

DX-D 100 / DX-D 100 Wireless Mobile X-Ray Unit

Contains the following reference in chapter “Troubleshooting”:

Link to video “Replacing the Column Steel Cable in DX-D 100 Mobile Units with Telescopic Column”, Document ID [79816314](#) (references to Agfabox).

► **Purpose of this document**

This document contains the manufacturers’ service documentation for the Mobile X-Ray Unit. The service documentation is only applicable for DX-D 100 / DX-D 100 Wireless.

► **Changes compared to previous revision**

The following modifications have been implemented:

- Updated chapter Troubleshooting, TR-1100R31, OCT 04, 2022

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LIST OF DOCUMENTS

This Service Manual comprises the following documents:

CODE / REVISION	DOCUMENT	Date
SP-1100R14	Startup Primer	NOV 27, 2019
DB-1100R1	Data book	DEC 14, 2016
CC-1100R3	Configuration & Calibration	DEC 05, 2018
TR-1100R31	Troubleshooting	OCT 04, 2022
MA-1100R8	Maintenance	DEC 05, 2018
SC-1100R22	Schematics	APR 30, 2021
RP-xxxx	Spare Parts List	--
AP-0061R0	Appendix - X-ray Unit with Extra-Short Column	SEPT 25, 2013
SIN 18-09-11	Service Information Note - Collimator Flange check and fixing screw adjustment	SEPT 11, 2018
SIN 19-07-08	Service Information Note - Upgrade Adaption 15Ah battery in mobile Generators	JUL 04, 2019
SIN 19-10-13	Service Information Note - Upgrade filter with battery charger -16 in mobile	OCT 22, 2019
SIN 22-03-05	USB-HUB & POWER SUPPLY REPLACEMENT	MAR 05, 2022

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Technical Publication

SP-1100R14

Startup Primer

Mobile X-Ray Unit

REVISION HISTORY

REVISION	DATE	REASON FOR CHANGE
0	FEB 18, 2013	First Edition
1	DEC 11, 2013	General Update
2	JUN 10, 2014	Maximum Symmetrical Radiation Field
3	MAY 22, 2015	Preliminary Notes: Inclination Ramps; Telescopic Column (Option); Lead-Crystal Batteries; Factors: Power Line Operation, Maximum Input Power, Battery Capacity, Environmental Conditions; Physical Characteristics; Unpacking: Transport Surfaces; General Update
4	JUL 01, 2015	Advisory Indications in Section 1 and Section 3.2.
5	SEPT 23, 2015	Factors: Duty Cycle; Physical Characteristics: Weight; Pictures.
6	SEPT 23, 2016	Installation of Protective Lower Cover.
7	DEC 09, 2016	Illustrations Update.
8	SEP 20, 2017	General Cautions.
9	OCT 31, 2017	Tools and Test Equipment.
10	JAN 19, 2018	Physical Characteristics; Illustrations update.
11	JUN 06, 2018	Illustrations Update.
12	DEC 05, 2018	Tools and Test Equipment.
13	JUL 23, 2019	Physical Characteristics, Dosimetry and Illustrations
14	NOV 27, 2019	Power Line Connection and Dosimetry

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, CATASTROPHIC DAMAGE TO EQUIPMENT OR DATA.



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



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.

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SECTION 1 PRELIMINARY NOTES

Note 

This Mobile Unit has been configured, calibrated and tested by the Manufacturer. No service intervention is necessary as the Unit is ready for normal operation.



THE OPERATION MANUAL MUST BE READ AND UNDERSTOOD BEFORE UNPACKING AND SERVICING THE UNIT.



ALWAYS MAKE SURE BEFORE ANY SERVICE PROCEDURE THAT THE MANUALS USED ARE IN ACCORDANCE WITH THE EQUIPMENT VERSION.



DRIVE THE UNIT WITH THE ARM IN PARKING POSITION. WHEN NOT IN PARKING POSITION, MOVEMENT VELOCITY IS REDUCED SIGNIFICANTLY.

FOR SAFETY REASONS, DO NOT DRIVE THE UNIT OVER SURFACES WITH AN INCLINATION ANGLE >5°.



TO AVOID THE RISK OF OVERBALANCE, THE MOBILE UNIT MUST NOT BE IN STATIONARY POSITION ON SURFACES WITH THE FOLLOWING INCLINATION ANGLES:

- WITH THE ARM IN PARKING POSITION: >10°
- WITH THE ARM OUT OF PARKING POSITION: >5°

IF FOR ANY REASON THE UNIT EXCEEDS THE INDICATED INCLINATION ANGLES AND LOSES THE VERTICALITY, THE ARM COULD RISE SHARPLY TO THE TOP OF THE COLUMN; THIS COULD CAUSE PERSONAL INJURY AND/OR DAMAGE TO THE EQUIPMENT.



DUE TO THE WEIGHT OF THE MOBILE UNIT, THE BRAKING DISTANCE AT FULL SPEED ON A SMOOTH SURFACE IS 1 METER MAXIMUM.



**MONITOR THE SYSTEM MOVEMENTS WITH SPECIAL CARE.
AVOID ANY IMPACT OF THE UNIT WITH WALLS, FURNITURE
OR OTHER ELEMENTS IN THE ROOM THAT MAY CAUSE
DAMAGE TO THE EQUIPMENT.**



**DO NOT DRIVE THE MOBILE UNIT OVER WET SURFACES
AND / OR IMPREGNATED WITH CLEANING PRODUCTS
(SPECIALLY BLEACH, AMMONIA, ETC), THE UNIT COULD
SLIP AND MOMENTARILY LOSE CONTROL. IT ALSO MAY
BLEACH THE WHEELS CAUSING DAMAGES TO THE FLOOR.**



**MONITOR WITH SPECIAL CARE THE PATIENT POSITION OR
ANYONE PRESENT, TO AVOID INJURY CAUSED BY UNIT
MOVEMENTS.**

**INTRAVENOUS TUBING, CATHETERS AND OTHER PATIENT
CONNECTED LINES SHOULD BE ROUTED AWAY FROM
MOVING EQUIPMENT.**



**ALWAYS USE THE HAND-GRIPS OF THE
TUBE-COLLIMATOR ASSEMBLY TO CONTROL AND DRIVE
THE COLUMN AND ARM MOVEMENTS, NEVER PUSH
DIRECTLY ON X-RAY TUBE OR COLLIMATOR.**



***Controls for positioning (Column, Arm, etc.) are only enabled
when the Switch-Key of the Front Panel is in the “ON”
position.***



***Always place the Unit in Parking position before turning the
Generator and Console off, even though lock controls will
remain enabled for 15 seconds after turning off both the
Generator and Console in order to place the Unit in Parking
position.***

SECTION 2 TECHNICAL SPECIFICATIONS

2.1 GENERATOR SPECIFICATIONS

2.1.1 MINIMUM CURRENT TIME PRODUCT (mAs)

- Minimum Current Time Product obtained at 0.1 s is 1 mAs.
- Minimum Current Time Product within the specified ranges of compliance for linearity and constancy is 0.1 mAs.

2.1.2 ACCURACY OF RADIOGRAPHIC PARAMETERS

Note 

Specified accuracy does not include test equipment accuracy. The tolerance of the accuracy of parameter values should be better than the values in the table below.

PARAMETERS		ACCURACY (with 12 BITS HT Controller)
RAD	kV	± (3% + 1 kV)
	mA	± (4% + 1 mA)
	Exposure Time	± (2% + 0.1 ms)

2.1.3 HV FREQUENCY

The operating HV Frequency of this Generator is 25 kHz / 30 kHz.

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2.2 FACTORS

	Generator Model			
Maximum Power kW <i>(Refer to Identification Label)</i>	20 kW	32 kW	40 kW	50 kW
kVp Range	40 to 125 (40 to 150 optional)	40 to 150	40 to 150	40 to 150
	From 40 kV to 125 kV or 150 kV in 1 kV steps. <i>(Depending on the Generator model)</i>			
mAs Range	Product of mA x Time values from 0.1 mAs to 500 mAs			
mA Range	10 to 320	10 to 500	10 to 500	10 to 500
	From 10 mA to 320 or 500 mA through the following mA stations: 10, 12.5, 16, 20, 25, 32, 40, 50, 64, 80, 100, 125, 160, 200, 250, 320, 400, 500. <i>(Depending on the Generator model)</i>			
Exposure Time Range	From 1 millisecond to 10 seconds through the following Time stations: Milliseconds: 1, 2, 3, 4, 5, 6, 8, 10, 12, 16, 20, 25, 32, 40, 50, 64, 80, 100, 125, 160, 200, 250, 320, 400, 500, 640, 800. Seconds: 1, 1.25, 1.6, 2, 2.5, 3.2, 4, 5, 6.4, 8, 10.			
Power Output (@ 0.1s)	125 kVp @ 160 mA 100 kVp @ 200 mA 80 kVp @ 250 mA 62 kVp @ 320 mA	150 kVp @ 200 mA 128 kVp @ 250 mA 100 kVp @ 320 mA 80 kVp @ 400 mA 64 kVp @ 500 mA	150 kVp @ 250 mA 125 kVp @ 320 mA 100 kVp @ 400 mA 80 kVp @ 500 mA	150 kVp @ 320 mA 125 kVp @ 400 mA 100 kVp @ 500 mA
Duty Cycle	18 exposures per hour at maximum mAs (lapse time between exposures: 3 min.)			
	Maximum leakage radiation depends on the type of X-ray Tube (<0.88 mGy/h)			
Collimator	Manual with electronic timer and meter			
X-ray Tube	<i>Refer to Section 2.3</i>			

Generator Model				
Maximum Power kW (Refer to Identification Label)	20 kW	32 kW	40 kW	50 kW
Power Line Operation	100 / 110 / 120 / 127 / 220 / 230 / 240 VAC – Single-Phase 50 / 60 Hz Automatic Line Compensation $\pm 10\%$ VAC Connection to standard outlets with GND that complies with local regulations			
	The General Circuit Breaker installed in the Mobile Unit is 10 A (1P+N curve type D), the Power Line Installation should be provided with a Differential of 30 mA Sensitivity and with a Thermomagnetic Interruptor / Circuit Breaker of: ≥ 13 A (curve type D) or ≥ 20 A (curve type C) or ≥ 32 A (curve type B) Power Line Impedance must be less than the maximum indicated value: 1.2 Ω for 110 VAC, 2.5 Ω for 230 VAC			
Maximum Input Power	1.5 kVA			
Operation independent from mains supply (Stand-Alone)	Standard			
Battery Capacity for the Generator	Batteries fully charged float voltage of approx. 420 Volts at nominal of approx. 382 Volts. Charge Capacity: 14 Ah for Lead-Crystal Batteries – 15 Ah for Lead-Gel Batteries			
	The required time for the Batteries to be fully charged is approximately: 9 hours for Lead-Crystal Batteries – 10 hours for Lead-Gel Batteries The maximum Storage Energy Capacity is: 137.500 mAs @ 80 kVp <i>(This is the maximum energy available for making Exposures and supplying energy to the Generator)</i>			
Battery Capacity for the Motors	Batteries fully charged float voltage of approx. 112 Volts at nominal of approx. 102 Volts. Charge Capacity 9 Ah			
	The required time for the Batteries to be fully charged is 6 hours. With the Batteries fully charged and disconnected from the mains, the Mobile Unit can be in continuous movement during 4 hours (around 20 km). If the Mobile Unit is left on in Stand-Alone (disconnected from the mains) during 40 hours, it will be 100% discharged from full charge.			
Radiation Output Accuracy (Reproducibility related to loading factors)	C.V. (Coefficient of variation) ≤ 0.05			
Maximum Symmetrical Radiation Field	Measured at 75kV: 200 mm in "X" axis and 260 mm in "Y" axis. Measured at 125kV: 200 mm in "X" axis and 260 mm in "Y" axis. <i>(Test performed at a distance from the Focal Spot of 1200 mm, in accordance with IEC 60806:1984).</i>			
Maximum Heat Output	260 W (1130 BTU/h)			
Storage / Transport Environmental Conditions	Temperature range of -15°C to 40°C Relative Humidity range of 20% to 90% Atmospheric Pressure range of 700 hPa to 1060 hPa			
Operating Environmental Conditions	Temperature range of 10°C to 35°C <i>(the recommended temperature for a longer life cycle of batteries is: $15^{\circ}\text{C} \sim 25^{\circ}\text{C}$ for Lead-Crystal Batteries and $22^{\circ}\text{C} \sim 25^{\circ}\text{C}$ for Lead-Gel Batteries)</i> Relative Humidity (no condensing) range of 30% to 75% Atmospheric Pressure range of 700 hPa to 1060 hPa			

2.3 X-RAY TUBES

Maximum Power kW <i>(Refer to Identification Label)</i>	20 kW	32 kW	40 kW	50 kW
Standard X-ray Tubes	Canon E7865X		Canon E7884X	
Optional X-ray Tubes	Canon E7884X		-	

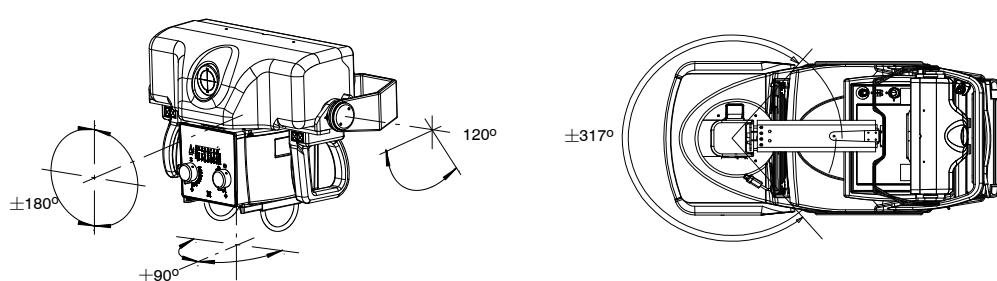
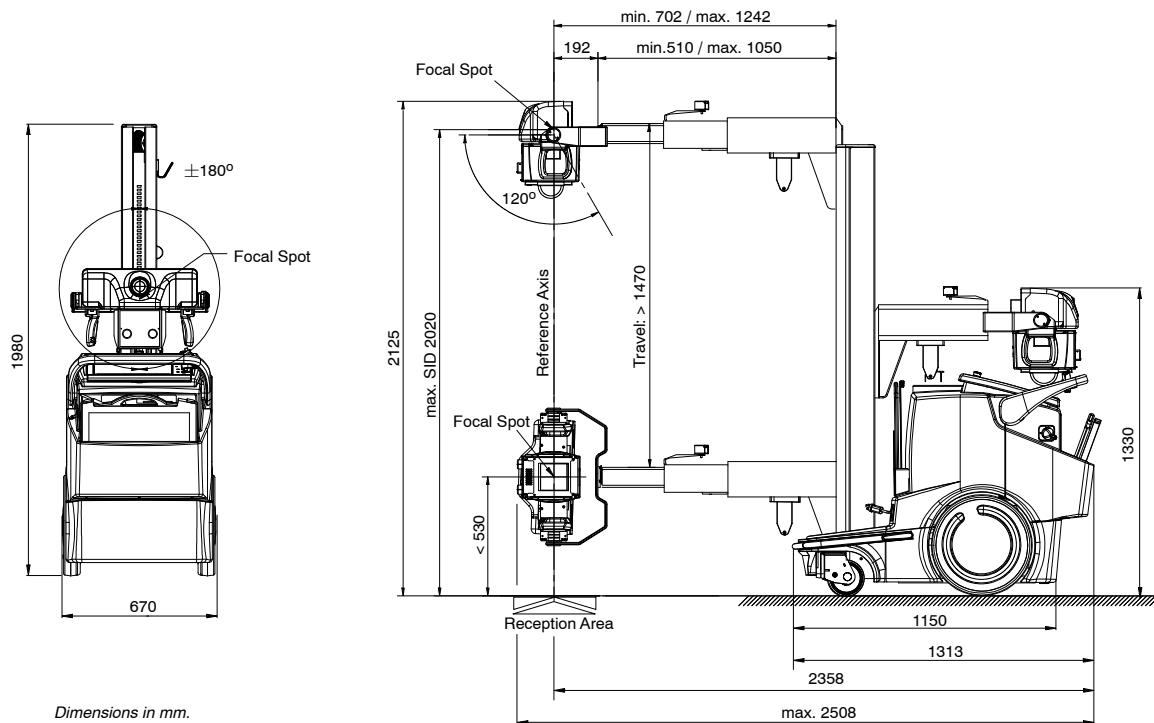
Canon E7865X	Low Speed - Rotating Anode, Focal Spots: 0.3 mm / 1.0 mm Anode kHU / kVp: 140 kHU / 150 kVp, Target Angle: 12° Maximum Specified Energy Input in 1 hour: 150 kVp @ 1440 mAs Inherent Filtration of X-ray Source (Tube + Collimator): refer to Identification Label
Canon E7884X	Low Speed - Rotating Anode, Focal Spots: 0.6 mm / 1.2 mm Anode kHU / kVp: 300 kHU / 150 kVp, Target Angle: 12° Maximum Specified Energy Input in 1 hour: 150 kVp @ 3408 mAs Inherent Filtration of X-ray Source (Tube + Collimator): refer to Identification Label

2.4 PHYSICAL CHARACTERISTICS: MOBILE WITH WIRELESS DR DETECTOR

2.4.1 MOBILE WITH WIRELESS DR DETECTOR AND STANDARD COLUMN

LENGTH	WIDTH	HEIGHT*	WEIGHT
minimum 1313 mm maximum 2508 mm	670 mm	minimum 1980 mm maximum 2125 mm	560 kg (without Detectors and/or Accessories)

* Note: There is an optional "Short Column" that reduces in 130 mm the Column height, the maximum SID and the Vertical Travelling of the Arm.

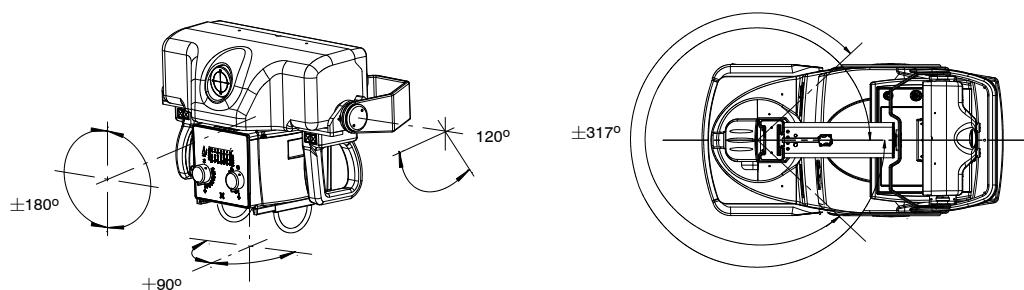
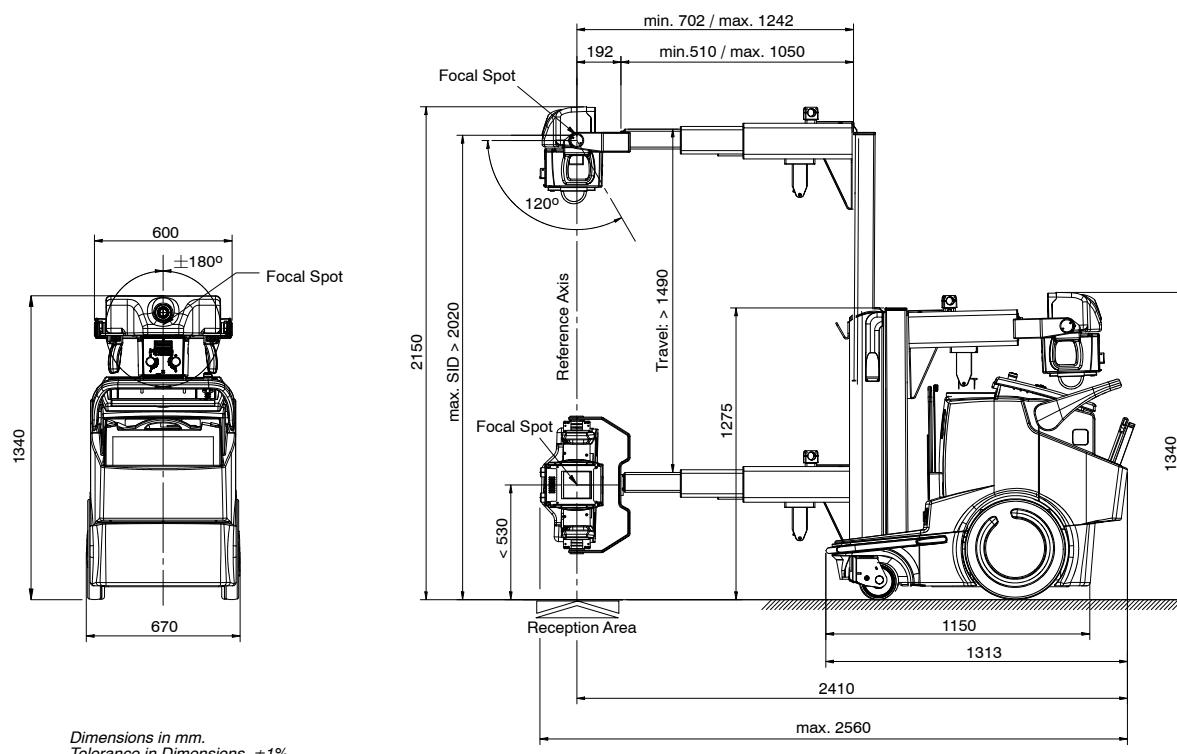


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2.4.2 MOBILE WITH WIRELESS DR DETECTOR AND TELESCOPIC COLUMN (OPTION)

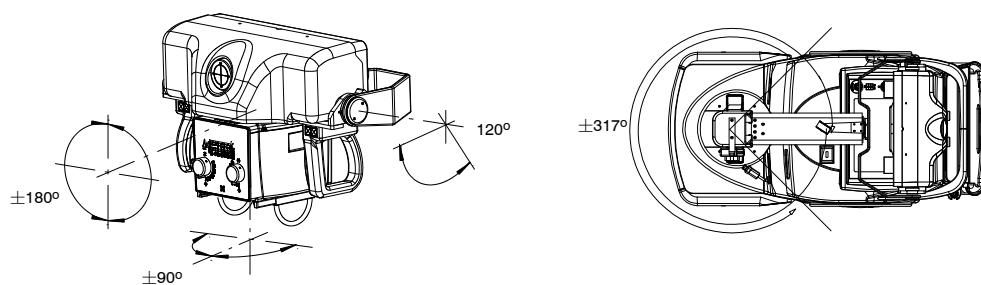
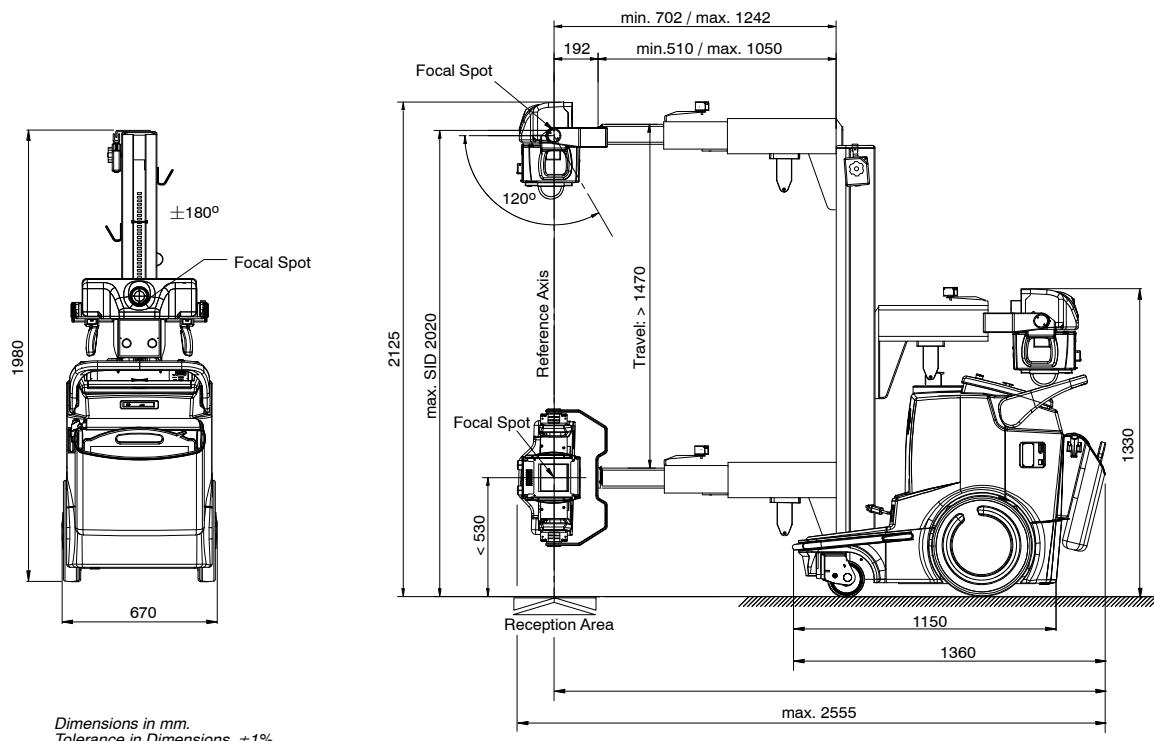
LENGTH	WIDTH	HEIGHT	WEIGHT
minimum 1313 mm maximum 2560 mm	670 mm	minimum 1340 mm maximum 2150 mm	580 kg (without Detectors and/or Accessories)



2.5 PHYSICAL CHARACTERISTICS: MOBILE WITH PORTABLE DR DETECTOR

LENGTH	WIDTH	HEIGHT*	WEIGHT
minimum 1360 mm maximum 2555 mm	670 mm	minimum 1980 mm maximum 2125 mm	560 kg (without Detectors and/or Accessories)

* Note: There is an optional "Short Column" that reduces in 130 mm the Column height, the maximum SID and the Vertical Travelling of the Arm.



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SECTION 3

UNPACKING AND INSTALLATION

3.1 TOOLS AND TEST EQUIPMENT

The following tools and test equipment are required for Configuration, Calibration, Troubleshooting and/or Maintenance:

- Standard service engineers tool kit including Allen and Torx key sets.
- Antistatic Kit.
- Silicone Insulating Grease (proofing compound).
- Alcohol cleaning agent.
- Keyboard and Mouse to connect to the Unit to access the GSM program (configuration and calibration procedure).
- Digital Multimeter.
- Digital mAs Meter.
- Non-invasive kVp Meter.
- Oscilloscope (Tektronics 486 or similar).
- Calculator.
- Dynamometer (for Motor Chain adjustment).
- Auxiliary Table, Ladder, Level (for some procedures related to the Column, Arm and Tube-Collimator Assembly).
- Metal Plate Tool (for TC Sliding Section disassembly).

The following tools are required for Collimator adjustment:

- Collimator Test Tool (model RMI 161B).
- Beam Alignment Test Tool (model RMI 162A).
- Light Meter (Standard).

3.2 UNPACKING

Note 

The Unit is shipped in a container to facilitate the transport and storage.



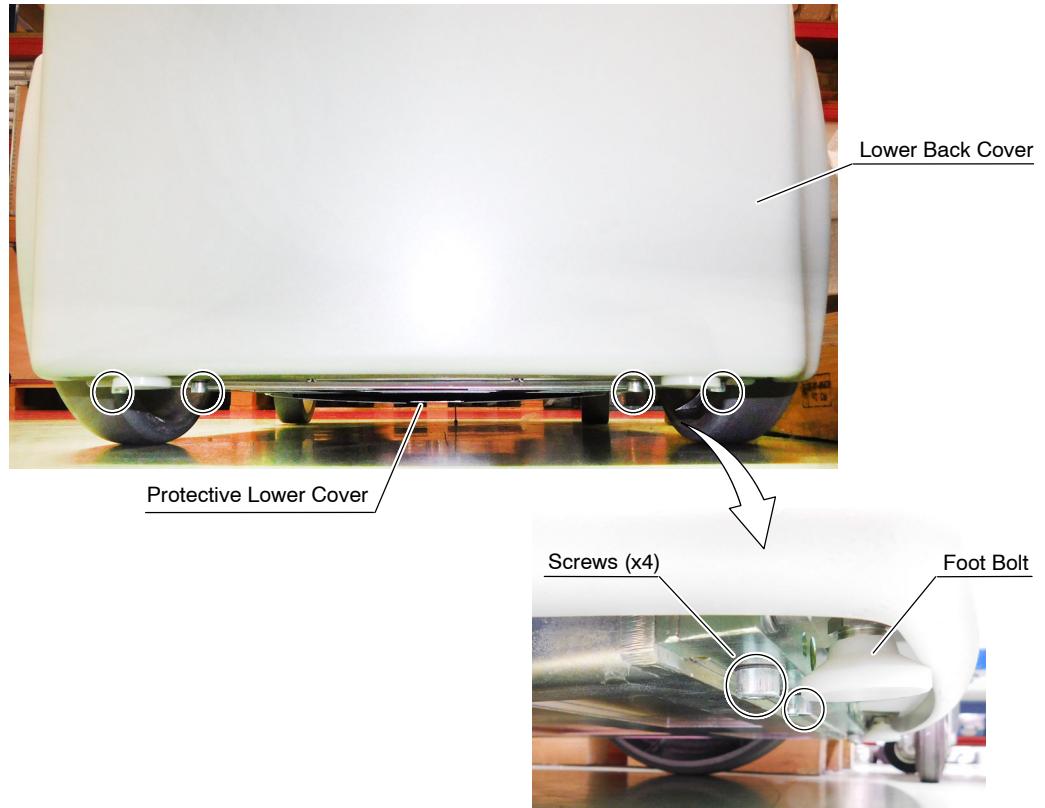
BEFORE UNPACKING THE UNIT, PLACE THE SHIPPING CONTAINER ON A FLAT SURFACE AND KEEP IN MIND THE PRELIMINARY NOTES IN SECTION 1.

Note 

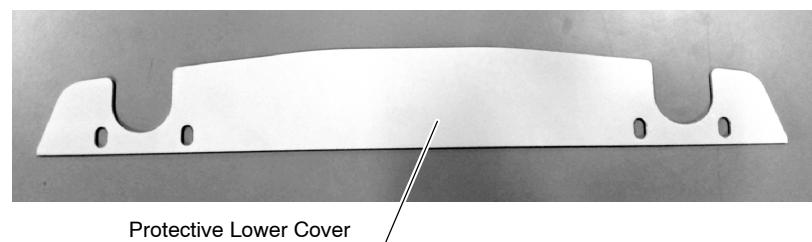
Although the Unit is shipped from the Factory with the Batteries charged, with the Unit OFF, plug it in and leave it sufficient time to completely charge. The recommended time is approximately 9-10 hours, until the Battery Charge Level Indicators on both columns stop scrolling and the upper Green Indicators remain illuminated.

Upon receipt of the Unit, inspect the shipping container for signs of damage. If damage is found, immediately notify the carrier or agent.

1. Open the shipping box. Do not discard any packing material such as envelopes, boxes, bags until all parts are accounted for as listed on the packing list.
2. Remove the packing material from the pallet. One of the laterals is adapted to be used as a ramp for moving the Unit down.
3. Place the Unit near the edge of the pallet. Unpack the Protective Lower Cover and install it underneath the Lower Back Cover of the Unit:
 - a. Remove the Screws (x4) located underneath the Lower Back Cover of the unit.



- b. Remove the white films at both sides of the new Protective Lower Cover, mount the Protective Lower Cover to the unit and secure it with the Screws (x4) applying Loctite 243 to the Screws.



4. Assemble the ramp to the pallet base.



5. Move the Unit down from the shipping pallet. Switch ON the Unit and drive backwards down the ramp.
6. Confirm that the part number and serial number match identification labels and inspect all pieces for visible damage. If damaged parts are found, repair or order replacements to prevent unnecessary delay.
7. Verify that all items on the customer order are present.

3.3 POWER LINE CONNECTION

The Unit should be plugged into a wall socket compliant with local regulations and electrical requirements of the equipment (*refer to Section 2 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.

The unit is factory provided with the cable and plug for connecting to the line voltage (wall socket) according to the customer order. If required, change the line cord and plug to conform to local codes and requirements.

The Power Line Operation is described in Section 2.2.



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

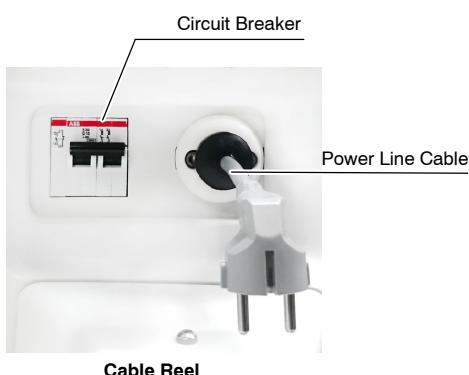


For safety reasons and for proper functioning, make sure that the Unit is connected to a standard outlet with GND.



WHEN NOT GENERATING X-RAYS, KEEP THE UNIT CONNECTED TO THE MAINS (MAXIMUM 48 HOURS) WITH THE CIRCUIT BREAKER IN THE ON POSITION, EVEN WHEN BATTERIES ARE FULLY CHARGED. THIS ENSURES MAXIMUM STORAGE ENERGY.

The Line Circuit Breaker in the ON position allows the Charging Circuits to charge batteries when the Unit is connected to the mains.

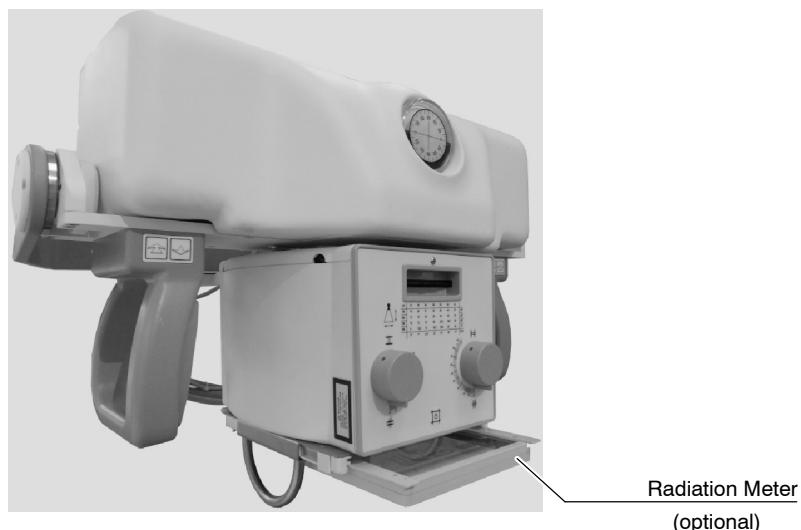


3.4 DOSIMETRY (OPTIONAL)

The optional Radiation Meter consists of an Ionization Chamber installed under the Collimator and reads radiation as Dose Area Product (DAP) in $\text{mGy} \cdot \text{cm}^2$. (Refer to the accompanying manual of the Radiation Meter).

Note 

Do not install any accessories between the Radiation Meter and the patient. This will disturb the radiation reading.



The Radiation Meter can be removed from the rail system to be cleaned or serviced. To remove the Radiation Meter, pull back on the two tabs which lock the Radiation Meter to the rails and pull out the Radiation Meter. The cable connection to the PC is found behind the Collimator (for further information refer to Schematic 54302xxx).



SECTION 4 SYSTEM INTERCONNECTION SIGNALS

4.1 SYSTEM INTERCONNECTION SIGNALS

All of the System Input Signals are active low and inputs must be pulled to ground (chassis ground of the generator) by relay contacts, transistors or other switching devices. The current requirement of the switch is less than 10 mA.



Do not apply 115 / 220 VAC logic signals to any of the logic inputs. If 115 / 220 VAC logic signals are used in the X-ray table (i.e. fluoro command), these signals must be converted to a contact closure by a relay.

The output signals from the generator to the subsystem devices are usually active low (switched to chassis ground of the generator). The output are open collector transistor drivers with a maximum current of 0.5 Amperes.

Table 4-1
System Interconnection Signals

SIGNAL NAME	SIGNAL DESCRIPTION
-AUTO OFF	When the generator is operating in Stand-alone mode (Power Line off), the Auto Off signal shuts off the power from the Battery Generator cabinet if the Control Console is not active for 5 minutes.
AUX BUCKY SPLY	Auxiliary external voltage supply required for Bucky motion whenever this voltage is not +24 VDC.
-BUCKY 1 DR CMD	Low signal to the Interface Control PCB as a command to output a Bucky-1 (e.g., Table Bucky) drive signal.
-BUCKY 1 MOTION	This low signal from Bucky-1 indicates "Bucky-1 in motion", exposure enabled.
BUCKY 1 DR	This signal originates from the Bucky supply of the Power Module when an exposure order is given. It starts the Bucky.
-BUCKY EXP	This low signal (0 volts) starts the Bucky exposure. The signal originates in the Interface PCB
BUCKY SPLY	Voltage supply required for the Bucky drive command.
C-HT CLK	Serial data clock to the HT Control PCB. This clock synchronizes the C-HT DATA signal.
C-HT DATA	Serial data to the HT Control PCB. This data is synchronous with the C-HT CLK signal.

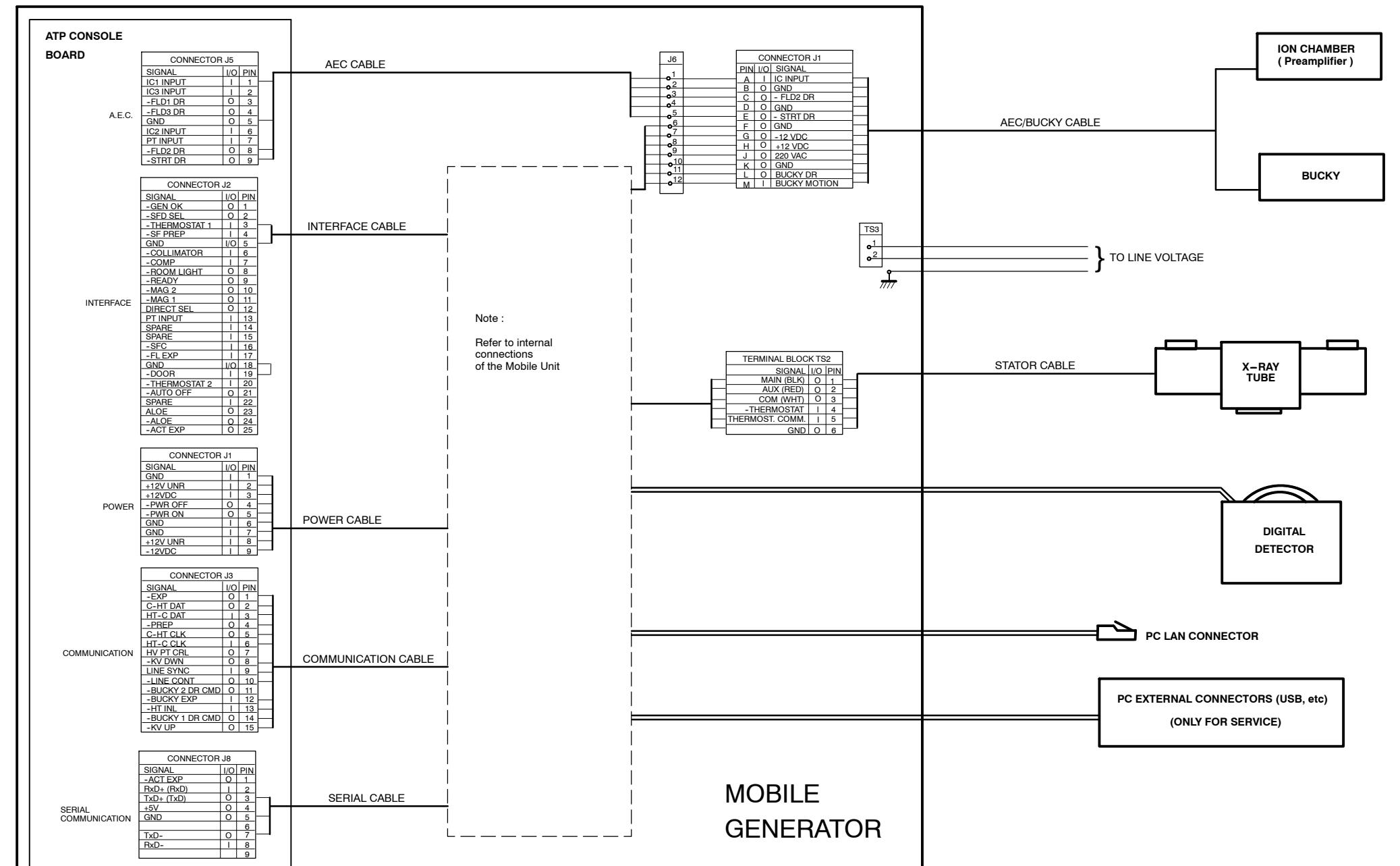
Table 4-1 (cont.)**System Interconnection Signals**

SIGNAL NAME	SIGNAL DESCRIPTION
-COLLIMATOR	This low signal indicates that a NO EXPOSURE HOLD condition exists at the Collimator. This input is read only when the Radiographic Tube is selected.
-EXP	Low Exposure signal to the HT Control PCB. If -PREP is low then a Spot Film or RAD exposure is made, otherwise, it is understood as a Fluoro exposure.
HT-C CLK	Serial data clock from the HT Control PCB. This clock synchronizes the HT-C DATA signal.
HT-C DAT	Serial data from the HT Control PCB. This data is synchronous with the HT-C CLK signal.
-HT INL	This signal is low when the switch in the high voltage transformer is in the RAD position. This is a safety interlock which prevents an exposure if the high voltage switch (in the HV Transformer) is in the wrong position.
-LINE CONT	A low signal energizes the main line contactor K5 in the Power Module.
-PREP	Command to the HT Control PCB to boost X-ray Tub Filament to the value of mA selected and to start the X-ray Tube Rotor if RAD Tube is selected.
-READY	This low going signal indicates the system is ready to make an exposure (Prep cycle completed).
-THERMOSTAT	This signal from X-ray Tube indicates the overheat of the Tube.

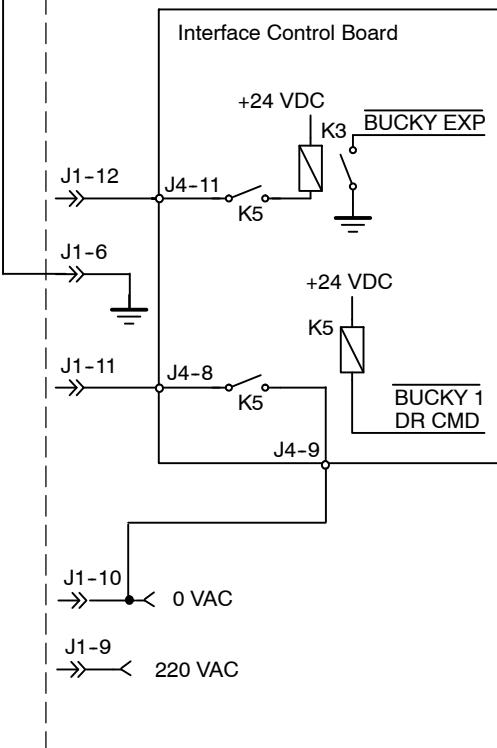
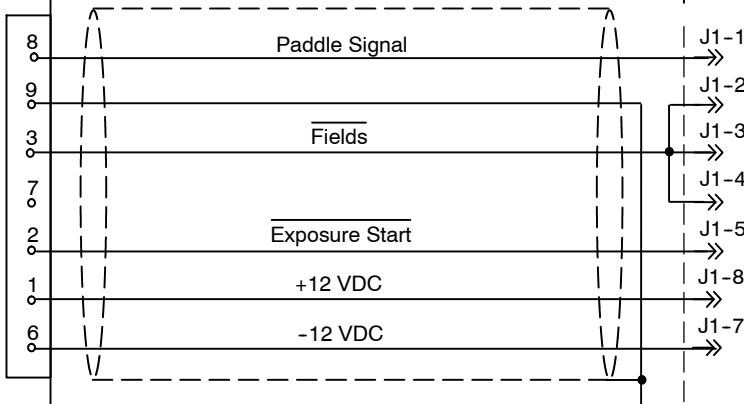
4.2 INTERCONNECTION MAPS

Refer to the following maps for details of the wire connections.

- Digital Mobile-RAD Interconnection 54301089
- Mobile Interface I/F-034



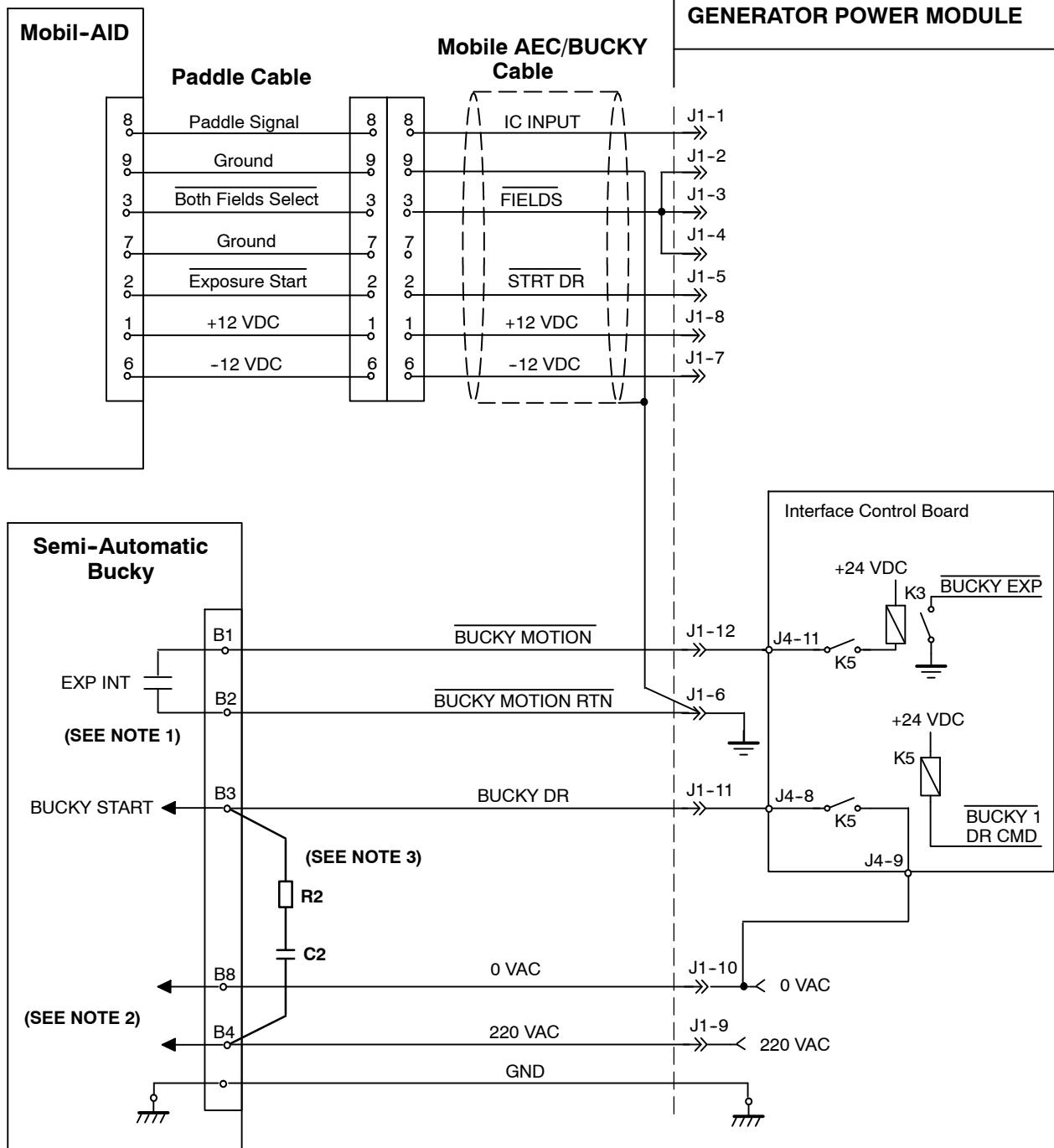
					NAME	DATE	SHEET / OF	DWG:	54301089		
				DRAWING	F. GARCIA	04/04/05	1 / 1				
				REVISED	A. DIAZ	04/04/05					A
				 SEDECAL				DIGITAL MOBILE-RAD INTERCONNECTION			
A		F. Garcia	24/06/09								
REV	DESCRIPTION	ISSUED BY	DATE								

Mobil-AID**GENERATOR POWER MODULE****Paddle Cable**

					NAME	DATE	SHEET / OF	Interconnection Cable Cable de Interconexión			I/F-034
				DRAWING	F. GARCIA	08/08/99					
				REVISED	A. DIAZ	08/08/99	1 / 2				
C	NC 11/062	S. Pérez	22/02/11							C	B
B	NC 10/237	F. García	08/06/10							A	REV
A	NC 00/171	F. Garcia	25/07/00								
REV	DESCRIPTION	ISSUED BY	DATE								

SEDECAL

**MOBILE INTERFACE
INTERFACE MOVIL**



NOTE 1: Be sure that B2 terminal is not connected to B3 terminal.

NOTE 2: Select correct voltage in the bucky according to AC input

NOTE 3: In the case of noise due to Bucky, add R2=22 ohm, 1/2w, 5%; and C2=470 nF, 250 VAC as shown.
Don't add that R2-C2 for Liebel-Flarsheim 8000 Series Bucky.

NOTA 1: Asegurarse que el terminal B2 no está conectado al B3.

NOTA 2: Seleccionar la tensión del bucky según la entrada AC

NOTA 3: En caso de ruidos debido al Bucky, añadir R2=22 ohm, 1/2w, 5%, y C2=470 nF, 250 VAC según se muestra.
Para Bucky Liebel-Flarsheim Series 8000, no añadir esa R2-C2.

				DRAWING	NAME	DATE	SHEET / OF	Interconnection Cable			I/F-034		
								Cable de Interconexión			C	B	A
								REVISED	A. DIAZ	08/08/99			
C	NC 11/062	S. Pérez	22/02/11								C	B	A
B	NC 10/237	F. García	08/06/10										REV
A	NC 00/171	F. Garcia	25/07/00										
REV	DESCRIPTION	ISSUED BY	DATE		SEDECAL								

MOBILE INTERFACE
INTERFACE MOVIL

Technical Publication

DB-1100R1

Data Book

Mobile X-Ray Units

REVISION HISTORY

REVISION	DATE	REASON FOR CHANGE
0	FEB 18, 2013	First Edition
1	DEC 14, 2016	Tables for Workstation configuration

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.

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1.1	Installation Data	1
1.2	Maintenance History	2
2	DATA TABLES	3

Mobile X-Ray Units

Data Book

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SECTION 1 INTRODUCTION

This Data Book is the register of the Configuration and Calibration data of the Generator and the register of each Periodic Maintenance Service carried out. Keep this book always with the equipment for reference.

Note 

Enter the data with a pencil in order to modify them later due to future changes.



If the HT Controller Board or the ATP Console CPU Board are replaced, check specially that Extended Memory data have not been lost or modified with the Board change. Compare Extended Memory data displayed on the Console with the values noted in this document.

Also, make some exposures using different techniques and Focal Spot and check that mA stations are calibrated correctly, if not perform Calibration procedures.

Note 

Verify that "Configuration Control Sheet" and "Final Test Results" pages from factory have been included with the equipment.

1.1 INSTALLATION DATA

Enter the following information.

HOSPITAL			
INSTALLED AND TESTED BY		DATE	

1.2 MAINTENANCE HISTORY

Enter the following information after each data modification in this book or Periodic Maintenance Service.

SECTION 2 DATA TABLES

Table 2-1
3024SW1 - ATP Console CPU Board

3024SW1 POSITION	OPEN (OFF)	CLOSED (ON)
1		
2		
3		
4		

Table 2-2
3024SW2 - ATP Console CPU Board

3024SW2 POSITION	OPEN (OFF)	CLOSED (ON)
1		
2		
3		
4		

Table 2-3
3024SW3 and 3024SW4 - ATP Console CPU Board

Note 

Dip switches 3024SW3 and 3024SW4 are not used for configuration but all their switches must be set in “Off” position.

Table 2-4
3000SW2 - HT Controller Board

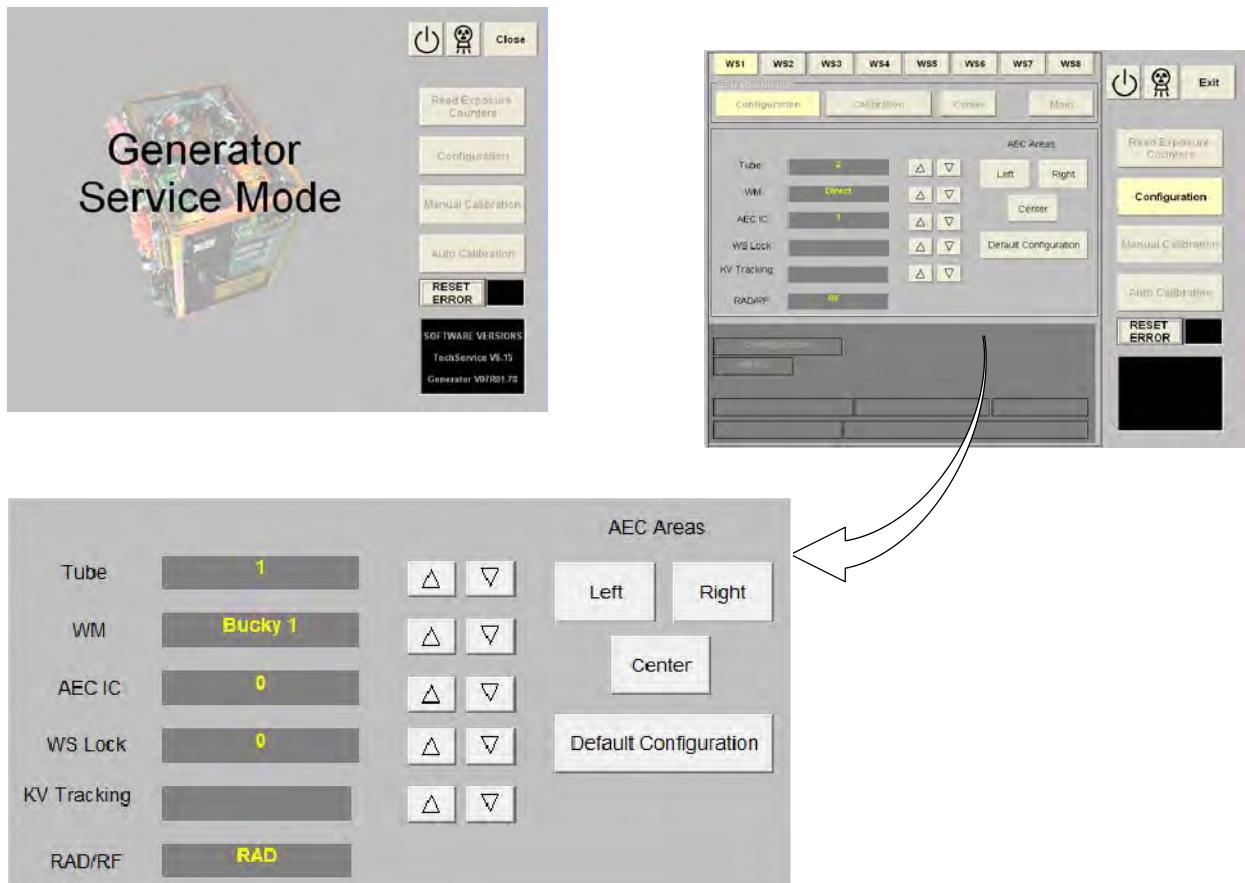
3000SW2 POSITION	OPEN (OFF)	CLOSED (ON)
1		
2		
3		
4		
5		
6		
7		
8		

Mobile X-Ray Units

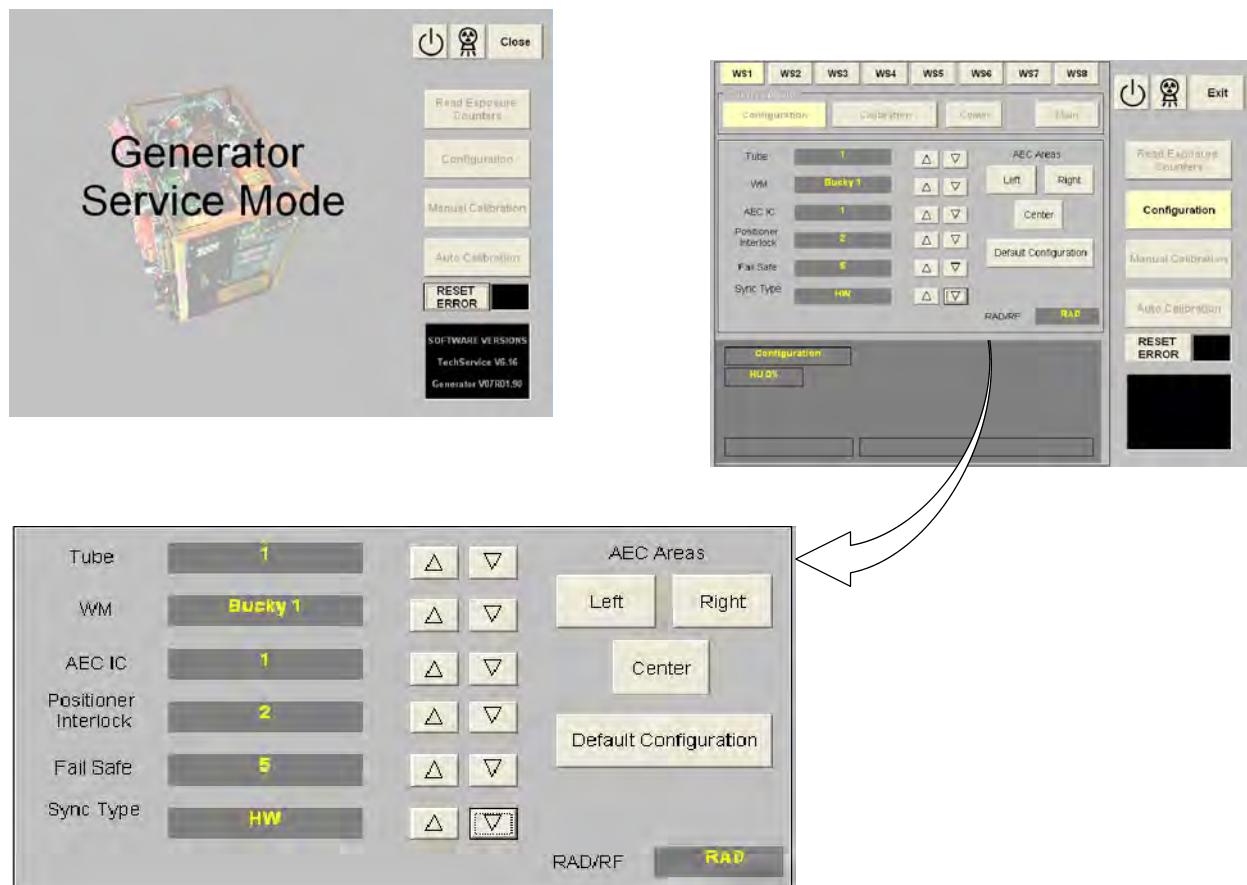
Data Book

Table 2-5

Configured Workstations using the GSM with TechService V6.15



CONFIGURATION OF WORKSTATIONS USING TECHSERVICE V6.15								
WORKSTATION	WS1	WS2	WS3	WS4	WS5	WS6	WS7	WS8
TUBE								
WM								
AEC IC								
WS LOCK								
kV TRACKING								
RAD/RF								

Table 2-6**Configured Workstations using the GSM with TechService ≥ V6.16**

CONFIGURATION OF WORKSTATIONS USING TECHSERVICE V6.16								
WORKSTATION	WS1	WS2	WS3	WS4	WS5	WS6	WS7	WS8
TUBE								
WM								
AEC IC								
POSITIONER INTERLOCK								
FAIL SAFE								
SYNC TYPE								
RAD/RF								

Mobile X-Ray Units

Data Book

Table 2-7
Jumpers in other Generator Boards

GENERATOR BOARDS	JUMPERS POSITION	
HT CONTROLLER	JP1 and JP2	
	JP3, JP5 and JP6	
	JP4	
FILAMENT CONTROL	W1	
INTERFACE CONTROL	W1	
	W2	
	W3 to W10	
ATP CONSOLE CPU	JP1, JP2 and JP3	
	JP4	
	JP5	
	JP6	
	Connector J8 configured for RS232 so: JP9, JP10 and JP11 in "A". JP7, JP8, JP21 and JP22 do not matter jumpers position	
	JP12	
	JP13	
	JP14	
	JP15, JP16, JP17 and JP18	
	JP19	

Table 2-8
Extended Memory Locations

MEMORY LOCATION	FUNCTION	VALUE
E01	TUBE-1 - RAD filament stand-by (Autocalibrated. Not field changeable)	
E02	TUBE-1 - RAD tube type	
E03	Low Digital mA Loop Closed (from 10 mA to 80 mA)	
E05	High Digital mA Loop Closed (from 100 mA)	
E06	kV Loop	
E07	Maximum kW (Factory set. Only field changeable to lower value)	
E13	TUBE-1 - Exposure Time adjustment - Delay	
E15	TUBE-1 - Exposure Time adjustment - Ceq kV	
<i>* Note. - Memory Locations not listed are not used.</i>		

Table 2-9
Rotor Acceleration Time Configuration

OPERATION MODE	3000SW2-2			
	OPEN (OFF)	CLOSED (ON)		
Rotor Speed	Low Speed	-		
TUBE-1 ROTOR ACCELERATION TIME AND FILAMENT SETTING TIME	3000SW2-7	3000SW2-8		
_____ seconds	OPEN (OFF)	CLOSED (ON)	OPEN (OFF)	CLOSED (ON)

Table 2-10
mA Calibration Numbers - Tube-1

mA STATION	FILAMENT CURRENT NUMBERS AT kVp BREAK POINT			
	40	50	80	120
10				
12.5				
16				
20				
25				
32				
40				
50				
64				
80				
100				
125				
160				
200				
250				
320				
400				
500				

Note. - The mA station values depend on the Generator model. Some models do not contain all the mA stations listed above.

Table 2-11**SW1 Velocity Limit Switch - Digital Motion Control Board**

SW1 POSITION	OPEN (OFF)	CLOSED (ON)
1		
2		
3		
4		

Note 

For further information about SW1 Velocity Limit Switch on the Digital Motion Control Board, refer to Troubleshooting Chapter "Driving Velocity Limits Selection Switch".

Technical Publication

CC-1100R3

Configuration & Calibration

HF Series Generators

REVISION HISTORY

REVISION	DATE	REASON FOR CHANGE
0	FEB 18, 2013	First Edition
1	MAY 22, 2015	Toshiba E7884X Power Ratings
2	DEC 14, 2016	TechService ≥ 6.16; Illustrations and General Update
3	DEC 05, 2018	X-Ray Tubes

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SECTION 1

PRELIMINARY CONSIDERATIONS

Note 

This Mobile Unit has been configured, calibrated and tested by the Manufacturer. No service intervention is necessary as the Unit is ready for normal operation.

None of the procedures indicated in this chapter of the Service Manual should be necessary upon first run, unless esteemed otherwise.

Note 

Configuration and Calibration should only be performed by Service Engineers who are specialized in servicing this specific Mobile Unit.

Note 

Before performing the Configuration and Calibration, verify that the Unit has been connected to the mains for at least ten (10) hours. This will ensure a complete and full Battery charging.

The required tools and test equipments are listed on the Startup Primer document of this Service Manual.

Note 

SW8 X-Ray Inhibition in Parking/Column:

SW8 in "Parking" position: the unit cannot perform exposures when the Arm is secured in the Parking position (Factory set), i.e. with the Column rotated at 0° and the Arm secured with the Parking mechanism.

SW8 in "Column" position: optionally, the unit cannot perform exposures when the Arm with the Tube-Collimator Assembly is straight above the Control Panel with Column rotated at 0°, but not secured in the parking position.

To change the configuration, access to SW8 at the left side underneath the Console Frame.



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SECTION 2 CONFIGURATION

Configuration provides the initial settings for extended memory and checkout procedures that must be carried out before making X-ray exposures. Functional characteristics of this Generator are defined at this time.

Calibration and some configuration data are stored in a non-volatile memory chip (U3-EEPROM) located on the HT Controller Board.

When the initial setup and checkout are complete, the Generator is ready for Calibration.

Note 

Record all the configuration settings in the Data Book.



DO NOT SUPPLY THE MAIN POWER UNTIL SPECIFICALLY INSTRUCTED TO DO SO IN THIS DOCUMENT.

THE MAIN CAPACITORS OF THE HIGH VOLTAGE INVERTER RETAIN A LARGE PORTION OF THEIR CHARGE FOR APPROX. 3 MINUTES AFTER THE UNIT IS TURNED OFF.

The Generator configuration is determined by:

- X-ray Tube model.
- Maximum kV, kW.

Specific versions of U24-EPROM on the ATP Console CPU Board and U5 on the HT Controller Board are based on the Generator configuration. (*Refer to Illustration 2-1*).

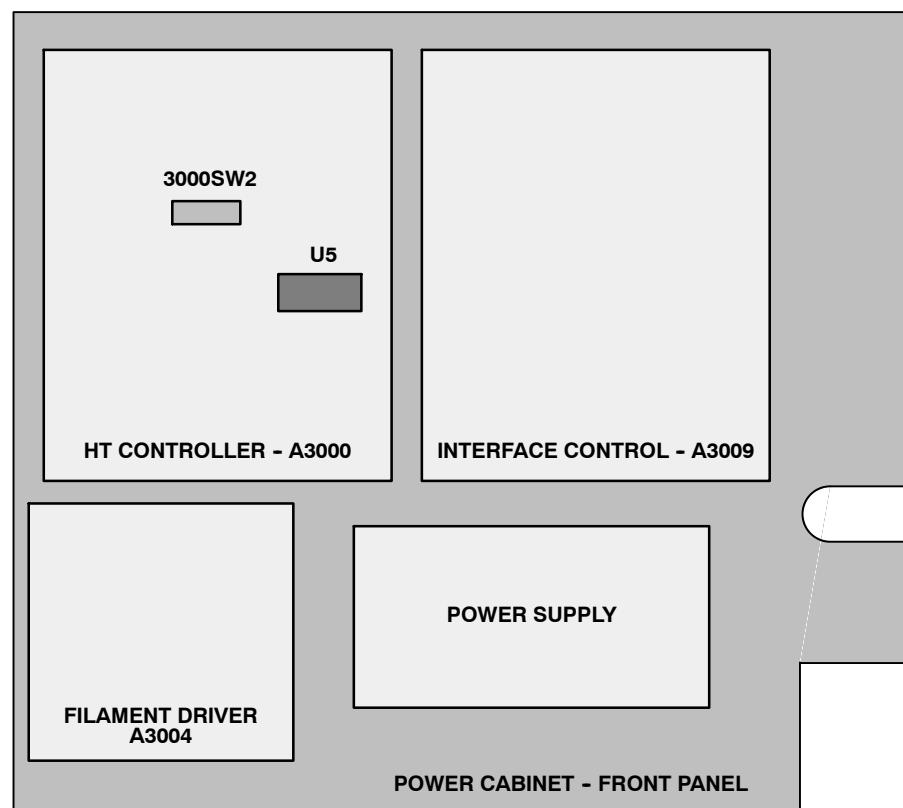
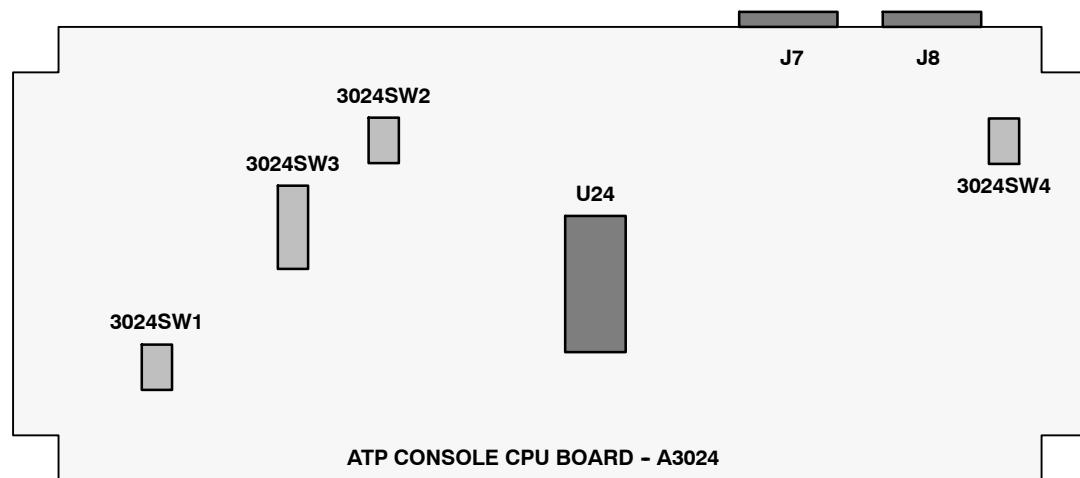
The system configuration and test switches are:

DIP SWITCH LOCATION	FUNCTION
3024SW1 - ATP Console CPU Board	System Configuration
3024SW2 - ATP Console CPU Board	Test
3024SW3 - ATP Console CPU Board	Not used for Configuration
3000SW2 - HT Controller Board	System Configuration and Test

HF Series Generators

Configuration and Calibration

Illustration 2-1
EPROM and Switch locations



2.1 CONFIGURATION AND TEST SWITCHES

ATP Console Dip Switches must be configured with the Generator turned OFF, and they are read when the Generator is turned ON again.

2.1.1 3024SW1 - ATP CONSOLE CPU BOARD

Set dip switch 3024SW1 in accordance with the Table 2-1.

Table 2-1
System Configuration Dip Switch 3024SW1 on the ATP Console CPU Board

3024SW1 POSITION	OPEN (OFF)	CLOSED (ON)
1	60 Hz *1)	-
2	-	Normal - Application mode. Exposures are inhibited when Door Interlock Switch is opened.
3	Not used. Set in "OFF" position.	Not used.
4	Not used. Set in "OFF" position.	Not used.

Note.- *1) This switch is related with the frequency of the Rotor Controller. Set always SW1-1 to 60 Hz.

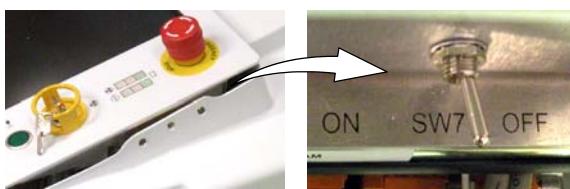
2.1.2 3024SW2 - ATP CONSOLE CPU BOARD

Set dip switch 3024SW2 verifying that each position is set as Table 2-2.

Table 2-2
Test Dip Switch 3024SW2 on the ATP Console CPU Board

3024SW2 POSITION	OPEN (OFF)	CLOSED (ON)
1	Skips reception with the HT Controller. Use only for display purposes, troubleshooting or Demo Consoles when there is no Power Module. Be sure that J3 connector is not plugged to the ATP Console CPU Board.	Normal - Application mode.
2	Tick Sound (button / command acknowledge) is not emitted by the ATP Console CPU Board.	Tick Sound (button / command acknowledge) is emitted by the ATP Console CPU Board.
3	Always set in “OFF” position. Application and Service modes available by setting the Switch SW7 “Calibration ON/OFF”, located at the right side under the Console Frame (<i>Refer to Illustration 2-2</i>).	Never set in “ON” position. If this Switch is set in “ON” position, the unit will always be in Service mode and Switch SW7 “Calibration ON/OFF” will be disabled.
4	-	kV Lineal Scale Mode for kV variation (Normal mode) (kV changes one by one).

Illustration 2-2
Switch SW7 “Calibration ON/OFF” accessibility



1. Open the Pencil Tray and remove the two screws that fasten the Console Frame to the Unit. Push the Console Frame towards the Column. Do not lift up the Console Frame until its upper side is fully released.
2. Remove the three (3) Lateral Screws placed on the Front Cover, at the right side underneath the Console Frame, in order to facilitate an access between the console and the cover.
3. Set Switch SW7 “Calibration ON/OFF” in “ON” position to enable Service mode, or in “OFF” position to enable Application mode.

2.1.3 3024SW3 - ATP CONSOLE CPU BOARD

Dip switch 3024SW3 is not used for configuration but all their switches must be set in “*Off*” position.

2.1.4 3024SW4 - ATP CONSOLE CPU BOARD

Dip Switch 3024SW4 is not used for configuration but all their switches must be set in “*Off*” position.

2.1.5 3000SW2 - HT CONTROLLER BOARD

HT Controller Dip Switches can be configured while the Generator is ON except Dip Switch 3000SW2-1.

Set dip switch 3000SW2 as indicated in Table 2-3.

Table 2-3
Test Dip Switch 3000SW2 on the HT Controller Board in the Power Module

3000SW2 POSITION	OPEN (OFF)	CLOSED (ON)
1	Normal.	Programming of Rotor Acceleration Time and RAD Filament Setting Time *1) *2)
2	Normal.	Bypasses: Filament, Rotor Ready, Error E11. *1) *3)
3	Normal – Not used.	Not used.
4	Normal – Digital mA Loop Closed	Digital mA Loop Open / Filament Current Constant *1)
5	125 kV *4)	150 kV *4)
6	Normal. One RAD X-ray Tube	-
7	Filament Boosting for Tube-1	No Filament Boosting for Tube-1 *5)
8	Not used.	Not used.

Notes. – *1) Set in Closed (On) position only when indicated in the Service Manual.

*2) Note that SW2-1 in Closed (On) position is only set to program the Rotor Acceleration Time and Rad Filament Setting Time, therefore it changes the functions of Switches SW2-2 and SW2-7 to SW2-8. Refer to Section 3.

*3) This turns off the filaments so no radiation will be produced during the exposure.

WARNING: THE KV OUTPUT OF THE HV TRANSFORMER WILL BE WHATEVER IS SET BY THE CONSOLE. IF THE X-RAY TUBE HV CABLES ARE NOT CONNECTED INTO THE HV TRANSFORMER, FILL COMPLETELY BOTH HV RECEPTACLES WITH HV OIL.

*4) Set SW2-5 according to the Generator kV rating (refer to the Generator model and/or specifications).

*5) Set to “No Filament Boosting” when using X-ray Tubes with Small Focal Spot smaller than 0.6 .

2.2 BASIC CONFIGURATION OF GENERATOR BOARDS

The following Jumpers are factory set or removed to configure the Generator Boards according to the customer order. Verify Jumper positions on the Generator Boards.

GENERATOR BOARDS	JUMPERS POSITION
HT CONTROLLER	JP1 and JP2 in "2"
	JP3, JP5 and JP6 in "2" and JP4 in "1"
FILAMENT CONTROL	W1 in "A"
INTERFACE CONTROL	W1 in "2-3"
	W2 in "1-2"
	W3 to W10 in "A"
ATP CONSOLE CPU	JP1, JP2 and JP3 in "B" (soldered)
	JP4 in "B" (Cam-Sync)
	JP5 in "B" : Standard
	JP6 in "A" (soldered)
	Connector J8 configured for RS232 so: JP9, JP10 and JP11 in "A". JP7, JP8, JP21 and JP22 do not matter jumpers position
	JP12 removed
	JP13 removed
	JP14 installed (soldered)
	JP15, JP16, JP17 and JP18 removed
	JP19 in "A" (soldered)

2.3 GENERATOR SERVICE MODE (GSM)

The Generator Service Mode (GSM) program allows the access to the service screens for Reading the Exposure Counters, Configuration and Calibration procedures. After accessing to the GSM program, a black Information Area may appear at the lower right corner of the screen showing some messages about the process (a.e. "Power Up the Generator").

To start/close the GSM program, connect a keyboard to the Unit (the PC runs on a Windows-based platform) and carry out the following:

1. Close the RAD Application with the keys "Control" + "Alt" + "Delete" to open the Task Manager and then select the running RAD Application.
2. Once the RAD Application is closed, press the "Start-Windows" button, then select: "Start / Programs / TechService / TechService".

Note 

Once open, a message (status / process / software version) may appear on the Information Area on the lower right of the screen.

3. Perform all the Configuration and Calibration procedures required.
4. Once finished, the "Close" button will safely shutdown the GSM program.
5. To come back to the Operator's Application, restart the computer. The application will run automatically.

If after pressing the "Configuration", "Calibration" or "Auto Calibration" buttons, the GSM program prompts an error message: "Please check calibration dip switch and toggle with power off"; it means that these functions are disabled because position of Switch SW7 "Calibration ON/OFF" (located at the right side under the Console Frame) is not in "Service Mode Allowed". Turn OFF the Generator, set switch SW7 "Calib. ON/OFF" in "On" position to permit the Service mode (refer to Illustration 2-2). turn ON the Generator and start the GSM program again.

Illustration 2-3
Example of GSM Menu



The screens to “*Read Exposure Counters*” or to enter in “*Configuration*”, “*Manual Calibration*” and “*Auto Calibration*” are displayed after selecting the respective button on the right side. Press again the selected button (in yellow on the right side) to return to the GSM menu.

The “*Exit*” button can also be used to return to the GSM menu, especially if others buttons are disabled.

The “*Configuration*” screen can displays different buttons depending on the version of the “*TechService*” supplied for the Generator, refer to *Illustration 2-4* see as example of “*Configuration*” screens.

Note 

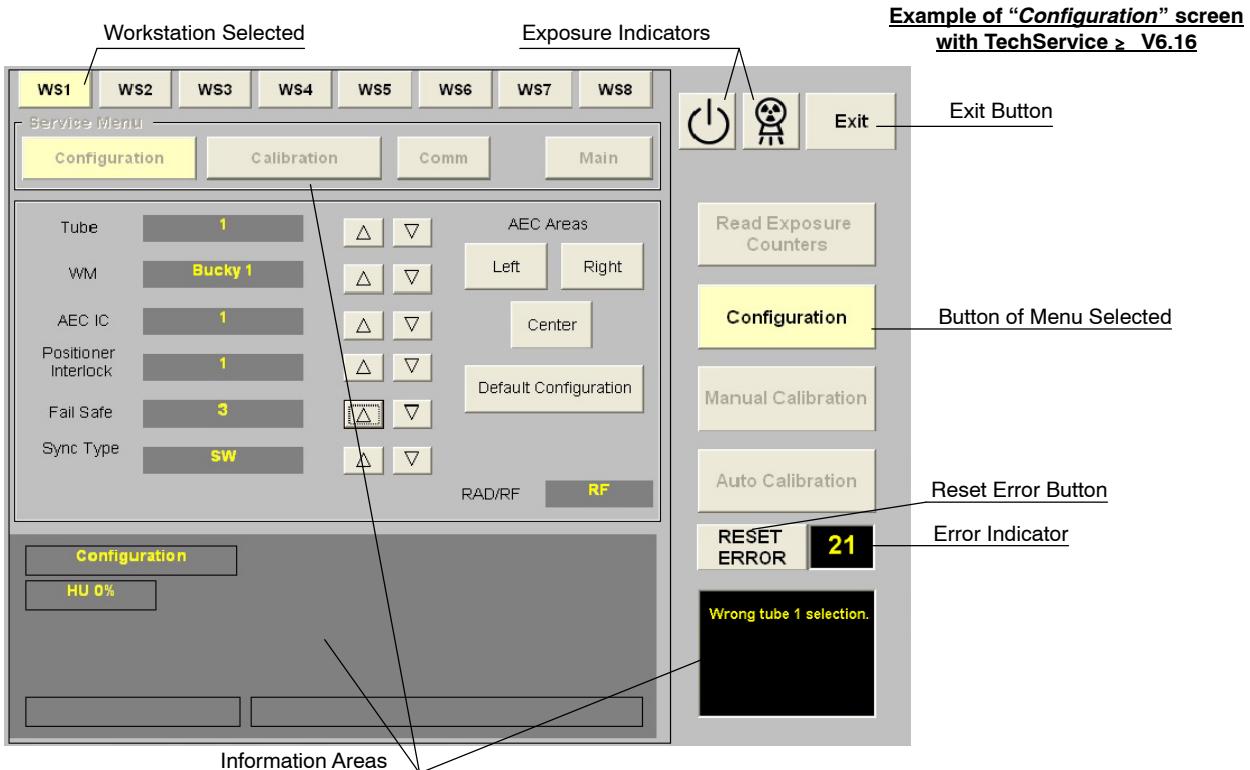
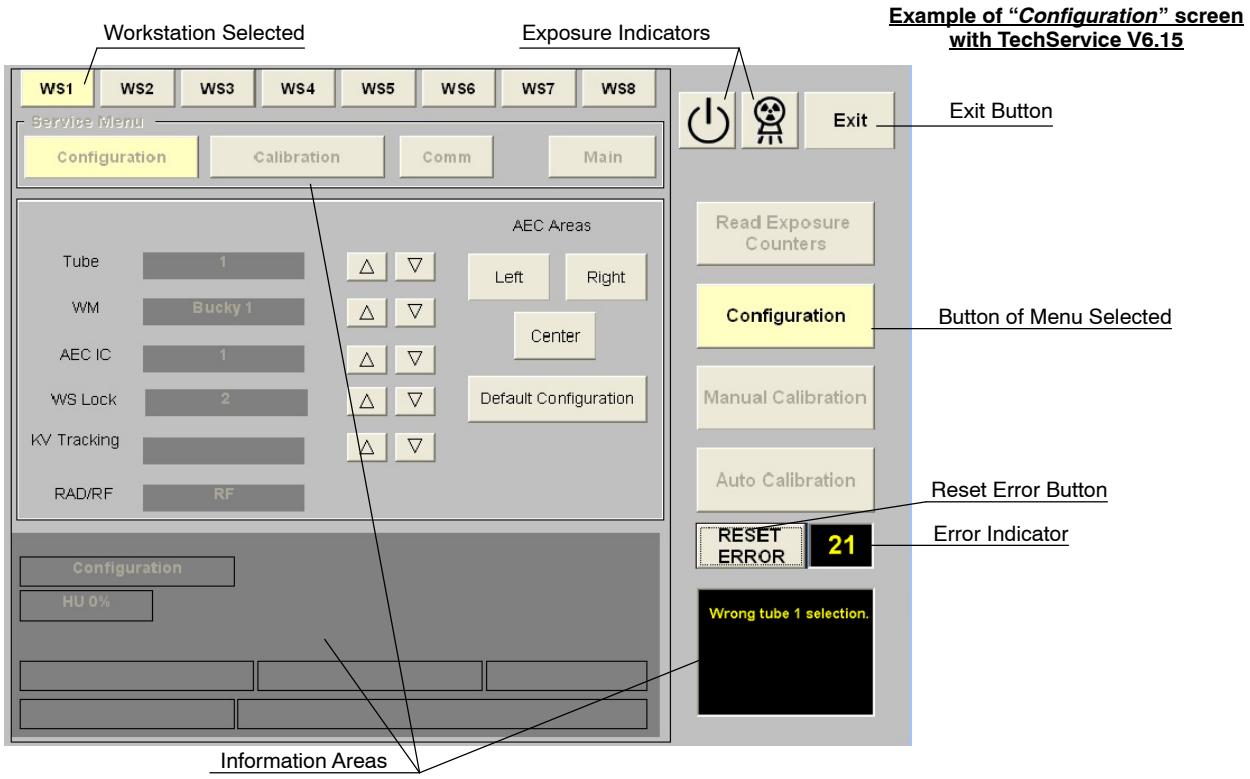
Whenever the “Configuration” menu is closed (by pressing any of “Configuration” or “Exit” buttons) a double-beep will sound confirming the storage of the values set for each workstation.

During operation of the GSM program the color of the selected buttons changes to yellow when they are selected.

Exposure status indicators for “*Ready*” and “*X-ray On*” are located on the upper right area of the GSM screens. The “*Information Area*” displays data related to the service mode, remaining heat units, working mode, errors indicators, etc.

When an error code or message is displayed on the GSM program press the “*Reset Error*” button to clear its indication.

Illustration 2-4
Status and Error Indicators

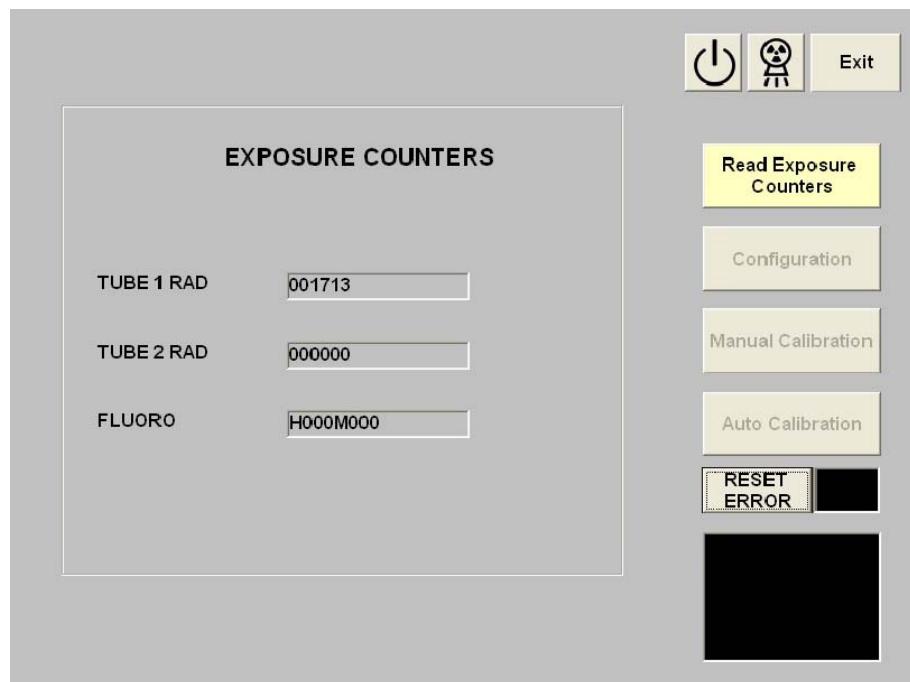


2.4 EXPOSURE COUNTERS

The Exposure Counters display the number of Rad exposures made with the X-ray Tube.

1. Enter in the GSM program and select “*Read Exposure Counters*”. The emerging screen is similar to *Illustration 2-5*.
2. Exit from this screen by pressing the “*Read Exposure Counters*” button or the “*Exit*” button again.

Illustration 2-5
Exposure Counters



2.5 WORKSTATIONS CONFIGURATION

From this screen, Workstations (Tube, Working Mode) are established. The different displays/buttons related to the Workstation configuration that appear on the “*Configuration*” screen depend on the version of the “TechService” supplied for the Generator (refer to Illustration 2-6).

Note 

The X-ray Tube of the Mobile Unit has to be configured, calibrated and used as Tube-1.

Workstations can be configured according to customer preferences or default. If a workstation is configured with the value “*Tube - 0*”, its button cannot be selected during operation.

CUSTOMIZED CONFIGURATION

Note 

*This procedure **must be performed** whenever replacing the “ATP Console CPU Board”.*

1. Enter in the GSM program and select “*Configuration*”. The screen should be similar to Illustration 2-6.

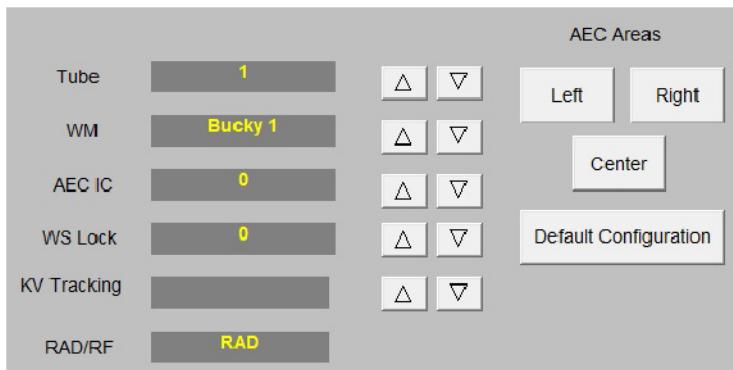
HF Series Generators

Configuration and Calibration

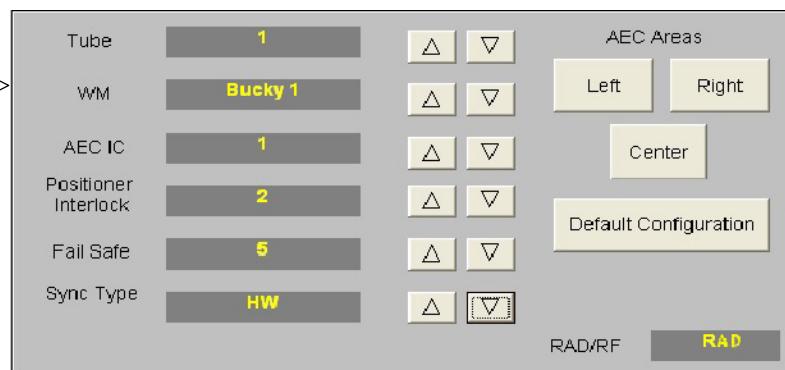
Illustration 2-6 Configuration screen depending on TechService version



Example of “Configuration” screen with TechService V6.15



Example of “Configuration” screen with TechService ≥ V6.16



2. Select the first Workstation to be configured by pressing the respective button (icon highlighted in yellow). The Values may be the following:

CONFIGURATION VALUES WITH TECHSERVICE V6.15			
DISPLAY	FUNCTION	VALUE	DESCRIPTION
TUBE	Tubes	0	No-configured workstation (Not selectable by the operator)
		1	Tube-1
		2	Not used
WM	Devices - Working Modes	0 - Direct	Direct
		1 - Bucky 1	First Receptor (Bucky-1 or DR)
		2 - Bucky 2	Not used
		3 - STD Tomo	
		4 - STD RF	
		5 - DSI	
		6 - Cine	
		7 - DSA	
AEC IC	-	0	Not used
WS LOCK	-	0	Not used
KV TRACKING	-	-	Not used
RAD/RF	Generator Type	RAD	Only for RAD
		RF	Not used

HF Series Generators

Configuration and Calibration

CONFIGURATION VALUES WITH TECHSERVICE ≥ V6.16			
DISPLAY	FUNCTION	VALUE	DESCRIPTION
TUBE	Tubes	0	No-configured workstation (Not selectable by the operator)
		1	Tube-1
		2	Not used
WM	Devices - Working Modes	0 - Direct	Direct
		1 - Bucky 1	First Receptor (Bucky-1 or DR)
		2 - Bucky 2	Not used
		3 - STD Tomo	
		4 - STD RF	
		5 - DSI	
		6 - Cine	
		7 - DSA	
AEC IC	-	0	Not used
POSITIONER INTERLOCK	-	0	Not used
FAIL SAFE	-	0	Not used
SYNC TYPE	Generator - DR Synchronization Type ^{*1)} (optional)	HW	DR Synchronization by Hardware
		SW	DR Synchronization by Software
RAD/RF	Generator Type	RAD	Only for RAD
		RF	Not used

Notes:

**1) Consult the documentation of the Acquisition Software and the System Interface schematics in order to set the Synchronization type between the Mobile Unit and DR (Detector Power Box).*

3. Set the new value by pressing the corresponding “Increase” or “Decrease” buttons.
4. Continue setting values for the required number of workstations.
5. When finished, exit Configuration Mode by pressing the “Configuration” button again. A double-bip will sound confirming the process.

DEFAULT CONFIGURATION

Default Configuration sets some default values to each workstation. It only should be used to reinitialize the workstation configuration when:

- The complete configuration has been lost.
- It is not possible to select a workstation.

After performing a “*Default Configuration*” it is recommended to carry out a manual “*Customized Configuration*” of workstations. Set Default Configuration as follows:

1. Enter in the GSM program and select “*Configuration*”.
2. Press the “*Default Configuration*” button.
3. Exit from Configuration Mode by pressing “*Configuration*”. A double-bip will sound to confirm the process.

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SECTION 3 EXTENDED MEMORY SETTING

3.1 EXTENDED MEMORY LOCATIONS

Miscellaneous configuration and calibration data are stored in the Extended Memory Locations. It is recommended to note in Table 3-1 below the stored factory values in each Memory Location.

Table 3-1
Extended Memory Locations

MEMORY LOCATION	FUNCTION	VALUE
E01	TUBE-1 – RAD filament stand-by (<i>Autocalibrated. Not field changeable</i>)	
E02	TUBE-1 – RAD Tube type	
E03	Low Digital mA Loop Closed (from 10 mA to 80 mA)	
E05	High Digital mA Loop Closed (from 100 mA)	
E06	kV Loop	
E07	Maximum kW (<i>Factory set. Only field changeable to lower value</i>)	
E13	TUBE-1 – Exposure Time adjustment - Delay	
E15	TUBE-1 – Exposure Time adjustment - Ceq kV	
<i>* Note. – Memory Locations not listed are not used.</i>		

3.2 HOW TO ENTER AND STORE DATA IN THE EXTENDED MEMORY

Extended Memory data are introduced when the Unit is in Service Mode. Access memory locations as indicated below:

1. Turn the Generator OFF and set switch SW7 “*Calib. ON/OFF*” in “**On**” position to permit the Service mode (*refer to Illustration 2-2*).
2. Power ON the Unit. Open the GSM Program according to the instructions in Section 2.3.
3. Select “*Manual Calibration*” in the GSM program and then select the Workstation (WS) using the “*Up*” and “*Down*” buttons. Press “*OK*” to enter Calibration.

Note 

In Calibration Mode, only the kV and mA parameters can be modified. Values for Time and mAs are factory programmed.

4. Increase the mA value beyond the maximum mA position. The mA Display will show the first Extended Memory location (E01), they will continue sequentially as the “*Increase mA*” button is pressed.

The values stored in each location are shown on the “*Calibration Value Display*” after pressing “*Read*”.

Note 

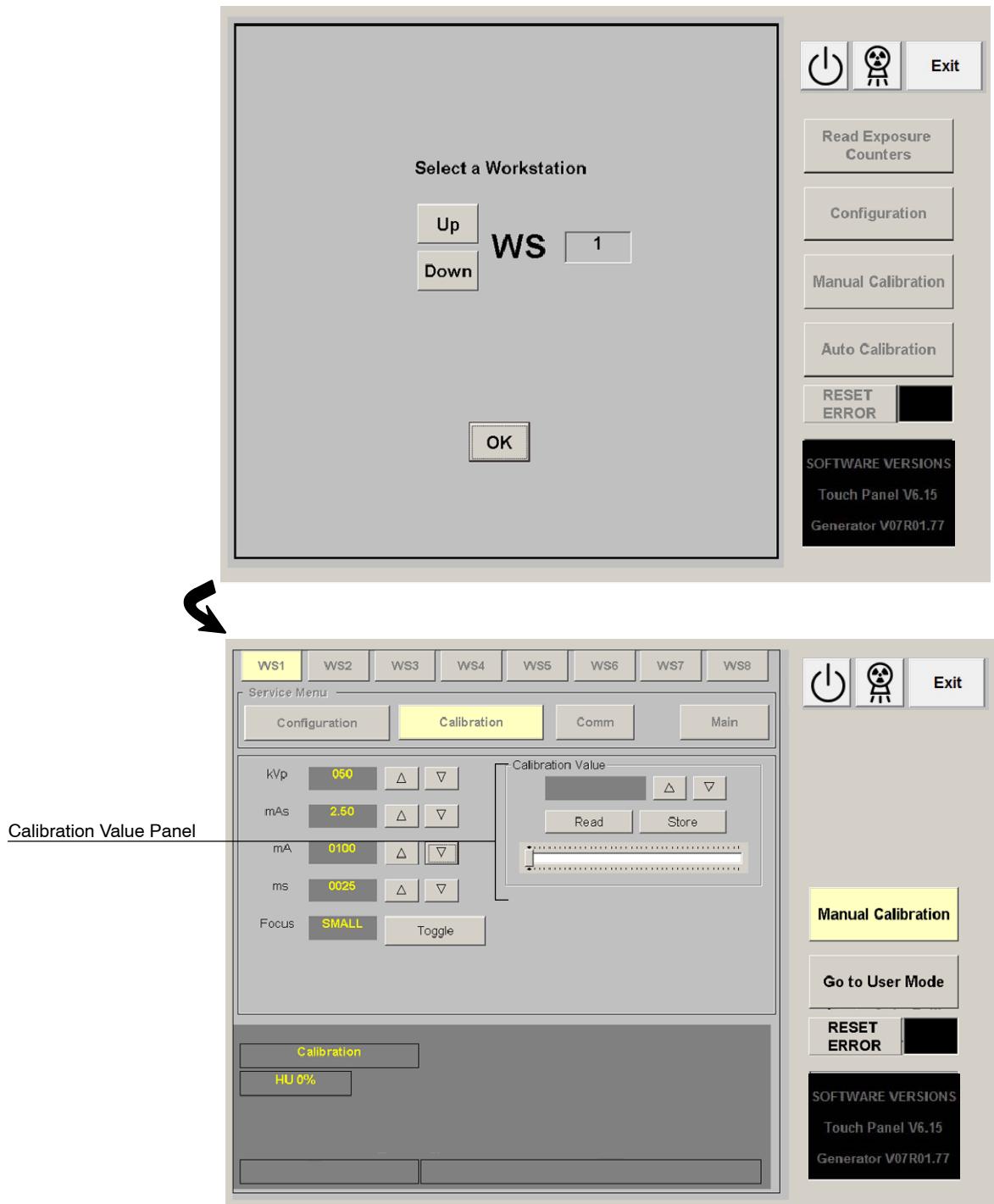
*Although these values also appear after pressing the “*Increase*” or “*Decrease*” buttons of this panel, and these buttons are used to increase or decrease the stored values, one number should be added to or subtracted from the reading, to obtain the current stored value.*

5. Select the new value by pressing the “*Increase*” and “*Decrease*” buttons. Each time these buttons are pressed the value displayed on the calibration panel is increased or decreased one step.
6. Store the new value by pressing “*Store*”.

Note 

*If “*Store*” is not pressed after a new value is selected, no modified data will be retained.*

7. When finished, exit Calibration Mode by pressing the “*Manual Calibration*” button again.
8. Turn the Generator OFF and set switch SW7 “*Calib. ON/OFF*” in “**Off**” position to place the Generator in Application mode (*refer to Illustration 2-2*).

Illustration 3-1
Calibration

3.3 LIMIT OF MAXIMUM kW

The Maximum kW of the Generator is factory set according to the Generator performance. Generator kW can be limited to a lower value.

Note 

This limit can be set to a lower value to match the maximum Generator power to the Line power, due to a high line impedance.

1. Enter in calibration mode by pressing the “Manual Calibration” button on the GSM program. Select any workstation (WS) and press the “OK” button.
2. Select the E07 Memory Location (memory location is shown on the mA Display).
3. Set the new limit of Maximum kW by pressing the “Increase” or “Decrease” calibration buttons and store the value by pressing the “Store” button.
4. Exit from calibration mode.

Note 

Record configuration data for E07 in the Data Book.

SECTION 4 X-RAY TUBE SELECTION

4.1 COMMON X-RAY TUBES

Table 4-1 lists common Tubes used in this Mobile Units and their corresponding number. If a replacement Tube is not listed, refer to *Section 6 “X-ray Tube Data”*.

Table 4-1
X-ray Tube Numbers

TUBE NUMBER	TUBE CODE (ID)	MODEL	FOCAL SPOT	POWER RATINGS LS (kW)	KHU
006	407	CANON E7884X	0.6 / 1.2	22 / 54.7	300
007	310	CANON E7843X	0.6 / 1.2	22 / 49	150
008	344	CANON E7865X	0.3 / 1.0	3 / 40	140
011	441	CANON E7886X	0.7 / 1.3	16.9 / 40	300

Note . - Power Ratings are for 60 Hz. To calculate Power Ratings for 50 Hz multiply the values by 0.91

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4.2 X-RAY TUBE INSERT PROTECTION CURVES

In order to properly select the X-ray Tube Insert Protection Curves for the Tube connected to the Generator, perform the following procedure:

1. Enter in calibration mode by pressing the “*Manual Calibration*” button on the GSM program. Select one of the workstation (WS) related to the X-ray Tube to be configured. Then press the “*OK*” button.
2. Select the E02 Memory Location (memory location is shown on the mA Display).
3. Identify in *Section 4.1 “Common X-ray Tubes”*, the X-ray Tube that is being installed and note its Tube type number. If the X-ray Tube is not listed, refer to *Section 6 “X-ray Tube Data”*.
4. Set the Tube number by pressing the “*Increase*” or “*Decrease*” calibration buttons until the correct number is showed on the “*Calibration Value*” panel.
5. Store the value by pressing the “*Store*” button.

6. Verify that the Tube code (ID) shown in the mAs Display is the same of the Tube code listed in *Section 4.1 “Common X-ray Tubes”*. If the X-ray Tube is not listed, refer to *Section 6 “X-ray Tube Data”*. The Tube code (ID) can be only read for the selected X-ray Tube after pressing the “Store” button.
7. Exit from calibration mode.

Note 

Record configuration data for E02 in the Data Book.

4.2.1 STATOR VOLTAGE AND CAPACITOR SELECTION



Check that the capacitor value of the Low Speed Starter corresponds to the value recommended by the X-ray Tube manufacturer. If needed, replace the capacitor. The Rotor speed must be indicated by the manufacturer.

The DC Brake of the Low Speed Starter (LF-RAC) can be removed by desoldering CR6 on the LF-RAC Board (refer to schematic A3096-XX). In this case, the Tube will remain coasting after releasing the “Prep” order.

4.2.1.1 CONFIGURATION FOR A TUBE WITH A STANDARD STATOR



Voltage and capacitor is factory set to 220 VAC, 30 µF. Verify that this corresponds to the X-ray Tube Product Data.

4.2.1.2 CONFIGURATION FOR A TUBE WITH A STARTING VOLTAGE OF 110 VAC

If the Stator requires a starting voltage of 110 VAC (Canon E7239 / E7240 / E7242 / E7252 / E7299 / E7813 / E7865), perform the following modification:

- If the Power Input Transformer 6T2 is for using with power lines up to 240 VAC (part number 50509030), remove the wire labelled as “4” that is connected to Terminal 4 (230 VAC RTR) and connect it to Terminal 3 or 8 (110 VAC).
- For X-ray Tube Canon E7252 or E7813 (or when it is required) replace also the Fuse F1 (6A) on the LF-RAC Board by another fuse of 10 A.

4.2.2 PROGRAMMING OF ROTOR ACCELERATION TIME AND RAD FILAMENT SETTING TIME



Rotor Acceleration Time is determined by the X-ray Tube and Rotor characteristics and it must be considered when the Generator is about to be configured. X-ray Tube could be permanently damaged unless the required RPM are reached before an exposure. (Refer to technical information of the X-ray Tube).

Dip Switch 3000SW2 on the HT Controller Board is used to program:

- *Rotor Acceleration Time.* That depends on stator voltage, stator frequency, stator type, quality of X-ray Tube bearings, and X-ray Tube anode size. A reed tachometer or a stroboscope can be used to determine the anode RPM. Be sure that the Rotor Acceleration Times meet all requirements for anticipated customer applications.

This value is programmable from 0.8 to 2.7 seconds. After this time the Rotor is hold running in maintaining mode as long as “Prep” is active.

- *Rad Filament Setting Time.* This parameter has the same configuration value than the Rotor Acceleration Time. Sometimes, if it is required to increase the Rad Filament Setting Time to the next value, configure the respective switches again. This adjustment avoids Error-12.

Note

The Rotor Acceleration Time and Rad Filament Setting Time is factory set to 1.8 seconds. Maintain this value when it is unknown or not provided with the X-ray Tube documentation.

1. Turn the Generator OFF and note current settings of the dip switch 3000SW2 on the HT Controller Board.

Note

Configuration of these times are only allowed when dip switch 3000SW2-1 is in “Closed” (On) position after power the Generator OFF and back ON again.

2. Set dip switches 3000SW2-1 and 3000SW2-2 as indicated below, in order to enable the selection of times with the Low Speed Starter. **Dip switch 3000SW2-1 has to be switched ONLY with the Generator powered OFF.**

3000SW2-1 (selection enable)	3000SW2-2 (Low Speed Starter)
ON	OFF

3. Configure the Rotor and Filament Times by setting the dip switches 3000SW2-7 through 3000SW2-8 per Table 4-2.

Table 4-2
Low Speed: Configuration of Rotor and Filament Times

TUBE-1 ROTOR ACCELERATION TIME AND FILAMENT SETTING TIME	3000SW2-7		3000SW2-8	
	OPEN (OFF)	CLOSED (ON)	OPEN (OFF)	CLOSED (ON)
0.8 seconds		<input type="checkbox"/>		<input type="checkbox"/>
1.2 seconds	<input type="checkbox"/>			<input type="checkbox"/>
1.8 seconds		<input type="checkbox"/>	<input type="checkbox"/>	
2.7 seconds	<input type="checkbox"/>		<input type="checkbox"/>	

Note 

Record the switch configuration in the Data Book.

4. To validate previous configuration, turn the Generator ON, wait until Error-01 (E01) appears on the Console and turn the Generator OFF.
5. Set dip switch 3000SW2 to the original settings as noted in step-1. (Refer to Section 2.1.5 for the normal settings of Dip Switch 3000SW2).

4.3 ANODE ROTATION TEST

Perform the following tests for the X-ray Tube.

Note 

Two people are recommended, one at the Console and the other looking at / testing the anode of the X-ray Tube. These tests can also be done by listening to the sound of the anode rotating.



DO NOT MAKE EXPOSURES DURING TESTING, OTHERWISE THE PERSON NEAR THE X-RAY TUBE WILL BE EXPOSED.

1. With the switch SW7 “Calib. ON/OFF” in “**On**” position to permit the Service mode (refer to Illustration 2-2), turn the Console ON and select the corresponding X-ray Tube.
2. Select low kVp and mAs values for an Anode Rotation at low speed.
3. Press the “Prep” push-button and visually check that the Tube anode rotates properly. (Refer to the X-ray Tube documentation).
4. Maintain the “Prep” push-button pressed and check that the rotation speed of the anode is in compliance with the X-ray Tube’s specifications.

Note 

For this test is recommended to turn the Tube Filaments OFF by setting 3000SW2-2 on the HT Controller in “ON” position and use a stroboscope to measure the anode speed.

5. Release the “Prep” push-button.

4.4 FOCAL SPOTS CONFIGURATION

This configuration determines the smallest mA station for the Large Focal Spot. All mA stations may be assigned to either Small or Large Focal Spot.

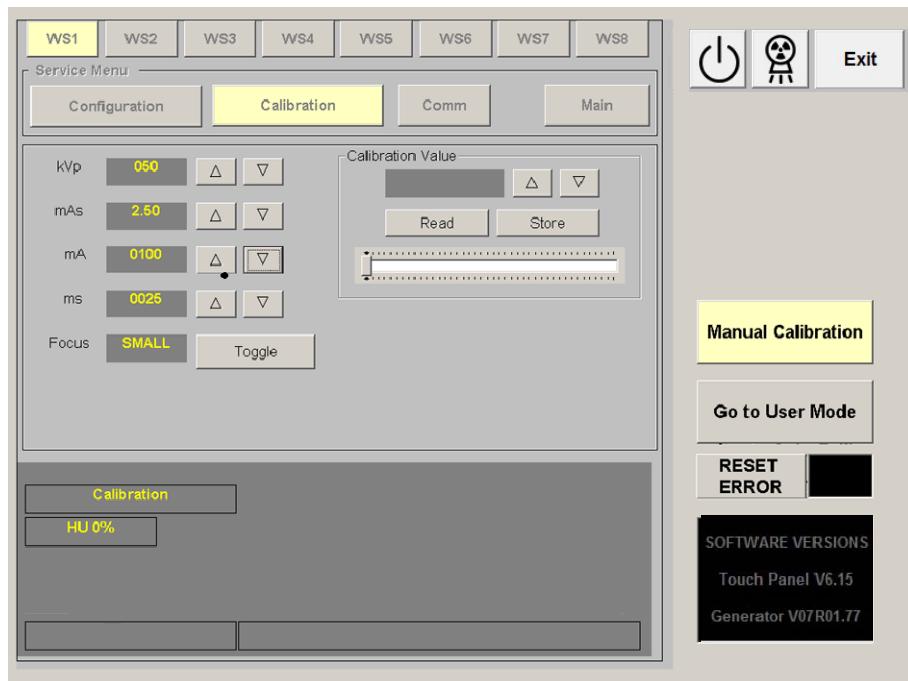
The smallest mA station for the Large Focal Spot must be selected according to the Tube ratings for the Small Filament and customer preferences.



**IF THE mA STATION FOR FOCAL SPOT CHANGE IS NOT
CONFIGURED ACCORDING TO THE X-RAY TUBE RATINGS,
THE TUBE FILAMENTS MAY BE PERMANENTLY DAMAGED.**

1. Enter in calibration mode by pressing the “*Manual Calibration*” button on the GSM program. Select any workstation (WS) of the corresponding X-ray Tube and press the “OK” button.

Illustration 4-1
Focal Spots Configuration



2. Select the smallest mA station for the Large Focal Spot using the “Increase” or “Decrease” mA buttons. When required to configure all mA stations for the Small Focal Spot, select “E01” Memory Location.

Note 

Default value is factory set at 200 mA except when using X-ray Tubes with Small Focal Spot smaller than 0.6 .

3. Press the “Toggle” button to store the select mA station and then press the “Confirm” or “Dismiss” buttons to confirm or cancel the process. When it is confirmed, the ATP Console CPU Board emits a “double-beep”.



IF THE FOCAL SPOT SWITCH-OVER POINT IS CHANGED AFTER mA CALIBRATION, THE mA STATIONS AFFECTED MUST BE RE-CALIBRATED.

4. Exit from calibration mode.

Perform the following test (*it is not mandatory*).

Note 

Select a “Direct” workstation and a mA station for the Small Filament. Press “Prep” and observe through the X-ray Tube window that the Small Filament lights more than the Large Filament.

1. Select the highest mA station for the Small Focal Spot. Verify that effectively the Small Filament is ON (lighted) and the Large Filament is OFF. Observe filaments through the X-ray Tube window.
2. Select the lowest mA station for the Large Focal Spot. Verify that effectively the Large Filament is ON (lighted) and the Small Filament is OFF. Observe filaments through the X-ray Tube window.

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SECTION 5 CALIBRATION

This Calibration Section provides information and procedures to perform all the adjustments required to establish an optimal performance of this Generator; provided that the Configuration procedures have been correctly carried out.



Calibrate the Generator immediately after Configuration is completed.

Calibration data is entered digitally and stored in a non-volatile memory chip (U3-EEPROM) on the HT Controller Board, thus no battery back-up is required.

Note

Calibration procedures must be performed in the order listed in this document. Perform only the sections required to calibrate this unit.

Note

Enter in the GSM Program for Calibration procedures as described in the Section 2.3 "Generator Service Mode (GSM)"

Calibration data should be stored in the Extended Memory Locations as described in Section 3.2 of "How to Enter and Store Data in the Extended Memory".

Record all Calibration data in the Data Book.

Before calibration, bear in mind that:

- To calibrate and measure the kVp, a Non-Invasive kVp Meter is necessary. This Meter is placed in the X-ray beam.
- To calibrate and measure mA or mAs, an mAs Meter should be plugged into the banana connections on the HV Transformer (connect the mAs Meter for Digital mA Loops calibration).

Note

Test points on the HT Controller Board can be used to monitor (with a scope) the kV and mA readings but should not be used for calibration:

mA test point is TP-5 and the scale factor is:

- from 10 to 80 mA, 1 volt = 10 mA
- from 100 mA, 1 volt = 100 mA

*kV test point is TP-7 and the scale factor is 1 volt = 33.3 kV
(0.3 volt = 10 kV)*

- Verify that dip switch SW7 “*Calib. ON/OFF*” in “**On**” position to permit the Service mode (refer to *Illustration 2-2*).
- Verify position of dip switches on the HT Controller Board during every calibration procedure:

DIP SWITCH	OPEN (OFF)	CLOSED (ON)
3000SW2-2	Position during operation – Enables Filament and Rotor Interlocks	Disables Filament and Rotor Interlocks (this turns off the filament so no radiation will be produced during the exposure).
3000SW2-4	Position during operation – Digital mA Loop Closed	Digital mA Loop Open / Filament Current Constant

Note 

- When the Digital mA Loop is open (dip switch 3000SW2-4 in “**On**”), the rotor runs for two minutes after releasing the handswitch button from “Preparation” position. After this time the rotor will brake (unless DC Brake is removed).

- When the Digital mA Loop is closed (dip switch 3000SW2-4 in “**Off**”), the rotor will brake after releasing the handswitch button from “Preparation” position (unless DC Brake is removed).

- Be sure that X-ray Tube configured in E02 Memory Location corresponds with the installed X-ray Tube.

5.1 FILAMENT STANDBY CURRENT

Note 

The Filament Standby value is auto-calibrated by the Generator and automatically stored in the E01 Memory Location. Filament Standby values cannot be modified in the field.

5.2 EXPOSURE TIME ADJUSTMENT

The values stored in these Extended Memory Locations only affect to Exposure Times for techniques below 20 ms. The Memory Locations which affect short exposure times are:

FUNCTION	MEMORY LOCATION
	TUBE-1
EXPOSURE TIME ADJUSTMENT - DELAY	E13
EXPOSURE TIME ADJUSTMENT - Ceq kV	E15

The Generator has been optimized at the factory to produce correct exposures at the lower times (<20 ms.) Therefore **do not change** the value factory set for E13 Memory Location and only adjust the value for E15 Memory Location according to the HV Cables length.

The Exposure Time adjustment is calibrated by performing the following steps:

1. Enter in calibration mode by pressing the “*Manual Calibration*” button on the GSM Program. Select an available workstation (WS) and press the “OK” button.
2. Select the E13 Memory Location. Value in this Memory Location adjusts the time delay of the exposure. It is factory set for a value of 17, 18 or 19 (*default value is “18”*). Only read this value, **do not change it**.
3. Select the E15 Memory Location. Value in this Memory Location is set in relation to the length in meters of one of the HV Cables (1 ft = 0.3048 m). Verify the HV Cable length in meters and set the following value:

HV CABLE LENGTH	VALUE TO SET IN MEMORY
4 m	27
6 m	31
9 m	38
12 m	45
14 m	49
16 m	54
For another HV Cable length	$\text{value} = (2.2711 \times \text{cables length}) + 17.744$

4. Store the value of each Memory Location by pressing the “*Store*” button of the calibration panel.
5. Exit from calibration mode and record the new values in the Data Book.

5.3 KV LOOP

Extended Memory Location E06 contains the calibration factor for kV Loop. Each number above or below of the indicated in the E06 memory location increases or decreases respectively the kV gain value.

Note 

*Value in E06 Memory Location is only related to the Generator performance (it is not related to the X-ray Tube or another components installed), so value in **this Memory Location is factory adjusted**. Only perform this procedure if the HT Controller Board and/or HV Transformer have been replaced in the unit.*

The kV Gain for kV Loop can be manually calibrated with a Non-Invasive kV Meter (recommended procedure) or Auto-calibrated with HV Bleeder.

Manual Calibration of E06 Memory Location

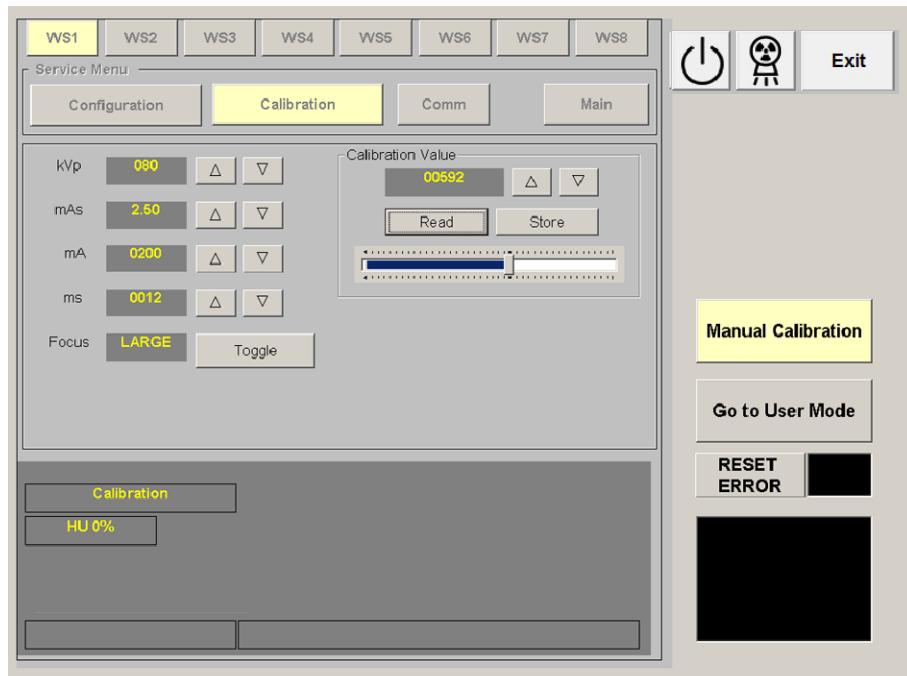
1. With the Generator power OFF:
 - Set Dip switch 3000SW2-2 on the HT Controller Board in “**Off**” position (enables Filament and Rotor Interlocks).
 - Set Dip switch 3000SW2-4 on the HT Controller Board in “**On**” position (Digital mA Loop Open / Filament Current Constant).
 - Remove the link between the banana plug connections on the HV Transformer. Connect the mAs Meter to the banana plug connections to measure mA or mAs.
 - Place and center a Non-Invasive kVp Meter on the X-ray Tube output at the required SID (*refer to the Non-Invasive kVp Meter documentation*).
2. Enter in calibration mode by pressing the “*Manual Calibration*” button on the GSM Program. Select an available workstation (WS) and press the “*OK*” button.
3. Select the E06 Memory Location and read the calibration value by pressing the “*Read*” button. Enter the value “**200**” and store it by pressing the “*Store*” button.

4. Calibrate manually the Filament Current Number for 80 kV / 200 mA combination, as indicated in the following steps (*if it has not been previously calibrated*).

In calibration mode, Filament Current Numbers are shown on the calibration panel by pressing the “Read” button after selecting the respective kV / mA combination. They can be changed by pressing the “Increase” and “Decrease” buttons and stored by pressing the “Store” button of the calibration panel.

Select 80 kV, 200 mA, Large Focus. Enter the value “344” as Filament Current Number (calibration value) and press the “Store” button. Make an exposure with these parameters. The mAs read on the mAs Meter must be the same mAs displayed on the calibration screen with a tolerance of ± 0.1 mAs (tolerance of the parameter and mAs Meter).

If the mAs is low, increase the filament number. If the mA is high (or “Generator Overload” Error is shown), decrease the filament number. Press the “Store” button before making a new exposure. Repeat until the mAs read is correct and the mA station is calibrated.



5. Enter in user mode inside calibration mode by pressing the “*Go to User Mode*” button.
6. Select: RAD Menu, 80 kV, 200 mA, 100 ms and Large Focus. Make an exposure and note the kV value at the end of the exposure.



7. If calibration of the kV Loop is correct (80 ± 1 kV), record value “**200**” in the Data Book.
8. If calibration of the kV Loop is not correct:
 - a. Exit from the “*User Mode*” screen by pressing the “*Manual Calibration*” button. Select the E06 Memory Location. Press the “*Read*” button to read the value stored.
 - b. Increase or decrease the value to increase or decrease the kV respectively. Enter the new value and store it by pressing the “*Store*” button.
 - c. Exit calibration mode and repeat the exposure (*steps 5 and 6*) to determine if the new value has had the proper effect, if not repeat step-8.
 - d. When it is correct, record the new value for E06 Memory Location in the Data Book.
9. After calibration of E06 Memory Location, remove the Non-Invasive kVp Meter.

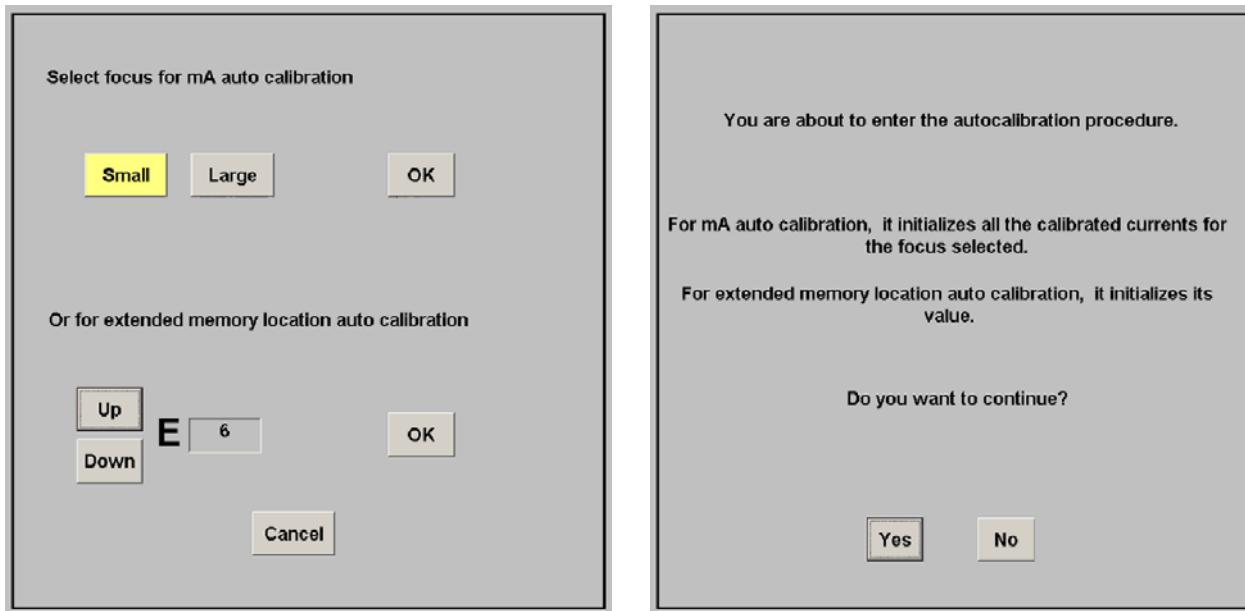
Auto-Calibration of E06 Memory Location

1. With the Generator power OFF:

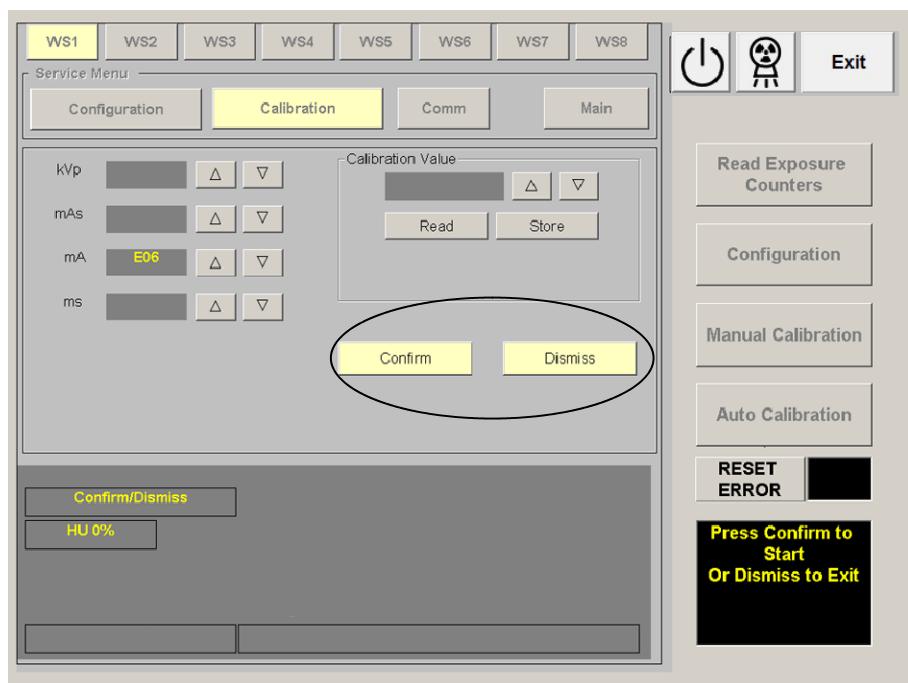
- Set Dip switch 3000SW2-2 on the HT Controller Board in “**On**” position (disables Filament and Rotor Interlocks).
- Remove the HV Cables from the X-ray Tube and connect them to the HV Bleeder, then connect a short couple of HV Cables from the HV Bleeder to the X-ray Tube.

2. Enter in Auto-calibration mode by pressing the “*Auto Calibration*” button on the GSM menu. Select an available workstation (WS) and press the “*OK*” button. Then, select the E06 Memory Location and press the “*OK*” button.

Confirm or leave the Auto-calibration by pressing the respective button (“*Yes*” or “*No*”) on the new screen.



Confirm or leave the Auto-calibration (second confirmation) by pressing the respective button (“*Confirm*” or “*Dismiss*”) on the calibration screen.



Auto-calibration is activated when the “*Auto Calibration*” button is lighted and the “*Press Prep and Expose*” message appears on the screen.

3. Make an exposure (technique parameters are pre-programmed at 100 kV, 200 mA and 32 ms and they can be shown when pressing the “*Prep*” button).
4. Read the kVp measured with the HV Bleeder and enter this value on the kV Display by pressing the “*kV Increase*” or “*kV Decrease*” buttons.
5. Exit from Auto-calibration mode pressing the “*Auto Calibration*” button. At this moment, the Generator will calculate and store the new value in E06 Memory Location. Auto-calibration is deactivated and the process is finished when the screen shows the GSM menu.
6. Press the “*Manual Calibration*” button. Select an available workstation (WS) and press the “*OK*” button. Then, select the E06 Memory Location and read its new value on the Calibration Display. Record this value in the Data Book.
7. Exit calibration mode.
8. After calibration of E06 Memory Location:
 - Switch the Generator power OFF.
 - Remove the HV Bleeder and connect the HV Cables from the Generator directly to the X-ray Tube.

5.4 DIGITAL mA LOOP CLOSED

Extended Memory Locations E03 and E05 contain the calibration factor for Digital mA Loop Closed. Each number above or below the indicated in the Memory Locations increases or decreases respectively the mA gain value.

Note 

*Values in E03 and E05 Memory Locations are only related to the Generator performance (they are not related to the X-ray Tube installed), so values in **these Memory Locations are factory adjusted**. Only perform this procedure if the HT Controller Board and/or HV Transformer have been replaced in the unit.*

The mA Gain for Digital mA Loop Closed is calibrated by performing the following steps:

1. With the Generator power OFF, set:
 - Dip switch 3000SW2-2 on the HT Controller Board in “**Off**” position (enables Filament and Rotor Interlocks).
 - Dip switch 3000SW2-4 on the HT Controller Board in “**On**” position (Digital mA Loop Open / Filament Current Constant).
 - Remove the link between the banana plug connections on the HV Transformer. Connect the mAs Meter to the banana plug connections to measure mA or mAs.
2. Calibration of E03 and E05 Memory Locations is performed by means of the “*Auto Calibration*” menu.



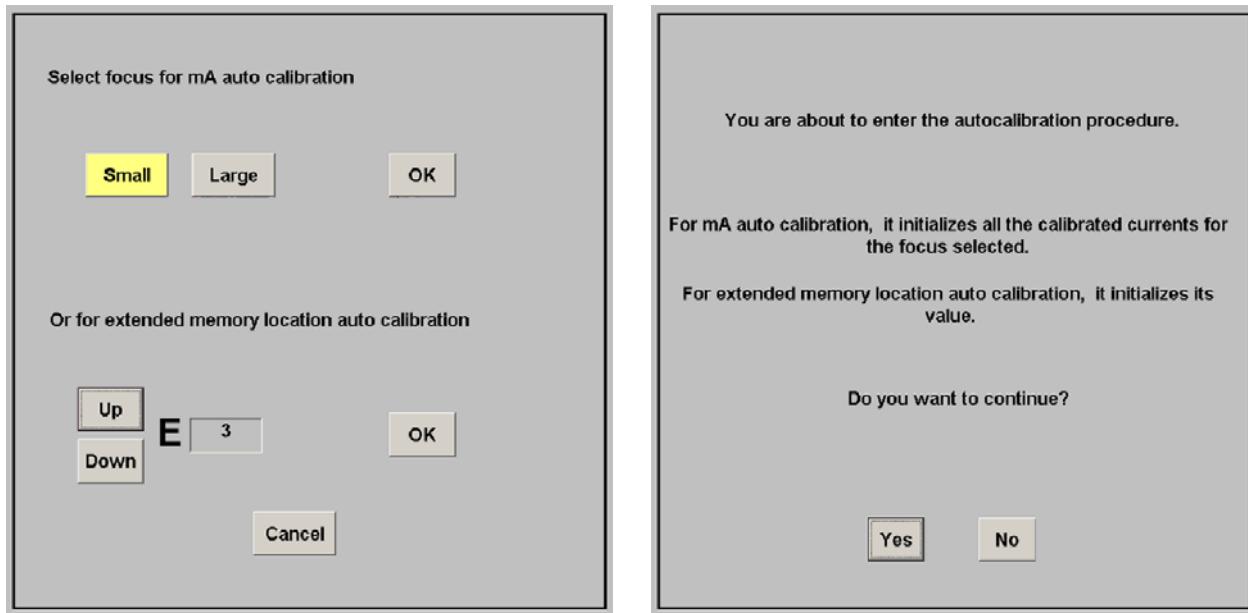
EACH TIME THAT AUTO-CALIBRATION IS ACTIVATED IN ONE OF THESE MEMORY LOCATIONS, CALIBRATION DATA STORED FOR THIS MEMORY LOCATION IS DELETED AND A NEW CALIBRATION FOR IT WILL BE REQUIRED.

HF Series Generators

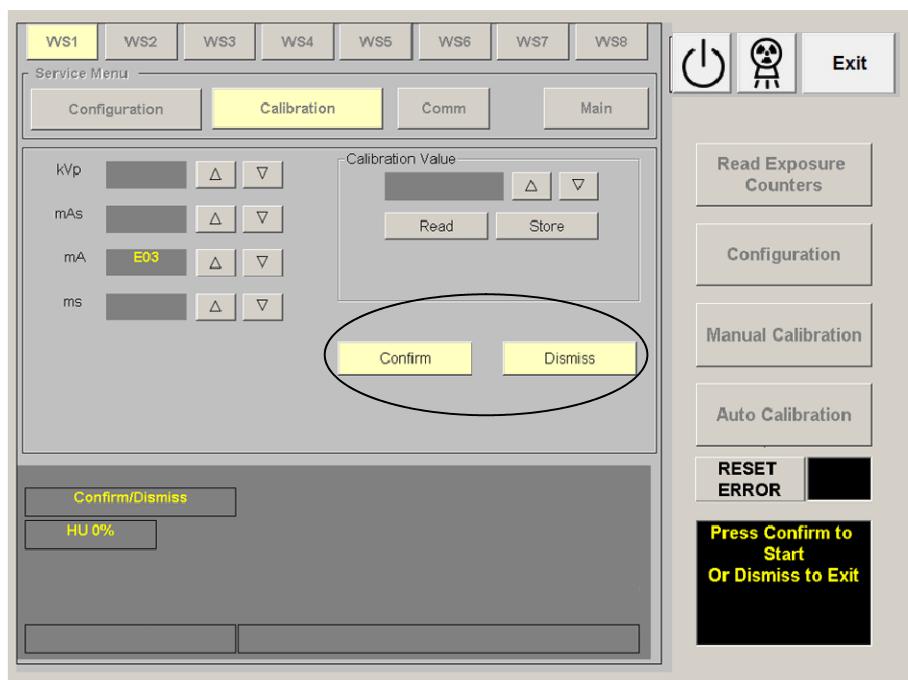
Configuration and Calibration

3. Enter in Auto-calibration mode by pressing the “Auto Calibration” button on the GSM menu. Select an available workstation (WS) and press the “OK” button. Then, select the respective Memory Location (E03 or E05) and press the “OK” button.

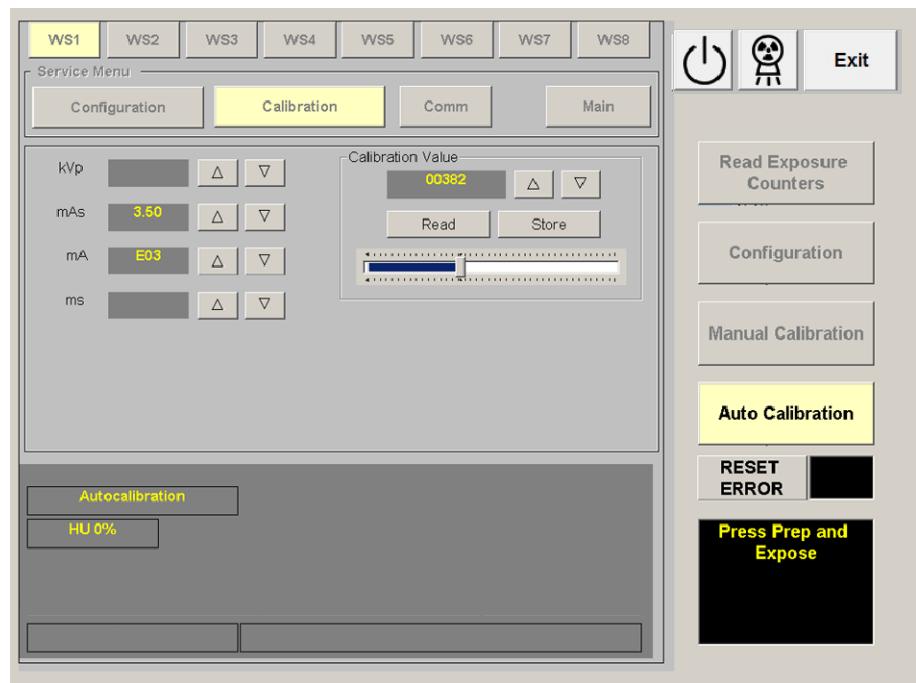
Confirm or leave the Auto-calibration by pressing the respective button (“Yes” or “No”) on the new screen.



Confirm or leave the Auto-calibration (second confirmation) by pressing the respective button (“Confirm” or “Dismiss”) on the calibration screen.



Auto-calibration is activated when the “Auto Calibration” button is lighted and the “Press Prep and Expose” message appears on the screen.



4. Calibrate E03 and E05 Memory Locations as described in the following pages.

For Low mA stations (from 10 mA to 80 mA) (E03 Memory Location):

1. Enter in Auto-calibration mode by pressing the “*Auto Calibration*” button on the GSM menu and select the E03 Memory Location. Confirm all the following screens.
2. When Auto-calibration is activated, “*Auto Calibration*” button is lighted and the “3.5 mAs” value is shown on the screen.
3. Perform the following steps:
 - a. Make an exposure (technique parameters are pre-programmed at 80 kV, 32 mA and 100 ms and they can be shown when pressing the “*Prep*” button).
 - b. Read the mAs measured on the mAs Meter.
 - c. Read the Filament Current Number shown on the calibration panel.
 - d. Increase or decrease the Filament Current Number (by pressing the “*Increase*” or “*Decrease*” buttons) to determine the correction needed to obtain a value between 3.00 and 4.00 mAs in the mAs Meter after making a new exposure.
 - e. Repeat the above steps until a proper mAs value is obtained in the mAs Meter.
4. Enter the mAs value read in the mAs Meter (it must be a value between 3.00 and 4.00 mAs) in the mAs Display pressing the “*mAs Increase*” or “*mAs Decrease*” buttons.
5. Exit from Auto-calibration mode pressing the “*Auto Calibration*” button. At this moment, the Generator will calculate and store the new value in E03 Memory Location. Auto-calibration is deactivated and the process is finished when the screen shows the GSM menu.
6. Press the “*Manual Calibration*” button. Select an available workstation (WS) and press the “OK” button. Then, select the E03 Memory Location and read its new value on the Calibration Display. Record this value in the Data Book.
7. Exit calibration mode.

For High mA stations (from 100 mA) (E05 Memory Location):

1. Enter in Auto-calibration mode by pressing the “*Auto Calibration*” button on the GSM menu and select the E05 Memory Location. Confirm all the following screens.
2. When Auto-calibration is activated, “*Auto Calibration*” button is lighted and the “*7.75 mAs*” value is shown on the screen.
3. Perform the following steps:
 - a. Make an exposure (technique parameters are pre-programmed at 80 kV, 125 mA and 64 ms (or 63 ms or 65 ms depending on Generator) and they can be shown when pressing the “*Prep*” button).
 - b. Read the mAs measured on the mAs Meter.
 - c. Read the Filament Current Number shown on the calibration panel.
 - d. Increase or decrease the Filament Current Number (by pressing the “*Increase*” or “*Decrease*” buttons) to determine the correction needed to obtain a value between 7.00 and 8.50 mAs in the mAs Meter after making a new exposure.
 - e. Repeat the above steps until a proper mAs value is obtained in the mAs Meter.
4. Enter the mAs value read in the mAs Meter (it must be a value between 7.00 and 8.50 mAs) in the mAs Display pressing the “*mAs Increase*” or “*mAs Decrease*” buttons.
5. Exit from Auto-calibration mode pressing the “*Auto Calibration*” button. At this moment, the Generator will calculate and store the new value in E05 Memory Location. Auto-calibration is deactivated and the process is finished when the screen shows the GSM menu.
6. Press the “*Manual Calibration*” button. Select an available workstation (WS) and press the “*OK*” button. Then, select the E05 Memory Location and read its new value on the Calibration Display. Record this value in the Data Book.
7. Exit calibration mode.
8. After calibration of E03 and E05 Memory Locations:
 - Switch the Generator power OFF.
 - Disconnect the mAs Meter to the banana plug connections.
 - Re-install the link between the banana plug connections on the HV Transformer.

5.5 DIGITAL mA LOOP OPEN (X-RAY TUBE CALIBRATION)

To achieve the most accurate calibration, **this procedure has to be automatically performed by the Generator (Auto-calibration)**. Calibration procedure will be manually performed by the field engineer only if Auto-calibration is not possible.

Two different methods are described in this section: Auto-calibration and Manual Calibration.

Digital mA Loop Open is calibrated by performing the following steps:

1. With the Generator power OFF, set:
 - Dip switch 3000SW2-2 on the HT Controller Board in “**Off**” position (enables Filament and Rotor Interlocks).
 - Dip switch 3000SW2-4 on the HT Controller Board in “**On**” position (Digital mA Loop Open / Filament Current Constant).
2. Turn the Generator ON.
3. Perform the Auto-calibration procedure as described in Section 5.5.1.

5.5.1 AUTO-CALIBRATION OF DIGITAL mA LOOP OPEN

Auto-calibration of the Filament Current Numbers is divided in two separated procedures related to the mA stations configured for the Small or Large Focal Spots.

It is recommended to start with the Small Focal Spot (first group) and continue with the Large Focal Spot (second group).

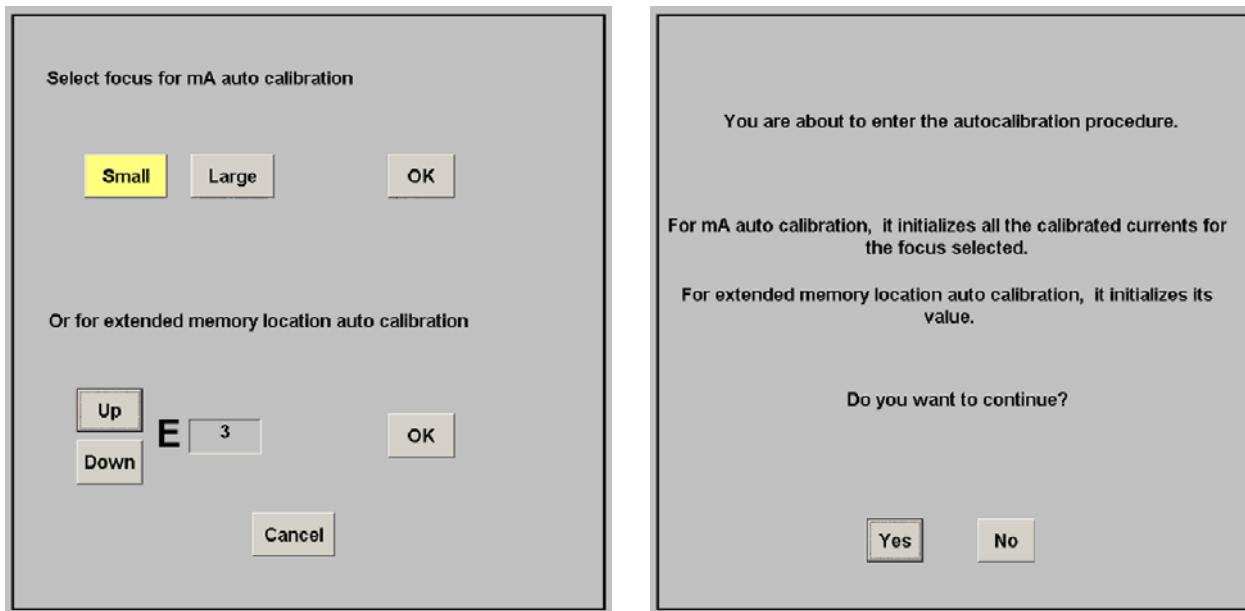


EACH TIME THAT AUTO-CALIBRATION IS STARTED FOR THE SMALL OR LARGE FOCAL SPOT, ALL CALIBRATION DATA STORED FOR THE FILAMENT CURRENT NUMBERS OF THE SELECTED FOCAL SPOT ARE AUTOMATICALLY SET TO “344”. SO A NEW COMPLETE CALIBRATION OF THE FILAMENT CURRENT NUMBERS FOR THIS FOCAL SPOT WILL BE REQUIRED.

Auto-calibration starts with the minimum available mA station for the selected Focal Spot at 50 kV and follows with the other combinations of mA stations for the selected Focal Spot at 80 kV, 120 kV and 40 kV.

1. Enter in Auto-calibration mode by pressing the “*Auto Calibration*” button on the GSM menu.
2. Select an available workstation (WS) of the X-ray Tube to be calibrated and press the “*OK*” button. This workstation has to be one of the previously configured as “*Direct*”.
3. Select the **Small Focal Spot** by pressing the “*Small*” button and then press the “*OK*” button.

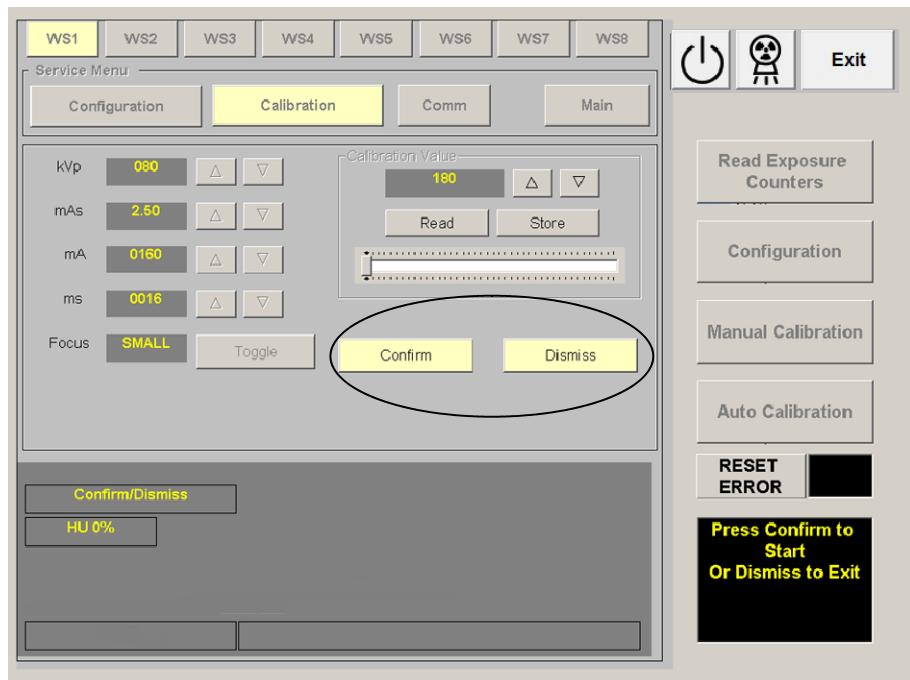
Confirm or leave the Auto-calibration by pressing the respective button (“*Yes*” or “*No*”) on the new screen.



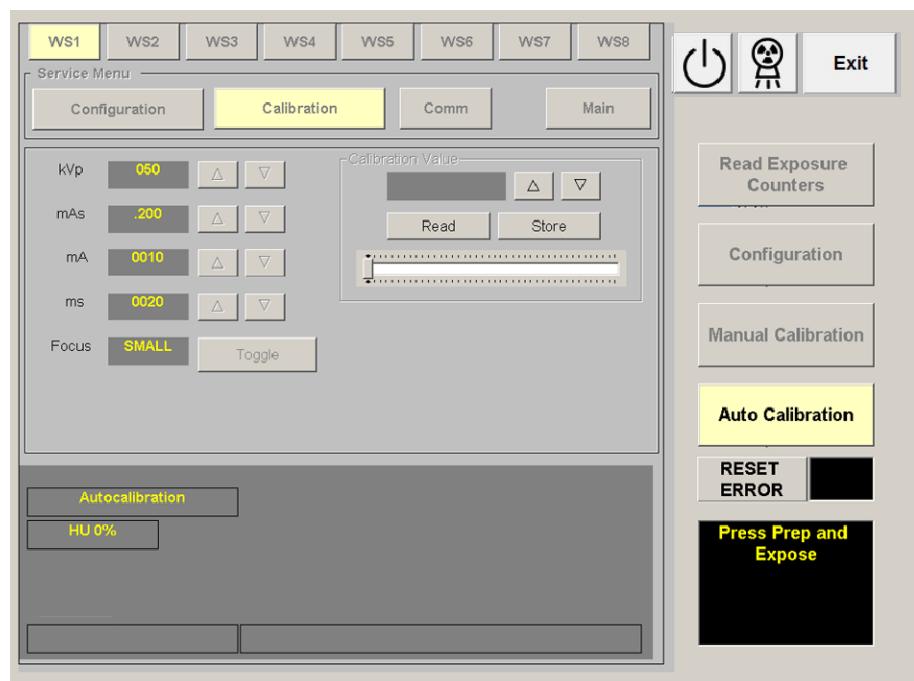
HF Series Generators

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4. Confirm or leave the Auto-calibration (second confirmation) by pressing the respective button ("Confirm" or "Dismiss") on the calibration screen.



5. Auto-calibration is activated when the "Auto Calibration" button is lighted and the "Press Prep and Expose" message appears on the screen. At this moment, the Generator has checked the mA stations available for the **Small Focal Spot**.



6. Check that the Heat Units capacity available for the X-ray Tube is 100% or nearly (HU 0% displayed on the screen).



**BEFORE MAKING ANY EXPOSURE IN AUTO-CALIBRATION,
VERIFY THAT THE LINK BETWEEN THE BANANA PLUG
CONNECTIONS ON THE HV TRANSFORMER IS INSTALLED.**

7. Keep fully pressed the Handswitch button to perform continuous exposures.

Note

In Auto-calibration mode, all technique parameters are factory pre-programmed and they can not be changed.



Auto-calibration can be paused momentarily releasing the Handswitch button, whenever there is not an exposure in process. Do not exit from Auto-calibration before the procedure has been completed.

Note

Auto-calibration can be cancelled by pressing the "Auto Calibration" button. A message on the screen informs that Auto-calibration has been cancelled and after a while the screen shows the GSM menu.

If during Auto-calibration process, any error indication is shown momentarily (such as "Tube Overload", etc.), it means that Generator can not calibrate in this moment the selected kV / mA combination (because anode overheated, space charge, Generator power limit, etc.). In this case, the Generator will continue with Auto-calibration of the following available kV / mA combinations for the selected Focal Spot. At the end of the process it will try to calibrate or calculate the combinations previously uncalibrated.

If the Heat Units value displayed is more than 60%, exposures are inhibited momentarily and message "Tube too hot" is shown on the screen. This message will disappear and exposures can be made again when the X-ray Tube begins to cool and recovers the Heat Units capacity.

At this point, it is recommended to wait until the Heat Units value displayed are close to the 20% before making any exposure.

Generator tries to calibrate each kV / mA combination for ten (10) attempts (maximum). If calibration is cancelled (after ten attempts), message “*Auto calibration failure*” is shown on the screen until press the “*Auto Calibration*” button to exit from Auto-calibration mode and go back to the GSM menu. Calibration can be also cancelled due to space charge during calibration of the lowest kV at the highest mA stations for the Focal Spot selected, so message “*Auto calibration failure*” is also shown on the screen until press the “*Auto Calibration*” button to exit from Auto-calibration mode and go back to the GSM menu.



ONLY IF AUTO-CALIBRATION IS CANCELLED DUE TO “*AUTO CALIBRATION FAILURE*”, CONTINUE THE AUTO-CALIBRATION PROCEDURE FOR THE OTHER FOCAL SPOT. CHECK AT THE END OF THE AUTO-CALIBRATION PROCEDURE WHICH kV / mA COMBINATIONS HAVE NOT BEEN AUTO-CALIBRATED FOR EACH FOCAL SPOT (THESE COMBINATIONS HAVE THE FILAMENT CURRENT NUMBER SET TO “344”). MANUALLY CALIBRATE THESE kV / mA COMBINATIONS AS EXPLAIN IN SECTION 5.5.2.

When Auto-calibration is successfully performed, message “*Auto Calibration OK*” is shown on the screen until press the “*Auto Calibration*” button to exit from Auto-calibration mode and go back to the GSM menu.

8. Repeat the same procedure for the **Large Focal Spot**.

Enter in Auto-calibration mode by pressing the “*Auto Calibration*” button on the GSM menu.

Select an available workstation (WS) of the X-ray Tube to be calibrated and press the “*OK*” button. This workstation has to be one of the previously configured as “*Direct*”.

Select the **Large Focal Spot** by pressing the “*Large*” button and then press the “*OK*” button.

Confirm or leave the Auto-calibration by pressing the respective button on each screen.

Auto-calibration is activated when the “*Auto Calibration*” button is lighted. At this moment, the Generator has checked the mA stations available for the **Large Focal Spot**.

Before starting the exposures, it is recommended to wait until the Heat Units value displayed are close to the 20%.

9. After performing both procedures (for Small and Large Focal Spots), enter in “*Manual Calibration*” mode and select each combination of the available mA stations for each Focal Spot at the kV break points (40, 50, 80 and 120 kV). Press the “*Read*” button to read on the calibration panel the new value of the Filament Current Number stored for each combination and record the new values in the Data Book.

Note that the highest mA station for Small Focal Spot may have numbers larger than the lowest mA station for Large Focal Spot. This is normal.

10. Exit from calibration mode.
11. **Turn the Generator power OFF and set Dip Switch 3000SW2-4 on the HT Controller Board in “Off” position (Digital mA Loop Closed).**

5.5.2 MANUAL CALIBRATION OF DIGITAL mA LOOP OPEN

This procedure describes the Manual calibration of all the Filament Current Numbers. It has to be also used to calibrate the kV / mA combinations not performed during Auto-calibration procedure because it has not been completed. These combinations have the Filament Current Number set to “344”, so only these combinations have to be manually calibrated as described in this procedure. If Auto-calibration for one of the Focal Spots has been successful, it is only required to perform the manual calibration of the mA station do not calibrate for the other Focal Spot.

Manual Calibration is initiated at the 80 kV break point by entering the appropriate Filament Current Number for the proper Tube current at each selectable mA. Calibration at the other kV break points (40, 50, 80 and 120 kV) are obtained by adding or subtracting values as indicated in Table 5-1.

Although the suggested values (Table 5-1) could change depending on the X-ray Tube used, entering those values will approximate accurate calibration without making excessive exposures.

In “*Manual Calibration*” mode, the Filament Current Numbers are shown on the calibration panel by pressing the “*Read*” button after selecting the respective kV / mA combination. The value can be changed by pressing the “*Increase*” or “*Decrease*” buttons of the calibration panel and stored by pressing the “*Store*” button.

Note that in calibration mode, only the mA stations and kV (at the break points) can be selected.

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Table 5-1
mA Calibration Numbers Change

mA STATION	FILAMENT CURRENT NUMBERS AT KV BREAK POINT			
	40	50	80	120
10	A ₁₁₊₇	A ₁₁₊₆	A ₁₁	A ₁₁₋₅
12.5	A ₁₂₊₇	A ₁₂₊₆	A ₁₂	A ₁₂₋₅
16	A ₁₃₊₇	A ₁₃₊₆	A ₁₃	A ₁₃₋₅
20	A ₁₄₊₇	A ₁₄₊₆	A ₁₄	A ₁₄₋₅
25	A ₁₅₊₇	A ₁₅₊₆	A ₁₅	A ₁₅₋₅
32	A ₁₆₊₇	A ₁₆₊₆	A ₁₆	A ₁₆₋₅
40	A ₁₇₊₇	A ₁₇₊₆	A ₁₇	A ₁₇₋₅
50	A ₁₈₊₇	A ₁₈₊₆	A ₁₈	A ₁₈₋₅
64	A ₁₉₊₇	A ₁₉₊₆	A ₁₉	A ₁₉₋₅
80	A ₂₀₊₇	A ₂₀₊₆	A ₂₀	A ₂₀₋₅
100	A ₂₁₊₁₀	A ₂₁₊₈	A ₂₁	A ₂₁₋₇
125	A ₂₂₊₁₀	A ₂₂₊₈	A ₂₂	A ₂₂₋₇
160	A ₂₃₊₁₀	A ₂₃₊₈	A ₂₃	A ₂₃₋₇
200	A ₂₄₊₁₀	A ₂₄₊₈	A ₂₄	A ₂₄₋₇
250	A ₂₅₊₁₀	A ₂₅₊₈	A ₂₅	A ₂₅₋₇
320	A ₂₆₊₁₄	A ₂₆₊₁₁	A ₂₆	A ₂₆₋₉
400	A ₂₇₊₁₄	A ₂₇₊₁₁	A ₂₇	A ₂₇₋₉
500	A ₂₈₊₁₄	A ₂₈₊₁₁	A ₂₈	A ₂₈₋₉

Note.- The mA station values depends on the Generator model. Some models do not contain all the mA stations listed above.

1. With the Generator power OFF, set:
 - Dip switch 3000SW2-2 on the HT Controller Board in “*Off*” position (enables Filament and Rotor Interlocks).
 - Dip switch 3000SW2-4 on the HT Controller Board in “*On*” position (Digital mA Loop Open / Filament Current Constant).
 - Remove the link between the banana plug connections on the HV Transformer. Connect the mAs Meter to the banana plug connections to measure mA or mAs.
2. Turn the Generator ON and enter in calibration mode by pressing the “*Manual Calibration*” button on the GSM menu.
3. Select an available workstation (WS) of the X-ray Tube to be calibrated and press the “*OK*” button. This workstation has to be one of the previously configured as “*Direct*”.
4. Check that the Heat Units available for the X-ray Tube is 100% or nearly (HU 0% displayed on the screen).
5. Accordingly to X-ray Tube ratings or maximum Generator power, check which kV / mA combinations in Table 5-1 are allowed.

If error “*Tube Overload*” is shown after selection of a kV / mA combination, it means this combination is not allowed for the selected X-ray Tube.

In calibration mode, if Generator power is exceeded by a kV / mA combination selection, error “*E-16*” is shown after “*Preparation*”. Reset this error by pressing the “*Reset Error*” button.

Note which combinations in Table 5-1 can not be calibrated by making exposures (combinations not allowed due to Tube rating, maximum Generator power, space charge, etc.) and the Exposure Time assigned to these combinations in calibration mode.

6. Enter in user mode inside calibration mode by pressing the “*Go to User Mode*” button. Select the mA station and Exposure Time of each kV / mA combination not allowed. Increase or decrease the kV value as required to determine the kV value allowed nearest to the kV value of the combination. Note the kV value allowed in the respective cell of Table 5-1.

7. Exit from the “User Mode” screen by pressing the “Manual Calibration” button. Select 80 kV and lowest mA station available (first combination available). Enter a Filament Number of “344” for this combination.
8. Make an exposure. The mAs read on the mAs Meter must be the same mAs displayed on the calibration screen with a tolerance of ± 0.1 mAs (tolerance of the parameter and mAs Meter). If the mAs read is close to zero, increase the filament number in big steps (a.e. increase values in 40). As the mAs read is close to the mAs displayed on the Console, increase (or reduce) the filament number in smaller steps (a.e. increase value in 30, 20, 10, ...).

If the mAs is low, increase the filament number. If the mA is high, decrease the filament number. Press the “Store” button before making a new exposure. Repeat until the mA station is calibrated.

Note 

Press the “Store” button to store the new data (filament number) before selecting the next kV or mA stations.



Calibration data (presently in memory) may or may not be close to your requirements. If it is not close, the potential exists to damage the X-ray Tube (i.e. too much mA). Thus, as you start the mA calibration procedure note how close or how far off the mA break points are. If a large adjustment (more than 40 points) is required at the low mA stations, make estimated adjustments to the high mA stations before those exposures are made.

9. Select the next mA station at 80 kV. Before making any exposure, enter as filament number the value calibrated for the previous mA station increased in 10.

If the mAs is low, increase the filament number. If the mA is high, decrease the filament number. Press the “Store” button before making a new exposure. Repeat until the mA station is calibrated.

10. Complete the calibration process for all mA stations at 80 kV as described before. When select the first mA station for the Large Focal Spot, enter as a filament number the value calibrated for the first mA station for the Small Focal Spot. Note that the highest mA station for Small Focal Spot may have numbers larger than the lowest mA station for Large Focal Spot. This is normal.

Press the “Read” button to read on the calibration panel the new value of the Filament Current Number stored for each mA station at 80 kV. Record the new values in the Data Book.

11. Complete the calibration process for the remaining kV / mA combinations using Table 5-1 as a guide. It is not necessary to make exposures to do this. Compute the value for all the kV break points of each available mA station although the Generator power can not reach all the kV / mA combinations. Select the corresponding kV / mA combination and enter the computed value.
12. Check calibration at all break points (making exposures) and correct any calibration points as needed.

Note 

If “Tube Overload” error is shown directly after selection of an allowed combination (refer to step-5.), wait until the X-ray Tube anode cools down to permit the calibration of the mA station.

13. Recalculate the values of the non-allowed combinations in accordance to the new values obtained by exposures. (*Refer to Table 5-1*).
14. Enter in user mode inside calibration mode by pressing the “Go to User Mode” button. Select the mA station, Exposure Time and kV value noted for each kV / mA combination not allowed (*refer to step-6*.). Check calibration at these kV / mA combinations by making exposures. If needed, enter in calibration mode and correct the Filament Current Number of the respective kV / mA combination not allowed.

15. Exit from the “*User Mode*” screen by pressing the “Manual Calibration” button. In calibration mode, select each combination of the available mA stations at the kV break points (40, 50, 80 and 120 kV). Press the “Read” button to read on the kV Display the new value of the Filament Current Number stored for each combination. Record the new values in the Data Book.

Note that the highest mA station for Small Focal Spot may have numbers larger than the lowest mA station for Large Focal Spot. This is normal.

16. Exit calibration mode.
17. After calibration of Filament Current Numbers:
 - Switch the Generator power OFF.
 - Disconnect the mAs Meter to the banana plug connections.
 - Re-install the link between the banana plug connections on the HV Transformer.
 - **Set Dip Switch 3000SW2-4 on the HT Controller Board in “Off” position (Digital mA Loop Closed).**

5.6 FINAL CHECKS

Verify that all Configuration and Calibration data have been properly stored in memory.

1. Enter in calibration mode and check that the values noted for the “*Filament Current Numbers*” and “*Extended Memory Locations*” tables of the Data Book are the same that the values displayed and stored in memory. Press the “*Read*” button to read the stored values.
2. Exit from calibration mode and Service mode.
3. Turn the Generator OFF and verify position of dip switches on the HT Controller Board are:
 - Dip switch 3000SW2-2 in “*Off*” position (enables Filament and Rotor Interlocks).
 - Dip switch 3000SW2-4 in “*Off*” position (Digital mA Loop Closed).
4. Set switch SW7 “*Calib. ON/OFF*” in “*Off*” position to place the Generator in Application mode.

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SECTION 6**X-RAY TUBE DATA**

The following table lists several common X-ray Tubes and their corresponding number. If a specific Tube is not listed, Tube specifications are given to enable you chose a similar Tube type. If none of the listed Tubes are satisfactory, contact your Generator supplier to obtain special software.

Table 6-1
X-ray Tube Numbers

TUBE NUMBER	TUBE CODE (ID)	MODEL	FOCAL SPOT	POWER RATINGS		KHU
				LS (kW)	HS (kW)	
001	139	CANON E7239X	1.0 / 2.0	22 / 45	-	133
002	201	CANON E7240X	0.6 / 1.2	15 / 30	-	140
003	140	CANON E7242X	0.6 / 1.5	18 / 49	-	187
004	090	CANON E7252X	0.6 / 1.2	15 / 42	26 / 73	300
005	412	CANON E7254FX	0.6 / 1.2	23 / 60	40 / 102	400
006	407	CANON E7884X	0.6 / 1.2	22 / 54.7		300
007	310	CANON E7843X	0.6 / 1.2	22 / 49	-	150
008	344	CANON E7865X	0.3 / 1.0	3 / 40	-	140
009	402	CANON E7876X	0.6 / 1.2	22 / 53		230
010	260	IAE RTM 101 HS	0.6 / 1.2	22 / 55	37 / 99	400
011	441	CANON E7886X	0.7 / 1.3	16.9 / 40		300
012	381	CANON E7869 X	0.6 / 1.2	21 / 55	36 / 96	600
013	404	VARIAN RAD 14	0.6 / 1.2	21 / 54	32 / 77	300
014	161	VARIAN RAD 21	0.6 / 1.2	21 / 64	36 / 100	300
015	395	VARIAN RAD 60	0.6 / 1.2	26.1 / 66	40 / 100	400
016	238	VARIAN RAD 74	0.6 / 1.5	20 / 52	-	200
017	252	VARIAN RAD 92	0.6 / 1.2	26 / 62	40 / 99	600
018	092	VARIAN A-192	0.6 / 1.2	25 / 63	40 / 96	300
019	309	VARIAN A196	0.6 / 1.0	20 / 47	32 / 72	350
020	438	VARIAN A-292	0.6 / 1.2	25 / 62.5	39.6 / 96	400
021	208	VARIAN G 292	0.6 / 1.2	25 / 63	39 / 95	600
022	051	GE-CGR MN 640	1.0 / 1.8	23 / 46	-	150
023	064	GE MAXIRAY-75	0.6 / 1.5	12 / 37	21 / 62	300
024	062	GE MAXIRAY-100	0.6 / 1.25	18 / 55	31 / 100	350
025	261	SIEMENS DR 154/30/50	1.2 / 1.8	31 / 53	-	200
026						
027						

Note . - Power Ratings are for 60 Hz. To calculate Power Ratings for 50 Hz multiply the values by 0.91

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Technical Publication

TR-1100R31

Troubleshooting

Mobile X-Ray Unit

REVISION HISTORY

REVISION	DATE	REASON FOR CHANGE
0	FEB 18, 2013	First Edition
1	JUN 12, 2013	Column Rotation Brake; Power Line Cable and Line Circuit Breaker
2	OCT 31, 2013	Battery Tray Replacement upgrade; Digital Motion Control Board upgrade; Troubleshooting Gauges update; Replacement of Parking Detent, Arm, Handgrips and general update; Error E97
3	DEC 20, 2013	Covers, Power Line Cable, Access Point and general update, Error E31, Digital Motion Control Board upgrade, Fuse F38
4	JAN 10, 2014	Deadman Replacement
5	JUN 10, 2014	Tools, Torque values, Input Voltage (120VAC), Column Steel Cable/Spring Replacement, Motor Group Update, Chain Adjustment, Gauge Replacement, Microcontroller Update
6	JUL 22, 2014	Covers Update
7	MAY 22, 2015	Input Voltage; Lead-Crystal Batteries (option); Telescopic Column (option): Covers removal, Column Steel Cable and Spring replacement, Replacement of the Column Rotation Brake, Arm Replacement; General Update
8	JUN 25, 2015	Replacement of the PFC1000 Board; Replacement of the Column Rotation Brake/Chain upgrade; Upgrade of the Arm Procedures (for Telescopic Column): Arm Replacement and Troubleshooting of the Arm; Update of the Tube-Collimator Assembly Horizontal Rotation Adjustment
9	SEPT 28, 2015	Covers Removal, Access Point Replacement and General Update
10	MAY 30, 2016	General Update
11	SEPT 23, 2016	General Update
12	DEC 09, 2016	General Update

REVISION	DATE	REASON FOR CHANGE
13	MAR 29, 2017	Tools, General Cautions, Console Assembly Warning; TC Sliding Section Disassembly; Replacement of the Antifall System and/or Bearing Kit; Collimator and X-Ray Tube Replacement for units with Handgrips-Support (option); Handgrips and Microswitches Replacement for units with Handgrips-Support (option); General Update
14	JUN 29, 2017	Covers; Microswitches Replacement; Replacement of the new Access Point
15	SEP 20, 2017	General Cautions; Collimator Adjustments
16	OCT 31, 2017	Tools and Test Equipment; Update of E13 and E27
17	DEC 12, 2017	Replacement of the Touch Screen Monitor; Troubleshooting of the Touch Screen Console; Update of Errors
18	JAN 19, 2018	Illustrations; Replacement of the new Access Point
19	JUN 06, 2018	Illustrations Update
20	DEC 05, 2018	Tools and Test Equipment; Column Steel Cable / Spring Replacement; X-Ray Tubes; Collimator Adjustments
21	JAN 14, 2019	Table of Fuses in Section 2.5
22	APR 15, 2019	Collimator and X-Ray Tube Replacement; HV Cables Replacement
23	JUL 23, 2019	Covers Removal; Cylindrical Brake Replacement and Illustrations
24	NOV 27, 2019	Power Line Cable; Batteries and Chargers; Mobile Units with Telescopic Column; Procedures related to the Telescopic Column with Cylindrical Brake; Illustrations and General Update

REVISION	DATE	REASON FOR CHANGE
25	JAN 20, 2020	Batteries and Chargers
26	MAY 22, 2020	Information on Indicators and Charge Cycles; Parking Catch Replacement; Replacement of Power Line Cable and Line Circuit Breaker; Column Base Bearing Replacement, new Access Point
27	JUN 23, 2020	Access Point update
28	NOV 16, 2020	Replacement of Power Line Cable and Line Circuit Breaker
29	OCT 27, 2021	Upper Pulley Replacement in TC Sliding Section; Procedure for Changing the Input Voltage; Troubleshooting of the Arm
30	APR 01, 2022	Updated Section: 3.1.1 Procedures Related to the Column. New Section: 3.1.1.2 Column Steel Cable / Spring Replacement (with Spiral Pulley Assembly SC+A16049-01). Updated Titles: 3.1.1.1 Column Steel Cable / Spring Replacement (with Spiral Pulley Assembly SC+A520089-01), 3.2.2 Procedures Related to the Arm (in Telescopic Column with Rectangular Brake), 3.2.4 Procedures Related to the Arm (in Telescopic Column with Cylindrical Brake).
31	OCT 04, 2022	Updated Sections: 2.2.2.3, 3.2, 3.2.1.1, 3.2.1.2, 3.2.2.1, 3.2.3.1, 3.2.3.2, 3.2.4.1, improved text in wires to J16, Lower Pulley Assembly and Lower Cover installation.

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 A small icon of a document with a checkmark.

Alert readers on 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.

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Mobile X-Ray Unit

Troubleshooting

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SECTION 1 INTRODUCTION

The Unit has self-diagnostic routines which facilitate troubleshooting. Self-diagnostic functions require the correct functioning of all microprocessors. Each microprocessor contains LEDs that indicate correct operation.

Note 

The first step in any troubleshooting procedure is to verify the correct Power Supply Voltages and to visually inspect all Boards and Cable connections.

The Service Engineer should carry out the following operations:

- If the Unit does not Power up, run troubleshooting for Error Code E01.
- If the Unit can be Powered up:
 - Check which Error Code is displayed on the Console and run the troubleshooting routines for the last Error Code displayed.
 - If the Console does not display an Error Code, try to reproduce the failure in the conditions reported by the Operator. It is possible that the Error Code displayed is different from that indicated by the Operator. In all cases, run the troubleshooting routines for the last Error Code displayed.



When any major component is replaced in the system, (X-ray Tube, HV Transformer or Circuit Board), perform the corresponding Configuration and Calibration procedures.

When replacing the HT Controller Board or ATP Console CPU Board, ensure that Extended Memory data have not been lost or modified with the Board change. Compare Extended Memory data displayed on the Console with the values noted in the Data Book.

When replacing the HT Controller Board in the Power Module, transfer U3-EEPROM from the old Board to the new Board. U3-EEPROM contains calibration data. If the U3-EEPROM is not transferred, a complete Calibration must be performed.

Make a functional check of the system (exposures with different techniques and Focal Spots) to verify that mA stations are calibrated, calibrating if necessary.

Update and record in the Data Book any new data entered in the Extended Memory Locations.

1.1 TOOLS AND TEST EQUIPMENT REQUIRED

Note 

Tools and Test Equipment for the Troubleshooting process are indicated in Section 3 of the "Startup Primer".

1.2 GENERAL CAUTIONS



**THE GENERAL CAUTIONS INDICATED IN THIS SECTION
MUST BE COMPLETELY UNDERSTOOD AND HEEDED.**



CAREFULLY HANDLE ALL INTERNAL PARTS OF THE EQUIPMENT, ESPECIALLY PARTS LOCATED UNDER COVERS. DANGEROUS DC VOLTAGE IS PRESENT IN THE UNIT EVEN WHEN UNPLUGGED FROM THE AC LINE.

BEFORE HANDLING ANY ELECTRIC PART OF THE UNIT, REFER TO THE GENERAL SCHEMATICS IN ORDER TO ISOLATE THE AFFECTED AREA.



THESE UNITS CAN BE POWERED ON IN ALL SITUATIONS (WHEN CONNECTED TO THE POWER LINE THROUGH THE LINE PLUG OR WORKING IN STAND-ALONE MODE). WHEN THE UNIT IS TURNED ON, THE NEON LAMP (GREEN) LOCATED ON THE TRANSFORMER T2 IS ON.

KEEP THE PROTECTIVE COVERS IN PLACE AT ALL THE TIMES, REMOVING THEM ONLY TO PERFORM SERVICE OPERATIONS. INTERNAL PARTS, SUCH AS CONTACTOR K5, RELAYS (K7, K11), FUSES (F1, F9, F10, F11, F12), CIRCUIT BOARDS (STAND-ALONE, INVERTER 1-2 AND MOTOR BATTERY CHARGER, BATTERY TEST 02-03), ON/OFF KEY AND EMERGENCY STOP BUTTON, ARE PERMANENTLY POWERED ON AND HAVE THE FULL VOLTAGE POTENTIAL OF THE BATTERIES (APPROX.400 VDC) EVEN WHEN DISCONNECTED FROM THE POWER LINE OR WITH THE CONTROL CONSOLE OFF. USE CAUTION WHEN WORKING IN THIS AREA.



ENSURE THAT THE MAIN CAPACITORS OF THE HIGH VOLTAGE INVERTER DO NOT HAVE RESIDUAL CHARGE. WAIT UNTIL THE LIGHT EMITTING DIODES ON THE CHARGE-DISCHARGE MONITOR BOARDS ARE OFF, APPROXIMATELY 3 MIN AFTER TURNING OFF THE UNIT.



THE “IPM DRIVER BOARD” MUST ALWAYS BE CONNECTED IN THE GENERATOR PREVIOUS TO ACTIVATING MAINS POWER. IF THE “IPM DRIVER BOARD” IS NOT CONNECTED, PERMANENT DAMAGE WILL OCCUR IN THE IGBTs.



ALWAYS MAKE SURE BEFORE ANY SERVICE PROCEDURE THAT THE MANUALS USED ARE IN ACCORDANCE WITH THE EQUIPMENT VERSION.

Note

Before performing any troubleshooting procedures, verify that the Unit has been connected to the mains for approximately 9-10 hours, until the Battery Charge Level Indicators on both columns stop scrolling and the upper Green Indicators remain illuminated. This will ensure a complete and full Battery charge.

1.3 INFORMATION ON INDICATORS AND CHARGE CYCLES



The Unit has a Battery Charger Board for charging eight (8) Batteries for the Motors and two Battery Charger Boards for charging thirty (30) Batteries for the X-ray Exposures (Generator).

The Battery Charge Level Indicators are two columns of Color Indicators located on the Control Panel. The column with the “exposure” symbol indicates the charge level of the Batteries used for radiographic operations (X-ray exposures) and the column with the “motor” symbol indicates the charge level of the batteries used for the Mobile motion (motors).

When plugged into the mains (with the Line Circuit Breaker ON and the Emergency Switch-Off deactivated), the Batteries automatically charge. The color Indicators on both columns illuminate and scroll from the current Generator battery charge level to 100%, until the Batteries are fully charged. During the charging process both columns scroll up from the same level.

Mobile X-Ray Unit

Troubleshooting

Note

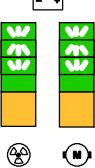
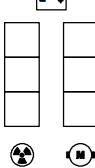
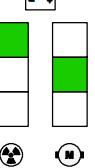
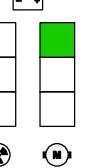
The Batteries require approximately 9-10 hours for a full charge. To charge the Batteries, there is no need to have the Console turned ON. When the Batteries are fully charged, the Battery charge level Indicators on both columns stop scrolling and only the Upper Green Indicators remain illuminated.

When unplugged from mains, the Batteries discharge independently depending on their use (X-ray exposures or motors) since the Mobile is provided with two independent battery modules.

Note

Upon disconnecting the Unit from the mains, if the Unit has been connected for a short period of time, after several exposures or after one heavy duty exposure, the Batteries need at least 30 seconds to stabilize the charge, after which the correct charge level is shown on the Indicator.

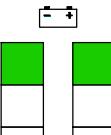
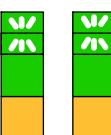
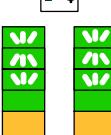
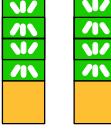
The Battery Charge Level Indicators can be:

MOBILE UNIT PLUGGED INTO MAINS	MOBILE UNIT UNPLUGGED FROM MAINS		
Key in "OFF" or "ON" position	Key in "OFF" position	Key in "ON" position and Console turned ON	Key in "ON" position and Console turned OFF
			
Both Columns are scrolling as described in the following Table.	Both Columns are OFF.	Each Column shows the respective Battery charge level as described in the following Table.	Only the Motors Column shows the respective Battery charge level as described in the following Table.

Note

Due to the constant float level fluctuation, the Battery Charge Level Indicator is filtered. This filter can be removed during service to aid in adjustments and in troubleshooting. See Section 2.7 "Battery Monitor Board".

Both columns comprise three Indicators, each one representing a battery status as described below:

MOBILE UNIT IN CHARGING MODE (PLUGGED TO MAINS)		MOBILE UNIT IN STAND-ALONE MODE (UNPLUGGED FROM MAINS)	
LED INDICATORS AND STATUS		LED INDICATORS AND STATUS	
	After charging during approximately 9 hours, the upper Green Indicators are lighting steady and the rest of the Indicators below are off. The batteries charge level is 100 % of the total charge.		When the upper Green Indicators light steady, normal operation is allowed.
	After charging during approximately 2.5 to 6 hours, the upper Green Indicators are scrolling up and the lower Green Indicators and the Orange Indicators are lighting steady. In 4 hours, the batteries charge level is 80% of the total charge.		When the upper Green Indicators light steady, normal operation is allowed.
	After charging during approximately 1.5 to 2.5 hours, Indicators are scrolling up from the upper half of the lower Green Indicators and the rest of the Indicators below are lighting steady.		When the lower Green Indicators light steady, normal operation is allowed although it is recommended to charge the Batteries.
	After charging during approximately 30 to 90 minutes, all Green Indicators are scrolling up and the Orange Indicators are lighting steady.		When the lower Green Indicators start blinking, normal operation is allowed but it is urgent to charge the Batteries.
	After charging during approximately less than 30 minutes, all the Indicators are scrolling up.		When the Orange Indicator blinks, exposures are not allowed. It is necessary to charge the Batteries.
Indicator colors:  Green  Orange  Indicator Off  Blinking / Scrolling			

For the Motors, the Battery charge level will be reduced according to the movements made with the Unit. If the Battery Charge Level for the Motors is reduced too quickly or the indicators are off after charging the Batteries, this can be due a failure of the PFC Board, Motors Battery Charge Board or faulty Batteries for Motors. In this case, perform *Section 2.8.3*.

For the Generator, the Battery charge level will be reduced consistent with the exposures made by the Generator. During the charging sequence, connected to the mains, the Battery Charge Level for the **Generator** reaches approximately 420 Volts. When the Unit is unplugged and Batteries are fully charged, the Battery Charge Level reduces to about 390 Volts.

When the Generator Battery charge level is below 10% (Orange indicators are blinking when the Unit is unplugged from mains), the “*Battery Low*” signal becomes active. Error “E25” is shown when the Generator is in “*Prep*” and the “*Battery Low*” signal (from the “*Battery Monitor Board*” to J2-7 of the “*ATP Console CPU Board*”) is at “*High Level*” (around 5 Volts).

SECTION 2 GENERAL PROCEDURES

2.1 TORQUE VALUES FOR SCREWS

Generally, when any screw is re-installed during the procedures described in this document, it is recommended to apply the torque listed in the Table 2-1, except in case that the torque value to be applied is specified in the corresponding procedure.



Apply only the tightening torques listed in Table 2-1 for mounting the mechanical parts of the unit (metallic parts to metallic parts), never for mounting electrical or electronic parts (e.g. electronic boards).

Note

It is also recommended to apply a drop of Loctite 243 to the end of the metallic screws before tightening them.

Table 2-1
Recommended Torque Values for Screws

SCREW SIZE (Metric ISO Screw Thread)	TORQUE APPLIED
M4	2.9 Nm
M5	5.7 Nm
M6	10 Nm
M8	24.1 Nm
M10	47.7 Nm
M12	82 Nm

*Note. - Conversion factor: 1 Nm = 0.10197 kgf*m ; 1 Kgf*m = 9.80665 Nm*

2.2 COVERS REMOVAL

For Troubleshooting, certain Covers may need to be removed. Refer to the specific sections to dismount the respective Cover.

For Mobile Units with Standard Column refer to section 2.2.1; for Mobile Units with Telescopic Column (option), refer to section 2.2.2.

Note 

The procedures for removing the external Covers are described in the following steps as required, although some of these covers could have been dismounted previously (therefore, some of the pictures could show the unit without one or some covers).

Illustration 2-1
Covers Removal: Mobile Unit with Wireless DR Detector

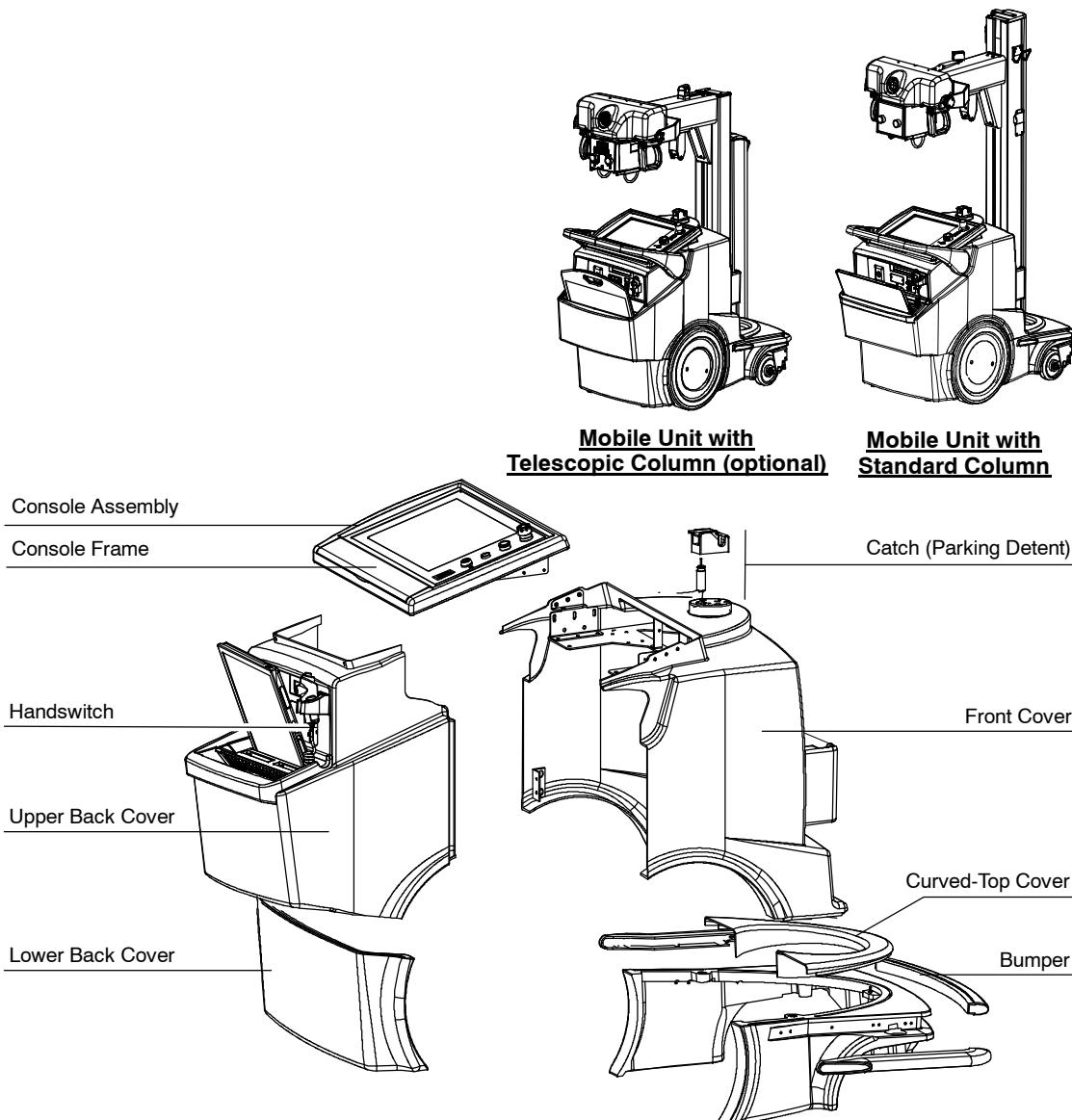
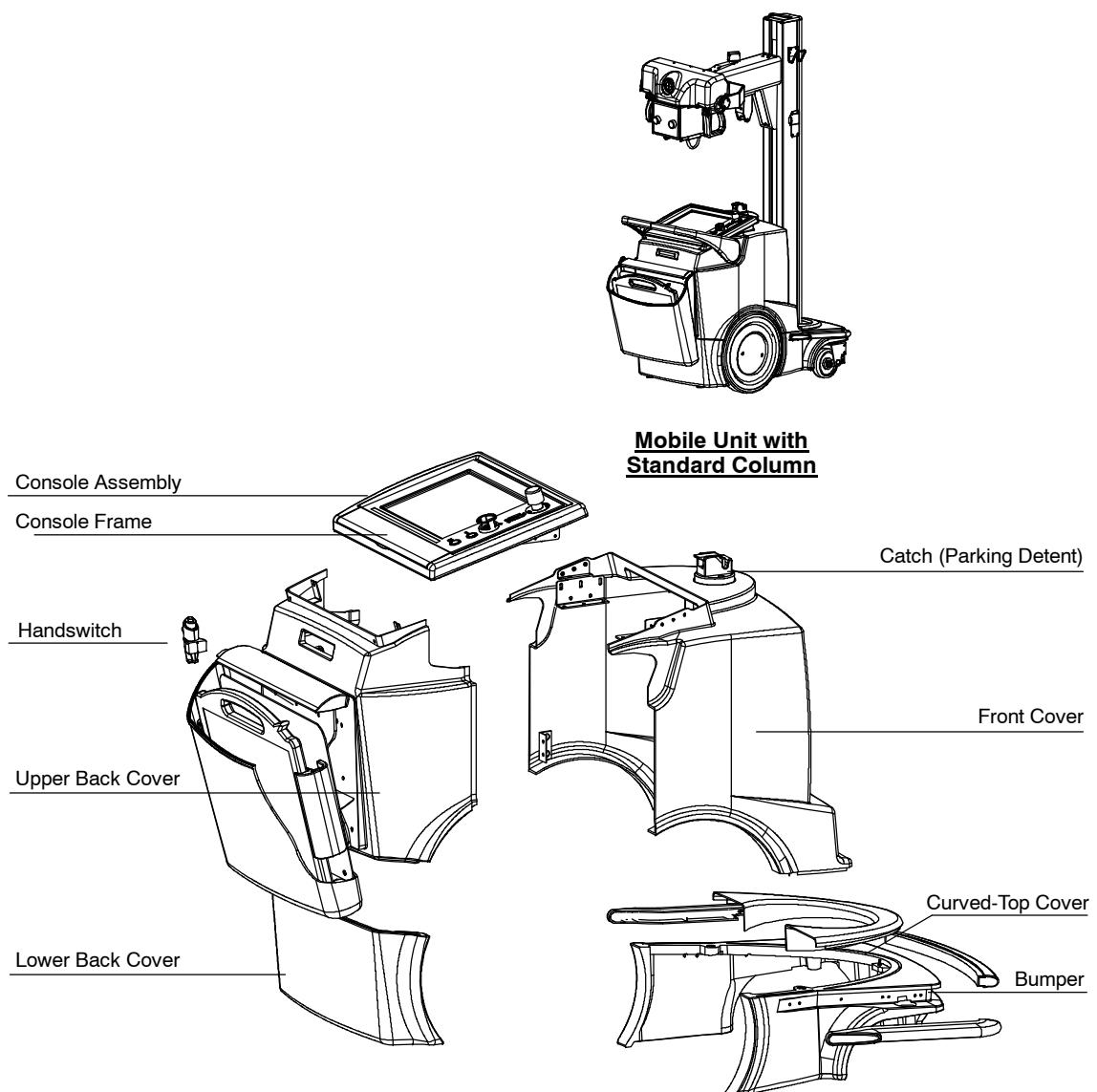


Illustration 2-2

Covers Removal: Mobile Unit with Portable DR Detector



2.2.1 MOBILE UNITS WITH STANDARD COLUMN: EXTERNAL COVERS**2.2.1.1 REAR WHEELS HUBCAP****WHEELS WITH SCREWED HUBCAP**

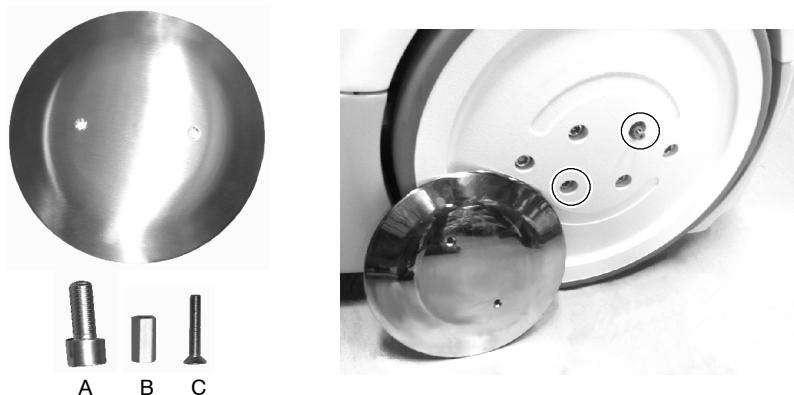
1. Dismount the Hubcap from the wheel Rim by removing the two (2) fixing screws shown in the picture below, taking care not to lose these screws and the two (2) spacers located behind the Hubcap.



2. To reassemble the Hubcap, place the two (2) spacers in the original position, mount the Hubcap and secure it with the two (2) fixing screws.

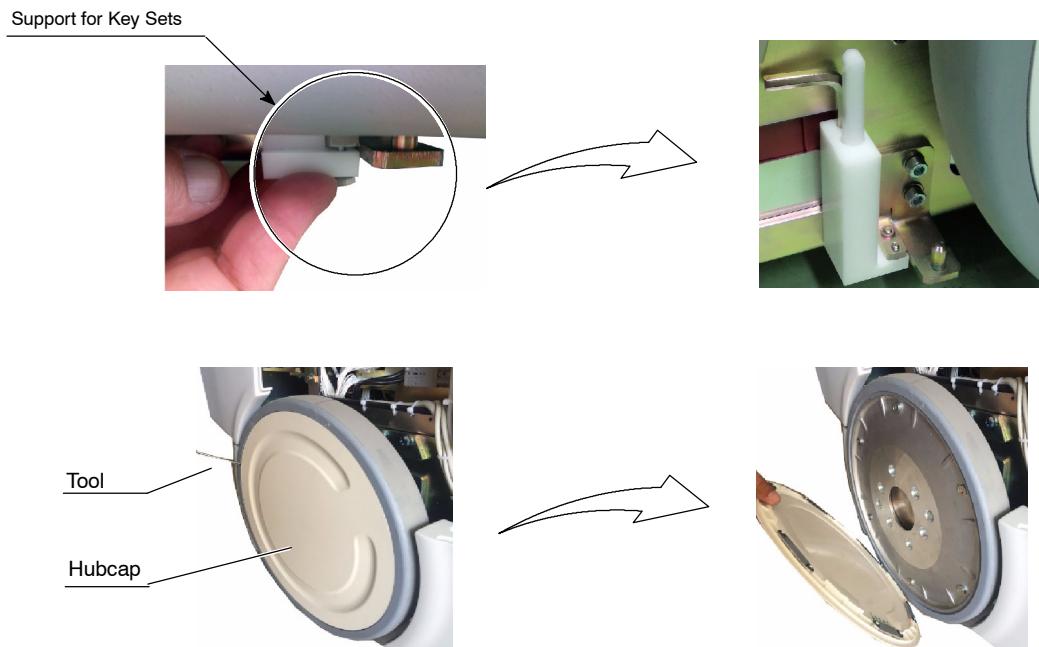
Note

In order to mount the Hubcaps in units without them, it is necessary to replace two (2) of the four screws from the wheel Rim as shown in the picture below, with the two (2) fixing screws (A) provided with the kit; these screws have an internal hole threaded for allowing fixing the Hubcap later. Once tightened, insert into them the two (2) spacers hexagon-shape (B) provided with the kit. Mount the Hubcap on the Rim and secure it with the two (2) fixing screws (C).



WHEELS WITH MAGNETIC HUBCAP

Remove the Hubcap using the tool provided in the Key Set, that is located near the left Back Wheel of the Unit. For accessing this Key Set, dismount the Support from the lower side of the Mobile Unit.



2.2.1.2 CONSOLE FRAME

1. Open the Pencil Tray and remove the two (2) Screws that fasten the Console Frame to the Unit.
2. Push the Console Frame towards the Column.

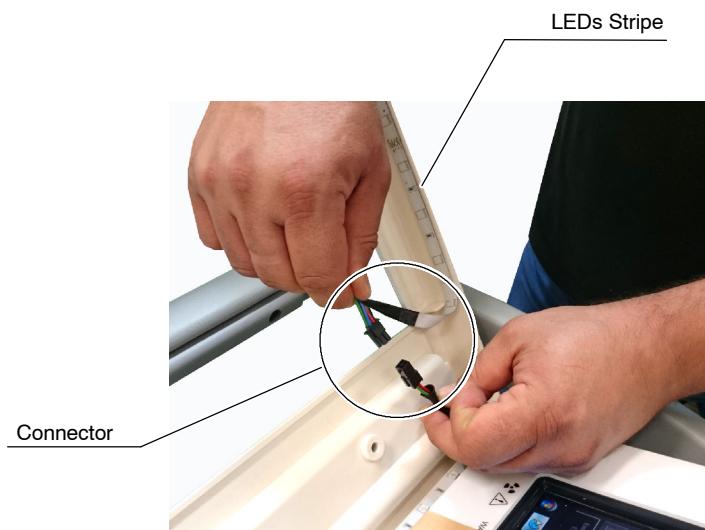
Do not lift up the Console Frame until its upper side is fully released.



3. For Mobile units with LED Beacon Light, consisting of a Stripe of Leds placed below and around the Console Frame, carefully lift the Console Frame and place it aside.



4. Then, disconnect the LED Beacon Light Connector and remove the Console Frame.



2.2.1.3 FRONT COVERS

1. Remove the six (3+3) Lateral screws placed on the Front Cover, at both sides underneath the Console Frame.



Mobile X-Ray Unit

Troubleshooting

2. Remove the two (2) Screws at both sides of the Curved-Top Cover and pull the Cover upwards to disengage the Snap underneath.



3. Remove the two (2) Fixing Screws that fix the Front Cover to the Mobile Frame; for units with Bucky Connector Cover, remove the three (3) screws and dismount it.



4. Before dismounting the Front cover, remove two (2) screws to dismount the Catch of the Parking Detent device. Keep it loose in order to dismount the covers afterwards.



5. Follow the indications described in the following steps a., b., c. or d. in order to remove the Front Cover from each different Mobile model.

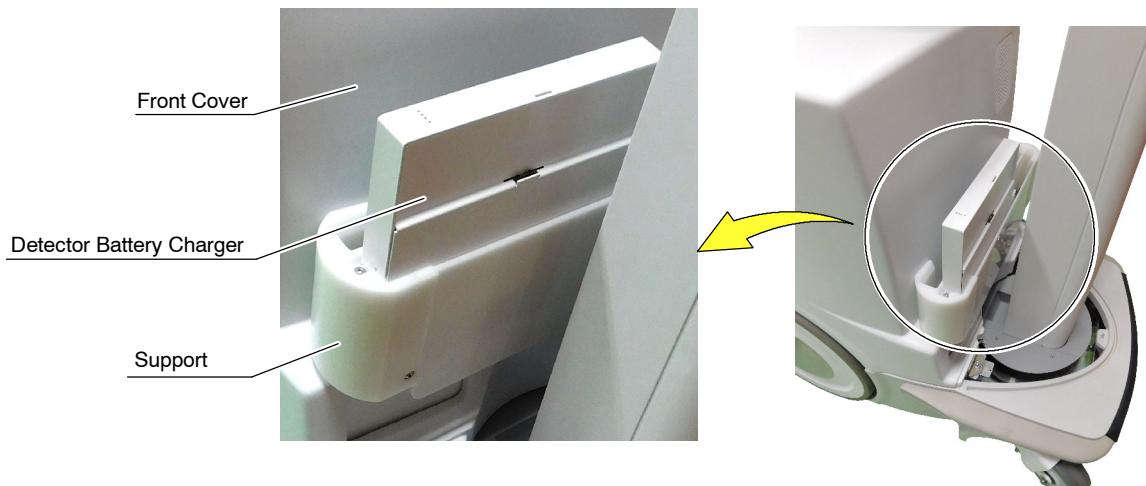
After removing the corresponding Front Cover, continue in step 7. in order to remove the Ring Cover.

a. **Mobile Unit with Wireless DR Detectors DR-14s C/G, DR-10s C.**

- Lift the Front Cover slightly from the Unit.



- For Units with Infrared Remote Control (optional), disconnect the Sensor Signal Cable from the PCB.
- Remove the Battery from the Detector Battery Charger, in the Support of the Front Cover.



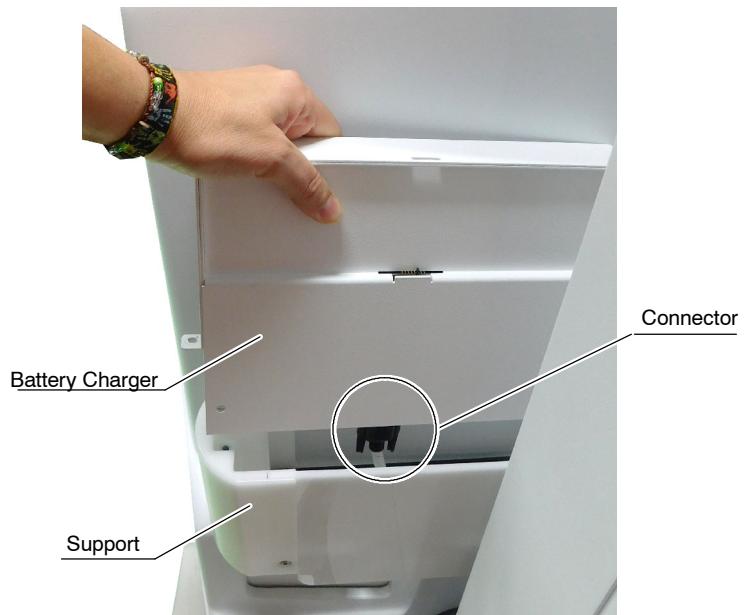
Mobile X-Ray Unit

Troubleshooting

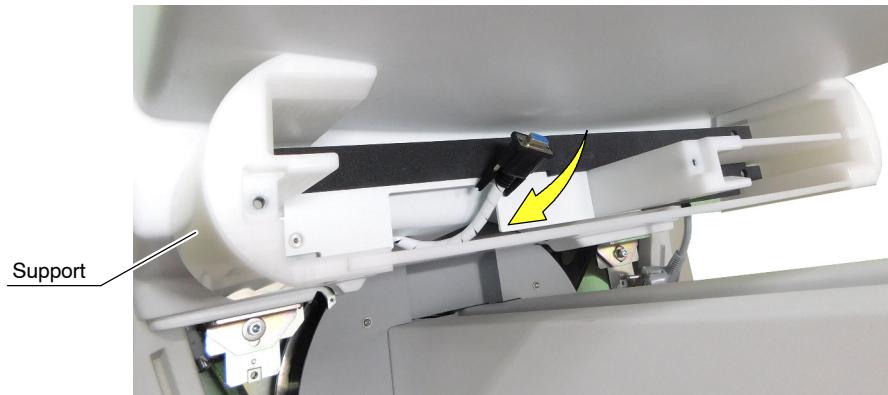
- Remove the screws (2) that fix the Detector Battery Charger to the Support.



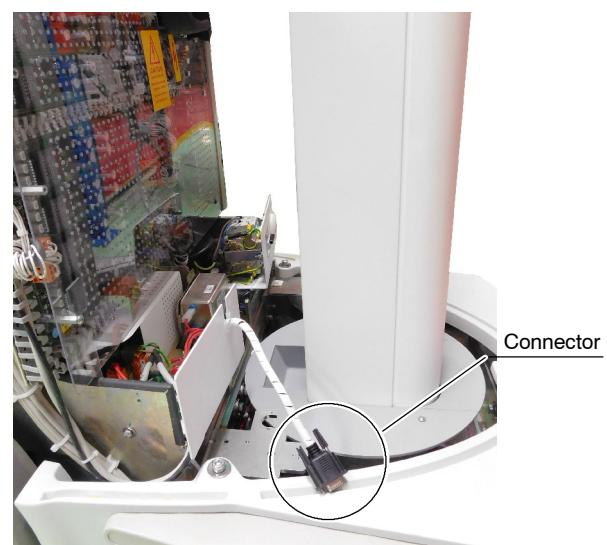
- Remove the Detector Battery Charger upwards, and disconnect it from the Connector at the bottom.



- Pass the Charger Connector through the gap, at the base of the Support.



- Finally, fully remove the Front Cover upwards, passing the Power Line Plug through its window.

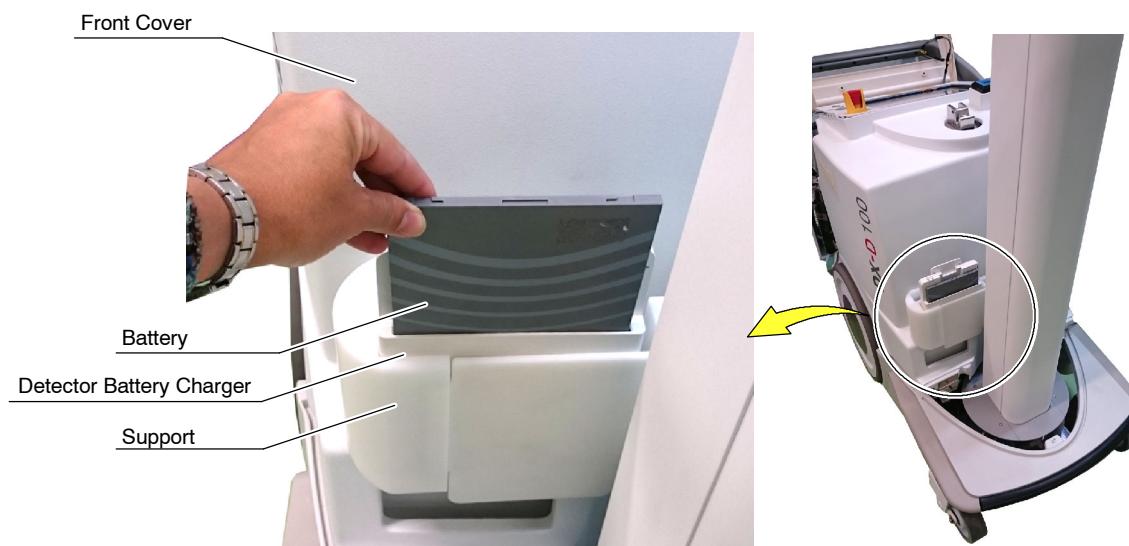


b. Mobile Unit with Wireless DR Detectors DX-D40, DX-D45.

- Lift the Front Cover slightly from the Unit.



- For Units with Infrared Remote Control (optional), disconnect the Sensor Signal Cable from the PCB.
- Remove the Battery from the Detector Battery Charger, in the Support of the Front Cover.



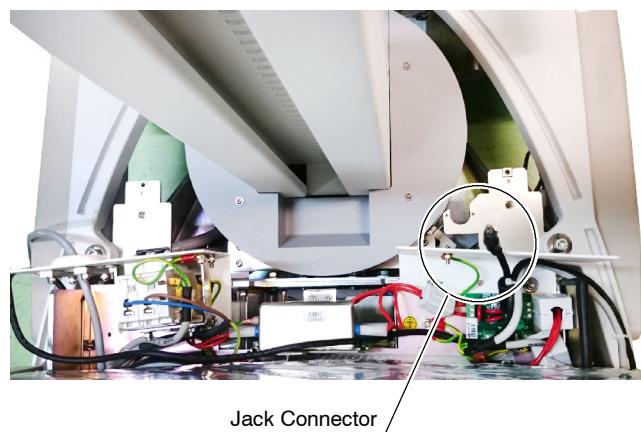
- Remove the four (4) screws that fix the Detector Battery Charger to the Fixing Plate.



- Remove the Detector Battery Charger upwards, it will disconnect it from the Jack Connector at the bottom.



- Finally, fully remove the Front Cover upwards, passing the Jack Connector through the hole at the Bottom and the power line plug through its window.



c. **Mobile Unit with Wireless DR Detectors DX-D30, DX-D35.**

- Lift the Front Cover slightly from the Unit as shown below, passing the power line plug through its window.

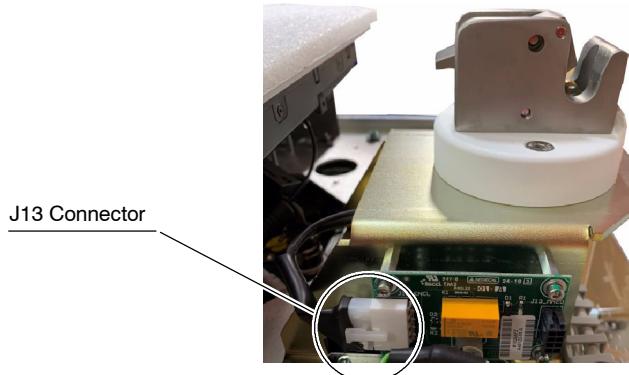


- For Units with Infrared Remote Control (optional), disconnect the Sensor Signal Cable from the PCB; then, remove the Front cover completely from the unit.

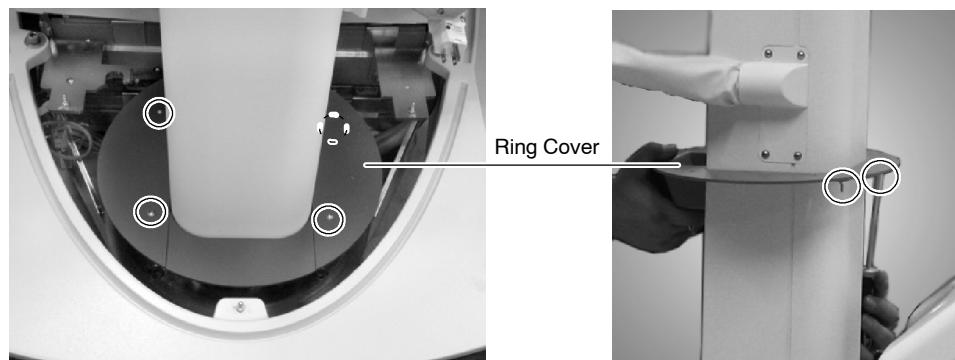
d. **Mobile Unit with Portable DR Detectors DX-D10, DX-D20.**

- Follow the same procedures described in step c. for Wireless DR Detectors DX-D30, DX-D35.

6. Disconnect the Sensor Signal Cable Connector J13.

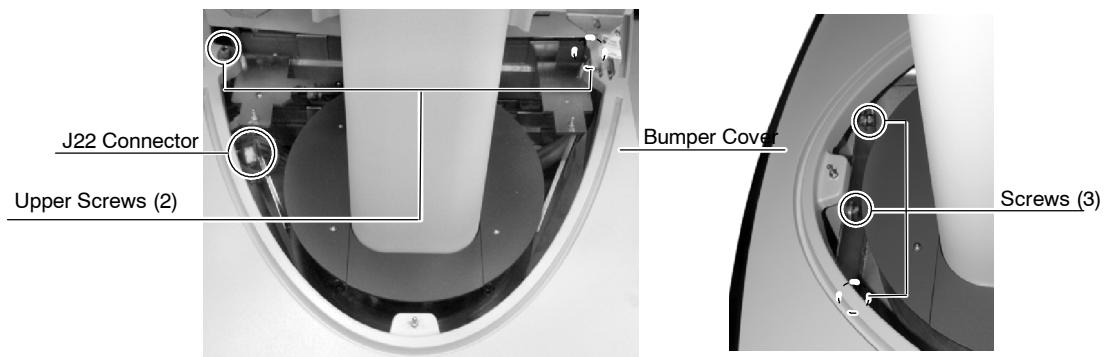


7. Remove the four (4) Screws (picture in the left) and lift the Ring Cover to have access to remove the two (2) Screws underneath the Ring Cover (picture in the right); then, remove the Ring Cover.



8. Unplug Connector J22 (Anticollision Bumper Sensor).

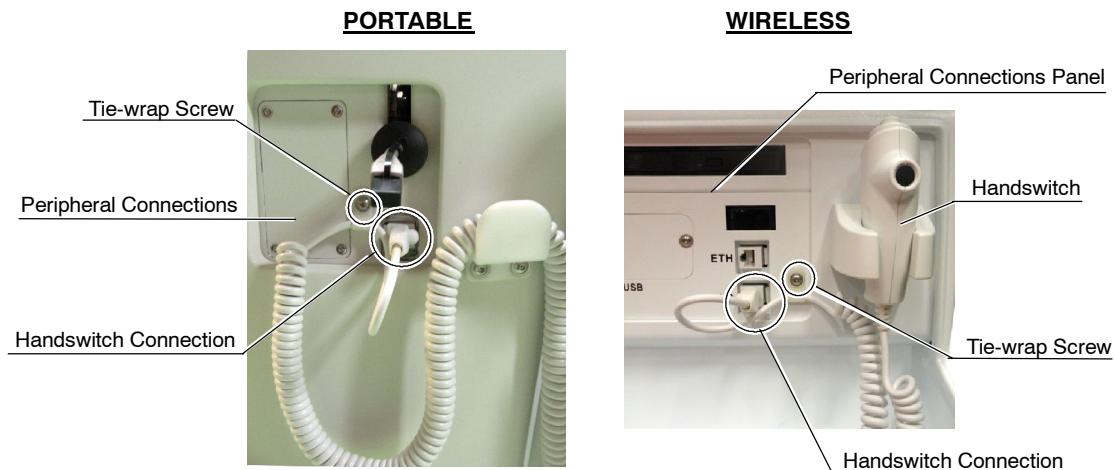
Remove the two (2) Upper Screws and the three (3) Screws under the Bumper Cover, then remove the Bumper cover.



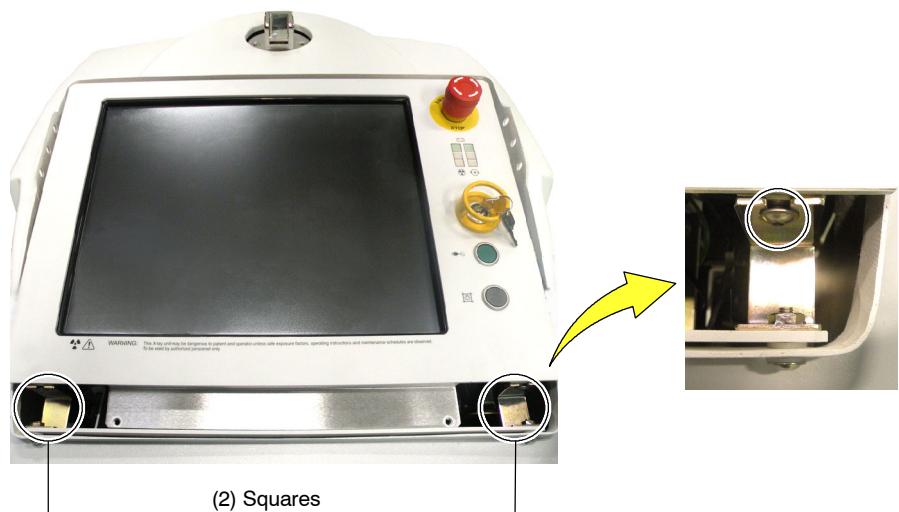
2.2.1.4 BACK COVERS

Once the Front Cover has been lifted slightly as described in the previous steps 1-6 (there is no need to remove it), proceed as described below.

1. Remove the screw and the Tie-wrap that holds the Handswitch cable to the Connections Panel and unplug the Handswitch from its connection.



2. Remove the two (2) screws that fix the two (2) Squares placed at both sides underneath the Console Frame to the Console Chassis.



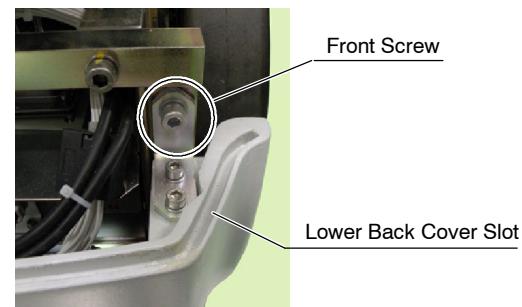
3. Lift the Upper Back Cover, passing the Ethernet cable through the window. Place the Back Cover aside in order to have access for disconnecting the Detector Charger Cable from the Power Box and the GND cable at the rear side of the Back Cover. Remove the Back Cover.



Note 

When assembling, remind passing the cables through its apertures and ensure that the Upper Back Cover fits into the Lower Back Cover slot.

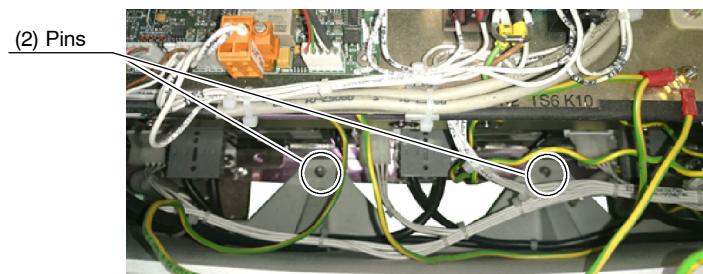
4. Remove the Front Screw from the two (2) Squares that fasten the Lower Back Cover to the Unit.



5. Lift the Lower Back Cover up and remove it.

Note 

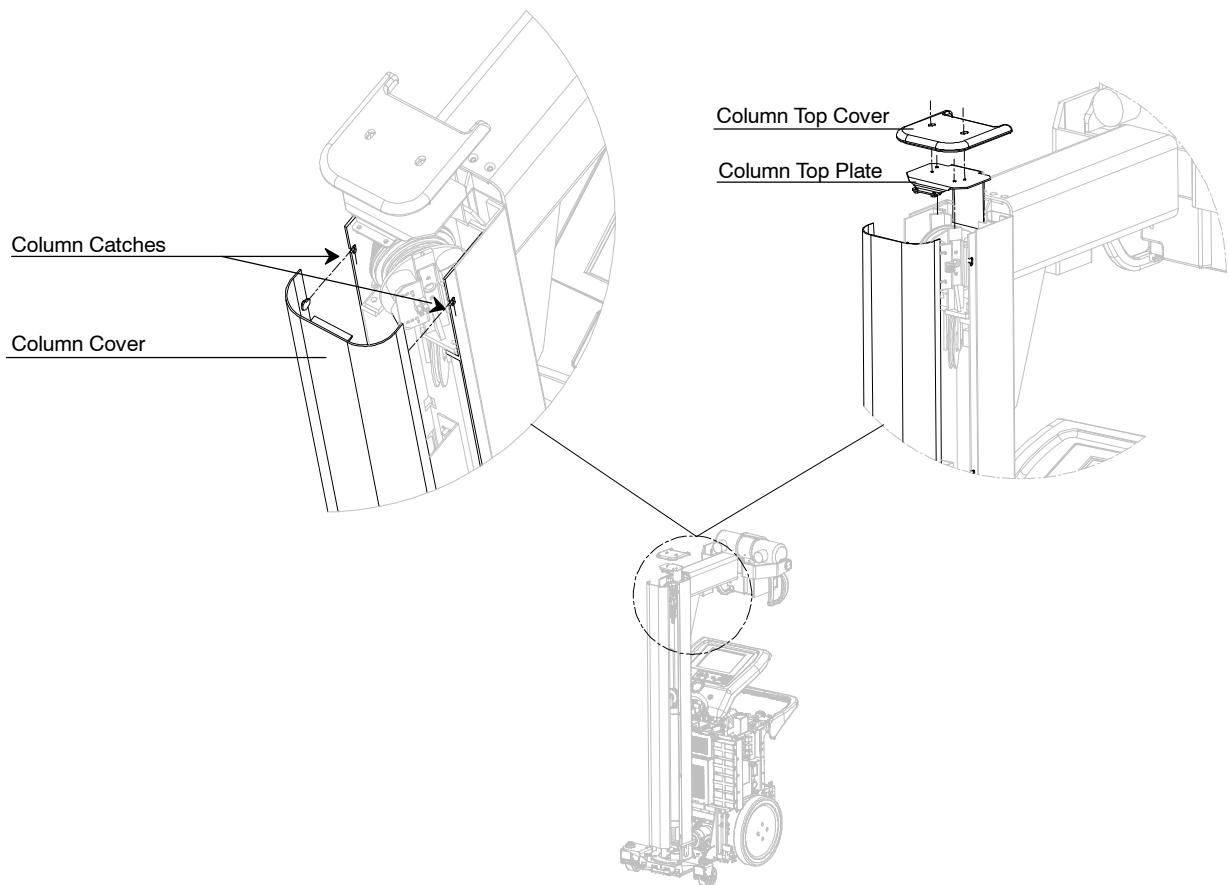
When assembling, ensure that the Lower Back Cover fits into the two (2) Pins below the Unit frame.



2.2.1.5 COLUMN COVERS**Note** 

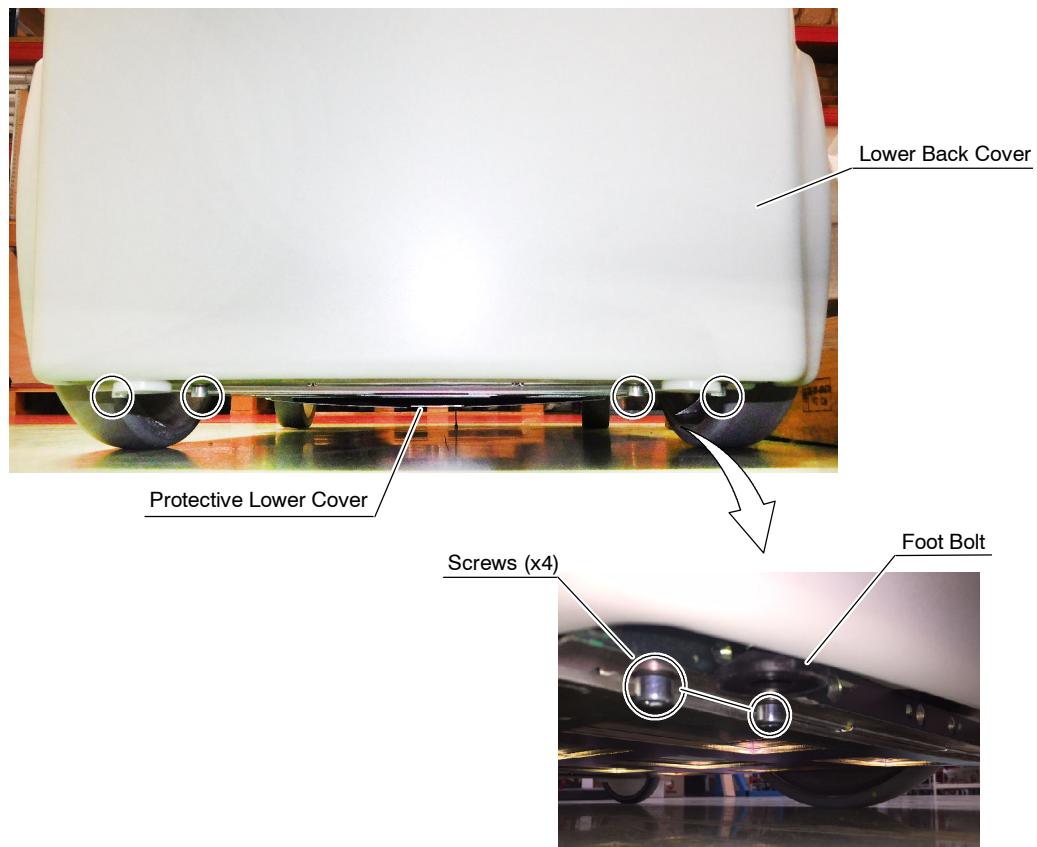
If it is necessary to dismount the Column Cover, the Console Frame and all the Front Covers (Front, Curved-Top, Ring and Bumper Covers) of the Unit have to be removed before (refer to Sections 2.2.1.2 and 2.2.1.3).

1. Remove the two (2) screws of the Column Top Cover, remove the cover.
2. Remove the two (2) screws that secure the Column Cover to the Column Top Plate.
3. Carefully lift up the Column Cover to uncouple the Column Catches, then remove the Column Cover.

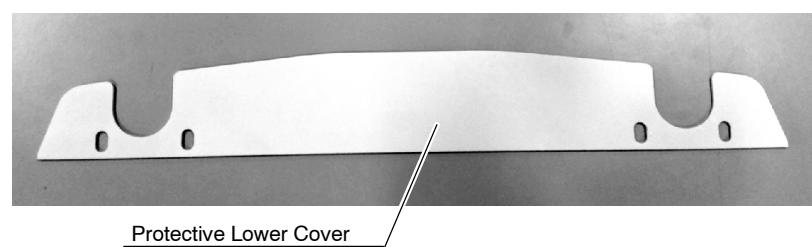


2.2.1.6 PROTECTIVE LOWER COVER

1. Remove the Screws (x4) fixing the Protective Lower Cover, located underneath the Lower Back Cover of the unit, and dismount the Protective Lower Cover.



2. Remove the white films at both sides of the new Protective Lower Cover, mount the Protective Lower Cover to the unit and secure it with the Screws (x4) applying Loctite 243 to the Screws.



2.2.2 MOBILE UNITS WITH TELESCOPIC COLUMN (OPTION): EXTERNAL COVERS**Note** 

*To dismount the **Rear Wheels Hubcap** and the **Console Frame**, proceed as described for Mobile Units with Standard Column in sections 2.2.1.1 and 2.2.1.2.*

Note 

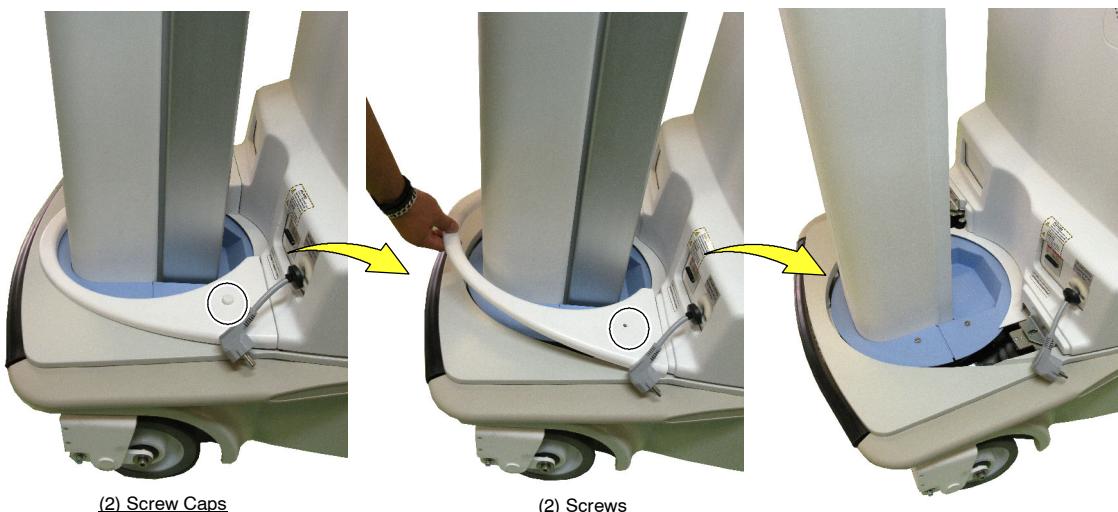
*To dismount the **Protective Lower Cover**, proceed as described for Mobile Units with Standard Column in section 2.2.1.6*

2.2.2.1 FRONT COVERS

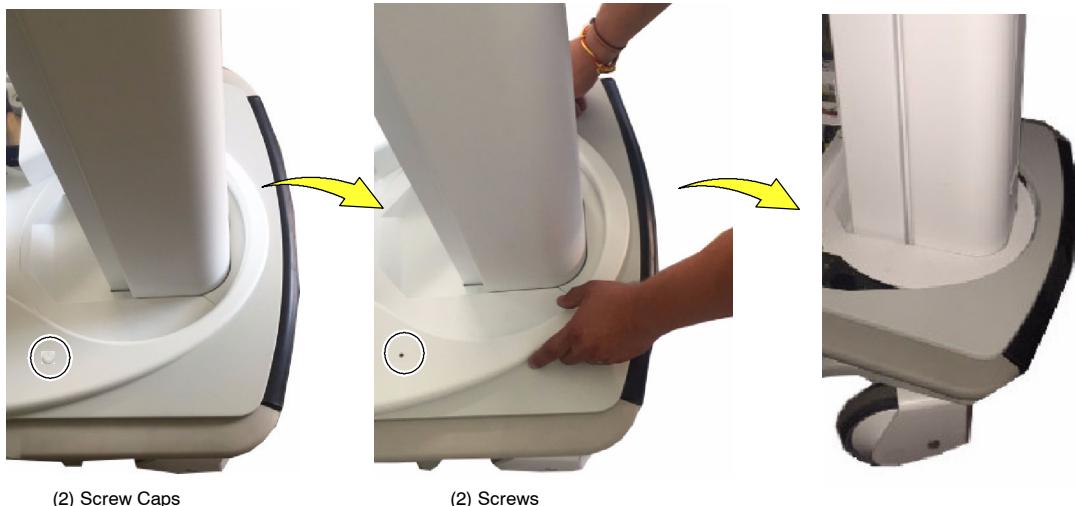
1. Remove the six (3+3) Lateral Screws placed on the Front Cover, at both sides underneath the Console Frame.



2. Remove the two (2) Screw Cover Caps and the two (2) Screws in order to dismount the Curved-Top Cover.

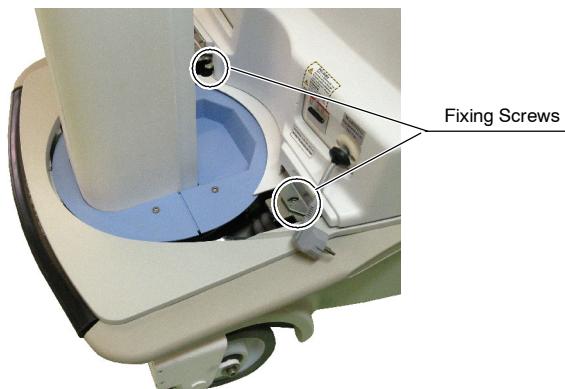
Mobile Units with non-reinforced Frame(2) Screw Caps(2) Screws

Mobile Units with reinforced Frame

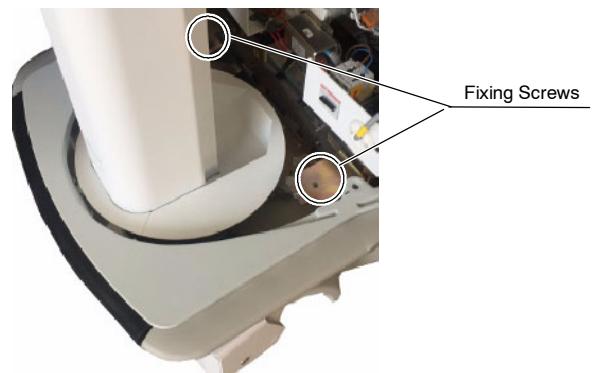


3. Remove the two (2) Fixing Screws that fix the Front Cover to the Mobile Frame.

Mobile Units with non-reinforced Frame



Mobile Units with reinforced Frame



4. Before dismounting the Front cover, remove two (2) screws to dismount the Catch of the Parking Detent device. Keep it loose in order to dismount the covers afterwards.



5. Follow the indications described in the following steps a., b., c. or d. in order to remove the Front Cover from each different Mobile model.

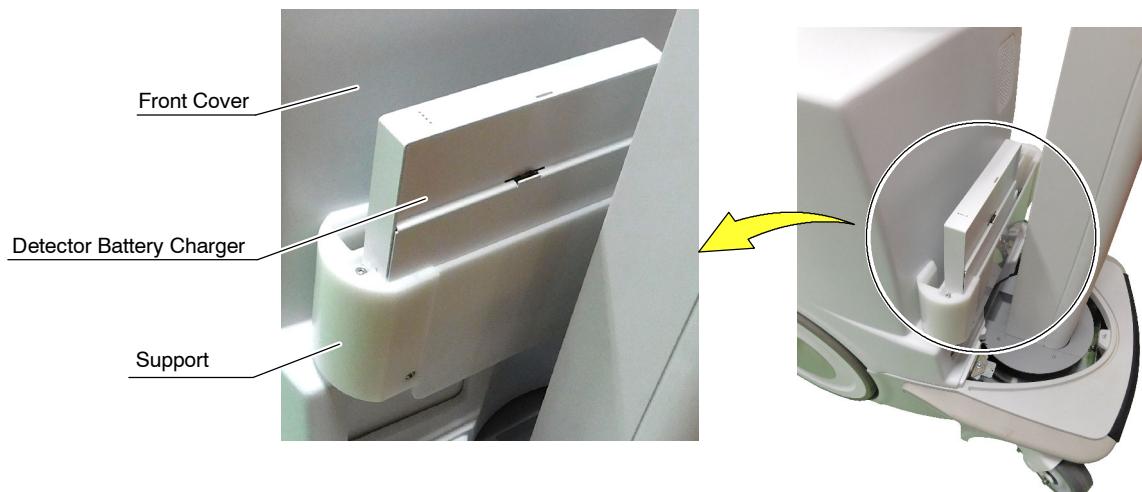
After removing the corresponding Front Cover, continue in step 7. in order to remove the Ring Cover.

- a. **Mobile Unit with Wireless DR Detectors DR-14s C/G, DR-10s C.**

- Lift the Front Cover slightly from the Unit.



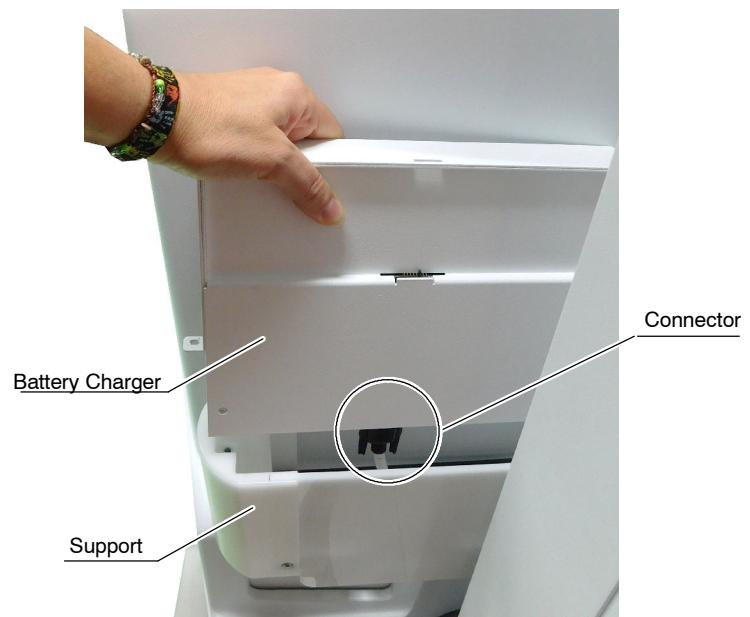
- For Units with Infrared Remote Control (optional), disconnect the Sensor Signal Cable from the PCB.
- Remove the Battery from the Detector Battery Charger, in the Support of the Front Cover.



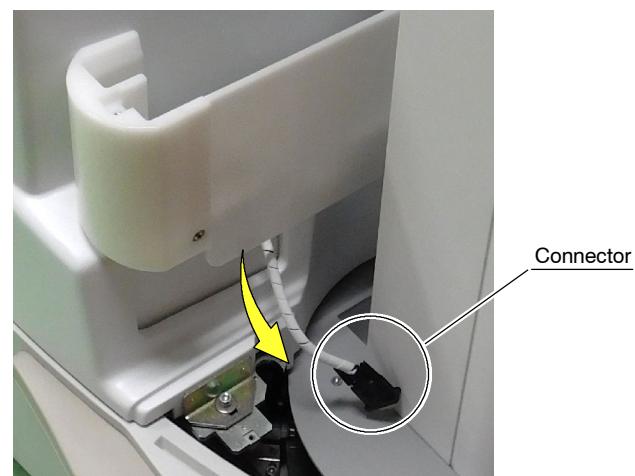
- Remove the screws (2) that fix the Detector Battery Charger to the Support.



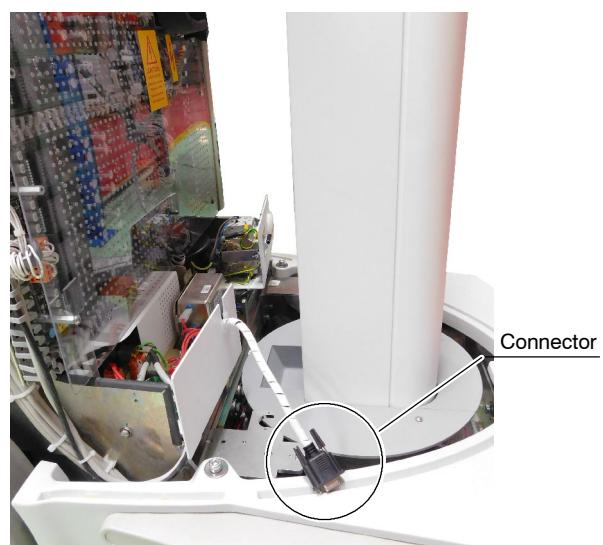
- Remove the Detector Battery Charger upwards, and disconnect it from the Connector at the bottom.



- Pass the Charger Connector through the gap, at the base of the Support.



- Finally, fully remove the Front Cover upwards, passing the Power Line Plug through its window.

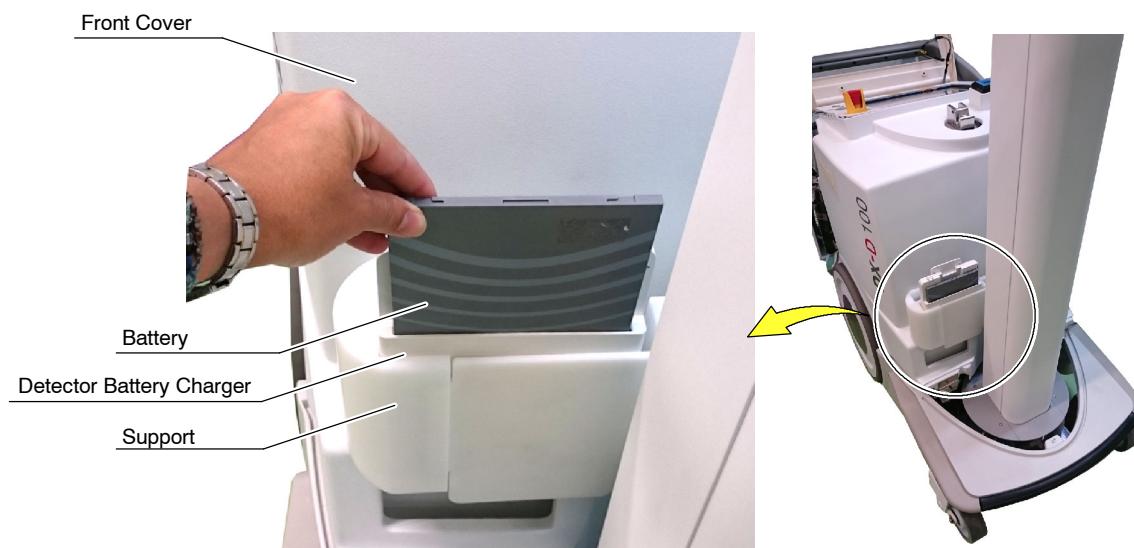


b. Mobile Unit with Wireless DR Detectors DX-D40, DX-D45.

- Lift the Front Cover slightly from the Unit.



- For Units with Infrared Remote Control (optional), disconnect the Sensor Signal Cable from the PCB.
- Remove the Battery from the Detector Battery Charger, in the Support of the Front Cover.



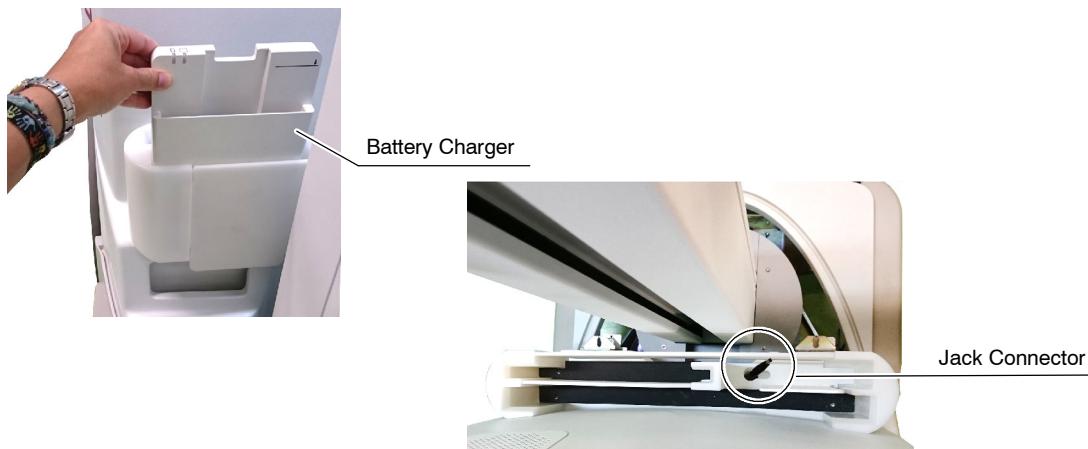
Mobile X-Ray Unit

Troubleshooting

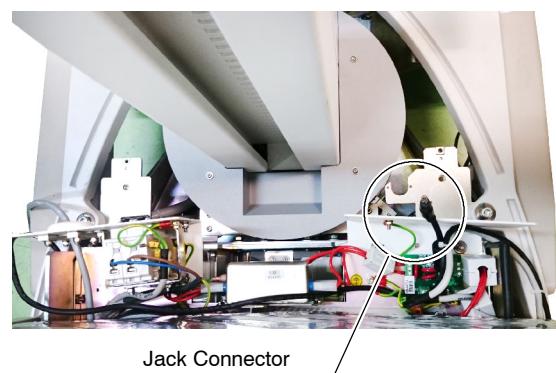
- Remove the four (4) screws that fix the Detector Battery Charger to the Fixing Plate.



- Remove the Detector Battery Charger upwards, it will disconnect it from the Jack Connector at the bottom.



- Finally, fully remove the Front Cover upwards, passing the Jack Connector through the hole at the Bottom and the power line plug through its window.



c. Mobile Unit with Wireless DR Detectors DX-D30, DX-D35.

- Lift the Front Cover slightly from the Unit as shown below, passing the power line plug through its window.

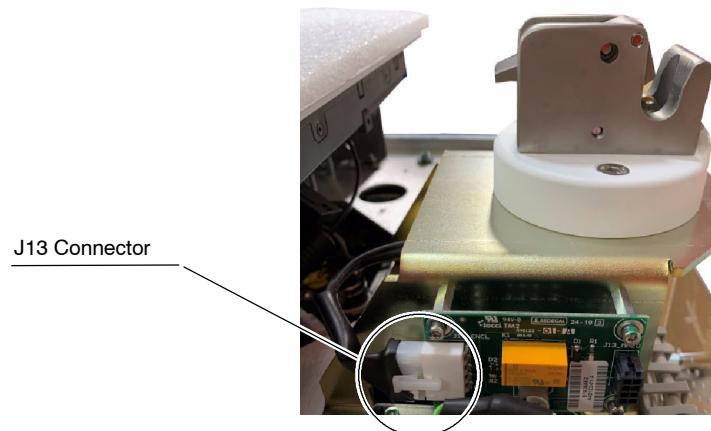


- For Units with Infrared Remote Control (optional), disconnect the Sensor Signal Cable from the PCB; then, remove the Front cover completely from the unit.

d. Mobile Unit with Portable DR Detectors DX-D10, DX-D20.

- Follow the same procedures described in step c. for Wireless DR Detectors DX-D30, DX-D35.

6. Disconnect the Sensor Signal Cable Connector J13.



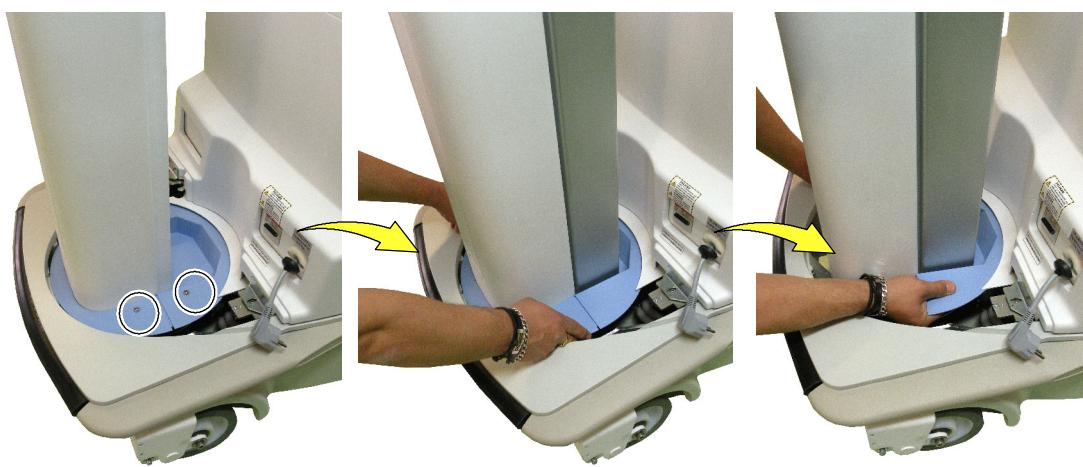
Mobile X-Ray Unit

Troubleshooting

7. Remove the four (4) Screws for non-reinforced frame Units and the two (2) Screws for reinforced frame Units from both Column Base Covers (a).

For Units with non-reinforced frame, disengage the front Column Base Cover (b) and remove it; disengage the rear Column Base Cover (c) and remove it. For Units with reinforced frame, lift the Column Base Cover a few centimeters (b) and untighten the two (2) Screws underneath it, disengage it and remove it (c).

Mobile Units with non-reinforced Frame



a. Column Base covers: (4) Screws

b. Column Base Cover (front)

c. Column Base Cover (rear)

Mobile Units with reinforced Frame



a. Column Base cover: (2) Screws

b. Column Base Cover (front)

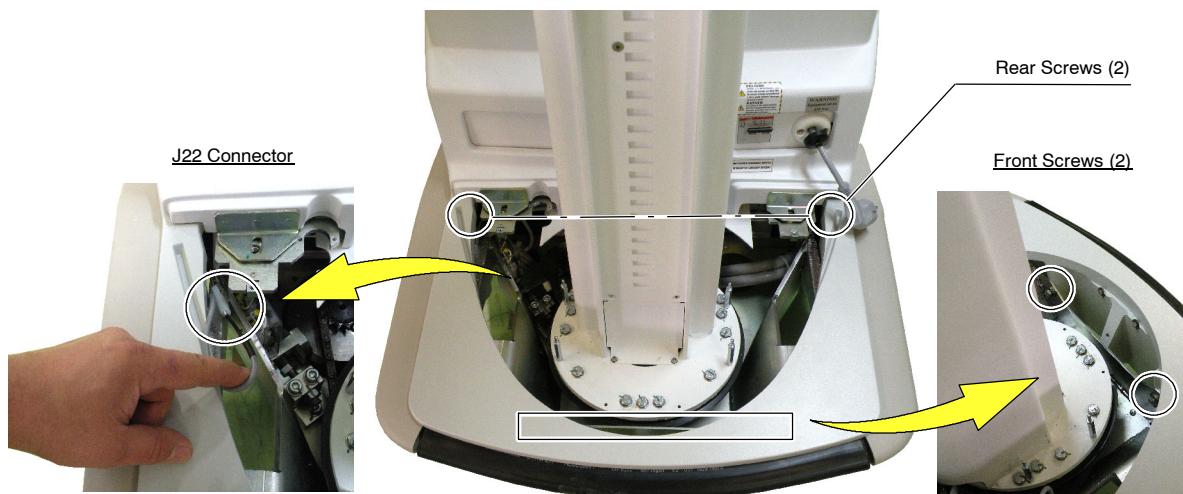
c. Column Base Cover (rear)

8. Unplug Connector J22 (Anticollision Bumper Sensor). Remove the two (2) Rear Screws and the two (2) Front Screws with spacers under the Bumper Cover, then remove the Bumper Cover.

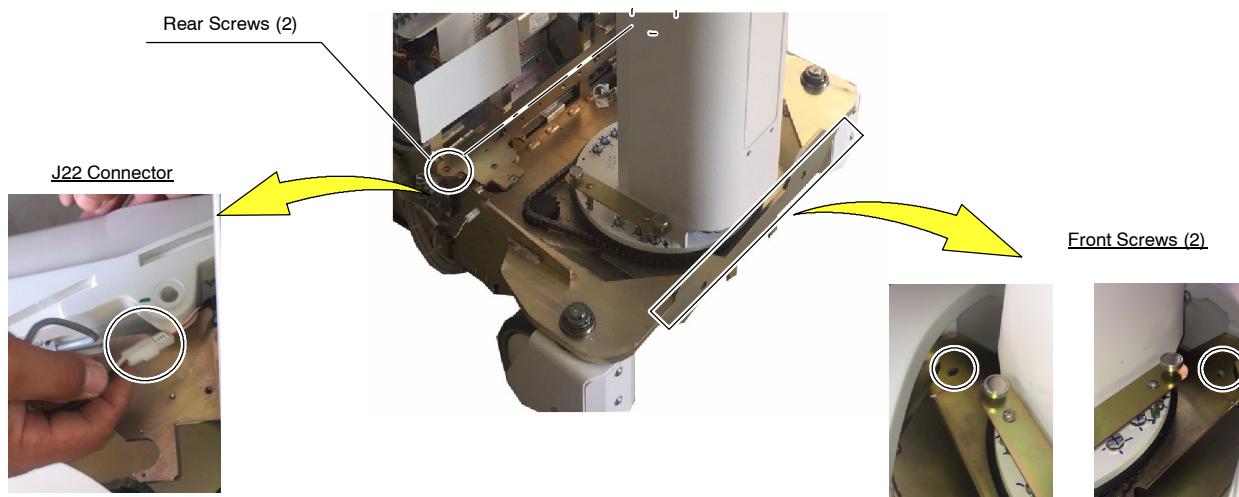
Note 

When re-installing the Bumper Cover, use the same spacers (washers or nylon bushing) between the unit frame and the Bumper Cover.

Mobile Units with non-reinforced Frame



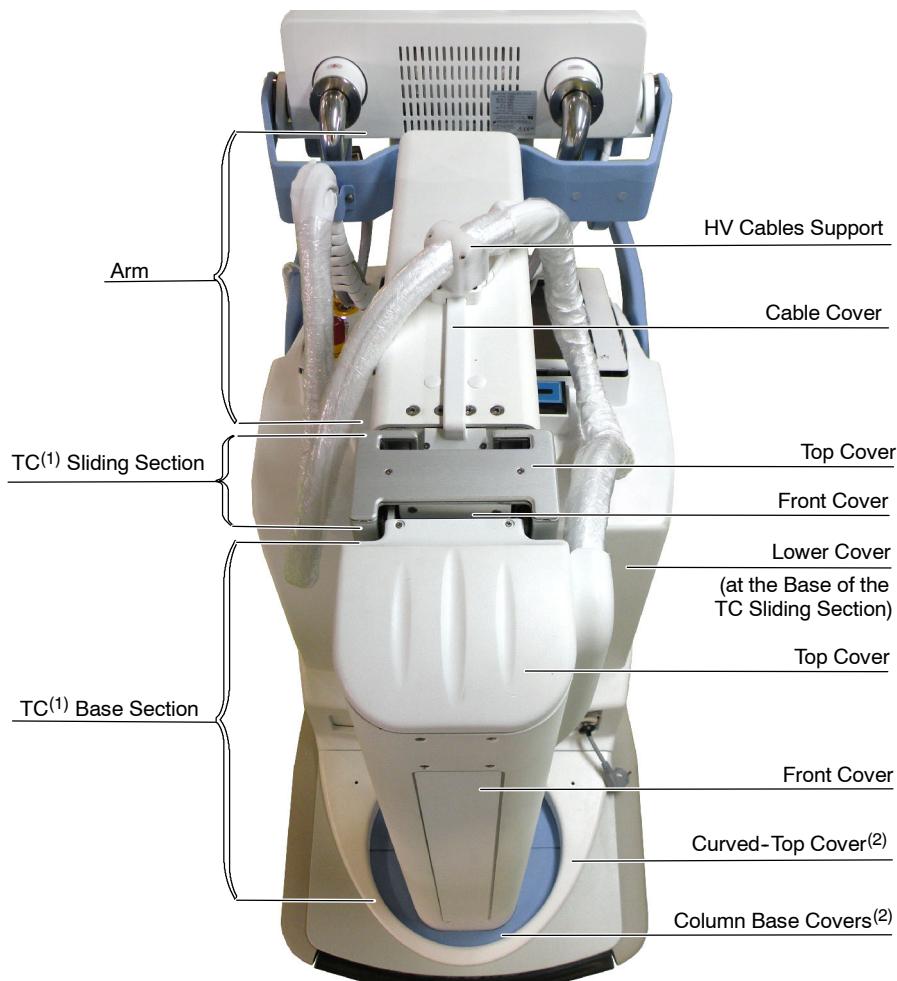
Mobile Units with reinforced Frame



2.2.2.2 BACK COVERS

Note 

*To dismount the **Back Covers**, proceed as described for Mobile Units with Standard Column in Section 2.2.1.4.*

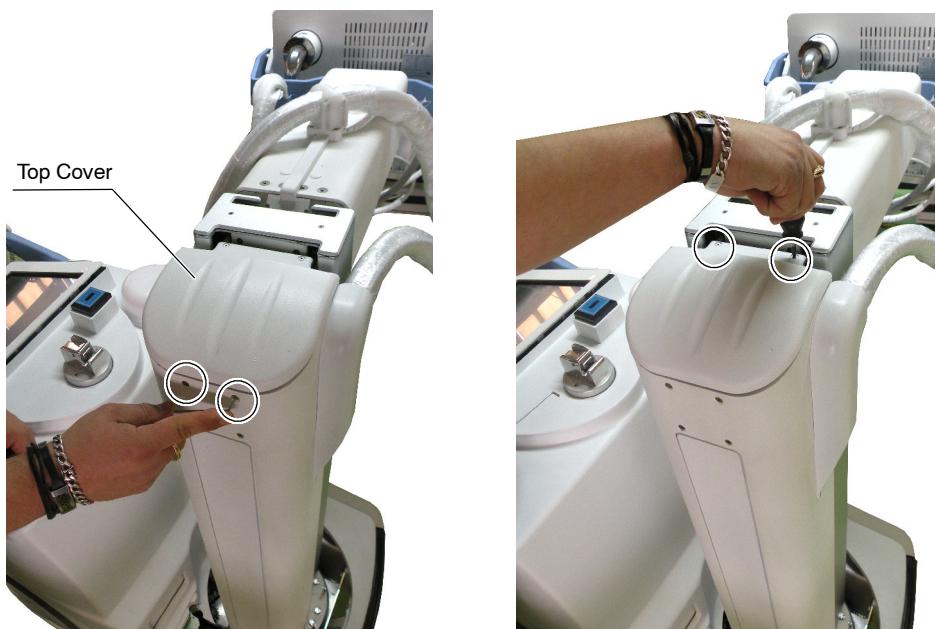
2.2.2.3 TELESCOPIC COLUMN (TC) AND ARM COVERS

(1) TC = Telescopic Column

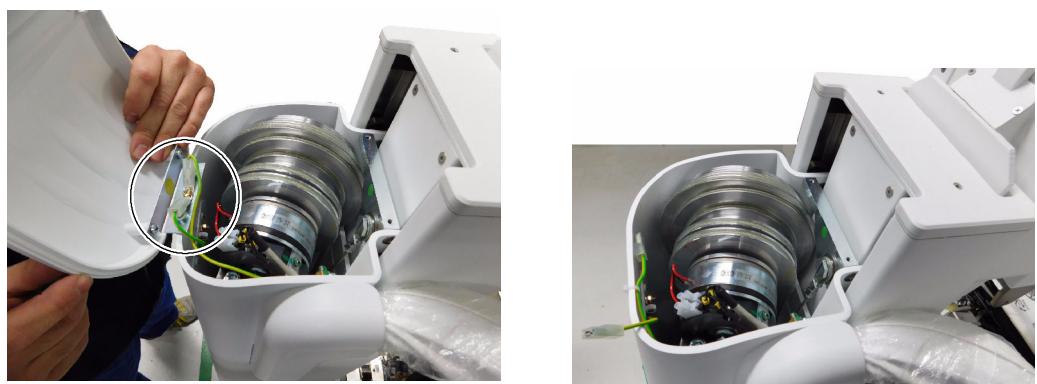
(2) Refer to Section 2.2.2 for Front Covers

TELESCOPIC COLUMN (TC) - BASE SECTION COVERS

1. Remove the four (4) Screws that secure the Top Cover of the TC Base Section.



2. Dismount without removing the Top Cover of the TC Base Section in order to disconnect GND Connectors. Then, remove the Top Cover.



