SVM 2025
Rev.01 03-2013

INVERTEC® 270SX & 400SX

For use with machines having code numbers: 52077, 52078, 52081, 52082

SERVICE MANUAL

LINCOLN ELECTRIC EUROPE
www.lincolnelectric.eu

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TECHNICAL SPECIFICATIONS AND ACCESSORIES

INPUT			
Input Voltage 400V ± 15% Three Phase	Input Power at Rated Output 270SX 6.3kW @ 100% Duty Cycle 9.5kW @ 35% Duty Cycle 10.9kW @ 100% Duty Cycle 400SX 16.4kW @ 35% Duty Cycle	EMC Class A A	Frequency 50/60Hz

RATED OUTPUT AT 40°C			
	Duty Cycle (Based on a 10 min. period)	Output Current	Output Voltage
270SX	100% 35%	200A 270A	28.0Vdc 30.8Vdc
400SX	100% 35%	300A 400A	32.0Vdc 36.0Vdc

OUTPUT RANGE		
	Welding Current Range	Maximum Open Circuit Voltage
270SX	5 – 270A	45Vdc (CE model) 12Vdc (AUSTRALIA model)
400SX	5 – 400A	

RECOMMENDED INPUT CABLE AND FUSE SIZES		
	Fuse (delayed) or Circuit Breaker (“D” characteristic) Size	Input Power Cable
270SX	20A	$4x2.5mm^2$
400SX	30A	$4x4mm^2$

PHYSICAL DIMENSIONS				
	Height	Width	Length	Weight
270SX	389mm	247mm	502mm	22kg
400SX	455mm	301mm	632mm	37kg
Operating Temperature -10°C to +40°C			Storage Temperature -25°C to +55°C	

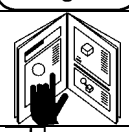
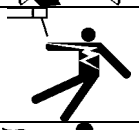
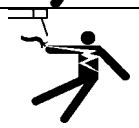
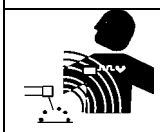
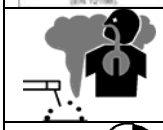
Accessories

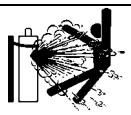
W6100317R	Remote Connector (6 pins).
K10095-1-15M	Hand Amptrol.
K870	Foot Amptrol.

SAFETY

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 Equipments (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.

S	SAFETY MARK: This equipment is suitable for supplying power for welding operations carried out in an environment with increased hazard of electric shock.
kg	EQUIPMENT WEIGHT OVER 30kg: Move this equipment with care and with the help of another person. Lifting may be dangerous for your physical health.
	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.
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.

Installation and Operator Instructions

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

Location and Environment
This machine can 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:
  - 270SX: IP23
  - 400SX: 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.

Input Supply Connection
Check the input voltage, phase, and frequency supplied to this machine before turning it on. The allowable input voltage is indicated in the technical specification section of this manual and on the rating plate of the machine. Be sure that the machine is grounded.

Make sure the power available at the input connection is adequate for normal operation of the machine. The fuse rating and cable sizes are both indicated in the technical specification section of this manual.

Input Supply From Engine Driven Generators
The machines are designed to operate on engine driven generators as long as the auxiliary can supply adequate voltage, frequency and power as indicated in the "Technical Specification" section of this manual. The auxiliary supply of the generator must also meet the following conditions:

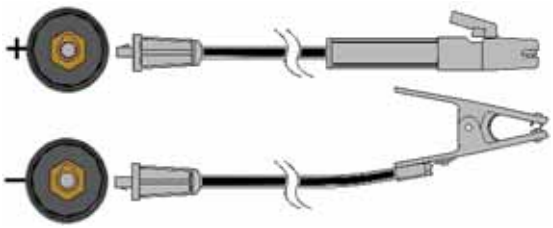
- Vac peak voltage: below 670V.
- Vac frequency: in the range of 50 and 60Hz.
- RMS voltage of the AC waveform: 400Vac ± 15%.

It is important to check these conditions because many engine driven generators produce high voltage spikes. Operation of this machine with engine driven generators not conforming to these conditions is not recommended and may damage the machine.

Output Connections
A quick disconnect system using Twist-Mate™ cable plugs is used for the welding cable connections. Refer to the following sections for more information on connecting the machine for operation of stick welding (MMA) or TIG welding.

- (+) Positive Quick Disconnect: Positive output connector for the welding circuit.
- (-) Negative Quick Disconnect: Negative output connector for the welding circuit.

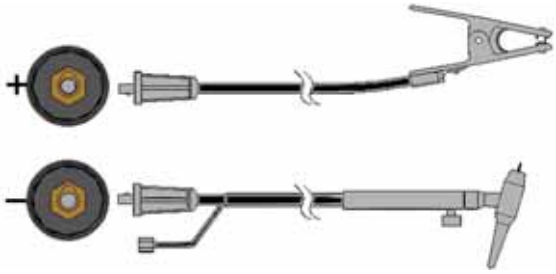
Stick Welding (MMA)
First determine the proper electrode polarity for the electrode to be used. Consult the electrode data for this information. Then connect the output cables to the output terminals of the machine for the selected polarity. Shown here is the connection method for DC(+) welding.



Connect the electrode cable to the (+) terminal and the work clamp to the (-) terminal. Insert the connector with the key lining up with the keyway and rotate approximately ¼ turn clockwise. Do not over tighten.

For DC(-) welding, switch the cable connections at the machine so that the electrode cable is connected to (-) and the work clamp is connected to (+).

TIG Welding
This machine does not include a TIG torch necessary for TIG welding, but one may be purchased separately. Refer to the accessories section for more information. Most TIG welding is done with DC(-) polarity shown here. If DC(+) polarity is necessary switch the cable connections at the machine.



Connect the torch cable to the (-) terminal of the machine and the work clamp to the (+) terminal. Insert the connector with the key lining up with the keyway and rotate approximately ¼ turn clockwise. Do not over tighten. Finally, connect the gas hose to the gas regulator on the cylinder of gas to be used.

Remote Control Connection

Refer to the accessories section for a list of remote controls. If a remote control is used, it will be connected to the remote connector on the front of the machine. The machine will automatically detect the remote control, turn on the REMOTE LED, and switch to remote control mode. More information on this mode of operation will be given in the next section.

Features Enabled With MMA Welding
Hot Start
This is a temporary increase in the initial welding current. This helps ignite the arc quickly and reliably.

Anti-Sticking
This is a function that decreases the output current of the machine to a low level when the operator makes an error and sticks the electrode to the work piece. This decrease in current allows the operator to remove the electrode from the electrode holder without creating large sparks that can damage the electrode holder.

Arc Force
This is a temporary increase in the output current during normal stick welding. This temporary increase in output current is used to clear intermittent connections between the electrode and the weld puddle that occur during normal stick welding.

Auto Adaptive Arc Force (only with Soft or Crisp MMA welding)
During MMA welding is activated the function Auto Adaptive Arc Force that increases temporary the output current, used to clear intermittent connections between the electrode and the weld puddle that occur during stick welding.

This is an active control feature that guarantees the best arrangement between the arc stability and spatter presence. The feature "Auto Adaptive Arc Force" has instead of a fixed or manual regulation, an automatic and multilevel setting: its intensity depends by the output voltage and it is calculated in real time by the microprocessor where are also mapped the Arc Force levels. The control measure in each instant the output voltage and it determines the amount of the peak of current to apply; that value is enough to breaks the metal drop that is being transferred from the electrode to the workpiece as to guarantee the arc stability, but not too high to avoid spatters around the welding puddle. That means:

- Electrode / workpiece sticking prevention, also with low current values.
- Spatters reduction.

The welding operations are simplified and the welded joins looks better, also if not brushed after the welding.

Refer to the section below for more details.

Controls and Operational Features
Machine Start-Up:
When the machine is turned ON, an auto-test is executed; during this test all LEDs and display's shown "888"; after few seconds the LEDs and display turn OFF. Only the Power ON/OFF LED lights up.

- The Machine is ready to operate when on the Front Control Panel lights up the Power ON LED with one of the four LED of the Welding mode command.

Front Panel Controls

Output Current Knob: Potentiometer used to set the output current used during welding.

Power ON/OFF LED: This LED lights up when the machine is ON.

If blinking, this LED indicates that an Input Voltage Overrange protection is active; the Machine restarts automatically when the Input Voltage returns in the correct range. If the Machine does not restart automatically, an Internal auxiliary undervoltage condition may be present: the machine needs to be turned OFF then ON again to restart.

Note: The Fan could be automatically switched OFF if the error condition persist for more than 2seconds.

Remote LED: This indicator will turn on when a remote control is connected to the machine via the remote control connector. Using a remote control will replace the function of the output current control, that will be automatically disabled.

Thermal LED: This indicator will turn on when the machine is overheated and the output has been disabled. This normally occurs when the duty cycle of the machine has been exceeded. Leave the machine on to allow the internal components to cool. When the indicator turns off, normal operation is again possible.

VRD LED's (enabled on Australian Machines only): This machine is provided by VRD (Voltage Reduction Device) function: this reduces the voltage at the output leads.

The VRD function is enabled by factory default only on machines that meet the AS 1674.2 Australian Standards. (C-Tick logo "✓" on/near the Rating Plate applied on the machine).

The VRD LED is ON when the Output Voltage is below 12V with the Machine at idle (no welding time).

For others machines this function is disabled (the LED is always OFF).

Welding Mode Switch: With four positions, controls the welding mode of the machine: three for Stick welding (Soft, Crisp and User defined) and one for Lift TIG welding.

- Soft Stick: For a welding with a low spatter presence. The Auto Adaptive Arc Force is enabled.
- Crisp Stick: For an aggressive welding, with an increased Arc stability. The Auto Adaptive Arc Force is enabled.
- User defined MMA parameters: with this welding mode the Auto Adaptive Arc Force is disabled. This welding mode allows to manually adjust the Hot Start and the Arc Force as following:

  Hot Start: The Output Current initial increment is adjustable between 0 and 60% of the current set through the Output Current Knob.

  Arc Force: The Output Current temporary increments are adjustable between 0 and 50% of the current set through the Output Current Knob.

- Lift TIG: When the mode switch is in the Lift TIG position, the stick welding functions are disabled and the machine is ready for Lift TIG welding. Lift TIG is a method of starting a TIG weld by first pressing the TIG torch electrode on the work piece in order to create a low current short circuit. Then, the electrode is lifted from the work piece to start the TIG arc.

Meter: The meter displays the preset welding current before welding and the actual welding current during welding.

Through the Pushbutton on the Display right side, the Display alternatively shown the output Current (A) or Voltage (V). The LEDs (A) (V) on top side indicates the measure unit of the value shown by the Display.

A flashing dot on the Display indicates that the value read is the average value (V or A) of the previous welding time. This feature shown the average value for 5seconds after every welding time.

Other Controls and Features

A. Power Switch: It turns ON / OFF the input power to the machine.

B. Input cable: Connect it to the mains.

C. Fan: This machine has a F.A.N. (Fan As Needed) circuitry inside: the fan is automatically turned ON or OFF. This feature reduces the amount of dirt which can be drawn inside the machine and reduces power consumption. When the machine is turned ON the fan will turn ON. The fan will continue to run whenever the machine is welding. If the machine doesn't weld for more than five minutes, the fan will turn OFF.

Maintenance

⚠ WARNING

For any maintenance or repair operations it is recommended to contact the nearest technical service center or Lincoln Electric. Maintenance or repairs performed by unauthorized service centers or personnel will null and void the manufacturers warranty.

The frequency of the maintenance operations may vary in accordance with the working environment. Any noticeable damage should be reported immediately.

- Check cables and connections integrity. Replace, if necessary.
- Regularly clean the torch head, check its consumables and if necessary replace them.

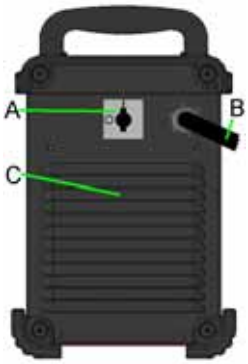
⚠ WARNING

Refer to the torch instructions before changing or servicing the torch.

- Keep clean the machine. Use a soft dry cloth to clean the enclosing case, especially the airflow inlet / outlet louvers.

⚠ WARNING

Do not open this machine and do not introduce anything into its openings. Power supply must be disconnected from the machine before maintenance and service. After each repair, perform proper tests to check safety requirements.



Electromagnetic Compatibility (EMC)

11/04

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 with, if necessary, assistance from Lincoln Electric.

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.

MAINTENANCE

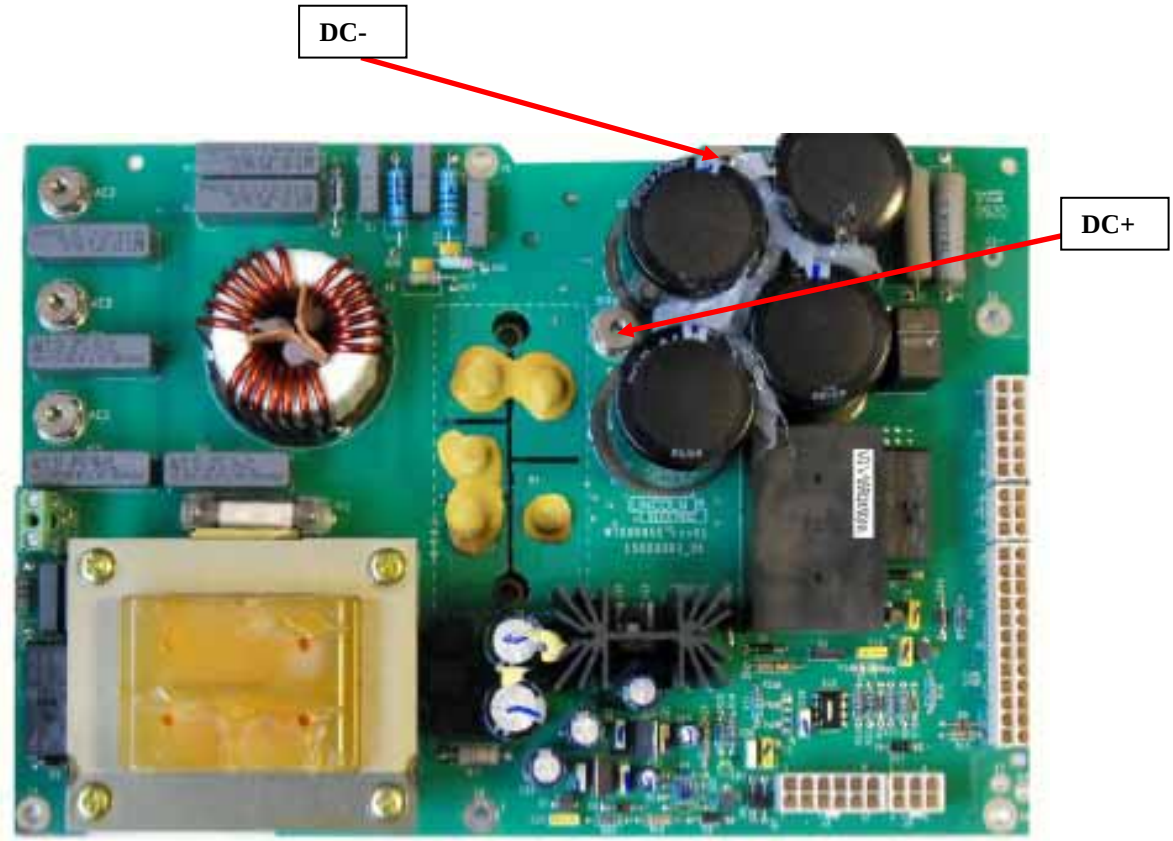
WARNING

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

INPUT FILTER CAPACITOR DISCHARGE PROCEDURE

1. Remove input power to Invertec® 270SX and 400SX machine
2. Remove the cover 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 input board. **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.



INPUT BOARD - Figure 1
Showing 270SX input board

ROUTINE MAINTENANCE

1. Keep the welding area around the machine clean and free of combustible materials. No debris should be allowed to collect which could obstruct air flow to the machine
2. Every 6 months the machine should be cleaned with a low pressure and dry airstream. Keeping the machine clean will result in cooler operation and higher reliability.
3. Examine the sheet metal case for dents or breakage. Repair the case as required. Keep the case in good condition to insure that high voltage parts are protected and correct spacing are maintained. All external sheet metal screw must be in place to ensure case strength and electrical ground continuity.

THERMAL PROTECTION

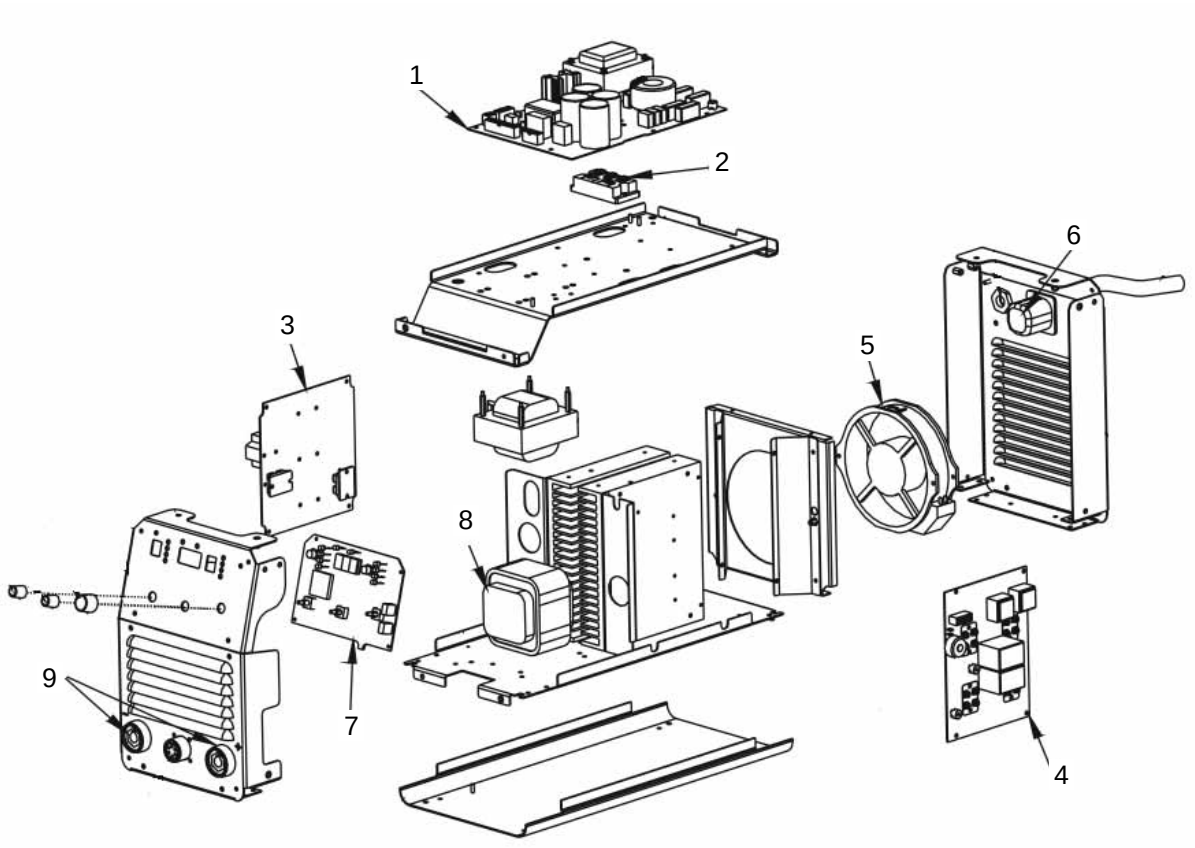
Thermal detection device protect the machine from excessive operating temperatures. Excessive temperatures may be caused by a lack of cooling air or operating the machine beyond the duty cycle and output rating. If excessive operating temperatures should occur, the yellow LED will light and the detection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

