SVM 3103-A
Rev.01 01-2024

POWERTEC i350S, i420S, i500S

For use with machines having code numbers: 50658, 50659, 50660

SERVICE MANUAL

LINCOLN ELECTRIC EUROPE
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INDEX OF CONTENTS

TECHNICAL SPECIFICATIONS

NAME	INDEX
POWERTEC® i350S	**K14183-1**
POWERTEC® i420S	**K14184-1**
POWERTEC® i500S	**K14185-1**

INPUT			
	Input Voltage U_1	EMC Class	Frequency
i350S	400V ± 15% 3-phase	A	50/60Hz
i420S			
i500S			
	Input Power at Rated Cycle	Input Amperes I_{1max}	PF
i350S	15 kVA @ 50% Duty Cycle (40°C)	21A	0,90
i420S	19 kVA @ 100% Duty Cycle (40°C)	27A	0,92
i500S	23 kVA @ 60% Duty Cycle (40°C)	34A	0,94
	Efficiency	Idle Power	
i350S	85%	35W	
i420S	85%	35W	
i500S	85%	35W	

RATED OUTPUT					
	Open Circuit Voltage		Duty Cycle 40°C (based on a 10 min. period)	Output Current	Output Voltage
i350S	U_{0peak} = 54Vdc U_{0rms} = 54Vdc	GMAW	50%	350A	31,5Vdc
			60%	340A	31,0Vdc
			100%	250A	26,5Vdc
		FCAW	50%	350A	31,5Vdc
			60%	340A	31,0Vdc
			100%	250A	26,5Vdc
		SMAW	30%	350A	34,0Vdc
			60%	320A	32,8Vdc
			100%	250A	30,0Vdc
i420S	U_{0peak} = 60Vdc U_{0rms} = 54Vdc	GMAW	100%	420A	35,0Vdc
		FCAW	100%	420A	35,0Vdc
		SMAW	100%	420A	36,8Vdc
i500S	U_{0peak} = 60Vdc U_{0rms} = 54Vdc	GMAW	60%	500A	39,0Vdc
			100%	420A	35,0Vdc
		FCAW	60%	500A	39,0Vdc
			100%	420A	35,0Vdc
		SMAW	60%	480A	39,2Vdc
			100%	420A	36,8Vdc

WELDING CURRENT RANGE			
	GMAW	FCAW	SMAW
i350S	20A÷350A	20A÷350A	10A÷350A
i420S	20A÷420A	20A÷420A	10A÷420A
i500S	20A÷500A	20A÷500A	10A÷480A

WELDING VOLTAGE REGULATION RANGE		
	GMAW	FCAW
i350S	15V÷ 33,5V	15V÷ 33,5V
i420S	15V ÷ 37V	15V ÷ 37V
i500S	15V ÷ 41V	15V ÷ 41V

RECOMMENDED INPUT CABLE AND FUSE SIZES		
	Fuse Type: Time-Delay or Circuit Breaker Type D	Power Lead
	400V	
i350S	25A	4 Conductor, 2,5mm^2
i420S	32A	4 Conductor, 4,0 mm^2
i500S	32A	4 Conductor, 4,0 mm^2

DIMENSION				
	Weight	Height	Width	Length
i350S	68kg	932 mm	560 mm	925 mm
i420S	78kg			
i500S	79kg			

Protection Rating	Operating Humidity (t=20°C)	Operating Temperature	Storage Temperature
IP23	≤ 90 %	from -10 ºC to +40 ºC	from -25 ºC to +55 ºC

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. 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 with, if necessary, assistance from Lincoln Electric.

WARNING

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

- 105 mΩ for the **POWERTEC® i350S**
- 25 mΩ for the **POWERTEC® i420S**
- 35 mΩ for the **POWERTEC® i500S**.

This equipment is compliant with IEC 61000-3-11 and IEC 61000-3-12 and can be connected to public lowvoltage 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 kept as short as possible and should be positioned together. 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

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 can be potential difficulties in ensuring electromagnetic compatibility in those locations, due to conducted as well as radio-frequency disturbances.

Safety

11/04

WARNING

This equipment must 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 damage to this equipment. 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 damage to this equipment. 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 damage to this equipment.
	ELECTRIC SHOCK CAN KILL: Welding equipment generates high voltages. Do not touch the electrode, work clamp, or connected work pieces when this equipment is on. Insulate yourself from the electrode, work clamp and connected work pieces.
	ELECTRICALLY POWERED EQUIPMENT: Turn off 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.
	ELECTRIC AND MAGNETIC FIELDS MAY BE DANGEROUS: Electric current flowing through any conductor creates electric and magnetic fields (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. Use suitable clothing made from durable flame-resistant material to protect you skin and that of your helpers. 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 readily available. 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 operate this equipment when flammable gases, vapors or liquid combustibles 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 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.
S	SAFETY MARK: This equipment is suitable for supplying power for welding operations carried out in an environment with increased hazard 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

POWERTEC® i350S, i420S, i500S inverter sources have to be connected with wire feeders **LF52D and LF56D.** Signal from the power source will be displayed on wire feeders user interface. For communication, inverter source-wire feeder is usedCAN protocol.
Inverter source-wire feed configuration allows the welding:
GMAW (MIG/MAG)
FCAW
SMAW (MMA)

POWERTEC® i350S, i420S, i500S work with the water cooler **COOL ARC®26**.

The complete packaging includes the following items:
Inverter source
USB with Operator's Manual
Work lead - 3m
Slow-blow fuse – 2A (2 units)
Gas hose -2m
Chain

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

Installation and Operator Instructions

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

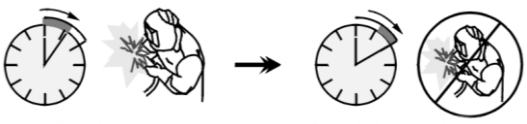
Location and Environment

This machine can be operate in harsh environment. However, it is important to use simple preventative measures, which provide long life and reliable operation.
Do not place or operate this machine on a surface with an incline higher than 15° from horizontal.
Do not use this machine for pipe thawing.
This machine must be located in a place 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.
Keep awaz from 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 a 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 higher than 40°C.

Duty cycle and Overheating

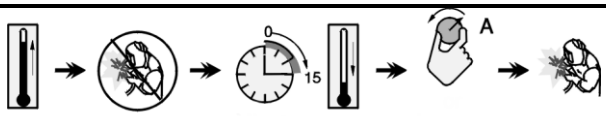
The duty cycle of a welding machine is the percentage of time in a 10 minute cycle at which the welder can operate the machine at rated welding current.

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 the outlet plug to power lead and connecting the welding machine had to be made in accordance with the appropriate National Electrical Code and local regulations.

Check the input voltage, phases, and frequency supplied to this machine before turning it on. Verify the connection of grounding wires from the machine to the input power source. **POWERTEC® i350S, i420S, i500S** can only be connected to a mating grounded receptacle.
Input voltages is 3x400V 50/60Hz. For more information about input supply please 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 type of protection 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.
See "Technical Specifications" chapter.

WARNING

In case of powering welder from a generator make sure to turn off welding machine first, before generator is shut down, in order to prevent damage to welding machine!

Output Connections

Refer to points [2], [3] and [4] of the figures below.

Controls and Operational Features

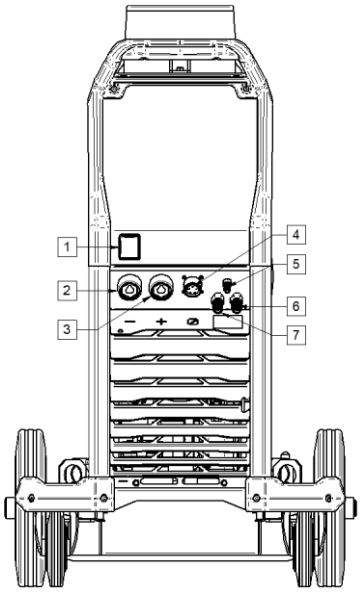


Figure 1.

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

2. Negative Output Socket for the Welding Circuit: Depending on the configuration of power source, for connecting a work lead, the electrode holder with lead or the source/wire feeder welding cable.

3. Positive Output Socket for the Welding Circuit: Depending on the configuration of power source, for connecting a work lead, the electrode holder with lead or the source/wire feeder welding cable.

4. Control Receptacle: 5 pins receptacle for wire feeder or remote controller connection. To communication wire feeder or remote controller with power source is used CAN protocol.

5. Gas Connector: For connection a gas hose from interconnecting cable.

6. Quick Connect Coupling: Coolant inlet (takes warm coolant from torch/gun).

7. Quick Connect Coupling: Coolant outlet (supplies cool coolant to the torch/gun).

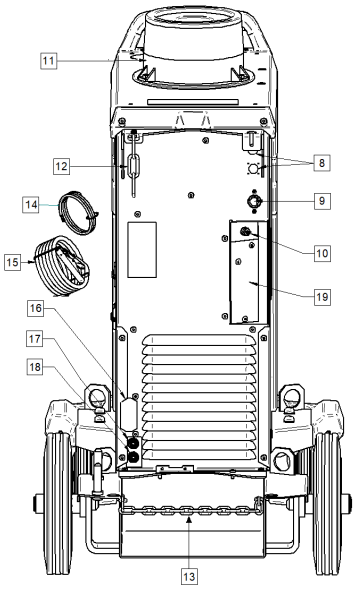


Figure 2.

8. Supply Plug: for gas heater kit (see “Accessories Suggested” chapter).

9. Power Lead (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 Connector: For connection a gas hose from cylinder.

11. Swivel bracket: For mounting the wire feeder.

12. Top Chain: To protect gas bottle.

13. Bottom chain: For properly securing the gas cylinder

WARNING

Not using both chains at the same time to secure the gas cylinder may result in damage to the cylinder, the device and personal injury.

14. Gas hose: For connection between the cylinder and machine.

15. Mass welding cable

16. Cover bracket: To intall **COOL ARC®26** power supply and control cable (see "Accessories Suggested" chapter).

17. Quick Connect Coupling: Coolant inlet (supplies cool coolant to the torch/gun).

18. Quick Connect Coupling: Coolant outlet (takes warm coolant from torch/gun).

19. Cover bracket: To install the welding and control sockets on the rear panel of the device (see chapter "Accessories Suggested") to connect the wire feeder.

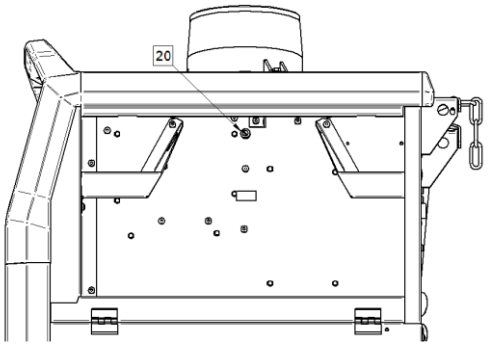


Figure 3.

20. Fuse F1: Use the 2A/400V (6,3x32mm) low blow fuse

Welding Cables Connection

Insert the plug of the work lead into the socket [2]. The other end of this lead connect to the work piece with the work clamp.

Connect the wire feeder to the power source:
Insert the positive welding cable into the output socket [3].
Insert the wire feeder control cable into the socket [4] (see "Accessories Suggested" chapter).

Use the possible shortest cable lengths.

Water Cooler Connection

POWERTEC® i350S, i420S, i500S work with the water cooler **COOL ARC®26** (see "Accessories Suggested" chapter).

⚠ WARNING

Read the cooler manual before connecting it to the power source.

The **COOL ARC®26** is supplied by welding power source using 10-PIN socket.

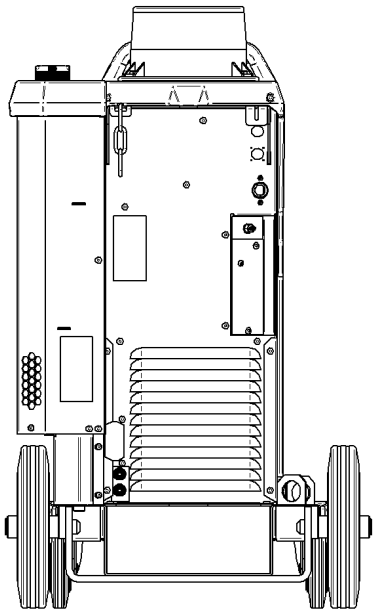


Figure 4.

Machine and Circuit Protection

Power Source is protected against overheating, overload and accidental short-circuits.

If the machine is overheated, the thermal protection circuit will decrease the output current to 0. This information will be shown by wire feeder user interface. Please refer to wire feeder user manual.

Transport & Lifting

⚠ WARNING

Falling equipment can cause injury and damage to unit.

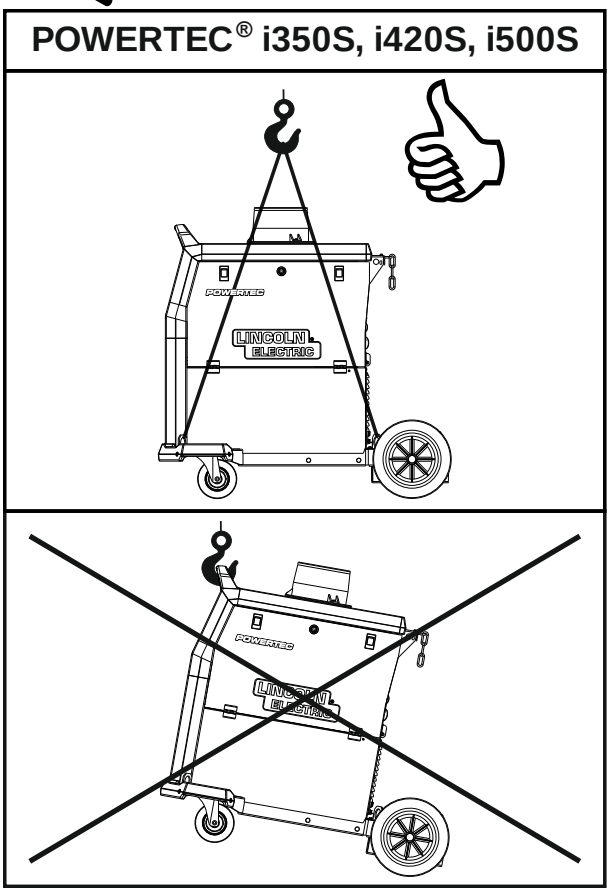


Figure 5.

During transportation and lifting with a crane, adhere to the following rules:
The device contains elements adapted for transport.
For lifting a suitable lifting equipment capacity.
For lifting and transport use minimum four belts.
Lift and transport only power source without gas cylinder, cooler and wire feeder, or/and any other accessories.

Maintenance

WARNING

For any repair operations, modifications or maintenances, it is recommended to contact the nearest Technical Service Center or Lincoln Electric. Repairs and modifications performed by unauthorized service or personnel will cause, that the manufacturer's warranty will be lost.

Any noticeable damage should be reported immediately and repaired.

Routine maintenance (everyday)

Check condition of insulation and connections of the work leads and insulation of power lead. If any insulation damage exists replace the lead immediately.

Remove the spatters from the welding gun nozzle. Spatters could interfere with the shielding gas flow to the arc.

Check the welding gun condition: replace it, if necessary.

Check condition and operation of the cooling fan. Keep clean its airflow slots.

Periodic maintenance (every 200 working hours, but at list once a year)

Perform the routine maintenance and, in addition:

Keep the machine clean. Using a dry (and low pressure) airflow, remove the dust from the external case and from the cabinet inside.

If it is required, clean and tighten all weld terminals.

The frequency of the maintenance operations may vary according to the working environment where the machine is placed.

WARNING

Do not touch electrically live parts.

WARNING

Before the case of welding machine will be removed, the welding machine has to be turned off and the power lead had to be disconnected from mains socket.

WARNING

Mains supply network must be disconnected from the machine before each maintenance and service. After each repair, perform proper tests to ensure safety.

