise, you need to select the exam type manually pressing the button PROC as in indicated below. All the procedures set in the system will be displayed.

X RAY GENERATION SETTING AND IMAGE ACQUISITION

- The exposure parameters for the X-ray generator must be set to suit the exam and the patient size selected.
- To make things easier, the equipment shows the best X-ray generator settings for each exam and patient size (pre-set in the database during installation, as agreed with the users.)
- The following parameters are shown:
  - 2-point technique (kV and mAs) or 3-point technique (kV, mA, and ms),
  - kV, mAs, mA and ms, to suit the technique,
  - Patient size.
  - Status warning: "Ready for acquisition"

IMAGE PROCESSING FRAME



A. Previews / Exams List
B. Image area and dose information
C. Patient data
D. Image Processing commands
E. Study commands

Grey Scale	Exposure Values	Radiation Dose (DAP)	• ELT: Exposure index target according to the data of the selected technique. • EI: Exposure Index detected in the acquired image. • DI: Deviation of the Exposure index achieved from the target.	Exam / Projection	Acquisition date and time	• Image N° • Digital Zoom

	• Patient´s name • Birth Date • Patient ID • Weight and height • Total Dose

IMAGE POST- PROCESSING

- Vertical/Horizontal image flip.
- Digital Zoom
- Spatial filters
- SMOOTH filter: this softens the edges of the image
- SHARP filter: this hardens the edges of the image
- SMOOTH + SHARP filters: both types of correction are applied.
- Images Cropping.
- Add object and text
- Duplicate images
- Store DICOM
- No grid function
- Protect an image
- Image Multiview
- ATH Harmonization
- Measurements
- Distance calculation (with calibration function)
- Angle calculation.
- Rotate images
- Report Tool
- Magnifying glass
- Reject and image/Restore images
- Thumbnail.
- Brightness and contrast control.
- STATISTICS: The statistics function is used by the Technical Service when checking the system and so can only be accessed by the Advanced user.
  - Allow to find the co-ordinates and pixel values for the image.
  - Rectangle of a size set by the operator.
  - Raw image statistics (RAW).
    - Equalized image statistics applied parameters:
    - Harmonization algorithm (ATH).
    - ROI for automatic W and L correction.
    - Gamma correction curve (LUT).
  - Possibilities to export image to a removable device (CD or PEN DRIVE) in either DICOM or RAW format.
- OVERVIEW You can view more than one image in a study on the monitor at the same time. Select the overview function by pressing the relevant command.

IMAGES RECORDS

The following DICOM functions can be used to produce image records:

Export images to PENDRIVE or CD/DVD	Send images TO WORKSTATION/ PACS DICOM (Store DICOM)	Send images to DICOM printer	SPOOLER DICOM
			

STUDIES REPORT

The software incorporates a powerful reporting tool System with immediate on-screen information display or the possibility of a later analysis by exporting the report to a folder into the hard disk.

The exported data include the following information for each study:

- Acquisition date.
- Patient Surname and first name.
- Study image number.
- Image N° and % removed from the study
- Image N° and % rejected from the study.
- Image N° and % accepted from the study.
- The reasons why an image has been rejected.

GRIDLESS IMAGING. DIRECT EXPOSURES FREEDOM

The software includes SRR (Scatter Radiation Reduction package) which allows the detector to be used live without the need to incorporate a grid while maintaining high image quality.

WITHOUT SCATTER CORRECTION

WITH SCATTER CORRECTION

IMAGE QUALITY CONTROL TOOLS

The software allows the acquisition of images in "Raw" format (RAW) from the same user station. RAW images have a DICOM extension so they can be opened from external image control applications such as those specific to some quality control phantoms. Additionally, the verification of the images can be done from the application itself, as a complete module is available with the possibility of selecting ROIs and tools for measuring the average pixel value and noise.

SYSTEM CONNECTIVITY

The acquisition station incorporates the following functionalities in accordance with the standard DICOM 3.0:

- Modality Worklist.
- Storage.
- Modality Performed Procedure Step (MPPS).
- Basic Greyscale Print.
- Storage Commitment
- Verification.
- Grayscale Standard Display Function (GSDF).
- Radiation Dose Structured Report (RDSR).

DAP SYSTEM

VAD-DIG-LW

Measurement system to determinate the radiation level which a patient is exposed to during exposure.

TECHNICAL SPECIFICATIONS	
Range of kV	From 40 to 150 kV.
Measuring DAP rate	From 0.1 to 99,999,999 μGy·m².
Measuring DAP rate range	Digital resolution, 0.01 μGy·m²
Active Area Dimensions	From 0.1 to 35,000 μGy·m²/s.
Temperature range	From +10°C to +40°C
Transparency	> 70%.
Quality equivalent filtration	0.2mm. Al
Rails & Guides	123x123 mm
Cable	15m

PORTABLE SYSTEM RAYBOW FLEX DR

TXLW4

RAYBOW FLEX DR 4kW is a completely integrated system, that combines a modern High Frequency X-ray Generator's Technology with and excellent flexibility for any clinic emergency room, Intensive Care Unit, etc.

Perfectly adapted for external use, in mobile unit for emergency, rural locations and difficult access places. High-performance X-ray system provides the complete diagnostic radiology tools available in human medicine today.

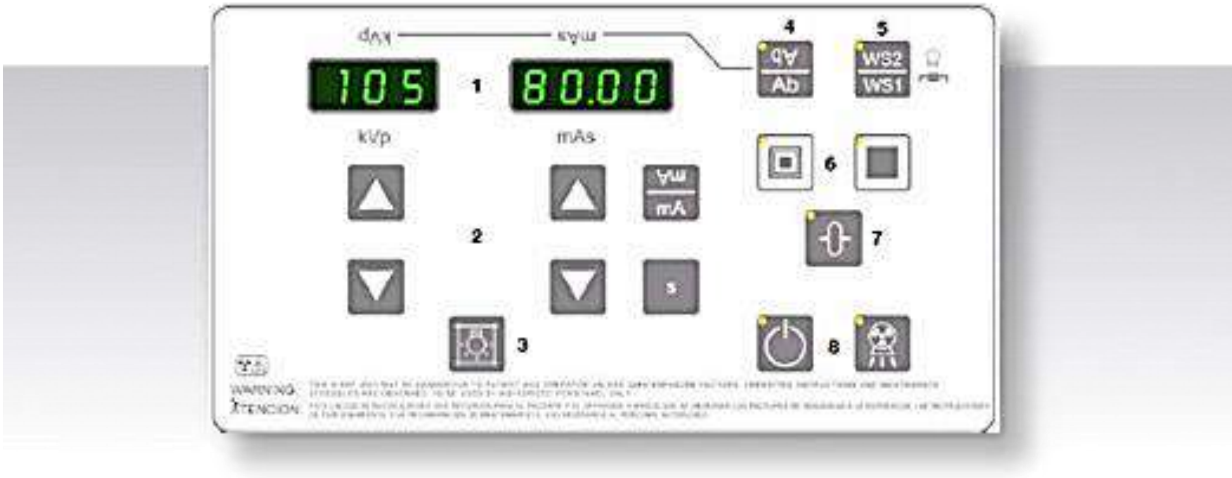
The main features of this Portable X-Ray Unit are:

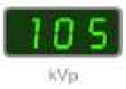
- Safe and easy operation.
- Constant potential high frequency operating on single phase lines.
- Radiographic operation from:
- Touch Screen Console.
- X-Ray Unit Control Panel located at the head.
- Tube protection circuitry prolongs Tube life and increases system performance.
- Filament Power Down Mode to increase the Tube Filament life.
- Standard electric outlet operation from 110 to 130 VAC or 220 to 240VAC for 4 kW.
- Equipped with closed loop control of X-Ray Tube current, kVp and filaments, which minimize potential errors and the need for readjustments.
- Automatic line voltage compensation due to closed loop operation of X-ray Tube current and kVp
- Remaining percentage of the Thermal capacity of the X-ray Tube and Generator.
- Its sophisticated system level self-diagnostics greatly increases serviceability and reduces down time.

TECHNICAL FEATURES

Generator type	SINGLE PHASE, HIGH FREQUENCY. 1 TUBE
Input line operation	100/240VAC
Frequency	50/60Hz
MAXIMUM POWER kW	4.0kW, According to IEC definition IEC (0.1s, 100kV)
kVp RANGE	From 40kVp to 125kVp. In steps of 1kVp
kVp high frequency ripple	300 kVp
kVp accuracy	± (3% +1 kVp)
mAs RANGE	From 0.1mAs a 250mAs in 35 steps, Renard10 Scale.
mAs Accuracy	± (5% + 0.1mAs)
mA RANGE	From 5 mA to 100 mA in 15 steps, Renard10 Scale. 5,6,4,8,10,12.5,16,20,25,32,40,50,63,80,100
Exposure time range	From 1.0msec to 10,000msec (0.001 a 10 seconds).
Maximum exposure time range for dr	From 0.001 to 1.6 seconds.
OUTPUT POWER (@ 0,1s)	121 - 125 kVp @ 20 mA 111 - 120 kVp @ 25 mA 101 - 110 kVp @32 mA 100 kVp @ 40 mA 50 kVp @ 80 mA 40 kVp @ 100 mA
Input power	6.6kVA
Line voltage automatic compensation	± 10%Vac
X ray tube:	
Small focus	0.5mm
Large focus	1.8mm
Target angle	16°
Anode heat content	35,500 J (47,215 HU)
Inherent filtration	
Added filter	0.5 mm Al @ 75 kVp
X-ray tube assembly	1.3 mm Al @ 75 kVp
Collimator assembly	2.0 mm Al @ 75 kVp
Total inherent filtration	3.8 mm Al @ 75 kVp
Power line cable	6 meters

CONTROL PANEL AT THE HEAD OF THE X-RAY UNIT

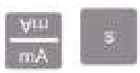




kVp DISPLAY: Here can be showed:

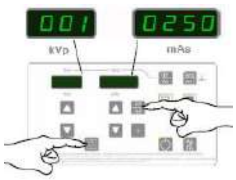
- The radiographic kVp value selected for the technique.
- The Power percentage.
- The Error messages during a system fault.

mAs DISPLAY, can be showed: The radiographic mAs value selected for the technique.



mA: The mA values (selected X-Ray Tube current) will be shown on the mAs display.

s (Exposure Time in seconds): The values of the selected Exposure Time in seconds will be shown on mAs display.



The combination of two buttons will display:

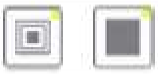
- kVp and mAs from the last exposure (Reset).
- Exposures Counter (Collimator Light and mA).
- Energy Counter (Collimator Light y s).
- Remaining Thermal Capacity (%) of the X-ray Tube and Generator (Collimator Light and Focal Spot).

INCREASE/DECREASE of the following Radiographic Technique values:

- kVp: Selects the X-ray Tube voltage.
- mAs: Selects the mAs exposure (X-ray Tube current * exposure time).

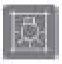
ROTATION OF THE CONTROL PANEL: The readout of the Radiographic displays and the function of the increase/decrease RAD parameters (kVp and mAs) and APR buttons can be inverted (180°).

WORKSTATIONS: This button selects the Workstation "Direct" (WS1) or "Receptor" (WS2).



LARGE FOCAL SPOT & SMALL FOCAL SPOT

PREP: The push-button indicator will light when the X-ray Tube is prepared.



COLIMATOR LIGHT: After pressing this push-button, the Collimator Light remains illuminated for 30 seconds.

X-RAY ON: push-button to start the X-ray exposure.

RESET: to reset the error messages.

POWER ON / OFF:

The Unit should be plugged into a wall socket that accomplishes with local regulations, by pressing the switch of: General Circuit Breaker, X-Ray Unit and Touch Screen Console, the startup routine takes place and disconnect the plug from the mains to disconnect.

AUTOMATIC LINE POWER DETECTION SYSTEM:

By means of this System, the Unit detects the maximum operative Power Line adapting the Exposure Parameters to the Power available and avoiding undesired line breakdowns when operating with poor electricity lines.

mAs-METER MODE:

This automatic mode allows the generator to adapt the Exposure Parameters to avoid interrupted exposures due to poor electricity lines. If the Unit detects undesired voltage drops when operating with poor electricity lines.

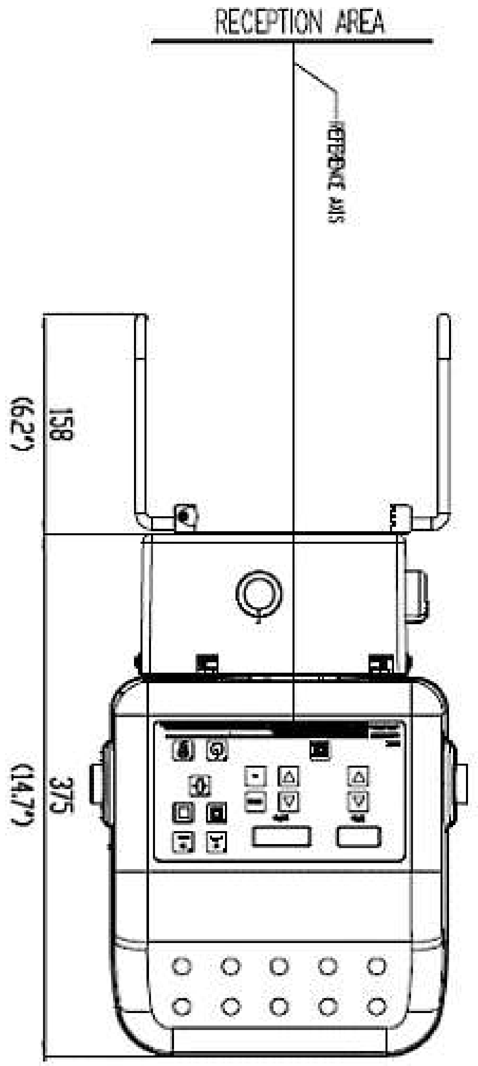
MANUAL POWER REDUCTION:

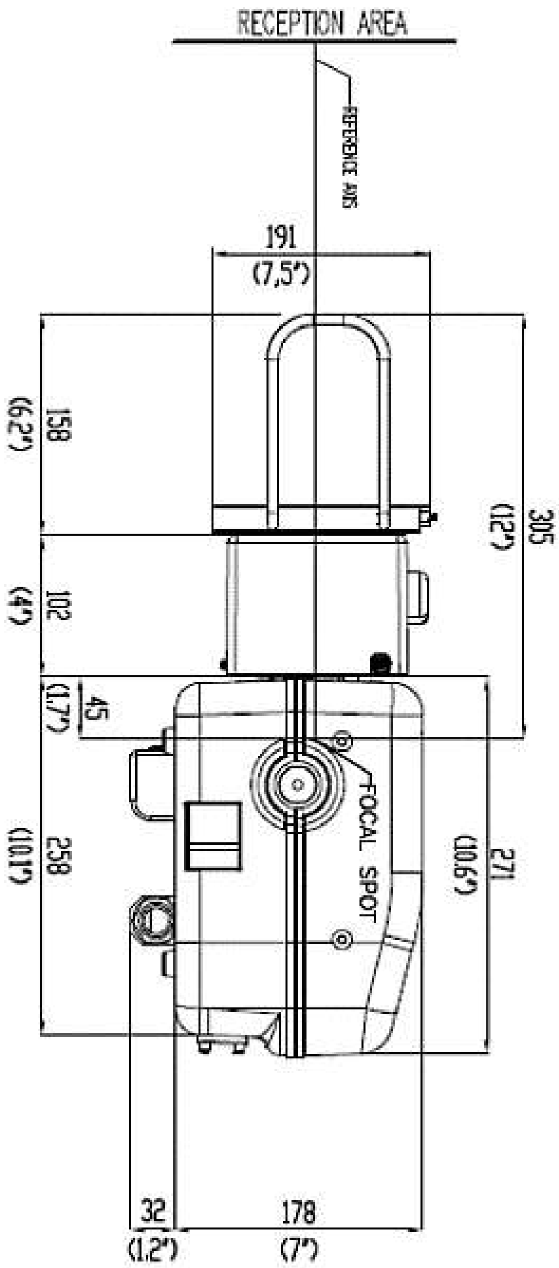
The operator may reduce the Unit maximun Power to avoid blown fuses or Circuit Breakers down in poor electricity lines.

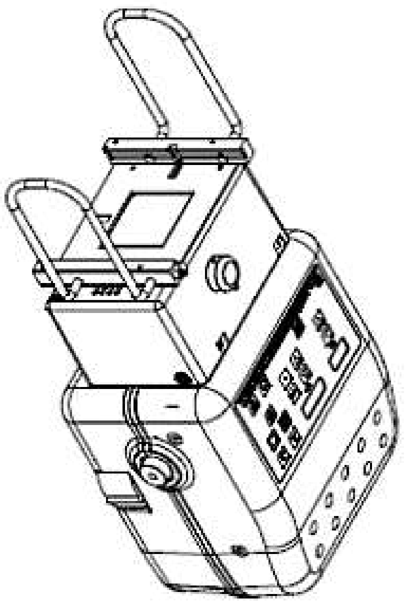
FOCUS SKIN-DISTANCE SPACER

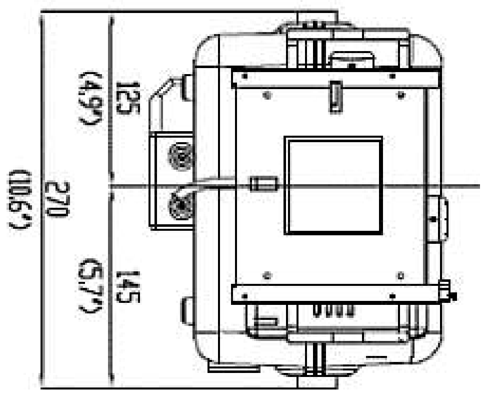
The Unit is supplied with a SID Guard with rails for accessories (Dosimeter and Aluminium Filters, optional). This accessory ensures a minimum safety distance between the X-ray focus and the patient.
Designed for General Radiography: From Head to toe including thorax and abdomen.

DIMENSIONS


RECEPTION AREA
REFERENCE AXIS
158
(6.2")
375
(14.7")


RECEPTION AREA
REFERENCE AXIS
191
(7,5")
158
(6.2")
102
(4")
45
(1.7")
258
(10.1")
305
(12")
271
(10.6")
FOCAL SPOT
32
(1.2")
178
(7")

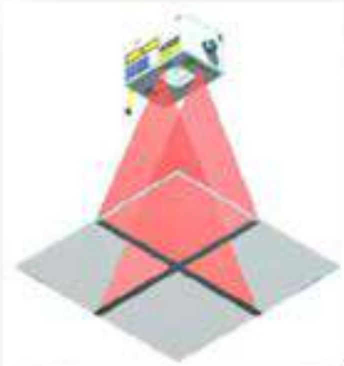



125
(4.9")
270
(10.6")
145
(5.7")

COLLIMATOR WITH LASER

R72S

Manual Collimator with a Single layer, square field with a lightweight and compact design for installation on portable X-ray equipment.
2 lasers with cross projection, for patient centering.



TECHNICAL FEATURES

Continuous Film Coverage Max	Max: 43 x 43 cm at 100 cm SID
Maximum Radiation Leakage	125 kVp - 4 mA
Minimum Inherent Filtration	2 mm aluminium equivalent
Light Field	Providing high luminosity for X-ray field simulation. The light field is controlled by an electronic timer to avoid overheating
Light Field Indicator	at 100cm SID,160 lux
Field Positioning	Manual, by rotating the control knobs
Laser	2 lasers with cross projection, for better patient centering.
GC-Led-5A timer board	GC-Led-5A for light source supply and operation. The board is CanBus controlled
Retractable Tape	1 unit. Mounted on a radiological unit, measures the distance between the focus and the patient
Light on time	Light source ON time for the light field is factory set at 30 seconds. It is adjustable from 30 to 45 seconds
Time Adjustment	Maximum light ON time is 15 min. for safety reasons, but it can be adjusted from 30s to 120s up to run
Rotation	±90°

DETECTOR HOLDER

SCDF-2

- Protective frame and holder for detectors 35x43, for easy transport lightweight feel and safe use
- It has a lock on the handle to prevent the detector from accidentally slipping out of the frame.
- With **optional** integrated grid, designed to fit the Digital Detector.

WITHOUT GRID

WITH GRID

ADDITIONAL LOCK

All data provided by the manufacturer:

RADIOLOGÍA
Pelaya, 13. Polígono Industrial "Río de Janeiro"
28110 Algete, Madrid - España (Spain)
Phone: +34 902 195 770
Fax: +34 902 103 367 www.radiologia-sa.com

CE 1639

PRIMAX INTERNATIONAL srl
Via A. Volta 10, 24060
Torre de Roveri ITALY
Phone +39 035 4500002

primax INTERNATIONAL

Portable X-Ray Units

Service Manual

Technical Publication
SM-1153R6_EN_PRX

Service Manual

Portable X-Ray Units
with Digital Detectors

Technical Publication
SM-1153R6_EN_PRX

Service Manual

Portable X-Ray Units
with Digital Detectors

This manual covers the following equipments / Este manual cubre los siguientes equipos Ce manuel couvre les équipements suivants / Il presente manuale descrive i seguenti dispositivi
Portable X-Ray Unit TRANSPORTIX L: **TXLW4** **TXLW8**

RADIOLOGÍA
Pelaya, 13. Polígono Industrial “Río de Janeiro”
28110 Algete, Madrid - España (Spain)
Phone: +34 902 195 770
Fax: +34 902 103 367 www.radiologia-sa.com

Manufactured by RADIOLOGÍA for PRIMAX INTERNATIONAL srl
Via Alessandro Volta 10
24060 Torre de’ Roveri (BG) - Italia (Italy)

REVISION HISTORY

REVISION	DATE	REASON FOR CHANGE
0	APR 24 2020	First Edition
1	NOV 27 2020	TS Sensor CA and AP Replacement
2	APR 22 2021	Technical specifications for 5 kW model
3	JUL 06 2021	Troubleshooting and Renewal parts update
4	OCT 28 2021	Lower steering handles installation / replacement and Renewal parts update
5	DEC 23 2022	Renewal parts and Schematics update
6	JAN 31, 2023	Control Board Update

This Document is the English original version, edited and supplied by the manufacturer.

The Revision state of this Document is indicated in the code number shown at the bottom of this page.

ADVISORY SYMBOLS

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

DANGER !

DANGERS ADVISE OF CONDITIONS OR SITUATIONS THAT IF NOT HEEDED OR AVOIDED WILL CAUSE SERIOUS PERSONAL INJURY OR DEATH.

WARNING

ADVISE OF CONDITIONS OR SITUATIONS THAT IF NOT HEEDED OR AVOIDED COULD CAUSE SERIOUS PERSONAL INJURY, OR CATASTROPHIC DAMAGE OF EQUIPMENT OR DATA.

CAUTION

Advise of conditions or situations that if not heeded or avoided could cause personal injury or damage to equipment or data.

Note ☞

Alert readers to pertinent facts and conditions. Notes represent information that is important to know but which do not necessarily relate to possible injury or damage to equipment.

SERVICE NOTE TO PORTABLE X-RAY UNITS

THIS PORTABLE UNIT HAS BEEN CONFIGURED, CALIBRATED AND TESTED BY THE MANUFACTURER.

IT IS READY FOR NORMAL OPERATION. NO SERVICE TASK IS REQUIRED.

REFER TO THIS SERVICE MANUAL ONLY FOR PERIODIC MAINTENANCE OR REPAIRS.

TABLE OF CONTENTS

Section **Page**

Section **Page**

SECTION 1 INSTALLATION REQUIREMENTS

1.1 OBJECTIVE AND SCOPE OF THIS MANUAL

This Service Manual is intended to describe the installation, adjustments, configuration, calibration, troubleshooting and periodic maintenance of the Portable X-Ray Unit.

WARNING

SERVICE PERSONNEL MUST HAVE SUFFICIENT KNOWLEDGE TO COMPETENTLY PERFORM THE SERVICE TASKS RELATED TO X-RAY DEVICES AND PARTICULARLY TO THE EQUIPMENT DESCRIBED IN THIS MANUAL. THIS KNOWLEDGE IS ACQUIRED THROUGH A VARIETY OF EDUCATIONAL METHODS FOR TECHNICIANS IN ACCORDANCE WITH LOCAL LAWS OR REGULATIONS, INCLUDING SPECIFIC TRAINING ON THIS EQUIPMENT.

CAUTION

The Portable Unit has been Configured, Calibrated and Tested by the Manufacturer. It is ready for normal operation. No service task is required. Refer to this Service Manual only for Periodic Maintenance or repairs.

1.2 POWER LINE REQUIREMENTS

Note ☞

The Unit is factory provided with a Power Cable (6 meters) and a Plug for connection to line voltage (wall socket) according to customer order. If required, change the line cord and plug to conform to local codes and requirements.

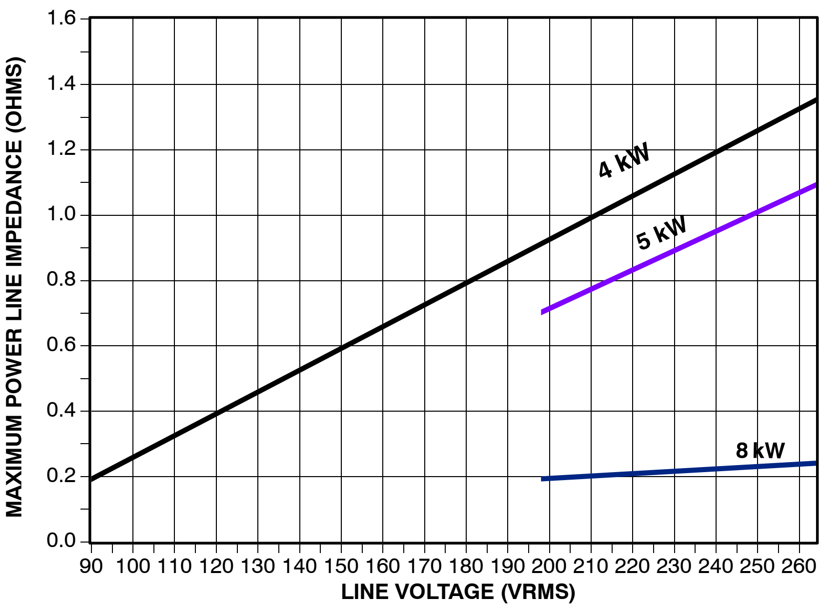
DANGER !

ACCORDING TO MDD/93/42/CEE, THIS UNIT IS EQUIPPED WITH EMC FILTERS. THE LACK OF PROPER GROUNDING MAY PRODUCE ELECTRICAL SHOCK TO THE USER.

Portable X-ray Units power requirements are:

Maximum Power kW	4.0	5.0	8.0
Power Line Operation	Single-Phase, 100 – 240 V~, 50 / 60 Hz.	Single-Phase, 220 – 240 V~, 50 / 60 Hz.	Single-Phase, 220 – 240 V~, 50 / 60 Hz.
	Line voltage automatic compensation: ±10%		
	Power line cable of the Portable Unit: 6 meters. Connection to standard outlets with GND that accomplishes local regulations.		
Input Power	6.6 kVA	7.5 kVA	12.5 kVA
Maximum Power Line Impedance	*Refer to Illustration 1-1*		
Minimum recommended Thermomagnetic / Circuit Breaker	The General Circuit Breaker installed in the Portable Unit is 32 A (curve type C) with a 30 mA Sensitivity Differential. The Power Line Installation should be provided with a 30 mA Sensitivity Differential and with a Thermomagnetic Interruptor / Circuit Breaker of at least:		
	$\geq$30 A (curve type C) or $\geq$16 A (curve type D) for 100 – 120 V~ $\geq$16 A (curve type C) or $\geq$10 A (curve type D) for 220 – 240 V~	$\geq$16 A (curve type C) or $\geq$13 A (curve type D) for 220 – 240 V~	$\geq$30 A (curve type C) or $\geq$16 A (curve type D) for 220 – 240 V~
	Momentary Line Current based on 100 ms X-ray exposure (RMS)		

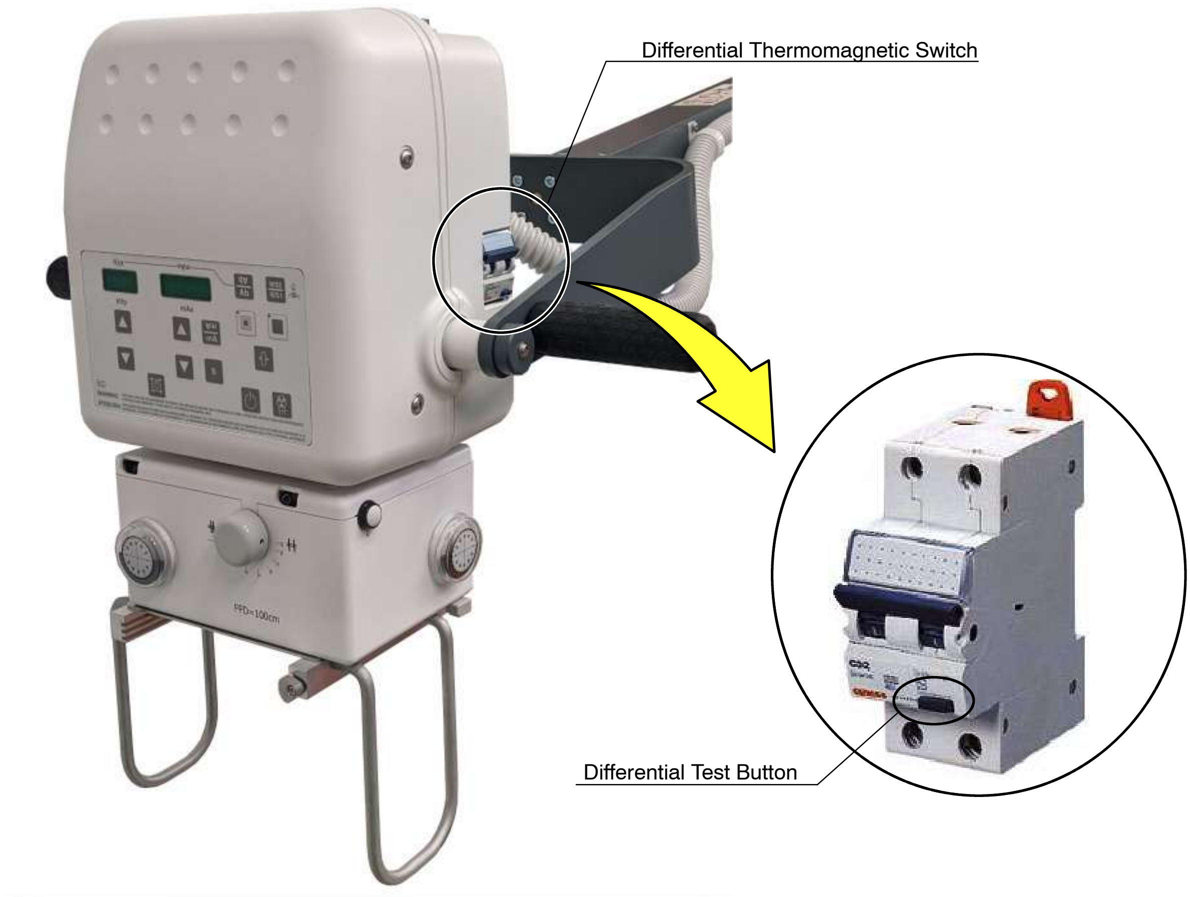
Illustration 1-1
Maximum Power Line Impedance



1.2.1 TEST OF DIFFERENTIAL THERMOMAGNETIC SWITCH

The X-ray Unit is equipped with a Differential Thermomagnetic Switch (Circuit Breaker) with a Differential Test button.

The Test button does not operate when the unit is connected to power lines below 160 V~, but it does not mean that the Differential Thermomagnetic Switch does not work properly.



1.3 TOOLS AND TEST EQUIPMENT

The following test equipment is required in Configuration, Calibration, Troubleshooting and Maintenance:

- Standard service engineers tool kit including Allen and Torx key sets.
- Oscilloscope.
- Non-invasive kVp Meter.
- Digital Multimeter.
- Calculator.
- Torque Wrench to check proper fixation of the screws in the X-ray Unit Support. The tool should be capable to measure 8 Nm and 30 Nm (*refer to Section 7.6 and the corresponding Troubleshooting procedures dismounting the X-ray Unit Support*).

The following Tools are used to adjust the alignment of X-Ray Beam (*refer to Section 4*) and they are not included with the System:

- Collimator Test Tool (Model RMI 161B9).
- Beam Alignment Test Tool (Model RMI 162A).

1.4 GENERAL CAUTIONS

WARNING

OPERATOR AND SERVICE MANUALS SHOULD BE CAREFULLY READ AND UNDERSTOOD BY SERVICE PERSONNEL BEFORE USING AND SERVICING THE EQUIPMENT, ESPECIALLY THE INSTRUCTIONS CONCERNING SAFETY, REGULATORY, DOSAGE AND RADIATION PROTECTION. KEEP THE MANUALS WITH THE EQUIPMENT AT ALL TIMES AND PERIODICALLY REVIEW THE OPERATING AND SAFETY INSTRUCTIONS.

DANGER !

TO AVOID THE RISK OF ELECTRIC SHOCK, THIS EQUIPMENT MUST ONLY BE CONNECTED TO A SUPPLY MAINS WITH PROTECTIVE EARTH. DO NOT TOUCH ANY HEATSINK OF THE CIRCUIT BOARDS EVEN THE GENERATOR IS TURNED OFF. PREVIOUS TO DISASSEMBLE ANY BOARD, REMOVE ALL CONNECTORS PLUGGED TO IT.

SECTION 2 CONFIGURATION PROCEDURE

CAUTION

Configuration and Calibration procedures should only be performed at field if Portable Control Board, Control Driver Board or the High Voltage Transformer are replaced or the EEPROM memory is re-initialized.

All procedures described in this Service Manuals are performed from the Control Panel of the X-ray Unit.

Configuration provides the initial settings and checkout procedures that must be carried out before starting to work with the Unit. Functional characteristics of this Generator are defined during Configuration.

Calibration data and some configuration data are stored in the extended memory area of the non-volatile memory U25-EEPROM Microcontroller. It is located on the Portable Control Board (*A3175-05*).

CAUTION

Do not supply the main power until specifically instructed in this document.

2.1 CONFIGURATION OF DIP SWITCHES

The Dip Switches located in the Portable Control Board *(A3175-05)* define the Unit configuration:

Dip Switch SW1	Description
1*	ON = Service mode enabled OFF= Service mode disabled
2	ON = Hardware errors disabled OFF= Hardware errors enabled
3	ON = Demo mode enabled OFF= Demo mode disabled
4	ON = Filaments disabled OFF= Filaments enabled
* *NOTE.- Access to Service mode can be also performed using the keyboard as indicated in Section 2.2 while dipswitch is in "OFF" position.*	

All Dip Switches are Factory set to OFF position for normal operation.

2.2 HOW TO ENTER AND STORE DATA IN CONFIGURATION MODE

Configuration data is entered from the Control Panel when the Unit is in Service Mode. Access and configure data as indicated below:

1. Turn the Unit ON and immediately press and hold *"Reset"* push-button to enter in Service Mode. The Unit starts its power-up routine and the software version (e.g. P01 0103) is shown on the Display of the Control Panel.

= Vers. 1, Rev. 01.03

2. When the letters "*CAL*" appear in the kVp Display, release *"Reset"* push-button.

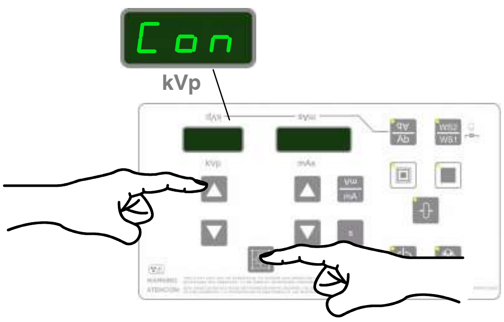
3. Then the Displays show the selected power percentage (e.g. Po = 100) followed by the standard kVp and mAs values.

Unit power = 100%

The Unit is equipped with ten (10) Configuration groups (C01 to C0A) and their subgroups are shown on the kVp Display when they are selected. *(Refer to Table 2-1 "Configuration Menus").*

4. **To enter or exit the Configuration menu:**

   a. Press and hold *"Collimator Light"* push-button and then press and release *"kVp Increase"* push-button (two beeps sound). (Con) appears on the kVp Display while *"Collimator Light"* is pressed, then release *"Collimator Light"* (kVp Display shows C01 and both Focal Spot Leds blink).



1 Press and hold Collimator Light
2 Press and release kVp Increase
3 Release Collimator Light

b. Press *"kVp Increase"* or *"kVp Decrease"* push-buttons to move through Configuration menus to select any of them (the kVp Display shows menus from C01 to C0A).

c. Press *"Collimator Light"* push-button to enter in the sub-menus.

d. Press *"kVp Increase"* or *"kVp Decrease"* to scroll through sub-menus of each menu and select any of them. The desired selection will be shown on the kVp Display.

e. Press *"Collimator Light"* push-button to exit the sub-menus.

f. To exit Configuration Mode, press and hold *"Collimator Light"* push-button and then press and release *"kVp Increase"* push-button (two beeps sound). Then release the *"Collimator Light"* push-button.

Table 2-1
Configuration Menus

Value on kVp Display		DESCRIPTION	NOTES
C01	**WORKSTATION-1 CONFIGURATION**		*Values factory set.* *Original values must not be modified.* *Refer to Section 2.2.1*
	C1.1	X-ray Tube present 0 = WS not used, 1 = Tube 1	
	C1.2	Workstation Type: 0 = Direct, 1 = Bucky / Detector, 2 = not used, 3 = not used, 4 = not used	
	C1.3	Device selection: 0 = none, 1 = Detector / Standard Bucky (Receptor synchronization by hardware), 2 = Detector / Bucky Com (Receptor synchronization by software)	
	C1.4	0 = not used	
C02	**WORKSTATION-2 CONFIGURATION**		*Values factory set.* *Original values must not be modified.* *Refer to Section 2.2.1*
	C2.1	X-ray Tube present 0 = WS not used, 1= Tube 1	
	C2.2	Workstation Type: 0 = Direct, 1 = Bucky / Detector, 2 = not used, 3 = not used, 4 = not used	
	C2.3	Device selection: 0 = none, 1 = Detector / Standard Bucky (Receptor synchronization by hardware), 2 = Detector / Bucky Com (Receptor synchronization by software)	
	C2.4	0 = not used	
C03	**mA STATION CONFIGURATION FOR EACH FOCUS**		*Refer to Section 2.2.2*
	C3.1	mA Stations for *"Small Focal Spot":* 5.000 mA - 100.0 mA	Set Maximum mA station for *"Small Focal Spot"*
	C3.2	mA Stations for *"Large Focal Spot"*: 5.000 mA - 100.0 mA	Set Minimum mA Station for *"Large Focal Spot"*

Table 2-1 (cont.)
Configuration Menus

Value on kVp Display		DESCRIPTION	NOTES
C04	**X-RAY TUBE LIST SELECTION / number of Tube in the list**		*Refer to Section 2.2.3*
	C4.1	X-ray Tube Configuration as Tube–1: 1 - 5	
C05	**TIME CONFIGURATION FOR "PREP" AND COLLIMATOR LIGHT**		*Refer to Section 2.2.4*
	C5.1	*"Prep"* Time Configuration: 10 - 50 seconds	Factory Configured at 30 seconds.
	C5.2	*"Collimator Light"* Time Configuration: 30 -45 seconds	Factory Configured at 30 seconds.
C06	**MAXIMUM X-RAY TUBE POWER**		*Refer to Section 2.2.5*
	C6.1	Maximum percentage limit for X-Ray Tube	Select the maximum power percentage at 100, 90, 80 or 70.
C07	**MISCELLANEOUS**		*Refer to Section 2.2.6*
	C7.1	Speaker Sound: OFF / ON / ES OFF / ES ON	OFF = all sounds disabled. ON = all sounds enabled. (Factory set) ES OFF = Exposure sound disabled. Every other sound enabled. ES ON = Exposure sound enabled. Every other sound disabled. *C7.1 = OFF and C7.1 = ES OFF are not compatible with C9.4 = NO.*
	C7.2	Winter / Summer Automatic Time Update: NO / EU / USA	NO = automatic time update disabled. EU = EU automatic time update enabled (factory set). USA = USA automatic time update enabled.
	C7.3	Collimator Light ON with PREP: OFF / ON	OFF = Collimator Light only enabled with push- button (Factory set). ON = Collimator Light enabled when pressing "*PREP*".
	C7.4	Protocol Syntax: NO / YES	NO = Standard Protocol. (Factory set) YES = Protocol only compatible with units that require the Tech Service application for configuration / calibration and communication.
	C7.5	ABC input: 0 = None, 1 = kV ±	0 = When the system is not interfaced with an ABC System or to keep the kV constant when calibrating fluoro to make possible the mA reading. (Factory set) 1 = When the Generator is interfaced with an ABC System. The customer's system sends the signals to adjust the kV.

Table 2-1 (cont.)
Configuration Menus

Value on kVp Display		DESCRIPTION	NOTES
C08	**DATE AND TIME**		*Factory set at GMT +1.Refer to Section 2.2.7*
	C8.1	Hour	0 - 23
	C8.2	Minutes	0 - 59
	C8.3	Date	1 - 31
	C8.4	Month	1 - 12
	C8.5	Year	2000 - 2099
C09	**X-RAY TUBE MISCELLANEOUS**		*Refer to Section 2.2.8*
	C9.1	Tube 1 max kV: 80–125	125 factory set.
	C9.2	Fluoro max kV: 80–125 (only for Fluoro units)	120 factory set (never greater than Tube 1 max kV)
	C9.3	High Dose Auto OFF: NO / YES (only for Fluoro units)	NO = High Dose Button always enabled (Factory set) YES = High Dose Button automatically disabled when not in use.
	C9.4	"RX Enable" Required: NO / YES	NO = X-ray enabled when starting the Unit YES = X-ray disabled when starting the Unit. "RX Enable" comes from RS232, so the Serial Port license must be enabled. *When C9.4 = NO, the Exposure sound is always enabled. Configuration of C7.1 = OFF and C7.1 = ES OFF are not compatible with this selection (C9.4 = NO).*
	C9.5	mAs Meter Mode: NO / YES	NO = mAs Meter Mode disabled. YES = mAs Meter Mode enabled. (Factory set)
	C9.6	First DSI Exp: E50 Disabled	NO = E50 is displayed when handswitch is released during the first exposure. (Factory set) YES = E50 is not displayed when handswitch is released during the first exposure .
	C.9.7	RAD Sync Timeout	0–60 seconds 2 (Factory set)
	C9.8	Fluoro Sync Timeout (only for Fluoro units)	0–60 seconds 2 (Factory set)

Value on kVp Display		DESCRIPTION	NOTES
C09	**X-RAY TUBE MISCELLANEOUS**		*Refer to Section 2.2.8*
	C9.9	X-Ray Key: NO / YES (optional feature)	NO = X-ray Key feature enabled YES = X-ray Key feature disabled
	C9.A	Enable both filaments (only for Fluoro units)	NO = Enable both filaments feature enabled YES = Enable both filaments feature disabled
C0A	**MAXIMUM MS FOR DIGITAL WORKSTATION**		*Refer to Section 2.2.9*
	CA.1	Max ms for Digital Workstation	0 = 2.5 seconds (by default) 1 = 3.2 seconds

Note ☞ *If any of the configurated values is not consistent with the Unit Parameters, the system will not allow to exit from Configuration mode. Double check the configured values (Refer to Table 2-1).*

2.2.1 CONFIGURATION OF WORKSTATIONS (1) - (2)

The Workstations are factory configured according to the *Primo S* application, therefore, during normal operation, the user always selects the workstation from the *Primo S* Application.

In Service Mode (Configuration and Calibration), press  to select Workstation 1 or Workstation 2.

Note ☞

In case the Receptor Workstation for the Digital Detector or Bucky is selected and no Digital Detector or Bucky is connected to the Unit or the connection is malfunctioning, error code "E24" appears on the Display. Press "Reset" push-button and check connections and signals of the Digital Detector or Bucky, or select the Workstation for Direct if no Receptor is needed.

Factory Setting			
Workstation 1 (used for Direct on Primo S application)		**Workstation 2 (used for Digital Detector on Primo S application)**	
C 1.1	1	C 2.1	1
C 1.2	0	C 2.2	1
C 1.3	0	C 2.3	1 or 2 *
C 1.4	0	C 2.4	0

* *Note*: *Select 1 for Receptor synchronization by hardware (e.g. Detector with synchronization box).*
Select 2 for Receptor synchronization by software (e.g. Wireless Detector without synchronization box).

In case a Workstation configuration needs to be modified:

1. Enter Configuration Menu C01 (for Workstation-1) or C02 (for Workstation-2).

2. Enter sub-menu C1.X or C2.X, the kVp Display shows (C1.X) or (C2.X) and the mAs Display shows the selectable values.

   As example, enter sub-menu C1.1 or C2.1. The kVp Display shows (C1.1) or (C2.1) and the mAs Display shows (0) or (1). "X-ray Tube present" value is "*0*" for Workstation not used or "*1*" for X-ray Tube-1 present (Workstation used).

3. Press *"mAs Increase"* to change the corresponding value from e.g. "*0*" (Workstation not used) to "*1*" (Tube present – Workstation used) or viceversa.

4. Press *"Reset"* push-button to save value.

2.2.2 CONFIGURATION OF mA STATIONS FOR EACH FOCUS

1. Enter Configuration menu C03.

2. Enter sub-menu C3.1. The kVp Display shows (C3.1) and the mAs Display shows (16.00) for 4 kW and 5 kW Units or (12.5) for 8 kW Units (Factory set).

3. To change the corresponding maximum value of mA station for Small Focus, press *"mAs Increase"* or *"mAs Decrease"*. Factory default value is 16 mA for 4 kW and 5 kW Units or 12.5 mA for 8 kW Units.

4. Press *"Reset"* push-button to save value.

5. Press *"kVp Increase"*, the kVp Display shows sub-menu (C3.2) and mAs Display shows (5.000) (Factory set).

6. To change the corresponding minimum value of mA station for Large Focus, press *"mAs Increase"* or *"mAs Decrease".* Factory default value is 5 mA.

7. Press *"Reset"* push-button to save value.

8. Press *"Collimator Light"* push-button to exit the sub-menus. The kVp Display shows (C03).

Note ☞ *Maximum mA station recommended for the "Small Focus" is 16 mA for 4 kW* and 5 kW *Units or 12.5 mA for 8 kW Units.. The minimum mA station for "Large Focus" should be the lowest mA station allowed by the Unit.*

2.2.3 X-RAY TUBE SELECTION

1. Select Configuration menu C04.
2. Enter sub-menu C4.1 for Tube-1. The kVp Display shows (C4.1) shows the Tube identifier.
3. To change the X-ray Tube ID (identifier, shown on the kVp Display for seconds) press *“mAs Increase / Decrease”* and set the ID shown on the *“Inspection Report”* document of the Unit.
4. Press *“Reset”* push-button to save data. The Tube ID is momentarily shown on the kVp Display and a beep sounds.
5. Press *“Collimator Light”* push-button to exit the sub-menus. The kVp Display shows (C04).

Error E08 appear when the Tube ID is a default value.

In case the HV Transformer has been replaced, request the manufacturer the Tube identifier to be configured.

2.2.4 TIME CONFIGURATION FOR “PREP” AND COLLIMATOR LIGHT

1. Select configuration menu C05.
2. Enter sub-menu C5.1 for “*Prep*” Time Configuration. The kVp Display shows (C5.1) and the mAs Display shows (30). Factory set at 30 seconds, within this lapse of time *“Exp”* button should be pressed, otherwise the exposure will not be allowed.
3. Press *“mAs Increase”* or *“mAs Decrease”* to change Preparation Time. Value Factory set at 30 (range from 10 to 50).
4. Press *“Reset”* push-button to save value.
5. Press *“kVp Increase”* to enter sub-menu C5.2 for Collimator Light Time. The kVp Display shows (C5.2) and mAs shows (30) (Factory set).
6. Press *“mAs Increase”* or *“mAs Decrease”* to change Collimator Light Time. Value Factory set at 30 seconds (range from 10 to 50).
7. Press *“Reset”* push-button to save value.
8. Press *“Collimator Light”* push-button to exit sub-menus. The kVp Display shows (C05).

2.2.5 MAXIMUM X-RAY TUBE POWER

Note ☞ *The maximum X-Ray Tube Power (power curves) can be set at 70, 80, 90 or 100% of the maximum rate. This power limitation increases the total life of the Tube.*

1. Select Configuration menu C06.
2. Enter sub-menu 6.1. The kVp Display shows (C6.1) and the mAs Display shows (100) (Factory set).
3. To change the Percentage Rating, press *"mAs Increase"* or *"mAs Decrease"* push-buttons (70, 80, 90 or 100). Value factory set at 100.
4. Press *"Reset"* push-button to save the value.
5. Press *"Collimator Light"* push-button to exit sub-menus. The kVp Display shows (C06).

2.2.6 MISCELLANEOUS

1. Select configuration menu C07.
2. Enter sub-menu C7.1 for Speaker Sound Configuration. The kVp Display shows (C7.1) and the mAs Display shows (ON) (factory set).
3. Press *"mAs Increase"* or *"mAs Decrease"* to change Speaker Sound Configuration. Press *"Reset"* push-button to save value.
4. Press *"kVp Increase"* to enter sub-menu C7.2 for Winter / Summer Automatic Time Update. The kVp Display shows (C7.2) and mAs shows (EU) (Factory set).
5. Press *"mAs Increase"* or *"mAs Decrease"* to change the Winter / Summer Automatic Time Update. Press *"Reset"* push-button to save value.
6. Press *"kVp Increase"* to enter sub-menu C7.3 for Collimator Light ON with PREP. The kVp Display shows (C7.3) and mAs shows (OFF) (Factory set).
7. Press *"mAs Increase"* or *"mAs Decrease"* to change the Collimator Light ON with PREP. Press *"Reset"* push-button to save value.

8. Press *“kVp Increase”* to enter sub-menu C7.4 for Protocol Syntax. The kVp Display shows (C7.4) and mAs shows (NO) (Factory set).

9. Press *“mAs Increase”* or *“mAs Decrease”* to change the Protocol Syntax. Press *“Reset”* push-button to save value.

10. Press *“kVp Increase”* to enter sub-menu C7.5 for ABC input. The kVp Display shows (C7.5) and mAs shows (0) (Factory set).

11. Press *“mAs Increase”* or *“mAs Decrease”* to change the ABC input. Press *“Reset”* push-button to save value.

12. Press *“Collimator Light”* push-button to exit sub-menus. The kVp Display shows (C07).

2.2.7 DATE AND TIME (FACTORY SET AT GMT +1)

Note ☞ *When entering the Date and Time data, keep in mind that they are not roll over numbers.*

1. Select configuration menu C08 to enter the date/time at the RTC (Real Time Clock).

2. Enter sub-menu:

   C8.1 for Hour Configuration (range from 0 to 23).

   C8.2 for Minute Configuration (range from 0 to 59).

   C8.3 for Date Configuration (range from 1 to 31).

   C8.4 for Month Configuration (range from 1 to 12).

   C8.5 for Year Configuration (range from 2000 to 2099).

   The kVp Display shows (C8.X) and the mAs Display shows the Factory set values.

3. Press *“mAs Increase”* or *“mAs Decrease”* to change the values.

4. Press *“Reset”* push-button to save values.

5. Press *“Collimator Light”* push-button to exit sub-menus. The kVp Display shows (C08).

2.2.8 X-RAY TUBE MISCELLANEOUS

1. Select configuration menu C09.
2. Enter sub-menu C9.1 for Tube 1 max kV: 80–125. The kVp Display shows (C9.1) and the mAs Display shows (125) (Factory set).
3. Press *"mAs Increase"* or *"mAs Decrease"* to change the value. Press *"Reset"* push-button to save value.
4. Press *"kVp Increase"* to enter sub-menu C9.2 for Fluoro max kV: 80–125. The kVp Display shows (C9.2) and mAs shows (120) (Factory set).
5. Press *"mAs Increase"* or *"mAs Decrease"* to change the value. Press *"Reset"* push-button to save value.
6. Press *"kVp Increase"* to enter sub-menu C9.3 for High Dose Auto OFF. The kVp Display shows (C9.3) and mAs shows (NO) (Factory set).
7. Press *"mAs Increase"* or *"mAs Decrease"* to change the High Dose Auto OFF status. Press *"Reset"* push-button to save it.
8. Press *"kVp Increase"* to enter sub-menu C9.4 for X-Ray Enable Required. The kVp Display shows (C9.4) and mAs shows (NO) (Factory set).
9. Press *"mAs Increase"* or *"mAs Decrease"* to change the X-Ray Enable Required status. Press *"Reset"* push-button to save it.
10. Press *"kVp Increase"* to enter sub-menu C9.5 for mAs Meter Mode. The kVp Display shows (C9.5) and mAs shows (YES) (Factory set).
11. Press *"mAs Increase"* or *"mAs Decrease"* to change the mAs Meter Mode status. Press *"Reset"* push-button to save it.
12. Press *"kVp Increase"* to enter sub-menu C9.6 for First DSI Exposure without E50. The kVp Display shows (C9.6) and mAs shows (NO) (Factory set).
13. Press *"mAs Increase"* or *"mAs Decrease"* to change the First DSI Exposure without E50 status. Press *"Reset"* push-button to save it.
14. Press *"kVp Increase"* to enter sub-menu C9.7 for RAD Sync Timeout. The kVp Display shows (C9.7) and mAs shows (2) seconds (Factory set).
15. Press *"mAs Increase"* or *"mAs Decrease"* to change the value. Press *"Reset"* push-button to save it.

16. Press *“kVp Increase”* to enter sub-menu C9.9 for X-Ray Key option. The kVp Display shows (C9.9) and mAs shows (YES) or (NO).
17. Press *“mAs Increase”* or *“mAs Decrease”* to change the X-Ray Key option status. Press *“Reset”* push-button to save it.
18. Press *“Collimator Light”* push-button to exit sub-menus. The kVp Display shows (C09).
19. Press and hold first *“Collimator Light”* push-button and then press *“kVp Increase”* push-button, release *“kVp Increase”* and then release *“Collimator Light”* in order to exit Configuration Mode.

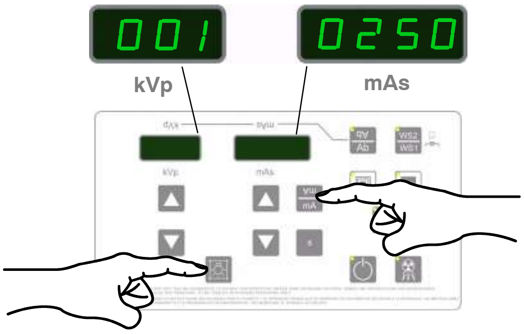
2.2.9 MAXIMUM MS FOR DIGITAL WORKSTATIONS

1. Select configuration menu C0A.
2. Enter sub-menu CA.1. The kVp Display shows (CA.1) and the mAs Display shows (2.5) (Factory set).
3. Press *“mAs Increase”* or *“mAs Decrease”* to change the value. Press *“Reset”* push-button to save value.
4. Press *“Collimator Light”* push-button to exit sub-menus. The kVp Display shows (C0A).
5. Press and hold first *“Collimator Light”* push-button and then press *“kVp Increase”* push-button, release *“kVp Increase”* and then release *“Collimator Light”* in order to exit Configuration Mode.

2.3 COUNTERS FOR SERVICE PURPOSES

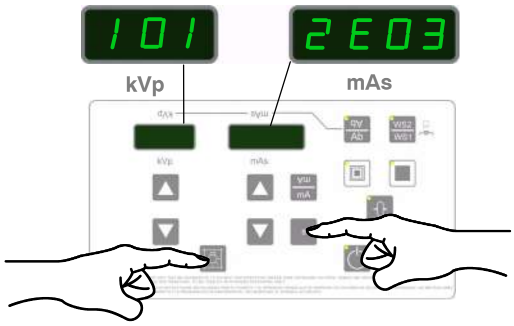
2.3.1 EXPOSURE COUNTER

To display the totalled number of performed exposures of the selected Focal Spot, press simultaneously *"Collimator Light"* and *"mA"* push-buttons, e.g. (001) (0250) = 10.250 exposures.



2.3.2 ENERGY COUNTER

To display the totalled Energy of performed exposures of the selected Focal Spot expressed in Joules (J), press simultaneously *"Collimator Light"* and *"s"* push-buttons, e.g. (1.01) (2E03) = 1.012 * 10^3.



To reset the Energy counter (totalled Energy for the selected focal Spot), press and hold simultaneously *"Collimator Light", "s"* and *"Reset"*.

SECTION 3 CALIBRATION

CAUTION

Calibration procedures should only be performed at field if Portable Control Board, Control Driver Board or the High Voltage Transformer are replaced, the EEPROM memory is re-initialized, or otherwise specified.

CAUTION

Previous to starting the Calibration procedure, restore default power values, that is, no restrictions will be set due to the Line Power Detection System (refer to the ending of Section 5.1), and check that the line complies with the Portable X-ray Unit power requirements (refer to Section 1.2).

The Calibration process is as follows:

CALIBRATION PROCESS		
STEP	**ACTION**	**COMMENTS**
1	Connection of the Oscilloscope for kVp and mA measurements.	Preliminary Steps (*Refer to Section 3.1*)
2	Preliminary calibration of Filament Current.	20 mA in Large Focus at 40 kVp and 80 kVp. (*Refer to Section 3.2.1).*
3	Calibration of kVp Gain.	P01 (*Refer to Section 3.2.2).*
4	Calibration of mA Gain.	P02 (*Refer to Section 3.2.3).*
5	Autocalibration.	If the Autocalibration process is done properly, the Calibration is finished. If not, perform the Manual Calibration of the Filament Current (step 6). (*Refer to Section 3.2.4).*
6	Manual Calibration of Filament Current.	To be performed only when the Autocalibration did not work properly. All mA stations in Small Focus and Large Focus at 80 kVp, 40 kVp and 110 kVp. (*Refer to Section 3.2.5).*

Note ☞ *The kV values to be selected in Calibration Mode are: 40, 80 and 110 kVp depending on the maximum kVp of the Unit.*

3.1 PRELIMINARY STEPS

1. Connect Oscilloscope CH1 to measure kVp in the following points:

	TEST Connector (*J4*) of the X-ray Power Unit	**Portable Control Board (*A3175-05*)**	**kVp relation**
kVp	J4-1	TP22	1 V = 30 kVp
GND	J4-5	TP5	
Note: If the unit is not provided with TEST Connector (J4), kVp has to be measured directly on the Portable Control Board TPs (e.g. upgraded units)			

Oscilloscope CH1 can be also connected on Control Driver Board (*A3189-07*) but the access is more complicated:

	Control Driver Board (*A3189-07*)	**kVp relation**
kVp	TP15	1 V = 30 kVp
GND	TP4 or TP14	

2. Connect Oscilloscope CH2 to measure mA in the following points:

	TEST Connector (*J4*) of the X-ray Power Unit	**Portable Control Board (*A3175-05*)**	**mA relation**
mA	J4-6	TP21	1 V = 25 mA
GND	J4-5	TP5	
Note: If the unit is not provided with TEST Connector (J4), mA has to be measured directly on the Portable Control Board TPs (e.g. upgraded units)			

Oscilloscope CH2 can be also connected on Control Driver Board (*A3189-07*) but the access is more complicated:

	Control Driver Board (*A3189-07*)	**mA relation**
mA	TP9	1 V = 10 mA
GND	TP4 or TP14	

3. Configure CH1 in 1V/div and CH2 in 0.2V/div. Time base in 5 ms/div; trigger in Normal mode by positive edge of CH1.

4. kVp and mA relation, measured in the Oscilloscope, is indicated in previous tables.

