`I/300/31

ELECTROSURGICAL UNIT

Type series ES350

SERVICE MANUAL

I/300/31

Electrosurgical Unit ES350 – (Ref. No. 100-007)

Electrosurgical Unit ES350 with argon module - (Ref. No. 100-008)

Electrosurgical Unit ES350 with argon and ThermoStapler® - (Ref. No. 100-008-T)

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In purpose to preserve the highest quality of our products please communicate us all your opinions, suggestions and remarks using:

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With all your opinions and suggestions we will be able to improve and our products and live up your expectations.

Due to constant products' development the manufacturer reserve the right to implement changes with no prior notification.

SYMBOLS USED IN THIS MANUAL:

Warning

Contents:

1 SAFETY

HAZARDOUS VOLTAGE IS PRESENT IN THE PCBs AFTER POWERING UP THE SYSTEM!

BEFORE OPENING THE HOUSING DISCONNECT THE POWER SUPPLY, EVEN IF ADJUSTMENTS WILL BE DONE WITH THE HOUSING OPEN.

Since the transposition of the 2002/96/EU directive into the national law the following rules are binding.

- Electric and electronic equipment may not be disposed of together with household waste.
- The user is obliged to dispose of a broken or redundant electrical or electronic device at a dedicated collection point or return it to the seller.

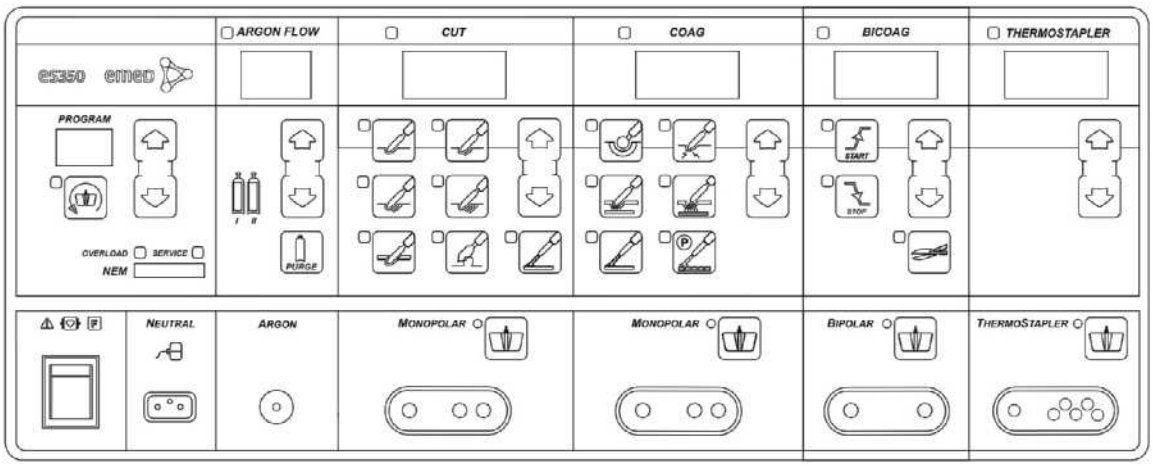
Details of the electric and electronic waste disposal are specified by the relevant national laws. This obligation is contained on the product packaging or in the manual in the form of a crossed-out waste bin. 2002/96/EU directive are marked with the crossed out wheeled bin symbol. By sorting waste for recycling you help to protect the environment.

THIS SERVICE MANUAL IS INTENDED FOR QUALIFIED SERVICE TECHNICIANS. IT IS NOT MEANT FOR THE CASUAL DO-IT-YOURSELFER. QUALIFIED TECHNICIANS HAVE THE NECESSARY TEST EQUIPMENT AND TOOLS, AND HAVE BEEN TRAINED TO PROPERLY AND SAFELY REPAIR COMPLEX PRODUCTS SUCH AS THOSE COVERED BY THIS MANUAL.
IMPROPERLY PERFORMED REPAIRS CAN ADVERSELY AFFECT THE SAFETY AND RELIABILITY OF THE PRODUCT AND MAY VOID THE WARRANTY, AS WELL AS POSE A THREAT TO BOTH PATIENT AND SURGEON.
IF YOU ARE NOT QUALIFIED TO PERFORM THE REPAIR OF THIS PRODUCT PROPERLY AND SAFELY, YOU SHOULD NOT RISK TRYING TO DO SO AND REFER THE REPAIR TO A QUALIFIED SERVICE TECHNICIAN.

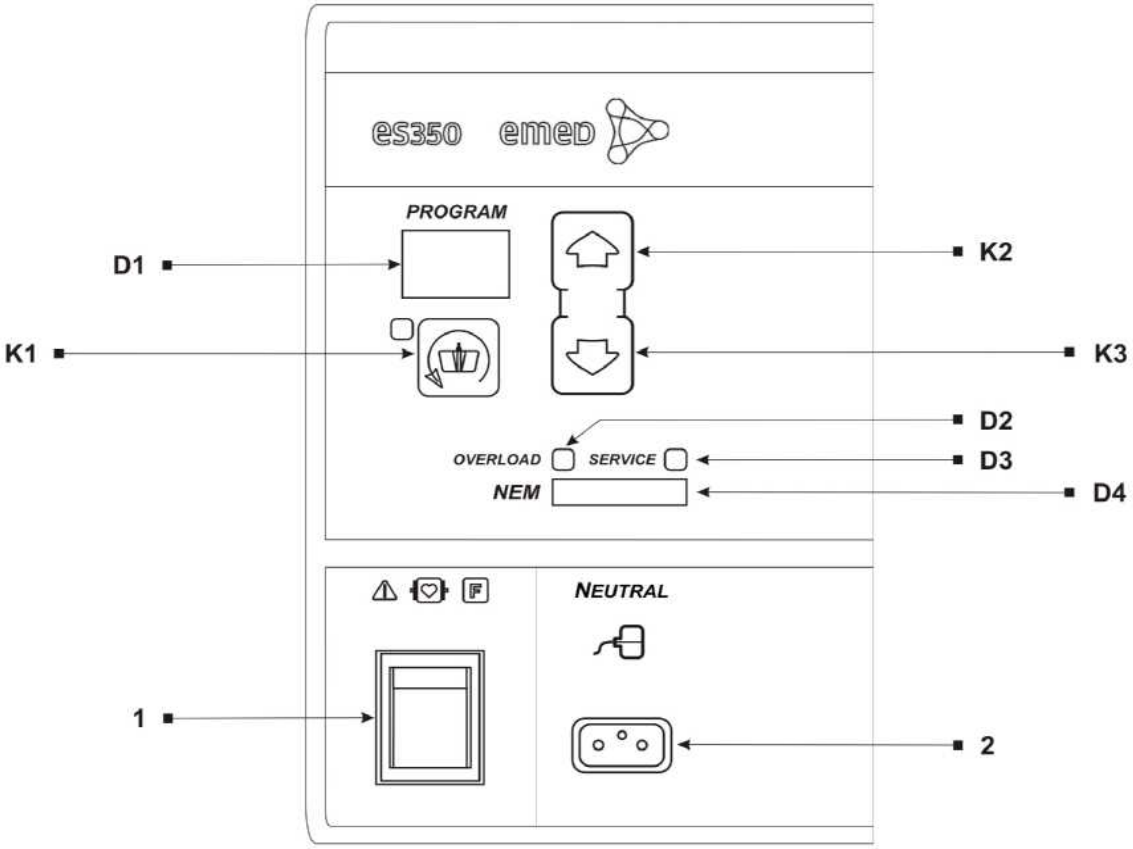
2 DEVICE APPEARANCE AND CONSTRUCTION

Casing of the device is made out of metal and contains no ventilation holes. The front panel is made of plastic material.

2.1 Front panel

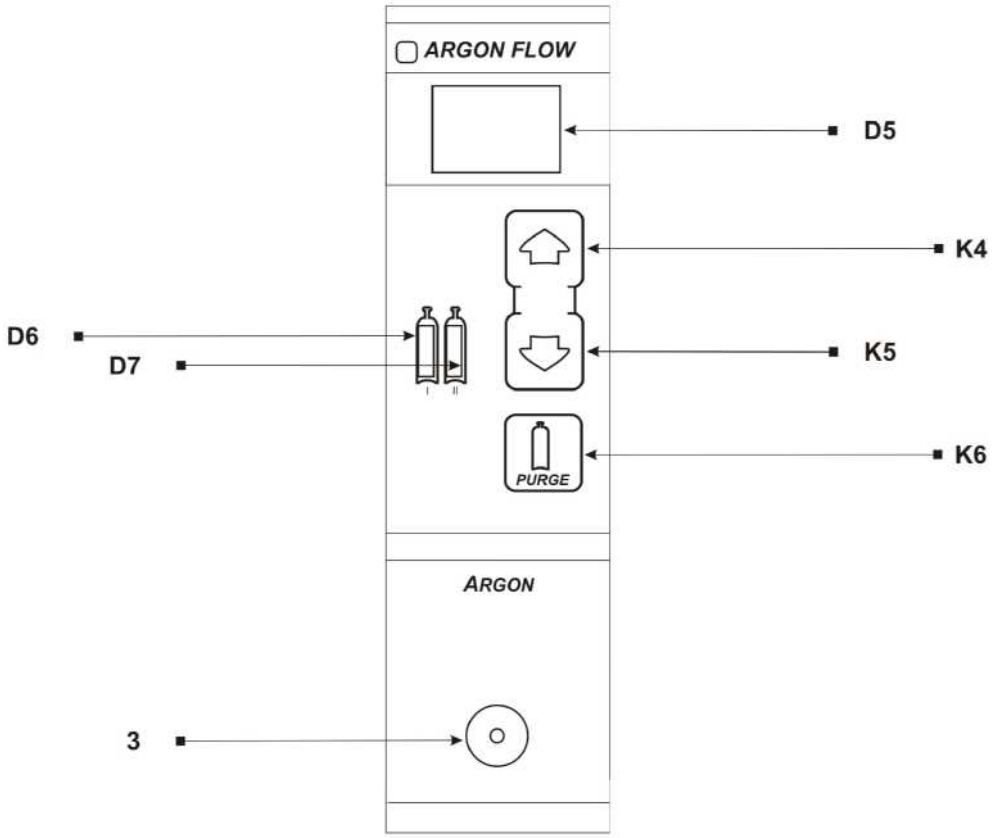


The front panel of the casing contains the following segments:

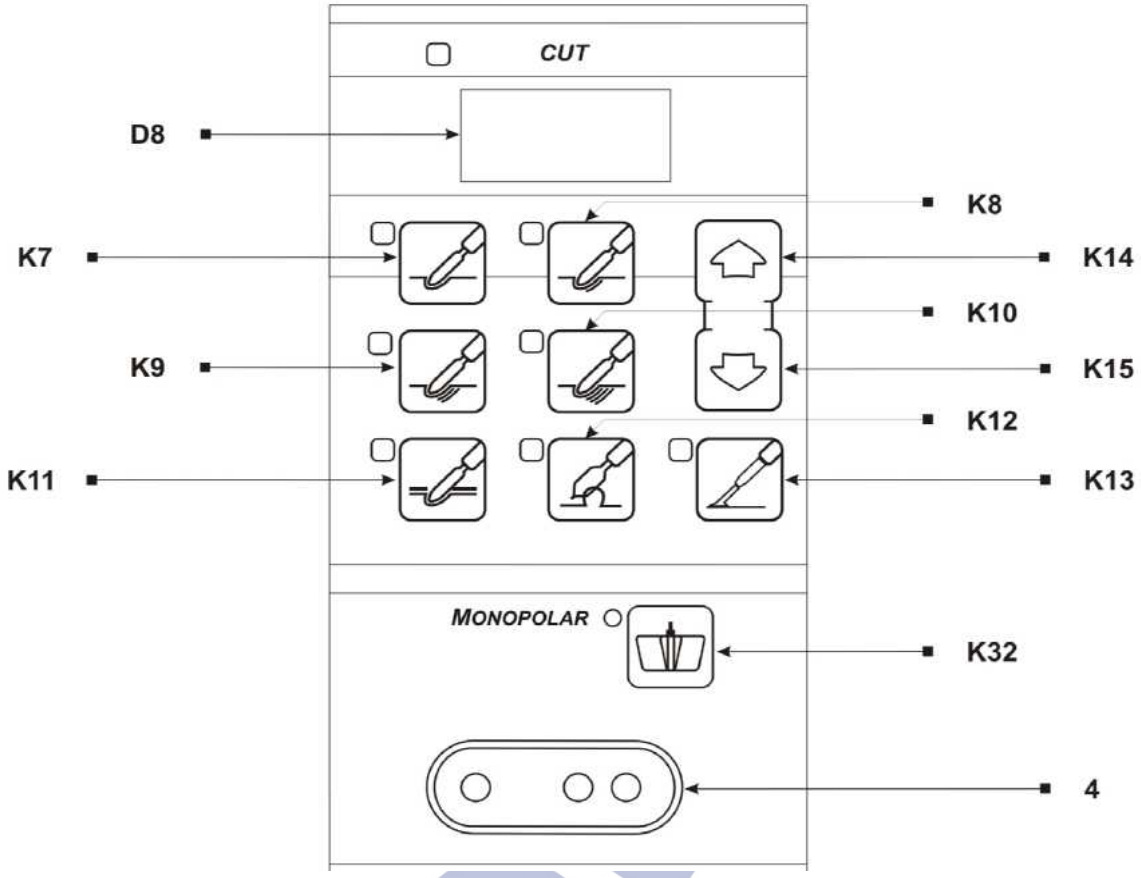


- power switch (1)
- neutral electrode socket (2)
- selected program display (D1)
- overload indicator (D2)
- information about the expiry deadline of technical inspection (D3)
- bar display – neutral electrode monitoring NEM (D4)
- MultiSwitch – for remote changes of settings (K1)
- program number selection (up K2, down K3)

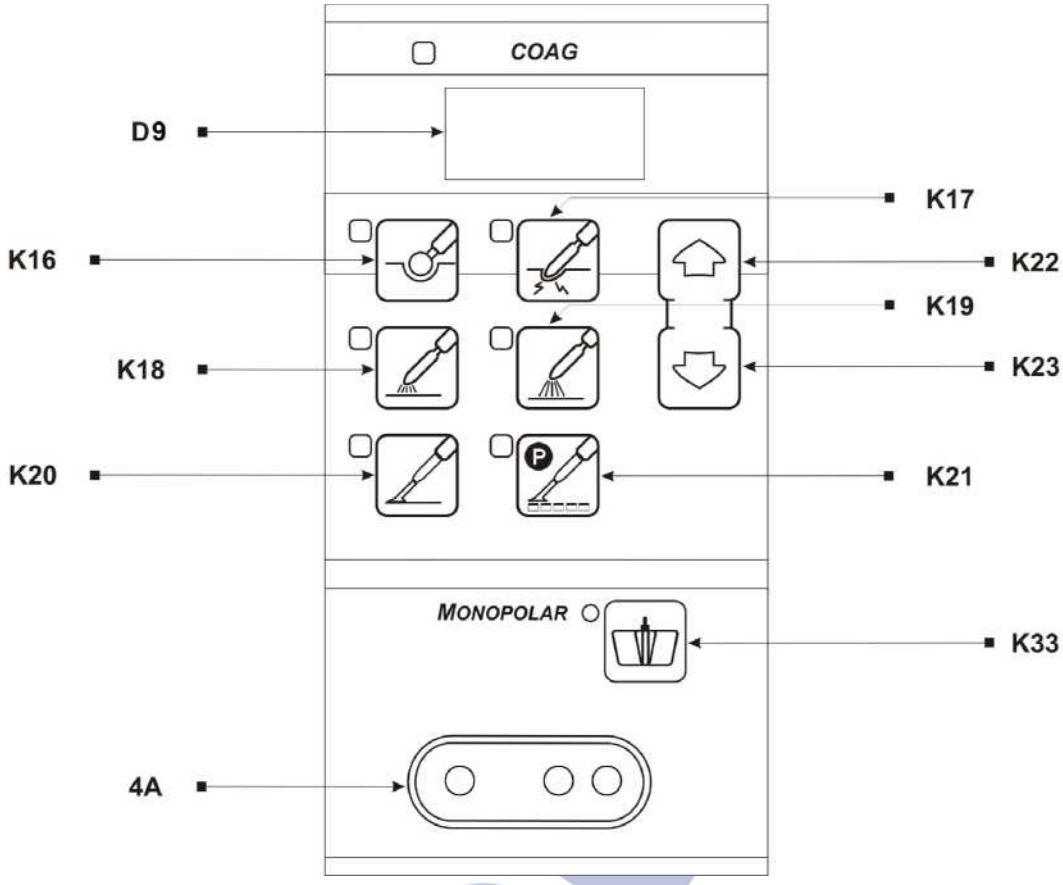
APPLIES ONLY TO Ref. Nos. 100-008 and 100-008-T



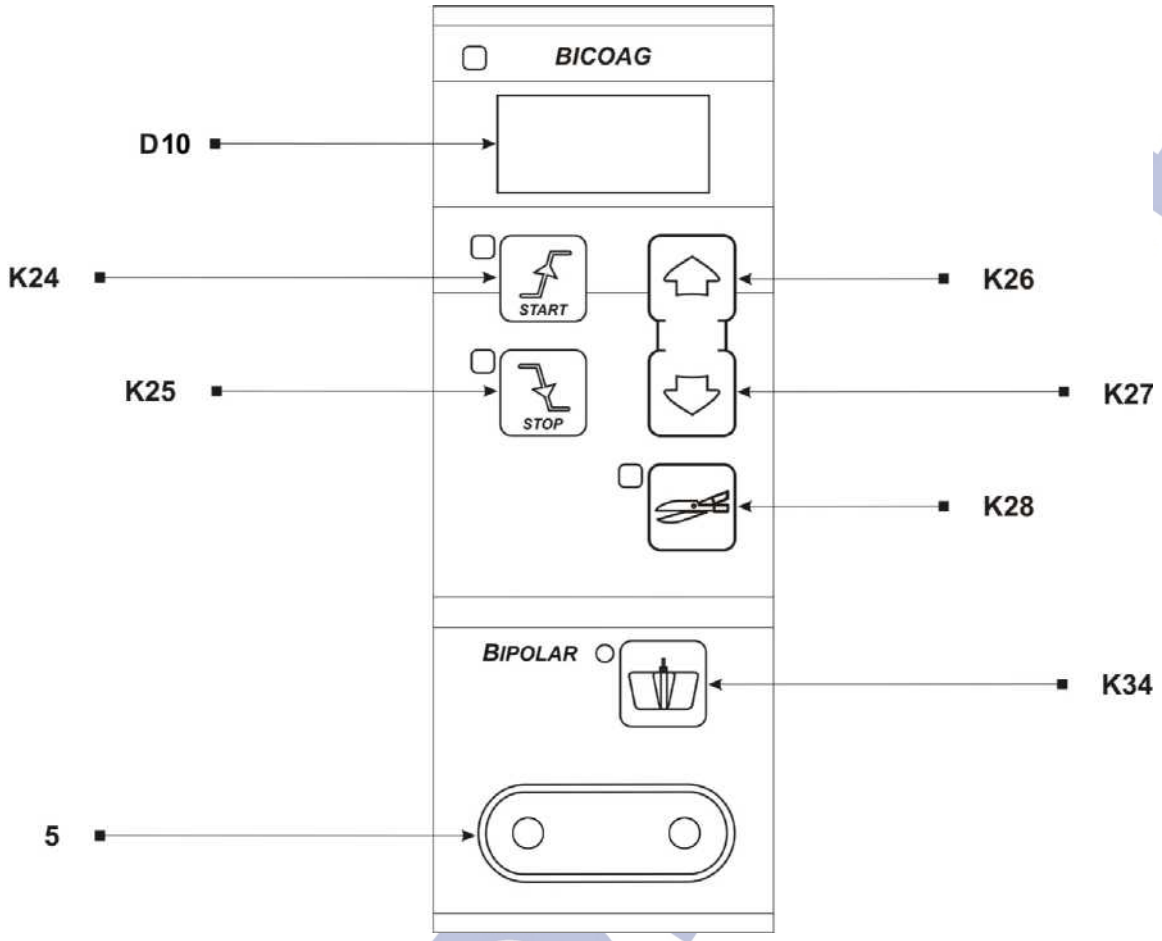
- argon electrode socket, argon outlet (3)
- gas flow volume display (D5)
- gas level indicator for cylinder I (D6)
- gas level indicator for cylinder II (D7)
- gas flow volume regulation buttons – increase (K4), decrease (K5)
- purge – filling up the instruments with argon (K6)



- monopolar electrode I socket (4)
- display of selected cutting power (D8)
- pure cut (K7)
- cutting with various amount of hemostasis (K8, K9, K10)
- urological cutting (K11)
- endoscopic cutting (K12)
- argon-enhanced cutting (K13) - APPLIES ONLY TO Ref. Nos. 100-008 and 100-008-T
- power adjustment buttons cutting: increase (K14), decrease (K15)
- footswitch control – monopolar output I (K32)

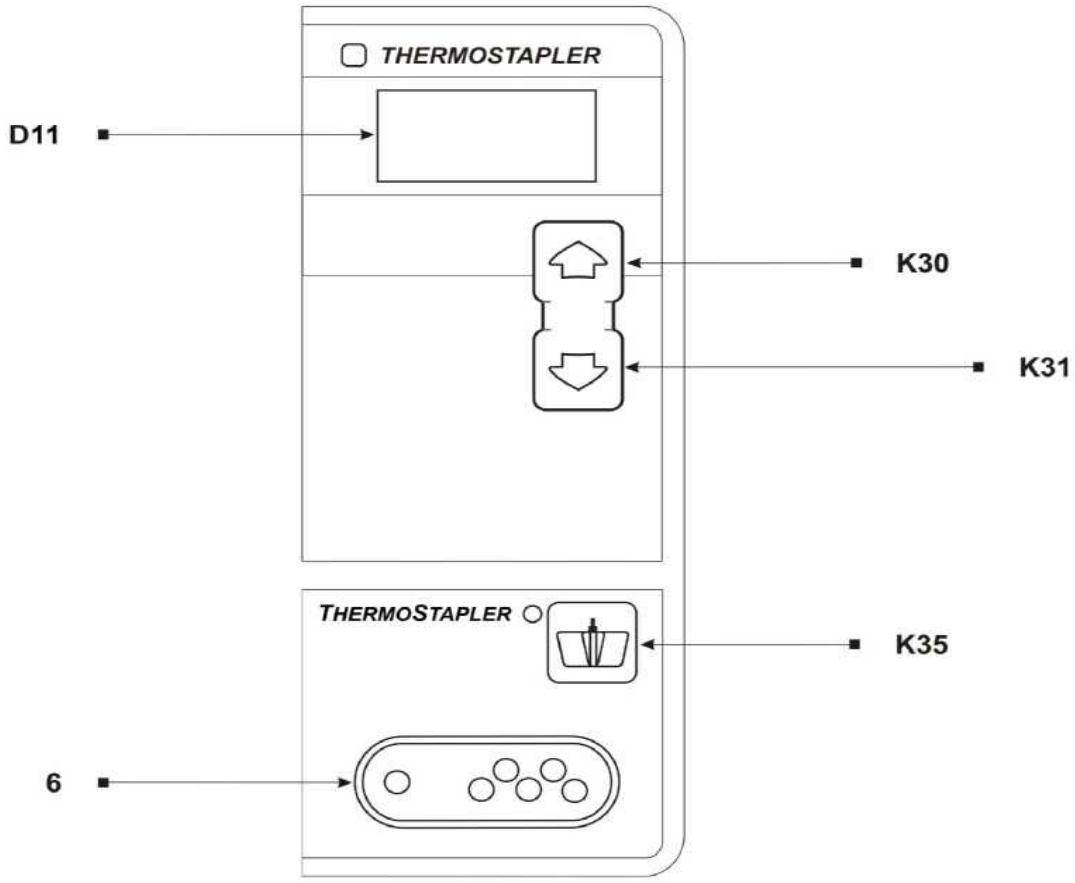


- monopolar electrode II socket (4A)
- display of selected monopolar coagulation power (D9)
- soft coagulation (K16)
- forced coagulation (K17)
- hybrid coagulation (K18)
- spray coagulation (K19)
- argon-enhanced coagulation (K20)
  - APPLIES ONLY TO Ref. Nos. 100-008 and 100-008-T
- argon-enhanced pulse coagulation (K21)
  - APPLIES ONLY TO Ref. Nos. 100-008 and 100-008-T
- power adjustment buttons coagulation: increase (K22), decrease (K23)
- footswitch control – monopolar output II (K33)



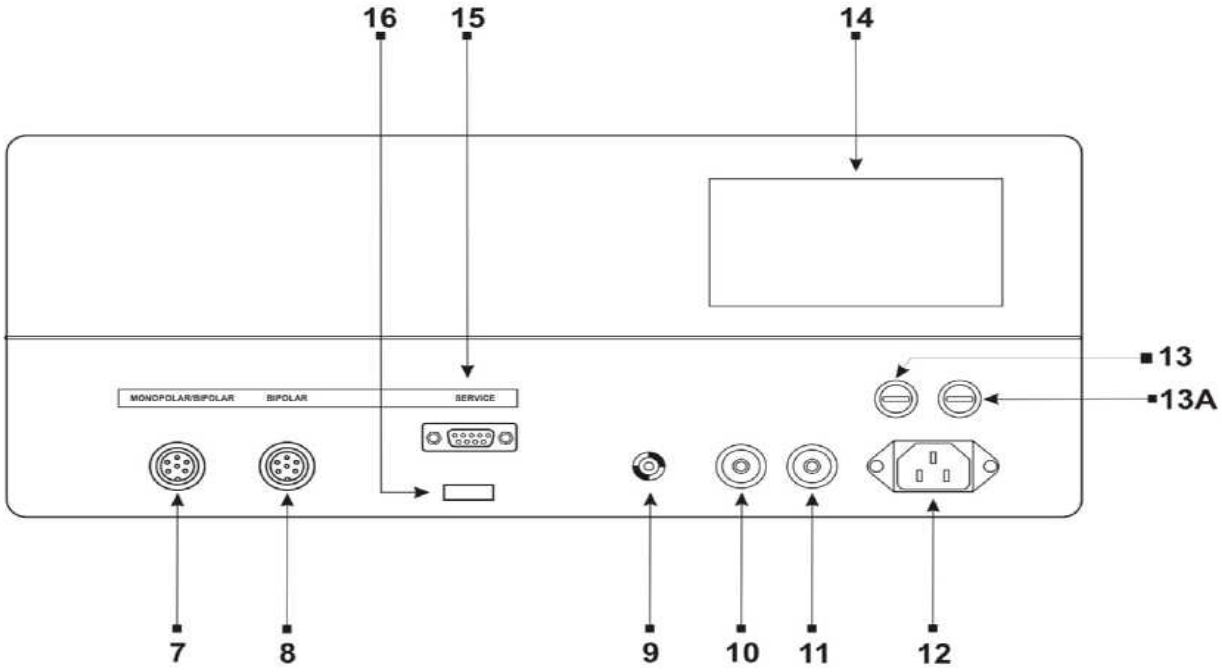
- bipolar electrode socket (5)
- display of bipolar coagulation power (D10)
- automatic start-up of the bipolar coagulation AutoStart (K24)
- limitation of the bipolar coagulation time AutoStop (K25)
- power adjustment buttons bipolar coagulation: increase (K26), decrease (K27)
- bipolar cutting (K28)
- footswitch control – bipolar output (K34)

APPLIES ONLY TO Ref. Nos. 100-008 and 100-008-T



- ThermoStapler® socket (6)
- display of selected ThermoStapler® power (D11)
- power adjustment buttons ThermoStapler®: increase (K30), decrease (K31)
- footswitch control – ThermoStapler® socket (K35)

2.2 Back panel



- monopolar/bipolar (universal) footswitch socket (7)
- bipolar footswitch socket (8)
- additional grounding pin (9)
- argon socket I (10) – APPLIES ONLY TO Ref. Nos. 100-008 and 100-008-T
- argon socket II (11) – APPLIES ONLY YO Ref. Nos. 100-008 and 100-008-T
- power cord socket (12)
- fuse sockets (13, 13A)
- manufacturer's label (14)
- RS type service socket (15)
- USB type service socket (16)

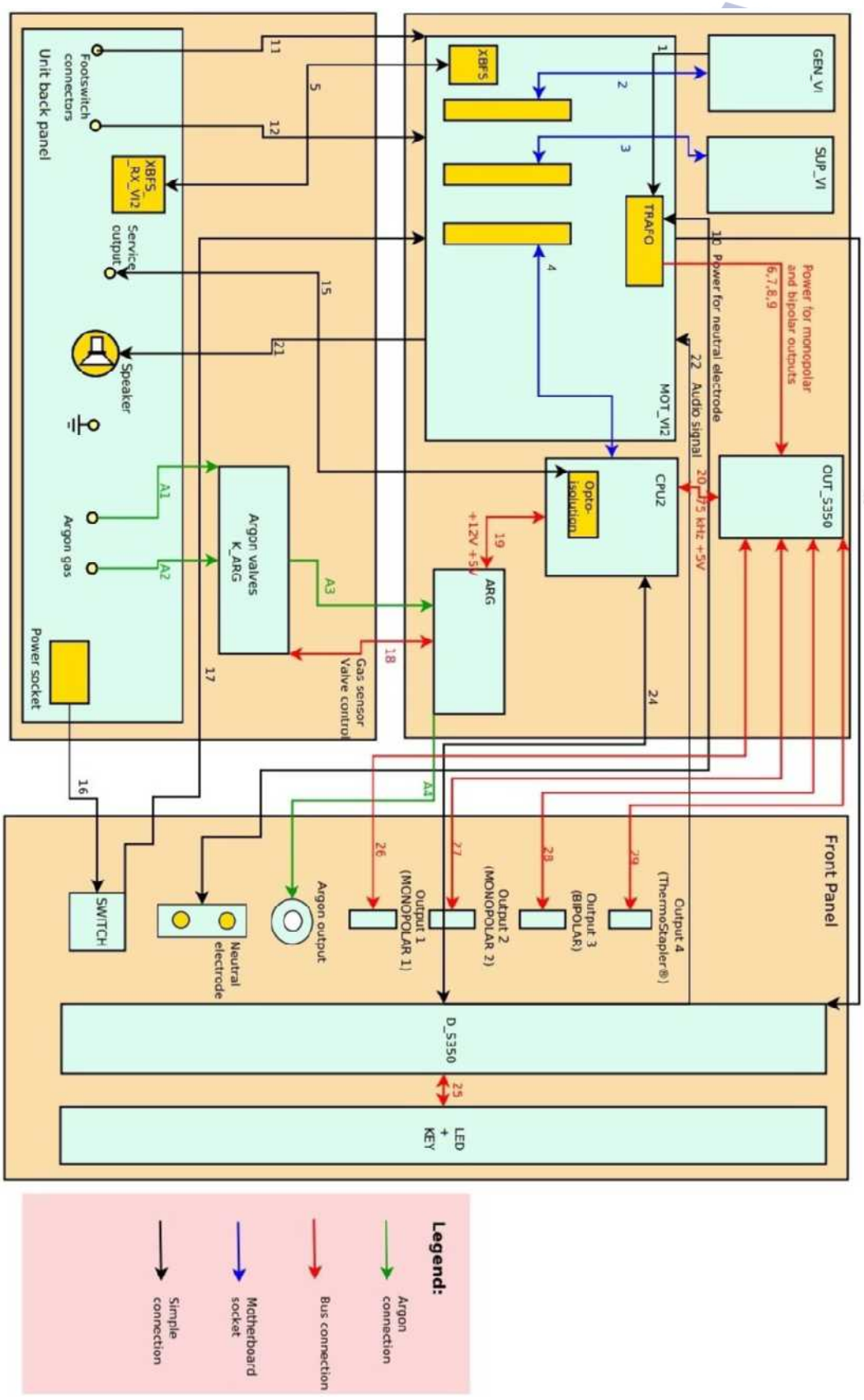
3 MESSAGES FOR THE USER

Error POST	
Error code	**Description of the error**
311	Shorting of the CUT button on the handle at the OUT1 output.
312	Shorting of the COAG button on the handle at the OUT1 output.
321	Shorting of the CUT button on the handle at the OUT2 output.
322	Shorting of the COAG button on the handle at the OUT2 output.
331	Shorting of the CUT button on the handle at the OUT3 output.
332	Shorting of the COAG button on the handle at the OUT3 output.
341	Shorting of the CUT button on the handle at the OUT4 output.
342	Shorting of the COAG button on the handle at the OUT4 output.
371	Shorting of the CUT button on the UNIVERSAL footswitch.
372	Shorting of the COAG button on the UNIVERSAL footswitch.
381	Shorting of the CUT button on the BIPOLAR footswitch.
382	Shorting of the COAG button on the BIPOLAR footswitch.
373	Shorting of the MULTI button on the MONOPOLAR footswitch..
383	Shorting of the MULTI button on the BIPOLAR footswitch.
314	Shorting of bipolar scissors (OUT1).
324	Shorting of bipolar scissors (OUT2).
334	Shorting of bipolar scissors (OUT3).
344	Shorting of ThermoStapler clamps (OUT4).

Internal errors	
Internal error – the electrosurgical unit does work properly. For safety reasons the functions of the unit cannot be activated. Please contact the authorised EMED service.	
Error code	**Description of the error**
501	It is applies to the outputs responsible for the settings of relays. It is checked whether after a certain state has been generated at a processor port the desirable state has really been achieved at its legs. It may be caused by a breakdown of the ULN2003 system which is connected to the processor outputs.
502	When the unit is started the voltage is read out at measurement pins in the state of no activation. All the measured results are treated as zero points and if voltage levels are higher than those acceptable in this state, an error is reported. The acceptable voltage is the voltage corresponding to 7 units of a 8-bit converter with 5V reference voltage, i.e. 137mV as a maximum. It may be caused by failure to connect or incorrect connection of the MPM module.
503	The error of voltage, current or power output measurements. The voltage, current or power output levels are continuously controlled during activation and at all times it is checked whether the obtained results make sense (e.g. it is an error when the voltage and current are almost zero, whereas the power is very high). If the measured results do not make sense and the situation repeats in successive measurements, an error is reported.