Customer Assistance Policy

The business of The Lincoln Electric Company is manufacturing and selling high quality welding equipment, consumables, and cutting equipment. Our challenge is to meet the needs of our customers and to exceed their expectations. On occasion, purchasers may ask Lincoln Electric for advice or information about their use of our products. We respond to our customers based on the best information in our possession at that time. Lincoln Electric is not in a position to warrant or guarantee such advice, and assumes no liability, with respect to such information or advice. We expressly disclaim any warranty of any kind, including any warranty of fitness for any customer's particular purpose, with respect to such information or advice. As a matter of practical consideration, we also cannot assume any responsibility for updating or correcting any such information or advice once it has been given, nor does the provision of information or advice create, expand or alter any warranty with respect to the sale of our products

Lincoln Electric is a responsive manufacturer, but the selection and use of specific products sold by Lincoln Electric is solely within the control of, and remains the sole responsibility of the customer. Many variables beyond the control of Lincoln Electric affect the results obtained in applying these types of fabrication methods and service requirements.

Subject to Change – This information is accurate to the best of our knowledge at the time of printing. Please refer to www.lincolnelectric.com for any updated information

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 CAPACITOR DISCHARGE PROCEDURE

1. Remove main input power to the **POWERTEC® i350S, i420S, i500S**.
2. Remove the left side panel following the case removal procedure available in this Service manual.
3. The capacitors are discharged by discharge resistors integrated into the main board in about 2 (two) minutes.
4. Locate the terminals **POS** and **NEG** on the Input Rectifier Bridge, **See Figure 1.**
5. Connect your multi-meter positive probe to **POS** terminal point and your negative probe to **NEG** terminal and check the voltage.
6. In case of presence of residual voltage follow the next steps
7. Obtain a high resistance and high wattage resistor (500-1000 ohms and 25 watts minimum). This resistor is NOT supplied with the machine. NEVER USE A SHORTING STRAP FOR THIS PROCEDURE.
8. Use electrically insulate gloves and insulated pliers. Hold the body of the resistor and connect the resistor leads across the two points POS and NEG. **See Figure 1**. Hold the resistor in place for 10 seconds. DO NOT TOUCH CAPACITOR TERMINALS WITH YOUR BARE HANDS.
9. Check again the voltage across the two terminals. Voltage should be zero. If any voltage remains, repeat this procedure.

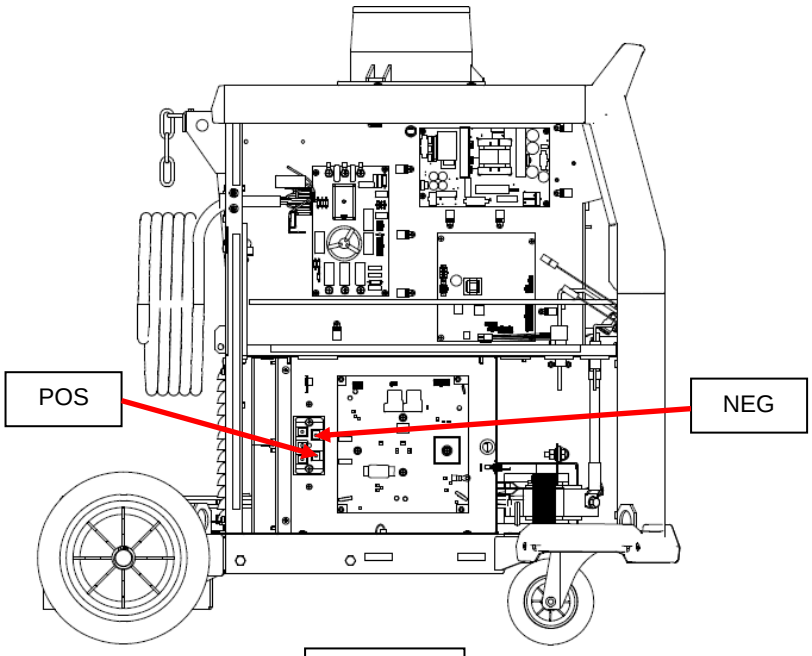


Figure 1

THERMAL PROTECTION

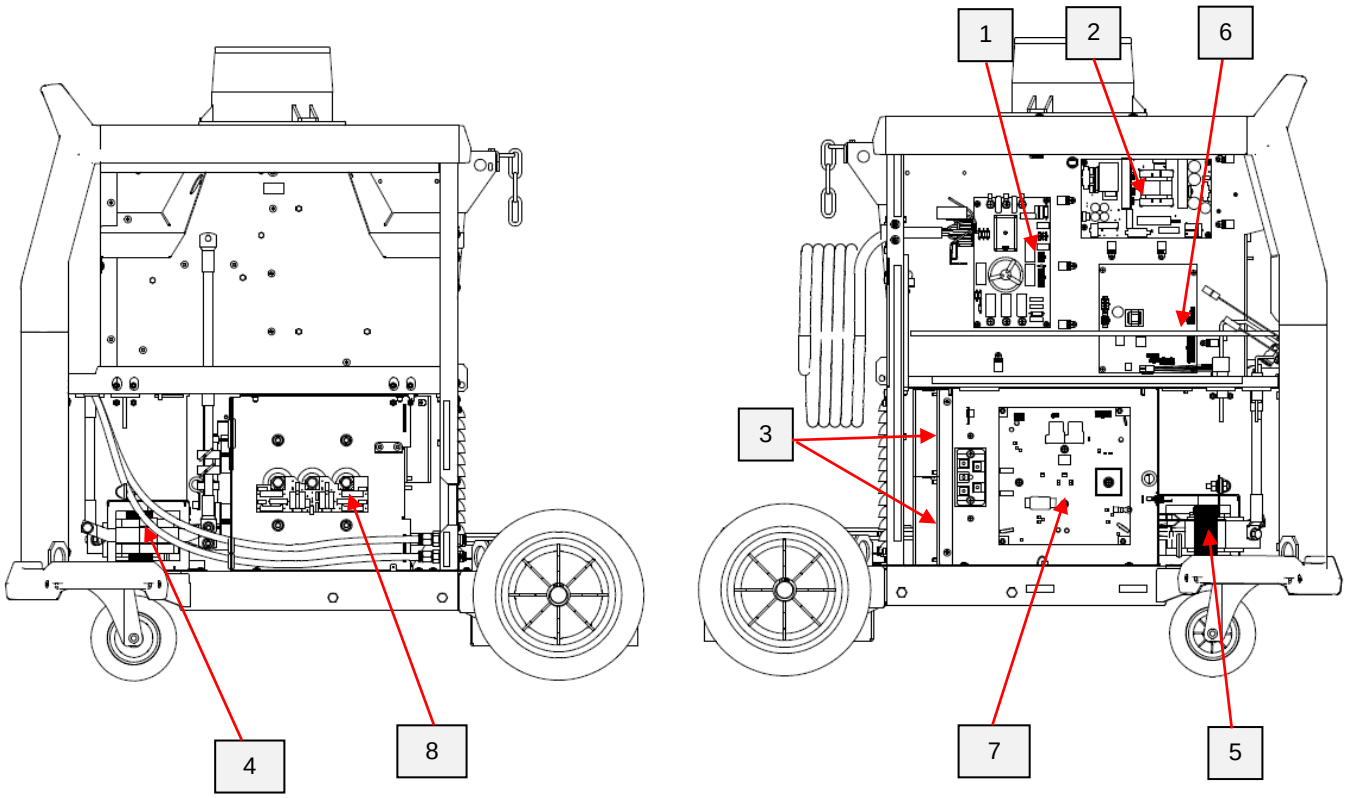
Thermal detection devices protect the machine from excessive operating temperatures. Excessive temperatures may be caused by a lack of cooling air or operating the machine beyond the duty cycle and output rating. If excessive operating temperatures should occur, the yellow LED will light and the detection device will prevent output voltage or current.

These detection devices are self-resetting once the machine cools sufficiently. If the thermostat shutdown 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 a 15 minute period. If the fan is not turning or the air intake louvers were obstructed , then the power must be switched off and the fan problem or air obstruction must be corrected.

MAJOR COMPONENTS LOCATION

POWERTEC i350S, i420S, i500S

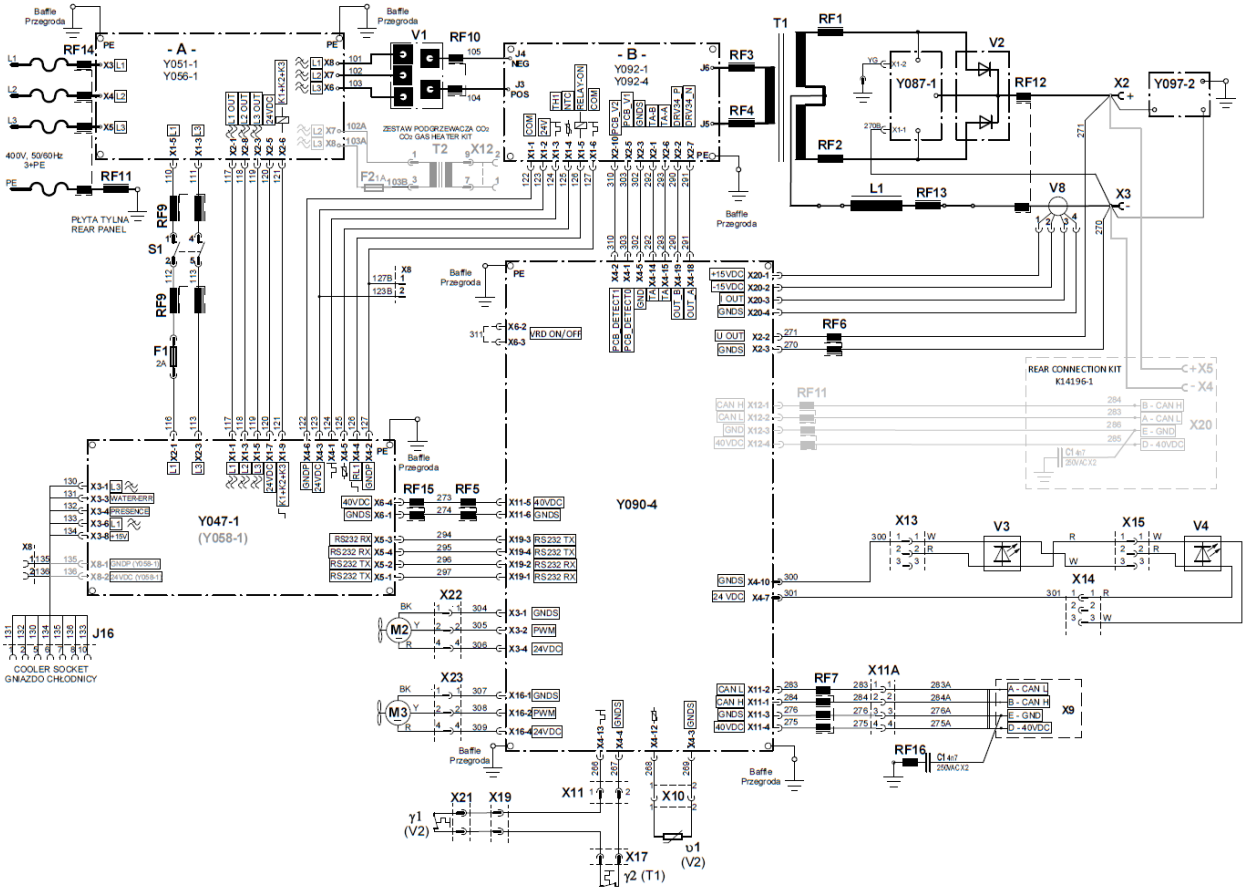
1. EMI Filter
2. Supply Board
3. Fans
4. Output transformer
5. Output Choke
6. Control Board
7. Inverter Board
8. Output diodes



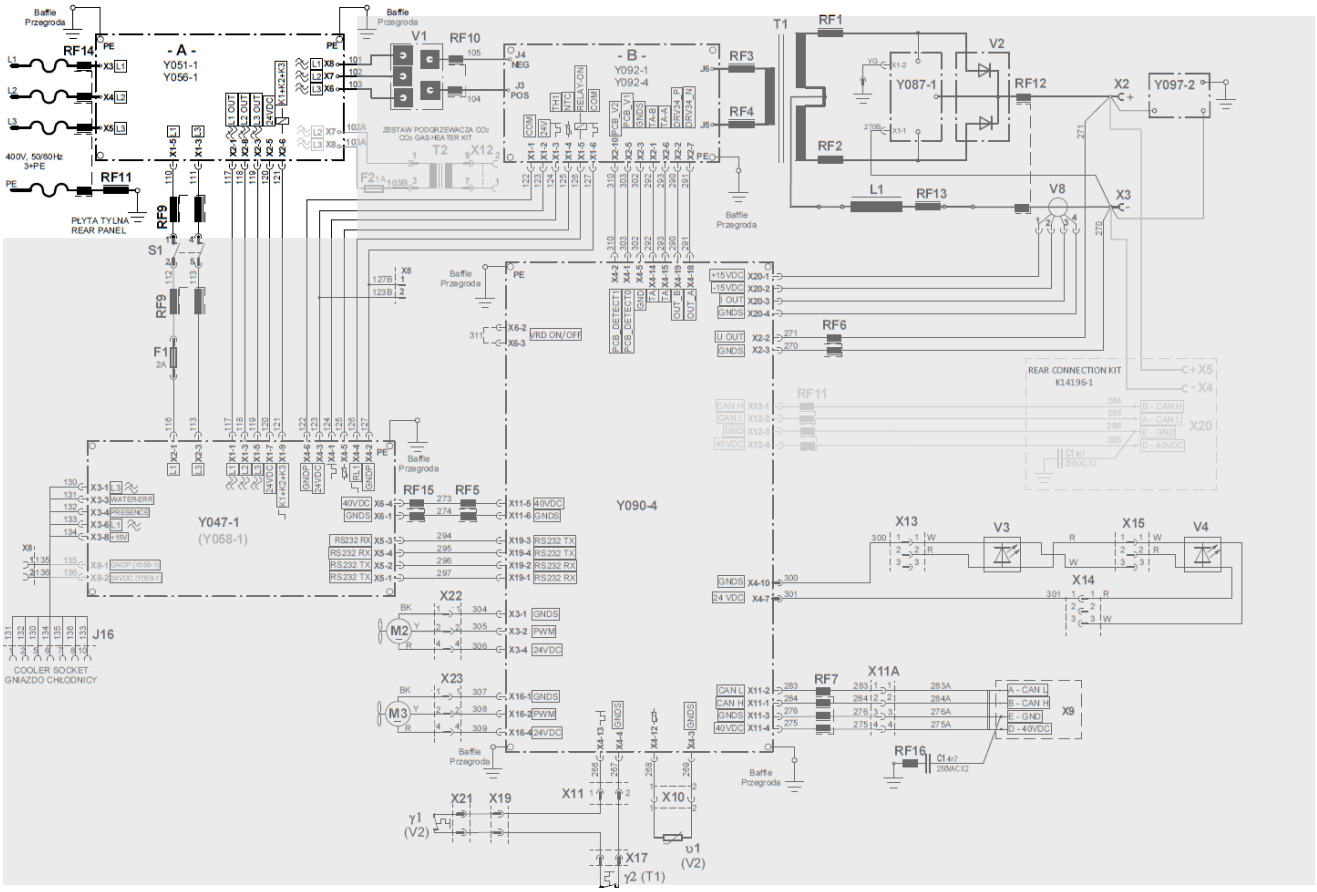
THEORY OF OPERATION

- General description
- Main Board
- Output choke – Polarity change – User Interface
- Protection Circuits
- IGBT operation