CAUTION

Whenever an exposure is performed during the Calibration procedure (except for Autocalibration), elapse a minimum of 5 seconds between "PREP" and "EXP", this will avoid undesired loss of time.

CAUTION

During Calibration procedure Collimator blades must be fully closed until otherwise instructed in this manual.

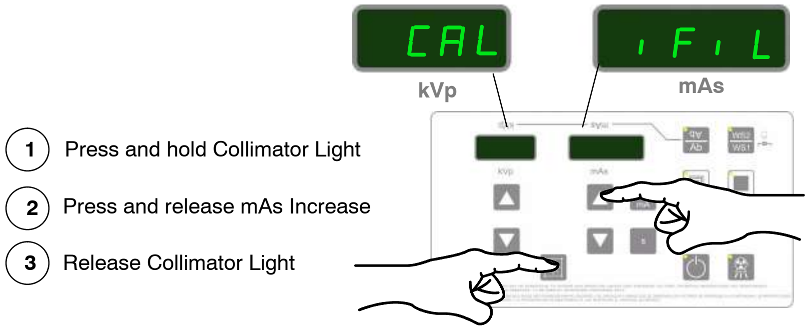
3.2 CALIBRATION OF PARAMETERS

CAUTION

Before calibrating kVp Gain, a calibration of the Filament Current for 20 mA in Large Focus at 40 and 80 must be performed. Refer to Section 3.2.1.

3.2.1 PRELIMINARY CALIBRATION OF FILAMENT CURRENT

1. **To enter Calibration of Filament current** press and hold *"Collimator Light"* push-button and then press and release *"mAs Increase"* push-button (two beeps sound). (CAL iFiL) appears on the displays while *"Collimator Light"* is pressed. Then release *"Collimator Light"* push-button (the kVp Display shows 40, 80 or 110 and one of the Focal Spot Leds blinks).



2. Select: 40 kVp, *"Large Focal Spot" (led blinks),* and 20 mA in Large Focal Spot (by pressing the mAs push-buttons). During Calibration the mAs Display shows the mA value.

3. Make an exposure and measure kVp and mA signal values with the Oscilloscope.

   a. Verify that both signals are flat.

   b. If the mA value obtained is not the selected, increase or decrease the filament current value *(shown on the kVp Display)* by pressing *"mA"* or *"s"* push-buttons.

4. Make an exposure again to verify that the mA value in the Oscilloscope is the one selected; if it is not, repeat the procedure to increase or decrease the value.

5. Once the correct mA value is reached, save the value pressing *"Reset"* push-button (one beep will sound and the saved value is shown on the kVp Display). It is important to write down this data for later reference during calibration (Refer to Table 3-1).

Note ☞ *Once a value for filament current is saved, the value remains in memory for the next mA station. This feature helps to save time at entering new data for the next station.*

6. Repeat above procedure to calibrate the Filament Current for 80 kVp at 20 mA in Large Focal Spot. The Filament Current value is few steps below the one calibrated for 40 kVp. (*Refer to Table 3-1)*.

Note ☞ *The calibration data for Filament Current should not be repeated at any station.*

Table 3-1
Calibration Data for Reference

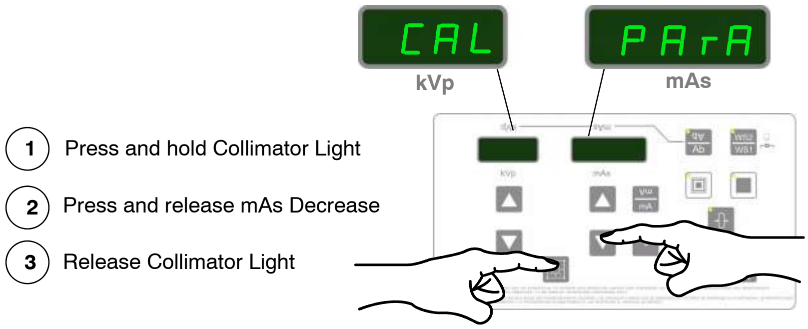
kVp	mA	Value	Example
40	20		810
80	20		800

Note ☞ *Values above 999 are shown on kVp display as "= XX", e.g. "=23" means 1023.*

7. To exit Calibration Mode, press and hold *"Collimator Light"* push-button and then press and release *"mAs Increase"* push-button (two beeps sound). Then release *"Collimator Light"* push-button.

3.2.2 CALIBRATION OF kVp GAIN

1. **To enter Calibration Menu**, press and hold *"Collimator Light"* push-button and then press and release *"mAs Decrease"* push-button (two beeps sound). (CAL PArA) appears on the displays while *"Collimator Light"* is pressed. Then release *"Collimator Light"* push-button. The kVp Display shows P01 and one of the Focal Spot Leds blinks.



2. Press *"Collimator Light"* to enter calibration of kVp Gain (P01).

3. Place a Non-Invasive kVp meter aligned to the X-ray beam at SID 100 cm. Open the light field to center it with the kVp meter.

4. Make an exposure (parameters are automatically selected: 80 kVp, 20 mA and 100 ms), read kVp and take note of the value. Enter kVp read value in the mAs Display pressing *"mAs Increase"* or *"mAs Decrease"* push-buttons.

5. Save the value by pressing *"Reset"* push-button. The mAs Display shows kVp Gain value during two seconds (this value represents the Gain correction automatically applied, 200 is the reference value).

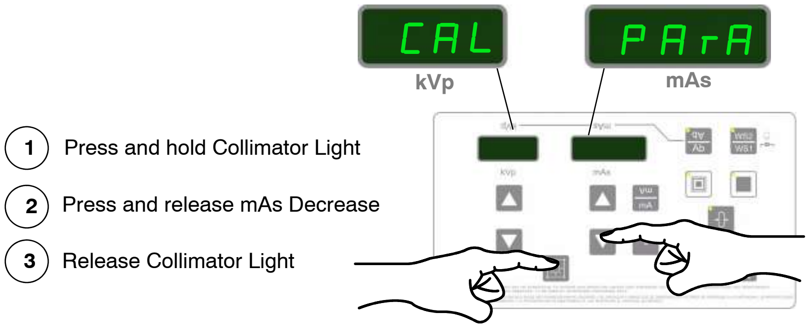
6. Press *"Collimator Light"* to exit menu P01.

7. To exit Calibration Mode, press and hold "*Collimator Light*" push-button and then press and release *"mAs Decrease"* (two beeps sound). Then release *"Collimator Light"* (kVp and mAs parameters are shown).

3.2.3 CALIBRATION OF mA GAIN

mA Gain should be calibrated before performing the autocalibration process.

1. **To enter Calibration Menu**, press and hold *"Collimator Light"* push-button and then press and release *"mAs Decrease"* push-button (two beeps sound). (CAL PArA) appears on the displays while *"Collimator Light"* is pressed. Then release *"Collimator Light"* push-button. The kVp Display shows P01 and one of the Focal Spot Leds blinks.



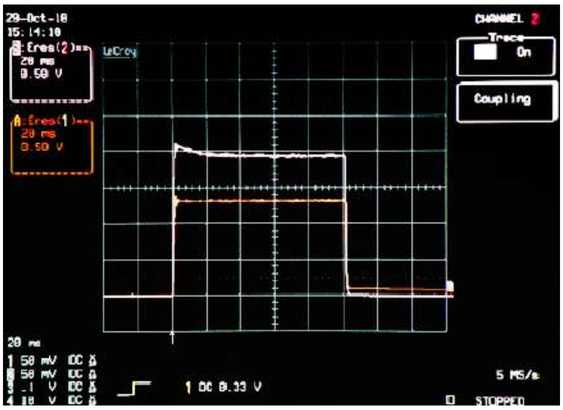
2. Select menu P02 by pressing the *"kVp Increase"* push-button (kVp Display shows P02).

3. Press *"Collimator Light"* to enter calibration of mA Gain (P02).

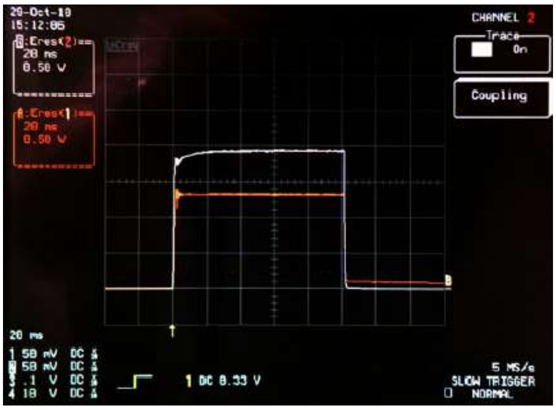
4. The Unit automatically selects: 40 kVp, 20 mA, 2000 ms, and Large focal Spot. Select on the kVp Display the Filament Current value (previously calibrated) by pressing *"mA"* or *"s"* push-buttons.

5. Make an exposure and measure mA signal value with the Oscilloscope. Verify that mA signal is flat, make sure that the signal is balanced before it arrives to 20 ms.

Note ☞ *In order to display a noiseless waveform it is necessary to apply a bandwidth filter of 8 KHz when measuring any signals with the oscilloscope. Waveforms captured without the filter may be noisy.*



a



b

In these examples, the white line (upper) represents the mA Signal.
The signal in both cases (a and b) is balanced before it arrives to 20 ms.

6. If the signal is not balanced before it arrives to 20 ms, change the "*Ifil*" (*Filament Current*) value with mA and s and repeat the exposure until the signal is flat before 20ms as shown in the previous picture.

7. Enter mA read value in the mAs Display pressing *"mAs Increase"* or *"mAs Decrease"* push-buttons.

8. Save the value by pressing *"Reset"* push-button. The mAs Display shows mA Gain value during two seconds (this value represents the Gain correction automatically applied, 200 is the reference value).

9. Press *"Collimator Light"* to exit menu P02.

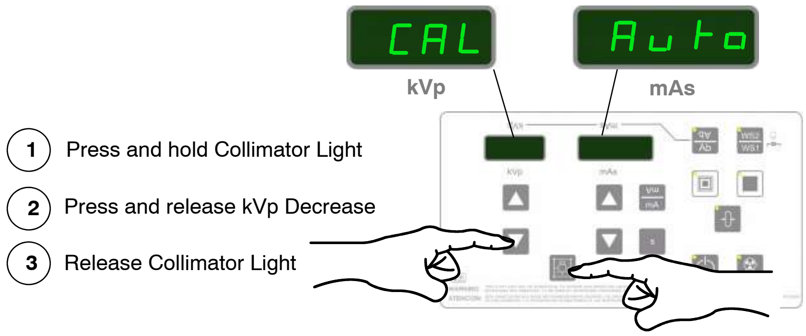
10. To exit Calibration Mode, press and hold "*Collimator Light*" push-button and then press and release *"mAs Decrease"* (two beeps sound). Then release *"Collimator Light"* (kVp and mAs parameters are shown).

Note ☞ *P03 and up are not used menus.*

3.2.4 AUTOCALIBRATION

1. Select Large Focal Spot.

2. **To enter Autocalibration,** press and hold *"Collimator Light"* push-button and then press and release *"kVp Decrease"* push-button (two beeps sound). The text (CAL Auto) appears on the displays while *"Collimator Light"* is pressed. Then release *"Collimator Light"* push-button.



3. Double check that the Large Focal Spot Led is On. The Displays show (YES no). Press *"kVp Increase"* push-button to select "YES" (to select "*no*" and exit Autocalibration process, press *"mAs Increase"* push-button).

Double check the selected Focus

4. To start the Autocalibration process, press "*Prep*" and then press and hold *"Exposure"* with the Handswitch (or the corresponding push-buttons on the Control Console).

Be prepared to write down the Autocalibration data in Table 3-5.

The Unit starts a series of exposures, a maximum of 20 in order to start the process and a maximum of 10 in order to find each mA Station. The kVp Display shows (n20) in a countdown sequence (e.g. n19, n18, n17...), or (n10) in a countdown sequence (e.g. n9, n8, n7...) until the Unit finds all the mA Stations for that Focal Spot. It may not be needed to perform all the exposures.

Once a Station is found, a long bip sounds and kVp display shows the Calibration value for that mA Station. Then the process is paused after every kVp station calibration, and it is mandatory to release the Handswitch. Wait a few seconds (30 seconds is enough) and then press and hold the Handswitch again in order to continue with the calibration process. When all mA Stations are Autocalibrated, the Displays show (End Auto).

Note ☞ *It is mandatory to release the handswitch and keep it released for quite a while to prevent filament overheat when many stations are to be calibrated.*

5. To exit Autocalibration, press and hold *"Collimator Light"* push-button and then press and release *"kVp Decrease"* (two beeps sound). Release *"Collimator Light"*.

6. Repeat the process for Small Focal Spot.

Note ☞ *If any error message (e.g. E60) stops the Autocalibration during the process, press "Reset" push-button and continue. If the error persists, exit Autocalibration and repeat the Autocalibration process from the beginning. If the problem persists, contact the Manufacturer.*

If the troubles arise at the end of the Autocalibration process (only a few stations to end), press "Reset" push-button and continue. If it does not work, press "Reset" push-button to store the data corresponding to the previously autocalibrated mA stations and start the Manual Calibration process for the remaining stations (Refer to section 3.2.5). If the problem still persists, contact the Manufacturer.

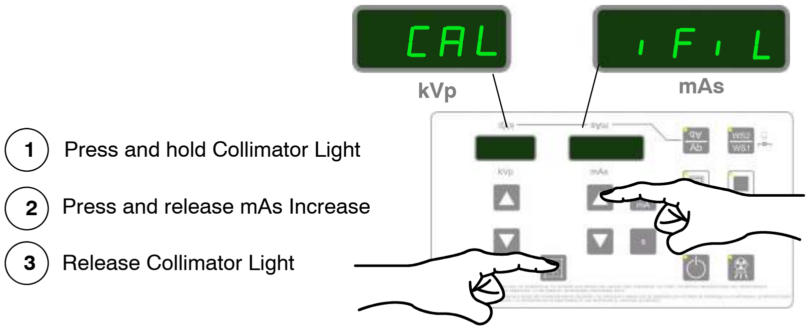
WARNING

IF THE DIP-SWITCH SW1-1 OF THE PORTABLE CONTROL BOARD HAS BEEN SET IN "ON" POSITION TO ENABLE SERVICE MODE, DO NOT FORGET TO SET IT IN "OFF" POSITION (SERVICE MODE DISABLED) ONCE THE CALIBRATION IS FINISHED.

3.2.5 MANUAL CALIBRATION OF FILAMENT CURRENT (SMALL AND LARGE FOCAL SPOTS)

Note ☞ *Perform this Manual Calibration only when the Autocalibration process has not finished properly.*

1. **To enter Calibration of Filament current** press and hold *"Collimator Light"* push-button and then press and release *"mAs Increase"* push-button (two beeps sound). (CAL iFiL) appear on the displays while *"Collimator Light"* is pressed. Then release *"Collimator Light"* push-button (the kVp Display shows 40, 80 or 110 and the selected Focal Spot Led blinks).



2. Select the corresponding Focal Spot. The Led blinks.

3. Select the corresponding kVp value where the Autocalibration stopped (40, 80, or 110 kVp) pressing *"kVp Increase"* or *"kVp Decrease"* push-buttons, and the corresponding mA Station where the Autocalibration stopped by pressing the mAs push-buttons.

Note ☞ *Values above 999 are shown on mAs display as "= XX", e.g. "=23" means 1023.*

4. Make an exposure and measure kVp and mA signal values with the Oscilloscope.

   a. Verify that both signals are flat.

   b. If the mA value obtained is not the selected, increase or decrease the filament current value *(shown on the kVp Display)* by pressing *"mA"* or *"s"* push-buttons.

5. Make an exposure again to verify that the mA value in the Oscilloscope is the one selected; if it is not, repeat the procedure from step 4.b. to increase or decrease the value.

6. Once the correct mA value is reached, save the value pressing *"Reset"* push-button (one beep will sound and the saved value is shown on the kVp Display). It is important to write down this data for later reference during calibration (*refer to Table 3-5*).

Note ☞ *Once a value for Filament Current is saved, the value remains in memory for the next mA station. This feature helps to save time at entering new data for the next station.*

7. Repeat above procedure to calibrate the Filament Current for the following kVp station and the non calibrated mA stations, in the corresponding Focal Spot. The Filament Current value is few steps above the one calibrated before (*refer to Table 3-5*).

Note ☞ *Values above 999 are shown on mAs display as "= XX", e.g. "=23" means 1023.*

8. To exit Calibration Mode, press and hold *"Collimator Light"* push-button and then press and release *"mAs Increase"* push-button (two beeps sound). Then release *"Collimator Light"* push-button.

Note ☞ *At the end of the Filament Current calibration process there are some stations that do not admit exposure, in those cases enter manually the value following the trend. (Refer to Table 3-2 or Table 3-4 as examples).*

WARNING

KEEP IN MIND THAT ALL FILAMENT CURRENTS SHOULD HAVE A VALUE, EVEN THE ONES OUT OF RANGE (EXPOSURES NOT ALLOWED). IN THOSE CASES A CONTINUOUS BEEP WILL SOUND AND THE VALUES ON THE DISPLAYS BLINK.

WARNING

IF THE DIP-SWITCH SW1-1 OF THE PORTABLE CONTROL BOARD HAS BEEN SET IN "ON" POSITION TO ENABLE SERVICE MODE, DO NOT FORGET TO SET IT IN "OFF" POSITION (SERVICE MODE DISABLED) ONCE THE CALIBRATION IS FINISHED.

Table 3-2
Example of manual calibrated data for Filament Current in a 4 kW Unit.

	mA Stations	40 kVp	80 kVp	110 kVp
SMALL FOCAL SPOT	5 mA	591	580	577
	6.4 mA	603	592	589
	8 mA	612	603	598
	10 mA	621	613	610*
	12.5 mA	630	623*	–
	16 mA	642	634*	–
LARGE FOCAL SPOT	5 mA	734	726	724
	6.4 mA	748	739	737
	8 mA	760	754	752
	10 mA	772	766	764
	12.5 mA	785	778	776
	16 mA	799	792	790
	20 mA	814	805	802
	25 mA	829	819	816
	32 mA	848	836	829
	40 mA	864	849	842*
	50 mA	881	866	–
	64 mA	902	882*	–
	80 mA	921	900*	–
	100 mA	942	942*	–

*NOTE: Some of the values with * should be entered manually following the numeric trend, the values with – are not calibrated.*

Table 3-3
Example of manual calibrated data for Filament Current in a 5 kW Unit.

	mA Stations	40 kVp	80 kVp	110 kVp
SMALL FOCAL SPOT	**5 mA**	591	580	577
	6.4 mA	603	592	589
	8 mA	612	603	598
	10 mA	621	613	610*
	12.5 mA	630	623*	–
	16 mA	642	634*	–
LARGE FOCAL SPOT	**5 mA**	734	726	724
	6.4 mA	748	739	737
	8 mA	760	754	752
	10 mA	772	766	764
	12.5 mA	785	778	776
	16 mA	799	792	790
	20 mA	814	805	802
	25 mA	829	819	816
	32 mA	848	836	829
	40 mA	864	849	842
	50 mA	881	866	873*
	64 mA	902	882*	–
	80 mA	921	900*	–
	100 mA	942	942*	–

*NOTE: Some of the values with * should be entered manually following the numeric trend, the values with – are not calibrated.*

Table 3-4
Example of manual calibrated data for Filament Current in a 8 kW Unit.

	mA Stations	40 kVp	80 kVp	110 kVp
SMALL FOCAL SPOT	5 mA	612	602	598
	6.4 mA	624	613	610
	8 mA	631	622	–
	10 mA	640	630*	–
	12.5 mA	651	640*	–
LARGE FOCAL SPOT	5 mA	751	744	742
	6.4 mA	767	756	752
	8 mA	778	768	767
	10 mA	789	780	780
	12.5 mA	801	793	793
	16 mA	817	809	808
	20 mA	831	825	822
	25 mA	844	838	835
	32 mA	861	853	851
	40 mA	874	867	864
	50 mA	891	883	879
	64 mA	912	900	897
	80 mA	929	917	913*
	100 mA	949	934	–

*NOTE: Some of the values with * should be entered manually following the numeric trend, the values with – are not calibrated.*

Note ☞

It is suggested to write down the Autocalibration or Manual Calibration data in the table below. Keep in mind that pressing "mA" to check a value, the data will be increased in 1 point.

Example: in order to read the Calibration value for 80 kVp, 25 mA and Large Focal Spot, press "kVp Increase/Decrease" push-buttons to select 80 kVp, press "mAs Increase/Decrease" to select 25 mAs and then press "mA". If the kVp Display shows 802, the correct value is 801. To check the following mA station, ***press twice*** *"mAs Increase" and once "mA". If the kVp Display shows 824, the correct value is 823.*

Table 3-5
Filament Current Manual Calibration Data

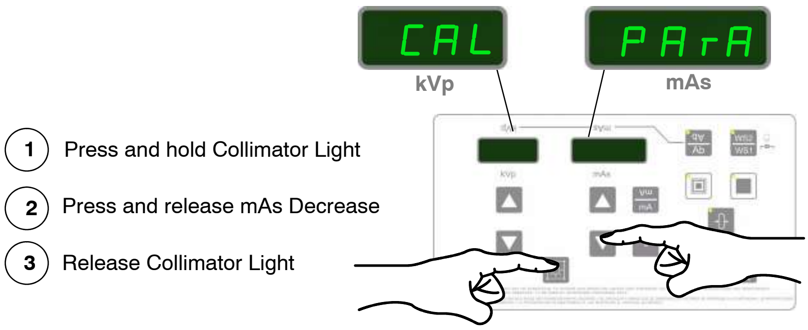
	mA Stations	40 kVp	80 kVp	110 kVp
SMALL FOCAL SPOT	5 mA			
	6.4 mA			
	8 mA			
	10 mA			
	12.5 mA			
	16 mA			
LARGE FOCAL SPOT	5 mA			
	6.4 mA			
	8 mA			
	10 mA			
	12.5 mA			
	16 mA			
	20 mA			
	25 mA			
	32 mA			
	40 mA			
	50 mA			
	64 mA			
	80 mA			
	100 mA			

*NOTE: Based on the tables above, some of the values with * should be entered manually following the numeric trend, and values with – are not calibrated.*

3.2.6 MANUAL MODIFICATION OF KVP GAIN AND mA GAIN

Note ☞ *In some situations in which it is difficult to perform the calibration of kVp Gain and/or mA Gain or when the value is already known, these values can be manually set.*

1. **To enter Calibration Menu,** press and hold *"Collimator Light"* push-button and then press and release *"mAs Decrease"* push-button (two beeps sound). (CAL PArA) appears on the displays while *"Collimator Light"* is pressed. Then release *"Collimator Light"* push-button. The kVp Display shows P01 and one of the Focal Spot Leds blinks.



Note ☞ *In case you have to manually modify the mA Gain instead of the kVp Gain, select menu P02 by pressing the "kVp Increase" push-button (kVp Display shows P02).*

2. Press any *"Focal Spot"* push-button to check the current Gain value (kVp o mA Gain), it is displayed on the mAs display for a couple of seconds.
3. Press *"mAs Decrease" or "mAs Increase",* to set the new value.
4. Press *"Reset"* push-button to save the value, a long beep sounds.
5. Exit Calibration by pressing and holding *"Collimator Light"* push-button and then press and release *"mAs Decrease"* (two beeps sound). Then release *"Collimator Light"* (kVp and mAs parameters are shown).

WARNING

IF THE DIP-SWITCH SW1-1 OF THE PORTABLE CONTROL BOARD HAS BEEN SET IN "ON" POSITION TO ENABLE SERVICE MODE, DO NOT FORGET TO SET IT IN "OFF" POSITION (SERVICE MODE DISABLED) ONCE THE CALIBRATION IS FINISHED.

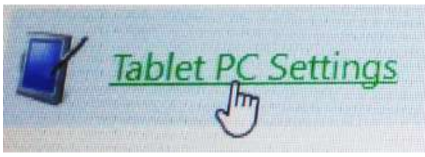
3.3 TOUCH SCREEN SENSOR CALIBRATION

The Sensor of the Touch Screen needs to be calibrated when the buttons cannot be properly selected. The steps below should be followed whenever a calibration process is required.

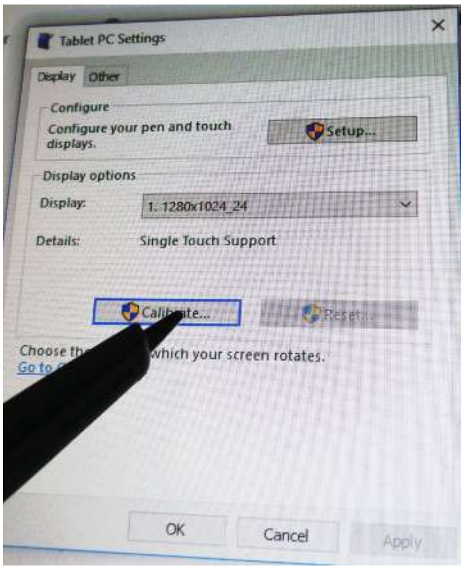
1. Connect a Keyboard and a Mouse to the USB ports located at the Connections Panel.

2. Open the Control Panel (Start > Control Panel, or alternatively pressing the Windows Icon on the keyboard and selecting the Control Panel once the pop-up Menu appears).

3. Select *"Tablet PC Settings".*



4. On the *"Tablet PC Settings"* window, select the tab *"Display"* and press *"Calibrate"* to calibrate the sensor.



5. Follow the instructions indicated on the screen.

6. Once the process has been completed, click on *"Yes"* to save the calibration data.

7. Check the Touch Screen Pointer.

SECTION 4 ADJUSTMENTS

4.1 ALIGNMENT OF X-RAY BEAM

1. Place the Portable Unit in vertical position. The Unit has to be perfectly aligned with the Digital Detector. With a level, check the correct horizontal position of both parts.

Note ☞ *The Digital Detector used for testing can be located on the floor or a Table.*

2. Place SID at 100 cm.

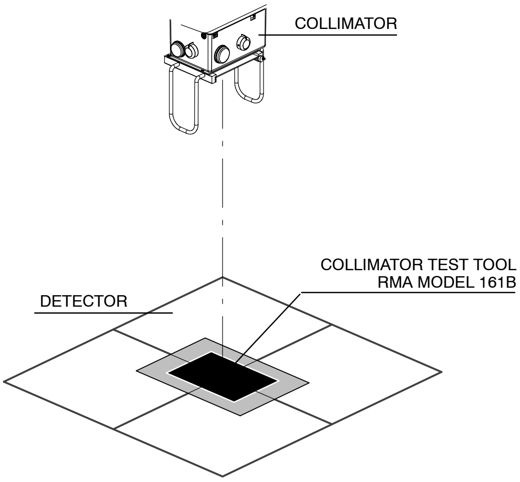
3. Turn on Collimator light and center the Collimator in relation to the Digital Detector. Horizontal and transverse position of the light axes projected by the Collimator Light must be in line with the Detector axes.

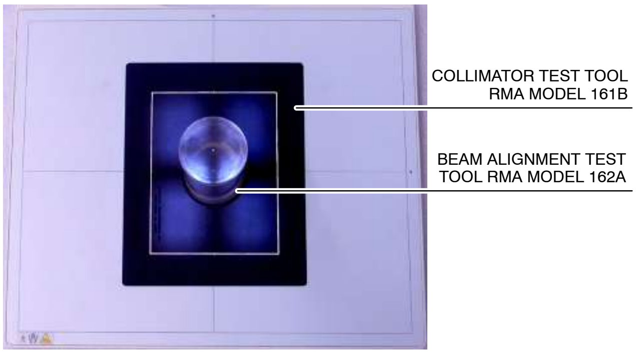
4. Set the Collimator Test Tool (RMI model 161B) in transversal direction with respect to the Collimator, centered on the Digital Detector (*refer to Illustration 4-1*).

5. Turn on Collimator light and adjust the Light Field of the Collimator Light to the rectangle drawn inside the Collimator Test Tool.

6. Place centered the Beam Alignment Test Tool (RMI model 162A) on the Collimator Test Tool.

Illustration 4-1
Alignment Test Tools

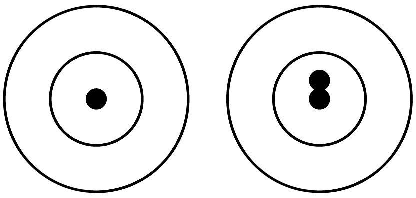




7. Make an exposure at 55 kVp / 5 mAs (10 mA / 0.5 s) and Small Focal Spot.

8. Check in the image that the X-ray Beam is perpendicular to the plane of the Digital Detector. The perpendicularity of the X-ray Beam can be checked using the Beam Alignment Test Tool. If the image of the two balls coincide as shown in the drawings (A or B), the X-ray Beam is perpendicular; within the allowed tolerance of 0.5º (top ball is within the threshold of the first circle).

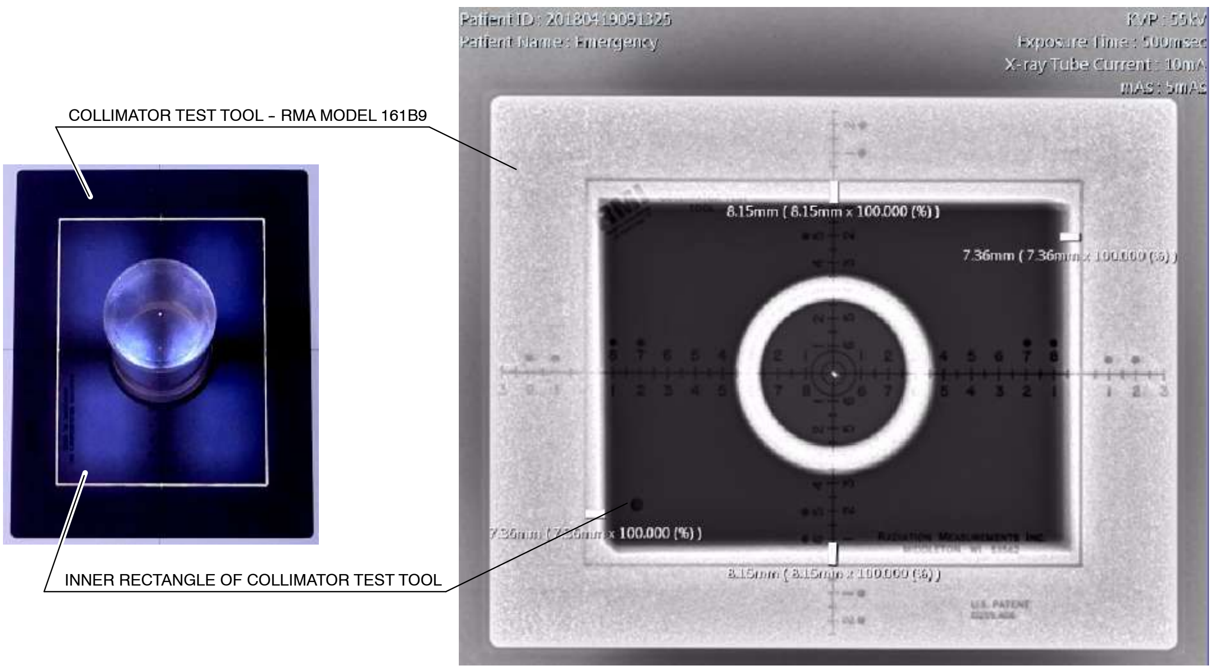
A
Completely aligned



B
Aligned within tolerance

If the top ball is outside the first circle, correct the position of the X-Ray Unit. Repeat the process until the perpendicularity is correct.

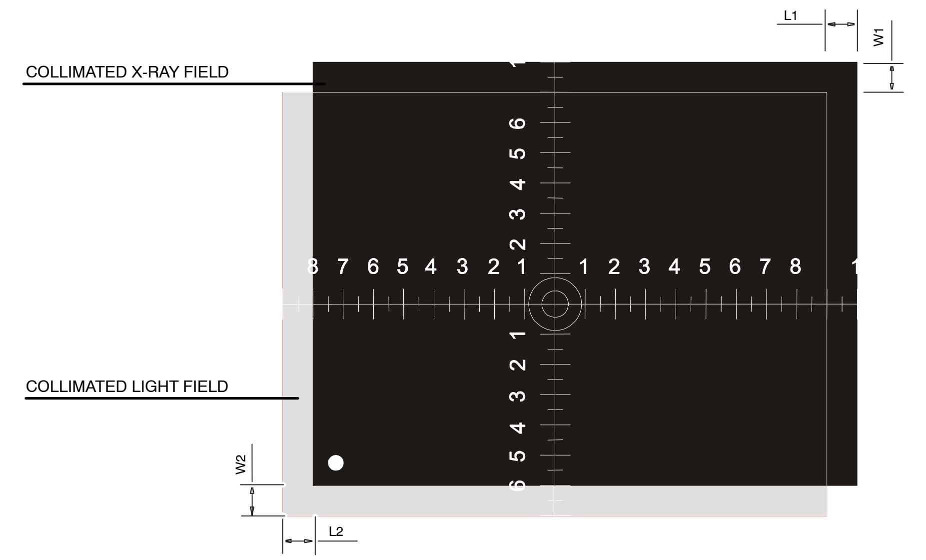
9. Check in the image that the X-ray Field falls just within the image of the inner rectangle of the Collimator Test Tool.



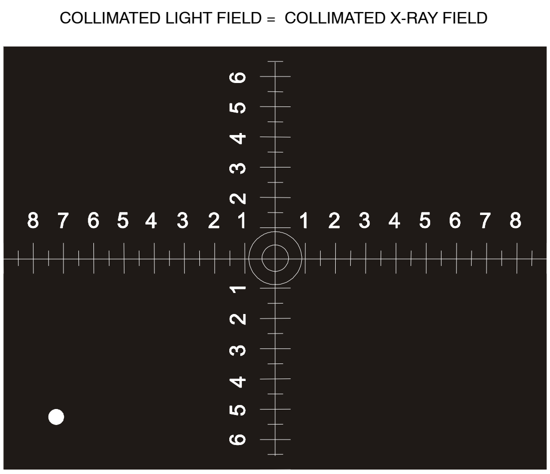
If any edge of the X-ray Field does not coincide with the edge of the inner rectangle means a misalignment of the Light Field with respect to the X-ray Field. The maximum misalignment allowed is 2% of SID (for SID 100 cm = 2 cm tolerance) for both axes.

If case of misalignment, follow with next step.

10. Check on the image the adjustment required to meet the Light Field with the X-ray Field. Identify the deviation on the axes shown on the image.
Deviation axis X = L1 + L2, should be ≤ 2 cm.
Deviation axis Y = W1 + W2, should be ≤ 2 cm.



LIGHT FIELD MISALIGNMENT



GOOD FIELD ALIGNMENT

11. Do not remove the Collimator Test Tool from its original position.

12. Modify Collimator position by carefully unscrewing and screwing the four Centering Adjustment and Security Screws (Allen) until the Light Field coincides with the axes reference imaged (numbers and dots) on the Image.

Illustration 4-2
Collimator Screws

13. Repeat exposure and procedure until the result is satisfactory. The maximum misalignment allowed is 2 % of SID (for SID 100 cm = 2 cm of tolerance).

Note ☞ *If adjustment is still necessary, modify position of Collimator Light (refer to the Collimator Manual).*

14. Repeat the process making an exposure at 55 kVp / 5 mAs (10 mA / 0.5 s) and Large Focal Spot.

WARNING

IF THE COLLIMATOR SECURITY SCREWS HAVE BEEN ADJUSTED, VERIFY THAT THE COLLIMATOR IS PROPERLY SEATED AND NO RISK FOR ACCIDENTAL FALL IS POSSIBLE BY TURNING COLLIMATOR AROUND AND PULLING DOWNWARDS FROM IT.

4.2 FIELD SIZE INDICATOR TEST

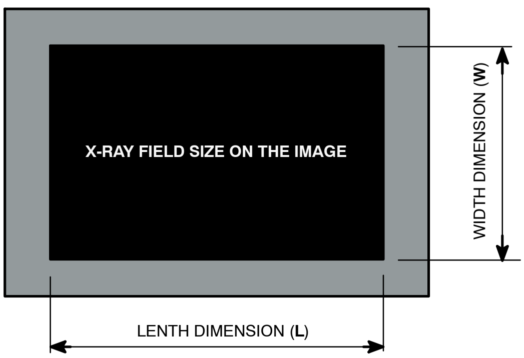
Note ☞ *Before starting with the Field Size Indicator Test, the Alignment of X-Ray Beam should be performed.*

1. Place the Portable Unit in vertical position. The Unit has to be perfectly aligned with the Digital Detector. Check with a level correct horizontal position of both parts.

Note ☞ *The Digital Detector used for testing can be located on the floor or a Table.*

2. Place SID at 100 cm.
3. Turn on Collimator light and center the Collimator in relation to the Digital Detector. Horizontal and transverse position of the light axes projected by the Collimator Light must be in line with the Detector axes.
4. Open the Collimator blades to set a Field Size of 24 x 30 cm for SID 100 cm.
5. Make an exposure at 55 kVp, 1 mAs.
6. Check in the image the following measurements known (*refer to Illustration 4-3*):
   a. Measure the length of the X-ray Field on the Image (identified as **L**)
   b. Measure the width of the X-ray Field on the Image (Identified as **W)**

Illustration 4-3
X-ray Field Size



7. With the measurements obtained and according to the field size indication selected, the results should be:

    - Length dimension (**L**) = 300 mm
    - Width dimension (**W**) = 240 mm

8. The difference between the indicated Field Size and the obtained Field Size may not exceed 1.5 % (rejection limit) of the SID in either direction. Therefore the deviation in any direction should not be higher than 15 mm (rejection limit) for SID at 100 cm.

9. If the deviation of Field Size Indication is out acceptance limits, it is necessary to readjust the index of Collimator Blades Control Knobs. For that, loosen each Collimator Control Knob and position it according to deviation. Repeat the complete tests until the X-Ray Field Size selected (24 x 30 cm) is obtained.

SECTION 5 OPERATING POWER ADJUSTMENTS

5.1 AUTOMATIC LINE POWER DETECTION SYSTEM

By means of this System, the Unit detects the maximum operative Power Line adapting the Exposure Parameters to the Power available and avoiding undesired line breakdowns when operating with poor electricity lines.

1. Press and hold the *"Collimator Light"* push-button and then turn the Unit *"ON"*. The Display shows *"LPd ACT"* (Line Power Detection Active).

2. Release the *"Collimator Light"* push-button, the Display shows *"LPd P-E"* (Line Power Detection Preparation-Exposition).

3. Press "Prep", then press and hold *"X-Ray ON"* to perform consecutive exposures. After each exposure, the display will show "LPd StP" for a few seconds. In case the X-ray tube is too hot, the display will show "LPd StP" for a while until the tube cools down; when the display shows "LPd P-E" the procedure can be continued.

4. The Display shows "*LPd End*" when the procedure has finished (approximately ten (10) exposures). Release *"X-Ray ON"* button, then the Display shows normal parameters. Now the Unit has detected the Maximum Power Line that can be used during normal operation.

   If error code *"E95"* appears at this moment, it means that the line is not good enough and exposures will not be allowed, if possible, change the Unit Plug to another socket (line).

   If error code *"E96"* appears during the procedure at any mA station, it means that the corresponding station is not calibrated and power is limited to the previous mA station. The procedure ends and the Unit should be calibrated again.

Once the Line Power Detection Procedure is performed:

- It is **necessary** to perform the Warm Up procedure.
- Perform the procedure every time the Unit is plugged into a different socket as the Unit **applies the data of the last Power Line acknowledged.**
- After finishing the procedure, the remaining thermal capacity (%) is **reduced and certain techniques could be temporarily inhibited.** Wait a few minutes for the Tube to cool.
- This procedure does not take into account the limitations of the **Circuit Breaker (Thermomagnetic Switch) installed at site.** If the Circuit Breaker (Thermomagnetic Switch) installed at site still goes down, perform the Manual Power Reduction procedure below.

Note ☞ *If any error code appears on Display during procedure, press "Reset" push-button.*

To restore default values (which means that no restrictions will be set due to the Line Power Detection System):

1. Press and hold the *"Collimator Light"* push-button and turn the Unit *"ON"*. After a few seconds, the Display will show *"LPd ACT"* (Line Power Detection Active).
2. At this point press and hold the *"Reset"* push-button.
3. Release the *"Collimator Light"* push-button.
4. Release the *"Reset"* push-button. The values will be set to the maximum range available (no restrictions due to the line) and the *"LPd rSt"* (Line Power Detection Reset) message will be shown on the displays. When the kVp and mAs parameters are displayed, the X-Ray Unit will be ready for operation.

5.2 mAs-METER MODE

This automatic mode allows the generator to adapt the Exposure Parameters in order to avoid interrupted exposures due to poor electricity lines.

If the Unit detects undesired voltage drops when operating with poor electricity lines, mA are automatically reduced, Exposure Time is increased and the exposure finishes once the mAs selected by the operator are reached.

Note ☞ *Exposure Parameters values selected by the operator may vary when this mode is enabled. In order to visualize time, mA average during exposure and mAs actual values, press the "Reset" button and they will be shown on the displays for a while.*

Note ☞ *If the electricity line is so poor that the exposure cannot be completed (e.g. generator time-out (10 seconds) or receptor time-out (2.5), if applicable), E17 or E49 may occur.*

Note ☞ *The mAs-Meter Mode is factory set and it can only be disabled by a Service Engineer. The minimum Exposure Time in mAs-Meter Mode is 0.01 seconds.*

5.3 MANUAL POWER REDUCTION

The operator may reduce the Unit maximum Power in order to avoid blown fuses or Circuit Breakers down in poor electricity lines. For that, press and hold any *"Focal Spot"* push-button and increase or decrease the percentage by pressing the *"kVp Increase o Decrease"* push-buttons respectively.

The kVp Display shows the selected Power Percentage in 10% steps, preceded by the letter "*P*", from 10% up to 100%. For example, a display of *"P80"* would indicate that the Power of the Unit will be limited to a maximum of 80%. *"P - - "* indicates that the Unit will operate at full Power (100% - factory set).

In case a technique exceeds the power required, the kVp and mAs displays will blink, modify the technique or modify Power percentage.

Note ☞ *The Power Percentage selected by the Operator is stored in memory and applied each time the Unit is turned ON.*

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SECTION 6 TROUBLESHOOTING

The Generator contains many self-diagnostic routines which greatly facilitates troubleshooting. The self-diagnostic functions require proper operation of the microprocessor.

As a general rule, the first step in any troubleshooting procedure is to verify correct power supply voltage.

CAUTION

If Portable Control Board, Control Driver Board or the High Voltage Transformer are replaced or the EEPROM memory is re-initialized, Configuration and Calibration procedures should be performed.

6.1 GENERAL PROCEDURES

6.1.1 RE-INITIALIZATION OF EEPROM (U25)

Calibration data and some configuration data are stored in the extended memory area of the non-volatile memory U25-EEPROM Microcontroller. It is located on the Portable Control Board (*A3175-05*).

In case the EEPROM memory has to be re-initialized, perform the following steps:

1. With the Unit power "*OFF*" and the Dip-switch SW1-1 in "*OFF*" position on the Portable Control Board, press and hold "*Reset*", "*kVp Increase*" and "*mAs Increase*" push-buttons at the same time.

2. Turn the Unit ON and wait until the message "*ini EEP*" is shown in the kVp and mAs Displays.

3. Release the "*Reset*", "*kVp Increase*" and "*mAs Increase*" push-buttons.

4. Wait until the message "*ini EEP*" disappears from the kVp and mAs Displays (it will take 30 seconds approx.).

5. After that, the EEPROM memory has been re-initialized and it is necessary to perform the complete Configuration (*refer to Section 2*) and Calibration process (*refer to Section 3*).

6.2 ERROR CODES OF THE X-RAY GENERATOR

Table 6-1
Error Code List

ERROR	DESCRIPTION
No Error Code	System does not Start-up (No indication of Activity) – Precharge Resistors.
E01	Backup Timer I2C error.
E02	Wrong Workstation configuration.
E03	No Workstation configured.
E04	Fluoro Order error.
E05	“Exposure” order is active during power-up.
E06	“Preparation” order is active during power-up.
E08	Wrong identifier for X-ray Tube 1.
E10	EEPROM corrupted or not initialized. Wrong data calibration.
E11	Load Capacitor error.
E12	mA is out of range during exposure.
E13	kVp is out of range during exposure.
E14	kVp ramp error.
E15	Large Filament current is out of range.
E16	Small Filament current is out of range.
E17	DC Bus is out of range.
E19	mA without exposure order.
E20	kVp without exposure order.
E23	EEPROM error.
E24	Bucky / Digital Panel error.
E25	Large Filament current demand is over the limit.
E26	Small Filament current demand is over the limit.
E27	Collimator Light current is out of range.
E28	Collimator Light current is present without order.
E30	Wrong date/time at the RTC (Real Time Clock).
E31	Wrong Time Stamp.
E32	I2C Bus error while accessing the RTC.
E33	Serial Communication error.

Table 6-1 (cont.)
Error Code List

ERROR	DESCRIPTION
E34	Exposure Timer error.
E35	The acknowledge for X-Rays from the Bucky or Flat Panel Detector has been lost before the end of the exposure
E36	Presostat / Thermostat error.
E38	System error - Chopper failure.
E39	System error - Power supply error.
E40	System error - kVp Unbalanced.
E41	System error - mA Unbalanced.
E42	Corrupted Counters.
E43	Corrupted Error Log.
E44	I2C Bus error when entering the Potentiometer.
E45	I2C Bus error when entering the Multiplexor.
E46	Busy I2C Bus.
E47	APR Lite check error.
E48	Bucky / Digital Panel interface error.
E49	Exposure Timeout - mAs-Meter Error
E50	Exposure has been interrupted
E51	Incorrect Exposure Time.
E53	The timeout for receiving the Fluoro synchronism pulse has elapsed.
E60	The preprogrammed exposures for Autocalibration has finished without complete the Autocalibration process.
E61	There has been an error while trying to access the license data. Default options have been selected.
E74	The generator has been reset because of the COP module.
E75	The generator has been reset because of the CLK module.
E76	The generator has been reset because of an illegal operation code.
E77	The generator has been reset because of a software interrupt.
E78	The generator has been reset because of a memory overflow interrupt.
E95	Power Line not good enough for operation.
E96	Line Power Non Calibrated Technique Error
E97	License - I2C Error.
Err rAn	Defective RAM memory.
Err nrAn	Defective NVRAM memory.
OL	Tube or Generator Overload.

NO ERROR CODE : NO ACTIVITY AT START-UP

DESCRIPTION : System does not start-up. There are no indicators for this error.

POSIBLE CAUSES

The unit is not connected / powered from mains.

Open Precharge Resistors (R1, R2) during start-up.

Excessive resistance in the Precharge Resistors (R1, R2).

ACTIONS

1. Turn the Unit OFF and ON.
2. Check the unit is powered from mains and the Circuit Breaker of the unit is in “ON” position.
3. Check Resistors R1 and R2 on the EMC Input Filter Board (*A3191-04*) during start-up, if they are open or if the resistance is too high, replace the EMC Input Filter Board (*A3191-04*).
4. If the problem persists, contact the manufacturer.

ERROR CODE : E01

DESCRIPTION :

Backup Timer I2C error. I2C Bus error while trying to access the external redundant backup timer. “Recoverable” with the “*Reset*” push-button.

POSIBLE CAUSES

It is not possible to communicate with the secondary microcontroller (U56) that practises as the redundant backup timer.

ACTIONS

1. Turn the Unit OFF and ON.
2. If the error persists, check on the Control Portable Board (*A3175-05*):
   - Make sure the secondary microcontroller (U56) has been properly burned (DS29 should be flashing).
   - Review all the hardware connected to the I2C Bus: P89LPC922 (U56), M41T56 (U54).
3. Check on the Control Driver Board (*A3189-07*) the digital potentiometer AD5245 (U10) and the multiplexer MAX4586 (U12).
4. Check the related components to all of them.
5. Replace the defective hardware.

ERROR CODE : E02

DESCRIPTION : Wrong Workstation configuration. One or more workstations are not properly configured, a default value has been assigned. "Recoverable" with the "*Reset*" push-button.

POSIBLE CAUSES

The workstation configuration is invalid, for example a workstation configured as bucky/digital panel (C1.2 or C2.2) has no input selected (C1.3 or C2.3). Or the EEPROM is not initialized, that is very uncommon.

ACTIONS

1. Review the workstation configuration (C01 and C02 menus) and correct the wrong value.
2. Consider initializing the EEPROM (*refer to Section 6.1.1*). If the EEPROM is initialized, the calibration data will be lost and the system configuration will be overwritten with the default values.

ERROR CODE : E03

DESCRIPTION : No Workstation configured. All the workstations have no Tube configured, there is no workstation available, a default value has been assigned. "Recoverable" with the "*Reset*" push-button.

POSIBLE CAUSES

The workstation configuration is invalid, or the EEPROM is not initialized, that is very uncommon.

ACTIONS

1. Review the workstation configuration (C1.1 and C2.1 submenus) and configure at least one of them with a value different from "0".
2. Consider initializing the EEPROM (*refer to Section 6.1.1*). If the EEPROM is initialized, the calibration data will be lost and the system configuration will be overwritten with the default values.

ERROR CODE : E04

DESCRIPTION :

The “*Fluoro*” order input signal is active during the Start-up sequence.
“Unrecoverable”, the system remains lock.

POSIBLE CAUSES

The “*Fluoro*” order input signal is active and/or defective hardware related to this input.

ACTIONS

1. Make sure that the “*Fluoro*” order input signal in J11.5 of the Portable Control Board (*A3175-05*) is inactive during the Start-up.
2. Verify the possible defective hardware related to this input.
3. Deactivate the input or replace the defective hardware.

ERROR CODE : E05

DESCRIPTION :

“*Exposure*” order input signal is active during the Start-up sequence.
“Unrecoverable”, the system remains lock.

POSIBLE CAUSES

The microprocessor has detected “*Exposure*” during the Start-up sequence.

ACTIONS

1. Make sure that the “*Exposure*” order is inactive during the Start-up by first checking the Handswitch control and Console Overlay.
2. Make sure that the “*Exposure*” order is inactive during the Start-up by checking the signal in:
   - connector J6.2, J8.4, J12.5 and J13.2 on Portable Control Board (*A3175-05*).
   - connector J2.3 (Handswitch) and J1.8 (RS-232) of the Portable Unit.
   - overlay ribbon cables signal connected to J13.2 on Portable Control Board (*A3175-05*).
   - connector J4.3 on the Remote Console Connectors (*A3632-02*)
3. Verify the possible defective hardware related to these inputs.
4. Deactivate the input or replace the defective hardware.

ERROR CODE : E06

DESCRIPTION :

"*Preparation*" order input signal is active during the Start-up sequence.
"Unrecoverable", the system remains lock.

POSIBLE CAUSES

The microprocessor has detected "*Preparation*" during the Start-up sequence.

ACTIONS

1. Make sure that the "*Preparation*" order is inactive during the Start-up by first checking the Handswitch control and Console Overlay.
2. Make sure that the "*Preparation*" order is inactive during the Start-up by checking the signal in:
   - connector J6.3, J8.3, J12.2 and J13.3 on Portable Control Board (*A3175-05*).
   - connector J2.5 (Handswitch) and J1.7 (RS-232) of the Portable Unit.
   - overlay ribbon cables signal connected to J13.3 on Portable Control Board (*A3175-05*).
   - connector J4.5 on the Remote Console Connectors (*A3632-02*).
3. Verify the possible defective hardware related to these inputs.
4. Deactivate the input or replace the defective hardware.

ERROR CODE : E08

DESCRIPTION :

Wrong identifier for X-ray Tube-1.
The Tube identifier (that points a Tube in the Tube list) configured for the Tube-1 is a default value. "Recoverable" with the "*Reset*" push-button.

POSIBLE CAUSES

The Tube model configuration is invalid, or the EEPROM is not initialized, that is very uncommon.

ACTIONS

1. Review the workstation configuration (C4.1 submenu) and configure a valid Tube identifier.
2. Consider initializing the EEPROM (*refer to Section 6.1.1*). If the EEPROM is initialized, the calibration data will be lost and the system configuration will be overwritten with the default values.

ERROR CODE : E10

DESCRIPTION :

EEPROM corrupted or not initialized. Wrong data calibration in EEPROM.
"Unrecoverable", the system remains lock.

POSIBLE CAUSES

The EEPROM is not initialized, or the EEPROM is defective.

ACTIONS

1. Initialize the EEPROM (*refer to Section 6.1.1*).
2. If the error persists, replace the Portable Control Board (*A3175-05*) and initialize the new EEPROM (*refer to Section 6.1.1*).

ERROR CODE : E11

DESCRIPTION :

Load Capacitor Error - DC Bus error during Start-up.
Error while charging the load capacitors. The DC Bus voltage doesn't reach the correct value during Start-up. "Unrecoverable", the system remains lock.

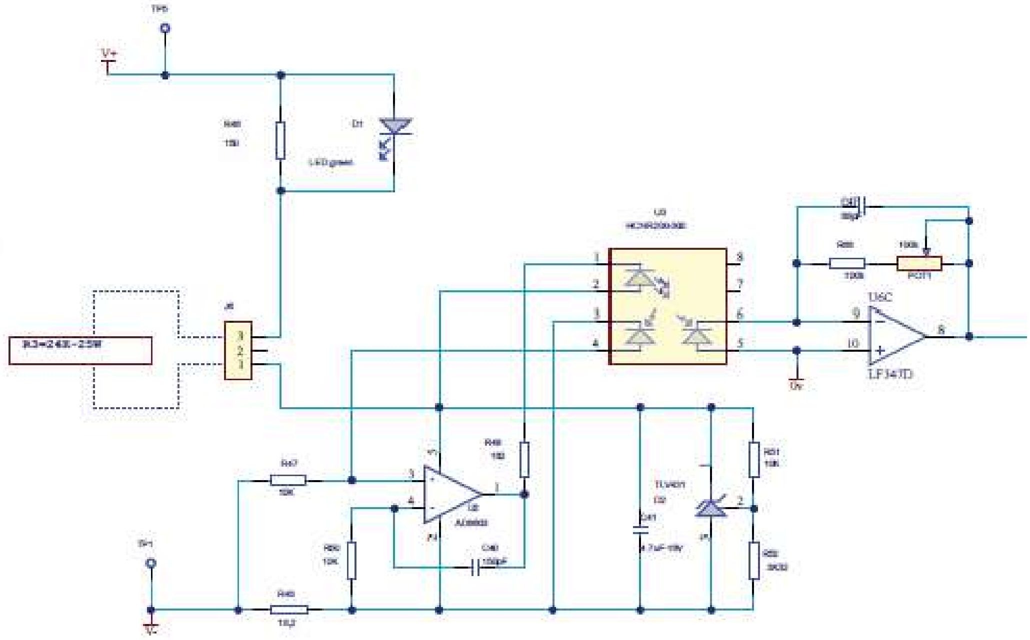
POSIBLE CAUSES

Defective DC Bus hardware. Fault at the measuring of the DC Bus voltage.

ACTIONS

1. With the generator OFF, verify with ohmmeter the pre-charge resistors R1 & R2 located on the EMC Input Filter A3191-XX. If any of the resistors is damaged (opened) replace the EMC Input Filter A3191-XX. Verify preventively the status of the IGBTs as described in step 8.

2. With the generator OFF, verify with ohmmeter the resistor R3 connected to the control driver board:



Ensure that this resistor is properly connected to the Control Driver board A3189-XX and not damaged.

3. Power ON the unit and measure the DC Bus voltage between TP1 & TP5 of the Control Driver board A3189-XX. In stand-by, you should measure Vmains x 1.41 (for example, 230 V~ x 1.41 = 324 V=). If the voltage is present continue in step 6.

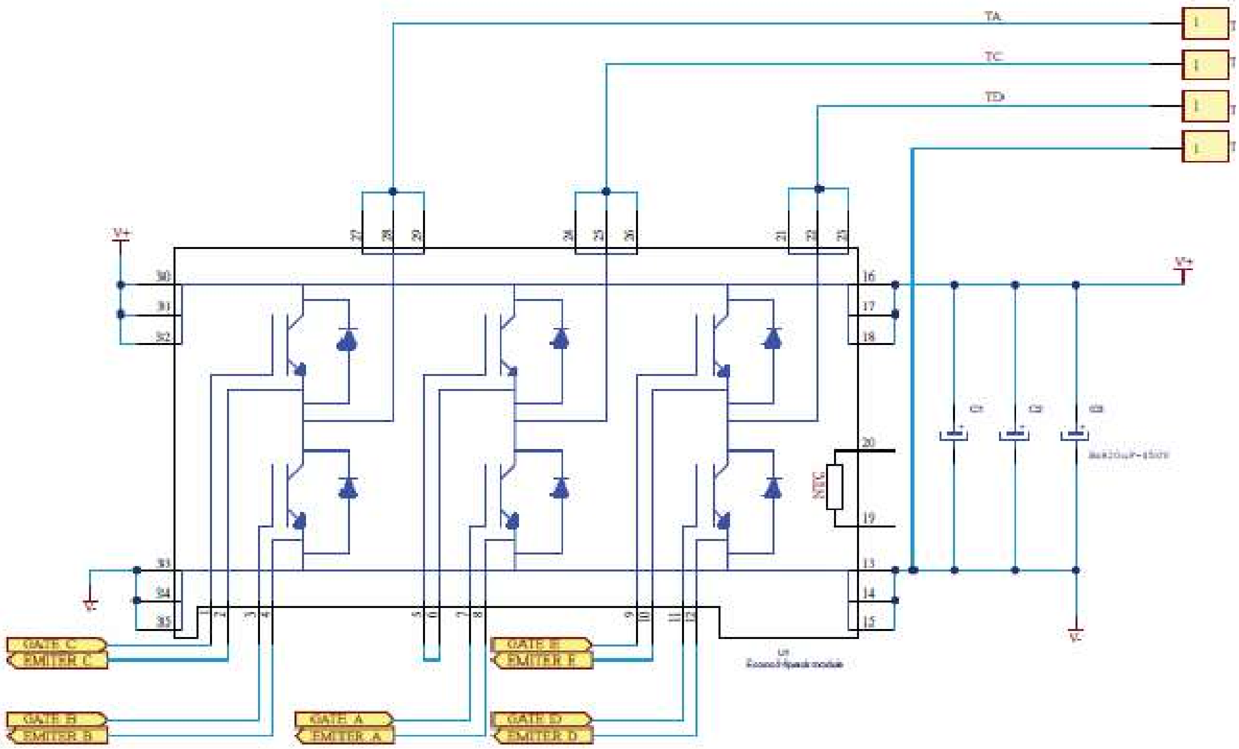
4. If the voltage is not present, check voltage on J4 & J5 of EMC Input Filter A3191-XX. If the DC Bus voltage is present on J4 & J5 of EMC Input Filter A3191-XX, verify connections from J4 & J5 of EMC Input Filter A3191-XX to Control Driver board A3189-XX through the inductance L1.

