SVM 3179
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INVERTEC® 400 TP

For use with machines having code numbers: 50618

SERVICE MANUAL

LINCOLN ELECTRIC EUROPE
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INDEX OF CONTENTS

INDEX OF CONTENTS 2
TECHNICAL SPECIFICATIONS 3
ELECTROMAGNETIC COMPATIBILITY (EMC) 4
SAFETY 5
INTRODUCTION 7
INSTALLATION AND OPERATOR INSTRUCTIONS 8
MAINTENANCE 12
MAJOR COMPONENTS LOCATION 13
THEORY OF OPERATION 14
TROUBLESHOOTING AND REPAIR SECTION 20
CASE COVER REMOVAL AND DC BUS CAPACITOR DISCHARGE PROCEDURE 24
DC BUS CAPACITORS DISCHARGE PROCEDURE 26
EMI FILTER BOARD RESISTANCE TEST 27
INPUT RECTIFIER RESISTANCE TEST 29
INVERTER BOARD RESISTANCE TEST 31
OUTPUT BRIDGE RESISTANCE TEST 33
GAS SOLENOID COIL RESISTANCE TEST 35
OUTPUT STUDS RESISTANCE TEST 37
EMI FILTER BOARD VOLTAGE TEST 39
INPUT RECTIFIER VOLTAGE TEST 41
AUX. POWER SUPPLY BOARD VOLTAGE TEST 43
INVERTER BOARD VOLTAGE TEST 45
CONTROL BOARD VOLTAGE TEST 47
DISASSEMBLY OPERATIONS 50
RETEST AFTER REPAIR 62
ELECTRICAL SCHEMATICS 63
ERROR CODES 64
NOTE 65

Technical Specifications

NAME	INDEX
INVERTEC®400TP	**K14390-1**

INPUT		
	Input Voltage U_1	**EMC Class**
INVERTEC®400TP	400V ± 15%, 3-phase	A

	I_{1eff}	**I_{1max}**
INVERTEC®400TP	16,9A	24,9A

	Input Power at Rated Cycle	**Input Amperes I_{1max}**	**PF(400V)**
INVERTEC®400TP	4,0 kVA @100% (GTAW)	12,1A	0,89
	11,1 kVA @60% (GTAW)	15,7A	0,91
	12,9 KVA @40% (GTAW)	18,6A	0,92
	11,9 kVA @100% (SMAW)	16,9A	0,91
	15,1 kVA @60% (SMAW)	21,5A	0,92
	17,4 kVA @40% (SMAW)	24,9A	0,93

RATED OUTPUT				
	Process	**Duty Cycle 40°C (based on a 10 min. period)**	**Output Current**	**Output Voltage**
INVERTEC®400TP	GTAW	100%	300A	22V
		60%	360A	24,4V
		40%	400A	26V
	SMAW	100%	300A	32V
		60%	360A	34,4V
		40%	400A	36V

OUTPUT RANGE			
	GTAW	**SMAW**	**Peak Open Circuit Voltage U_0**
INVERTEC®400TP	5 – 400A	5 – 400A	85V

RECOMMENDED INPUT CABLE AND FUSE SIZES		
	Fuse Type gR or Circuit Breaker Type Z	**Power Lead**
INVERTEC®400TP	25A, 400 Vac	4 Conductors, 4,0mm^2

DIMENSION				
	Weight	**Height**	**Width**	**Length**
INVERTEC®400TP	31,5kg	509 mm	294 mm	624 mm

OTHERS		
	Protection Rating	**Maximum Gas Pressure**
INVERTEC®400TP	IP23	0,5MPa (5 bar)

	Operating Temperature	**Storage Temperature**
INVERTEC®400TP	from -10°C to +40°C	from -25°C to 55°C

Electromagnetic Compatibility (EMC)

01/11

This machine has been designed in accordance with all relevant directives and standards. However, it may still generate electromagnetic disturbances that can affect other systems like telecommunications (telephone, radio, and television) or other safety systems. These disturbances can cause safety problems in the affected systems. Read and understand this section to eliminate or reduce the amount of electromagnetic disturbance generated by this machine.

This machine has been designed to operate in an industrial area. To operate in a domestic area it is necessary to observe particular precautions to eliminate possible electromagnetic disturbances. The operator must install and operate this equipment as described in this manual. If any electromagnetic disturbances are detected the operator must put in place corrective actions to eliminate these disturbances, if necessary with assistance from Lincoln Electric.

⚠ WARNING

Provided that the public low voltage system impedance at the point of common coupling is lower than:

- 68 mΩ for the **INVERTEC®400TP.**

This equipment is compliant with IEC 61000-3-11 and IEC 61000-3-12 and can be connected to public low voltage systems. It is the responsibility of the installer or user of the equipment to ensure, by consultation with the distribution network operator if necessary, that the system impedance complies with the impedance restrictions.

Before installing the machine, the operator must check the work area for any devices that may malfunction because of electromagnetic disturbances. Consider the following.

- Input and output cables, control cables, and telephone cables that are in or adjacent to the work area and the machine.
- Radio and/or television transmitters and receivers. Computers or computer controlled equipment.
- Safety and control equipment for industrial processes. Equipment for calibration and measurement.
- Personal medical devices like pacemakers and hearing aids.
- Check the electromagnetic immunity for equipment operating in or near the work area. The operator must be sure that all equipment in the area is compatible. This may require additional protection measures.
- The dimensions of the work area to consider will depend on the construction of the area and other activities that are taking place.

Consider the following guidelines to reduce electromagnetic emissions from the machine.

- Connect the machine to the input supply according to this manual. If disturbances occur if may be necessary to take additional precautions such as filtering the input supply.
- The output cables should be as short as possible and positioned together as close as possible to each other. If possible connect the work piece to ground in order to reduce the electromagnetic emissions. The operator must check that connecting the work piece to ground does not cause problems or unsafe operating conditions for personnel and equipment.
- Shielding of cables in the work area can reduce electromagnetic emissions. This may be necessary for special applications.

⚠ WARNING

EMC classification of this product is class A in accordance with electromagnetic compatibility standard EN 60974-10 which means that the product is designed to be used in an industrial environment only.

⚠ WARNING

The Class A equipment is not intended for use in residential locations where the electrical power is provided by the public low-voltage supply system. There may be potential difficulties in ensuring electromagnetic compatibility in those locations, due to conducted as well as radiated disturbances.

Safety

01/11

WARNING

This equipment have to be used by qualified personnel. Be sure that all installation, operation, maintenance and repair procedures are performed only by qualified person. Read and understand this manual before operating this equipment. Failure to follow the instructions in this manual could cause serious personal injury, loss of life, or equipment damage. Read and understand the following explanations of the warning symbols. Lincoln Electric is not responsible for damages caused by improper installation, improper care or abnormal operation.

	WARNING: This symbol indicates that instructions must be followed to avoid serious personal injury, loss of life, or equipment damage. Protect yourself and others from possible serious injury or death.
	READ AND UNDERSTAND INSTRUCTIONS: Read and understand this manual before operating this equipment. Arc welding can be hazardous. Failure to follow the instructions in this manual could cause serious personal injury, loss of life, or equipment damage.
	ELECTRIC SHOCK CAN KILL: Welding equipment generates high voltages. Do not touch the electrode, work clamp, or connected work pieces when this equipment is turned on. Insulate yourself from the electrode, work clamp, and connected work pieces.
	ELECTRICALLY POWERED EQUIPMENT: Turn off the input power using the disconnect switch at the fuse box before working on this equipment. Ground this equipment in accordance with local electrical regulations.
	ELECTRICALLY POWERED EQUIPMENT: Regularly inspect the input, electrode, and work clamp cables. If any insulation damage exists replace the cable immediately. Do not place the electrode holder directly on the welding table or any other surface in contact with the work clamp to avoid the risk of accidental arc ignition.
	ELECTROMAGNETIC FIELD MAY BE DANGEROUS: Electric current flowing through any conductor creates electromagnetic field (EMF). EMF fields may interfere with some pacemakers, and welders having a pacemaker shall consult their physician before operating this equipment.
	CE COMPLIANCE: This equipment complies with the European Community Directives.
	ARTIFICIAL OPTICAL RADIATION: According with the requirements in 2006/25/EC Directive and EN 12198 Standard, the equipment is a category 2. It makes mandatory the adoption of Personal Protective Equipment (PPE) having filter with a protection degree up to a maximum of 15, as required by EN169 Standard.
	FUMES AND GASES CAN BE DANGEROUS: Welding may produce fumes and gases hazardous to health. Avoid breathing these fumes and gases. To avoid these dangers the operator must use enough ventilation or exhaust to keep fumes and gases away from the breathing zone.
	ARC RAYS CAN BURN: Use a shield with the proper filter and cover plates to protect your eyes from sparks and the rays of the arc when welding or observing. To protect the skin, use suitable clothing made of durable, fireproof material. Protect other nearby personnel with suitable, non-flammable screening and warn them not to watch the arc nor expose themselves to the arc.

	WELDING SPARKS CAN CAUSE FIRE OR EXPLOSION: Remove fire hazards from the welding area and have a fire extinguisher easily accessible. Welding sparks and hot materials from the welding process can easily go through small cracks and openings to adjacent areas. Do not weld on any tanks, drums, containers, or material until the proper steps have been taken to insure that no flammable or toxic vapors will be present. Never use this equipment when flammable gases, vapors or flammable liquids are present.
	WELDED MATERIALS CAN BURN: Welding generates a large amount of heat. Hot surfaces and materials in work area can cause serious burns. Use gloves and pliers when touching or moving materials in the work area.
	CYLINDER MAY EXPLODE IF DAMAGED: Use only certificate, compressed gas cylinders containing the correct shielding gas for the process used and properly operating regulators designed for the gas and pressure used. Always keep cylinders in an upright position securely chained to a fixed support. Do not move or transport gas cylinders with the protection cap removed. Do not allow the electrode, electrode holder, work clamp or any other electrically live part to touch a gas cylinder. Gas cylinders must be located away from areas where they may be subjected to physical damage or the welding process including sparks and heat sources.
	MOVING PARTS ARE DANGEROUS: There are moving mechanical parts in this machine, which can cause serious injury. Keep your hands, body and clothing away from those parts during machine starting, operating and servicing.
HF	CAUTION: The high frequency used for contact-free ignition with TIG (GTAW) welding, can interfere with the operation of insufficiently shielded computer equipment, EDP centers and industrial robots, even causing complete system breakdown. TIG (GTAW) welding may interfere with electronic telephone networks and with radio and TV reception.
	HOT COOLANT CAN BURN SKIN: Always be sure coolant is NOT HOT before servicing the cooler.
S	SAFETY MARK: This equipment is suitable for supplying power for welding operations carried out in an environment with increased risk of electric shock.

The manufacturer reserves the right to make changes and/or improvements in design without upgrade at the same time the operator's manual.

Introduction

The welding machines **INVERTEC®400TP** enables welding:

- GTAW (TIG),
- SMAW (MMA),
- GOUGING (CAG).

The complete package contains:

- Work lead – 5m,
- Gas hose – 1,5m,
- Manual Instruction (USB).

Recommended equipment, which can be bought by user, was mentioned in the chapter "Accessories".

Installation and Operator Instructions

Read this entire section before installation or operation of the machine.

Location and Environment

This machine will operate in harsh environments. However, it is important that simple preventative measures are followed to assure long life and reliable operation.

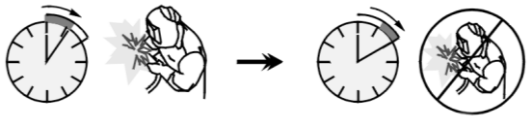
- Do not place or operate this machine on a surface with an incline greater than 15° from horizontal.
- Do not use this machine for pipe thawing.
- This machine must be located where there is free circulation of clean air without restrictions for air movement to and from the air vents. Do not cover the machine with paper, cloth or rags when switched on.
- Dirt and dust that can be drawn into the machine should be kept to a minimum.
- This machine has a protection rating of IP23. Keep it dry when possible and do not place it on wet ground or in puddles.
- Locate the machine away from radio controlled machinery. Normal operation may adversely affect the operation of nearby radio controlled machinery, which may result in injury or equipment damage. Read the section on electromagnetic compatibility in this manual.
- Do not operate in areas with an ambient temperature greater than 40°C.

Duty cycle and Overheating

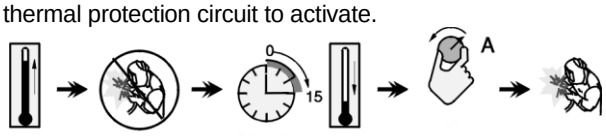
The duty cycle of a welding machine is the percentage of time in a 10 minute cycle at which the welder can operate the machine at rated welding current.

Example: 60% duty cycle

Welding for 6 minutes. Break for 4 minutes.



Excessive extension of the duty cycle will cause the thermal protection circuit to activate.



Minutes or decrease Duty Cycle

Input Supply Connection

⚠ WARNING

Only a qualified electrician can connect the welding machine to the supply network. Installation had to be made in accordance with the appropriate National Electrical Code and local regulations.

Check the input voltage, phase and frequency supplied to this machine before turning it on. Verify the connection of ground wires from the machine to the input source. The welding machine **INVERTEC®400TP** must be connected to a correctly installed plug-in socket with an earth pin.
Input voltage is 400 Vac 50/60Hz. For more information about input supply refer to the technical specification section of this manual and to the rating plate of the machine.

Make sure that the amount of mains power available from the input supply is adequate for normal operation of the machine. The necessary delayed fuse or circuit breaker and cable sizes are indicated in the technical specification section of this manual.

⚠ WARNING

The welding machine can be supplied from a power generator of output power at least 30% larger than input power of the welding machine.

⚠ WARNING

When powering the machine from a generator be sure to turn off welder first, before generator is shut down, in order to prevent damage to welder!

Output Connections

Refer to points [3] and [7] of the Figures below.

Controls and Operational Features

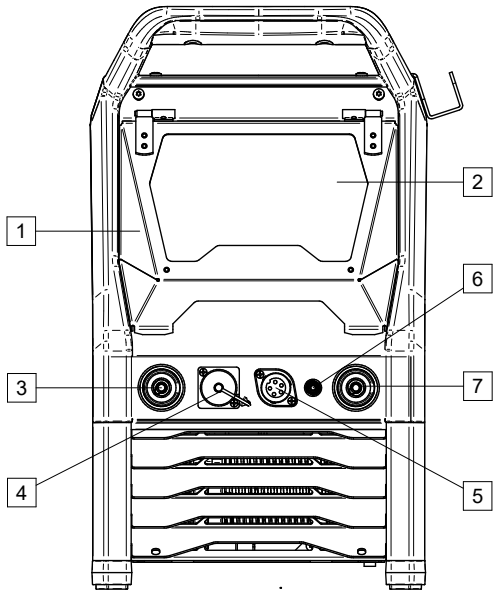


Figure 1

1. Display Cover. Display protection for User Interface.

2. User Interface: See User Interfaces chapter.

3. Positive Output Socket for the Welding Circuit: Depending on the process to connecting:

Process	Symbol	Description
GTAW		Work Lead
SMAW		Electrode Holder with lead / work lead depending on the require configuration
GAUGE		Gauge Torch / work lead depending on the require configuration

4. Remote Control Connector Plug: To install Remote Control Kit. This connector allows connection Remote Control. See "Accessories" chapter.

5. TIG Control Connector: To connect TIG Torch Trigger or "Up and Down".

6. Gas Connector: Connection TIG torch gas line.

7. Negative Output Socket for the Welding Circuit: Depending on the process to connecting:

Process	Symbol	Description
GTAW		TIG Torch
SMAW		Electrode Holder with lead / work lead depending on the require configuration
GAUGE		Gauge Torch / work lead depending on the require configuration

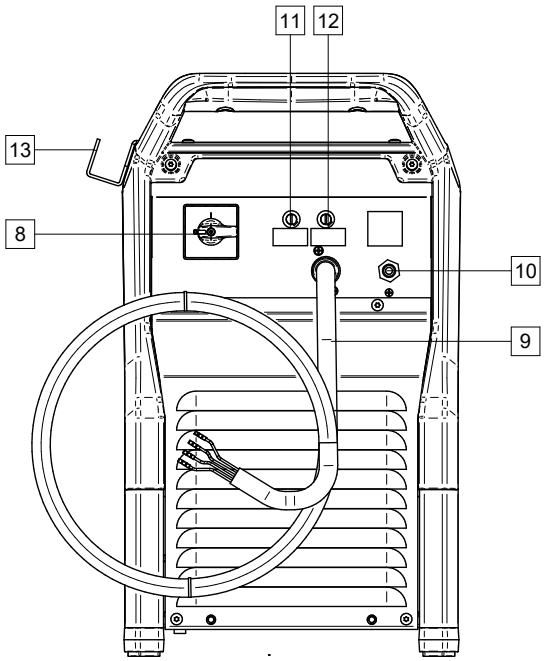


Figure 2

8. Power Switch ON/OFF (I/O): Controls the input power to the machine. Be sure the power source is connected to the mains supply before turning power on ("I").

9. Main Intput Cord (5m): Connect the supply plug to the existing input cable that is rated for the machine as indicated in this manual, and conforms to all applicable standards. This connection shall be performed by a qualified person only.

10. Gas Quick Coupling Socket: For connecting a gas line.

⚠ WARNING

The machine allows the use all suitable shielding gases with a maximum pressure of 5 bar.

11. Fuse F1: Use the 2A/400V (6,3x32mm) slow-blow fuse. See "Spare Parts" chapter.

12. Fuse F2: Use the 2A/400V (6,3x32mm) slow-blow fuse. See "Spare Parts" chapter.

13. TIG Torch Holder: Rotary TIG torch handle.

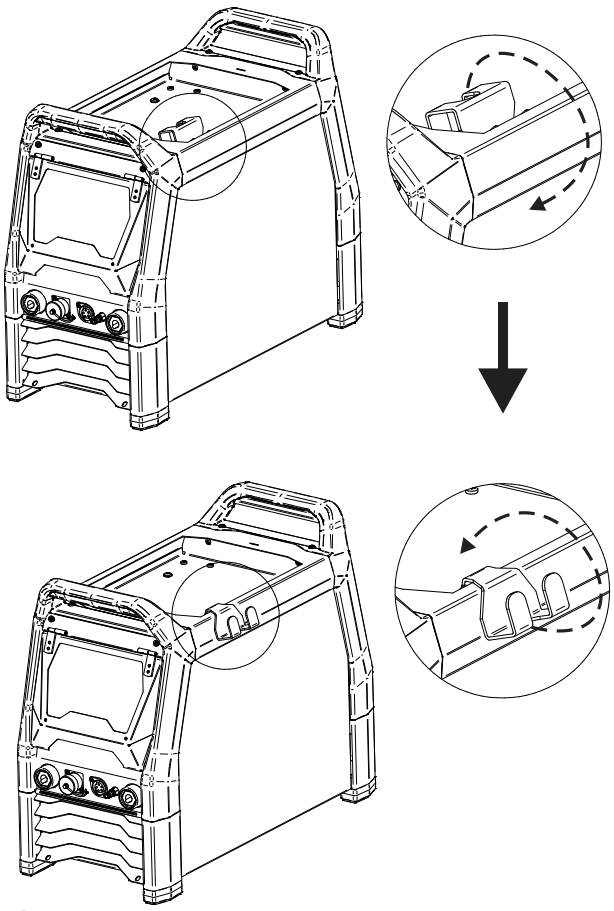


Figure 3

User Interface

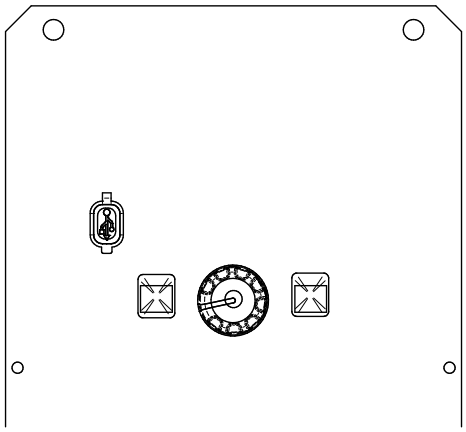


Figure 4

Detailed operation of Global User Interface can be found in the IM3187 user manual.

Welding GTAW Process

INVERTEC®400TP can be used to GTAW process with DC (-).

INVERTEC®400TP does not include the torch to GTAW welding, but the one can be purchased separately. See "Accessories" chapter.