4 CONSTRUCTION

4.1 Block diagram



4.2 Description of connections

1. 2-wire cable (Connection GEN_VI - MOT_VI2)
2. multi-pin connectors located on the motherboard (Connection GEN_VI - MOT_VI2)
3. multi-pin connectors located on the motherboard (Connection SUP_VI - MOT_VI2)
4. multi-pin connectors located on the motherboard (Connection CPU2 - MOT_VI2)
5. 4-wire cable for XBFS_RX_VI2 receiver (Connection XBFE_RX_VI2 - MOT_VI2)
6. power output cables (Connection OUT_S350 - MOT_VI2)
7. power output cables (Connection OUT_S350 - MOT_VI2)
8. power output cables (Connection OUT_S350 - MOT_VI2)
9. power output cables (Connection OUT_S350 - MOT_VI2)
10. neutral electrode power cable (Connection Front panel - MOT_VI2)
11. 6-wire cable for footswitch socket UNIVERSAL (Connection Back panel – MOT_VI2)
12. 6-wire cable for footswitch socket BIPOLAR (Connection Back panel - MOT_VI2)
13. multi-pin connectors located on the motherboard (Connection MPM - MOT_VI2)
14. multi pin connectors located on the motherboard (Connection MPM - MOT_VI2)
15. 9-wire ribbon cable for Service output (Connection Back panel – CPU2)
16. 2-wire power supply cable (Connection Back panel – Front panel)
17. 2-wire power supply for main switch (Connection Front panel - MOT_VI2)
18. 8-wire ribbon cable for gas sensors and valve control

(Connection Back panel - ARG)

19. 14-wire ribbon cable connecting the CPU module with argon module (Connection CPU2 – ARG)
20. 20-wire ribbon data transfer cable (Connection OUT_S350 – CPU2)
21. 2-wire cable for audio signal (Connection Back panel – MOT_VI2)
22. 2-wire cable for audio signal (Connection D_S350 – MOT_VI2)
23. 3-wire cable for D_S350 power supply (Connection D_S350 – MOT_VI2)
24. 9-wire data transfer cable (Connection D_S350 – CPU2)
25. 12-wire cable (Connection D_S350 - keyboard)
26. cables for output socket on the front panel (Connection OUT_S350 – Front Panel)
27. cables for output socket on the front panel (Connection OUT_S350 – Front Panel)
28. cables for output socket on the front panel (Connection OUT_S350 – Front Panel)
29. cables for output socket on the front panel (Connection OUT_S350 – Front Panel)
30. 2-wire cable for spray resistor
31. 1 wire cable grounding upper casing
32. 1 wire cable grounding module MOT_VI2
33. 1 wire cabel grounding Front Panel

A1. Pneumatic cable (connecting the argon gas socket and argon valves K_ARG) located on the back panel

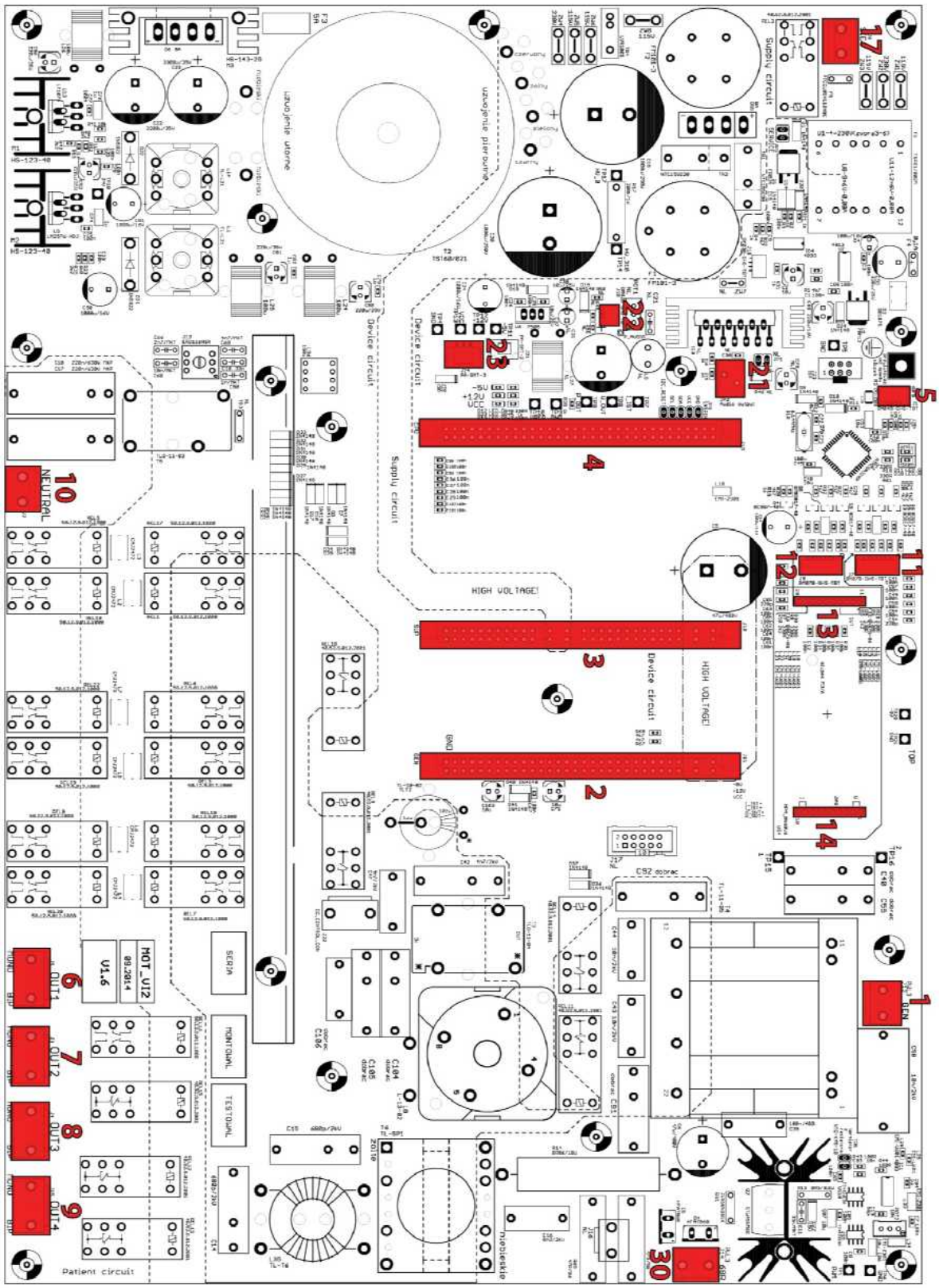
A2. Pneumatic cable (connecting the argon gas socket and argon valves K_ARG) located on the back panel

A3. Pneumatic cable (connecting the argon argon valves K_ARG and argon module ARG) located on the back panel

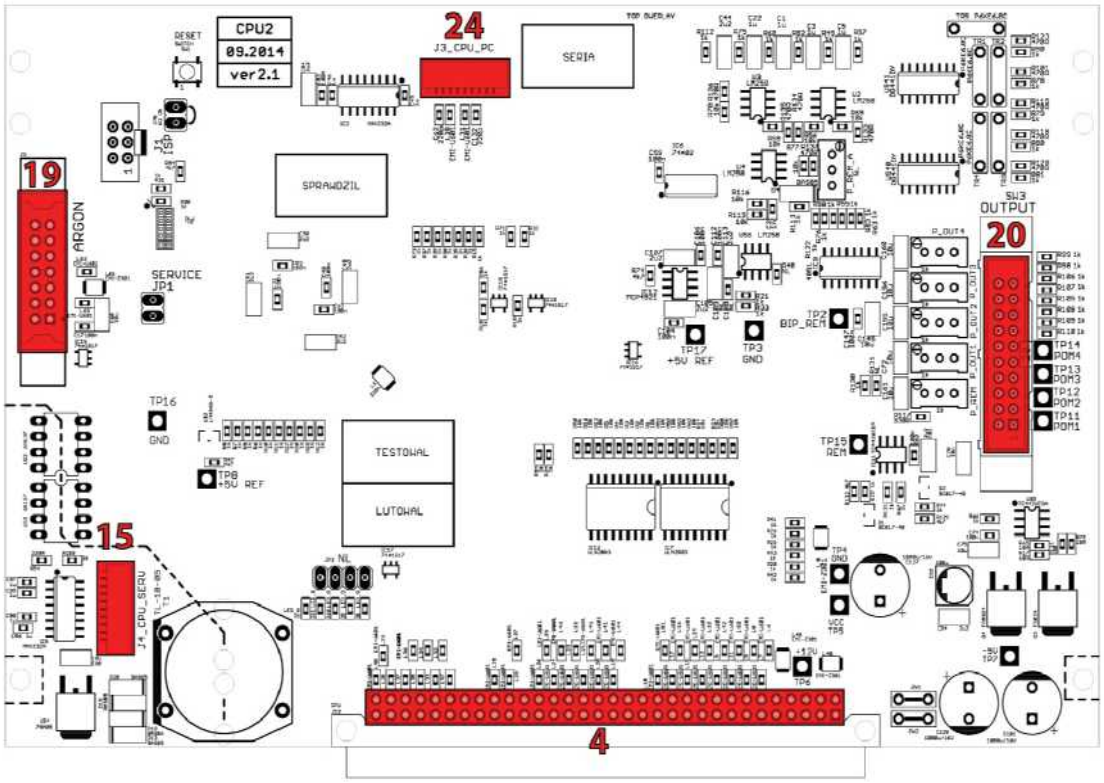
A4. Pneumatic cable (connecting the argon module ARG and argon gas socket, argon outlet) located on the front panel

4.3 Connection diagram

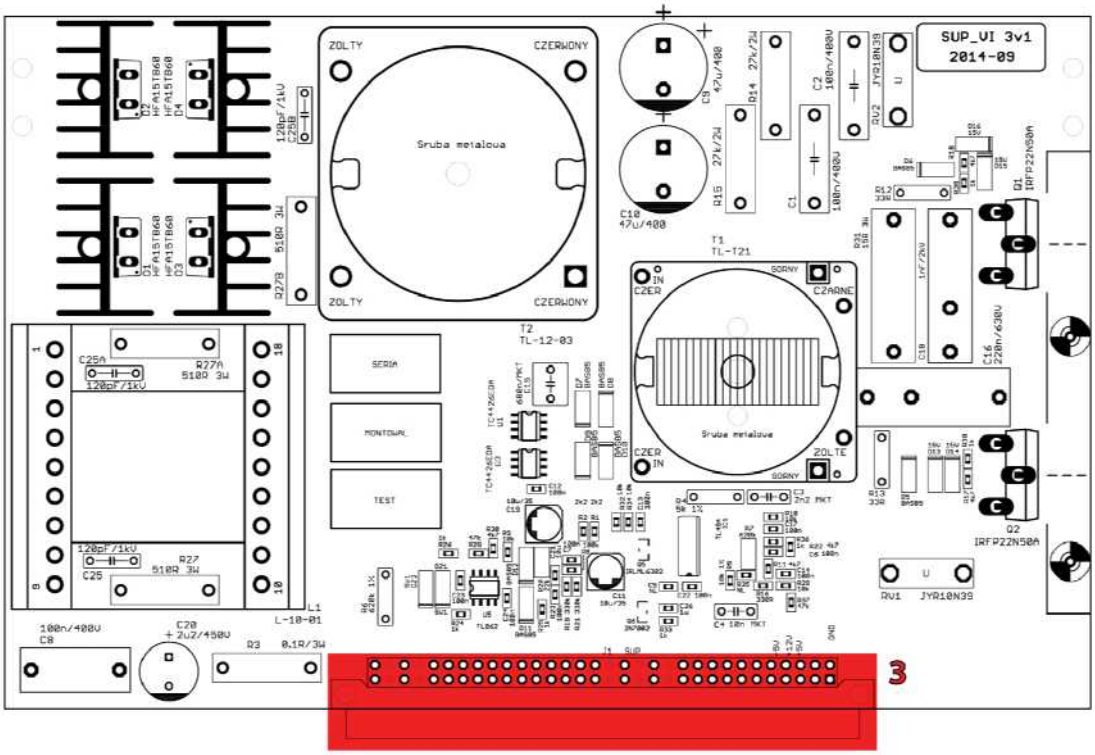
MOT_VI2 module



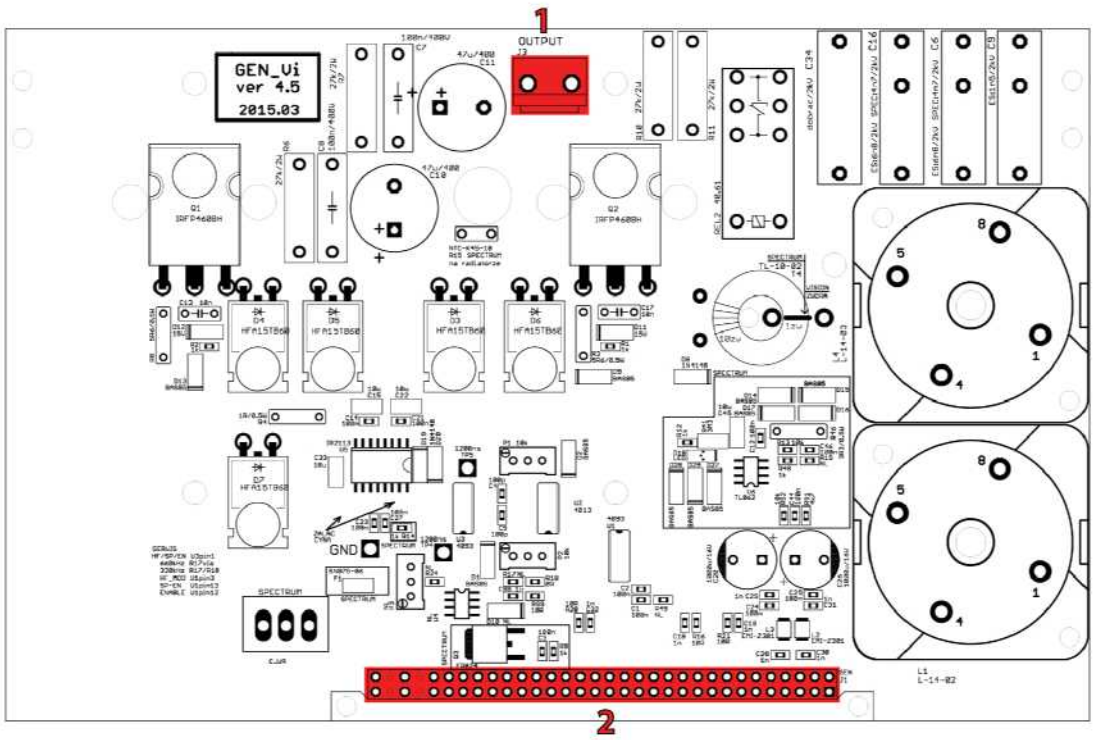
CPU2 module



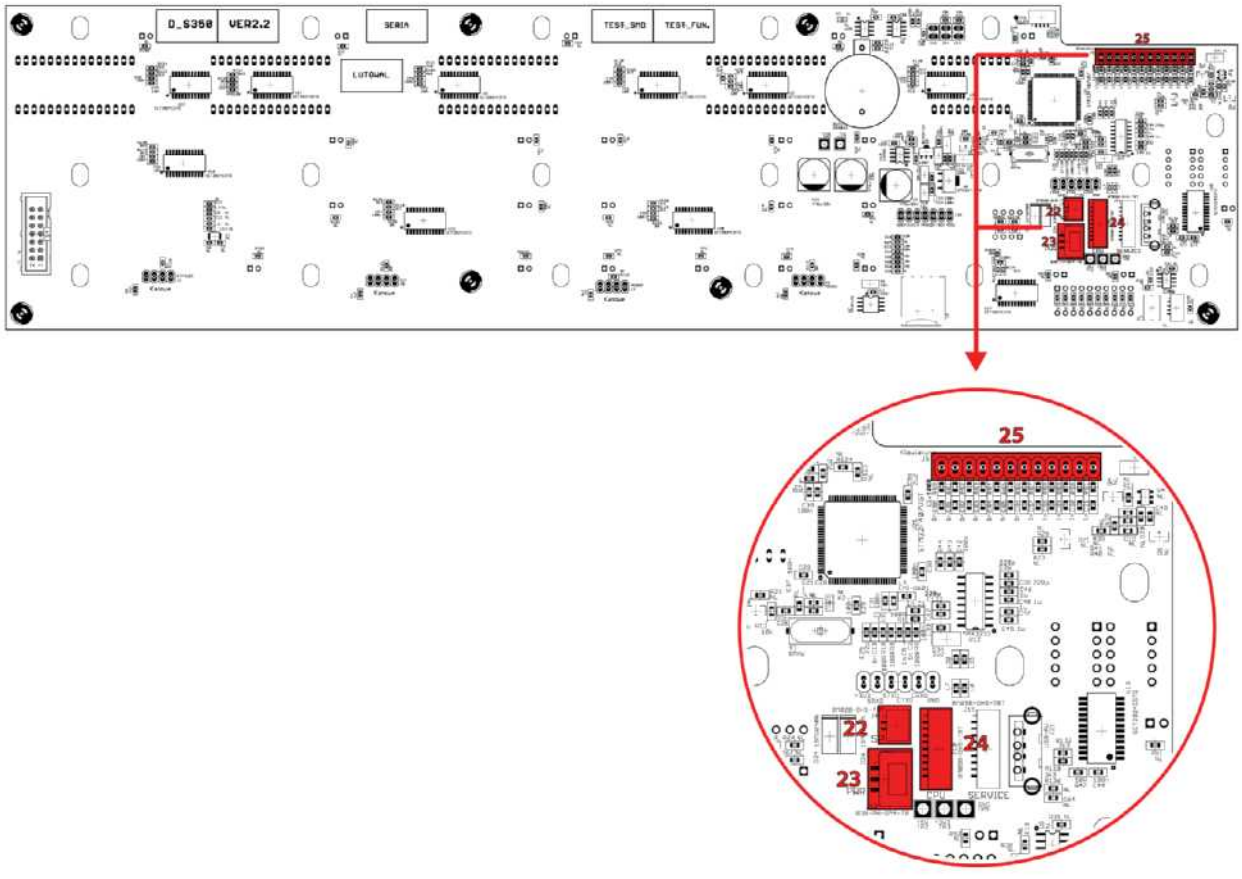
SUP_VI module



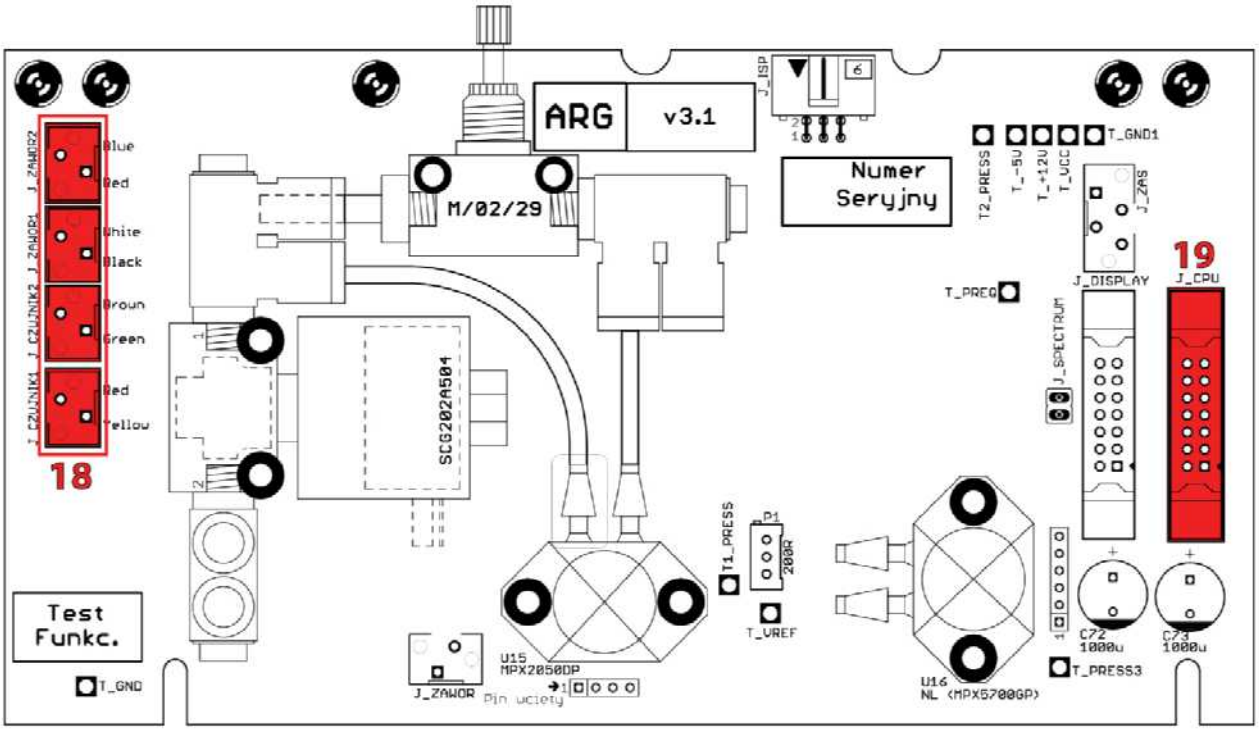
GEN_VI module



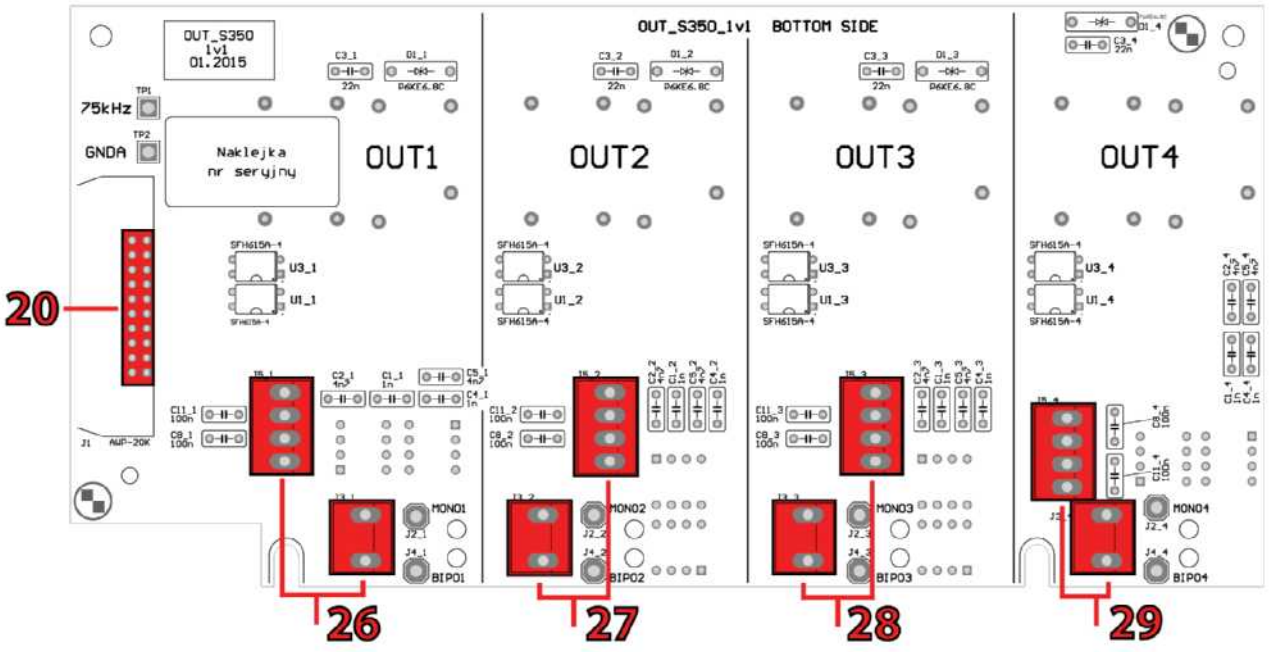
D_S350 module



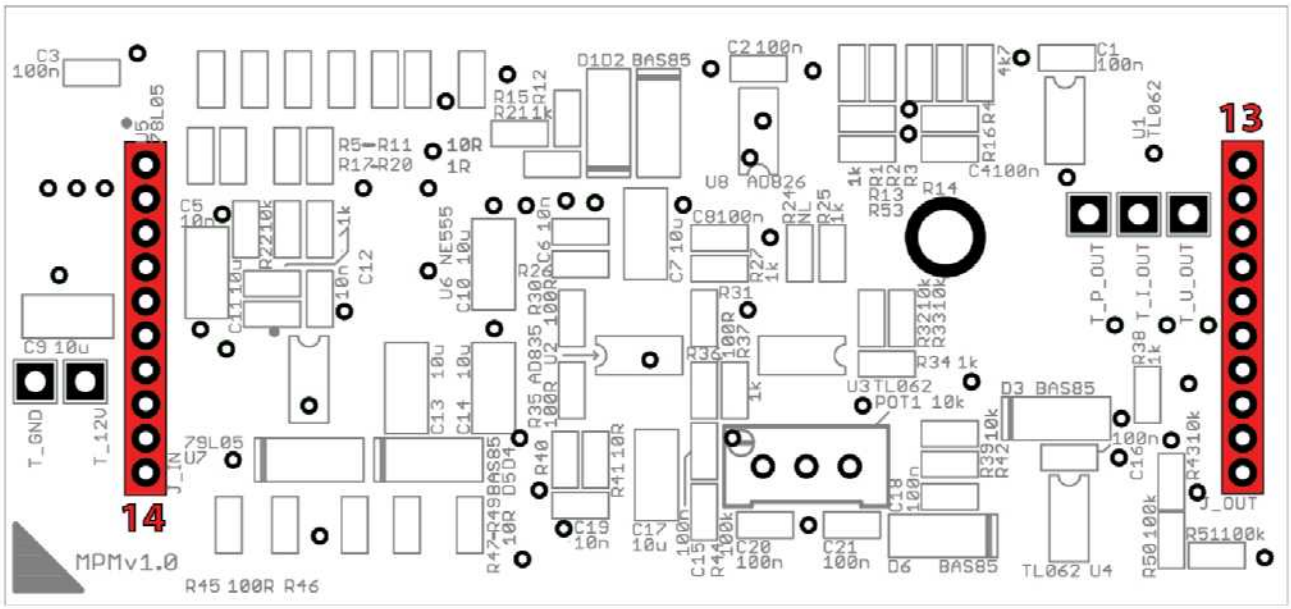
ARG module



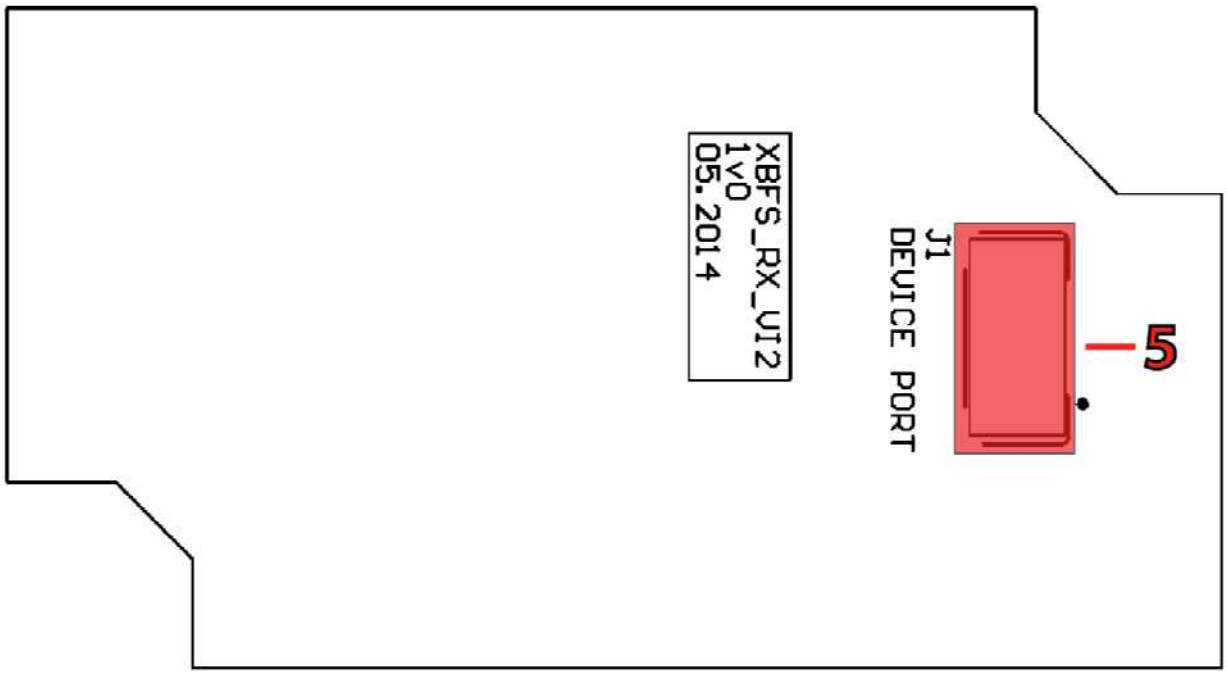
OUT_S350 module



MPM module

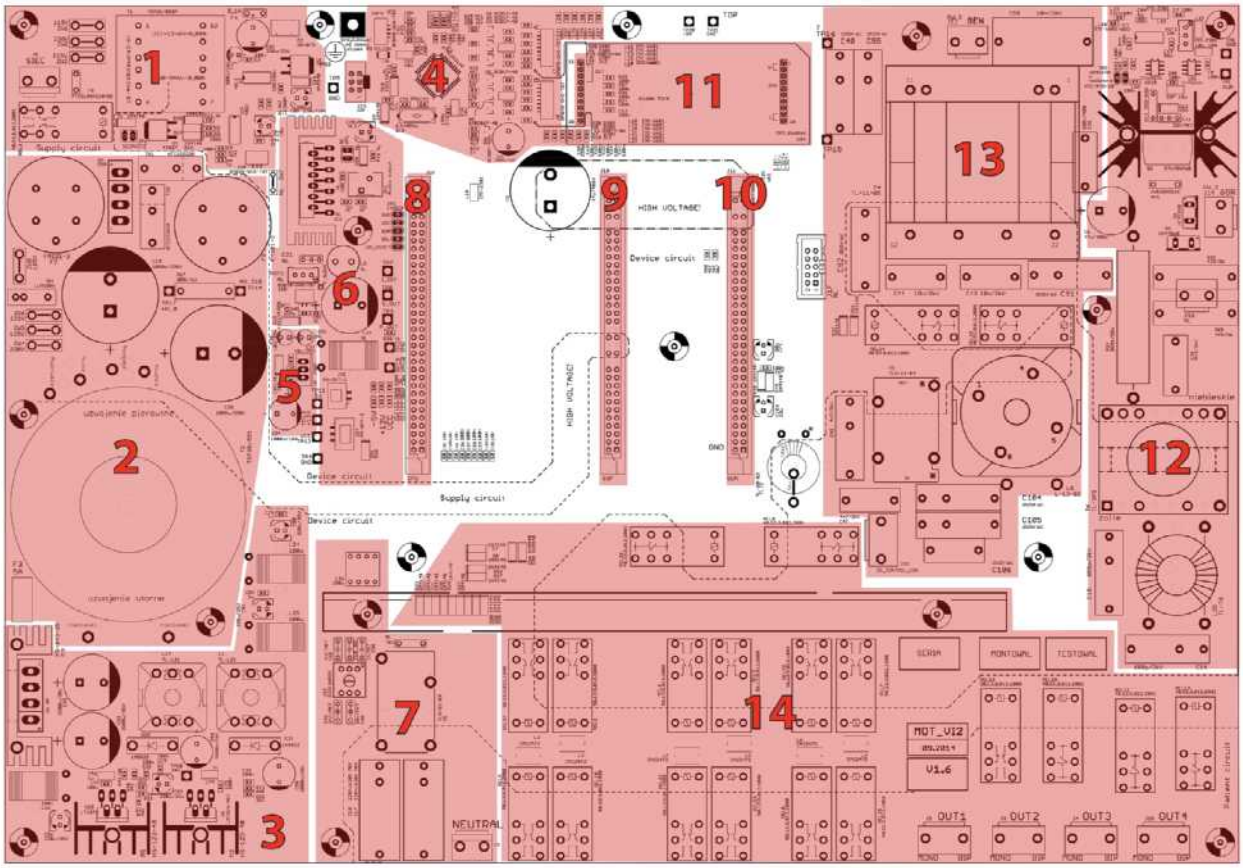


XBFS_RX_VI2 module



4.4 Description of modules

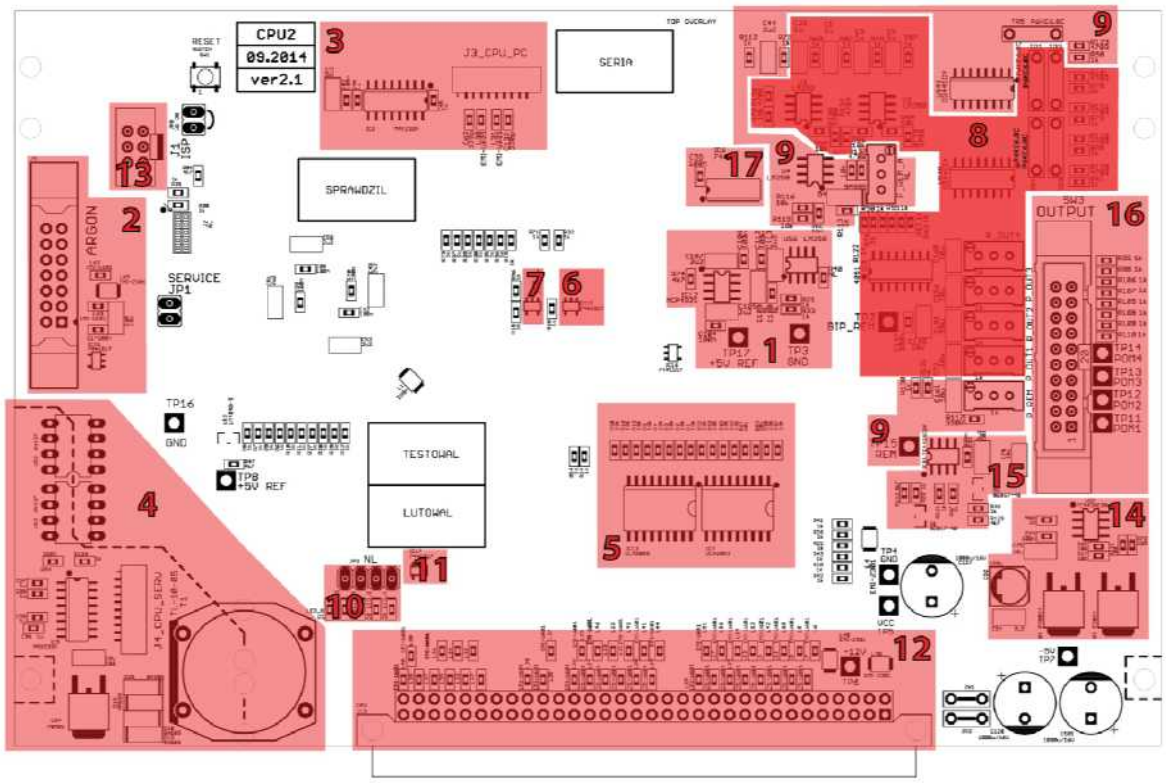
4.4.1 MOT_VI2 module – SP-1-02-06

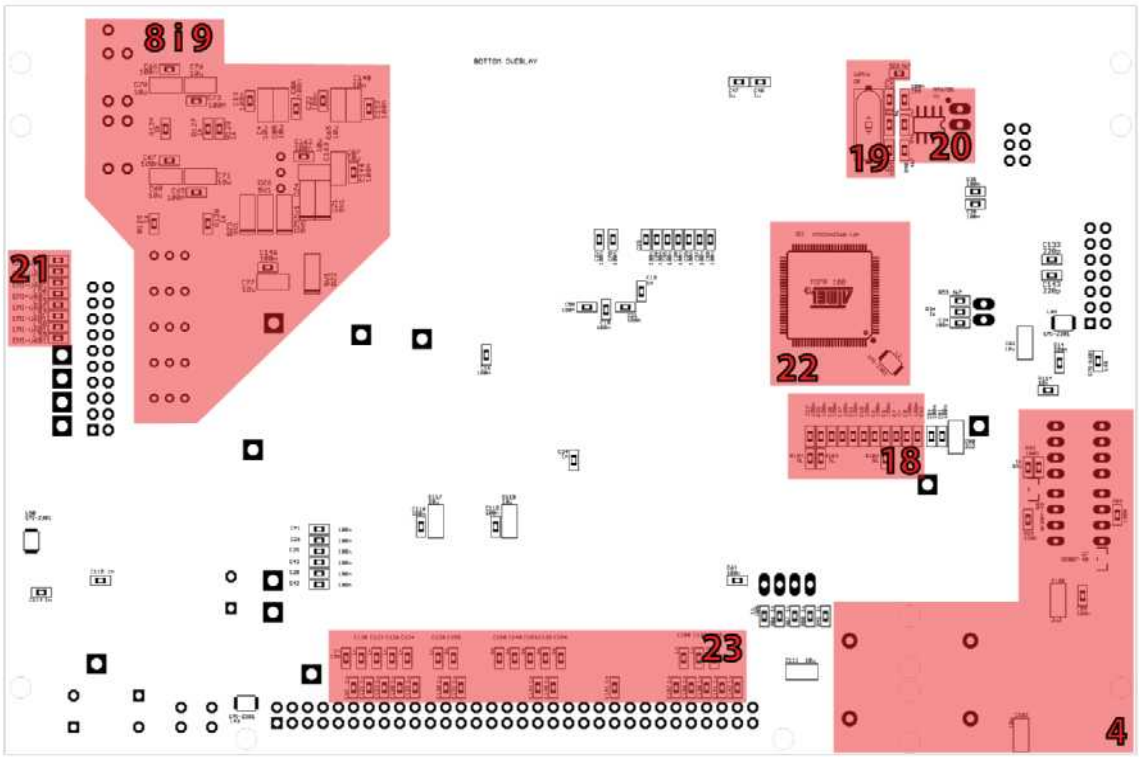


1. Stand-By
2. The system which is responsible for switching on the main power supply with a switch on the front of the unit. In the Es350 unit, the jumper Jp3 is mounted; it deactivates the unit. The unit is switched on with a mechanical switch on the front.
3. Mains filter
4. The system of mains filters with the transformer T2 which supplies the logic of the PCB board.
5. Low-voltage power supplies
   The system of low-voltage power supplies based on pulsed power converters for generating voltage levels of +12V and +5V. The correctness of generated voltage levels can be checked at the test points TP12 and TP13.
6. Operation of the radio switch
   The system cooperates with the optional module XBFS mounted on the back wall of the unit under the black encasing.