5. If the DC Bus voltage is not present on J4 & J5 of EMC Input Filter A3191-XX, verify the presence of the line voltage on J2 & J3 of EMC Input Filter A3191-XX. If the line voltage is present, replace the EMC Input Filter A3191-XX. Verify preventively the status of the IGBTs as described in step 8.
If the line voltage is not present, check connections between breaker CB1 and J2 & J3 of EMC Input Filter A3191-XX.

6. If DC Bus voltage between TP1 & TP5 of the Control Driver board A3189-XX is present, measure the voltage between TP10 and GND (TP2, TP14, TP17) of the Control Driver board A3189-XX to verify the signal VCarr (Relation of the VCarr and DCBUS is 1V~100V). If signal VCarr is not correct, replace the Control Driver board A3189-XX.

7. If signal VCarr is correct (VCarr = DCBUS / 100), measure the voltage between TP25 and GND of the Control Portatil PCB A3175-XX to be able to check that the VCarr is present on the Control Portatil PCB A3175-XX. If the voltage is correct between TP25 and GND, replace the Control Portatil PCB A3175-XX. If the voltage is not present check the connection between the control driver and the Control Portatil PCB A3175-XX.

8. Verification of IGBT Module on Control Driver board A3189-XX.
This verification is recommended in case of EMC Input Filter A3191-XX has been found damaged.
Example:
Multi meter positive probe connected to 21 and negative probe to 19 (open circuit in diode mode)
Multi meter positive probe connected to 19 and negative probe to 21 (0.3 V= in diode mode)
Check the status of all the IGBTs in the corresponding electrical points: 17-21, 15-21, 19-20, 17-20, 15-20
If any of the IGBT is found defective, replace the Control Driver board A3189-XX.



ERROR CODE : E12

DESCRIPTION : mA is out of range during exposure. Tube current out of range during exposure. “Recoverable” with the “*Reset*” push-button.

POSIBLE CAUSES

The filament current demand is not calibrated properly.
Defective filament control hardware, noise or fault in the mA measure.

ACTIONS

1. Calibrate the mA stations again.
2. If the error persists, replace the defective hardware.

ERROR CODE : E13

DESCRIPTION : kVp is out of range during exposure. Anode-Cathode voltage is out of range during exposure. “Recoverable” with the “*Reset*” push-button.

POSIBLE CAUSES

The DC Bus is going down during exposure.
Defective kVp control hardware, noise or fault in the kVp measure.

ACTIONS

If the error persists, replace the defective hardware.

ERROR CODE : E14

DESCRIPTION : kVp ramp error. Anode-Cathode voltage does not reach the final value in the designated rise time. “Recoverable” with the “*Reset*” push-button.

POSIBLE CAUSES

The DC Bus is going down during exposure.
Defective kVp control hardware, noise or fault in the kVp measure.

ACTIONS

If the error persists, replace the defective hardware.

ERROR CODE : E15

DESCRIPTION : Large filament current is out of range. “Recoverable” with the “*Reset*” push-button.

POSIBLE CAUSES

Fault in the Tube filament current control hardware.

The Tube filament has blown up or it is not connected.

ACTIONS

If the error persists, replace the defective hardware.

ERROR CODE : E16

DESCRIPTION : Small filament current is out of range. “Recoverable” with the “*Reset*” push-button.

POSIBLE CAUSES

Fault in the Tube filament current control hardware.

The Tube filament has blown up or it is not connected.

ACTIONS

If the error persists, replace the defective hardware.

ERROR CODE : E17

DESCRIPTION : DC Bus is out of range. The DC Bus voltage is too high or low during unit operation or the precharge relay is opened. "Recoverable" with the "*Reset*" push-button.

POSIBLE CAUSES

Defective DC Bus hardware, noise or fault at the measuring of the DC Bus voltage. The precharge relay can not be activated (if the cause of this error is the precharge relay, it is very important to avoid pressing on the "*Collimator Light*" or "*Preparation*" controls as it could blow up the precharge resistors).

ACTIONS

If the error persists, replace the defective hardware.

ERROR CODE : E19

DESCRIPTION : mA without "*Exposure*" order. Tube current is present without "*Exposure*" order from the U25-EEPROM Microcontroller. "Recoverable" with the "*Reset*" push-button.

POSIBLE CAUSES

Defective hardware or noise in the mA measure.

ACTIONS

If the error persists, replace the defective hardware.

ERROR CODE : E20

DESCRIPTION : kVp without "*Exposure*" order. Anode-Cathode voltage is present without "*Exposure*" order from the U25-EEPROM Microcontroller. "Recoverable" with the "*Reset*" push-button.

POSIBLE CAUSES

Defective hardware or noise in the kVp measure.

ACTIONS

If the error persists, replace the defective hardware.

ERROR CODE : E23

DESCRIPTION : Error while writing in the EEPROM. “Unrecoverable”, the system remains lock.

POSIBLE CAUSES

The EEPROM is defective.

ACTIONS

1. Initialize the EEPROM (*refer to Section 6.1.1*).
2. If the error persists, replace the Portable Control Board (*A3175-05*) and initialize the new EEPROM (*refer to Section 6.1.1*).

ERROR CODE : E24

DESCRIPTION : Bucky / Digital Panel error. A Workstation configured as Bucky / Digital Panel has elapsed 10 seconds since exposure signal was activated while the equipment was ”*Ready*” without any acknowledge from the Bucky or Digital Panel. “Recoverable” with the “*Reset*” push-button.

POSIBLE CAUSES

Defective interconnection cable or hardware related to the signals RX_RQ (Request) or RX_ORDER (Acknowledge). Or the Bucky / Digital Panel is not sending the RX_ORDER signal.

ACTIONS

If the error persists, check the cable connections and signal of the Image Receptor, or replace the defective hardware.

1. Check cable connections and signal from/to the Image Receptor .
2. Check the RX signals in:
   - connector J9.3 (RX_RQ), J9.4 (RX_ACKN) on Portable Control Board (*A3175-05*).
   - connector J1.9 (RX_RQ), J1.4 (RX_ACKN) of RS-232 connector of the Portable Unit.
   - connector J5.2 and J1.10 (RX_RQ), and J5.3 and J1.23 (RX_ACKN) on the Remote Console Connectors (*A3632-02*).
3. Verify the possible defective hardware related to these inputs.
4. Replace the defective hardware.

ERROR CODE : E25

DESCRIPTION : Large Filament current demand is over the limit. “Recoverable” with the “*Reset*” push-button.

POSIBLE CAUSES

The filament current demand is not calibrated properly.

ACTIONS

Calibrate the mA stations again and check that all the needed data for the interpolation or extrapolation have been entered (*refer to Section 3.2*).

ERROR CODE : E26

DESCRIPTION : Small Filament current demand is over the limit. “Recoverable” with the “*Reset*” push-button.

POSIBLE CAUSES

The filament current demand is not calibrated properly.

ACTIONS

Calibrate the mA stations again and check that all the needed data for the interpolation or extrapolation have been entered (*refer to Section 3.2*).

ERROR CODE : E27

DESCRIPTION : Collimator Light current is out of range. “Recoverable” with the “*Reset*” push-button.

POSIBLE CAUSES

Fault in the Collimator Light current control hardware.
The Collimator LED circuitry has blown up or it is not connected.

ACTIONS

If the error persists, replace the defective hardware.

ERROR CODE : E28

DESCRIPTION : Collimator Light current is present without order from the U25-EEPROM Microcontroller. “Recoverable” with the “*Reset*” push-button.

POSIBLE CAUSES

Defective hardware or noise in the Collimator Light current measure.

ACTIONS

If the error persists, replace the defective hardware.

ERROR CODE : E30

DESCRIPTION :

Wrong date/time at the RTC (Real Time Clock). Wrong date stored in the RTC (Real Time Clock) and/or the Time Stamp. “Recoverable” with the “*Reset*” push-button.

POSIBLE CAUSES

The RTC has not been configured, the RTC battery is discharged or missed or the RTC is failing.

ACTIONS

1. Check the RTC configuration (*refer to Section 2.2.7*).
2. If the error persists, check the battery BAT1 (model CR 1216, 3V) of the Portable Control Board (*A3175-05*) and replace if needed.
3. If the error persists, replace the Portable Control Board (*A3175-05*) and initialize the new EEPROM (*refer to Section 6.1.1*).

ERROR CODE : E31

DESCRIPTION :

Wrong Time Stamp. The Time Stamp checksum is wrong. “Recoverable” with the “*Reset*” push-button.

POSIBLE CAUSES

The RTC has not been configured, the RTC battery is discharged or missed or the RTC is failing.

ACTIONS

1. Check the RTC configuration (*refer to Section 2.2.7*).
2. If the error persists, check the battery BAT1 (model CR 1216, 3V) of the Portable Control Board (*A3175-05*) and replace if needed.
3. If the error persists, replace the Portable Control Board (*A3175-05*) and initialize the new EEPROM (*refer to Section 6.1.1*).

ERROR CODE : E32

DESCRIPTION :

I2C Bus error while trying to access the Real Time Clock (RTC).
“Recoverable” with the “*Reset*” push-button.

POSIBLE CAUSES

It is not possible to communicate with the RTC.

ACTIONS

1. Check on the Control Portable Board (*A3175-05*):
   - Review all the hardware connected to the I2C Bus: P89LPC922 (U56), M41T56 (U54).
2. Check on the Control Driver Board (*A3189-07*) the digital potentiometer AD5245 (U10) and the multiplexer MAX4586 (U12).
3. Check the related components to all of them.
4. Replace the defective hardware.

ERROR CODE : E33

DESCRIPTION :

Serial Communication error. The Generator has lost the serial communications with the PC after establishing the link. “Recoverable” with the “*Reset*” push-button.

POSIBLE CAUSES

The Generator / PC is not receiving the status requests at the required rate.

ACTIONS

1. Check the cable and connections between the Generator and the Remote Console.
2. Check the related components to each signal of the communication cables.
3. Replace the defective hardware.

ERROR CODE : E34

DESCRIPTION :

Exposure Timer error. The software backup timer has finished the exposure. “Unrecoverable”, the system remains lock.

POSIBLE CAUSES

Fault in the Microcontroller backup timer (U56) of Portable Control Board (*A3175-05*).

ACTIONS

1. Turn the Unit OFF and ON.
2. If the equipment remains inoperative, replace the Portable Control Board (*A3175-05*)and initialize the new EEPROM (*refer to Section 6.1.1*).

ERROR CODE : E35

DESCRIPTION :

Flat Panel Detector (FPD)/ Receptor error. The Receptor acknowledge signal has been lost during the exposure so the exposure has been aborted. “Recoverable” with the “*Reset*” push-button.

POSIBLE CAUSES

When the FPD (or its power/interface box) is wired to the Generator (the Workstation in use should be Bucky 1), the RX_ACKN signal from the FPD has been lost before the end of the exposure.

When the FPD (or its power/interface box) is not wired to the Generator (the Workstation in use should be Bucky COM), the Host Controller has sent a message to the Generator in order to abort the exposure because it has lost the X-Ray acknowledge from the FPD.

ACTIONS

If the error persists,

- When the FPD (or its power/interface box) is wired to the Generator, check the RX_ACKN signal from the FPD, present at J9.4 in the Portable Control Board (A3175-05).
  - If the signal is OK, replace the Portable Control Board (A3175-05).
  - If the signal is not reaching properly the board or it is noisy, check the cable connections between the FPD (or its power/interface box) and the generator, or the FPD itself.
  - If the signal is clean but it is deactivated before the end of the exposure, check the system configuration or the FPD.
- When the FPD (or its power/interface box) is not wired to the Generator, check the items between the FPD and the System and replace the defective hardware.

ERROR CODE : E36

DESCRIPTION :

Presostat / Thermostat error.
This error does not require to press the "*Reset*" push-button, the error code disappears automatically.

POSIBLE CAUSES

The housing presostat / thermostat has been opened due to overheat or hardware fault.

ACTIONS

1. Wait for the unit (housing) to cool.
2. If the error code does not disappear after 15 minutes, turn the Unit OFF and ON.
3. If the equipment remains inoperative, check the hardware and replace if needed.

ERROR CODE : E38

DESCRIPTION :

System error – Chopper failure.
The DC Bus voltage and / or the Chopper Coil current is/are too high.
"Recoverable" with the "*Reset*" push-button.

POSIBLE CAUSES

Over voltage or over current in the Chopper, noise or fault in the hardware that measure these parameters.

ACTIONS

1. Turn Off/ON the unit.
2. If the error persists, replace the defective hardware.

ERROR CODE : E39

DESCRIPTION :

System error - Power supply error.
15 V power supply fault.
"Recoverable" with the "*Reset*" push-button.

POSIBLE CAUSES

15 V power supply goes down, noise or fault in the hardware.

ACTIONS

1. Turn Off/ON the unit.
2. If the error persists, replace the defective hardware.

ERROR CODE : E40

DESCRIPTION :

System error - kVp unbalanced.
Anode and Cathode branches have different voltage.
"Recoverable" with the "*Reset*" push-button.

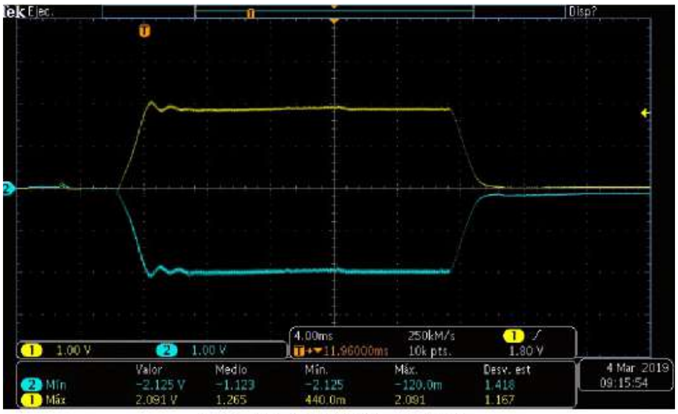
POSIBLE CAUSES

Defective High Voltage Transformer, Control Driver board A3189-xx or Control Portatil A3175-xx

ACTIONS

1. Connect the oscilloscope to the following test points on Control Driver board A3189-xx:
   CH1: TP6 (+kV)
   CH2: TP8 (-kV)
   GND: TP2, TP4, TP14, TP17, TP21, TP23, TP24, TP25, TP26, TP30

2. Perform an exposure with the parameters that produce the error message and verify the symmetry of the kV signals during the exposure with the oscilloscope. Example of expected signals (no error condition) for a 40kV exposure:



CH1: kV+ & CH2: kV- at 40kVp

3. If the signals +kV and -kV are not symmetrical, verify the ribbon cable between the Control Driver board A3189-xx, and the HV Transformer. If the cable is OK, continue to *Step 4.*

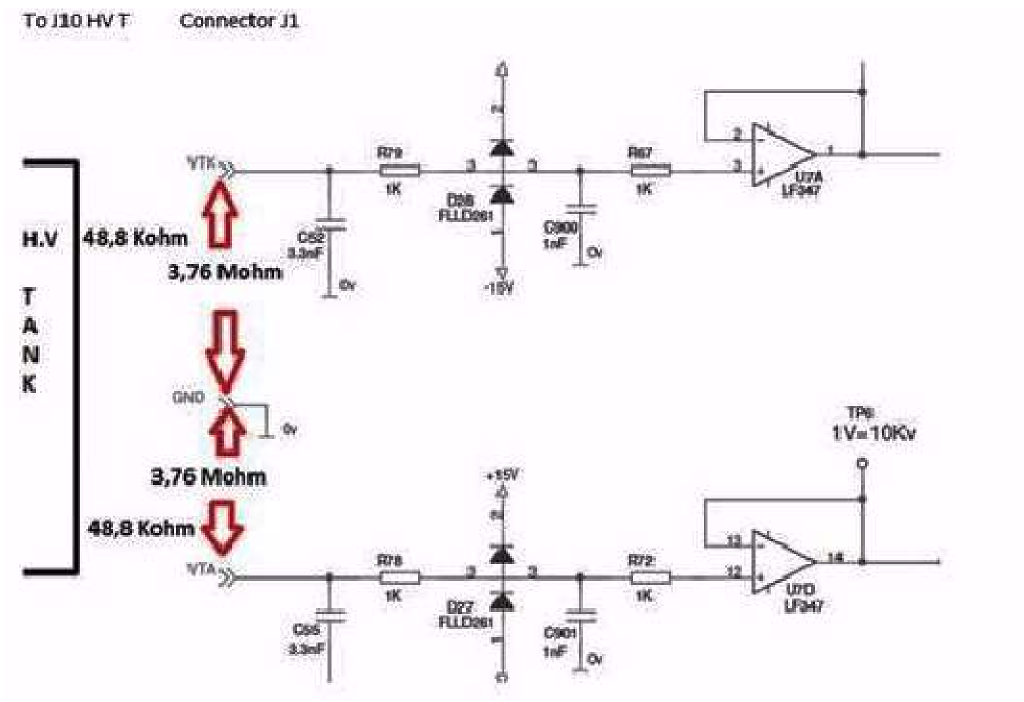
4. Disconnect the ribbon cable J1 on the Control Driver. Measure the following resistances of the kV feedback inputs in the connector J1 of the Control Driver board:

    J1-1 (VTK) to J1-3 (GND)
    J1-2 (VTA) to J1-3 (GND)

    The resistance must be similar in both branches. A significant difference between branches means a defect in the hardware.

Note ☞ *Due to the characteristics of the electronic components in the circuit (capacitors, diodes, etc.) the measured ohmic value may vary (from ≈ 400kohm to ≈ 4Mohm) depending on the tester used for the measurement.*

5. If the value of the resistance on the Control Driver are correct, disconnect the ribbon cable from J10 of HV Transformer and measure resistance on the following points of the HV Transformer:
   J10-1 to J10-2 or J10-15 ? 48.8 kohm.
   J10-14 to J10-2 or J10-15 ? 48.8 kohm.



Note: Ohmic values for informative purposes only. Refer to Note in Step 4.

6. If the kV signals in *Step 2.* are correct but the error E40 appears, verify the ribbon cable between Control Driver board A3189-xx and Control Portatil A3175-xx.

7. If the ribbon cable is not defective, replace Control Driver board A3189-xx and Control Portatil A3175-xx.

ERROR CODE : E41

DESCRIPTION :

System error – mA unbalanced.
Anode and Cathode branches have different current.
“Recoverable” with the “*Reset*” push-button.

POSIBLE CAUSES

Defective High Voltage Transformer, noise or fault in the measuring hardware.

ACTIONS

1. Turn Off/ON the unit.
2. If the error persists, replace the defective hardware.

ERROR CODE : E42

DESCRIPTION :

Corrupted counters. The counters checksum is wrong.
“Recoverable” with the “*Reset*” push-button.

POSIBLE CAUSES

Defective Non-Volatile RAM memory in U25-EEPROM Microcontroller (Portable Control Board *A3175-05*) or it has not been initialized.
Defective Portable Control Board (*A3175-05*).

ACTIONS

1. Press the “*Reset*” push-button.
2. If the error persists, turn Off/ON the unit.
3. If the error persists, initialize the EEPROM (*refer to Section 6.1.1*).
4. If the error persists, replace the Portable Control Board (*A3175-05*) and initialize the new EEPROM (*refer to Section 6.1.1*).

ERROR CODE : E43

DESCRIPTION :

Corrupted error log. The error log checksum is wrong.
“Recoverable” with the “*Reset*” push-button.

POSIBLE CAUSES

Defective Non-Volatile RAM memory in U25-EEPROM Microcontroller (Portable Control Board *A3175-05*) or it has not been initialized.
Defective Portable Control Board (*A3175-05*).

ACTIONS

1. Press the “*Reset*” push-button.
2. If the error persists, turn Off/ON the unit.
3. If the error persists, initialize the EEPROM (*refer to Section 6.1.1*).
4. If the error persists, replace the Portable Control Board (*A3175-05*) and initialize the new EEPROM (*refer to Section 6.1.1*).

ERROR CODE : E44

DESCRIPTION :

I2C Bus error while trying to access the digital potentiometer.
“Recoverable” with the “*Reset*” push-button.

POSIBLE CAUSES

It is not possible to communicate with the digital potentiometer AD5245 (U10) (Control Driver Board *A3189-07*).

ACTIONS

1. Check on the Control Portable Board (*A3175-05*):
   - Review all the hardware connected to the I2C Bus: P89LPC922 (U56), M41T56 (U54).
2. Check on the Control Driver Board (*A3189-07*) the digital potentiometer AD5245 (U10) and the multiplexer MAX4586 (U12).
3. Review the related components to all of them.
4. If the error persists, replace the defective hardware.

ERROR CODE : E45

DESCRIPTION :

I2C Bus error while trying to access the multiplexer.
“Recoverable” with the “*Reset*” push-button.

POSIBLE CAUSES

It is not possible to communicate with the multiplexer MAX4586 (U12) (Control Driver Board *A3189-07*).

ACTIONS

1. Check on the Control Portable Board (*A3175-05*):
   - Review all the hardware connected to the I2C Bus: P89LPC922 (U56), M41T56 (U54).
2. Check on the Control Driver Board (*A3189-07*) the digital potentiometer AD5245 (U10) and the multiplexer MAX4586 (U12).
3. Review the related components to all of them.
4. If the error persists, replace the defective hardware.

ERROR CODE : E46

DESCRIPTION :

Busy I2C bus. I2C Bus error, the Bus remains always busy.
"Recoverable" with the "*Reset*" push-button.

POSIBLE CAUSES

It is not possible to communicate as the Bus is always busy.

ACTIONS

1. Check on the Control Portable Board (*A3175-05*):
   - Review all the hardware connected to the I2C Bus: P89LPC922 (U56), M41T56 (U54).
2. Check on the Control Driver Board (*A3189-07*) the digital potentiometer AD5245 (U10) and the multiplexer MAX4586 (U12).
3. Review the related components to all of them.
4. If the error persists, replace the defective hardware.

ERROR CODE : E47

DESCRIPTION :

The APR Lite checksum is wrong.
"Recoverable" with the "*Reset*" push-button.

POSIBLE CAUSES

Defective Non-Volatile RAM memory in U25-EEPROM Microcontroller (Portable Control Board *A3175-05*) or it has not been initialized.
Defective Portable Control Board (*A3175-05*).

ACTIONS

1. Press the "*Reset*" push-button.
2. If the error persists, turn Off/ON the unit.
3. If the error persists, initialize the EEPROM (*refer to Section 6.1.1*).
4. If the error persists, replace the Portable Control Board (*A3175-05*) and initialize the new EEPROM (*refer to Section 6.1.1*).

ERROR CODE : E48

DESCRIPTION :

Bucky / Digital Panel interface error.
The user is trying to perform an exposure with a Bucky or a Digital Panel but this interface is not available.
“Recoverable” with the “*Reset*” push-button.

POSIBLE CAUSES

The workstation configuration is wrong.

The unit has not installed the proper software for Bucky / Digital Panel interface.

ACTIONS

Configure the workstation without bucky/digital interface or ask for the proper software which supports the bucky/digital interface.

1. If the error is due to a wrong configured Workstation, perform actions described in error codes “E02” and “E03”. If a Bucky / Digital Panel is not interfaced to this Workstation, configure it for “*Direct*” Workstation.
2. If the error is due to a wrong software version, contact to the manufacturer.

ERROR CODE : E49

DESCRIPTION :

The programmed exposure time has elapsed but the mAs measured have not reached the expected value.

POSIBLE CAUSES

The microcontroller is not measuring properly the tube current, there is no tube current (e.g. filaments disabled) or the corresponding exposure time for the selected mAs was close to the maximum and there is not enough margin to compensate the line drop (mA reduction while extending the exposure time).

ACTIONS

1. Press the “*Reset*” push-button.
   Make sure the filaments are enabled and check the selected parameters. Modify them as required.
   In case of poor electricity line, reduce the mAs (mA / exposure time) or connect the Unit to a better power line. Try a new exposure.
2. If the error code persists, turn the Unit OFF and ON.
3. If the error persists, verify the possible defective hardware and replace if needed.

ERROR CODE : E50

DESCRIPTION : The exposure has been interrupted.

POSIBLE CAUSES

The exposure is interrupted:

- By the user, when releasing the handswitch “Exp” control before the exposure has finished.
- By the detector through the Software Interface (only for XIF Software integration with WIFI Detector). Detector has aborted the exposure once the acquisition time window has expired. In that case, the Error Message is preceded by WNC753.

Malfunction of the Exposure Switch.

ACTIONS

1. Reset the Error indication.
2. Repeat the exposure.
3. If the error persists:
   a. If the exposure was interrupted by the user:
      - Check the correct status of the exposure device (Handswitch, Control Panel, ...) and their respective cable connections.
      - Verify the possible defective hardware related to these inputs and replace the defective hardware, if needed.

   b. If the exposure was interrupted by the Detector, refer to the Troubleshooting procedures of the Detector Service Manual.

ERROR CODE : E51

DESCRIPTION : Incorrect exposure time. The exposure time is above the maximum (very uncommon) or it is so short that it is not reachable according to the present configuration (rise time and kVp tail / high voltage capacity). “Recoverable” with the “*Reset*” push-button.

POSIBLE CAUSES

The exposure time is shorter than the added of the 25% of the rise time plus the kVp tail from the selected kVp to the 75% of that value.

ACTIONS

Change the exposure parameters increasing the exposure time.

ERROR CODE : E53

DESCRIPTION : The timeout for receiving the Fluoro synchronism pulse has elapsed.

POSIBLE CAUSES

The interconnection cable between the Image System and the Generator is defective.

ACTIONS

1. Check the interconnection cable between the Image System and the Generator. if it is ok,
2. Check the Image System synchronism signal, if it is ok,
3. Replace the Portable Control Board (*A3175-05*)of the Generator.

ERROR CODE : E60

DESCRIPTION : The preprogrammed exposures for Autocalibration has finished without complete the Autocalibration process. The number of exposures to autocalibrate a mA station have run out. This error can be only shown in Service Mode during Autocalibration process. “Recoverable” with the “*Reset*” push-button.

POSIBLE CAUSES

Tube instability, defective filament control hardware, noise or fault in the mA measure.

ACTIONS

If the error persists, replace the defective hardware.

ERROR CODE : E61

DESCRIPTION : There has been an error while trying to access the License data. Default options have been selected. “Recoverable” with the Reset command.

POSIBLE CAUSES

The License has not been burned or is defective.

ACTIONS

1. If the error persists, dismount the Portable Control Board and the License. Send them to the manufacturer, providing the serial number of the Unit.
2. Mount the new Portable Control Board and the new License.

ERROR CODE : E74

DESCRIPTION : The generator has been reset because of the COP module.

POSIBLE CAUSES

Unlikely error. Code corruption.

ACTIONS

If the error persists, contact the manufacturer. Factory test self diagnosis.
It may be necessary to replace the Portable Control Board Software.

ERROR CODE : E75

DESCRIPTION : The generator has been reset because of the CLK module.

POSIBLE CAUSES

Unlikely error. Code corruption.

ACTIONS

If the error persists, contact the manufacturer. Factory test self diagnosis.
It may be necessary to replace the Portable Control Board Software.

ERROR CODE : E76

DESCRIPTION : The generator has been reset because of an illegal operation code.

POSIBLE CAUSES

Unlikely error. Code corruption.

ACTIONS

If the error persists, contact the manufacturer. Factory test self diagnosis.
It may be necessary to replace the Portable Control Board Software.

ERROR CODE : E77

DESCRIPTION : The generator has been reset because of a software interrupt.

POSIBLE CAUSES

Unlikely error. Code corruption.

ACTIONS

If the error persists, contact the manufacturer. Factory test self diagnosis.
It may be necessary to replace the Portable Control Board Software.

ERROR CODE : E78

DESCRIPTION : The generator has been reset because of a memory overflow interrupt.

POSIBLE CAUSES

Unlikely error. Code corruption.

ACTIONS

If the error persists, contact the manufacturer. Factory test self diagnosis.
It may be necessary to replace the Portable Control Board Software.

ERROR CODE : E95

DESCRIPTION : Power Line not good enough for operation. The Generator could not finish properly the “Automatic Line Power Detection” procedure. No exposure will be allowed until the user performs a successful test. “Unrecoverable”, the system remains lock.

POSIBLE CAUSES

The line impedance is too high.

ACTIONS

1. Repeat the “Automatic Line Power Detection” procedure (*refer to Section 5.1*).
2. If error persists, plug the unit to another socket line and try again.

ERROR CODE : E96

DESCRIPTION : Generator power limited during the Automatic Line Power Detection System due to non calibrated mA station.

POSIBLE CAUSES

At least one mA Station is not calibrated.

ACTIONS

1. Press the “*Reset*” push button.
2. Perform the Calibration procedure *(refer to Section 3)*.
3. Repeat the “Automatic Line Power Detection” procedure (*refer to Section 5.1).*

ERROR CODE : E97

DESCRIPTION : I2C bus error while trying to access the License. “Recoverable” with the Reset command.

POSIBLE CAUSES

It is not possible to communicate with the License. Make sure the license is installed and properly plugged in. Check the I2C bus pull-up resistors (RP20 and RP21) and review all the elements connected to the I2C bus: TXS0104E (U68), MKL02Z32VFG4 (U56), M41T56 (U54), License, and the related components to all of them.

ACTIONS

1. Check that the License SD is correctly inserted, remove it and insert it again.
2. If the error persists, dismount the Portable Control Board and the License. Send them to the manufacturer, providing the serial number of the Unit.
3. Mount the new Portable Control Board and the new License.

ERROR CODE : Err rAn

DESCRIPTION :

Defective RAM Memory. Memory fault in U25-EEPROM Microcontroller.
"Unrecoverable", the system restarts again after 3 seconds.

POSIBLE CAUSES

Defective RAM memory in U25-EEPROM Microcontroller (Portable Control Board *A3175-05*).

ACTIONS

1. Turn the Unit OFF and ON.
2. If the equipment remains inoperative, replace the Portable Control Board (*A3175-05*)and initialize the new EEPROM (*refer to Section 6.1.1*).

ERROR CODE : Err nrAn

DESCRIPTION :

Defective NVRAM Memory.
Non-Volatile Memory fault in U25-EEPROM Microcontroller.
"Unrecoverable", the system restarts again after 3 seconds.

POSIBLE CAUSES

Defective Non-Volatile RAM memory in U25-EEPROM Microcontroller (Portable Control Board *A3175-05*).

ACTIONS

1. Turn the Unit OFF and ON.
2. If the equipment remains inoperative, replace the Portable Control Board (*A3175-05*) and initialize the new EEPROM (*refer to Section 6.1.1*).

ERROR CODE : OL

DESCRIPTION :

Tube or Generator Overload.
The selected technique is beyond the X-ray Tube ratings, the present conditions of the X-ray Tube/Generator inhibit the exposure (anode/inverter overheated) or the calculated remaining thermal capacity (%) for the next exposure is beyond the Generator capacity.
Parameters for next exposure may be temporally limited by the Unit.
This error does not require to press the "*Reset*" push-button, the error code disappears automatically.

POSIBLE CAUSES

The selected exposure is not possible due to the X-Ray Tube or Generator thermal status.

The selected technique is beyond the X-Ray Tube or Generator ratings, or present conditions of the X-Ray Tube (anode overheated) or Generator (Inverter overheated) inhibit the exposure.

Parameters for next exposure may be temporally limited by the Unit.

ACTIONS

1. Check that the remaining thermal capacity (%) is lower than the calculated for the next exposure (thermal capacity close to 0%).
2. Wait until the Generator cools down.
3. If the error code does not disappear after 15 minutes, turn the Unit OFF and ON.
4. If the equipment remains inoperative, check the hardware and replace if needed.

6.2.1 INTERLOCK MESSAGES

Interlock messages indicate a transitory situation that prevents the use of the system.

This condition disappears when the cause of the inhibition expires.

Table 6-2
Interlock Messages

CODE	MESSAGE / DESCRIPTION
IL103	**Generator Overload**
IL106	**Thermal Switch**. If the housing is too hot, wait for the housing to cool.
IL108	**Tube Overload.** Indicates that either the technique selected is beyond the X-ray Tube ratings or the present conditions of the X-ray Tube inhibit the exposure (anode overheated). Parameters for the next exposure may be temporally limited by the Generator (change the exposure values or wait for the X-ray Tube to cool). Check that heat units available are lower than those calculated for the next exposure (heat units close to zero). Reduce exposure factors or wait for the X-ray Tube to cool.
IL115	**X-Ray Disabled.** Reduce exposure factors in order to reduce the Energy, or wait for the X-ray Tube to cool.

6.2.2 WARNING MESSAGES

The Warning messages described in this section indicate a limit or an inhibit during the parameter selection, e.g. while increasing or decreasing kVp, when the value reaches the limits, the message *"Maximum/Minimun kVp Value"* is shown and the variation above or below limits inhibited.

Warnings show a condition that inhibits exposures temporarily, when the warning source disappears, the warning message disappears.

Table 6-3
Warning Messages (WN)

CODE	INFORMATION MESSAGE	DESCRIPTION
WN801	Generator Power Limit	The selected power exceeds the maximum Generator Power or the maximum Generator Power limit configured by the operator.
WN802	Tube Power Limit	The selected power exceeds the X-ray Tube Power limit due to Anode temperature (remaining Heat Units). Wait for X-ray Tube cool. The selected power exceeds the maximum X-ray Tube Power or the maximum Tube Power limit configured in the Unit.
WN803	Space Charge Limit	Filament emission limit for a combination of kVp and mA in a selected Focal Spot.
WN804	kVp Range Limit	Maximum or minimum kVp (Generator limit).
WN805	mAs Range Limit	Maximum or minimum mAs (Generator limit).
WN806	mA Range Limit	Maximum or minimum mA (Generator limit configured for each Focal Spot).
WN807	ms Range Limit	Maximum or minimum Exposure Time (ms) (Generator limit).
WN808	Focus Change Inhibit	Present conditions of X-ray Tube unable the change (remaining Heat Units, power limit for selected mAs, space charge).
WN809	Wrong APR Technique	Values of the selected APR Technique exceed the Generator range limits, Generator Power limit, X-ray Tube Power limits or values are limited by the present conditions of X-ray Tube.
WN810	Inverter Load Limit	Inverter Overheating error. Refer to Error Code ER848.
WN811	Power Line Too Low	Power Line not good enough for operation. Refer to Error Code E95.
WN812	Wrong APR Workstation	Values of the selected APR Workstation exceed the Generator range limits, Generator Power limit, X-ray Tube Power limits or values are limited by the present conditions of X-ray Tube.
WN813	PPS Range Limit	Maximum or minimum PPS (Generator limit).
WN113	Generator Power ON	
WN114	Generator Power OFF	

6.3 GENERAL DISASSEMBLY PROCEDURES

DANGER !

DO NOT MANIPULATE INSIDE THE UNIT WITHOUT DISCONNECTING IT FROM MAINS, RISK OF ELECTRIC SHOCK.

WARNING

WHENEVER THE REPLACEMENT REQUIRES TO OPEN THE X-RAY POWER UNIT, DISMOUNT IT FROM THE TROLLEY AS DESCRIBED IN SECTION 6.3.1.

NEVER ATTEMPT TO UNFOLD THE UNIT IN LAYING POSITION. UNFOLD ONLY IN VERTICAL POSITION.

CAUTION

Configuration and Calibration procedures should only be performed at field if Portable Control Board, Control Driver Board or the High Voltage Transformer are replaced or the EEPROM memory is re-initialized.

Note ☞

Refer to Renewal Parts Section for further information on parts identification.

6.3.1 DISASSEMBLING THE X-RAY POWER UNIT FROM THE ARM

Note ☞ *If the equipment is provided with the Optional "Quick Disconnect" of the X-Ray Unit, go to step 2.*

The X-ray Power Unit can be disassembled from the Arm in two different ways:

1. **Method-1 for disassembling the X-ray Power Unit from the Arm (removing the four (4) fixing screws from the "U" shaped support)**:

   a. Fully extend the Arm, then lay down the Trolley, with the Detector Basket resting on the floor, and leave the Power Unit face up on a table or similar (this will avoid the arm to push up when removing the X-Ray Power Unit).

   b. Open the Coin Screw Lock located at the top of the Detector Assembly in order to access to the X-ray Power Unit connector plate and disconnect P1 and J 1. Carefully take out the Cable Hose from its entry.

c. Disengage the Power / Communication Harness from the Arm (Cable Clamps).

d. Remove the four (4) fixing screws from the “U” shaped support at the Arm end.

DANGER !

KEEP IN MIND TO USE A 8 Nm TORQUE WRENCH WHEN RE-INSTALLING THE “U” SHAPED SUPPORT WITH THE FOUR (4) FIXING SCREWS.

e. Separate the X-ray Power Unit with the Harness from the Arm.

2. **Method-2 for disassembling the X-ray Power Unit from the Arm, only for equipment with optional “Quick Disconnect”.**

By means of this tool free disconnect feature, the user can disconnect and pick the Head of the unit up. Follow the steps below to dismount the X-ray Unit from the Arm.

a. Place the Unit in Parking position, that is, with the arm locked in the parking detent and the Safety Knob installed to prevent the Arm from springing out when removing the weight of the X-Ray Unit.

DANGER !

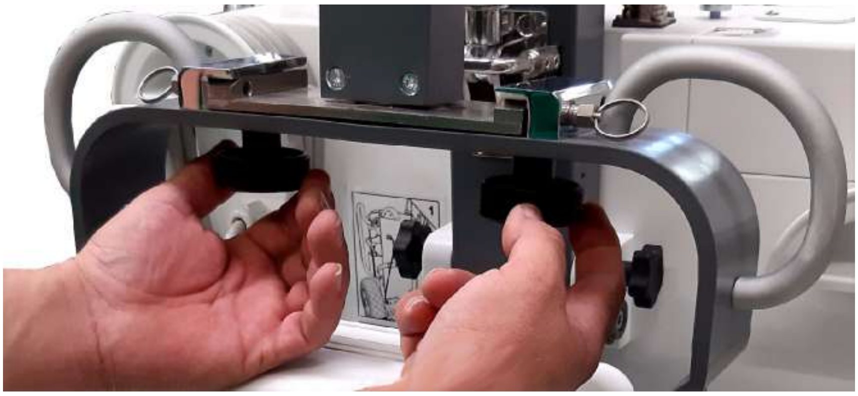
THE ARM MUST BE LOCKED WITH THE SAFETY KNOB WHEN THE X-RAY UNIT IS DISASSEMBLED FROM THE ARM.

b. Open the Coin Screw Lock located at the top of the Detector Assembly in order to access to the X-Ray Unit connector plate and disconnect P1 and J 1.

c. Carefully take out the Cable Hose from its entry.

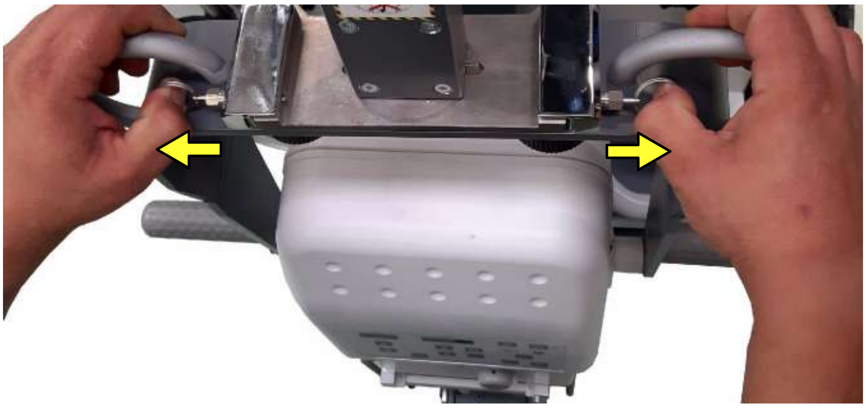
d. Dismount the cable Hose from the Flexible Cable Hooks. Grab the cable Hose (that goes to the X-ray Unit) and leave it aside.

e. Unscrew both Quick Disconnect Knobs.

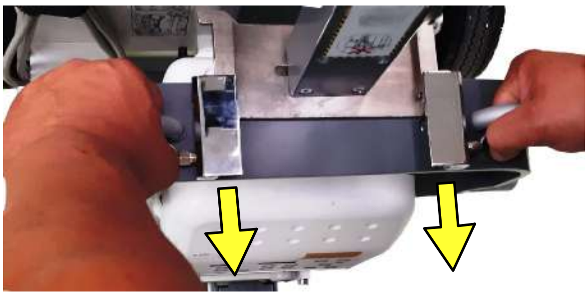


f. Grab and hold with both hands the Support Handles.

g. Pull both pin locks with both thumbs inserted in the rings in order to unlock the Control Unit.



h. Carefully slide backwards the Control Unit. Place it on a safe place. Keep in mind that the flexible cable is part of the X-ray Unit.



DANGER !

THE UNIT IS COMPLETELY RELEASED AND ITS WEIGHT IS NOW IN YOUR ARMS. LET IT REST IN A SAFE AREA.

6.3.2 SYSTEM DISASSEMBLY FOR TRANSPORT

WARNING

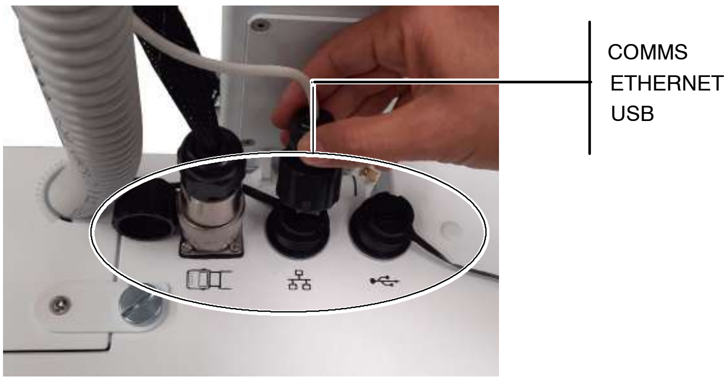
AT LEAST TWO PEOPLE ARE NEEDED TO CARRY OUT THE FOLLOWING INSTRUCTIONS.

Component disassembly is not recommended unless absolutely necessary. The Unit has been designed for transport and maximum spatial efficiency. Follow the steps below to remove the main components from the Frame.

Follow the steps to disassemble the main column elements:

- Portable X-Ray generator with handles
- Foldable column
- Detector basket
- Touch screen computer

1. Once the X-Ray Unit is dismounted as described in *Section 6.3.1*, disconnect the three (3) round connectors located at the top of the Detector Assembly COMMS – Ethernet – USB.



2. Dismount the PC Touch Screen. Follow the steps below:

   a. Unlock and open both hinges that attach the Touch Screen to the frame.

   b. Grab the Touch Screen with both hands and move the Touch screen upwards to the limit.

   c. Pull it in order to release it from its bracket.

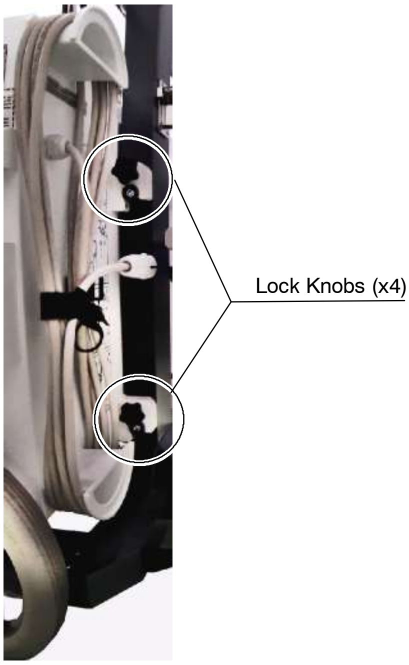
   d. Place the Touch Screen on a safe place. Do not forget that some cables are still attached to the touch screen.

a

b

c

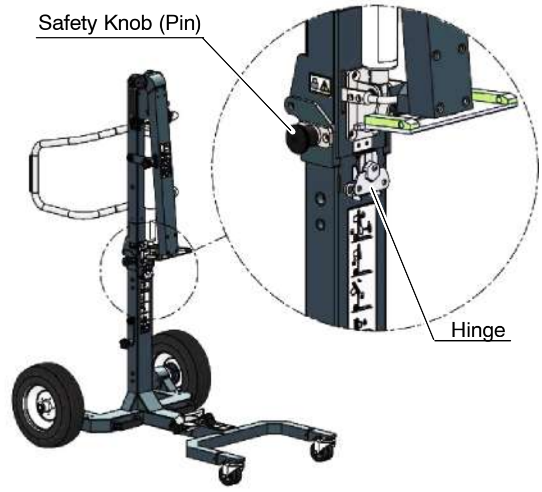
3. Dismount the Detector Basket. Unscrew the four (4) lock knobs located at both sides of the column that attach the Column of the Trolley to the Detector Basket.



4. Grab the Detector Basket with both hands from the Front Handles, lift it, and carefully carry it to a safe place.

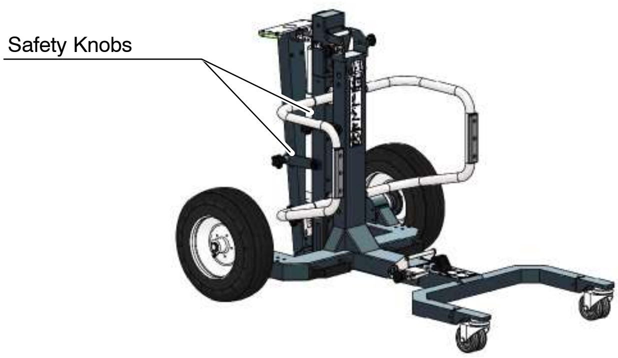
5. Fold the Column as describe below.

   a. Open the hinge and extract the safety knob pins located at both sides of the Column.



   b. Carefully fold the Column backwards.

   c. Lock the folded column with the two (2) Safety Knobs.



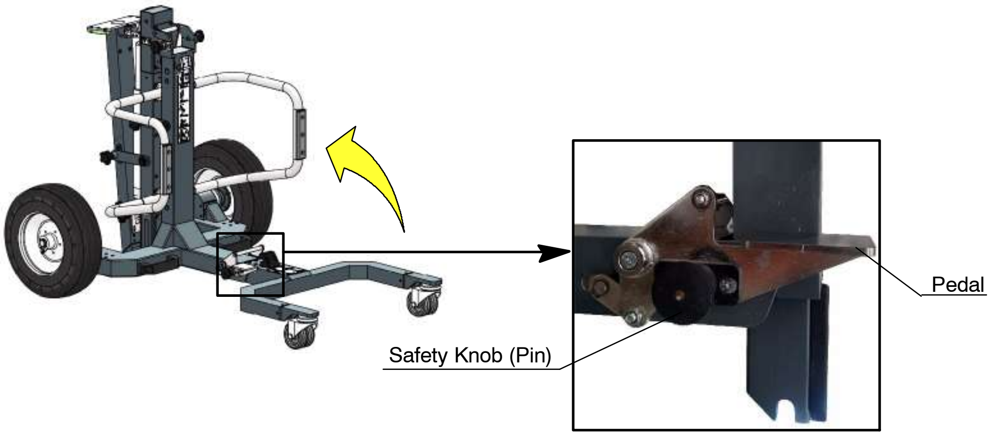
6. Fold the Leg as described below.

   a. Extract the Safety Knob (Pin).

   b. Holding the Unit from the Handle, step on the pedal. Hard the Leg falls down.

   c. Fold the Leg until it is locked in vertical position.

   d. Insert the Safety Knob (Pin).



7. Once the Unit is dismounted and folded, it is ready to be transported in the Double Transport Box.

6.3.3 COLLIMATOR

Note ☞ *For replacement of the internal parts of the Collimator included in the Spare Parts List of this Manual, refer to the Collimator Manual.*

1. Turn the Unit Off and Disconnect it from mains.

2. To replace the Collimator is not necessary to remove the X-Ray Power Unit from the Trolley, it can be replaced in situ.
   If the X-ray Power Unit is removed from the Arm, follow section 6.3.1 and place it on a table close to the Trolley.

3. If applicable, remove the DAP Rails and SID Guard attached to the Collimator. (*Refer to Section 6.3.4*).

4. Disconnect the Collimator cable from Lower Cover of the X-ray Power Unit.

5. Fully Unscrew the four (4) Collimator Adjusting Screws and carefully remove the Collimator.

CAUTION

Collimator replacement will affect centering of Collimator light. Screwing may modify position of Collimator and it must be manually centered while tightening the Safety Screws. It is recommended 5 turns to each screw, check parallelism between the Collimator and Unit Chassis (correct position if necessary) and finally tighten the Safety Screws.

6. Replace the Collimator and re-install the parts step by step.

CAUTION

Once the Collimator is replaced, the Unit fully assembled and ready for operation, perform the Adjustments described in Section 4.

WARNING

VERIFY THAT THE COLLIMATOR IS PROPERLY SEATED AND NO RISK FOR ACCIDENTAL FALL IS POSSIBLE BY TURNING THE COLLIMATOR AROUND AND PULLING DOWNWARDS FROM IT.

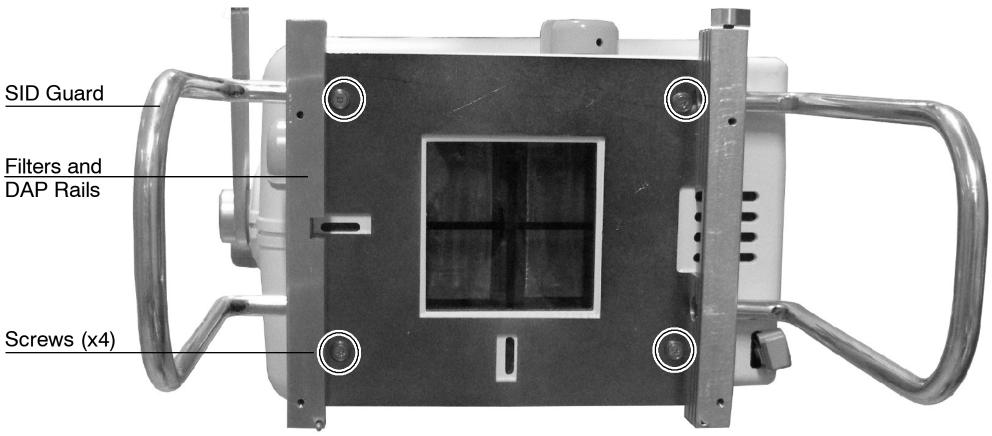
6.3.4 SID GUARD / ALUMINIUM FILTERS AND DAP RAILS

1. Turn the Unit Off and Disconnect it from mains.

2. Disconnect the DAP cable (if applicable) from the Lower Cover of the X-ray Power Unit.

3. Remove the aluminium filters (if applicable).

4. Remove the screws (x4) to disassemble the SID Guard / Filters and DAP Rails from the X-Ray Unit.



6.3.5 ACCESS INSIDE THE X-RAY POWER UNIT

Note ☞ *This section only describes the previous steps to carry out the components replacement inside the X-ray Power Unit without removing it from the Trolley. For covers replacement refer to Sections 6.3.6 and 6.3.7.*

1. Turn the Unit Off and Disconnect it from mains.

2. Unlock the Arm and raise it so the X-ray Power Unit can be close to the surface of a table, to facilitate the Covers disassembly. Lock the Arm in this position.

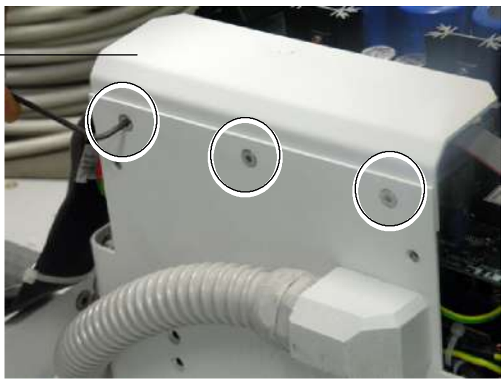
3. Remove the Upper Cover screws and carefully lift the Upper Cover. It is not necessary to unplug any cable.

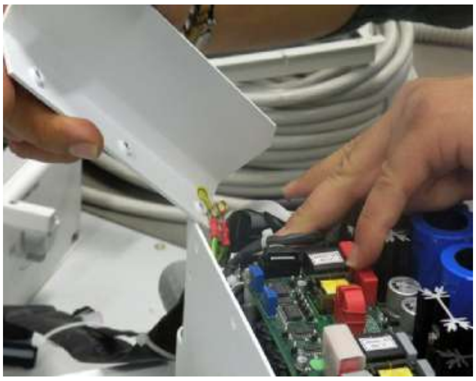
4. Disconnect the Collimator cable from the Lower Cover of the Unit and the DAP cable if connected.

5. Remove the four legs located at the Lower Cover.

6. Carefully remove the Lower Cover. Pass the Power / Communication Harness through the Lower Cover window.

7. Unscrew the Protecting Plate. It is not necessary to disconnect the ground connection.



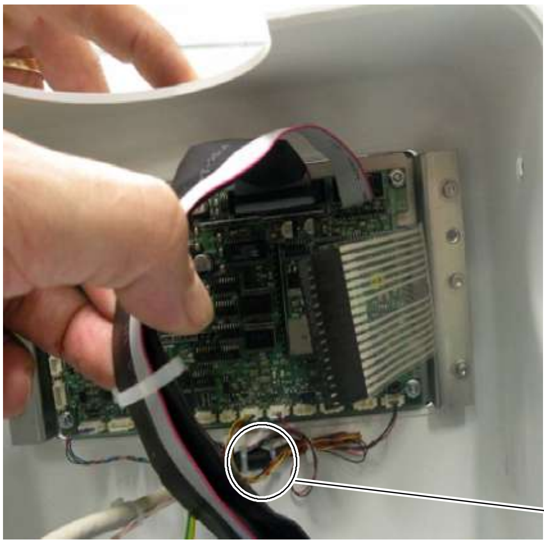


6.3.6 UPPER COVER

Note ☞ *To replace the Upper Cover is not necessary to remove the X-Ray Power Unit from the Trolley, it can be replaced in situ.*

1. Turn the Unit Off and Disconnect it from mains.
2. Remove the Upper Cover screws and carefully lift the Upper Cover.

3. Cut the tie wrap of the inner part of the Cover. It is not necessary to disconnect any cable from the Portable Control Board (*A3175-05*) for Upper Cover replacement.



Tie Wrap

4. Unscrew the Hex screws at both sides of the Portable Control Board support and remove it from the Cover.

5. Re-install the plate support to the new Cover with the Hex screws.

6. Secure the cables connected to Portable Control Board (*A3175-05*) using a tie wrap with base in the inner part of the Upper Cover.

7. Replace the cover and assemble in reverse order.

6.3.7 LOWER COVER

Note ☞ *To replace the Lower Cover is not necessary to remove the X-Ray Power Unit from the Trolley, it can be replaced in situ.*

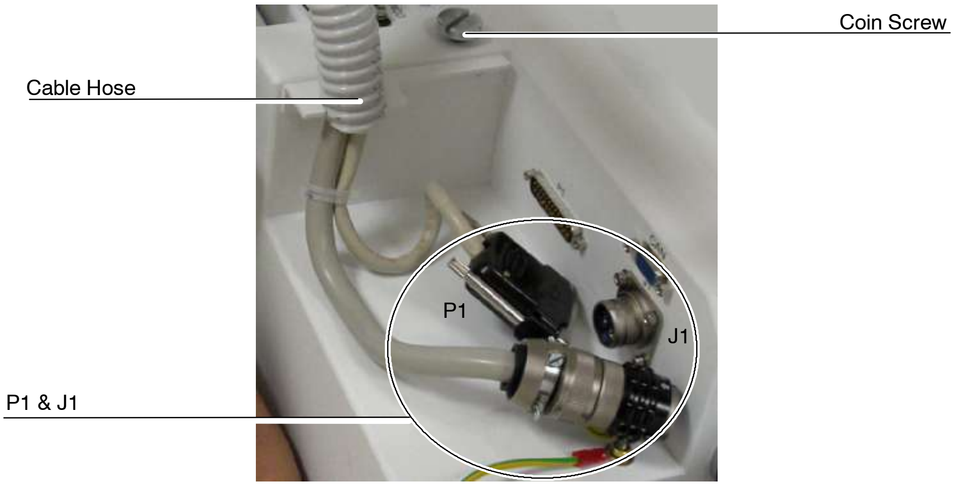
1. Turn the Unit Off and Disconnect it from mains.

2. Unlock the Arm and raise it so the X-ray Power Unit can be close to the surface of a table, to facilitate the Covers disassembly. Lock the Arm in this position.

Note ☞ *It is not necessary to remove the Handle for covers replacement.*

3. Remove the Upper Cover screws and carefully lift the Upper Cover. It is not necessary to unplug any cable.

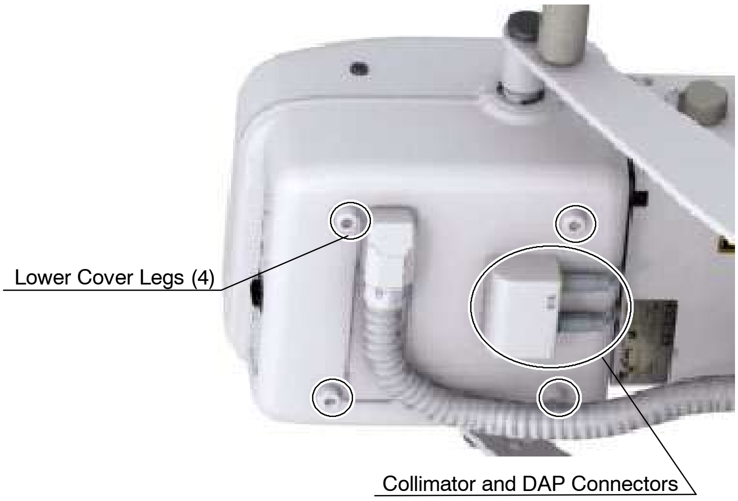
4. Open the Hinge Lock located at the top of the Detector Assembly in order to access to the X-Ray Unit connector plate and disconnect P1 and J1.