These detection device 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

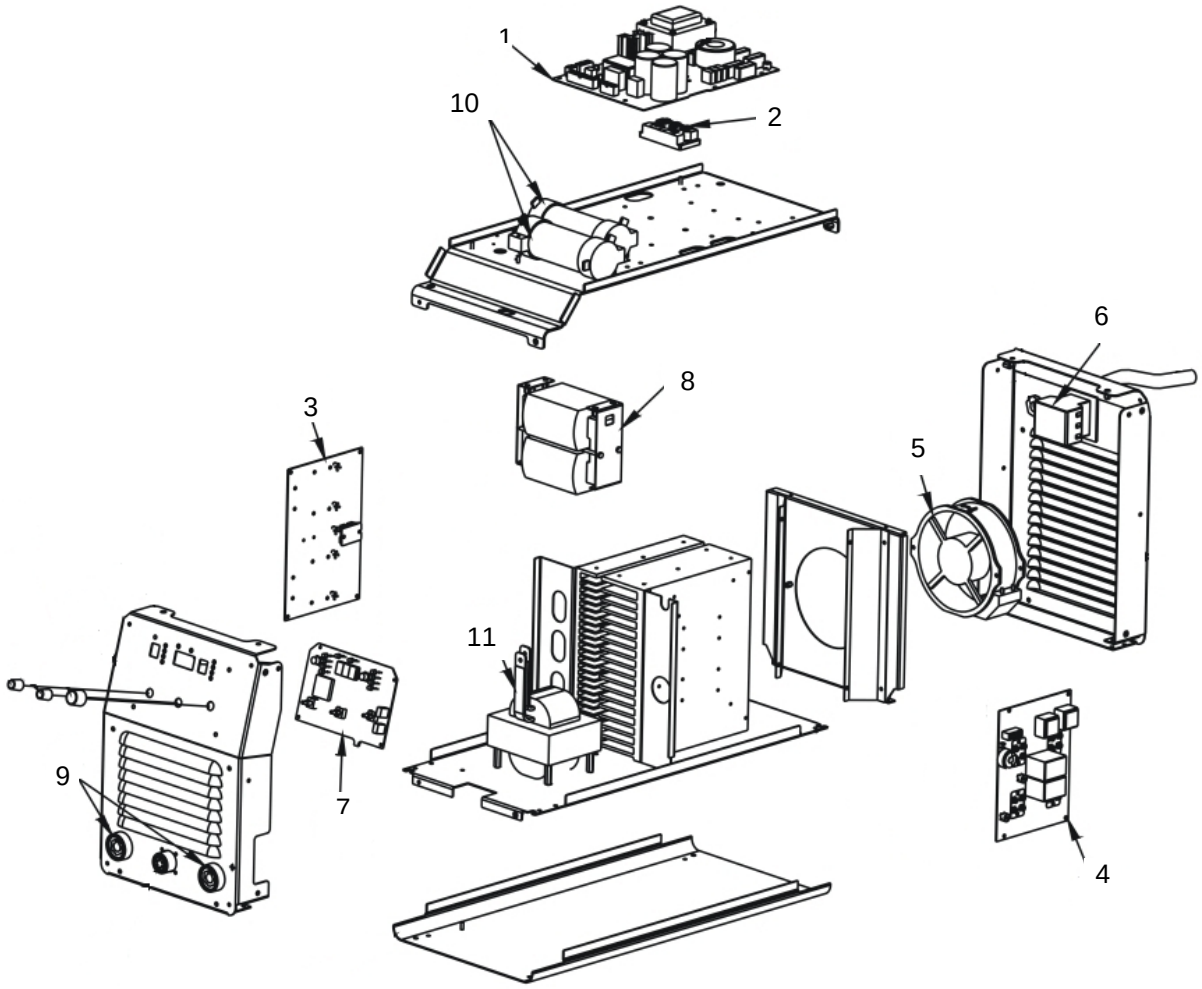
INVERTEC® 270SX

1. Input Board
2. Input Rectifier Diode Module
3. Output Board
4. Inverter Board
5. Fan
6. Mains Switch
7. Control Board
8. Output Transformer
9. Output Studs



INVERTEC® 400SX

1. Input Board
2. Input Rectifier Diode Module
3. Output Board
4. Inverter Board
5. Fan
6. Mains Switch
7. Control Board
8. Output Transformer
9. Output Studs
10. Input Filter Capacitors
11. Output Choke

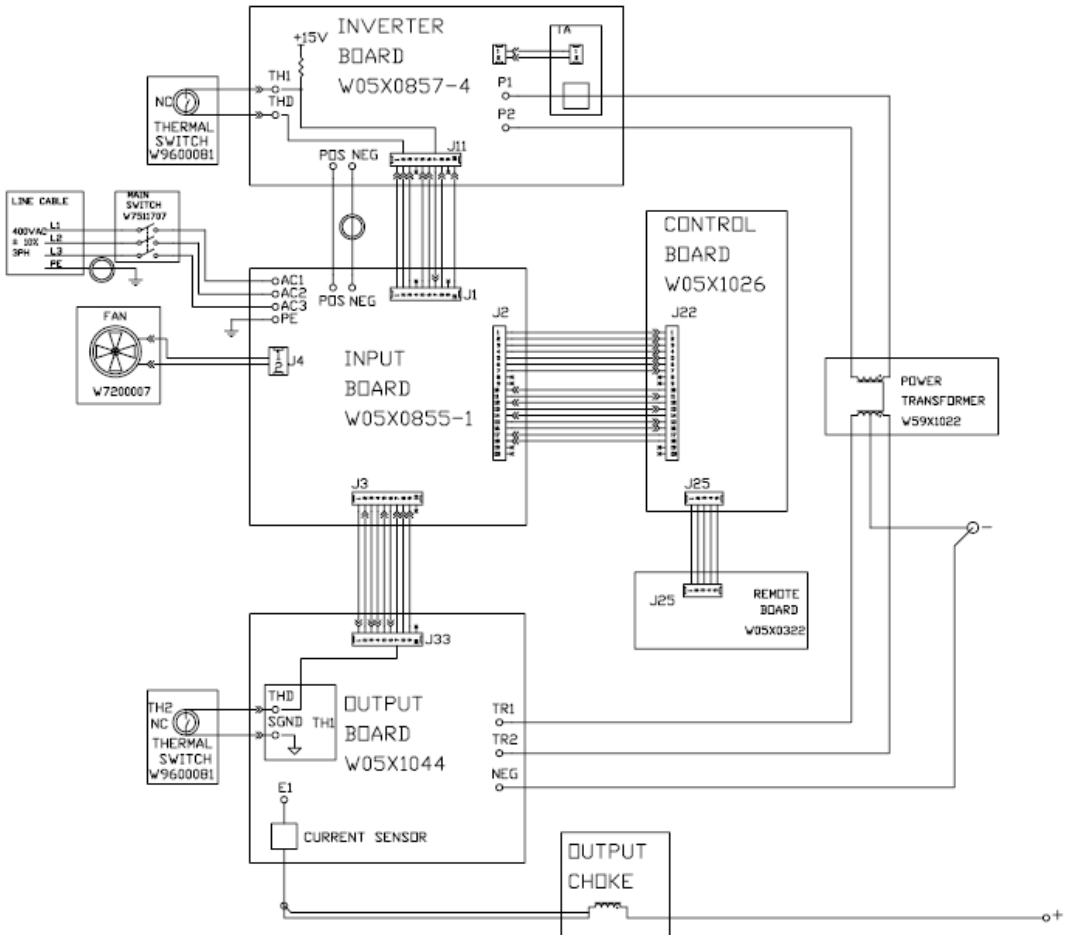


THEORY OF OPERATION

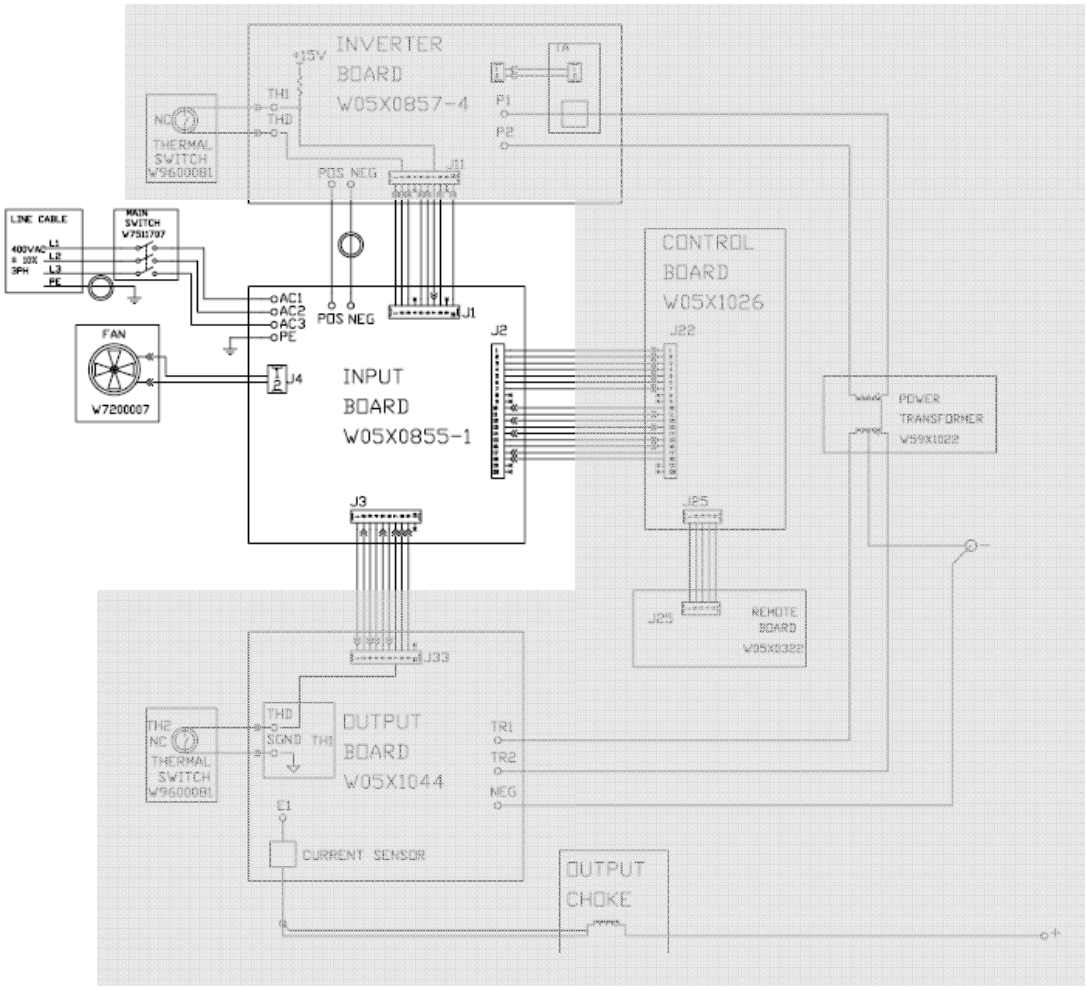
- General description
- Input Line Voltage, Auxiliary Voltage, Precharge
- Inverter Board , Main Transformer,
- Output Section
- Control Board
- Protection Circuits
- IGBT operation

BLOCK DIAGRAM

(showing 270SX block diagram)



INPUT SECTION



GENERAL DESCRIPTION

The Invertec® 270Sx and 400SX are inverter based welding power sources that offers multi-mode (TIG and Stick) constant current welding. The machines can be operated on three phase input power. The welding response of these Invertec has been optimized for the stick (SMAW) and TIG (GTAW) welding processes.

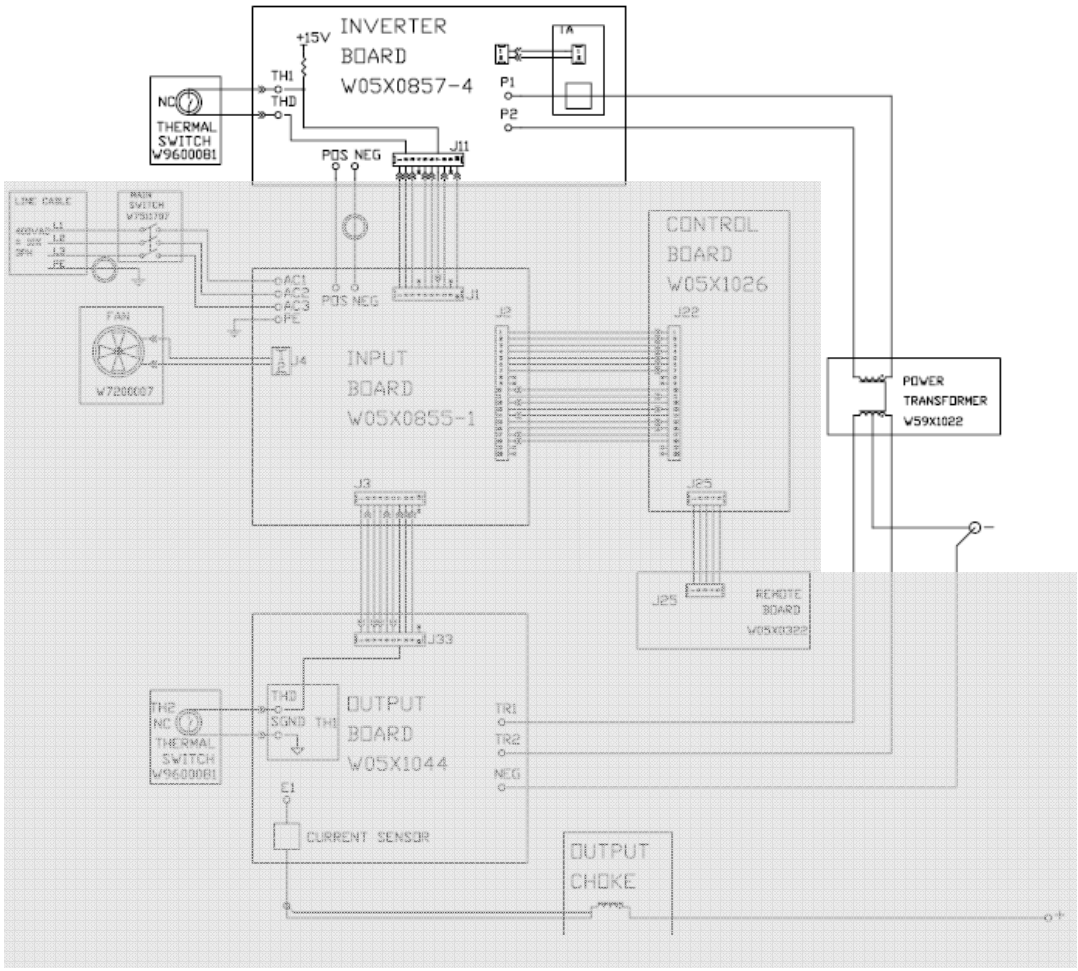
INPUT LINE VOLTAGE, AUXILIARY VOLTAGE AND PRECHARGE

The 400V 3 phases input power AC is conneted to the machine, through an input cable, to the main switch located on the back of the power source. Once 400 Vac +/- 15% voltage is applied to the machine via the input switch, the following activities will be managed by the input board W05X0855 (-1version for the 270SX, -2 version for the 400SX):

- the auxiliary power supplies (+24, +15V, -5V) to all the boards will be generated.
- a uController on the input board manages the soft stat and pre-charge operation. If the uController is correctly programmed LED LD1 on the input board is turned ON.
    - During this phase a signal called READY_OK signals to the control board that the machine is not still working; the green led on the front panel is blinking during this phase.
    - If the input power supply is in the correct range, the ucontroller on the input board wait about 4 seconds before to short the precharge relay that shorts the precharge power resistance (PTC1) to let the precharge of the input capacitors.
- after the precharge phase, another 1 second is necessary for the uctroller to release the READY_OK signal to the conrol board. After that, the control board signals to the user that the machine is ready to go keeping the fron panel green led always turned ON.

- Under and over voltage control and alarm

INVERTER SECTION AND MAIN TRANSFORMER

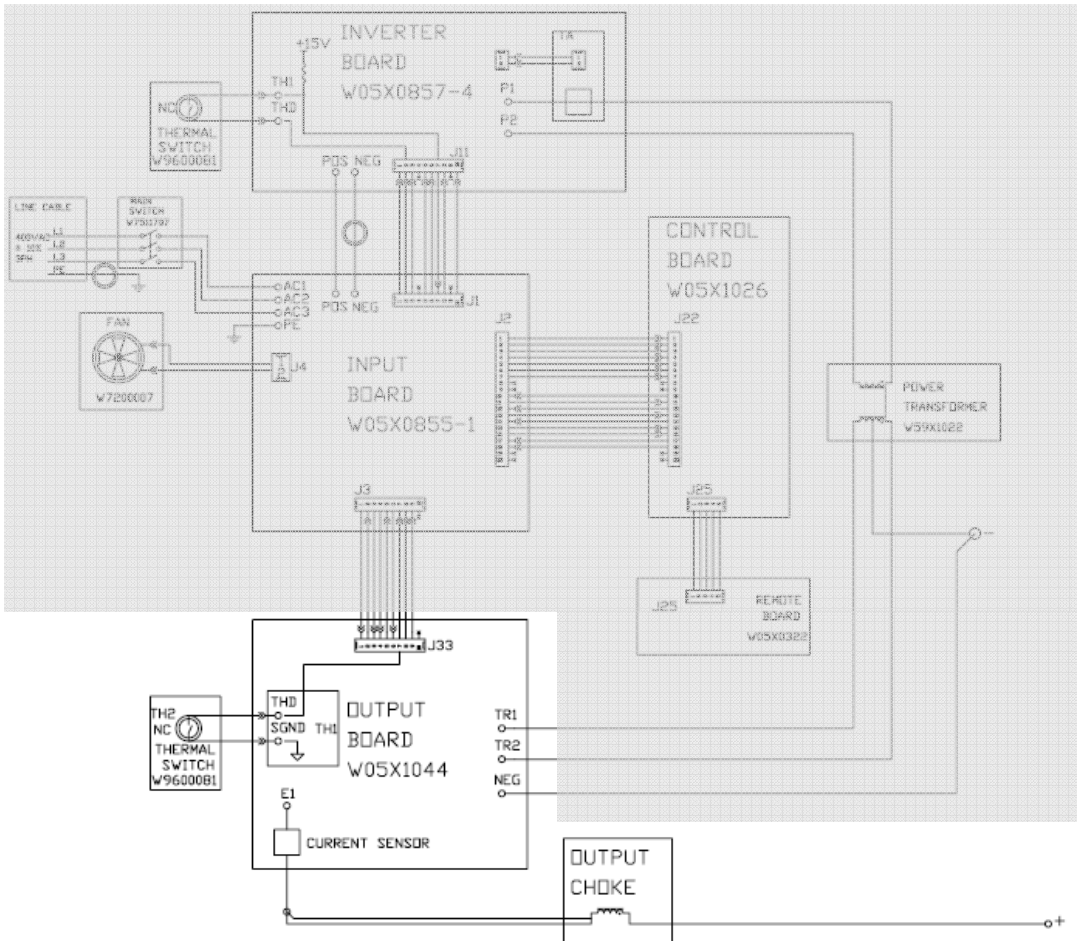


Inverter and Main Transformer

When the input filter capacitors are fully charged they act as power supplies for the IGBT switching circuit. The IGBT switch the DC power from the input capacitors "on and off," thus supplying pulsed DC current to the main transformer primary windings. The full bridge inverter switching frequency is 25KHz. Current transformer located on the inverter board monitor the primary current. If the primary current become abnormally high, the inverter control circuit will shut off the IGBTs, thus disabling the machine's output. A thermal protector is also present, to the inverter heatsink, to protect the IGBTs from overheating conditions.

The main transformer insulate the primary circuit from the secondary circuit; this secondary winding supplies the electrode-to-nozzle and electrode-to-work voltages and the resulting currents. This high current winding is capable of supplying maximum output current during the cutting process.

