



# BASIC 100-15 100-30

MOBILE RADIOGRAPHIC UNIT

## SERVICE MANUAL



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# INDEX

## GENERAL INDEX

### SECTION 0 - INDEX (doc. 7760)

*Valid from 6<sup>th</sup> JUNE 2004*

	PAGE
<b>SECTION 1 - GENERAL description (doc. 7761)</b>	
1 GENERAL description	2
1.1 Applications and use	2
2 Composition	2
2.1 Mobile radiographic unit	2
2.2 CONTROL panel	4
2.3 COLLIMATOR	6
3 TECHNICAL data	7
3.1 Classification of the apparatus	7
3.2 TECHNICAL CHARACTERISTICS	7
3.2.1 DIMENSIONS AND WEIGHTS	9
3.2.2 kV - mA Relationship	10
3.2.3 RX EXPOSURE TIME	12
<b>SECTION 2 - INSTALLATION (doc. 7762)</b>	
1 INTRODUCTION	2
2 UNPACKING	3
2.1 PACKING WITH CELLOPHANE	3
2.2 PACKING WITH CARTON	5
2.3 PACKING WITH WOOD CRATE	6
3 ELECTRICAL CONNECTIONS	7
4 ACCEPTANCE TEST	7
4.1 CHECKING CABLES AND CONNECTORS	7
4.2 MECHANICAL CHECKS	8
4.3 ELECTRICAL CHECKS	8

	PAGE
<b>SECTION 3 – MAINTENANCE (doc. 7763)</b>	
1 ROUTINE MAINTENANCE	2
1.1 GENERAL RECOMMENDATIONS	2
1.2 FREQUENT CHECKS AND INSPECTIONS	3
1.3 GENERAL CHECKS AND INSPECTIONS	3
1.4 CLEANING AND DISINFECTION	4
2 SPECIAL MAINTENANCE	5
2.1 TROUBLESHOOTING	5
2.2 REPLACEMENT OF COMPONENTS	6
2.3 LIST POTENTIOMETERS	7
2.4 LIST LEDS	8
2.5 LIST FUSES	9
3 SPARE PARTS	10

## SECTION 4 – X-RAY SETTINGS (doc. 7764)

1 INTRODUCTION	2
1.1 Dip switch	3
2 ROTATING ANODE STATOR POWER SUPPLY ADJUSTMENT	3
3 SET-UP PROCEDURE	4
3.1 SERVICE MENU	5
4 kV ADJUSTMENT	6
4.1 ADJUSTMENT “SET-UP” VOLTAGE	6
4.2 ADJUSTMENT OF MAXIMUM kV SETTING SAFETY	6
4.3 CHECKING MAXIMUM kV SETTING SAFETY	7
5 ADJUSTMENT OF THE FILAMENT CURRENT	8
5.1 ADJUSTMENT OF FILAMENT CURRENT	9
6 MAS ADJUSTMENT	11
7 ADJUSTMENT OF THE BATTERY VOLTAGE	12

# SERVICE MANUAL

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## INDEX

8	CHECKING THE RADIOGRAPHIC PARAMETER	13
8.1	CHECKING kV AND MAS DURING RADIOGRAPHY	13
9	CENTERING THE COLLIMATOR	15
10	SPRING ADJUSTMENT	16

## SECTION 5 – DRAWINGS (doc. 7765)

## ANNEX 1 – TEST SHEET

## ANNEX 2 – 115VAC POWER SUPPLY (optional)

# GENERAL Description

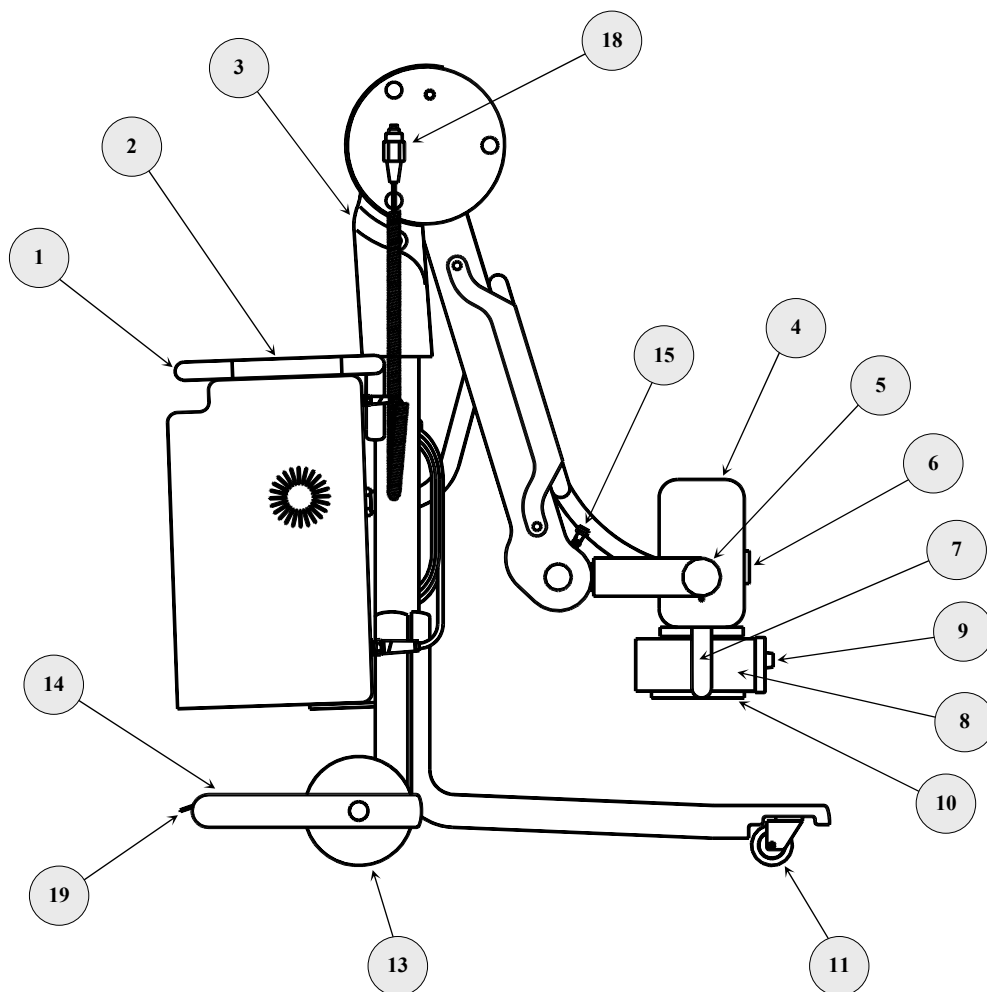
## 1 GENERAL DESCRIPTION

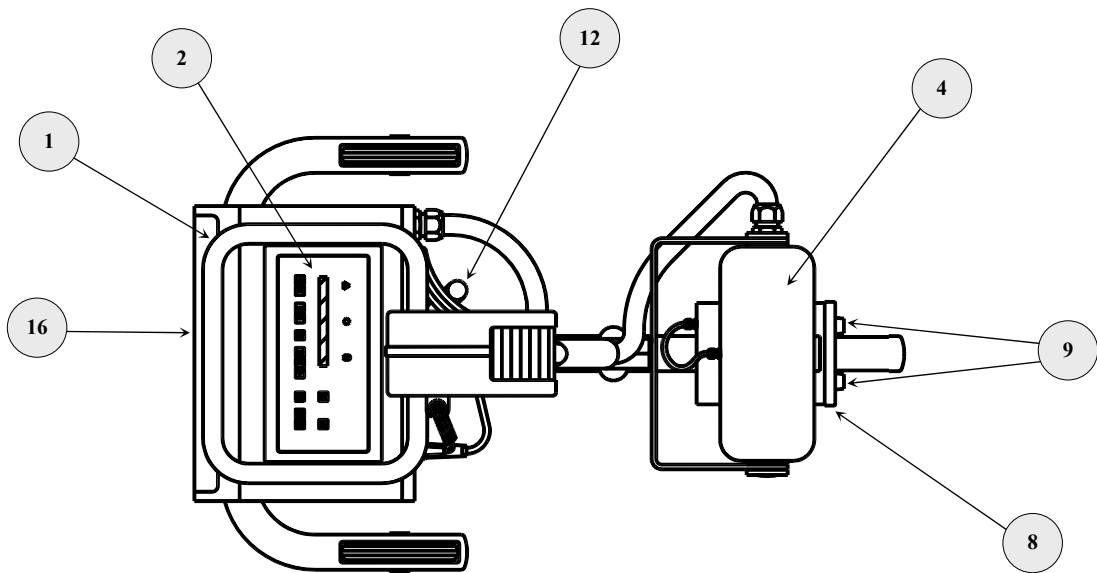
### 1.1 APPLICATIONS AND USE

The equipment is a **MOBILE RADIOGRAPHIC UNIT** for radiography on X-ray film, that may be used in different places and situations: operating theatre, orthopedics, intensive care, emergency room.

## 2 COMPOSITION

### 2.1 MOBILE RADIOGRAPHIC UNIT

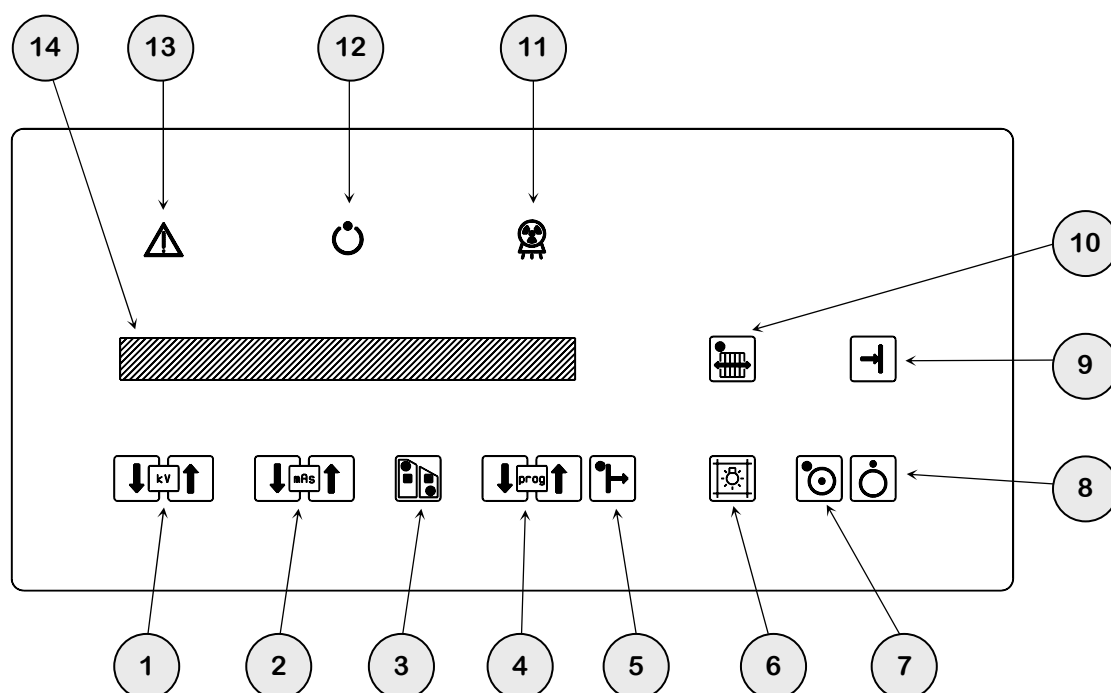




















MOBILE RADIOGRAPHIC UNIT			
1	Transport handle with brake	11	Pivoting wheel (front wheel)
2	Control panel	12	Power supply cable holder
3	Handle for tilting (optional)	13	Wheels (main wheel)
4	X-ray tube head	14	Support for Tilting
5	Lateral goniometer	15	Pantograph arm lock
6	Front goniometer	16	Cassette holder
7	X-ray tube head positioning handle	...	
8	Collimator	18	X-ray control pushbutton
9	Adjustment of collimator diaphragms	19	Pedal for Stationary brake
10	Rail for filters and accessories		



### 2.2 CONTROL PANEL



- |   |                                                                                                                                                                                                                                         |    |                                                                                                                             |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|-----------------------------------------------------------------------------------------------------------------------------|
| 1 | <br><b>kV</b> < kV decrease<br><br>< kV increase                      | 7  | <br>< Unit <b>ON</b>                       |
| 2 | <br><b>mAs</b> < mAs decrease<br><br>< mAs increase                   | 8  | <br>< Unit <b>OFF</b>                      |
| 3 | <br>< HP/LP <sup>(1)</sup> Power selection                                                                                                             | 9  | <br>< Data storage in anatomical technique |
| 4 | <br><b>Prog</b> < N° of exams memorized in Technique Anatomical<br> | 10 | <br>< Potter-Bucky selection               |
| 5 | <br>< Anatomical Technique Selection                                                                                                                 | 11 | <br>< X-Ray exposure                       |
| 6 | <br>< Collimator light activation                                                                                                                    | 12 | <br>< X-Ray ready                          |
|   |                                                                                                                                                                                                                                         | 13 | <br>< Alarm signalling                   |
|   |                                                                                                                                                                                                                                         | 14 | < Display for Dates and Messages                                                                                            |

(1) A change of the Power level involves a change of the used focal spot:

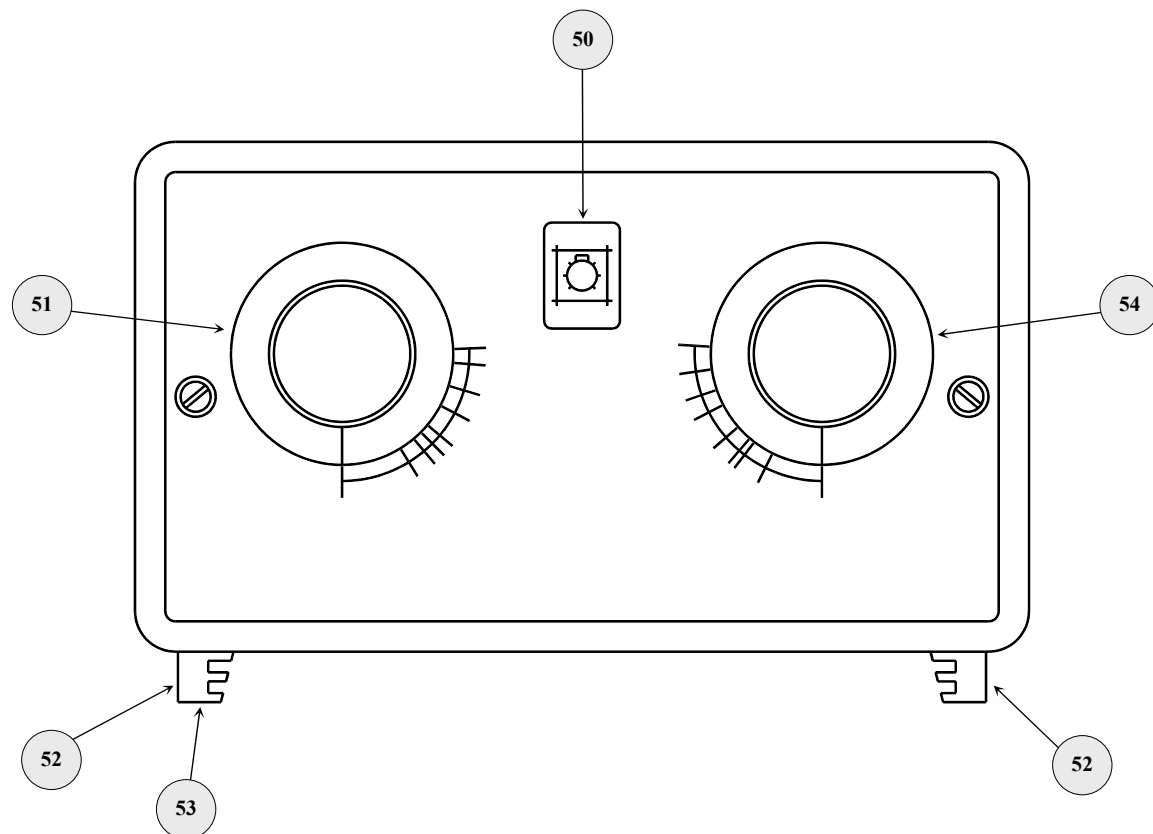
- High Power (HP) – Big Focus
- Low Power (LP) – Small Focus

In the following paragraphs the abbreviations **HP** and **LP** will be used.