Mobile X-Ray Unit

Troubleshooting

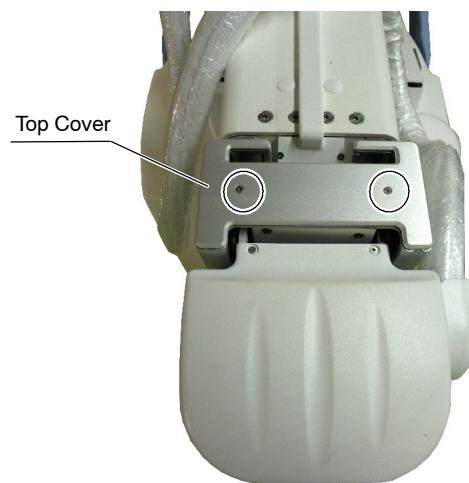
3. Remove the four (4) Screws that secure the Front Cover of the TC Base Section.

Remove the Front Cover from inside the TC Base Section by sliding upwards.

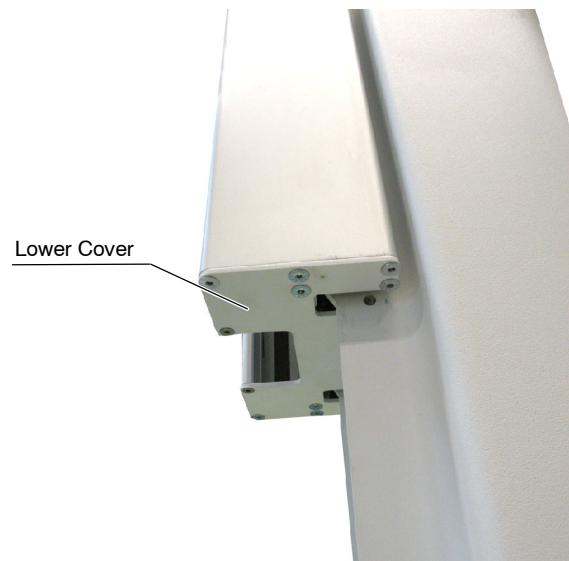


TELESCOPIC COLUMN (TC) - SLIDING SECTION COVERS

1. Remove the two (2) Screws that secure the Top Cover of the TC Sliding Section.



2. Remove the twelve (12) Screws that secure the Lower Cover of the TC Sliding Section and remove de Lower Cover.



Mobile X-Ray Unit

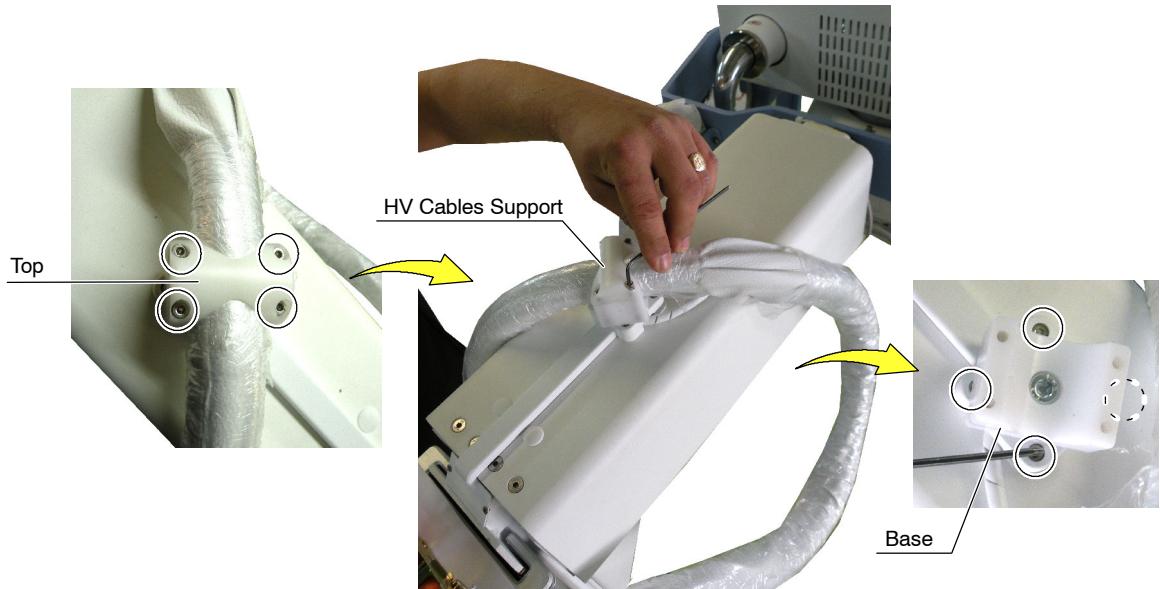
Troubleshooting

3. With the TC Sliding Section in the upward position, remove the six (6) Screws that secure the Front Cover of the TC Sliding Section and dismount the Front Cover.

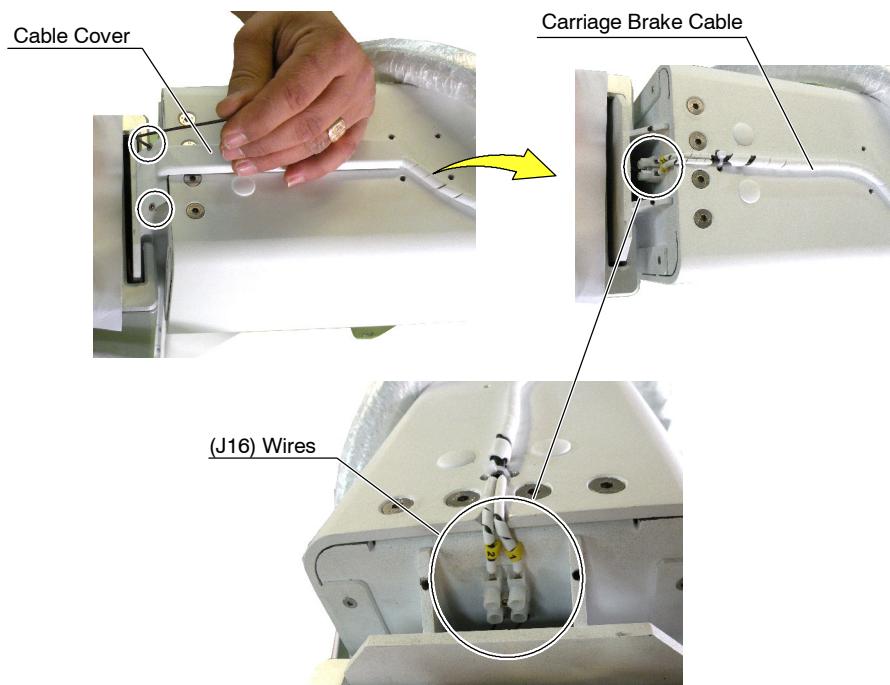


ARM COVERS / CONNECTORS

1. Remove the four (4) Screws of the HV Cables Support at the upper side of the Arm. Remove the HV Cables Support top and place the HV Cables aside. Remove the (4) Screws at the base of the HV Cables Support and dismount the HV Cables Support base.



2. Remove the two (2) Screws of the Cable Cover and dismount the Cover. Note of the position of both wires into the terminals and disconnect both wires of the Carriage Brake Cable (J16), isolate the wire ends with electrical tape.



2.2.3 CONSOLE ASSEMBLY**Note** 

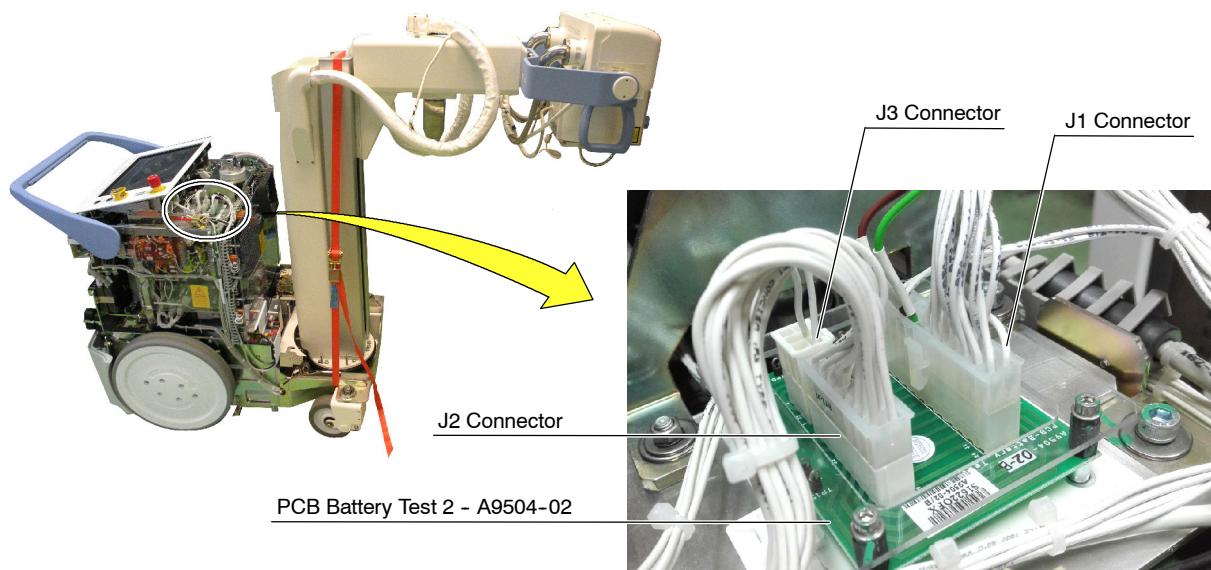
To access underside the Console in order to repair or replace the Emergency Switch OFF, the Switch ON/OFF Key, the Battery Monitor Board, the Power Line Lamp, the Collimator Lamp etc., remove the Console Frame and loose the Front Cover as shown in Section 2.2.1.2.



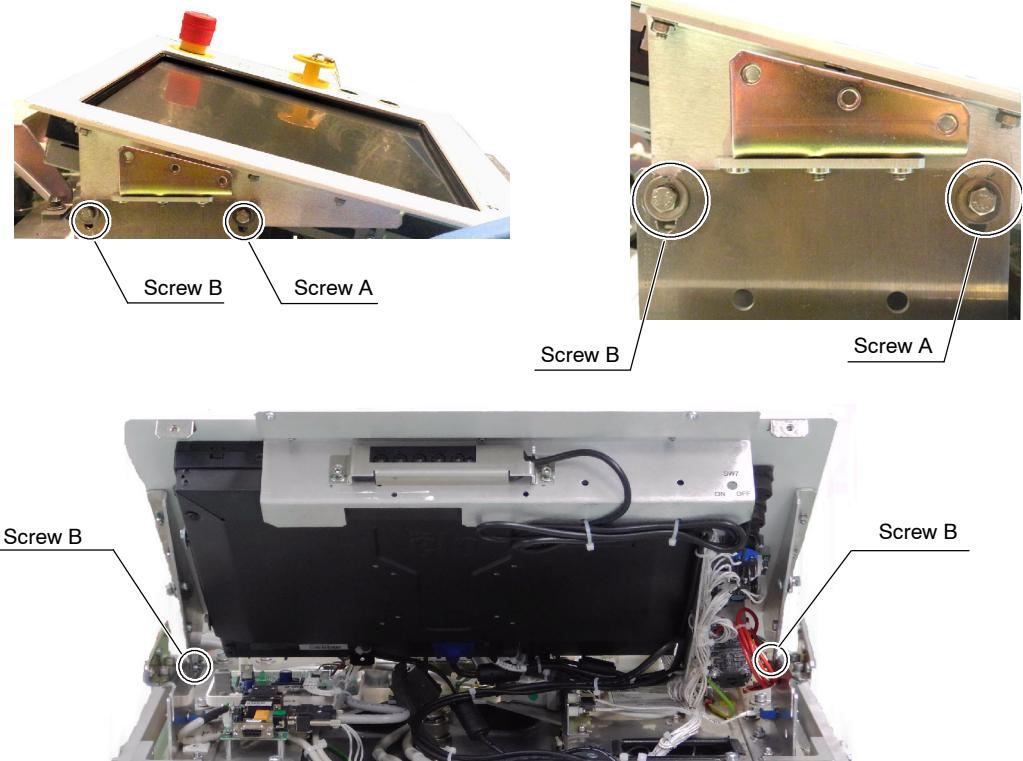
CAREFULLY HANDLE ALL THE INTERNAL PARTS OF THE EQUIPMENT, ESPECIALLY PARTS LOCATED UNDER THE COVERS; DANGEROUS DC VOLTAGE IS PRESENT IN THE UNIT EVEN WHEN UNPLUGGED FROM THE AC LINE.

WHEN IT IS NEEDED TO MANIPULATE ANY INTERNAL PART, DISCONNECT THE UNIT FROM MAINS, SWITCH OFF THE LINE CIRCUIT BREAKER, ACTIVATE THE EMERGENCY SWITCH OFF AND REMOVE THE FRONT COVER. DISCONNECT J1, J2 AND J3 FROM THE PCB BATTERY TEST 2 (A9504-02) IN ORDER TO SAFELY HANDLE THE EMERGENCY SWITCH OFF, THE SWITCH ON/OFF KEY, THE PCB BATTERY TEST 2, ETC. THIS ACTION IS NOT NEEDED TO REPLACE THE TOUCH SCREEN MONITOR.

REFER TO SCHEMATIC 543022XX FOR FURTHER INFORMATION. AFTER SERVICING, ENSURE THAT THE EMERGENCY SWITCH OFF IS ACTIVATED BEFORE RECONNECTING J1 AND J2.



To access inside the Console Assembly loose without removing the two (2) Screws A and the two (2) Screws B located at both sides of the Console, lift up the lower end of the Console and tighten both screws B to fix it in place. Do not pinch the cables or connections.

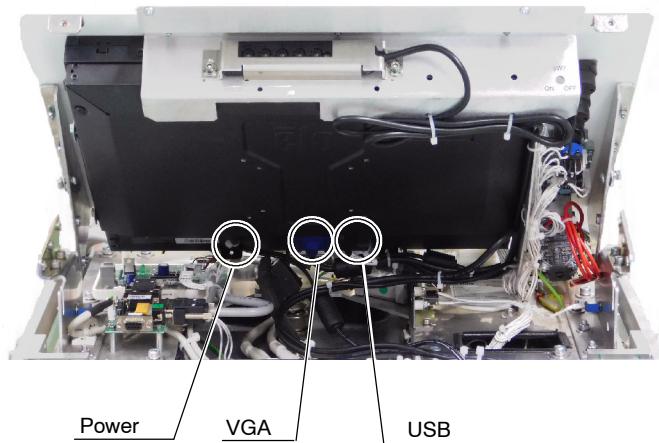


Note

If it is necessary to replace the Touch Screen Monitor, follow the Section 2.2.3.1.

2.2.3.1 REPLACEMENT OF THE TOUCHSCREEN MONITOR

1. With the Console Assembly lifted up as described in previous section, cut the necessary tie wraps of the cables connected to the Monitor.



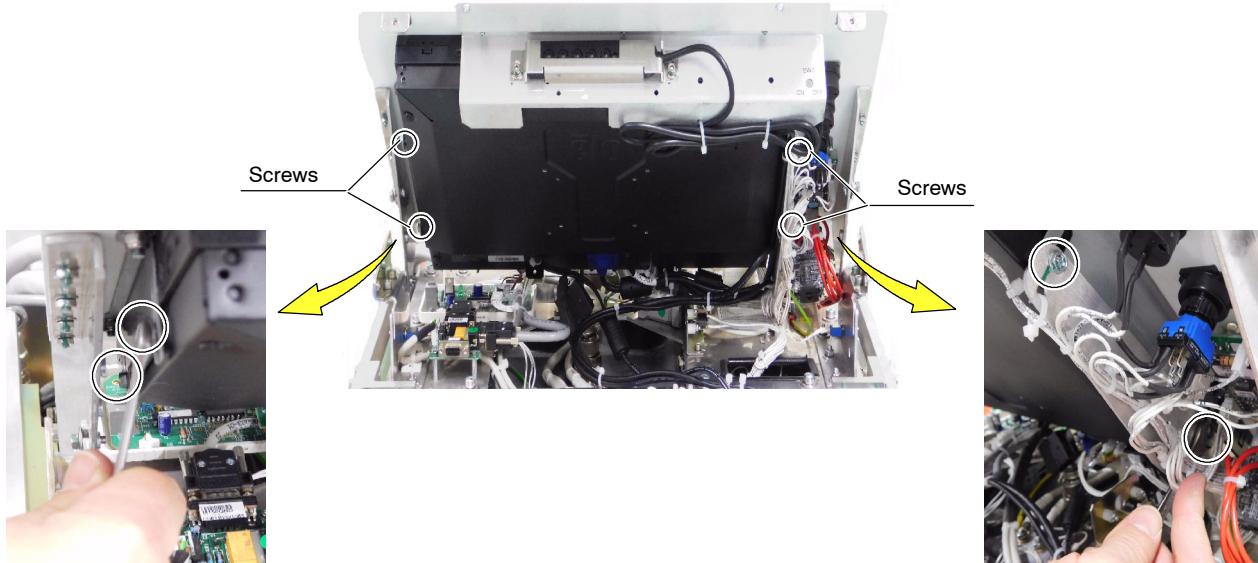
2. Cut the OSD cable tie wraps and dismount the OSD Control and its support. Place them on an auxiliary table beside the equipment.



OSD Control and its Support

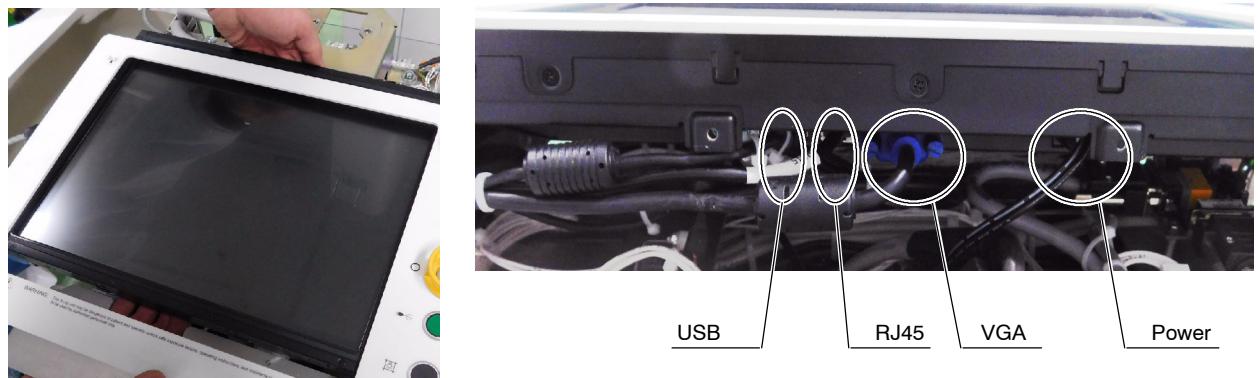


3. Remove the four screws to dismount the Monitor.



4. Carefully, while holding the screen, put the Console Assembly down with space enough to:

- a. Disconnect the Monitor cables (Power, VGA for Video, USB for Touch Sensor) except from the OSD Control cable plugged at the RJ45 connector.



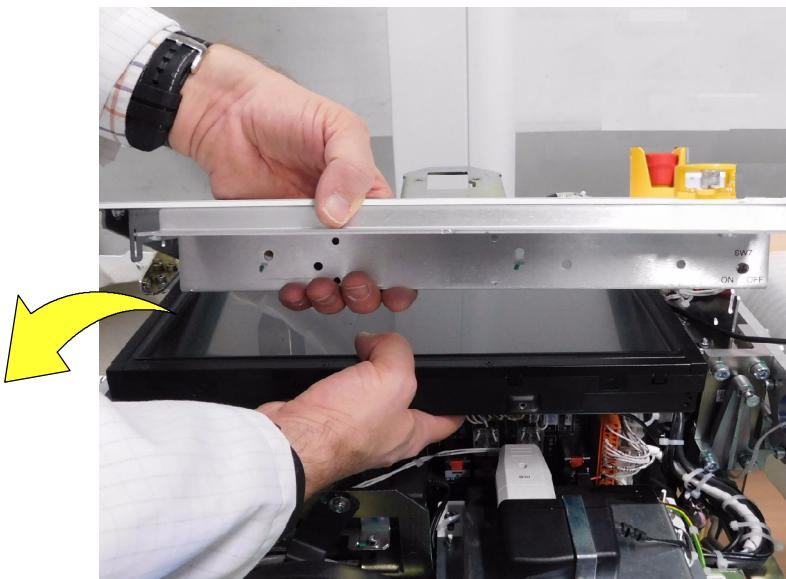
Mobile X-Ray Unit

Troubleshooting

5. Move the Monitor backwards to disengage it from its Frontal Support.



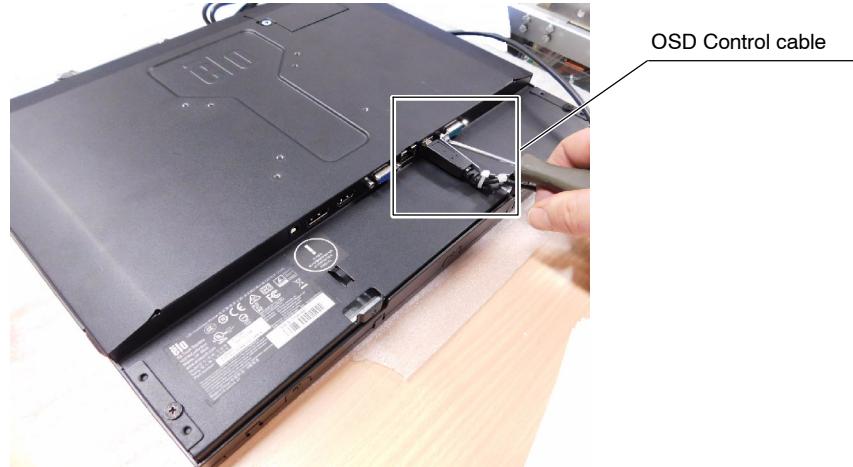
6. Lift the Console Frame and move the Monitor forward in order to release it.



7. Place the screen on the auxiliary table beside the equipment.



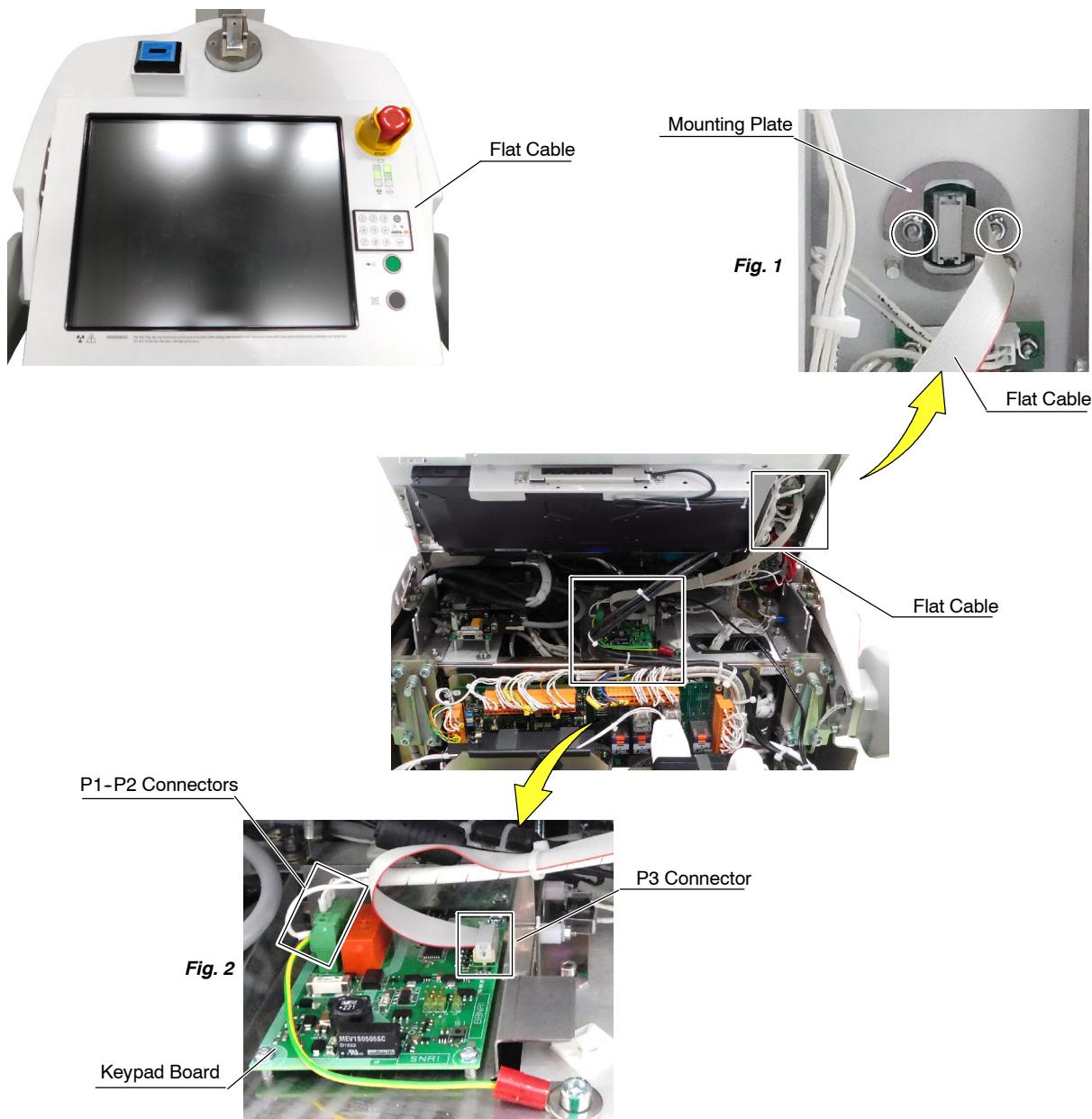
8. Remove the OSD Control cable.



9. Replace the Touch Screen Monitor and install the OSD Control cable.
10. Install the new Monitor following the previous steps in reverse order, connecting the cables and using tie wraps as necessary.

2.2.3.2 REPLACEMENT OF THE KEYPAD (OPTION)

1. For units with Keypad (option) for Access Control, turn the unit OFF and lift the Console Assembly as described in *Section 2.2.3*.
2. Remove the Fixing Screws (x2) from the Mounting Plate underneath the Control Panel; disconnect the Flat Cable from the Keypad (see *Fig. 1*).



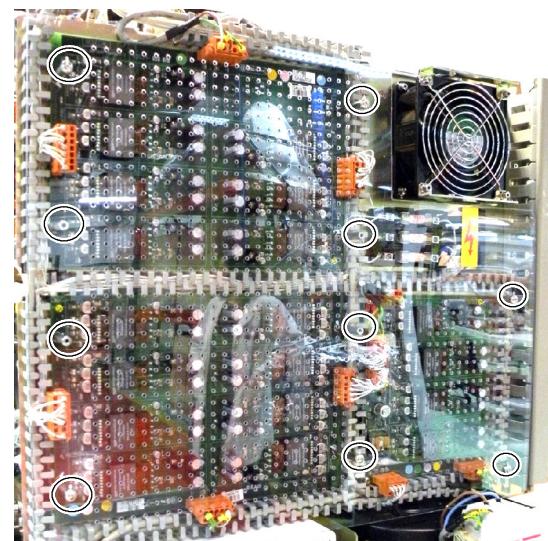
3. Disconnect the Flat Cable Connector from P3 and Connectors from P1 and P2, from the Keypad Board located on the Chassis of the unit, underneath the Console Assembly (see *Fig. 2*). Remove the Fixing Screws (x4) from the Board.

4. Inspect all parts and replace as necessary.
5. Repeat the previous steps in reverse order.
6. Perform a functional check:
 - a. Turn the unit ON by pressing and holding a second the ON/OFF control on the Keypad.
 - b. Insert the password (92643718 set by default).
 - c. Press Enter.
7. Reinstall the covers to the unit.

2.2.4 BATTERY CHARGERS COVER

This internal cover is under the Front Cover of the Unit, so the Front Cover has to be previously removed, *refer to Section 2.2.1 for Mobile units with Standard Column or in Section 2.2.2 for Mobile units with Telescopic Column (option)*.

Remove the screws of the Battery Chargers Cover and dismount the cover.



2.3 PARKING DETENT REPLACEMENT

The Parking Detent device is comprised by the Lock and the Catch.



2.3.1 PARKING LOCK REPLACEMENT

1. Release the Mobile Unit from the Parking position placing the Telescopic Arm fully extended at an easily accessible height.



Note 

For **Shaft replacement** only:

- Remove the Screws (x2) with the washers fixing the Shaft to the Parking Lock of the unit and dismount the Shaft.

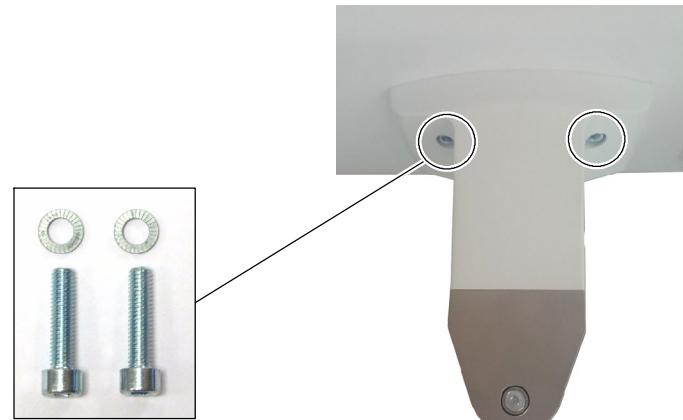
- Identify the Shaft, and replace it by the same Shaft version previously installed in the Parking Lock, the old or the new, both included in the spare parts kit:

1. New Shaft: M5x8 mm Pan Head Allen Screw (x2); Axis 52 mm; Black Cover 45 mm.

2. Old Shaft: M5x16 mm Flat Head Allen Screw (x2); Axis 44 mm; Black Cover 43.8 mm.



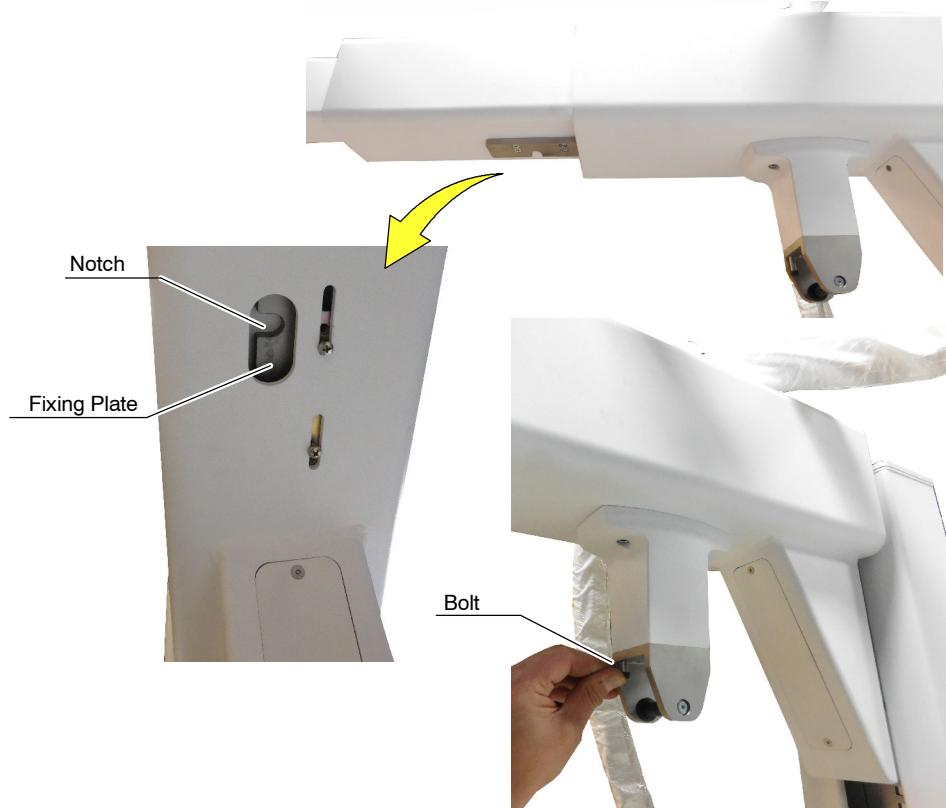
2. Remove the two (2) fixing Screws and the Nord-Lock Washers and dismount the Parking Lock mechanism from the Arm.



3. Mount the new Parking Lock mechanism to the Fixing Plate, securing it with the two (2) Screws and the two (2) Nord-Lock Washers removed before. Do not fully tighten the Screws yet, in order to adjust the Parking Lock at the end of the process.



4. Fully retract the Telescopic Arm. Press on the Bolt of the Parking Lock while adjusting its position on the Arm, until fitting the Bolt into the Notch of the Fixing Plate located in the intermediate Segment of the Arm.

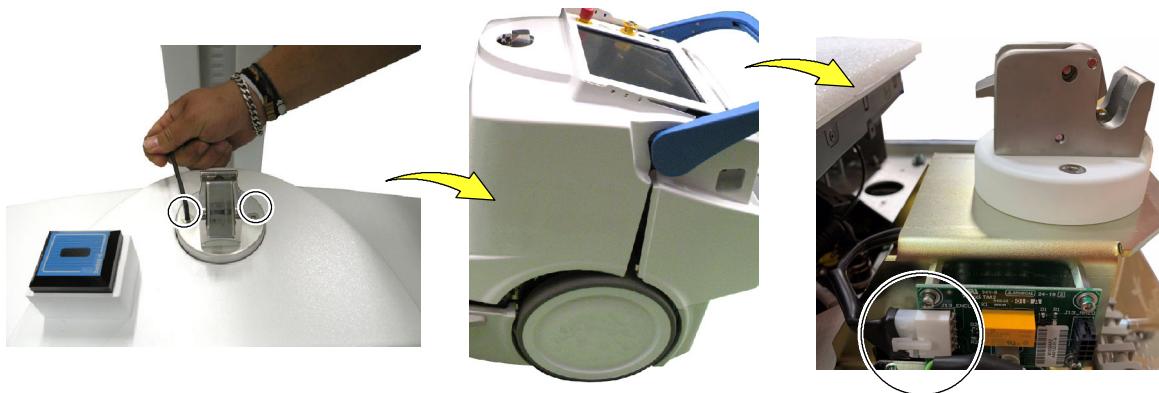


5. Place the Arm in the Parking position in order to check that it is properly centered. Finally, place the Arm out of the Parking Position and tighten the Fixing Screws (x2) of the Parking Lock Mechanism.



2.3.2 PARKING CATCH REPLACEMENT

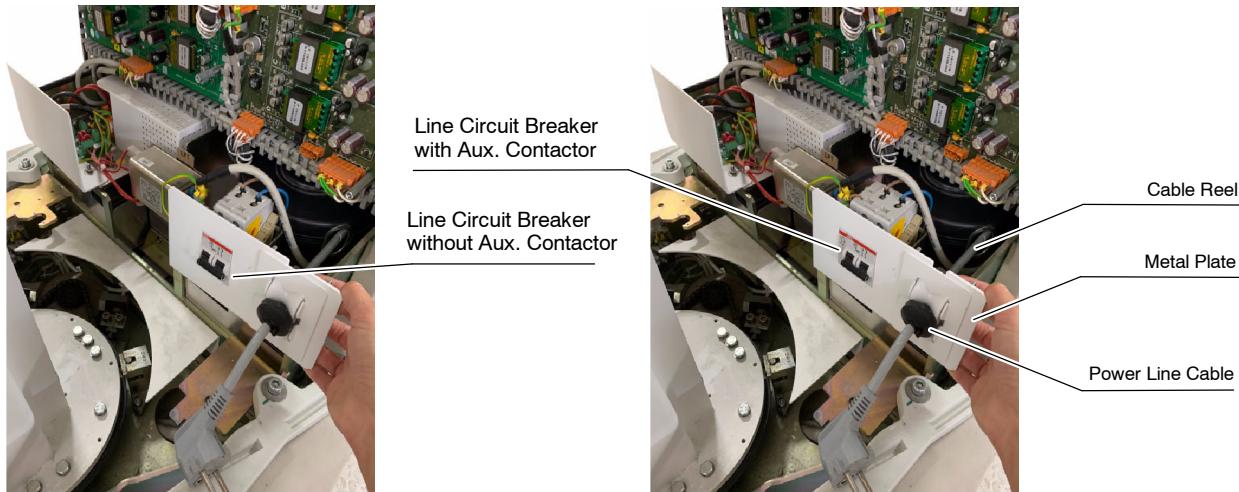
1. Release the Mobile Unit from the Parking position in order to access the Parking Catch mechanism.
2. Remove two (2) screws to dismount the Catch of the Parking Detent device, keep it loose in order to remove the covers. Then disconnect the Sensor Signal Cable connector J13.



3. Replace the Catch, connecting the Sensor Signal Cable connector J13 and mounting the two fixing screws.

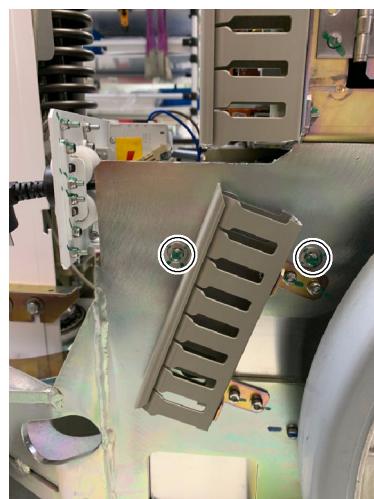
2.4 REPLACEMENT OF POWER LINE CABLE, LINE CIRCUIT BREAKER AND PFC1000 BOARD

1. In order to access to the Power Line Cable, the Line Circuit Breaker and the PFC1000 Board, turn OFF the unit and disconnect the Power Line Cable from mains. Then, remove the Back and the Front Covers; refer to Section 2.2 of *Covers Removal*.

**Note**

Depending on the date of manufacture of the unit, the Line Circuit Breaker may or may not be equipped with an Auxiliary Contactor.

2. Remove the Screws that fix the tray containing the Power Line Cable assembly and the Line Circuit Breaker to both sides of the chassis: two (2) screws in the right side and two (2) screws in the left side.



3. Slide the tray containing the Power Line Cable assembly and the Line Circuit Breaker block, as shown in the pictures below.



4. Follow the indications in section 2.4.1 in order to replace the Line Circuit Breaker, follow the indications in section 2.4.2 in order to replace the Power Line Cable and follow the indications in section 2.4.3 in order to replace the PFC1000 Board.

2.4.1 REPLACEMENT OF THE LINE CIRCUIT BREAKER**Note** 

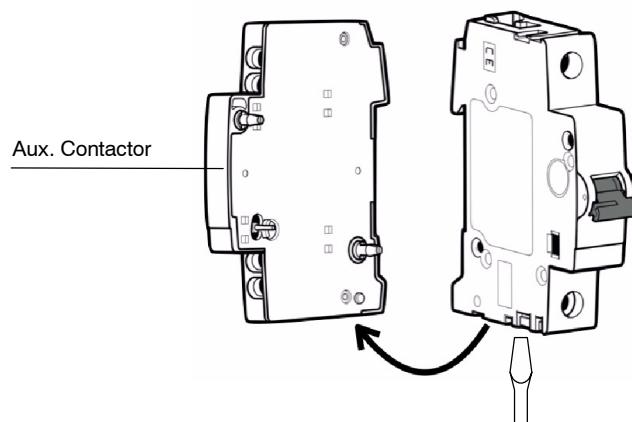
Depending on the date of manufacture of the unit, the Line Circuit Breaker may or may not be equipped with an Auxiliary Contactor.

The Line Circuit Breaker spare part is a generic component supplied with an Auxiliary Contactor, so if it is not needed, remove it by levering it with a flat screwdriver.

Line Circuit Breaker
without Aux. Contactor



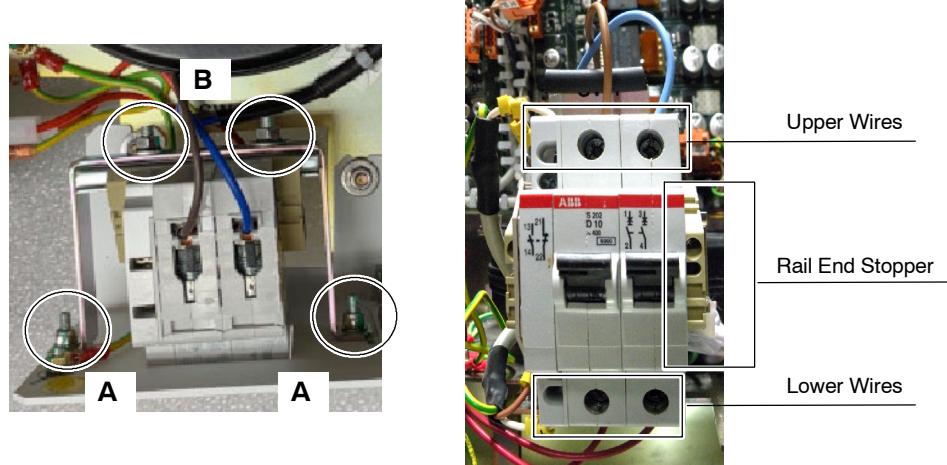
Line Circuit Breaker
with Aux. Contactor



1. Remove the fixing screws (2) at both sides of the Line Circuit Breaker block in order to remove the Metal Plate.



2. Remove the two Nuts (A) of the Line Circuit Breaker Support and dismount the whole Assembly. Remove the two Nuts (B) of the Circuit Breaker Rail. Remove the Rail End Stopper, disconnect the upper and lower wires and finally, slide the Line Circuit Breaker block in order to replace it.



3. Follow the steps in *Section 2.4* in reverse order until mounting all the unit covers back in place.

2.4.2 REPLACEMENT OF THE POWER LINE CABLE AND/OR THE METAL PLATE**Note** 

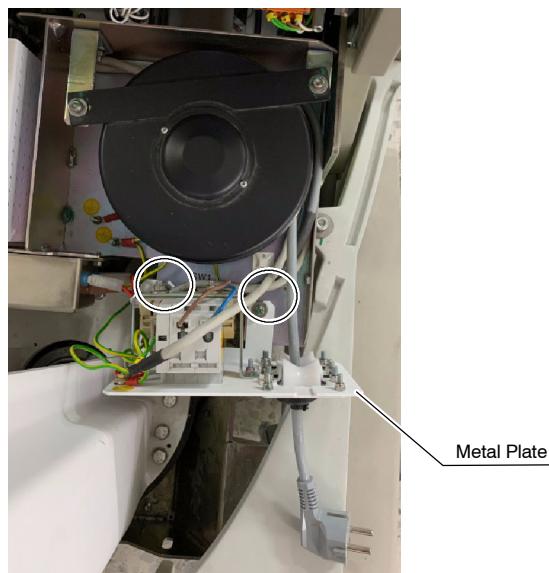
The Cable Reel is provided with the specific Plug according to the country. Metal Plate with Rollers is another Spare Part which is not included in the Cable Reel Spare Part (except in the Upgrade Kit)

The Cable Reel Upgrade Kit includes the Cable Reel with its Cord installed through the Metal Plate Rollers.

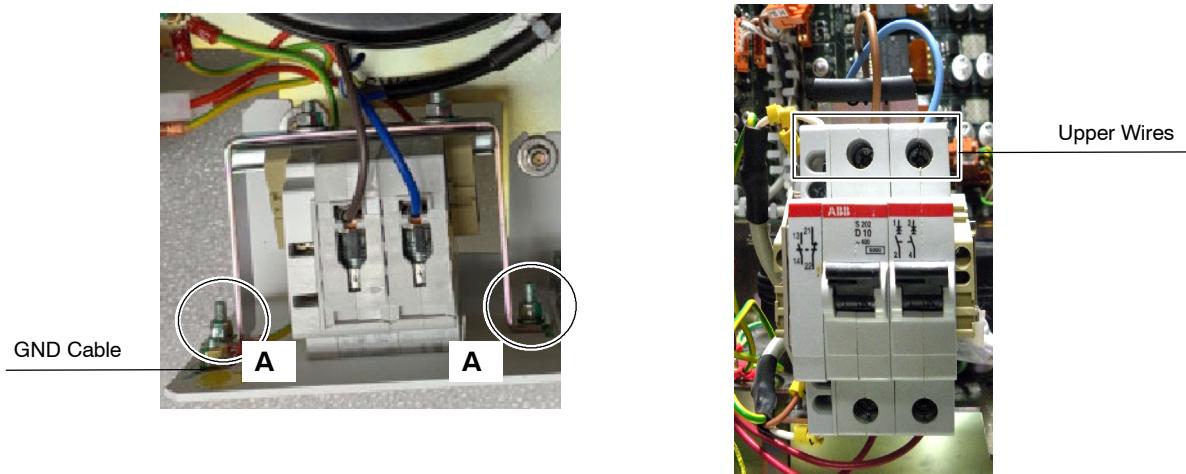
Follow the procedure according to the Spare Part to be replaced based on the three scenarios.

CABLE REEL UPGRADE KIT

1. Remove the fixing screws (2) at both sides of the Line Circuit Breaker block in order to remove the Metal Plate.



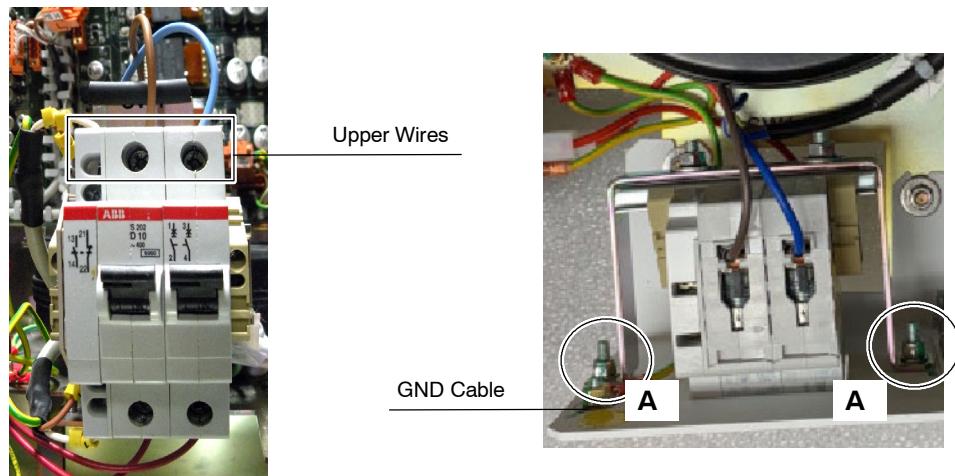
2. Remove the two Nuts (A) of the Line Circuit Breaker Support and the GND Cable connected to the Plate. Place aside the Line Circuit Breaker Assembly and disconnect the upper wires of the Line Circuit Breaker.



3. Remove the fixing screws of the current Cable Reel and disconnect GND cable. Install the new Cable Reel and connect the GND cable.



4. Connect the upper wires of the Line Circuit Breaker and install the Line Circuit Breaker Assembly in the new Metal Plate using the two Nuts (A), then connect the GND Cable in the Metal Plate.



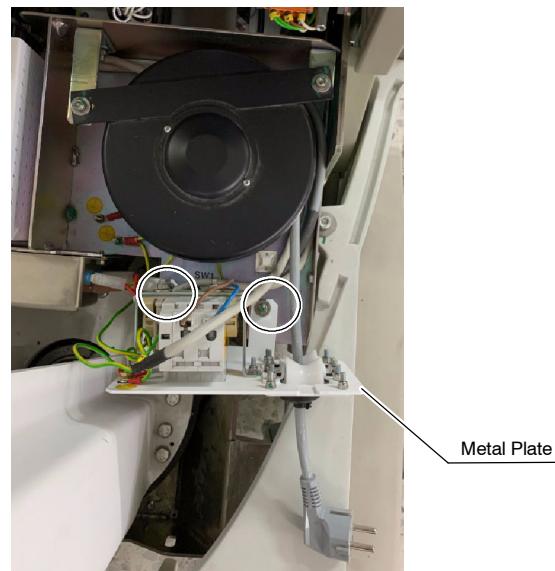
5. Install the new Metal Plate into the Mobile Chassis with the fixing screws (2) at both sides of the Line Circuit Breaker block.



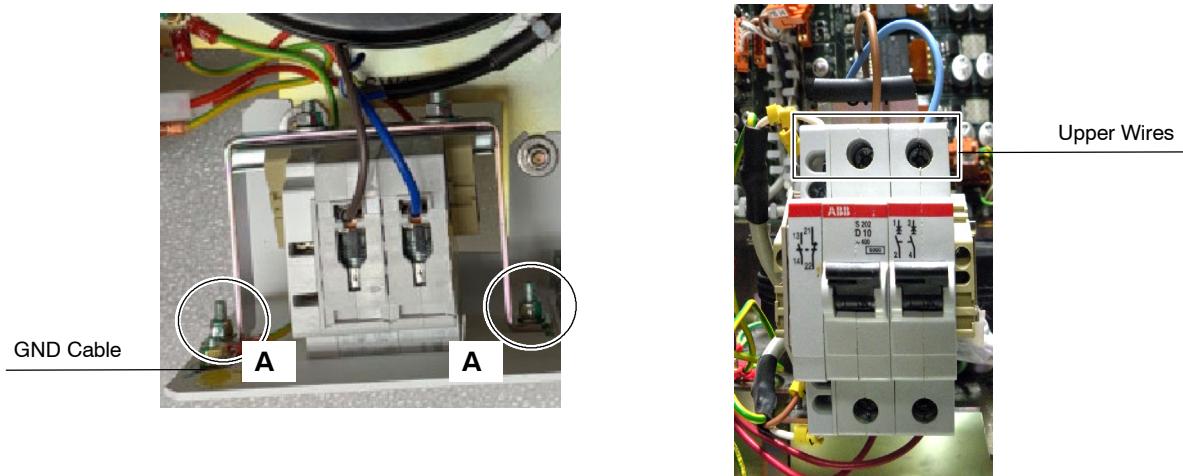
6. Follow the steps in *Section 2.4* in reverse order until mounting all the unit covers back in place.

ONLY CABLE REEL

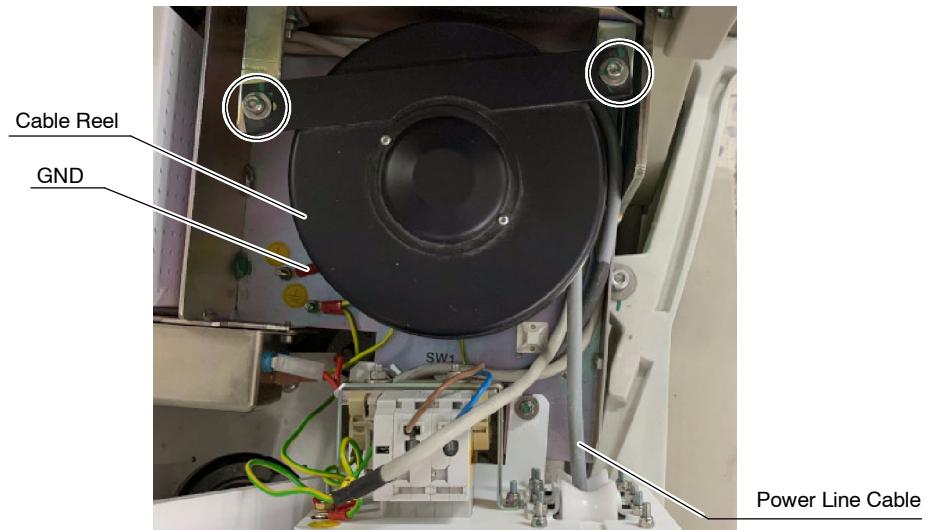
1. Remove the fixing screws (2) at both sides of the Line Circuit Breaker block in order to remove the Metal Plate.



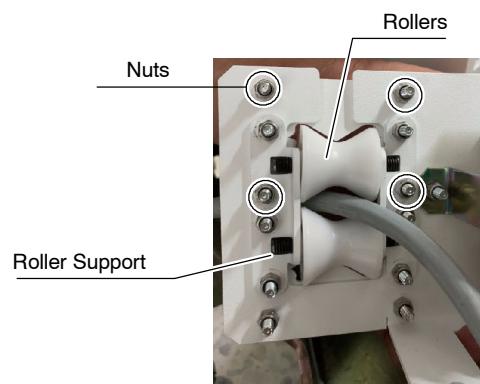
2. Remove the two Nuts (A) of the Line Circuit Breaker Support and the GND Cable connected to the Plate. Place aside the Line Circuit Breaker Assembly and disconnect the upper wires of the Line Circuit Breaker.



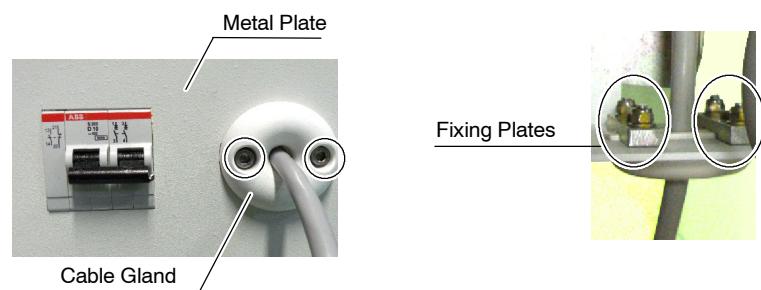
3. Remove the fixing screws of the Cable Reel and disconnect GND.



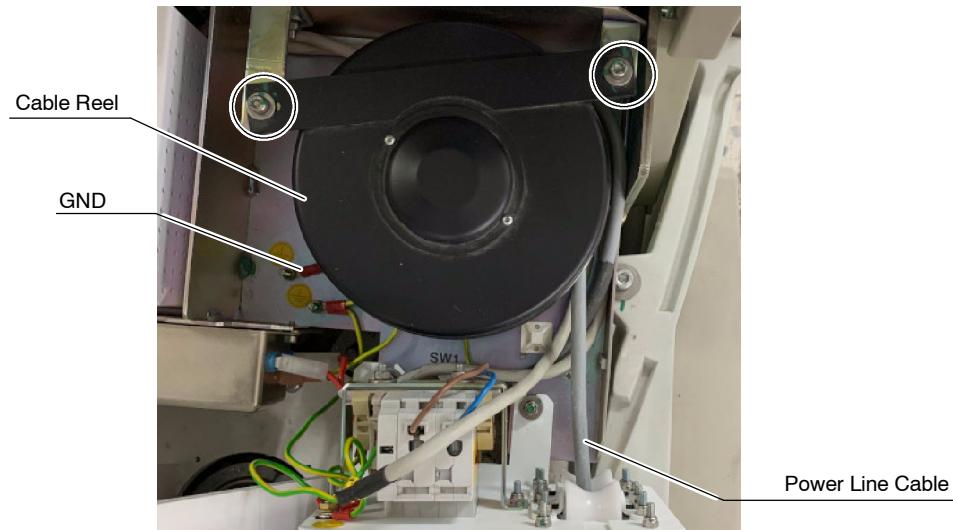
4. Unscrew the four (4) Nuts indicated in the illustration below that hold the Upper Roller to the Plate, loosen the part that holds this Roller and remove the Cord of the old Cable Reel. Pass the new Power Line Cable through the slot and reinstall the Upper Roller and its Support by screwing again the four (4) Nuts.



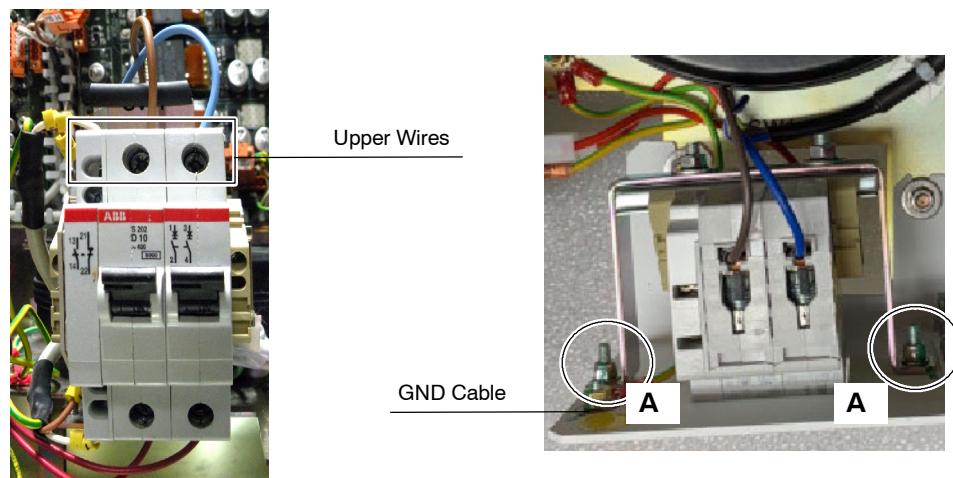
For Units with Cable Reel without Rollers, unscrew the four (4) Nuts indicated in the illustration below to release the two (2) Fixing Plates of the old Metal Plate. Remove the Cord of the old Cable Reel. Then, pass the new Power Line Cable through the slot and reinstall in reverse order.



5. Install the Cable Reel with the two (2) fixing screws and connect the GND wire.



6. Connect the two upper wires in the Line Circuit Breaker. Reinstall the Line Circuit Breaker Assembly using the two Nuts (A) and connect again the GND Cable.



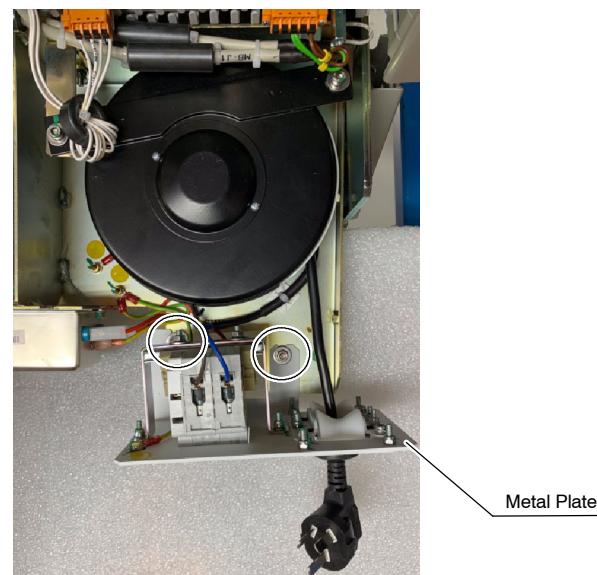
7. Reinstall the Metal Plate into the Mobile Chassis with the fixing screws (2) at both sides of the Line Circuit Breaker block.



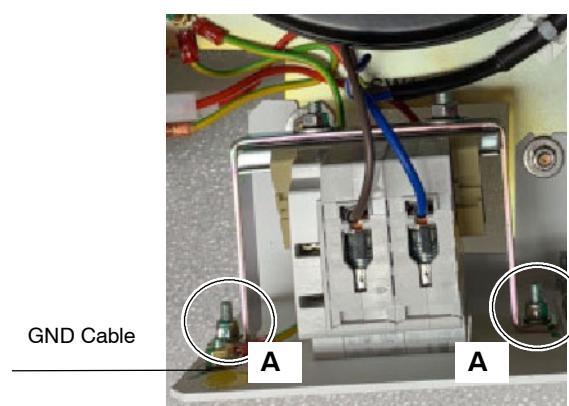
8. Follow the steps in *Section 2.4* in reverse order until mounting all the unit covers back in place.

ONLY METAL PLATE

1. Remove the fixing screws (2) at both sides of the Line Circuit Breaker block in order to remove the Metal Plate.



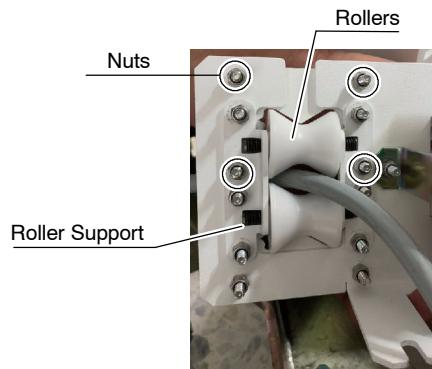
2. Remove the two Nuts (A) of the Line Circuit Breaker Support and the GND Cable connected to the Plate. Place aside the Line Circuit Breaker Assembly. It is not necessary to disconnect any cable of the Circuit Breaker.



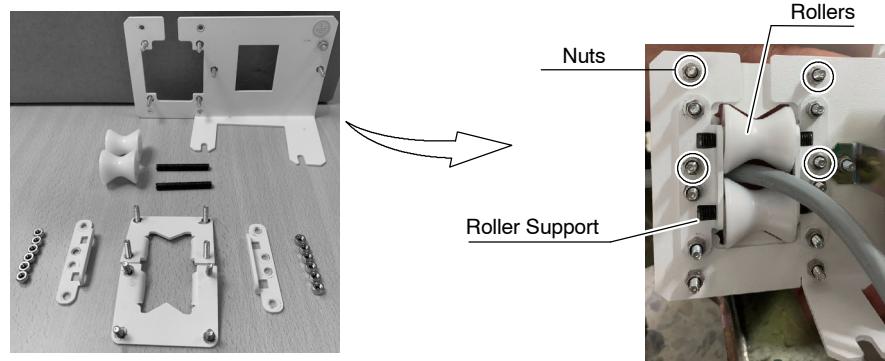
Mobile X-Ray Unit

Troubleshooting

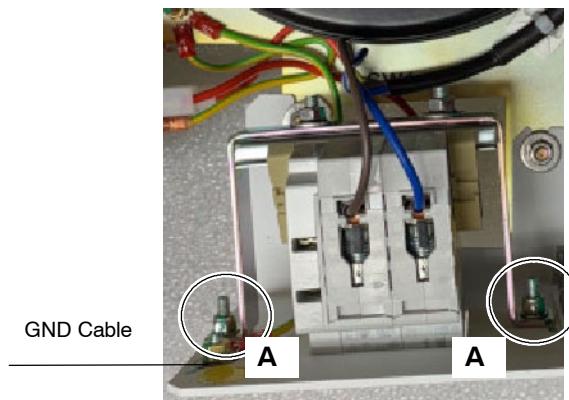
3. In the current Metal Plate, unscrew the four (4) Nuts indicated in the illustration below that hold the Upper Roller to the Plate, loosen the part that holds this Roller and remove the Power Line Cord of the Cable Reel.



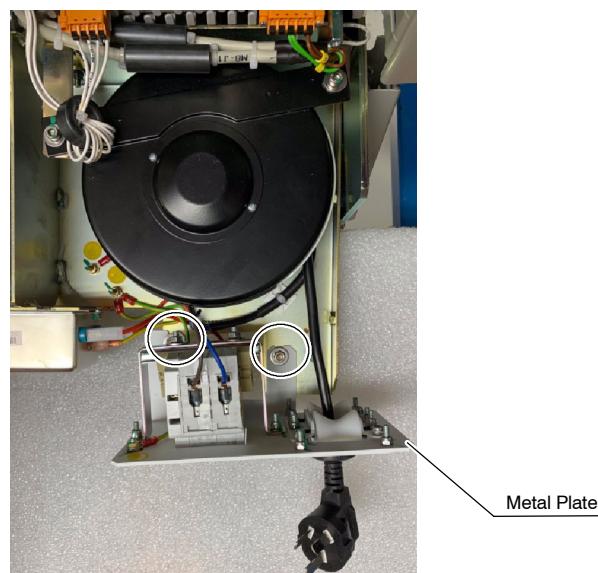
4. In the new Metal Plate, mount the Power Line Cable between the Rollers and fix the Rollers with their Supports and Nuts to the Metal Plate.



5. Reinstall the Line Circuit Breaker Support using the two Nuts (A) and connect the GND Cable to the Plate.



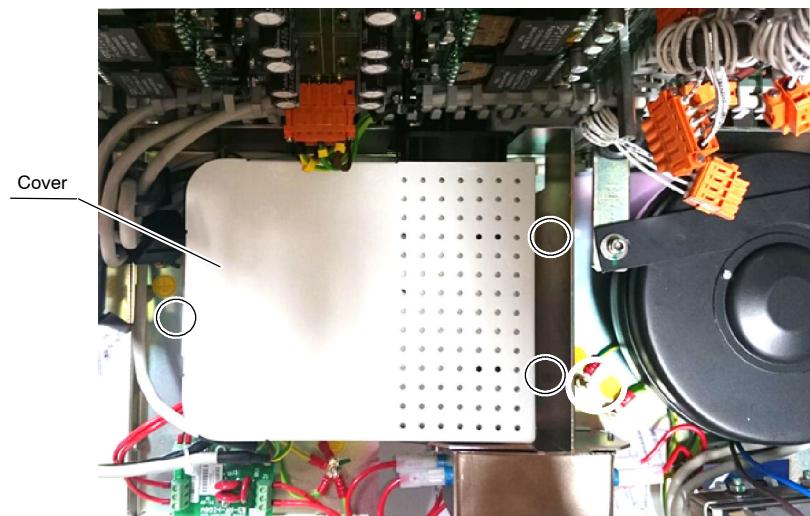
6. Reinstall the Metal Plate into the Mobile Chassis with the fixing screws (2) at both sides of the Line Circuit Breaker block.



7. Follow the steps in *Section 2.4* in reverse order until mounting all the unit covers back in place.

2.4.3 REPLACEMENT OF THE PFC1000 BOARD

1. Remove the three (3) Fixing Nuts and remove the Cover of the PFC1000 Board.



2. Disconnect J1, J2, J3 and J4; remove the four (4) Fixing Screws of the PFC1000 Board and replace it.



3. Connect J1, J2, J3 and J4 secure the PFC1000 Board with the Fixing Screws, place the Cover and secure it with the Fixing Nuts.

2.5 REPLACEMENT OF FUSES

In order to replace the Fuses of the unit refer to the Renewal Parts chapter to find its position inside the unit.

Table 2-2

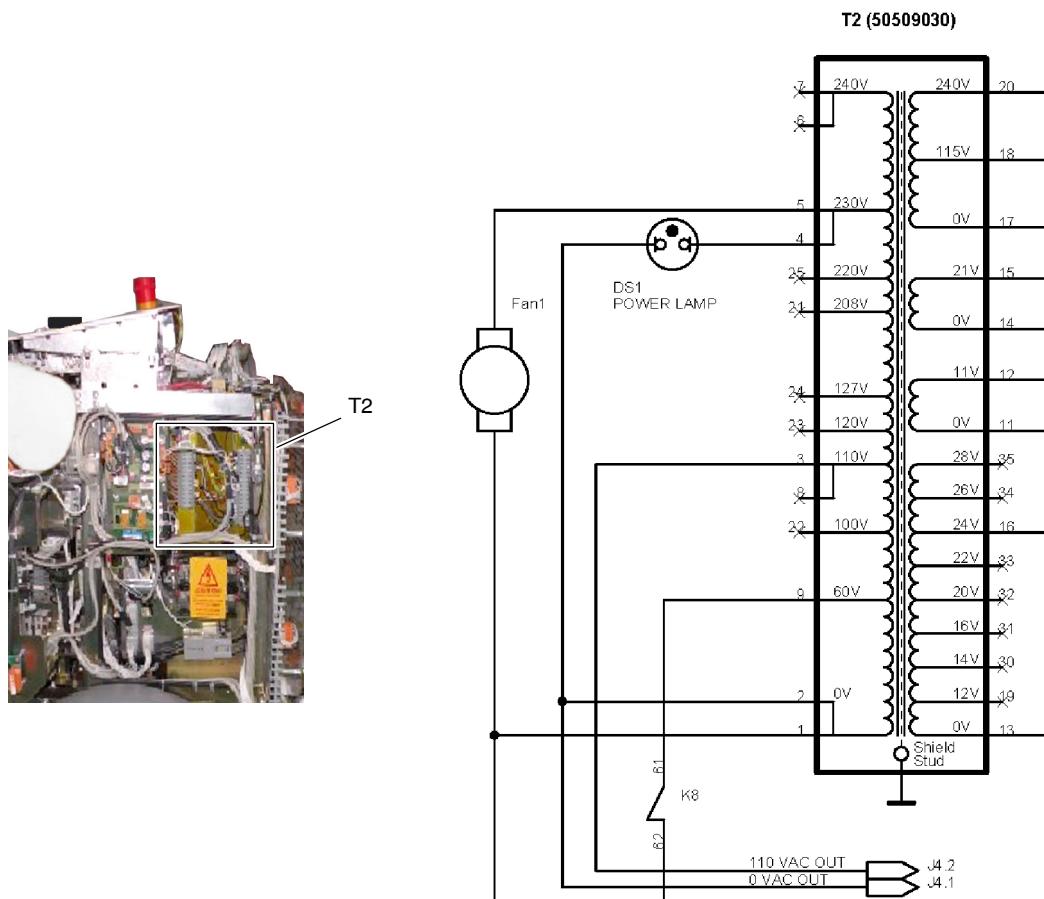
Fuses

Position in the Unit	Fuse	Voltage	Current	Operating Speed	Breaking Capacity
Input Line	F1	600 VAC	35 A (for 20 or 32 kW) 50 A (for 40 or 50 kW)	SLOW	300 KA
	F9	600 VAC	35 A (for 20 or 32 kW) 50 A (for 40 or 50 kW)	SLOW	300 KA
Generator Front Panel	F2	250 VAC	1.5 A	SLOW	100 A
	F7	250 VAC	3 A	SLOW	100 A
	F8	250 VAC	3 A	SLOW	100 A
	F6	250 VAC	6.25 A	SLOW	100 A
Low Voltage Power Supply	F5	250 VAC	0.4 A	SLOW	100 A
LF-RAC	F1	250 VAC	6 A	SLOW	200 A
Brake Board	F1	250 VAC	10 A	SLOW	400 A
	F2	250 VAC	10 A	SLOW	400 A
Front Area (Charger Module)	F10	600 VAC	6 A	FAST	100 KA
	F11	600 VAC	6 A	FAST	100 KA
	F12	500 VAC	10 A	SLOW	10 KA
Battery Trays	F13-F32	250 VAC	10 A	SLOW	10 KA
	F33, F37	250 VAC	10 A	FAST ACTING	10 KA
	F34, F35, F36	250 VAC	2 A	FAST ACTING	10 KA
Back Area (aerial over Digital Motion Control Board)	F38	250 VAC	1 A	FAST ACTING	100 A

2.6 PROCEDURE FOR CHANGING THE INPUT VOLTAGE

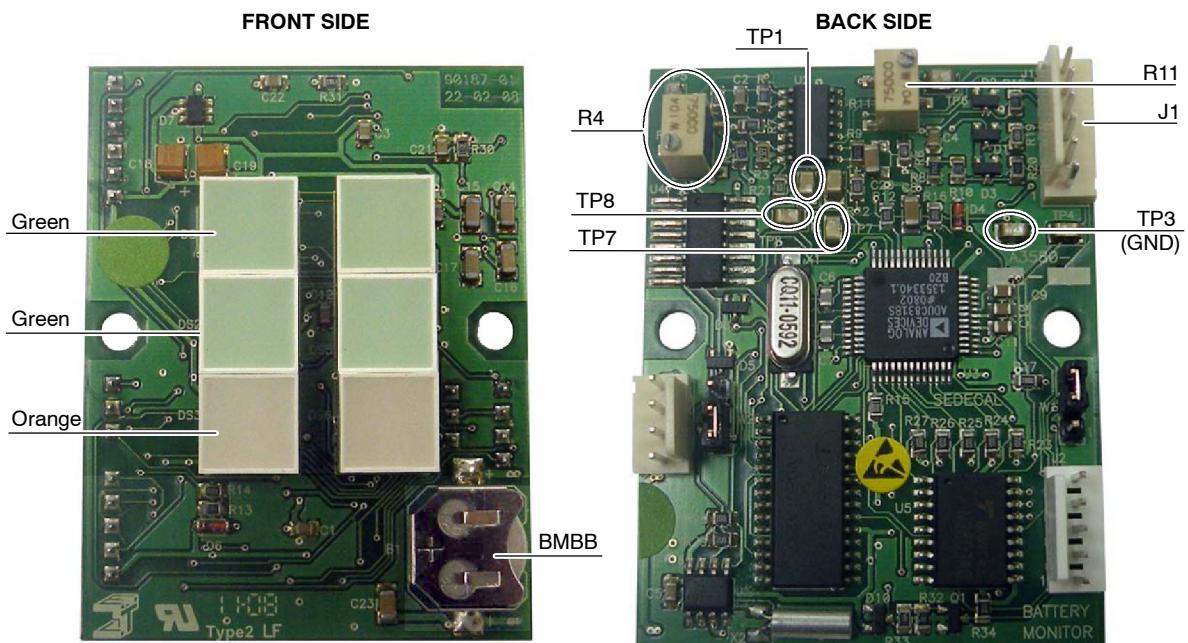
1. Identify the wire labelled as TRF-3-4 in the Input Transformer T2. This wire goes from the relay K8-44 to the Transformer T2 (*Refer to General Schematic 54302xxx*).
2. Connect the wire labelled as TRF-3-4 of the step 1 to the terminal of the Input Transformer T2 according to the mains supply voltage and proceed as indicated in the Table below.

If Mains Supply Voltage is	100 VAC	110 VAC	120 VAC	127 VAC	220 VAC	230 VAC	240 VAC
Connect wire TRF-3-4 to	T2.22	T2.3 or T2.8	T2.23	T2.24	T2.25	T2.4 or T2.5	T2.6 or T2.7



3. Change the plug of the power line cable of the mobile unit for 100/110/120/127/220/230/240 VAC according to the electrical plug of the country where the unit will be used (*refer to Section 2.4.2*).
4. If applicable, replace or modify the label on the Plate close to the Plug, according to the new Input Voltage set.

2.7 BATTERY MONITOR BOARD



The Battery Monitor Board is located on the underside of the Console Assembly. Follow the instructions in *Section 2.2.3 "Console Assembly"* to access to the Battery Monitor Board.

As indicated in *Section 1.3 "Information on Indicators and Charge Cycles"*, the total battery charge required for operation is displayed. The Battery Monitor Board applies a filter to this level to establish the available voltage which might not be the actual battery level, since the voltage of the Batteries can vary greatly depending on several factors (load, flotation voltage, elapsed time since it was disconnected to the charge, etc). This filter prevents sudden fluctuations and drops in the indicators during and after exposures. To disable the filter and display the actual battery level, refer to *Section 2.7.1*.

The reference for both the Generator and Motors Charge goes through the Battery Test Board (A9504-02) from the Battery Chargers. Generator voltage enters at J1-3 (VGen-) & J1-4 (VGen+) of the Battery Monitor Board. Motors voltage enters at J1-2 (Vmot) of the Battery Monitor Board.

2.7.1 DISABLE / ENABLE FILTER

To disable the Filter, shutdown the unit and make a jumper between TP7 (μ processor) & TP3 (GND). After startup, the actual level (sensitive and variable) appears.

To enable the filter, shutdown the unit and remove the jumper.

2.7.2 RESET OF THE NON-VOLATILE MEMORY

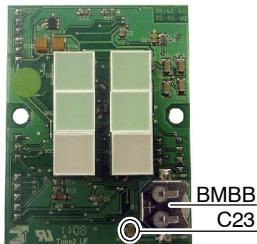


The Non-Volatile Memory of the Battery Monitor Board should not be reset except for service operations (after Batteries or Battery Monitor Board replacement), whenever a right charge level readout is required and the Batteries have not been charging for 9-10 hours minimum.

It is always recommended to charge the Batteries for 9-10 hours instead of resetting the Non-Volatile Memory.

To reset the Non-Volatile Memory, shutdown the unit and make a jumper between TP8 (uprocessor) and TP3 (GND), then restart the unit and wait for 30 seconds. Shutdown the unit, remove the jumper and restart the unit again. The Battery Monitor displays 100% of charge level and after fifteen (15) minutes establishes the right filtered level.

2.7.3 BATTERY MONITOR BOARD BATTERY (BMBB)



The BMBB is on the front side of the Battery Monitor Board. It provides 3V to a Non-Volatile Memory, storing the last level displayed. Upon startup, the stored level appears on the indicators until stabilized.

If the BMBB is discharged, the indicated level might be erroneous upon startup. This level is regulated to the actual battery voltage over time, but it is recommended to change this battery. If the Operator reports erroneous battery levels upon startup, perform the following test:

1. Measuring across Capacitor C23 should give 3V. Replace the Battery if this voltage is not present.
2. Charge the Batteries for 9-10 hours or reset the Non-Volatile Memory of the Battery Monitor Board (*as described in Section 2.7.2*).
3. If the problem persists, replace the Battery Monitor Board.

2.7.4 BATTERY CHARGE INDICATORS (OFF)

If Battery Indicators are not lit during operation, ensure that J5-2 on the Motors Battery Charger Board provides 5 VDC to J1-1 on the Battery Monitor Board (A3580-xx). This voltage runs across "Battery Test Board" (A9504-02) which can also be checked at TP13 (0V) and TP15 (5V). This board is located underneath the Console Assembly.

2.8 BATTERIES AND CHARGERS

2.8.1 PRELIMINARY LOAD CAPACITY TEST FOR GENERATOR BATTERIES

Note 

Since the Load Capacity Test for the Generator Batteries requires making a large number of exposures, it is recommended to place the unit in a leaded room.

The duration of this test will depend on the number of exposures allowed by the Generator batteries capacity, after performing a complete charging process.

1. Turn the Mobile Unit OFF and connect the plug to the mains for 10 hours.

Note 

Before performing this procedure, verify that the Unit has been connected to the mains for 9-10 hours, until the Battery Charge Level Indicators on both columns stop scrolling and the upper Green Indicators remain illuminated. This will ensure a complete and full Battery charging.

2. Disconnect the Mobile Unit from mains and turn it ON. If the Batteries are fully charged, only the upper Green Indicators on both columns are lit.
3. Close the Collimator Blades.
4. Set the Exposure parameters: 70 kV, 200 mA, 500 ms.
5. Start the exposure sequence making one exposure every 3 minutes, keeping track of the number of exposures performed, until the batteries are fully discharged and Error E-25 is displayed.

If the number of the total exposures performed are < 60 exposures, the batteries load capacity is lower than the 50%. In this case, all the Generator batteries (30) should be replaced.

2.8.2 PRELIMINARY TEST OF BATTERIES AND CHARGERS CONDITIONS**Note** 

Before performing this procedure, verify that the Unit has been connected to the mains for 9-10 hours, until the Battery Charge Level Indicators on both columns stop scrolling and the upper Green Indicators remain illuminated. This will ensure a complete and full Battery charging.



ALWAYS USE PROTECTIVE GLOVES TO PREVENT ELECTRIC SHOCK AND SAFETY GLASSES WHEN HANDLING BATTERIES OR BATTERY CHARGERS.

This section describes how to determine the condition of the Batteries and Battery Chargers (*for further information, refer to Block Diagram 54302xxx*):

1. Dismount the Covers of the Mobile Unit.

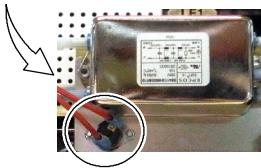
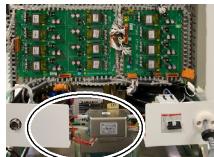


Power Line Connection Lamp

2. With the unit in charging mode, that is connected to mains with the “*Line Circuit Breaker (Magnetothermic Switch)*” in ON position and the “*Emergency Switch Off*” not pressed, check that the external “*Power Line Connection Lamp*” lights.

Note 

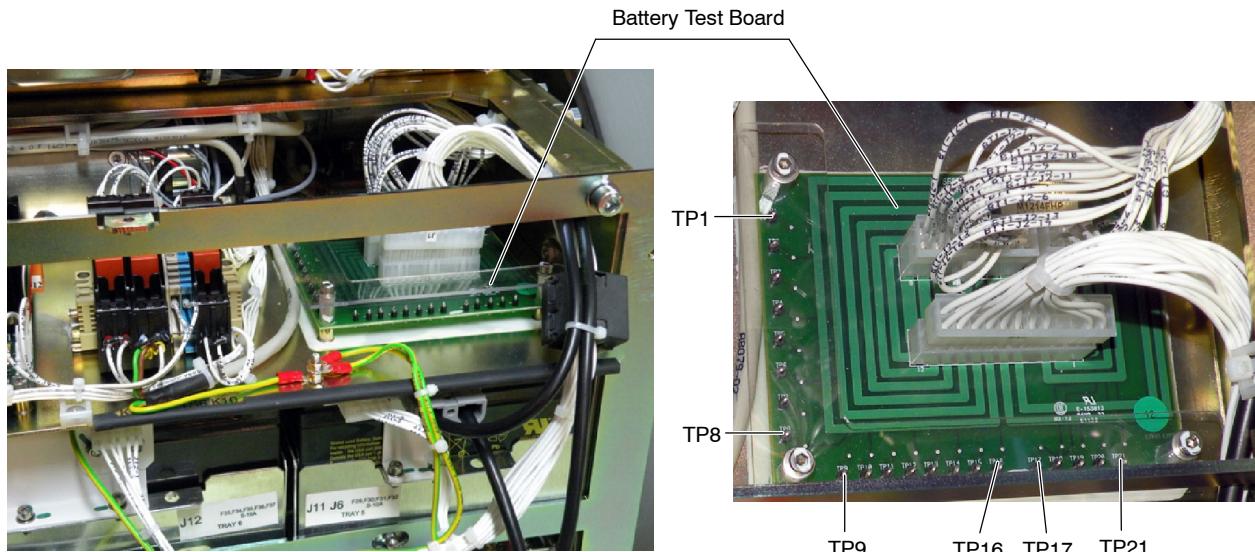
*If during the Battery charging process, the “*Power Line Connection Lamp*” is OFF and a correct voltage is present in the mains, it could mean that the temperature inside the unit (batteries area) has reached $50 \pm 3^\circ\text{C}$ ($122 \pm 5.4^\circ\text{F}$) due to one or more damaged batteries, and thus the Thermal Switch (located at the batteries area under the Battery Charger Boards) interrupts the charging process in order to prevent damages in the other batteries. This Lamp can also be turned off due to another failure in the unit.*



Thermal Switch

If the Lamp does not light when the unit is in charging mode, perform Section 2.8.3 before continuing with next steps.

3. Open the Generator Front Panel to access the *Battery Test Board* (A9504-03) located over the Battery Trays.
4. Carefully remove the Plastic Protection from the Battery Test Board.



5. Check the unit is in charging mode. The "Power Line Connection Lamp" should be ON.



**IN THIS STEP, J1 ON THE BATTERY TEST BOARD (A9504-03)
IS DISCONNECTED AS INDICATED.**

**THE SYSTEM SHOULD BE PLUGGED IN AND IN CHARGING
CONDITION AT LEAST FOR 1 MINUTE BEFORE
RECONNECTING J1. THIS PREVENTS DAMAGE TO THE
CONNECTOR.**

Disconnect J1 on the *Battery Test Board* (A9504-03) and carefully measure the voltage between the following consecutive Test Points (TP) on the *Battery Test Board* (A9504-03):

Note

As a protective measure, this Battery Test Board (A9504-03) contains resistances that open if a short occurs. This will not affect the performance of the system but a short circuit will alter the reading.

- For Generator Batteries, measure between TP-1 and TP-2, TP-2 and TP-3, TP-3 and TP-4, and consecutively until TP-15 and TP-16. The voltage measurement depends on the environmental temperature inside the Mobile unit. As a reference for 21°C (70°F), the voltage measured for a Battery sector (a Battery pair) must be between 26.8 and 27.6 VDC (*refer to Table 2-3 for voltage measurement at different environmental temperatures*). Note the voltage in *Table 2-4 (Reading on Charger side)*.
- For Motor Batteries, measure between TP-17 and TP-18, TP-18 and TP-19, TP-19 and TP-20, TP-20 and TP-21. The voltage measurement depends on the environmental temperature inside the Mobile unit. As a reference for 21°C (70°F), the voltage measured for a Battery sector (a Battery pair) must be between 26.8 and 27.6 VDC (*refer to Table 2-3 for voltage measurement at different environmental temperatures*). Note the voltage in *Table 2-4 (Reading on Charger side)*.

Table 2-3
Voltage measurement for each Battery Sector

VOLTAGE MEASUREMENT FOR EACH BATTERY SECTOR (VDC measured between two consecutive TP on the Battery Test Board)			
	* Environmental Temperature inside the Mobile unit.		
	at 21°C (70°F)	at 26°C (79°F)	at 31°C (88°F)
V max.	27.6 VDC	27.4 VDC	27.2 VDC
V nominal	27.3 VDC	27.1 VDC	26.9 VDC
V min.	26.8 VDC	26.6 VDC	26.4 VDC

* Note.- Each °C degree (1.8°F) increased of environmental temperature, reduces the voltage measurement in 0.04 VDC for each Battery sector (a Battery pair)

If the voltage measured between a pair of Test Points is out of limits (*refer to Table 2-3*), test the corresponding points on the connector J2 (for Generator) or J3 (for Motors). If input voltage is correct, the problem may be the protecting resistance for the Test Point on the back of the *Battery Test Board (A9504-03)*, replace the *Battery Test Board* and continue the process. This resistance does not affect performance.

If the voltage measured between any pair of points on the connectors is out of limits (*refer to Table 2-3*), the problem may be in one of the “*Battery Charger Boards*” (A353x-xx), troubleshoot the corresponding Charger Board (*see Section 2.8.4.*).

If voltage is correct, connect the unit to the mains and ensure that the Thermomagnetic Switch is ON and that the Emergency Stop Button is not activated. Reconnect J1 and proceed to the next step.

6. Cut the power supply by switching OFF the “*Thermomagnetic Switch*” or by unplugging the Unit.



IN THIS STEP, J2, J3 ON THE BATTERY TEST BOARD (A9504-03) ARE DISCONNECTED AS INDICATED.

THE SYSTEM SHOULD BE PLUGGED IN AND IN CHARGING CONDITION AT LEAST FOR 1 MINUTE BEFORE RECONNECTING J2, J3. THIS PREVENTS DAMAGE TO THE CONNECTOR.

Disconnect J2 for Generator and J3 for Motors on the *Battery Test Board (A9504-03)* and carefully measure the voltage between the following consecutive Test Points (TP) on the *Battery Test Board (A9504-03)*:

- For Generator Batteries, measure between TP-1 and TP-2, TP-2 and TP-3, TP-3 and TP-4, and consecutively until TP-15 and TP-16. The voltage measurement should be around 26 VDC. If the voltage measured between a pair of Test Points is not around 26 VDC, note the Battery pair which is giving the low voltage in *Block Diagram 54302xxx*.
- For Motor Batteries, measure between TP-17 and TP-18, TP-18 and TP-19, TP-19 and TP-20, TP-20 and TP-21. The voltage measurement should be around 26 VDC. If the voltage measured between a pair of Test Points is not around 26 VDC, note the Battery pair which is giving the low voltage in *Block Diagram 54302xxx*.

Connect the unit to the mains and ensure that the Thermomagnetic Switch is ON and that the Emergency Stop Button is not activated. Reconnect J2 and J3. Re-install the Protective Cover of the Battery Test Board and the Generator Front Door.

If a Battery pair is giving low voltage, or if the voltage measured is correct but error “E25” was produced during normal operation, perform *Section 2.8.5 “Identifying Faulty Batteries”*.

Mobile X-Ray Unit**Troubleshooting**

Table 2-4
Voltage Checks on Battery Test Board (A9504-03)

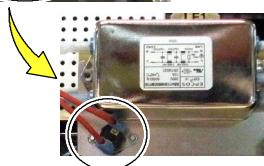
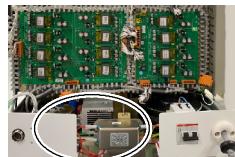
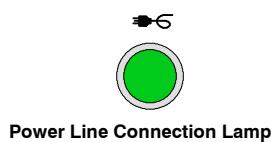
RELATED BATTERY CHARGER BOARD	TEST POINTS	READING ON CHARGER SIDE (Environmental Temperature on the Batteries is:)
Inverter Battery Charger 2 Board (A3534-xx)	1 - 2	
	2 - 3	
	3 - 4	
	4 - 5	
	5 - 6	
	6 - 7	
	7 - 8	
Inverter Battery Charger 1 Board (A3533-xx)	8 - 9	
	9 - 10	
	10 - 11	
	11 - 12	
	12 - 13	
	13 - 14	
	14 - 15	
	15 - 16	
Motors Battery Charger Board (A3532-xx)	17 - 18	
	18 - 19	
	19 - 20	
	20 - 21	

2.8.3 INDICATOR LAMP AND THERMAL SWITCH CHECKING

Note 

Only perform this section if the “Power Line Connection Lamp” is OFF during the Battery charging process.

1. Dismount the Front Cover of the Mobile Unit.
2. With the unit disconnected (not in charging mode), reduce the temperature around the Thermal Switch below 29°C (84.2°F) in order to close the contacts of the Thermal Switch.
3. Set the unit in charging mode, then check if the “Power Line Connection Lamp” is ON.



If the “Power Line Connection Lamp” is OFF, check that the lamp is not burnt or disconnected by measuring 27 VDC between J2-8 and J2-16 of the *Battery Test Board* (A9504-02), located under the Console Assembly (refer to Schematic 54302xxx).

If the Lamp is correct, check the Thermal Switch and replace it if needed. The Thermal Switch contacts are opened at $50 \pm 3^\circ\text{C}$ ($122 \pm 5.4^\circ\text{F}$) and the contacts are closed at $35 \pm 6^\circ\text{C}$ ($95 \pm 10.8^\circ\text{F}$).

If the Lamp and Thermal Switch are correct, the problem could be in the “*Motors Battery Charger Board*”, in the “*PFC Board*” or the most probably due to one or more damaged batteries. Follow with Section 2.8.2, step 3.

2.8.4 BATTERY CHARGERS TESTING

The Battery Charger Boards consist of several Battery Charge Sectors. Each Sector charges two 12 Volt Batteries, supplying approximately 14 Volts to each Battery (during the charging process).

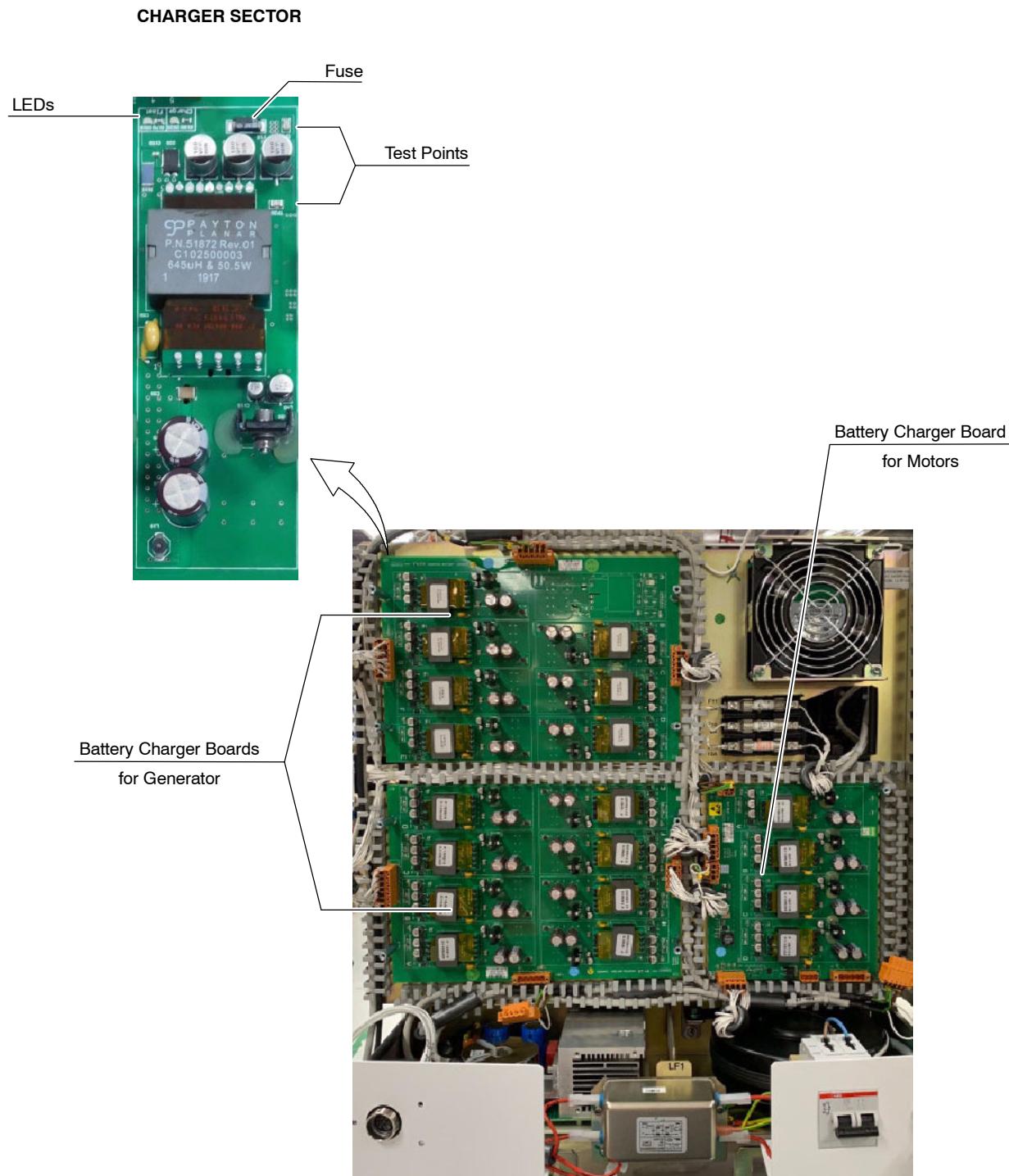
Each Sector has:

- a green “Charge” LED (DS2x), visual indication when the Charging Sector receives voltage from the PFC Board.
- a blue “Float” LED (DS1x), indicates that the Batteries are in flotation state.
- a Fuse (Fxx) that protects Batteries against a current overload during the charging process, and the Charging Sector against the Battery current when the Charger is switched OFF.
- two Test Points: TP4 (+) and TP3 (-) to measure output voltage value of the load module of each sector. Its value must be approximately around 28 Volts according to Table 2-3.

Refer to the following Illustration.

Mobile X-Ray Unit

Troubleshooting



1. Dismount the Protective Battery Chargers Cover (*refer to Section 2.2.4*).
2. Set the Unit in charging mode.
3. Ensure that the “*PFC 1000 Board*” (A3578-xx) supplies a voltage of approximately 360 VDC to the “*Motors Battery Charger Board*” (A3532-xx), this voltage can be measured between TP1 (V+) & TP2 (V-) on the “*Motors Battery Charger Board*” (A3532-xx) and on each “*Inverter Battery Charger Board*” (A3533-xx, A3534-xx).

If the voltage is correct, proceed to the next step. If this voltage is not present, check the connections between each Charger Board and the PFC 1000 Board, replacing the “*PFC 1000 Board*” or repairing the connections as necessary.

If the “*PFC 1000 Board*” is faulty or if Fuse F1 of the “*Motors Battery Charger Board*” (A3532-xx) is blown, all LEDs in Charging Sectors will be OFF while the Unit is connected to the mains.

“*PFC 1000 Board*” is located behind a Protective Cover on the horizontal board under the Front Cover.

4. Visually check that the green LED (D3x) of every Charging Sector is lit on each Battery Charger. If a LED on a Sector is OFF or blinking, this Sector is faulty and the respective Charger Board must be replaced. (*refer to Section 2.8.7*).

Note 

Although the Chargers may be replaced, the batteries may have suffered from faulty Charger Boards. Recharge the batteries once the Charger Board has been replaced.

5. Perform Section 2.8.5.

2.8.5 IDENTIFYING FAULTY BATTERIES

USE PROTECTIVE GLOVES AND EYEWEAR TO PREVENT ELECTRIC SHOCK WHEN HANDLING BATTERIES TO LOWER THE RISK OF ELECTRIC SHOCK DURING SERVICE TASKS.

IN CASE OF BATTERY CASING RUPTURE, ELECTROLYTE LOSS OR ANY OTHER EXPOSURE TO THE ELECTROLYTE, RINSE WITH WATER. IN CASE OF CONTACT WITH EYES, RINSE FOR AT LEAST 15 MINUTES AND IMMEDIATELY CONSULT A DOCTOR.



WHEN IT IS NECESSARY TO DISMOUNT ANY BATTERIES TRAY, ENSURE THAT THE MOBILE UNIT IS IN PARKING POSITION, IN ORDER TO AVOID ANY RISK OF UNBALANCE.

Note

Apart from the standard Batteries, there is an option of Lead-Crystal Batteries. All the procedures described along sections 2.8.5 and 2.8.6 are the same for both battery types, standard and optional, unless any other particular information be specified in the corresponding step.

Battery lifetime depends on environmental and working conditions. If deeply or completely discharged, capacity diminishes over time and sulfation may occur, which impedes recharge.

A physical inspection for sulfation of all battery connection points should be part of not only the regular maintenance tasks but also part of any service intervention involving the power supply.

Note

If Batteries do not complete a charge cycle, they eventually lose their maximum charge capacity and reduce output.

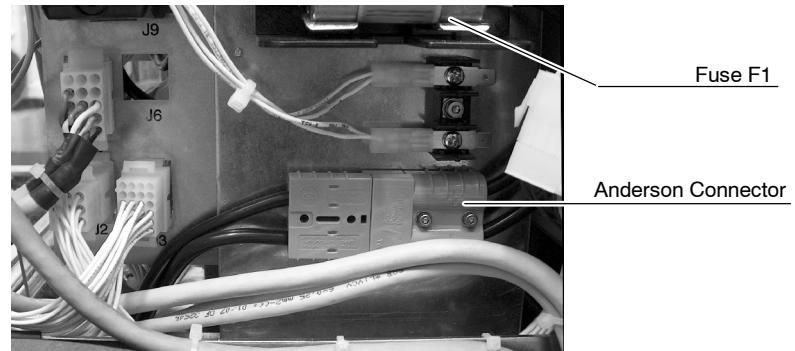
Tools required to determine which Batteries are defective:

- Digital Multimeter.
- Load Resistance of at least 4 or 5 Ω , > 100 Watts.
- A heatsink is also recommended.

Note 

Before performing the following procedure, the Unit must be connected to the mains for at least 9-10 hours with the Generator OFF in order to ensure a complete charging cycle.

1. Once fully charged, turn the Unit OFF and unplug from the wall socket.
2. Remove the Front Covers; refer to Section 2.2 of Covers Removal.
3. Unplug the Anderson Connector J1 (located at the lateral side of the Generator Frame below Fuse F1).



4. Remove the Lower Back Cover; refer to Section 2.2 of Covers Removal.

Mobile X-Ray Unit

Troubleshooting

Illustration 2-3
Mobile Unit with Standard Batteries

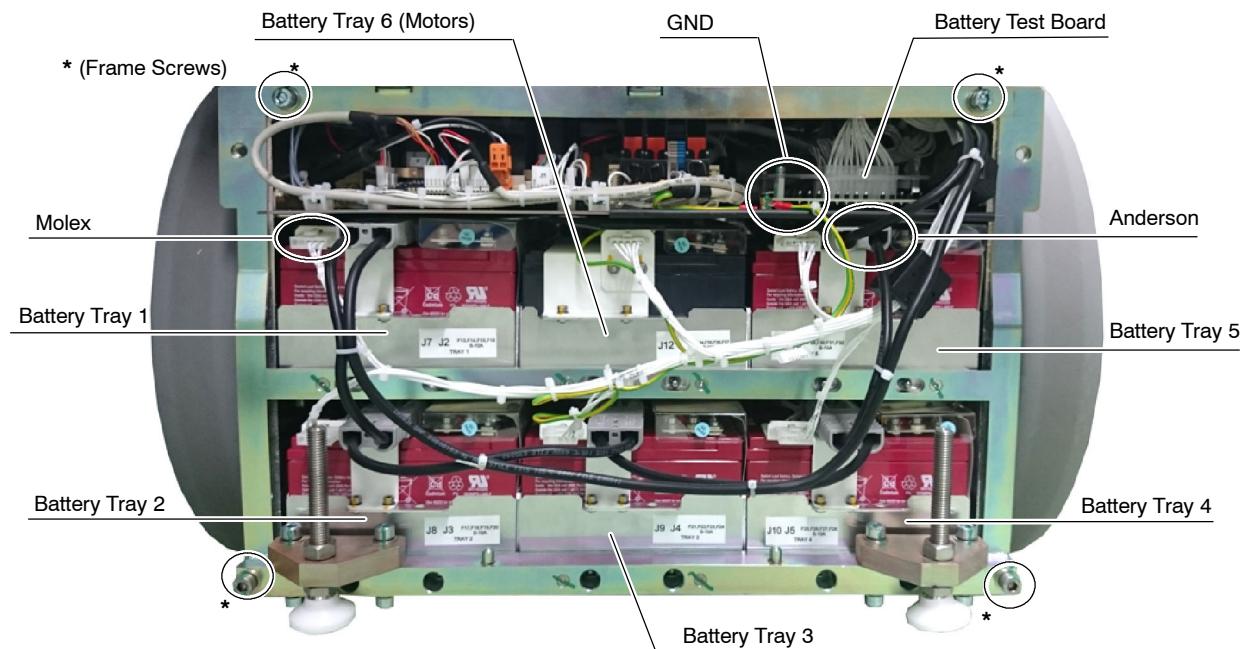
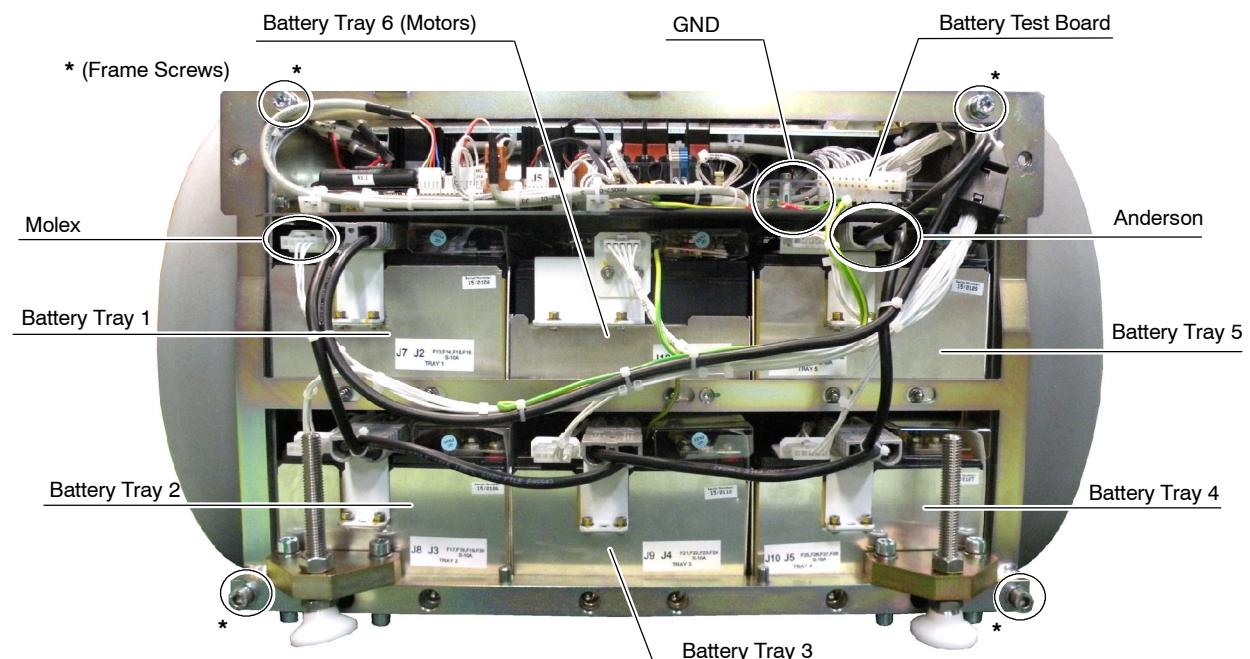


Illustration 2-4
Mobile Unit with Lead-Crystal Batteries (Option)



5. Disconnect Anderson and Molex connectors from all the Batteries Trays:

Anderson connectors: J2 for Tray 1, J3 for Tray 2, J4 for Tray 3, J5 for Tray 4, J6 for Tray 5.

Molex connectors: J7 for Tray 1, J8 for Tray 2, J9 for Tray 3, J10 for Tray 4, J11 for Tray 5, J12 for Tray 6.

6. Disconnect the GND wires of the Battery Trays 3 and 6, connected on the left side of the Battery Test Board. Cut the Tie-wraps that hold the GND wires to the Molex Connector cables.
7. Remove the four (4) screws and dismount the Frame that secures the Battery Trays to the Unit.
8. Slide the selected Battery Tray out of the Unit.
9. Once the Battery Tray is out of the Unit, dismount the Protective Cover of the Battery Tray by removing the screws that fix it to the Tray.

BATTERY TRAY WITH STANDARD BATTERIES



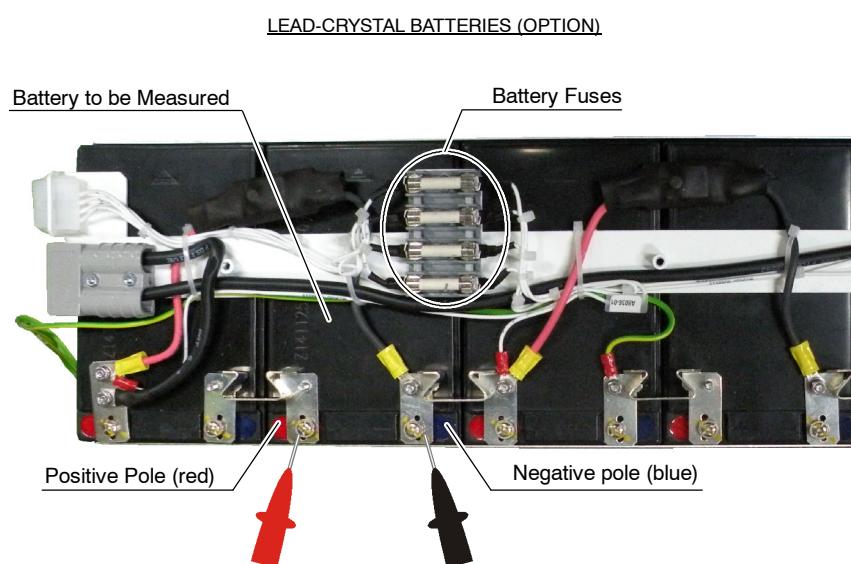
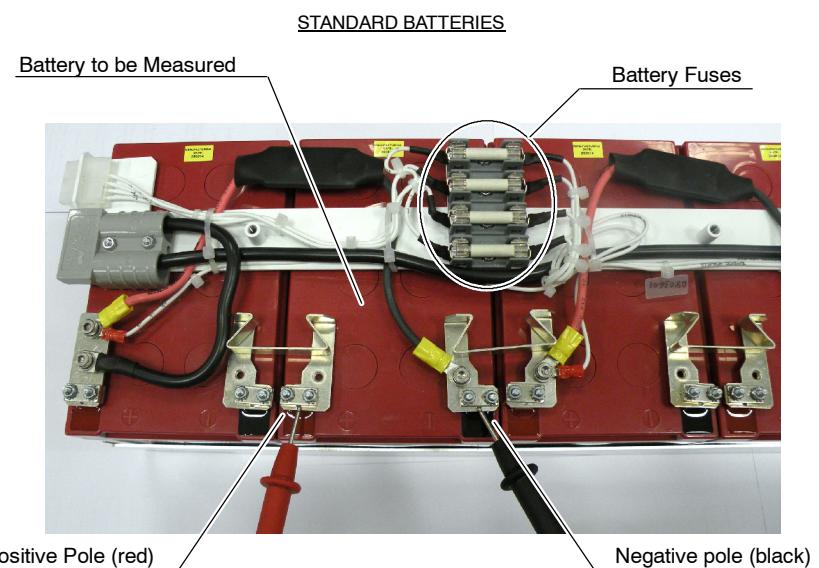
BATTERY TRAY WITH LEAD-CRYSTAL BATTERIES (OPTION)



10. Ensure that all Battery Fuses are functioning properly.
11. Identify the positive and negative poles of the Battery to be measured. Measure for around 12V.

Note 

Measuring Battery Output Voltage is not enough to determine the Battery status. The same test must be performed with a Load.



12. Repeat measurement with a Load, resistance of 4 or 5 Ω , > 100 Watts, connected to the positive and negative Battery poles. This Voltage should be around 12 V. If Voltage with load is less than 10 V (usually close to 0 V), the Battery is faulty.

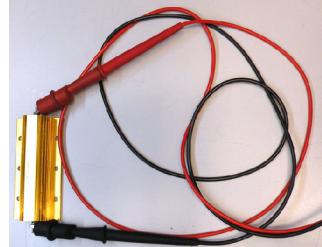
Note 

The measurement with a Load have to be read once the voltage value stabilizes, which happens approx. after 10-15 seconds.



A HEATSINK IS RECOMMENDED AS THE LOAD RESISTANCE WILL HEAT UP DURING THE TEST.

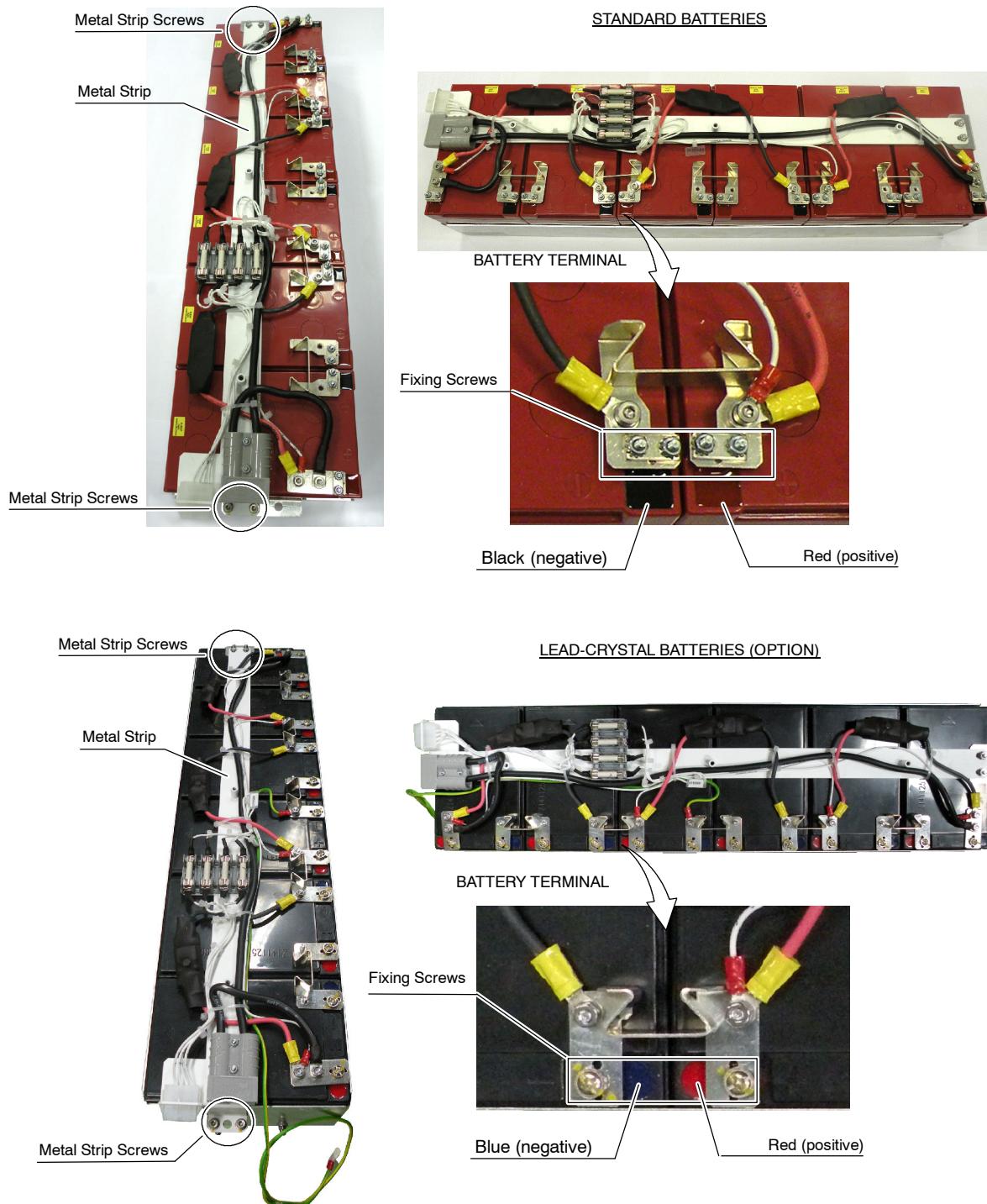
Load Resistance



13. If needed, repeat from step 8. in order to identify other faulty Batteries.
14. Continue with *Section 2.8.6* for replacing the faulty Batteries/Trays and for reassembling the Battery Trays inside the unit.

2.8.6 REPLACING FAULTY BATTERIES**Note** 

Generator Batteries for replacement can be provided by pairs or by full Trays (6 batteries).



1. With the Protective Cover removed, dismount all Terminals by removing their Fixing Screws from all the batteries without removing the Cables.
2. Dismount the Metal Strip by removing the Metal Strip Screws and replace the faulty batteries.



If batteries need to be replaced it is mandatory that always both batteries related to one Charger Section are replaced at the same time (refer to schematic 54302xxx).

3. Mount the Metal Strip and the Terminals with the Fixing Screws.

For Lead-Crystal Batteries (option), the tightening torque to be applied to the Fixing Screws is 1.5 Nm.

4. Secure the Battery connections and mount the Protective Cover.



Ensure that the Positive and Negative markings on the replacement battery coincide with those on the Battery Tray.

5. Slide the selected Battery Tray inside the Unit.



When it is needed to replace one full Battery Tray, the new Tray may come with or without the GND wire factory set.

This GND wire must be used only for the replacement of the Battery Tray 3.

If the new Tray comes without GND wire factory set, only for Tray 3, remove the GND wire of the original Tray 3 and mount it in the new one, between B15 and B16 Batteries.

If the new Tray comes with GND wire factory set, remove it for Trays 1, 2, 4 and 5.

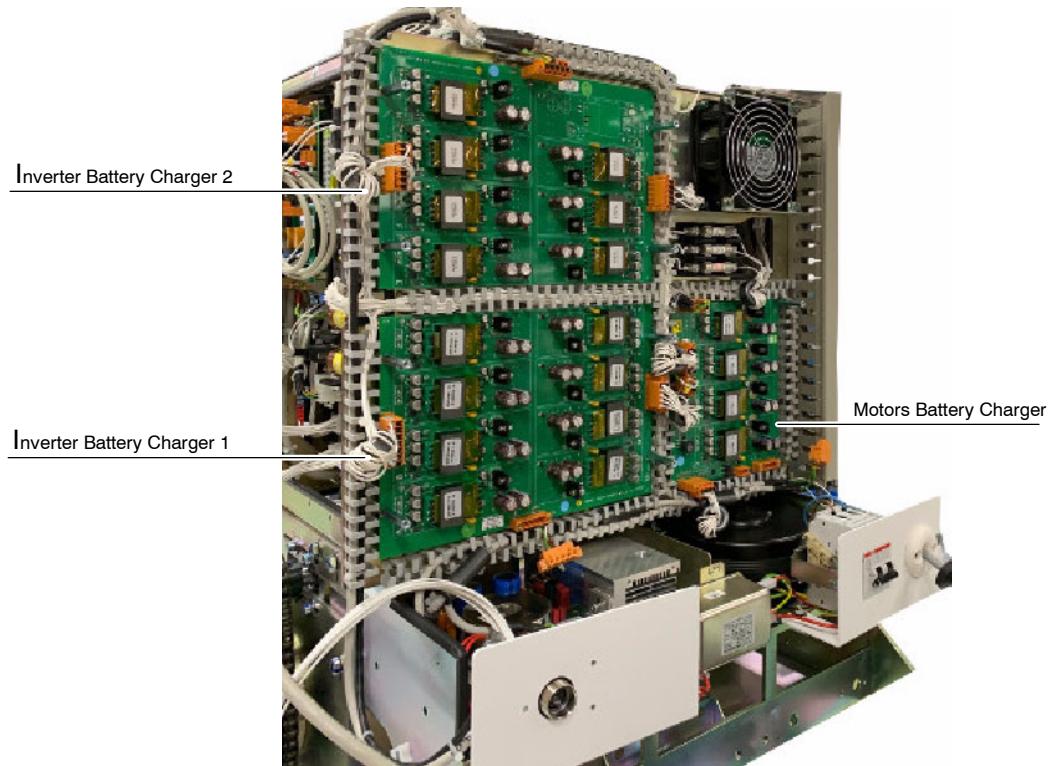
6. Mount the Frame that secures the Battery Tray in the Unit.
7. Connect:
 - a. Anderson for Battery Trays 1, 2, 3, 4 and 5.
 - b. GND wire for Battery Trays 3 and 6.



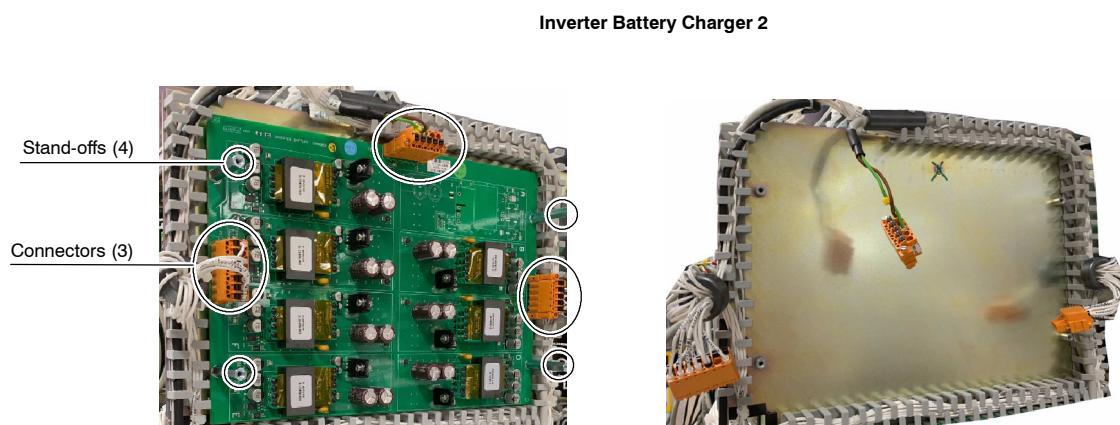
THE SYSTEM SHOULD BE PLUGGED IN AND IN CHARGING CONDITION AT LEAST FOR 1 MINUTE BEFORE RECONNECTING THE MOLEX CONNECTORS PREVIOUSLY REMOVED: J7, J8 J9, J10, J11 AND J12 (STEP 5. SECTION 2.8.5). THIS PREVENTS DAMAGE TO THE CONNECTORS.

- c. Molex Connectors of Battery Tray.
8. Mount the Lower Back Cover, plug the Anderson Connector J1 (in the side of the Generator Frame below Fuse F1); reassembly the Front Covers.
9. Keep the unit connected to the mains for at least 9-10 hours with the Generator OFF in order to ensure a complete charging cycle and perform a functional check.

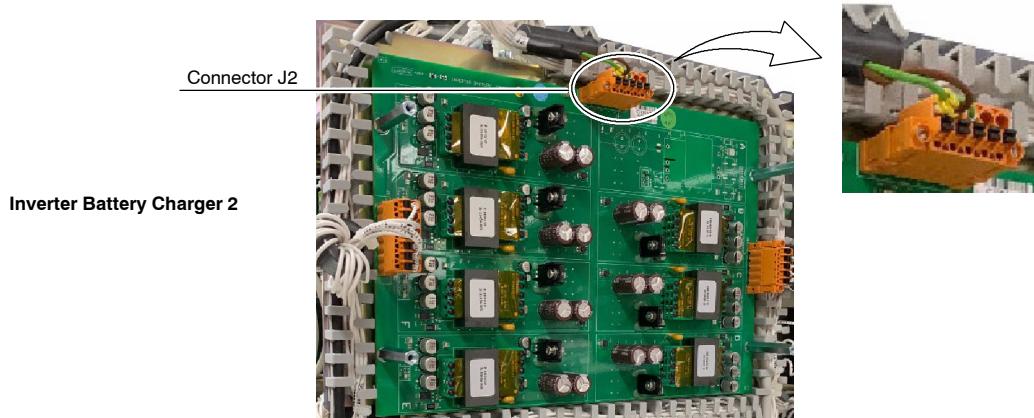
2.8.7 REPLACING BATTERY CHARGER BOARDS



1. To access to the Battery Charger Boards, turn OFF the unit and disconnect the Power Line Cable from mains. Then, remove the Front Cover, *refer to Section 2.2 of Covers Removal*, and remove the Battery Chargers Cover, *refer to Section 2.2.4*.
2. Unplug all the connectors and remove the Stand-offs of the corresponding Board, then remove the Board.



3. Mount the new Battery Charger Board with the Stand-offs and **plug only the following connectors** of the corresponding Board:



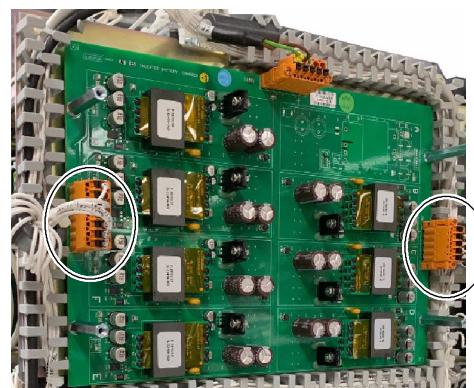
- Inverter Battery Charger Board 2: **J2** connector.
 - Inverter Battery Charger Board 1: **J2** connector.
 - Motors Battery Charger: **J1, J2, J4 AND J5** connectors.
4. Connect the Power Line Cable of the Unit, ensuring that the Line Circuit Breaker is ON, the Emergency Switch-off is deactivated and the Battery Charge Level Indicators at the Control Panel are in charge (scrolling).



THE SYSTEM SHOULD BE PLUGGED IN AND IN CHARGING CONDITION AT LEAST FOR 1 MINUTE BEFORE RECONNECTING THE CONNECTORS, TO PREVENT DAMAGE.

5. Plug in the remaining connectors of the replaced Battery Charger Board (J1 and J3 at the Inverter Battery Chargers 1 and 2, and J3 at the Motors Battery Charger), verifying that all LEDs on the Board light steady. Also plug connector J6 in the Motors Battery Charger if the optional Discharging Resistor is present.

Inverter Battery Charger 2



6. Disconnect the Unit and mount the Battery Chargers Cover and the Front Cover.

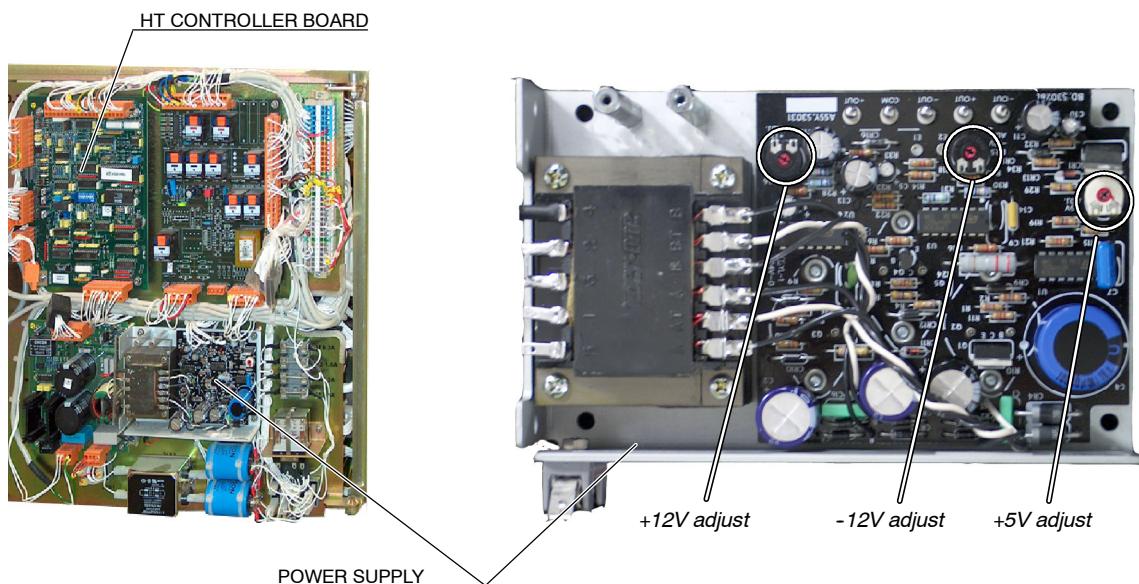
2.9 LOW DC VOLTAGE POWER SUPPLY TEST

The Generator operates from a Low DC Voltage Power Supply located in the Front Panel (MOD. 3) of the Generator frame (refer to *Illustration 2-5*).

Turn the Generator ON and with a Digital Multimeter measure between:

- P2-3 (+) and P2-4 on the HT Controller Board. Check that the voltage at this point is $+5 \pm 0.2$ VDC. If required, adjust voltage with the +5 VDC Adjustment Potentiometer on the Power Supply Board.
- P2-2 (+) and P2-4 on the HT Controller Board. Check that the voltage at this point is $+12 \pm 0.1$ VDC. If required, adjust voltage with the +12 VDC Adjustment Potentiometer on the Power Supply Board.
- P2-1 (-) and P2-4 on the HT Controller Board. Check that the voltage at this point is -12 ± 0.1 VDC (this voltage must be -12.7 ± 0.1 VDC if the Console is provided with a Graphic Display). If required, adjust voltage with the -12 VDC Adjustment Potentiometer on the Power Supply Board.

Illustration 2-5
Power Supply and HT Controller Board in the Front Panel





The ATP Console CPU Board operates from a 12 VDC Non-Regulated Supply located in the Generator frame that supplies to a 5 VDC Switching Regulator located in the ATP Console CPU Board.

Turn the Generator ON and with a Digital Multimeter measure between:

- J1-2 or J1-8 (12V UNR) with J1-6 or J1-1 (GND) on the ATP Console CPU Board; likewise, TP11 (GND UNR) with TP9 (12V UNR) on the ATP Console CPU Board. Check that the voltage at this point is +12 (± 1.5 VDC).
If the measured voltage is not +12 (± 1.5 VDC), check the 12 VDC Unregulated Supply of the Generator, that is, between terminals 11 and 12 of the Input Transformer T2, Fuse F7 (3A, 250 V), Contactor K3, Rectifier BR4, and Capacitor C7 (*Refer to schematic 54302xxx*).
- TP1 GND and TP3 +5 V on the ATP Console CPU Board. Check that the voltage at this point is +5 (± 0.2 VDC). If not, replace the ATP Console CPU Board.

Note

No adjustments are required for both voltage measurements.

2.10 MICROPROCESSORS AND GENERAL OPERATION

The following LEDs indicate the proper operation of each Microprocessor in the Generator:

- The LED DS1 located on the HT Controller Board blinks fast during power up, then slows to a steady blink of about 2 per second, indicating that the Microprocessor U5 is operating normally.
- The LED DS2 located on the ATP Console CPU Board normally blinks at the same rate as LED DS1 on the HT Controller Board, indicating that the Console Microprocessor U30 is operating correctly.

Also observe the following LEDs to facilitate general troubleshooting:

- When LED DS1 located on the Interface Control Board is ON (lit), it indicates that the Generator is ON.
- The LED DS1 located on the ATP Console CPU Board should be ON (lit), indicating that the Watch-Dog Timer (Console) is operating and ensuring the correct timing of data communications with the HT Controller Board.

2.11 REPLACEMENT OF MEMORY IN ATP CONSOLE CPU BOARD AND/OR HT CONTROLLER BOARD

After having replaced the memory of either the ATP Console CPU or the HT Controller Board, and before starting up the system, set switch SW7 "Calib. ON/OFF" in "**On**" position to permit the Service mode. A few seconds after turning ON the Console, E10 will appear (this is shown because the EPROM U24 has been replaced).

Reset the error indication by pressing the respective button on the Console and keep it pressed until the Error 10 disappears. Turn the system OFF and restart, normal start-up will take place.

We recommend setting this switch back to OFF once the installation is complete. This will not allow the operator to enter in Configuration or in Calibration Mode (Service Modes).

2.12 PROCEDURES RELATED TO THE TOUCHSCREEN CONSOLE

2.12.1 TROUBLESHOOTING THE TOUCHSCREEN CONSOLE

Note 

Certain problems described in this section are circumstantial and assume a correct functioning of the equipment.

*Have Block Diagrams **54302xxx** at hand for quick reference as it will be needed during the troubleshooting procedures.*

Batteries should be fully charged before these tests. It is advisable to leave the Unit approximately 9-10 hours charging before attempting startup and/or troubleshooting. If not fully charged, ensure that the Unit is plugged into the mains and that it is charging.

PROBLEM #	PROBLEM
1	NO IMAGE AFTER THE STARTUP SEQUENCE
2	PLURAL BEEPING DURING THE STARTUP SEQUENCE
3	NO IMAGE ON THE SCREEN
4	PC OPERATING SYSTEM NOT LAUNCHED OR STARTUP ANOMALIES
5	LOCKUP OR UNEXPECTED SHUTDOWN OF THE TOUCH SCREEN MONITOR / PC
6	TOUCH SCREEN NOT RESPONDING OR ABNORMALLY RESPONDING

Problem 1: No image after the Start-up Sequence

This problem assumes that neither the Touch Screen Console nor the Generator have startup. No message has appeared on the Touch Screen at startup.

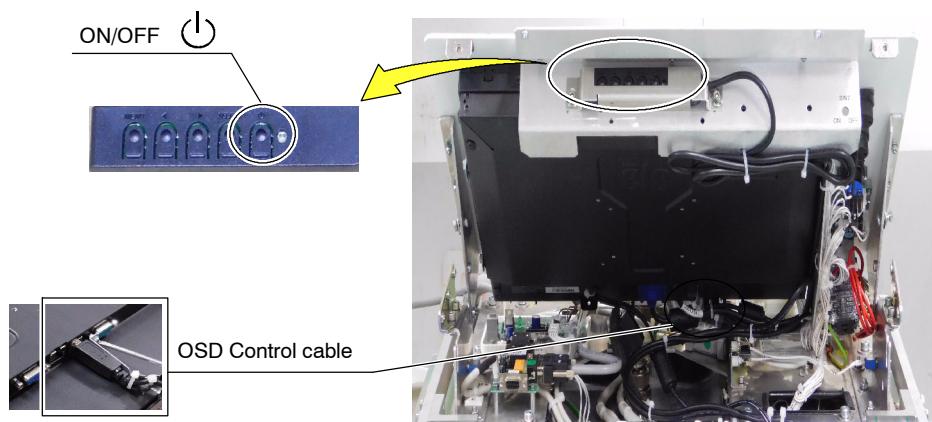
Theory: When turning the key (emergency button not activated), 420 VDC arrives at the Stand Alone Board (A3138-xx) through Fuses F10 & F11 from the Generator Battery Chargers. +11V Perm is generated from Stand Alone Board (A3138-xx) and goes to the Auto ON/OFF Board (A3179-xx) which in turn produces the signal POWER ON (-PWR ON) that goes to the ATP Console CPU Board (A3024-xx) and the Stand Alone Board (A3138-xx). Auto ON/OFF Board (A3179-xx) also generates *ON_PC*, a signal which goes to the PC to permit startup.

When -PWR ON arrives at Stand Alone Board, 110 VAC is generated from Stand Alone Board and runs to Transformer T2. From T2, 115 VAC is generated and goes through TS9 (beside the Ethernet reel) to the **Power/Interface Box**, the AC Connector for the PC and the Power Supply of the Touch Screen Console. This Power Supply generates +12 V for Screen.

1. Perform the tests indicated in *Section 2.8.1 "Preliminary Test of Battery and Charger Conditions"*. Continue to the next step once batteries are confirmed to be in good condition.
2. Ensure that the battery voltage reaches the Stand Alone Control Board (A3138-xx) at J1. If voltage is not present, revise connections, fuses F10 and F11, relay K11 and TS3. If voltage is present, go to the next step.
3. Ensure that +11V Perm generated at the Stand Alone Board (A3138-xx) at J3-3 goes to the Auto ON/OFF Board (A3179-xx) at J2-1 through J4, repairing or replacing as necessary.
4. Ensure that 110 VAC OUT leaves the Stand Alone Board (A3138-xx) from J2-5 (110 VAC OUT) and J2-3 (0 VAC OUT) and arrives at Input Transformer T2 at T2-3 (110) and T2-2 (0).
5. Ensure that fuses F2, F6, F7 & F8 are not blown, replacing as necessary.
6. Ensure that 115 VAC arrives at terminal TS9. Identify the GND wire and only measure between 115 VAC and 0 VAC.
7. Ensure that cables are properly connected from TS9 to the **Power/Interface Box**, to the AC Connector at the PC and to the Power Supply of the Touch Screen Monitor, and from here to the Touch Screen Monitor.

8. Check Video Input signal on the Touch Screen. The text "NO VIDEO INPUT" on the Touch Screen indicates that +12 VDC arrives to the Touch Screen Monitor. If the text does not appear, push the Touch Screen Console ON/OFF push-button at the front of the Touch Screen Monitor.

Check that the OSD control is correctly plugged into the RJ45 monitor connector.



If after pressing the ON/OFF the text does not appear yet, the problem may be either in the Power Supply or in the Touch Screen Monitor. Repair or replace as necessary.

After a few seconds, the display "NO VIDEO INPUT" disappears and PC Operating System starts up, which indicates that the PC starts up correctly.

If PC Operating System does not appear, check VGA cable. If the cable is right, then the problem may be:

- the "ON_PC" signal is not present at J3-6 of the PC. In this case, check the Auto ON/OFF Board (A3179-xx, out of the PC) and the Interface Control Board (A3009-xx). Ensure that there is a shortcut at the Auto ON/OFF Board between J3-1 & J3-2 when the unit is turned on. If there is no shortcut, replace the Auto ON/OFF Board.
- at the PC or at the Touch Screen Monitor. Connect a Laptop (Portable computer) to the Touch Screen Monitor and check that the Monitor functions correctly from another source. If the Screen functions correctly, connect an auxiliary Monitor to the PC and restart the system. Repair or replace as necessary.

Problem 2: Plural beeping during the Startup Sequence**Note** 

This may be a temporal corruption during the startup dialogue, restart the Console to confirm fault before attempting service.

During the normal startup sequence, an audible beep is emitted. A fault is detected when the Console, during startup, emits either a single long beep followed by three short beeps (— · ·), or a continuous series of long beeps (— — —).

Possible Causes:

These are BIOS errors and may be caused by either a faulty RAM, Video Card or PC Hard Disk.

1. Visually check and ensure a proper connection not only for external cable connections from and to the Console, but also for internal board connections inside the PC, repairing or replacing if necessary.
2. If connections are secure, connect a Laptop (Portable Computer) to the Console and check that it works from another source. If the Screen functions correctly, connect an auxiliary monitor to the PC and restart the system. Repair or replace as necessary.

Problem 3: No Image on Screen**Possible Causes:**

This may be caused by a lack of +12 V from the Power Supply of the Console, however, the most probable cause is a faulty of the Console.

1. Follow Troubleshooting steps for Problem 1 if fans on the PC do not rotate after having turned the key to ON on the Control Panel. If fans rotate when Console is turned ON, go to the next step.
2. Ensure a correct connection of the cables from the PC to the Console. Replace the cable in the event of visible damage. If no damage is present and the connections are correct, go to the next step.
3. Ensure that +12 V are reached to the Console from its Power Supply. Replace or repair if necessary.
4. If +12V are present at the Console, connect a Laptop (Portable Computer) to the Console and check that it works from another source. If the Screen functions correctly, connect an auxiliary monitor to the PC and restart the system. Repair or replace as necessary.

Problem 4: PC Operating System not Launched or Startup Anomalies**Possible Causes:**

This may be a temporary corruption or communication failure during the startup dialogue or a Hard Disk failure, restart the Console to confirm problem before attempting service. This may also be caused by loosened or damaged connections between the hardware inside the PC.

1. Visually check inside the PC for loose cables and damaged components.
2. If satisfactory, replace the PC.

Problem 5: Lock-Up or Unexpected Shutdown of the Touch Screen Monitor / PC**Theory:**

The Ventilation and Cooling Fans inside the PC must function whenever the PC is ON. Internal components in the PC may suffer irreversible damage if these fans are not functioning properly. Notwithstanding, the PC shuts down as a self-protective measure in case of a BIOS system error to safeguard internal components.

When the System is not used for a period of time, a message appears alerting the Operator of a Power-saving shutdown. If this option has been disabled, the system will shutdown without previous warning when the battery charge level has reached a minimum critical level.

Note 

The Unit may suffer irreversible damage if the ventilation fans are not functioning properly. Nevertheless, ensure that the Console functions properly and the batteries are fully charged before troubleshooting the fans.

1. Inside the PC, ensure that all the fans are clean and functioning. If fans are not functioning, check that +12 V are reached to the Console from its Power Supply and that the fans are properly connected inside the PC, replacing or repairing as necessary.
2. If the problem persists and the fans are functioning properly, clean the Heat Sinks on the Boards in the PC of dust.
3. Connect a Laptop (Portable Computer) to the Console and check that it works from another source. If the Screen functions correctly, connect an auxiliary monitor to the PC and restart the system. Repair or replace as necessary.

Problem 6: Touch Screen not Responding or Abnormally Responding**Possible Causes:**

Faulty Touch Screen Sensor or Drivers may also be corrupt.

Note 

If the Touch Screen is miscalibrated, follow the instructions in the section entitled Touch Screen Sensor Calibration in this document.

1. Ensure correct cable connections between the Console and the PC, replacing or repairing as necessary.
2. Uninstall and then reinstall the Touch Sensor Control Drivers in the PC.
3. Make sure that the screen surface is clean and that there is no drop of liquid on it.
4. Make sure to press on the touch screen controls by using the fingertip, not the nail.
5. If the problem persists, the problem may be at the Touch Screen Sensor. Replace the Console.

2.12.2 TOUCHSCREEN SENSOR CALIBRATION

The Sensor of the Touch Screen needs calibration when the buttons cannot be properly selected. The steps below should be followed whenever a calibration is required:

1. Access to the USB ports located at the Peripheral Connections Panel, connect a Keyboard and a Mouse to the USB ports.
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 the icon identified as “*Elo Touchscreen*” and then select “Align”.
4. Click on the Align button to calibrate the sensor and follow the instructions indicated therein by clicking on the indicated places.
5. Select the “Sound” tab and uncheck the “*Enable Click Sound*” entry.
6. Click on “OK” once finished.
7. Disconnect the Keyboard and Mouse and reinstall the cover of the USB ports located at the Peripheral Connections Panel if it is required.

SECTION 3 COLUMN AND ARM

3.1 MOBILE UNITS WITH STANDARD COLUMN



WARNING

BEFORE, DURING AND AFTER PERFORMING A TROUBLESHOOTING PROCEDURE RELATED TO THE COLUMN, VISUALLY CHECK FOR THE PROPER CONDITION OF THE INTERNAL AND EXTERNAL ITEMS RELATED (STEEL CABLE, SPRING, ANTIFALL SYSTEM, PULLEYS, BRAKES, ELECTRICAL CONNECTIONS, ETC.) REPAIRING OR REPLACING WHEN NECESSARY.

AFTER FINISHING THE TROUBLESHOOTING PROCEDURE, CHECK FOR THE CORRECT MOVEMENT OF THE VERTICAL TRAVEL OF THE ARM AND THE COLUMN ROTATION.

3.1.1 PROCEDURES RELATED TO THE COLUMN

The procedures related to the Column are:

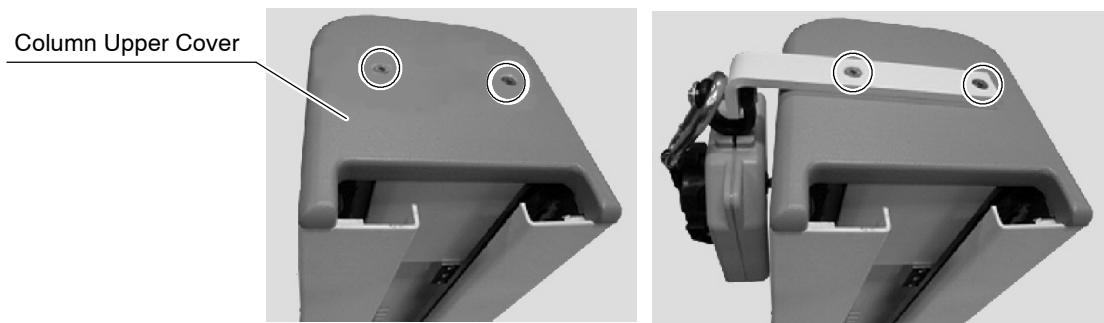
- Column Steel Cable / Spring Replacement. This procedure depends on the Spiral Pulley Assembly mounted inside the Column, as indicated below:

Description	AGFA Reference	Remarks	Spare Part Image	Section in Document
Main Pulley Kit	SC+A520089-01	Standard until 1 st December-2018.		<i>Refer to Section 3.1.1.1</i>
Brake Pulley Assembly	SC+A16049-01	Brake Pulley Assembly with higher braking force. Optional until 1 st December-2018 and Standard from 1 st December-2018.		<i>Refer to Section 3.1.1.2</i>

- Adjustment of the Column Rotation Brake (*Refer to Section 3.1.1.3*).

**3.1.1.1 COLUMN STEEL CABLE / SPRING REPLACEMENT (WITH SPIRAL PULLEY ASSEMBLY
SC+A520089-01)****Note** *Two people are necessary to carry out the entire procedure.*

1. Turn the Mobile Unit ON and place the Unit in Parking Position.
2. Unscrew the two (2) Fixing Screws from the Column Upper Cover and remove the Cover. For Mobile Units with Portable DR Detector, these Screws also fix the Tools Balance Support or “Detector Cable Tether”.

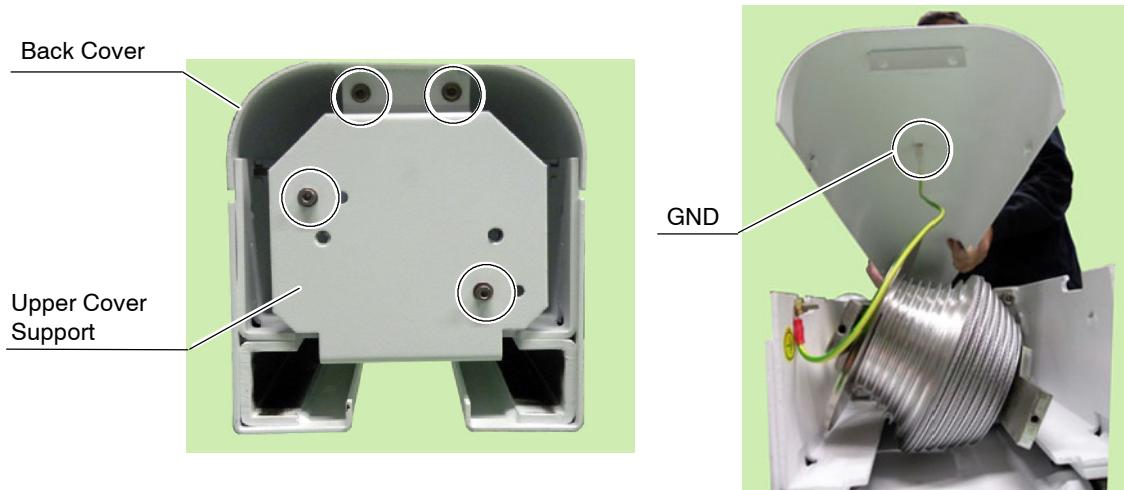


3. Remove the Cables Access Cover by removing the four (4) Fixing screws.



4. Remove the two (2) Fixing Screws from the Column Back Cover.

Slide the Column Back Cover a few centimeters upwards, then remove the cover backwards and disconnect GND cable.



5. Remove the Column Upper Cover Support after removing the two (2) fixing Screws, as shown in the picture above.
6. Before following with the next steps, place an auxiliary table beside the Unit Column.
7. Release the Arm from Parking position, turn the Column 90° and place the Arm fully extended with the Tube-Collimator Assembly on the table.
8. Turn the Unit OFF.



KEEP THE UNIT TURNED OFF AND ISOLATED FROM THE POWER SUPPLY.

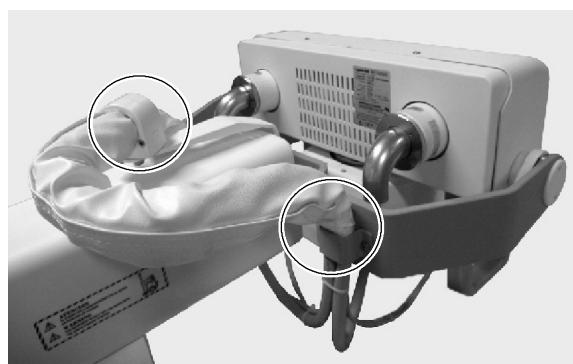
9. A counterweight of equal weight of the Tube-Collimator Assembly has to be secured on the Arm (a.e. if the Collimator weights 10 kg / 22 lb, the Tube weights 18 kg / 40 lb, and the remaining parts of the Assembly (HV Cables, Supports, Tube covers, etc.) weights approx. 13 Kg / 29 lb, the counterweight must be of $10+18+13= 41$ kg / 91 lb. Refer to the Collimator and Tube manuals to find out their weight.



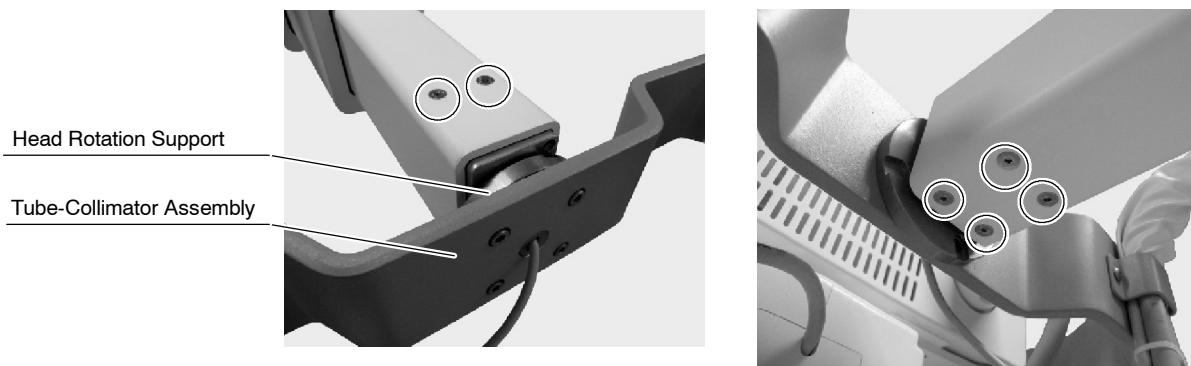
IF PARTS OF THE ARM ARE REMOVED, THE ARM WILL NOT BE BALANCED ANYMORE.

IF NO ADDITIONAL COUNTERWEIGHT HAS BEEN SECURED ON THE ARM, THE ARM WILL SPRING UPWARDS WHEN REMOVING THE TUBE-COLLIMATOR ASSEMBLY.

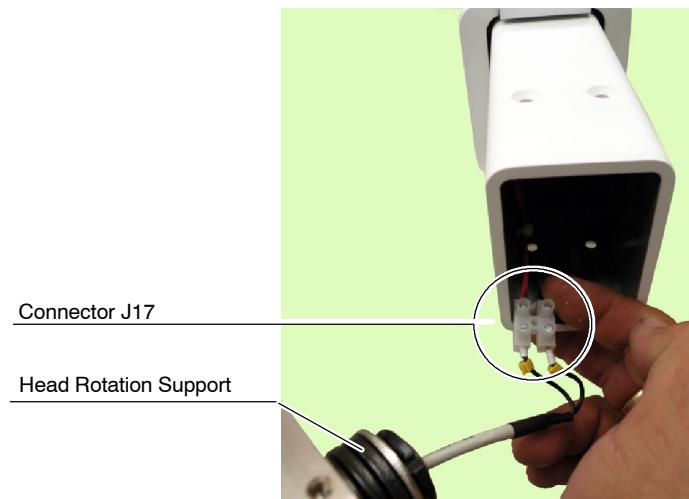
10. Remove the two (2) Brackets of the HV Cables by removing the corresponding Screws.



11. Remove the two (2) Screws from the upper side and the four (4) Screws from the lower side of the Arm.

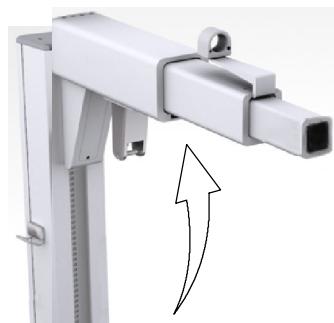


12. Carefully remove the Tube-Collimator Assembly with the Head Rotation Support just to disconnect connector J17. Then, carefully place and secure the Tube-Collimator Assembly on the table.

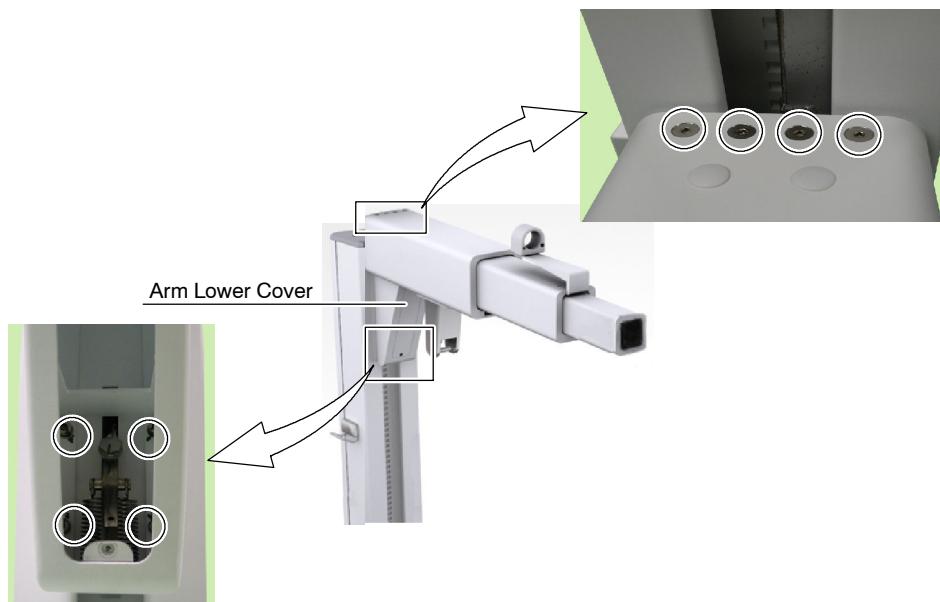


THE WEIGHT OF THE TUBE-COLLIMATOR ASSEMBLY IS HEAVY, UNSTEADY AND DIFFICULT TO HANDLE, THEREFORE AT LEAST TWO PEOPLE IS NEEDED TO REMOVE IT. THIS WILL AVOID PERSONAL INJURIES OR DAMAGE TO THE EQUIPMENT.

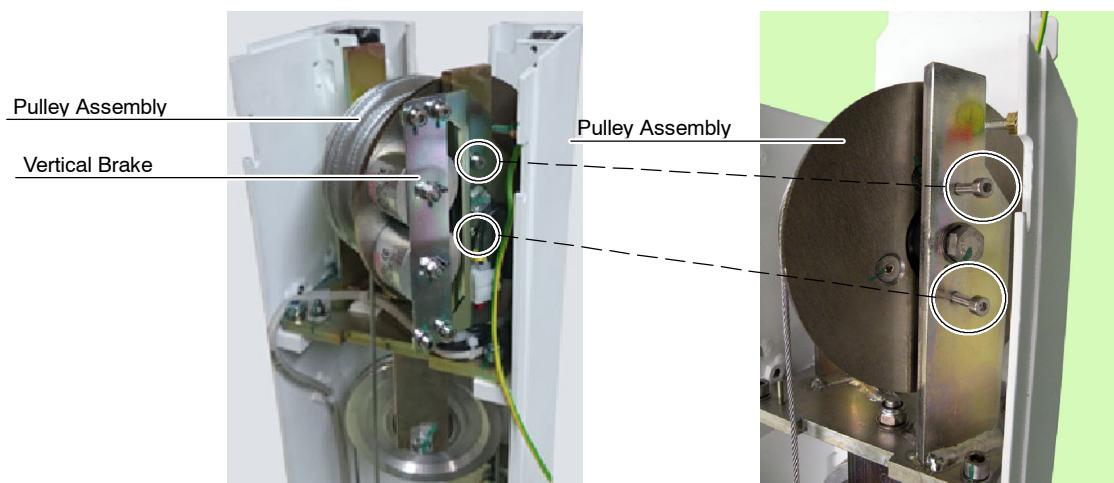
13. Place the Arm at the upper end of the Column, as shown in the picture below and carefully release the added counterweight from the Arm.



14. Remove the Arm Lower Cover and then dismount the Arm from the Column Carriage by removing the corresponding Fixing Screws. Place the Arm carefully on the table.



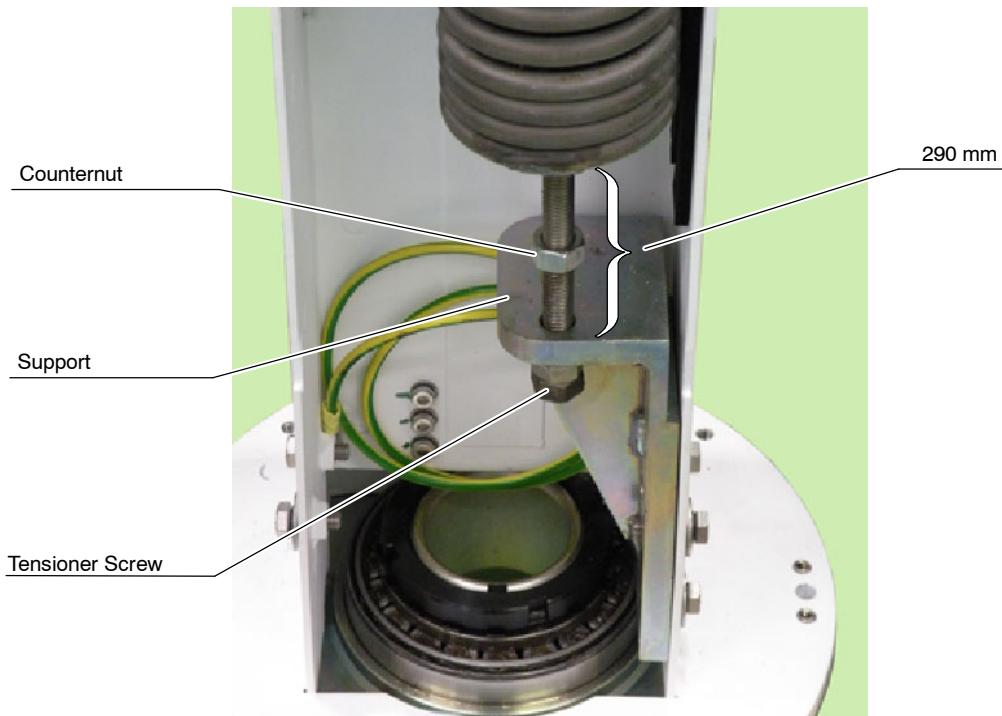
15. Remove the Vertical Brake of the Column, and lock the Pulley Assembly at the top of the Column with the two (2) screws M4 without washers of the Vertical Brake Assembly, to keep it in place when loosening the Steel Cable.



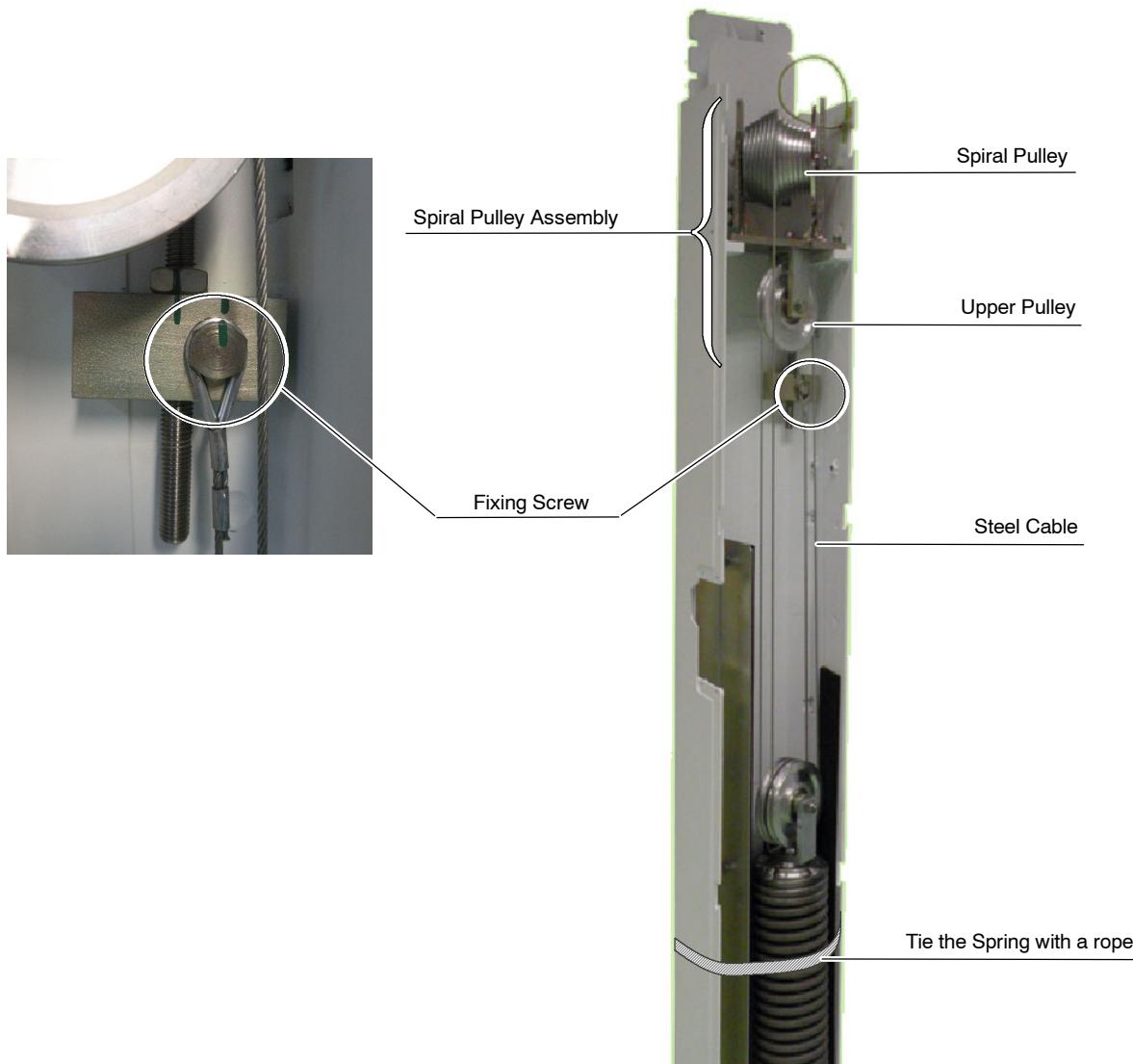
16. Loosen the Spring by loosening the counternut and the Tensioner Screw in order to slack the Steel Cable, that is, approximately 290 mm of distance between the Spring and the Support. Turn the counternut until touch the top of the Support avoiding the Spring slides down.



Do not turn the Tensioner Screw over 290 mm of distance between the Spring and the Support. Spring could be disengaged.



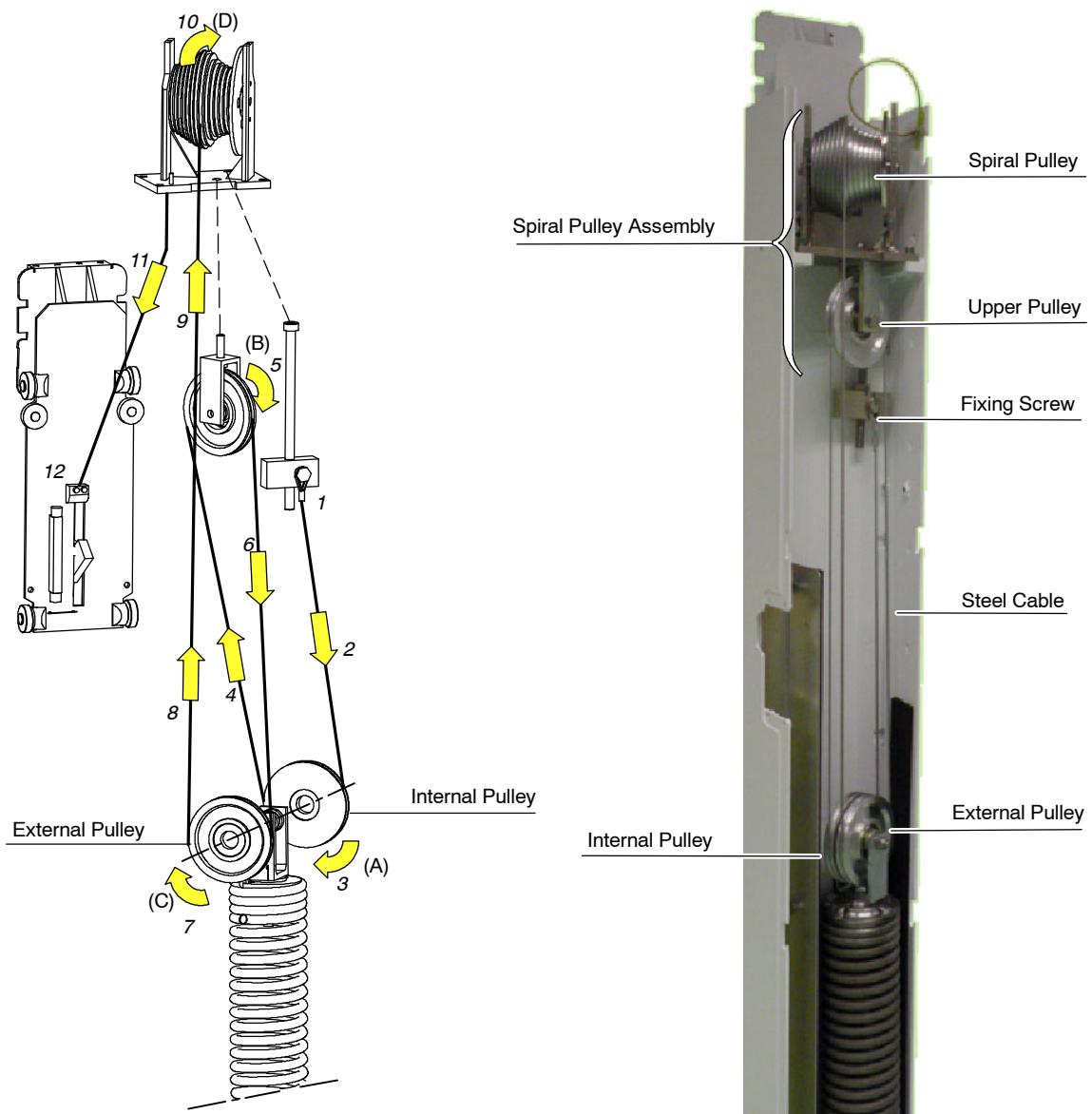
17. Use a rope to tie the Spring to the Column, then remove the Fixing Screw that secures the Steel Cable to the lower area of the Spiral Pulley Assembly. When the Steel Cable is released, the Arm Carriage is locked with the Column Anti-crashing System, anyway, hold the Arm Carriage with a hand until it is locked to avoid possible painting damage on the Column.



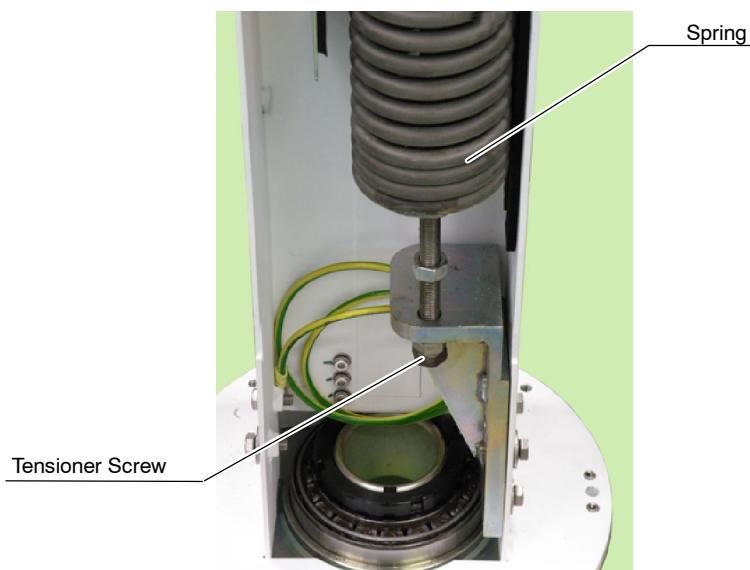
18. Replace the Steel Cable and / or Spring if needed.
- In case of replacing only the Steel Cable or replacing the Steel Cable and Spring follow process from step 19.
 - In case of replacing only the Spring follow process from step 20.

19. Replacement of only **Steel Cable** or replacement of **Steel Cable and Spring**.

- a. Remove the Cable Fixing Screw (1) and remove the Steel Cable firstly from the Internal Pulley (A) of the Spring Assembly.
- b. Remove the Steel Cable from the Upper Pulley (B) of the Spiral Pulley Assembly.
- c. Remove the Steel Cable from the External Pulley (C) of the Spring Assembly
- d. Finally remove the Steel Cable from the Spiral Pulley (D).



- e. If it is needed to replace the **Spring** follow this procedure, it not goes to step 19.f.
- Loosen the Spring Tensioner Screw until both, Tensioner Screw and Spring, are disengaged.

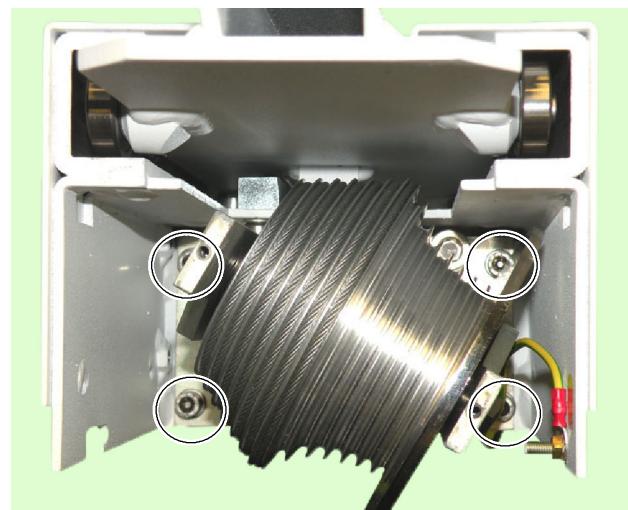


- Remove the rope that holds the Spring to the Column.
- Replace the Spring securing the new Spring with the Tensioner Screw. Do not forget to insert previously the counternut between the Spring and Support.
- Use the rope to tie the Spring to the Column.
- Tighten or Loosen the Spring by using the Tensioner Screw in order to keep approximately 290 mm of distance between the Spring base and the Support. Turn the counternut until touch the top of the Support avoiding the Spring slides down.



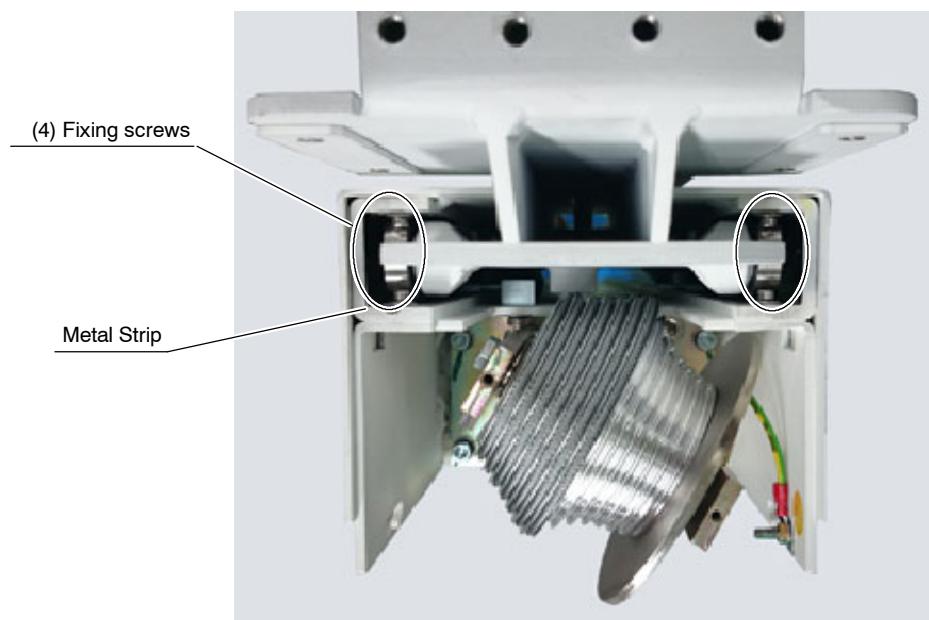
Do not turn the Tensioner Screw over 290 mm of distance between the Spring and the Support. Spring could be disengaged.

- f. Unscrew the four (4) Fixing screws, carefully dismount the Spiral Pulley Assembly and place it on a safe area.

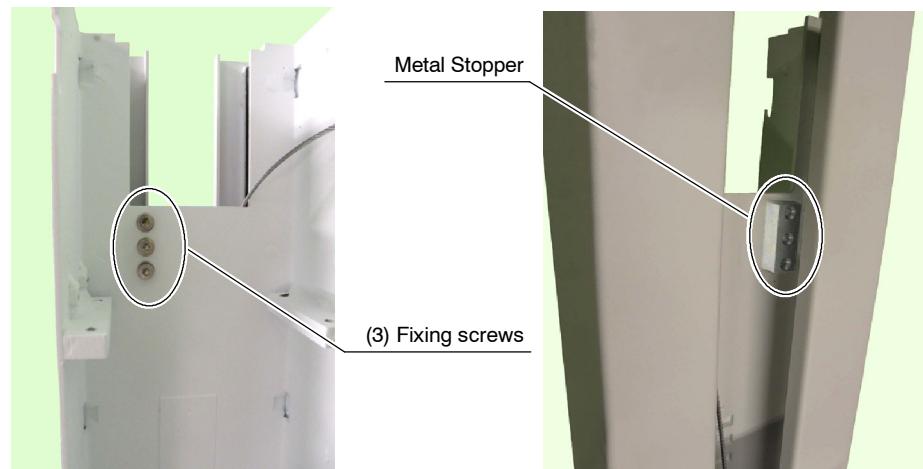


- g. At the top of the Column:

- Remove the four (4) Fixing screws that secure Metal Strips of the Carriage Bearings to the Column, for that purpose previously heat up (by a heat gun) these screws in order to remove them easier because they were mounted with Loctite.

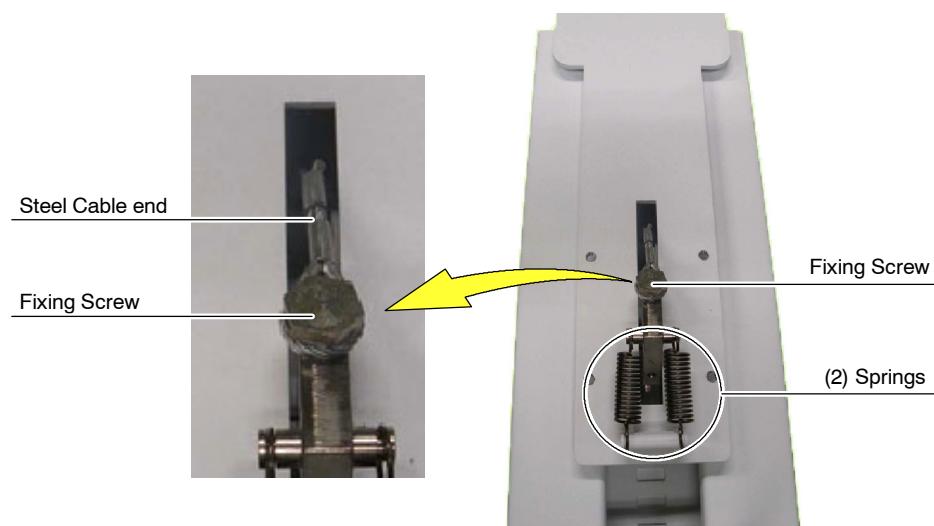


- Remove the three (3) Fixing screws while holding the Metal Stopper with the other hand and then remove it.

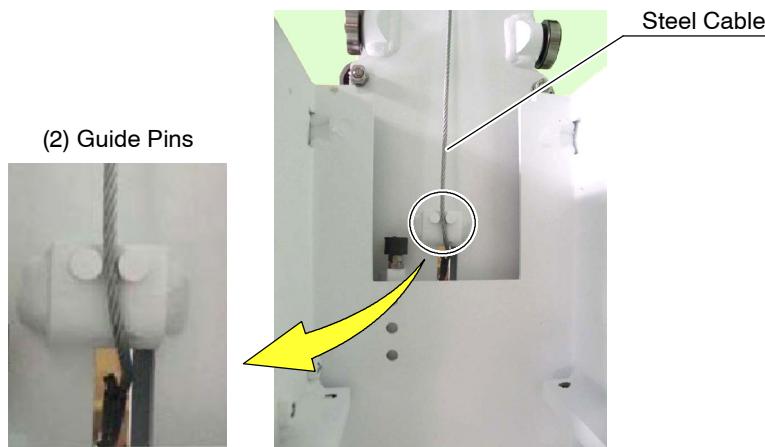


- h. Remove the two (2) Springs from the Column Anti-crashing System while holding the Carriage with the other hand.

Slide the Carriage upwards to remove it and, once it has been placed on a safe area, remove the Fixing Screw, replace the Steel Cable and tighten the Fixing Screw adding Loctite 243 and using a torque of 15 Nm.

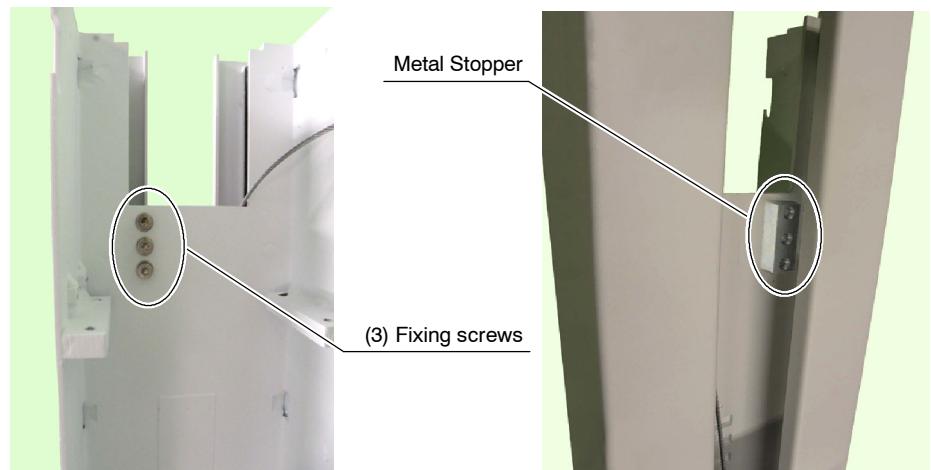


- i. Insert the Carriage to the Column, routing the Steel Cable between the two (2) Guide Pins located at the back side of the Carriage and slide the Carriage into the Column.

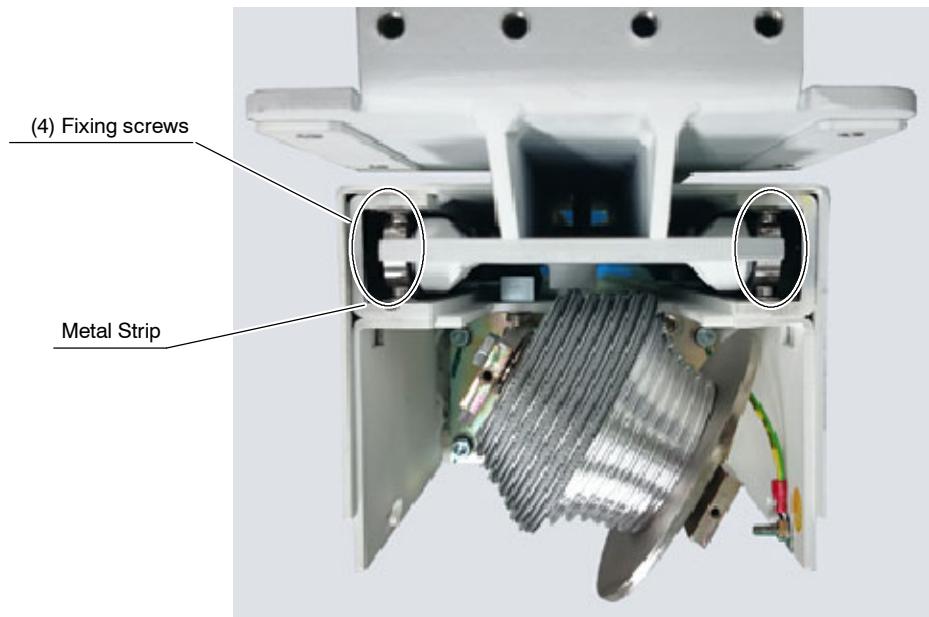


- j. At the top of the Column:

- Place the Metal Stopper back in place securing it with the three (3) Fixing screws adding Loctite 243 and using a torque of 10.5 Nm.

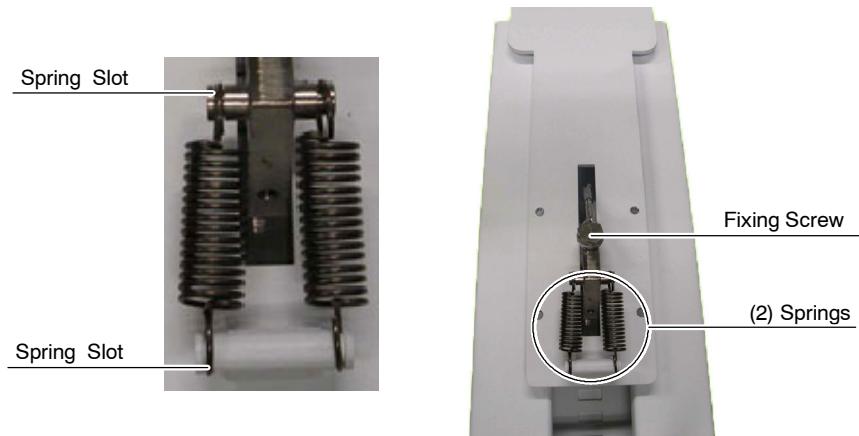


- Re-install the four (4) Fixing screws that secure Metal Strips of the Carriage Bearings to the Column adding Loctite 243.

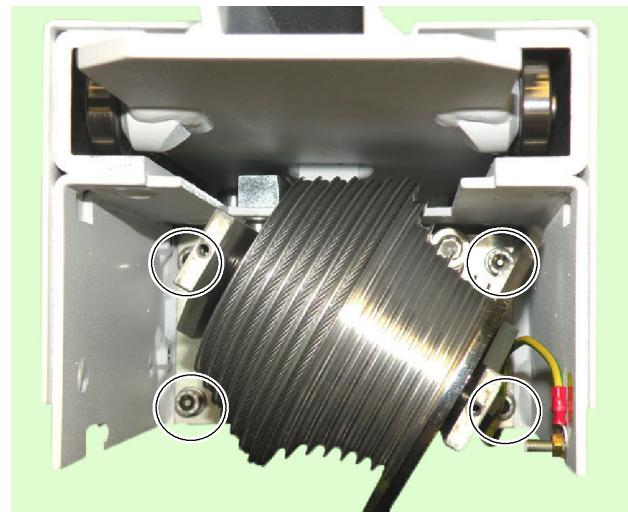


- Slide the Carriage upwards until it contacts the Metal Stopper and hold it with one hand while placing the two (2) Springs at the Column Anti-crashing System. The Springs should be placed in the corresponding slots.

Once the Springs are mounted, the Arm Carriage is locked in position with the Column Anti-crashing System.



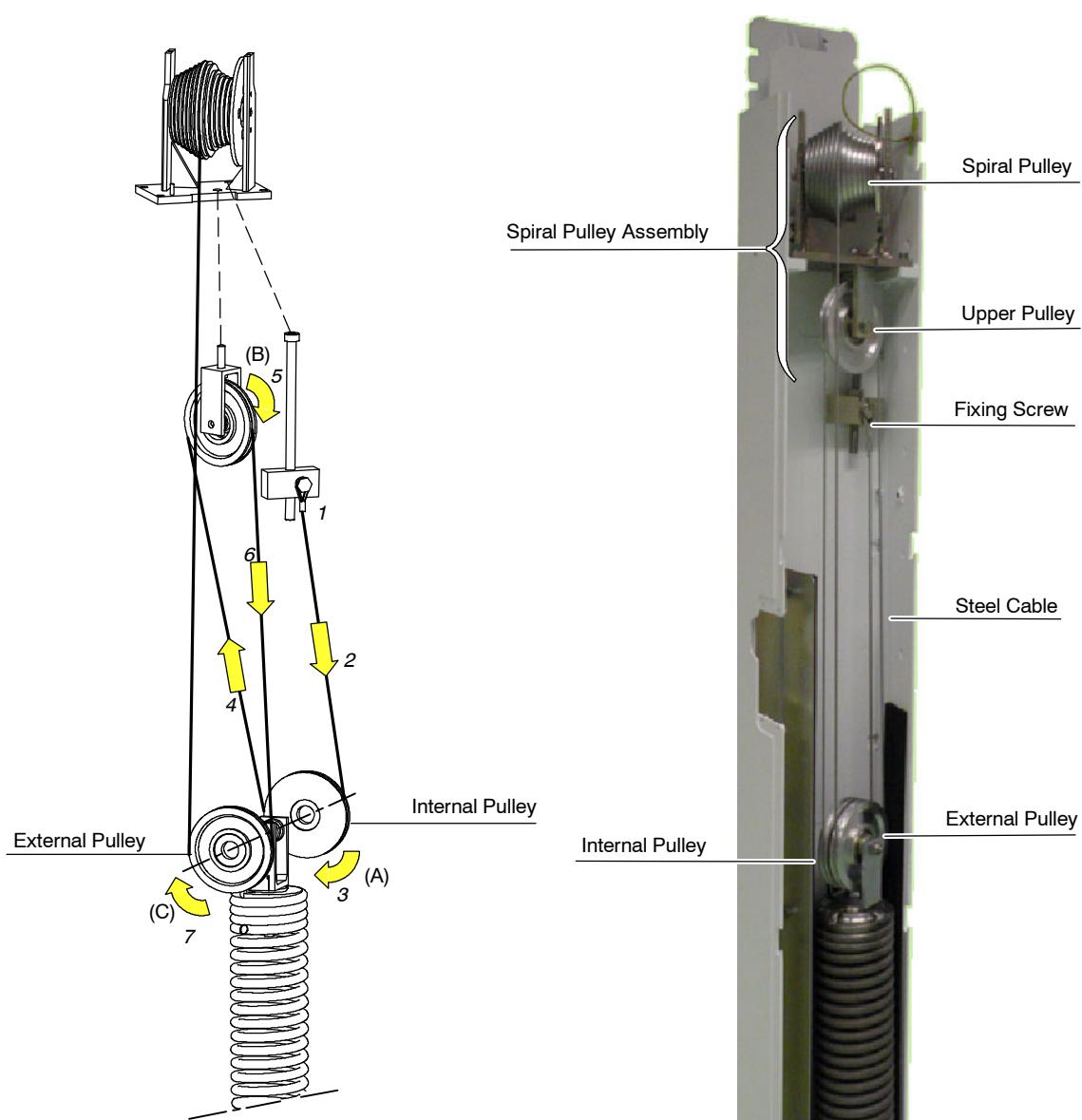
- I. Mount the Spiral Pulley Assembly and secure it with the four (4) Fixing screws adding Loctite 243 and using a torque of 10.5 Nm.



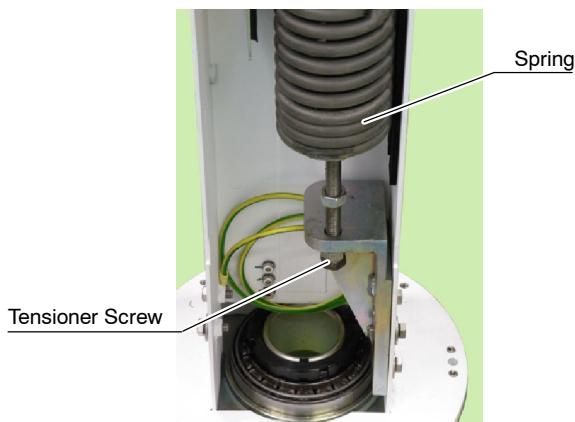
- m. Follow with step 21.

20. If It is only needed the **Spring replacement**.

- a. Remove the Cable Fixing Screw (1) and remove the Steel Cable firstly from the Internal Pulley (A) of the Spring Assembly (*refer to next illustration*).
- b. Remove the Steel Cable from the Upper Pulley (B) of the Spiral Pulley Assembly.
- c. Remove the Steel Cable from the External Pulley (C) of the Spring Assembly.
- d. Do not remove the Steel Cable from the Spiral Pulley.



- e. Loosen the Spring Tensioner Screw until both, Tensioner Screw and Spring, are disengaged.

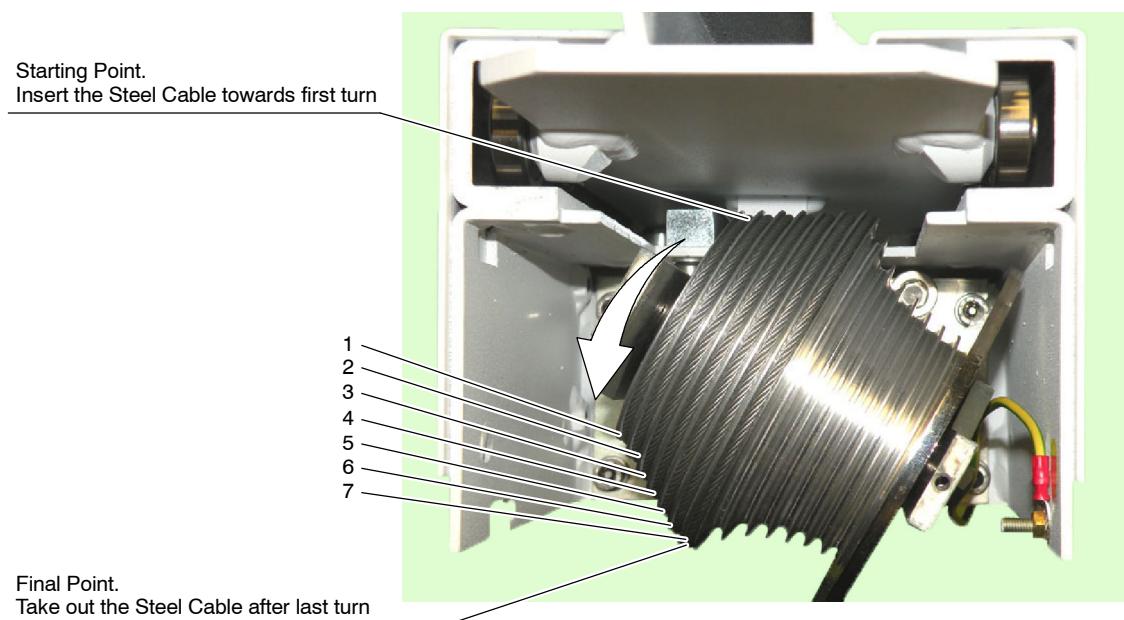


- f. Remove the rope that holds the Spring to the Column.
- g. Replace the Spring securing the new Spring with the Tensioner Screw. Do not forget to insert previously the counternut between the Spring and Support.
- h. Use the rope to tie the Spring to the Column.
- i. Tighten or Loosen the Spring by using the Tensioner Screw in order to keep approximately 290 mm of distance between the Spring base and the Support. Turn the counternut until touch the top of the Support avoiding the Spring slides down.

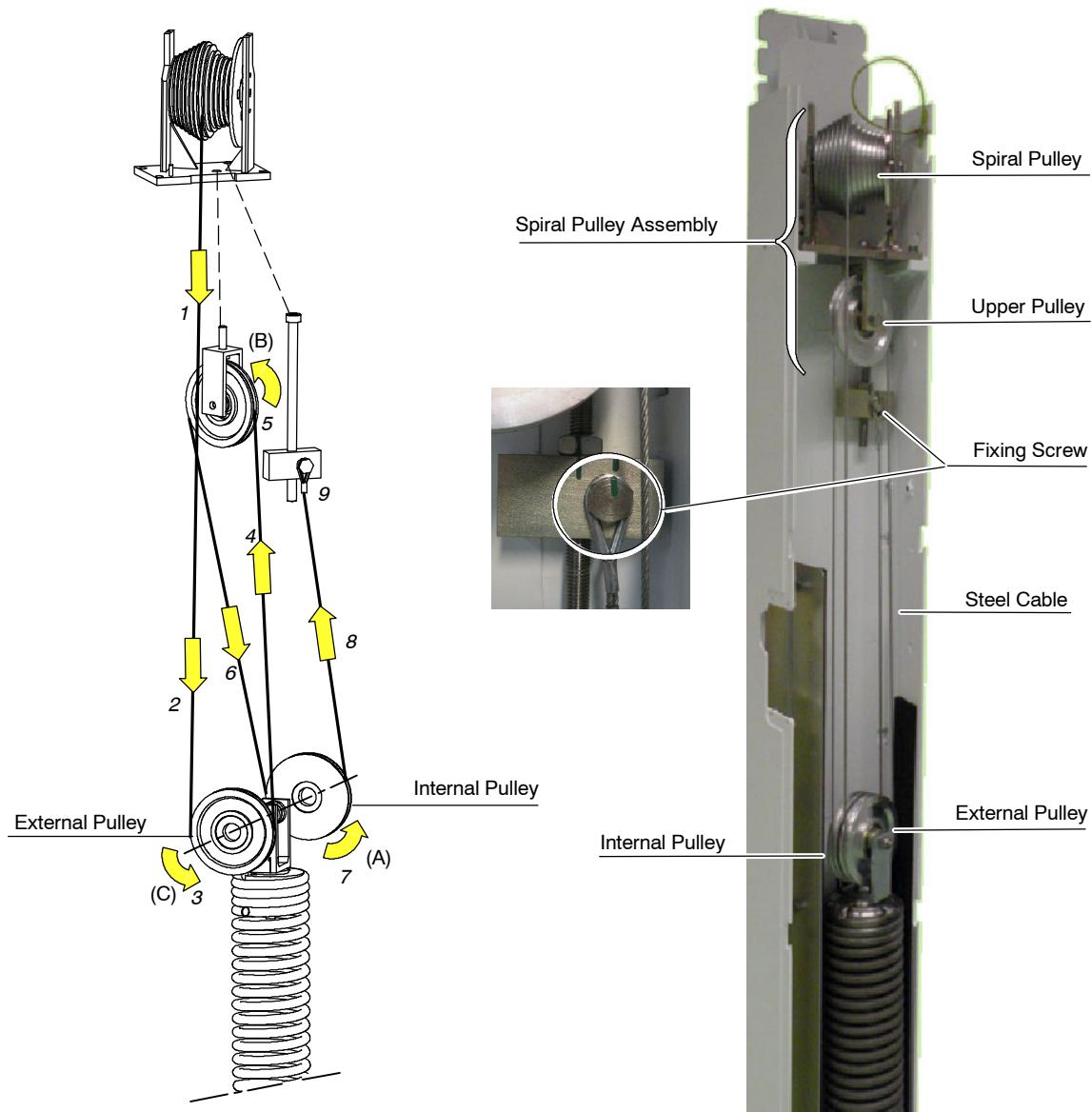


Do not turn the Tensioner Screw over 290 mm of distance between the Spring and the Support. Spring could be disengaged.

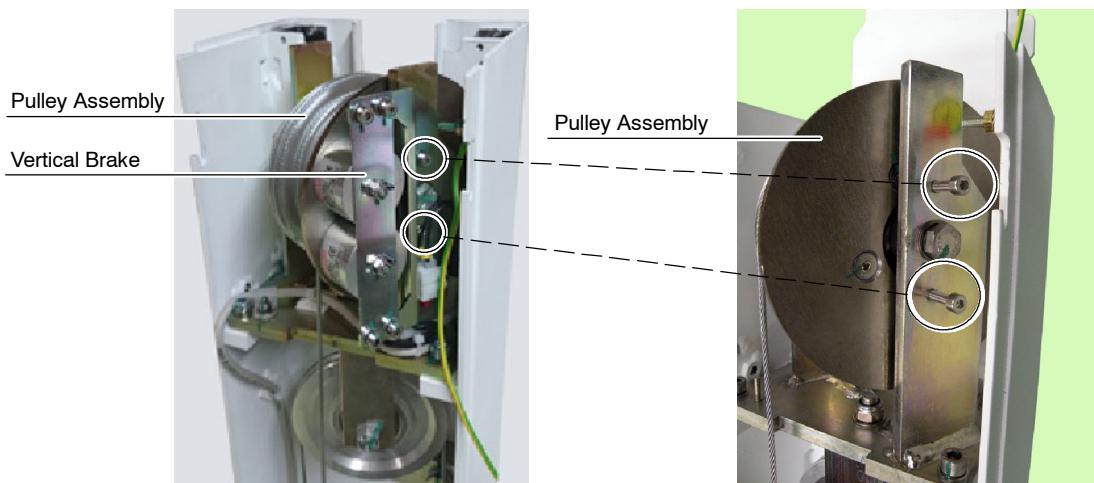
- j. Follow with step 21.
-
21. With the Carriage on the top of the Column, that is, touching the Metal Stopper, roll the Steel Cable seven turns around the Spiral Pulley, from the Starting Point towards the Center of the Pulley, as shown in the picture below.



22. Route the Steel Cable around the External Pulley (C) of the Spring Assembly.
23. Route the Steel Cable around the Upper Pulley (B) of the Spiral Pulley Assembly.
24. Route the Steel Cable around the Internal Pulley (A) of the Spring Assembly.
25. Finally, secure the other end of the Steel Cable to the Spiral Pulley Assembly tightening the Cable Fixing Screw (9) adding Loctite 243 and using a torque of 15 Nm.

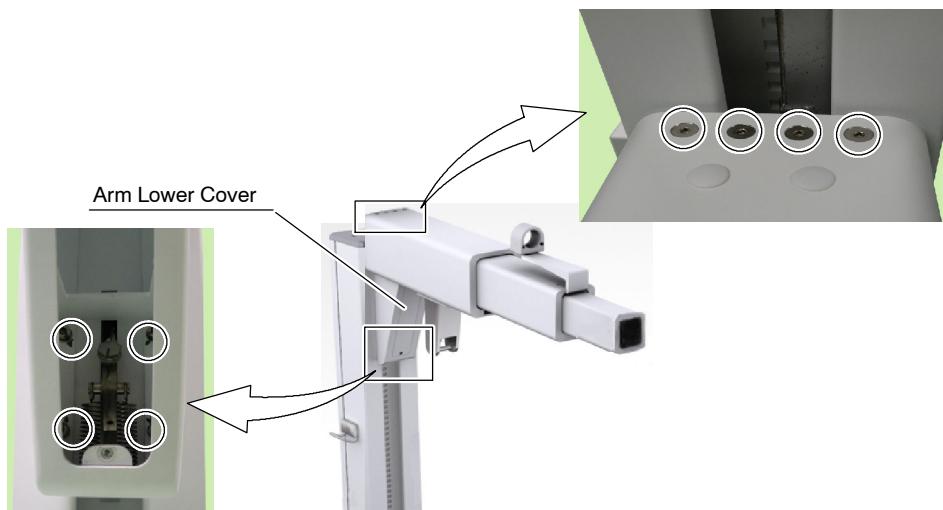


26. Remove the rope that tie the Spring to the Column.
27. Remove the two (2) screws that lock the Pulley Assembly at the top of the Column and re-install the Vertical Brake of the Column with these two (2) screws M4 adding Loctite 243 and using a torque of 2.9 Nm.

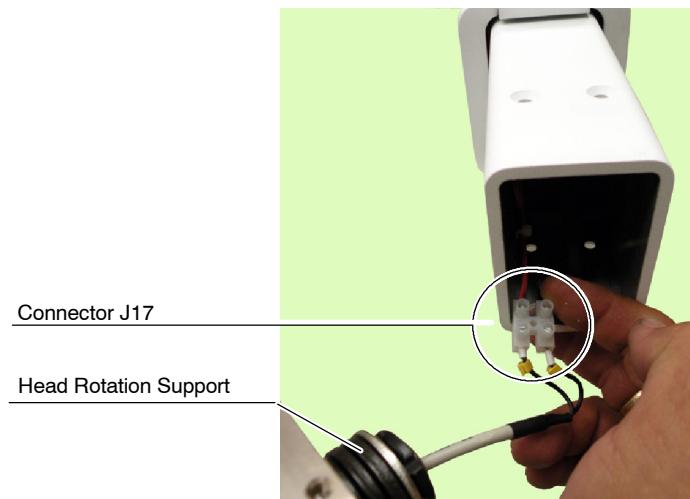


Before following with next steps, make sure that the Steel Cable is properly routed and secure.

28. Tighten the Spring until the Tensioner Screw reaches a distance of around 90 mm between the Spring and the Support.
29. Mount the Arm in the Column Carriage and secure it with the corresponding Fixing screws adding Loctite 243 and using a torque of 10.5 Nm. Mount the Arm Lower Cover.

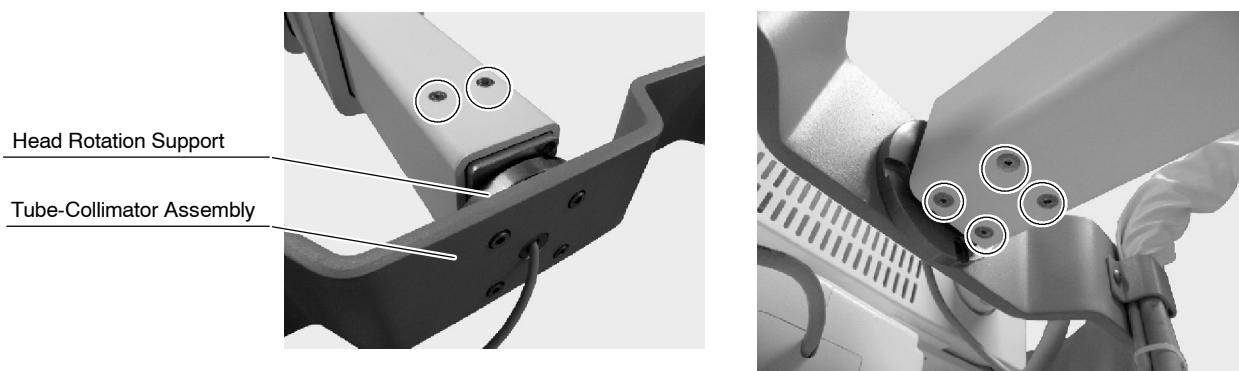


30. Secure the additional counterweight, previously released, on the Arm. Then, carefully place the Arm on the table.
31. Place the Tube-Collimator Assembly with the Head Rotation Support closed to the Arm and connect J17.



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32. Mount the Tube-Collimator Assembly by securing the Head Rotation Support with the two (2) Screws to the upper side and the four (4) Screws to the lower side of the Arm, adding Loctite 243 and using a Torque of 8 Nm.



33. Remove the added counterweight from the Arm.
34. Route and secure the HV Cables with the corresponding Brackets.
35. Remove the auxiliary table near the Unit Column.
36. Turn the Unit ON.
37. Tighten / loosen the Spring by adjusting the Tensioner Screw and balance the vertical movement of the Arm until reach the following force results on the vertical movements:
 - Dynamic effort to perform the upwards vertical movement of Arm must be \leq 3.5 kg.
 - Dynamic effort to perform the downwards vertical movement of Arm must be \leq 5 kg.

Note 

Tighten the Spring with the Tensioner Screw if the force applied is higher than needed.

Loosen the Spring with the Tensioner Screw if the force applied is lower than needed.

38. Secure the position of the Tensioner Screw by turning the counternut until touch the top of the Support.
39. Place the Arm in the upper position.
40. Lubricate the Steel Cable with Multipurpose Lithium Grease. Apply grease using a brush along the Steel Cable and around the Pulleys (Spiral, Upper, Internal and External Pulleys).

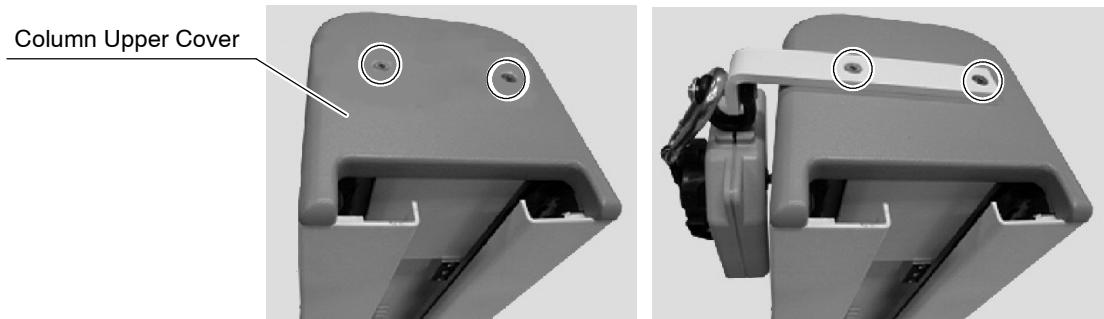
Note 

Nylon-coated steel cables do not require lubrication.

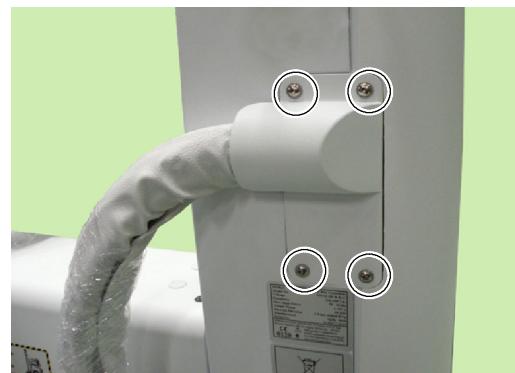
41. Place the Mobile Unit in Parking Position and turn the Unit OFF.
42. Assemble the Column Upper Cover Support.
43. Mount the Column Back Cover connecting the Ground Cable.
44. Mount the Cables Access Cover.
45. Install the Column Upper Cover securing the Tools Balance Support if required.

**3.1.1.2 COLUMN STEEL CABLE / SPRING REPLACEMENT (WITH SPIRAL PULLEY ASSEMBLY
SC+A16049-01)****Note** *Two people are necessary to carry out the entire procedure.*

1. Turn the Mobile Unit ON and place the Unit in Parking Position.
2. Unscrew the two (2) Fixing Screws from the Column Upper Cover and remove the Cover. For Mobile Units with Portable DR Detector, these Screws also fix the Tools Balance Support or “Detector Cable Tether”.

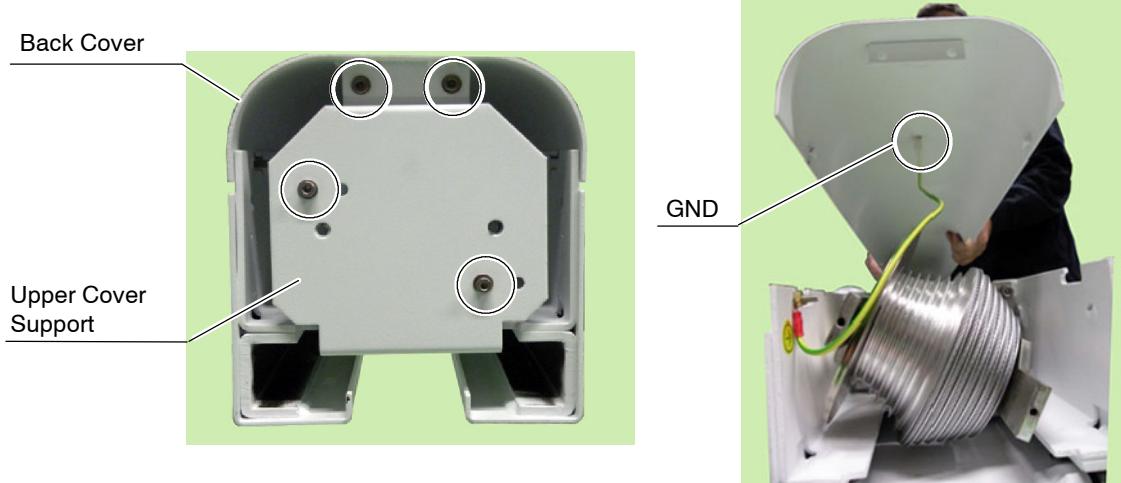


3. Remove the Cables Access Cover by removing the four (4) Fixing screws.



4. Remove the two (2) Fixing Screws from the Column Back Cover.

Slide the Column Back Cover a few centimeters upwards, then remove the cover backwards and disconnect GND cable.



5. Remove the Column Upper Cover Support after removing the two (2) fixing Screws, as shown in the picture above.
6. Before following with the next steps, place an auxiliary table beside the Unit Column.
7. Release the Arm from Parking position, turn the Column 90° and place the Arm fully extended with the Tube-Collimator Assembly on the table.
8. Turn the Unit OFF.



KEEP THE UNIT TURNED OFF AND ISOLATED FROM THE POWER SUPPLY.

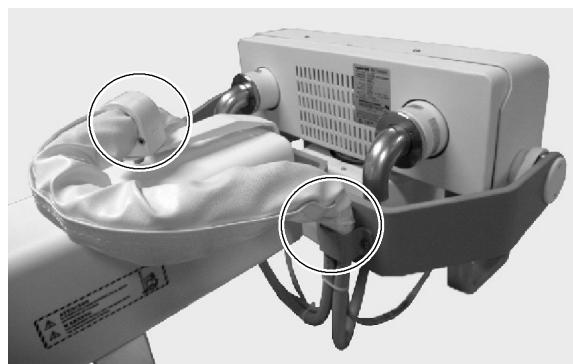
9. A counterweight of equal weight of the Tube-Collimator Assembly has to be secured on the Arm (a.e. if the Collimator weights 10 kg / 22 lb, the Tube weights 18 kg / 40 lb, and the remaining parts of the Assembly (HV Cables, Supports, Tube covers, etc.) weights approx. 13 Kg / 29 lb, the counterweight must be of $10+18+13= 41$ kg / 91 lb. Refer to the Collimator and Tube manuals to find out their weight.



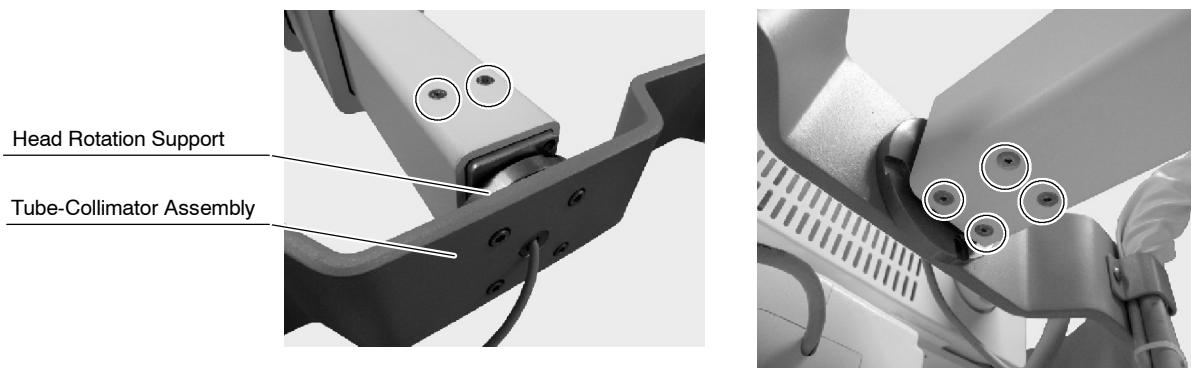
IF PARTS OF THE ARM ARE REMOVED, THE ARM WILL NOT BE BALANCED ANYMORE.

IF NO ADDITIONAL COUNTERWEIGHT HAS BEEN SECURED ON THE ARM, THE ARM WILL SPRING UPWARDS WHEN REMOVING THE TUBE-COLLIMATOR ASSEMBLY.

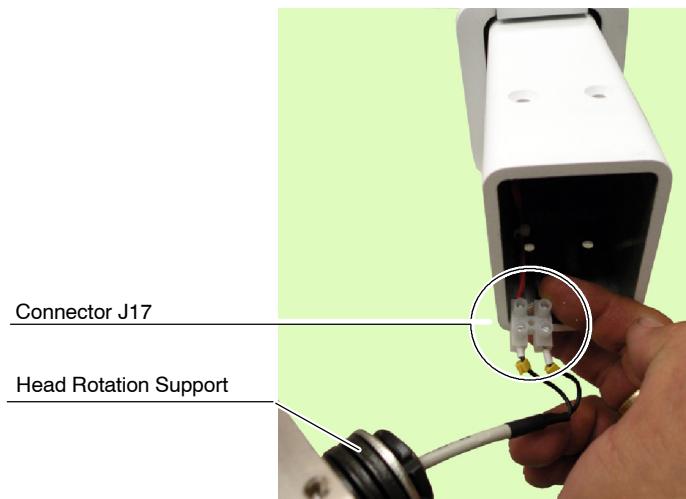
10. Remove the two (2) Brackets of the HV Cables by removing the corresponding Screws.



11. Remove the two (2) Screws from the upper side and the four (4) Screws from the lower side of the Arm.



12. Carefully remove the Tube-Collimator Assembly with the Head Rotation Support just to disconnect connector J17. Then, carefully place and secure the Tube-Collimator Assembly on the table.

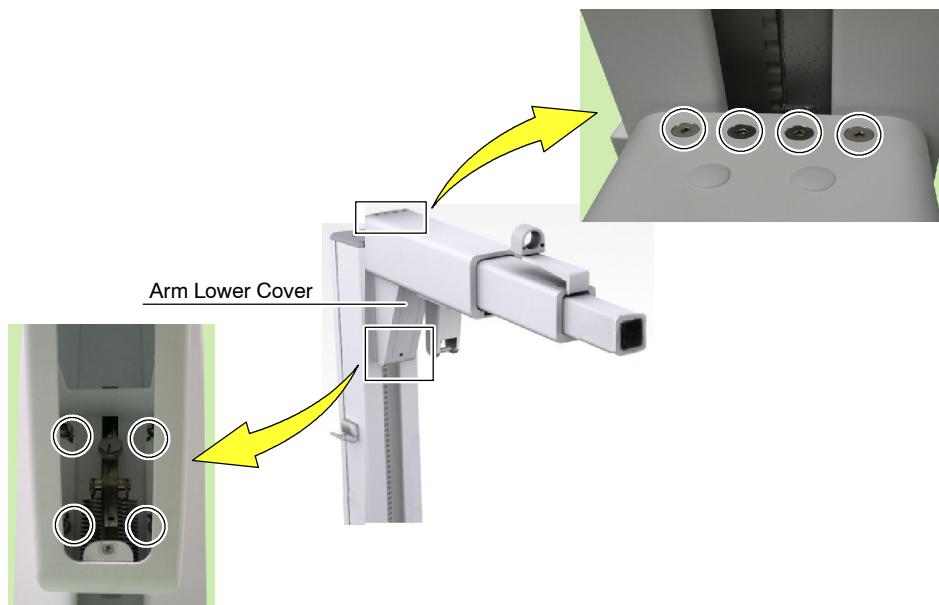


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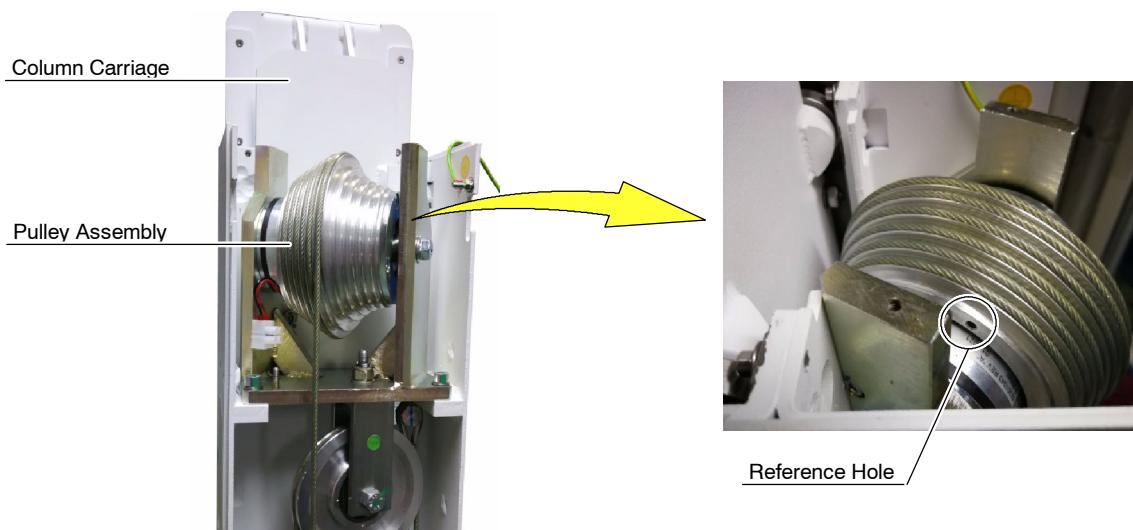
13. Place the Arm at the upper end of the Column, as shown in the picture below and carefully release the added counterweight from the Arm.



14. Remove the Arm Lower Cover and then dismount the Arm from the Column Carriage by removing the corresponding Fixing Screws. Place the Arm carefully on the table.



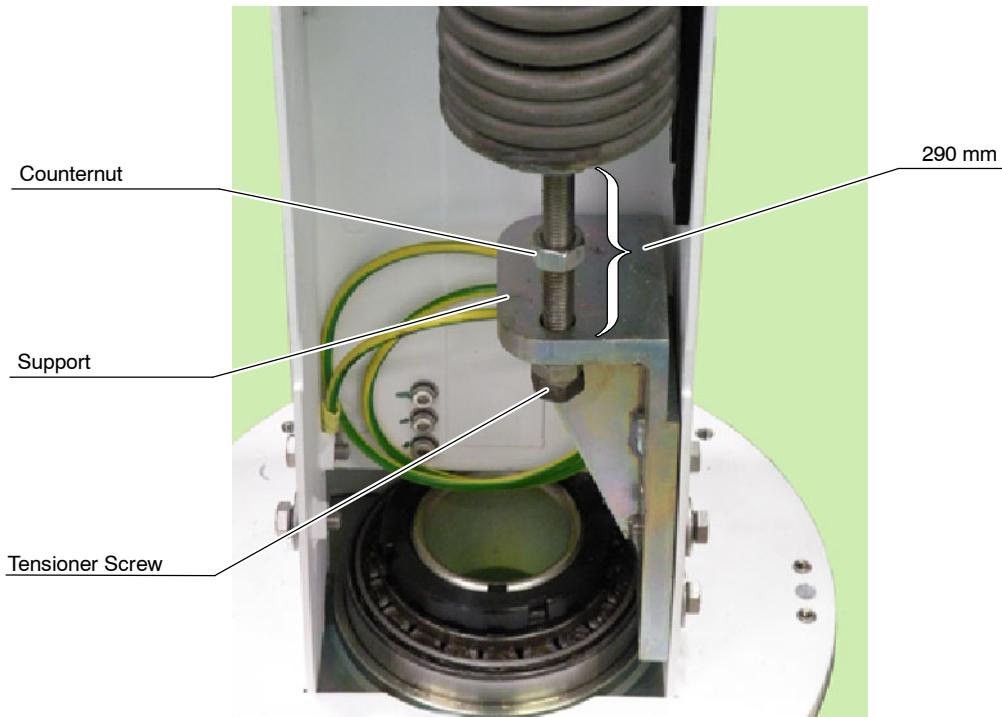
15. Check the Reference Hole of the Spiral Pulley is located on the top of the Pulley Assembly when the Column Carriage is at the upper end of the Column.



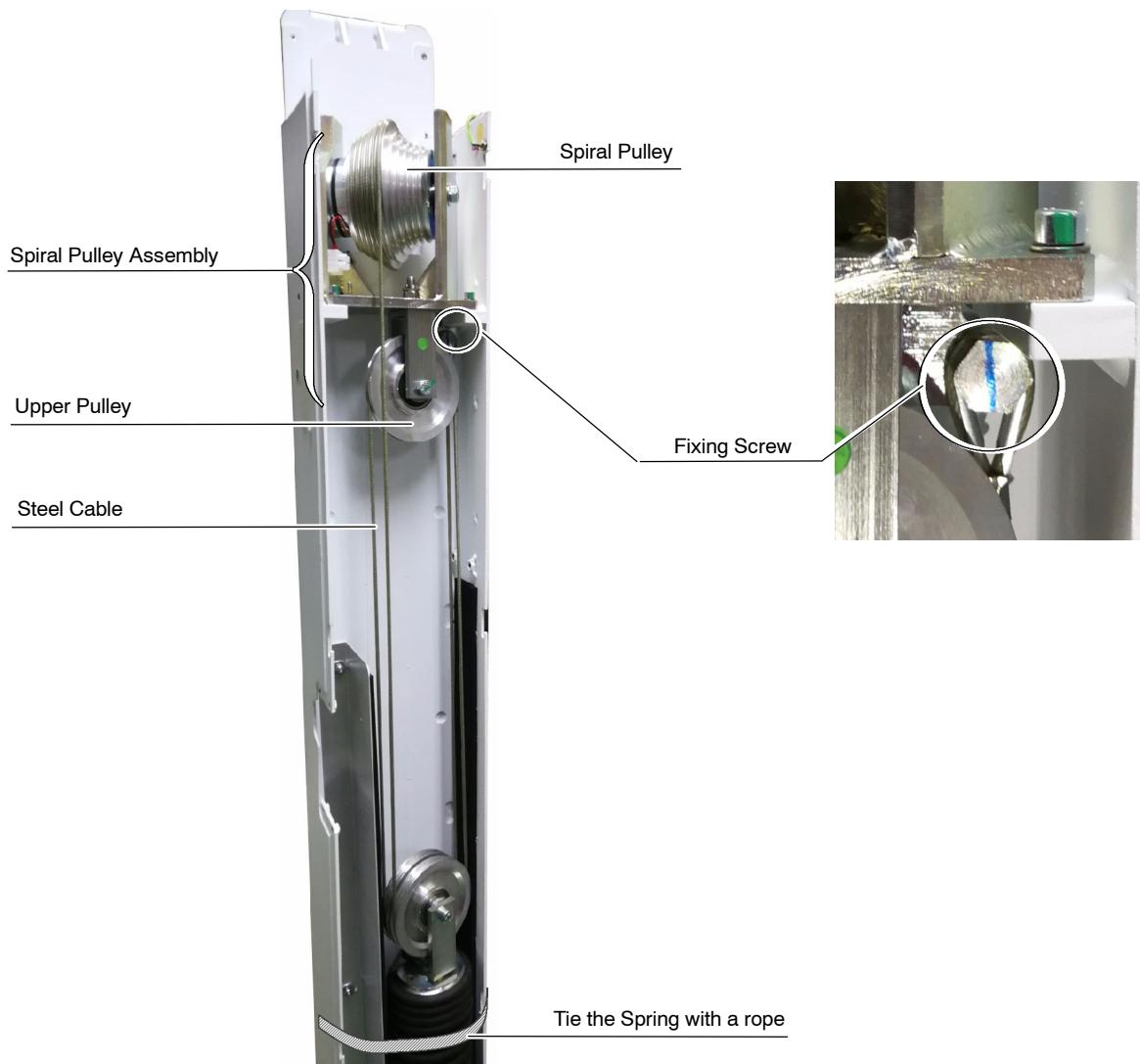
16. Loosen the Spring by loosening the counternut and the Tensioner Screw in order to slack the Steel Cable, that is, approximately 290 mm of distance between the Spring and the Support. Turn the counternut until touch the top of the Support avoiding the Spring slides down.



Do not turn the Tensioner Screw over 290 mm of distance between the Spring and the Support. Spring could be disengaged.



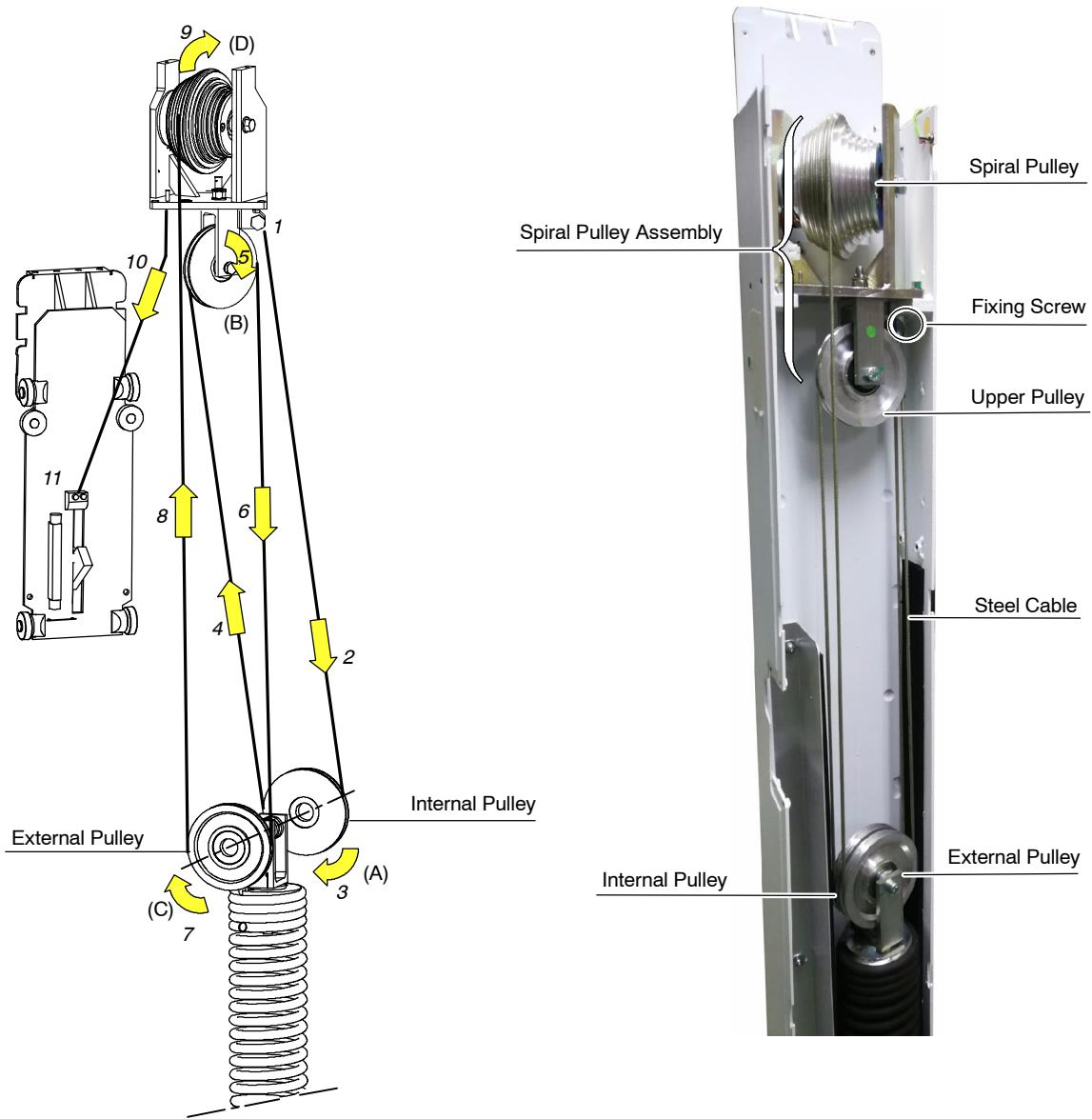
17. Use a rope to tie the Spring to the Column, then remove the Fixing Screw that secures the Steel Cable to the lower area of the Spiral Pulley Assembly. When the Steel Cable is released, the Arm Carriage is locked with the Column Anti-crashing System, anyway, hold the Arm Carriage with a hand until it is locked to avoid possible painting damage on the Column.



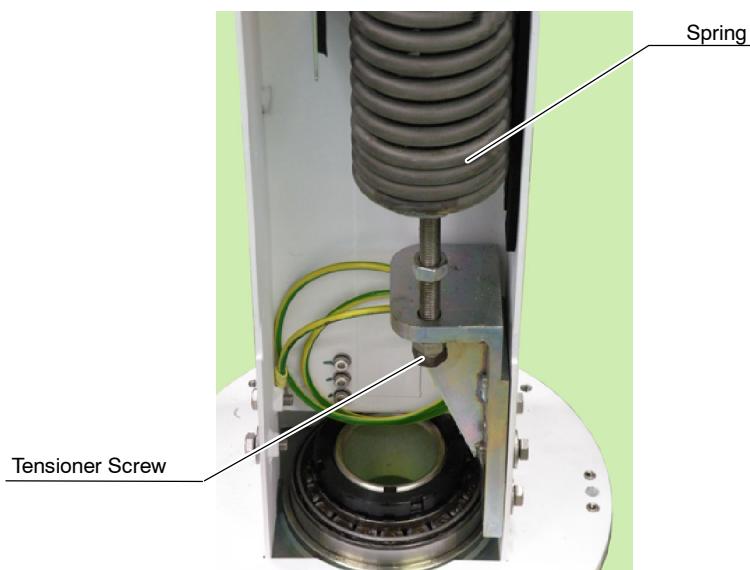
18. Replace the Steel Cable and / or Spring if needed.
- In case of replacing only the Steel Cable or replacing the Steel Cable and Spring follow process from step 19.
 - In case of replacing only the Spring follow process from step 20.

19. Replacement of only **Steel Cable** or replacement of **Steel Cable and Spring**.

- a. Remove the Cable Fixing Screw (1) and remove the Steel Cable firstly from the Internal Pulley (A) of the Spring Assembly.
- b. Remove the Steel Cable from the Upper Pulley (B) of the Spiral Pulley Assembly.
- c. Remove the Steel Cable from the External Pulley (C) of the Spring Assembly
- d. Finally remove the Steel Cable from the Spiral Pulley (D).



- e. If it is needed to replace the **Spring** follow this procedure, it not goes to step 19.f.
- Loosen the Spring Tensioner Screw until both, Tensioner Screw and Spring, are disengaged.



- Remove the rope that holds the Spring to the Column.
- Replace the Spring securing the new Spring with the Tensioner Screw. Do not forget to insert previously the counternut between the Spring and Support.
- Use the rope to tie the Spring to the Column.
- Tighten or Loosen the Spring by using the Tensioner Screw in order to keep approximately 290 mm of distance between the Spring base and the Support. Turn the counternut until touch the top of the Support avoiding the Spring slides down.



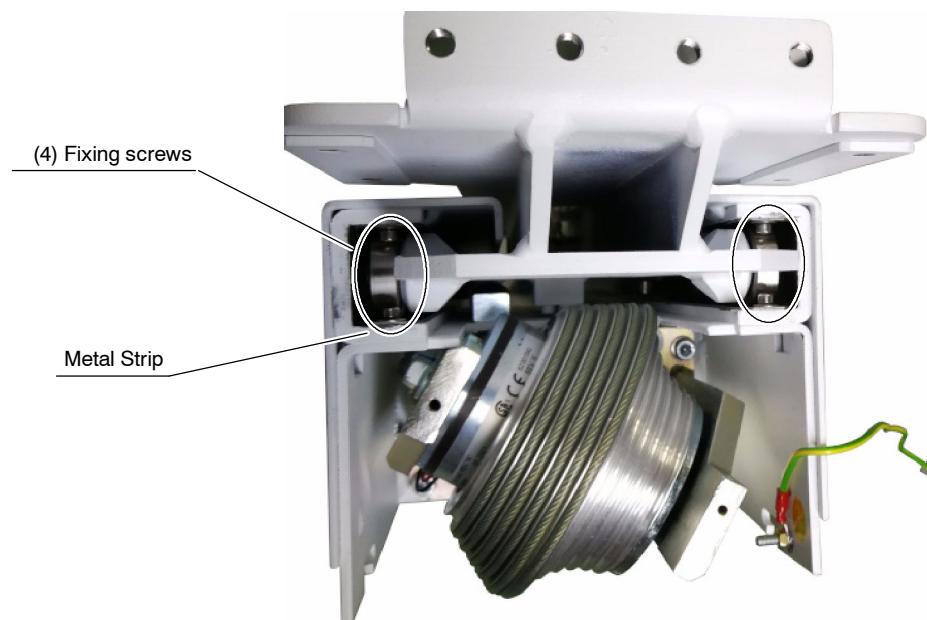
Do not turn the Tensioner Screw over 290 mm of distance between the Spring and the Support. Spring could be disengaged.

- f. Unscrew the four (4) Fixing screws, carefully dismount the Spiral Pulley Assembly and place it on a safe area.

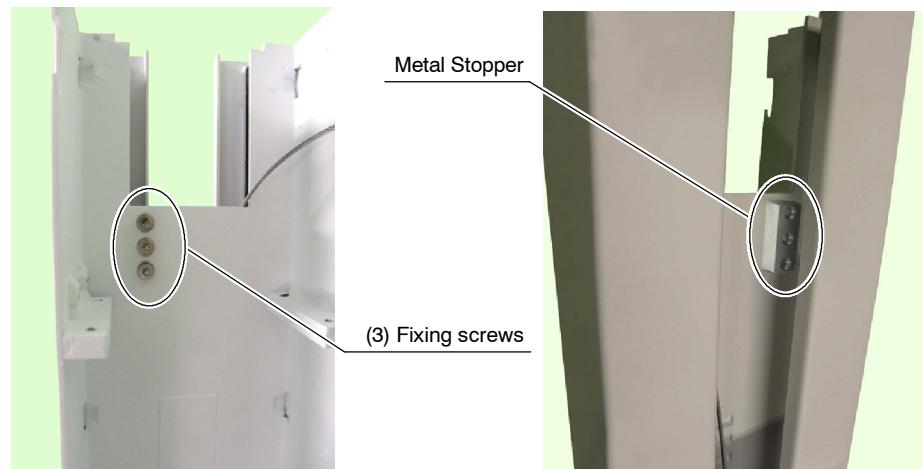


- g. At the top of the Column:

- Remove the four (4) Fixing screws that secure Metal Strips of the Carriage Bearings to the Column, for that purpose previously heat up (by a heat gun) these screws in order to remove them easier because they were mounted with Loctite.

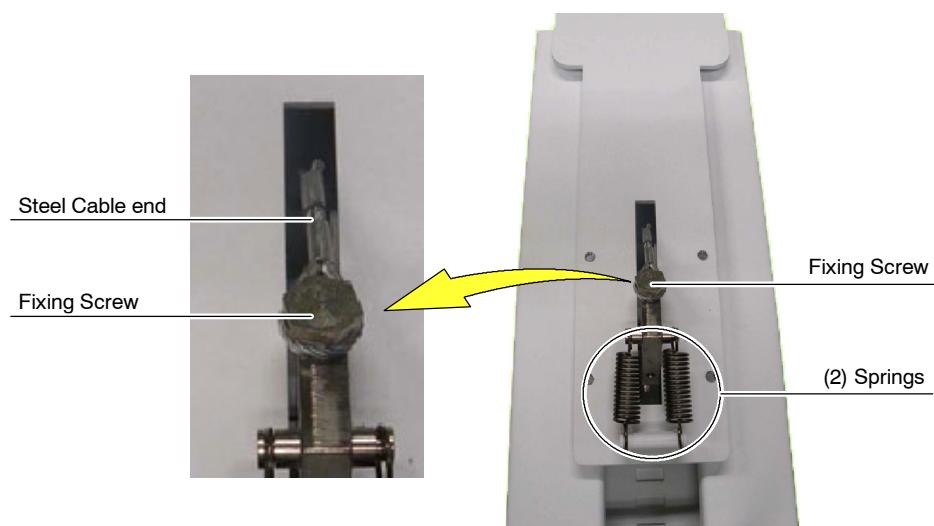


- Remove the three (3) Fixing screws while holding the Metal Stopper with the other hand and then remove it.

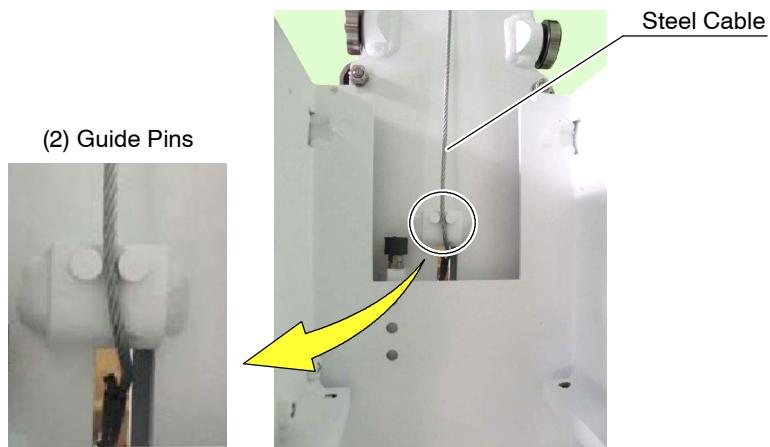


- h. Remove the two (2) Springs from the Column Anti-crashing System while holding the Carriage with the other hand.

Slide the Carriage upwards to remove it and, once it has been placed on a safe area, remove the Fixing Screw, replace the Steel Cable and tighten the Fixing Screw adding Loctite 243 and using a torque of 15 Nm.

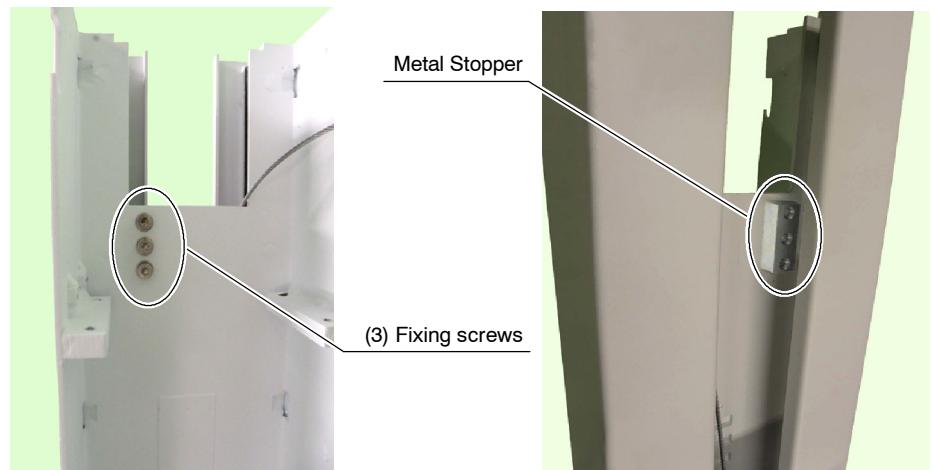


- i. Insert the Carriage to the Column, routing the Steel Cable between the two (2) Guide Pins located at the back side of the Carriage and slide the Carriage into the Column.

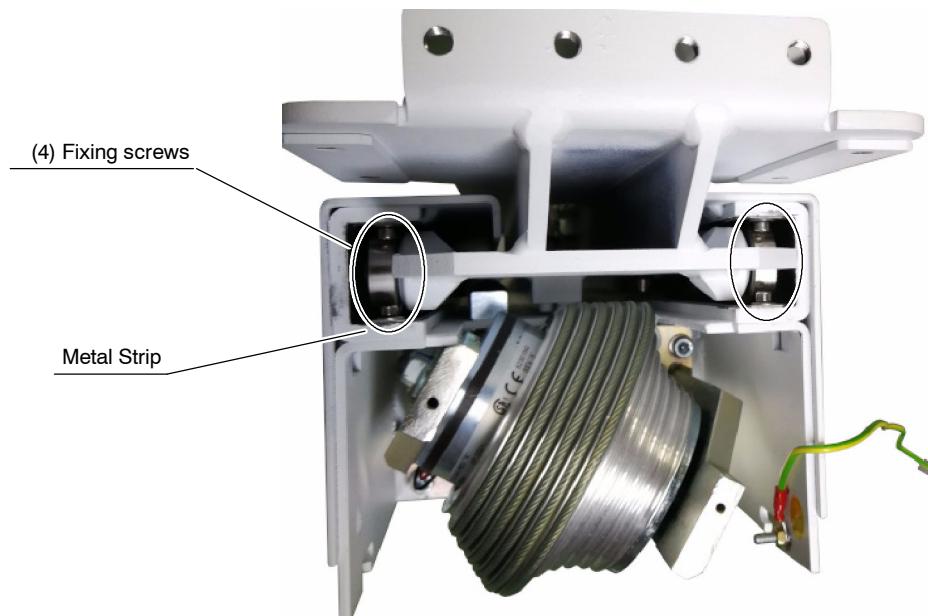


- j. At the top of the Column:

- Place the Metal Stopper back in place securing it with the three (3) Fixing screws adding Loctite 243 and using a torque of 10.5 Nm.

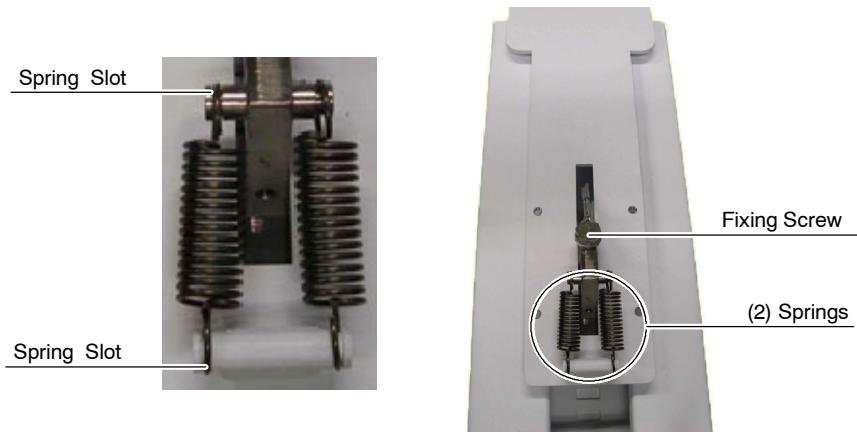


- Re-install the four (4) Fixing screws that secure Metal Strips of the Carriage Bearings to the Column adding Loctite 243.



- Slide the Carriage upwards until it contacts the Metal Stopper and hold it with one hand while placing the two (2) Springs at the Column Anti-crashing System. The Springs should be placed in the corresponding slots.

Once the Springs are mounted, the Arm Carriage is locked in position with the Column Anti-crashing System.



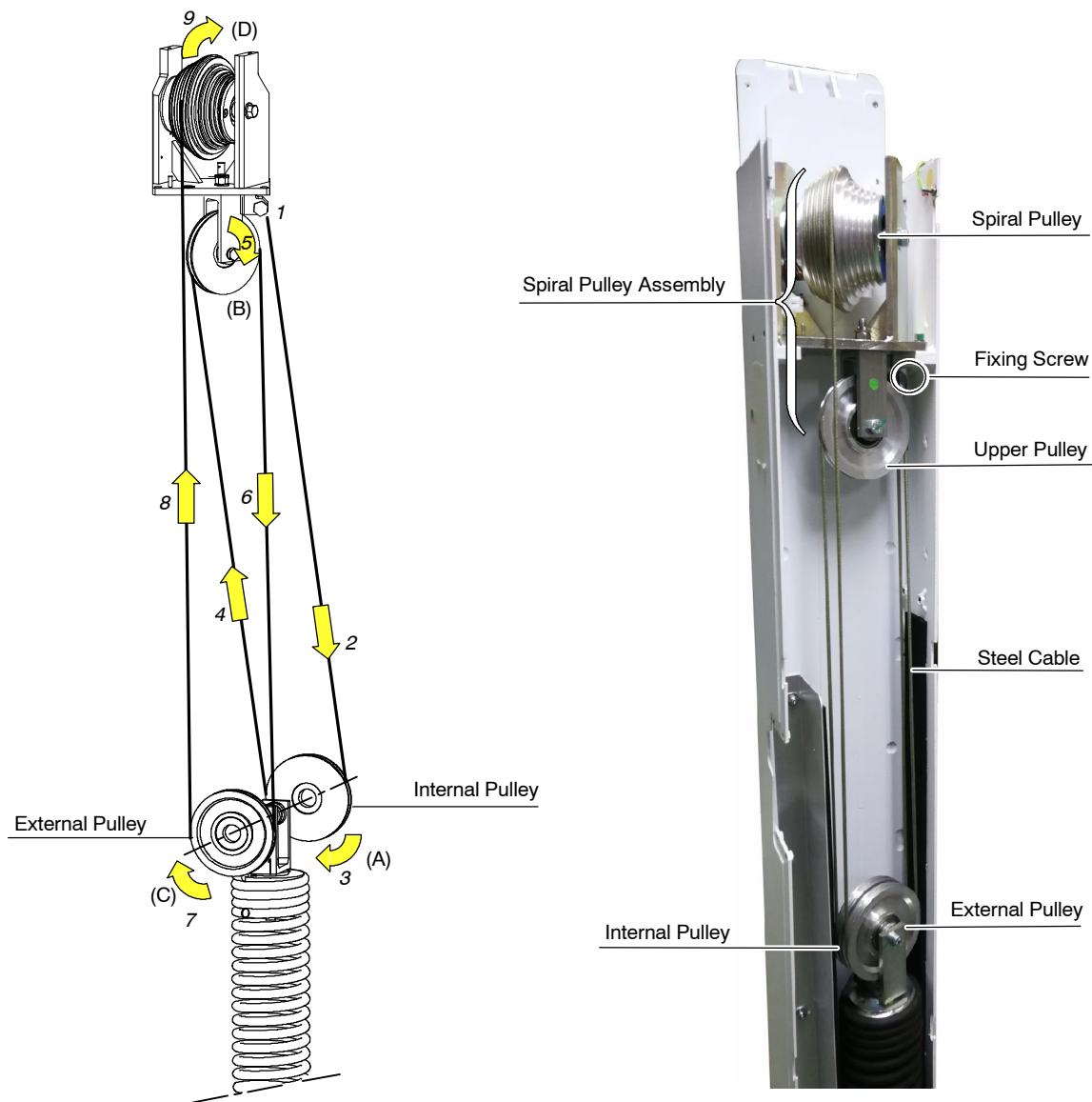
- I. Mount the Spiral Pulley Assembly and secure it with the four (4) Fixing screws adding Loctite 243 and using a torque of 10.5 Nm.



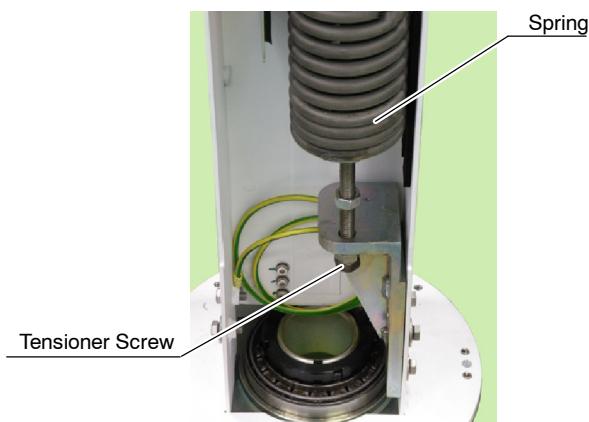
- m. Follow with step 21.

20. If It is only needed the **Spring replacement**.

- a. Remove the Cable Fixing Screw (1) and remove the Steel Cable firstly from the Internal Pulley (A) of the Spring Assembly (*refer to next illustration*).
- b. Remove the Steel Cable from the Upper Pulley (B) of the Spiral Pulley Assembly.
- c. Remove the Steel Cable from the External Pulley (C) of the Spring Assembly.
- d. Do not remove the Steel Cable from the Spiral Pulley.



- e. Loosen the Spring Tensioner Screw until both, Tensioner Screw and Spring, are disengaged.



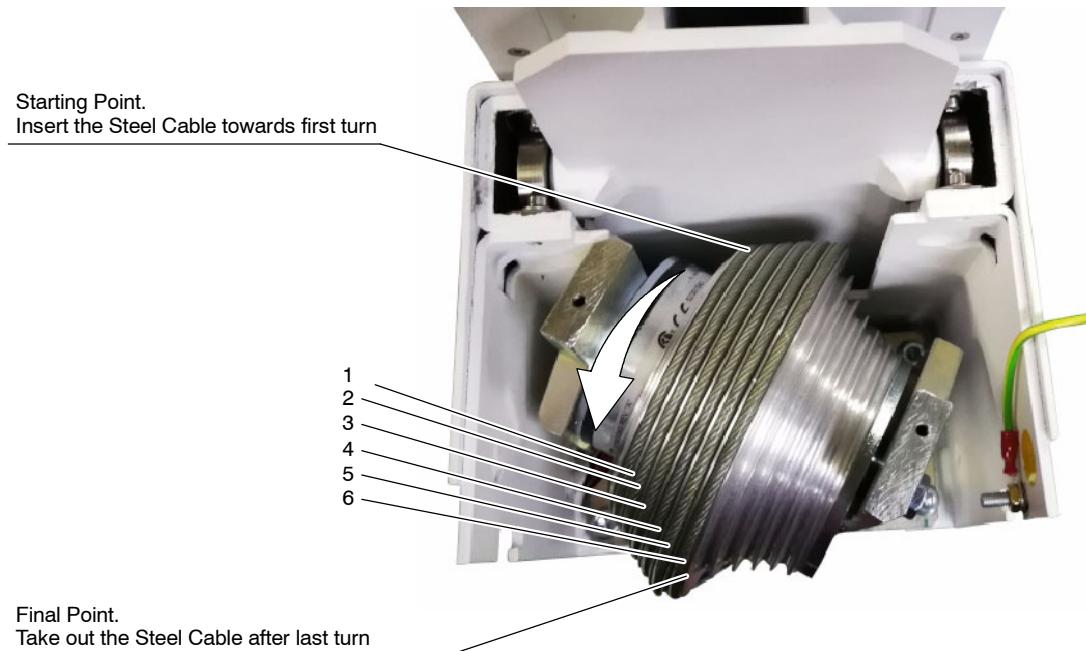
- f. Remove the rope that holds the Spring to the Column.
- g. Replace the Spring securing the new Spring with the Tensioner Screw. Do not forget to insert previously the counternut between the Spring and Support.
- h. Use the rope to tie the Spring to the Column.
- i. Tighten or Loosen the Spring by using the Tensioner Screw in order to keep approximately 290 mm of distance between the Spring base and the Support. Turn the counternut until touch the top of the Support avoiding the Spring slides down.