7. -5V power supply
   It supplies the GEN, SUP and CPU modules connected to the connectors J10, J11 and J19.
8. Audio amplifier
   The system is not mounted on the PCB.
9. NEM electrode
10. The system of filters which serves to detect how the neutral electrode adheres to the patient.
11. CPU
12. The connector which serves to connect the CPU module.
13. SUP
14. The connector which serves to connect the SUP_vi module.
15. GEN
16. The connector which serves to connect the GEN_Vi module.
17. MPM
18. The place for connecting the MPM measuring module.
19. Spray
20. The signal generator for Spray coagulation, the control and implementing parts.
21. Output systems
22. Output filters with a transformer separating the unit from the patient.
23. Relays
24. The relays which serve to distribute the energy of the unit to the appropriate outputs OUT1, OUT2 etc.

4.4.2 CPU2 module – SP-1-03-04





1. UREQ system.

   It is a DAC which is controlled by a microcontroller. It sets the required voltage of the power supply.

2. Argon module connector.
3. A communication connector with the D_S350 module and the MAX232 voltage converter.
4. Service connector system.

   Power supply and communication separated galvanically.

5. Relay control systems.
6. ENABLE signal buffer.

   This buffer switches on the generator.

7. SPRAY_EN signal buffer.

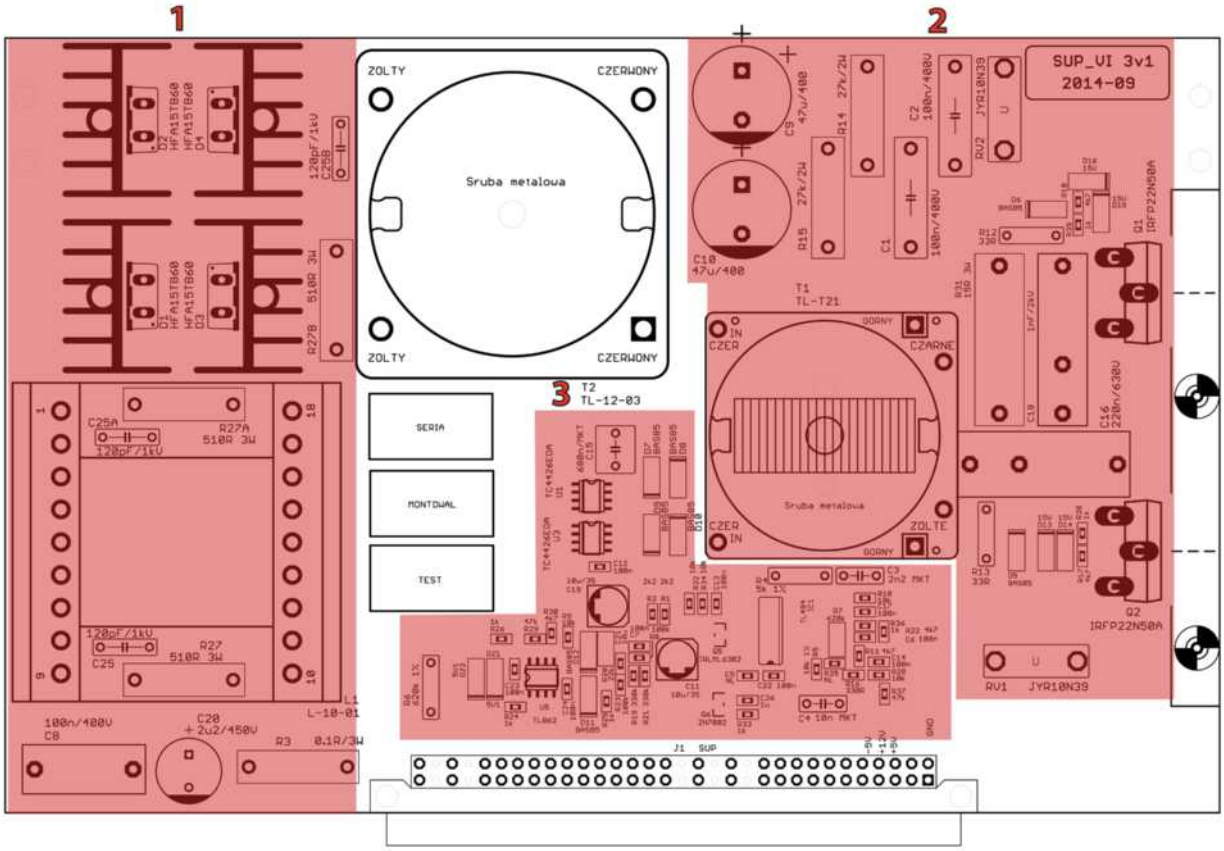
   It switches on the SPRAY generator.

8. Bipolar detection system.
9. Neutral electrode measurement system.
10. Indicator LED diodes.
11. XBFS microcontroller reset buffer.
12. Connector to the MOT_Vi2 module.
13. ISP connector for programming the microcontroller.
14. 12VAC/75kHz generator.
    It supplies modules which require galvanic insulation, e.g. OUT_S350.
15. The system which switches on signals for REM and BIPOLAR.
16. OUT_S350 module connector.
17. The system of the generator of 666kHz and HF-MOD signals.

    They serve to control the generator.

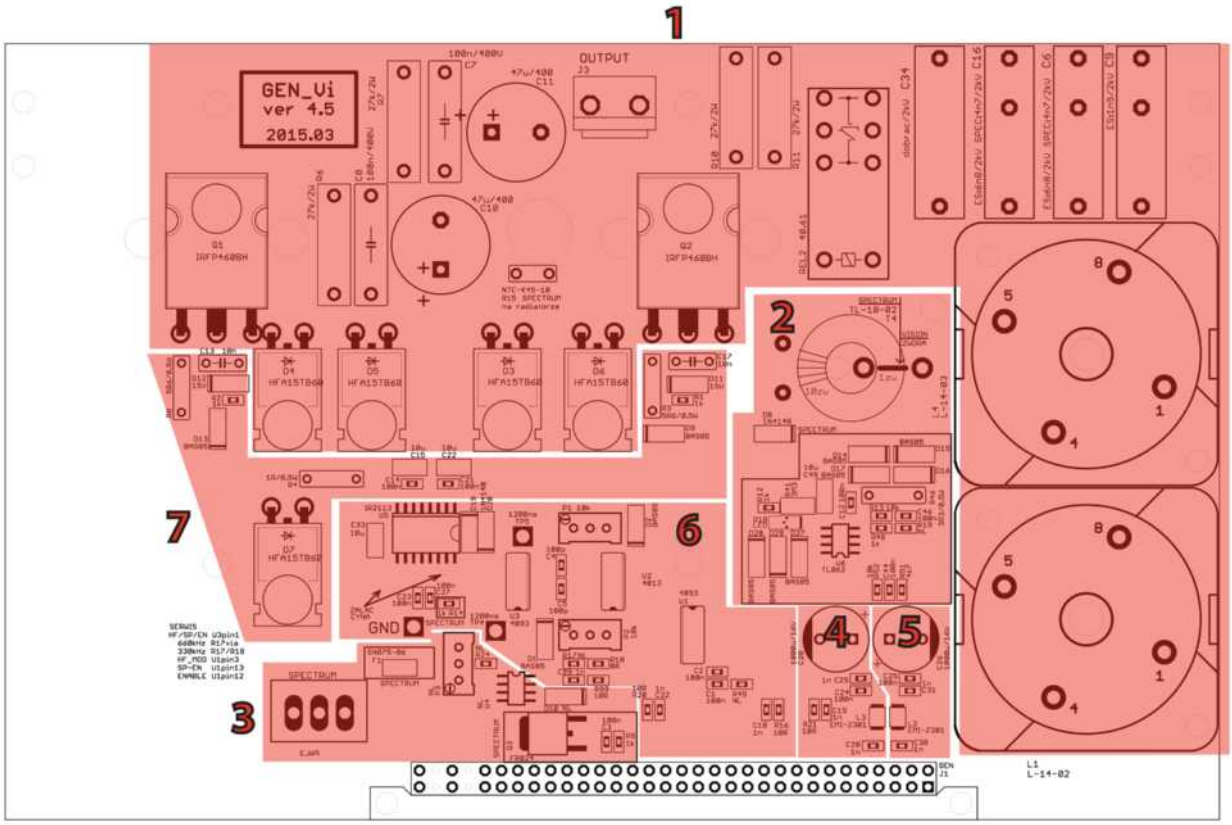
18. ADC filters.
19. Quartz
20. Watchdog.
21. Button filters.
22. Microcontroller.
23. Filters at the MOTVi2 connector.

4.4.3 SUP_VI module – SP-1-04-02



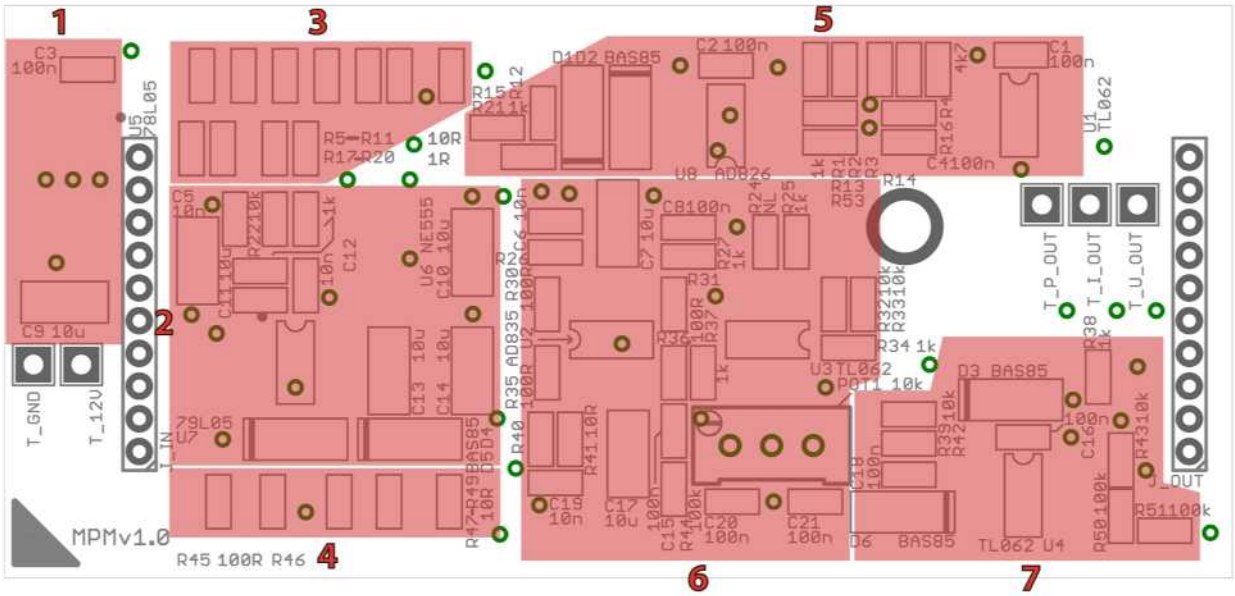
1. Output circuit
2. The power supply circuit separated with the transformer T2, with a rectifier and an output voltage filter.
3. Power circuit
   The system transforms the rectified mains voltage into regulated HV voltage of the unit by keying the transistors Q1 and Q2. The transistors are controlled by the transformer T1.
4. Control system
5. A logic which serves to control power transistors so that the voltage output is consistent with the preset UREQ voltage.

4.4.4 GEN_VI module – SP-1-05-04



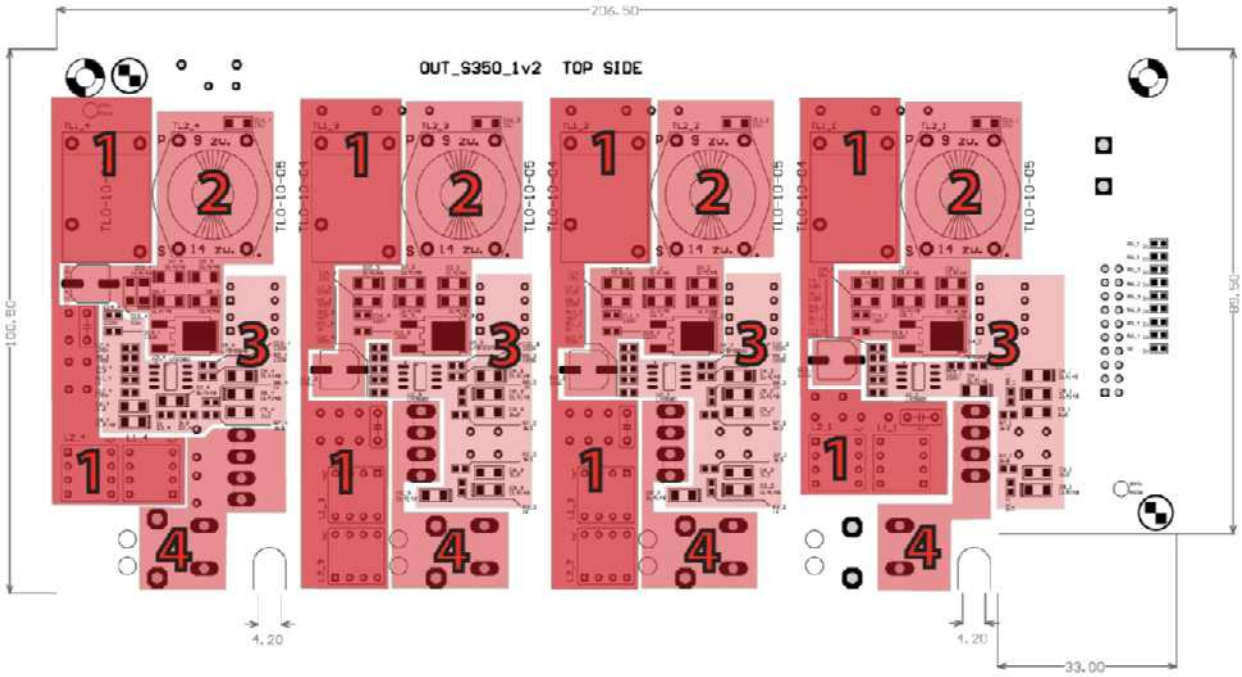
1. Output system
   The system which generates sinusoidal alternating voltage at a frequency of 333kHz, from HV voltage supplied by the SUP_Vi module. The output is generated by the alternating keying of the transistors Q1 and Q2 and using the 333kHz resonance filter connected to their output.
2. Maximum current measurement system
   In the es350 unit it is solderless.
3. Fan control system
   In the es350 unit it is solderless.
4. +12V
   An LC filter damping the interference on the +12V power supply line which comes from the J1 connector.
5. +5V
   An LC filter damping the interference on the +5V power supply line which comes from the J1 connector.
6. Driver control
   The logic which serves to control the driver of power transistors. The potentiometers P1 and P2 serve to set the lag time between the switching-off of one of the transistors and the switching-on of the other.
7. Control of transistors
   The system which serves to directly control the power transistors Q1 and Q2.

4.4.5 MPM module – SP-1-10-01



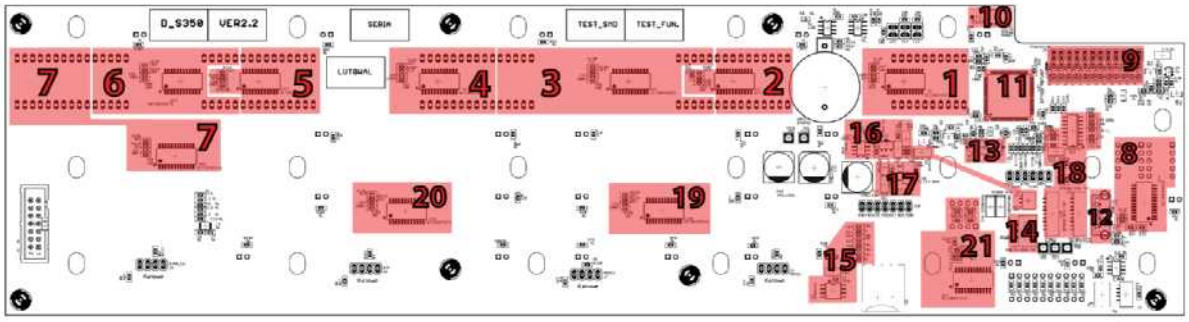
1. A +5V regulator
   The system generates +5V regulated voltage which is used to supply the systems U3 and U8. It takes energy from +12V voltage supplied from the outside by the power strip J_IN.
2. A -5V regulator
   The system generates -5V voltage which is used to supply all the operational power supplies (U1, U3, U4, U8) and the multiplier system (U2) on the PCB board. The system U6 is solderless.
3. Current measurement resistors
   The system of resistors on which a voltage drop is measured, making it possible to measure the output current of the unit.
4. Voltage measurement resistors
   The resistors form a voltage divider where the voltage is proportional to the output voltage of the unit.
5. Output current measurements
   The system measures the output current of the unit using measurement resistors (Item 3) and its construction is based on operational power supplies.
6. Power output measurement
   It serves to measure the power output of the unit as the product of current and voltage.
7. Peak output voltage measurement
   It serves to measure the peak output voltage of the unit.

4.4.6 OUT_S350 module – SP-1-08-05



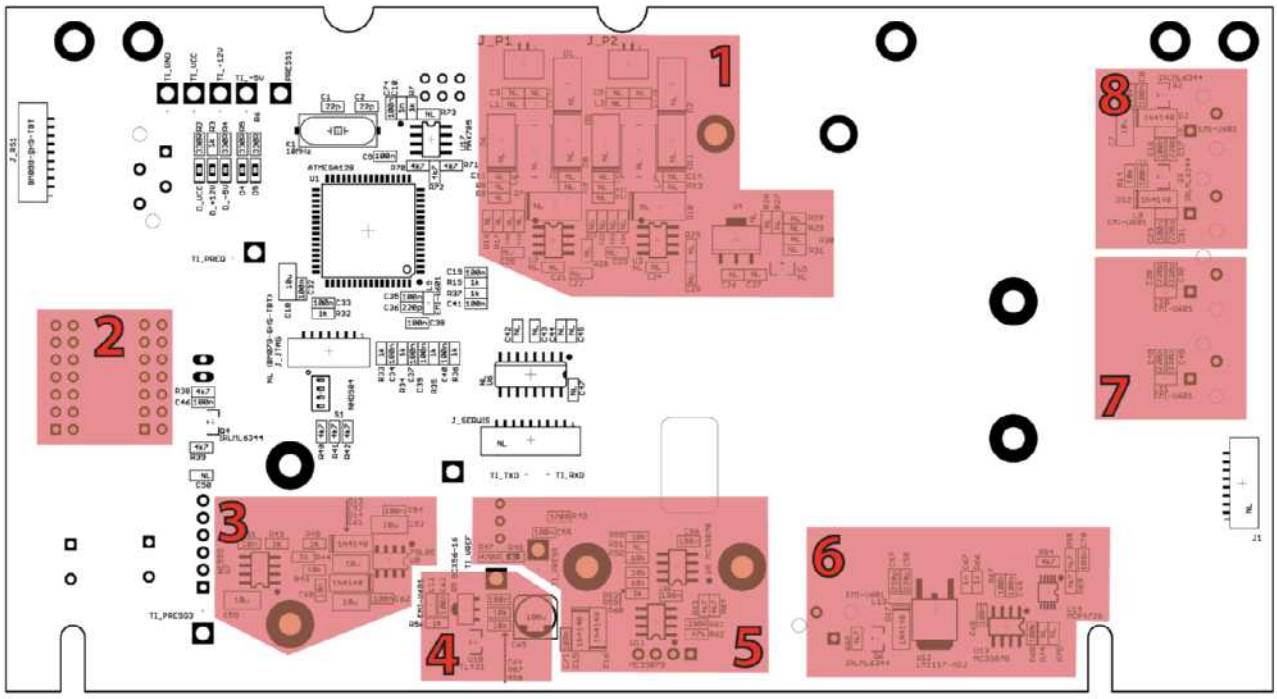
1. BIPOLAR system.
2. Power supply system.
   It generates 5V/75kHz power supply.
3. The system for detecting the buttons on the handle.
4. Output connectors.
   To connect OUT sockets.

4.4.7 D_S350 module – SP-1-01-09



1. Display controller.
2. Display controller.
3. Display controller.
4. Display controller.
5. Display controller.
6. Display controller.
7. Display controller.
8. Display controller.
9. Connector and filters of the upper keyboard.
10. Programming controller (SWD).
11. Microcontroller.
12. USB connector.
13. Microcontroller quartz.
14. Power supply connector.
15. FLASH memory.
    It stores all the settings of the unit.
16. AUDIO circuit.
17. 3.3V voltage source.
    It supplies the microcontroller and most of integrated circuits.
18. Connectors to the CPU2, service connectors and Max3232.

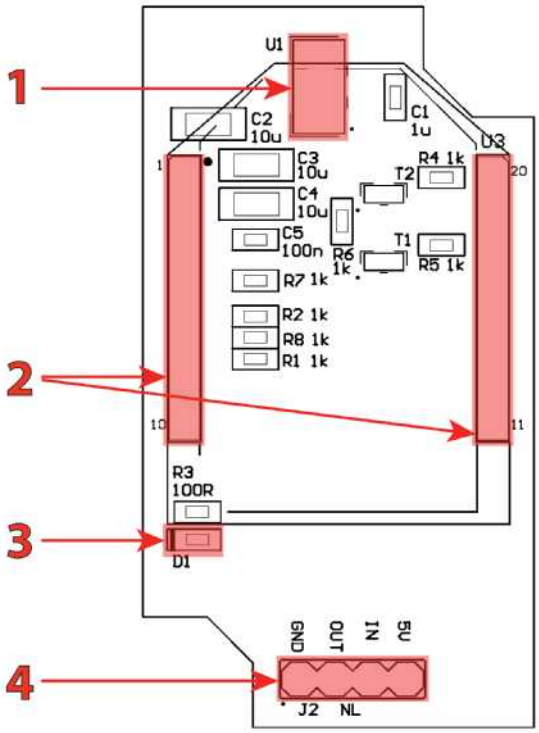
4.4.8 ARG module – SP-1-06-02



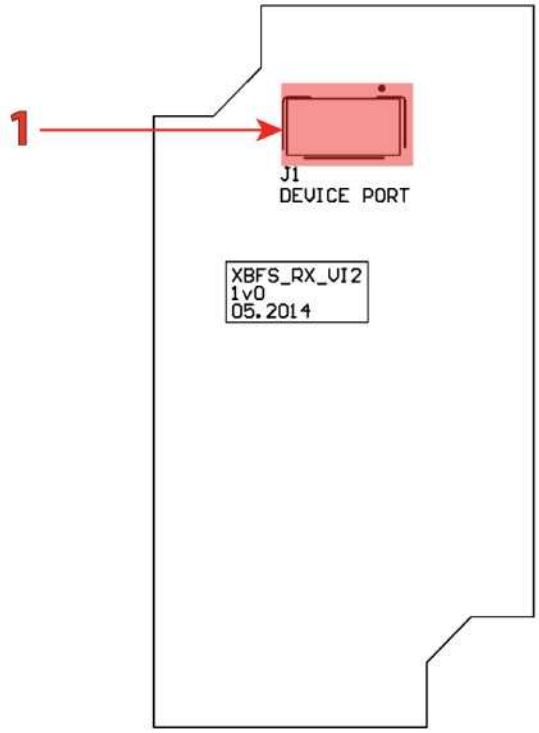
1. The system which operates pressure sensors in bottles
   It reads out pressure levels from 4-20mA current sensors at argon bottle regulators.
2. Connectors to DISPLAY and CPU_CTR/CPU2
3. -5V power supply
   It supplies -5V voltage to systems which measure the flow and operate pressure sensors in bottles (1 and 5).
4. Reference voltage system for the flow measurement system
   It supplies +5V reference voltage for the sensor used to measure the flow in the system (5) and for the microprocessor as the reference source for the ADC converter.
5. Flow measurement system
   It consists of a differential pressure sensor and a system of amplifiers for conditioning a signal from this sensor for the purposes of the flow adjustment system (6). The sensor measures the pressure difference between the ends of a regulated reducer serving to calibrate the system.
6. Flow adjustment system
   It is responsible for regulating the argon flow. It consists of an error amplifier which compares a signal from the DAC and a signal from the system and the control which controls the proportional valve.
7. Connectors of sensors for the presence of a bottle
8. Connectors of argon flow valves

4.4.9 XBFS_RX_VI2 module – SP-1-07-01

An optional module, which is not required to ensure that the equipment operates correctly. It enables communication with a wireless footswitch.



1. A +3.3 V regulator
   It supplies the system U3, with energy taken from +5V voltage.
2. The connectors to which the system U3 is connected (XBee Pro from Digi International).
3. The LED diode D1 indicates +3.3V voltage.
4. The connector J2 serves as a quadruple test point for checking: +5V voltage, the USART_Rx and USART_Tx lines and the board mass.



1. The connector for communication with the CPU

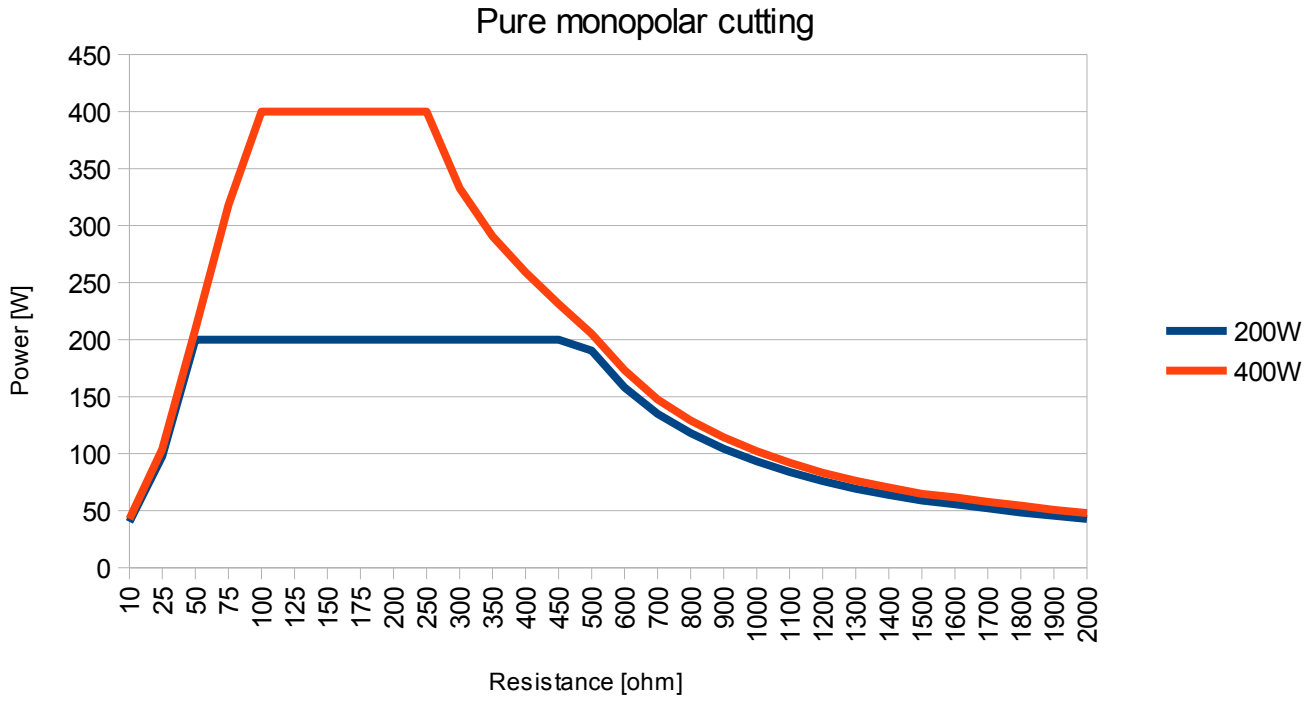
5 TECHNICAL SPECIFICATIONS

PARAMETER DESCRIPTION	ES350 ARGON ThermoStapler®	ES350 ARGON	ES350
POWER SUPPLY:			
Power supply voltage	220-240 [V] +/- 10% 50/60 [Hz] or optional 110-120 [V] +/- 10% 50/60 [Hz]		
Nominal power consumption	1080 [VA]		
SAFETY CONDITIONS:			
Electric shock protection:	Class: I, Type: CF		
Degree of protection	IP2X		
Low-frequency leakage currents	in compliance with EN 60601-1		
High-frequency leakage currents	in compliance with EN 60601-2-2		
Generator operating frequency	333 [kHz]		
Defibrillation impulse resistance	in compliance with EN 60601-1		
NEUTRAL ELECTRODE MONITORING SYSTEM (NEM):			
Optical signalling	8 levels		
Required resistance (at least one green segment on)	<240 [Ω]		
MONOPOLAR CUTTING	**ES350 ARGON ThermoStapler®**	**ES350 ARGON**	**ES350**
Pure monopolar cutting (200 [Ω])	400 [W]	400 [W]	400 [W]
Monopolar cutting blend I (200 [Ω])	180 [W]	180 [W]	180 [W]
Monopolar cutting blend II (200 [Ω])	150 [W]	150 [W]	150 [W]
Monopolar cutting blend III (200 [Ω])	150 [W]	150 [W]	150 [W]
Monopolar urological cutting in liquid environment (200 [Ω])	400 [W]	400 [W]	400 [W]
Argon-enhanced cutting (300 [Ω])	350 [W]	350 [W]	-
Monopolar endoscopic cutting	400 [W]	400 [W]	400 [W]
MONOPOLAR COAGULATION			
Soft coagulation (50 [Ω])	180 [W]	180 [W]	180 [W]
Forced coagulation (200 [Ω])	180 [W]	180 [W]	180 [W]
Spray coagulation (1250 [Ω])	80 [W]	80 [W]	80 [W]
Hybrid coagulation (200 [Ω])	180 [W]	180 [W]	180 [W]
Argon-enhanced coagulation (1250 [Ω])	80 [W]	80 [W]	-
Argon-enhanced pulse coagulation (1250 [Ω])	80 [W]	80 [W]	-
BIPOLAR COAGULATION			
Bipolar coagulation (50 [Ω])	120 [W]	120 [W]	120 [W]
AutoStart	YES	YES	YES
AutoStop	YES	YES	YES
BIPOLAR CUTTING			
Pure bipolar cutting (200 [Ω])	150 [W]	150 [W]	150 [W]
Bipolar cutting blend (I,II,III) (200 [Ω])	150 [W]	150 [W]	150 [W]
Bipolar urological cutting (50 [Ω])	400 [W]	400 [W]	400 [W]

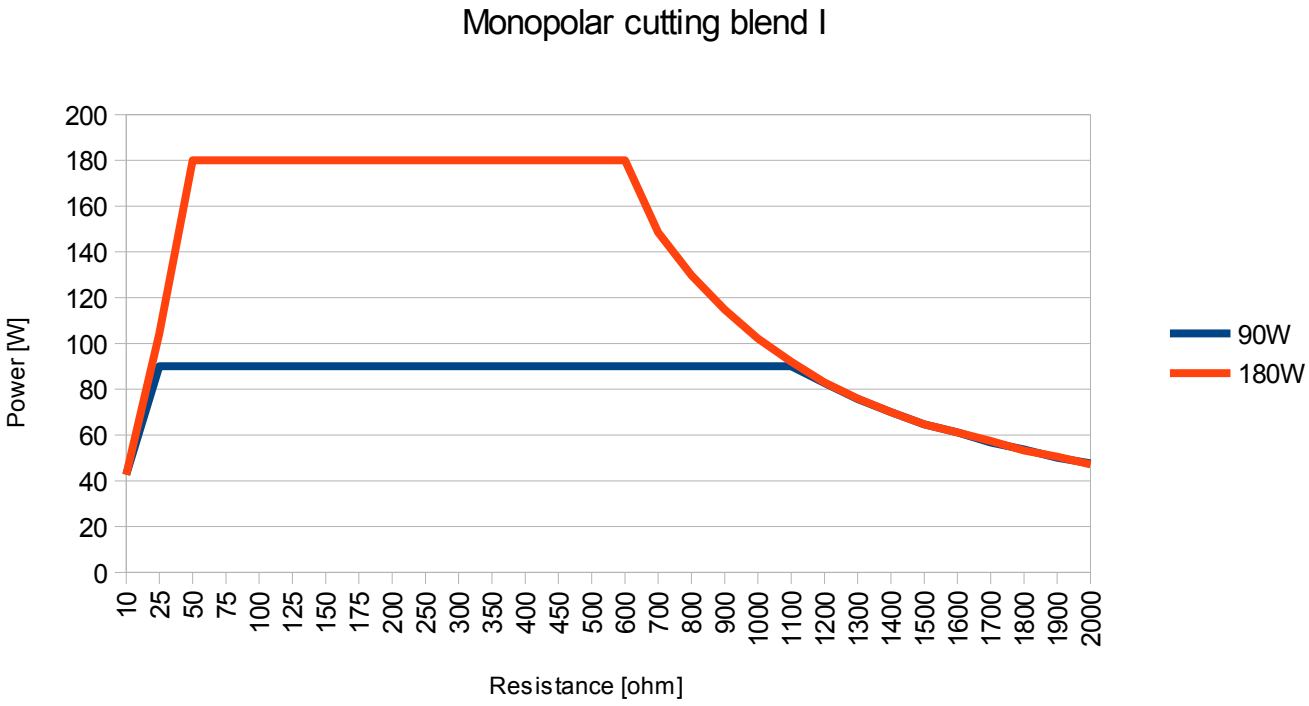
VESSEL SEALING SYSTEM			
ThermoStapler® (50 [Ω])	300 [W]	-	-
Argon – type	Pure argon 4.8 (99,998%) or higher		-
Input gas pressure	0.25-0.4 [MPa]		-
Gas outflow	0,1-9,9 [l/min]		-
Adjustment	in 0.1 [l/min] increments		-
Pressure measurement	Reducer with manometer (0.4 [MPa]) on argon cylinder		-
OTHER:	**ES350 ARGON ThermoStapler®**	**ES350 ARGON**	**ES350**
Programmable settings		YES	
MultiSwitch – remote program change		YES	
Monopolar sockets	2	2	2
Bipolar sockets	1	1	1
ThermoStapler® socket	1	-	-
Argon socket	1	1	-
Dimensions (LWH)	420x415x180	420x415x180	420x415x180
Weight	10,3 [kg]	10,3 [kg]	9,6 [kg]
WORKING LIFE	10 years	10 years	10 years