5. Release the Power / Communication Harness from the Cable Clamps attached to the Arm.

6. Disconnect the Collimator cable from the Lower Cover of the Unit and the DAP cable if connected.

7. Remove the four legs located at the Lower Cover.



8. Carefully remove the Lower Cover. Pass the Power / Communication Harness through the Lower Cover window.

9. Replace the cover and assemble in reverse order.

6.3.8 PORTABLE CONTROL BOARD

Note ☞ *To replace the Portable Control Board is not necessary to remove the X-Ray Power Unit from the Trolley, it can be replaced in situ.*

1. Turn the Unit Off and Disconnect it from mains.
2. Unlock the Arm and raise it so the X-ray Power Unit can be close to the surface of a table, to facilitate the Covers disassembly. Lock the Arm in this position.
3. Remove the Upper Cover screws and carefully lift the Upper Cover. It is not necessary to unplug any cable.

4. Unplug all the cables connected to the Portable Control Board (*A3175-05*).

5. Unscrew the nuts located at each corner of the Portable Control Board and remove it.

6. Remove the License by pushing and pulling it, and install it in the new Portable Control Board.

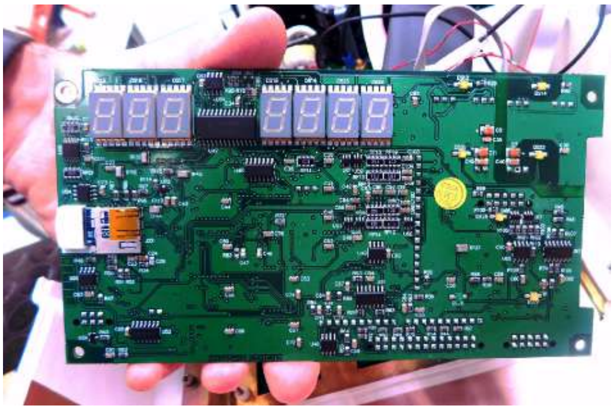
7. Install the new Portable Control Board.

8. Reconnect all the cables and assemble in reverse order.

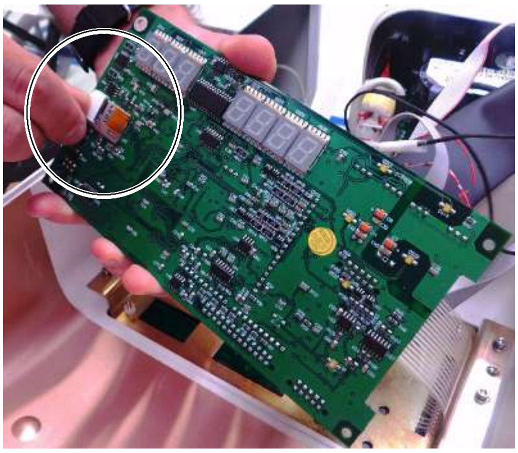
9. Initialize the new EEPROM (*refer to Section 6.1.1*).

6.3.9 PORTABLE CONTROL BOARD LICENSE

1. Turn the Unit Off and Disconnect it from mains.
2. Place the Unit on a table.
3. Remove the Upper Cover screws and carefully lift the Upper Cover.
4. Unplug the Overlay Flat Flex Cable connected to the Portable Control Board (*A3175-05*).
5. Unscrew the nuts located at each corner of the Portable Control Board and turn it.



6. Remove the License by pushing and pulling it.



7. Install the new License.
8. Reconnect the Overlay Flat Flex Cable to J3 and assemble in reverse order.
9. Initialize the new EEPROM (*refer to Section 6.1.1*).

6.3.10 REAL TIME CLOCK BATTERY

Note ☞ *To replace the Real Time Clock Battery is not necessary to remove the X-Ray Power Unit from the Trolley, it can be replaced in situ.*

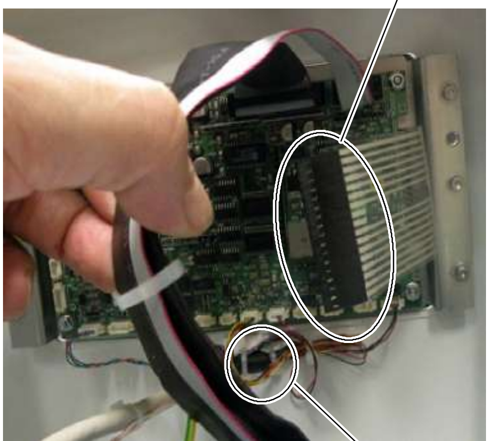
1. Access to the Portable Control Board (*A3175-05*) as described in *Section 6.3.8 (steps 1. to 3.)*.
2. Take the battery BAT1 out of the Portable Control Board (A3175-05) and replace it with model "CR1225".

3. Assemble in reverse order.

6.3.11 KEYBOARD

Note ☞ *To replace the Keyboard is not necessary to remove the X-Ray Power Unit from the Trolley, it can be replaced in situ.*

1. Access to the Portable Control Board (*A3175-05*) as described in *Section 6.3.8 (steps 1 to 3)*.
2. Disconnect the Keyboard cable (J13) from the Portable Control Board.
3. Cut the tie wrap of the inner part of the Cover. It is not necessary to disconnect the rest of cables from the Portable Control Board for Keyboard replacement.
4. Unscrew the Hex screws at both sides of the Portable Control Board support and remove it.



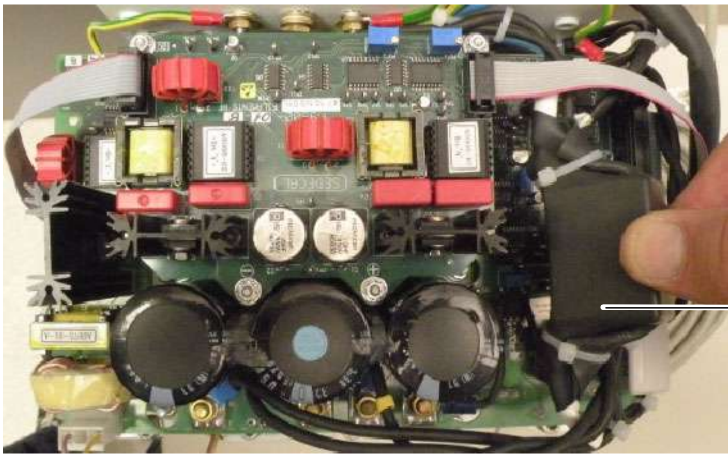
5. Unstick the old Keyboard from the plate support.
6. Clean the remaining glue with alcohol from the support plate and stick the new Keyboard.
7. Reconnect and assemble in reverse order.

6.3.12 SNUBBER

1. Access inside the Unit by removing Upper and Lower Covers and unscrewing the Protecting Plate (*refer to Section 6.3.5*).

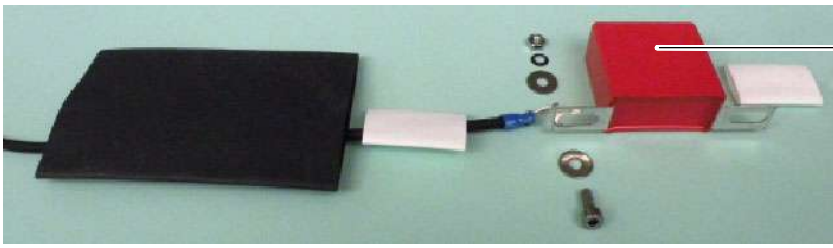
2. Cut the Tie Wraps at both sides of the Snubber and others if needed.

3. Cut the Heat Shrinks (large and small ones) and remove the screws, nuts and washers from the Snubber.



4. Pass the cable through the new large Heat Shrink and then through one of the new small Heat Shrinks.

5. Tighten the screws, nuts and washers previously removed at both sides of the new Snubber, cover both terminals with the small Heat Shrinks and apply heat to reduce the Heat Shrinks.



6. Cover the Snubber and its terminals with the large Heat Shrink, apply heat to reduce the Heat Shrink and fasten it with two Tie Wraps at the ends. Replace the other Tie Wraps previously removed.

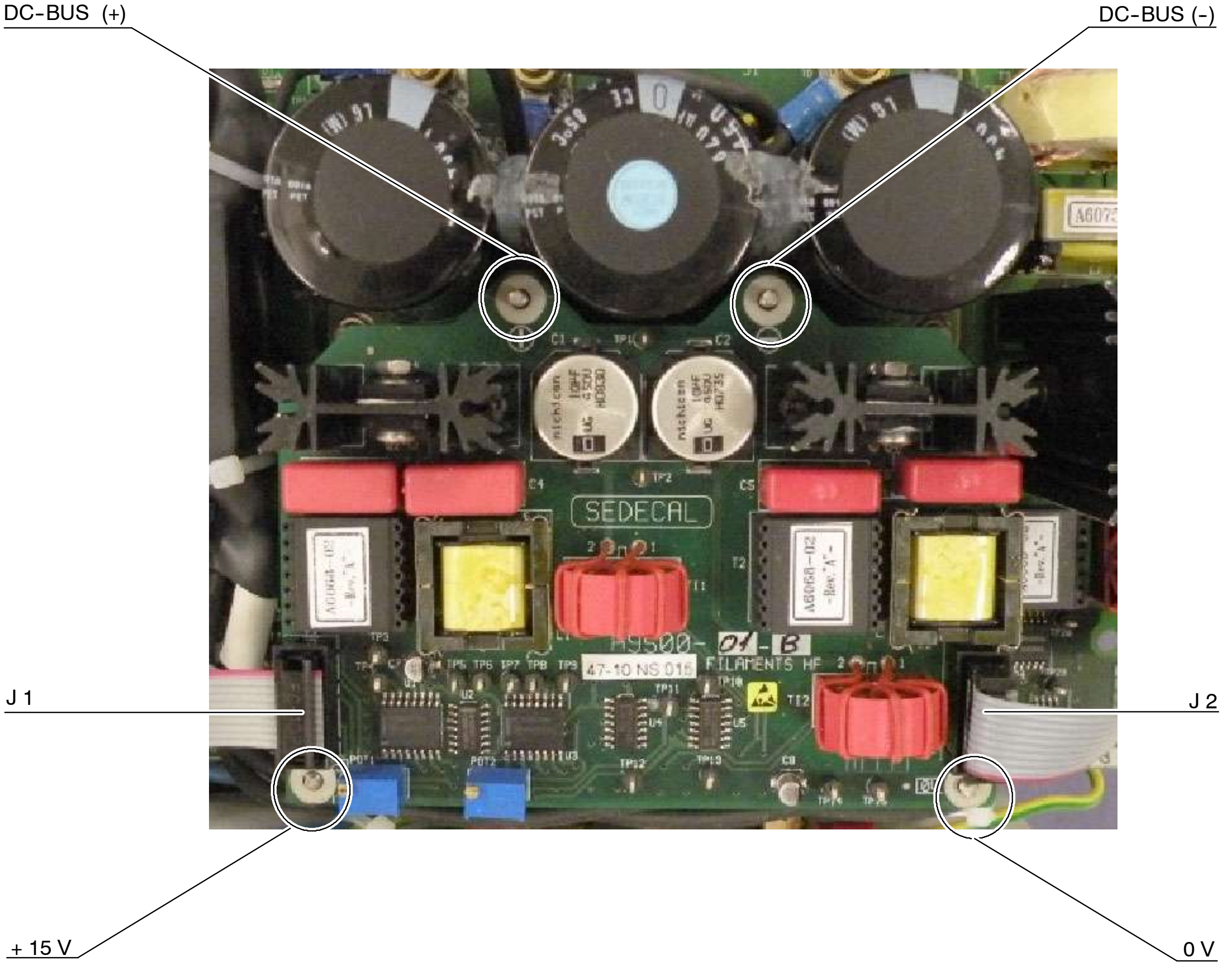
7. Reconnect and assemble in reverse order.

6.3.13 FILAMENTS HF BOARD

1. Access inside the Unit by removing Upper and Lower Covers and unscrewing the Protecting Plate (*refer to Section 6.3.5*).

2. Remove the two Ribbon cables connected to J1 and J2 of the Filaments HF Board (*A9500-01*).

3. Carefully unscrew the four (4) nuts and washers that assemble the Filaments HF Board (*A9500-01*) to the Control Driver Board (*A3189-07*). These screws are the contacts for 0 V, +15 V, DC-BUS (+) and DC-BUS (-). Carefully remove the board.



4. Replace the Filaments HF Board (*A9500-01*), reconnect and assemble in reverse order.

5. After replacing the Filaments HF Board (*A9500-01*), follow the next steps in order to verify the large and small focus adjustment.

LARGE FOCUS:

a. On Filaments HF Board (*A9500-01*), connect the oscilloscope:

- CH1: TP11 (V)
- CH2: TP9 or TP8 (frequency)
- GND = TP14 / TP15

b. Select LF, enter in manual calibration, select 40 kVp / 100 mA and enter the data "930".

c. Press PREP and adjust the POT 2 to see the maximum possible voltage on TP11 (4.5 Volts approx. in PREP; 2.4 Volts in Standby). Once the maximum voltage on TP11 has been reached and the voltage stops increasing, apply two more turns to the potentiometer in the same direction.

d. Verify that the frequency on TP9 is 106.4 < f < 159.6 kHz.

SMALL FOCUS:

e. On Filaments HF Board (*A9500-01*), Connect the oscilloscope:

- CH1: TP12 (V)
- CH2: TP3 or TP4 (frequency)
- GND = TP14 / TP15

f. Select SF, enter in manual calibration, select 40 kVp / 20 mA and enter the data "700".

g. Press PREP and adjust the POT 1 to see the maximum possible voltage on TP12 (3.4 Volts approx. in PREP; 2.4 Volts in Standby). Once the maximum voltage on TP12 has been reached and the voltage stops increasing, apply two more turns to the potentiometer in the same direction.

h. Verify that the frequency on TP3 is 106.4 < f < 159.6 kHz.

6. Perform Autocalibration (*Refer to Section 3.2.4*).

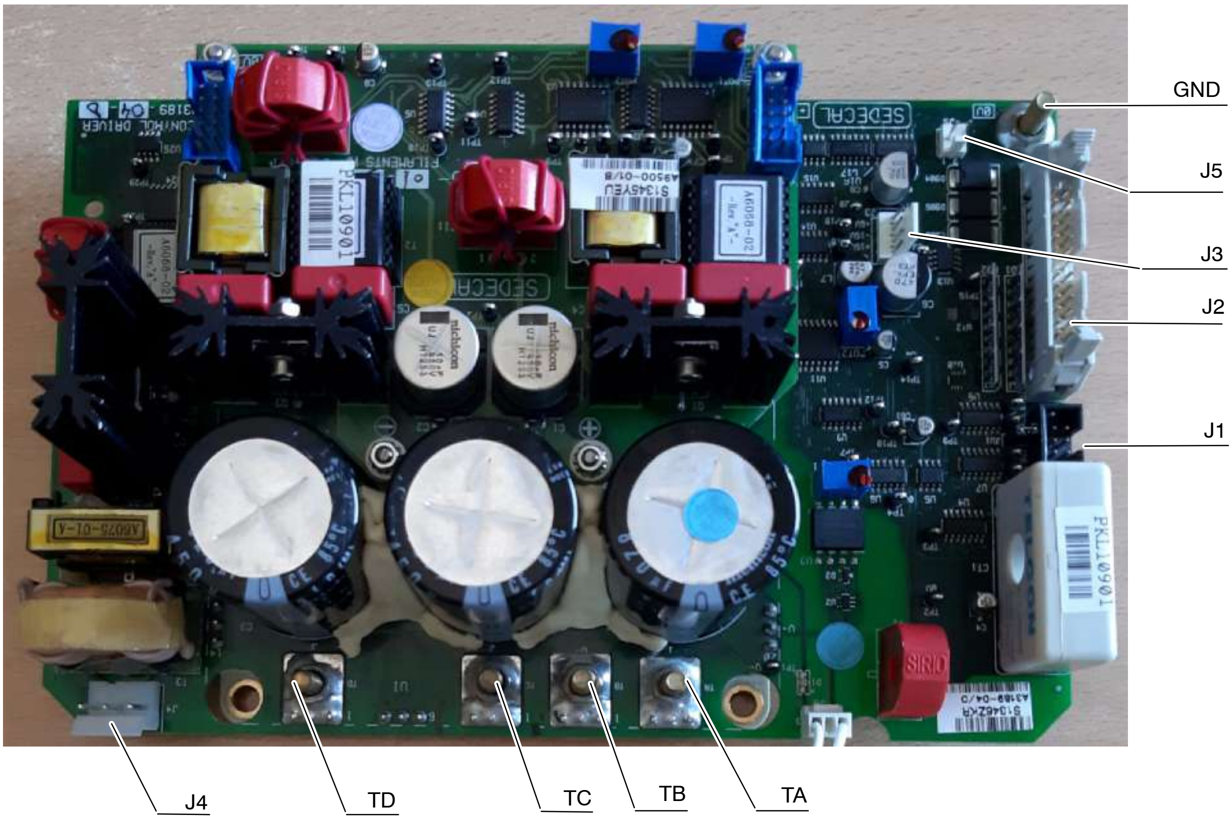
6.3.14 CONTROL DRIVER BOARD

1. Access inside the Unit by removing Upper and Lower Covers and unscrewing the Protecting Plate (*refer to Section 6.3.5*).

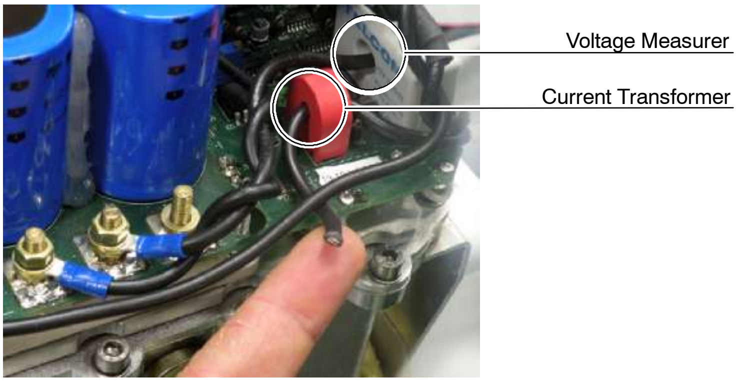
2. Disconnect from the Control Driver Board (*A3189-07*) the cables connected to J1, J2, J3, J4, J5, GND. Then remove the four (4) nuts attaching the cables connected to TA, TB, TC, TD bolts and take out the cables from the bolts.

CAUTION

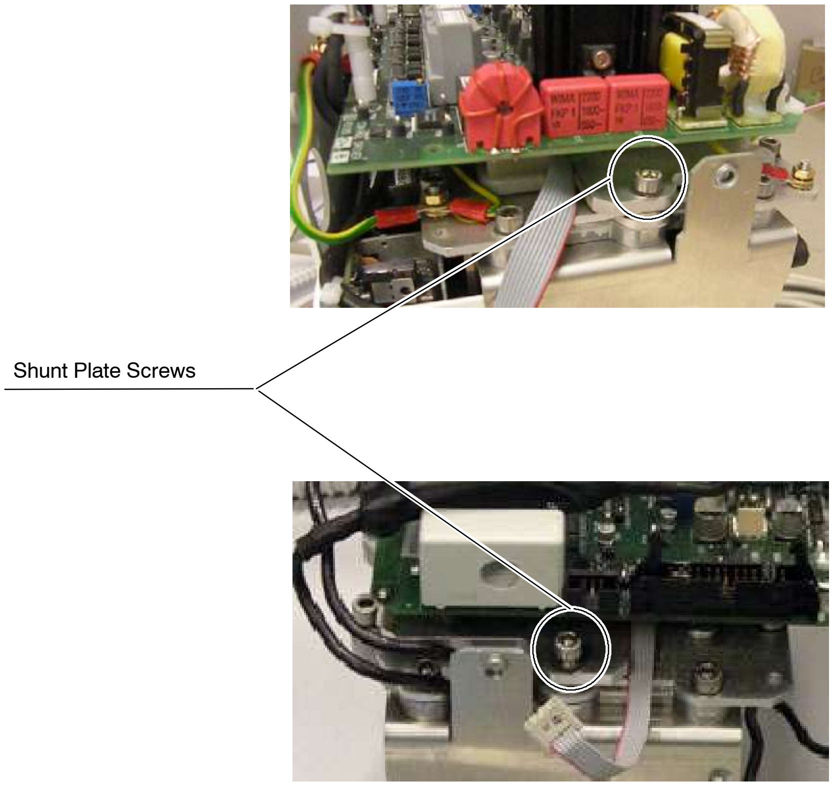
Take note of the correspondence of each cable connected to each bolt (TA, TB, TC, TD). It is recommended to mark each cable to avoid any mistakes when replacing the Board.



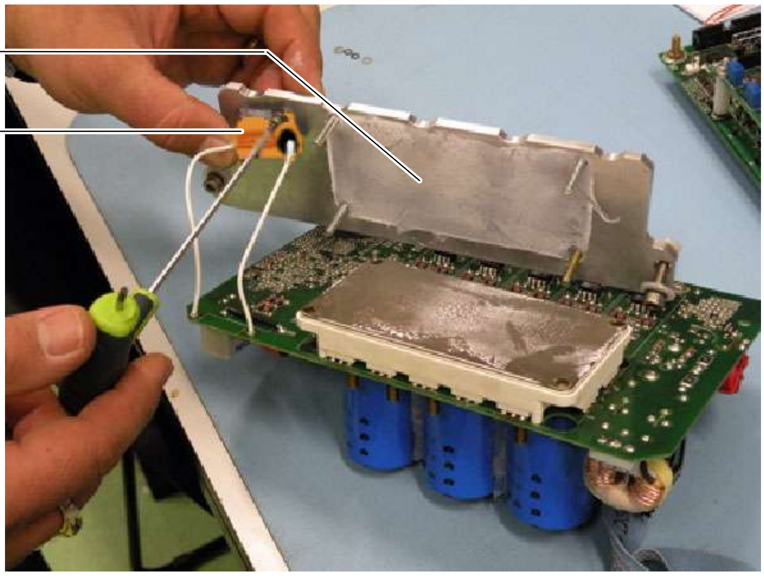
3. Cut the Tie Wraps when needed. Cut the round connector of the TA cable and take it out through the red (round) Current Transformer and take out TB cable (it is not necessary to cut this one) through the grey (square) Voltage Measurer.



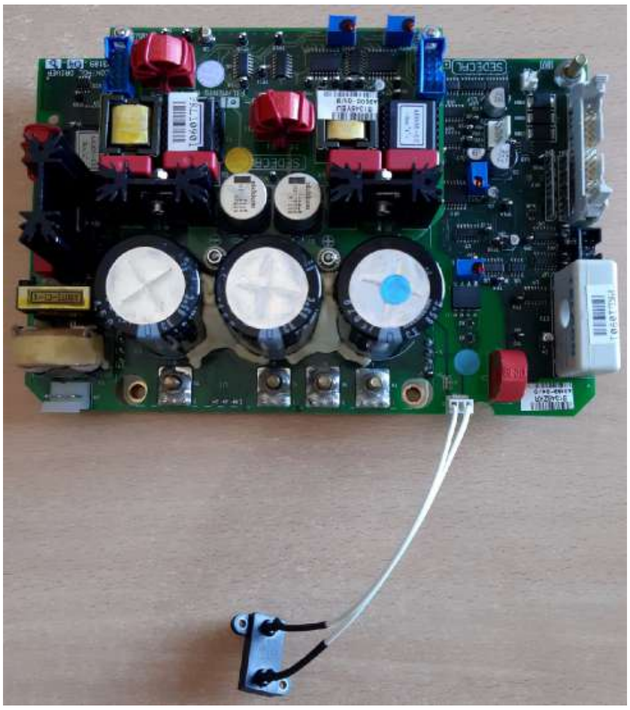
4. The Control Driver Board assembly comprises this Board, the Filaments HF Board, the IGBT, an external Resistor and an aluminium Shunt Plate that is fixed to the HV Transformer with two screws. Unscrew the two (2) allen screws located under both sides of the Control Driver Board and take out the assembly.



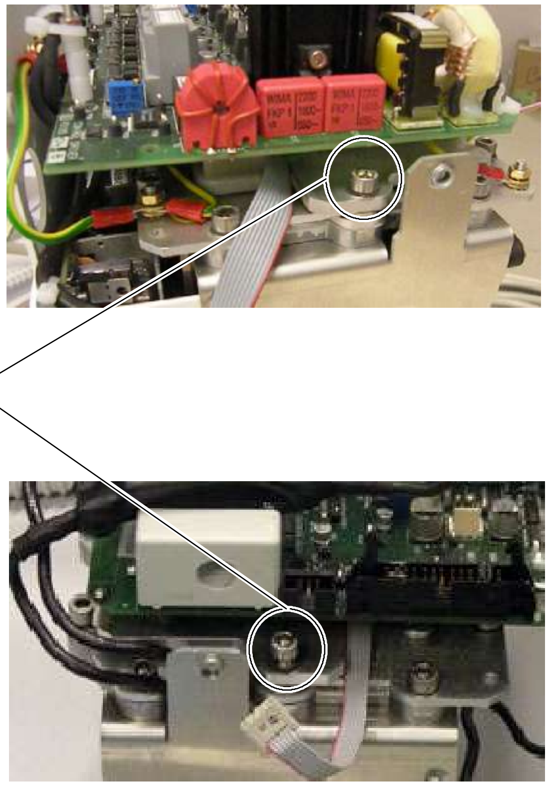
5. Disassemble the Shunt Plate and the Resistor.



6. Remove old silicone on the Shunt Plate and apply a new layer on its surface. Assemble the new Control Driver Board (*A3189-07*) to the Shunt Plate by screwing the Resistor and the IGBT screws.



7. Secure the Control Driver Board assembly to the HV Transformer with the two screws removed before.



8. Pass the TA cable through the red (round) Current Transformer, crimp the round connector included in the kit. Pass the TB cable through the grey (square) Voltage Measurer. Attach cables with Tie Wraps when needed.

9. Reconnect and assemble in reverse order.

10. After replacing the Control Driver Board (*A3189-07*), follow the next steps in order to verify the large and small focus adjustment.

LARGE FOCUS:

a. On Filaments HF Board (*A9500-01*), connect the oscilloscope:
   - CH1: TP11 (V)
   - CH2: TP9 or TP8 (frequency)
   - GND = TP14 / TP15

b. Select LF, enter in manual calibration, select 40 kVp / 100 mA and enter the data “930”.

c. Press PREP and adjust the POT 2 to see the maximum possible voltage on TP11 (4.5 Volts approx. in PREP; 2.4 Volts in Standby). Once the maximum voltage on TP11 has been reached and the voltage stops increasing, apply two more turns to the potentiometer in the same direction.

d. Verify that the frequency on TP9 is 106.4 < f < 159.6 kHz.

SMALL FOCUS:

e. On Filaments HF Board (*A9500-01*), Connect the oscilloscope:
   - CH1: TP12 (V)
   - CH2: TP3 or TP4 (frequency)
   - GND = TP14 / TP15

f. Select SF, enter in manual calibration, select 40 kVp / 20 mA and enter the data “700”.

g. Press PREP and adjust the POT 1 to see the maximum possible voltage on TP12 (3.4 Volts approx. in PREP; 2.4 Volts in Standby). Once the maximum voltage on TP12 has been reached and the voltage stops increasing, apply two more turns to the potentiometer in the same direction.

h. Verify that the frequency on TP3 is 106.4 < f < 159.6 kHz.

11. Perform Autocalibration (*Refer to Section 3.2.4*).

6.3.15 HV TRANSFORMER

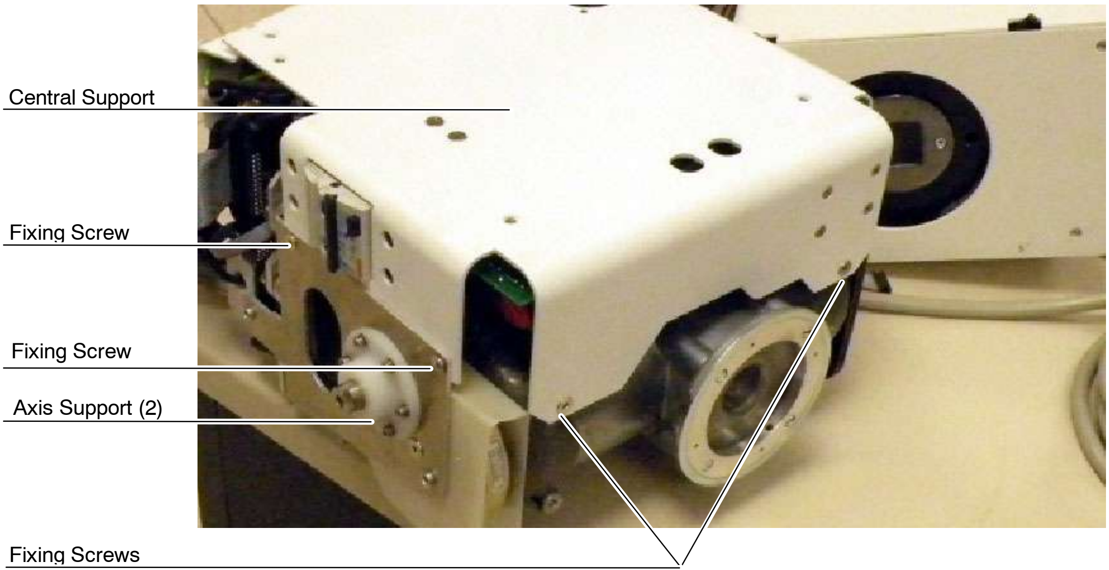
1. Disassemble the X-ray Power Unit from the Arm (*refer to Section 6.3.1*).

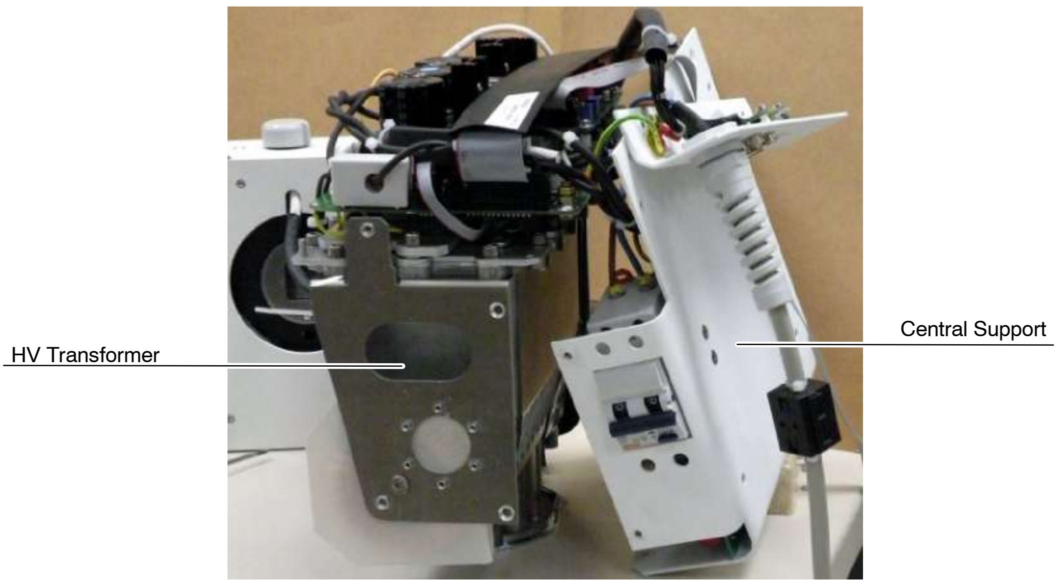
2. Remove the Collimator (*refer to Section 6.3.3*).

3. Access inside the Unit by removing Upper and Lower Covers and unscrewing the Protecting Plate (*refer to Section 6.3.5, steps 3. to 7.*).

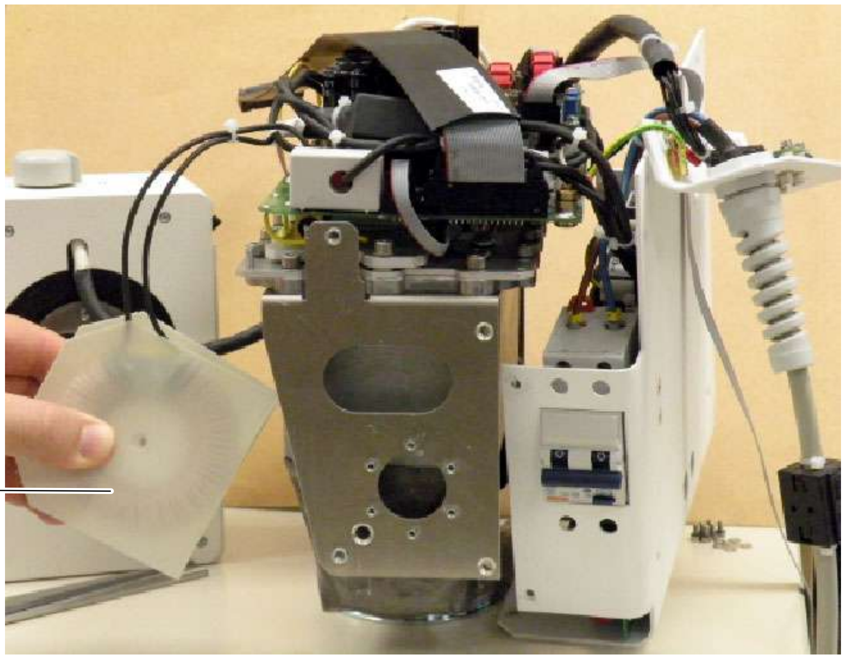
4. Remove the Shaft Assemblies as described in Section *6.3.18*.

5. Put aside the Central Support by removing the four (4) fixing screws located at both sides and the two (2) fixing screws located at the front side of the Central Support. Remove the two Handle Axis Supports.

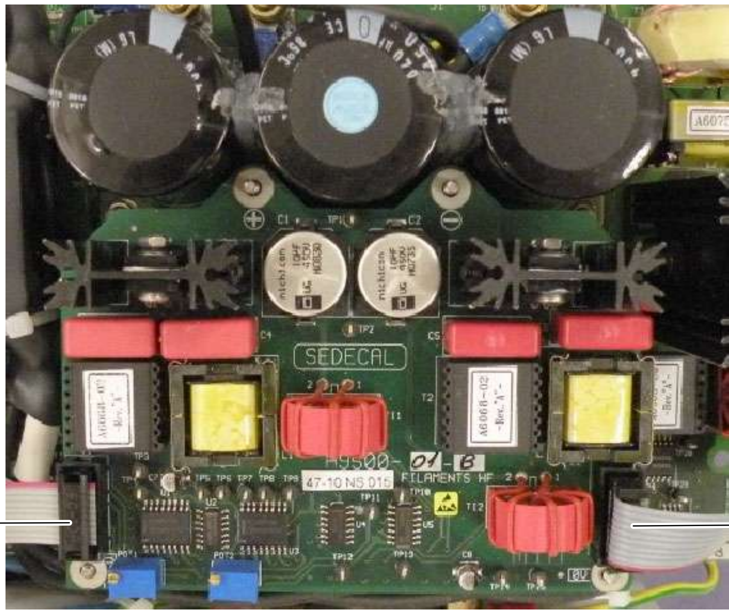




6. Put aside the Resonant Inductance cutting the Tie Wrap and removing the screw that fixes it to the HV Transformer Support.

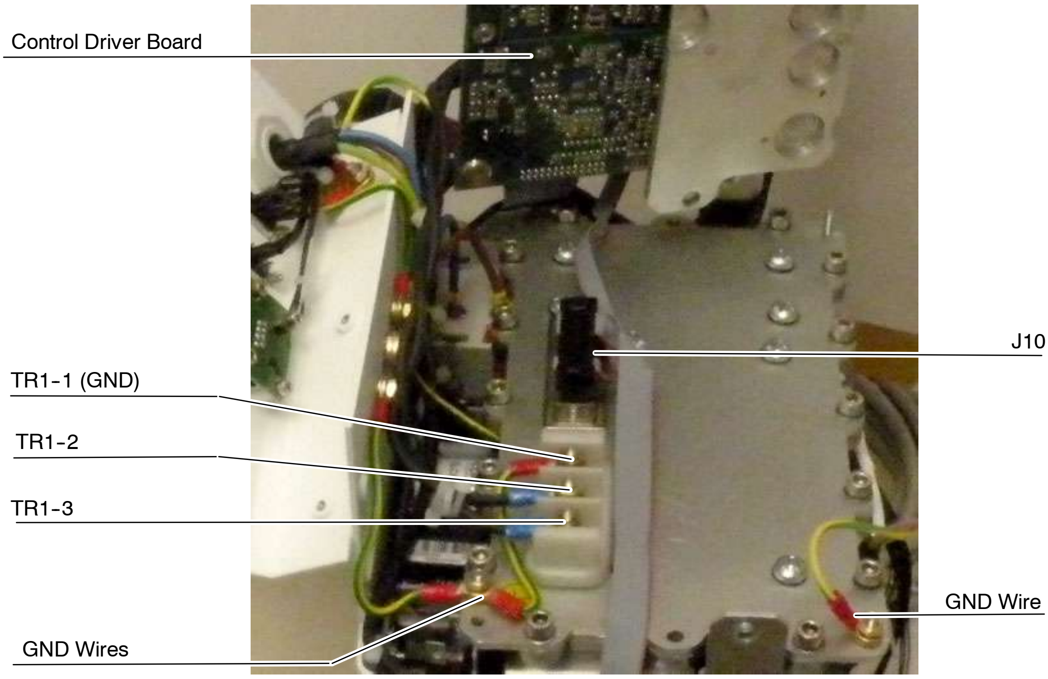


7. Remove the two Ribbon cables connected to J1 and J2 of the Filaments HF Board (*A9500-01*).



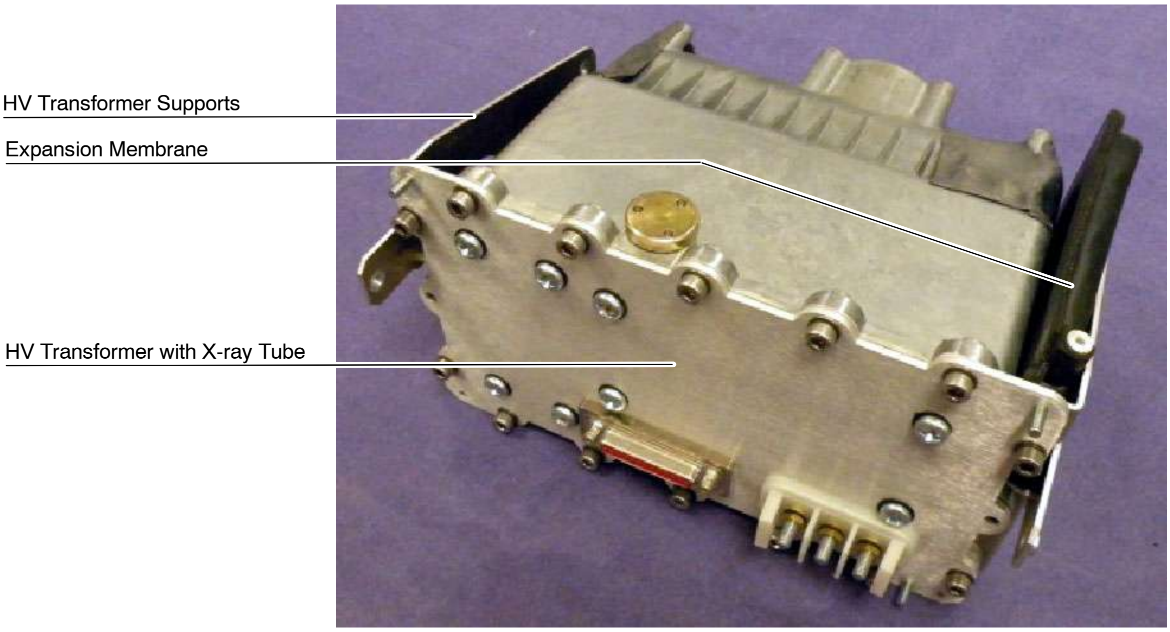
8. Remove the Control Driver Board as described in *Section 6.3.14 (steps 3. to 9.)* without disassembling the Filaments HF Board (*A9500-01*).

9. From the HV Transformer, disconnect the J10 Ribbon cable, the wires connected to TR1-2, TR1-3, TR1-1 (GND) and the three GND wires fixed to the HV Transformer screws.



10. Remove the Collimator Adaptation Ring.

11. Replace the HV Transformer. The HV Transformer assembly comprises the HV Transformer with the X-ray Tube, the Expansion Membrane and the two HV Transformer Supports.



12. Re-install the Collimator Adaptation Ring in the new HV Transformer.

13. Connect the J10 Ribbon cable, the wires connected to TR1-2, TR1-3, TR1-1 (GND) and the three GND wires fixed to the HV Transformer screws.

14. Re-install the Control the Control Driver Board (*A3189-07*) and connect the two Ribbon cables to J1 and J2 of the Filaments HF Board (*A9500-01*).

15. Mount the Resonant Inductance in HV Transformer fixing its wires with a Tie Wrap.

16. At this point, follow the steps below in order to verify the large and small focus adjustment.

LARGE FOCUS:

a. On Filaments HF Board (*A9500-01*), connect the oscilloscope:
   - CH1: TP11 (V)
   - CH2: TP9 or TP8 (frequency)
   - GND = TP14 / TP15

b. Select LF, enter in manual calibration, select 40 kVp / 100 mA and enter the data “930”.

c. Press PREP and adjust the POT 2 to see the maximum possible voltage on TP11 (4.5 Volts approx. in PREP; 2.4 Volts in Standby). Once the maximum voltage on TP11 has been reached and the voltage stops increasing, apply two more turns to the potentiometer in the same direction.

d. Verify that the frequency on TP9 is 106.4 < f < 159.6 kHz.

SMALL FOCUS:

e. On Filaments HF Board (*A9500-01*), Connect the oscilloscope:
   - CH1: TP12 (V)
   - CH2: TP3 or TP4 (frequency)
   - GND = TP14 / TP15

f. Select SF, enter in manual calibration, select 40 kVp / 20 mA and enter the data “700”.

g. Press PREP and adjust the POT 1 to see the maximum possible voltage on TP12 (3.4 Volts approx. in PREP; 2.4 Volts in Standby). Once the maximum voltage on TP12 has been reached and the voltage stops increasing, apply two more turns to the potentiometer in the same direction. Press and adjust the POT 1 to see the maximum possible voltage on TP12.

h. Verify that the frequency on TP3 is 106.4 < f < 159.6 kHz.

17. Once verified the Filament Adjustment, proceed with the HV Seasoning as follows:

    a. Close Collimator Blades fully and make sure that no one will be exposed.

    b. Make sure that X-ray Tube is fully cold (at least 30 minutes without making exposures).

    c. Reduce the power manually to 20% in case of 4 kW or 5 kW units or 10% in case of 8 kW units. On the X-ray Unit Control Panel, press and hold the “Large Focal Spot” push-button and then press the “kVp Decrease” push-button several times until “P10 or P20” respectively is shown in the kVp display.

    d. Select 70 kVp, 10 mAs and Large Focus. Perform one exposure per minute increasing 5 kVp in every exposure up to the maximum Tube voltage.

    e. If there are not signs of instability, the tube is ready for normal use.

    f. If instability is observed during procedure, reduce 5 kVp of the selected kVp and make two exposures at those KVp, then continue the process.

    g. Once the seasoning procedure is completed, set the power at 100% again. On the X-ray Unit Control Panel, press and hold the “Large Focal Spot” push-button and then press the “kVp Increase” push-button several times until “P--” is shown in the kVp display.

Note ☞ *Check that the remaining Thermal Capacity of the X-ray Tube is above 80% during this process.*

18. Perform Autocalibration (*Refer to Section 3.2.4*).

19. Assemble the Central Support and the two Handle Axis Supports.

20. Assemble the Protecting Plate and the Upper and Lower Covers.

21. Re-install the Collimator.

CAUTION

Collimator replacement will affect centering of Collimator light. Screwing may modify position of Collimator and it must be manually centered while tightening the Safety Screws. It is recommended 5 turns to each screw, check parallelism between the Collimator and Unit Chassis, correct position if necessary and finally tighten each Safety Screw with the same number of turns (one by one).

CAUTION

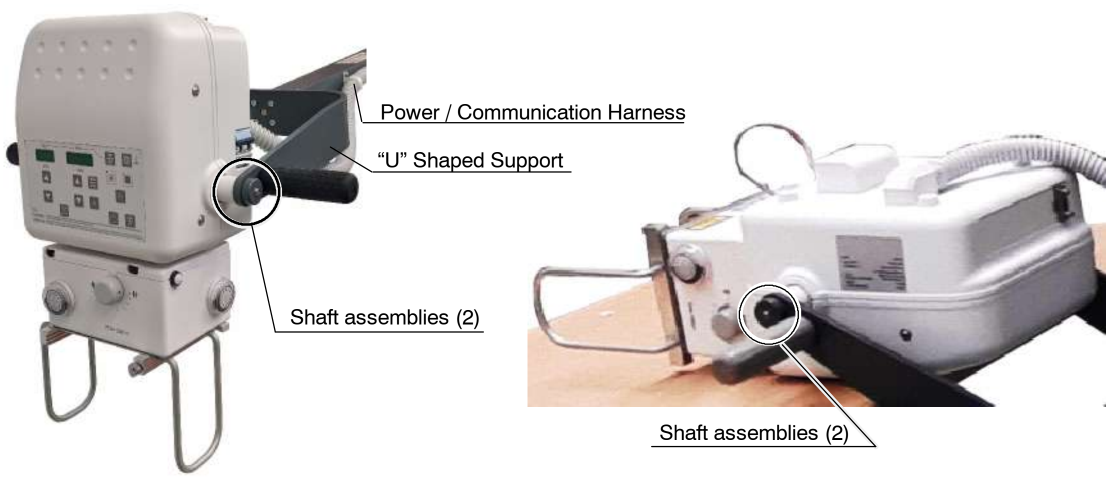
Once the Collimator is replaced, the Unit fully assembled and ready for operation, perform the Adjustments described in Section 4.

22. If applicable, assemble the DAP Rails and SID Guard attached to the Collimator.

23. Re-install the X-ray Power Unit in the "U" shaped support of the Arm (do not scratch the covers). The two (2) shaft assemblies must be installed in the same order that were removed.

DANGER !

KEEP IN MIND TO TIGHTEN THE LOCK NUT ENOUGH FOR THE X-RAY UNIT TO STAY STILL IN A SPECIFIC POSITION, AND ENOUGH FOR THE X-RAY UNIT TO BE EASY TO MOVE. DO NOT FORGET TO LOCK THE NUT WITH THE LOCKING WASHER TOOTH.



6.3.16 PARTS REPLACEMENT IN THE CENTRAL SUPPORT

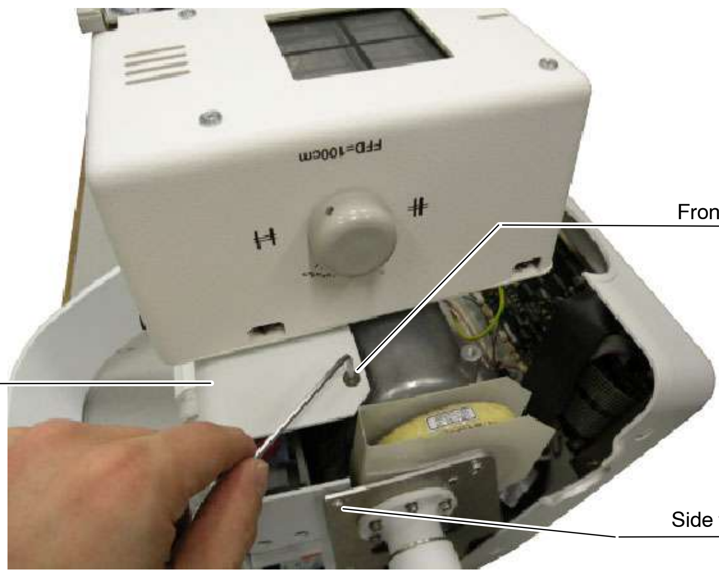
6.3.16.1 ACCESS INSIDE THE CENTRAL SUPPORT

1. Fully extend the Arm, then lay down the Trolley, with the Detector basket resting on the floor, and leave the X-ray Power Unit face up on a table or similar.

2. Access inside the Unit by removing Upper and Lower Covers and unscrewing the Protecting Plate (*refer to Section 6.3.5, steps 3. to 7.*).

3. Unscrew the Central Support by removing the four (4) fixing screws located at both sides and the two (2) fixing screws located at the front side of the Central Support.

Note ☞ *It is not necessary to remove the Collimator to access the front side screws due to the rotatory movement of the Collimator. Accordingly, it is not necessary to perform any Collimator adjustments once the X-ray Power Unit is re-assembled.*



4. Cut the needed Tie Wraps to facilitate the access to the Central Support components.

5. Replace the respective part in the Central Support as described in the next sections.

6. Once the components in the Central Support have been replaced, replace the Tie Wrap previously removed.

7. Screw the Protecting Plate to the Central Support and Assemble it to HV Transformer.

8. Assemble the Upper and Lower Covers.

6.3.16.2 CIRCUIT BREAKER

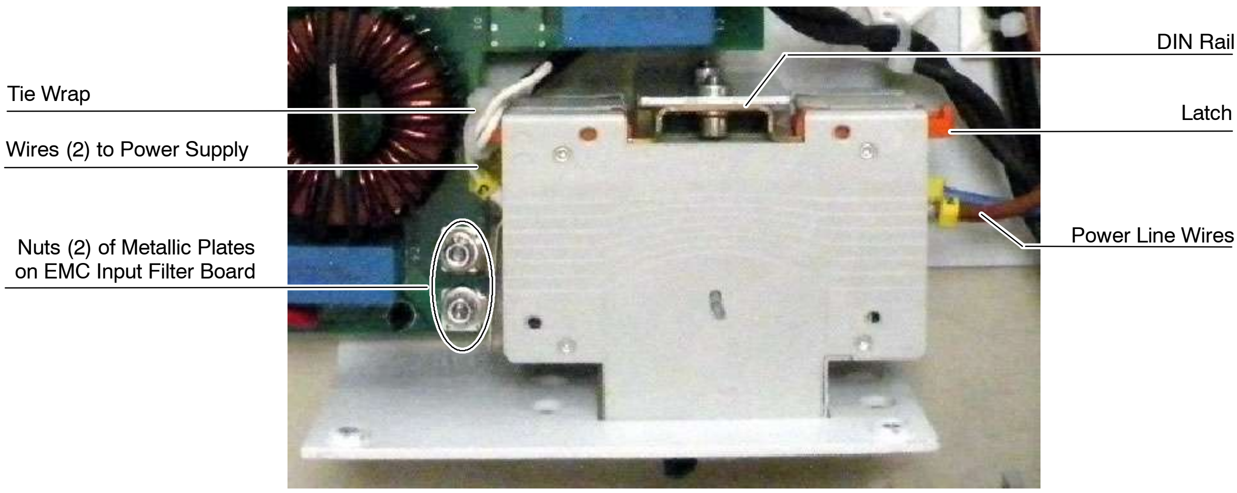
1. Access inside the Central Support as described in *Section 6.3.16.1.*

2. Remove the fixing screws located at the back of the Central Support.

3. Cut the Tie Wrap which secures the two wires connected to the Power Supply. Disconnect the four wires attached keeping in mind the correspondence of each cable.

4. Loosen without removing the two nuts which fixes the two metallic plates in contact with the Circuit Breaker and the EMC Input Filter Board. Disconnect the two metallic plates from the Circuit Breaker, do not remove them from the EMC Input Filter Board.

5. Pull the two Latches and remove the Circuit Breaker from its DIN Rail.



6. Replace the Circuit Breaker, reconnect in reverse order and assemble the X-ray Power Unit as described in *Section 6.3.16.1*.

6.3.16.3 EMC INPUT FILTER BOARD

1. Access inside the Central Support as described in *Section 6.3.16.1.*

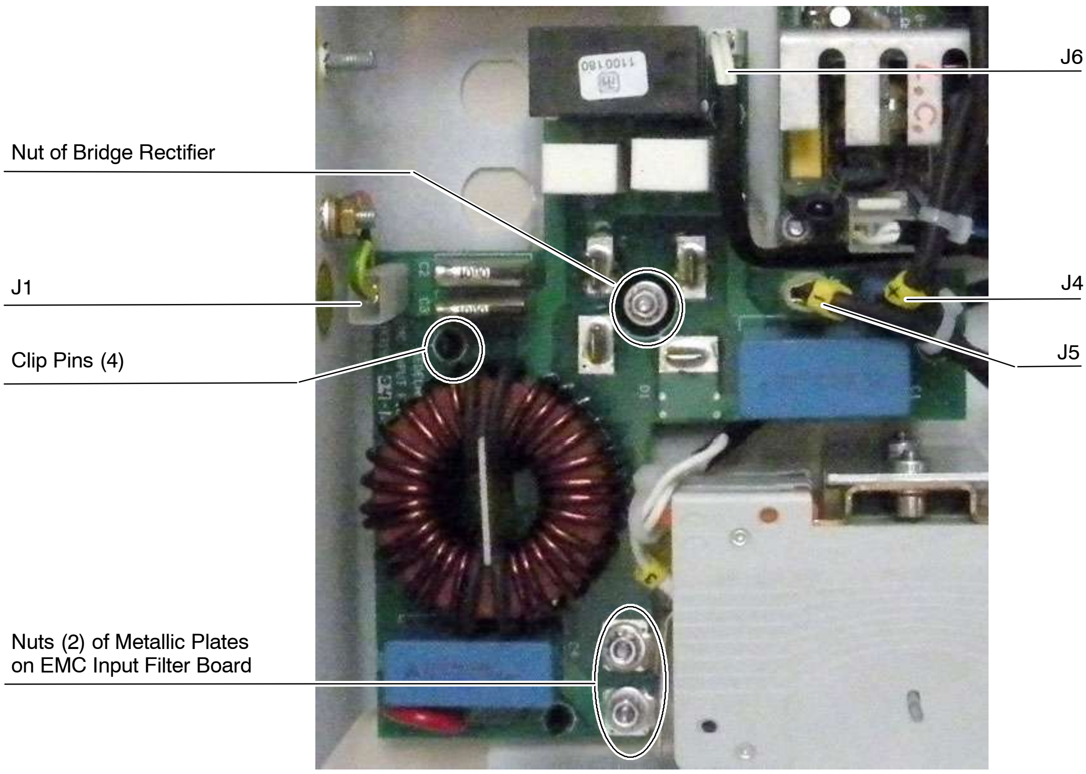
2. Disconnect the cables connected to J1, J4, J5 and J6. Cut the Tie Wraps if needed.

3. Loosen the two screws of the Circuit Breaker that fixes the two (2) wires from the Power Supply by unscrewing them through the external part of the Central Support. Disconnect both wires.

4. Loosen without removing the two nuts which fixes the two metallic plates in contact with the Circuit Breaker and the EMC Input Filter Board. Disconnect the two metallic plates from the Circuit Breaker, do not remove them from the EMC Input Filter Board.

5. Remove the fixing nut of the Bridge Rectifier (located at the center of the Board).

6. Push one by one the four (4) clip pins and remove the Board.



7. Remove the two (2) metallic Plates from the old Board and install them on the new Board.

8. Clean the silicone paste from the Central Support surface where the Bridge Rectifier was in contact.

9. Apply a thin film of conductive silicone paste on the surface of the Bridge Rectifier.

10. Install the new EMC Input Filter Board securing it with the four (4) clip pins and the fixing nut of the Bridge Rectifier (located at the center of the Board).

11. Connect the wires to the Circuit Breaker terminals and the metallic plates. Tighten the two nuts which fixes the two metallic plates in contact with the Circuit Breaker and the EMC Input Filter Board.

12. Plug the cables connected to J1, J4, J5 and J6.

13. Assemble the X-ray Power Unit as described in *Section 6.3.16.1*.

6.3.16.4 INDUCTANCE CHOPPER

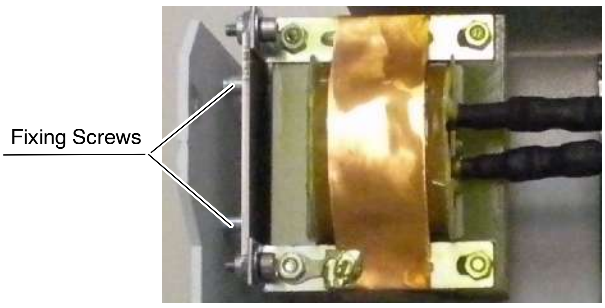
1. Access inside the Central Support as described in *Section 6.3.16.1.*

2. Cut the Tie Wrap if needed.

3. Cut the Heat Shrinks and unsolder the two (2) wires attached keeping in mind the correspondence of each cable.

4. Unscrew the four fixing screws located at the side of the Central Support.

5. Dismount the Inductance Chopper from its support.



6. Assemble the new Inductance Chopper on its support and then in the Central Support.

7. Solder the two (2) wires in the respective terminals covering both cables with the new Heat Shrinks and applying heat to reduce the Heat Shrinks.

8. Assemble the X-ray Power Unit as described in *Section 6.3.16.1*.

6.3.16.5 POWER SUPPLY

1. Access inside the Central Support as described in *Section 6.3.16.1.*
2. Cut the Tie Wrap that secures the cable connected to J2 and disconnect the cables connected to J1, J2 and GND.
3. Remove the four (4) fixing nuts.

4. Replace the Power Supply and assemble in reverse order.
5. Assemble the X-ray Power Unit as described in *Section 6.3.16.1*.

6.3.16.6 POWER / COMMUNICATIONS HARNESS

1. Open the Hinge Lock located at the top of the Detector Assembly in order to access to the X-Ray Unit connector plate and disconnect P1 and J1.