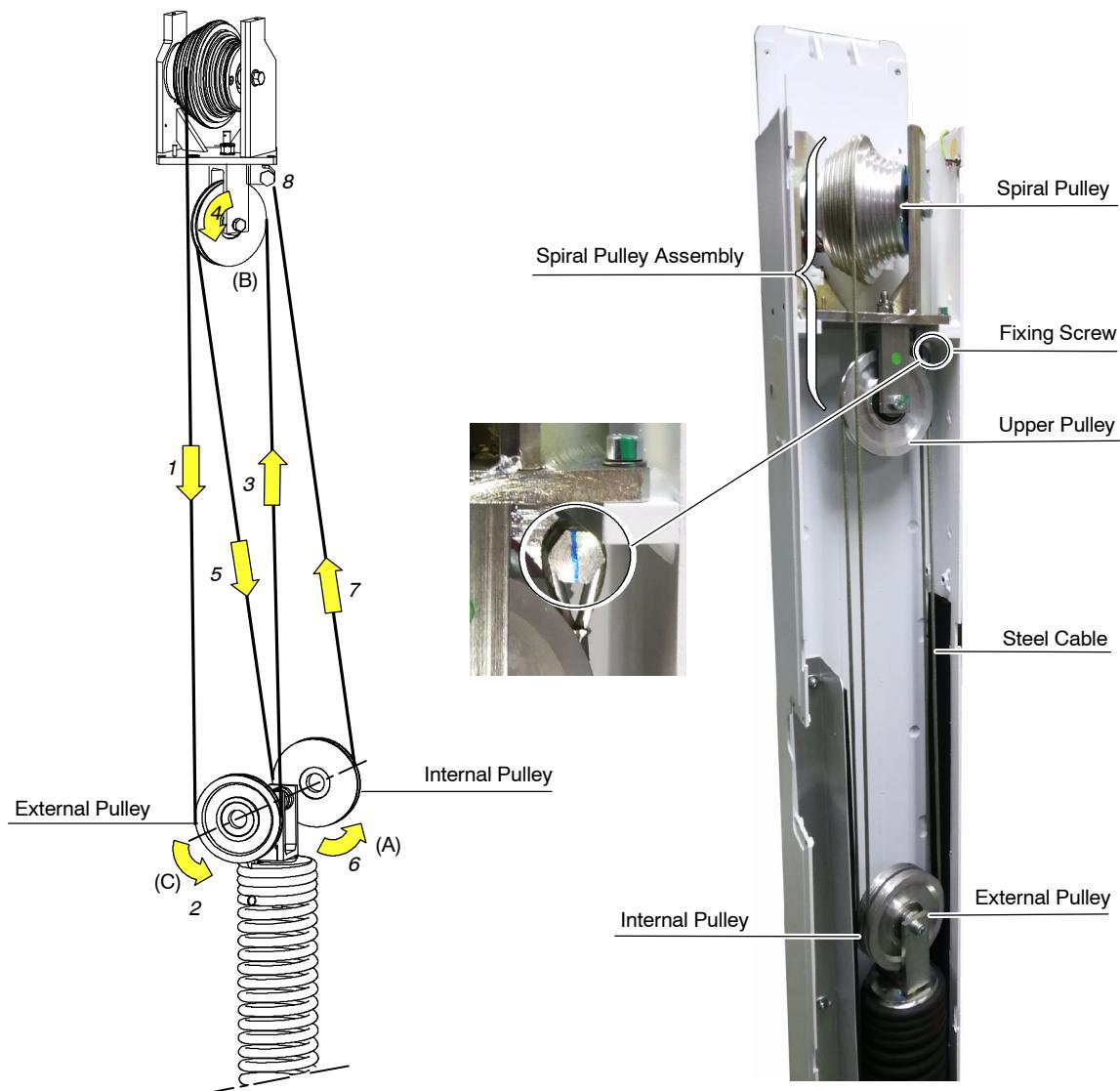
Do not turn the Tensioner Screw over 290 mm of distance between the Spring and the Support. Spring could be disengaged.

- j. Follow with step 21.

21. With the Carriage on the top of the Column, that is, touching the Metal Stopper, roll the Steel Cable six turns around the Spiral Pulley, from the Starting Point towards the Center of the Pulley, as shown in the picture below.



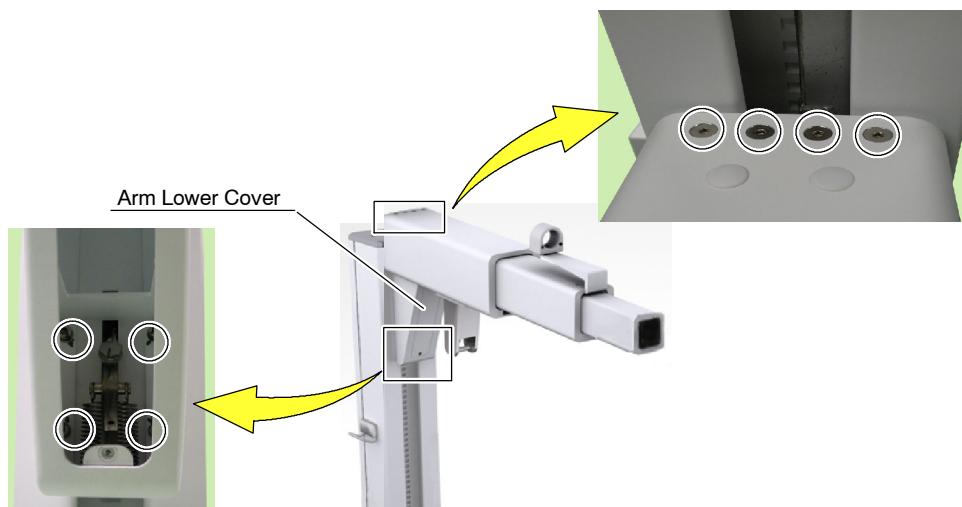
22. Route the Steel Cable around the External Pulley (C) of the Spring Assembly.
23. Route the Steel Cable around the Upper Pulley (B) of the Spiral Pulley Assembly.
24. Route the Steel Cable around the Internal Pulley (A) of the Spring Assembly.
25. Finally, secure the other end of the Steel Cable to the Spiral Pulley Assembly tightening the Cable Fixing Screw (8) adding Loctite 243 and using a torque of 15 Nm.





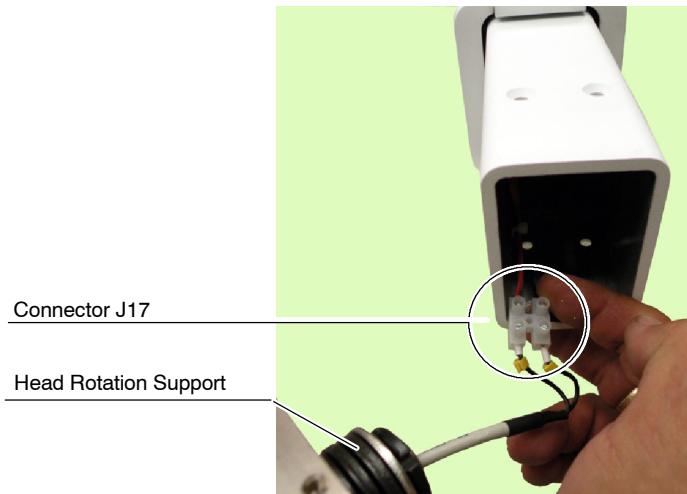
Before following with next steps, make sure that the Steel Cable is properly routed and secure.

26. Remove the rope that tie the Spring to the Column.
27. Tighten the Spring until the Tensioner Screw reaches a distance of around 90 mm between the Spring and the Support.
28. Mount the Arm in the Column Carriage and secure it with the corresponding Fixing screws adding Loctite 243 and using a torque of 10.5 Nm. Mount the Arm Lower Cover.



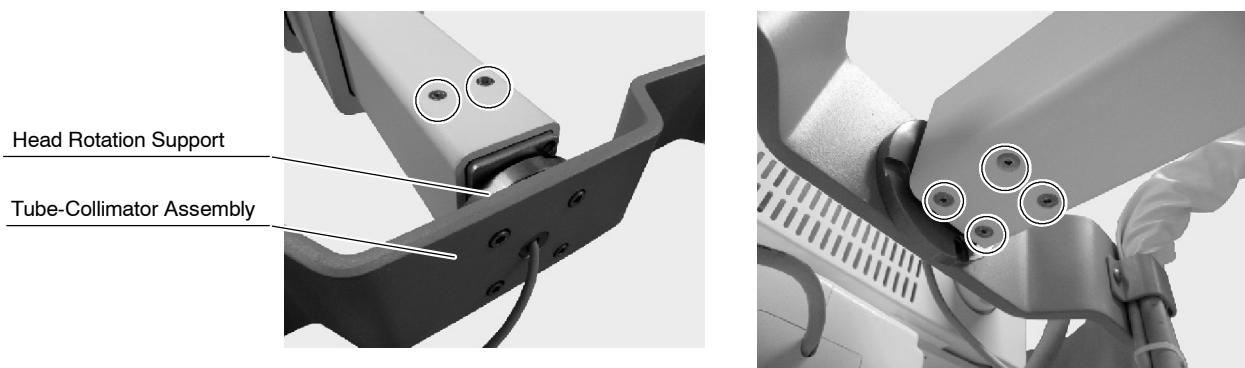
29. Secure the additional counterweight, previously released, on the Arm. Then, carefully place the Arm on the table.

30. Place the Tube-Collimator Assembly with the Head Rotation Support close to the Arm and connect J17.



THE WEIGHT OF THE TUBE-COLLIMATOR ASSEMBLY IS HEAVY, UNSTEADY AND DIFFICULT TO HANDLE, THEREFORE AT LEAST TWO PEOPLE IS NEEDED TO INSTALL IT. THIS WILL AVOID PERSONAL INJURIES OR DAMAGE TO THE EQUIPMENT.

31. Mount the Tube-Collimator Assembly to the Arm by securing the Head Rotation Support with the two (2) Screws to the upper side and the four (4) Screws to the lower side of the Arm, using Loctite 243 and applying a torque of 8 Nm.



32. Remove the added counterweight from the Arm.
33. Route and secure the HV Cables with the corresponding Brackets.
34. Remove the auxiliary table near the Unit Column.
35. Turn the Unit ON.
36. Tighten / loosen the Spring by adjusting the Tensioner Screw and balance the vertical movement of the Arm until reach the following force results on the vertical movements:
 - Dynamic effort to perform the upwards vertical movement of Arm must be ≤ 3.5 kg.
 - Dynamic effort to perform the downwards vertical movement of Arm must be ≤ 5 kg.

Note 

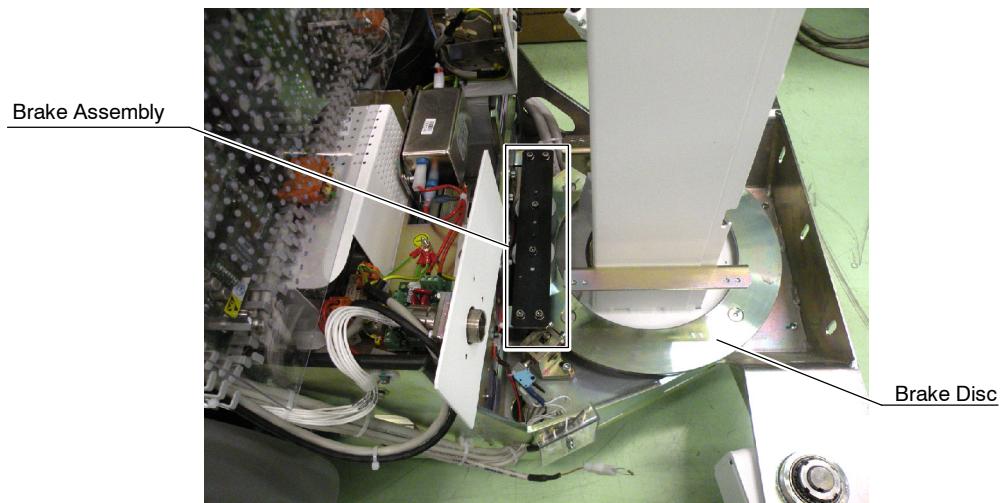
Tighten the Spring with the Tensioner Screw if the force applied is higher than needed.

Loosen the Spring with the Tensioner Screw if the force applied is lower than needed.

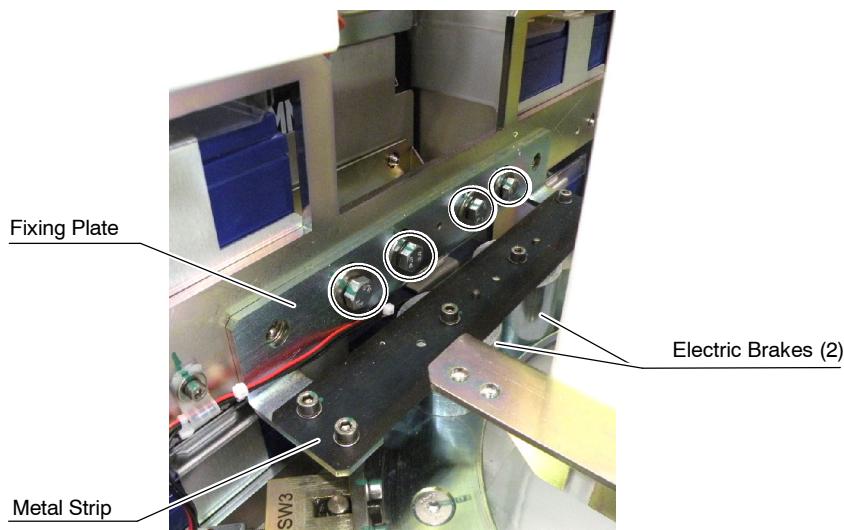
37. Secure the position of the Tensioner Screw by turning the counternut until touch the top of the Support.
38. Place the Arm in the upper position.
39. Place the Mobile Unit in Parking Position and turn the Unit OFF.
40. Assemble the Column Upper Cover Support.
41. Mount the Column Back Cover connecting the Ground Cable.
42. Mount the Cables Access Cover.
43. Install the Column Upper Cover securing the Tools Balance Support if required.

3.1.1.3 ADJUSTMENT OF THE COLUMN ROTATION BRAKE

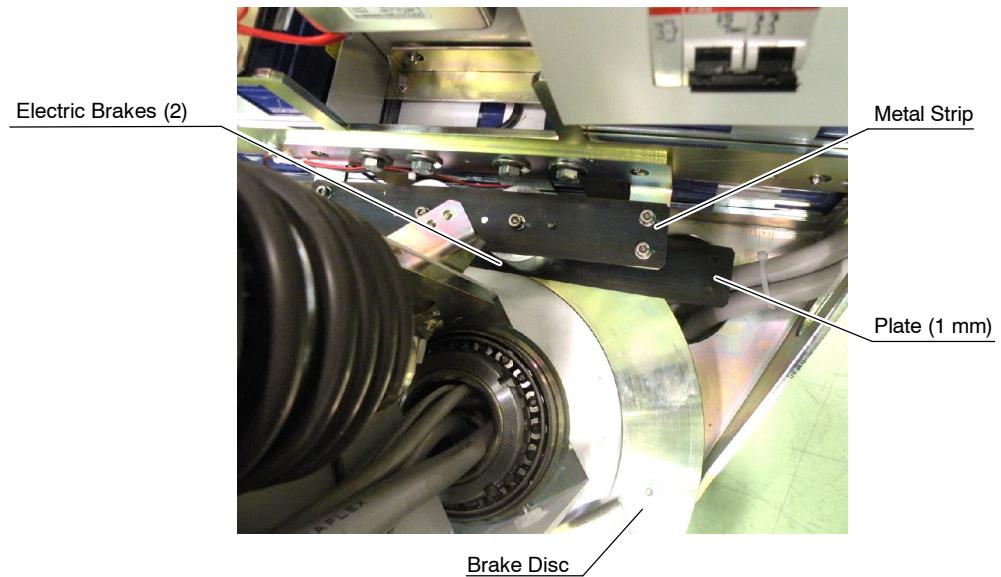
1. Remove the corresponding covers of the Mobile unit as described in Section 2.2, until dismounting the Ring Cover at the Column Base.



2. Loosen without removing the four (4) Screws fixing the Column Rotation Brake Assembly (Fixing Plate, Metal Strip, Electric Brakes) to the Chassis of the Mobile unit.



3. Turn the unit ON. Press the Handgrip Buttons in order to release the Electric Brakes and insert a Plate (1mm) between the Electric Brakes and the Brake Disc.



4. Release the Handgrip Buttons and tighten the four (4) Fixing Screws of the Column Rotation Brake Assembly to the Chassis of the Mobile unit.

Then, press again the Handgrips Buttons in order to remove the Plate.

5. Check that there is not friction between the Electric Brakes and the Brake Disc and place back the covers to the unit.

3.1.2 PROCEDURES RELATED TO THE ARM**3.1.2.1 ARM REPLACEMENT**

Note 

Two people are necessary to carry out the entire procedure.

Before starting the procedure, place an auxiliary table beside the Unit Column.

1. Release the Arm from Parking position, turn the Column 90° and place the Arm fully extended with the Tube-Collimator Assembly on the table.
2. Turn the unit OFF.



KEEP THE UNIT TURNED OFF AND ISOLATED FROM THE POWER SUPPLY.

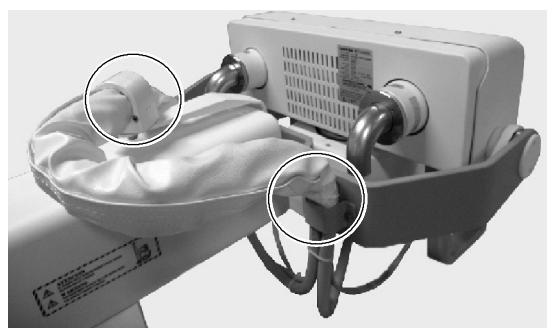
3. A counterweight of equal weight of the Tube-Collimator Assembly has to be secured on the Arm (a.e. if the Collimator weights 10 kg / 22 lb, the Tube weights 18 kg / 40 lb, and the remaining parts of the Assembly (HV Cables, Supports, Tube covers, etc.) weights approx. 13 Kg / 29 lb, the counterweight must be of $10+18+13= 41$ kg / 91 lb. Refer to the Collimator and Tube manuals to find out their weight.



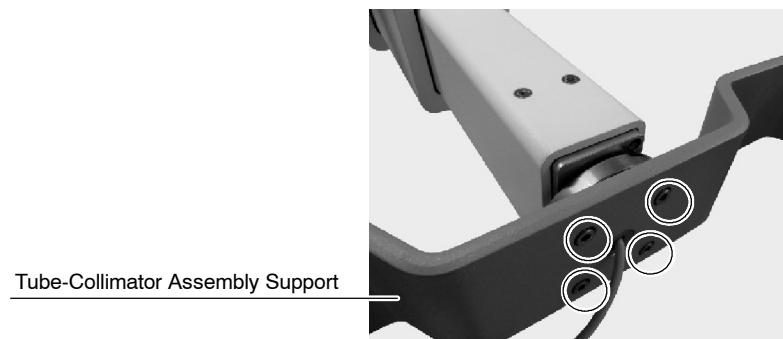
IF PARTS OF THE ARM ARE REMOVED, THE ARM WILL NOT BE BALANCED ANYMORE.

IF NO ADDITIONAL COUNTERWEIGHT HAS BEEN SECURED ON THE ARM, THE ARM WILL SPRING UPWARDS WHEN REMOVING THE TUBE-COLLIMATOR ASSEMBLY.

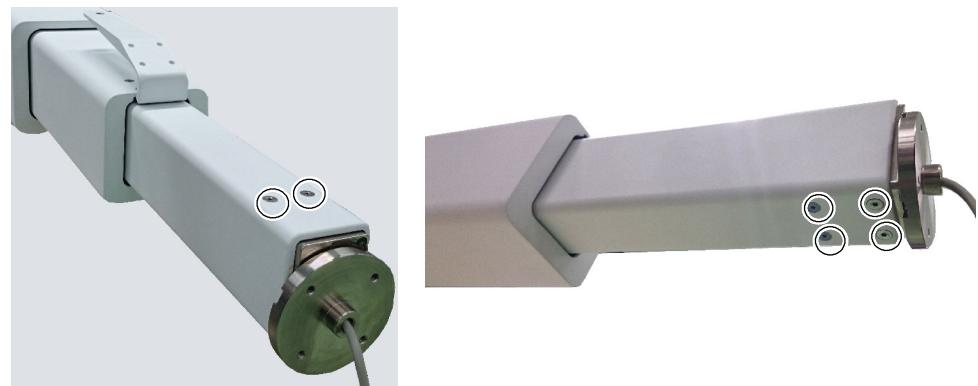
4. Remove the two (2) Brackets of the HV Cables by removing the corresponding Screws.



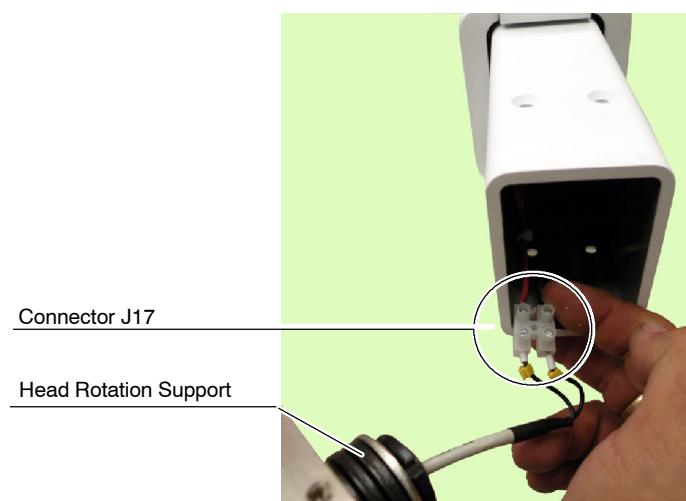
5. Remove the four (4) Screws that fix the Tube-Collimator Assembly Support to the Head Rotation Support. Carefully secure the Tube-Collimator Assembly on the table.



6. Remove the two (2) Screws from the upper side and the four (4) Screws from the lower side of the Arm.



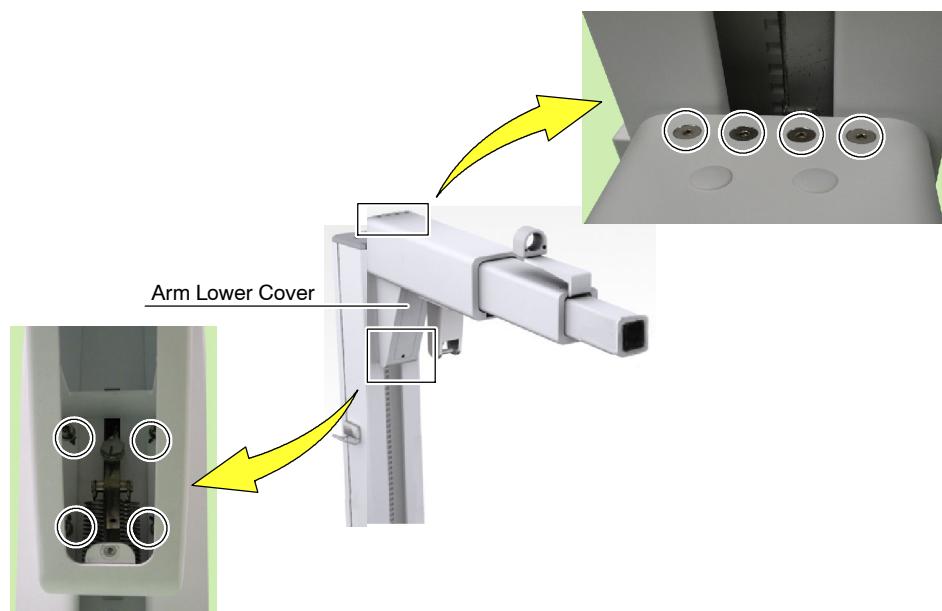
7. Remove the Head Rotation Support and disconnect connector J17.



8. Place the Arm at the upper end of the Column, as shown in the picture below and carefully release the added counterweight from the Arm.

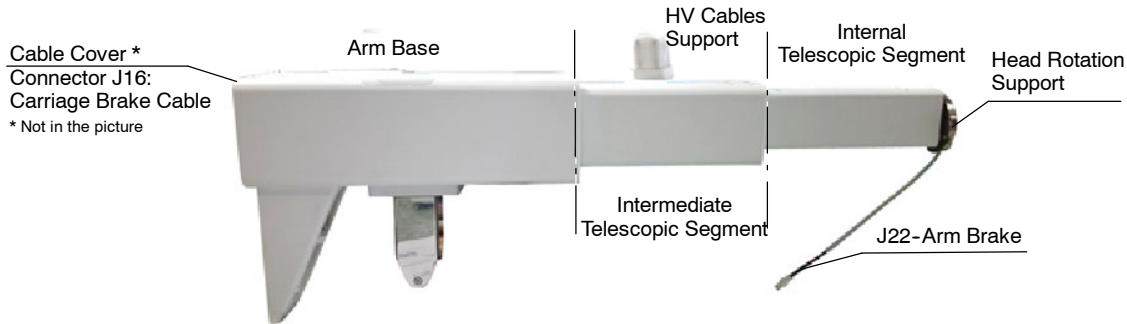


9. Remove the Arm Lower Cover and then dismount the Arm from the Column Carriage by removing the corresponding Fixing Screws. Place the Arm carefully on the table.



10. Replace the Arm by mounting the new Arm in the Column Carriage and securing it with the corresponding Fixing screws adding Loctite 243 and using a torque of 10.5 Nm. Mount the Arm Lower Cover.
11. Secure the additional counterweight, previously released, on the Arm. Then, carefully place the Arm on the table.
12. Connect J17 and mount the Head Rotation Support into the Arm by using the two (2) Screws to the upper side and the four (4) Screws to the lower side of the Arm, adding Loctite 243 and using a Torque of 8 Nm.
13. Mount the Tube-Collimator Assembly on the Arm by using the four (4) Screws that fix the Tube-Collimator Assembly to the Head Rotation Support, adding Loctite 243 and using a Torque of 10.5 Nm.
14. Remove the additional counterweight.
15. Route and secure the HV Cables with the corresponding Brackets.
16. Test the Unit.

3.1.2.2 TROUBLESHOOTING OF THE ARM



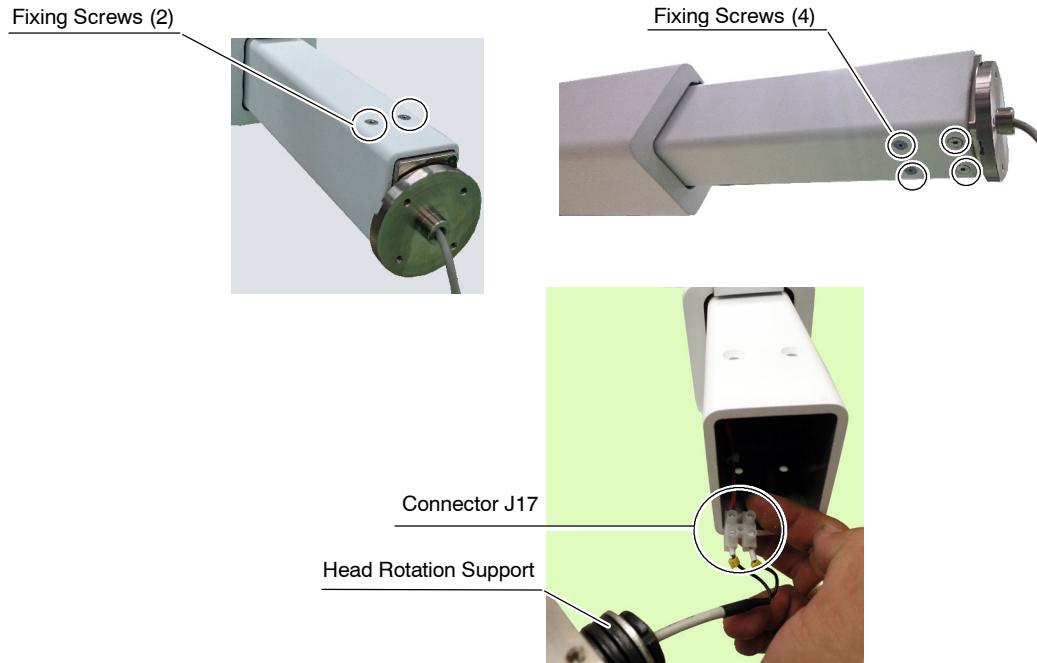
Note

For the replacement of the HV Cables Support or the Carriage Brake Cable Cover, turn the unit OFF and follow the procedures described in Section 3.1.2.1 of "Arm Replacement".

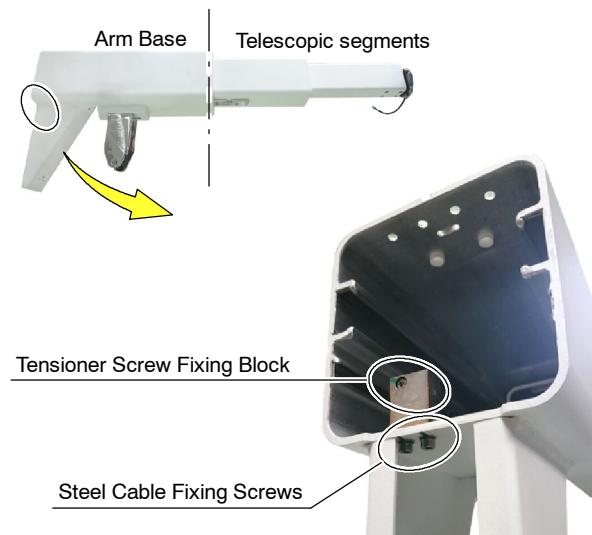
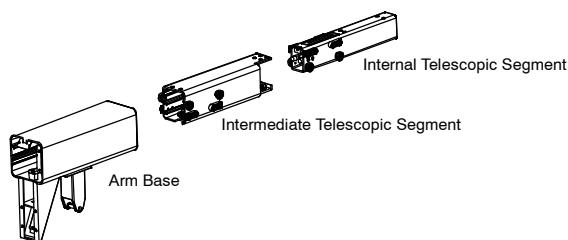
Note

For the replacement of the Head Rotation Support only, turn the unit OFF and follow the procedures described in Section 3.1.2.1 of "Arm replacement" in order to dismount the Tube-Collimator Assembly; then, remove the (2) Fixing Screws (2+4), dismount the Head Rotation Support from the Arm, disconnect J17 and pass the cable through the Head Rotation Support.

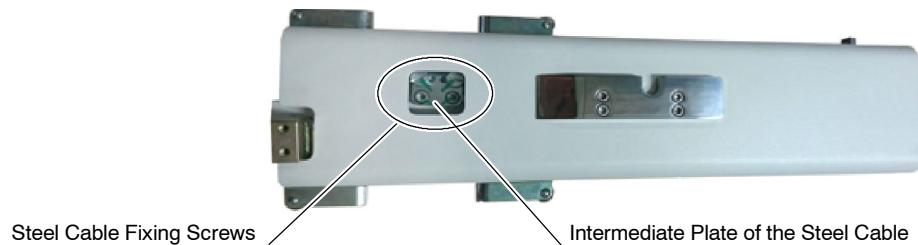
Replace the Head Rotation Support, passing the cable through the new Support, connecting J17 and securing it by using the two (2) Screws to the upper side and the four (4) Screws to the lower side of the Arm, adding Loctite 243 and using a Torque of 8 Nm.



1. Remove the Screws that secure the Tensioner Screw Fixing Block (one end of the Steel Cable) to the lower side of the Arm Base and dismount the Telescopic segments from the Arm Base.



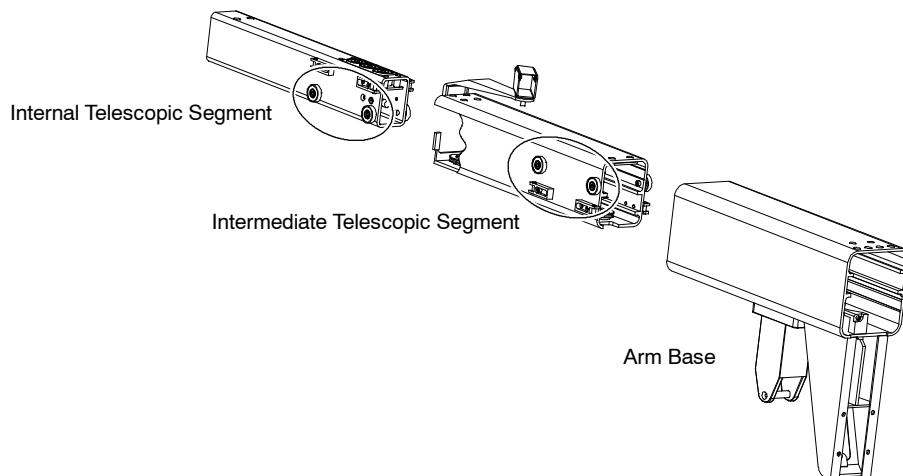
2. Remove the Screws that fix the Intermediate Plate of the Steel Cable to the lower side of the Internal Telescopic Segment. Pull out the Steel Cable and disengage both segments (Internal and Intermediate).



3. Replace the defective items (pulleys, bearing kits, bumpers, etc).

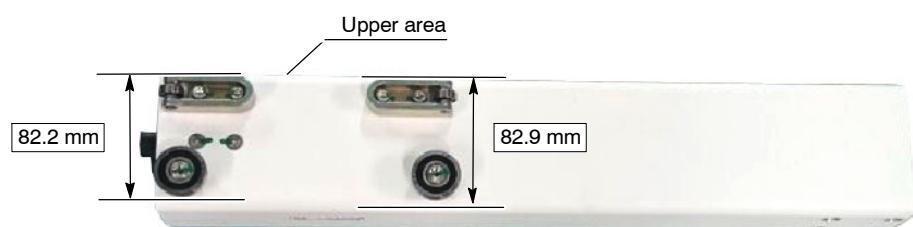
Note 

For **Bearing kits replacement**, proceed as described below.



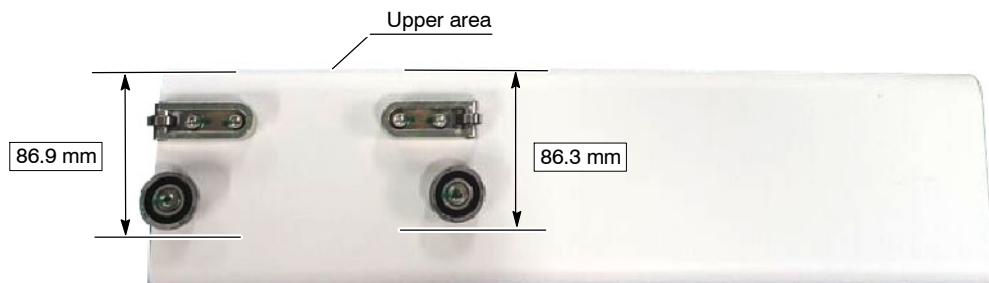
- **Internal Telescopic Segment.**

In order to replace the Bearing kit, adjust both bearings to the following measures, taking the Upper area of the Internal Segment as a reference:

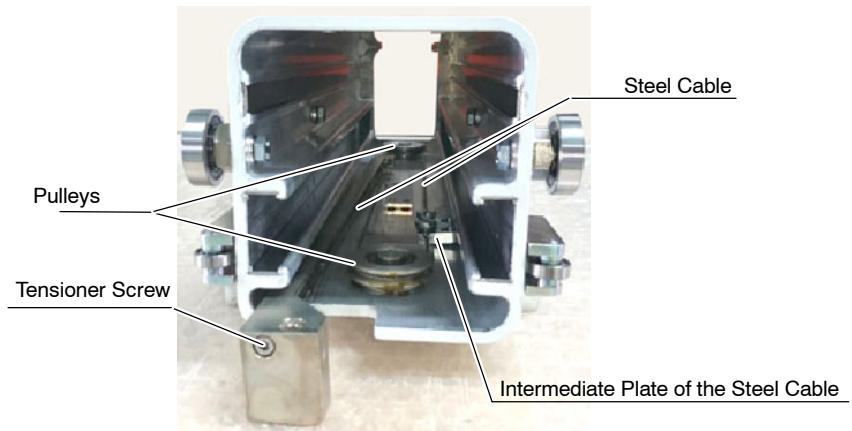


- **Intermediate Telescopic Segment.**

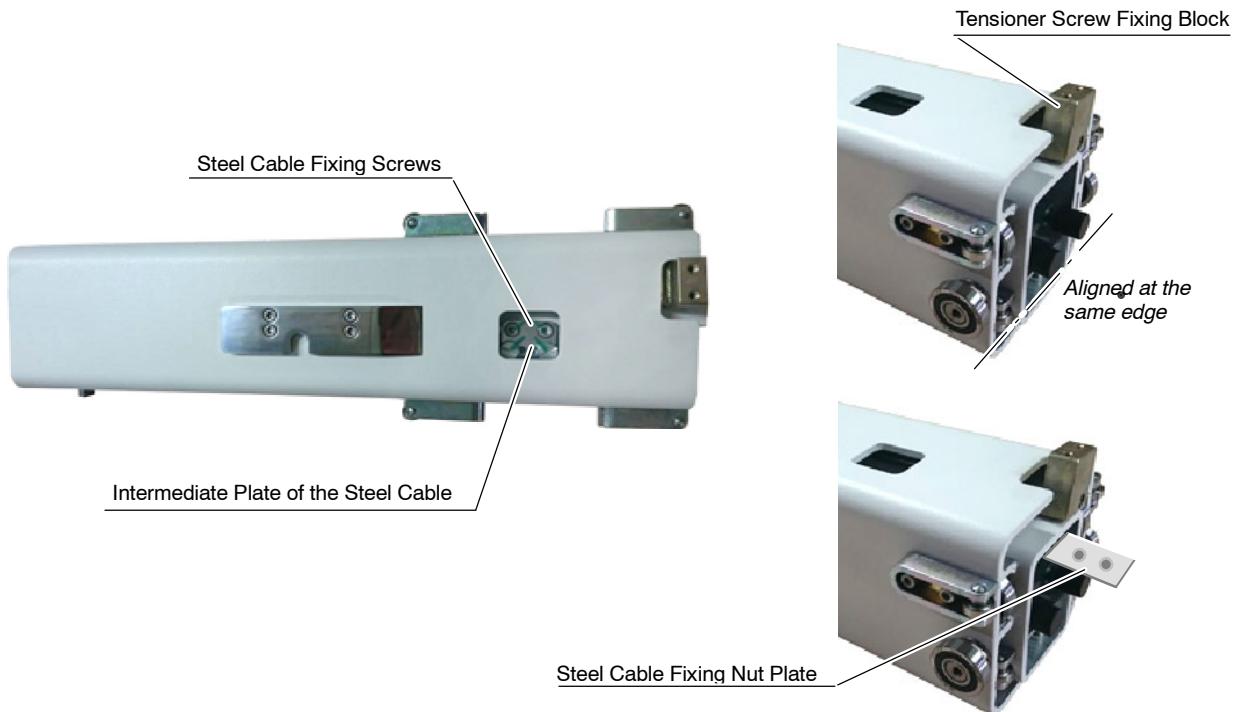
In order to replace the Bearing kit, adjust both bearings to the following measures, taking the Upper area of the Intermediate Segment as a reference.



4. At the inside of the Intermediate Telescopic segment, pass the Steel Cable along the two (2) Pulleys and tense the Steel Cable by tightening the Tensioner Screw.



5. Insert the Internal Telescopic segment into the Intermediate segment. In order to fix the Intermediate Plate of the Steel Cable, align the Internal segment, the Tensioner Screw Fixing Block and the Intermediate segment at the same edge. Then, fix the Steel Cable to the Nut Plate by tightening the Fixing Screws through the window.

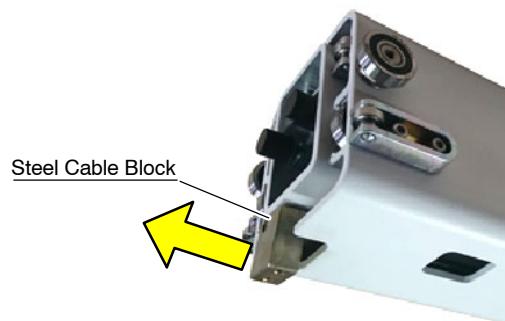


6. Adjust the tension of the Steel Cable. To do so:

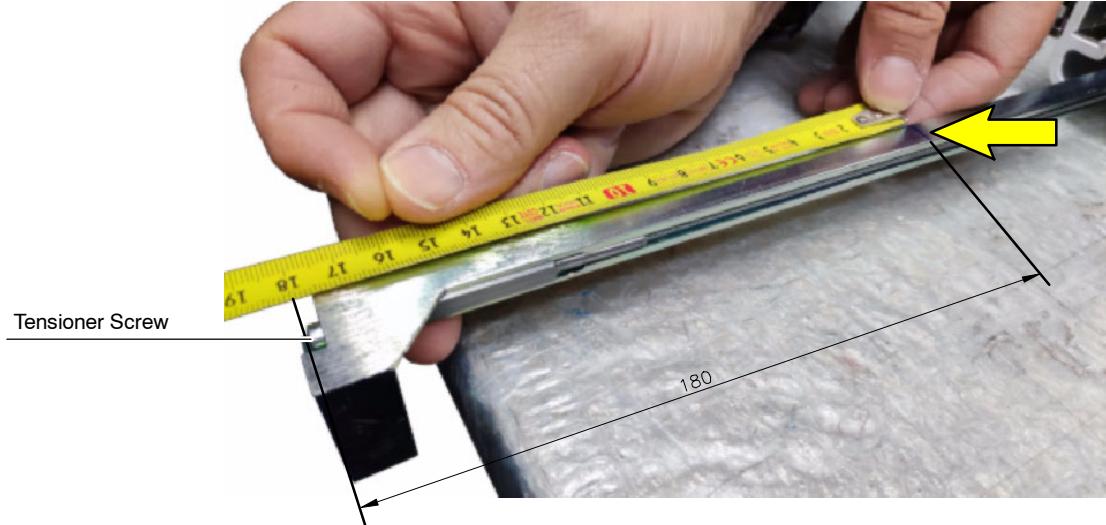
Note 

Two people are necessary to carry out the Steel Cable adjustment.

- a. Pull out the Steel Cable Block from the Intermediate Telescopic Segment to allow the Steel Cable tension adjustment.



- b. Use a marker pen to mark a distance of 180 mm from the Tensioner Screw on the Steel Cable.

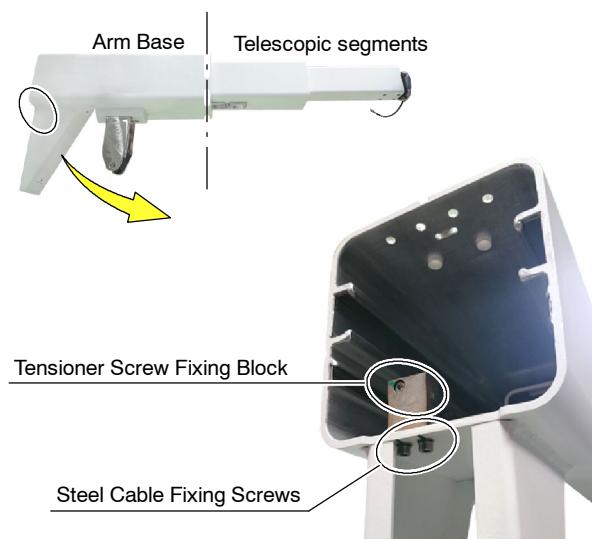


- c. Impregnate the thread of the Tensioner Screw with a drop of Loctite 243 (or similar) and adjust it for regulating the Steel Cable tightness.

While a person checks with a dynamometer that a force of 1 kg is being applied at the 180 mm mark, the other person measures the deflection of the Steel Cable, taking the inner edge of the Tension Bar as a reference which should be 6 mm.



7. Insert the Telescopic segments assembly inside the Arm Base and fix the other end of the Steel Cable with the fixing Screws.



8. Mount the Arm of the Mobile Unit as described in *section 3.1.2.1 of "Arm replacement"*, from step 10.

3.2 MOBILE UNITS WITH TELESCOPIC COLUMN

**WARNING**

BEFORE, DURING AND AFTER PERFORMING A TROUBLESHOOTING PROCEDURE RELATED TO THE TELESCOPIC COLUMN AND/OR ARM, VISUALLY CHECK FOR THE PROPER CONDITION OF THE INTERNAL AND EXTERNAL ITEMS RELATED (STEEL CABLE, SPRING, ANTIFALL SYSTEMS, PULLEYS, BRAKES, ELECTRICAL CONNECTIONS, ETC.) REPAIRING OR REPLACING WHEN NECESSARY.

AFTER FINISHING THE TROUBLESHOOTING PROCEDURE, CHECK FOR THE CORRECT MOVEMENT OF THE VERTICAL TRAVEL OF THE ARM AND THE TELESCOPIC COLUMN AND THE ROTATION OF THE TELESCOPIC COLUMN.

Note

The procedures for removing the external Covers of the Telescopic Column are going to be described in the following steps as required, although some of these covers could have been dismounted previously (therefore, some of the pictures could show the unit without one or more covers).

Note

There are two types of Mobile Units with Telescopic Column: Arm Carriage type A (Rectangular Brake) and Arm Carriage type B (Cylindrical Brake). The Arm Carriage type and Brake model can be identified from the outside by looking at the carriage from below.

Refer to Section 3.2.1 for procedures in Telescopic Column with Carriage type A.

Refer to Section 3.2.3 for procedures in Telescopic Column with Carriage type B.

Rectangular Brake Arm Carriage (type A)



Cylindrical Brake Arm Carriage (type B)



3.2.1 PROCEDURES RELATED TO THE TELESCOPIC COLUMN WITH RECTANGULAR BRAKE

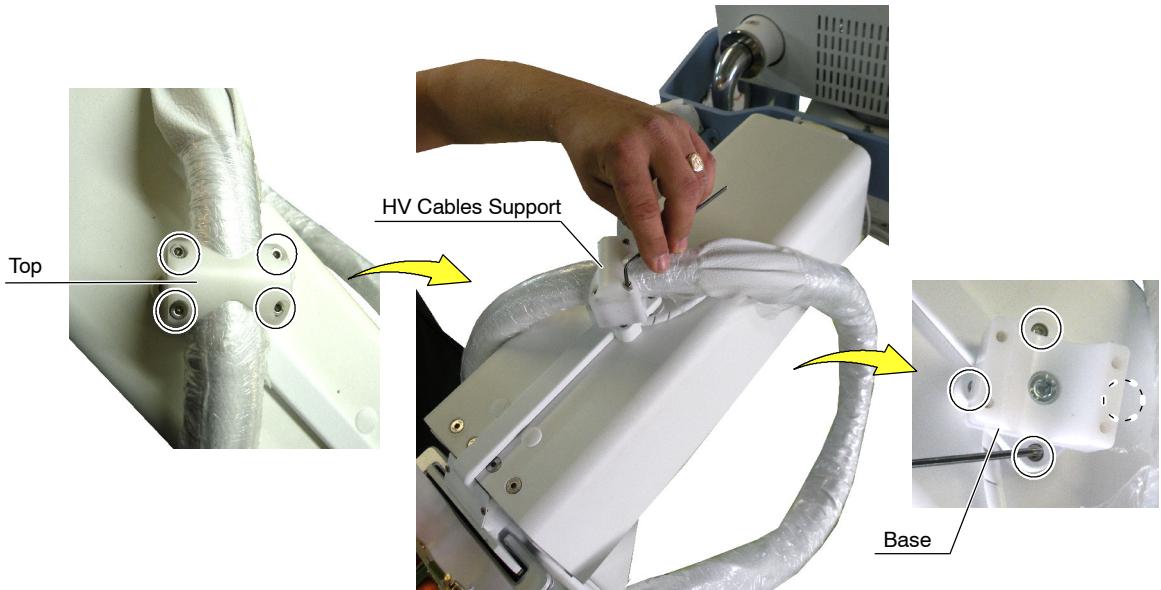
3.2.1.1 COLUMN STEEL CABLE REPLACEMENT

DISMOUNTING THE STEEL CABLE

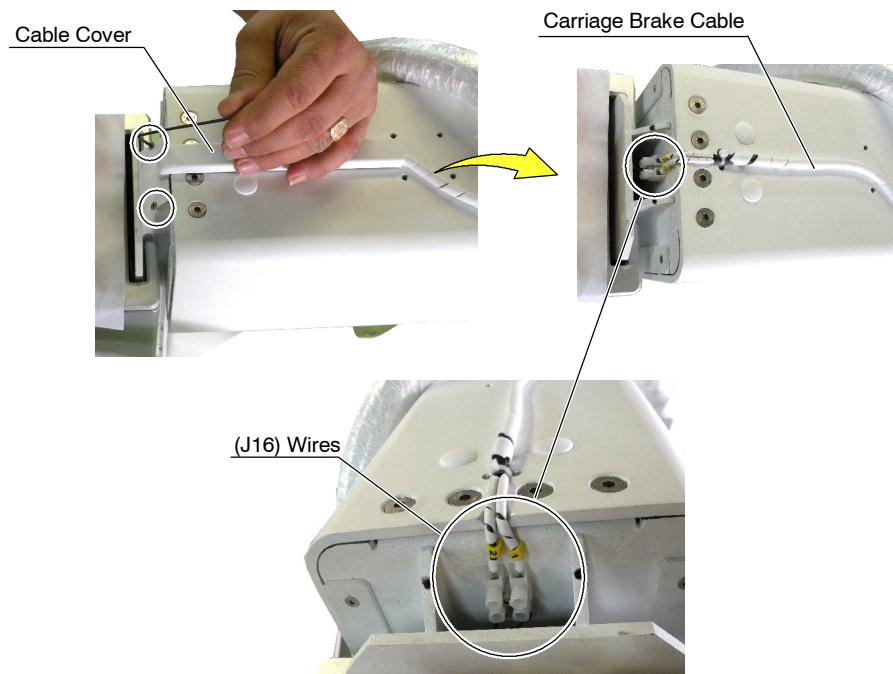
Note 

Two people are necessary to carry out the entire procedure.

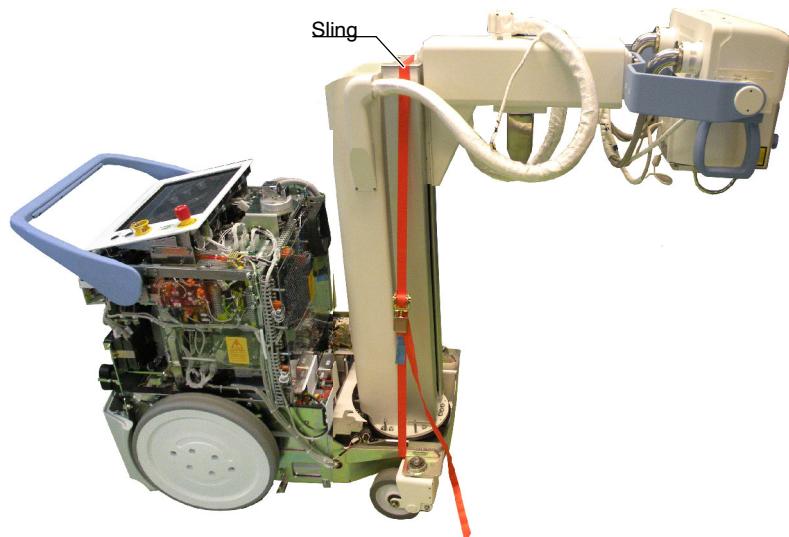
1. Turn the Mobile Unit ON. Release the Arm from the Parking Position.
2. Turn the Unit OFF. Remove all the required Front Covers of the unit (refer to Section 2.2.2).
3. Turn the Mobile Unit ON. Rotate the Arm 180°, place the Telescopic Column (TC) Sliding Section fully down and rise the Arm to the top of the TC Sliding Section, keeping the TC Sliding Section fully down.
4. Turn the Mobile Unit OFF. Remove the four (4) Screws of the HV Cables Support, at the upper side of the Arm. Remove the HV Cables Support Top and place the HV Cables aside. Remove the (4) Screws at the Base of the HV Cables Support and dismount the HV Cables Support base and place the Cables aside (refer to the next picture).



5. Remove the two (2) Screws of the Cable Cover and dismount the Cover. Note of the position of both wires into the terminals and disconnect both wires of the Carriage Brake Cable (J16), isolate the wire ends with electrical tape.



6. Secure the TC Sliding Section fully down with a Sling, passing the Sling around the Chassis at the base of the Mobile Unit and around the Top Cover of the TC Sliding Section, as shown in the picture below, keeping the Arm fully up.

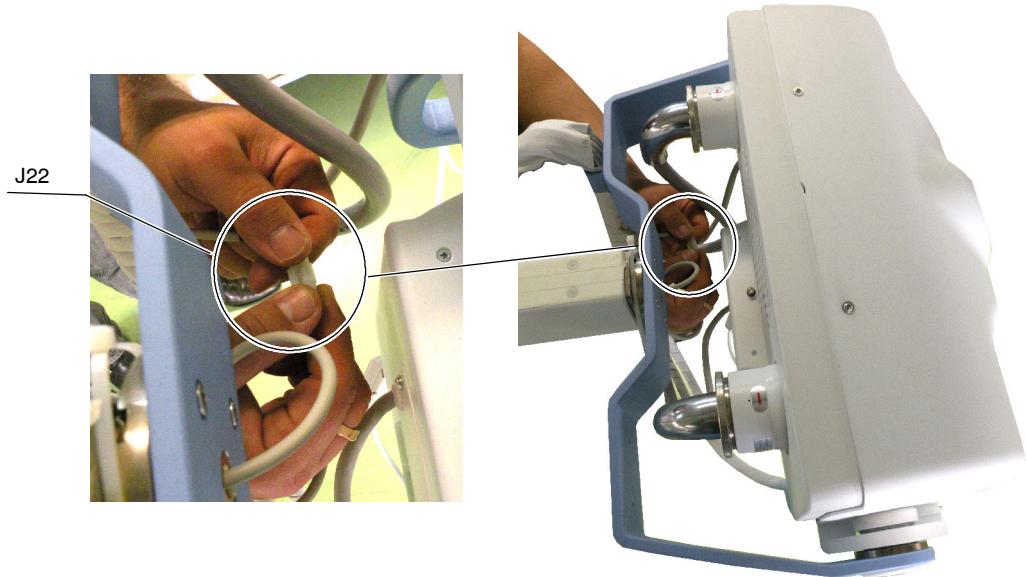




IF PARTS OF THE TUBE-COLLIMATOR ASSEMBLY AND/OR THE ARM ARE GOING TO BE REMOVED, THE UNIT WILL NOT BE BALANCED ANYMORE.

IF NO ADDITIONAL SLING HAS BEEN SECURED ON THE SLIDING SECTION OF THE TELESCOPIC COLUMN AS DESCRIBED, THE ARM AND OR TELESCOPIC COLUMN COULD SPRING UPWARDS WHEN REMOVING THE PARTS OF THE TUBE-COLLIMATOR ASSEMBLY, AND/OR THE ARM.

7. Disconnect Connector J22 (Arm Brake) and isolate the ends with electrical tape.



8. Before following with the next steps, place an auxiliary table beside the Mobile Unit, near the Tube-Collimator Assembly.

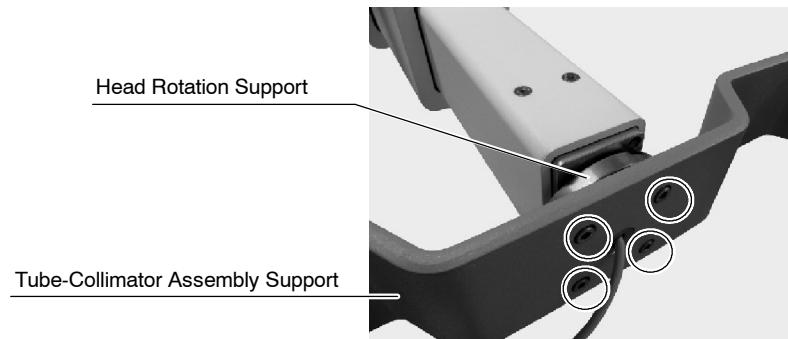


THE WEIGHT OF THE TUBE-COLLIMATOR ASSEMBLY IS HEAVY, UNSTEADY AND DIFFICULT TO HANDLE, THEREFORE AT LEAST TWO PEOPLE ARE NEEDED TO REMOVE IT. THIS WILL AVOID PERSONAL INJURIES OR DAMAGE TO THE EQUIPMENT.

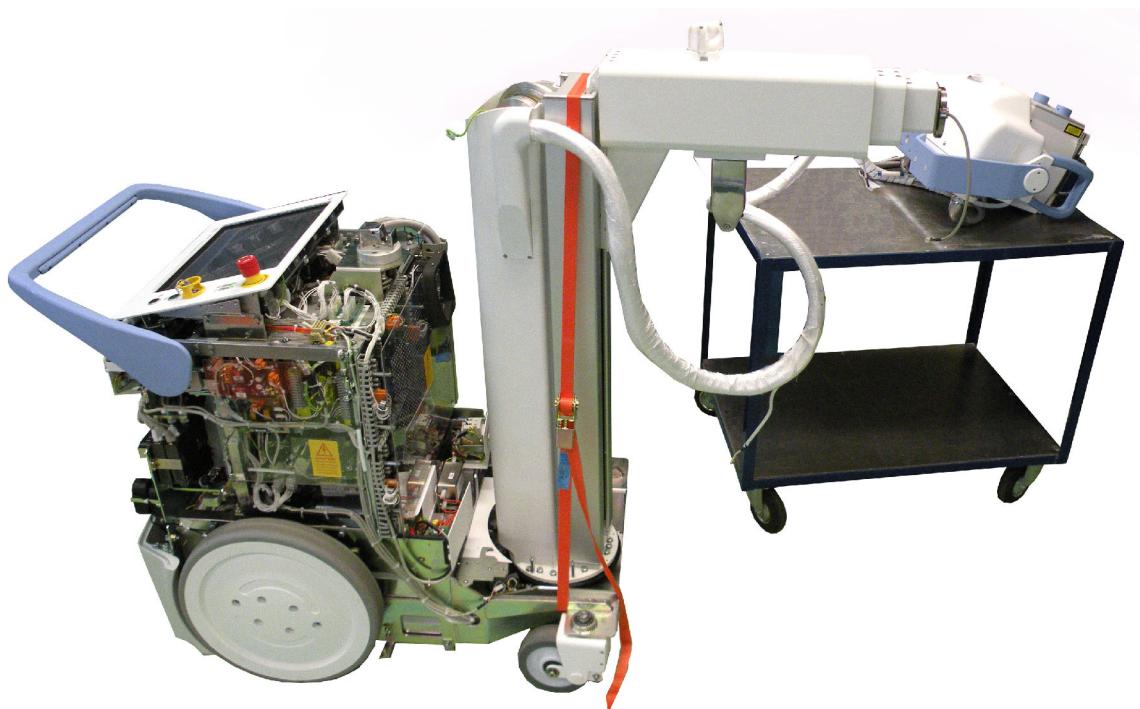
Mobile X-Ray Unit

Troubleshooting

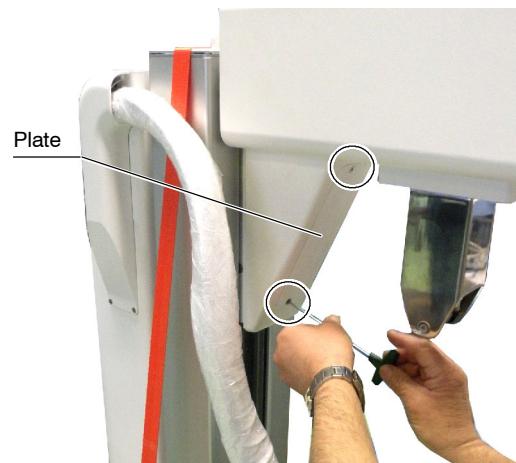
9. While one person supports the Tube-Collimator Assembly, the other removes the four (4) Screws that fix the Tube-Collimator Assembly Support to the Head Rotation Support.



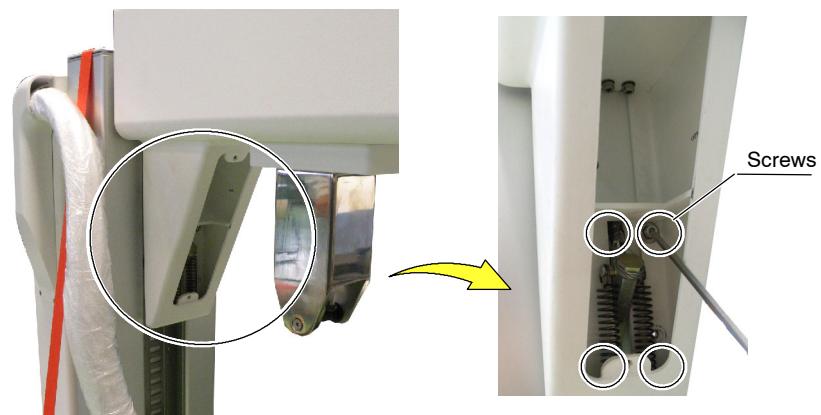
10. Carefully remove the Tube-Collimator Assembly, passing the HV Cables below the Arm, and place the Assembly on the auxiliary table taking care not to place it over the HV Cables, DAP Cable, etc.



11. Remove the two (2) Screws from the Plate under the Arm end closer to the Column.



12. Remove the four (4) internal Screws that fix the Arm to the Carriage.

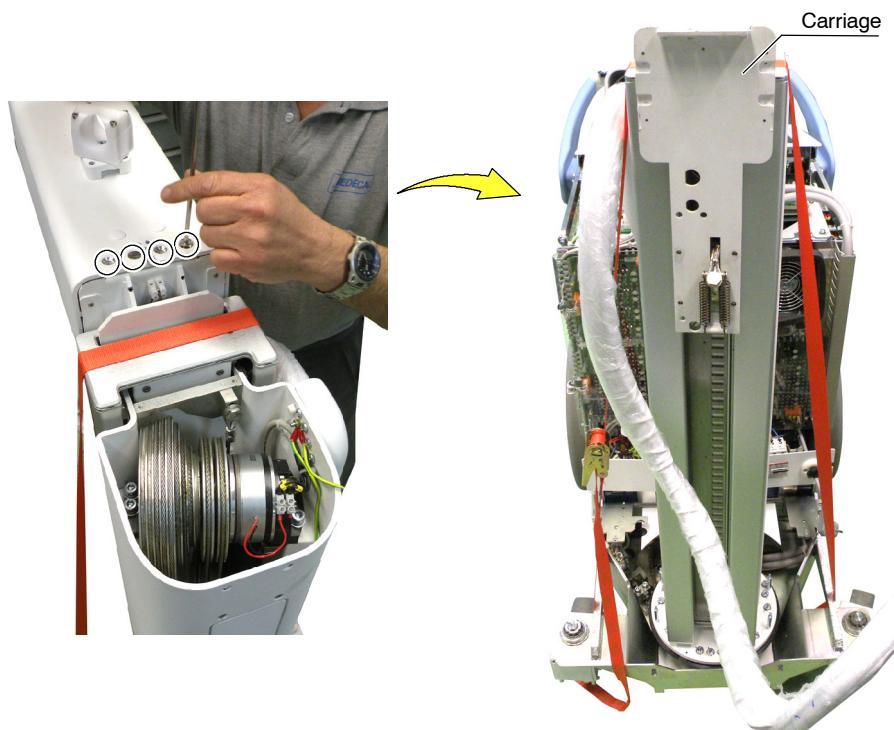


Mobile X-Ray Unit

Troubleshooting

13. While one person supports the weight of the Arm, the other removes the four (4) Screws on the upper side of the Arm.

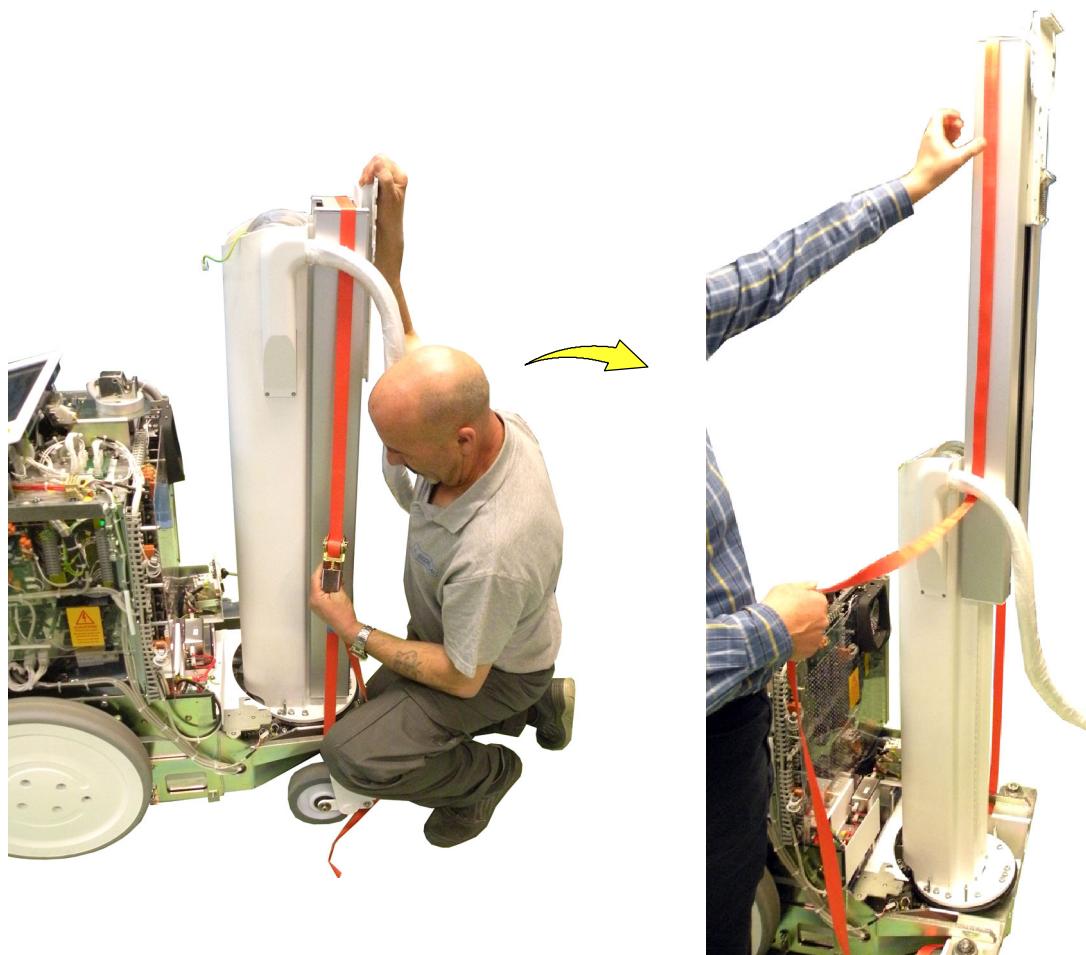
Then, dismount the Arm from the Carriage.



14. Carefully place the Arm on a safe surface. Insert a tie-wrap through the drills for the Carriage Brake Cable Cover as shown below, this will make it easier to mount the Carriage Brake Cable at a later time.



15. While one person holds the TC Sliding Section in order to avoid the Sliding Section to rise, the other person carefully releases the Sling. Then, rise slowly the (TC) Sliding Section to the top and remove the Sling.



Mobile X-Ray Unit

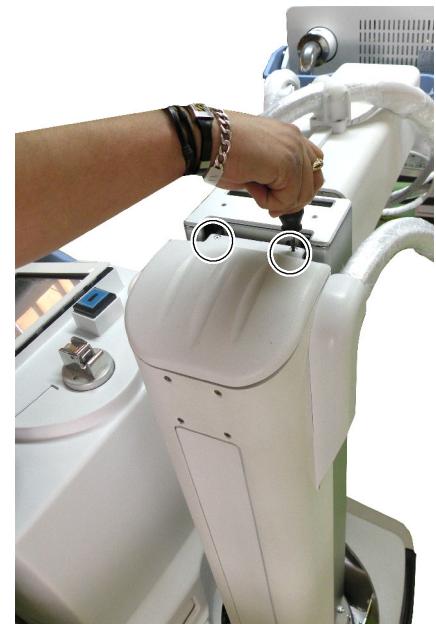
Troubleshooting

16. Turn the Mobile Unit ON and use the Tube-Collimator Assembly Motion Controls in order to rotate the Column 180°.

Turn the Mobile Unit OFF.



17. Remove the four (4) Screws that secure the Top Cover of the TC Base Section.



18. Dismount without removing the Top Cover of the TC Base Section in order to disconnect GND Connectors. Then, remove the Top Cover.



Mobile X-Ray Unit

Troubleshooting

19. Remove the four (4) Screws that secure the Front Cover of the TC Base Section.

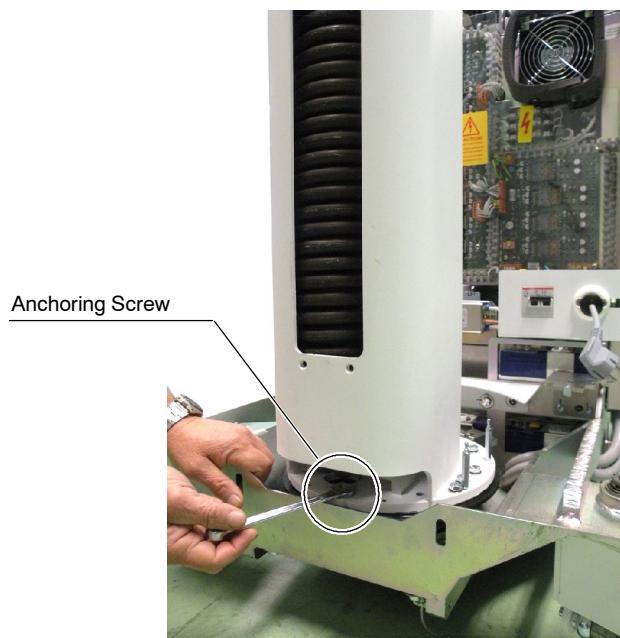
Disconnect GND and remove the Front Cover from inside the TC Base Section by sliding upwards.



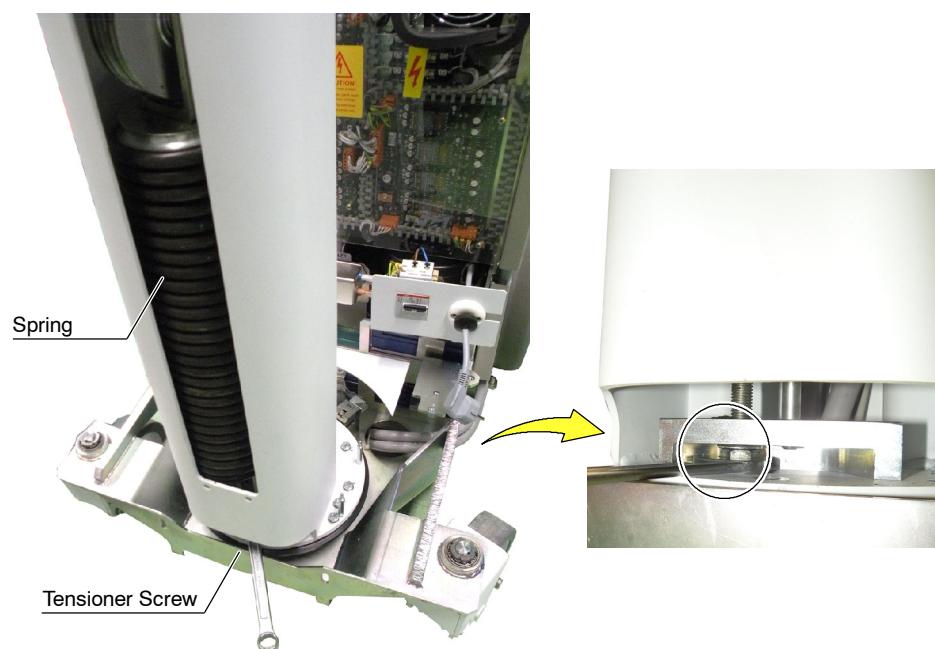
20. With the TC Sliding Section in the upward position, remove the six (6) Screws that secure the Front Cover of the TC Sliding Section and dismount the Front Cover.



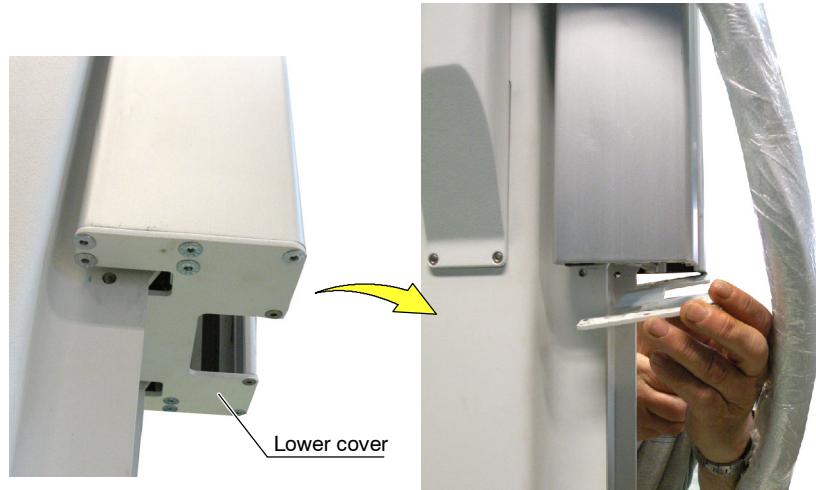
21. At the base of the TC Base Section, remove the Anchoring Screw in the front, in order to gain access to the Tensioner Screw of the Spring.



22. Unscrew the Tensioner Screw several times by using a 19 mm Spanner in order to loosen the Spring slightly, until slightly decreasing the tension of the Steel Cable.

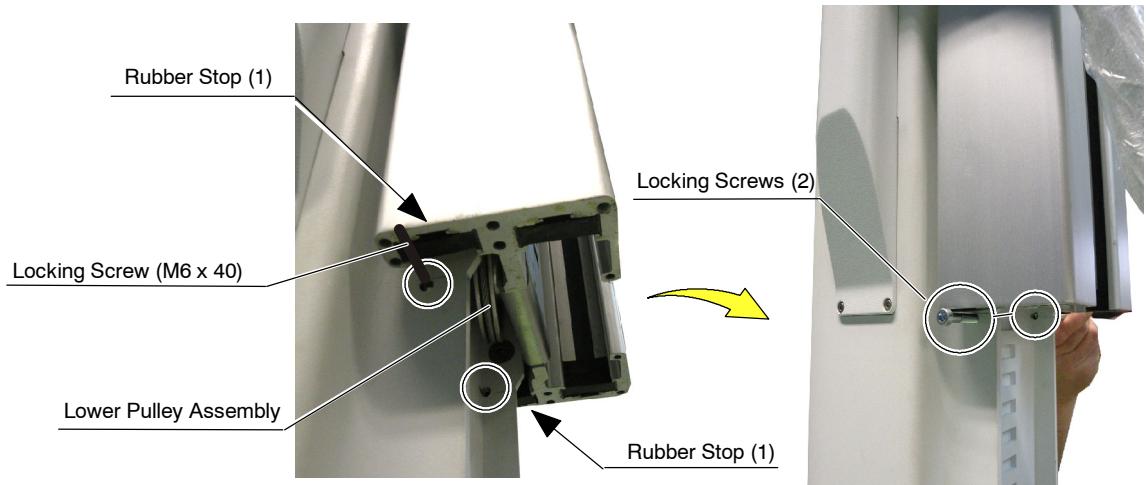


23. Remove the twelve (12) Screws that secure the Lower Cover of the TC Sliding Section and dismount de Lower Cover.



24. Remove the Rubber Stop at both sides inside the lower end of the TC Sliding Section (in order to dismount the Lower Pulley Assembly later).

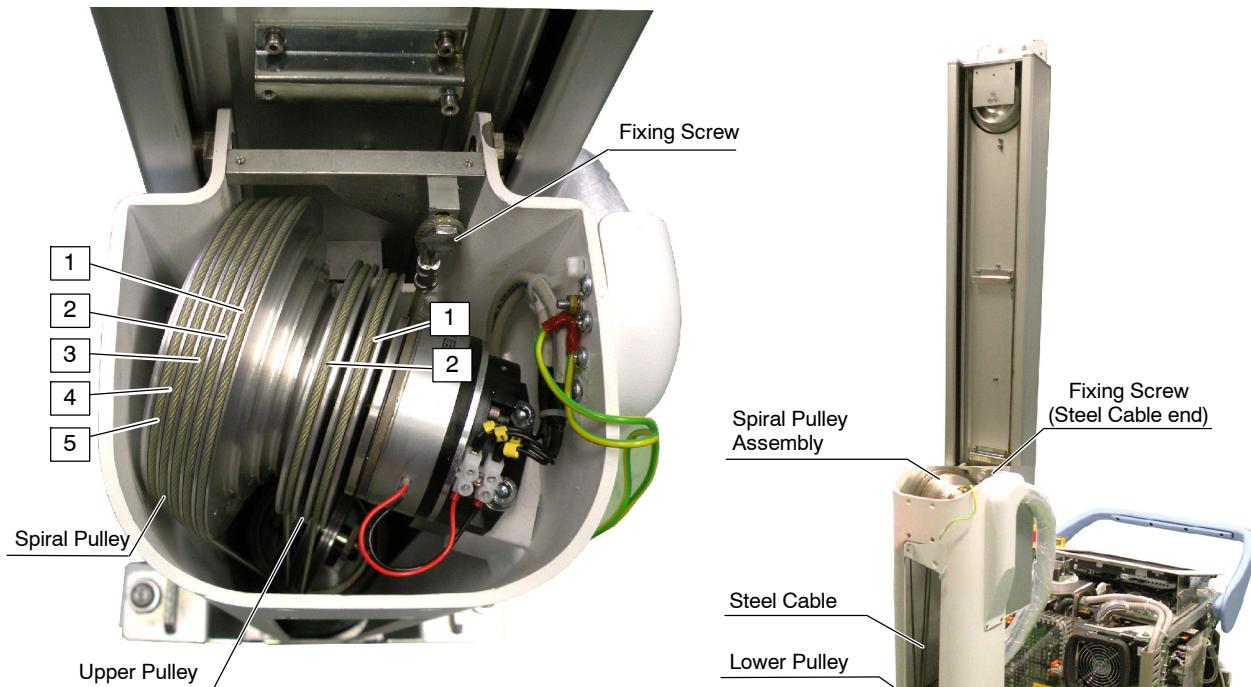
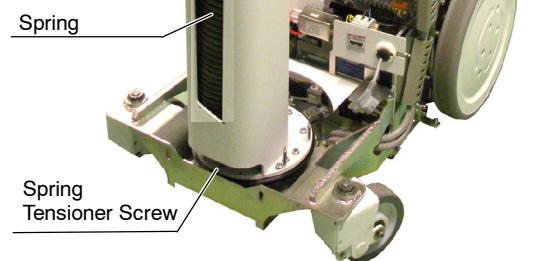
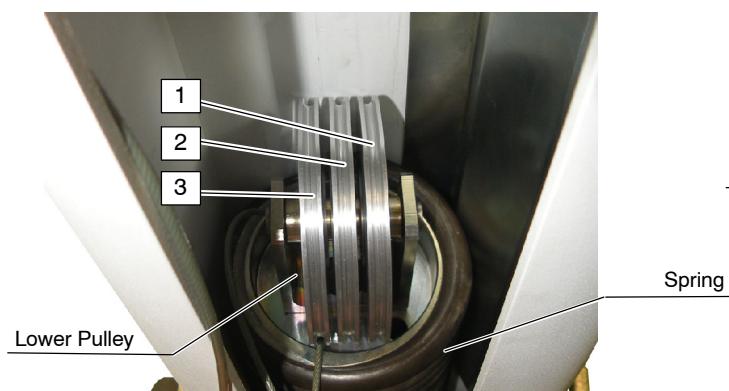
Place two (2) M6x40 Locking Screws, in the drills at both sides of the TC Base Section, to keep the TC Sliding Section in the top position and preventing it from falling when releasing the Steel Cable.



IF THE LOCKING SCREWS DO NOT COINCIDE WITH THE CORRESPONDING DRILLS, IT MIGHT BE NEEDED TO RAISE SLIGHTLY THE TC SLIDING SECTION (ONLY A FEW MILLIMETERS). IN THIS CASE, IF THE TC SLIDING SECTION IS RAISED OVER THE LOWER BEARING ON THE TC BASE SECTION, THE TC SLIDING SECTION WILL BE DISENGAGED FROM THE TC BASE SECTION. IT COULD CAUSE PERSONAL INJURIES OR DAMAGE TO THE UNIT.

Note 

For procedures related to the TC Base Section (from step 25.), refer to Illustration 3-1.

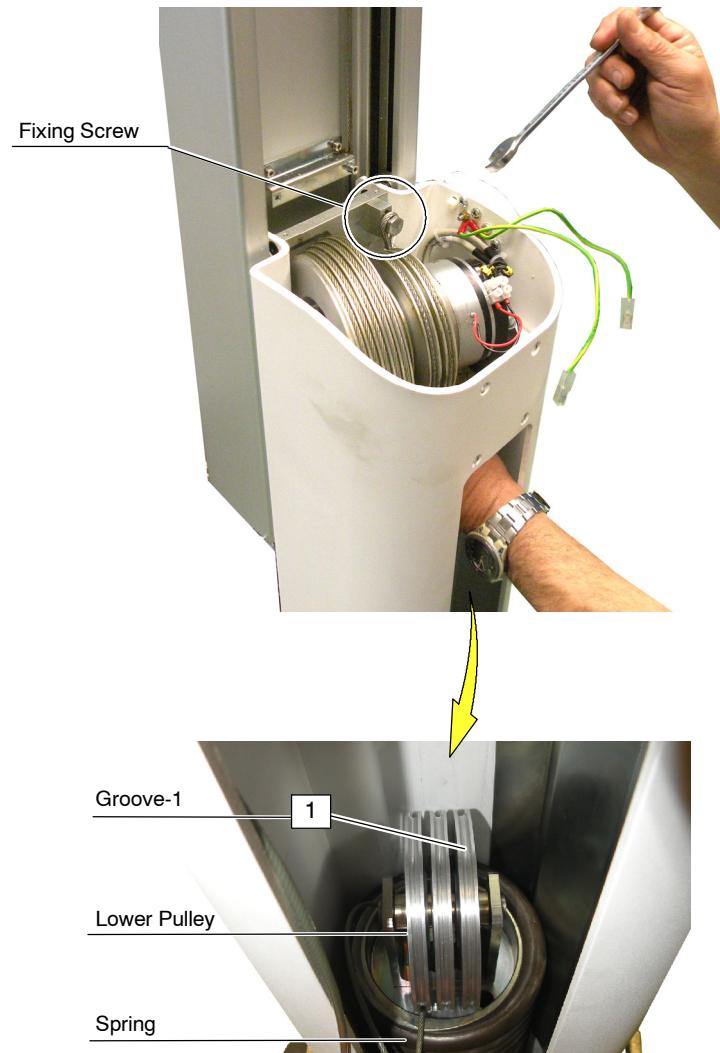
**Illustration 3-1
TC Base Section****Spiral Pulley Assembly****Lower Pulley**

25. Carefully release the Steel Cable from the TC Base Section, as described in the following steps:

a. From Fixing Screw → to Lower Pulley groove-1:

Remove the Fixing Screw that secures one end of the Steel Cable to the upper side of the TC Base Section, by using a 15 mm Spanner.

Take the Steel Cable downwards the TC Base Section to the Lower Pulley (over the Spring) and release the Steel Cable clockwise, from the first groove at the right of the Lower Pulley.



b. From Lower Pulley groove-1 → to Upper Pulley groove-1:

Guide the Steel Cable upwards and release it from the first groove at the right, around the Upper Pulley (beside the Spiral Pulley).

c. From Upper Pulley groove-1 → to Lower Pulley groove-2:

Guide the Steel Cable downwards and release it from the second groove around the Lower Pulley.

d. From Lower Pulley groove-2 → to Upper Pulley groove-2:

Guide the Steel Cable upwards and release it from the second groove around the Upper Pulley.

e. From Upper Pulley groove-2 → to Lower Pulley groove-3:

Guide the Steel Cable downwards and release it from the third groove around the Lower Pulley.

f. From Lower Pulley groove-3 → to Spiral Pulley groove-1:

Guide the Steel Cable upwards and release it from the first groove around the Spiral Pulley.

g. From Spiral Pulley groove-1 → to Spiral Pulley grooves-2-3-4-5:

Release the Steel Cable from the first groove of the Spiral Pulley and continue releasing the Steel Cable from the second, the third, the fourth and the fifth grooves of the Spiral Pulley.

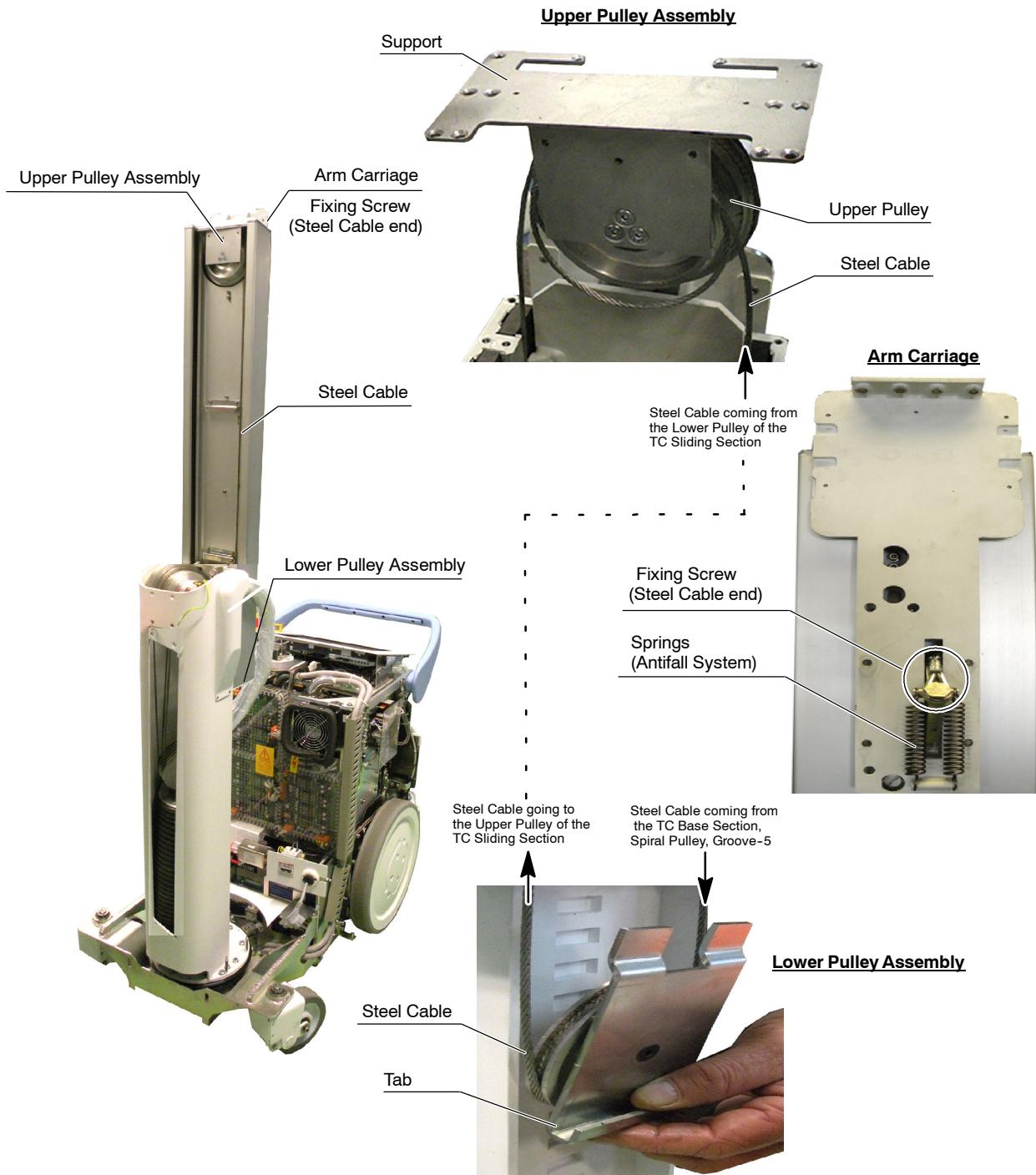
h. From Spiral Pulley groove-5 → to Lower Pulley (TC Sliding Section):

Release the Steel Cable from the fifth groove of the Spiral Pulley, leaving the TC Base Section to the Lower Pulley at the bottom of the TC Sliding Section, as described from *step 26*.

Refer to Illustration 3-2.

Note

For procedures related to the TC Sliding Section (from step 26.), refer to Illustration 3-2.

Illustration 3-2
TC Sliding Section Section

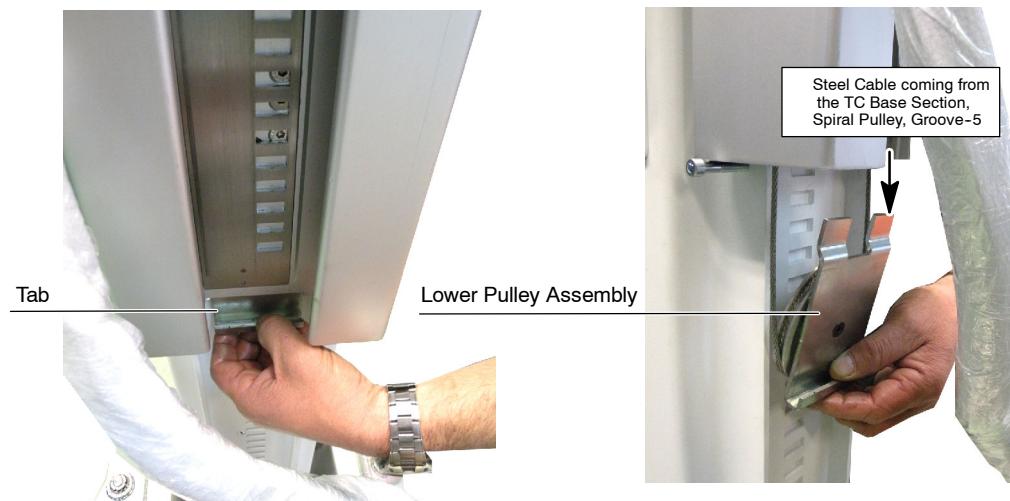
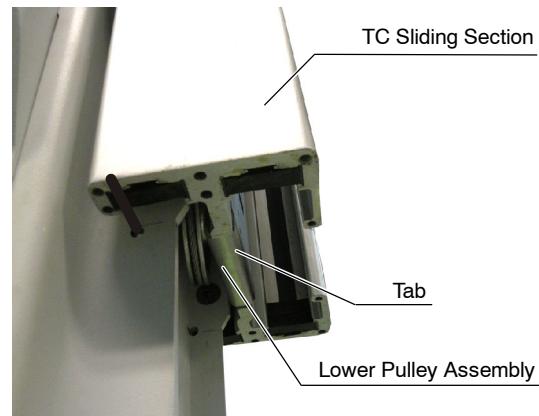
26. Carefully release the Steel Cable from the TC Sliding Section, as described in the following steps (*refer to Illustration 3-2.*):

- a. Dismount the Lower Pulley Assembly by pulling its Tab downwards.

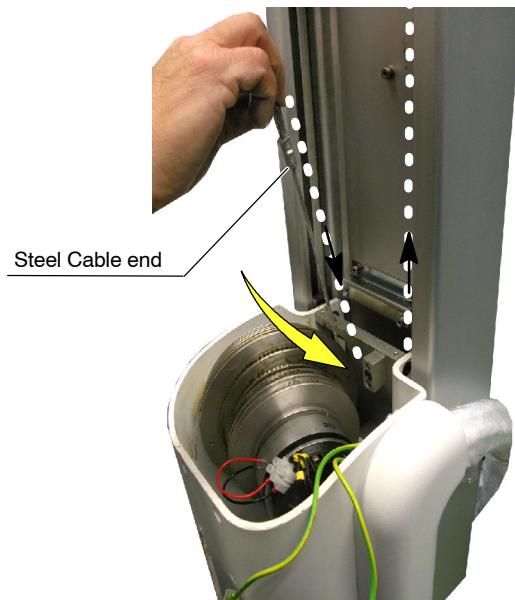
Note 

Previously, the Rubber Stops (2+2) have been removed and two (2) Locking Screws have been mounted in the drills at both sides of the TC Base Section, in order to lock the TC Sliding Section in the top position; for further details refer to step 24.

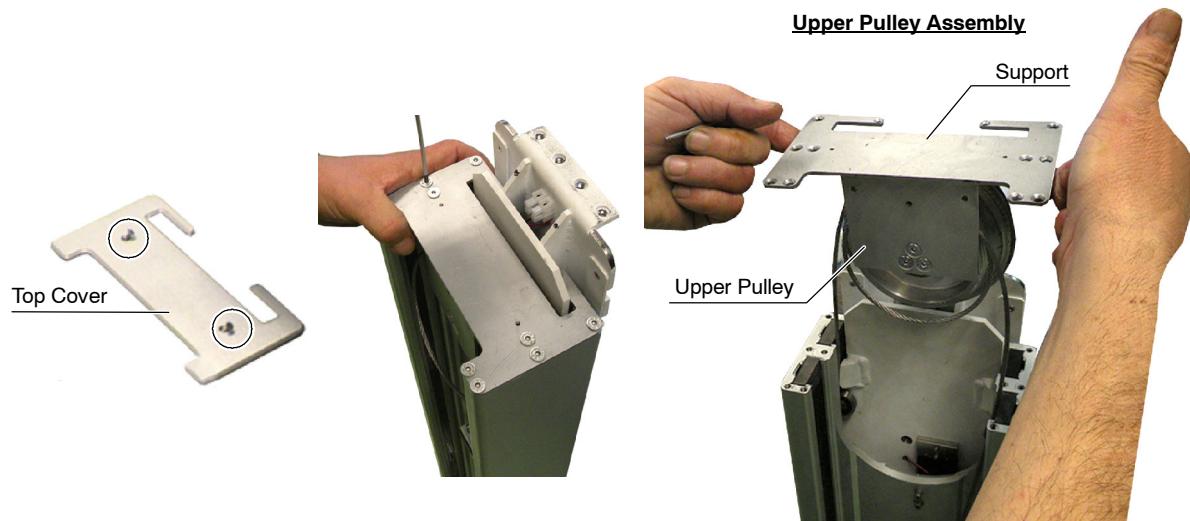
- b. Then, release the Steel Cable by removing the Lower Pulley.



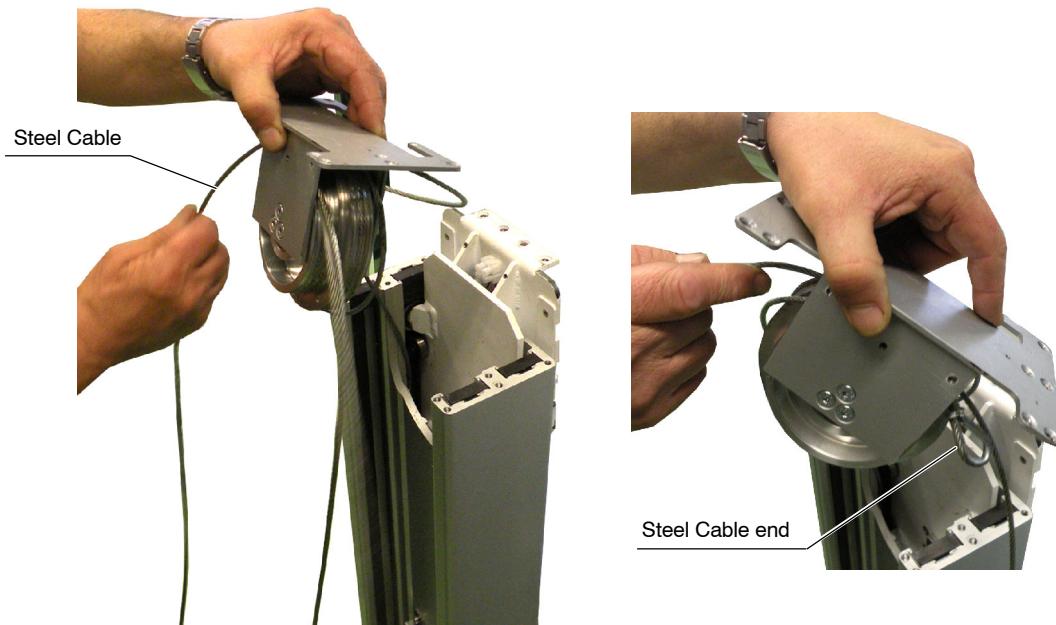
- c. After releasing the Steel Cable from the TC Base Section, pass the end of the Steel Cable through the gap between both Sections of the Telescopic Column, as shown in the picture below.



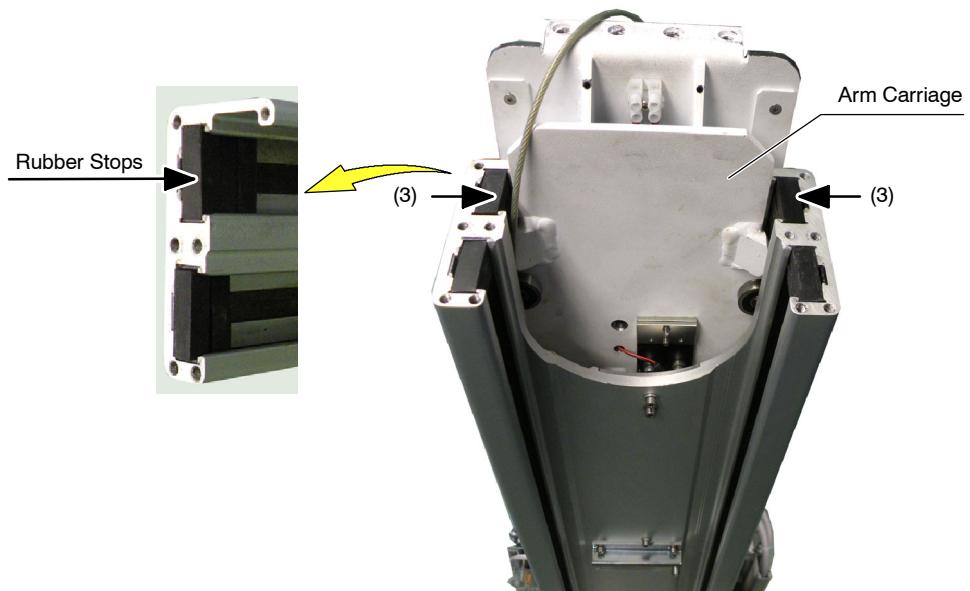
- d. Remove the two (2) Screws that secure the Top Cover of the TC Sliding Section. Then, remove the twelve (12) Screws on the Support fixing the Upper Pulley Assembly to the TC Sliding Section and dismount the Assembly.



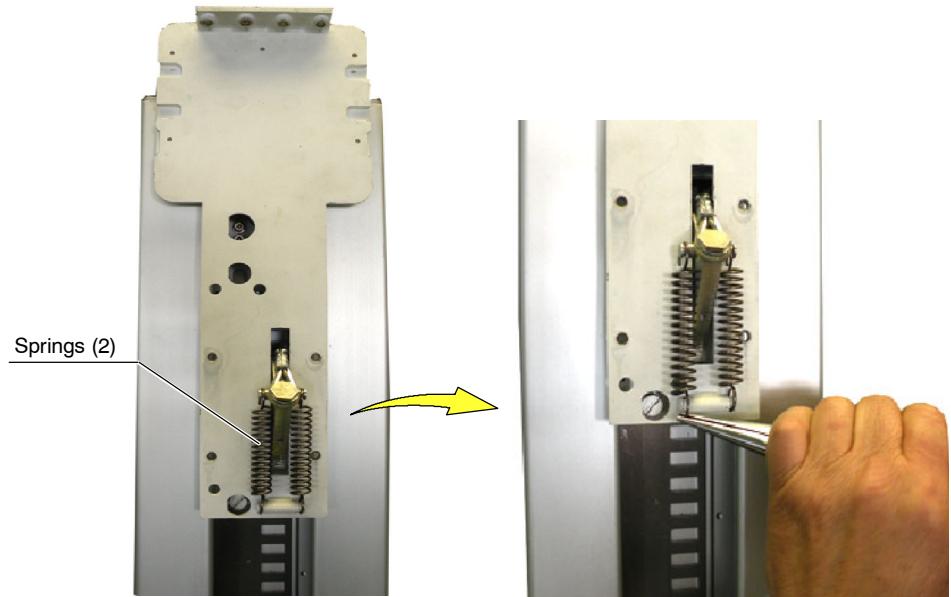
- e. Disengage the Steel Cable from all the grooves of the Upper Pulley Assembly, passing the Steel Cable end between the Pulley and the Support to remove it.



- f. Remove the three (3) Rubber Stops at both sides inside the upper end of the TC Sliding Section, in order to dismount the Arm Carriage.

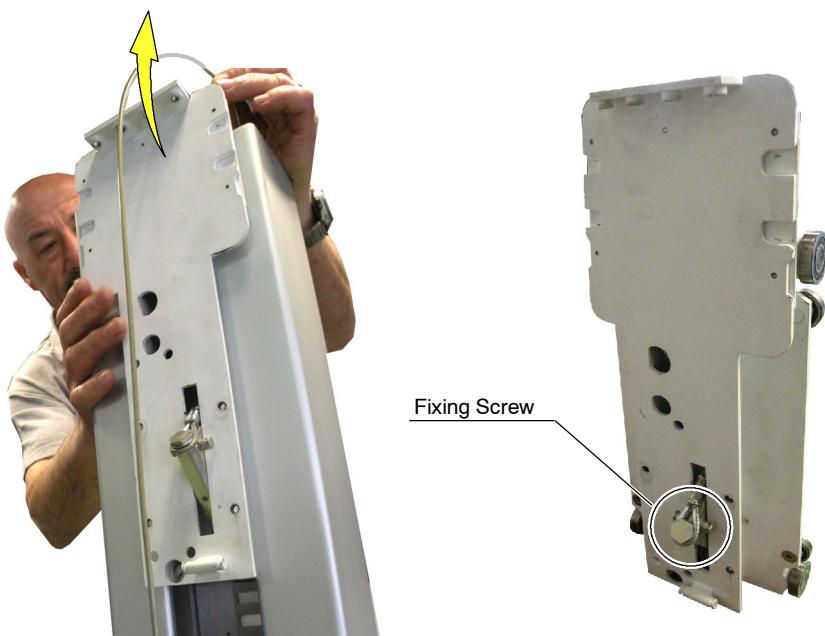


- g. Dismount the two (2) Springs of the Antifall System of the Arm Carriage.



- h. Slide the Carriage with the Steel Cable upwards and dismount it.

Remove the other end of the Steel Cable from the Fixing Screw.



MOUNTING THE NEW STEEL CABLE**Note** 

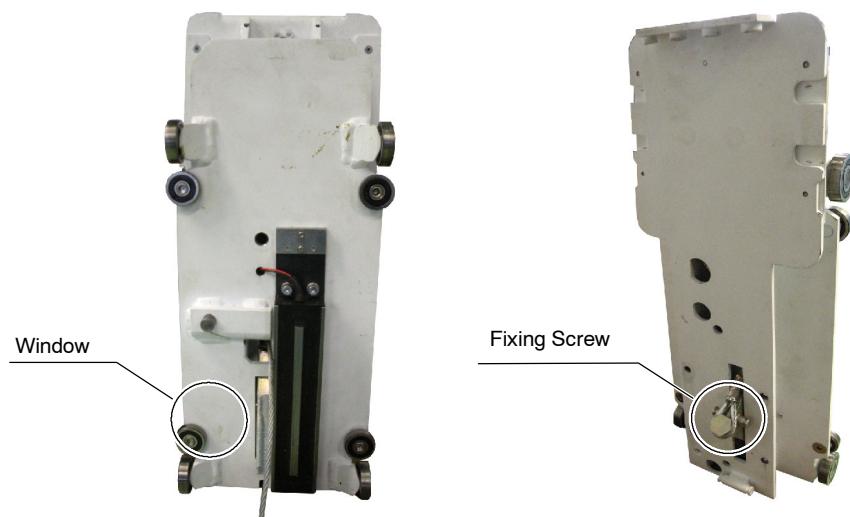
Two people are necessary to carry out the entire procedure; while one person performs the mounting process, the other person holds the Steel Cable tight along the entire procedure.

Note 

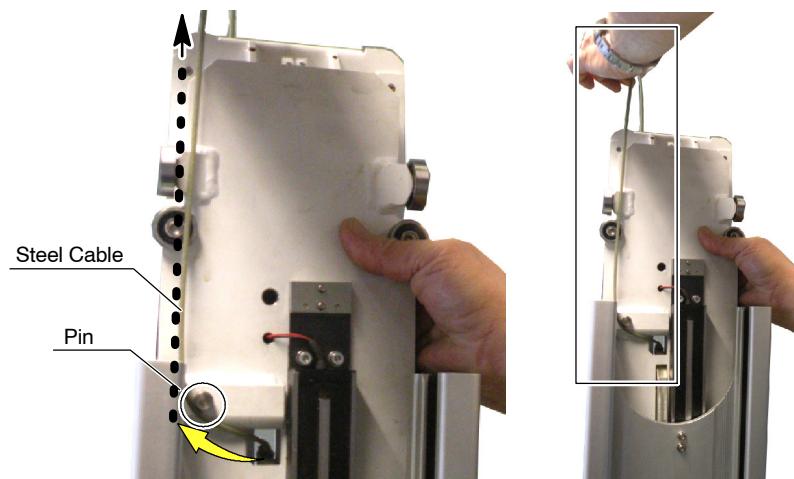
For procedures related to the TC Sliding Section, refer to Illustration 3-2.

27. Pass the new Steel Cable through the Window in the Carriage, secure it with the Fixing Screw adding Loctite 243 and using a torque of 15Nm.

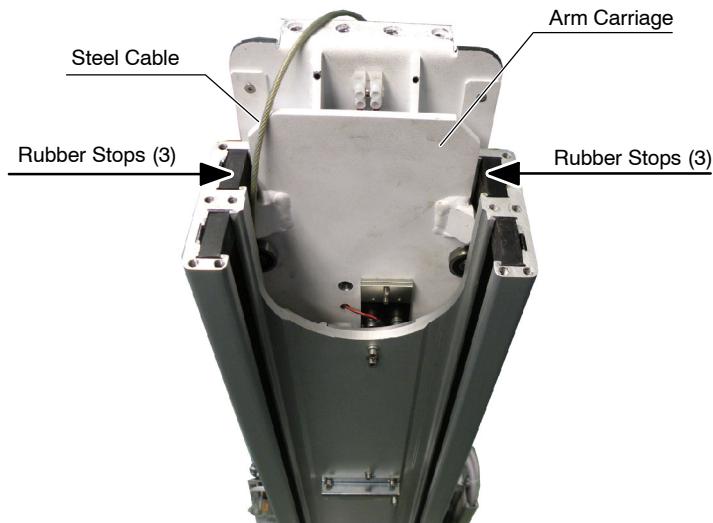
Rectangular Brake Arm Carriage (type A)



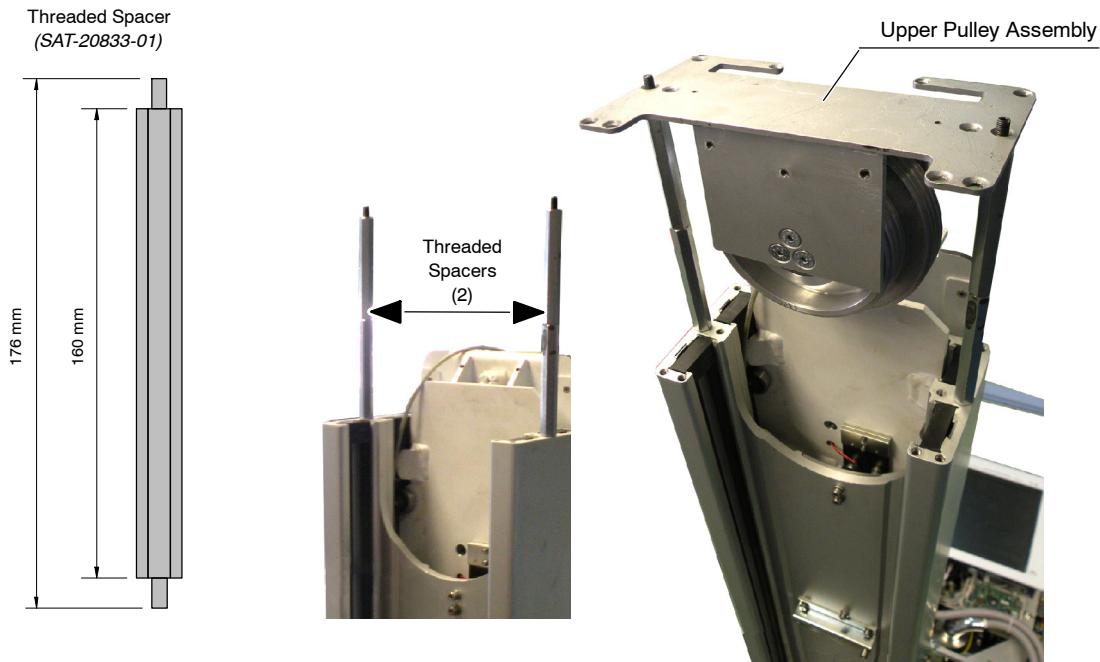
28. Apply some grease on the Bearings and slide the Arm Carriage downwards the TC Sliding Section, placing the Steel cable to the left of the Carriage around the Pin, as shown in the picture below.



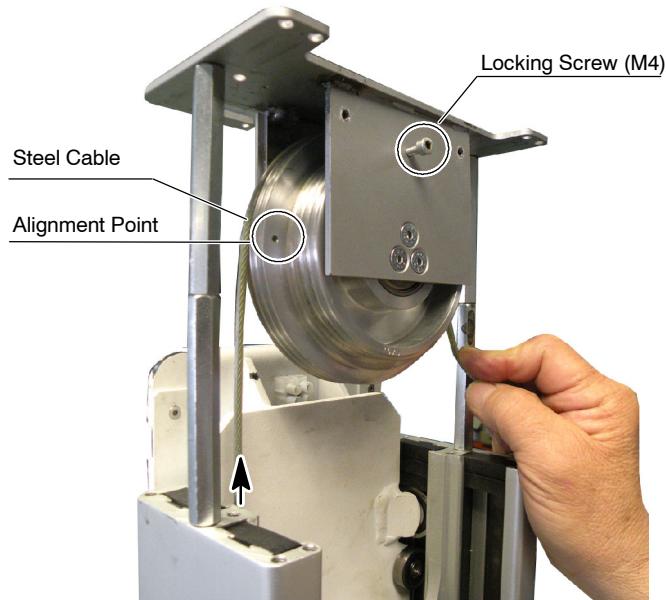
29. Place the three (3) Rubber Stops at both sides inside the upper end of the TC Sliding Section.



30. Place two (2) Threaded Spacers (Spacer:160 mm; Threaded ends: 8 mm x M5) (*spare part SAT-20833-01*) in the drills at both sides on the upper end of the TC Sliding Section, in order to ease the mounting process of the Steel Cable in the next steps.
Mount the Upper Pulley Assembly on the Threaded Spacers.

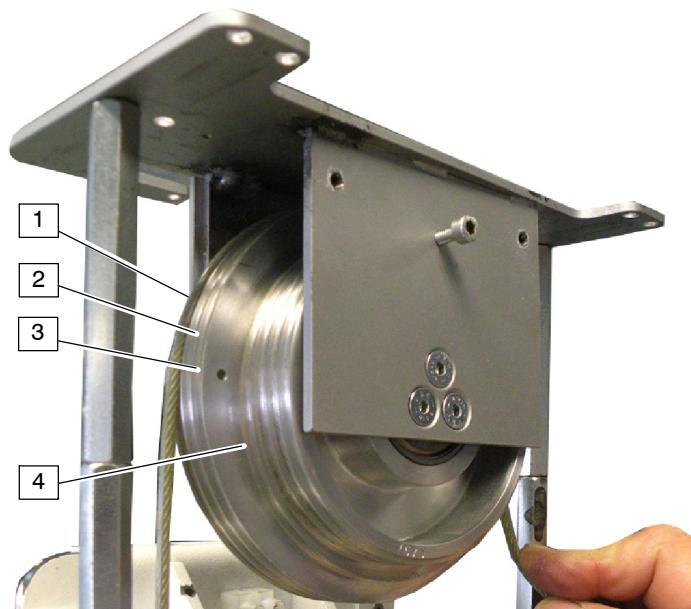


31. Turn the Upper Pulley until the Alignment Point is at 90° degrees, as shown in the picture below, and lock the Pulley in that position with the Locking Screw (M4).



32. Pass one end of the Steel Cable through the gap between the Pulley and the Support, adjust the Steel Cable starting from the larger diameter section of the Pulley, turning it clockwise around the first groove (1), the second groove (2) and the third groove (3).

Change to the smaller diameter section of the Pulley and turn the Steel Cable around the fourth groove (4).



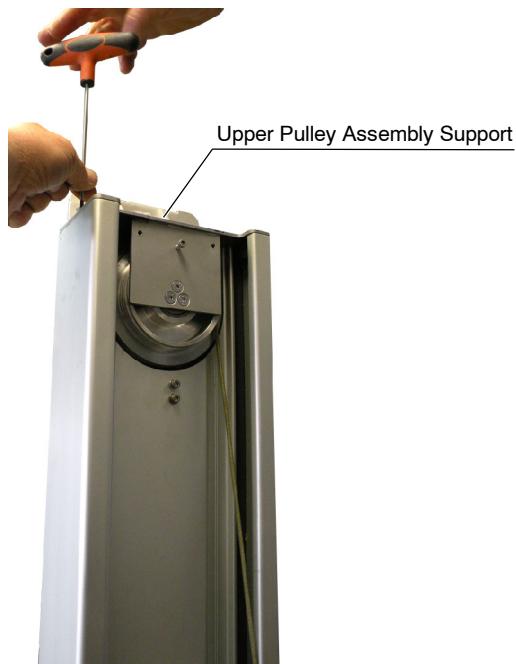
33. While one person holds the Upper Pulley Assembly keeping the Steel Cable tense, the other removes the Threaded Spacers and then loosens the Locking Screw, without removing it.



34. One person keeps tight the Steel Cable while the other lowers the Upper Pulley Assembly to mount it on the top of the TC Sliding Section. Then, lock the Pulley with the Locking Screw.



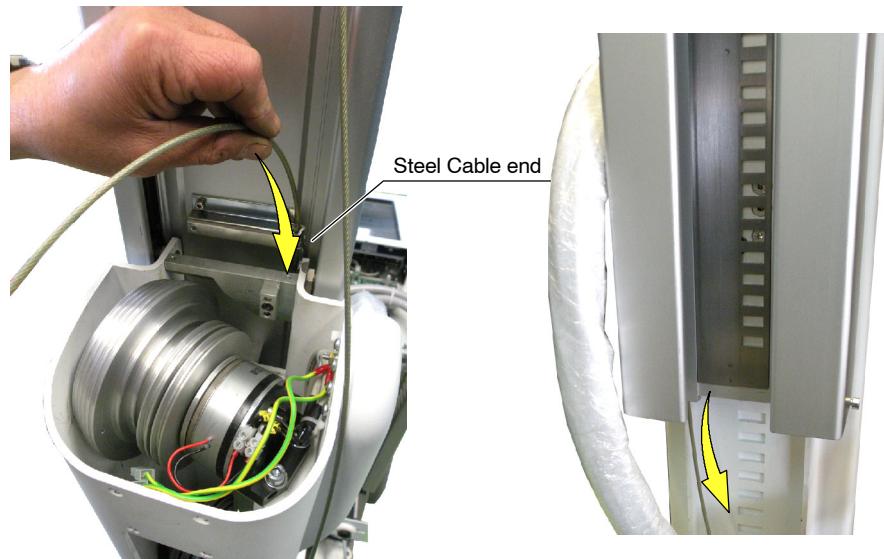
35. Mount the twelve (12) Screws on the Support fixing the Upper Pulley Assembly to the TC Sliding Section.



36. Apply tension to the Steel Cable and fix it with a Tie-wrap, half way of the TC Sliding Section as shown in the picture below, in order to ease the mounting process later.

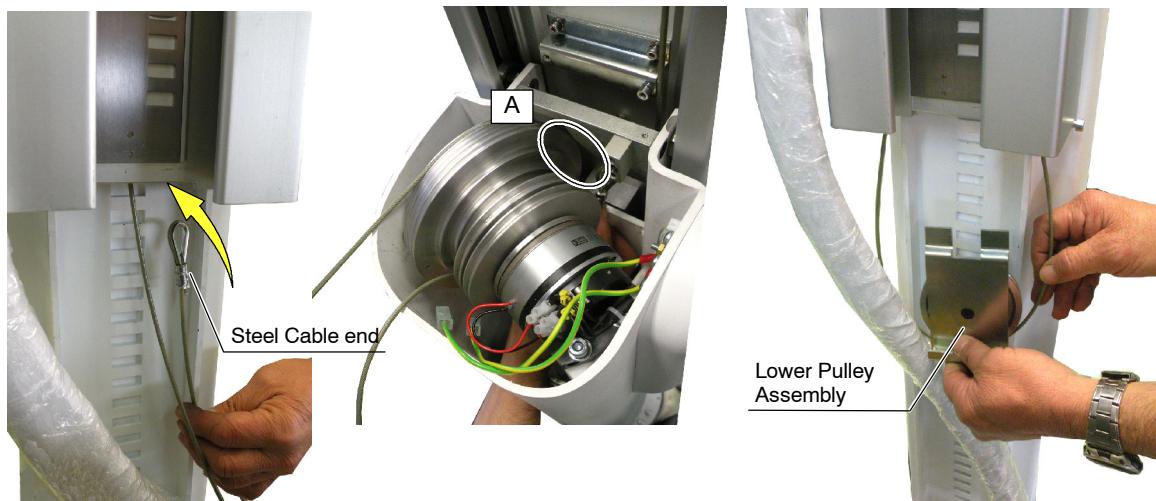


37. Pass the end of the Steel Cable downwards through the gap between both Sections of the Telescopic Column, as shown in the picture below.



38. Pass the Steel Cable end upwards through the gap between both Sections of the Telescopic Column and through the window (A) in the TC Base Section.

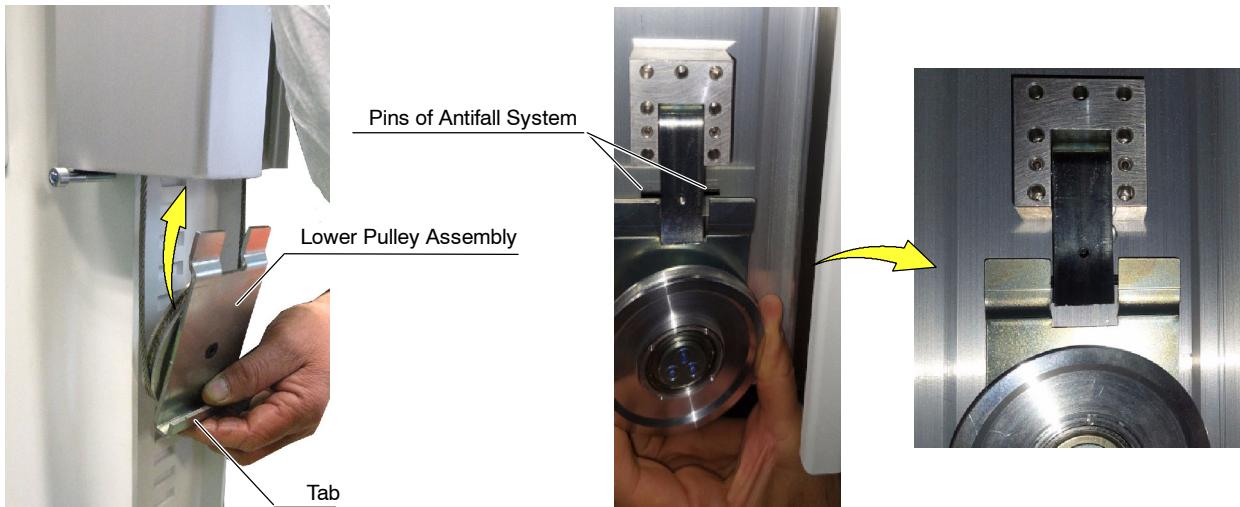
Place the Lower Pulley Assembly with the Steel Cable around the Pulley groove, as shown in the picture below.



39. While keeping tension on the Steel Cable, mount the Lower Pulley Assembly inside the lower end of the TC Sliding Section.

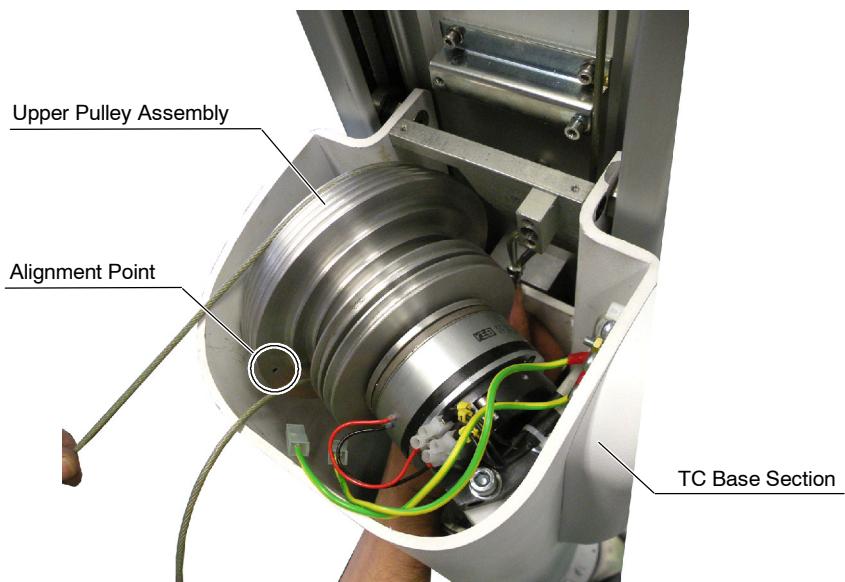


It is very important that the two (2) pins of the Antifall System are positioned between the surface of the Column and the two (2) lugs of the pulley support, otherwise the column will be always blocked with the Antifall System.



With the steel cable tight, check the correct installation of the Lower Pulley Assembly by inserting a rigid strip of metal, plastic or similar, 1 mm thick and at least 25 cm long, into the column and in front of the pulley, verify that the strip can move freely without colliding with the Antifall System.

40. With the Steel Cable tight, turn the unit ON.
Press the Tube-Collimator Assembly Handgrips in order to release the Brake of the Upper Pulley Assembly in the TC Base Section.
Turn the Assembly until the Alignment Point of the Spiral Pulley is at 90° degrees, as shown in the picture below.
Turn the unit OFF.



41. Carefully guide the Steel Cable as described in the following steps:

Note 

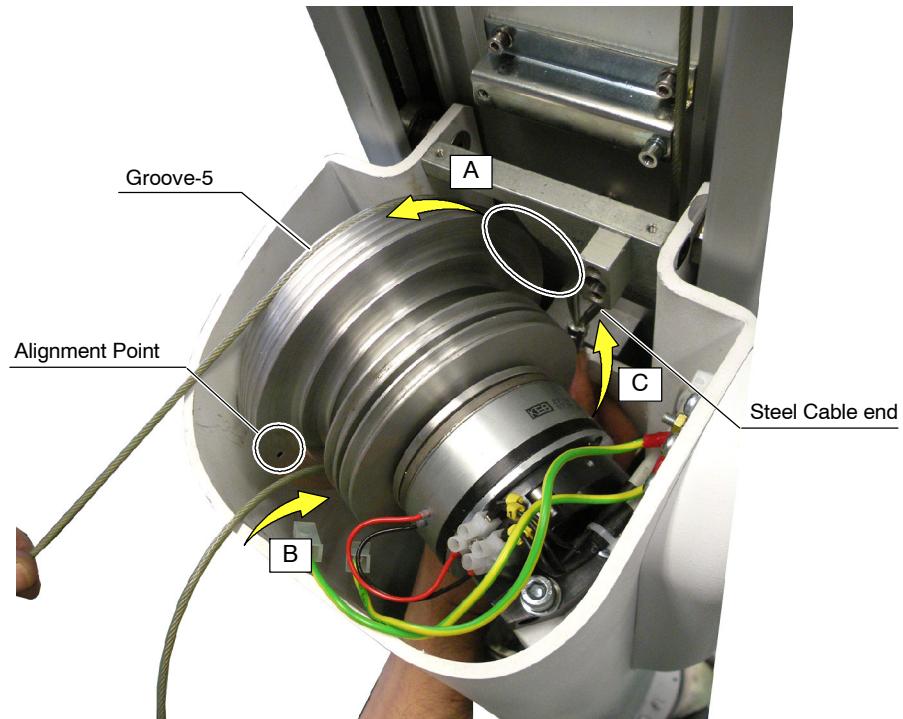
For procedures related to the TC Base Section, refer to Illustration 3-1.

- a. From Lower Pulley (TC Sliding Section) → to Spiral Pulley groove-5 (TC Base Section):

(A) Take the Steel Cable end coming from the TC Sliding Section through the window in the TC Base Section, keeping the Cable tight.

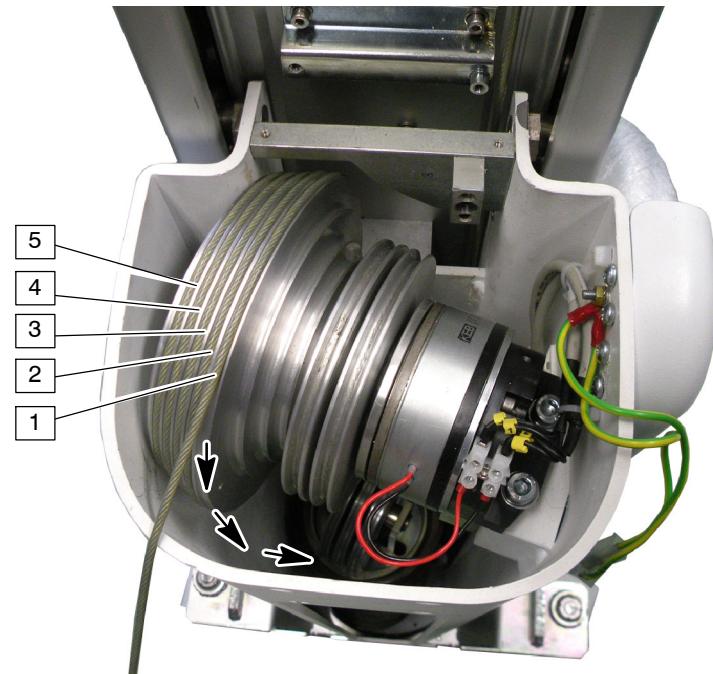
(B) Turn the Steel Cable counterclockwise around the fifth Groove of the Spiral Pulley.

(C) Pass the Steel Cable end below the Spiral Pulley as shown in the picture.



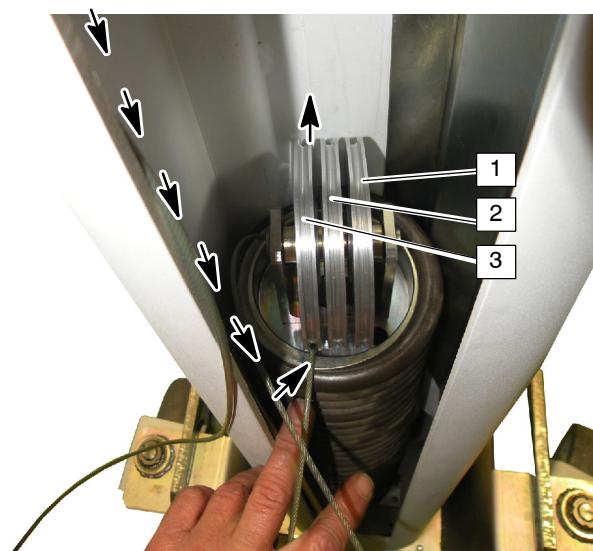
b. From Spiral Pulley groove-5 → to Spiral Pulley grooves-4-3-2-1:

Turn the Steel Cable counterclockwise around the Spiral Pulley from the fifth groove, to the fourth, third, second and first grooves.



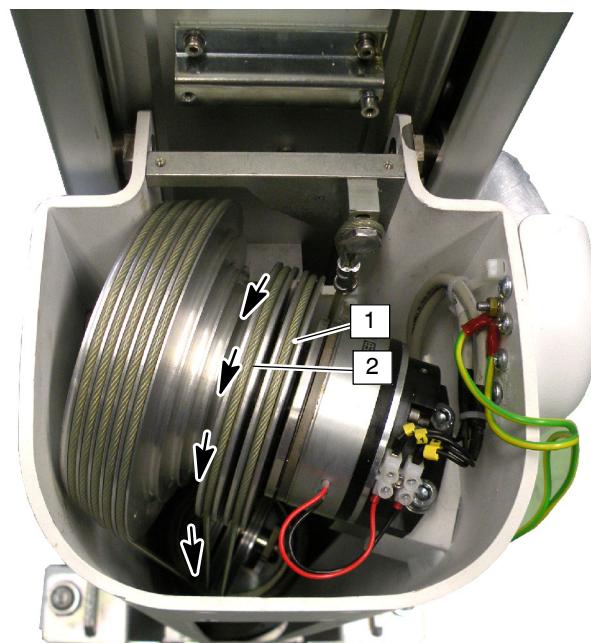
c. From Spiral Pulley groove-1 → to Lower Pulley groove-3:

Keeping the Steel Cable tight, guide the Cable downwards from the first groove of the Spiral Pulley and turn it counterclockwise around the third groove of the Lower Pulley.

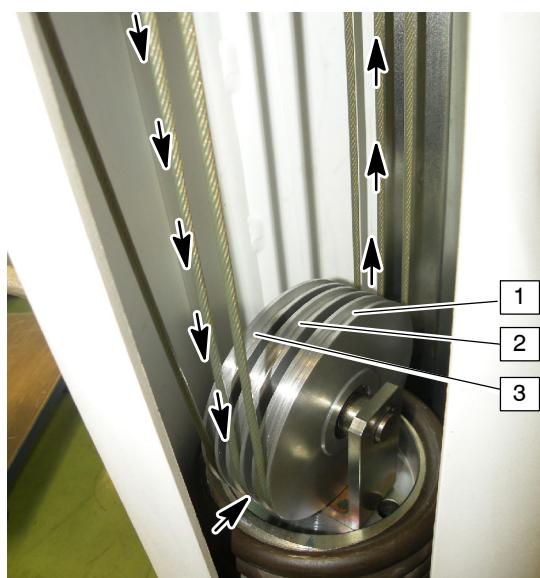


d. From Lower Pulley groove-3 → to Upper Pulley groove-2:

Guide the Steel Cable upwards from the third groove of the Lower Pulley and turn it around the second groove of the Upper Pulley.

e. From Upper Pulley groove-2 → to Lower Pulley groove-2:

Guide the Steel Cable downwards from the second groove of the Upper Pulley to the second groove of the Lower Pulley.



f. From Lower Pulley groove-2 → to Upper Pulley groove-1:

Guide the Steel Cable upwards from the second groove of the Lower Pulley and turn it around the first groove of the Upper Pulley.

g. From Upper Pulley groove-1 → to Lower Pulley groove-1:

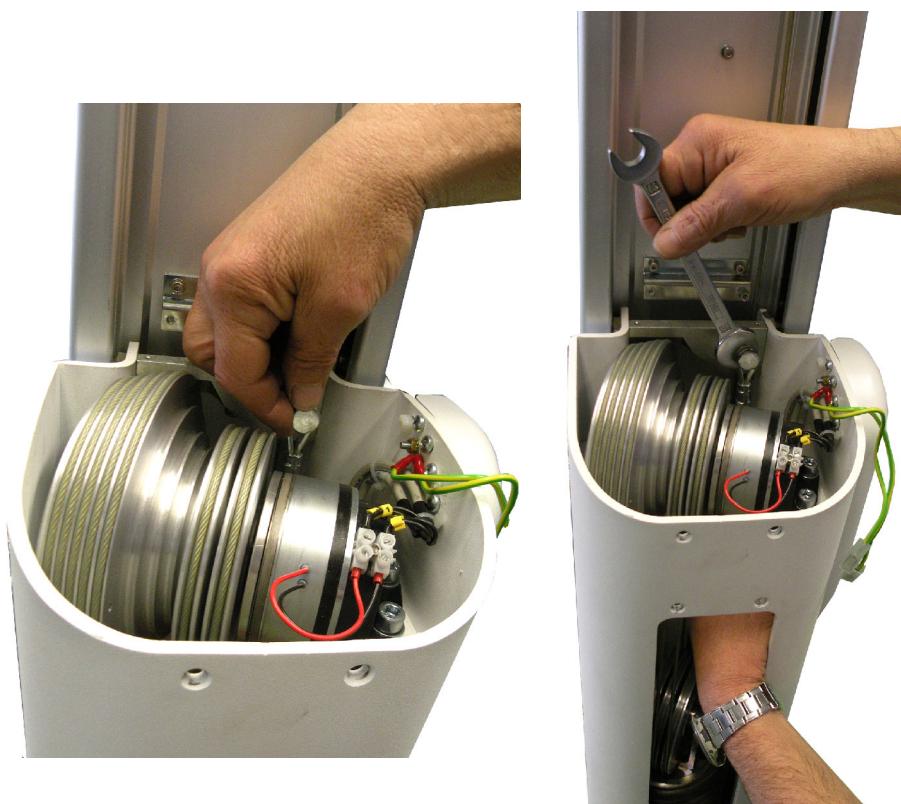
Guide the Steel Cable downwards from the first groove of the Upper Pulley to the first groove of the Lower Pulley.

h. From Lower Pulley groove-1 → to Fixing Screw :

Guide the Steel Cable upwards from the first groove of the Lower Pulley to the Fixing Screw drill.

If necessary, unscrew the Spring Tensioner Screw at the lower end of the TC Base Section in order to loosen the Spring to reach the Fixing Screw drill with the end of the Steel Cable.

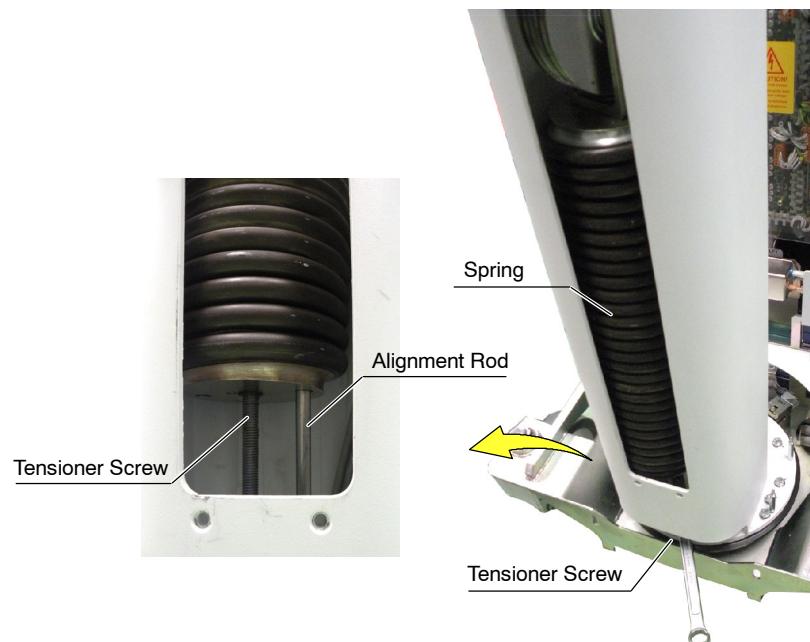
While one person keeps the Steel Cable tight, the other ensures the Steel Cable end with the Fixing screw, adding Loctite 243 and using a Torque of 15 Nm.



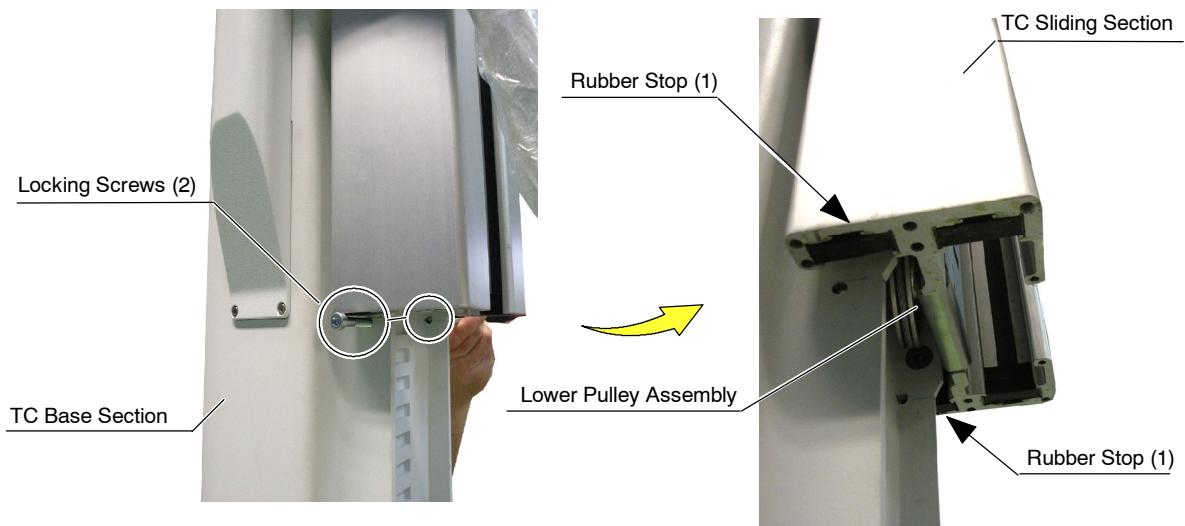
42. While one person keeps tight the Steel Cable, the other person cuts the Tie-wrap at the TC Sliding Section and removes the Locking Screw from the Upper Pulley assembly.



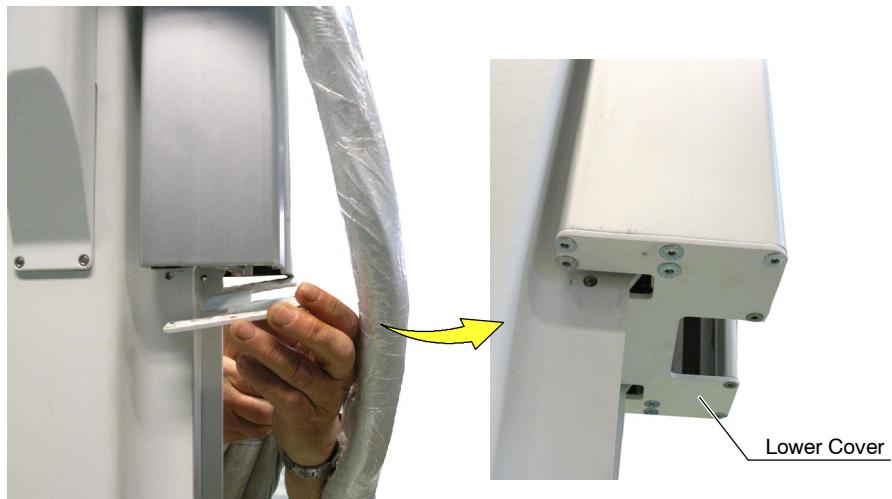
43. At the lower end of the TC Base Section, ensure that the Spring is into the Alignment Rod. Adjust the Tensioner Screw several times to tight the Spring and the Steel Cable.



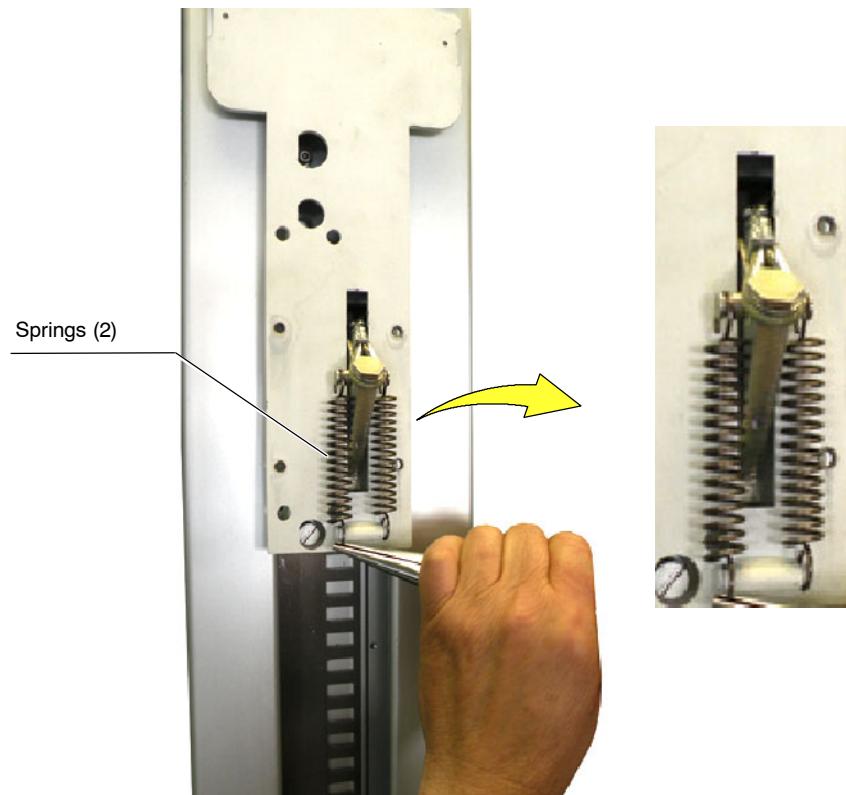
44. Carefully remove the two (2) Locking Screws at both sides of the TC Base Section and mount the Rubber Stops at both sides of the TC Sliding Section as shown in the picture.



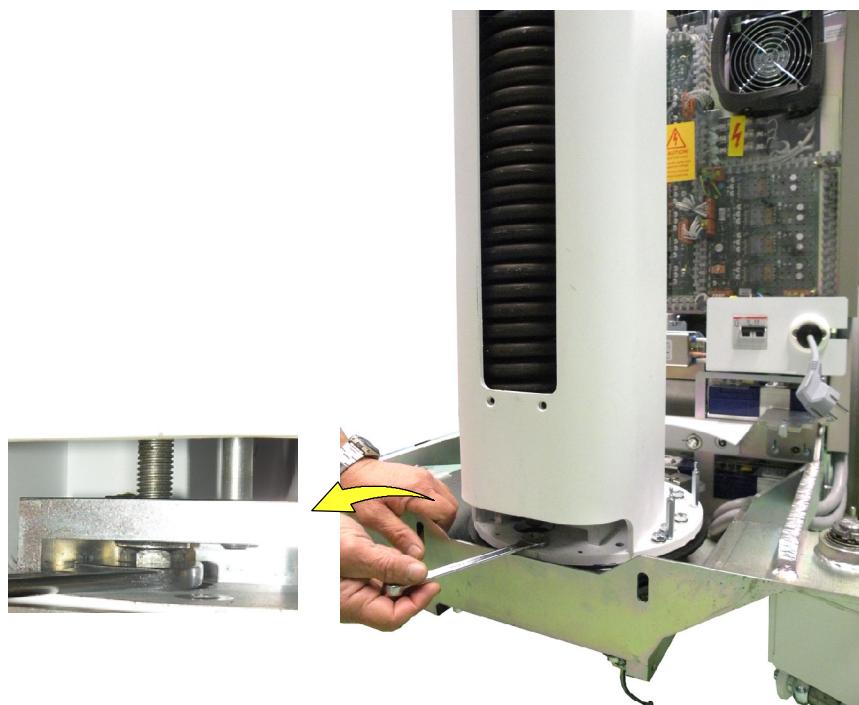
45. Mount the Lower Cover using the twelve (12) Screws that secure the cover of the TC Sliding Section.



46. Mount the two (2) Springs of the Antifall System in the Arm Carriage.



47. Adjust again the Tensioner Screw several times until is achieved the required tension for the Spring and the Steel Cable.



Note

When the Arm, the Tube-Collimator Assembly and all the covers of the Telescopic Column are assembled in the unit, the Tensioner Screw will be adjusted again, in order to get the adequate tension for the Spring and the Steel Cable.

48. Turn the unit ON.

Press the Tube-Collimator Assembly Handgrips to release the Brake in order to turn the Telescopic Column at 180° degrees.

49. Place the Sling over the top of the TC Sliding Section.

While one person presses the Tube-Collimator Assembly Handgrips the other moves the TC Sliding Section fully down and secures it with the Sling.

Turn the unit OFF.

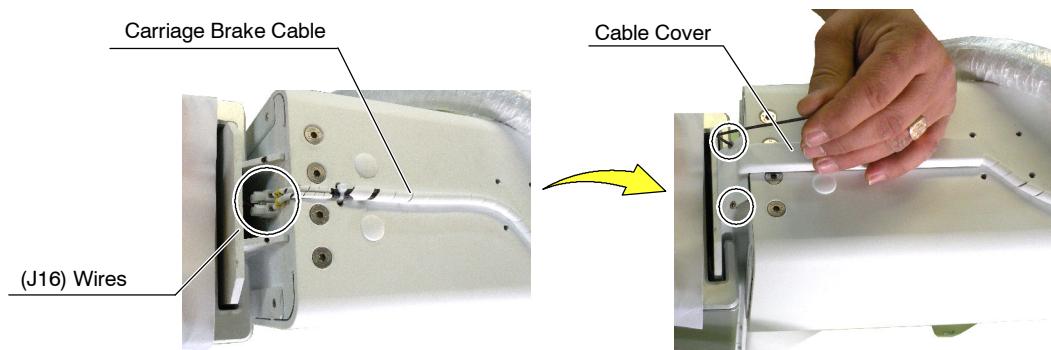
50. Carefully mount the Arm on the Carriage:

- a. While one person supports the weight of the Arm, the other secures the Arm with the corresponding fixing Screws (4+4) adding Loctite 243 and using a Torque of 10.5 Nm.

Then, mount the Plate.



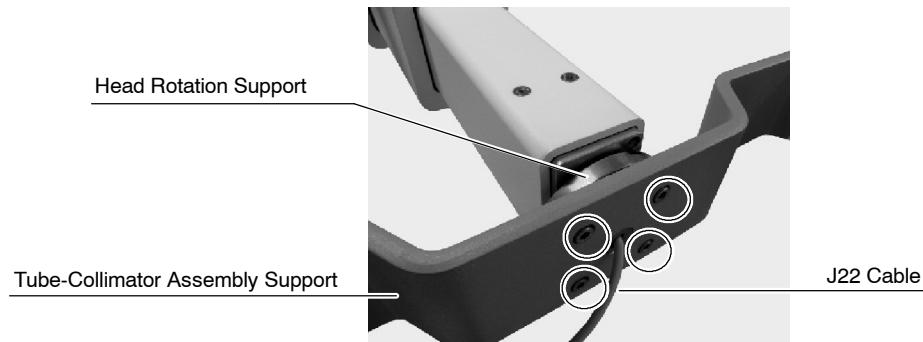
- b. Pass the Carriage Brake Cable through the tie-wrap previously mounted on the Arm, remove the electrical tape from the cable wires, connect both wires in the position noted before and finally mount the Carriage Brake Cable Cover with the two (2) Screws.



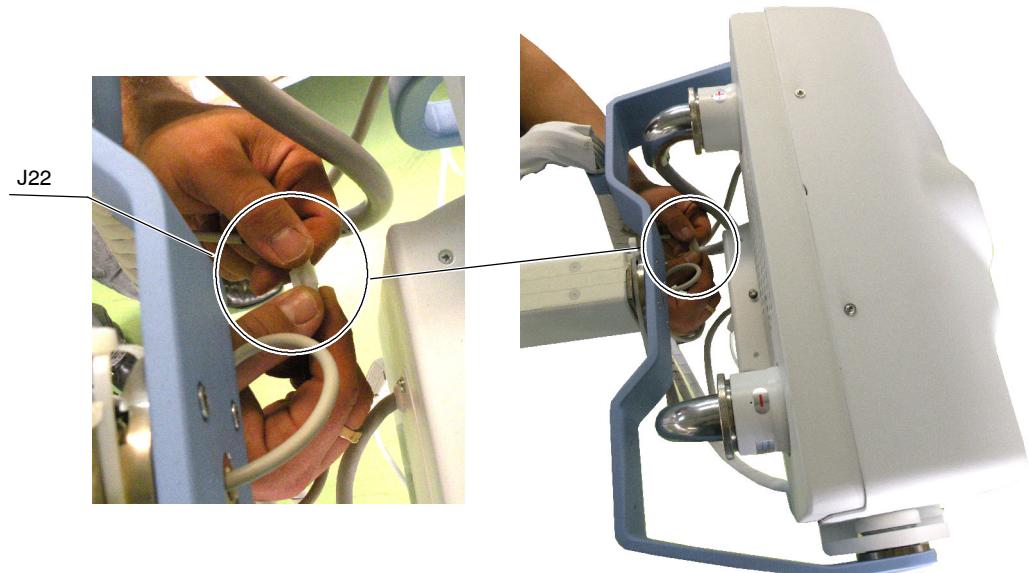
51. Carefully **mount the Tube-Collimator Assembly:**

- a. Place the auxiliary table with the Tube-Collimator Assembly closer to its final position in the Arm.

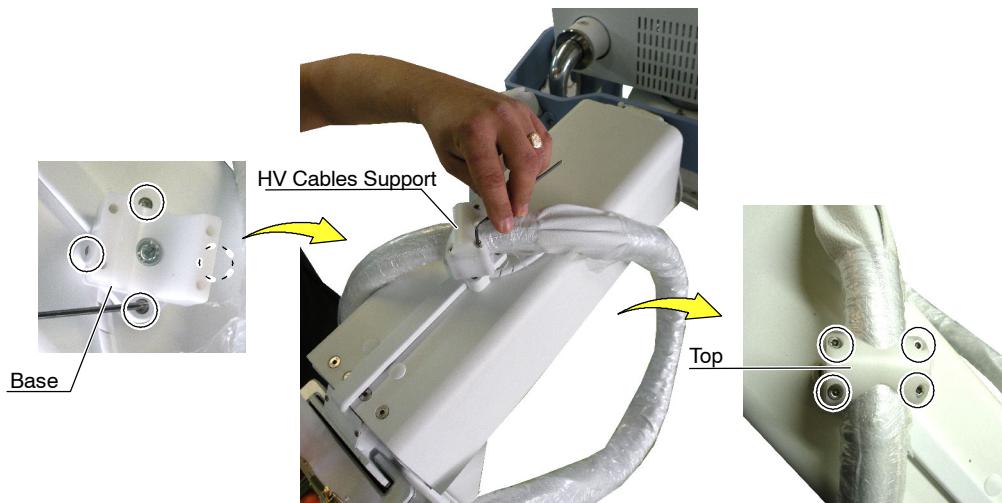
While one person holds the the Tube-Collimator Assembly towards the Arm, the other holds the HV Cables above the Arm, passes J22 Cable through the Support of the Tube-Collimator Assembly and mounts the four (4) Screws that fix the Tube-Collimator Assembly to the Head Rotation Support, adding Loctite 243 and using a Torque of 10.5 NM.



- b. Remove the electrical tape from the wires of Connector J22 (Arm Brake) and connect J22.



52. Mount the HV Cables Support (base) to the upper side of the Arm with the four (4) Screws, place the HV Cables inside and mount the HV Cables Support (Top).

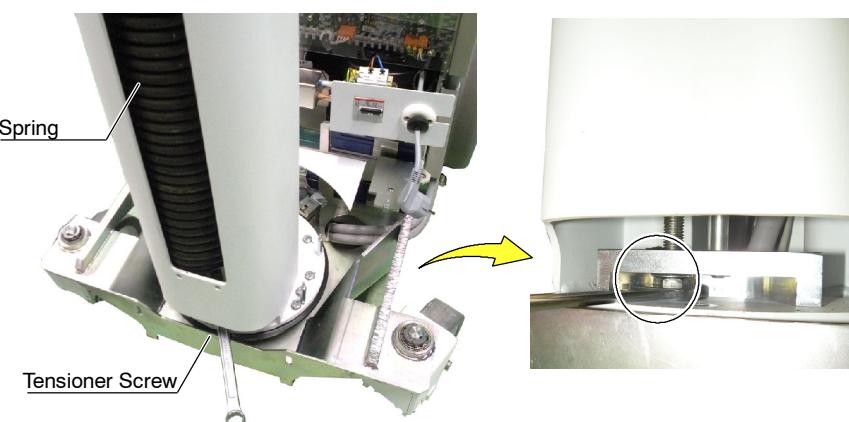


53. Release the Sling from the unit.
54. Turn ON the Mobile Unit and perform a functional check:

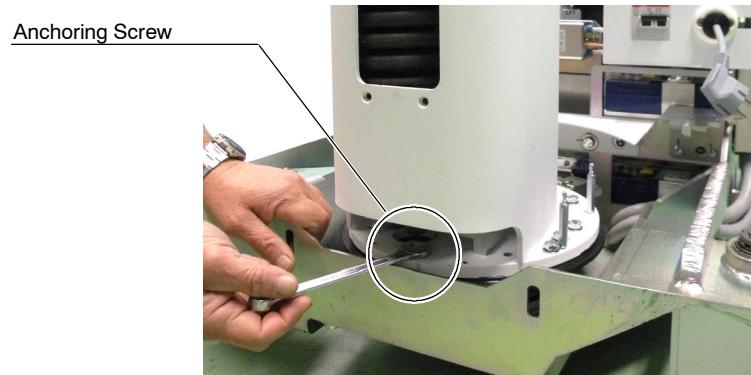
Check for the correct movement of the vertical travel of the Arm and the Telescopic Column. Check for the correct rotation of the Telescopic Column.

Tighten / loosen the Spring by adjusting the Tensioner Screw and balance the vertical movement of the Arm until reaching the following force results on the vertical movements:

- Dynamic effort to perform the upwards and downwards vertical movement of Arm and Telescopic Column with brakes released must be between 3 and 6 kg.



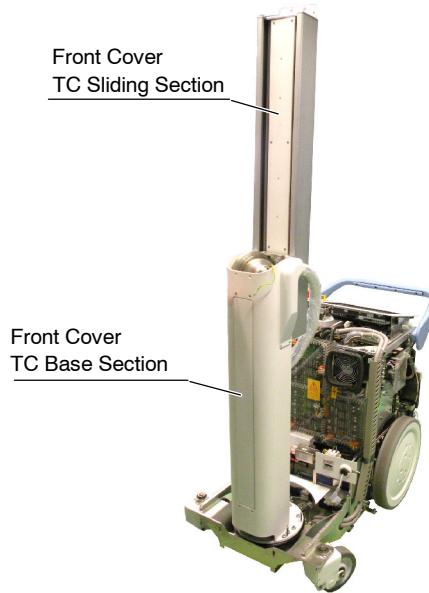
55. Turn OFF the Mobile Unit.
56. At the base of the TC Base Section, mount the Anchoring Screw.



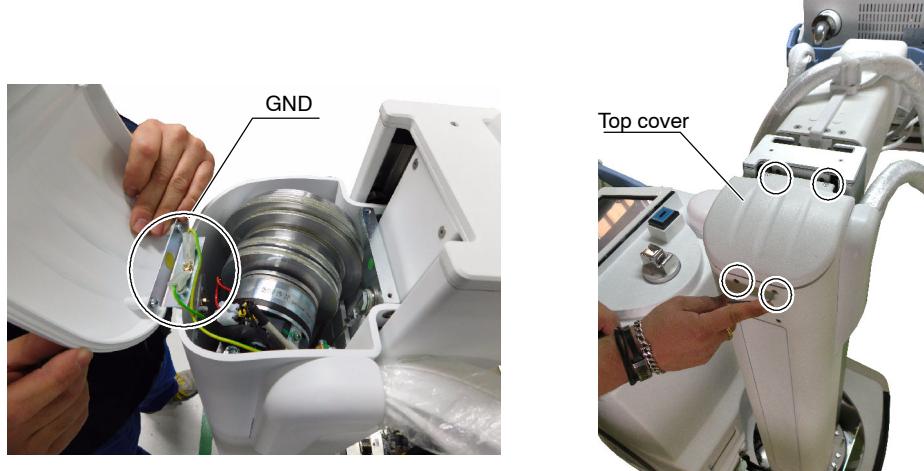
57. With the TC Sliding Section upwards:

Mount the Front Cover of the TC Sliding Section and secure it with the six (6) Screws.

Mount the Front Cover of the TC Base Section by sliding the cover inside the TC Base Section. Secure it with the six (4) Screws and Connect GND connector.



58. Connect GND connectors at the Top Cover of the TC Base Section, mount the Top Cover and secure it with the four (4) Screws.



59. Mount all the Covers of the unit previously removed (*refer to Section 2.2.2*).
60. Test the Unit.

3.2.1.2 TC BASE SECTION: REPLACEMENT OF THE UPPER PULLEY ASSEMBLY

Note 

To replace the Upper Pulley Assembly (Spiral Pulley) of the TC Base Section is needed to loosen and dismount a long part of the Steel Cable.

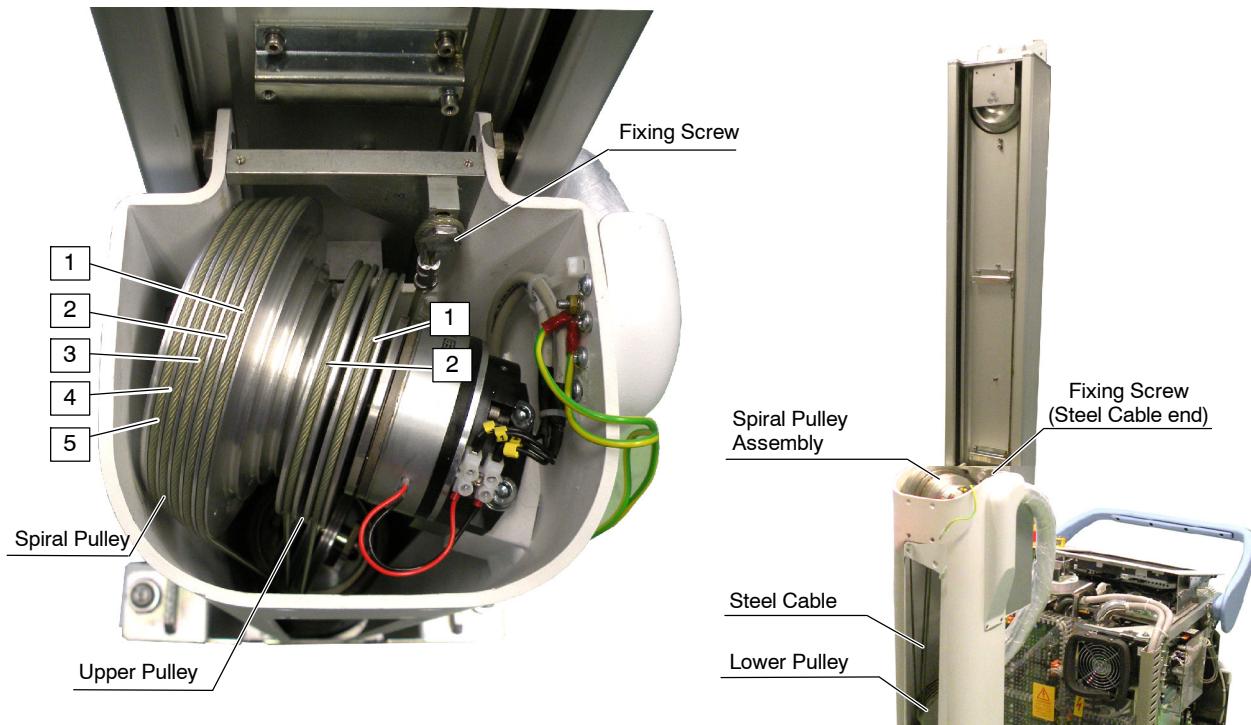
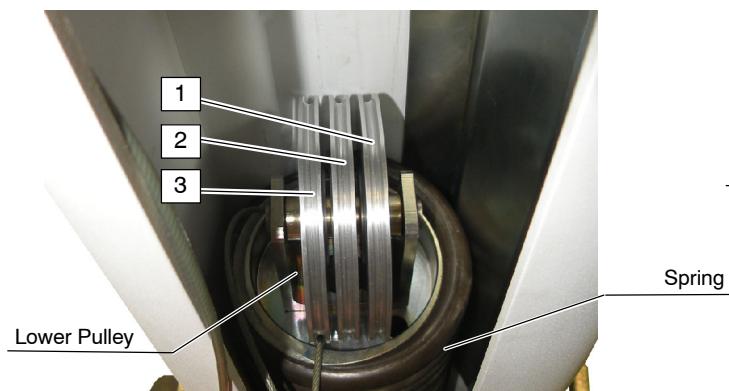
1. Before releasing the Steel Cable from the TC Base Section, perform the process described in *Section 3.2.1.1* from the beginning until step 24. included.

2. With the Steel Cable tight, lock the Pulley with the Locking Screw (M4) and fix the Steel Cable with a Tie-wrap half way of the TC Sliding Section as shown in the picture below.



Note 

For procedures related to the TC Base Section (from step 3.), refer to Illustration 3-3.

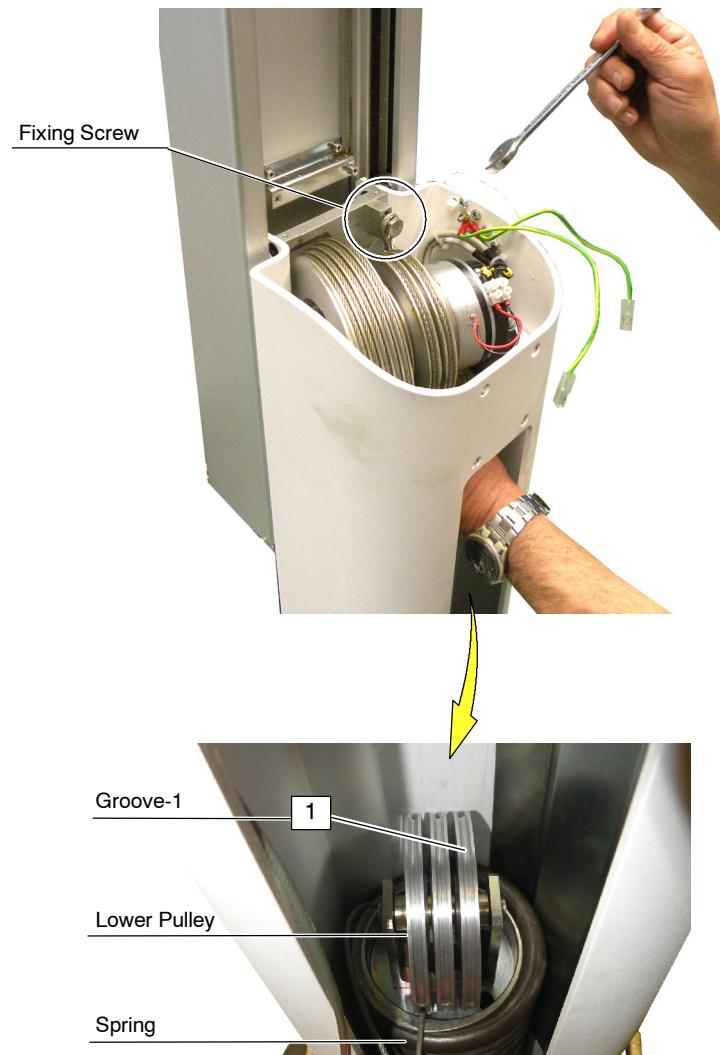
Illustration 3-3
TC Base SectionSpiral Pulley AssemblyLower Pulley

3. Carefully release the Steel Cable from the TC Base Section, as described in the following steps:

a. From Fixing Screw → to Lower Pulley groove-1:

Remove the Fixing Screw that fix one end of the Steel Cable to the upper side of the TC Base Section, by using a 15 mm Spanner.

Take the Steel Cable downwards the TC Base Section to the Lower Pulley (over the Spring) and release the Steel Cable clockwise, from the first groove at the right of the Lower Pulley.



b. From Lower Pulley groove-1 → to Upper Pulley groove-1:

Guide the Steel Cable upwards and release it from the first groove at the right, around the Upper Pulley (beside the Spiral Pulley).

c. From Upper Pulley groove-1 → to Lower Pulley groove-2:

Guide the Steel Cable downwards and release it from the second groove around the Lower Pulley.

d. From Lower Pulley groove-2 → to Upper Pulley groove-2:

Guide the Steel Cable upwards and release it from the second groove around the Upper Pulley.

e. From Upper Pulley groove-2 → to Lower Pulley groove-3:

Guide the Steel Cable downwards and release it from the third groove around the Lower Pulley.

f. From Lower Pulley groove-3 → to Spiral Pulley groove-1:

Guide the Steel Cable upwards and release it from the first groove around the Spiral Pulley.

g. From Spiral Pulley groove-1 → to Spiral Pulley grooves-2-3-4-5:

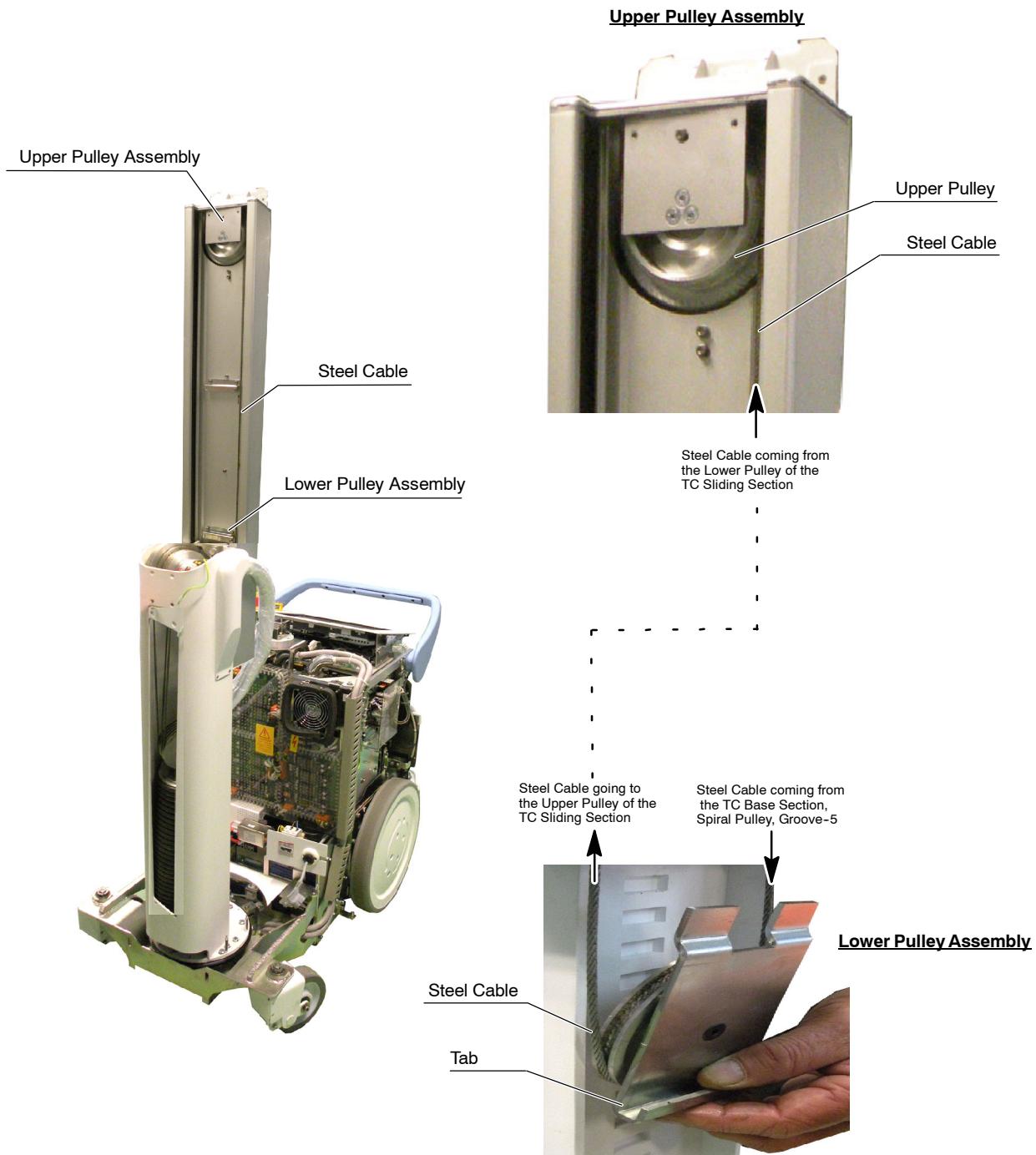
Release the Steel Cable from the first groove of the Spiral Pulley and continue releasing the Steel Cable from the second, the third, the fourth and the fifth grooves of the Spiral Pulley.

h. From Spiral Pulley groove-5 → to Lower Pulley (TC Sliding Section):

Release the Steel Cable from the fifth groove of the Spiral Pulley.

4. Carefully loosen the Steel Cable from the Lower Pulley Assembly of the TC Sliding Section, as described in the following steps (*refer to Illustration 3-4.*):

Illustration 3-4
TC Sliding Section Section

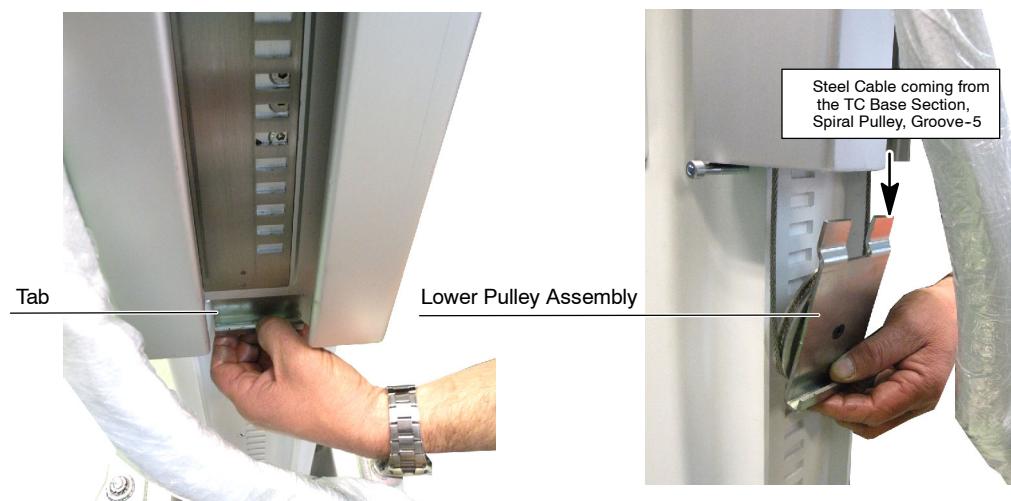
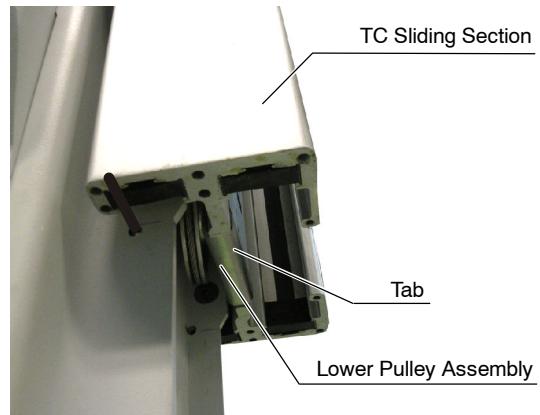


- a. Dismount the Lower Pulley Assembly by pulling its Tab downwards.

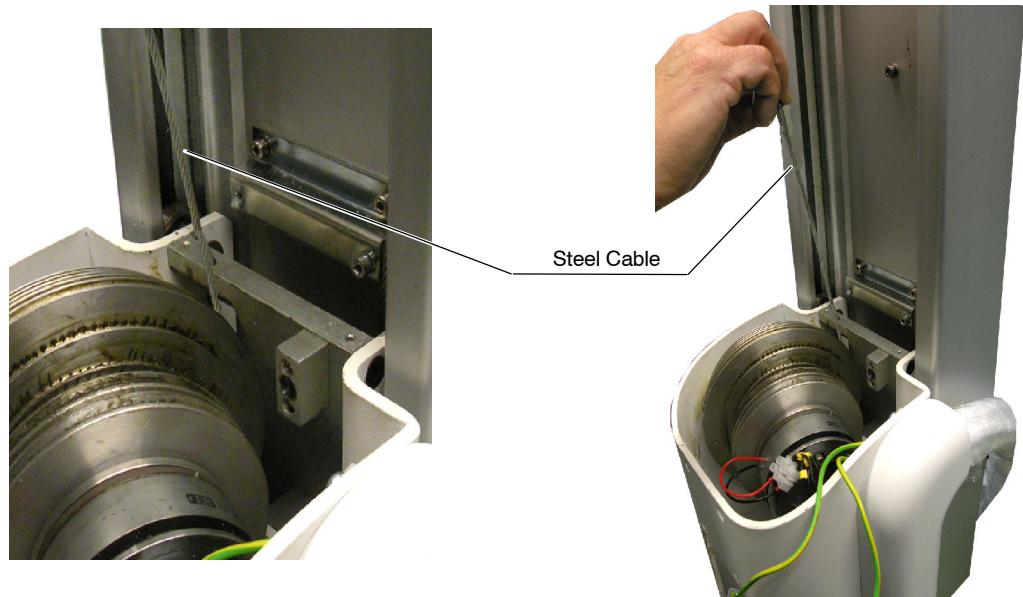
Note 

Previously, the Rubber Stops (2+2) have been removed and two (2) Locking Screws have been mounted in the drills at both sides of the TC Base Section, in order to lock the TC Sliding Section in the top position.

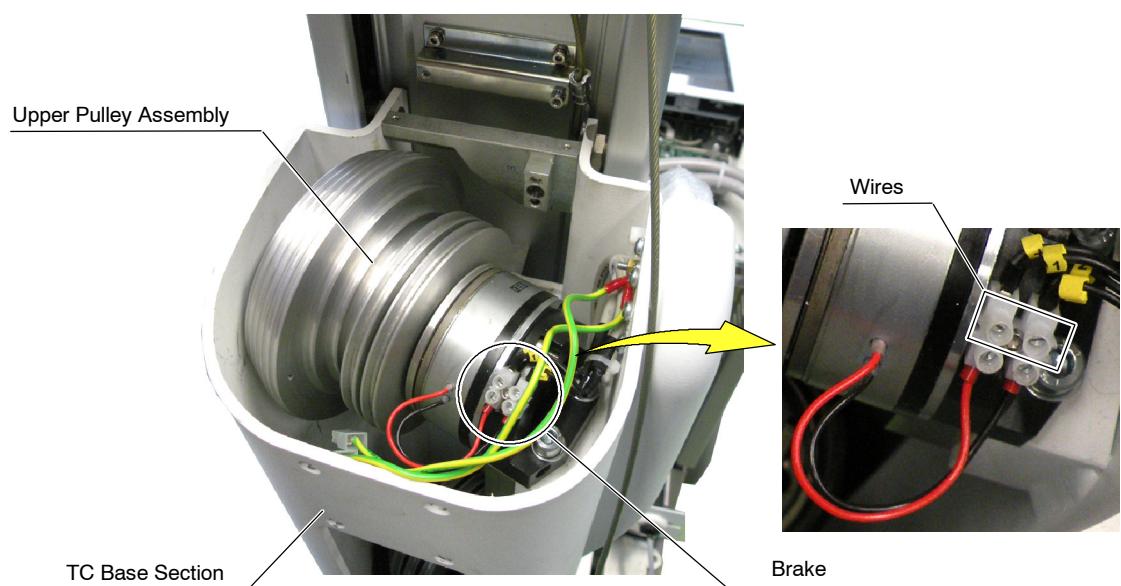
- b. Then, loosen the Steel Cable by removing the Lower Pulley.



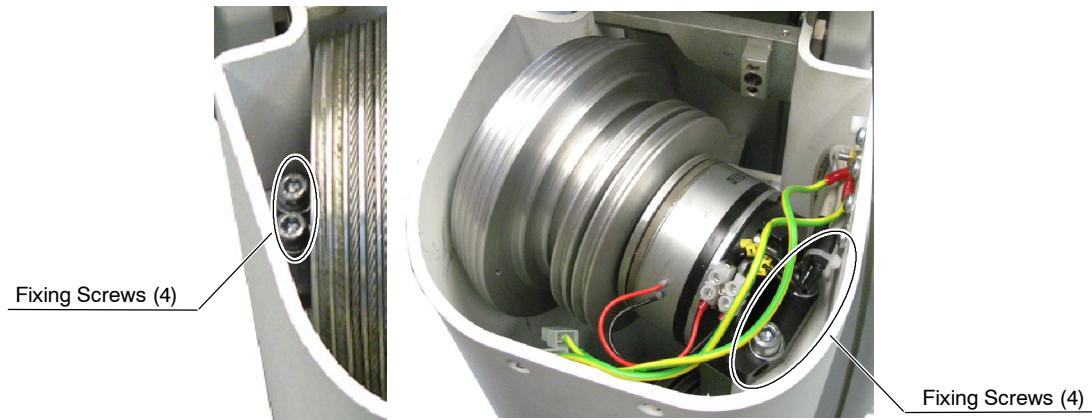
- c. After release the Steel Cable from the TC Base Section, keep the Steel Cable loosen close to the Spiral Pulley Assembly.



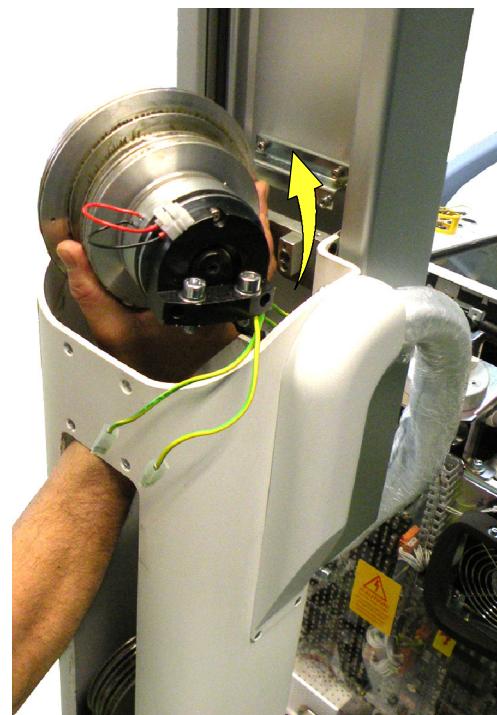
5. Disconnect wires from the Brake of the Upper Pulley Assembly and isolate the ends with electrical tape.



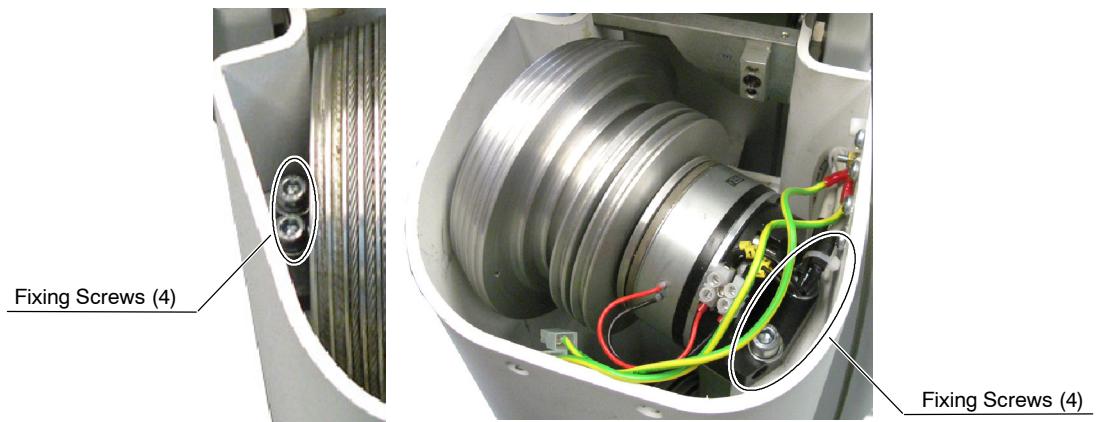
6. Remove the four (4) Fixing Screws that fix the Upper Pulley Assembly to the TC Base Section.



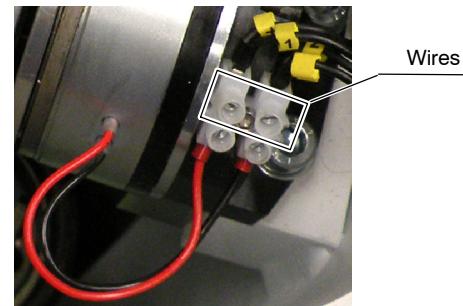
7. Dismount upwards the Upper Pulley Assembly from the TC Base Section as shown in the picture below.



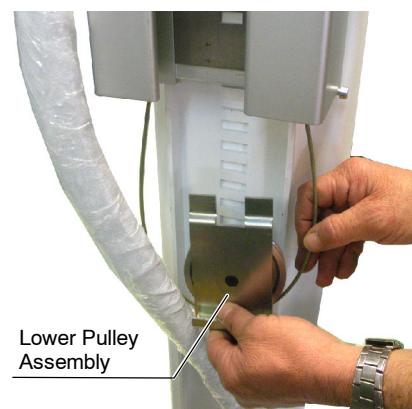
8. Replace the Upper Pulley Assembly and fix it to the TC Base Section with the four (4) Fixing Screws, applying Loctite 243.



9. Remove the electrical tape from the wires of the Brake Cable and connect the wires to the Brake of the Upper Pulley Assembly.



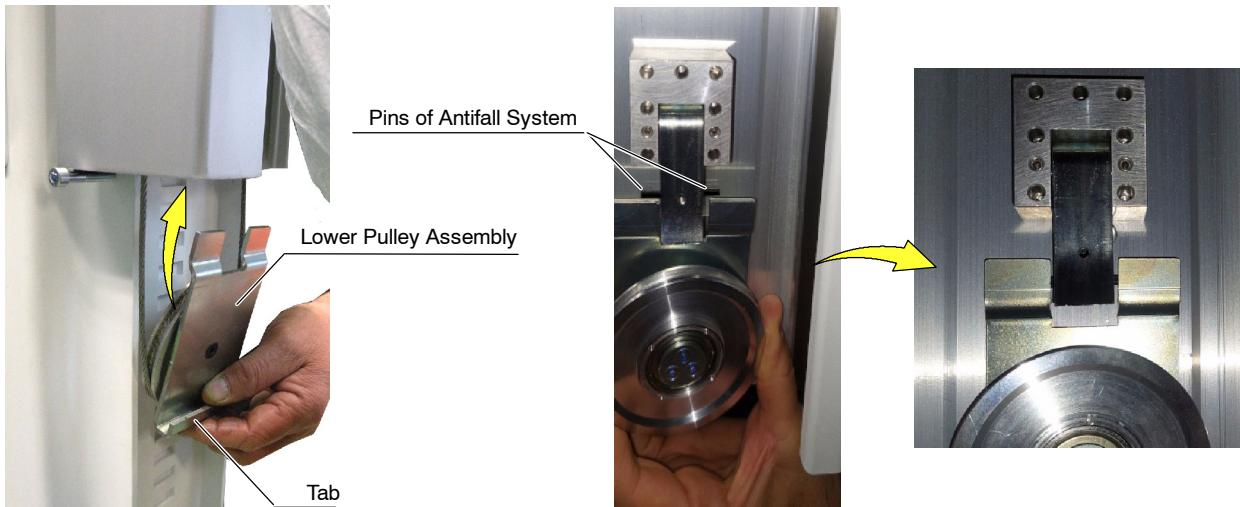
10. Place the Lower Pulley Assembly with the Steel Cable around the Pulley groove, as shown in the picture below.



11. While keeping tension on the Steel Cable, mount the Lower Pulley Assembly inside the lower end of the TC Sliding Section.

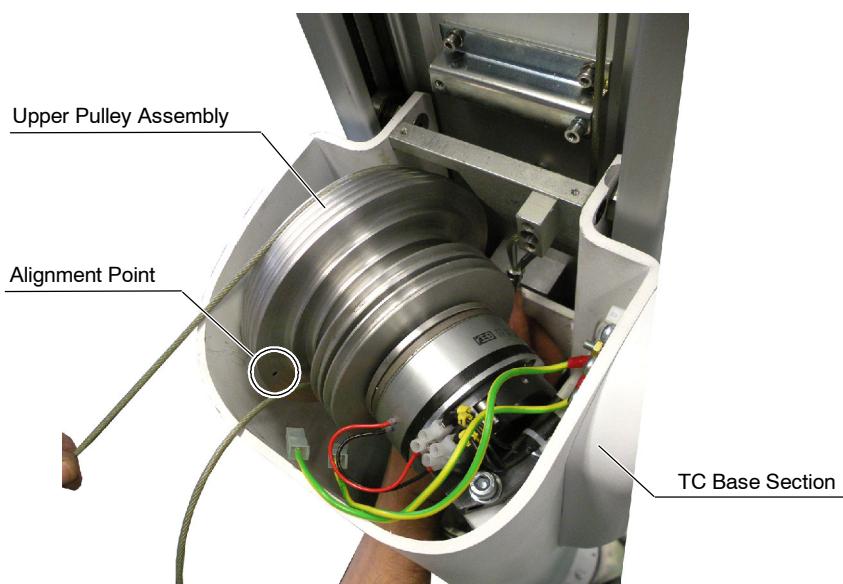


It is very important that the two (2) pins of the Antifall System are positioned between the surface of the Column and the two (2) lugs of the pulley support, otherwise the column will be always blocked with the Antifall System.



With the steel cable tight, check the correct installation of the Lower Pulley Assembly by inserting a rigid strip of metal, plastic or similar, 1 mm thick and at least 25 cm long, into the column and in front of the pulley, verify that the strip can move freely without colliding with the Antifall System.

12. With the Steel Cable tight, turn the unit ON.
Press the Tube-Collimator Assembly Handgrips in order to release the Brake of the Upper Pulley Assembly in the TC Base Section.
Turn the Assembly until the Alignment Point of the Spiral Pulley is at 90° degrees, as shown in the picture below.
Turn the unit OFF.



13. Carefully guide the Steel Cable as described in the following steps:

Note 

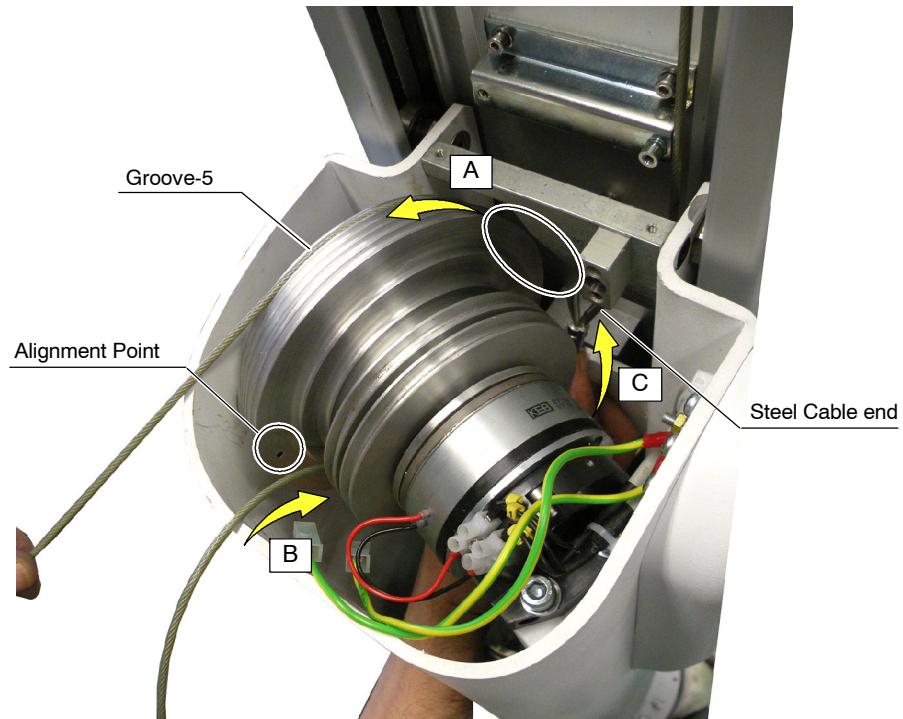
For procedures related to the TC Base Section, refer to Illustration 3-3.

- a. From Lower Pulley (TC Sliding Section) → to Spiral Pulley groove-5 (TC Base Section):

(A) Take the Steel Cable end coming from the TC Sliding Section through the window in the TC Base Section, keeping the Cable tight.

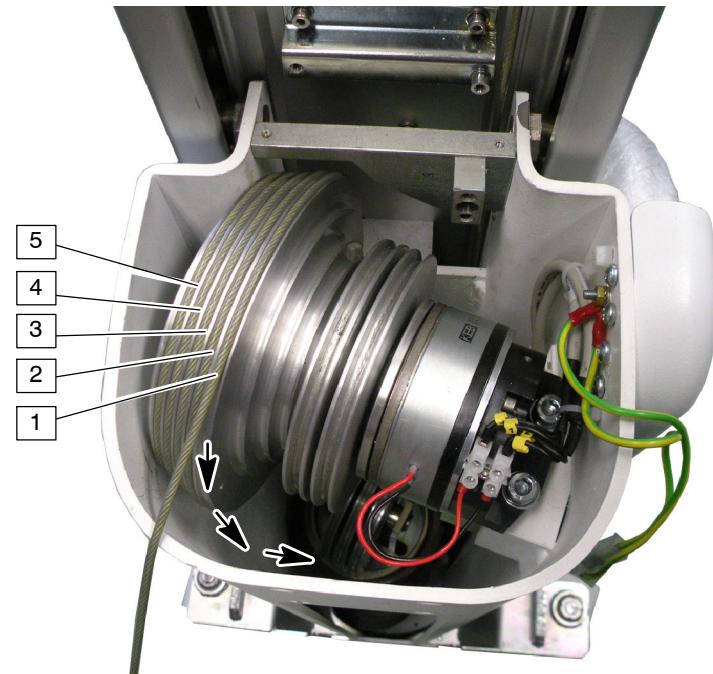
(B) Turn the Steel Cable counterclockwise around the fifth Groove of the Spiral Pulley.

(C) Pass the Steel Cable end below the Spiral Pulley as shown in the picture.



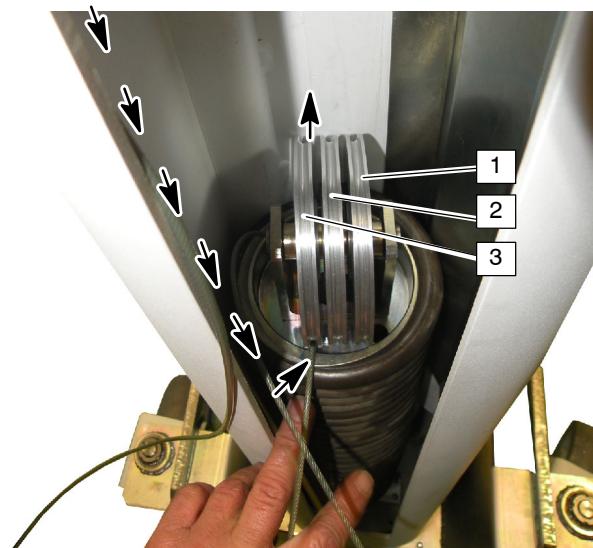
b. From Spiral Pulley groove-5 → to Spiral Pulley grooves-4-3-2-1:

Turn the Steel Cable counterclockwise around the Spiral Pulley from the fifth groove, to the fourth, third, second and first grooves.



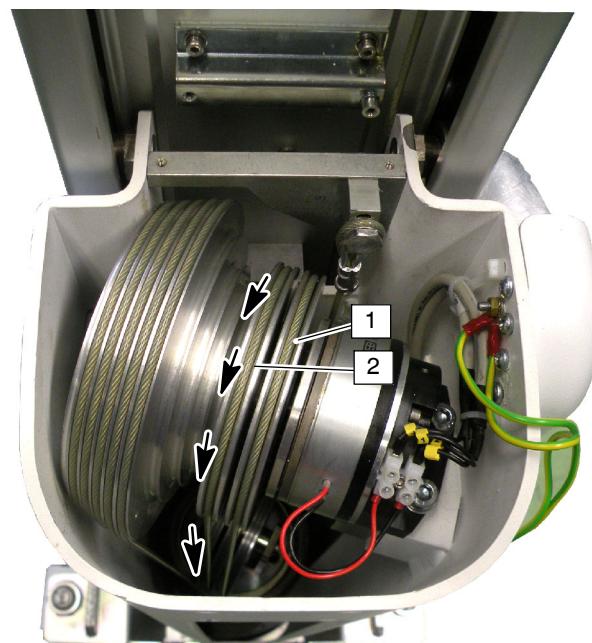
c. From Spiral Pulley groove-1 → to Lower Pulley groove-3:

Keeping the Steel Cable tight, guide it Cable downwards from the first groove of the Spiral Pulley and turn it counterclockwise around the third groove of the Lower Pulley.

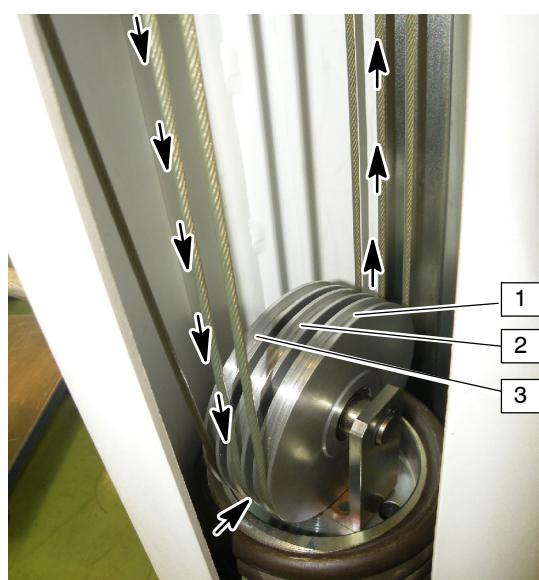


d. From Lower Pulley groove-3 → to Upper Pulley groove-2:

Guide the Steel Cable upwards from the third groove of the Lower Pulley and turn it around the second groove of the Upper Pulley.

e. From Upper Pulley groove-2 → to Lower Pulley groove-2:

Guide the Steel Cable downwards from the second groove of the Upper Pulley to the second groove of the Lower Pulley.



f. From Lower Pulley groove-2 → to Upper Pulley groove-1:

Guide the Steel Cable upwards from the second groove of the Lower Pulley and turn it around the first groove of the Upper Pulley.

g. From Upper Pulley groove-1 → to Lower Pulley groove-1:

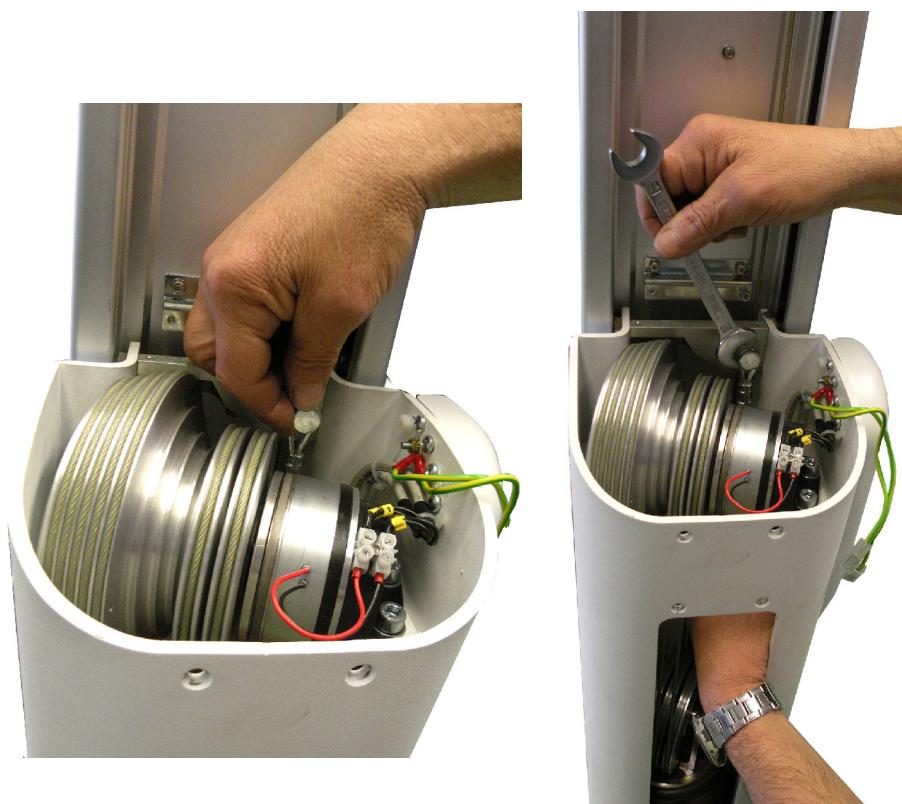
Guide the Steel Cable downwards from the first groove of the Upper Pulley to the first groove of the Lower Pulley.

h. From Lower Pulley groove-1 → to Fixing Screw :

Guide the Steel Cable upwards from the first groove of the Lower Pulley to the Fixing Screw drill.

If it is necessary, unscrew the Spring Tensioner Screw at the lower end of the TC Base Section in order to loosen the Spring and reach the Fixing Screw drill with the end of the Steel Cable.

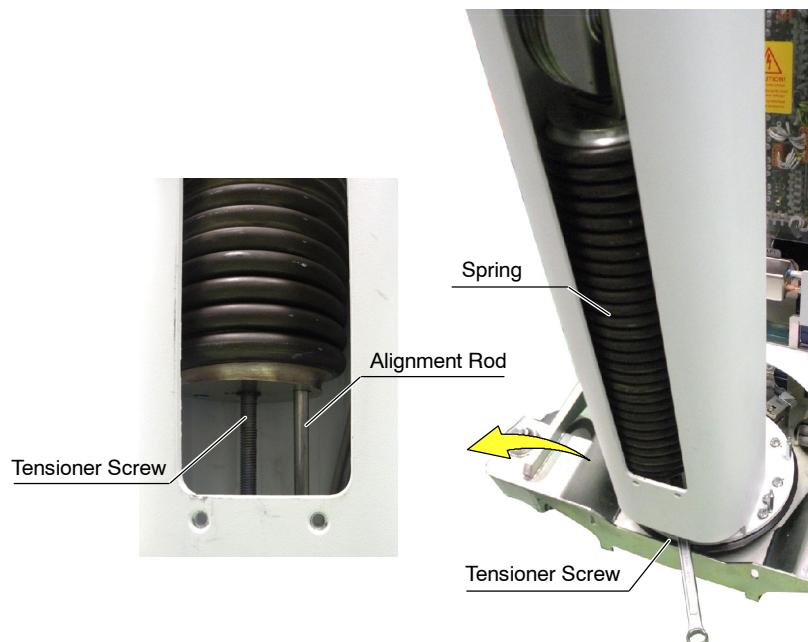
While one person keeps the Steel Cable tight, the other ensures the Steel Cable end with the Fixing screw, adding Loctite 243 and using a Torque of 15 Nm.



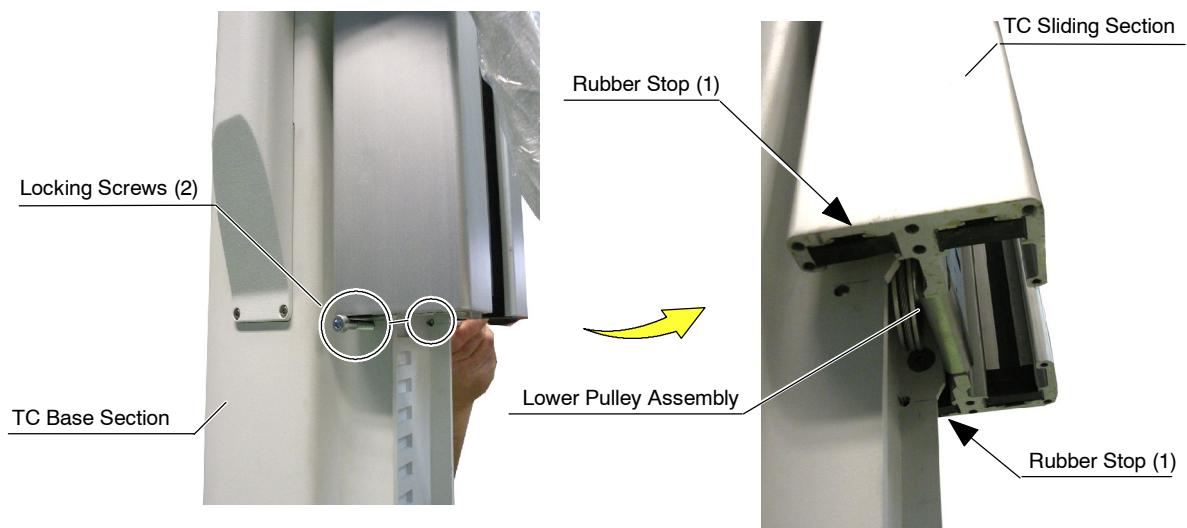
14. While one person keeps holding tight the Steel Cable, the other person cuts the Tie-wrap at the TC Sliding Section and removes the Locking Screw from the Upper Pulley assembly.



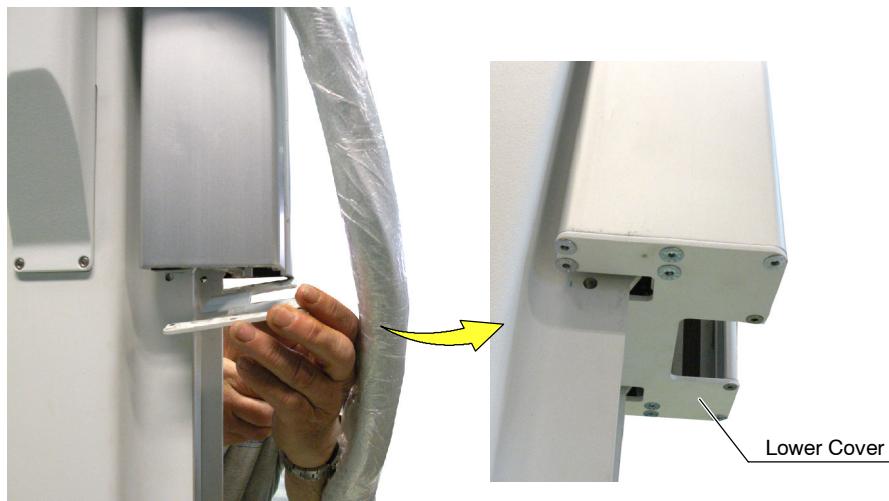
15. At the lower end of the TC Base Section, ensure that the Spring is into the Alignment Rod. Adjust the Tensioner Screw several times to get some tension for the Spring and the Steel Cable.



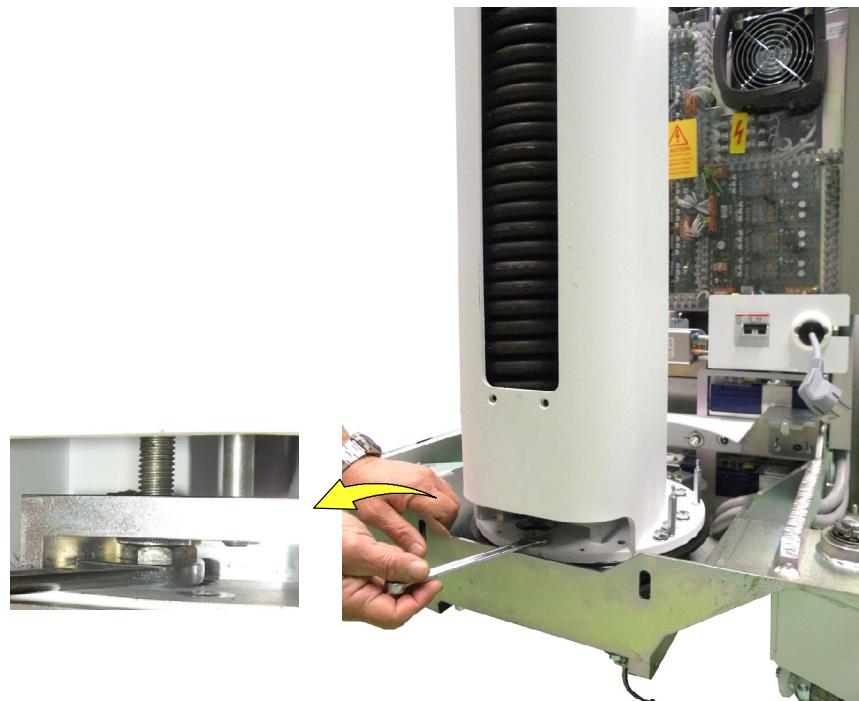
16. Carefully remove the two (2) Locking Screws at both sides of the TC Base Section and mount the Rubber Stops at both sides of the TC Sliding Section as shown in the picture.



17. Mount the Lower Cover using the twelve (12) Screws that secure the cover of the TC Sliding Section.



18. Adjust again the Tensioner Screw several times until getting the required tension for the Spring and the Steel Cable.

**Note** 

When the Arm, the Tube-Collimator Assembly and all the covers of the Telescopic Column are assembled in the unit, the Tensioner Screw will be adjusted again, in order to get the adequate tension for the Spring and the Steel Cable.

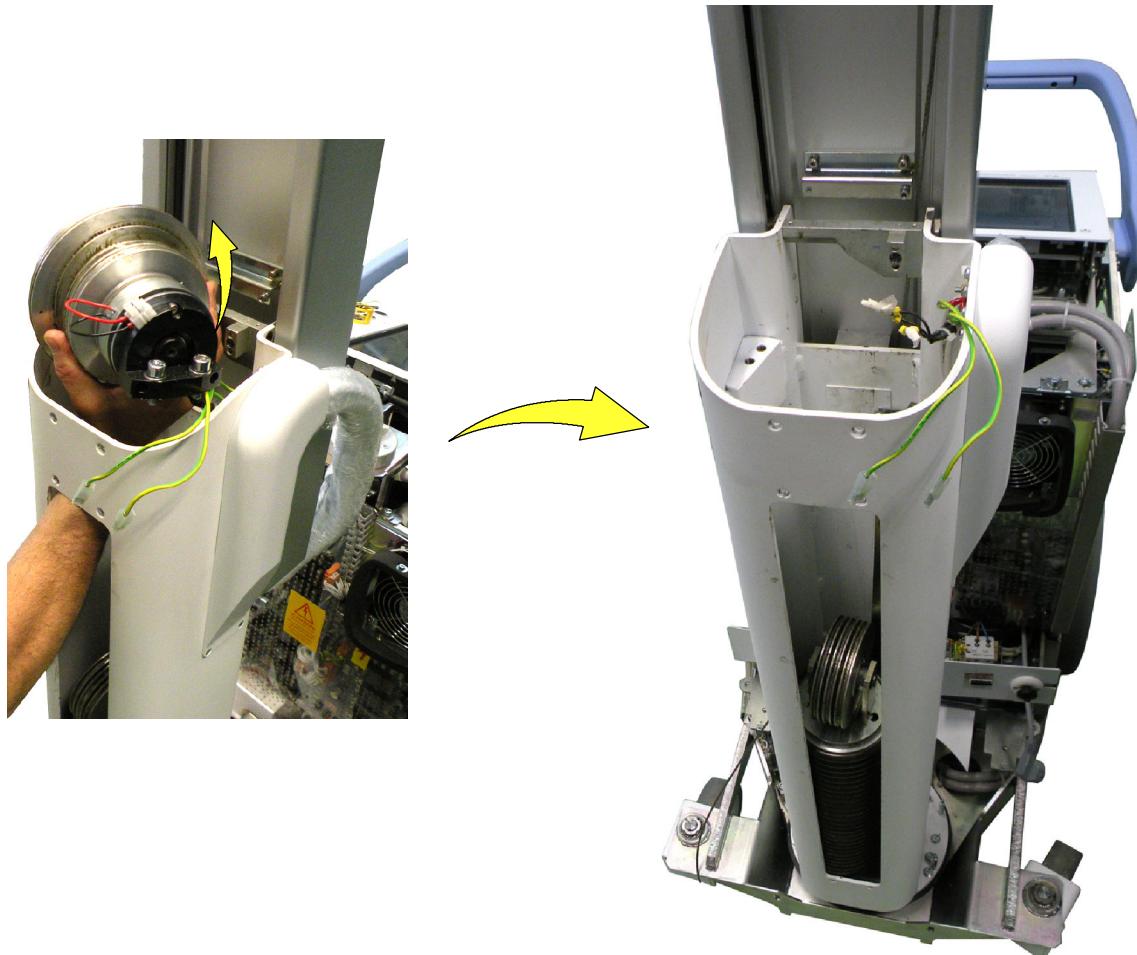
19. Complete the procedure by performing the process described in Section 3.2.1.1 from the step 48. until the end.

3.2.1.3 TC BASE SECTION: SPRING REPLACEMENT

Note 

To replace the Spring of the TC Base Section is needed to loosen and dismount a long part of the Steel Cable and remove the Upper Pulley Assembly (Spiral Pulley) of the TC Base Section.

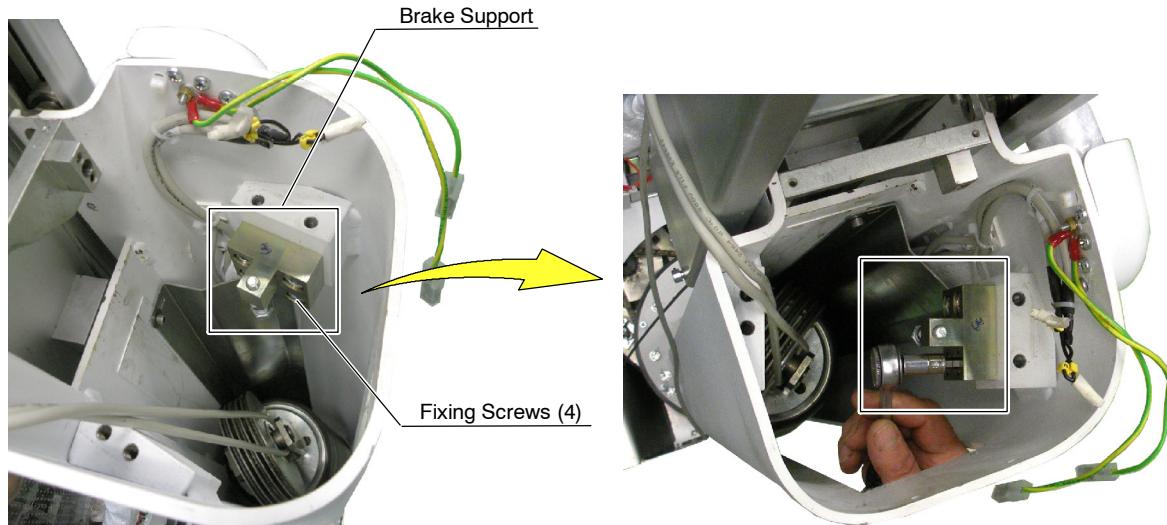
1. To dismount the Upper Pulley Assembly in order to get access to the Spring, follow the procedures described in Section 3.2.1.2 from the beginning until step 7. included.



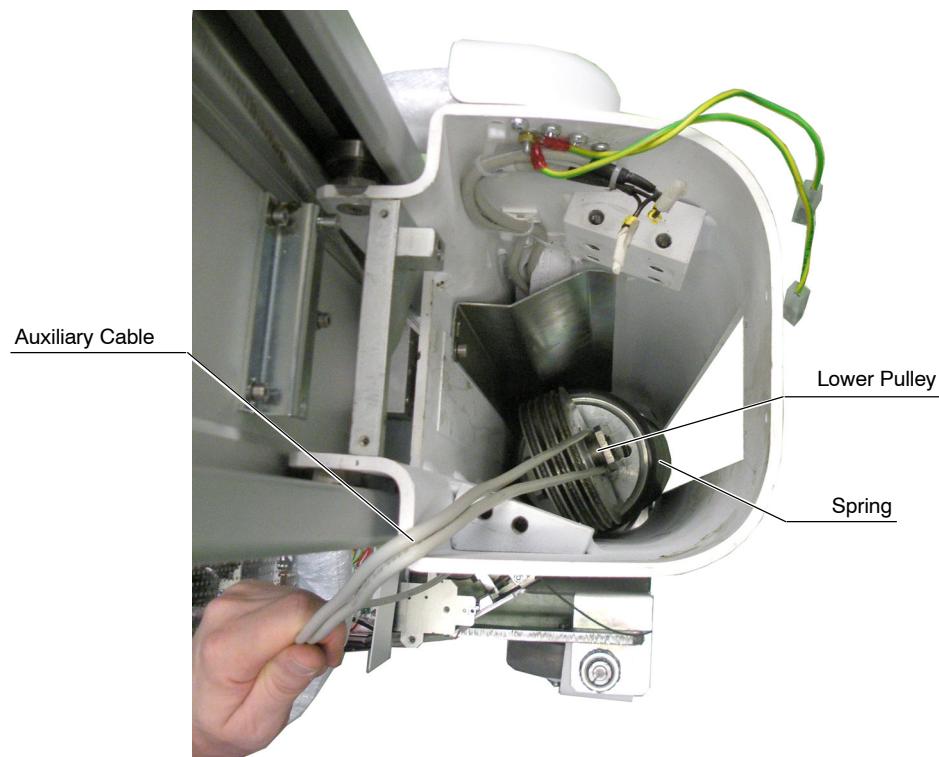
Mobile X-Ray Unit

Troubleshooting

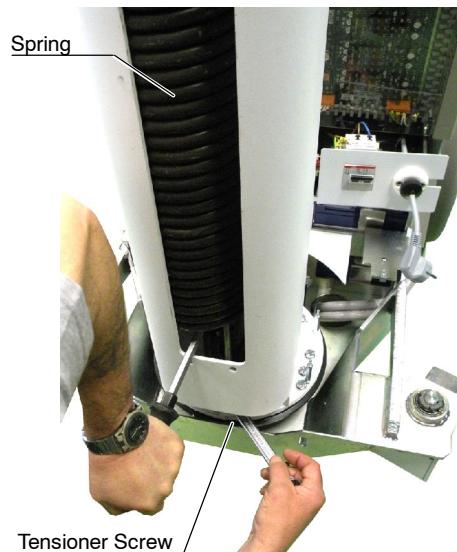
2. Dismount the Support for centering the Brake by removing the four (4) Fixing Screws.



3. Place an Auxiliary Cable or Sling around the Lower Pulley of the Spring, as shown in the picture below, in order to ease the Spring removal in the following steps.



4. At the lower end of the TC Base Section, unscrew the Tensioner Screw several times, while keeping the Spring up with the other hand by using a lever or a big screwdriver as shown in the next picture, until completely release the Spring.



5. Lift the Spring Assembly by lifting the Auxiliary Cable or Sling previously mounted around the Lower Pulley. Remove the Spring Assembly.

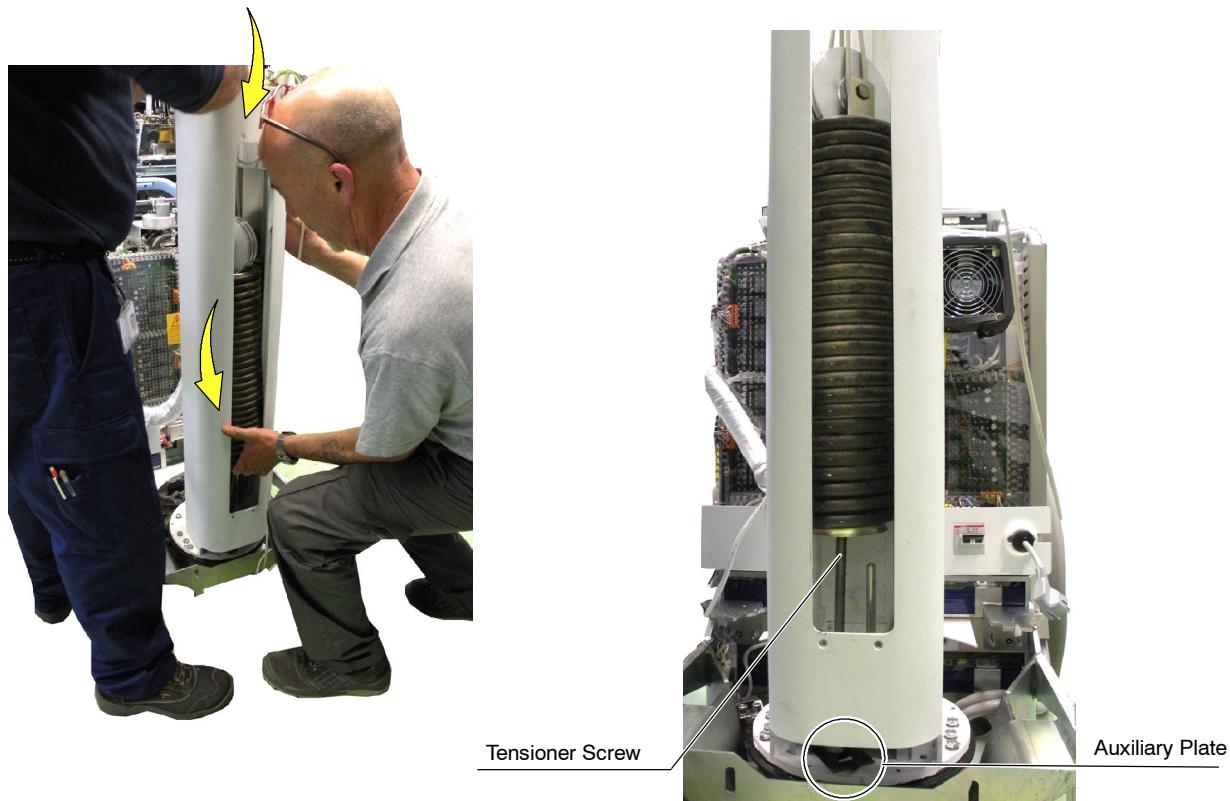


Mobile X-Ray Unit

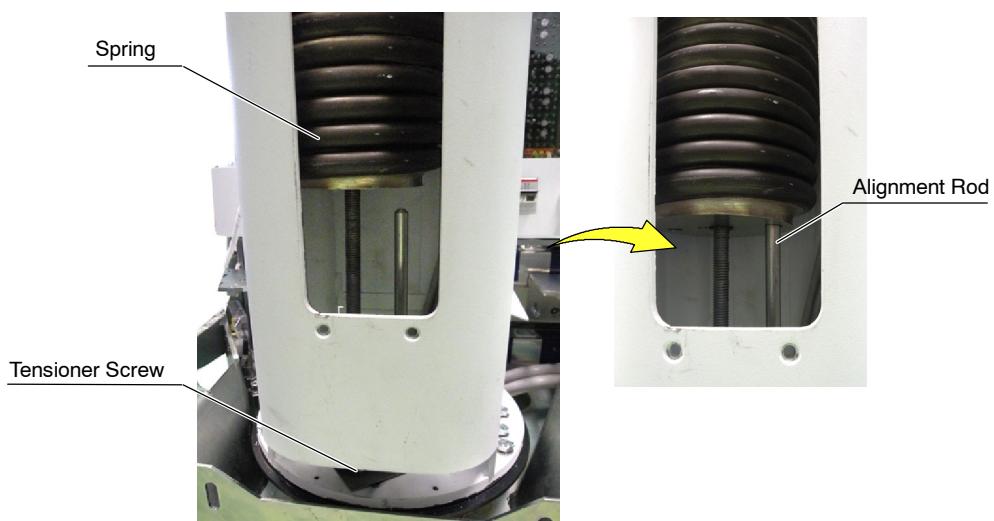
Troubleshooting

6. Place an Auxiliary Plate at the Base of the Column, under the Tensioner Screw to avoid it from falling down the hole.

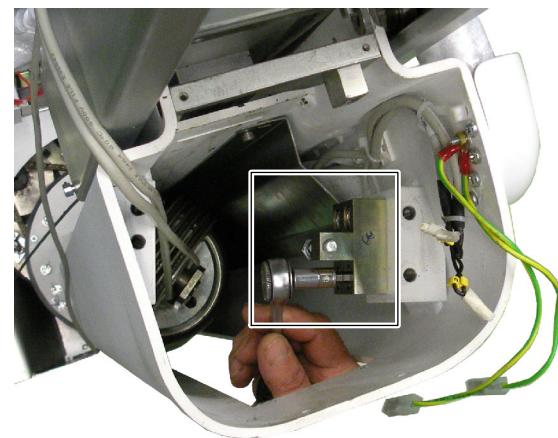
Place the auxiliary cable around the Lower Pulley of the new Spring Assembly; then, carefully lower the Spring until it is inserted into the Tensioner Screw.



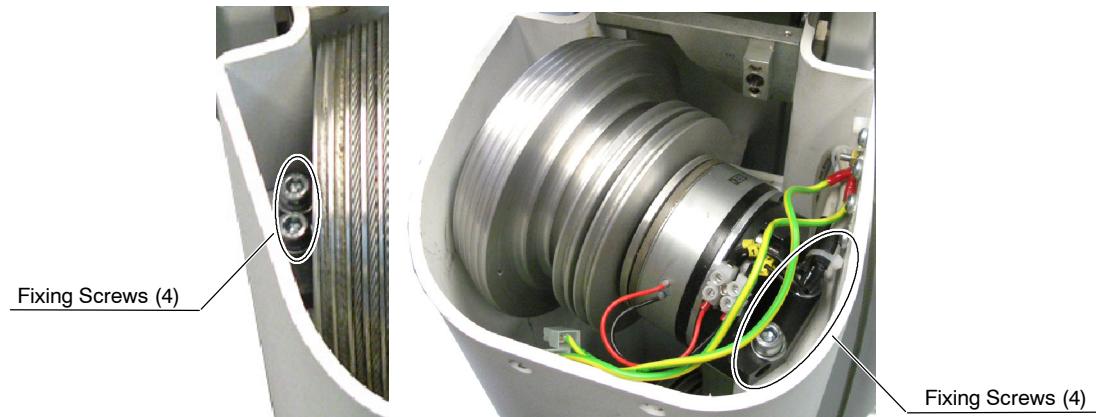
7. Adjust the Tensioner Screw carefully until inserting the Spring inside the Alignment Rod.



8. Mount the Support for centering the Brake by fixing the four (4) Fixing Screws, applying Loctite 243.



9. Mount the Upper Pulley Assembly and fix it to the TC Base Section with the four (4) Fixing Screws.



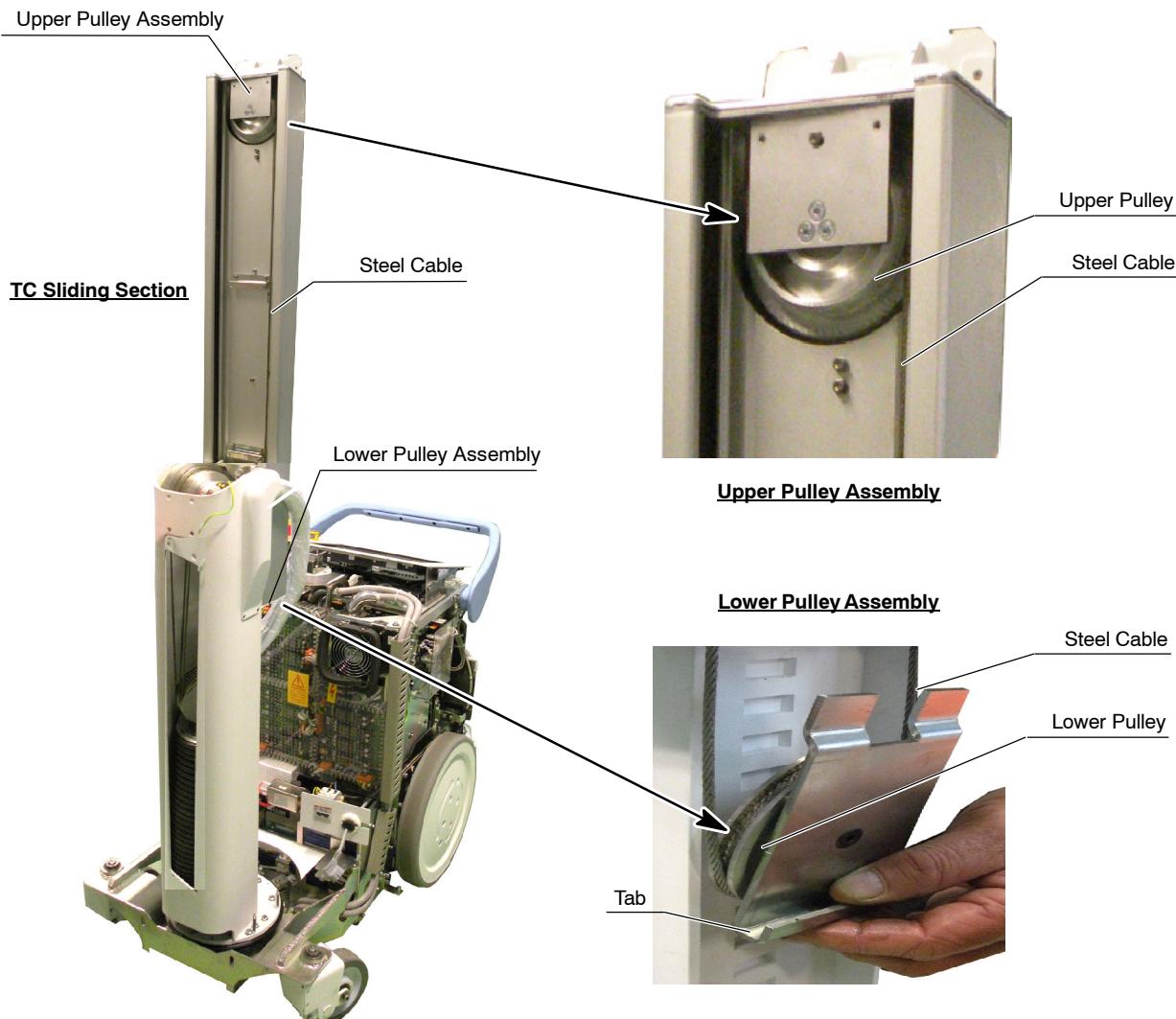
10. Complete the procedure by performing the process described in Section 3.2.1.2 from the step 9. until the end.

3.2.1.4 TC SLIDING SECTION: UPPER AND LOWER PULLEYS REPLACEMENT**Note** 

To dismount the Upper and Lower Pulleys of the TC Sliding Section Carefully follow the necessary steps of Section 3.2.1.1 for the replacement of the Steel Cable until the corresponding steps for dismount the pulleys.

Then, replace the Pulleys and follow the necessary steps to mount the Upper Pulley and/or Lower Pulley of the TC Sliding Section as described in Section 3.2.1.1.

Read the instruction in the next page when replacing the Upper Pulley.





In case the Upper Pulley is replaced by a newer one version (renewal part reference A526556-01), keep only one counterweight mounted in the TC Sliding Section and remove all others counterweights.

TC Sliding Section



Upper Pulley (previous version)
(in spare part SAT-A16624-01)



Upper Pulley (new version)
(in spare part A526556-01)

**3.2.1.5 TC SLIDING SECTION DISASSEMBLY:
REPLACEMENT OF THE ANTIFALL SYSTEM AND/OR THE BEARING KIT**

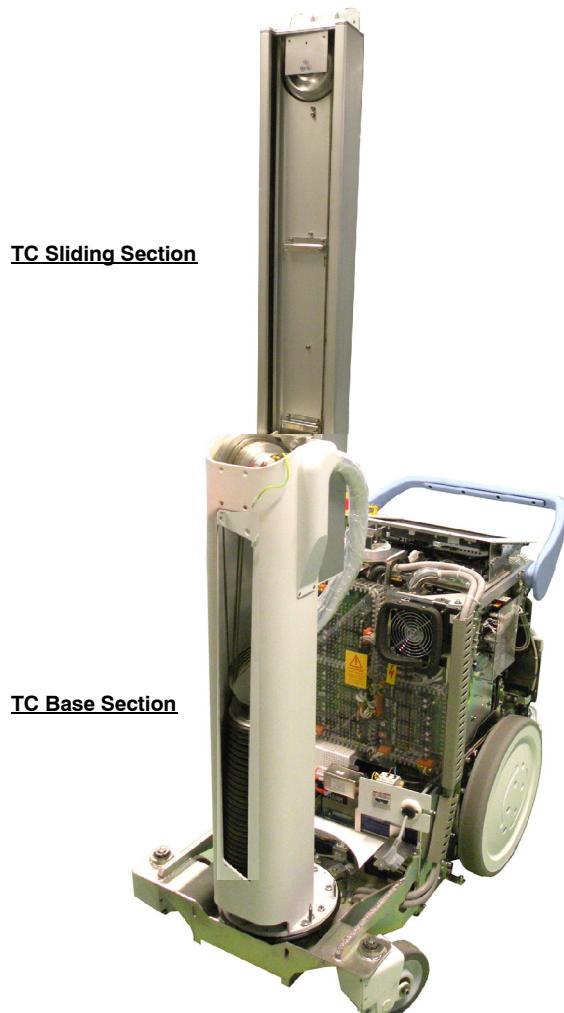
Note 

Two people are necessary to carry out the entire procedure.

Note 

In addition to the Standard Service Engineers Tool Kit, it will be necessary to use an auxiliary table to place it beside the Unit and the Metal Plate Tool (reference SAT-34071-01).

1. Follow the procedures described in *Section 3.2.1.1 for Column Steel Cable Replacement*, from step 1. to step 24.



2. Insert the Metal Plate Tool, see *fig. 1*, as shown in the following pictures, see *fig. 2 and 3.*; secure the Tool to the TC Base Section with the Fixing Screw (*fig. 4*).

Fig. 1



Fig. 2



Fig. 3

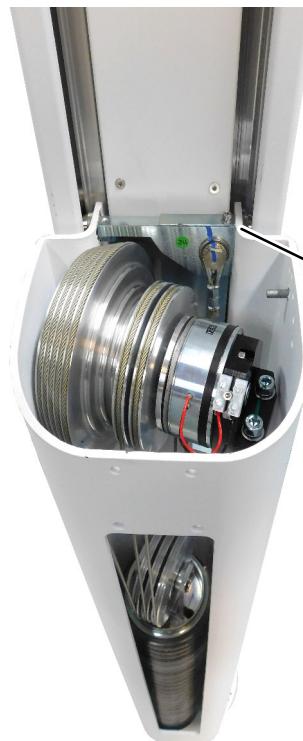


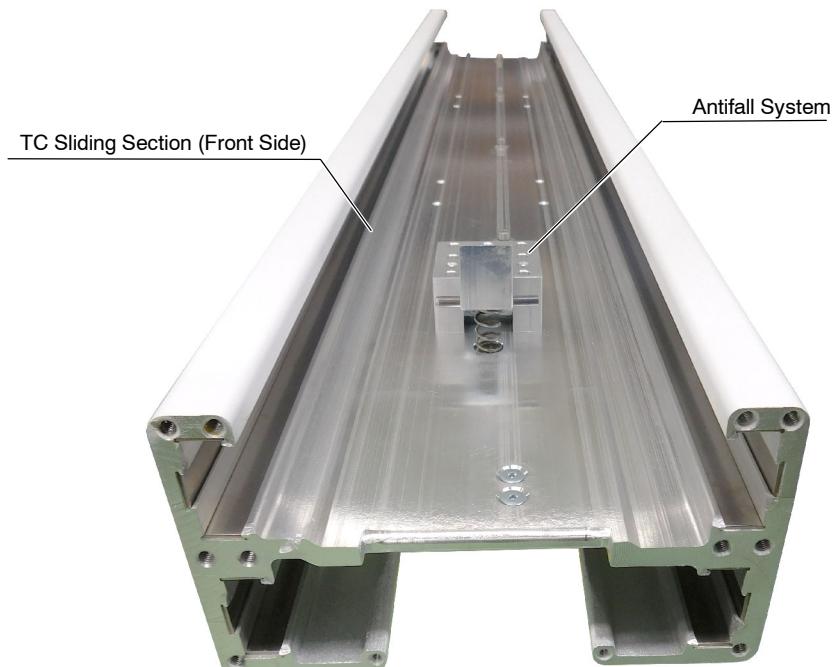
Fig. 4



Note 

The Metal Plate Tool is used to prevent the damage of the Antifall System (Parachute kit Spring) in the TC Sliding Section, when disassembling the TC Sliding Section from the TC Base Section.

3. Continue performing the procedures described in *Section 3.2.1.1* for *Column Steel Cable Replacement*, from *step 25.* to *step 26.*, in order to completely dismount and remove the Steel Cable from the Mobile Unit.
4. Slide the TC Sliding Section upwards to disengage it from the TC Base Section, and carefully place the TC Sliding Section on the auxiliary table.



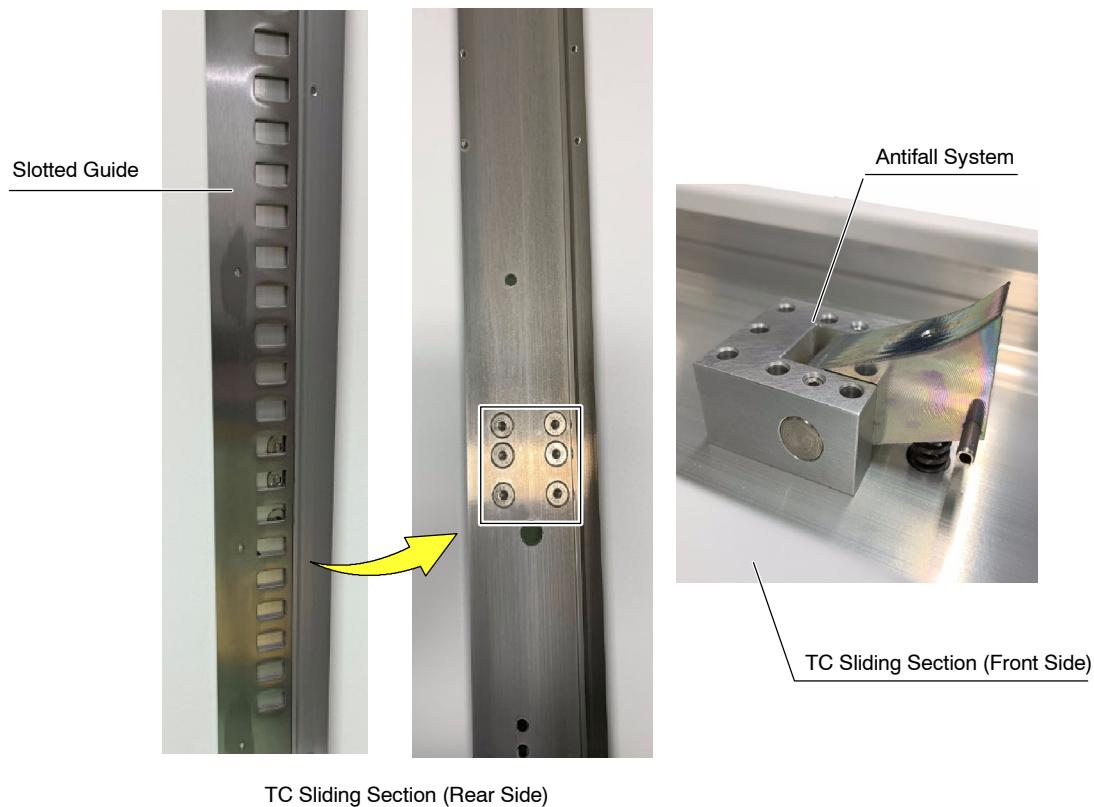
Note 

*Follow the procedures described in step 5. in order to replace the **Antifall System**.*

*Follow the procedures described in step 6. in order to replace the **Bearing Kit**.*

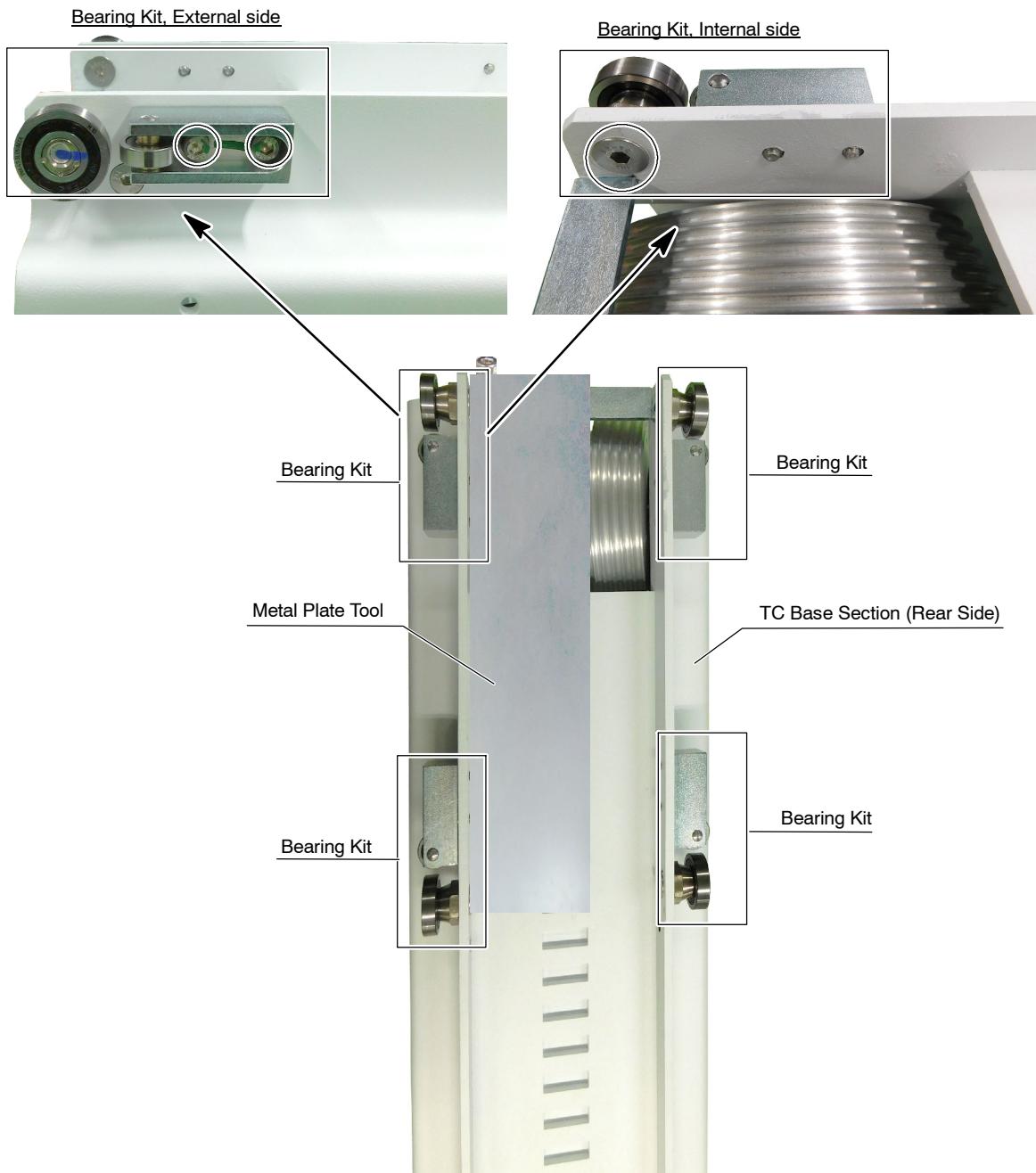
5. Antifall System replacement:

- a. Turn the TC Sliding Section in order to access to the rear side.
- b. Remove the Safety Slotted Guide.
- c. Remove the Screws (x6) that fix the Antifall System to the Column.
- d. Replace the Antifall System and fix it with the Screws (x6).
- e. Re-install the Safety Slotted Guide.



6. Bearing Kit replacement:

- a. The Bearing kit (x4) are placed on the rear side of the TC Base Section.
- b. Remove the Fixing Screws, on the External side (x2) and on the Internal side (x1), from each Bearing Kit to be replaced.
- c. Replace each Bearing kit, and mount the corresponding Fixing Screws, on the External side (x2) and on the Internal side (x1).

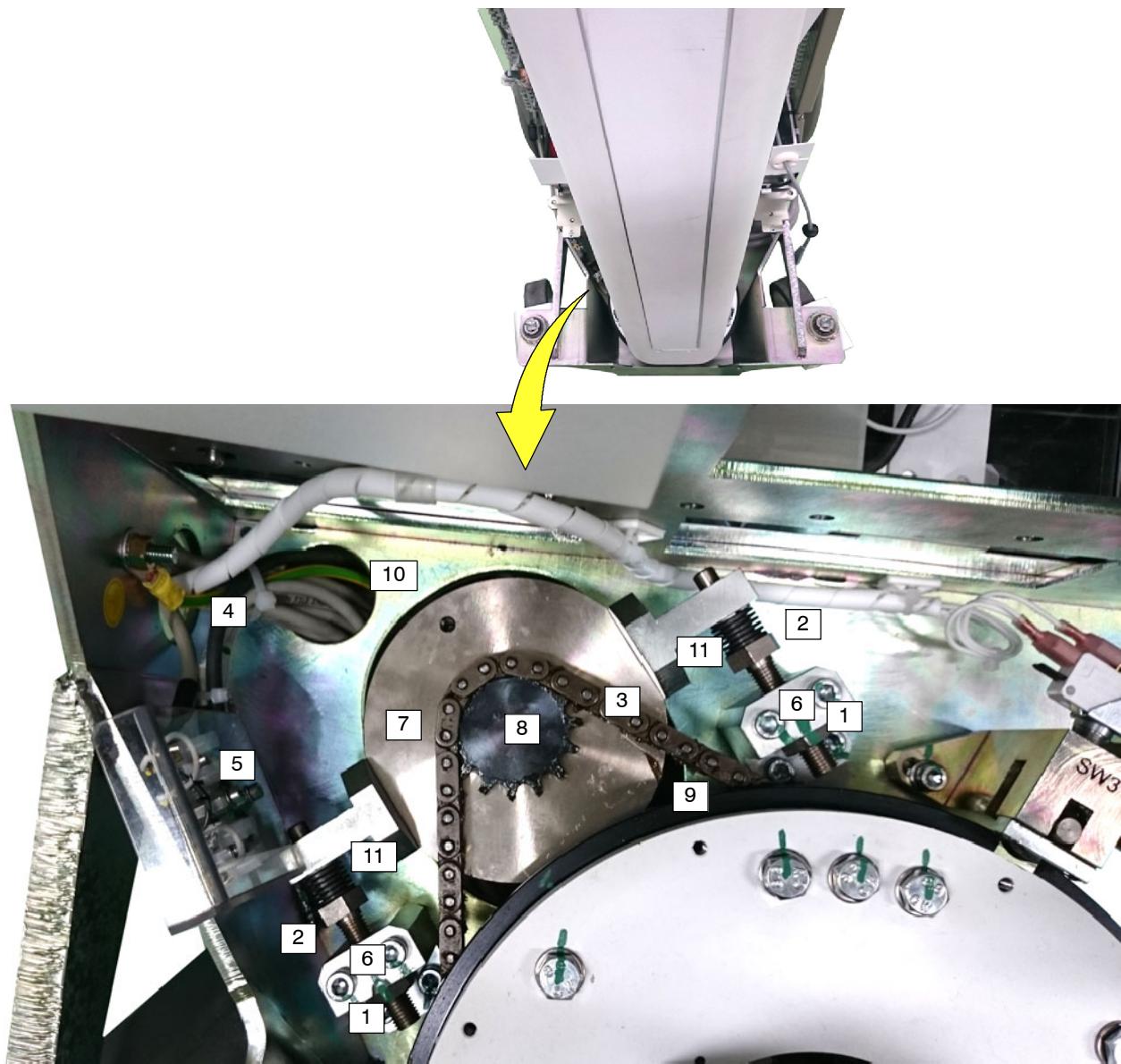


7. Mount the TC Sliding Section on the TC Base Section, sliding it downwards.
8. Remove the Metal Plate Tool.
9. Continue performing the procedures described in *Section 3.2.1.1* for *Column Steel Cable Replacement*, from *step 27.* to the end, in order to mount the Steel Cable in the Mobile Unit.
10. Mount all the Covers of the unit previously removed (*refer to Section 2.2.2*).
11. Test the Unit.

3.2.1.6 REPLACEMENT / ADJUSTMENT OF THE COLUMN ROTATION BRAKE AND/OR CHAIN FOR COLUMNS WITH NON-REINFORCED FRAME

1. Turn the Unit OFF.
2. Dismount the Front Covers, Curved-Top Cover, Column Base Covers and Bumper Cover as described in *Section 2.2.2*.

Illustration 3-5
Column Rotation - Brake Assembly



1. Nut

2. Tensioner Screw

3. Chain

4. Brake Cable

5. Plastic Cover and J14

6. Tensioner Screw Support

7. Brake Assembly

8. Gear

9. Chassis Hole

10. Cable Harness

11. Spring Washers

Note 

For Chain replacement only, it is not required to remove the Brake Assembly; follow the procedure indicated in the steps 3., 4., 9., 10., 13., 15., 16. and finally steps 19., 20., 21. and 22.

3. Loosen without removing the Nuts [1] of the Tensioner Screws [2], at both sides of the Brake Assembly.
4. Loosen without removing the Tensioner Screws [2], in order to release the tension of the Chain [3].
5. Cut the Tie-wraps of the Cable Harness in order to release the Brake Cable (black wire) [4].
6. Remove the Plastic Cover [5] and disconnect connectors J14-1 and J14-4.
7. Remove the four (4) Fixing Screws from the Tensioner Screw Supports [6] and move the Chain [3] away from the Gear [8].
8. Remove the complete Brake Assembly [7].
9. Remove the Chain from the Unit by dismounting its Coupling Link.
10. Mount the new Chain provided with the Brake Assembly around the Column Base Gear and close the Chain with the Coupling Link.
11. In order to replace the Brake Assembly [7], first insert the Brake Cable (black wire) [4] below the hole in Chassis of the Unit [9], and then pass it through the window for Cables Harness [10].
12. Place the Brake Assembly on its housing.
13. Engage the Chain around the Gear [8] of the Brake Assembly.
14. Fix the Tensioner Screw Supports [6] with the four (4) Fixing Screws, adding Loctite 243 and using a torque of 10.5 Nm.

15. Adjust the tension of the Chain by tightening the Tensioner Screws [2] at both sides of the Brake Assembly in order to compress the Spring Washers until getting a distance of 11.7 mm, as shown in next picture.



16. Secure the position of the Tensioner Screws [2] by tightening the Nuts [1].
17. Connect connectors J14-1 and J14-4 and install the Plastic Cover [5].
18. Fix the Brake Cable (black wire) [4] to the Cable Harness using Tie-wraps.
19. Turn the Unit ON and check the Column rotation is correct and smooth, check the Rotation Brake is activated when the Lock Controls are not pressed.
20. Turn the Unit OFF.
21. Grease the Chain, applying the Grease provided with the Brake Assembly or with the Chain.
22. Mount the Front Covers, Curved-Top Cover, Column Base Covers and Bumper Cover as described in *Section 2.2.2*.