6 OUTPUT POWER DISTRIBUTION

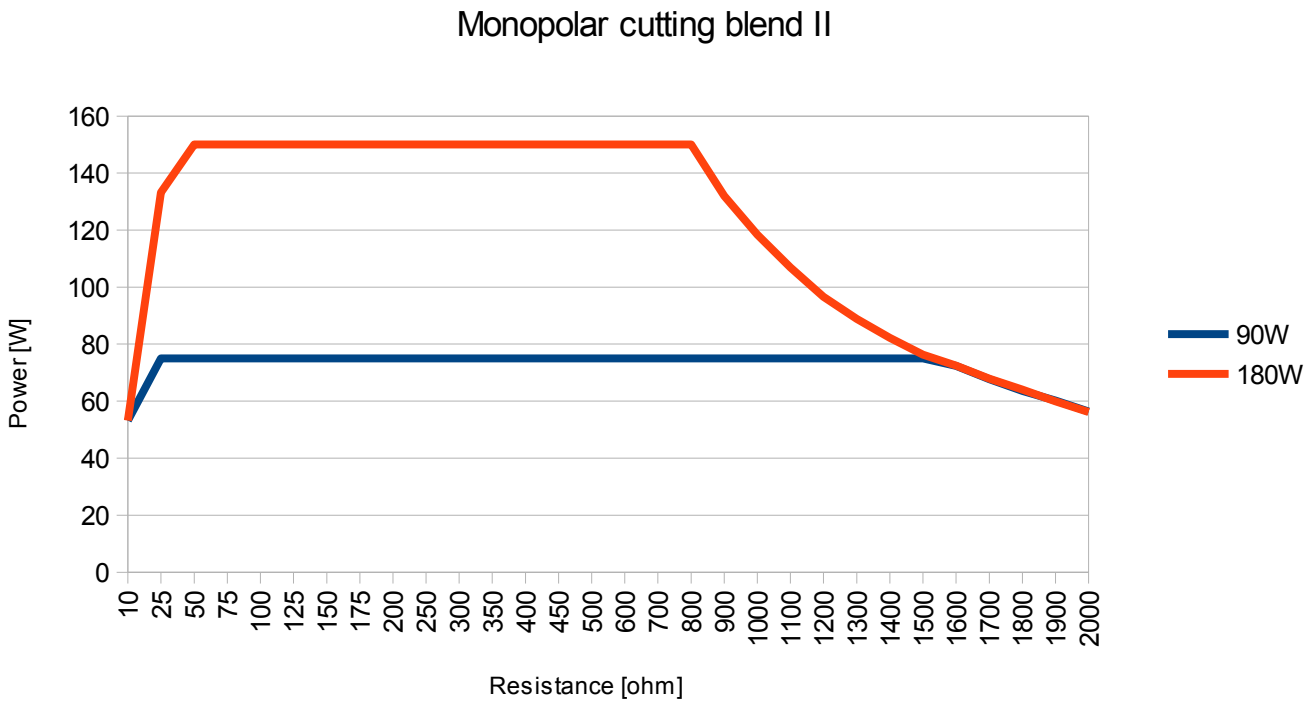
6.1 Pure monopolar cutting



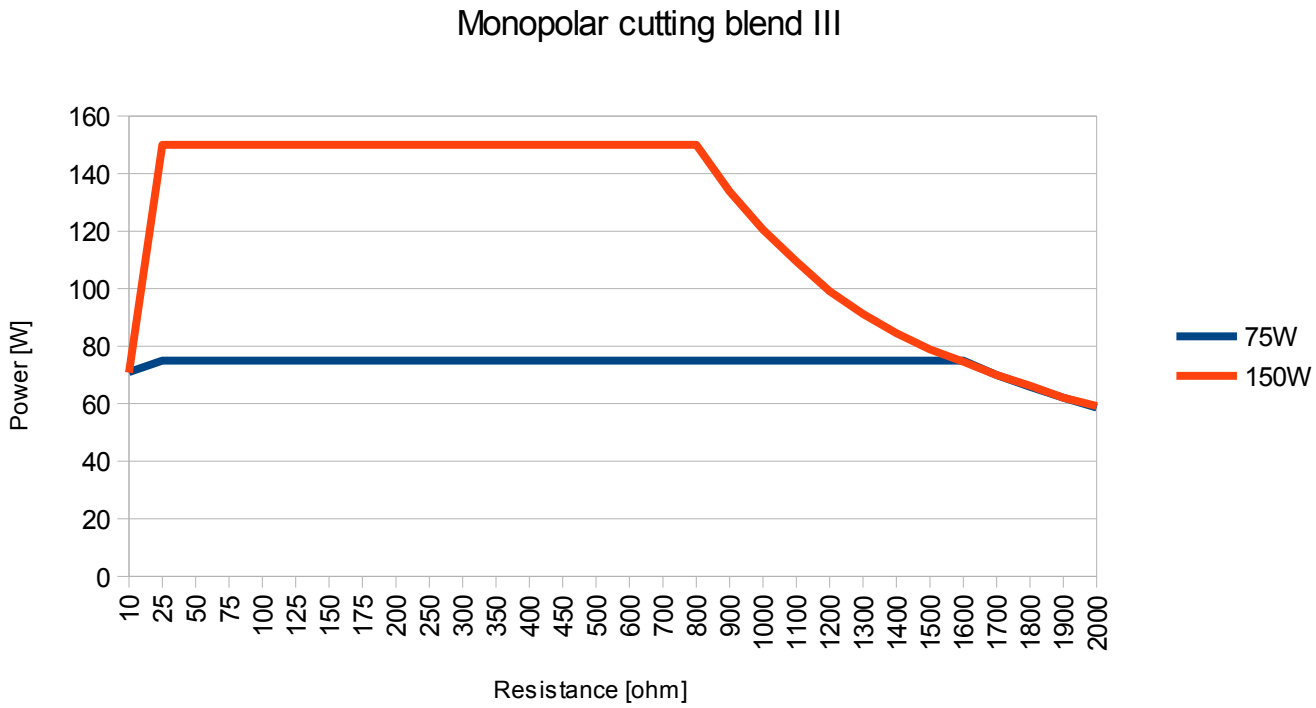
6.2 Monopolar cutting blend I



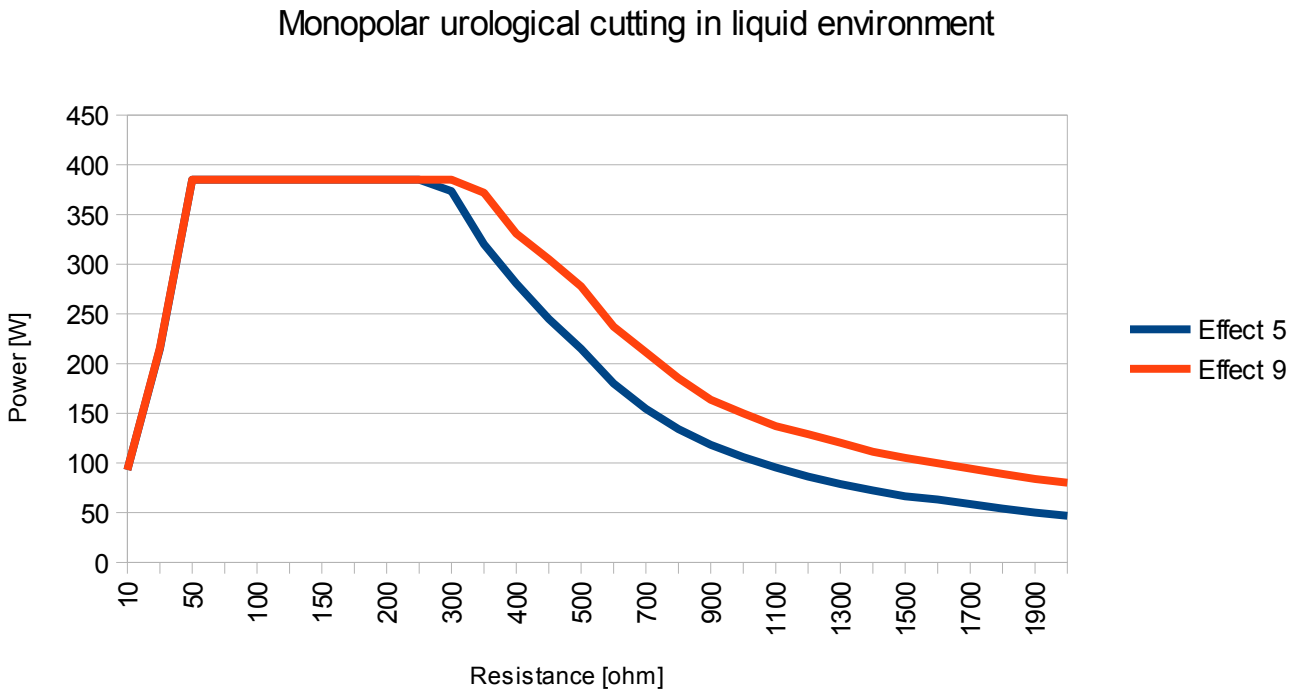
6.3 Monopolar cutting blend II



6.4 Monopolar cutting blend III

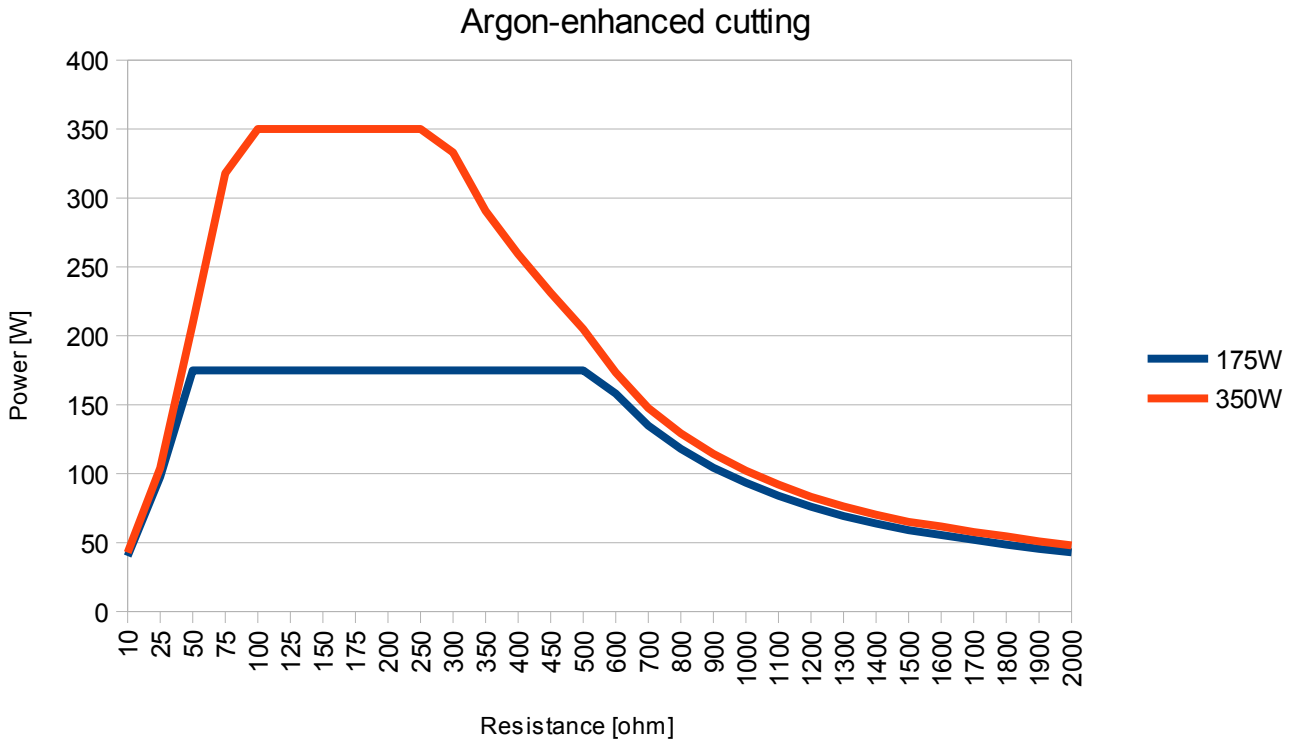


6.5 Monopolar urological cutting in liquid environment

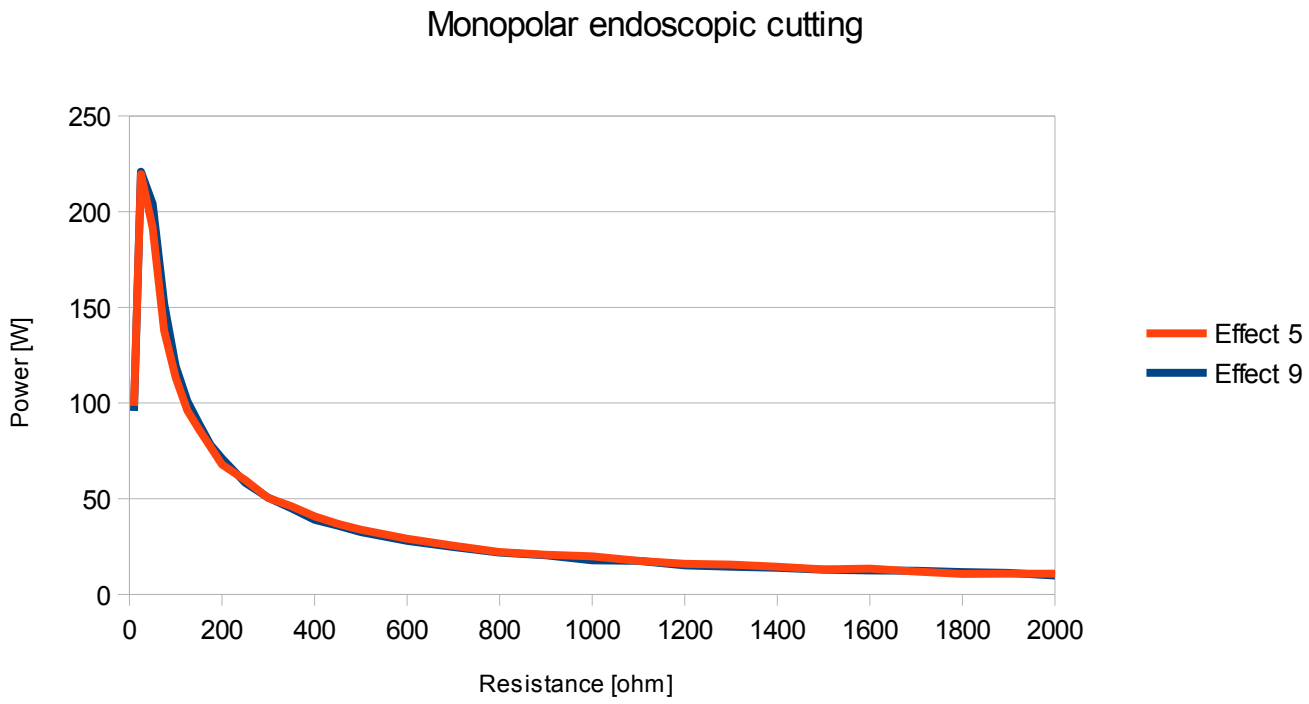


6.6 Argon-enhanced cutting

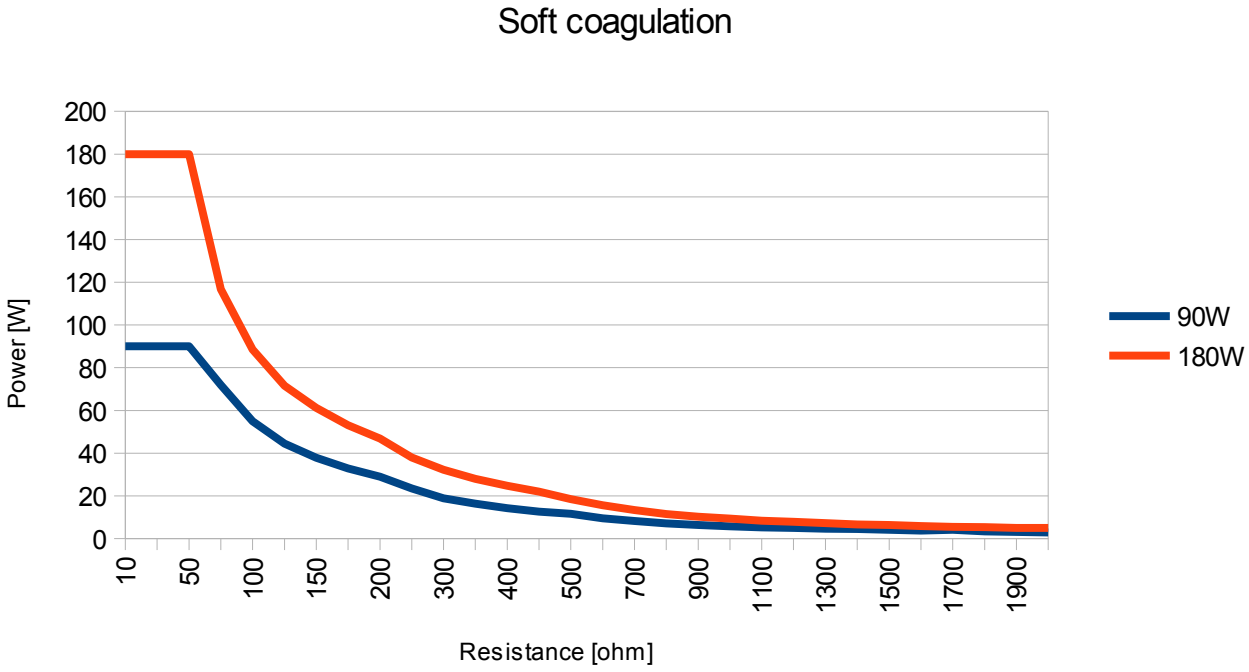
APPLIES ONLY TO Ref. Nos. 100-008 and 100-008-T



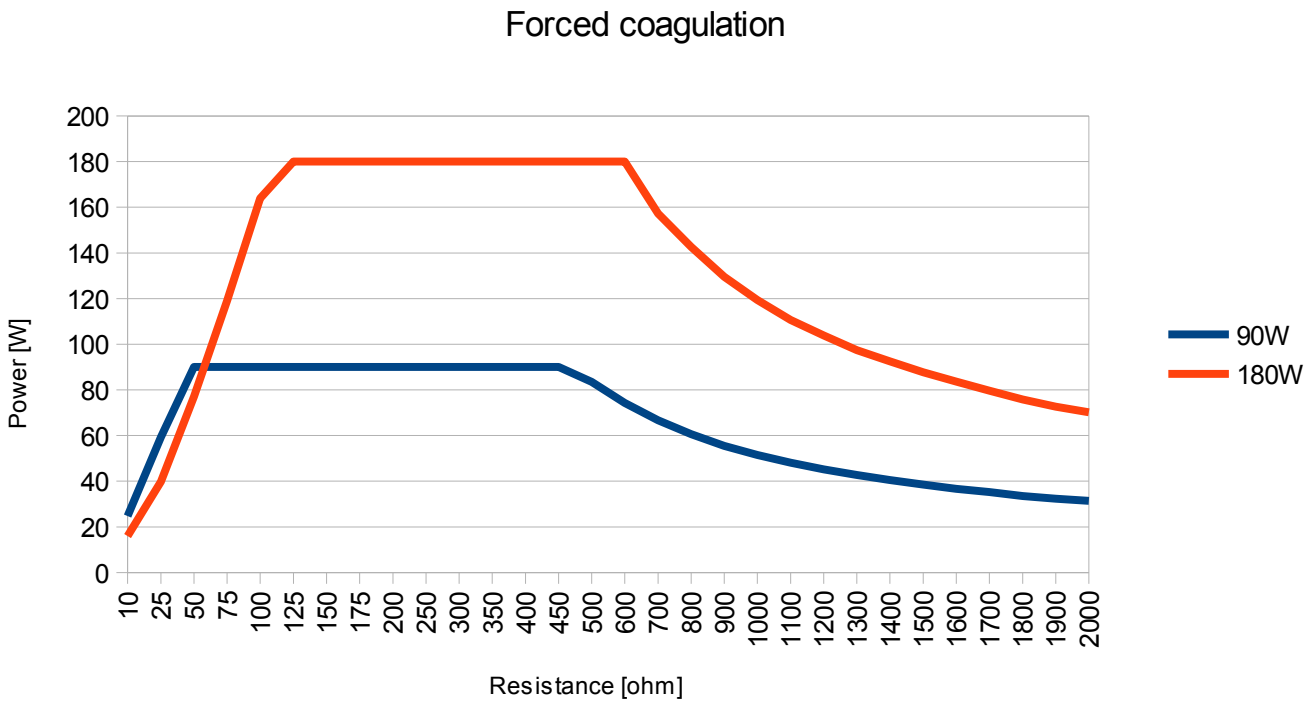
6.7 Monopolar endoscopic cutting



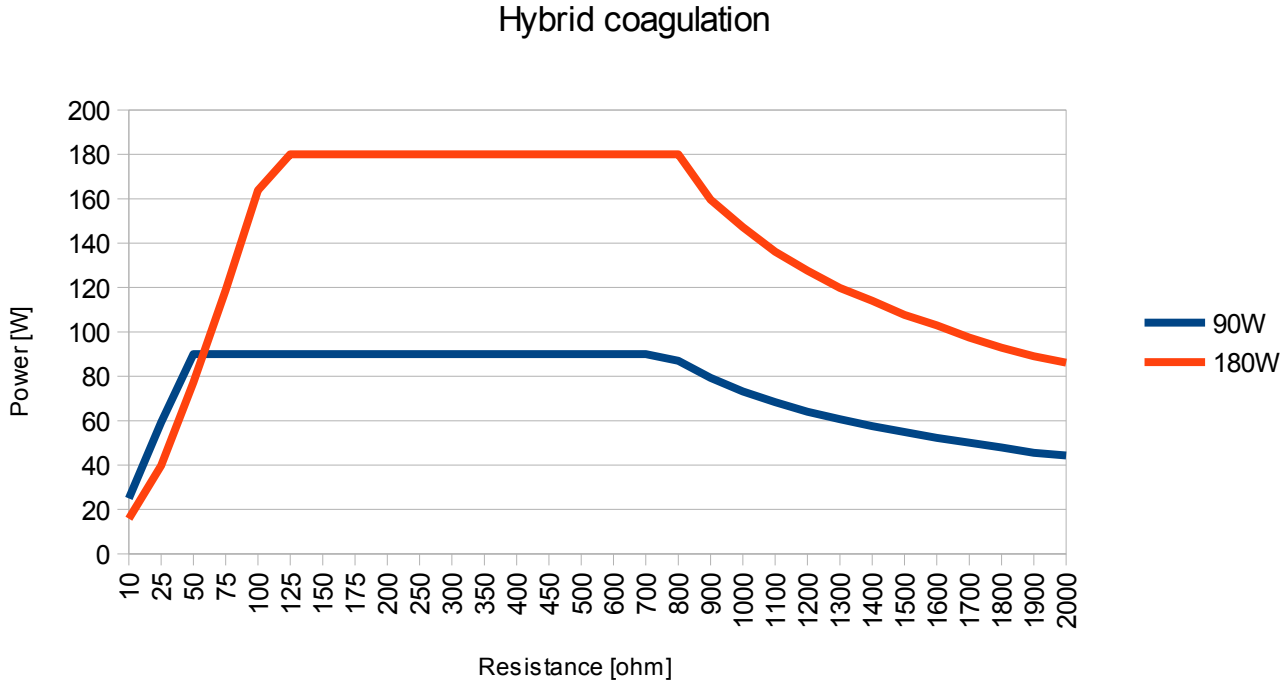
6.8 Soft coagulation



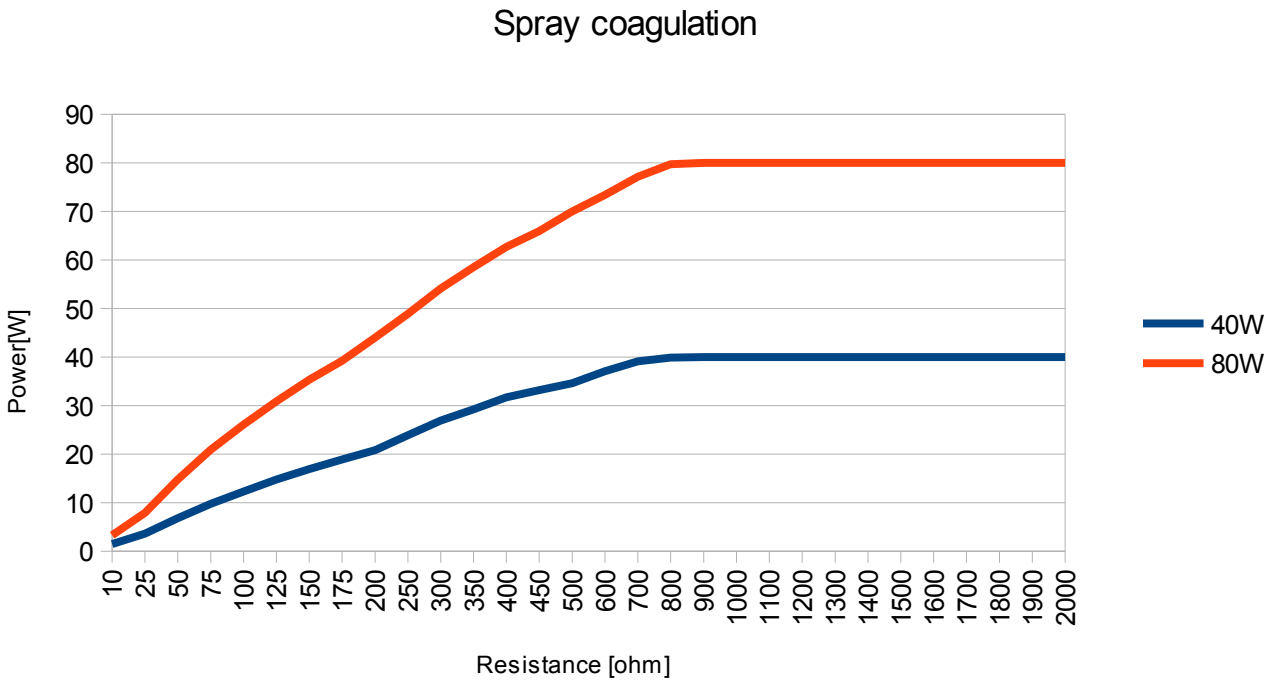
6.9 Forced coagulation



6.10 Hybrid coagulation

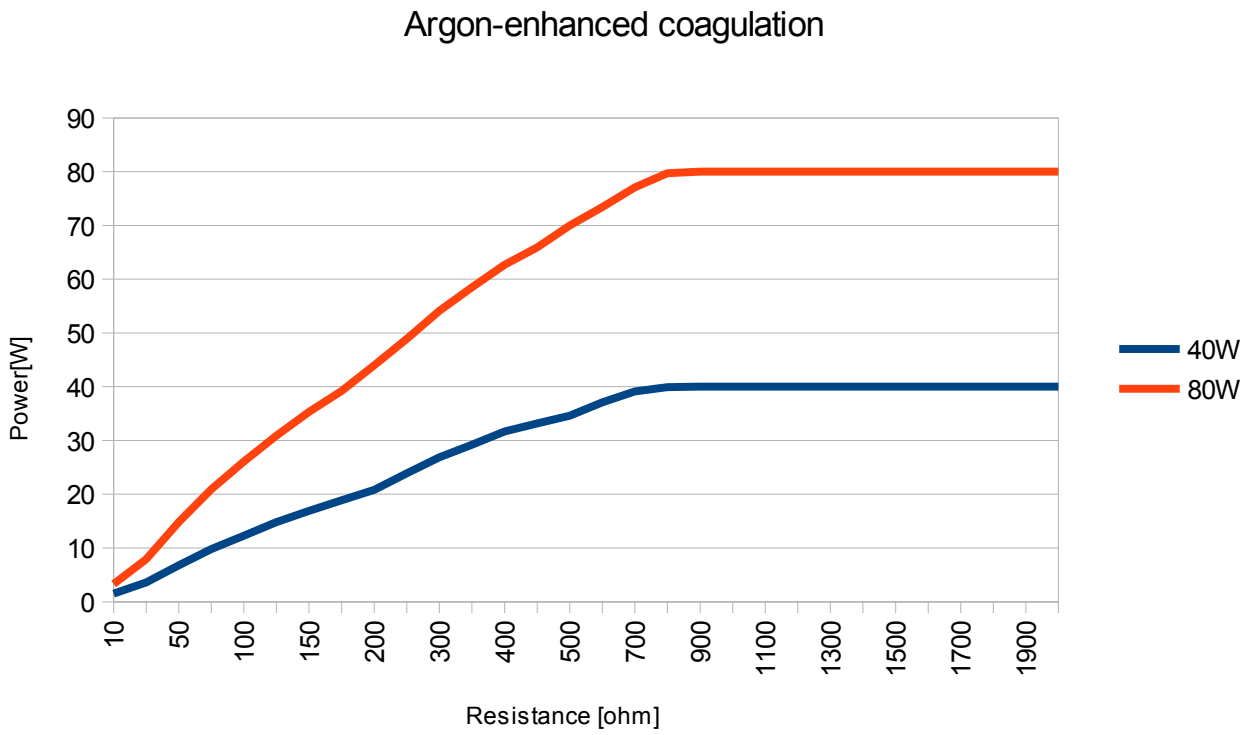


6.11 Spray coagulation



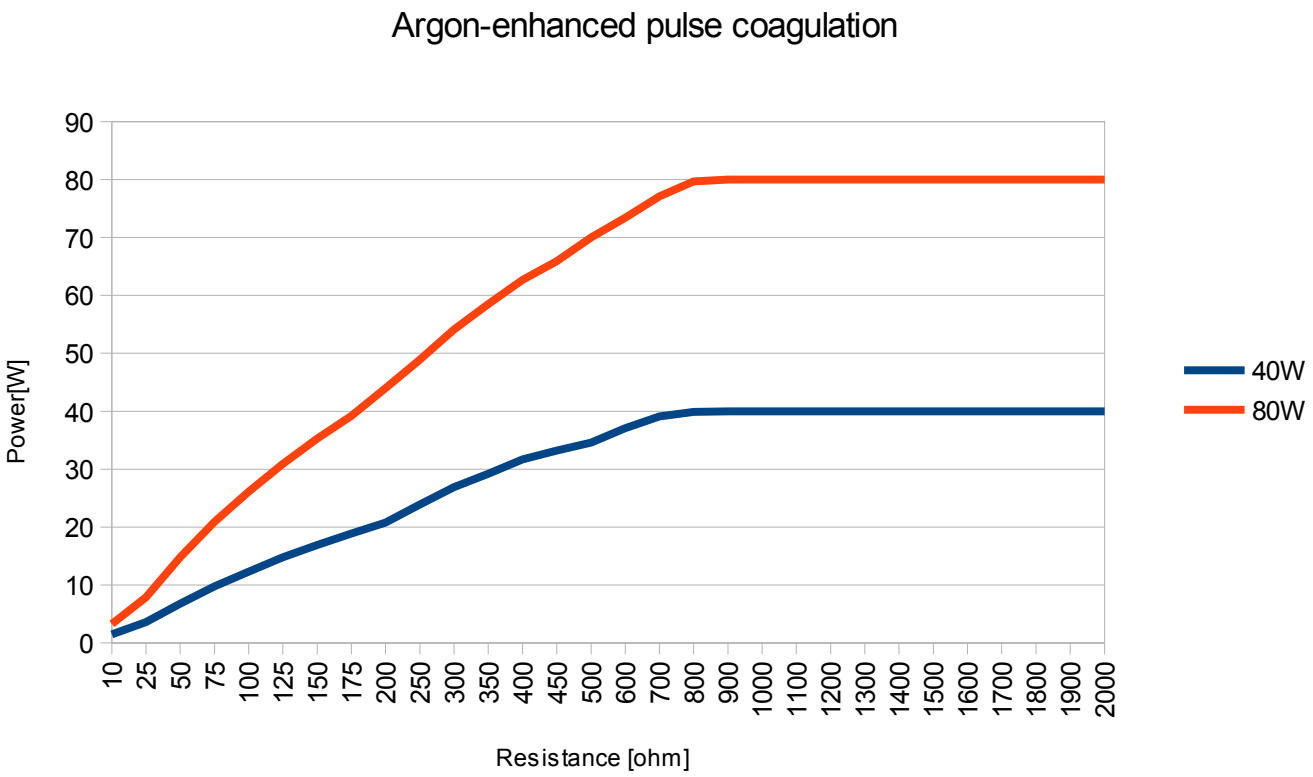
6.12 Argon-enhanced coagulation

APPLIES ONLY TO Ref. Nos. 100-008 and 100-008-T

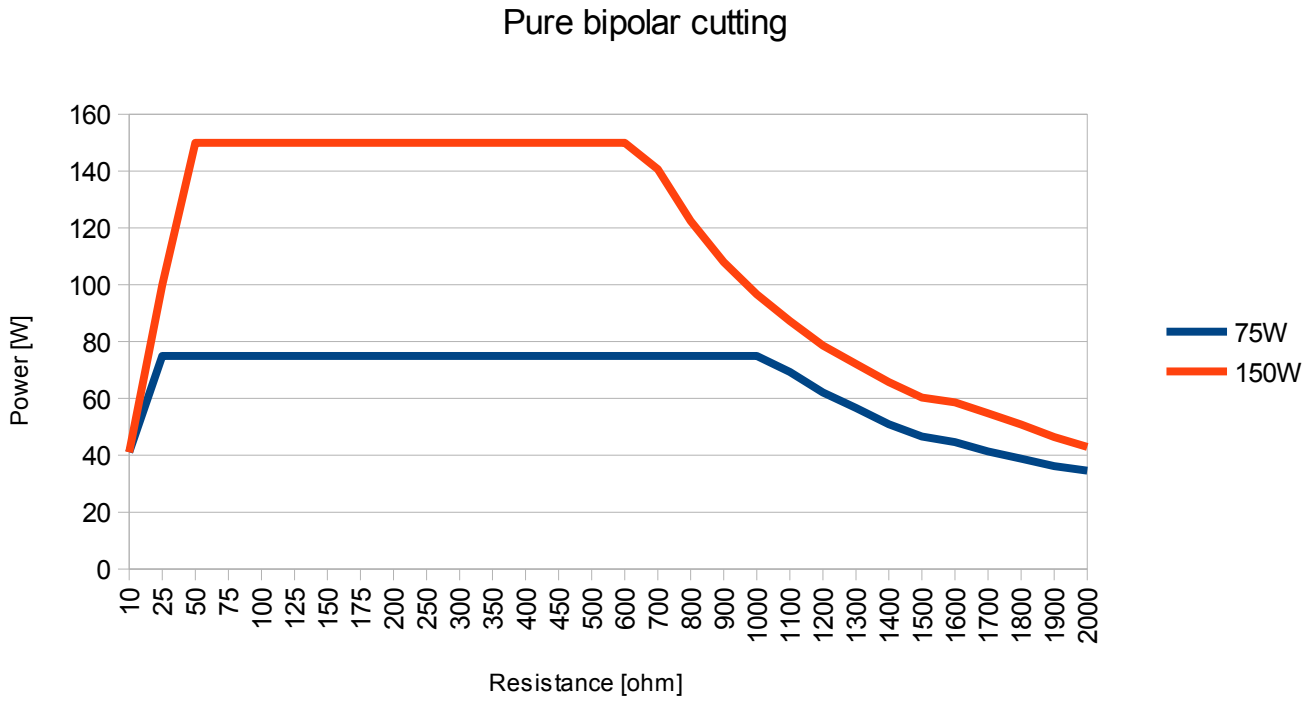


6.13 Argon-enhanced pulse coagulation

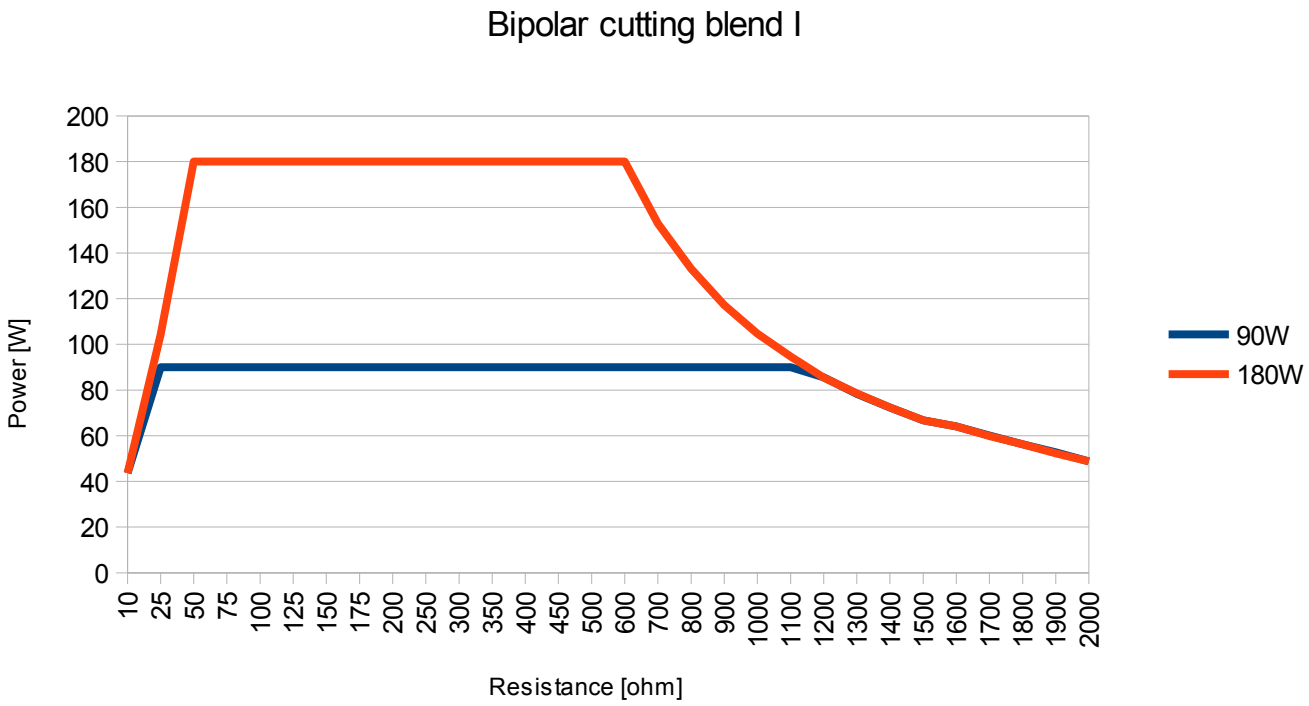
APPLIES ONLY TO Ref. Nos. 100-008 and 100-008-T