OUTPUT SECTION

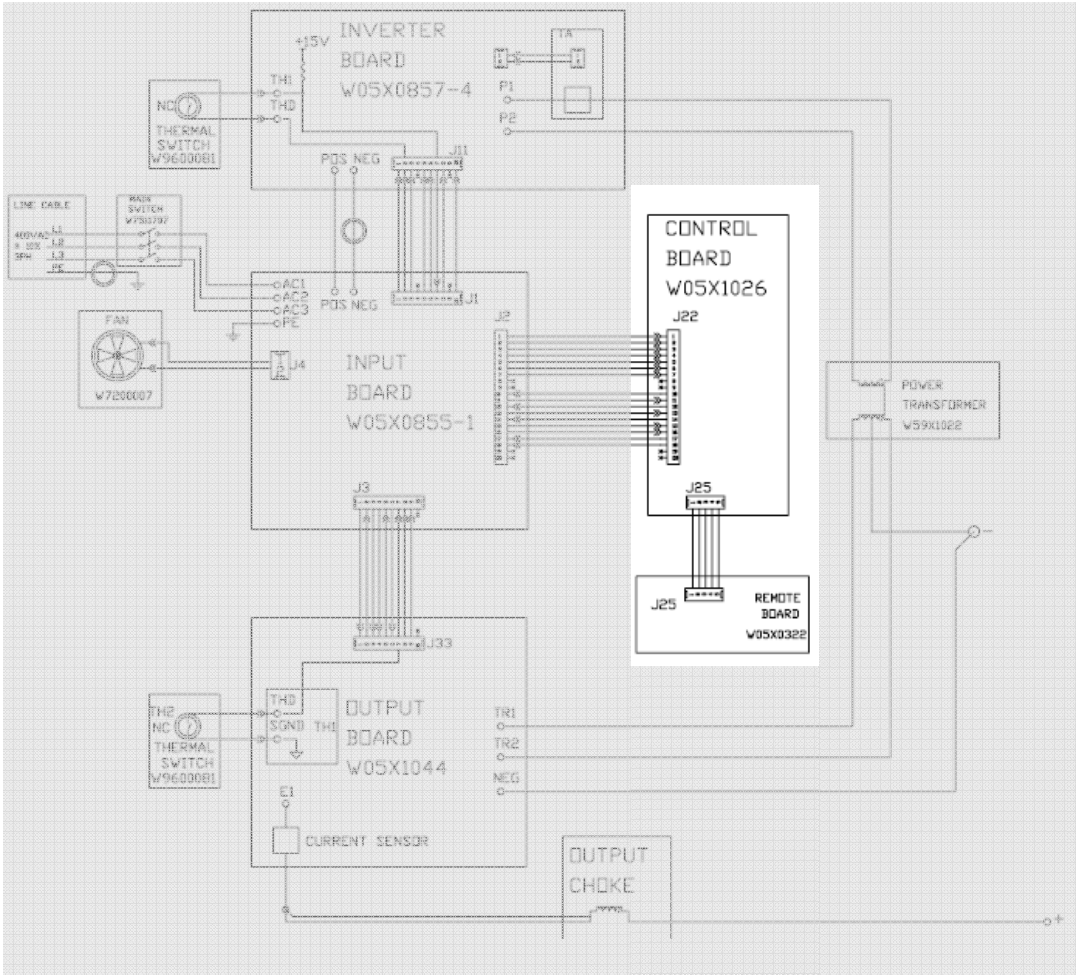


Output Section

The output board receives the AC output from the main transformer secondary windings and rectifies it to a DC voltage level. Since the output choke is in series with the positive leg of the output rectifier and also in series with the welding load, a filtered DC output current is applied through the machine's output terminals.

Current sensor to the output board gives current feedback to the control board.

CONTROL BOARD AND REMOTE BOARD



Control Board (User Interface) and Remote Board

The control board receives status and analog feedback signals from the inverter board, input board and various sensors.

It receives also commands from the user-operated controls that are connected to the control board. These push buttons and potentiometer's allow the operator to set the current output of the machine. Other controls allow for the adjusting of the Arc Force the selection of the Hot Start option and the Stick or TIG mode of operation.The control board processes and compares these commands with the voltage and current feedback information it receives from the output current sensor and the output voltage sensing leads.

Control board also gives error codes, using its LEDs, to the user, see dedicated section, later on this service manual.

On the remote board is located the remote control connector and the PTCs that protect the control board in the event that a remote cable is damaged.

OVERLOAD PROTECTION

Invertec® 270SX and 400SX are electrically protected from producing higher than normal output currents. An electronic protection circuit limits the current to within the capabilities of the machine.

THERMAL PROTECTION

There is one thermal device located on the inverter heatsink and one located on output diodes heatsink; 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 LED indicator on the control board, will turn ON and the thermostat will prevent output current.
The thermal protection device is 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.

PROTECTIVE CIRCUITS

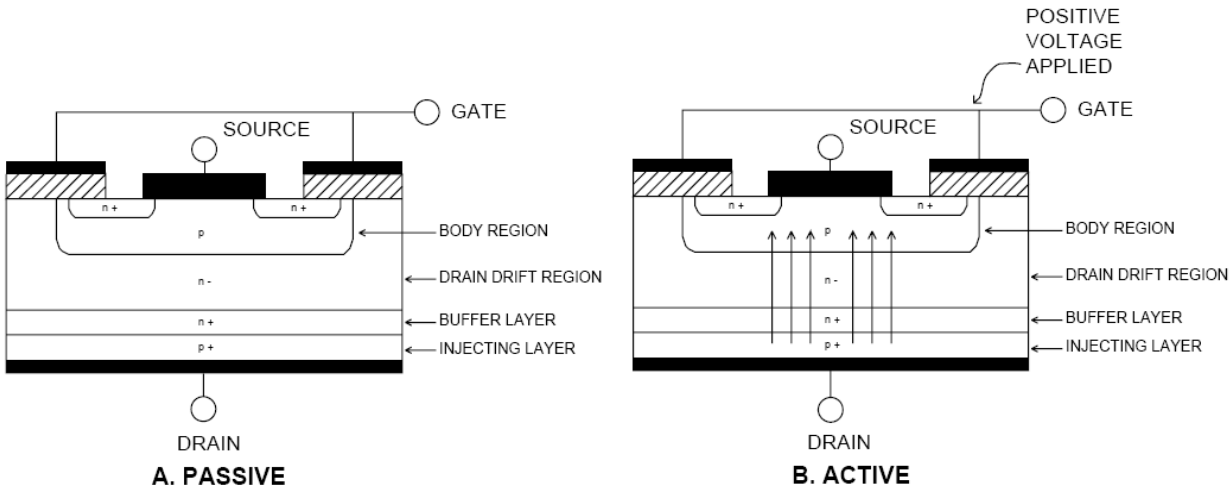
Protective circuits are designed into the 270SX and 400SX to sense trouble and shut down the machine before damage occurs to the machine's internal components. There are resetable fuses on the remote board in the event that a remote cable is damaged.

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
- Input board resistance test
- Inverter board resistance test
- Output board resistance test
- Input board voltage test
- Inverter board voltage test
- Output board voltage test

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

---

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 caus-ing 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 symp-tom 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 HARNESS.**

PROBLEMS / SYMPTOMS	CHECKS	RECOMMENDED COURSE OF ACTION
A VISUAL DAMAGE IS EVIDENT WHEN YOU OPEN THE COVER	----------	• CHANGE THE PART BROKEN AND PERFORM THE TESTS FOR THE OTHER PARTS
MACHINE IS DEAD, NO LED, NO FAN	• MAKE SURE THAT THE INPUT LINE IS PRESENT • CHECK THE INPUT SWITCH • THE INPUT VOLTAGE MUST MATCH THE RATING PLATE • PERFORM THE INPUT BOARD TESTS	• CONNECT THE INPUT LINE • REPLACE THE IF NECESSARY • REPLACE THE INPUT BOARD IF NECESSARY
THE GREEN POWER ON LED ON THE FRONT PANEL IS BLINKING ALL THE TIME	• AN INPUT VOLTAGE OVER RANGE IS PRESENT • INTERNAL AUXILIARY UNDERVOLTAGE CONDITION	• CHECK THE INPUT VOLTAGE • TURN OFF AND ON AGAIN THA MACHINE TO RESET THE ERROR CONDITION • PERFORM THE INPUT BOARD TEST
THE MACHINE REGULARLY OVERHEATS AND THE YELLOW THERMAL LIGHT IS ON INDICATING A THERMAL OVERLOAD	• THE WELDING APPLICATION MAY BE EXCEEDING THE RECOMMENDED DUTY CYCLE OF THE 270SX OR 400SX • DIRT AND DUST MAY HAVE CLOGGED THE COOLING CHANNELS INSIDE THE MACHINE • THE AIR INTAKE AND EXHAUST LOUVERS MAY BE BLOCKED DUE TO INADEQUATE CLEARANCE AROUND THE MACHINE • MAKE CERTAIN THE FAN AS NEEDED (F.A.N.) CIRCUIT IS OPERATING PROPERLY. THE FAN SHOULD OPERATE ALL THE TIME DURING WELDING AND / OR WHEN THERE IS AN OVER TEMPERATURE CONDITION. IF THE MACHINE DOESN'T WELD FOR MORE THAN FIVE MINUTES, THE FAN WILL TURN OFF	• CHECK AND RESPECT THE RECOMMENDED DUTY CYCLE • CLEAN WITH LOW PRESSURE DRY AIR THE COOLING CHANNEL INSIDE THE MACHINE • MAKE SURE TO HAVE ADEQUATE CLEARANCE AROUND THE MACHINE • ONE OF THE THERMOSTATS MAY BE FAULTY.ONE NORMALLY CLOSED THERMOSTAT IS LOCATED ON THE INVERTER HEAT SINK AND ANOTHER IS ON THE OUTPUT BOARD HEAT SINK. SEE THE WIRING DIAGRAM.
THE MAIN INPUT FUSES OR BREAKERS REPEATEDLY FAIL	• MAKE CERTAIN THE FUSES OR BREAKERS ARE PROPERLY SIZED FOR THE INPUT DRAW OF THE MACHINE	• PERFORM THE INPUT RECTIFIER TEST • PERFORM THE INVERTER TEST
POOR STICK ELECTRODE WELDING PERFORMANCE	• MAKE SURE THE ARC FORCE CONTROL, IF USING THE MACHINE IN USER MODE, IS SET PROPERLY FOR THE PROCESS • CHECK FOR LOOSE OR FAULTY WELDING CABLES • IS THE ELECTRODE DRY? TRY WELDING WITH ANOTHER ELECTRODE FROM A DIFFERENT BOX. MAKE SURE YOU HAVE THE CORRECT ELECTRODE FOR THE APPLICATION • CHECK THE INPUT VOLTAGE, MUST MATCH THE RATING PLATE	• CHECK THE ARC FORCE SETTING • REPLACE THE FAULTY WELDING CABLES • PERFORM THE OUTPUT BOARD TEST
THE MACHINE HAS OUTPUT CURRENT BUT IT IS NOT ADJUSTABLE	• CHECK THE CURRENT POTENTIOMETER	• REPLACE THE CONTROL BOARD • PERFORM THE INVERTER BOARD TEST
UNABLE TO CHANGE WELDING MODES	• THE WELDING MODE PUSH BUTTON IS DEFECT	• REPLACE THE CONTROL BOARD

CASE COVER REMOVAL AND DC LINK 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.

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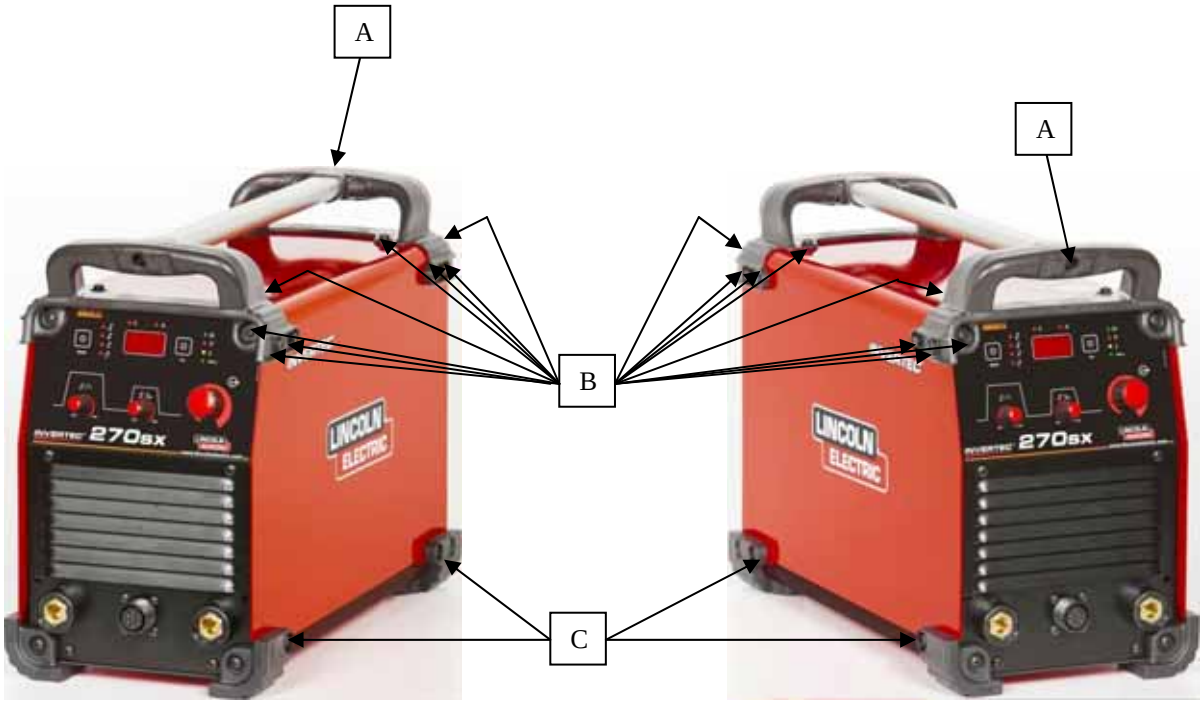
DESCRIPTION

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

MATERIALS NEEDED

Phillips screwdriver PH02

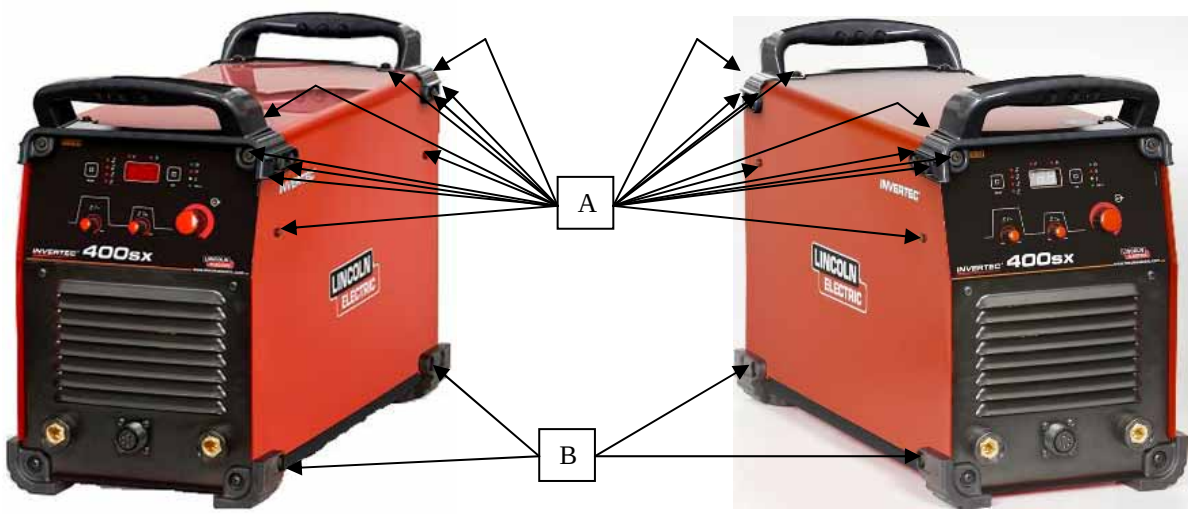
INVERTEC® 270SX - CASE COVER REMOVAL



Procedure:

1. Turn on/off switch to off position.
2. Disconnect Input Power from the machine !
3. Remove the 2 screws of the alluminum handle (A).
4. Remove the 16 screws of the plastic handle (B).
5. Remove the 4 screws on the rubber corners (C).
6. Don’t remove the 4 bottom rubber corners
7. Pull up the red case cover.
8. Follow the next session to **perform the input filter discharge procedure**

INVERTEC® 400SX - CASE COVER REMOVAL



Procedure:

1. Turn on/off switch to off position.
2. Disconnect Input Power from the machine !
3. Remove the 16 screws from the plastic handle + 4 from the cover (A).
4. Remove the 4 screws on the rubber corners (B).
5. Don't remove the 4 bottom rubber corners.
6. Pull up the red case cover.
7. Follow the next session to **perform the input filter discharge procedure**

DC LINK CAPACITORS DISCHARGE PROCEDURE

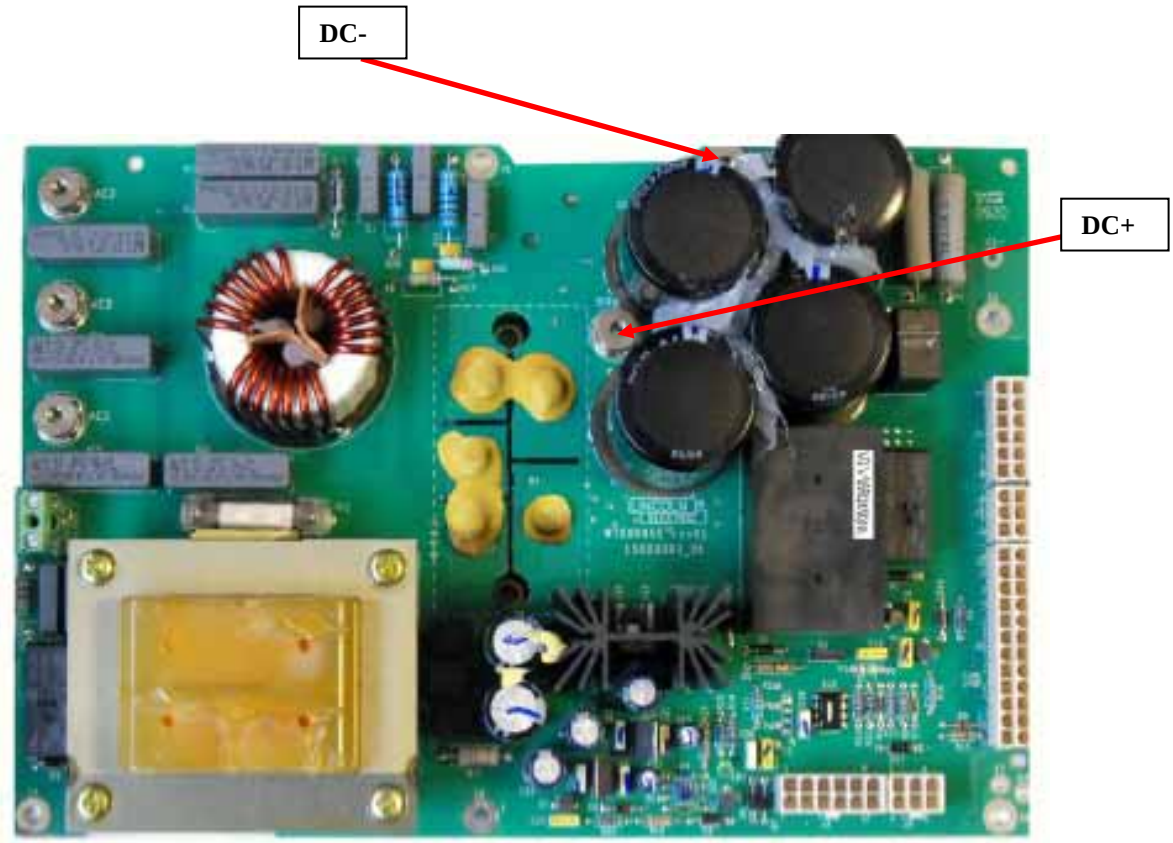
WARNING

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

INPUT FILTER CAPACITOR DISCHARGE PROCEDURE

1. Remove input power to 270SX & 400SX machine
2. Remove the cover 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 input board. **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.