3.2.2 PROCEDURES RELATED TO THE ARM (IN TELESCOPIC COLUMN WITH RECTANGULAR BRAKE)

3.2.2.1 ARM REPLACEMENT

Note 

Two people are necessary to carry out the entire procedure.

1. Turn the Mobile Unit ON.
Release the Arm from the Parking Position.
2. Turn the Unit OFF.
Remove all the required Covers of the unit: Curved-Top Cover, Front Cover (there is not required to be removed, only lifted), Column Base Covers (*refer to Section 2.2.2*).
3. Turn the Mobile Unit ON.
Rotate the Arm 180°, place the Telescopic Column (TC) Sliding Section fully down and rise the Arm to the top of the TC Sliding Section, keeping the TC Sliding Section fully down.
4. Pass a Sling around the Chassis at the base of the Mobile Unit and around the Top Cover of the TC Sliding Section, as shown in the following pictures, keeping the Arm fully up. It is recommended to cover the surfaces at the Top of the Column with a piece of paper or a cloth to avoid damages (a.e. scratches).



5. Ensure the TC Sliding Section fully down, keeping the Arm fully up, as shown in the picture below, by tightening the Sling.



IF PARTS OF THE TUBE-COLLIMATOR ASSEMBLY AND/OR THE ARM ARE GOING TO BE REMOVED, THE UNIT WILL NOT BE BALANCED ANYMORE.

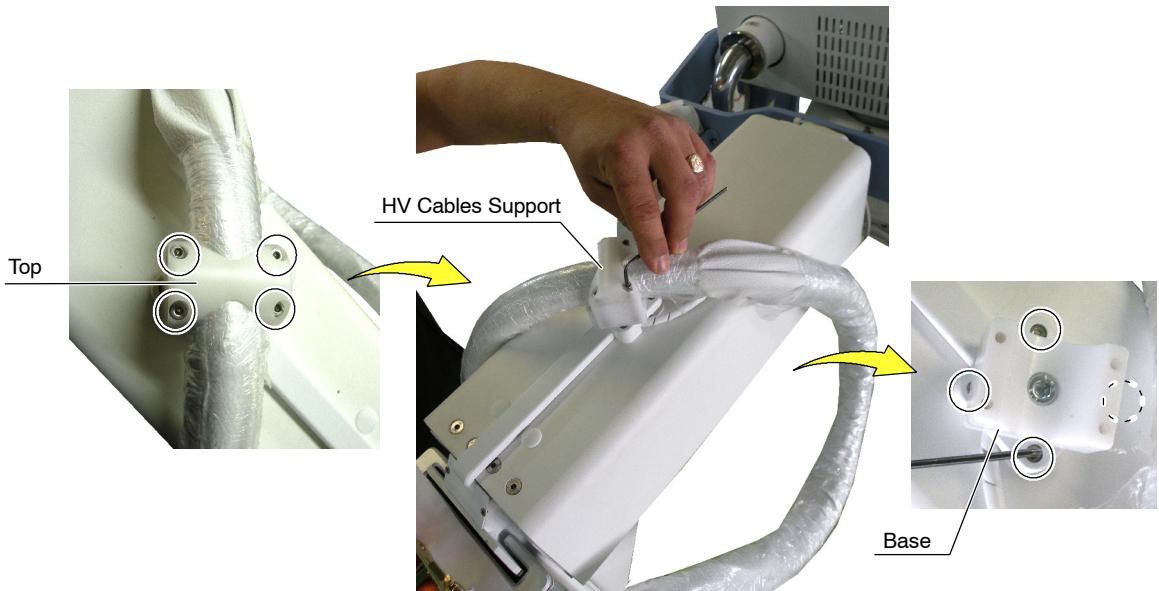
IF NO ADDITIONAL SLING HAS BEEN SECURED ON THE SLIDING SECTION OF THE TELESCOPIC COLUMN AS DESCRIBED, THE ARM AND OR TELESCOPIC COLUMN COULD SPRING UPWARDS WHEN REMOVING THE PARTS OF THE TUBE-COLLIMATOR ASSEMBLY, AND/OR THE ARM.

6. Turn the Mobile Unit OFF.

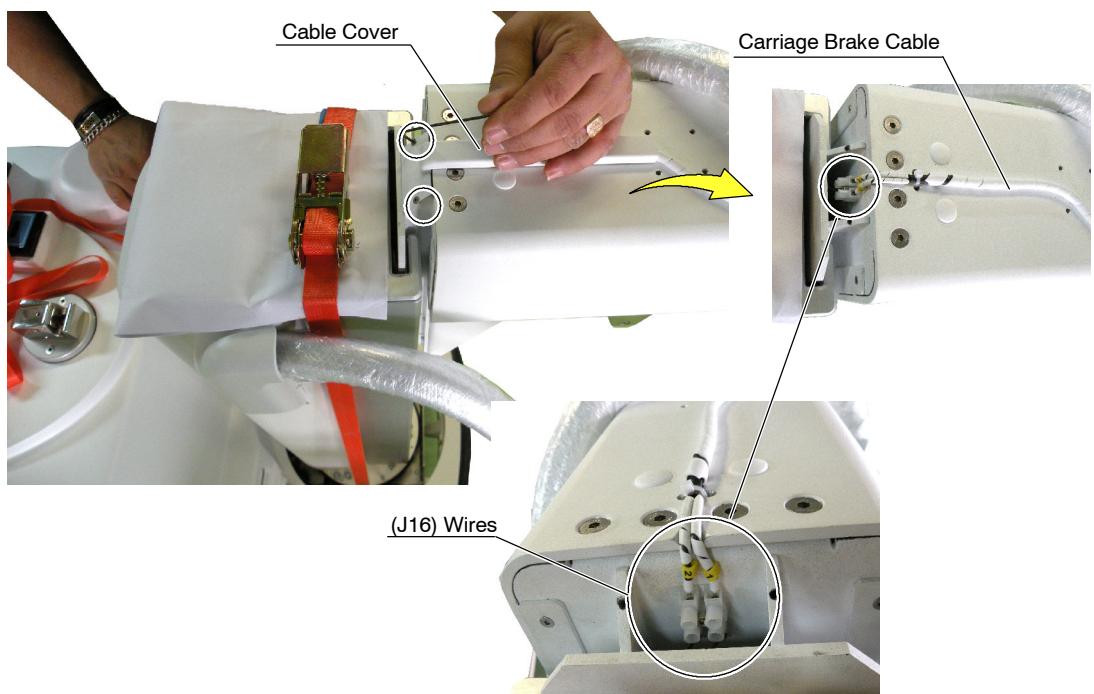


KEEP THE UNIT TURNED OFF AND ISOLATED FROM THE POWER SUPPLY.

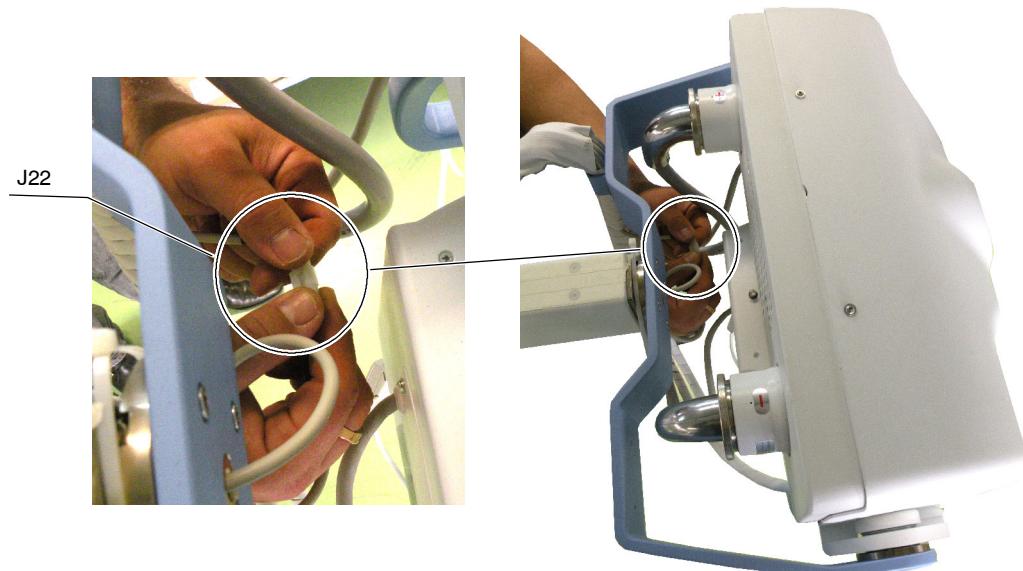
7. Remove the four (4) Screws of the HV Cables Support, at the upper side of the Arm. Remove the HV Cables Support Top and place the HV Cables aside. Remove the (4) Screws at the Base of the HV Cables Support and dismount the HV Cables Support base.



8. Remove the two (2) Screws of the Carriage Brake Cable Cover and dismount the Cover. Note of the position of both wires into the terminals and disconnect both wires of the Carriage Brake Cable (J16), isolate the wire ends with electrical tape.



9. Disconnect Connector J22 (Arm Brake) and isolate the ends with electrical tape.

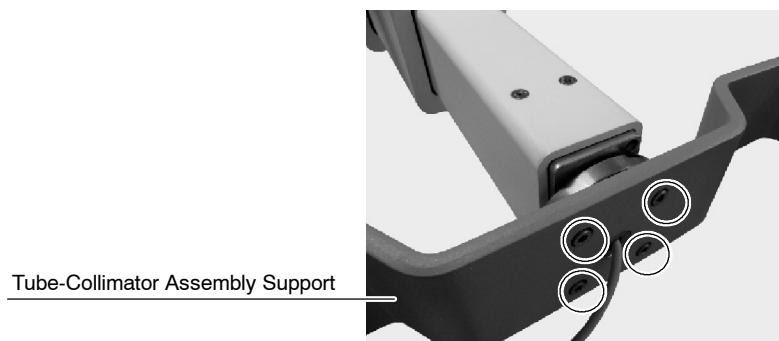


10. Before following with the next steps, place an auxiliary table beside the Mobile Unit, near the Tube-Collimator Assembly.

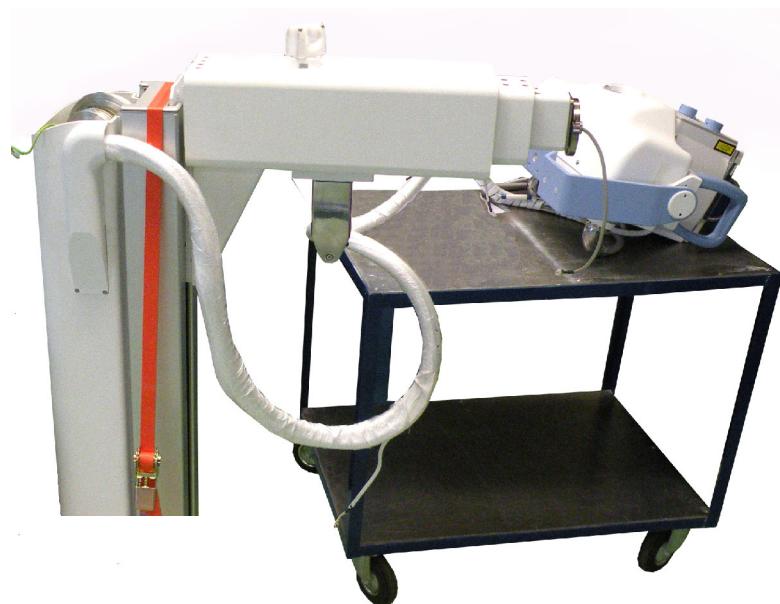


THE WEIGHT OF THE TUBE-COLLIMATOR ASSEMBLY IS HEAVY, UNSTEADY AND DIFFICULT TO HANDLE, THEREFORE AT LEAST TWO PEOPLE IS NEEDED TO REMOVE IT. THIS WILL AVOID PERSONAL INJURIES OR DAMAGE TO THE EQUIPMENT.

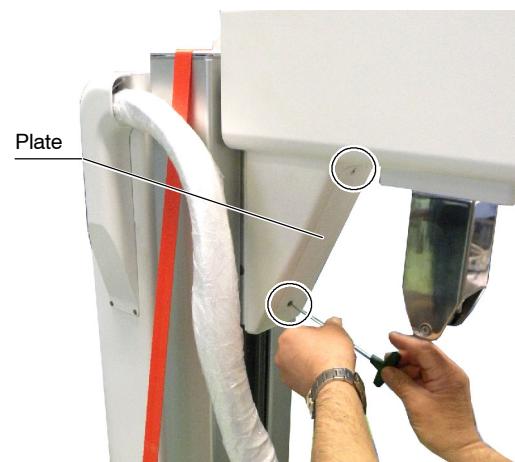
11. While one person supports the the Tube-Collimator Assembly, the other removes the four (4) Screws that fix the Tube-Collimator Assembly Support to the Head Rotation Support.



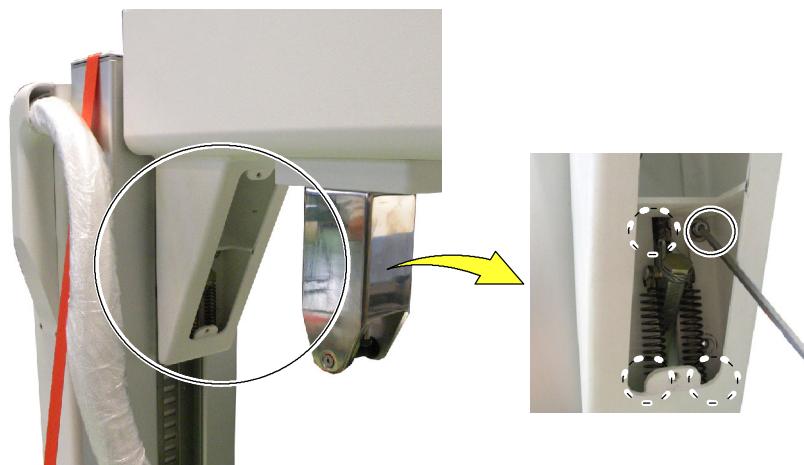
12. Carefully remove the Tube-Collimator Assembly with the Head Rotation Support, passing the HV Cables below the Arm, and place the Assembly on the auxiliary table taking care not to place it over the HV Cables, DAP Cable, etc.



13. Remove the two (2) Screws from the Plate under the Arm end closer to the Column.

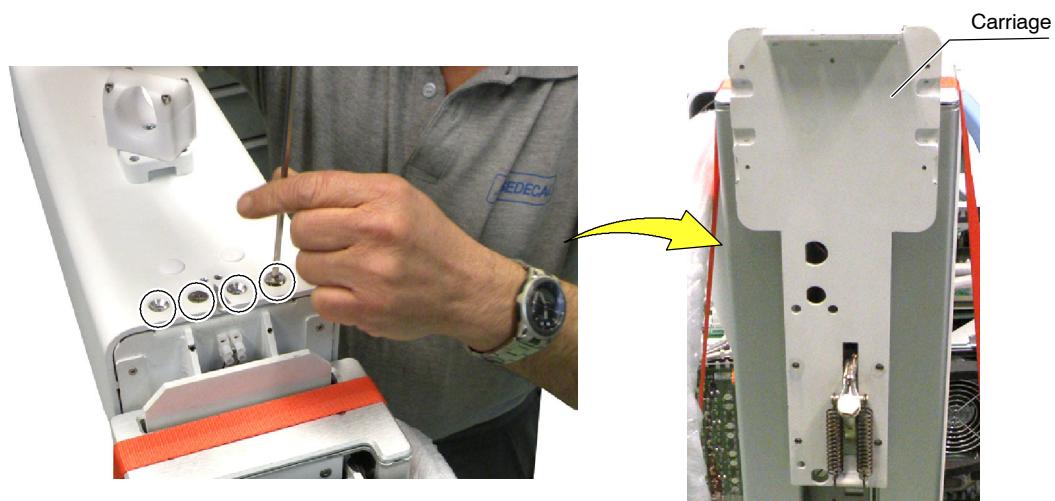


14. Remove the four (4) Screws that fix the Arm to the Carriage.



15. While one person supports the weight of the Arm, the other removes the four (4) Screws on the upper side of the Arm.

Then, dismount the Arm from the Carriage.



16. Carefully place the Arm on a safe surface.

**Note** 

Before performing the Troubleshooting or the Replacement of the Arm, insert a tie-wrap through the drills for the Carriage Brake Cable Cover of the old or the new Arm, as shown in the picture above, this will make it easier to mount the Carriage Brake Cable at a later time.

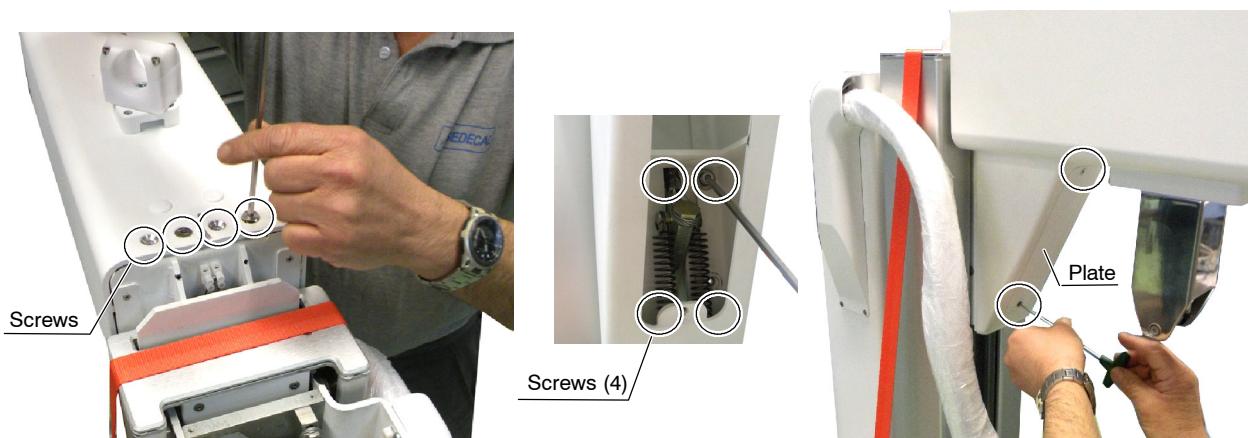
17. Perform the required procedure:

- Troubleshooting (refer to Section 3.2.2.2)
- Replacement of the Arm (follow with next steps).

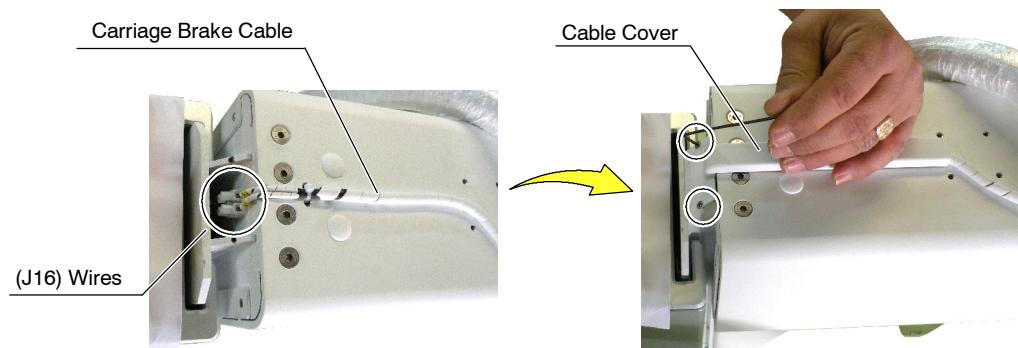
18. Carefully mount the Arm on the Carriage:

- a. While one person supports the weight of the Arm, the other secures the Arm with the corresponding fixing Screws (4+4) adding Loctite 243 and using a Torque of 10.5 Nm.

Then, mount the Plate.



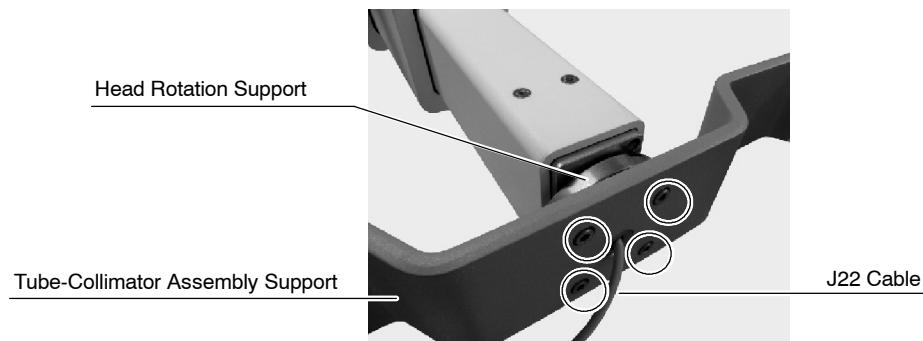
- b. Pass the Carriage Brake Cable through the tie-wrap previously mounted on the Arm, remove the electrical tape from the cable wires, connect both wires in position noted before and finally mount the Carriage Brake Cable Cover with the two (2) Screws.



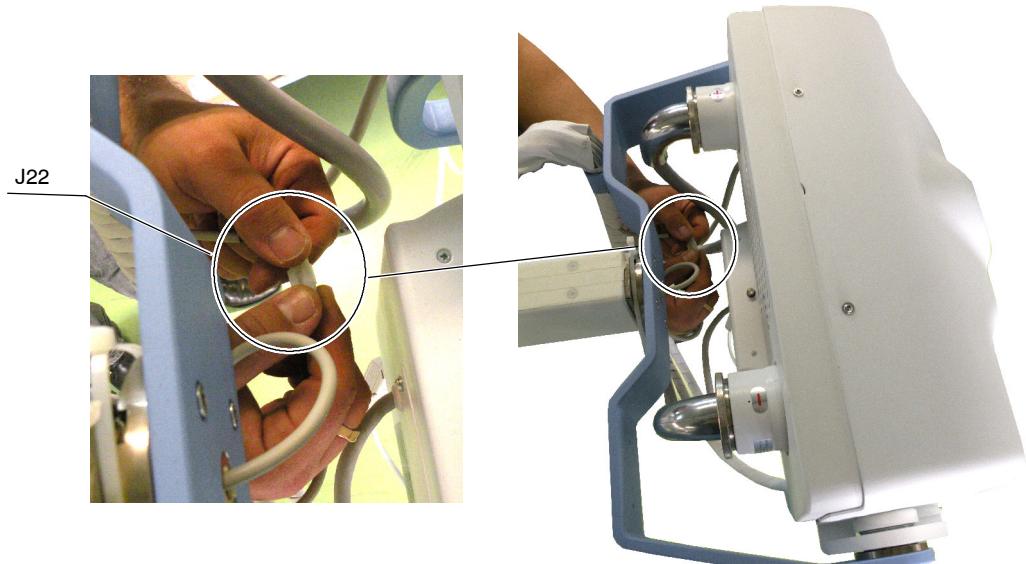
19. Carefully **mount the Tube-Collimator Assembly:**

- a. Place the auxiliary table with the Tube-Collimator Assembly closer to its final position in the Arm.

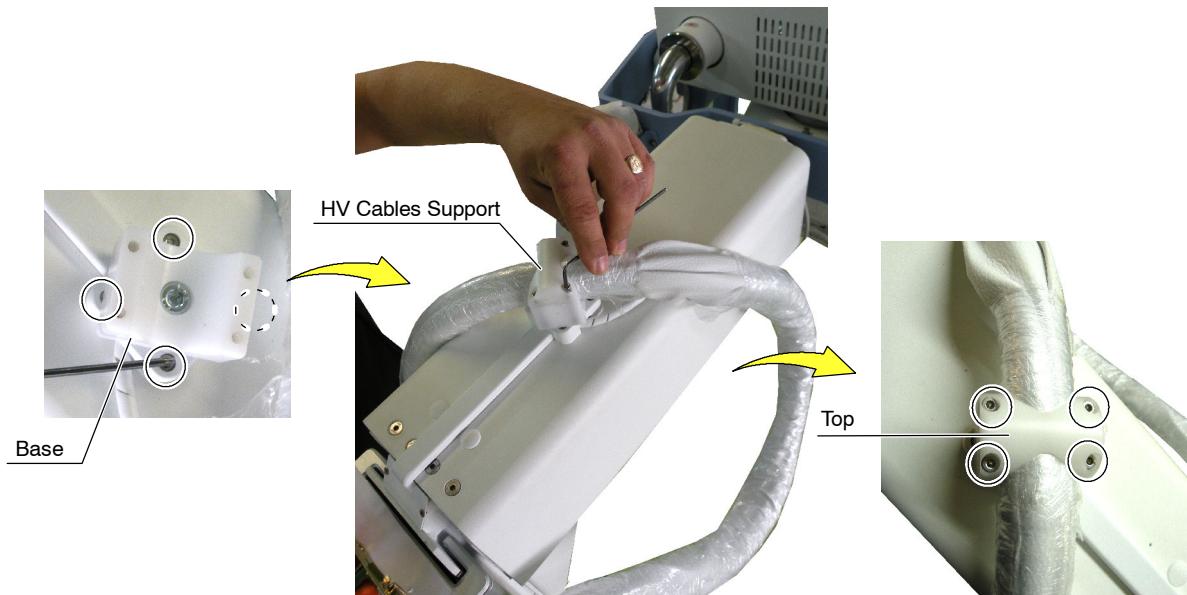
While one person holds the Tube-Collimator Assembly towards the Arm, the other holds the HV Cables above the Arm, passes J22 Cable through the Support of the Tube-Collimator Assembly and mounts the four (4) Screws that fix the Tube-Collimator Assembly to the Head Rotation Support, adding Loctite 243 and using a Torque of 10.5 NM.



- b. Remove the electrical tape from the wires of Connector J22 (Arm Brake) and connect J22.

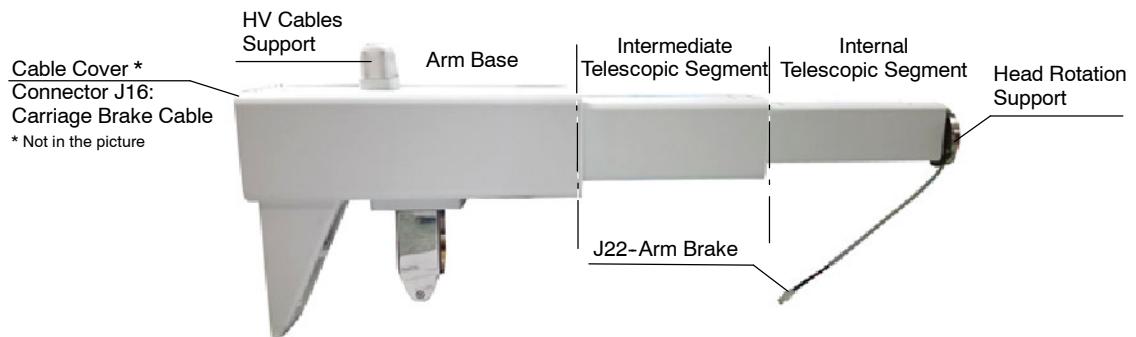


20. Mount the HV Cables Support (base) to the upper side of the Arm with the four (4) Screws, place the HV Cables inside and mount the HV Cables Support (Top).



21. Release the Sling from the unit.
22. Turn ON the Mobile Unit and perform a functional check for the correct movement of the vertical travel of the Arm and the Telescopic Column.
23. Turn OFF the Mobile Unit.
24. Mount all the Covers of the unit previously removed (*refer to Section 2.2.2*).

3.2.2.2 TROUBLESHOOTING OF THE ARM



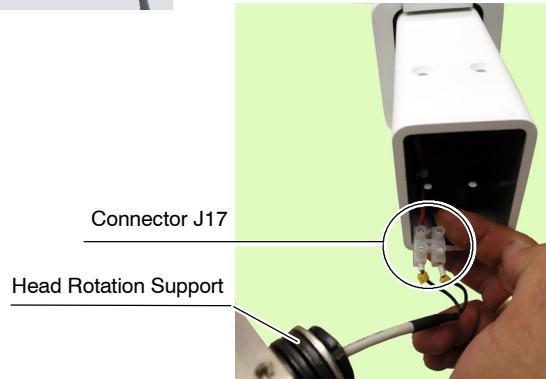
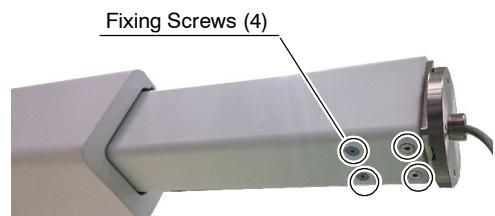
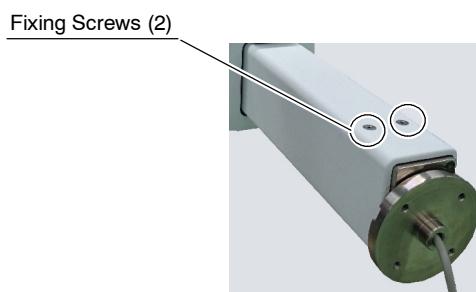
Note

For the replacement of the HV Cables Support or the Carriage Brake Cable Cover, turn the unit OFF and follow the procedures described in Section 3.2.2.1 of "Arm Replacement".

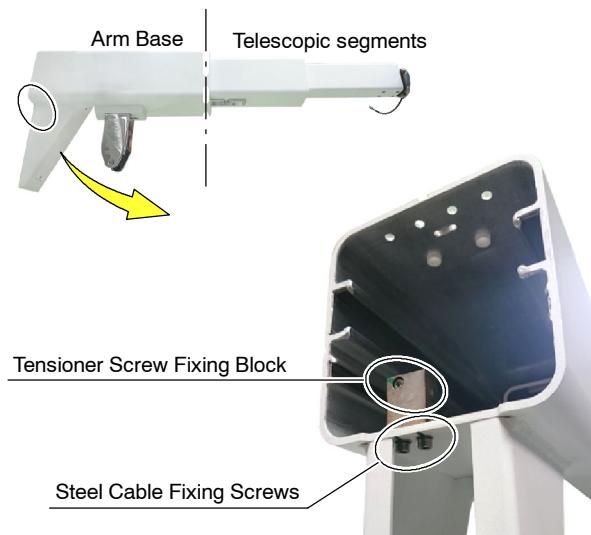
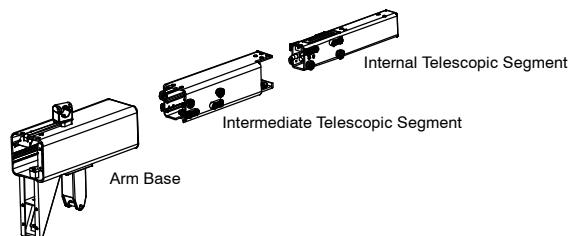
Note

For the replacement of the Head Rotation Support only, turn the unit OFF and follow the procedures described in Section 3.2.2.1 of "Arm replacement" in order to dismount the Tube-Collimator Assembly; then, remove the (2) Fixing Screws (2+4), dismount the Head Rotation Support from the Arm, disconnect J17 and pass the cable through the Head Rotation Support.

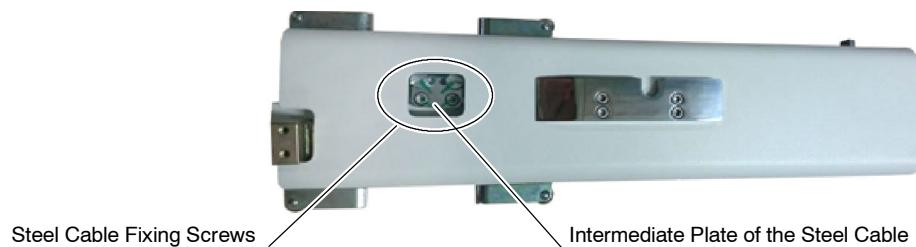
Replace the Head Rotation Support, passing the cable through the new Support, connecting J17 and securing it by using the two (2) Screws to the upper side and the four (4) Screws to the lower side of the Arm, adding Loctite 243 and using a Torque of 8 Nm.



1. Remove the Screws that secure the Tensioner Screw Fixing Block (one end of the Steel Cable) to the lower side of the Arm Base and dismount the Telescopic segments from the Arm Base.



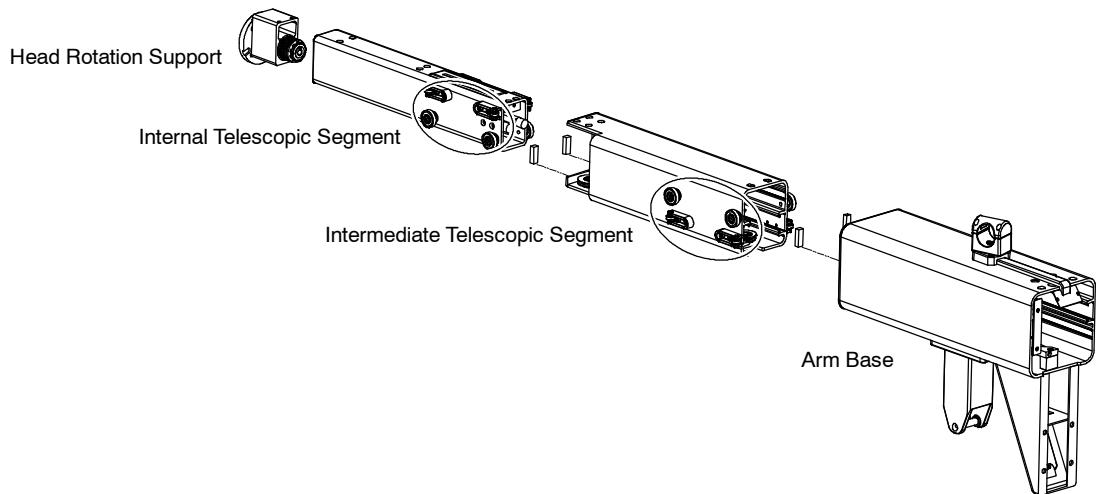
2. Remove the Screws that fix the Intermediate Plate of the Steel Cable to the lower side of the Internal Telescopic Segment. Pull out the Steel Cable and disengage both segments (Internal and Intermediate).



3. Replace the defective items (pulleys, bearing kits, bumpers, etc).

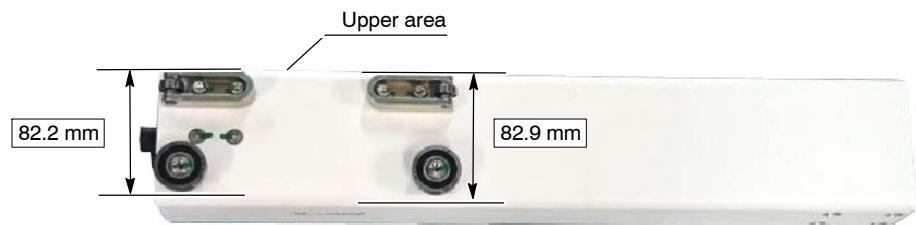
Note 

For **Bearing kits replacement**, proceed as described below.



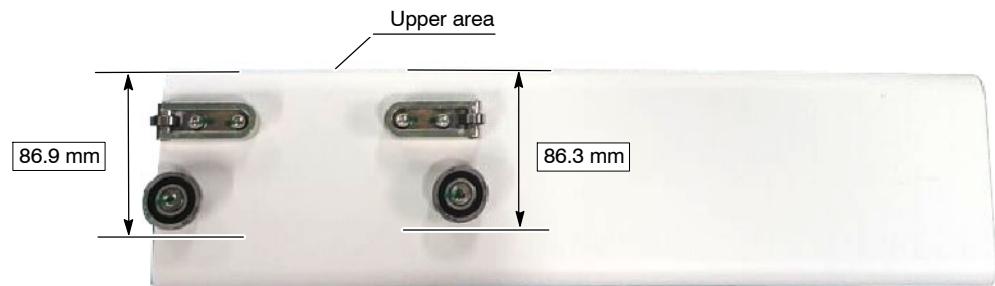
- **Internal Telescopic Segment.**

In order to replace the Bearing kit, adjust both bearings to the following measures, taking the Upper area of the Internal Segment as a reference:

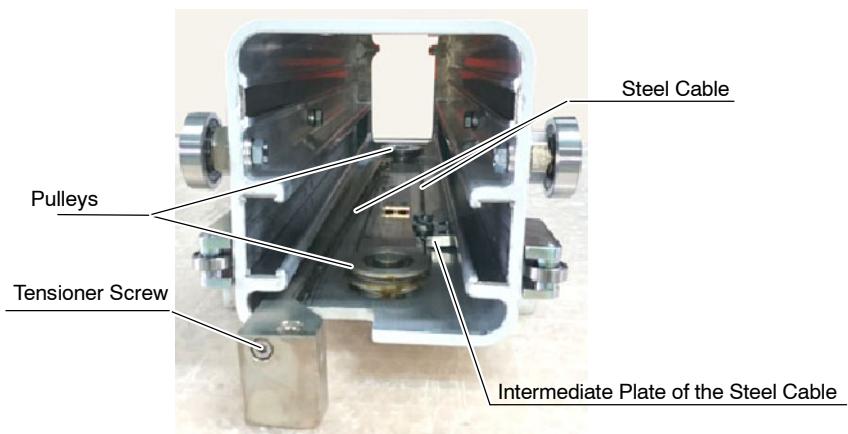


- **Intermediate Telescopic Segment.**

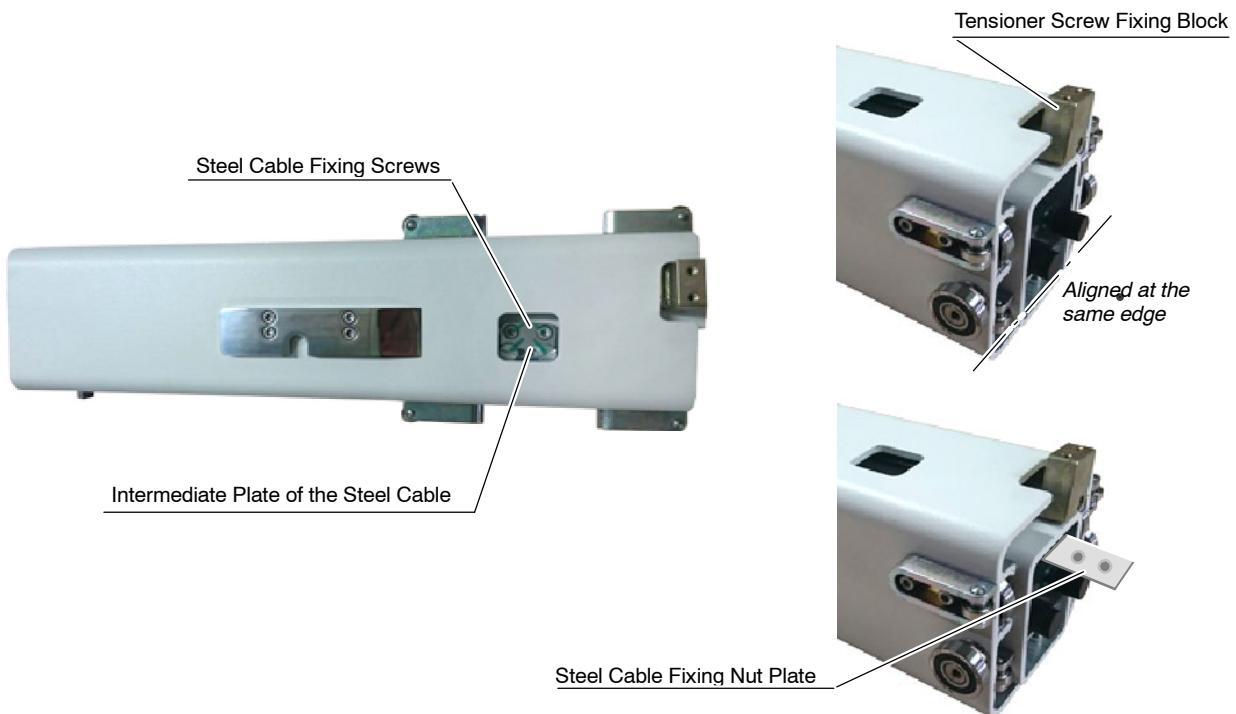
In order to replace the Bearing kit, adjust both bearings to the following measures, taking the Upper area of the Intermediate Segment as a reference.



4. At the inside of the Intermediate Telescopic segment, pass the Steel Cable along the two (2) Pulleys and tense the Steel Cable by tightening the Tensioner Screw.



5. Insert the Internal Telescopic segment into the Intermediate segment. In order to fix the Intermediate Plate of the Steel Cable, align the Internal segment, the Tensioner Screw Fixing Block and the Intermediate segment at the same edge. Then, fix the Steel Cable to the Nut Plate by tightening the Fixing Screws through the window.

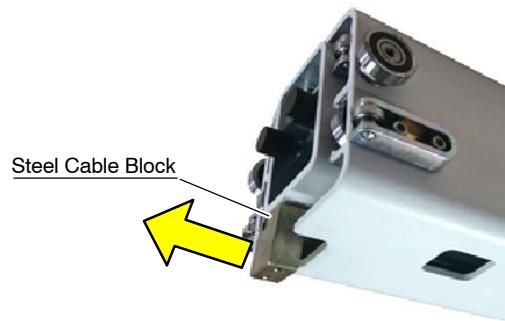


6. Adjust the tension of the Steel Cable. To do so:

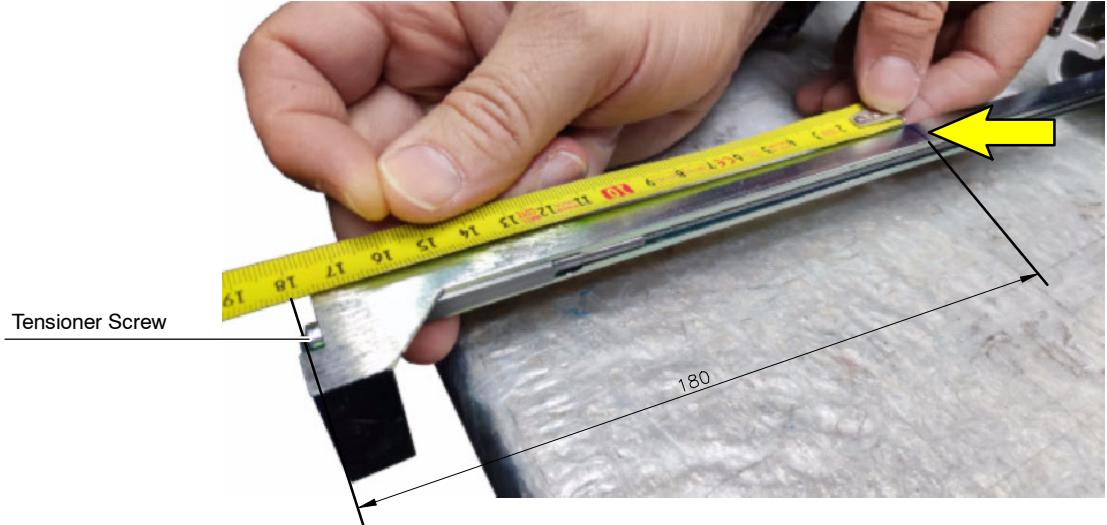
Note 

Two people are necessary to carry out the Steel Cable adjustment.

- a. Pull out the Steel Cable Block from the Intermediate Telescopic Segment to allow the Steel Cable tension adjustment.



- b. Use a marker pen to mark a distance of 180 mm from the Tensioner Screw on the Steel Cable.

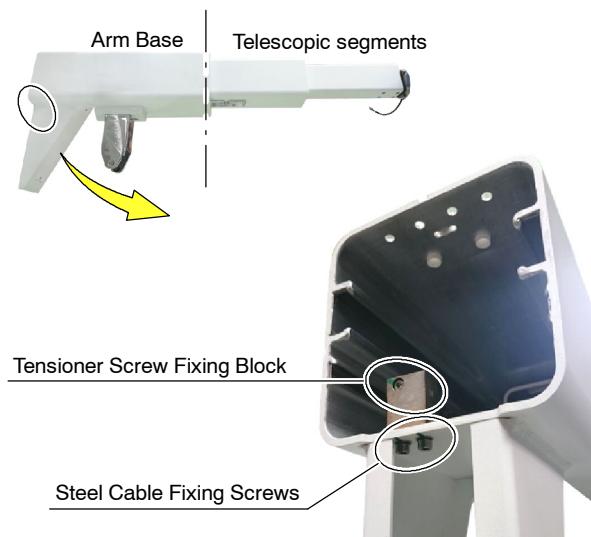


- c. Impregnate the thread of the Tensioner Screw with a drop of Loctite 243 (or similar) and adjust it for regulating the Steel Cable tightness.

While a person checks with a dynamometer that a force of 1 kg is being applied at the 180 mm mark, the other person measures the deflection of the Steel Cable, taking the inner edge of the Tension Bar as a reference which should be 6 mm.



7. Insert the Telescopic segments assembly inside the Arm Base and fix the other end of the Steel Cable with the fixing Screws.



8. Mount the Arm of the Mobile Unit as described in *section 3.2.2.1 of "Arm replacement"*, from step 18.

3.2.3 PROCEDURES RELATED TO THE TELESCOPIC COLUMN WITH CYLINDRICAL BRAKE

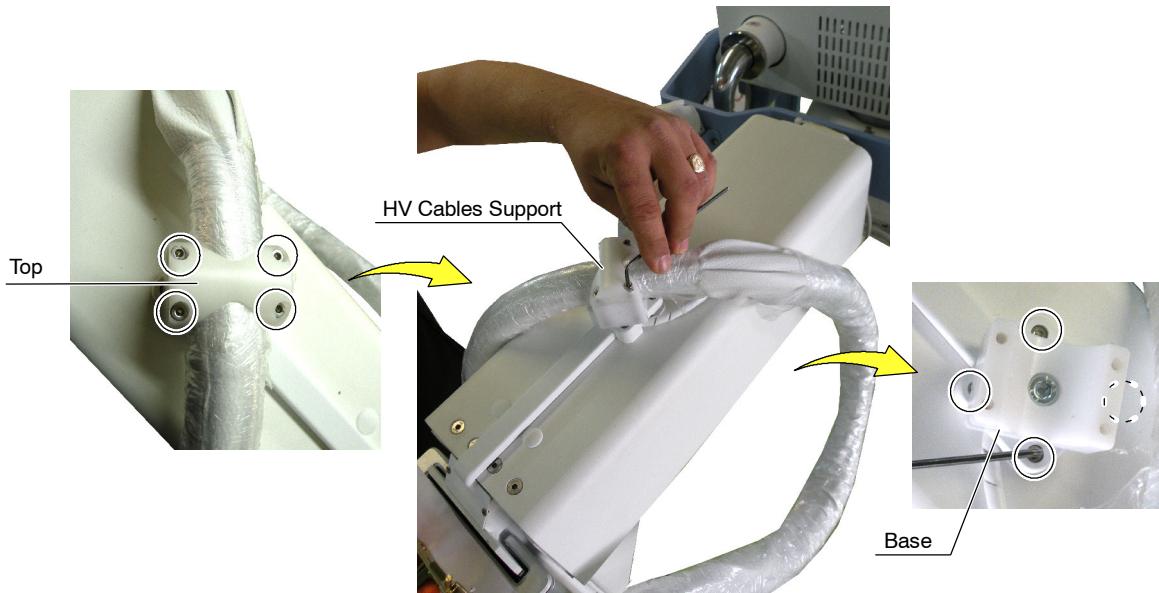
3.2.3.1 COLUMN STEEL CABLE REPLACEMENT

DISMOUNTING THE STEEL CABLE

Note 

Two people are necessary to carry out the entire procedure.

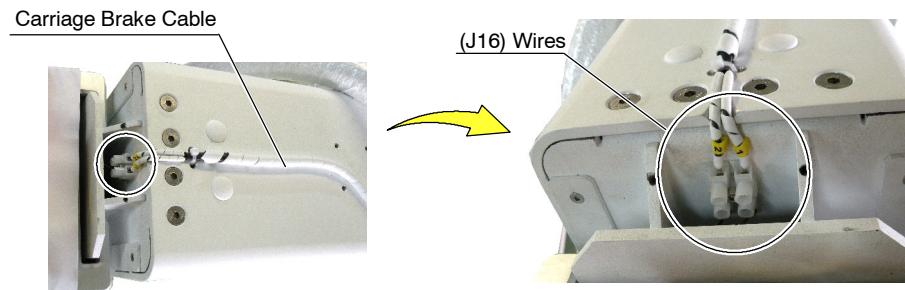
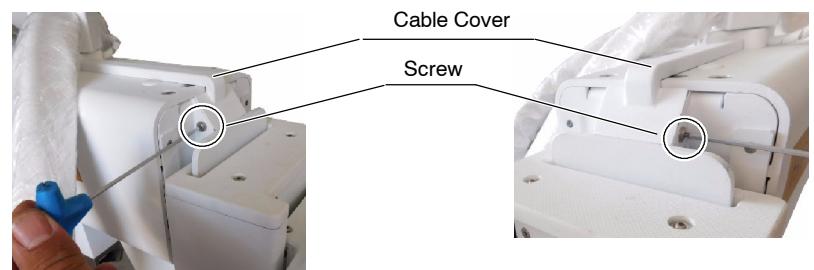
1. Turn the Mobile Unit ON. Release the Arm from the Parking Position.
2. Turn the Unit OFF. Remove all the required Front Covers of the unit (refer to Section 2.2.2).
3. Turn the Mobile Unit ON. Rotate the Arm 180°, place the Telescopic Column (TC) Sliding Section fully down and rise the Arm to the top of the TC Sliding Section, keeping the TC Sliding Section fully down.
4. Turn the Mobile Unit OFF. Remove the four (4) Screws of the HV Cables Support, at the upper side of the Arm. Remove the HV Cables Support Top and place the HV Cables aside. Remove the (4) Screws at the Base of the HV Cables Support and dismount the HV Cables Support base and place the Cables aside (refer to the next picture).



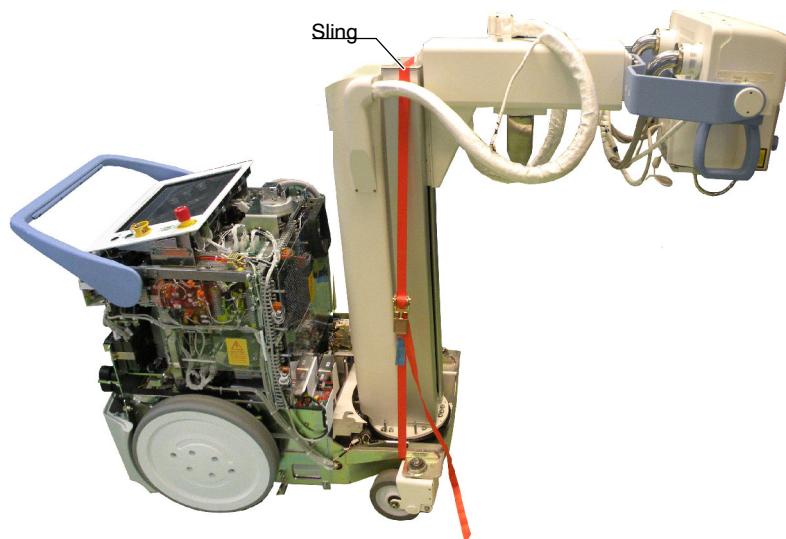
Mobile X-Ray Unit

Troubleshooting

5. Remove the two (2) Screws of the Carriage Brake Cable Cover and dismount the Cover. Note of the position of both wires into the terminals and disconnect both wires of the Carriage Brake Cable (J16) that are connected to the upper side of the terminal block and isolate the ends with electrical tape.



6. Secure the TC Sliding Section fully down with a Sling, passing the Sling around the Chassis at the base of the Mobile Unit and around the Top Cover of the TC Sliding Section, as shown in the picture below, keeping the Arm fully up.

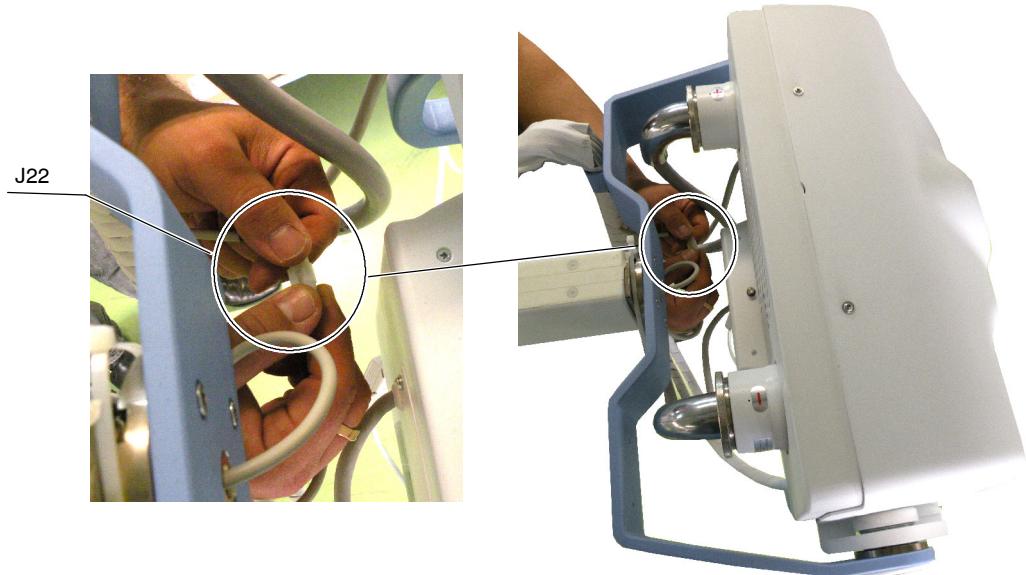




IF PARTS OF THE TUBE-COLLIMATOR ASSEMBLY AND/OR THE ARM ARE GOING TO BE REMOVED, THE UNIT WILL NOT BE BALANCED ANYMORE.

IF NO ADDITIONAL SLING HAS BEEN SECURED ON THE SLIDING SECTION OF THE TELESCOPIC COLUMN AS DESCRIBED, THE ARM AND OR TELESCOPIC COLUMN COULD SPRING UPWARDS WHEN REMOVING THE PARTS OF THE TUBE-COLLIMATOR ASSEMBLY, AND/OR THE ARM.

7. Disconnect Connector J22 (Arm Brake) and isolate the ends with electrical tape.



8. Before following with the next steps, place an auxiliary table beside the Mobile Unit, near the Tube-Collimator Assembly.

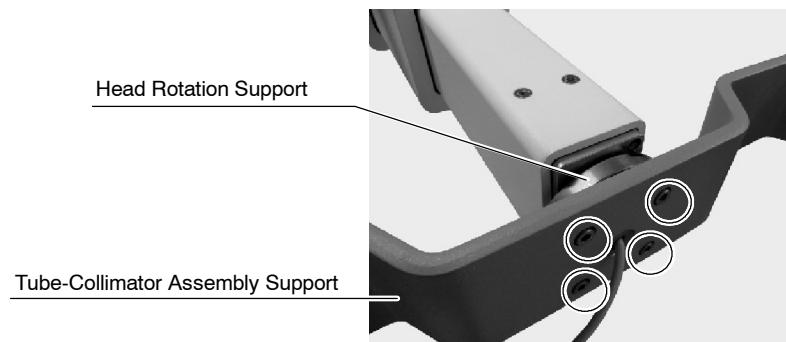


THE WEIGHT OF THE TUBE-COLLIMATOR ASSEMBLY IS HEAVY, UNSTEADY AND DIFFICULT TO HANDLE, THEREFORE AT LEAST TWO PEOPLE ARE NEEDED TO REMOVE IT. THIS WILL AVOID PERSONAL INJURIES OR DAMAGE TO THE EQUIPMENT.

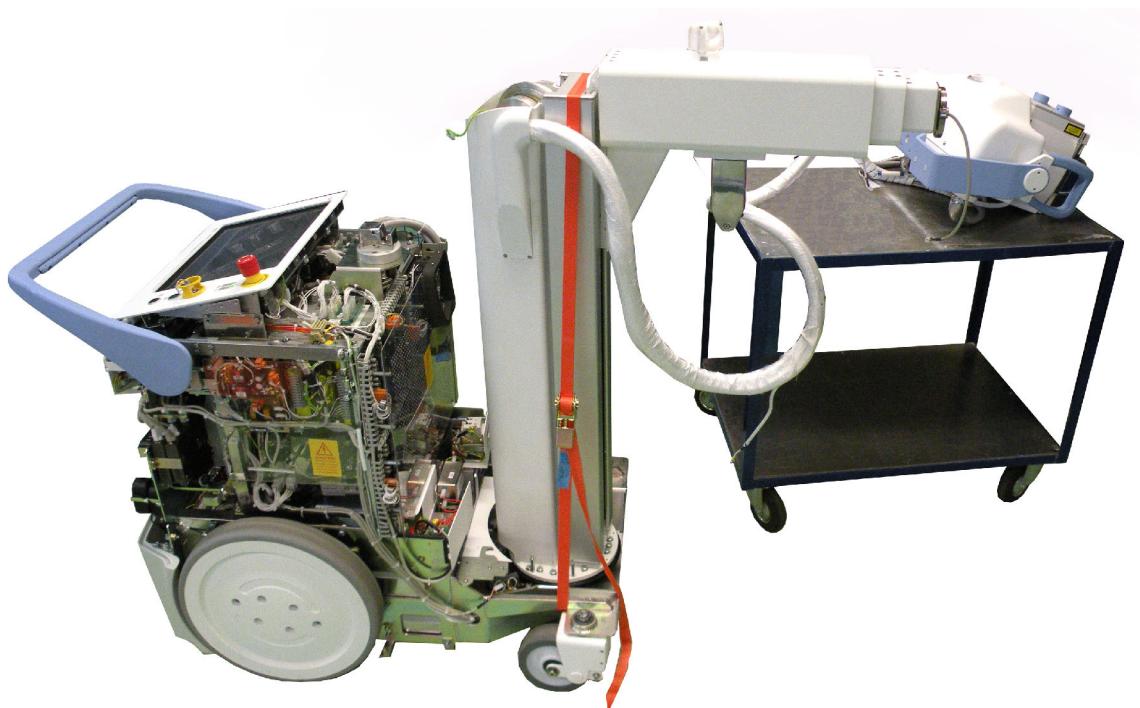
Mobile X-Ray Unit

Troubleshooting

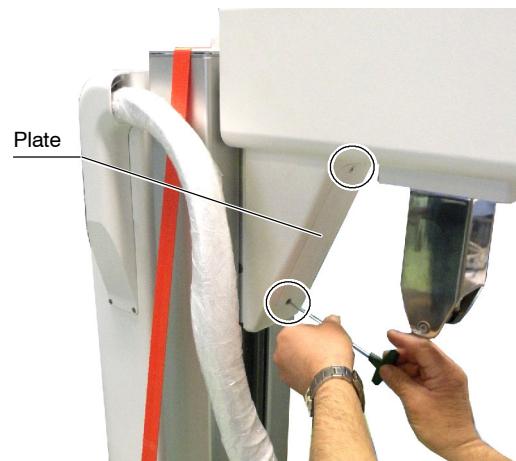
9. While one person supports the Tube-Collimator Assembly, the other removes the four (4) Screws that fix the Tube-Collimator Assembly Support to the Head Rotation Support.



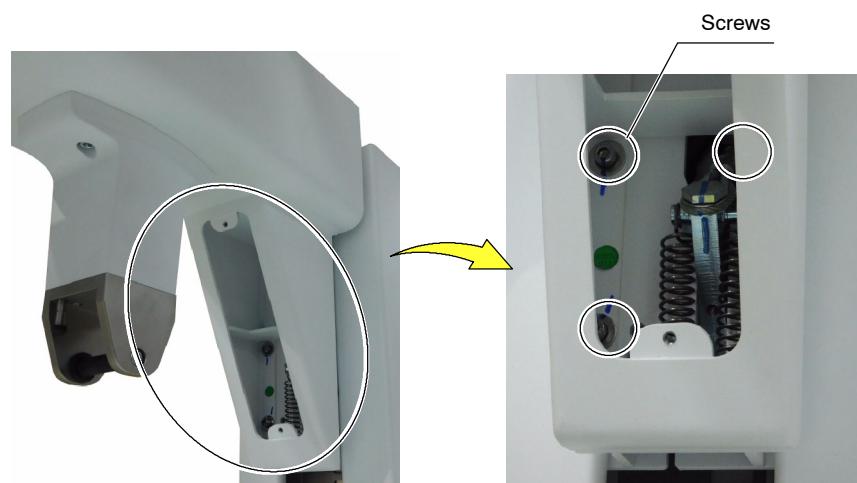
10. Carefully remove the Tube-Collimator Assembly, passing the HV Cables below the Arm, and place the Assembly on the auxiliary table taking care not to place it over the HV Cables, DAP Cable, etc.



11. Remove the two (2) Screws from the Plate under the Arm end closer to the Column.



12. Remove the three (3) internal Screws that fix the Arm to the Carriage.

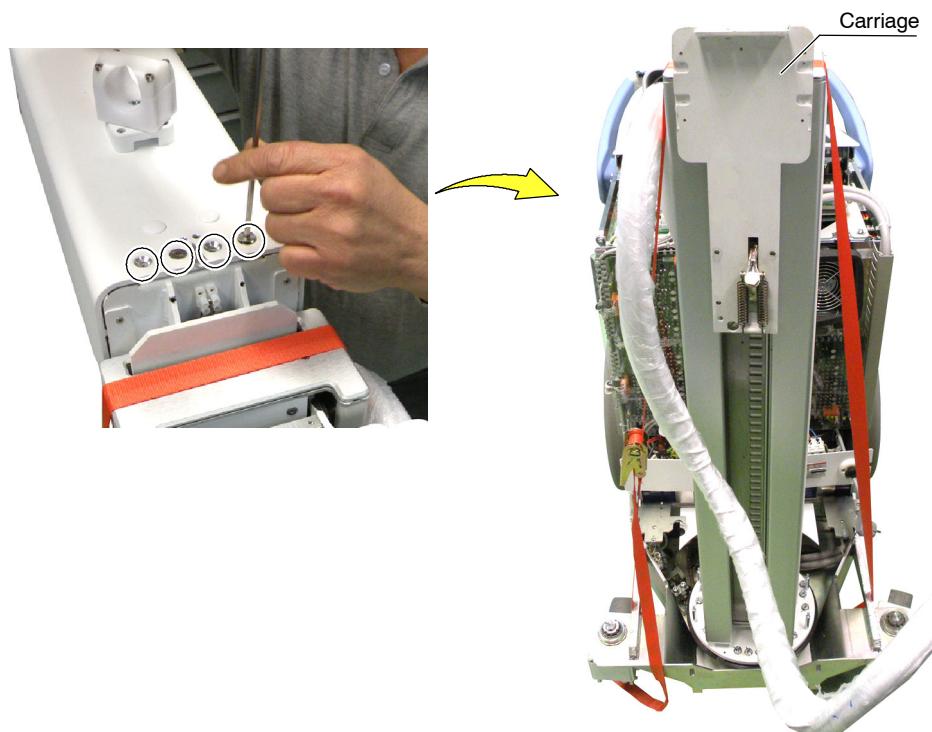


Mobile X-Ray Unit

Troubleshooting

13. While one person supports the weight of the Arm, the other removes the four (4) Screws on the upper side of the Arm.

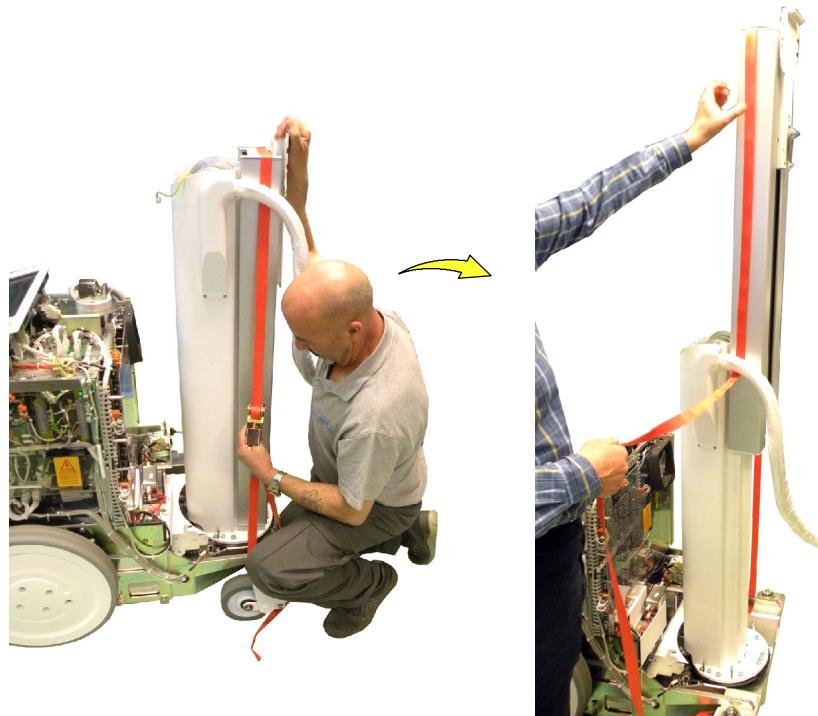
Then, dismount the Arm from the Carriage.



14. Carefully place the Arm on a safe surface. Insert a tie-wrap through the drills for the Carriage Brake Cable Cover as shown below, this will make it easier to mount the Carriage Brake Cable at a later time.



15. While one person holds the TC Sliding Section in order to avoid the Sliding Section to rise, the other person carefully releases the Sling. Then, rise slowly the (TC) Sliding Section to the top and remove the Sling.



Mobile X-Ray Unit

Troubleshooting

16. Turn the Mobile Unit ON and use the Tube-Collimator Assembly Motion Controls in order to rotate the Column 180°.

Turn the Mobile Unit OFF.



17. Remove the four (4) Screws that secure the Top Cover of the TC Base Section.



18. Dismount without removing the Top Cover of the TC Base Section in order to disconnect GND Connectors. Then, remove the Top Cover.



Mobile X-Ray Unit

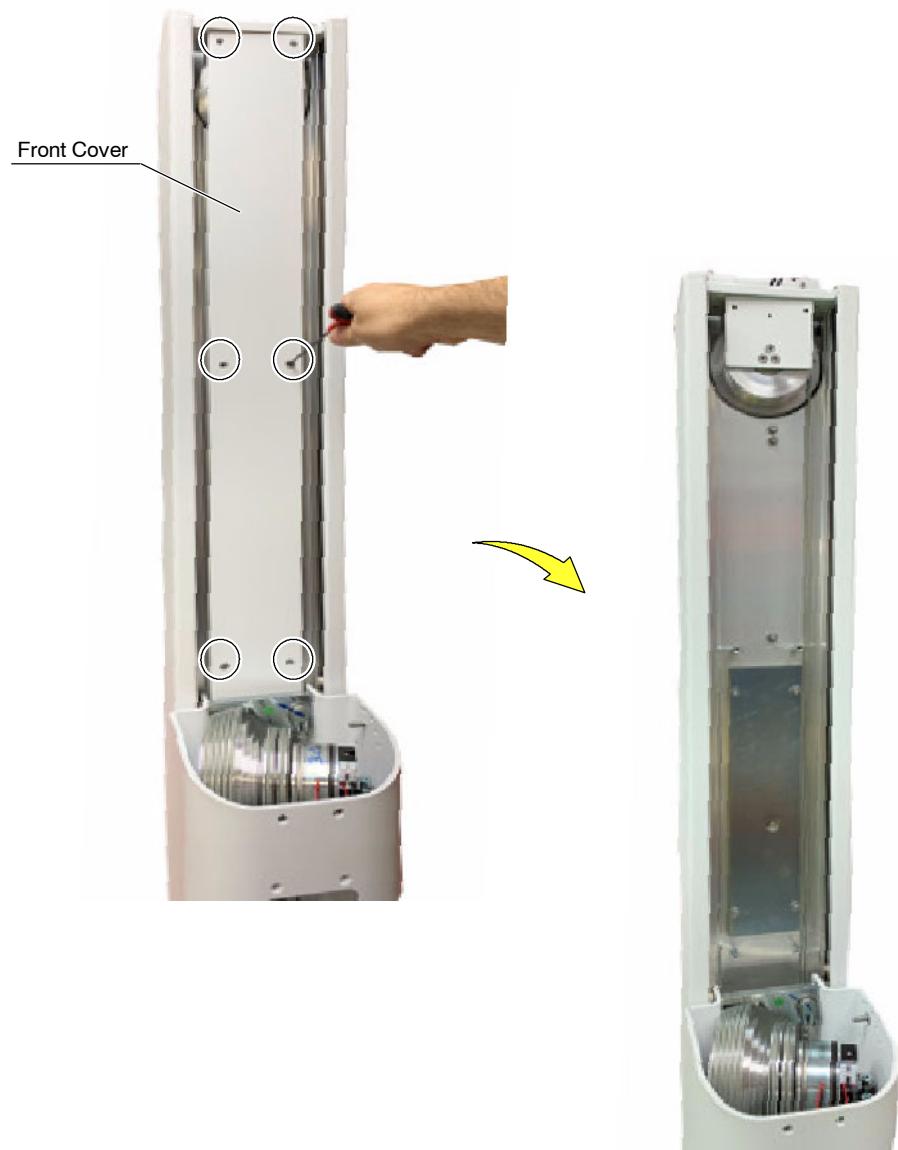
Troubleshooting

19. Remove the four (4) Screws that secure the Front Cover of the TC Base Section.

Disconnect GND and remove the Front Cover from inside the TC Base Section by sliding upwards.



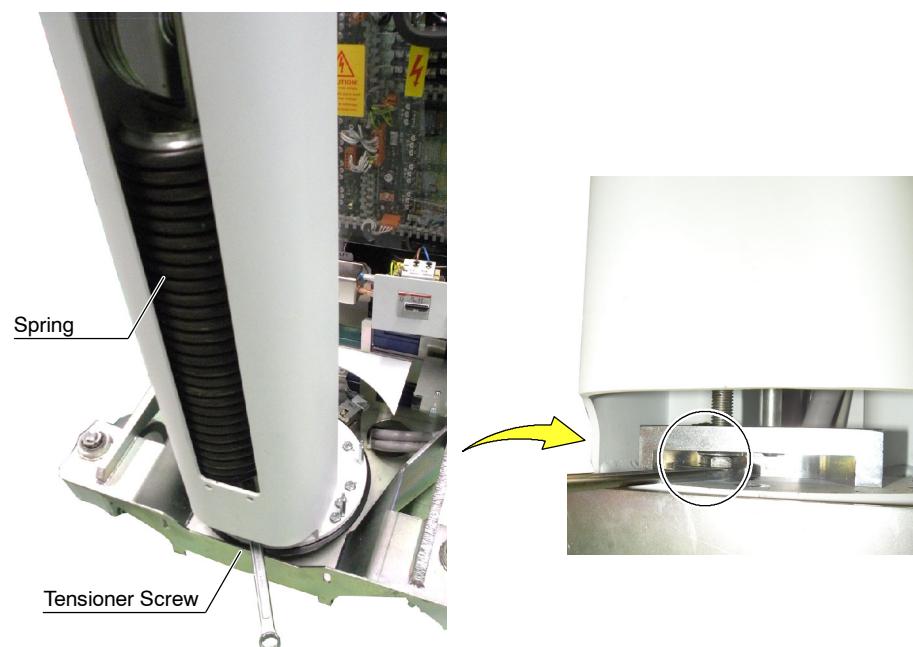
20. With the TC Sliding Section in the upward position, remove the six (6) Screws that secure the Front Cover of the TC Sliding Section and dismount the Front Cover.



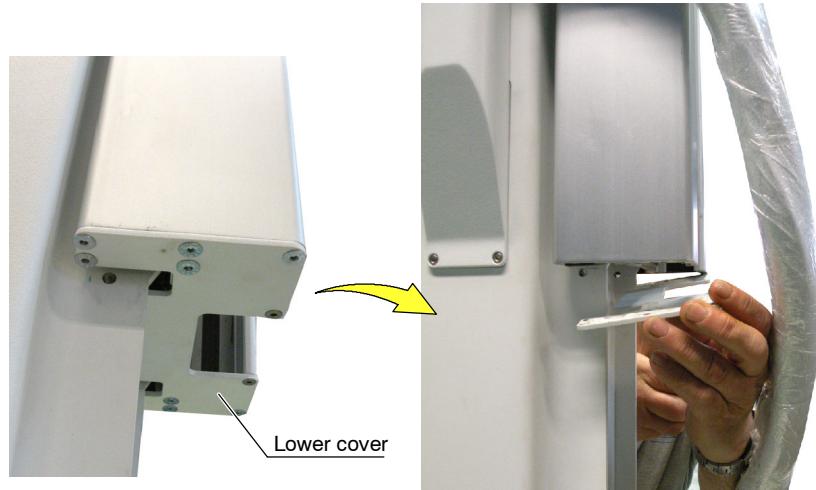
21. At the base of the TC Base Section, remove the Anchoring Screw in the front, in order to gain access to the Tensioner Screw of the Spring.



22. Unscrew the Tensioner Screw several times by using a 19 mm Spanner in order to loosen the Spring slightly, until slightly decreasing the tension of the Steel Cable.

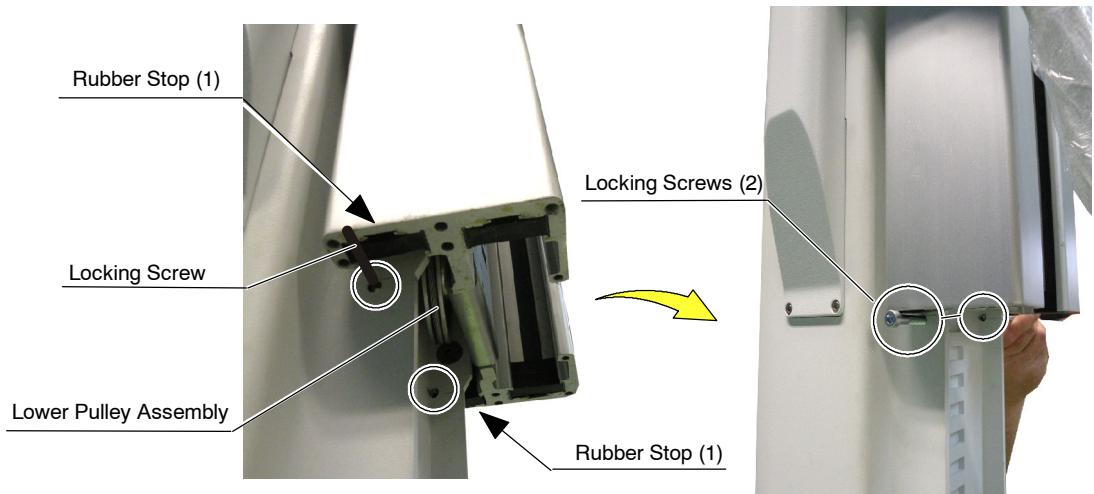


23. Remove the twelve (12) Screws that secure the Lower Cover of the TC Sliding Section and dismount the Lower Cover.



24. Remove the Rubber Stop at both sides inside the lower end of the TC Sliding Section (in order to dismount the Lower Pulley Assembly later).

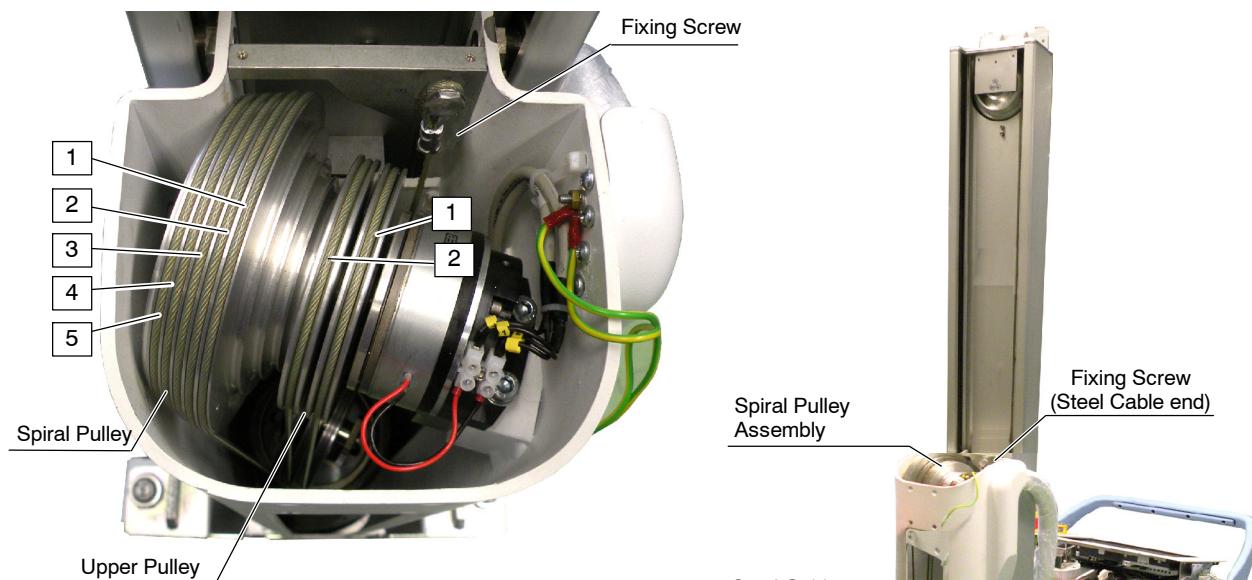
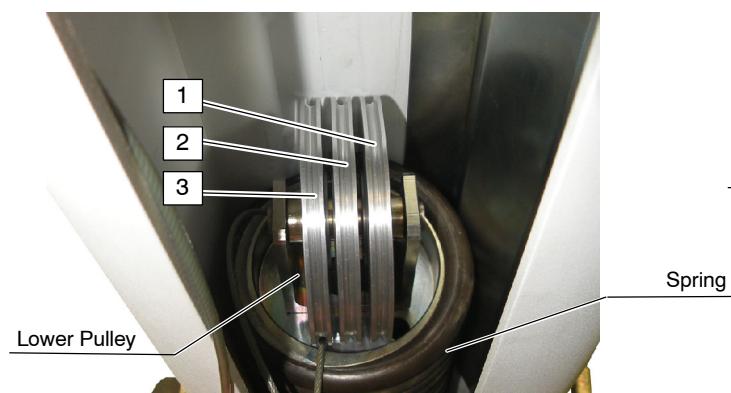
Place two (2) M6x40 Locking Screws, in the drills at both sides of the TC Base Section, to keep the TC Sliding Section in the top position and preventing it from falling when releasing the Steel Cable.



IF THE LOCKING SCREWS DO NOT COINCIDE WITH THE CORRESPONDING DRILLS, IT MIGHT BE NEEDED TO RAISE SLIGHTLY THE TC SLIDING SECTION (ONLY A FEW MILLIMETERS). IN THIS CASE, IF THE TC SLIDING SECTION IS RAISED OVER THE LOWER BEARING ON THE TC BASE SECTION, THE TC SLIDING SECTION WILL BE DISENGAGED FROM THE TC BASE SECTION. IT COULD CAUSE PERSONAL INJURIES OR DAMAGE TO THE UNIT.

Note 

For procedures related to the TC Base Section (from step 25.), refer to Illustration 3-6.

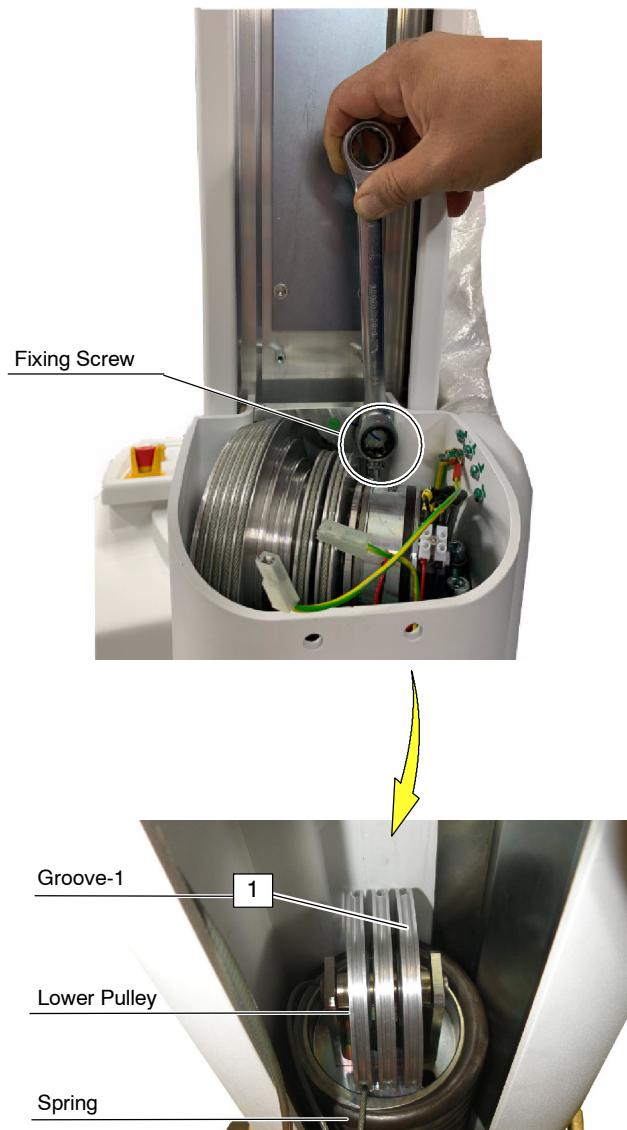
Illustration 3-6
TC Base Section**Spiral Pulley Assembly****Lower Pulley**

25. Carefully release the Steel Cable from the TC Base Section, as described in the following steps:

a. From Fixing Screw → to Lower Pulley groove-1:

Remove the Fixing Screw that secures one end of the Steel Cable to the upper side of the TC Base Section, by using a 15 mm Spanner.

Take the Steel Cable downwards the TC Base Section to the Lower Pulley (over the Spring) and release the Steel Cable clockwise, from the first groove at the right of the Lower Pulley.



b. From Lower Pulley groove-1 → to Upper Pulley groove-1:

Guide the Steel Cable upwards and release it from the first groove at the right, around the Upper Pulley (beside the Spiral Pulley).

c. From Upper Pulley groove-1 → to Lower Pulley groove-2:

Guide the Steel Cable downwards and release it from the second groove around the Lower Pulley.

d. From Lower Pulley groove-2 → to Upper Pulley groove-2:

Guide the Steel Cable upwards and release it from the second groove around the Upper Pulley.

e. From Upper Pulley groove-2 → to Lower Pulley groove-3:

Guide the Steel Cable downwards and release it from the third groove around the Lower Pulley.

f. From Lower Pulley groove-3 → to Spiral Pulley groove-1:

Guide the Steel Cable upwards and release it from the first groove around the Spiral Pulley.

g. From Spiral Pulley groove-1 → to Spiral Pulley grooves-2-3-4-5:

Release the Steel Cable from the first groove of the Spiral Pulley and continue releasing the Steel Cable from the second, the third, the fourth and the fifth grooves of the Spiral Pulley.

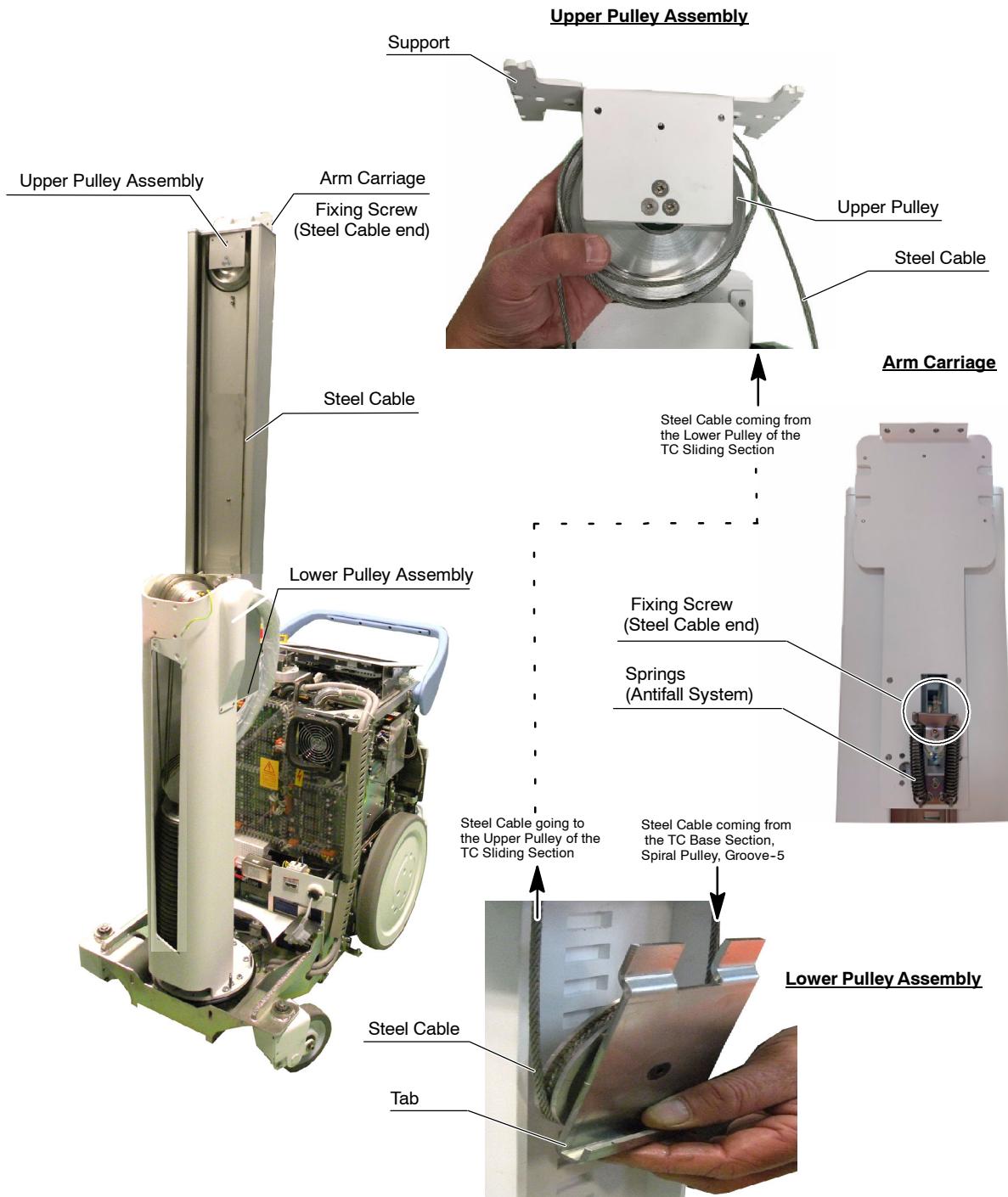
h. From Spiral Pulley groove-5 → to Lower Pulley (TC Sliding Section):

Release the Steel Cable from the fifth groove of the Spiral Pulley, leaving the TC Base Section to the Lower Pulley at the bottom of the TC Sliding Section, as described from *step 26*.

Refer to Illustration 3-7.

Note

For procedures related to the TC Sliding Section (from step 26.), refer to Illustration 3-7.

Illustration 3-7
TC Sliding Section Section

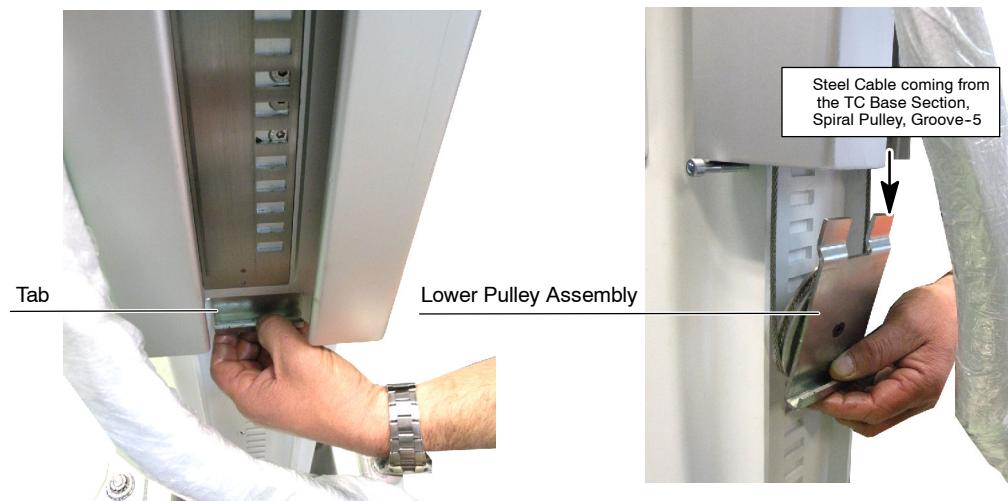
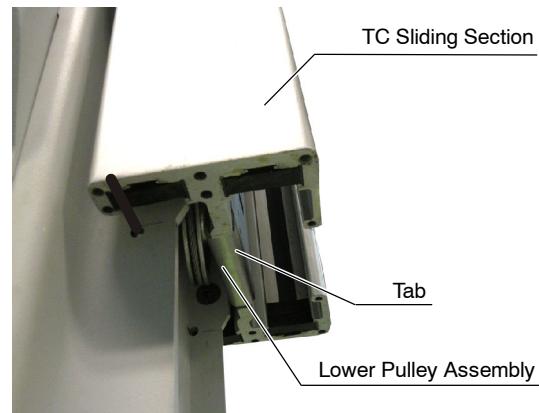
26. Carefully release the Steel Cable from the TC Sliding Section, as described in the following steps (*refer to Illustration 3-7.:*)

- a. Dismount the Lower Pulley Assembly by pulling its Tab downwards.

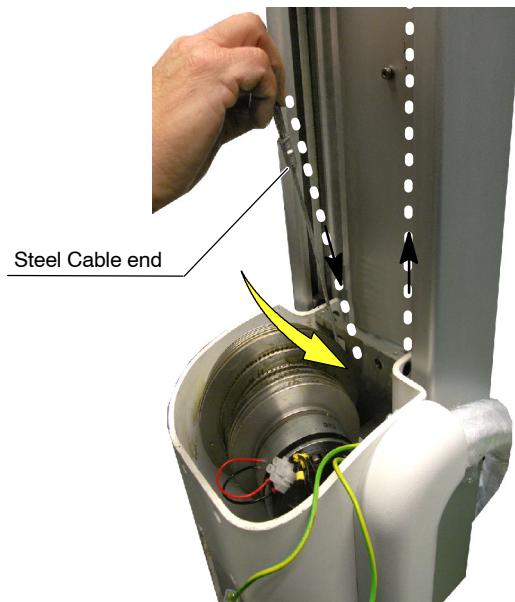
Note 

Previously, the Rubber Stops (2+2) have been removed and two (2) Locking Screws have been mounted in the drills at both sides of the TC Base Section, in order to lock the TC Sliding Section in the top position; for further details refer to step 24.

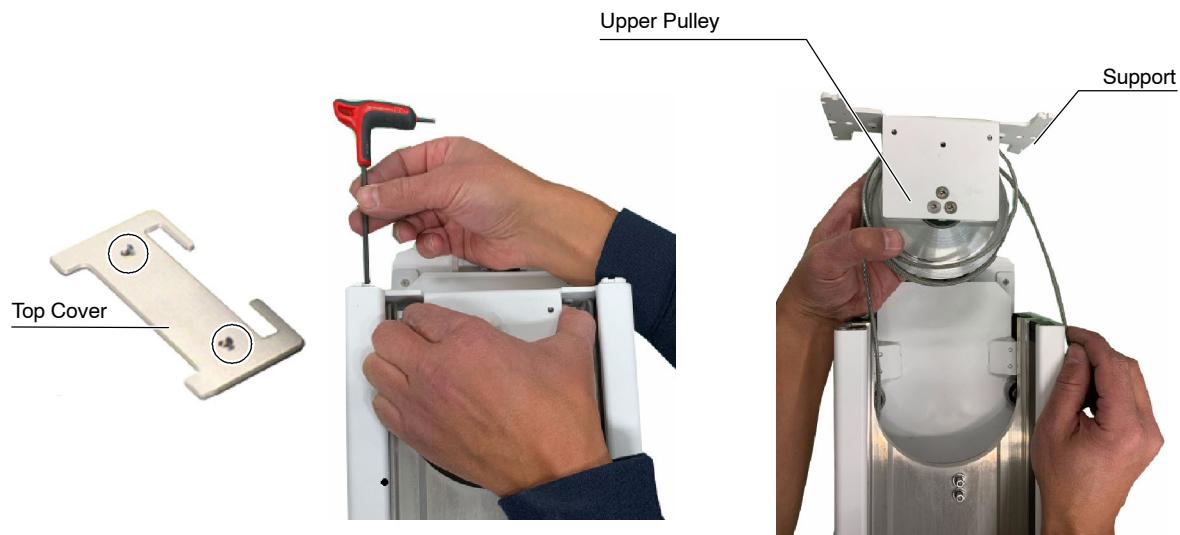
- b. Then, release the Steel Cable by removing the Lower Pulley.



- c. After releasing the Steel Cable from the TC Base Section, pass the end of the Steel Cable through the gap between both Sections of the Telescopic Column, as shown in the picture below.



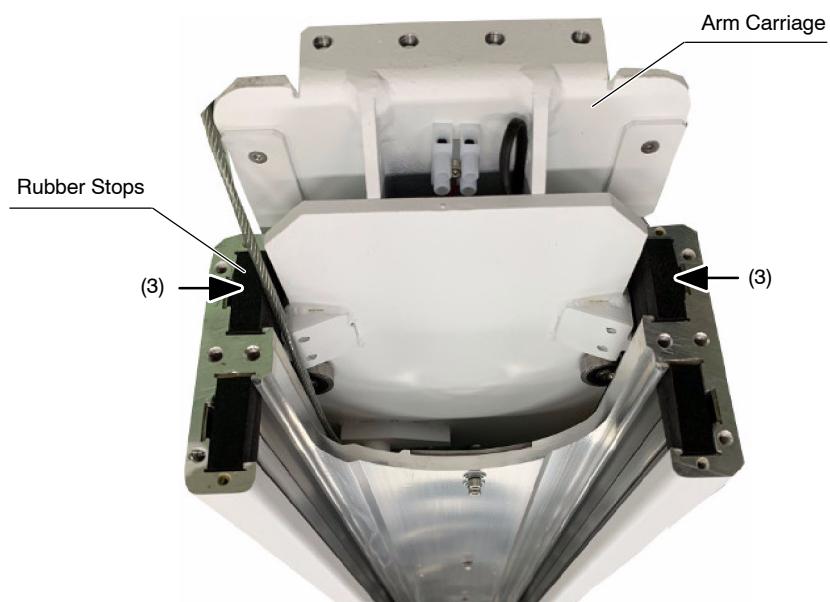
- d. Remove the two (2) Screws that secure the Top Cover of the TC Sliding Section. Then, remove the twelve (12) Screws on the Support fixing the Upper Pulley Assembly to the TC Sliding Section and dismount the Assembly.

Upper Pulley Assembly

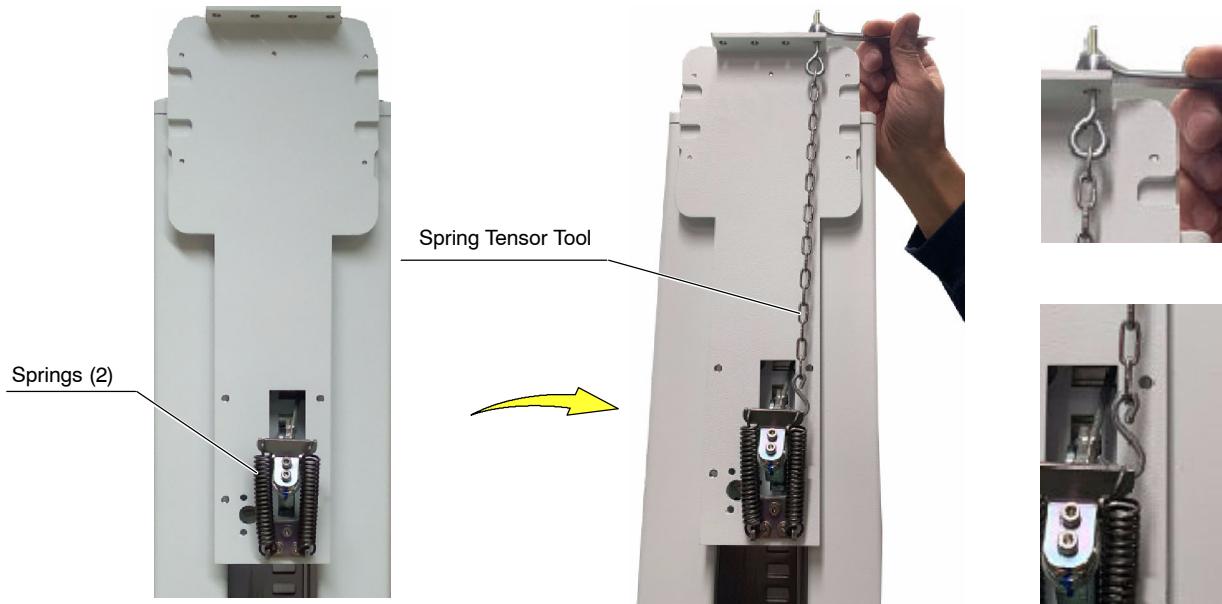
- e. Disengage the Steel Cable from all the grooves of the Upper Pulley Assembly, passing the Steel Cable end between the Pulley and the Support to remove it.



- f. Remove the three (3) Rubber Stops at both sides inside the upper end of the TC Sliding Section, in order to dismount the Arm Carriage.

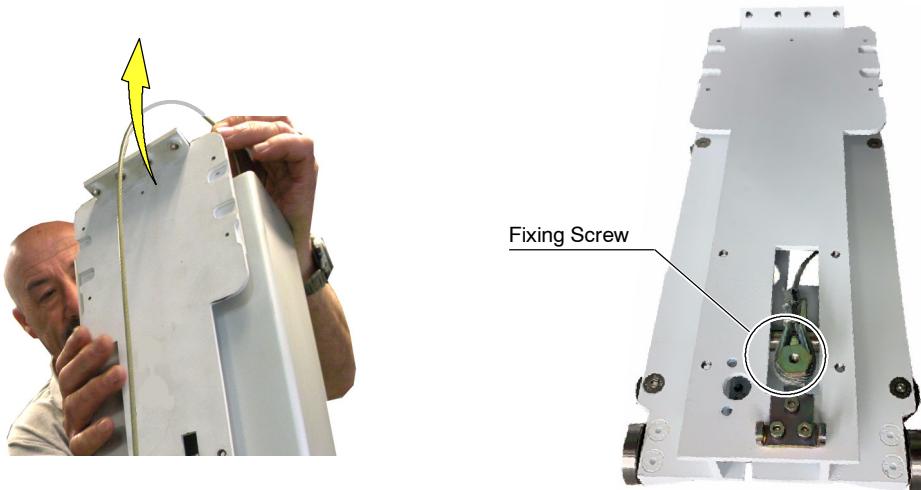


- g. Dismount the two (2) Springs of the Antifall System of the Arm Carriage using the Spring Tensor Tool (provided in the spare part SAT-AS00794)



- h. Slide the Carriage with the Steel Cable upwards and dismount it.

Remove the other end of the Steel Cable from the Fixing Screw.



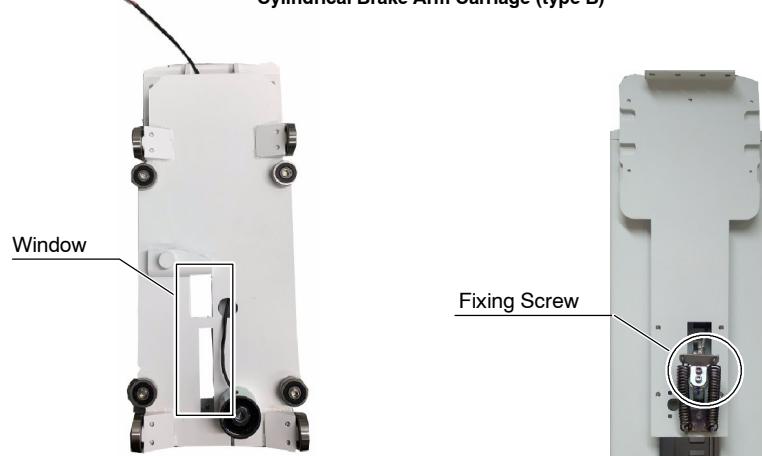
MOUNTING THE NEW STEEL CABLE**Note** 

Two people are necessary to carry out the entire procedure; while one person performs the mounting process, the other person holds the Steel Cable tight along the entire procedure.

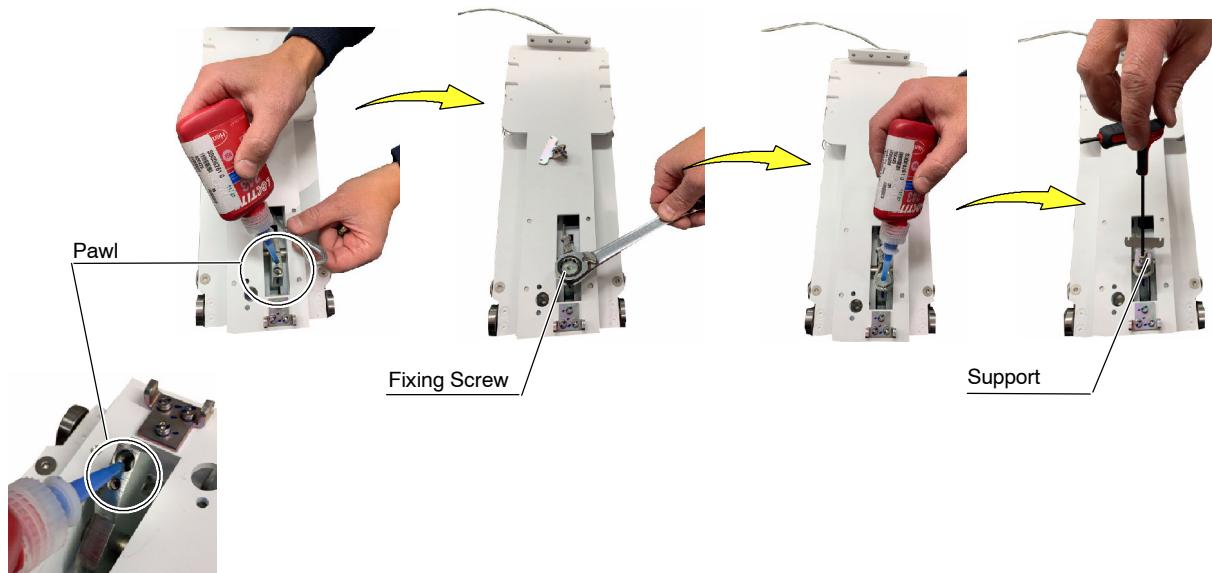
Note 

For procedures related to the TC Sliding Section, refer to Illustration 3-7.

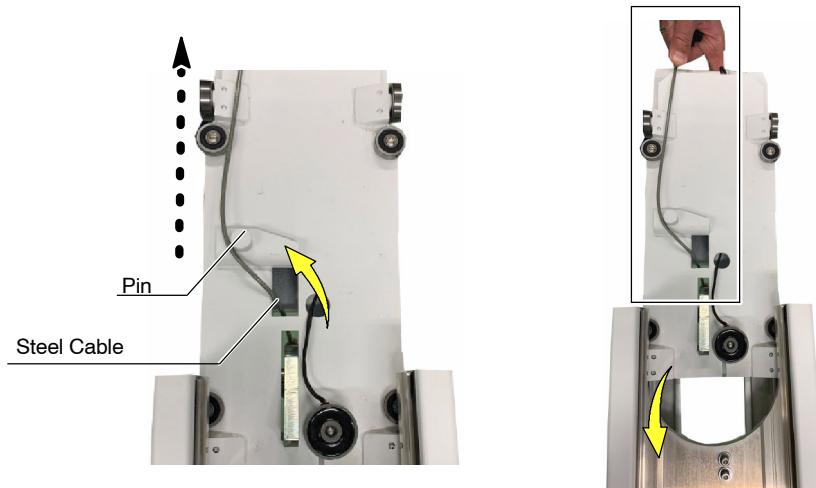
Cylindrical Brake Arm Carriage (type B)



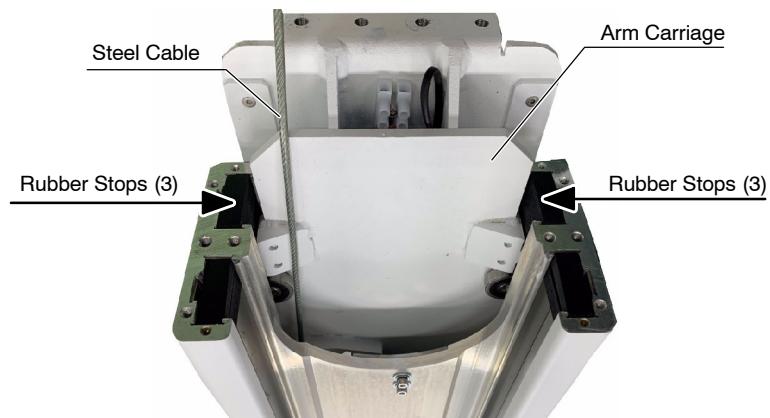
27. Before re-installing the new Steel Cable, apply Loctite 243 on the two holes of the Pawl as well on the Fixing Screw after adjusting it. Secure the Steel Cable with the Fixing Screw. Finally, screw the Support for Springs and Pawl.



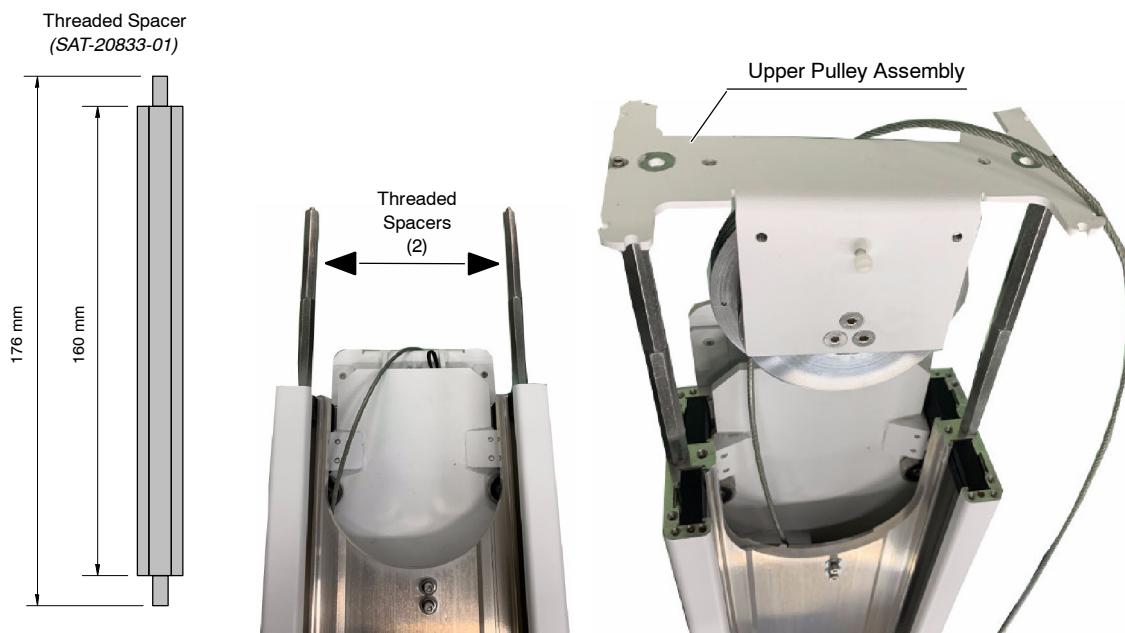
28. Apply some grease on the Bearings and slide the Arm Carriage downwards the TC Sliding Section, placing the Steel Cable to the left of the Carriage around the Pin, as shown in the picture below.



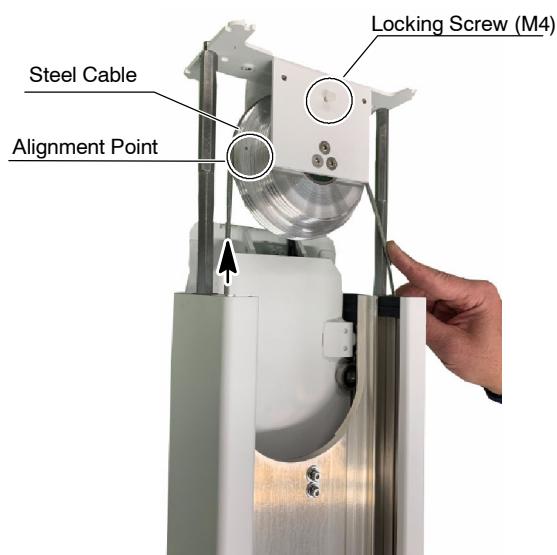
29. Place the three (3) Rubber Stops at both sides inside the upper end of the TC Sliding Section.



30. Place two (2) Threaded Spacers (Spacer:160 mm; Threaded ends: 8 mm x M5) (*spare part SAT-20833-01*) in the drills at both sides on the upper end of the TC Sliding Section, in order to ease the mounting process of the Steel Cable in the next steps.
Mount the Upper Pulley Assembly on the Threaded Spacers.



31. Turn the Upper Pulley until the Alignment Point is at 90° degrees, as shown in the picture below, and lock the Pulley in that position with the Locking Screw (M4).



32. Pass one end of the Steel Cable through the gap between the Pulley and the Support, adjust the Steel Cable starting from the larger diameter section of the Pulley, turning it clockwise around the first groove (1), the second groove (2) and the third groove (3).

Change to the smaller diameter section of the Pulley and turn the Steel Cable around the fourth groove (4).



33. While one person holds the Upper Pulley Assembly keeping the Steel Cable tense, the other removes the Threaded Spacers and then loosens the Locking Screw, without removing it.



Mobile X-Ray Unit

Troubleshooting

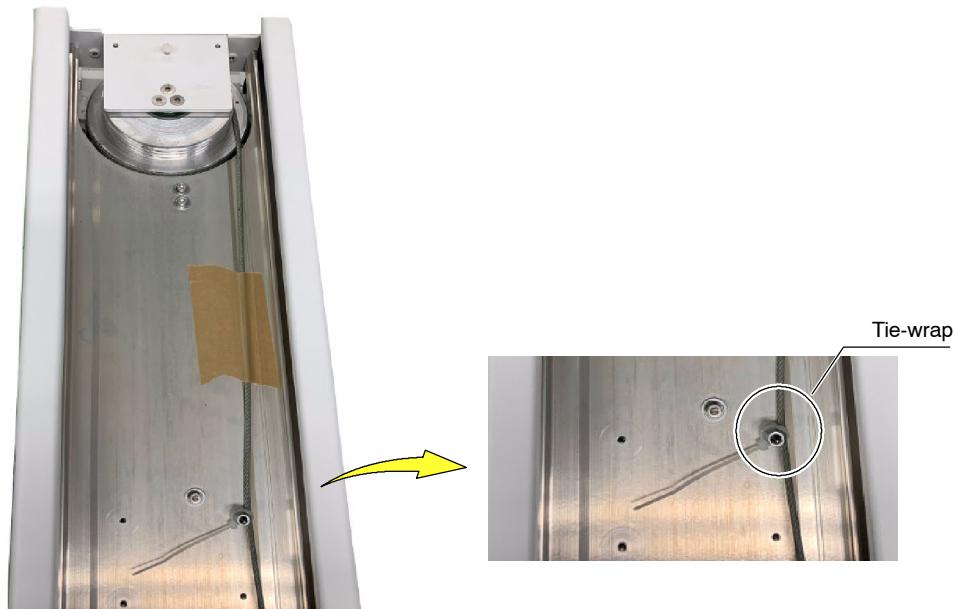
34. One person keeps tight the Steel Cable while the other lowers the Upper Pulley Assembly to mount it on the top of the TC Sliding Section. Then, lock the Pulley with the Locking Screw.



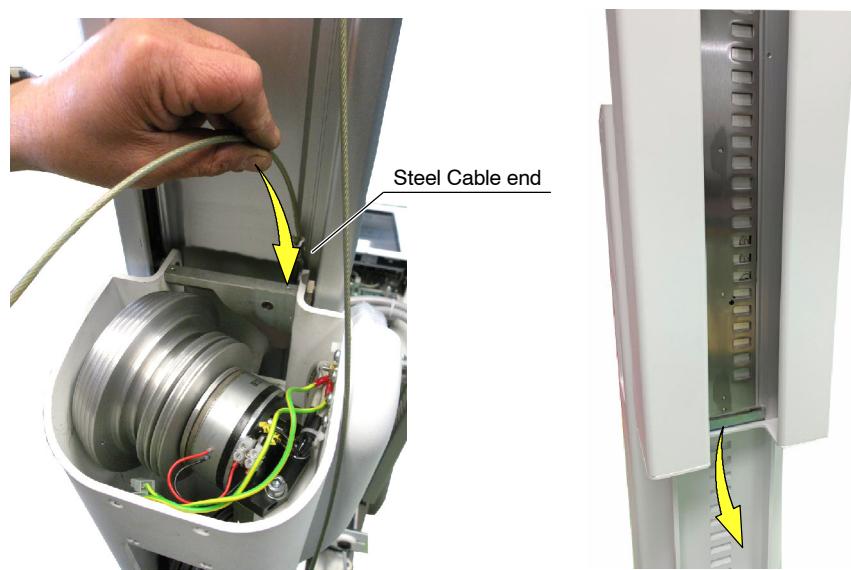
35. Mount the twelve (12) Screws on the Support fixing the Upper Pulley Assembly to the TC Sliding Section. Re-install the Upper Cover.



36. Apply tension to the Steel Cable and fix it with a Tie-wrap, half way of the TC Sliding Section as shown in the picture below, in order to ease the mounting process later.

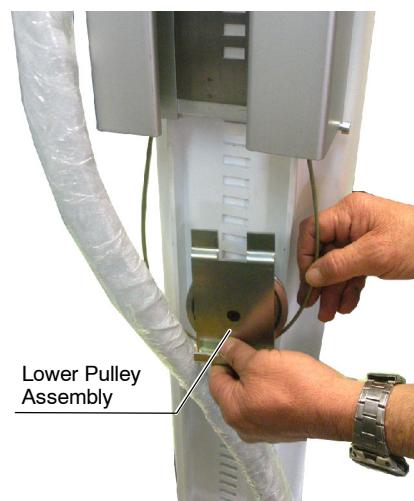
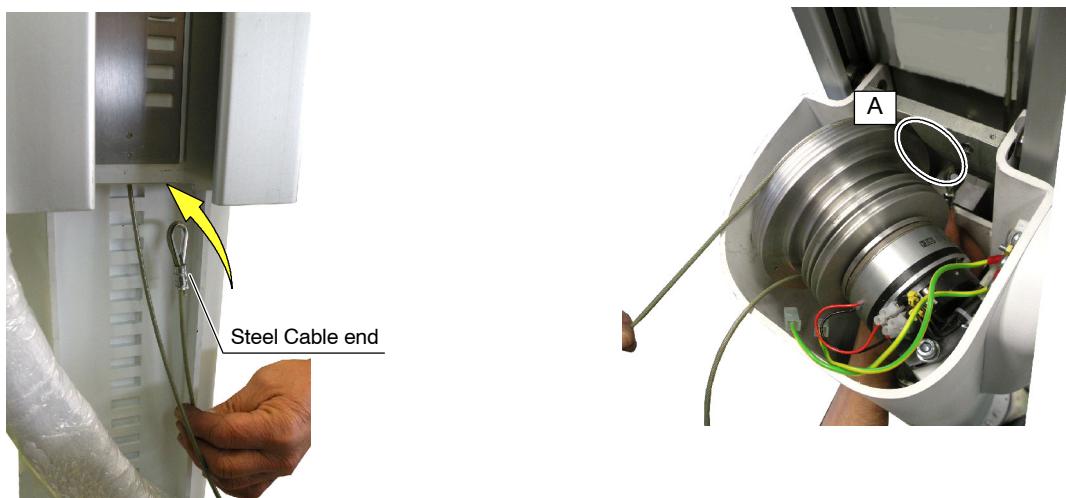


37. Pass the end of the Steel Cable downwards through the gap between both Sections of the Telescopic Column, as shown in the picture below.



38. Pass the Steel Cable end upwards through the gap between both Sections of the Telescopic Column and through the window (A) in the TC Base Section.

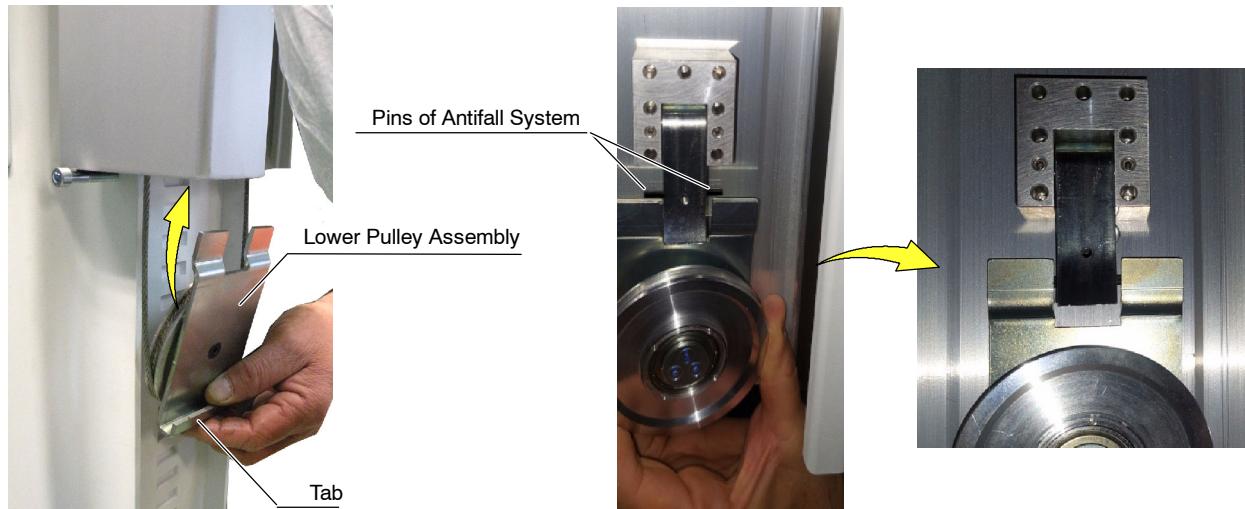
Place the Lower Pulley Assembly with the Steel Cable around the Pulley groove, as shown in the picture below.



39. While keeping tension on the Steel Cable, mount the Lower Pulley Assembly inside the lower end of the TC Sliding Section.

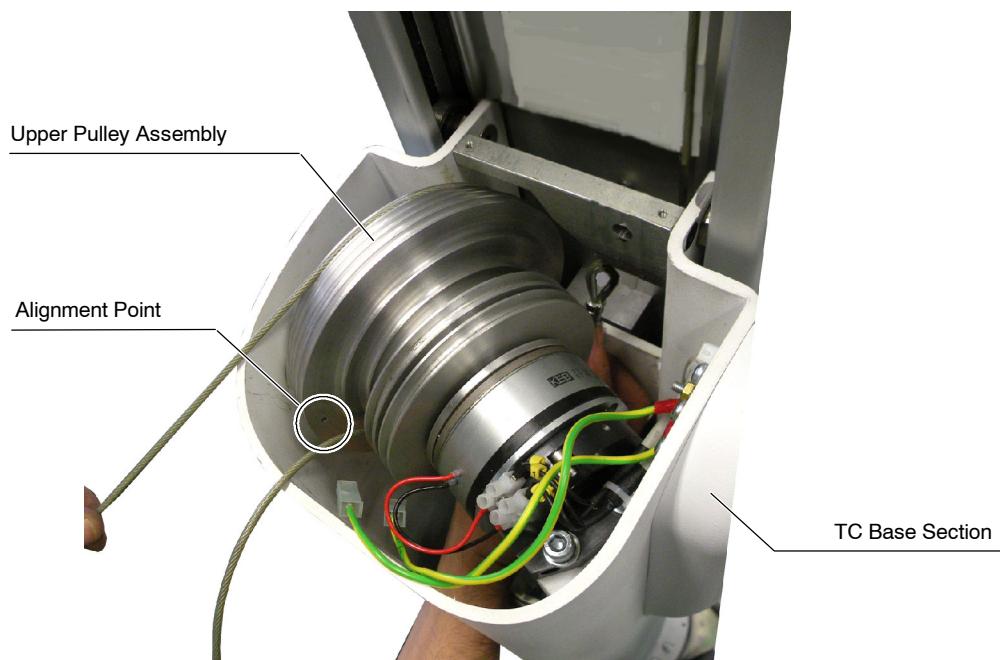


It is very important that the two (2) pins of the Antifall System are positioned between the surface of the Column and the two (2) lugs of the pulley support, otherwise the column will be always blocked with the Antifall System.



With the steel cable tight, check the correct installation of the Lower Pulley Assembly by inserting a rigid strip of metal, plastic or similar, 1 mm thick and at least 25 cm long, into the column and in front of the pulley, verify that the strip can move freely without colliding with the Antifall System.

40. With the Steel Cable tight, turn the unit ON.
Press the Tube-Collimator Assembly Handgrips in order to release the Brake of the Upper Pulley Assembly in the TC Base Section.
Turn the Assembly until the Alignment Point of the Spiral Pulley is at 90° degrees, as shown in the picture below.
Turn the unit OFF.



41. Carefully guide the Steel Cable as described in the following steps:

Note 

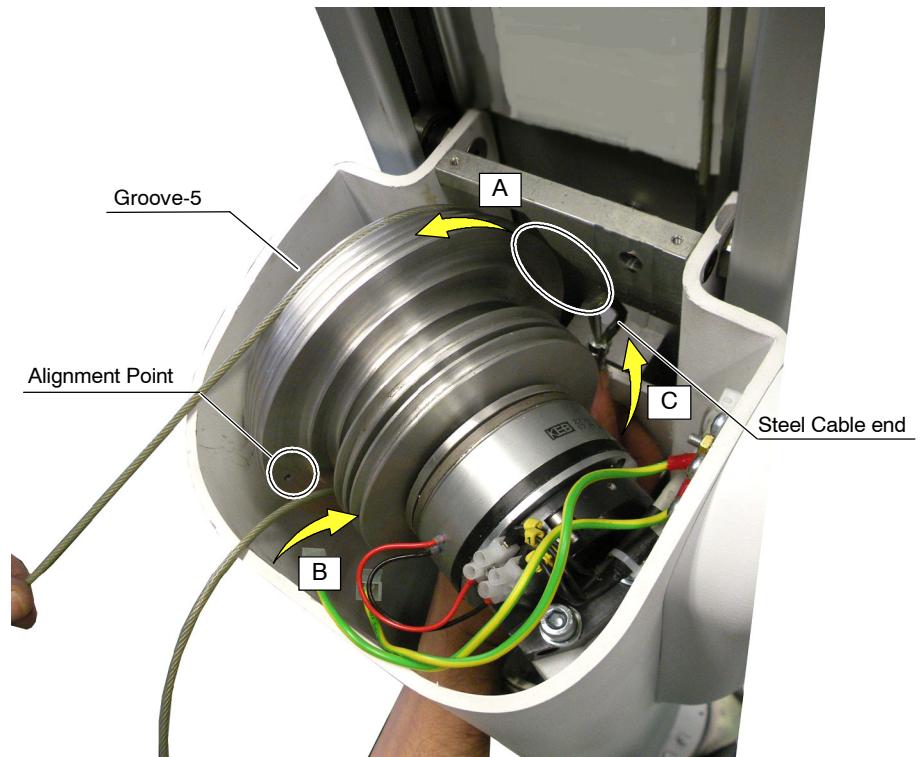
For procedures related to the TC Base Section, refer to Illustration 3-6.

- a. From Lower Pulley (TC Sliding Section) → to Spiral Pulley groove-5 (TC Base Section):

(A) Take the Steel Cable end coming from the TC Sliding Section through the window in the TC Base Section, keeping the Cable tight.

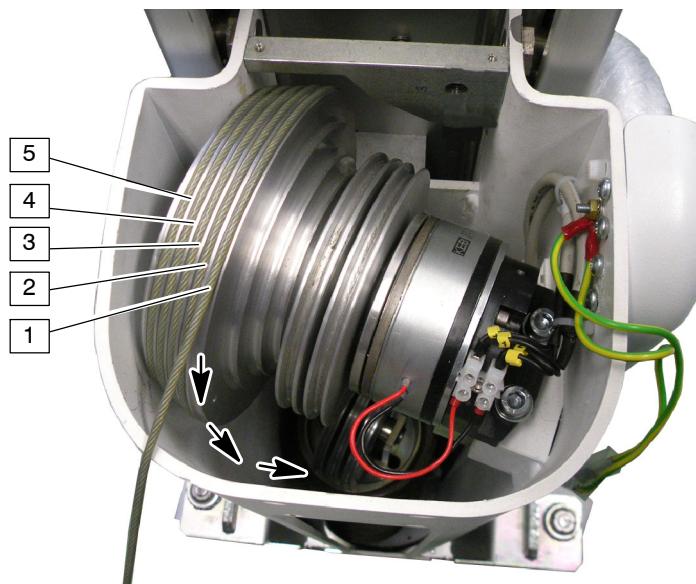
(B) Turn the Steel Cable counterclockwise around the fifth Groove of the Spiral Pulley.

(C) Pass the Steel Cable end below the Spiral Pulley as shown in the picture.



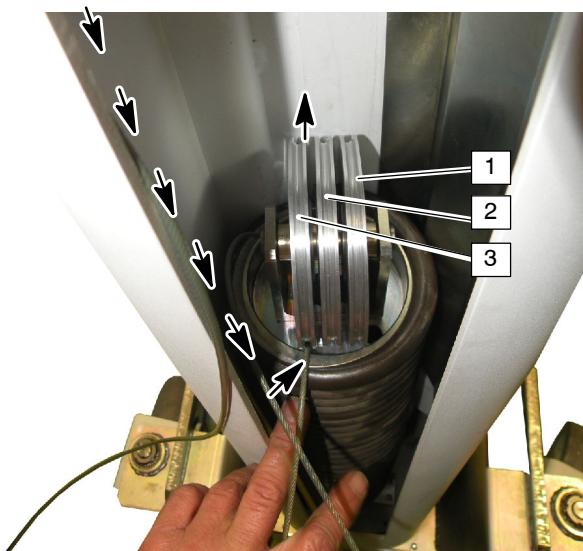
b. From Spiral Pulley groove-5 → to Spiral Pulley grooves-4-3-2-1:

Turn the Steel Cable counterclockwise around the Spiral Pulley from the fifth groove, to the fourth, third, second and first grooves.



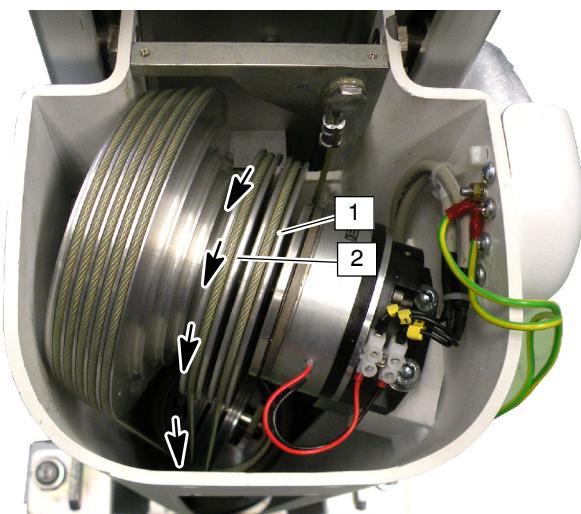
c. From Spiral Pulley groove-1 → to Lower Pulley groove-3:

Keeping the Steel Cable tight, guide the Cable downwards from the first groove of the Spiral Pulley and turn it counterclockwise around the third groove of the Lower Pulley.



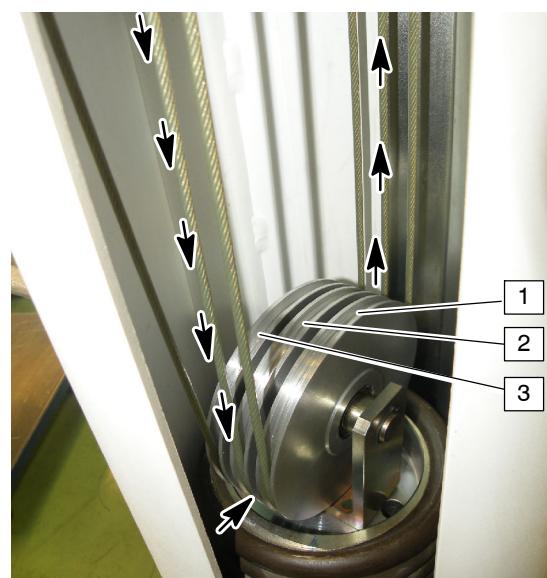
d. From Lower Pulley groove-3 → to Upper Pulley groove-2:

Guide the Steel Cable upwards from the third groove of the Lower Pulley and turn it around the second groove of the Upper Pulley.



e. From Upper Pulley groove-2 → to Lower Pulley groove-2:

Guide the Steel Cable downwards from the second groove of the Upper Pulley to the second groove of the Lower Pulley.



f. From Lower Pulley groove-2 → to Upper Pulley groove-1:

Guide the Steel Cable upwards from the second groove of the Lower Pulley and turn it around the first groove of the Upper Pulley.

g. From Upper Pulley groove-1 → to Lower Pulley groove-1:

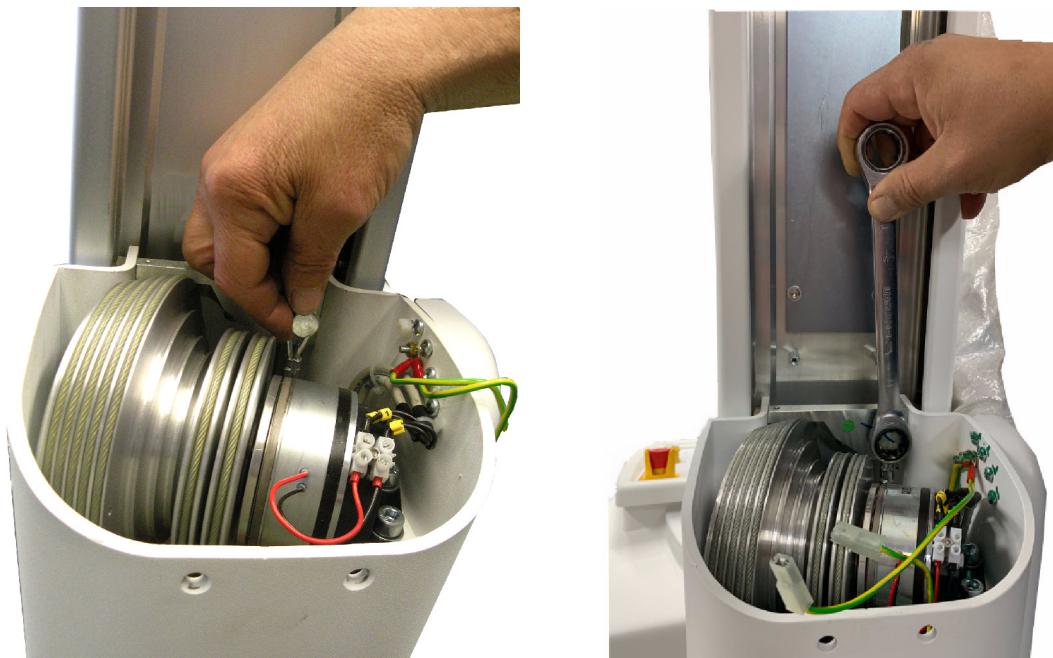
Guide the Steel Cable downwards from the first groove of the Upper Pulley to the first groove of the Lower Pulley.

h. From Lower Pulley groove-1 → to Fixing Screw :

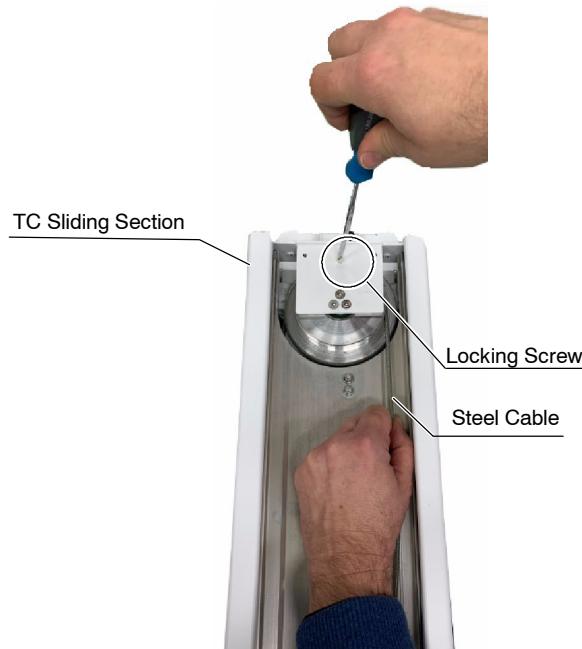
Guide the Steel Cable upwards from the first groove of the Lower Pulley to the Fixing Screw drill.

If necessary, unscrew the Spring Tensioner Screw at the lower end of the TC Base Section in order to loosen the Spring to reach the Fixing Screw drill with the end of the Steel Cable.

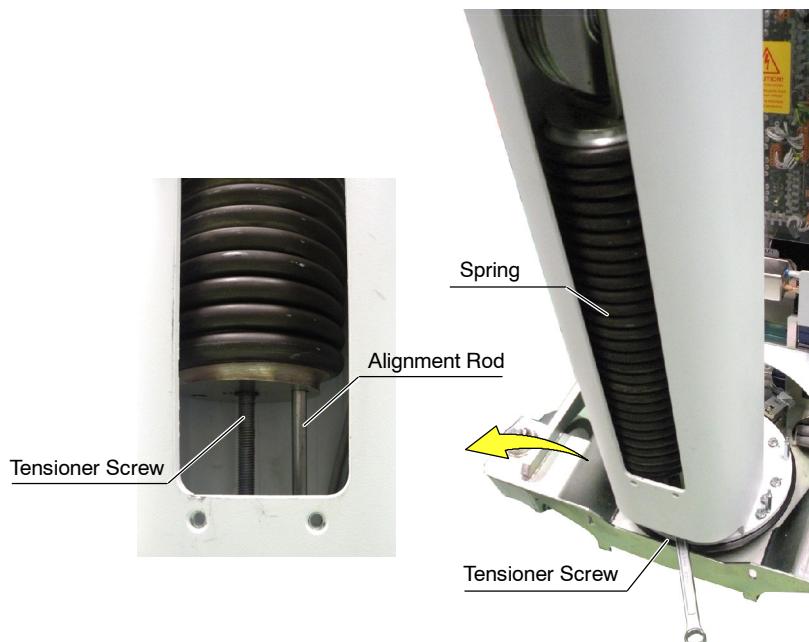
While one person keeps the Steel Cable tight, the other ensures the Steel Cable end with the Fixing screw, adding Loctite 243 and using a Torque of 15 Nm.



42. While one person keeps tight the Steel Cable, the other person cuts the Tie-wrap at the TC Sliding Section and removes the Locking Screw from the Upper Pulley assembly.



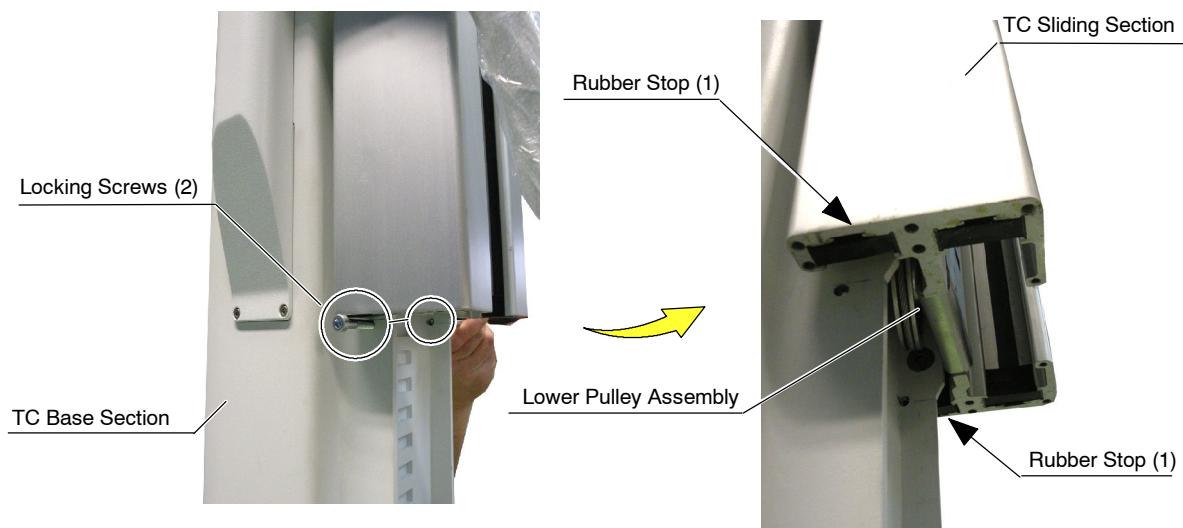
43. At the lower end of the TC Base Section, ensure that the Spring is into the Alignment Rod. Adjust the Tensioner Screw several times to tight the Spring and the Steel Cable.



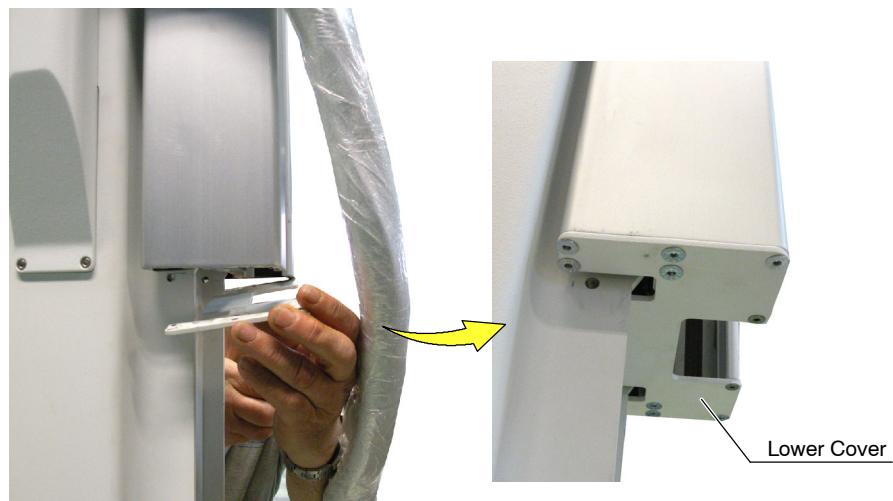
Mobile X-Ray Unit

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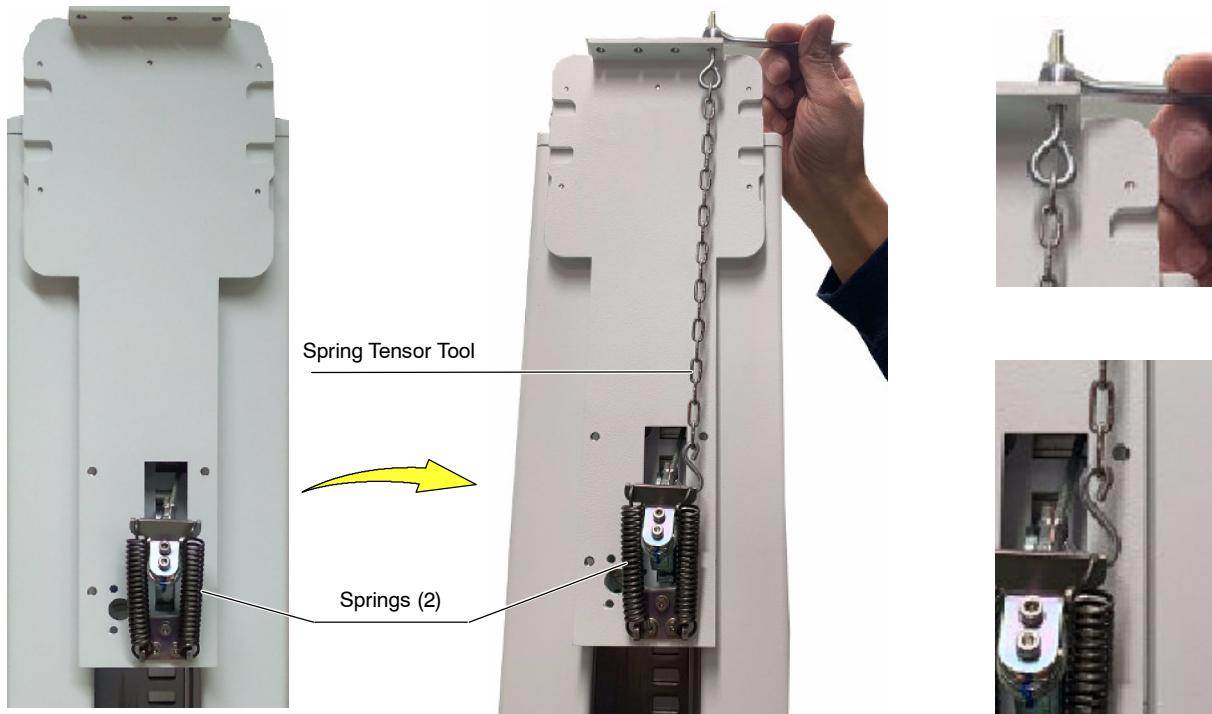
44. Carefully remove the two (2) Locking Screws at both sides of the TC Base Section and mount the Rubber Stops at both sides of the TC Sliding Section as shown in the picture.



45. Mount the Lower Cover using the twelve (12) Screws that secure the cover of the TC Sliding Section.



46. Mount the two (2) Springs of the Antifall System in the Arm Carriage using the Spring Tensor Tool (provided in the spare part SAT-AS00794)



47. Adjust again the Tensioner Screw several times until is achieved the required tension for the Spring and the Steel Cable.

**Note** 

When the Arm, the Tube-Collimator Assembly and all the covers of the Telescopic Column are assembled in the unit, the Tensioner Screw will be adjusted again, in order to get the adequate tension for the Spring and the Steel Cable.

48. Turn the unit ON.

Press the Tube-Collimator Assembly Handgrips to release the Brake in order to turn the Telescopic Column at 180° degrees.

49. Place the Sling over the top of the TC Sliding Section.

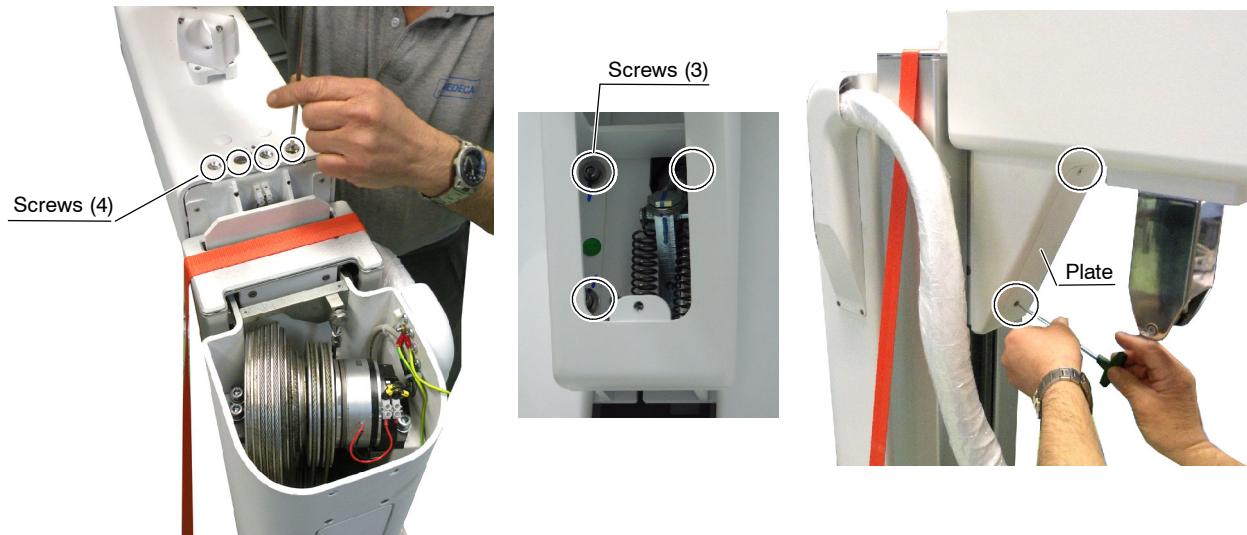
While one person presses the Tube-Collimator Assembly Handgrips the other moves the TC Sliding Section fully down and secures it with the Sling.

Turn the unit OFF.

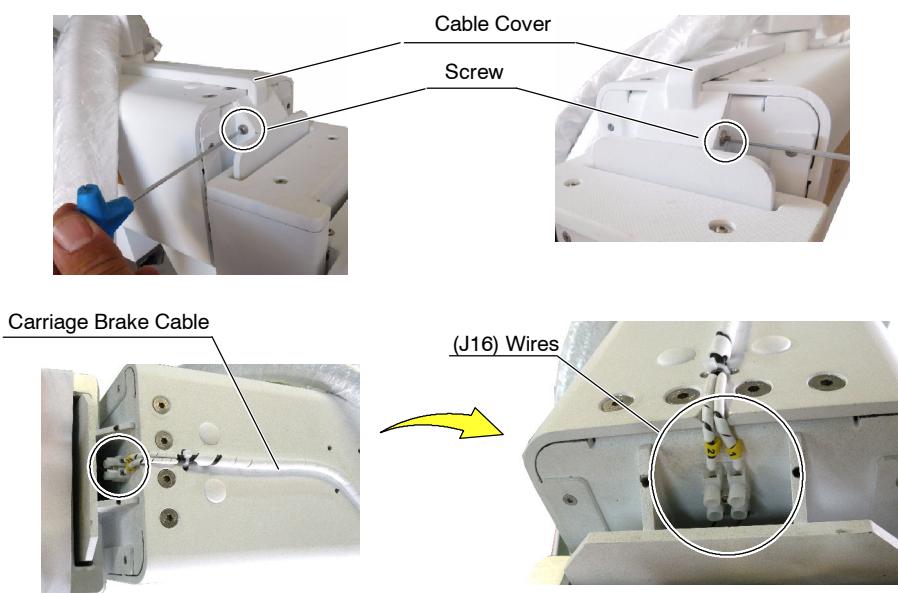
50. Carefully **mount the Arm on the Carriage:**

- a. While one person supports the weight of the Arm, the other secures the Arm with the corresponding fixing Screws (4+3) adding Loctite 243 and using a Torque of 10.5 Nm.

Then, mount the Plate.



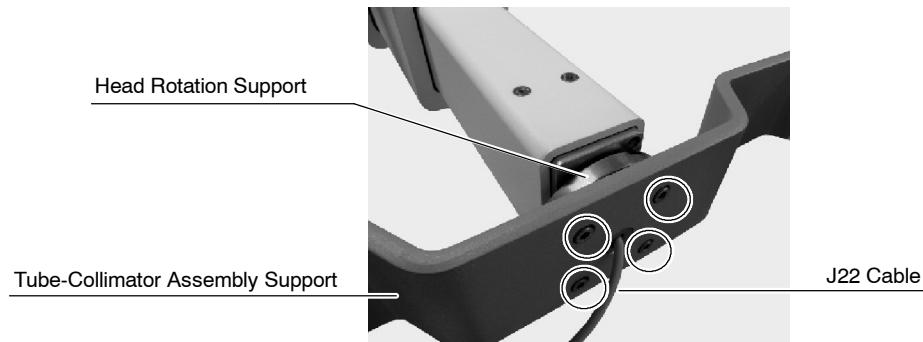
- b. Pass the Carriage Brake Cable through the tie-wrap previously mounted on the Arm, remove the electrical tape from the cable wires, connect both wires in the position noted before and finally mount the Carriage Brake Cable Cover with the two (2) Screws.



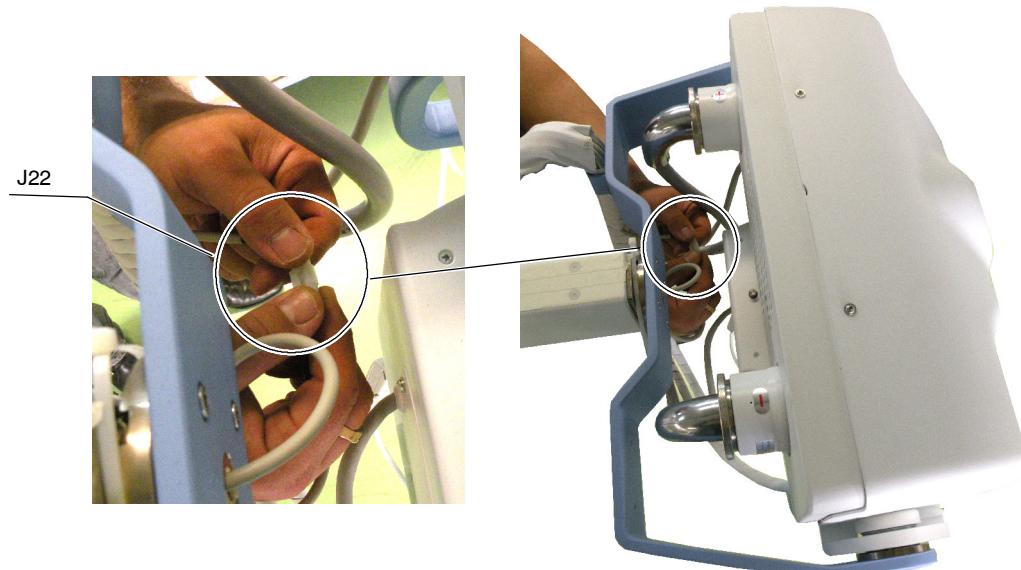
51. Carefully mount the Tube-Collimator Assembly:

- a. Place the auxiliary table with the Tube-Collimator Assembly closer to its final position in the Arm.

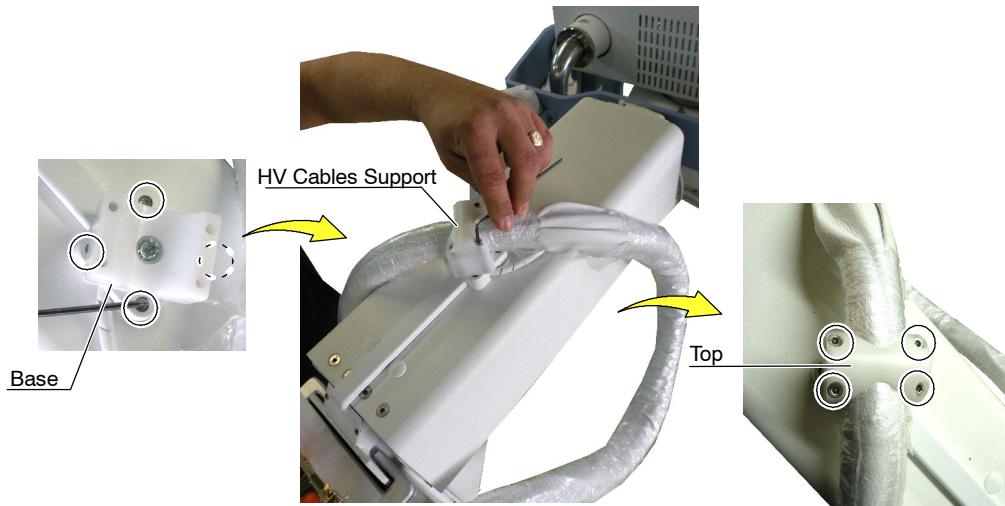
While one person holds the the Tube-Collimator Assembly towards the Arm, the other holds the HV Cables above the Arm, passes J22 Cable through the Support of the Tube-Collimator Assembly and mounts the four (4) Screws that fix the Tube-Collimator Assembly to the Head Rotation Support, adding Loctite 243 and using a Torque of 10.5 NM.



- b. Remove the electrical tape from the wires of Connector J22 (Arm Brake) and connect J22.



52. Mount the HV Cables Support (base) to the upper side of the Arm with the four (4) Screws, place the HV Cables inside and mount the HV Cables Support (Top).

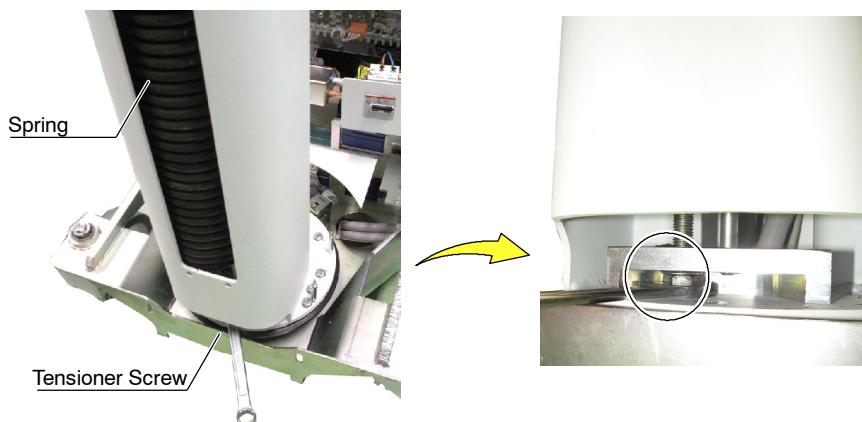


53. Release the Sling from the unit.
54. Turn ON the Mobile Unit and perform a functional check:

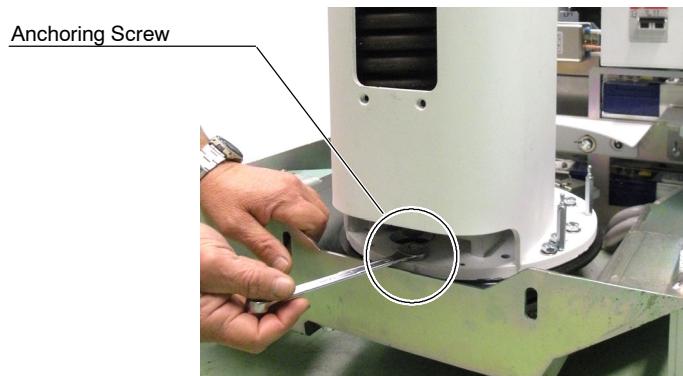
Check for the correct movement of the vertical travel of the Arm and the Telescopic Column. Check for the correct rotation of the Telescopic Column.

Tighten / loosen the Spring by adjusting the Tensioner Screw and balance the vertical movement of the Arm until reaching the following force results on the vertical movements:

- Dynamic effort to perform the upwards and downwards vertical movement of Arm and Telescopic Column with brakes released must be between 3 and 6 kg.



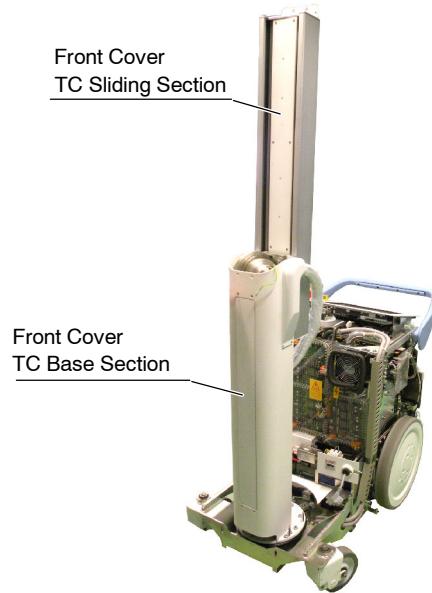
55. Turn OFF the Mobile Unit.
56. At the base of the TC Base Section, mount the Anchoring Screw.



57. With the TC Sliding Section upwards:

Mount the Front Cover of the TC Sliding Section and secure it with the six (6) Screws.

Mount the Front Cover of the TC Base Section by sliding the cover inside the TC Base Section. Secure it with the six (4) Screws and Connect GND connector.



58. Connect GND connector from the Top Cover of the TC Base Section, mount the Top Cover and secure it with the four (4) Screws.



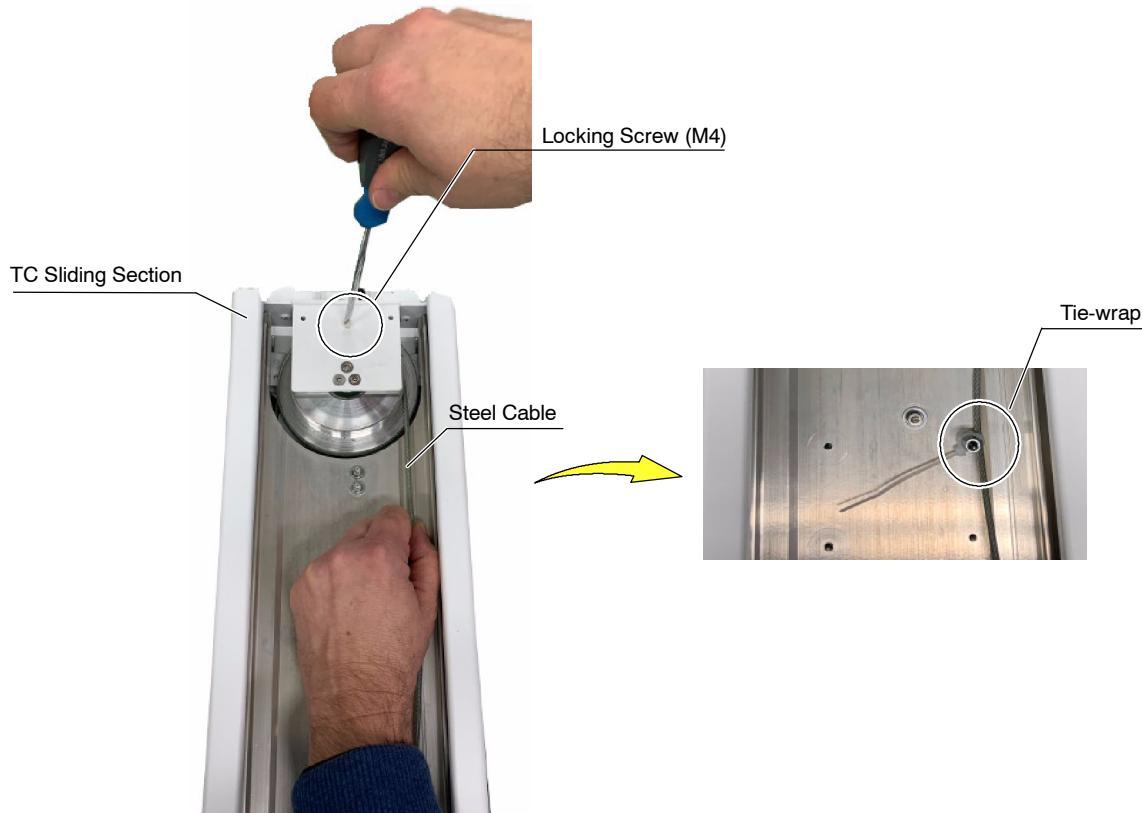
59. Mount all the Covers of the unit previously removed (*refer to Section 2.2.2*).
60. Test the Unit.

3.2.3.2 TC BASE SECTION: REPLACEMENT OF THE UPPER PULLEY ASSEMBLY**Note** 

To replace the Upper Pulley Assembly (Spiral Pulley) of the TC Base Section is needed to loosen and dismount a long part of the Steel Cable.

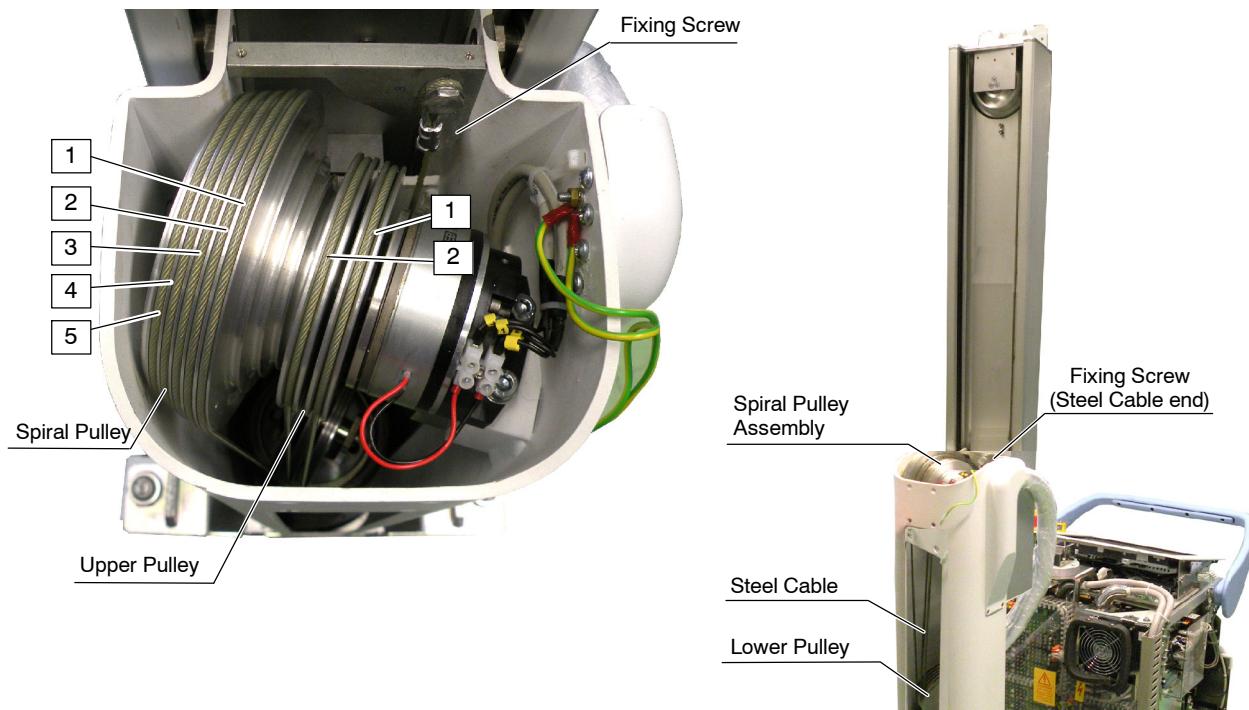
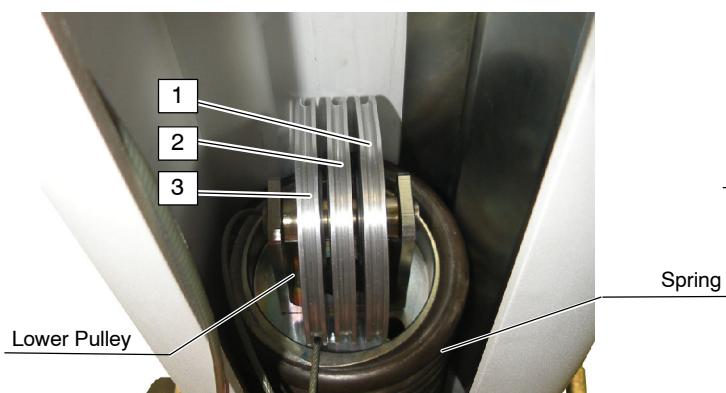
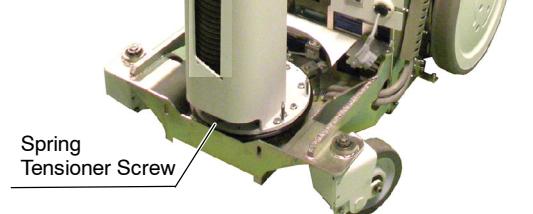
1. Before releasing the Steel Cable from the TC Base Section, perform the process described in *Section 3.2.3.1* from the beginning until step 24. included.

2. With the Steel Cable tight, lock the Pulley with the Locking Screw (M4) and fix the Steel Cable with a Tie-wrap half way of the TC Sliding Section as shown in the picture below.



Note

For procedures related to the TC Base Section (from step 3.), refer to Illustration 3-8.

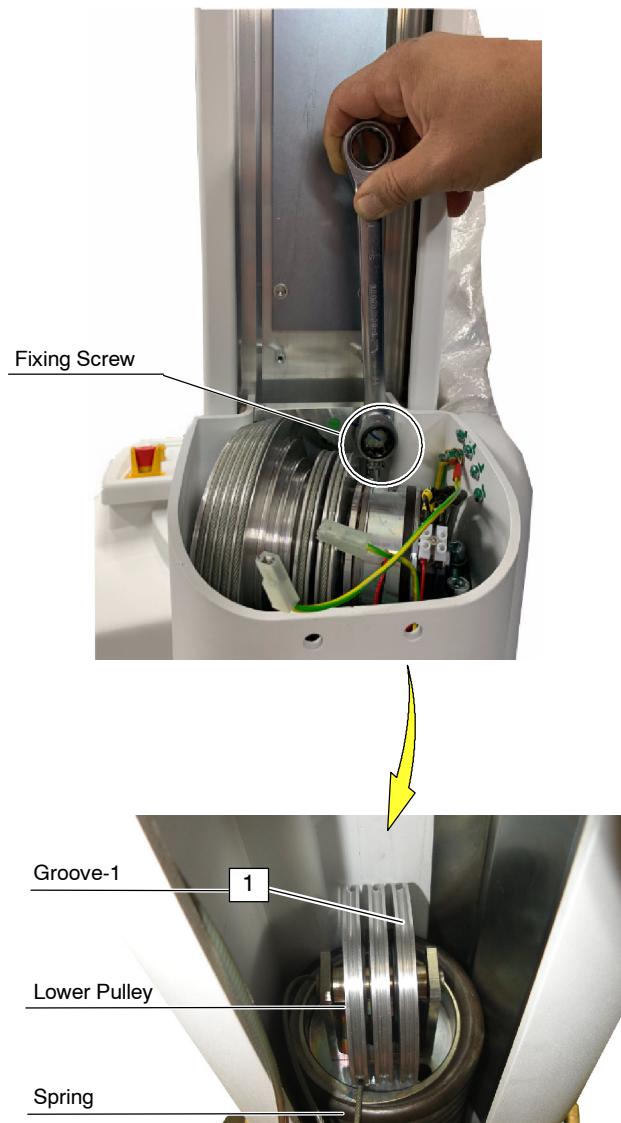
Illustration 3-8
TC Base Section**Spiral Pulley Assembly****Lower Pulley****Spring**

3. Carefully release the Steel Cable from the TC Base Section, as described in the following steps:

a. From Fixing Screw → to Lower Pulley groove-1:

Remove the Fixing Screw that fix one end of the Steel Cable to the upper side of the TC Base Section, by using a 15 mm Spanner.

Take the Steel Cable downwards the TC Base Section to the Lower Pulley (over the Spring) and release the Steel Cable clockwise, from the first groove at the right of the Lower Pulley.



b. From Lower Pulley groove-1 → to Upper Pulley groove-1:

Guide the Steel Cable upwards and release it from the first groove at the right, around the Upper Pulley (beside the Spiral Pulley).

c. From Upper Pulley groove-1 → to Lower Pulley groove-2:

Guide the Steel Cable downwards and release it from the second groove around the Lower Pulley.

d. From Lower Pulley groove-2 → to Upper Pulley groove-2:

Guide the Steel Cable upwards and release it from the second groove around the Upper Pulley.

e. From Upper Pulley groove-2 → to Lower Pulley groove-3:

Guide the Steel Cable downwards and release it from the third groove around the Lower Pulley.

f. From Lower Pulley groove-3 → to Spiral Pulley groove-1:

Guide the Steel Cable upwards and release it from the first groove around the Spiral Pulley.

g. From Spiral Pulley groove-1 → to Spiral Pulley grooves-2-3-4-5:

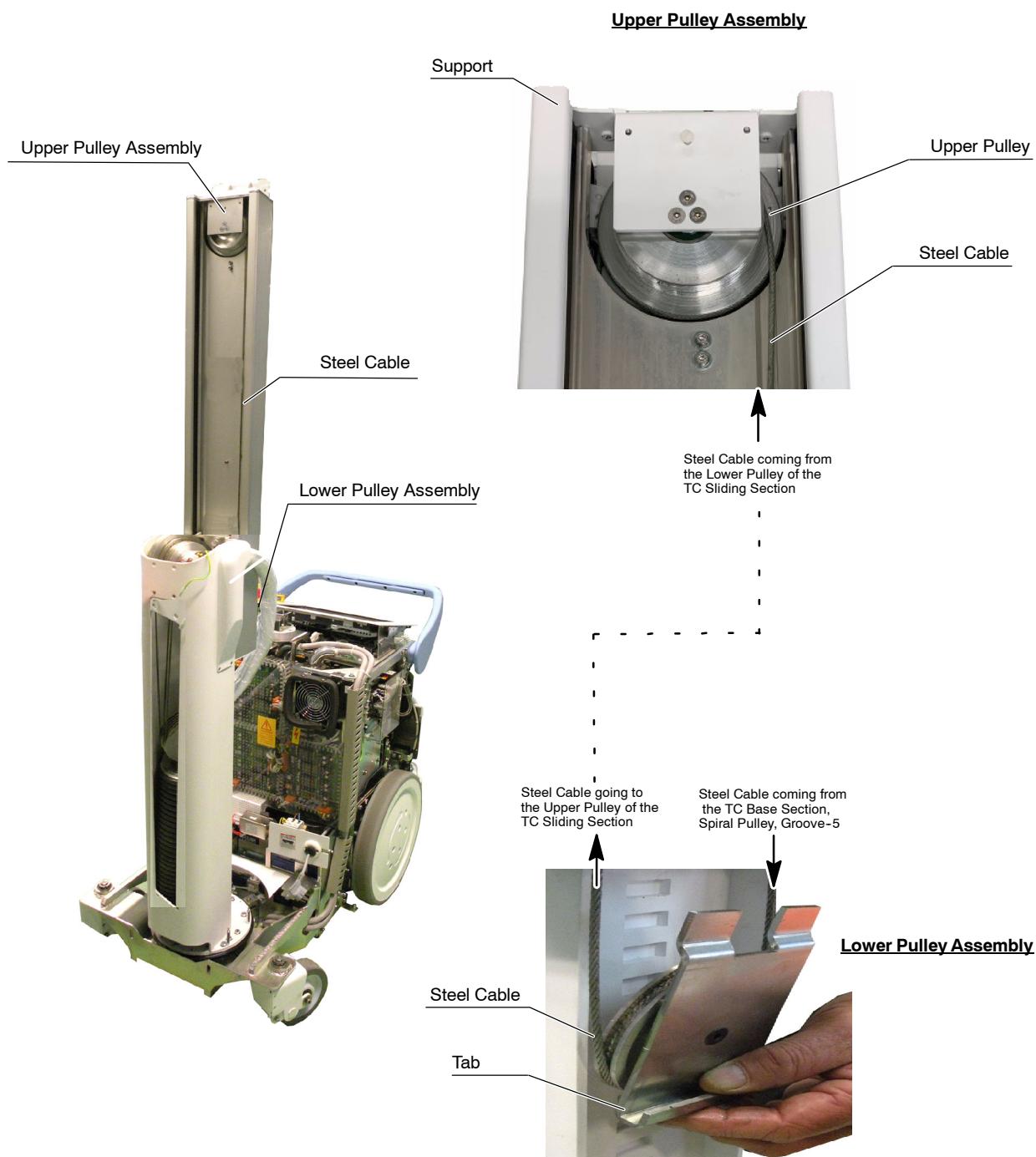
Release the Steel Cable from the first groove of the Spiral Pulley and continue releasing the Steel Cable from the second, the third, the fourth and the fifth grooves of the Spiral Pulley.

h. From Spiral Pulley groove-5 → to Lower Pulley (TC Sliding Section):

Release the Steel Cable from the fifth groove of the Spiral Pulley.

4. Carefully loosen the Steel Cable from the Lower Pulley Assembly of the TC Sliding Section, as described in the following steps (*refer to Illustration 3-9.:*)

Illustration 3-9
TC Sliding Section Section

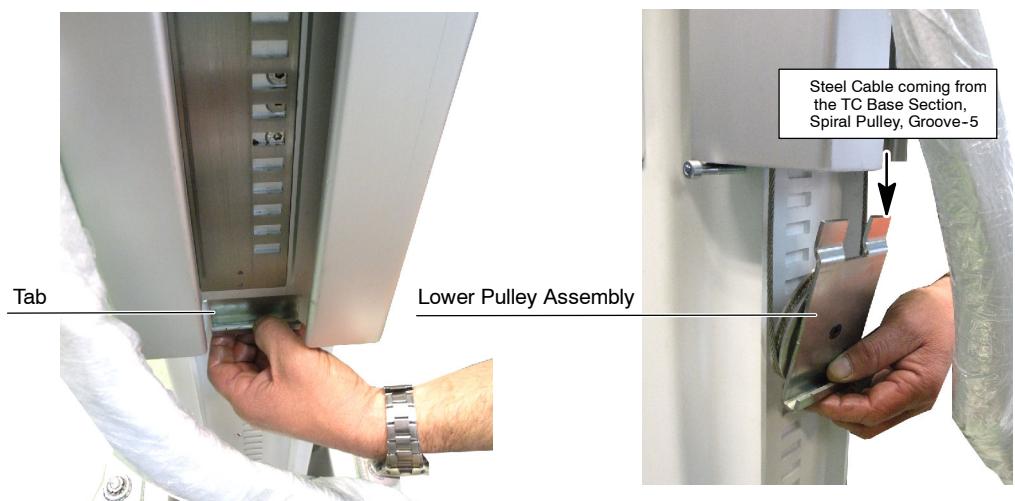
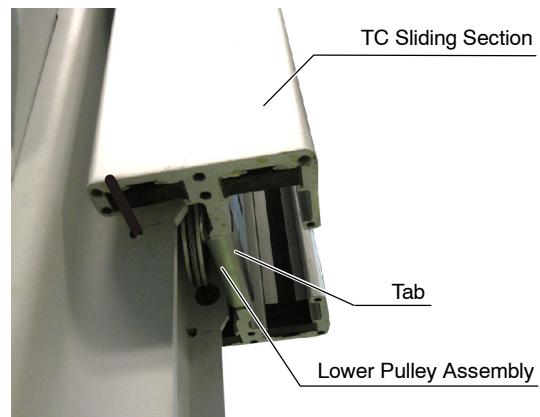


- a. Dismount the Lower Pulley Assembly by pulling its Tab downwards.

Note 

Previously, the Rubber Stops (2+2) have been removed and two (2) Locking Screws have been mounted in the drills at both sides of the TC Base Section, in order to lock the TC Sliding Section in the top position.

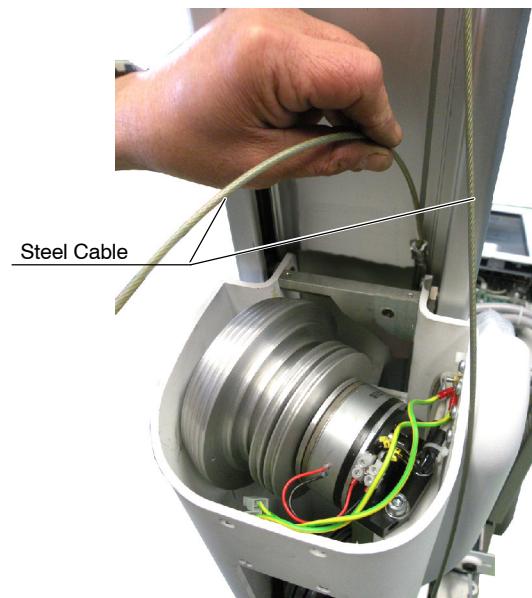
- b. Then, loosen the Steel Cable by removing the Lower Pulley.



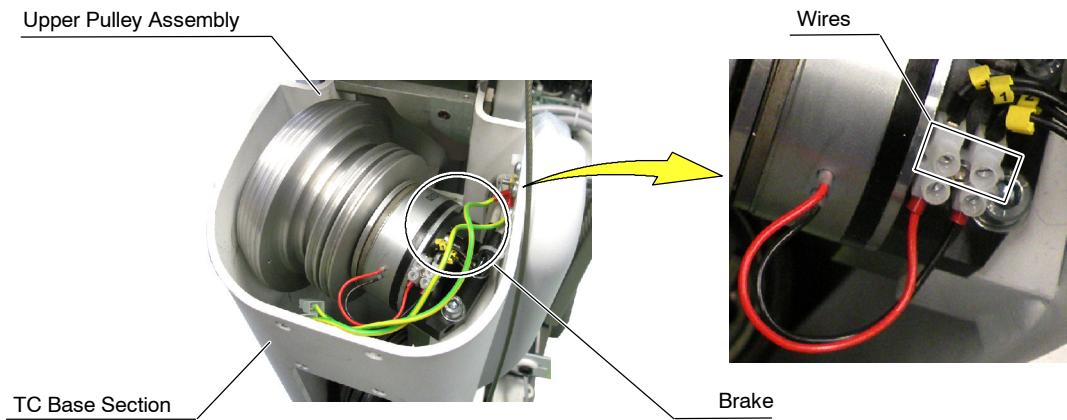
Mobile X-Ray Unit

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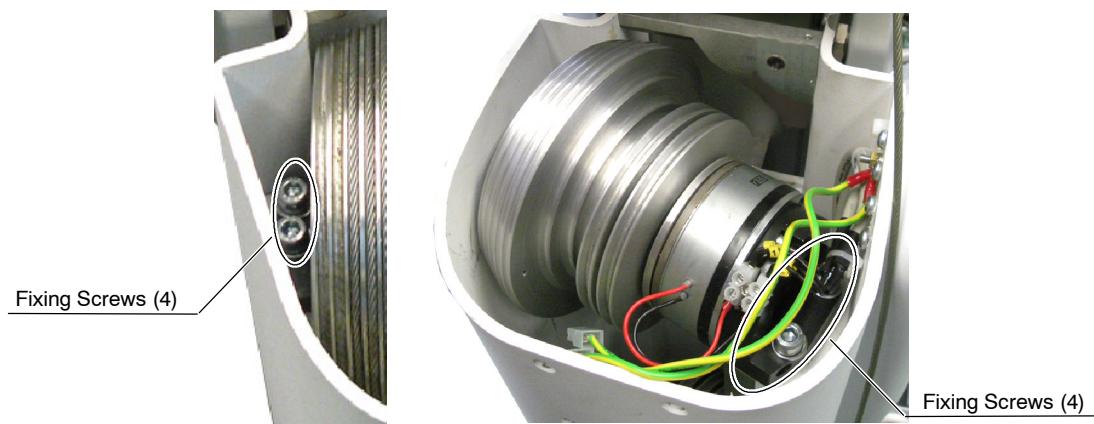
- c. After release the Steel Cable from the TC Base Section, keep the Steel Cable loosen close to the Spiral Pulley Assembly.



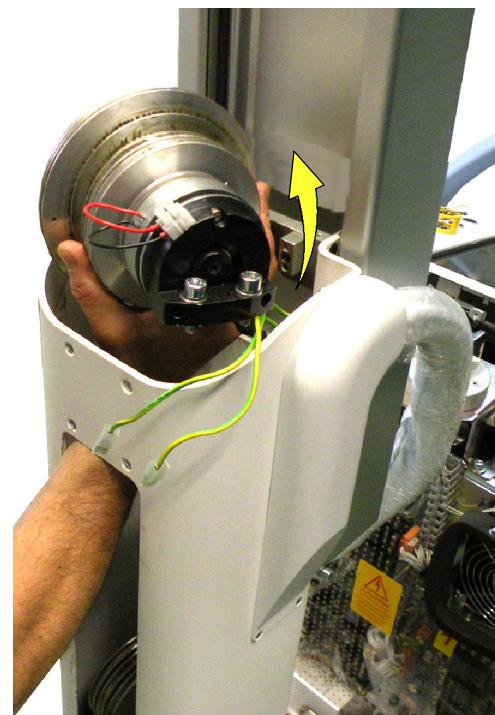
5. Disconnect wires from the Brake of the Upper Pulley Assembly and isolate the ends with electrical tape.



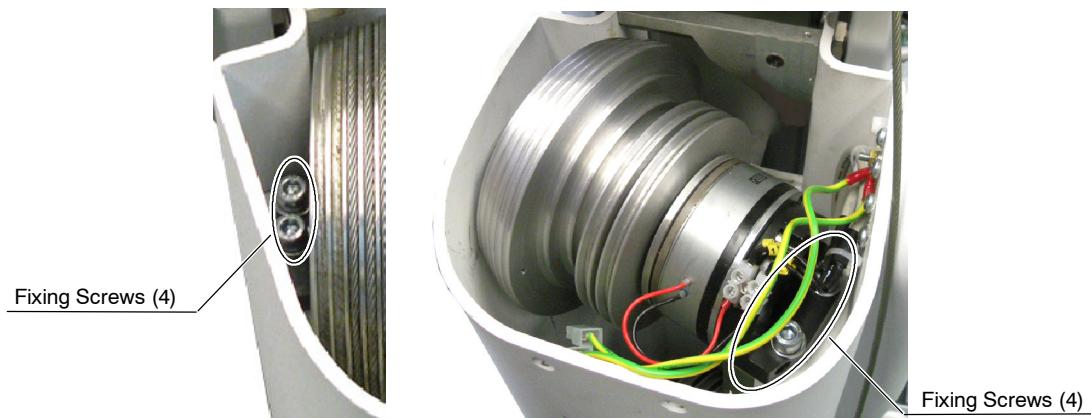
6. Remove the four (4) Fixing Screws that fix the Upper Pulley Assembly to the TC Base Section.



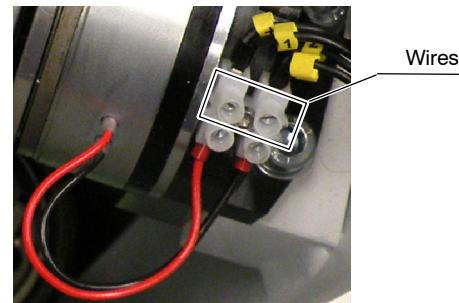
7. Dismount upwards the Upper Pulley Assembly from the TC Base Section as shown in the picture below.



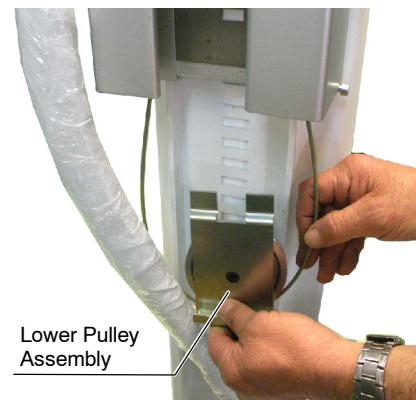
8. Replace the Upper Pulley Assembly and fix it to the TC Base Section with the four (4) Fixing Screws, applying Loctite 243.



9. Remove the electrical tape from the wires of the Brake Cable and connect the wires to the Brake of the Upper Pulley Assembly.



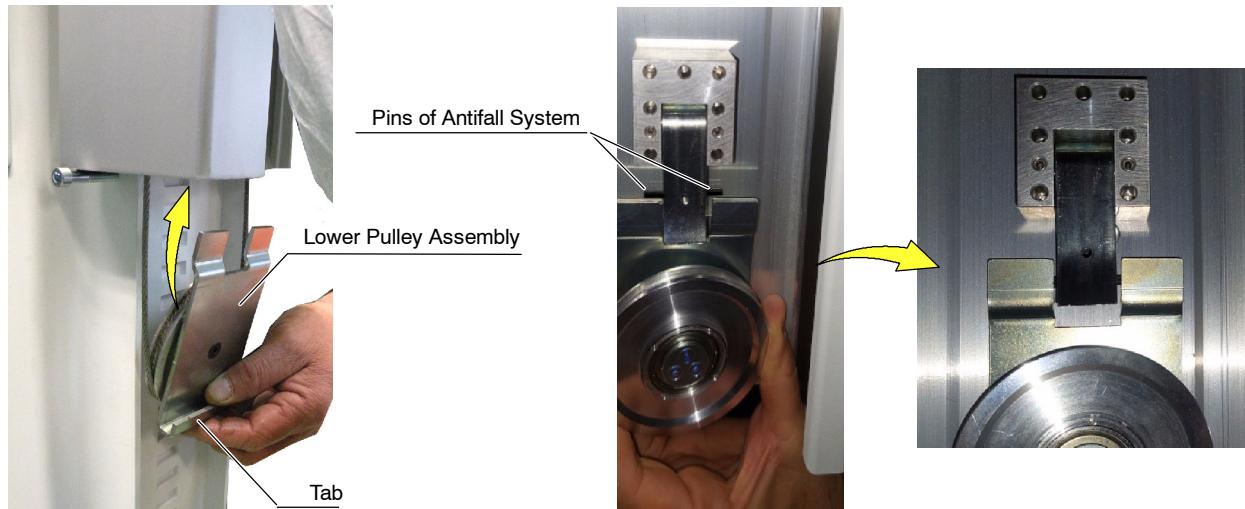
10. Place the Lower Pulley Assembly with the Steel Cable around the Pulley groove, as shown in the picture below.



11. While keeping tension on the Steel Cable, mount the Lower Pulley Assembly inside the lower end of the TC Sliding Section.

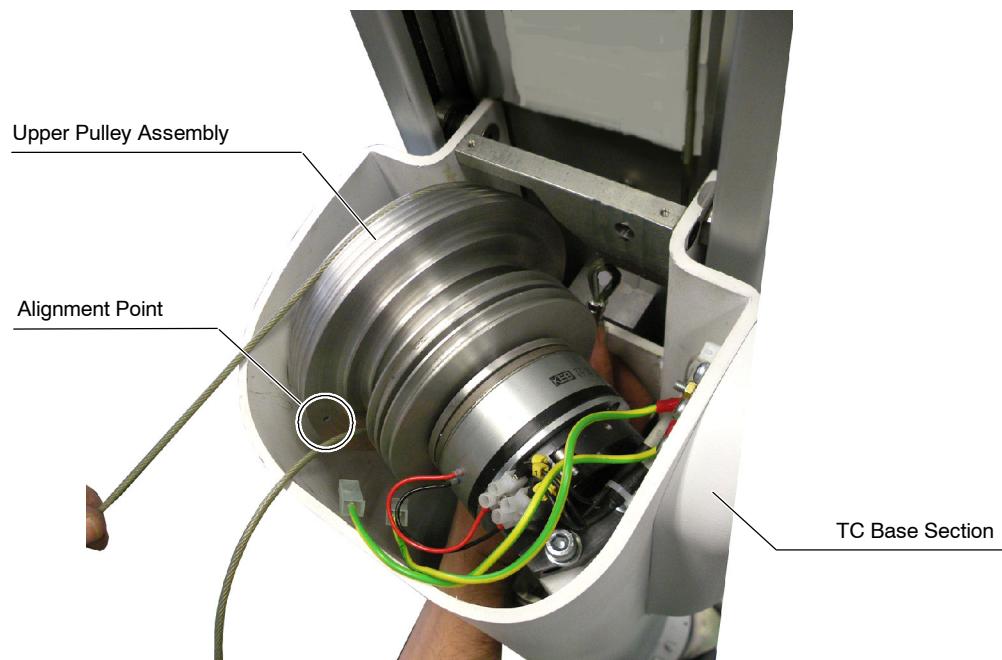


It is very important that the two (2) pins of the Antifall System are positioned between the surface of the Column and the two (2) lugs of the pulley support, otherwise the column will be always blocked with the Antifall System.



With the steel cable tight, check the correct installation of the Lower Pulley Assembly by inserting a rigid strip of metal, plastic or similar, 1 mm thick and at least 25 cm long, into the column and in front of the pulley, verify that the strip can move freely without colliding with the Antifall System.

12. With the Steel Cable tight, turn the unit ON.
Press the Tube-Collimator Assembly Handgrips in order to release the Brake of the Upper Pulley Assembly in the TC Base Section.
Turn the Assembly until the Alignment Point of the Spiral Pulley is at 90° degrees, as shown in the picture below.
Turn the unit OFF.



13. Carefully guide the Steel Cable as described in the following steps:

Note 

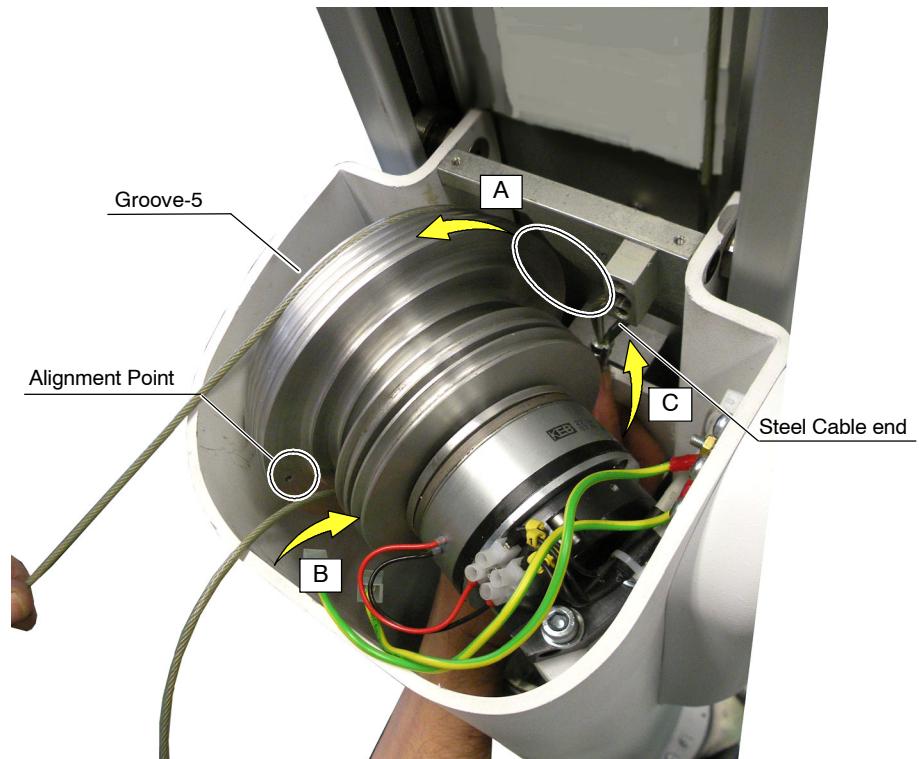
For procedures related to the TC Base Section, refer to Illustration 3-8.

- a. From Lower Pulley (TC Sliding Section) → to Spiral Pulley groove-5 (TC Base Section):

(A) Take the Steel Cable end coming from the TC Sliding Section through the window in the TC Base Section, keeping the Cable tight.

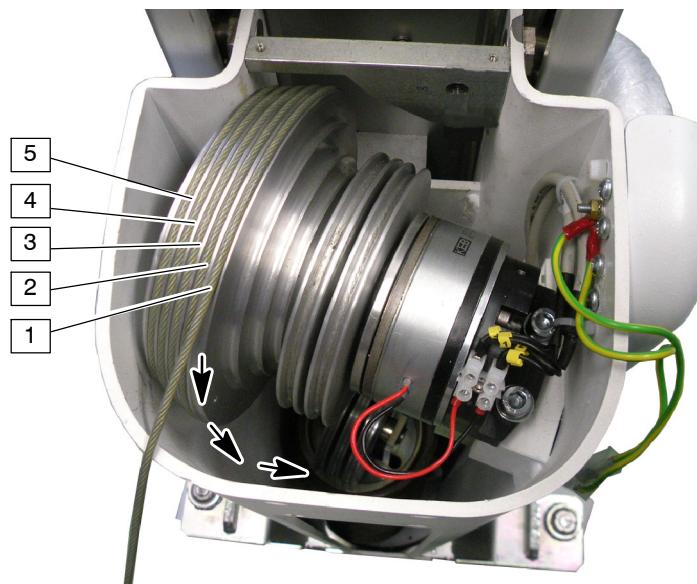
(B) Turn the Steel Cable counterclockwise around the fifth Groove of the Spiral Pulley.

(C) Pass the Steel Cable end below the Spiral Pulley as shown in the picture.



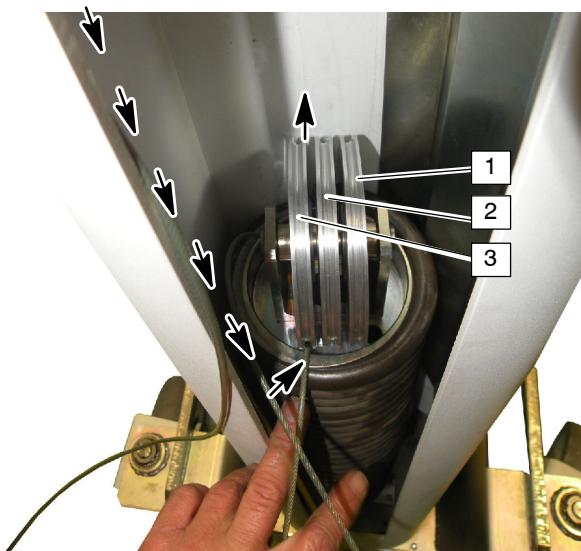
b. From Spiral Pulley groove-5 → to Spiral Pulley grooves-4-3-2-1:

Turn the Steel Cable counterclockwise around the Spiral Pulley from the fifth groove, to the fourth, third, second and first grooves.



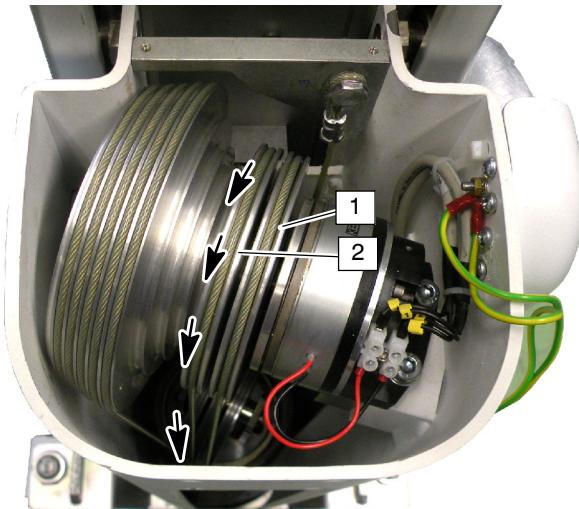
c. From Spiral Pulley groove-1 → to Lower Pulley groove-3:

Keeping the Steel Cable tight, guide it Cable downwards from the first groove of the Spiral Pulley and turn it counterclockwise around the third groove of the Lower Pulley.



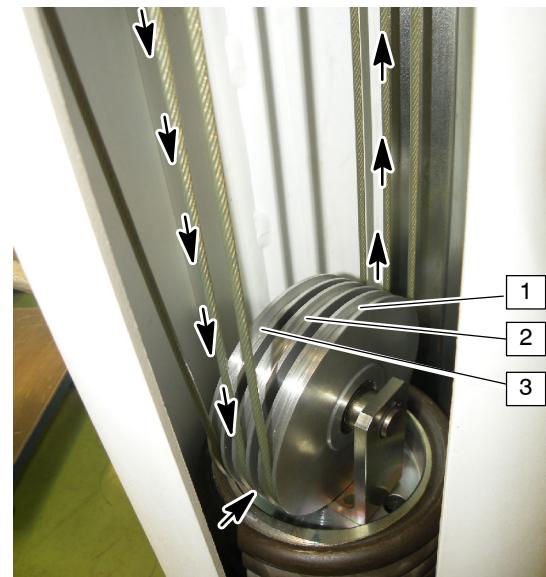
d. From Lower Pulley groove-3 → to Upper Pulley groove-2:

Guide the Steel Cable upwards from the third groove of the Lower Pulley and turn it around the second groove of the Upper Pulley.



e. From Upper Pulley groove-2 → to Lower Pulley groove-2:

Guide the Steel Cable downwards from the second groove of the Upper Pulley to the second groove of the Lower Pulley.



f. From Lower Pulley groove-2 → to Upper Pulley groove-1:

Guide the Steel Cable upwards from the second groove of the Lower Pulley and turn it around the first groove of the Upper Pulley.

g. From Upper Pulley groove-1 → to Lower Pulley groove-1:

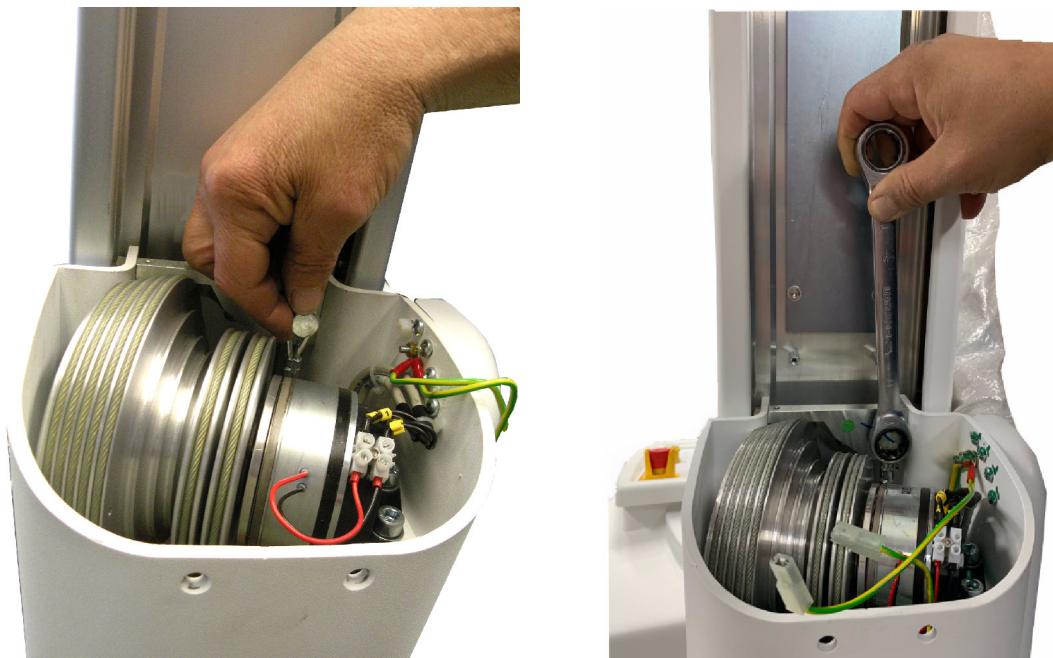
Guide the Steel Cable downwards from the first groove of the Upper Pulley to the first groove of the Lower Pulley.

h. From Lower Pulley groove-1 → to Fixing Screw :

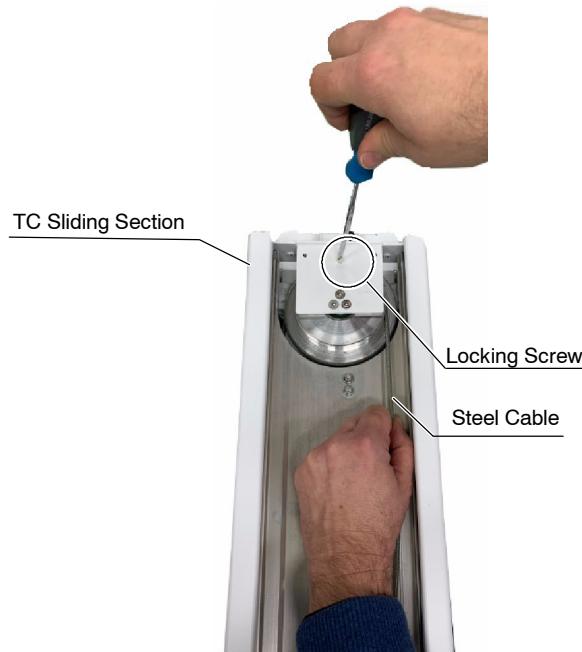
Guide the Steel Cable upwards from the first groove of the Lower Pulley to the Fixing Screw drill.

If necessary, unscrew the Spring Tensioner Screw at the lower end of the TC Base Section in order to loosen the Spring to reach the Fixing Screw drill with the end of the Steel Cable.

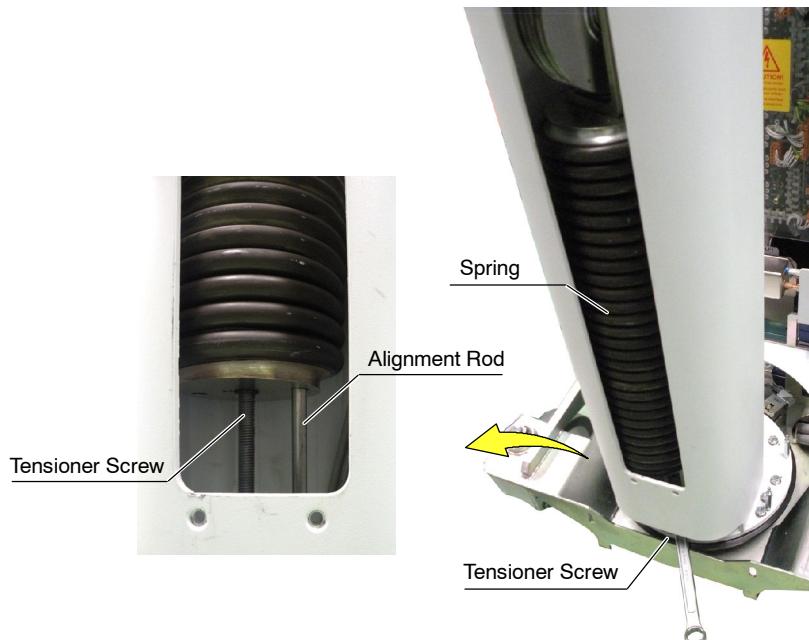
While one person keeps the Steel Cable tight, the other ensures the Steel Cable end with the Fixing screw, adding Loctite 243 and using a Torque of 15 Nm.



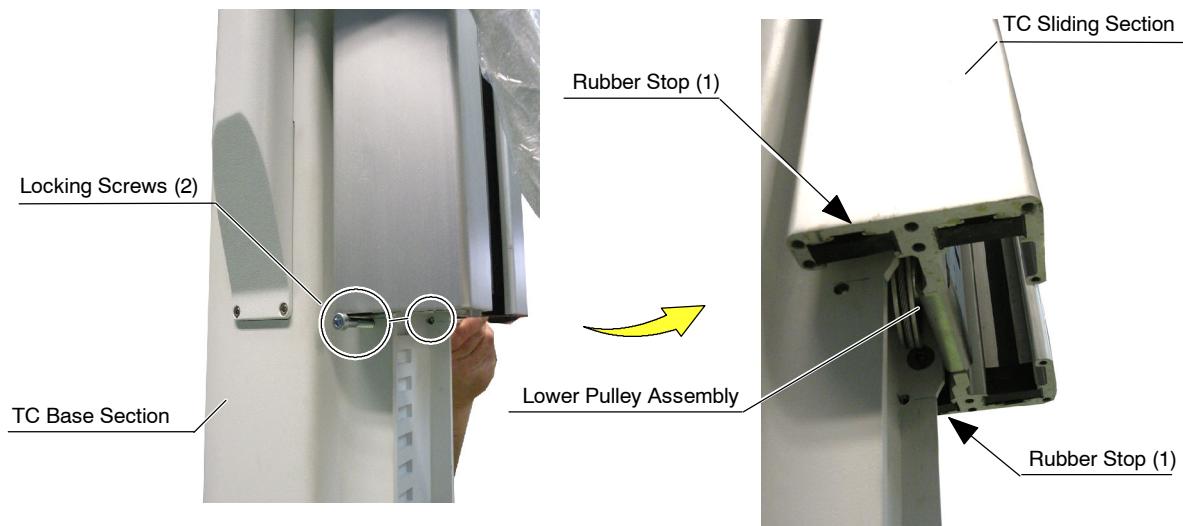
14. While one person keeps holding tight the Steel Cable, the other person cuts the Tie-wrap at the TC Sliding Section and removes the Locking Screw from the Upper Pulley assembly.



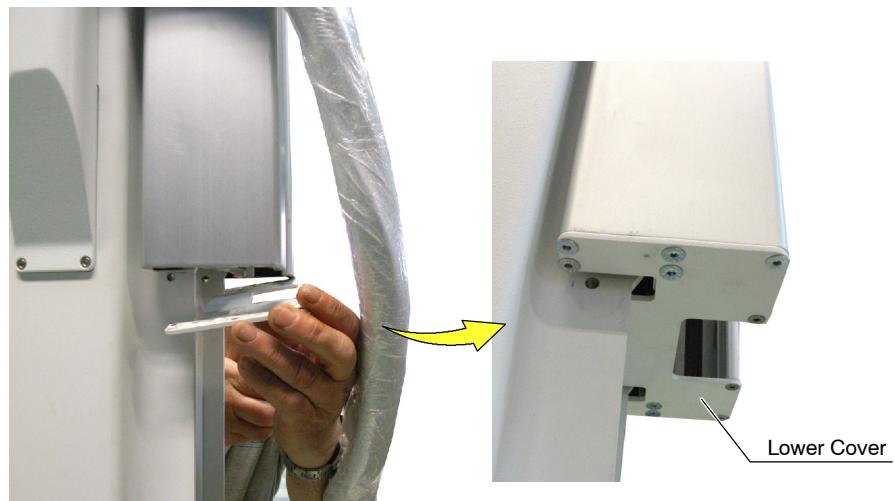
15. At the lower end of the TC Base Section, ensure that the Spring is into the Alignment Rod. Adjust the Tensioner Screw several times to get some tension for the Spring and the Steel Cable.



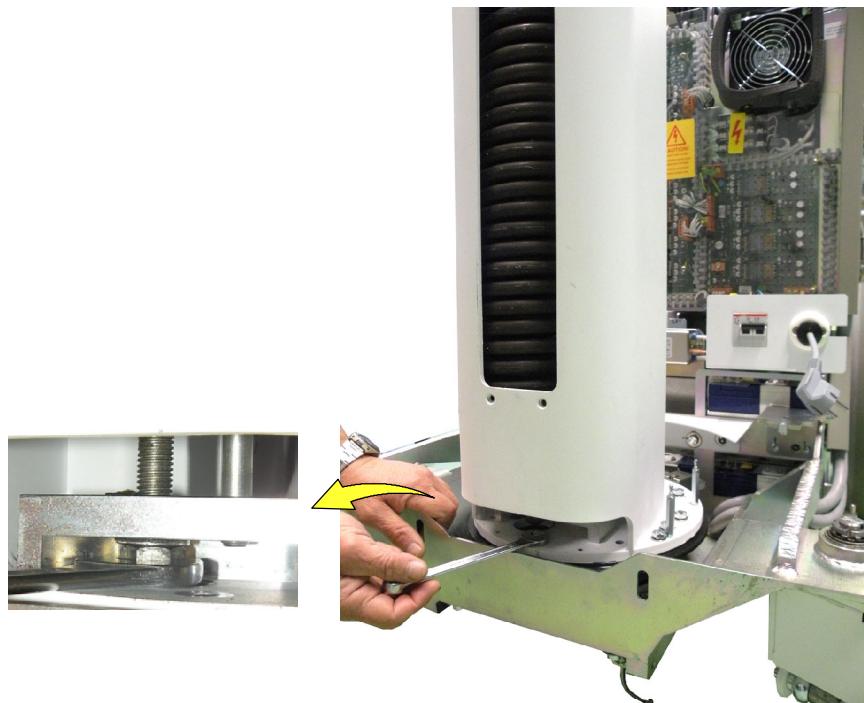
16. Carefully remove the two (2) Locking Screws at both sides of the TC Base Section and mount the Rubber Stops at both sides of the TC Sliding Section as shown in the picture.



17. Mount the Lower Cover using the twelve (12) Screws that secure the cover of the TC Sliding Section.



18. Adjust again the Tensioner Screw several times until getting the required tension for the Spring and the Steel Cable.



Note 

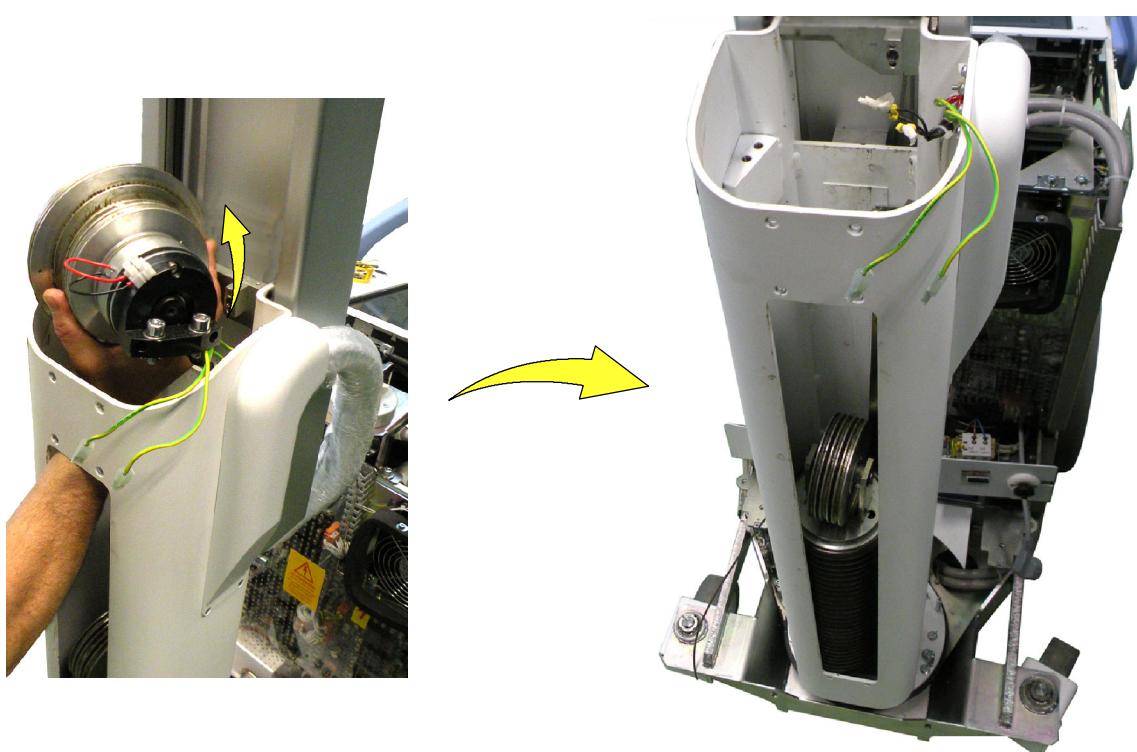
When the Arm, the Tube-Collimator Assembly and all the covers of the Telescopic Column are assembled in the unit, the Tensioner Screw will be adjusted again, in order to get the adequate tension for the Spring and the Steel Cable.

19. Complete the procedure by performing the process described in Section 3.2.3.1 from the step 48. until the end.

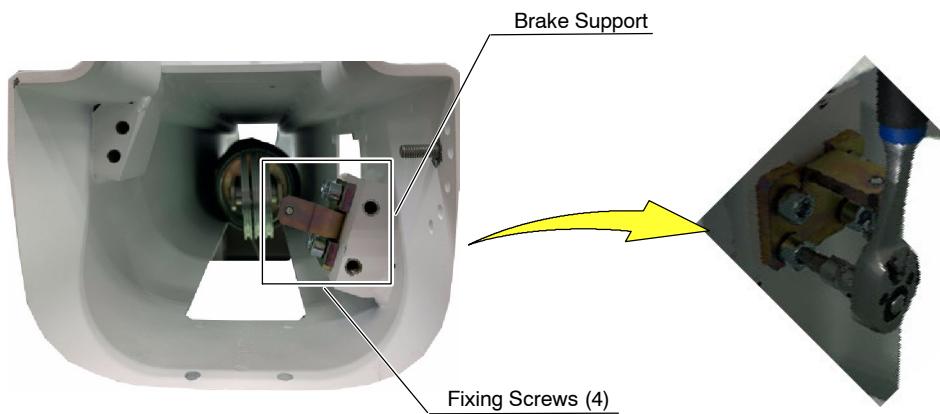
3.2.3.3 TC BASE SECTION: SPRING REPLACEMENT**Note** 

To replace the Spring of the TC Base Section is needed to loosen and dismount a long part of the Steel Cable and remove the Upper Pulley Assembly (Spiral Pulley) of the TC Base Section.

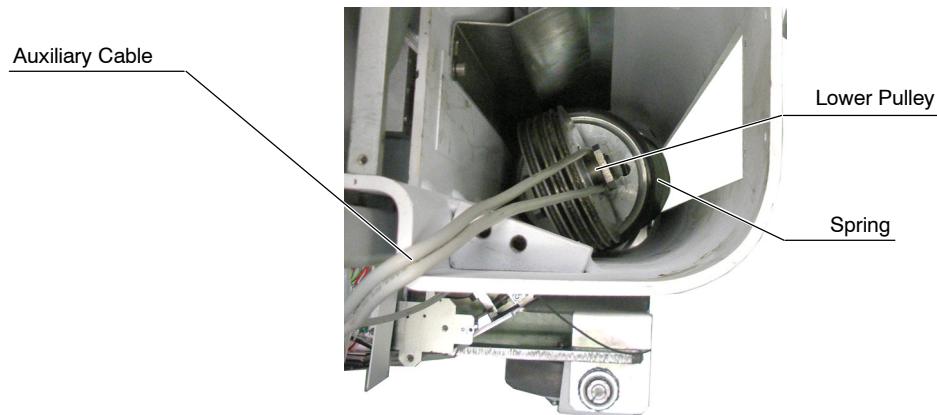
1. To dismount the Upper Pulley Assembly in order to get access to the Spring, follow the procedures described in Section 3.2.3.2 from the beginning until step 7. included.



2. Dismount the Support for centering the Brake by removing the four (4) Fixing Screws.



3. Place an Auxiliary Cable or Sling around the Lower Pulley of the Spring, as shown in the picture below, in order to ease the Spring removal in the following steps.



4. At the lower end of the TC Base Section, unscrew the Tensioner Screw several times, while keeping the Spring up with the other hand by using a lever or a big screwdriver as shown in the next picture, until completely release the Spring.



5. Lift the Spring Assembly by lifting the Auxiliary Cable or Sling previously mounted around the Lower Pulley. Remove the Spring Assembly.

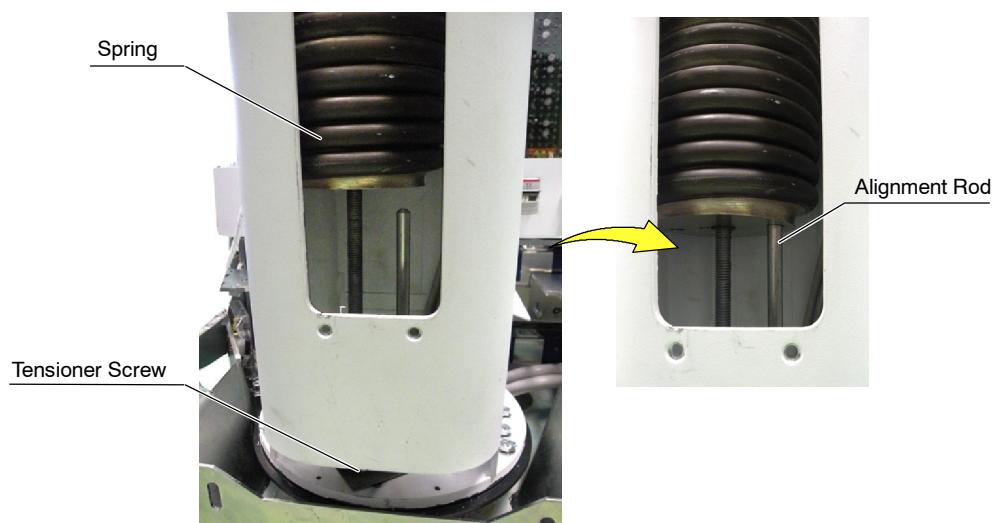


6. Place an Auxiliary Plate at the Base of the Column, under the Tensioner Screw to avoid it from falling down the hole.

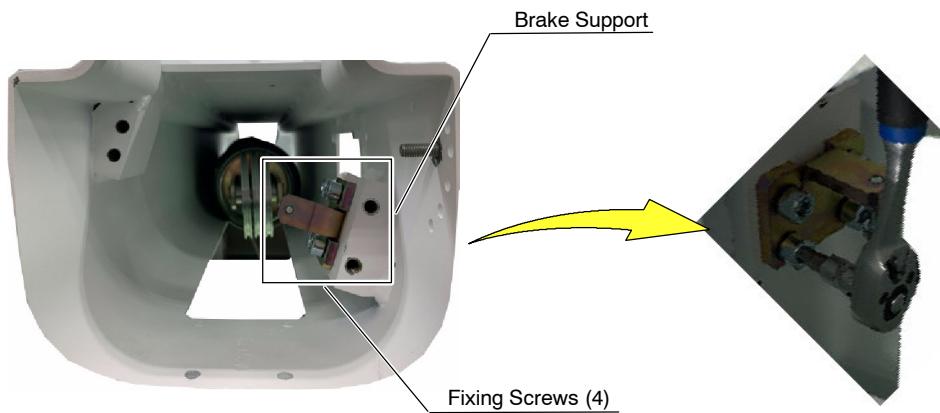
Place the auxiliary cable around the Lower Pulley of the new Spring Assembly; then, carefully lower the Spring until it is inserted into the Tensioner Screw.



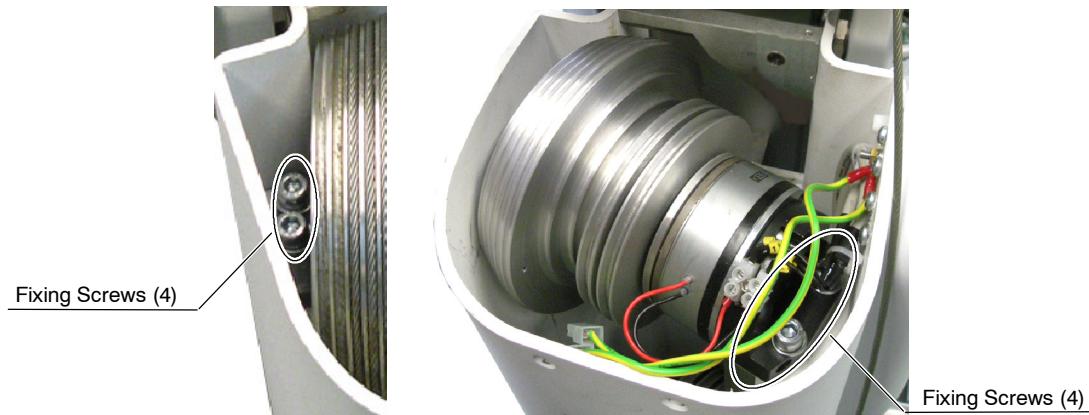
7. Adjust the Tensioner Screw carefully until inserting the Spring inside the Alignment Rod.



8. Mount the Brake Support for centering the Brake by fixing the four (4) Fixing Screws, applying Loctite 243.



9. Mount the Upper Pulley Assembly and fix it to the TC Base Section with the four (4) Fixing Screws.



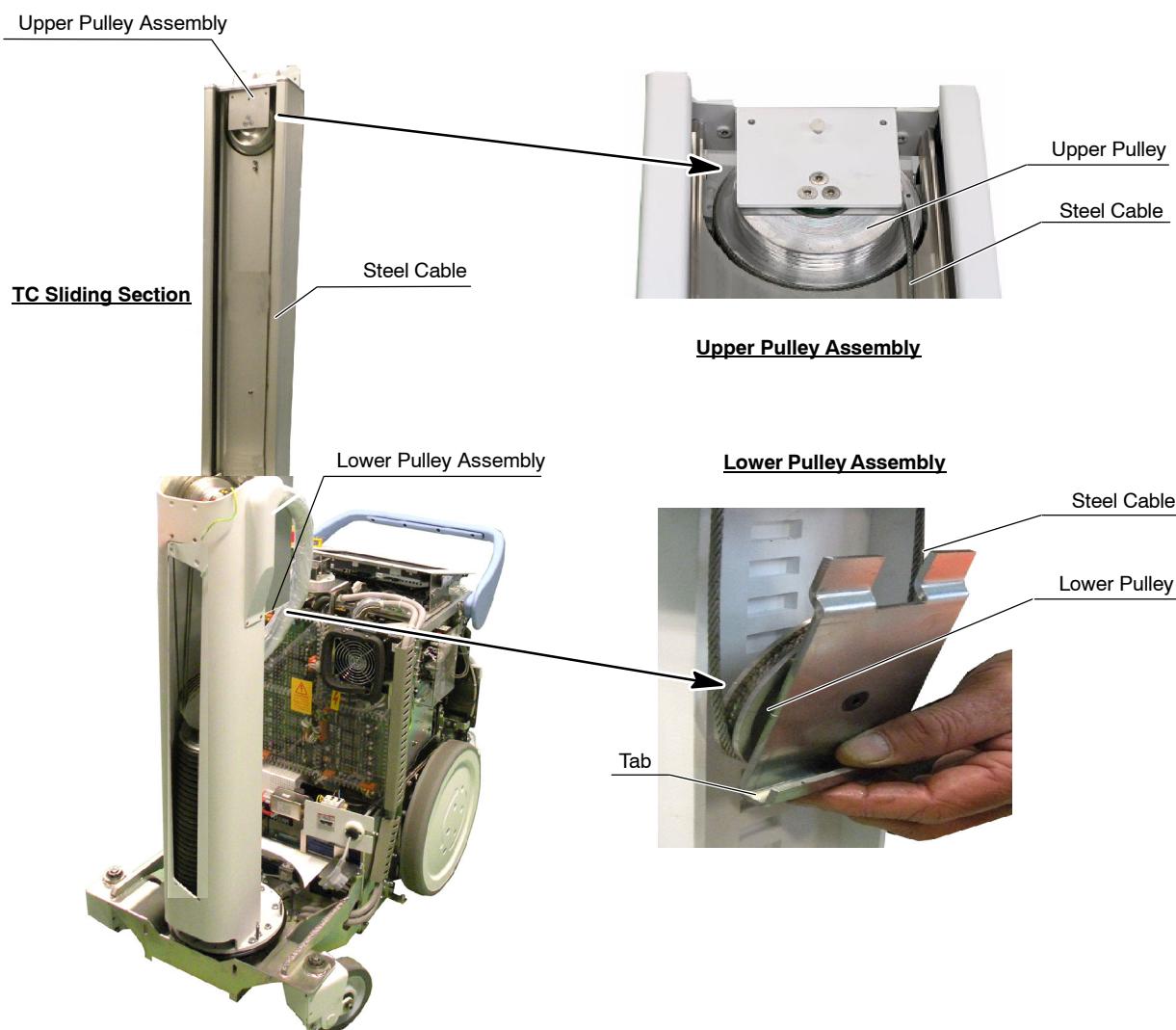
10. Complete the procedure by performing the process described in Section 3.2.3.2 from the step 9. until the end.

3.2.3.4 TC SLIDING SECTION: UPPER AND LOWER PULLEYS REPLACEMENT

Note 

To dismount the Upper and Lower Pulleys of the TC Sliding Section Carefully follow the necessary steps of Section 3.2.3.1 for the replacement of the Steel Cable until the corresponding steps for dismount the pulleys.

Then, replace the Pulleys and follow the necessary steps to mount the Upper Pulley and/or Lower Pulley of the TC Sliding Section as described in Section 3.2.3.1



**3.2.3.5 TC SLIDING SECTION DISASSEMBLY:
REPLACEMENT OF THE ANTIFALL SYSTEM AND/OR THE BEARING KIT****Note** 

Two people are necessary to carry out the entire procedure.

Note 

In addition to the Standard Service Engineers Tool Kit, it will be necessary to use an auxiliary table to place it beside the Unit and the Locking Screw with the five Nylon Washers provided in the spare part SAT-AS00794.

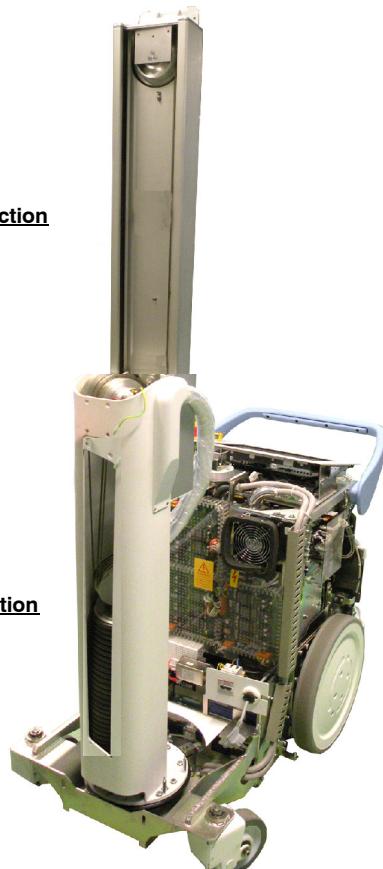


Locking Screw with Nylon Washers

1. Follow the procedures described in *Section 3.2.3.1 for Column Steel Cable Replacement*, from step 1. to step 24.

TC Sliding Section

TC Base Section

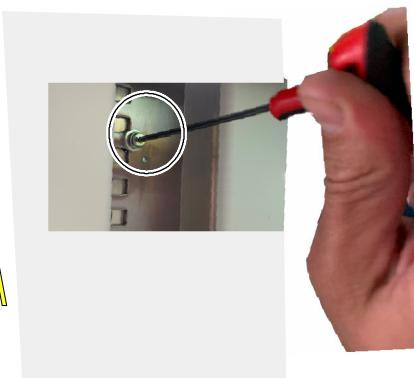


2. Insert the Locking Screw with the five Nylon Washers as shown in the following pictures.

TC Sliding Section



Locking Screw with Nylon Washers



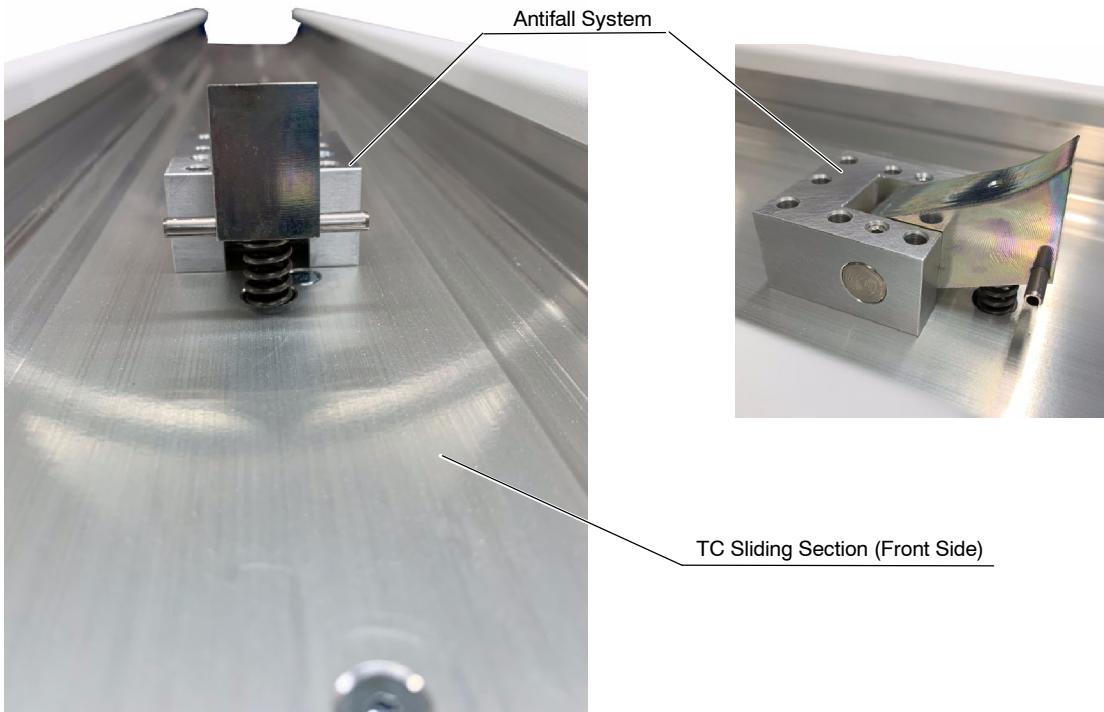
TC Base Section



The Locking Screw is used to prevent the damage of the Antifall System (Parachute kit Spring) in the TC Sliding Section, when disassembling the TC Sliding Section from the TC Base Section.

3. Continue performing the procedures described in Section 3.2.3.1 for *Column Steel Cable Replacement*, from step 25. to step 26., in order to completely dismount and remove the Steel Cable from the Mobile Unit.

4. Slide the TC Sliding Section upwards to disengage it from the TC Base Section, and carefully place the TC Sliding Section on the auxiliary table.



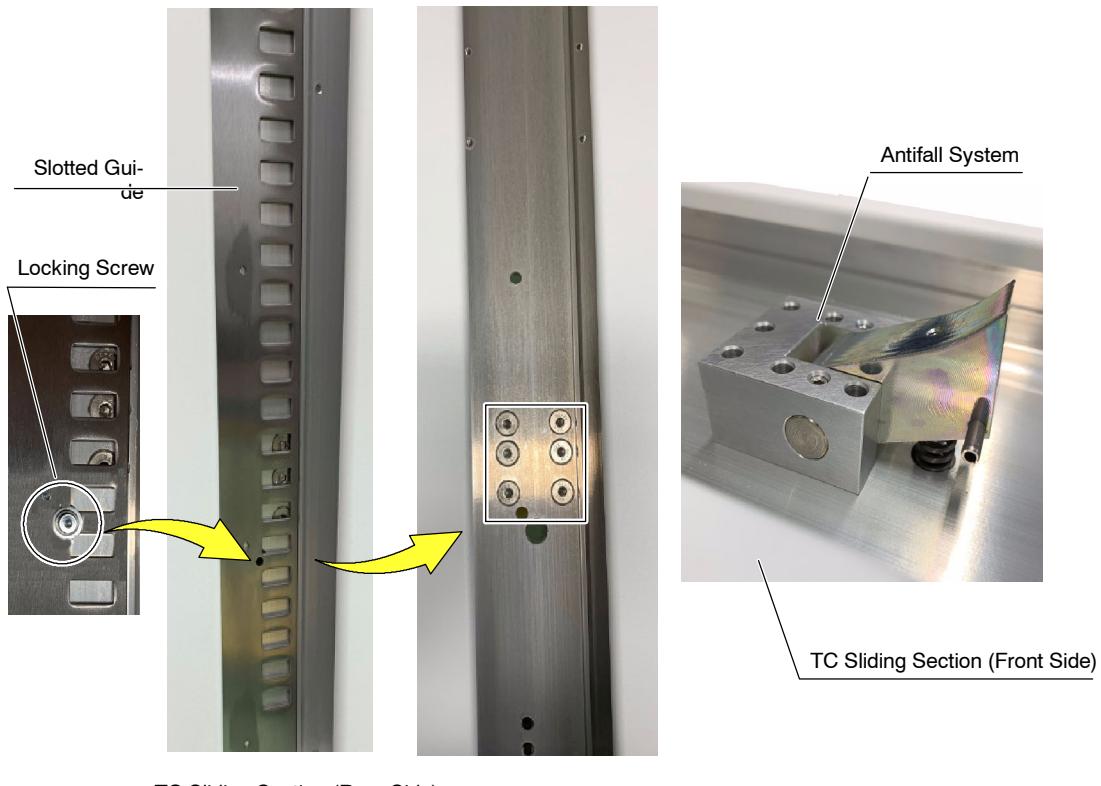
Note

*Follow the procedures described in step 5. in order to replace the **Antifall System**.*

*Follow the procedures described in step 6. in order to replace the **Bearing Kit**.*

5. **Antifall System** replacement:

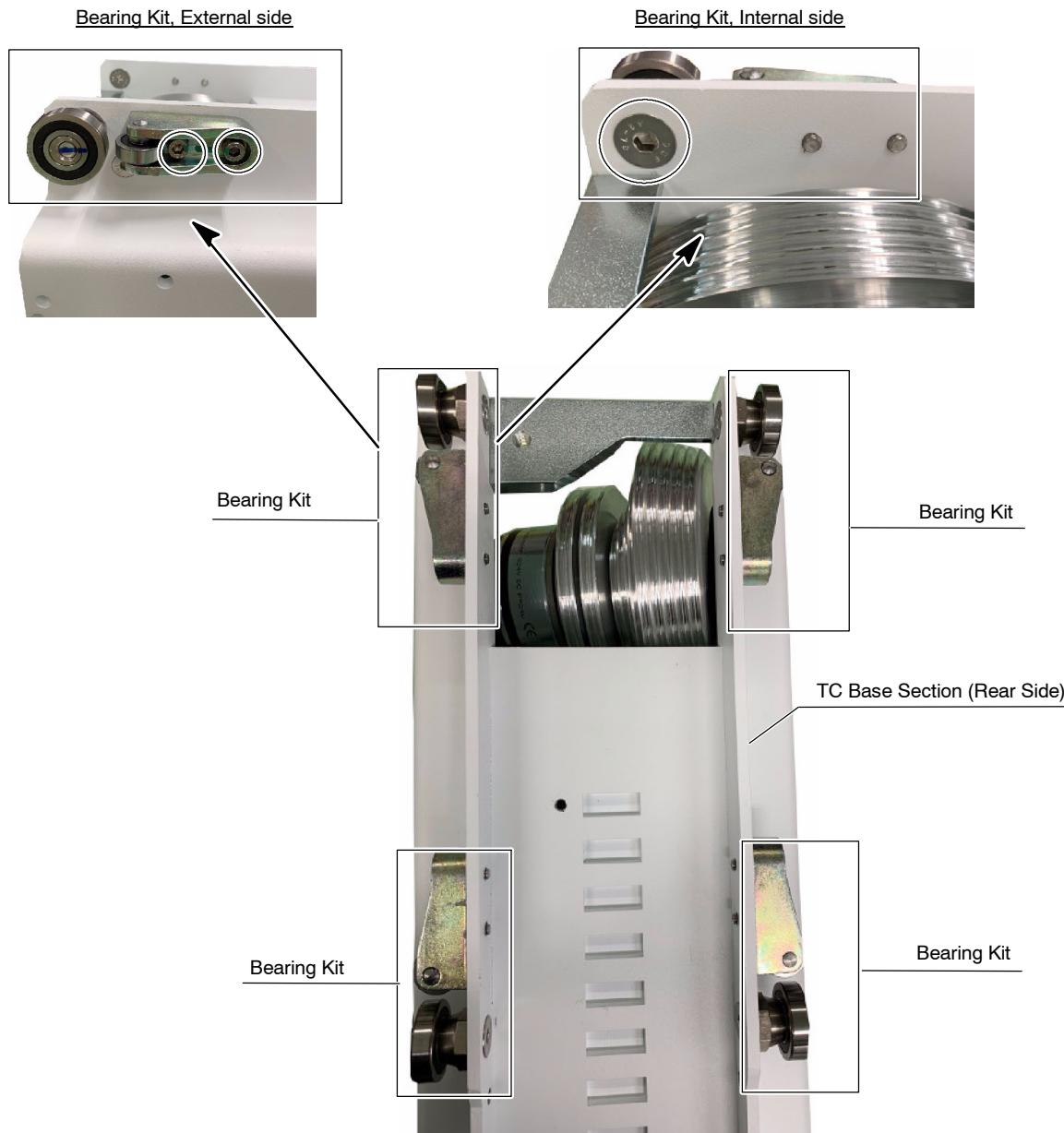
- a. Turn the TC Sliding Section in order to access to the rear side.
- b. Remove the Locking Screw with Nylon Washers and the Safety Slotted Guide.
- c. Remove the Screws (x6) that fix the Antifall System to the Column.
- d. Replace the Antifall System and fix it with the Screws (x6).
- e. Re-install the Safety Slotted Guide and the Locking Screw with the five Nylon Washers.



TC Sliding Section (Rear Side)

6. Bearing Kit replacement:

- a. The Bearing kits (x4) are placed on the rear side of the TC Base Section.
- b. Remove the Fixing Screws, on the External side (x2) and on the Internal side (x1), from each Bearing Kit to be replaced.
- c. Replace each Bearing kit, and mount the corresponding Fixing Screws, on the External side (x2) and on the Internal side (x1).



7. Mount the TC Sliding Section on the TC Base Section, sliding it downwards.
8. Remove the Locking Screw.



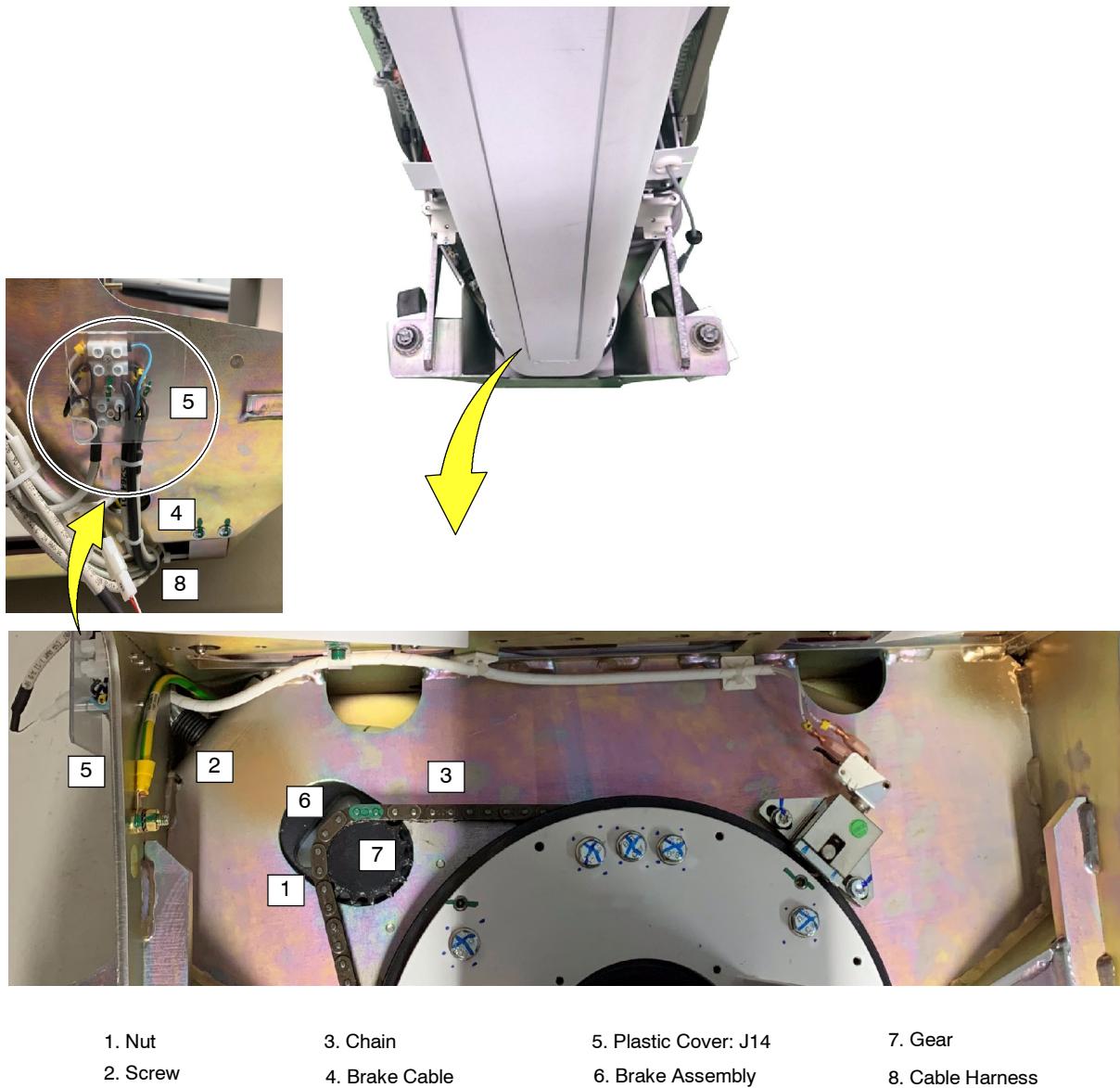
DO NOT FORGET TO REMOVE THE LOCKING SCREW AT THE END OF THE STEEL CABLE INSTALLATION PROCESS. FAILURE TO DO SO MAY RESULT IN SERIOUS DAMAGE TO THE EQUIPMENT.

9. Continue performing the procedures described in *Section 3.2.3.1* for *Column Steel Cable Replacement*, from step 27. to the end, in order to mount the Steel Cable in the Mobile Unit.
10. Mount all the Covers of the unit previously removed (*refer to Section 2.2.2*).
11. Test the Unit.

3.2.3.6 REPLACEMENT / ADJUSTMENT OF THE COLUMN ROTATION BRAKE AND/OR CHAIN FOR COLUMNS WITH REINFORCED FRAME

1. Turn the Unit OFF.
2. Dismount the Front Covers, Curved-Top Cover, Column Base Covers and Bumper Cover as described in *Section 2.2.2*.

Illustration 3-10
Column Rotation - Brake Assembly



Note 

For Chain replacement only, it is not required to remove the Brake Assembly; follow the procedure indicated in the steps 3., 4., 5., 6., 7., 8., 9., 13., 14. and finally steps 15., 16., 17., 18. and 19.

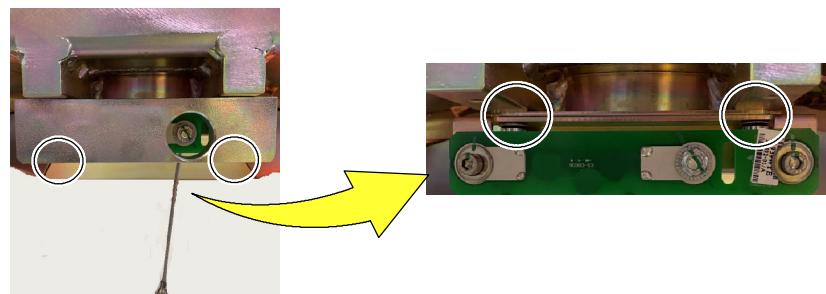
3. Elevate the Mobile System with two wooden dowels (12-15 cm approx. each) to keep the Unit in an upper position.



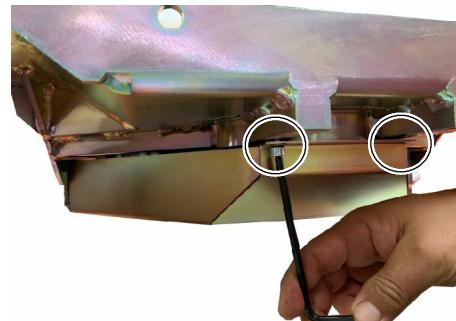
4. Remove the Plastic Cover [5] and disconnect connectors J14-1 and J14-3 (black and blue wires).



5. Remove the two Screws that fix the thick plate that protects the arrestor. Then remove the Arrestor by unscrewing the two (2) Screws that hold it.



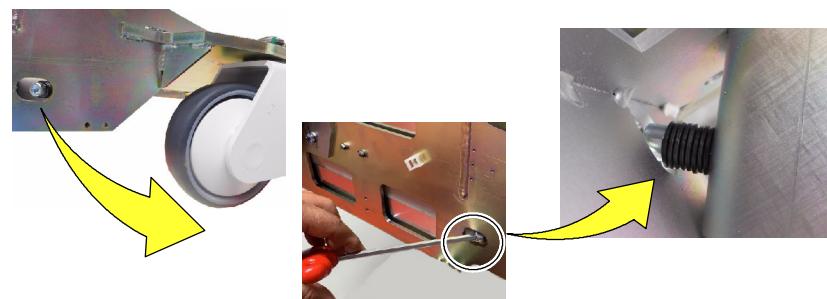
6. Remove the crankcase cover at the lower part of the Mobile Unit.



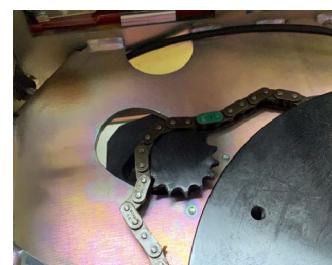
7. Loosen the Nut [1] on the bottom side of the Brake Assembly.



8. Release the Screw [2] in order to loosen the tension of the Chain [3].



9. Remove the Chain [3] away from the Gear [7] by dismounting its Coupling Link.



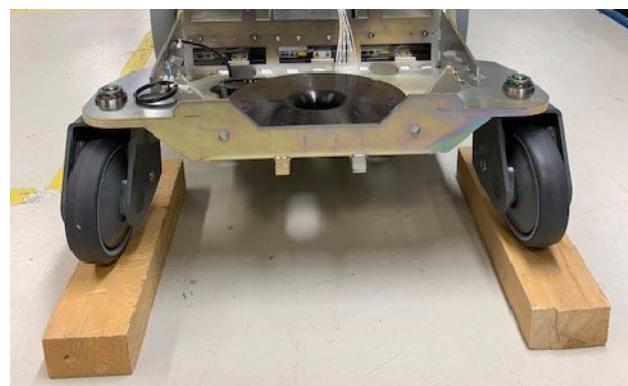
10. With one hand, holding it as it is released, remove the complete Brake Assembly [6] from the guides where it is placed.



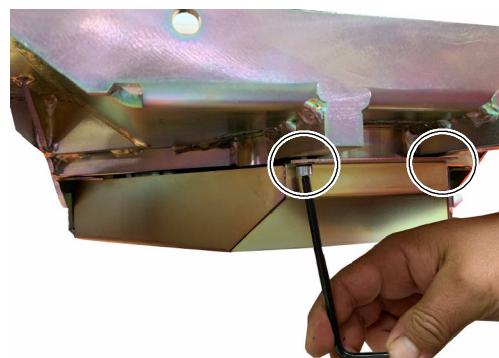
11. In order to replace the Brake Assembly [6], first insert the Brake Cable (black wire) [4] below the hole in Chassis of the Unit, and then pass it through the window for Cables Harness [8] fixing it with tie-wraps.
12. Place the Brake Assembly on its housing.
13. Engage the Chain around the Gear [7] of the Brake Assembly adjusting its tension.
14. Fix the Screw [2] and the Nut [1].
15. Connect connectors J14-1 and J14-3 and install the Plastic Cover [5].
16. Turn the Unit ON and check the Column rotation is correct and smooth, check the Rotation Brake is activated when the Lock Controls are not pressed.
17. Turn the Unit OFF.
18. Grease the Chain, applying the Grease provided with the Brake Assembly or with the Chain.
19. Mount the Front Covers, Curved-Top Cover, Column Base Covers and Bumper Cover as described in *Section 2.2.2*.

3.2.3.7 COLUMN BASE BEARING REPLACEMENT

1. Turn the Unit OFF.
1. Dismount the Front Covers, Curved-Top Cover, Column Base Covers and Bumper Cover as described in *Section 2.2*.
2. Elevate the Mobile System with two wooden blocks (12-15 cm approx. each) to keep the Unit in an upper position.



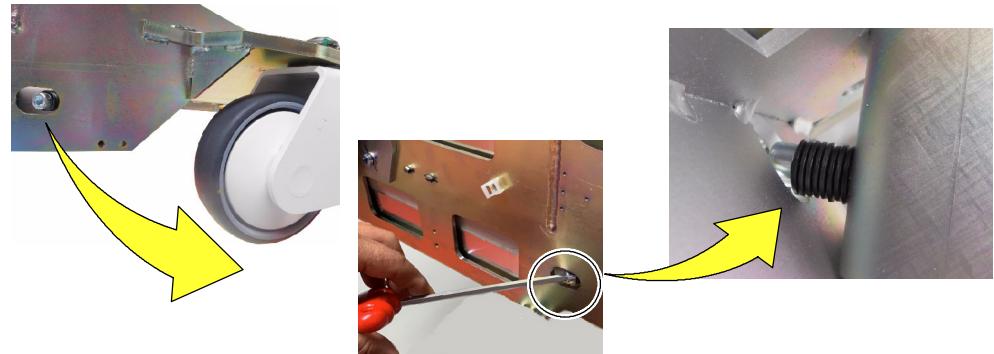
3. Remove the crankcase cover to access to the lower part of the Mobile Unit.



4. Loosen the Nut [1] on the bottom side of the Brake Assembly.



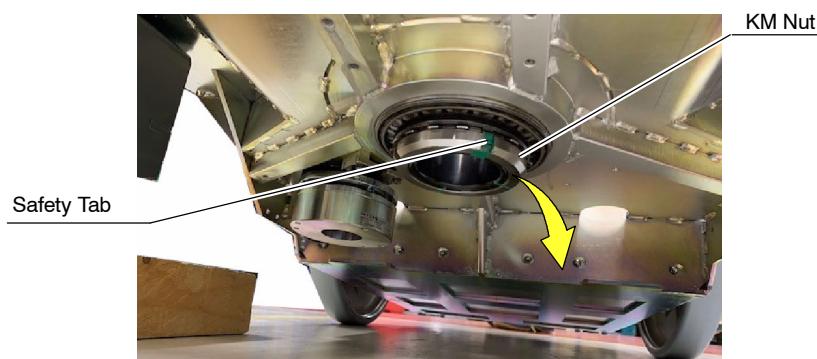
5. Loosen the Screw in order to loosen the tension of the Clutch Chain.