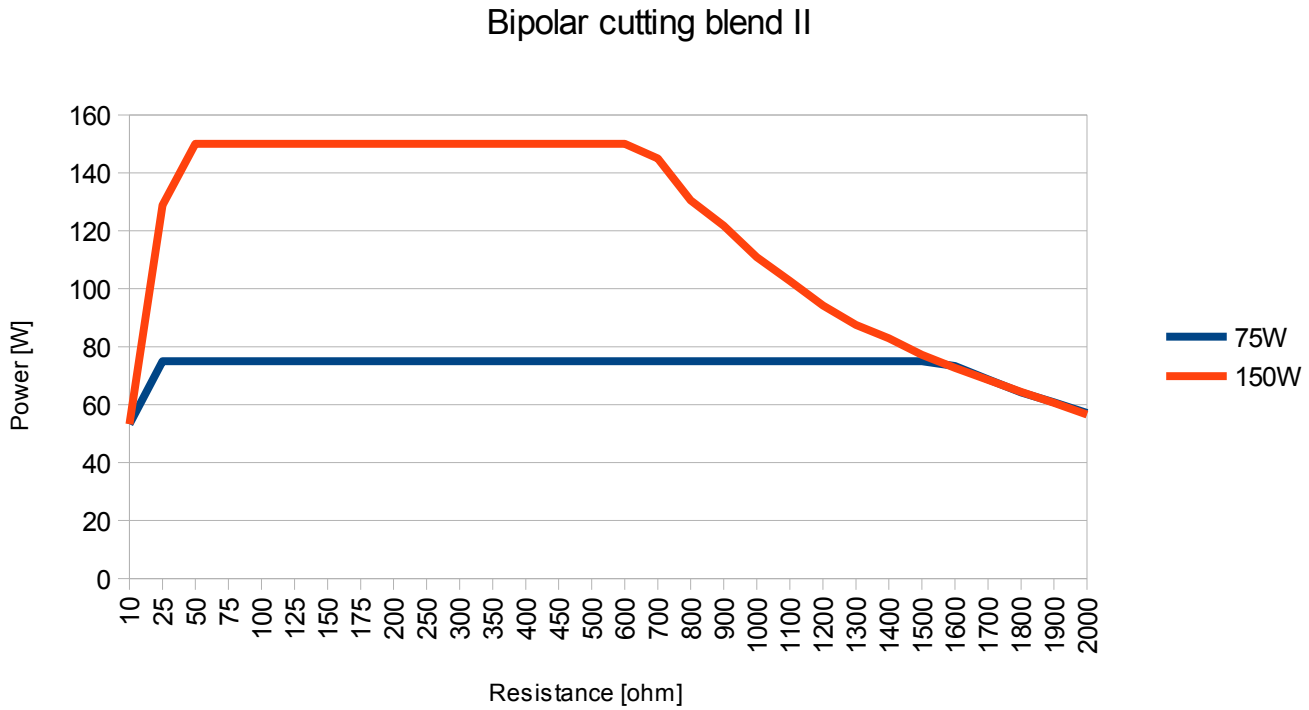
6.14 Pure bipolar cutting



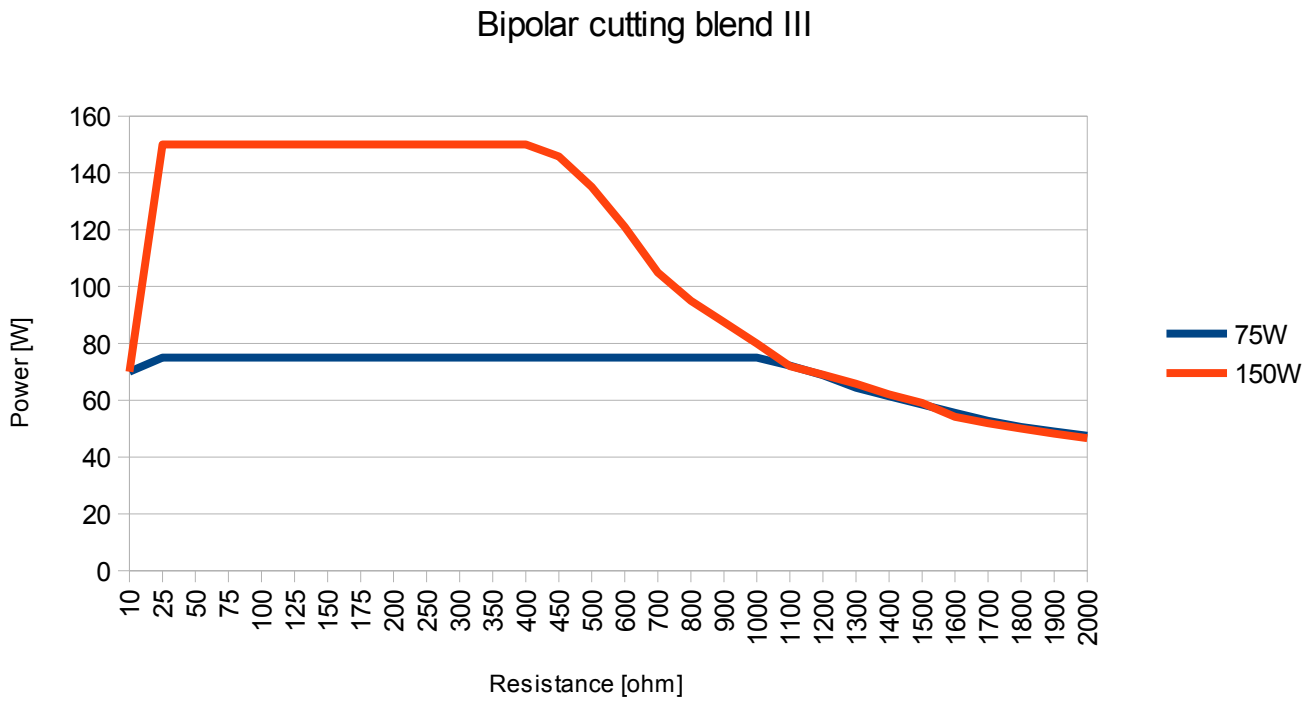
6.15 Bipolar cutting blend I



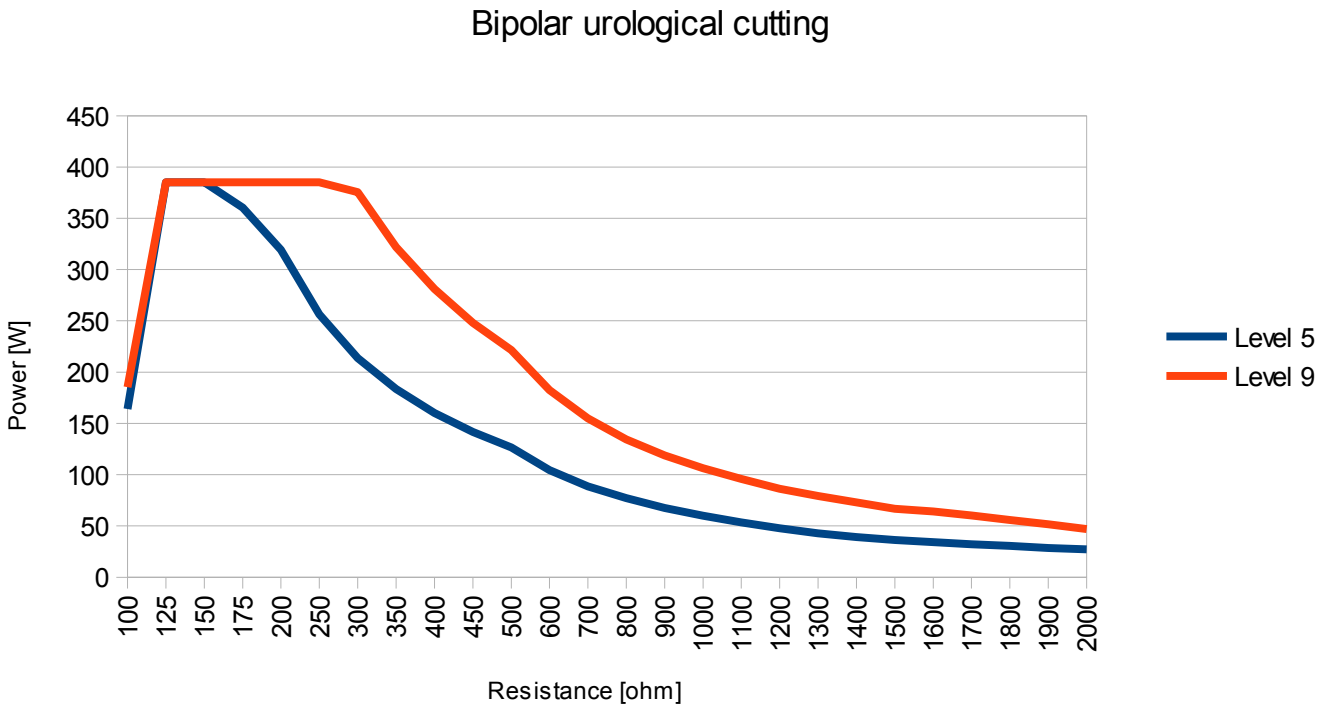
6.16 Bipolar cutting blend II



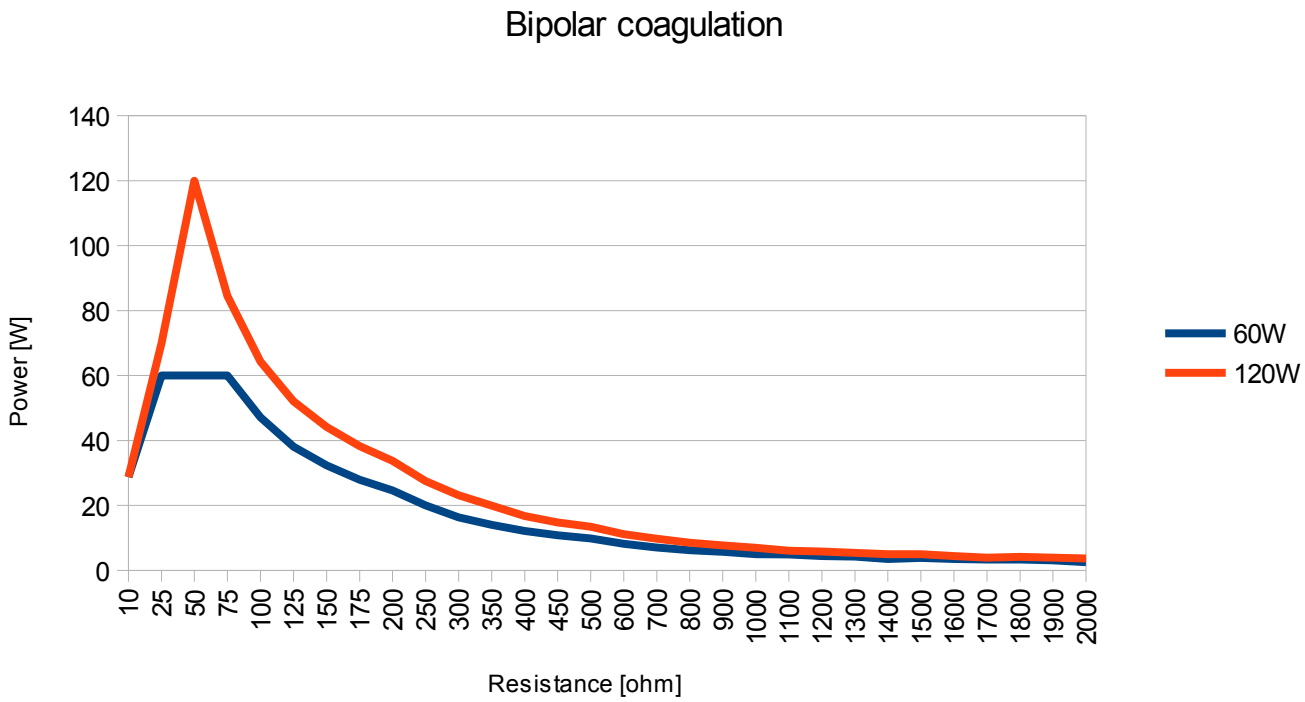
6.17 Bipolar cutting blend III



6.18 Bipolar urological cutting



6.19 Bipolar coagulation



7 OPEN CIRCUIT MAXIMUM VOLTAGES

7.1 Maximum voltage on monopolar output

Operating mode	Maximum power setting	Maximum voltage (V_p)	Frequency	Load impedance (Ω)
Pure monopolar cutting	400W	510	333kHz	200Ω
Monopolar cutting blend I	180	510	333kHz	200Ω
Monopolar cutting blend II	150	610	333kHz	200Ω
Monopolar cutting blend III	150	710	333kHz	200Ω
Monopolar urological cutting in liquid environment	Level 9	620	333kHz	200Ω
Argon-enhanced cutting	350	460	333kHz	300Ω
Monopolar endoscopic cutting	Level 9	588	333kHz	-
Soft coagulation	180	140	333kHz	50Ω
Forced coagulation	180	-	333kHz	200Ω
Spray coagulation	80	-	1MHz	1250Ω
Hybrid coagulation	180	-	333kHz	200Ω
Argon-enhanced coagulation	80	-	1MHz	1250Ω
Argon-enhanced pulse coagulation	80	-	1MHz	1250Ω

7.2 Maximum voltage on bipolar output

Operating mode	Maximum power setting	Maximum voltage (V_p)	Frequency	Load impedance
Bipolar coagulation	120	119	333kHz	50Ω
Pure bipolar cutting	150	460	333kHz	200Ω
Bipolar cutting blend (I)	180	-	333kHz	200Ω
Bipolar cutting blend (II,III)	150	-	333kHz	200Ω
Bipolar urological cutting	400	-	333kHz	50Ω
ThermoStapler®	300	-	333kHz	50Ω

7.3 List of spare parts

	Replacement part number (XXX - is the version number of the replacement parts)	Description	Electrosurgical unit		
			ES 350	ES 350 with argon module	ES 350 with argon and ThermoStapler®
01.	SP-1-02-06-XXX	PCB module - MOT_VI2	x	x	x
02.	SP-1-03-04-XXX	PCB module - CPU2	x	x	x
03.	SP-1-04-02-XXX	PCB module - SUP_VI	x	x	x
04.	SP-1-05-04-XXX	PCB module - GEN_VI	x	x	x
05.	SP-1-06-02-XXX	PCB module - ARG		x	x
06.	SP-1-07-01-XXX	PCB module - XBFS_RX_VI2	x	x	x
07.	SP-1-08-01-XXX	PCB module - OUT_TRA	x	x	x
08.	SP-1-08-04-XXX	PCB module - OUT_CTR	x	x	x
09.	SP-1-08-05-XXX	PCB module - OUT_S350	x	x	x
10.	SP-1-10-01-XXX	PCB module - MPM	x	x	x
11.	SP-1-01-09-XXX	PCB-module - D_S350	x	x	x
12.	SP-2-01-45-XXX	Front panel for ES 350	x		
13.	SP-2-01-46-XXX	Front panel for ES 350A		x	

14.	SP-2-01-47-XXX	Front panel for ES 350AT			x
15.	SP-3-01-10-XXX	Metal casing for ES 350	x		
16.	SP-3-01-11-XXX	Metal casing for ES 350A and ES 350AT		x	x
17.	SP-4-01-03-XXX	2 wire cable, Generator HV (Connection MOT_VI2 - GEN_VI)	x	x	x
18.	SP-4-01-04-XXX	20 wire cable (Connection CPU2 - ARG)		x	x
19.	SP-4-01-06-XXX	4 wire cable (Connection XBFS - MOT_VI2)	x	x	x
20.	SP-4-01-07-XXX	20 wire cable (Connection CPU2 - OUT_S350)	x	x	x
21.	SP-4-01-08-XXX	13 wire cable (Connection D_S350 – MOT_VI2, CPU2)	x	x	x
22.	SP-4-01-40-XXX	2 wire cable with loudspeaker	x	x	x
23.	SP-4-02-04-XXX	Pneumatic cable for ES 350A and ES 350AT	x	x	x
24.	SP-5-01-10-XXX	Screw set	x	x	x
25.	SP-5-02-07-XXX	Angled mounting strip	x	x	x
26.	SP-6-01-07-110	Mains fuses for version 110V-120V	x	x	x
27.	SP-6-01-16-230	Mains fuses for version 220V-230V	x	x	x
28.	SP-6-04-03-XXX	SPRAY resistor with cable (68Ω)	x	x	x

8 DISASSEMBLING / REPLACEMENT / ASSEMBLING OF MODULES

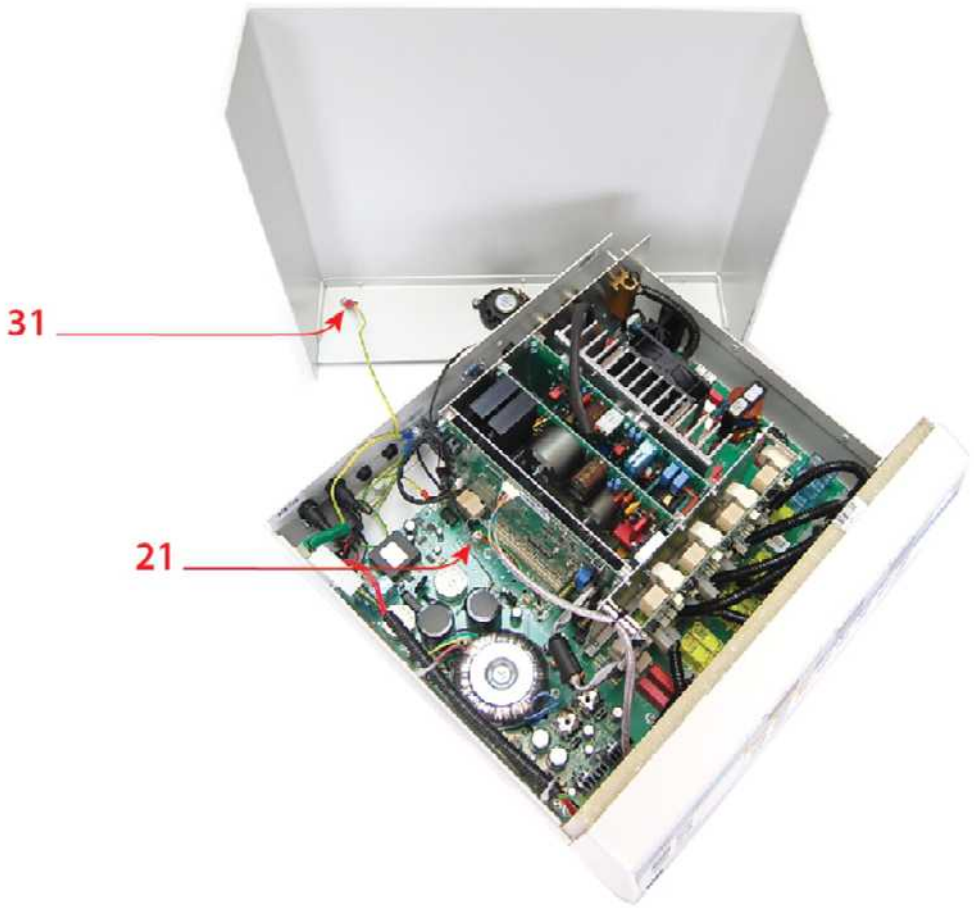
8.1 Upper casing – SP-3-01-10 / SP-3-01-11

PLEASE REFER TO THE VIDEO INCLUDED ON ATTACHED PENDRIVE „ASSEMBLY OF UNIT CASE" AND „DISASSEMBLY OF UNIT CASE"

SYMBOL	DESCRIPTION
A	M3x8

8.1.1 Required equipment

- Allen key size 2.0mm,



8.1.2 Disassembling

Unscrew the six screws situated on the side walls of the unit. Carefully lift the upper casing and disconnect the loudspeaker cable and the earthing cable.

8.1.3 Assembling

Connect the following cables (for more information, see the sections "Description of connections" and "Connection diagram"):

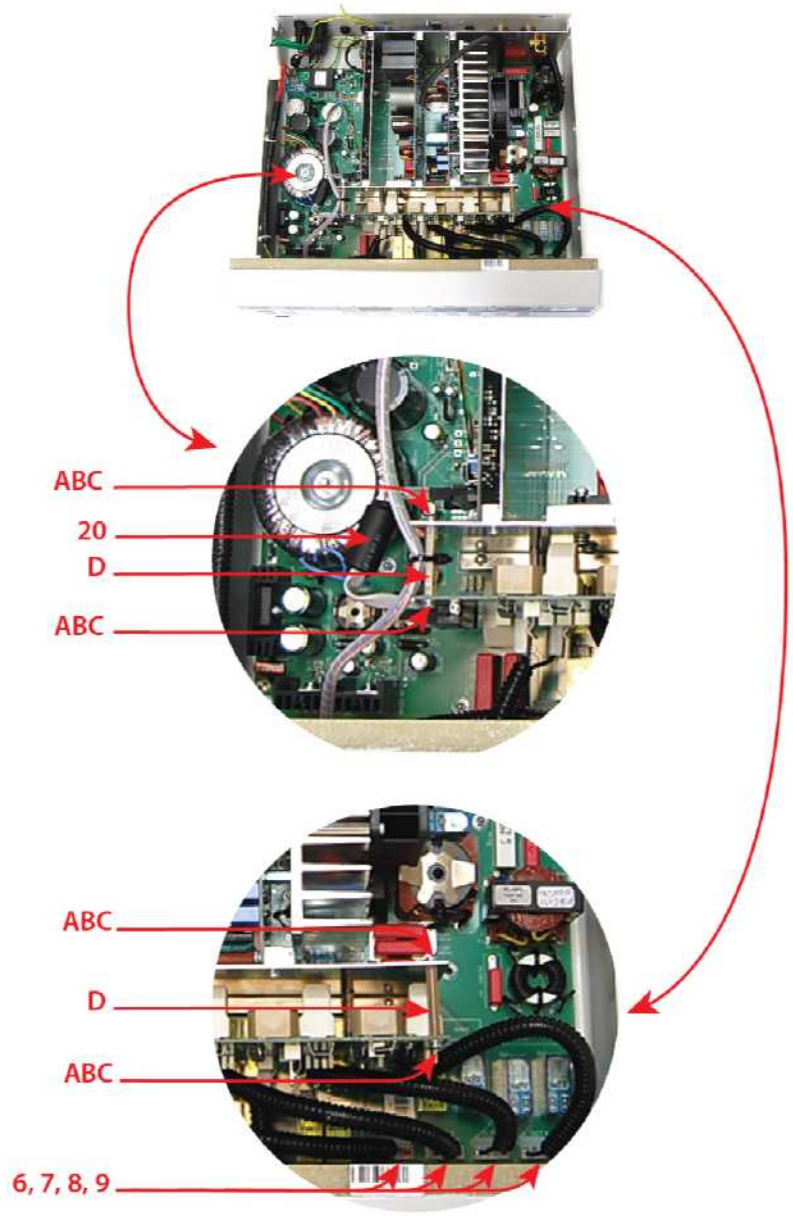
the cable earthing the upper casing,

the loudspeaker (audio signal) cable.

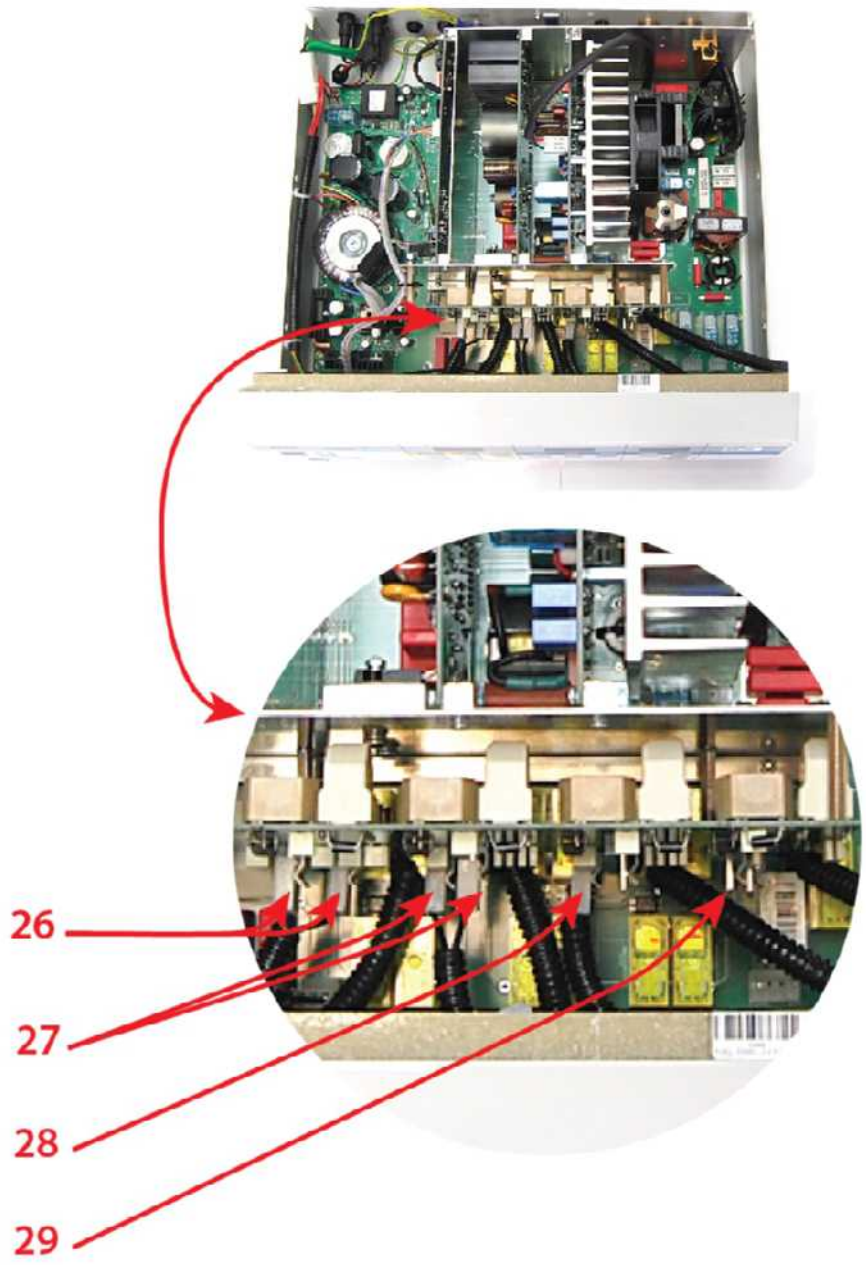
Fasten the casing to the unit using six screws.

8.2 OUT_S350 module - SP-1-08-05

PLEASE REFER TO THE VIDEO INCLUDED ON ATTACHED PENDRIVE „ASSEMBLY OF SUP_VI, GEN_VI, OUT_S350" AND „DISASSEMBLY OF OUT_S350 MODULE"



SYMBOL	DESCRIPTION
A	M3x8
B	elastic washer M3
C	flat washer M3
D	Hex standoffs with internal threads M3x30



8.2.1 Required equipment

- Screwdriver PH0,
- socket screwdriver 5,5mm,
- socket screwdriver 5mm

8.2.2 Disassembling

Disconnect four power cables and the data transfer tape (CPU2 - OUT_S350).

Unscrew two screws with elastic and flat washers.

Disconnect the cables of output sockets.

Push out the OUT_S350 module upwards.

8.2.3 Assembling

Connect the following cables (for more information, see the sections "Description of connections" and "Connection diagram"):

the power cables,

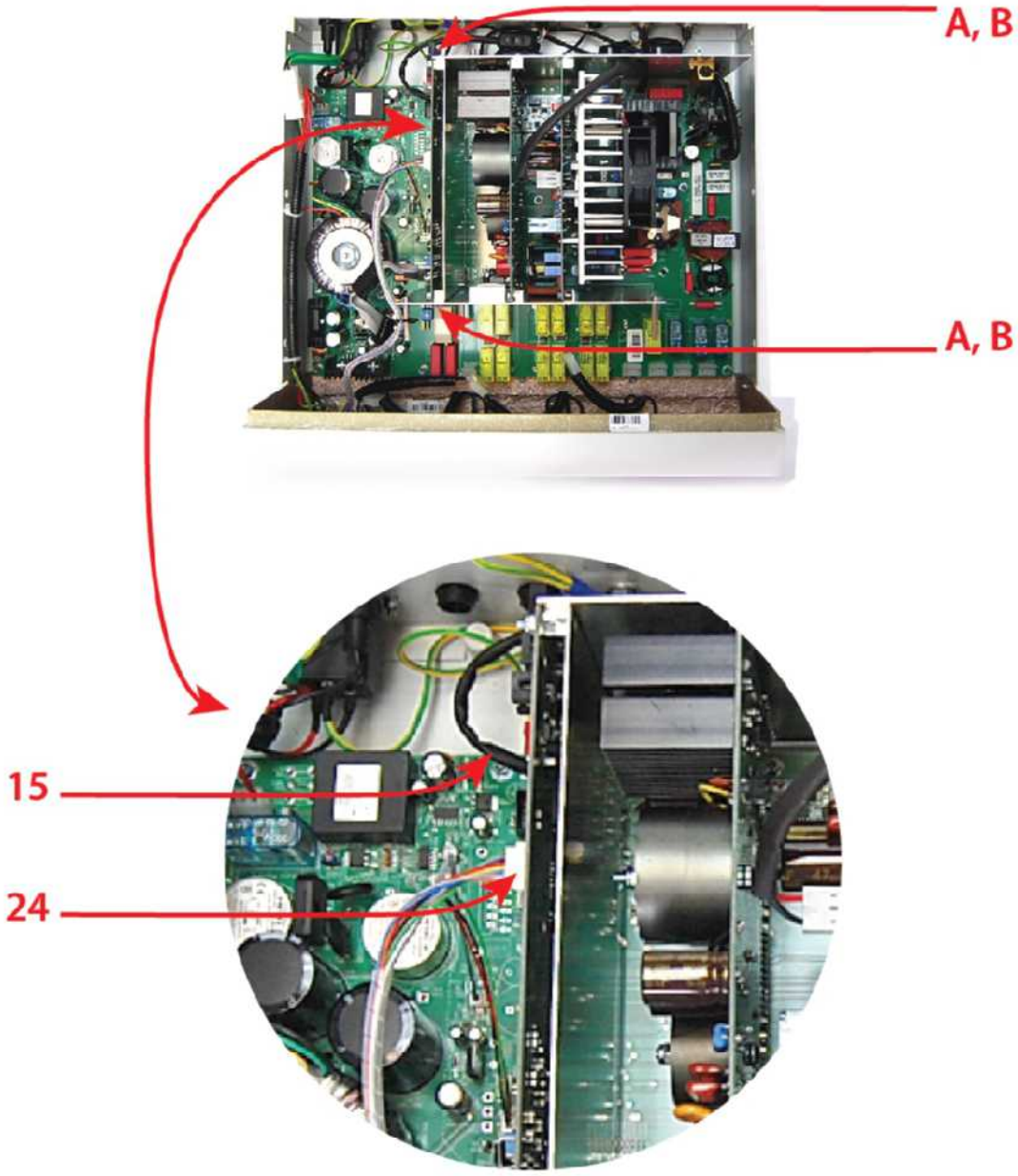
the data transfer tape (CPU2 – OUT_S350).

the cables of output sockets.