# SERVICE MANUAL

## GENERAL DESCRIPTION

### 2.3 COLLIMATOR



#### **COLLIMATOR**

<b>50</b>	Collimator light on	<b>53</b>	Retractable meter
<b>51</b>	Adjustment of transverse diaphragm	<b>54</b>	Adjustment of longitudinal diaphragm
<b>52</b>	Rail for filters and accessories		

## 3 TECHNICAL DATA

### 3.1 CLASSIFICATION OF THE APPARATUS

#### CLASSIFICATION – EN 60601 1 § 5

- ➡ Type of protection against short circuit: **CLASS I**
- ➡ Degree of protection against direct and indirect contact: **TYPE B**
- ➡ Use conditions: **CONTINUOUS WORKING WITH INTERMITTENT LOAD**
- ➡ Unit not to be used in the presence of an inflammable anaesthetic mixture with air or nitrous oxide

#### CLASSIFICATION – 93/42/EEC DIRECTIVE



- ➡ In according with Annex IX: **CLASS II b**

### 3.2 TECHNICAL CHARACTERISTICS

ELECTRICAL CHARACTERISTICS				
SINGLE PHASE VOLTAGE		230 Vac $\pm$ 10%, 16 A (Optional: 115 Vac $\pm$ 10%)		
FREQUENCY		50/60 Hz		
MAX ABSORBED CURRENT	STAND-BY WORKING	1 A (115 Vac: 2.5 A)		
	RADIOGRAPHY WORKING	12 A (115 Vac: 23 A)		
LINE COMPENSATION		Automatic		
LINE RESISTANCE		< 2.5 $\Omega$		
Radiological characteristics				
	15 kW		30 kW	
	LP (Low Power)	HP (High Power)	LP (Low Power)	HP (High Power)
MAX POWER	7.5 kW	15 kW	7.5 kW	30 kW
MAX CURRENT IN RADIOGRAPHY	150 mA	375 mA	150 mA	425 mA
EXPOSURE TIME	3 ms $\div$ 1.3 s	1 ms $\div$ 0.6 s	3 ms $\div$ 1.3 s	1 ms $\div$ 0.5 s
	Selected by the processor according to the mAs			
WORKING FREQUENCY	100 kHz			
RANGE kV	40 $\div$ 125 (Step of 1 kV)			
RANGE mAs	0.5 $\div$ 200 in 25 values			
A.T. PILOTAGE	Inverter driven by IGBT			
RIPPLE	$\leq$ 3% at Max Power			
TOTAL FILTRATION	> 2.7 mmAl			
RIISING TIME	$\leq$ 1 ms			

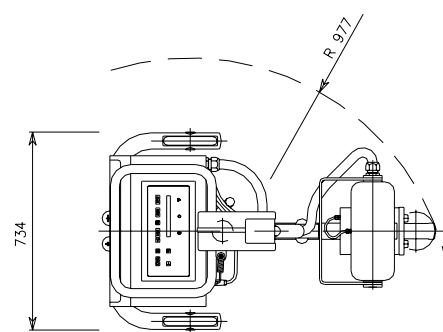
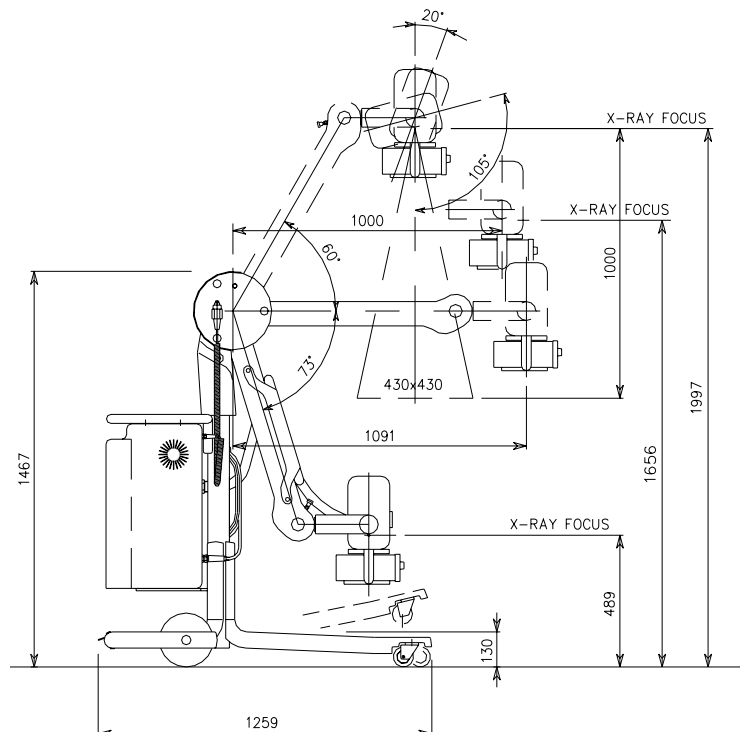
# SERVICE MANUAL

## GENERAL DESCRIPTION

X-RAY TUBE HEAD		
TYPE OF ANODE		Rotation with speed 3000 RPM
FOCAL SPOTS		0.6 mm
		1.3 mm
All the other information relevant to the X-Ray Tube Head and to the X-Ray Tube can be found in the X-Ray Tube Head Technical Data Sheet		
Collimator (optional)		
SHUTTERS TO MULTIPLE PLANS		Parallels and perpendicular with manual movement
All the other information relevant to the Collimator can be found in the relative Technical Data Sheet		
Dosimeter (optional)		
MODEL		Kermax-plus      VacuDap 2000 with printer optional
ACTIVE AREA		146 x 146 mm <sup>2</sup> 147 x 147 mm <sup>2</sup>
MINIMAL DOSE RESOLUTION		1 mGycm <sup>2</sup> 1 mGycm <sup>2</sup>
MAXIMAL MEASURABLE DOSE		9999.9999 mGycm <sup>2</sup> 9999.9999 mGycm <sup>2</sup>
OPERATING MODES AND functionality		
INTERFACE USER		Polycarbonate flat keyboard with alphanumeric LCD display for all the operative parameters and messages of possible anomalous conditions – administrated by a microprocessor.
OPERATING MODES	RADIOGRAPHY	Two-points techniques (kV-mAs)
		40 programmable anatomic technique (20 for LP and 20 for HP)
X-RAY CONTROL		Distance control with double – click and extensible cable (≥4m)
SAFETY	Filament current	
	mA <sub>min</sub> and mA <sub>max</sub>	
	Maximum exposure time	
	Temperature maximum X-ray tube head	
	Count thermal units X-ray tube head	
	Max kV, min kV, max ΔkV, max I	
	Anode rotation	
	Microprocessor self – test	
TRANSPORT AND STORAGE CONDITIONS		
MAXIMAL TEMPERATURE		–10°C ÷ 55°C
RECOMMENDED TEMPERATURE		0°C ÷ 40°C
RELATIVE HUMIDITY		20% ÷ 90%
ATMOSPHERIC PRESSURE		500 hPa ÷ 1060 hPa
OPERATING CONDITIONS		
TEMPERATURE		10°C ÷ 40°C
RELATIVE HUMIDITY		30% ÷ 75%
ATMOSPHERIC PRESSURE		700 hPa ÷ 1060 hPa

MECHANICAL CHARACTERISTICS	
WIDTH	734 mm
LENGHT	1259 mm
HEIGHT	1467 mm
MIN SOURCE-FLOOR DISTANCE	489 mm
MAX SOURCE-FLOOR DISTANCE	1997 mm
MAX RANGE	1091 mm
FOCUS MAXIMUM HEIGHT, WITH RANGE 1000 MM	1656 mm
PIVOTING FRONT WHEEL Ø 75	360°
MAXIMUM DIFFERENCE IN LEVEL WHICH CAN BE OVERCOME WITH TILTING	25 mm
BACK WHEELS DIAMETER	Ø 200
MINIMUM DEFLECTING RAY	977 mm
WEIGHT	191 kg (115 Vac: 205 kg)
MOVEMENT	Manual
CASSETTE HOLDER 35x43	4

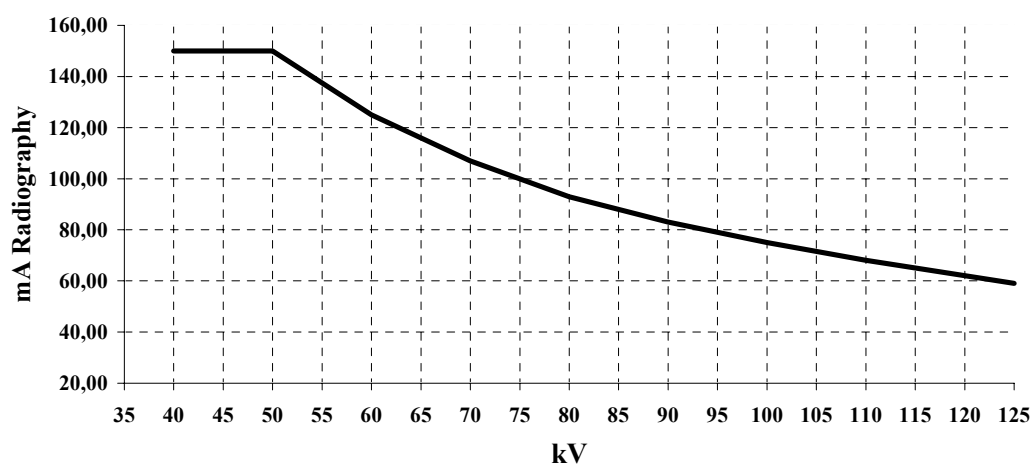
### 3.2.1 DIMENSIONS AND WEIGTHS



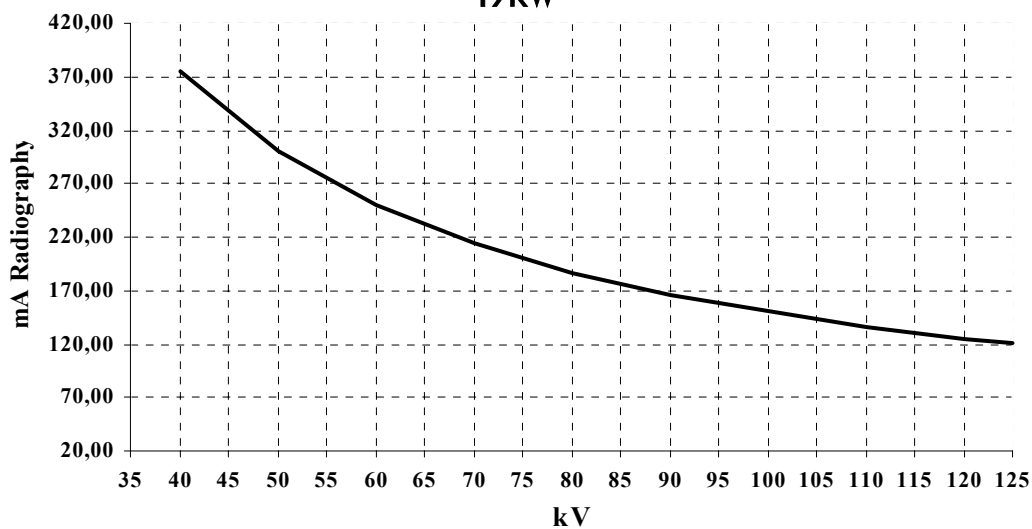
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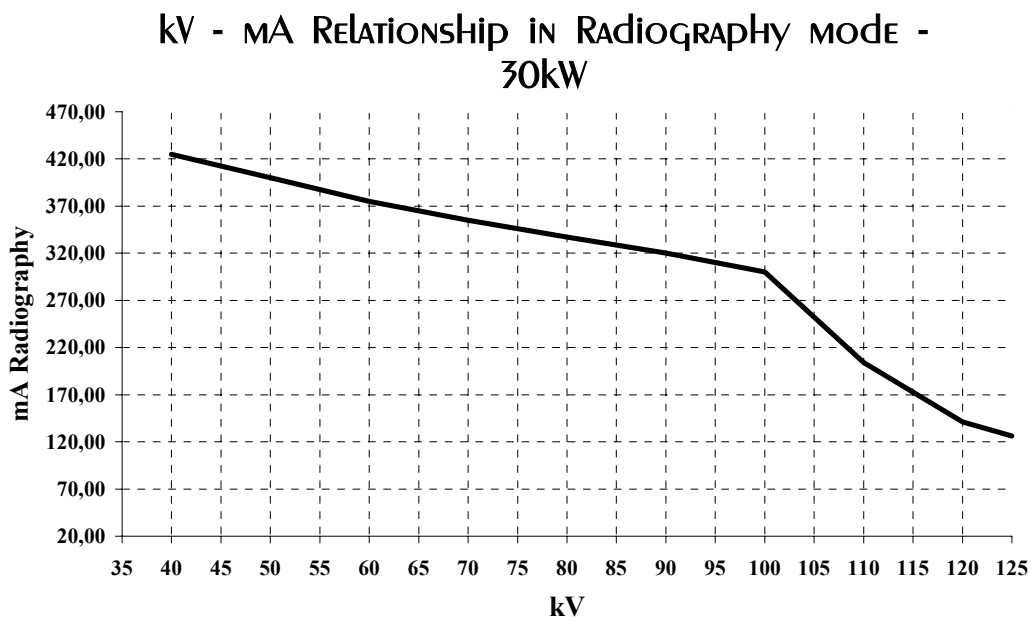
### 3.2.2 kV – mA RELATIONSHIP

kV - mA RELATIONSHIP in Radiography mode -  
7.5kW



kV - mA RELATIONSHIP in Radiography mode -  
15kW







# SERVICE MANUAL

## GENERAL DESCRIPTION

### 3.2.3 RX EXPOSURE TIME

In the following tables the exposure times (s) associated to kV and mAs are reported. Since the apparatus is a device functioning with a two point technique (kV and mAs) we remind that the values indicated in the table are merely theoretical and can undergo a variation in relation to the tolerance of the mA.