BLOCK DIAGRAM



GENERAL DESCRIPTION



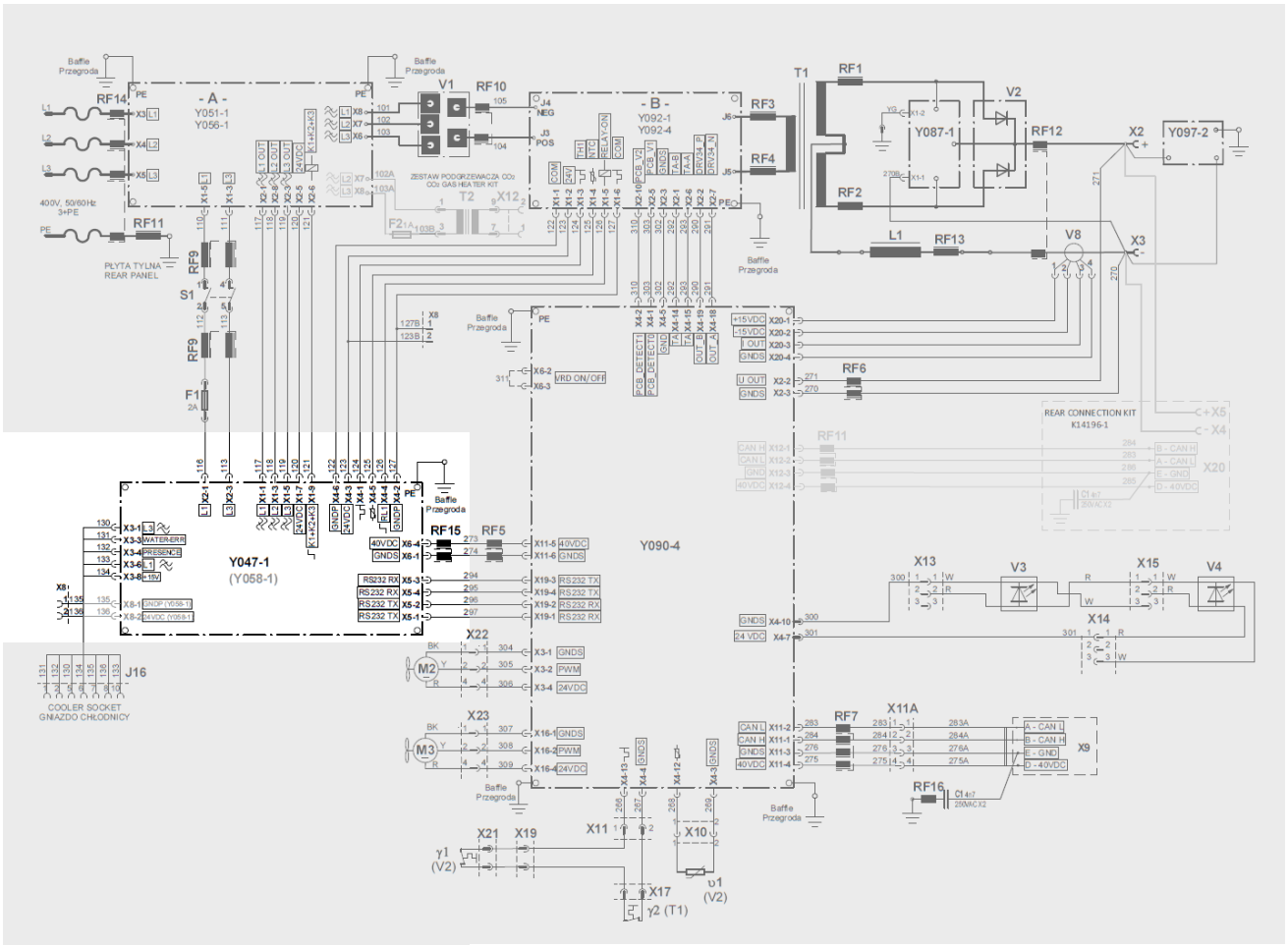
GENERAL DESCRIPTION

The POWERTEC® i350S, i420S, i500S are industrial arc welding power sources which utilize three phases input power, to produce constant voltage or constant current output. The welding response of these units has been optimized for GMAW, FCAW-SS, SMAW and GTAW-lift TIG. The units are ideal for industrial applications.
The POWERTEC® i350S, i420S, i500S, when connected to the input voltage of 400Vac, produce a welding output according to the technical table available at the beginning of this manual.
It operates on three phases input power 400Vac only. It is environmentally hardened to an IP23 rating for operating in difficult environments.

EMI FILTER (Y051-1 for PT i350S; Y056-1 for PT i420S and i500S)

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.
On the EMI filter are also located three relays K1,K2,K3, for Y051-1 and one relay RL1 for Y056-1 that, when close are/is responsible to provide the power supply to the inverter board through the input bridge V1.

VOLTAGE SUPPLY BOARD



VOLTAGE SUPPLY BOARD

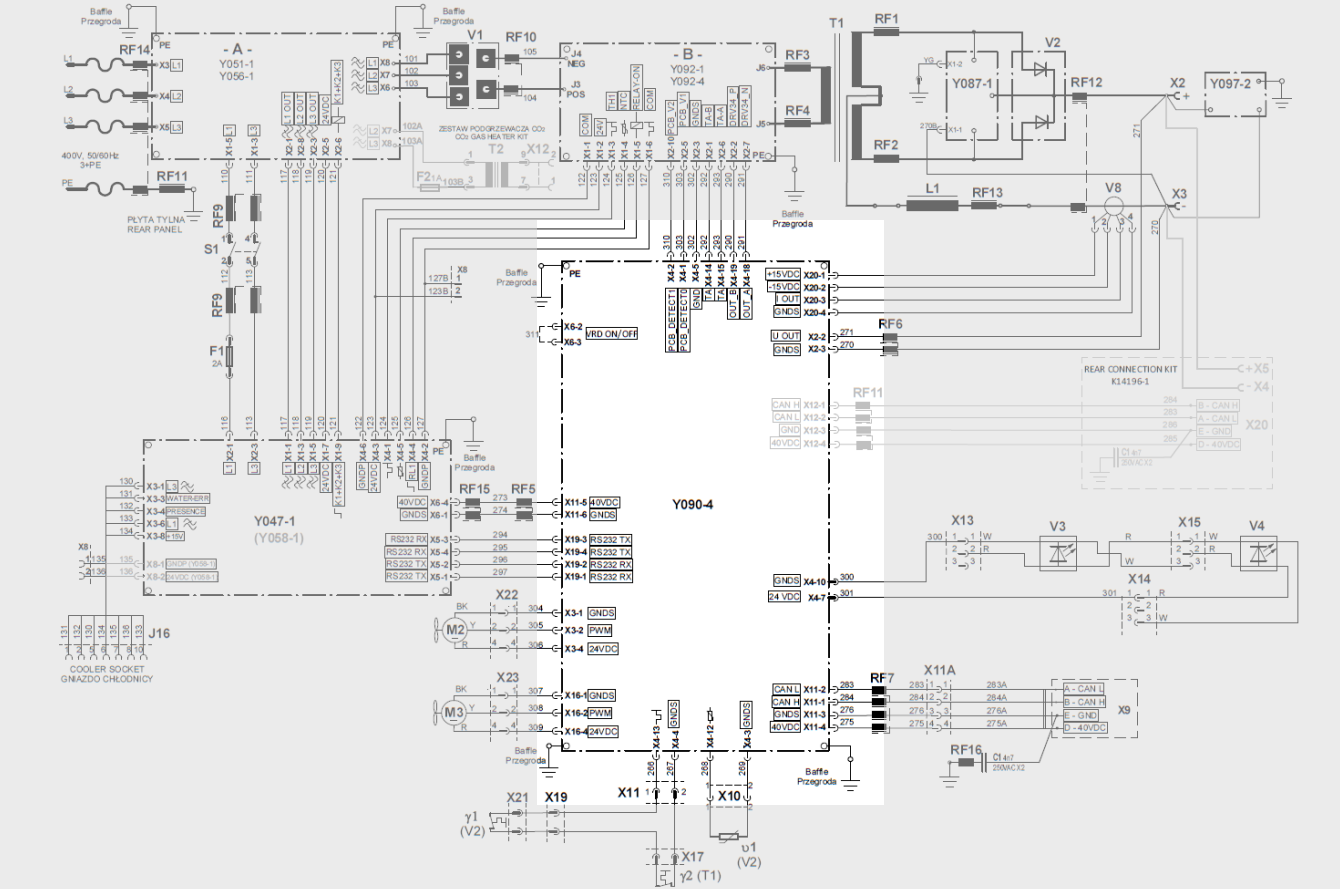
The VOLTAGE SUPPLY BOARD receives the three phases 400Vac (L, L2, L3) from the EMI filter board.

It generates all the auxiliary voltages needed by the machine circuits (24Vdc and 40Vdc).
It also provides, after checking the correctness of the input voltage supply applied to the machine, the OK, to the three relays that are located on the EMI filter, to close.
It also communicate via RS232 to the control board informing about the status of the input line.

When the machine ON/OFF switch is closed the AC input voltage (L1,L3) is applied to the Voltage Supply Board. Input voltage is verified and if correct (+/- 10%) micro controller gives command to close K1, K2,K3 relays (for Y056-1) or RL1 relay (for Y051-1)on EMI filter.

After few milliseconds another command is generated from the Voltage Supply Board to close the relay RL1A on the Inverter Board, the contact of this relay by pass the PTC needed to provide a soft charge to the DC BUS capacitors.

CONTROL BOARD



CONTROL BOARD (Y090-4)

The Control Board performs the primary interfacing functions to establish and maintain output control of the POWERTEC® i350S, i420S, i500S machines.

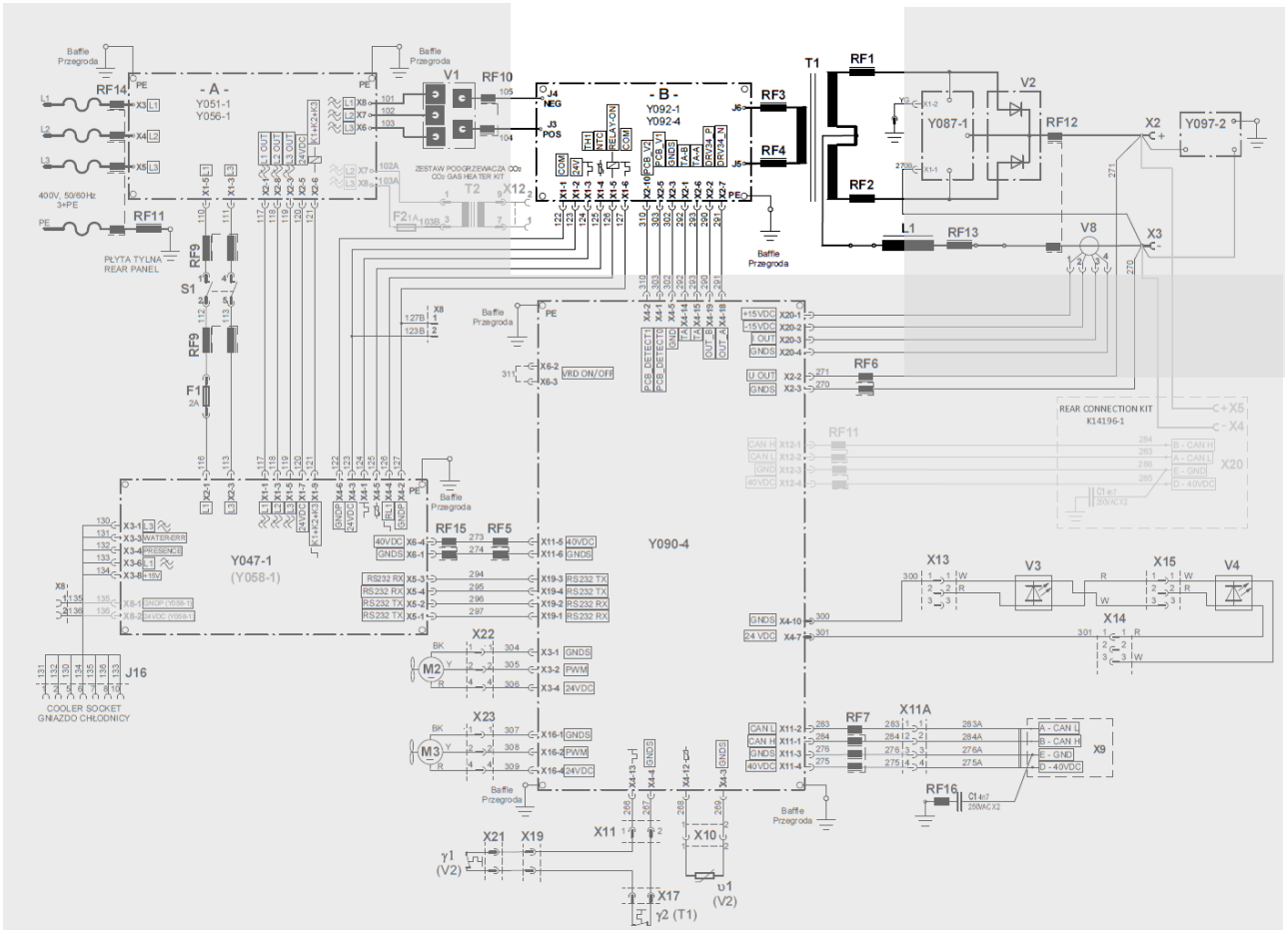
Digital user command signals from the UI and feedback information are received and processed by the Control Board.
Software loaded in the Control Board processes the command and feedback information and sends the appropriate pulse width modulation (PWM) signals to the Inverter board IGBTs.

The Control Board is supplied by 40VDC generated by the Voltage Supply Board (Y047-1/Y058-1)).

In addition, the Control Board performs the following functions:

- monitors output current
- monitors the thermostats status
- supply the fans
- supply the gas solenoid
- supply the wire drive motor

INVERTER AND MAIN TRANSFORMER



INVERTER AND MAIN TRANSFORMER

When the DC Bus capacitors are fully charged they act as power supplies for the IGBT switching circuit.
The IGBT switch the DC power from the DC Bus capacitors "on and off," thus supplying pulsed DC current to the main transformer primary winding.

The full bridge inverter switching frequency is 34KHz.

Current transducer located on the inverter board monitor the primary current. If the primary current become abnormally high, the control board circuit will shut off the IGBTs, thus disabling the machine's output.

A thermal protector is also present, to the inverter heat-sink, to protect the IGBTs from overheating conditions.

The main transformer insulate the primary circuit from the secondary circuit; this secondary winding supplies the welding voltages and the welding currents.
This high current winding is capable of supplying maximum output current during the welding process.

OVERLOAD PROTECTION

POWERTEC® i350S, i420S, i500S are electrically protected from producing higher than normal output current. An electronic protection circuit limits the current to within the capabilities of the machine.

THERMAL PROTECTION

There are two thermal devices located on the output diodes heat-sink; one on the main transformer, one on the output choke and two on the inverter board. They protect the machine from excessive operating temperature.
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 Overload indicator on the front panel, will turn ON and the thermostat will prevent output current. One PTC is also mounted on the output diodes heatsink to monitor the ambient temperature, if the temperature rise up, the control board will increase the fans speed.