Fasten the OUT_S350 module using two screws with elastic and flat washers.

8.3 CPU2 module - SP-1-03-04

PLEASE REFER TO THE VIDEO INCLUDED ON ATTACHED PENDRIVE „ASSEMBLY OF SUP_VI, GEN_VI, OUT_S350" AND „DISASSEMBLY OF CPU2, SUP_VI, GEN_VI MODULES "



SYMBOL	DESCRIPTION
A	M3x8
B	elastic washer M3

8.3.1 Required equipment

- Screwdriver PH0

8.3.2 Disassembling

Disconnect the following cables from the CPU2 module:

the data transfer cable (CPU2 – D_S350),

the data transfer cable (CPU2 – OUT_S350),

the service connector cable.

Unscrew two screws with elastic washers. Disconnect (push out upwards) the CPU2 module from the J19 connector on the MOT_VI2 module.

8.3.3 Assembling

Connect the CPU2 module to the J19 connector on the MOT_VI2 module.

Fasten the CPU2 module to the mounting elements, using two screws and elastic washers.

Connect the following cables (for more information, see the sections "Description of connections" and "Connection diagram"):

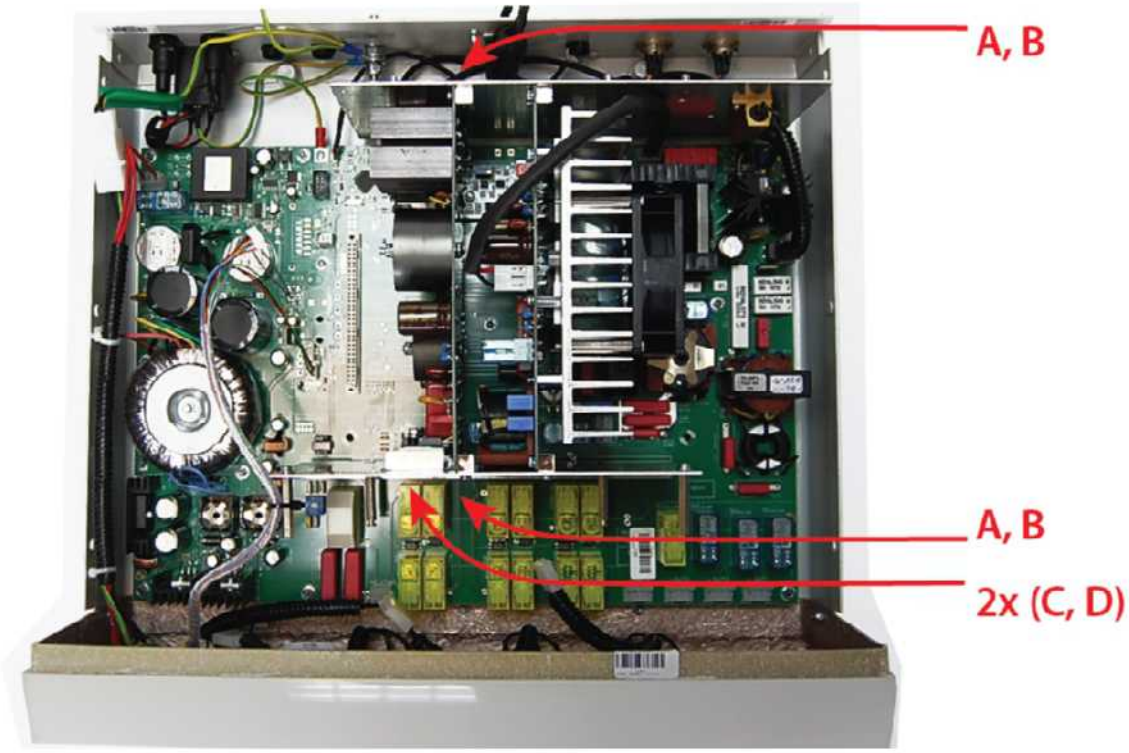
the data transfer cable (CPU2 – D_S350),

the data transfer cable (CPU2 – OUT_S350)

the service connector cable.

8.4 SUP_VI module - SP-1-04-02

PLEASE REFER TO THE VIDEO INCLUDED ON ATTACHED PENDRIVE „ASSEMBLY OF SUP_VI, GEN_VI, OUT_S350" AND „DISASSEMBLY OF CPU2, SUP_VI, GEN_VI MODULES"



SYMBOL	DESCRIPTION
A	M3x8
B	elastic washer M3
C	M4x12
D	elastic washer M4

8.4.1 Required equipment

- screwdriver PH0
- screwdriver PH1

8.4.2 Disassembling

Unscrew four screws with elastic washers. Disconnect (push out upwards) the SUP_VI module from the J10 connector on the MOT_VI2 module.

8.4.3 Assembling

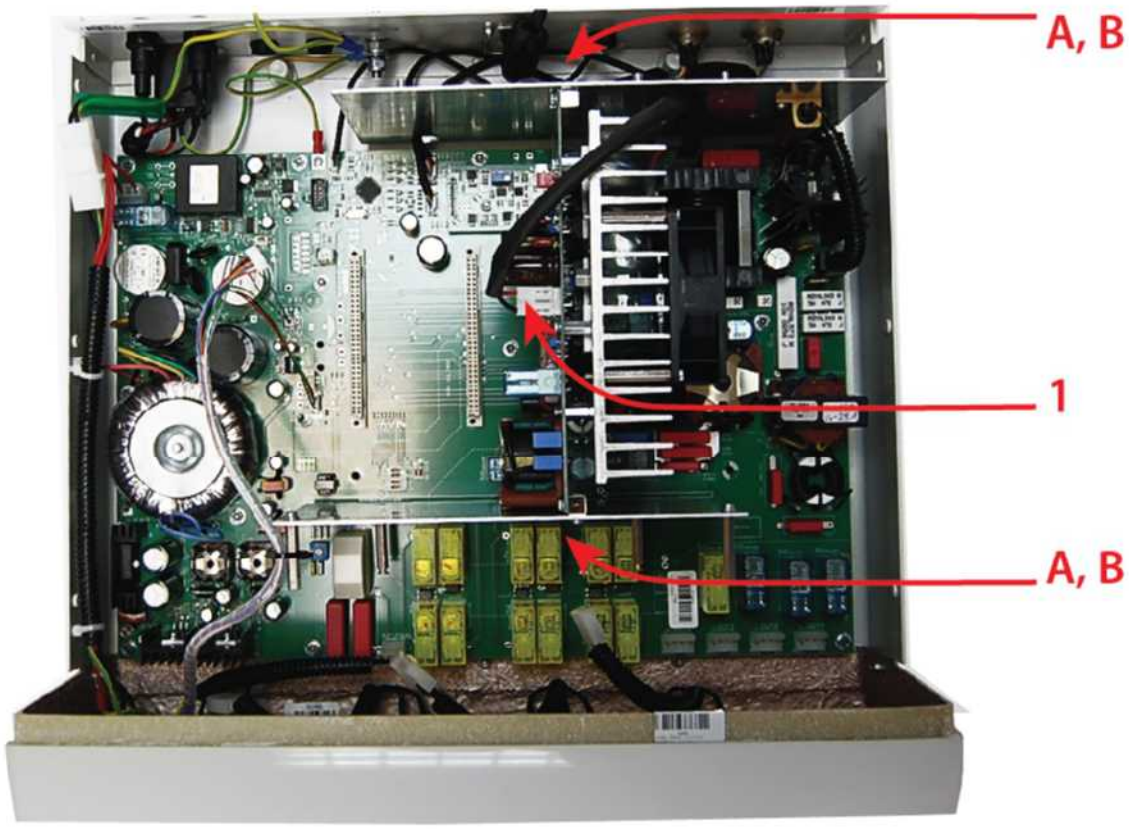
Connect the SUP_VI module to the J10 connector on the MOT_VI2 module.

Fasten the SUP_VI module to the mounting elements, using two screws and elastic washers.

Fasten the radiator of the SUP_VI module, using two screws and elastic washers. After it has been fastened the radiator must adhere with its entire surface to the mounting element.

8.5 GEN_VI module - SP-1-05-04

PLEASE REFER TO THE VIDEO INCLUDED ON ATTACHED PENDRIVE „ASSEMBLY OF SUP_VI, GEN_VI, OUT_S350”, AND „DISASSEMBLY OF CPU2, SUP_VI, GEN_VI MODULES”



SYMBOL	DESCRIPTION
A	M3x8
B	elastic washer M3

8.5.1 Required equipment

- screwdriver PH0

8.5.2 Disassembling

Disconnect the cable connecting the GEN_VI module to the MOT_VI2 module.

Unscrew two screws with elastic washers. Disconnect (push out upwards) the SUP_VI module from the J11 connector on the MOT_VI2 module.

8.5.3 Assembling

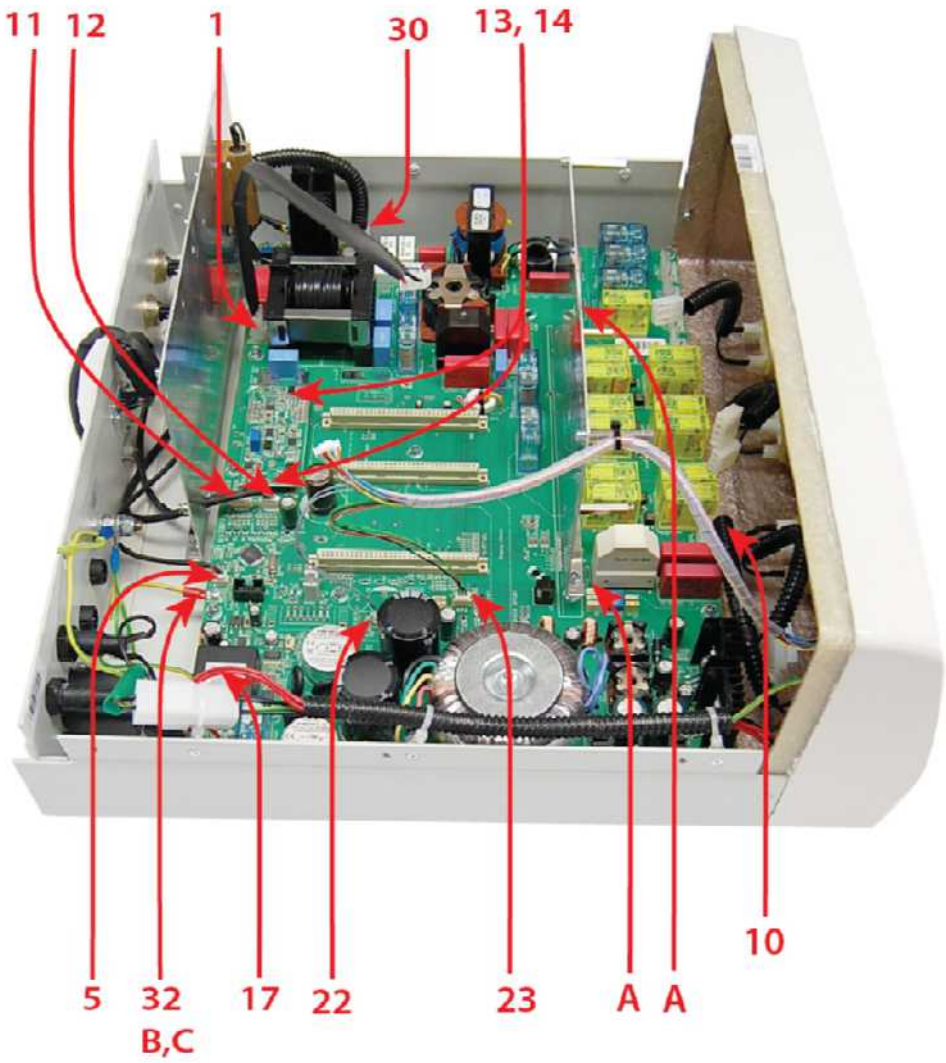
Connect the SUP_VI module to the J11 connector on the MOT_VI2 module.

Fasten the SUP_VI module to the mounting elements, using two screws and elastic washers.

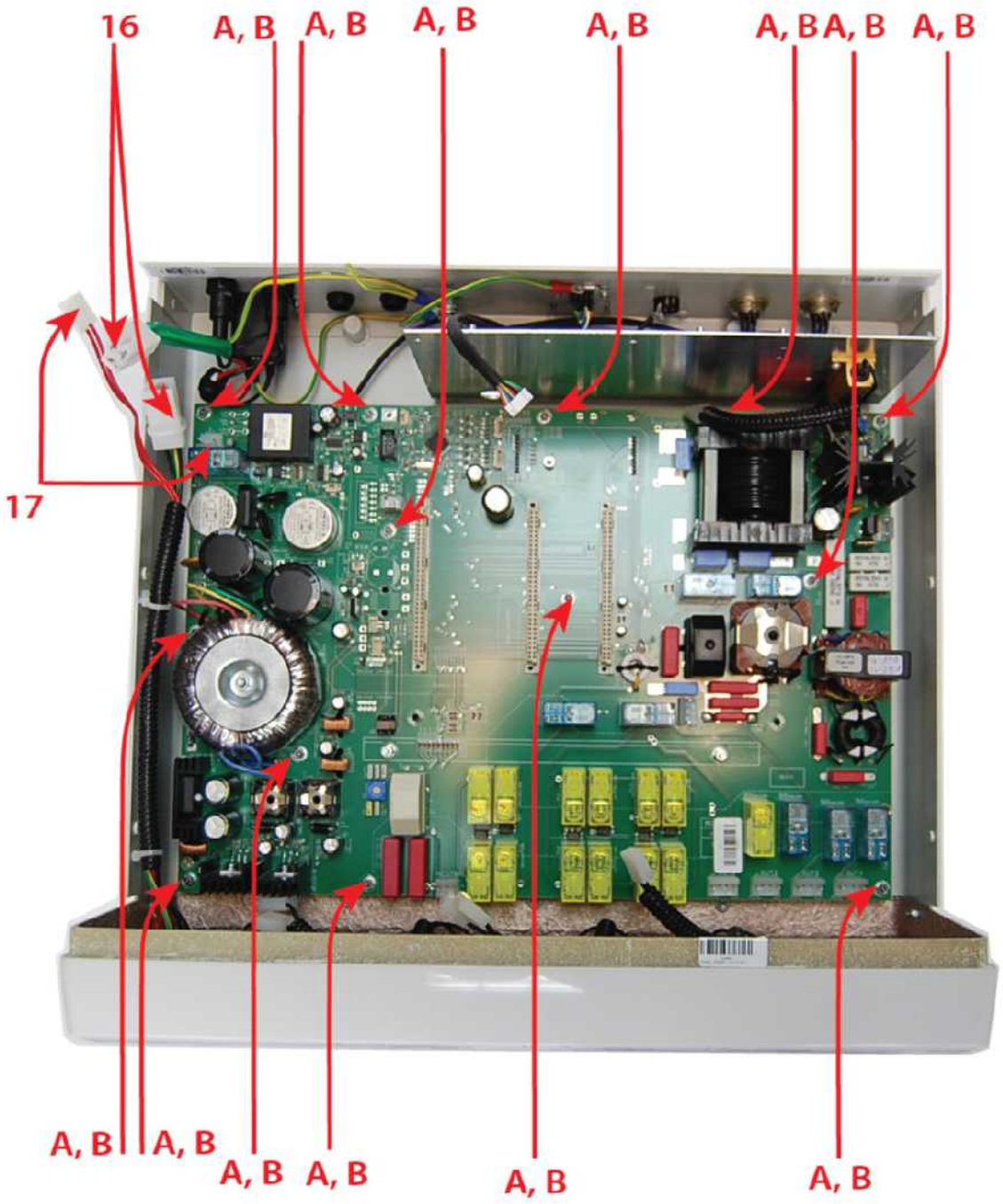
Connect the cable connecting the GEN_VI module to the MOT_VI2 module (for more information, see the points "Description of connections" and "Connection diagram").

8.6 MOT_VI2 module - SP-1-02-06

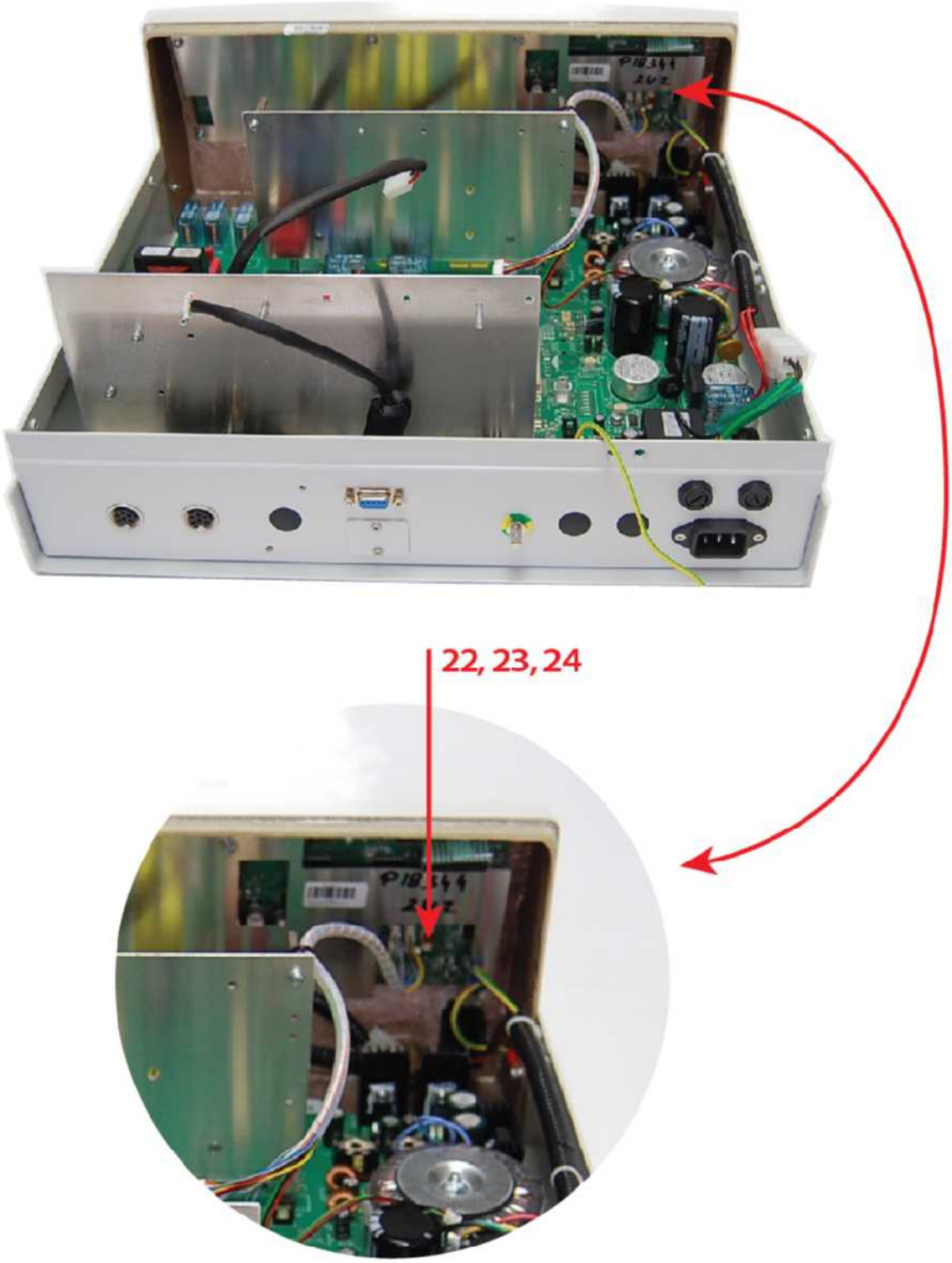
PLEASE REFER TO THE VIDEO INCLUDED ON ATTACHED PENDRIVE „ASSEMBLY OF MOT_VI2 MODULE", „ASSEMBLY OF MPM MODULE" AND „DISASSEMBLY OF MOT_VI2, MPM MODULES"



SYMBOL	DESCRIPTION
A	self-locking nuts + hex standoffs with internal and external threads M3x12
B	M3x8
C	flat washer M3



SYMBOL	DESCRIPTION
A	self-locking nuts
B	flat washer M3


22, 23, 24

8.6.1 Required equipment

- screwdriver PH0
- Socket screwdriver 5 mm,
- Socket screwdriver 5,5 mm,

8.6.2 Disassembling

Disconnect the following cables from the MOT_VI2 module:

the neutral electrode cable,

the cable supplying the D_S350 mode,

the audio signal cable,

the main switch cable,

the cable of the XBFS_RX_VI2 receiver,

the footswitch socket cable (UNIVERSAL),

the footswitch socket cable (BIPOLAR),

the cable connecting the GEN_VI module to the MOT_VI2 module,

the SPRAY resistor cable.

Disconnect the following cables from the D_S350 module:

the cable supplying the D_S350 module,

the audio signal cable,

the data transfer cable (CPU2 – D_S350).

Unscrew the self-locking nut which fixes the MPM module and disconnect (push out upwards) the MPM module from the connectors on the MOT_VI2 module.

Unscrew the screw with an elastic washer which fixes the earthing cable of the MOT_VI2 module.

Unscrew two self-locking nuts which fix the aluminium screen and take it out of the unit.

Unscrew thirteen self-locking nuts with flat washers and carefully take the MOT_VI2 module out of the unit casing.

8.6.3 Assembling

Carefully put the MOT_VI2 module into the unit casing and set it on the mounting pillars. Pay attention to the cables, as none of them can remain between the unit casing and the MOT_VI2 module.

Unscrew the MOT_VI2 module to the casing, using 13 self-locking nuts with flat washers.

Fasten the earthing cable of the MOT_VI2 module using a cap screw and an elastic washer.

Connect the MPM module to the connectors of the MOT_VI2 module and fasten it using a self-locking nut.

Connect the following cables to the MOT_VI2 module (for more information, see the sections "Description of connections" and "Connection diagram):

the neutral electrode cable,

the cable supplying the D_S350 module,

the audio signal cable,

the main switch cable,

the cable of the XBFS_RX_VI2 receiver,

the footswitch socket cable (UNIVERSAL),

the footswitch socket cable (BIPOLAR),

the cable connecting the GEN_VI module to the MOT_VI2 module,

the SPRAY resistor cable.

Connect the following cables to the D_S350 module (for more information, see sections "Description of connections" and "Connection diagram"):

the cable supplying the D_S350 module,

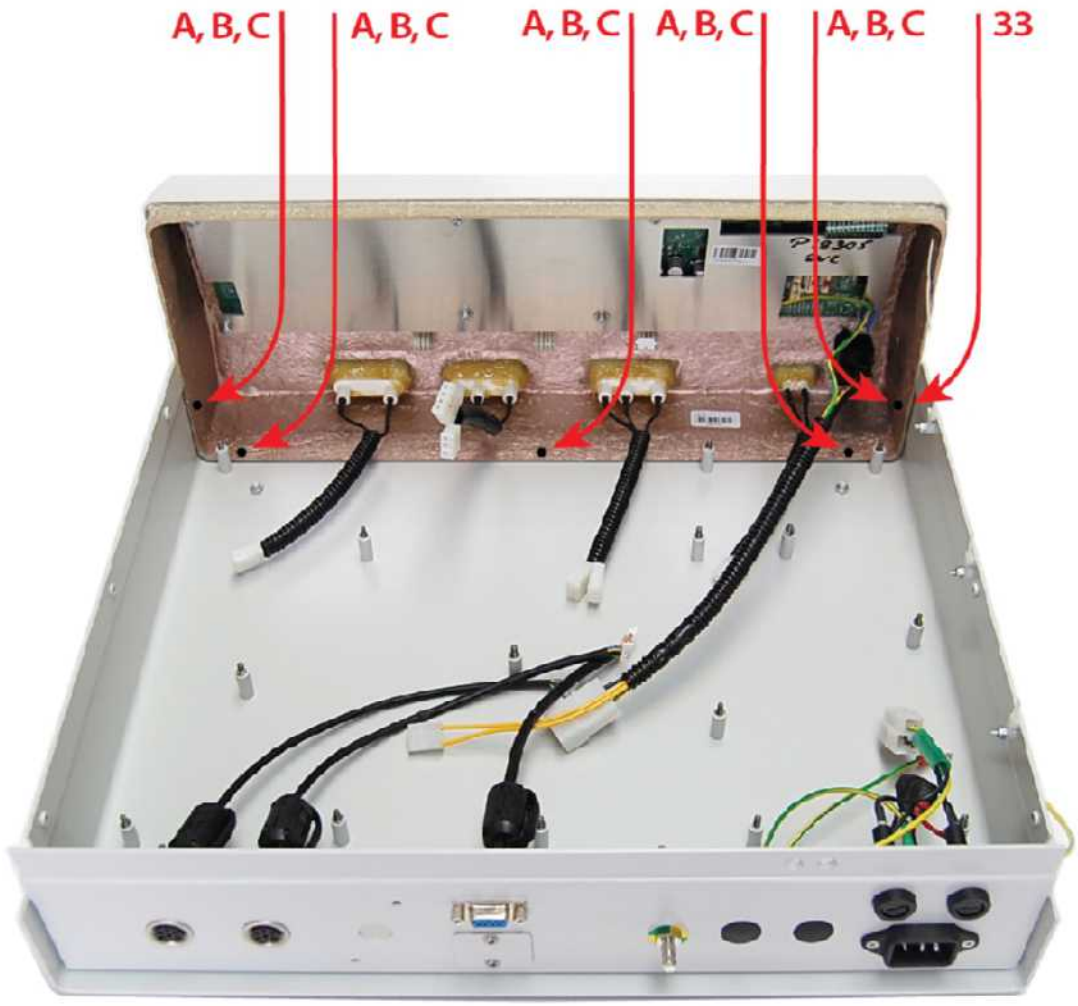
the audio signal cable,

the data transfer cable (CPU2 – D_S350).

Fasten the aluminium screen to two mounting pillars, using self-locking nuts.

8.7 Front panel – SP-2-01-45 / SP-2-01-46 / SP-2-01-47

PLEASE REFER TO THE VIDEO INCLUDED ON ATTACHED PENDRIVE „ASSEMBLY OF FRONT PANEL", „DISASSEMBLY OF D_S350 MODULE" ANS „ DISASSEMBLY OF D_S350 MODULE"



SYMBOL	DESCRIPTION
A	M3x10
B	self-locking nuts
C	flat washer M3

8.7.1 Required equipment

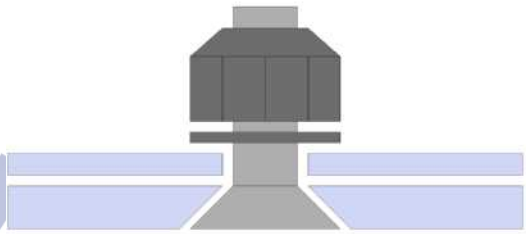
- Allen key size 2.0mm,
- Socket screwdriver 5,5 mm,

8.7.2 Disassembling

Unscrew 5 screws with self-locking nuts and flat washers (three on the bottom wall and one on each side wall) and pay attention to the earthing cable (on the side of the main switch).

Push the front panel out of the bottom casing.

8.7.3 Assembling



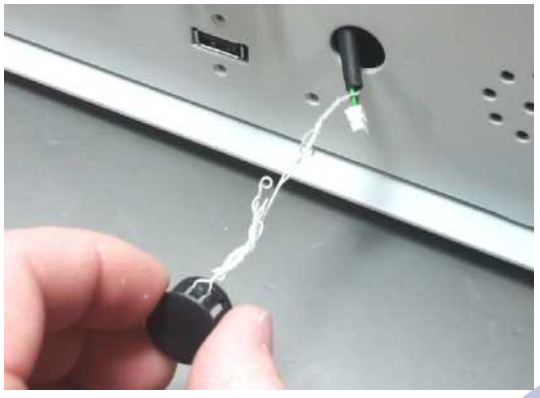
Put the front panel into the bottom base.

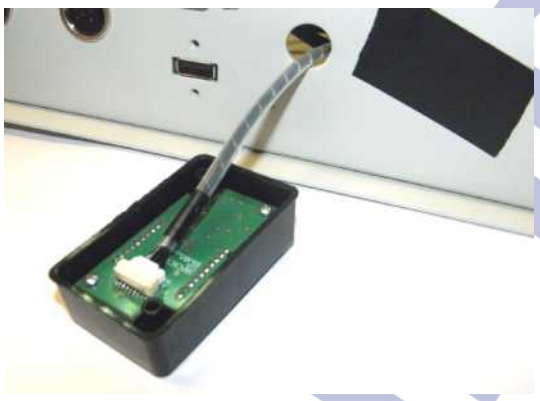
Fasten the front panel to the bottom wall, using three screws, self-locking nuts and flat washers.

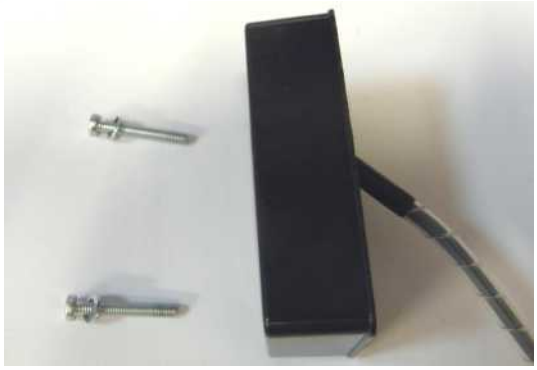
Fasten the earthing cable of the front panel to the mounting hole which is situated on the side wall (on the side of the main switch), using a screw, a self-locking nut and a flat washer.

Fasten the front panel to the side wall, using a screw, a self-locking nut and a flat washer (on the side of the BICOAG segment).

8.8 XBFS_RX_VI2 module - SP-1-07-01







8.8.1 Required equipment

- screwdriver PH0
- flat screwdriver

8.8.2 Disassembling

Using a PHO screwdriver, unscrew two M3 screws with elastic washers which fix the casing of the XBFS_RX_VI2 module to the back panel. When removing the casing of the XBFS_RX_VI2 module, pay attention to the cable connecting the XBFS_RX_VI2 module to the MOT_VI2 module. Subsequently, unscrew two screws fixing the XBFS_RX_VI2 module to the unit casing, carefully take out the module and disconnect the cable from the J1 connector of the XBFS_RX_VI2 module.

8.8.3 Assembling

A unit which is equipped with the XBFS_RX_VI2 module.

Connect the cable connecting the XBFS_RX_VI2 module to the MOT_VI2 module. Using a PHO screwdriver, fasten the XBFS_RX_VI2 module to the casing with two screws. Place the casing of the module against the back panel, put the excess cable inside the unit through a hole and fasten the casing, along with the module, to the back panel, using two screws with elastic washers.

A unit which is not equipped with the XBFS_RX_VI2 module.

Using a flat screwdriver carefully pry away the cap of the XBFS module on the back panel.

Attention! The cable connecting the XBFS_RX_VI2 module to the FM4_CPU module is attached to the cap. When removing the cap, take care not to damage the cable. After the cap has been disassembled, take the cable out of the unit and, subsequently, remove the cap and wire which fastens the cable to it. Connect the cable to the XBFS_RX_VI2 module. Using a PH0 screwdriver, fasten the XBFS_RX_VI2 module to the casing with two screws. Place the casing of the module against the back panel, push the excess cable through a hole into the unit and fasten the casing, along with the module, to the back panel with two screws with elastic washers.

9 TECHNICAL INSPECTION

(Periodic) technical inspections are intended to supervise technical condition of equipment. Technical inspections are carried out on new equipment and the equipment already in operation.

During the technical inspection, both electrosurgical unit and available accessories must be checked.

The technical inspection can be provided by a person with the knowledge, experience and competence related to the application of the relevant measurement methods, the knowledge of standards and local regulations, trained by EMED in field of:

- periodic inspections rules and methods
- product operation and maintenance

and equipped with required measurement tools.

The authorisation to carry out a periodic technical inspection DOES NOT AUTHORISE the performance of service.

A technical inspection is carried out in the following situations:

- during the installation of equipment
- after repair or calibration
- periodically at least every 12 months.

After the technical inspection, unit should be restored to its operational condition/settings.

9.1 Documentation of the technical inspection

All the measurements and tests made during a technical inspection must be appropriately documented. The documentation must contain at least the following data:

- data of the company performing the inspection (e.g. the name of the company, its department, etc.),
- family name of the person performing the measurements, tests and evaluation of the results,
- date of the technical inspection,
- inspected unit information (type, serial number) and accessories information (reference and lot numbers)
- list of the testers and meters used,
- a description of the tests and measurements performed, along with their results,
- final evaluation of the inspection.

All the activities related to the inspection must be appropriately documented and the results of inspections must be immediately sent to the EMED Company.

9.2 Technical inspection – Procedure

An exact description of the procedure of the technical inspection is contained in the document:

- ESU Routine Maintenance Test Manual

This document is provided in its electronic version on the pendrive attached to these instructions.

10 CALIBRATION

All the service activities (calibration and repairs) which have been carried out must be appropriately documented. The documentation must contain at least the following data:

– data of the company performing the inspection (e.g. the name of the company, its department, etc.),

– family name of the person performing the measurements, tests and evaluation of the results,

– date when the service activities were made,

– inspected unit information (type, serial number)

– a list of the testers, meters and spare parts used,

– a description of the service activities and their results.

All the service activities must be appropriately documented and the results of calibration and repairs must be immediately sent to the EMED Company.