Procedure of begin welding of GTAW process:

- First turn the machine off.
- Connect GTAW torch to [7] output socket.
- Connect the work lead to [3] output socket.
- Connect the work lead to the welding piece with the work clamp.
- Install the proper tungsten electrode in the GTAW torch.
- Turn the machine on.
- Set the welding parameters.

⚠ WARNING

Detailed operation can be found in the IM3187 user manual.

- The welding machine is now ready to weld.
- By applying the principle of occupational health and safety at welding, welding can be begun.

Welding SMAW Process

INVERTEC®400TP does not include the electrode holder with lead necessary for SMAW welding, but the one can be purchased separately. See "Accessories" chapter.

Procedure of begin welding of SMAW process:

- First turn the machine off.
- Determine the electrode polarity for the electrode to be used. Consult the electrode data for this information.
- Depending on the polarity of using electrode, connect the work lead and the electrode holder with lead to output socket [3] or [7] and lock them. See the Table 1.

Table 1 Polarity

			Output Socket	
POLARITY	DC (+)	The electrode holder with lead to SMAW	[3]	+
		Work lead	[7]	−
	DC (-)	The electrode holder with lead to SMAW	[7]	−
		Work lead	[3]	+

- Connect the work lead to the piece with the work clamp.
- Install the proper electrode in the electrode holder.
- Turn the machine on.
- Set the welding parameters.

⚠ WARNING

Detailed operation can be found in the IM3187 user manual.

- The welding machine is now ready to weld.
- By applying the principle of occupational health and safety at welding, welding can be begun.

Gouging

INVERTEC®400TP does not include the torch holder with lead necessary for gauging, but the one can be purchased separately. See "Accessories" chapter.

Procedure of begin of gouging process:

- First turn the machine off.
- Determine the electrode polarity for the electrode to be used. Consult the electrode data for this information.
- Depending on the polarity of using electrode, connect the work lead and the electrode holder with lead to output socket [3] or [7] and lock them. See the Table 1.

Table 2 Polarity

			Output Socket	
POLARITY	DC (+)	Gouging holder	[3]	+
		Work lead	[7]	−
	DC (-)	Gouging holder	[7]	−
		Work lead	[3]	+

- Connect the air connector of gouging holder to air source.
- Connect the work lead to the piece with the work clamp.
- Install the proper electrode in the electrode holder.
- Turn the machine on.
- Set the gouging parameters.

⚠ WARNING

Detailed operation can be found in the IM3187 user manual.

- The machine is now ready to gouging.
- By applying the principle of occupational health and safety at welding, welding can be begun.

Gas Connection

⚠ WARNING

- CYLINDER may explode if damaged.
- Always fix the gas cylinder securely in an upright position, against a cylinder wall rack or purpose-made cylinder cart.
- Keep cylinder away from areas where it may be damaged, heated or electrical circuits to prevent possible explosion or fire.
- Keep cylinder away from welding or other live electrical circuits.
- Never lift welder with cylinder attached.
- Never allow welding electrode to touch cylinder.
- Build up of shielding gas may harm health or kill. Use in a well-ventilated area to avoid gas accumulation.
- Close the gas cylinder valves thoroughly when not in use to avoid leaks.

⚠ WARNING

Welding machine supports all suitable shielding gases at a maximum pressure of 5,0 bar.

⚠ WARNING

Before use, make sure that the gas cylinder contains gas suitable for the intended purpose.

- Turn off input power at the welding power source.
- Install a proper gas flow regulator to the gas cylinder.
- Connect the gas hose to the regulator using the hose clamp.
- The other end of gas hose connect to the gas connector on the power source rear panel.
- Turn on input power at the welding power source.
- Open the gas cylinder valve.
- Adjust the shielding gas flow of the gas regulator.

MAINTENANCE

WARNING

ELECTRIC SHOCK can kill

Have an electrician install and service this equipment
Turn the input power off at the fuse box before working on equipment
Do not touch electrically hot parts
Prior to performing preventive maintenance, perform the following capacitor discharge procedure to avoid electric shock.

DC BUS CAPACITORS DISCHARGE PROCEDURE

1. Remove input power to the INVERTEC® 400TP
2. Remove the side panels following the instruction available in this Service Manual.
3. Obtain a high resistance and high wattage resistor (25-1000 ohms and 25 watts minimum). This resistor is NOT supplied with the machine. NEVER USE A SHORTING STRAP FOR THIS PROCEDURE.
4. Locate the two terminals **DC+** and **DC –** on the Inverter Board on the left side of the machine (**See Figure 1**).
5. Use electrically insulate gloves and insulated pliers. Hold the body of the resistor and connect the resistor leads across the two terminals. Hold the resistor in place for 10 seconds. DO NOT TOUCH CAPACITOR TERMINALS WITH YOUR BARE HANDS.
6. Check the voltage across the two terminals. Voltage should be zero. If any voltage remains, repeat this procedure.

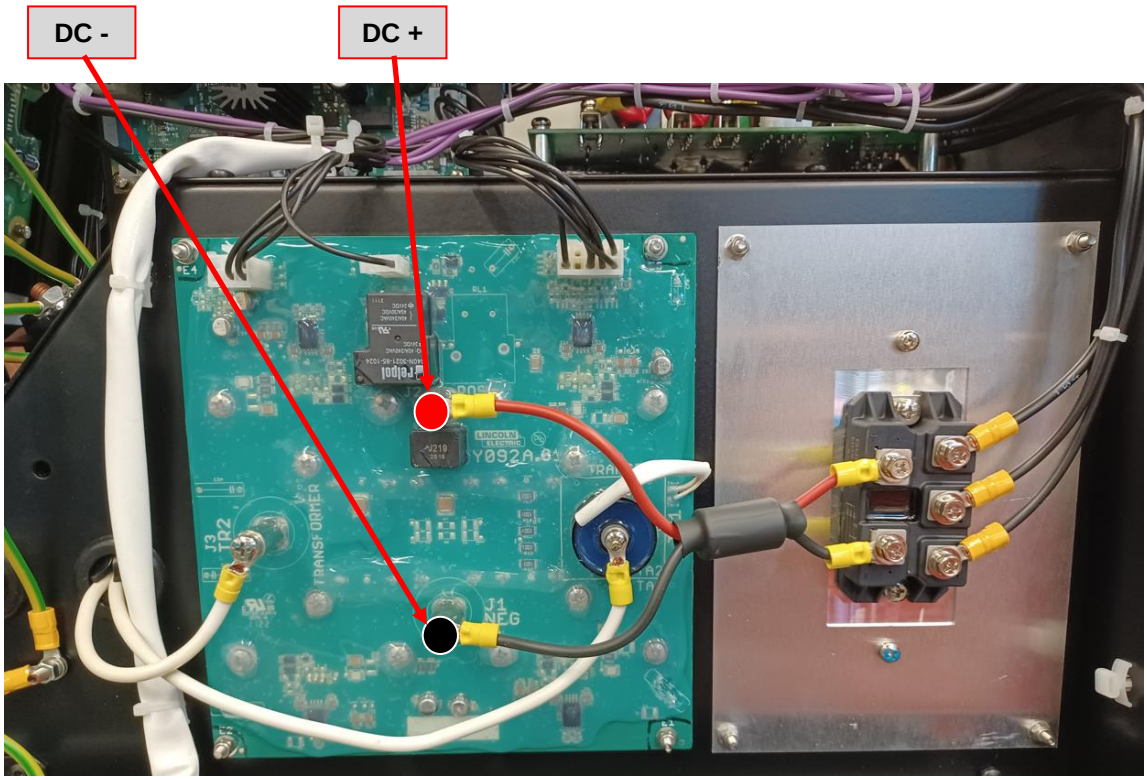
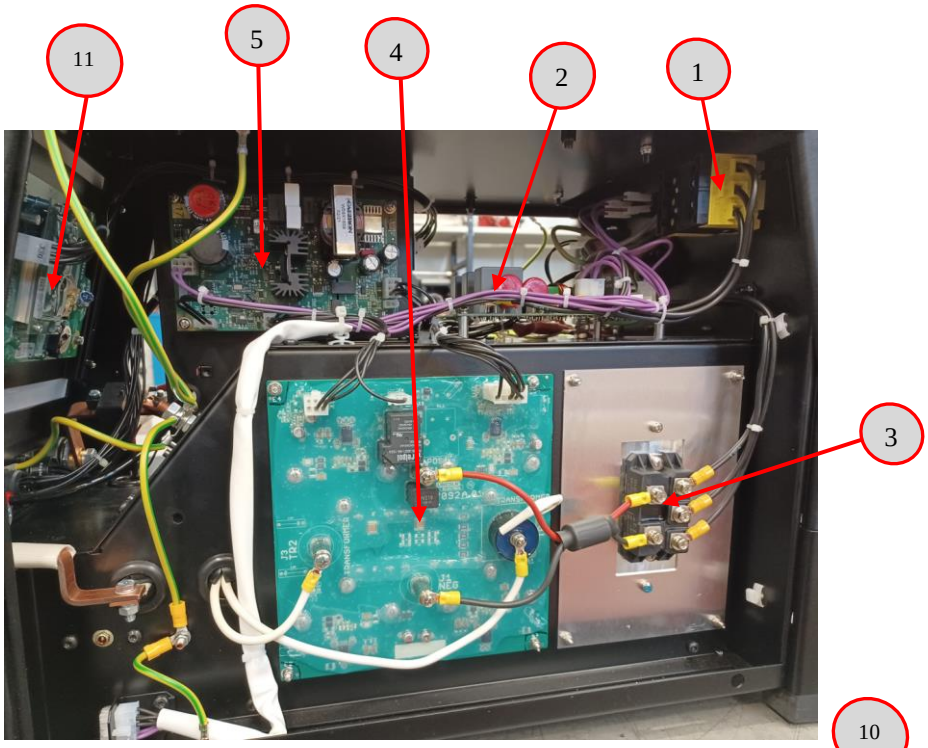


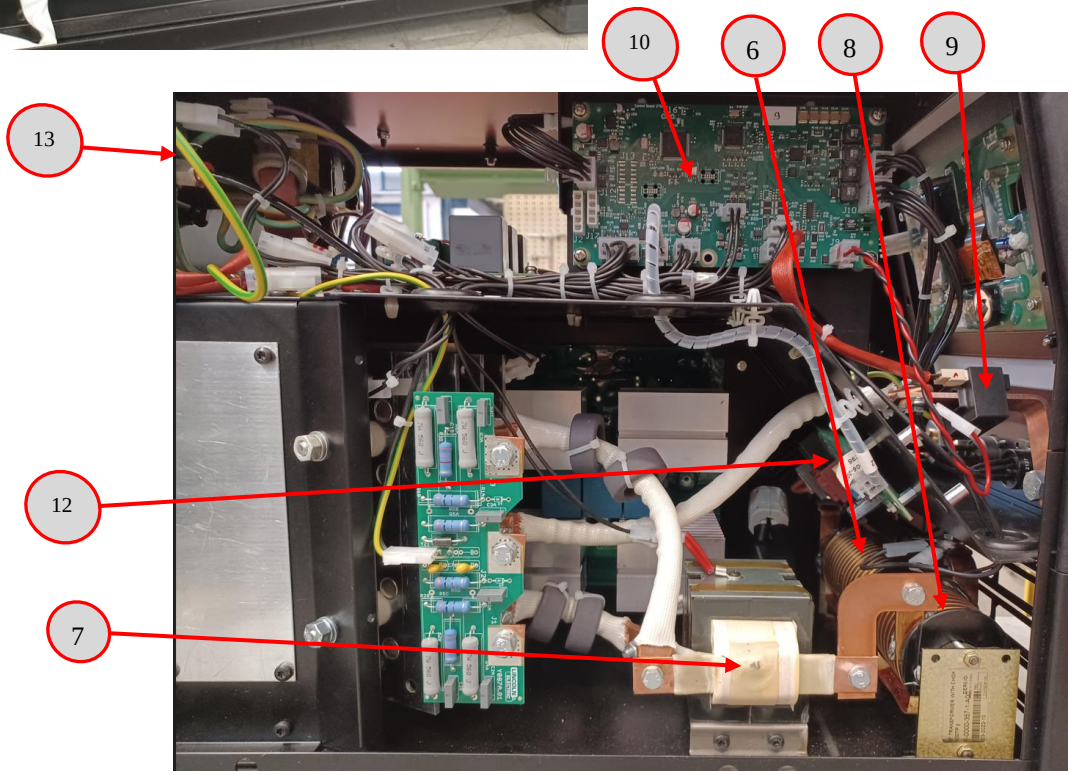
Figure 1
Showing machine right side

MAJOR COMPONENTS LOCATION

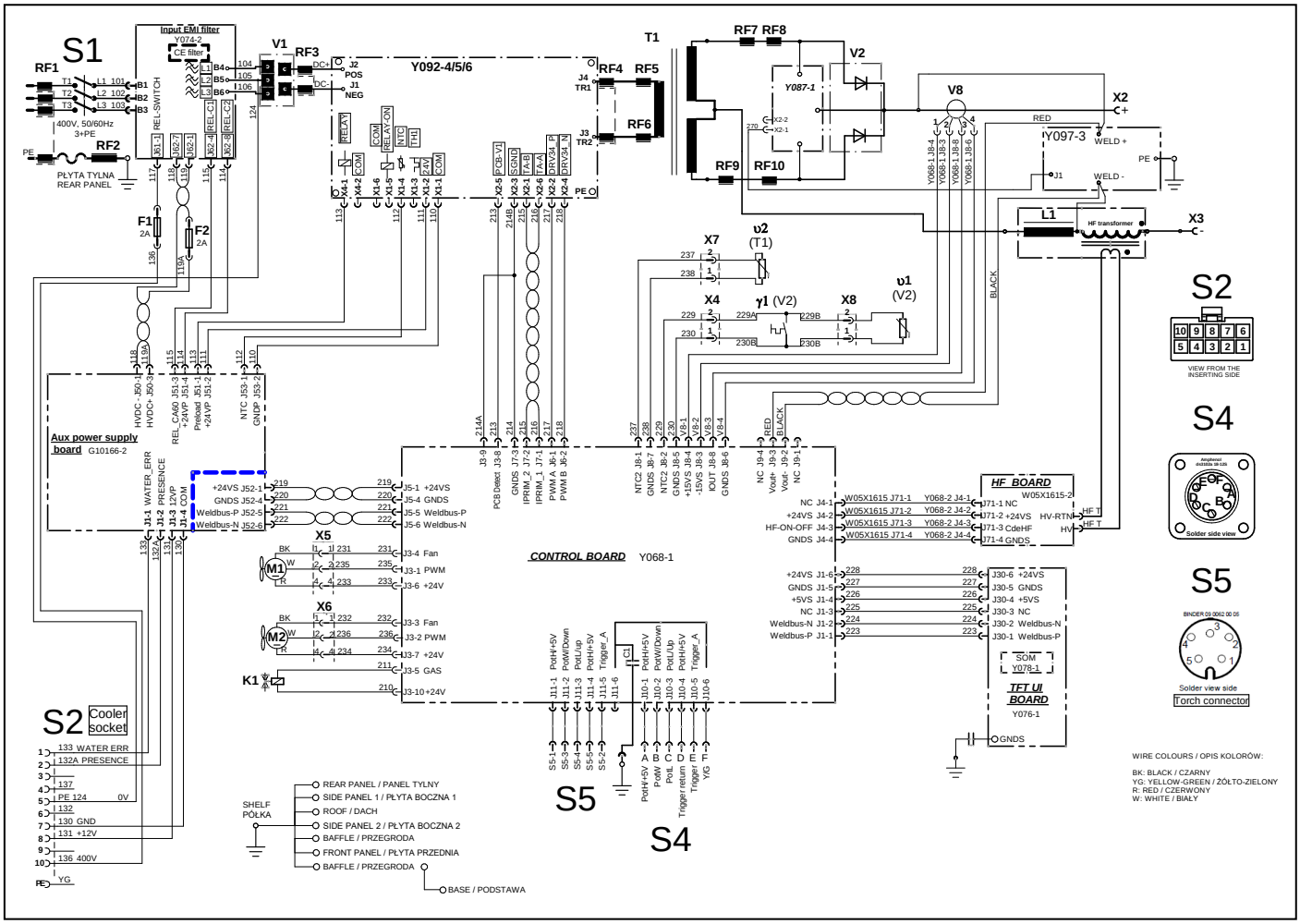
INVERTEC® 400TP

1. Main Switch
2. EMC Filter Board
3. Input Rectifier
4. Inverter
5. Aux. Power Supply Board
6. Output Choke
7. Output Transformer
8. HF Transformer
9. Output Current Transducer
10. Control Board
11. TFT UI Board
12. HF Board
13. Gas solenoid





INVERTEC® 400TP – WIRING DIAGRAM

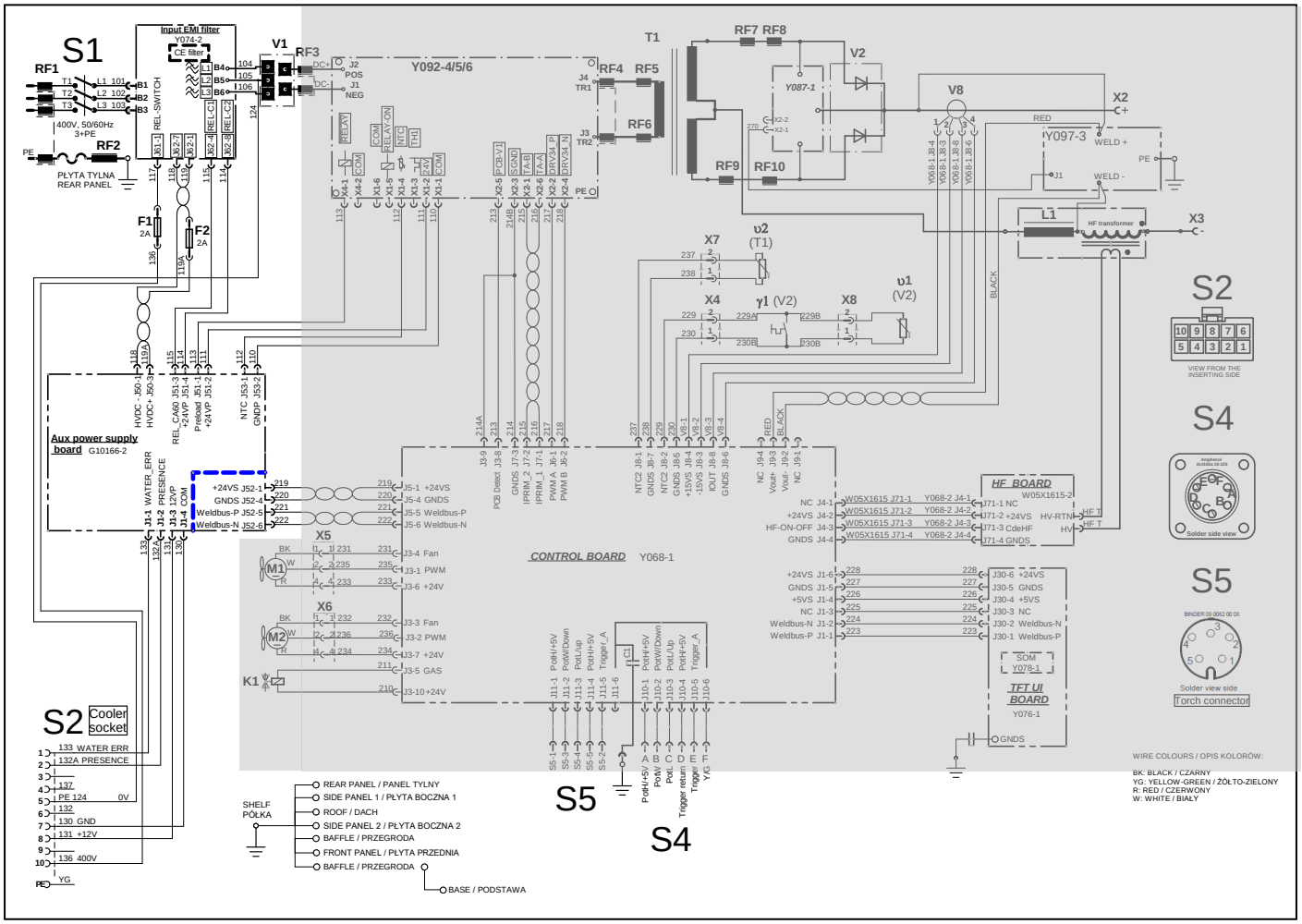


GENERAL DESCRIPTION

The Invertec® 400 TP is an inverter based welding power source that offer multi-mode (TIG and Stick) constant current welding. The machines operates on three phases input voltage 400Vac. The welding response of these Invertec is optimized for the stick (SMAW) and TIG (GTAW) welding processes.