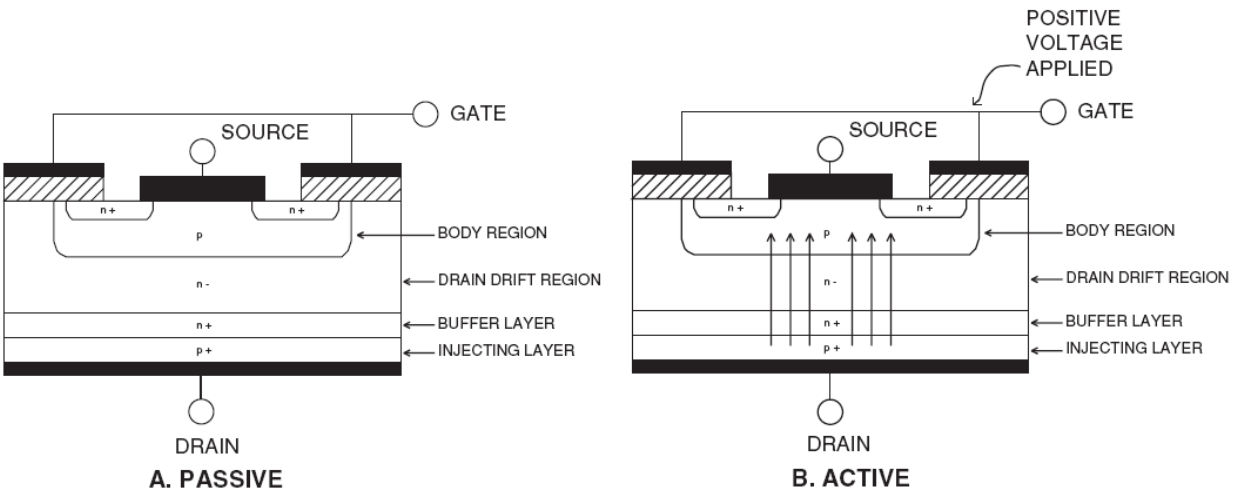
The thermal protection devices are self-resetting once the machine cools sufficiently. If the shutdown was caused by excessive output or duty cycle and the fan is operating normally, the power switch may be left on and the reset should occur within about 8-10 minutes period. If the fan is not turning 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 semiconductors 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
- Side panels 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 to assure 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 followed 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 HARNESSES.**

PROBLEMS / SYMPTOMS	POSSIBLE AREAS OF MISADJUSTMENT(S)	CHECKS	RECOMMENDED COURSE OF ACTION
THE LINE CIRCUIT BREAKER TRIPS WHEN MACHINE ON/OFF SWITCH IS MOVED TO " ON"	• INPUT RECTIFIER BRIDGE IS IN SHORT CIRCUIT • DC BUS CAPACITORS FAILURE • IGBTs SHORT CIRCUITED	• PERFORM THE INPUT RECTIFIER BRIDGE AND INVERTER BOARD RESISTANCE TEST	• REPLACE THE INPUTC RECTIFIER BRIDGE OR THE INVERTER BOARD
THE MACHINE IS DEAD, NO LIGHTS, NO DISPLAY, NO OUTPUT	• THERE IS NO POWER SUPPLY ON INPUT LINE • THE INPUT POWER SUPPLY CABLE IS INTERRUPTED • THE EMI FILTER IS DAMAGED • LINE SWITCH FAILURE • THE VOLTAGE SUPPLY BOARD IS DAMAGED	• CHECK THE PHASE INPUT VOLTAGE ON THE MACHINE • CHECK THE INPUT POWER SUPPLY CABLE • PERFORM THE EMI FILTER BOARD RESISTANCE AND VOLTAGE TEST • CHECK THE LINE SWITCH • PERFORM THE VOLTAGE SUPPLY BOARD TEST	• RECONNECT THE POWER SUPPLY • REPLACE THE INPUT POWER CABLE • REPLACE THE EMI FILTER BOARD • REPLACE THE LINE SWITCH • REPLACE THE VOLTAGE SUPPLY BOARD
THERMAL INDICATOR LIT (ON) ON USER INTERFACE (UI)	• ONE OF THE THERMAL PROTECTIONS HAVE TRIPPED.	• WAIT THE MACHINE TO COOL, THE RESET SHOULD OCCUR WITHIN ABOUT 8-10 MINUTES • CHECK FANS AND THERMAL PROTECTION CIRCUIT	• REPLACE THE DEFECTIVE FAN • REPLACE THE BOARD /ASSEMBLY WHERE THE FAULTY THERMAL SENSOR IS MOUNTED
THERE IS NO WIRE FEED WHEN THE TRIGGER IS ACTIVATED. OPEN CIRCUIT VOLTAGE IS PRESENT AND GAS SOLENOID WORKS PROPERLY	• IF THE DRIVE ROLL IS TURNING A MECCANICAL RESTRICTION IN THE WIRE FEED PATH CAN BE THE CAUSE • THE GUN LINER MAY BE CLOGGED • THE DRIVE ROLL IS NOT TURNING	• CHECK THE WIRE FEED PATH FOR MECCANICAL RESTRICTION/PROBLEMS • CHECK THE GUN LINER • CHECK THE DRIVE ROLL PRESSURE • PERFORM THE CONTROL BOARD VOLTAGE TEST	• REMOVE ANY POSSIBLE RESTRICTION • REPLACE THE GUN LINER • SET THE CORRECT DRIVE ROLLS PRESSURE • REPLACE THE WIRE DRIVE MOTOR OR CONTROL BOARD
THE ARC IS UNSTABLE	• THE CONTACT TIP MAY BE WORN • BAD OR LOOSE CONNECTIONS ON THE WORK OR GUN CABLE • WELDING POLARITY MAY IS NOT CORRECT FOR THE PROCESS BEING USED • WELDING WIRE MAY BE RUSTED OR DIRTY	• CHECK THE STATUS OF THE CONTACT TIP • CHECK THE STATUS OF THE WORK AND GUN CABLE • CHECK THE WELDING POLARITY • CHECK THE CONDITION OF THE WELDING WIRE	• REPLACE THE CONTACT TIP IF WORN • REPLACE THE WORK CABLE OR TORCH • CHANGE THE POLARITY ACCORDINGLY TO THE USED PROCESS • REPLACE THE WELDING WIRE IF DIRTY OR RUSTED
POROSITY ARE PRESENT ON WELD BEAD	• WELDING POLARITY MAY IS NOT CORRECT FOR THE PROCESS BEING USED • SHIELDING GAS OR FLOW MAY IS NOT CORRECT • THE WELDING JOINT IS CONTAMINATED	• CHECK THE WELDING POLARITY • CHECK THE SHIELDING GAS OR THE GAS FLOW • CHECK THE WELDING JOINT, FOR OIL, RUST OR ANY OTHER CONTAMINATIONS	• CHANGE THE POLARITY ACCORDINGLY TO THE USED PROCESS • CHANGE THE GAS TYPE OR FLOW RATE • CHECK THE GAS CIRCUIT FOR LOOSEN CONNECTIONS OR BROKEN TUBE • CLEAN THE JOINT
THERE IS NO GAS FLOW WHEN GUN IS TRIGGER IS PULLED. WIRE FEEDS AND WELD VOLTAGE IS PRESENT	• THE GAS BOTTLE MAY BE EMPTY • THE GAS HOSE MAY BE BROKEN	• CHECK GAS SOURCE AND HOSES FOR LEAKS OR KINKS • CHECK GAS REGULATOR ON THE BOTTLE FOR THE PRESSURE BEING SET TO HIGH • THE GAS SOLENOID MAY BE FAULTY • THE CONTROL BOARD MAY BE FAULTY	• REPLACE THE GAS BOTTLE • REPLACE THE GAS HOSE • REDUCE THE PRESSURE OF THE GAS REGULATOR • REPLACE THE GAS SOLENOID • REPALCE THE CONTROL BOARD

SIDE PANELS REMOVAL AND DC BUS CAPACITORS 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.

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DESCRIPTION

This procedure will aid the technician in the removal and replacement of the left and right metal panels and discharging the DC Bus capacitors making it safe for the technician to work on the machine.

MATERIALS NEEDED

Torx T25 wrench

POWERTEC® i350S, i420S, i500S – SIDE PANELS COVER REMOVAL

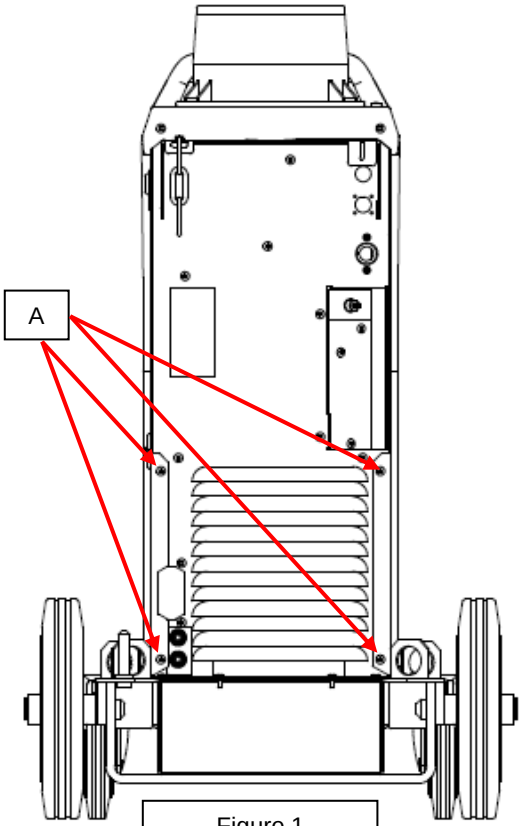

Figure 1

Necessary tool:

- Torx T25 wrench

Procedure:

1. Turn ON/OFF switch to OFF position.
2. Disconnect Input Power from the machine !
3. Remove the 4 screws (**A**) from the rear position of the left and right side panel. **See Figure 1**
4. Remove the left and right panel sliding them to the back of the machine

Follow the next session to **perform the discharge procedure**

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 CAPACITOR DISCHARGE PROCEDURE

1. Remove main input power to the POWERTEC® i350S, i420S, i500S.
2. Remove the left side panel following the case removal procedure available in this Service manual.
3. The capacitors are discharged by discharge resistors integrated into the main board in about 2 (two) minutes.
4. Locate the terminals **POS** and **NEG** on the Input Rectifier bridge, **See Figure 1.**
5. Connect your multi-meter positive probe to **POS** terminal point and your negative probe to **NEG** terminal and check the voltage.
6. In case of presence of residual voltage follow the next steps
7. Obtain a high resistance and high wattage resistor (500-1000 ohms and 25 watts minimum). This resistor is NOT supplied with the machine. NEVER USE A SHORTING STRAP FOR THIS PROCEDURE.
8. Use electrically insulate gloves and insulated pliers. Hold the body of the resistor and connect the resistor leads across the two points POS and NEG. **See Figure 1**. Hold the resistor in place for 10 seconds. DO NOT TOUCH CAPACITOR TERMINALS WITH YOUR BARE HANDS.
9. Check again the voltage across the two terminals. Voltage should be zero. If any voltage remains, repeat this procedure.

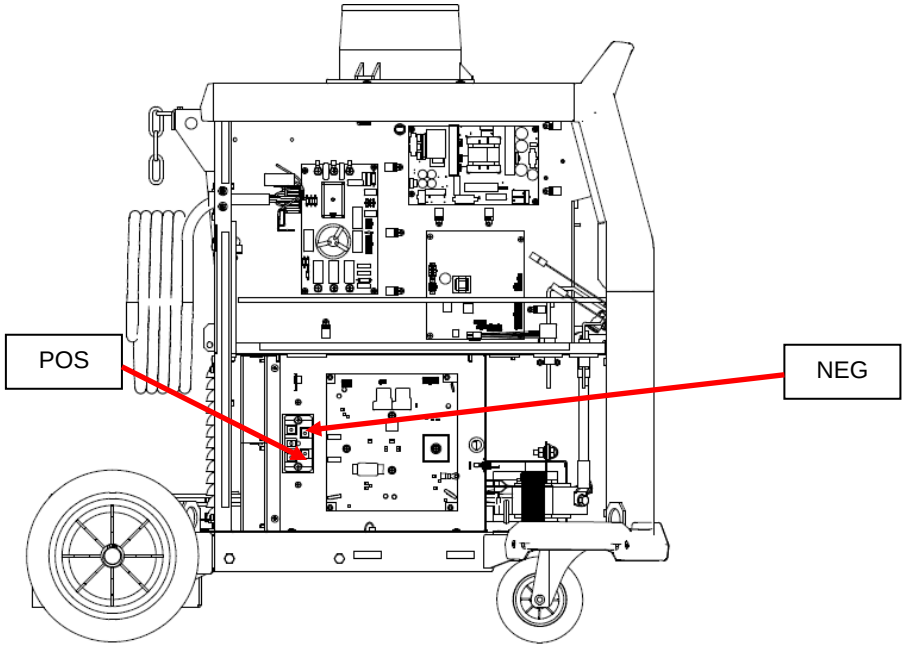

Figure 1

EMI FILTER BOARD RESISTANCE TEST

WARNING

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……..

TEST DESCRIPTION

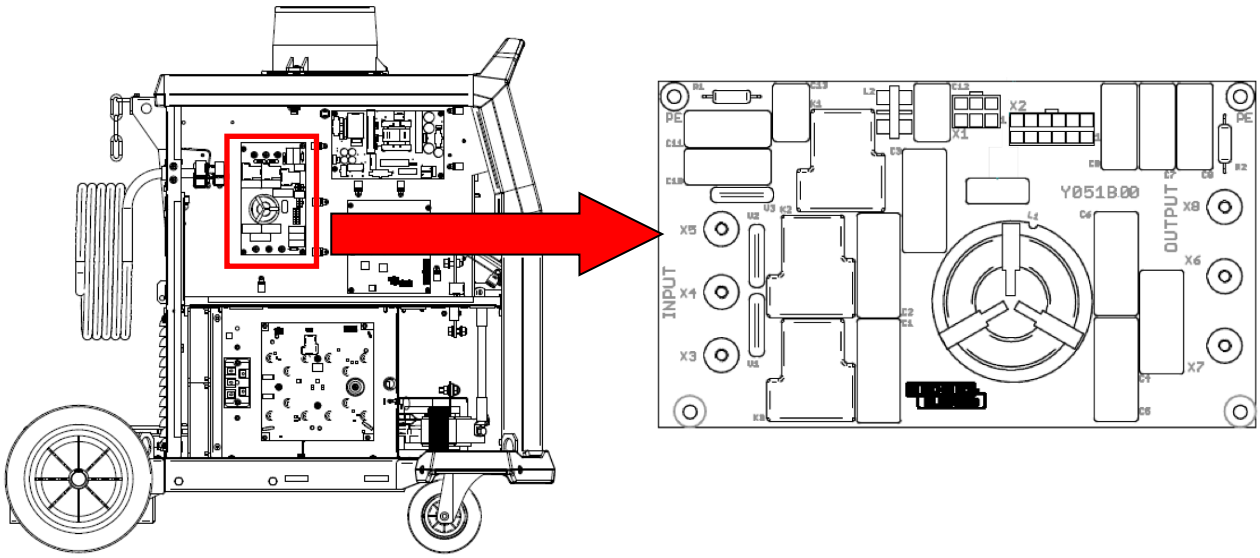
This test will determine if the EMI Filter Board (Y051-1 for PT i350S; Y056-1 for PT i420S and i500S) is good or defect.

MATERIALS NEEDED

Volt / Ohmmeter

EMI FILTER BOARD RESISTANCE TEST (continued)

Y051-1 for PT i350S



TEST PROCEDURE

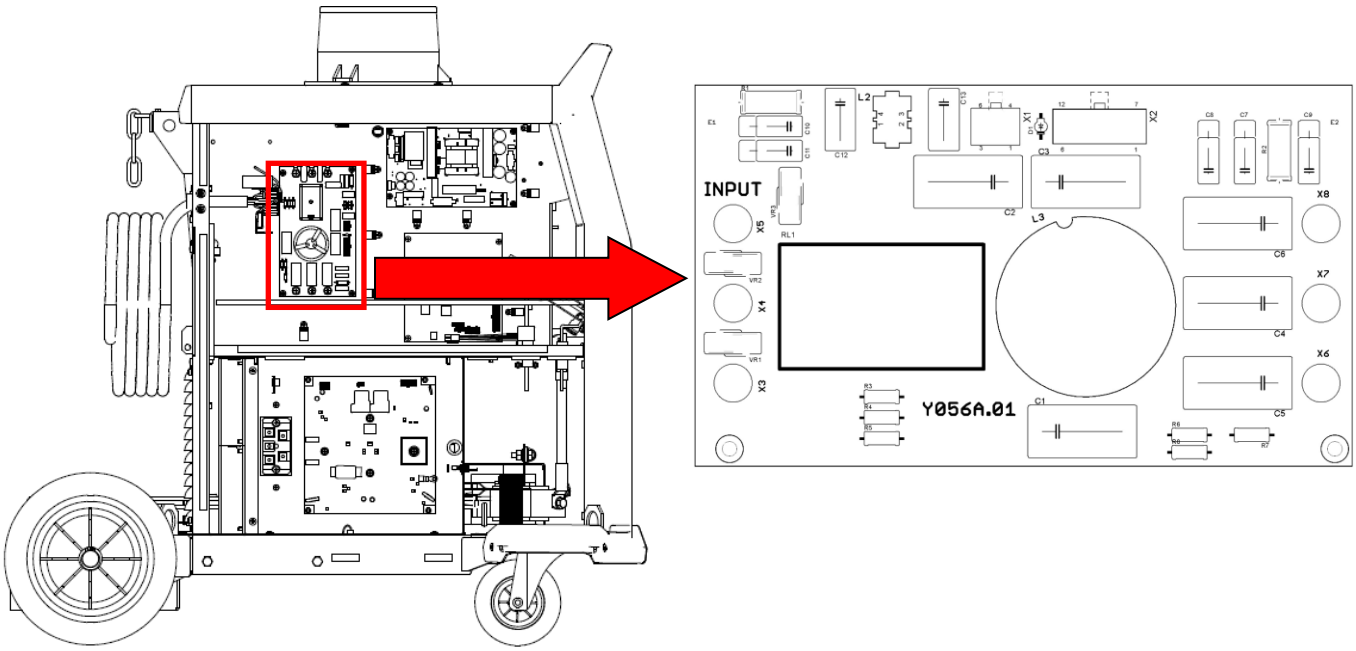
1. Remove main input power to the POWERTEC i350S.
2. **WARNING !** EMI filter is directly connected to the main line, be sure to have the plug removed from the mains !
3. The following tests can be performed without removing the EMI filter from the machine, just disconnect all cables from points **X3,X4,X5,X6,X7,X8** and connectors **X1**,**X2** from it.
4. Visually check for burned or damaged components. If any components are physically damaged the EMI filter board has to be replaced.
5. Using the Volt-Ohmmeter (ohm mode) perform the tests following the below table test:

EMI Filter Board - Table tests 1

Positive Probe (RED)	*Negative Probe (BLACK)*	*Value*
X3	X4	*OPEN*
X4	X5	*OPEN*
X3	X5	*OPEN*
X6	X7	*OPEN*
X7	X8	*OPEN*
X6	X8	*OPEN*
X3	X6,X7,X8	*OPEN*
X4	X6,X7,X8	*OPEN*
X5	X6,X7,X8	*OPEN*
X3	X1/5	*0 OHMS*
X5	X1/3	*0 OHMS*
X6	X2/1	*0 OHMS*
X7	X2/8	*0 OHMS*
X8	X2/3	*0 OHMS*

EMI FILTER BOARD RESISTANCE TEST (continued)

Y056-1 for PT i420S and i500S



TEST PROCEDURE

1. Remove main input power to the POWERTEC i420S and i500S.
2. **WARNING !** EMI filter is directly connected to the main line, be sure to have the plug removed from the mains !
3. The following tests can be performed without removing the EMI filter from the machine, just disconnect all cables from points **X3,X4,X5,X6,X7,X8** and connectors **X1**,**X2** from it.
4. Visually check for burned or damaged components. If any components are physically damaged the EMI filter board has to be replaced.
5. Using the Volt-Ohmmeter (ohm mode) perform the tests following the below table test:

EMI Filter Board - Table tests 1

Positive Probe (RED)	*Negative Probe (BLACK)*	*Value*
X3	X7	*OPEN*
X4	X6	*OPEN*
X5	X8	*OPEN*
X6	X7	*OPEN*
X7	X8	*OPEN*
X6	X8	*OPEN*
X3	X6,X7,X8	*OPEN*
X4	X6,X7,X8	*OPEN*
X5	X6,X7,X8	*OPEN*
X3	X1/5	*0 OHMS*
X5	X1/3	*0 OHMS*
X6	X2/8	*0 OHMS*
X7	X2/1	*0 OHMS*
X8	X2/3	*0 OHMS*

INPUT RECTIFIER BRIDGE RESISTANCE TEST

WARNING

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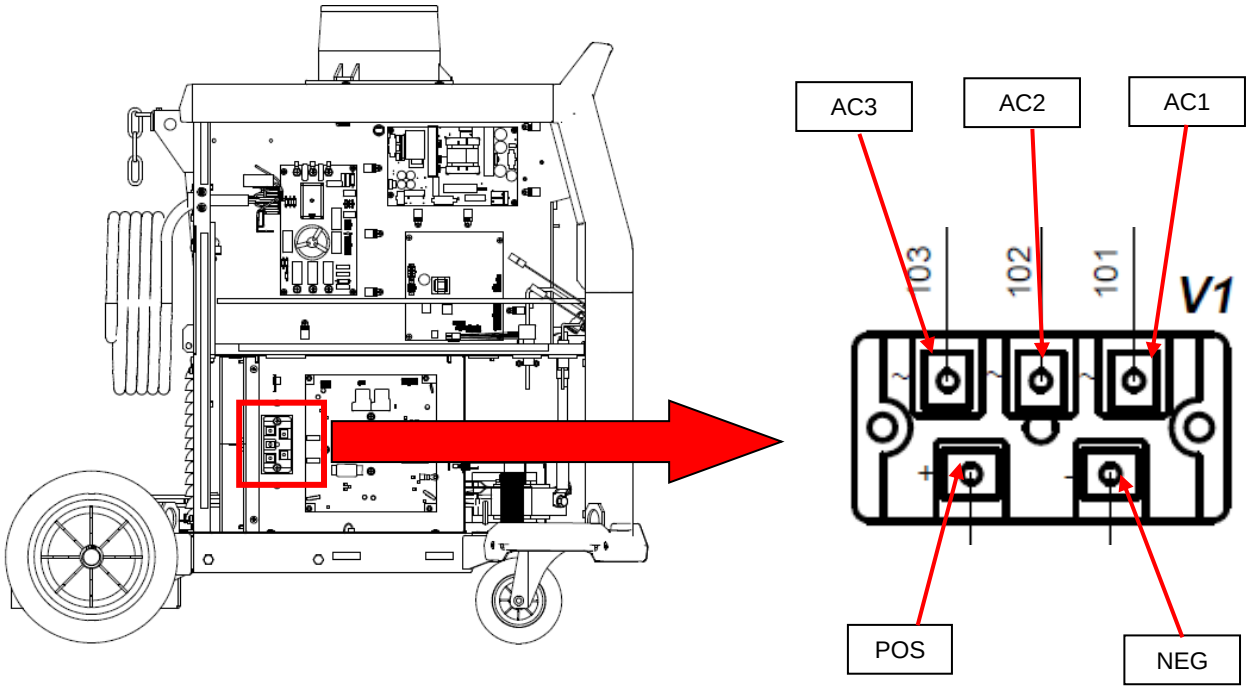
TEST DESCRIPTION

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

MATERIALS NEEDED

Volt / Ohmmeter
Machine Wiring Diagrams

INPUT RECTIFIER BRIDGE RESISTANCE TEST (continued)



TEST PROCEDURE

1. Remove main input power to the POWERTEC® i350S, i420S, i500S.
2. Perform the **Discharge procedure**
3. Disconnect the cables 104 and 105 from the POS and NEG rectifier bridge terminals
4. Using the Volt-Ohmmeter (diode test mode) check the Input Rectifier **V1** (see **Table tests 1**)

Input Bridge V1 - Table tests 1

Positive Probe (RED)	*Negative Probe (BLACK)*	*Value*
AC1	**+**	*0.3V - 0.7V*
AC2	**+**	*0.3V - 0.7V*
AC2	**+**	*0.3V - 0.7V*
+	**AC1**	OPEN
+	**AC2**	OPEN
+	**AC3**	OPEN
-	**AC1**	*0.3V - 0.7V*
-	**AC2**	*0.3V - 0.7V*
-	**AC3**	*0.3V - 0.7V*
AC1	**-**	OPEN
AC2	**-**	OPEN
AC3	**-**	*OPEN*

INVERTER 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.

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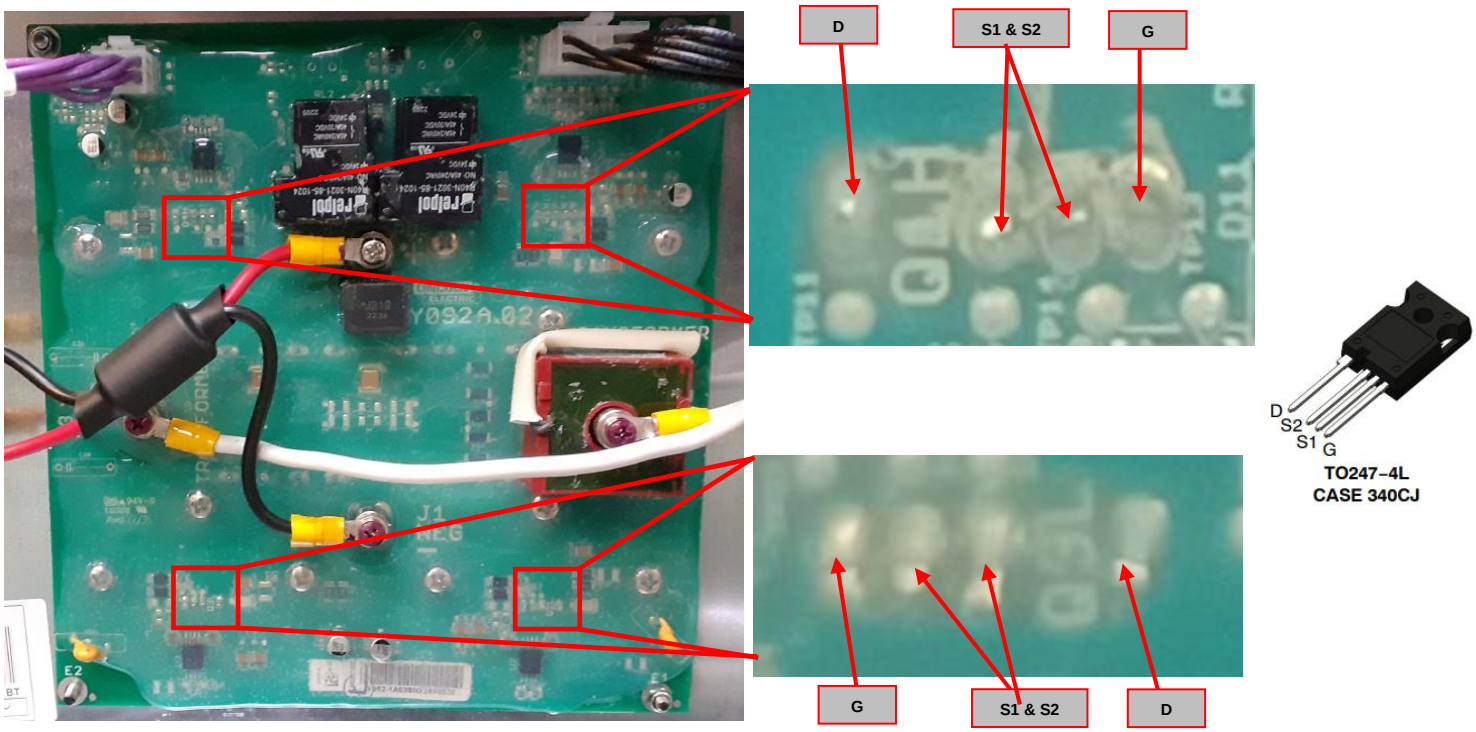
TEST DESCRIPTION

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)



(picture refers to PT i500S)

TEST PROCEDURE

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

1. Remove main input power to the POWERTEC® i350S, i420S, i500S.
2. Perform the **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 RECTIFIER MODULES 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.
……

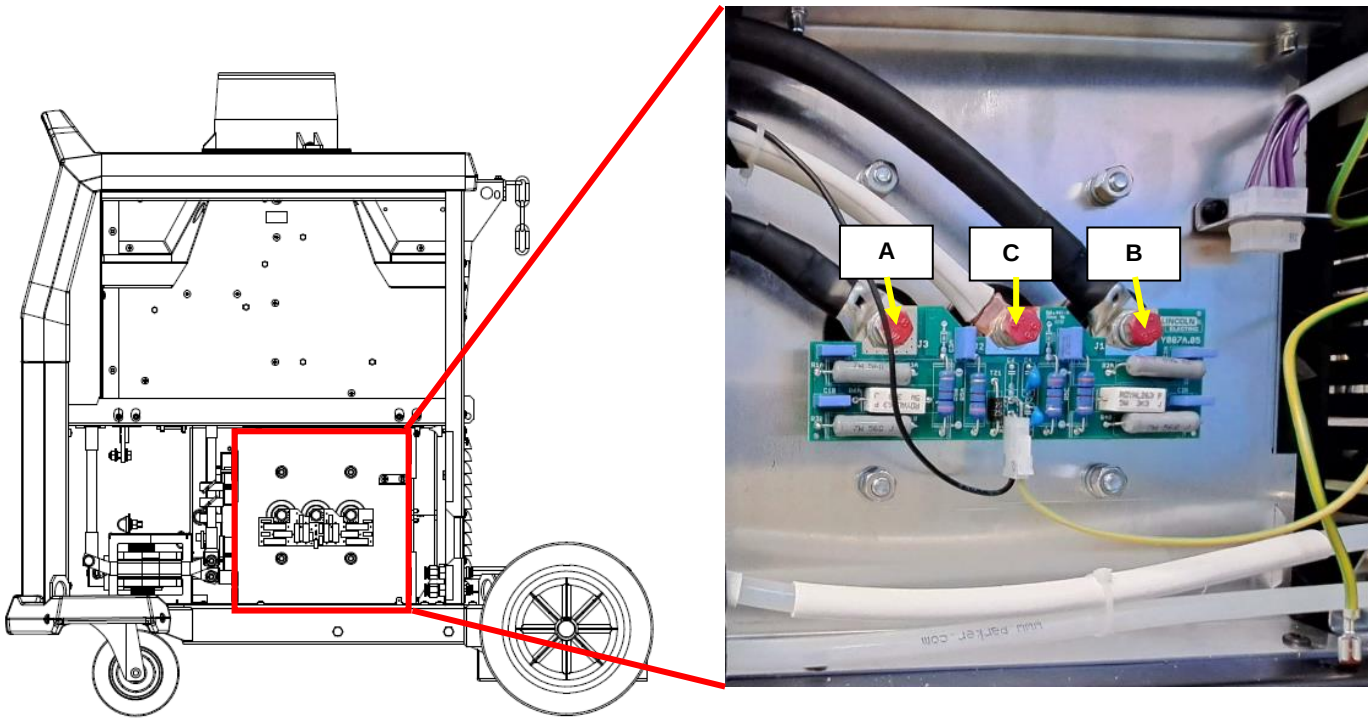
TEST DESCRIPTION

This test will help determine if the output diode modules are functioning correctly.

MATERIALS NEEDED

Volt / Ohmmeter
Machine Wiring Diagrams
13 mm wrench

OUTPUT RECTIFIER MODULES RESISTANCE TEST (continued)



TEST PROCEDURE

1. Remove main input power to the POWERTEC® i350S, i420S, i500S.
2. Perform the Discharge procedure
3. Locate the output diodes module on the right side of the machine
4. Visually check for burned or damaged components. If any components are physically damaged should be replaced.
5. Using a 13mm wrench remove the cables (**A**), (**B**) and (**C**) as shown in the above picture.
6. Using the multi-meter in diode test mode check each rectifier module following the table tests below:

Output diode module Test

Positive Probe (RED)	*Negative Probe (BLACK)*	*Value*
A	**C**	0,3V-0,4V
C	**A**	OPEN
C	**B**	OPEN
B	**C**	0,3V-0,4V

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

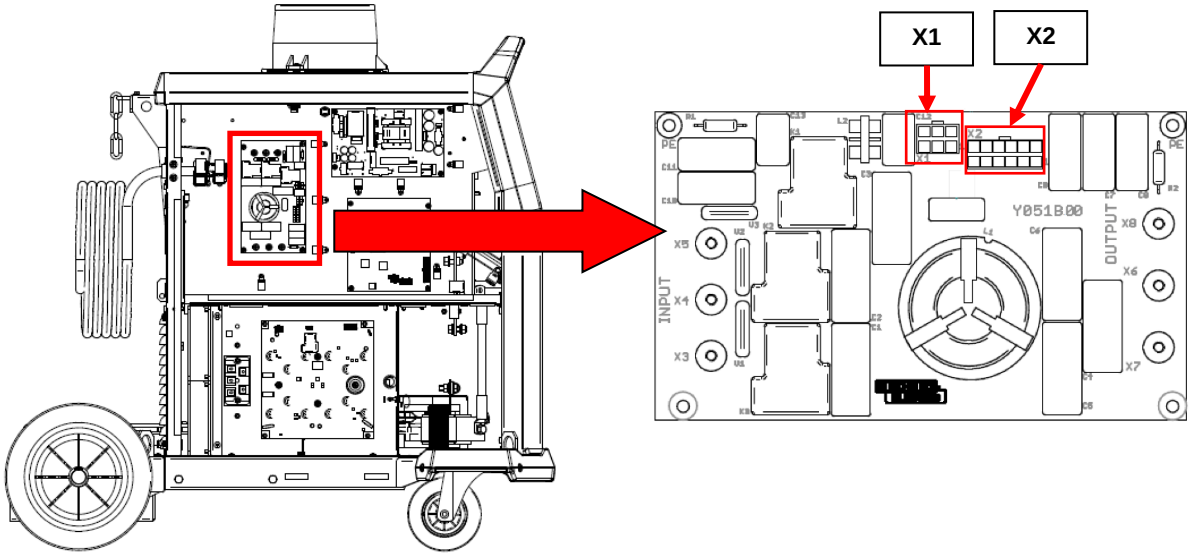
This test will help to determine if the input voltage applied to the EMI filter is passing through it and arrive correctly to the main board.