TABLE 1 – 7.5KW POWER

mAs \ kV	0,5	1	1,3	1,6	2	2,5	3,2	4	5	6,3	8	10	13	16	20	25	32	40	50	63	80	100	130	160	200
40 (150mA)	0,003	0,006	0,008	0,010	0,013	0,016	0,021	0,026	0,033	0,042	0,053	0,066	0,086	0,106	0,133	0,166	0,213	0,266	0,333	0,420	0,533	0,666	0,866	1,066	1,333
50 (150mA)	0,003	0,006	0,008	0,010	0,013	0,016	0,021	0,026	0,033	0,042	0,053	0,066	0,086	0,106	0,133	0,166	0,213	0,266	0,333	0,420	0,533	0,666			
60 (125mA)	0,004	0,008	0,010	0,012	0,016	0,020	0,025	0,032	0,040	0,050	0,064	0,080	0,104	0,128	0,160	0,200	0,256	0,320	0,400	0,504	0,640				
70 (107mA)	0,004	0,009	0,012	0,014	0,018	0,023	0,029	0,037	0,046	0,058	0,074	0,093	0,121	0,149	0,186	0,233	0,299	0,373	0,467	0,588					
80 (93mA)	0,005	0,010	0,013	0,017	0,021	0,026	0,034	0,043	0,053	0,067	0,086	0,107	0,139	0,172	0,215	0,268	0,344	0,430	0,537	0,677					
90 (83mA)	0,006	0,012	0,015	0,019	0,024	0,030	0,038	0,048	0,060	0,075	0,096	0,120	0,156	0,192	0,240	0,301	0,385	0,481	0,602						
100 (75mA)	0,006	0,013	0,017	0,021	0,026	0,033	0,042	0,053	0,066	0,084	0,106	0,133	0,173	0,213	0,266	0,333	0,426	0,533	0,666						
110 (68mA)	0,007	0,014	0,019	0,023	0,029	0,036	0,047	0,058	0,073	0,092	0,117	0,147	0,191	0,235	0,294	0,367	0,470	0,588							
120 (62mA)	0,008	0,016	0,020	0,025	0,032	0,040	0,051	0,064	0,080	0,101	0,129	0,161	0,209	0,258	0,322	0,403	0,516	0,645							
125 (59mA)	0,008	0,017	0,022	0,027	0,034	0,042	0,054	0,068	0,085	0,107	0,136	0,169	0,220	0,271	0,339	0,424	0,542	0,678							

TABLE 2 – 15KW POWER

mAs \ kV	0,5	1	1,3	1,6	2	2,5	3,2	4	5	6,3	8	10	13	16	20	25	32	40	50	63	80	100	130	160	200
40 (375mA)	0,001	0,002	0,003	0,004	0,005	0,006	0,008	0,010	0,013	0,016	0,021	0,026	0,034	0,042	0,053	0,066	0,085	0,106	0,133	0,168	0,213	0,266	0,346	0,426	0,533
50 (300mA)	0,001	0,003	0,004	0,005	0,006	0,008	0,010	0,013	0,016	0,021	0,026	0,033	0,043	0,053	0,066	0,083	0,106	0,133	0,166	0,210	0,266	0,333	0,433	0,533	
60 (250mA)	0,002	0,004	0,005	0,006	0,008	0,010	0,012	0,016	0,020	0,025	0,032	0,040	0,052	0,064	0,080	0,100	0,128	0,160	0,200	0,252	0,320	0,400	0,520		
70 (214mA)	0,002	0,004	0,006	0,007	0,009	0,011	0,014	0,018	0,023	0,029	0,037	0,046	0,060	0,074	0,093	0,116	0,149	0,186	0,233	0,294	0,373	0,467	0,607		
80 (187mA)	0,002	0,005	0,006	0,008	0,010	0,013	0,017	0,021	0,026	0,033	0,042	0,053	0,069	0,085	0,106	0,133	0,171	0,213	0,267	0,336	0,427	0,534			
90 (166mA)	0,003	0,006	0,007	0,009	0,012	0,015	0,019	0,024	0,030	0,037	0,048	0,060	0,078	0,096	0,120	0,150	0,192	0,240	0,301	0,379	0,481	0,602			
100 (150mA)	0,003	0,006	0,008	0,010	0,013	0,016	0,021	0,026	0,033	0,042	0,053	0,066	0,086	0,106	0,133	0,166	0,213	0,266	0,333	0,420	0,533				
110 (136mA)	0,003	0,007	0,009	0,011	0,014	0,018	0,023	0,029	0,036	0,046	0,058	0,073	0,095	0,117	0,147	0,183	0,235	0,294	0,367	0,463	0,588				
120 (125mA)	0,004	0,008	0,010	0,012	0,016	0,020	0,025	0,032	0,040	0,050	0,064	0,080	0,104	0,128	0,160	0,200	0,256	0,320	0,400	0,504					
125 (121mA)	0,004	0,008	0,011	0,013	0,016	0,021	0,026	0,033	0,041	0,052	0,066	0,082	0,107	0,132	0,165	0,207	0,264	0,331	0,413	0,521					

TABLE 3 – 30kW POWER

<div>mAs</div> <div>kV</div>	0,5	1	1,3	1,6	2	2,5	3,2	4	5	6,3	8	10	13	16	20	25	32	40	50	63	80	100	130	160	200
<div>40</div> <div>(425mA)</div>	0,001	0,002	0,003	0,003	0,004	0,005	0,007	0,009	0,011	0,014	0,018	0,023	0,030	0,037	0,047	0,058	0,075	0,094	0,117	0,148	0,188	0,235	0,305	0,376	0,470
<div>50</div> <div>(400mA)</div>	0,001	0,002	0,003	0,004	0,005	0,006	0,008	0,010	0,012	0,015	0,020	0,025	0,032	0,040	0,050	0,062	0,080	0,100	0,125	0,157	0,200	0,250	0,325	0,400	
<div>60</div> <div>(375mA)</div>	0,001	0,002	0,003	0,004	0,005	0,006	0,008	0,010	0,013	0,016	0,021	0,026	0,034	0,042	0,053	0,066	0,085	0,106	0,133	0,168	0,213	0,266	0,346		
<div>70</div> <div>(355mA)</div>	0,001	0,002	0,003	0,004	0,005	0,007	0,009	0,011	0,014	0,017	0,022	0,028	0,036	0,045	0,056	0,070	0,090	0,112	0,140	0,177	0,225	0,281	0,366		
<div>80</div> <div>(337mA)</div>	0,001	0,002	0,003	0,004	0,005	0,007	0,009	0,011	0,014	0,018	0,023	0,029	0,038	0,047	0,059	0,074	0,094	0,118	0,148	0,186	0,237	0,296			
<div>90</div> <div>(320mA)</div>	0,001	0,003	0,004	0,005	0,006	0,007	0,010	0,012	0,015	0,019	0,025	0,031	0,040	0,050	0,062	0,078	0,100	0,125	0,156						
<div>100</div> <div>(300mA)</div>	0,001	0,003	0,004	0,005	0,006	0,008	0,010	0,013	0,016	0,021	0,026	0,033	0,043	0,053	0,066	0,083	0,106	0,133	0,166						
<div>110</div> <div>(204mA)</div>	0,002	0,004	0,006	0,007	0,009	0,012	0,015	0,019	0,024	0,030	0,039	0,049	0,063	0,078	0,098	0,122	0,156	0,196	0,245	0,308	0,392				
<div>120</div> <div>(141mA)</div>	0,003	0,007	0,009	0,011	0,014	0,017	0,022	0,028	0,035	0,044	0,056	0,070	0,092	0,113	0,141	0,177	0,226	0,283	0,354	0,446					
<div>125</div> <div>(126mA)</div>	0,004	0,008	0,010	0,013	0,016	0,020	0,026	0,032	0,040	0,050	0,063	0,079	0,103	0,127	0,159	0,198	0,254	0,317	0,397	0,500					

# SERVICE MANUAL

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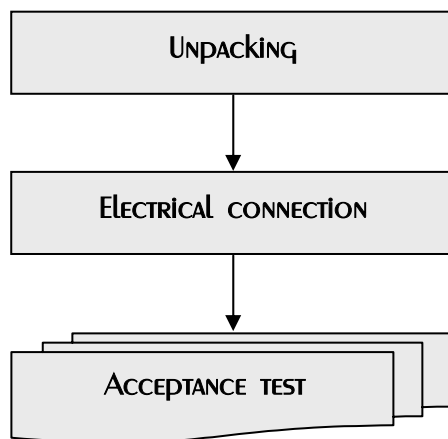
## GENERAL DESCRIPTION

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# INSTALLATION

### 1 INTRODUCTION

The installation procedure consists of different operations to be carried out in the order shown in the flow chart below.



The various operations indicated are described in detail in the following paragraphs.

The installation process can only be considered completed after the **TEST SHEET** regarding the acceptance tests provided with this manual has been filled in.

***NOTE:** the radiological system is normally pre-installed and configured in the factory according to the specific requirements of the customer. Certain adjustments may, however, be necessary when components are replaced.*

*The whole machine parameter adjustment procedure is described in detail in this manual (SECTION 4).*

## 2 UNPACKING

The radiological system is packed in a single case containing all the parts of the apparatus. To unpack the unit, proceed as described on the following page, according to the type of packing:

- ➡ simple pallet with cellophane – SEE § 2.1
- ➡ pallet with carton – SEE § 2.2
- ➡ wood packing crate – SEE § 2.3

If necessary, follow the unpacking procedure backwards to pack the unit again.

### 2.1 PACKING WITH CELLOPHANE

1. Cut the tape (4) and remove the slide (5) – SEE FIGURE 1
2. remove the protective bag (6)
3. unscrew the four self-threading screws (7) which fix the anterior wheel fixing bracket (8)
4. free the X-ray Tube Head fixing brackets (9) from the tie-rod (14) - SEE FIGURE 2 - working on nuts (10)
5. unscrew the self-threading screws (11) and remove the X-ray Tube Head fixing brackets (9)
6. put the slide (5) on the floor, as shown in FIGURE 1
7. unscrew the screws (12) which fix the stand to the packing bracket (13)
8. slowly move the mobile unit towards the slide (5), paying attention to the packing bracket (13)
9. let the unit move slowly from the slide (5) till its complete positioning on the floor.

# SERVICE MANUAL

## INSTALLATION

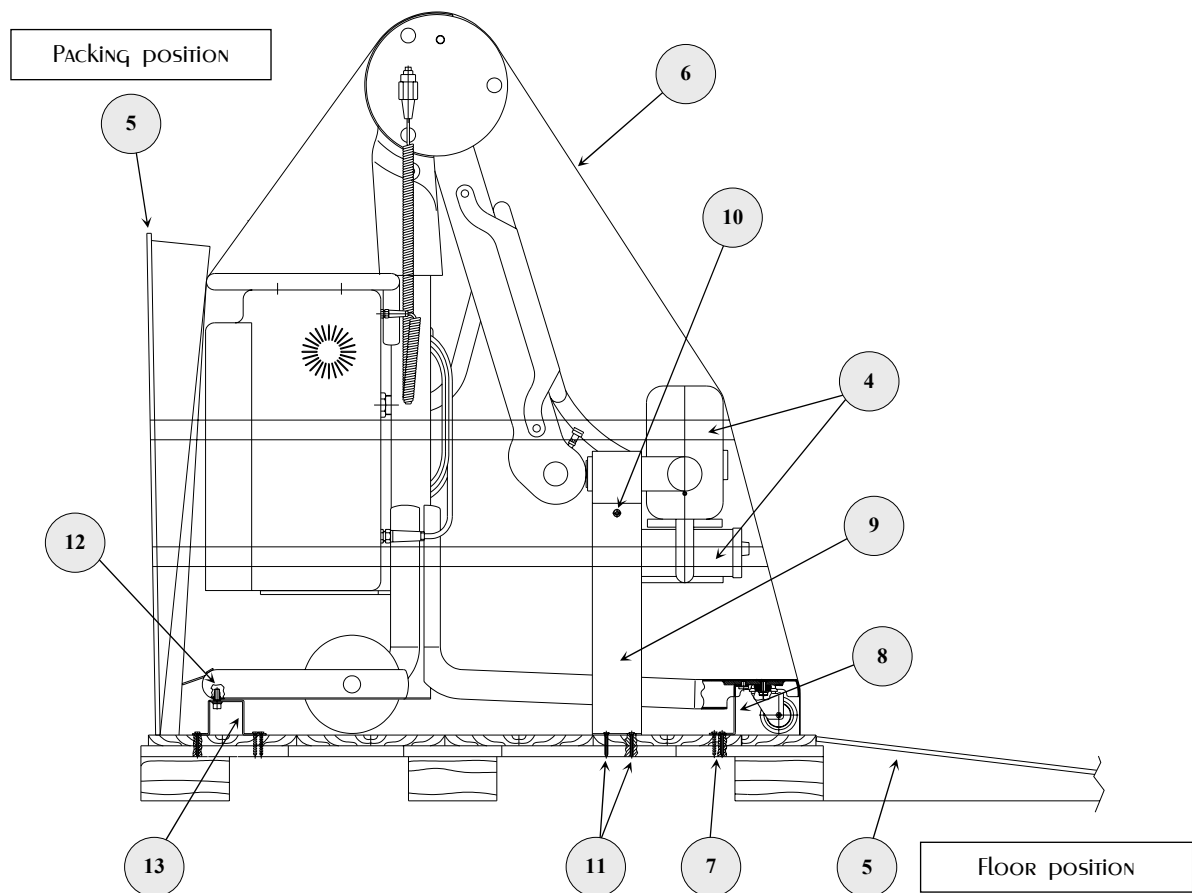


FIGURE 1 - LATERAL VIEW

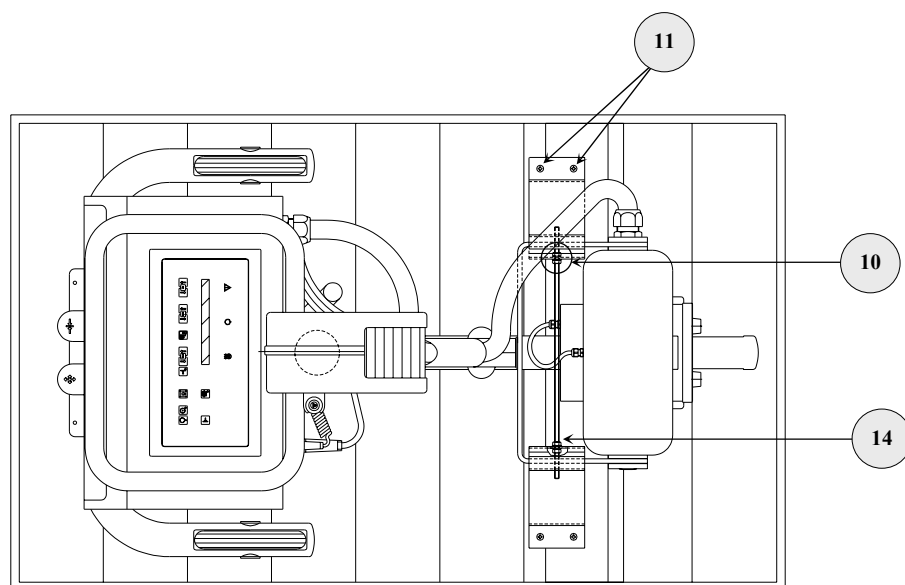


FIGURE 2 - VIEW FROM ABOVE

## 2.2 PACKING WITH CARTON

1. Remove the screws (1) - SEE FIGURE 3 - which fix the packing carton to the crate pallet (2)
2. cut the band (3)
3. remove the carton packing from its housing; the mobile unit is as shown in FIGURE 1
4. proceed according to the packing with cellophane procedure (§ 2.1).

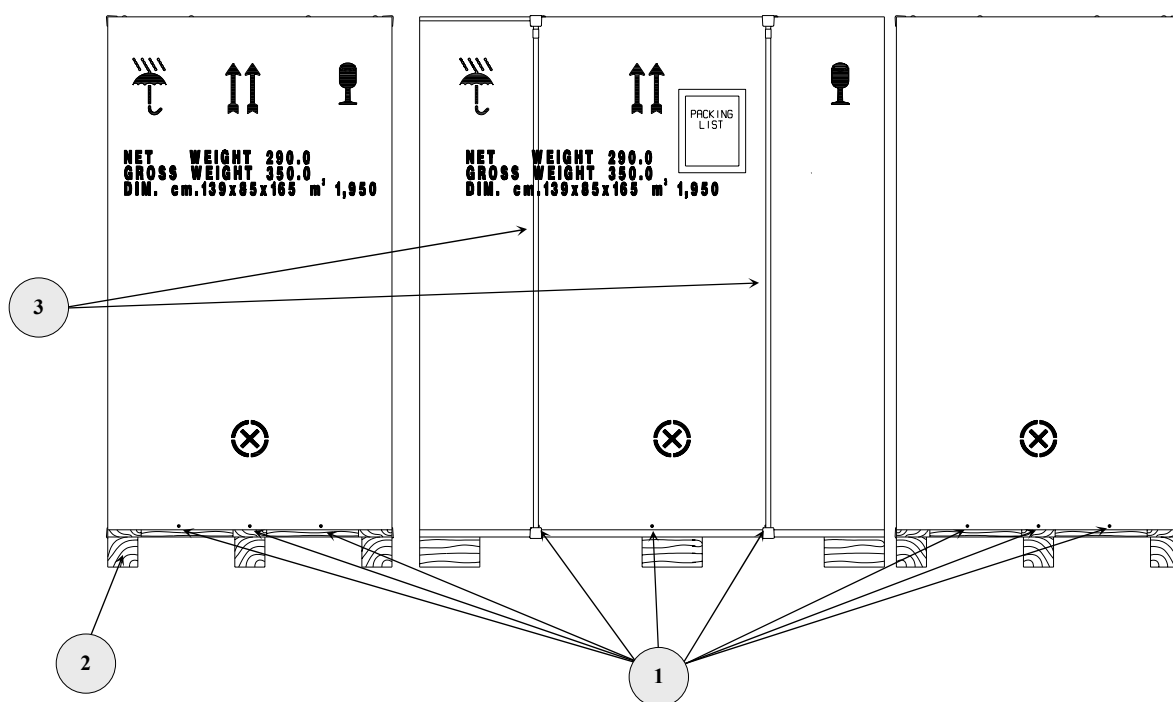


FIGURE 3 - PALLET WITH CARTON



### 2.3 PACKING WITH WOOD CRATE

1. Dismantle the crate cover (1) – SEE FIGURE 4
2. remove the crate walls: be careful not to ruin the wall (5) that has to be used as slide; the mobile unit is as shown in FIGURE 1

*Note: in the wood packing case, the slide (5) is not mounted as shown in FIGURE 1, because it is substituted by the wall (5), previously mentioned*

3. proceed according to the packing with cellophane procedure (§ 2.1).