Thanks to their IP23 rating and potted boards this power source can be used in both factory or field operations.
Water Cooler is available as an option and has to be installed on the bottom of the machine.

INPUT SECTION



INPUT SECTION

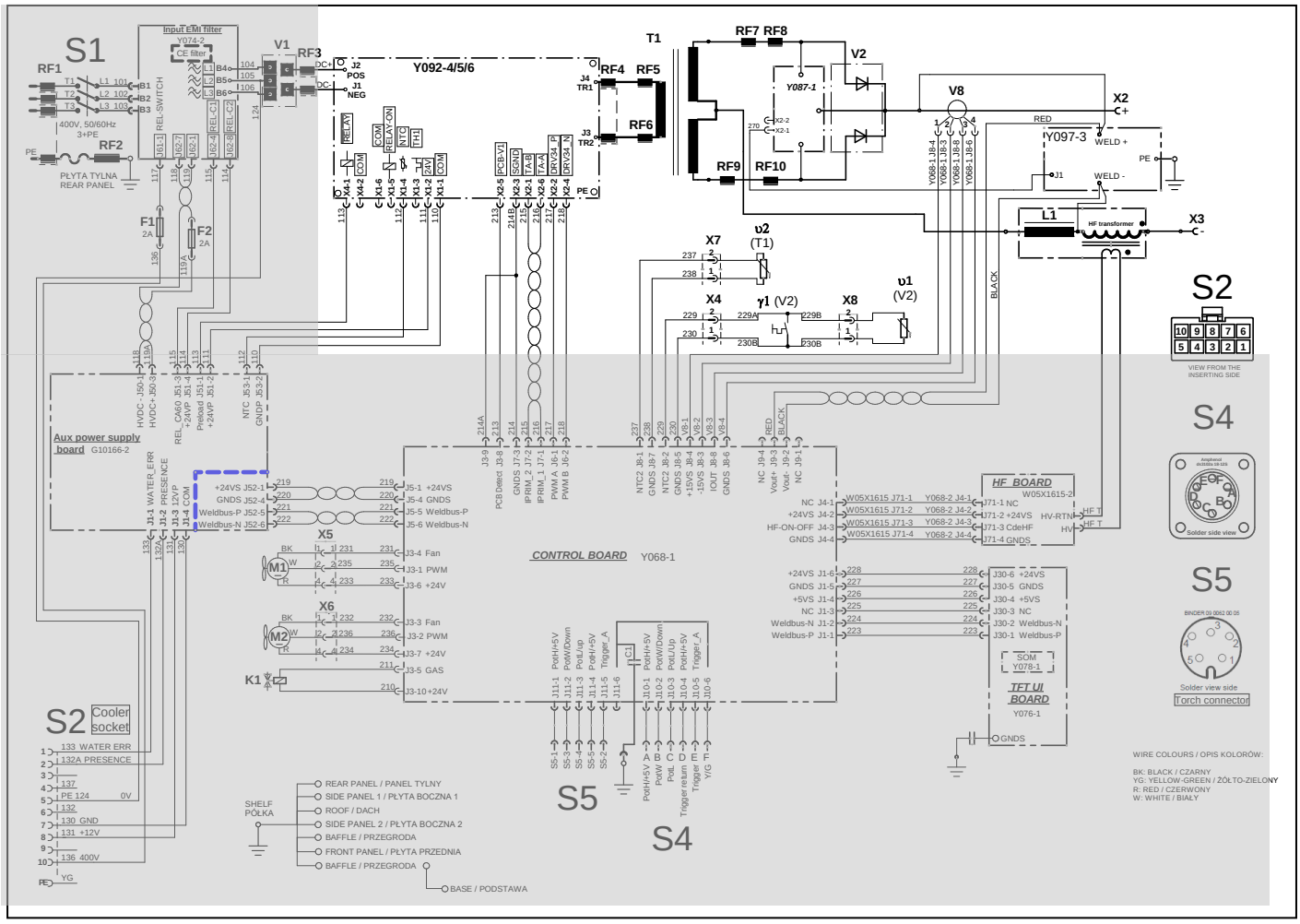
When the three phase input voltage 400Vac is applied to the Invertec® 400 TP and the input switch S1 is closed the voltage is applied to the Input EMI filter board.

EMI filter circuit prevents noise from the machine from being transmitted along the main power line and vice versa, necessary to be in accordance with all relevant directives and standards.

The three phases coming out from the EMI filter board are rectified by the input rectifier bridge and the resultant 565VDC voltage is applied to the Inverter Board.

The DC BUS voltage is reaching also the Aux. Power Board. The software loaded into the Aux. Power board monitors the input voltage and if all is correct provides the command to the relay on the Inverter board to close bypassing the start NTC resistor.
During this time the DC BUS capacitors on the Inverter board started to charge throught the NTC resistor located on the Inverter board. Once the relay closes the DC BUS capacitors on inverter board complete their charge.

The Aux. Power Supply board provides all the lower power supply needed by the machine's PCBs including the insulated 24Vdc needed to supply the Control Board.



INVERTER AND OUTPUT CIRCUITS, MAIN TRANSFORMER AND OUTPUT SECTIONS

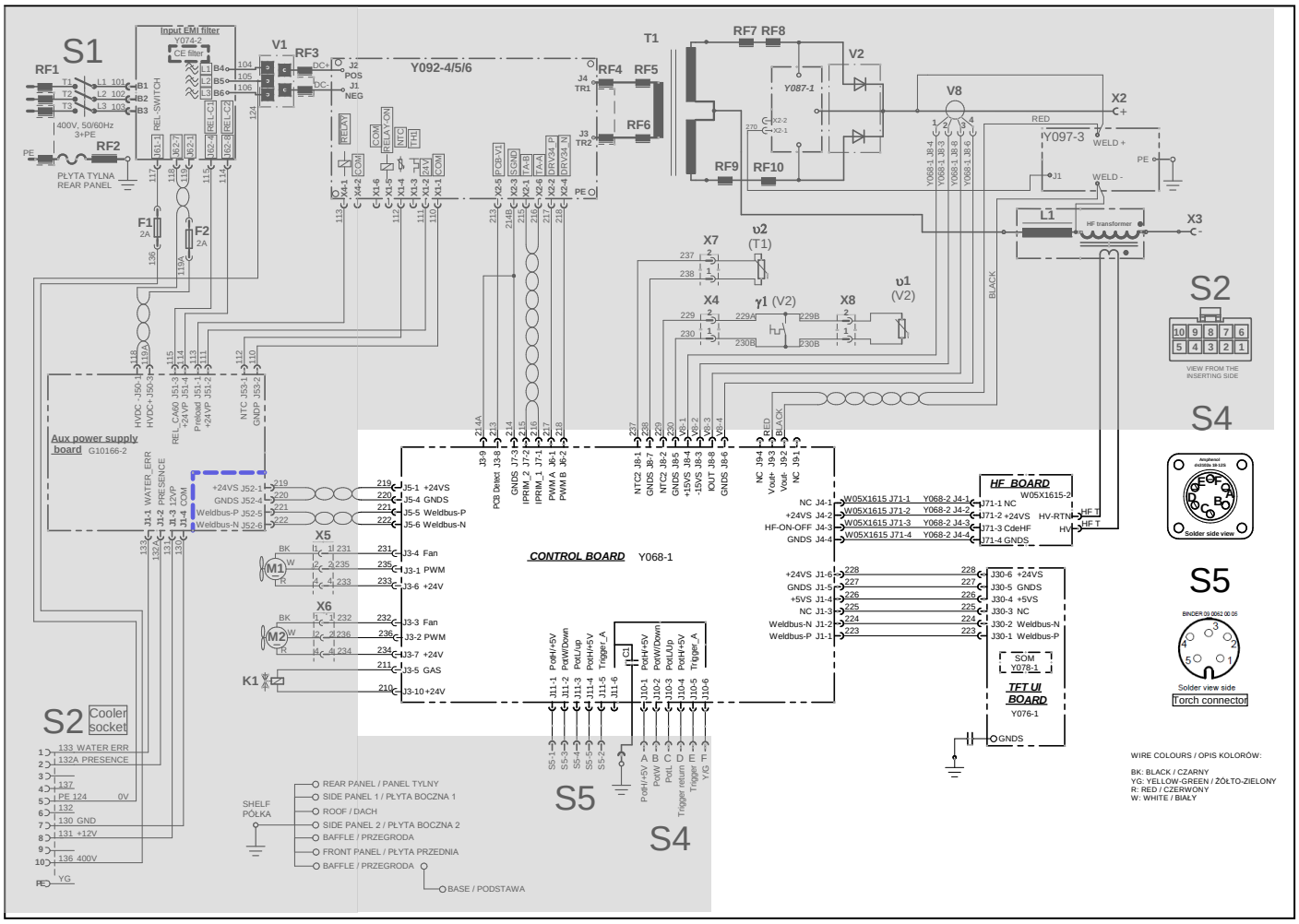
The inverter board receives the rectified primary power from the rectifier bridge (565Vdc) and it converts this power from DC to AC high frequency that is applied to the primary windings of the main welding transformer (T1).

The primary winding of the main welding transformer receives the Pulse Width Modulated power from the switch board. The AC output that is created on the secondary windings is applied to the output rectifier circuit (located on the same board of the Inverter circuits).
The resultant rectified DC- power is applied, through an output choke, to the HF transformer and after to the negative output terminal. The DC+ pass through the current transducer and it is connected to the positive stud.

The output choke L1 provides filtering to enhance the arc performance and accurate waveform response.

The current transducer provides an accurate feedback of output current to the control circuits section of the control board to obtain the correct output characteristic.

CONTROL BOARD – TFT UI & HF BOARD



CONTROL BOARD AND TFT UI BOARD

The Control Board managing all the functions of the machine, a microprocessor is present on it to make the correct operations. The Control Board receives signals from different area of the machine, power supply from Aux. Power Supply board and selecting parameters from the User Interface to create the reference signal for the inverter.
Control Board and User interface communicate via serial bus.
The Control Board supplies power for the User Interface Board and supplies signals to the User Interface to show set and actual current values, error codes and pre-set values. It also receives signals from the TIG torch connector (pin 1 & 2) or remote connector (pin D & E) to initiate the welding output.
The remote control signals (Pins A, B & C) are also fed into the Control Board from the 6 pins connector located on the front of the machine.

HF BOARD AND HF TRANSFORMER

The HF Board generates a set of 97Hz pulses of about 1000V. These pulses are applied to the high voltage/frequency transformer that is located in the negative welding output leg of the machine and are amplified to about 10KV.
This high frequency/voltage pulse is transferred to the TIG torch via the high frequency transformer.
This allows the remote starting of the TIG arc without the need for the tungsten electrode to touch the work.
This high frequency pulse is switched off when the welding arc is established.
The HF command signals are received from the microprocessor on the Control Board and stays on, if the welding arc is not established for about 3 seconds maximum. The HF Board is supplied from the input power board with 24Vdc and 15Vdc.
HF is disable in Stick and Lift TIG modes.

OVERLOAD PROTECTION

Invertec® 400 TP is electrically protected from producing higher output currents. An electronic protection circuit limits the current to within the capabilities of the machine.

THERMAL PROTECTION

Thermal Protection Devices protect the machine from excessive operating temperatures.
Excessive temperature may be caused by a lack of cooling air or by operating the machine beyond the duty cycle and output rating. If excessive operating temperature should occur, the Thermal LED indicator on the front panel, will turn ON and the thermostat will prevent output current.

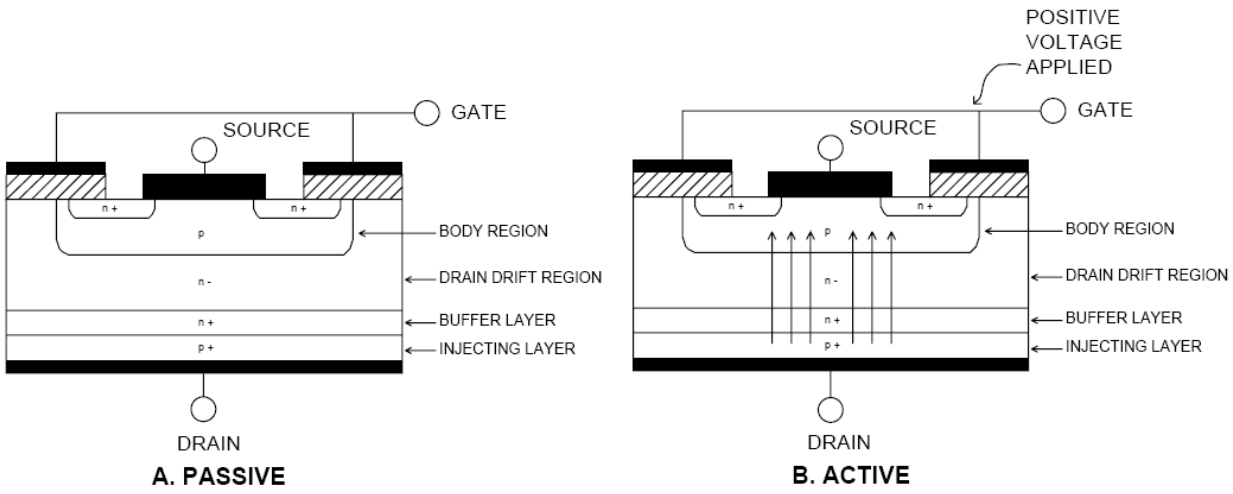
The thermal protections are self-resetting once the machine cools sufficiently. If the shut down was caused by excessive output or duty cycle and the fan is operating normally, the power switch may be left on and the reset should occur within about 15 minute period. If the fan is not turning or the air intake louvers are obstructed, the input power must be removed and the fan problem or air obstruction must be corrected.

INSULATED GATE BIPOLAR TRANSISTOR (IGBT) OPERATION

An IGBT is a type of transistor. IGBTs are semicon-ductors well suited for high frequency switching and high current applications. Drawing A shows an IGBT in a passive mode. There is no gate signal, zero volts relative to the source, and therefore, no current flow. The drain terminal of the IGBT may be connected to a voltage supply; but since there is no conduction the circuit will not supply current to components connected to the source. The circuit is turned off like a light switch in the OFF position.

Drawing B shows the IGBT in an active mode. When the gate signal, a positive DC voltage relative to the source, is applied to the gate terminal of the IGBT, it is capable of conducting current. A voltage supply connected to the drain terminal will allow the IGBT to conduct and supply current to circuit components coupled to the source. Current will flow through the conducting IGBT to downstream components as long as the positive gate signal is present. This is similar to turning ON a light switch

IGBT



TROUBLESHOOTING AND REPAIR SECTION

- How to use troubleshooting Guide
- Troubleshooting Guide
- Case cover removal and capacitor discharge procedure

HOW TO USE TROUBLESHOOTING GUIDE

Service and repair should be performed by only Lincoln Electric Factory Trained Personnel. Unauthorized repairs performed on this equipment may result in danger to the technician and machine operator and will invalidate your factory warranty. For your safety and to avoid Electrical Shock, please observe all safety notes and precautions detailed throughout this manual.

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This Troubleshooting Guide is provided to help you locate and repair possible machine malfunctions. Simply follow the three-step procedure listed below.

Step 1. LOCATE PROBLEM (SYMPTOM). Look under the column labeled “PROBLEMS”. This column describes possible symptoms that the machine may exhibit. Find the listing that best describes the symptom that the machine is exhibiting. Symptoms are grouped into three main categories: Output Problems, Function Problems, and LED Function Problems.

Step 2. PERFORM EXTERNAL TESTS. The second column, labeled “CHECKS”, lists the obvious external possibilities that may contribute to the machine symptom. Perform these tests/checks in the order listed. In general, these tests can be conducted without removing the case wrap-around cover.

Step 3. PERFORM COMPONENT TESTS. The last column, labeled “RECOMMENDED COURSE OF ACTION ” lists the most likely components that may have failed in your machine. It also specifies the appropriate test procedure to verify that the subject component is either good or bad. If there are a number of possible components, check the components in the order listed to eliminate one possibility at a time until you locate the cause of your problem.

All of the referenced test procedures referred to in the Troubleshooting Guide are described in detail at the end of this chapter. Refer to the Troubleshooting and Repair Table of Contents to locate each specific Test Procedure. All of the referred to test points, components, terminal strips, etc., can be found on the referenced electrical wiring diagrams and schematics. Refer to the Wiring Diagrams Section Table of Contents to locate the appropriate diagram.

WARNING

ELECTRIC SHOCK can kill

- Have an electrician install and service this equipment
- Turn the input power off at the fuse box before working on equipment
- Do not touch electrically hot parts
- Prior to performing preventive maintenance, perform the following capacitor discharge procedure to avoid electric shock

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Sometimes machine failures appear to be due to PC board failures. These problems can sometimes be traced to poor electrical connections. To avoid problems when troubleshooting and replacing PC boards, please use the following procedure:

1. Determine to the best of your technical ability that the PC board is the most likely component causing the failure symptom.
2. Check for loose connections at the PC board toassure that the PC board is properly connected.
3. If the problem persists, replace the suspect PC board using standard practices to avoid static electrical damage and electrical shock.
4. Test the machine to determine if the failure symptom has been corrected by the replacement PC board.

NOTE: Allow the machine to heat up so that all electrical components can reach their operating temperature.

5. Remove the replacement PC board and substitute it with the original PC board to recreate the original problem.
   - If the original problem does not reappear by substituting the original board, then the PC board was not the problem. Continue to look for bad connections in the control wiring harness, junction blocks, and terminal strips.
   - If the original problem is recreated by the substitution of the original board, then the PC board was the problem. Reinstall the replacement PC board and test the machine.
6. Always indicate that this procedure was follow when warranty reports are to be submitted.

NOTE: Following this procedure and writing on the warranty report, “INSTALLED AND SWITCHED PC BOARDS TO VERIFY PROBLEM,” will help avoid denial of legitimate PC board warranty claims.

TROUBLESHOOTING

!! WARNING !! **BEFORE CONNECT POWER SUPPLY, MAKE A CAREFUL VISUAL INSPECTION INSIDE THE MACHINE, CHECK ALL THE BOARDS AND HARNESS.**

PROBLEMS / SYMPTOMS	CHECKS / ERROR DESCRIPTION	RECOMMENDED COURSE OF ACTION
A VISUAL DAMAGE IS EVIDENT WHEN YOU OPEN THE COVER	----------	• REPLACE THE BROKEN PART AND PERFORM THE TESTS FOR THE OTHER MACHINE COMPONENTS
MACHINE IS DEAD, NO STATUS LED	• MAKE SURE THAT THE INPUT LINE IS PRESENT • CHECK THE MACHINE ON/OFF SWITCH • CHECK THE PRESENCE OF THE 565 Vdc AT THE INPUT RECTIFIER DC+ AND DC-	• CONNECT THE INPUT LINE • REPLACE THE MACHINE ON/OFF SWITCH IF NECESSARY • PERFORM THE INPUT RECTIFIER VOLTAGE TEST AND THE PRELOAD BOARD TEST AVAILABLE ON THIS MANUAL
THE MAIN INPUT FUSES REPEATEDLY FAIL OR THE INPUT LINE CIRCUIT BREAKER TRIPPING	• MAKE CERTAIN THE FUSES OR BREAKERS ARE PROPERLY SIZED FOR THE INPUT DRAW OF THE MACHINE. SEE MACHINE RATING PLATE OR TECHNICAL SPECIFICATION AVAILABLE IN THIS SERVICE MANUAL • A SHORT CIRCUIT MAY BE PRESENT INSIDE THE MACHINE	• PERFORM THE 3PH INPUT RECTIFIER BRIDGE • PERFORM THE INVERTER BOARD TEST
THERE IS NO WELDING OUTPUT	• MAKE SURE THAT THE RECTIFIED VOLTAGE IS APPLIED TO THE INVERTER BOARD. • ONE OF THE MACHINE THERMAL SENSOR MAY HAS TRIPPED, CHECK TERMAL STATUS LED. • MAY BE ONE OF THE OUTPUT RECTIFIER DIODE IS IN SHORT CIRCUIT	• CHECK THE PRESENCE OF THE INPUT 3 PHASES AT INPUT SWITCH , EMI FILTER; PERFORM THE EMC FILTER BOARD AND INPUT RECTIFIER BRIDGE TESTS • DO NOT TURN THE UNIT OFF, ALLOW THE MACHINE TO COOL DOWN, THE THERMAL PROTECTION CIRCUITS WILL RESET THEMSELVES, IF NOT CHECK THE THERMAL SENSORS AND THERMAL SENSORS CIRCUIT • PERFORM THE OUTPUT RECTIFIER MODULES TESTS
THE THERMAL LAMP IS ON, THE MACHINE OVERHEAT VERY FREQUENTLY	• THE WELDING CURRENT USED MAY EXCEED THE MACHINE DUTY CYCLE • DUST MAY HAVE CLOGGED THE COOLING HEAT-SINK • LOUVERS MAY BE BLOCKED BY INADEQUATE CLEARANCE AROUND THE MACHINE • MAY BE THE FAN IS NOT WORKING	• CHECK AND FOLLOW THE MACHINE DUTY CYCLE • CLEAN THE MACHINE USING DRY COMPRESSED AIR • REMOVE ANY PARTS AROUND THE MACHINE THAT MAY BLOCK THE AIR FLOW AND THE LOUVERS • PERFORM THE FANS TEST

These tests and repair should only be performed by Lincoln Electric Factory Trained Personnel. Unauthorized repairs performed on this equipment may result in danger to the technician and machine operator and will invalidate your factory warranty. For your safety and to avoid Electrical Shock, please observe all safety notes and precautions detailed throughout this manual.