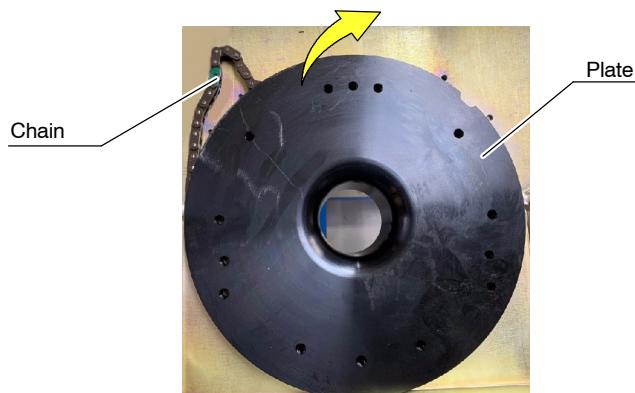
6. Remove the Chain by disengaging it.



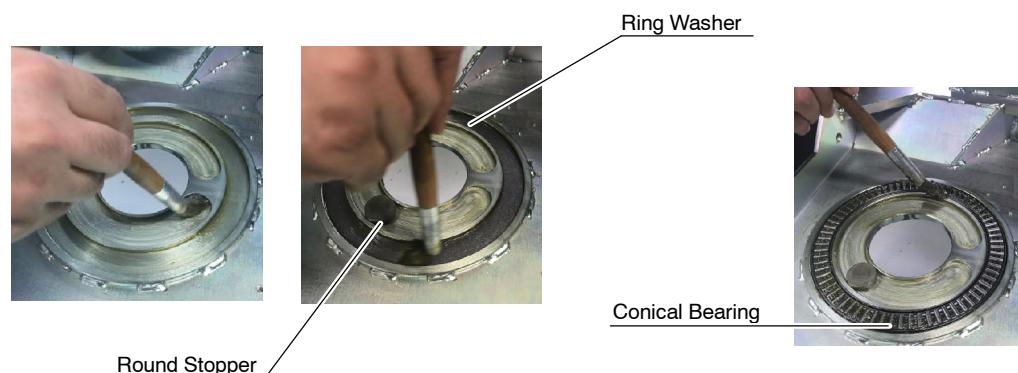
7. Separate the Safety Tab of the KM Nut and hold with one hand the whole assembly that falls when released.



8. Remove the Plate with the Chain. Then, remove the Roller Bearing.



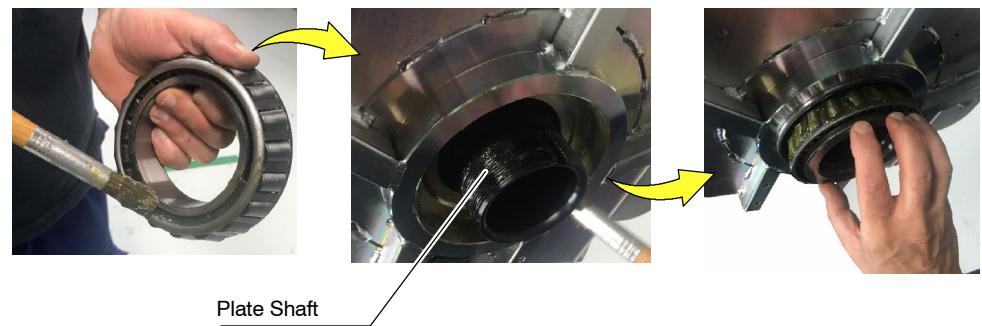
9. Mount the Ring Washer, the round stopper and the Roller Bearing. Lubricate all parts with Multipurpose Lithium grease.



10. Mount the Ring Washer on the Plate. Place the Chain around the Plate and carefully insert the Plate into the chassis.



11. Lubricate the Conical Bearing, the Washer and the KM Nut assembly. Lubricate the Shaft of the Plate previously mounted above. From below, mount the assembly into the Shaft. Ensure that all parts are properly lubricated.



12. Close the Safety Tab.



13. In the upper part of the chassis, engage the Chain around the Gear of the Brake Assembly adjusting its tension. Fix it by tightening the Screw and the Nut previously loosened in steps 5. and 6.
14. Follow the steps described in *Section 2.2* to re-install the Front Covers, Curved-Top Cover, Column Base and Bumper Cover.

3.2.4 PROCEDURES RELATED TO THE ARM (IN TELESCOPIC COLUMN WITH CYLINDRICAL BRAKE)**3.2.4.1 ARM REPLACEMENT**

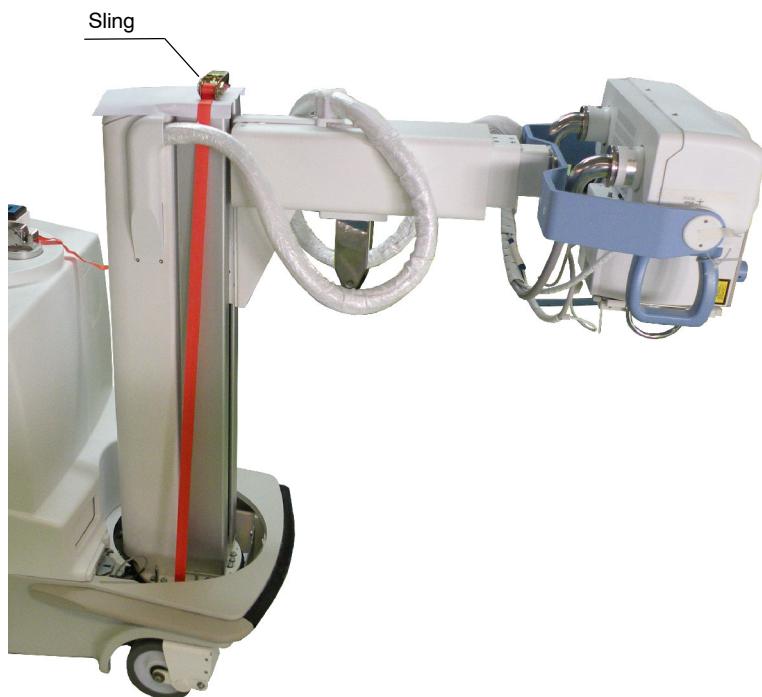
Note 

Two people are necessary to carry out the entire procedure.

1. Turn the Mobile Unit ON.
Release the Arm from the Parking Position.
2. Turn the Unit OFF.
Remove all the required Covers of the unit: Curved-Top Cover, Front Cover (there is not required to be removed, only lifted), Column Base Covers (*refer to Section 2.2.2*).
3. Turn the Mobile Unit ON.
Rotate the Arm 180°, place the Telescopic Column (TC) Sliding Section fully down and rise the Arm to the top of the TC Sliding Section, keeping the TC Sliding Section fully down.
4. Pass a Sling around the Chassis at the base of the Mobile Unit and around the Top Cover of the TC Sliding Section, as shown in the following pictures, keeping the Arm fully up. It is recommended to cover the surfaces at the Top of the Column with a piece of paper or a cloth to avoid damages (a.e. scratches).



5. Ensure the TC Sliding Section fully down, keeping the Arm fully up, as shown in the picture below, by tightening the Sling.

**WARNING**

IF PARTS OF THE TUBE-COLLIMATOR ASSEMBLY AND/OR THE ARM ARE GOING TO BE REMOVED, THE UNIT WILL NOT BE BALANCED ANYMORE.

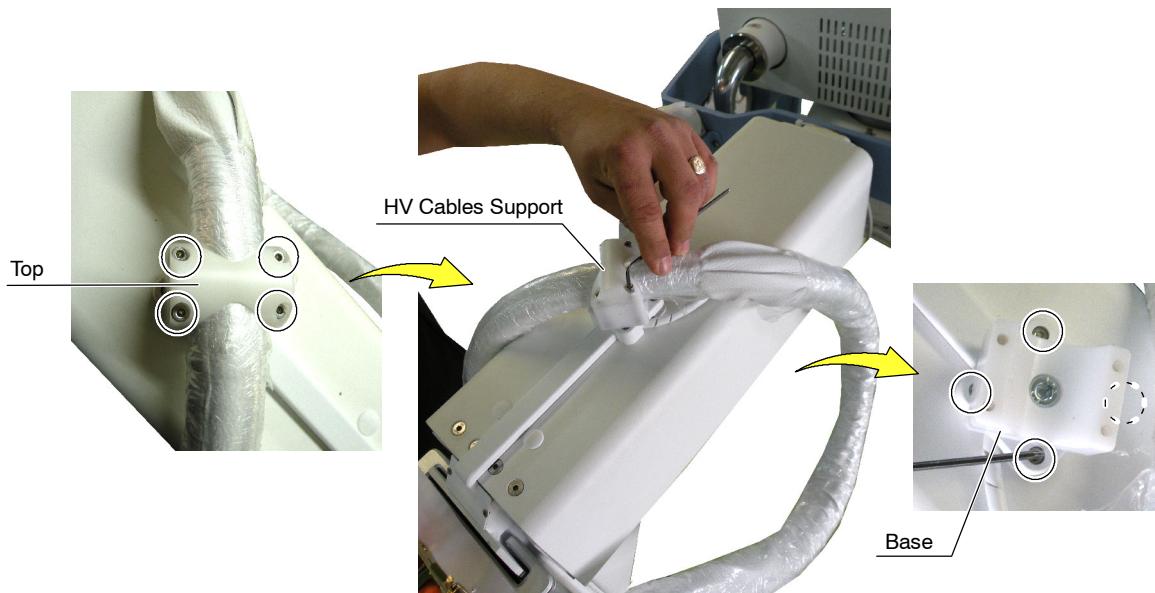
IF NO ADDITIONAL SLING HAS BEEN SECURED ON THE SLIDING SECTION OF THE TELESCOPIC COLUMN AS DESCRIBED, THE ARM AND OR TELESCOPIC COLUMN COULD SPRING UPWARDS WHEN REMOVING THE PARTS OF THE TUBE-COLLIMATOR ASSEMBLY, AND/OR THE ARM.

6. Turn the Mobile Unit OFF.

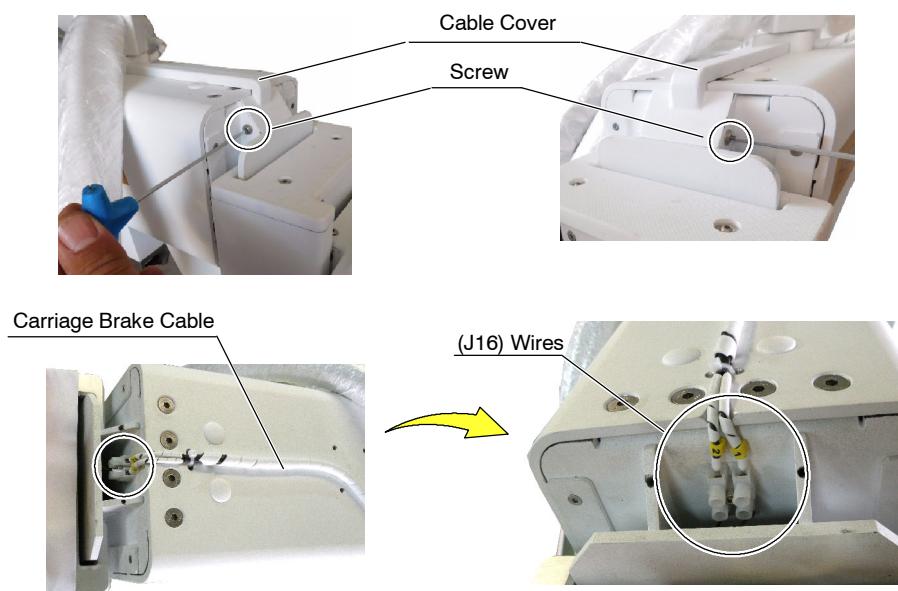


KEEP THE UNIT TURNED OFF AND ISOLATED FROM THE POWER SUPPLY.

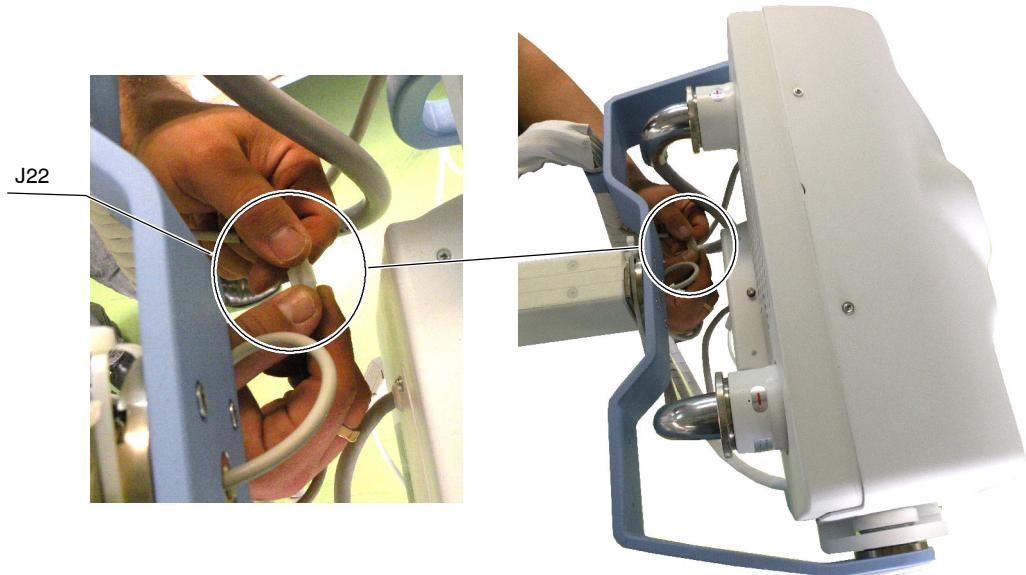
7. Remove the four (4) Screws of the HV Cables Support, at the upper side of the Arm. Remove the HV Cables Support Top and place the HV Cables aside. Remove the (4) Screws at the Base of the HV Cables Support and dismount the HV Cables Support base.



8. Remove the two (2) Screws of the Carriage Brake Cable Cover and dismount the Cover. Note of the position of both wires into the terminals and disconnect both Wires of the Carriage Brake Cable (J16) that are connected to the upper side of the terminal block and isolate the ends with electrical tape.



9. Disconnect Connector J22 (Arm Brake) and isolate the ends with electrical tape.

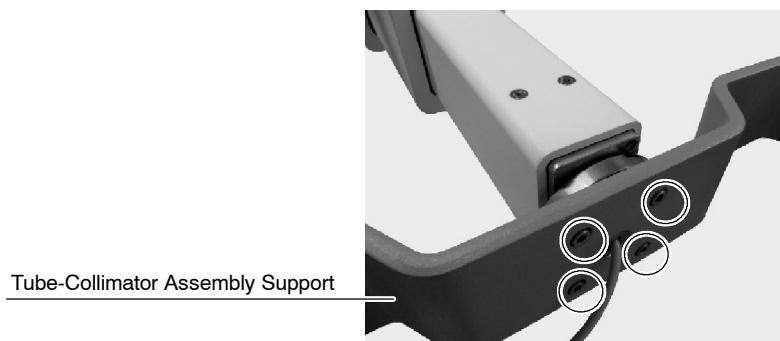


10. Before following with the next steps, place an auxiliary table beside the Mobile Unit, near the Tube-Collimator Assembly.

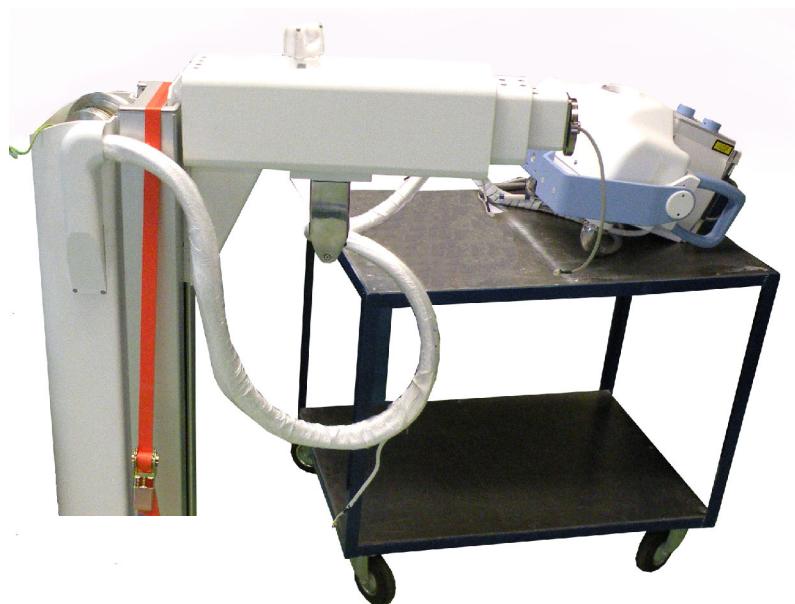


THE WEIGHT OF THE TUBE-COLLIMATOR ASSEMBLY IS HEAVY, UNSTEADY AND DIFFICULT TO HANDLE, THEREFORE AT LEAST TWO PEOPLE IS NEEDED TO REMOVE IT. THIS WILL AVOID PERSONAL INJURIES OR DAMAGE TO THE EQUIPMENT.

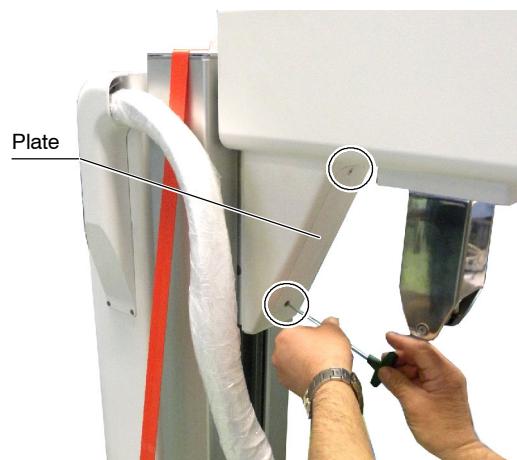
11. While one person supports the the Tube-Collimator Assembly, the other removes the four (4) Screws that fix the Tube-Collimator Assembly Support to the Head Rotation Support.



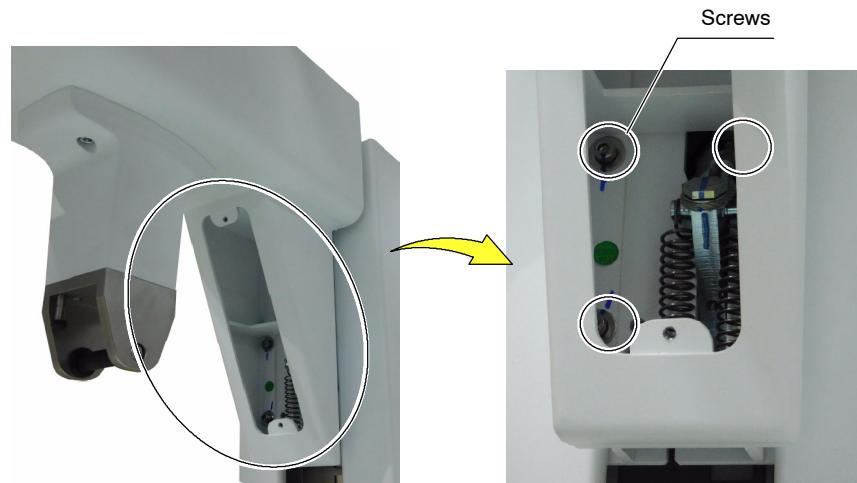
12. Carefully remove the Tube-Collimator Assembly with the Head Rotation Support, passing the HV Cables below the Arm, and place the Assembly on the auxiliary table taking care not to place it over the HV Cables, DAP Cable, etc.



13. Remove the two (2) Screws from the Plate under the Arm end closer to the Column.

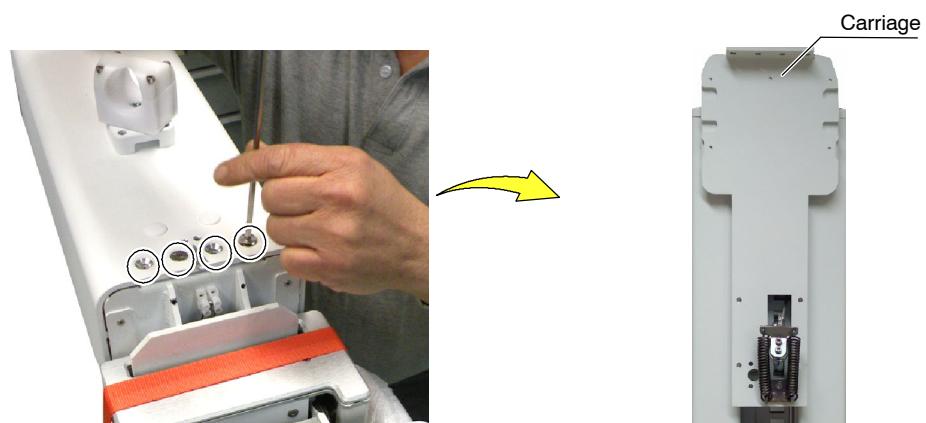


14. Remove the three (3) internal Screws that fix the Arm to the Carriage.



15. While one person supports the weight of the Arm, the other removes the four (4) Screws on the upper side of the Arm.

Then, dismount the Arm from the Carriage.



16. Carefully place the Arm on a safe surface.

**Note** 

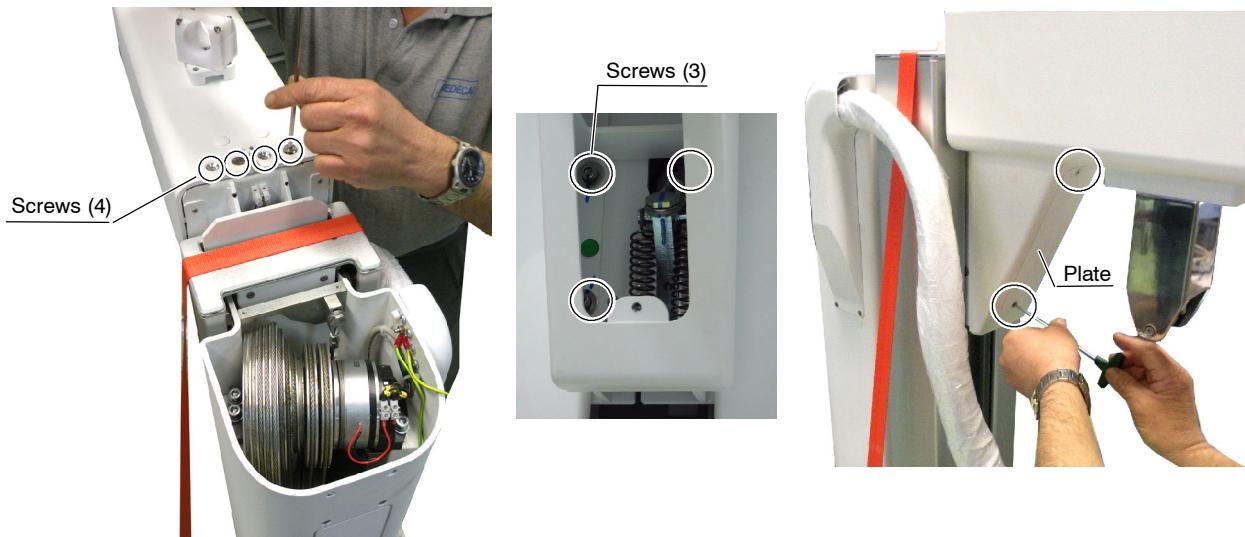
Before performing the Troubleshooting or the Replacement of the Arm, insert a tie-wrap through the drills for the Carriage Brake Cable Cover of the old or the new Arm, as shown in the picture above, this will make it easier to mount the Carriage Brake Cable at a later time.

17. Perform the required procedure:
 - Troubleshooting (refer to Section 3.2.4.3)
 - Replacement of the Arm (follow with next steps).

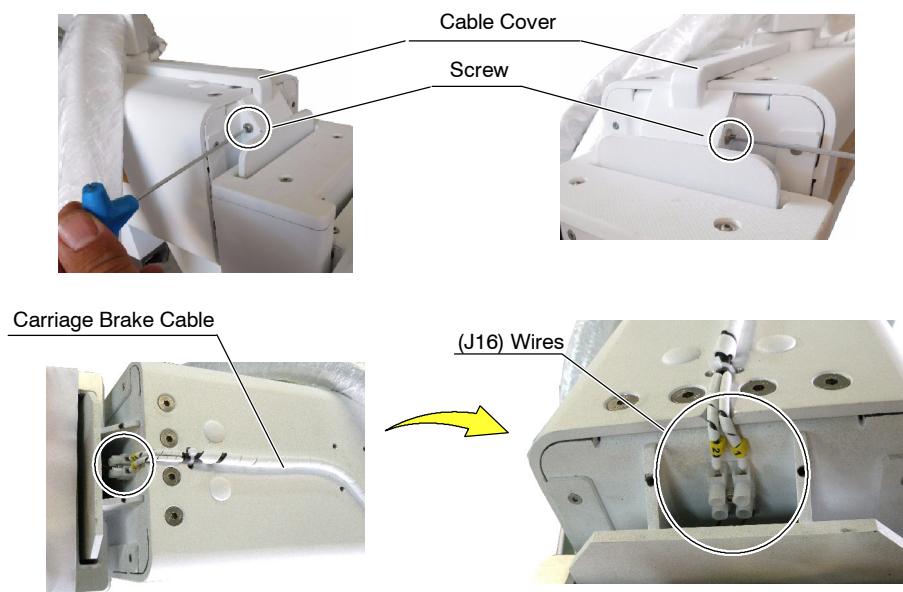
18. Carefully **mount the Arm on the Carriage:**

- a. While one person supports the weight of the Arm, the other secures the Arm with the corresponding fixing Screws (4+3) adding Loctite 243 and using a Torque of 10.5 Nm.

Then, mount the Plate.



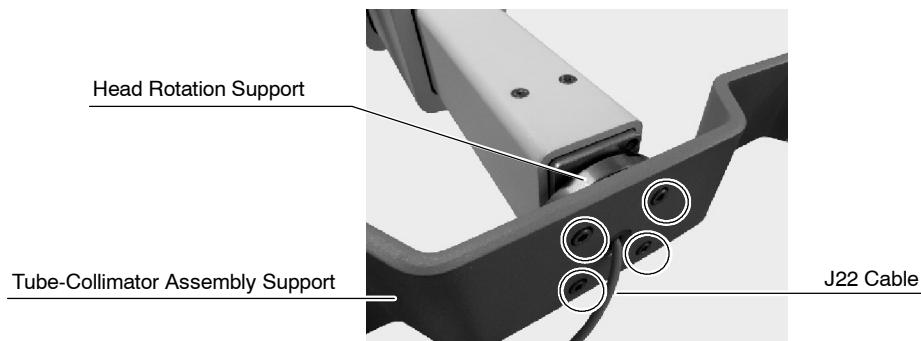
- b. Pass the Carriage Brake Cable through the tie-wrap previously mounted on the Arm, remove the electrical tape from the cable wires, connect both wires in the position noted before and finally mount the Carriage Brake Cable Cover with the two (2) Screws.



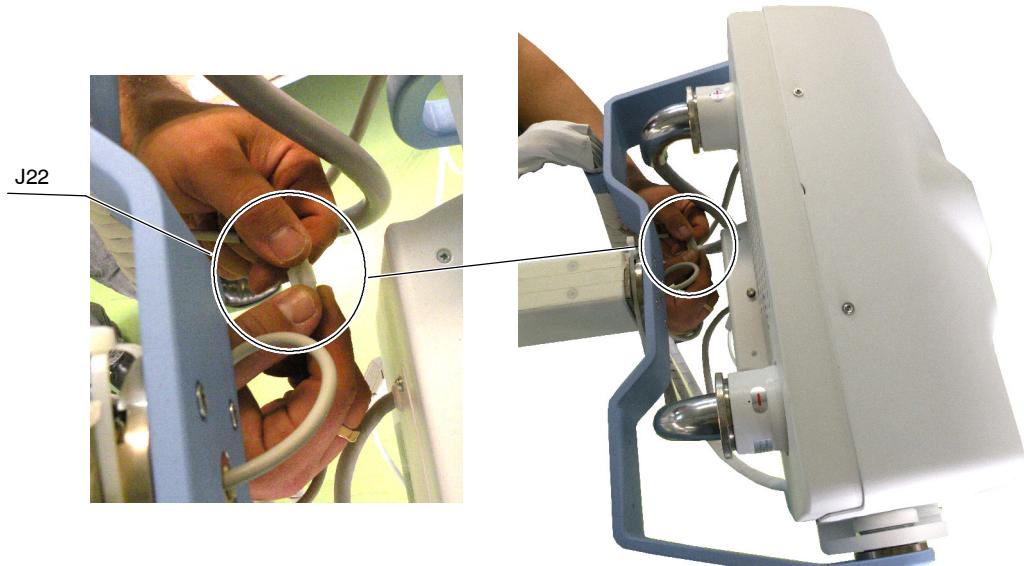
19. Carefully mount the Tube-Collimator Assembly:

- a. Place the auxiliary table with the Tube-Collimator Assembly closer to its final position in the Arm.

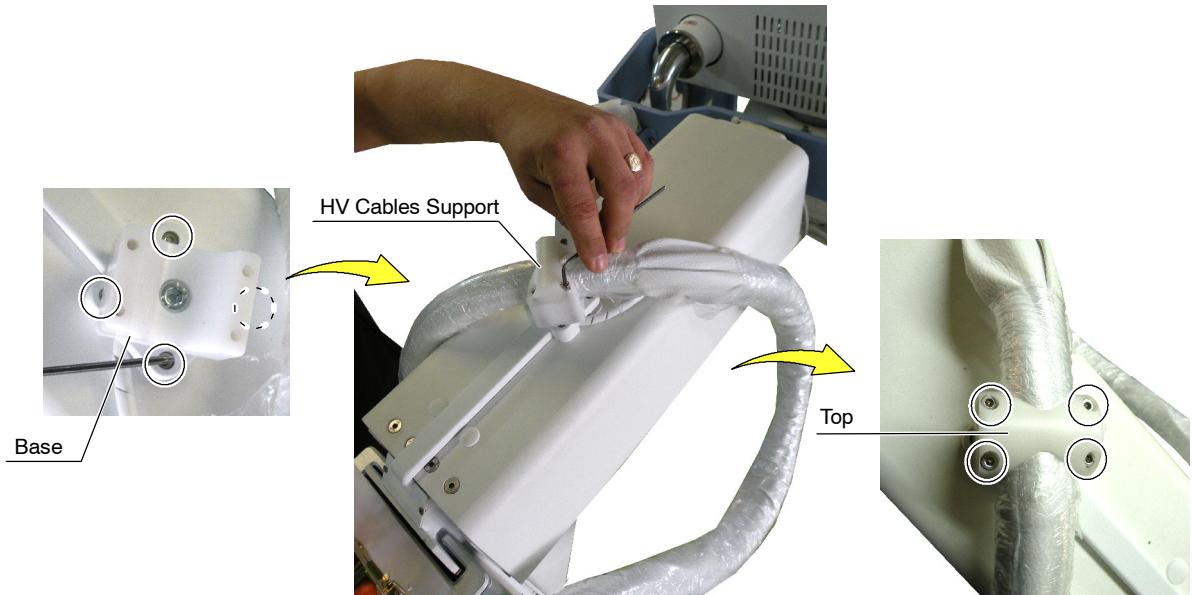
While one person holds the Tube-Collimator Assembly towards the Arm, the other holds the HV Cables above the Arm, passes J22 Cable through the Support of the Tube-Collimator Assembly and mounts the four (4) Screws that fix the Tube-Collimator Assembly to the Head Rotation Support, adding Loctite 243 and using a Torque of 10.5 NM.



- b. Remove the electrical tape from the wires of Connector J22 (Arm Brake) and connect J22.



20. Mount the HV Cables Support (base) to the upper side of the Arm with the four (4) Screws, place the HV Cables inside and mount the HV Cables Support (Top).

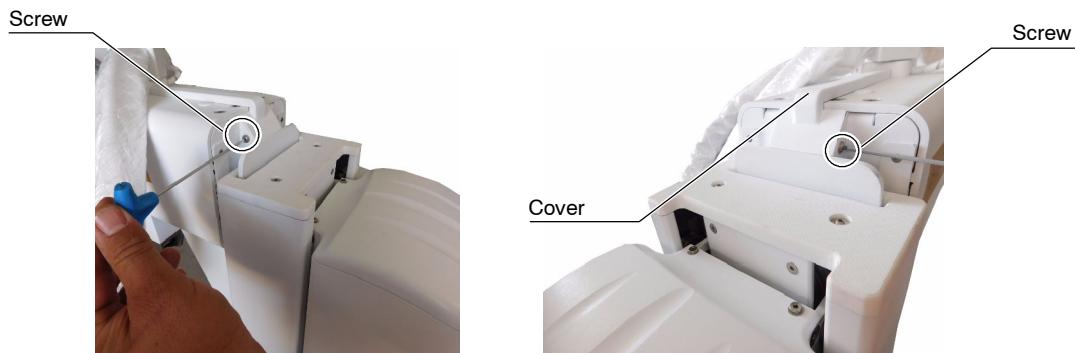


21. Release the Sling from the unit.
22. Turn ON the Mobile Unit and perform a functional check for the correct movement of the vertical travel of the Arm and the Telescopic Column.
23. Turn OFF the Mobile Unit.
24. Mount all the Covers of the unit previously removed (*refer to Section 2.2.2*).

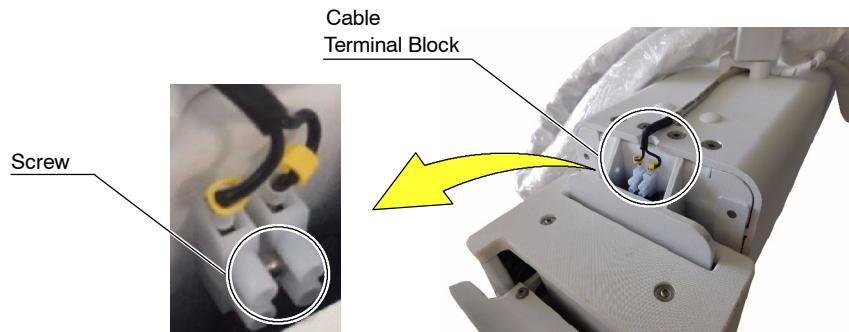
3.2.4.2 CYLINDRICAL BRAKE REPLACEMENT**Note** 

For Mobile Units with Telescopic Column and Reinforced Frame, follow the next steps in order to proceed with the Arm Carriage Brake replacement.

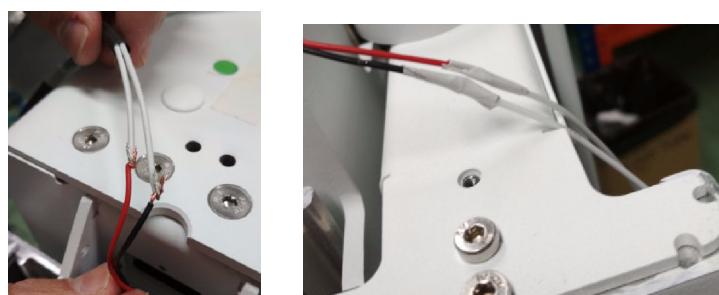
1. Remove the two (2) Screws and remove the cover.



2. Carefully untighten the Screw to release the terminal block and then unplug the two wires that are connected to the lower side of the terminal block from the Arm Carriage.



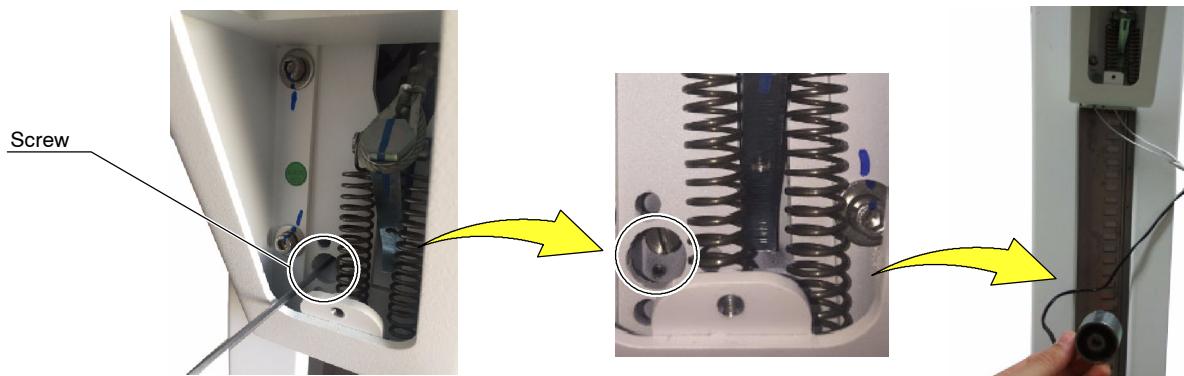
3. Without releasing these two wires, join 1 m cable with electrical tape. This cable stays as a guide to connect the wires of the new Brake.



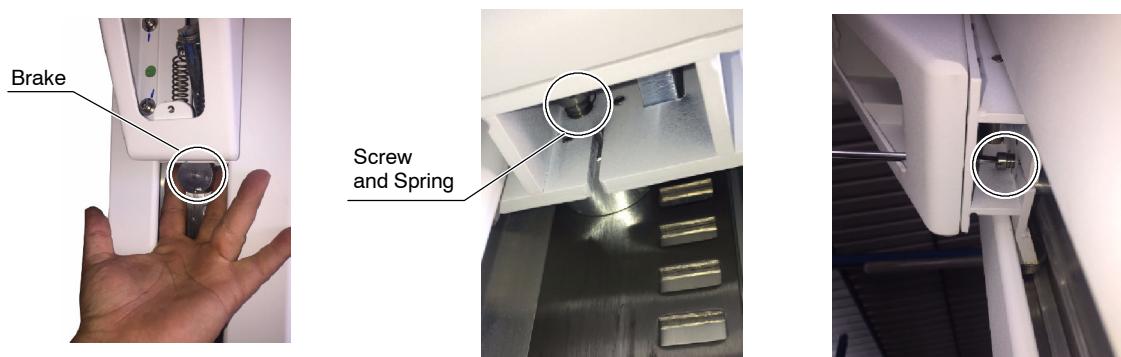
4. Put the Column up and take off the cover.



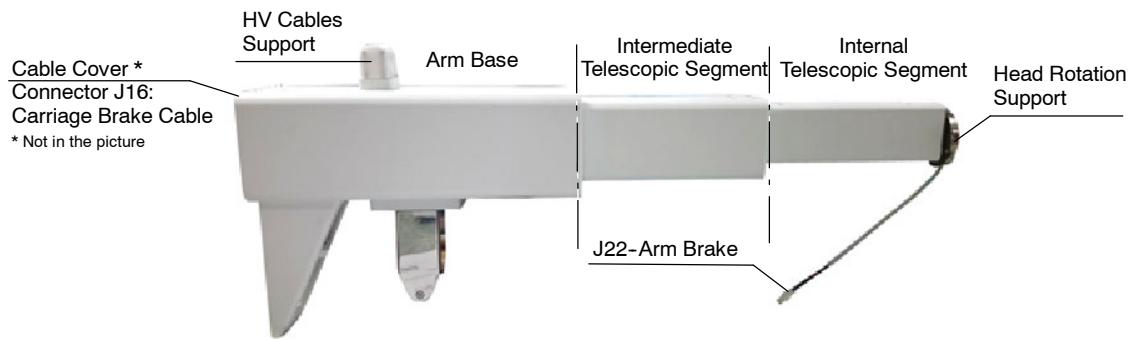
5. Through the hole in the Carriage, remove the Screw that includes a spring that holds the Brake. When releasing the screw with the spring, the Cylindrical Brake falls. Place one hand below to proceed with its replacement.



6. When the Brake goes down, the wires are visible as well as the guide. Replace the Brake joining the wires to the cable guide. Install the new Brake sliding the pin along the slot in the Carriage and tighten again the Screw with the spring.



7. Reinstall the cover. Carefully remove the cable guide and connect the two wires of the Brake in the Terminal Block. Mount the Terminal Block and the cable cover.

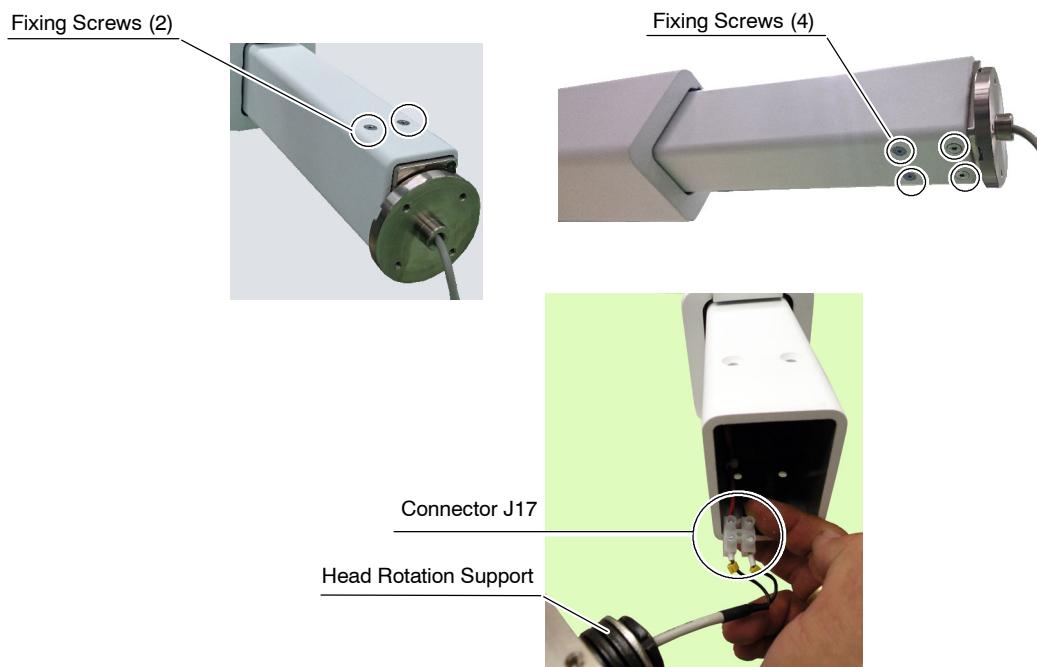
3.2.4.3 TROUBLESHOOTING OF THE ARM**Note**

For the replacement of the HV Cables Support or the Carriage Brake Cable Cover, turn the unit OFF and follow the procedures described in Section 3.2.4.1 of "Arm Replacement".

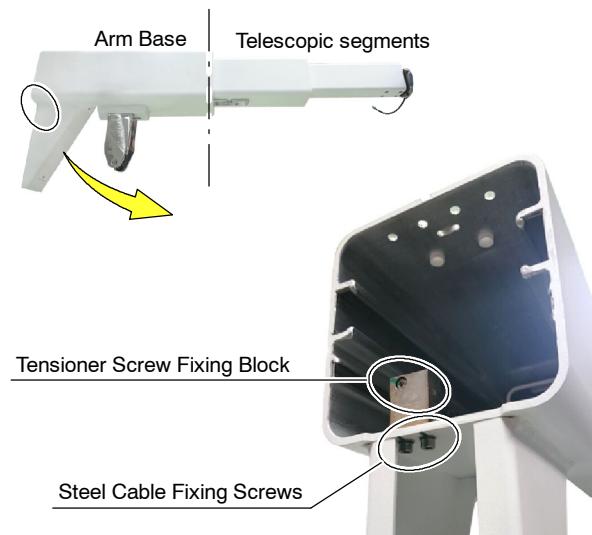
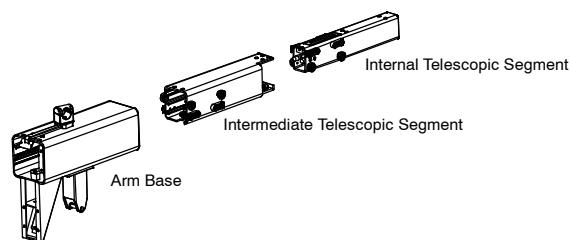
Note

For the replacement of the Head Rotation Support only, turn the unit OFF and follow the procedures described in Section 3.2.4.1 of "Arm replacement" in order to dismount the Tube-Collimator Assembly; then, remove the (2) Fixing Screws (2+4), dismount the Head Rotation Support from the Arm, disconnect J17 and pass the cable through the Head Rotation Support.

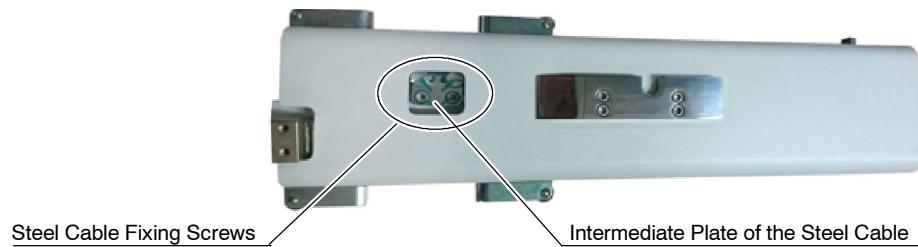
Replace the Head Rotation Support, passing the cable through the new Support, connecting J17 and securing it by using the two (2) Screws to the upper side and the four (4) Screws to the lower side of the Arm, adding Loctite 243 and using a Torque of 8 Nm.



1. Remove the Screws that secure the Tensioner Screw Fixing Block (one end of the Steel Cable) to the lower side of the Arm Base and dismount the Telescopic segments from the Arm Base.



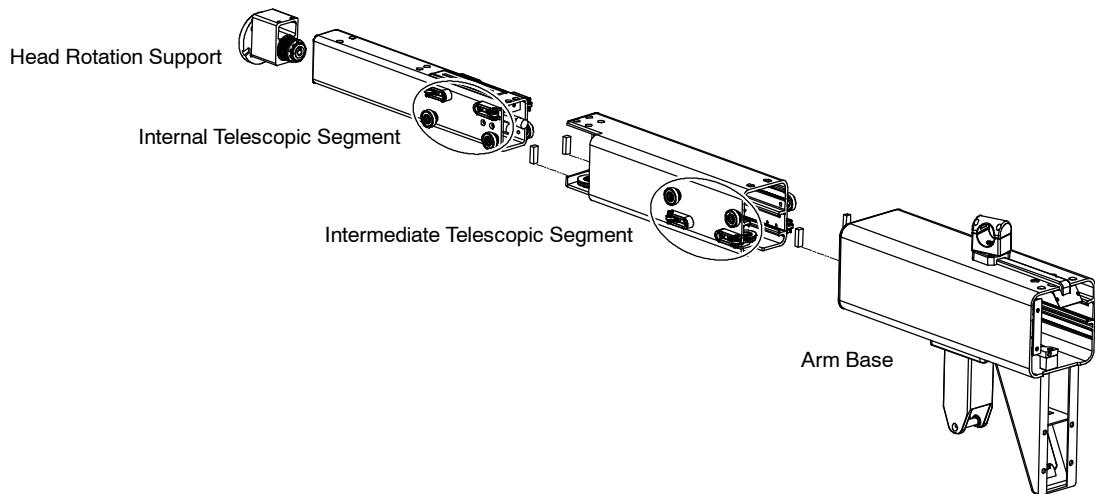
2. Remove the Screws that fix the Intermediate Plate of the Steel Cable to the lower side of the Internal Telescopic Segment. Pull out the Steel Cable and disengage both segments (Internal and Intermediate).



3. Replace the defective items (pulleys, bearing kits, bumpers, etc).

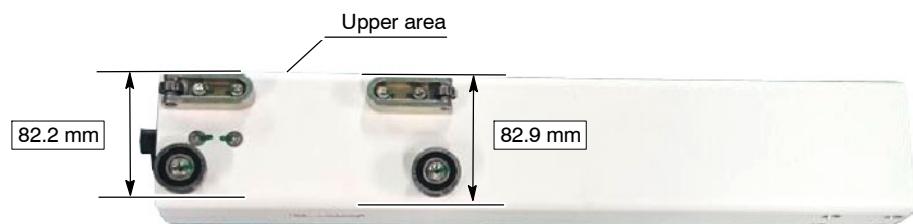
Note 

For **Bearing kits replacement**, proceed as described below.



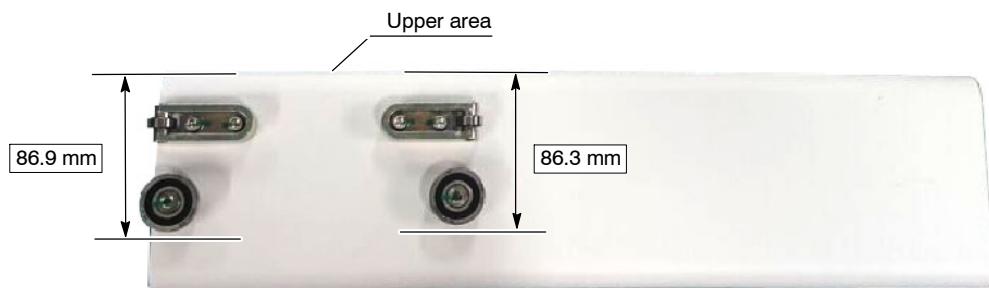
- **Internal Telescopic Segment.**

In order to replace the Bearing kit, adjust both bearings to the following measures, taking the Upper area of the Internal Segment as a reference:

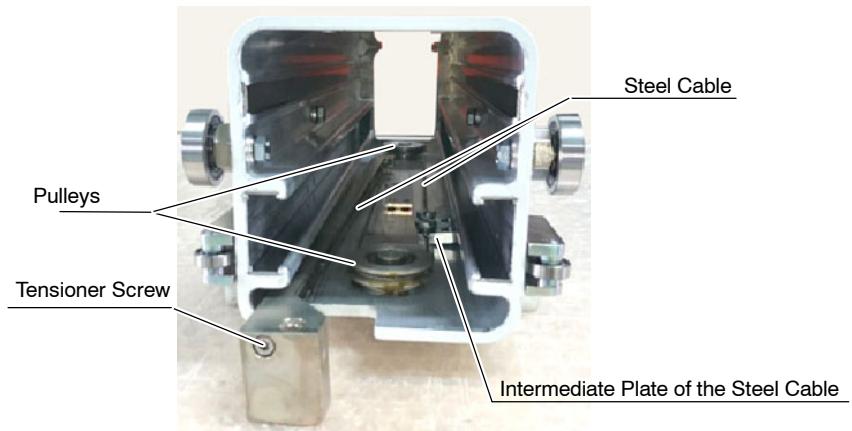


- **Intermediate Telescopic Segment.**

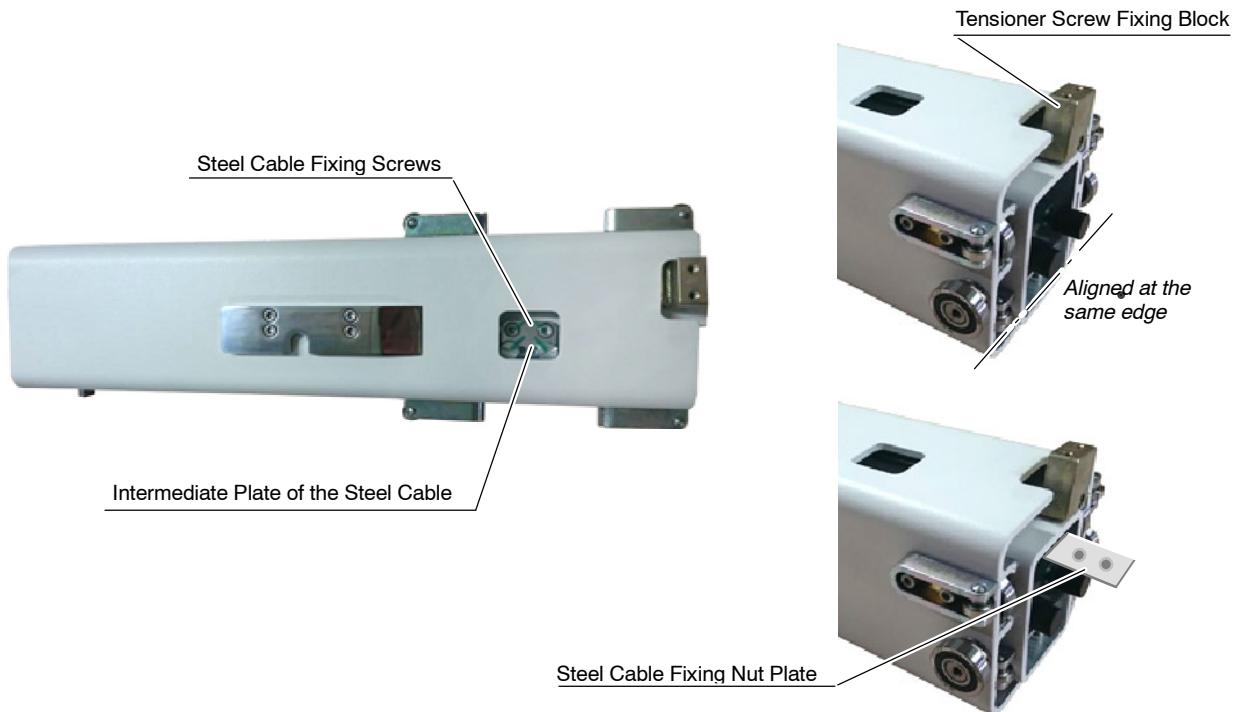
In order to replace the Bearing kit, adjust both bearings to the following measures, taking the Upper area of the Intermediate Segment as a reference.



4. At the inside of the Intermediate Telescopic segment, pass the Steel Cable along the two (2) Pulleys and tense the Steel Cable by tightening the Tensioner Screw.



5. Insert the Internal Telescopic segment into the Intermediate segment. In order to fix the Intermediate Plate of the Steel Cable, align the Internal segment, the Tensioner Screw Fixing Block and the Intermediate segment at the same edge. Then, fix the Steel Cable to the Nut Plate by tightening the Fixing Screws through the window.

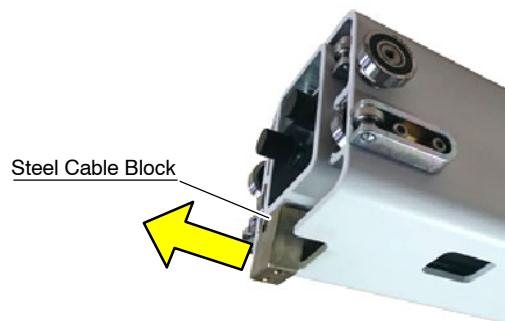


6. Adjust the tension of the Steel Cable. To do so:

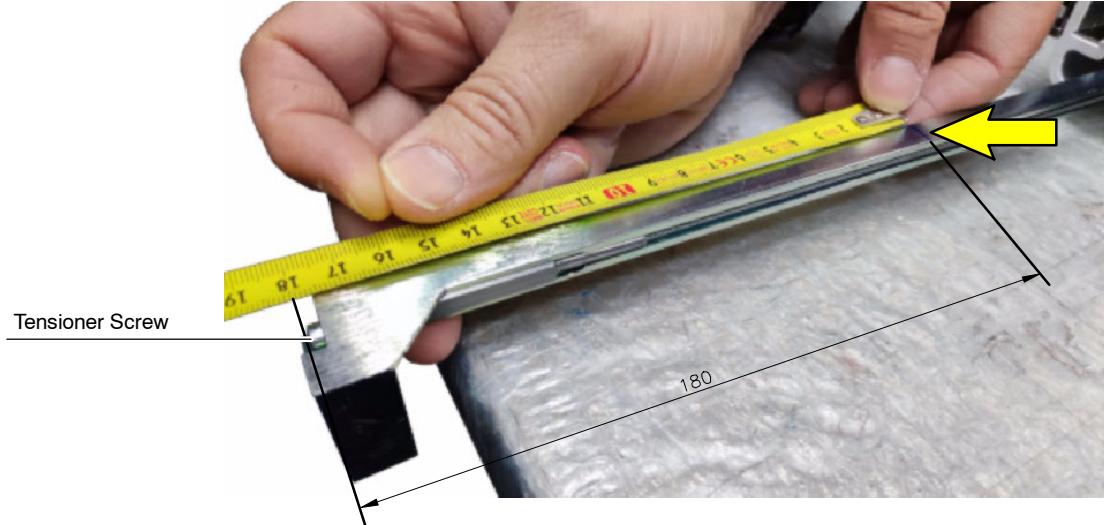
Note 

Two people are necessary to carry out the Steel Cable adjustment.

- a. Pull out the Steel Cable Block from the Intermediate Telescopic Segment to allow the Steel Cable tension adjustment.

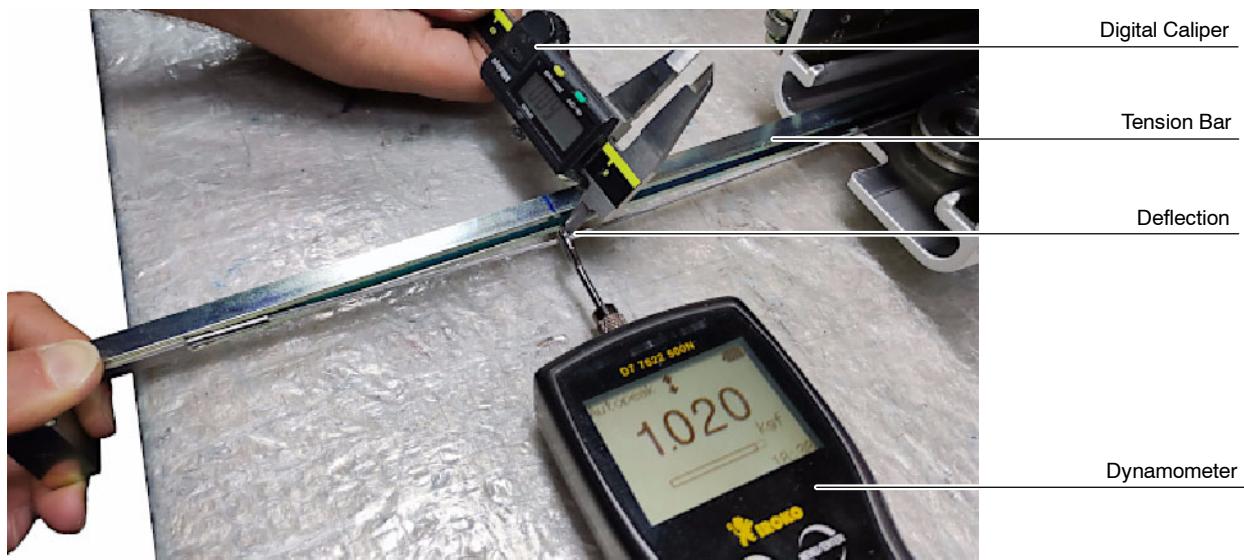


- b. Use a marker pen to mark a distance of 180 mm from the Tensioner Screw on the Steel Cable.

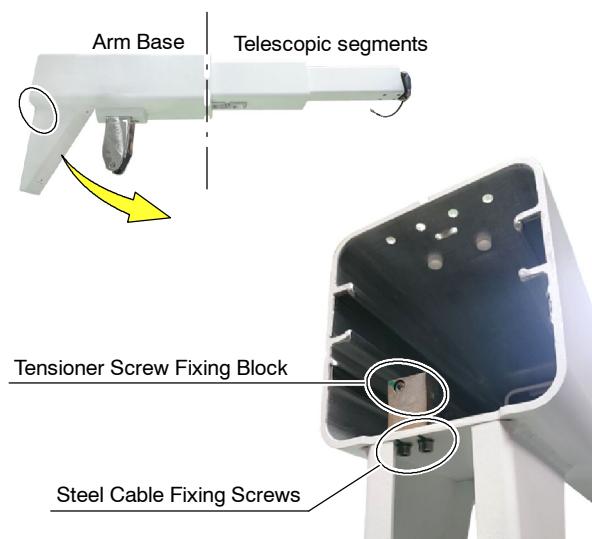


- c. Impregnate the thread of the Tensioner Screw with a drop of Loctite 243 (or similar) and adjust it for regulating the Steel Cable tightness.

While a person checks with a dynamometer that a force of 1 kg is being applied at the 180 mm mark, the other person measures the deflection of the Steel Cable, taking the inner edge of the Tension Bar as a reference which should be 6 mm.



7. Insert the Telescopic segments assembly inside the Arm Base and fix the other end of the Steel Cable with the fixing Screws.



8. Mount the Arm of the Mobile Unit as described in *section 3.2.4.1 of "Arm replacement"*, from step 18.

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SECTION 4

COLLIMATOR AND X-RAY TUBE REPLACEMENT

Note 

There are two possible configurations for the Tube-Collimator Assembly: Standard and Optional. Perform exclusively the required Section as per the unit configuration:

*Refer to Section 4.1 for X-Ray units with Tube-Collimator Assembly
standard configuration: Collimator, Flange and Tube.*

Refer to Section 4.1.1 for Collimator and Flange replacement.

Refer to Section 4.1.2 for Tube (only) or Tube and Collimator replacement.

*Refer to Section 4.2 for X-Ray units with Tube-Collimator Assembly
optional configuration: Collimator, Handgrips-Support,
Flange and Tube.*

Refer to Section 4.2.1 for Collimator and Flange replacement.

Refer to Section 4.2.2 for Tube (only) or Tube and Collimator replacement.

Note 

Before starting the procedures, place an auxiliary table beside the X-Ray Unit.

Note 

Two people are necessary to carry out the entire procedure.

Note 

The Manual provided with the Collimator must be always reviewed to conduct the proper installation process.

4.1 STANDARD CONFIGURATION: COLLIMATOR, FLANGE AND TUBE

4.1.1 COLLIMATOR AND FLANGE REPLACEMENT

1. Release the Arm from Parking position, turn the Column 90° and place the Arm fully extended.
2. Turn the unit OFF.

Remove the Radiation Meter (option) from the rail system.



KEEP THE UNIT TURNED OFF AND ISOLATED FROM THE POWER SUPPLY.

3. In order to counterbalance the weight of the part to be replaced, a counterweight of equal weight has to be secured on the Arm (a.e. if the Collimator weights 10 kg / 22 lb, the counterweight must be 10 kg / 22 lb). *Refer to the Collimator manual to find out its weight.*



IF NO COUNTERWEIGHT HAS BEEN SECURED ON THE ARM, IT WILL SPRING UPWARDS WHEN REMOVING THE COLLIMATOR.

4. Disconnect the Collimator Cables.
5. Dismount the Collimator: while one person holds the weight of the Collimator, the other loosens the Allen Screws (x4) located at the four corners that fix the Collimator to the X-ray Tube through the Flange (Adaptation Ring).



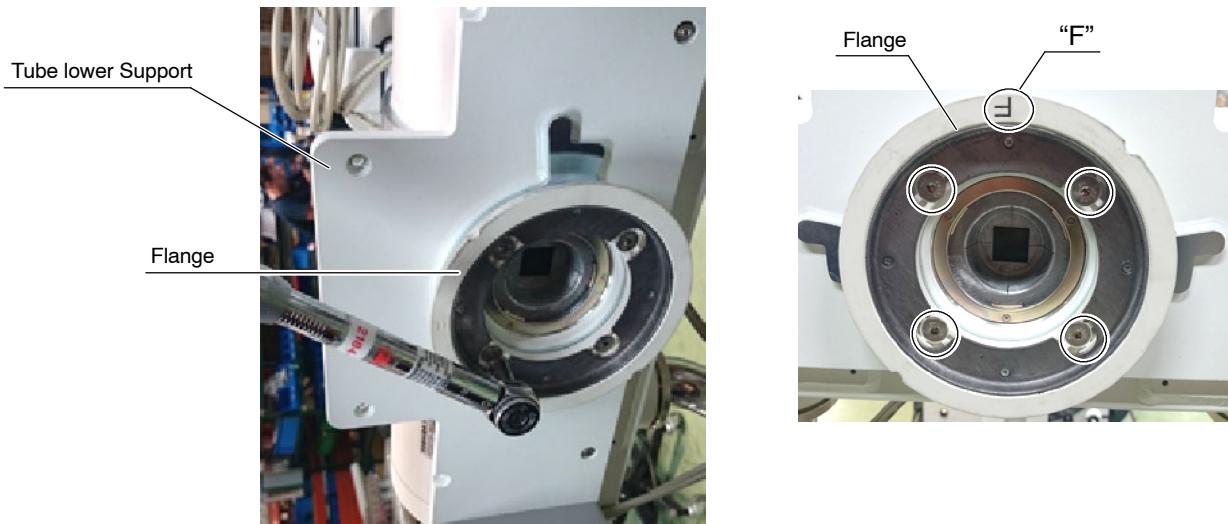
6. Dismount the Flange (Adaptation Ring).



When the Collimator needs to be replaced, the Flange installed on the unit must be removed and has to be replaced by the Flange delivered with the new Collimator.

Place the Tube Assembly with the Flange towards the floor. Carefully dismount the old Flange from the unit by removing the countersunk Screws M6 (x4), bearing in mind that these Screws secure the X-Ray Tube.

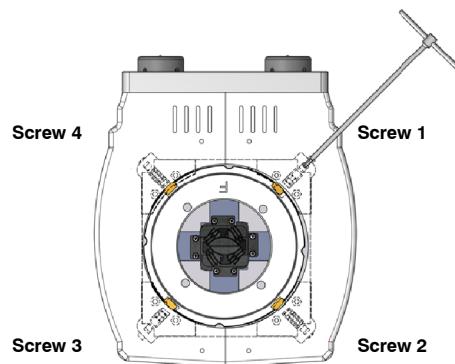
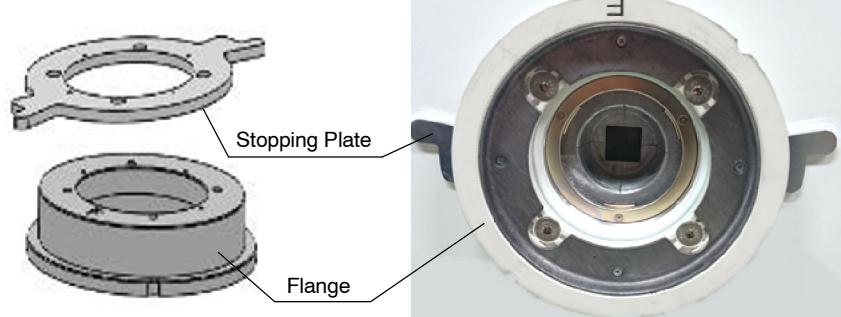
Place the new Flange (provided with the new Collimator) on the Tube Lower Support, with the letter "F" turned toward the Tube front (if the Flange is marked) and fix the Flange to the Tube with the countersunk Screws M6 (x4), **applying Loctite 243** on the Screws and a tightening torque of 6.6 Nm (the current Flange is made of Resin material, for Flanges made of Metal material the tightening torque is 11.3 Nm).



7. Install the new Collimator to the Flange by adjusting and tightening the Collimator Allen Screws (x4) as described in next tables according to the Bracket and Flange versions.

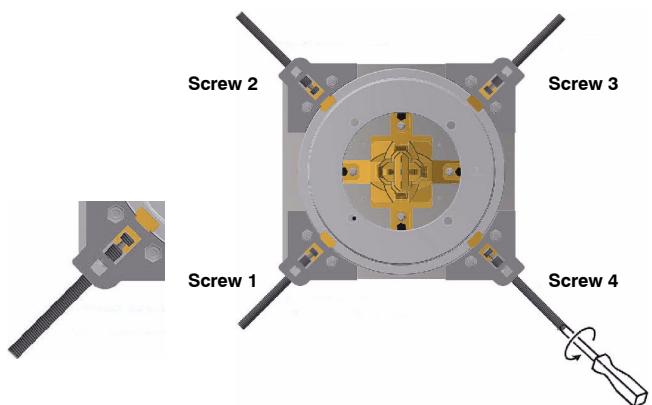
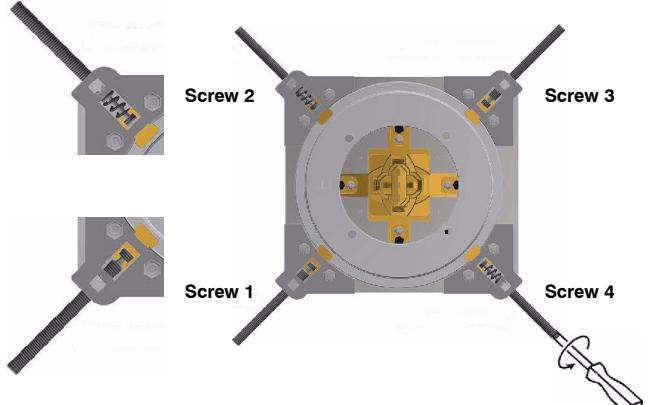


Current version of Mobile Unit is provided with the Collimator Mounting Bracket Type B and Flange Type B1 (Resin material) with the Metal Stopping Plate. For the installation of the current version refer to the Table 4-1 and Table 4-2.

**Note**

Mobile Units manufactured until December 2013 can be provided with the Collimator Mounting Bracket Type A or B and Flange Type A1, A2, B1 or B2. For the installation of this version refer to the Table 4-1 and Table 4-3 or Table 4-4.

Table 4-1
Collimator Mounting Bracket Types

COLLIMATOR MOUNTING BRACKET TYPES	
Collimator Mounting Bracket Type A (with 4 Fixing Screws without spring)	
Collimator Mounting Bracket Type B (with 2 Fixing Screws with spring and 2 Fixing Screws without spring)	

Mobile X-Ray Unit

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Table 4-2

Flange Type B1 (Resin Flange) with the Metal Stopping Plate (used in current Mobile Units)

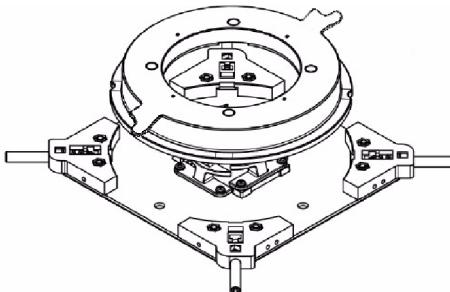
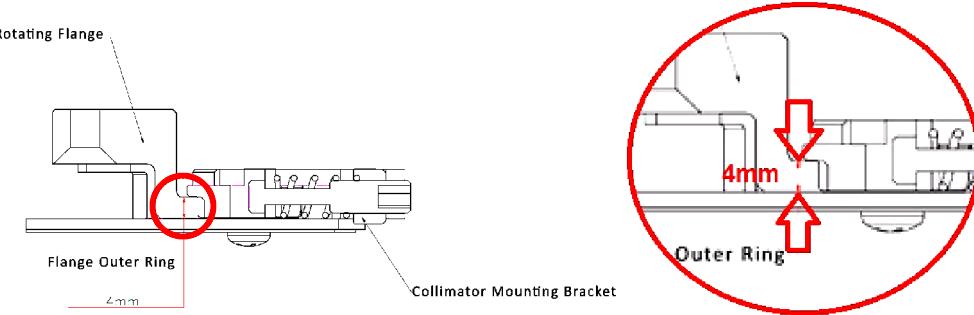
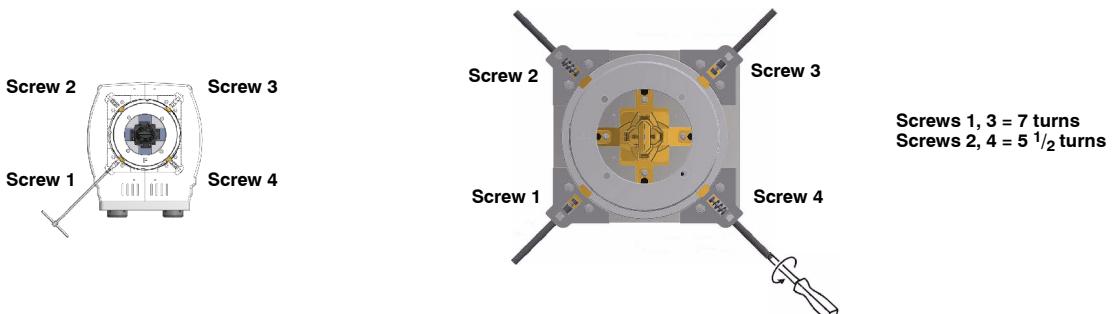
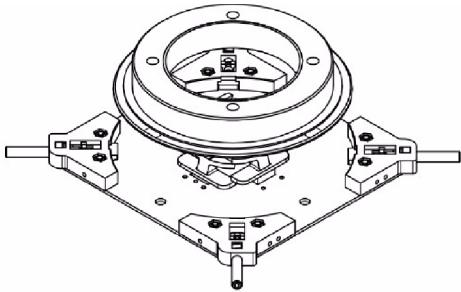
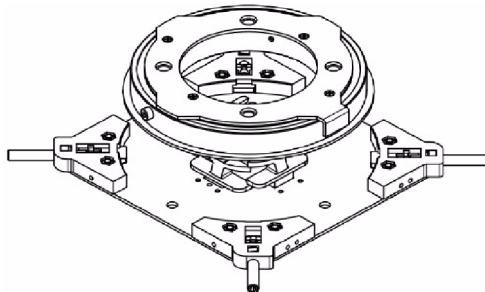
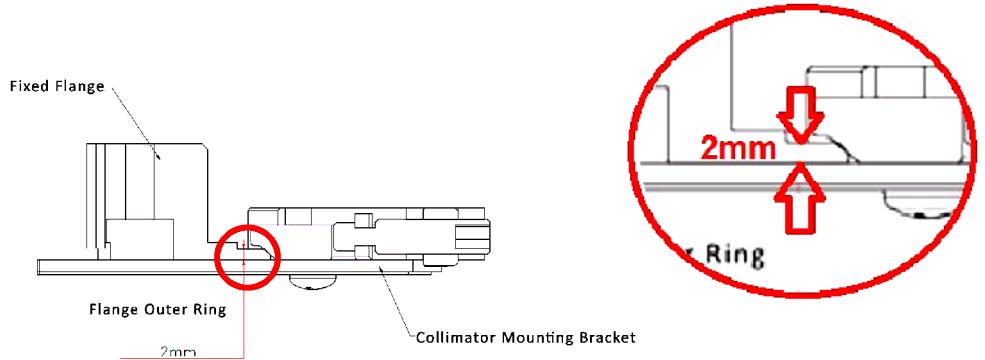
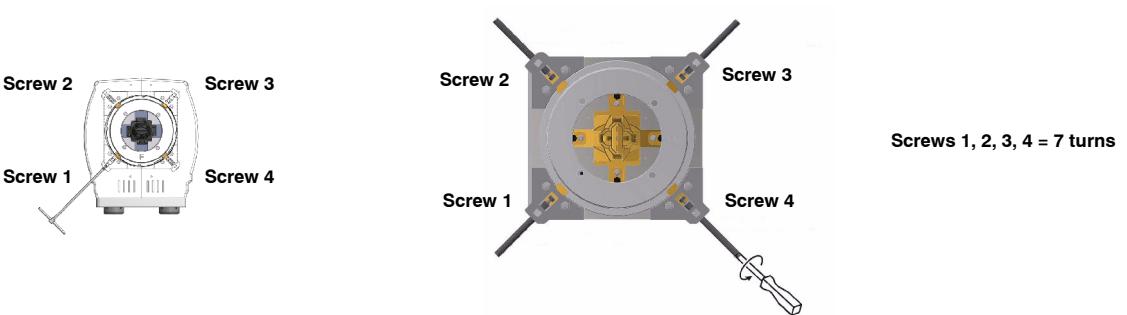
FLANGE TYPE B1 WITH METAL STOPPING PLATE (Compatible with Collimator Mounting Bracket Type B)	
Flange B1 - Resin Flange	
Collimator Mounting Bracket Type B (with 2 Fixing Screws with spring and 2 Fixing Screws without spring)	This combination allows the Collimator rotation
	 <p>Bracket Type B Flange Type B1 with Metal Stopping Plate</p>
	 <p>The thickness of the Flange outer ring is 4 mm for the Flange type B</p>
INSTALLATION	
<p>The installation of the Collimator with the Mounting Bracket type B and Flange type B1 with Metal Stopping Plate needs to be made as follows:</p> <ul style="list-style-type: none"> - Install the Collimator on the Flange: while one person holds the weight of the Collimator, the other tightens the Fixing Screws (x4) located at the four corners that fix the Collimator to the Flange. - With the Tabs (Fixing Screws) fully retracted, tight the four Screws: <ul style="list-style-type: none"> - Screws 1 and 3 up to the end stroke (at least 7 turns on each one) applying a Torque of 0.45 Nm. - Screws 2 and 4 (with integrated adjustable spring), 5 1/2 turns exactly. <i>(If Screws 2 and 4 are tightened more than 5 1/2 - 6 turns, the Collimator will not rotate).</i> - Check the installation of the Collimator as described in step 8. of this procedure, specially if the previous steps cannot be performed. 	
 <p>Screws 1, 3 = 7 turns Screws 2, 4 = 5 1/2 turns</p>	

Table 4-3**Flanges Type A (used in Mobile Units manufactured until December 2013)**

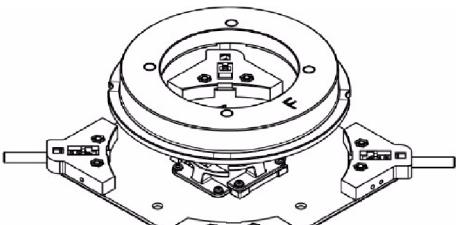
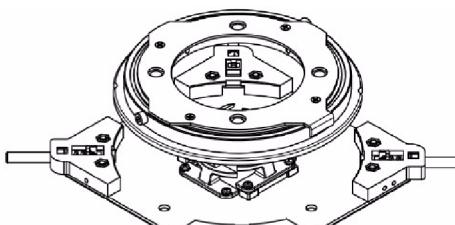
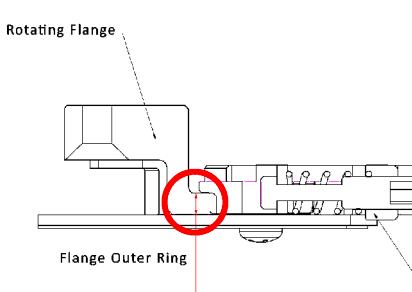
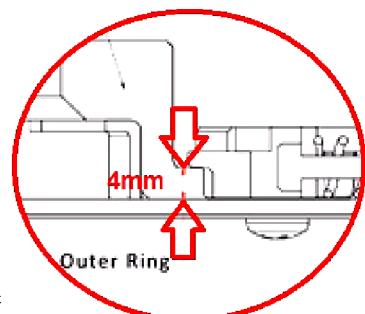
FLANGES TYPE A (Compatible with Collimator Mounting Bracket Type A)		
	Flange A1 - Fixed Metal Flange	Flange A2 - Rotating Metal Flange
Collimator Mounting Bracket Type A (with 4 Fixing Screws without spring)	This combination does not allow the Collimator rotation  Bracket Type A Flange Type A1	This combination allows the Collimator rotation  Bracket Type A Flange Type A2
 <p>The thickness of the Flange outer ring is 2 mm for the Flange type A</p>		
INSTALLATION		
<p>The installation of the Collimator with the Mounting Bracket type A and Flange type A1 or A2 needs to be made as follows:</p> <ul style="list-style-type: none"> - Install the Collimator on the Flange: while one person holds the weight of the Collimator, the other tightens the Fixing Screws (x4) located at the four corners that fix the Collimator to the Flange. - With the Tabs (Fixing Screws) fully retracted, tight the four Screws up to the end stroke (at least 7 turns on each one) applying a Torque of 0.45 Nm. - Check the installation of the Collimator as described in step 8. of this procedure, specially if the previous steps cannot be performed.  <p>Screws 1, 2, 3, 4 = 7 turns</p>		

Mobile X-Ray Unit

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Table 4-4

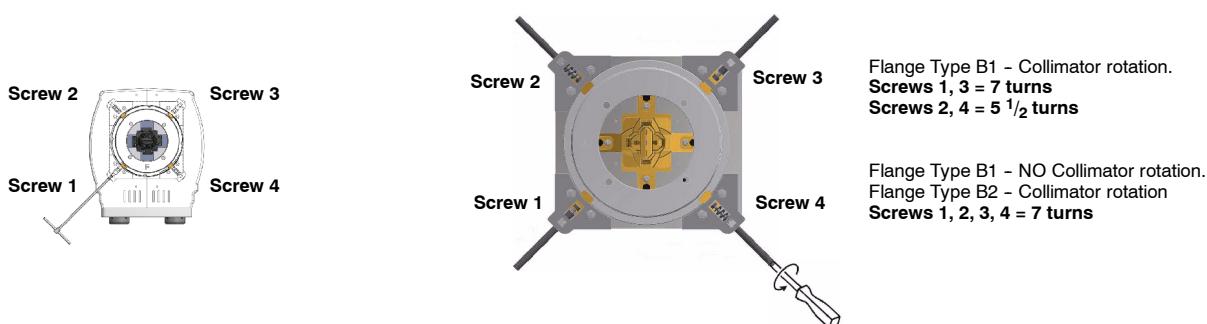
Flanges Type B (used in Mobile Units manufactured until December 2013)

	FLANGES TYPE B (Compatible with Collimator Mounting Bracket Type B)	
	Flange B1 - Resin Flange	Flange B2 - Rotating Metal Flange
Collimator Mounting Bracket Type B (with 2 Fixing Screws with spring and 2 Fixing Screws without spring)	This combination allows rotation and no rotation of the Collimator depending on the number of turns applied to the Fixing Screws	This combination allows the Collimator rotation
	 <p>Bracket Type B Flange Type B1</p>	 <p>Bracket Type B Flange Type B2</p>
	 <p>The thickness of the Flange outer ring is 4 mm for the Flange type B</p>	 <p>Outer Ring</p>

INSTALLATION

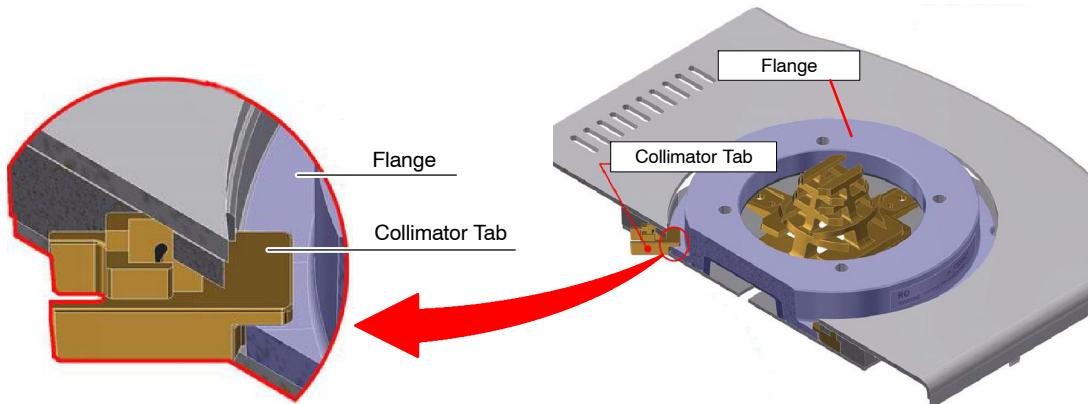
The installation of the Collimator with the Mounting Bracket type B and Flange type B1 or B2 needs to be made as follows:

- Install the Collimator on the Flange: while one person holds the weight of the Collimator, the other tightens the Fixing Screws (x4) located at the four corners that fix the Collimator to the Flange.
- With the Tabs (Fixing Screws) fully retracted, tight the four Screws according to Flange type and Collimator Rotation function:
 - With Flange type B1 and with Collimator rotation:
 - Screws 1 and 3 up to the end stroke (at least 7 turns on each one) applying a Torque of 0.45 Nm.
 - Screws 2 and 4 (with integrated adjustable spring), 5 1/2 turns exactly.
(If Screws 2 and 4 are tightened more than 5 1/2 - 6 turns, the Collimator will not rotate).
 - With Flange type B1 and with NO Collimator rotation or with Flange type B2 with Collimator rotation:
 - Screws 1, 2, 3 and 4 up to the end stroke (at least 7 turns on each one) applying a Torque of 0.45 Nm.
- Check the installation of the Collimator as described in step 8. of this procedure, specially if the previous steps cannot be performed.

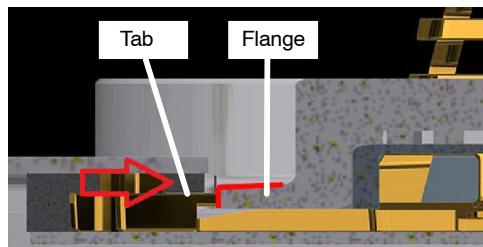


8. Make sure that the Collimator is well positioned:

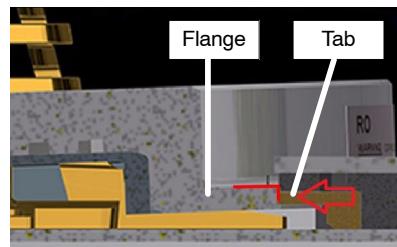
- a. Turn the Collimator to both sides if rotation function is present and pulling it down to ensure that it is safely and properly mounted.
- b. Make sure that the four Tabs present on the Collimator Mounting Bracket overlap the Flange (as shown on the next picture).



- c. Ensure that the four Tabs are not in contact with only the Flange and that they do not lock the Flange Outer Ring instead of overlapping it.



Incorrect Tab Mounting



Incorrect Tab Mounting



AN IMPROPER ASSEMBLY COULD CAUSE THE COLLIMATOR FALLING WITH THE SUBSEQUENT RISK FOR PATIENT AND USER.

9. Reinstall the Collimator Cables.
10. Perform the procedures in *Section 4.3 of "Collimator Adjustments"*.

4.1.2 X-RAY TUBE REPLACEMENT



If the Tube Model is not listed in the “X-Ray Tube Data” list in the Configuration and Calibration Chapter, order a new EPROM U24 on the ATP Console CPU. Contact the Generator Supplier / Agent for the correct EPROM U24 and Tube Data for the Extended Memory Code (E02).

DIP switch 3000SW2-7 on the HT Controller Board may need to be revised depending on the Small Focal Spot size of the Replacement Tube. Refer to the Configuration Section of the Calibration and Configuration Chapter for more information.

1. Release the Arm from Parking position, turn the Column 90° and place the Arm fully extended with the Tube-Collimator Assembly on the table.
2. Turn the unit OFF.



KEEP THE UNIT TURNED OFF AND ISOLATED FROM THE POWER SUPPLY.

3. For Tube replacement it is necessary to dismount the Tube-Collimator assembly, therefore a counterweight of equal weight has to be secured on the Arm (a.e. if the Collimator weights 10kg / 22lb and the Tube weights 18kg / 40lb, the counterweight must be of $10+18 = 28$ kg / 62 lb). *Refer to the Collimator and Tube manuals to find out their weight.*

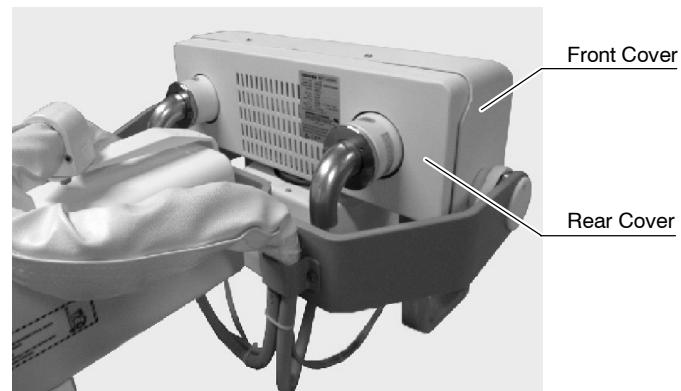


IF NO COUNTERWEIGHT HAS BEEN SECURED, IT WILL SPRING UPWARDS WHEN REMOVING THE TUBE-COLLIMATOR ASSEMBLY.

4. Disconnect the Collimator Cables.
5. Dismount the Collimator: while one person holds the weight of the Collimator, the other loosens the Allen Screws (x4) located at the four corners that fix the Collimator to the X-ray Tube through the Flange (Adaptation Ring).



6. Disconnect the High Voltage Cables from the Tube.
7. Dismount the Rear and Front Tube Covers by removing the Cover Screws.

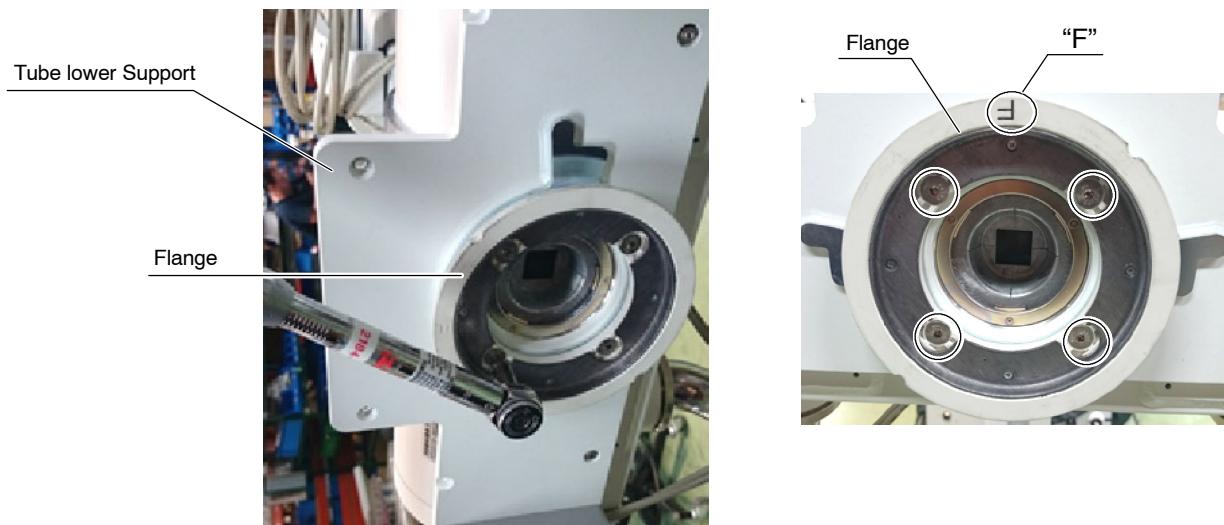


8. Disconnect the Stator Cable of the Tube.

Mobile X-Ray Unit

Troubleshooting

9. Place the Tube Assembly with the Flange towards the floor. Carefully dismount the Flange (Adaptation Ring) by removing the countersunk Screws M6 (x4) bearing in mind that these Screws secure the X-Ray Tube.



10. Perform this step **only** if the replacement Tube is different from the old Tube and if Spacers for adapting to Tube Support Assembly are required.

These Spacers are only required when the new Tube is a Canon E7252X and the old Tube is a Canon E7843X, E7865X or E7884X.

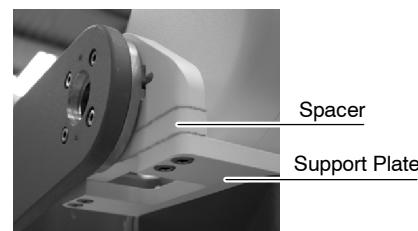
- a. Remove the Support Plate by removing the Screws (x8).
- b. Install the Spacers and the Plate Support with the Screws (x8).



Kit of spacers and Screws



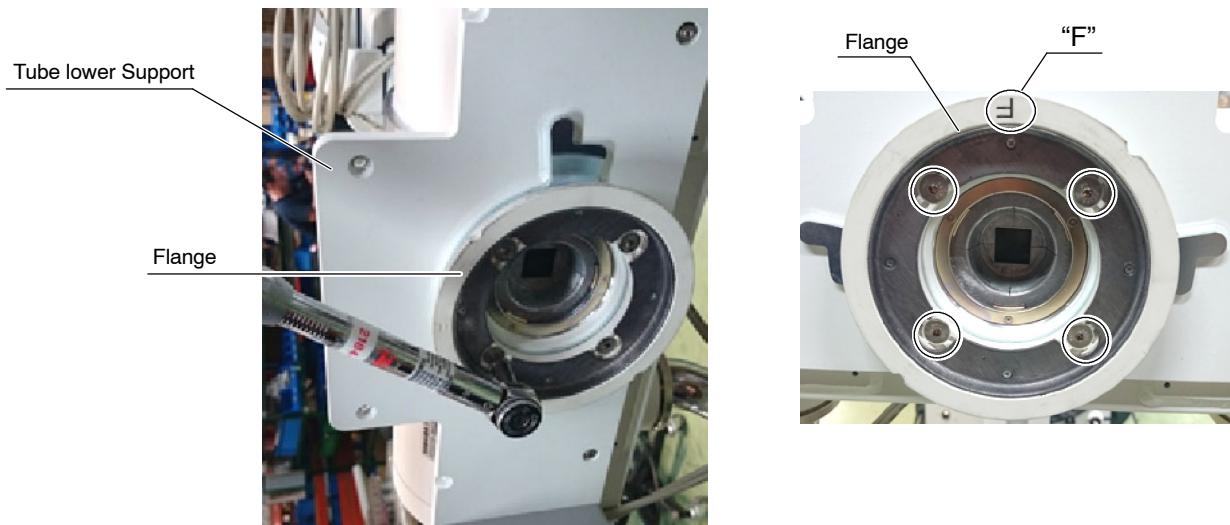
Support Plate assembly for Tubes:
Canon E7843X, E7865X or E7884X



Support Plate assembly for Tubes:
Canon E7252X

11. Replace the Tube and reinstall the Flange (Adaptation Ring):

Place the Flange on the Tube Lower Support, with the letter "F" turned toward the Tube front and fix the Flange to the Tube with the countersunk Screws M6 (x4), **applying Loctite 243** on the Screws and a tightening torque of 6.6 Nm if the Flange is made of Resin material (current Flange) or a tightening torque of 11.3 Nm if the Flange is made of Metal material. For further information, refer to Section 4.1.1 Step 7.



12. Connect the Stator Cable to the replacement Tube.

The Tube Documentation provides information on how to connect the Stator (Main, Shift, Common & Thermostat).

13. Reinstall the Tube Covers.

14. Connect the High Voltage Cables to the Tube.

15. Reinstall the Collimator previously removed or replace it if necessary.
Install the Collimator to the Flange (Adaptation Ring) as described in the procedure of Section 4.1.1 from Steps 7. and 8.
16. Reinstall the Collimator Cables.
17. Set switch SW7 “*Calib. ON/OFF*” in “**ON**” to permit the Service mode.
18. For replace Tubes of the same model and type, go to step 21. For new Tubes which are listed on the “*X-Ray Tubes*” list (*Configuration and Calibration Chapter*), go to step 20. For new Tubes which are not listed on the “*X-Ray Tube Data*” list, proceed to the next step.
19. Replace EPROM U24 and follow the directions as detailed in *Section 2.11 “Replacement of Memory in ATP Console CPU Board and/or HT Controller Board”*.
20. Follow the procedures detailed in the Sections entitled “*Workstations Configuration*” and “*X-Ray Tube Selection*” (*Configuration and Calibration Chapter*).
21. It is advisable to follow the instructions in section entitled “*Anode Rotation Test*” (*Configuration and Calibration Chapter*).
22. Follow the instructions in the section entitled “*Digital mA Loop Open (X-Ray Tube Calibration)*” (*Configuration and Calibration Chapter*). The batteries must be fully charged to carry out these procedures.
23. Do not forget to disable Service Mode by setting switch SW7 “*Calib. ON/OFF*” in “**Off**” position when finished with this task.
24. Perform all the procedures in *Section 4.3 “Collimator Adjustments”* when both Tube and Collimator have been replaced, or only perform *Section 4.3.2 “Alignment of Light Field with X-Ray Field”* when the Tube has been replaced.

4.2 OPTIONAL CONFIGURATION: COLLIMATOR, HANDGRIPS-SUPPORT, FLANGE AND TUBE

4.2.1 COLLIMATOR AND FLANGE REPLACEMENT

1. Release the Arm from Parking position, turn the Column 90° and place the Arm fully extended.
2. Remove the Radiation Meter (option) from the rail system.
3. Place the Tube-Collimator Assembly on the auxiliary table.



4. Turn the unit OFF.



KEEP THE UNIT TURNED OFF AND ISOLATED FROM THE POWER SUPPLY.

5. In order to counterbalance the weight of the part to be replaced, a counterweight of equal weight has to be secured on the Arm (a.e. if the Collimator weights 10 kg / 22 lb, the counterweight must be 10 kg / 22 lb). Refer to the Collimator manual to find out its weight.



IF NO COUNTERWEIGHT HAS BEEN SECURED, IT WILL SPRING UPWARDS WHEN REMOVING THE COLLIMATOR.

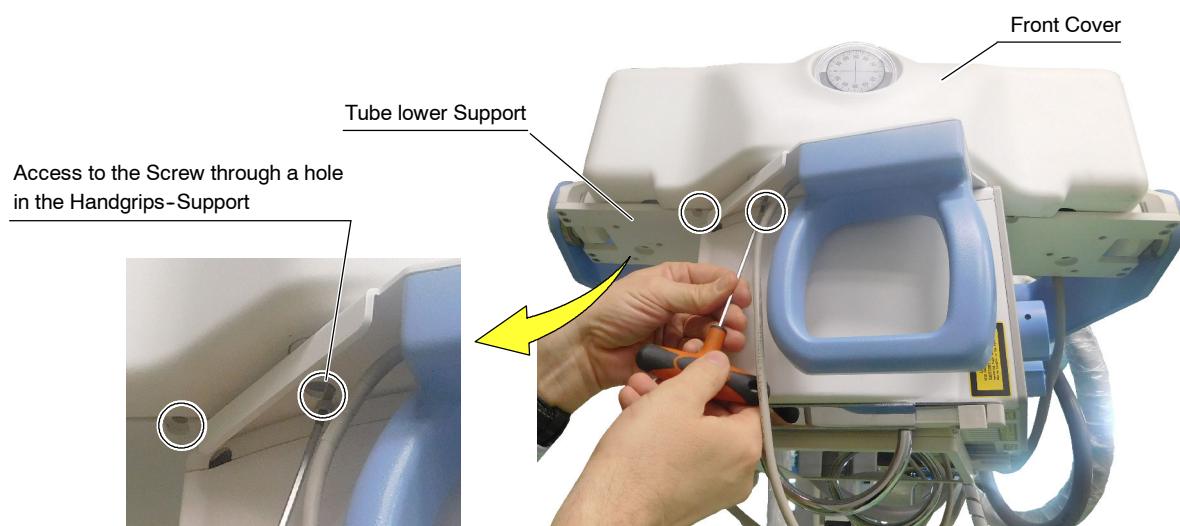
Mobile X-Ray Unit

Troubleshooting

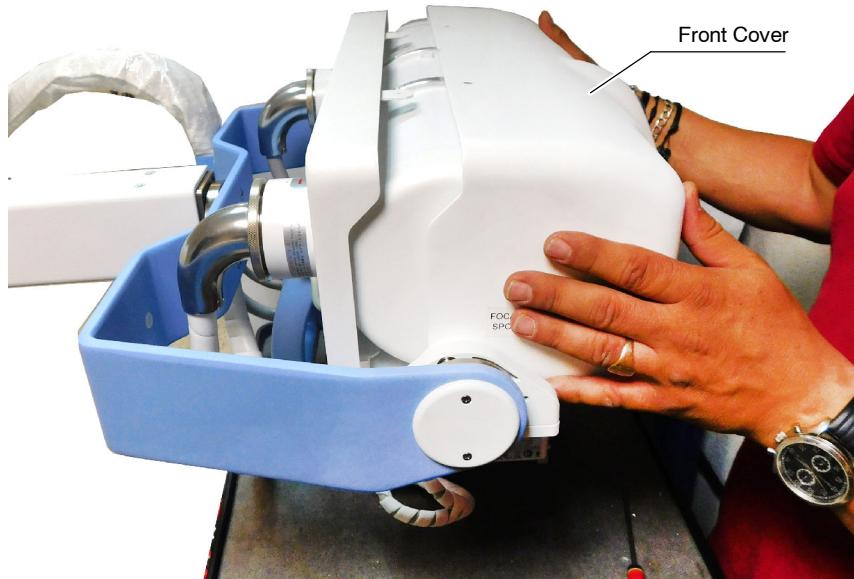
6. Remove the Screws (x2) fixing the Tube Front Cover and the Rear Cover, at the top of the Tube Covers.



7. Turn the Collimator in order to gain access to the Screws underneath that fix the Tube Front Cover and the Tube Lower Support.
Remove the Screws (x2) at one side, then turn again the Collimator and remove the Screws (x2) at the other side.

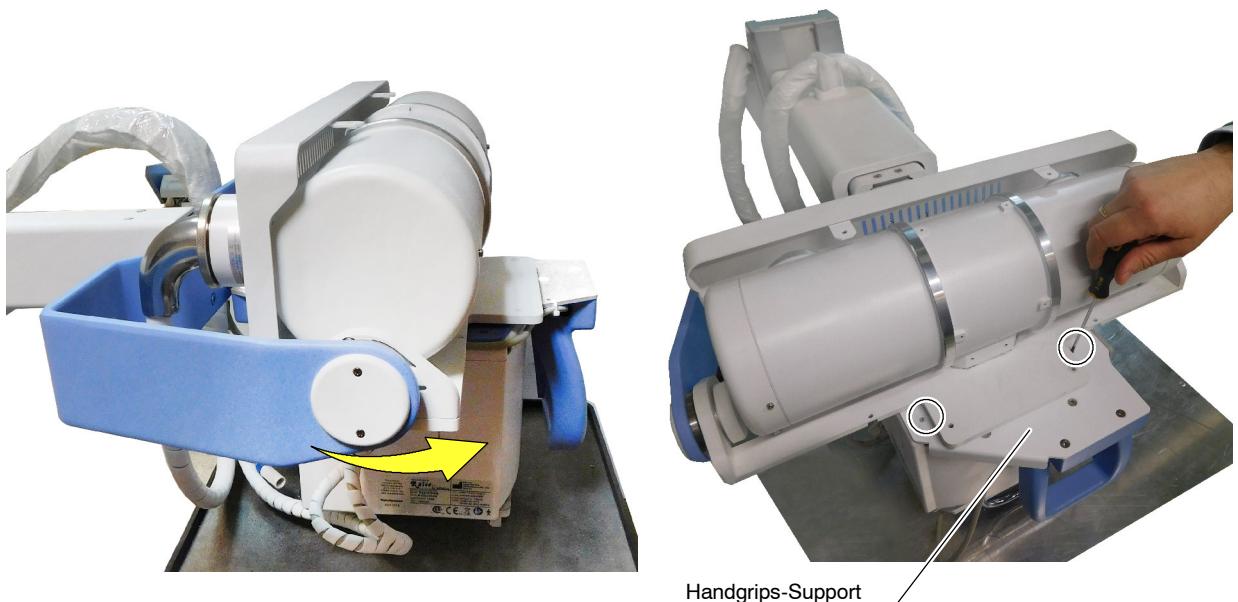


8. Dismount the Front Cover from the X-Ray Tube and place it aside.



9. Turn the Collimator with the Handgrips-Support to access to the Screws that secures the Handgrips-Support to the Collimator.

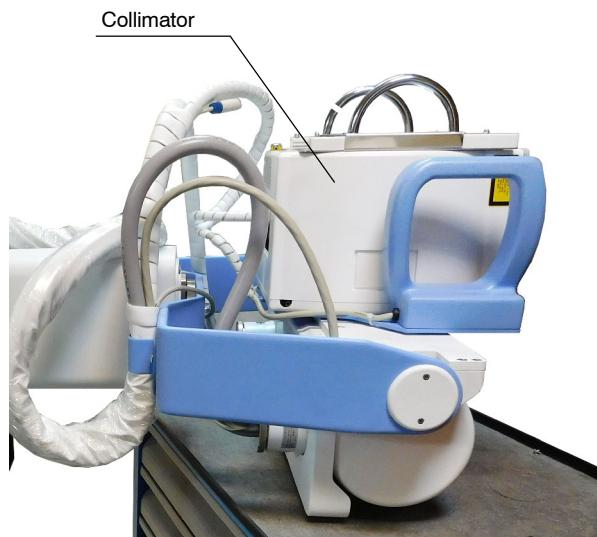
Remove the Screws (x2) from one side of the Handgrips-Support. Turn again the Collimator and remove the Screws (x2) from the other side of the Handgrips-Support.



Mobile X-Ray Unit

Troubleshooting

10. Move aside the auxiliary table and turn the Tube-Collimator Assembly upside down, placing the X-Ray Tube lying on the auxiliary table again.



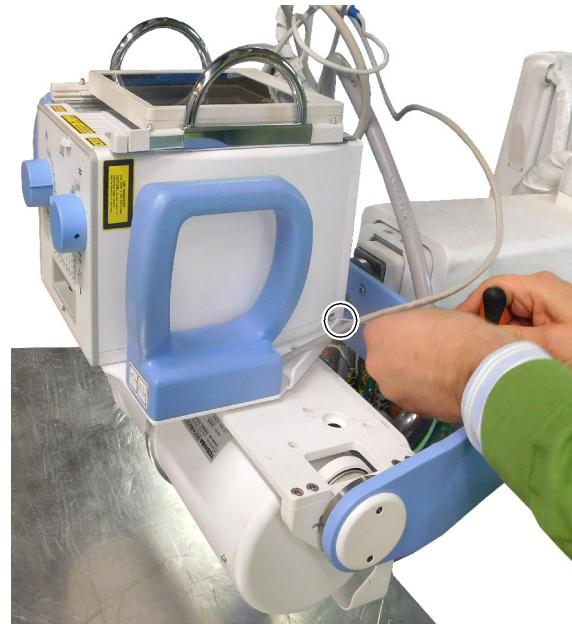
11. Open the plate on the rear side of the Collimator, by removing the fixing Screw, in order to gain access to the Collimator Cable.



12. Disconnect the Collimator Cable.



13. Loosen the Allen Screws (x4) located at the four corners, that fix the Collimator to the X-ray Tube through the Flange (Adaptation Ring).



14. Carefully dismount the Collimator, keeping in mind that the Collimator upper cover is loose.

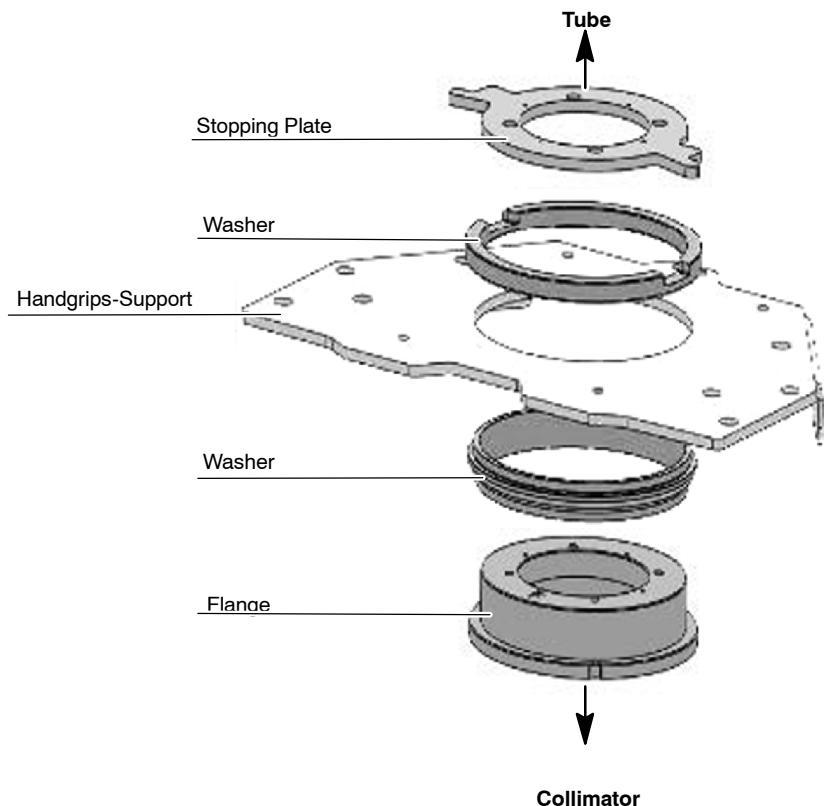


When the Collimator needs to be replaced, the Flange installed on the unit must be removed and has to be replaced by the Flange delivered with the new Collimator.

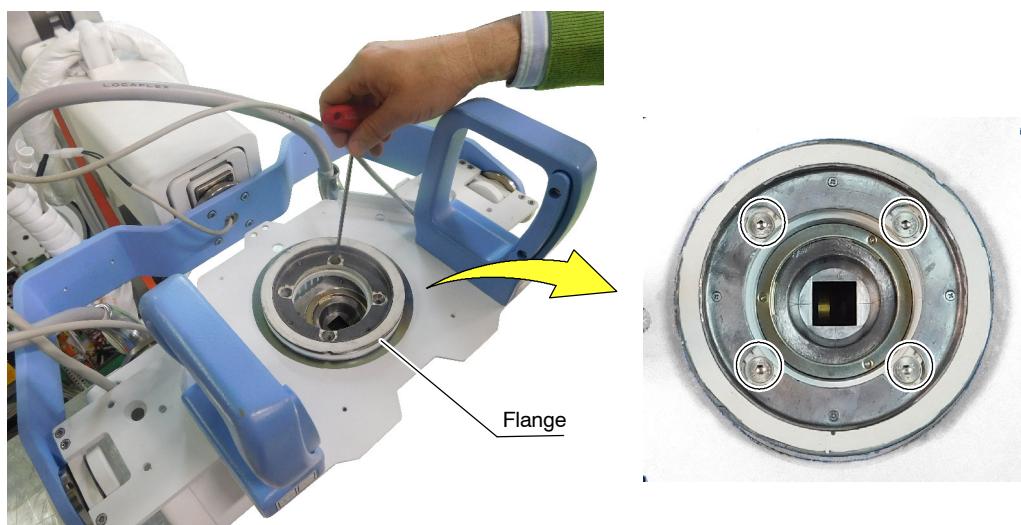
Note 

To replace the Flange (Adaptation Ring, provided with the new Collimator) proceed as indicated in the following Steps and the exploded view of the Flange Assembly.

Illustration 4-1
Flange Assembly



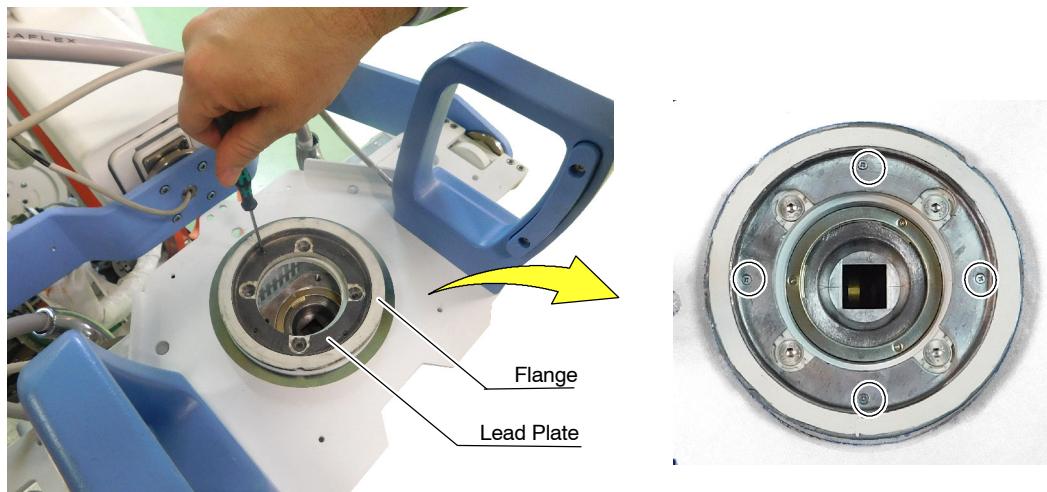
- a. Carefully remove the countersunk Screws M6 (x4) that fix the Flange Assembly to the Tube, bearing in mind that the Tube will fall on the auxiliary table.



Mobile X-Ray Unit

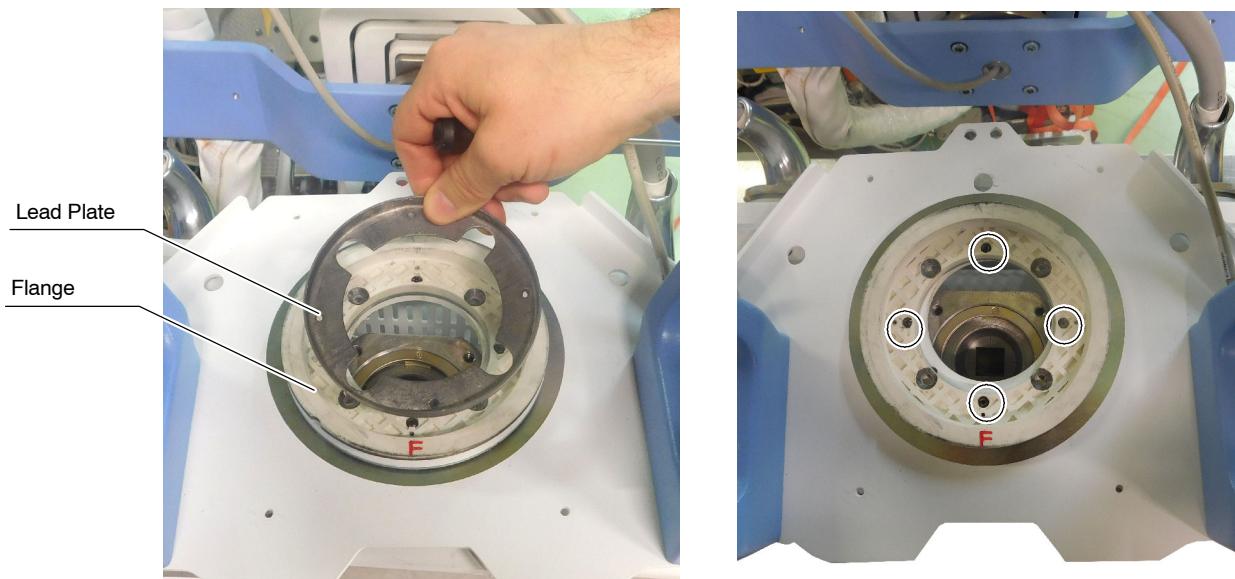
Troubleshooting

- b. Remove the Screws (x4) that fix the Lead Plate to the Flange.

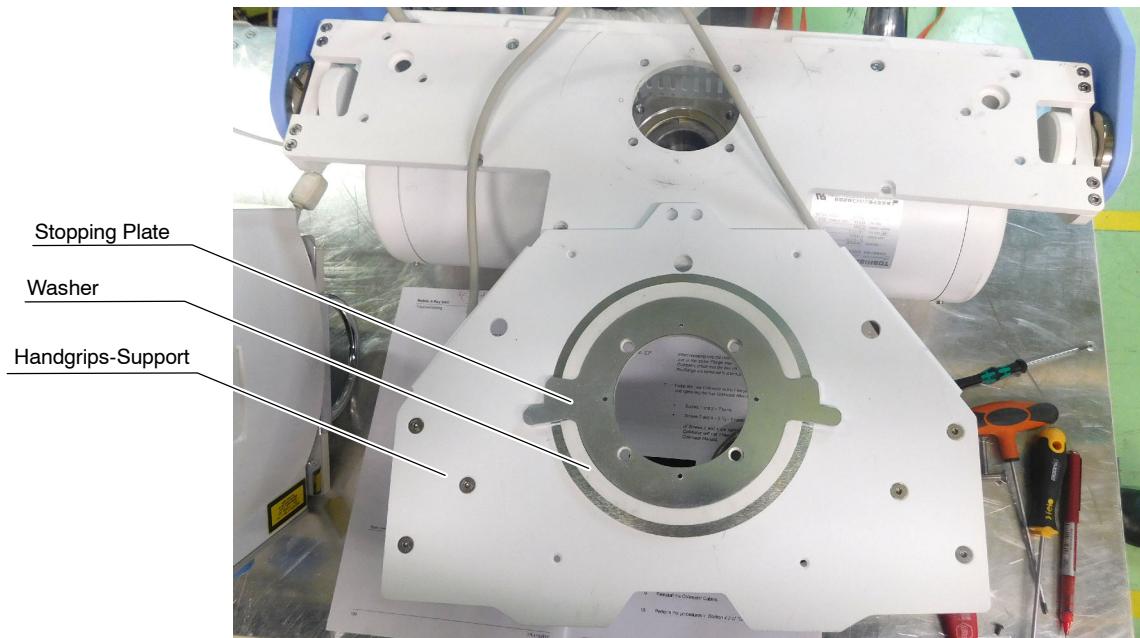


- c. Dismount the Lead Plate and remove the Screws (x4) that fix the Flange to the Stopping Plate (located at the other side of the Handgrips-Support).

Remove the Flange and the Washer from the Handgrips-Support



- d. Dismount the Handgrips-Support, the Stopping Plate and the Washer located on the other side.



- e. Replace the Flange.
Refer to the *Illustration 4-1* for further information about the flange Assembly exploded view.
- f. Align the the Washer Grooves (x2) with the Stopping Plate Flaps (x2) and mount the assembly back to the Handgrips-Support, as shown in the picture below.

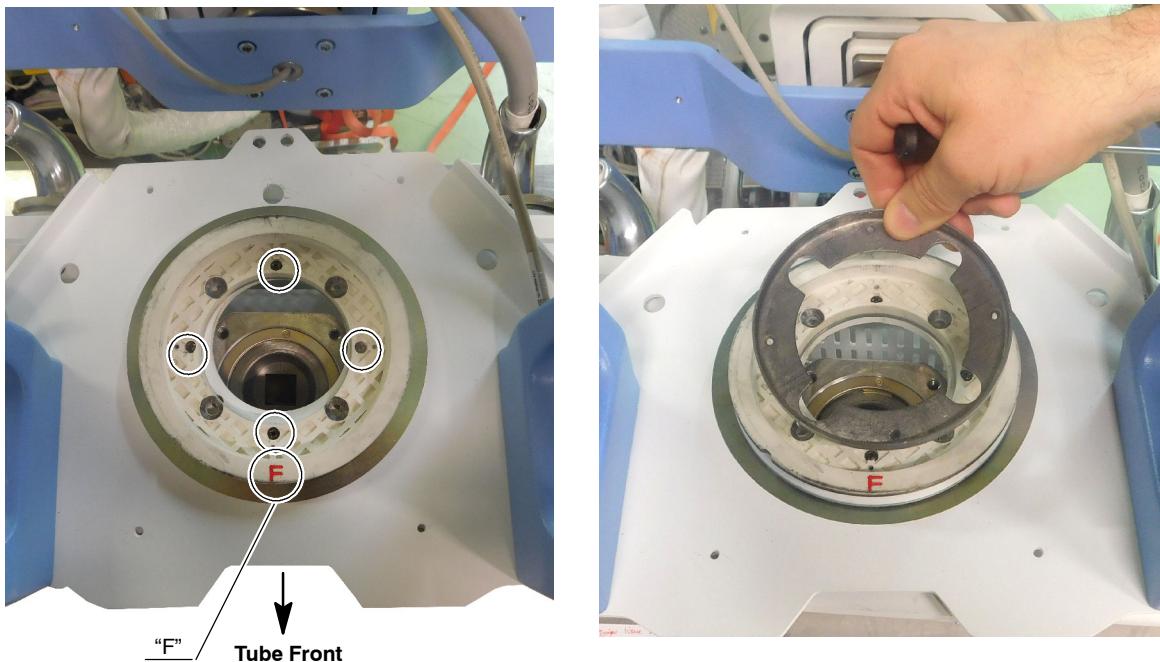


Mobile X-Ray Unit

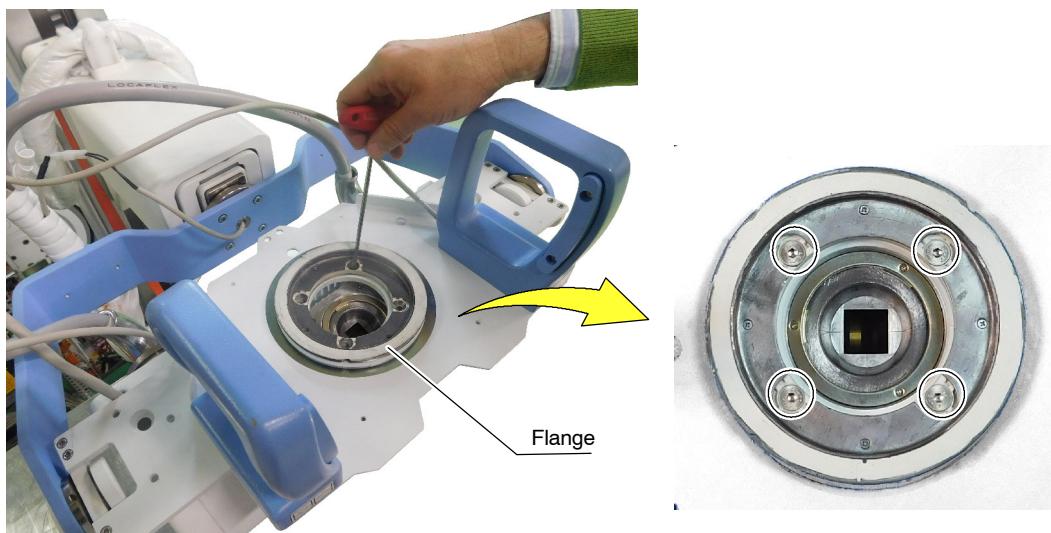
Troubleshooting

- g. Mount the other Washer on the Flange and place the assembly back to the Handgrips-Support, positioning the letter "F" turned toward the Tube front, as shown in the picture below.

Mount the Lead Plate to the Flange with the fixing Screws (x4) being careful not to cross the Washer.



- h. Carefully align the Tube with the Flange Assembly and mount the countersunk Screws M6 (x4) that fix the Flange Assembly to the Tube, **applying Loctite 243** and a tightening torque of 6.6 Nm (the current Flange is made of Resin material).



15. Install the new Collimator to the Flange by adjusting and tightening the Collimator Allen Screws (x4) as described in the next tables.



Current version of Mobile Unit is provided with the Collimator Mounting Bracket Type B and Flange Type B1 (Resin material) with the Metal Stopping Plate.

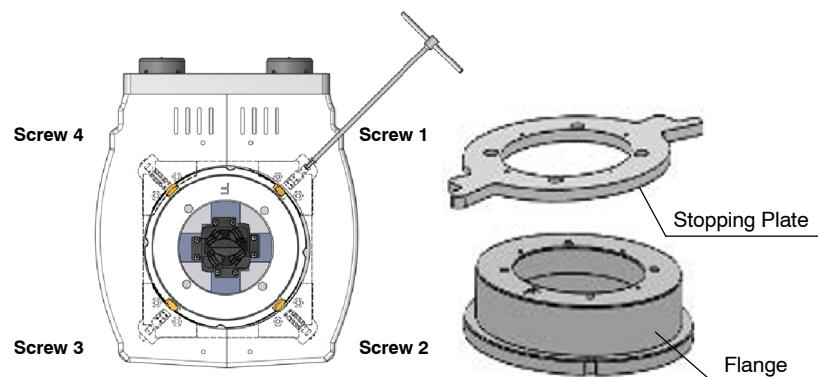


Table 4-5
Collimator Mounting Bracket Type B

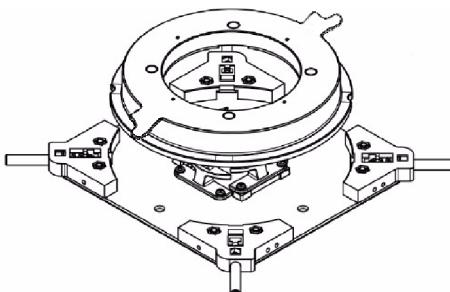
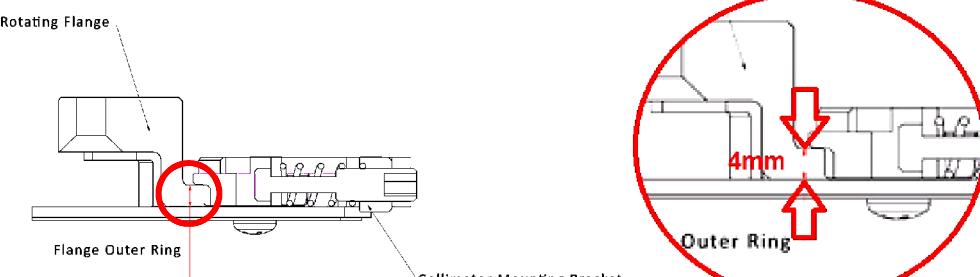
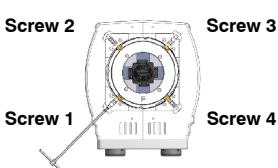
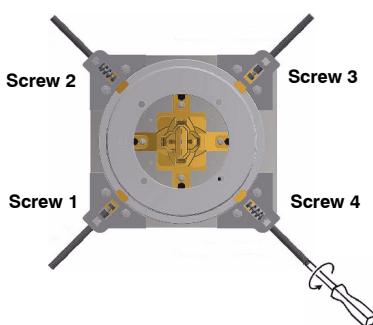
COLLIMATOR MOUNTING BRACKET TYPE B	
Collimator Mounting Bracket Type B (with 2 Fixing Screws with spring and 2 Fixing Screws without spring)	

Mobile X-Ray Unit

Troubleshooting

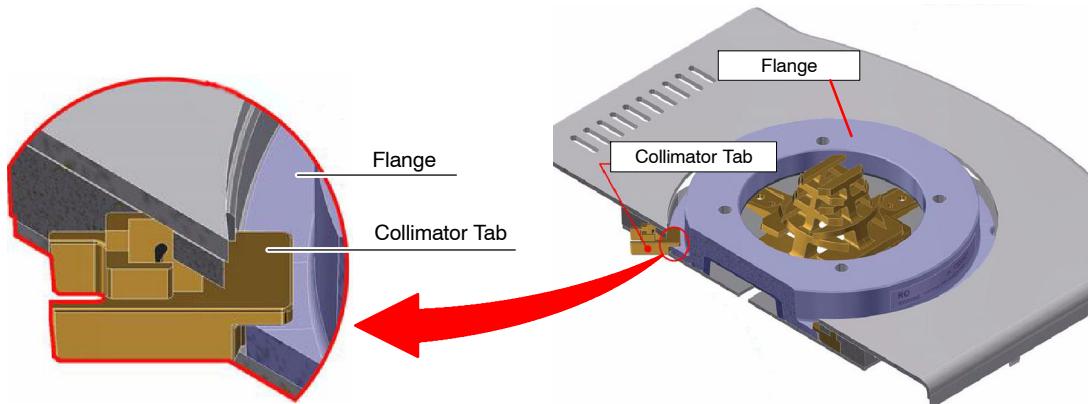
Table 4-6

Flange Type B1 (Resin Flange) with the Metal Stopping Plate (used in current Mobile Units)

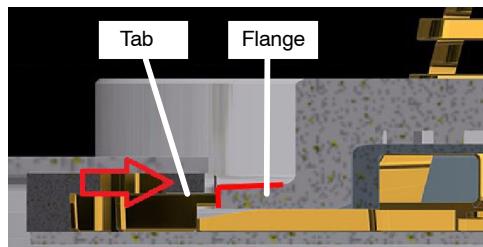
FLANGE TYPE B1 WITH METAL STOPPING PLATE (Compatible with Collimator Mounting Bracket Type B)	
Flange B1 - Resin Flange	
Collimator Mounting Bracket Type B (with 2 Fixing Screws with spring and 2 Fixing Screws without spring)	This combination allows the Collimator rotation
	 <p>Bracket Type B Flange Type B1 with Metal Stopping Plate</p>
	 <p>The thickness of the Flange outer ring is 4 mm for the Flange type B</p>
INSTALLATION	
<p>The installation of the Collimator with the Mounting Bracket type B and Flange type B1 with Metal Stopping Plate needs to be made as follows:</p> <ul style="list-style-type: none"> - Install the Collimator on the Flange: while one person holds the weight of the Collimator, the other tightens the Fixing Screws (x4) located at the four corners that fix the Collimator to the Flange. - With the Tabs (Fixing Screws) fully retracted, tighten the four Screws: <ul style="list-style-type: none"> - Screws 1 and 3 up to the end stroke (at least 7 turns on each one) applying a Torque of 0.45 Nm. - Screws 2 and 4 (with integrated adjustable spring), 5 1/2 turns exactly. <i>(If Screws 2 and 4 are tightened more than 5 1/2 - 6 turns, the Collimator will not rotate).</i> - Check the installation of the Collimator as described in step 16. of this procedure, specially if the previous steps cannot be performed. 	
 <p>Screw 1 Screw 2 Screw 3 Screw 4</p>  <p>Screw 1 Screw 2 Screw 3 Screw 4</p> <p>Screws 1, 3 = 7 turns Screws 2, 4 = 5 1/2 turns</p>	

16. Make sure that the Collimator is well positioned:

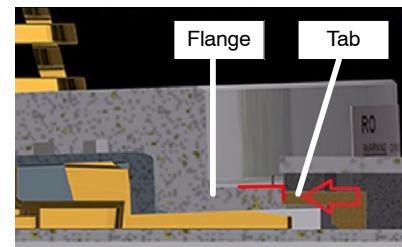
- a. Turn the Collimator to both sides if rotation function is present and pulling it down to ensure that it is safely and properly mounted.
- b. Make sure that the four Tabs present on the Collimator Mounting Bracket overlap the Flange (as shown on the next picture).



- c. Ensure that the four Tabs are not in contact with only the Flange and that they do not lock the Flange Outer Ring instead of overlapping it.



Incorrect Tab Mounting



Incorrect Tab Mounting



AN IMPROPER ASSEMBLY COULD CAUSE THE COLLIMATOR FALLING WITH THE SUBSEQUENT RISK FOR PATIENT AND USER.

17. Reinstall the Collimator Cables.

18. Move the auxiliary table aside and turn the Tube-Collimator Assembly, placing the Tube in the upwards position and the Collimator on the auxiliary table again.
19. Turn the Collimator in order to mount the Screws (x2), on one side of the Handgrips-Support; turn it again and mount the Screws (x2), on the other side of the Handgrips-Support.
20. Reinstall the Rear and the Front Covers of the X-Ray Tube in the reverse order and reinstall the the Radiation Meter (option) to the rail system.
21. Perform the procedures of the *Section 4.3 of “Collimator Adjustments”*.

4.2.2 X-RAY TUBE REPLACEMENT



If the Tube Model is not listed in the “X-Ray Tube Data” list in the Configuration and Calibration Chapter, order a new EPROM U24 on the ATP Console CPU. Contact the Generator Supplier / Agent for the correct EPROM U24 and Tube Data for the Extended Memory Code (E02).

DIP switch 3000SW2-7 on the HT Controller Board may need to be revised depending on the Small Focal Spot size of the Replacement Tube. Refer to the Configuration Section of the Calibration and Configuration Chapter for more information.

1. Release the Arm from Parking position, turn the Column 90° and place the Arm fully extended.
2. Remove the Radiation Meter (option) from the rail system.
3. Place the Tube-Collimator Assembly on the auxiliary table.



4. Turn the unit OFF.



KEEP THE UNIT TURNED OFF AND ISOLATED FROM THE POWER SUPPLY.

5. For Tube replacement it is necessary to dismount the Tube-Collimator assembly, therefore a counterweight of equal weight has to be secured on the Arm (a.e. if the Collimator weights 10kg / 22lb and the Tube weights 18kg / 40lb, the counterweight must be of $10+18 = 28$ kg / 62 lb). Refer to the Collimator and Tube manuals to find out their weight.



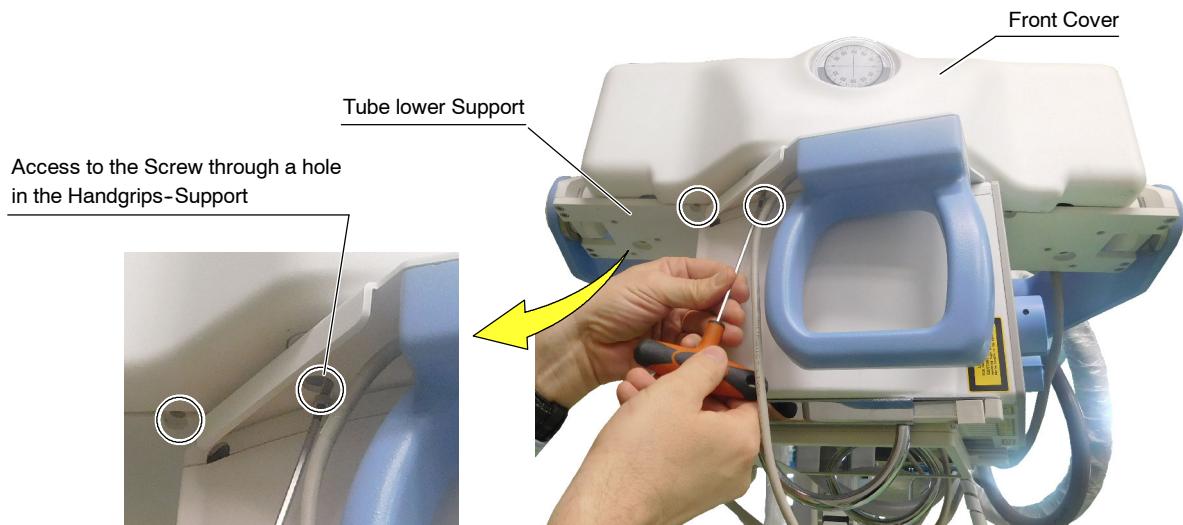
IF NO COUNTERWEIGHT HAS BEEN SECURED, IT WILL SPRING UPWARDS WHEN REMOVING THE TUBE-COLLIMATOR ASSEMBLY.

6. Remove the Screws (x2) fixing the Tube Front Cover and the Rear Cover, at the top of the Tube Covers.

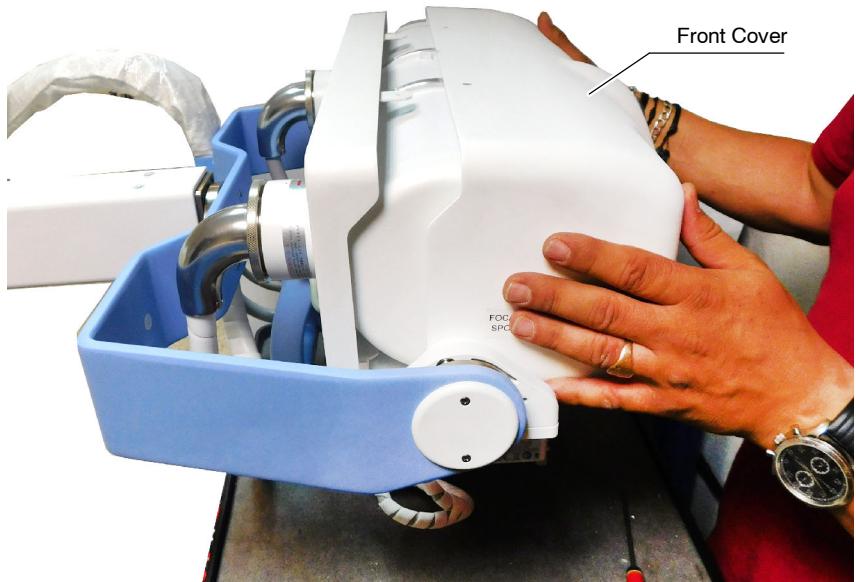


7. Turn the Collimator in order to gain access to the Screws underneath that fix the Tube Front Cover and the Tube Lower Support.

Remove the Screws (x2) at one side, then turn again the Collimator and remove the Screws (x2) at the other side.



8. Dismount the Front Cover from the X-Ray Tube and place it aside.

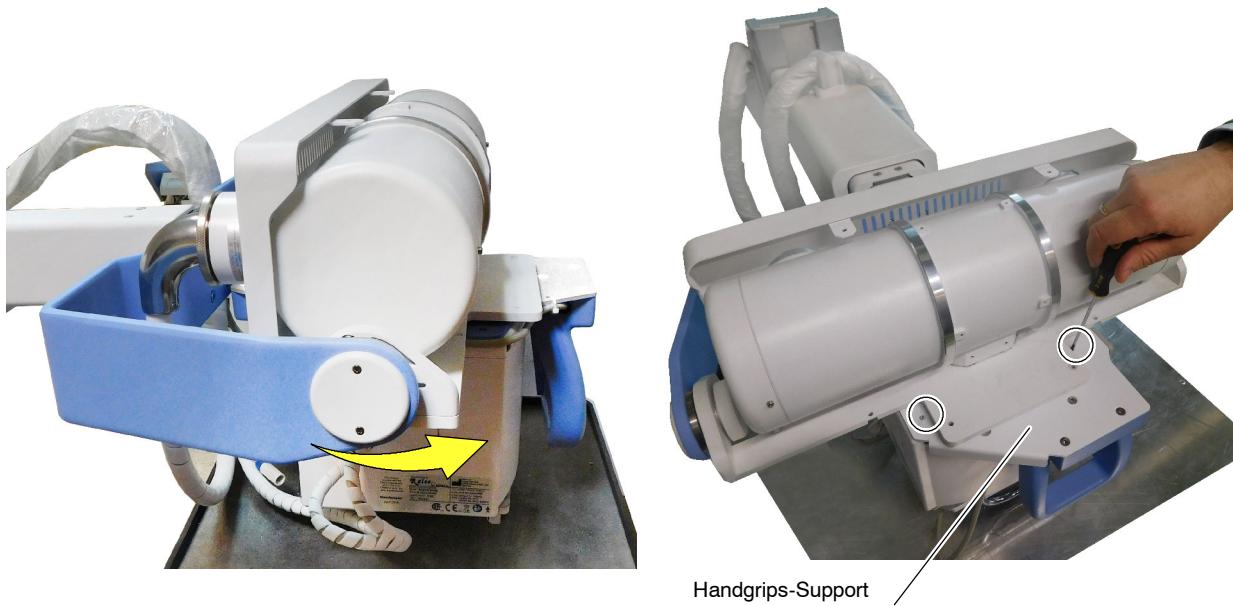


Mobile X-Ray Unit

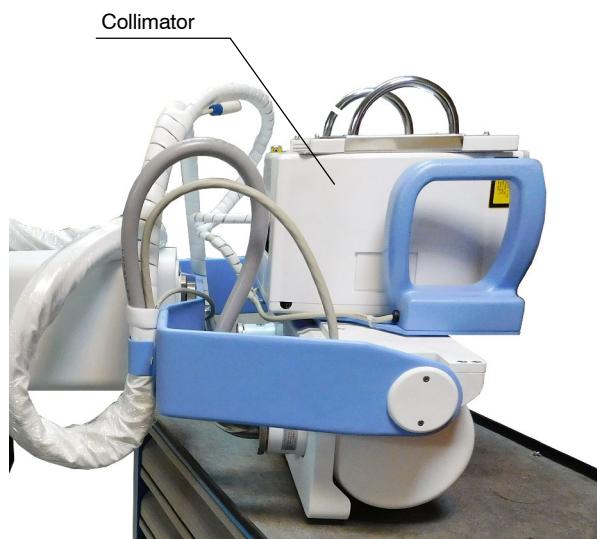
Troubleshooting

9. Turn the Collimator with the Handgrips-Support to access to the Screws that secures the Handgrips-Support to the Collimator.

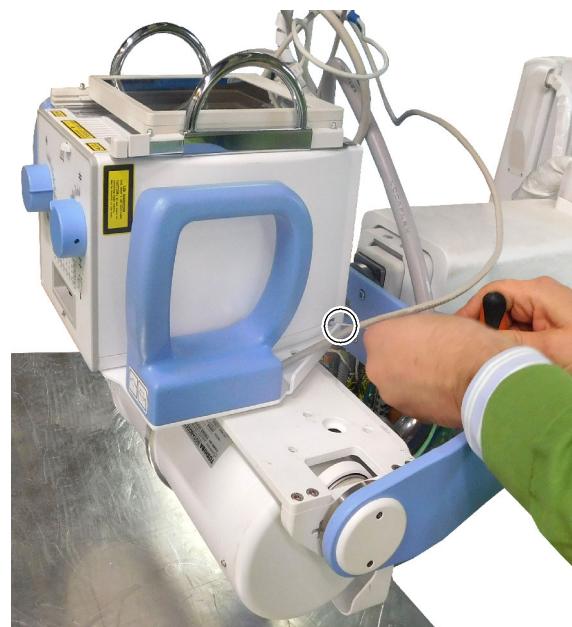
Remove the Screws (x2) from one side of the Handgrips-Support.
Turn again the Collimator and remove the Screws (x2) from the other side of the Handgrips-Support.



10. Move aside the auxiliary table and turn the Tube-Collimator Assembly upside down, placing the X-Ray Tube lying on the auxiliary table again.



11. Loosen the Allen Screws (x4) located at the four corners, that fix the Collimator to the X-ray Tube through the Flange (Adaptation Ring).



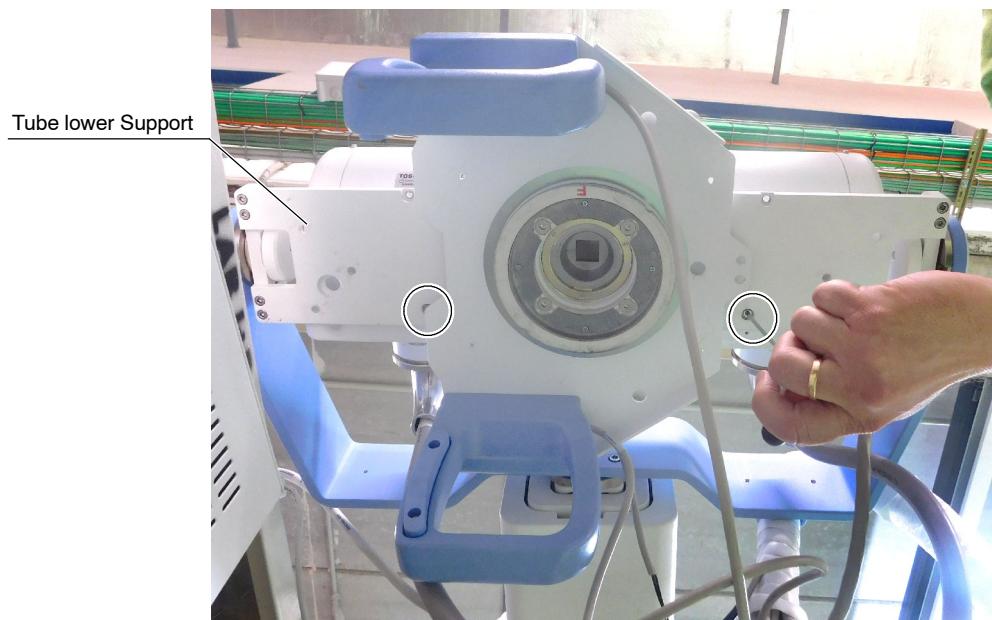
12. Carefully dismount the Collimator, keeping in mind that the Collimator upper cover is loose. If it is needed to replace the Collimator too, disconnect the Collimator Cables.



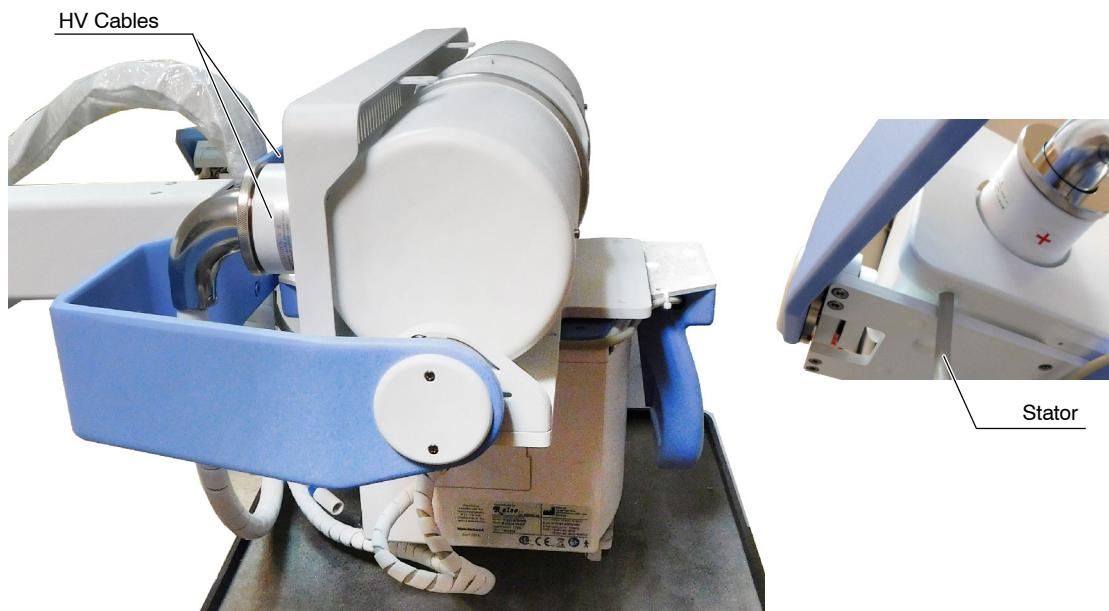
Mobile X-Ray Unit

Troubleshooting

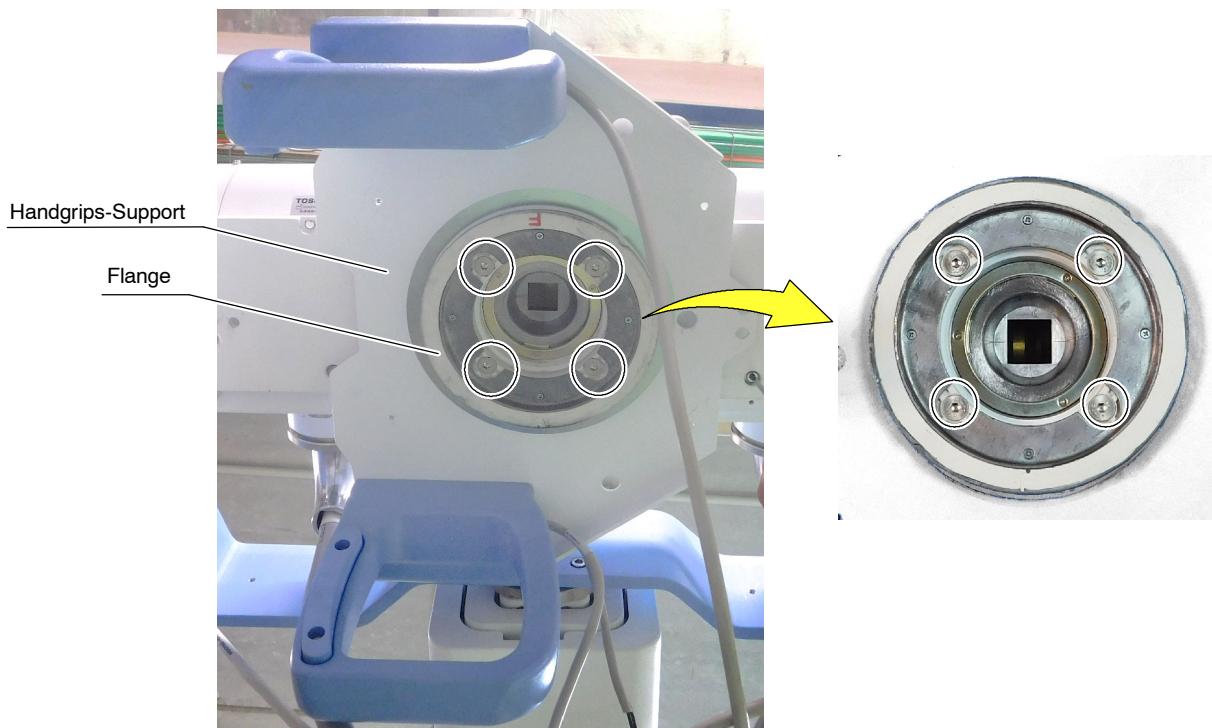
13. Move aside the auxiliary table and turn the Tube 180° to the upwards position.
14. Dismount the Rear Cover of the Tube by removing the Screws (x2) located under the Tube Lower Support.



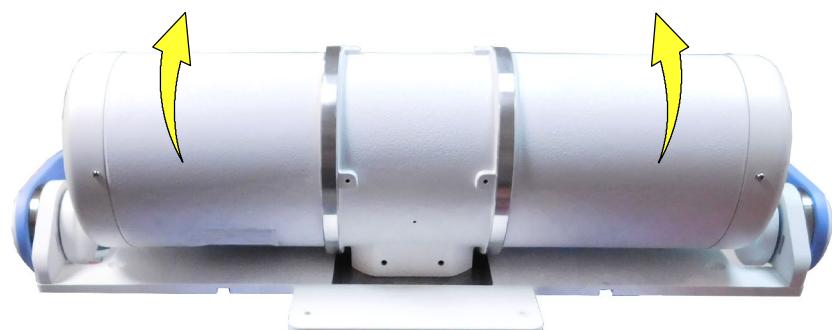
15. Disconnect the High Voltage Cables from the Tube.
Disconnect the Stator Cable.



16. Carefully remove the countersunk Screws M6 (x4) that fix the Flange to the Tube, bearing in mind than these Screws secure the X-Ray Tube.



17. Carefully dismount the Flange with the Handgrips-Support and put them aside on the auxiliary table, keeping in mind the cables length.
18. Carefully dismount the Tube.



Mobile X-Ray Unit

Troubleshooting

19. Perform this step **only** if the replacement Tube is different from the old Tube and if Spacers for adapting to Tube Support Assembly are required.

These Spacers are only required when the new Tube is a Canon E7252X and the old Tube is a Canon E7843X, E7865X or E7884X.

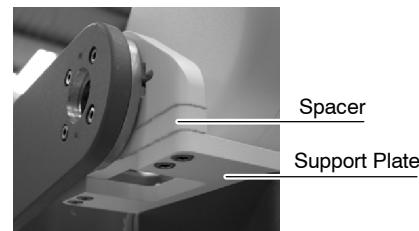
- a. Remove the Support Plate by removing the Screws (x8).
- b. Install the Spacers and the Plate Support with the Screws (x8).



Kit of spacers and Screws



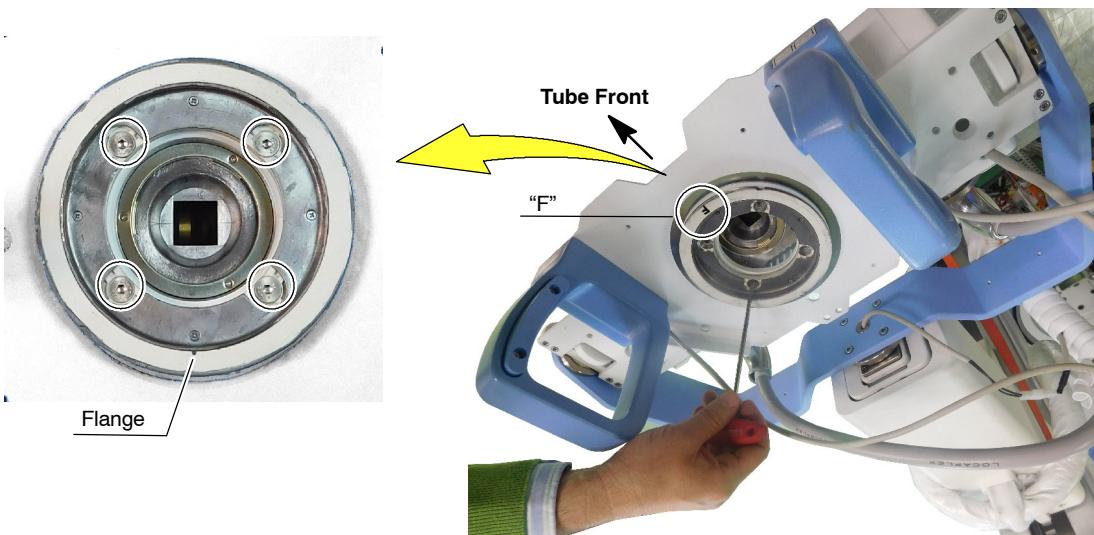
Support Plate assembly for Tubes:
Canon E7843X, E7865X or E7884X



Support Plate assembly for Tubes:
Canon E7252X

20. Replace the Tube.
21. Reinstall the Flange with the Handgrips-Support and carefully align the Tube with the Flange Assembly, positioning the letter "F" turned toward the Tube front, as shown in the picture below.

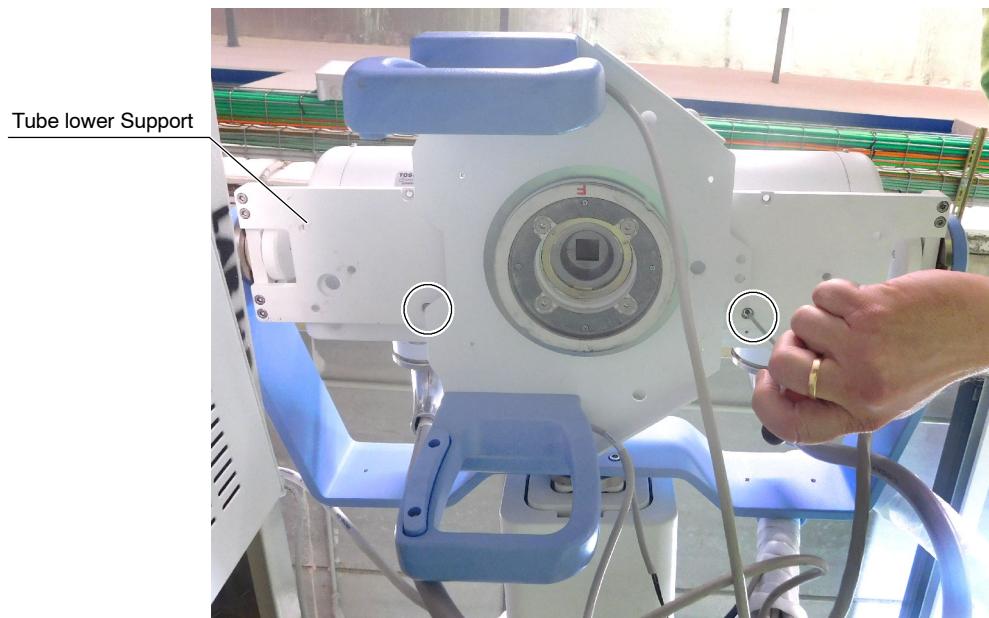
Mount the countersunk Screws M6 (x4) that fix the Flange Assembly to the Tube, **applying Loctite 243** and a tightening torque of 6.6 Nm.



22. Connect the Stator Cable to the replacement Tube.

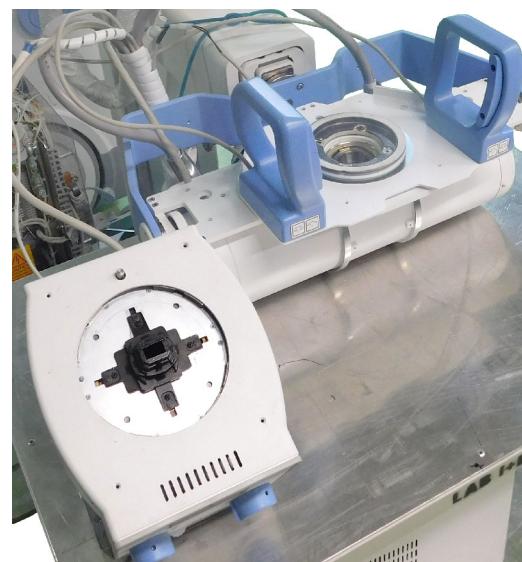
The Tube Documentation provides information on how to connect the Stator (Main, Shift, Common & Thermostat).

23. Reinstall the Rear Cover of the Tube with the Screws (x2) under the Tube Lower Support.



24. Connect the High Voltage Cables to the Tube.

25. Move aside the auxiliary table and turn the Tube-Collimator Assembly upside down, placing the X-Ray Tube lying on the auxiliary table again.



26. Reinstall the Collimator previously removed or replace it if necessary.
Install the Collimator to the Flange (Adaptation Ring) as described in the procedure of Section 4.2.1 in Steps 15. and 16.
27. In case that the Collimator cables were previously disconnected in order to replace the Collimator too, reinstall the Collimator Cables.
28. Move the auxiliary table aside and turn the Tube-Collimator Assembly, placing the Tube in the upwards position and the Collimator on the auxiliary table again.
29. Turn the Collimator in order to mount the Screws (x2), on one side of the Handgrips-Support; turn it again and mount the Screws (x2), on the other side of the Handgrips-Support.
30. Reinstall the Rear and the Front Covers of the X-Ray Tube in the reverse order and reinstall the the Radiation Meter (option) to the rail system.
31. Plug the Unit into the Power Supply.
32. Set switch SW7 “*Calib. ON/OFF*” in “**ON**” to permit the Service mode.
33. For replace Tubes of the same model and type, go to step 36. For new Tubes which are listed on the “*X-Ray Tubes*” list (*Configuration and Calibration Chapter*), go to step 35. For new Tubes which are not listed on the “*X-Ray Tube Data*” list, proceed to the next step.
34. Replace EPROM U24 and follow the directions as detailed in *Section 2.11 “Replacement of Memory in ATP Console CPU Board and/or HT Controller Board”*.
35. Follow the procedures detailed in the Sections entitled “*Workstations Configuration*” and “*X-Ray Tube Selection*” (*Configuration and Calibration Chapter*).
36. It is advisable to follow the instructions in section entitled “*Anode Rotation Test*” (*Configuration and Calibration Chapter*).
37. Follow the instructions in the section entitled “*Digital mA Loop Open (X-Ray Tube Calibration)*” (*Configuration and Calibration Chapter*). The batteries must be fully charged to carry out these procedures.
38. Do not forget to disable Service Mode by setting switch SW7 “*Calib. ON/OFF*” in “**OFF**” position when finished with this task.
39. Perform all the procedures in *Section 4.3 “Collimator Adjustments”* when both Tube and Collimator have been replaced, or only perform *Section 4.3.2 “Alignment of Light Field with X-Ray Field”* when the Tube has been replaced.

4.3 COLLIMATOR ADJUSTMENTS

4.3.1 TEST EQUIPMENT

The following tools are required for Collimator adjustment (not included with the Unit): Collimator Test Tool (Model RMI 161B), Beam Alignment Test Tool (Model RMI 162A) and Light Meter (Standard).

4.3.2 ALIGNMENT OF LIGHT FIELD WITH X-RAY FIELD

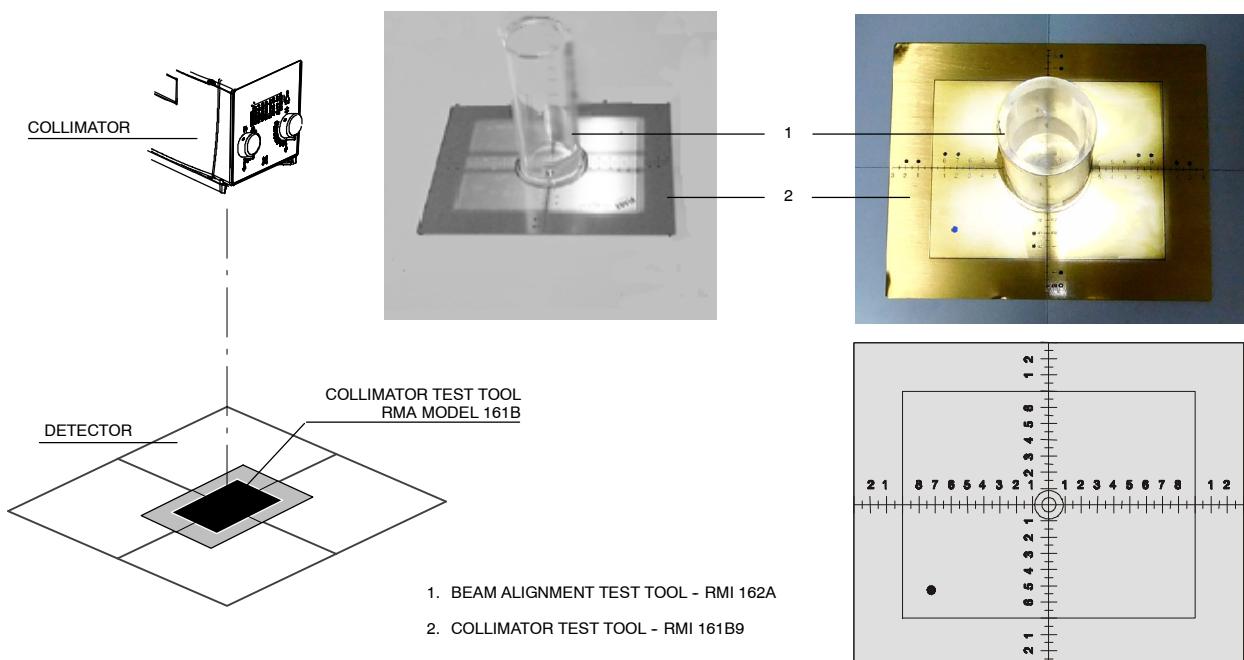
1. Place the Tube-Collimator Assembly vertically at 100 cm (40") SID from the Digital Detector. With a level, check the correct horizontal position of the Tube-Collimator Assembly and Detector, both must be in parallel.

Note 

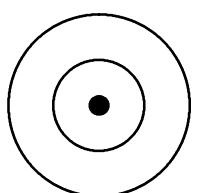
The Detector used for testing can be located on the floor or a Table.

2. Turn on Collimator light and center the Collimator in relation to the Detector. Horizontal and transverse position of the light axes projected by the Collimator Light must be in line with the Detector axes.
3. Set the Collimator Test Tool (RMI model 161B) centered on the Digital Detector (*refer to Illustration 4-2*).

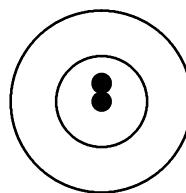
Illustration 4-2
Alignment Test Tools



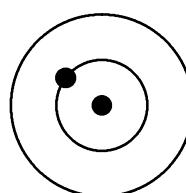
4. Turn on Collimator light and adjust the Light Field of the Collimator Light to the rectangle drawn inside the Collimator Test Tool.
5. Place centered the Beam Alignment Test Tool (RMI model 162A) on the Collimator Test Tool (*refer to Illustration 4-2*).
6. Make an exposure at 55 kVp / 5 mAs (10 mA / 0.5 s) and Small Focal Spot.
7. 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) the X-ray Beam is perpendicular.
 - If the image of the top ball (larger shadow) intercepts the central ball shadow or is within the threshold of the first circle, as shown in the drawings (B or C), the X-ray Beam is about 1° away from the perpendicular. In both cases, perpendicularity is within tolerance for 100 cm (40") SID.
 - If the image of the top ball (larger shadow) is outside the first circle, correct the position of the X-Ray Unit. Repeat the process until the perpendicularity is correct.



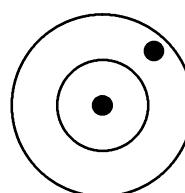
A
Completely aligned



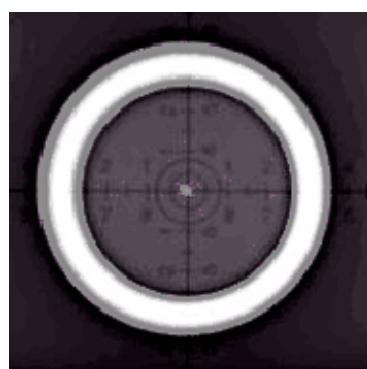
B
Aligned within tolerance



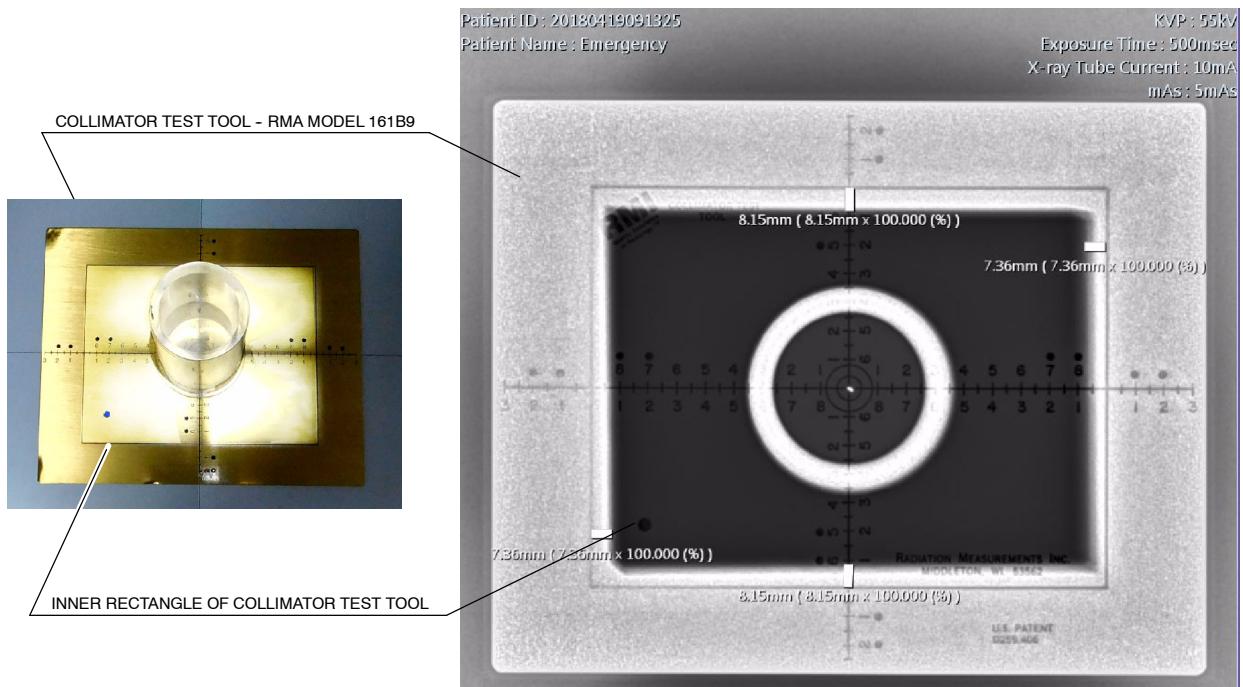
C



D
Misaligned



8. 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.

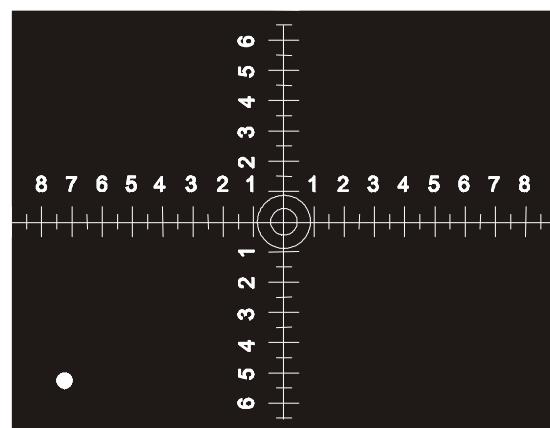
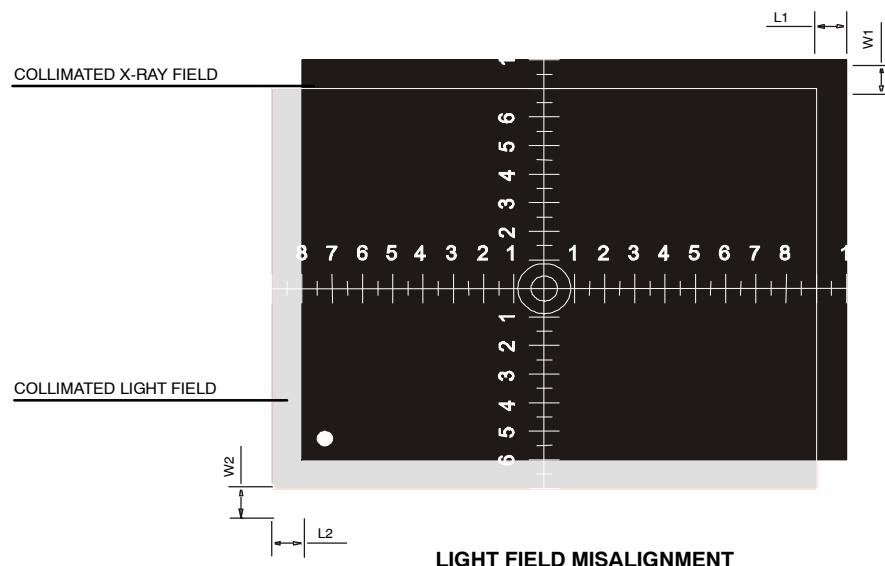
If case of misalignment, follow with next step.

Mobile X-Ray Unit

Troubleshooting

9. 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 \leq 2 cm.
Deviation axis Y = W₁ + W₂, should be \leq 2 cm.

The maximum misalignment allowed is 2 % of SID (for SID 100 cm (40") = 2 cm of tolerance).



COLLIAMTED LIGHT FIELD = COLLIMATED X-RAY FIELD
GOOD FIELD ALIGNMENT

10. If the adjustment is not possible, replace the Collimator.
11. Repeat the process making an exposure at 55 kVp / 5 mAs (10 mA / 0.5 s) and Large Focal Spot.

4.3.3 FIELD SIZE INDICATOR TEST

Note 

Before starting with the Field Size Indicator Test, the Alignment of Light Field with X-Ray Field should be performed.

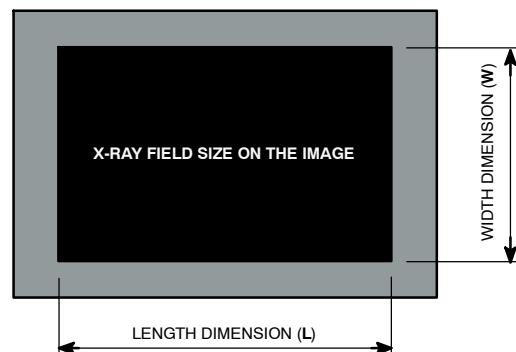
1. Place the Tube-Collimator Assembly vertically at 100 cm (40") SID from the Digital Detector. With a level, check the correct horizontal position of the Tube-Collimator Assembly and Detector, both must be in parallel.

Note 

The Detector used for testing can be located on the floor or a Table.

2. Turn on Collimator light and center the Collimator in relation to the Detector. Horizontal and transverse position of the light axes projected by the Collimator Light must be in line with the Detector axes.
3. Open the Collimator blades to set a Field Size of 24 x 30 cm for 100 cm (40") SID.
4. Make an exposure at 55 kVp, 1 mAs.
5. Check in the image the following measurements known (refer to Illustration 4-3):
 - a. Measure the length of the X-ray Field on the Processed Film (identified as L)
 - b. Measure the width of the X-ray Field on the Processed Film (Identified as W)

Illustration 4-3
X-ray Field Size



6. 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
7. 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 (40").
8. 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.

4.3.4 COLLIMATOR LIGHT BRIGHTNESS TEST

4.3.4.1 COLLIMATOR LIGHT FIELD INTENSITY

1. Place the Tube-Collimator Assembly vertically at 100 cm (40") SID from the Digital Detector. With a level, check the correct horizontal position of the Tube-Collimator Assembly and Detector, both must be in parallel.

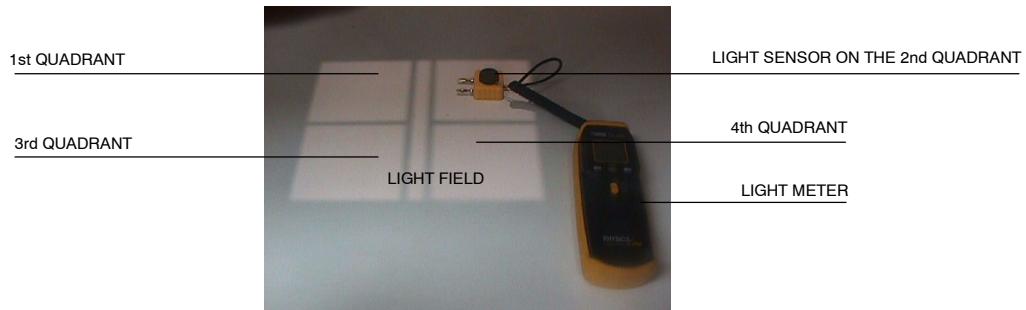
Note 

The Detector used for testing can be located on the floor or a Table.

2. Turn on Collimator light and center the Collimator in relation to the Detector. Horizontal and transverse position of the light axes projected by the Collimator Light must be in line with the Detector axes.
3. Open the Collimator blades to set a Field Size of 24 x 24 cm for 100 cm (40") SID.

4. Place the Light Meter on the Detector with sensor directed toward the Light Source.
5. With the Collimator Light ON, place the Light Meter in the center of one quadrant of the light field (*refer to Illustration 4-4*).

Illustration 4-4
Light Meter on Receptor



6. With Collimator Light OFF, measure and note the ambient light level.
7. Do not move the Light Meter. With the Collimator Light ON, measure and keep record of light level of that quadrant.
8. Determine the light intensity of that quadrant by subtracting the ambient light level from the corresponding light level.
9. Repeat measurements at the approximate center of remaining three quadrants of light field.
10. With the measurements obtained on the step-9., the results of Light Field Intensity in all quadrants should be higher of 170 lux (16 foot-candles) and among all the quadrants the intensity light field shall be not differ more than 10%.
11. The average illumination at a distance of 1 meter from the focal spot shall not be less than 160 lux (15 foot-candles). Rejection limit is 170 lux (16 foot-candles).

12. If the deviation of Light Field Intensity is out acceptance limits:
 - Check that the light field projected is clear and homogeneous.
 - Check that the Collimator Led, the Mirror and the Mylar window are not dirty. (*Refer to Collimator Manual*).

Check the light level again. If it is still low, replace the Collimator Led and/or the Collimator "Timer Power Led" Board. (*Refer to Collimator Manual*).

Finally, if it is necessary, replace the Collimator.

4.3.4.2 COLLIMATOR LIGHT FIELD CONTRAST RATIO

1. Place the Tube-Collimator Assembly vertically at 100 cm (40") SID from the Digital Detector. With a level, check the correct horizontal position of the Tube-Collimator Assembly and Detector, both must be in parallel.

Note 

The Detector used for testing can be located on the floor or a Table.

2. Turn on Collimator light and center the Collimator in relation to the Detector. Horizontal and transverse position of the light axes projected by the Collimator Light must be in line with the Detector axes.
3. Open the Collimator blades to set a Field Size of 24 x 24 cm for 100 cm (40") SID.
4. Place the Light Meter on the Detector with sensor directed toward the Light Source.
5. With the Collimator Light ON, place the Light Meter in the center of one quadrant of the light field (*refer to Illustration 4-4*).
6. Minimize the room lighting. With the Collimator Light OFF, measure and record the ambient light level.

7. Turn ON the Collimator Light. Measure the maximum illumination; this should occur near the field center. Slide the light sensor along the Detector, and locate the point where the illumination drops to a 75% of the maximum. This point is defined by BRH as lying on the edge of the Light Field (*refer to Illustration 4-5*). All subsequent measurements will be referenced to this point and to this definition of "edge".

Illustration 4-5 Light Contrast Calculation



8. Measure the illumination at a point 3 mm from the edge of the field toward the center of the field (Light sensor on the left of edge). (*Refer to Illustration 4-5*). Record this as I_1 .
9. Measure the illumination at a point 3 mm from the edge of the field away from the center of the field (Light sensor on the right of edge). (*Refer to Illustration 4-5*). Record this as I_2 .
10. Correct the values of I_1 and I_2 by subtracting from each value the ambient light level measured in step-6. Now divide the corrected value of I_1 by I_2 . This ratio should be 4 or more.

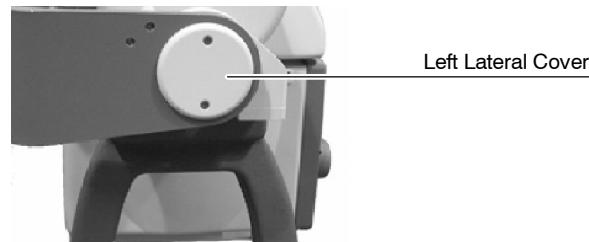
$$\frac{I_1 - \text{Ambient Light}}{I_2 - \text{Ambient Light}} = \geq 4$$

11. Repeat the process from step-7. for all quadrants of Light Field.
12. If the deviation of Light Field Contrast Ratio is out acceptance limits, it is necessary check the following:
 - Check that the light field projected is clear and homogeneous.
 - Check that the Collimator Led, the Mirror and the Mylar window are not dirty. (*Refer to Collimator Manual*).
 - The Light Field Intensity level shall be higher of 170 lux.
 - The ambient light level shall be low as it affects the accuracy of the measurements.

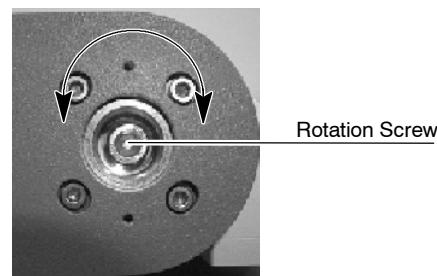
4.4 TUBE-COLLIMATOR ASSEMBLY VERTICAL ROTATION ADJUSTMENT

The vertical rotation movement of the Tube-Collimator Assembly on the Tube Longitudinal Axes can be adjusted (hard or soft movement) as described below.

1. Dismount the left lateral cover of the Tube-Collimator Support by removing the two (2) screws.



2. Tighten or loosen the internal screw (Allen-6) for rotational adjustment.



3. Remount the left lateral cover of the Tube-Collimator Support.

4.5 TUBE-COLLIMATOR ASSEMBLY HORIZONTAL ROTATION ADJUSTMENT

Note 

Two people are necessary to carry out the entire procedure.

Before starting the procedure, place an auxiliary table beside the Unit Column.

1. Release the Arm from Parking position, turn the Column 90° and place the Arm fully extended with the Tube-Collimator Assembly on the table.
2. Turn the unit OFF.



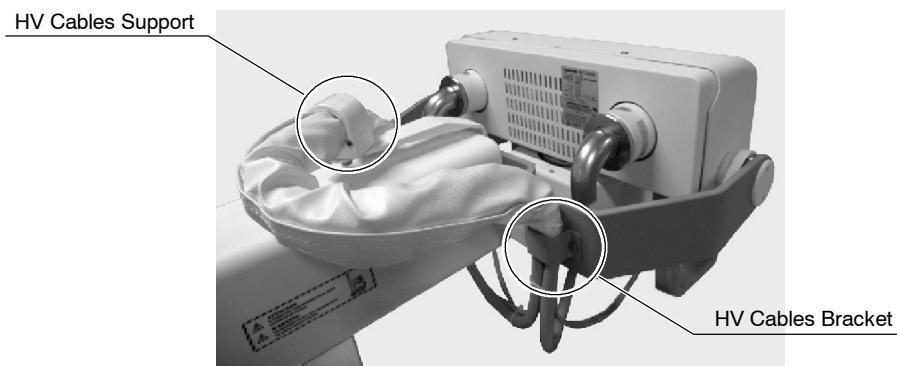
KEEP THE UNIT TURNED OFF AND ISOLATED FROM THE POWER SUPPLY.

3. A counterweight of equal weight of the Tube-Collimator Assembly has to be secured on the Arm (a.e. if the Collimator weights 10 kg / 22 lb, the Tube weights 18 kg / 40 lb, and the remaining parts of the Assembly (HV Cables, Supports, Tube covers, etc.) weights approx. 13 Kg / 29 lb, the counterweight must be of $10+18+13= 41$ kg / 91 lb. *Refer to the Collimator and Tube manuals to find out their weight.*



IF NO COUNTERWEIGHT HAS BEEN SECURED ON THE ARM, IT WILL SPRING UPWARDS WHEN REMOVING THE TUBE-COLLIMATOR ASSEMBLY.

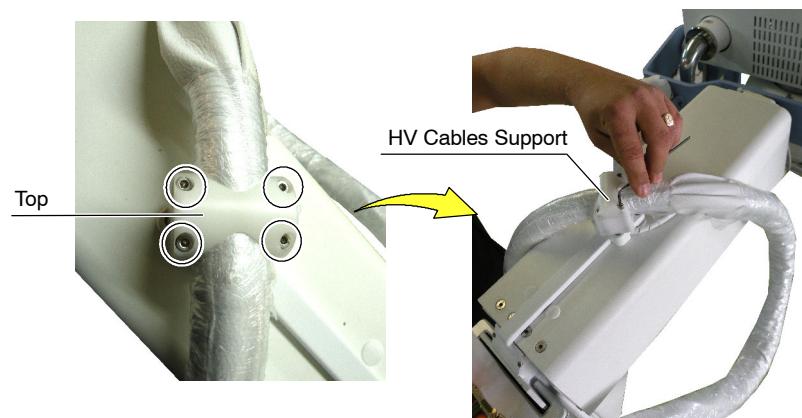
4. Remove the Brackets and Supports of the HV Cables by removing the corresponding Screws.
 - a. For Mobile Unit with Standard Column.



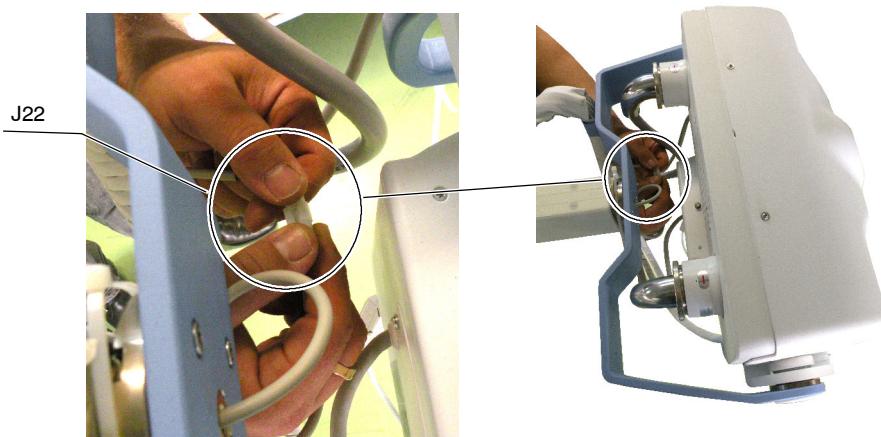
b. For Mobile Unit with Telescopic Column (option):



- Remove the two (2) Screws of the HV Cables Bracket and the four (4) Screws of the HV Cables Support. Remove the HV Cables Support Top and place the HV Cables aside.



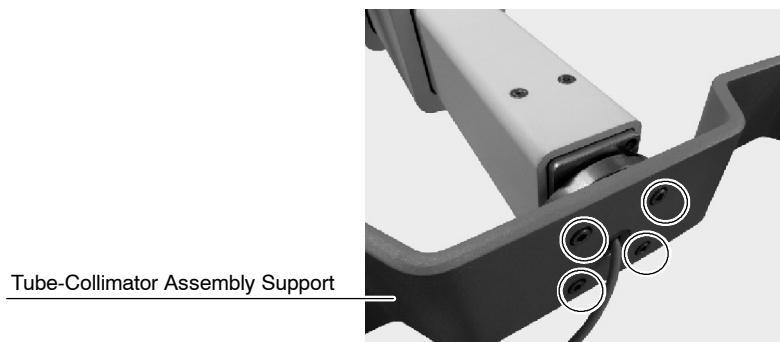
- Disconnect Connector J22 (Arm Brake) and isolate the ends with electrical tape.





THE WEIGHT OF THE TUBE-COLLIMATOR ASSEMBLY IS HEAVY, UNSTEADY AND DIFFICULT TO HANDLE, THEREFORE AT LEAST TWO PEOPLE ARE NEEDED TO REMOVE IT. THIS WILL AVOID PERSONAL INJURIES OR DAMAGE TO THE EQUIPMENT.

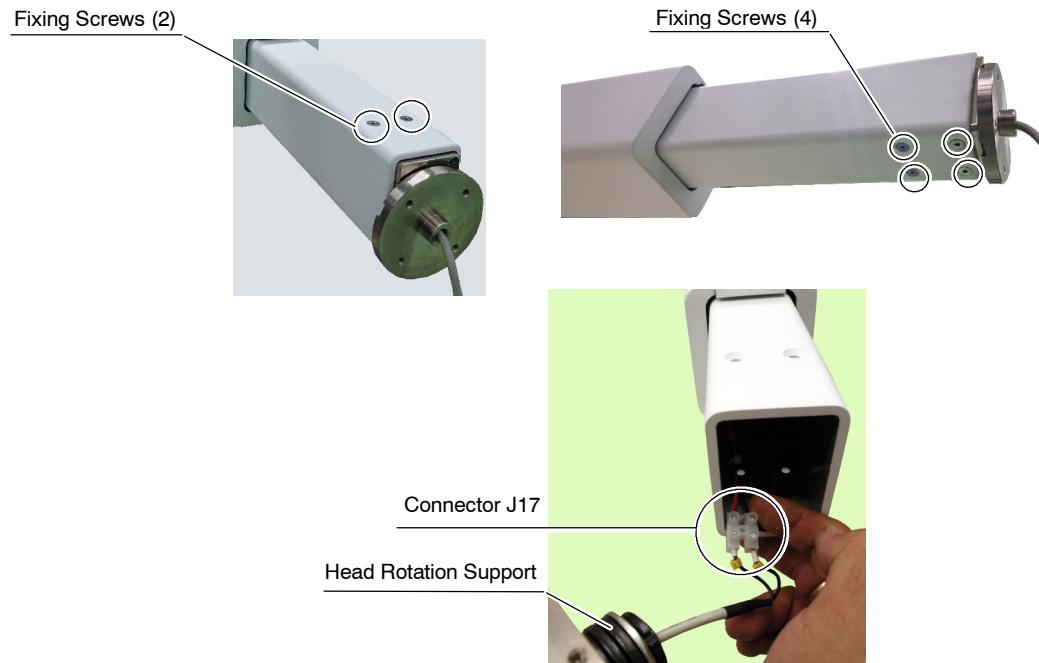
5. While one person supports the the Tube-Collimator Assembly, the other removes the four (4) Screws that fix the Tube-Collimator Assembly Support to the Head Rotation Support.



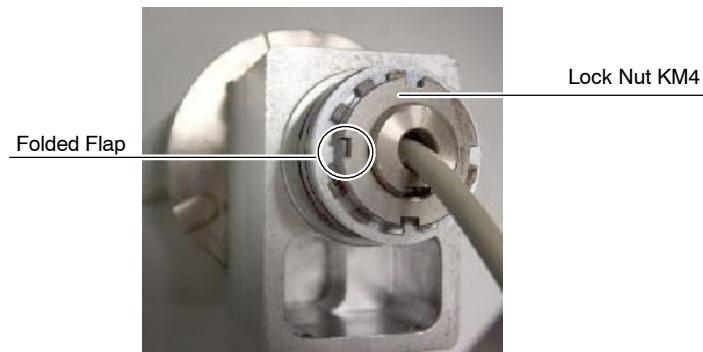
6. Carefully remove the Tube-Collimator Assembly with the Head Rotation Support, passing the HV Cables below the Arm, and place the Assembly on the auxiliary table taking care not to place it over the HV Cables, DAP Cable, etc.



7. Remove the two (2) Screws from the upper side and the four (4) Screws from the lower side of the Arm.
Remove the Head Rotation Support and disconnect connector J17



8. At the back side of the Head Rotation Support, unfold the Flap of the Lock Nut KM4, adjust the Nut and fold the Flap that coincides with a groove.



9. Follow the procedure in reverse order to reassemble the Arm and the Tube-Collimator Assembly. Finally, test the Unit.

SECTION 5

HV TRANSFORMER REPLACEMENT

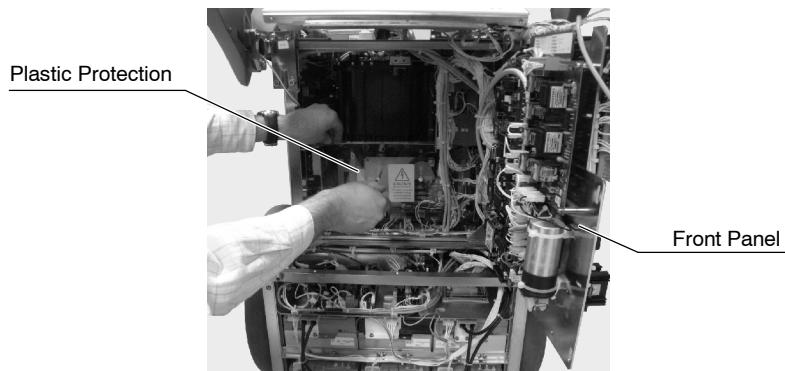


Never open the Oil Entrance located at the top of the HV Transformer. This HV Transformer is hermetic and the Oil Level does not need to be checked.

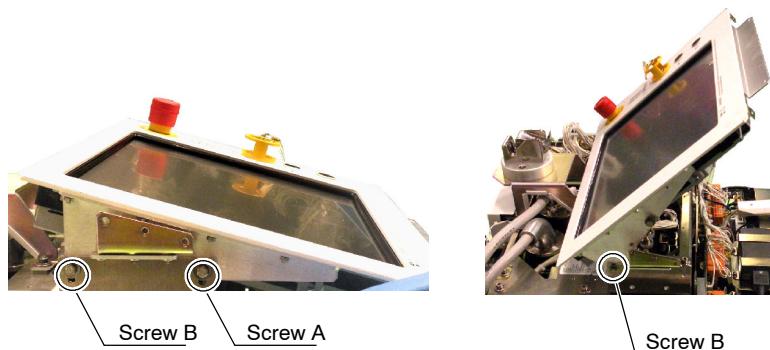
Note

Before proceeding with the replacement, check the oil level of the new HV Transformer. Take out the Receptacle Caps and put approximately 1 cm (0.5") of HV Oil "Shell Diala AX", use the oil tubes provided with the HV Cables or, otherwise, use silicon grease. Put the Receptacle Caps back in place.

1. Remove the Console Frame, Upper Back Cover and Front Cover, as indicated in the corresponding *Section of "Cover Removal"* of this document.
2. Open the PC Module and the Generator Front Panel to access the HV Transformer.
3. Remove the Plastic Protection from the Inverter Module.



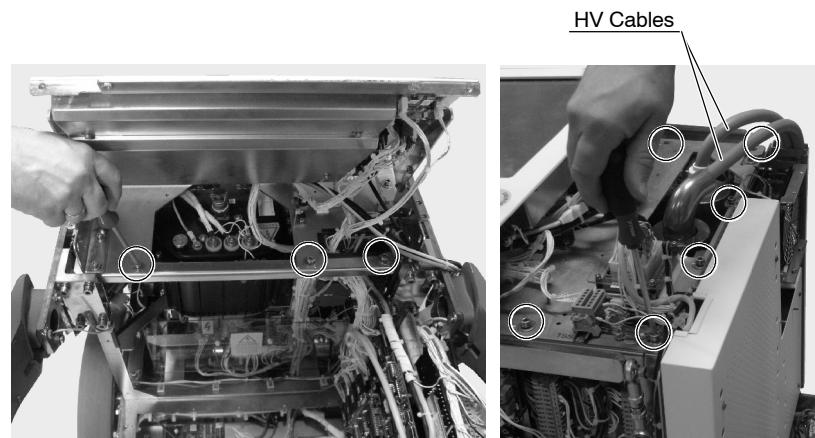
4. For lifting the Console Assembly up, loosen the two (2) Screws A and the two (2) Screws B, lift up the lower end of the Console and tighten both Screws B to fix the Console in place. Do not pinch the cables or connections.



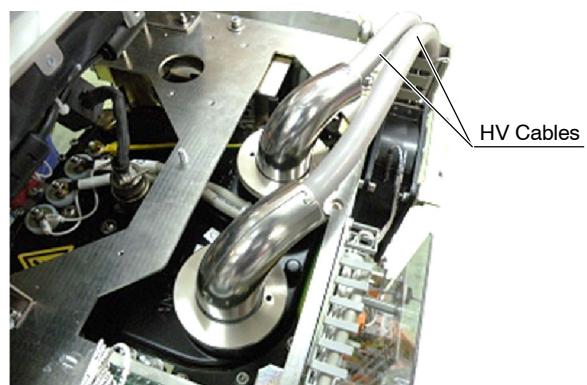
Mobile X-Ray Unit

Troubleshooting

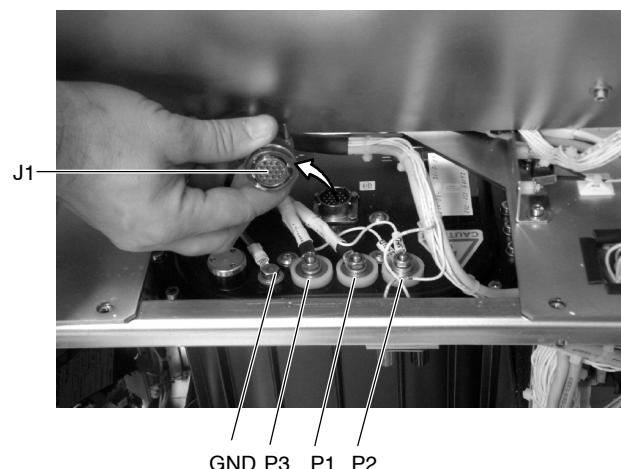
5. Remove the three (3) screws at the front side of the Plate that fix it to the Chassis, then remove the six (6) screws placed at the back side. This action allows the Plate movement to facilitate the HV Transformer disassembly.



6. Remove the HV Cables, handling carefully HV Cables terminal Pins.



7. Remove the HV Transformer Cables: P1, P2-Shield, P3, GND and J1.



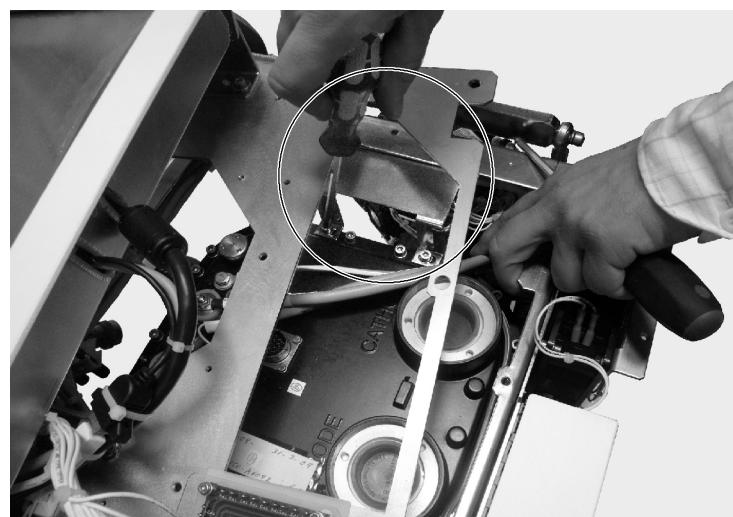
8. Remove the support of mA banana plugs.



9. Remove the four (4) screws that fix the right Anchor to the HV Transformer, then remove the Anchor.



10. Remove the two (2) screws that fix the left Anchor to the HV Transformer, and the two (2) screws at the other side of this Anchor that fix it to the Chassis. Do not remove the Anchor.

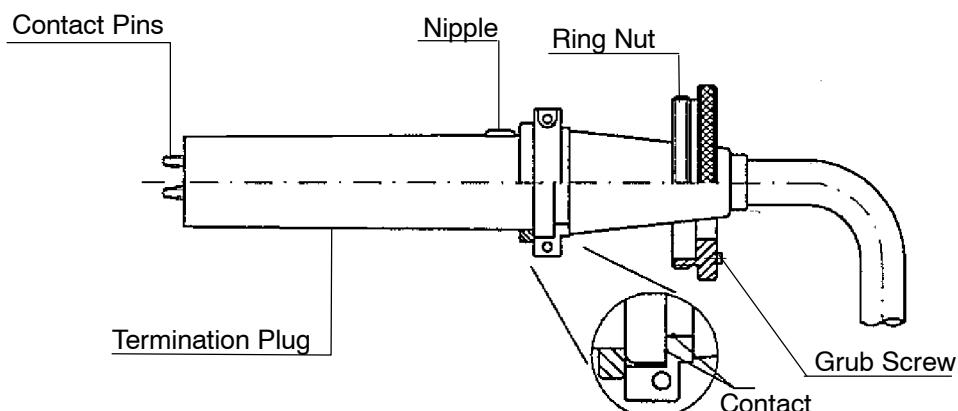


11. To access the HV Transformer, open the Stand-Alone Module.
12. Lift the left Anchor and remove the HV Transformer by sliding it towards the Front Panel.
13. Insert the new HV Transformer inside the Cabinet, and secure it fixing the Anchors to the HV Transformer and to the Chassis. Then, install the support of mA banana plugs.
14. Connect the cables on the HV Transformer:
 - P2-Shield (2 thin wires), P1 and P3. Connect these cables to the stud-brass terminals using two wrenches to tighten the nuts (one to hold the base nut in place and the other to tighten the nut over the cable) and avoiding twisting the studs. Ensure that the connection is secure and properly tightened.
 - Ground wire to Ground stud.
 - Connector J1.
15. Take out the Receptacle Caps and connect the High Voltage Cables, following the next steps:



The Terminal Pins of the High Voltage cables are extremely delicate and easily damaged. They therefore must be handled carefully. Make sure that they are straight and that the splits in the pins are open (parallel to sides).

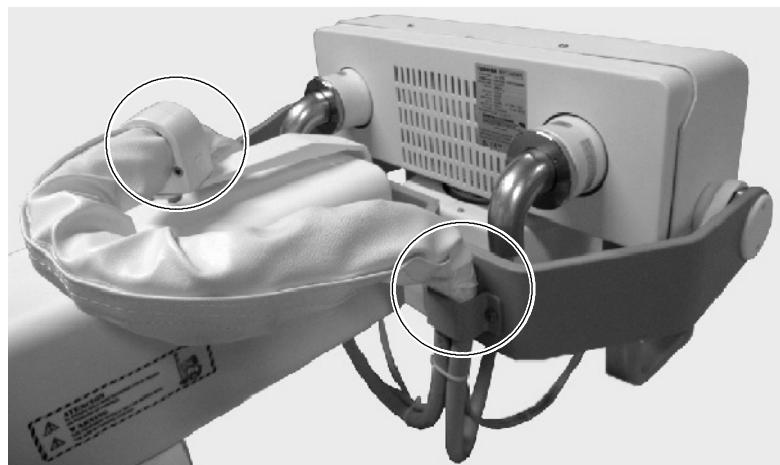
- Unscrew the grub Screw of the ring nut. (Refer to the illustration below.)



- Carefully insert the Anode and Cathode termination plug into the respective receptacle socket (watch the nipple on the plug to ensure correct positioning of the contact pins).
 - Hand tighten the ring nut. It must be secure. Tighten the grub Screw.
16. Continue the rest of the process in reverse order, fixing the Plate to the Chassis, lowering and fixing the Console Assembly, placing the Plastic Protection, securing the Module Panels in place and finally, assembling the Covers and the Console Frame.

5.1 HV CABLES REPLACEMENT

1. Turn the Mobile Unit OFF by turning OFF the Key located on the Control Panel, pressing the Emergency Switch OFF and disconnecting the Power Line Cable from the mains.
2. Remove all the Covers from the Mobile Unit.
3. Remove the Brackets (x2) that hold the HV Cables by removing the corresponding Screws.

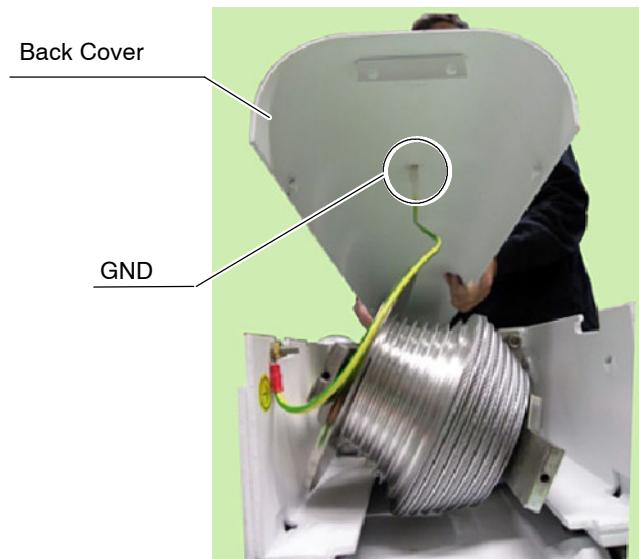


4. Remove the Cables Access Cover at one side of the Column, by removing the Fixing Screws (x4).

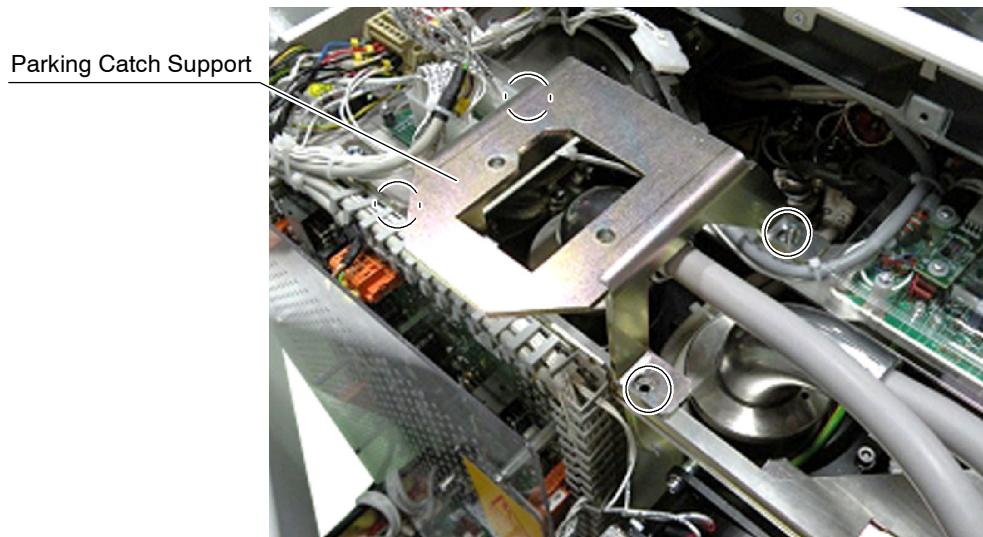


5. Remove the Column Covers.

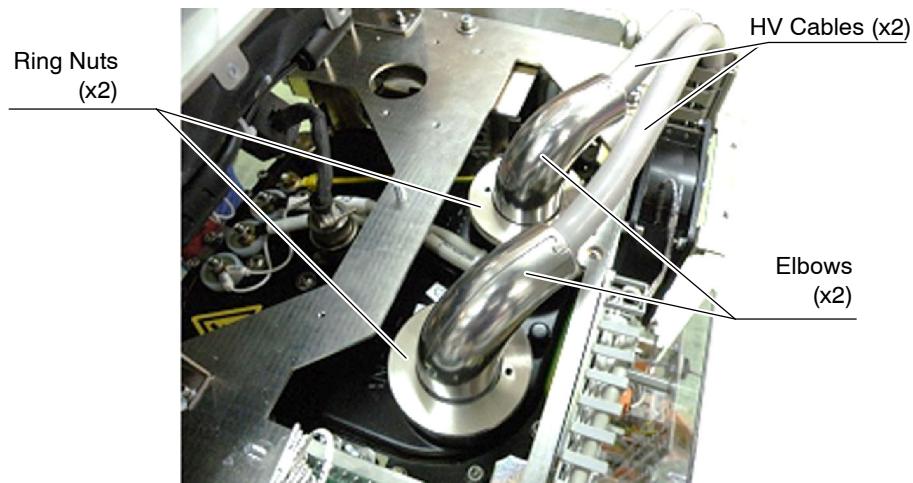
Remove the two (2) Fixing Screws from the Column Back Cover, slide the Column Back Cover a few centimeters upwards, remove the cover backwards and disconnect GND cable.



6. Dismount the Parking Catch Support by removing the (x4) Fixing Screws.



7. Disconnect the High Voltage Cables (x2) from the High Voltage Transformer, disassemble the High Voltage Cable Ring Nuts (x2) and the Elbows (x2) that set the High Voltage Cables to 90°.



8. Lift the lower front area of the Mobile Unit by pushing the Column towards the back area, in order to lift the front wheels around 10 cm from the floor; place the front wheels on the pieces of wood (x2) of 10 cm approximately, to secure the Mobile Unit in this position to be able to have access underneath the Column base.

Remove the Lower Cover underneath the Column Base, by removing the Screws (x4).



9. Remove the High Voltage Cables by cutting the fixing tie wraps. Replace the Cables with the new ones.



When replacing the High Voltage Cables, do not install the Silicon Washers supplied with the HV Cables. Install only the black Rubber Gaskets on the terminals of the HV Cables that go to the X-ray Tube.

Connect the HV Cables applying silicon grease on the HV Cables termination plug before plugging them into the Tube.

10. Repeat the process in reverse order to mount the covers of the Mobile Unit.

Note 

On the HV Tank side, High Voltage Cables are provided with four oil tubes. In case that the level of oil in the HV Transformer connectors is lower than 1 cm, the Field Service engineer can use the oil tubes to fill the HV Transformer connector to reach 1 cm level.

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SECTION 6 MOTOR GROUP



ALTHOUGH THE MOBILE UNIT IS OFF AND DISCONNECTED FROM MAINS, DANGEROUS VOLTAGE IS PRESENT IN THE UNIT (REFER TO SECTION 1.2 "GENERAL CAUTIONS").

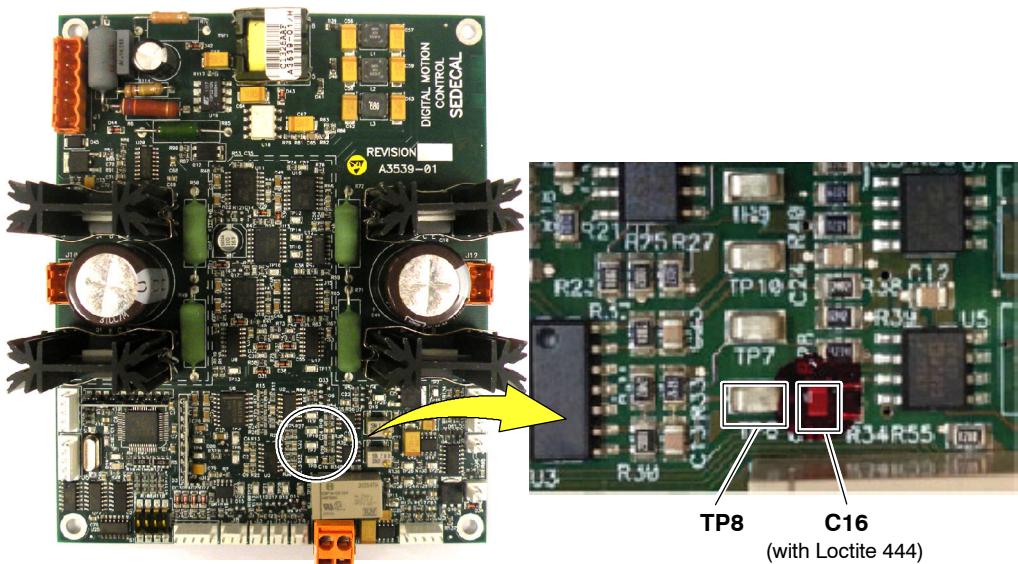
6.1 FUNCTIONAL CHECK



TAKE CARE NOT TO CAUSE A SHORT CIRCUIT WHEN MEASURING WITH A MULTIMETER THE TEST POINTS ON THE DIGITAL MOTION CONTROL BOARD, BY ACCIDENTALLY CONTACTING ON ANY OTHER SENSIBLE POINT ON THE BOARD.

THIS WARNING SPECIALLY APPLIES WHEN REPLACING THE DIGITAL MOTION CONTROL BOARD OR DURING THE ADJUSTMENT PROCESS OF THE GAUGES VOLTAGE, WHEN MEASURING ON TEST POINT TP8 AND ACCIDENTALLY CONTACTING ON CAPACITOR C16, SINCE IT CAN BE DAMAGED THE MICROPROCESSOR.

TO AVOID DAMAGES, IT IS HIGHLY RECOMMENDED TO APPLY A COATING PROTECTION LIKE LOCTITE 444 OR ELECTRICAL TAPE (TO BE REMOVED AFTER THE ADJUSTMENT) OVER CAPACITOR C16, BEFORE MEASURING ON TEST POINT TP8.



Mobile X-Ray Unit

Troubleshooting

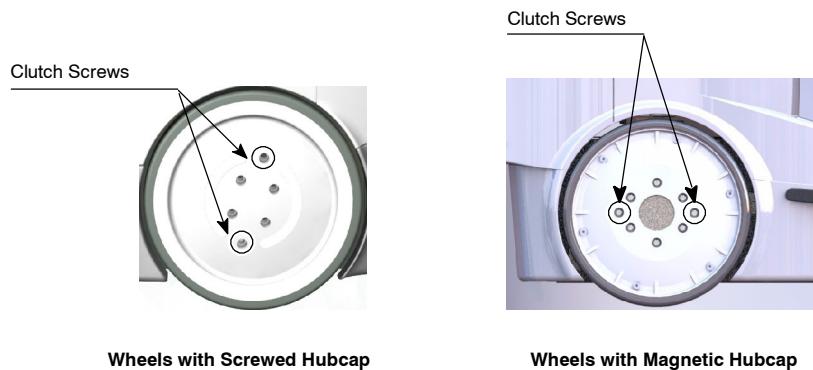
Note

If the unit displacement is not allowed when activating the Handle (Deadman) or the Fine Positioning Controls on the Handgrips, refer to Section 6.8.

Note

If the voltage is incorrect during the functional check, refer to Section 6.7 "Troubleshooting Gauges".

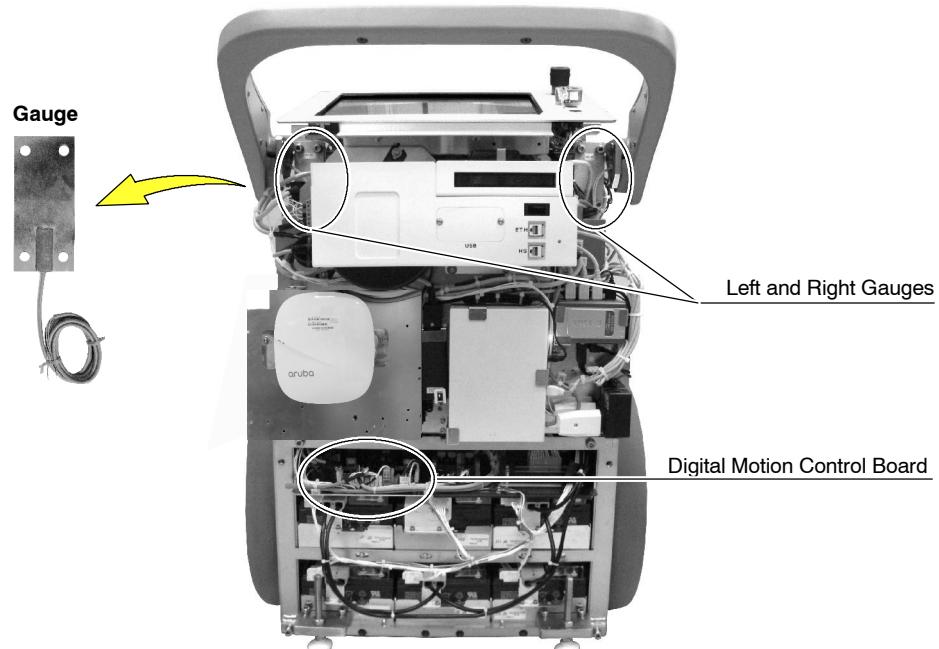
1. Remove the Clutch Screws from both wheels to disengage the gears.



Wheels with Screwed Hubcap

Wheels with Magnetic Hubcap

Illustration 6-1 Motion Control



2. Turn the unit ON.
3. With an Oscilloscope or a Voltmeter (DC) connected to TP8 (left gauge) and TP23 (GND) or to TP10 (right gauge) and TP23 (GND) of the Digital Motion Control Board (A3539-xx), ensure that the static position (without movement) is 2.5 ± 0.1 VDC.
4. Test Forward motion (do not press the Deadman switch, press only the Handlebar) checking that the voltage increases proportionally to the force applied to the Handlebar.

The voltage measured at TP8 (left) or TP10 (right) should be 4.2 VDC -100 mV / +200 mV (that is, from 4.1 VDC to 4.4 VDC) when the Handlebar is fully pressed.

When the motion impulse stops, the reading should return to 2.5 ± 0.1 VDC.

5. Test Backward motion (do not press the Deadman switch, pull only the Handlebar) checking that the voltage decreases proportionally to the force applied to the Handlebar.

The voltage measured at TP8 (left) and TP10 (right) should be 0.4 VDC -300 mV / +100 mV (that is, from 0.5 VDC to 0.1 VDC) when the Handlebar is fully pulled.

When the motion impulse stops, the reading should return to 2.5 ± 0.1 VDC.

6. Turn the unit OFF.
7. Reinstall the Clutch Screws to both wheels to engage the gears.

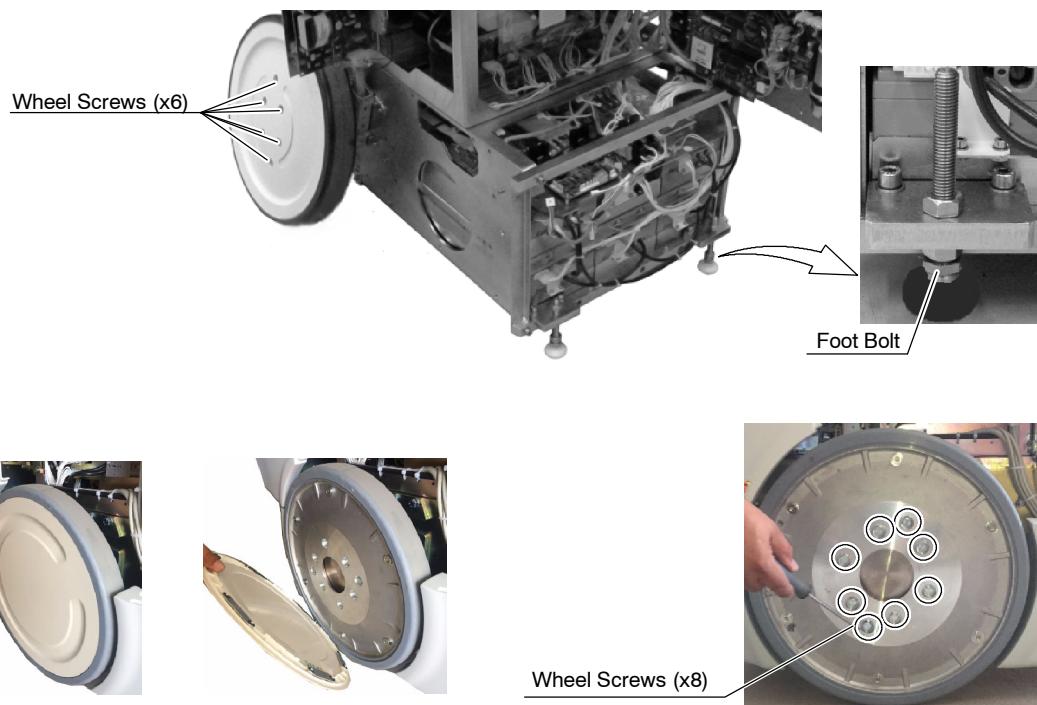
6.2 MOTOR BRAKE CHECK

Although the Unit is equipped with two motors, they share a single brake signal. According to schematic diagram A3539-xx, when a movement command is received by the Microcontroller, the /BRAKE signal is sent to relay K1, which permits +24VDC to run across J11 (A3539-xx) to the each motor brake at the same time through TS7 (see *Block Diagram 543022xx*).

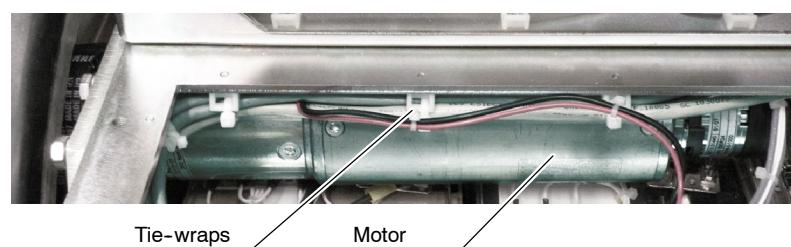
1. Check connections between Motors Encoder and the Digital Motion Control Board:
 - a. Verify carefully the proper connection at the motor side. A wrong connection in one of the lines from the Encoder to the Digital Motion Control Board may cause jerky motion.
Also check Fuse F38 connected between J1-4 and J11-2 of the Digital Motion Control Board.
 - b. Remove the Encoder connector on the motors side (right and left motor) and check the wires individually and check that all pins are not damaged or bend at the connectors on the motors side.
Wires must be correctly crimped and not damaged in the Molex connector connected to the motors.
 - c. When reconnecting the Molex connector to the Motor Encoder, ensure that it is properly connected and no pins are bend (it can cause bad reading of the motor speed and rotation way).
 - d. Repeat the previous verifications at the Digital Motion Control side, on J4 and J6 connectors.
2. To check the brakes, proceed as follows; repair or replace where necessary.
 - a. Turn the unit ON.
 - b. With reference to J1-5 (0 VDC-1), ensure that +24 VDC runs from J1-4 to J11-2.
 - c. When releasing the Deadman, ensure that these +24 VDC leaves J11-1 and runs through TS7.
 - d. Turn the unit OFF.

6.3 MOTOR REPLACEMENT

1. Loosen, without removing, the Screws from the wheel of the motor to be replaced and turn both Foot Bolts to raise the wheels of the floor.
2. Remove the Screws and dismount the wheel. For units with Magnetic Hubcap, dismount the Hubcap before loosening the Screws.



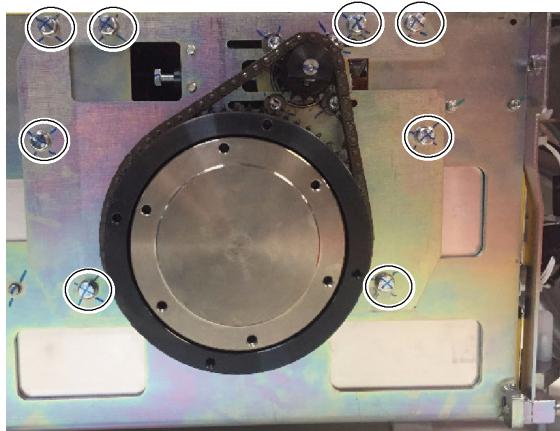
3. From the Digital Motion Control Board (A3539-xx) disconnect:
 - a. Encoder connector (J4 left motor / J6 right motor).
 - b. Command Voltage connector (J10 left motor / J12 right motor).
 - c. Brake connector (wires 1 and 2 of TS7 Terminal Block).
4. Cut the tie-wraps of the harness, from the Motor to PCB Board.



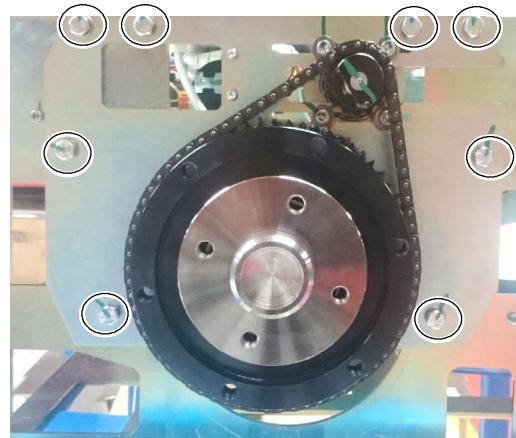
5. Remove the eight (8) Screws that fix the Motor Plate to the Chassis. Then remove the Plate with the Motor group and place it on a table.



The weight of the motor group is unsteady and difficult to handle, two people are recommended to avoid damage. Although the batteries are covered, be careful of loose cables.

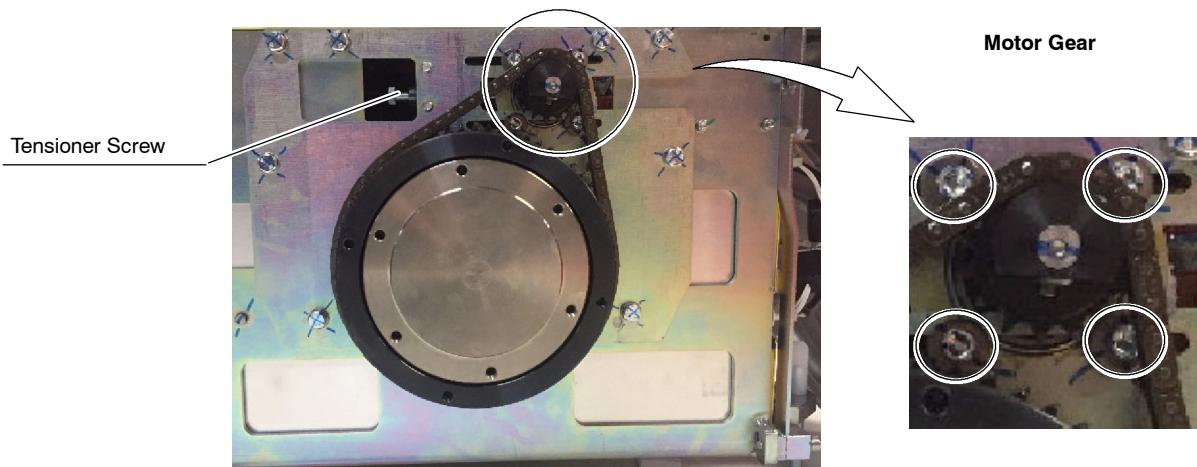


Wheels with Magnetic Hubcap

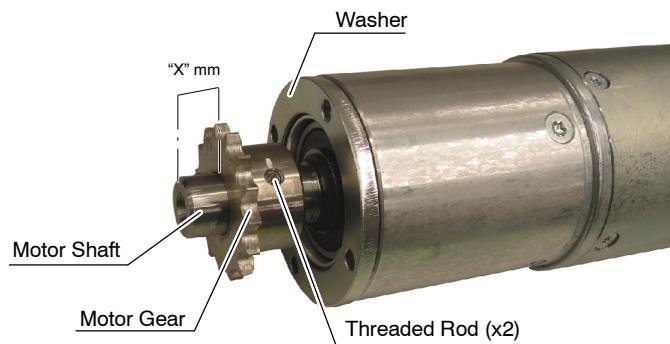


Wheels with Screwed Hubcap

6. Loosen slightly the four (4) Fixing Screws around the Motor Gear.
7. Loosen the Tensioner Screw and remove the Chain from the Motor Gear.



8. Remove the four (4) Fixing Screws around the Motor Gear, dismount the Motor Group from the Plate and place it aside.
9. Dismount the Motor Gear from the old Motor, as described below.
 - a. For Mobile units with the previous version of Motor Gear:
 - Measure the distance between the Motor Gear and the end of the Motor Shaft, for its later use.
 - Remove the two (2) Threaded Rods around the Motor Gear.
 - Disassembly the Motor Gear and the Washer from the Motor.



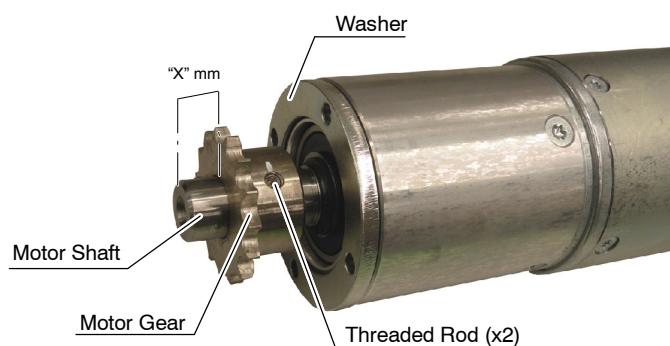
- b. For Mobile units with the new version of Motor Gear:
 - Remove the Front Screw from the Motor Gear.
 - Remove the Threaded Rod around the Motor Gear.
 - Disassembly the Motor Gear and the Washer from the Motor.



10. Replace the Motor; place the Washer on the new Motor and assemble the Motor Gear through the Motor Shaft as described below.

a. For Mobile units with the previous version of Motor Gear:

- Place the Motor Gear into the Motor Shaft, at the same distance measured before, from the end of the Motor Shaft.
- Apply Loctite 243 to the two (2) Threaded Rods and tighten them around the Motor Gear.



b. For Mobile units with the new version of Motor Gear:

- Fully insert the Motor Gear into the Motor Shaft.
- Apply Loctite 243 and then tighten the Front Screw and the Threaded Rod around the Motor Gear.

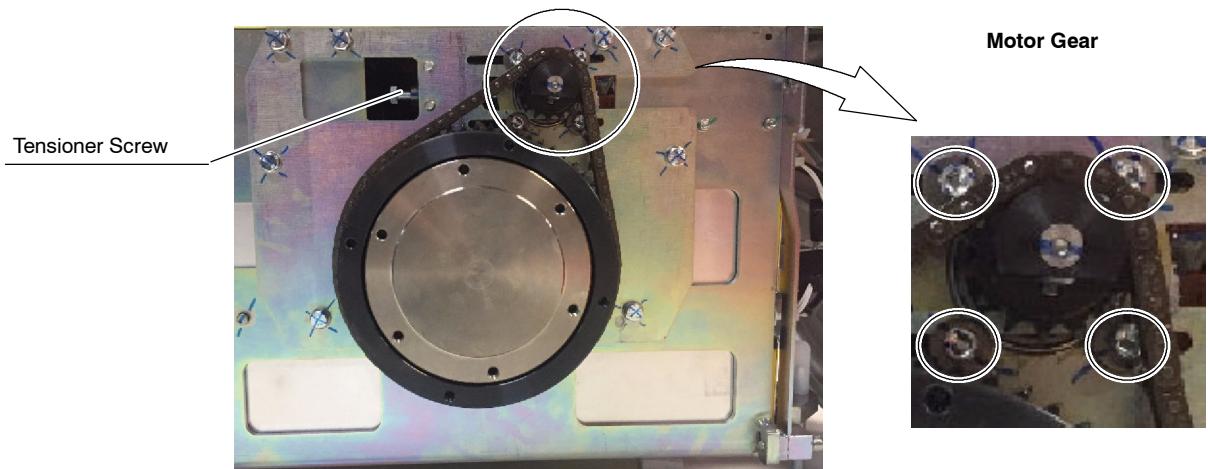


11. Insert the Motor assembly through the Motor Plate to its original position and engage the Chain around the Motor Gear; then, secure the Motor Gear with the (4) Fixing Screws around the Motor Gear, but do not fully tighten them yet.



12. Place the Chain onto both Gears. Tighten the Tensioner Screw until the tension is sufficient and fix it with the counternut.

Then, fully tighten the four Fixing Screws around the Motor Gear.



13. Insert the Motor group into the Mobile, ensuring that the cables are not pinched.



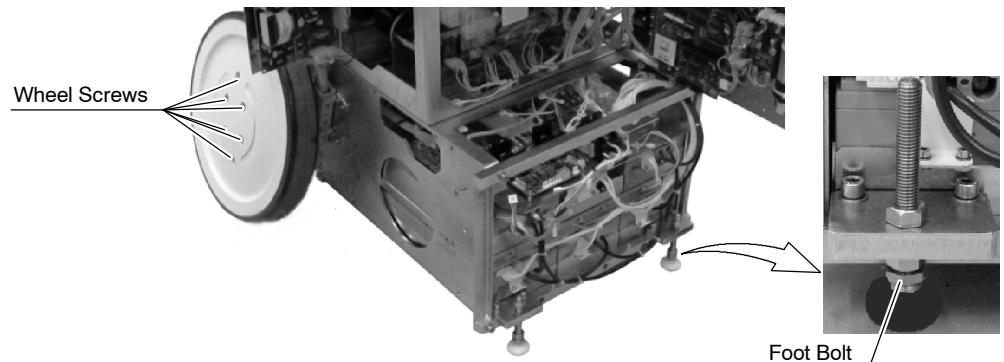
14. Tighten the eight (8) Screws that fix the Motor Plate to the Chassis.



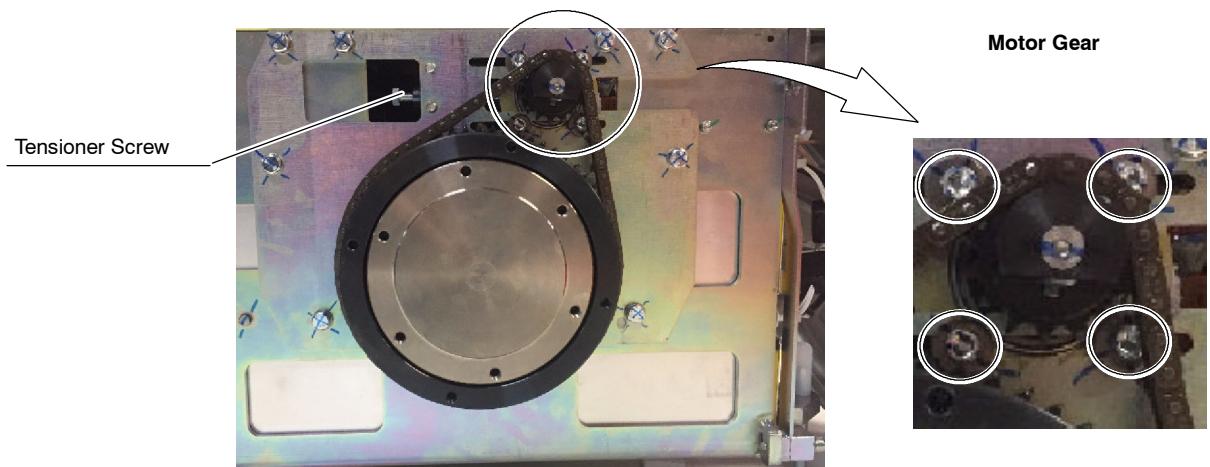
15. Reconnect the connectors that were previously removed in step 3. Secure the wires with tie-wraps.
16. Refer to *Section 6.3.1* for Chain Adjustment.
17. Assemble the wheel by tightening the Screws, using a recommended torque of 60 Nm.
18. Turn both Foot Bolts to lower the wheels and ensure the Screws.
19. Run a functional check of the system, ensuring brake activation.

6.4 CHAIN REPLACEMENT ONLY

1. Loosen, without removing, the Screws from the wheel of the motor to be replaced and turn both Foot Bolts to raise the wheels of the floor.
2. Remove the Screws and dismount the wheel. (*For units with Magnetic Hubcap see Step 2. from Section 6.3*).



3. Loosen the four (4) Fixing Screws around the Motor Gear.
4. Loosen the Tensioner Screw and remove the Chain.

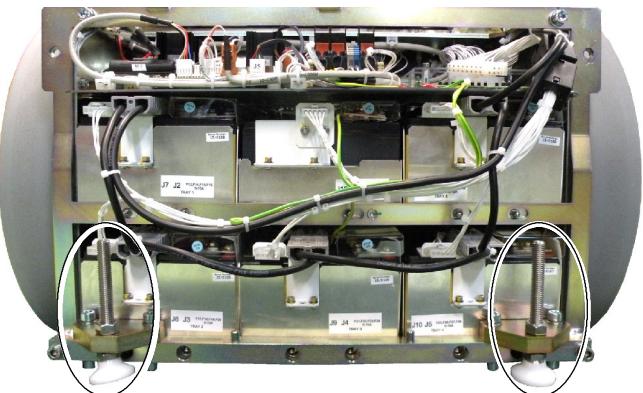


5. Place the new Chain onto both Gears. Tighten the Tensioner Screw until the tension is sufficient and fix it with the counternut. Then, tighten the four Fixing Screws around the Motor Gear.
6. Refer to *Section 6.4.1* for Chain Adjustment.
7. Assemble the wheel and tighten the Screws, using a recommended torque of 60 Nm.
8. Turn both Foot Bolts to lower the wheels and ensure the Screws.
9. Run a functional check of the system, ensuring brake activation.

6.4.1 CHAIN ADJUSTMENT**Note** 

The following procedure applies to all mobile units that may have suffered problems in the motion system (a. e. replacement of the Chain, Motor, Transmission Group).

1. With the Unit turned OFF loosen, without removing, the six (6) Screws from each wheel; turn both Foot Bolts to raise the wheels off the floor.

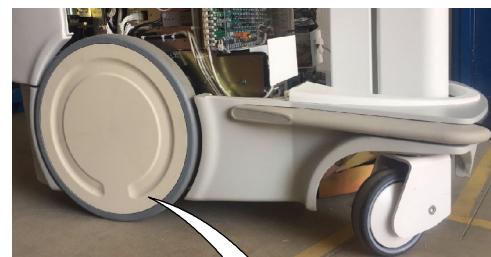


2. For Units with Screwed Hubcap, remove the six (6) Screws and dismount the wheels from the unit. For Units with Magnetic Hubcap, remove the Hubcap first and then remove the eight (8) Screws.

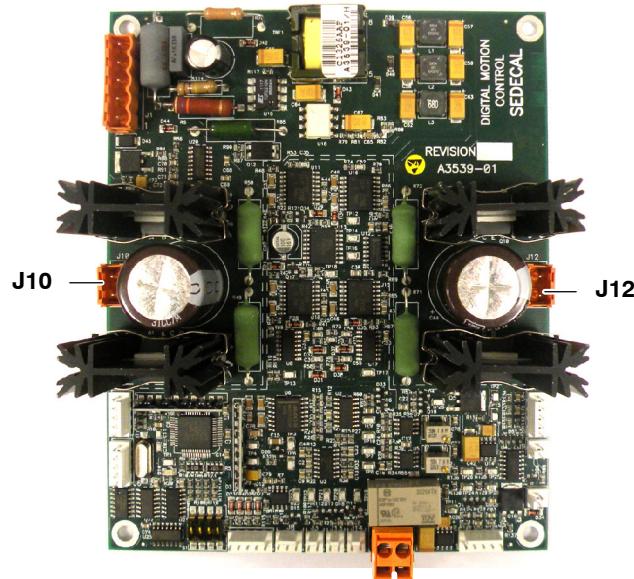
Wheels with Screwed Hubcap



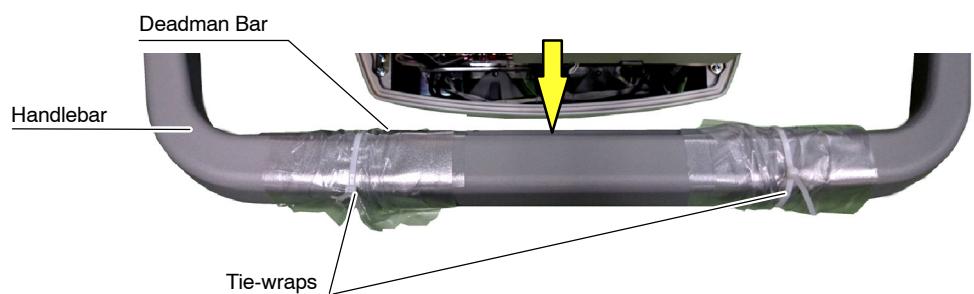
Wheels with Magnetic Hubcap



3. Remove the plastic cover located above the Digital Motion Control Board in order to access to the connectors.
4. Disconnect the Power Supply of the left and right motor by disconnecting J10 and J12 connectors on the Digital Motion Control, in order to disable the motor rotation when the unit is powered ON.



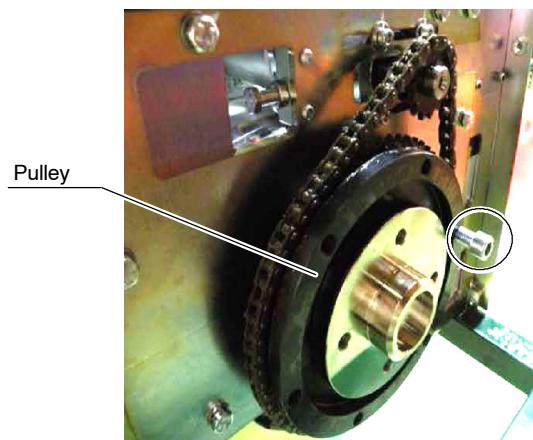
5. Turn ON the unit.
6. Press and release the Deadman Bar to ensure that the motor brakes are activated / deactivated, it is checked by hearing a "click" at the motors.
7. This procedure requires to have the Motor Pulleys released, therefore the Motor Brakes have to be deactivated by keeping the Deadman Bar pressed. To do so, wrap the Handlebar with a plastic and hold the Deadman pressed with two tie-wraps as shown below.



Mobile X-Ray Unit

Troubleshooting

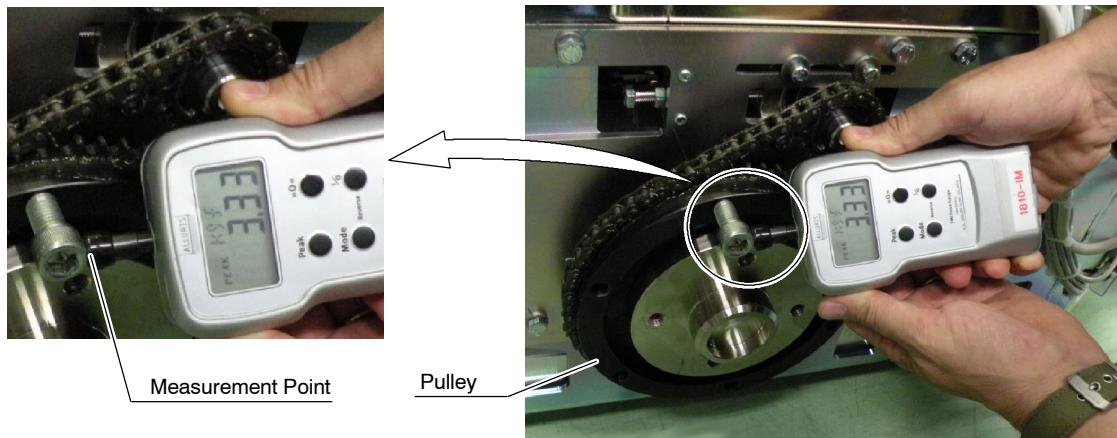
8. Place and tighten one Screw on the pulley has show in the picture below.



Note

A Dynamometer of minimum range 0 - 50 N (0 - 5 Kg) is needed for the Chain adjustment.

9. Place the measurement point of the dynamometer on the Screw of the Pulley. Check that the Pulley is rotating, applying a force between 25 N and 35 N (approx. 2.5 kg – 3.5 kg) on the dynamometer.



10. In case that the force is not in the range (between 25 N and 35 N (approx. 2.5 – 3.5 kg)) the position of the motor needs to be readjusted to have the correct Chain tension adjustment.

Loosen slightly the 4 Screws that hold the Motor Gear to the plate and adjust the Chain Tensioner Screw until the force displayed on the dynamometer, when the pulley starts rotating, is between 25 N and 35 N (approx. 2.5 – 3.5 kg).

11. Tighten the 4 motor Screws at 7.7 Nm (\pm 5%) and check again the force on the Screw of the pulley. If the force is not in the range repeat the procedure.
12. Repeat the procedure from step 8. in order to adjust the other wheel.
13. Turn OFF the unit.
14. Remove the tie-wraps from the Handlebar (Deadman).
15. Connect the J10 and J12 connectors on the Digital Motion Control board.
16. Install the wheels of the mobile tightening the Screws to 60 Nm (\pm 10%).
17. Install the Digital motion control board cover previously removed.
18. Turn both Foot Bolts to lower the wheels and ensure the Screws.
19. Turn ON the unit and check the movement of the unit.

6.5 TRANSMISSION GROUP REPLACEMENT

Note 

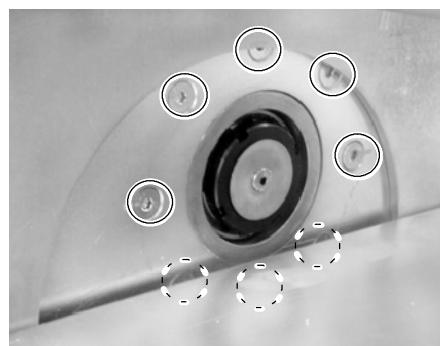
The Transmission Group comprises the Chain, the Motor Gear and the Wheel Gear.

1. Follow the instructions in *Section 6.3 for "Motor Replacement"*, steps 1. to 9., in order to dismount the Motor Gear from the Motor.
2. Replace the Motor Gear and assemble it through the Motor Shaft: Fully insert the Motor Gear into the Motor Shaft. Apply Loctite 243 and then tighten the Front Screw and the Threaded Rod around the Motor Gear.



(*not in the picture)

3. On the backside of the Wheel Gear, remove the eight (8) Fixing Screws and remove the Wheel Gear assembly.

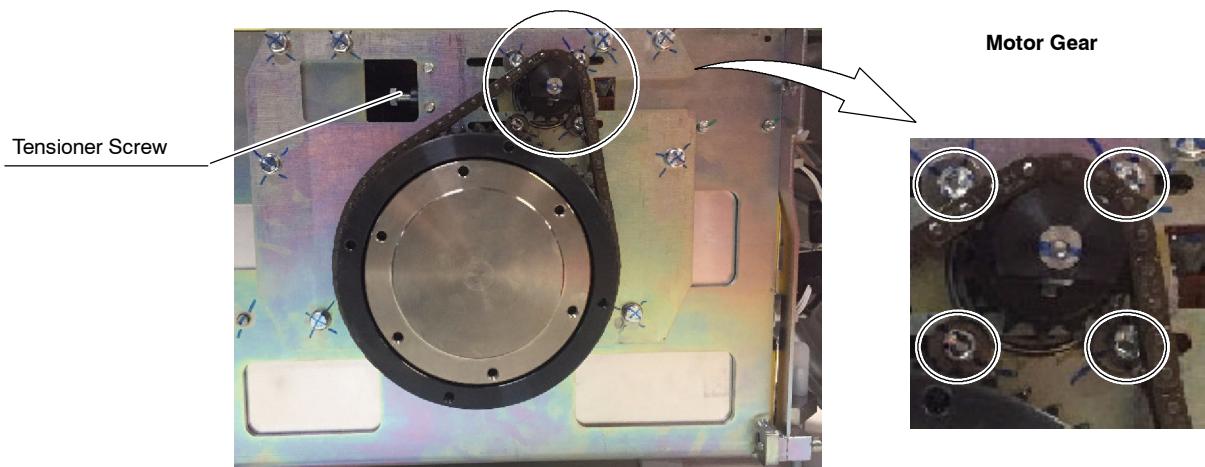


4. Install the new Wheel Gear assembly, fixing it with the eight (8) Screws.
5. Insert the Motor assembly through the Motor Plate to its original position and engage the Chain around the Motor Gear; then, secure the Motor Gear with the (4) Fixing Screws around the Motor Gear but do not fully tighten them yet.



6. Place the Chain onto both Gears. Tighten the Tensioner Screw until the tension is sufficient and fix it with the counternut.

Then, fully tighten the four Fixing Screws around the Motor Gear.



7. Continue following the instructions in *Section 6.3 "Motor Replacement"*, steps 13. to 19., for re-installing the Motor Group to the Mobile Unit.

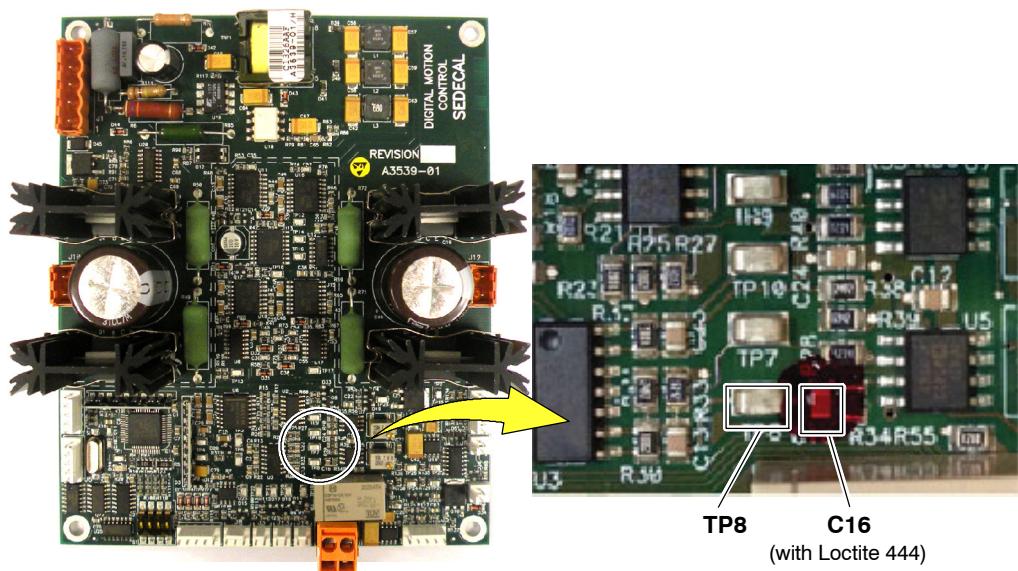
6.6 GAUGE REPLACEMENT



TAKE CARE NOT TO CAUSE A SHORT CIRCUIT WHEN MEASURING WITH A MULTIMETER THE TEST POINTS ON THE DIGITAL MOTION CONTROL BOARD, BY ACCIDENTALLY CONTACTING ON ANY OTHER SENSIBLE POINT ON THE BOARD.

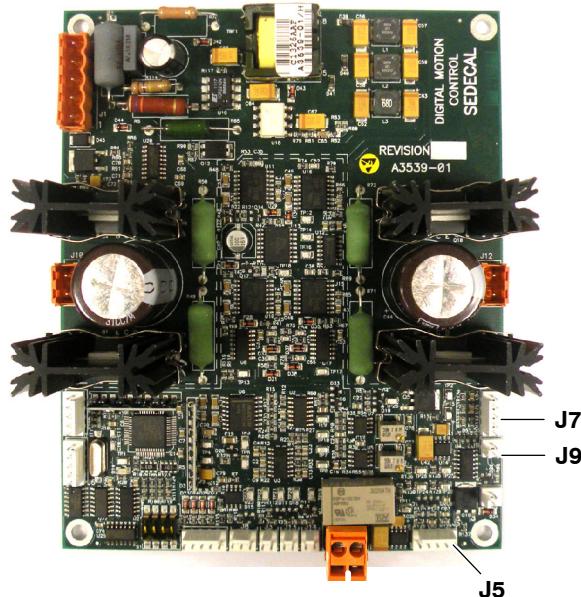
THIS WARNING SPECIALLY APPLIES WHEN REPLACING THE DIGITAL MOTION CONTROL BOARD OR DURING THE ADJUSTMENT PROCESS OF THE GAUGES VOLTAGE, WHEN MEASURING ON TEST POINT TP8 AND ACCIDENTALLY CONTACTING ON CAPACITOR C16, SINCE IT CAN BE DAMAGED THE MICROPROCESSOR.

TO AVOID DAMAGES, IT IS HIGHLY RECOMMENDED TO APPLY A COATING PROTECTION LIKE LOCTITE 444 OR ELECTRICAL TAPE (TO BE REMOVED AFTER THE ADJUSTMENT) OVER CAPACITOR C16, BEFORE MEASURING ON TEST POINT TP8.

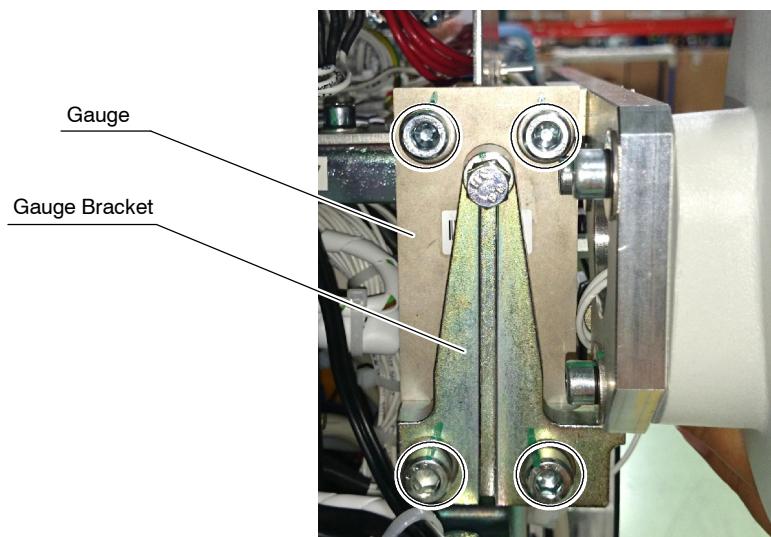


1. Disconnect the faulty Gauge connector from the Digital Motion Control Board (J5 = left Gauge / J7 = right Gauge).

Disconnect connector J9 in order to disable the Deadman switch.