INPUT BOARD - Figure 1
Showing 270SX input board

INPUT 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

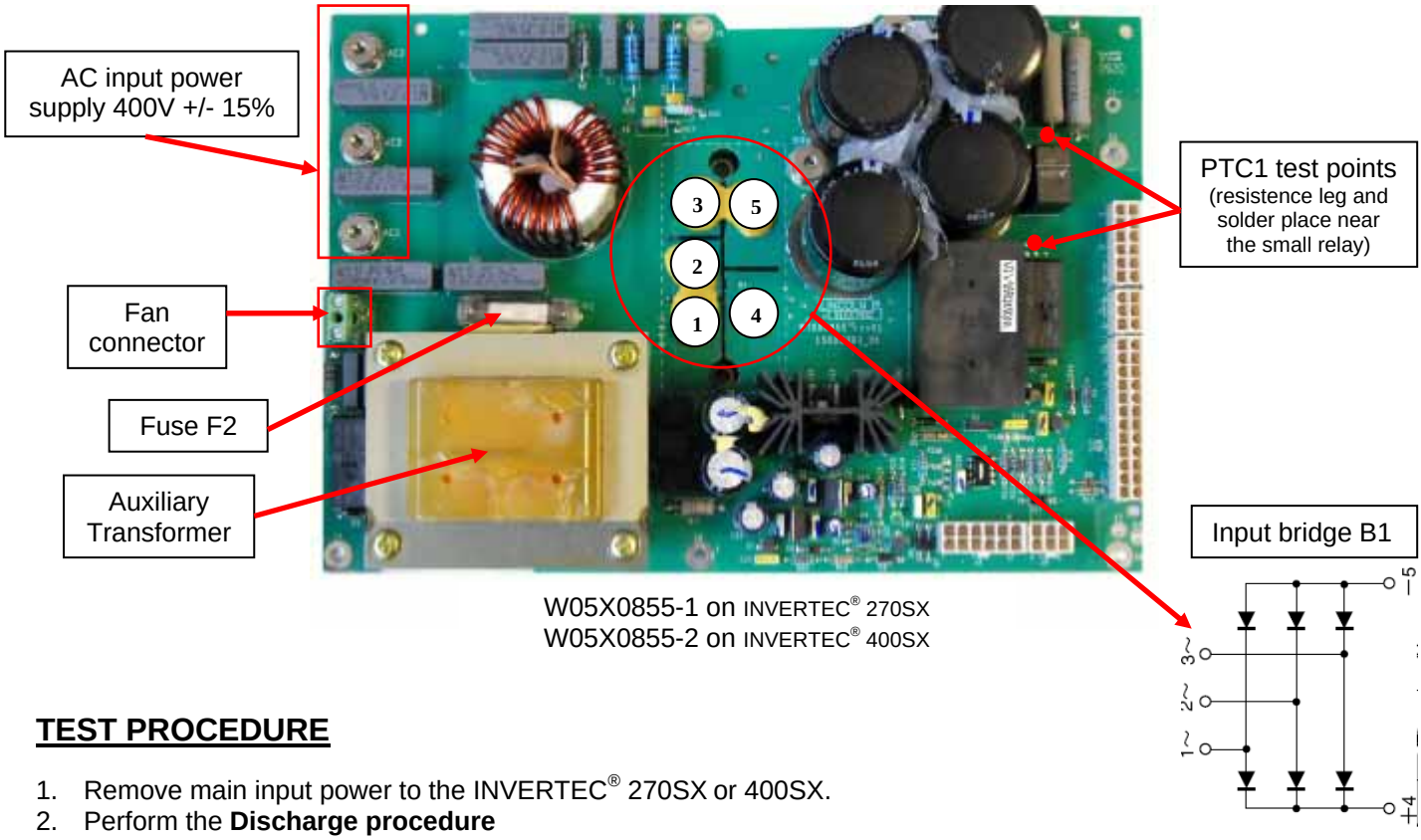
This test will determine if the input board has any " shorted " or "open" components.

MATERIALS NEEDED

Volt/Ohmmeter
Schematic X0855

INPUT BOARD RESISTANCE TEST (continued)

Picture is related to Invertec® 270SX Input board. Invertec® 400SX input board is the same but without the four black snap-in capacitors



W05X0855-1 on INVERTEC® 270SX
W05X0855-2 on INVERTEC® 400SX

TEST PROCEDURE

1. Remove main input power to the INVERTEC® 270SX or 400SX.
2. Perform the **Discharge procedure**
3. Visually check for burned or damaged components.
   If any components are physically damaged the input board should be replaced
4. Using the Volt-Ohmmeter (diode test mode) check the Input Rectifier (see Table 1)
5. Failure of the Input Rectifier is typically the result of another problem. If the Input Rectifier does not pass the tests detailed in Table 1 perform the IGBT test on inverter board
6. Check the PTC1 for 100 ohms +/- 20%. If PTC1 doesn not pass the test may be a failure (short) on capacitors or IGBT is present.
7. Check the fan resistence across the fan connector. For Invertec 270SX fan resistance should be 260 ohm +/- 20%, while for Invertec 400SX should be 370 ohms +/- 20%.
8. Check the fuse F1 for continuity. Typically if F1 is open a problem occurred on the fan or on the auxiliary transformer primary winding.

Table 1. Input Bridge test table

Positive Probe (RED)	*Negative Probe (BLACK)*	*Value*
1 (AC)	**4** (+)	*0.3V - 0.7V*
2 (AC)	**4**(+)	*0.3V - 0.7V*
3 (AC)	**4**(+)	*0.3V - 0.7V*
4 (+)	**1** (AC)	*OPEN*
4(+)	**2** (AC)	*OPEN*
4(+)	**3** (AC)	*OPEN*
5 (-)	**1**(AC)	*0.3V - 0.7V*
5 (-)	**2** (AC)	*0.3V - 0.7V*
5 (-)	**3** (AC)	*0.3V - 0.7V*
1 (AC)	**5** (-)	*OPEN*
2 (AC)	**5** (-)	*OPEN*
3 (AC)	**5** (-)	*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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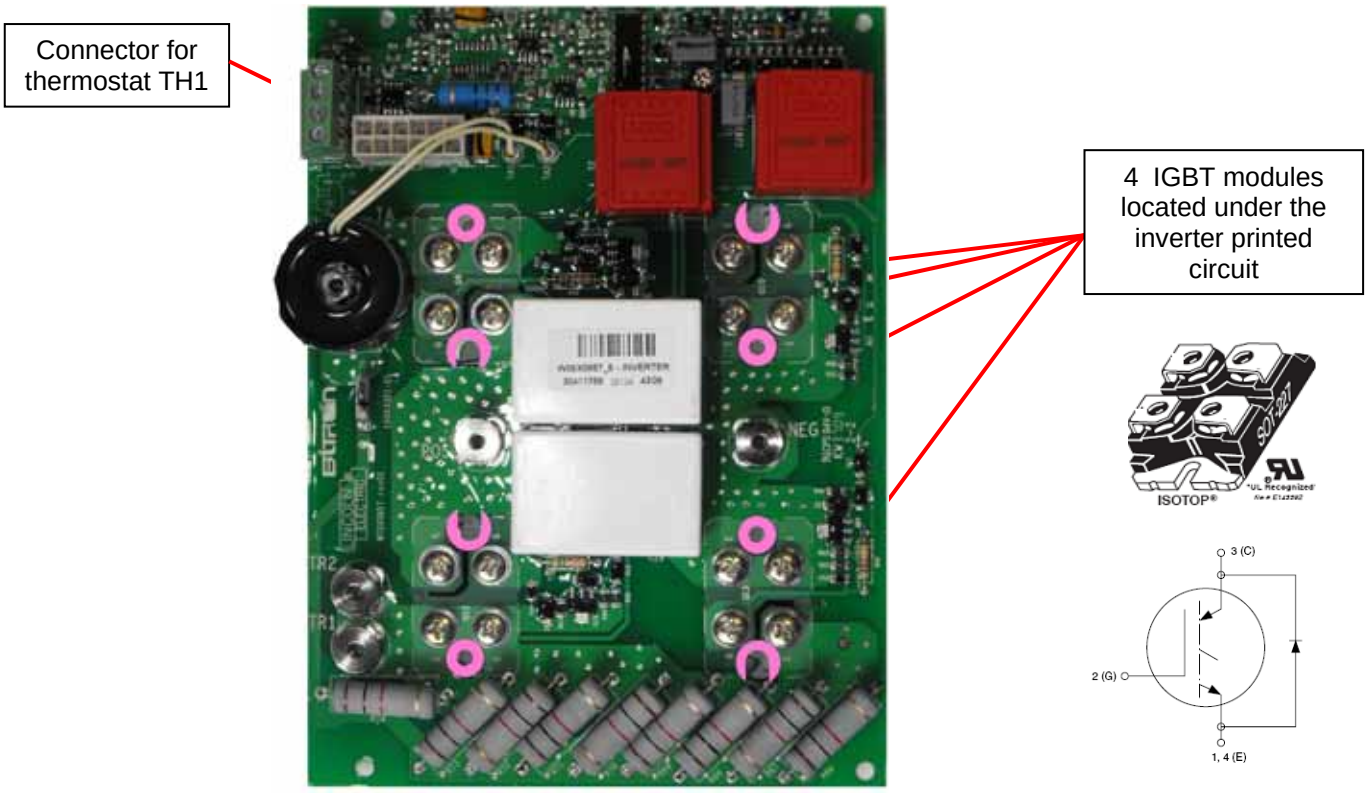
TEST DESCRIPTION

This test will help determine if the “power section” of the inverter board are functioning correctly. This test will NOT indicate if the entire PCboard is functional. This resistance test is preferable to a voltage test with the machine energized because this board can be damaged easily. In addition, it is dangerous to work on this board with the machine energized.

MATERIALS NEEDED

Volt/Ohmmeter
Schematic X0857

INVERTER BOARD RESISTANCE TEST (continued)



W05X0857-4 on 270SX
W05X0857-5 on 400SX

TEST PROCEDURE

1. Remove main input power to the INVERTEC® 270SX or 400SX.
2. Perform the **Discharge procedure**
3. Visually check for burned or damaged components. If any components are physically damaged the input board should be replaced
4. Check the thermostat TH1, connected to the green connector (see picture above), with ohmmeter; correct value is 0 (zero) ohms (short)
5. Check each IGBT module (Q9,Q10,Q12,Q13), with multimeter in diode test mode, following the table below:

IGBT modules - table tests

Positive Probe (RED)	***Negative Probe (BLACK)***	***Value***
Emitter (E)	Collector (C)	*0.3V - 0.7V*
Collector (C)	Emitter (E)	Capacitor charge
Emitter (E)	Gate (G)	*0.3V - 0.7V*

OUTPUT 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

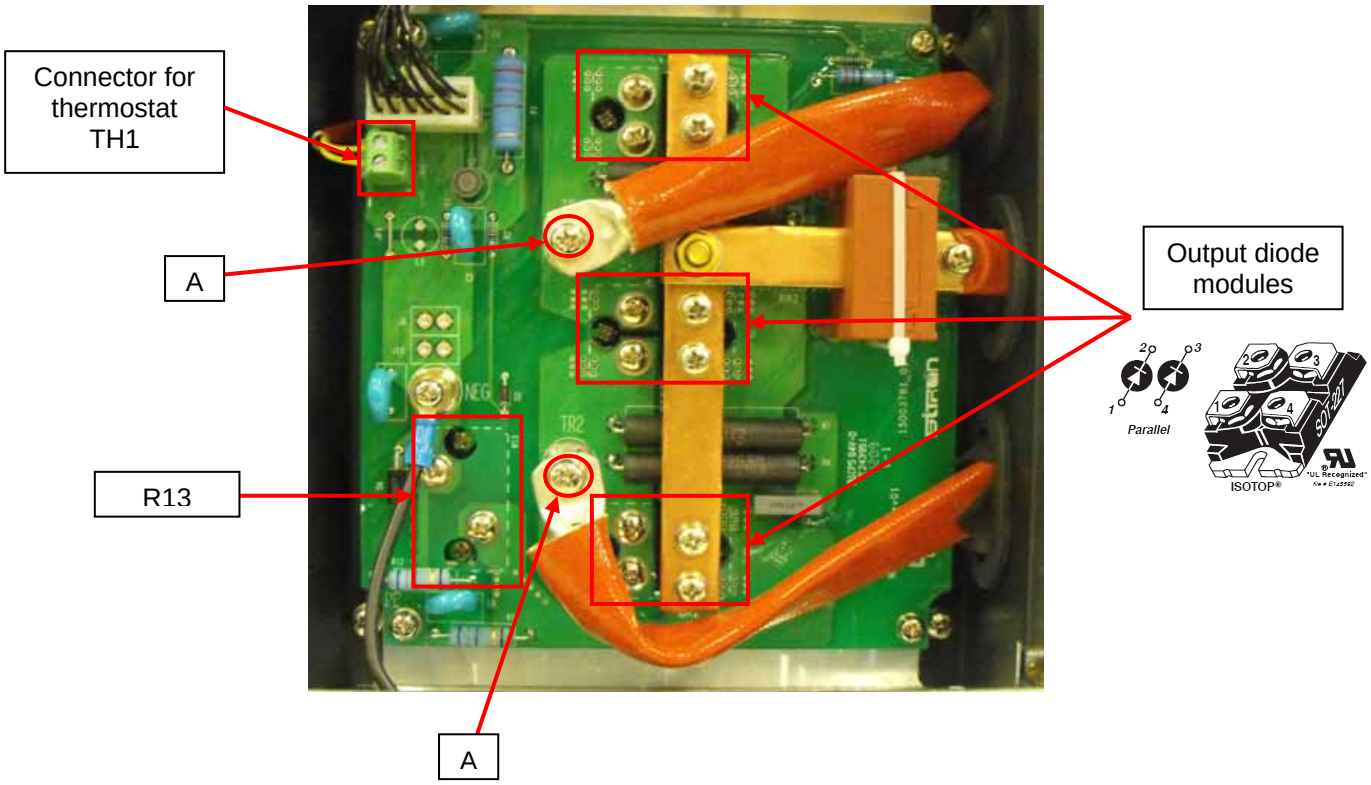
This test will help determine if the “power section” of the output board are functioning correctly. This test will NOT indicate if the entire PCboard is functional but will give you the first feedback regarding the status of the output power components.

MATERIALS NEEDED

Volt/Ohmmeter
Schematic X1044 for Invertec® 270SX
Schematic X1043 for Invertec® 400SX

OUTPUT BOARD RESISTANCE TEST (continued)

for INVERTEC® 270SX

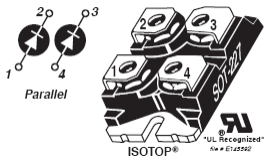


TEST PROCEDURE

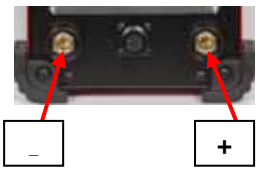
1. Remove main input power to the INVERTEC® 270SX
2. Perform the **Discharge procedure**
3. Visually check for burned or damaged components. If any components are physically damaged the input board should be replaced
4. Check the thermostat TH1, connected to the green connector (see picture above), with ohmmeter; correct value is 0 (zero) ohms (short)
5. Check the Resistor **R13** using ohmmeter, value shall be 100 ohms
6. Disconnect the two cables (**A**)
7. Follow the below tables to perform the remaining tests:

Output Diode modules (D1 – D3 – D5)

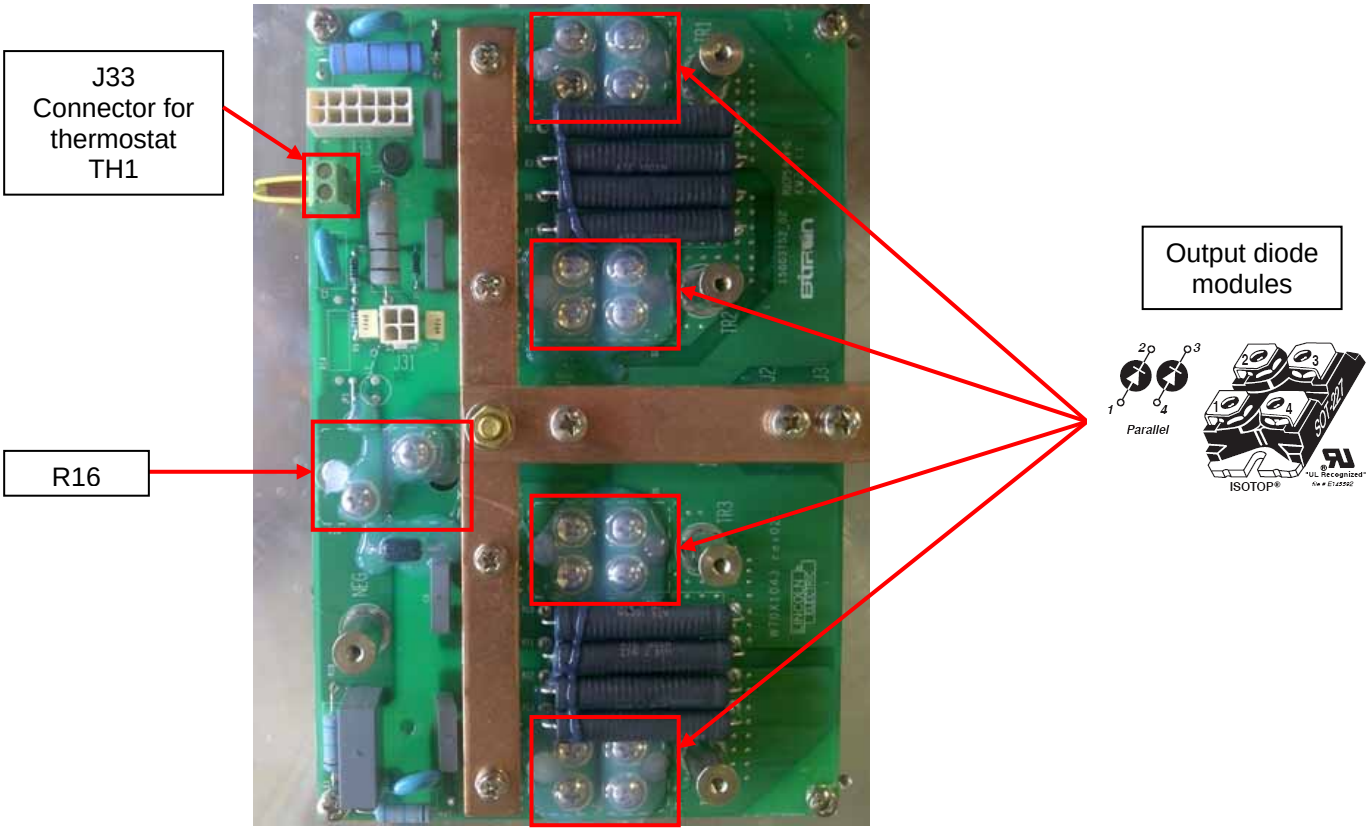
Positive Probe (RED)	Negative Probe (BLACK)	Value
4 (anode)	**3** (cathode)	0.3V - 0.7V
3 (cathode)	**4** (anode)	OPEN
1 (anode)	**2** (cathode)	0.3V - 0.7V
2 (cathode)	**1** (anode)	OPEN



Resistance value measured between output studs (+) and (-) shall be 100 ohms (see below picture)



for INVERTEC® 400SX

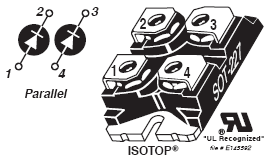


TEST PROCEDURE

1. Remove main input power to the INVERTEC® 400SX
2. Perform the **Discharge procedure**
3. Visually check for burned or damaged components. If any components are physically damaged the input board should be replaced
4. Check the thermostat TH1, connected to the green J33 connector (see picture above), with ohmmeter; correct value is 0 (zero) ohms (short)
5. Check the Resistor **R16** using ohmmeter, value shall be **47** ohms (+/-5%)
6. Follow the below tables to perform the remaining tests:

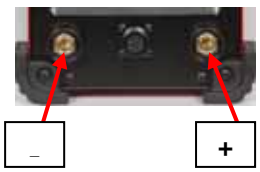
Output Diode modules (D2 – D4 – D5 – D6)

Positive Probe (RED)	Negative Probe (BLACK)	Value
4 (anode)	**3** (cathode)	48 ohms
3 (cathode)	**4** (anode)	48 ohms
1 (anode)	**2** (cathode)	48 ohms
2 (cathode)	**1** (anode)	48 ohms



The reading of the above test is affected by the resistor R16 mounted on the 400SX output board, if a short circuit condition is present performing the output diode modules test, to identify the shorted module is necessary to perform the output board removal procedure and check each diode module.