CASE COVER REMOVAL AND DC BUS CAPACITOR DISCHARGE PROCEDURE

WARNING

Service and repair should be performed only by Lincoln Electric factory trained personnel.Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact your Local Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed.

……

DESCRIPTION

This procedure will aid the technician in the removal and replacement of the case sheet metal cover and discharging the DC link capacitor making it safe for the technician to work on the machine.

MATERIALS NEEDED

TORX wrench TX-25

INVERTEC® 400TP - SIDE PANELS AND TOP COVER REMOVAL

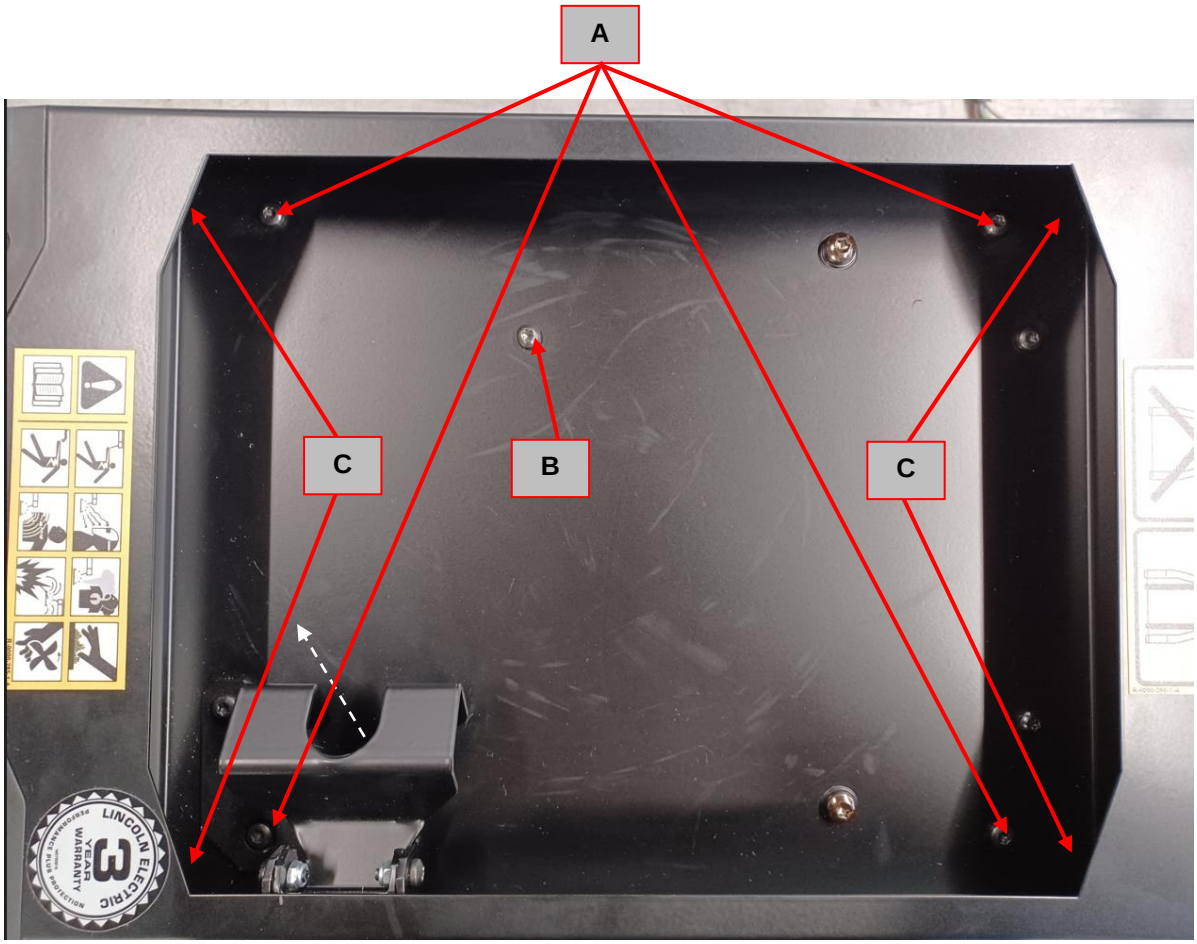

Figure 1

Procedure:

1. Turn ON/OFF switch to OFF position.
2. **Disconnect Input Power from the machine !**
3. Using the TORX wrench TX-25 driver, remove the 4 screws (**A**) on the bottom of machine
4. Remove the two side panels sliding them downward, taking care to disconnect the two ground wires connected to each panel.
5. Using the TORX wrench TX-25 driver, remove the screw (**B**) on the top of machine
6. Using the TORX wrench TX-25 driver, remove the 4 screw (**C**) on the top of machine that fix the cover to the front and rear machine frame.
7. Careefully remove the cover from the machine
8. Follow the next page for **DC BUS capacitors discharge procedure!**

DC BUS CAPACITORS DISCHARGE PROCEDURE

WARNING

ELECTRIC SHOCK can kill

Have an electrician install and service this equipment
Turn the input power off at the fuse box before working on equipment
Do not touch electrically hot parts
Prior to performing preventive maintenance, perform the following capacitor discharge procedure to avoid electric shock.

DC BUS CAPACITORS DISCHARGE PROCEDURE

1. Remove input power to the INVERTEC® 400 TP
2. Remove the side panels following the instruction available in this Service manual.
3. Obtain a high resistance and high wattage resistor (25-1000 ohms and 25 watts minimum). This resistor is NOT supplied with the machine. NEVER USE A SHORTING STRAP FOR THIS PROCEDURE.
4. Locate the two terminals **DC+** and **DC –** on the Switch Board on the right side of the machine (**See Figure 1**).
5. Use electrically insulate gloves and insulated pliers. Hold the body of the resistor and connect the resistor leads across the two terminals. Hold the resistor in place for 10 seconds. DO NOT TOUCH CAPACITOR TERMINALS WITH YOUR BARE HANDS.
6. Check the voltage across the two terminals. Voltage should be zero. If any voltage remains, repeat this procedure.

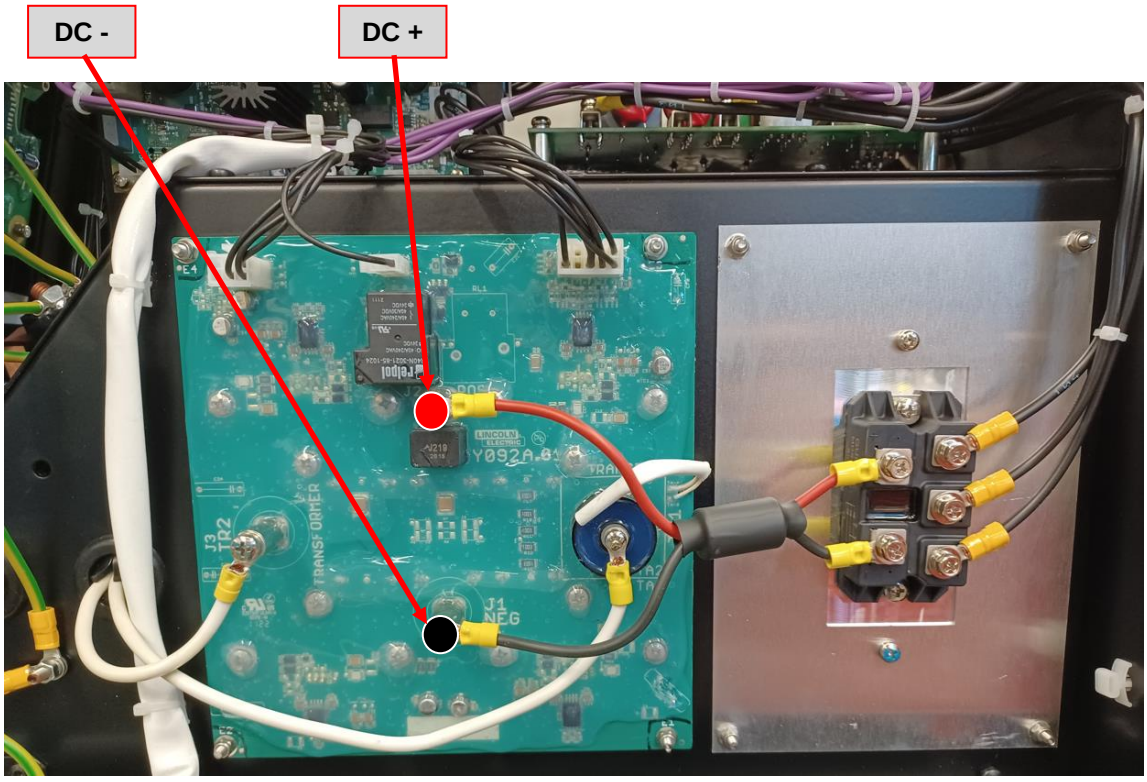

Figure 1
Showing machine right side

EMI FILTER BOARD RESISTANCE TEST

WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual. If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact your Local Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed.

……

TEST DESCRIPTION

This test will determine if the EMI Filter board has failed.

MATERIALS NEEDED

Multimeter
Machine wiring diagram

EMI FILTER BOARD RESISTANCE TEST (continued)

⚠ WARNING

- Disconnect input power before servicing.
- Do not operate with covers removed.
- Do not touch electrically live parts.
- Only qualified persons should install, use or service this equipment.

ELECTRIC SHOCK CAN KILL

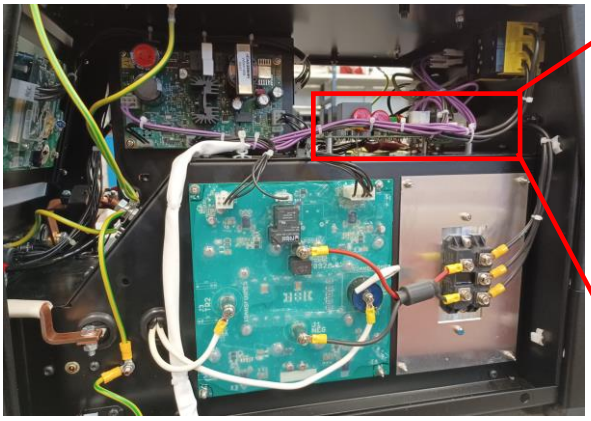

Figure 1

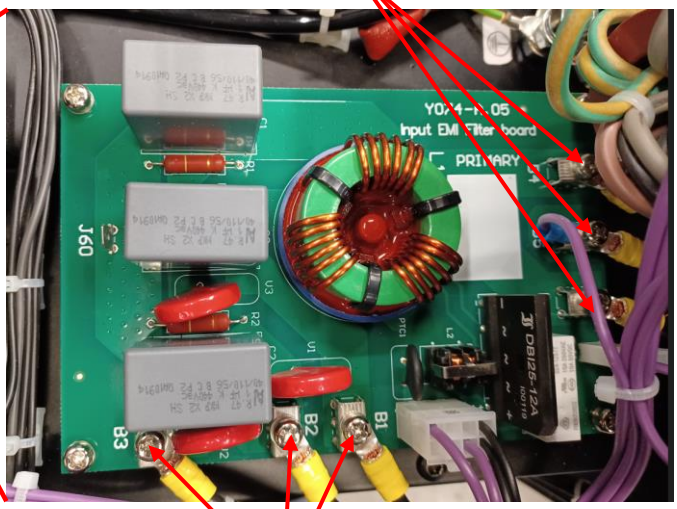

Figure 2

TEST PROCEDURE

⚠ **Use always electrically insulate gloves during this test procedure**

1. Remove main input power to the INVERTEC® 400 TP
2. Perform the **Side Panels removal** and **Discharge procedure**
3. Locate the EMI filter board on the right side of the machine. **See Figure 1**
4. Visually check for burned or damaged components. If any components are physically damaged they have to be replaced
5. Using the multimeter (ohm mode) perform the tests as indicated in **Test Table 1**. See **Figure 2** for correct test points location.

Test table 1 – EMI FILTER BOARD test

Machine condition	*Probe*	*Probe*	*Value*
Machine disconnected from input voltage and capacitors discharged.	B1	B4	Less than 10 ohms
	B2	B5	Less than 10 ohms
	B3	B6	Less than 10 ohms

INPUT RECTIFIER RESISTANCE TEST

WARNING

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TEST DESCRIPTION

This test will determine if the Input Rectifier Bridge has failed.

MATERIALS NEEDED

Multimeter
8mm nut driver
Machine Wiring Diagram

INPUT RECTIFIER RESISTANCE TEST (continued)

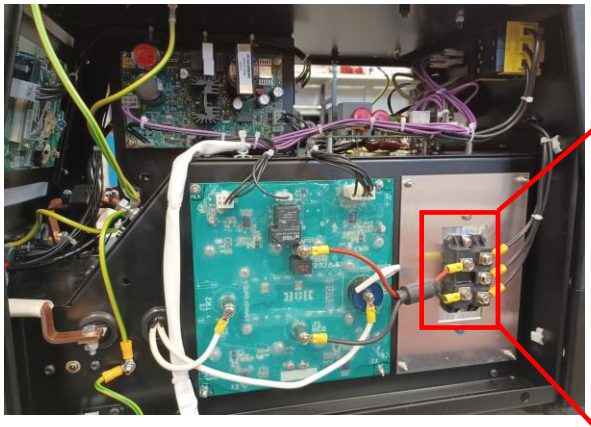

Figure 1

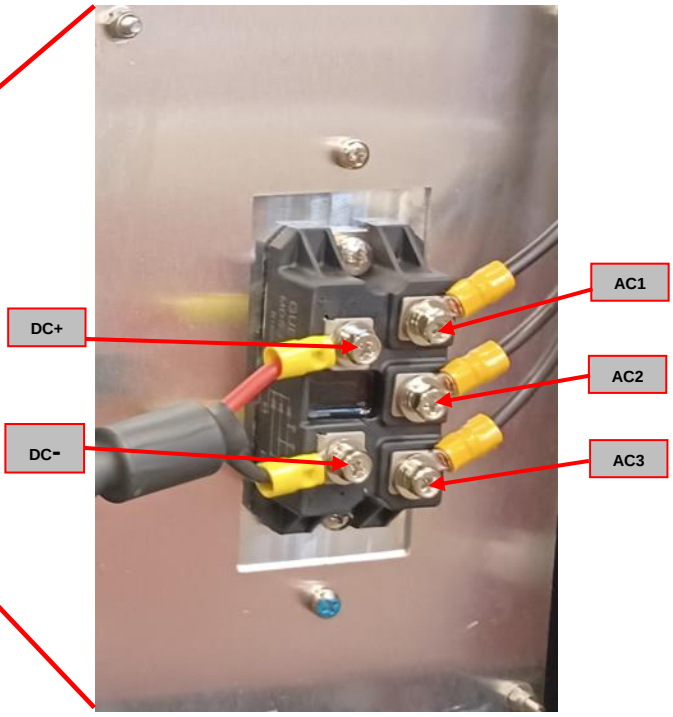

Figure 2

TEST PROCEDURE

⚠ **Use always electrically insulate gloves during this test procedure**

1. Remove main input power to the INVERTEC® 400 TP.
2. Perform the **Side Panels removal** and **Discharge procedure**
3. Locate the Input Rectifier Bridge. See **Figure 1**.
4. Using the multimeter (diode test mode) perform the tests as detailed in **Test table 2**. See also **Figure 2** for terminals locations.
5. If the tests results are questionable, label and remove all of the leads from the Input Rectifier Bridge and re-test.
6. If any portion of the test fails, the input rectifier may be faulty and it must be replaced.

Test table 2 – Input Rectifier Bridge Test

Positive Probe (RED)	*Negative Probe (BLACK)*	*Value*
Terminal AC1	Terminal AC2 – AC3	Open
Terminal AC2	Terminal AC1 – AC3	Open
Terminal AC3	Terminal AC1 – AC2	Open
Terminal AC1 – AC2 – AC3	DC+	0,3-0,4
Terminal AC1 – AC2 – AC3	DC-	Open

INVERTER BOARD RESISTANCE TEST

WARNING

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……

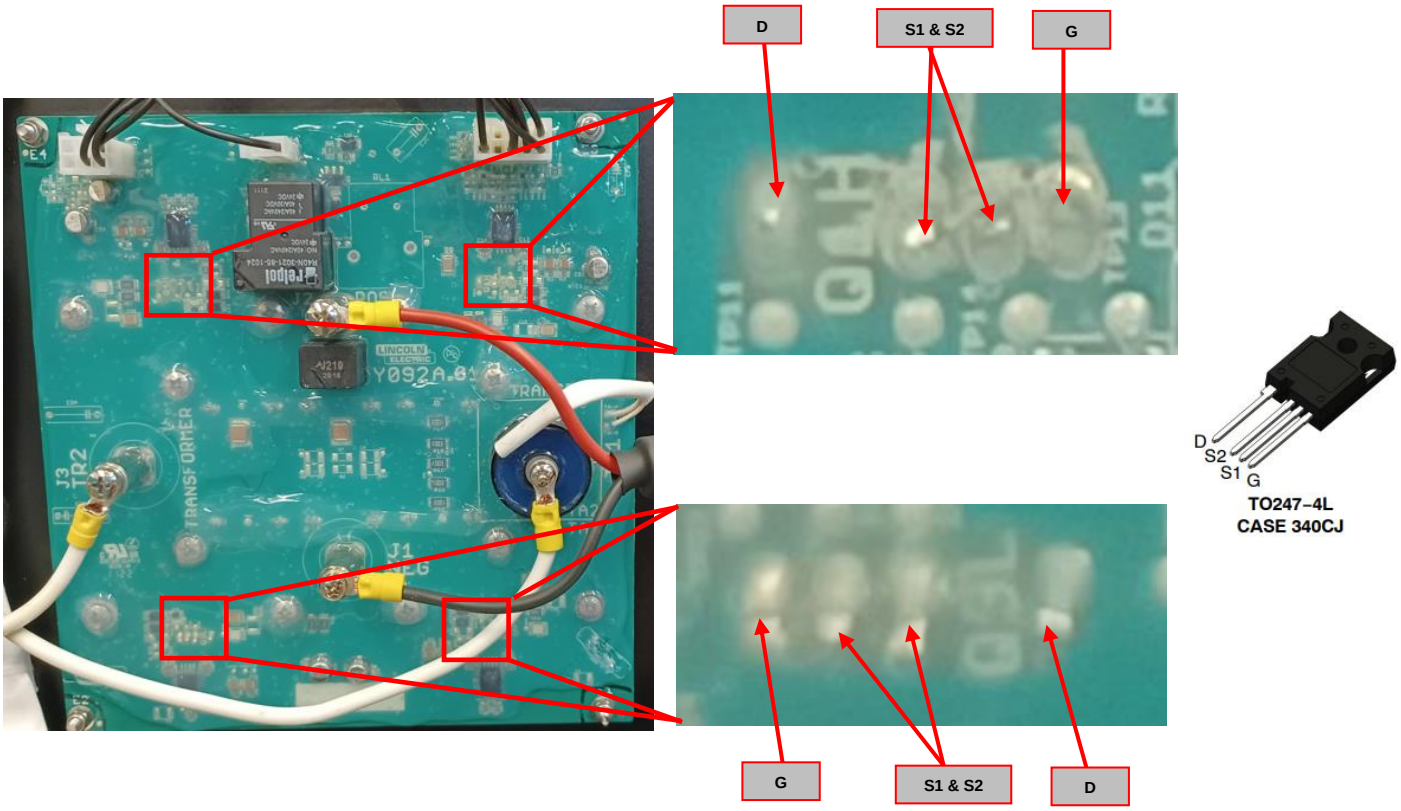
TEST DESCRIPTION

This test will help to determine if the power section of the inverter board is working correctly. This test will not indicate if the entire board is fuctional.