MATERIALS NEEDED

Volt/Ohmmeter
Machine Wiring Diagrams

EMI FILTER BOARD VOLTAGE TEST (continued)

Y051-1 for PT i350S



TEST PROCEDURE

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

1. Remove main input power to the POWERTEC i350S.
2. Follow the case removal procedure available in this Service Manual
3. Apply 400 Vac +/- 10% to the POWERTEC i350S.
4. **WARNING!** EMI filter is connected before the machine ON/OFF switch !
5. Check between EMI filter input voltage points **X3, X4 and X5** for 400Vac +/- 10% and between EMI output points **X6, X7, X8** also for 400Vac +/- 10%
6. Check also other voltages as per the following Table tests:

X1: EMI filter Board to ON/OFF Switch

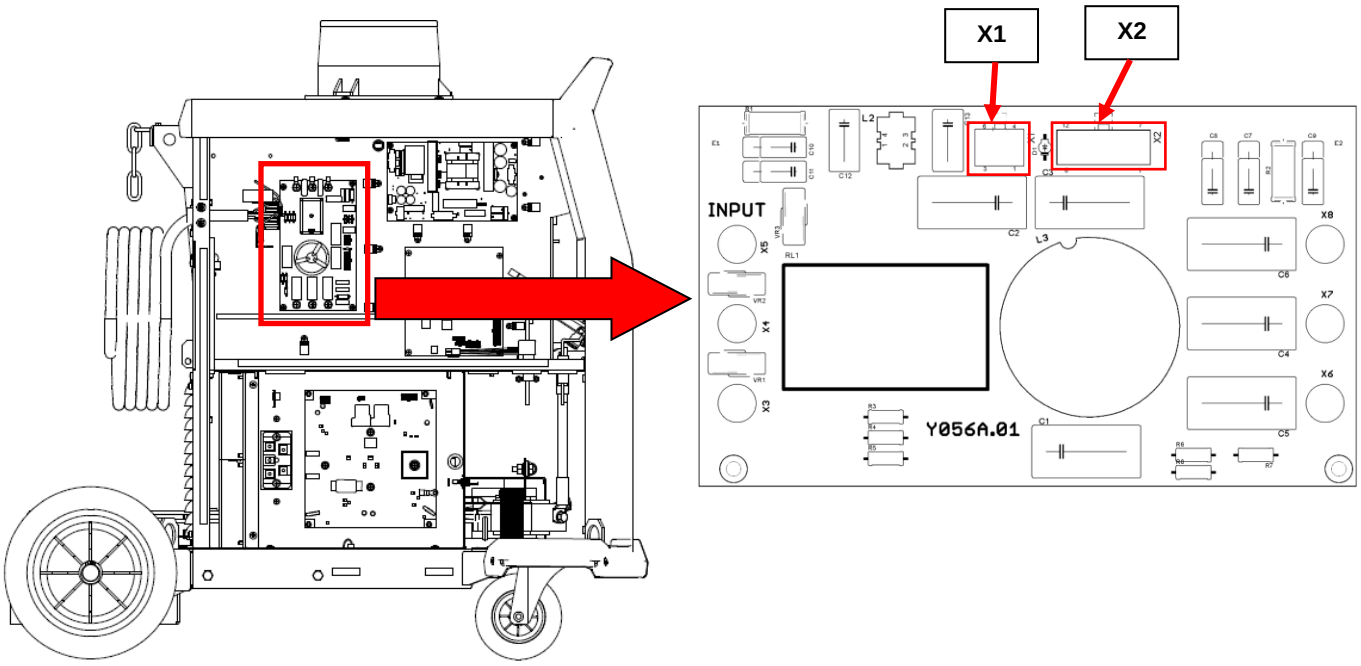
Pin #	Description	Value	Notes
3	To ON/OFF switch	400Vac +/- 10%	Always also when switch is to OFF position
5			

X2: EMI Filter Board to Voltage Supply Board

Pin #	Description	Value	Notes
1	Power supply to Voltage Supply Board	400Vac between each of the three pins	Only after mains switch is ON
3			
8			
5	Power supply for relays K1,K2,K3	+ 24Vdc +/-10%	When Mains switch is to ON
6			

EMI FILTER BOARD VOLTAGE TEST (continued)

Y056-1 for PT i420S and i500S



TEST PROCEDURE

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

7. Remove main input power to the POWERTEC i420S and i500S.
8. Follow the case removal procedure available in this Service Manual
9. Apply 400 Vac +/- 10% to the POWERTEC i420S and i500S.
10. **WARNING!** EMI filter is connected before the machine ON/OFF switch !
11. Check between EMI filter input voltage points **X3, X4 and X5** for 400Vac +/- 10% and between EMI output points **X6, X7, X8** also for 400Vac +/- 10%
12. Check also other voltages as per the following Table tests:

X1: EMI filter Board to ON/OFF Switch

Pin #	Description	Value	Notes
3	To ON/OFF switch	400Vac +/- 10%	Always also when switch is to OFF position
5			

X2: EMI Filter Board to Voltage Supply Board

Pin #	Description	Value	Notes
1	Power supply to Voltage Supply Board	400Vac between each of the three pins	Only after mains switch is ON
3			
8			
5	Power supply for relays K1,K2,K3	+ 24Vdc +/-10%	When Mains switch is to ON
6			

VOLTAGE SUPPLY BOARD 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 correct input voltages are applied to the voltage supply board and also if the correct regulated voltages are being processed by the board.

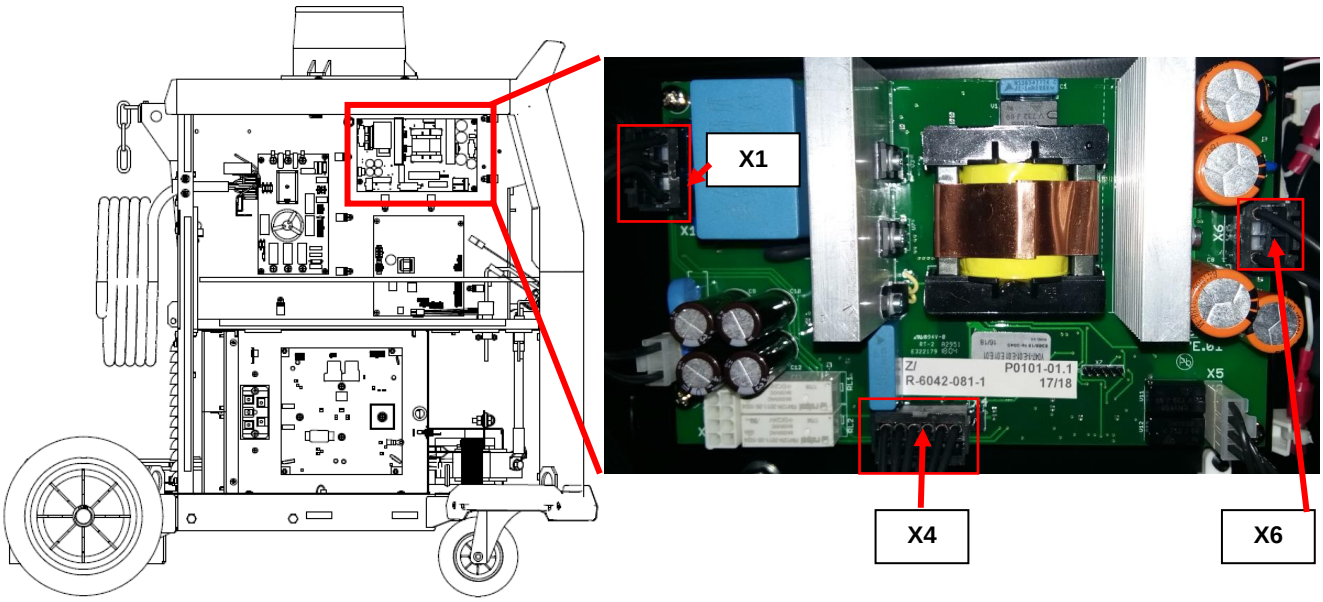
MATERIALS NEEDED

Volt/Ohmmeter
Machine Wiring Diagrams

VOLTAGE SUPPLY BOARD TEST (continued)

⚠ WARNING

DO NOT CONNECT THE SAME SCOPE GROUND BETWEEN HIGH SIDE AND LOW SIDE



TEST PROCEDURE

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

1. Remove main input power to the POWERTEC® i350S, i420S, i500S.
2. Follow the case removal procedure available in this Service Manual
3. Apply 400 Vac +/- 10% to the POWERTEC® i350S, i420S, i500S.
4. Turn the machine mains switch to ON position
5. Follow the below tables tests:

X1: Voltage Supply Board to EMI Filter

Pin #	Description	Value	Notes
1	Power supply to Voltage Supply Board	400Vac between each of the three pins	Only after mains switch is ON
3			
5			
7	Power supply for relays K1,K2,K3	+ 24Vdc +/-10%	When Mains switch is to ON
9			

X4: Voltage Supply Board to Inverter Board (pin 6 is the GND)

Pin #	Description	Value	Notes
3	Inverter supply	+24 Vdc +/-10%	When Mains switch is to ON
6			
6	NTC1	+2,7 Vdc +/-10%	Normal condition , no over temperature condition
5			
6	RL1A power supply	+5Vdc +/-10%	After about 2 seconds after machine switch ON. Before the 2 seconds the value is 0 (zero) volt. It is the power supply for the relay RL1 That is by-pass the capacitors pre-charge PTC
4			

X6: Voltage Supply Board to Control Board

Pin #	Description	Value	Notes
1	Power supply to Control Board	+40Vdc +/- 0,1V	Power supply generated by the Voltage supply board for the Control Board
4			

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.

……..

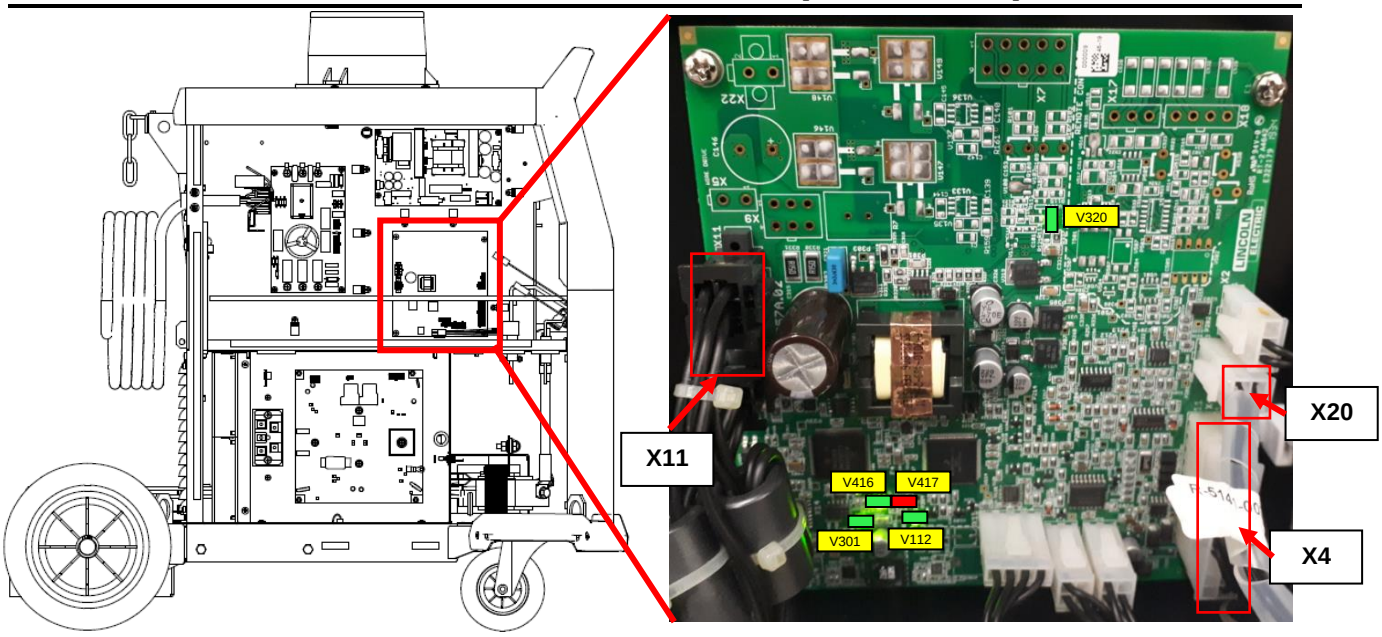
TEST DESCRIPTION

This test will help to determine if the correct input voltage is being applied to the control board and if it may be faulty.

MATERIALS NEEDED

Volt/Ohmmeter
Machine Wiring Diagrams

CONTROL BOARD TEST (continued)



TEST PROCEDURE

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

1. Remove main input power to the POWERTEC® i350S, i420S, i500S.
2. Follow the case removal procedure available in this Service Manual
3. Apply 400 Vac +/- 10% to the POWERTEC® i350S, i420S, i500S.
4. Turn the machine mains switch to ON position
5. Follow the below tables tests

LEDs Table

LED	Description	Status	Notes
V301	+24 Vdc	Always ON GREEN	It indicates that the 24Vdc is present
V416 & V417	Standard Arclink LEDs as in every Arclink control board	V416 has to be green if machine status is OK. V417 has to be OFF	In case or machine error they start blinking V416 green and V417 RED providing together the error code number (Lincoln Standard error codes)
V320	3,3V dc	Always ON (GREEN)	It indicates that the 3,3 V dc is present
V112	Status LED green	Always ON after about 10 seconds from Power ON	Indicated correct machine status

X11: Voltage Supply Board to Control Board (pin 6 is GND)

Pin #	Description	Value	Notes
5	Power supply to Control Board	+40Vdc +/- 0,1V	Power supply generated by the Voltage supply board for the Control Board
6			

X20: Control Board to Current transducer (use pin 4 is GND)

Pin #	Description	Value	Notes
1	Power supply	+15Vdc +/- 10%	Positive voltage supply for the current transducer
2	Power supply	-15Vdc +/- 10%	Negative voltage supply for the current transducer
3	Current feedback	Different values linked to the welding current	Welding current transducer feedback to control board

X4: Control Board to LEDS and thermal sensors

Pin #	Description	Value	Notes
7	Power supply for the internal LEDS	+24 Vdc +/- 10%	Always present
10			
4	Thermal sensors	0 Vdc	If all thermal sensors Y1, Y2, Y3 are closed If thermal is activated voltage is about 2,9 Vdc
13			

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.

……..

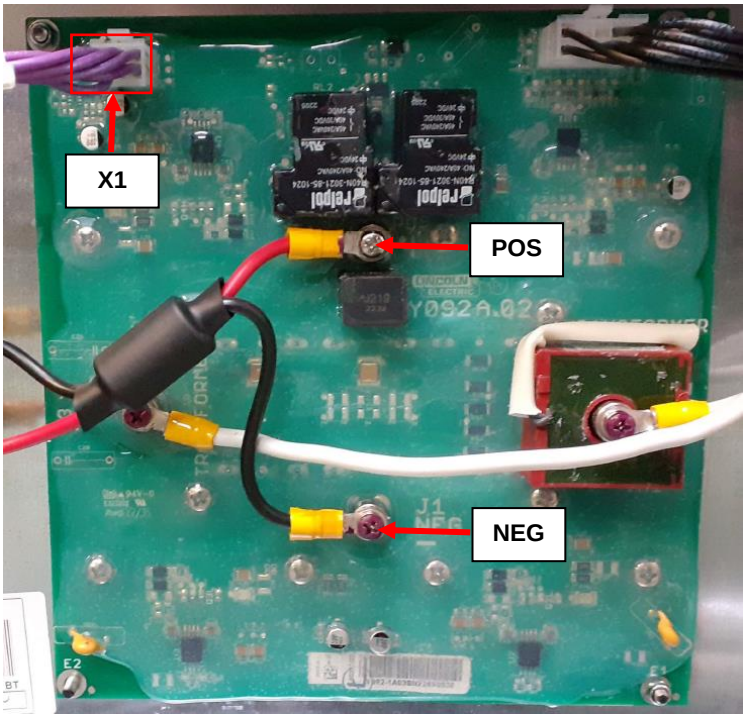
TEST DESCRIPTION

This test will help to determine if the main inverter board is receiving the correct input voltages and if the correct regulated voltages are being processed and maintained by the inverter.