Resistance value measured between output studs (+) and (-) shall be 48 ohms (see below picture)



INPUT 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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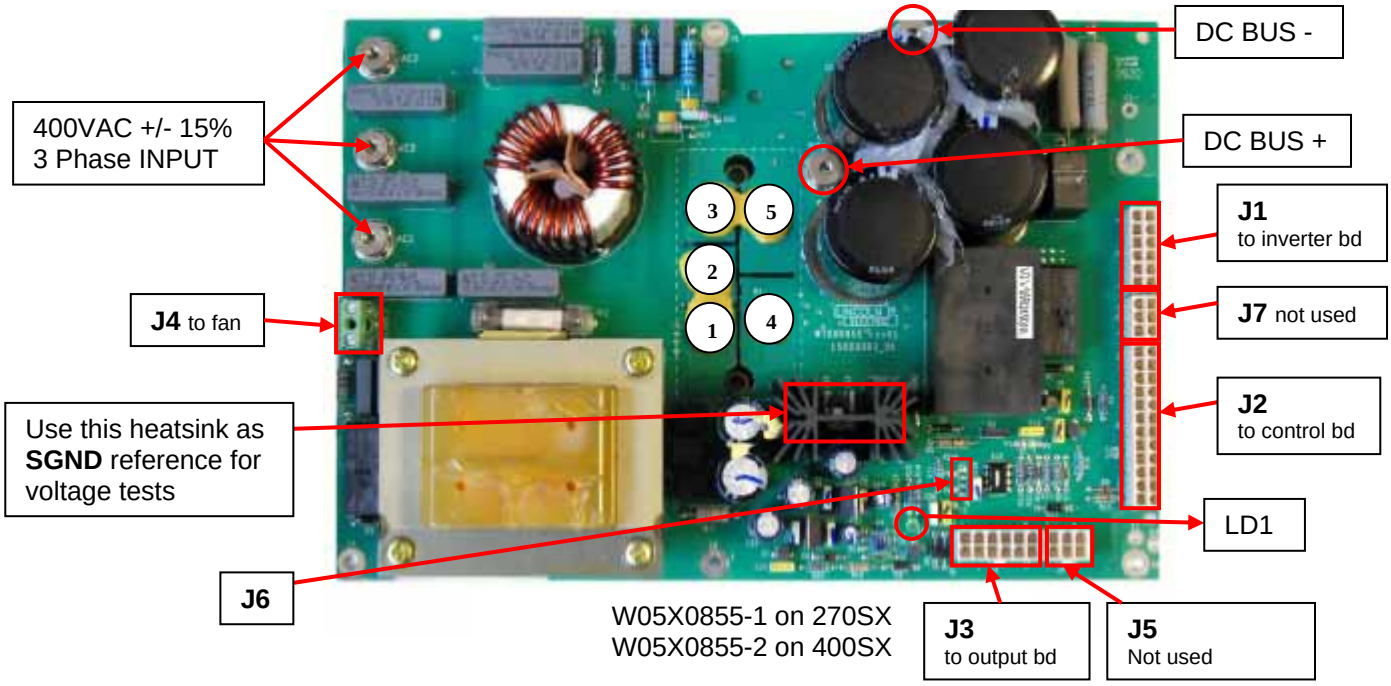
TEST DESCRIPTION

This test will help to determine if the correct input voltage is being applied to the input board and also if the correct voltages are being processed on the input board.

MATERIALS NEEDED

Volt/Ohmmeter
Schematic X0855

INPUT BOARD VOLTAGE TEST (continued)



TEST PROCEDURE

1. Apply 400V +/- 15% to the INVERTEC® 270SX or 400SX
2. Turn the machine input swith to ON position, soft start operation starts and power LED on front panel starts to blink.
3. Verify that the green LD1, on input board is lit and that, after 5 seconds, the power LED on front panel is steady green.This means that the input voltage is in the correct range and the capacitors precharge phase is finish.
4. Check for 564Vdc +/-15% between terminals DC BUS+ and DC BUS-.
5. Follow the below tables test to perform the voltage tests on connectors:

J1: Input/Inverter connector

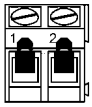
Pin#	Description	Value (use SGND as 0V ref.)	Notes
1	VREG	• +12Vdc in Lift TIG mode, stand-by condition (no OCV, no fan), thermal and any overload condition. • 0,7Vdc in any stick mode during OCV condition **for 270SX** • 0,4Vdc in any stick mode during OCV condition **for 400SX**	+12Vdc switch the inverter OFF.
2	DUTY CUT	• For 270SX: 50A=1,4Vdc_150A=4Vdc_270A=7,2Vdc • For 400SX: 50A=1,0Vdc_200A=4Vdc_400A=8Vdc	Output current set signal
3	TA	-	Inverter TA signal (only for factory test)
4	-5V	-5Vdc	-5V power supply generated by the input board.
5	THD	• 0V=normal value • 9,7Vdc +/- 10% = thermic activated on output board	Thermal tab on the output heat sink
6	SGND	SGND	Secondary GND for power supply (0V ref.)
7	Not Used	-	-
8	SDINVB	-	Not used
9	ICUT_CLP	-	Not used
10	I_EL	• 3,6Vdc=270A for 270SX • 4Vdc=400A for 400SX	Electrode Current feedback from HCS2
11	TH1	• 0V=normal value • 9,7Vdc +/- 10% = thermic activated on inverter board	Thermostat on the inverter heat sink signal
12	+15V	+15Vdc	+15V power supply generated by the input board.

J6: Input Board uController Programming connector – <u>Only for Lincoln Engineering use</u>

INPUT BOARD VOLTAGE TEST (continued)

J4: Fan connector

Pin#	Description	Value	Notes
1	Fan	15 Vac in idle mode 230Vac when fan ON	Fan is switch ON by signal coming from control board
2			



J2: Input/Control connector

Pin#	Description	Value (use SGND as 0V ref.)	Notes
1	+15V	+15Vdc	+15V power supply generated by the input board
2	SGND	SGND	Secondary GND for power supply (0V ref.)
3	GASERR	-	Not used
4	I_EL	• 3,6Vdc=270A for 270SX • 4Vdc=400A for 400SX	Electrode Current feedback from HCS2
5	I_WP		Not used
6	SGND	SGND	Secondary GND for power supply (0V ref.)
7	VREG-NOZ	In any stick modes For 270SX: 50A=1,5Vdc_270A=7,2Vdc For 400SX: 50A=1Vdc_400A=8Vdc	In LIFT TIG mode (stand-by) = 12Vdc
8	REMSIGN	-	Not used
9	READY_OK	• +5Vdc only during Power Up sequence • 0V during normal operation condition	If +5Vdc are present means that something not normal is detected by the input board, like power supply out of range.
10	SW_CTRL		Not used
11	TH1	• 0V=normal value • 9,7Vdc +/- 10% = thermic activated on inverter board	Thermostat on the inverter heat sink signal
12	DUTYCUT	• For 270SX: 50A=1,4Vdc_150A=4Vdc_270A=7,2Vdc • For 400SX: 50A=1,0Vdc_200A=4Vdc_400A=8Vdc	Output current set signal
13	/PIP		Not used
14	SDINVB	-	Not used
15	TH2	-	Not used
16	/TR	-	Not used
17	SOL		Not used
18	FAN	• 0V=Fan OFF • 1,6Vdc=Fan ON	Fan signal
19	ARCINITIATED	-	Not used
20	ICUT_CLP	-	Not used
21	BBST	-	Not Used
22	CE/US	5Vdc= CE version	Machine version
23	ACLOSS	+5Vdc	Always
24	TA	-	Inverter TA signal (only for factory test)

J3: Input/Output connector

Pin#	Description	Value (use SGND as 0V ref.)	Notes
1	V_OUT ref	• 3,9Vdc in any stick modes • 0Vdc in Lift Tig mode	Only in stick modes Stand-by condition during OCV
2	SW_CTRL	-	Not Used
3	-5V	-5Vdc	-5V power supply generated by the input board
4	I_EL	• 3,6Vdc=270A for 270SX • 4Vdc=400A for 400SX	Electrode Current feedback from HCS2
5	SGND	SGND	Secondary GND for power supply (0V ref.)
6	Not Used	-	-
7	/TR		Not Used
8	/PIP		Not Used
9	ARCINITIATED		Not Used
10	THD	• 0V=normal value • 9,7Vdc +/- 10% = thermic activated on output board	Thermal tab on the output heat sink
11	+15V	+15Vdc	+15V power supply generated by the input board
12	VREG-NOZ	-	Passer-by signal

INVERTER BOARD VOLTAGE TEST

WARNING

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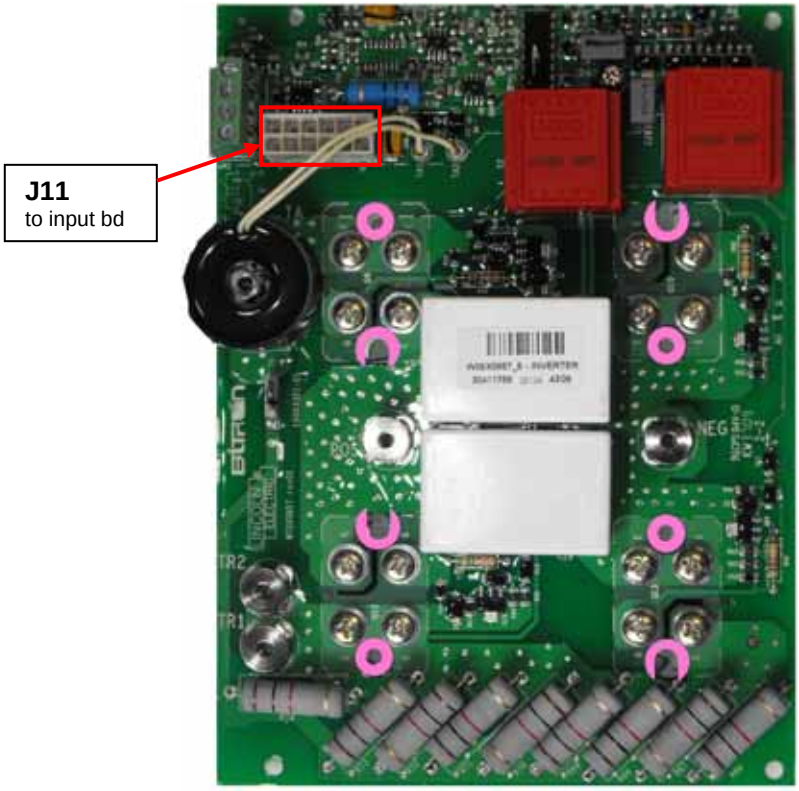
TEST DESCRIPTION

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

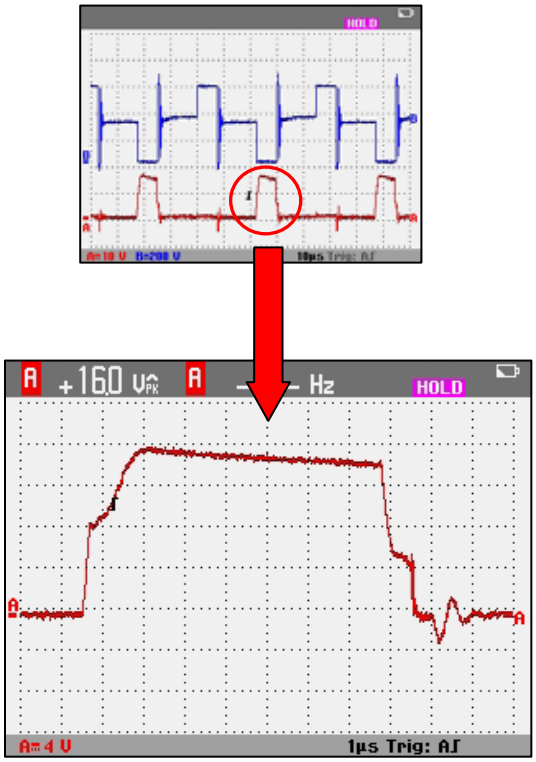
Volt/Ohmmeter
Schematic X0857

INVERTER BOARD VOLTAGE TEST (continued)



W05X0857-4 on INVERTEC 270SX
W05X0857-5 on INVERTEC 400SX

BLUE= VCE at 60A/105V output
RED = VGE at 60A/105V output



TEST PROCEDURE

1. Apply 400V +/- 15% to the INVERTEC® 270SX or 400SX
2. Turn the machine input swith to ON position, and wait till the power LED on front panel is stady green.
3. Check for 564Vdc +/-15% between terminals POS and NEG to be sure that the inverter is correctly supplied from the input board.
4. Follow the below tables test to perform the voltage tests on connectors:

J11: Inverter/Input connector

Pin#	Description	Value (use SGND as 0V ref.)	Notes
1	VREG	• +12Vdc in Lift TIG mode, stand-by condition (no OCV, no fan), thermal and any overload condition. • 0,7Vdc in any stick mode during OCV condition **for 270SX** • 0,4Vdc in any stick mode during OCV condition **for 400SX**	+12Vdc switch the inverter OFF.
2	DUTY CUT	• For 270SX: 50A=1,4Vdc_150A=4Vdc_270A=7,2Vdc • For 400SX: 50A=1,0Vdc_200A=4Vdc_400A=8Vdc	Output current set signal
3	TA	-	Inverter TA signal (only for factory test)
4	-5V	-5Vdc	-5V power supply generated by the input board.
5	THD	• 0V=normal value • 9,7Vdc +/- 10% = thermic activated on output board	Thermal tab on the output heat sink
6	SGND	SGND	Secondary GND for power supply (0V ref.)
7	Not Used	-	-
8	SDINVB	-	Not used
9	ICUT_CLP	-	Not used
10	I_EL	• 3,6Vdc=270A for 270SX • 4Vdc=400A for 400SX	Electrode Current feedback from HCS2
11	TH1	• 0V=normal value • 9,7Vdc +/- 10% = thermic activated on inverter board	Thermostat on the inverter heat sink signal
12	+15V	+15Vdc	+15V power supply generated by the input board.

OUTPUT BOARD VOLTAGE TEST

WARNING

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TEST DESCRIPTION

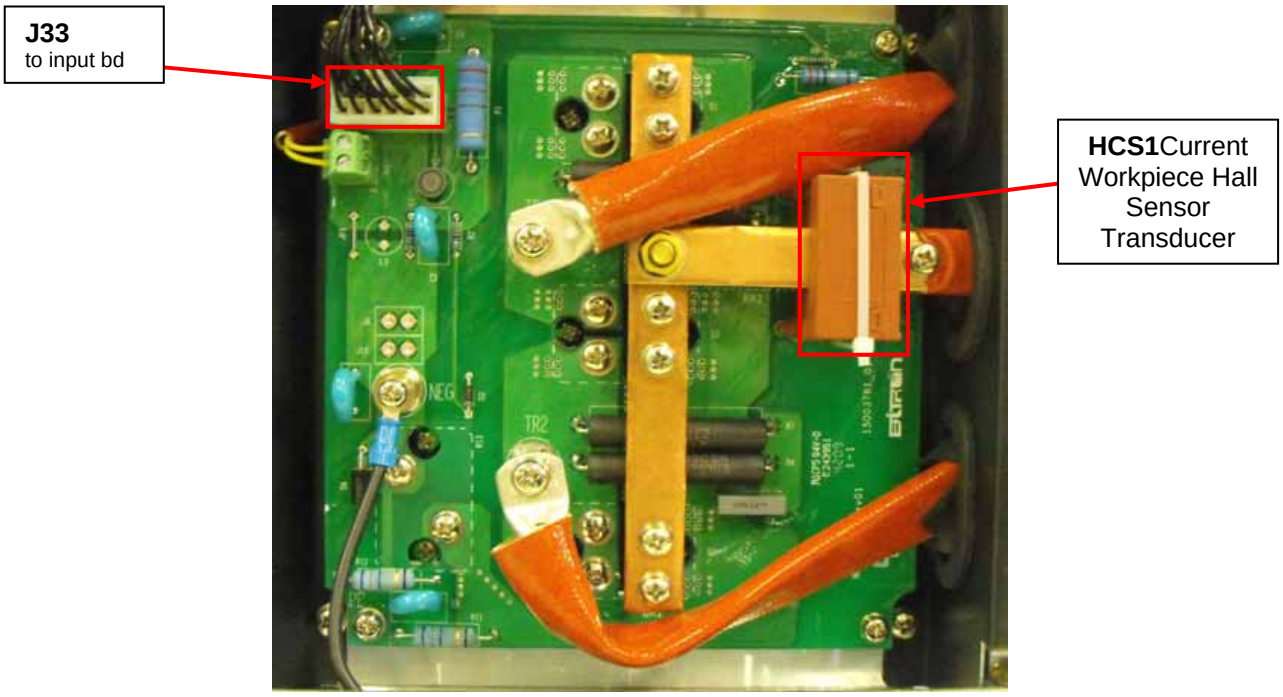
This test will help to determine if the output module is faulty.