10.1 REM system

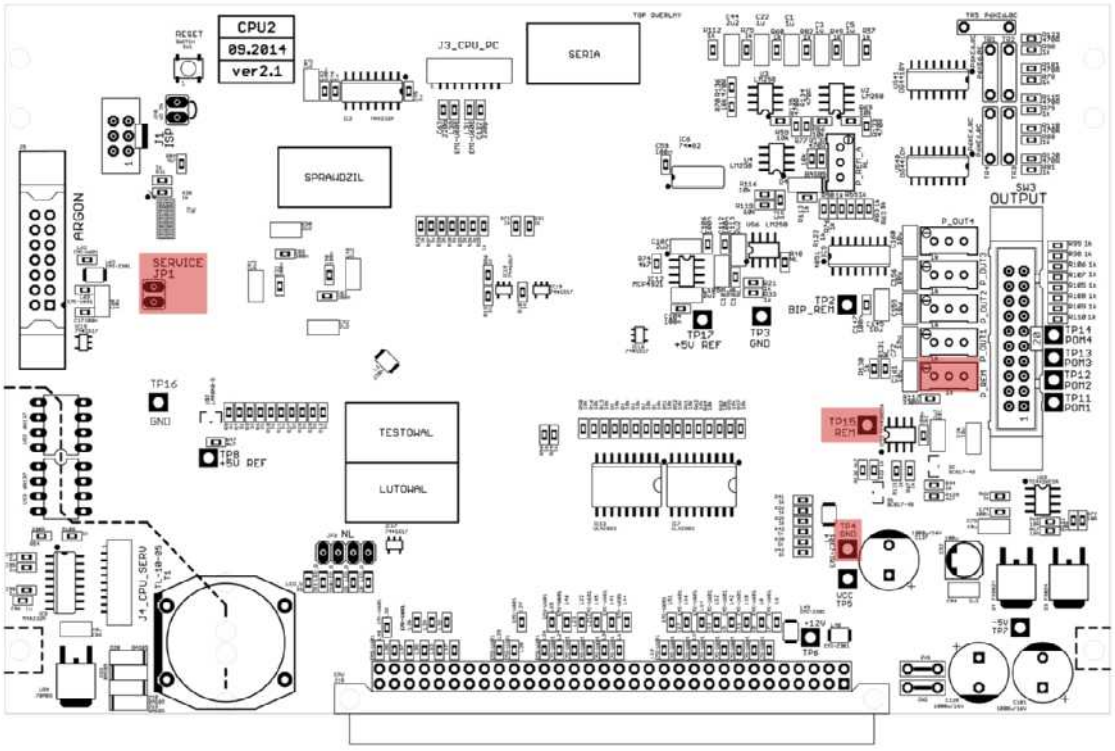
10.1.1 Required equipment

- Set of testers from the ETC1 case (Ref. No. 010-002)
- 2mm straight blade screwdriver
- Multimeter

10.1.2 Calibration process

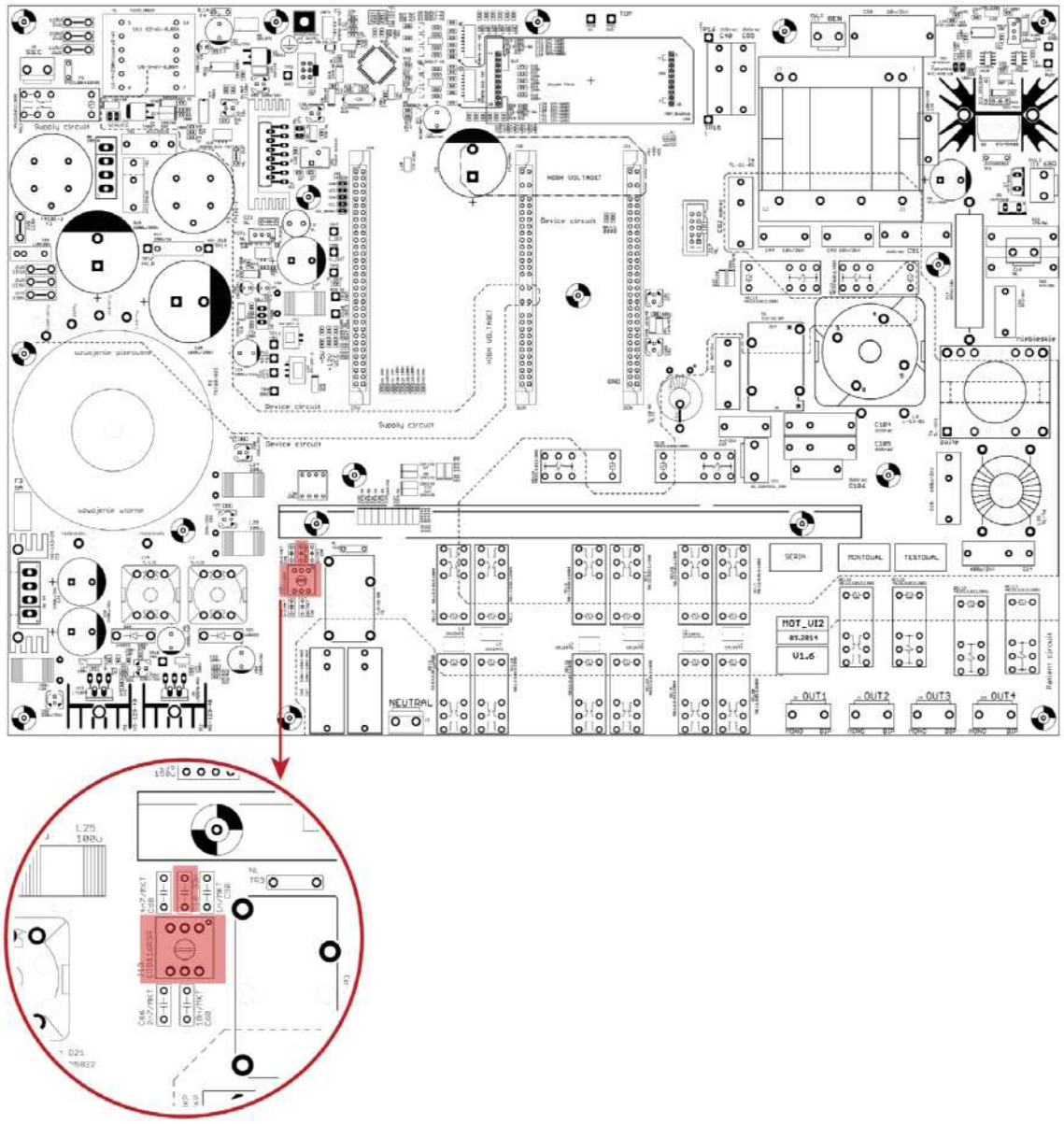
Disconnect all the accessories from the unit.

Connect the multimeter set for measuring the alternating voltage between the points TP15 REM and TP4 GND (the CPU2 module).



Switch on the unit.

Set the maximum voltage by changing the position of the J13 selector (an erd rotary dip switch) (the MOT_VI2 module).



Connect the NEM TESTER (Ref. No. 901-205) to the neutral electrode socket.

Press and hold the "SET" button of the tester.

Watch the display of the neutral electrode application control.

Use the P_REM potentiometer (the CPU module) to adjust until the first green segment is lighted.

Release the "SET" button of the tester and disconnect the NEM TESTER.

10.1.3 Control of calibration

Connect the NEM TESTER and perform the check:

- Press and hold the "SET" button – the first green segment is lighted on the display of the neutral electrode application control.
- Press and hold the "FULL SCALE TEST" button – all the segments are lighted on the display of the neutral electrode application control.
- Do not press any button – no segment is lighted on the display of the neutral electrode application control.

If after the SET button has been pressed the unit does not illuminate the first green segment, turn the potentiometer of the tester to the extreme right position and, subsequently, press and hold the "check" button. Slowly turning the potentiometer of the tester to the left, find the moment when the first green segment of the application level indicator of the neutral electrode is lighted and, subsequently, release the "check" button. Leave the potentiometer in the position for which the first green segment has lighted and the indicator of the potentiometer should be within the green range. Connect an ohmmeter to the 4mm sockets of the tester, press and hold at the same time the "check" and "readout" buttons. The readout level must fall within the range of 230Ω – 250kΩ. If the readout level does not fall within the range, perform the calibration process again. When the situation repeats read the section "Identification and removal of defects" or get in touch with the Company EMED SP. Z O.O. SP. K.

Not all the cases listed above require the repetition of the calibration process for the NEM system.

10.2 Bipolar detect system

10.2.1 Required equipment

- Set of testers from the ETC1 case (Ref. No. 010-002)
- 2mm straight blade screwdriver
- Multimeter

10.2.2 Calibration process

Switch on the unit.

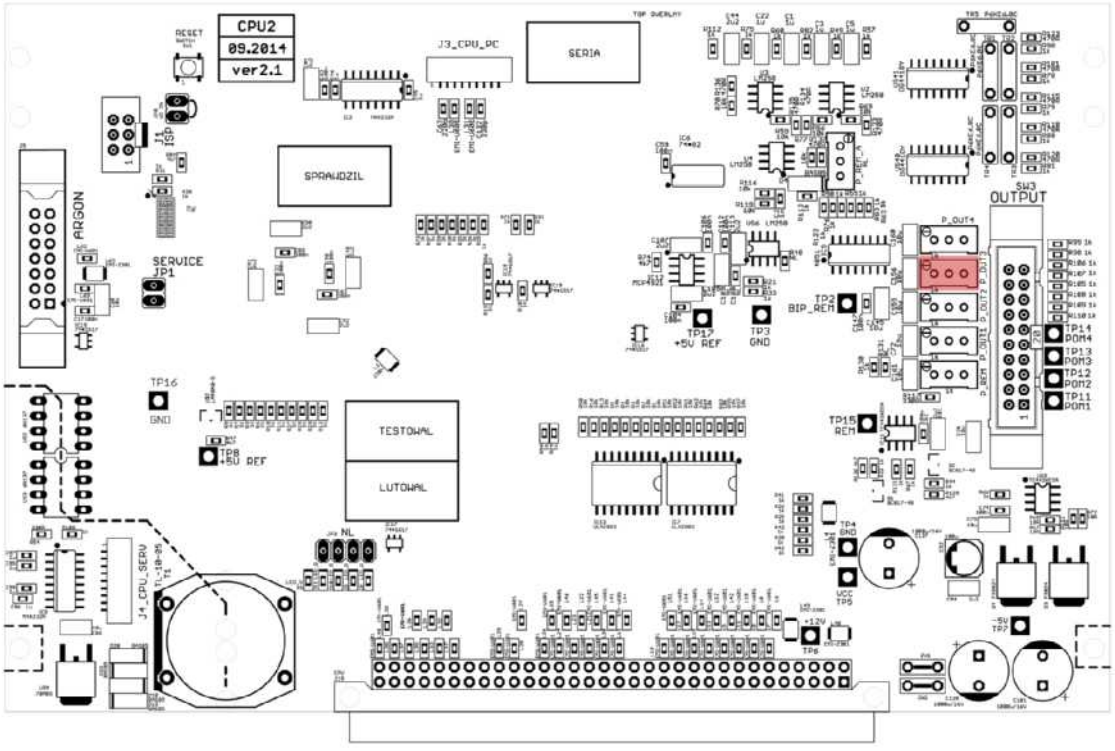
For the SOFT BI-COAG mode, lower the power setting to 4 and switch on the autostart function.

Connect the BIPOLAR TESTER (Ref. No. 901-206) to the bipolar electrode socket.

Press and hold the "SET" button of the tester.

Watch the light indicating the activation of the SOFT BI-COAG mode on the front panel of the unit.

Use the P_OUT3 potentiometer (the CPU module) to adjust until when the SOFT BI-COAG mode is activated (the blue light is lighted).



Release the "SET" button of the tester and disconnect the NEM TESTER.

10.2.3 Control of calibration

Set the SOFT BI-COAG mode at power level 4 and switch on the autostart function.

Connect the NEM TESTER and perform the check:

- Press and hold the "SET" button – the unit should activate the power for the SOFT BI-COAG mode as long as the button is pressed.
- Do not press any button – the unit should stop power activation.
- turn the potentiometer of the tester to the extreme left position and, subsequently, press and hold the "check" button. Slowly turning the potentiometer of the tester to the right, find the moment when the power of the unit is activated and, subsequently, release the "check" button. Leave the potentiometer in the position for which the unit activated its power and the indicator of the potentiometer should be within the green range. Connect an ohmmeter to the 4mm sockets of the tester, press and hold at the same time the "check" and "readout" buttons. The readout level must fall within the range from 1.5kΩ to 1.9kΩ. If the readout level does not fall within the range, perform the calibration process again. When the situation repeats read the section "Identification and removal of defects" or get in touch with the Company EMED SP. Z O.O. SP. K.

10.3 Argon system

Applicable to the ES350A and ES350AT versions only.

10.3.1 Required equipment

- Manometer (with an accuracy of 0.01 kPa and a range of up to 0.5 kPa).
- 2.5mm hex key
- ETC1
- Argon flow meter, e.g. VA ARGON FLOW METER (Ref. No. 010-002)
- Argon cylinder (full)
- Argon regulator (e.g. Ref. No. 5501565)
- Pneumatic hose (e.g. Ref. No. 100-053)

10.3.2 Calibration process

Adjustment of the regulator of the K_ARG module

Disconnect the A3 pneumatic hose from the K_ARG module.

Connect a manometer to the argon outlet on the regulator on the K_ARG module.

Connect a full argon cylinder and open the regulator valve on the cylinder.

Connect the FS emulator tester (901-208) to the footswitch socket (UNIVERSAL).

Switch on the unit.

Assign activation from the footswitch to the first output.

Set the ARGON-ENHACED COAGULATION mode with a flow rate of 5.0 l/min.

Activate the power of the COAG mode for 3 seconds and measure the pressure. The allowable pressure range is 0.33 – 0.35 kPa. If the pressure does not fall within the allowable range adjust the regulator on the K_ARG module so as to achieve a pressure level within the range specified above.

Argon flow adjustment

Before starting to adjust the flow make sure that the regulator on the K_ARG module has been adjusted.

Connect a full argon cylinder and open the regulator valve.

Connect a flow meter to the argon outlet socket.

Connect the FS emulator tester (901-208) to the footswitch socket (MONOPOLAR / BIPOLAR).

Switch on the unit.

Assign activation from the footswitch to the first output.

Set the ARGON-ENHACED COAGULATION mode with a flow rate of 5.0 l/min.

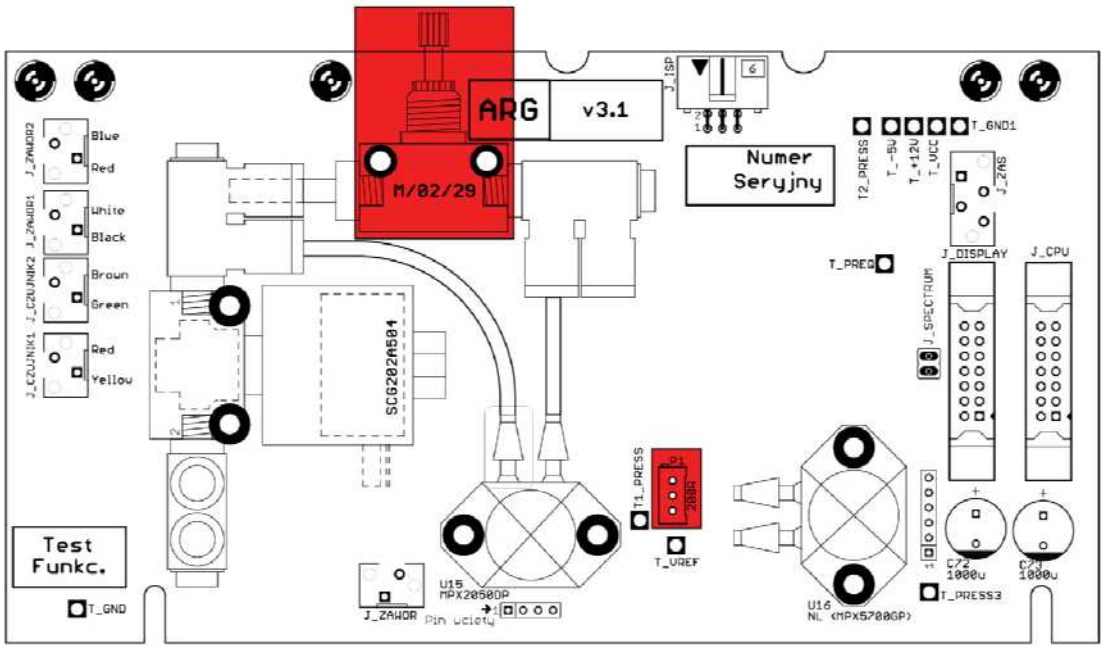
Set the COAG mode and measure the argon flow rate. The allowable pressure range is 4.9 – 5.1 l/min.

If the flow rate does not fall within the specified range adjust the flow rate on the ARG module so as to achieve a flow rate within the range specified above.

Lower the flow rate to 0.8 l/min.

Activate the power of the COAG mode and measure the flow rate. The allowable flow range is
0.7-0.9 l/min.

If the flow rate does not fall within the specified range adjust the flow rate with the P1 potentiometer on the ARG module so as to achieve a flow rate within the range specified above.



10.3.3 Control of calibration

After each adjustment check the argon flow for the following settings:

1 l/min,

2.5 l/min,

5 l/min,

7.5 l/min,

10 l/min,

10% tolerance is allowed for the settings listed above.

Subsequently, verify the operation of the argon valve, checking the flow for the following settings:

0.0 l/min – the real flow of 0.0 l/min

0.1 l/min – the real flow of >0.1 l/min.

10.4 Power circuits

10.4.1 Required equipment

- SZMM - Integrated Power Meter
- Soldering iron and lead-free tin
- 2kV DC polypropylene capacitors (e.g. FKP1, FKP10)

10.4.2 Calibration process

Connect the SZMM Power Meter so that the activation cable is connected to the footswitch socket (MONOPOLAR/BIPOLAR) and the power is measured at the first monopolar output.

Using the programme change buttons, set programme "r1".

Activate the "PuF" service mode with a setting of 400, using a button to choose the "Pure monopolar cutting" mode.

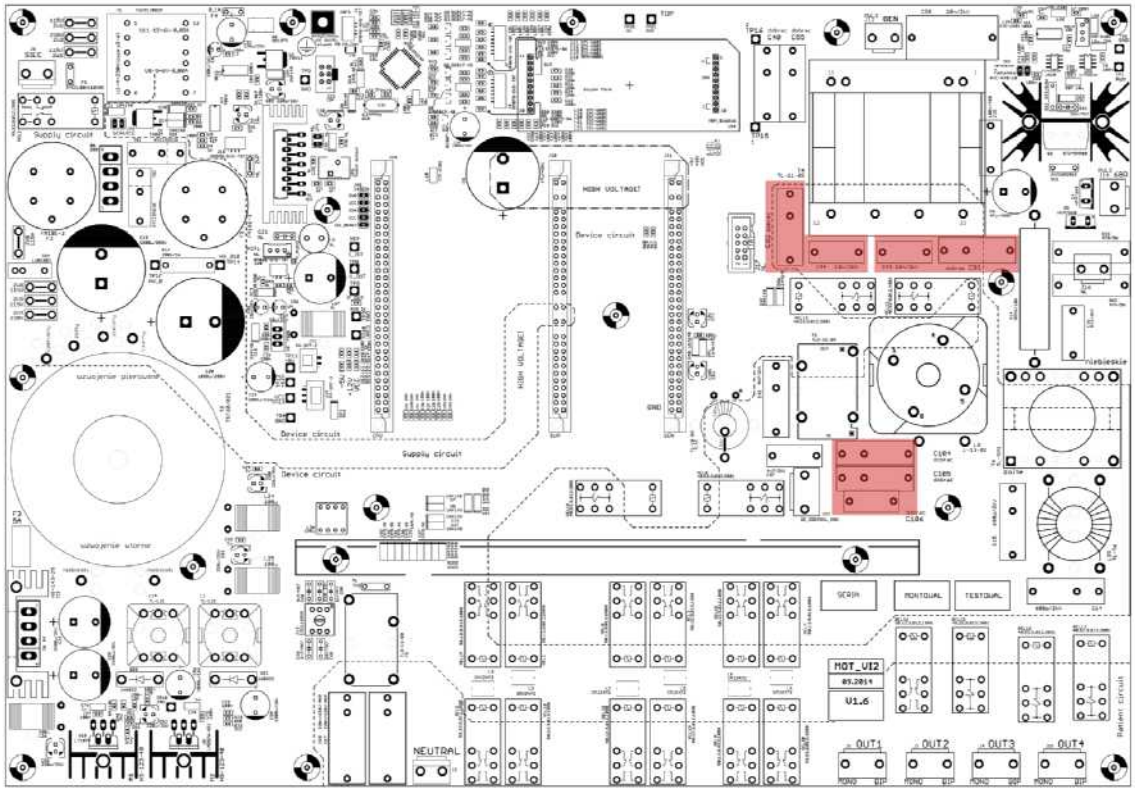
Set the meter for a measurement with 2.5Ω resistance.

When the measurement is carried out with the SZMM Power Meter set the resistance at 0Ω and connect external 2.5Ω resistance in series between the unit and the meter.

Measure the current and read the result. The allowable range is 2.5A – 3.5A.

If the measured current level does not fall within the allowable range, select the capacitances C104, C105 and C106 so that the measured current level falls within the allowable range.

The total value of the selected capacitance must fall within the range from 4.2 to 5.1 nF.



Activate the "PuG" service mode with a setting of 300, using a button to choose the "Monopolar cutting blend I" mode.

Set the meter for a measurement with 25Ω resistance.

Measure the current and read the result. The allowable range is 1.0A – 1.6A.

If the measured current level does not fall within the allowable range, select the capacitances C44 and C92 so that the measured current level falls within the allowable range.

The total value of the selected capacitance must fall within the range from 4.7 to 10 nF.

Activate the "Pub" service mode with a setting of 250, using a button to choose the "Monopolar cutting blend II" mode.

Set the meter for a measurement with 25Ω resistance.

Measure the current and read the result. The allowable range is 1.2A – 1.9A.

If the measured current level does not fall within the allowable range, select the capacitances C43 and C91 so that the measured level falls within the allowable range.

The total value of the selected capacitance must fall within the range from 4.7 to 10 nF.

Activate the "PuC" service mode with a setting of 200, using a button to choose the "Monopolar cutting blend III" mode.

Set the meter for a measurement with 25Ω resistance.

Measure the current and read the result. The allowable range is 0.8A – 1.5A.

10.5 Spray circuit

10.5.1 Required equipment

- Oscilloscope
- SZMM - Integrated Power Meter
- Soldering iron and lead-free tin
- 2 kV DC polypropylene capacitors (e.g. FKP1, FKP10)

10.5.2 Calibration process

Before starting the calibration of the SPRAY power circuit check if the spray resistor is connected to the J14 connector on the MOT_VI2 module.

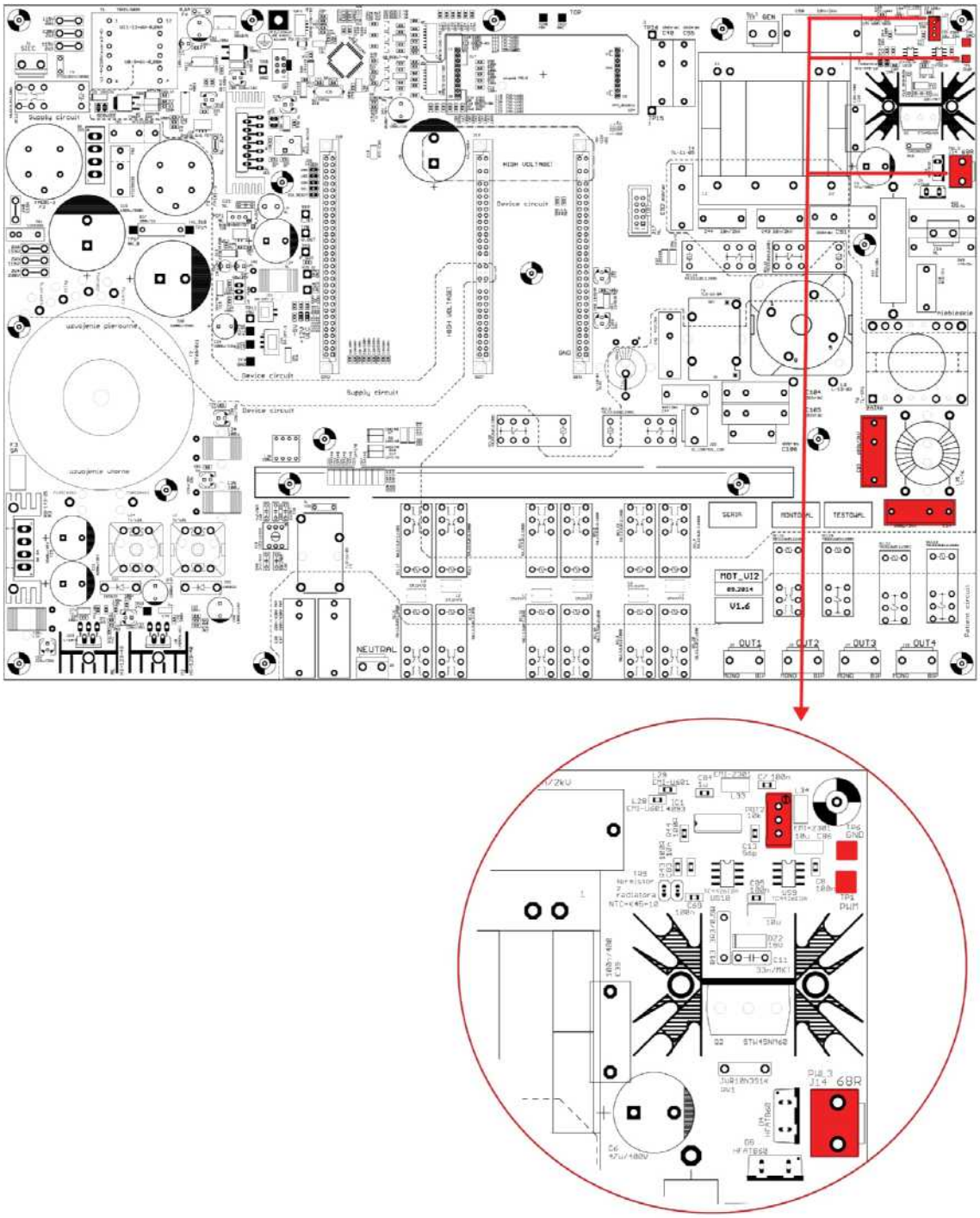
Connect the SZMM Power Meter so that the activation cable is connected to the footswitch socket (UNIVERSAL) and the power is measured at the first monopolar output.

Switch on the unit.

Using the programme change buttons, set programme "1".

Select the SPRAY COAG mode with a setting of 80W.

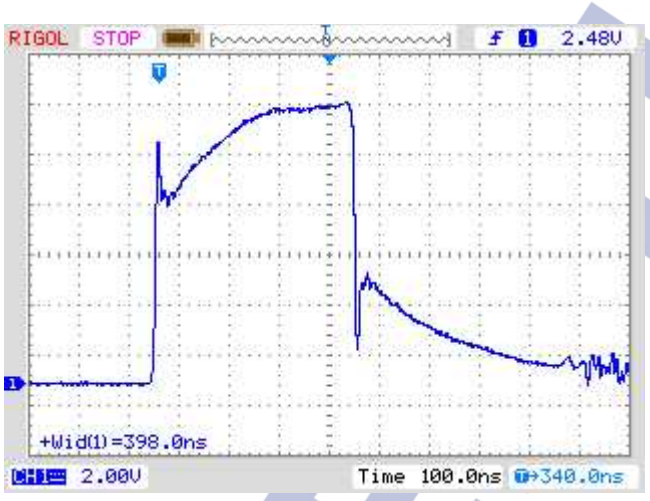
Connect the oscilloscope (DC, 5V/div, 100 ns/div and triggered by a growing slope) to the points TP1 PWM and TP6 GND on the MOT_VI2 module.



Set the meter for a measurement with 1,250Ω resistance.

Activate the power of the unit and use the POT2 potentiometer on the MOT_VI2 module to set the real power level of 80W +/- 4W.

Control the pulse width at high states; it must not exceed 460ns.



Stop the activation and disconnect the oscilloscope.

Check if the peak power occurs in the resistance range from 1,000Ω to 1,500Ω.

If the peak power occurs outside the specified range select the capacitors C14 (in the range from 330 pF to 1,000 pF) and C15 (in the range from 330 pF – 1,000 pF).

Perform the calibration again.

A correctly calibrated spray board has the following characteristics:

- the peak power in the resistance range from 1,000Ω to 1,500Ω,
- the power output in the range from 76W to 84W for a setting of 80 at 1,250Ω resistance,
- a control pulse not exceeding 460ns at a high state.

10.6 Automatic controls

10.6.1 Required equipment

- SZMM - Integrated Power Meter

10.6.2 Calibration process

Connect the SZMM Power Meter so that the activation cable is connected to the footswitch socket (UNIVERSAL) and the power is measured at the first monopolar output.

Current measurement calibration

Using the programme change buttons, set programme "rA".

Activate the "tFI" service mode with a setting of 500, using a button to choose the "Pure monopolar cutting" mode.

Set the meter for a measurement with 50Ω resistance.

Measure the current and read the result. The allowable range is 0.5A – 0.6A.

If the measured current level does not fall within the allowable range, set programme "A".

Change the configurations of current restrictions (the display in the COAG panel).

Repeat the activities to calibrate current restrictions until the measured current level falls within the allowable range.

Voltage measurement calibration

Using the programme change buttons, set programme "rA".

Activate the "tCU" service mode with a setting of 500, using a button to choose the "Monopolar cutting blend III" mode.

Set the meter for a measurement with 600Ω resistance.

Measure the current and read the result. The allowable range is 340mA – 360mA.

If the measured current level does not fall within the allowable range, set programme "A".

Change the configurations of current restrictions (the display in the CUT panel).

Repeat the activities to calibrate current restrictions until the measured current level falls within the allowable range.

Power measurement calibration

Using the programme change buttons, set the "rA" programme.

Activate the "tGP" service mode with a setting of 100, using a button to choose the "Monopolar cutting blend I" mode.

Set the meter for a measurement with 200Ω resistance.

Measure the current and read the result. The allowable range is 97W – 103W.

If the measured current level does not fall within the allowable range, set programme "A".

Change the configurations of power restrictions (the display in the BICOAG panel).

Repeat the activities to calibrate power restrictions until the measured power level falls within the allowable range.

11 THE CHECK TO BE PERFORMED ON THE OPERATION OF EQUIPMENT AFTER CALIBRATION OR REPAIR

11.1 The check to be performed before the unit casing is closed

Before closing the unit casing check if all mechanical spare parts (screws, nuts, fixing elements, radiators, modules) and cable connectors are fixed properly.

In particular, check if:

- all cable plugs have been pressed into place and are securely seated in sockets,
- screws which fix brackets and the front to the casing have been tightly fastened,
- argon cables have been connected,
- IDC50 tape connecting X350_MOT with X350_GEN has been pressed into place,
- none of the radiators is in contact with the grounded part of the unit (its casing, grounding leaves or mounting pillars),
- screws of the elements fixing the thermal tube have been well fastened,
- no foreign element has remained inside the unit.

11.2 Test after closing the casi

After the unit casing has been closed shake the unit and make sure that nothing moves inside. In particular, listen for loose washers, nuts etc.

In order to carry out a more accurate check, perform the technical inspection.

Check the guarantee seals. The seals must be attached in a manner which ensures that the unit cannot be opened without damaging them.

12 VERIFICATION OF CORRECT OPERATION OF INDIVIDUAL BLOCKS, ADJUSTMENT METHODS AND MOST LIKELY FAILURE CAUSES

CAUTION! HAZARDOUS VOLTAGE IS PRESENT IN THE PCBs AFTER

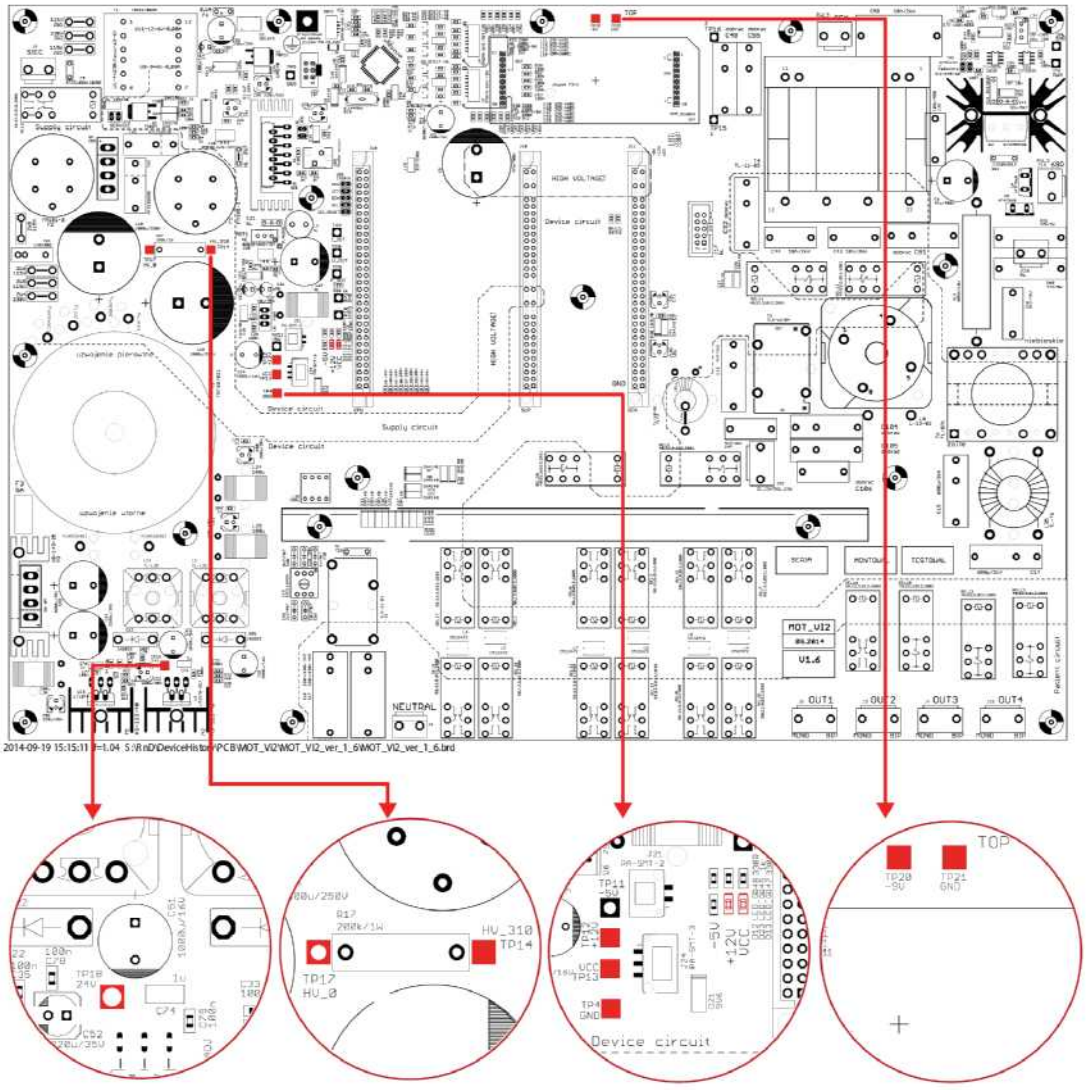
POWERING UP THE SYSTEM

MOT_VI2 module

Test the motherboard after removing the other boards (CPU2, SUP_Vi, GEN_Vi).