MATERIALS NEEDED

Volt/Ohmmeter
Machine Wiring Diagrams

INVERTER BOARD TEST (continued)



TEST PROCEDURE

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

1. Remove main input power to the POWERTEC® i350S, i420S, i500S.
2. Follow the case removal procedure available in this Service Manual
3. Apply 400 Vac +/- 10% to the POWERTEC i350S.
4. Turn the machine mains switch to ON position
5. Check for 565Vdc +/- 10% between POS and NEG points
6. Follow the below tables tests

X1: Inverter Board to Control Board

Pin #	Description	Value	Notes
1 2	Inverter circuit power supply	+ 24 Vdc +/- 10%	Generated by the Voltage supply Board
1 4	Thermal sensor signal	+ 2,3 Vdc +/- 10%	ON/OFF thermal sensor signal
1 5	Power Relay RL1A	+5 Vdc after 2 seconds from power up, before value is 0 (zero)	Control signal for the power Relay RL1A

DISASSEMBLY OPERATIONS

FANS REMOVAL AND REPLACEMENT PROCEDURE

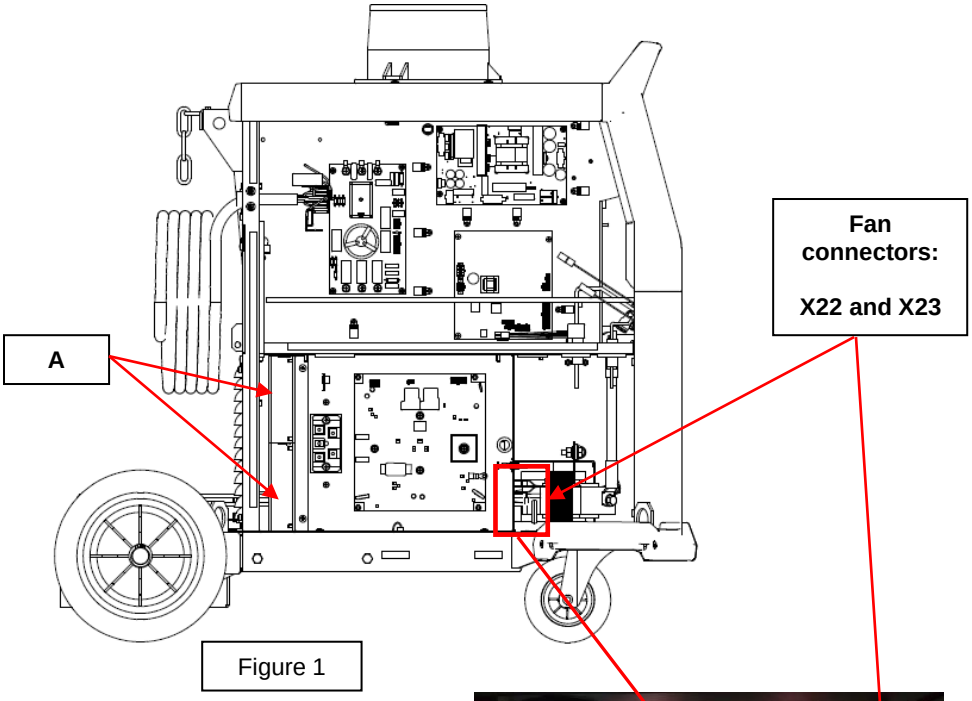


Figure 1

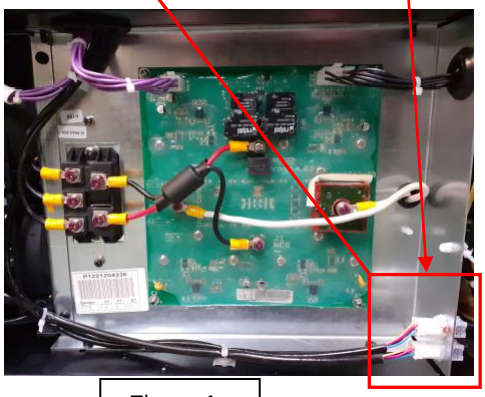


Figure 1a

REMOVAL PROCEDURE

Necessary tool:

- Screwdriver type PH02
- Torx T25 wrench

1. Remove main input power to the POWERTEC® i350S, i420S, i500S
2. Open the left side panel of the machine following the case cover removal procedure.
3. **WARNING!** EMI filter is connected before the machine ON/OFF switch! Be sure to have disconnected the machine plug from the power supply.
4. Locate the two screws **A**, see **Figure 1,** and remove them.
5. Disconnect the two fan connectors **X22** and X**23**, see **Figure 1** and plastic tyes that fix them to the machine harness and bottom plate. See **Figure 1.**
6. Pull the metal frame where the fans are mounted.
7. Remove the 4 screws that fix the broken fan to the metal frame

For the Fans re-assembly operations, make the previous steps in the reverse order.

DISASSEMBLY OPERATIONS

INPUT RECTIFIER REMOVAL AND REPLACEMENT PROCEDURE

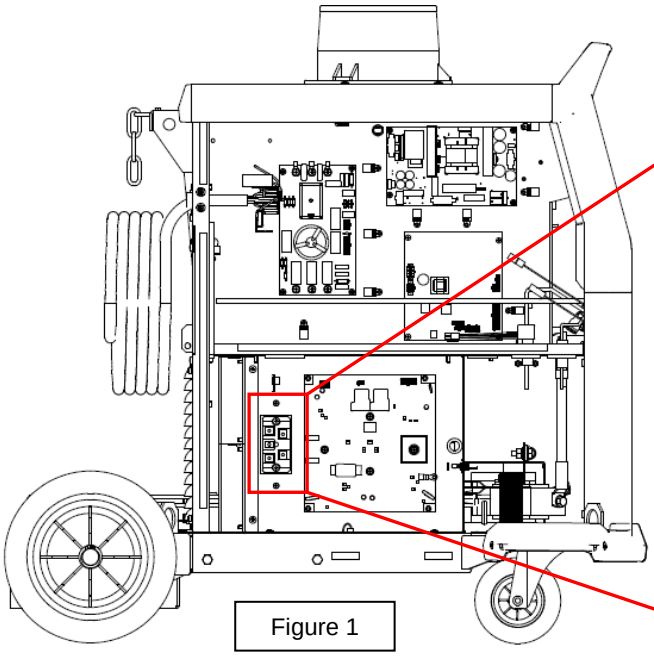


Figure 1

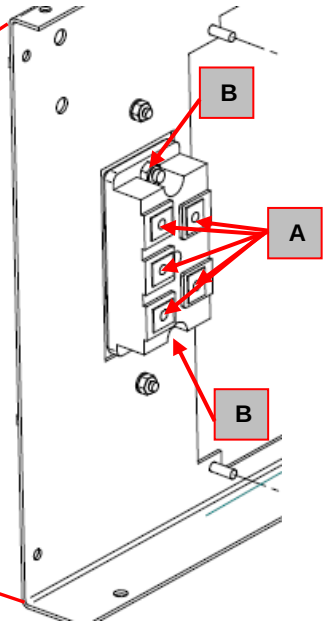


Figure 1a

REMOVAL PROCEDURE

Necessary tools:

- 8mm nut driver
- Dow Corning 340 Heat Sink Compound
- Torque wrench
- PH02 screw driver

1. Remove main input power to the POWERTEC® i350S, i420S, i500S.
2. Open the left side panel of the machine following the case cover removal procedure.
3. Perform the discharge procedure.
4. Locate the 3 phases input rectifier bridge. See **Figure1**
5. Using the 8mm nut driver label and remove the 3 AC input cables and the 2 output DC+ and DC- cables (**A**) from the 3 phases input rectifier bridge. See **Figure 1a**
6. Using PH02 screw driver remove the 2 screws (**B**) that fix the 3 phases input rectifier bridge to the heat sink. See **Figure 1a**
7. Carefully remove the 3 phases input rectifier bridge from the machine.

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 (**A**) previously removed (torque 3Nm max.)
4. Assemble the 3 AC input cables and the 2 output cables DC+ and DC- previously removed (torque 3,5Nm max.)

DISASSEMBLY OPERATIONS

INVERTER BOARD REMOVAL AND REPLACEMENT PROCEDURE

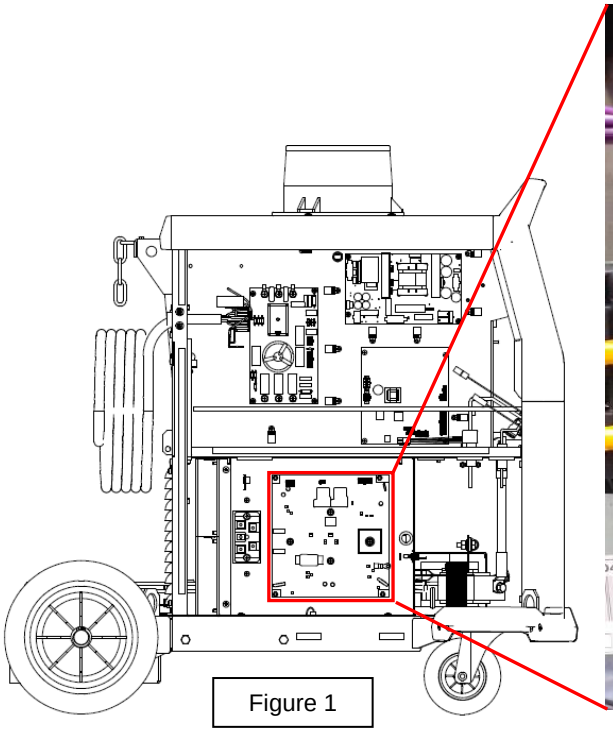


Figure 1

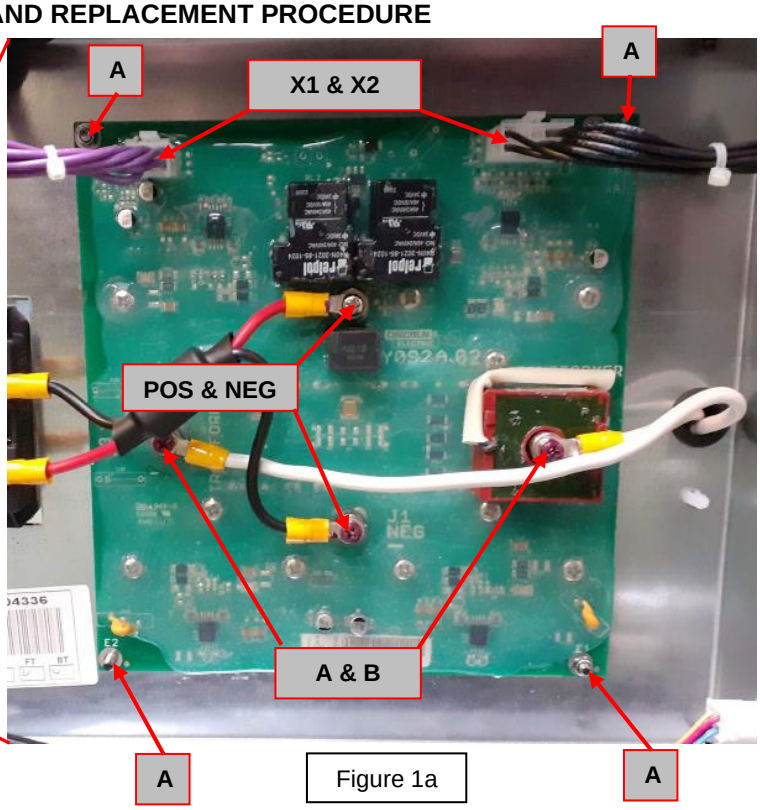


Figure 1a

REMOVAL PROCEDURE

Necessary tools:

- 7mm nut driver
- PH02 screwdriver

1. Remove main input power to the POWERTEC® i350S, i420S, i500S.
2. Open the left side panel of the machine following the case cover removal procedure.
3. Perform the **Discharge procedure**
4. Locate the inverter board. See **Figure1.**
5. Using the PH02 screwdriver label and remove the cables from terminals **POS,NEG, A** and **B**. See **Figure 1a**.
6. Remove the plugs from the connectors **X1 and X2**. See **Figure1a.**
7. Using the 7mm nut driver remove the 4 nuts (**A**) that are fixing the inverter PCB to the machine. See **Figure 1a.**
8. Carefuly remove the inverter Board from the machine.

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

DISASSEMBLY OPERATIONS

EMI FILTER BOARD REMOVAL AND REPLACEMENT PROCEDURE

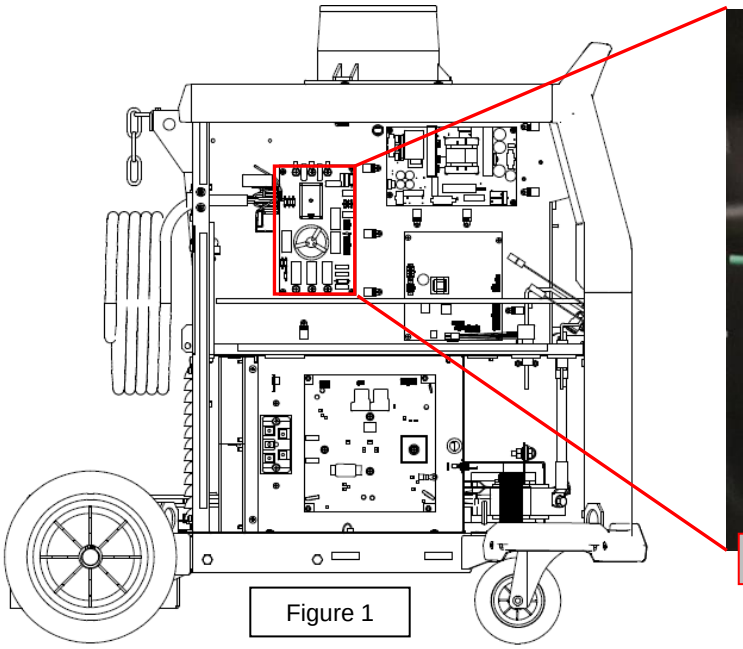


Figure 1

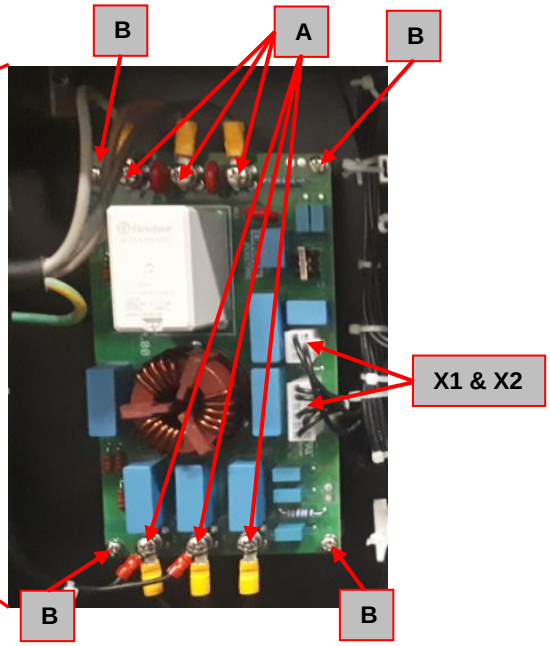


Figure 1a

REMOVAL PROCEDURE

Necessary tools:

- PH02 screwdriver

1. Remove main input power to the POWERTEC® i350S, i420S, i500S.
2. Open the left side panel of the machine following the case cover removal procedure.
3. Perform the **Discharge procedure**
4. Locate the EMI filter board. See **Figure1.**
5. Using the PH02 screwdriver remove the cables from the 6 terminals **(A)**. See **Figure 1a**.
6. Remove the plugs from the connectors **X1 and X2**. See **Figure1a**.
7. Using the PH02 screwdriver remove the 4 screws (**B**) that are fixing the EMI filter PCB to the machine. See **Figure 1a.**

For the EMI filter board re-assembly operations, **make the previous steps in the reverse order.**