2. Release the Power / Communication Harness from the Cable Clamps attached to the Arm.

3. Access inside the Central Support as described in *Section 6.3.16.1.*

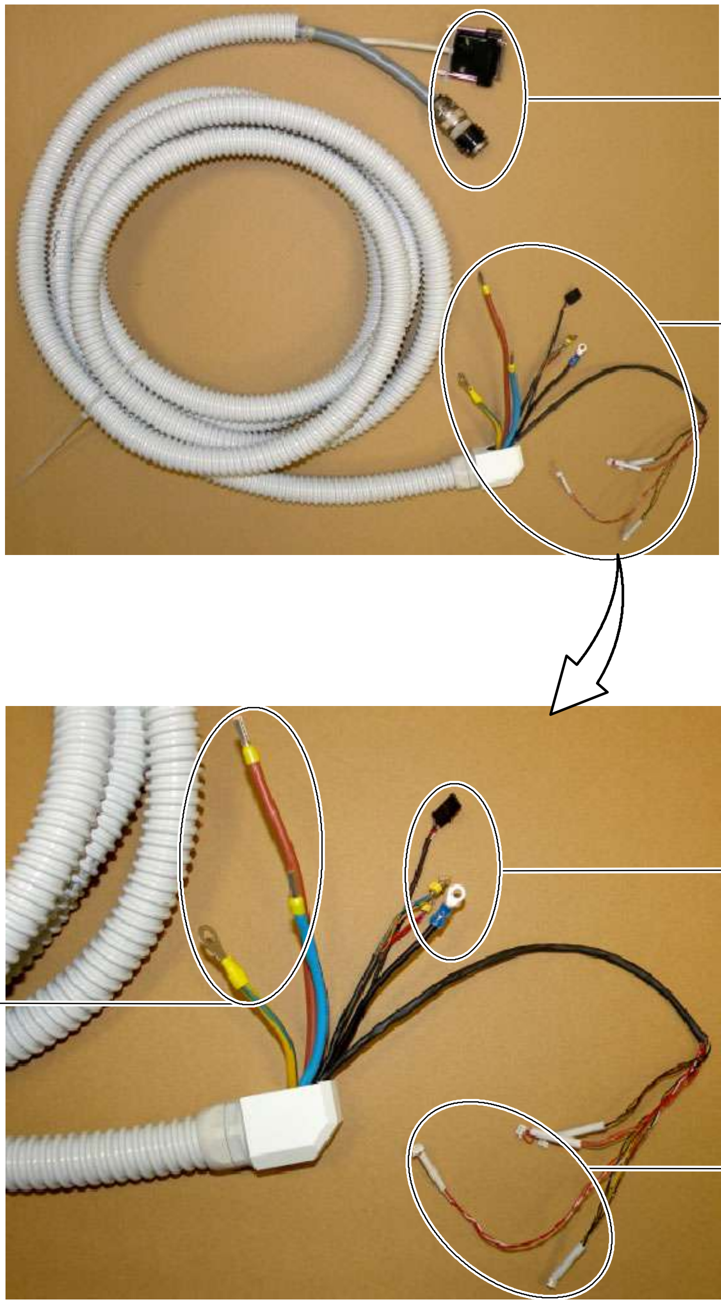
4. Cut the needed Tie Wraps and Heat Shrinks. Disconnect the connectors and wires of the Power / Communication Harness in their respective connectors of the Portable Control Board (J1, J6, J9, J12), Power Supply (J2), Circuit Breaker and GND stud of the Central Support.

5. Remove the four (4) screws of the Power / Communication Harness from the Central Support.

6. Remove the Power / Communication Harness from the Central Support.

7. Install the new Power / Communication Harness by screwing the four (4) screws at the Central Support.

8. Install all the connectors and wires of the Power / Communication Harness in the respective connectors of the Portable Control Board (J1, J6, J9, J12), Power Supply (J2), Circuit Breaker and GND stud of the Central Support. Install the required Tie Wraps.



9. Assemble the X-ray Power Unit as described in *Section 6.3.16.1*.

10. Attach the Power / Communication Harness to the Arm with the Cable Clamps.

11. Connect the two cables of the Power / Communication Harness in the Connector Module of the Trolley and install its cover.

6.3.17 "U" SHAPED SUPPORT

1. Fully extend the Arm, then lay down the Trolley with the Detector basket resting on the floor, and leave the X-ray Power Unit face up on a table or similar (this will avoid the arm to push up when removing the X-ray Power Unit).

2. Disengage the Power / Communication Harness from the Arm (Cable Clamps).

3. Remove the four (4) fixing screws from the "U" Shaped Support at the Arm end.

4. Separate the X-ray Power Unit with the "U" shaped support and the Harness from the Arm and leave it on the table.

5. Remove the two (2) shaft assemblies from the "U" shaped support at both sides of the X-ray Power Unit.

6. Replace the "U" Shaped Support and assemble in reverse order.

7. Re-install the X-ray Power Unit in the "U" Shaped Support of the Arm (do not scratch the covers). The two (2) shaft assemblies must be installed in the same order that were removed.

DANGER !

KEEP IN MIND TO TIGHTEN THE LOCK NUT ENOUGH FOR THE X-RAY UNIT TO STAY STILL IN A SPECIFIC POSITION, AND ENOUGH FOR THE X-RAY UNIT TO BE EASY TO MOVE. DO NOT FORGET TO LOCK THE NUT WITH THE LOCKING WASHER TOOTH.

8. Re-install the "U" Shaped Support and X-ray Power Unit at the Arm using the four (4) fixing screws.

DANGER !

KEEP IN MIND TO USE A 8 Nm TORQUE WRENCH WHEN RE-INSTALLING THE "U" SHAPED SUPPORT WITH THE FOUR (4) FIXING SCREWS.

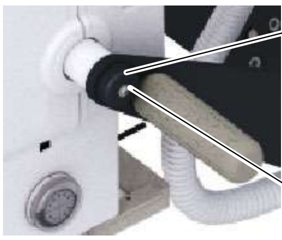
6.3.18 SHAFT ASSEMBLIES REPLACEMENT

1. Fully extend the Arm, then lay down the Trolley, with the Detector Basket resting on the floor, and leave the Power Unit face up on a table or similar (this will avoid the arm to push up when removing the X-Ray Power Unit).

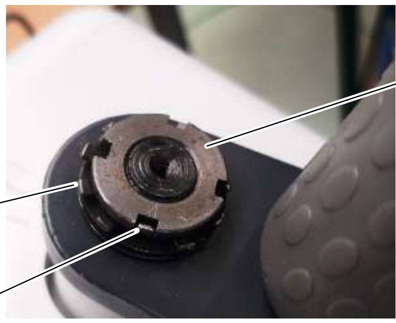
2. Remove the Upper Cover and the Lower Cover as described in their respective Sections *6.3.6* and *6.3.7.*

3. Remove the Shaft Assembly to be replaced from the “U” shaped support as follows:

   a. Remove the Cover Screw and the Cover.



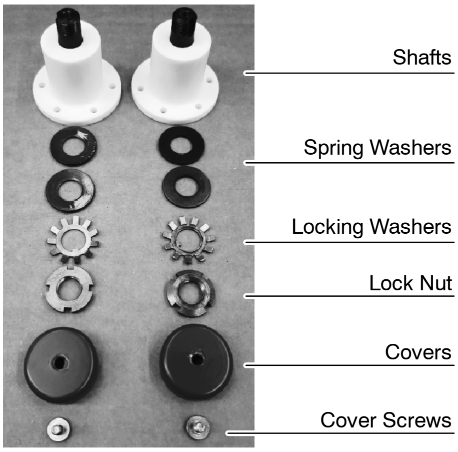
   b. Open the Tooth of the Locking Washer and unscrew the Lock Nut.



c. Remove the lock nut, the locking washer and the spring washers (x2).

d. Unscrew the Shaft screws (x6), remove the Shaft and replace it.

4. Re-assemble the X-ray Power Unit. Do not forget to install every element that has been disassembled.



Shaft Assembly

DANGER !

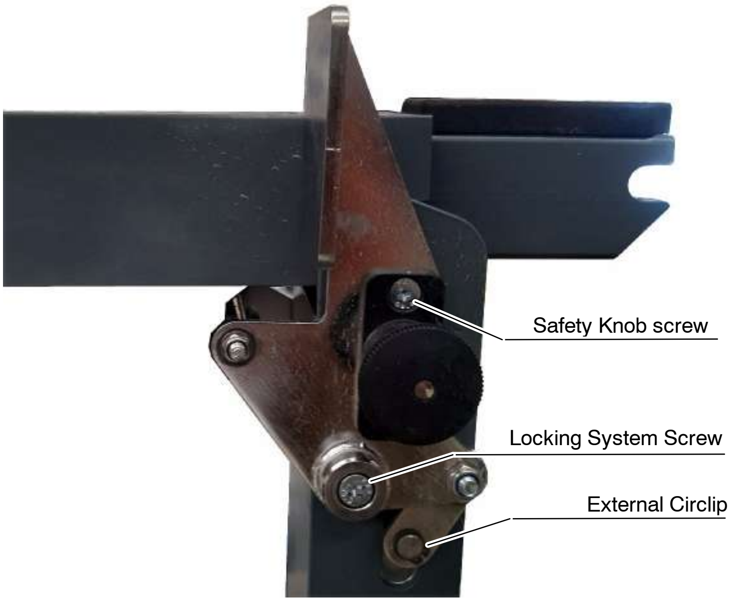
KEEP IN MIND TO TIGHTEN THE LOCK NUT ENOUGH FOR THE X-RAY UNIT TO STAY STILL IN A SPECIFIC POSITION, AND ENOUGH FOR THE X-RAY UNIT TO BE EASY TO MOVE. DO NOT FORGET TO LOCK THE NUT WITH THE LOCKING WASHER TOOTH.

6.3.19 FOLDING LEG LOCKING SYSTEM REPLACEMENT

1. With the unit in laying position and the leg folded, remove the Safety Knob screws (x2) and remove the Safety Knob.

2. Remove the external circlips (x2) with external circlip pliers.

3. Remove the Locking System Screws (x2) and the washers (x4).

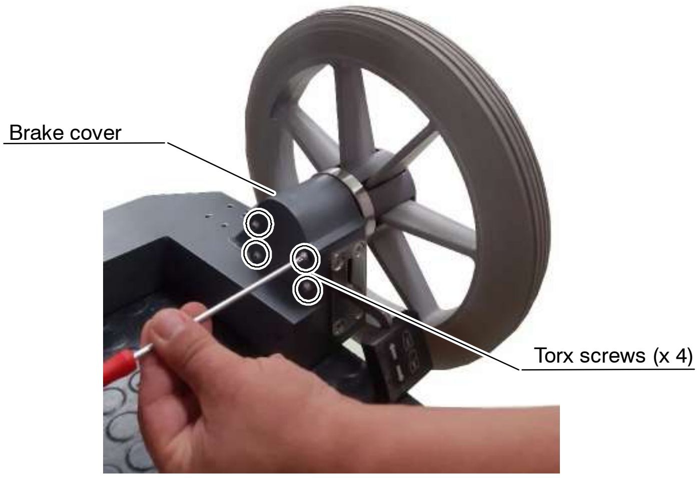


4. Remove the axis and the Locking System.

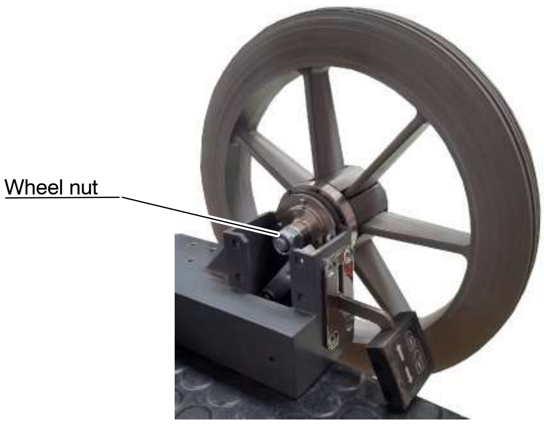
5. Install the new Locking System. Firstly, place the axis and the circlip to immobilize the Locking System.

6.3.20 SOLID WHEELS REPLACEMENT

1. Place the Arm in Parking Position. To place the Arm in the Parking Position:
   a. Stand up in front of the Unit.
   b. Position the Power Module in parallel to the Arm.
   c. Unlock the Gas Spring with the Arm Lock Lever.
   d. Push the Power Module downwards with both hands until the parking detent is locked.
2. Remove the Detector Basket as described in Section *6.3.27.1.*
3. Loosen the four Brake Cover screws in order to remove the Brake Cover of the wheel to be replaced.



4. Lock the brake and remove the security nut and washer.



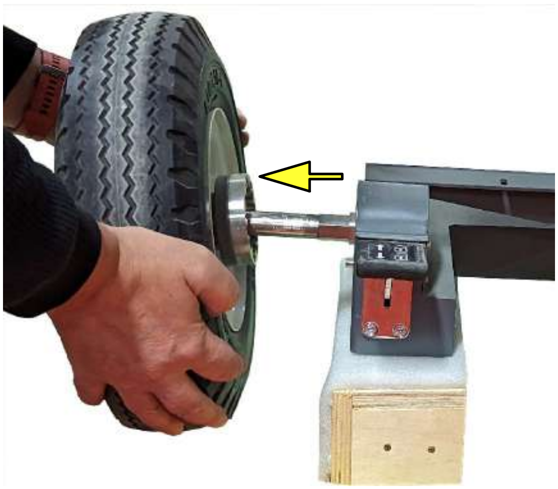
5. Release the Brake and replace the Wheel.

6.3.21 ALL-TERRAIN WHEELS REPLACEMENT

1. Place the arm in parking position.
2. Place a wood block or equivalent under the brake so that the wheel to be replaced is raised from the floor.

3. Open and remove the lock ring that holds the wheel.

4. Take out the wheel of the shaft, replace it and install the lock ring again.



6.3.22 STEERING WHEELS REPLACEMENT

1. Place the Arm in Parking Position. To place the Arm in the Parking Position:

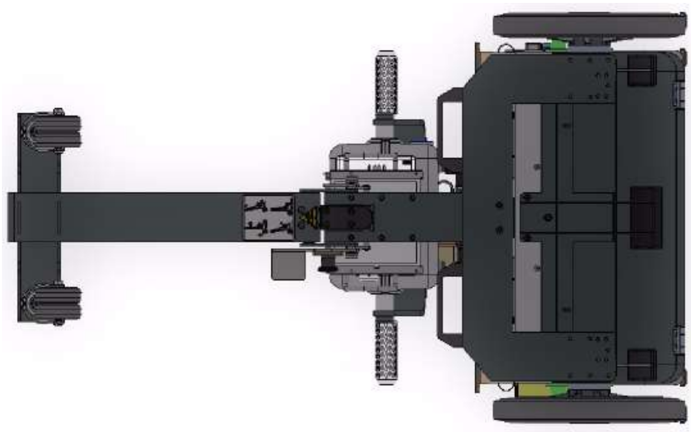
   a. Stand up in front of the Unit.

   b. Position the Power Module in parallel to the Arm.

   c. Unlock the Gas Spring with the Arm Lock Lever.

   d. Push the Power Module downwards with both hands until the parking detent is locked.

2. Lay the Trolley down on its side with the leg fully extended.

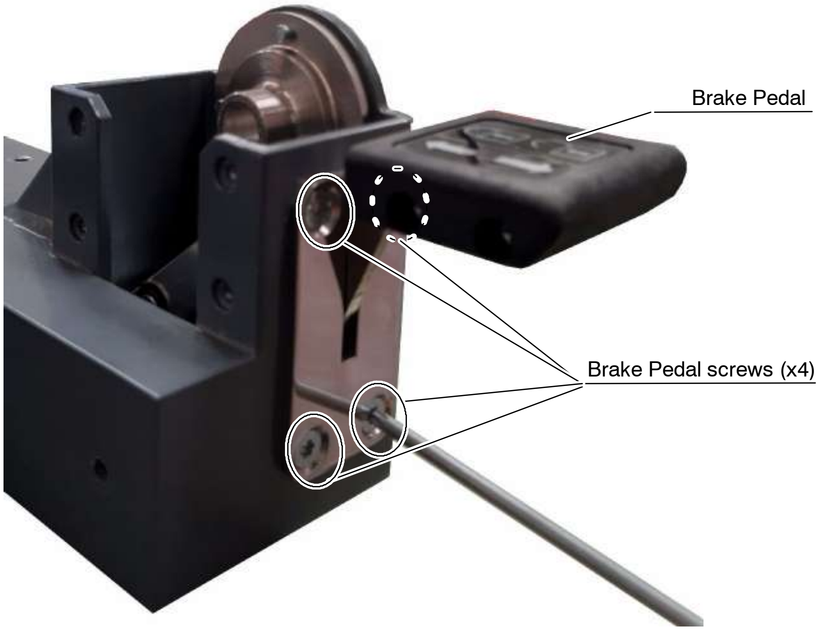


3. Unscrew the Wheel support nut and replace the Steering Wheel.

6.3.23 BRAKE MECHANISM AND BRAKE PEDALS

1. Follow the steps in Sections *NO TAG* or *6.3.20*, depending on the type of wheels.

2. Remove the Brake Pedal screws (x4).



3. Replace the Pedal, or leave it aside and continue with next step to replace the Brake Mechanism.

4. Remove the Brake Mechanism screws (x6) and replace the Brake Mechanism.

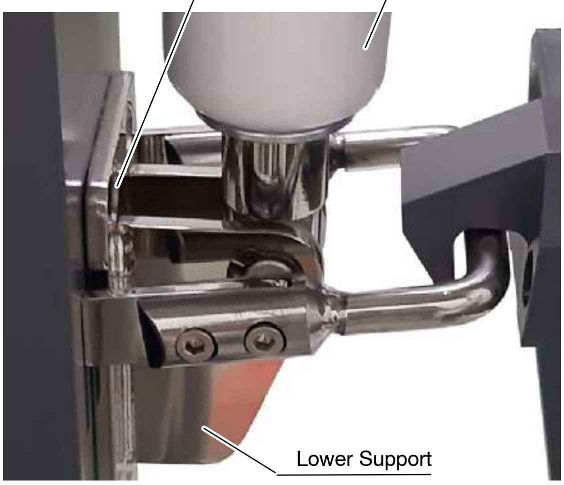

Brake Pedal screws


Brake Mechanism

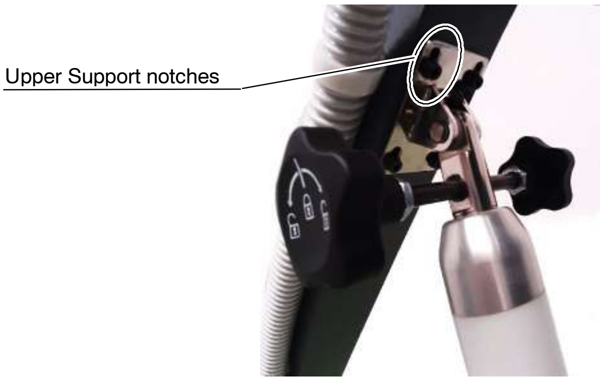
6.3.24 GAS SPRING REPLACEMENT

1. Fully extend the Arm, then lay down the Trolley, with the Detector Basket resting on the floor, and leave the X-ray Power Unit face up on a table or similar, preventing the Arm from springing up when removing the Gas Spring.

2. Remove the four (4) screws at the Upper Support (Arm) and the four (4) screws of the Lower Support (Column Bracket) of the Gas Spring.



3. Install the new Gas Spring using the same screws to fix the Upper and Lower Supports in the following way:
    a. Install the Lower Support screws.
    b. Install the Upper Support screws using the middle notches.
4. Place the Unit in upright position and fully extend the Arm. In case a lack of strength is detected, install the Upper Support screws in the next position notches.



6.3.25 LED REPLACEMENT

1. Turn the Unit off.
2. Remove the four (4) screw of the LED Plate cover located at the unit frame.

3. Take out the white plastic plate that protects the LED Plate window.

4. Remove the four (4) nuts the attach the LED Plate support to the chassis. Use a 3 mm socket wrench.

5. Unscrew the cable gland support located at the chassis, above the Detector Case.

6. Disconnect the LED Cable connector at the Detector Case.

7. Carefully take out the LED Cable through the Cable Gland.

8. Pull up the LED Plate with the cable from the LED Plate window through the Chassis column.

9. Install the new LED Plate and the cable in reverse order.

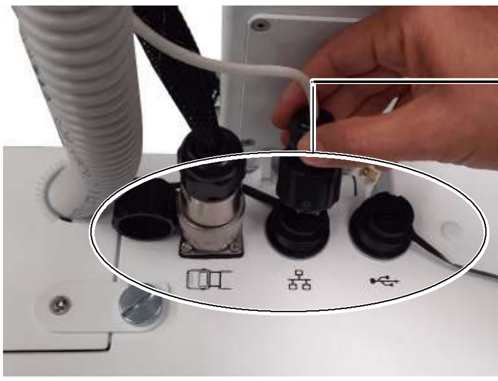
6.3.26 TOUCH SCREEN REPLACEMENT

1. Turn the Unit Off and Disconnect it from Mains.

2. Place the Unit in Parking Position and lock the Gas Spring.

3. Secure the Arm with the Safety Knob.

4. Disconnect the three (3) round connectors located at the top of the Detector Assembly COMMS – Ethernet – USB.



COMMS
ETHERNET
USB

5. Dismount the Touch Screen. Follow the steps below:

   a. Unlock and open both hinges that attach the Touch Screen to the frame.

   b. Grab the Touch Screen with both hands and move the Touch screen upwards to the limit.

   c. Pull it in order to release it from its bracket.

   d. Place the Touch Screen on a safe place. Do not forget that some cables are still attached to the touch screen.

a

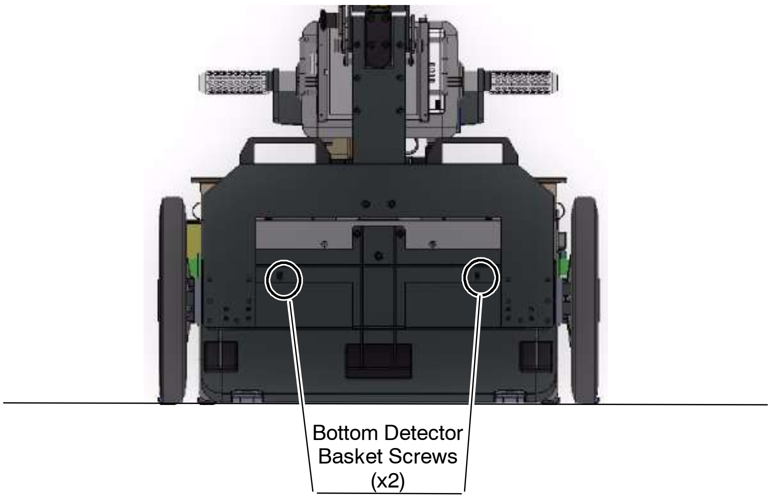
b

c

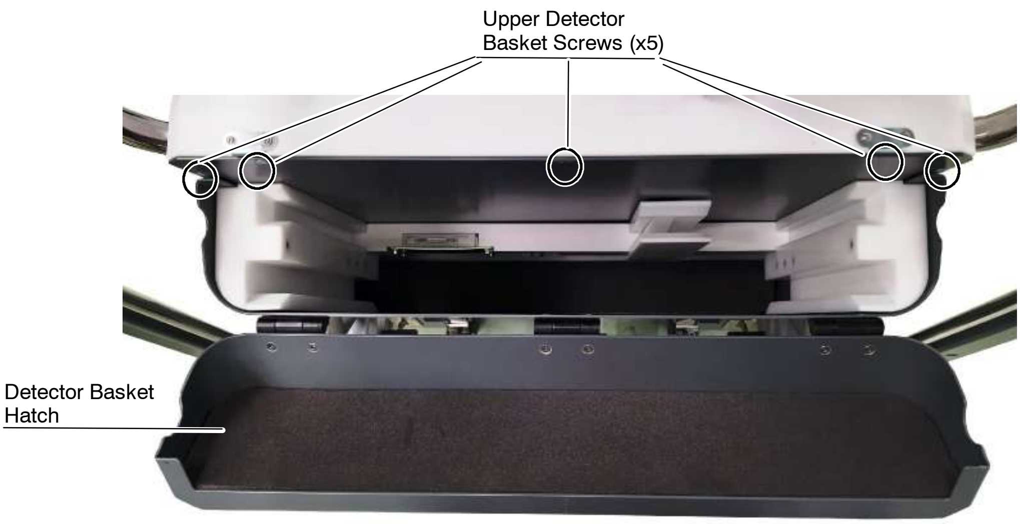
6.3.27 PARTS REPLACEMENT IN THE DETECTOR BASKET / POWER BOX

6.3.27.1 POWER BOX ACCESS

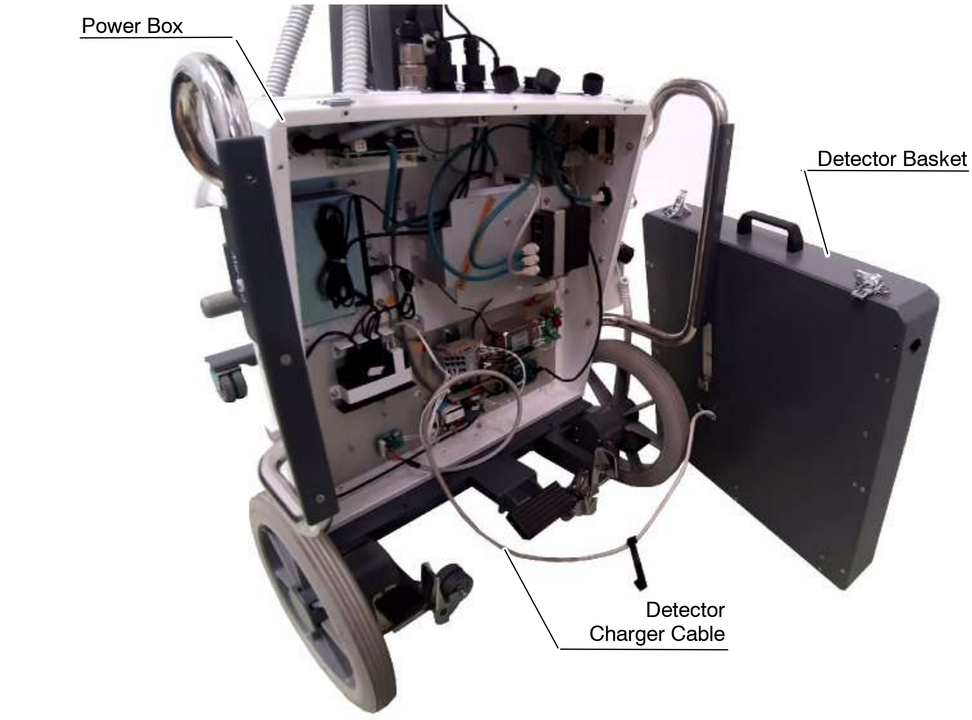
1. With the Unit OFF, place it in Parking position and lock the Gas Spring.
2. Secure the Arm with the Safety Knob.
3. Remove the Detector, the Grid, the Grid Frame and the rest of accessories from the Detector Basket and place them in a safe place.
4. Lay down the Unit and remove the screws (x2) located at the bottom of it.



5. Lift the Unit and check that it is in Parking Position.
6. Open the Detector Basket Hatch. Holding the Detector Basket, remove the Torx Detector Basket screws (x5). Be careful with the detector charger cable.



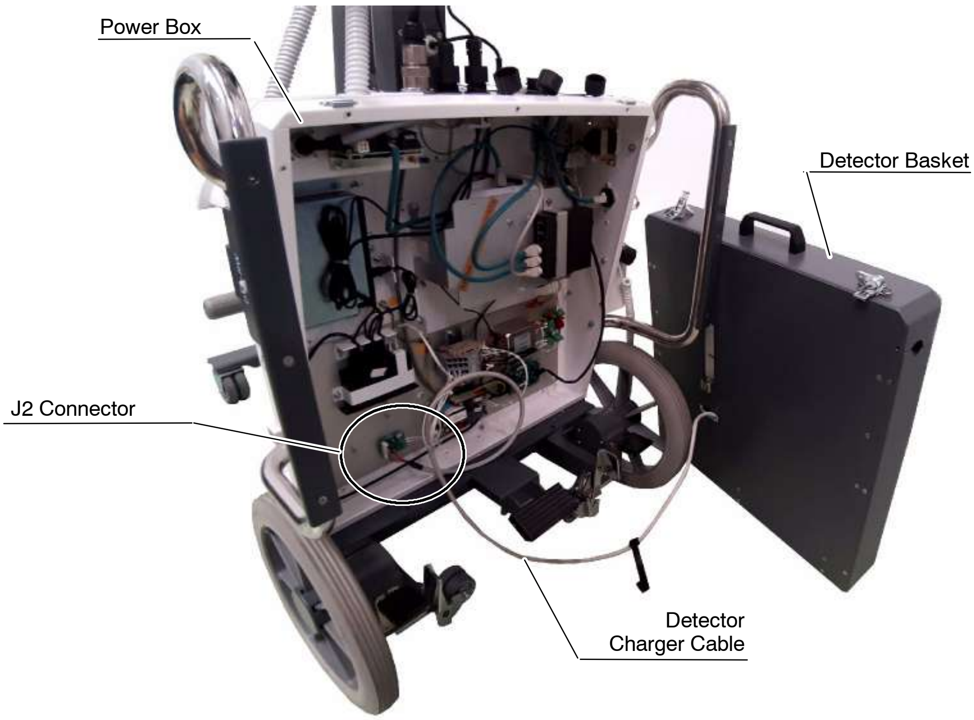
7. Leave the Detector Basket aside.



6.3.27.2 DETECTOR BASKET ACCESS

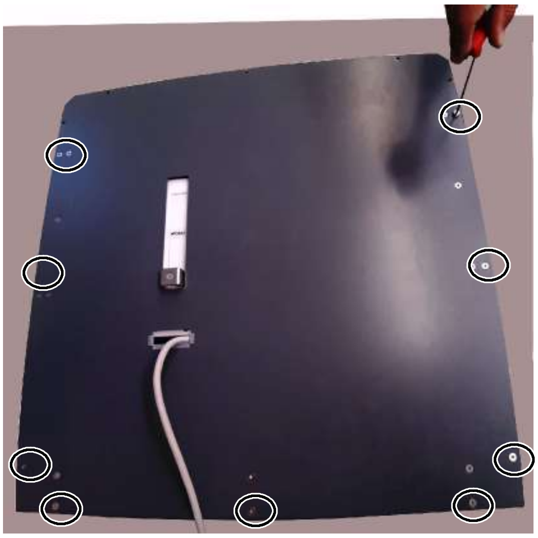
1. Follow the steps *1. - 7.* in Section *6.3.27.1*.

2. Disconnect the Detector Charger Cable from the J2 Connector.



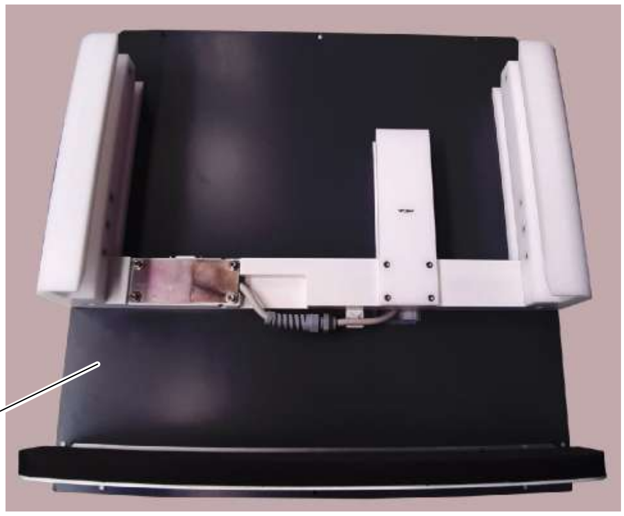
3. Place the Detector Basket on a Table or similar.

4. Remove the screws (x9) located at the back cover of the Detector Basket.



Back Cover Screws

5. Turn the Detector Basket and, by gently sliding down, remove the front cover. Place it in a safe place.



6.3.27.3 DETECTOR CHARGER CABLE

1. Access the Detector Basket as indicated in Section *6.3.27.2*.

2. Remove the screws (x4) and the Plate.

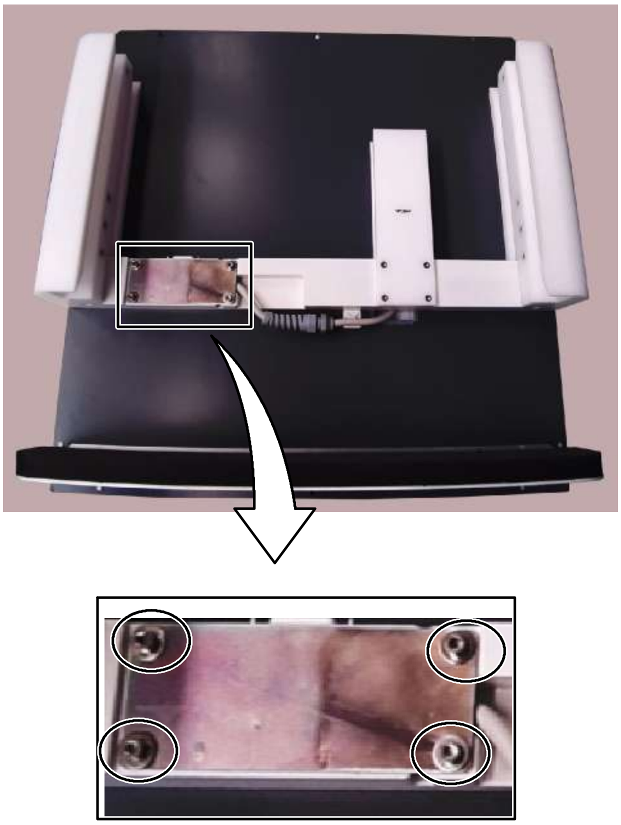


Plate screws (x4)

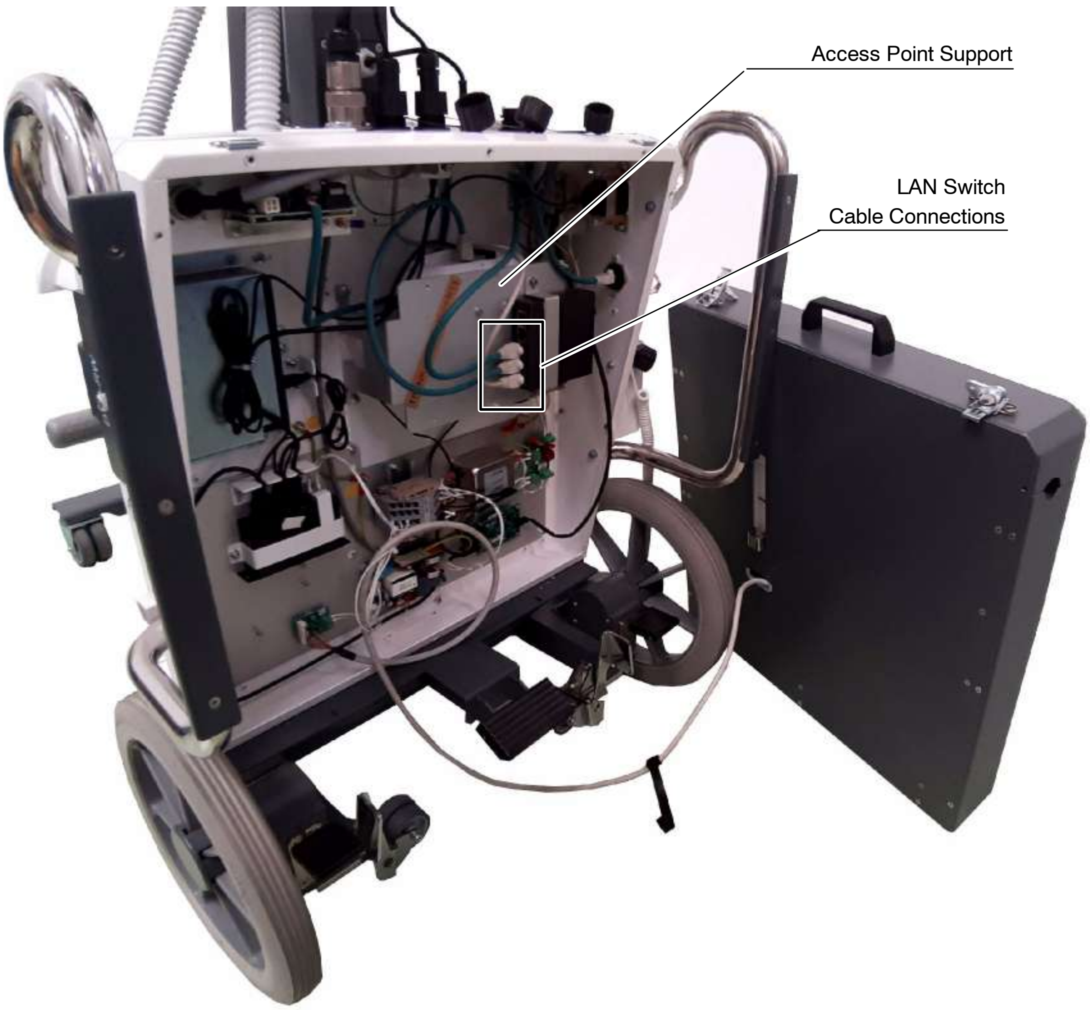
3. Disconnect the Detector Charger Cable, pass it through the Back Cover hole and replace it.

6.3.27.4 ACCESS POINT REPLACEMENT

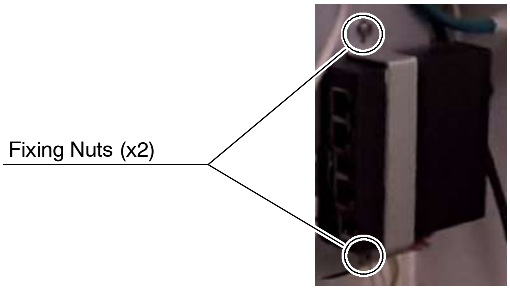
Note ☞ *The following procedure describes the necessary steps to replace the Access Point device only, not the other items included in the spare parts kit (Power Supply, Fixing Plates, cables and assorted hardware). Replace them, if necessary.*

Note ☞ *In case the equipment works with a Wireless Digital Detector provided with its own Access Point, it will not have the Access Point described in this section installed.*

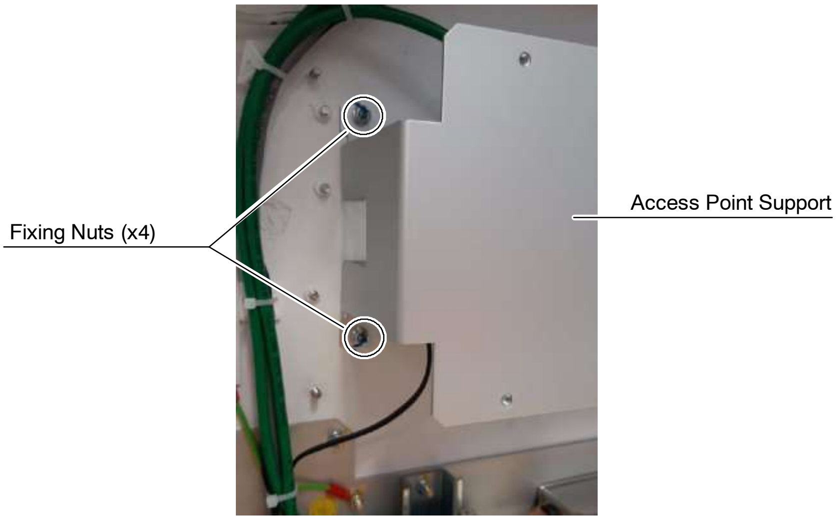
1. Access the Power Box as described in Section *6.3.27.2.*
2. Disconnect the Ethernet, the Access Point and the Backup Cables from the LAN Switch.



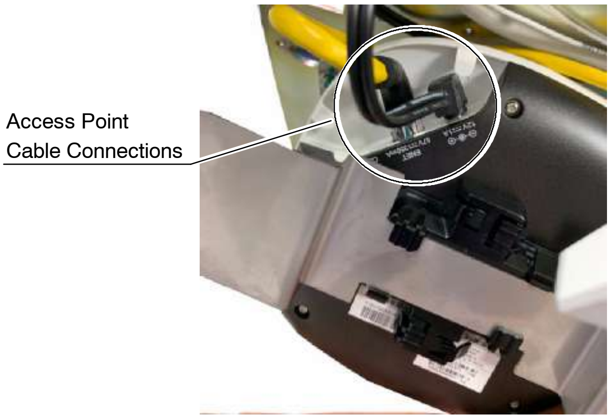
3. Remove the Fixing Nuts of the LAN Switch Support to disengage it from the Access Point Support.



4. Remove the Fixing Nuts of the Access Point Support in order to disengage it from the Power Box.

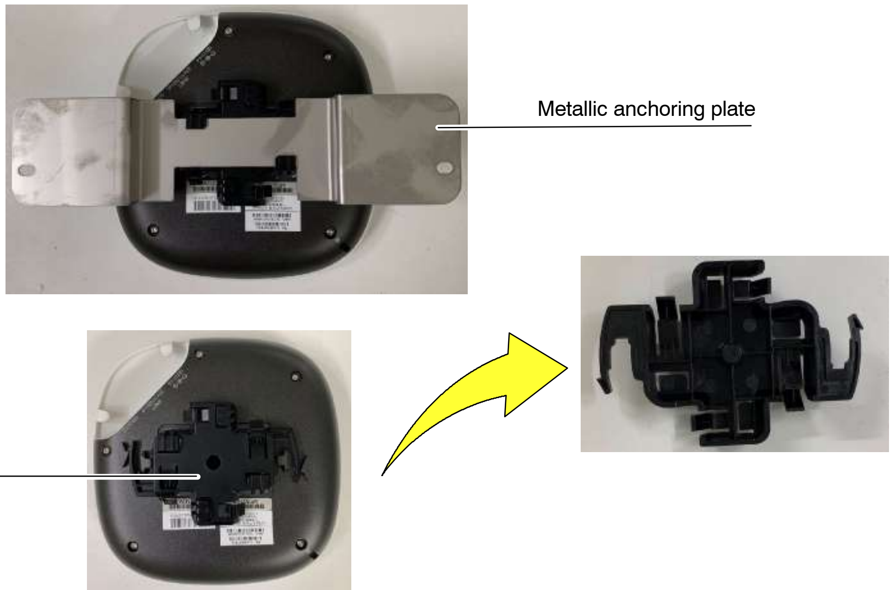


5. While holding the Access Point Support, disconnect the LAN and DC Supply Cables from the Access Point.

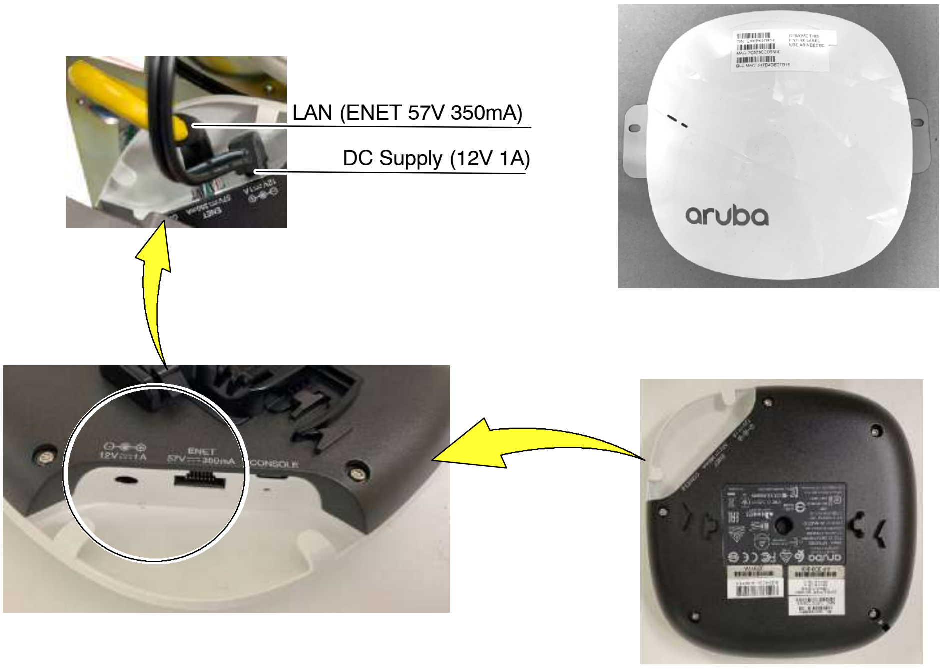


6. Remove the Fixing Nuts of the metallic anchoring plate in order to disengage it from the Access Point Support.

7. Rotate the metallic anchoring plate to release it and afterwards, repeat the same procedure with the black support plate that lays underneath.



8. Replace the Access Point following the previous step in reverse order. Plug the LAN Cable connector into the socket labelled as “ENET 57V, 350mA” and the DC Supply Cable Connector into the socket labelled as “12V, 1A” (refer to the next pictures).



9. Mount the Access Point and the rest of the elements.

10. Once every part is reassembled, turn ON the unit.

11. Perform a functional check.

Note ☞ *If the Access Point has to be replaced or reconfigured, refer to Service Note SN1257, sent with the documentation of this X-ray Unit.*

6.3.27.5 POWER LINE CABLE REPLACEMENT

1. Disconnect the power cable from mains.

2. Access the Power Box (*refer to Section 6.3.27.1*).

3. Remove the Nuts (2) that support the Circuit Breaker.

4. Unscrew the Ground cable end from the Unit Chassis.

5. Disconnect the Power Line cable from the circuit Breaker.

6. Release the outer PVC Cable Gland and remove the old power Line Cable.

7. Re-Install the Power Line Cable and other parts in reverse order.

6.3.27.6 MAGNETOTHERMIC REPLACEMENT (CIRCUIT BREAKER)

1. Disconnect the power cable from mains.

2. Access the Power Box (*refer to Section 6.3.27.1*).

3. Remove the Nuts (2) that support the Circuit Breaker.

4. Disconnect the Power Line cable from the Circuit Breaker.

5. Replace the Circuit Breaker.

6. Re-install the parts in reverse order.

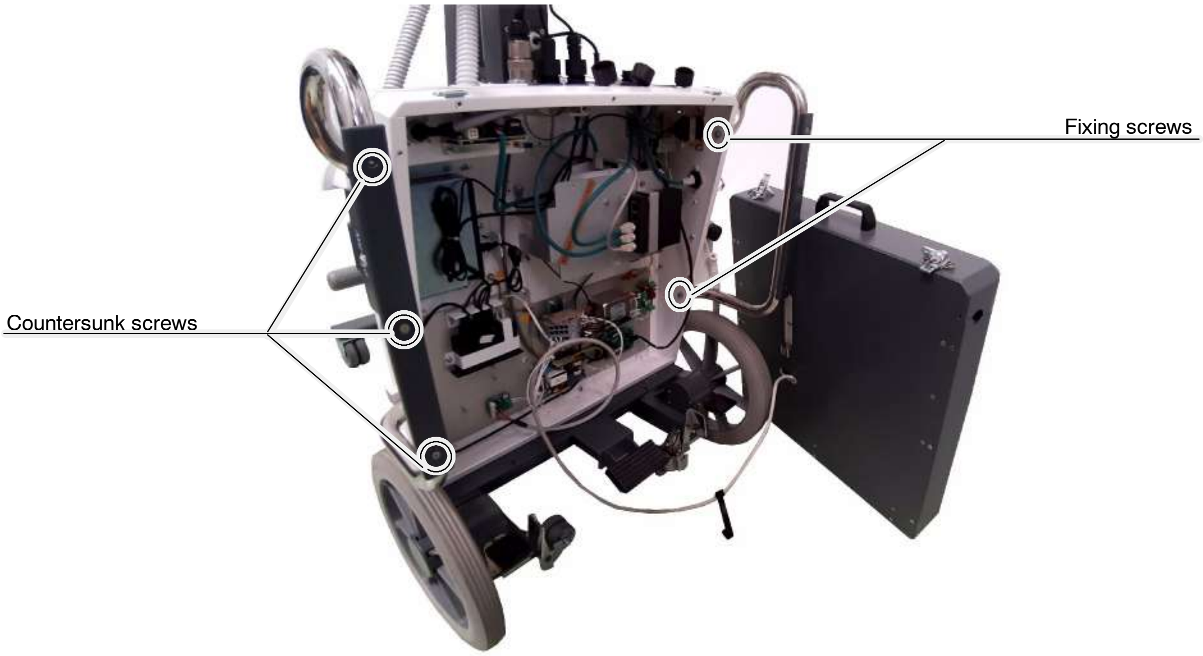
6.3.27.7 LOWER STEERING HANDLES INSTALLATION / REPLACEMENT

1. Follow the steps *1. to 7.* in Section *6.3.27.1*.

Note ☞ *In case of replacement, unscrew the old* Steering Handles *before step 2.*

2. Once the Power Box is open, remove the stickers and attach the Steering Handles, right and left, using four (4) fixing screws. Apply a torque of 8 Nm.

3. Screw each Steering Handle Slide with three (3) countersunk screws.



SECTION 7 MAINTENANCE

The purpose of this Periodic Maintenance is to guaranty a continue safe performance of the Unit, to increase serviceability, to reduce costs (down time, repairs, etc.) and to assure the safety (personal risk).

The following checks and maintenance procedures, at the suggested intervals, are the manufacturer's recommendation for the most effective Periodic Maintenance schedule for this Portable Unit.

Service tasks here described must be performed exclusively by service personnel specifically trained on medical X-ray Generators.

The first periodic maintenance service should be performed six (6) months after installation and the subsequent services every twelve (12) months. Periodic Maintenance Service depends on the working load of the Unit.

It is the Owner's responsibility to supply or arrange the required tasks to perform the Quality Control procedures according to the frequency and acceptance criteria established by the local regulations.

The manufacturer undertakes to have available spare parts for this equipment at least for ten (10) years after the unit manufacturing.

WARNING

NEVER ATTEMPT TO PERFORM MAINTENANCE TASKS WHILE THE ME EQUIPMENT IS IN USE WITH A PATIENT.

7.1 PERIODIC MAINTENANCE PROCEDURES

Prior to any periodic maintenance procedure, it is recommended to perform a test exposure using the same operating factors and conditions as for a typical exposure.

Perform the X-ray Tube warm-up procedure when the unit has been off for more than four hours.

CAUTION

Before performing X-ray exposures ensure that the Tube is properly warmed-up. Make sure that no people will be inadvertently exposed to unnecessary X-rays during this procedure.

7.2 GENERAL CLEANING

NEVER ATTEMPT TO CLEAN OR HANDLE ANY PART OF THE UNIT WHEN IT IS ON. SWITCH IT OFF AND DISCONNECT IT FROM THE MAINS BEFORE CLEANING OR INSPECTING.

7.2.1 EXTERNAL SURFACES

Clean external Covers and surfaces frequently, particularly if corroding chemicals are present, with a cloth moistened in warm water with mild soap. Rinse wipe with a cloth moistened in clean water. Do not use cleaners or solvents of any kind.

Clean console keyboard and displays with a cloth dampened in warm water with mild soap. Rinse wipe with a cloth dampened in clean water.

Also check painted surfaces for scratching and touch up as required.

7.2.2 INTERNAL CLEANING

NEVER ATTEMPT TO CLEAN INTERNALLY THE UNIT. THE UNIT MUST BE ALWAYS KEPT SHUT UNLESS A SPECIFIC TROUBLESHOOTING PROCEDURE IS TO BE UNDERTAKEN BY HIGHLY QUALIFIED SERVICE PERSONNEL.

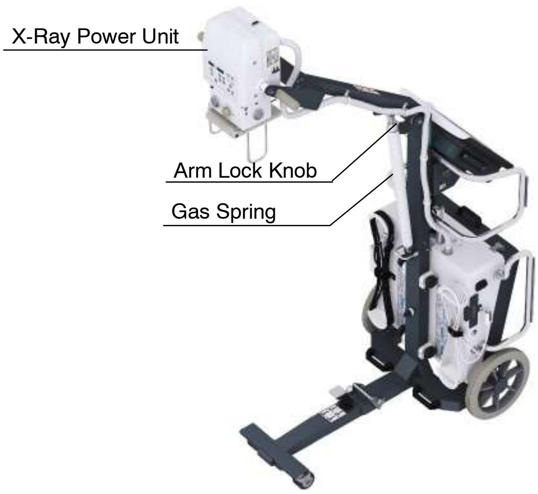
7.3 CABLE CHECKS

Check that all electrical connections are firm and secure and that all cable Lights and strain reliefs are in place. Also check that connectors do not have exposed wire-veins and check cable sheaths (cable cover) for wear and fraying.

Check that all cables are correctly routed.

7.4 GAS SPRING

Check that the X-ray Power Unit can be properly supported by the Gas Spring. To be able to do that, place the Unit in upright position and fully extend the Arm, release the Arm Knob Lock and verify that the X-ray Power Unit remains in position without falling down.

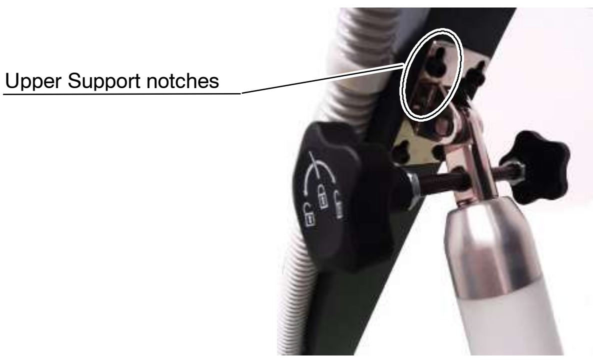


Failure to support the weight of the X-ray Power Unit or failure in the locking handle mechanism will require immediate substitution of the Gas Spring Assembly (*refer to Section 6.3.24*).

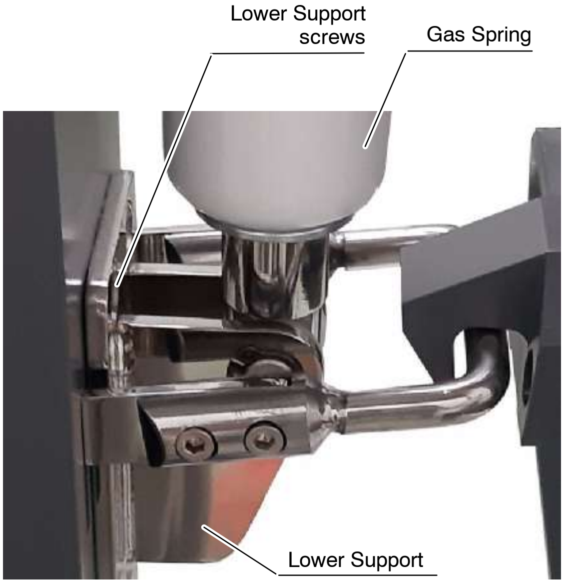
DANGER !

GAS SPRING ASSEMBLY FUNCTIONALITY IS A CRITICAL PART TO THE EQUIPMENT SAFETY. FAILURE IN LOCKING MECHANISM OR IN THE SPRING STRENGTH MAY CAUSE ACCIDENTAL DAMAGE TO USER OR PATIENT.

In case a lack of strength is detected, install the Upper Support screws in the next position notches.



Lock the Gas Spring and verify that all screws at elbow, Upper Support and Lower Support are tightened and present.



7.5 FOLDING LEG LOCKING SYSTEM

Verify that the action of the Locking System to fold the Leg assures that the system locks in place and does not release unless it is released.

Failure of the assembly will require immediate substitution of the assembly to assure safety of the unit *(refer to Section 6.3.19)*.

DANGER !

LOCKING SYSTEM MISUSE OR FAILURE CAN CAUSE UNIT TO ACCIDENTALLY TIP OVER AND HARM USER OR PATIENT.

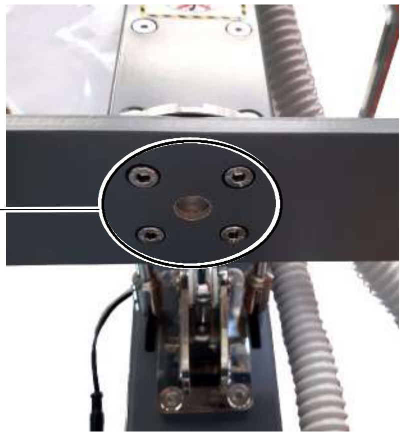
7.6 X-RAY UNIT SUPPORT

Check the correct fixation of the X-ray Power Unit and “U” Shaped Support performing the following steps:

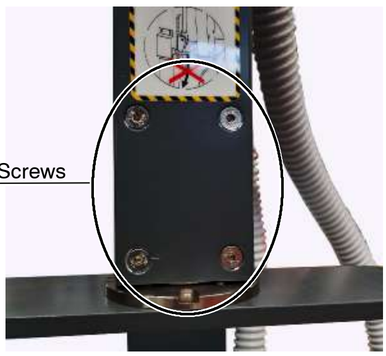
1. Check that the four (4) Fixing Screws are in place and the “U” Shaped Support is fixed to the rotation mechanism of the Trolley using a calibrated torque wrench. The screws are M6 size, A2 steel with a value of 70 Hardness, the torque to the Allen type head is to be tightened using the torque wrench to 8 Nm.

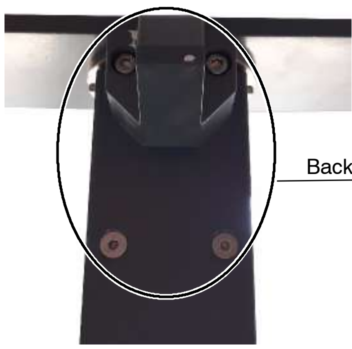
DANGER !

KEEP IN MIND TO USE A 8 Nm TORQUE WRENCH WHEN VERIFYING THE “U” SHAPED SUPPORT FIXATION WITH THE FOUR (4) FIXING SCREWS.



2. Verify that the eight (8) screws attaching rotation mechanism to the chassis are also in place and are properly tightened. There are four (4) screws on the front and four (4) screws on the back side. There is no specification for the torque on these screws as the load is transversal to the screw, but they have to be fully tightened.





3. Check that the X-ray Power Unit is fixed to the “U” Shaped Support and that the Shaft Assembly is in place: Check that the Lock Nut is tightened enough for the X-ray Unit to stay still in a specific position, and enough for the X-Ray Unit to be easy to move, and that the Locking Washer Tooth is securing the Lock Nut.

Note ☞ *Refer to Section 6.3.18 for more information about the Shaft Assembly.*

DANGER !

SHOULD ANY SCREW BE MISSING OR NOT PROPERLY TIGHTENED THERE IS A RISK OF X-RAY POWER UNIT HEAD FALLING DAMAGING EQUIPMENT AND HARMING USER OR PATIENT.