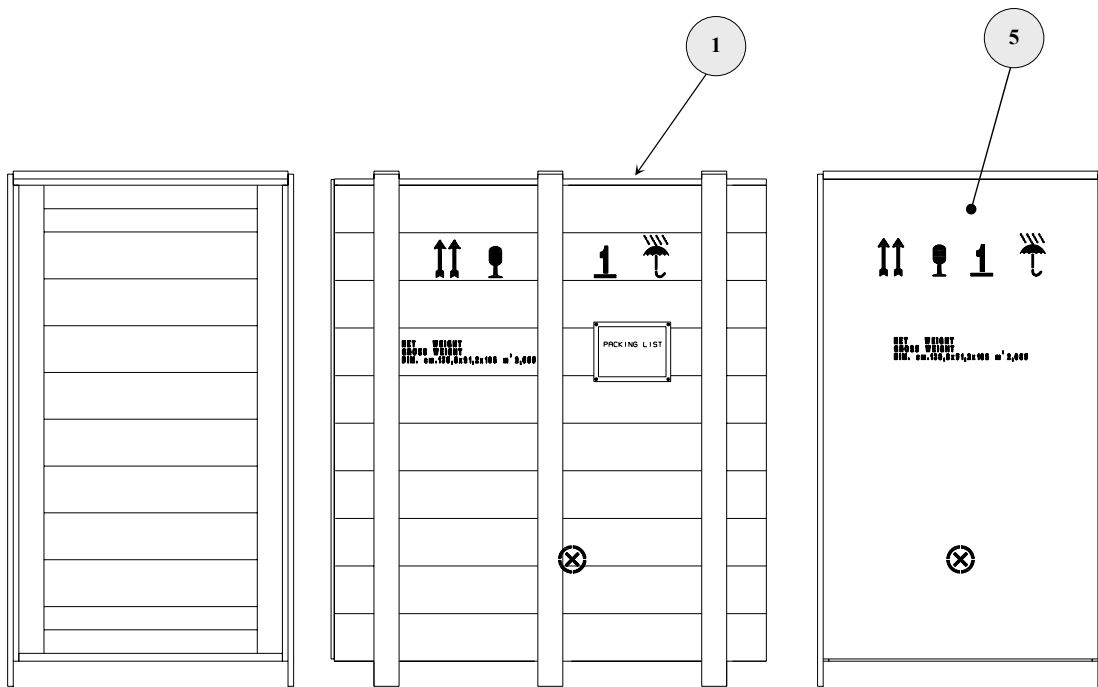


FIGURE 4 - WOOD CRATE

## 3 ELECTRICAL CONNECTIONS

The power supply single-phase alternate voltage and maximum absorbed current values are reported both on the unit label and on the technical data (SEE SECTION 1 - § 3.2).



**Make sure that the power supply socket is approved for the values reported on the unit label**

## 4 ACCEPTANCE TEST

The **ACCEPTANCE TEST** includes all the control and checking operations listed on the **TEST SHEET**. These operations must be grouped together under three general categories:

- ➡ checking cables and connectors
- ➡ mechanical checks
- ➡ electrical checks

Each operation is identified by a code which is then used on the **TEST SHEET**.

### 4.1 CHECKING CABLES AND CONNECTORS

Visually control each cable and each connector, checking that there are no interruptions and/or crushing.

- A.1 Power supply cable of the unit
- A.2 Radiography control pushbutton cable
- A.3 Connection cable between unit/X-ray tube head

### 4.2 MECHANICAL CHECKS

The mechanical checks include the following operations:

- ▣ **MOVEMENTS:** all the movements foreseen must be possible without excessive force or jerks
- ▣ **BRAKES** all the movement locking brakes must be operating and easily applied
- ▣ **SOUNDNESS:** check that there are no breakages and/or damage which might have jeopardised operation and safety of the apparatus.

The single checking phases are listed below.

- B.1 Unit sliding movement
- B.2 Unit parking brake
- B.3 Proper Functioning of the antitilting assemblies
- B.4 Integrity of the Control panel
- B.5 Integrity and fixing of the carters
- B.6 Balance of the pantograph arm.

### 4.3 ELECTRICAL CHECKS

With regard to the electrical part, correct operation of the following must be checked:

- ▣ **SAFETY DEVICES**
- ▣ **SIGNALS**

**NOTE:** Remove the carters to carry out the electrical checks.

The procedure is described below:

- C.1 **POWER SUPPLY:** connect the unit to the mains power supply;
- C.2 **INITIAL TEST:** check that the initial automatic test is correct of the unit;
- C.3 **SOFTWARE:** check that the visualization of installed software;
- C.4 **LOADING:** check that the switching on the unit appears the increment of voltage on display until 350 V. The complete loading of the capacitors battery is ready in about 40/45 sec;

- C.5 DISCHARGING: switch the unit off and check the complete discharging of the capacitors battery by means the switching off the **LD3** led mounted on **S25** board;



**Do not carry out switching the unit On and Off**

- C.6 SET-UP DATES IN MEMORY: enter on SET-UP (SEE SECTION 4 - § 3) and check that the SET-UP dates are in according with dates selected (SEE SECTION 4 - § 3 – TAB. 2);
- C.7 X-RAY TUBE FORMATION: when not in used the unit for a long time, before to use the unit normally, carry out the “formation” of the X-ray tube with a serial of exposure using the following dates (carry out for each value of **kV** and **mAs** 10 exposure and keep a pause of 1 minute between an exposure and another one):

40 kV	➤	100 mAs
50 kV	➤	80 mAs
60 kV	➤	64 mAs
70 kV	➤	64 mAs
80 kV	➤	50 mAs
90 kV	➤	50 mAs
100 kV	➤	40 mAs
110 kV	➤	40 mAs
120 kV	➤	40 mAs

During this formation check with oscilloscope the value of **kV** [**S19/B** board **Tp11** (-); **Tp3** (+) ] and **mA** [**S19/B** board: **Tp11** (-); **Tp6** (+) ] on inverter. Select the oscilloscope in the following way:

CHANNEL A: 1 V/DIV ( 1V read is equal to 50 mA)

CHANNEL B: 1 V/DIV ( 1V read is equal to 20 KV)

BASE TIME: 25ms/DIV

# SERVICE MANUAL

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## INSTALLATION

In case of kV wave form presents of high voltage discharge or you hear discharge inside X-ray tube interrupt the sequence, wait few minutes before starting again; repeat the initial formation checking that the fuse **F7** is interrupted (100A) (SEE ELECTRICAL DRAW);



**Warning: presence of 350 Vdc voltage!**

- C.8 EXPOSURE TIME: check that during exposure time the X-ray passage led until the end of exposure the display shows the real exposure time in second (SEE SECTION 1 - § 3.2.3).

# MAINTENANCE

## 1 ROUTINE MAINTENANCE

### 1.1 GENERAL RECOMMENDATIONS

The radiological system requires regular checks and maintenance. The following recommendations have the aim of helping the operator to keep the apparatus in good working and safe conditions during service.

The system contains mechanical parts subject to wear according to use: following prolonged use, wear on parts may decrease safety during use. For this reason, it is essential for the checking and maintenance operations indicated below to be carried out consistently to protect the operators and patients against any damage caused by mechanical breakdowns.

Correct adjustment of the electrical and electronic systems has a direct influence on the operation of the system, on the quality of the image and on the electrical safety of the system, as well as on the level of exposure to radiation the operators and patients are subjected to.

The **MAINTENANCE PROGRAMME**, described in the following paragraphs, consists of controls and interventions to be carried out by specialised personnel authorised by the manufacturer. All maintenance operations are the responsibility of the owner of the apparatus.



**Should it be necessary to replace components or parts which may in any way condition the safety of the machine, only use original spare parts.**

## 1.2 FREQUENT CHECKS AND INSPECTIONS

The operating personnel must be suitably trained to be able to carry out the daily and weekly checks indicated in TABLE 1.

The other controls described in this chapter and the interventions described in the following chapters are reserved for qualified and authorised personnel of the technical assistance service.

TABLE 1

INTERVAL	CHECK
<b>DAILY CHECKS</b>	Operation of the signals, displays and LEDs Operation of the stationary brake Integrity of the warning and danger labels
<b>WEEKLY CHECKS</b>	Absence of oil leaks from the X-ray tube head Absence of unusual noises in the X-ray tube head during X-ray emission
<b>6-MONTHLY CHECKS</b>	Correct operation and the value of the whole earthing circuit Power supply voltage value Value of the continuous voltages generated inside the system Fixing and general state (dust and corrosion) of the boards Centering of the X-ray tube head-collimator assembly

## 1.3 GENERAL CHECKS AND INSPECTIONS

Every six months, and in any case **according to local legislation in force**, the procedures indicated in the **ACCEPTANCE TEST REPORT** must be carried out completely. The results obtained are noted down on the **TEST SHEET** together with the description of any interventions carried out.

The checks listed below must be added to those contained on the Test Sheet:

- D.1 Power supply voltage check
- D.2 DC power supply check
- D.3 Protection earth check
- D.4 Internal earth connection check



### 1.4 CLEANING AND DISINFECTION

Products with a high content of alcohol, corrosive and/or abrasive detergents or solvents must not be used to clean the surfaces of the apparatus.

To disinfect the system, only use methods in compliance with the laws in force regarding disinfection and protection procedures against explosion.

To carry out the cleaning and disinfection operations, take the following precautions:

- turn the system off and disconnect the mains power supply cable
- make sure that no liquid gets into the apparatus so as to avoid any short-circuits or corrosion of the electrical and electromechanical parts.



**The unit has not to be used in presence of anaesthetic and/or inflammable disinfectant and cleaning products.**

**If, producing explosive gaseous, mixture, are used, make sure that gases are dispersed before switching on the unit.**

## 2 SPECIAL MAINTENANCE

### 2.1 TROUBLESHOOTING

Troubleshooting can be facilitated by the indications given in TABLE 2, which illustrates the most common incorrect operating conditions, showing their probable causes. In the presence of the following alarms visualized on the display, the X-ray exposition is disqualified and the console's alarm red led light up. In case it is also present after the execution of the suggested intervention, please contact the service assistance department.

TABLE 2

N°	FAULT NOTED	LIKELY CAUSE	RECOMMENDED INTERVENTION
1	The unit doesn't switch on (on key LED switched on)	No power supply on input	Check / Replace the S22-F2 or TR2-F24V fuse
	The unit doesn't switch on (on key LED switched off)	No power supply on input	Check / Replace the S22-F1 or F1 fuse (on input)
2	The apparatus works but does not emit rays – No alarm on the unit display	Radiography pushbutton fault	Check the Radiography pushbutton cable and connector
3	Alarm: "SUPPLY FAULT"	+15V or -15V fault of the S22 board supply	Check power supply (+15VA/-15VA/+24VA voltage on S22 voltage)
4	Alarm: "FILAMENT FAULT"	400 Hz power supply absent	Check / Replace TR2-F130V0 fuse
		X-ray tube filament interrupted	Replace the X-ray tube head
		S15 board fault	Replace the board
5	Alarm: "INVERTER FAULT"	If the indication appears on stand-by: P1 Set-Up on S22 board faulty	Carry out set-up as in Section 4 - § 4.2
		If the indication appears while carrying out X-ray: faulty on X-ray power circuit	Switching the unit off, switching it on and repeat the X-ray
		F2 and F3 fuses blown	Replace F2 and F3 fuses
		F6 and F7 fuses blown on the Power circuit	Replace F6 and F7 fuses
6	Alarm: "kV FAULT"	During a radiograph the effective kV are less than 85% of those set: fault on the power circuit	Switching the unit off, switching it on and repeat the X-ray
7	Alarm: "mA FAULT"	During an exposure the mA value is lower than the allowed limit	Switching the unit off, switching it on and repeat the X-ray
8	Alarm: "THERMIC SAFETY"	X-ray tube head overheated	Do not carry out any X-rays and wait for the X-ray tube head to cool down
		Breakage of the thermal sensor	Replace the thermal sensor located on the X-ray tube head and/or check the relevant wiring on S22 board
9	Alarm: "MAN STOP RX"	During a radiograph with cassette, the control pushbutton for X-ray command has been released early	Repeat the radiography
10	Alarm: "X-RAY LACKING"	Error in the high voltage generation circuit	Switching the unit off, switching it on and repeat exposure

# SERVICE MANUAL

## MAINTENANCE

N°	FAULT NOTED	LIKELY CAUSE	RECOMMENDED INTERVENTION
11	Alarm: "MAX TIME"	The radiography time has exceeded the concurred limit	Check that the mA are correct Check the mA reading on board S22-Tp1 or S19/B-Tp6
12	Alarm: "STARTER FAULT"	During anode preparation it was not put into rotation	Check the fuses on board S21A Check the stator winding of the X-ray tube head
		Fault on board S21/A Fault on board S20	Replace board S21/A Replace board S20
13	Alarm: "SWITCH OFF FOR 1 MIN"	Capacitors bank still loads	With the unit off wait 1 minute before switching it on
14	Alarm: "BATTERY FAULT"	Power Circuit Fault	Contact technical service
15	Alarm: "OVERVOLTAGE BATTERY"	Battery Circuit Fault	Contact technical service
16	Alarm: "X-RAY COMMAND ACTIVE"	The operator has pressed the radiography command before the system had finished the initial control stage	Release the radiography pushbutton and wait until the system is ready
17	Alarm: "X-RAY TUBE TOO HOT"	It is not possible to begin exposure since the remaining thermal units available are too few	Wait for the X-ray tube to cool down.
18	Alarm: "WAIT CONNECTION"	The keyboard does not communicate with the unit	Switching the unit off, switching it on and repeat exposure
19	Alarm: "POTTER FAULT" (only with Potter installed)	Potter Fault	Check the F4 - F5 fuses of the Potter power supply and the K3 relè

## 2.2 REPLACEMENT OF COMPONENTS

Replacement of a component can mean the need to carry out checks and adjustments in order to reset correct operation of the radiological unit. TABLE 3 shows typical situations where an adjustment is necessary.

TABLE 3

COMPONENT REPLACED	ADJUSTMENT AND CHECKS	REFERENCE
15 BOARD	Verify <b>mA</b> set up in SET UP	SECTION 4 - § 5
S19/B BOARD	Check of <b>kV</b> e <b>mA</b>	SECTION 4 - § 5.1 and 8
S20 BOARD	Check Run voltage	SECTION 4 - § 2
	Check start 800 ms	
S22 BOARD	Check max Set kV (P1)	SECTION 4 - § 4.3
	Check max exposure time (P2)	SECTION 4 - § 4.1 and 4.2
S25 BOARD	Check max voltage of battery	SECTION 4 - § 7
S28 BOARD	Check LCD Display contrast (P1)	

**Before effecting the monoblock replacement make the following operations:**



- for safety purposes add some counterweight on the front part of the unit in order to avoid the possible tilting of the same.
- fasten the pantograph arm to the base of the unit (using some ropes) to avoid the arm making not required movements, due to the loss of weight when the X-ray tube head is removed.