MATERIALS NEEDED

Multimeter
Machine schematic
PH02 screw driver

INVERTER BOARD RESISTANCE TEST (continued)



TEST PROCEDURE

⚠ **Use always electrically insulate gloves during this test procedure**

1. Remove main input power to the INVERTEC® 400 TP.
2. Perform the **Side Panels removal** and **Discharge procedure**
3. Locate the Inverter board.
4. Visually check for burned area or damaged components. If any components are physically damaged or there are clear sign of burned area the Inverter board should be replaced
5. Using the multimeter in diode test mode perform the tests detailed in **Test Table 1**. See above picture for Test Point locations.

Test table 1 – Inverter board resistance test

Positive Probe (RED)	*Negative Probe (BLACK)*	*Value*
D	S1 or S2	Open
S1 or S2	D	1,0-1,3
D	G	Open
G	D	1-1,4
G	S1 or S2	0,7
S1 or S2	G	0,7

Note: If any of the above test fails the Inverter board may be faulty and must be replaced

OUTPUT BRIDGE RESISTANCE TEST

WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual. If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact your Local Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed.

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TEST DESCRIPTION

This test will help to determine if the power section of the inverter board is working correctly. This test will not indicate if the entire board is fuctional.

MATERIALS NEEDED

Multimeter
Machine schematic
10 mm wrench

OUTPUT BRIDGE RESISTANCE TEST

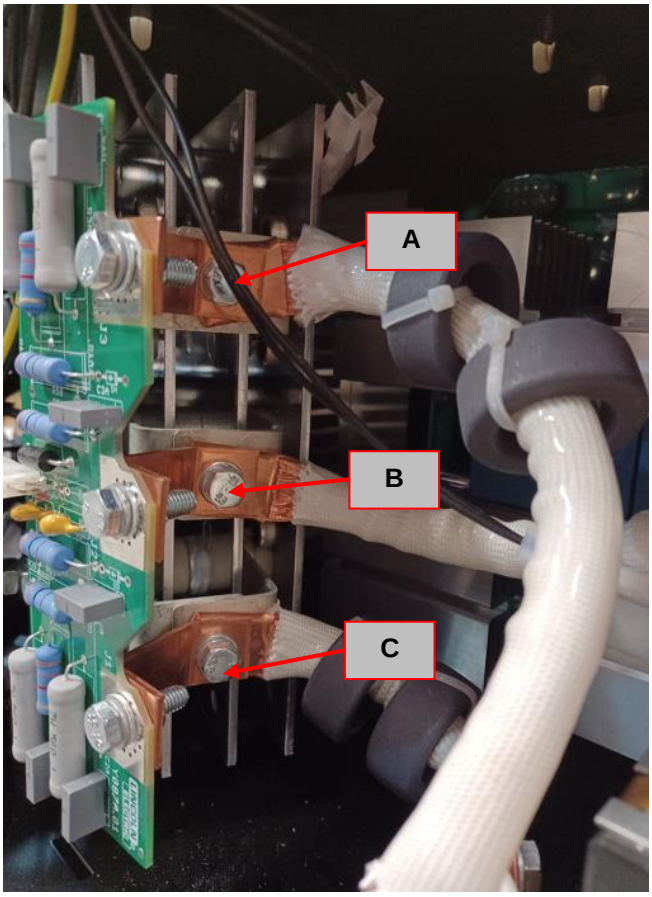

Figure 1

TEST PROCEDURE

⚠ **Use always electrically insulate gloves during this test procedure**

1. Remove main input power to the INVERTEC® 400 TP.
2. Perform the **Side Panels removal** and **Discharge procedure**
3. Locate the output bridge location inside the machine. See **Figure 1**.
4. Using the 10mm wrench, disconnect cables (**A**), (**B**), (**C**) from the Output Diodes. See **Figure 1.**

Test table 2 – Output Rectifier Bridge Test

Positive Probe (RED)	*Negative Probe (BLACK)*	*Value*
A	B	0,3 – 0,4
A	C	open
B	A	Open
B	C	Open
C	A	open
C	B	0,3 – 0,4

GAS SOLENOID COIL RESISTANCE TEST

WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual. If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact your Local Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed.

……

TEST DESCRIPTION

This test will help determine if the gas solenoid is Damaged or not.

MATERIALS NEEDED

Multimeter
Machine schematic

GAS SOLENOID COIL RESISTANCE TEST (continued)

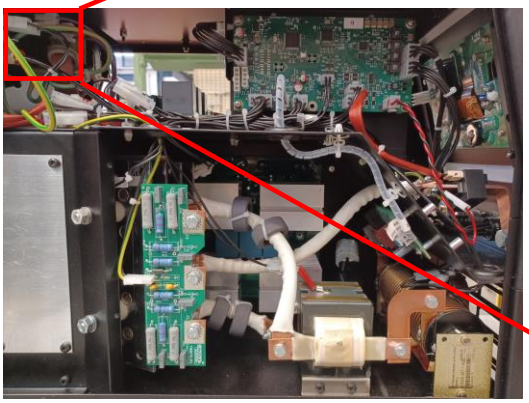

Figure 1

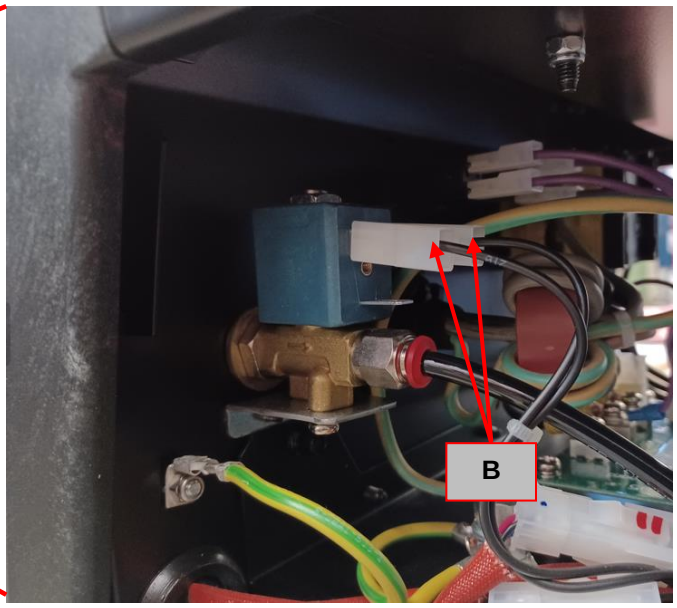

Figure 2

TEST PROCEDURE

⚠ **Use always electrically insulate gloves during this test procedure**

5. Remove main input power to the INVERTEC® 400 TP.
6. Perform the **Side Panels removal** and **Discharge procedure**
7. Locate the gas solenoid location inside the machine. See **Figure 1**.
8. Disconnect at least one cable (**B**) form the gas solenoid. See **Figure 2**.
9. Using the ohmmeter check the resistance value of the gas solenoid coil. It should be **60 ohms** +/- 15%

OUTPUT STUDS RESISTANCE TEST

WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual. If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact your Local Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed.

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TEST DESCRIPTION

This test will help determine if the output of the machine ahs the correct resistance value.

MATERIALS NEEDED

Multimeter
Machine schematic

OUTPUT STUDS RESISTANCE TEST (continued)

Figure 1 – Output studs location

TEST PROCEDURE

⚠ **Use always electrically insulate gloves during this test procedure**

1. Remove main input power to the INVERTEC® 400 TP.
2. Perform the **Side Panels removal** and **Discharge procedure**
3. Locate the Output Studs. See **Figure 1**.
4. Using the ohmmeter check the resistance value between the Positive and Negative Studs, correct value should be between 1,5 and 1,6 Kohms.
5. If different value is measured, perform the output diode test.

EMI FILTER BOARD VOLTAGE TEST

WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual. If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact your Local Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed.

……..

TEST DESCRIPTION

This test will help to determine if the input voltage applied to the EMI filter is passing through it and arrive correctly to the Preload board.

MATERIALS NEEDED

Volt/Ohmmeter
Machine Wiring Diagrams

EMI FILTER BOARD VOLTAGE TEST (continued)

WARNING

ELECTRIC SHOCK CAN KILL

- Disconnect input power before servicing.
- Do not operate with covers removed.
- Do not touch electrically live parts.
- Only qualified persons should install, use or service this equipment.

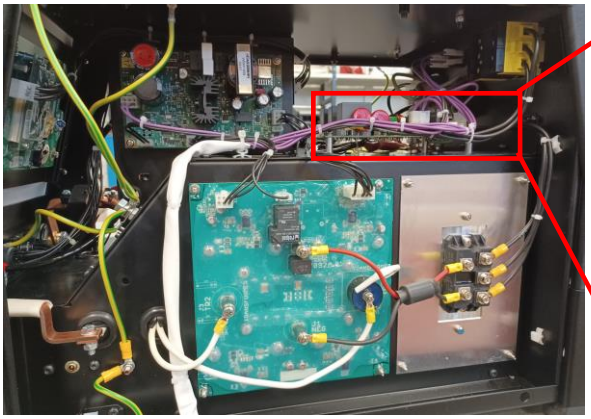

Figure 1

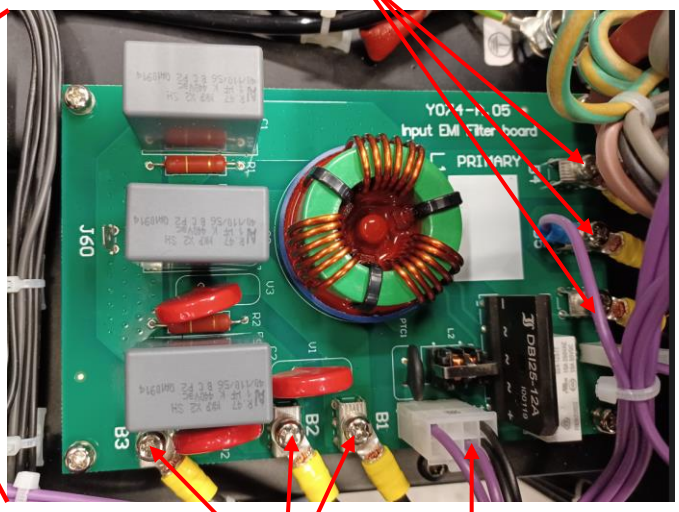

Figure 2

TEST PROCEDURE

⚠ **Use always electrically insulate gloves during this test procedure**

1. Remove main input power to the INVERTEC® 400 TP.
2. Perform the **Side Panels removal** and **Discharge procedure** available in this Service Manual
3. Apply 400 Vac +/- 10% to the INVERTEC® 400 TP.
4. Switch ON the machine.
5. Check between EMI filter input voltage points **B1, B2** and **B3** for 400Vac +/- 10% and between EMI output points **B4, B5** and **B6** also for 400Vac +/- 10%
6. Perform the test following Test table 1:

Test table 1 – EMI BOARD Voltage Test

Probe	*Probe*	*Value*
J62 / pin 1	J62 / pin 7	550Vdc +/-15%

INPUT RECTIFIER VOLTAGE TEST

WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual. If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact your Local Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed.

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TEST DESCRIPTION

This test will determine if the Input Rectifier Bridge is working.

MATERIALS NEEDED

Multimeter
Machine Wiring Diagram

INPUT RECTIFIER VOLTAGE TEST (continue)

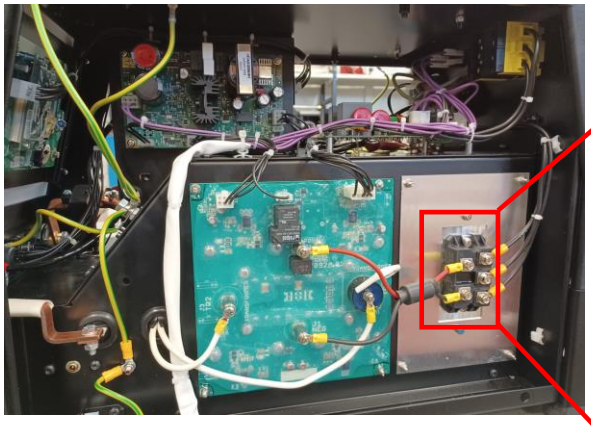

Figure 1

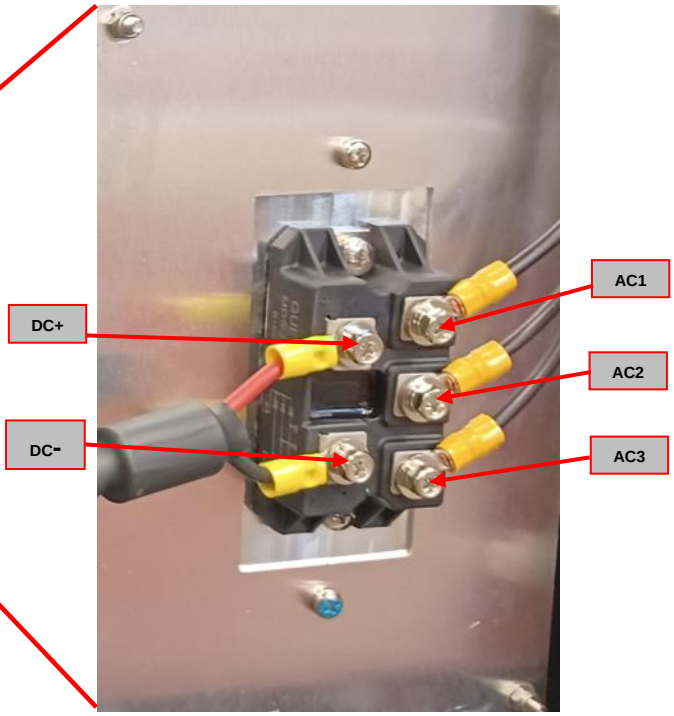

Figure 2

TEST PROCEDURE

⚠ **Use always electrically insulate gloves during this test procedure**

1. Remove main input power to the INVERTEC® 400 TP.
2. Perform the **Side Panels removal** and **Discharge procedure** available in this Service Manual
3. Apply 400 Vac +/- 10% to the INVERTEC® 400 TP.
7. Switch ON the machine
8. Using the multimeter in VAC and VDC mode perform the tests as indicated in **Test Table 1**. See **Figure 10** for correct test point locations.

Test table 1 – Input Rectifier Bridge Voltage Test

Positive Probe (RED)	*Negative Probe (BLACK)*	*Value*
Terminal AC1	Terminal AC2	400Vac +/-15%
Terminal AC2	Terminal AC3	400Vac +/-15%
Terminal AC1	Terminal AC3	400Vac +/-15%
Terminal DC+	Terminal DC-	565 Vdc +/-15%

AUX. POWER SUPPLY BOARD VOLTAGE TEST

WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual. If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact your Local Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed.

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TEST DESCRIPTION

This test will determine if the Aux. Power Supply Board is providing proper auxiliary voltages.

MATERIALS NEEDED

Multimeter
Machine Wiring Diagram

AUX. POWER SUPPLY BOARD VOLTAGE TEST (continue)

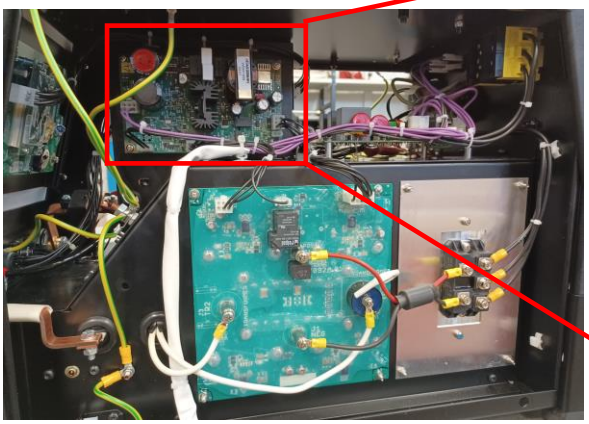

Figure 1

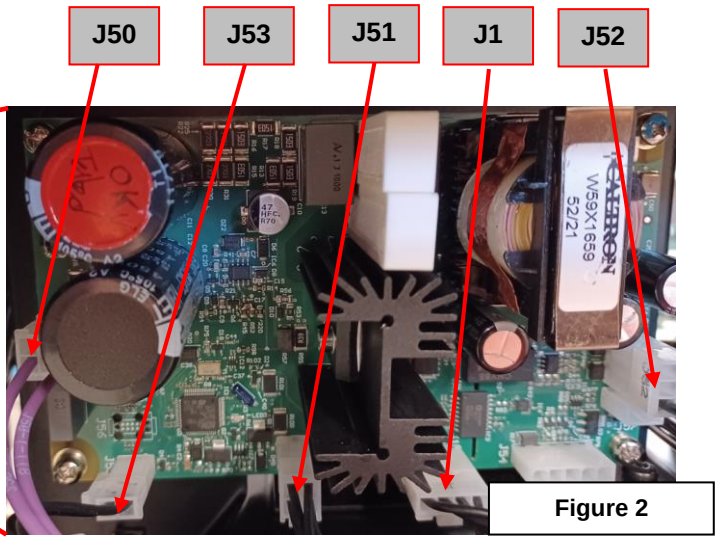

Figure 2

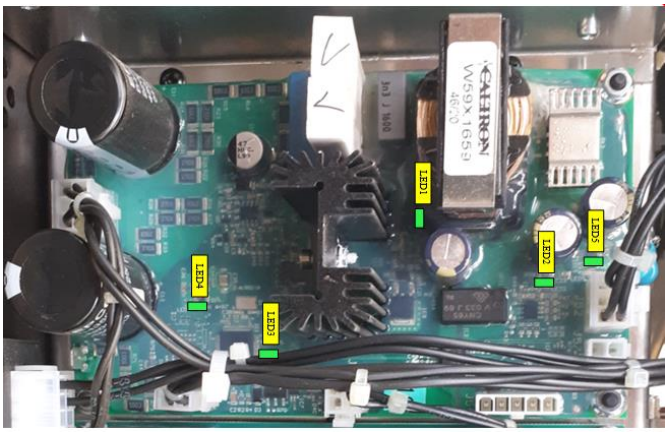

Figure 3

TEST PROCEDURE

WARNING: Black heatsink in on primary side: Do not touch it.

⚠ **Use always electrically insulate gloves during this test procedure**

1. Remove main input power to the INVERTEC® 400 TP.
2. Perform the **Side Panels removal** and **Discharge procedure** available in this Service Manual
3. Apply 400 Vac +/- 10% to the INVERTEC® 400 TP.
4. Switch ON the machine
5. Check LEDs following the table here below and their location following Figure 3.

LEDs Table

LED #	Description	Status	Notes
LED1	+15 Vdc primary side	Always ON - GREEN	It indicates that the 15Vdc is present
LED2	+ 24Vdc secondary side	Always ON - GREEN	It indicates that the 24Vdc is present
LED3	Microprocessor Heartbeat	Always flashing (GREEN)	It indicates that the microprocessor is programmed and working
LED4	+3,3 Vdc	Always ON - GREEN	It indicates that the 3,3 Vdc is present
LED5	+5 Vdc	Always ON - GREEN	It indicates that the 5 Vdc is present

6. Using the multimeter in VDC mode perform the tests as indicated in **Test Table 1**. See **Figure 2** for correct tests point location.

Test table 1 – Aux. Power Supply Board Voltage Test

Positive Probe (RED)	*Negative Probe (BLACK)*	*Value*
J51 - 2	J53 - 2	+24Vdc/1
J50 - 3	J50 - 1	+565Vdc
J52 - 1	J52 - 4	+24Vdc/2
J53 – 1	J53 – 2	2,5 Vdc (when not in thermal condition)

INVERTER BOARD VOLTAGE TEST

WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual. If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact your Local Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed.

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TEST DESCRIPTION

This test will determine if the Inverter Board is working.