DISASSEMBLY OPERATIONS

VOLTAGE SUPPLY BOARD REMOVAL AND REPLACEMENT PROCEDURE

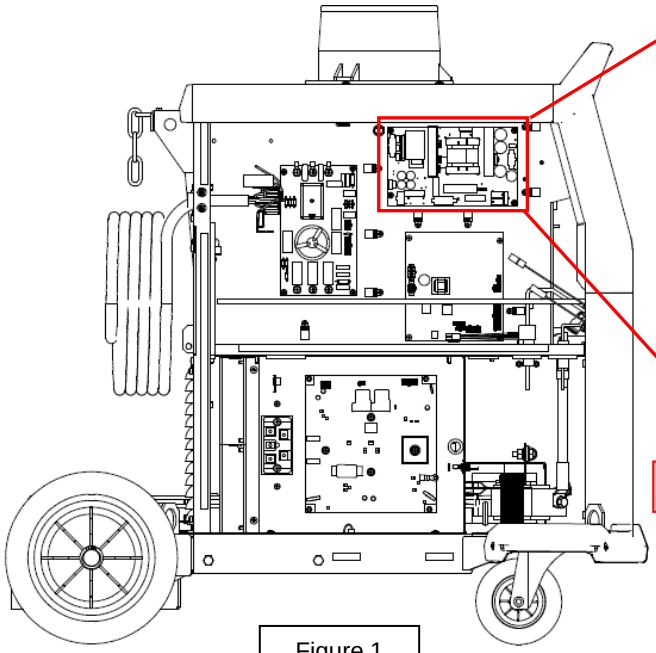


Figure 1

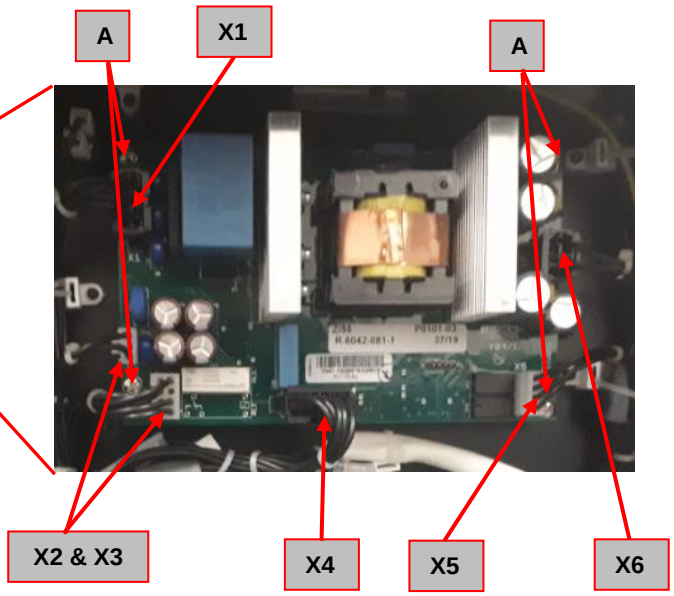


Figure 1a

REMOVAL PROCEDURE

Necessary tools:

- PH02 screwdriver

1. Remove main input power to the POWERTEC® i350S, i420S, i500S.
2. Open the left side panel of the machine following the case cover removal procedure.
3. Perform the **Discharge procedure**
4. Locate the Voltage Supply board. See **Figure1.**
5. Remove the plugs from the connectors **X1,X2, X3, X4, X5 and X6**. See **Figure1a**.
6. Using the PH02 screwdriver remove the 4 screws (**A**) that are fixing the Voltage Supply PCB to the machine. See **Figure 1a.**

For the Voltage Supply board re-assembly operations, **make the previous steps in the reverse order.**

DISASSEMBLY OPERATIONS

CONTROL BOARD REMOVAL AND REPLACEMENT PROCEDURE

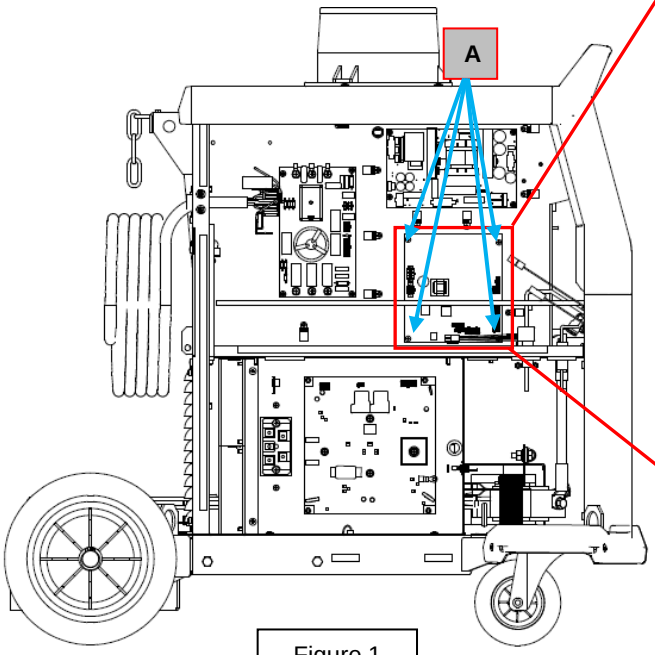


Figure 1

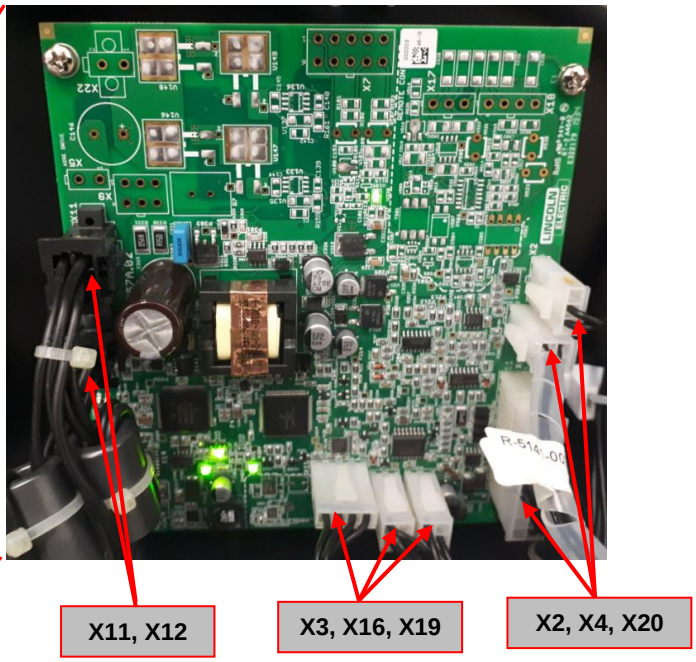


Figure 1a

REMOVAL PROCEDURE

Necessary tools:

- PH02 screwdriver

1. Remove main input power to the POWERTEC® i350S, i420S, i500S.
2. Open the left side panel of the machine following the case cover removal procedure.
3. Perform the **Discharge procedure**
4. Locate the Control board. See **Figure1.**
5. Remove the plugs from the connectors **X2, X3, X4, X11,X12, X16, X19 and X20**. See **Figure1a**.
6. Using the PH02 screwdriver remove the 4 screws (**A**) that are fixing the Control PCB to the machine. See **Figure 1a.**

For the Control board re-assembly operations, **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

POWERTEC® i350S, i420S, i500S

Model	Input Voltage	Input Current (A)	Rated Output in GMAW
Powertec i350S	**400Vac/3ph/50Hz**	**21 max**	**350A@50%**
Powertec i420S	**400Vac/3ph/50Hz**	**27 max**	**420A@100%**
Powertec i500S	**400Vac/3ph/50Hz**	**34 max**	**500A@60%**

Output current range GMAW - FCAW	
PT i350S	**20 – 350 Amps**
PT i420S	**20 – 450 Amps**
PT i500S	**20 – 500 Amps**

Output current range SMAW	
PT i350S	**10 – 350 Amps**
PT i420S	**10 – 450 Amps**
PT i500S	**10 – 480 Amps**

Maximum Open Circuit Voltage $U_{0\ peak}$	
PT i350S	**54 Vdc**
PT i420S – PT i500S	**60 Vdc**

IMPORTANT !

After the repair, the unit shall be tested accordingly to the norm **EN60974-4 Arc welding equipment "In-service inspection and testing"**

CALIBRATION PROCEDURE

<u>This calibration has to be performed using the Feeder, either LF-52D or LF-56D, connected to the machine.</u>

1. Prepare the external reference ammeter (A) and voltmeter (V). Connect a load to output with A and V.

2. Enter to Service Mode: on the feeder, push the right button (LF 52D) or right encoder (LF 56D) and switch machine on. Release button after end starting.

3. General information: left encoder is used for switch output **on/off** (clockwise: **on**, counter-clockwise: **off**)

4. There are 3 service modes (selected by right encoder and accepted by pushing right button /right encoder/):
a) Selecting test modes (**tESt**)
b) Voltmeter calibration (**CAL U**)
c) Ammeter calibration (**CAL I**)

5. **tESt**: you can select test mode numbers below:
a) **200** (CC)
b) **201** (CV)
c) **202** (CP)
d) **212**

6. **CAL U**: you can follow procedure:
a) Left display shows **rEF** <-> **oFF**
b) Switch the output on: display shows **rEF** <-> **on**
c) Set reference voltage to ca. 25,0V/200A on external meter by turning right encoder and adjusting load
d) Confirm the setting by pushing the right button (right encoder) – machine is switching off
e) Switch the output on: display shows **SEt** <-> **on**
f) Set voltmeter value (on right display) to ca. 25,0V by turning right encoder. **WARNING:** be sure that the setting value is the same as the external reference voltmeter value.
g) Confirm the setting value by pushing the right button (right encoder) – machine is switching off
h) After that machine goes into the service modes selection (point 4)

7. **CAL I**: you can follow procedure:
a) Left display shows **rEF** <-> **oFF**
b) Switch the output on: display shows **rEF** <-> **on**
c) Set reference current to ca. 25,0V/200A on external meter by turning right encoder and adjusting load
d) Confirm the setting by pushing the right button (right encoder) – machine is switching off
e) Switch the output on: display shows **SEt** <-> **on**
f) Set ammeter value (on right display) to ca. 200A by turning right encoder. **WARNING:** be sure that the setting value is the same as the external reference ammeter value
g) Confirm the setting value by pushing the right button (right encoder) – machine is switching off
h) After that machine goes into the service modes selection (point 4)

8. Exit from Service Mode: switch machine off.

COMPENSATION OF VOLTAGE DROP THROUGH WELDING CABLES

This compensation can be performed when machine is used in combination of feeders using U22 user interface

Compensation of voltage drop through welding leads

The compensation allows taking into account the voltage drop through the welding leads during the welding process. This is important to ensure optimal welding parameters, especially when using long interconnection welding cables. For this purpose, to eliminate the influence of voltage drop through the welding leads, calibration should be performed.

Note: Calibration should always be performed after changing the configuration of the welding system.

Preparation of the welding system to calibration procedure:

- Prepare the welding set.
- Connect the GMAW, FCAW-GS or FCAW-SS gun to Euro Socket.
- Connect the work lead to output sockets of the power source and lock it.
- Connect the work lead to the welding piece with the work clamp.
- Depending on the gun type, either nozzle or protection cap must be removed.
- Turn the welding machine on.
- Insert the wire into the welding gun.

  Note: Cut the electrode wire just behind the contact tip and make sure that the electrode wire does not protrude from the contact tip!
- Go to the compensation setting in Basic Menu to run the calibration procedure.

The calibration procedure:

- The default setting:

Figure 6

- Press the Right Button [9].
- On the Right Display [4] OFF flashes.
- Set the "CAL" on the Right Display [4] – turn the Right Control to the right.

Figure 7

- Confirm with the Right Button [9].
- The Left Display [1] shows "rEAd", the Right Display [4] shows "MAnU". Information on the displays indicates that the user must read and follow the operator's manual.

Figure 8

- Confirm that the manual has been read – press the Right Button [9].
- The Left Display [1] shows "tOUC", the Right Display [4] shows "trI9". Displays show the information to touch the contact tip to the welding material and pull the trigger.

Note: Ensure that the electrode wire does not protrude from the contact tip!

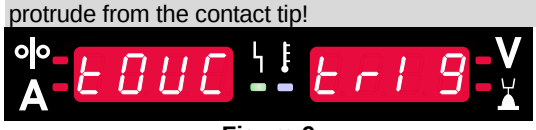


Figure 9

- If the calibration procedure has been performed in accordance with the steps described, then the procedure has ended successfully. The information will appear on the displays:

Figure 10

- Confirm the calibration - press the Right Button [9].

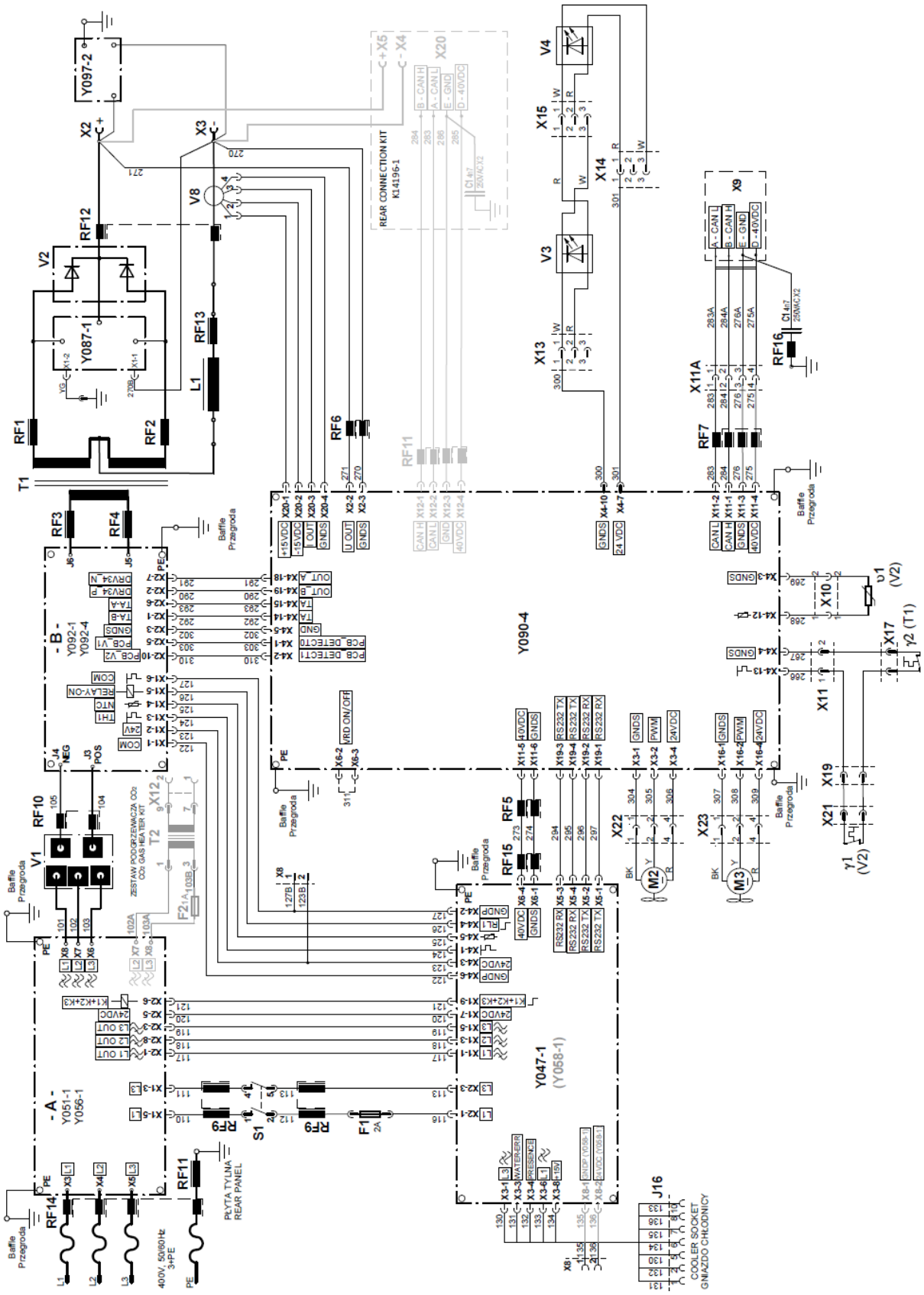
if the calibration procedure failed, the message will appear on the displays:

Figure 11

This means that the procedure was not performed as described. In this case, perform the procedure again as described in the instruction manual.

ELECTRICAL SCHEMATICS

Block Diagram:



NOTE

Lincoln Electric Europe