**Consult in any case Mechanical Assembly and Dismantling of the present section.**

## 2.3 LIST POTENTIOMETERS

BOARD	POTENTIOMETER	VALUE	NAME	NOTE
S15	P1	5K	MANUAL SET I FIL (ONLY FOR TEST)	Only factory adjustment
	P2	5K	MAX I FG	Only factory adjustment
	P3	5K	MAX I FP	Only factory adjustment
S17	P1	10K	FEEDBACK KV+	Only factory adjustment
	P2	10K		Only factory adjustment
	P3	10K	FEEDBACK KV-	Only factory adjustment
	P4	10K		Only factory adjustment
S19/B	P1	2K	MAX CURRENT	Only factory adjustment
	P2	2K	FREQUENCY SET	Only factory adjustment
	P3	2K	MA FLUORO OFFSET ADJ.	N.U.
	R66		FEEDBACK MA ADJ	Only factory adjustment
S20	P1	1K	RUN VOLTAGE	Only factory adjustment
	P2	1M	START 800MS	Only factory adjustment
S22	P1	2K	MAX SET KV	Only factory adjustment
	P2	100K	MAX TIME RAD	Only factory adjustment
S25	P1	5K	MAX V CAPACITORS BANK	Only factory adjustment
S28	P1	20K	LCD CONTRAST	Only factory adjustment

# SERVICE MANUAL

## MAINTENANCE

### 2.4 LIST LEDS

BOARD	LED	COLOR	NAME	NOTE
S15	LD1	YELLOW	+24V	
	LD2	GREEN	+15VA	
	LD3	RED	SAFETY MAX I FIL	
S19/B	LD1	YELLOW	COM-RX	
	LD2	RED	$\Delta$ kV MAX	
	LD3	RED	kV > 110%	
	LD4	RED	kV MIN	
	LD5	RED	I MAX	
	LD6	YELLOW	COM. 1	
	LD7	YELLOW	COM. 2	
	LD8	YELLOW	PRE-RX	
	LD9	GREEN	+15V	
	LD10	GREEN	-15V	
S20	LD1	YELLOW	STARTER ON	
	LD2	GREEN	STARTER OK	
	LD3	YELLOW	FLUORO PREP (N.U.)	
S22	DL1	YELLOW	N.U.	
	DL2	YELLOW	N.U.	
	DL3	YELLOW	N.U.	
	DL4	YELLOW	N.U.	
	DL5	YELLOW	N.U.	
	DL6	YELLOW	N.U.	
	DL7	YELLOW	N.U.	
	DL8	YELLOW	N.U.	
	DL9	YELLOW	STARTER OK	
	DL10	YELLOW	PREP K1A	
	DL11	YELLOW	RAD	
	DL12	YELLOW	kV 85%	
	DL13	YELLOW	POTTER OK	
	DL14	GREEN	THERMIC	
	DL15	YELLOW	kV OK	
	DL16	GREEN	FIL OK	
	DL17	YELLOW	PRE RX	
	DL18	YELLOW	RX	
	DL19	YELLOW	PREP K1A	
	DL20	YELLOW	START POTTER	
	DL21	GREEN	+24VA	
	DL22	GREEN	+24VA	
	DL23	YELLOW	ON/OFF	
	DL25	GREEN	+24VA	
	DL26	YELLOW	CAPACITORS BANK CHANGE	
	DL27	YELLOW	CAPACITORS BANK CHARGE	
	DL28	YELLOW	OUT WD	
	DL29	YELLOW	PREP STARTER	
	DL30	YELLOW	FP	
	DL31	YELLOW	CORR MA	

## 2.5 LIST FUSES

BOARD	NAME	TYPE	NOTE
LOADING BATTERY	F2	16A	Input power supply protection
	F3	16A	
INVERTER	F6	63A	Protection Inverter
	F7	63A	
TR1 TRANSFORMER	F1	200mA-T	Protection TR1 Transformer
TR2 TRANSFORMER	F230V	2A-T	Protection TR2 Transformer
	F115V	3.15A-T	
	F135V	1A-T	
	F24V	2A-T	
	F12V	10A-T	
POTTER BUCKY	F4V	2A-T	Protection Potter Bucky (Optional)
	F5V	2A-T	
AUTOTRANSFORMER	F10	2A-T	Protection 115Vac power supply (Optional)
S21/A	F1	10A-T	Input power supply protection S21/A Board
	F2	10A-T	
	F3	500mA-T	Protection TR1 Transformer S21/A Board
S22	F1	1A-T	Protection Bridge Rectifier (24Vac)
	F2	2A-T	
S25	F1	80mA-T	Input power supply protection S25 Board
S29	F1	200mA-T	Protection Bridge Rectifier Group 1 (24Vac)
	F2	200mA-T	
	F3	200mA-T	Protection Bridge Rectifier Group 2 (24Vac)
	F4	200mA-T	
	F5	200mA-T	Protection Bridge Rectifier Group 3 (24Vac)
	F6	200mA-T	
	F7	200mA-T	Protection Bridge Rectifier Group 4 (24Vac)
	F8	200mA-T	
	F9	315mA-T	Input power supply protection S29 Board

### 3 SPARE PARTS

In case of replacing of parts that can be negative for the safety of the machine, use only original parts. For the list of the spare parts and relative codes to make reference to the SECTION 5 – EXPLODED DRAWINGS.

**NOTE:** *When you require spare parts ,it is necessary to tell the code of the piece and the **serial number of the unit** too.*

# X-RAY SETTINGS



### 1 INTRODUCTION

The radiological system is fully regulated in the factory: it is therefore only necessary to install it in order to use it.

All the information contained in this section and SECTION 3 of this manual must be used when extraordinary maintenance is necessary.



**In the case of any intervention, it is essential for the adjustment operations to be carried out in the sequence indicated.**



**In TABLE 1 indicates the potentiometers which do not require any further adjustments since they have already been regulated and sealed in the factory.**

TABLE 1

BOARD	POTENTIOMETER	DESCRIPTION
S15	P1	Manual Setting of the filament current
	P2	Maximum current of large focus
	P3	Maximum current of small focus
S17 (X-ray tube head)	P1	Return of the kV+
	P2	
	P3	Return of the kV-
	P4	
S19/B	P1	Maximum current
	P2	Frequency setting
S22	P1	Maximum kV setting
	P2	Maximum exposure time
S25	P1	Maximum battery voltage

**NOTE :** Jumper S19/B-J2A and J2B ON: safety  $kV_{max}$  set up for rotating anode

Jumper S19/B-J2A and J2B OFF: safety  $kV_{max}$  set up for stationary anode

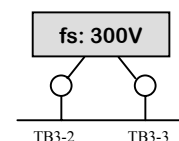
## 1.1 DIP SWITCH

Here follows the function of the dip-switch **S22-SW1** pins:

- |                                                       |                             |
|-------------------------------------------------------|-----------------------------|
| 1 – Only factory adjustment                           | 6 – Only factory adjustment |
| 2 – Only factory adjustment                           | 7 – Only factory adjustment |
| 3 – ON – It doesn't display the name when switched on | 8 – Only factory adjustment |
| 4 – Only factory adjustment                           |                             |
| 5 – ON – Small Focus when switched on                 |                             |

## 2 ROTATING ANODE STATOR POWER SUPPLY ADJUSTMENT

- ➡ Connect an AC voltmeter (*true* RMS if possible) with full-scale set at **300 V** between the **TB3-2** and **TB3-3** test points of board **S21/A** (power supply of the main winding);
- ➡ connect the probe of an oscilloscope between **IC2-8 (+)** and **Dz1 Anode (-)** of board **S20** and prepare the instrument to read a time of **800 ms**;
- ➡ take the **Radiography Command** pushbutton.



**For maximum operator safety, at this point it is advisable to temporarily disable the X-ray command signal by disconnecting the wire coming from S22-X4-3.**

- ➡ only press the **first click** of the **Radiography Command** pushbutton (*preparation pushbutton*);
- ➡ check that the stator is supplied with a voltage of about **230 Vac** for approximately **0,8 seconds**. If necessary, adjust this time interval using potentiometer **P2** of board **S20**;
- ➡ check that once the 0,8 seconds have passed the stator is supplied with a voltage of about **70 Vac**. If necessary, adjust this value by using potentiometer **P1** of board **S20**.

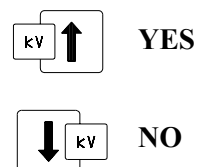
### 3 SET-UP PROCEDURE

To access the modality of SET-UP procedure to follow what underneath reported:

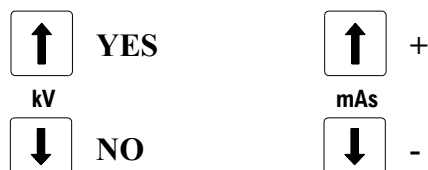
- ➡ press the keys of the console indicated to side at the same time



- ➡ the wording "SET-UP PROCEDURE ?" will appear on the display;  
to confirm selection, press the key indicated at the side marked with "YES", whereas to cancel the procedure, press the key marked "NO".



**NOTE:** In the Set-up procedure, the functions for editing the content of the fields shown on the display have been assigned to the keys as indicated below.



**TABLE 2 – MINIMUM, MAXIMUM AND OF DEFAULT VALUES OF SET-UP ADJUSTMENT**

FUNCTION			VALUE		
DIRECTORY		FILE	MINIMUM	MAXIMUM	DEFAULT
kV ADJUSTMENT		KV40	300	600	380
		kV120	1000	1500	1190
SMALL FIL. ADJ	7.5 kW	150 mA (40 kV)	1000	2000	1600
		75 mA (100 kV)	900	2000	1360
LARGE FIL. ADJ	15 kW	375 mA (40 kV)	1000	2000	1690
		150 mA (100 kV)	900	2000	1450
	30 kW	425 mA (40 kV)	1000	2000	1750
		300 mA (100 kV)	900	2000	1560
MAS ADJ		kV 050 (50 mAs)	250	1000	530
BATTERY		V = 350			

## 3.1 SERVICE MENU

When the unit is off, pushing both the keys underneath you enter the SERVICE MENU of the unit which subsequently visualizes the following data:

- name of the device and software version
- chosen anatomical program
- X-ray tube model
- total number of radiographic exposures
- total mAs accumulated.

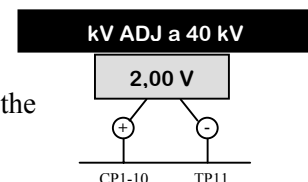


## 4 kV ADJUSTMENT

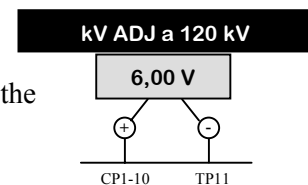
### 4.1 ADJUSTMENT "SET-UP" VOLTAGE

The **SET KV** voltage is supplied by the microcomputer and must be adjusted according to the relationship **kV/20** (i.e.:  $1V = 20kV$ ).

- ➡ First of all, enter the **SET-UP** procedure, following the instructions indicated in the previous paragraph;
- ➡ On board **S19/B** connect the probes of a **Vdc** digital multimeter between **CP1-10 (+)** and **TP11 (-)**;
- ➡ in Set-up select "**kV ADJ at 40 kV**";
- ➡ adjust the value until a reading of **2,00 V** is obtained on the voltmeter;



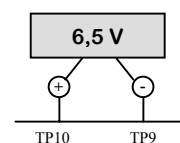
- ➡ in SET-UP select "**kV ADJ at 120 kV**";
- ➡ adjust the value until a reading of **6,00 V** is obtained on the voltmeter;
- ➡ exit the **SET-UP** procedure by using the key;
- ➡ then select **100 kV**, **80 kV** and **60 kV**, checking that the voltage read on the voltmeter is  $V_{read} = (Kv_{SET}/20) \pm 25 mV$ .



### 4.2 ADJUSTMENT OF MAXIMUM kV SETTING SAFETY

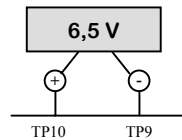
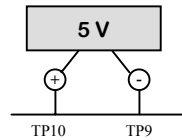
The maximum parameter value of **SET KV** under operating conditions must be **6 V**, corresponding to **120 kV**. The **MAX SET KV** safety device intervention is normally set to **130 kV**.

- ➡ connect the probes of a **Vdc** digital voltmeter between test points **TP10 (+)** and **TP9 (-)** of board **S22**;
- ➡ turn the system on and use potentiometer **P1** until a reading of **6,5 V**  $\pm 0,1 V$  is obtained.



## 4.3 CHECKING MAXIMUM kV SETTING SAFETY

- ➡ Connect the voltmeter to test points **TP10 (+)** and **TP9 (-)** of board **S22**
- ➡ lower the **MAX SET KV** safety intervention to **100 kV** adjusting potentiometer **P1** until a reading of **5 V  $\pm$  0,1 V** is obtained on the voltmeter;
- ➡ checking that by setting the **kV** to a higher value than **100 kV** the "**kV FAULT**" alarm goes off;
- ➡ put the **MAX SET KV** safety intervention back to **130 kV** using potentiometer **P1** again until a reading of **6.5 kV  $\pm$  0,1 V** is obtained.



### 5 ADJUSTMENT OF THE FILAMENT CURRENT

The following tables indicate the **mA** anode values associated with the **kV** and the typical filament currents determined on a **sample X-ray tube head** for **30 kW**, **15 kW** and **7.5 kW** power.

**TABLE 3**

		RADIOGRAPHY – 30 kW	
Set kV	kV	mA	I <sub>Filament</sub>
S22: TP10 – TP9 [V]	on display [kV]	S19/B: TP6 - TP11 [1V=10mA]	S15: CP6-2 [mA]
2	40	425	870
2,5	50	400	817
3	60	375	822
3,5	70	355	803
4	80	337	814
4,5	90	320	806
5	100	300	795
5,5	110	204	769
6	120	141	753
		Pre-switching:	466

**TABLE 4**

		RADIOGRAPHY – 15 kW	
Set kV	kV	mA	I <sub>Filament</sub>
S22: TP10 – TP9 [V]	on display [kV]	S19/B: TP6 - TP11 [1V=10mA]	S15: CP6-2 [mA]
2	40	375	799
2,5	50	300	752
3	60	250	733
3,5	70	214	723
4	80	187	713
4,5	90	166	703
5	100	150	693
5,5	110	136	684
6	120	125	673
		Pre-switching:	448

TABLE 5

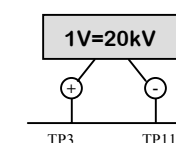
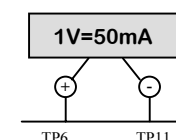
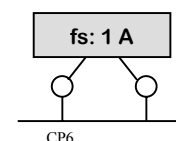
		RADIOGRAPHY – 7.5 kW	
Set kV	kV	mA	I <sub>Filament</sub>
S22: TP10 – TP9 [V]	on display [kV]	S19/B: TP6 - TP11 [1V=10mA]	S15: CP6-2 [mA]
2	40	150	826
2,5	50	150	777
3	60	125	757
3,5	70	107	747
4	80	93	737
4,5	90	83	727
5	100	75	716
5,5	110	68	706
6	120	62	696
		Pre-switching:	471

## 5.1 ADJUSTMENT OF FILAMENT CURRENT

**NOTE:** by **Filament Current** the current which runs through the primary winding of the transformer supplying the power to the filament itself is intended (Coolidge Transformer).

### MEASUREMENTS

- To measure the Filament Current, connect an ammeter with *true RMS* reading in series with terminal **CP6-2** of board **S15**. Set the full-scale to **1A** in **AC**.
- to measure the anode **mA** in **RADIOGRAPHY**, connect the probe of an oscilloscope between test points **TP6 (+)** and **TP11 (-)** of board **S19/B** to display the wave form of the mA (reading correspondence is **1V = 50 mA**) and between test points **TP3 (+)** and **TP11 (-)** of board **S19/B** to display the wave form of the kV (reading correspondence is **1V = 20 kV**).