MATERIALS NEEDED

Multimeter
Machine Wiring Diagram

INVERTER BOARD VOLTAGE TEST (continue)

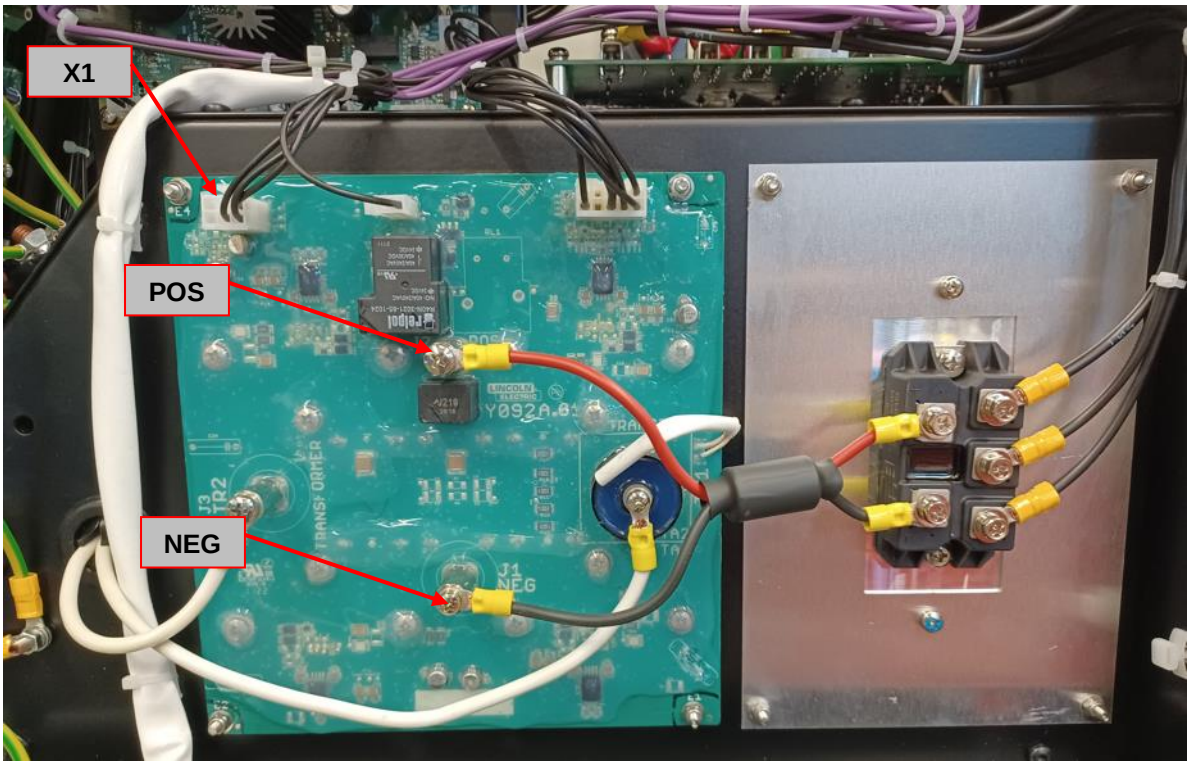

Figure 1

TEST PROCEDURE

⚠ **Use always electrically insulate gloves during this test procedure**

1. Remove main input power to the INVERTEC® 400 TP.
2. Perform the **Side Panels removal** and **Discharge procedure** available in this Service Manual
3. Apply 400 Vac +/- 10% to the INVERTEC® 400 TP.
4. Switch ON the machine
5. Using the multimeter in VDC mode perform the tests as indicated in **Test Table 1**. See **Figure 1** for correct test points location.

Test table 1 – Inverter Voltage Test

Positive Probe (RED)	*Negative Probe (BLACK)*	*Value*	*Note*
POS	NEG	+ 565 Vdc	
X1-2	X1-1	+ 24Vdc	Inverter auxiliary supply

CONTROL BOARD VOLTAGE TEST

WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual. If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact your Local Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed.

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TEST DESCRIPTION

This test will determine if the Inverter Board is working.

MATERIALS NEEDED

Multimeter
Machine Wiring Diagram

CONTROL BOARD VOLTAGE TEST (continue)

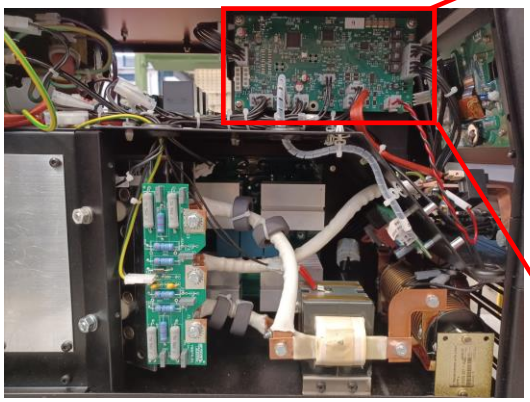


Figure 1

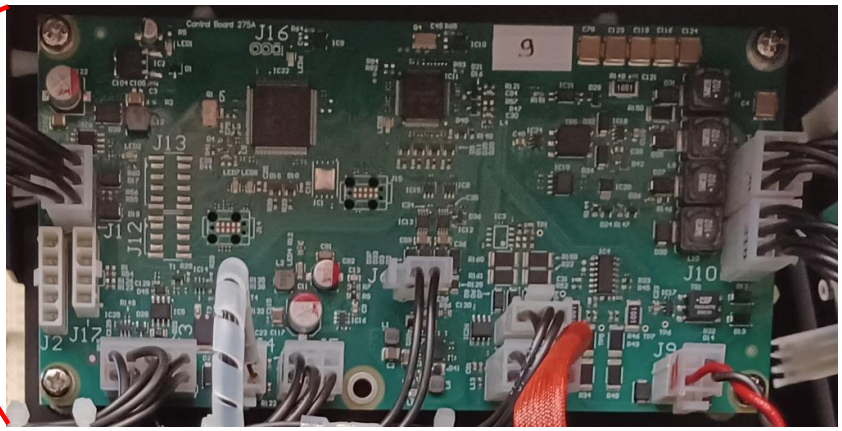


Figure 2

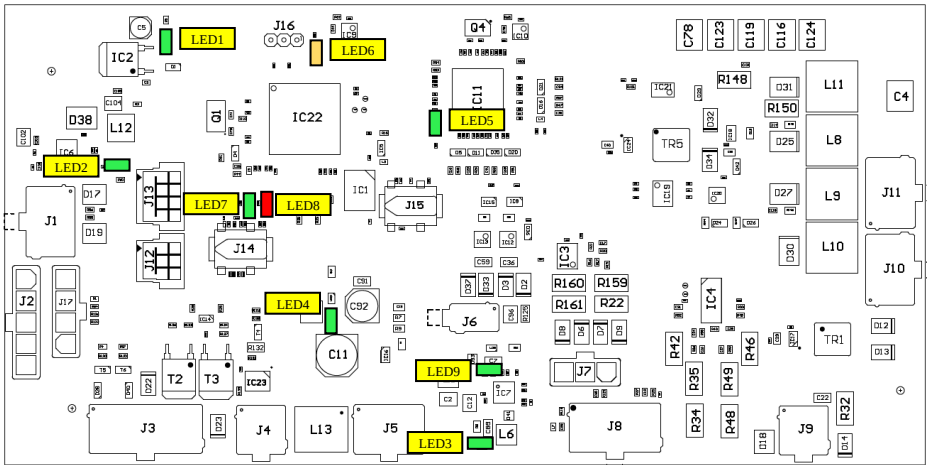


Figure 2a

TEST PROCEDURE

⚠ **Use always electrically insulate gloves during this test procedure**

1. Remove main input power to the INVERTEC® 400 TP.
2. Perform the **Side Panels removal** and **Discharge procedure** available in this Service Manual
3. Apply 400 Vac +/- 10% to the INVERTEC® 400 TP.
4. Switch ON the machine
5. Check LEDs following the table here below. See **Figure 2a** for correct LEDs location.

LEDs Table

LED #	Description	Status	Notes
LED 1	+3,3 Vdc	Always ON - GREEN	It indicates that the 3,3 Vdc is present
LED 2	+ 5Vdc secondary side	Always ON - GREEN	It indicates that the 5Vdc is present
LED 3	-15Vdc	Always ON - GREEN	It indicates that the -15Vdc for current sensor is present
LED 4	+15Vdc	Always ON - GREEN	It indicates that the +15Vdc is present
LED 5	Microprocessor	Always Flashing - GREEN	It indicates that the microprocessor is programmed and working
LED 6	DSP	ON - YELLOW	Only ON when Output is present
LED 7	Microprocessor Heartbeat	Always Flashing - GREEN	It indicates that the microprocessor is programmed and working
LED 8	Error	ALWAYS OFF - RED	Indicates error condition
LED 9	+15Vdc	Always ON - GREEN	It indicates that the +15Vdc for current sensor is present

CONTROL BOARD VOLTAGE TEST (continue)

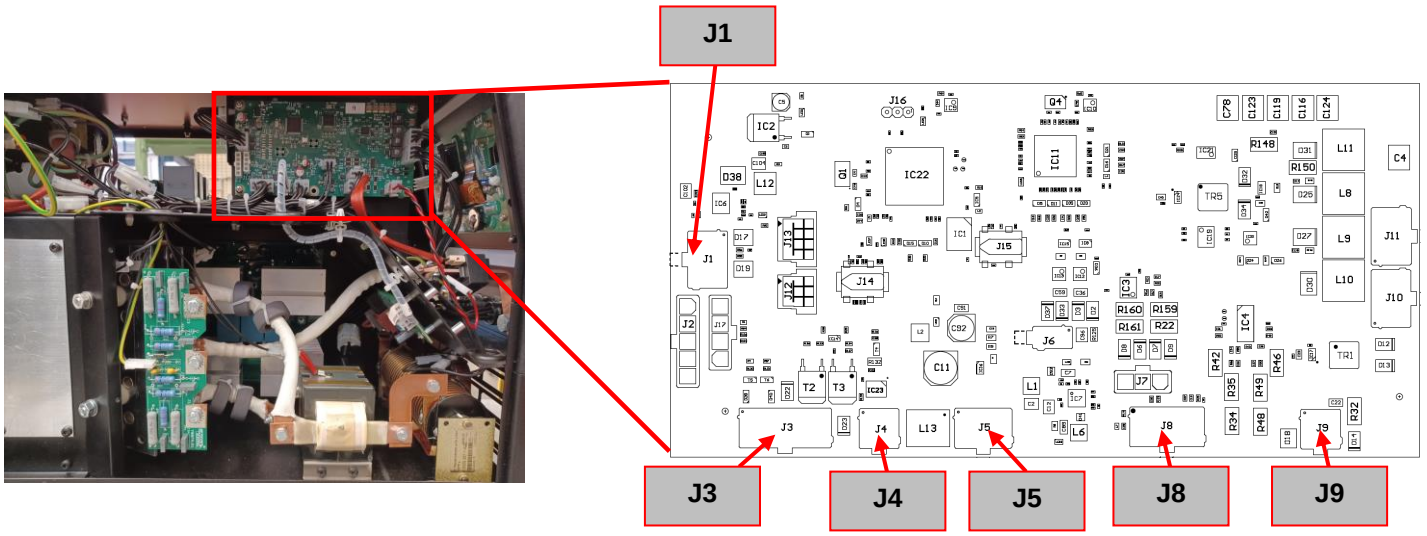


Figure 1 – Control Board location and Test Points

TEST PROCEDURE

⚠ **Use always electrically insulate gloves during this test procedure**

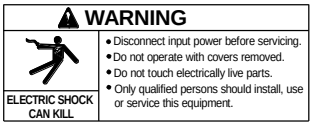
1. Remove main input power to the INVERTEC® 400 TP.
2. Perform the **Side Panels removal** and **Discharge procedure** available in this Service Manual
3. Apply 400 Vac +/- 10% to the INVERTEC® 400 TP and switch ON the machine
4. Using the multimeter in VDC mode perform the tests as indicated in **Test Table 1**. See **Figure 1** for correct test points location.

Test table 1 – Control Board Voltage Test

Positive Probe (RED)	*Negative Probe (BLACK)*	*Value*	*Note*
J1 – 6	J1 – 5	+24Vdc	
J1 – 4	J1 – 5	+5Vdc	
J1 – 1 / J1 - 2	J1 – 5	2,5 Vdc	
J3 – 6 / J3 - 7	J3 – 4 / J3 - 3	+24 Vdc	Fan Power Supply, only in stick Mode or TIG with tigger pressed
J3 – 5	J3 – 10	24 Vdc	Gas solenoid supply, only in TIG mode with trigger pressed. Only for 3-4 seconds if the arc does not start.
J4 – 2	J4 – 4	+24Vdc	
J4 – 3	J4 – 4	+15Vdc	**WARNING!!** To avoid damaging your Multimeter, disconnect the connector J4 and take the measure from the J4 socket on control Board. This value is present in TIG mode with trigger pressed only for 3-4 seconds
J8 – 2	J8 – 5	2,5 -3 Vdc	If no thermal condition is present
J8 – 4	J8 – 6	+15Vdc	Positive Supply for current transducer
J8 – 3	J8 – 6	-15 Vdc	Negative Supply for current transducer
J9 – 3	J9 – 2	78Vdc	OCV in Stick mode. Measured with True RMS multimeter
J5 – 1	J5 – 4	24 Vdc	From Aux. Power Supply Board

DISASSEMBLY OPERATIONS

LEFT AND RIGHT PANEL REMOVAL PROCEDURE



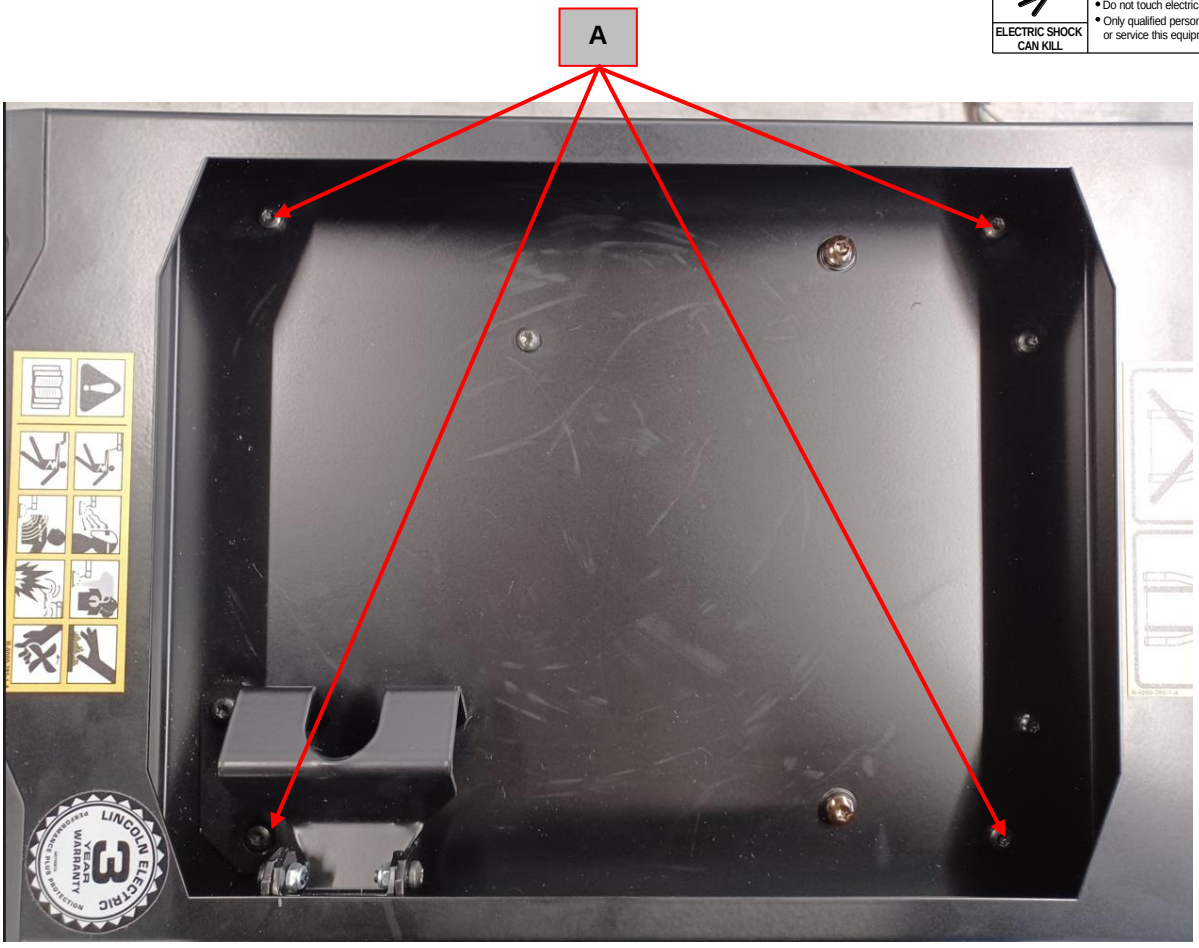


Figure 1

REMOVAL PROCEDURE

Necessary tool:

- Torx 25 wrench

1. Remove main input power to the INVERTEC® 400 TP.
2. Locate the 4 screws (**A**). See **Figure 1**
3. Using the Torx 25 wrench remove the 4 screws (**A**). See **Figure 1**
4. Slide down gently the left and right panel and remove them from the machine.
5. **For the re-assembly operations,** make the previous steps in the reverse order

DISASSEMBLY OPERATIONS

EMI FILTER REMOVAL AND REPLACEMENT PROCEDURE

WARNING

ELECTRIC SHOCK CAN KILL

- Disconnect input power before servicing.
- Do not operate with covers removed.
- Do not touch electrically live parts.
- Only qualified persons should install, use or service this equipment.