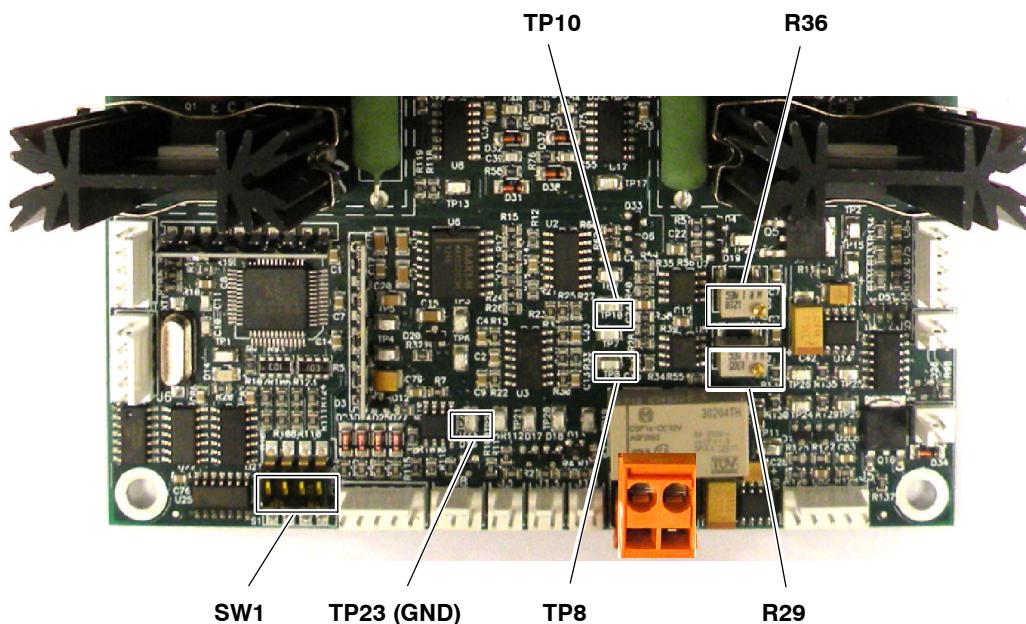
2. Cut the tie-wraps and remove the cable(s) to the Gauge.
3. Dismount the Gauge Bracket by removing the two (2) Screws (M10) and the washers. Dismount the Gauge by removing the two (2) Screws (M10) and the washers.



4. Mount the new Gauge, fixing it with the two (2) Screws and the washers.
5. Mount the Gauge Bracket with the two (2) Screws and the washers.
6. Route the cable(s) and connect the Gauges to the respective connections at the Digital Motion Control Board (J5 left / J7 right).
7. Turn the unit ON.
8. With an Oscilloscope or a Voltmeter (DC) connected to TP8 (left gauge) and TP23 (GND) or to TP10 (right gauge) and TP23 (GND) of the Digital Motion Control Board, ensure that the voltage measured in static position (without movement) is 2.5 ± 0.1 VDC.

With a Screwdriver, adjust Potentiometer R29 (left) or R36 (right) to 2.5 ± 0.1 VDC

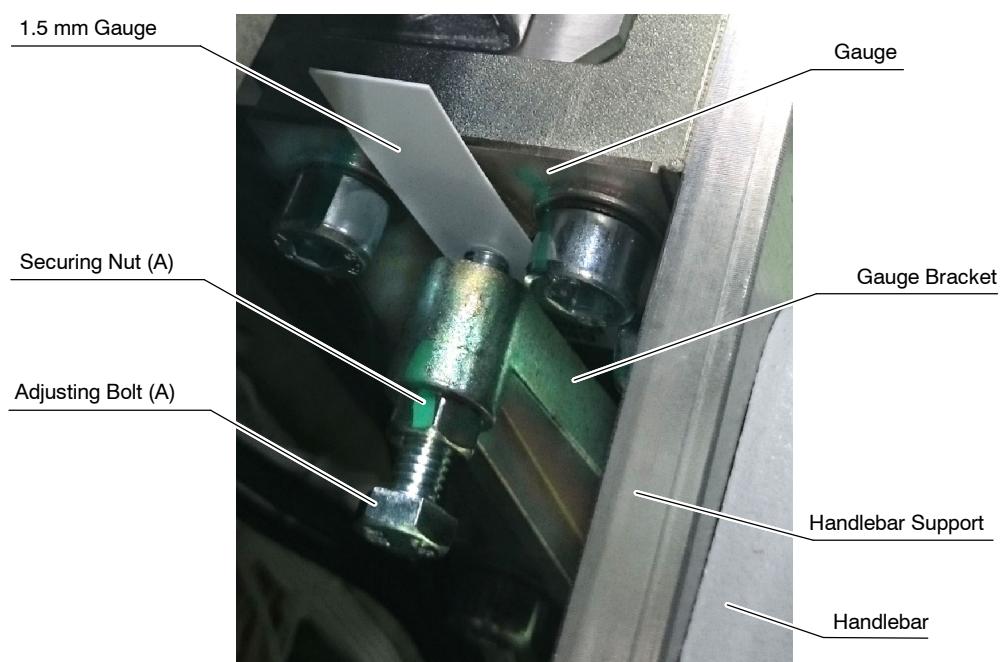
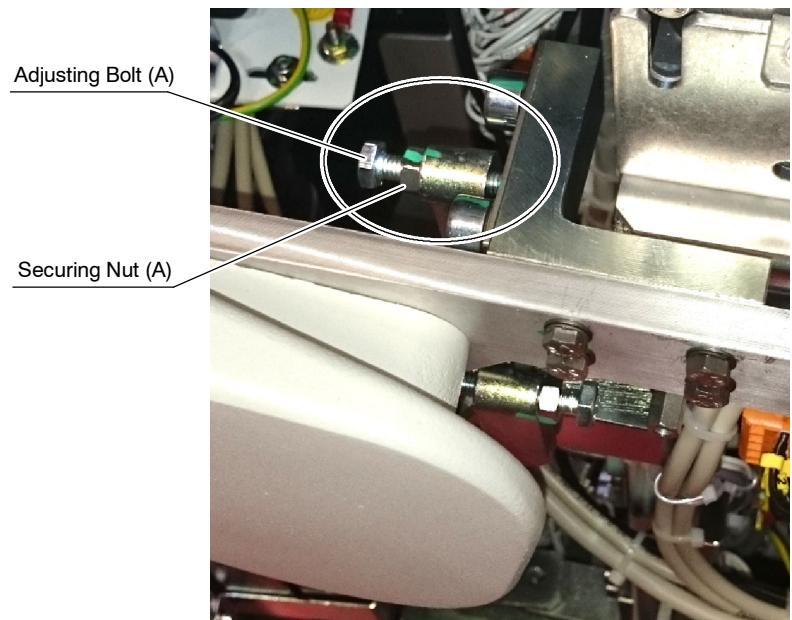
(refer to Schematic Diagram A3539-01).



9. As a preliminary adjustment:

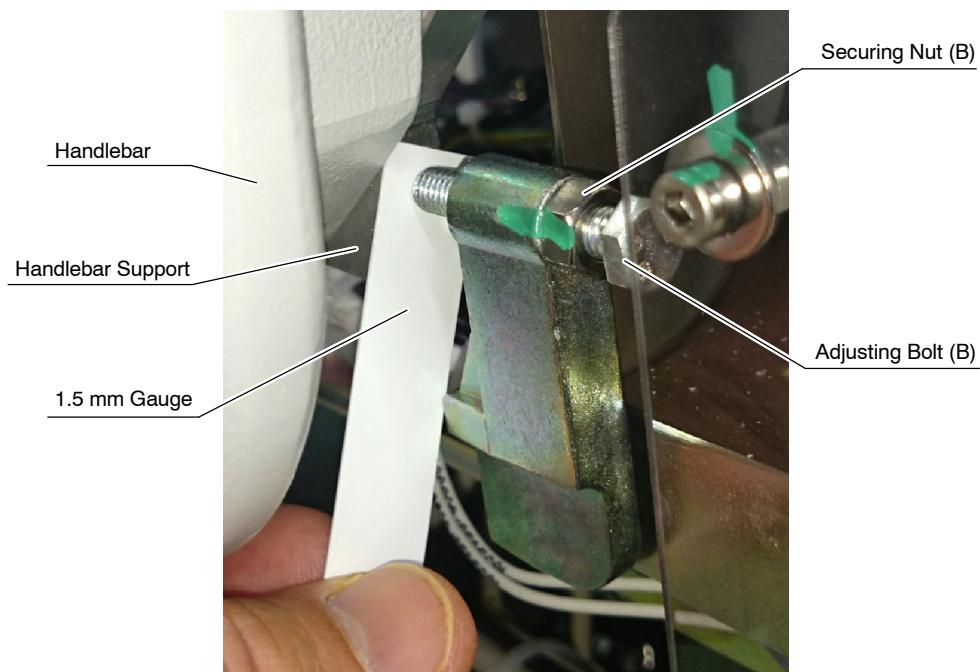
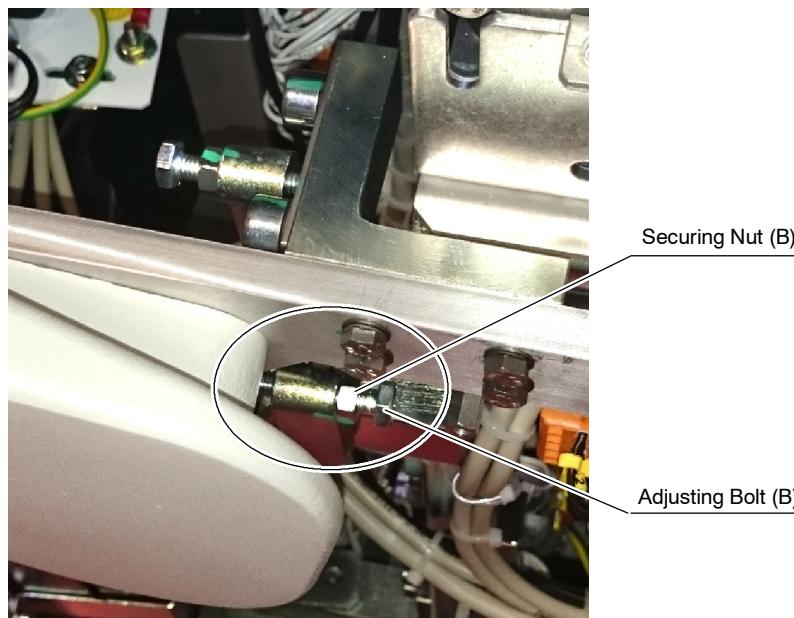
- a. Place a 1.5 mm Gauge between the end of the Adjusting Bolt (A) and the left/right Gauge, as shown in the picture below.

Adjust the Bolt (A) until having it in contact with the 1.5 mm Gauge; then secure the adjusting Bolt by tightening the secure Nut (A).



- b. Place the 1.5 mm Gauge between the Handlebar Support of the Mobile unit and the Adjusting Bolt (B) (of the left/right Gauge) as shown in the picture below.

Adjust the Bolt (B) until having it in contact with the 1.5 mm Gauge; then secure the adjusting Bolt (B) by tightening the secure Nut (B).



10. With an Oscilloscope or a Voltmeter (DC) connected to TP8 (left gauge) and TP23 (GND) or to TP10 (right gauge) and TP23 (GND) of the Digital Motion Control Board:

- a. **Push** slowly (forward motion) the left side of the Handlebar (for the left gauge) or the right side (for the right gauge), checking that the voltage measured on TP8 or TP10 reaches 4.2 VDC -100 mV / +200 mV (that is, from 4.1 VDC to 4.4 VDC) when the Bolt (B) is in contact with the Handlebar Support.

If the voltage does not reach 4.2 VDC -100 mV / +200 mV (that is, from 4.1 VDC to 4.4 VDC), loosen the securing Nut (B) of the Adjusting Bolt (B) and slightly modify the position of the Bolt (B) until reaching this voltage measurement in TP8 or TP10 when the Handlebar is fully pushed. Tight the securing Nut (B) in order to secure the adjustment.

- b. **Pull** slowly (backward motion) the left side of the Handlebar (for the left gauge) or the right side (for the right gauge), checking that the voltage measured on TP8 or TP10 reaches 0.4 VDC -300 mV / +100 mV (that is, from 0.5 VDC to 0.1 VDC) when the Bolt (A) is in contact with the Gauge on the Handlebar Support.

If the voltage does not reach 0.4 VDC -300 mV / +100 mV (that is, from 0.5 VDC to 0.1 VDC), loosen the securing Nut (A) of the Adjusting Bolt (A) and slightly modify the position of the Bolt (A) until reaching this voltage measurement in TP8 or TP10 when the Handlebar is fully pulled. Tight the securing Nut (A) in order to secure the adjustment.

- c. **Push** and **pull** slowly the left or the right side of the Handlebar several times, checking than the voltage measured on TP8 (left gauge) or TP10 (right gauge) reaches 2.5 ± 0.1 VDC when the Handlebar is in static position.

11. Reconnect connector J9 of the Digital Control Motion Board.

12. Make a functional check (*Section 6.1*) of system movements.

Note 

If the voltage during the functional check is incorrect, refer to Section 6.7 “Troubleshooting Gauges”.

13. Turn OFF the unit and Tie-wrap the cabling to the Digital Motion Control Board.

6.7 TROUBLESHOOTING GAUGES

If, after a functional check (*described in Section 6.1*), the readings from the Oscilloscope or Voltmeter (DC) connected to either TP8 (right gauge) or TP10 (left gauge) are not correct; perform the following steps to determine the proper corrective action. *See Block Diagram 54302xxx for more details.*

Note 

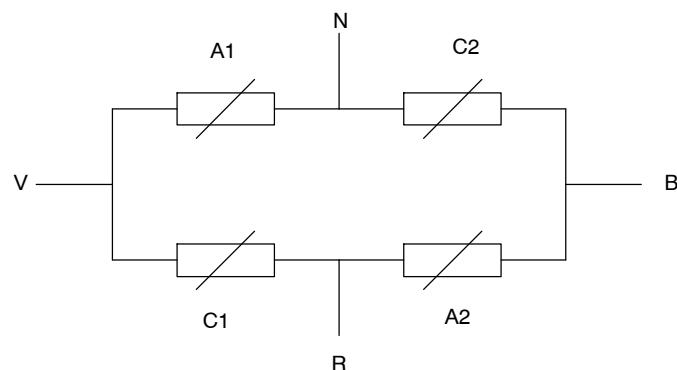
For voltage measurement in Test Points, use TP23 (GND) as a ground reference.

1. With the unit ON, check for voltage entering the Digital Motion Control Board (A3539-xx) from the Motors Battery Charger Board (A3532-xx) between J1-1 & J1-5: 90 VDC (unit disconnected from mains) or 112 VDC (unit charging batteries). If voltage (90 VDC or 112 VDC) is not present, go to the next step. If voltage is present, proceed to step 3.
2. Check cable connections (referring to the block diagram) from J3-1 on the Motors Battery Charger (A3532-xx), ensuring proper functioning and power supply. Repair or replace as necessary.
3. Ensure 15 VDC at TP20 on the Digital Motion Control Board. If 15 VDC is not present, replace the Digital Motion Control Board (*refer to Section 6.8.7*). If 15 VDC is present, proceed to the next step.
4. Check that 5 VDC are present at TP15 (right gauge) and at TP11 (left gauge). If this voltage is not present, replace the Digital Motion Control Board (*refer to Section 6.8.7*). If this voltage is present, go to the next step.
5. Disconnect the respective Gauge from the Digital Motion Control Board (J5 left / J7 right).
6. Connect an Oscilloscope or Voltmeter (DC) to TP8 (left gauge) or to TP10 (right gauge).
7. With a Screwdriver, adjust Potentiometer R29 (left) or R36 (right) to 2.5 ± 0.1 VDC. If this adjustment is not possible, replace the Digital Motion Control Board (*refer to Section 6.8.7*).

Note

With the Gauges disconnected from the Digital Motion Control Board, Gauges can also be verified without applying force to the Handlebar by ohmmeter.

The gauges are made of a resistor bridge:



N = Black wire pin #3

R = Red wire pin #1

V = Green wire pin #2

B = White wire pin #4

The nominal value of each resistor is $1200 \Omega \pm 15\%$

The gauges can be checked by measuring resistance between V-B (pins 2 and 4) and N-R (pins 1 and 3). Expected value is between 1020Ω and 1380Ω .

8. Connect the Gauges to the respective connections at the Digital Motion Control Board (J5 left / J7 right).
9. Ensure 2.5 ± 0.1 VDC at TP8 (left) and TP10 (right), adjusting again with the respective Potentiometers R29 (left) or R36 (right) if necessary. If this adjustment is not possible, the corresponding gauge should be replaced (refer to Section 6.6 "Gauge Replacement").
10. Make the following functional check, replacing the Gauge if the following readings are incorrect (refer to Section 6.6 "Gauge Replacement").

Note

Before performing this checking, ensure that there is not a mechanical issue that impedes the correct movement and release of the Handlebar.

- a. Turn the unit OFF and remove the Clutch Screws from both wheels to disengage the gears.
- b. Turn the unit ON.
- c. Connect an Oscilloscope or a Voltmeter (DC) to TP8 (left gauge) or to TP10 (right gauge) of the Digital Motion Control Board.
- d. Test Forward motion (do not press the Deadman switch, press only the Handlebar) checking that the voltage increases proportionally to the force applied to the Handlebar. The voltage measured at TP8 (left) or TP10 (right) should be 4.2 VDC -100 mV / +200 mV (that is, from 4.1 VDC to 4.4 VDC) when the Handlebar is fully pressed.

When the motion impulse stops, the reading should return to 2.5 ± 0.1 VDC. If not, replace the corresponding Gauge.

- e. Test Backward motion (do not press the Deadman switch, pull only the Handlebar) checking that the voltage decreases proportionally to the force applied to the Handlebar. The voltage measured at TP8 (left) and TP10 (right) should be 0.4 VDC -300 mV / +100 mV (that is, from 0.5 VDC to 0.1 VDC) when the Handlebar is fully pulled.

When the motion impulse stops, the reading should return to 2.5 ± 0.1 VDC. If not, replace the corresponding Gauge.

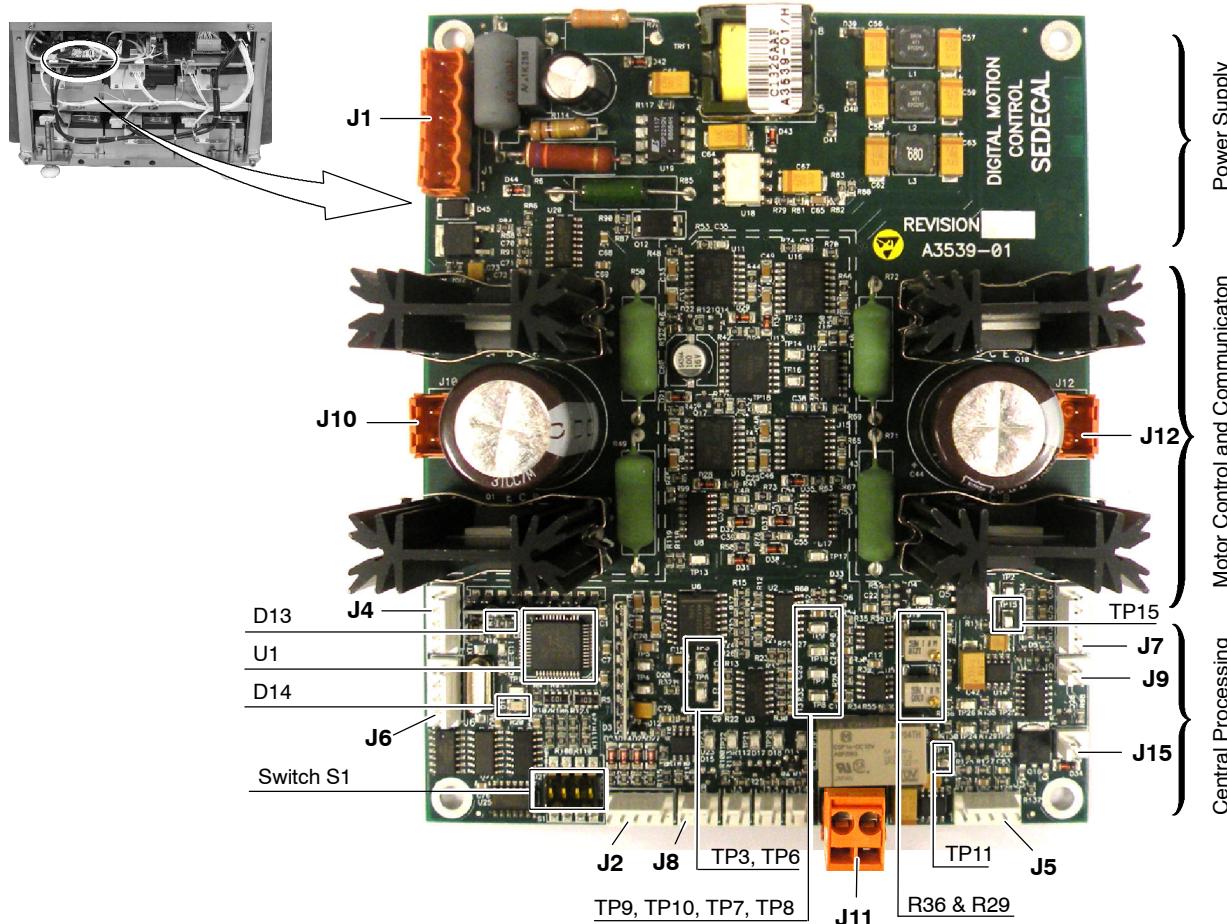
- f. Turn the unit OFF.
- g. Reinstall the Clutch Screws to both wheels to engage the gears.

Note 

The unit displacement can also be blocked during the driving, in this case refer to Table 6-1 in order to identify the possible cause.

6.8 DIGITAL MOTION CONTROL BOARD

This Board controls motion and is divided into 3 sections: Central Processing (Microcontroller), Motor Control and Communication, and Power Supply.



During normal operation, LED D14 (Microcontroller U1) blinks without interruption and LED D13 is continuously OFF.

LED D13 also presents errors based upon the number of blinks every 2 seconds (*refer to Table 6-1*), that matches with the number of beeps emitted by a buzzer at the same time.

If the unit displacement is not allowed when activating the Handle (Deadman) or the Fine Positioning Controls on the Handgrips, it can be due to the fact that any of these controls are activated during the startup of the unit (controls are pressed or pulled by the operator or there is a short-circuit). Check that the controls are not pressed and try the movement again. If the problem persists, refer to Table 6-1 in order to identify the possible cause.

The unit displacement can also be blocked during the driving. Refer to Table 6-1 in order to identify the possible cause.



TAKE CARE NOT TO CAUSE A SHORT CIRCUIT WHEN MEASURING WITH A MULTIMETER THE TEST POINTS ON THE DIGITAL MOTION CONTROL BOARD, BY ACCIDENTALLY CONTACTING ON ANY OTHER SENSIBLE POINT ON THE BOARD.

THIS WARNING SPECIALLY APPLIES WHEN REPLACING THE DIGITAL MOTION CONTROL BOARD OR DURING THE ADJUSTMENT PROCESS OF THE GAUGES VOLTAGE, WHEN MEASURING ON TEST POINT TP8 AND ACCIDENTALLY CONTACTING ON CAPACITOR C16, SINCE IT CAN BE DAMAGED THE MICROPROCESSOR.

TO AVOID DAMAGES, IT IS HIGHLY RECOMMENDED TO APPLY A COATING PROTECTION LIKE LOCTITE 444 OR ELECTRICAL TAPE (TO BE REMOVED AFTER THE ADJUSTMENT) OVER CAPACITOR C16, BEFORE MEASURING ON TEST POINT TP8.

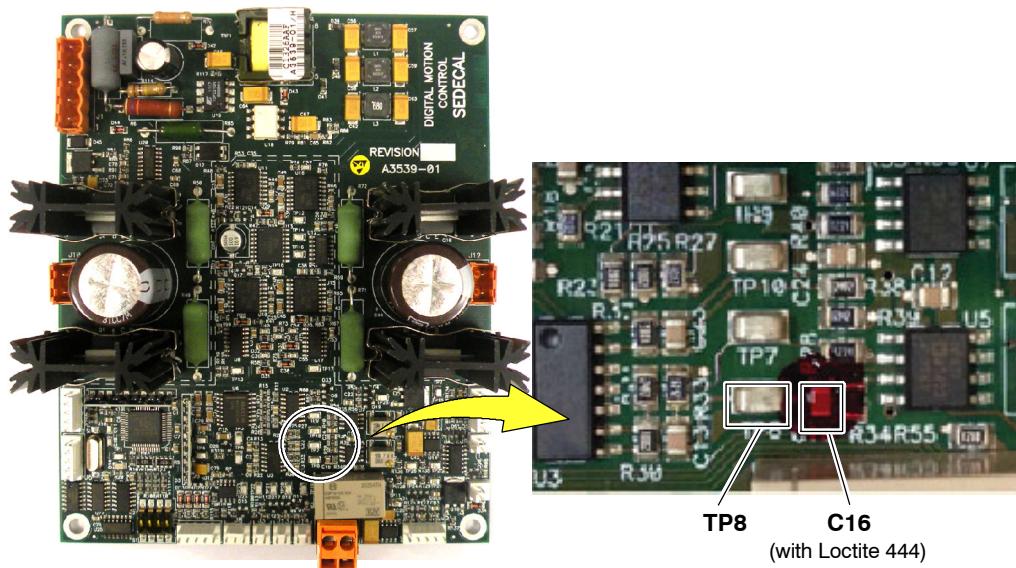


Table 6-1
LED 13 & Buzzer: Error codes

Blinks/Beeps	Description	Status	Action
1	Handlebar (Deadman) activated during startup.	Mobile movements are only allowed using the Fine Positioning Controls.	<p>Check that the Handlebar is not pressed and try the movement again using the Handlebar.</p> <p>If error persists, check connection of J9 on the Digital Motion Control Board, then restart the unit.</p> <p>If error persists, disconnect J9 from the Digital Motion Control Board and check Handle switch circuit.</p> <ul style="list-style-type: none"> - If it is short-circuited, replace the Handle switches. - If it is not short-circuited, keep J9 disconnected and restart the unit; if the problem persists, replace the Digital Motion Control Board.
2	Motor Current Error.	Mobile movements are not allowed.	<p>Replace the Digital Motion Control Board.</p> <p>Also, see <i>Section 6.8.5 "Motor Current"</i>.</p>
3	Commands from Gauges during startup. It could be from pressure on the Handlebar during startup.	Mobile movements are only allowed using the Fine Positioning Controls.	<p>Check that the Handlebar is not pressed nor pulled, then try the movement again using the Handlebar.</p> <p>If error persists, restart the unit and try the movement again.</p> <p>If error persists, check that the wires from the Gauges to the Digital Motion Control Board J5 and J7 are not broken nor disconnected, repairing or replacing as necessary, then try the movement again using the Handlebar.</p> <p>If error persists, restart the unit and try the movement again.</p> <p>If error persists, see <i>Section 6.7 "Troubleshooting Gauges"</i>.</p>
4	Commands from Fine Positioning Controls on the Handgrips detected during startup.	Mobile movements are only allowed using the Handlebar (Deadman).	<p>Check connection of J2 on the Digital Motion Control Board, then restart the unit.</p> <p>If error persists, disconnect J2 from the Digital Motion Control Board and check Fine Positioning Controls switch circuit.</p> <ul style="list-style-type: none"> - If it is short-circuited, replace where necessary (cables or Handgrip overlay). - If it is not short-circuited, keep J2 disconnected and restart the unit; if the problem persists, replace the Digital Motion Control Board.
5	-	-	-
6	Motor Encoder Error	<p>Mobile movements are blocked.</p> <p>After releasing the Handlebar (deadman) and pressing on it again, it is allowed driving the unit at slow speed, in order to move it to an adequate area for servicing purposes.</p>	<p>Check connection between J4 (left Motor) and J6 (right Motor) of the Digital Motion Control Board and the corresponding Motor Encoder.</p> <p>Check that the Motor brakes are not blocked. See <i>Section 6.2 "Motor Brake Check"</i>.</p> <p>If previous checking are correct but the error persists, replace the Digital Motion Control Board.</p>
7	-	-	-
8	Gauges wires are broken or disconnected.	Mobile movements are only allowed using the Fine Positioning Controls.	<p>Check that the wires from the Gauges to the Digital Motion Control Board J5 and J7 are not broken nor disconnected, repairing or replacing as necessary, then try the movement again using the Handlebar.</p> <p>If error persists, restart the unit and try the movement again.</p> <p>If error persists, see <i>Section 6.7 "Troubleshooting Gauges"</i>.</p>
Continuous Blink (No beeps)	Fatal error. RAM Test Error.	Mobile movements are blocked.	Microcontroller U1 is corrupted. Replace the Digital Motion Control Board.
Continuous Beep and LED D14 OFF	Fatal error.	Mobile movements are blocked.	Perform <i>Section 6.8.1 "Ignored Commands"</i>

Table 6-2 indicates some other possible problems related to the Digital Motion Control Board and their corresponding section for troubleshooting.

Table 6-2
Troubleshooting the Digital Motion Control Board

Description	Section for Troubleshooting
No movement (left and/or right motor) after activating the Handle (Deadman) nor the Fine Positioning Controls on the Handgrips.	6.8.1 "Ignored Commands"
No movement (left and/or right motor) after activating the Handle (Deadman), but commands from the Fine Positioning Controls on the Handgrips DO function.	Perform actions described in Table 6-1 for 1 blink-beep and in Section 6.7 "Troubleshooting Gauges"
No movement (left and/or right motor) after activating the Fine Positioning Controls on the Handgrips, but commands from the Handle (Deadman) DO function.	Perform actions described in Table 6-1 for 4 blinks-beeps and in Section 6.8.2 "Ignored Commands from Fine Positioning Controls on the Handgrips"
Jerky, oversensitive upon activating Handle (Deadman).	6.8.3 "Deadman Sensitivity"

6.8.1 IGNORED COMMANDS

No movement (left and/or right motor) after activating the Handle (Deadman) nor the Fine Positioning Controls on the Handgrips.

1. Visually check the status of D14. If D14 is not blinking, proceed to step 3. If D14 is blinking, continue to the next step.
2. With a Multimeter, ensure the correct power supply to the motors, **not referred to GND**. This is 0V without movement command and up to 90VDC (this could be as low as 5V, with readings of 10VDC, 30VDC, 40VDC, etc.; depending on command and battery charge level). For each movement command, measure in the Digital Motion Control Board, for left movement between J10-1 and J10-2, and for right movement between J12-1 and J12-2.
 - If voltage is not present during a movement command, replace the Digital Motion Control Board (A3539-xx).
 - If voltage is present, check the connections to the Motor and the Motor itself; repairing or replacing where necessary.
3. Ensure the power supply at J1 (between 90 and 112VDC, depending on the Battery Charge level) between J1-1 and GND (see A3539-xx). If voltage is correct, replace the Digital Motion Control Board. If this voltage is not present, the problem can be due to a failure of the Motors Battery Charger Board or due to defective batteries (*refer to Section 2.8*).

6.8.2 IGNORED COMMANDS FROM FINE POSITIONING CONTROLS ON THE HANDGRIPS

No movement (left and/or right motor) after activating the Fine Positioning Controls on the Handgrips, but commands from the Handle (Deadman) DO function (refer to actions described in Table 6-1, 4 blinks-beeps).

1. Visually check the status of D14. If D14 is not blinking, proceed to step 3. If D14 is blinking, continue to the next step.
2. Test for continuity of the commands from each Fine Positioning Control on the Handgrips, in the cable connected to J2 in the Digital Motion Control Board (*refer Block Diagram 54302xxx*).
 - If Fine Positioning Control Commands are not continuous, visually check the connections, repairing where necessary (cables or Handgrip overlay).
 - If Fine Positioning Control Commands are continuous, replace the Digital Motion Control Board (A3539-xx).
3. Ensure the power supply at J1 (between 90 and 112VDC, depending on the Battery Charge level) between J1-1 and GND (see A3539-xx). If voltage is correct, replace the Digital Motion Control Board. If this voltage is not present, the problem can be due to a failure of the Motors Battery Charger Board or due to defective batteries (*refer to Section 2.8*).

6.8.3 DEADMAN SENSITIVITY

Jerky movement, oversensitive, tendency to move forwards or backwards (right or left) upon activating Deadman.

1. Visually check the status of D14. If D14 is not blinking, proceed to step 5. If D14 is blinking, continue to the next step.
2. With an Oscilloscope or a Voltmeter (DC) connected to TP8 (left gauge) and TP23 (GND) or to TP10 (right gauge) and TP23 (GND) of the Digital Motion Control Board, ensure that the static position (without movement) is 2.5 ± 0.1 VDC.
3. With a Screwdriver, adjust Potentiometer R29 (left) or R36 (right) to 2.5 ± 0.1 VDC (*refer to Schematic Diagram A3539-xx*).
4. If the problem persists, check for 2.5 VDC at both TP3 (for left) and TP6 (for right). If 2.5 VDC is present, *go to Section 6.7 "Troubleshooting Gauges"*. If 2.5 VDC is not present, replace the Digital Motion Control Board (A3539-xx).
5. Ensure the power supply at J1 (between 90 and 112VDC, depending on the Battery Charge level) between J1-1 and GND (see A3539-xx). If voltage is correct, replace the Digital Motion Control Board. If this voltage is not present, the problem can be due to a failure of the Motors Battery Charger Board or due to defective batteries (*refer to Section 2.8*).

6.8.4 DRIVING VELOCITY LIMIT SELECTION SWITCH

Table 6-3 details the possible configurations and corresponding movement velocity of Switch SW1 of the Digital Motion Control Board (A3539-xx). By default, the speed is regulated to 5 km/h (3.1 mph) forwards and 2.5 km/h (1.6 mph) backwards (Configuration 3).

This speed is for Handlebar driving only. When not in the Parking Position, the speed reduces to 1.6 km/h (1 mph) and cannot be modified.

Table 6-3
Velocity Selection Switch

Configuration	SW1	SW2	SW3	SW4	Km/h (mph)	
					Forwards	Backwards
0	0	0	0	0	<i>Disable Motion</i>	
1	0	0	0	1	3.2 (2)	1.6 (1)
2	0	0	1	0	4.0 (2.5)	2.0 (1.25)
3	0	0	1	1	5.0 (3.1)	2.5 (1.6)
4	0	1	0	0	2.5 (1.6)	1.6 (1)
5	0	1	0	1	3.2 (2)	2.0 (1.25)
6	0	1	1	0	4.0 (2.5)	2.5 (1.6)
7	0	1	1	1	5.0 (3.1)	3.2 (2)
8	1	0	0	0	2.5 (1.6)	2.0 (1.25)
9	1	0	0	1	3.2 (2)	2.5 (1.6)
10	1	0	1	0	4.0 (2.5)	3.2 (2)
11	1	0	1	1	5.0 (3.1)	4.0 (2.5)
12	1	1	0	0	2.5 (1.6)	2.5 (1.6)
13	1	1	0	1	3.2 (2)	3.2 (2)
14	1	1	1	0	4.0 (2.5)	4.0 (2.5)
15	1	1	1	1	5.0 (3.1)	5.0 (3.1)
<i>When OUT OF PARKING POSITION</i>					1.6 (1)	1.6 (1)

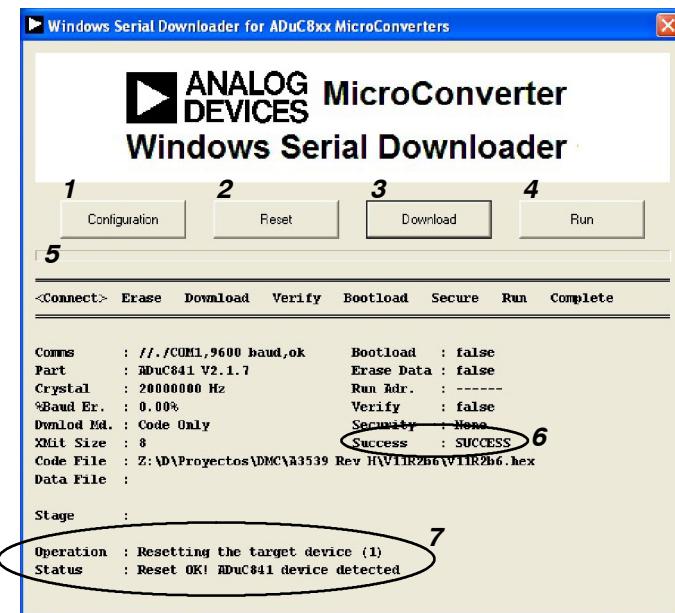
6.8.5 MOTOR CURRENT

Current generated by the Digital Motion Control Board (A3539-xx) is controlled by the Microcontroller. This current is checked at the startup during the boards autocheck. If Error 2 appears at LED D13, internal current may be at fault and the Digital Motion Board must be replaced.

6.8.6 UPDATING THE MICROCONTROLLER

1. Obtain the **Windows Serial Downloader (WSD) Program Kit** and ensure that the correct version of the Digital Motion Control Software (.hex file) is accessible to upload.
2. To install the WSD program, follow the route to the Windows Serial Downloader and click on the Setup icon to start the installation. The Install Shield will automatically open. Follow the instructions on the Install Shield program and then restart the PC when the installation is complete.
3. Open the route: *Start / Analog Devices / WSD*. The following screen appears. The information in this window depends on its configuration.

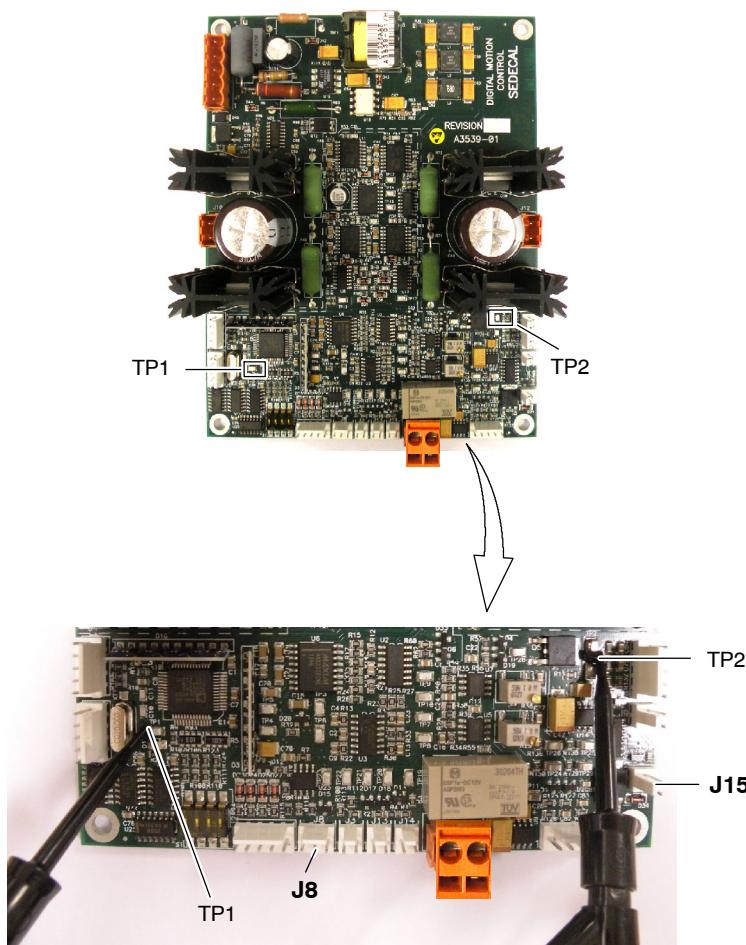
1. Access to the Configuration Window
2. Reset: not used
3. Download: begins the upgrade
4. Run: not used
5. Progress Bar: displays percentage of download done
6. Success: displays last action outcome
7. Operation and Status: action and status in course or last operation and status



Note

To avoid any unexpected behaviour from the Motor Group, never use *Reset* or *Run* while using the WSD program.

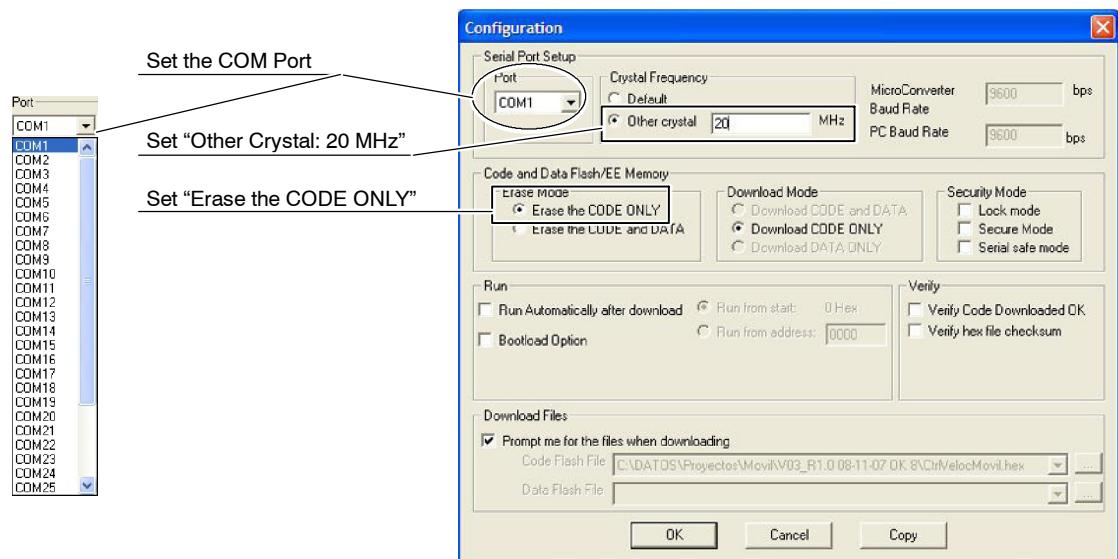
4. With the Unit OFF, connect the Clips of the *DMC Programming Cable* (A7130-xx) to TP1 and TP2, then connect the J8 connector of this cable to J8 of the Digital Motion Control Board and the other end (SubD9-PC) of the cable to the available COM Port of the Computer (PC).

**Note**

With TP1 and TP2 jumpered for firmware updating, when the unit is turned ON, the buzzer emits a continuous beep, so it is suggested to disconnect the buzzer from connector J15 of the Digital Motion Control Board (A3539-xx) until completing the process. If J15 is disconnected, do not forget reconnecting it at the end.

5. Select “*Configuration*” and ensure / select the following parameters on the Configuration Screen that appears:

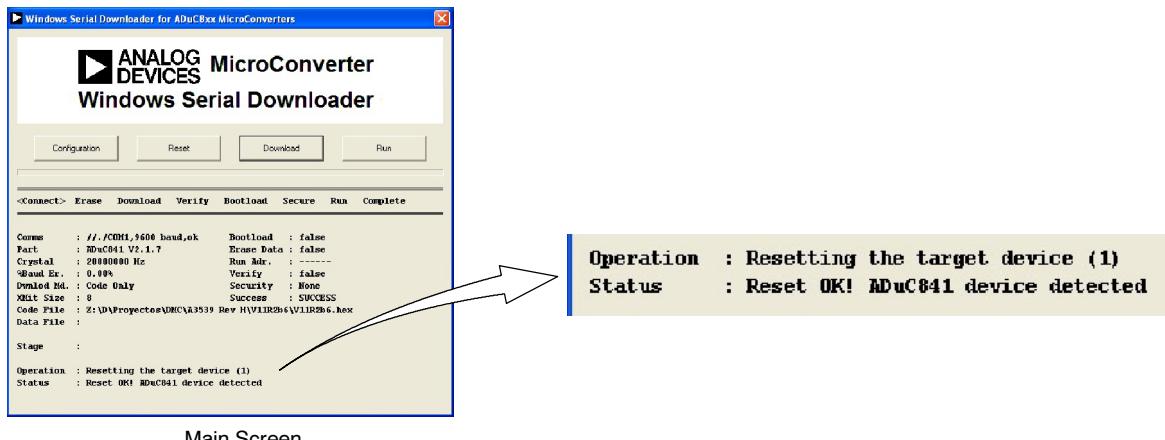
- COM Port : Select the available COM port of the Computer (PC) (COM1 is the default port, but another one could be selected).
- Select “*Other Crystal*” and enter “20” for the MHz.
- Ensure that “*Erase the CODE ONLY*” is selected.



6. Once configured, click on “OK” to return to the main screen.

7. Startup the Unit (the PC should be ON with the WSD open).

8. If selections and cable connections are correct, the “*Status*” indication will be “*OK - device detected*” (as shown below).



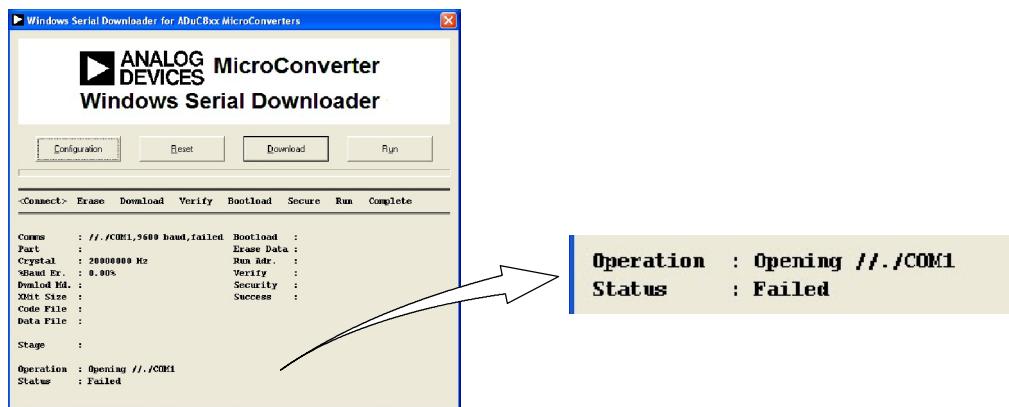
Main Screen

Mobile X-Ray Unit

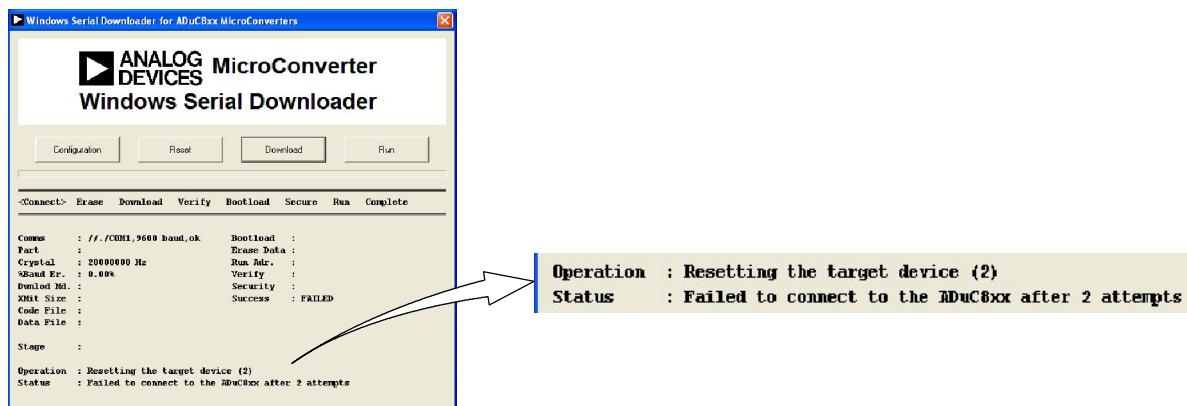
Troubleshooting

9. If a problem is present, it could be due to:

- The selected Serial Port of the Computer (PC) is not available. The “*Operation / Status*” indication will be “*Opening //./COM_ ; Failed*” (as shown below).

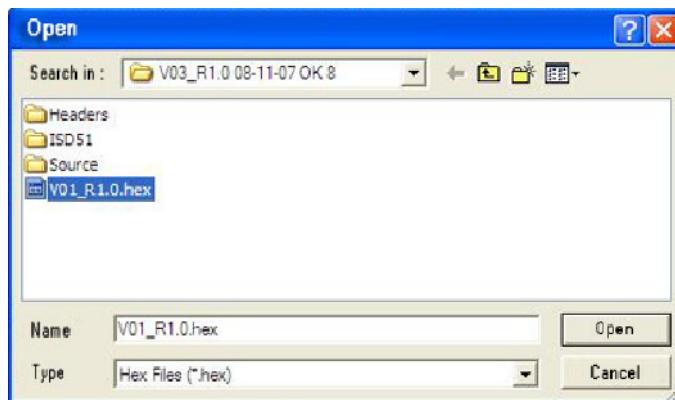


- Check if the selected Serial Port is correct, otherwise click on “*Configuration*” button and select the proper Serial Port.
 - Check if other application has the Serial Port open. If so, close this application.
-
- Connection is not correct. The “*Operation / Status*” indication will be “*Resetting the target device ; Failed to connect ...*” (as shown below).



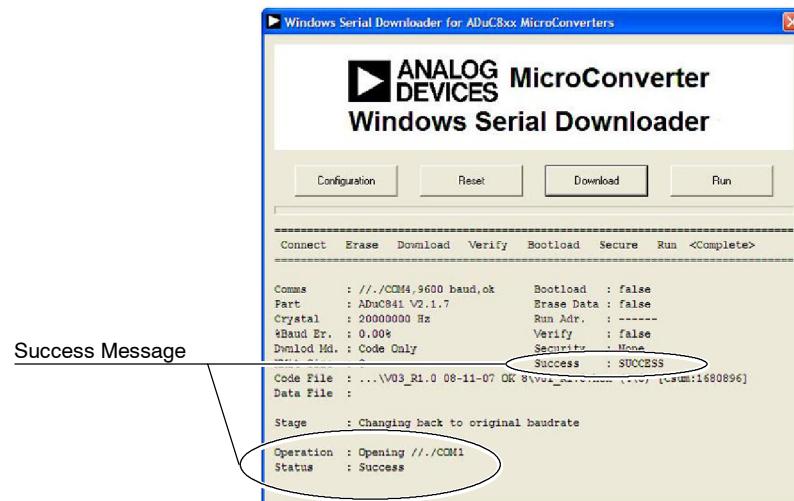
- Check if the Unit is powered ON.
- Check the Clips of the *DMC Programming Cable* (A7130-xx) are connected to TP1 and TP2, as well as the *DMC Programming Cable* is connect to J8 of the Digital Motion Control Board and to the correct COM Port of the Computer.

10. Once the Unit has completely startup, select “Download”. On the emerging Window, select the correct Hex file and then “Open”.



* This illustration
is an example

11. The emerging window closes and the *Progress Bar* scrolls from left to right showing the percentage of the upgrade finished while in the field on the lower left, *Operation and Status*, events during the upload are shown.
12. After the Upload, the Success Message on the WSD window indicates a correct upgrade. Once the Success Message appears, safely turn the Unit OFF. Disconnect the *DMC Programming Cable*, reconnect terminal J15 to the Digital Motion Control Board (if it was disconnected) and restart the Unit. Perform a functional check.



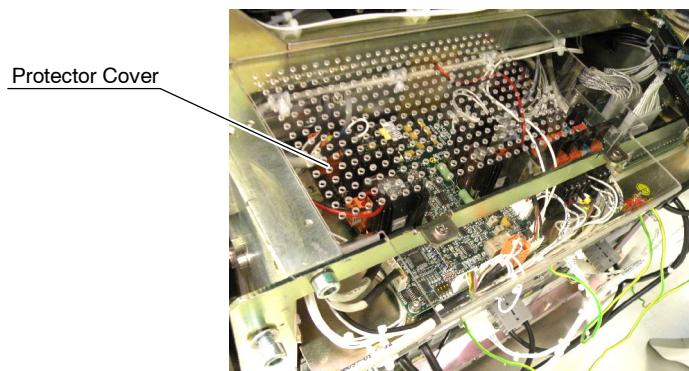
Note

In the event of a failed upgrade, follow step 9., confirm a correct configuration of the WSD and ensure continuity of the DMC Programming Cable, then perform the process again.

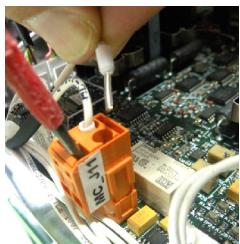
If the problem continues, restart both the Unit and the PC and select “Download” again. If the problem persists, contact the Manufacturer.

6.8.7 REPLACEMENT OF THE DIGITAL MOTION CONTROL BOARD

1. Turn OFF the unit, disconnect the Power Line Cable from mains and press the Emergency Switch OFF.
2. In order to access to the Digital Motion Control Board, remove the Back Cover (*refer to Section 2.2 of Covers Removal*).
3. In order to access to the internal area of the Generator, open the Generator door(s) by removing the fixing Screws that holds the door(s) to the Generator chassis.
4. Remove the Protector Cover of the Digital Motion Control Board by removing the two (2) fixing Screws.



5. Unplug all the connectors from the Digital Motion Control Board. These connectors will need to be plugged to the new Digital Motion Control Board (A3539-xx) in the same position.
6. Remove the old Digital Motion Control Board by removing the four (4) Screws located on each corner of the board, and install the new Digital Motion Control Board in the same position.
7. Plug all the connectors removed in step 5.



Notice that J11 female Connector is assembled to the new Board so remove the two wires from the original Connector J11 by unlocking each wire using a flat Screwdriver in the squared holes, then mount them into the new J11 Connector on the Board in the same position.

8. Configure the Velocity Selection Switches of the the new Digital Motion Control Board as per the old one (*Refer to Table 6-3 of Velocity Selection Switch*).

9. Software Checking. In order to verify that the Software version of the new Board is the required version, refer to the following table:

Table 6-4
Software Checking

Previous Board		New Board	
Hardware	Software	Hardware	required Software
A3539-01 revision \geq H	DMC- V \geq 11 Ry	A3539-01 revision \geq H	DMC - Vx (same) R \geq y

Note 

If the Software version of the new Board is not the required one, perform the microcontroller Updating procedure described in section 6.8.6.

10. Turn the unit ON.
11. Check the Deadman Sensitivity as described:
 - a. Visually check that D14 is blinking.
 - b. With an Oscilloscope or a Voltmeter (DC) connected to TP8 (left gauge) and TP23 (GND) or to TP10 (right gauge) and TP23 (GND) of the Digital Motion Control Board, ensure that the static position (without movement) is 2.5 ± 0.1 VDC.
 - c. With a Screwdriver, adjust Potentiometer R29 (left) or R36 (right) to 2.5 ± 0.1 VDC (refer to *Schematic Diagram A3539-xx*).

Note 

These adjustments must be made with the mobile handle in stand-by (without any pressure on the mobile handle).

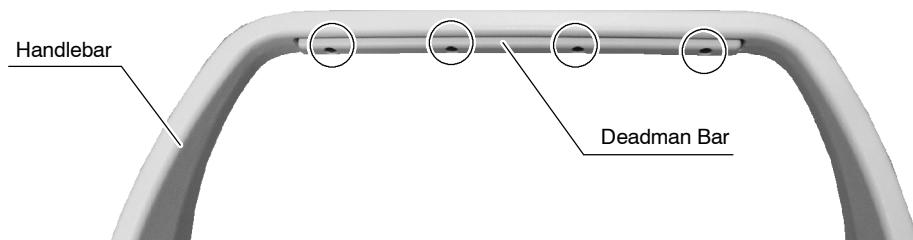
12. Turn the unit OFF.
13. Install the Protector Cover of the Digital Motion Control Board.
14. Close the Generator door(s) with the fixing Screws that holds the door(s) to the Generator chassis.
15. Turn the unit ON and make the motion functional check of the unit.
16. Turn the unit OFF and install the Back Cover.

6.9 HANDLEBAR DEADMAN REPLACEMENT

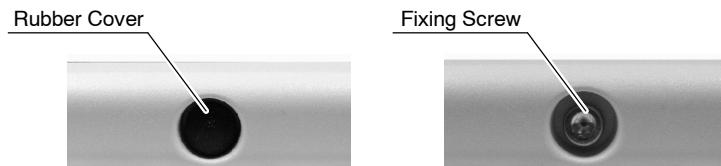
1. Release the Arm from Parking position.
2. Turn the unit OFF.



KEEP THE UNIT TURNED OFF AND ISOLATED FROM THE POWER SUPPLY.



3. Remove the rubber covers from the four (4) fixing Screws of the Deadman Bar by using a flat head Screwdriver; then remove the glue from the head of the Screws with the Screwdriver.



4. Remove the four (4) fixation Screws and dismount the Deadman bar.



5. Mount the new Deadman Bar in the Handlebar with the four (4) fixing Screws.
6. Turn the unit ON and check for the proper operation of the Deadman Bar.
7. If the operation is correct, turn the unit OFF and dismount the fixing Screws again, in order to lock them by using Loctite 243 over the thread.
8. Finally, fix the rubber covers to the Screws by using Loctite 410.

6.10 HANDGRIPS AND MICROSWITCHES REPLACEMENT

Note 

Before starting the procedure, place an auxiliary table beside the Unit Column.

6.10.1 HANDGRIPS AND MICROSWITCHES REPLACEMENT IN UNITS WITH STANDARD CONFIGURATION

Note 

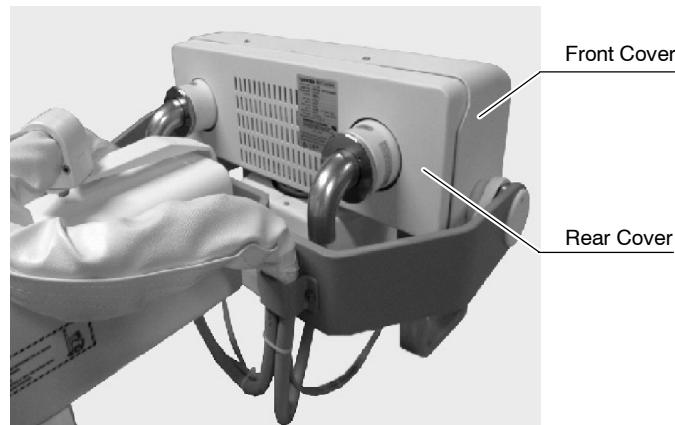
Two people are necessary to carry out the entire procedure.

Note 

*For units with **Tube-Collimator Assembly Standard Configuration (Collimator, Flange and X-Ray Tube)**, proceed as described in Section 4.1.1 until the step 5., without disconnecting the Collimator Cables, in order to dismount the Collimator from the X-ray Tube through the Flange (Adaptation Ring).*

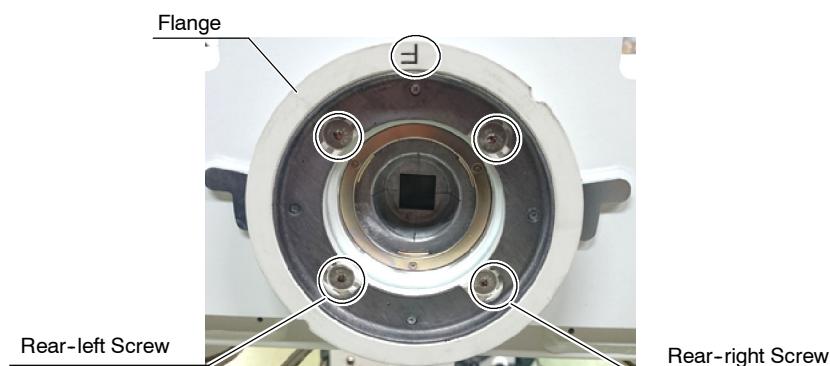
Carefully place the Collimator on the auxiliary table.

1. Dismount the Rear and the Front Covers from the X-Ray Tube, by removing the corresponding Screws.

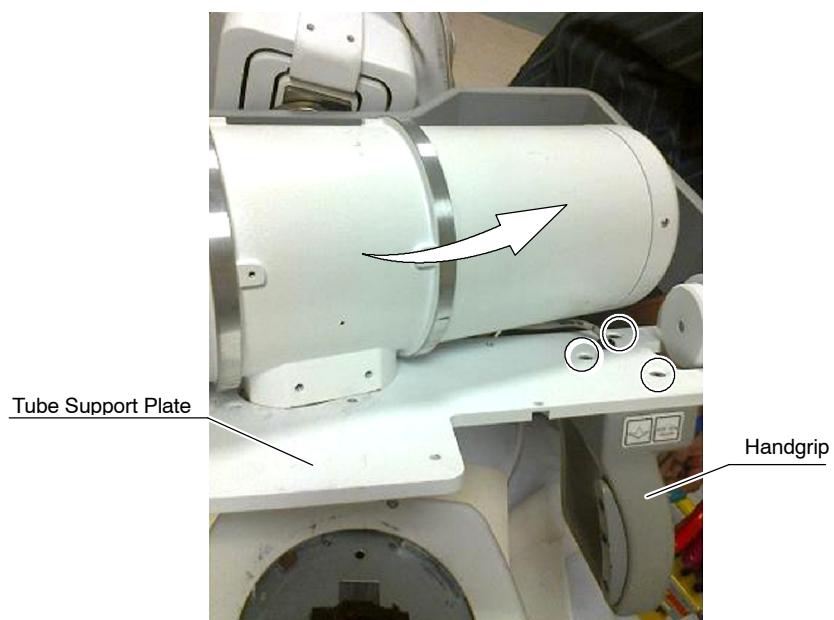


2. Depending on the Switch/Handgrip to be replaced, slightly loosen without removing one of the Countersunk Screws M6 (x4) of the Flange:
 - the Rear-left Screw in order to access to the right Handgrip
 - the Rear-right Screw in order to access to the left Handgrip.

Remove the remaining (x3) countersunk Screws M6 of the Flange.



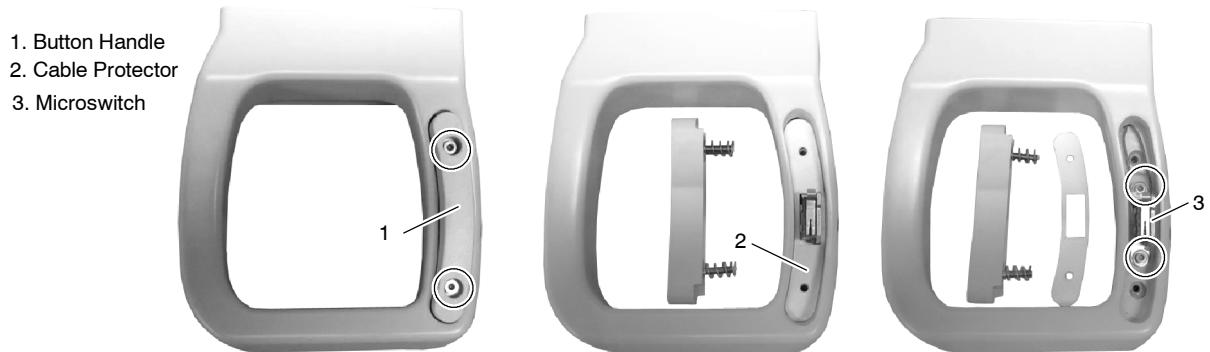
3. Slide the Tube backwards to have access to the Screws (x3) that fix the Handgrip to the Tube Support Plate; remove the Screw Caps and the Screws.



4. Release the Handgrip, in order to access the connectors.
5. In order to fully remove the Handgrip, disconnect:
 - Microswitch: SW1 (right) or SW2 (left).
 - Overlay connector: J21 (right) or J20 (left).

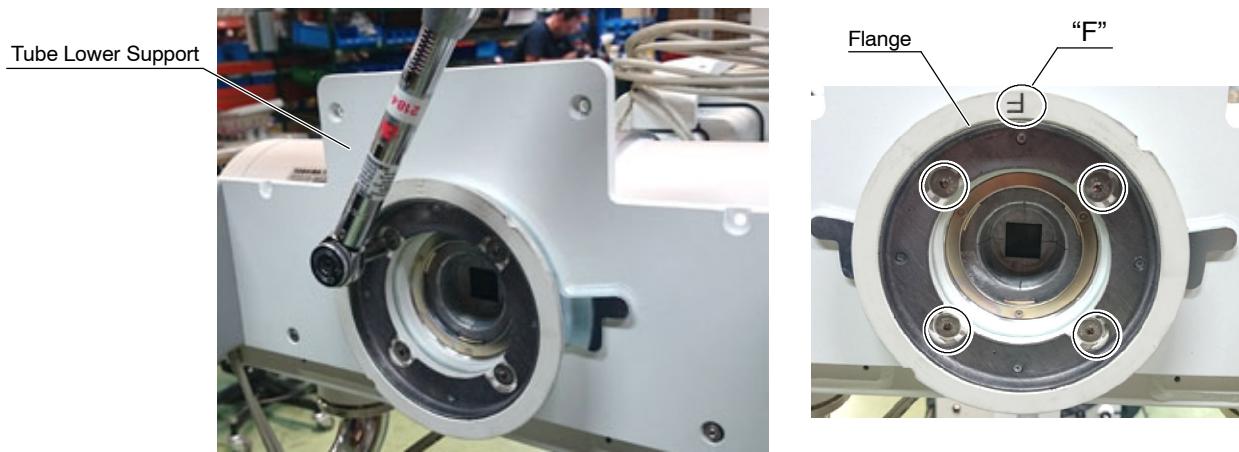


6. If it is needed to replace the complete Handgrip, follow with step 8.
7. If it is needed to replace the Microswitch, continue in the following steps:
 - a. Remove the Screws (x2) in order to dismount the Button Handle and the Cable Protector, to have access to the Microswitch. Remove the defective Microswitch by removing the Allen Screws (x2).



- b. Install the new Microswitch by previously dismounting the plastic box of the connector to pass the wires through the hole of the Handgrip. Assemble the plastic box of the connector again.
- c. Mount the Cable Protector and the Button Handle, plug the Microswitch and the Overlay connectors.

8. Mount the Handgrip (new or repaired) to the Tube Support Plate by tightening the corresponding Screws (x3) previously removed, it is recommended to apply Loctite 243 in the Screws in order to reinforce these joints.
9. Align the Tube and place the Flange on the Tube Lower Support, with the letter "F" turned toward the Tube front and fix the Flange to the Tube with the countersunk Screws M6 (x4), applying Loctite 243 on the Screws and a tightening torque of 6.6 Nm (the current Flange is made of Resin material, for Flanges made of Metal material the tightening torque is 11.3 Nm).



10. Mount the Rear and Front Tube Covers with the corresponding Screws.
11. Reinstall the Collimator to the Flange (Adaptation Ring) as described in the procedure of Section 4.1.1 from Step 7.

6.10.2 HANDGRIPS AND MICROSWITCHES REPLACEMENT IN UNITS WITH OPTIONAL CONFIGURATION, WITH HANDGRIPS-SUPPORT

Note 

For units with **Tube-Collimator Assembly Optional Configuration (Collimator, Handgrips-Support, Flange and X-Ray Tube)**, proceed as described in the following steps.

1. Release the Arm from Parking position, turn the Column 90° and place the Tube-Collimator Assembly in a comfortable height to remove the Handgrips.
2. Turn the unit OFF.
3. Remove the Screws (x2) fixing the Tube Front Cover and the Rear Cover, at the top of the Tube Covers.

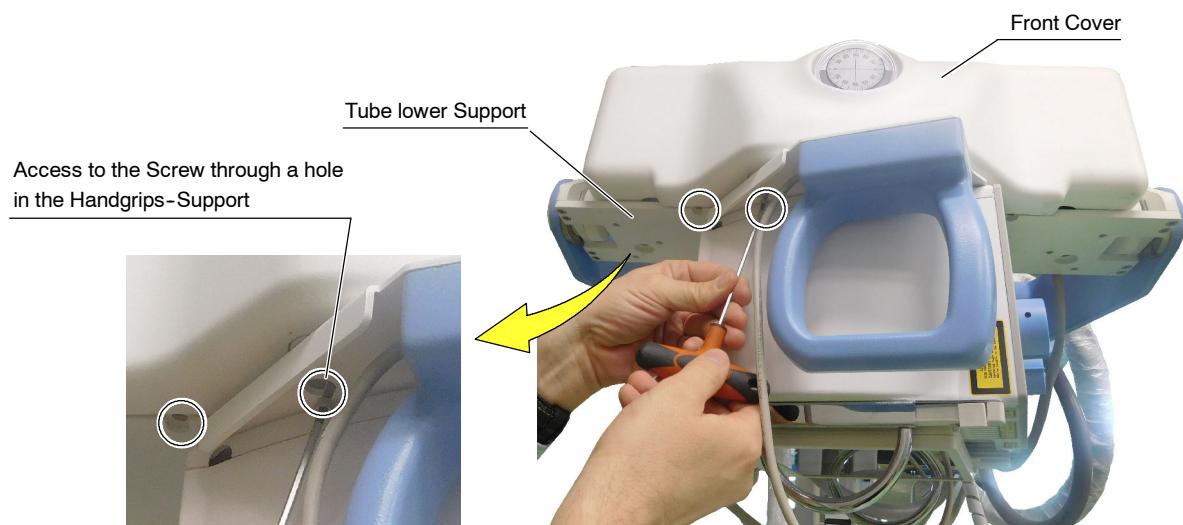


Mobile X-Ray Unit

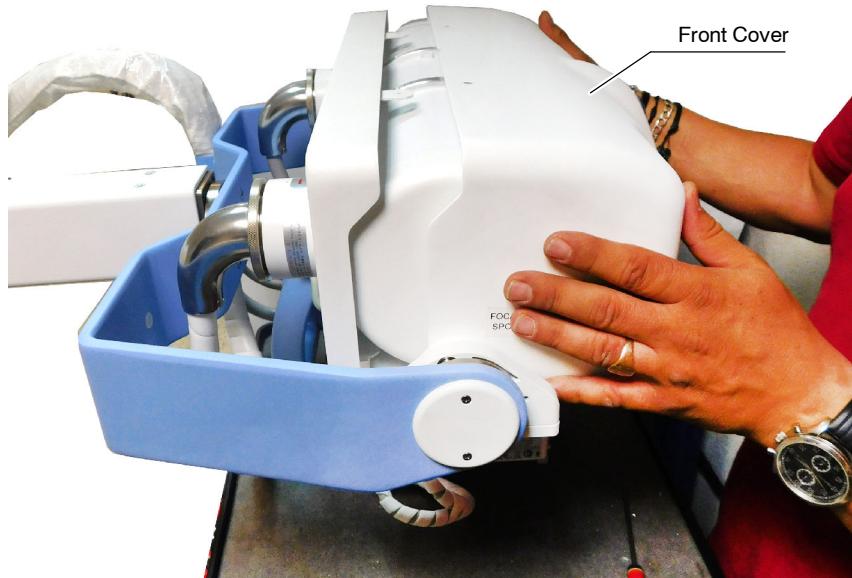
Troubleshooting

4. Turn the Collimator in order to gain access to the Screws underneath that fix the Tube Front Cover and the Tube Lower Support.

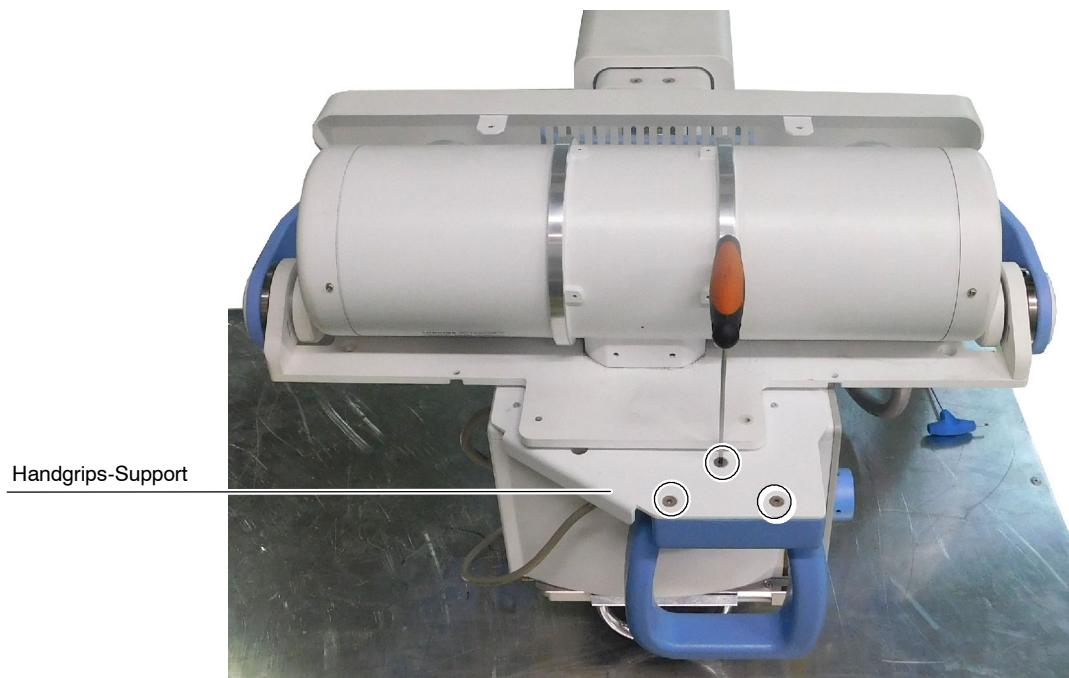
Remove the Screws (x2) at one side, then turn again the Collimator and remove the Screws (x2) at the other side.



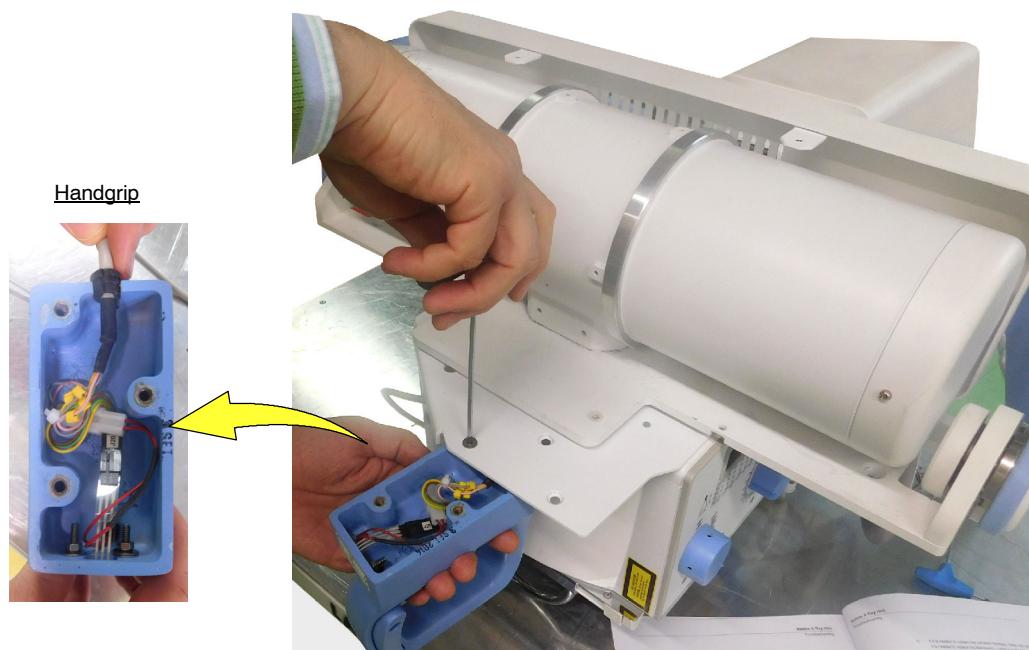
5. Dismount the Front Cover from the X-Ray Tube and place it aside.



6. Turn the Handgrips-Support to have access to the Screws (x3) that fix the Handgrip to the Support; remove the Screw Caps and the Screws.



7. Release the Handgrip, in order to access the connectors.



8. In order to fully remove the Handgrip, disconnect:

- Microswitch: SW1 (right) or SW2 (left).
- Overlay connector: J21 (right) or J20 (left).



9. If it is needed to replace the complete Handgrip, follow with step 11.

10. If it is needed to replace the Microswitch, continue in the following steps.

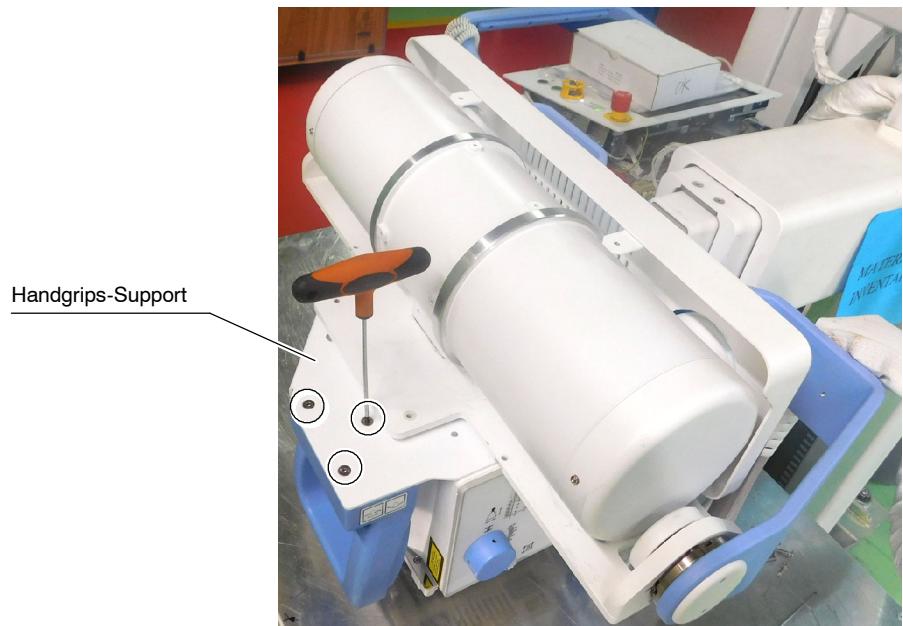
- a. Remove the Screws (x2) in order to dismantle the Button Handle and the Cable Protector, to have access to the Microswitch. Remove the defective Microswitch by removing the Allen Screws (x2).



- b. Install the new Microswitch by previously dismantling the plastic box of the connector to pass the wires through the hole of the Handgrip. Assemble the plastic box of the connector again.

- c. Mount the Cable Protector and the Button Handle, plug the Microswitch and the Overlay connectors.

11. Mount the Handgrip (new or repaired) to the Handgrips-Support by tightening the corresponding Screws (x3); previously, it is recommended to apply Loctite 243 in the Screws in order to reinforce these joints.



12. Mount the Front Tube Cover with the corresponding Screws.

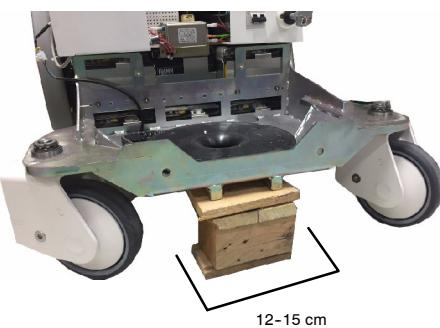
6.11 FRONT WHEELS REPLACEMENT

In order to replace the Front Wheel only or the complete Front Wheel Kit, it is needed to remove the corresponding covers until dismounting the Bumper Cover (*refer to Section 2.2 of Covers Removal*).



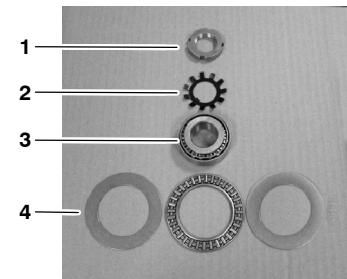
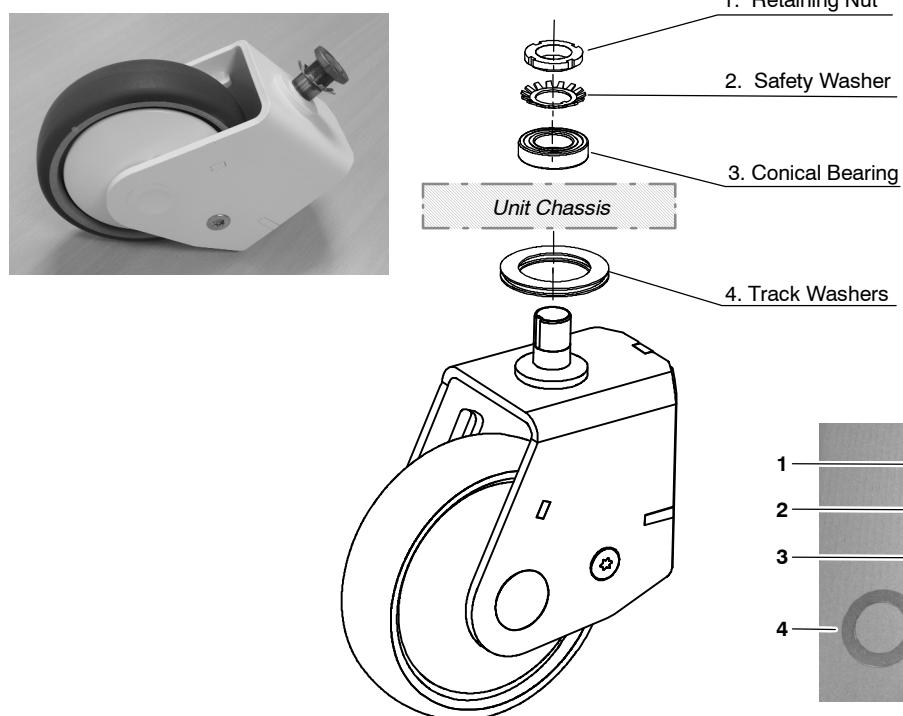
Then, lift slightly the lower front part of the Mobile by pushing the Column towards the back area.

Place a piece of wood under the unit (12-15 cm approx.) to keep the mobile in this position.



6.11.1 INSTRUCTIONS FOR REPLACING THE FRONT WHEEL KIT

Front Wheel Kit



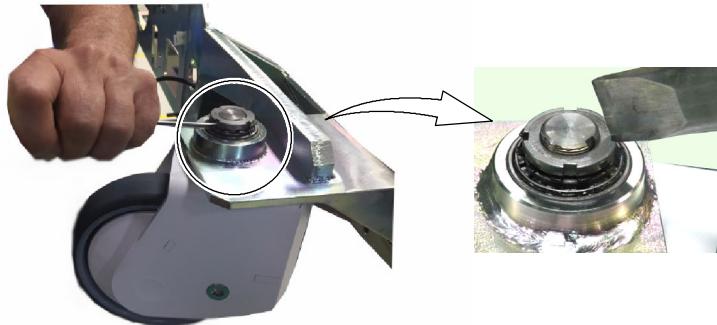
1. Unfold the Flap of the Safety Washer that is folded in the Retaining Nut.



2. Using a Hook Spanner (# 30-32), unscrew the Retaining Nut.



In order to unscrew the Retaining Nut, a Punch and a Hammer can be used alternatively, as shown in pictures below.



3. Remove the Front Wheel Kit with all the bearings.
4. Install the new Wheel Kit, placing each item in the original position, as shown in the illustration at the beginning of section 6.11.1.
5. Screw the Retaining Nut and verify the correct rotation of the Wheel Kit.
6. Fold one Flap of the Safety Washer, in order to block the position of the Retaining Nut.
7. Mount the covers in reverse order.

SECTION 7

REPLACEMENT OF THE ACCESS POINT FOR UNITS WITH WIRELESS DR DETECTORS

7.1 REPLACEMENT OF ARUBA 303 ACCESS POINT

Note 

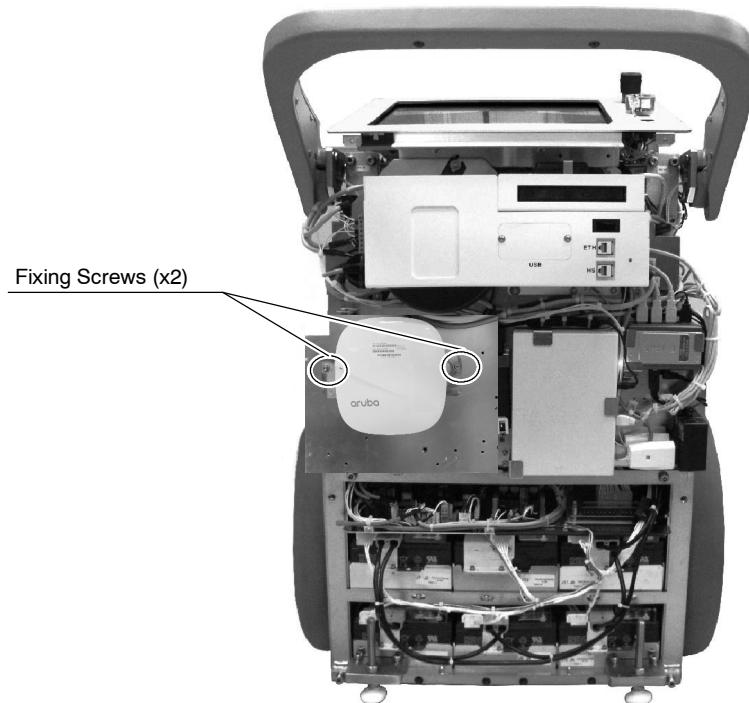
The following procedure describes the necessary steps to replace the Access Point device only, not the other items included in the spare parts kit (Power Supply, Fixing Plates, cables and assorted hardware). Replace them, if necessary.

Note 

In order to replace the Access Point, it is only needed to dismount the Back Cover. After dismounting the Back Cover, place it beside the unit, taking care of the Cables attached (GND).

Refer to Section 2.2 for Covers removal.

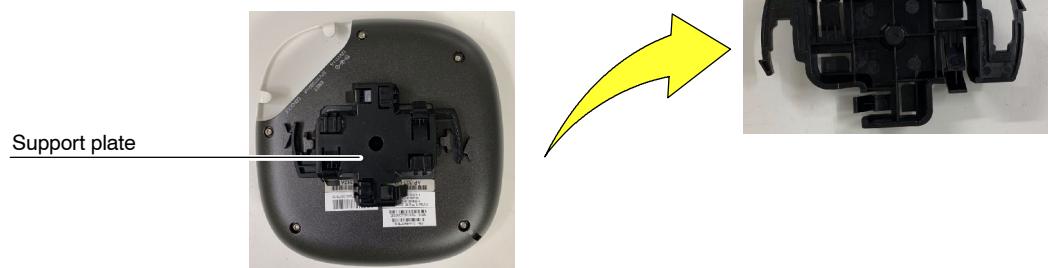
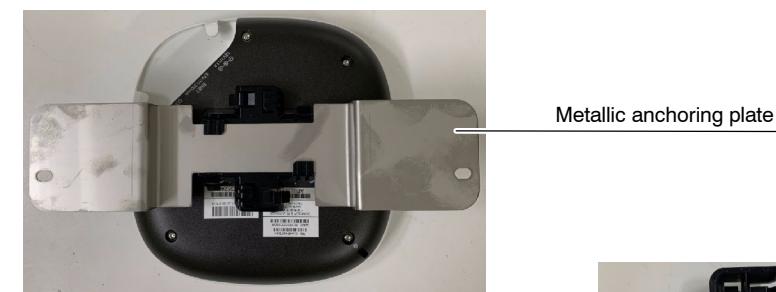
1. Remove the Fixing Screws of the Bracket in order to disengage the Access Point.



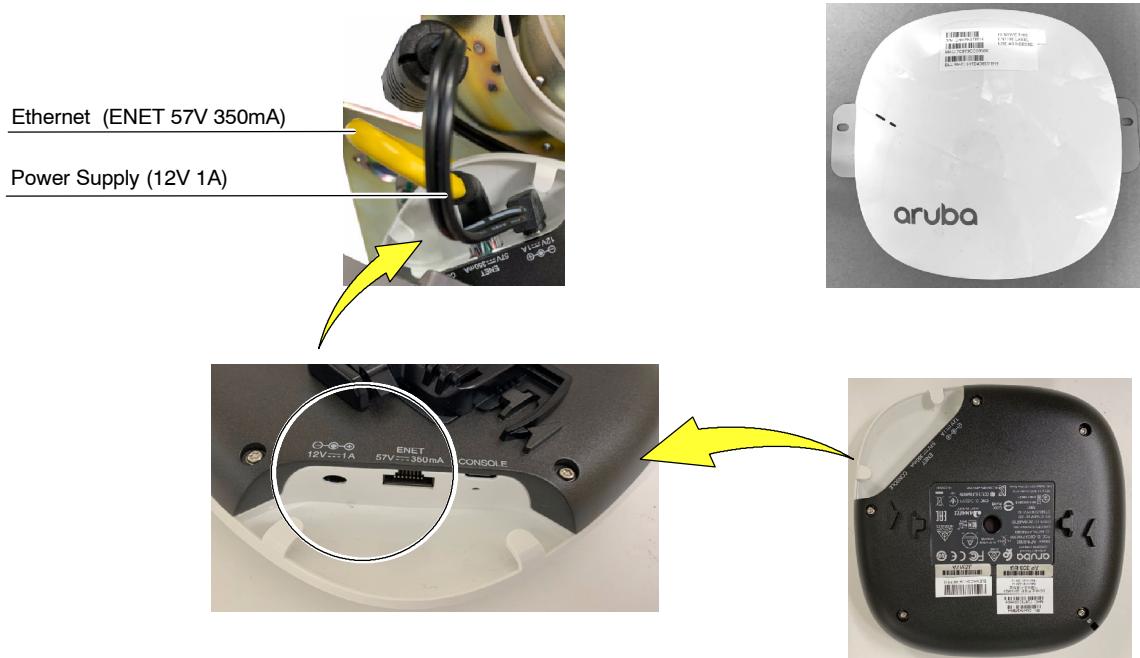
2. While holding the Access Point, disconnect the Ethernet and the Power Supply Cables.



3. Rotate the metallic anchoring plate to release it and afterwards, repeat the same procedure with the black support plate that lays underneath.



4. Replace the Access Point following the previous step in reverse order. Plug the Ethernet Cable connector into the socket labelled as "ENET 57V, 350mA" and the Power Supply Cable Connector into the socket labelled as "12V, 1A" (refer to the next pictures).



5. Mount the Access Point again and secure it with the Fixing Screws.



6. Mount the Covers previously removed in reverse order.
7. Turn ON the unit.
8. Perform a functional check.

Note

For configuration refer to the DR wireless networking - Service Manual, Document ID: 58221971.

7.2 REPLACEMENT OF ARUBA 207 ACCESS POINT

Note

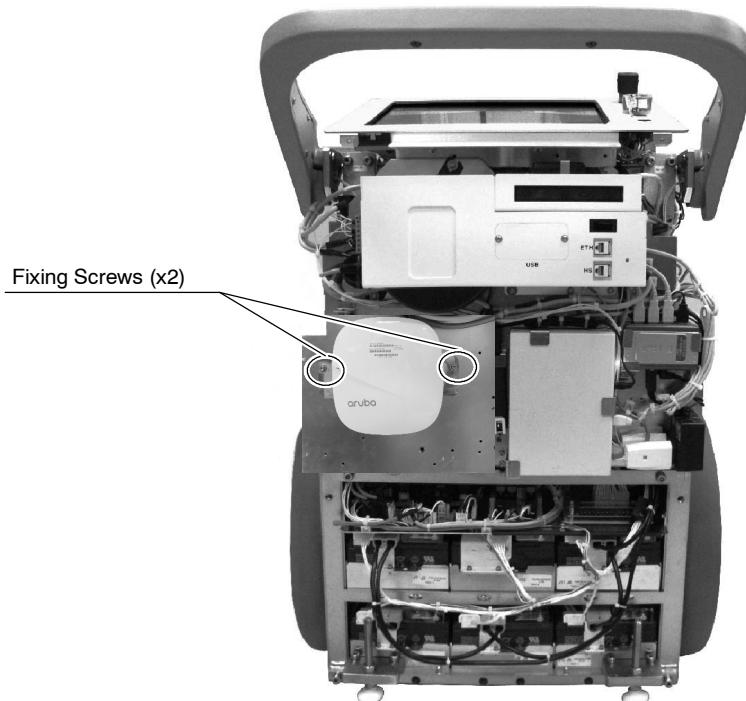
The following procedure describes the necessary steps to replace the Access Point device only, not the other items included in the spare parts kit (Power Supply, Fixing Plates, cables and assorted hardware). Replace them, if necessary.

Note

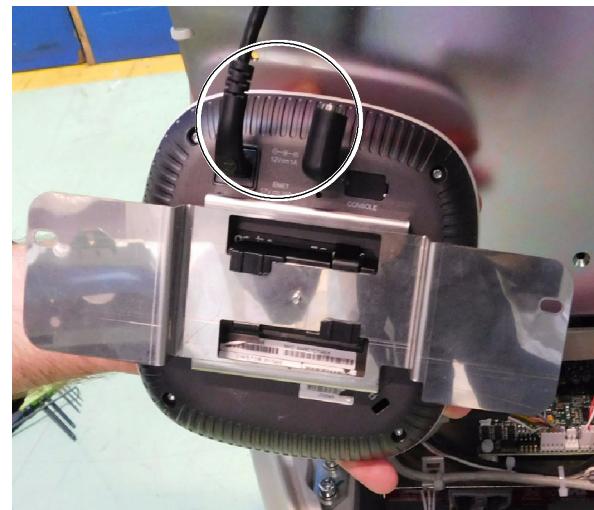
In order to replace the Access Point, it is only needed to dismount the Back Cover. After dismounting the Back Cover, place it beside the unit, taking care of the Cables attached (GND).

Refer to Section 2.2 for Covers removal.

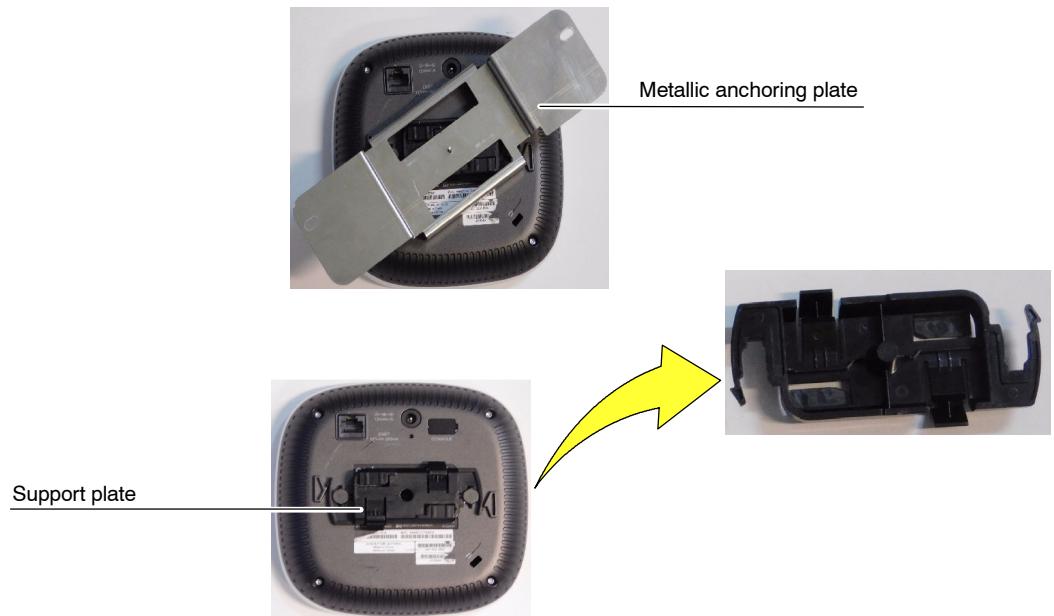
1. Remove the Fixing Screws of the Bracket in order to disengage the Access Point.



2. While holding the Access Point, disconnect the Ethernet and the Power Supply Cables.



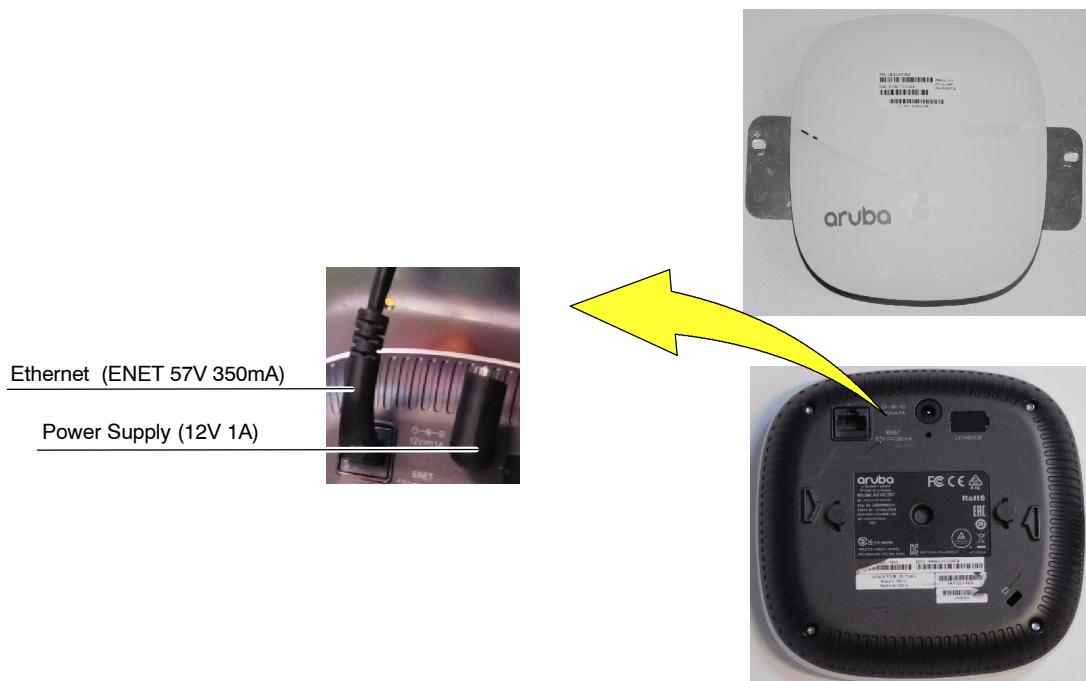
3. Rotate the metallic anchoring plate to release it and afterwards, repeat the same procedure with the black support plate that lays underneath.



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4. Replace the Access Point following the previous step in reverse order. Plug the Ethernet Cable connector into the socket labelled as “ENET 57V, 350mA” and the Power Supply Cable Connector into the socket labelled as “12V, 1A” (refer to the next pictures).



5. Mount the Access Point again and secure it with the Fixing Screws.



6. Mount the Covers previously removed in reverse order.
7. Turn ON the unit.
8. Perform a functional check.

Note

For configuration refer to the DR wireless networking - Service Manual, Document ID: 58221971.

7.3 REPLACEMENT OF HUAWEI ACCESS POINT

Note

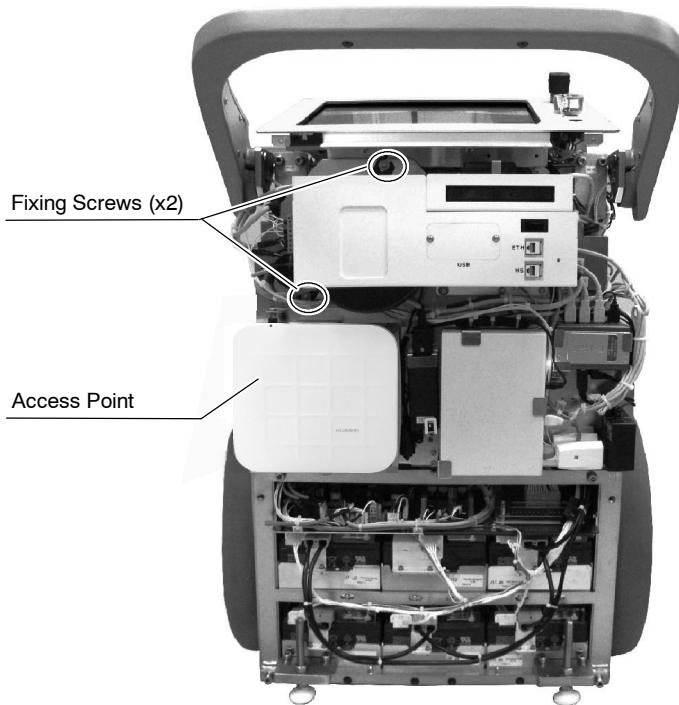
The following procedure describes the necessary steps to replace the Access Point device only, not the other items included in the spare parts kit (Anchoring Plate, Fixing Plate, Power Supply, other plates and assorted hardware). Replace them, if necessary.

Note

In order to replace the Access Point, it is only needed to dismount the Back Cover. After dismounting the Back Cover, place it beside the unit, taking care of the Cables attached (GND).

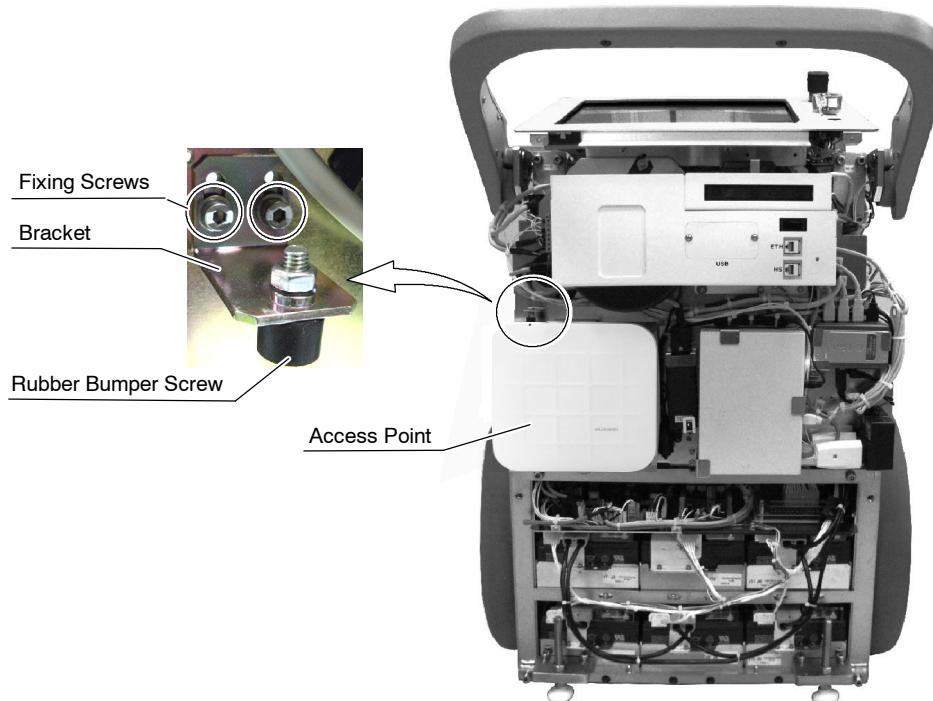
Refer to Section 2.2 for Covers removal.

1. Loosen without removing the fixing Screws (x2) of the Ethernet Cable Reel, in order to get space enough for later disengage the Access Point upwards.

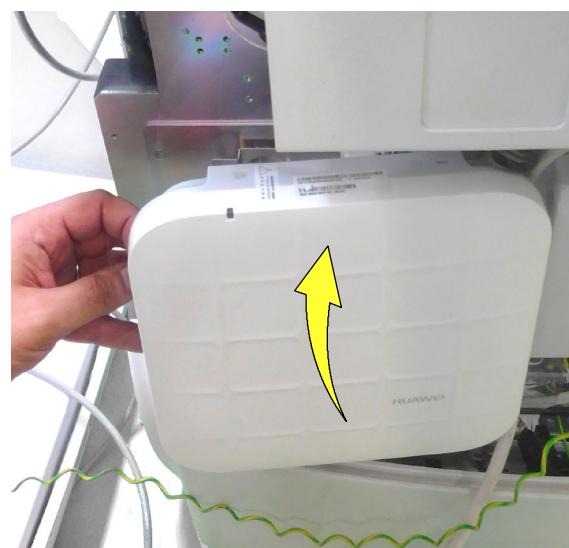


Note: The appearance of the Mobile unit may vary depending on the model

2. Remove the Fixing Screws of the Bracket with the Rubber Bumper Screw, placed in the upper area of the Access Point.



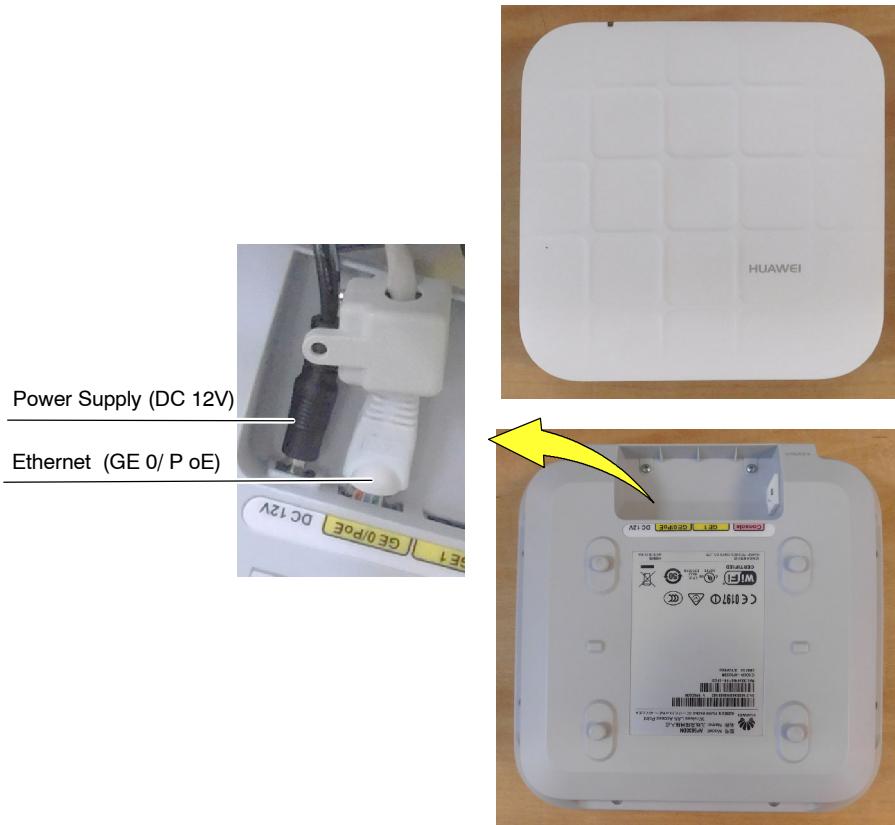
3. Slide the Access Point upwards in order to disengage it from the Anchoring plate.



4. Disconnect the Ethernet and the Power Supply Cables.



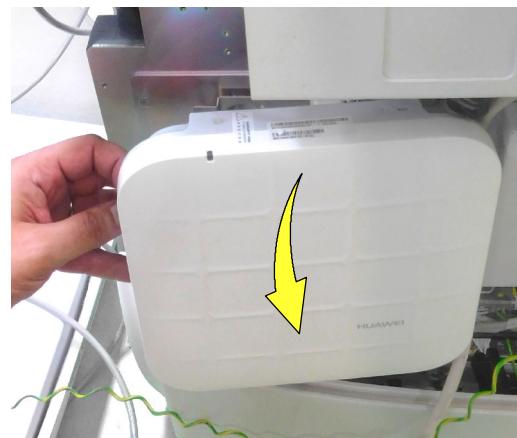
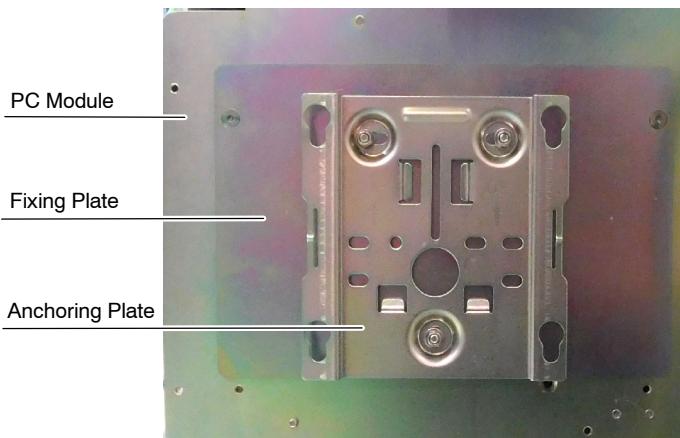
5. Replace the Access Point, plug the Ethernet Cable connector into the socket labelled as “GE 0/PoE” and the Power Supply Cable Connector into the socket labelled as “DC 12V” (refer to the next picture).



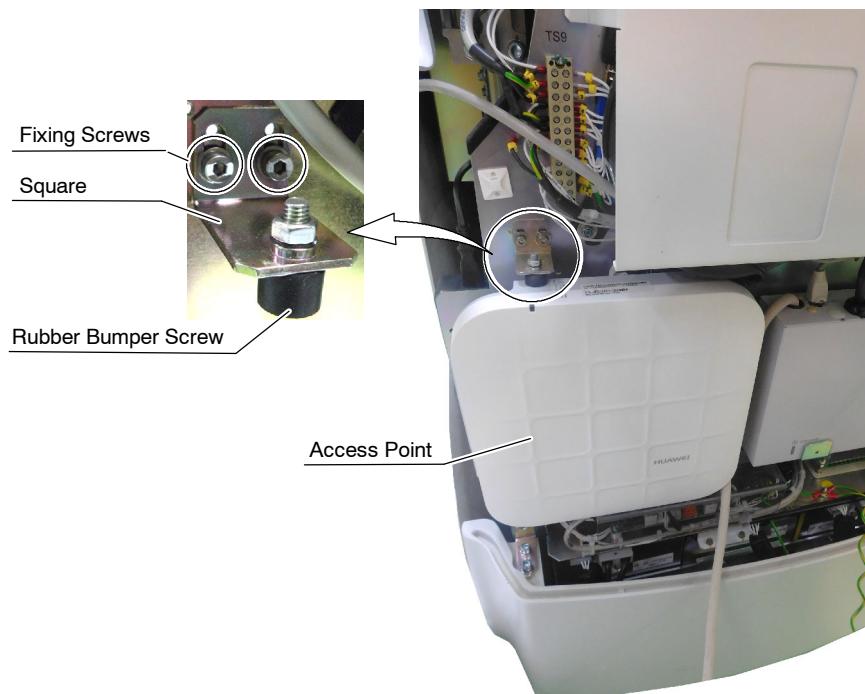
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6. Slide the Access Point downwards the Anchoring Plate, on the PC Module.



7. Mount the Bracket with the Rubber Bumper Screw back in place and secure it with the Fixing Screws.



8. Adjust the fixing Screws (x2) of the Ethernet Cable Reel.
9. Mount the Covers previously removed in reverse order.
10. Turn ON the unit.1
11. Perform a functional check.

Note 

Access Point default configuration:

IP address: 169.254.1.1; Subnet mask: 255.255.0.0.

User name: admin; Password: admin@huawei.com.

Change the Password on the first login to: Huawei 1234.

If it is necessary to make the initial configuration of the new Access Point, perform the procedures described in the following steps:

- 1. Assign to the PC an IP address in the same Network segment as the default IP address of the device (a.e. 169.254.1.2).*
- 2. Open the browser on the PC and visit <http://169.254.1.1> or <https://169.254.1.1>, to open the login page.*
- 3. Enter the **User name** and the **Password**, and click **Login** to log in to the main page of the web platform, on which you can perform the device management and maintenance operations. For details, see: *Huawei Wireless Access Points Configuration Guide (Web)*.*

Configuration data is related to the Wireless Digital Detector; refer to the corresponding manual to obtain this information (IP, SSID, Password, Frequency, etc).

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SECTION 8 ERROR CODES

ERROR CODE LIST	
ERROR CODE	DESCRIPTION
E01	Failure in power up routine. No communication link between HT Controller Board and ATP Console CPU Board.
E02	Failure in power up routine. RAD Generator configured as R&F Generator. No communication link between ATP Console CPU Board and Fluoro CPU Board.
E03	Failure in power up routine. Workstations are not configured.
E04	"Prep" signal received without Console order.
E06	"Prep" and/or "Exposure" orders activated during power-up routine.
E07	Wrong data for X-ray Tube-2.
E08	Wrong data for X-ray Tube-1.
E09	Generator overload. Arcing or IGBT fault.
E10	EPROM corrupted or not initialized on ATP Console CPU Board or on HT Controller Board. Wrong data calibration.
E11	No voltage in the Main Storage Capacitors of the Generator (Inverter Module).
E12	No mA during exposure or mA out of tolerance.
E13	No kVp during exposure, kVp out of tolerance ($\pm 33\%$).
E14	Exposure signal without X-ray Exposure Console command.
E15	Filament Driver Circuit Open, No current on Filament. Wrong selection of Focal Spot detected during "Prep".
E16	Invalid value of : kVp, mA or kW.
E17	Communication error between ATP Console, CPU Board and HT Controller Board.
E18	Rotor error or Rotor running without order (only with Low Speed Starter).
E19	mA detected without "Exp" command.
E20	kVp detected without "Exp" command.
E21	Wrong Tube-1 selection.
E22	Wrong Tube-2 selection.
E23	Calibration data not stored
E24	Bucky Movement Signal has not been detected or DR Device is not ready for exposure.
E25	Battery failure in Battery Powered Generators.
E27	Failure in EPROM U24 of the ATP Console CPU Board. Bad checksum.

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ERROR CODE LIST	
ERROR CODE	DESCRIPTION
E31	Exposure Switch (Handswitch / Remote Control) pressed when releasing the unit from Parking position
E33	No communication link between the Generator and the Operator Console or PC Unit.
E34	Technique error.
E36	Safety Thermostat Open. Overheating.
E37	Tube Overload.
E41	Dosimeter failure. Communication failure between Tube-1 Dosimeter and Generator.
E42	Dosimeter failure. Autotest error on Tube-1 Dosimeter.
E43	Dosimeter failure. Tube-1 DAP Ion Chamber status check error.
E50	Interrupted Exposure.
E97	Exposure Switch (Handswitch / Remote Control) released before starting the exposure.
E98	Switch SW7 "Calib. ON/OFF" set in " On " position to permit the Service mode.

ERROR CODE : E01

DESCRIPTION :	Failure in power up routine. No communication link between HT Controller Board and ATP Console CPU Board.
ERROR TYPE :	Fatal error. Generator can not continue with power up.
APPLICABLE TO :	All Generators
APPEARS WHEN :	Only during initialization phase. If it appears during normal functioning of equipment, it means that a problem has caused a power off in the unit.
INFORMATION / SYMPTOM :	This Error Code requires that the Generator be turned OFF/ON before it can be fixed.

POSSIBLE CAUSES

Dip Switch 3000SW2-1 is in "ON" position at the HT Controller Board.

It has not been possible to establish a correct communication link between the ATP Console CPU Board and the HT Controller Board during power ON.

The communication link between the ATP Console Board and the HT Controller Board is not reliable.

The Microprocessor U5 on the HT Controller Board has not started-up.

The Generator has been affected by a loss of the main power.

Faulty DC power supply.

ACTIONS

1. With the Generator switched OFF, check that Dip Switch 3000SW2-1 is in "OFF" position at the HT Controller Board.

This switch is set in "ON" position only for programming the Rotor Acceleration Time, Rad Filament Setting Time, Fluoro Rotor and Filament Hold-over Time, therefore it changes the functions of Dip Switches SW2-2 and SW2-4 to SW2-8. For normal operation it must set in "OFF" position.

2. Turn OFF/ON the Generator to verify that the initialization procedure has been established correctly. Check that connections of the ATP Console CPU Board and HT Controller Board are secure.
3. If the error appears just after EPROM U24 on the ATP Console Board (A3024-xx) or Microprocessor U5 on the HT Controller Board (A3000-xx) have been replaced or updated, then check the software version compatibility. If necessary, replace or update again .
4. Visually check the performance of DS1 on the HT Controller Board during start-up.
 - If DS1 *remains illuminated* (not blinking), replace the HT Controller Board (A3000-xx).
 - If DS1 *blinks*, go to step-6.
 - If DS1 *remains OFF*, go to step-5.

5. The DC supply may be faulty either at the source or at the Boards themselves.
 - On the HT Controller Board, check for DC at TP3 (+12V), TP4 (-12V) and TP2 (+5V) with GND connection at either TP1, TP9 & TP10.
 - On the ATP Console Board, measure between TP9 (+12V UNREG) with TP11 (GND UNREG); TP10 (+12V ISO), TP3 (+5V), TP7 (+12V) and TP8 (-12V) with TP1 (GND).
 - If DC supply is *not present*, there might be a faulty fuse: shutdown the Generator and test Fuse F9 on the Generator with an Multimeter (replacing if necessary). Fuse F9 is located below the Power Supply PS1 in the Generator Front Panel.
 - If DC supply is *present* (or error persists with correct DC), proceed to the next step.
6. Check continuity between J3 terminals 2, 3, 5 and 6 on the ATP Console CPU Board with P1 terminals 4, 11, 5 and 10 on the HT Controller Board respectively. Connector J3 terminals 2, 3, 5 and 6 on the Generator should also be checked. Repair or replace if necessary.

If there is continuity in these connections, proceed to the next step.
7. Verify with an oscilloscope the signal presence (pulses) for C-HT CLK (J3-5) and C-HT DAT (J3-2) from the ATP Console Board to the HT Controller Board (P1-5 and P1-4 respectively).
 - If any signal is *not present*, replace the ATP Console CPU Board.
 - If the signals *are present*, proceed to the next step.
8. Verify with an oscilloscope the signal presence (pulses) for HT-C CLK (P1-10) and HT-C DAT (P1-11) from the HT Controller Board to the ATP Console CPU Board (J3-6 and J3-3 respectively). If any signal is not present, replace the HT Controller Board. If the problem persists, replace Microprocessor U5 on the HT Controller Board.

ERROR CODE : E02

DESCRIPTION :	Failure in power up routine. RAD Generator configured as R&F Generator. No communication link between ATP Console CPU Board and Fluoro CPU Board.
ERROR TYPE :	Fatal error. Generator can not continue with power up.
APPLICABLE TO :	R&F Generators or Generators configured by mistake as R&F.
APPEARS WHEN :	Only during initialization phase. If it appears during normal functioning of equipment, it means that a problem has caused a power-off in the unit.
INFORMATION / SYMPTOM :	This Error Code requires that the Generator be turned OFF/ON before it can be fixed. An incorrect or corrupt communication link occurred between the ATP Console and the Fluoro CPU Boards during power ON and the Generator is not able to make exposures.

POSSIBLE CAUSES

A RAD Generator has been configured by mistake as a R&F Generator. See Configuration Section.
The communication link between ATP Console CPU Board and Fluoro CPU Board is not reliable.
The Fluoro CPU Board does not work properly.
The Microprocessor U9 on the Fluoro CPU Board did not start-up.
An incorrect communication between the ATP Console and Fluoro CPU Board has been established during power ON.
After changing the ATP Console CPU Board or U18 / U23. The error is removed by entering and then exiting from Workstation configuration.

ACTIONS

1. Turn OFF/ON the Generator to verify that the initialization procedure has been established correctly. Check that connections of the ATP Console CPU Board and Fluoro CPU Board are secure.
2. If the error appears just after EPROM U24 on the ATP Console Board (A3024-xx) or Microprocessor U9 on the Fluoro CPU Board (A3213-xx) have been replaced or updated, then check the software version compatibility. If necessary, replace or update again .
3. Visually check the performance of DS1 on the Fluoro CPU Board during startup.
 - If DS1 *remains illuminated* (not blinking), replace Microcontroller U9 on the Fluoro CPU Board.
 - If DS1 *blinks*, go to step-6.
 - If DS1 *remains OFF*, go to step-5.
4. The DC supply may be faulty either at the source or at the Boards themselves. On the Fluoro CPU Board, check for DC at TP5 (+12V), TP3 (+5V) with GND connection at TP4. If DC supply is present (or error persists with correct DC), proceed to the next step.
5. Check continuity between J4 terminals 1, 7, 3 and 4 on the ATP Console CPU Board with J4 terminals 1, 4, 5 and 7 on the Fluoro CPU Board respectively. Repair or replace if necessary.

If there is continuity in these connections, proceed to the next step.

6. Verify signal presence for C-FL CLK (J4-7) and C-FL DAT (J4-1) from the ATP Console CPU Board to the Fluoro CPU Board (J4-4 & J4-1 respectively).
 - If any signal is *not present*, replace the ATP Console CPU Board.
 - If the signals *are present*, proceed to the next step.
7. Verify signal presence for FL-C CLK (J4-7) and FL-C DAT (J4-5) from the Fluoro CPU Board to the ATP Console CPU Board (J4-4 and J4-3 respectively). If any signal is not present, replace the Fluoro CPU Board . If the problem persists, replace Microcontroller U9 on the Fluoro CPU Board.

ERROR CODE : E03

DESCRIPTION :	Failure in power up routine. Workstations are not configured.
ERROR TYPE :	Fatal error. Generator can not continue with power up.
APPLICABLE TO :	All Generators.
APPEARS WHEN :	Only during initialization phase. If it appears during normal functioning of equipment, it means that a problem has caused a power off in the unit.
INFORMATION / SYMPTOM :	This Error Code requires that the Generator be turned OFF/ON before it can be fixed. It has not been possible to establish a correct communication link between the ATP Console CPU Board and the HT Controller Board during power ON and the Generator is not able to make Exposures.

POSSIBLE CAUSES

All workstations have been configured as Tube = 0.

The EEPROM (U18) on the ATP Console CPU Board is defective.

ACTIONS

1. Configure workstations according to the Service Manual.
2. If not fixed after the previous steps, replace the ATP Console CPU Board and configure workstations again.

ERROR CODE : E04

DESCRIPTION :	"Prep" signal received without Console order.
ERROR TYPE :	Fatal error. Generator re-start automatically once error is solved.
APPLICABLE TO :	All Generators.
APPEARS WHEN :	At any moment once initialization phase is over.
INFORMATION / SYMPTOM :	This Error Code requires that the Generator be turned OFF/ON before it can be fixed. An incorrect or corrupt communication link has been established between the ATP Console CPU Board and the HT Controller Board.

POSSIBLE CAUSES

The Generator receives the "Prep" signal without a Console command.

ACTIONS

1. Check continuity between P1-3 on HT Controller Board and J3-4 on ATP Console CPU Board. Check with special care connector J3 of the Generator (J3-4 of the Generator connects with P2-3 on the HT Control Board).
2. If all is correct, check signal from P1-3 to U5 on HT Controller Board.
3. If the signal is OK, replace the HT Controller Board .

ERROR CODE : E06

DESCRIPTION : "Prep" and/or "Exposure" orders activated during power-up routine.

ERROR TYPE : Informative.

APPLICABLE TO : All Generators

APPEARS WHEN : At any moment once initialization phase is over.

INFORMATION / SYMPTOM : This Error Code requires that the Generator be turned OFF/ON before it can be fixed.

POSSIBLE CAUSES

The Generator has detected "Prep" or "Exposure" signals during initialization.

ACTIONS

1. In Generators equipped with "Prep" and "Exposure" keys on the Console, check that no object has accidentally activated the function. Also check for possible damages on keys. Check for damages on flat cables to connector J9 on the ATP Console CPU Board.
2. In Generators with external Handswitch, check contacts, cable and connectors.
3. If the error persists, replace the ATP Console CPU Board.

ERROR CODE : E07

DESCRIPTION :	Wrong data for X-ray Tube-2.
ERROR TYPE :	Fatal error. Generator can not continue with power up.
APPLICABLE TO :	All Generators
APPEARS WHEN :	Only during initialization phase.
INFORMATION / SYMPTOM :	This Error Code requires that the Generator be turned OFF/ON before it can be fixed. An incorrect or corrupt communication link has been established between the ATP Console CPU Board and the HT Controller Board during power ON.

POSSIBLE CAUSES

Data on Extended Memory Location "E18" are larger than the maximum allowed.

ACTIONS

1. Replace the HT Controller Board.

ERROR CODE : E08

DESCRIPTION :	Wrong data for X-ray Tube-1.
ERROR TYPE :	Fatal error. Generator can not continue with power up.
APPLICABLE TO :	All Generators
APPEARS WHEN :	Only during initialization phase.
INFORMATION / SYMPTOM :	This Error Code requires that the Generator be turned OFF/ON before it can be fixed. An incorrect or corrupt communication link has been established between the ATP Console CPU Board and the HT Controller Board during power ON.

POSSIBLE CAUSES

Data on Extended Memory Location "E02" are larger than the maximum allowed.

ACTIONS

1. Replace the HT Controller Board.

ERROR CODE : E09 - GENERATOR OVERLOAD

DESCRIPTION :	Generator overload. Arcing or IGBT fault.
ERROR TYPE :	Informative.
APPLICABLE TO :	All Generators
APPEARS WHEN :	<u>During the exposure and In Stand-by,</u>
INFORMATION / SYMPTOM :	This error may appear at the Console as "E09" Error Code or as a "Generator Overload" indication. <u>During exposure</u> an over current on the IGBTs of the HV Inverter Module has been detected. This may be produced by an arc or malfunction on the HV Circuitry. <u>In stand-by</u> , the Console is continuously displaying "E09" or "Generator Overload" due to a defective or overheated IGBT Module.

POSSIBLE CAUSES

Symptom-1:

- Defective X-ray Tube.
- Defective HV Transformer or HV Cable.
- Defective Inverter Module.
- Defective HT Controller Board.

Symptom-2:

- Extremely high Duty Cycle on Rad and Fluoro operation.

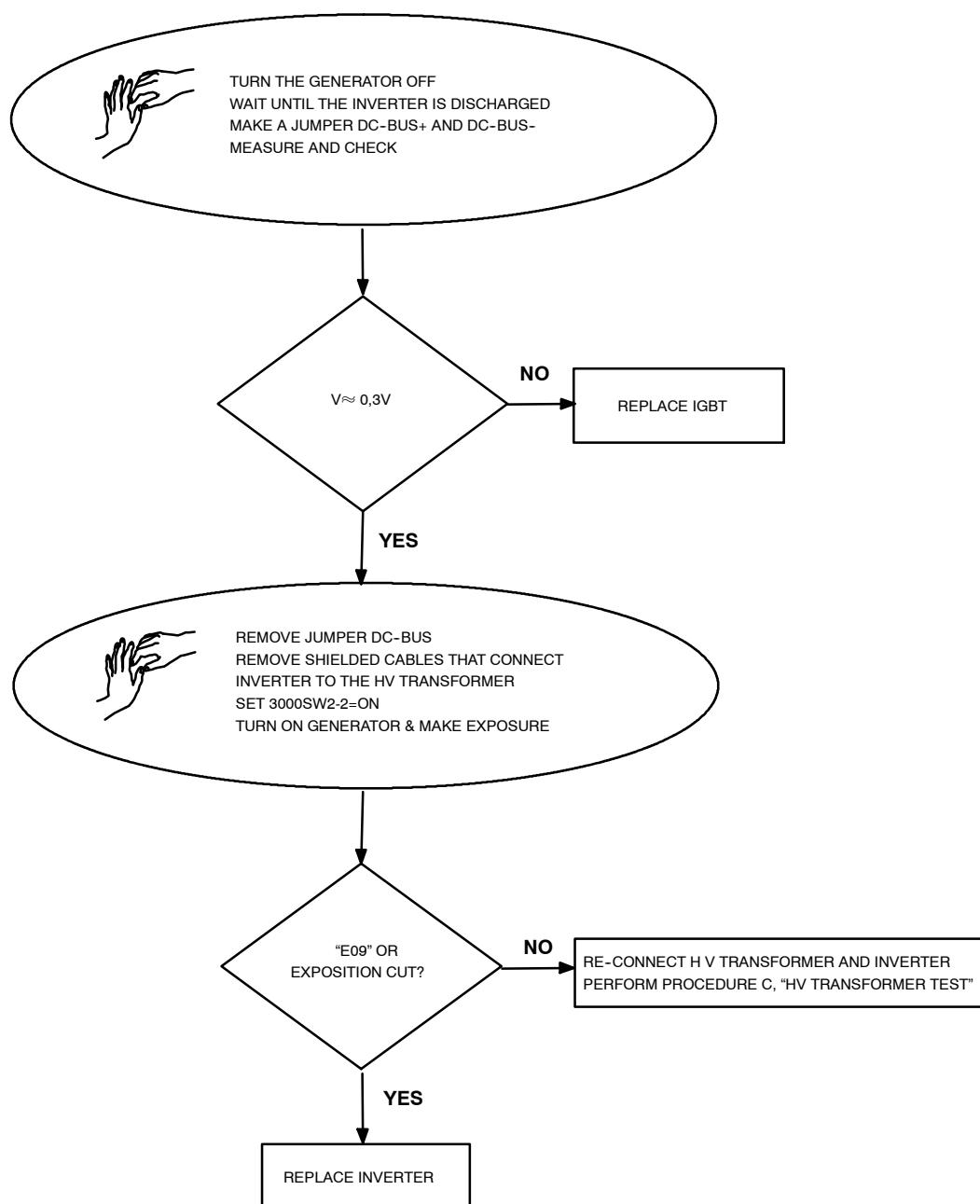
ACTIONS**A. PRELIMINARY**

1. Select minimum kVp , minimum mA, and 80 ms (for example 40 kVp, 10mA, and 80 ms). Make preparation and check that anode rotates in the X-ray Tube. If the anode is not rotating correctly, check the starter and the Stator connections.
2. In case the anode is rotating correctly, make an exposure:
 - If "09" or "Generator Overload" appears, follow the procedure in paragraph B, "Inverter Module Test."
 - If not, follow step 3.
3. Increment kVp in 10 kVp steps, select the same mA and time. Make an exposure:
 - If "E09" or "Generator Overload" appears, or the exposure is cut before 80 ms, then follow Procedure C, "HV Transformer Test."
 - If not, keep on increasing the kVp in 10 kVp steps (60, 70, 80, 90, 100, 110, 120, 130, 140, 150 kVp for 150 kVp HV Transformers) making Exposures at each kVp selected.
 - If "E09" or "Generator Overload" appears or the exposure is cut before 80 ms at any kVp selected, follow Procedure C, "HV Transformer Test."
 - If "E09" or "Generator Overload" has not appeared at the maximum kVp or the exposure was not cut before 80 ms, it means that the HV Transformer and the HV Cables are OK. Then follow Procedure F, "RANDOM "E09" or "Generator Overload"."

B. INVERTER MODULE TEST

Illustration 8-1 shows a Flowchart for Procedure "B."

Illustration 8-1
Flowchart for B: Inverter Module Test



Mobile X-Ray Unit

Troubleshooting

1. Turn the Generator and Electrical Room Cabinet (Main Disconnect) OFF.
2. Remove the cover from the Generator Cabinet.
3. Wait for the DC Bus of the Inverter to be fully discharged. When it is fully discharged the LEDs on the Charge-Discharge Monitor Board will be completely turned off.

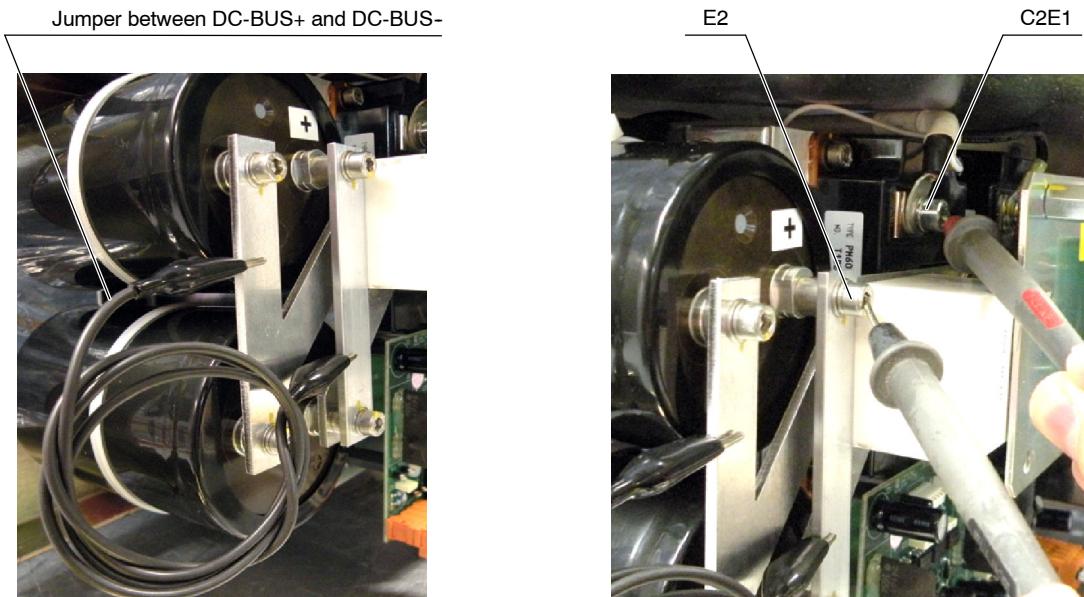


MAKE SURE THAT THE MAIN STORAGE CAPACITORS OF THE HIGH VOLTAGE INVERTER DO NOT CONTAIN ANY RESIDUAL CHARGE. WAIT UNTIL THE LIGHT EMITTING DIODES ON THE CHARGE-DISCHARGE MONITOR BOARDS ARE OFF, APPROXIMATELY THREE (3) MINUTES AFTER THE UNIT IS TURNED OFF.

4. When LEDs are off make a jumper between DC-BUS+ and DC-BUS- (use a wire AWG 22 (0.5 mm²) or higher). Make sure that there is less than 10 VDC across the BUS. (Refer to Illustration 8-2 to see where to make the jumper.)
5. Measure with a Multimeter in Diode (or ohms) between C2E1 (positive polarity) and E2 or C1 (negative polarity) in both IGBTs (refer to Illustration 8-2 for more details). Repeat the measure with different polarity between C2E1 (negative polarity) and E2 or C1 (positive polarity).

Voltage should be around 0.3 V (or the resistance must be a high impedance) for the IGBT to be OK. Normally when an IGBT is broken the voltage is = 0 volts (or the resistance is zero [0] Ohms) or very close.

Illustration 8-2 Jumper and Measurement Points



BATTERY POWERED GENERATOR

6. Repeat the measurements done in step 5 for the other IGBT.



DON'T FORGET TO REMOVE THE JUMPER ACROSS THE DC BUS AFTER ALL MEASUREMENTS ARE MADE, OTHERWISE THE INVERTER WILL SUFFER SERIOUS DAMAGE.

7. If any of the IGBTs are short-circuited, replace the IGBT.
8. If both IGBTs are OK, remove both shielded cables that connect the Inverter to the HV Transformer: P1, P3, and Shield (P2). Isolate the three (3) wires completely from each other and from the metal sheet or ground.



MAKE SURE THE WIRES ARE PERFECTLY ISOLATED AND THAT NO SHORT-CIRCUIT IS MADE, OTHERWISE SERIOUS DAMAGES COULD RESULT.

9. Set DIP switch 3000SW2-2 in the ON position at the HT Controller Board.
10. Turn the Room Electrical Cabinet (Mains Disconnect) and Generator ON.
11. Make an exposure:
 - If "E09" or "Generator Overload" does not appear and the exposure has not been cut before 80 ms, re-connect both shielded cables to the HV Transformer (P1, P3 and Shield). Follow Procedure C, "HV Transformer Test."
 - If "E09" or "Generator Overload" appears or the exposure has been cut before 80 ms, replace the whole Inverter Module.

Note

At the end of an Exposure and right after releasing the Handswitch, error "E13" is shown on the Console. This is normal. Reset and continue.

12. Turn the Electrical Room Cabinet (Main Disconnect) and generator OFF. Wait three (3) minutes for the Main Storage Capacitors to discharge.
13. Set DIP switch 3000SW2-2 in the OFF position at the HT Controller Board. Re-connect both shielded cables that connect the Inverter to the HV Transformer P1, P3 and Shield.

C. HV TRANSFORMER TEST

1. Make these connections with the Oscilloscope:
 - CH.1 on + mA (TP14) on the HT Controller Board.
 - CH.2 on - mA (TP13) on the HT Controller Board.
 - Base Time in 10 ms per division and 1 V per division
2. Turn the mains and Generator ON. Set DIP switch 3000SW2-4 to the ON position at the HT Controller Board.
3. Select 40 kVp, 10mA, and 80 ms. Make an exposure and check that both waveforms are almost symmetric (a difference of 12% is normal).
 - If it is OK, follow the procedure in step 4.
 - If it is not OK, check:
 - that in the mA Test Point of the HV Transformer the jumper is correctly placed and secure.
 - that connector J1 is correctly placed and secure in the HV Transformer.
 - continuity between J1-D and P4-7, J1-E and P4-6, J1-B and P4-2, and J1-C and P4-1. Check that they are correctly connected and secure.
 - if after these actions the waveform is not OK, replace the HV Transformer.
4. Turn the Generator and Electrical Room Cabinet (Main Disconnect) OFF. Wait three (3) minutes for the Main Storage Capacitors to discharge.
5. Remove the HV Cables from the HV Transformer (anode and cathode) and fill the HV Receptacles with oil.
6. On the HT Controller Board, set DIP switch 3000SW2-2 in ON position.
7. Turn the Electrical Room Cabinet (Main Disconnect) and Generator ON.
8. Make these connections with the Oscilloscope:
 - CH.1 on + kV (TP11) on the HT Controller Board.
 - CH.2 on - kV (TP12) on the HT Controller Board.
 - Base time in 10 msec. per division and 2 V per division.
9. Select 40 kVp, 10 mA, and 80 ms. Make an Exposure and check that both waveforms are symmetric. A difference of 12% is normal.
 - If it is OK, follow procedure in step 10.
 - If it is not OK, follow Procedure D, "Asymmetry on the kVp Signals."

10. Make exposures from 40 kVp to 150 kVp with the same Exposure Time and check that all kVp waveforms are symmetric and the values are similar according the table below.

Select	TP11 & TP12 on the HT Controller
50 kVp	2.1 V
70 kVp	2.9 V
90 kVp	3.7 V
110 kVp	4.5 V
130 kVp	5.3 V
150 kVp	6.1 V

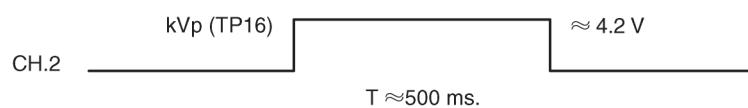
11. If the waveforms are not symmetric (within 12% at any point), follow Procedure D, "Asymmetry on the kVp Signals."
12. If everything is OK, it means that HV Transformer is OK and the problem could be in the X-ray Tube or in the HV Cables. In order to determine exactly what part must be replaced (the X-ray Tube or the HV Cables) it is necessary to replace one of both components and perform the procedure again. In most of the cases the part to be replaced usually is the X-ray Tube. To know when the Tube begins to arc follow Procedure E, "X-ray Tube Test."
13. Turn the Generator and Electrical Room Cabinet (Main Disconnect) OFF and wait three (3) minutes for the Main Storage Capacitors to discharge. Set DIP switches 3000SW2-4 and 3000SW2-2 in the OFF position at the HT Controller Board.

D. ASYMMETRY ON THE kVp SIGNALS

This procedure determines what part should be replaced due to asymmetry on the kVp Signals: the High Voltage Transformer or the HT Controller Board.

1. Turn the generator and Electrical Room Cabinet (Main Disconnect) OFF and wait three (3) minutes for the Main Storage Capacitors to discharge.
2. Set DIP Switch 3000SW2-2 to the "ON" position at the HT Controller Board.
3. Turn the Room Electrical Cabinet (Main Disconnect) and generator ON.
4. Make these connections with the Oscilloscope:
 - CH.1 on +kV (TP11) on the HT Controller Board.
 - CH.2 on kVp (TP16) on the HT Controller Board.
5. Apply +12VDC (P2-2) to +kV (P4-2) for 500 ms. This operation may cause Error "20" if the voltage is applied for more than 500 ms; in this case turn the generator OFF and ON to reset the error.

6. Check the waveform's result:



- If it is OK, follow the procedure in step 7.
 - If it is not OK, replace the HT Controller Board. It is recommended to perform Procedure C, "HV Transformer Test," again.
7. Make these connections with the Oscilloscope:
- CH.1 on -kV (TP12) on HT the Controller Board.
 - CH.2 on kVp (TP16) on HT the Controller Board.
8. Apply -12VDC (P2-1) to -kV (P4-1) for 500 ms. This operation may cause Error "20" if the voltage is applied for more than 500 ms. In this case turn the generator OFF and ON to reset the error.
9. Check the waveform's result:
-
- CH.1: -kV (TP12) shows a square wave pulse. The peak amplitude is approximately -12 V.
-
- CH.2: kVp (TP16) shows a square wave pulse. The peak amplitude is approximately 4.5 V, and the pulse width T is approximately 500 ms.
- If it is OK, replace the HV Transformer.
 - If it is not OK, replace the HT Controller Board. It is recommended to perform Procedure C, "HV Transformer Test," again.
10. Turn the Generator and Electrical Room Cabinet (Main Disconnect) OFF and wait three (3) minutes for the Main Storage Capacitors to discharge.
11. Set DIP Switch 3000SW2-2 in the OFF position at the HT Controller Board.

E. X-RAY TUBE TEST

After the performance of the above referred test everything is found OK, the Service (Field) Engineer may want to know the actual status of the Tube. Perform the following procedure in order to determine the point in which the X-ray Tube begins to arc.



It is strongly recommended to replace the Tube as soon as possible to prevent potential damage to the Generator.

1. Select 40kVp, 10mA, and 100 ms.
2. Make an exposure.
3. Increment kVp in 10 kVp steps, select same mA and time. Make an exposure.
 - If "E09" or "Generator Overload" appears follow Procedure C, "HV Transformer Test," if it has not been performed before. If Procedure C has been already performed follow the procedure in step 4.
 - If "E09" or "Generator Overload" does not appear, keep on incrementing the kVp in steps of 10 kVp (up to the maximum kVp), making exposures at each kVp selected.
 - If "E09" or "Generator Overload" appears at any kVp selected it means that the Tube has dielectric problems above the selected kVp.
 - If "E09" or "Generator Overload" does not appear (up to maximum kVp), it means that arcing may be due to mA or kW. Follow the procedure in step 4.
4. Select 40 kVp and 10 mA. Increment the mA one station and make an Exposure. Keep on incrementing the mA station (making exposures) until "E09" or "Generator Overload" appears. This will give an idea of the maximum mA allowed by the Tube without arcing. If "E09" or "Generator Overload" does not appear follow step 5.
5. If the Tube still does not arc, the problem is related to $kW = KV * mA$. Make selections on the Console at 100 ms incrementing kV and mA. A point will be reached in which "E09" or "Generator Overload" will appear. This will give an idea on the approximate value of kVp and mA that can be handled by the X-ray Tube. Also, this value may change when the Tube heats up.

F. RANDOM "E09" OR "GENERATOR OVERLOAD"

If everything is OK and random "E09" or "Generator Overload" appears, check:

1. That the signal IGBT FAULT on Pin 3 of P5 on the HT Controller Board is not low (logic 0) in stand-by and during the exposure. If there is noise, check for a loose connection between Pin 3 of P5 on HT Controller Board and Pin 4 of J2 in both IPM Driver Boards
2. If IGBT FAULT is active during an exposure, try to isolate when it occurs. It may be due to noise coming from any device outside the Generator. Or it may occur when selecting a high power Exposure and the voltage of the main line goes down more than 10%.

ERROR CODE : E10

DESCRIPTION : EEPROM corrupted or not initialized on ATP Console CPU Board or on HT Controller Board. Wrong data calibration.

ERROR TYPE : Fatal Error during power up (when EEPROM U3 on HT Controller Board is corrupted or not initialized).

Informative error during power up (when EEPROM U18 on ATP Console CPU Board is corrupted or not initialized or when EPROM U24 on ATP Console CPU Board has been changed). In both cases, "E10" appears together with "E34" Error Code or "Technique Error" indication.

APPLICABLE TO : All Generators.

APPEARS WHEN : Only during initialization phase.

INFORMATION / SYMPTOM : Generator does not continue with start up.

POSSIBLE CAUSES

EEPROM U3 on the HT Controller Board corrupted or not initialized.

EEPROM U18 on the ATP Console CPU Board corrupted or not initialized.

EPROM U24 on the ATP Console CPU Board has been changed.

ACTIONS

1. If EPROM U24 in the ATP Console CPU Board has been replaced, reset the Error Code to acknowledge that the NVRAM has been initialized.
2. If the error does not reset, turn the Generator OFF and set Dip-switch A3024SW2-3 in the ON position to allow Service Mode.
3. Turn the Generator ON and enter into Workstations Configuration and follow the checks as indicated in the Service Manual (do not forget to exit from Configuration mode to store the Workstation Configuration).
4. If the problem persists and "E10" appears together with the "E34" Error Code or "Technique Error" indication, replace the ATP Console CPU Board.
5. If the problem persists and only "E10" appears on the Console, replace the HT Controller Board.

ERROR CODE : E11

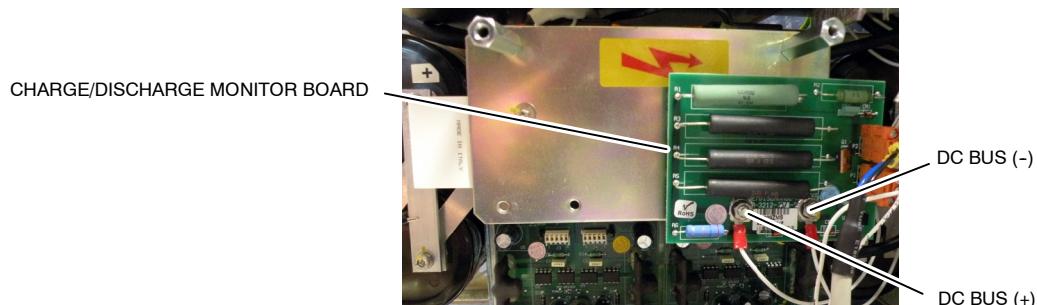
DESCRIPTION :	No voltage in the Main Storage Capacitors of the Generator (Inverter Module).
ERROR TYPE :	Informative. "Prep" is not allowed.
APPLICABLE TO :	Battery Powered Generators
APPEARS WHEN :	Only during initialization phase or when pressing "PREP".
INFORMATION / SYMPTOM :	-

POSSIBLE CAUSES

No voltage in the Main Storage Capacitors (C1, C2, C3, C4) of the Generator (Inverter Module).
 Defective Charge/Discharge Monitor Board.
 Precharge K5 contactor located inside the Generator Cabinet is not energized.
 Main battery power fuses F1 and/or F9 are blown.
 "-CHRG" signal of Pin 7 on connector P1 on the HT Controller Board is at high logic level.
 Cables disconnected accidentally or damaged connectors.

ACTIONS**A. IF LED DS1 IN CHARGE/DISCHARGE MONITOR BOARD IS ILLUMINATED**

With generator ON, check the voltage at the Main Storage Capacitors (C1, C2, C3, C4) (Inverter Module) measuring the voltage between DC BUS (+) and DC BUS (-) as indicated in the illustration below.



Voltage at the Main Storage Capacitors should be:

Input Power Line	Voltage at the Main Storage Capacitors
Battery Powered Generator at any Power Line	approx. 400 VDC ($\pm 10\%$) with all batteries fully charged.

- If the voltage is OK, check that P1-7 on the HT Controller is at logic level "0" (0.75 V).
 - If logic level is OK (logic level 0), replace the HT Controller Board.
 - If logic level is not OK, check the links between P1-7 on the HT Controller Board and P1-2 on Charge/Discharge Monitor Board #1 and P1-1 on Charge/Discharge Monitor Board #1 to ground,
 - If these links are OK, replace the Charge/Discharge Monitor Board.
 - If they are not OK, repair connection.
- If the voltage in capacitors is not OK, check battery voltage.

B. IF LED DS1 IN CHARGE/DISCHARGE MONITOR BOARD IS NOT ILLUMINATED

Check Contactor K5,

- If K5 is ON, check output voltage of K5 between T1 and T2.
 - If K5 output voltage is OK, replace defective R1.
 - If K5 output voltage is not OK, check and replace F1, F9, J1 and Anderson connectors at the Battery Trays, as needed.
- If K5 is not ON, check if signal +24VPSU is OK.
 - If it is not OK, check and/or replace F6 and T2.
 - If +24VPSU is OK, check that signal -LINE CONT is at 0 VDC on J3-10 at the ATP Console CPU Board,
 - If -LINE CONT is OK at the ATP Console CPU Board, repair the connection between J3-10 and "A2" in K5.
 - If -LINE CONT is not OK at the ATP Console CPU Board, replace the ATP Console CPU Board.
- If both signals (+24VPSU and -LINE CONT) are OK, then replace Contactor K5.

ERROR CODE : E12

DESCRIPTION :	No mA during exposure or mA out of tolerance.
ERROR TYPE :	Informative.
APPLICABLE TO :	All Generators
APPEARS WHEN :	After exposition.
INFORMATION / SYMPTOM :	Error 12 appears after the Exposure to alert the operator that the mA at the start of the exposure has not been correct. During the first 10 ms the Generator applies constant filament current to the Tube. This current is proportional to the current already calibrated for that mA station at the kVp selected for that Exposure (filament numbers). Near the end of these 10 ms, the HT Controller Board reads the mA and if they are found to be 30% under or over what has been selected, it sends error "12" to the Console.

POSSIBLE CAUSES

Calibration data for kVp and mA is not correct causing error E12.

The mA jumper on the HV Transformer is open, or it is not making good contact. The mA read at the beginning of the exposure is 50% of the correct value (because one branch is open).

There is a problem on the reading of the mA.

Wrong filament current.

No correct heating prior to the Exposure. The filament has not reached its correct temperature and the mA at the start of the exposure is low. It usually occurs when the "Prep" and "Exp" buttons are pressed down at the same time.

Making an exposure immediately after getting out of Calibration mode in Extended Memory.

+5 VDC , +12 VDC or -12 VDC Power Supplies of HT Control Board (measured at TP2, TP3 and TP4 of this Board) have excessive ripple or VDC measured is not correct.

ACTIONS

1. Connect a Oscilloscope to the following Test Points on the HT Controller Board and check that the voltage is correct. Adjust an incorrect voltage with the respective Potentiometer in the Power Supply Board (*refer to Section 2.9 - Low DC Voltage Power Supply Test*):

- TP2 (+5 VDC) on HT Control Board is adjusted with R12 Pot. in the Power Supply Board.
- TP3 (+12 VDC) on HT Control Board is adjusted with R26 Pot. in the Power Supply Board.
- TP4 (-12 VDC) on HT Control Board is adjusted with R25 Pot. in the Power Supply Board.

2. Check calibration data for the mA Open Loop (filament numbers) as described in the Service Manual for all combinations of kVp and mA when this error appears.

With a Oscilloscope connected to Test Point TP5 (mA) on the HT Controller Board, check that the mA reading is within a ratio of 1V=10mA from the min. mA to 80 mA and 1V=100mA from 100 mA to maximum rating.

If it is not, the cause could be that the mA second test is not measuring correctly, or a wrong measurement performed in the Generator. (*Refer to step 3*).

3. Check that the jumper in the mA Test Point of the HV Transformer is correctly placed and secure.

4. With a Oscilloscope check that during the entire Exposure signals on Test Points TP13 (-mA) and TP14 (+mA) on the HT Control Board connectors are symmetrical (12%).

- If one is found missing or not symmetrical, measure on Pin 6 and 7 of J4 on the HT Control Board.
- If they are symmetrical on both Points, the problem could be on the HT Control Board.
- If they are not correct, check that the connections made on the HV Transformer in J1-E, D terminals are correctly connected and secure. Also check that the GND wire is connected to GND stud.
- If connections are correct the problem is in the HV Transformer.

5. Connect an Oscilloscope to Test Point TP5 (mA) on the HT Controller Board.

Check that:

- when the exposure is made by pressing first the PREP control and then the EXP control, the mA reading at the beginning of exposure is correct.
- and when an exposure is made by pressing at the same time the PREP and EXP controls, the mA reading at the beginning of exposure is low.

6. Reprogram the "*Rotor Acceleration and Filament Setting Time*" as stated in the Service Manual (Configuration and Calibration chapter) : one step over the previously configured time (e.g.: if it was 1.2 seconds, reprogram for 1.8 seconds) and check if boosting is correctly configured.

If it is not correct, reprogram the "*Rotor Acceleration and Filament Setting Time*" another one step over the previously configured time and test again.

In order to verify that the problem has disappeared:

- select the highest mA station for Small Focus and the lowest kVp allowed for this mA station. Make an Exposure by pressing at the same time the PREP and EXP controls; check that the mA reading at the beginning of the Exposure is correct.
- select the highest mA station for Large Focus and the lowest kVp allowed for this mA station. Make an Exposure by pressing at the same time the PREP and EXP controls; check that the mA reading at the beginning of the Exposure is correct.

If it is not correct, reprogram the "*RAD Filament Setting Time*" one (1) step over the previously configured time and test again.

ERROR CODE : E13

DESCRIPTION : No kVp during exposure, kVp out of tolerance ($\pm 33\%$) .

ERROR TYPE : Informative. May abort exposition.

APPLICABLE TO : All Generators

APPEARS WHEN : During and after exposures.

INFORMATION / SYMPTOM : No kVp during exposure.

POSSIBLE CAUSES

Note 

This error assumes that the fault is not due to arcing in the X-ray Tube.

Connection between the ATP Console CPU Board and HT Controller Board (-EXP signal)

Connection on the IPM Driver Boards

Faulty HT Controller

Faulty IPM Driver Board

Faulty IGBT

Open Serial Capacitor (C9)

5V OUT during exposure

Power to IPM Drivers is not supplied from the Interface Control Board

ACTIONS

1. With an Oscilloscope, measure between TP-12 & TP-11 on the HT Controller. These signals should be incomplete and/or irregular.

2. Assure that the power supply to the *HT Controller Board* and the two *IPM Drivers* are correct.

HT Controller: Schematic A3000-xx - Check for 5V, -12VAC and +12VAC.

IPM Driver: Schematic A3063-xx - Check for +24 VDC $\pm 10\%$ (ROHS Generator) and check for 5 V (both voltages are supplied from the Interface Control Board). 5V should be constant (not presenting any variation), *including during the entire Exposure*.

3. Measure the pulses at P3-1 (KV DR1) and P3-2 (KV DR2) on the HT Controller. If these pulses are not present during the Exposure, change the HT Controller. If they are present, proceed to the next step.



The following procedures involve the IPM Driver Boards which are connected to the IGBTs. This area has dangerous HIGH VOLTAGE and must be treated with great care.

4. Ensure that KV DR1 and KV DR2 reach the IPM Drivers at J1-1 & J1-2. If these signals are not present at the connection points, revise the connection or cables. If these signals are present, proceed to the next step.

5. Turn OFF the equipment. Dismount one of the IPM Drivers from the IGBT disconnecting the terminals to IGBT side but keeping J1 & J2 connected.

Turn ON the equipment and ensure the power supply by measuring at J3-1 (+15 V OUTPUT 1) & J3-4 (GND 1), and by measuring at J4-1 (+15 V OUTPUT 2) & J4-4 (GND 2).

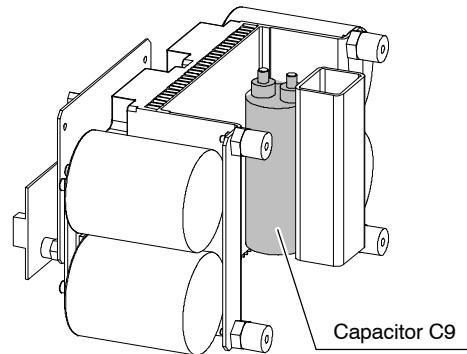
Turn OFF the equipment. If +15 V OUTPUT is not present, repair or replace if necessary. Return the first IPM Driver to its original position connected to the IGBT. Then dismount the second IPM Driver and repeat this step.

If +15 V OUTPUT is present in both IPM Drivers, proceed to the next step.

6. Turn OFF the equipment and **wait a few moments for the equipment to fully discharge**. Remove the rear cover of the Generator Cabinet for accessing to Capacitor C9 located at the back side of the HV Inverter. Check the Capacitor C9 as follows:

- by using a meter (e.g. Fluke 87) in "capacitor" mode
 - If Capacitor C9 is in good condition, the meter shows: "O.L μ f (out of limit)".
 - If Capacitor C9 is defective, the meter shows an abnormally low value (e.g: 0.19 μ f).
- or, by using a meter in "ohms" mode
 - If Capacitor C9 is in good condition, the meter shows the resistance changing. If the polarity of the probes is reversed, the meter shows a negative resistance.
 - If Capacitor C9 is defective, the meter shows a very high Impedance (1 M Ω) or Open circuit.

If Capacitor C9 is defective, replace it. If not, proceed to the next step.



7. Refer to Schematic 54302xxx for the connections between the HV Transformer and the IGBTs. Measure the resistance (continuity) of the following cables from the IGBTs to the HV Transformer, replacing or repairing where necessary:
 - Capacitor C9 (Transformer side terminal) and P1 of the HV Transformer.
 - IGBT2 C2E1 and P3
8. Disconnect P1 & P3 on the HV Transformer. Check that the resistance at P1 & P3 is low (approximately $0.2\ \Omega$). If the resistance is too high, replace the HV Transformer. If the resistance is correct, proceed to the next step.
9. On the HT Controller Board, place DIP Switch 3000SW2-2 to ON position. Disconnect ANDERSON J1.
10. Turn ON the equipment and verify that there is NO TENSION on the DC Bus (± 300 VDC), Charge / Discharge Screws or Capacitor Bars.

Note 

The following action requires the Inverter Module (L2), to which the Charge/Discharge Boards are mounted, to be dismounted in order to gain access to the IPM Driver Boards. Do not disconnect the Charge/Discharge Boards.

11. With an Oscilloscope at one of the IPM Driver boards, measure pulses between J3-4 (GND 1) & J3-3 (CP1 KVDR1) and pulses between J4-4 (GND 2) & J4-3 (CN1 KVDR2). Repeat the test on the other IPM Driver board. If the pulses are not present, replace the respective IPM Driver Board.

ERROR CODE : E14

DESCRIPTION : Exposure signal without X-ray Exposure Console command.

ERROR TYPE : Informative.

APPLICABLE TO : All Generators

APPEARS WHEN : During and after exposition.

INFORMATION / SYMPTOM : Exposure signal without X-ray Exposure Console command.

POSSIBLE CAUSES

The “*Exp*” signal is active on the HT Controller Board.

ACTIONS

1. Remove the connector J1 on HT Controller Board and check grounding of Pin 6 of P1.
2. If Pin 6 of P1 is grounded, replace the HT Controller Board.
3. If Pin 6 of P1 on the HT Controller Board is not grounded, then check grounding of Pin 6 of Connector J1.
4. If it is grounded, remove the connector J3 on the ATP Console CPU Board and check grounding of Pin 6 of Connector J1 again. If it is grounded, repair the wire short-circuit.
5. If it is not grounded, replace the ATP Console CPU Board.

Note 

The resistance value between Pin 6 of P1 on HT Controller Board and Ground (with all cables connected) should be around 900 Ω.

ERROR CODE : E15

DESCRIPTION :	Filament Driver Circuit Open, No current on Filament. Wrong selection of Focal Spot detected during "Prep".
ERROR TYPE :	Informative. Does not allow "Prep". Requires to be reset twice.
APPLICABLE TO :	All Generators
APPEARS WHEN :	At any moment.
INFORMATION / SYMPTOM :	No current detected on Focal Spot (Filaments Off). After resetting the Error Code, the filament driver will be shut off.

POSSIBLE CAUSES

Absence of -12 V Power Supply at the HT Controller

- A There is no power supplied to the Filament Board
Poor connection at the Cathode HV Cable
Defective Filament Transformer inside the HV Transformer
- B Wrong signal -FIL1 ACK

ACTIONS**Note** 

"E15" may be caused by an absence of -12 V (power supply) to the HT Controller at J2-1 (or P2-1), or from the Low Voltage Power Supply (LVDC Power Supply PS1) at connector J2-9. See schematics 54302xxx and HT Controller 3000-xx for further information.

Before Troubleshooting for the Possible Causes listed above, proceed with the following steps.

1. Verify -12V from the Low Voltage Power Supply to the HT Controller, identifying and correcting any possible short circuit. If -12V is present, Troubleshoot for the causes listed in the Possible Causes section above (Causes A and B). If -12V is not present, proceed to the next step.
 - A. **THERE IS NO SUPPLY TO THE FILAMENT BOARD, A POOR CONNECTION ON THE CATHODE HV CABLE, A DEFECTIVE FILAMENT TRANSFORMER OR DEFECTIVE CONNECTIONS INSIDE THE HV TRANSFORMER.**
 1. Visual Check for Unplugged Connectors: With the Generator turned OFF, first of all take a visual inspection at all the connectors in the Front Panel of the Generator (HT Controller Board, Filament Driver Board and Interface Control Board). It could have happened that by an accident some connector has been unplugged when removing or placing the generator cover. Take a close inspection because sometimes a connector is disconnected a little bit from one of the sides but not totally disconnected from the connector of the board. Please take a close look with a flash light.

Mobile X-Ray Unit

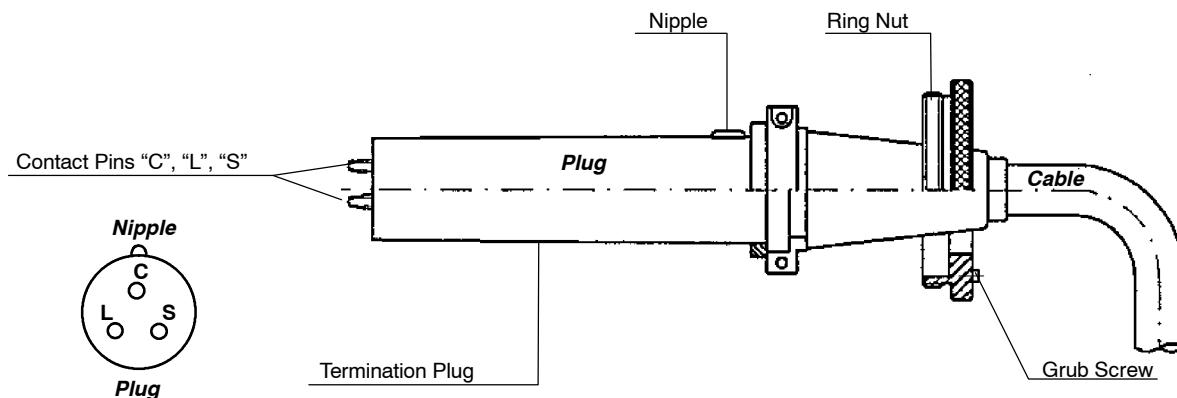
Troubleshooting

2. X-Ray Tube Filaments Resistance Test:

With the Generator turned OFF, measure the Filaments of each Tube by disconnecting the Cathode High Voltage Cable from the HV Transformer (Generator side)

There are three pins located at the male end of the Plug: "C" (Common), "L" (Large) and "S" (Small). With an Ohm meter, measure between "C" and "S". If the filaments are OK (not opened), the reading should be close to zero Ohms. Also measure between "C" and "L" and between "L" and "S".

If there is an open circuit in any of the Tube filaments, measure the resistance on the Tube side. Remove the Cable from the Tube and test the ohms in the female plug (Tube side) with an Ohm meter that has sufficiently long probes.



3. Primary Filament Resistance Test (1):

With the Generator turned off, measure the resistance of the primary of the Filament Transformer for the Small Focus by removing connector J1 on the HV Transformer and measuring on the Connector of the HV Transformer between the pin marked G (FIL SUP) and H (FIL2 RTN). Also measure between G (FIL SUP) and F (FIL1 RTN). These readings should be about 5 ohms each primary.

4. Primary Filament Resistance Test (2):

Reconnect J1 to the HV Transformer and ensure that it is securely connected and "locked" into position by twisting the outside cover until a "click" is heard. Measure the Ohms between the following points (Each one should read about 5 Ohms):

- FIL 1 RTN (Large Focus) P3-4 on the Filament Driver Board and P4-15 on the Interface Control Board.
- FIL 2 RTN (Small Focus) P3-4 on the Filament Driver Board and P4-16 on the Interface Control Board.

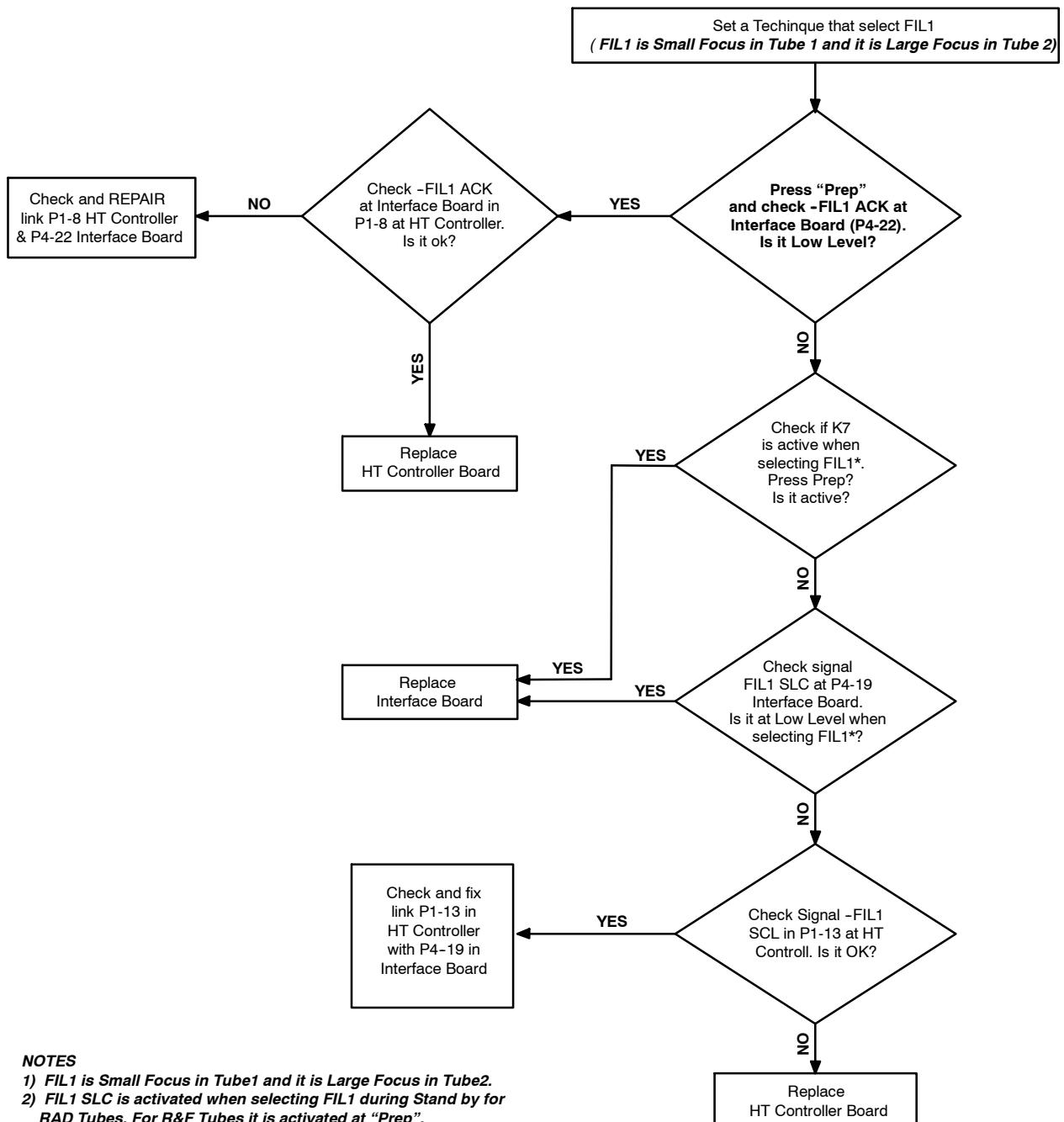
Move around the J1 cable that goes into the HV Transformer looking for a possible wrong connection.

5. High Voltage Connection:

- a. If the primary resistance tests do not reveal the source of the error, remove the Cathode High Voltage Cable from the X-Ray Tube.
 - b. Measure with an Ohm Meter the pins at the High Voltage Cable (Cathode). Measure between Common and Small Filament pins, and then measure between Common and Large Filament pins. The resistance should be around 0.5 Ohms for each Filament.
6. Once the test is finished, reconnect the Cathode HV cable in the X-ray Tube. If needed, clean the cable with a piece of clean dry paper before placing it inside the X-ray Tube. Make sure you tighten the big washer of the HV Cable at the X-ray Tube.

B. WRONG SIGNAL -FIL1 ACK

Perform the following diagnosis if after pressing "Prep" the Error Code "E15" appears on the Console.



ERROR CODE : E16**DESCRIPTION :** Invalid value of : kVp, mA or kW.**ERROR TYPE :** Informative. Does not allow “*Prep*” or “*Exp*”.**APPLICABLE TO :** All Generators**APPEARS WHEN :** In “*Prep*”**INFORMATION / SYMPTOM :** Selected mA or kVp are not correct.

POSSIBLE CAUSES

Wrong maximum kVp configuration.

Wrong software compatibility on the Generator Cabinet and Console.

When pressing “*Prep*” during the calibration of “Digital mA Loop Open” with a technique that overpasses the Generator power kVp/mA.

ACTIONS

1. Check Dip Switch 3000SW2-5 on the HT Controller Board , it must be set in accordance with the Generator configuration (maximum kVp of Generator) (dipswitch-5 must be in “open” position for 125 kVp Generator, / dipswitch-5 must be in “closed” position for 150 kVp Generator).
2. When “Digital mA Loop Open” is manually calibrated (in calibration mode), this error may appears if the Generator power is exceeded by a kVp / mA combination selection. Reset the error indication and enter manually the Filament Current number following the instructions described in the Calibration chapter without make any exposure for that combination (kVp / mA).

ERROR CODE : E17

DESCRIPTION :	Communication error among ATP Console CPU Board and HT Controller Board.
ERROR TYPE :	Fatal Error. Generator opens line contactor.
APPLICABLE TO :	All Generators
APPEARS WHEN :	Once initialization phase is over at any moment.
INFORMATION / SYMPTOM :	No communication link between HT Controller Board and ATP Console CPU Board. This Error Code requires that the Generator be turned OFF/ON before it can be fixed.

POSSIBLE CAUSES

The communication link between the ATP Console Board and the HT Controller Board is not reliable.
The Generator has been affected by a loss of the main power.
Faulty DC power supply.
Noise on the bucky circuitry.
Defective HT Controller Board or defective ATP Console CPU Board.

ACTIONS

1. Turn Generator OFF/ON.
2. If "E01" appears, follow the same procedure as for "E01".
3. If "E01" does not appear, error "E17" can be due:
 - a loss of the main power.
 - an intermittent error produced by an external device, install a R-C filter in the power supply and at Bucky start circuitry.

ERROR CODE : E18 OR ROTOR ERROR

DESCRIPTION :	Rotor error or Rotor running without order (only with Low Speed Starter).
ERROR TYPE :	Fatal Error when the Rotor is running without order. Exposure is not allowed. Informative Error when the Rotor is not running while "Prep" is active. Exposure is not allowed.
APPLICABLE TO :	All Generators.
APPEARS WHEN :	At any moment.
INFORMATION / SYMPTOM :	The X-ray Tube is not detected to be rotating while "Prep" is active, then exposure is inhibited. For Generators with Low Speed Starter, it can be due to the X-ray Tube anode is rotating without a command from the Console.

POSSIBLE CAUSES**For all Generators:**

"-PREP" signal is not going low in the HT Controller Board when "Prep" is pressed.

Only for Generators with Low Speed Starter:

"-RTR" signal on HT Controller Board is active.

Defective relay K1 (solid State) on the low speed module.

±12 VDC power supply missing on the HT Controller Board.

Defective Low Speed Control or HT Controller Boards.

ACTIONS**A. PREVIOUS CHECK**

Check that the "-PREP" signal is going low in the HT Controller Board when "Prep" is active.

- "-PREP" signal can be measured in connector P1-3 of the HT Controller Board or by looking at the LED DS2 in the HT Controller Board (it must be ON when "Prep" is active).
- If not, check the communication cable (J3) between the ATP console CPU Board and the Generator connector J3 and then to the HT Controller Board (P1-3). Make sure it is properly connected and that all the pins are well inserted on both sides (especially J3-4 on both sides).
 - If there is not signal continuity between the ATP Console CPU Board (J3-4) and the HT Controller Board (P1-3), repair or replace the communication cable.
 - If the "-PREP" signal is going low and there is signal continuity between the ATP Console CPU Board (J3-4) and the HT Controller Board (P1-3) and LED DS2 in the HT Controller Board is OFF when "Prep" is active, replace the ATP Console CPU Board.
 - If the "-PREP" signal is going low and there is signal continuity between the ATP Console CPU Board (J3-4) and the HT Controller Board (P1-3) and LED DS2 in the HT Controller Board is ON when "Prep" is active, perform next procedure.

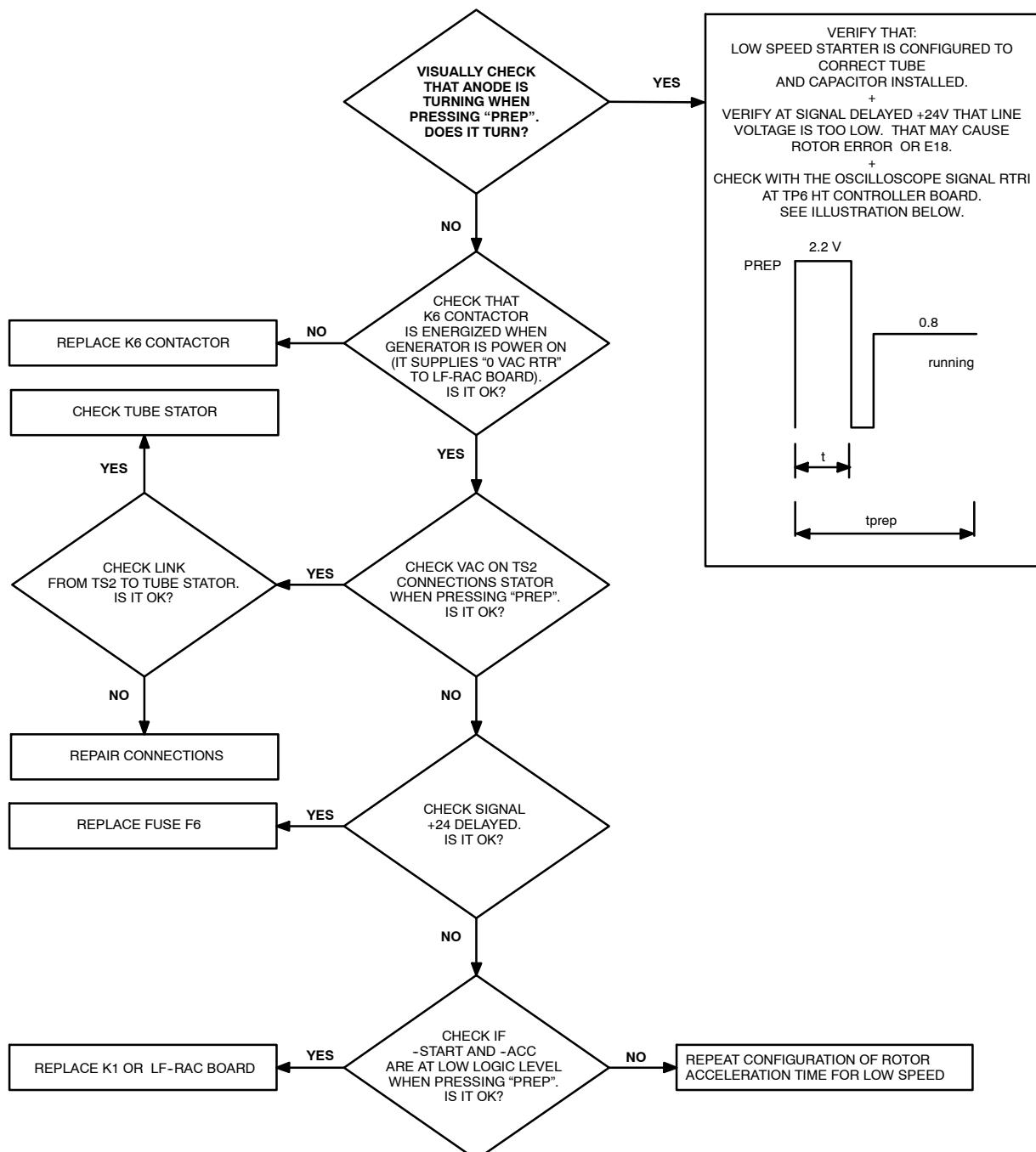
B. ONLY FOR GENERATORS WITH LOW SPEED STARTER (LF-RAC)In Stand-by (the Rotor is running without order)

1. Check if the signal "RTR I" Test Point (TP6 on HT Controller) is 0 VDC.
 - If it is 0 VDC, replace the HT Controller Board.
 - If it is not 0 VDC, remove wire P4-3 "RTR I2" on the HT Controller Board and check again the voltage at TP6.
 - If it is not 0 VDC, replace the HT Controller Board.
 - If it is 0 VDC, connect wire P4-3 "RTR I2" on the HT Controller Board and then ensure that Solid Relay K1 in the Low Speed Starter Module works properly. For that, check the voltage between terminals 3 and 4 of the Solid Relay K1 is 0 VDC.
2. If the voltage between terminals 3 and 4 of the Solid Relay K1 is not 0 VDC, replace the HT Controller Board.
3. If the voltage between terminals 3 and 4 of the Solid Relay K1 is 0 VDC, check the voltage between terminal 1 and 2 of the Solid Relay K1 is 60 VAC.
 - If it is 60 VAC replace the LF-RAC Board.
 - If it is not 60 VAC replace the Solid Relay K1.

In "Prep" (the Rotor is not running while "Prep" is active)

Refer to the following Flowchart for procedure in "Prep".

IF "E18" OR ROTOR ERROR APPEARS IN "PREP" (ONLY FOR LF-RAC)



ERROR CODE : E19

DESCRIPTION :	mA detected without "Exp" command.
ERROR TYPE :	Fatal Error. Generator has opened a line contactor that remains in an endless loop. It is necessary to turn off the equipment.
APPLICABLE TO :	All Generators
APPEARS WHEN :	In stand-by or during initialization.
INFORMATION / SYMPTOM :	Current in tube without "Prep" command.

POSSIBLE CAUSES

- ± 12 VDC power supplies missing on the HT Controller Board.
- Defective HT Controller.
- mA signal on H T Controller is active.

ACTIONS

1. Check ± 12 VDC power supplies.
2. In stand-by mode (no exposure), check for 0 VDC in TP5, TP13, TP14 as well as in connector P4-6 and P4-7 of the HT Controller Board.
3. If voltage $V \neq 0$ VDC in P4-6 and P4-7, check connections between P4-6 / P4-7 and J1 of the HV Transformer.
4. If it is OK, replace HT Controller Board.

Note 

As reference values:

- the resistance measured between P4-6 or P4-7 on the HT Controller Board and Ground (with all cables connected) should be around 900 Ω .
- the resistance measured between P4-6 or P4-7 on the HT Controller Board and Ground (with cable of J4 connector removed from the HT Controller Board) should be around 200 K Ω .

ERROR CODE : E20

DESCRIPTION :	kVp detected without "Exp" command.
ERROR TYPE :	Fatal Error. Generator has opened a line contactor that remains in an endless loop.
APPLICABLE TO :	All Generators.
APPEARS WHEN :	In stand-by or during initialization.
INFORMATION / SYMPTOM :	kVp detected without "Exp" command. "E20" on the Console indicates that the error must be solved with the equipment OFF.

POSSIBLE CAUSES

- 12 VDC power supply missing.
- Defective HT Controller Board.

ACTIONS

1. Check -12 VDC power supply.
2. In stand-by mode (no exposure), check for 0 VDC in TP7, TP11, TP12, as well as in connector P4-1 and P4-2 of the HT Controller Board.
3. If voltage $V \neq 0$ VDC in P4-1 and P4-2, check connections between P4-1 / P4-2 and J1 of the HV Transformer.
4. If it is OK, replace HT Controller Board.

Note 

As reference values:

- the resistance measured between P4-1 on the HT Controller Board and Ground (with all cables connected) should be around 18.5 KΩ.
- the resistance measured between P4-2 on the HT Controller Board and Ground (with all cables connected) should be around 17.5 KΩ.
- the resistance measured between P4-1 or P4-2 on the HT Controller Board and Ground (with cable of J4 connector removed from the HT Controller Board) should be around 20 KΩ.

ERROR CODE : E21**DESCRIPTION :** Wrong Tube-1 selection.**ERROR TYPE :** Informative. Does not allow operation until the error is solved or another Tube is selected.**APPLICABLE TO :** All Generators.**APPEARS WHEN :** Principally after initialization, at any moment or when changing Tube selection.**INFORMATION / SYMPTOM :** Wrong Tube 1 selection.

POSSIBLE CAUSES

The -HT INTLK is not grounding (Tube 1 selection).

The -HT INTLK is missing.

ACTIONS**Note** *Before performing any action, check the Workstation configuration for the Tube.*

1. Check the -HT INTLK in J3-13 (Generator Cabinet), it should be 0 VDC with Tube-1 selected.
2. If it is not 0 VDC, check the Jumper between J3-13 and J3-16 (GND).
3. If J3-13 = 0 VDC, check J3-13 on the ATP Console CPU Board.
4. If not 0 VDC in J3-13, check link between J3-13 of the Generator Cabinet and J3-13 on the ATP Console CPU Board.
5. If voltage is 0 VDC and "E21" appears, replace the ATP Console CPU Board.

ERROR CODE : E22**DESCRIPTION :** Wrong Tube-2 selection.**ERROR TYPE :** Informative. Does not allow operation until the error is solved or another Tube is selected.**APPLICABLE TO :** All Generators.**APPEARS WHEN :** At any moment mainly after initialization or when changing Tube selection.**INFORMATION / SYMPTOM :** Wrong Tube 2 selection.

POSSIBLE CAUSES

The -HT INTLK is not at high logic level 5V (Tube 2 selected).

The -HT INTLK is grounding.

ACTIONS**Note** *Before performing any action, check the Workstation configuration for the Tube.*

1. Check the -HT INTLK in J3-13 (Generator Cabinet), it should be 5 VDC with Tube 2 selected.
2. If it is not 5 VDC, check that J3-13 is not grounding.
3. If J3-13 = 5 VDC, check J3-13 on the ATP Console CPU Board.
4. If not 5 VDC in J3-13, disconnect J3-13 on the ATP Console CPU Board and check for short-circuits between J3-13 and ground or others signals.
5. If voltage is 5 VDC and "E22" appears, replace the ATP Console CPU Board.

ERROR CODE : E23

DESCRIPTION :	Calibration data not stored
ERROR TYPE :	Indicative although it is almost impossible to find if not provoked.
APPLICABLE TO :	All Generators.
APPEARS WHEN :	When trying to save calibration data.
INFORMATION / SYMPTOM :	Calibration data not stored. Calibration value intended to be stored has not been properly recorded.

POSSIBLE CAUSES

This problem may be shown randomly.

This problem is continuos or occurs frequently and the communication link between the Generator Cabinet and the Console is too noisy.

ACTIONS

1. Check calibration data and enter them manually if required.
2. Check communication cable (J3) between ATP Console CPU Board and HT Controller Board.
3. Route communication cables in a different way.

ERROR CODE : E24

DESCRIPTION : Bucky Movement Signal has not been detected or DR Device is not ready for exposure.

ERROR TYPE : Indicative. Does not allow exposition.

APPLICABLE TO : All Generators.

APPEARS WHEN : At the beginning of the exposition.

INFORMATION / SYMPTOM : Wrong Exposure signal from Buckies or DR Devices.

POSSIBLE CAUSES

Wrong Workstation configuration or selection.

Wrong wiring of the Bucky.

Malfunction of the Bucky / DR Device.

ACTIONS

1. Check the configuration of the selected Workstation corresponds to the device (Bucky / DR) connected to the Generator (*refer to the Installation / Configuration chapters of the Generator Service Manual*).
2. If none of these devices (Bucky / DR) have to be connected to the Generator and “E24” Error Code is present, check if the Workstation configuration is correct, that is, “Device value” \neq 1 (Bucky-1) (*refer to the Configuration chapter of the Generator Service Manual*).
3. **The error is present selecting a Workstation configured as Bucky-1 (1)**, make a provisional jumper between “-Bucky1 Motion” (J6-12 of the Generator or Interface Control Board J4-11) and GND. Then, make an exposure.
 - a. If the exposure is finished and “E24” Error Code is not present, check cable connection between the Generator and the respective Device (Bucky or DR). (*Refer to the Interconnection Map at the end of the Installation chapter of the Generator Service Manual*).
 - b. If “E24” Error Code is present, check if Relay K5 of the Interface Control Board (A3009-xx) is activated.
 - c. If Relay K5 is not activated, check if signal BUCKY1 DRCMD is active (“Low Level”) in P4-12 of the Interface Control Board when making an exposure.
 - If signal BUCKY1 DRCMD is active, replace the Interface Control Board (A3009-xx).
 - If it is not active, check this signal (BUCKY1 DRCMD) is active (“Low Level”) in J3-14 of the ATP Console CPU Board (A3024-xx) when making an exposure.
If it is active, check connection between J3-14 of the ATP Console CPU Board (A3024-xx) and P4-12 of the Interface Control Board.
If it is not active, replace the ATP Console CPU Board (A3024-xx).

- d. If Relay K5 is activated, check if Relay K3 is activated when making an exposure.
 - If Relay K3 is activated, check if signal BUCKY EXP is active ("Low Level") in P4-6 of the Interface Control Board when making an exposure.
 - If signal BUCKY EXP is not active, replace the Interface Control Board (A3009-xx).
 - If signal BUCKY EXP is active, check for this signal active in J3-12 of the ATP Console CPU Board (A3024-xx) when making an exposure.
If it is active, replace the ATP Console CPU Board (A3024-xx).
If it is not active, check connection between J3-12 of the ATP Console CPU Board (A3024-xx) and P4-6 of the Interface Control Board.
4. Finally, remove the provision between "-Bucky1 Motion" (J6-12 of the Generator or Interface Control Board J4-11) and GND.

ERROR CODE : E25

DESCRIPTION :	Battery failure in Battery Powered Generators.
ERROR TYPE :	Indicative. Does not allow exposition.
APPLICABLE TO :	All Battery Powered Generators.
APPEARS WHEN :	At "Prep" in any Battery Powered Generators and at any moment in Generators with Stand-Alone.
INFORMATION / SYMPTOM :	Battery charge level is momentarily low or some batteries are discharged or damaged.

POSSIBLE CAUSES

Batteries are discharged.

Some Battery Charger Sector/s may not be working properly or some Batteries are damaged.

ACTIONS

"E25" appears when the Generator has not been used for a long period of time, it usually allows 2 or 3 exposures and then "E25" appears.

If this is the case, charge Batteries and perform exposures until the batteries are totally discharged, then charge again and perform exposures again to discharge, repeat the procedure 5 or 6 times. This is the way to charge batteries fully and safely.

Note 

Before performing any troubleshooting procedures, verify that the Unit has been connected to the mains for approximately 9-10 hours, until the Battery Charge Level Indicators on both columns stop scrolling and the Green Indicators remain illuminated. This will ensure a complete and full Battery charging.

The Batteries require approximately 9-10 hours for a fully charge. To charge the Batteries, there is not need to have the Console turned ON. When the Batteries are fully charged, the Battery charge level Indicators on both columns stop scrolling and only the Green Indicators remain illuminated.

The Battery charge level (only for Generator) will be reduced consistent with the exposures made by the Generator. During the charging sequence, connected to the mains, the Battery Charge Level for the **Generator** reaches approximately 420 Volts. When the Unit is unplugged and Batteries are fully charged, the Battery Charge Level reduces to about 390 Volts.

When the Generator Battery charge level is below 10% (Red indicators are blinking when the Unit is unplugged from mains), the "Battery Low" signal becomes active. Error "E25" is shown when the Generator is in "Prep" and the "Battery Low" signal (from the "Battery Monitor Board" to J2-7 of the "ATP Console CPU Board") is at "High Level" (around 5 Volts).

Check status of the Generator Batteries and Generator Battery Charger Boards ("E25" Error Code does not apply to Batteries and Charger for Motors) as described in Section 2.8.2 "Preliminary Test of Battery and Charger Conditions".

ERROR CODE : E27

DESCRIPTION :	Failure in EPROM U24 of the ATP Console CPU Board. Bad checksum.
ERROR TYPE :	Fatal Error. Generator does not start.
APPLICABLE TO :	All Generators
APPEARS WHEN :	During Generator initialization.
INFORMATION / SYMPTOM :	The ATP Console CPU Board performs a checksum procedure of EPROM U24 when it has been configured to a non-allowed calibration and it has found this value to be incorrect.

POSSIBLE CAUSES

- The ATP Console CPU Board has been configured in a non communication mode.
- The non volatile RAM does not calculate and compare the ATP Console CPU Board checksum.
- The EPROM U24 has been corrupted.

ACTIONS

1. Check if Dip Switches 3024SW2 on ATP Console CPU Board is correctly configured (*refer to Configuration Chapter - "Configuration and Test Switches" of the Service Manual*).
2. If error remains, replace the ATP Console CPU Board installing the EPROM U24 from the previous board that has been removed.
3. If error remains, replace the EPROM U24 on ATP Console CPU Board.

ERROR CODE : E31

DESCRIPTION :	Exposure Switch (Handswitch/Remote Control) is in PREP/EXP position when releasing the unit from Parking position.
ERROR TYPE :	Indicative.
APPLICABLE TO :	Mobile units.
APPEARS WHEN :	The Exposure Switch "Prep" signal is active when releasing the Mobile unit from Parking Position.
INFORMATION / SYMPTOM :	Error Code "E31" is displayed.

POSSIBLE CAUSES

- The Exposure Switch button is stuck in PREP/EXP position due to a malfunction.
- Failure in the ATP Console CPU Board A3024-XX.

ACTIONS

1. Reset the error condition by touching the respective button on the Console. Verify the correct operation of the Exposure Switch buttons. Disconnect the Handswitch, remove the battery of the Remote Control and turn the unit OFF/ON; replacing as necessary.
2. If the problem persists, check the corresponding connections from the Exposure Switch to the ATP Console CPU Board A3024-XX (*refer to the corresponding Schematics*): from the Handswitch to J15 Connector or from the Infrared receptor to J14 Connector; repair or replace as necessary.
3. If the problem persists, replace the ATP Console CPU Board A3024-XX.

ERROR CODE : E33

DESCRIPTION :	No communication link between the Generator and the Operator Console or PC Unit.
ERROR TYPE :	Indicative.
APPLICABLE TO :	All Generators with Operator Console.
APPEARS WHEN :	At any moment.
INFORMATION / SYMPTOM :	Serial Communication Error.

POSSIBLE CAUSES

Connecting cable between Console and Generator is loose or damaged.

ATP Console CPU Board, or Operator Console, or Serial Port of the PC is damaged.

The Generator is turned OFF and PC is ON.

ACTIONS

This error means that there is NO serial communication (RS232) between the ATP Console CPU Board and the Operator Console or PC (depends on the installation).

Note 

The ATP Console CPU Board (for serial communication) is located at the back side of the Front Panel the Generator cabinet.

1. Check the connection cable between connector J8 (or J7 depends on the Generator configuration) from the ATP Console CPU Board to connector J5 of the Generator cabinet. Then check the serial communication cable and connections from J5 to the Operator Console or to the ON/OFF Interface Box (when a PC is used).

2. In order to isolate the problem, turn the Generator ON and measure if any of the following voltages are present in order to know if the Generator is really turned ON.
 - 240 VAC SW: between J6-9 and J6-10 of Interface Connection.
 - 115 VAC SW: between J4-1 and J4-3 of Interface Control Board.
 - Relay K3 (located on the front door of the generator) is energized.
 - LED DS1 in the Interface Control Board is ON.

3. If the Generator is turned ON, check the following points:
 - a. 12 VDC UNR: In the ATP Console CPU Board between TP9 and TP11.
If 12 VDC UNR is not present in the ATP Console CPU Board, check Fuse F7. If Fuse F7 is OK, check the presence of 11 VAC at the input of Rectifier BR4.
 - If 11VAC is not present, check for 11 VAC between terminals 11 and 12 of Transformer T2 and check Relay K3 works properly.
 - If 11 VAC is present at the input of Rectifier BR4, check for 12 VDC UNR measuring in Capacitor C7. If 12 VDC UNR is not present, replace the Rectifier BR4. If 12 VDC UNR is present, check the wire connections.

- b. If 12 VDC UNR is present between TP9 and TP11 of the ATP Console CPU Board, check for:

- 12 VDC ISO: In the ATP Console CPU Board between TP10 and TP1.
- 5 VDC of the ATP: In the ATP Console CPU Board between TP3 and TP1.
- DS1 of the ATP Console CPU Board (normally ON).

If any of the voltages is not present or correct, or if LED DS1 is OFF, replace the ATP Console CPU Board.

- c. If previous steps are correct, the problem is isolated in the RS232 connection between the ATP Console CPU Board and the Operator Console or PC (depends on the installation).

Check the Serial Port on the PC and if possible the RxD and TxD signal between the ATP Console CPU Board and the PC. Replace any defective part found.

To check the Serial Communication using an Oscilloscope measure the following signal:

- On the ATP Console CPU Board, measure and check that there is a wave form on the connector J8-3, if some RS232 signal is present that means the ATP Console CPU Board is sending some information to the Operator Console, in case that no signal is present on this pin replace the ATP Console CPU Board.
- On the ATP Console CPU Board, measure and check that there is a wave form on the connector J8-2, if some RS232 signal is present that means the ATP Console CPU Board is receiving some information from the Operator Console, in case that no signal is present check the following points:
 - If after the previous checking the wave form is present on the connector J8-2 but the "E33" Error Code persists, then replace the ATP Console CPU Board.

ERROR CODE : E34 - TECHNIQUE ERROR

DESCRIPTION :	Technique error.
ERROR TYPE :	Informative without acoustic alarm or Fatal error after exposition. It does not allow exposure.
APPLICABLE TO :	All Generators.
APPEARS WHEN :	At any moment after parameter selection or after exposure.
INFORMATION / SYMPTOM :	Warning Indication: "Technique error" on Consoles with written indicators. For other Consoles, "E34" appears on the display.

POSSIBLE CAUSES

Calibration for specific parameters is incorrect.

ACTIONS

1. If this error occurs with time parameters close to 1ms - The cable capacity is excessive for a short exposure. Also the calibration for that parameters is wrong. Check the Calibration section of the Service Manual: "*Exposure Time Adjustment*".
2. If this error occurs in Fluoroscopy mode with ABC, it means that the equipment is not able to perform the intended operation. Perform Jumper W1 in Fluoro CPU.
3. **DANGER: If it happens after an exposition, it indicates a failure in the exposition timer; backup timer has been cut.** Reset APR and reconfigure values.

ERROR CODE : E36 - HEAT UNITS

DESCRIPTION :	Safety Thermostat Open. Overheating.
ERROR TYPE :	Informative without acoustic alarm. Does not allow expositions.
APPLICABLE TO :	All Generators.
APPEARS WHEN :	At any moment.
INFORMATION / SYMPTOM :	Indicated with "Heat Unit" warning in Consoles with written indicators. For the rest of Consoles "E36" appears in display. Does not allow "Prep" and "Exp".

POSSIBLE CAUSES

The thermostat of the selected Tube is open due to an overheated Tube Housing (temperature > 60°C), a defective thermostat connection, or a faulty thermostat.

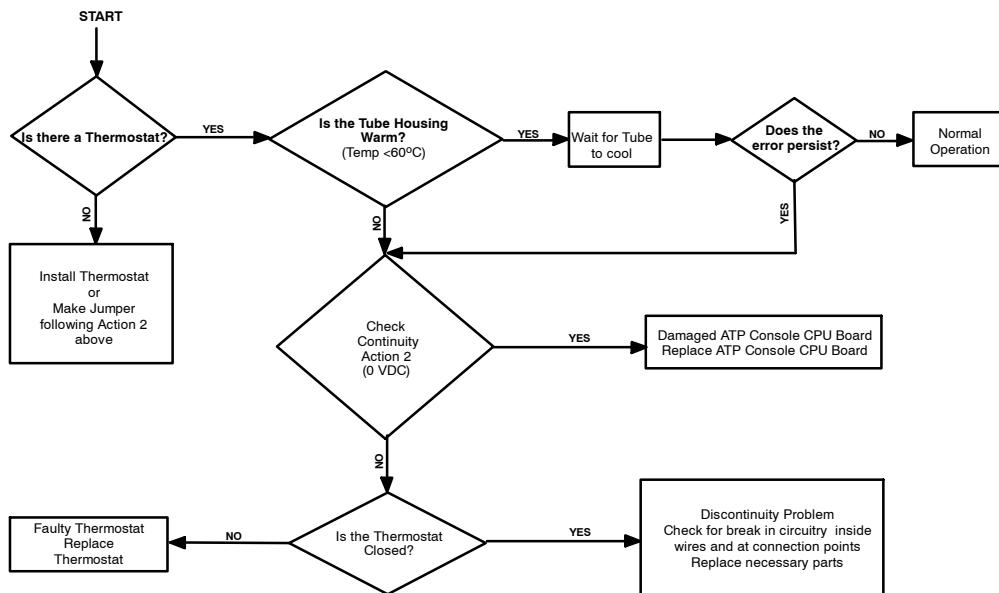
Discontinuity problem inside the wires or at connection points.

If the Tube Housing is cool (temperature < 60°C) and there is a closed circuit (connections are not faulty and Voltmeter reading for Tube-1/2 is 0 VDC), there is a damaged ATP.

It may also appear during calibration due to the high volume of exposures (starting, braking and Anode heating)

ACTIONS

1. If the error is due to overheating, wait until the temperature is lower than 60°C, the thermostat will be closed.
2. When there is no thermostat on the X-ray Tubes, the respective thermostat signals have to be connected to ground (For Tube-1: TS2-4 & TS2-5 / For Tube-2: TS2-12 & TS2-13)
3. Check for a correct installation of the Thermostat/Presostat (connections for Tube-1: TS2-4 & TS2-5 / For Tube-2: TS2-12 & TS2-13).
 - If the Tube does not have this signal, make the Jumpers as indicated above.
 - If the Tube has this signal, check for a faulty ATP Console CPU Board.



ERROR CODE : E37 - TUBE OVERLOAD

DESCRIPTION :	Tube Overload.
ERROR TYPE :	Informative without acoustic alarm. Does not allow Exposition.
APPLICABLE TO :	All Generators.
APPEARS WHEN :	After "Exp" due to Tube overheating. After changing radiographic parameters. In some Consoles this error may not appear as they are provided with an automatic blocking that disables parameters above Tube capacity.
INFORMATION / SYMPTOM :	Indicated with warning "Tube Overload" in Consoles with written indicators. For the rest of the Consoles "E37" appears in the display. Exposures are not allowed.

POSSIBLE CAUSES

Parameters selected for a new exposition are above Tube capacity. (Heat Units or Rating).
The Capacity Line frequency is wrong or the Tube selected in the extended position "E02" or "E18" is not correct.

ACTIONS

1. Wait until X-ray Tube temperature is lowered, so capacity of available Heat Units increase, or modify Exposition parameters.
2. If Heat Units of the Tube are 100% and "E37" or "Tube Overload" warning appear, check that Dip-switch 3024SW1-1 on ATP Console CPU Board is properly configured. (*Refer to the Configuration Chapter in the Service Manual*).
3. Check the X-Ray Tube configured in the Extended Memory Location "E02" for Tube-1 and "E18" for Tube-2 (*refer to Section "X-ray Tube Selection" of the Configuration Chapter of the Service Manual*).

ERROR CODE : E41

DESCRIPTION : Dosimeter failure. Communication failure between the Tube-1 Dosimeter and Generator.

ERROR TYPE : Indicative.

APPLICABLE TO : All Generators with Dosimeter.

APPEARS WHEN : Communication error starting the measuring.

INFORMATION / SYMPTOM : Indicated as Error Code "E41".

POSSIBLE CAUSES

Wrong Physical connection between Dosimeter and Generator for Tube-1.

Defective Radiation Meter Board (A3170-01) or defective ATP Console CPU Board (A3024-xx).

ACTIONS

1. Turn OFF/ON the Generator to reset the Radiation Measuring System.
2. Check the cable connections between the Dosimeter Ion Chamber for Tube-1 (located under the Collimator) and the Connector IC-1 located on the Front Panel (Module-3) of the Generator Cabinet (*for more information refer to Appendix "Adaptation of the Radiation Measuring System"*).
3. Check the cable connections between Connector IC-1 and Connector P2 of the Radiation Meter Board (A3170-01).
4. Check the cable connections between Connector P3 of the Radiation Meter Board (A3170-01) to Connector J7 of the ATP Console CPU Board (A3024-xx).
5. Verify +24VDC is present between J1-2 and J1-3 of the Radiation Meter Board (A3170-01).
 - If +24VDC is not present, check wire connections between J1 of the Radiation Meter Board and J5-16 / J1-2 of the Interface Control Board.
 - If +24VDC is present, disconnect the JACK connector next to Connector IC1 and check if verify 23 VDC is present on the JACK connector (Generator side).
 - If 23 VDC is not present, check wire connection between P2 of the Radiation Meter Board and JACK Connector, and if the connection is correct replace the Radiation Meter Board (A3170-01).
 - If 23 VDC is present, follow next step.
6. On the Radiation Meter Board, verify between both ends of Diode D1 is 0 VDC present.
 - If the voltage in Diode D1 is 24 VDC, check if there is a short-circuit between J1-1 and GND.
 - If the voltage in Diode D1 is 0 VDC, disconnect P2 and P3 of the Radiation Meter Board. Maintain the Unit switched ON, measure continuity between P3-2 and P2-2, and between P3-3 and P2-3. If there is not continuity between the mentioned points, replace the Radiation Meter Board (A3170-01).
7. Only for Radiation Measuring Systems with connections through the ATP Console CPU Board.
Using an Oscilloscope, measure on the ATP Console CPU Board the presence of pulses between connector J7-2 (reception) and GND, and between J7-3 (transmission) and GND.
 - If pulses are present in J7-3 but pulses are not present in J7-2 , replace the DAP Ion Chamber.
 - If pulses are not present in J7-3, replace the ATP Console CPU Board (A3024-xx).
 - If pulses are present in both mentioned points, replace the ATP Console CPU Board (A3024-xx).

ERROR CODE : E42

DESCRIPTION :	Dosimeter failure. Auto-test error on Tube-1 Dosimeter.
ERROR TYPE :	Indicative.
APPLICABLE TO :	All Generators with Dosimeter.
APPEARS WHEN :	Communication error starting the measuring for Tube-1 or during regular operation.
INFORMATION / SYMPTOM :	Indicated as Error Code "E42". Failure test in Dosimeter.

POSSIBLE CAUSES

Error during electronic checking of DAP Ion Chamber for Tube-1.

ACTIONS

1. Turn OFF/ON the Generator to reset the Radiation Measuring System.
2. If the error persists, replace the DAP Ion Chamber.

ERROR CODE : E43

DESCRIPTION :	Dosimeter failure. Tube-1 DAP Ion Chamber status check error.
ERROR TYPE :	Indicative.
APPLICABLE TO :	All Generators with Dosimeter.
APPEARS WHEN :	Communication error starting the measuring for Tube-1 or during regular operation.
INFORMATION / SYMPTOM :	Indicated as Error Code "E43". Wrong DAP Ion Chamber status request.

POSSIBLE CAUSES

Error during DAP Ion Chamber checking. DAP Ion Chamber not operative.

ACTIONS

1. Turn OFF/ON the Generator to reset the Radiation Measuring System.
2. If the error persists, it is necessary to recalibrate the DAP Ion Chamber.

ERROR CODE : E50

DESCRIPTION :	Interrupted Exposure.
ERROR TYPE :	Indicative.
APPLICABLE TO :	All Generators.
APPEARS WHEN :	When operator releases "Exp" control before exposure time has finished.
INFORMATION / SYMPTOM :	Indicated as Error Code "E50" or "Exposure Aborted by the Operator".

POSSIBLE CAUSES

Operator releases "Exp" button before exposure time has finished.

ACTIONS

1. Reset the Error indication.
2. Repeat the exposure.
3. If the error persists, check:
 - Handswitch condition and connections, replace if needed.
 - "EXP" button on the Console, Console condition and connections, replace the respective parts if needed.

ERROR CODE : E97

DESCRIPTION :	Exposure Switch (Handswitch / Infrared Remote Control) released before starting the exposure,
ERROR TYPE :	Indicative.
APPLICABLE TO :	All Generators, when not in "Direct" mode.
APPEARS WHEN :	After releasing the "Exp" button of the Exposure Switch before starting the exposure.
INFORMATION / SYMPTOM :	Error Code "E97" is displayed.

POSSIBLE CAUSES

User misuse. The Exposure Switch has been pressed and released before starting the X-ray.
Malfunction of the Exposure Switch.
For mobile units, low batteries of the Infrared Remote Control.

ACTIONS

1. Reset the error condition by touching the respective button on the Console.
2. Repeat the exposure process, ensuring not to release the Exposure Switch until completing the exposure. If no exposure has been performed during the normal time lapse after pressing the Exposure Switch, E97 will appear again after releasing the Exposure Switch; then, continue in the next step.
3. Repeat the complete exposure process, keeping the Exposure Switch fully pressed during 20 seconds approximately and check if Error E24 appears (Bucky Movement Signal has not been detected or DR Device is not ready for exposure); if so, troubleshoot for E24. If Error E24 does not appear, continue in next step.
4. Verify the correct operation of the Exposure Switch buttons and check the corresponding connections from the Exposure Switch to the Generator, ATP CONSOLE PCB A3024-XX (*Refer to the corresponding Schematics*), repairing or replacing as necessary:
 - For mobile units: From the Handswitch to J15 Connector.
5. For Mobile units with Infrared Remote Control: Verify the batteries, replacing as necessary. If the batteries are correct, also check the Infrared Remote Control connections, from the Infrared receptor to J14 connector in the ATP CONSOLE PCB A3024-XX, repairing or replacing as necessary.

ERROR CODE : E98

DESCRIPTION : Switch SW7 "Calib. ON/OFF" set in "**On**" position to permit the Service mode.

ERROR TYPE : Informative. It allows normal operation.

APPLICABLE TO : All Generators.

APPEARS WHEN : After turning on the Control Console.

INFORMATION / SYMPTOM : Error Code "E98" is displayed.

POSSIBLE CAUSES

Switch SW7 "Calib. ON/OFF" set in "**On**" position.

DIP Switch 3024SW2-3 on the ATP Console CPU Board (A3024-xx) set in the ON position.

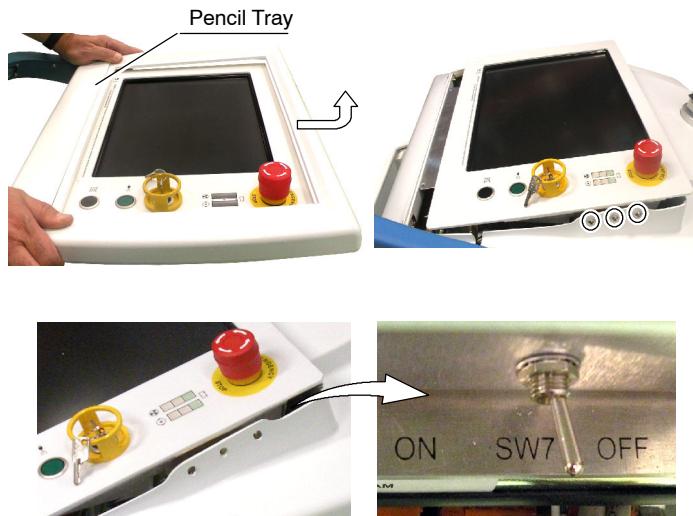
ACTIONS

1. Reset the error condition by pressing the respective button on the Console.

Note 

*Keep in mind that this error will appear each time the Generator is turned OFF/ON during service procedures (configuration, calibration, etc.) when Switch SW7 "Calib. ON/OFF" is in "**On**" position or when Dip Switch 3024SW2-3 on ATP Console CPU Board is in "**ON**" (closed) position (for Service Mode enabled).*

2. When servicing is finished and the Generator is ready for normal operation, turn the Generator OFF and set Switch SW7 "Calib. ON/OFF" in "**Off**" position to place the Generator in Application mode.



1. Open the Pencil Tray and remove the two screws that fasten the Console Frame to the Unit. Push the Console Frame towards the Column. Do not lift up the Console Frame until its upper side is fully released.
2. Remove the three (3) Lateral Screws placed on the Front Cover, at the right side underneath the Console Frame, in order to facilitate an access between the console and the cover.
3. Set Switch SW7 "Calibration ON/OFF" in "**ON**" position to enable Service mode, or in "**OFF**" position to enable Application mode.

Technical Publication

MA-1100R8

Maintenance

Mobile X-Ray Units

REVISION HISTORY

REVISION	DATE	REASON FOR CHANGE
0	FEB 18, 2013	First Edition
1	MAY 22, 2015	Mechanical Checks: Telescopic Column (option)
2	MAY 30, 2016	General Update
3	MAR 31, 2017	General Cautions, Radiation Leakage, General Update
4	SEP 20, 2017	General Cautions, Collimator Checking
5	OCT 31, 2017	Tools and Test Equipment, Maintenance Checklist, Cable Checks
6	JAN 19, 2018	General Cautions
7	JUN 06, 2018	Steel Cable Preventive Maintenance
8	DEC 05, 2018	X-Ray Tubes

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.

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Mobile X-Ray Units

Maintenance

SECTION 1 INTRODUCTION

The purpose of this Periodic Maintenance is to assure a continuous safe performance of the X-ray Unit, to increase serviceability, to reduce the costs (down time, repairs, etc.) and to assure personal safety.

The following checks and maintenance procedures together with the suggested intervals, are the manufacturer's recommendation for the most effective Periodic Maintenance schedule for this unit.

Service tasks herein 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 Generator and X-ray Tube.



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

Note 

Record in the Data Book all periodic maintenance services performed and data changes made during maintenance service.

1.1 TOOLS AND TEST EQUIPMENT REQUIRED

The following test equipment may be required for carrying the procedures detailed herein:

- Keyboard and Mouse to connect to the Unit to access the GSM program.
- Standard service engineers tool kit including Allen and Torx key sets.
- Silicone Insulating Grease (proofing compound).
- Alcohol cleaning agent.
- Digital Multimeter.
- Non-invasive kVp Meter.
- Digital mAs Meter.
- Calculator.

1.2 GENERAL CAUTIONS



THE GENERAL CAUTIONS INDICATED IN THIS SECTION MUST BE COMPLETELY UNDERSTOOD AND HEEDED.



CAREFULLY HANDLE ALL INTERNAL PARTS OF THE EQUIPMENT, ESPECIALLY PARTS LOCATED UNDER COVERS. DANGEROUS DC VOLTAGE IS PRESENT IN THE UNIT EVEN WHEN UNPLUGGED FROM THE AC LINE.

BEFORE HANDLING ANY ELECTRIC PART OF THE UNIT, REFER TO THE GENERAL SCHEMATICS IN ORDER TO ISOLATE THE AFFECTED AREA.



THESE UNITS CAN BE POWERED ON IN ALL SITUATIONS (WHEN CONNECTED TO THE POWER LINE THROUGH THE LINE PLUG OR WORKING IN STAND-ALONE MODE). WHEN THE UNIT IS TURNED ON, THE NEON LAMP (GREEN) LOCATED ON THE TRANSFORMER 6T2 IS ON.

KEEP THE PROTECTIVE COVERS IN PLACE AT ALL THE TIMES, REMOVING THEM ONLY TO PERFORM SERVICE OPERATIONS. INTERNAL PARTS, SUCH AS CONTACTOR K5, RELAYS (K7, K11), FUSES (F1, F9, F10, F11, F12), CIRCUIT BOARDS (STAND-ALONE; INVERTER 1-2 AND MOTOR BATTERY CHARGER; BATTERY TEST 02-03), ON/OFF KEY AND EMERGENCY STOP BUTTON, ARE PERMANENTLY POWERED ON AND HAVE THE FULL VOLTAGE POTENTIAL OF THE BATTERIES (APPROX.400 VDC) EVEN WHEN DISCONNECTED FROM THE POWER LINE OR WITH THE CONTROL CONSOLE OFF. USE CAUTION WHEN WORKING IN THIS AREA.



ENSURE THAT THE MAIN CAPACITORS OF THE HIGH VOLTAGE INVERTER DO NOT HAVE RESIDUAL CHARGE. WAIT UNTIL THE LIGHT EMITTING DIODES ON THE CHARGE-DISCHARGE MONITOR BOARDS ARE OFF, APPROXIMATELY 3 MIN AFTER TURNING OFF THE UNIT.



THE “IPM DRIVER BOARD” MUST ALWAYS BE CONNECTED IN THE GENERATOR PREVIOUS TO ACTIVATING MAINS POWER. IF THE “IPM DRIVER BOARD” IS NOT CONNECTED, PERMANENT DAMAGE WILL OCCUR IN THE IGBTs.



ALWAYS MAKE SURE BEFORE ANY SERVICE PROCEDURE THAT THE MANUALS USED ARE IN ACCORDANCE WITH THE EQUIPMENT VERSION.

Note

Before performing the periodic maintenance, verify that the Unit has been connected to the mains for at least 9-10 hours. This will ensure a complete and full Battery charging.

1.3 MAINTENANCE CHECKLIST

Note 

For further information about following steps refer to its respective Chapter and Section.

CHECKLIST FOR PERIODIC MAINTENANCE		DONE
1	General cleaning:	
	External Covers and Control Console cleaning, touching up of painted surfaces as required.	<input type="checkbox"/>
	Internal inspection of major components, vacuum cleaning when necessary.	<input type="checkbox"/>
2	Cable checks:	
	Electrical connectors, wires and ground lead interconnections checking	<input type="checkbox"/>
	Power Line and Detector Cables Rewind Mechanism cleaning and lubrication.	<input type="checkbox"/>
	Discharger of Arrestor (Iron wire with ball)	<input type="checkbox"/>
3	HV Transformer condition: Oil leakages and HV cable connections.	<input type="checkbox"/>
4	X-Ray Tube condition: Inspection, cleaning and HV cable connections.	<input type="checkbox"/>
5	Test of Battery and Charger conditions.	<input type="checkbox"/>
6	Control Console and Handswitch connections and cables checking, Console operation test, indicators and parameters verification.	<input type="checkbox"/>
7	Radiographic parameters:	
	Test for kV loop, verification of kV values.	<input type="checkbox"/>
	Test for digital mA loops open and closed, verification of mAs values.	<input type="checkbox"/>
8	Mechanical checks:	
	Column - Telescopic Arm - Tube-Colimator Support Assemblies, checking the movements, verifying controls, brakes, balance of vertical movement and conditions of the Steel Cable, Spring, Pulleys, Antifall System.	<input type="checkbox"/>
	Telescopic Column (Option) - Telescopic Arm - Tube-Collimator Support Assemblies, checking the movements, verifying controls, brakes, balance of vertical movement and conditions of the Steel Cable, Spring, Pulleys, Antifall Safety System.	<input type="checkbox"/>
	Motion Assemblies checking, lubrication, motor motion, operation of clutch, gauges, handle, brakes, microswitches, bumper and wheels.	<input type="checkbox"/>

Mobile X-Ray Units

Maintenance

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SECTION 2 PERIODIC MAINTENANCE PROCEDURES

2.1 GENERAL CLEANING



NEVER ATTEMPT TO CLEAN OR HANDLE ANY PART OF THE UNIT WHEN IT IS TURNED ON. SWITCH OFF THE UNIT MAIN DISCONNECT BEFORE CLEANING OR INSPECTING.

2.1.1 EXTERNAL SURFACES

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.

Also check painted surfaces for scratching and touch up as required.

2.1.2 INTERNAL CLEANING

Remove the external covers from the unit. Visually inspect all major components for dust or foreign items. Search carefully to detect objects which might cause short circuits and for loose connections.

If excess dust is present, clean the interior of the unit using a dry brush or vacuum cleaner.

Note

Do not re-install the external covers of the Unit until the Periodic Maintenance process has been completed.

2.2 CABLE CHECKS



CAREFULLY HANDLE ALL INTERNAL PARTS OF THE UNIT.

1. Check that all electrical connections are firm and secure and that all cable clamps and strain reliefs are in place. Also check that connectors do not have exposed wire-veins and check cable sheaths for wear and fraying.
2. Check that all cables are correctly routed.
3. The central reference ground is located at the Generator. Check the ground lead interconnections continuity using a multimeter at its lowest ohms range.
4. Verify the Rewind Mechanism of the Power Line Cable and Detector Cable. Clean the cables and lubricate the rewind mechanism if necessary.
5. Regardless of the condition, replace the Discharger of Arrestor (only iron wire with ball, not complete set) during every periodic maintenance. Once it is replaced, ensure that the ball makes contact with the floor.

2.3 HV TRANSFORMER CONDITION

The HV Transformer contains oil.

Ensure that:

- Oil leakage is not present.
- HV Cable terminal rings are tight.

2.4 X-RAY TUBE CONDITION

Ensure that:

- All parts are mechanically secure without leakage.
- Grease on HV Cable terminals is clean and shows no evidence of arcing.
- HV Cable terminal rings are tight.

2.5 PROCEDURES RELATED WITH THE BATTERIES AND BATTERY CHARGERS

Note 

This Section must be performed at least once a year.



**KEEP IN MIND THE GENERAL CAUTIONS FOR UNITS WITH
BATTERIES INDICATED IN SECTION 1.2.**

Within the recommended operating temperature, under optimum float conditions and depending upon the working load of the Unit, batteries service life expectancy could last for 2 - 5 years.



If the unit has not been used or it has been stored for two months, it should be energized to prevent deep discharge of the batteries. A deep discharge will cause permanent damage to the batteries.

If the unit is stored within its crate, recharge the batteries according to the date indicated in the label on the crate.

For battery maintenance, the Service Engineer must be familiar with the technical specifications for the batteries and related circuitry and must also understand how the indicators and charge cycles function (refer to Section "Information on Indicators and Charge Cycles" in the Troubleshooting Chapter).

Note 

The batteries must be fully charged before maintenance.

Follow the instructions in the Section entitled "Preliminary Test of Battery and Charger Conditions" in the Troubleshooting Chapter.

2.6 CONTROL CONSOLE CONDITION

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 Unit / Console ON.
2. Touch different points on the touch screen (in the operator applications) to check for proper calibrated. If necessary, perform the procedure described in the section entitled "*Touch Screen Sensor Calibration*" in the Troubleshooting Chapter of the Service Manual.
3. Check the Handswitch condition. Verify that the Handswitch cable and its connection to the Unit are in good condition.
4. 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.

2.7 RADIOGRAPHIC PARAMETERS

Before performing the following checks, bear in mind that:

- To measure the kVp, a Non-Invasive kVp Meter is necessary. This Meter is placed in the X-ray beam.
- To measure mA or mAs, an mAs Meter should be plugged into the banana connections on the HV Transformer (connect the mAs Meter for Digital mA Loops calibration).

Note 

*Test points on the HT Controller Board can be used to monitor (with a scope) the kV and mA readings but **should not be used** for calibration:*

mA test point is TP-5 and the scale factor is:

- from 10 to 80 mA, 1 volt = 10 mA
- from 100 mA, 1 volt = 100 mA

*kV test point is TP-7 and the scale factor is 1 volt = 33.3 kV
(0.3 volt = 10 kV)*

- Verify position of dip switches on the HT Controller Board during every test procedure:

DIP SWITCH	OPEN (OFF)	CLOSED (ON)
3000SW2-2	Position during operation - Enables Filament and Rotor Interlocks	Disables Filament and Rotor Interlocks (this turns off the filament so no radiation will be produced during the exposure).
3000SW2-4	Position during operation - Digital mA Loop Closed	Digital mA Loop Open / Filament Current Constant

Note 

- When the Digital mA Loop is open (dip switch 3000SW2-4 in "On"), the rotor runs for two minutes after releasing the handswitch button from "Preparation" position. After this time the rotor will brake.

- When the Digital mA Loop is closed (dip switch 3000SW2-4 in "Off"), the rotor will brake after releasing the handswitch button from "Preparation" position.

Note 

Before starting periodic maintenance perform the X-ray tube warm-up procedure if the tube has not been in use for approximately one hour (refer to Operator Manual).

2.7.1 TEST FOR KV LOOP

1. With the Generator power OFF:
 - Set Dip switch 3000SW2-2 on the HT Controller Board in “**Off**” position (enables Filament and Rotor Interlocks).
 - Set Dip switch 3000SW2-4 on the HT Controller Board in “**On**” position (Digital mA Loop Open / Filament Current Constant).
 - Place and center a Non-Invasive kVp Meter on the X-ray Tube output at the required SID (*refer to the Non-Invasive kVp Meter documentation*).
2. Turn the Unit ON and select the “*Direct*” (No Bucky) workstation.
3. Select 80 kV, 200 mA (or the first mA station for Large Focus), 100 ms. Make an exposure and note the kV at the end of the exposure.
4. Ensure that the kV value read on the kV Meter is 80 ± 1 kV.
If the kV value does not coincide with the above value, perform the respective Calibration procedures.
5. Turn the Unit OFF and remove the Non-Invasive kVp Meter.

2.7.2 TEST FOR DIGITAL mA LOOPS

1. With the Generator power OFF:
 - Set Dip switch 3000SW2-2 on the HT Controller Board in “**Off**” position (enables Filament and Rotor Interlocks).
 - Set Dip switch 3000SW2-4 on the HT Controller Board in “**On**” position (Digital mA Loop Open / Filament Current Constant).
 - Remove the link between the banana plug connections on the HV Transformer. Connect the mAs Meter to the banana plug connections to measure mA or mAs.
2. Turn the Unit ON and select the “*Direct*” (No Bucky) workstation.

TEST FOR DIGITAL mA LOOP OPEN

3. Select 80 kV and the following mA stations. Make an exposure and note the mAs values reading on the mAs Meter.

	Minimum mA for Small Focal Spot	Maximum mA for Small Focal Spot	Minimum mA for Large Focal Spot	Maximum mA for Large Focal Spot
mAs value				

4. Verify that the mAs values readings on the mAs Meter are the same mAs displayed on the Console with a tolerance of $\pm 6\%$ mAs.

If the mAs values do not comply with the above values, perform the respective Auto-Calibration procedures.

5. **Set Dip Switch 3000SW2-4 on the HT Controller Board in “Off” position (Digital mA Loop Closed).**

TEST FOR DIGITAL mA LOOP CLOSED

6. Select the following parameters, make an exposure and note the mAs values on the mAs Meter for:

	80 kV, 100 ms, 50 mA.	80 kV, 100 ms, 200 mA.
mAs value		

7. Verify that the mAs values readings on the mAs Meter are the same mAs displayed on the Console with a tolerance of $\pm 4\%$ mAs.

If the mAs values do not comply with the above values, perform the respective Auto-Calibration procedures.

8. After testing the Digital mA Loops:

- Switch the Generator power OFF.
- Disconnect the mAs Meter to the banana plug connections.
- Re-install the link between the banana plug connections on the HV Transformer.

2.8 MECHANICAL CHECKS

2.8.1 COLUMN / TELESCOPIC COLUMN - TELESCOPIC ARM - TUBE-COLLIMATOR SUPPORT ASSEMBLIES

1. Check correct operation of the controls, detents, limits and move to all possible positions. Movements must be balanced, noiseless and smooth.
2. Operate Brakes / Locks: Telescopic Arm, Column Rotation and Vertical Movement of the Tube-Collimator Assembly, replacing if necessary.
3. Lubricate the Column tracks with a cloth with lubricant oil. In case of noise during movement, clean and lubricate again (vertical movement).
4. Remove the Upper and Rear Column Cover and verify that the Steel Cable and Pulleys are in good condition. Replace the Steel Cable if it is damaged / frayed (*refer to Section 2.8.2*).
5. Verify the anchoring of the Steel Cable.
6. Verify the balance of the vertical movement, adjusting if necessary by tightening or loosing the Spring Tensioner Screw.

Note 

For units with Telescopic Column (option), also:

Perform the mechanical check of the Column Rotation, the Vertical Movement of the Tube-Collimator Assembly and Telescopic movement of the Column (Telescopic Column Sliding Section).

*Remove the corresponding Covers of the Sliding Section and the Base Section and verify that the Steel Cable and Pulleys are in good condition. Replace the Steel Cable if it is damaged / frayed (*refer to Section 2.8.2*).*

7. Check that Collimator is properly fixed by pulling and shaking it. Refer to Troubleshooting chapter if any Collimator adjustment is needed. *Please check the applicable Service Manual according to the Collimator version depending on the Flange type (metallic or plastic flange).*

2.8.2 STEEL CABLE PREVENTIVE MAINTENANCE

Steel cable (wire rope) in pulley is regarded as an expendable component, requiring replacement when the results of inspection indicate that its condition has diminished to the point where further use would be unwise from a safety standpoint.

While a new steel cable with a faulty strand wire will not create an issue, in older assemblies (over 2 years from cable installation), one faulty strand may cause a problem as the number of additional broken strands may be unknown and/or hidden within the cable and it can lead to an accelerated decay of the steel cable.

Note 

The rate of broken wires will depend on usage, and thus heavily used equipments may accelerate the process.



Though visual inspection cannot determine cable degradation, visual inspection of the external surface deterioration of the cable can be used to determine the need of a cable replacement. It is recommended for older equipments to exchange them as soon as signs of wear and tear appear on the cables.

Clean steel cable surface with a soft cloth or cotton bud. Do not use any type of cleaner or detergent as that can cause chemical reaction, degradation and rust on the steel cable.

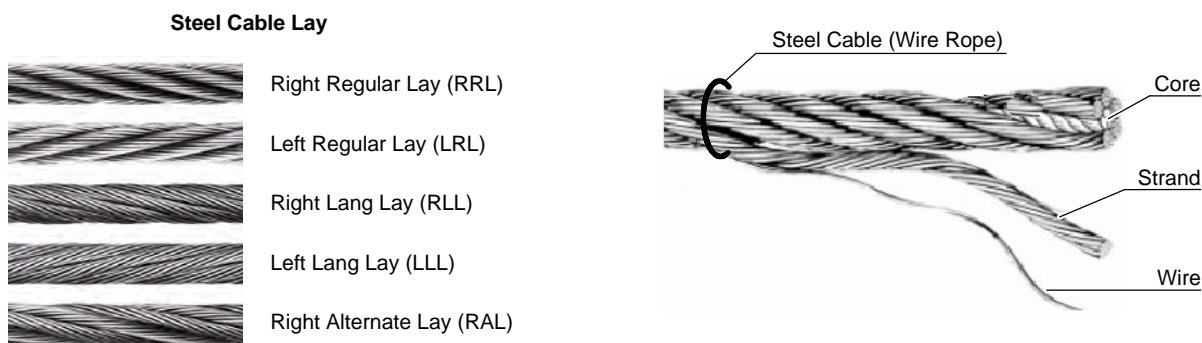
Remove excess grease or oil and dust accumulation so that the cable can be properly inspected. Coated steel cables do not require any lubrication.

Visual inspection, plus running a soft cloth or cotton bud over the cable's surface should be used to detect broken wires, cable abrasion and cable corrosion which are major types of cable deterioration.

When inspecting a cable at the pulleys, specially at the progressive pulley, be sure to mark the cable at that point and then move the cable so that when the mark reappears, no portion of the cable that passes over the pulley or that is subjected to abrasion is neglected.

Standard recommendations which are in line with ISO 4309, call for the following signs to promote a replacement:

- Replace the steel cable if there are:
 - 6 or more broken wires in one lay of the steel cable.
 - 3 or more broken wires in one strand (in one lay) of the steel cable.
 - 3 or more broken wires in one lay in standing steel cables.



- Worn / Abraded wires. Reduced diameter.
Replace if there are flat areas along cable outer surface, which would indicate friction. Look for brighter areas along the cable.
- Stretch.
- Corrosion.
Look for any signs of rust and discoloration along the cable, should there be any replace cables.
- Core protrusion.
Replace the steel cable when inner core starts poking through strands.
- Kinks.
Kinks seriously reduce steel cable strength. If there are sections with kinks, the steel cable should be discarded.
- Damages on the Nylon-coated Steel Cable.
Replace if there are any signs of damage on cable cover (abrasion, cuts, etc.) or if the cable is damaged.



**Close inspection should be made of cable terminations.
Broken wires at cable terminals will require immediate cable replacement.**

Note

Life test shows that cables may last for over 5 years without problems, but as precaution and given the fact that the damage of a broken wire in the Mobile Column can be far more expensive than a single steel cable replacement.



**THE STEEL CABLE OF THE COLUMN MUST BE REPLACED
EVERY 5 YEARS.**

After inspection or replacement, standard multipurpose lithium grease should be used to lubricate the steel cable. Again, using a cotton bud or soft cloth apply a thin coat of grease through the length of the cable.

Note

Nylon-coated steel cables do not require lubrication.

The cable revision can be scheduled during the regular yearly preventive maintenance revision.

2.8.3 MOTION ASSEMBLIES

1. Check lubrication and motor motion, check the clutch operation, and check both motion gauges by performing the Functional Check from the section entitled “*Motor Group - Functional Check*” in the Troubleshooting Chapter of the Service Manual.
2. Check operation of front Handle, Brakes and Microswitches.
3. Check operation of the Front Bumper.
4. Clean the front wheels and check that both run freely.

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SECTION 3 OTHER MAINTENANCE PROCEDURES

Note 

Local Standards may require checking procedures that are not considered Periodic Maintenance by the manufacturer.

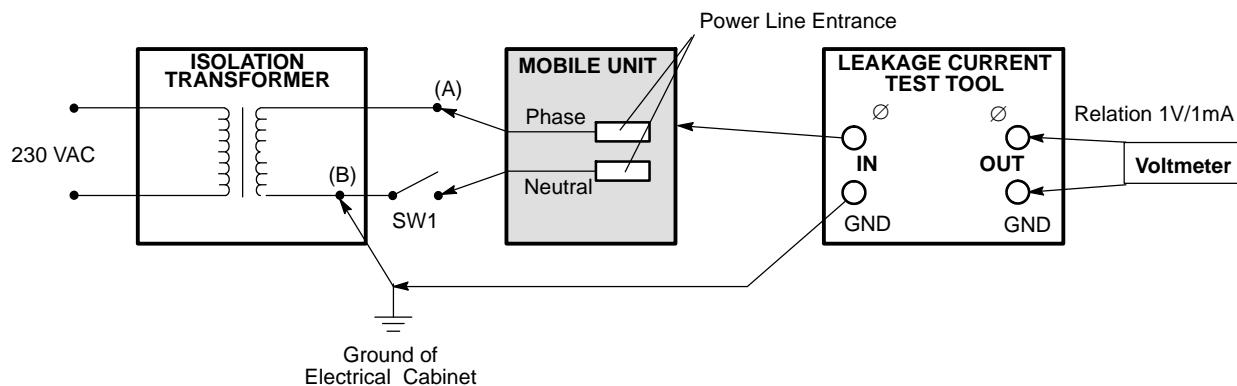
Below are described some of these procedures and the manufacturer recommendations to perform them.

3.1 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 Mobile.
 2. Place the Mobile 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 VAC.
 4. Turn ON the Mobile. Connect the Leakage Current Test Tool as follows:

Illustration 3-1
Leakage Current Test Connection

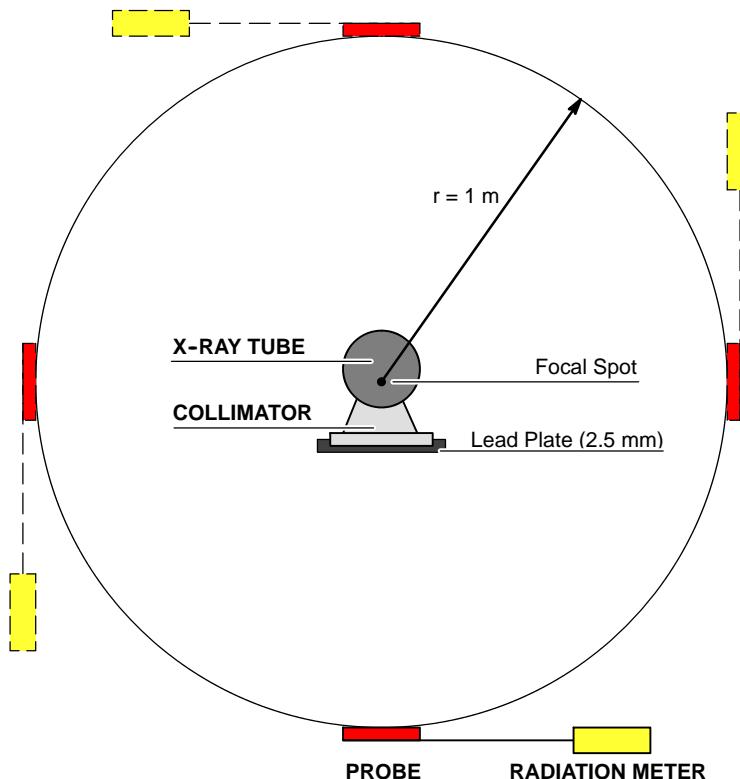


5. As shown in Illustration 3-1, the Voltmeter is set to VAC and connected to the Test Tool at the **OUT** points. Connect **Ø (IN)** to a metallic part of the Mobile Unit. Connect **GND (IN)** to the Ground of the Electrical Cabinet and to an output of the secondary of the Isolation Transformer (B).
6. The reading from the Voltmeter ($1V = 1mA$) gives the leakage current under **normal conditions**. Turn OFF the Mobile 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 Mobile (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 (VAC) for leakage current and replace the "EMC Filter" (line entrance) if required.
9. Disconnect all connections made in the previous steps and return the Mobile to operational wiring. Place the ground wire back to the plug and ensure a firm connection.

3.2 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 3-2

Illustration 3-2
Radiation Leakage Setup



1. On the Mobile Unit Console, select the following parameters:
maximum kVp (125 kVp or 150 kVp depending on the Generator limit),
50 mAs (20 mA , 2.5 s).
2. Cover the Collimator window with a Lead Plate (\approx 2 mm of thickness)
with at least 1 cm overlap on all sides and open the Collimator blades.
3. Select Dose mode (0.00 μ R) 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 3-2.

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5. The Radiation Leakage Technique Factor of each X-ray Tube is provided by the X-ray Tube manufacturer in the specifications document. As example of the Leakage Factor:

X-RAY TUBE MODEL	LEAKAGE FACTOR
CANON E7242X	4.0 mA @ 125 kVp
CANON E7843X	3.4 mA @ 150 kVp
CANON E7865X	3.4 mA @ 150 kVp
CANON E7884X	3.4 mA @ 150 kVp
CANON E7886X / FX	3.4 mA @ 150 kVp

6. Calculate the maximum value of the Radiation Leakage in one hour at any measured point, for an exposure of 20 mA (2.5 s) @ maximum Generator kVp (125 or 150 kVp), according to the following formula:

$$RL/h = D \times \frac{3600 \text{ (s)}}{1 \text{ (h)}} \times \frac{1}{\text{Exposure time (s)}} \times \frac{\text{Radiation Leakage Factor (mA)}}{\text{exposure current (mA)}}$$

where:

RL/h = rate of Radiation Leakage per hour [$\mu R/h$ or $\mu Gy/h$]

D = radiation readout [dose in μR or μGy]

RLF = Radiation Leakage Factor [mA]

The following is an example of the formula stated in Step 6.

X-ray Tube : Canon E7886X

Radiation Leakage Factor : 3.4 mA (at 150 kVp exposure)

Exposure values : 150 kVp, 20 mA, 2.5 s, 50 mAs

Radiation readout : 110 μR

$$\text{Rate of Radiation Leakage per hour} = \frac{110 \times 3600 \times 1 \times 3.4}{1 \times 2.5 \times 20} = 26928 \mu R/h \text{ or } 234.16 \mu R/Gy/h (\mu R/h / 115) \\ = 26.9 \text{ mR/h} \text{ or } 0.234 \text{ mGy/h (mR/h / 115)}$$

The Radiation Leakage limit is 100 mR / h (0.88 mGy / h); Based on the obtained result, the radiation leakage for this example is:

26.9 mR/h or 0.234 mGy/h (26.9 mR/h / 115)

7. 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 X-ray Tube and repeat this section.

When finished, remove the Lead Plate from the Collimator window.

3.3 RECOMMENDATIONS FOR INSULATION RESISTANCE TEST

VDRs (Voltage Dependent Resistor) connected between mains and earth avoid damage on the equipment due to overvoltage.

The Standard IEC 60601-1 states:

" 20 Dielectric strength:

Only insulation with a safety function need be subject to testing".

"20.4 Tests:

*j) Power-consuming voltage-limiting devices, in parallel with an insulation to be tested, are disconnected from the earthed side of the circuit. Lamps, electronic tubes, semiconductors or other automatic regulating devices may be removed or rendered inoperative if necessary to carry out the test".

In order to conduct the Insulation Resistance Test, 500 VDC have to be applied to the unit. The VDRs will work decreasing their resistance, avoiding that the overvoltage goes to the rest of the circuits. Therefore, the VDRs have to be removed before applying 500 VDC in order to measure the correct insulation resistance.

For further information on disconnecting the VDRs, refer to Schematics:
54302xxx General, A9524-xx Varistor Board.

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Technical Publication

SC-1100R22

Schematics

Mobile X-Ray Unit

REVISION HISTORY

REVISION	DATE	REASON FOR CHANGE
<i>Refer to each schematic</i>		

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

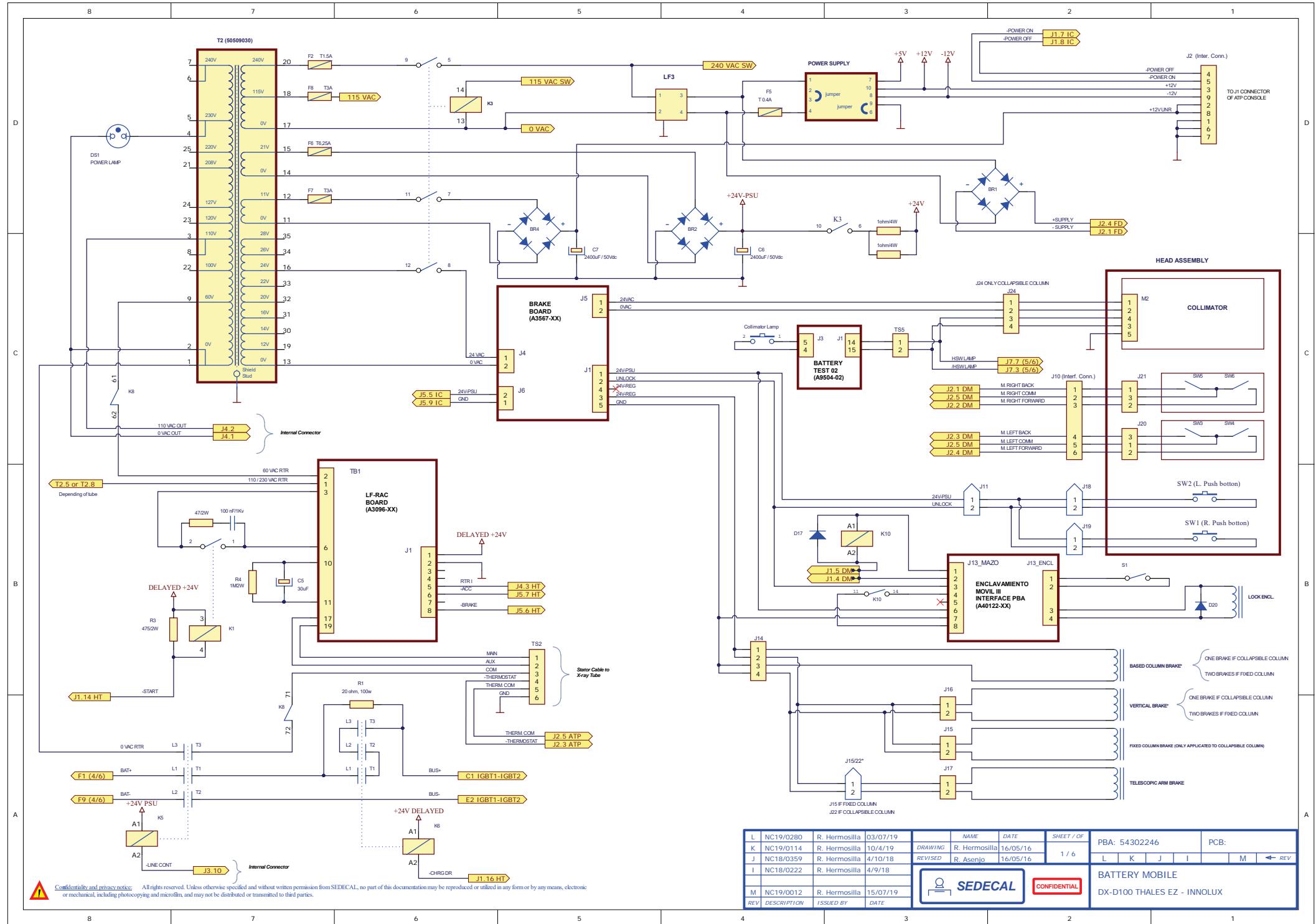
Alert readers to pertinent facts and conditions. Notes represent information that is important to know but which do not necessarily relate to possible injury or damage to equipment.