# SERVICE MANUAL

## X-RAY SETTINGS

### ► PROCEDURE (example with Small focus LP 7,5 kW)

- activate the **SET-UP** procedure;
- select "**SMALL FIL ADJ**";
- adjust the "**DAC**" value set until a filament current, displayed on the digital voltmeter, equal to the one indicated in TABLE 5 for **40 kV (826)** is obtained – Typical **DAC 1600** – FIGURE 1;
- give the **X-ray** command and check that the **anode mA** are **150**. If necessary, adjust the **SET-UP** until the desired value is obtained;
- proceed with **SET-UP**;
- adjust the set value of the "**DAC**" until a **filament current**, displayed on the digital voltmeter, equal to the one indicated in TABLE 5 for **100 kV (716)** is obtained – Typical **DAC 1360** – FIGURE 2;
- give the **X-ray** command and check that the **anode mA** are **75**; if necessary, adjust the **SET-UP** until the desired value is obtained;
- proceed with **SET-UP** by selecting "**LARGE FIL ADJ**";
- Repeat the same operations described for "**SMALL FIL ADJ**" with **40 kV** and **100 kV**. For the anode and filament current mA values, refer to TABLE 3 (**30 kW**) and TABLE 4 (**15 kW**) according to the power of the machine.
- Exit **SET-UP**.

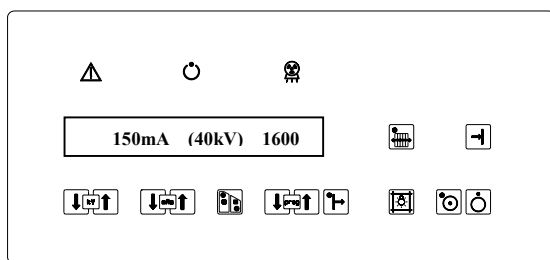
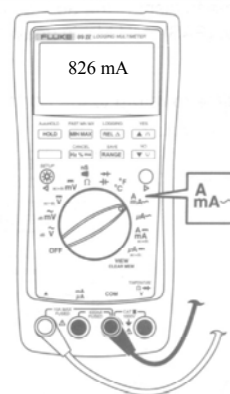


FIGURE 1 – DAC (40 kV) ADJUSTMENT



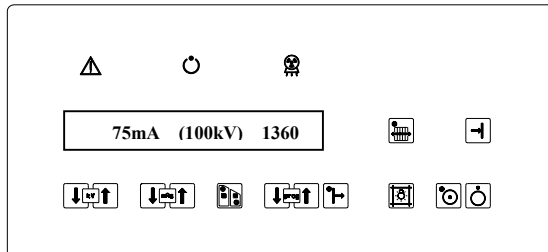
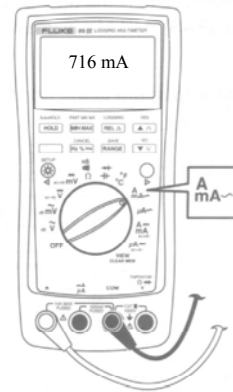


FIGURE 2 – DAC (100 kV) ADJUSTMENT



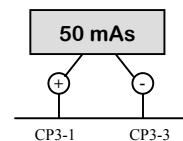
## 6 mAs ADJUSTMENT

### MEASUREMENTS

- Remove the bridge between terminals **CP3-1** and **CP3-3** of board **S19/B**
- connect a mAsmeter between the above-mentioned terminals.

### PROCEDURE

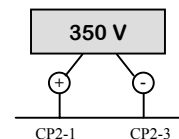
- activate the **SET-UP** procedure
- select "**mAs ADJ**" and give the **X-ray** command
- check that the **mAs** value on the instrument is really the one set (**50 mAs** – Typical **DAC 0530**); if necessary, adjust the **SET-UP** until the desired value is obtained
- exit **SET-UP**.



## 7 ADJUSTMENT OF THE BATTERY VOLTAGE

### MEASUREMENTS

- To measure the battery voltage, connect a voltmeter with true RMS reading between terminals **CP2-1 (+)** and **CP2-3 (-)** of board **S25**.



**Warning: presence of 350 Vdc voltage**

### PROCEDURE

- activate the **SET-UP** procedure;
- select "**V BATTERY ADJ**";
- Adjust the Set-up until the point in which the battery voltage measure value, reaches the battery voltage set value (tip. **350V**);
- exit **SET-UP**.

## 8 CHECKING THE RADIOGRAPHIC PARAMETER

After having completed the operations indicated in the previous paragraphs (§ 2, § 4, § 5), it is necessary to check the values of the signals proportional to the **kV** and to the **mA** which come from the **INVERTER**. The tolerance for the **kV** signal is  $\pm 5\%$  whereas for the **mA** it is  $\pm 15\%$ .

**NOTE:** If the **kV** value is not correct, it is necessary to repeat the **SET kV** adjustment.

**NOTE:** An oscilloscope with two channels is required for the checks below.

### 8.1 CHECKING kV AND mAs DURING RADIOGRAPHY

- ➡ Connect the probe of the oscilloscope as indicated below:

CHANNEL A: **TP3 (+) – TP11 (-)** of board **S19/B (REAL kV)**;

TIME BASE: 10 ms

- ➡ If necessary, connect the probe of the oscilloscope as indicated below:

CHANNEL B: **TP6 (+) – TP11 (-)** of board **S19/B (mA)**;

TIME BASE: 10 ms

- ➡ set the minimum value of the **kV (40 kV – 425 mA)**
- ➡ give the **X-RAY** command and check that the values read on the oscilloscope correspond with those indicated in TABLE 6; (FIGURE 3 shows an example of a 100 kV wave form)
- ➡ repeat the previous operations, setting the **kV** values to **80 kV** and **120 kV** both for **15 kW** and **7.5 kW** powers.

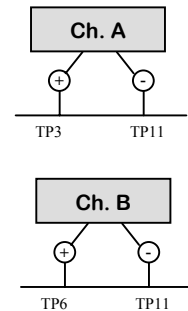


TABLE 6 – 30kW

kV		mAs		mA	Time (s)
Set	Acceptance range S19: TP3 - TP11 [1V = 20 kV]	Set	Acceptance range ( $\pm 10\%$ )	Theoretical	Theoretical
40	38 ÷ 42	16	14.5 ÷ 17.5	425	0.037
80	76 ÷ 84	16	14.5 ÷ 17.5	337	0.047
120	114 ÷ 126	16	14.5 ÷ 17.5	141	0.113

# SERVICE MANUAL

## X-RAY SETTINGS

TABLE 7 – 15kW

kV		mAs		mA	Time (s)
<i>Set</i>	<i>Acceptance range</i> S19: TP3 - TP11 [1V = 20 kV]	<i>Set</i>	<i>Acceptance range</i> (±10%)	<i>Theoretical</i>	<i>Theoretical</i>
40	38 ÷ 42	16	14.5 ÷ 17.5	375	0.042
80	76 ÷ 84	16	14.5 ÷ 17.5	187	0.085
120	114 ÷ 126	16	14.5 ÷ 17.5	125	0.128

TABLE 8 – 7.5kW

kV		mAs		mA	Time (s)
<i>Set</i>	<i>Acceptance range</i> S19: TP3 - TP11 [1V = 20 kV]	<i>Set</i>	<i>Acceptance range</i> (±10%)	<i>Theoretical</i>	<i>Theoretical</i>
40	38 ÷ 42	8	7.2 ÷ 8.8	150	0.053
80	76 ÷ 84	8	7.2 ÷ 8.8	93	0.086
120	114 ÷ 126	8	7.2 ÷ 8.8	62	0.129

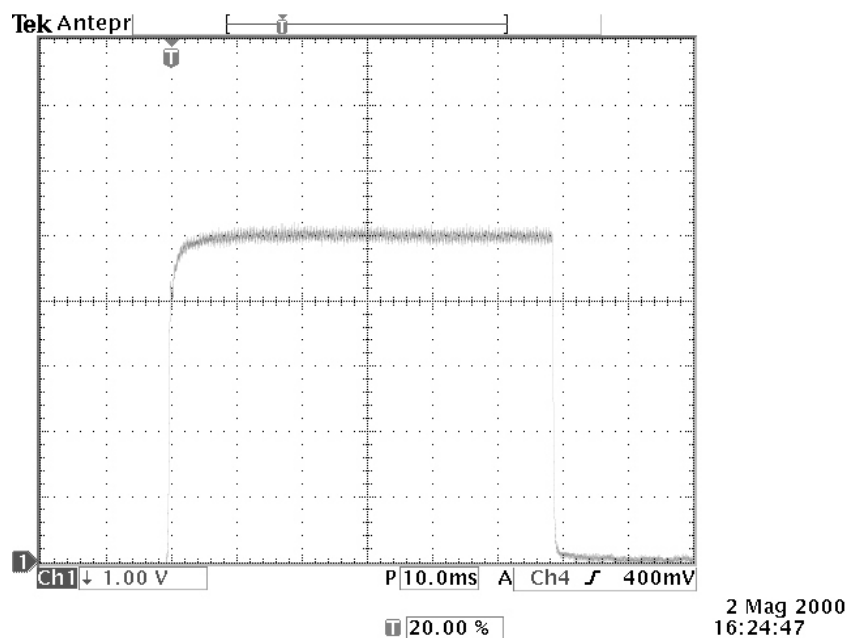


FIGURE 3 – ACQUISITION OF THE kV WAVE FORMS DURING RADIOGRAPHY [100 kV – 16 mAs – 30 kW]

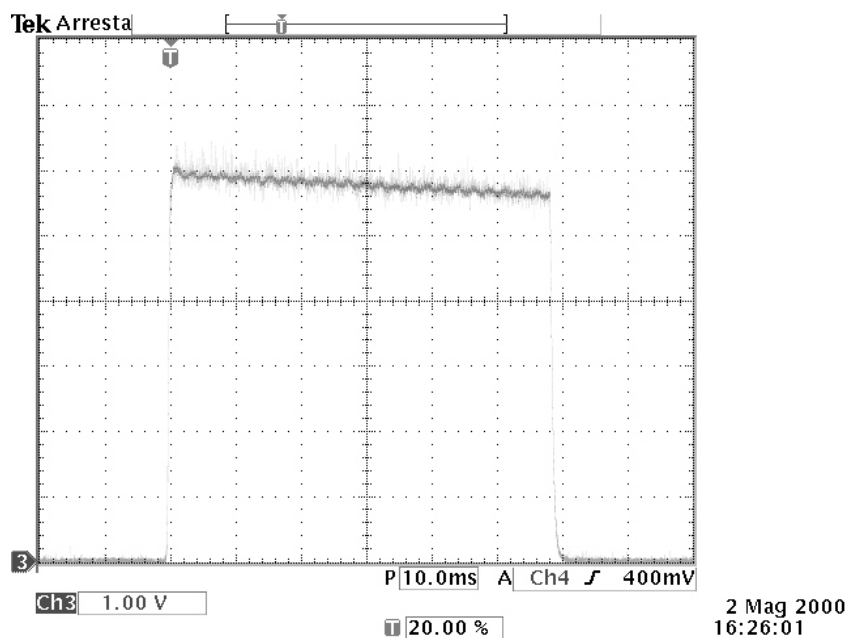


FIGURE 4 – ACQUISITION OF THE mA WAVE FORMS DURING RADIOGRAPHY [100 kV – 16 MAS – 30 kW]

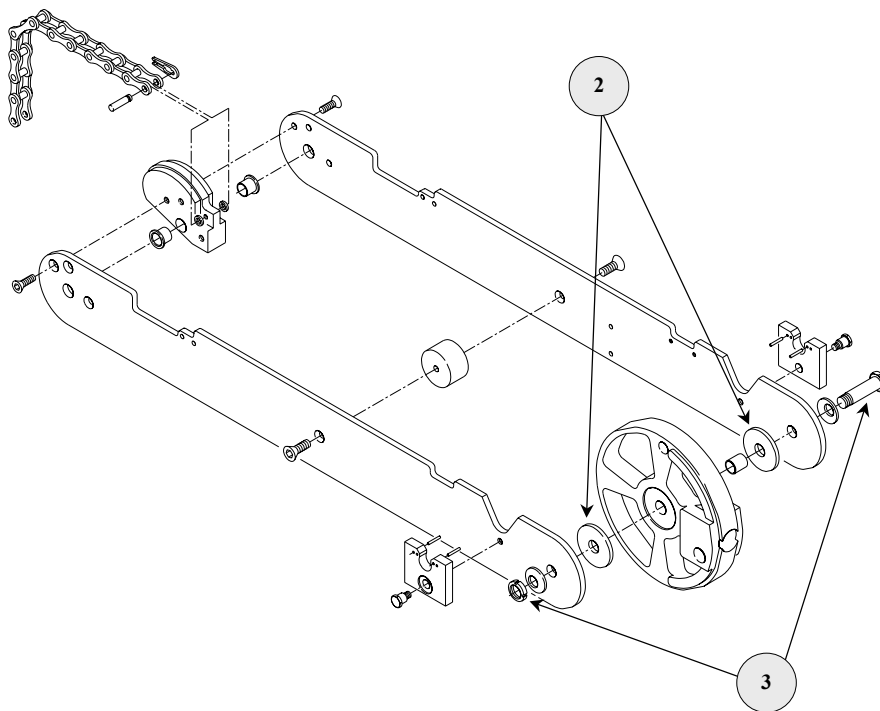
## 9 CENTERING THE COLLIMATOR

For any necessary centering of the collimator, refer to the **TECHNICAL MANUAL** of the collimator itself, enclosed with this manual.

### 10 SPRING ADJUSTMENT

The **BALANCED SUSPENSION** system of the mobile unit allows flowing movement of the **ARM** vertically and, therefore, of the **X-RAY UNIT**. This system has been studied and made to reduce the need for maintenance to a minimum.

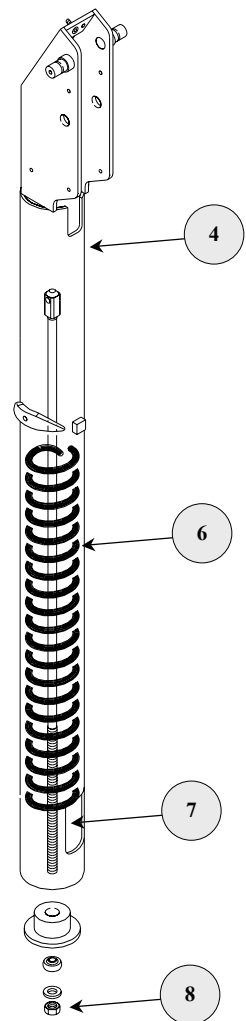
As time passes and due to the continual stresses, the balancing system may lose a very small amount of its efficiency. It is usually sufficient to adjust the **BOOM PIN (3)** which acts directly on the **CLUTCH DISKS (2)**; disassemble the arm carters for this operation (SEE 3 – MECHANICAL ASSEMBLY AND DISMANTLING).



**FIGURE 5** - EXPLODED DRAWING OF THE PANTOGRAPH ARM

If this operation is not sufficient to restore the optimum balanced condition, it is necessary to carry out an adjustment on the thrust of **SPRING (6)** as described below:

- remove the front casing of the **UNIT**
- loosen the **BOOM PIN (3)** using a hexagonal spanner, taking care of the sudden and unwanted movement of the **ARM** and **X-RAY UNIT**
- this brings the Arm in the highest possible position
- with a second person's help let the arm down till the **NUT (8)** is accessible in the **WINDOW (7)**
- with a spanner (12 mm), screw up or unscrew **NUT (8)** through the **WINDOW (7)** on the **SHAFT WITH SPRING (4)**. This operation modifies the pre-load applied to the **COMPRESSION SPRING (6)**
- to check correct balance, make sure that the **ARM** can remain in the horizontal position without any support and loaded with the clutch **(3)**
- on completion of balancing, put the clutch back to a compression value which, although keeping the arm steadily immobile, in any position allows easy handling (balancing to be checked with the assembled arm carter)
- on completion of the operations, replace the casings in their original positions.