7.7 COLLIMATOR

Check the Collimator condition performing the following test:

1. Turn the Unit ON.
2. Open fully the Collimator blades using the Collimator Control Knobs and switch On the Collimator Light. Check the Light lights properly. Check the Laser Pointer function if the Collimator is provided with this device.
3. Close fully the Collimator blades using the Collimator Control Knobs and switch On the Collimator Light. Check the Light lights is not emitted out of the Collimator.
4. Open / close the Collimator blades using the Collimator Control Knobs for selecting different "*SID / Image Size References*" (refer to the table on the Operator Manual). Check the final image size in the receptor by switching On the Collimator Light.
5. If any of these tests is not acceptable, remove the Collimator Cover and repair the blades mechanism or the Collimator (*refer to the Collimator manuals*).

WARNING

VERIFY THAT THE COLLIMATOR IS PROPERLY SEATED AND NO RISK FOR ACCIDENTAL FALL IS POSSIBLE BY TURNING COLLIMATOR AROUND AND PULLING DOWNWARDS FROM IT.

7.8 ALIGNMENT OF THE X-RAY BEAM AND FIELD SIZE INDICATOR TEST

Check the "*Alignment of the X-ray Beam*" and the "*Field Size Indicator Test*" as described in *Section 4.*

7.9 CONTROL PANEL

Verify that the Handswitch cable and its connection to the Unit are in good condition. Check the operation of the Handswitch button.

Check correct operation of the push-buttons, displays and indicators of the Control Panel by performing the following test:

1. Turn the Unit ON.
2. Select a radiographic technique and observe:
   - Technique parameters and other selections are displayed on the Control Panel. If the Unit has a Console on the Trolley , check the same paramaters on the Trolley's Console.
   - Change technique parameters and observe that changes are correctly displayed.
   - Select 70 kVp and maximum mAs.
   - Press "*Prep*" and verify that the "*Ready*" indicator is illuminated. Release "*Prep*" and observe that the "*Ready*" indicator is off.
   - Make a typical exposure, and verify that radiographic exposure sound signal and the "*X-ray ON*" indicator function correctly during the X-ray exposure.

7.10 TOUCH SCREEN CONSOLE

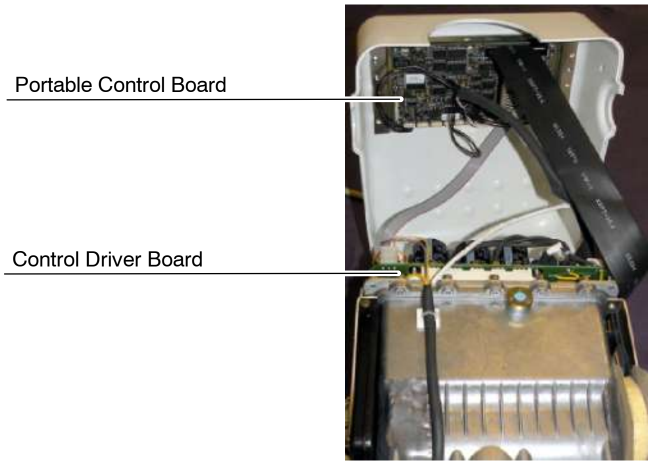
Check the proper connection and condition of the cables connected to the Console. Check correct operation of the Console by performing the following test:

1. Turn the Console ON.
2. Verify that the Console works properly:
   - Select a radiographic technique and verify that the different indicators and parameters on the Console appear when prompted, e.g. errors, limits, indications.
   - Change technique parameters and observe that changes are correctly displayed.
   - Select the parameters for a normal exposure. Press "*Prep*" and "*Exposure*" and observe that the respective indicators are activated during exposure.

7.11 RADIOGRAPHIC PARAMETERS TEST

1. Turn the Unit Off and Disconnect it from mains.

2. Remove the Upper Cover screws and carefully lift the Upper Cover. **Do not unplug any cable.**



3. Connect Oscilloscope to the Portable Control Board (*A3175-05*) as indicated in *Section 3.1.*

4. Turn the Unit ON.

5. kVp Test:

   - Place a Non-Invasive kVp Meter aligned to the X-ray beam at SID 100 cm to measure kVp. Open the light field to center it with the kVp Meter.

   - Select 80 kVp and the lowest mA station in Large Focus. Make an exposure and note the kVp read on the Non-invasive kVp Meter at the end of the exposure.

   - Check that the kVp value read must be the selected on the Control Panel: 80 ±(3% +1 kVp). If the kVp value does not comply with it, perform the respective Calibration procedures (*refer to Section 3*).

6. mA Test:

   - Select 80 kVp, Small Focus and the highest mA station in Small Focus (read the mA station on the Control Panel by pressing any "*Focal Spot*" and "*mAs Decrease*" push-buttons at the same time).

     Make an exposure and measure the mA signal value with the Oscilloscope. Verify that the signal is flat.

Note ☞ *In order to display a noiseless waveform it is necessary to apply a bandwidth filter of 8 KHz when measuring any signals with the oscilloscope. Waveforms captured without the filter may be noisy.*

   - Select 80 kVp, Large Focus and the lowest mA station in Large Focus (read the mA station on the Control Panel by pressing any "*Focal Spot*" and "*mAs Decrease*" push-buttons at the same time).

     Make an exposure and measure the mA signal value with the Oscilloscope. Verify that the signal is flat.

   - Check that the mA values read must be the selected on the Control Panel $\pm$(4% + 1 mA). If any mA value does not comply with it, perform the respective Calibration procedures (*refer to Section 3*).

7. Turn the Unit OFF. Disconnect the Oscilloscope and re-install the Upper Cover of the Unit.

7.12 OTHER MAINTENANCE PROCEDURES

Note ☞

Local Standards may require checking procedures that are not considered Periodic Maintenance by the manufacturer.
Below are described some of these procedures and the manufacturer recommendations to perform them.

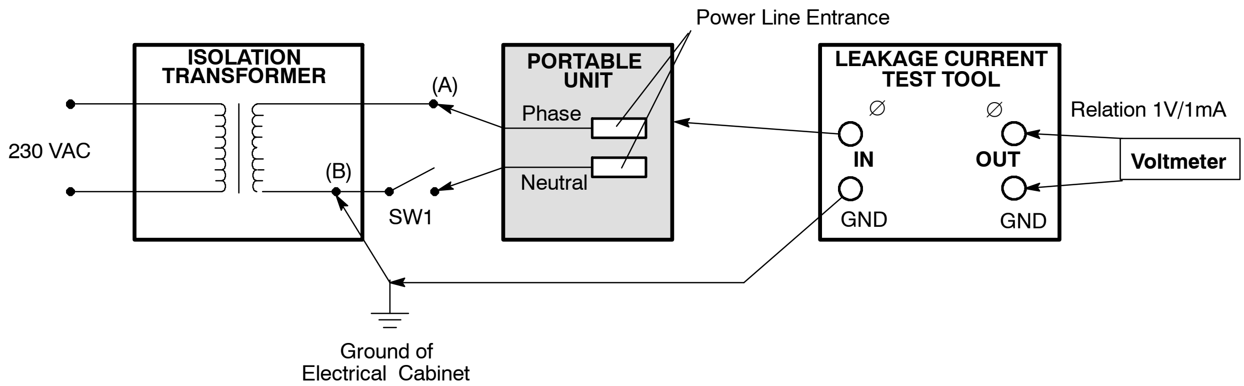
7.12.1 CHECKING THE LEAKAGE CURRENT

Besides the standard tools and test equipment, this procedure requires the following:

- Leakage Current Test Tool (RC).
- Isolation Transformer.
- Voltmeter.

1. Unplug the Unit from the mains. Remove the Ground wire of the AC plug. Remove any external Ground connection to the Portable Unit.
2. Place the Portable Unit on a surface that is isolated from ground such as wood or non-conductive plastic).
3. Connect the AC Power Supply Cable to the secondary of the Isolation Transformer and the primary of the Isolation Transformer to 230 V~.
4. Turn ON the Portable Unit. Connect the Leakage Current Test Tool as follows:

Illustration 7-1
Leakage Current Test Connection



5. As shown in Illustration 7-1, the Voltmeter is set to V~ and connected to the Test Tool at the **OUT** points. Connect **Ø (IN)** to a metallic part of the Portable Unit. Connect **GND (IN)** to the Ground of the Electrical Cabinet and to an output of the secondary of the Isolation Transformer (B).

6. The reading from the Voltmeter (1V = 1mA) gives the leakage current under **normal conditions**. Turn OFF the Portable Unit and disconnect the connection between the secondary of the Isolation Transformer (B) (or with a switch as identified in the illustration). The measurement in the voltmeter gives the leakage current under **fault conditions**.

7. Swap the wires connected from the Isolation Transformer to the Portable Unit (marked as "*A*" and "*B*" in the illustration) and repeat the measurement specified before (*step 6.*).

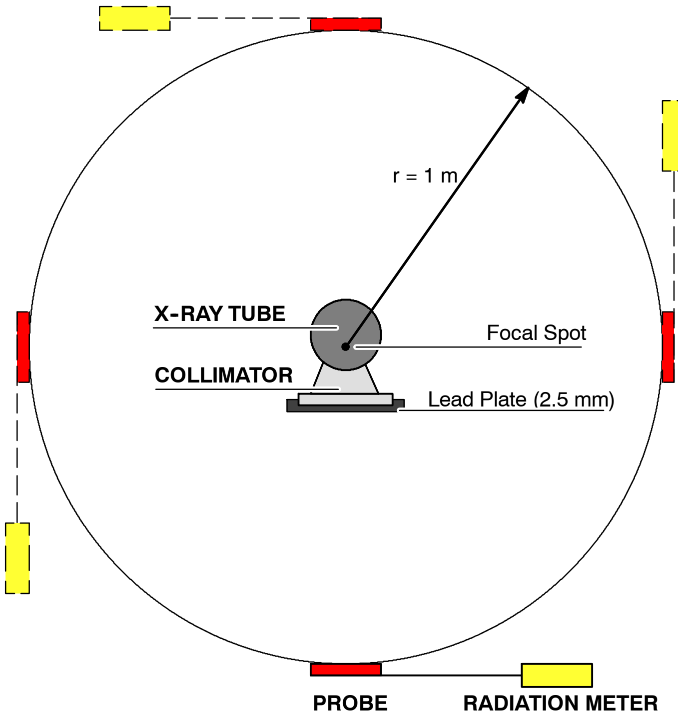
8. The Leakage Current Value should not exceed 5 mA under Normal Conditions or 2.5 mA under Fault Conditions. If the measurements exceed this range, check the Power Supply Cable and Plug (V~) for leakage current and replace the "EMC Filter" (line entrance) if required.

9. Disconnect all connections made in the previous steps and return the Portable Unit to operational wiring. Place the ground wire back to the plug and ensure a firm connection.

7.13 CHECKING THE RADIATION LEAKAGE

Besides the standard service tools, a Radiation Meter is necessary for checking Radiation Leakage. Radiation measurement will be setup as indicated in Illustration 7-2.

Illustration 7-2
Radiation Leakage Setup



1. On the Portable Unit Console, select the following parameters: 125 kVp, 50 mAs (20 mA , 2.5 s).

2. Cover the Collimator window with a Lead Plate (≅ 2.5 mm of thickness) with at least 1 cm overlap on all sides and open the Collimator blades.

3. Select *Dose* mode (0.00 μR) on the Radiation Meter.

4. Make an exposure and note the radiation readout, indicating the position where the probe is placed respect to the Tube-Collimator. Repeat this step with the probe at various positions around the Tube-Collimator (maintaining a radius of 1 meter). *Refer to Illustration 7-2.*

5. Based on the radiation readings, calculate the Radiation Leakage according to the following formula:

$$\frac{X}{s}$$

*Where **X** is the radiation readout (in mR) from the Radiation Meter and **s** is the time in seconds.*

The following is an example of the formula stated in Step 5.

a. If the maximum radiation is " *X = 5 mR* " in 2.5 seconds (time selected at the Console), the radiation leakage per second is:

$$\frac{X}{s} = \frac{5mR}{2.5s} = 2mR/s$$

b. The equivalent current in continuous operating mode for the duty cycle (12 exposures at maximum energy, 125 kVp – 100 mAs during one hour, consisting of four (4) consecutive series of three (3) exposures at 100%, 50% and 25%) of the Portable Unit is **0.19 mA** at 125 kVp.

The dose per second for the equivalent current in continuous operating mode:

$$A = \frac{2mR/s}{\left(\frac{20mA}{0.19mA}\right)} = \frac{2mR/s}{105.26} = 0.019mR/s$$

c. The total dose in one hour (3600 seconds) expressed in *mR*:
A (mR/s) x 3600s = 0.019 mR/s x 3600s = 68.4 mR

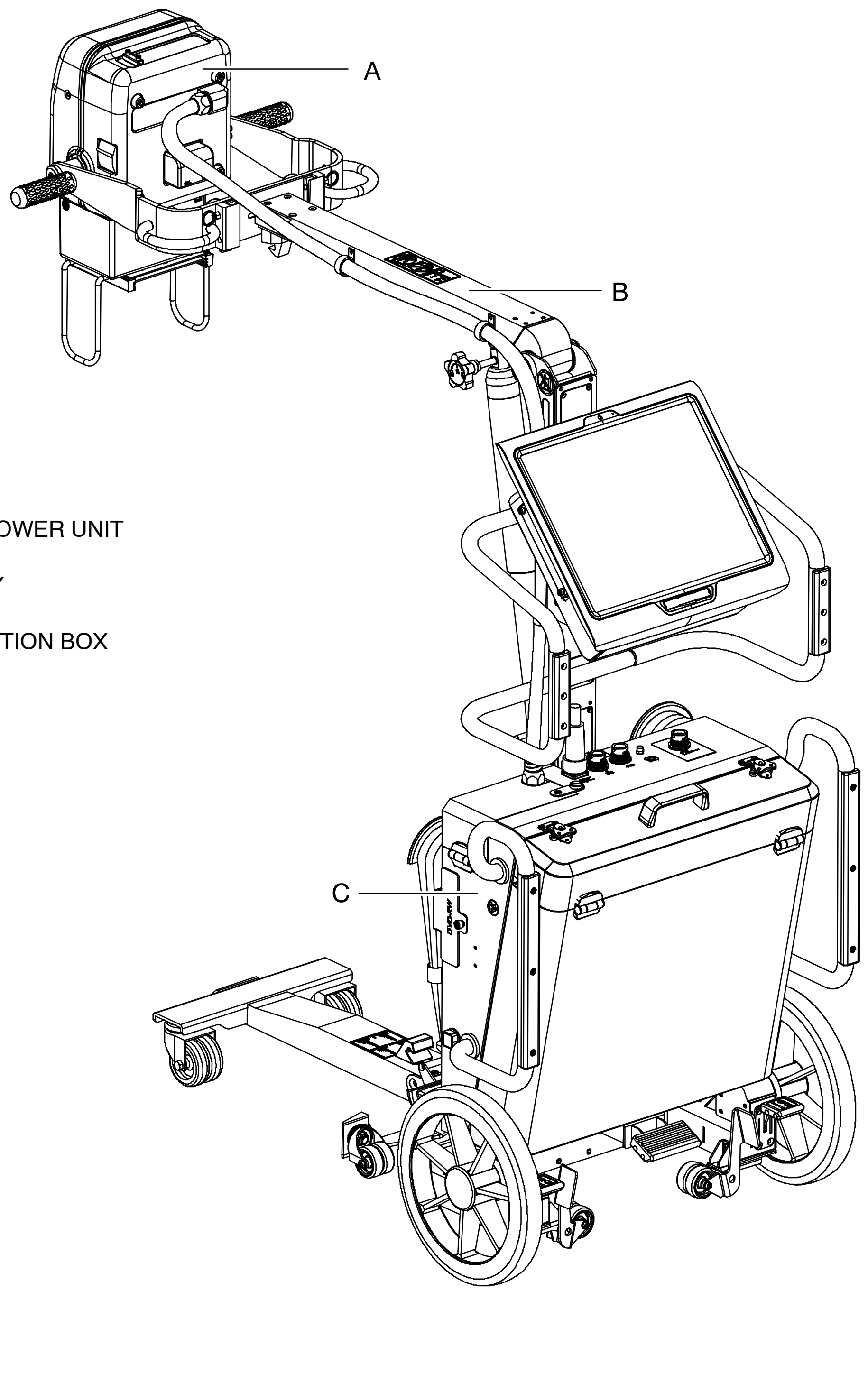
d. **The Radiation Leakage limit is 100 mR / h (0.88 mGy / h)**; Based on the obtained result, the radiation leakage for this example is:
68.4 mR/h *(68.4 mR/h / 115 =* ***0.59 mGy/h****)*

6. Based on the radiation reading at any position, ensure that the Radiation Leakage is lower than the limit of 100 mR/h (0.88 mGy/h). Note the position and value of the maximum radiation reading.

If the Radiation Leakage is over the limit at any position, first replace the Collimator and then repeat this procedure. If leakage is still present, replace the HV Transformer with the X-ray Tube and repeat this section.

When finished, remove the Lead Plate from the Collimator window.

SECTION 8 RENEWAL PARTS

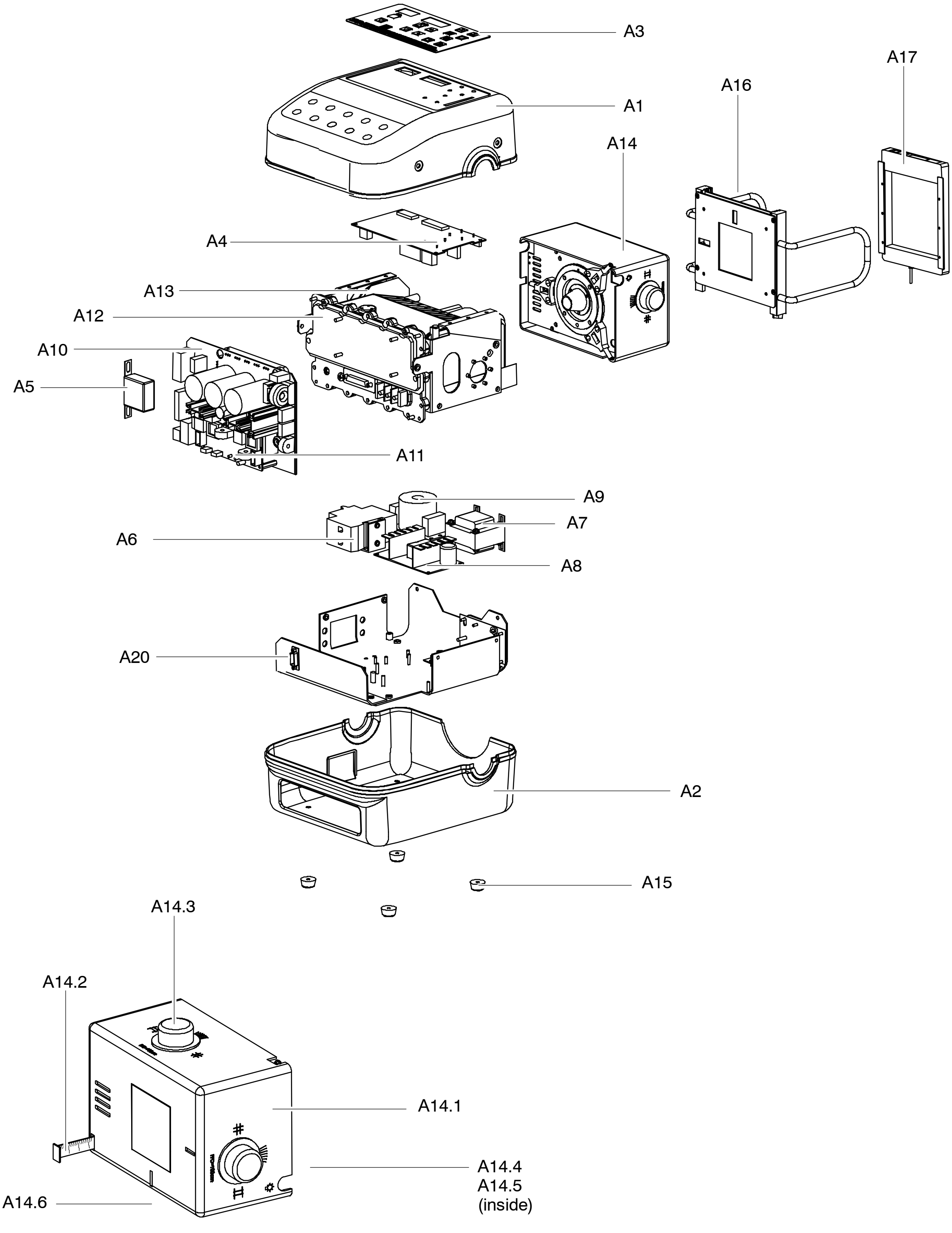


A – X–RAY POWER UNIT

B – TROLLEY

C – CONNECTION BOX

ITEM	DESCRIPTION	QTY	REFERENCE	REMARKS
A	**X-Ray Power Unit**			
A1	Upper Cover	1	SAT-13033-01	
A2	Lower Cover	1	SAT-13034-03	for Power Unit with Trolley
A3	Overlay	1	SAT-55808384	
A4	Portable Control Board	1	SAT-A3175-05	License SD with dedicated software not included, install the License from the replaced PCB. License is exclusive for each Generator.
A4.1	PCB License SD	1	SAT-A40013-01	License is exclusive for each Generator, so the corresponding Generator serial number has to be indicated in the Spare Part Order. This component must not be stored as a stock item.
A5	Snubber	1	SAT-54003036	
A6	Circuit Breaker	1	SAT-50613122	
A7	Inductance Chopper	1	SAT-A6065-03	
A8	Power Supply	1	SAT-53418052	
A9	EMC Input Filter PCB	1	SAT-A3191-04	
A10	Control Driver Board	1	SAT-A3189-07	Includes Item A11 (filament HF PCB)
A11	Filament HF PCB	1	SAT-A9500-01	
A12	HV Tank with X-Ray Tube	1	A520388-XX	XX= 04 for 4 kW and 5 kW XX= 07 for 8 kW
A13	Resonant Inductance	1	SAT-A6077-01	
A14	Collimator	1	A523016-01	without laser and with button
		1	A523014-01	with laser and lamp buttons
A14.1	Collimator Cover	1	A525430-01	
A14.2	Retractable Tape	1	A525129-01	
A14.3	Knob	1	A525128-01	
A14.4	Timer Power LED 3.5 A	1	A525182-01	
A14.5	LED	1	A525412-01	
A14.6	Collimator Cable	1	A7954-01	
A15	Leg Kit	1	SAT-54402102	Included 4 units
A16	SID Guard Dragon	1	SAT-A11921-01	
A17	Dosimeter	1	55902059	Optional
A18	Inclinometer Kit	1	SAT-A11915-02	Optional
A19	Cover DB-9	3	SAT-13078-01	
A20	26-Wires Ribbon Cable	1	A3334-01	Connected to [A3175 Board]-J17 / [A3189 Board]-J2
A21	Control Ribbon Cable	1	A3337-01	Connected to [HV Tank]-J10 / [A3189 Board]-J1 / [A9500 Board]-J2
A22	Test Ribbon Cable	1	A7111-01	Connected to [A3175 Board]-J21 / [Test DB9]
A23	Filaments Ribbon Cable	1	A7113-01	Connected to [A3175 Board]-J16 / [A9500 Board]-J1


A3
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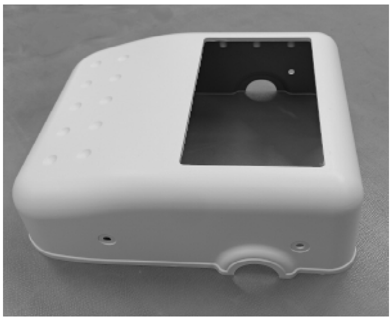
A14.3
A14.2
A14.1
A14.4
A14.5
(inside)
A14.6

A1



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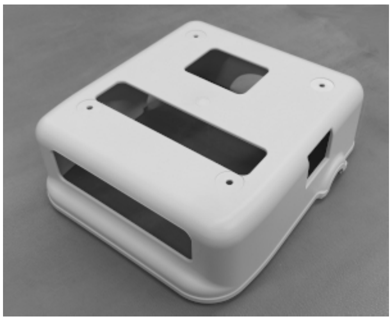
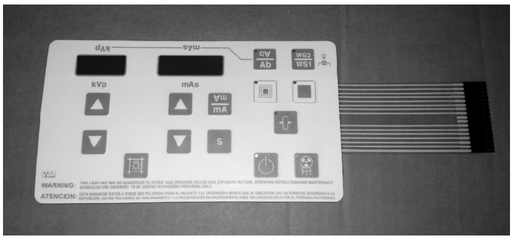
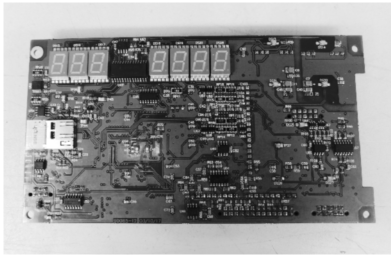


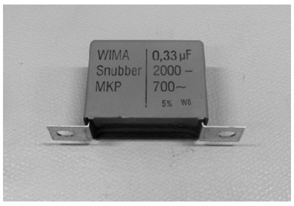
A3



A4



A5



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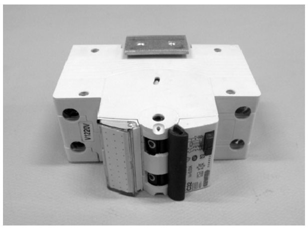

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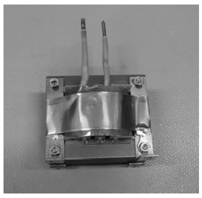
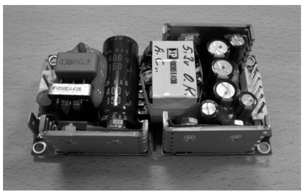
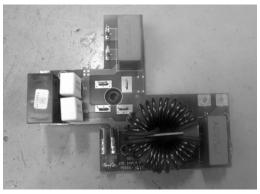


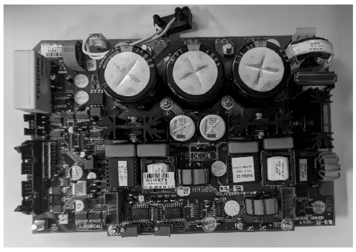
A8



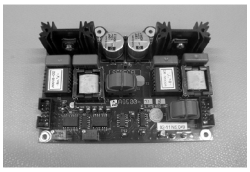
A9



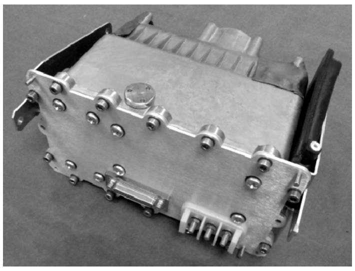
A10



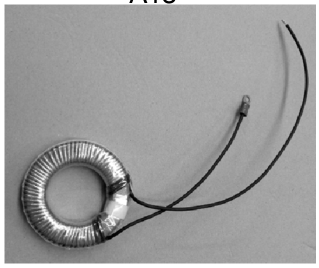
A11



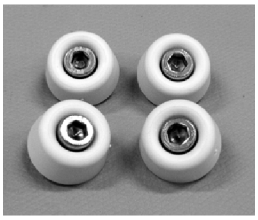
A12



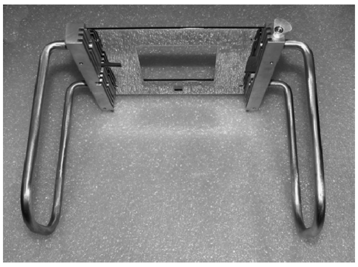
A13



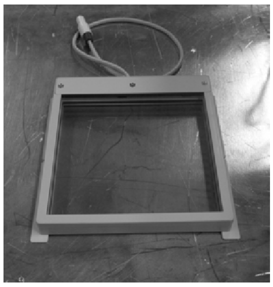
A15



A16

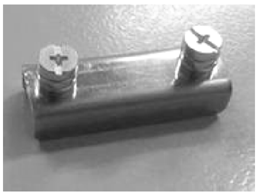


A17



A18

A19



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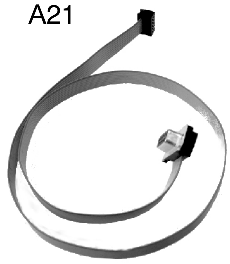
A21



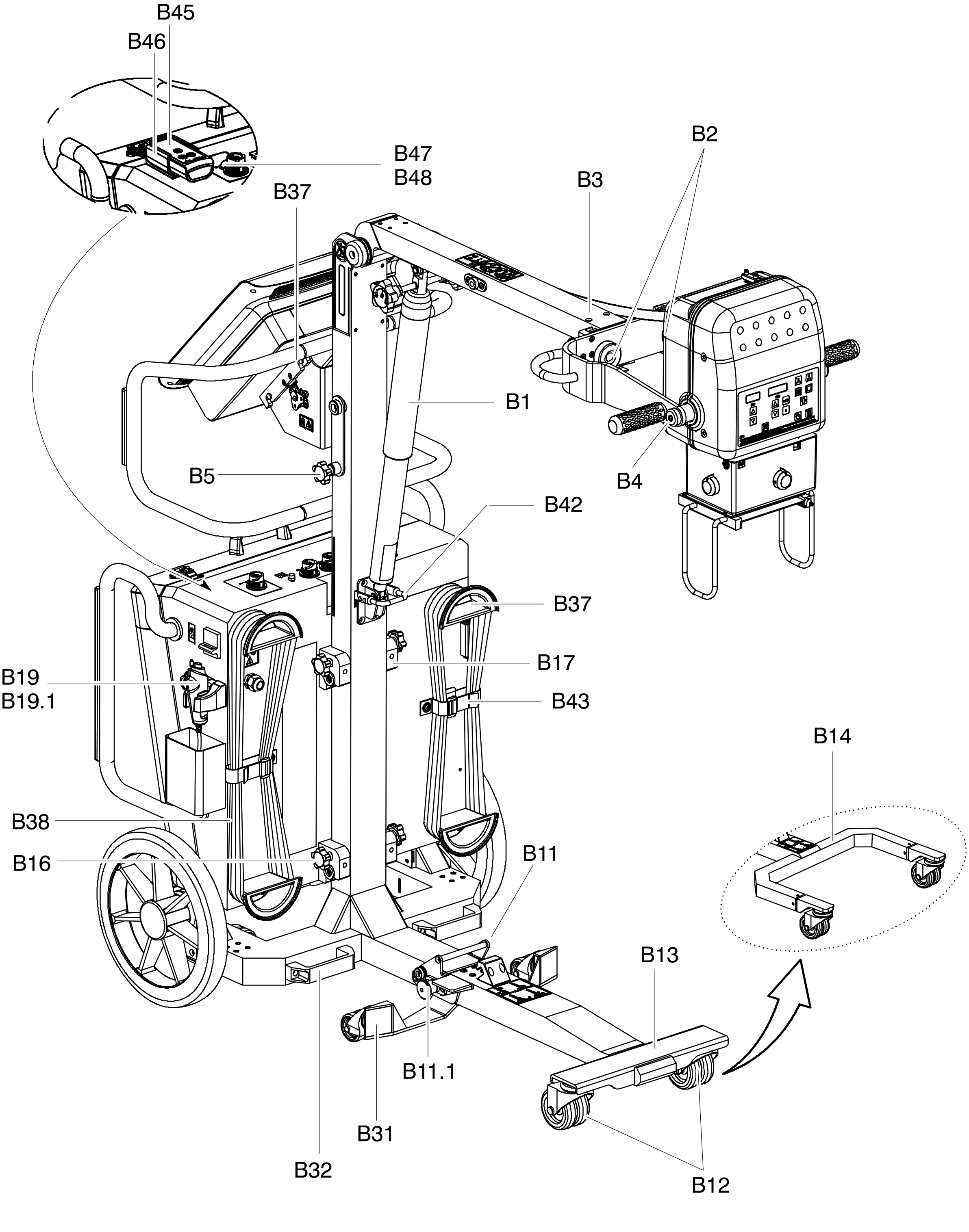
A22

A23

ITEM	DESCRIPTION	QTY.	REFERENCE	REMARKS
B	**TROLLEY**			
B1	Gas Spring Kit	1	SAT-A11807-05	Included ITEM B6
B2	Quick Disconnect Kit	1	A523024-01	Optional
B3	Rotation Kit of the X-ray Unit Support	1	A520232-01	
B4	X-Ray Unit Shaft	1	A520330-02	
B5	Fixing Arm Kit	1	SAT-A20216-01	
B6	Lock Handle Kit	1	A520329-02	
B7	Arm Catch Kit	1	A520234-02	
B8	Handgrips	2	A520231-02	On Monoblock Support
B9	Upper Protection Bars	1	SAT-AS01680	
B9.1	Lower Protection Bars (optional)	1	A526060-01	
B10	Head Handle	1	SAT-23846-01	Includes 2 units
B11	Leg Locking System	1	SAT-AS00086	Included ITEM B11.1
B11.1	Safety Knob (Pin)	1	SAT-54404044	
B12	Standard Steering Wheel (Castor)	2	SAT-53810071	
B13	T Shaped Leg & Wheels	1	SAT-A7969-05	with Standard Wheels - Includes B12
B14	Optional Leg “Y” shape	1	SAT-A7969-06	with Standard Wheels - Includes B12
B15	Corrugated Cable Clamp	1	SAT-53530106	Includes 5 units
B16	Fixing Box Right	1	SAT-A20217-01	Includes 2 units
B17	Fixing Box Left	1	SAT-A20217-02	Includes 2 units
B18	Communication Cable	1	A7910-04	
B19	Handswitch with Support	1	SAT-A6805-14	Includes Item B19.1
B19.1	Handswitch Support	1	SAT-11996-01	
B20	Detector Basket Handle	1	SAT-54402016	
B21	Detector Basket Cover Clasp	2	SAT-53830305	
B22	Detector Basket Hinge	2	SAT-53820025	
B23	DVD	1	SAT-55001366	

ITEM	DESCRIPTION	QTY.	REFERENCE	REMARKS
B	**TROLLEY**			
B24A	Detector Box Kit with standard Hatch and without Battery Charger connection	1	SAT-AS00022	Compatible with Detectors supplied with or without Removable Protective Frame (item B33): AR A3543W, 3543EZ, 3543DR, Mars 1417 Compatible with Detectors supplied without Removable Protective Frame (item B33): AR A4343W, Mars 1717
B24B	Detector Box Kit with standard Hatch and with Battery Charger connection	1	SAT-AS01257	Compatible with Detectors supplied with or without Removable Protective Frame (item B33): AR A3543W Compatible with Detectors supplied without Removable Protective Frame (item B33): AR A4343W
B24C	Detector Box Kit with opening Hatch and without Battery Charger connection	1	SAT-AS00039	Compatible with Detectors supplied with Removable Protective Frame (item B33): AR A4343W, Mars 1717
B24D	Detector Box Kit with opening Hatch and with Battery Charger connection	1	SAT-AS01258	Compatible with Detectors supplied with Removable Protective Frame (item B33): AR A4343W
B25	PC 8Gb, 500Gb	1	SAT-CC00256	
B25.1	Laptop	1	SAT-CC01053	Brazil
			SAT-CC01054	USA
			SAT-CC01055	Spain
B26	Uninterruptible Power Supply (UPS)	1	SAT-CC00012	Located inside the computer
B27	Standard Wheel	1	SAT-A20220-01	Included 2 wheels
B28	All-Terrain Wheel	1	SAT-A20220-02	Included 2 wheels
B29	Wheel Lock Lever Kit	1	SAT-A20211-01	Includes 2 units
B30	Lateral Motion Kit	1	SAT-A11828-03	Includes 2 units
B31	Lower Support Wheels	1	SAT-A11806-03	
B32	Loading Handles	2	SAT-54402037	
B33	Protective Frame for Detector (Grid Holder for Detector)	1	SAT-AS00153	for Detector 35 cm x 43 cm
		1	SAT-AS00154	for Detector 43 cm x 43 cm

ITEM	DESCRIPTION	QTY.	REFERENCE	REMARKS
B	**TROLLEY**			
B34	Grid 52L/cm FD110cm R10:1	1	6697-102	for Detector 35x43
	Grid 52L/cm FD140cm R10:1	1	6697-103	
	Grid 52L/cm FD180cm R10:1	1	6697-104	
	Grid 40L/cm FD110cm R10:1	1	6697-109	for Detector 43x43
	Grid 40L/cm FD140cm R10:1	1	6697-110	
	Grid 40L/cm FD180cm R10:1	1	6697-111	
B35	Brake Mechanism	1	SAT-AS00354	
B36	LED PCB	1	SAT-A11832-04	
B37	Cable Support	1	SAT-29936-01	Includes 4 units
B38	Power Line Cable	1	A3390-07	Europe
		1	A6725-08	USA
B39	Collimator Cable	1	A7954-01	
B40	Harness PC Dragon LW	1	A11820-21	
B41	Cable Kit Control Box LW	1	A6343-131	
B42	Column Lock	1	SAT-A20226-01	
B43	Straps Kit	1	A526052-01	
B44	Foot Switch	1	SAT-A6389-22	
B45	IR Remote Control	1	SAT-AS01855	Optional
B46	Support	1	SAT-11364079	
B47	IR Simple Transmitter	1	SAT-A40186-01	
B48	IR D888 to HSW Bypass	1	SAT-A40185-01	
B49	Conex IR Receiver IR Bypass	1	A21432-01	cable
B50	Conex Power Supply IR Bypass	1	A21434-01	cable
B51	Conex IR Bypass Conect	1	A21435-01	cable
B52	Power Cord	1	SAT-CC02424	Israel
		1	SAT-CC02425	Australia / New Zeland
		1	SAT-CC02426	Argentina
		1	SAT-CC02427	Switzerland
		1	SAT-CC02428	Chile
		1	SAT-CC02429	South Africa / India
		1	SAT-CC02430	Brazil
		1	SAT-50613056	UK
		1	SAT-50613032	China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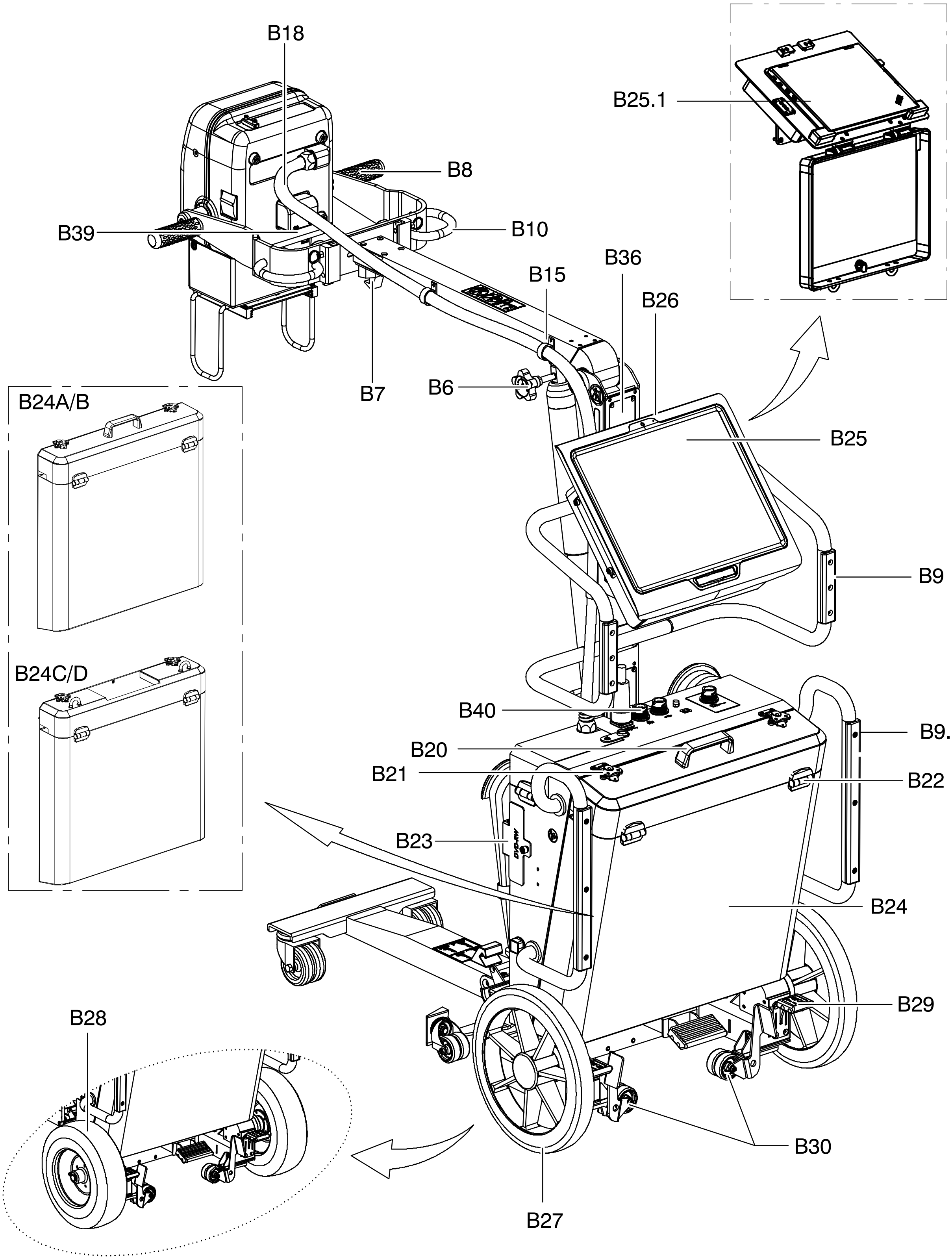
B12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B6
B24A/B
B25
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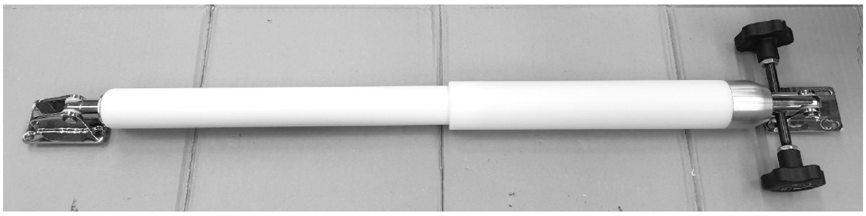

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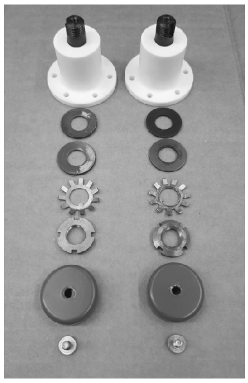

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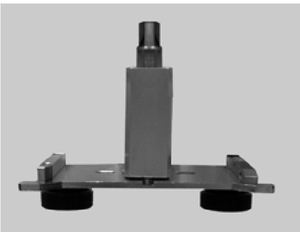

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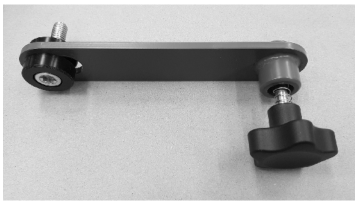

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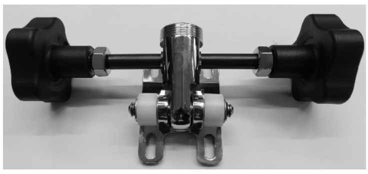

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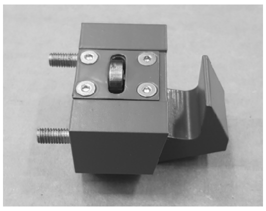

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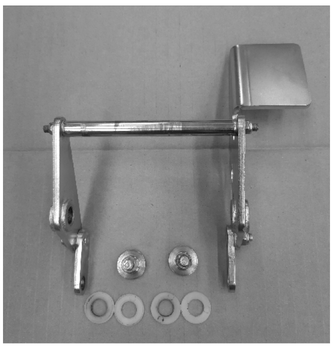

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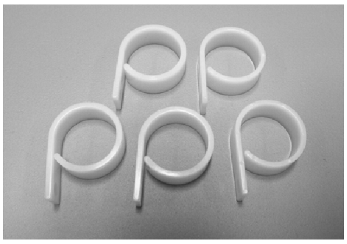

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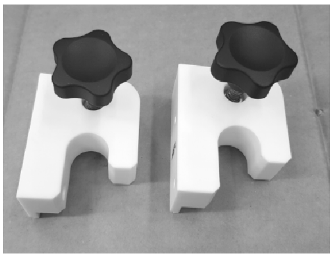

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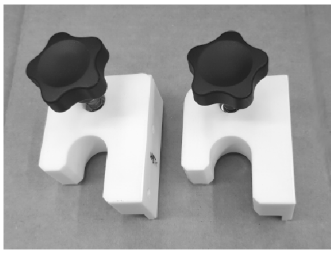

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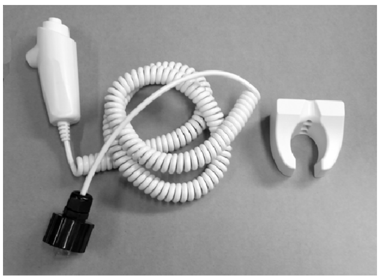

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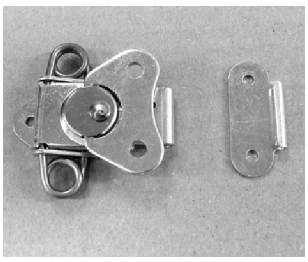

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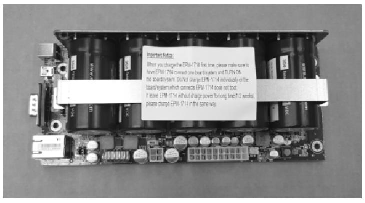

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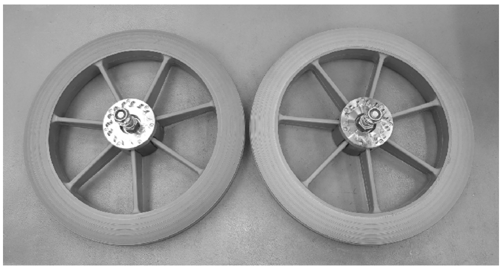

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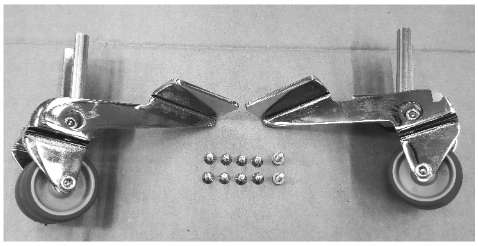

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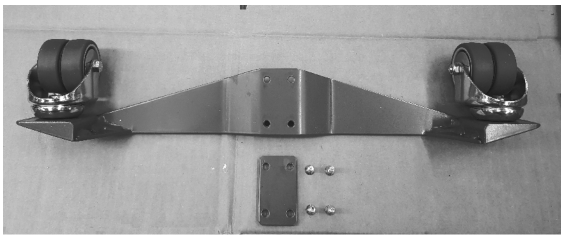

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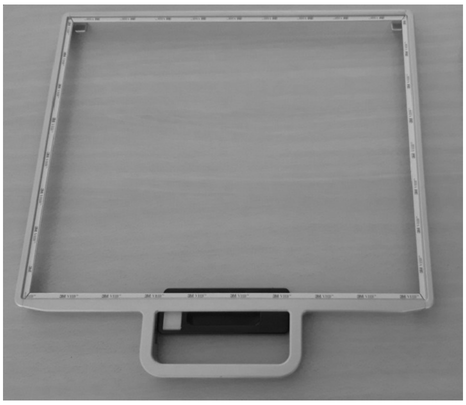

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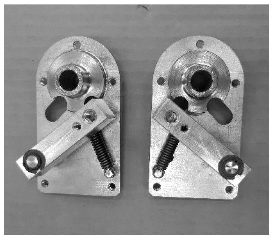

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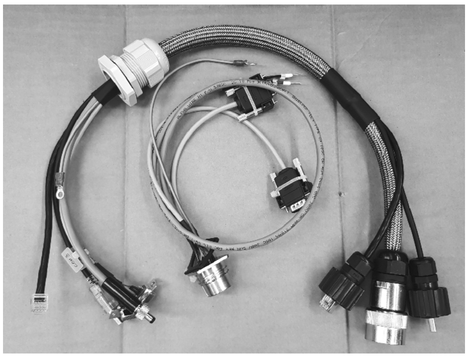

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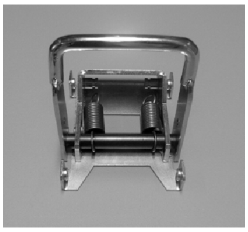

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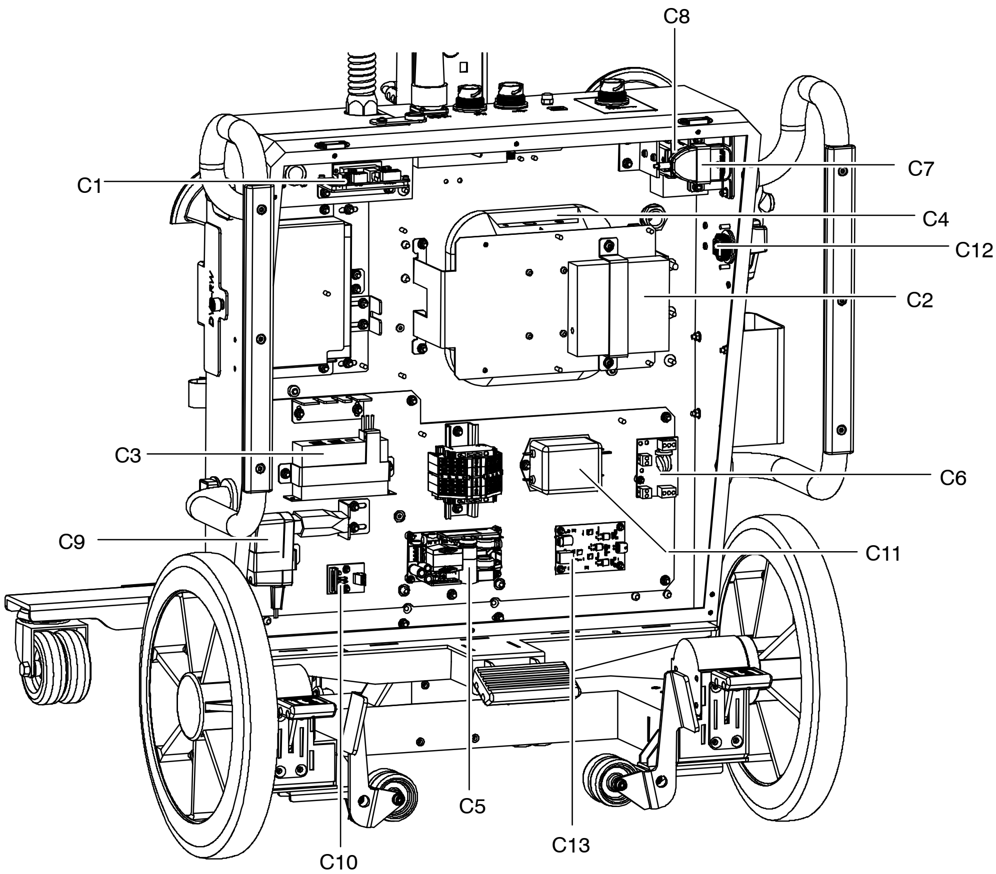
B44

B45

ITEM	DESCRIPTION	QTY.	REFERENCE	REMARKS
C	**CONNECTION BOX**			
C1	PCB Connect	1	SAT-A3632-02	
C2	Switch 5 ports ethernet	1	SAT-55001194	
C3	HUB for USB	1	SAT-55001275	
C4	Access Point (Aruba)	1	SAT-CC00923	for Egypt
			SAT-CC00924	for Israel
			SAT-CC00925	for Japan
			SAT-CC00926	for ROW
			SAT-CC00927	for USA
C5	Power Supply for X-Ray Unit	1	SAT-53418068	
C6	Varistor PCB	1	SAT-A9524-02	
C7	Infrared	1	SAT-55001176	
C8	Thermal Switch	1	SAT-50613105	
C9	Power Supply (Dosimeter)	1	SAT-CC00147	
C10	PBA Detector Charger	1	SAT-A40045-01	
C11	Line Filter	1	SAT-50208001	
C12	Handswitch Plug	1	SAT-55001229	
C13	PBA Warning Light	1	SAT-A3709-01	Optional
C14	Backup Cable	1	55901157	for AR-A3543W, AR-A4343W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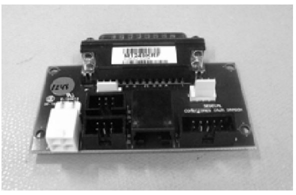
C1



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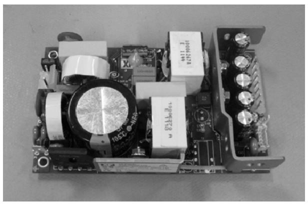
C3

C4

C5



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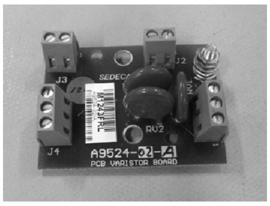

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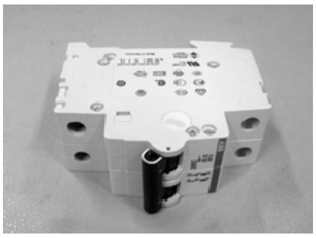
C8



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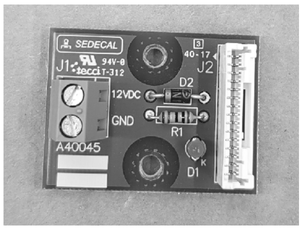

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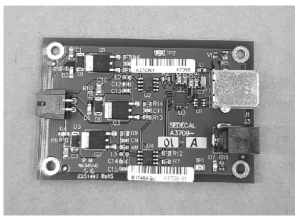

ITEM	DESCRIPTION	QTY.	REFERENCE	REMARKS
D	**FOLDING COLUMN OPTION** *(THE FOLLOWING LID CASES ARE SPECIFIC FOR THIS COLUMN OPTION)*			
D1	Lid Case 1 - Military Green (Trolley)	1	SAT-55411013	
D2	Lid Case 2 - Military Green (Detector)	1	SAT-55411014	
D3	Single Transport Military Box	1	SAT-A9000-07	

D1

D2

D3

SECTION 9 SCHEMATICS

SCHEMATIC	DESCRIPTION
54302307	SPSLWX-DRLW-II
54302052	Portable X-Ray Unit: Monoblock *(Generador Compacto Ligero Rad)*
A3175-05	Portable Control Board (*Control Portatil PCB)*
A3189-07	Control Driver Board - *Control Driver PCB*
A3191-04	EMC Input Filter Board
A9500-01	Filaments HF Board
A9524-02	Varistor Board
A3632-02	Remote Console Connectors (*Conectores Caja Dragón*)
A3709-01	Warning Light Board

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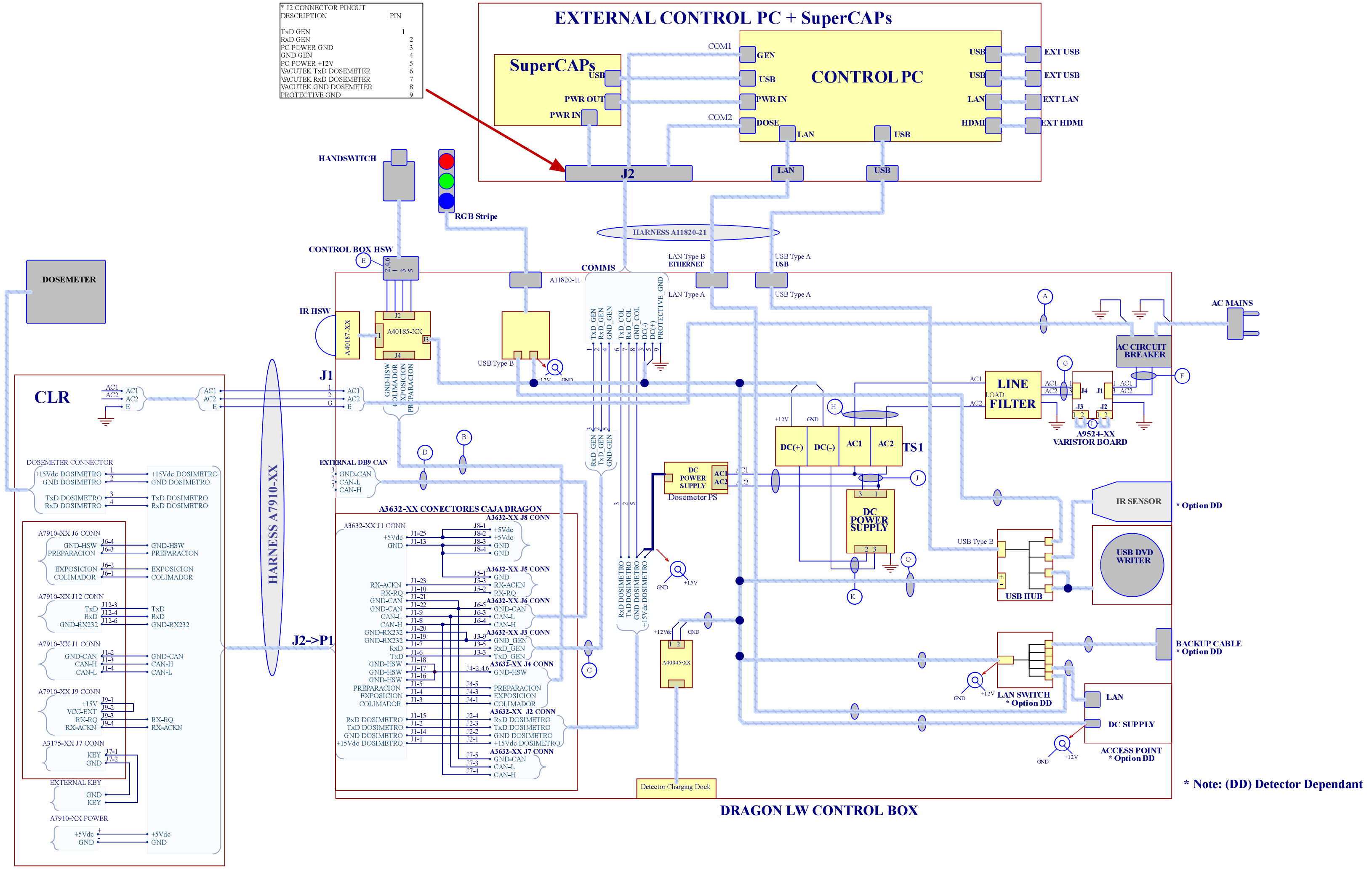
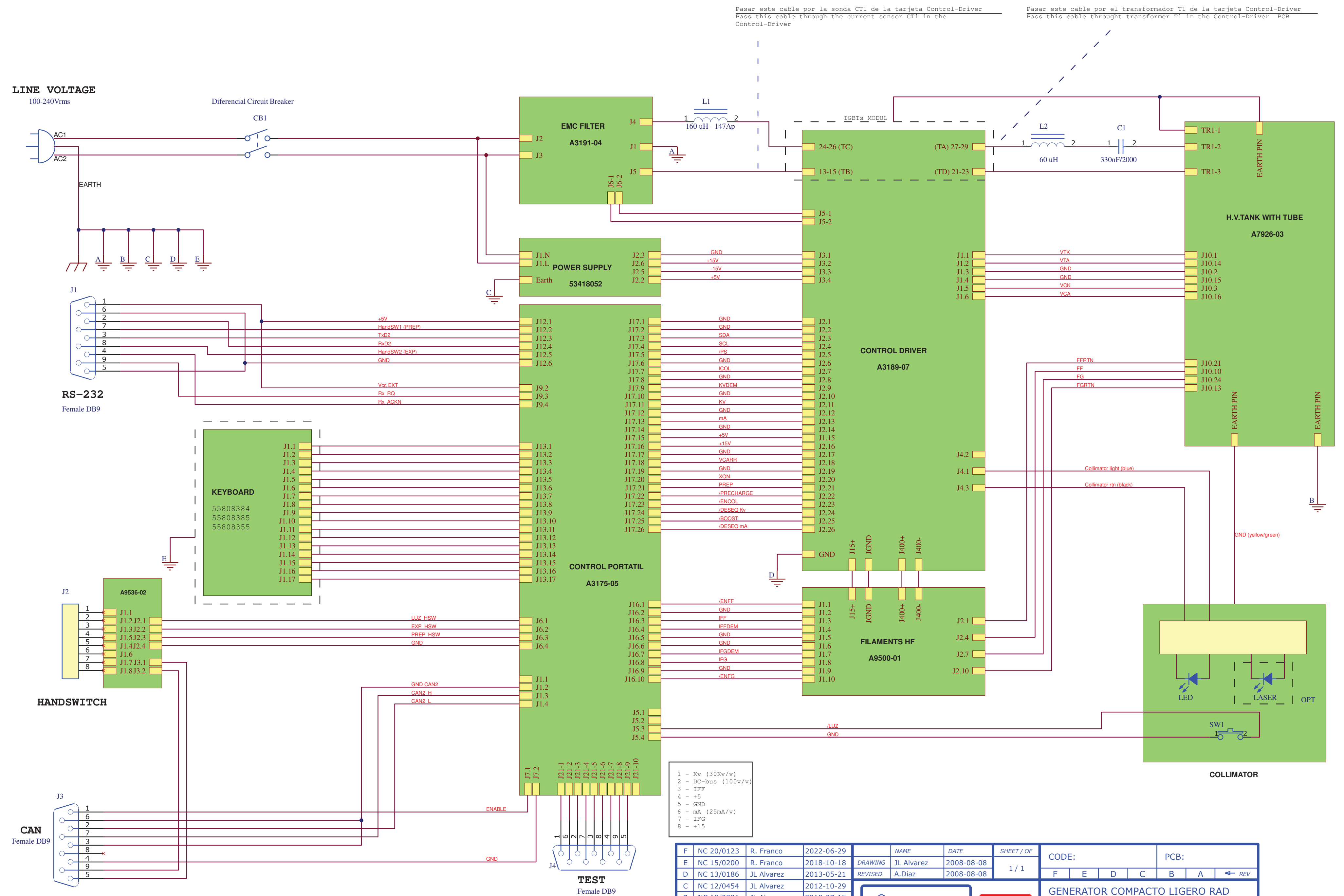