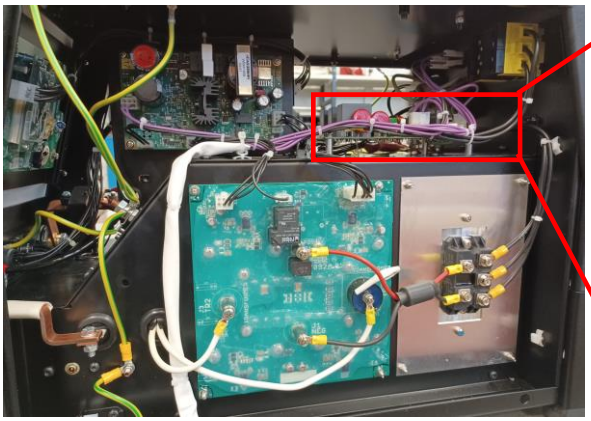


Figure 1

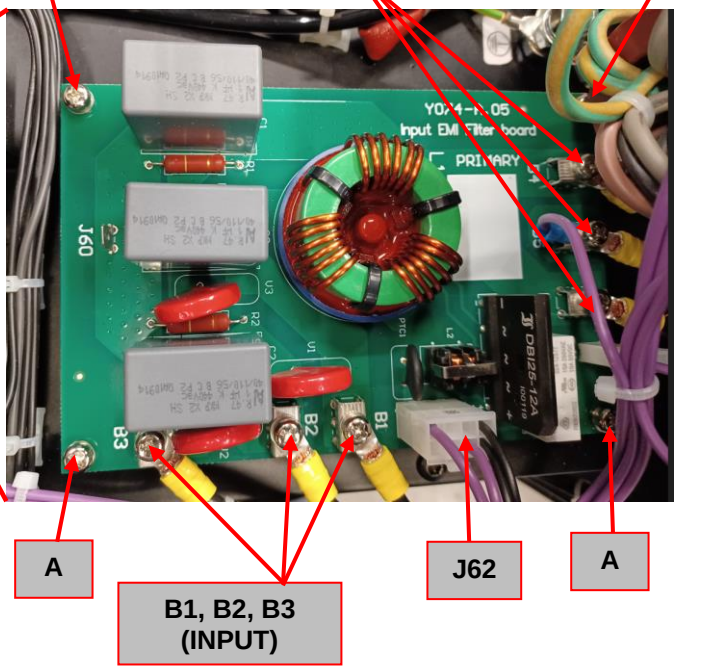


Figure 2

REMOVAL PROCEDURE

Necessary tools:

- Screwdriver PH02

1. Remove main input power to the INVERTEC® 400 TP.
2. Perform the **Discharge procedure.**
3. Locate the EMI Board. See **Figure 1**
4. Using the screwdriver PH02 remove the 3 input cables **B1, B2, B3** and the 3 output cables **B4, B5, B6**. See **Figure 2.**
5. Remove the connector J62. See **Figure 2.**
6. Remove the 4 screws (A). See **Figure 2.**
7. **For the re-assembly operations of EMI board,** make the previous steps in the reverse order

DISASSEMBLY OPERATIONS

INPUT RECTIFIER BRIDGE REMOVAL AND REPLACEMENT PROCEDURE

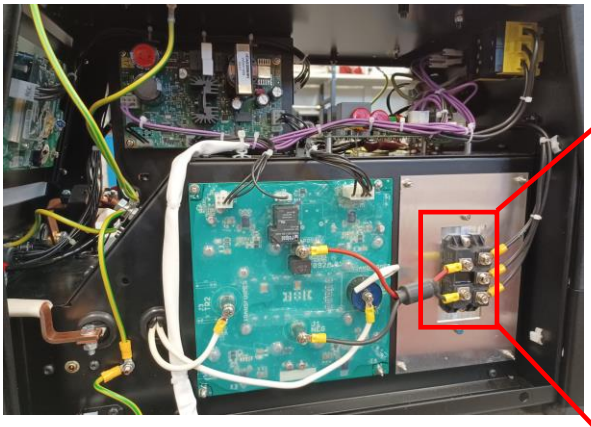


Figure 1

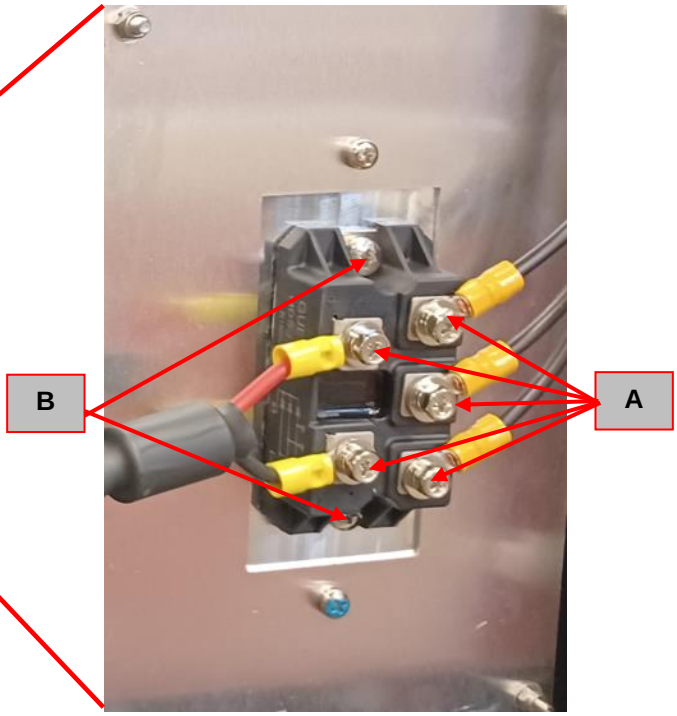


Figure 2

REMOVAL PROCEDURE

Necessary tools:

- Screwdriver PH02

1. Remove main input power to the INVERTEC® 400 TP.
2. Perform the **Discharge procedure.**
3. Locate the Input Rectifier Bridge. See **Figure 1**
4. Using the screwdriver PH02 remove the 5 screws (**A**). **See Figure 2.**
5. Using screwdriver PH02 remove the 2 screws (**B**) that are fixing the Rectifier Input Bridge to the heat sink. **See Figure 2.**
6. Remove the Rectifier Input Bridge from the machine.

For the re-assembly operations of Preload board, make the previous steps in the reverse order.

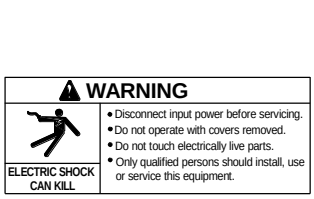
REASSEMBLY PROCEDURE

1. Clean the heat sink mounting surface from the old thermal compound.
2. Apply a thin layer of new thermal compound (0,1-0,3mm) to the mating surfaces of the new input rectifier bridge (Dow Corning 340)
3. Assemble the new 3 phases input rectifier bridge to the heat sink using the 2 screws (**B**) previously removed (torque 5Nm max.)
4. Assemble the 3 AC input cables and the 2 output cables DC+ and DC- previously removed (torque 3,5Nm max.)

DO NOT USE CORDLESS SCREWDRIVERS FOR THE POWER MODULEs!

DISASSEMBLY OPERATIONS

INVERTER BOARD REMOVAL AND REPLACEMENT PROCEDURE



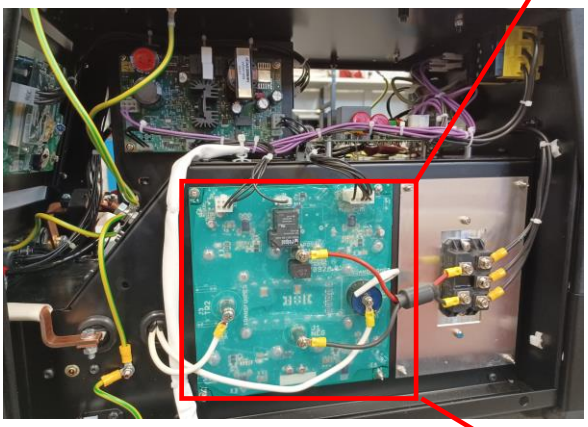


Figure 1

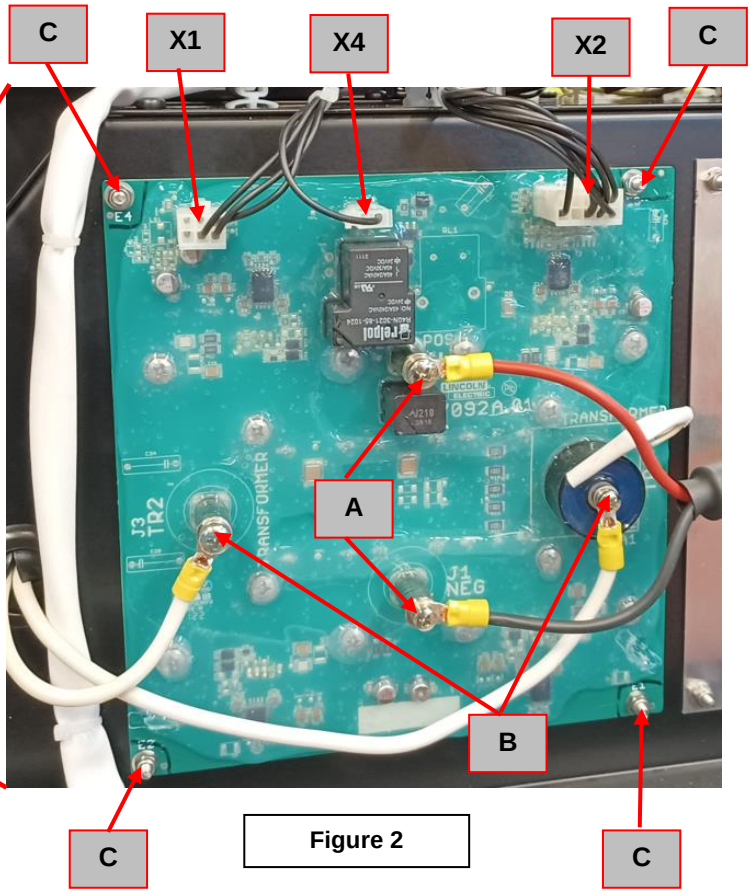


Figure 2

REMOVAL PROCEDURE

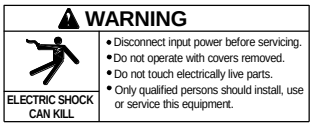
Necessary tools:

- Screwdriver PH02
- Socket wrench 7mm

1. Remove main input power to the INVERTEC® 400 TP.
2. Perform the **Discharge procedure.**
3. Locate the Inverter Board. See **Figure 1**
4. Using the PH02 screwdriver remove the 2 screws (**A**) and 2 screws (**B**). See **Figure 2**
5. Remove the connectors **X1, X2** and **X4**
6. Using the socket wrench 7mm remove the 4 bolts (**C)** . See **Figure 2**
7. Pull the Inverter board and remove it from the machine.
8. **For the re-assembly operations of Inverter board,** make the previous steps in the reverse order

DISASSEMBLY OPERATIONS

AUXILIARY POWER BOARD REMOVAL AND REPLACEMENT PROCEDURE



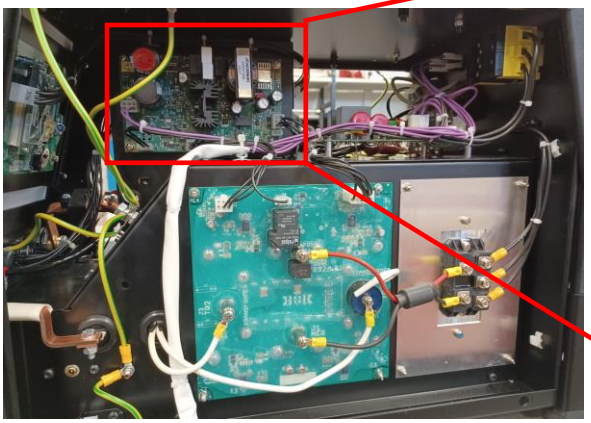


Figure 1

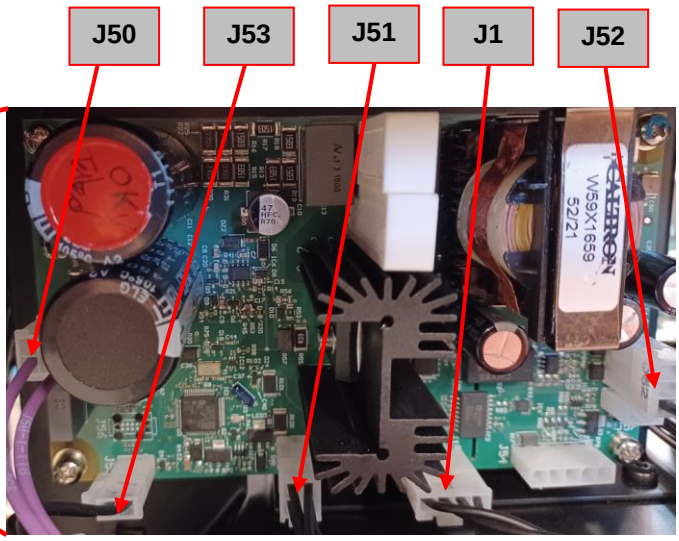


Figure 2

REMOVAL PROCEDURE

Necessary tools:

- Screwdriver PH02

1. Remove main input power to the INVERTEC® 400 TP.
2. Perform the **Discharge procedure.**
3. Locate the Aux.Power Supply Board. See **Figure 1**
4. Remove the 5 connectors **J1, J50, J51, J52, J53**. See **Figure 2**.
5. Using the screwdriver PH02 remove the 4 screws at the PCB corners. Remove Auxiliary Power Board from the machine
6. **For the re-assembly operations of Aux. Power Board,** make the previous steps in the reverse order

DISASSEMBLY OPERATIONS

CONTROL BOARD REMOVAL AND REPLACEMENT PROCEDURE

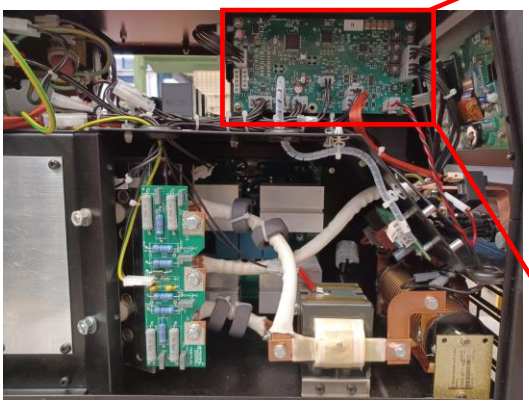


Figure 1

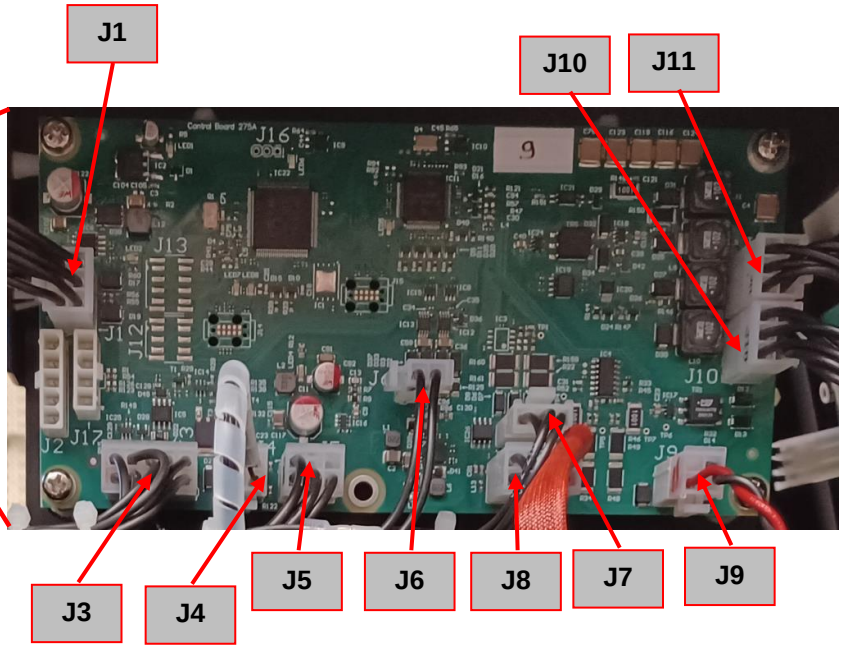


Figure 2

REMOVAL PROCEDURE

Necessary tools:

- Screwdriver PH02

1. Remove main input power to the INVERTEC® 400 TP.
2. Perform the **Discharge procedure.**
3. Locate the Control Board. See **Figure 1**
4. Remove all the connectors **J1, J3, J4, J5, J6, J7, J8, J9, J10, J11**.
5. Using the screwdriver PH02 remove the 4 screws at the Control PCB corners.
6. Remove the Control Board from the machine
7. **For the re-assembly operations of Control Board,** make the previous steps in the reverse order

DISASSEMBLY OPERATIONS

UI-TFT BOARD REMOVAL AND REPLACEMENT PROCEDURE

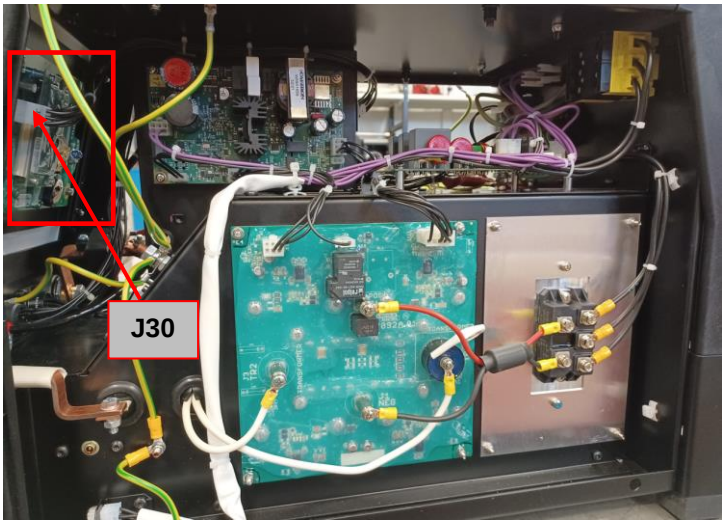


Figure 1

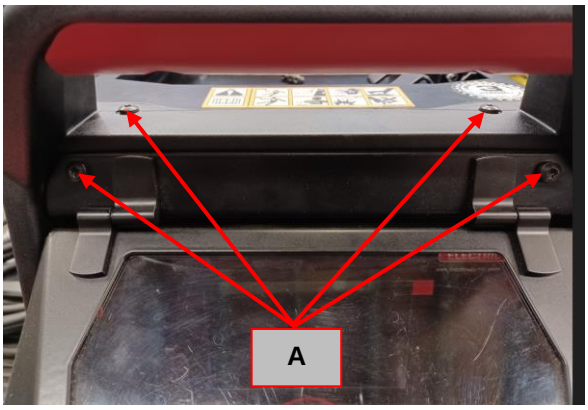


Figure 2

Figure 3

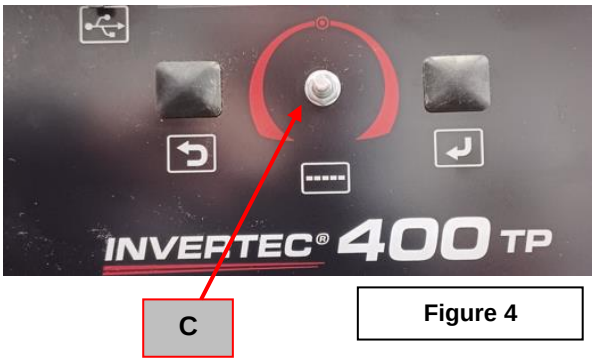


Figure 4

REMOVAL PROCEDURE

Necessary tools:

- Torx 25 wrench
- 1,5 mm allen wrench
- 10 mm and 7 mm wrench
- PH02 screwdriver

1. Remove main input power to the INVERTEC® 400 TP.
2. Perform the **Discharge procedure.**
3. Locate the UI TFT Board. See **Figure 1**
4. Disconnect the connector **J30**
5. Using the Torx 25 screwdriver remove the 4 screws **(A),** remove the **UI** protection panel and after remove the front plastic frame. See **Figure 2**
6. Using the 1,5 mm allen wrench loosen the allen screw (**B**) that secures the knob and remove it. See **Figure 3**.
7. Using the 10mm wrench remove the bolt (**C**) and the washer that lock the encoder shaft to the front panel. See **Figure 4**.

DISASSEMBLY OPERATIONS

UI-TFT BOARD REMOVAL AND REPLACEMENT PROCEDURE (CONTINUE)

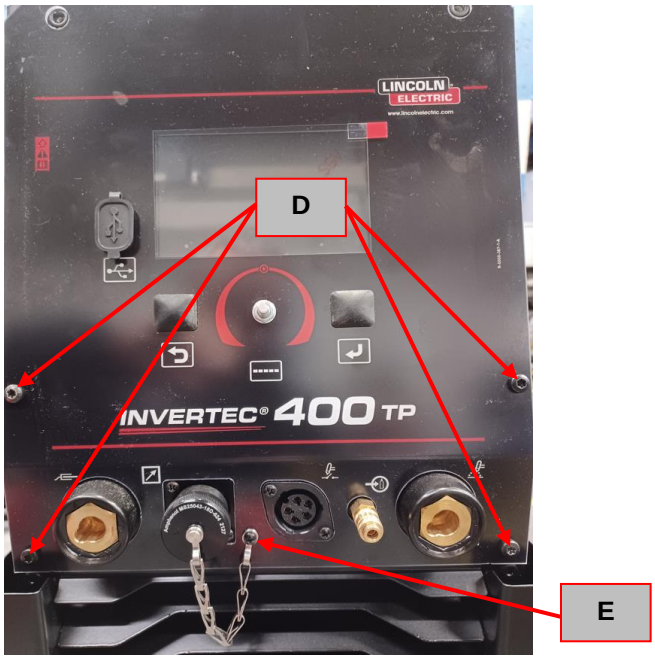


Figure 4

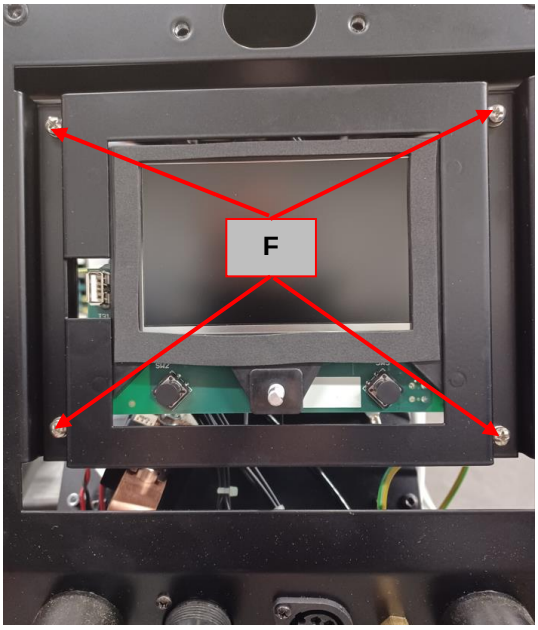


Figure 5

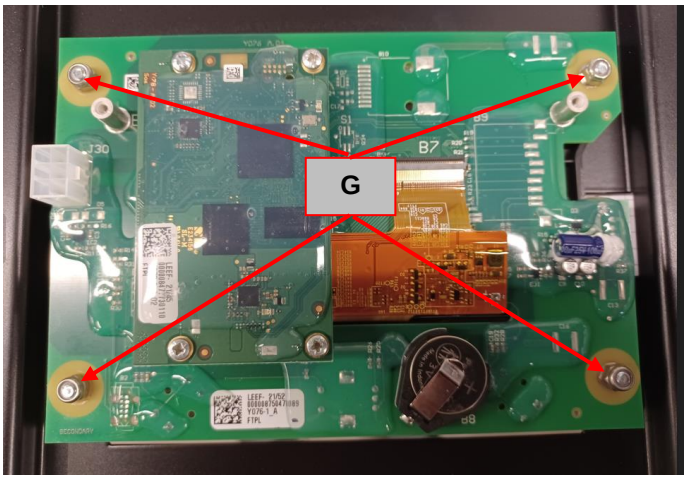


Figure 6

8. Using the torx 25 wrench remove the 4 screws (**D**). See **Figure 4**
9. Using the PH02 screwdriver remove the screw (**E**). See **Figure 4**
10. Remove the front plastic nameplate from the machine.
11. Using the PH02 screwdriver remove th 4 screws (**F**)
12. Using the 7 mm wrench remove the 4 bolts (**G**).
13. Pull arefully the TFT board and remove it from the metal frame.