TABLE OF CONTENTS

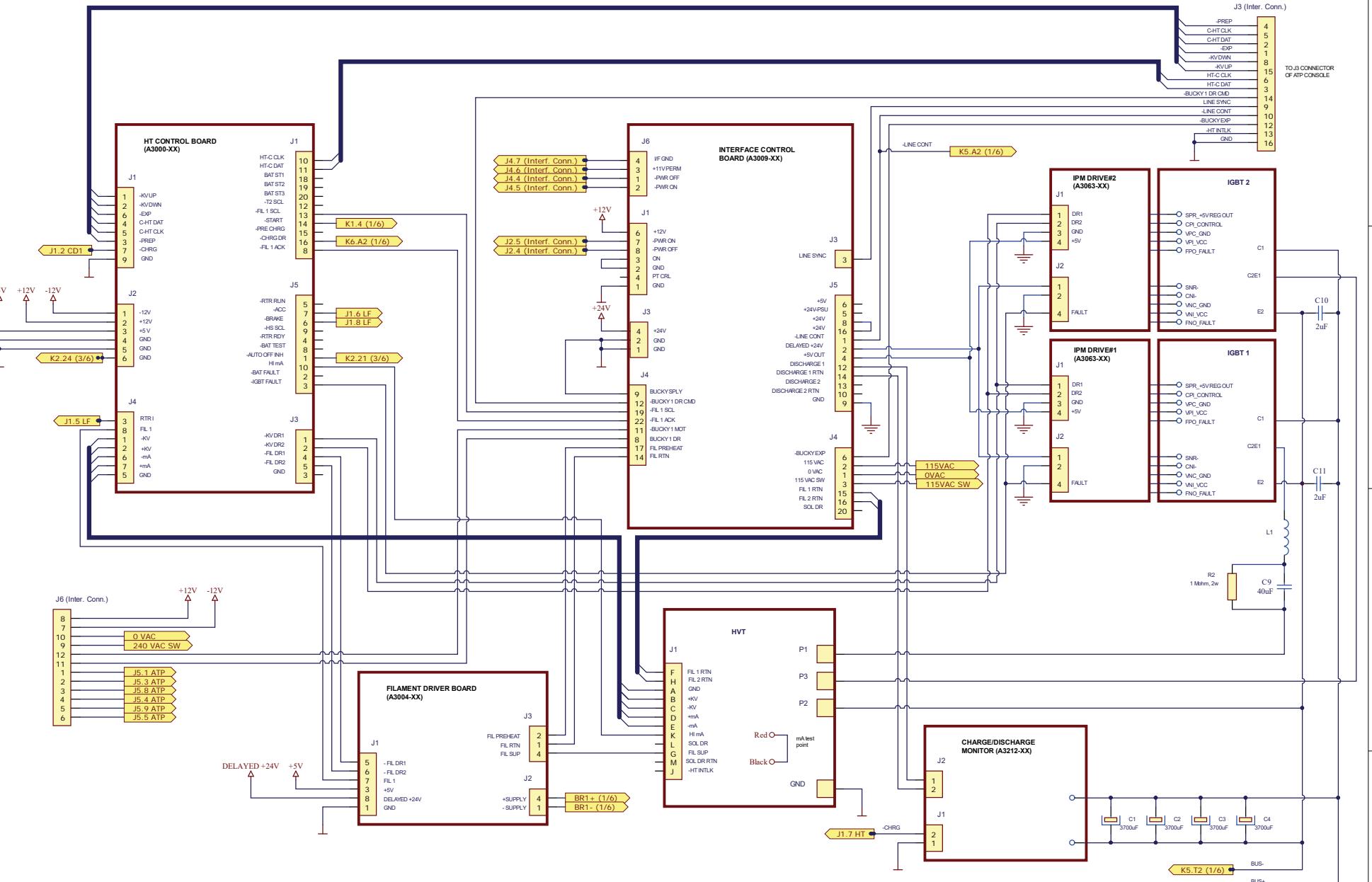
SCHEMATICS	
GENERATOR	
54302246	BATTERY MOBILE DX-D100 THALES EZ - INNOLUX
54302206	BATTERY MOBILE DX-D100 VW
54302244	BATTERY MOBILE DX-D100 CANON
54302245	BATTERY MOBILE DX-D100 VARIAN
A3096-02	LF-RAC PCB
A3000-81	HT Controller PCB (12 bits)
A3004-09/10/11/12	Filament Control PCB
A3009-09/10/11/12/15	Interface Control PCB
A3063-06	IPM Driver PCB
A3212-01	Charge / Discharge Monitor PCB
A3024-121	ATP Console CPU PCB
A3567-04	Brake Board PCB
A3580-1X_2X	Battery Monitor PCB
A3580-12	Battery Monitor PCB
A3580-15	Battery Monitor PCB
A3179-05	Auto ON/OFF Mobile
A3179-09/10/11	Low Profile Auto ON/OFF Mobile
A9504-02	Battery Test PCB
A9504-03	Battery Test PCB
A9524-02	Varistor Board PCB
A3610-03	Interface Varian PCB
A40122-01	Parking Interface PBA
ESM (ENERGY STORAGE MODULE) (EMC Kit)	
A3578-41	PFC 1000
A3533-16 (compatible with A3533-06)	Inverter Battery Charger-1 PCB (includes Charger)
A3534-16 (compatible with A3534-06)	Inverter Battery Charger-2 PCB (includes Charger)
A3138-03	Isolated Stand-Alone Control PCB
ESM (ENERGY STORAGE MODULE) (Non-EMC Kit) (until August 2019)	
A3578-31	PFC 1000
A3533-04	Inverter Battery Charger-1 PCB (includes Charger)
A3534-04	Inverter Battery Charger-2 PCB (includes Charger)
A3138-01	Isolated Stand-Alone Control PCB
MOBILE SERVO MOVEMENTS	
A3532-16 (compatible with A3532-06)	Motors Battery Charger PCB (includes Charger and DC-DC)
A3539-01	Digital Motion Control PCB
OPTIONS	
A3170-01	Radiation Meter Board
A3653-01	Remote Col Board
A3709-01	PBA Warning Lights

Mobile X-Ray Unit

Schematics



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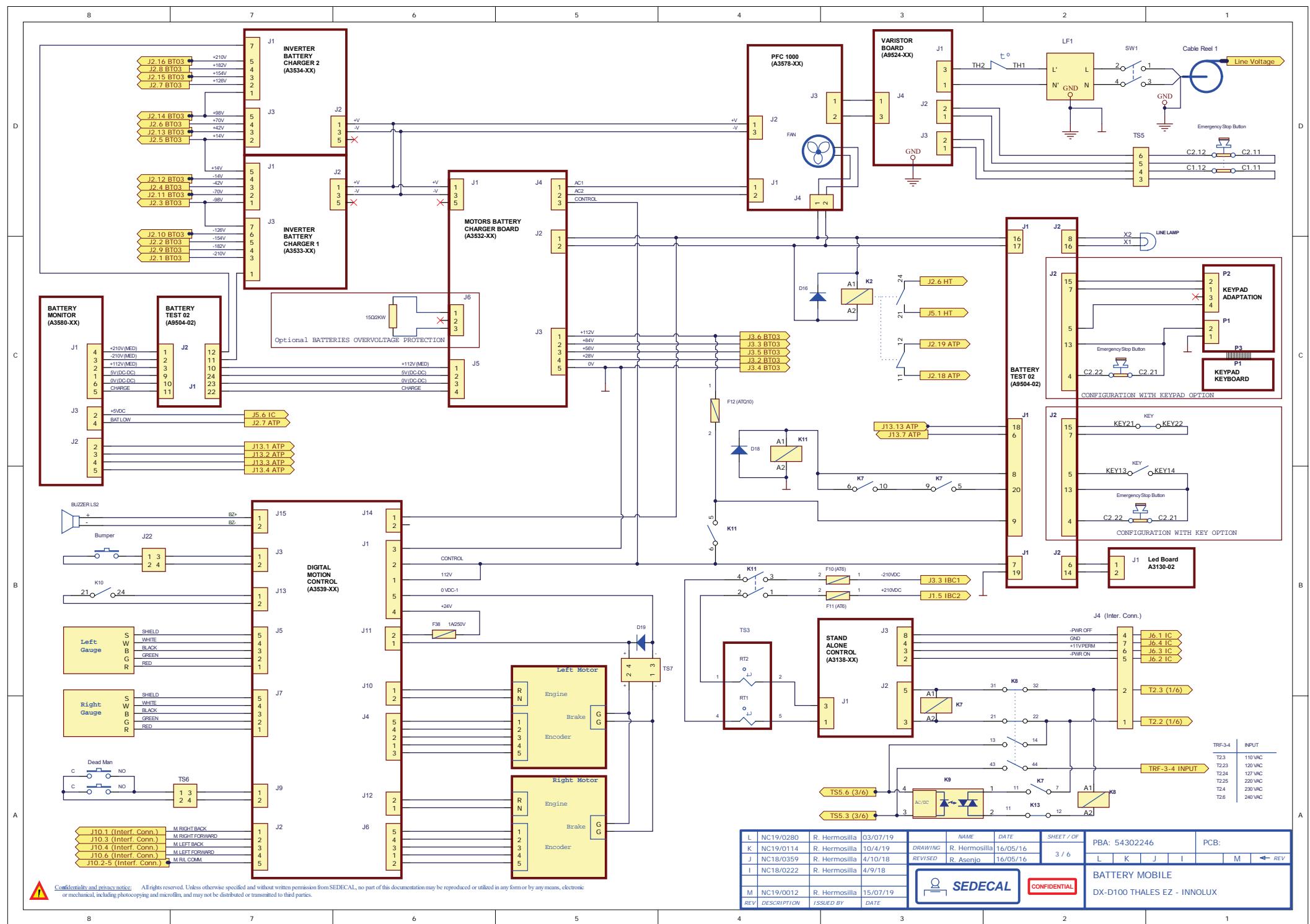


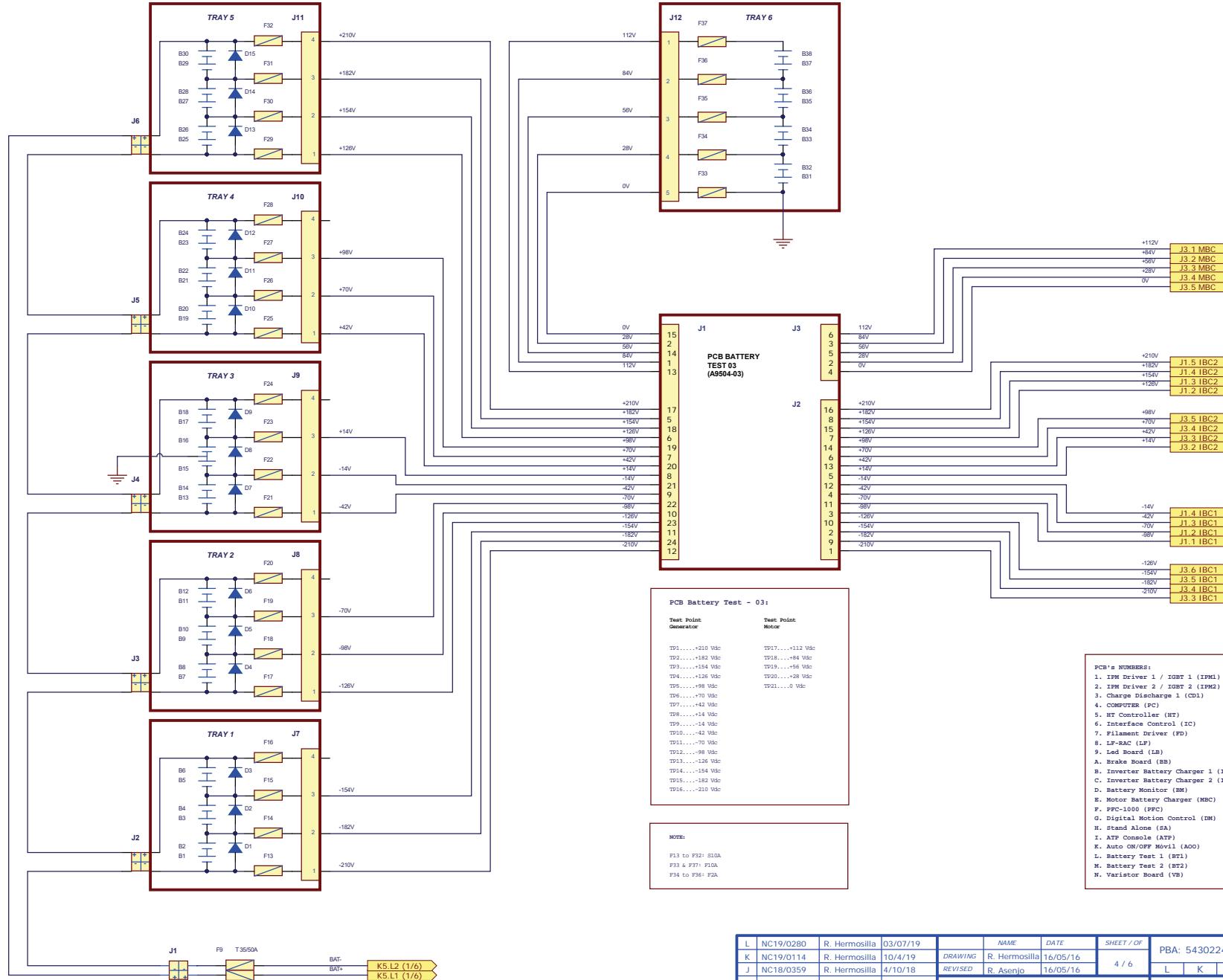
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 BATTERY MOBILE
 DX-D100 THALES EZ - INNOLUX



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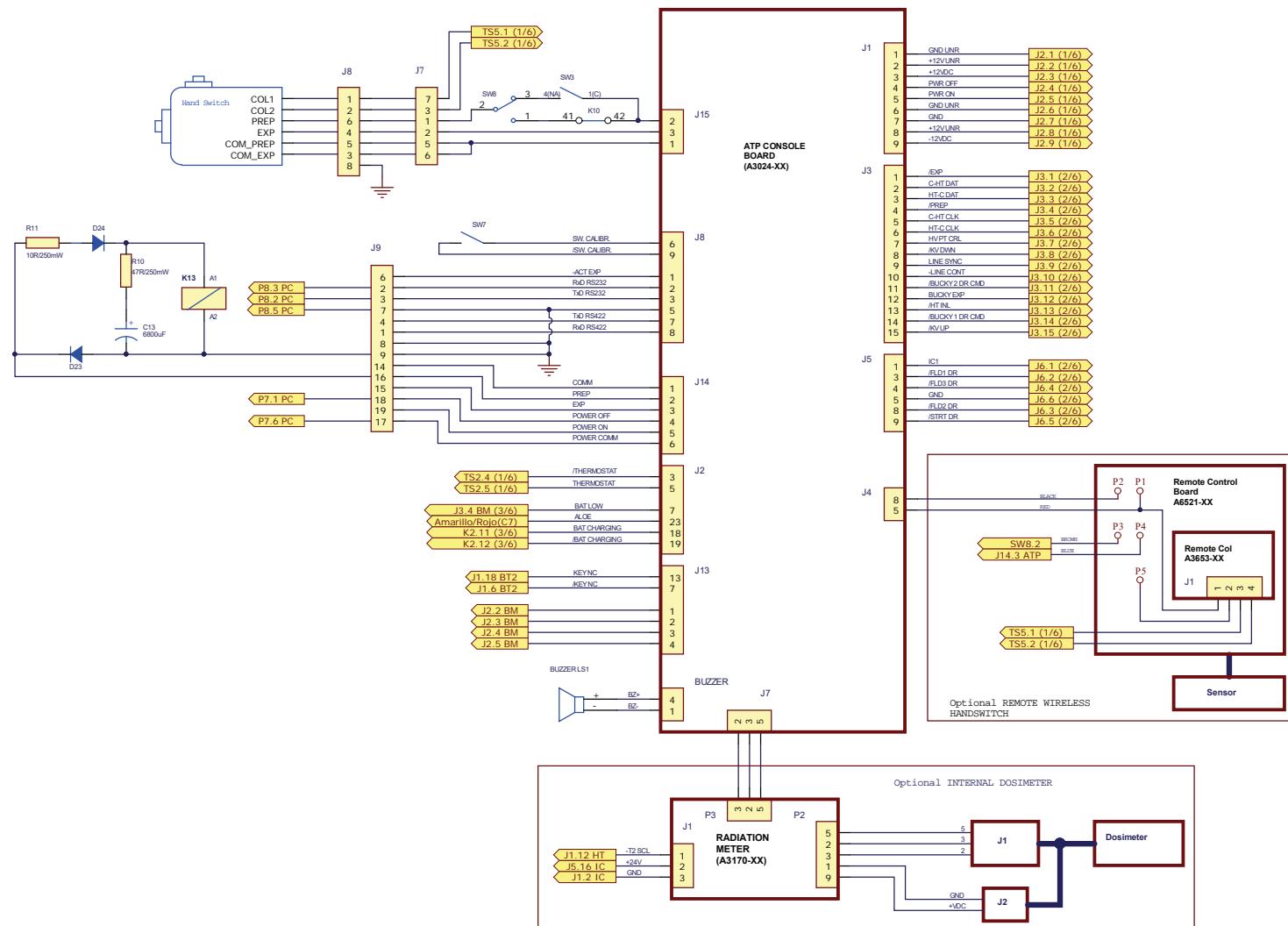
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DX-D100 THALES EZ - INNOLUX



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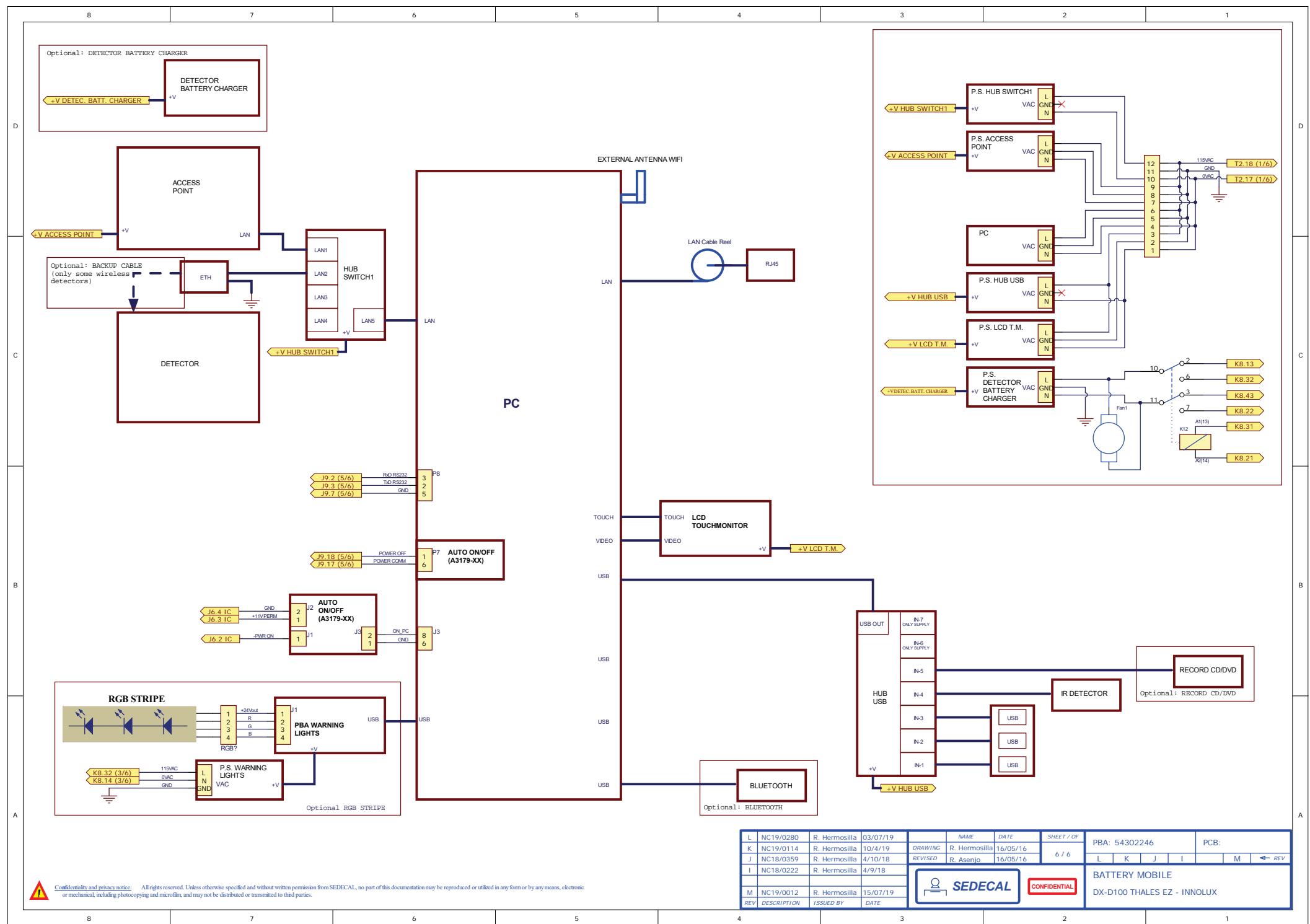
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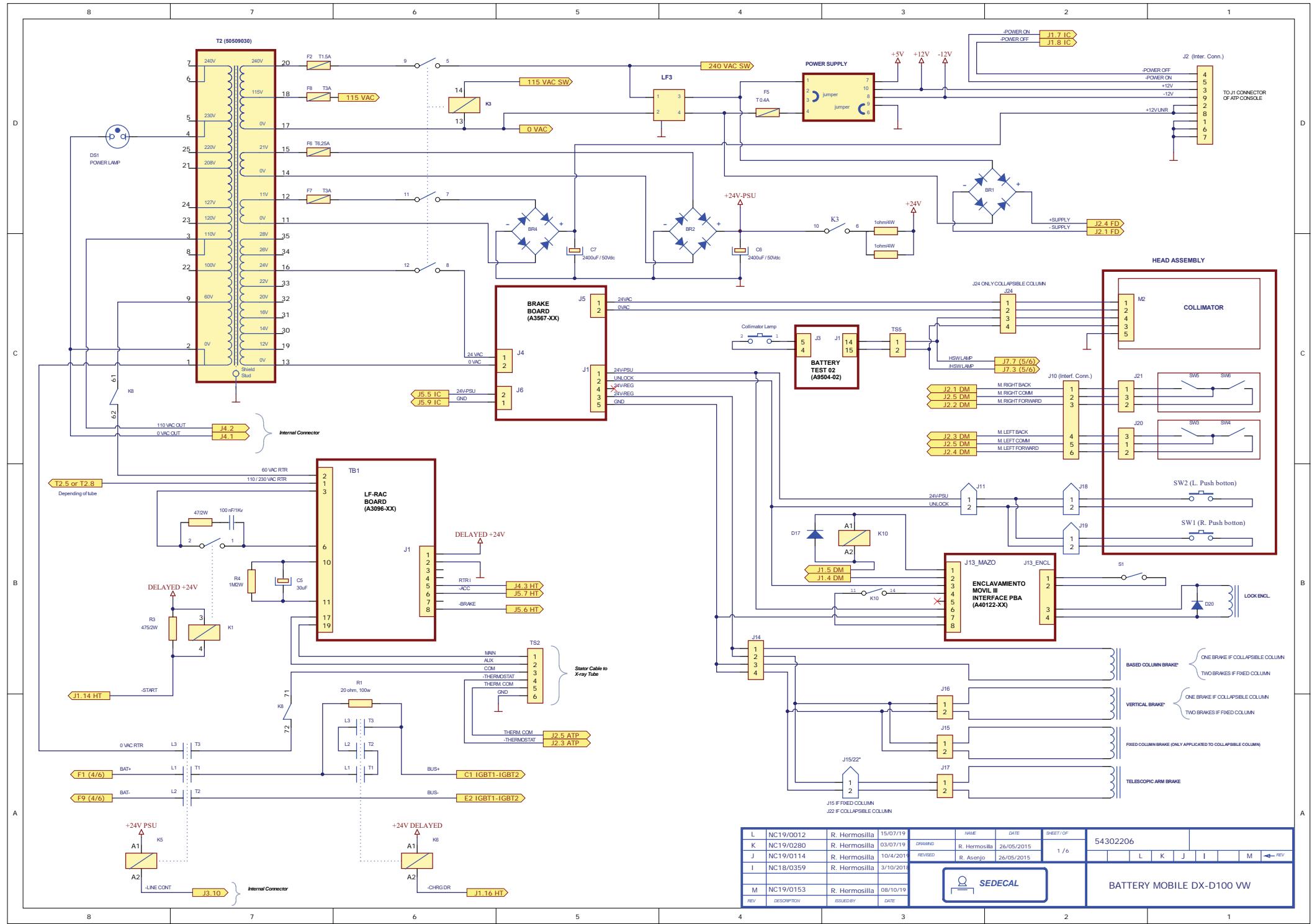
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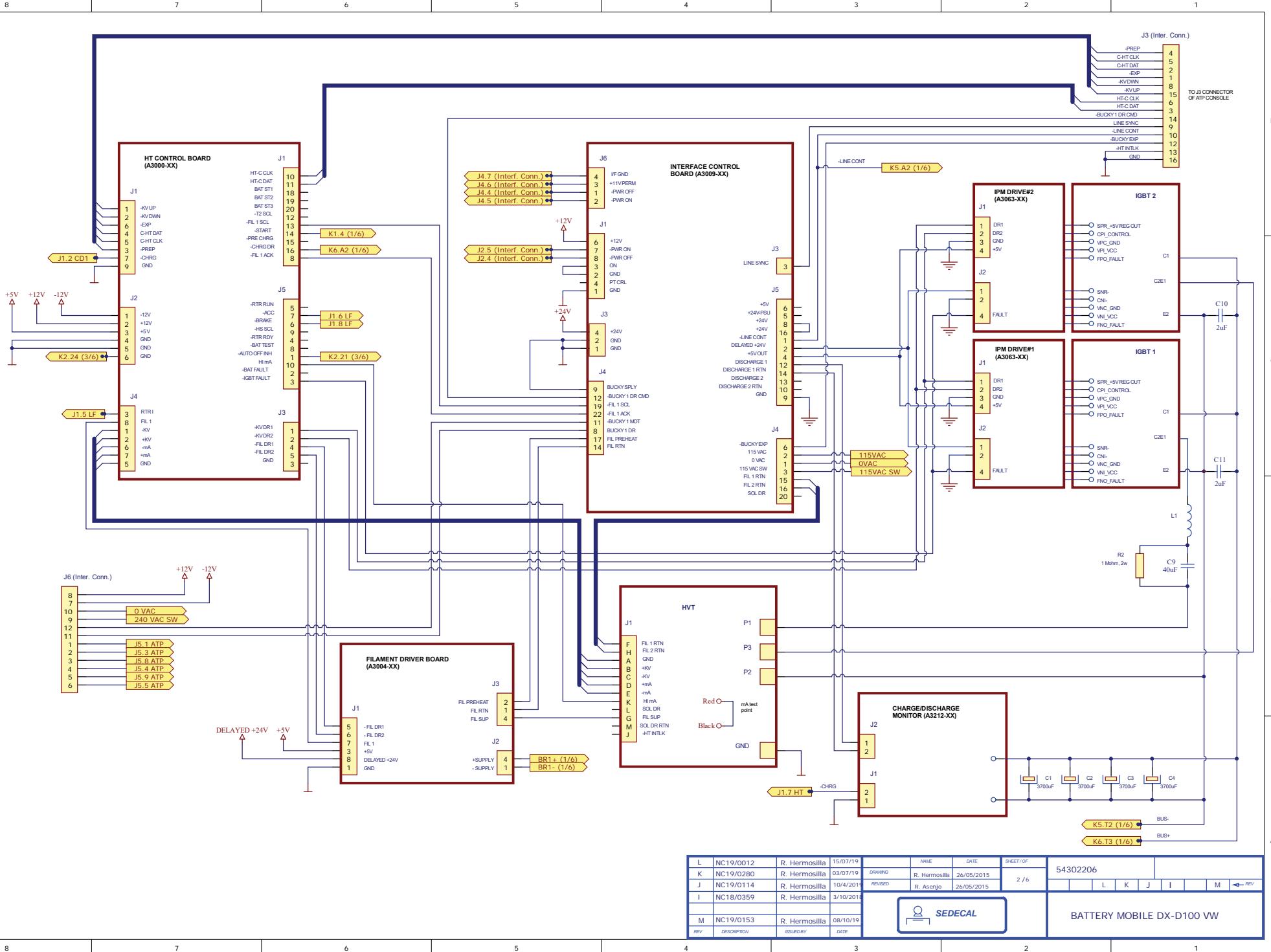
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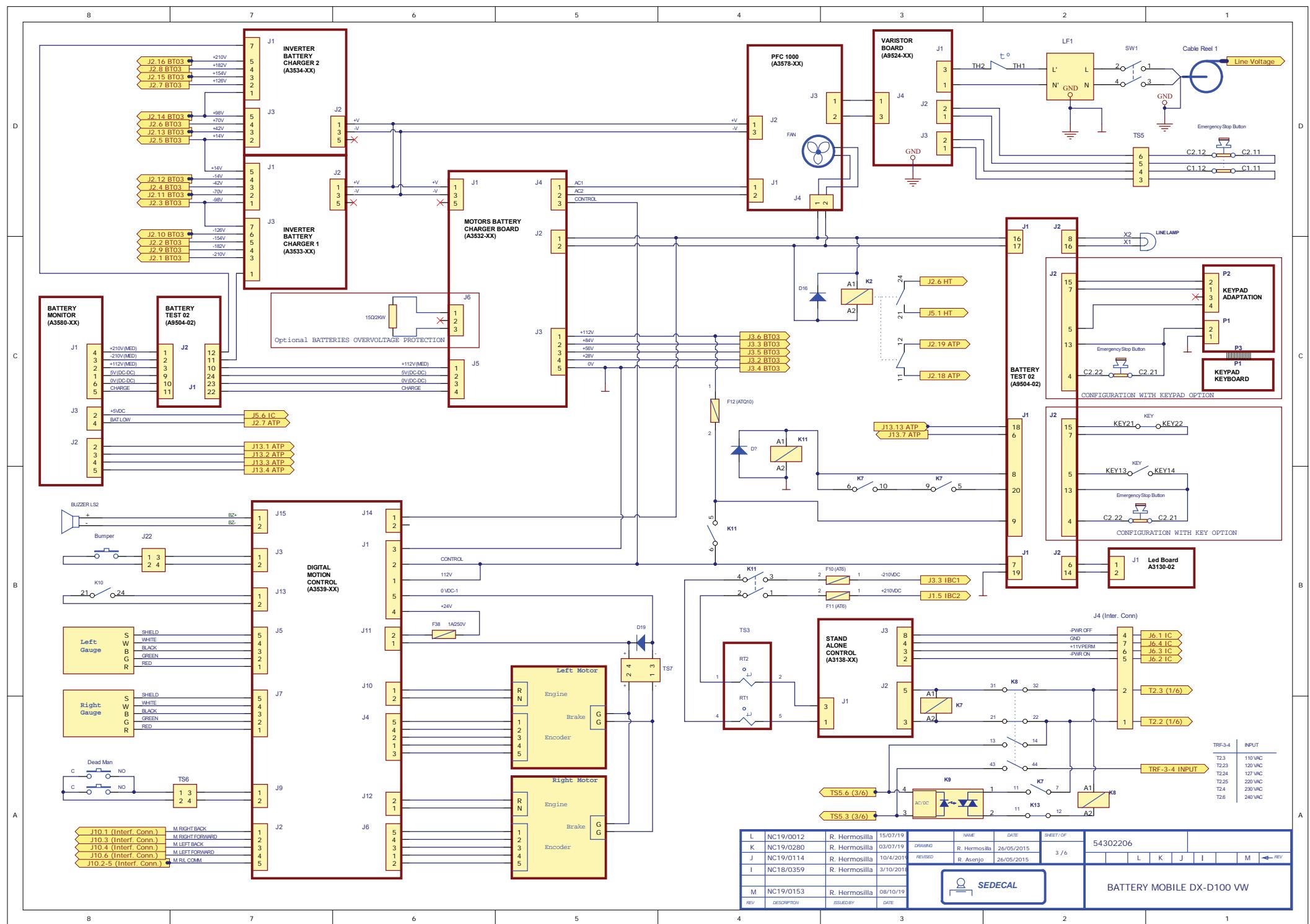


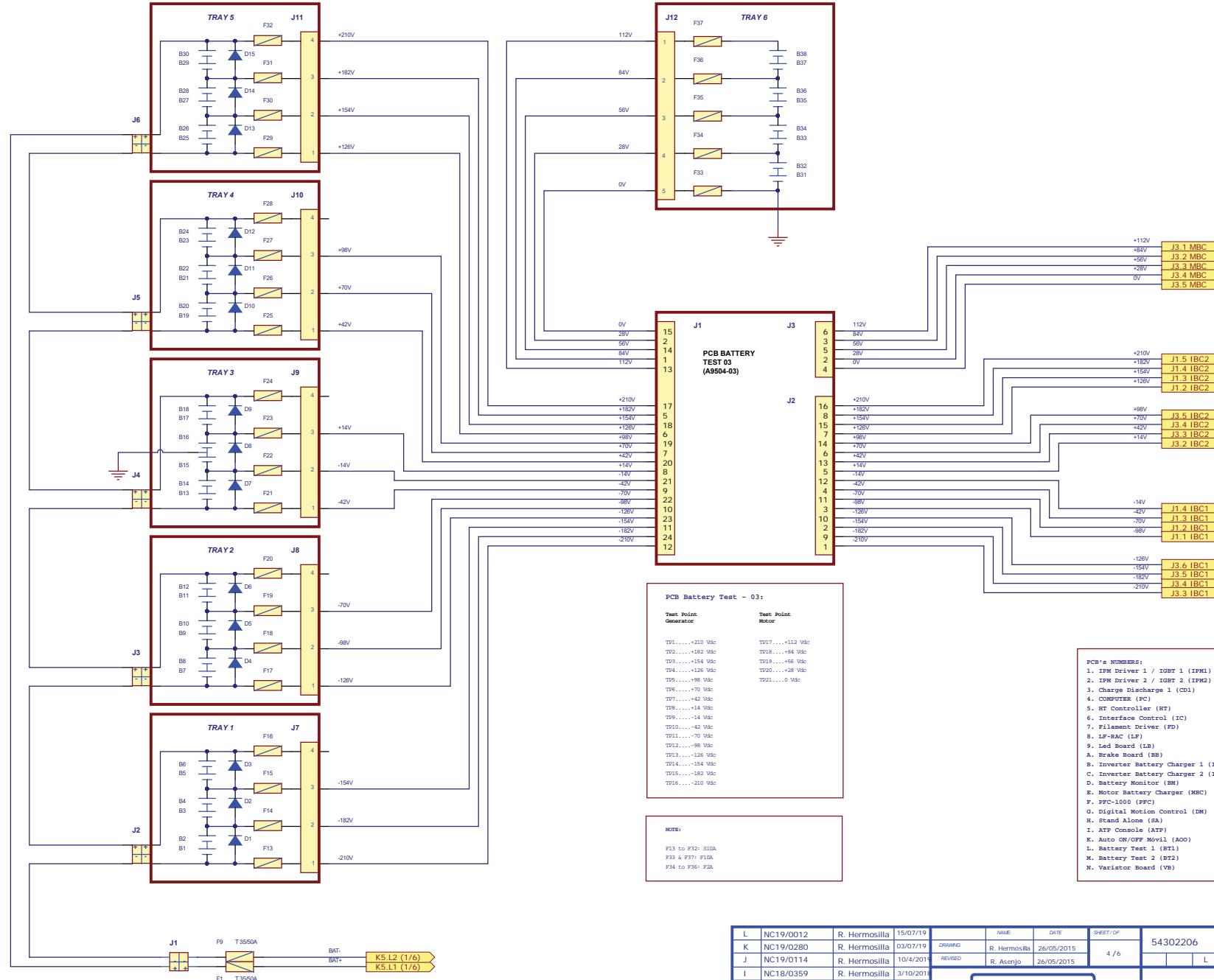
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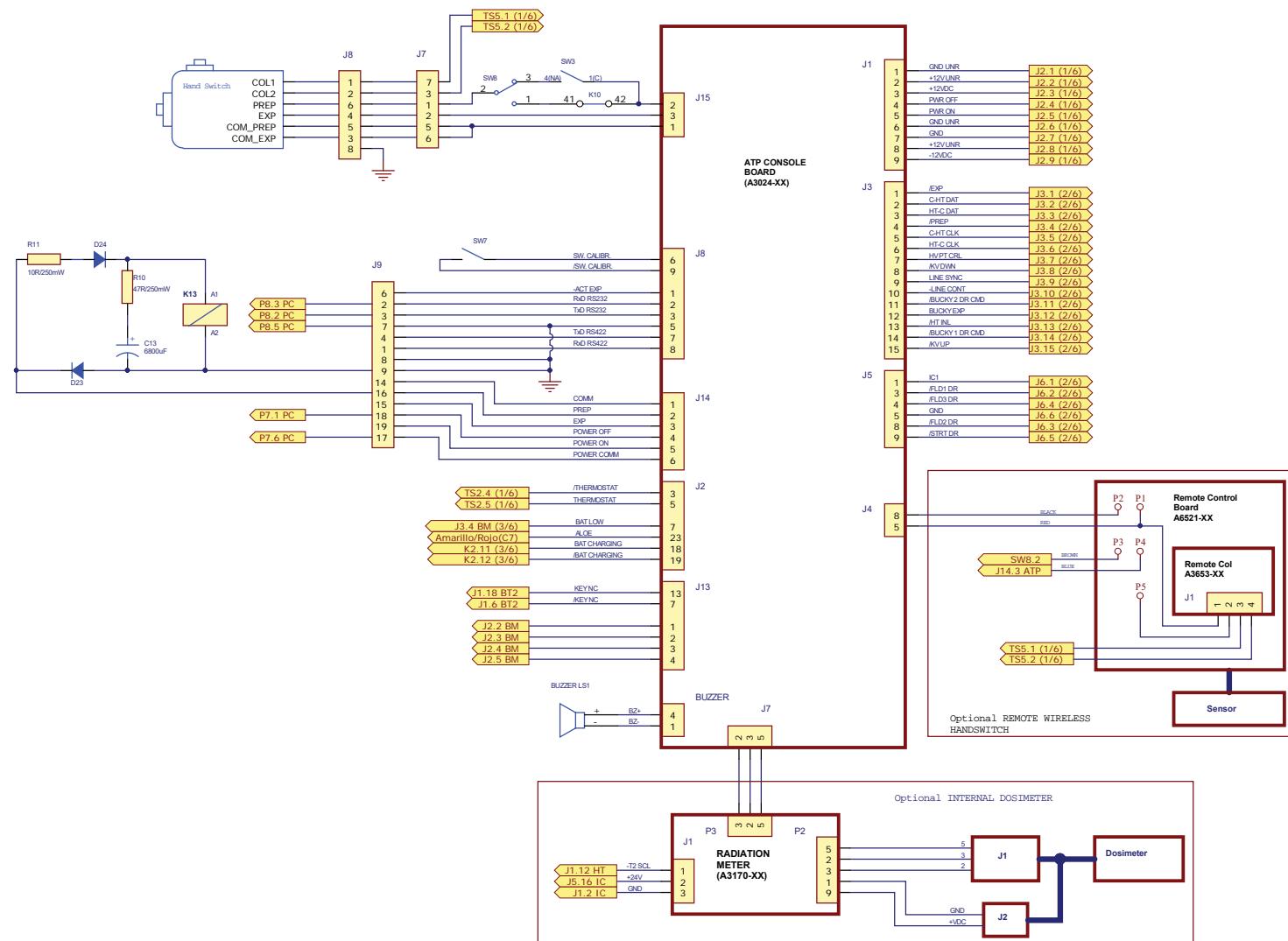
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BATTERY MOBILE DX-D100 VW

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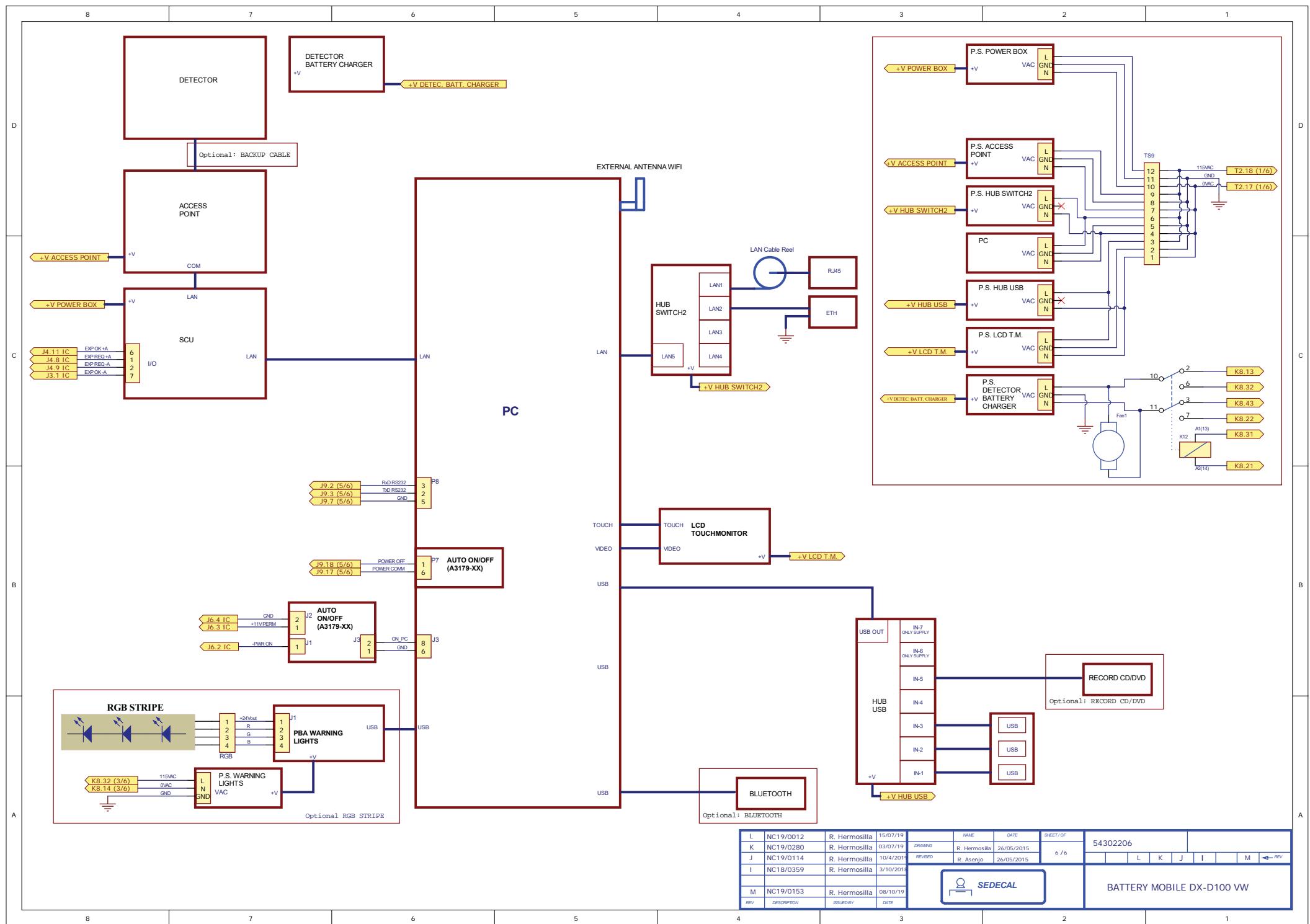
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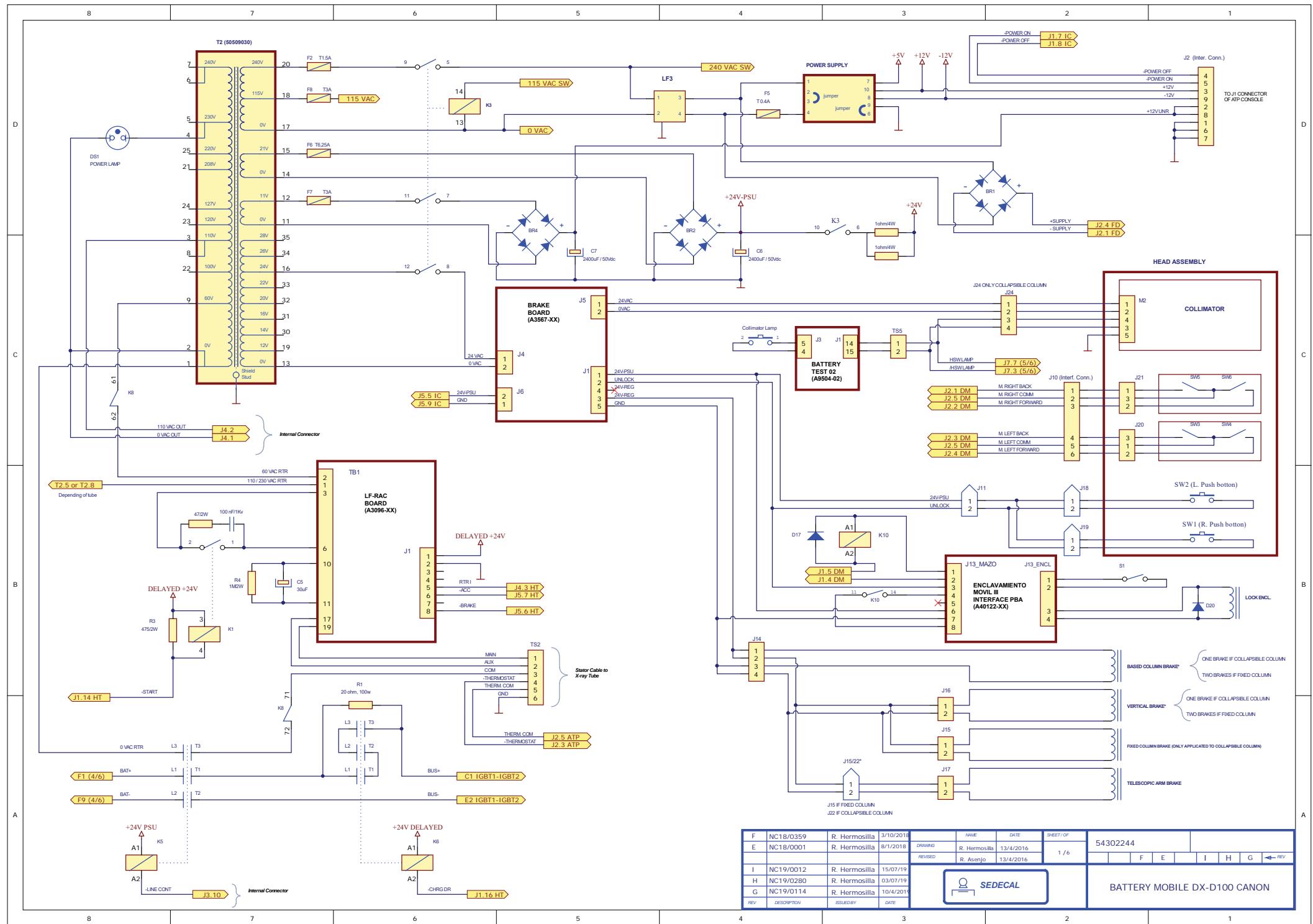


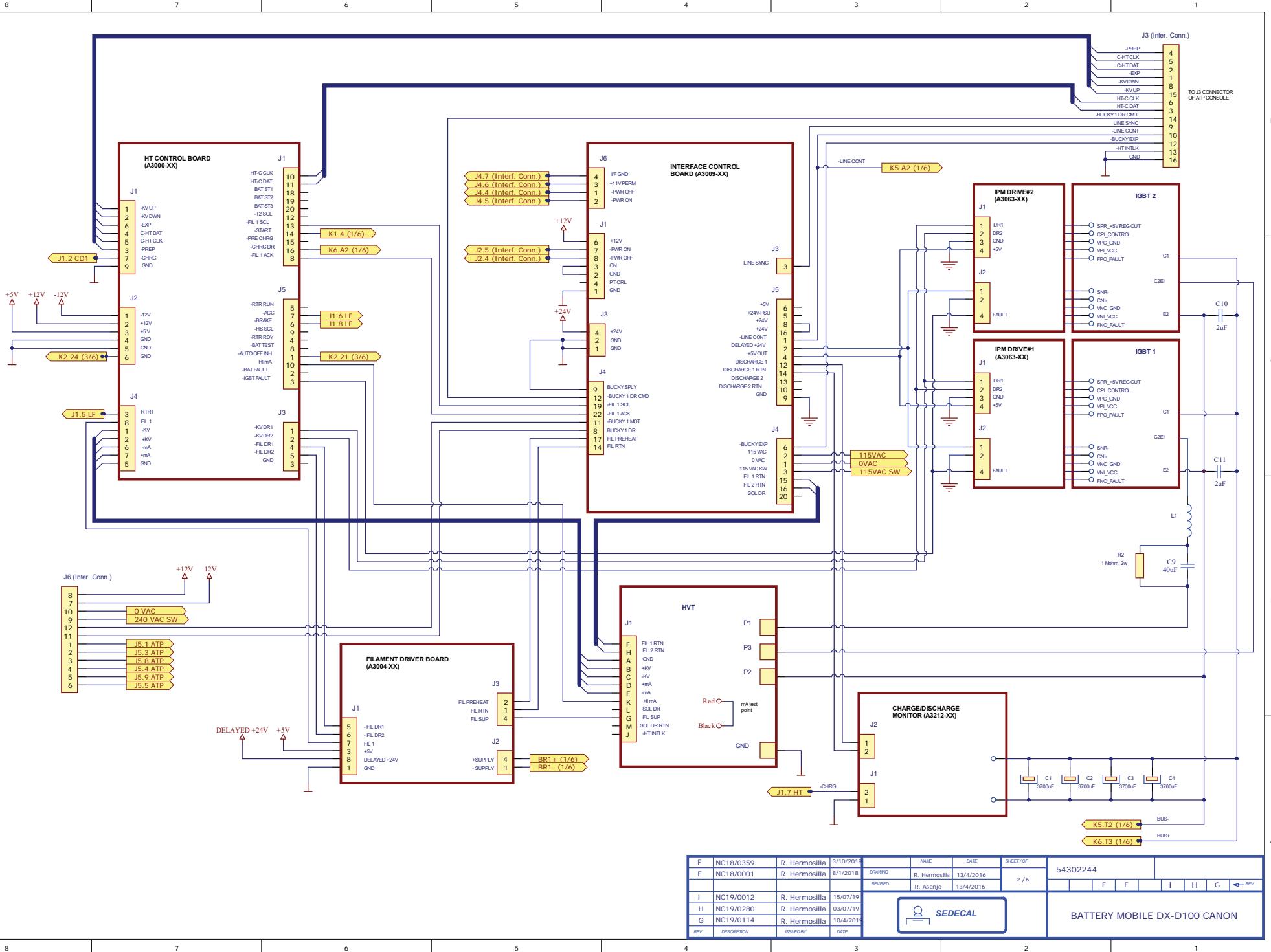
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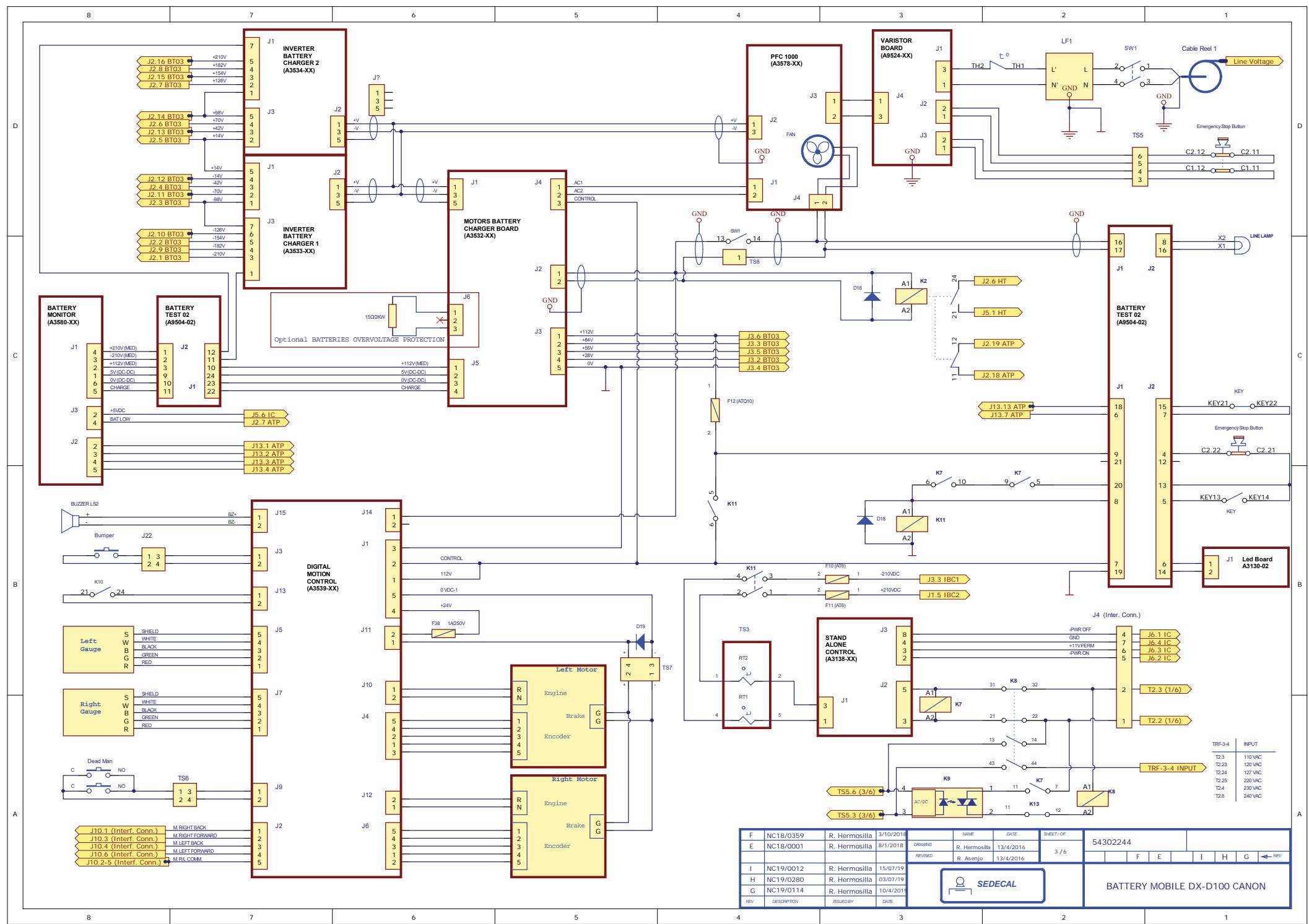
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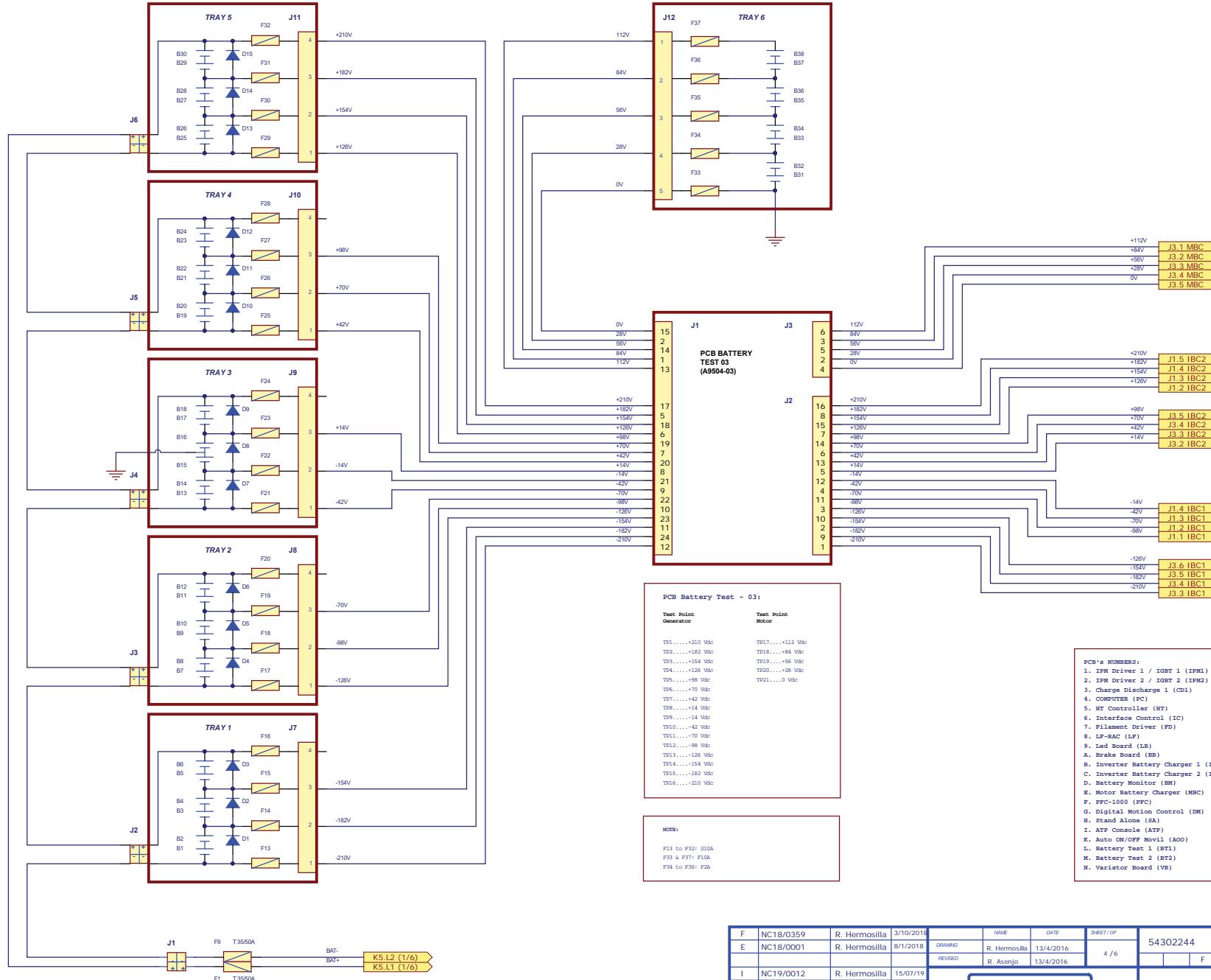
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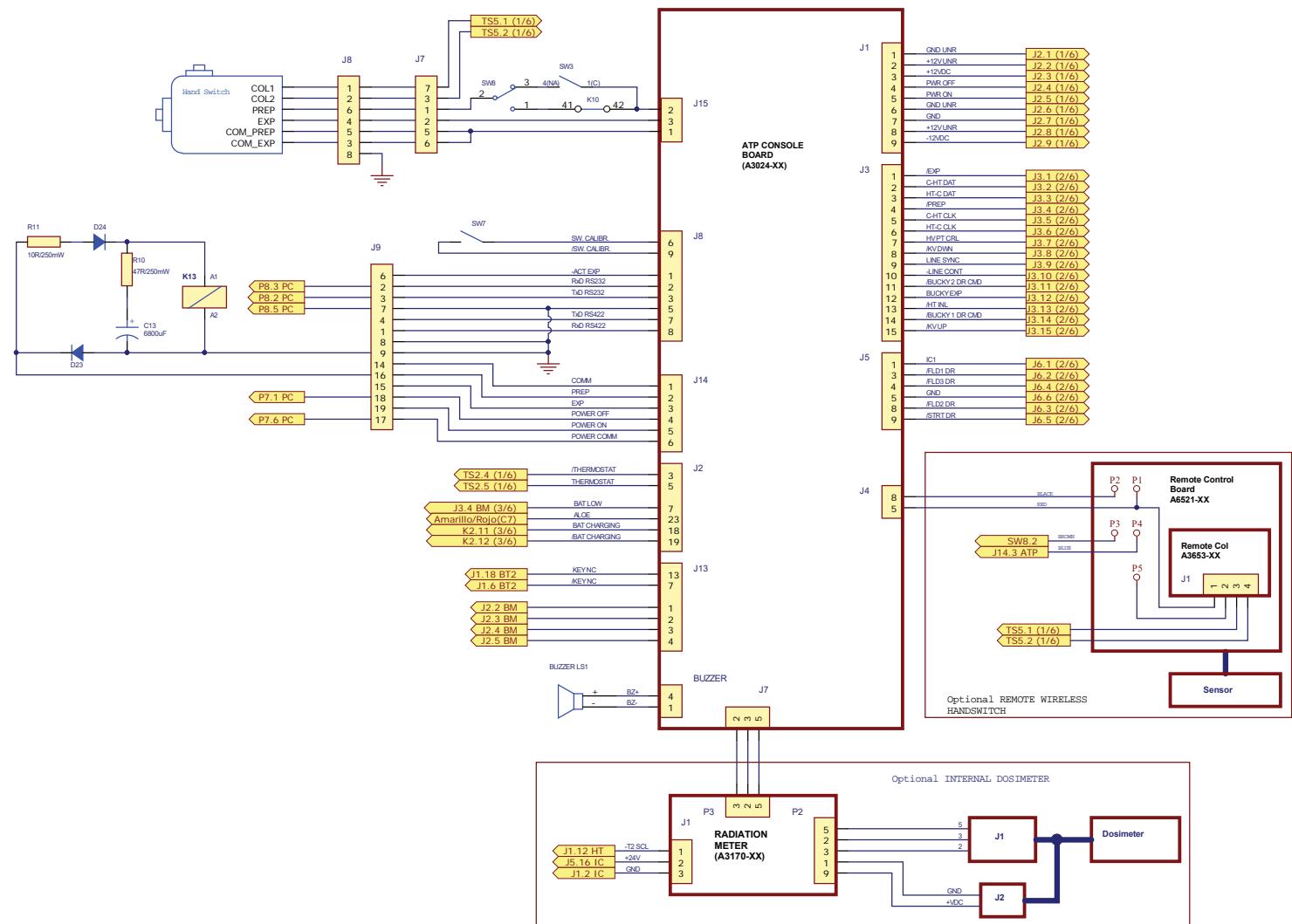


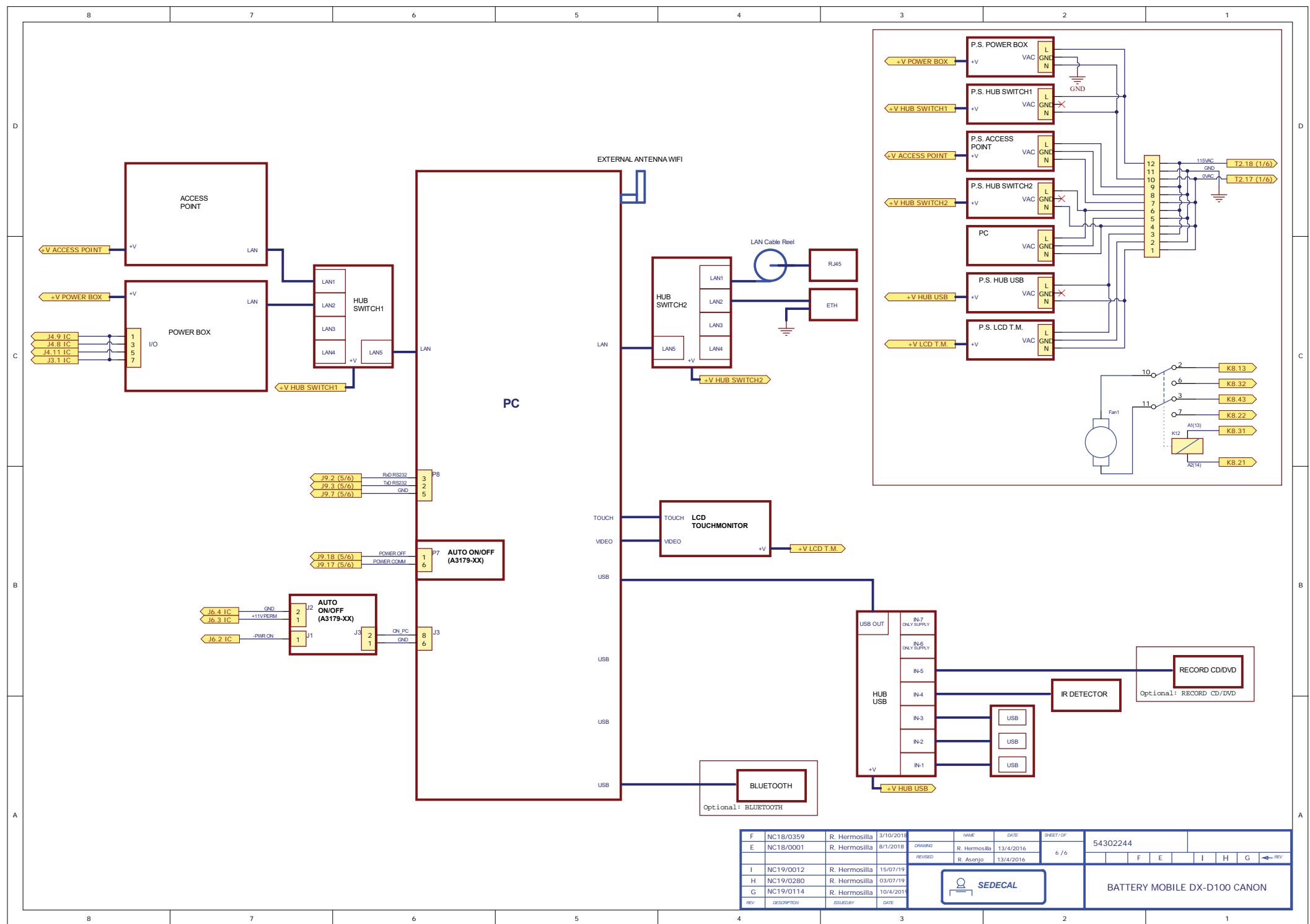


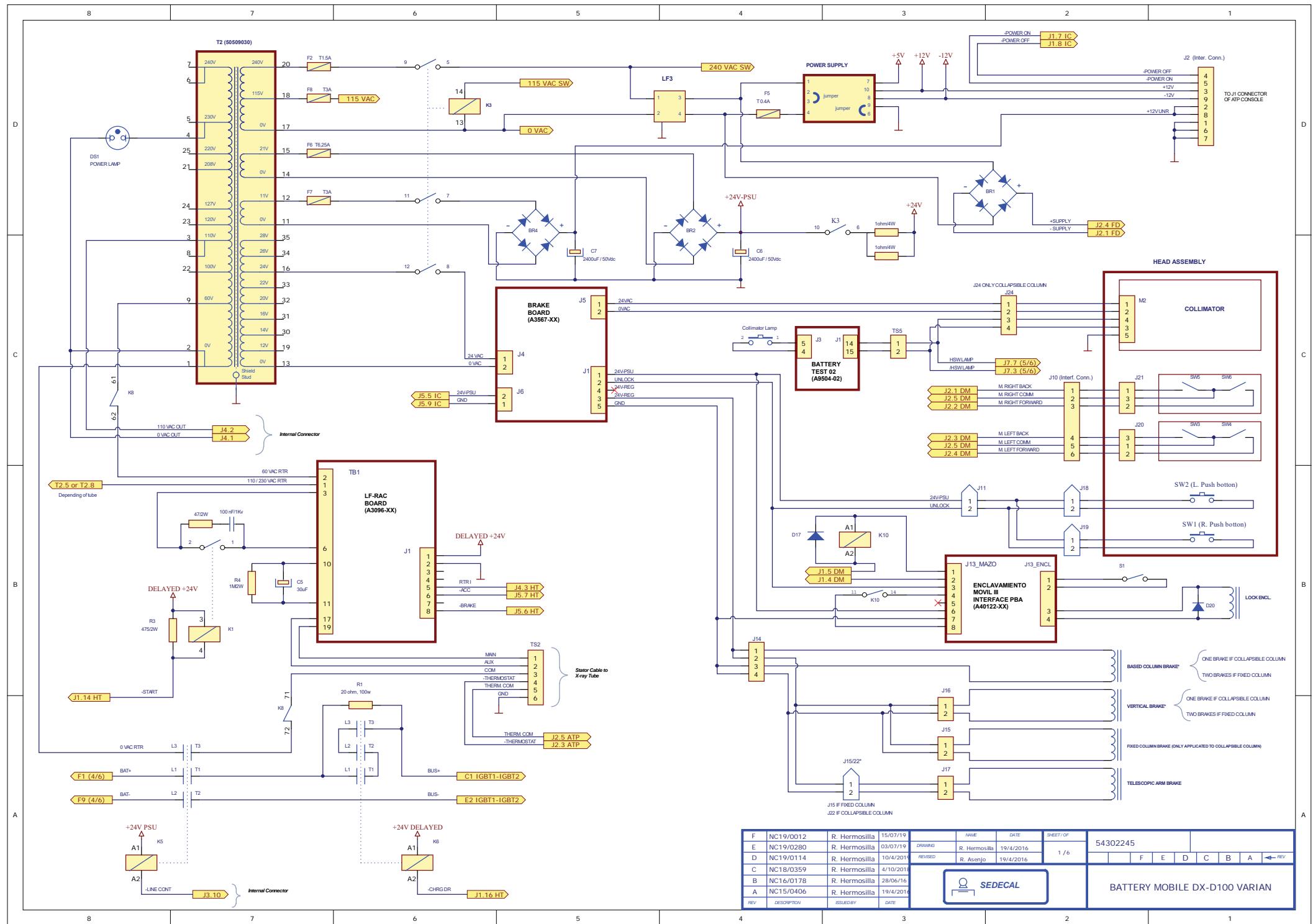
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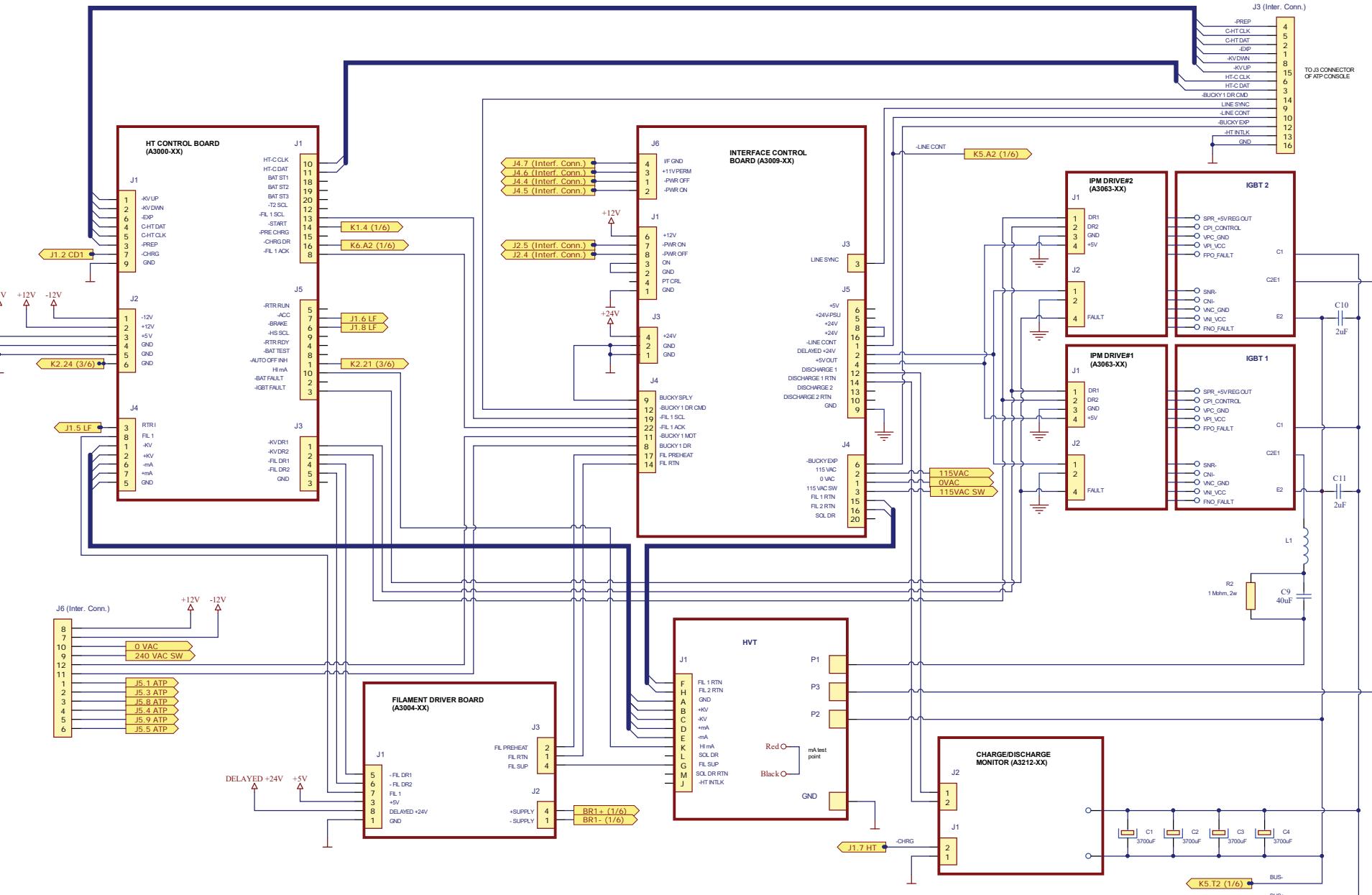
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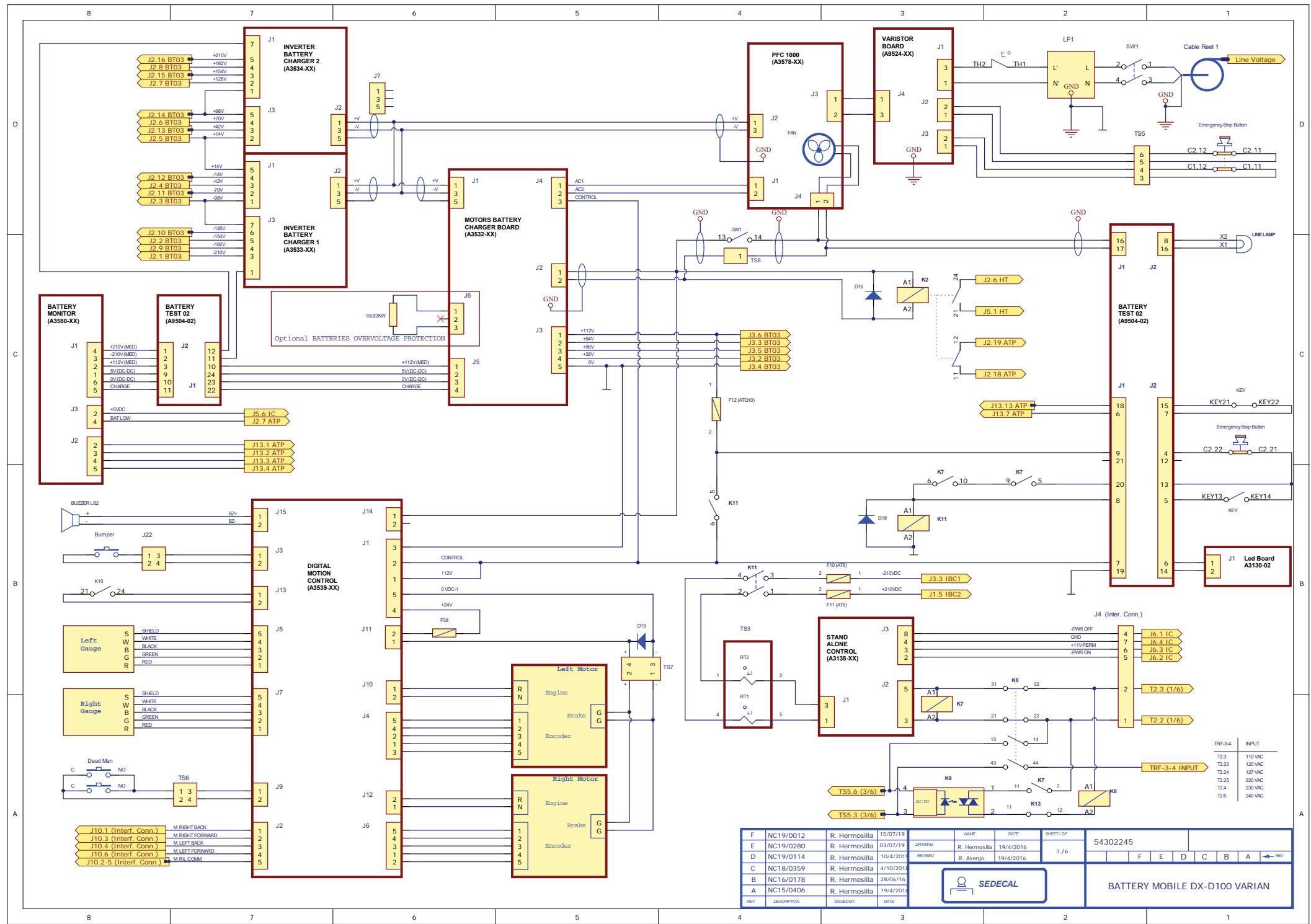
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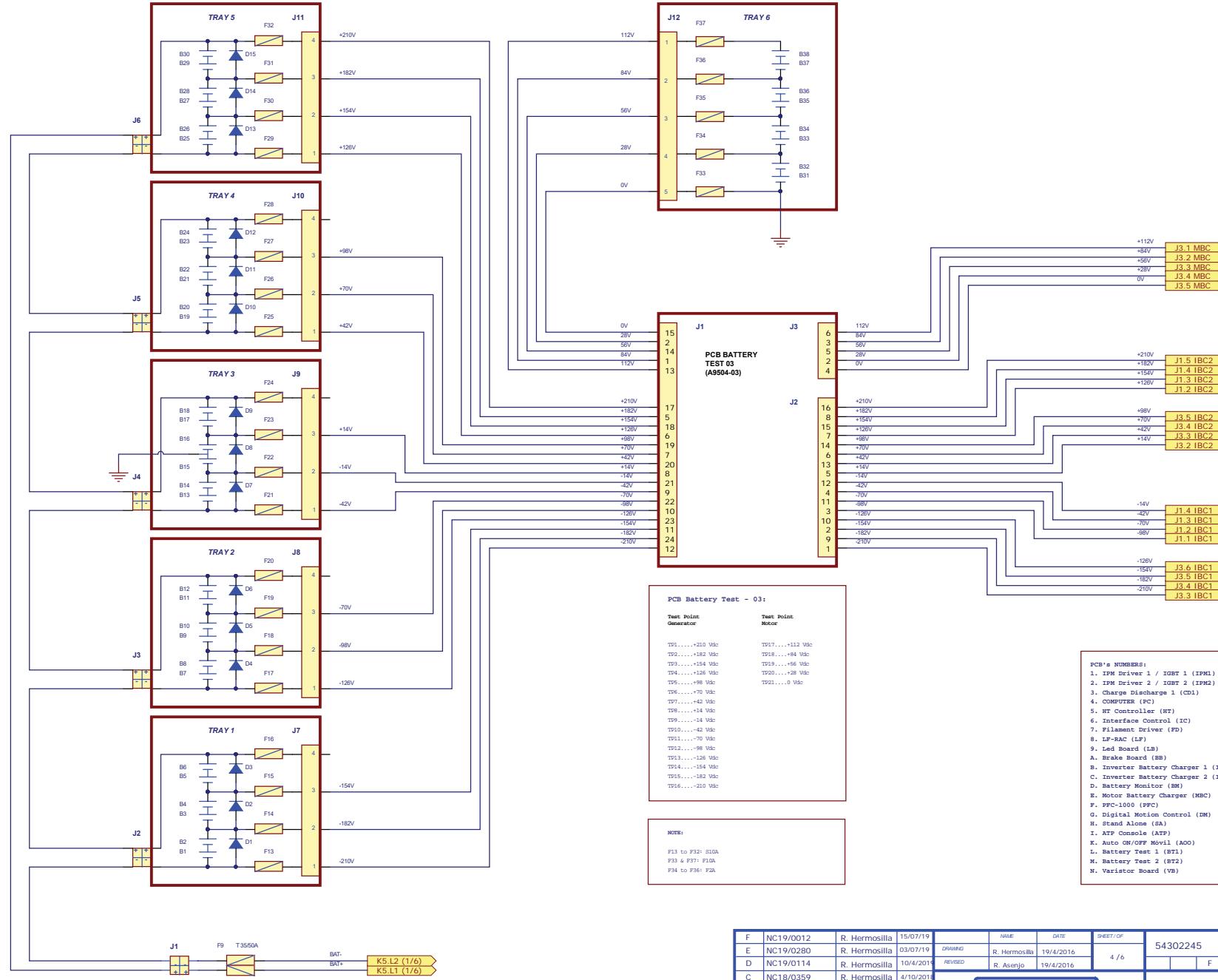


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BATTERY MOBILE DX-D100 VARIAN



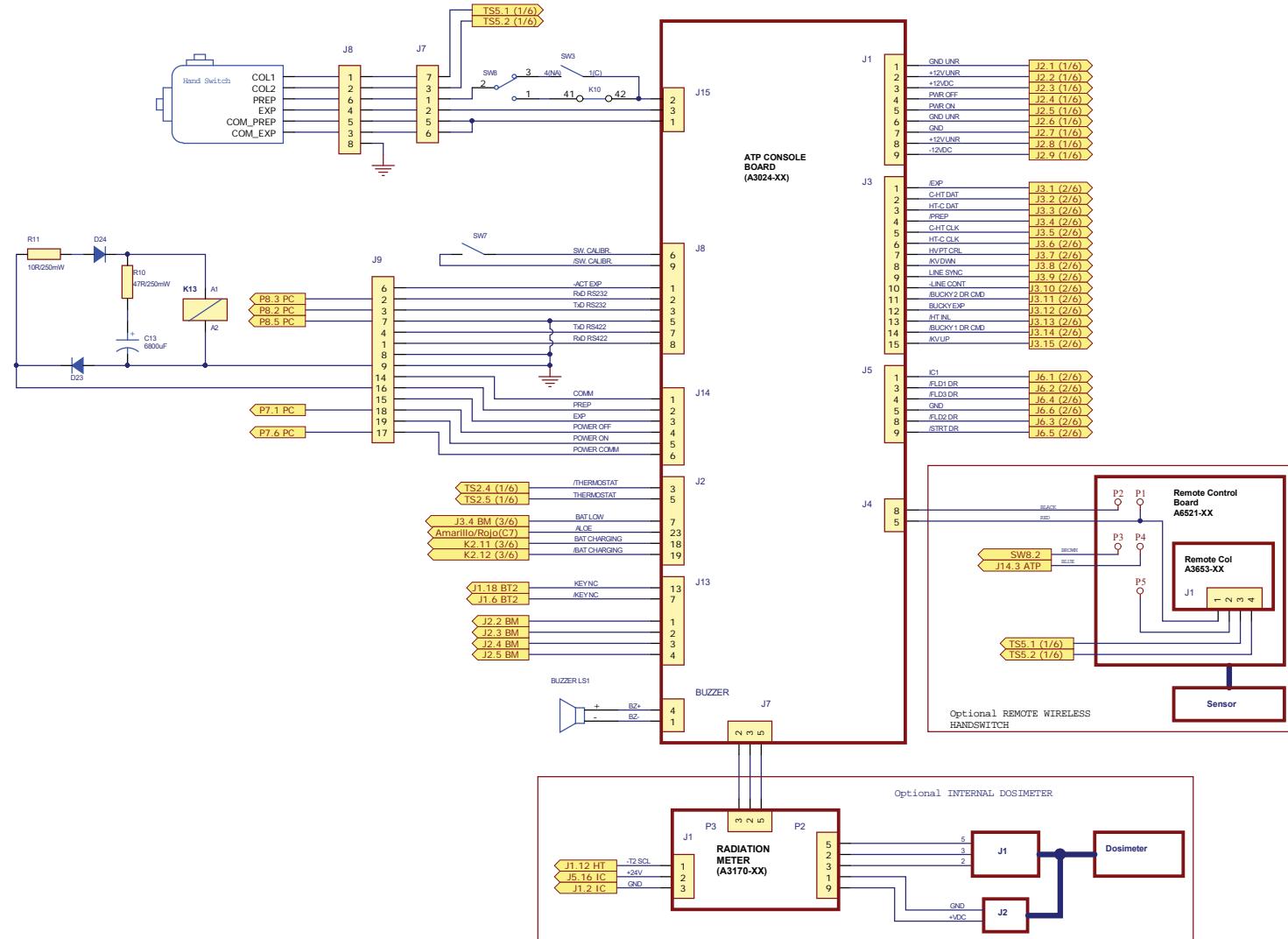


PCB's NUMBERS:
 1. IPM Driver 1 / IGBT 1 (IPM1)
 2. IPM Driver 2 / IGBT 2 (IPM2)
 3. Charge Discharge 1 (CD1)
 4. COMPUTER (PC)
 5. NT Controller (NT)
 6. Interface Control (IC)
 7. Filament Driver (FD)
 8. LF-RAC (LF)
 9. Led Board (LB)
 A. Brake Board (BB)
 B. Inverter Battery Charger 1 (IBC1)
 C. Inverter Battery Charger 2 (IBC2)
 D. Drive Motor (DM)
 E. Motor Battery Charger (MBC)
 F. FPC-1000 (FPC)
 G. Digital Motion Control (DM)
 H. Stand Alone (SA)
 I. ATP Console (ATP)
 K. Auto ON/OFF Movil (AOO)
 L. Battery Test 1 (BT1)
 M. Battery Test 2 (BT2)
 N. Varistor Board (VB)

F	NC19/0012	R. Hermosilla	15/07/19	NAME	DATE	SHEET/OF	54302245	
E	NC19/0280	R. Hermosilla	03/07/19	DRAWING	R. Hermosilla	19/4/2016		
D	NC19/0114	R. Hermosilla	10/4/2019	REVISED	R. Asenjo	19/4/2016	4 / 6	
C	NC18/0359	R. Hermosilla	4/10/2019					
B	NC16/0178	R. Hermosilla	28/06/16					
A	NC15/0406	R. Hermosilla	19/4/2016					
REV	DESCRIPTION	ISSUED/BY	DATE					

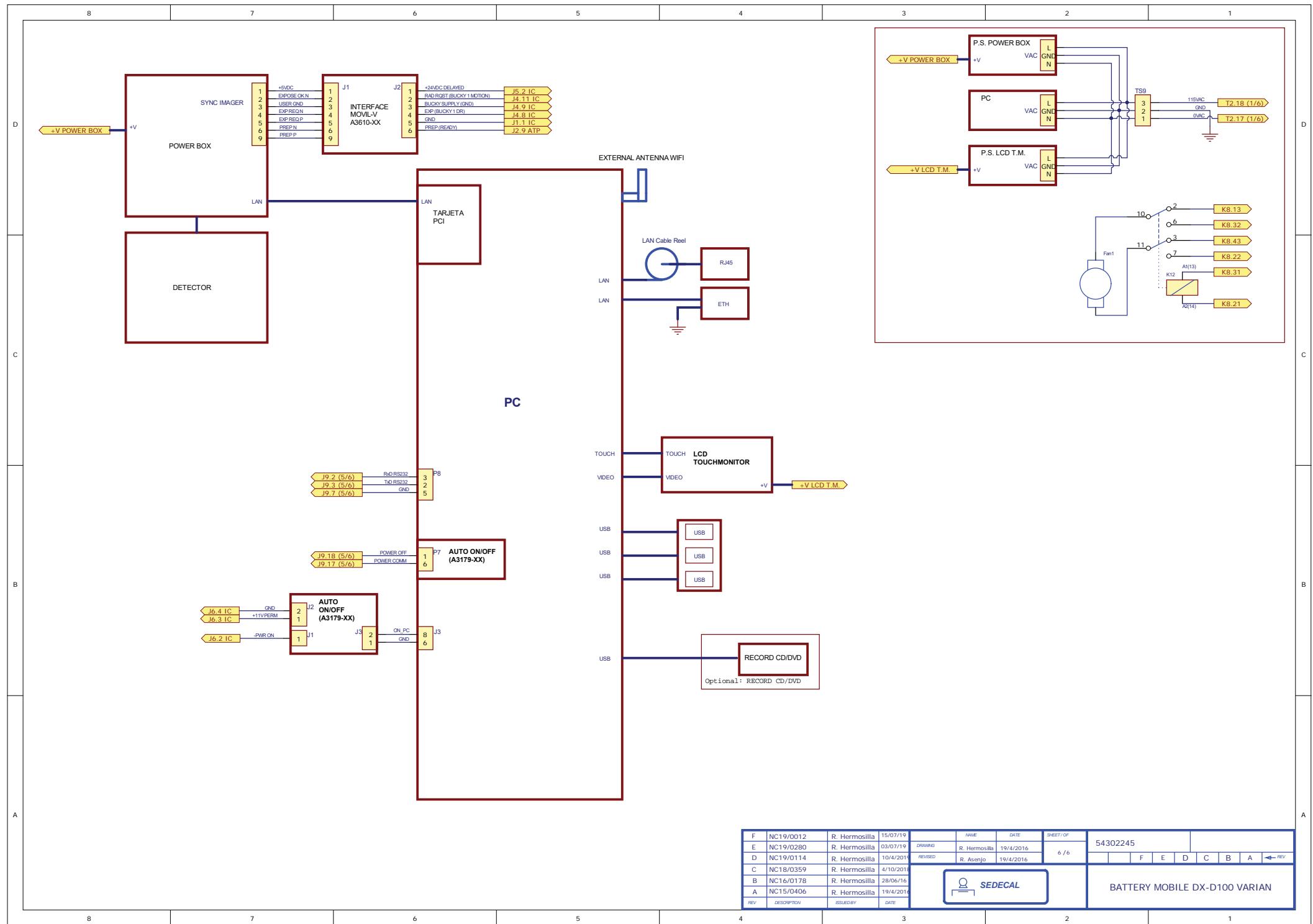


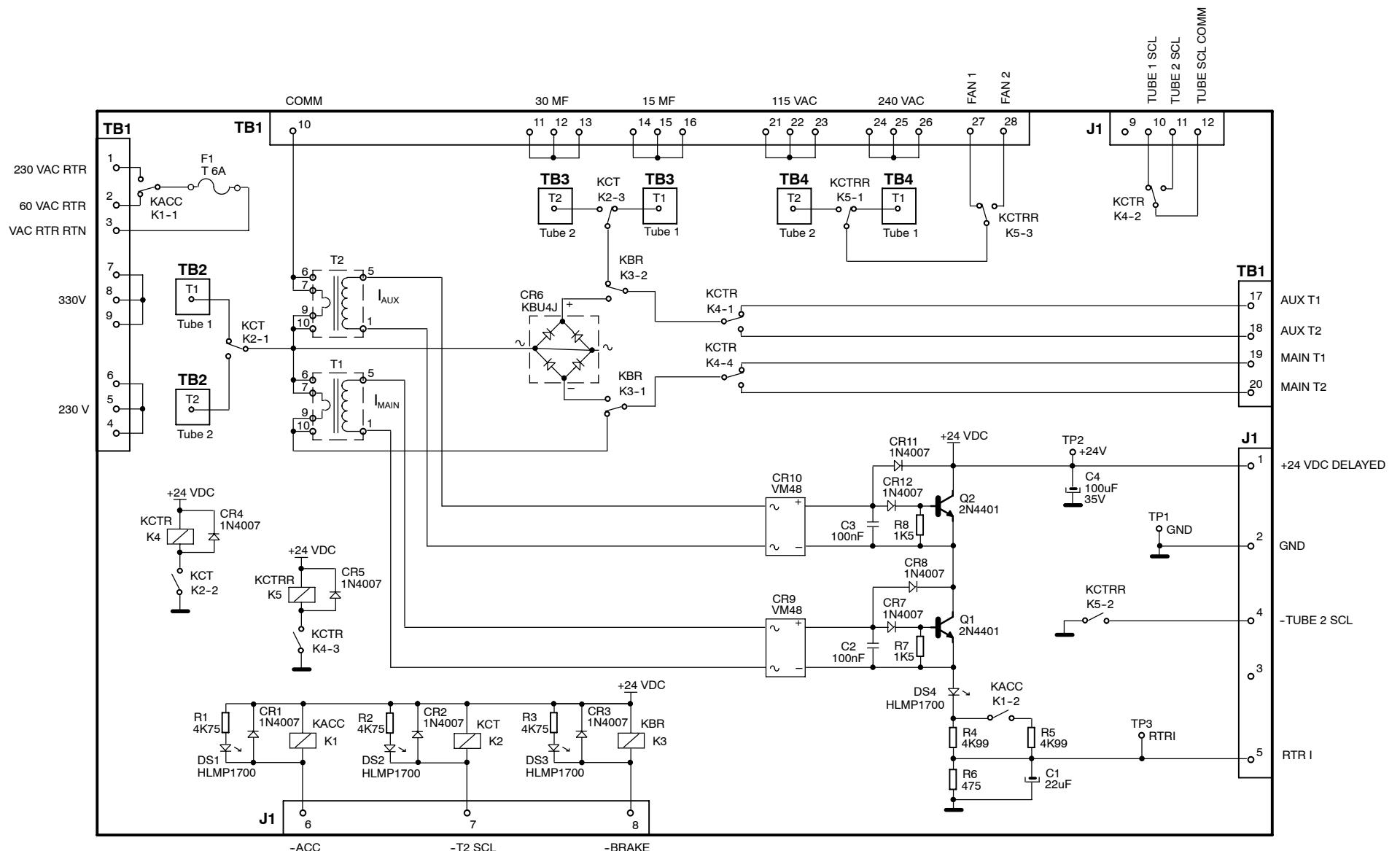
BATTERY MOBILE DX-D100 VARIAN



 SEDECAL

BATTERY MOBILE PX-D100 VARIAN





Note:

The LF-RAC shown in the Generator schematic (543020XX) is a basic documentation, only for interconnection purposes.

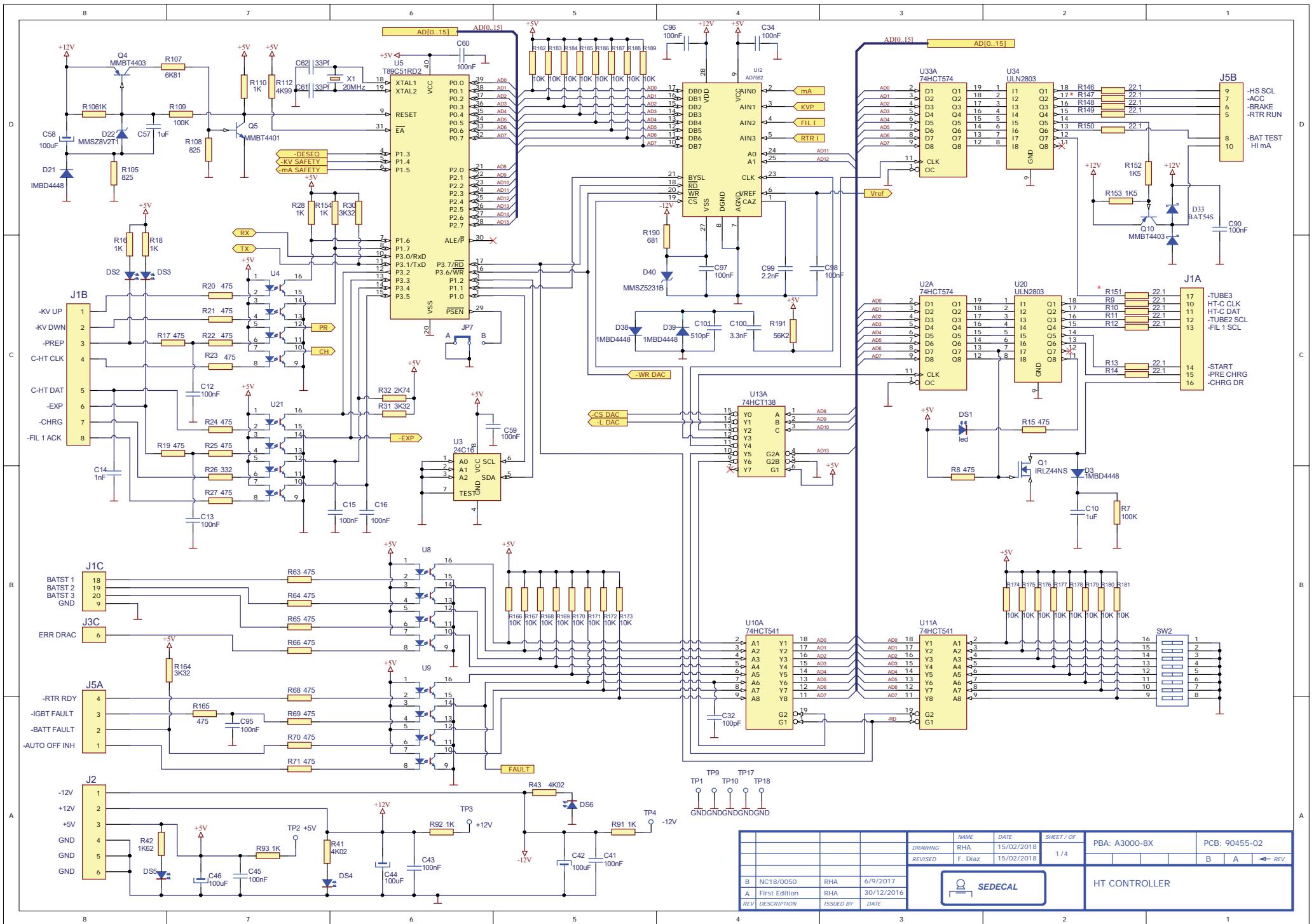
Follow this schematic for detailed component information of the LF-RAC board.

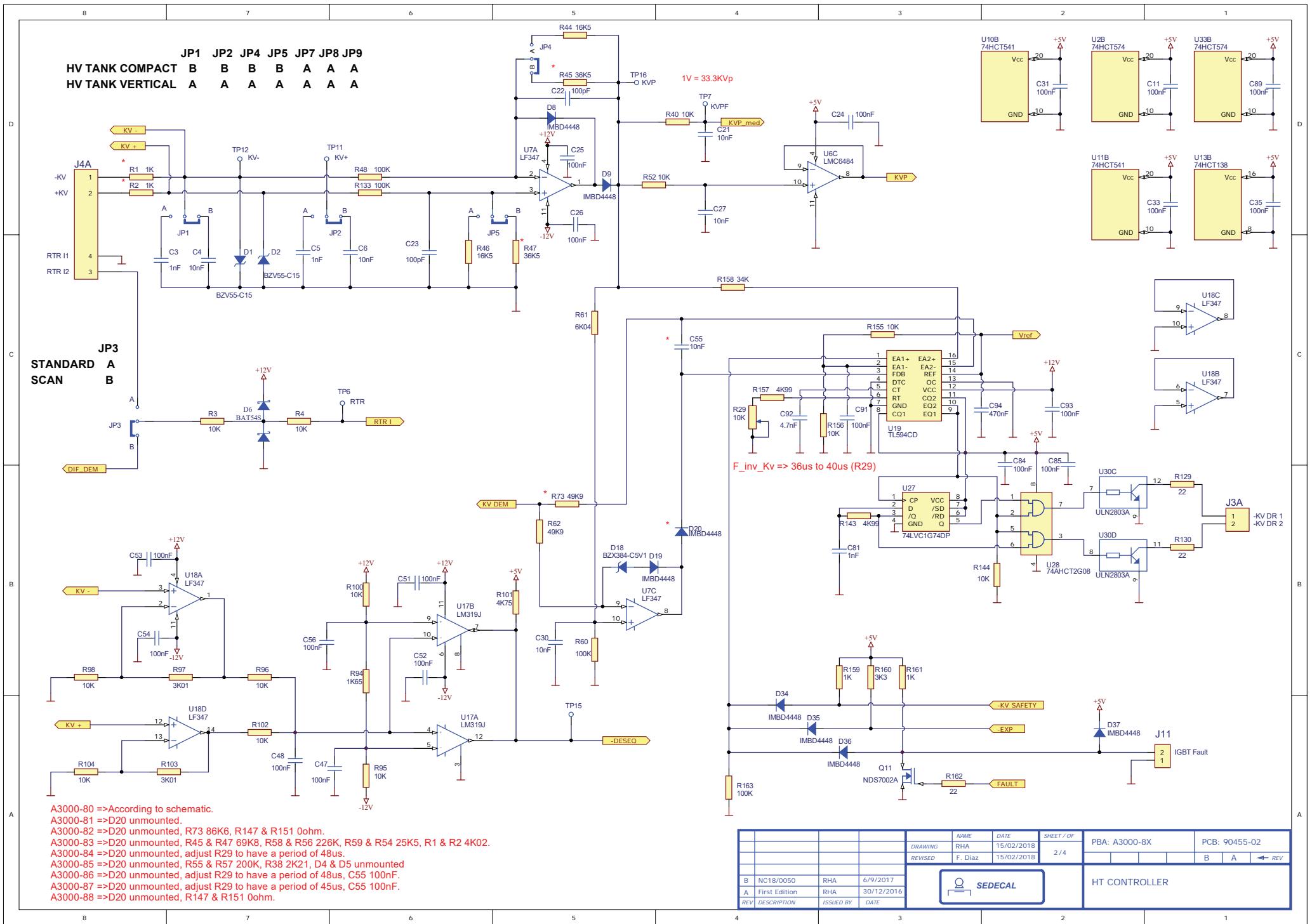
061109

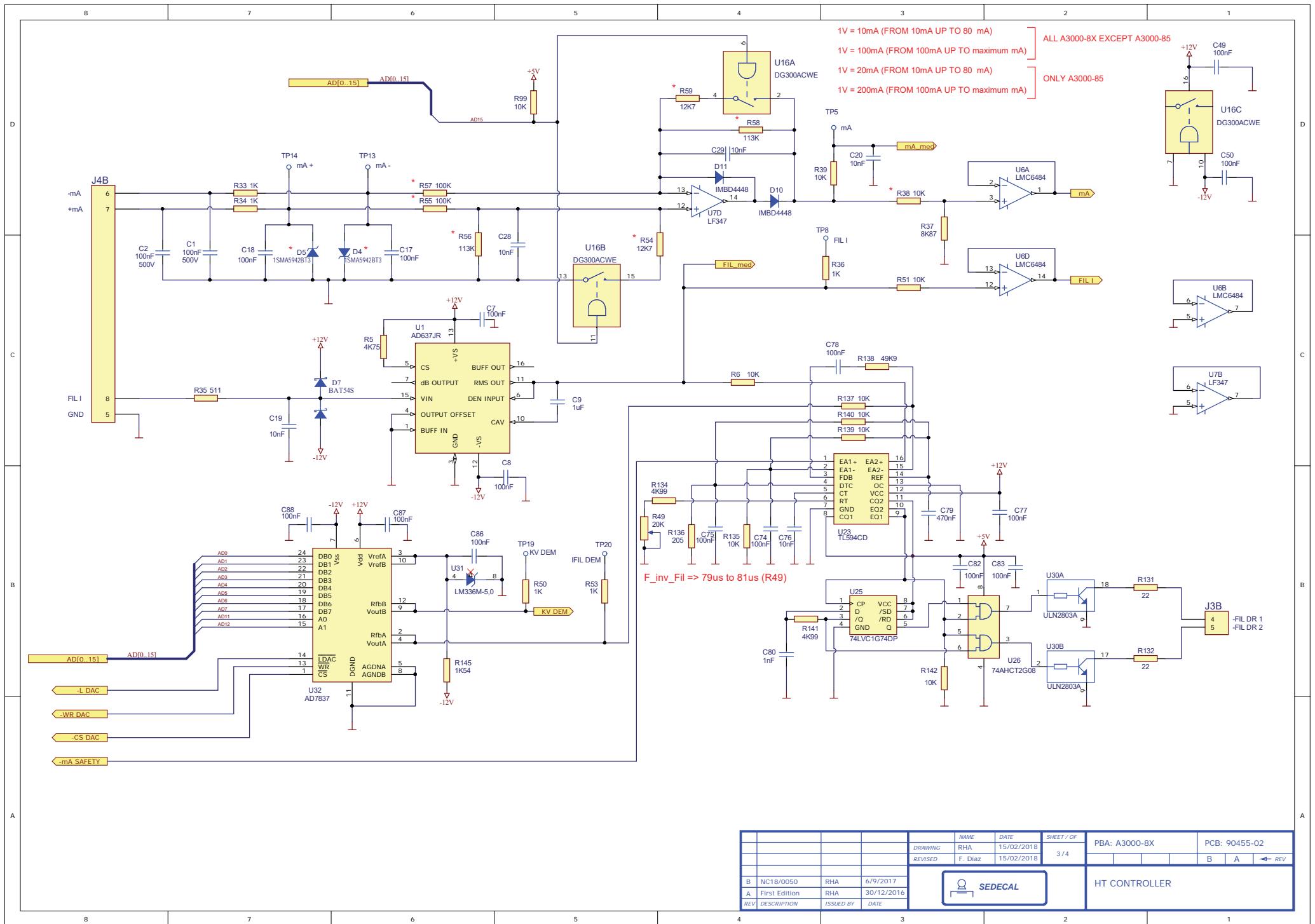
				NAME	DATE	SHEET / OF	DWG:	A3096-02	
DRAWING	F. GARCIA	21/09/97	1 / 1						
REVISED	A. DIAZ	21/09/97							
B	CN 03/004	F. Garcia	13/01/03						
REV	DESCRIPTION	ISSUED BY	DATE						
B									
REV									

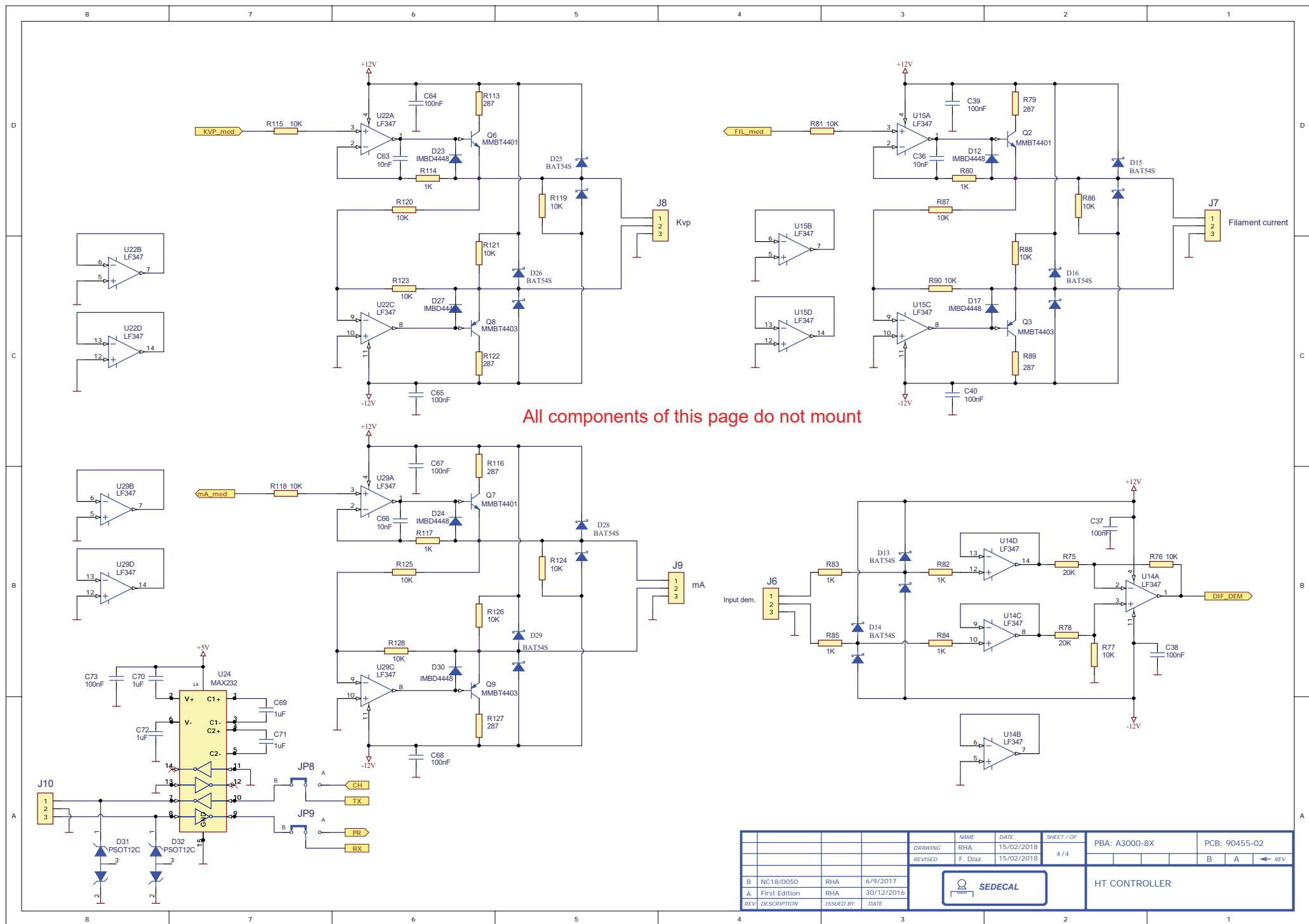
SEDECAL

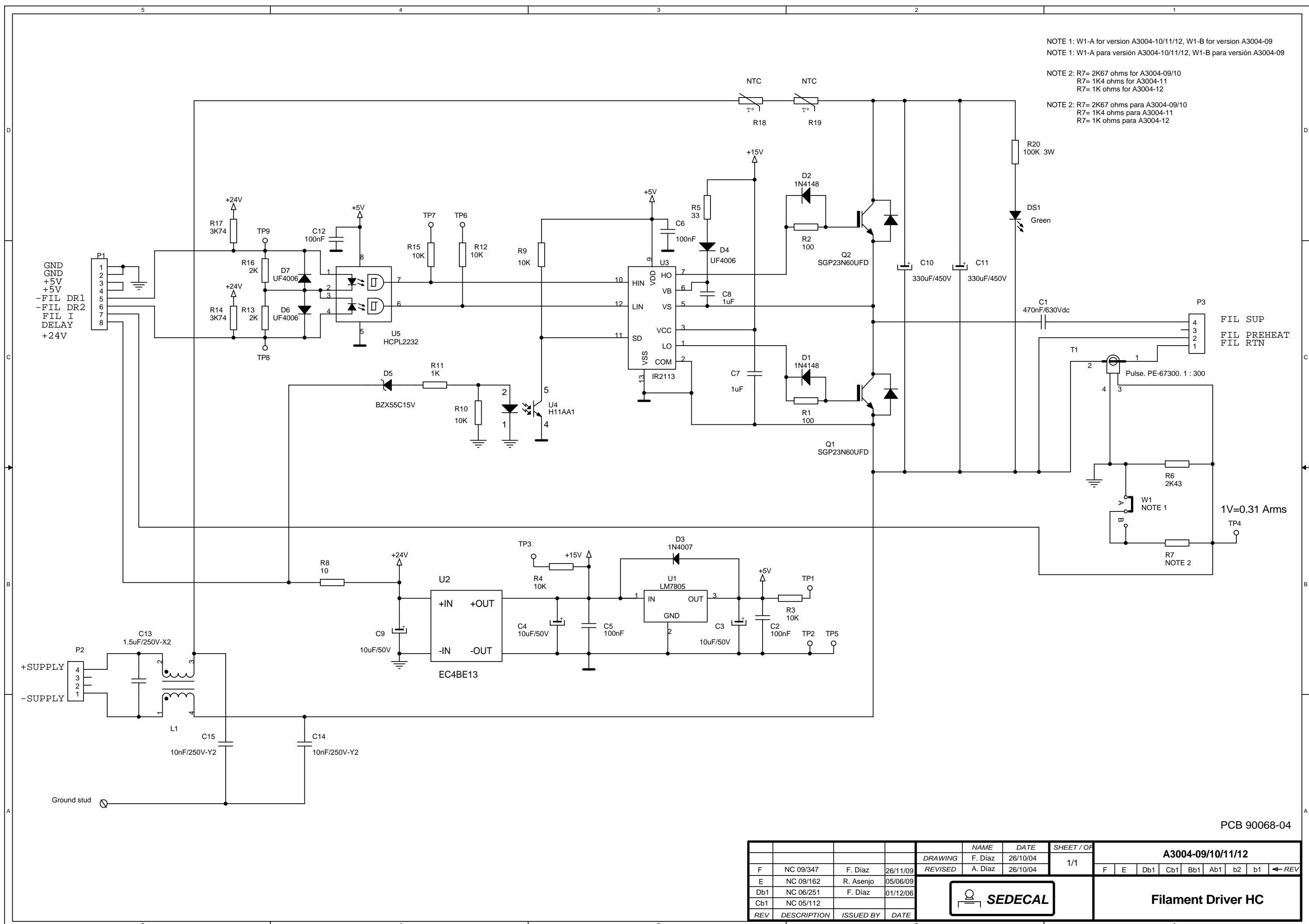
LF - RAC Board
(Line Frequency Rotatory Anode Controller)

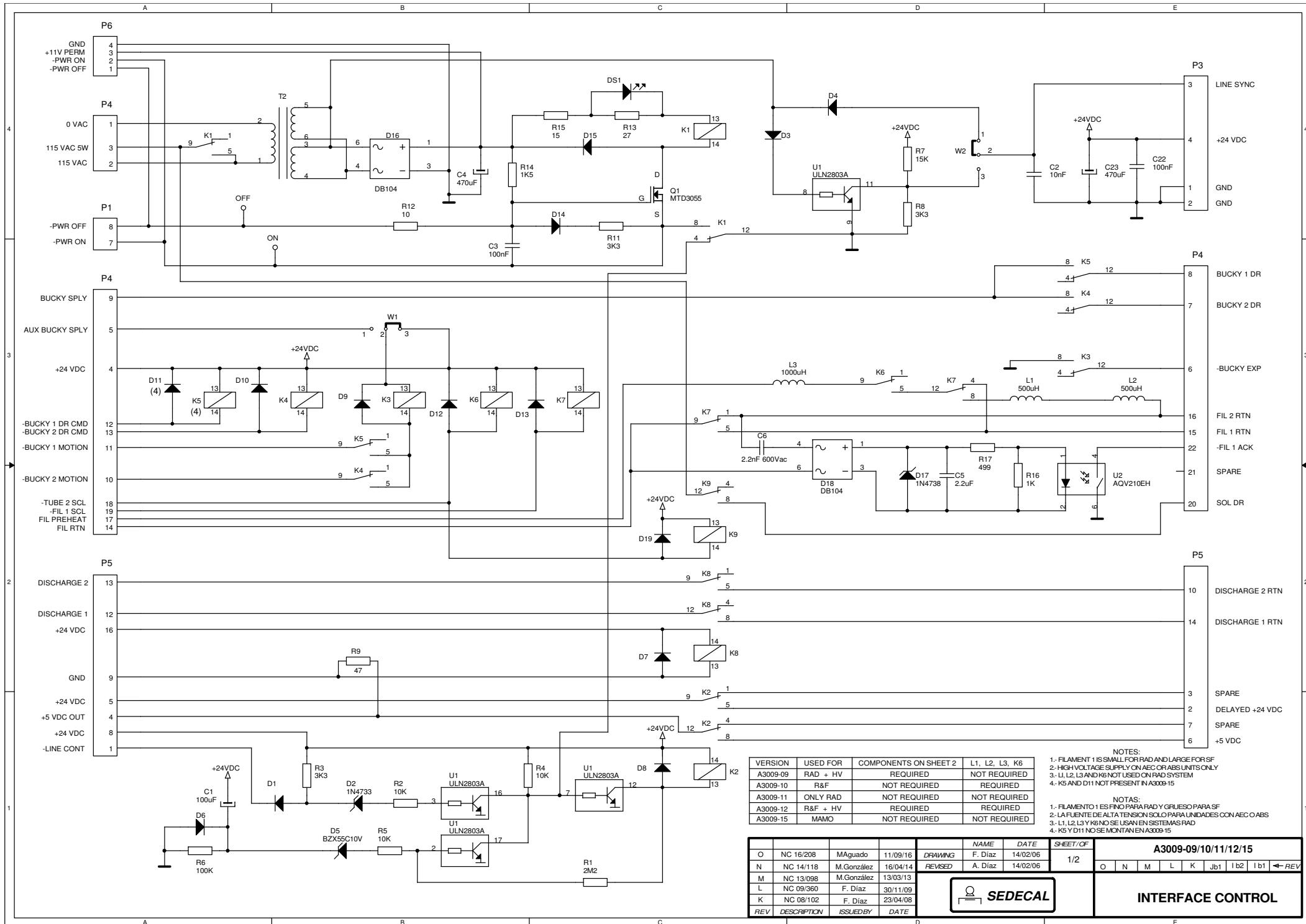


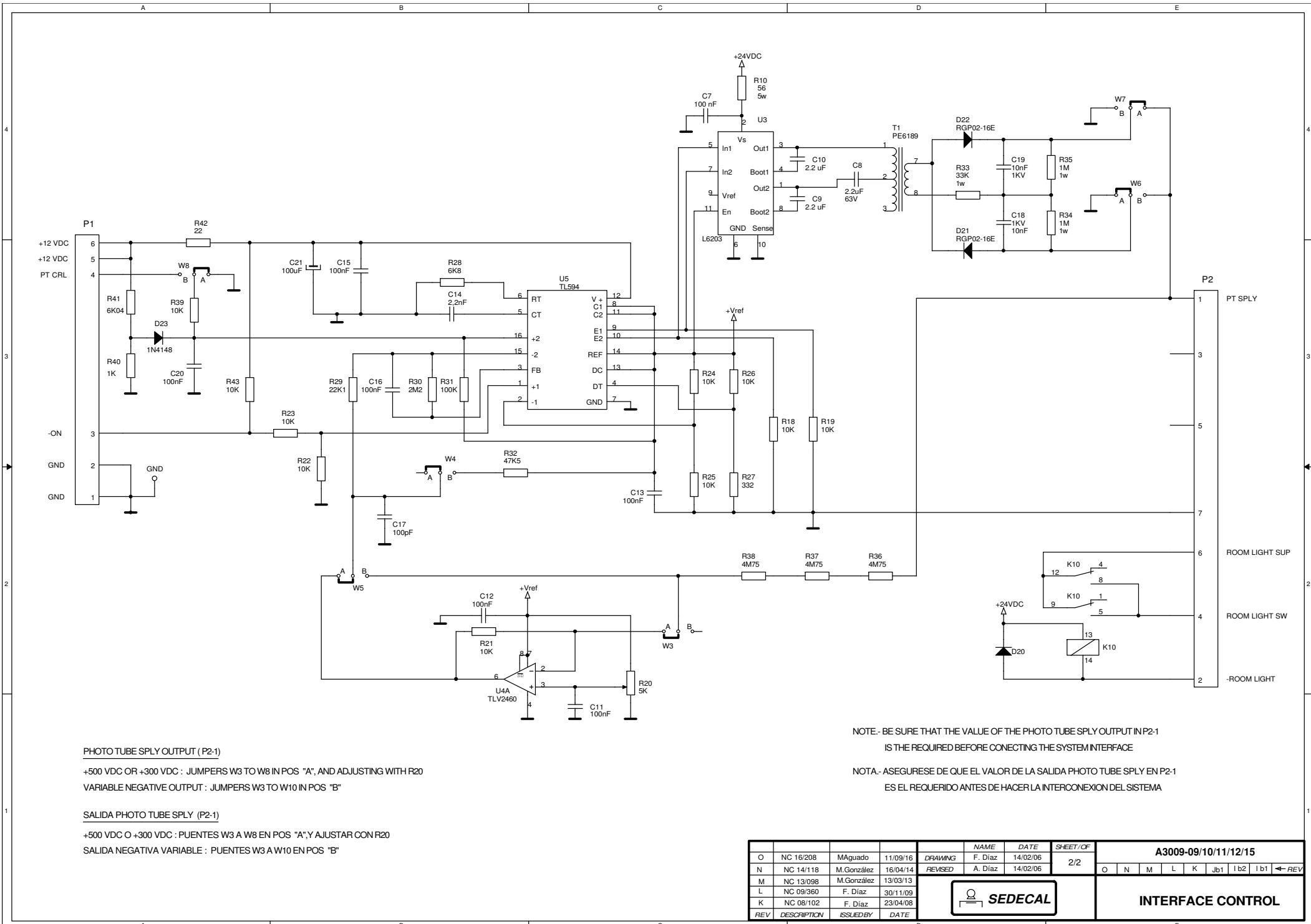


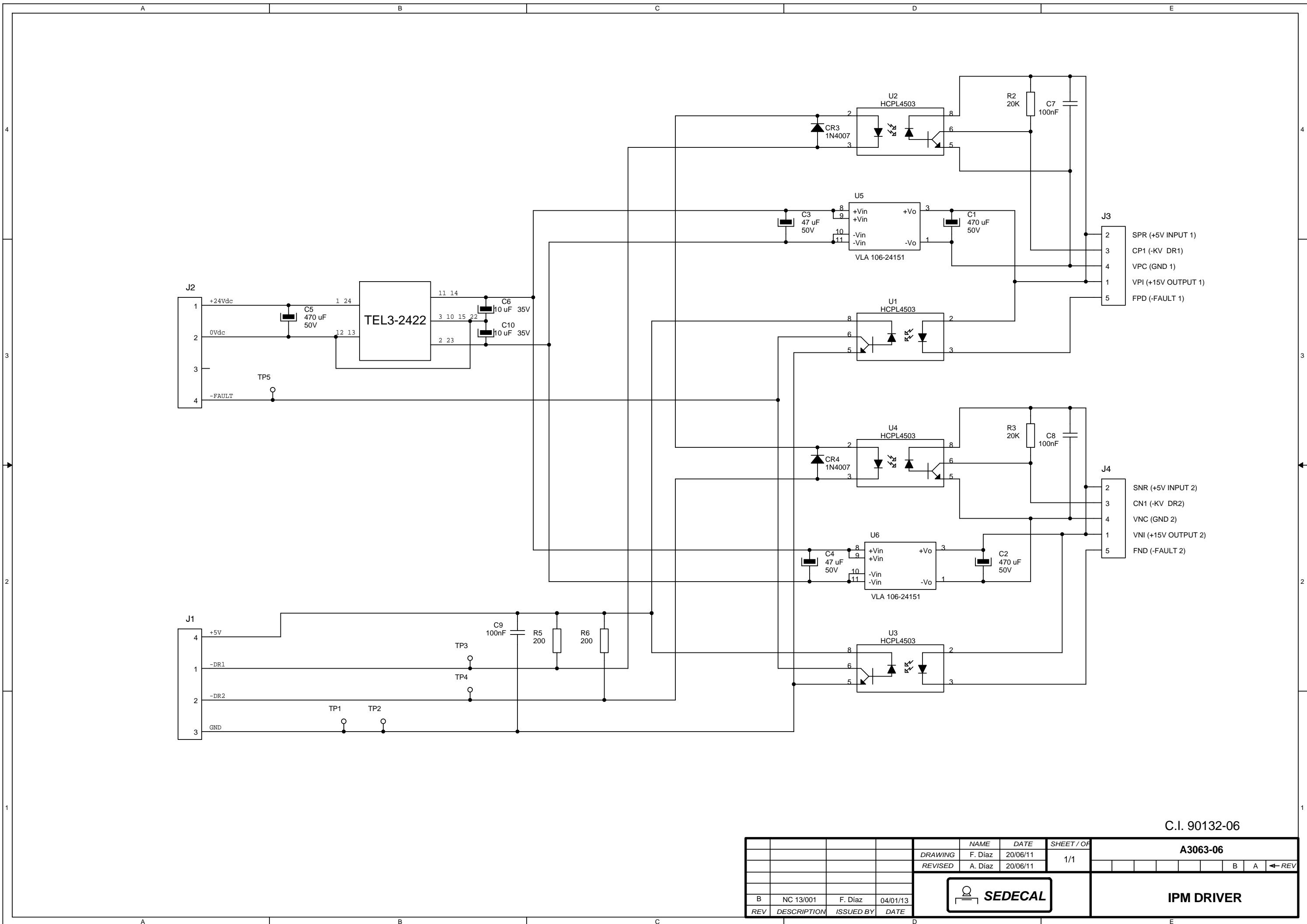


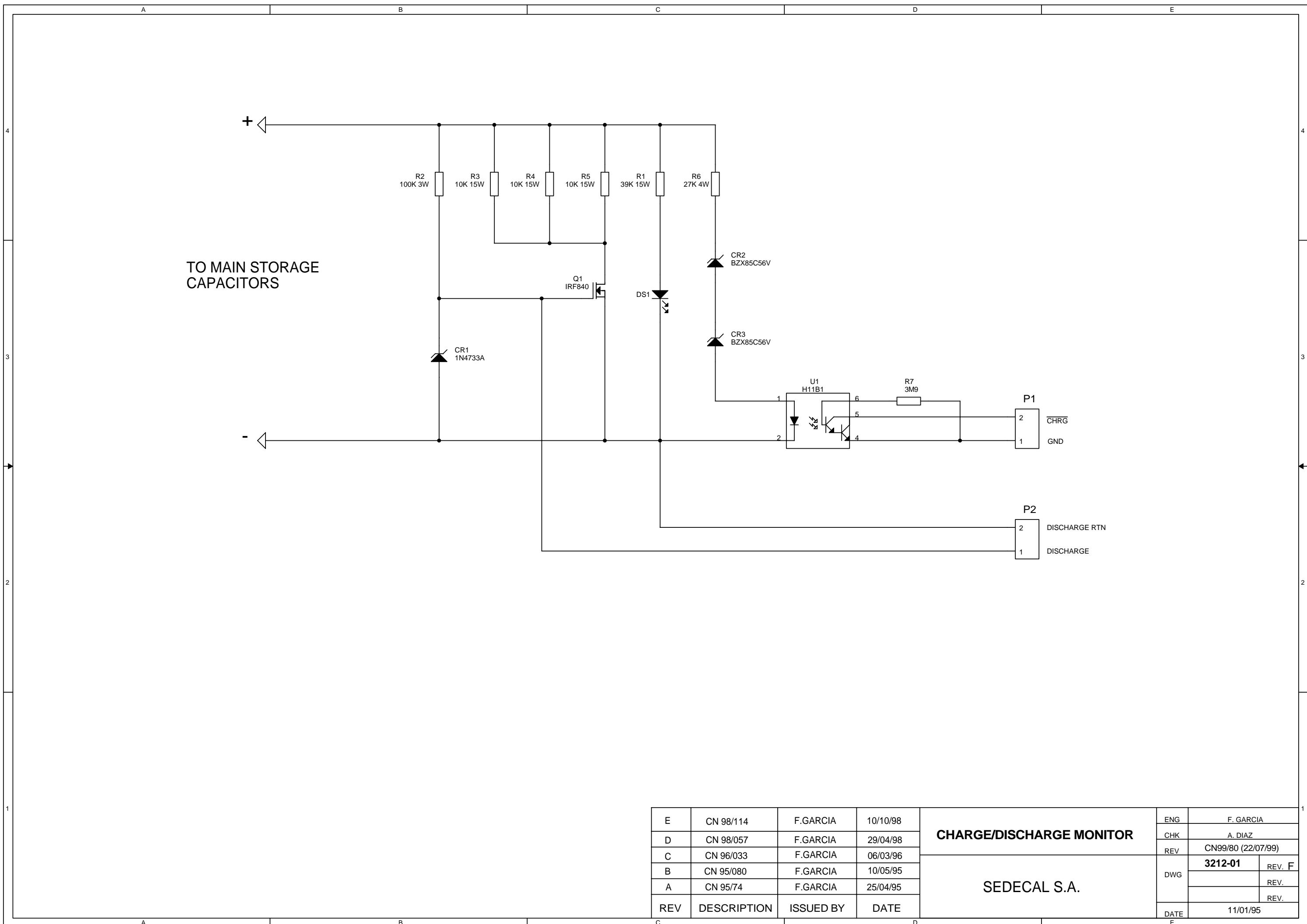


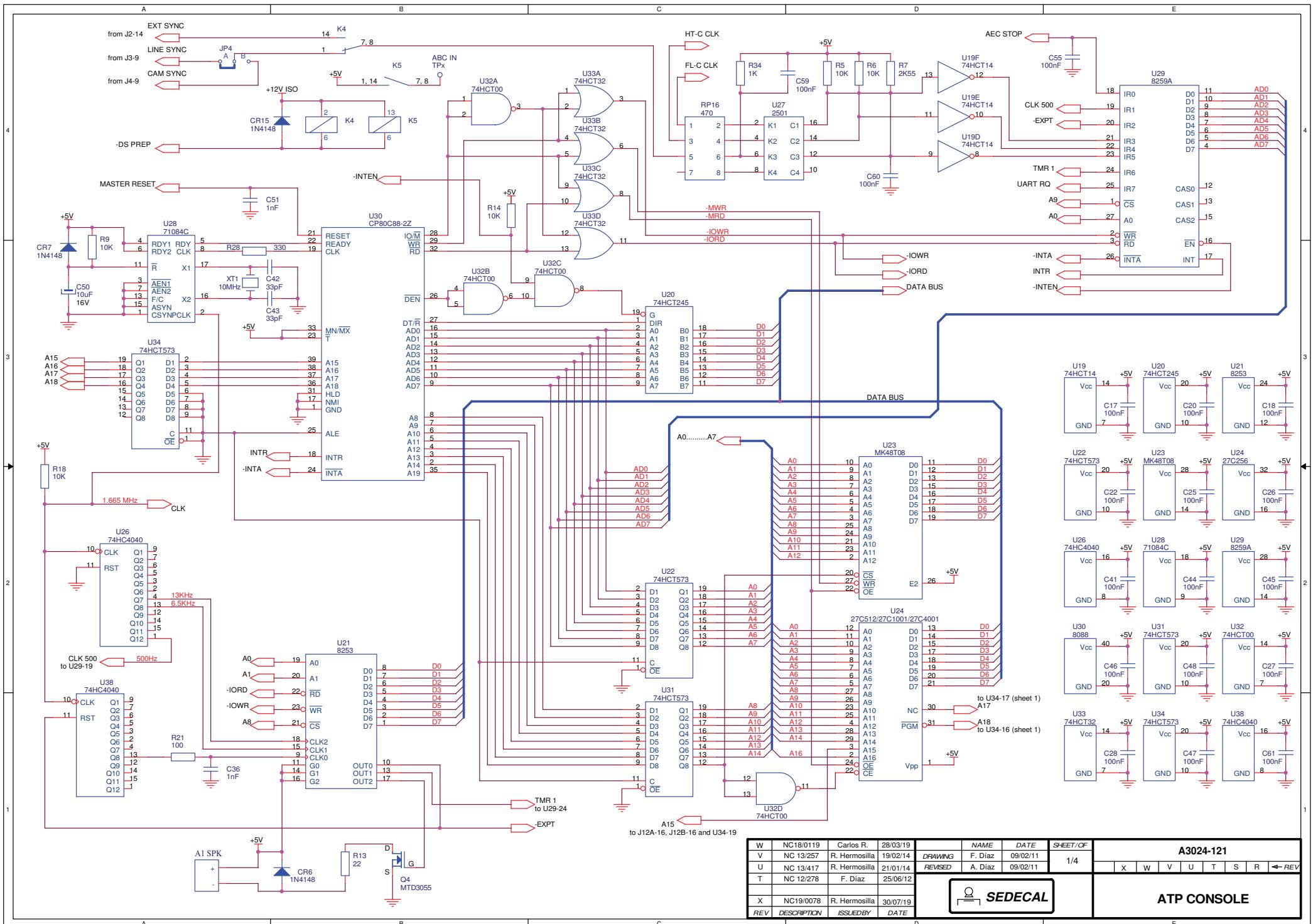












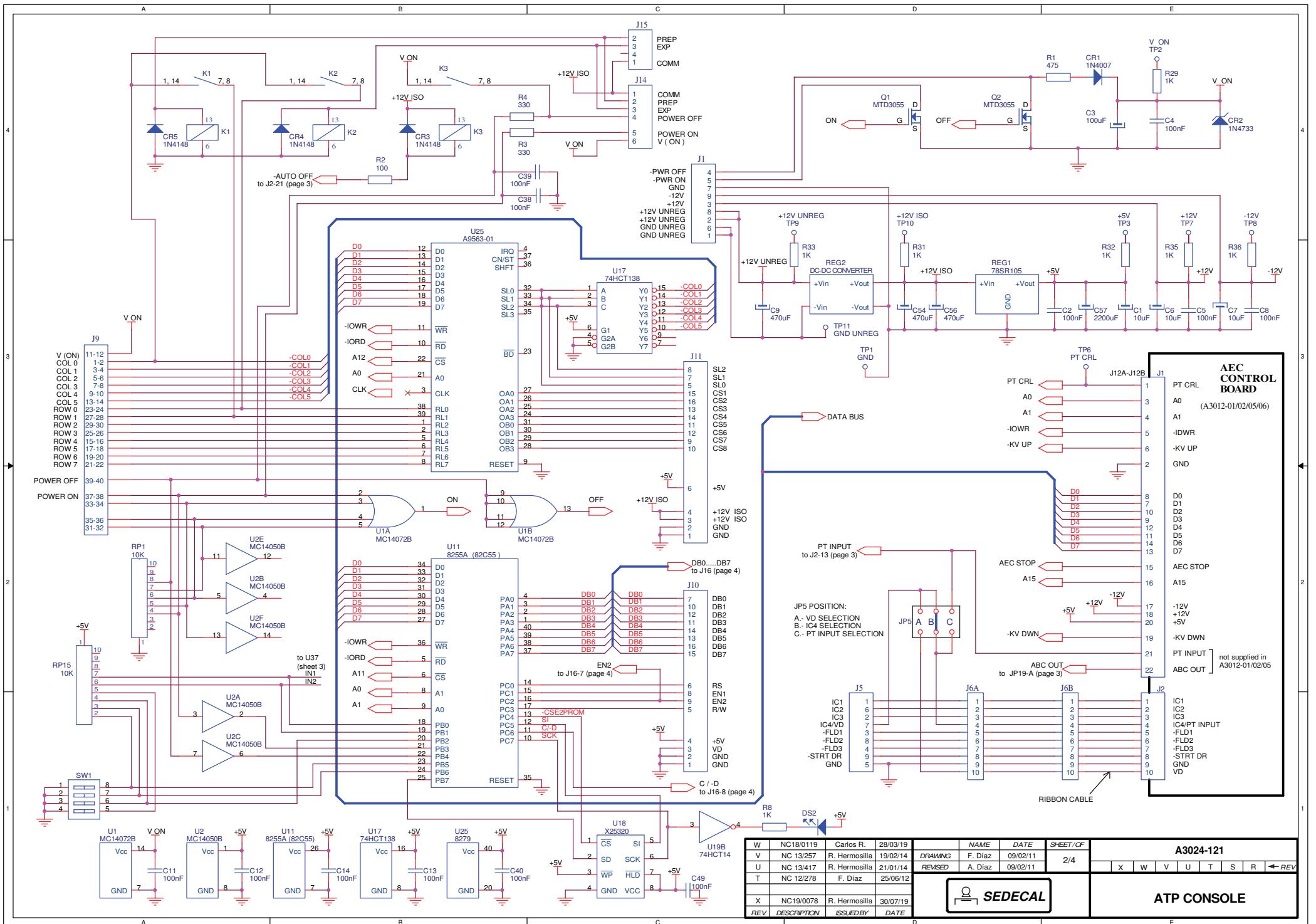
W	NC18/0119	Carlos R.	28/03/19	NAME	DATE	SHEET/OF
V	NC 13/257	R. Hermosilla	19/02/14	DRAWING	F. Diaz	09/02/11
U	NC 13/417	R. Hermosilla	21/01/14	REVISED	A. Diaz	09/02/11
T	NC 12/278	F. Diaz	25/06/12			
X	NC19/0078	R. Hermosilla	30/07/19			
REV	DESCRIPTION	ISSUED BY	DATE			



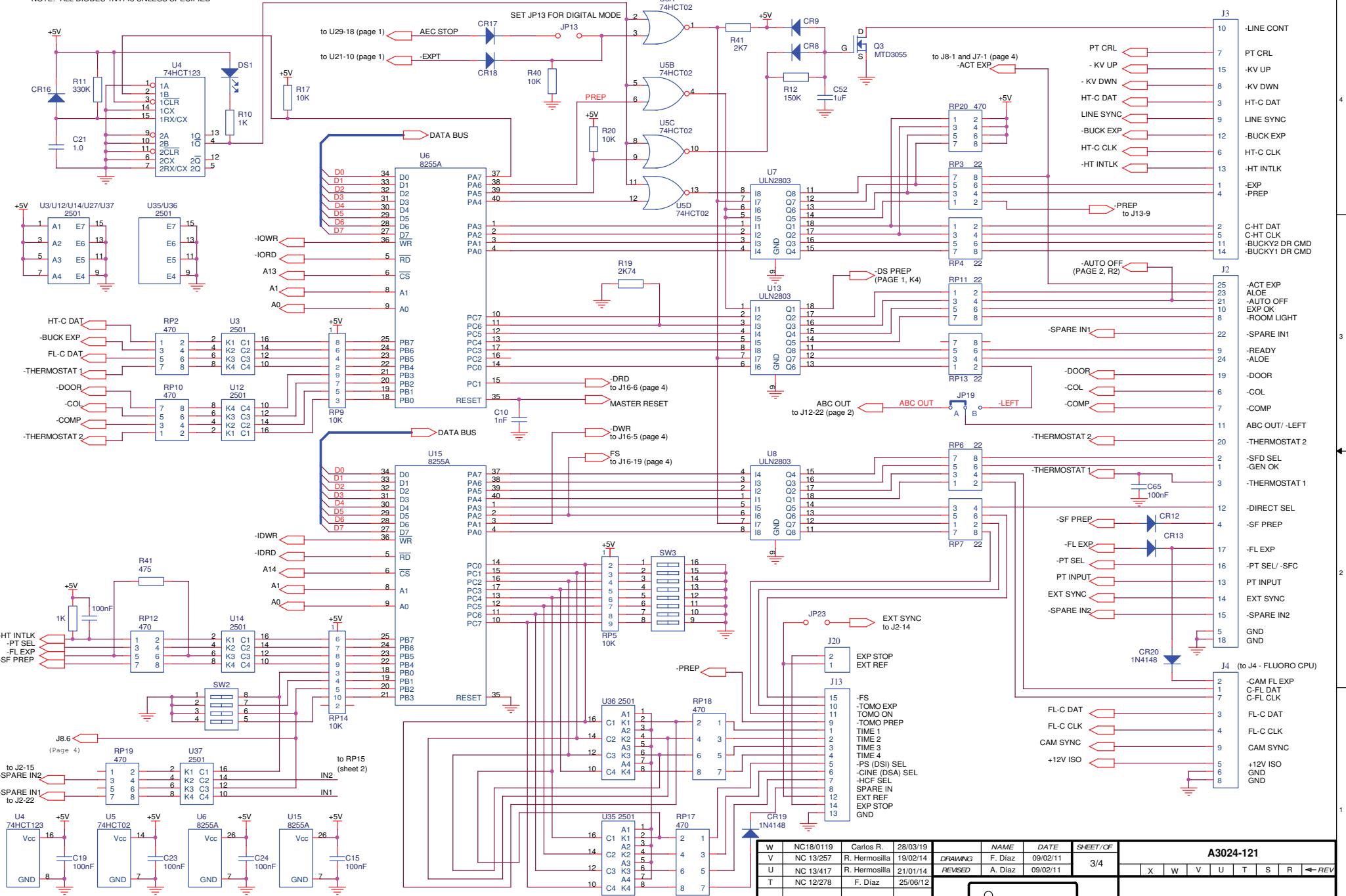
ATP CONSOLE

A3024-121

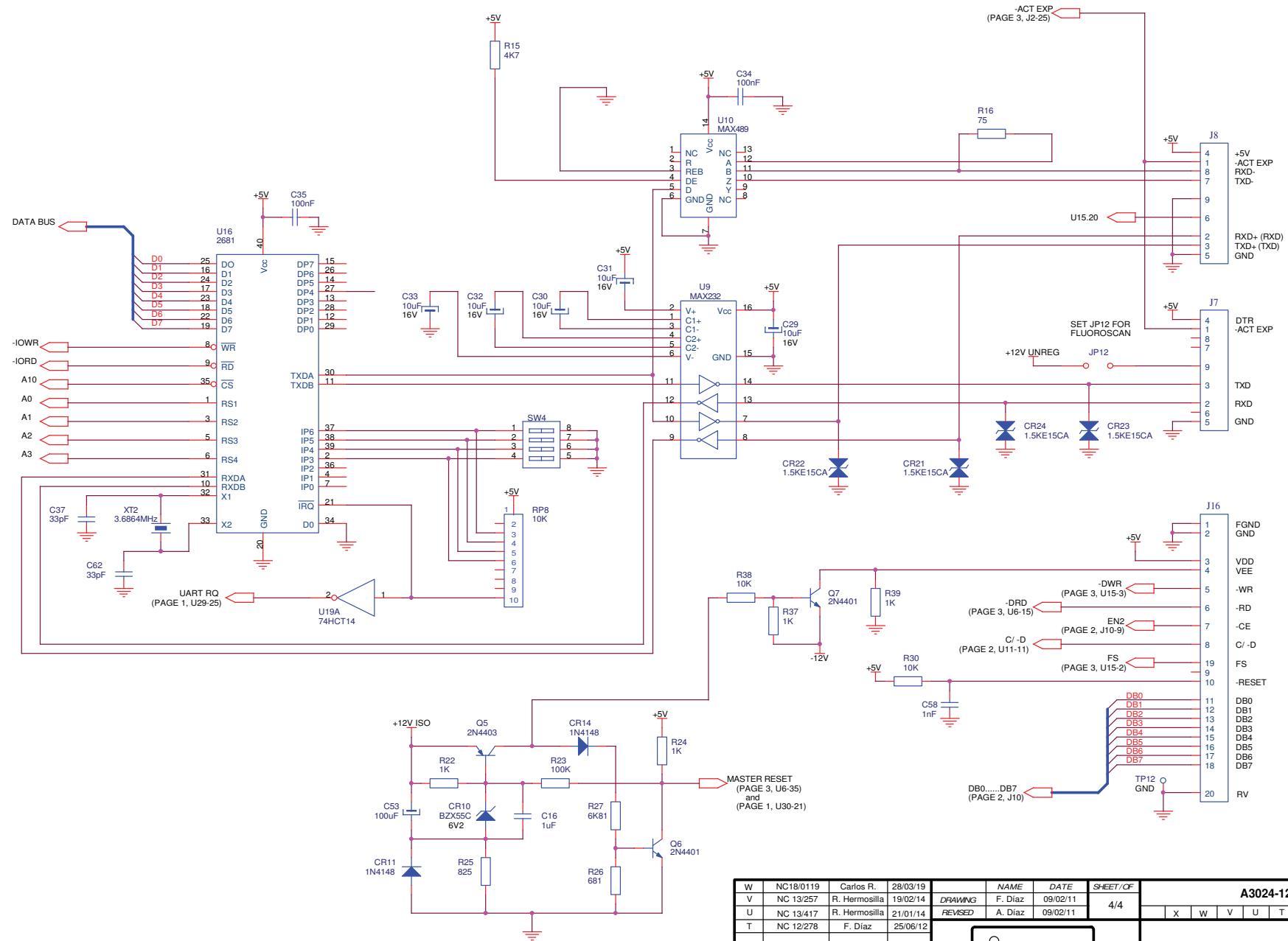
X W V U T S R ← REV



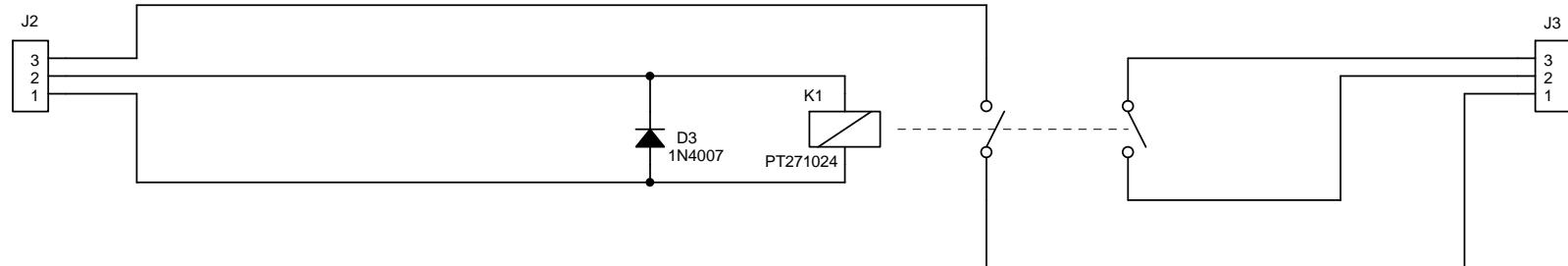
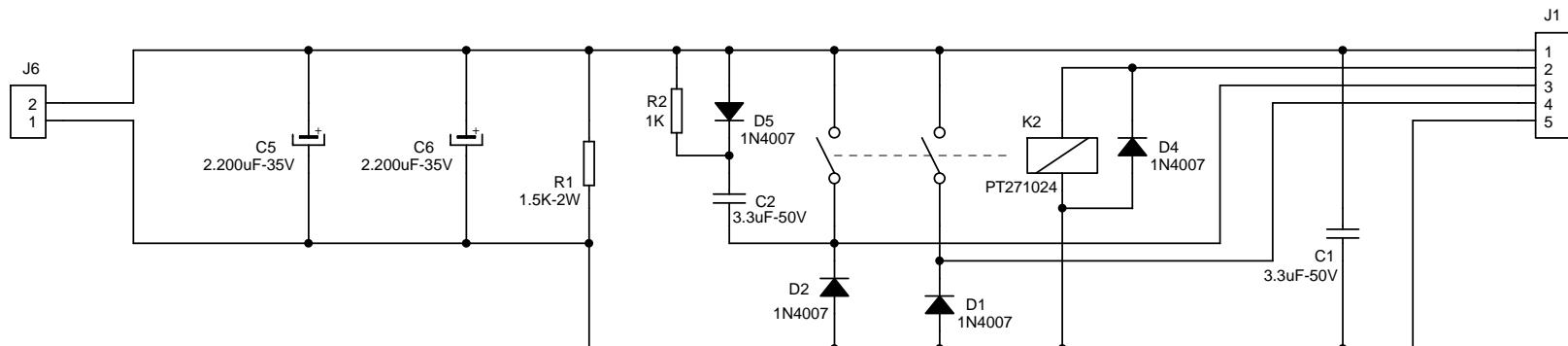
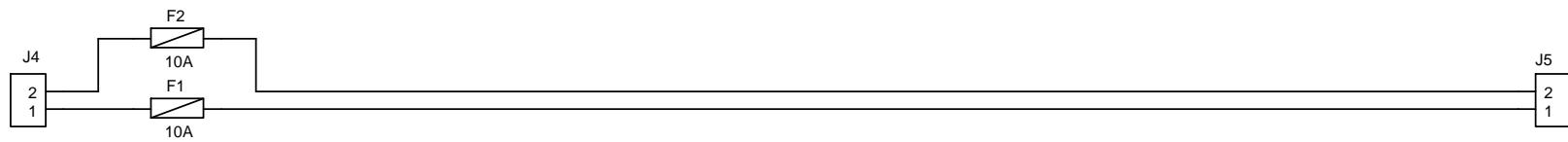
NOTE - ALL DIODES 1N4148 UNLESS SPECIFIED



W	NC18/0119	Carlos R.	28/03/19	V	NC 13/257	R. Hermosilla	19/02/14	U	NC 13/417	R. Hermosilla	21/01/14	T	NC 12/278	F. Diaz	25/06/12	DRAWING	F. Diaz	09/02/11	SHEET/OF	3/4
X	SEDECAL										ATP CONSOLE									
REV	DESCRIPTION	ISSUED BY	DATE	REV	DESCRIPTION	ISSUED BY	DATE	REV	DESCRIPTION	ISSUED BY	DATE	REV	DESCRIPTION	ISSUED BY	DATE	REV	DESCRIPTION	ISSUED BY	DATE	REV



W	NC18/0119	Carlos R.	28/03/19		NAME	DATE	SHEET/OF	A3024-121							
V	NC 13/257	R. Hermosilla	19/02/14	DRAWING	F. Diaz	09/02/11	4/4								
U	NC 13/417	R. Hermosilla	21/01/14	REVISED	A. Diaz	09/02/11		X	W	V	U	T	S	R	◀REV
T	NC 12/278	F. Diaz	25/06/12												
X	NC19/0078	R. Hermosilla	30/07/19	 SEDECAL		ATP CONSOLE									
REV	DESCRIPTION	ISSUED BY	DATE												

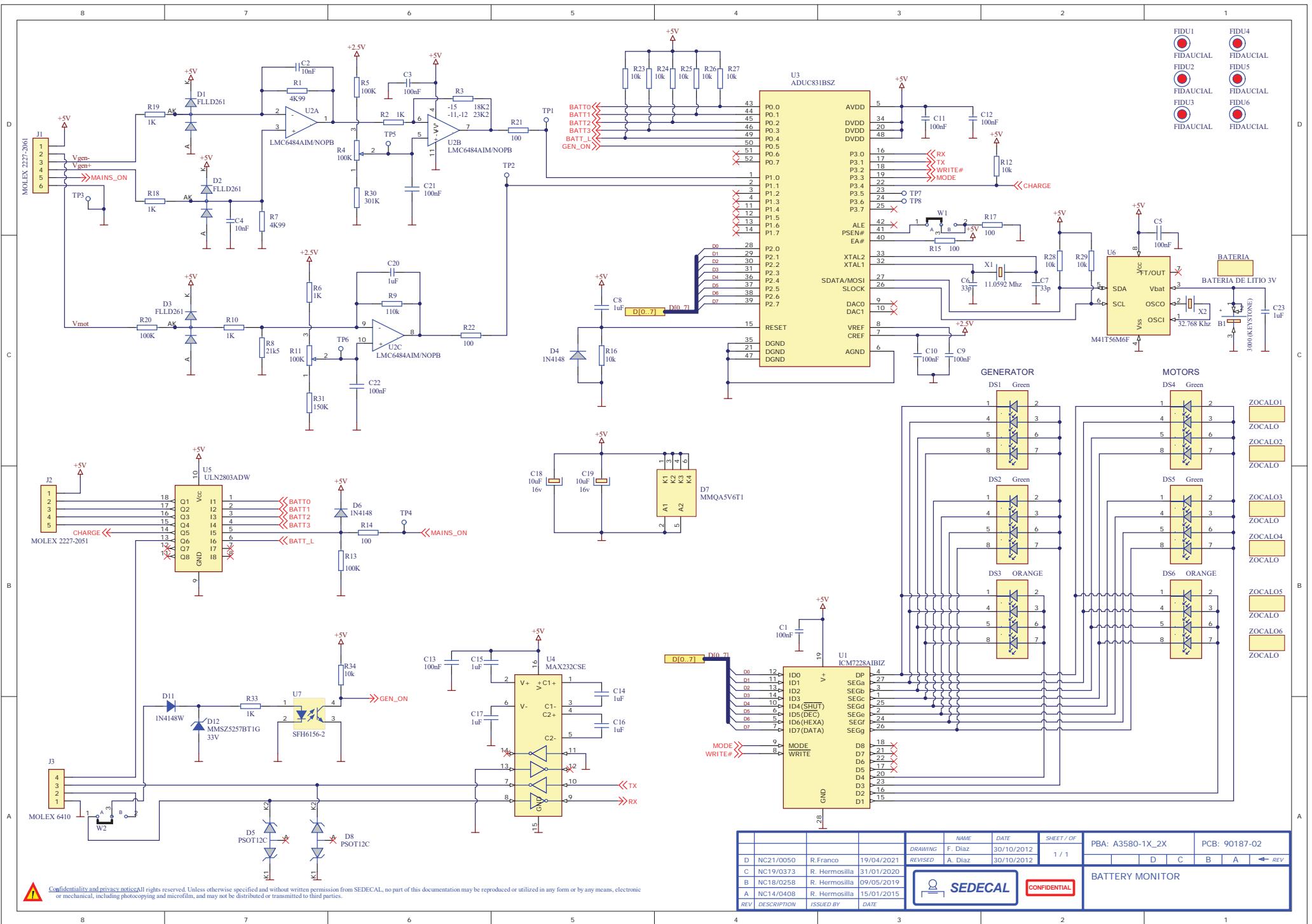


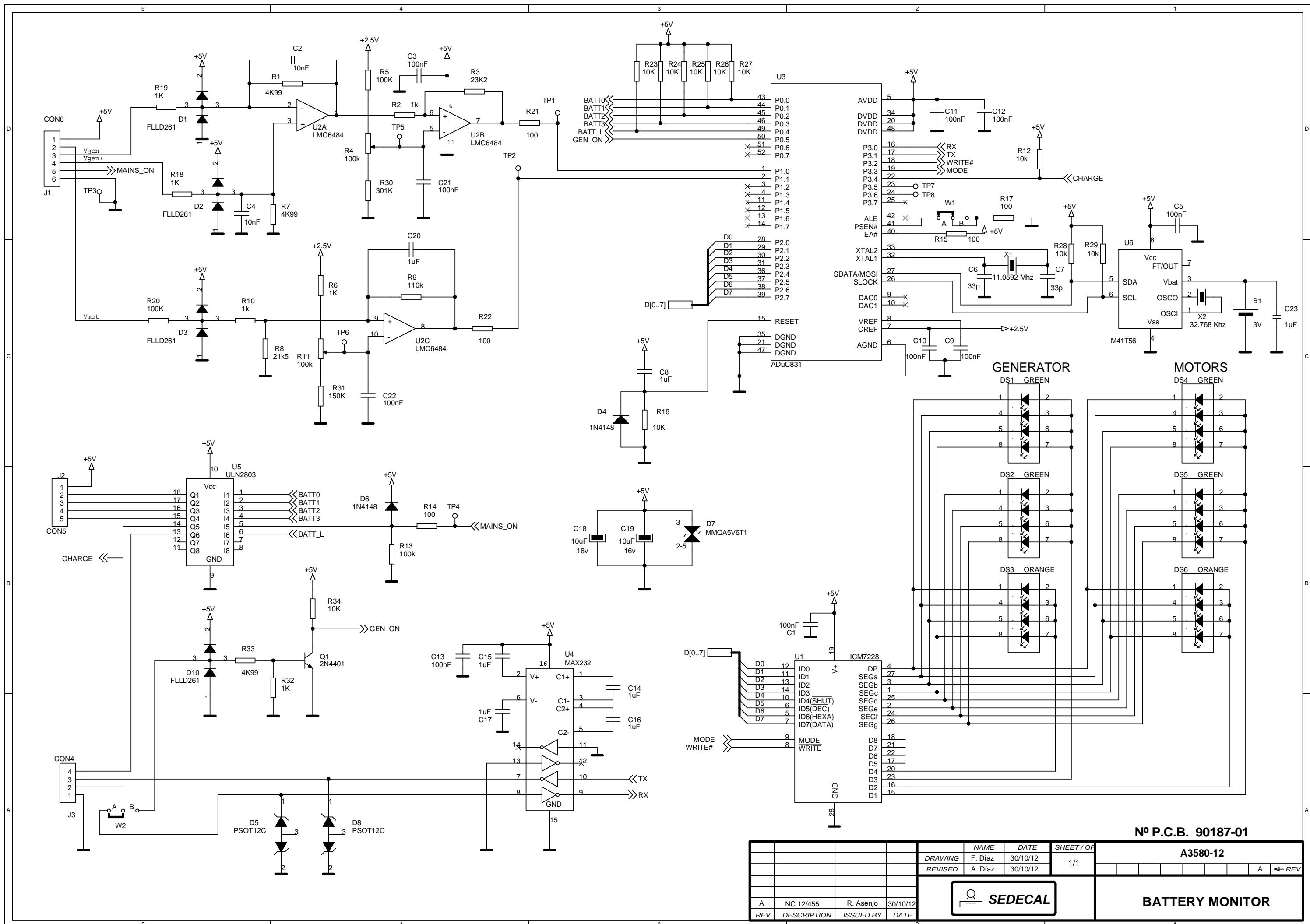
PCB 90109-02

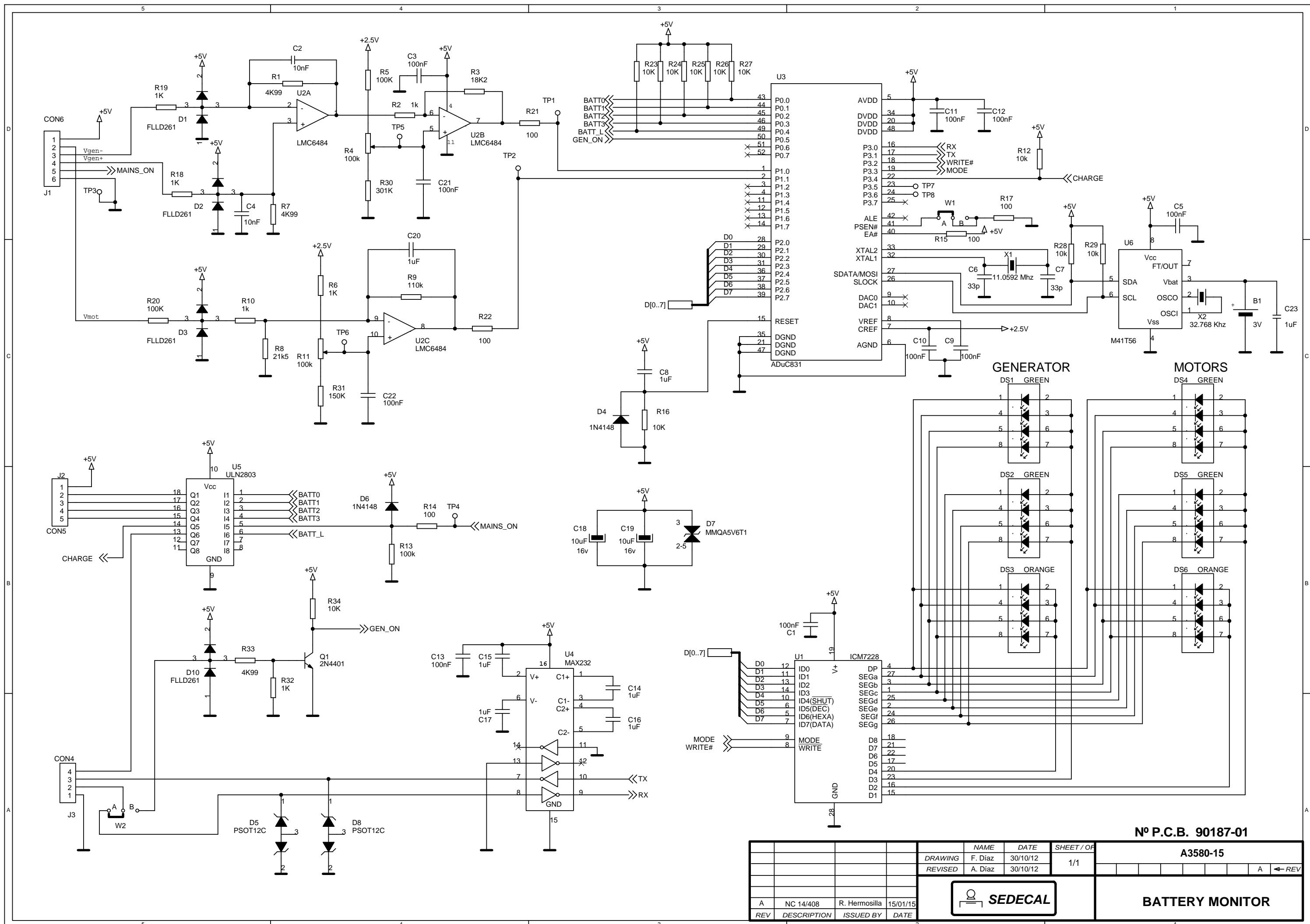
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					DRAWING	JLA	10-10-05	1/1	A
					REVISED	A. Diaz	10-10-05		← REV
A	NC 06/010 (24VDC)	JLA	06-10-10						
REV	DESCRIPTION	ISSUED BY	DATE						

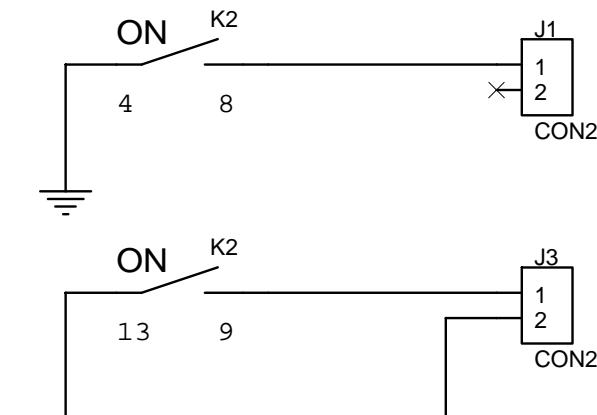
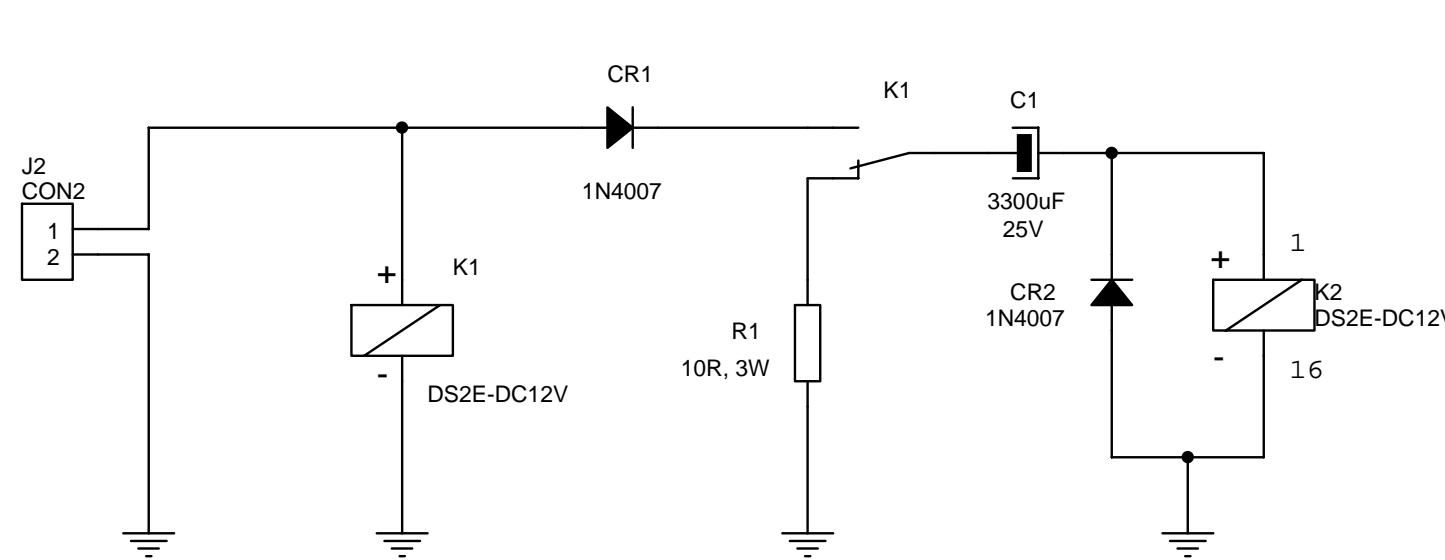
SEDECAL

BRAKE BOARD



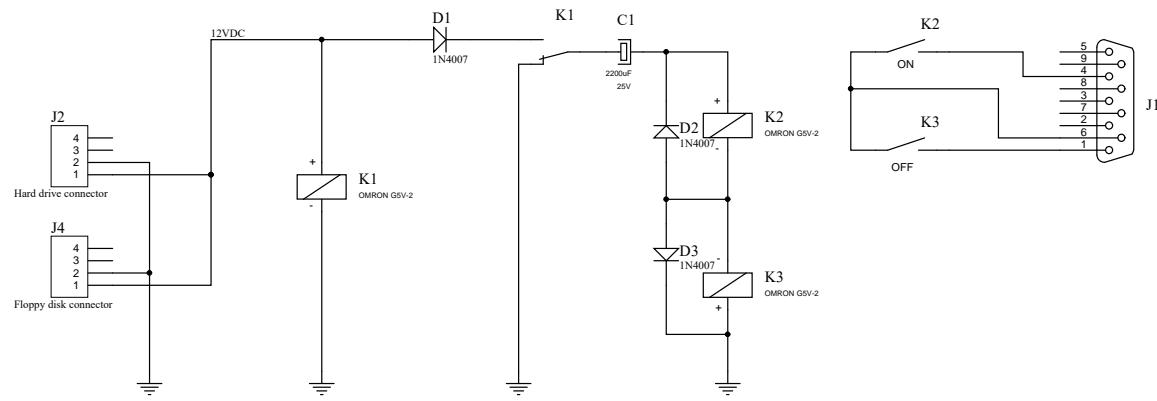






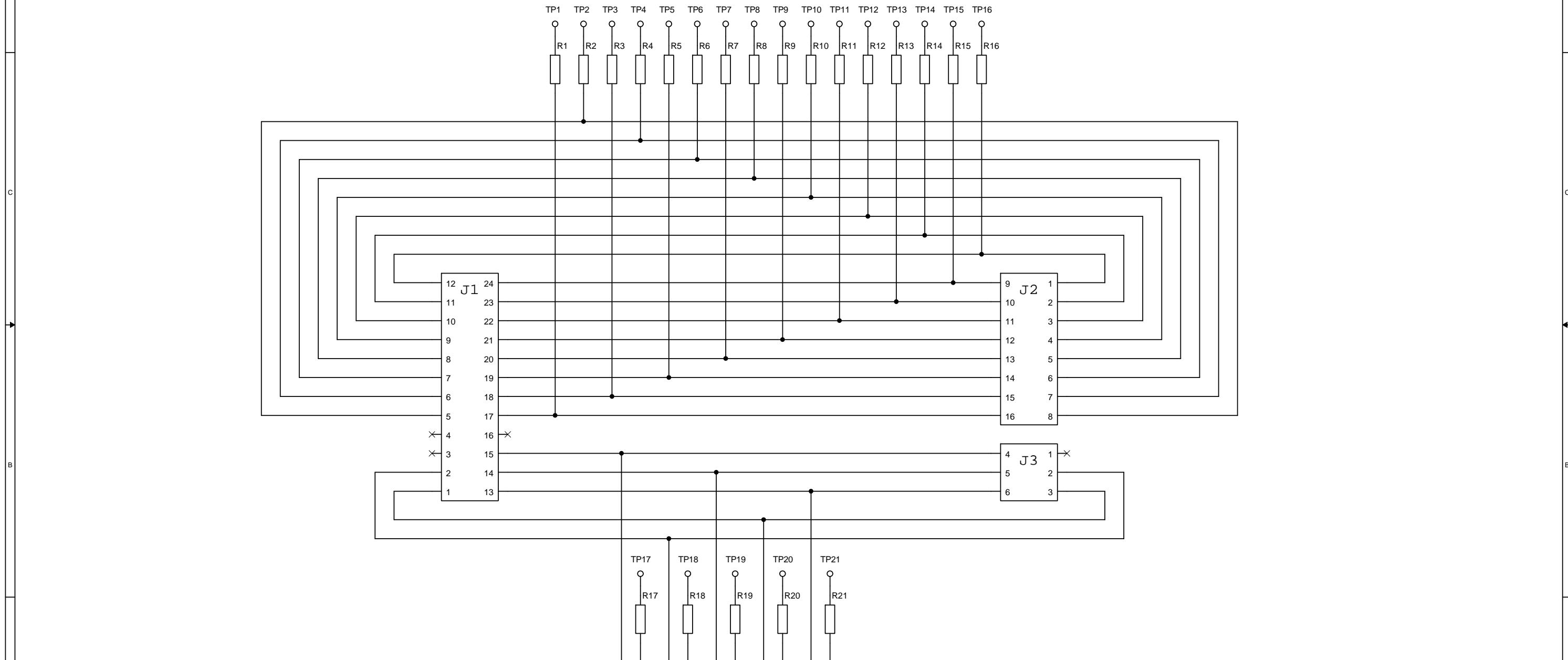
CODIGO PLACA 90077-01

				NAME	DATE	SHEET / OF	A3179-05				
				DRAWING	J.A. Garcia	02/12/04	1/1				
				REVISED	F. Diaz	02/12/04					
REV	DESCRIPTION	ISSUED BY	DATE	 SEDECAL				AUTO ON/OFF MOVIL			



PCB: 90241-01

			NAME	DATE	SHEET / OF	A3179-09-10-11									
			DRAWING	MC	14/01/10	1 / 1			B	A	REV				
			REVISED	F.Diaz	14/01/10										
B	NC 14/127	J.A.Garcia	29/05/14	 <p>SEDECAL</p>											
A	NE 223/10	MC	14/01/10												
REV	DESCRIPTION	ISSUED BY	DATE												

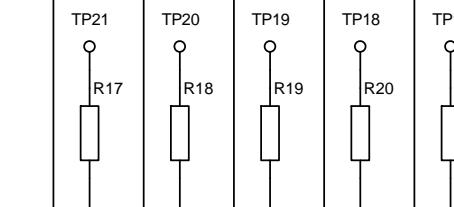
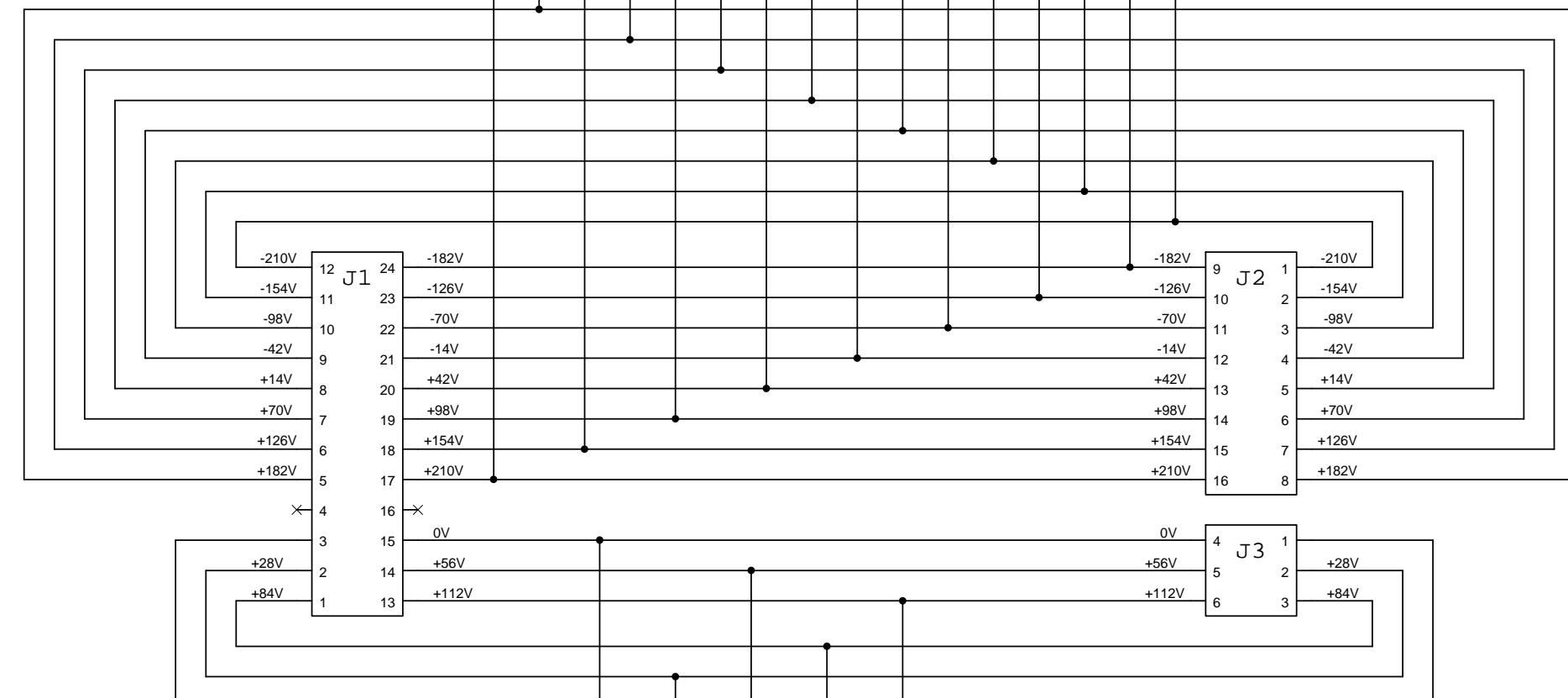
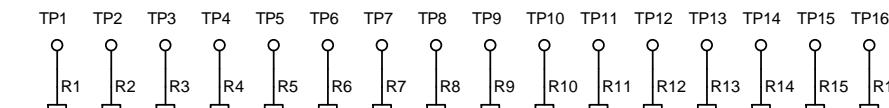


De R1 a R21 2k49/0.125W

				NAME	DATE	SHEET / OF	A9504-02			
B	NC 12/142	R. Asenjo	16/04/12	DRAWING	R. Asenjo	28/03/07	1/1	B	A	↔ REV
A	First Issue	R. Asenjo	28/03/07	REVISED	A. Diaz	28/03/07				
REV	DESCRIPTION	ISSUED BY	DATE	SEDECAL			PCB BATTERY TEST			

D

D



De R1 a R21 2k49/0.125W

					NAME	DATE	SHEET / OF	A9504-03				
B	NC 10/052	R. Asenjo	03/02/10	DRAWING	R. Asenjo	01/07/08 <th>1/1</th> <td></td> <td></td> <td></td> <td></td>	1/1					
A	First Issue	R. Asenjo	01/07/08	REVISED	A. Diaz	01/07/08						
REV	DESCRIPTION	ISSUED BY	DATE	SEDECAL	PCB BATTERY TEST							
				Ω SEDECAL								

D

D

C

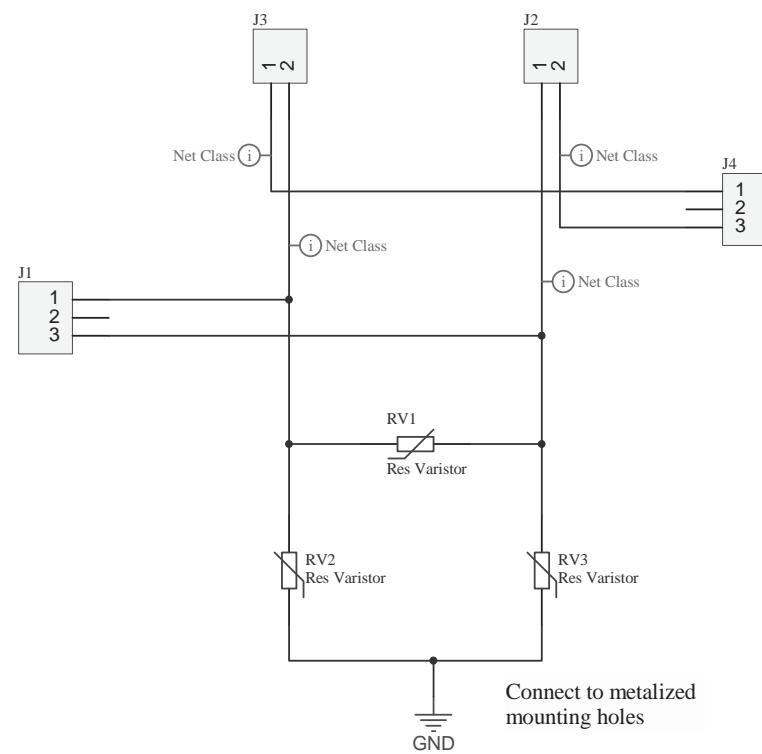
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B

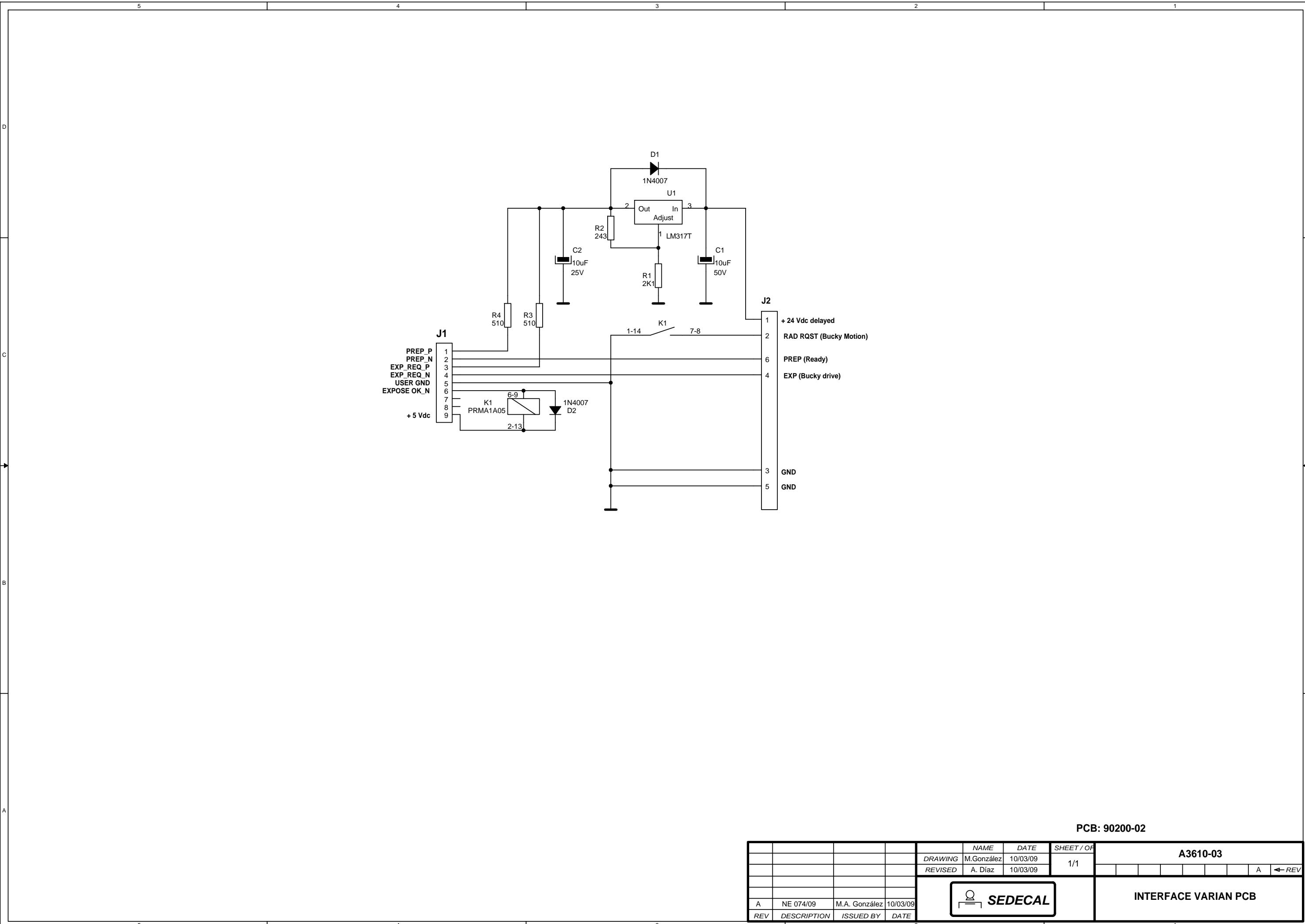
B

A

A



					NAME	DATE	SHEET/OF	A9524-02
					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		PCB VARISTOR BOARD	



D

4

6

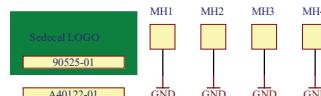
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B

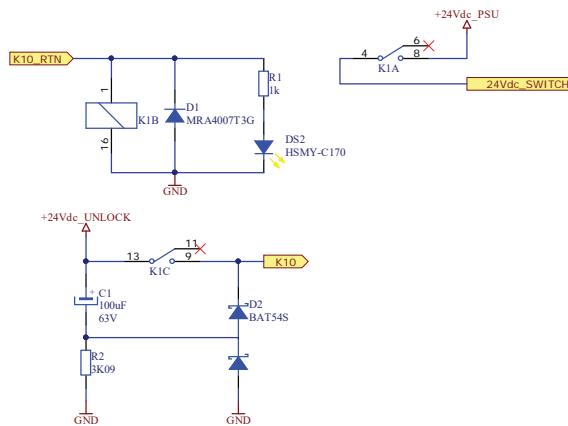
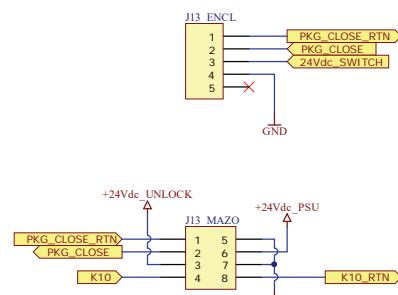
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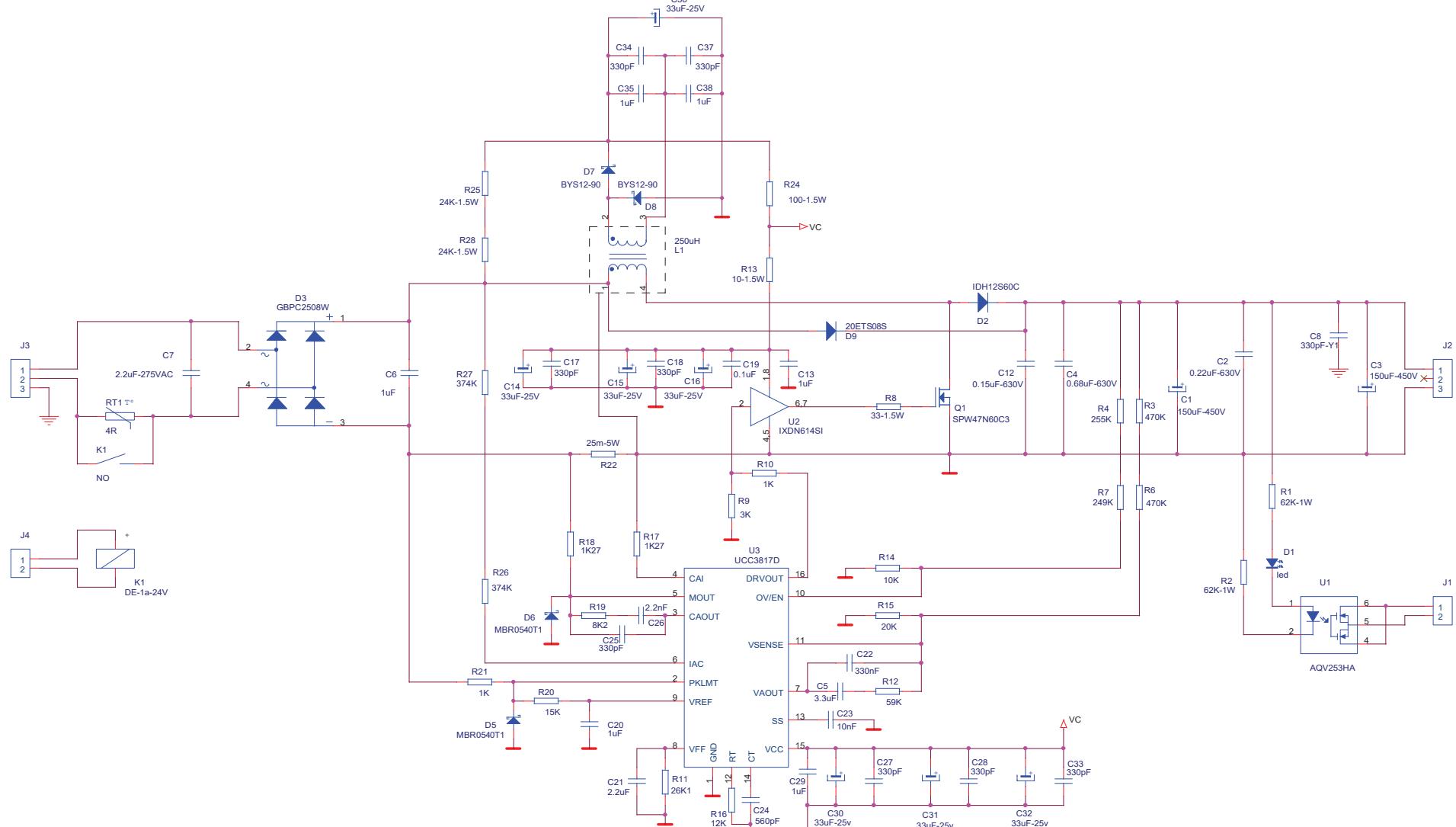
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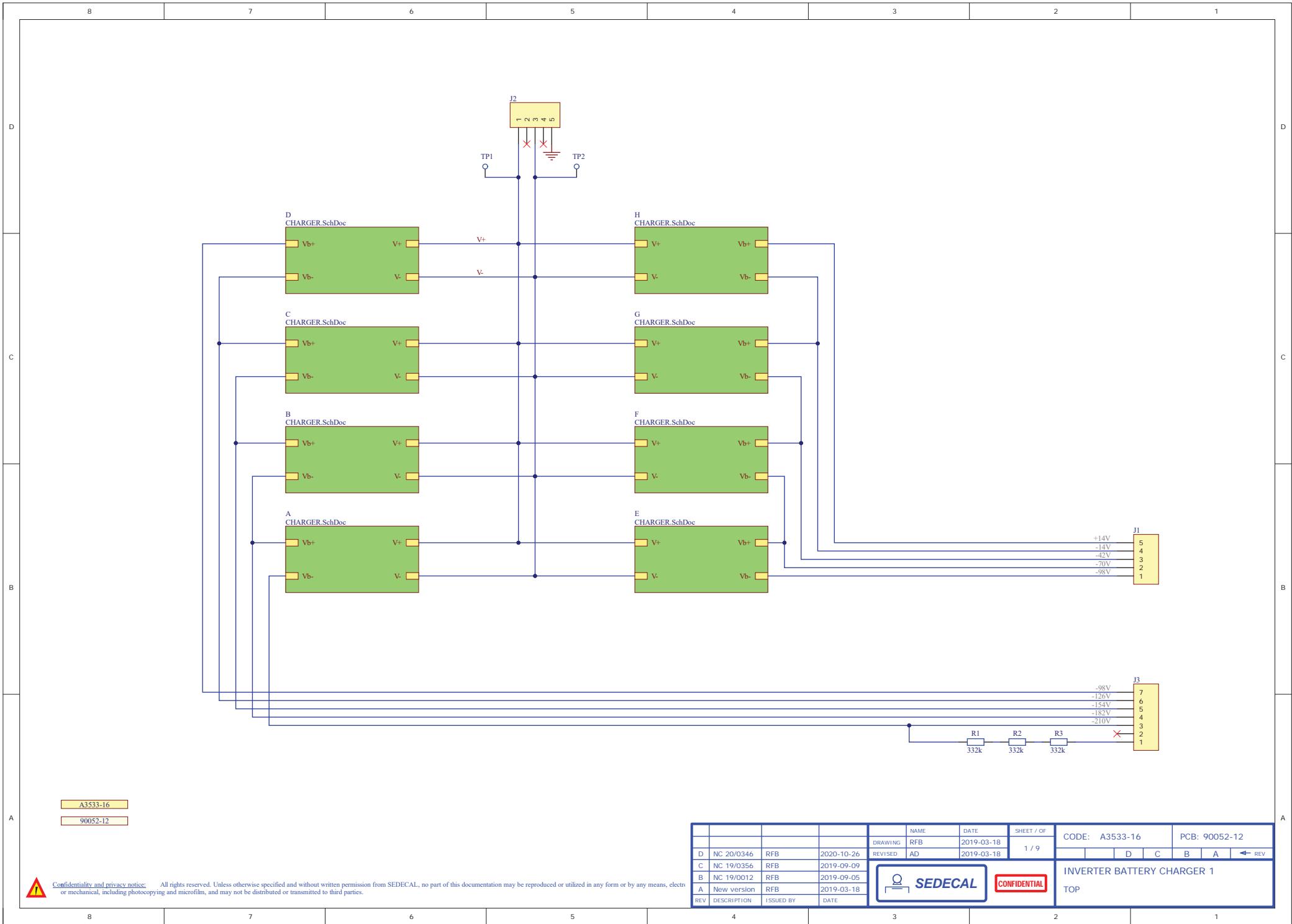


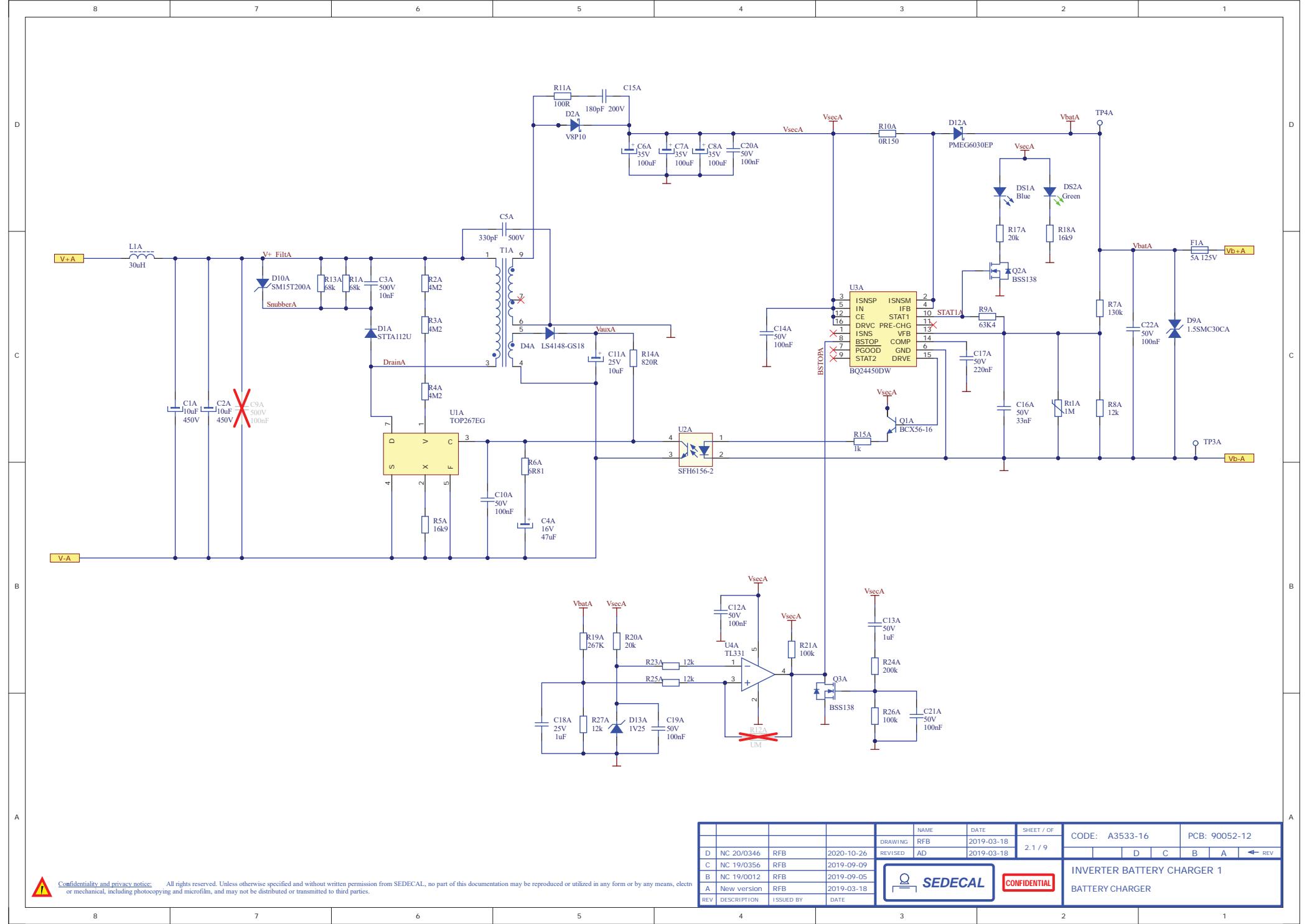
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			REVISED F. Diaz	14/02/19		A	← REV
A	NC19/0114	R. Hermosilla	14/02/19	 SEDECAL		CONFIDENTIAL	
REV.	DESCRIPTION	ISSUED BY	DATE	ENCLAVAMIENTO MOVIL III			
INTERFACE PBA							



PCB 90048-06

			NAME DRAWING	DATE JLA/FD	SHEET / OF 25/03/09	A3578-41	D	C	B	← REV	
			REVISED	A. Diaz	1/1						
D	NC 15/0461 PCB	R.Igea	15/12/15	 SEDECAL							
C	NC 15/0395 PCB	R.Asenjo	29/10/15			PFC 1000					
B	NC 15/325 C8	JMG	13/10/15								
REV	DESCRIPTION	ISSUED BY	DATE								





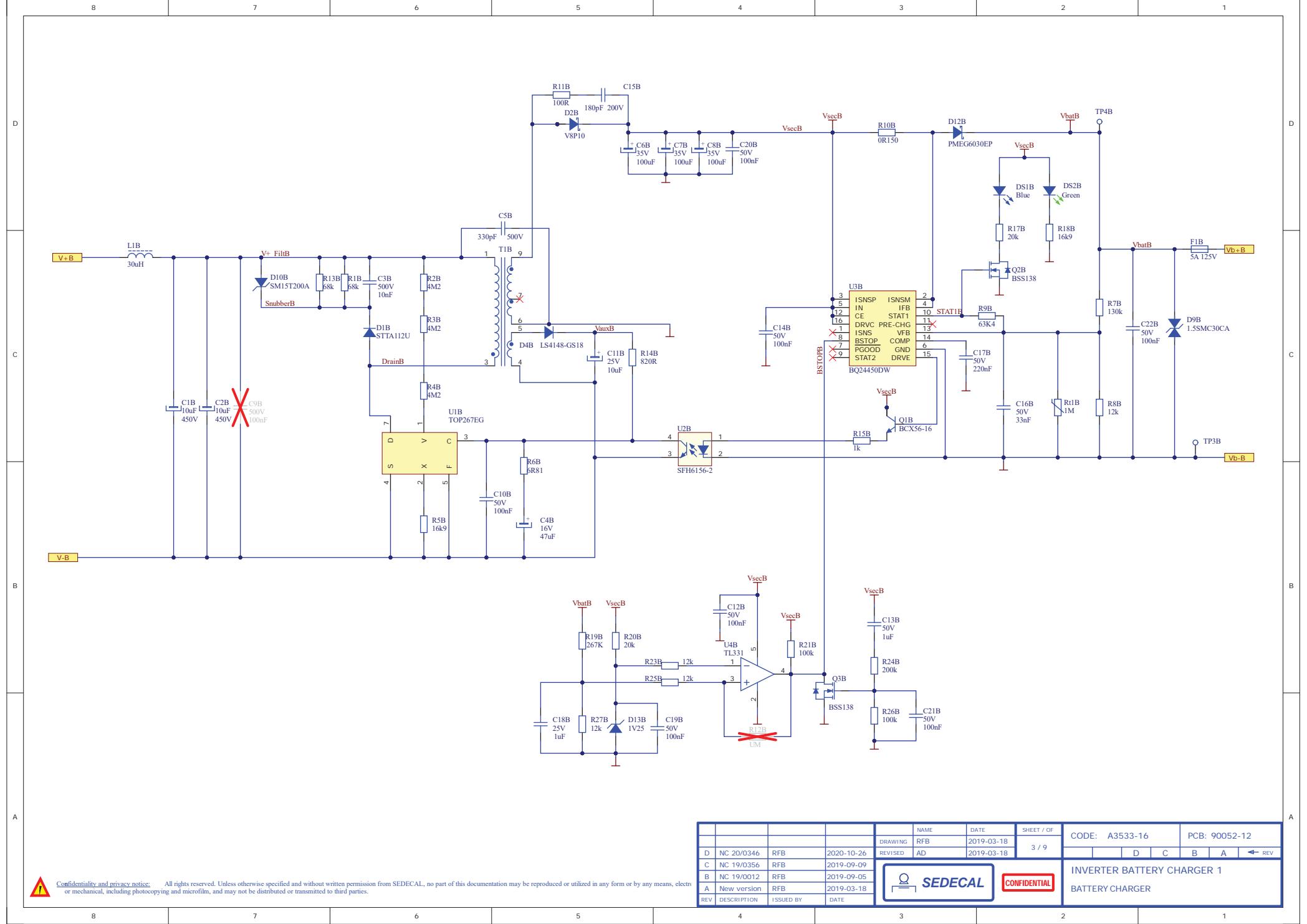
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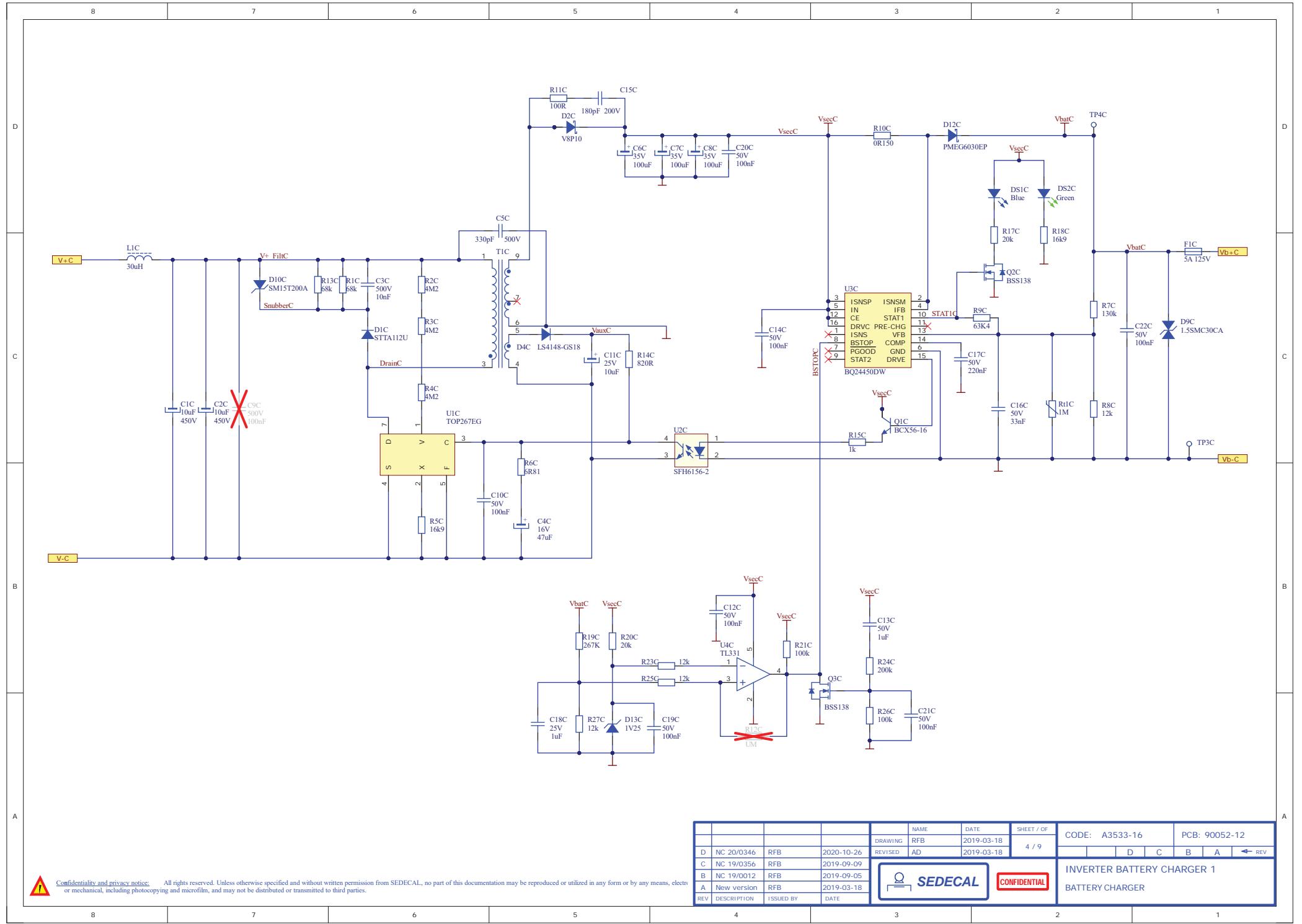
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C	NC 19/0356	RFB	2019-09-09	2019-03-18			
B	NC 19/0012	RFB	2019-09-05	2019-03-18			
A	New version	RFB					
REV	DESCRIPTION	ISSUED BY	DATE				



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INVERTER BATTERY CHARGER 1
BATTERY CHARGER





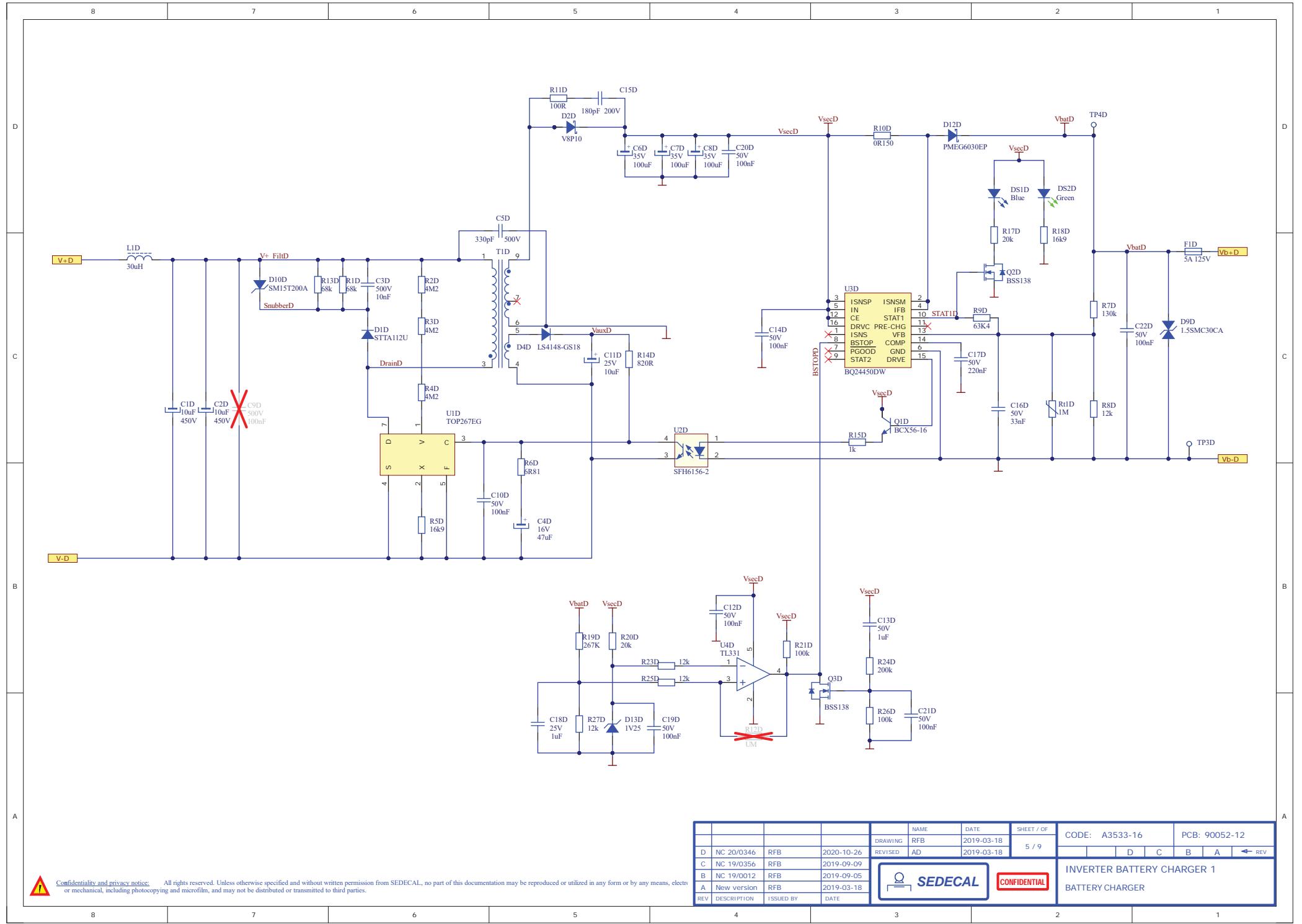
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C	NC 19/0356	RFB	2019-09-09	REVISED AD	2019-03-18		
B	NC 19/0012	RFB	2019-09-05				
A	New version	RFB	2019-03-18				
REV	DESCRIPTION	ISSUED BY	DATE				



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INVERTER BATTERY CHARGER 1
BATTERY CHARGER

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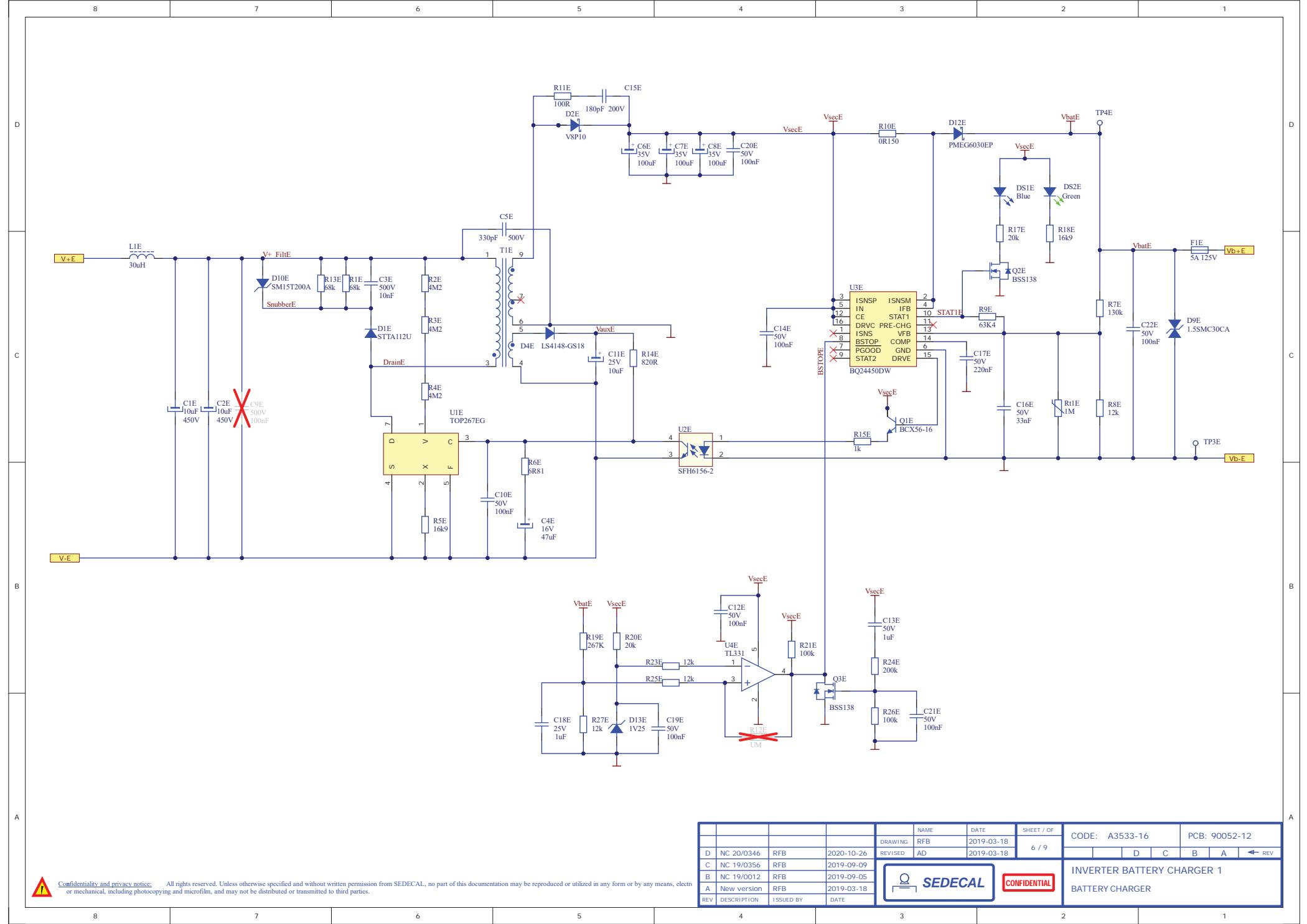
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			NAME	DATE	SHEET / OF	CODE: A3533-16	PCB: 90052-12
D	NC 20/0346	RFB	2020-10-26	RFB	2019-03-18	5 / 9	
C	NC 19/0356	RFB	2019-09-09		REVISED AD	2019-03-18	
B	NC 19/0012	RFB	2019-09-05				
A	New version	RFB	2019-03-18				
REV	DESCRIPTION	ISSUED BY	DATE				



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INVERTER BATTERY CHARGER 1
BATTERY CHARGER



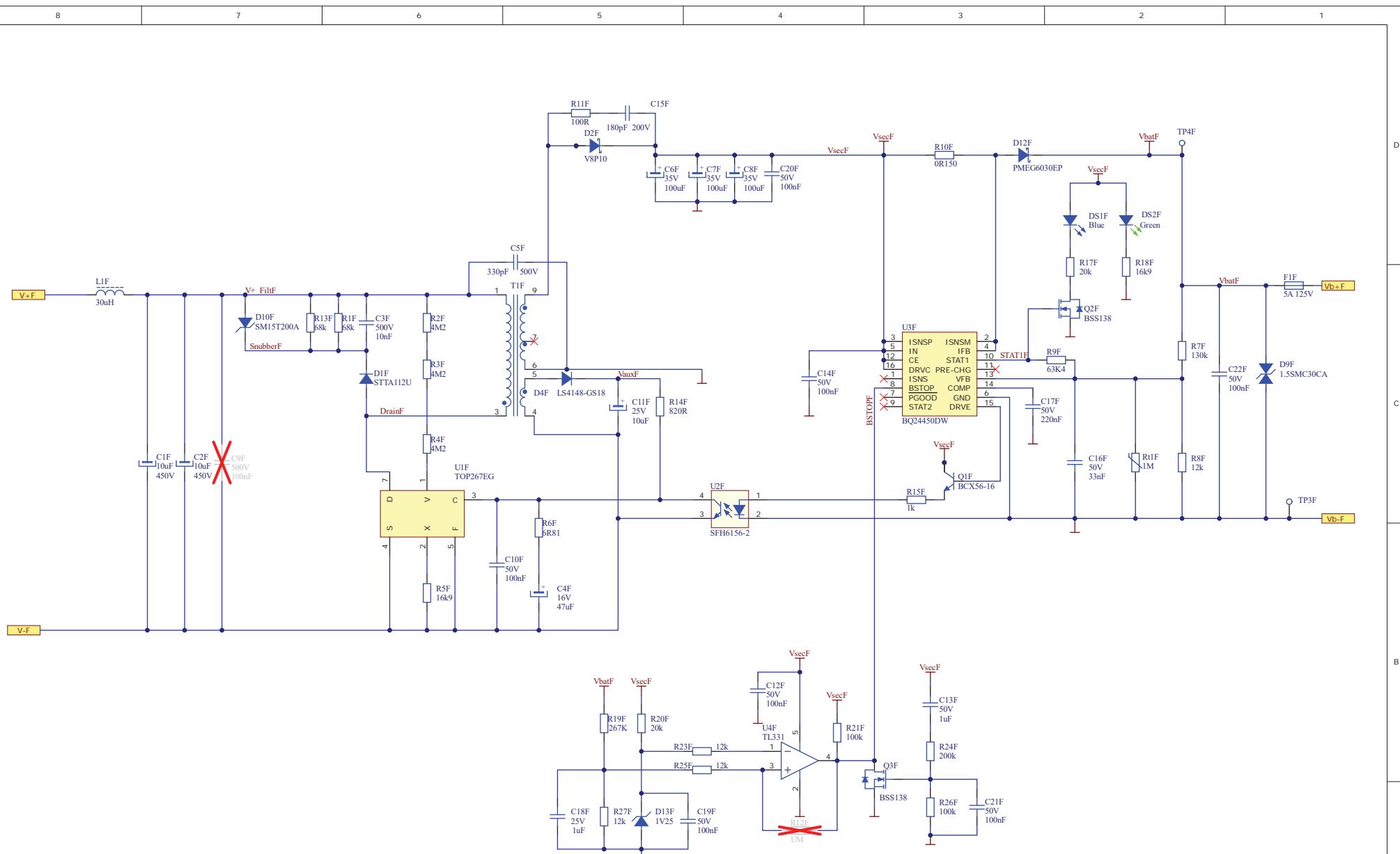
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C	NC 19/0356	RFB	2019-09-09	2019-03-18			
B	NC 19/0012	RFB	2019-09-05				
A	New version	RFB	2019-03-18				
REV	DESCRIPTION	ISSUED BY	DATE				



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INVERTER BATTERY CHARGER 1
BATTERY CHARGER



1

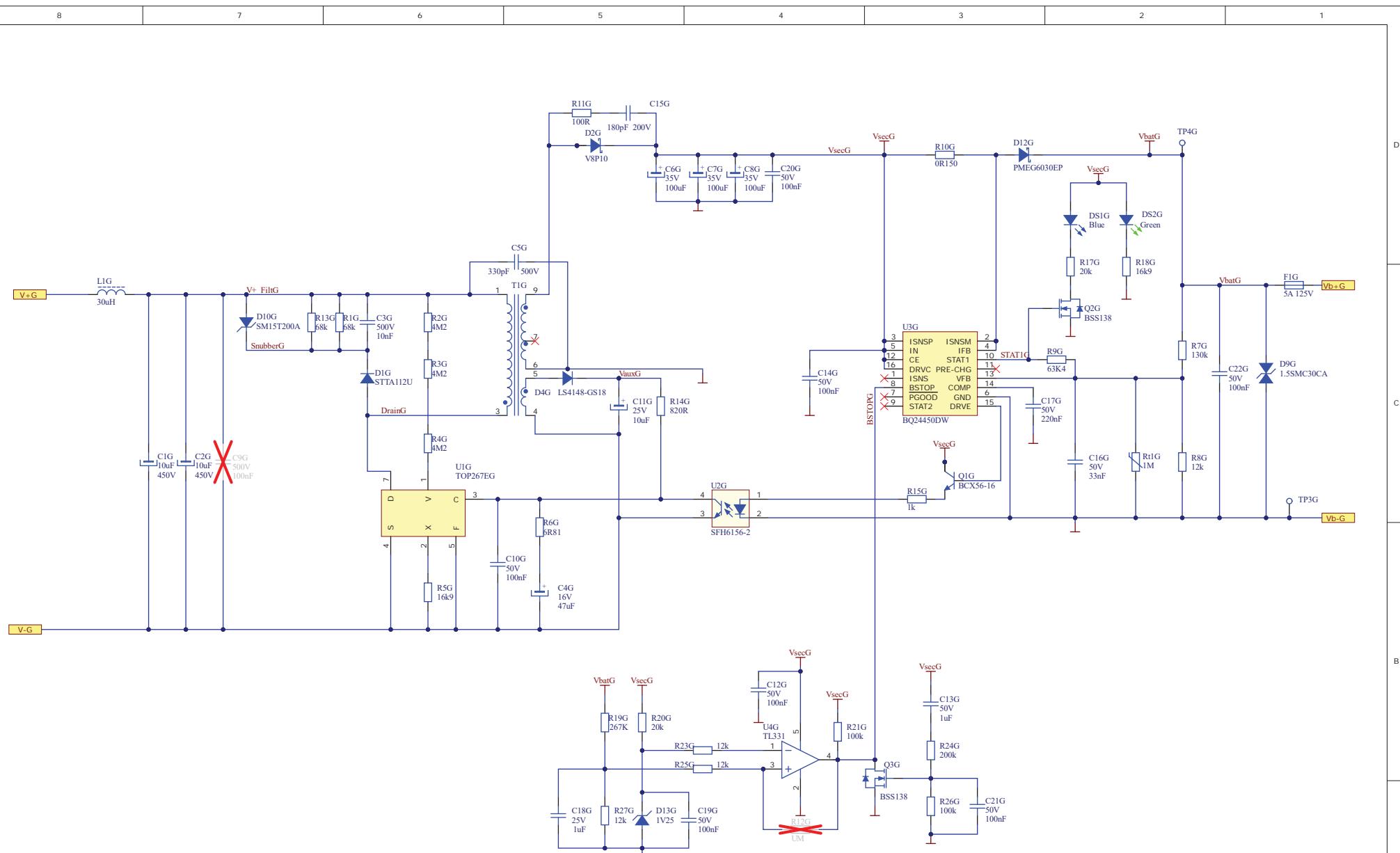
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D	NC 20/0346	RFB	2020-10-26	REVISED	AD	2019-03-18	D	C	B	A	REV
C	NC 19/0356	RFB	2019-09-09				INVERTER BATTERY CHARGER 1				
B	NC 19/0012	RFB	2019-09-05				BATTERY CHARGER				
A	New version	RFB	2019-03-18								
REV	DESCRIPTION	ISSUED BY	DATE								


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INVERTER BATTERY CHARGER 1

BATTERY CHARGER



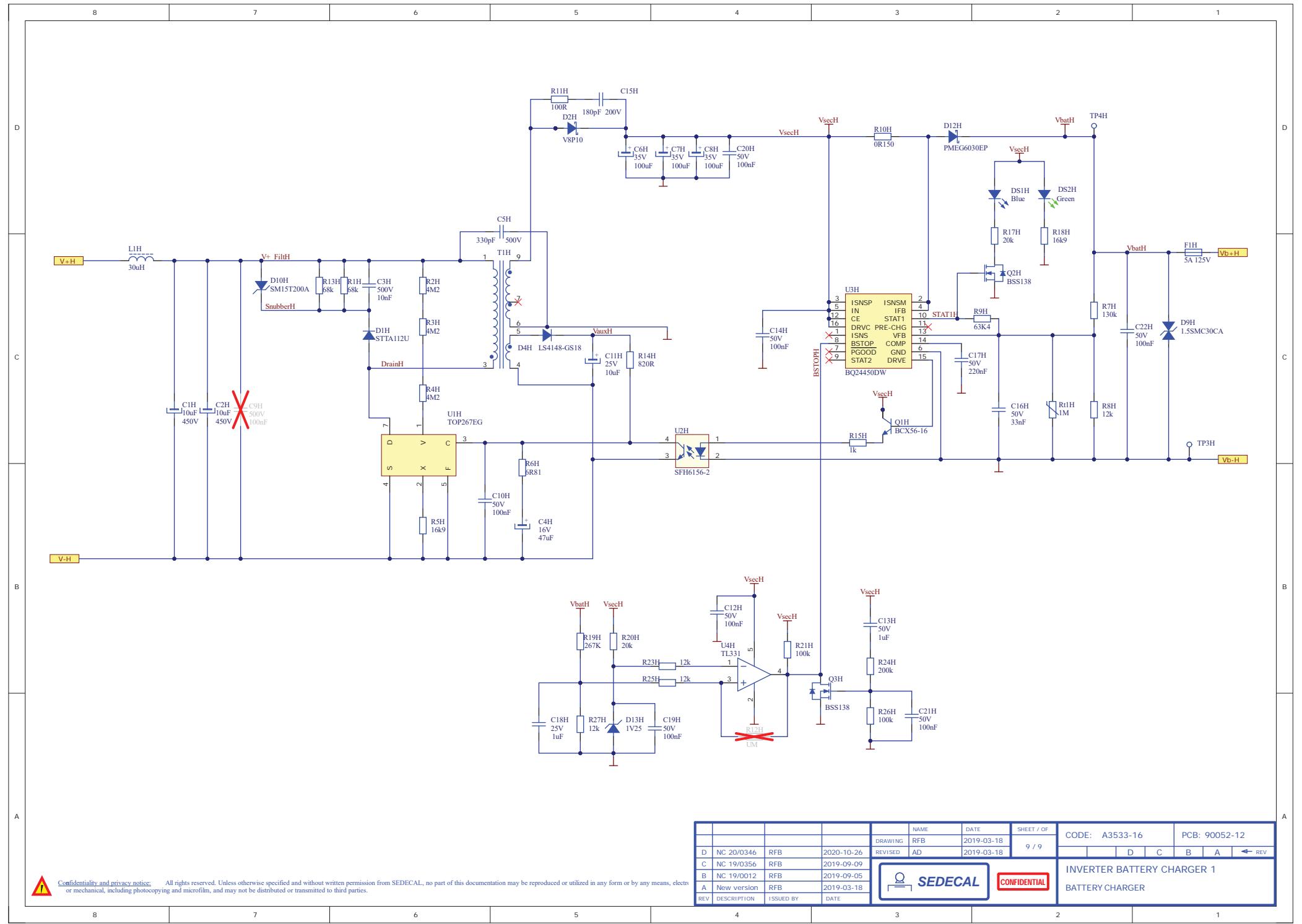
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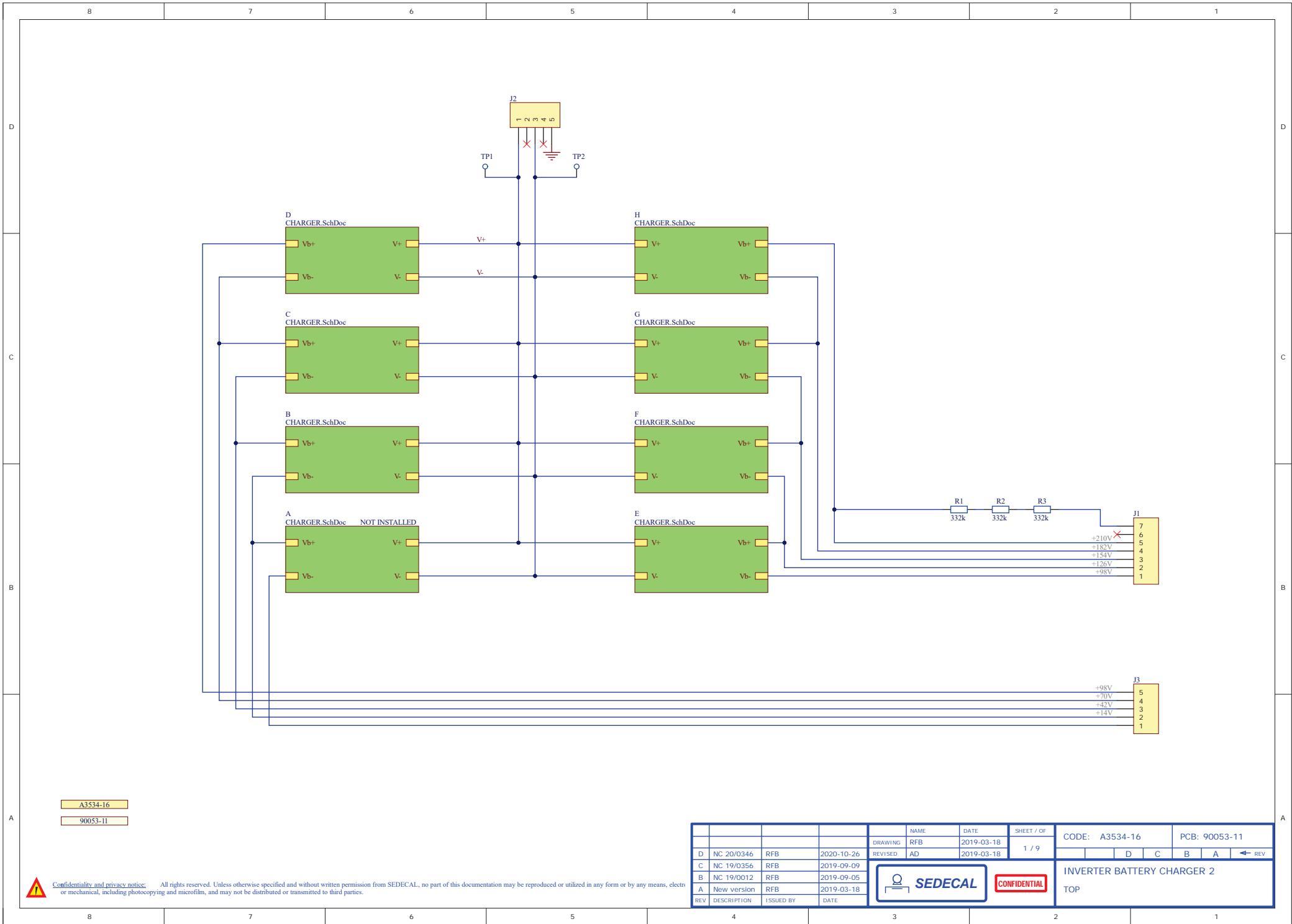
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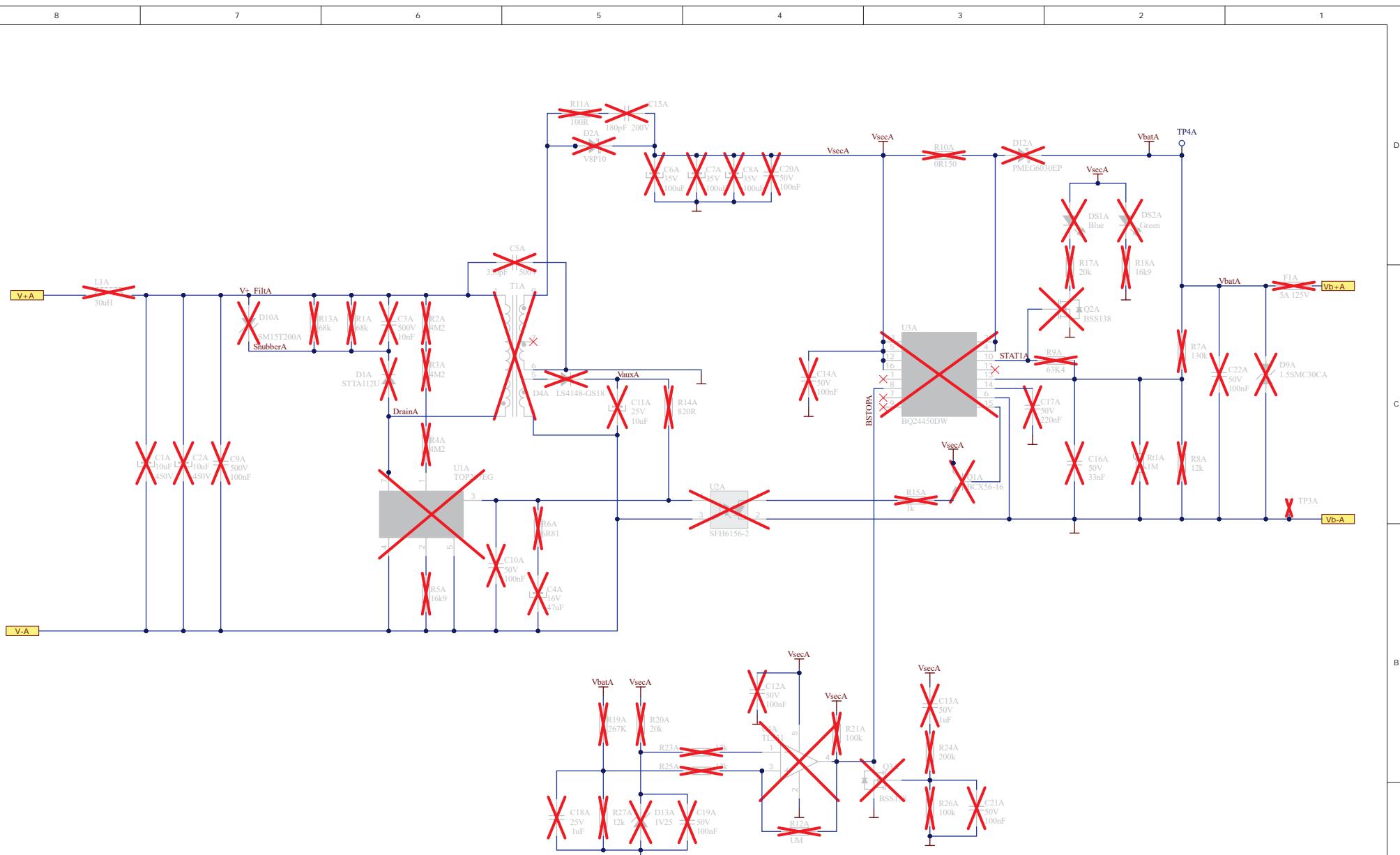
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C	NC 19/0356	RFB	2019-09-09				INVERTER BATTERY CHARGER 1					
B	NC 19/0012	RFB	2019-09-05				BATTERY CHARGER					
A	New version	RFB	2019-03-18									
REV	DESCRIPTION	ISSUED BY	DATE									


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INVERTER BATTERY CHARGER 1
BATTERY CHARGER



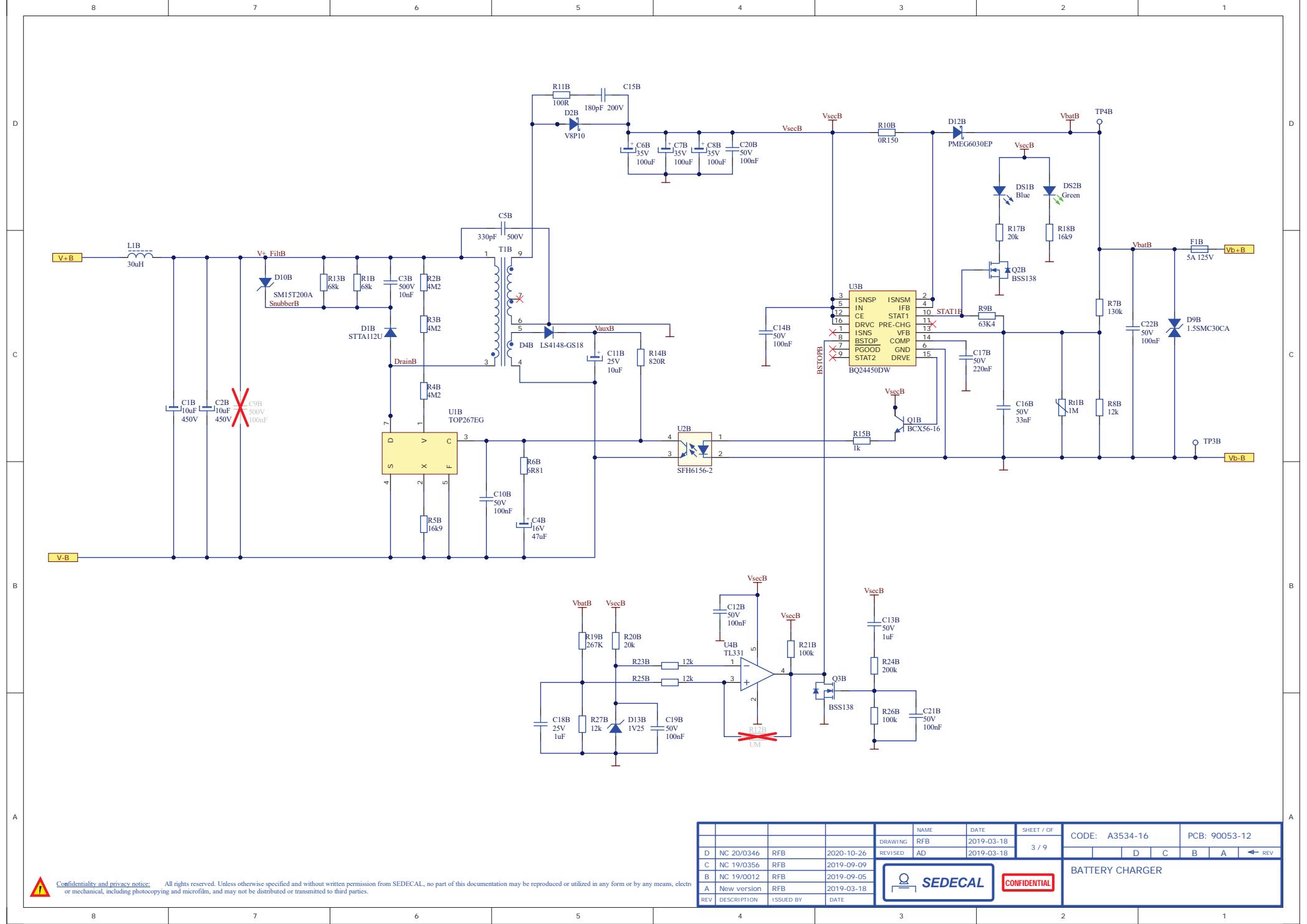




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C	NC 19/0356	RFB	2019-09-09									
B	NC 19/0012	RFB	2019-09-05									
A	New version	RFB	2019-03-18									
REV	DESCRIPTION	ISSUED BY	DATE				BATTERY CHARGER					


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			NAME	DATE	SHEET / OF	CODE: A3534-16	PCB: 90053-12
D	NC 20/0346	RFB	2020-10-26	RFB	2019-03-18	3 / 9	
C	NC 19/0356	RFB	2019-09-09		REVISED AD	2019-03-18	
B	NC 19/0012	RFB	2019-09-05				
A	New version	RFB	2019-03-18				
REV	DESCRIPTION	ISSUED BY	DATE				

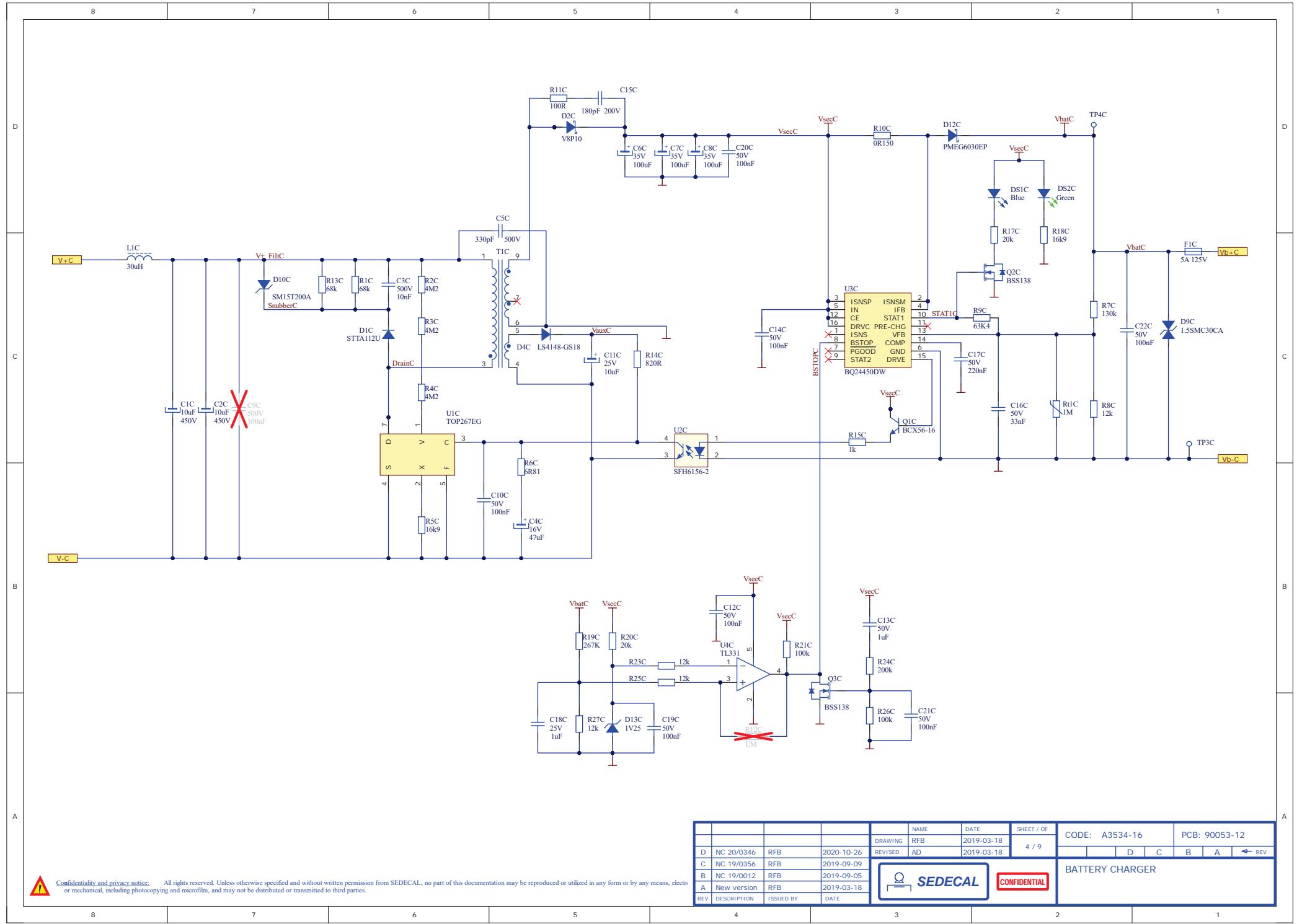


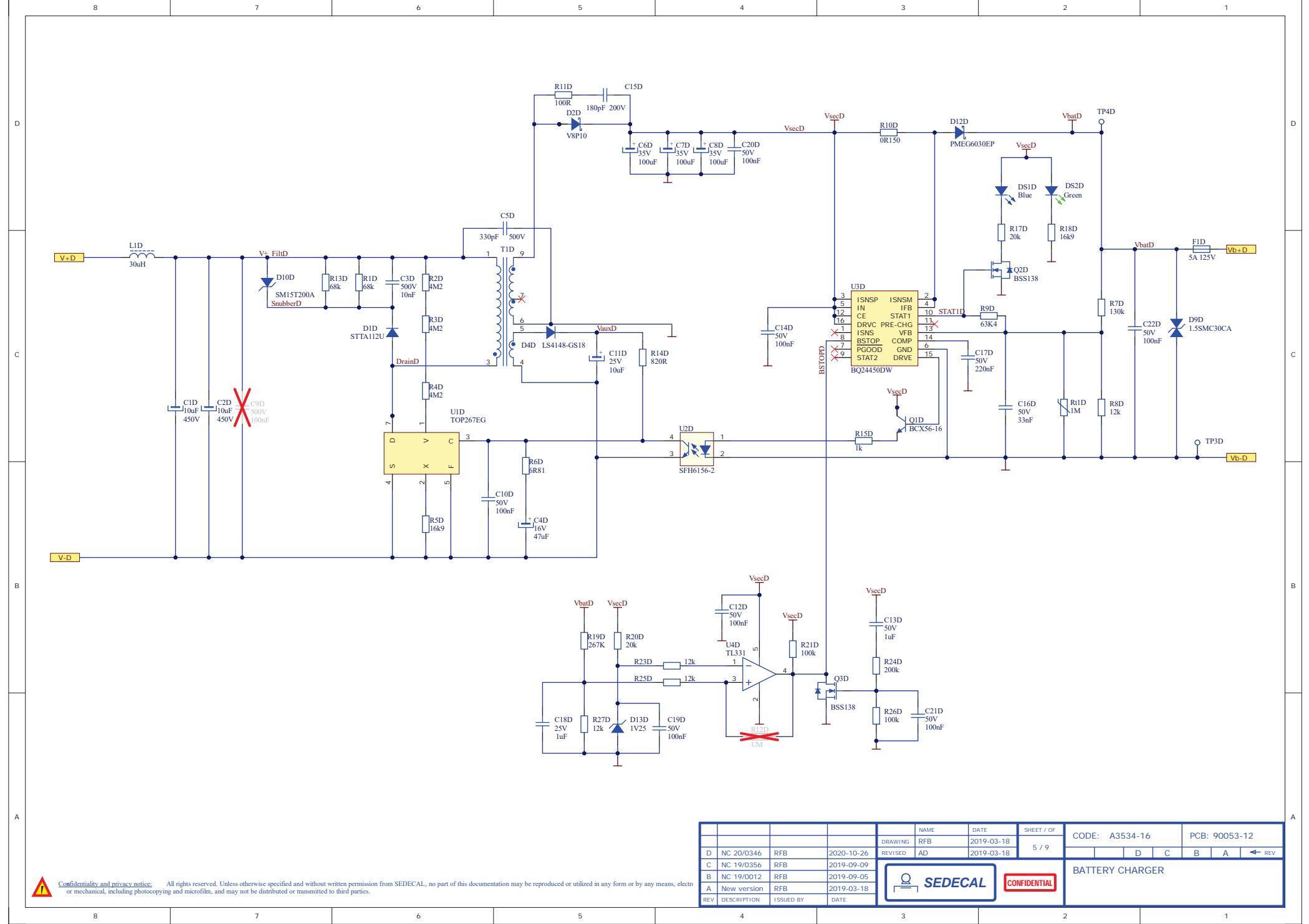
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BATTERY CHARGER





			NAME	DATE	SHEET / OF	CODE: A3534-16	PCB: 90053-12
D	NC 20/0346	RFB	2020-10-26	2019-03-18	5 / 9		
C	NC 19/0356	RFB	2019-09-09	REvised AD	2019-03-18		
B	NC 19/0012	RFB	2019-09-05				
A	New version	RFB	2019-03-18				
REV	DESCRIPTION	ISSUED BY	DATE				

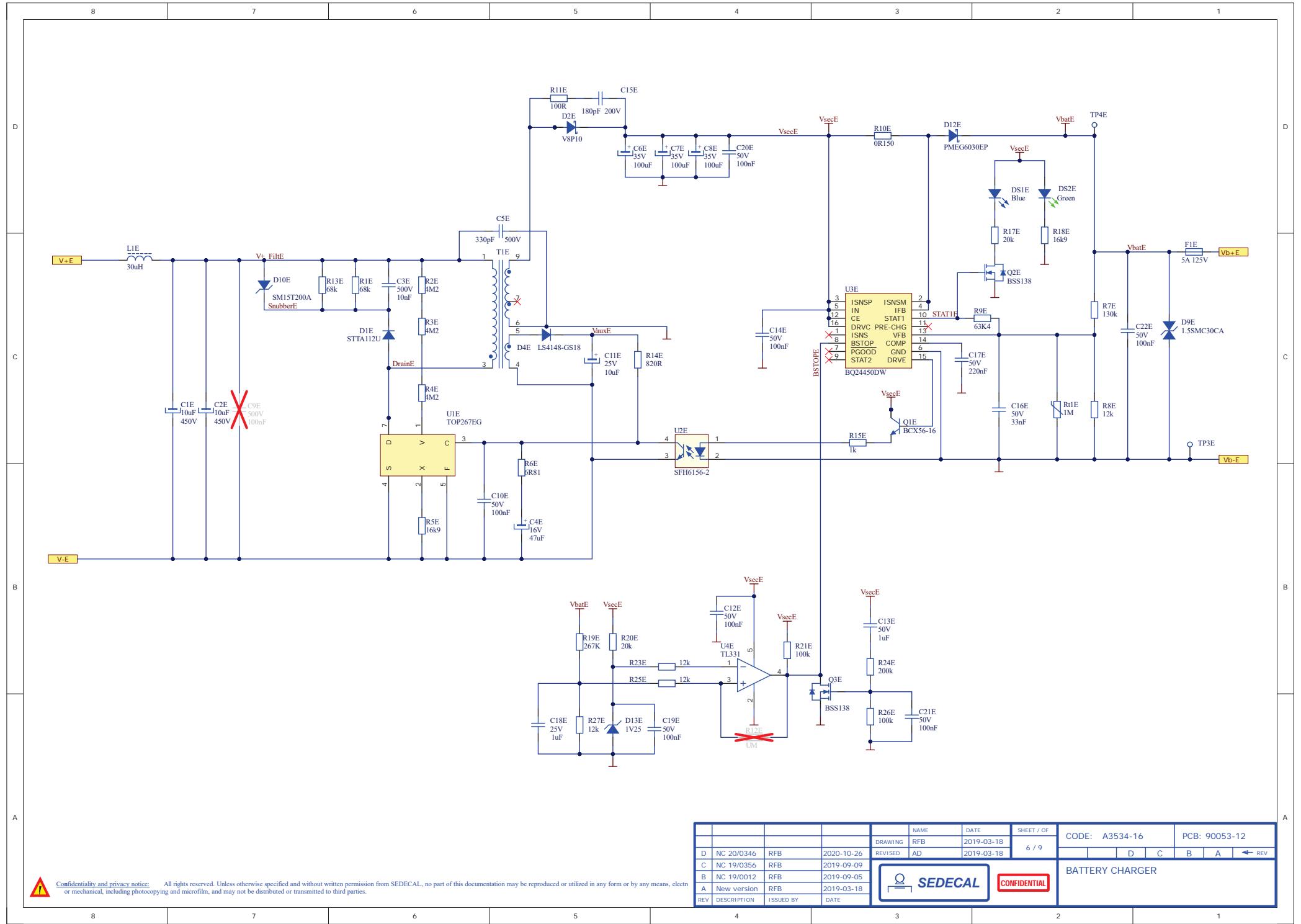


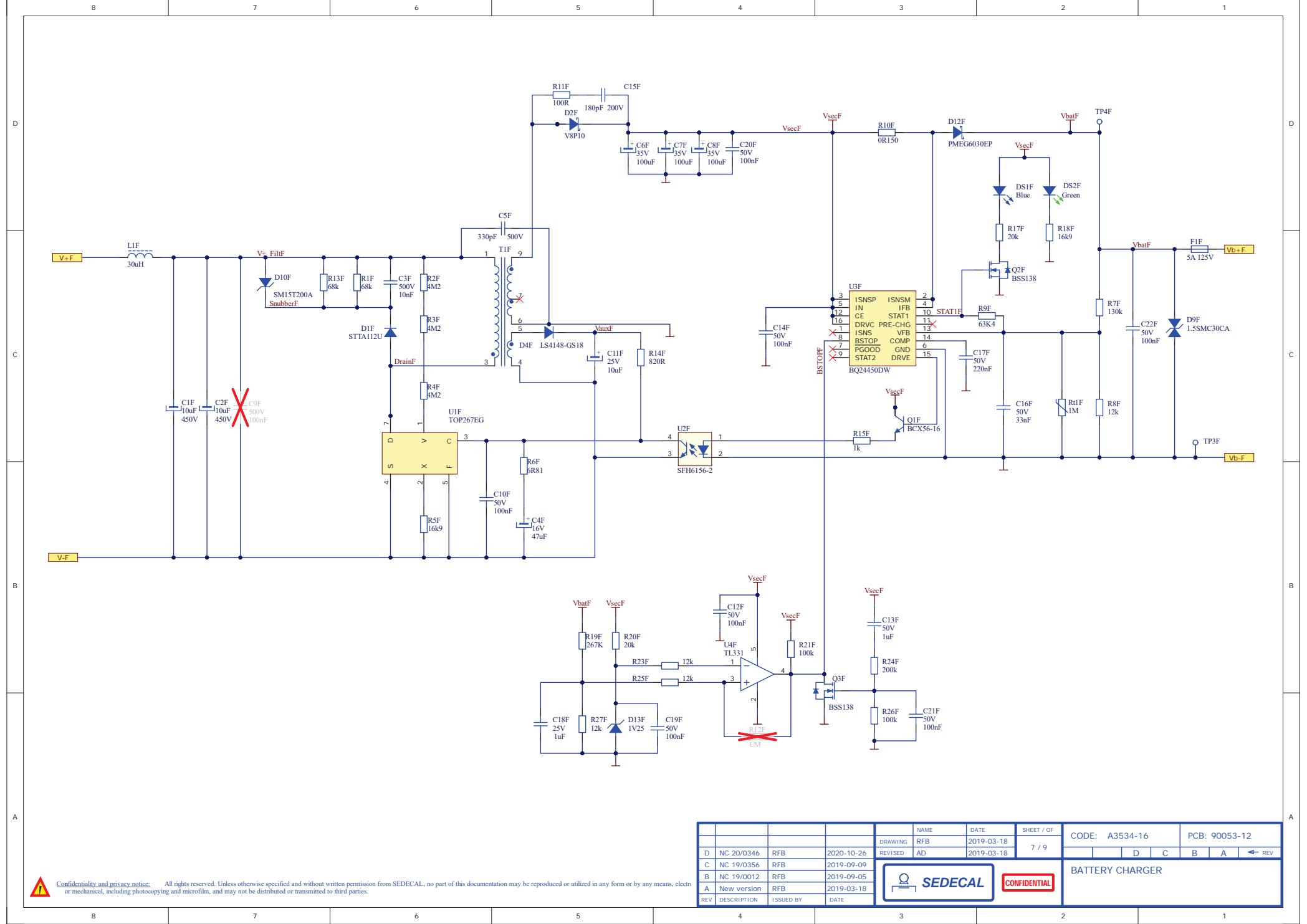
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BATTERY CHARGER





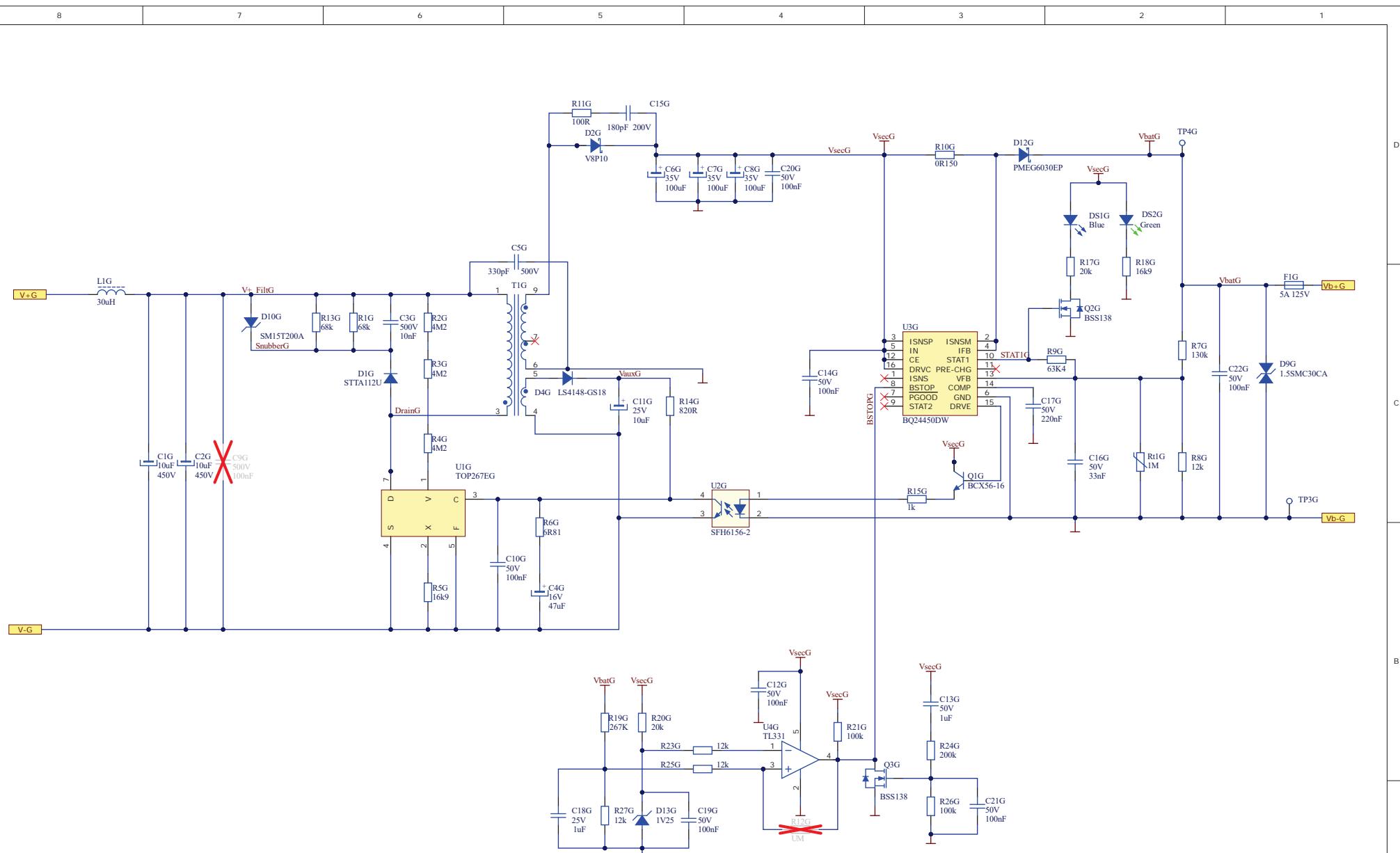
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			NAME	DATE	SHEET / OF	CODE: A3534-16	PCB: 90053-12
D	NC 20/0346	RFB	2020-10-26	DRAWING	RFB	2019-03-18	
C	NC 19/0356	RFB	2019-09-09	REVISED	AD	2019-03-18	7 / 9
B	NC 19/0012	RFB	2019-09-05				
A	New version	RFB	2019-03-18				
REV	DESCRIPTION	ISSUED BY	DATE				