If there is no visible damage, check the values DC of voltages generated by the power supplies, by measuring between the following points:

- +310V (+/-10V) T17 HV_0 – TP14 HV_310
- +24V (+/-5%) TP18 24V – TP4 GND
- -9V (+/-5%) TP28 -9 – TP21 GND
- +5V (+/-5%) TP13 VCC – TP4 GND
- +12V (+/-5%) TP12 +12V – TP4 GND
- -5V (+/-5%) TP11 -5V – TP4 GND (only with properly connected and programmed CPU2)

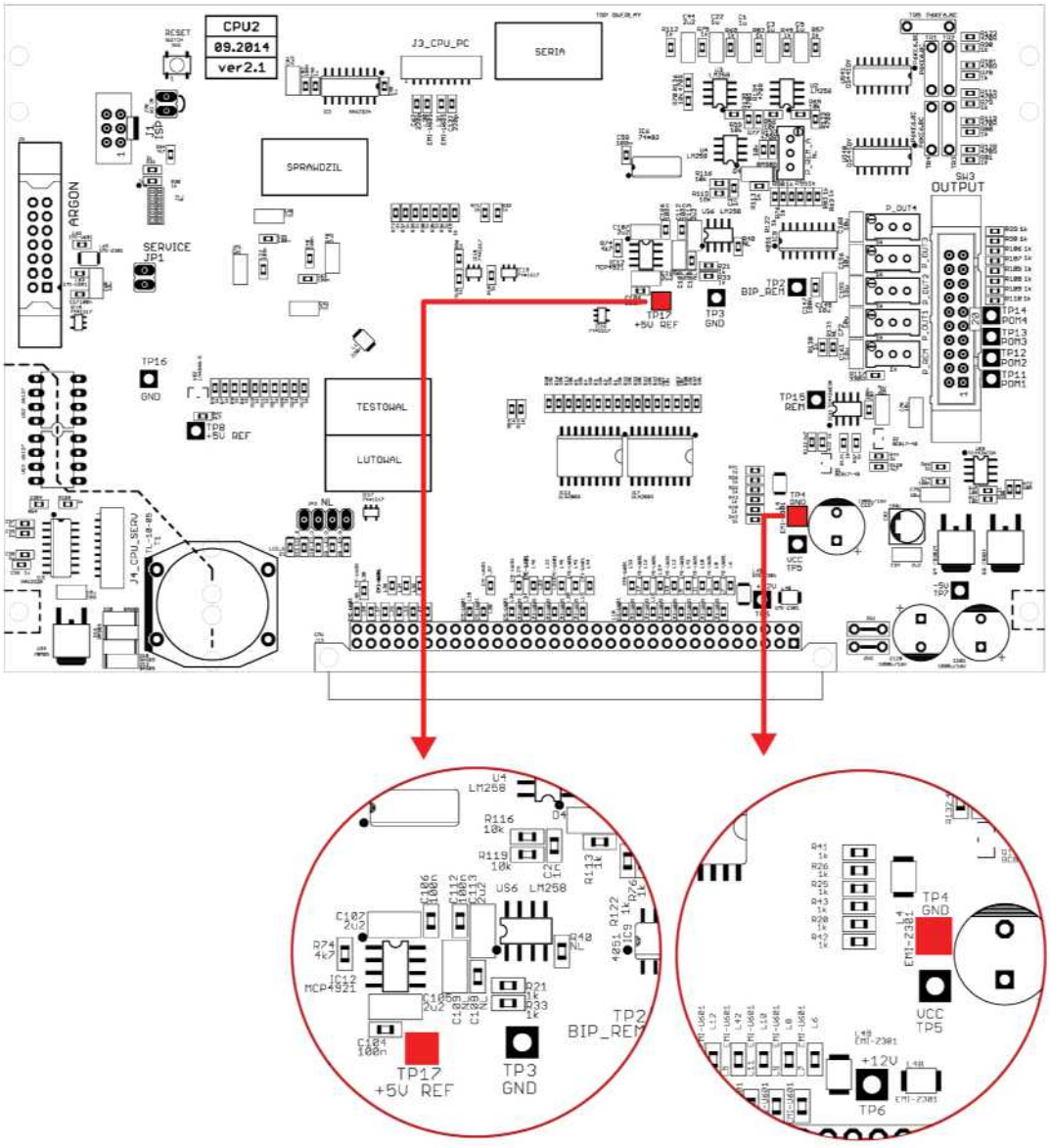


CPU2 module

Controls most functions of the system. Actual fault may be difficult to locate precisely. Test this module after inserting into a verified motherboard and connecting the display module (D_S350).

Measurement of 5V reference voltage:

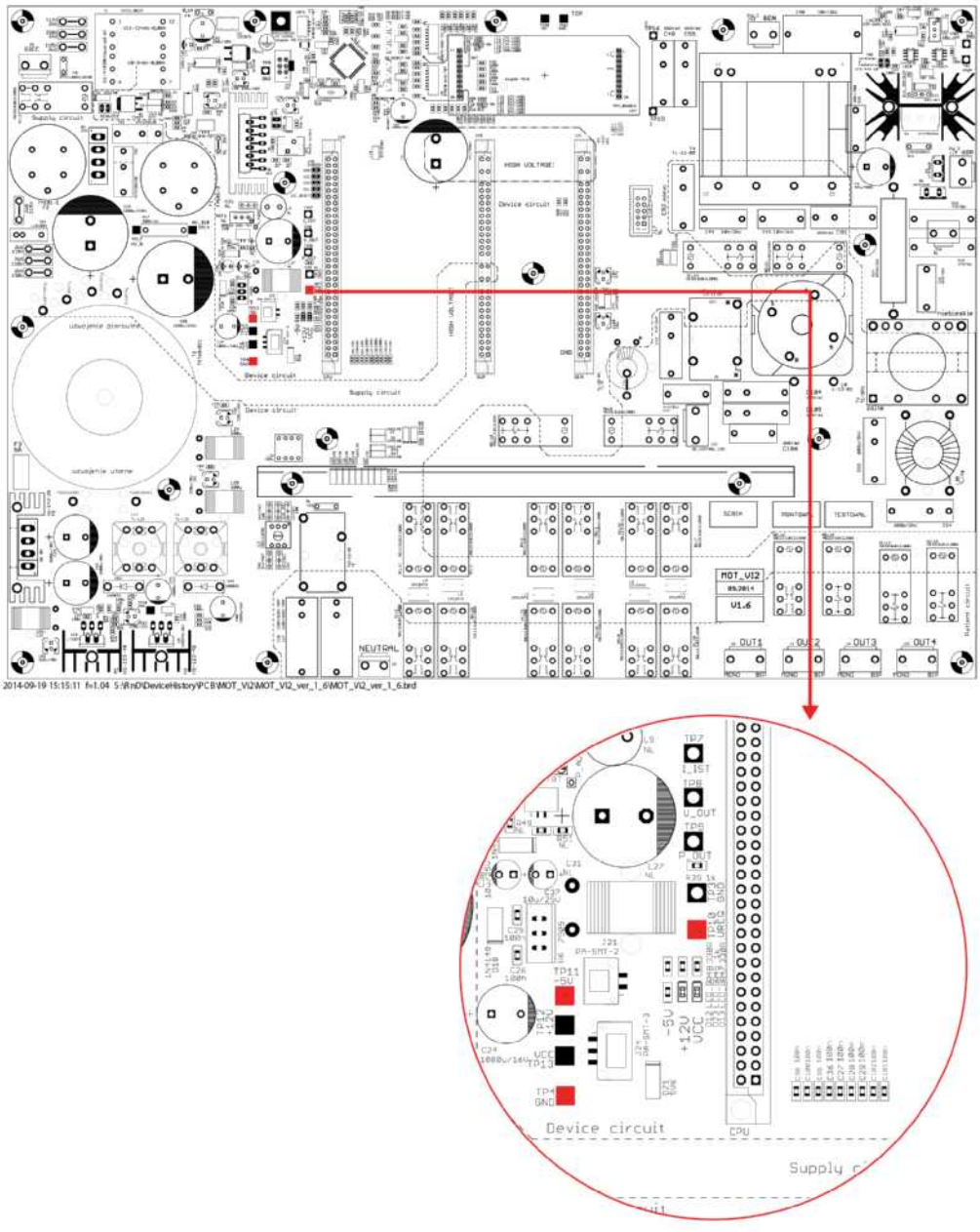
The reference voltage measured between TP17 (+5V REF) and TP4 (GND) of the CPU2 module should be 5V (±10mV).



Check the values of DC voltages generated by the power supplies, by measuring between the following points of the motherboard MOT_VI2 (*CAUTION: do not activate the unit during measurement!*):

-5V (±5%) TP11 -5V – TP4 GND

0,0V (±0,1V) TP10 UREQ – TP4 GND

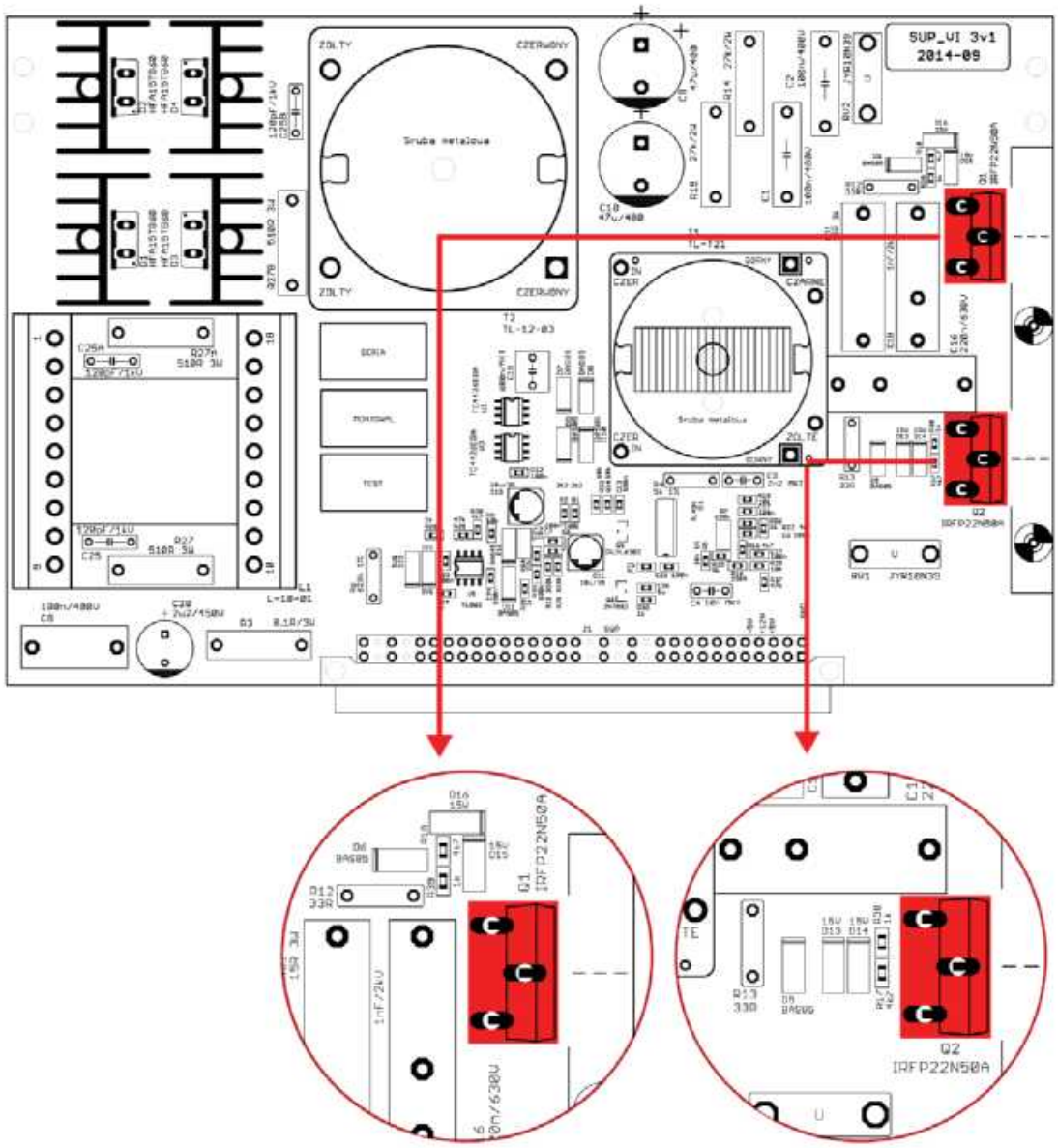


SUP_VI module

This module should be tested after connecting all PCBs.

If this module fails, fuses are blown typically immediately after powering up.

Such failure is indicative of damaged power transistors (2 x IRFP22N50). Measure the resistance value between left and right pin of Q1 and Q2. Any other value than 75 Ohm+/-10% means that the transistors are damaged.



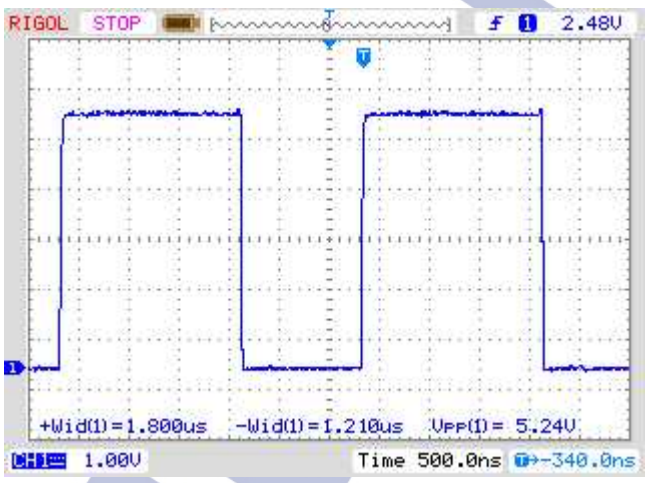
GEN_VI

The module has to be tested after connecting all PCBs except B2 (Sup_Vi).

Connect the oscilloscope to TP4 and start the generator for pure cutting.

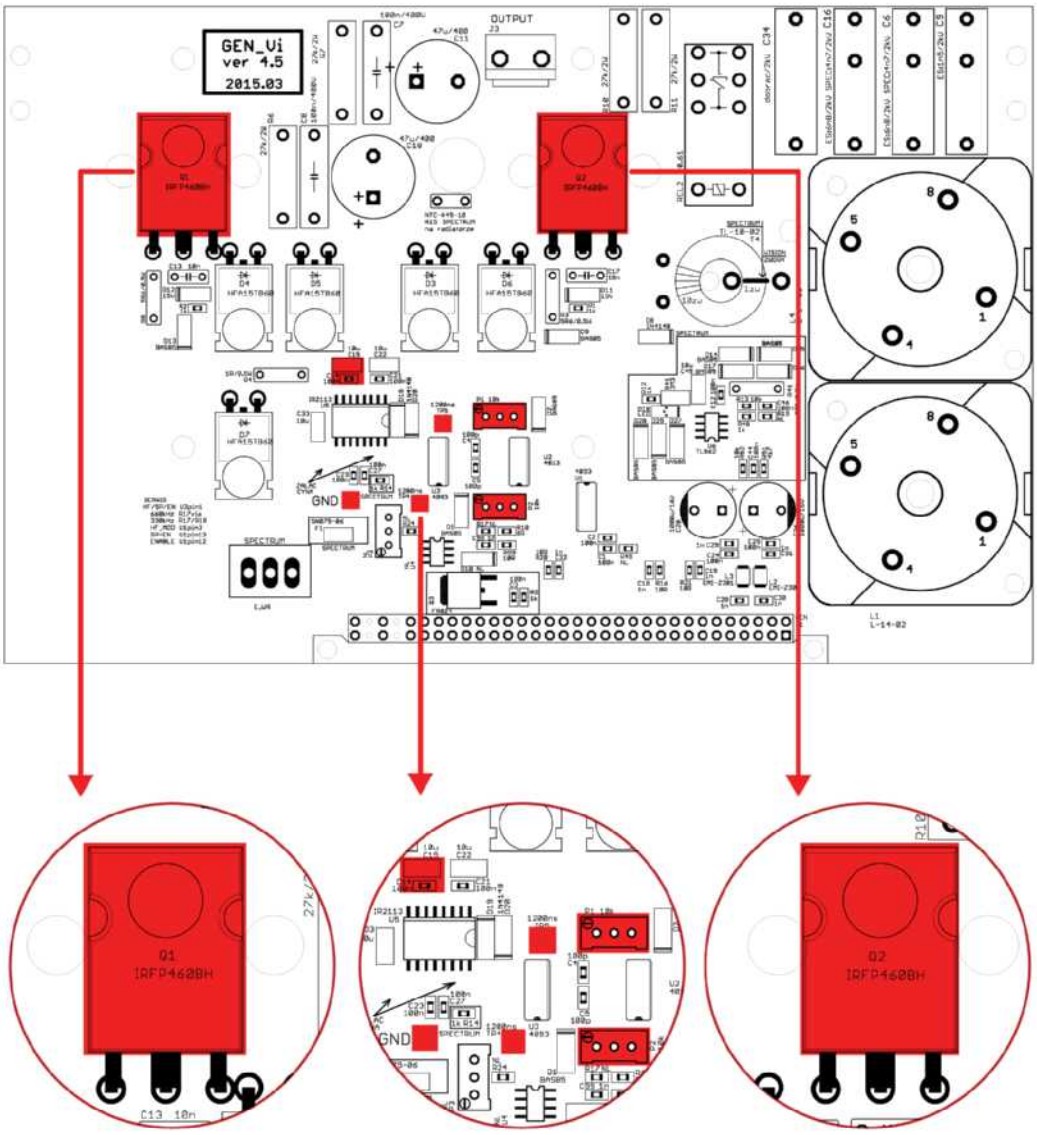
You should see a square wave with the amplitude of 4,5 - 5,5V, frequency of 333 kHz, consisting of 1200ns of the low state and 1800ns of the high state. The pulse width is adjusted with the P2 potentiometer.

Repeat the steps for TP5 and the P1 potentiometer.



Lack of power output can indicate failure of this module.

The Q1 and Q2 (IRFP460) power transistors can be defective. If the resistance between the poles of the C14 or C15 capacitor is less than 50 ohm, the transistors are defective.



ARG module

Check the voltages, measuring the values between T_GND1 and the following terminals:

T_-5V –5V ±0,2V

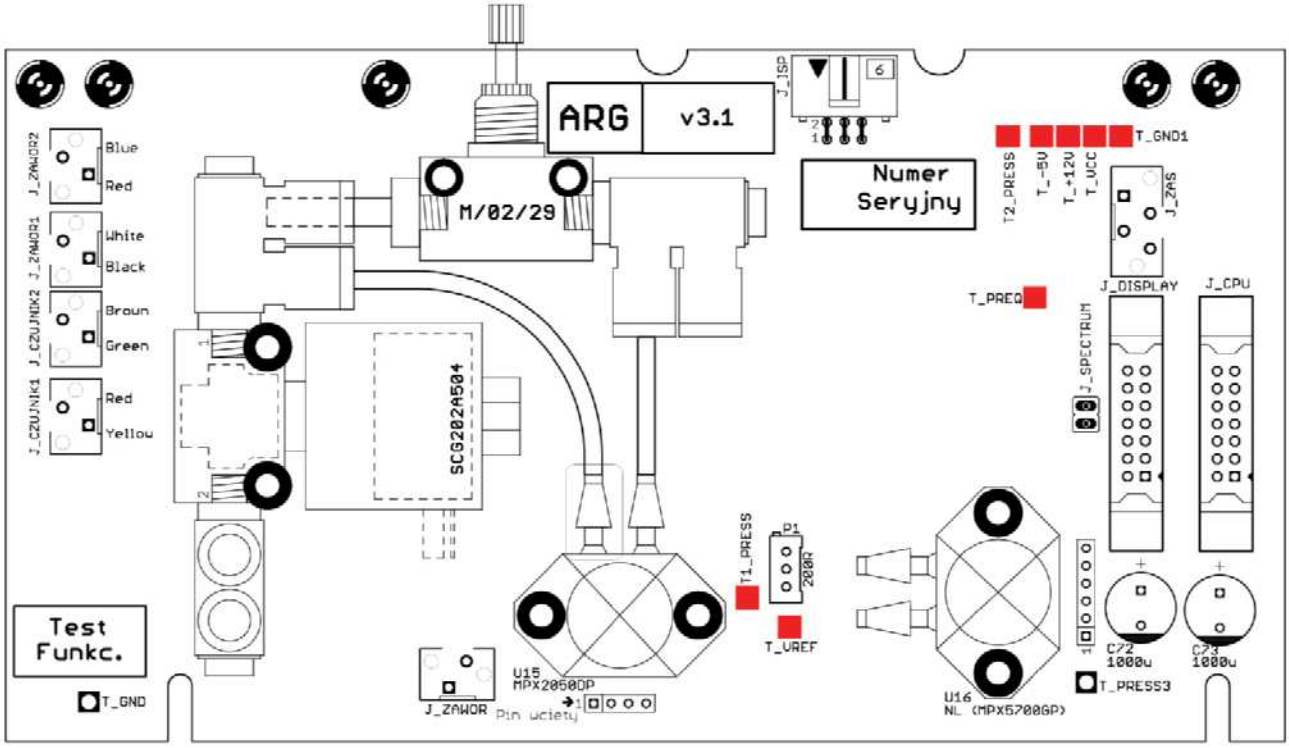
T_+12V 12 ±0,5V

T_Vcc 5V ±0,2V

Reference voltage T_VREF: 5V ± 50mV

T_PRESS1: 300mV ± 10mV

Check the voltage value between Offset T_PRESS1 and T_PREQ should amount to 0mV ± 1mV. Lack of gas flow can indicate a failure of this module.



13 TYPICAL PROBLEMS

13.1 Replacing the fuses

The fuse sockets are located on the back wall. In order to replace the fuses do the following:

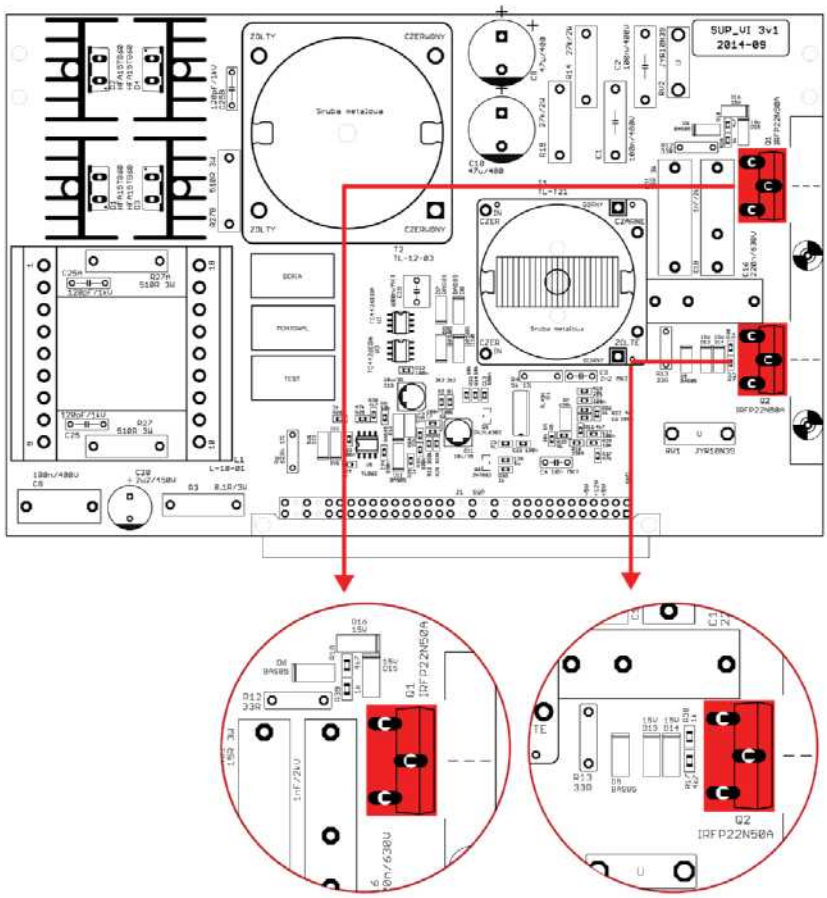
- disconnect the unit from the mains,
- unscrew the fuse sockets with a screwdriver,
- replace the fuses,
- tighten the fuse sockets with a screwdriver.

Specification of fuses			
Type of the fuse	Melting insert-based		
Characteristics of the fuse	Time-lag fuse		
Rated voltage	250 VAC		
Fuse type	5 x 20mm		
Rated current	**Unit**	**Power supply version**	**Fuse**
	100-007	110-120V	2 x T 10A / 250V
	100-007	220-240V	2 x T 5A / 250V
	100-008	110-120V	2 x T 10A / 250V
	100-008	220-240V	2 x T 5A / 250V
	100-008-T	110-120V	2 x T 10A / 250V
	100-008-T	220-240V	2 x T 5A / 250V

Information on the fuses is provided on the rating plate.

13.2 Blown fuses

1. Unscrew the M3 metal screws on both sides of the instrument, connecting the top and bottom part of the housing.
2. Check if there are no visible damages (burnt elements or cables) inside, especially on MOT board – in AC IN area.
3. pull out the HF SUPPLY board (SUP) (looking from the front of the unit it is the second board on the right). Check if there are no visible damages (burnt elements or cables).
4. Measure the resistance value between left and right pin of Q1 and Q2 on SUPPLY board. Any other value than 75 Ohm+/-10% means that the transistors are damaged. – the HF SUPPLY board (SUP) has to be replaced

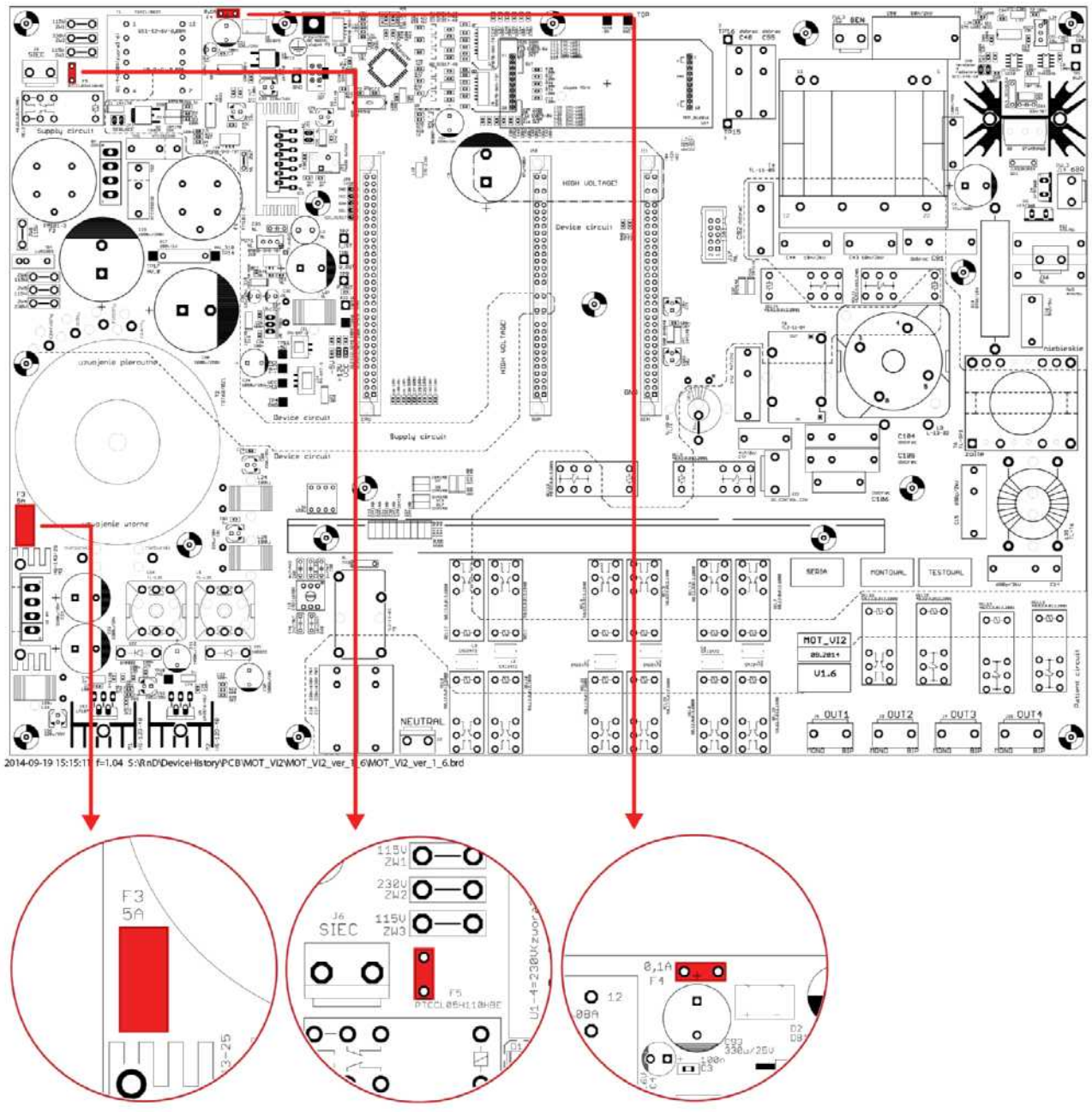


OR

5. replace the fuses and switch on the unit without the HF SUPPLY (SUP) inside – BE VERY CAREFUL.
6. If the fuses are ok – the problem is with the HF SUPPLY board (SUP) – it has to be replaced.
7. If the fuses blew again – the problem is probably caused by MOT board – it has to be replaced.

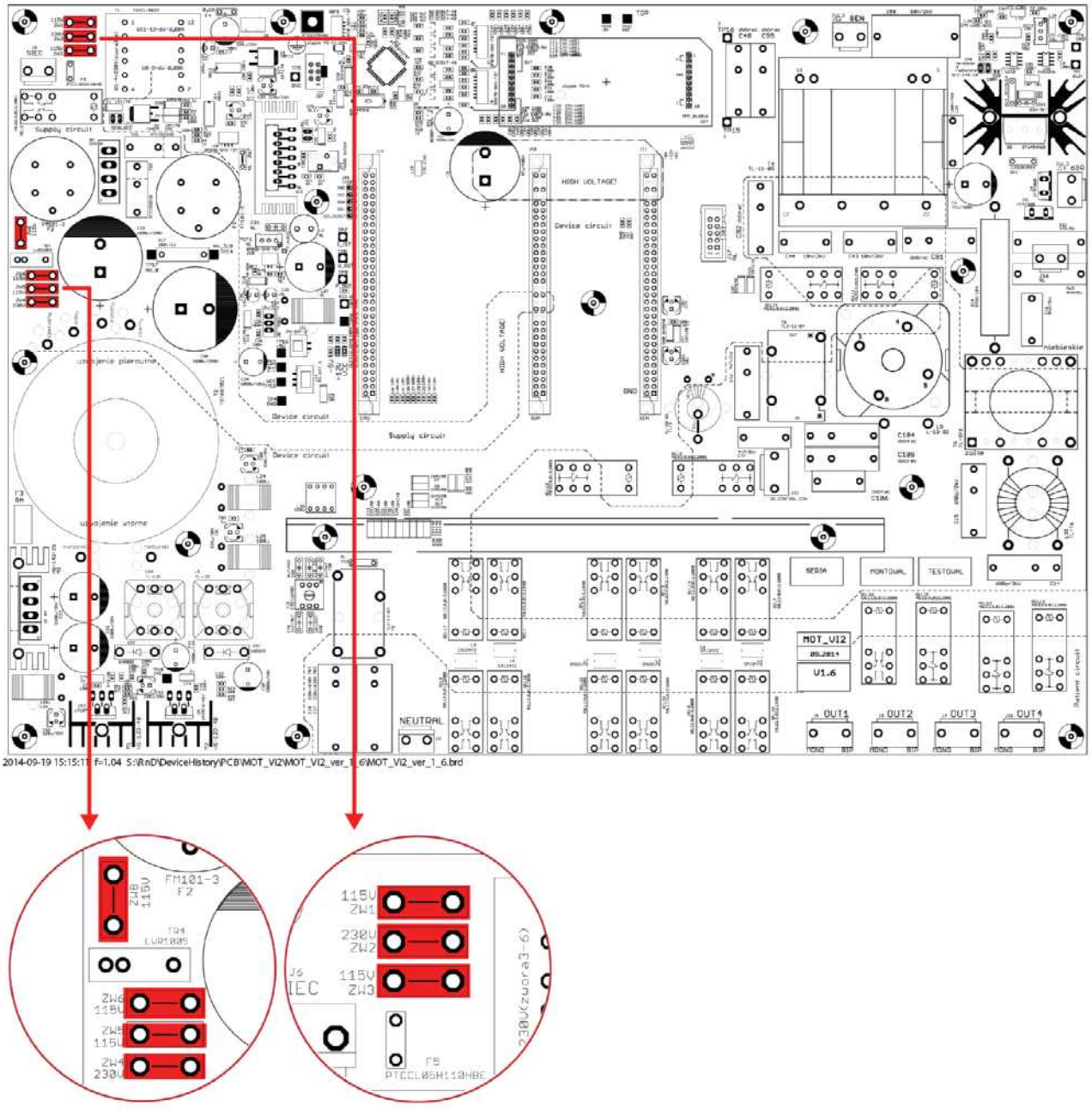
OR

8. Check fuses on MOT_VI2 motherboard.



13.3 Conversion of voltage input from 220-240V to 110-120V

Conversion of voltage input from 220-240V to 110-120V (or the other way round): conversion can be done by the proper jumper (bridge) setting on MOT_VI2.



14 LIST OF TESTERS, METERS AND ACCESSORIES USED TO PERFORM THE REVIEW OR CALIBRATION

- SZMM - Integrated Power Meter
- ETC1 – Emed ESU Test Case
- VA Argon flow meter
- Safety meter (for example: Fluke ESA620 or QA-90)
- Oscilloscope (digital or analogue)
- Digital multimeter
- Argon cylinder (full)
- Argon regulator (e.g. Ref. No. 5501565)
- Pneumatic hose (e.g. Ref. No. 100-053)
- Soldering iron and lead-free tin
- 2kV DC polypropylene capacitors (e.g. FKP1, FKP10)

15 THE LIST OF TOOLS NEEDED TO PERFORM MAINTENANCE ACTIVITIES

- Cutting Pliers,
- Tweezers,
- Socket screwdriver 5 mm,
- Socket screwdriver 5,5 mm,
- Flat Screwdriver
- Flat screwdriver 0,3 X 2,0 mm, (2mm straight blade screwdriver)
- Screwdriver PH0,
- Screwdriver PH1,
- Allen key size 2.0mm,
- Allen key size 2.5mm,

16 THE MANUFACTURER'S SERVICE

Contact

Service:

EMED SP. Z O. O. SP. K.,

05-816 Opacz Kolonia, ul. Ryżowa 69A

Tel. +48 (22) 723 08 00

Fax +48 (22) 723 00 81

email: support@emed.pl

17 SYSTEM TRANSPORT

Please adhere to standard safety measures when transporting the system. During transport, the system must be protected against mechanical damage and moisture.

If the system has been transported for a long time, it should be allowed to reach room temperature before it is started.

18 ENVIRONMENTAL REQUIREMENTS

	Transport and storage	Operation
Temperature	−20°C to +50°C	+10°C to +40°C
Relative humidity	10 – 90%	10 – 90%
Pressure	700 – 1060 hPa	700 – 1060 hPa

19 ENVIRONMENTAL PROTECTION GUIDELINES

Since the transposition of Directive 2002/96/EU into the national law the following rules have been binding:

- Electric and electronic equipment must not be disposed of together with household waste.
- The user is obliged to dispose of a broken or redundant electrical or electronic device at a dedicated collection point, put it in a special container, or possibly return it to the seller.

on  The details are set forth in the relevant national laws. This obligation is indicated the product packaging or in the manual in the form of a crossed-out waste bin. By sorting waste for recycling, you help to protect the natural environment.