					NAME	DATE	SHEET / OF	PBA: 54302307	PCB: NA
				DRAWING	J.A.Garcia	11/09/18	1 / 1		
				REVISED	F.Diaz	11/09/18		C B A ← REV	
C	NC 21/0451	J.A.Garcia	24/11/21	SEDECAL	CONFIDENTIAL			SPSLWX-DRLW-II	
B	NC: 21/0301	J.A.Garcia	06/08/21						
A	NC: 18/0352	J.A.Garcia	11/09/18						
REV	DESCRIPTION	ISSUED BY	DATE						



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E	NC 15/0200	R. Franco	2018-10-18
D	NC 13/0186	JL Alvarez	2013-05-21
C	NC 12/0454	JL Alvarez	2012-10-29
B	NC 10/0321	JL Alvarez	2010-07-15
A	First Is.	JL Alvarez	2008-08-08

	NAME	DATE
DRAWING	JL Alvarez	2008-08-08
REVISED	A.Diaz	2008-08-08

SHEET / OF 1 / 1

SEDECAL

CONFIDENTIAL

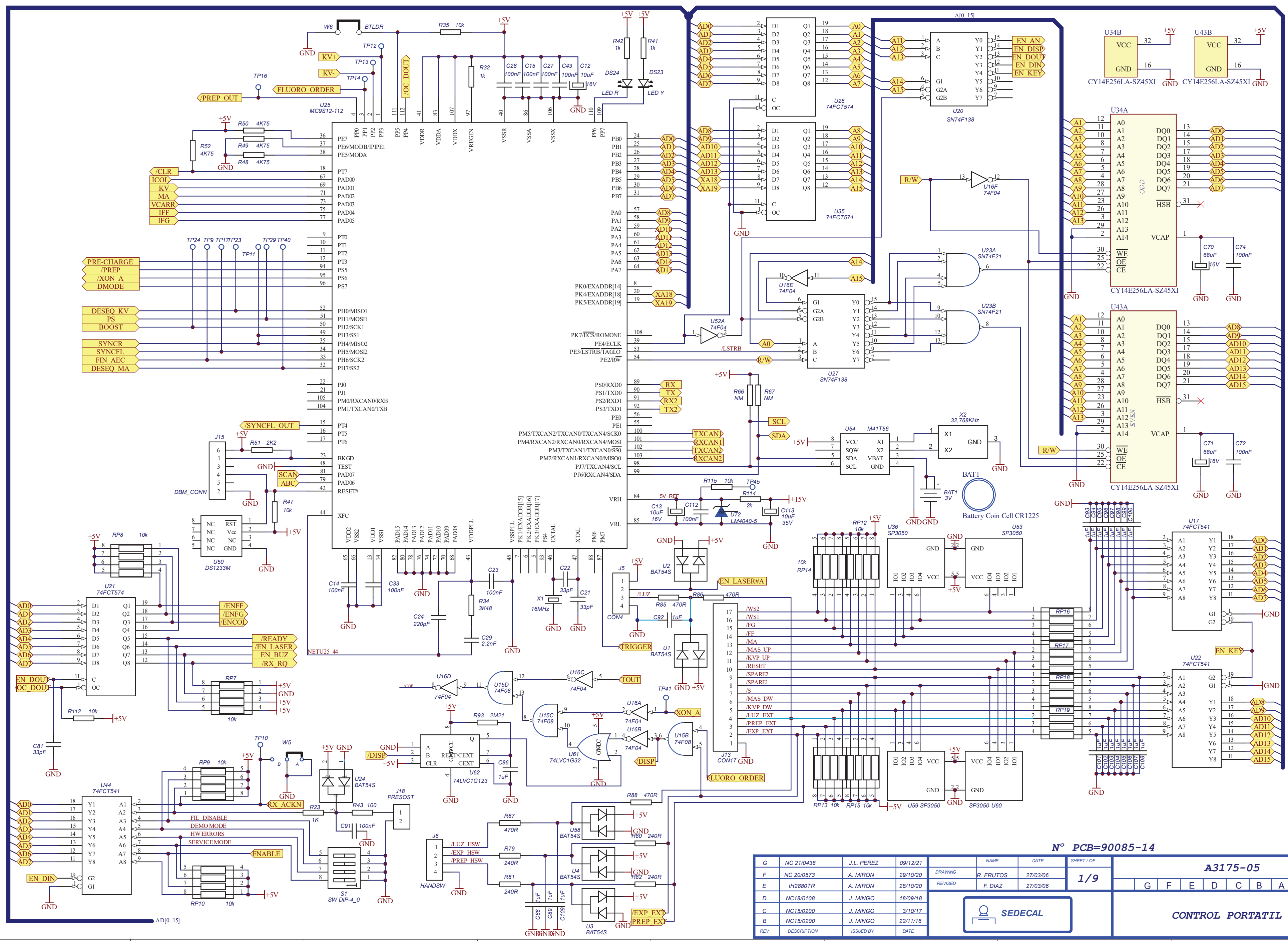
CODE:

PCB:

F E D C B A ← REV

GENERATOR COMPACTO LIGERO RAD

54302052



N° PCB=90085-14

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G	NC 21/0438	J.L. PEREZ	09/12/21
F	NC 20/0573	A. MIRON	29/10/20
E	IH2880TR	A. MIRON	28/10/20
D	NC18/0108	J. MINGO	18/09/18
C	NC15/0200	J. MINGO	3/10/17
B	NC15/0200	J. MINGO	22/11/16

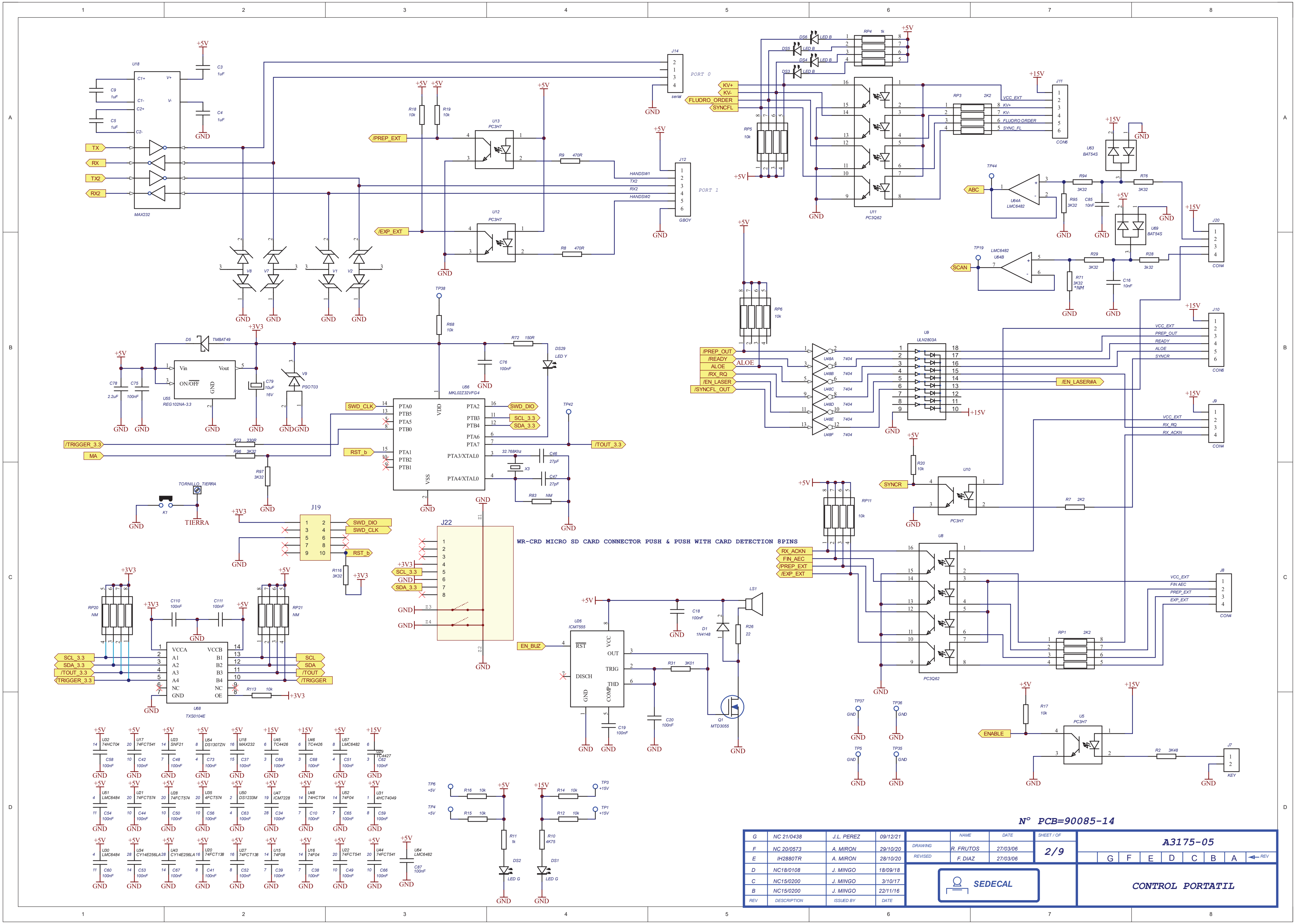
	NAME	DATE	SHEET / OF
DRAWING	R. FRUTOS	27/03/06	1/9
REVISED	F. DIAZ	27/03/06	

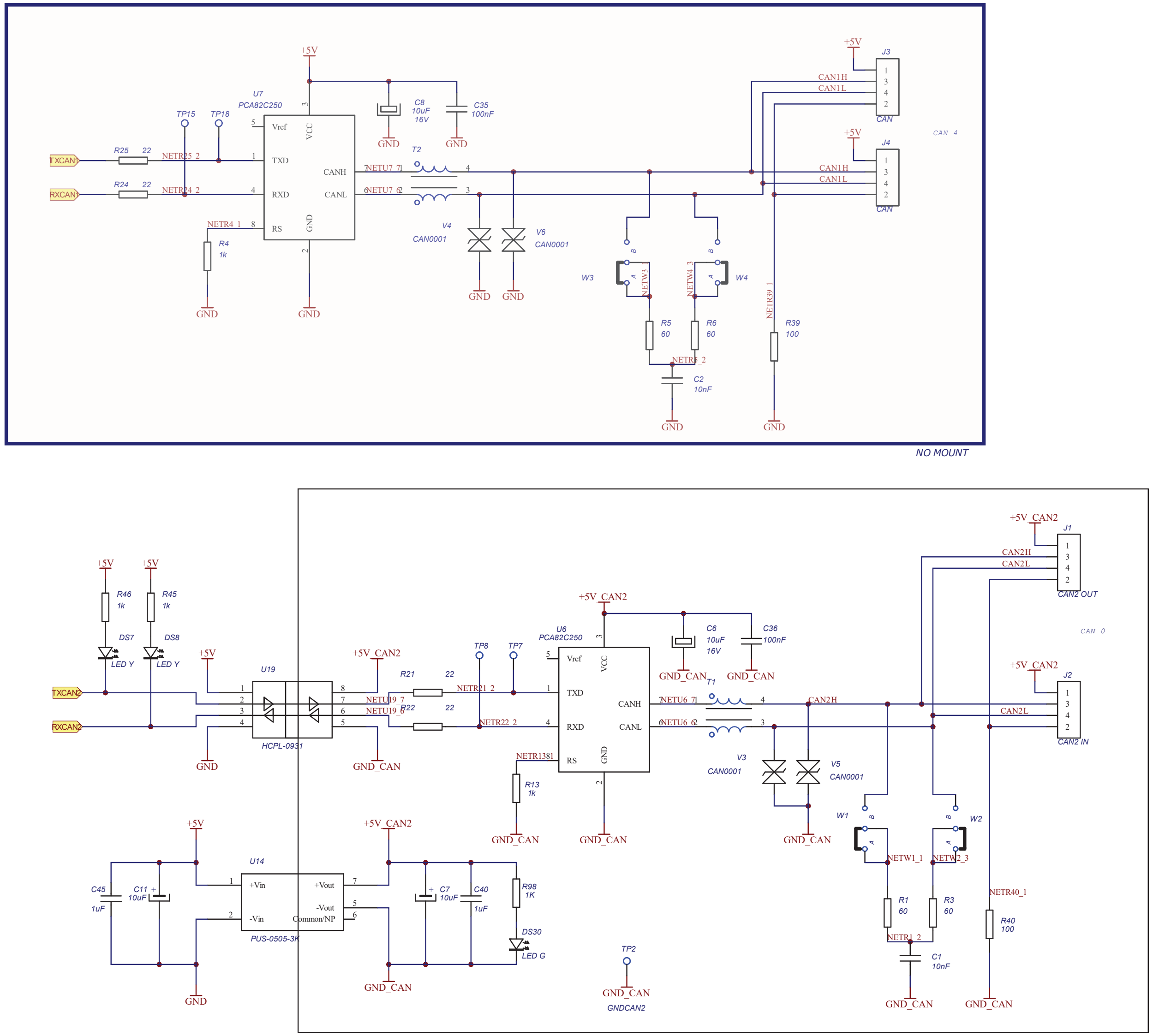
SEDECAL

A3175-05

G F E D C B A ← REV

CONTROL PORTATIL


WR-CRD MICRO SD CARD CONNECTOR PUSH & PUSH WITH CARD DETECTION 8PINS
PORT 0
PORT 1
Nº PCB=90085-14
A3175-05
CONTROL PORTATIL
SEDECAL
SHEET / OF
2/9
DRAWING R. FRUTOS 27/03/06
REVISED F. DIAZ 27/03/06
G NC 21/0438 J.L. PEREZ 09/12/21
F NC 20/0573 A. MIRON 29/10/20
E IH2880TR A. MIRON 28/10/20
D NC18/0108 J. MINGO 18/09/18
C NC15/0200 J. MINGO 3/10/17
B NC15/0200 J. MINGO 22/11/16
REV DESCRIPTION ISSUED BY DATE



N° PCB=90085-14

REV	DESCRIPTION	ISSUED BY	DATE
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F	NC 20/0573	A. MIRON	29/10/20
E	IH2880TR	A. MIRON	28/10/20
D	NC18/0108	J. MINGO	18/09/18
C	NC15/0200	J. MINGO	3/10/17
B	NC15/0200	J. MINGO	22/11/16

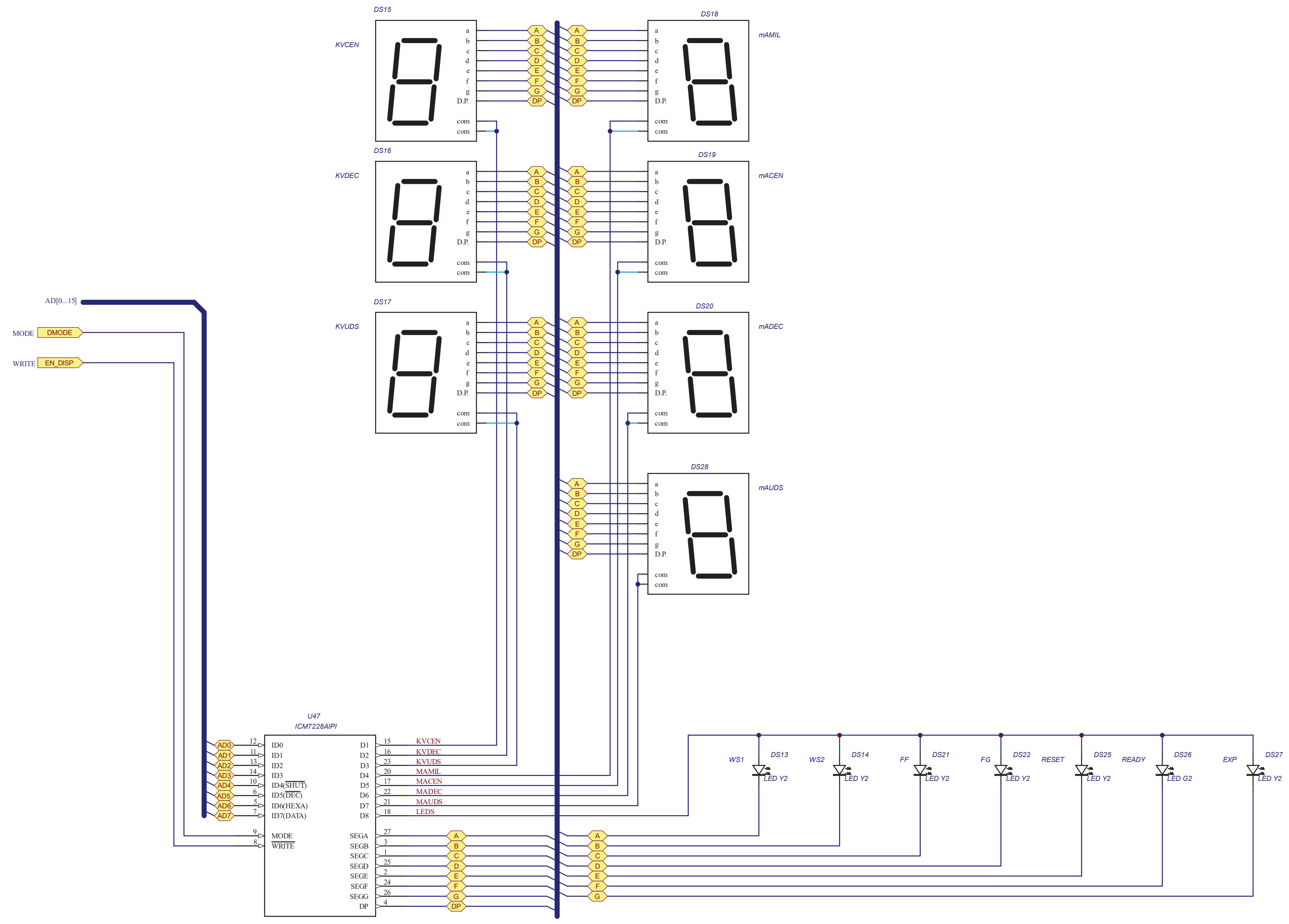
	NAME	DATE	SHEET / OF
DRAWING	R. FRUTOS	27/03/06	3/9
REVISED	F. DIAZ	27/03/06	

SEDECAL

A3175-05

G F E D C B A ← REV

CONTROL PORTATIL



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F	NC 20/0573	A. MIRON	29/10/20
E	IH2880TR	A. MIRON	28/10/20
D	NC18/0108	J. MINGO	18/09/18
C	NC15/0200	J. MINGO	3/10/17
B	NC15/0200	J. MINGO	22/11/16

	NAME	DATE
DRAWING	R. FRUTOS	27/03/06
REVISED	F. DIAZ	27/03/06

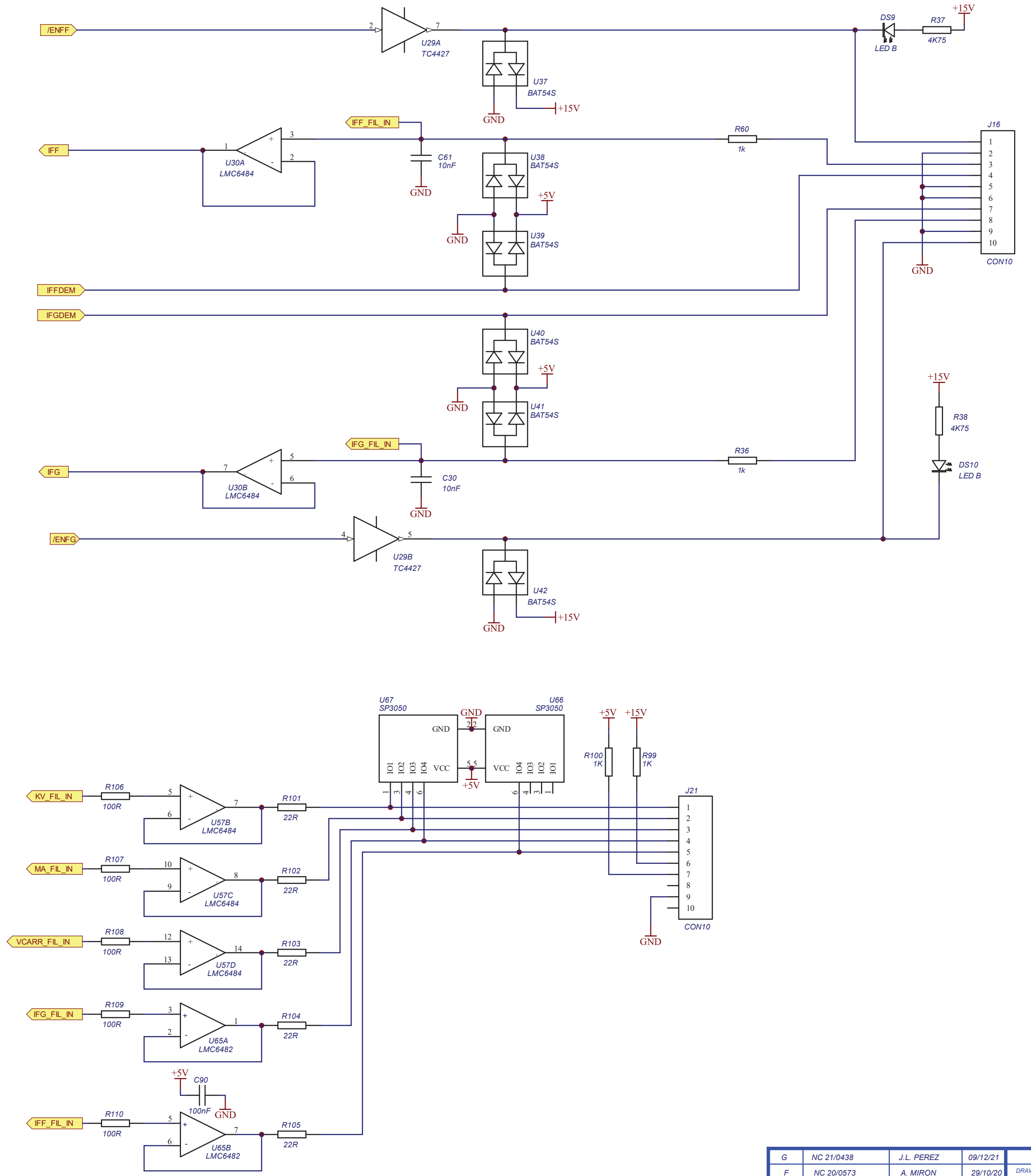
SHEET / OF 4/9

SEDECAL

A3175-05

G F E D C B A ← REV

CONTROL PORTATIL



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REV	DESCRIPTION	ISSUED BY	DATE
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E	IH2880TR	A. MIRON	28/10/20
D	NC18/0108	J. MINGO	18/09/18
C	NC15/0200	J. MINGO	3/10/17
B	NC15/0200	J. MINGO	22/11/16

	NAME	DATE
DRAWING	R. FRUTOS	27/03/06
REVISED	F. DIAZ	27/03/06

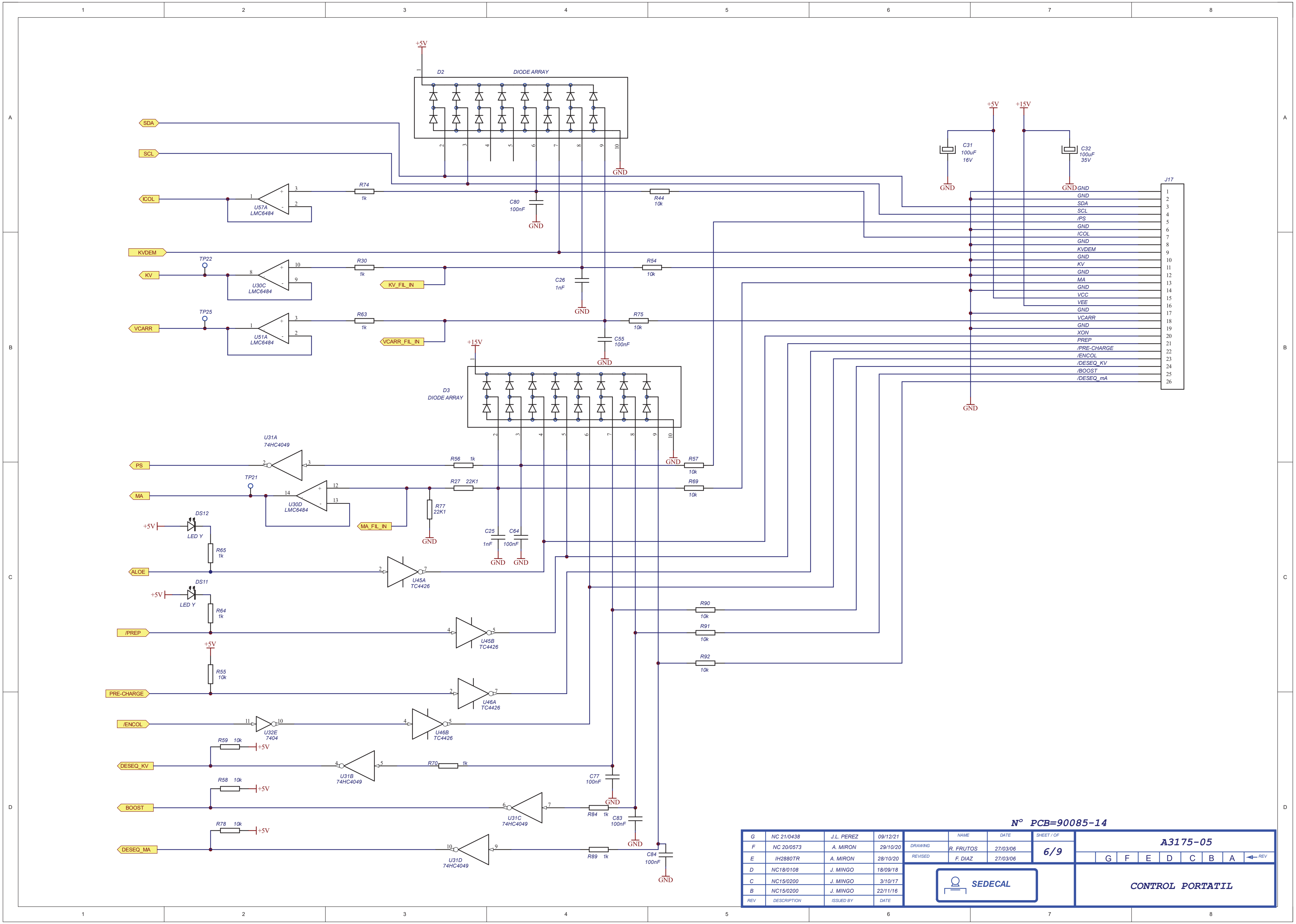
SHEET / OF 5/9

SEDECAL

A3175-05

G F E D C B A ← REV

CONTROL PORTATIL



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D3 DIODE ARRAY
+5V
+15V
GND
SDA
SCL
ICOL
KVDEM
KV
VCARR
PS
MA
ALOE
/PREP
PRE-CHARGE
/ENCOL
DESEQ_KV
BOOST
DESEQ_MA
KV_FIL_IN
VCARR_FIL_IN
MA_FIL_IN
TP22
TP25
TP21
U57A LMC6484
U30C LMC6484
U51A LMC6484
U30D LMC6484
U31A 74HC4049
U31B 74HC4049
U31C 74HC4049
U31D 74HC4049
U45A TC4426
U45B TC4426
U46A TC4426
U46B TC4426
U32E 7404
R74 1k
R30 1k
R63 1k
R44 10k
R54 10k
R75 10k
R56 1k
R57 10k
R27 22K1
R69 10k
R77 22K1
R65 1k
R64 1k
R55 10k
R59 10k
R58 10k
R78 10k
R70 1k
R84 1k
R89 1k
R90 10k
R91 10k
R92 10k
C80 100nF
C26 1nF
C55 100nF
C25 1nF
C64 100nF
C77 100nF
C83 100nF
C84 100nF
C31 100uF 16V
C32 100uF 35V
DS12 LED Y
DS11 LED Y
J17
GND
GND
SDA
SCL
/PS
GND
ICOL
GND
KVDEM
GND
KV
GND
MA
GND
VCC
VEE
GND
VCARR
GND
XON
PREP
/PRE-CHARGE
/ENCOL
/DESEQ_KV
/BOOST
/DESEQ_mA
N° PCB=90085-14
G NC 21/0438 J.L. PEREZ 09/12/21
F NC 20/0573 A. MIRON 29/10/20
E IH2880TR A. MIRON 28/10/20
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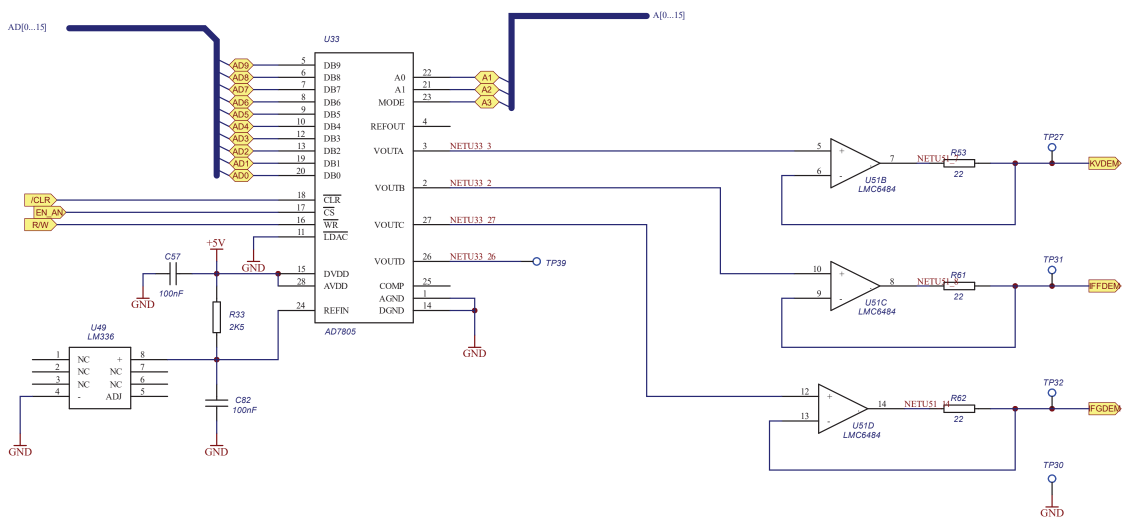
B NC15/0200 J. MINGO 22/11/16
REV DESCRIPTION ISSUED BY DATE
NAME DATE
DRAWING R. FRUTOS 27/03/06
REVISED F. DIAZ 27/03/06
SHEET / OF 6/9
SEDECAL
A3175-05
G F E D C B A REV
CONTROL PORTATIL



N° PCB=90085-14

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C	NC15/0200	J. MINGO	3/10/17
B	NC15/0200	J. MINGO	22/11/16

	NAME	DATE
DRAWING	R. FRUTOS	27/03/06
REVISED	F. DIAZ	27/03/06

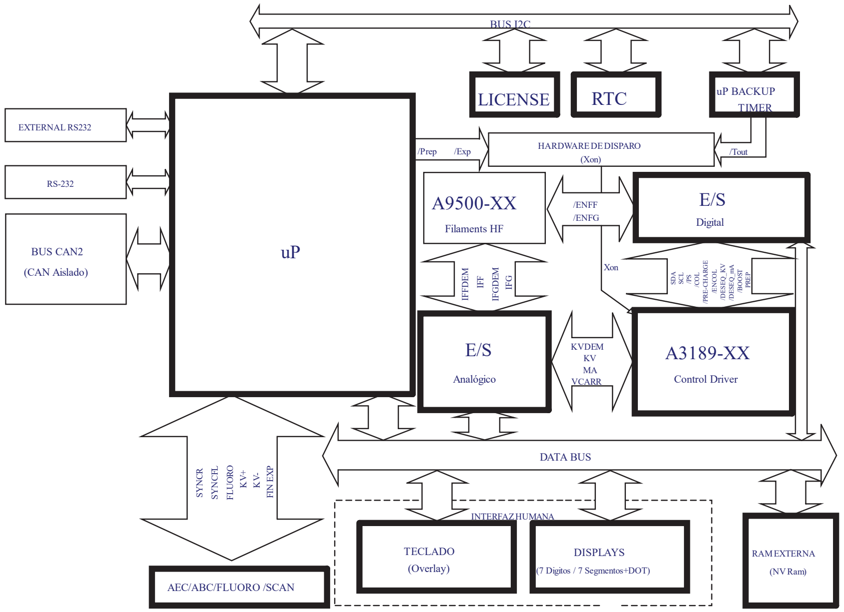
SHEET / OF 7/9

SEDECAL

A3175-05

G F E D C B A ← REV

CONTROL PORTATIL



N° PCB=90085-14

REV	DESCRIPTION	ISSUED BY	DATE
G	NC 21/0438	J.L. PEREZ	09/12/21
F	NC 20/0573	A. MIRON	29/10/20
E	IH2880TR	A. MIRON	28/10/20
D	NC18/0108	J. MINGO	18/09/18
C	NC15/0200	J. MINGO	3/10/17
B	NC15/0200	J. MINGO	22/11/16

	NAME	DATE
DRAWING	R. FRUTOS	27/03/06
REVISED	F. DIAZ	27/03/06

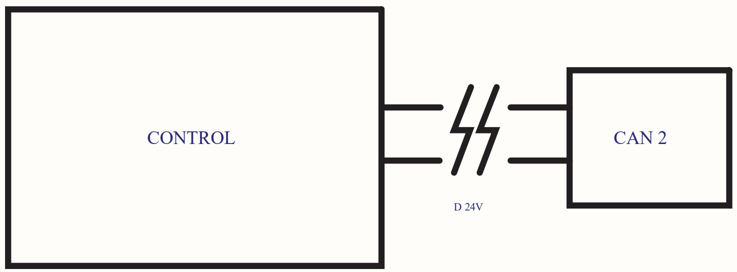
SHEET / OF 8/9

SEDECAL

A3175-05

G F E D C B A ← REV

CONTROL PORTATIL



N° PCB=90085-14

REV	DESCRIPTION	ISSUED BY	DATE
G	NC 21/0438	J.L. PEREZ	09/12/21
F	NC 20/0573	A. MIRON	29/10/20
E	IH2880TR	A. MIRON	28/10/20
D	NC18/0108	J. MINGO	18/09/18
C	NC15/0200	J. MINGO	3/10/17
B	NC15/0200	J. MINGO	22/11/16

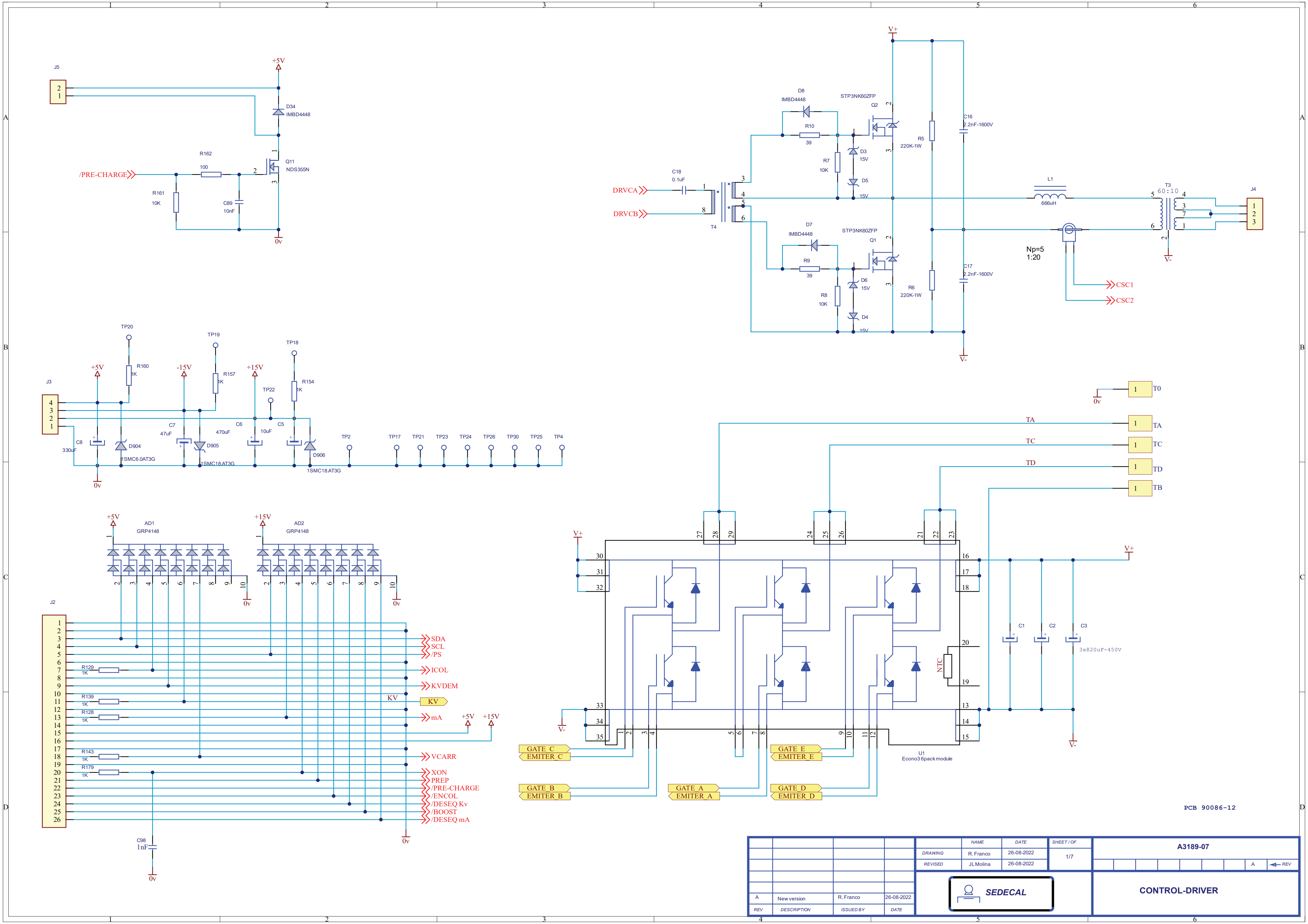
	NAME	DATE	SHEET / OF
DRAWING	R. FRUTOS	27/03/06	9/9
REVISED	F. DIAZ	27/03/06	

SEDECAL

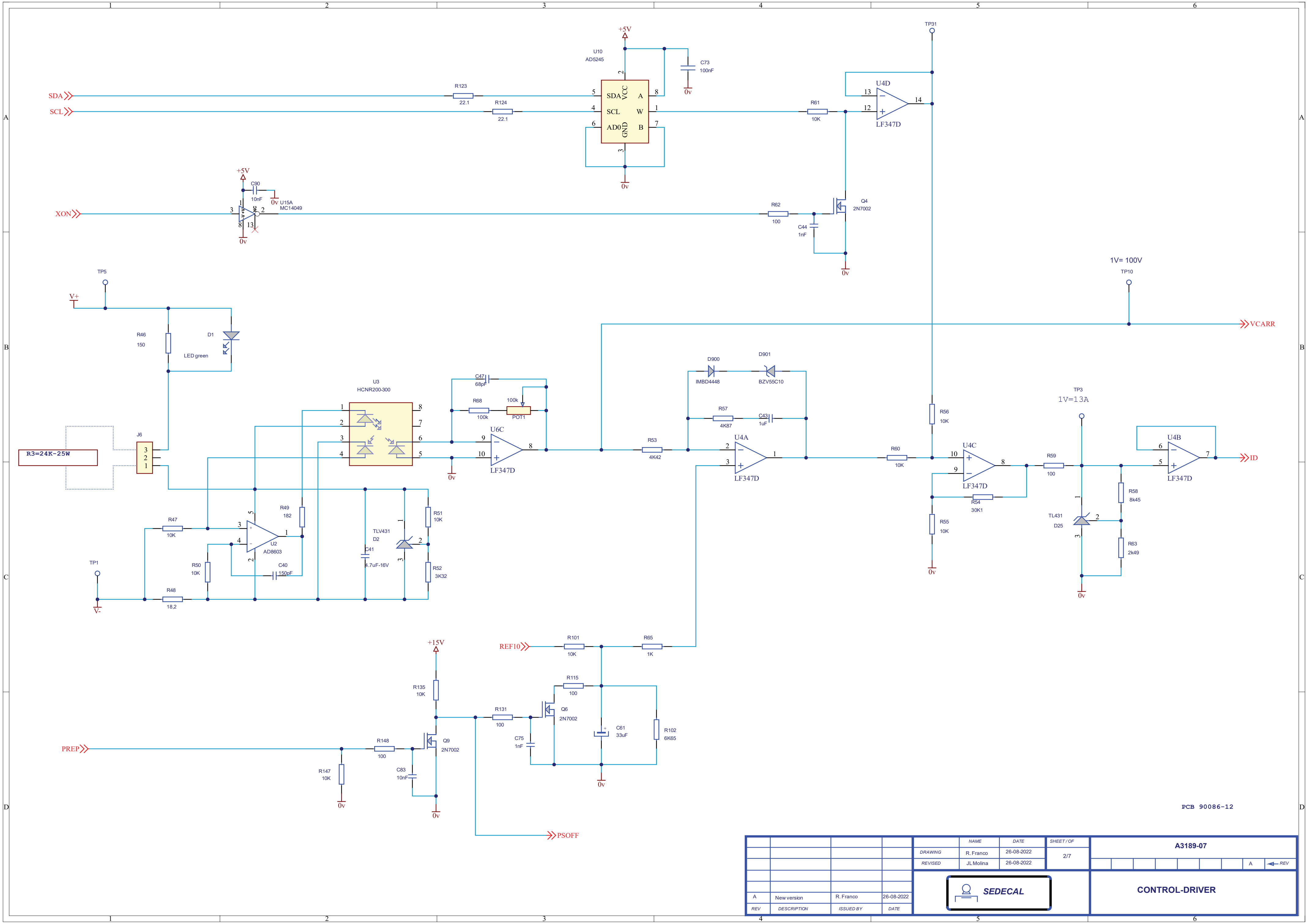
A3175-05

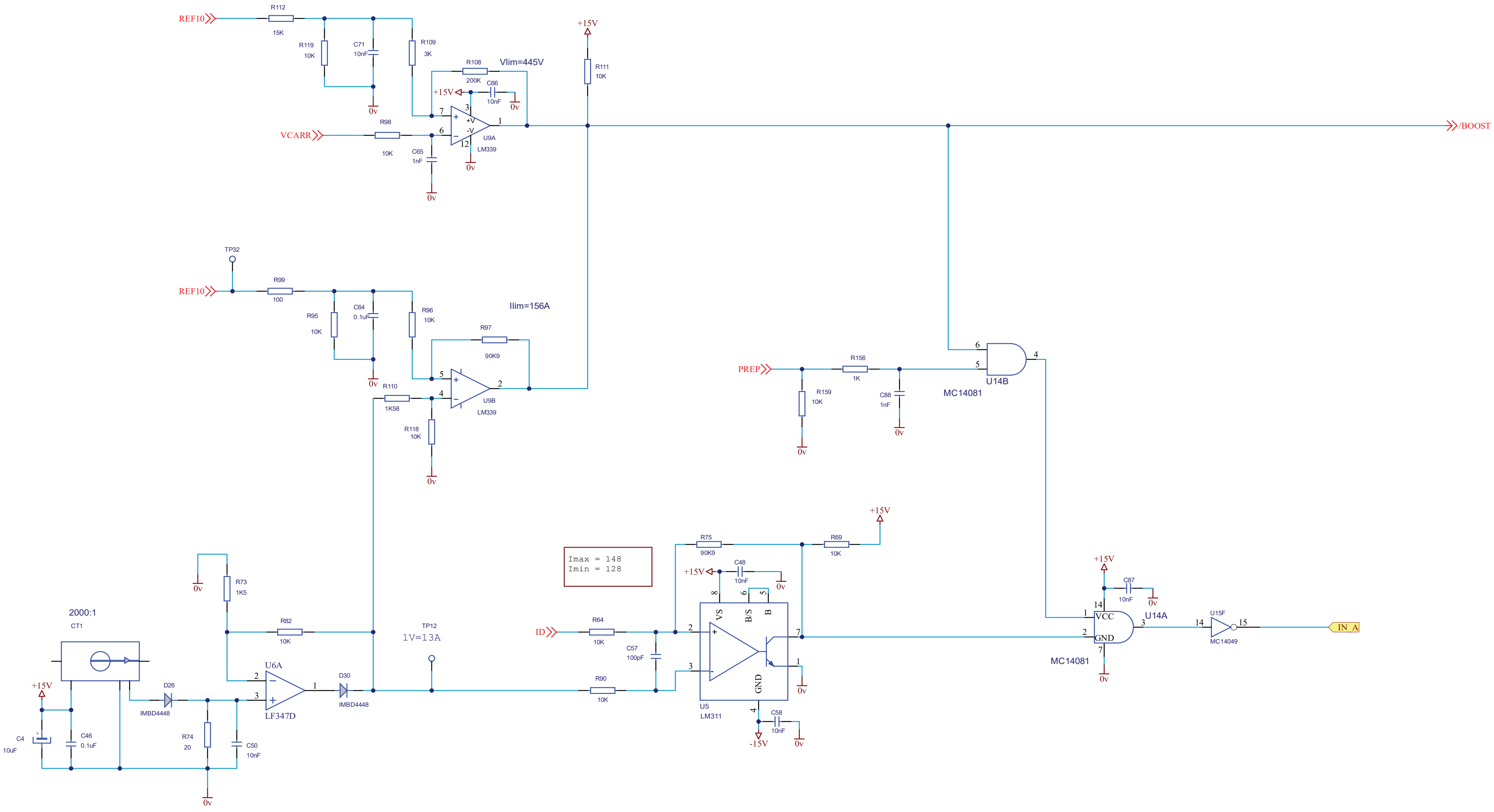
G	F	E	D	C	B	A	← REV

CONTROL PORTATIL



J5
+5V
D34
IMBD4448
R162
100
Q11
NDS355N
/PRE-CHARGE
R161
10K
C89
10nF
0v
V+
D8
IMBD4448
STP3NK60ZFP
Q2
R10
39
D3
15V
R7
10K
D5
15V
R5
220K-1W
C16
2.2nF-1600V
C18
0.1uF
DRVCA
DRVCB
T4
D7
IMBD4448
STP3NK60ZFP
Q1
R9
39
D6
15V
R8
10K
D4
15V
R6
220K-1W
C17
2.2nF-1600V
V-
L1
666uH
T3
60:10
J4
Np=5
1:20
CSC1
CSC2
TP20
R160
1K
TP19
R157
1K
TP18
R154
1K
J3
+5V
-15V
+15V
TP22
C7
47uF
C6
470uF
C5
10uF
C8
330uF
D904
1SMC6.0AT3G
D905
1SMC18AT3G
D906
1SMC18AT3G
TP2
TP17
TP21
TP23
TP24
TP26
TP30
TP25
TP4
T0
TA
TC
TD
TB
AD1
GRP4148
AD2
GRP4148
J2
R129
1K
R139
1K
R128
1K
R143
1K
R179
1K
C98
1nF
SDA
SCL
/PS
ICOL
KVDEM
KV
mA
VCARR
XON
PREP
/PRE-CHARGE
/ENCOL
/DESEQ Kv
/BOOST
/DESEQ mA
NTC
C1
C2
C3
3x820uF-450V
GATE_C
EMITER_C
GATE_B
EMITER_B
GATE_A
EMITER_A
GATE_E
EMITER_E
GATE_D
EMITER_D
U1
Econo3 6pack module
PCB 90086-12
NAME
DATE
SHEET / OF
DRAWING
R. Franco
26-08-2022
1/7
REVISED
JL Molina
26-08-2022
A3189-07
A
REV
SEDECAL
CONTROL-DRIVER
A
New version
R. Franco
26-08-2022
REV
DESCRIPTION
ISSUED BY
DATE


SDA
SCL
XON
R123
22.1
R124
22.1
+5V
U10
AD5245
C73
100nF
0v
SDA
SCL
AD0
VCC
GND
A
W
B
R61
10K
U4D
LF347D
TP31
R62
100
C44
1nF
Q4
2N7002
+5V
C90
10nF
U15A
MC14049
TP5
V+
R46
150
D1
LED green
1V= 100V
TP10
VCARR
J6
R3=24K-25W
U3
HCNR200-300
C47
68pF
R68
100k
100k
POT1
U6C
LF347D
D900
IMBD4448
D901
BZV55C10
R57
4K87
C43
1uF
R53
4K42
U4A
LF347D
R56
10K
R60
10K
U4C
LF347D
R54
30K1
R55
10K
R59
100
TP3
1V=13A
TL431
D25
R58
8k45
R63
2k49
U4B
LF347D
ID
R49
182
R47
10K
U2
AD8603
R50
10K
C40
150pF
TLV431
D2
C41
4.7uF-16V
R51
10K
R52
3K32
TP1
R48
18,2
V-
+15V
REF10
R101
10K
R65
1K
R115
100
R135
10K
R131
100
Q6
2N7002
C75
1nF
C61
33uF
R102
6K65
PREP
R148
100
Q9
2N7002
R147
10K
C83
10nF
PSOFF
PCB 90086-12
NAME
DATE
SHEET / OF
DRAWING
R. Franco
26-08-2022
REVISED
JL Molina
26-08-2022
2/7
A3189-07
A
REV
SEDECAL
CONTROL-DRIVER
A
New version
R. Franco
26-08-2022
REV
DESCRIPTION
ISSUED BY
DATE



PCB 90086-12

REV	DESCRIPTION	ISSUED BY	DATE
A	New version	R. Franco	26-08-2022

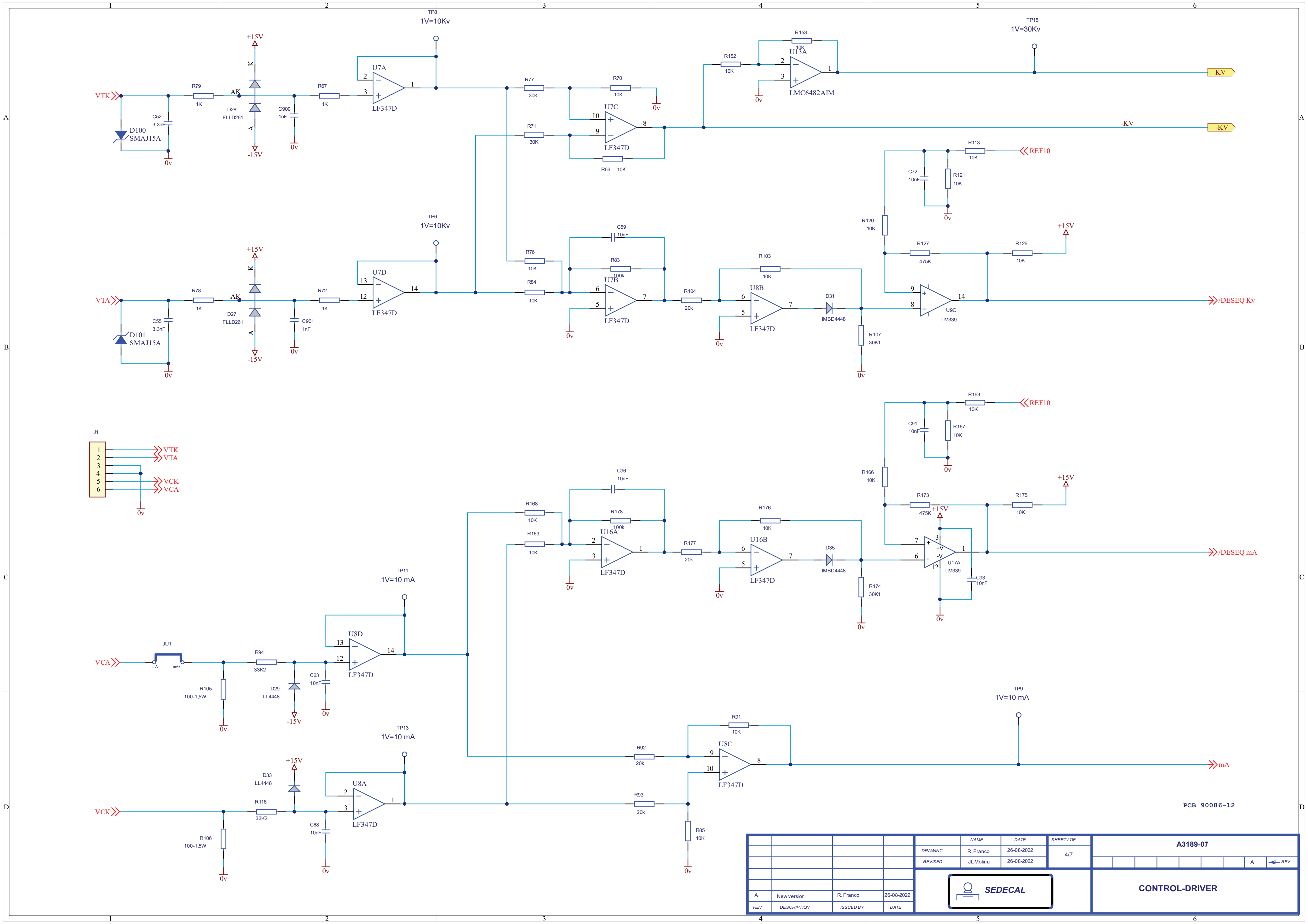
	NAME	DATE	SHEET / OF
DRAWING	R. Franco	26-08-2022	3/7
REVISED	JL Molina	26-08-2022	