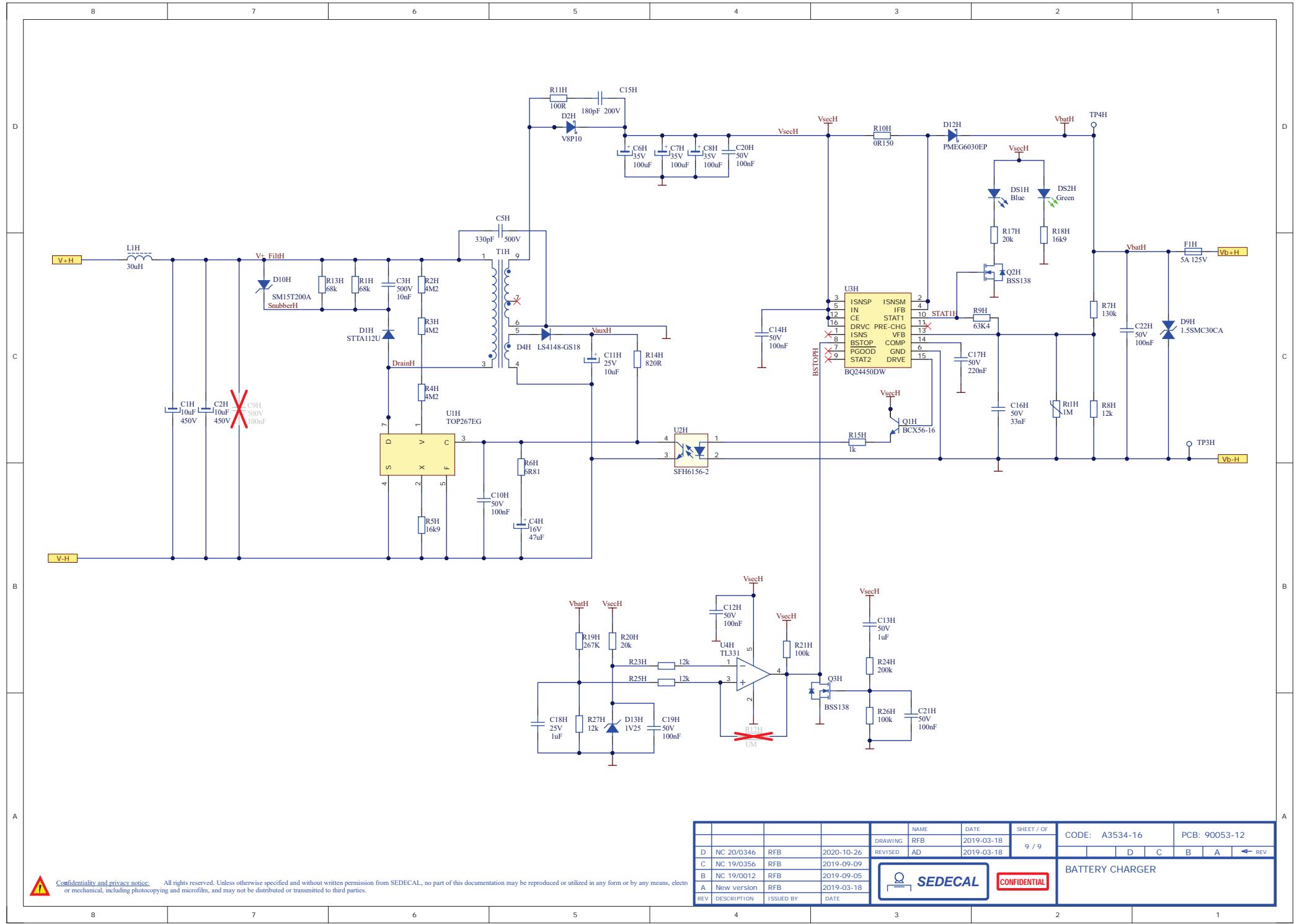
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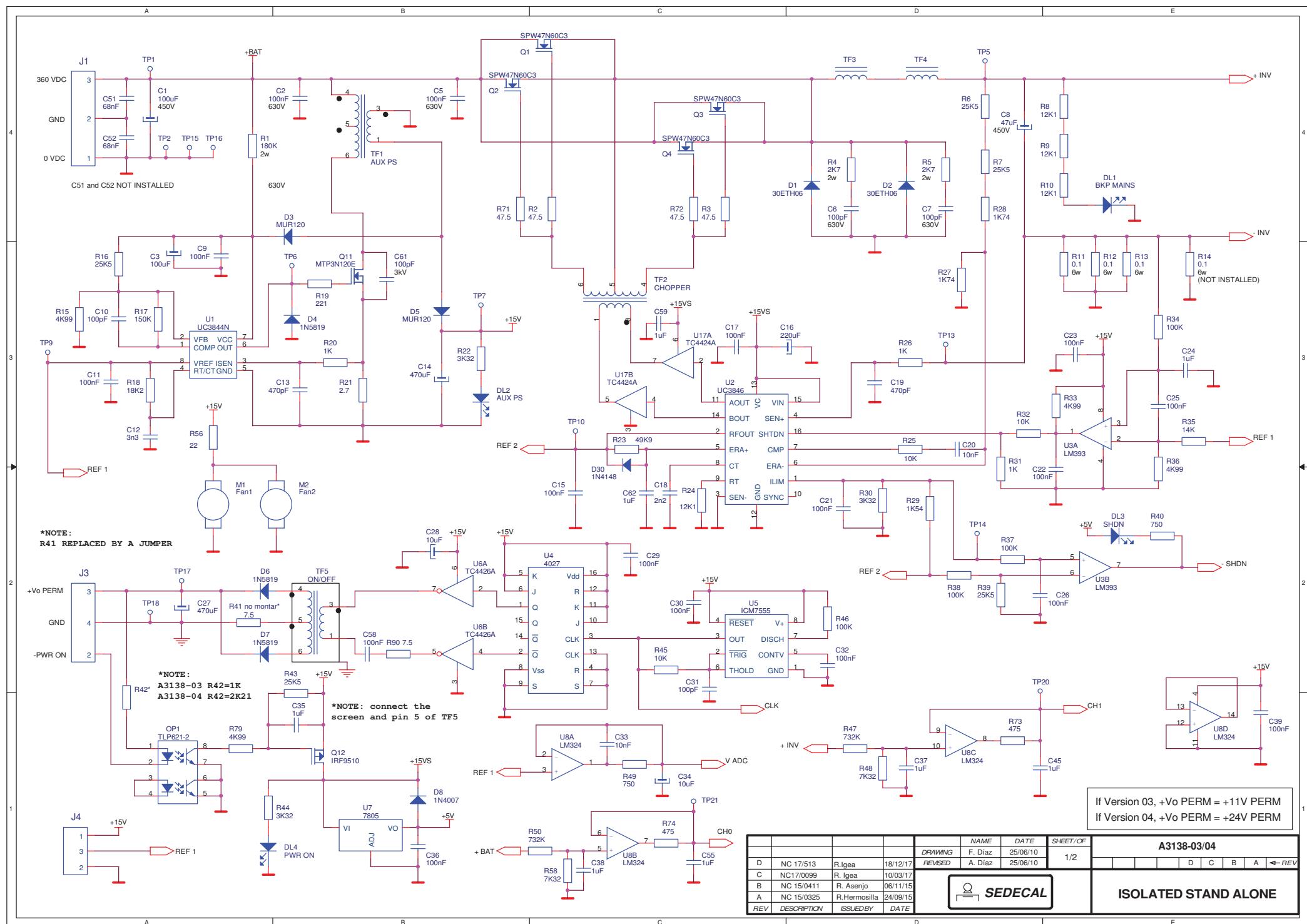
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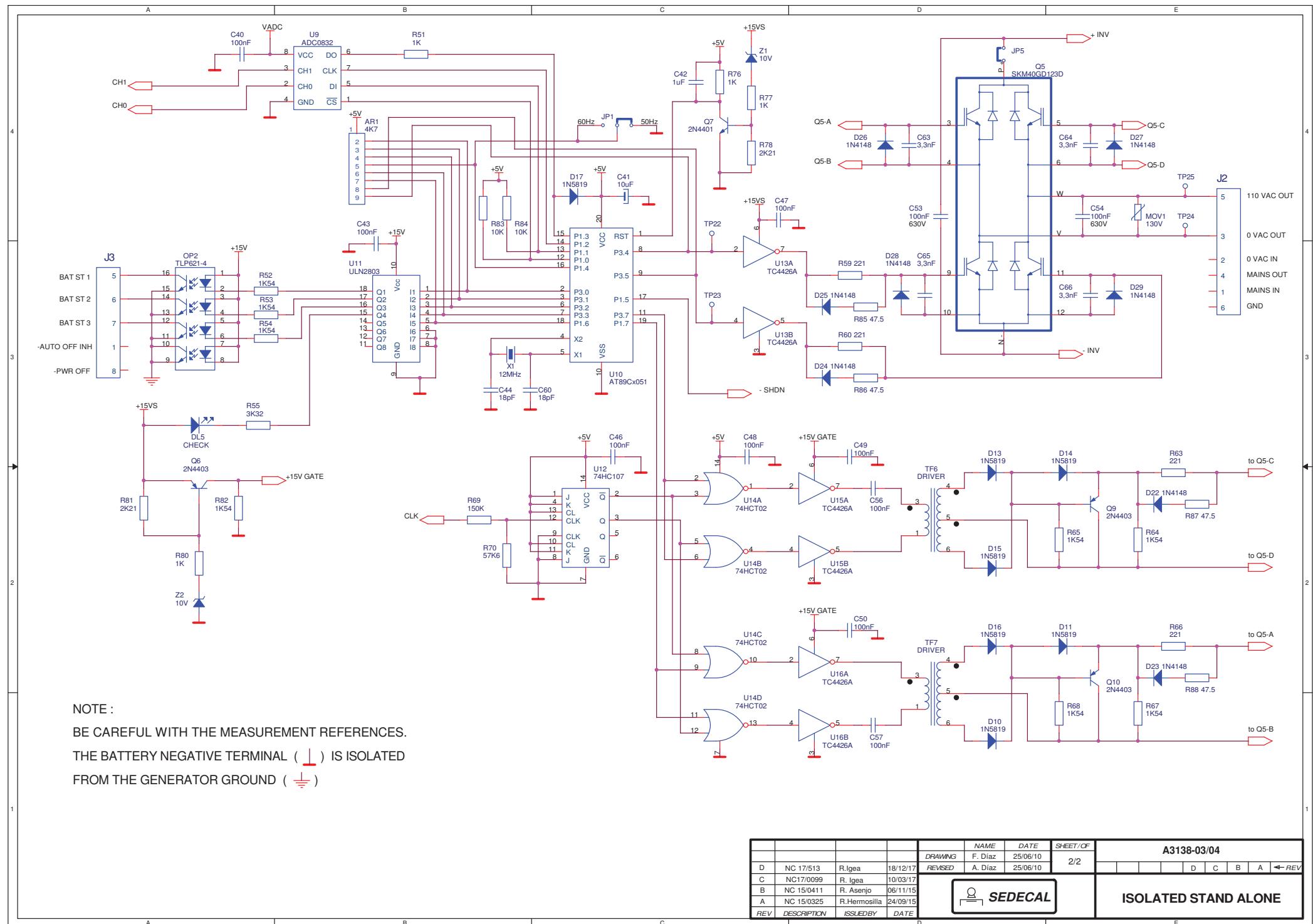


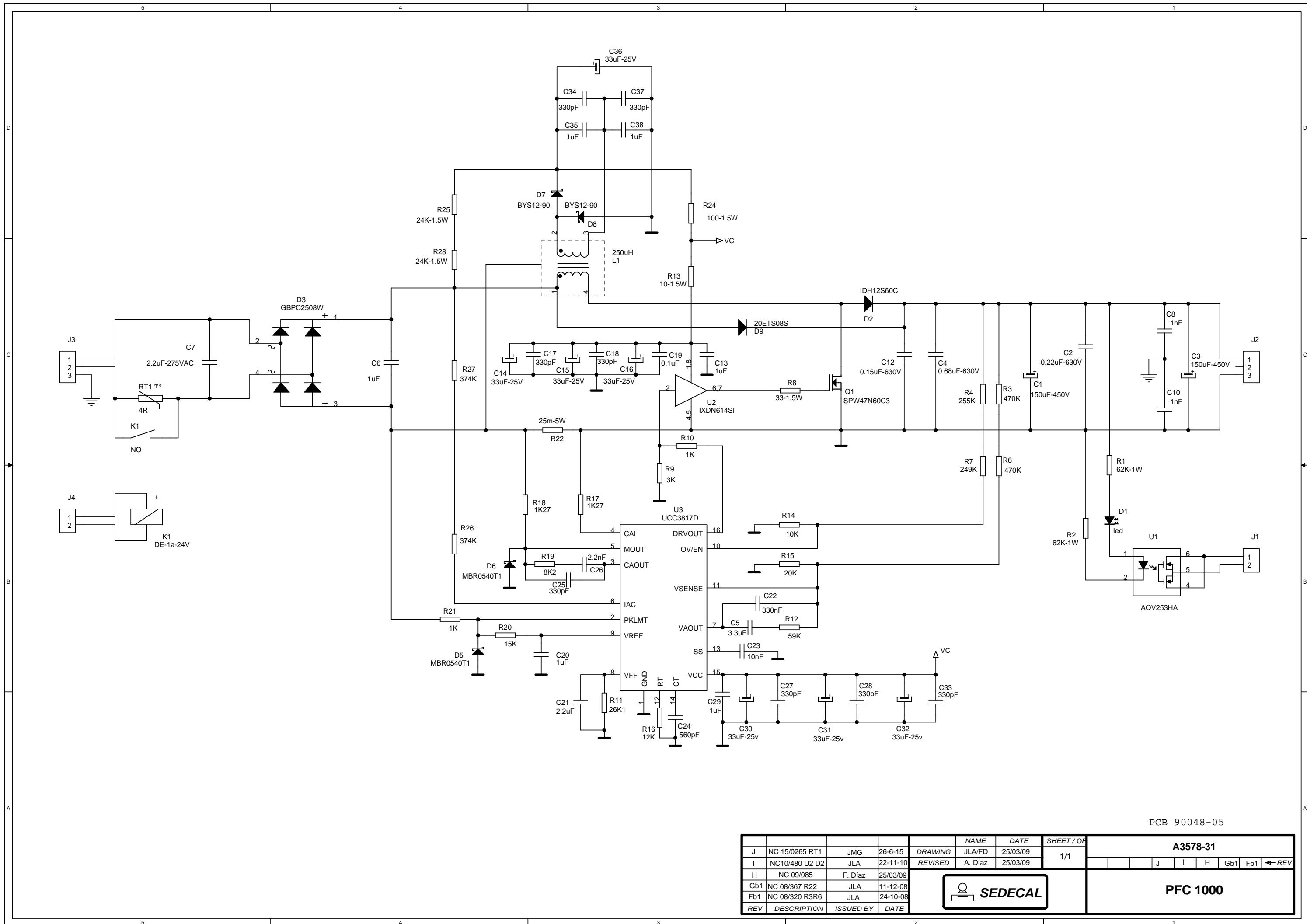
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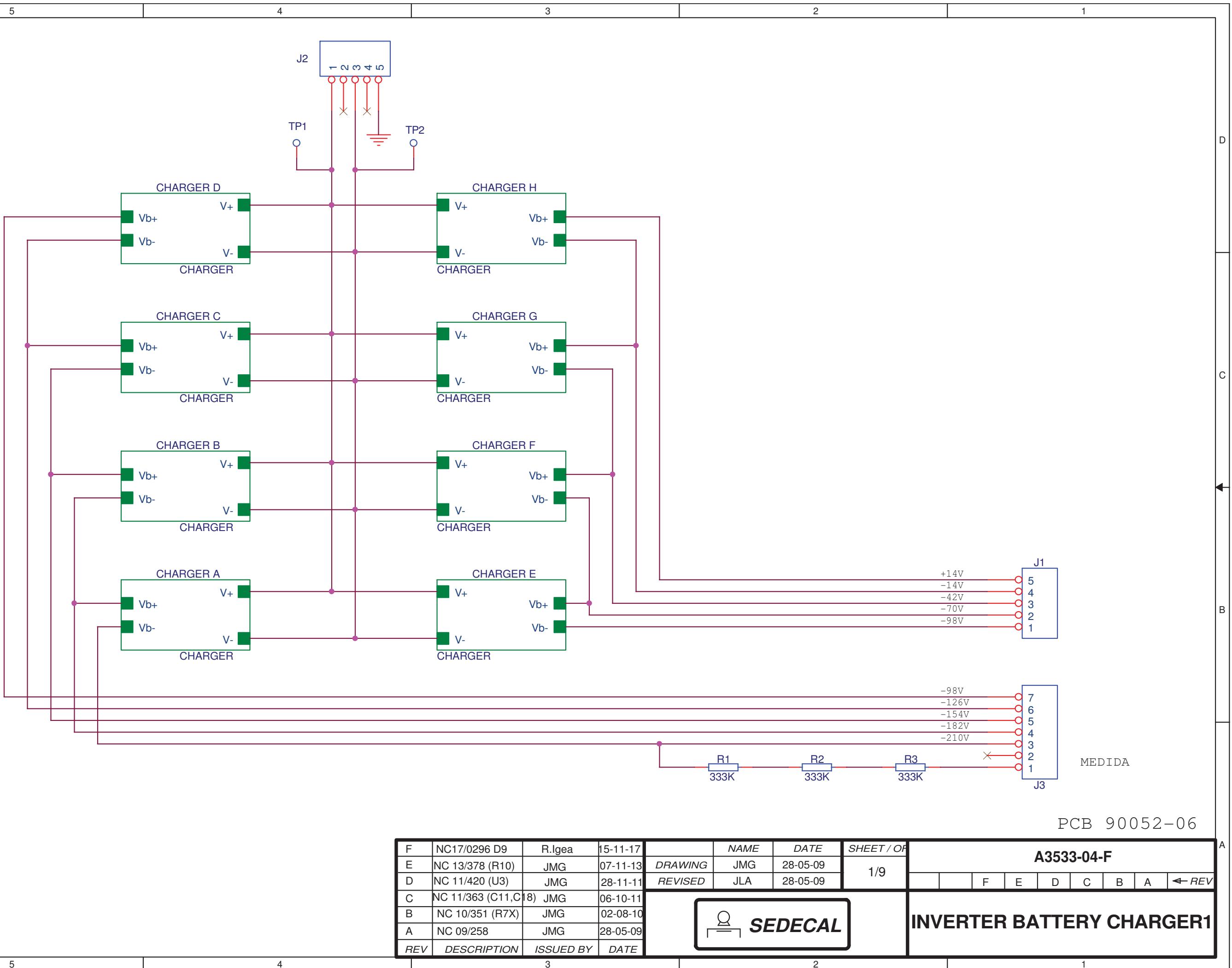
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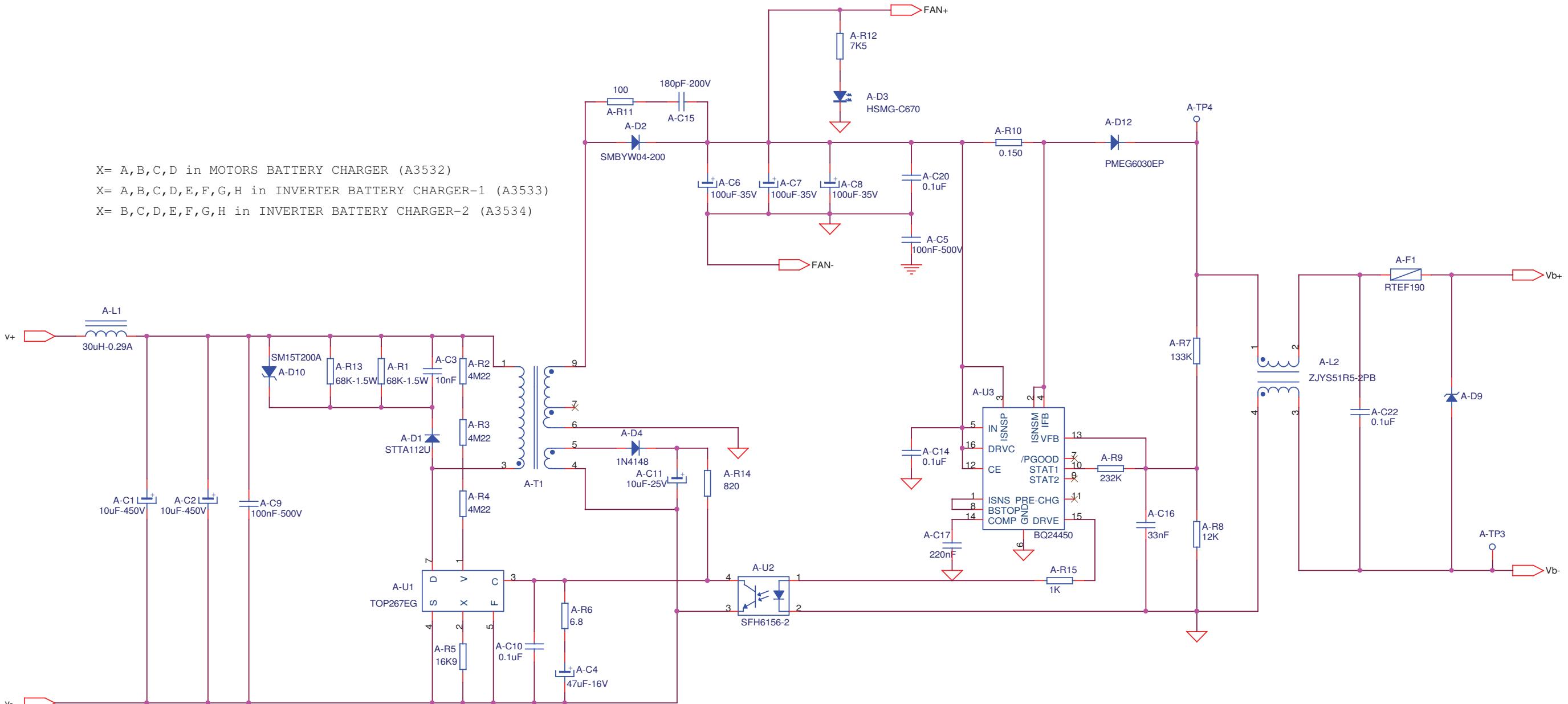










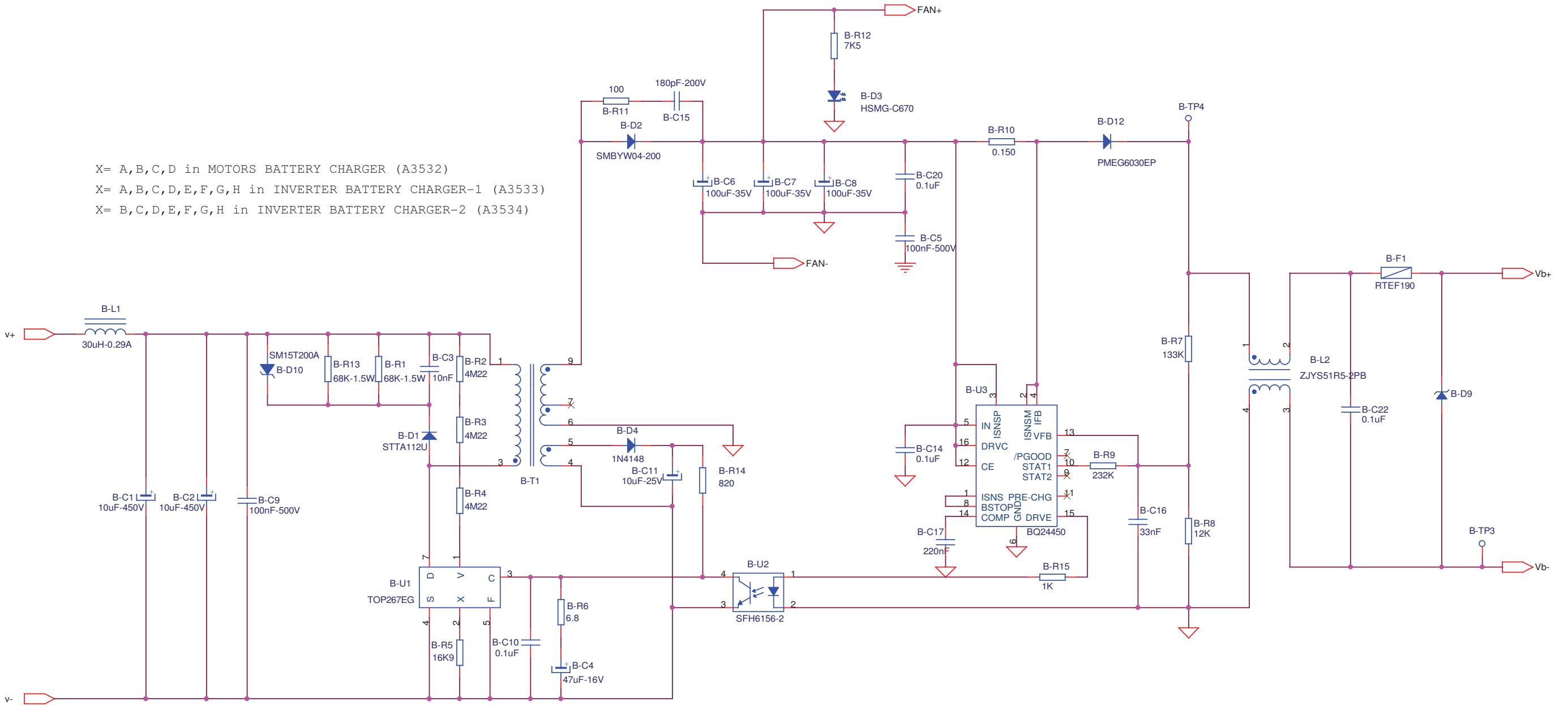


PCB 90052-06

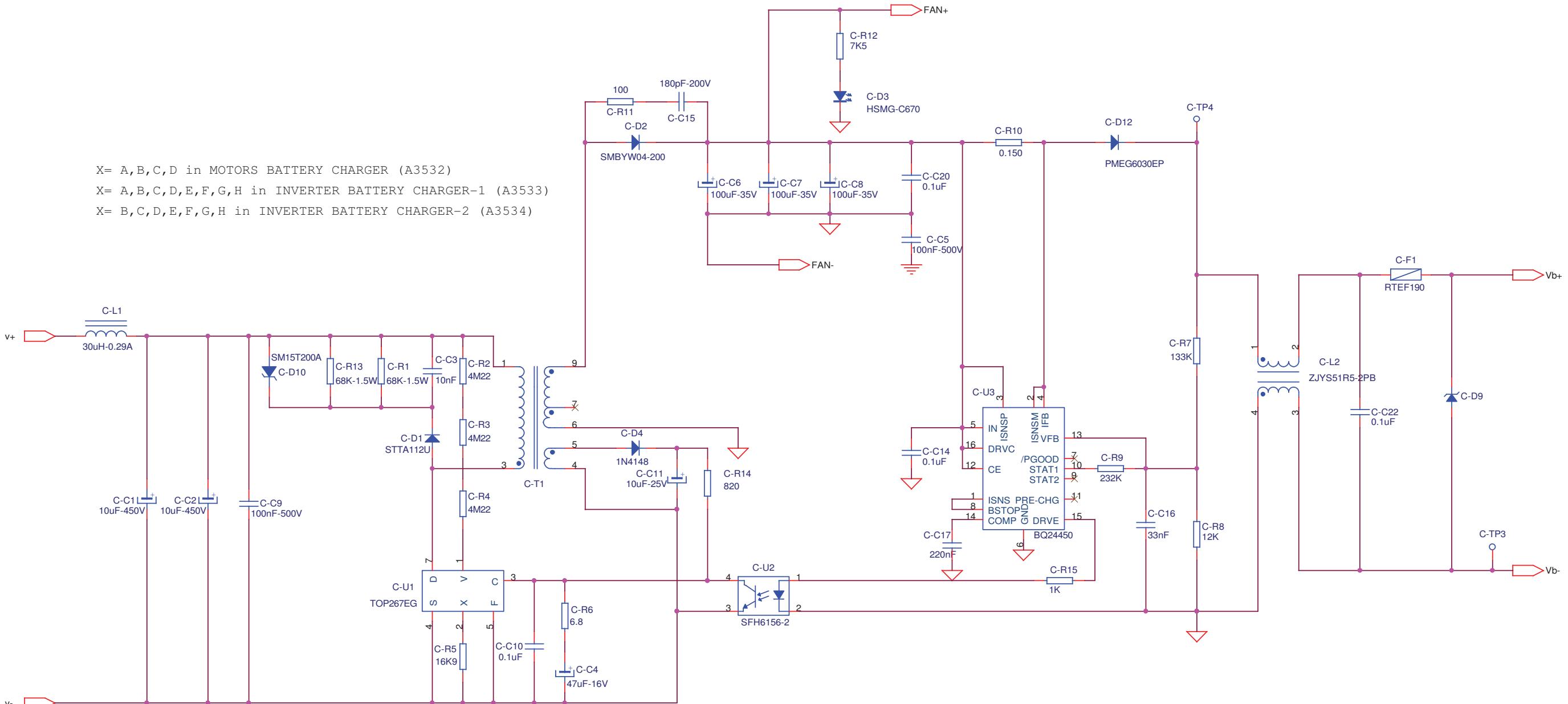
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E	NC 13/378 (R10)	JMG	07-11-13	DRAWING	JMG	28-05-09	2-9/9	F	E	D	C	B	A	◀ REV
D	NC 11/420 (U3)	JMG	28-11-11	REVISED	JLA	28-05-09								
C	NC 11/363 (C11,C18)	JMG	06-10-11											
B	NC 10/351 (R7X)	JMG	02-08-10											
A	NC 09/258	JMG	28-05-09											
REV	DESCRIPTION	ISSUED BY	DATE											



INVERTER BATTERY CHARGER1



PCB 90052-06



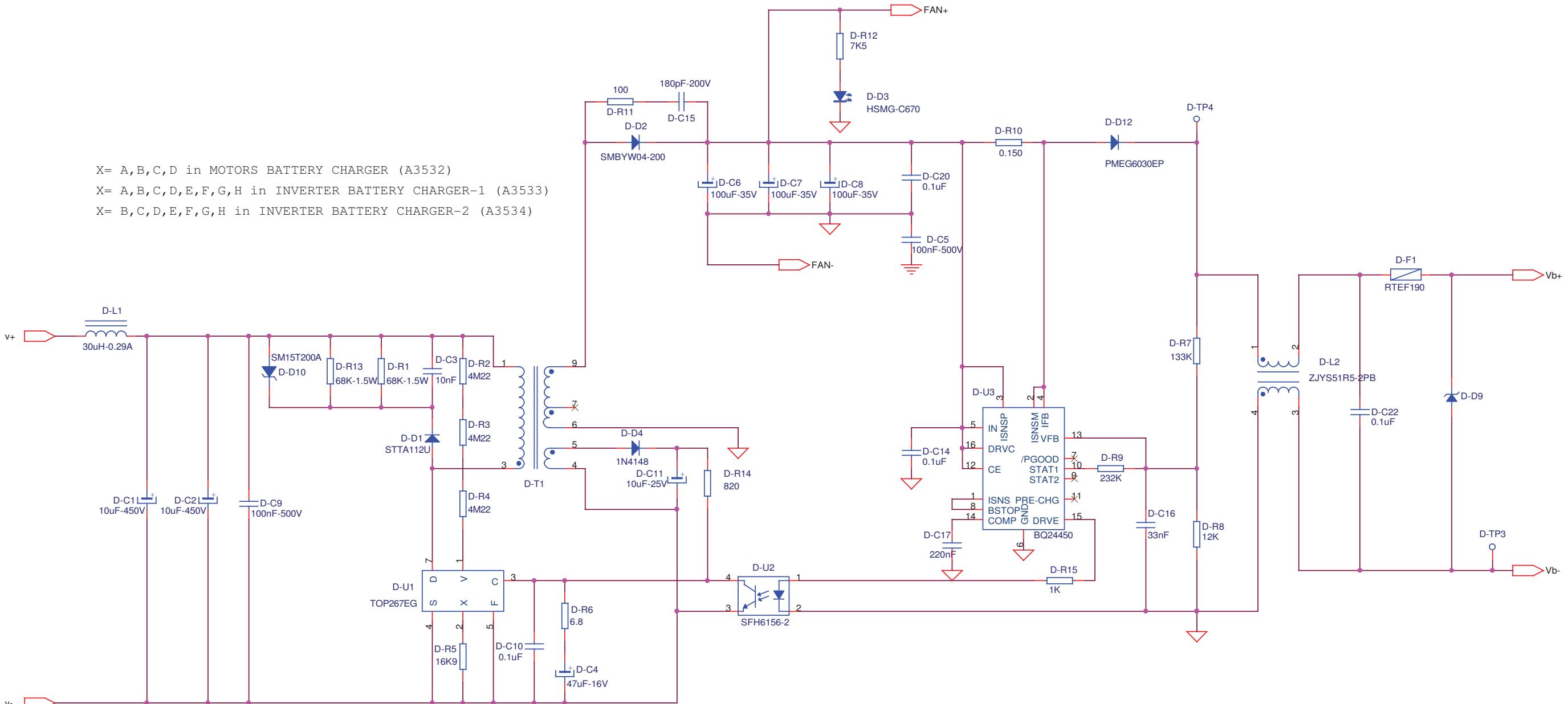
X= A,B,C,D in MOTORS BATTERY CHARGER (A3532)
X= A,B,C,D,E,F,G,H in INVERTER BATTERY CHARGER-1 (A3533)
X= B,C,D,E,F,G,H in INVERTER BATTERY CHARGER-2 (A3534)

PCB 90052-06

F	NC17/0296 D9	R.Igea	15-11-17		NAME	DATE	SHEET/OF	A3533-04-F					
E	NC 13/378 (R10)	JMG	07-11-13	DRAWING	JMG	28-05-09 <th data-kind="parent" data-rs="2">2-9/9</th> <td>F</td> <td>E</td> <td>D</td> <td>C</td> <td>B</td> <td>A</td>	2-9/9	F	E	D	C	B	A
D	NC 11/420 (U3)	JMG	28-11-11	REVISED	JLA	28-05-09							
C	NC 11/363 (C11,C18)	JMG	06-10-11										
B	NC 10/351 (R7X)	JMG	02-08-10										
A	NC 09/258	JMG	28-05-09										
REV	DESCRIPTION	ISSUED BY	DATE										



INVERTER BATTERY CHARGER1



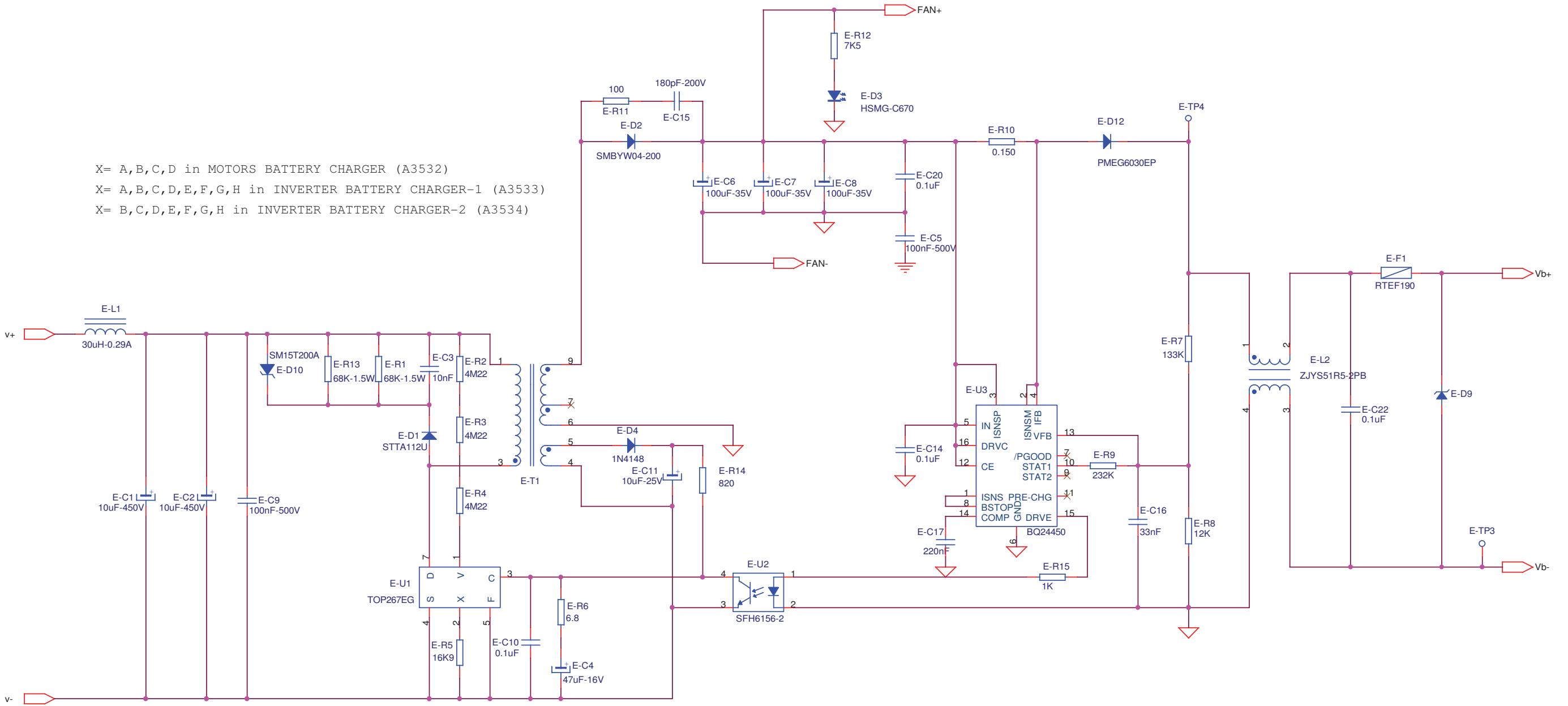
X= A,B,C,D in MOTORS BATTERY CHARGER (A3532)
X= A,B,C,D,E,F,G,H in INVERTER BATTERY CHARGER-1 (A3533)
X= B,C,D,E,F,G,H in INVERTER BATTERY CHARGER-2 (A3534)

PCB 90052-06

F	NC17/0296 D9	R.Igea	15-11-17		NAME	DATE	SHEET/OF	A3533-04-F					
E	NC 13/378 (R10)	JMG	07-11-13	DRAWING	JMG	28-05-09 <th data-kind="parent" data-rs="2">2-9/9</th> <td>F</td> <td>E</td> <td>D</td> <td>C</td> <td>B</td> <td>A</td>	2-9/9	F	E	D	C	B	A
D	NC 11/420 (U3)	JMG	28-11-11	REVISED	JLA	28-05-09							
C	NC 11/363 (C11,C18)	JMG	06-10-11										
B	NC 10/351 (R7X)	JMG	02-08-10										
A	NC 09/258	JMG	28-05-09										
REV	DESCRIPTION	ISSUED BY	DATE										

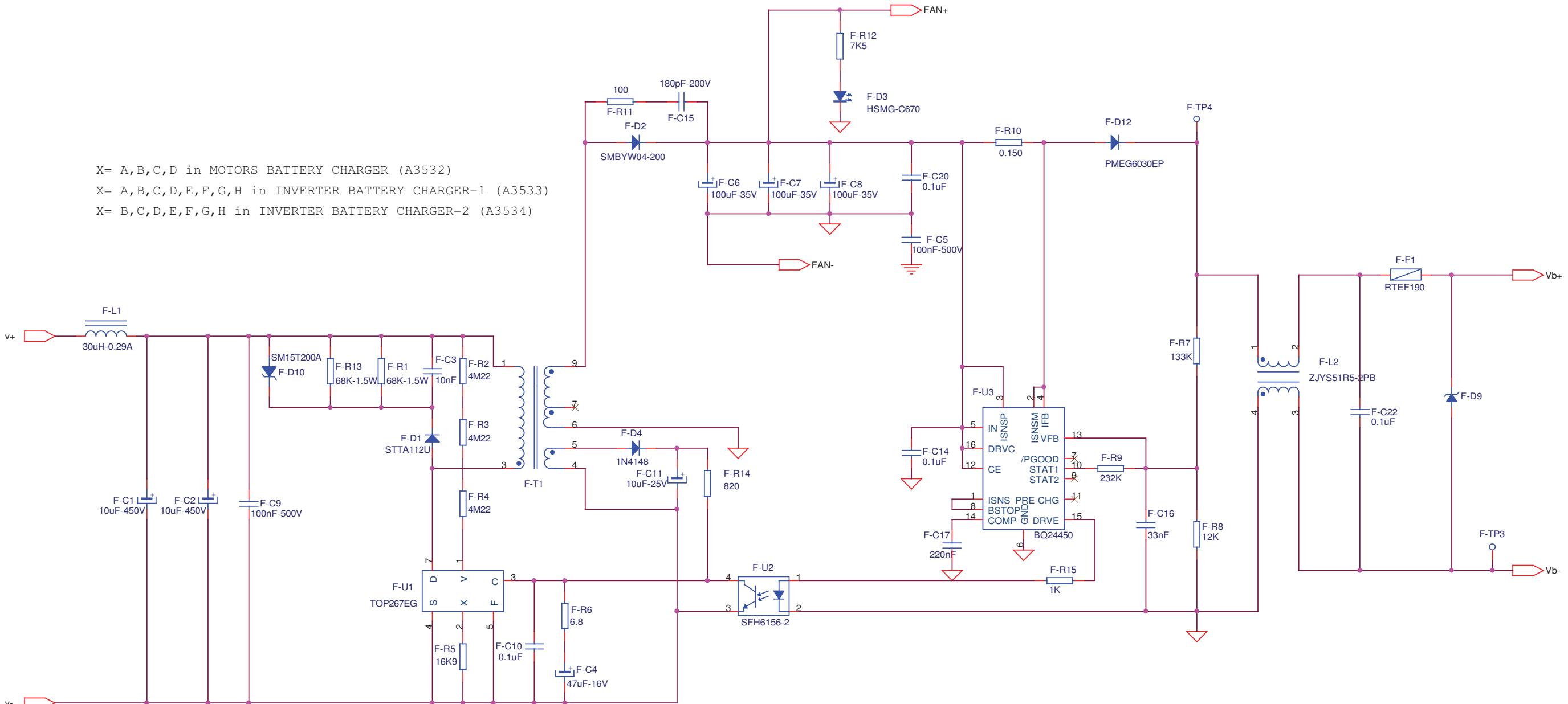


INVERTER BATTERY CHARGER1



PCB 90052-06

F	NC17/0296 D9	R.Igea	15-11-17		NAME	DATE	SHEET/OF	A3533-04-F							
E	NC 13/378 (R10)	JMG	07-11-13	DRAWING	JMG	28-05-09	2-9/9								
D	NC 11/420 (U3)	JMG	28-11-11	REVISED	JLA	28-05-09				F	E	D	C	B	A
C	NC 11/363 (C11,C18)	JMG	06-10-11												← REV
B	NC 10/351 (R7X)	JMG	02-08-10	 SEDECAL								INVERTER BATTERY CHARGER1			
A	NC 09/258	JMG	28-05-09												
REV	DESCRIPTION	ISSUED BY	DATE												

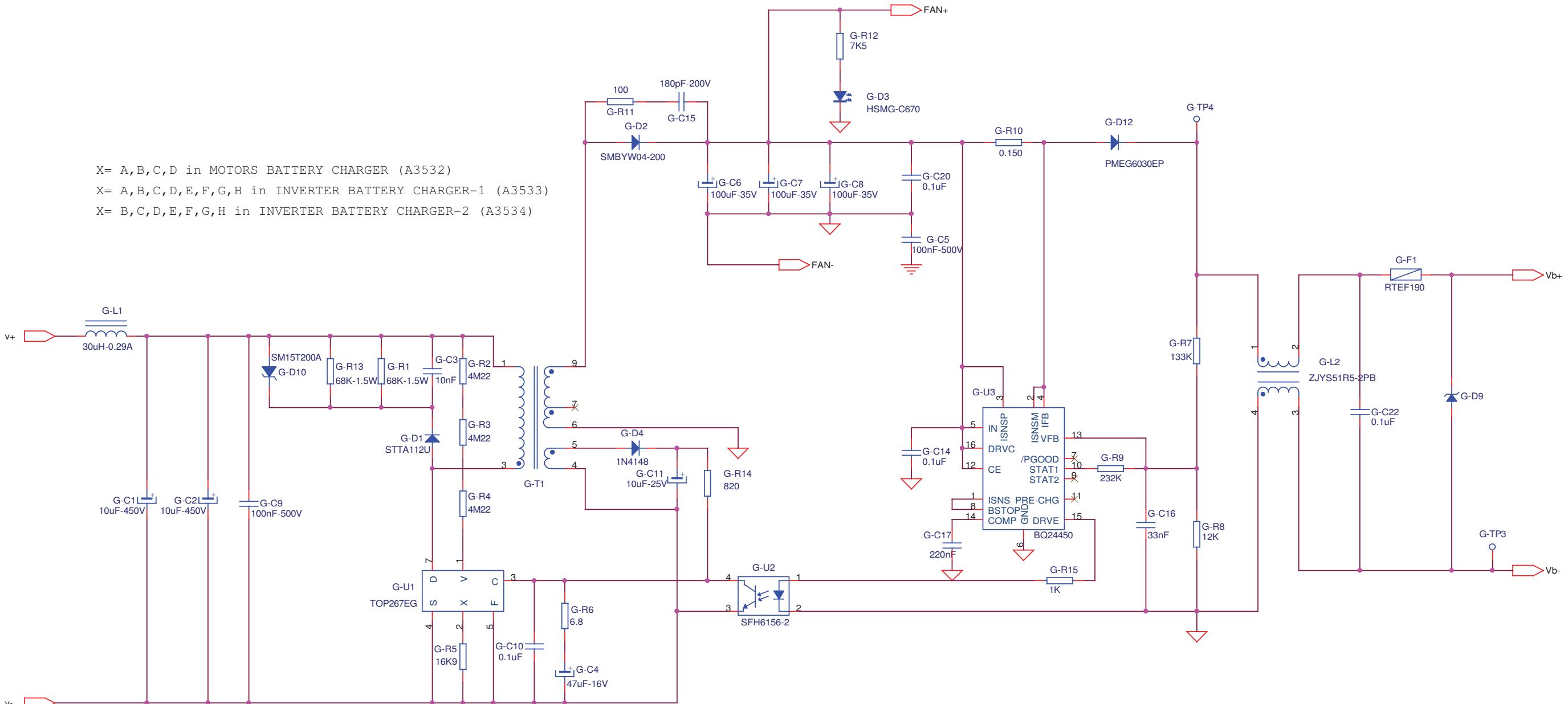


PCB 90052-06

F	NC17/0296 D9	R.Igea	15-11-17	NAME	DATE	SHEET/OF	A3533-04-F									
							DRAWING	JMG	28-05-09	2-9/9	F	E	D	C	B	A
E	NC 13/378 (R10)	JMG	07-11-13	DRAWING	JMG	28-05-09										
D	NC 11/420 (U3)	JMG	28-11-11	REVISED	JLA	28-05-09										
C	NC 11/363 (C11,C18)	JMG	06-10-11													
B	NC 10/351 (R7X)	JMG	02-08-10													
A	NC 09/258	JMG	28-05-09													
REV	DESCRIPTION	ISSUED BY	DATE													



INVERTER BATTERY CHARGER1

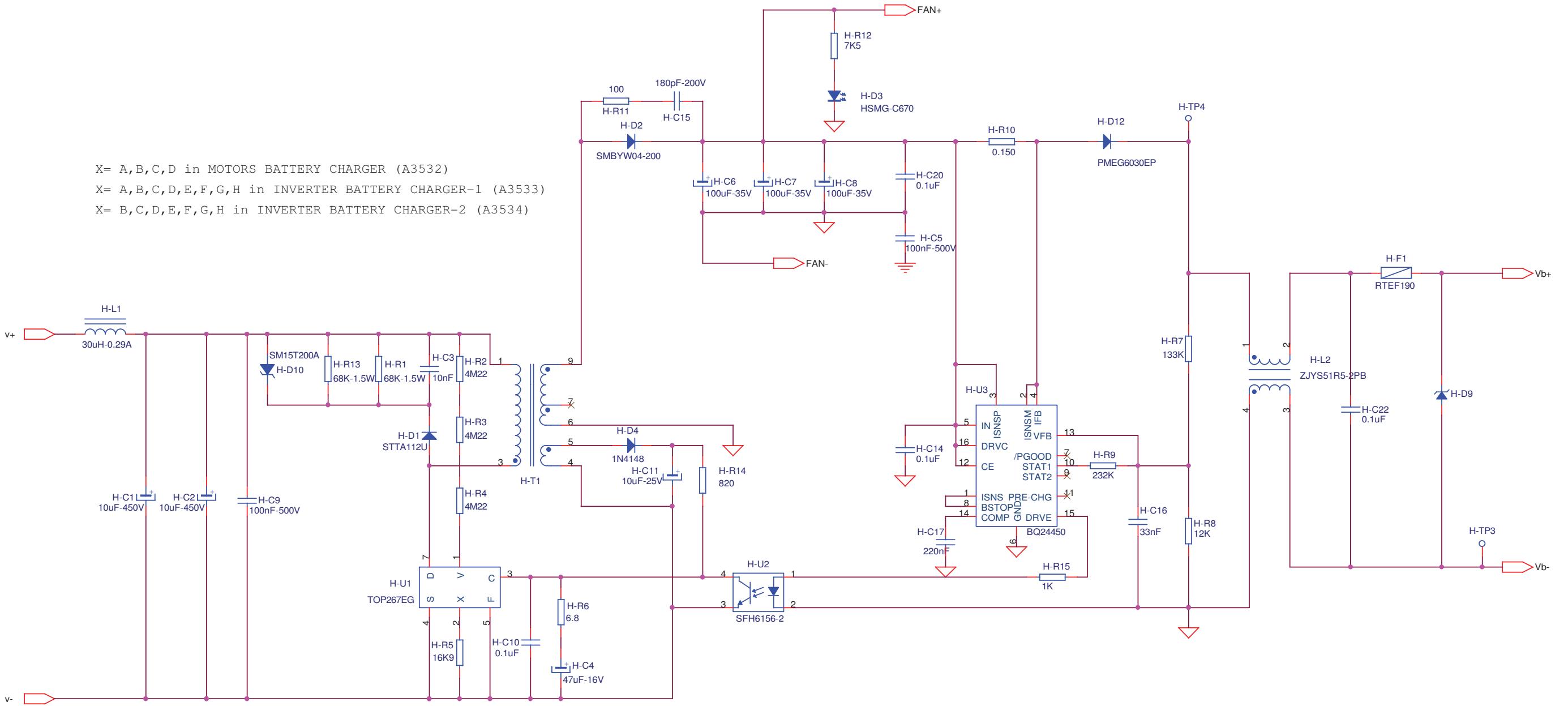


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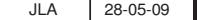
F	NC17/0296 D9	R.Igea	15-11-17		NAME	DATE	SHEET/OF	A3533-04-F						
E	NC 13/378 (R10)	JMG	07-11-13	DRAWING	JMG	28-05-09	2-9/9	F	E	D	C	B	A	◀ REV
D	NC 11/420 (U3)	JMG	28-11-11	REVISED	JLA	28-05-09								
C	NC 11/363 (C11,C18)	JMG	06-10-11											
B	NC 10/351 (R7X)	JMG	02-08-10											
A	NC 09/258	JMG	28-05-09											
REV	DESCRIPTION	ISSUED BY	DATE											

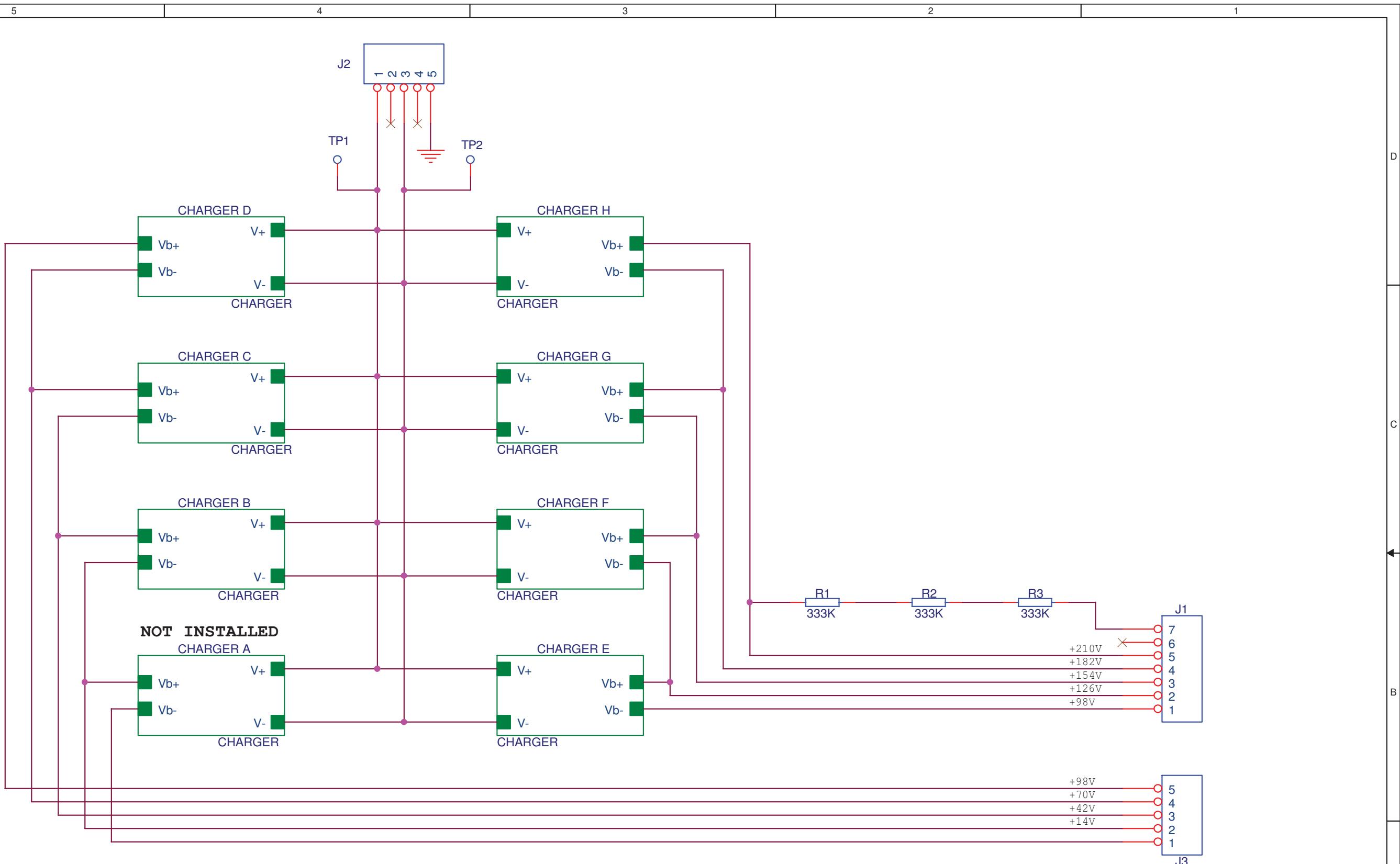


INVERTER BATTERY CHARGER1



PCB 90052-06

F	NC17/0296 D9	R.Igea	15-11-17		NAME	DATE	SHEET/OF	A3533-04-F							
E	NC 13/378 (R10)	JMG	07-11-13	DRAWING	JMG	28-05-09	2-9/9								
D	NC 11/420 (U3)	JMG	28-11-11	REVISED	JLA	28-05-09				F	E	D	C	B	A
C	NC 11/363 (C11,C18)	JMG	06-10-11												← REV
B	NC 10/351 (R7X)	JMG	02-08-10	 SEDECAL								INVERTER BATTERY CHARGER1			
A	NC 09/258	JMG	28-05-09												
REV	DESCRIPTION	ISSUED BY	DATE												

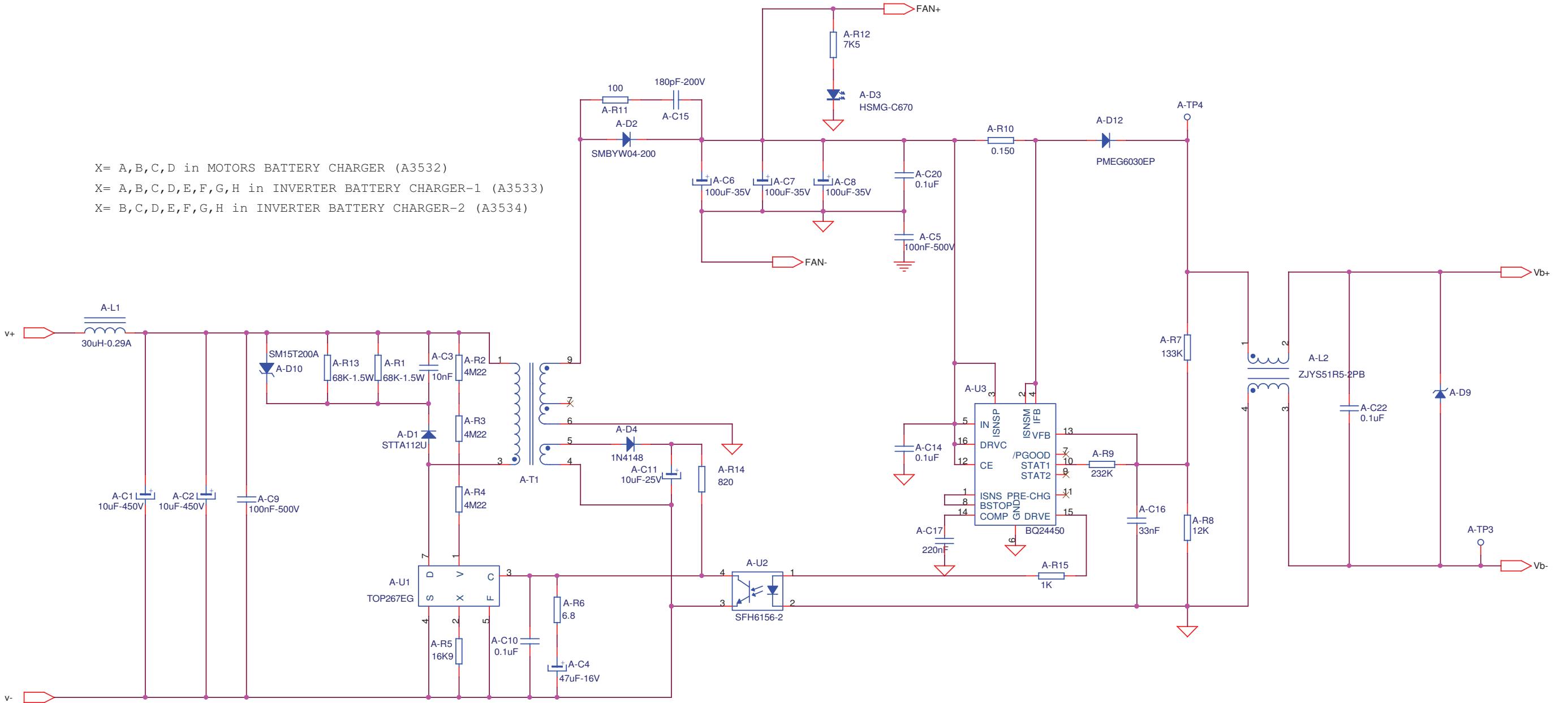


PCB 90053-06

F	NC17/0296 D9	R.lgea	15-11-17		NAME	DATE	SHEET / OF	A3534-04-F								
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D	NC 11/420 (U3)	JMG	28-11-11	REVISED	JLA	28-05-09										
C	NC 11/363 (C11,C18)	JMG	06-10-11													
B	NC 10/351 (R7X)	JMG	02-08-10													
A	NC 09/258	JMG	28-05-09													
REV	DESCRIPTION	ISSUED BY	DATE													

SEDECAL

INVERTER BATTERY CHARGER2

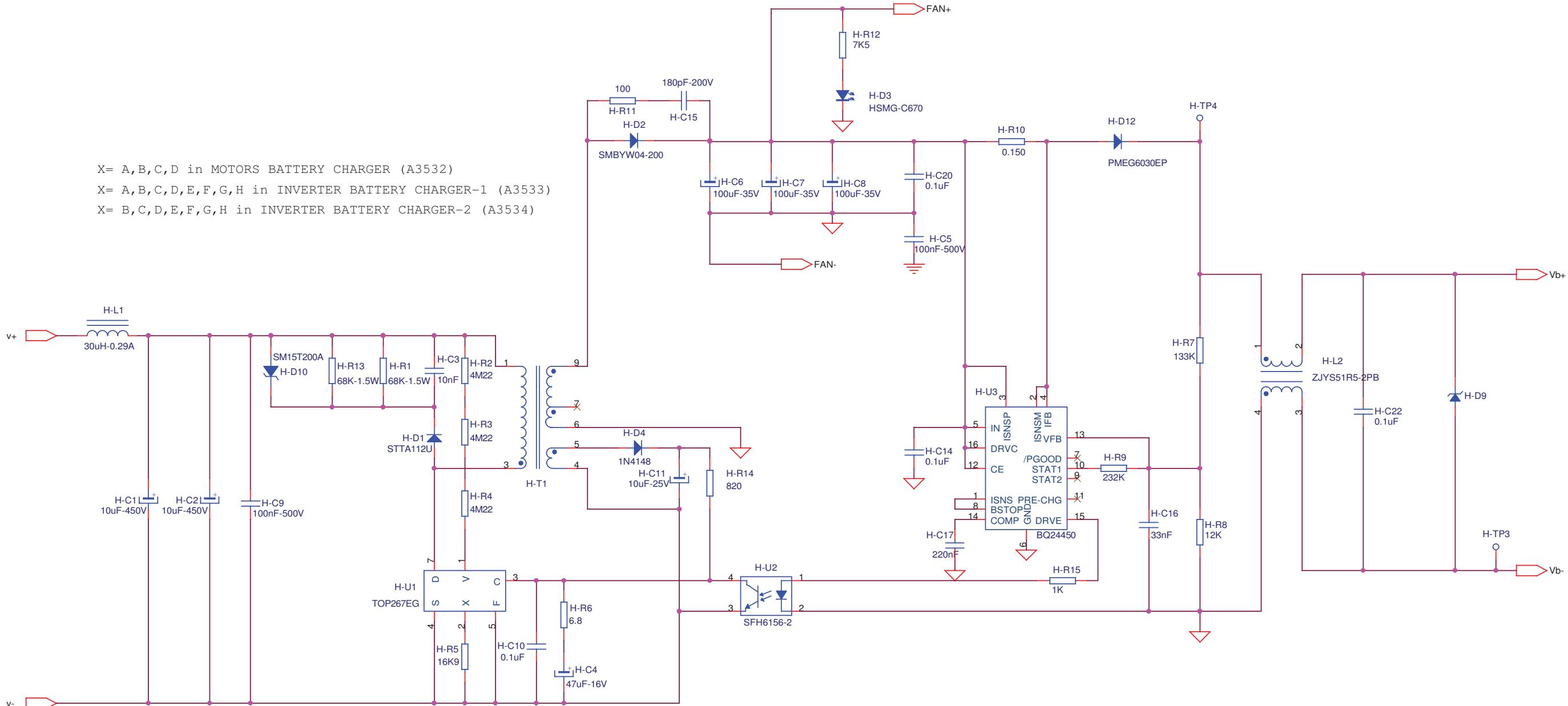


PCB 90053-06

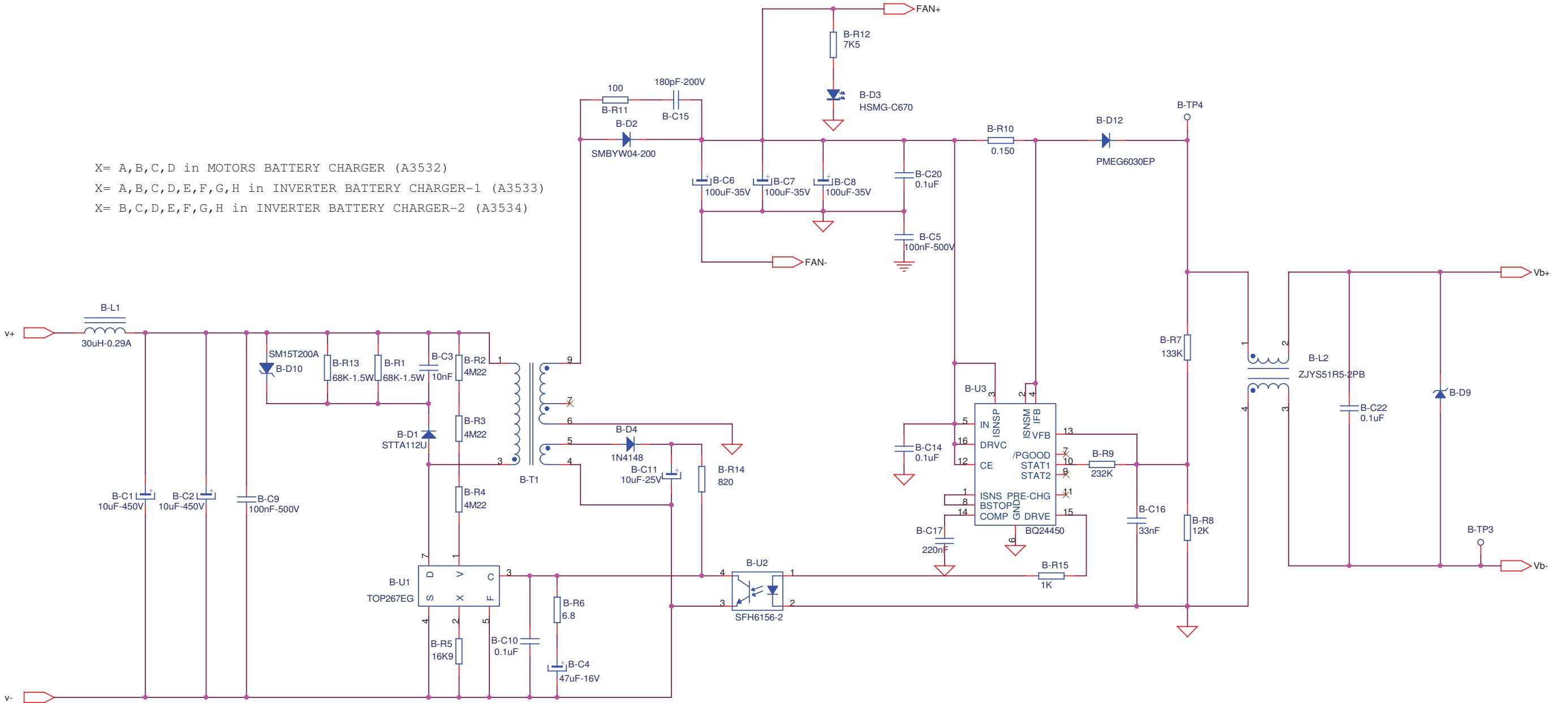
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D	NC 11/420 (U3)	JMG	28-11-11	REVISED	JLA	28-05-09							
C	NC 11/363 (C11,C18)	JMG	06-10-11										
B	NC 10/351 (R7X)	JMG	02-08-10										
A	NC 09/258	JMG	28-05-09	REV	DESCRIPTION	ISSUEDBY	DATE						



INVERTER BATTERY CHARGER2



PCB 90053-06

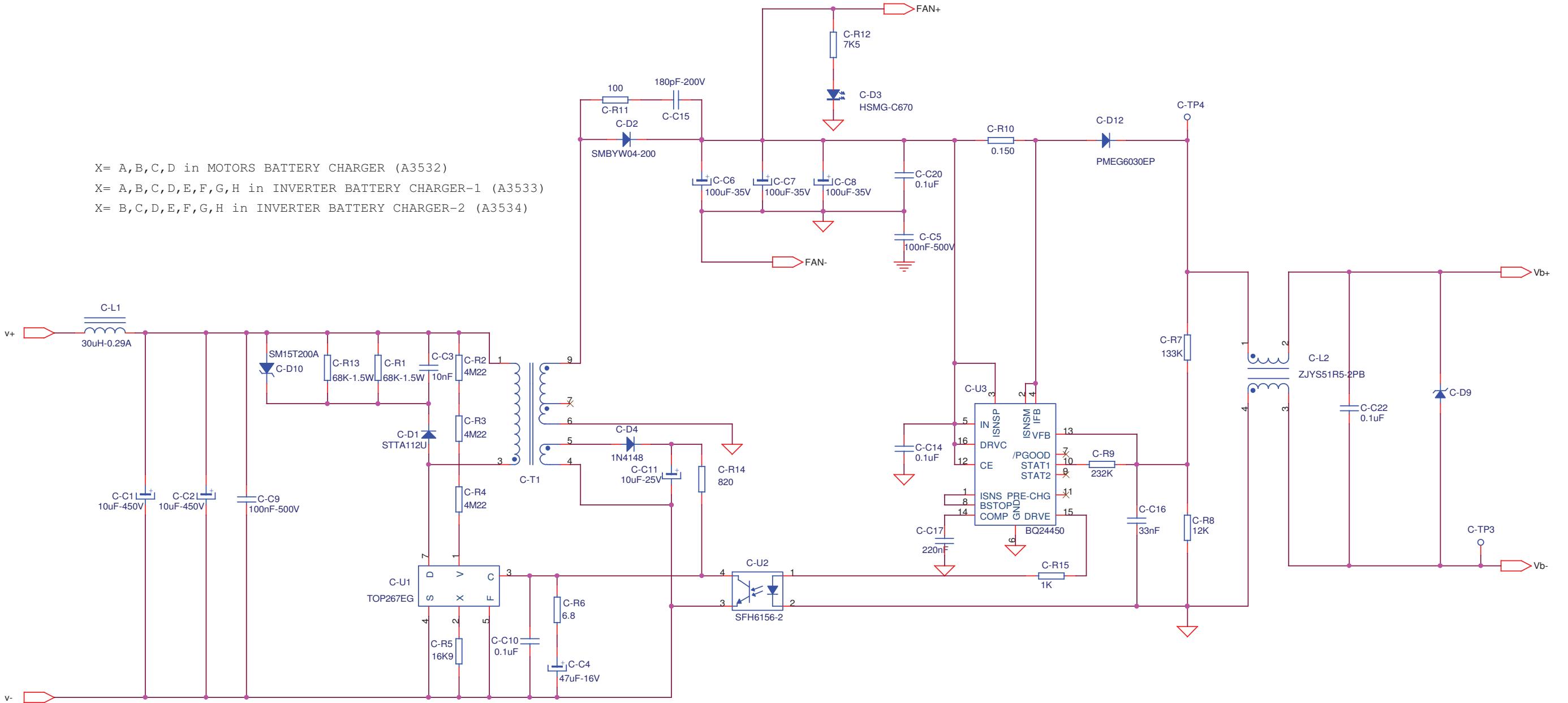


PCB 90053-06

F	NC17/0296 D9	R.Igea	17-11-17	NAME	DATE	SHEET/OF	A3534-04-F					
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D	NC 11/420 (U3)	JMG	28-11-11	REVISED	JLA	28-05-09						
C	NC 11/363 (C11,C18)	JMG	06-10-11									
B	NC 10/351 (R7X)	JMG	02-08-10									
A	NC 09/258	JMG	28-05-09									
REV	DESCRIPTION	ISSUEDBY	DATE									



INVERTER BATTERY CHARGER2

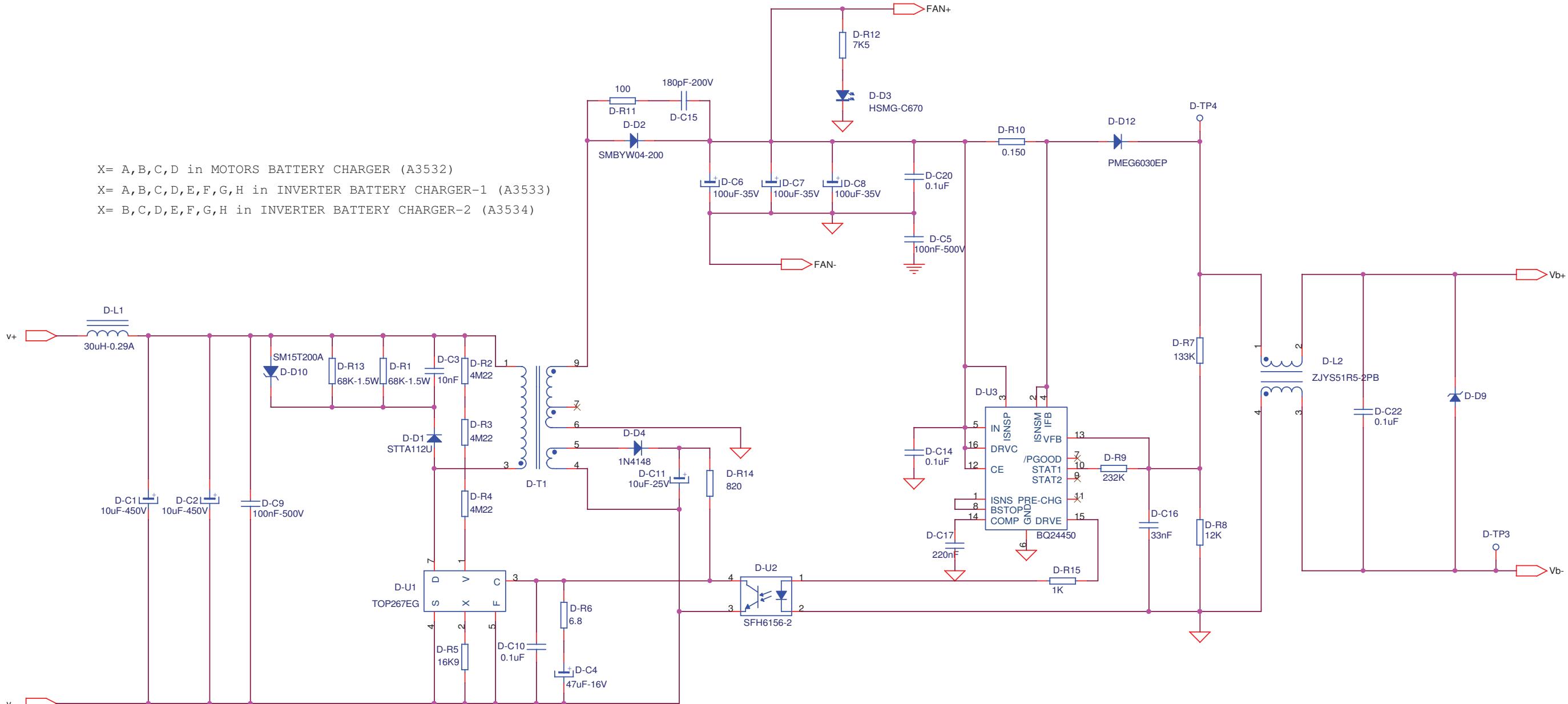


PCB 90053-06

F	NC17/0296 D9	R.Igea	17-11-17	NAME	DATE	SHEET/OF	A3534-04-F						
E	NC 13/378 (R10)	JMG	07-11-13	DRAWING	JMG	28-05-09 <th data-cs="6" data-kind="parent"></th> <th data-kind="ghost"></th> <th data-kind="ghost"></th> <th data-kind="ghost"></th> <th data-kind="ghost"></th> <th data-kind="ghost"></th>							
D	NC 11/420 (U3)	JMG	28-11-11	REVISED	JLA	28-05-09							
C	NC 11/363 (C11,C18)	JMG	06-10-11										
B	NC 10/351 (R7X)	JMG	02-08-10										
A	NC 09/258	JMG	28-05-09										
REV	DESCRIPTION	ISSUEDBY	DATE										

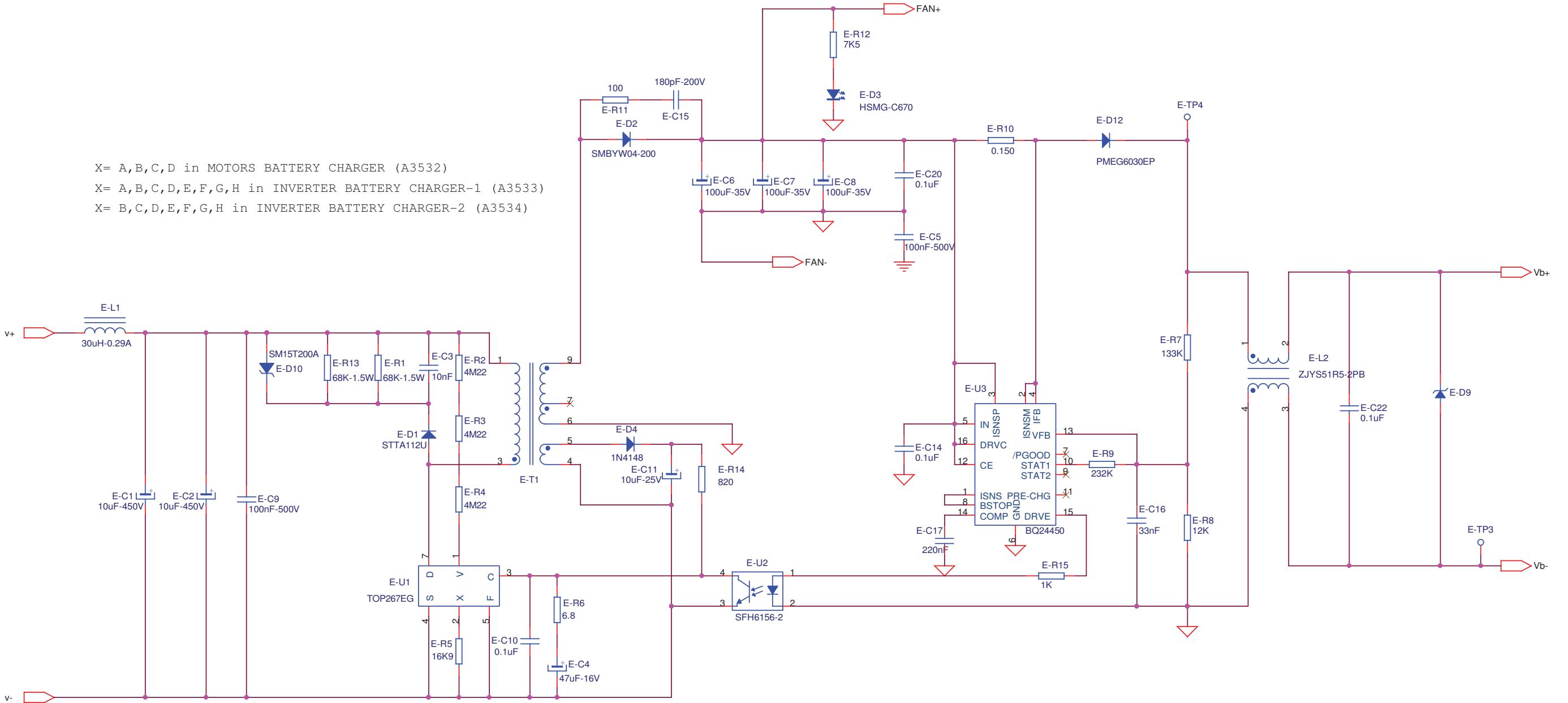


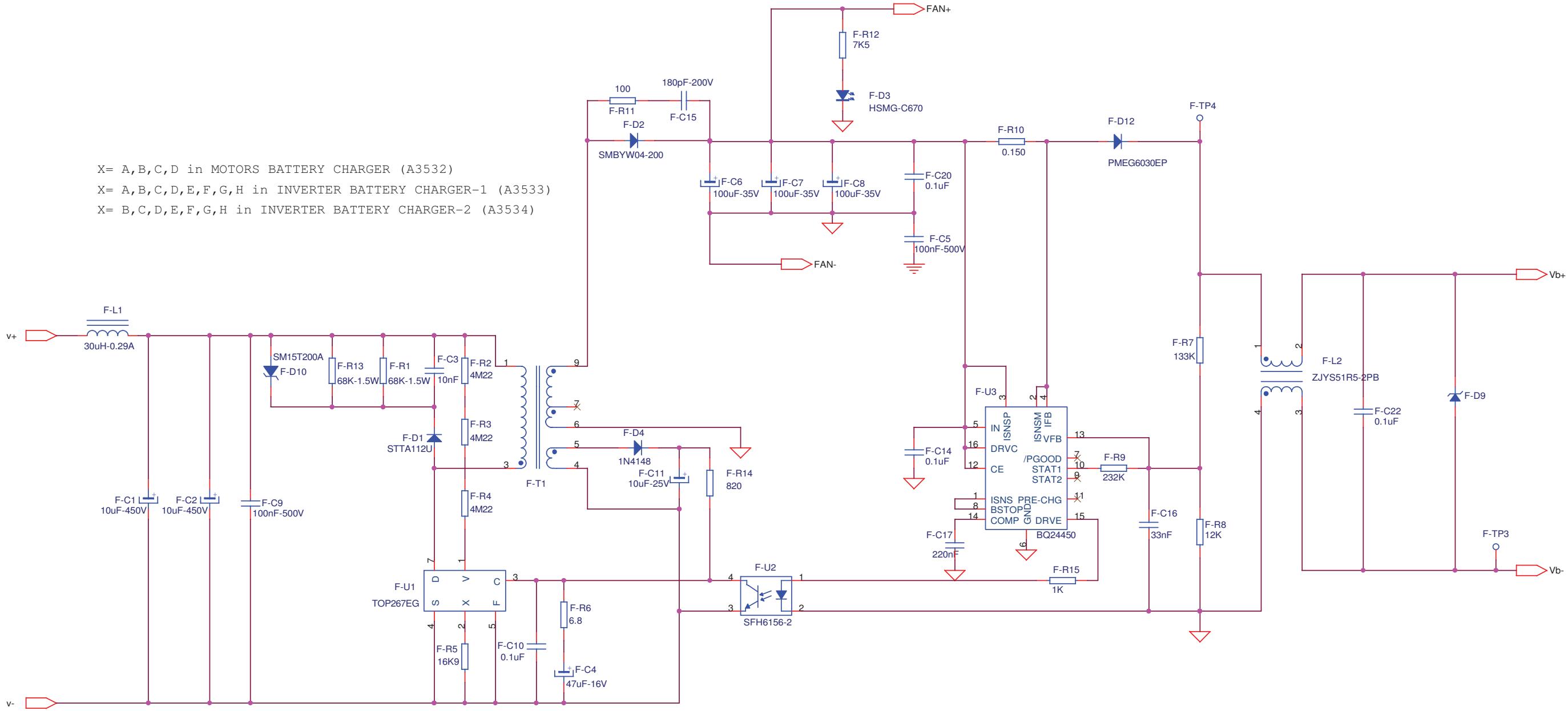
INVERTER BATTERY CHARGER2



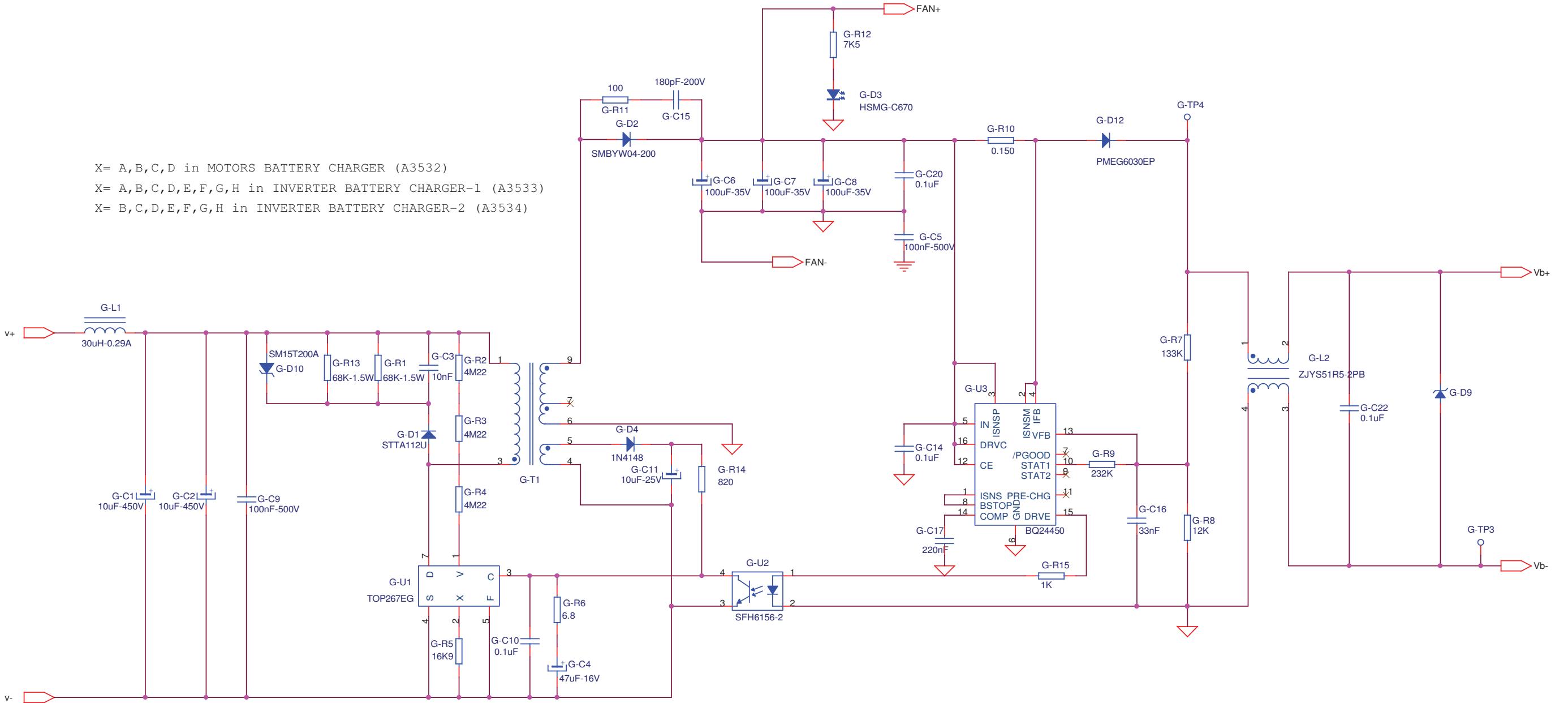
PCB 90053-06

F	NC17/0296 D9	R.Igea	17-11-17		NAME	DATE	SHEET/OF	A3534-04-F								
E	NC 13/378 (R10)	JMG	07-11-13	DRAWING	JMG	28-05-09	2-9/9									
D	NC 11/420 (U3)	JMG	28-11-11	REVISED	JLA	28-05-09			F	E	D	C	B	A	← REV	
C	NC 11/363 (C11,C18)	JMG	06-10-11													
B	NC 10/351 (R7X)	JMG	02-08-10													
A	NC 09/258	JMG	28-05-09													
REV	DESCRIPTION	ISSUED BY	DATE													
				 SEDECAL								INVERTER BATTERY CHARGER2				





PCB 90053-06

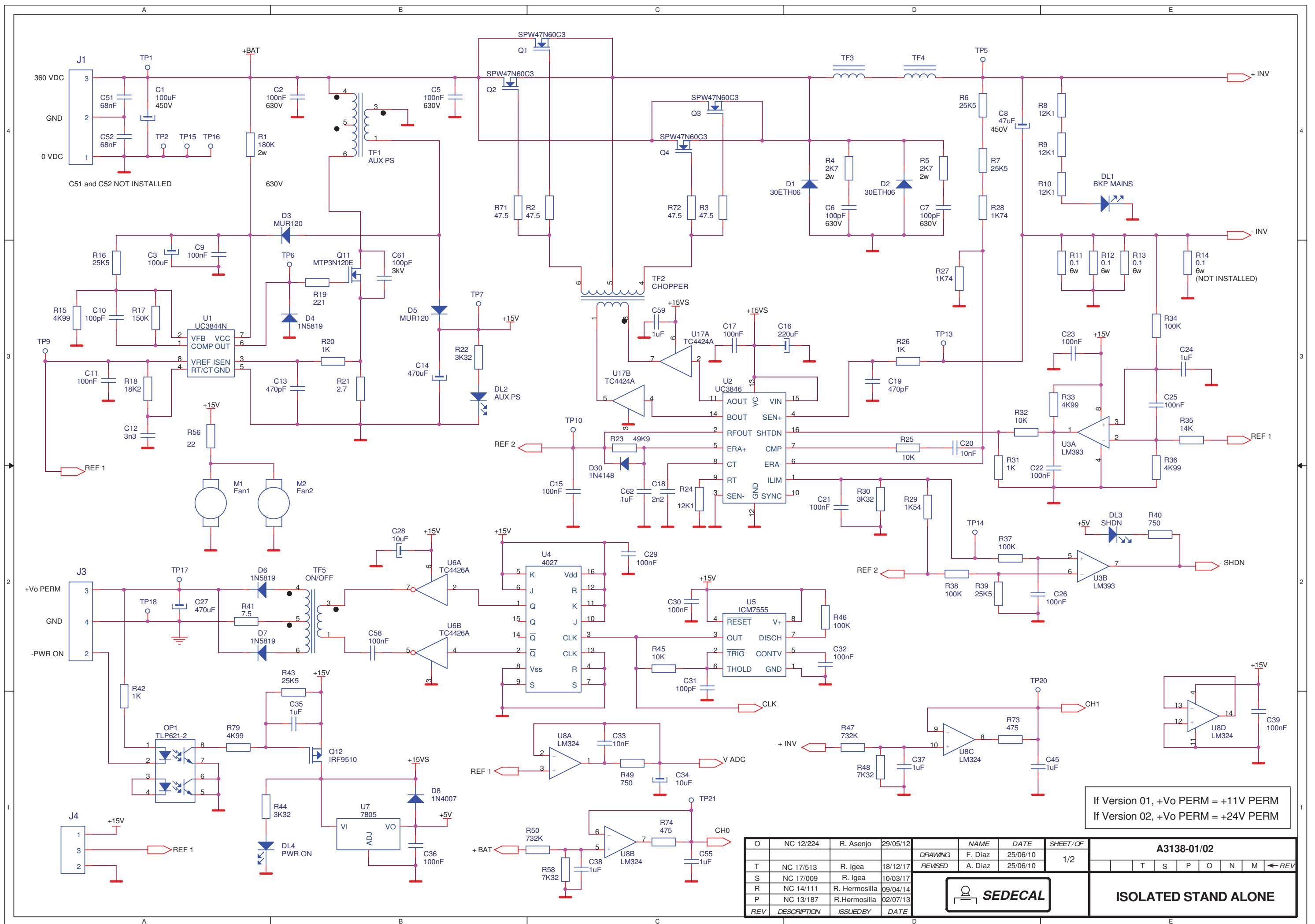


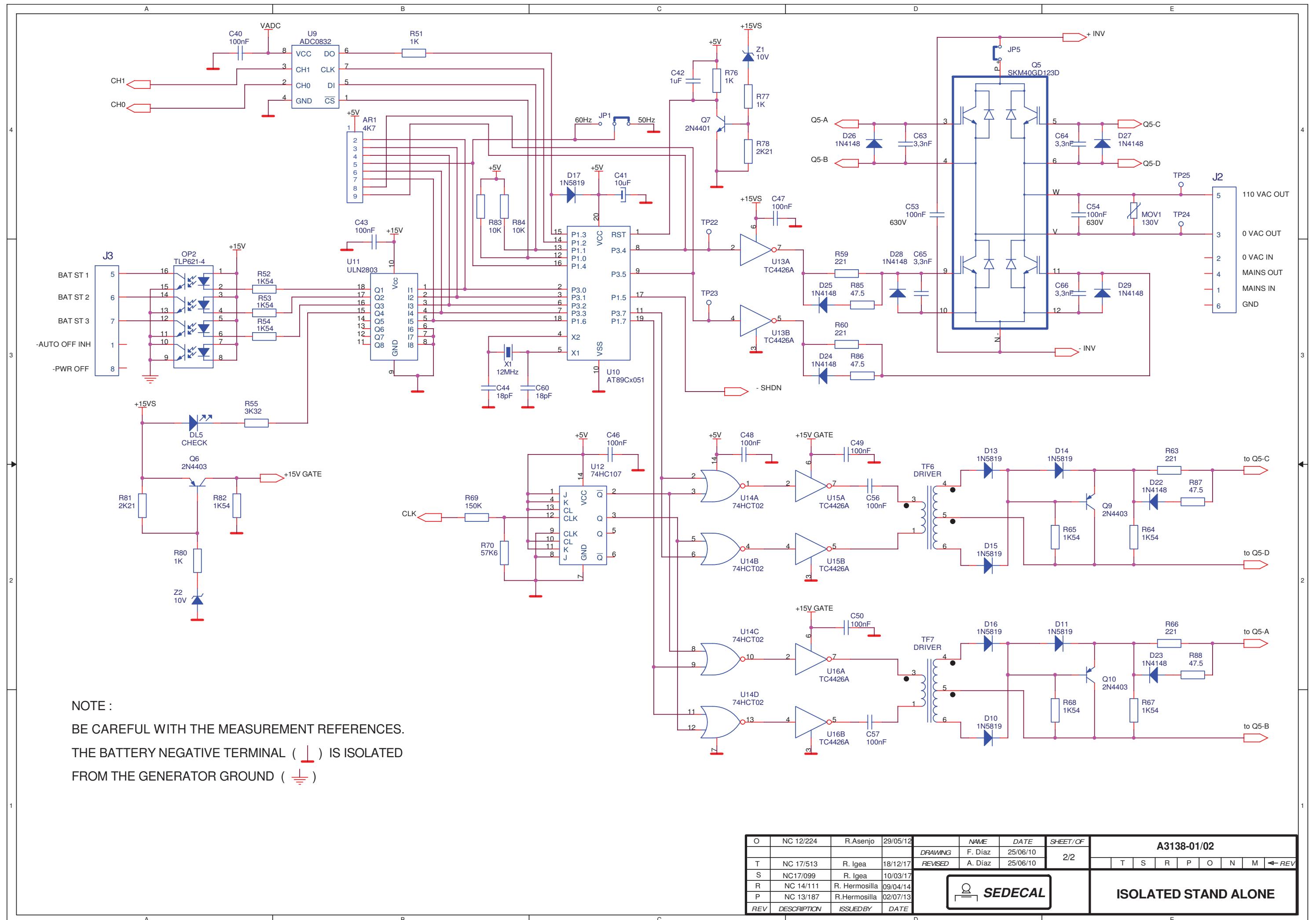
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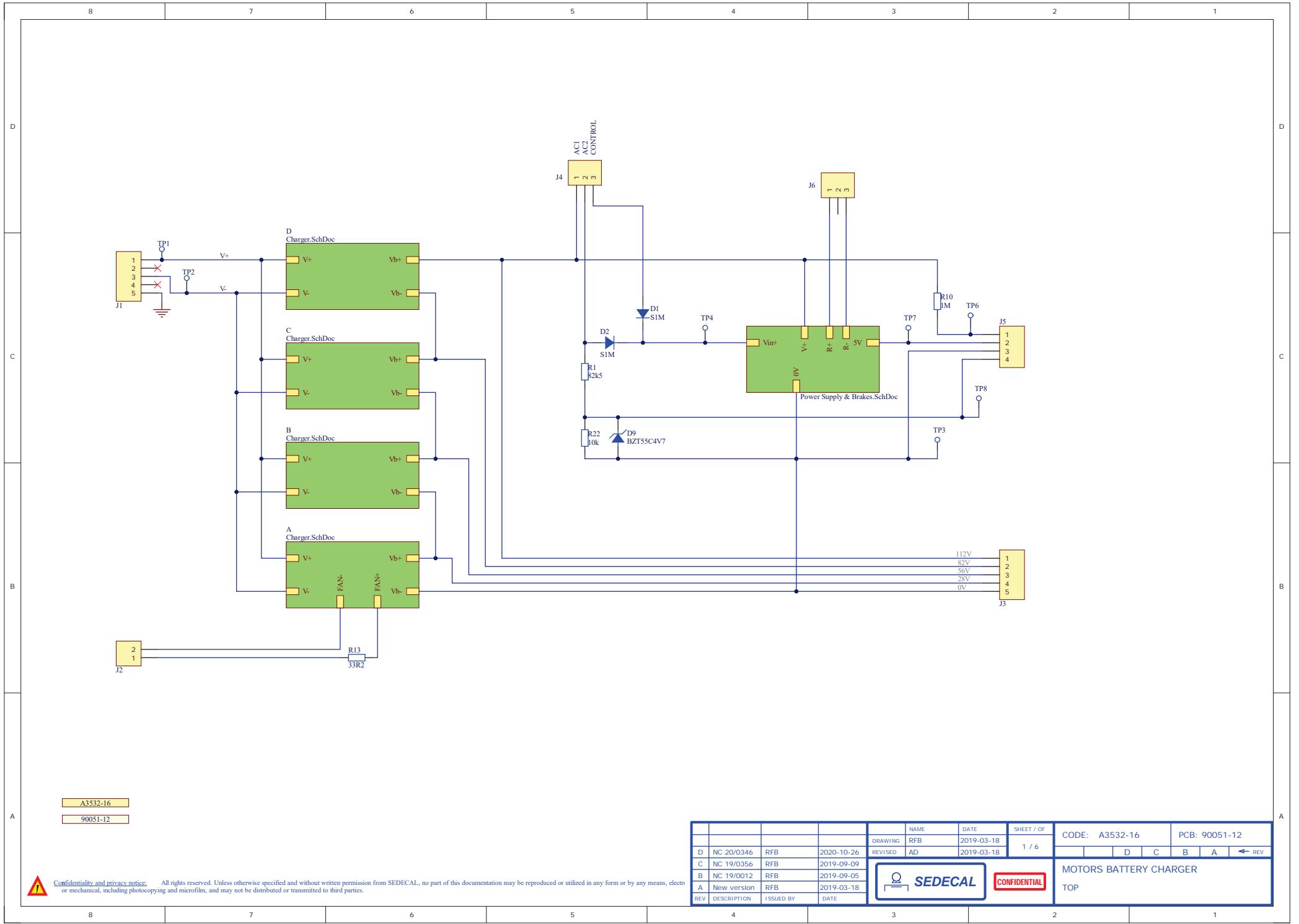
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D	NC 11/420 (U3)	JMG	28-11-11	REVISED	JLA	28-05-09								
C	NC 11/363 (C11,C18)	JMG	06-10-11											
B	NC 10/351 (R7X)	JMG	02-08-10											
A	NC 09/258	JMG	28-05-09											
REV	DESCRIPTION	ISSUEDBY	DATE											

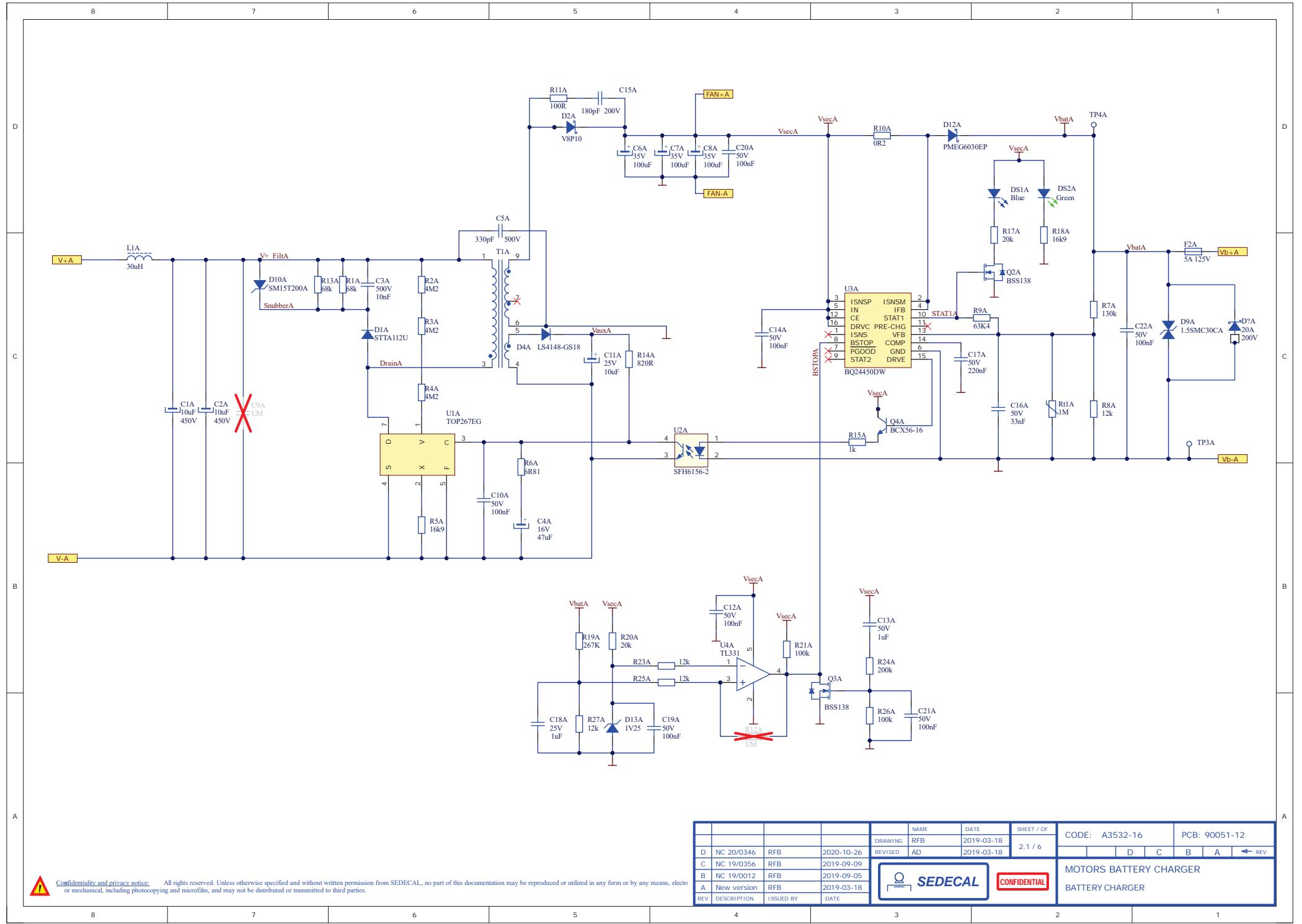


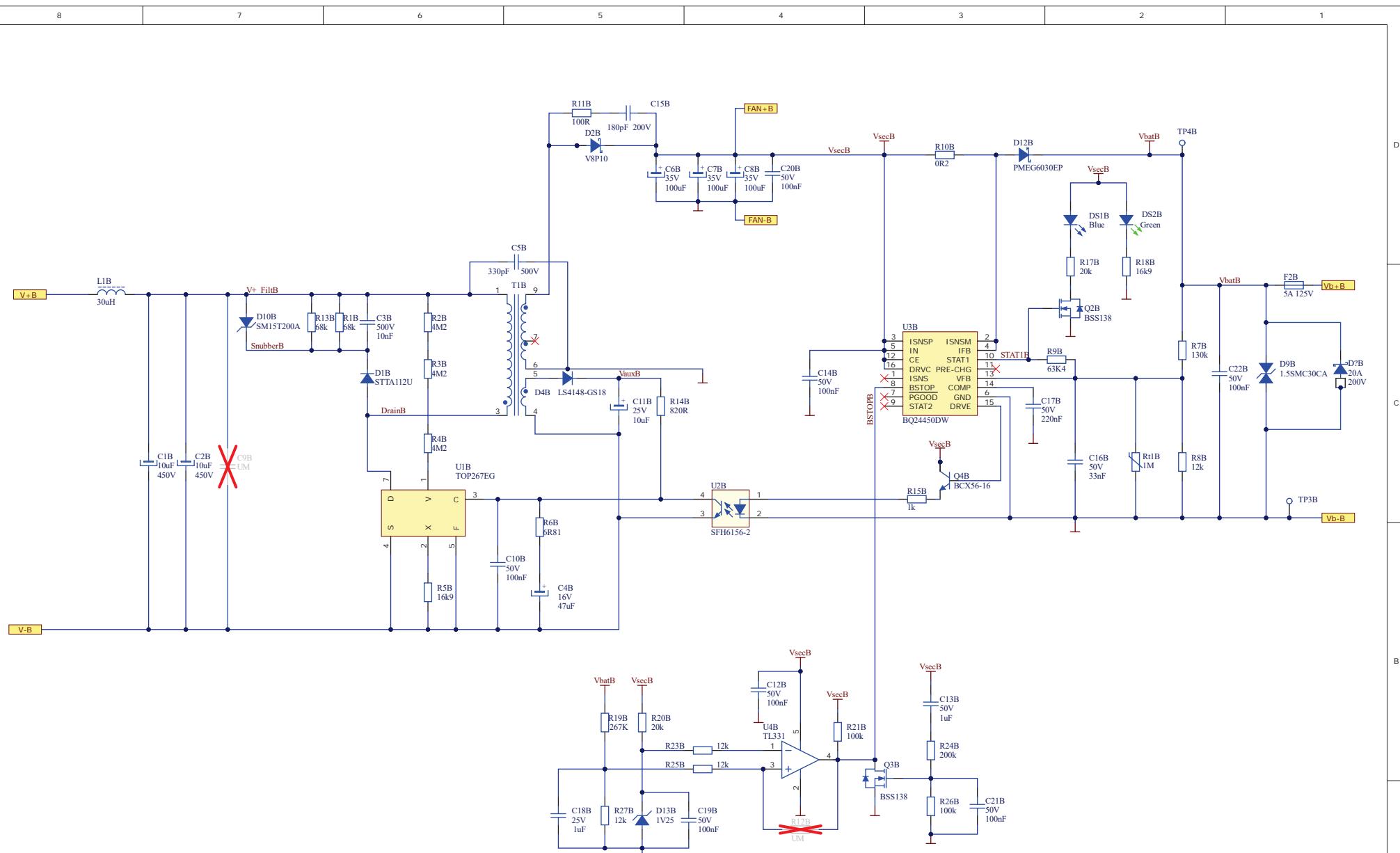
INVERTER BATTERY CHARGER2









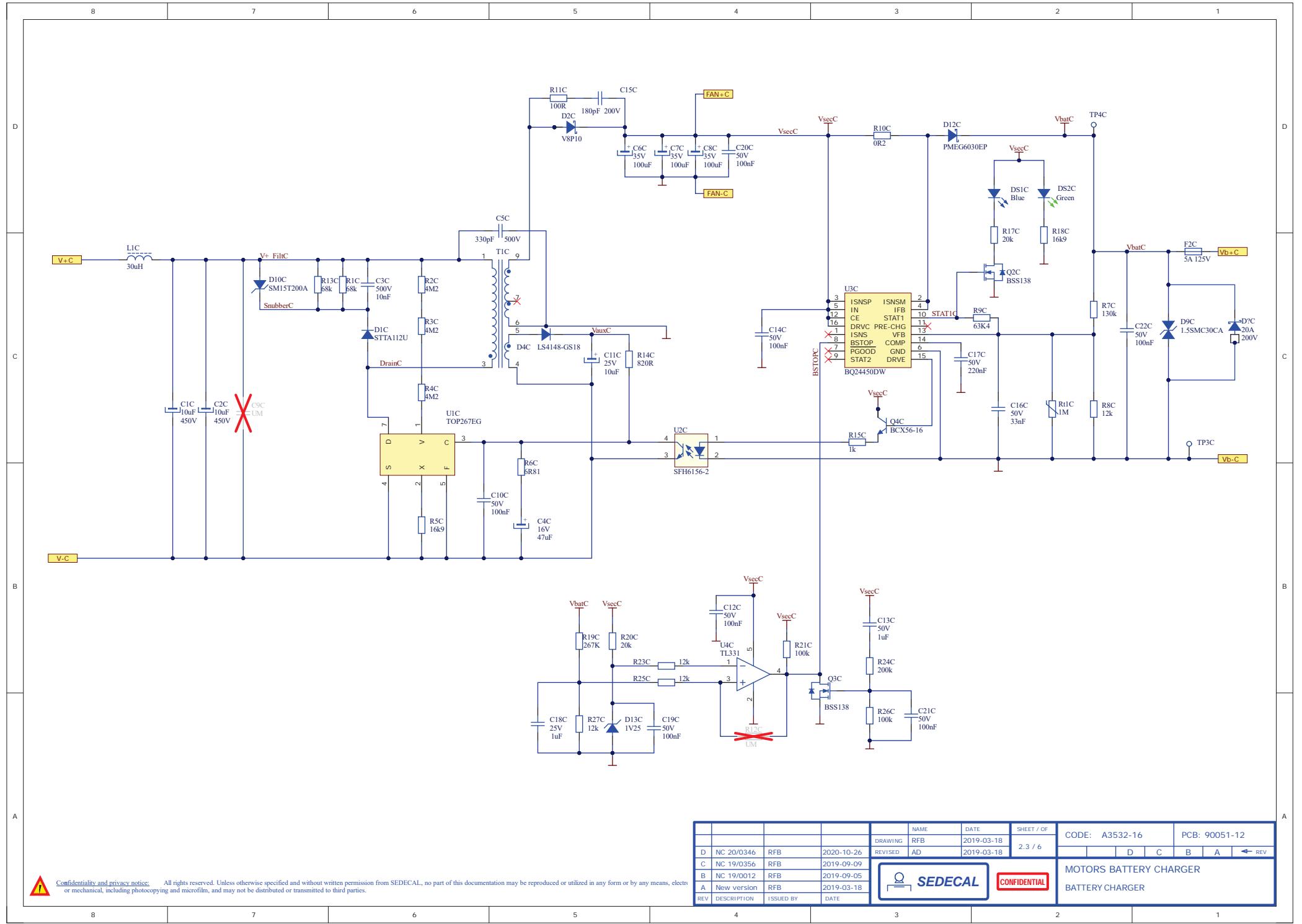


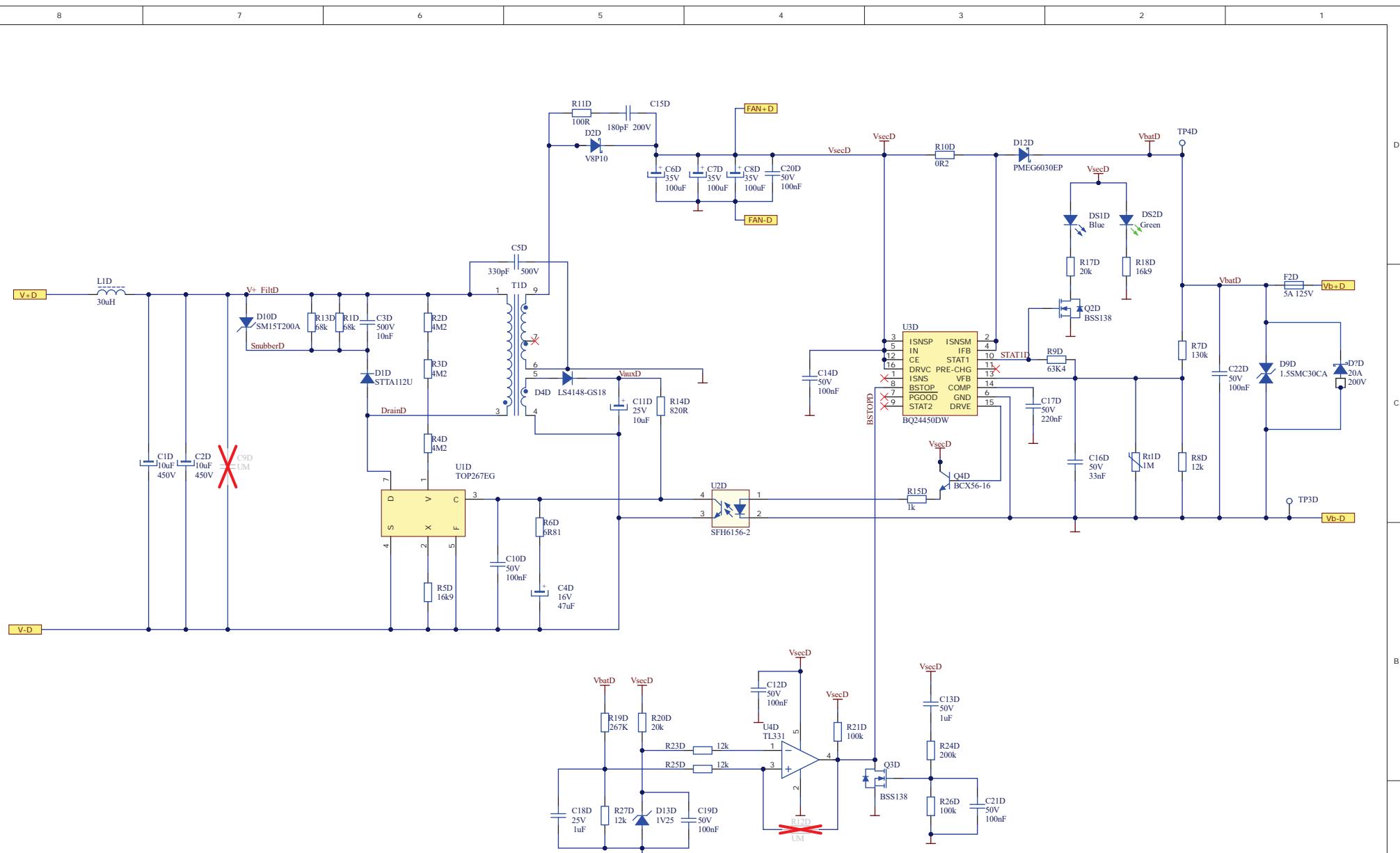
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			NAME	DATE	SHEET / OF	CODE: A3532-16		PCB: 90051-12			
D	NC 20/0346	RFB	RFB	2019-03-18	2.2 / 6						
C	NC 19/0356	RFB	REVISED	AD	2019-03-18	D	C	B	A	◀	REV
B	NC 19/0012	RFB				MOTORS BATTERY CHARGER					
A	New version	RFB				BATTERY CHARGER					
REV	DESCRIPTION	ISSUED BY	DATE								


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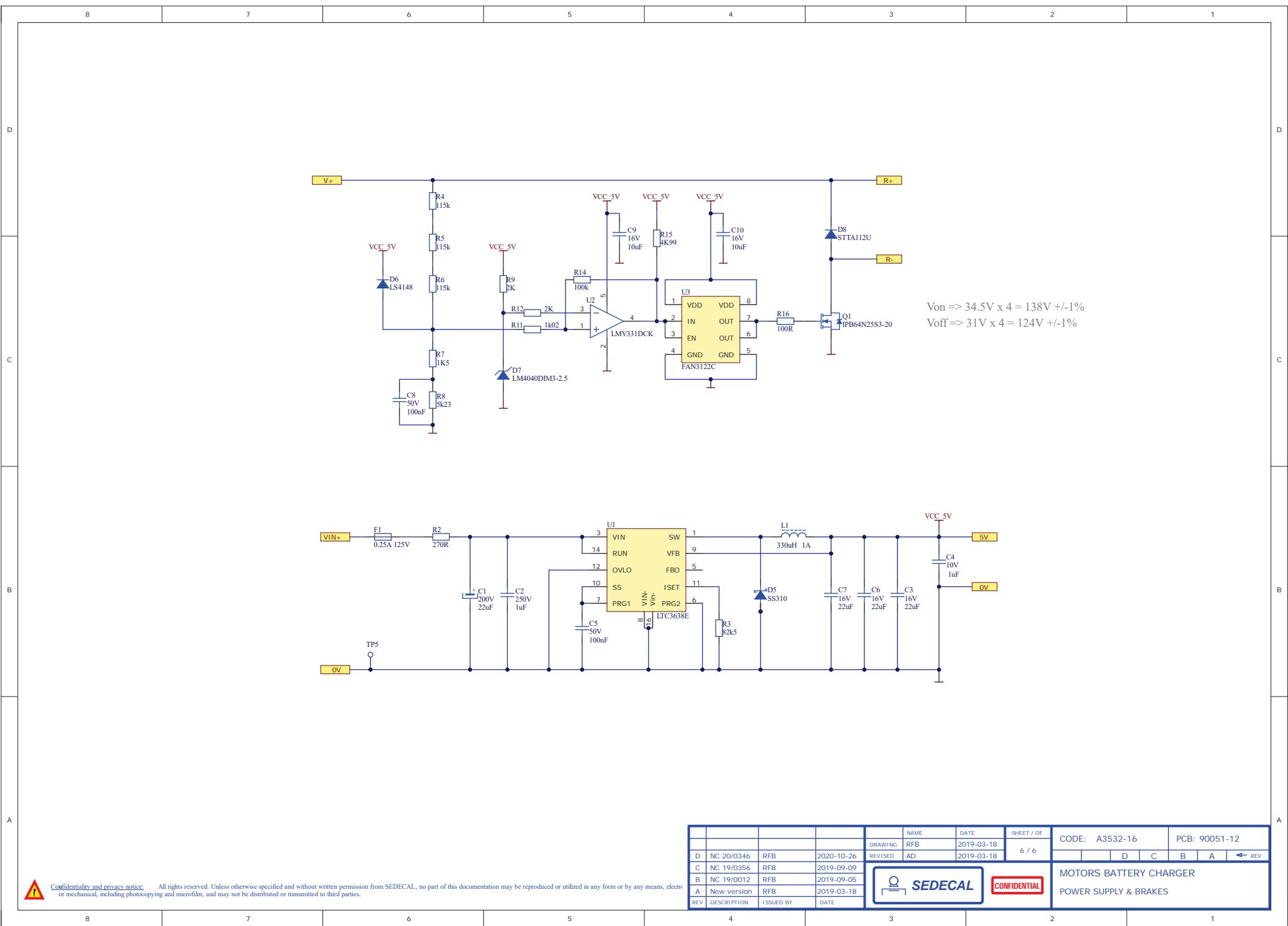
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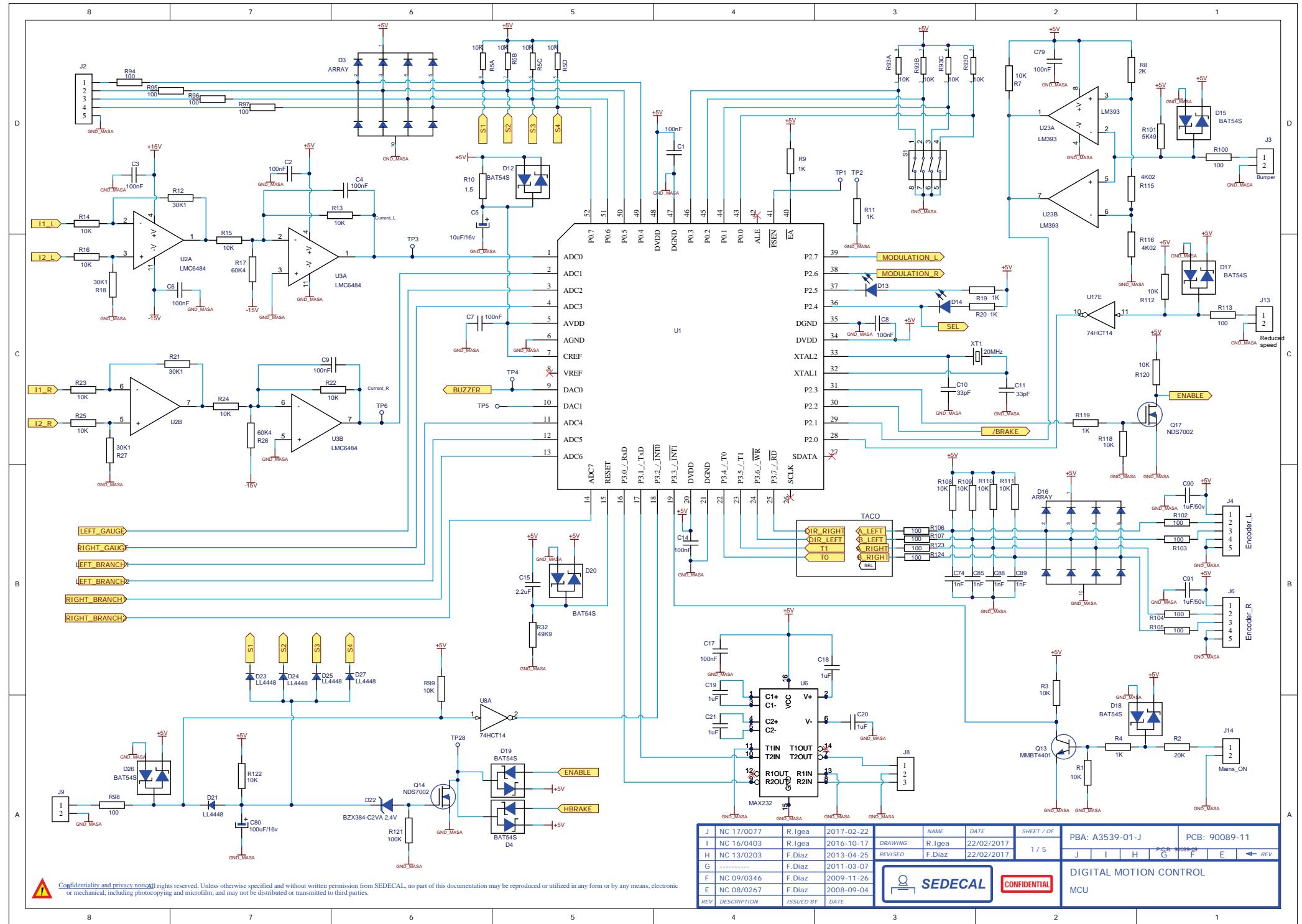
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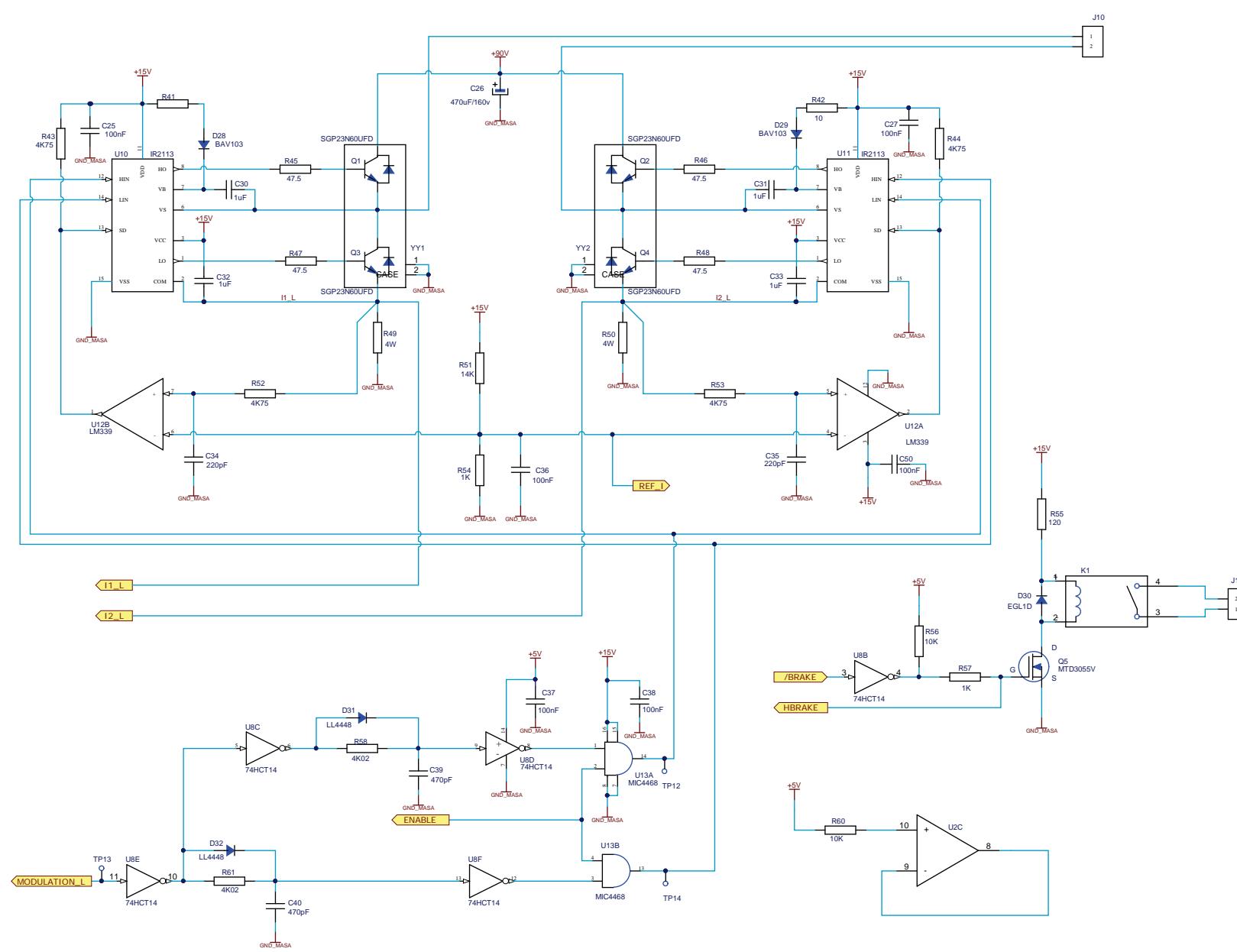
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D	NC 20/0346	RFB	RFB	2019-03-18	2.4 / 6		D	C	B	A	REV
C	NC 19/0356	RFB	REvised	AD	2019-03-18						
B	NC 19/0012	RFB									
A	New version	RFB									
REV	DESCRIPTION	ISSUED BY	DATE								

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MOTORS BATTERY CHARGER
BATTERY CHARGER







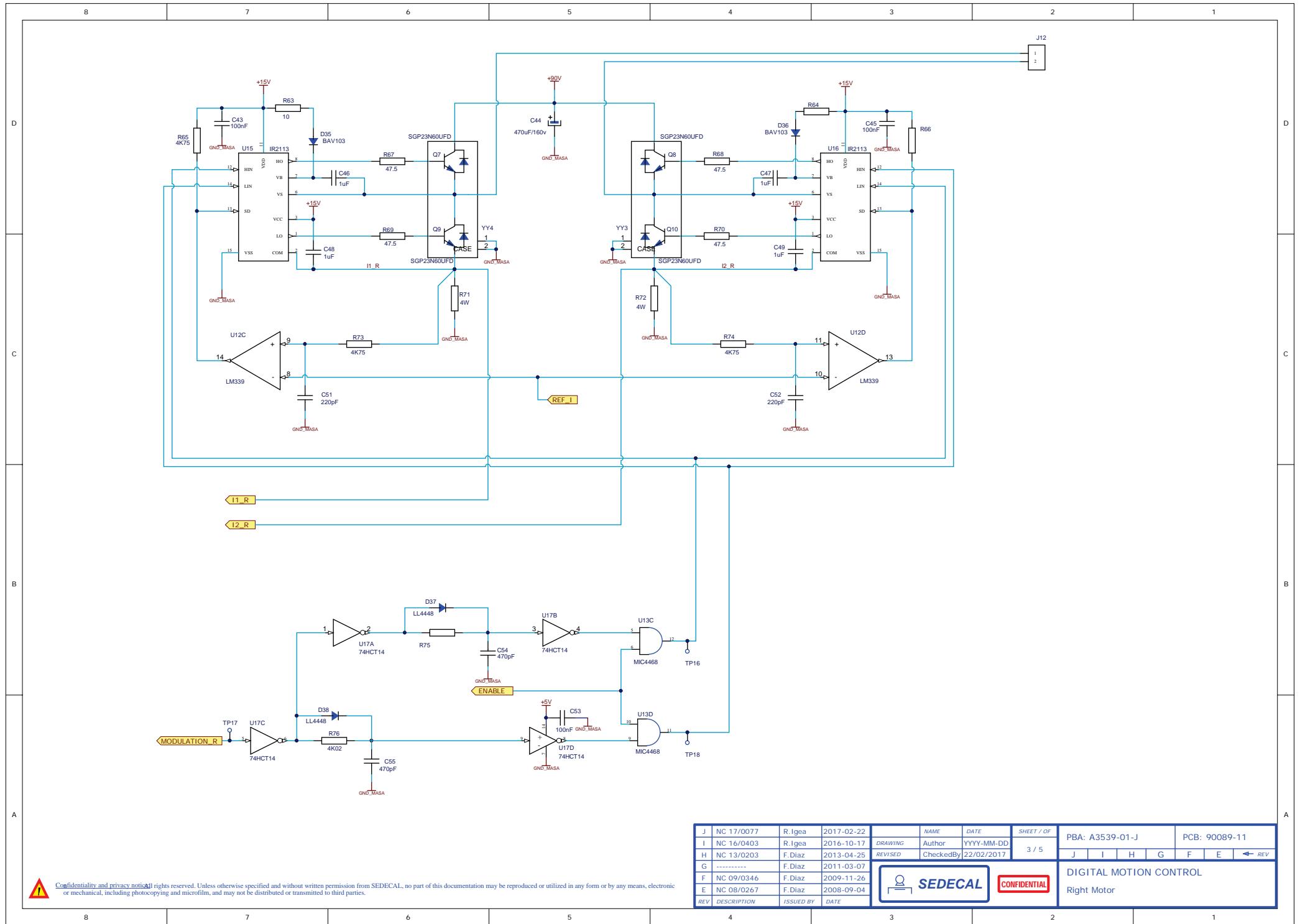
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I	NC 16/0403	R.Igea	2016-10-17	DRAWING	Author	YYYY-MM-DD		
H	NC 13/0203	F.Diaz	2013-04-25	REVISED	CheckedBy	22/02/2017	2 / 5	
G	-----	F.Diaz	2011-03-07					
F	NC 09/0346	F.Diaz	2009-11-26					
E	NC 08/0267	F.Diaz	2008-09-04					
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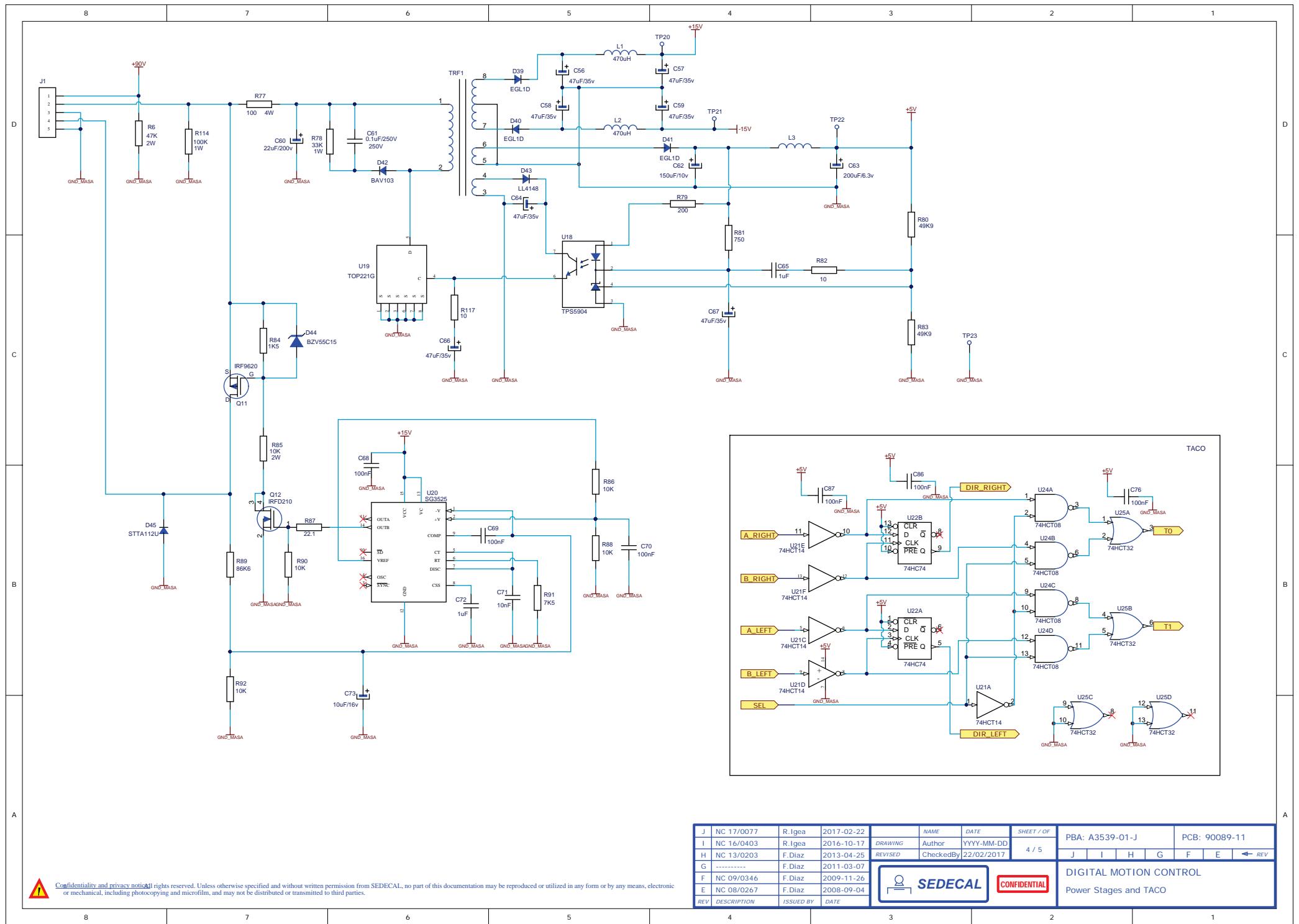
SEDECAL CONFIDENTIAL

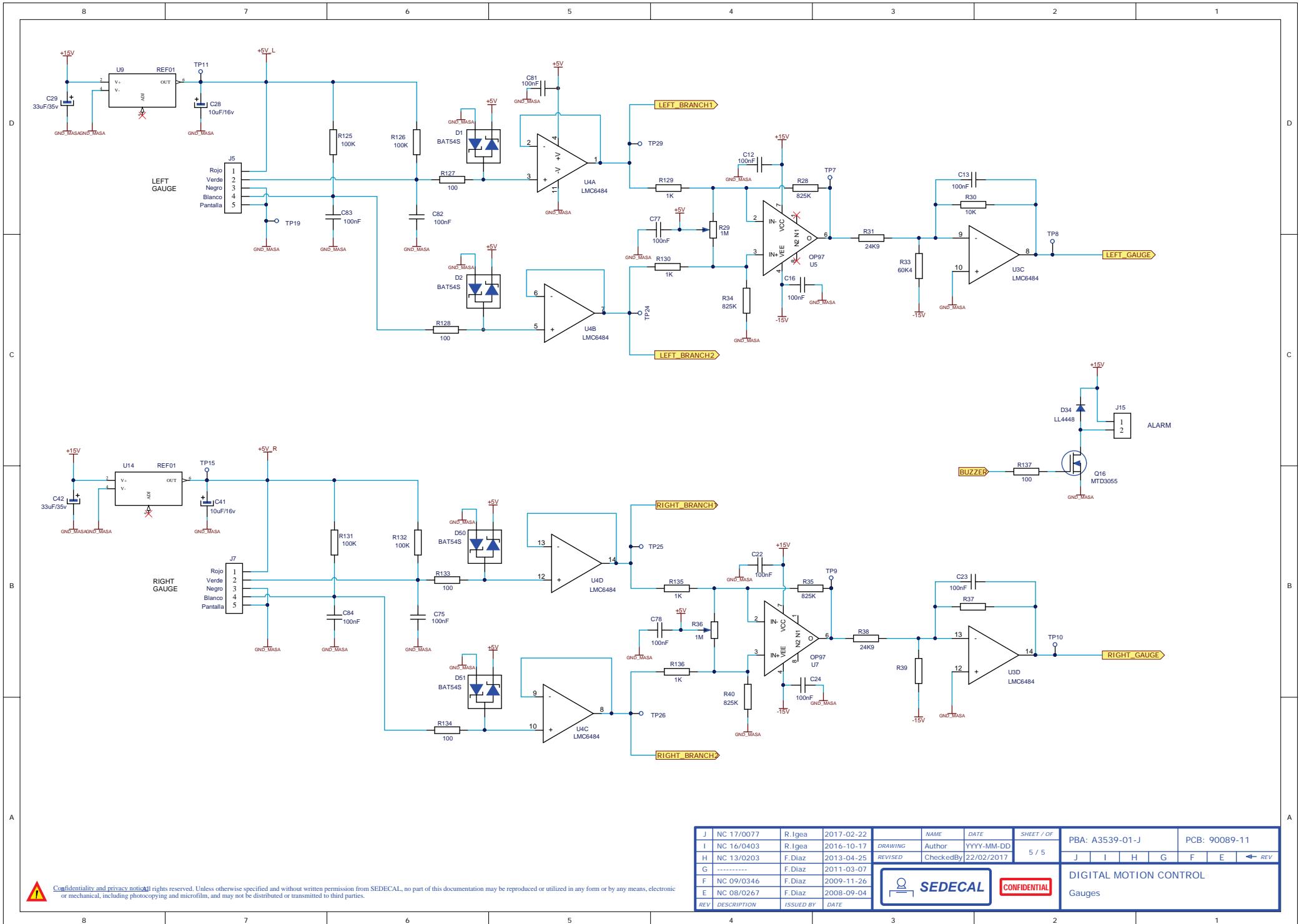
DIGITAL MOTION CONTROL
Left Motor

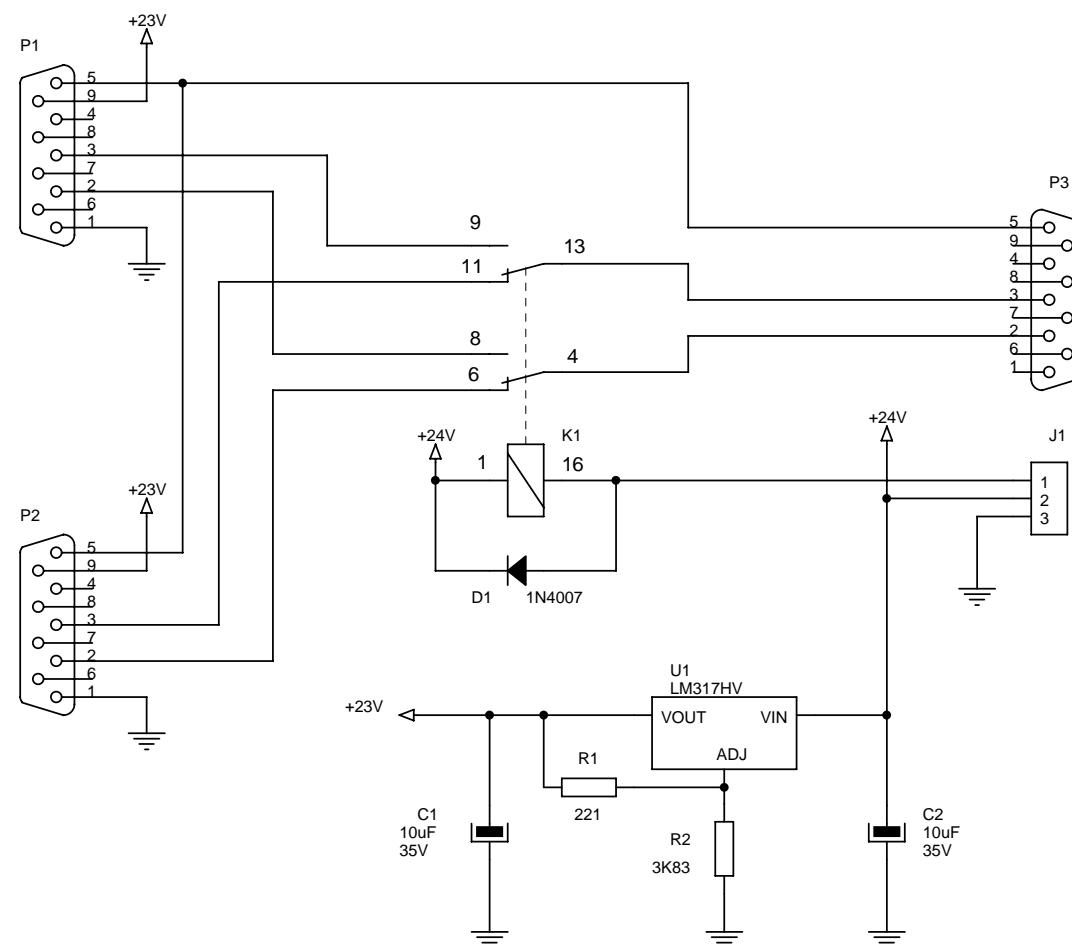


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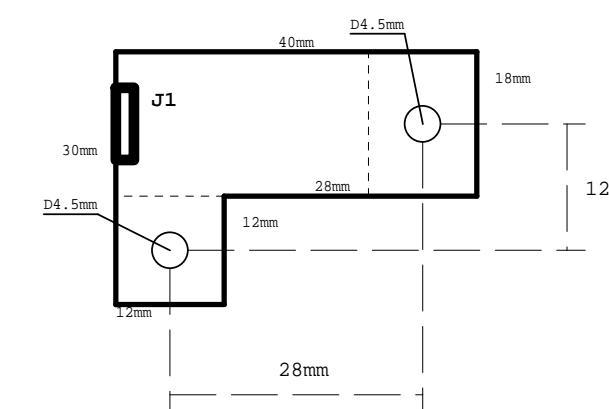
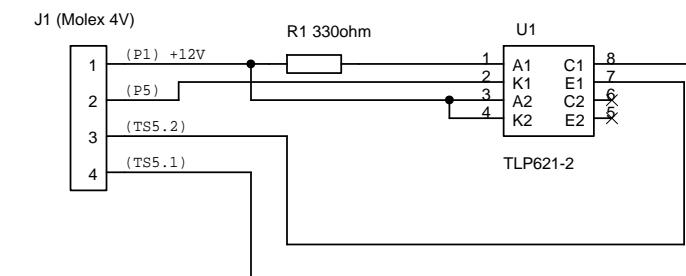


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 **SEDECAL**

RADIATION METER

A B C D E

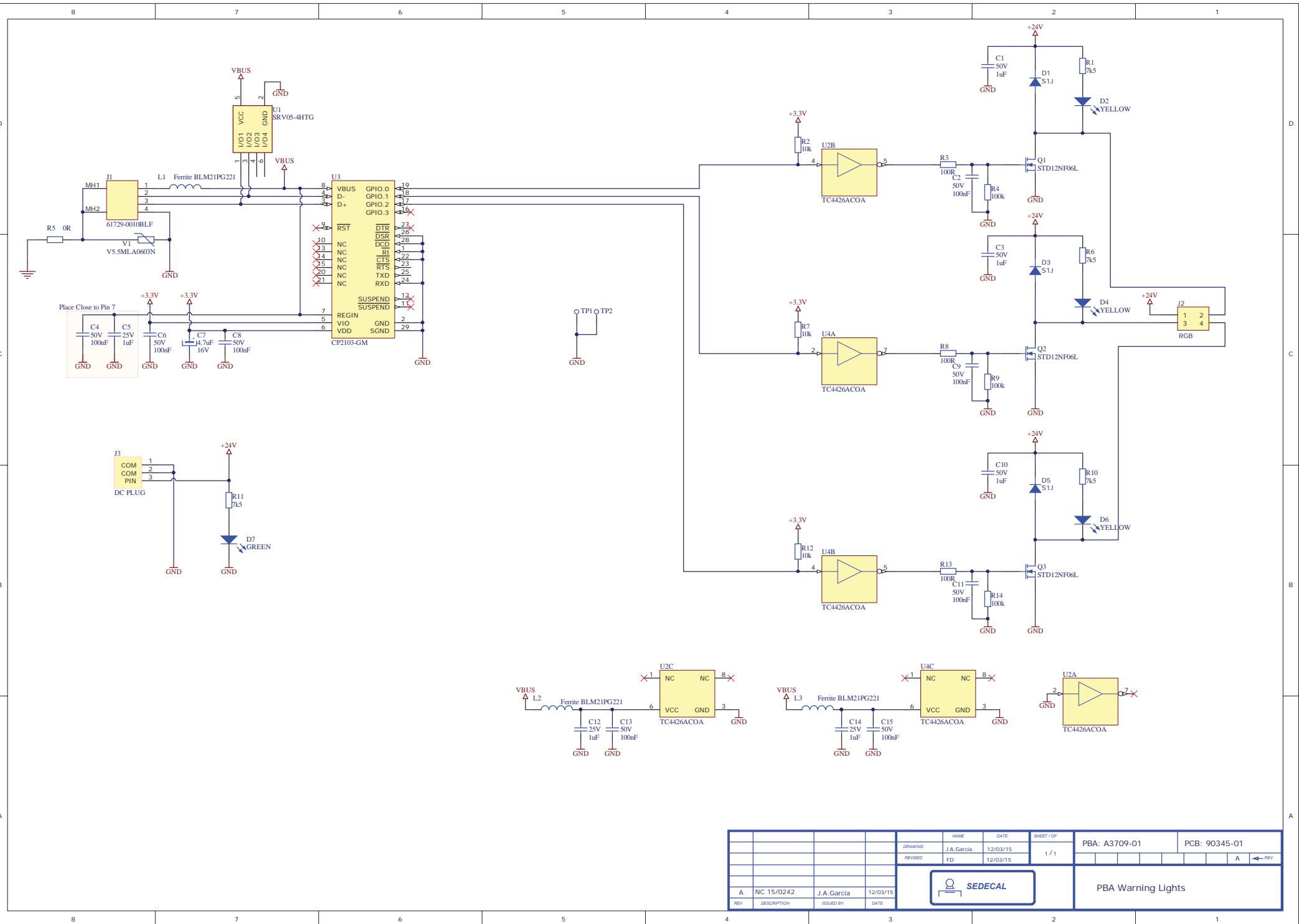


PCB: 90313-01

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REVISED	A. Diaz	02/03/11					
A	NC 11/090	R. Asenjo	02/03/11				
REV	DESCRIPTION	ISSUED BY	DATE				

SEDECAL

REMOTE COL PCB



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DRAWING		J.A.Garcia	12/03/15	1 / 1		
REVISED		FD	12/03/15			
A	NC 15/0242	J.A.Garcia	12/03/15			
REV	DESCRIPTION	ISSUED BY	DATE			



PBA Warning Lights

Mobile X-Ray Unit**► Purpose of this document**

The spare parts list is not integrated in this Service Manual.
Refer to the following document:

Document	Reference
DX-D 100 / DX-D 100 Wireless - Mobile X-Ray Unit - Spare Parts List	Document ID 30872155

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Appendix

Technical Publication

AP-0061R0

**DX-D 100
Mobile X-ray Unit
with Extra-Short Column**

REVISION HISTORY

REVISION	DATE	REASON FOR CHANGE
0	SEPT 25, 2013	First Edition

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.

SAFETY SYMBOLS

The following safety symbols may appear in the equipment.

Their meaning are described below.

	Caution. Consult accompanying documents.
	General Symbol. Follow operating instructions. <i>(Only applies to IEC 60601-1 Standard - Third edition)</i>
	Safety Symbol. Follow instructions for use, especially those instructions identified with Advisory Symbols to avoid any risk for the Patient or Operator. <i>(Only applies to IEC 60601-1 Standard - Third edition)</i>
	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. <i>(Only applicable to equipment with Laser Pointer)</i>

	Dangerous voltage.
	General warning, caution, risk of danger.
	Warning: Ionizing radiation.
	Warning: Non-ionizing radiation.
	Warning: Laser beam.
	Warning: Dangerous voltage.
	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.
	Electrostatic sensitive devices.
	No pushing.

	No sitting.
	No stepping on surface.
	Stop (of action).
	Emergency stop.
	“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.

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1.1.2 Mobile Unit with Portable DR Detector and Extra-short Column	3
2 TROUBLESHOOTING	5
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SECTION 1 INTRODUCTION

This Appendix applies to the **DX-D 100 Mobile X-ray Unit with Extra-Short Column**.

The main different with the standard Mobile X-ray Unit is the lower height of the Rotating Column.

Note 

This Appendix is a complement of the User and Service Manuals of the standard DX-D 100 Mobile X-ray Unit. For further information about Operation and Service, refer to the corresponding Manual.

Illustration 1-1 DX-D 100 Mobile X-ray Unit: Configuration Options



Configuration for Portable DR Detector

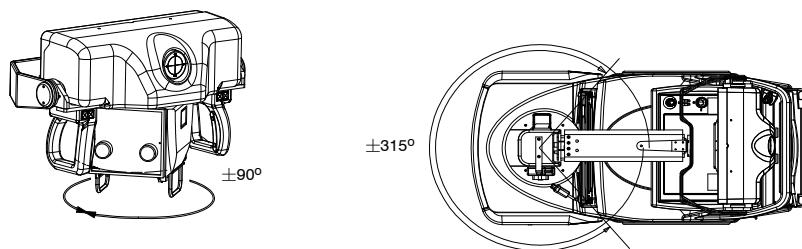
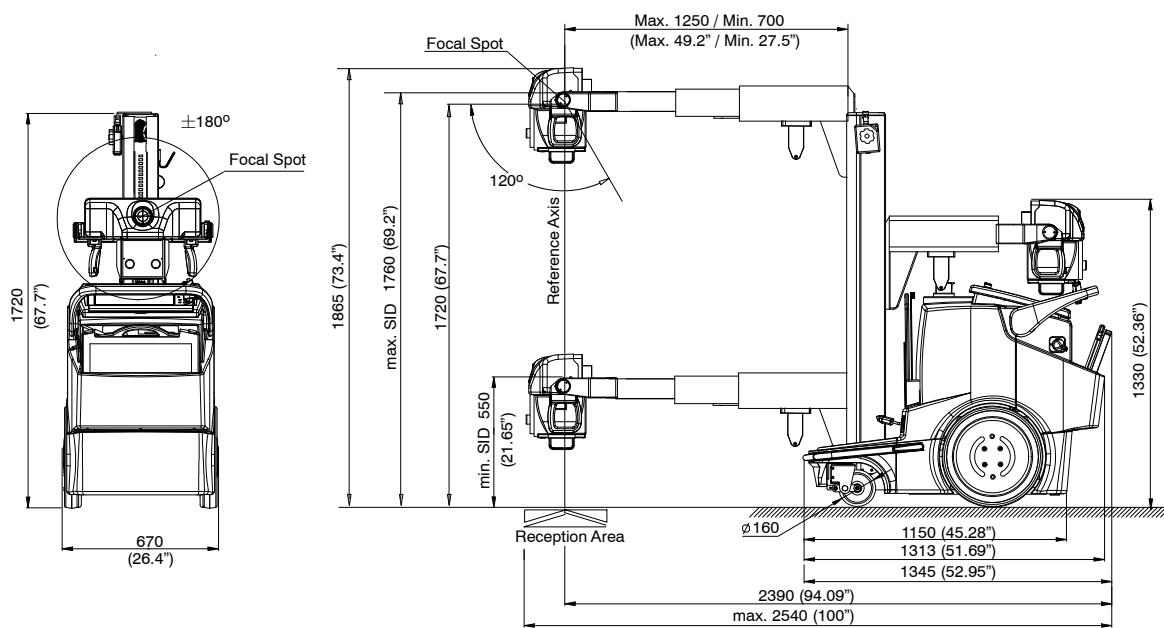


Configuration for Wireless DR Detector

1.1 PHYSICAL CHARACTERISTICS.

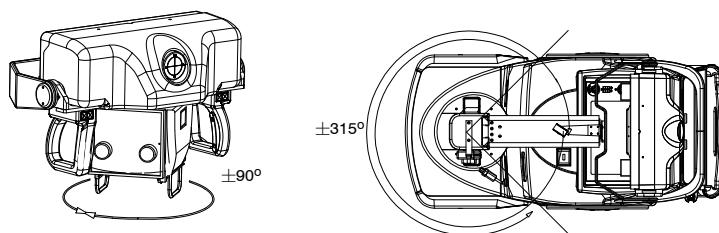
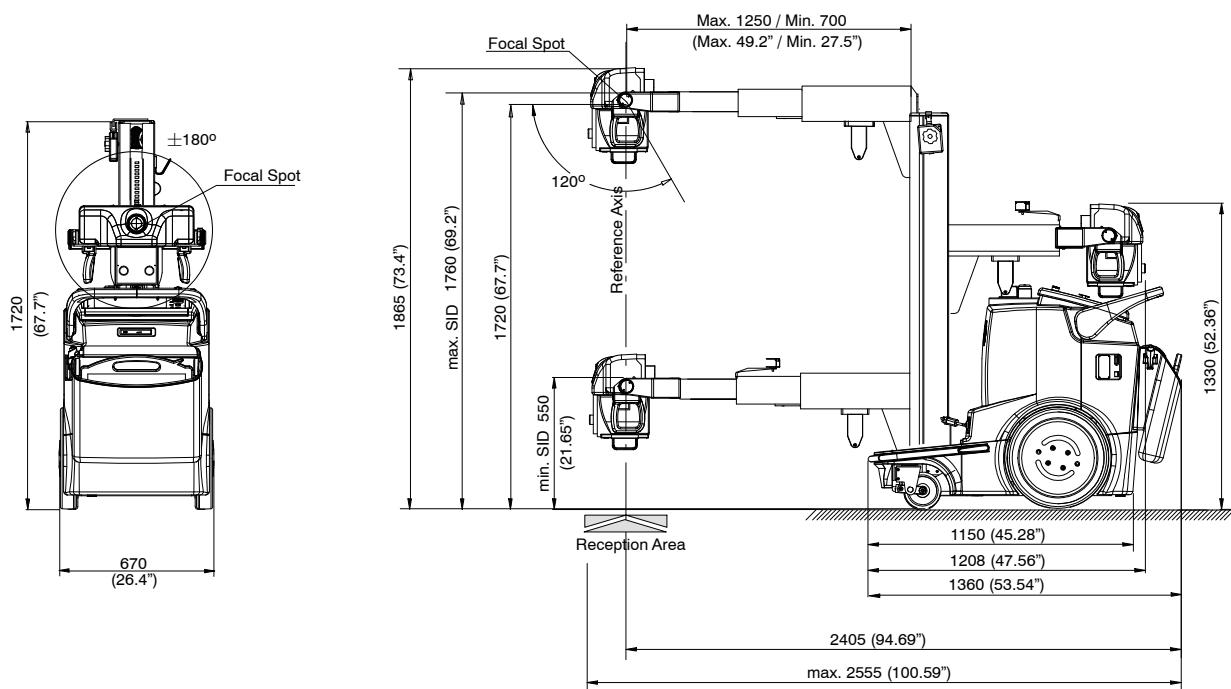
1.1.1 MOBILE UNIT WITH WIRELESS DR DETECTOR AND EXTRA-SHORT COLUMN

LENGTH	WIDTH	HEIGHT	WEIGHT
minimum 1345 mm (52.95") maximum 2540 mm (100")	670 mm (26.4")	minimum 1720 mm (67.7") maximum 1865 mm (73.4")	568 kg (1252 lb)



1.1.2 MOBILE UNIT WITH PORTABLE DR DETECTOR AND EXTRA-SHORT COLUMN

LENGTH	WIDTH	HEIGHT	WEIGHT
minimum 1360 mm (53.54") maximum 2555 mm (100.59")	670 mm (26.4")	minimum 1720 mm (67.7") maximum 1865 mm (73.4")	568 kg (1252 lb)



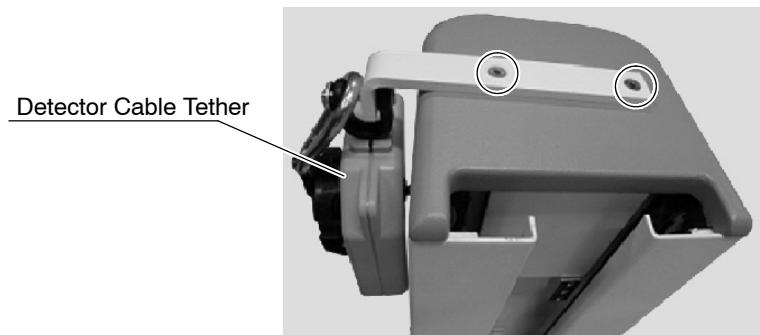
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SECTION 2 TROUBLESHOOTING

2.1 COLUMN STEEL CABLE / SPRING REPLACEMENT FOR EXTRA-SHORT COLUMN

For Steel Cable and/or Spring replacement, follow the next steps.

1. Place the Mobile Unit in Parking Position.
2. Unscrew the two (2) Fixing Screws from the Column Upper Cover and remove the Cover (for Digital Mobile Units, these Screws also fix the "Tools Balance Support" or "Detector Cable Tether").

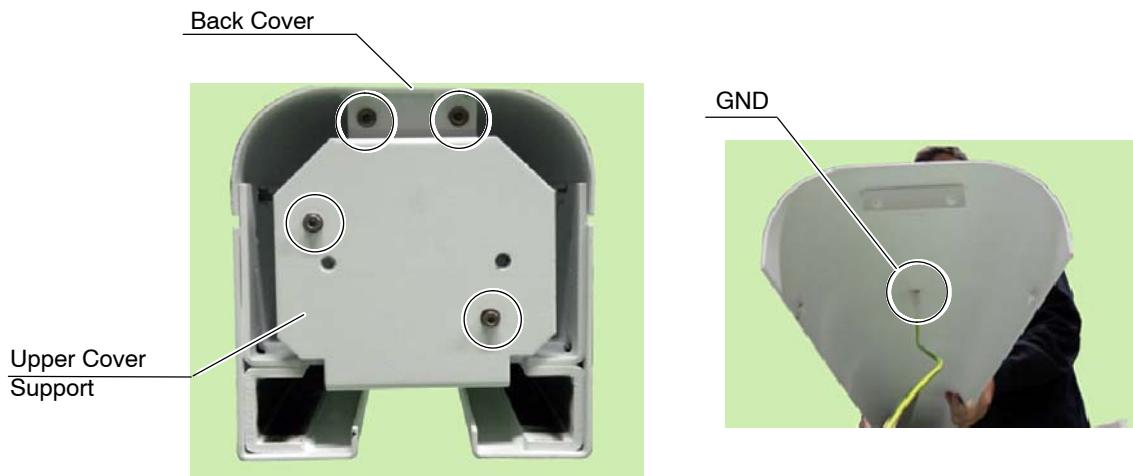


3. Loosen without remove the four (4) Fixing Screws from the Cables Access Cover located in the Column of the Mobile Unit.

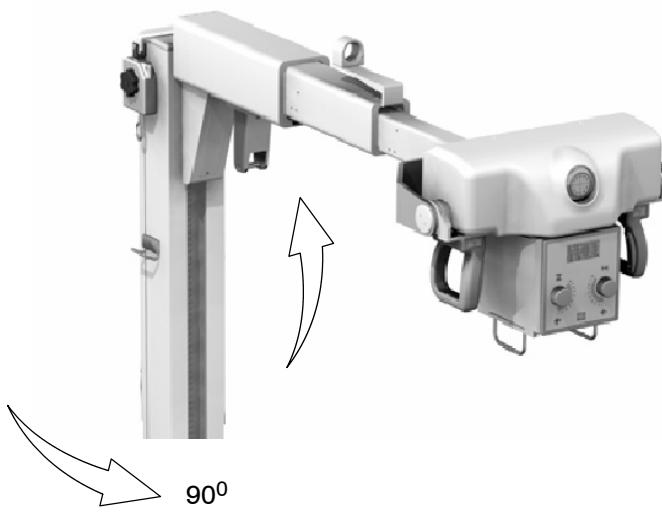


4. Remove the two (2) Fixing Screws from the Column Back Cover.

Slide the Column Back Cover a few centimeters upwards, then remove the cover backwards and disconnect GND cable.



5. Remove the Column Upper Cover Support after removing the two (2) fixing Screws, as shown in the picture above.
6. Release the Arm from Parking position, turn the Column 90^0 and place the Arm at the upper end of the Column, as shown in the picture below.



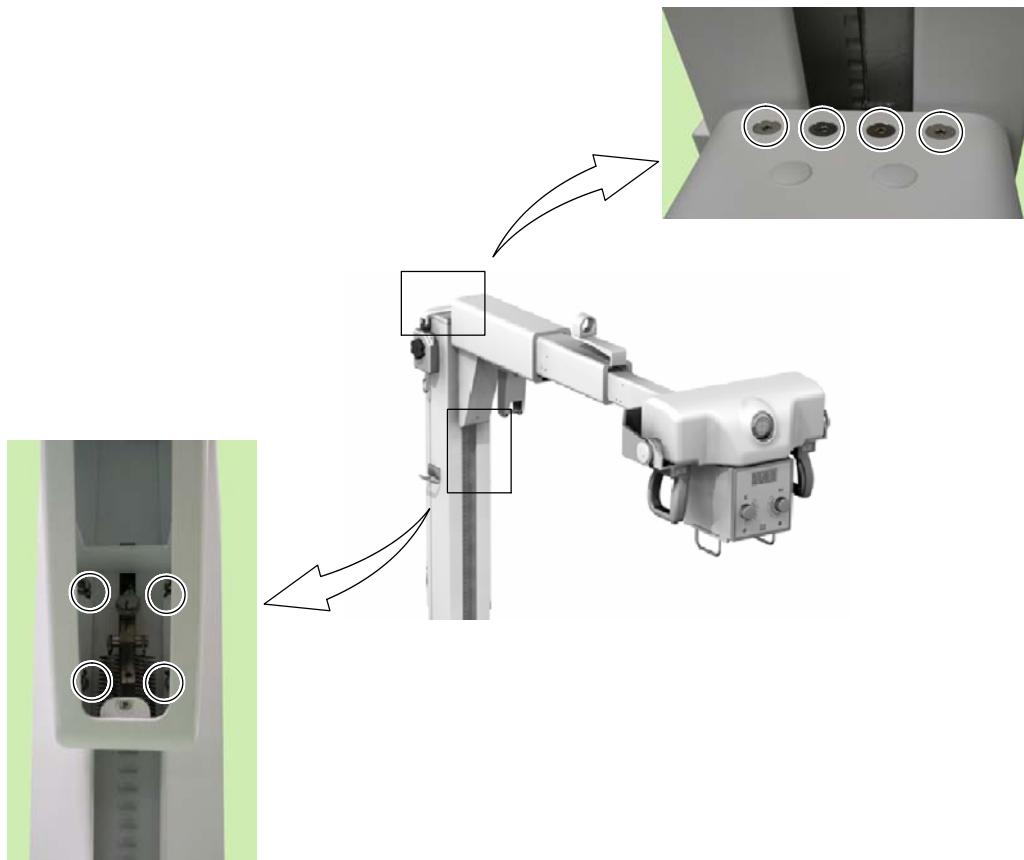
7. Place an auxiliary table next to the Column. Remove the Arm with the Tube-Collimator Assembly from the Column Carriage by removing the corresponding Fixing Screws. Place the Assembly carefully on the table.



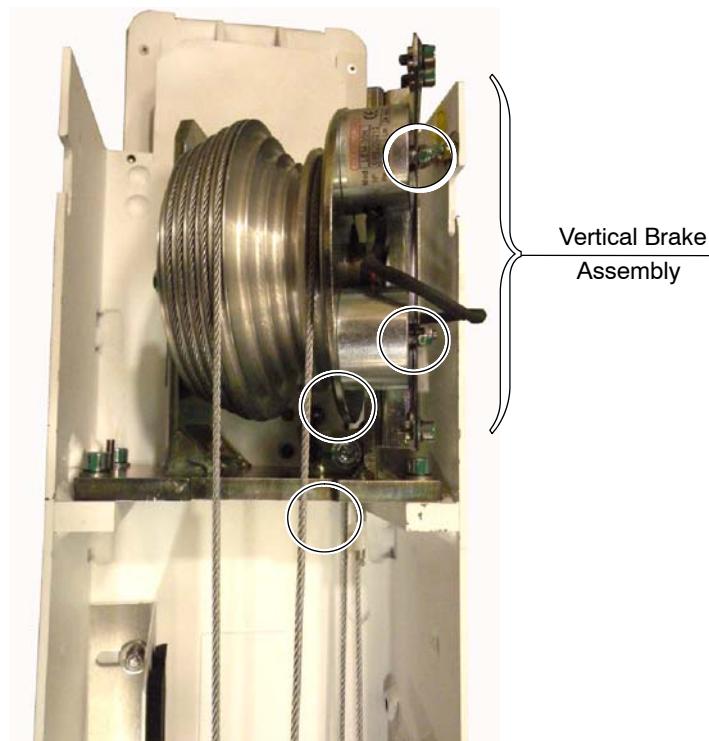
THE WEIGHT OF THE ARM WITH THE TUBE-COLLIMATOR ASSEMBLY IS HEAVY, UNSTEADY AND DIFFICULT TO HANDLE, THEREFORE AT LEAST TWO PEOPLE IS NEEDED TO REMOVE IT. THIS WILL AVOID PERSONAL INJURIES OR DAMAGE TO THE EQUIPMENT.

Note A small icon of a document with a checkmark.

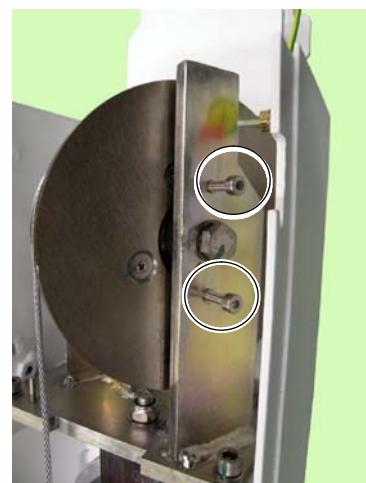
It can be useful devices such as Crane to maintain the Arm with the Tube-Collimator Assembly up in place when removing the Fixing Screws; in this case it is not needed two people to handle the Assembly.



8. Remove the two (2) screws to dismount the Vertical Brake Assembly, at the top of the Column.



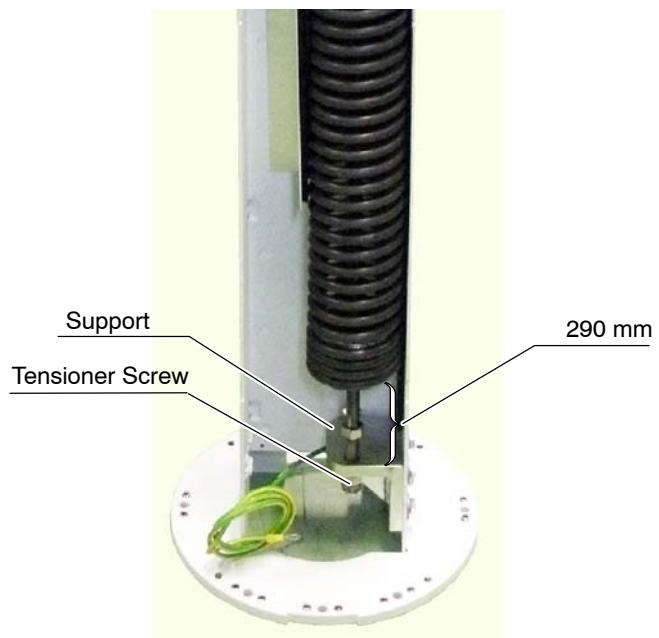
9. Lock the Pulley Assembly at the top of the Column with two (2) Screws M4, to keep it in place when loosening the Steel Cable.



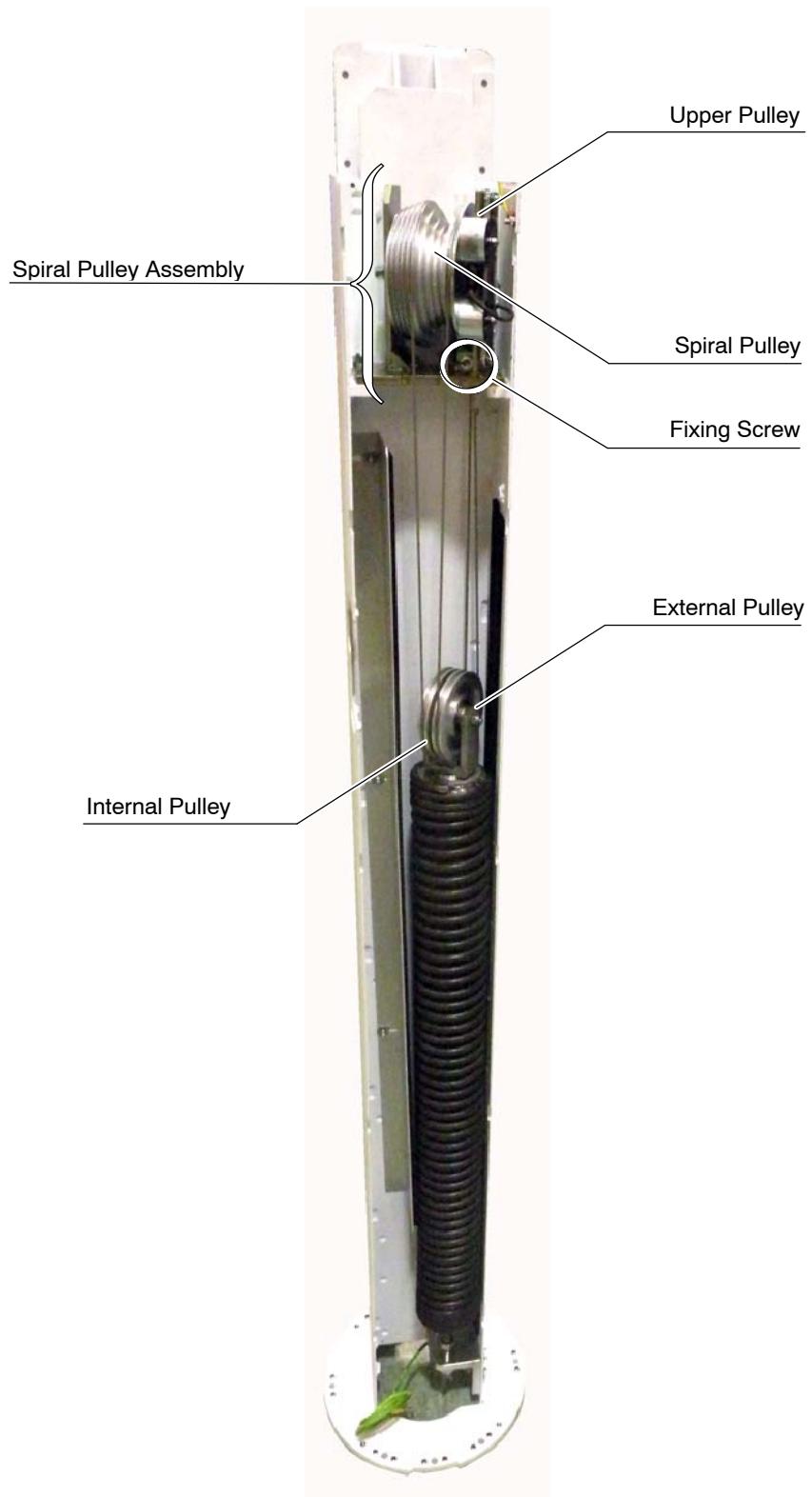
10. Loosen the Spring by loosening the Tensioner Screw at the bottom of the Column, until the Steel Cable has been left almost released.



Do not turn the Tensioner Screw over 290 mm of distance between the Spring end and the Support, not to release the Spring.



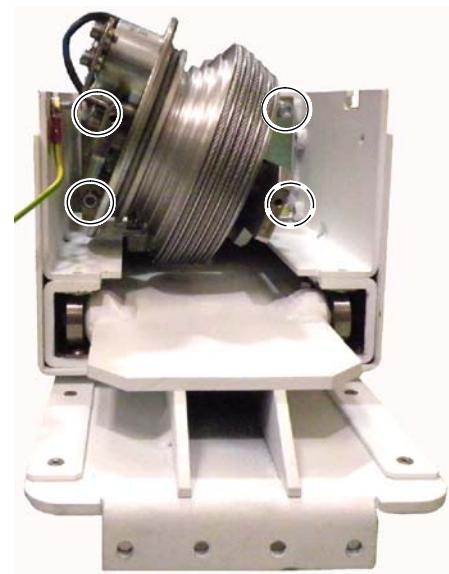
11. Remove the Fixing Screw that secures the Steel Cable to the lower area of the Spiral Pulley Assembly.



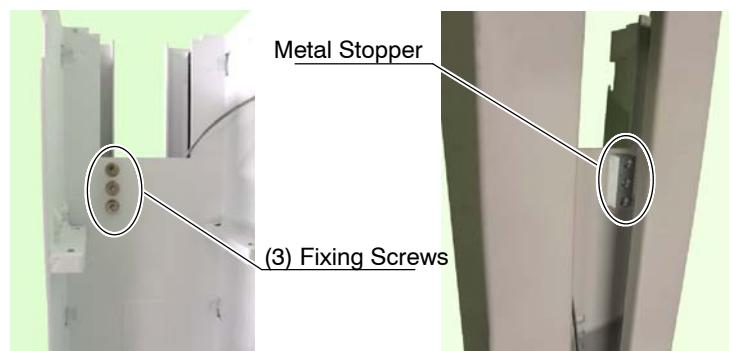
12. Replace the Steel Cable and / or the Spring, depending on the needs.

a. If it is only needed the **Steel Cable replacement**:

- Disengage the Steel Cable, firstly from the External Pulley of the Spring Assembly, then from the Upper Pulley of the Spiral Pulley Assembly and then from the Internal Pulley of the Spring Assembly; finally, disengage it from the Spiral Pulley (*refer to the picture in step 11.*)
- Unscrew the four (4) Fixing Screws fixing the Spiral Pulley Assembly; carefully dismantle the Spiral Pulley Assembly and place it on a safe area.

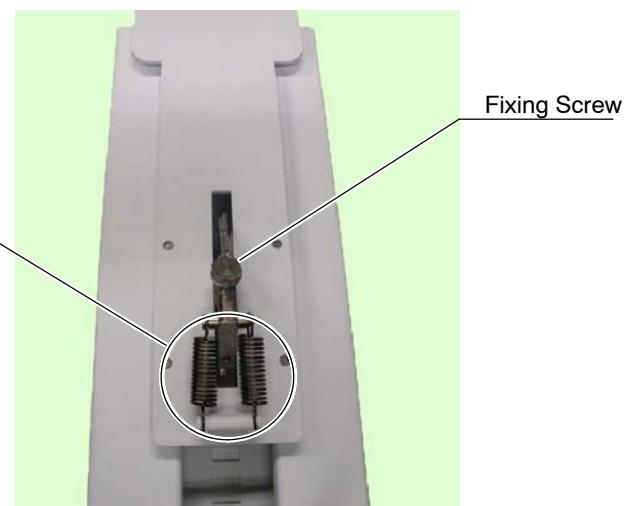


- At the top of the Column, remove the three (3) Fixing Screws while holding the Metal Stopper with the other hand and then remove it.

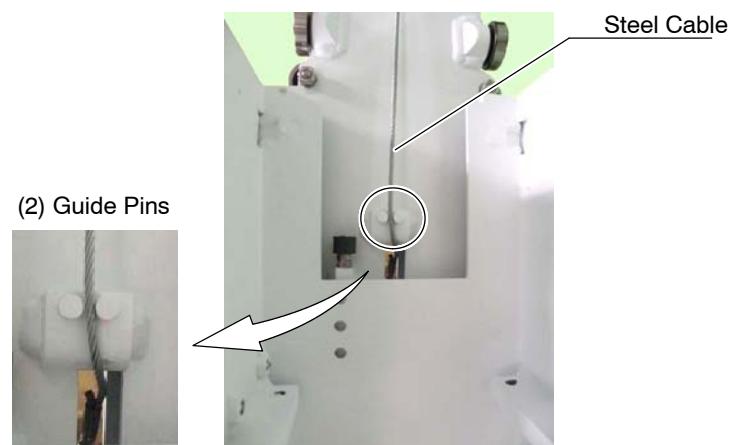


- Remove the two (2) Springs from the Column Anti-crashing System while holding the Carriage with the other hand.

Slide the Carriage upwards to remove it and, once it has been placed on a safe area, remove the Fixing Screw, replace the Steel Cable and tighten the Fixing Screw.

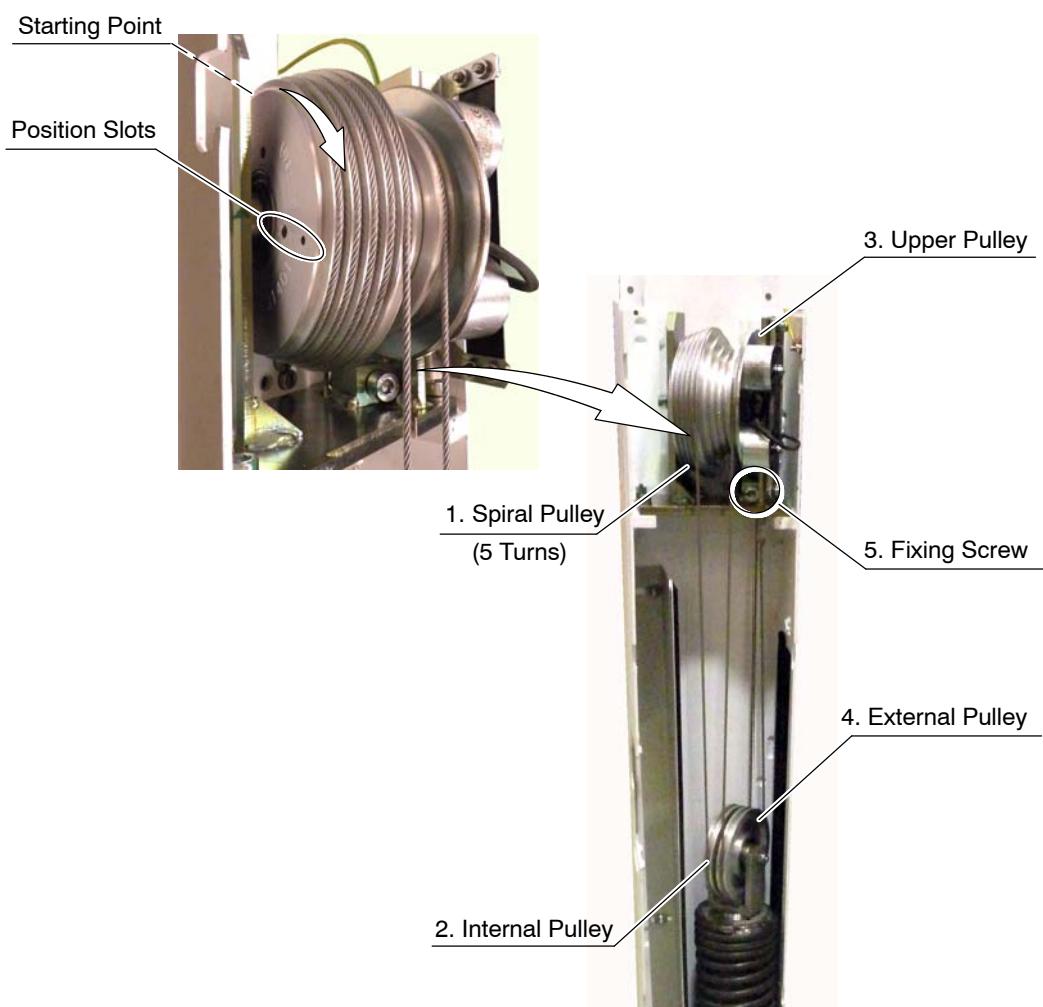


- Insert the Carriage into the Column, running the Steel Cable between the two (2) Guide Pins located at the back side of the Carriage and slide the Carriage to the Column Base.



- Place the Metal Stopper back in place securing it with the Fixing Screws.

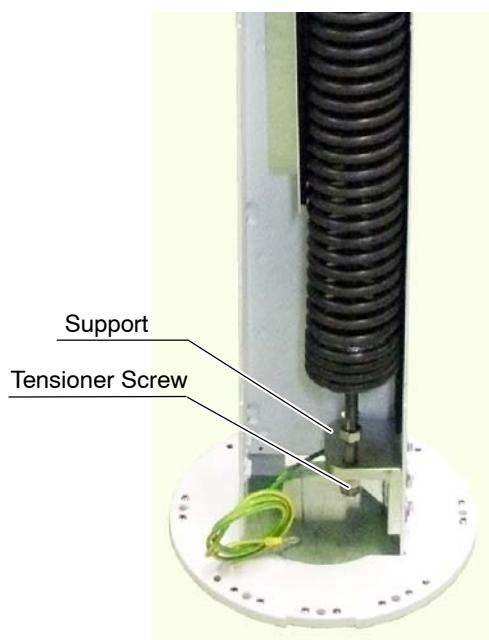
- Slide the Carriage upwards until it contacts the Metal Stopper and hold it with one hand while placing the two (2) Springs at the Column Anti-crashing System.
- Mount the Spiral Pulley Assembly and secure it with the four (4) Fixing Screws.
- Place the Spiral Pulley with the Position Slots as shown in the picture below, then coil the Steel Cable five (5) times around the Spiral Pulley, from the Starting Point towards the middle of the Spiral Pulley.



- Guide the Steel Cable coming from the Spiral Pulley (1.) around the Internal Pulley (2.), around the Upper Pulley (3.), around the External Pulley (4.) and finally, fix the end of the Steel Cable with the Fixing Screw (5) to the Spiral Pulley Assembly.

b. If It is only needed the **Spring replacement**:

- Disengage the Steel Cable from the External, Upper and Internal Pulleys.
- Loosen the Spring Tensioner Screw until both, Screw and Spring, are disengaged.



- Replace the Spring securing the new Spring with the Tensioner Screw.
- Ensure that the Steel Cable has been coiled five (5) times around the Spiral Pulley and guide it from the Spiral Pulley (1.) around the Internal Pulley (2.), around the Upper Pulley (3.) and around the External Pulley (4.). Finally, fix the end of the Steel Cable with the Fixing Screw (5) to the Spiral Pulley Assembly.

13. Tighten the Spring until the Tensioner Screw reaches a traveling distance of around 90mm between the Spring and the Support.

14. Mount the Arm with the Tube-Collimator Assembly on the Column Carriage and secure it with the Fixing Screws.
15. Tighten / loosen the Spring by adjusting the Tensioner Screw and balance the vertical movement of the Arm.
16. Assemble the Column Upper Cover Support.
17. Mount the Column Back Cover and connect Ground Cable.
18. Assemble the Column Upper Cover.
19. Secure the Cables Access Cover.
20. Test the Unit.

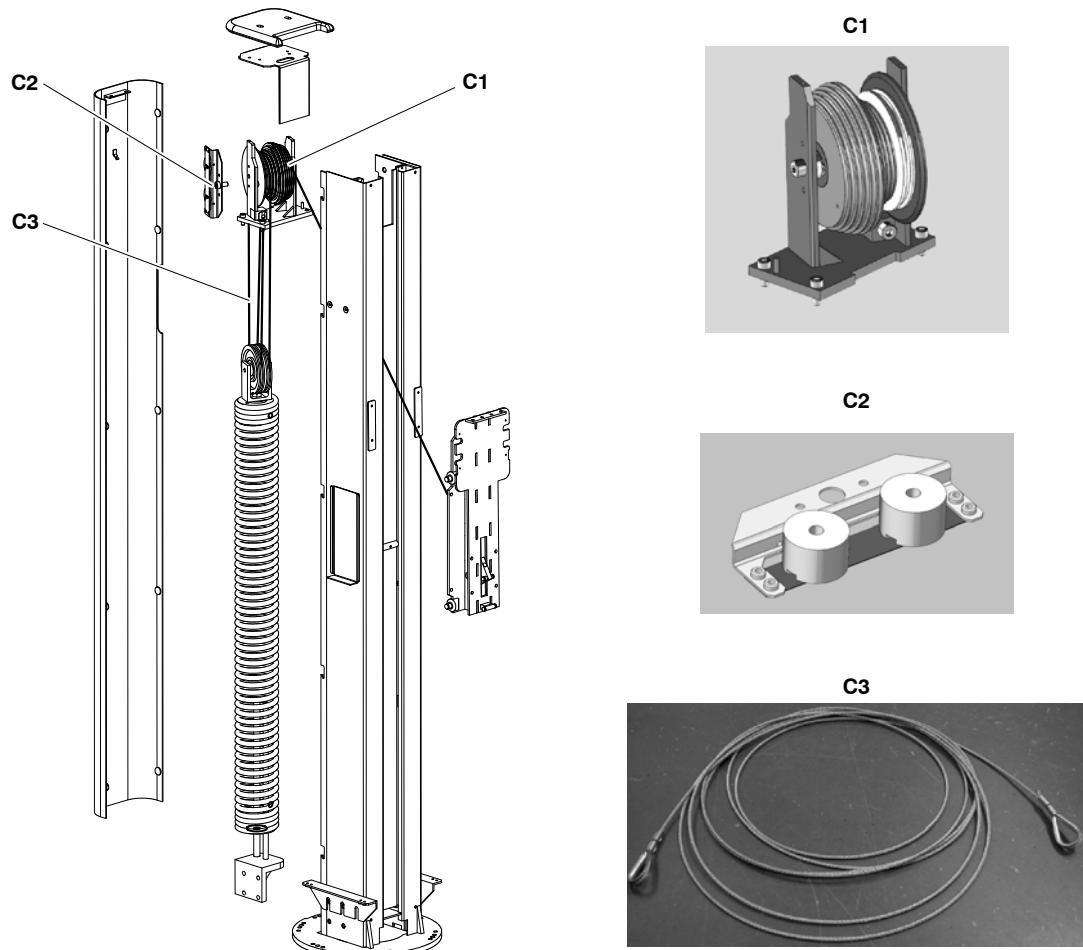
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SECTION 3 RENEWAL PARTS

Note 

The following table is a complement of the **DX-D 100 Mobile X-ray Unit**. For other components refer to the *Renewal Parts* document in the *Service Manual*.

ITEM	DESCRIPTION	QTY	REFERENCE	REMARKS
C0 ROTATING COLUMN				
C1	Main Pulley Kit	1	A520089-02	
C2	Vertical Brake Kit	1	A520084-03	
C3	Steel Cable	1	SAT-31414-01	



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**COLLIMATOR FLANGE CHECK AND COLLIMATOR
FIXING SCREWS ADJUSTMENT**

Rev. 4

SIN 18-09-11

SECTION 1 APPLICATION

This Service Information Note applies to all units with Ralco Collimators.

SECTION 2 OBJECT OF THIS SERVICE INFORMATION NOTE**Introduction.**

The object of this Service Information Note is to warn the distributors and Field Service Engineers about the importance of using in the field, the Flange (Adaptation Ring) delivered with the Collimator, as well as to perform a correct assembly and adjustment process according to the Collimator version.

IMPORTANT NOTES

NOTE 1: When a Collimator needs to be replaced in the field, the Flange installed in the unit must be removed and replaced by the Flange delivered with the new Collimator.

NOTE 2: Please ensure that the Flange is mounted properly by applying the correct torque and the retention Loctite (type 243 or similar) on the fixing screws.

If the Flange is made of Resin material the tightening torque is 6.6 Nm.

If the Flange is made of Metal material the tightening torque is 11.3 Nm.

NOTE 3: The manual provided with the Collimator must be always reviewed to conduct the proper installation process.



AN IMPROPER ASSEMBLY COULD CAUSE THE COLLIMATOR FALLING WITH THE SUBSEQUENT RISK FOR PATIENT AND USER.

Tools (Not provided).

- Standard Service Engineer's Tool Kit.

COLLIMATOR FLANGE CHECK AND COLLIMATOR FIXING SCREWS ADJUSTMENT

Rev. 4

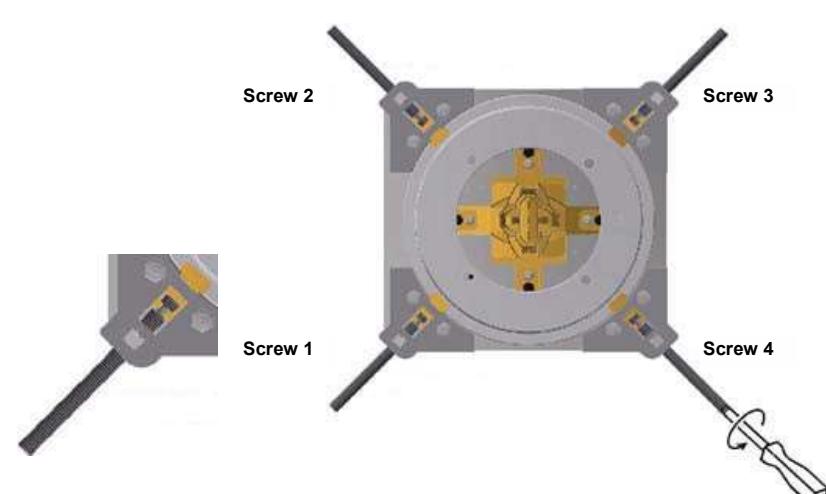
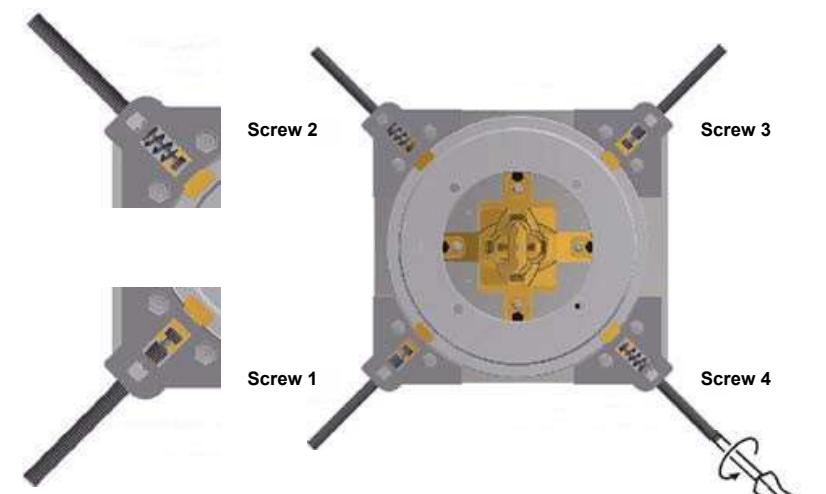
SIN 18-09-11

SECTION 3 COLLIMATOR. ASSEMBLY TYPES IN THE FIELD.

3.1. COLLIMATOR MOUNTING BRACKET VERSIONS

The **Collimator Mounting Bracket** is the part of the Collimator that fix the Collimator to the Flange.

There are two types of Collimator Mounting Bracket: **A** and **B**.

COLLIMATOR MOUNTING BRACKET TYPES	
Collimator Mounting Bracket type A (with 4 Fixing Screws without spring)	
Collimator Mounting Bracket type B (with 2 Fixing Screws with spring and 2 Fixing Screws without spring)	

COLLIMATOR FLANGE CHECK AND COLLIMATOR FIXING SCREWS ADJUSTMENT

Rev. 4

SIN 18-09-11

3.2. COLLIMATOR FLANGE VERSIONS AND INSTALLATION PROCEDURES

The **Collimator Flange** is the Adaptation Ring fixed to the X-Ray Tube and used to assemble the Collimator with the X-ray Tube.

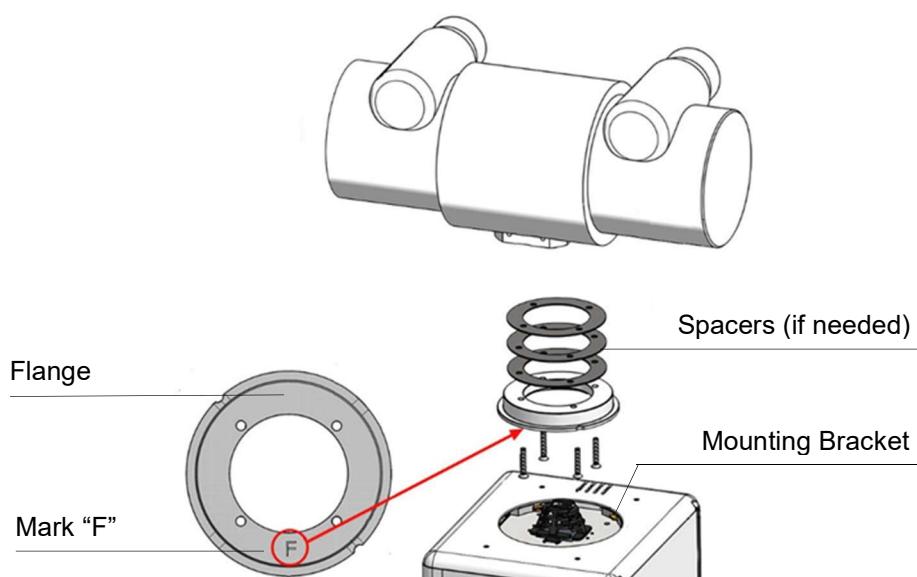
The types of Flange are the following ones:

- Flanges compatible with **Collimator Mouting Bracket type A**:
 - **Flange A1** : Fixed Metal Flange.
 - **Flange A2** : Rotating Metal Flange.
- Flanges compatible with **Collimator Mouting Bracket type B**:
 - **Flange B1** : Resin Flange that allows the rotation and no rotation of the Collimator.
 - **Flange B2** : Rotating Metal Flange.
 - **Flange B1 with Metal Stopping Plate**: Resin Flange that allows the rotation of the Collimator. *It is only used in the current Mobile Units.*

If the Flange is marked with the letter "F", the Flange must be installed with the letter "F" positioned toward the Collimator and Tube front.

During the installation, ensure that the Flange is mounted properly, fixing the Flange to the Tube with the countersunk Screws M6 (x4), applying retention Loctite (type 243 or similar) on the Screws and a tightening torque of 6.6 Nm for a Flange made of Resin material or a tightening torque of 11.3 Nm for a Flange made of Metal material.

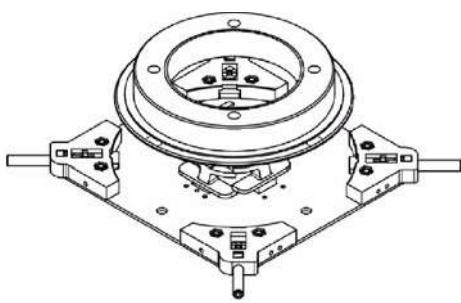
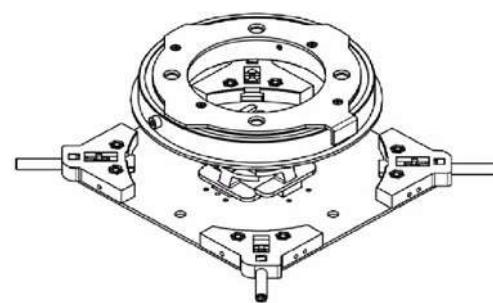
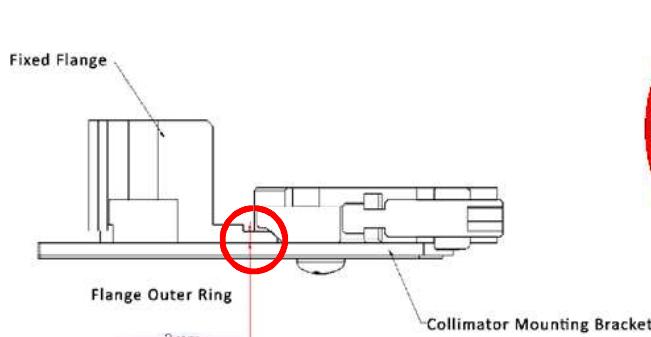
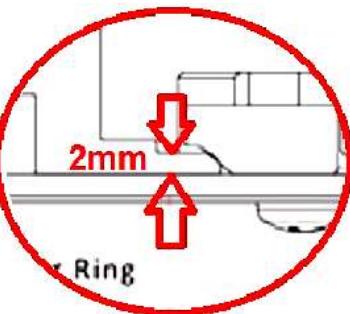
For further information, refer to the next Tables.



COLLIMATOR FLANGE CHECK AND COLLIMATOR FIXING SCREWS ADJUSTMENT

Rev. 4

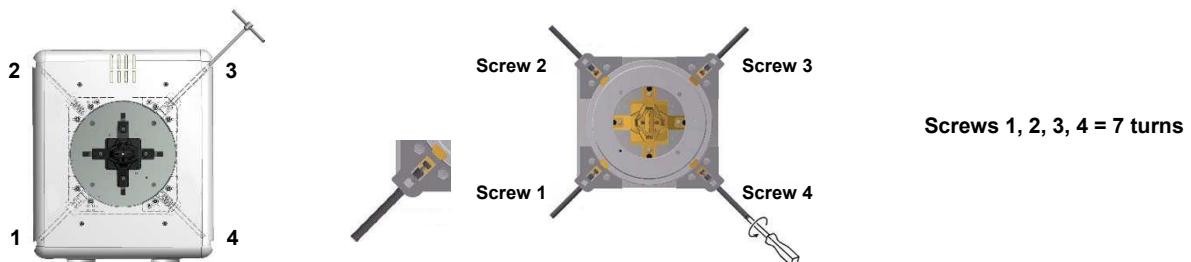
SIN 18-09-11

	FLANGES TYPE A (Compatible with Collimator Mounting Bracket Type A)	
	Flange A1 - Fixed Metal Flange	Flange A2 - Rotating Metal Flange
Collimator Mounting Bracket Type A (with 4 Fixing Screws without spring)	This combination does not allow the Collimator rotation  Bracket Type A Flange Type A1	This combination allows the Collimator rotation  Bracket Type A Flange Type A2
		
	The thickness of the Flange outer ring is 2 mm for the Flange type A	

INSTALLATION

Installation of the Collimator with the **Mounting Bracket type A** and **Flange type A1 or A2**:

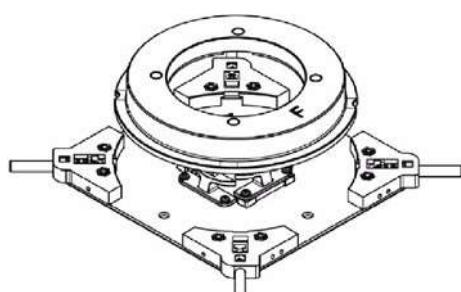
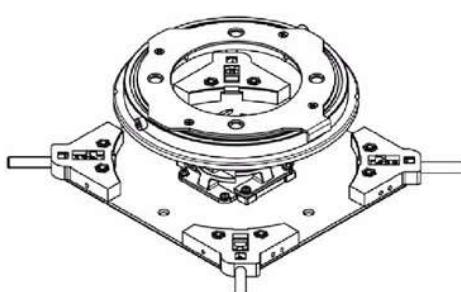
- Install the Collimator on the Flange: while one person holds the weight of the Collimator, the other tightens the Fixing Screws (x4) located at the four corners that fix the Collimator to the Flange.
- With the Tabs (Fixing Screws) fully retracted, tighten the four Screws up to the end stroke (at least 7 turns on each one) applying a Torque of 0.45 Nm.
- Check the installation of the Collimator as described in Section 3.3, especially if the previous steps cannot be performed.

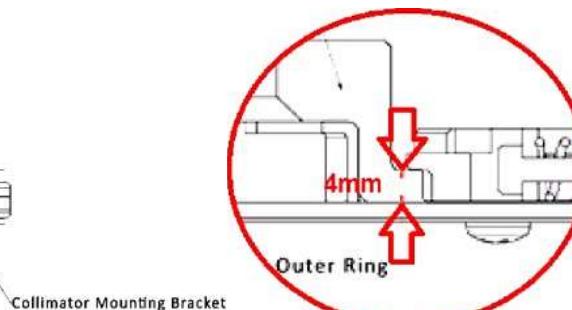
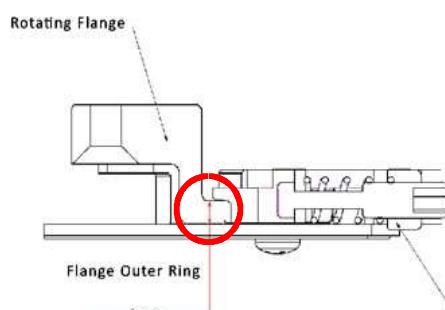


COLLIMATOR FLANGE CHECK AND COLLIMATOR FIXING SCREWS ADJUSTMENT

Rev. 4

SIN 18-09-11

	FLANGES TYPE B (Compatible with Collimator Mounting Bracket Type B)	
	Flange B1 – Resin Flange	Flange B2 - Rotating Metal Flange
Collimator Mounting Bracket Type B (with 2 Fixing Screws with spring and 2 Fixing Screws without spring)	<p>This combination allows rotation and no rotation of the Collimator depending on the number of turns applied to the Fixing Screws</p>  <p>Bracket Type B Flange Type B1</p>	<p>This combination allows the Collimator rotation</p>  <p>Bracket Type B Flange Type B2</p>



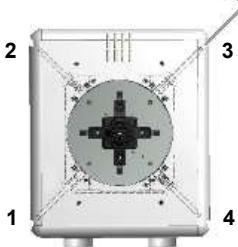
The thickness of the Flange outer ring is 4 mm for the Flange type B

INSTALLATION

Installation of the Collimator with the **Mounting Bracket type B** and **Flange type B1 or B2**:

- Install the Collimator on the Flange: while one person holds the weight of the Collimator, the other tightens the Fixing Screws (x4) located at the four corners that fix the Collimator to the Flange.

- With the Tabs (Fixing Screws) fully retracted, tight the four Screws according to Flange type and Collimator Rotation function:

- **With Flange type B1 and with Collimator rotation:**
 - Screws 1 and 3 up to the end stroke (at least 7 turns on each one) applying a Torque of 0.45 Nm.
 - Screws 2 and 4 (with integrated adjustable spring), 5 1/2 turns exactly.
(If Screws 2 and 4 are tightened more than 5 1/2 - 6 turns, the Collimator will not rotate).
 - **With Flange type B1 and with NO Collimator rotation or with Flange type B2 with Collimator rotation:**
 - Screws 1, 2, 3 and 4 up to the end stroke (at least 7 turns on each one) applying a Torque of 0.45 Nm.
- Check the installation of the Collimator as described in Section 3.3, especially if the previous steps cannot be performed.
- 

1
2
3
4



Screw 2
Screw 1
Screw 3
Screw 4

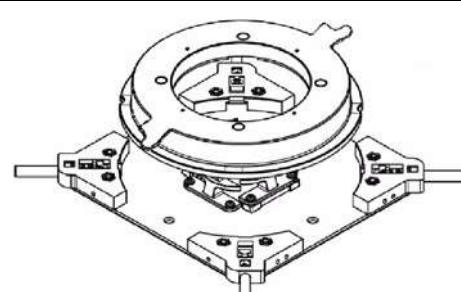
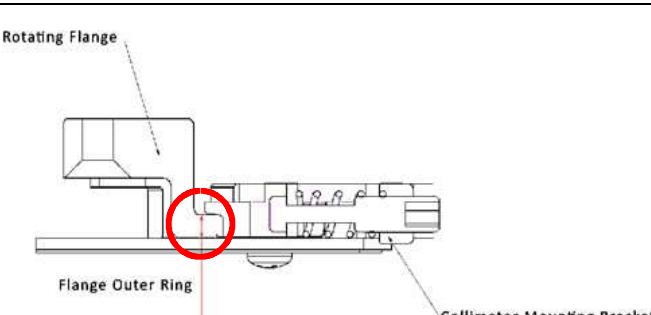
Flange Type B1 - Collimator rotation.
Screws 1, 3 = 7 turns
Screws 2, 4 = 5 1/2 turns

Flange Type B1 - NO Collimator rotation.
Flange Type B2 - Collimator rotation.
Screws 1, 2, 3, 4 = 7 turns

COLLIMATOR FLANGE CHECK AND COLLIMATOR FIXING SCREWS ADJUSTMENT

Rev. 4

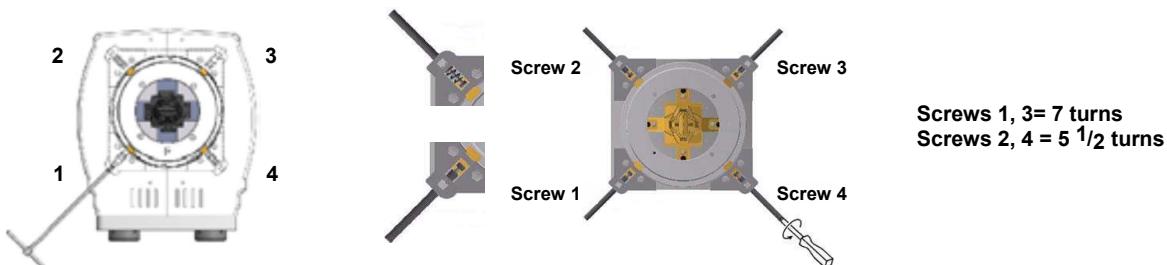
SIN 18-09-11

FLANGE TYPE B1 WITH METAL STOPPING PLATE (Compatible with Collimator Mounting Bracket Type B)	
Flange B1 – Resin Flange	
Collimator Mounting Bracket Type B (with 2 Fixing Screws with spring and 2 Fixing Screws without spring)	<p>This combination allows the Collimator rotation</p>  <p>Bracket Type B Flange Type B1 with Metal Stopping Plate</p>  <p>The thickness of the Flange outer ring is 4 mm for the Flange type A</p>

INSTALLATION

Installation of the Collimator with the **Mounting Bracket type B** and **Flange type B1 with Metal Stopping Plate**:

- Install the Collimator on the Flange: while one person holds the weight of the Collimator, the other tightens the Fixing Screws (x4) located at the four corners that fix the Collimator to the Flange.
- With the Tabs (Fixing Screws) fully retracted, tighten the four Screws:
 - Screws 1 and 3 up to the end stroke (at least 7 turns on each one) applying a Torque of 0.45 Nm.
 - Screws 2 and 4 (with integrated adjustable spring), 5 1/2 turns exactly.
(If Screws 2 and 4 are tightened more than 5 1/2 - 6 turns, the Collimator will not rotate).
- Check the installation of the Collimator as described in Section 3.3, especially if the previous steps cannot be performed.



**COLLIMATOR FLANGE CHECK AND COLLIMATOR
FIXING SCREWS ADJUSTMENT**

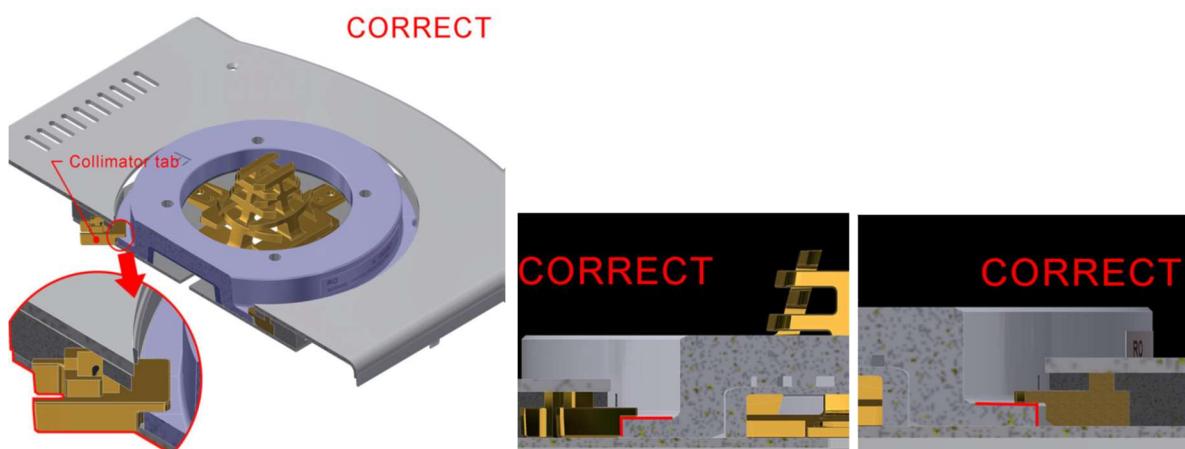
Rev. 4

SIN 18-09-11

3.3. COLLIMATOR MOUNTING CHECK

Make sure that the Collimator is well positioned:

- Turn the Collimator to both sides if rotation function is present and pulling it down to ensure that it is safely and properly mounted.
- Make sure that the four Tabs present on the Collimator Mounting Bracket overlap the Flange (as show on the next picture).



- Ensure that the four Tabs are not in contact with only the Flange and that they do not lock the Flange Outer Ring instead of overlapping it.



UPGRADE ADAPTATION 15Ah BATTERY IN MOBILE GENERATORS

Rev.C

SIN 19-07-08

SECTION 1 APPLICATION

This Service Information Note applies to Mobile Generators.

SECTION 2 DESCRIPTION OF INTERVENTION**2.1 Introduction.**

This Service Information Note describes the steps to upgrade Mobile units to the 15Ah Pb Batteries. These batteries will be used for the x-ray generation only, and not for the motion.

2.2 Tools (Not provided in the kit).

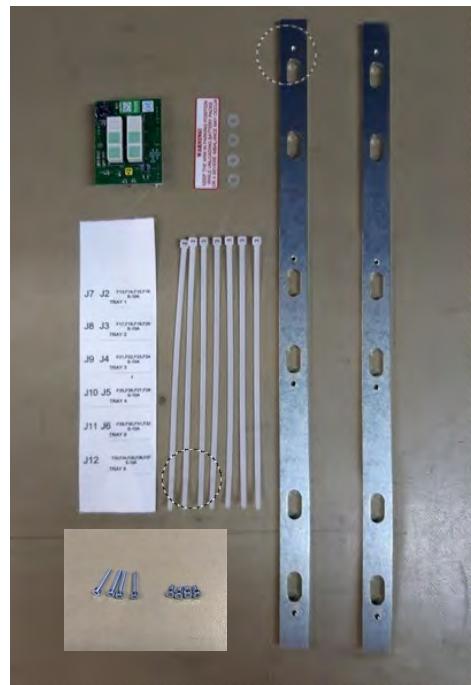
- Standard Service Engineer's Tool Kit

2.3 Materials.

- A521178-01 - UPGRADE ADAPTATION 15Ah BATTERY.

This KIT contains the following parts:

- A. Supplement Motor Battery Tray ----- 2 Units
- B. Battery Tray W. 15Ah Battery ----- 5 Units
- C. Battery Monitor SAT-A3580-12 ----- 1 Unit
- D. Tie-Wraps ----- 6 Units
- E. Warning Label ----- 1 Unit
- F. Battery Connectors Labels ----- 1 Unit
- G. Screw 4X8 ----- 4 Units
- H. Screw 4x25 ----- 4 Units



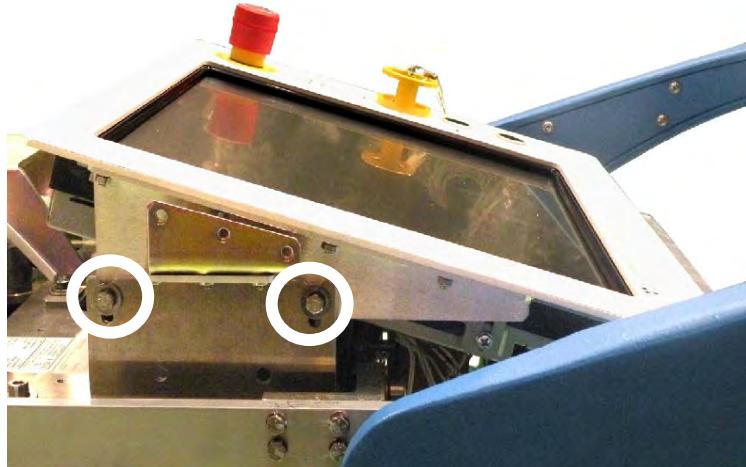
UPGRADE ADAPTATION 15Ah BATTERY IN MOBILE GENERATORS

Rev.C

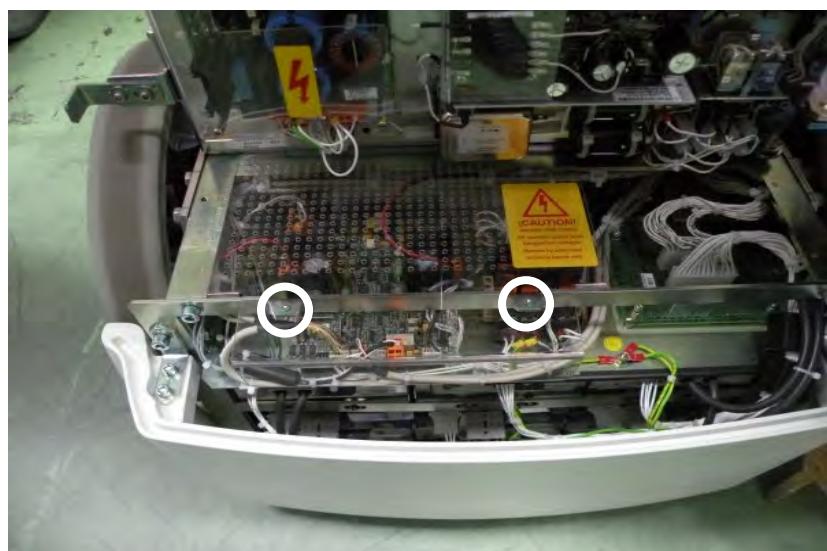
SIN 19-07-08

SECTION 3 FIELD ACTIONS

1. Switch the generator OFF. Press the emergency switch.
2. Remove the generator covers (lower back bumper, upper back cover, front cover, console frame) as explained in the Service Manual.
3. Loose the two screws located at both sides of the console. Lift up the lower end of the console. Tight both screws to fix the console in place.



4. Replace the battery monitor A3580-15 by the one provided in the replacement Kit A3580-12. Use the nylon washers to isolate both sides of the board.
5. Place the console as originally was.
6. Remove the 2 fixation screws of the cover for the DMC board.



UPGRADE ADAPTATION 15Ah BATTERY IN MOBILE GENERATORS

Rev.C

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7. Unplug the Anderson Connector J1 located at the lateral side of the unit.



8. Remove the 4 fixation screws and dismount the back bumper.
9. Move the left leg down to gain access to the batteries' connectors.



UPGRADE ADAPTATION 15Ah BATTERY IN MOBILE GENERATORS

Rev.C

SIN 19-07-08

10. Unplug the Anderson & Molex connectors from all the Battery Trays used for the Generator.

Anderson connectors: J2 for Tray 1, J3 for Tray 2, J4 for Tray 3, J5 for Tray 4, J6 for Tray 5.

Molex connectors: J7 for Tray 1, J8 for Tray 2, J9 for Tray 3, J10 for Tray 4, J11 for Tray 5, J12 for Tray 6



11. Disconnect the ground wires. Isolate them by using isolation tape to avoid short circuits.

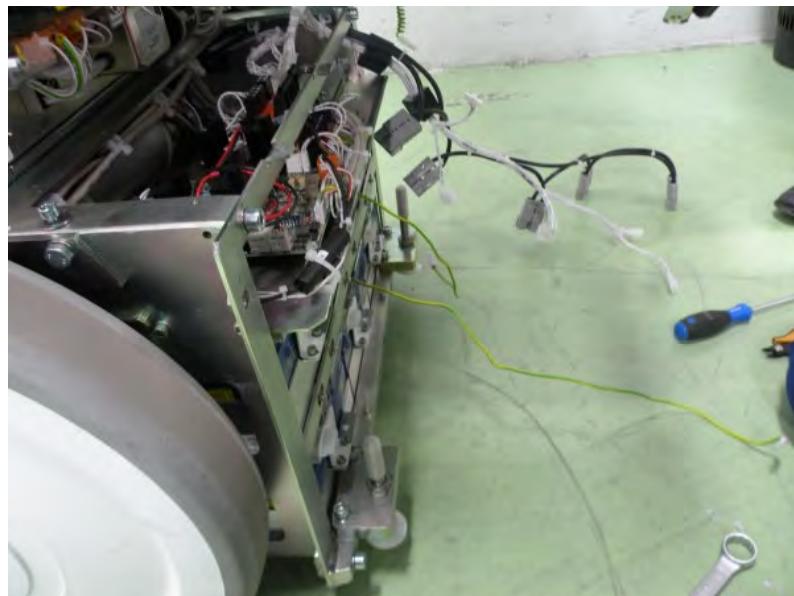


UPGRADE ADAPTATION 15Ah BATTERY IN MOBILE GENERATORS

Rev.C

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12. Cut the tie wraps which fix the ground wires with the batteries' interconnection harness.



13. Remove the 4 fixation screws and dismount the Frame that secures the battery trays to the Unit.



14. Slide the 5 generator batteries trays out of the generator in order to remove them.

15. Remove the GND wire of the original Tray 3 and mount it in the new one between B15 & B16 batteries.

UPGRADE ADAPTATION 15Ah BATTERY IN MOBILE GENERATORS

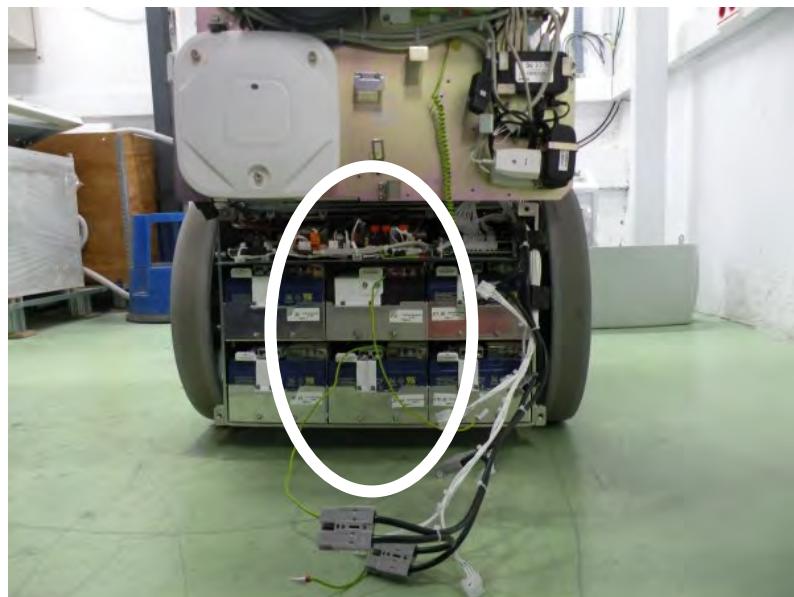
Rev.C

SIN 19-07-08

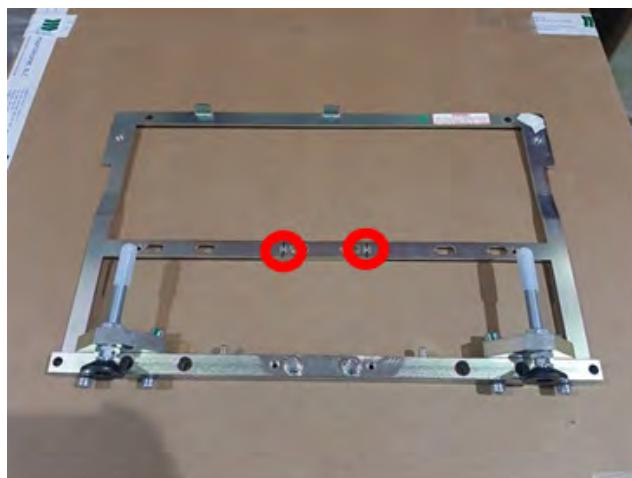
16. Install the generator Pb batteries trays inside the unit.

Motion Battery tray will remain in the original position.

Generator Battery Tray n° 3: Install this tray under the Motion Battery tray as originally was.



17. Remove the 2 screws and the spacer used to secure the motor battery tray (parts show in the next picture)

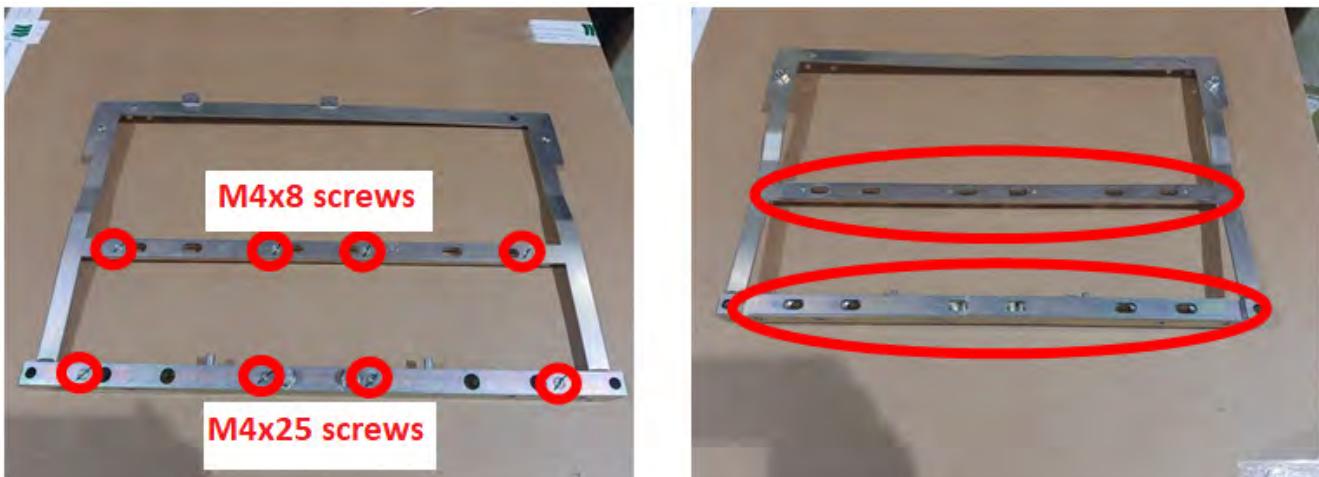


18. Mount the two spacers using the screws provided in the kit according to the next pictures, the spacers at the bottom with the M4x8 screws and in the center with the M4x25 screws.

UPGRADE ADAPTATION 15Ah BATTERY IN MOBILE GENERATORS

Rev.C

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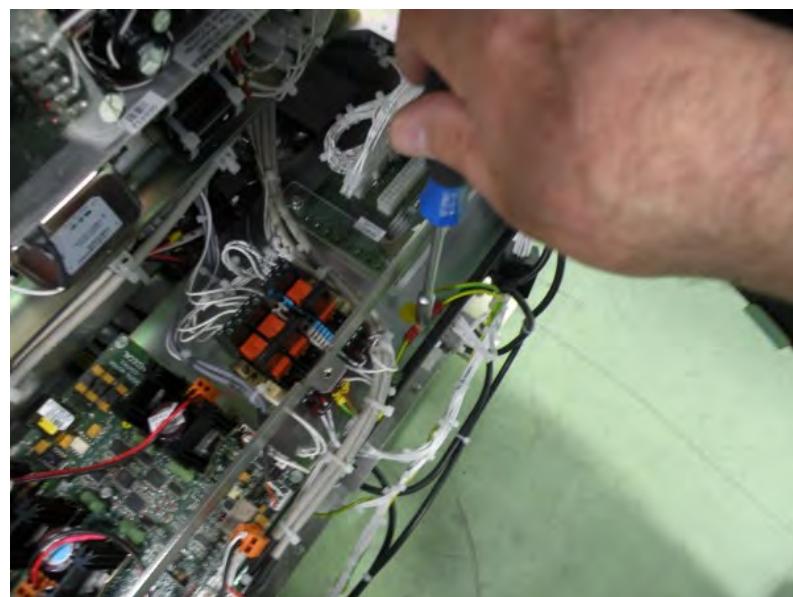


19. Install the modified frame to the unit to secure the Battery Trays in the mobile unit.

20. Remove the isolate tape from the GND wires.

Connect both GND wires as originally were (see step 10).

Make sure that the GND wires from the battery tray #3 and from battery tray #6 are not pinched between the chassis and the frame.



UPGRADE ADAPTATION 15Ah BATTERY IN MOBILE GENERATORS

Rev.C

SIN 19-07-08

21. Connect the Anderson connectors: J2 for Tray 1, J3 for Tray 2, J4 for Tray 3, J5 for Tray 4, J6 for Tray 5.

IN THIS STEP, J1 ON THE BATTERY TEST BOARD (A9504-03) IS DISCONNECTED AS INDICATED.

THE SYSTEM SHOULD BE PLUGGED IN AND IN CHARGING CONDITION AT LEAST FOR 1 MINUTE BEFORE RECONNECTING J1 (OR ANY CONNECTORS FROM THE INVERTER CHARGER BOARDS 1, 2 AND BATTERY MOTOR CHARGER BOARD) TO THE BATTERIES. THIS PREVENTS DAMAGE TO THE CONNECTORS.

22. Disconnect J1 on the Battery Test Board (A9504-03) and isolate it.

23. Connect Molex connectors: J7 for Tray 1, J8 for Tray 2, J9 for Tray 3, J10 for Tray 4, J11 for Tray 5, J12 for Tray 6.

24. Set the unit in charging mode and check that the power line connection lamp present on the console is ON



Check that the charging leds (green leds) present on the charger boards are ON

Carefully measure the voltage between the following consecutive Test Points (TP) on the Battery Test Board 3 (A9504-03):

The following steps need to be done to make sure that all charging module present on the inverter charger board 1 and 2 and on the battery motor charger board are working properly to avoid any damage on the fuses of the new battery trays installed on the unit.

IN CASE THAT AN OUTPUT VOLTAGE THAT WILL BE MEASURED ON THE BATTERY TEST POINT IS NOT IN THE SPECIFICATION, REPLACE THE DEFECTIVE CHARGER BOARD AND REPEAT THIS PROCESS BEFORE FOLLOWING THIS PROCEDURE.

- a. For Generator Batteries, measure between TP-1 and TP-2, TP-2 and TP-3, TP-3 and TP-4, and consecutively until TP-15 and TP-16. The voltage measurement depends on the environmental temperature inside the Mobile unit. As a reference for 21°C(70°F), the voltage measured for a Battery sector (a Battery pair) must be between 26.8 and 27.6 VDC.
- b. For Motor Batteries, measure between TP-17 and TP-18, TP-18 and TP-19, TP-19 and TP-20, TP-20 and TP-21. The voltage measurement depends on the environmental temperature inside the Mobile unit. As a reference for 21°C (70°F), the voltage measured for a Battery sector (a Battery pair) must be between 26.8 and 27.6 VDC.

THE SYSTEM SHOULD BE PLUGGED IN AND IN CHARGING CONDITION AT LEAST FOR 1 MINUTE BEFORE RECONNECTING J1 (OR ANY CONNECTORS FROM THE INVERTER CHARGER BOARDS 1, 2 AND BATTERY MOTOR CHARGER BOARD) TO THE BATTERIES. THIS PREVENTS DAMAGE TO THE CONNECTORS.

UPGRADE ADAPTATION 15Ah BATTERY IN MOBILE GENERATORS

Rev.C

SIN 19-07-08

25. Make sure that the unit is connected to the main power line and in charging mode during more than 1 minute before connecting the connector J1 on the battery test 3 (A9504-03).
26. Fix the GND wires to the interconnection harness for the batteries with tie wraps (see part 'M' in Fig 1 – Replacement Kit)
27. Isolate the Mobile unit from mains. Press the emergency switch.
28. Plug Anderson connector J1 (see step 7).
29. Switch ON the Mobile generator. Check proper functioning.
30. Mount the cover for the DMC board.
31. Mount the lower back bumper cover.
32. Mount the covers (upper back cover, front cover) & console frame of the unit as originally were. See the Service Manual of the unit.
33. Keep the unit connected to the mains for at least ten (10) hours with the Generator OFF in order to ensure a complete charging cycle. Perform a functional check.

Date: 2019/07/04

SERVICE INFORMATION NOTE

Page 10 of 10

UPGRADE ADAPTATION 15Ah BATTERY IN MOBILE GENERATORS

Rev.C

SIN 19-07-08

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Upgrade filter with battery charger -16 in mobile

Rev. A

SIN 19-10-13

SECTION 1 APPLICATION

This Service Information Note applies to digital mobile unit when replacing the inverter charger board to A353x-16.

SECTION 2 DESCRIPTION OF INTERVENTION**Introduction.**

This Service Information Note describes the steps to install a filter on the unit.

Tools (Not provided in the kit).

- Standard Service Engineer's Tool.

Materials.

- **SAT-A21085-01 - MAINS CONNECTION DELAY ASSEMBLY**



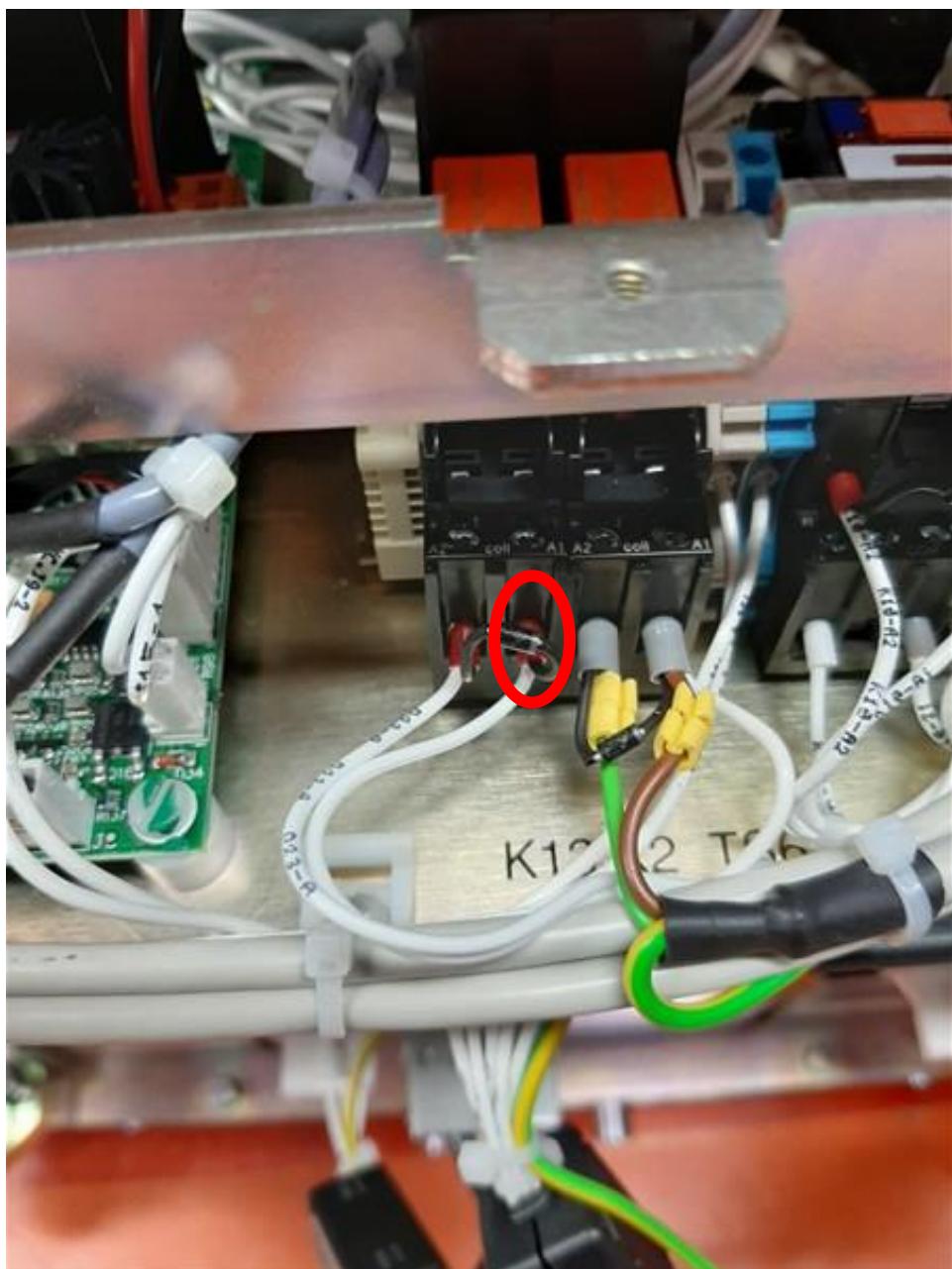
Upgrade filter with battery charger -16 in mobile

Rev. A

SIN 19-10-13

SECTION 3 FIELD ACTIONS

1. Using the procedure describe in the service manual, remove the covers of the unit to be able to have access to the K13 relay located on the back side of the mobile unit.
2. Remove the screws of the second door to be able to open it and to have access to the K13 relay.
3. Disconnect the wire that is connected on the K13-A1 of the K13 relay socket (See next picture)

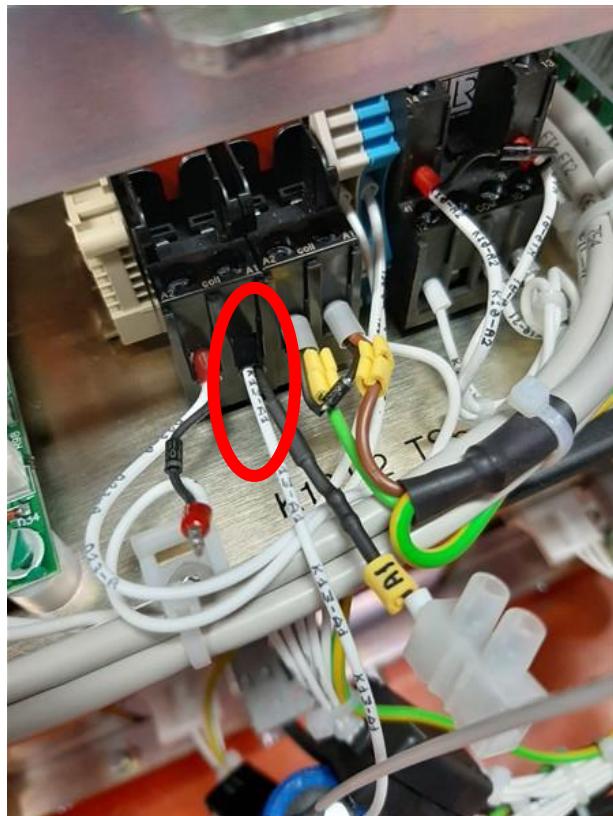


Upgrade filter with battery charger -16 in mobile

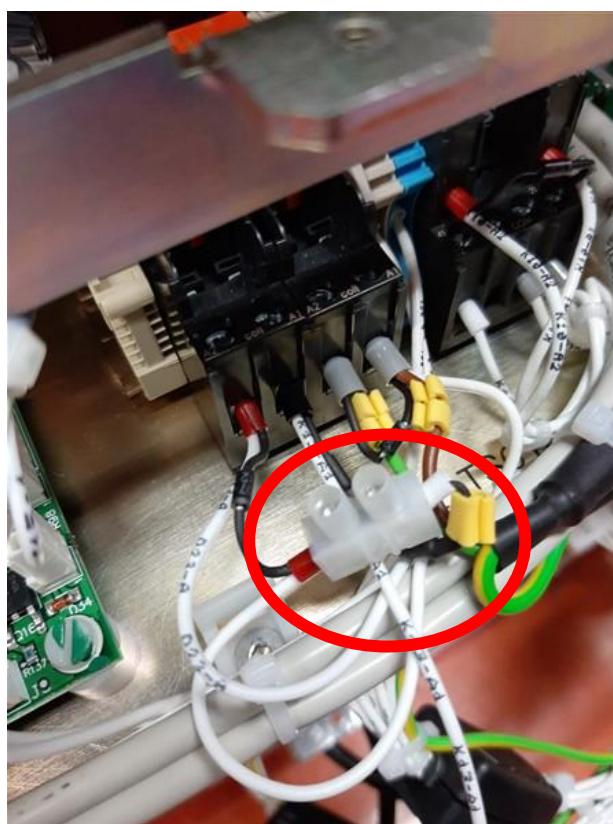
Rev. A

SIN 19-10-13

4. Connect the wire labeled K13-A1 of the part provided in the kit (As show in the next picture)



5. Connect the wire that was connected originally on the K13-A1 on the terminal labeled A1 of the part provided in the kit. (As show in the next picture)

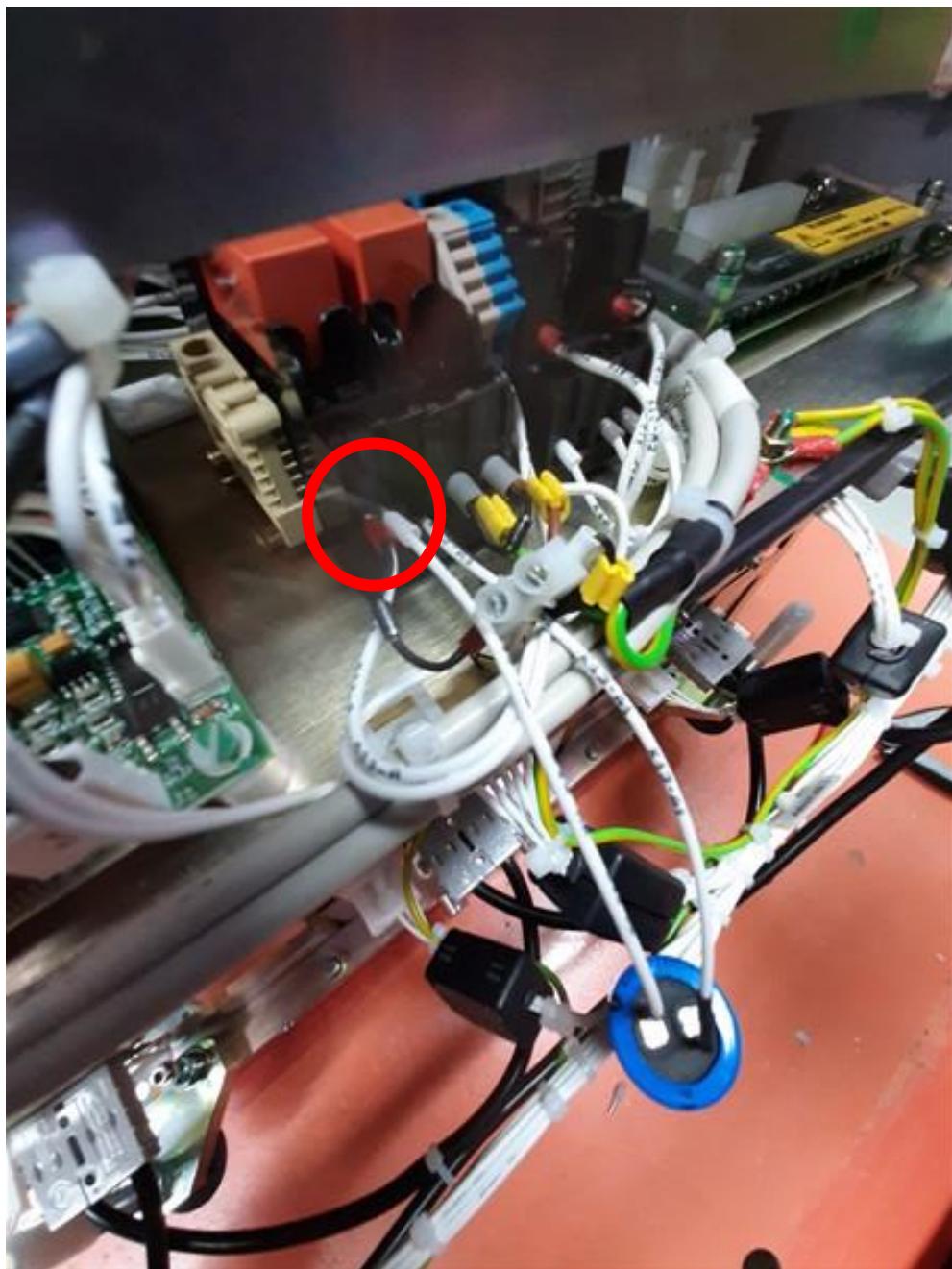


Upgrade filter with battery charger -16 in mobile

Rev. A

SIN 19-10-13

6. Add in the K13 relay socket the wire labeled K13-A2 of the part provided in the kit.
The wire that was originally in the K13-A2 need to remains in the K13-A2 terminal as show in the next picture).



Upgrade filter with battery charger -16 in mobile

Rev. A

SIN 19-10-13

7. Install the tie wrap holder as show on the next picture
Route and ensure the wires to make sure that they will not be damaged during the movement of the mobile unit.
Install the capacitor using the tie wrap provided with in the kit on the tie wrap holder.



8. Make a functional check of the mobile unit
9. Install the cover of the mobile unit

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SECTION 1. APPLICATION

This Service Information Note applies to Mobile III.

SECTION 2. DESCRIPTION OF INTERVENTION

Introduction.

This document describes the procedure to replace previous versions of USB Hub by the new one with revision G1, using the fixing plate included in the kit to allow installing the power supply. See image below.

Tools (Not provided in the kit).

- Standard Service Engineer's Tool.

Materials.

- **A521188-01 – 7 PORT HUB + POWER SUPPLY + FIXING PLATE**



USB-HUB & POWER SUPPLY REPLACEMENT

Rev. 0

SIN 22-03-05

SECTION 3. FIELD ACTIONS

1. Switch off the unit and press the safety switch. Remove relevant covers to access rear side of mobile unit. See Service Manual, Covers Removal section.
2. Remove the power supply currently in use by loosen the two M4 nuts securing the metal bracket. This bracket is no longer needed, remove and discard it.



USB-HUB & POWER SUPPLY REPLACEMENT

Rev. 0

SIN 22-03-05

3. Insert metal bracket supplied with the kit, into new power supply.



4. Using two nuts and two washers, screw the bracket to the fixing plate.



USB-HUB & POWER SUPPLY REPLACEMENT

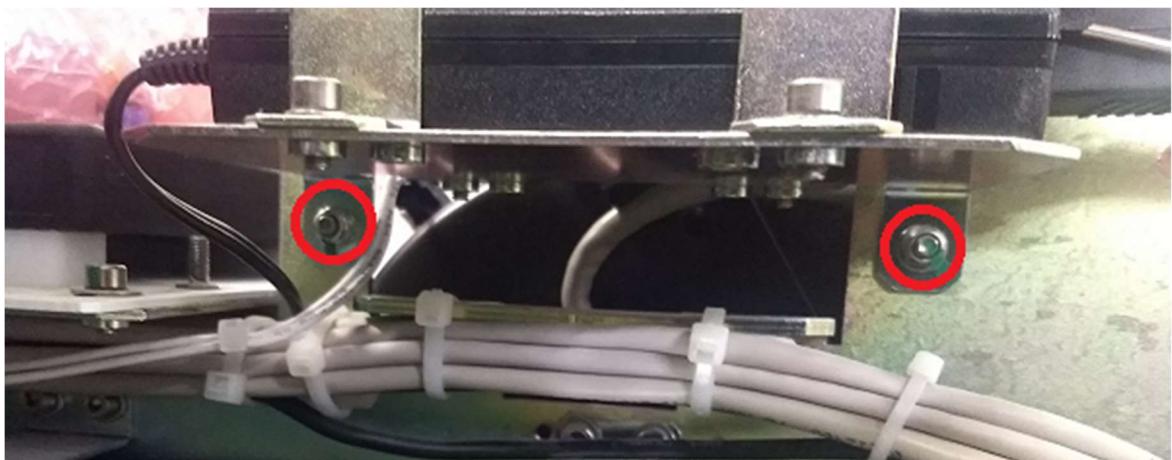
Rev. 0

SIN 22-03-05

5. remove the Allen screw securing the generator door and open it to gain access to the inside.



6. Remove the two nuts that fix Monitor's power supply fixing plate.

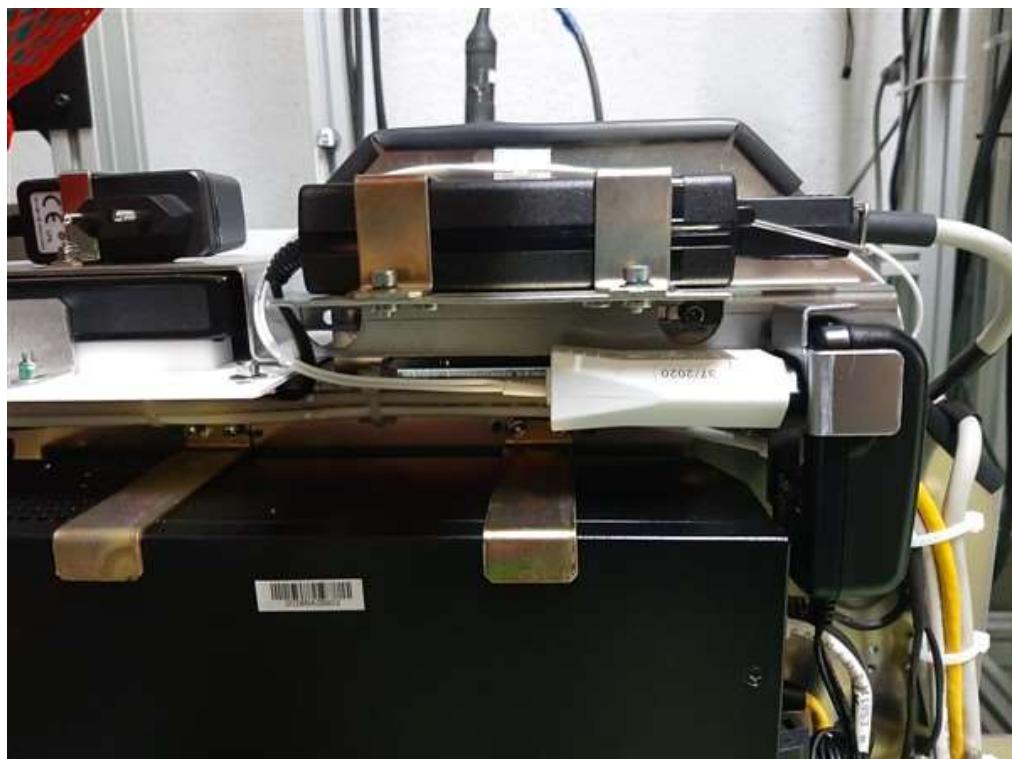


USB-HUB & POWER SUPPLY REPLACEMENT

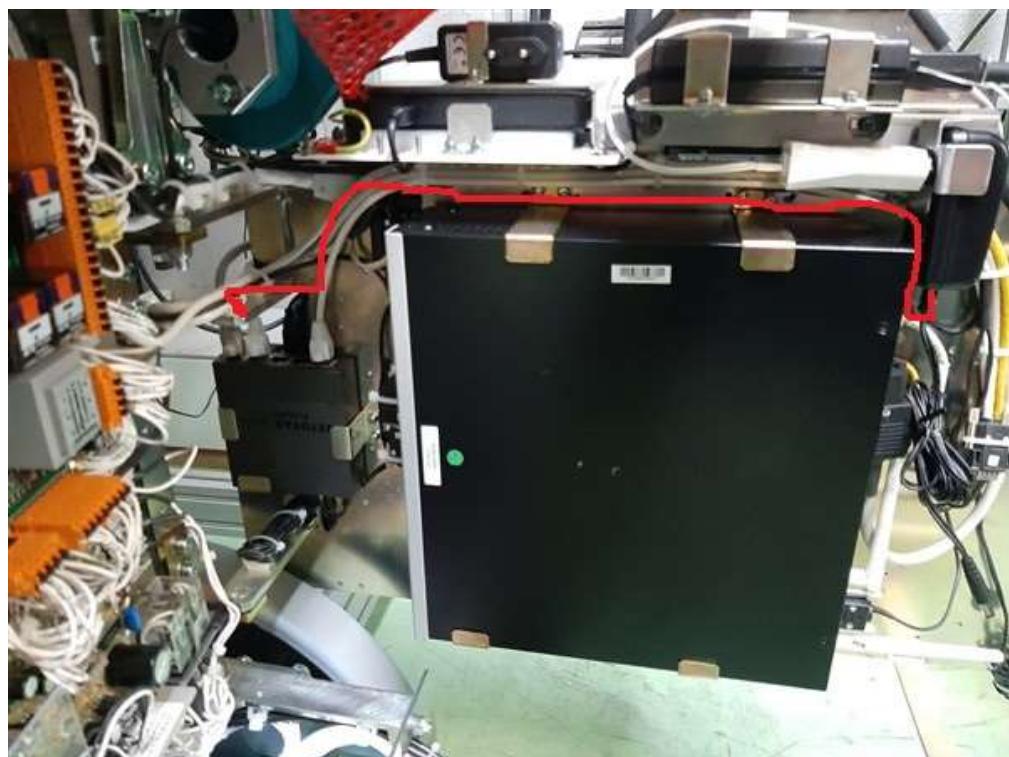
Rev. 0

SIN 22-03-05

7. Screw the two fixing plates together. Plug the white connector into the power supply.



8. Route the cable from the power supply to the USB HUB as shown in the image below.

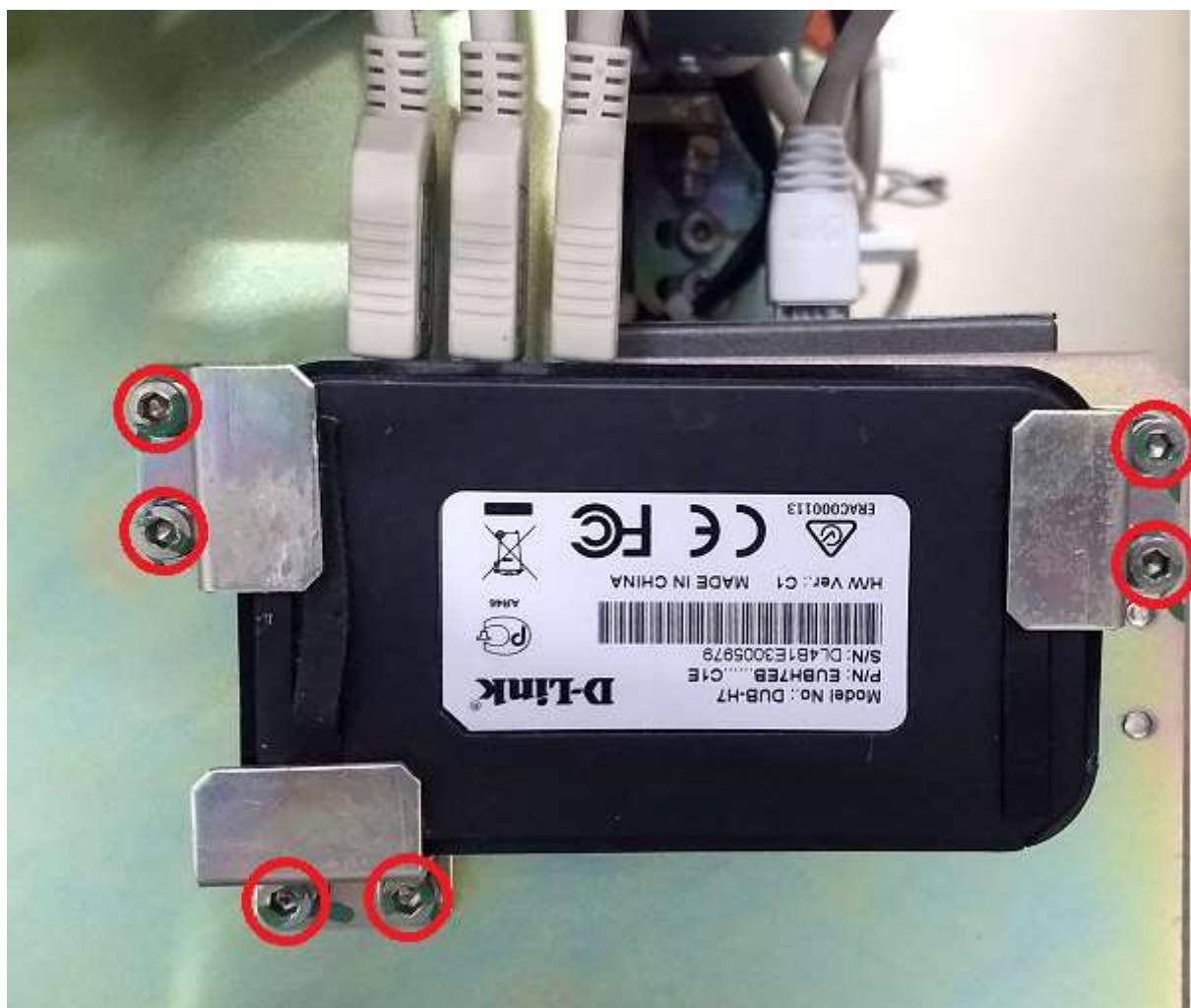


USB-HUB & POWER SUPPLY REPLACEMENT

Rev. 0

SIN 22-03-05

9. Disconnect USB cables and remove the six M4 Allen screws that secure USB Hub.



USB-HUB & POWER SUPPLY REPLACEMENT

Rev. 0

SIN 22-03-05

10. Mount new USB Hub in its place and secure it with six M4 Allen screws.



11. Reconnect USB cables and power supply cable.

12. Refer to Service Manual to reassemble covers,

13. Check unit functionality.

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