**FIGURE 6 - SHAFT WITH SPRING**



# SERVICE MANUAL

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X-RAY SETTINGS

White Page

# DRAWINGS

## INDEX

### ELECTRICAL

- 7615 ELECTRONIC GROUP 100
- 7616 S15 BOARD
- 7548 S17 BOARD
- 7617 S19/B BOARD
- 7618 S20 BOARD
- 7619 S21/A BOARD
- 7620 S22 BOARD
- 7621 S25 BOARD
- 7622 S28 BOARD
- 7623 S29 BOARD

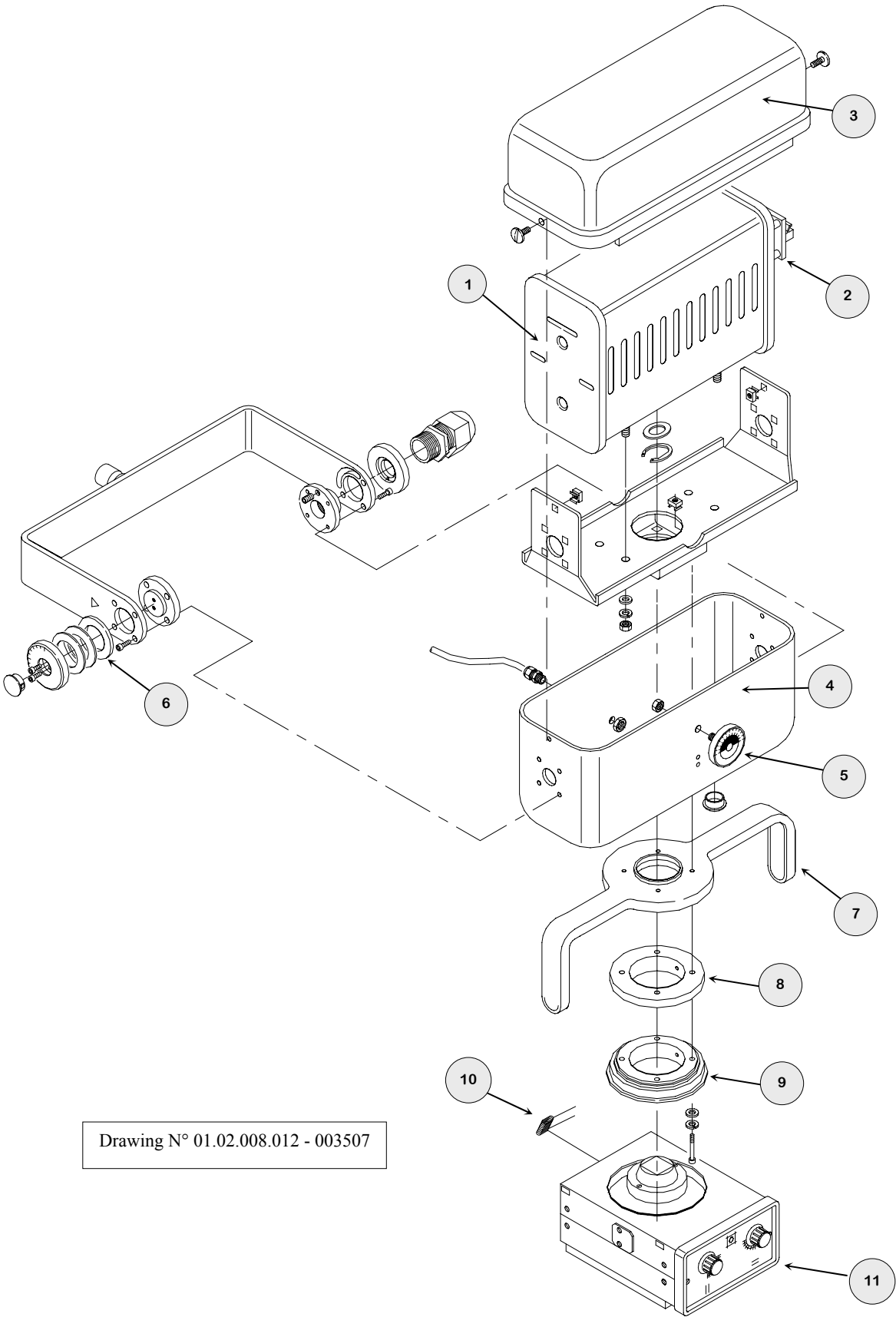
### TOPOGRAPHIC

- 630 S14 BOARD
- 1653 S15 BOARD
- 4617 S17 BOARD
- 7822 S19/B BOARD
- 46 S20 BOARD
- 457 S21/A BOARD
- 1401 S22 BOARD
- 1419 S25 BOARD
- 1141 S28 BOARD
- 1420 S29 BOARD

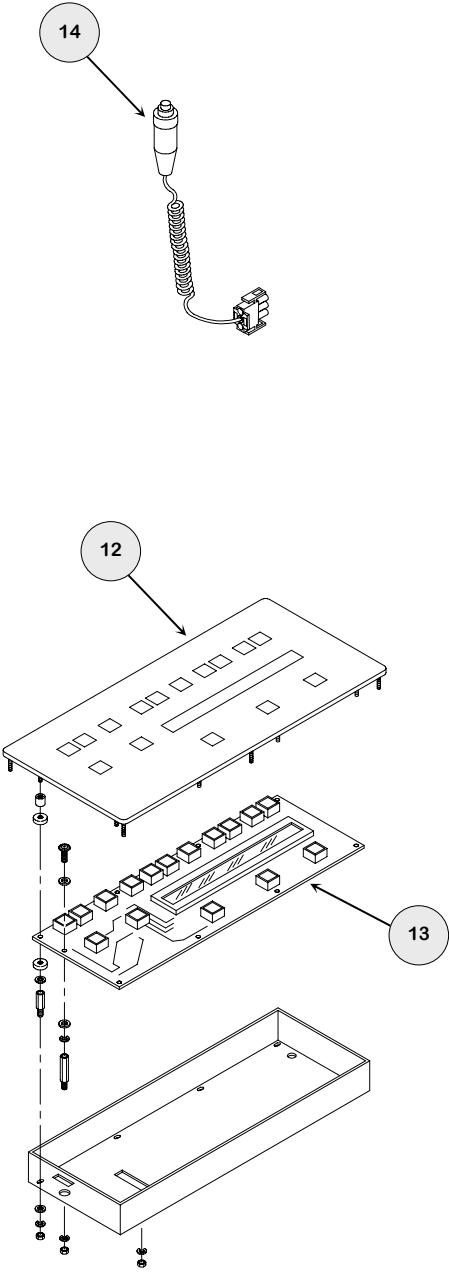
### EXPLODED VIEW

- 7766 MECHANICAL
- 7862 ELECTRICAL

N°	DESCRIPTION	CODE	NOTE
X-RAY TUBE HEAD SUPPORT GROUP		01.02.008.012	
1	X-ray tube head 100KHz	Depends on the customer	
2	S17 X-ray tube head Board	01.17.008.002	
3	Sup. carter with flat band	01.02.008.002	
4	Inf. carter without flat band	01.02.008.003	
5	Light blue goniometer	01.02.014.009	
	Light green goniometer	01.02.010.148	
6	Brake disk DI 38.5 DE 62.5	01.02.001.108	
7	Small X-ray tube head handle (grey)	01.02.008.006	
	Small X-ray tube head handle (green)	01.02.025.058	
8	Distance ring for rotating group	01.02.025.065	
9	Rotating adaptor Ralco mm. 18	49.18.002.001	
10	Lamp for centering 12V 100W	49.05.012.001	
11	Collimator R105 12V	49.18.006.001	
KEYBOARD GROUP		01.24.012.015	
12	Control Panel	Depends on the customer	
13	S28 Keyboard card	01.17.010.002	
	S62 Serial keyboard card	01.17.037.001	
14	Double-click pushbutton	01.02.003.007	



Drawing N° 01.02.008.012 - 003507



Drawing N° 01.24.012.015 - 003304

## TEST SHEET

The present document has to be filled up by the operator during the ordinary and extraordinary maintenance procedures.

The indicated procedures are described in detail on the SECTION 2 - § 4 of the equipment's service manual.

CODE	OPERATION	REFERENCES / NOTES	RESULT
A.1	Power supply cable of the unit		
A.2	Radiography control pushbutton cable		
A.3	Connection cable unit/X-ray tube head		
B.1	Unit sliding movement		
B.2	Unit parking brake		
B.3	Integrity of the control panel		
B.4	Integrity and fixing of the carters		
B.5	Balance of the pantograph arm		
C.1	Check power supply		
C.2	Check initial test		
C.3	Check software		
C.4	Check loading capacitors		
C.5	Check discharging capacitors		

# ANNEX 1

TEST SHEET

CODE	OPERATION	REFERENCES / NOTES	RESULT
C.6	Check Set-up dates in memory		
C.7	X-ray tube formation button		
C.8	Check X-ray exposure time		