SEDECAL

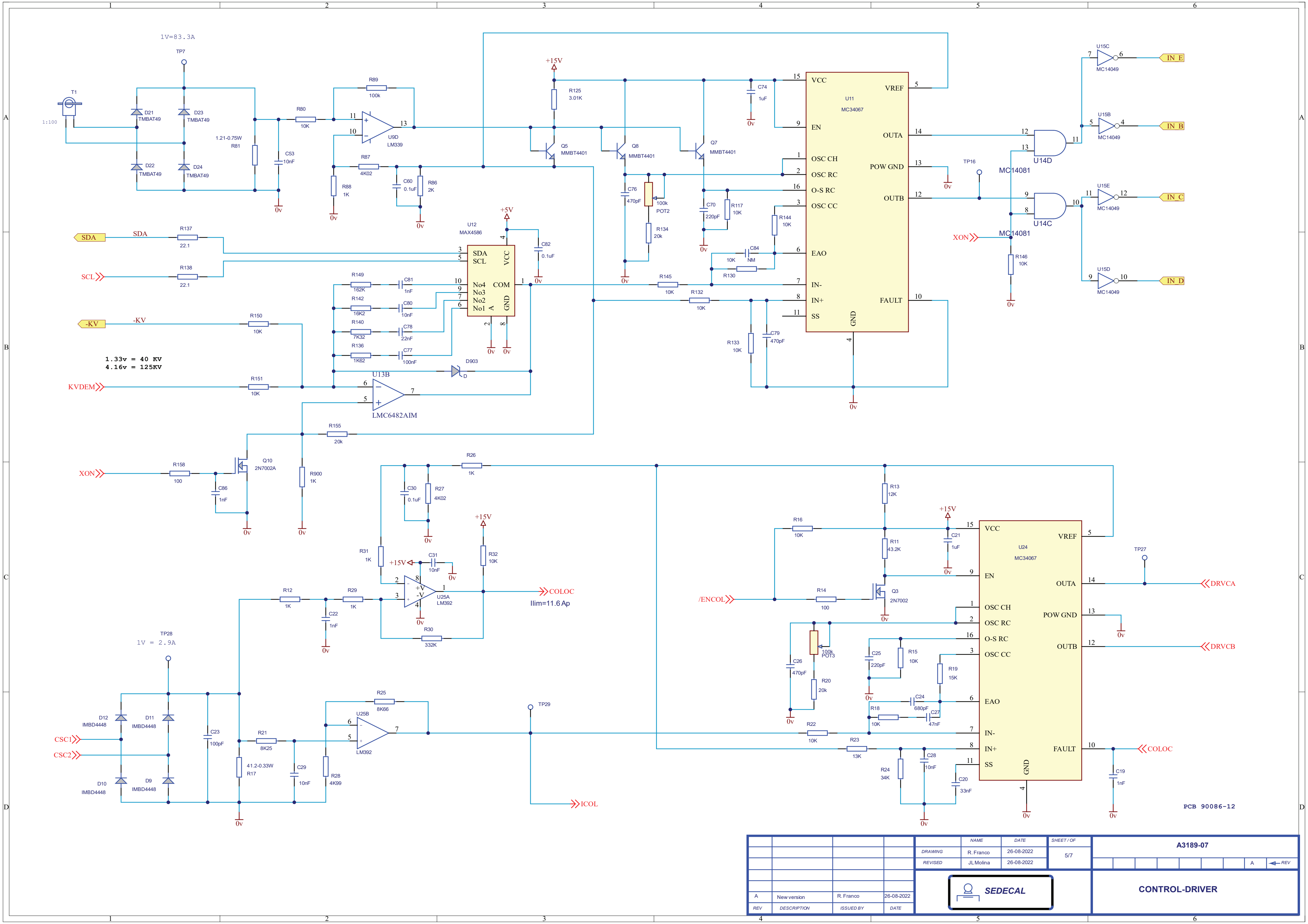
A3189-07

A REV

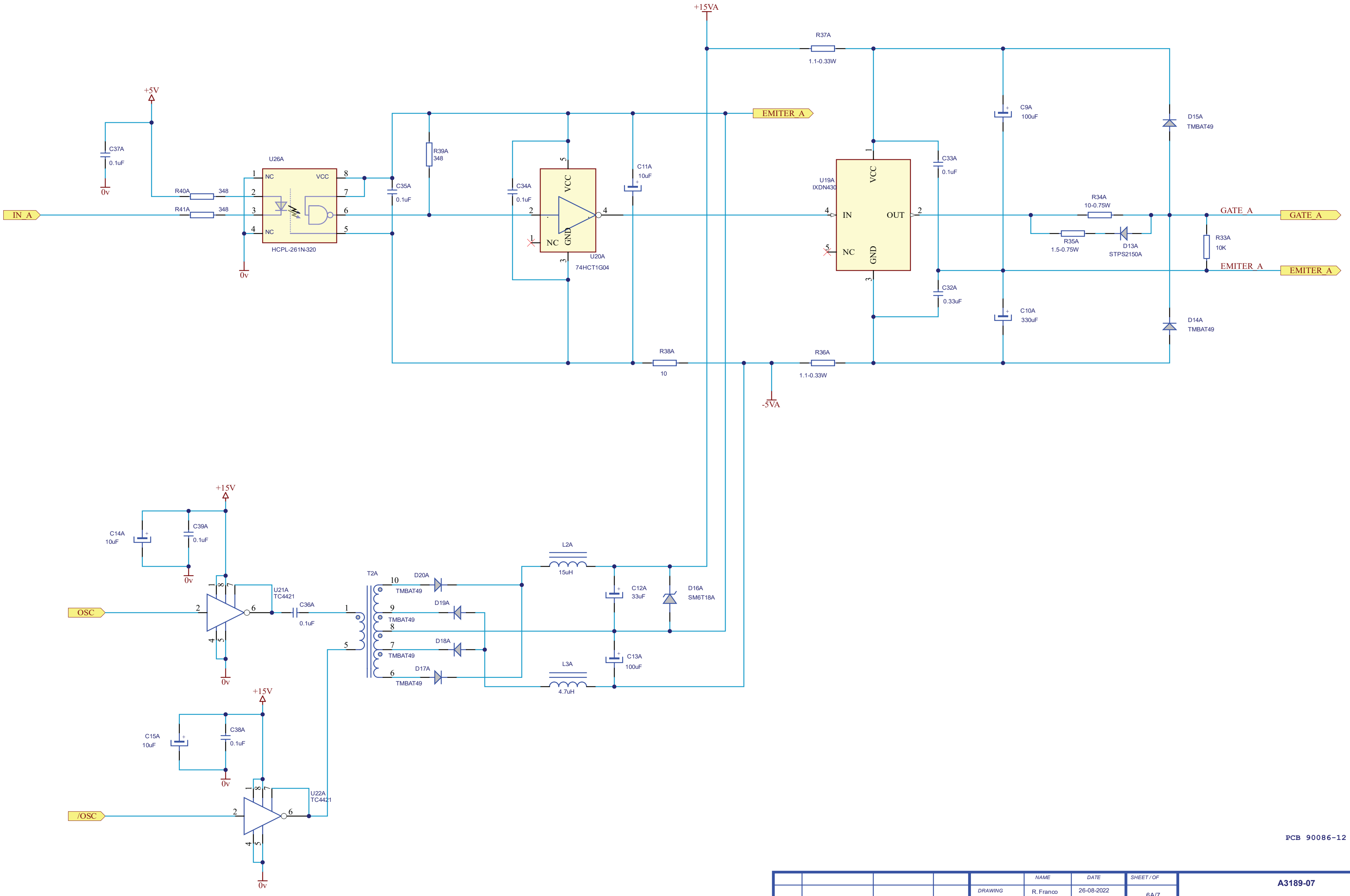
CONTROL-DRIVER



TP8
1V=10Kv
TP15
1V=30Kv
VTK
R79 1K
AK
D28 FLLD261
C900 1nF
R67 1K
U7A
LF347D
C52 3.3nF
D100 SMAJ15A
+15V
-15V
0v
R77 30K
R70 10K
U7C
LF347D
R71 30K
R66 10K
R152 10K
R153 10K
U13A
LMC6482AIM
KV
-KV
REF10
R113 10K
C72 10nF
R121 10K
R120 10K
R127 475K
R126 10K
TP6
1V=10Kv
VTA
R78 1K
D27 FLLD261
C901 1nF
R72 1K
U7D
LF347D
C55 3.3nF
D101 SMAJ15A
C59 10nF
R76 10K
R83 100k
R84 10K
U7B
LF347D
R104 20k
R103 10K
U8B
LF347D
D31 IMBD4448
R107 30K1
U9C
LM339
/DESEQ Kv
J1
VTK
VTA
VCK
VCA
R163 10K
C91 10nF
R167 10K
R166 10K
R173 475K
R175 10K
C96 10nF
R168 10K
R178 100k
R169 10K
U16A
LF347D
R177 20k
R176 10K
U16B
LF347D
D35 IMBD4448
R174 30K1
U17A
LM339
C93 10nF
/DESEQ mA
TP11
1V=10 mA
JU1
mA- mA+
VCA
R94 33K2
R105 100-1,5W
D29 LL4448
C63 10nF
U8D
LF347D
TP9
1V=10 mA
R91 10K
R92 20k
U8C
LF347D
mA
TP13
1V=10 mA
D33 LL4448
VCK
R116 33K2
R106 100-1,5W
C68 10nF
U8A
LF347D
R93 20k
R85 10K
PCB 90086-12
NAME DATE SHEET / OF
DRAWING R. Franco 26-08-2022
REVISED JL Molina 26-08-2022
4/7
A3189-07
A REV
SEDECAL
CONTROL-DRIVER
A New version R. Franco 26-08-2022
REV DESCRIPTION ISSUED BY DATE



1V=83.3A
TP7
T1
1:100
D21 TMBAT49
D23 TMBAT49
D22 TMBAT49
D24 TMBAT49
1.21-0.75W R81
C53 10nF
R80 10K
R89 100k
U9D LM339
R87 4K02
R88 1K
C60 0.1uF
R86 2K
+15V
R125 3.01K
Q5 MMBT4401
Q8 MMBT4401
Q7 MMBT4401
C74 1uF
C76 470pF
100k POT2
R134 20k
C70 220pF
R117 10K
R144 10K
C84 NM
R130
R145 10K
R132 10K
R133 10K
C79 470pF
U11 MC34067
VCC VREF EN OUTA OSC CH POW GND OSC RC O-S RC OUTB OSC CC EAO IN- IN+ FAULT SS GND
TP16
U14D MC14081
U14C MC14081
U15C MC14049
U15B MC14049
U15E MC14049
U15D MC14049
IN_E
IN_B
IN_C
IN_D
XON
R146 10K
SDA
R137 22.1
SCL
R138 22.1
+5V
U12 MAX4586
C82 0.1uF
SDA SCL VCC No4 COM No3 No2 No1 A GND
R149 162K
C81 1nF
R142 16K2
C80 10nF
R140 7K32
C78 22nF
R136 1K62
C77 100nF
D903
-KV
R150 10K
1.33v = 40 KV
4.16v = 125KV
KVDEM
R151 10K
U13B LMC6482AIM
R155 20k
XON
R158 100
C86 1nF
Q10 2N7002A
R900 1K
R26 1K
C30 0.1uF
R27 4K02
R31 1K
+15V
C31 10nF
R32 10K
U25A LM392
COLOC
Ilim=11.6 Ap
R12 1K
C22 1nF
R29 1K
R30 332K
TP28
1V = 2.9A
D12 IMBD4448
D11 IMBD4448
D10 IMBD4448
D9 IMBD4448
CSC1
CSC2
C23 100pF
R21 8K25
41.2-0.33W R17
C29 10nF
R28 4K99
R25 8K66
U25B LM392
TP29
ICOL
R13 12K
R16 10K
R11 43.2K
C21 1uF
/ENCOL
R14 100
Q3 2N7002
U24 MC34067
TP27
DRVCA
DRVCB
C26 470pF
100k POT3
R20 20k
C25 220pF
R15 10K
R19 15K
C24 680pF
R18 10K
C27 47nF
R22 10K
R23 13K
R24 34K
C28 10nF
C20 33nF
C19 1nF
COLOC
PCB 90086-12
A | New version | R. Franco | 26-08-2022
REV | DESCRIPTION | ISSUED BY | DATE
NAME | DATE | SHEET / OF
DRAWING | R. Franco | 26-08-2022 | 5/7
REVISED | J.L.Molina | 26-08-2022
SEDECAL
A3189-07
A REV
CONTROL-DRIVER



REV	DESCRIPTION	ISSUED BY	DATE
A	New version	R. Franco	26-08-2022

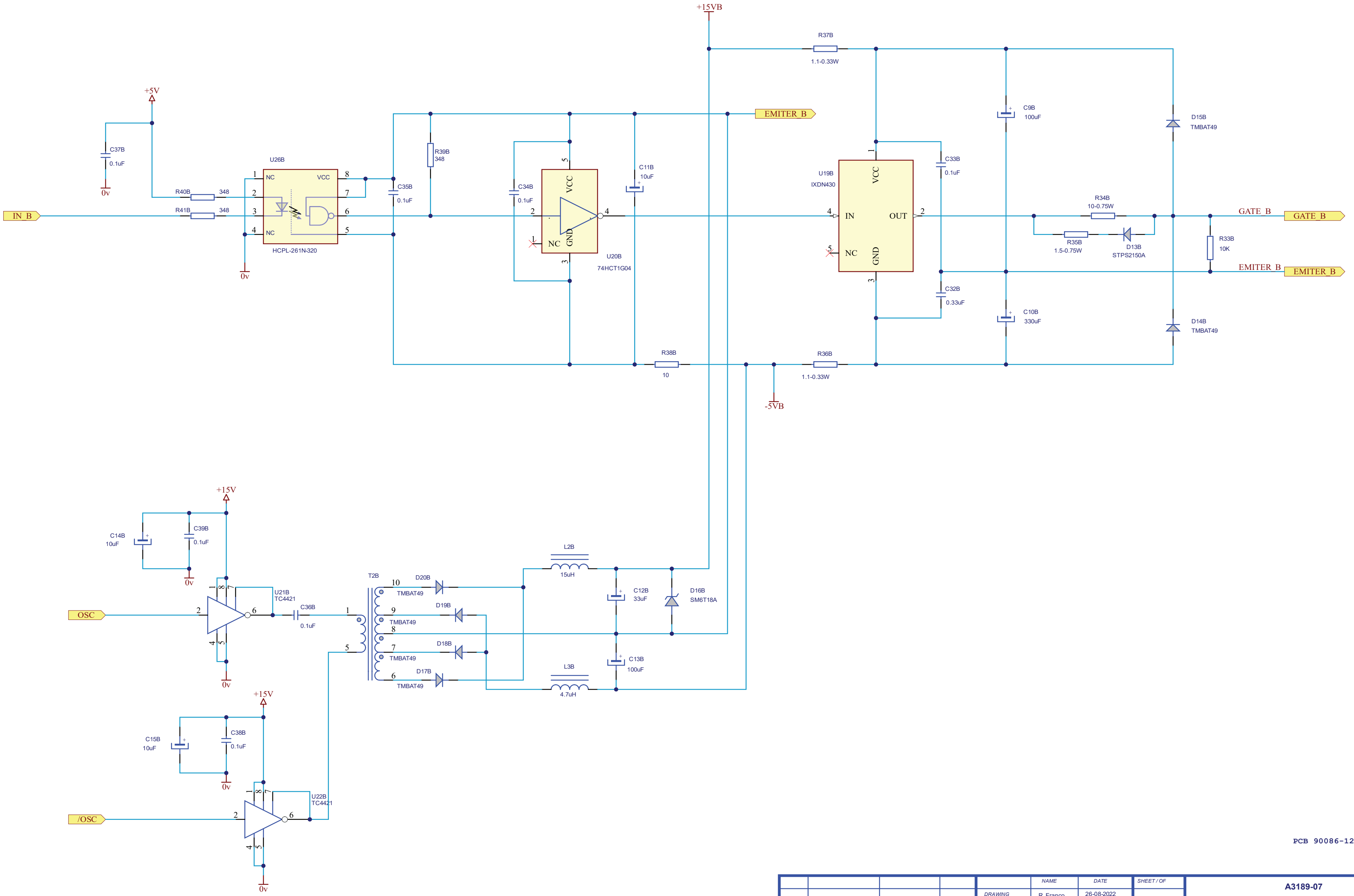
	NAME	DATE	SHEET / OF
DRAWING	R. Franco	26-08-2022	6A/7
REVISED	JL Molina	26-08-2022	

SEDECAL

A3189-07

A ← REV

CONTROL-DRIVER



	NAME	DATE	SHEET / OF
DRAWING	R. Franco	26-08-2022	6B/7
REVISED	JLMolina	26-08-2022	

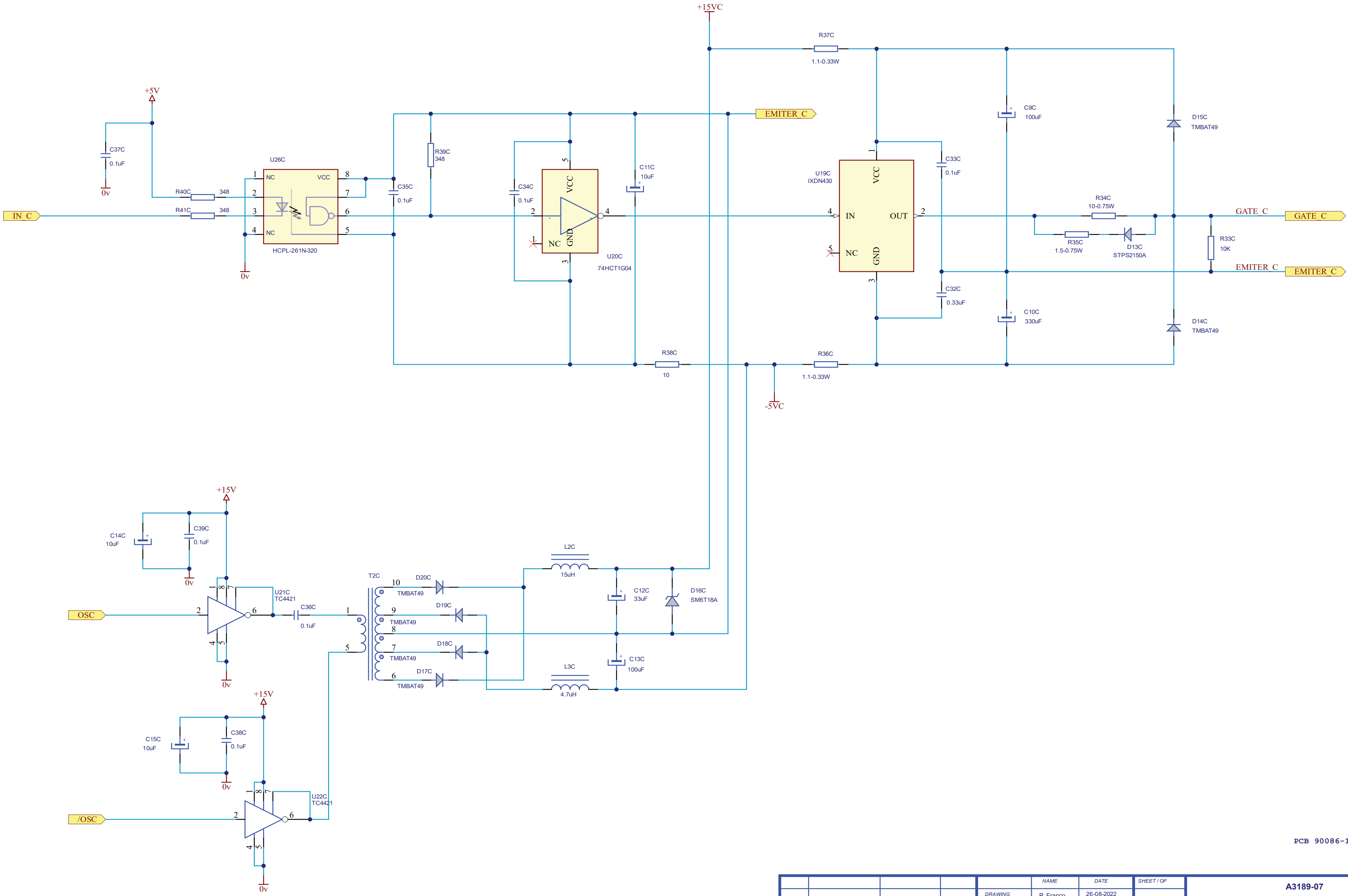
A3189-07

A ◄ REV

SEDECAL

CONTROL-DRIVER

REV	DESCRIPTION	ISSUED BY	DATE
A	New version	R. Franco	26-08-2022



PCB 90086-12

REV	DESCRIPTION	ISSUED BY	DATE
A	New version	R. Franco	26-08-2022

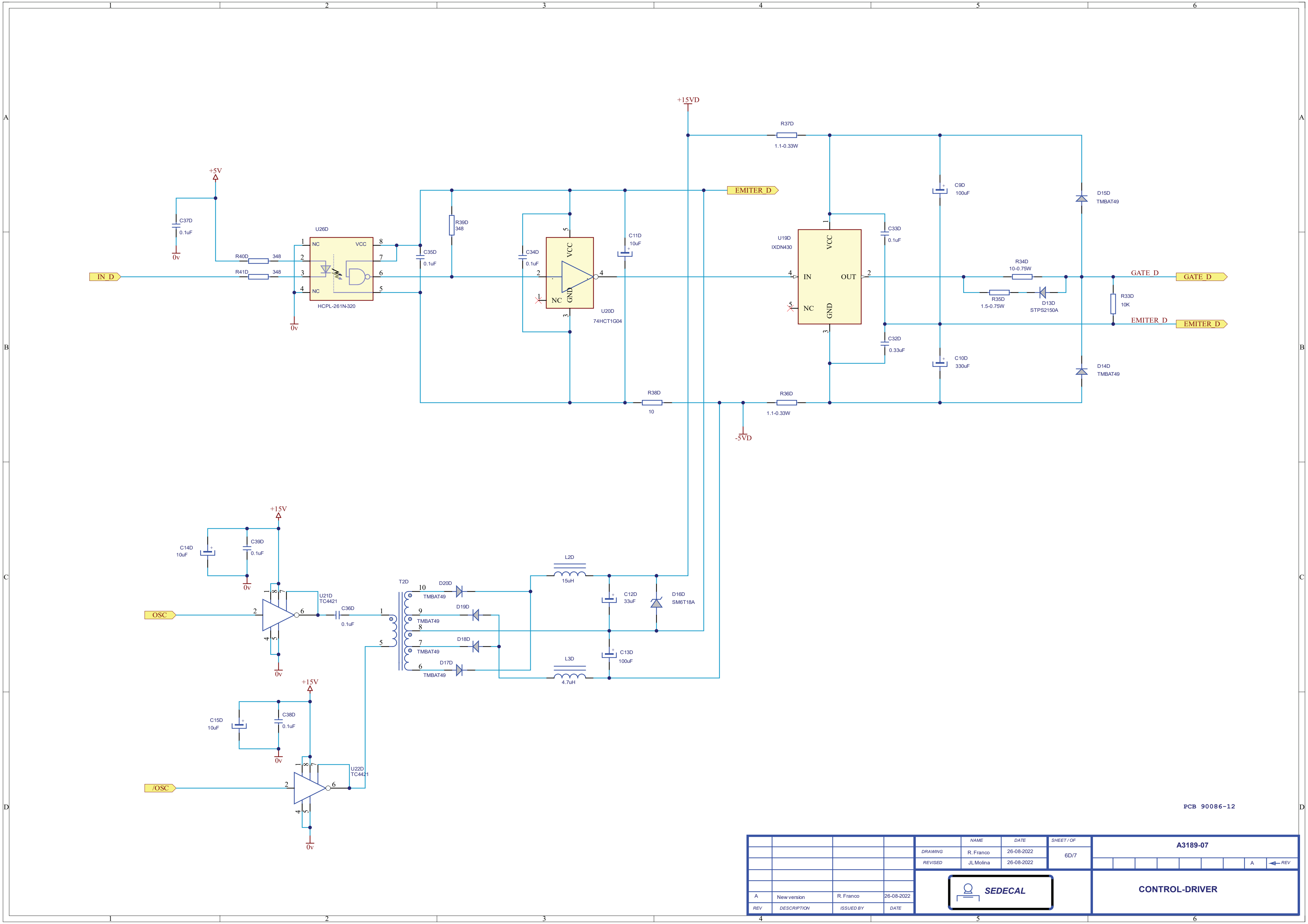
	NAME	DATE	SHEET / OF
DRAWING	R. Franco	26-08-2022	6C/7
REVISED	JLMolina	26-08-2022	

SEDECAL

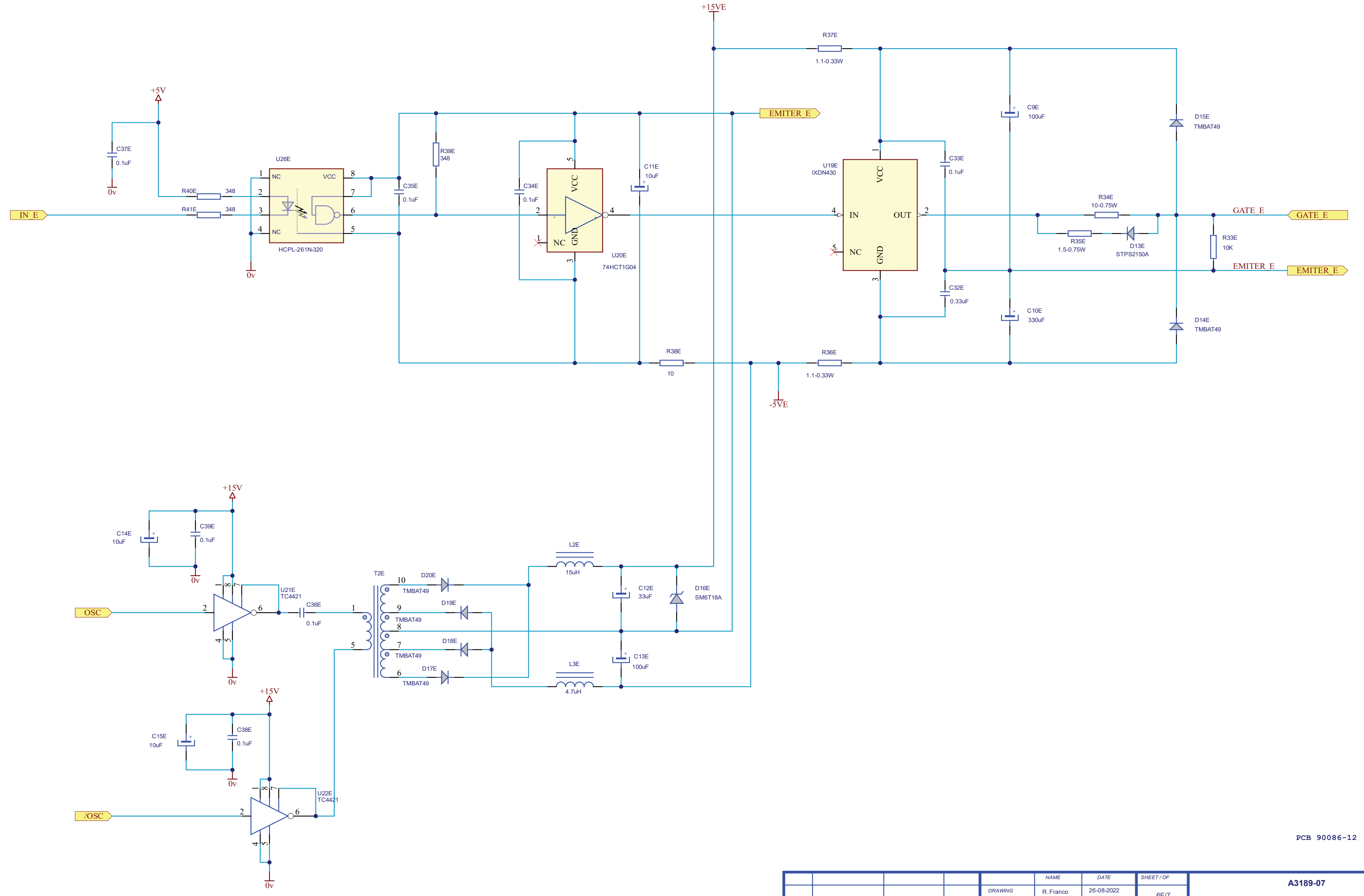
A3189-07

A ◄ REV

CONTROL-DRIVER



+15VD
R37D
1.1-0.33W
+5V
EMITER_D
C37D
0.1uF
0v
U26D
NC
VCC
R39D
348
C9D
100uF
D15D
TMBAT49
R40D
348
R41D
348
C35D
0.1uF
C34D
0.1uF
VCC
C11D
10uF
U19D
IXDN430
C33D
0.1uF
IN_D
IN
OUT
R34D
10-0.75W
GATE_D
NC
GND
HCPL-261N-320
R35D
1.5-0.75W
D13D
STPS2150A
R33D
10K
U20D
74HCT1G04
EMITER_D
C32D
0.33uF
C10D
330uF
D14D
TMBAT49
R38D
10
R36D
1.1-0.33W
-5VD
+15V
C14D
10uF
C39D
0.1uF
L2D
15uH
T2D
D20D
TMBAT49
U21D
TC4421
C36D
0.1uF
C12D
33uF
D16D
SM6T18A
OSC
D19D
TMBAT49
D18D
TMBAT49
C13D
100uF
D17D
TMBAT49
L3D
4.7uH
C15D
10uF
C38D
0.1uF
U22D
TC4421
/OSC
PCB 90086-12
NAME
DATE
SHEET / OF
A3189-07
DRAWING
R. Franco
26-08-2022
6D/7
REVISED
JLMolina
26-08-2022
A
REV
SEDECAL
CONTROL-DRIVER
A
New version
R. Franco
26-08-2022
REV
DESCRIPTION
ISSUED BY
DATE



A	New version	R. Franco	26-08-2022
REV	DESCRIPTION	ISSUED BY	DATE

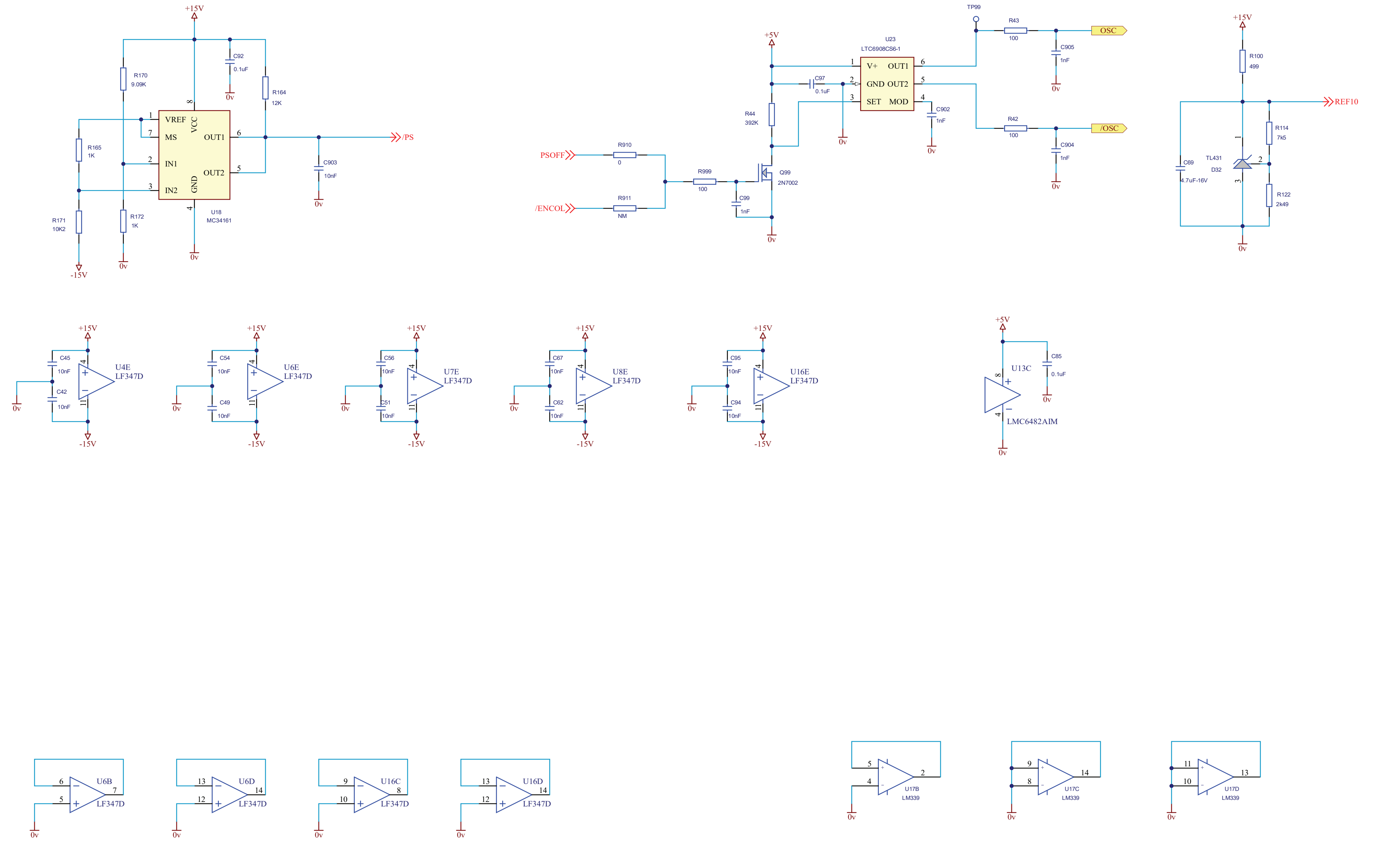
	NAME	DATE	SHEET / OF
DRAWING	R. Franco	26-08-2022	6E/7
REVISED	JL Molina	26-08-2022	

SEDECAL

A3189-07

A REV

CONTROL-DRIVER



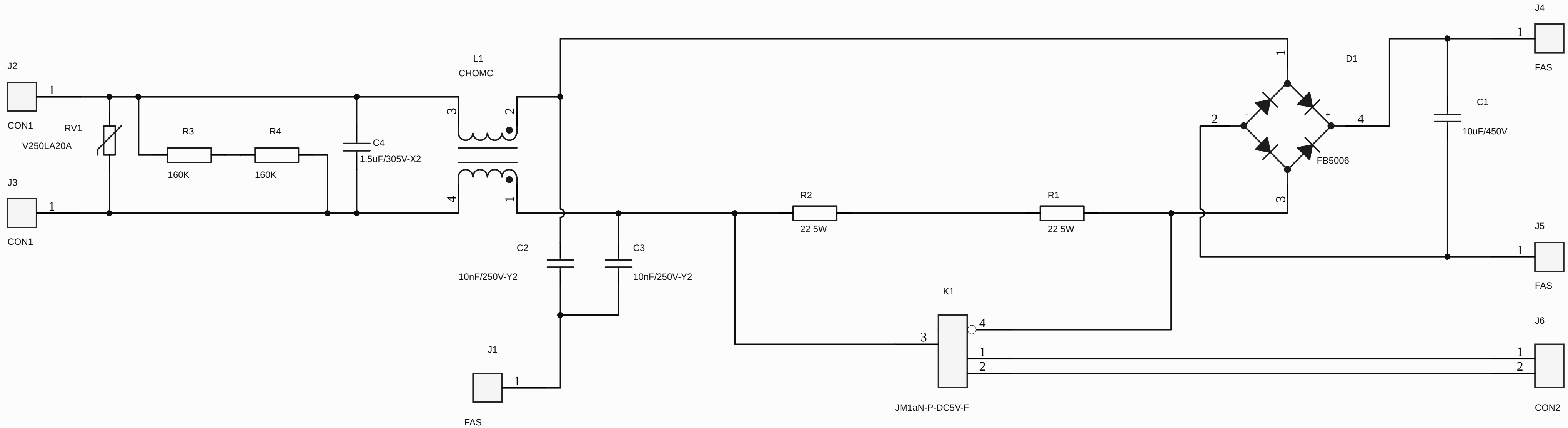
PCB 90086-12

	NAME	DATE	SHEET / OF	A3189-07			
DRAWING	R. Franco	26-08-2022	7/7			A	REV
REVISED	JL Molina	26-08-2022					

SEDECAL

CONTROL-DRIVER

REV	DESCRIPTION	ISSUED BY	DATE
A	New version	R. Franco	26-08-2022



PCB 90184-06

REV	DESCRIPTION	ISSUED BY	DATE
D	NC 18/0291	R. Franco	02/04/19
C	New PCB 90184-05	R. Franco	14/02/19
B	NC 10/503	J.M. Garrote	01/12/10
A	First Issue	J.M. Garrote	07/07/10

	NAME	DATE	SHEET / OF
DRAWING	J.M.Garrote	27/09/10	1/1
REVISED	J.L.Alvarez	27/09/10	

SEDECAL

A3191- 04

D C B A REV

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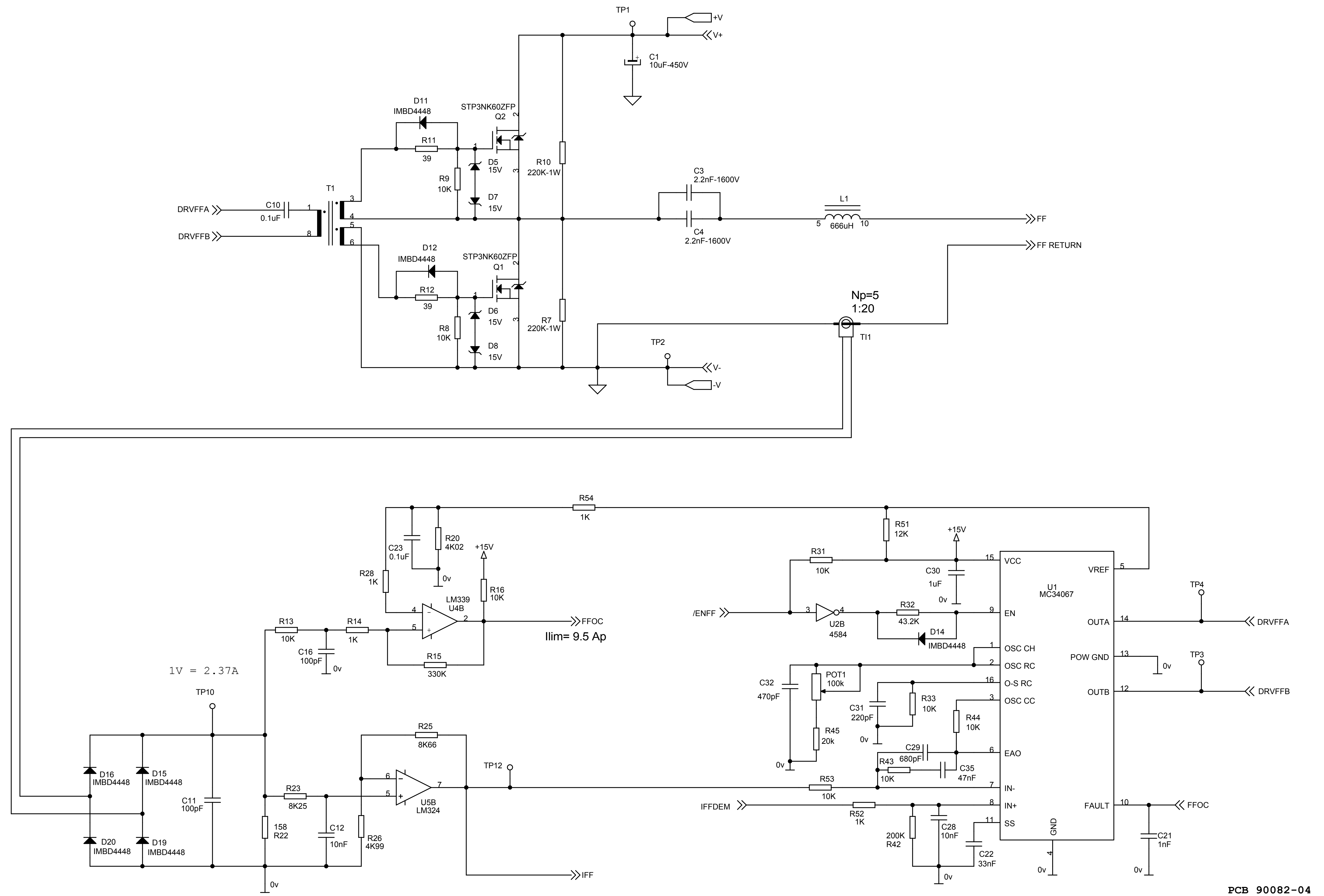


PCB 90082-04

	NAME	DATE	SHEET / OF
DRAWING	JALVAREZ	23-04-09	1/3
REVISED	ADIAZ	23-04-09	

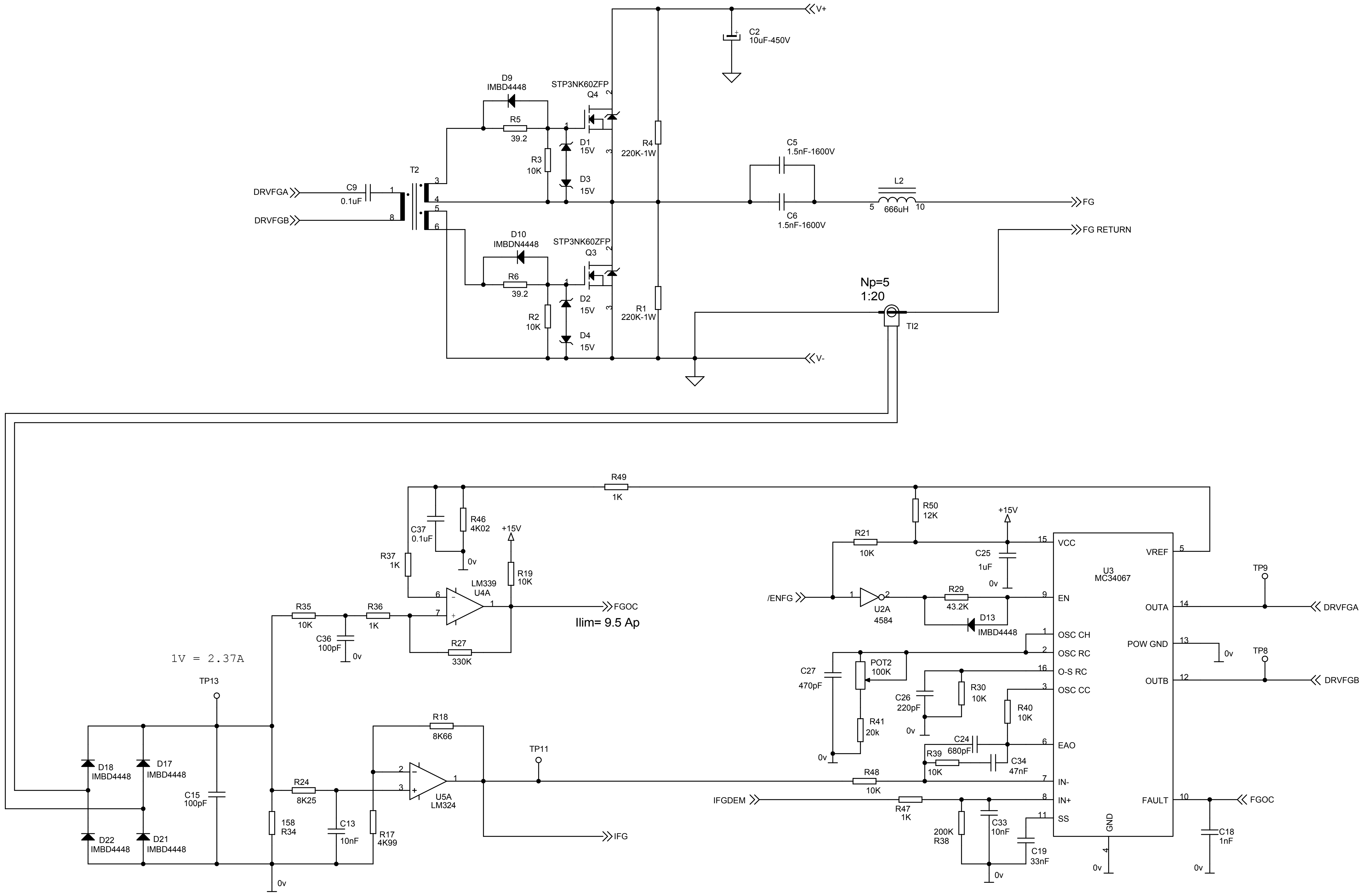
A9500-01

B | A | ← REV

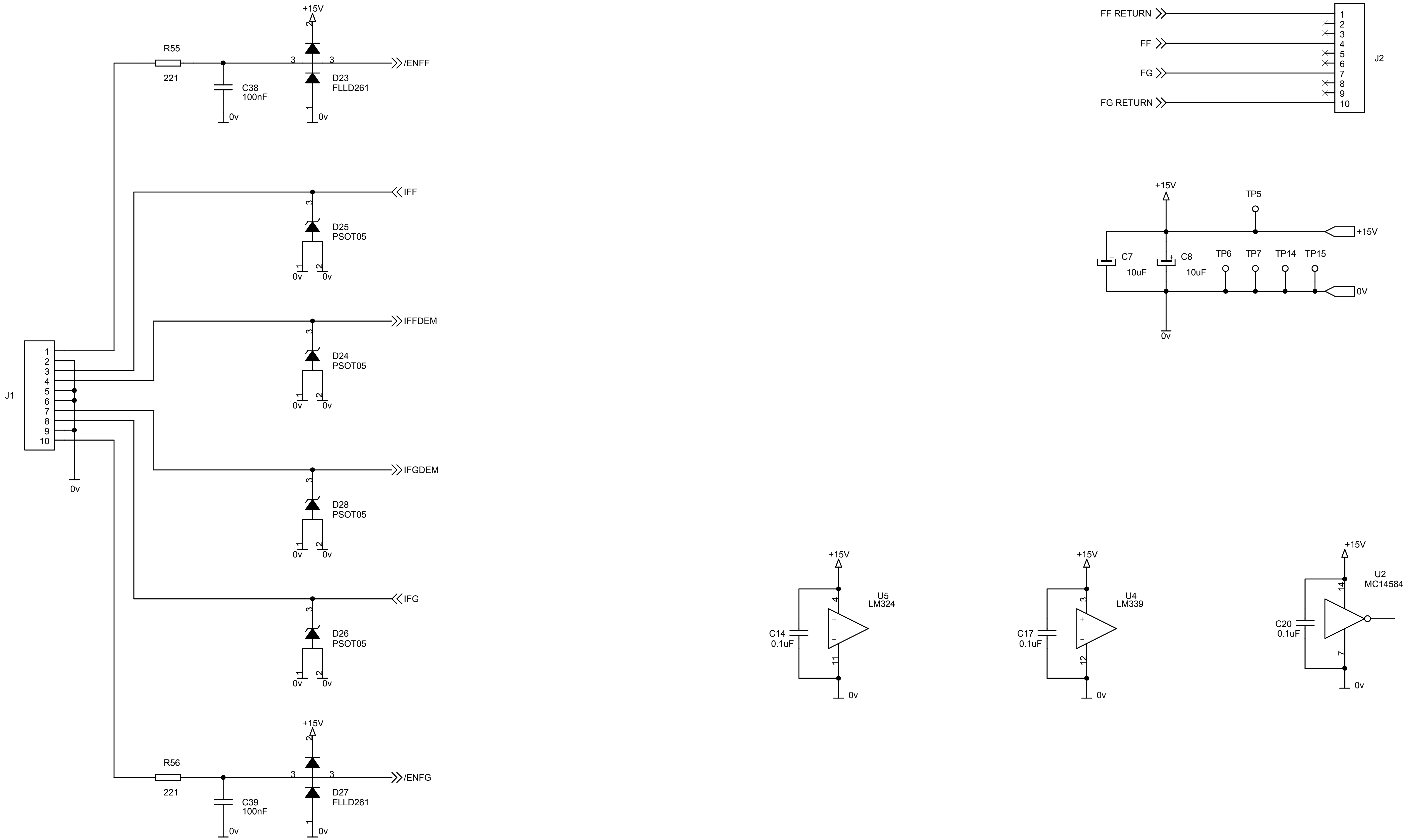
REV	DESCRIPTION	ISSUED BY	DATE
B	NC 09/308 R40/44	JLALVAREZ	06-11-09
A		JLALVAREZ	23-04-09

SEDECAL

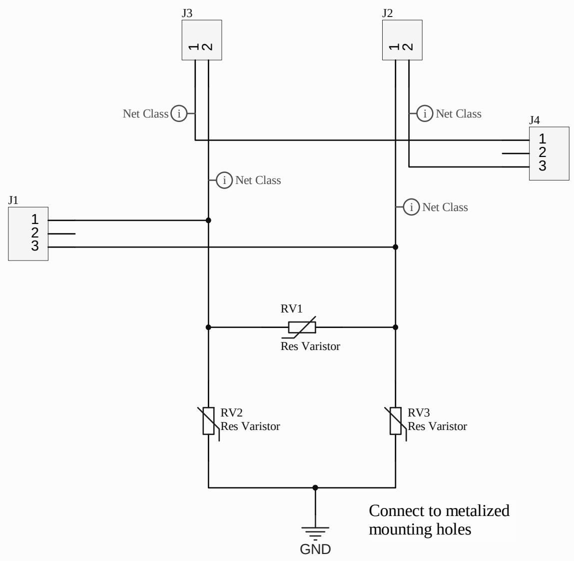
FILAMENTS HF



					NAME	DATE	SHEET / OF	A9500-01
				DRAWING	JALVAREZ	23-04-09	2/3	
				REVISED	ADIAZ	23-04-09		B / A / REV
B	NC 09/308 R40/44	JLALVAREZ	06-11-09	SEDECAL				FILAMENTS HF
A		JLALVAREZ	23-04-09					
REV	DESCRIPTION	ISSUED BY	DATE					



					NAME	DATE	SHEET / OF	A9500-01
				DRAWING	JLALVAREZ	23-04-09	3/3	B A ◄ REV
				REVISED	ADIAZ	23-04-09		
B	NC 09/308 R40/44	JLALVAREZ	06-11-09	SEDECAL				FILAMENTS HF
A		JLALVAREZ	23-04-09					
REV	DESCRIPTION	ISSUED BY	DATE					



PCB: 90248-01

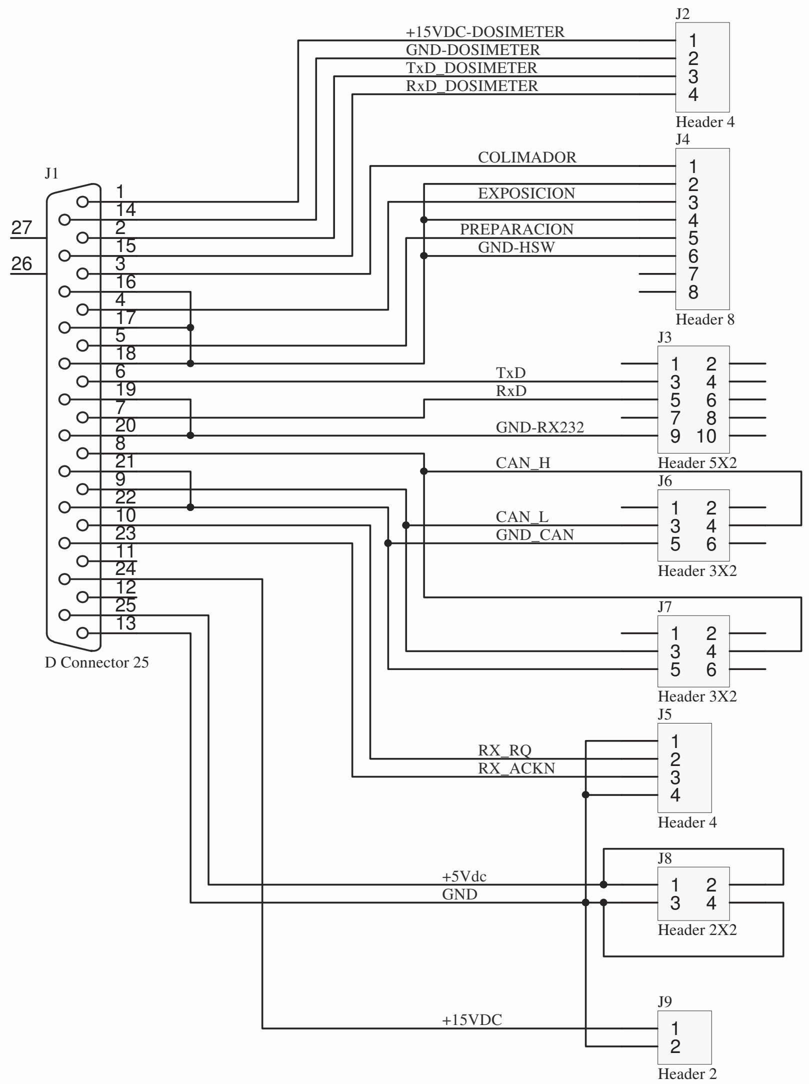
					NAME	DATE	SHEET / OF
				DRAWING	L. Jiménez	20/04/2010	1 / 1
				REVISED	F. Díaz	20/04/2010	
A	NC 10/170	L. Jiménez	20/04/2010				
REV	DESCRIPTION	ISSUED BY	DATE				

SEDECAL

A9524-02

A REV

PCB VARISTOR BOARD



CONNECTOR DESCRIPTION

J2	POWER AND COMMUNICATION FOR DOSEMETER
J4	HANDSWITCH
J3	SERIAL COMMUNICATIONS
J6	CAN-BUS COMMUNICATIONS
J7	CAN-BUS COMMUNICATIONS
J5	DIGITAL PANEL INTERFACE
J8	POWER SUPPLY FROM X-RAY GENERATOR.
J9	+15VDC-GND

PCB: 90240-03

REV	DESCRIPTION	ISSUED BY	DATE
B	NC 14/164	S.Pérez	24/03/2011
A	First Issue	J.A.Garcia	18/10/2010

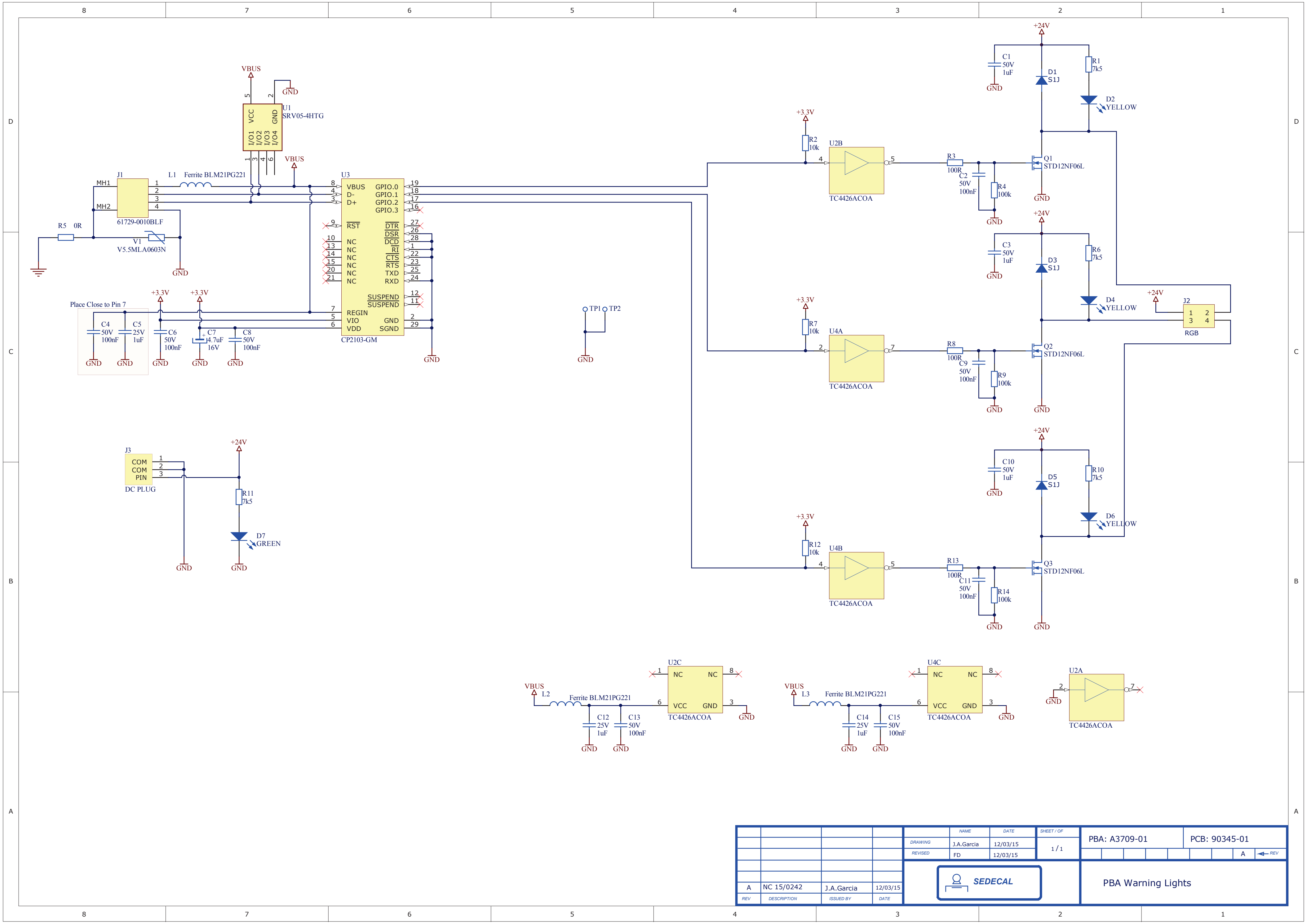
	NAME	DATE	SHEET / OF
DRAWING	J.A.Garcia	18/10/2010	1 / 1
REVISED	F.Díaz	18/10/2010	

SEDECAL

A3632-02

REV: B A

CONECTORES CAJA DRAGON



VBUS
GND
U1
SRV05-4HTG
VCC
I/O1 I/O2 I/O3 I/O4
J1
MH1
MH2
L1 Ferrite BLM21PG221
61729-0010BLF
R5 0R
V1
V5.5MLA0603N
U3
VBUS GPIO.0
D- GPIO.1
D+ GPIO.2
GPIO.3
RST DTR
NC DSR
NC DCD
NC RI
NC CTS
NC RTS
NC TXD
NC RXD
SUSPEND
SUSPEND
REGIN
VIO GND
VDD SGND
CP2103-GM
+3.3V
Place Close to Pin 7
C4 50V 100nF
C5 25V 1uF
C6 50V 100nF
C7 4.7uF 16V
C8 50V 100nF
TP1 TP2
J3
COM
COM
PIN
DC PLUG
+24V
R11 7k5
D7 GREEN
R2 10k
U2B
TC4426ACOA
R3 100R
C2 50V 100nF
R4 100k
Q1 STD12NF06L
C1 50V 1uF
D1 S1J
R1 7k5
D2 YELLOW
R7 10k
U4A
TC4426ACOA
R8 100R
C9 50V 100nF
R9 100k
Q2 STD12NF06L
C3 50V 1uF
D3 S1J
R6 7k5
D4 YELLOW
J2
RGB
R12 10k
U4B
TC4426ACOA
R13 100R
C11 50V 100nF
R14 100k
Q3 STD12NF06L
C10 50V 1uF
D5 S1J
R10 7k5
D6 YELLOW
U2C
NC NC
VCC GND
TC4426ACOA
L2 Ferrite BLM21PG221
C12 25V 1uF
C13 50V 100nF
U4C
TC4426ACOA
L3 Ferrite BLM21PG221
C14 25V 1uF
C15 50V 100nF
U2A
TC4426ACOA
A NC 15/0242 J.A.Garcia 12/03/15
REV DESCRIPTION ISSUED BY DATE
NAME DATE
DRAWING J.A.Garcia 12/03/15
REVISED FD 12/03/15
SHEET / OF
1 / 1
SEDECAL
PBA: A3709-01
PCB: 90345-01
A REV
PBA Warning Lights