MATERIALS NEEDED

Volt/Ohmmeter
Schematic X1044 for INVERTEC® 270SX
Schematic X1043 for INVERTEC® 270SX

OUTPUT BOARD VOLTAGE TEST (continued)

for INVERTEC® 270SX



TEST PROCEDURE

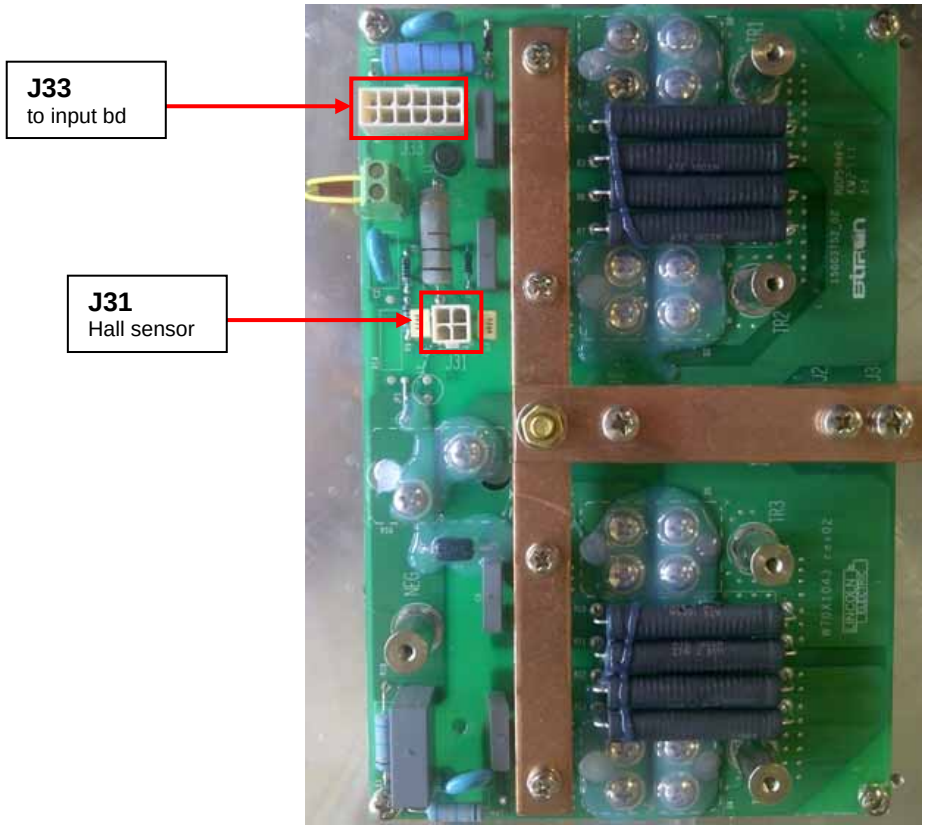
1. Apply 400V +/- 15% to the INVERTEC® 270SX
2. Turn the machine input swith to ON position, and wait till the power LED on front panel is stady green.
3. Follow the below tables test to perform the voltage tests on connectors and Static Switch IGBT:

J33: Output/Input connector

Pin#	Description	Idle Value/Ref	Notes
1	V_OUT ref	• 3,9Vdc in any stick modes • 0Vdc in Lift Tig mode	Only in stick modes Stand-by condition during OCV
2	SW_CTRL	-	Not Used
3	-5V	-5Vdc	-5V power supply generated by the input board
4	I_EL	• 3,6Vdc=270A for 270SX	Electrode Current feedback from HCS2
5	SGND	SGND	Secondary GND for power supply (0V ref.)
6	Not Used	-	-
7	/TR		Not Used
8	/PIP		Not Used
9	ARCINITIATED		Not Used
10	THD	• 0V=normal value • 9,7Vdc +/- 10% = thermic activated on output board	Thermal tab on the output heat sink
11	+15V	+15Vdc	+15V power supply generated by the input board
12	VREG-NOZ	-	Passer-by signal

OUTPUT BOARD VOLTAGE TEST (continued)

for INVERTEC® 400SX



TEST PROCEDURE

1. Apply 400V +/- 15% to the INVERTEC® 400SX
2. Turn the machine input swith to ON position, and wait till the power LED on front panel is stady green.
3. Follow the below tables test to perform the voltage tests on connectors and Static Switch IGBT:

J33: Output/Input connector

Pin#	Description	Idle Value/Ref	Notes
1	V_OUT ref	• 3,9Vdc in any stick modes • 0Vdc in Lift Tig mode	Only in stick modes Stand-by condition during OCV
2	SW_CTRL	-	Not Used
3	-5V	-5Vdc	-5V power supply generated by the input board
4	I_EL	• 4Vdc=400A for 400SX	Electrode Current feedback from HCS2
5	SGND	SGND	Secondary GND for power supply (0V ref.)
6	Not Used	-	-
7	/TR		Not Used
8	/PIP		Not Used
9	ARCINITIATED		Not Used
10	THD	• 0V=normal value • 9,7Vdc +/- 10% = thermic activated on output board	Thermal tab on the output heat sink
11	+15V	+15Vdc	+15V power supply generated by the input board
12	VREG-NOZ	-	Passer-by signal

J31: Hall Sensor

Pin#	Description	Idle Value/Ref	Notes
1	+15V	+ 15V	+ 15V power supply for the hall sensor probe
2	-5V	-5V	-5V power supply for the hall sensor probe
3	I OUT	50A=0,7Vdc 200A=2,7Vdc 400A= 5,3Vdc	Output current reference
4	SGND	SGND	Secondary GND for power supply (0V ref.)

CONTROL BOARD TEST

WARNING

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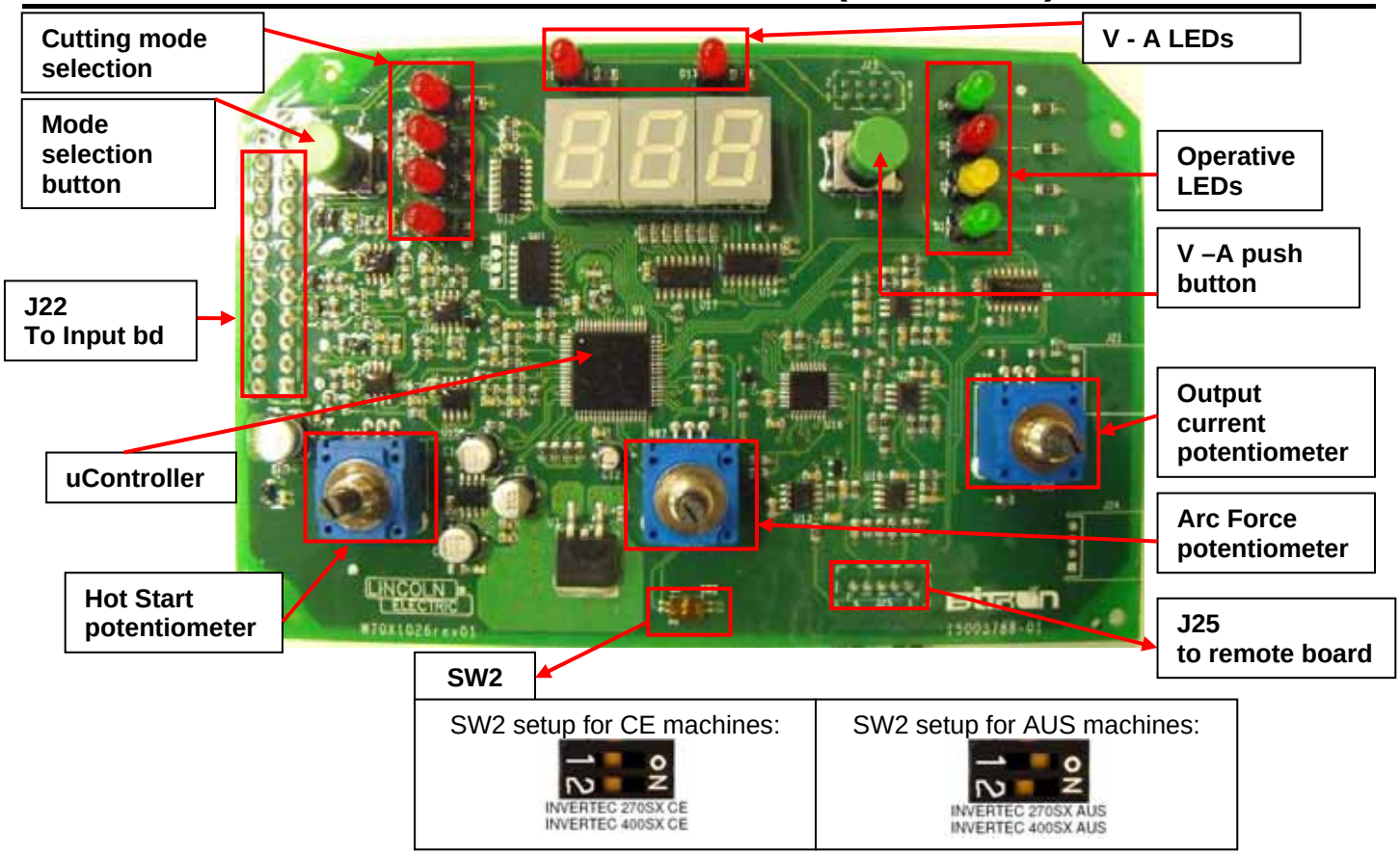
TEST DESCRIPTION

The control board is not easy to be checked, as it works mainly with software; this section will help, as best as possible, to determine if the control board is faulty and how to interpret error codes.

MATERIALS NEEDED

Volt/Ohmmeter
Schematic X1026

CONTROL BOARD TEST (continued)



SW2 setup for CE machines:	SW2 setup for AUS machines:
INVERTEC 270SX CE INVERTEC 400SX CE	INVERTEC 270SX AUS INVERTEC 400SX AUS

TEST PROCEDURE

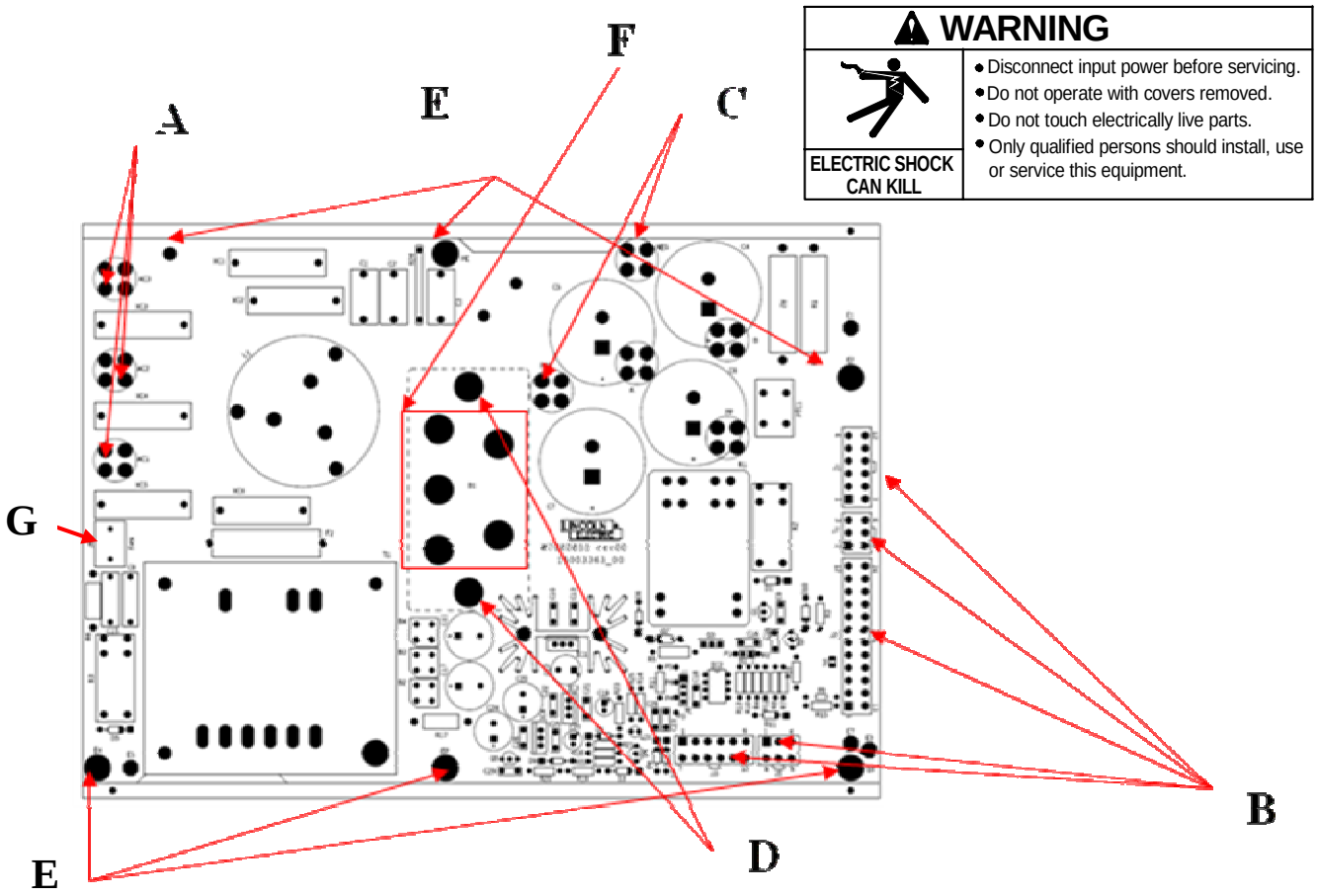
1. Apply 400V +/- 15% to the INVERTEC® 270SX or 400SX
2. Turn the machine input swith to ON position, and wait till the power LED on front panel is stady green.
3. Follow the below tables to perform the tests and understand error codes:

J22: Control/Input connector

Pin#	Description	Idle Value/Ref	Notes
1	+15V	+15Vdc	+15V power supply generated by the input board
2	SGND	SGND	Secondary GND for power supply (0V ref.)
3	GASERR	-	Not used
4	I_EL	• 3,6Vdc=270A for 270SX • 4Vdc=400A for 400SX	Electrode Current feedback from HCS2
5	V OUT Ref	• 3,9Vdc in any stick modes • 0Vdc in Lift Tig mode	Only in stick modes Stand-by condition during OCV
6	SGND	SGND	Secondary GND for power supply (0V ref.)
7	VREG-NOZ	In any stick modes For 270SX: 50A=1,5Vdc_270A=7,2Vdc For 400SX: 50A=1Vdc_400A=8Vdc	In LIFT TIG mode (stand-by) = 12Vdc
8	REMSIGN	-	Not used
9	READY_OK	• +5Vdc only during Power Up sequence • 0V during normal operation condition	If +5Vdc are present means that something not normal is detected by the input board, like power supply out of range.
10	SW_CTRL		Not used
11	TH1	• 0V=normal value • 9,7Vdc +/- 10% = thermic activated on inverter board	Thermostat on the inverter heat sink signal
12	DUTYCUT	• For 270SX: 50A=1,4Vdc_150A=4Vdc_270A=7,2Vdc • For 400SX: 50A=1,0Vdc_200A=4Vdc_400A=8Vdc	Output current set signal
13	/PIP		Not used
14	SDINVB	-	Not used
15	TH2	-	Not used
16	/TR	-	Not used
17	SOL		Not used
18	FAN	• 0V=Fan OFF • 1,6Vdc=Fan ON	Fan signal
19	ARCINITIATED	-	Not used
20	ICUT_CLP	-	Not used
21	BBST	-	Not Used
22	CE/US	5Vdc= CE version	Machine version
23	ACLOSS	+5Vdc	Always
24	TA	-	Inverter TA signal (only for factory test)

DISASSEMBLY OPERATIONS

INPUT BOARD 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.

REMOVAL PROCEDURE

Necessary tool:
- Phillips screwdriver PH02;

1. Unscrew the line cord from the AC1, AC2 and AC3 stand off (**A**);
2. Unplug the cables of the connectors (**B**),
3. Unscrew the DC+ and DC- cables (**C**);
4. Unscrew the fan wires from connector (**G**)
5. Unscrew the 2 screws of the input rectifier (**D**);
6. Unscrew the 6 screws that fix the board to the metal stand offs (**E**);
7. Unscrew the 5 screws of the input rectifier (**F**);

For the re-assembly operations, make the previous steps in the reverse order. Add silicon to the zones where the potting protection was removed. **ATTENTION:** use silicon type with low acetic, viscosity and adhesive grade.

NOTE:
Apply the thermal compound thin layer (0,1-0,2 mm) under the input rectifier component before the re-assembling. Screw torque 1,2/1,4 N/m (0.030/0.033 N/inch);

DO NOT USE CORDLESS SCREWDRIVERS FOR THE POWER MODULEs!

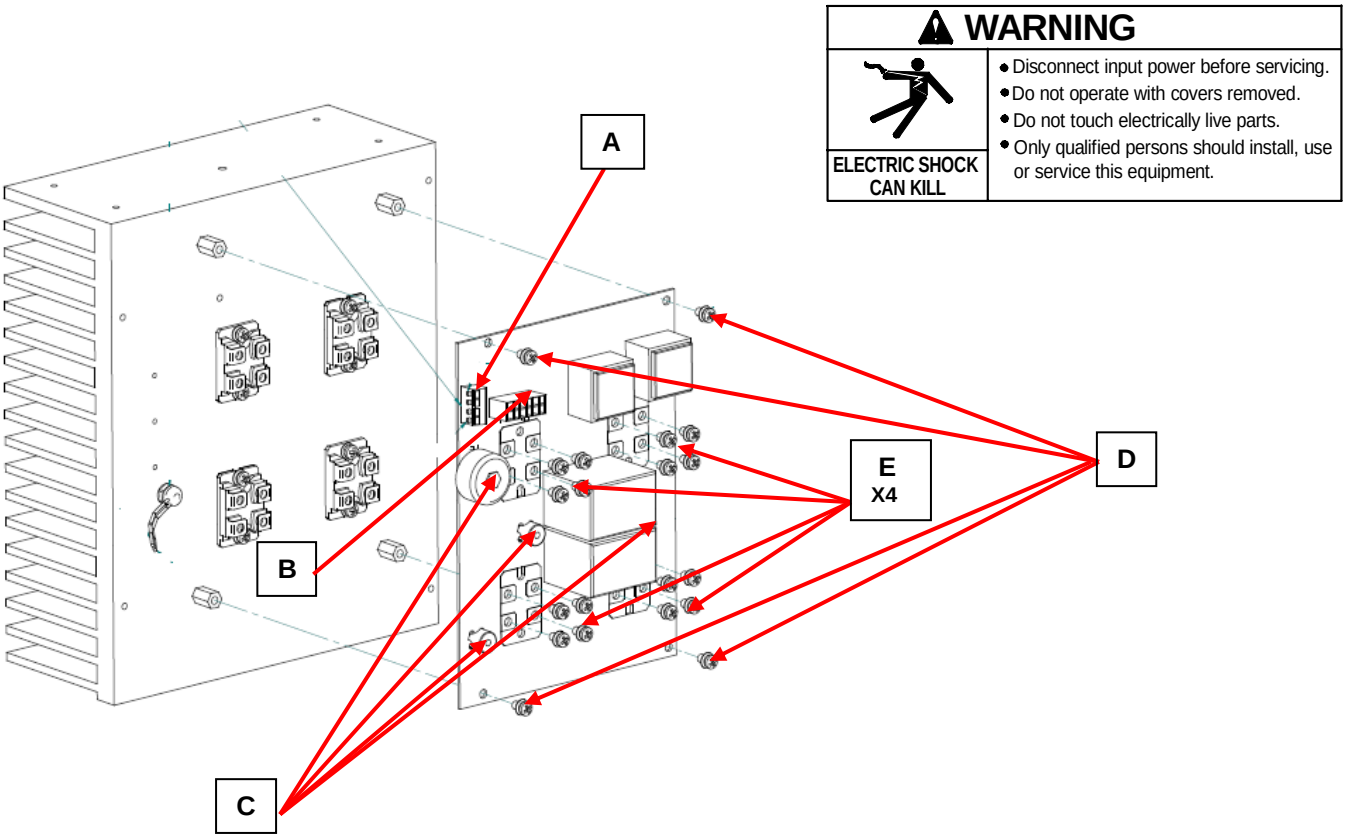
Invertec® 270SX

⚠ WARNING!
Remember to connect ground lead to the male faston on the input board corner.