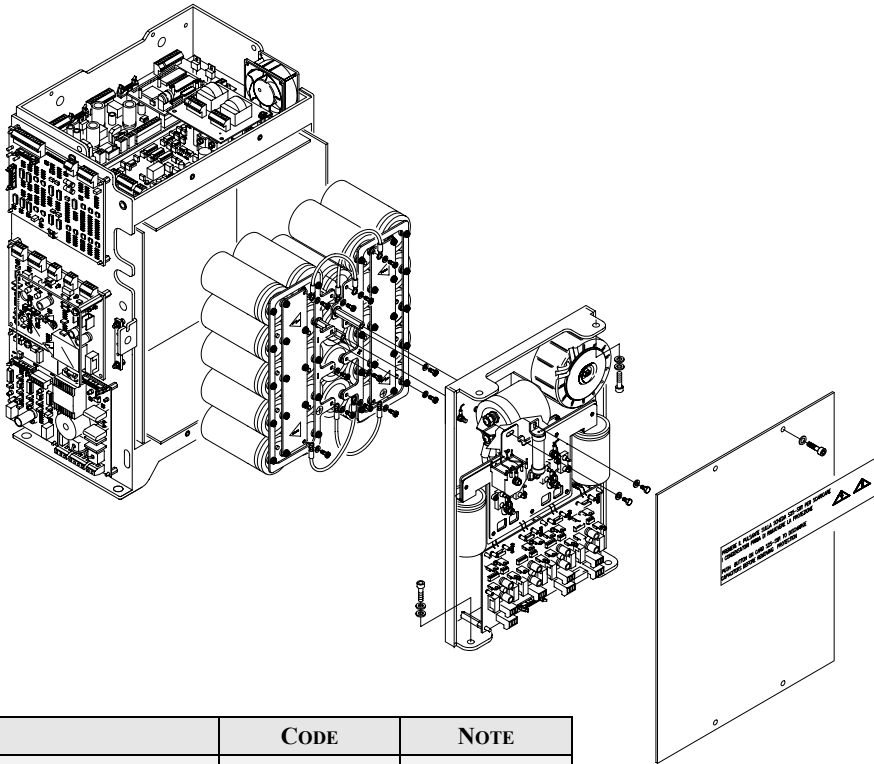
UNIT MODEL: \_\_\_\_\_

UNIT SERIAL NUMBER: \_\_\_\_\_

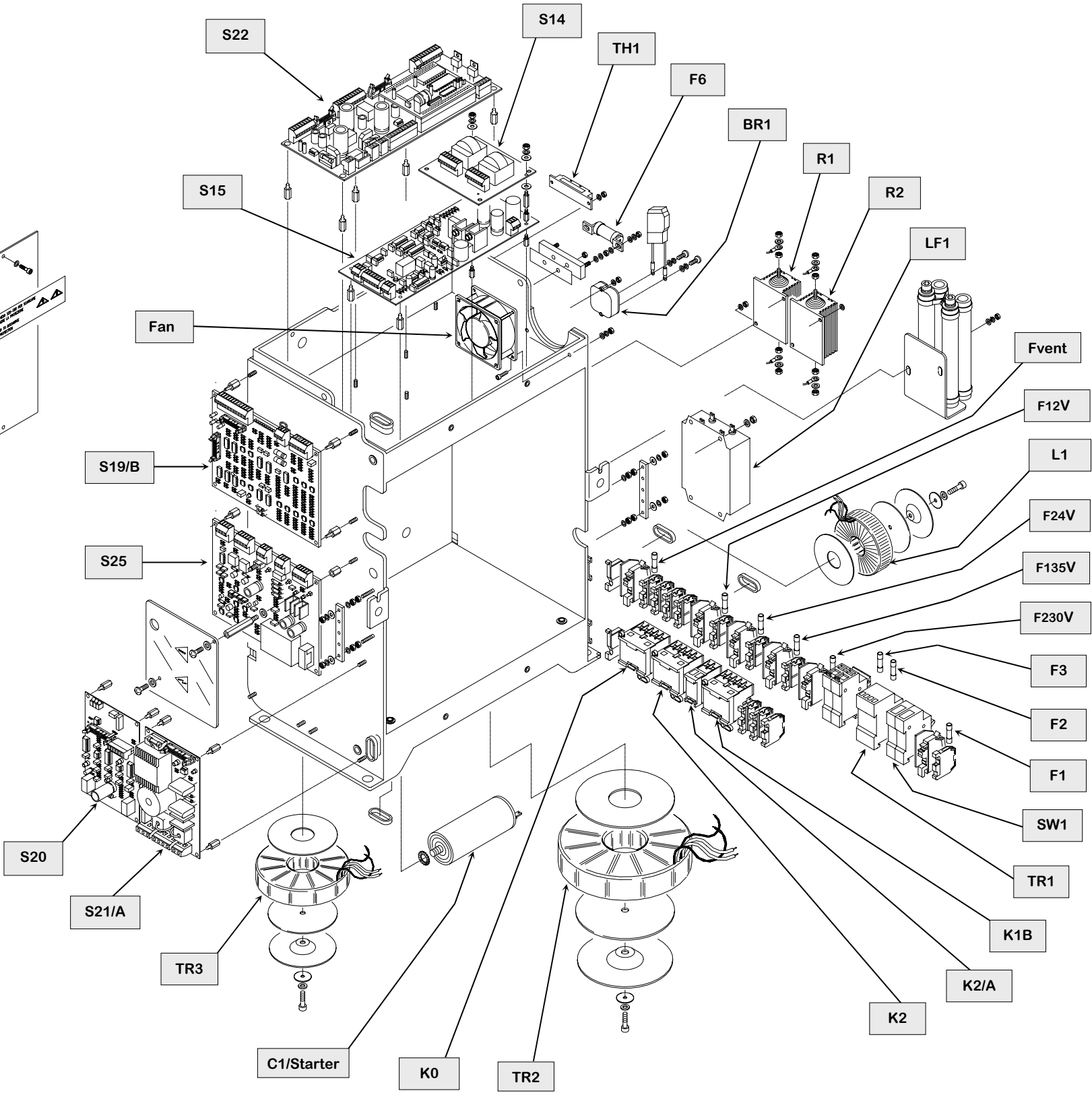
DATE: \_\_\_\_/\_\_\_\_/\_\_\_\_

OPERATOR: \_\_\_\_\_

Drawing N° 01.02.047.018 - 007823



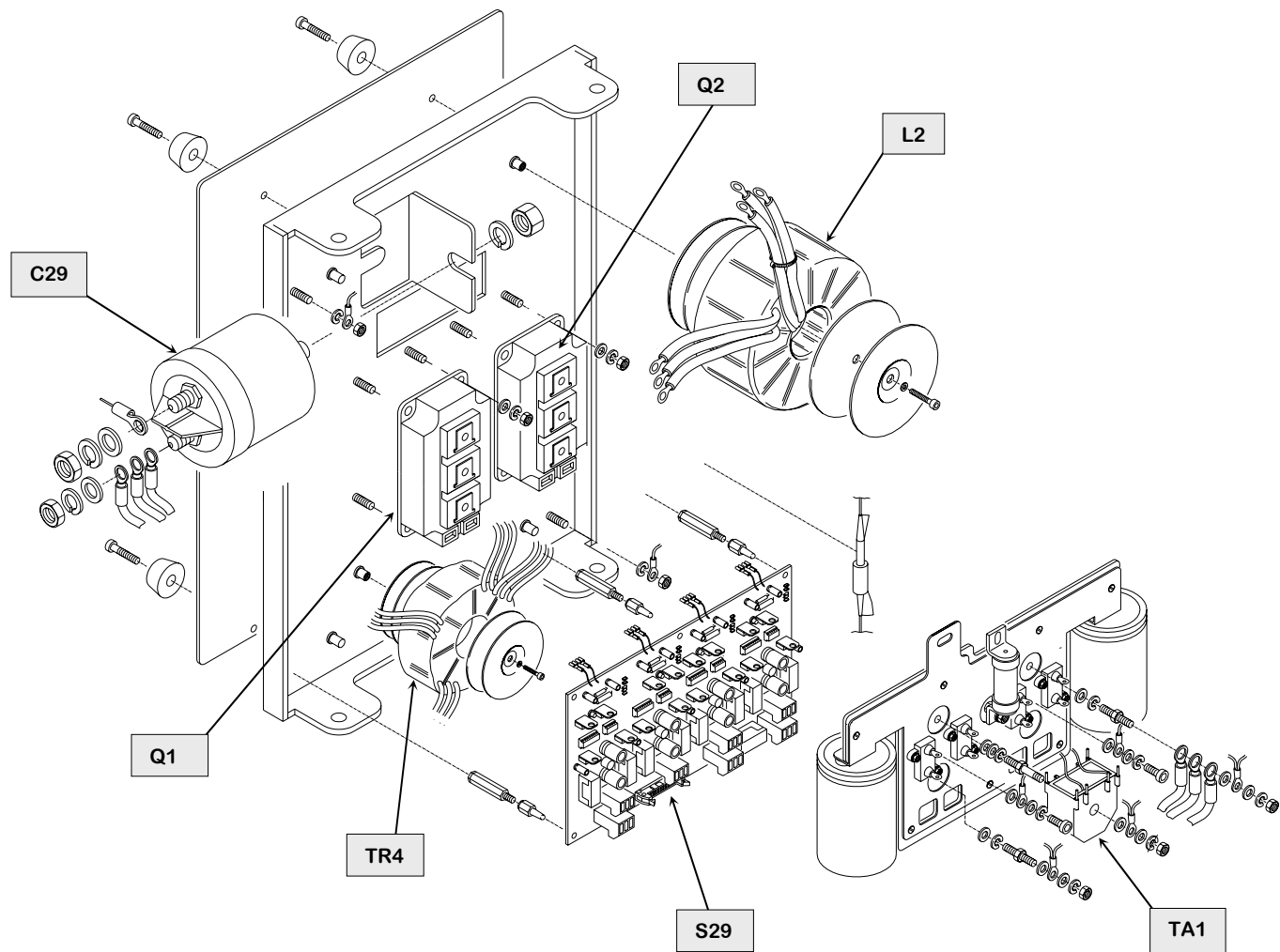
N°	DESCRIPTION	CODE	NOTE
<b>ELECTRONICS GROUP</b>		01.02.047.018	
BR1	Graetz bridge Semikron SKB 30/16A1	49.06.018.015	
C1/Starter	30 µF 450 Vdc Power capacitor	49.06.012.035	
FAN	Fan 80x80x25 230Vac 50Hz	49.06.023.008	
F1- Fvent	Fuse 5x20 200mA 250V	49.06.022.025	
F2-F3	Fuse 10x38 16A 500V GL	49.06.022.003	
F6	Fuse Brush 63FE (63A 660V)	49.06.022.001	
F12V	Fuse 5x20 10A 250V	49.06.022.022	
F24V-F230V	Fuse 5x20 2A 250V	46.06.022.013	
F135V	Fuse 5x20 1A 250V	49.06.022.011	
K1B-K2-K0	BC6-30-01 24Vdc 4kW Contactor	49.06.015.017	
K2/A	CA6-11M Auxiliary contactor	49.06.015.021	
L1	2,5 mm <sup>2</sup> Filter inductor	01.02.010.195	
LF1	EPCOS B84112-B-B120 Filter	49.06.030.006	
R1-R2	ATE RB 106 25E Resister	49.06.011.080	
S14	S14 Filter board	01.17.005.005	
S15	S15 Filament board	01.17.001.020	
S19/B	S19/B Inverter board	01.17.008.036	
S20	S20 Starter board	01.17.006.001	
S21/A	S21/A Rotation board	01.17.003.002	
S22	S22 Micro board	01.17.010.001	
S25	S25 Capacitors bank loading board	01.17.005.009	
SW1	Int. Aut. Multi 9 C60N C16A 2P	49.05.008.002	
TH1	Powerblock TT61 N 12 KOF	49.06.021.013	
TR1	TM 15/24 Module transformer	01.05.001.017	
TR2	300VA Tor. transformer	01.05.001.026	
TR3	230-250/330 600VA Tor. transformer	01.05.001.016	



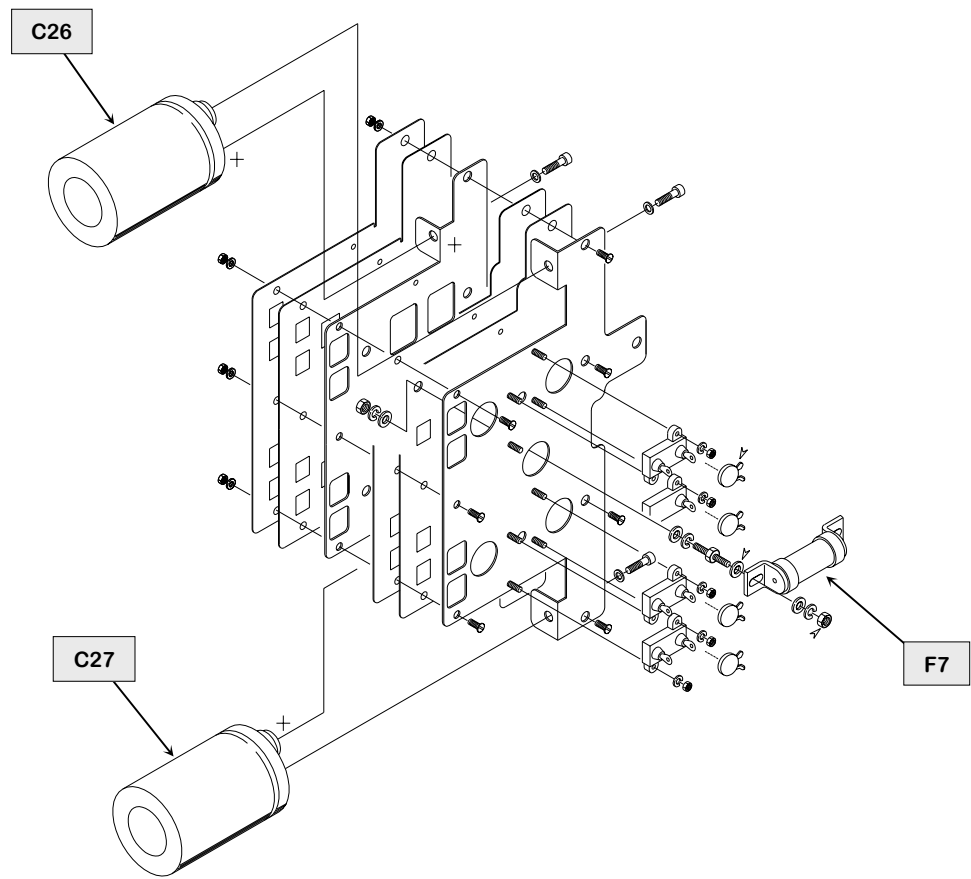
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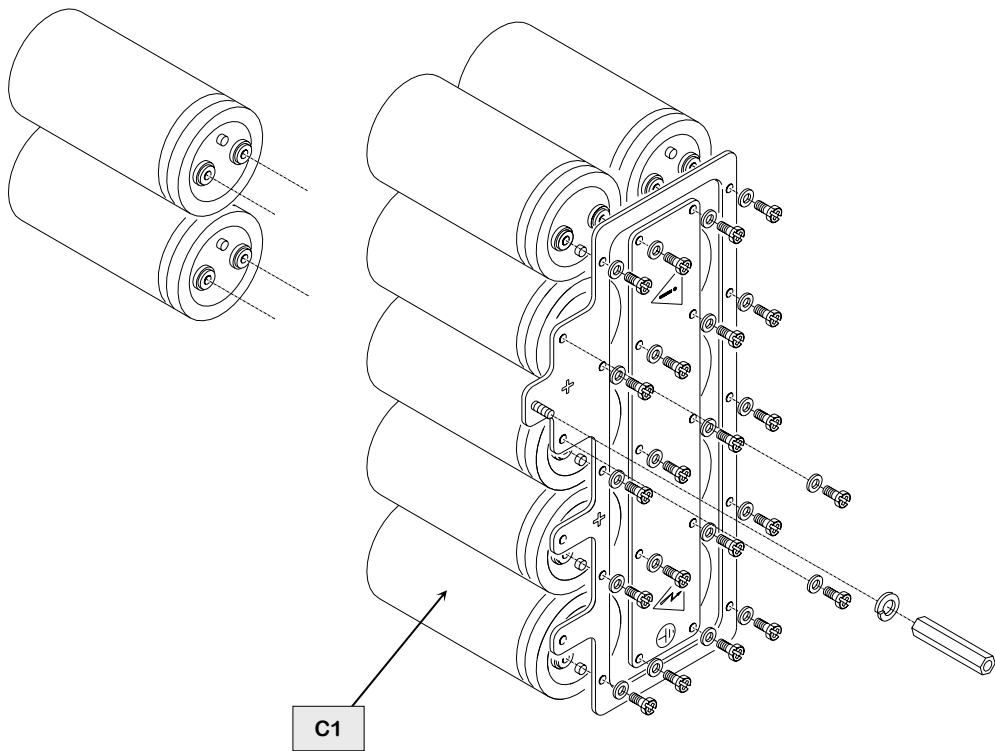
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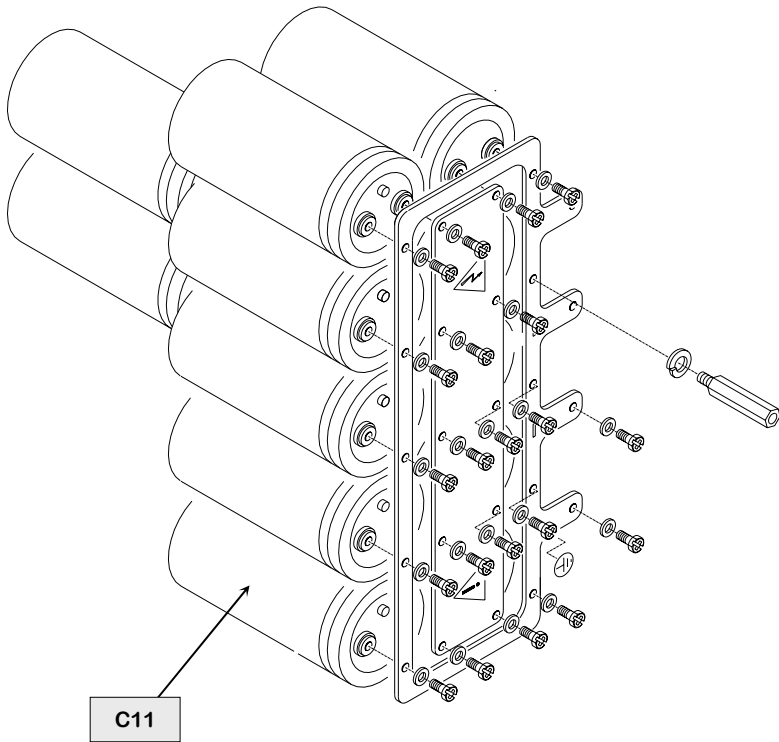
Drawing N° 01.02.025.018 - 003302

N°	DESCRIPTION	CODE	NOTE
C26-C27	1500 µF 400Vdc Elect. capacitor	49.06.012.079	
C29	(80A) 2 µF 1700 Vdc mkV capacitor	49.06.012.078	
F7	Fuse Brush 100 FE (100A 660V)	49.06.022.010	
L2	5,1 µH 45112 Tor. inductor	01.05.003.006	
Q1-Q2	Tr. IGBT Siemens BSM 300GB 120 DLC	49.06.017.025	
S29	S29 Driver board	01.17.008.023	
TR4	100kHz Driver tor. transformer	01.05.001.018	
TA1	ENCO 10701 1/500 Amper transformer	01.05.004.002	

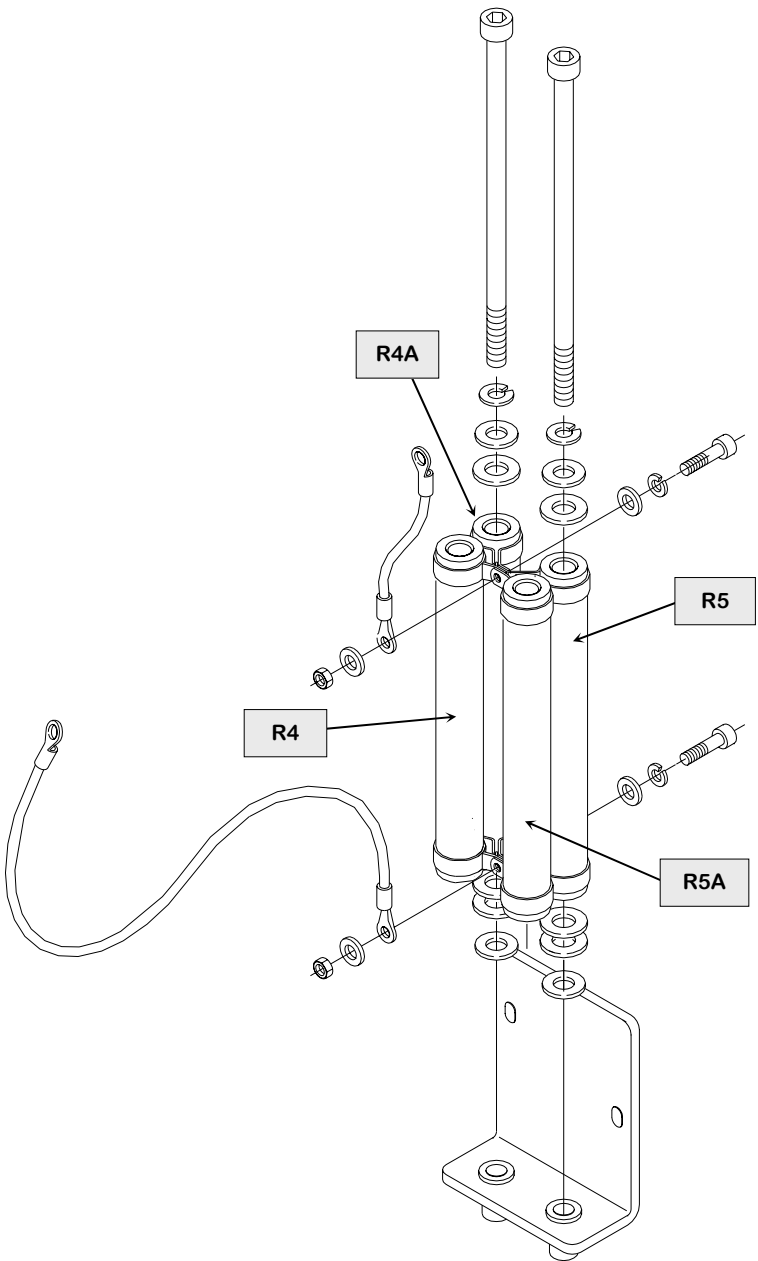




Drawing N° 01.02.047.016 - 007831



Drawing N° 01.02.047.017 - 007832



Drawing N° 01.02.025.027 - 003259

N°	DESCRIPTION	CODE	NOTE
C1÷C20B	V 16000 µF 350Vdc Itelcond Elect. capacitor	49.06.012.076	
R4-R4A-R5-R5A	IRE RCC 47 Ω Resister	49.06.011.088	