For the re-assembly operations of TFT Board, make the previous steps in the reverse order.

DISASSEMBLY OPERATIONS

HF BOARD REMOVAL AND REPLACEMENT PROCEDURE

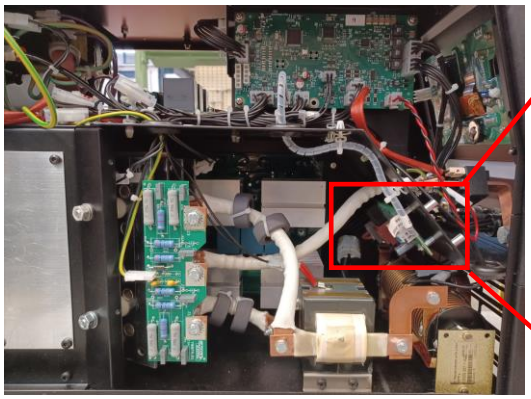


Figure 1

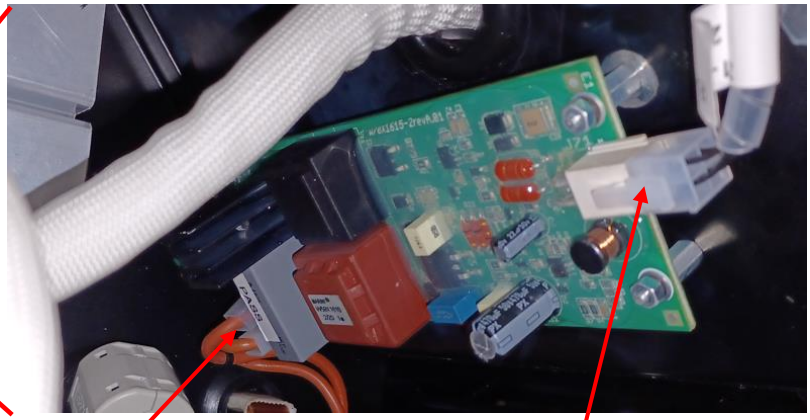


Figure 2

REMOVAL PROCEDURE

Necessary tools:

- 5,5mm jointed screwdriver

1. Remove main input power to the INVERTEC® 400 TP.
2. Perform the **Discharge procedure.**
3. Locate the HF Board. See **Figure 1**
4. Remove the two faston connections (**A**), taking note of the position of the wire with the plastic tie. See **Figure 2**.
5. Remove the connector **J71**. See **Figure 2**
6. Using a 5,5 mm jointed screwdriver remove the 4 bolts at the corner of the HF Board.
7. Pull the HF Board away from its standsoff and remove it from the machine.
8. **For the re-assembly operations of HF Board,** make the previous steps in the reverse order.

DISASSEMBLY OPERATIONS

ON/OFF SWITCH REMOVAL AND REPLACEMENT PROCEDURE

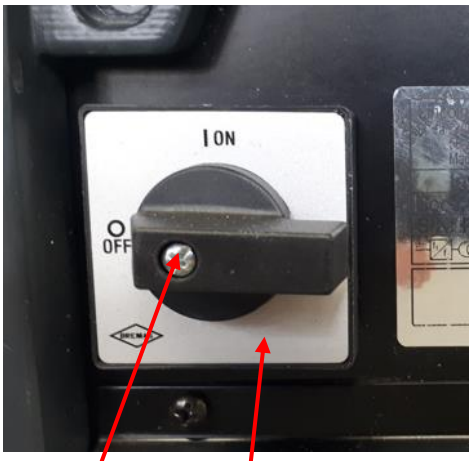


Figure 1

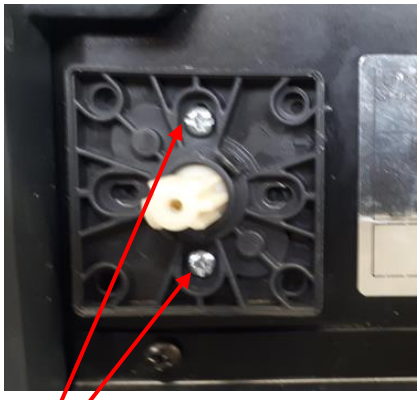


Figure 2

Figure 3

REMOVAL PROCEDURE

Necessary tools:

- Screwdriver PH02

1. Remove main input power to the INVERTEC® 400 TP.
2. Perform the **Discharge procedure.**
3. Locate the ON/OFF switch on the backside of the machine. See **Figure 1**
4. Using the PH02 screwdriver remove the screw (**A**) and remove the ON/OFF switch knob. See **Figure 2**.
5. Remove the metal plate (**B**) with the serigraphy to access the 2 fixing screws.
6. Using the PH02 screwdriver remove the 2 screws (**C**) and remove the black plastic plate. See **Figure 2**.
7. Remove the ON/OFF switch from the rear panel and using a PH02 screwdriver remove the 6 power cables. See **Figure 3**.
8. **For the re-assembly operations of ON/OFF Switch,** make the previous steps in the reverse order.

DISASSEMBLY OPERATIONS

GAS SOLENIOD REMOVAL AND REPLACEMENT PROCEDURE

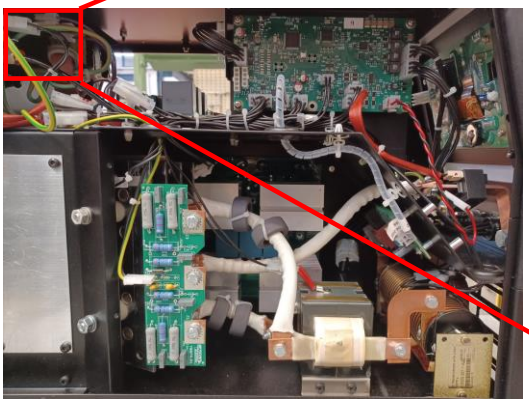


Figure 1

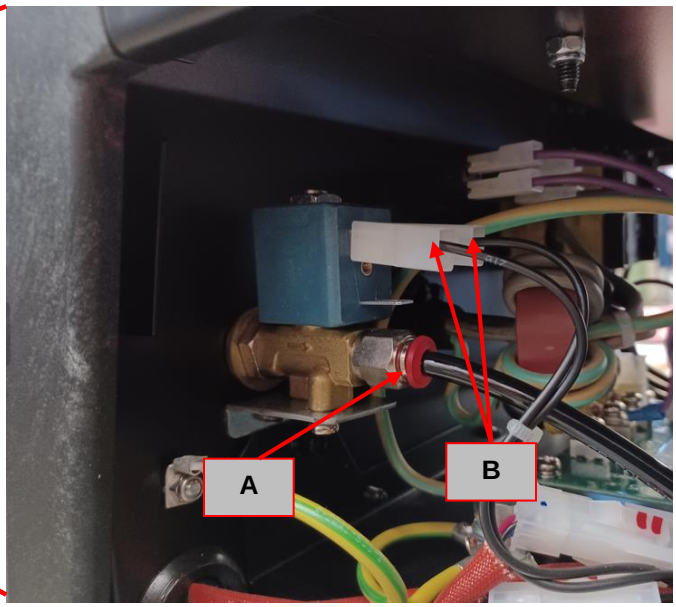


Figure 2

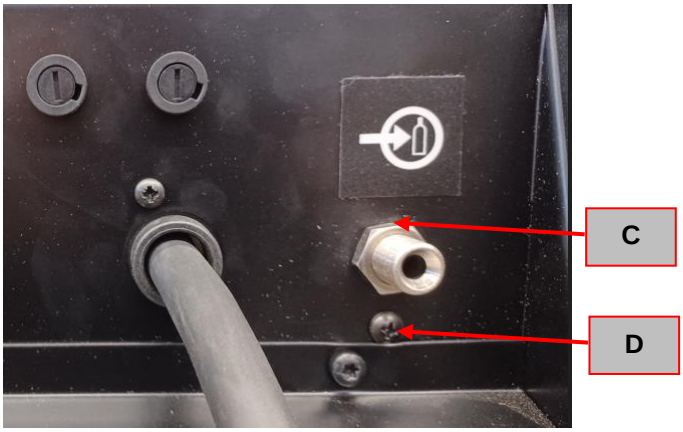


Figure 3

REMOVAL PROCEDURE

Necessary tools:

- 17mm wrench
- Screwdriver PH02

1. Remove main input power to the INVERTEC® 400 TP.
2. Perform the **Discharge procedure.**
3. Locate the Gas solenoid on the internal backside of the machine. See **Figure 1**
4. Disconnect the gas pipe (**A**) and the two faston (**B**). See **Figure 2**.
5. Using the 17mm wrench remove the bolt (**C**) that lock the gas solenoid on the rear machine panel and with the PH02 screwdriver remove the screw (**D**) See **Figure 3**.
6. Remove the gas solenoid from the machine and remove the metal anti-rotation plate.
7. Remove and reuse the bulkhead 1/4-1/8 GAS and the Quick connection G1/4 M D4 on the new solenoid valve
8. **For the re-assembly operations of Gas Solenoid,** make the previous steps in the reverse order

DISASSEMBLY OPERATIONS

FANS REMOVAL AND REPLACEMENT PROCEDURE

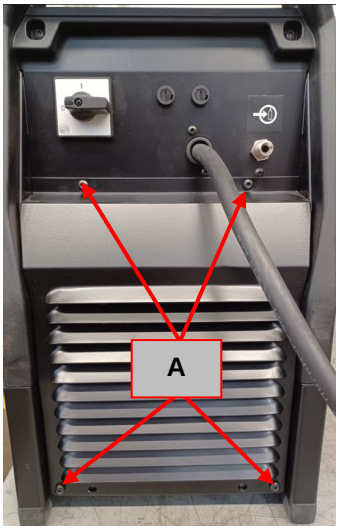


Figure 1

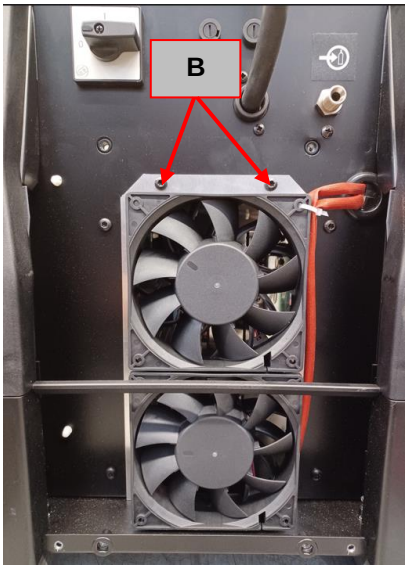


Figure 2

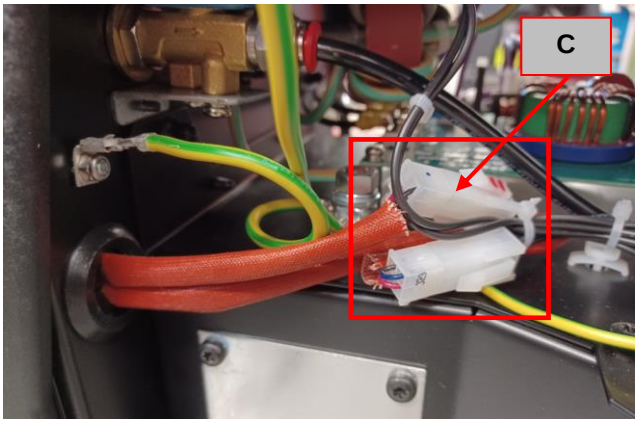


Figure 3

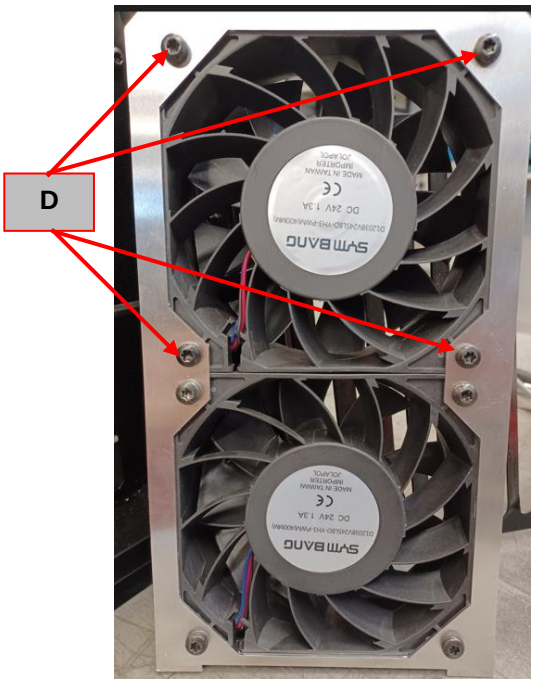


Figure 4

REMOVAL PROCEDURE

Necessary tools:

- TX25 wrench

1. Remove main input power to the INVERTEC® 400 TP.
2. Perform the **Discharge procedure.**
3. Using the TX25 screwdriver remove the 4 screws (**A**) and remove the rear grid panel. See **Figure 1**
4. Using the PH02 screwdriver remove the 2 screws (**B**) that are fixing the fan frame to the machine. See **Figure 2**
5. Disconnect the two fan connectors. See **Figure 3**
6. Carefully remove the fan support plate and using the TX25 screwdriver remove the 4 screws (D) of the fan that has to be replaced. See **figure 4**
7. **For the re-assembly operations of Fans,** make the previous steps in the reverse order.

RETEST AFTER REPAIR

Should a machine under test be rejected for any reason requiring the removal of any mechanical part that could affect the machine's electrical characteristics, or if any electrical components are repaired or replaced, the machine must be retested.

Machine input and output

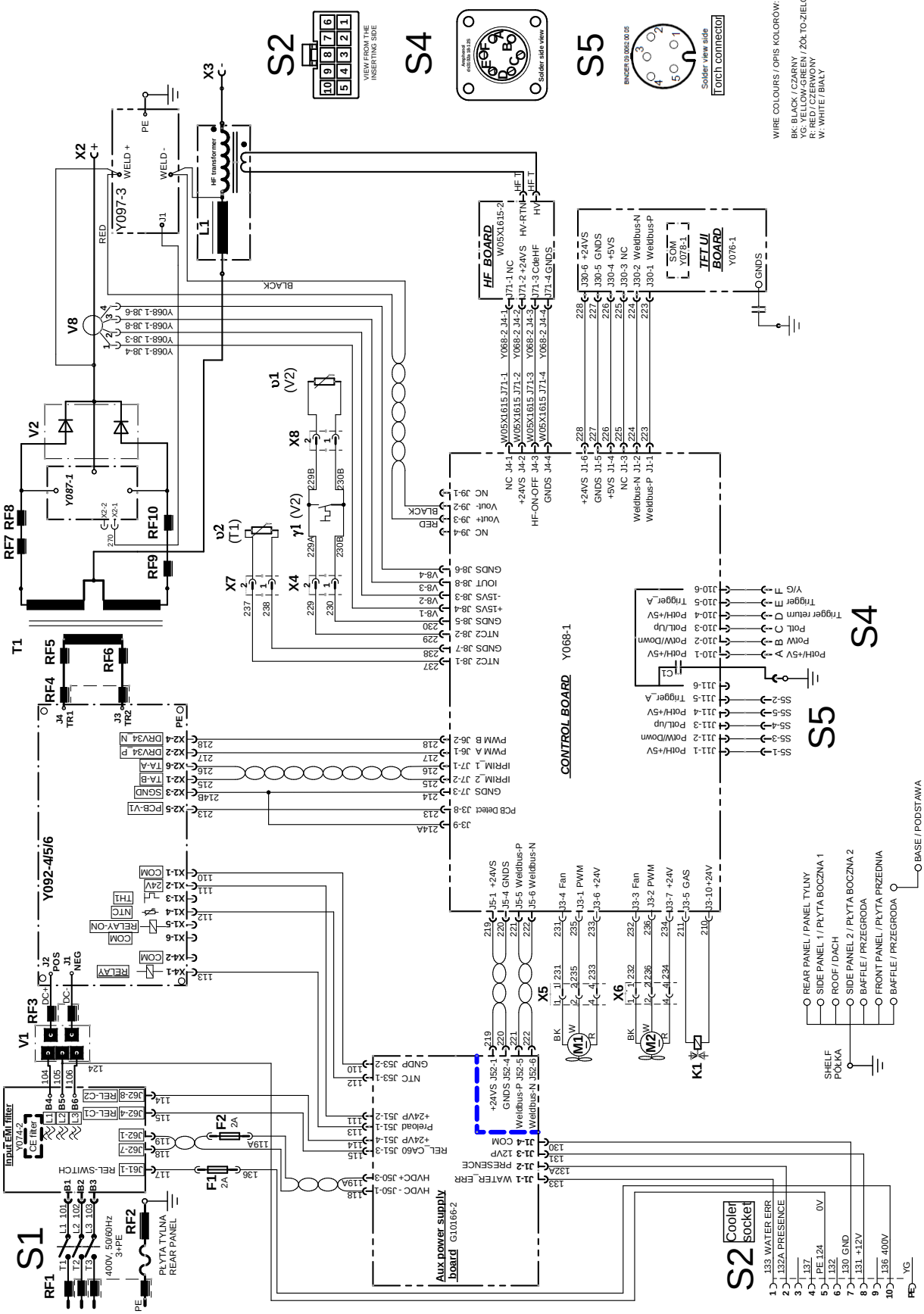
INVERTEC® 400TP

Input Voltage	Max Input Current	Rated Output	OCV (Peak open circuit voltage) U_0
400Vac-3ph-50/60Hz	24,9A	Stick Mode 300A/32V@100%	85 V

Output Current range	
SMAW & GTAW	5A - 400A

ELECTRICAL SCHEMATICS

Schematic Diagram: INVERTEC® 400TP



ERROR CODES

Security Description	Manufacturer specific Error code
Primary Over Current	=331
Secondary Over Current (short average)	=46
Secondary current probe failure	=40
Power Supply Over Voltage	=341
Power Supply Under Voltage	=342
Preload Time Out	=337
Primary Over Power	=338
Primary Thermal	=36
Secondary Thermal	=37
Cooler	=266
Calibration Default	=257
Primary Thermal Probe Default	=258
Secondary Thermal Probe Default	=260
Flash Erase Failure	=1119
Flash Program Failure	=1121
Flash Initialization Failure	=1126
Start application or size application error	=1117
Bad Uboot Sequences	=9520
Uboot Final keyword error	=9521
Uboot Wrong CRC	=9522
Uboot Start Application Address write flash failed	=9523
Uboot Length Application write flash failed	=9524
Uboot CRC Application write flash failed	=9525
Uboot launched (cyclic sent before upload)	=1114
Uboot ready to load application	=1115
Watchdog Error	=8121
Control Loop Failure	=8119
Timer 1 or 2 error	=9600
Timer 3 Error	=9601
MAIN_PROGRAM_UNFOUND	=8125
Trigger while default state	=599

NOTE

Lincoln Electric Europe