Invertec® 400SX

DISASSEMBLY OPERATIONS

INVERTER BOARD REMOVAL AND REPLACEMENT PROCEDURE



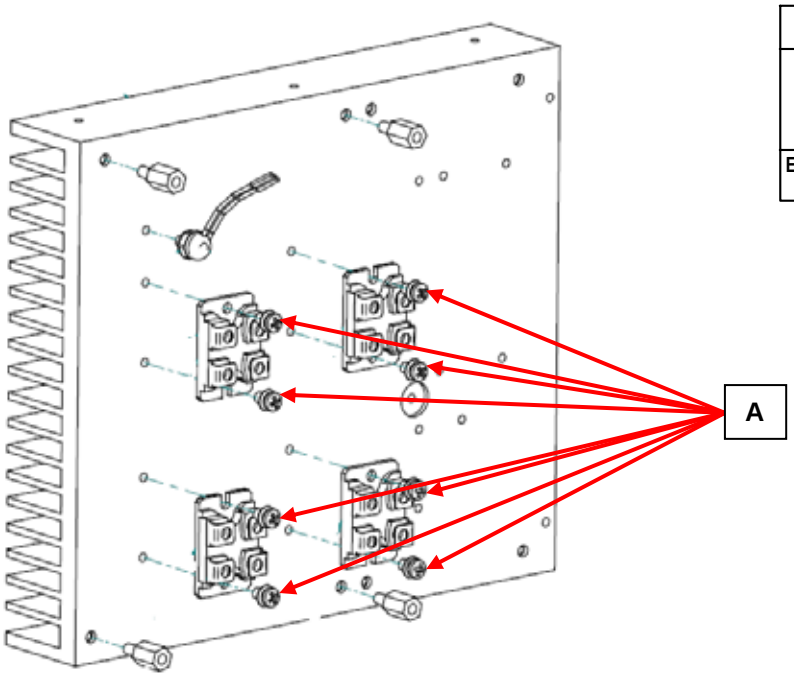
REMOVAL PROCEDURE

Necessary tools:
- Phillips screwdriver PH02
- A small flat bladed screwdriver (for **A**)

1. Remove the thermostats harness (**A**), signal harness (**B**) and unscrew the power harnesses (**C**)
2. Unscrew the 4 screws in the corner of the board that let it to be connected to the metal stand offs on the heat sink (**D**)
3. Remove the potting protection and unscrew the 16 screws that fix the board to the IGBT modules (**E**)

For the re-assembly operations, make the previous steps in the reverse order.
Add silicon to the zones where the potting protection was removed.
ATTENTION ! : use silicon type with low acetic, viscosity and adhesive grade.

DO NOT USE CORDLESS SCREWDRIVERS FOR THE POWER MODULEs !



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.

REMOVAL PROCEDURE

Necessary tools:
- Phillips screwdriver PH02

1. Unscrew the 8 screws (2 for each IGBT) between every IGBT and heat sink (**A**)
2. Remove the IGBTs and clean the heat sink from the residual thermal compound

For the re-assembly operations, make the previous steps in the reverse order. Add silicon to the zones where the potting protection was removed.
ATTENTION: use silicon type with low acetic, viscosity and adhesive grade.

NOTE: apply the thermal compound thin layer (0,1-0,2 mm) under each isotop component before the re-assembling.
Screw torque 1,2/1,4 N/m (0.030/0.033 N/inch);

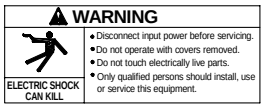
DO NOT USE CORDLESS SCREWDRIVERS FOR THE POWER MODULEs!

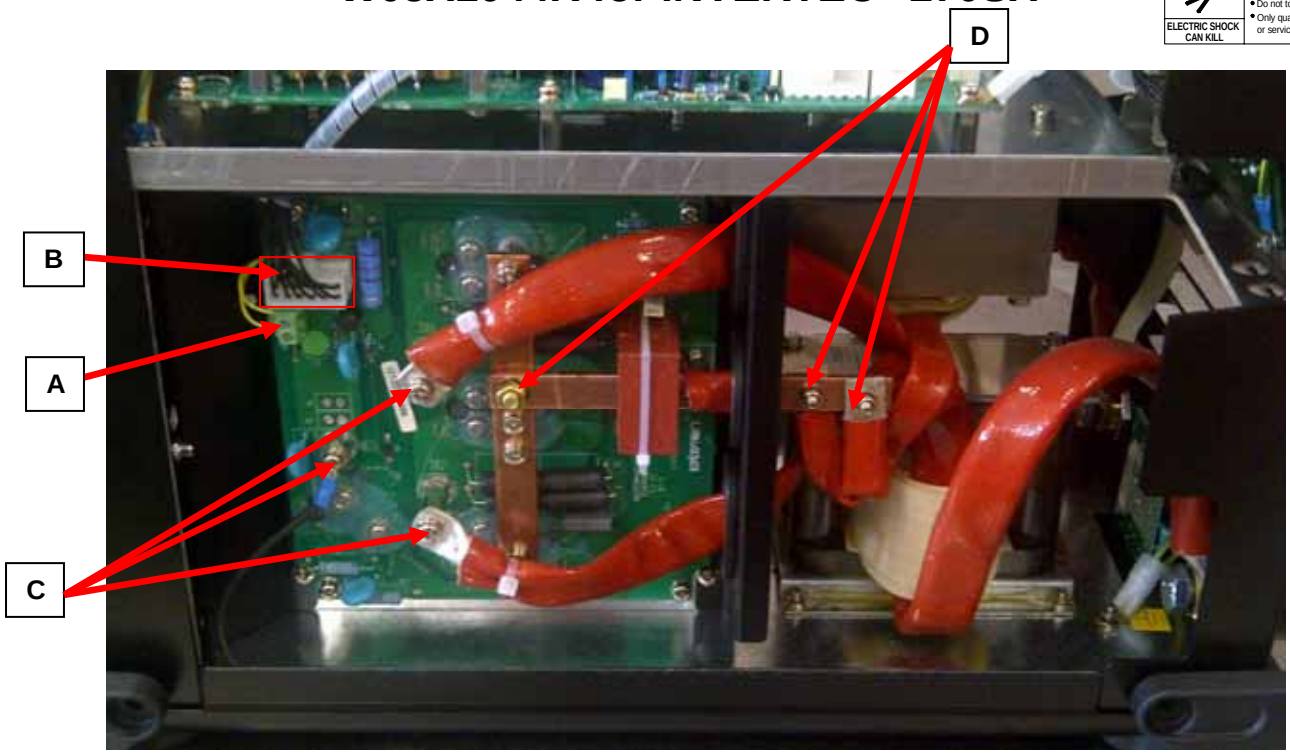
PAY ATTENTION ! of how to position the open end mounting of modules to heatsink.
Damages on new component if this is incorrect.
See printed circuit board for reference.

DISASSEMBLY OPERATIONS

OUTPUT BOARD REMOVAL AND REPLACEMENT PROCEDURE

W05X1044R for INVERTEC® 270SX

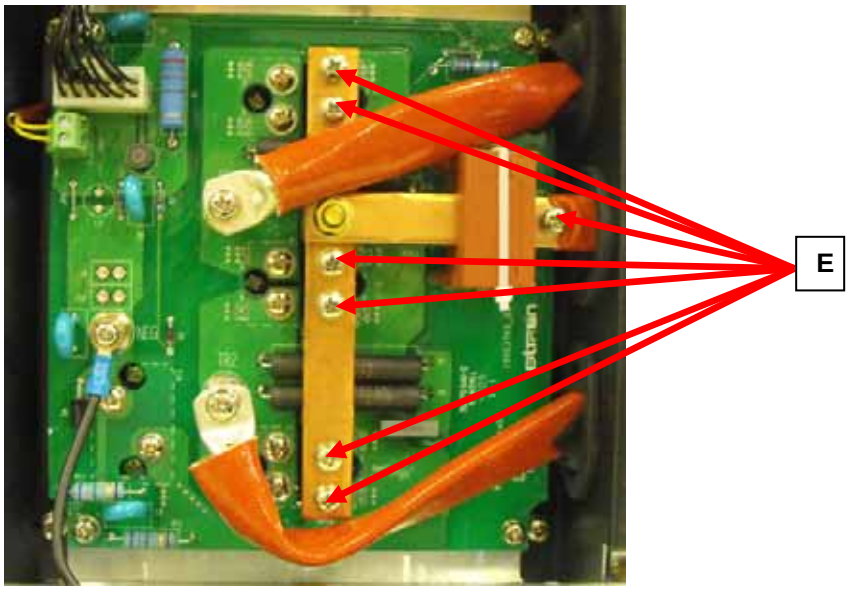




REMOVAL PROCEDURE

Necessary tools:
- Phillips screwdriver PH02
- A small flat bladed screwdriver (for **A**)
- 10mm wrench
- 7mm nut driver
- 6mm nut driver

1. Remove the thermostats harnesses (**A**), signal harness (**B**) and unscrew the power cables (**C**)
2. Unscrew the nuts (**D**) and remove the related bolts.

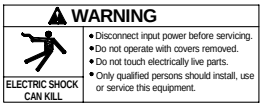


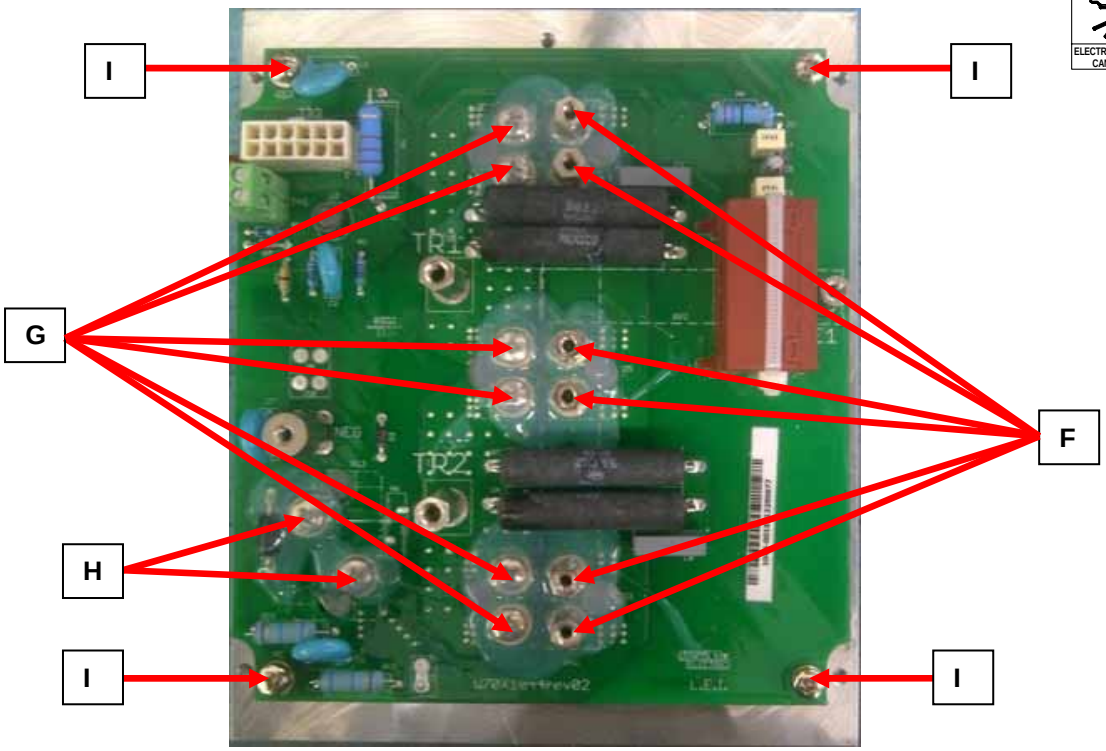
3. Unscrew the 7 screws (**E**) that fix the second copper bar and remove it.

DISASSEMBLY OPERATIONS

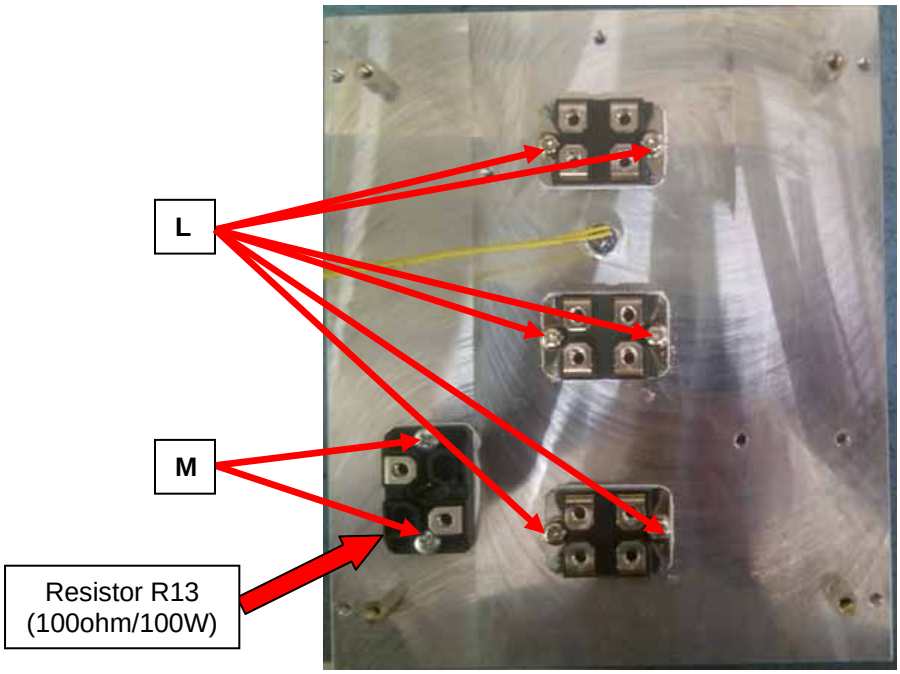
OUTPUT BOARD REMOVAL AND REPLACEMENT PROCEDURE (continued)

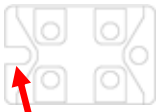
W05X1044R for INVERTEC® 270SX





4. Remove the potting protection and unscrew the 6 spacers (**F**), the 6 screws (**G**) and the 2 screws (**H**).
5. Unscrew the 4 screws (**I**) and remove the output board printed circuit.





Pay attention of how to position the open end mounting of diode modules to heatsink. Refering to the side picture the open end must be on the left side

6. Remove the 6 screws (**L**) that fix the diode modules and the 2 screws (**M**) that fix the resistor R13. Keep these 6 crews in a separate place as they are different from the ones that are fixing the diode modules to the PCB. Clean the heatsink from the residual thermal compound.

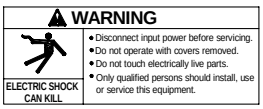
For the re-assembly operations, make the previous steps in the reverse order. Add silicon to the zones where the potting protection was removed.
ATTENTION ! : use silicon type with low acetic, viscosity and adhesive grade.

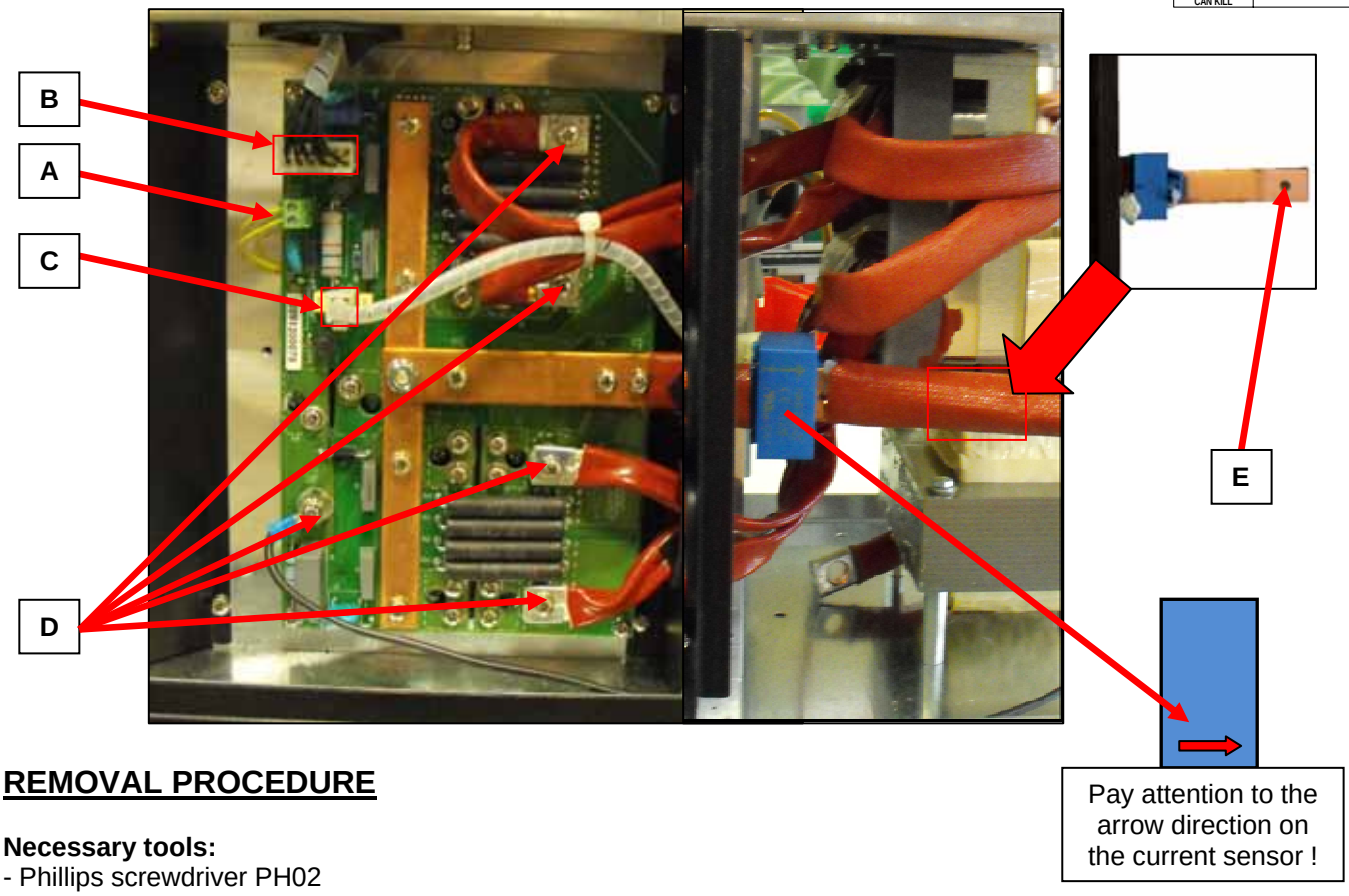
NOTE: apply the thermal compound thin layer (0,1-0,2 mm) under each isotop component before the re-assembling. Screw torque 1,2/1,4 N/m (0.030/0.033 N/inch);
DO NOT USE CORDLESS SCREWDRIVERS FOR THE POWER MODULEs!

DISASSEMBLY OPERATIONS

OUTPUT BOARD REMOVAL AND REPLACEMENT PROCEDURE

W05X1043R for INVERTEC® 400SX

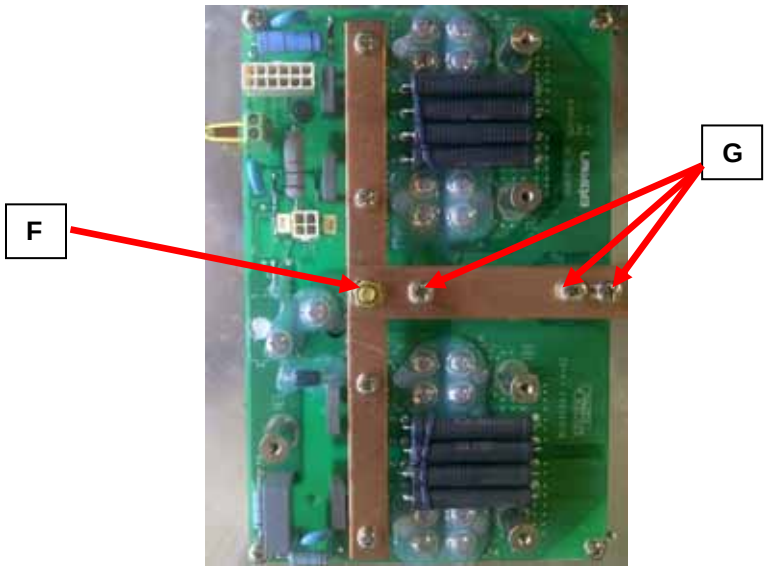




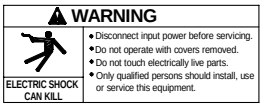
REMOVAL PROCEDURE

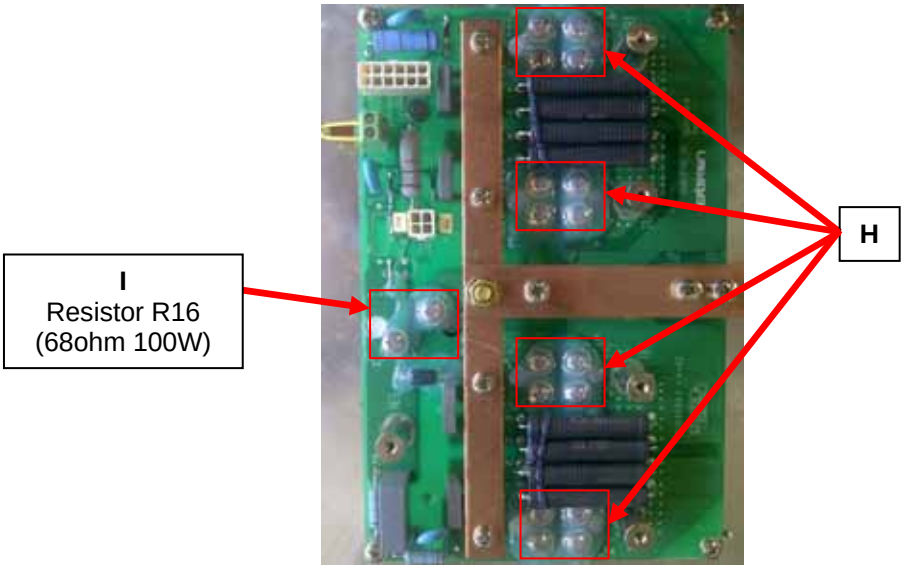
Necessary tools:
- Phillips screwdriver PH02
- A small flat bladed screwdriver (for **A**)
- 10mm wrench

1. Remove the thermostats harnesses (**A**), signal harness (**B**), Hall probe harness (**C**) and unscrew the power cables (**D**)
2. Remove the insulation protection to have access to the nut (**E**) and remove it along with its related bolt.

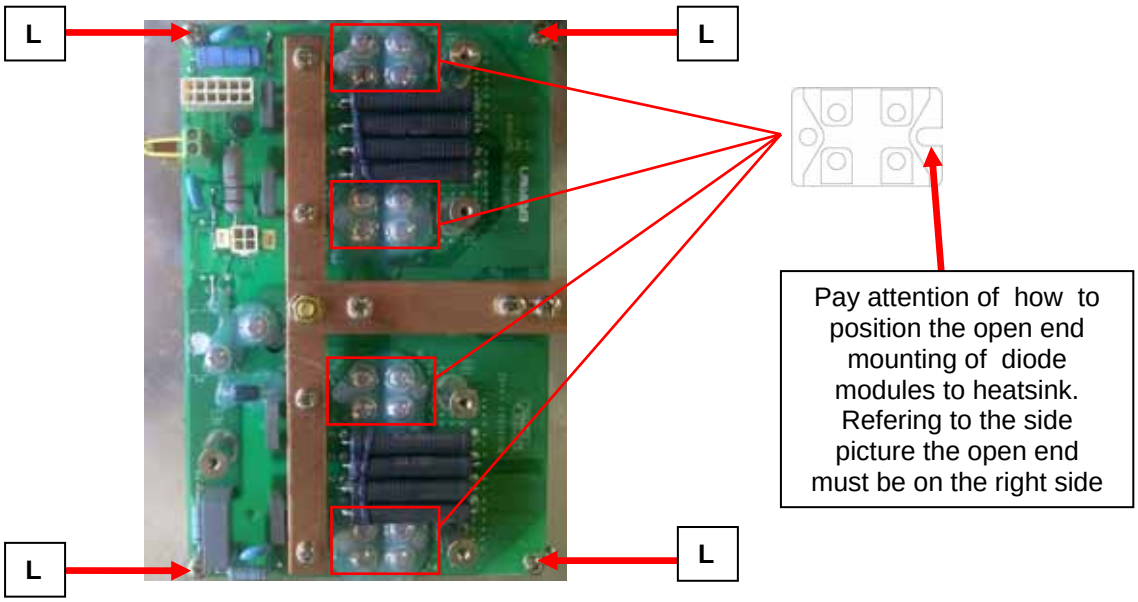


3. Remove the nut (**F**) and its related bolt
4. Unscrew the 3 screws (**G**) and remove the orizontal copper bar





5. Remove the potting protection and unscrew the 16 screws that fix the 4 diodes modules (**H**) to the PCB.
6. Remove the potting ptotection and unscrew the 2 screws that fix the resistor R16 (**I**) to the PCB



7. Unscrew the 4 screws (**L**) and remove the output board printed circuit.
8. Remove the 8 screws that fix the 4 diode modules and the 2 screws that fix the resistor R16 to the heatsink. Keep these 10 crews in a separate place as they are different from the ones that are fixing the diode modules to the PCB. Clean the heatsink from the residual thermal compound.

For the re-assembly operations, make the previous steps in the reverse order. Add silicon to the zones where the potting protection was removed.
ATTENTION ! : use silicon type with low acetic, viscosity and adhesive grade.

NOTE: apply the thermal compound thin layer (0,1-0,2 mm) under each isotop component before the re-assembling.
Screw torque 1,2/1,4 N/m (0.030/0.033 N/inch);
DO NOT USE CORDLESS SCREWDRIVERS FOR THE POWER MODULEs!

DISASSEMBLY OPERATIONS

CONTROL BOARD REMOVAL AND REPLACEMENT PROCEDURE

INVERTEC® 270SX & 400SX

WARNING

ELECTRIC SHOCK CAN KILL

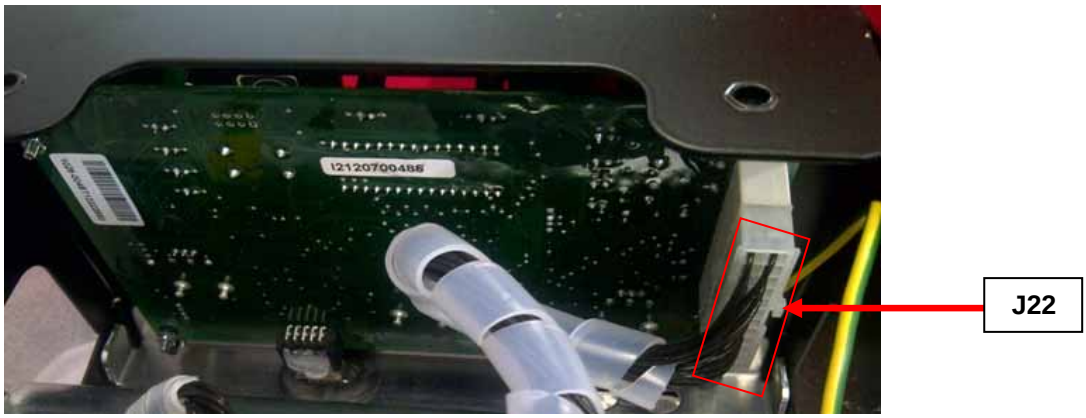
- Disconnect input power before servicing.
- Do not operate with covers removed.
- Do not touch electrically live parts.
- Only qualified persons should install, use or service this equipment.

REMOVAL PROCEDURE

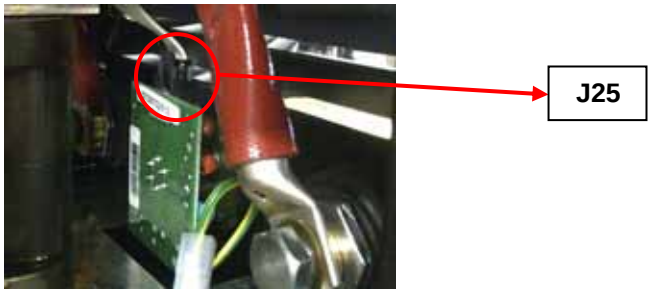
Necessary tool:

- 6 mm Nutdriver
- 5,5 mm Nutdriver
- Thin knife blade

1. Using a thin knife blade, remove the 3 red plastic caps (**A**) on the end of the output knob.
2. Using a 6mm nutdriver, remove the 3 knobs mounting nut and washers located behind the red plastic caps previously removed



3. Disconnect the connector **J22** from the control board.
4. Disconnect the remote flat cable from connector **J25** on remote PCB (ref. below picture)



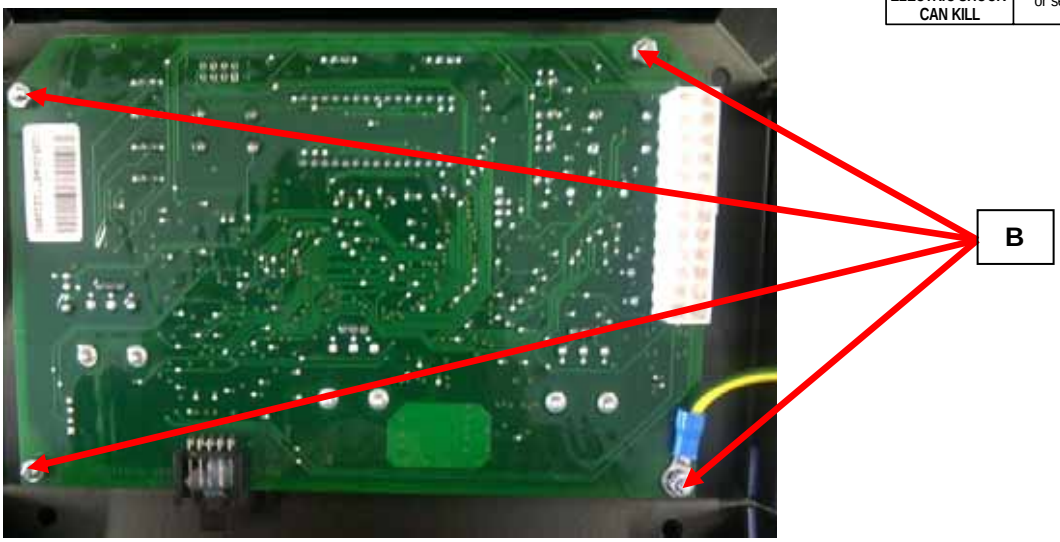
DISASSEMBLY OPERATIONS

CONTROL BOARD REMOVAL AND REPLACEMENT PROCEDURE (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.

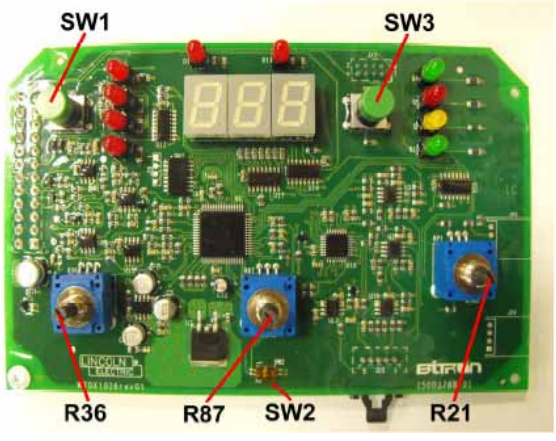


5. Using a 5,5 mm nutdriver remove the 4 nuts located on the corners of the solder side of the control board (**B**)
6. Remove the control board

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

⚠ **ATTENTION !**
reconnect the ground cable in the bottom right corner:

During re-assembly operation of a new control board make sure about the position of the dip-switches, follow the instruction that are inside the new control board box. See extraction below:



Operative notes:

SW1 (Job selection), SW3 (V/A display switch), R36 (Hot Start) R87 (Arc Force) and R21 (Output current potentiometer) aren't involved by the P.C. Board setup.

SW2 (machine configuration) is the unique item that has to be configured following the table below

SW2 setup for CE machines:

INVERTEC 270SX CE
INVERTEC 400SX CE

SW2 setup for AUS machines:

INVERTEC 270SX AUS
INVERTEC 400SX AUS

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® 270SX

Input Voltage	Input Current	Rated Output
400Vac/3ph/50Hz	20,4 A	270A @ 35%

Output current range	5- 270A

Maximum Open Circuit Voltage	48V CE Model 12V Australia model

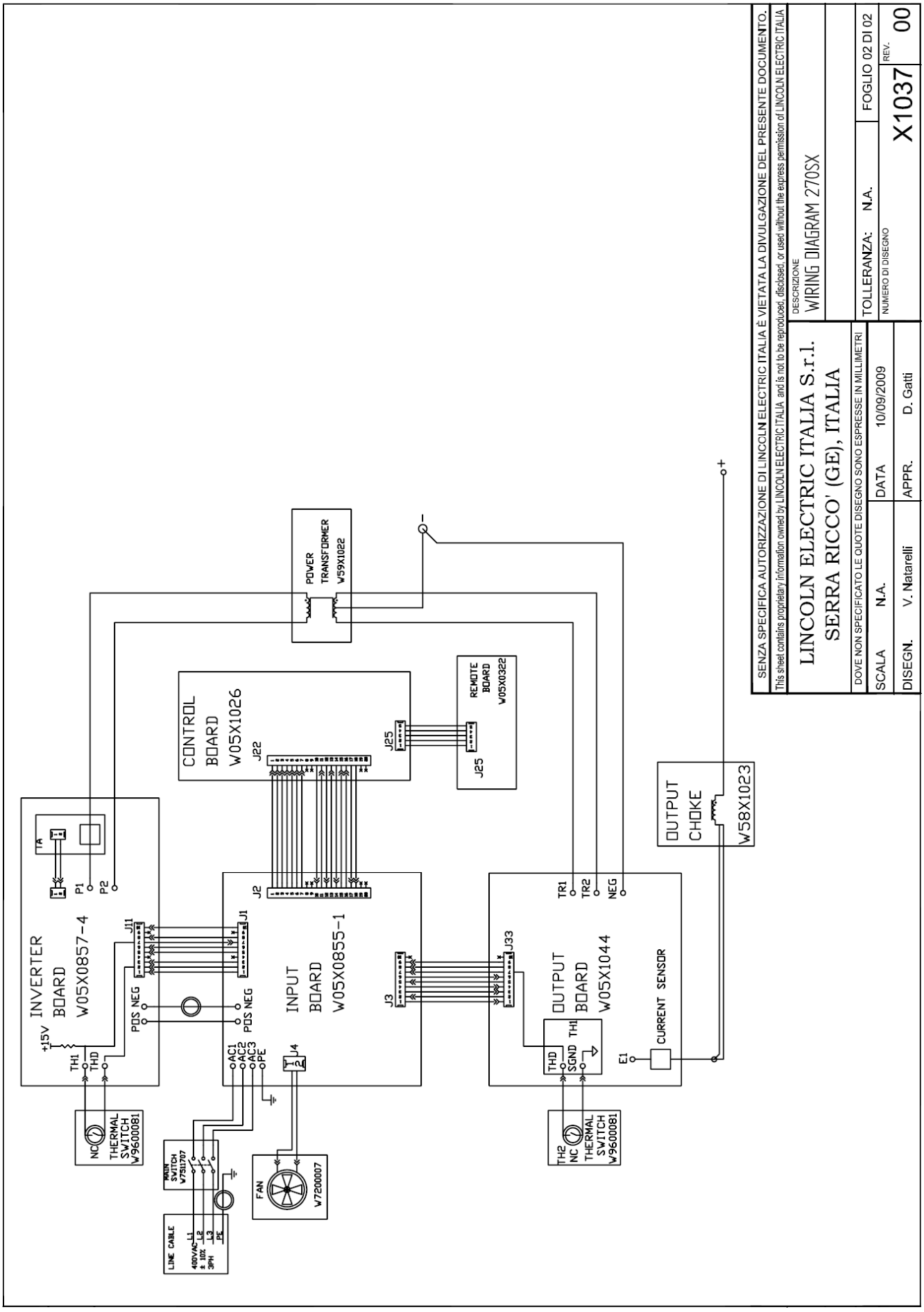
INVERTEC® 400SX

Input Voltage	Input Current	Rated Output
400Vac/3ph/50Hz	30A	400A @ 35%

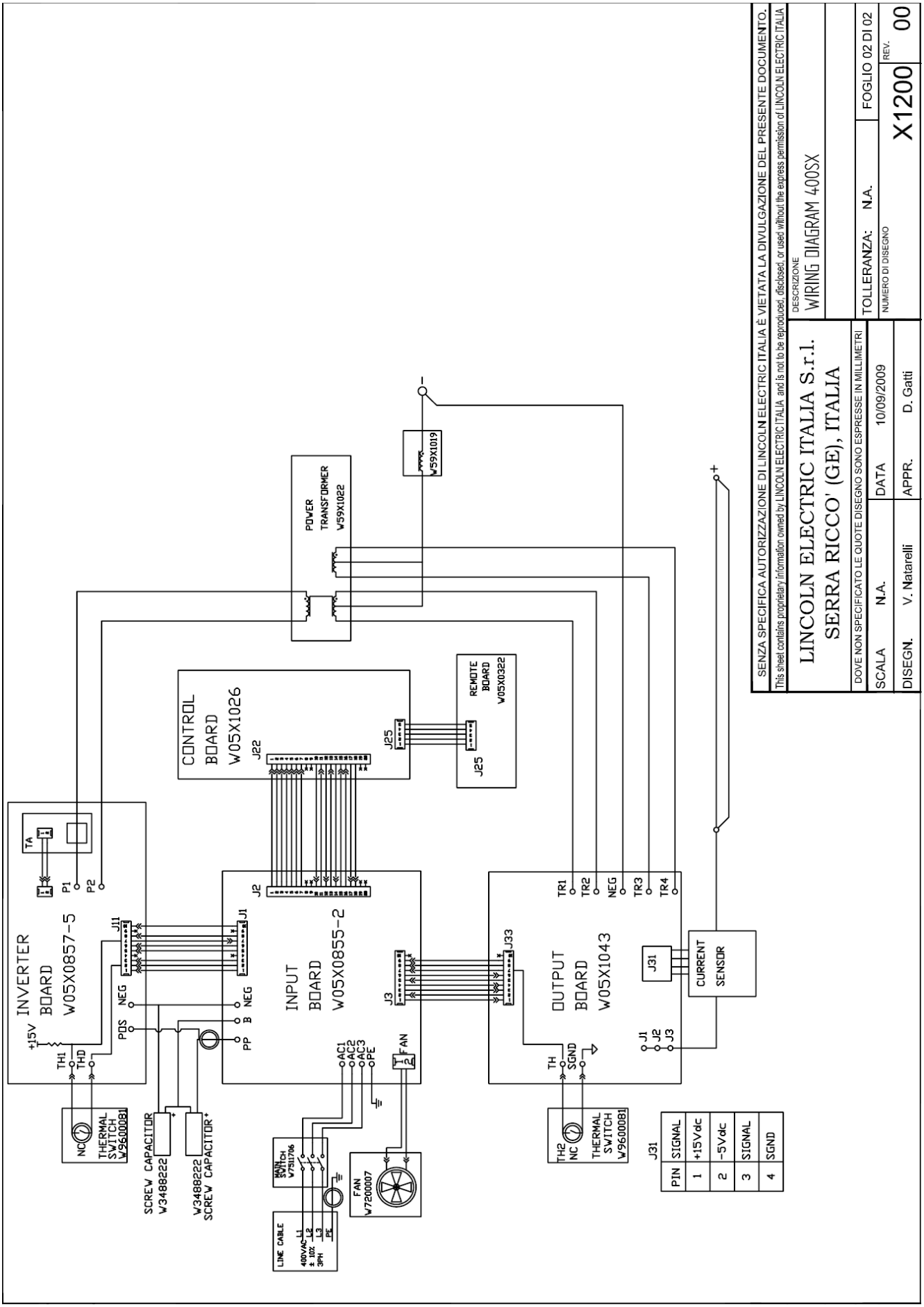
Output current range	5-400A

Maximum Open Circuit Voltage	48V CE model 12V Australia model

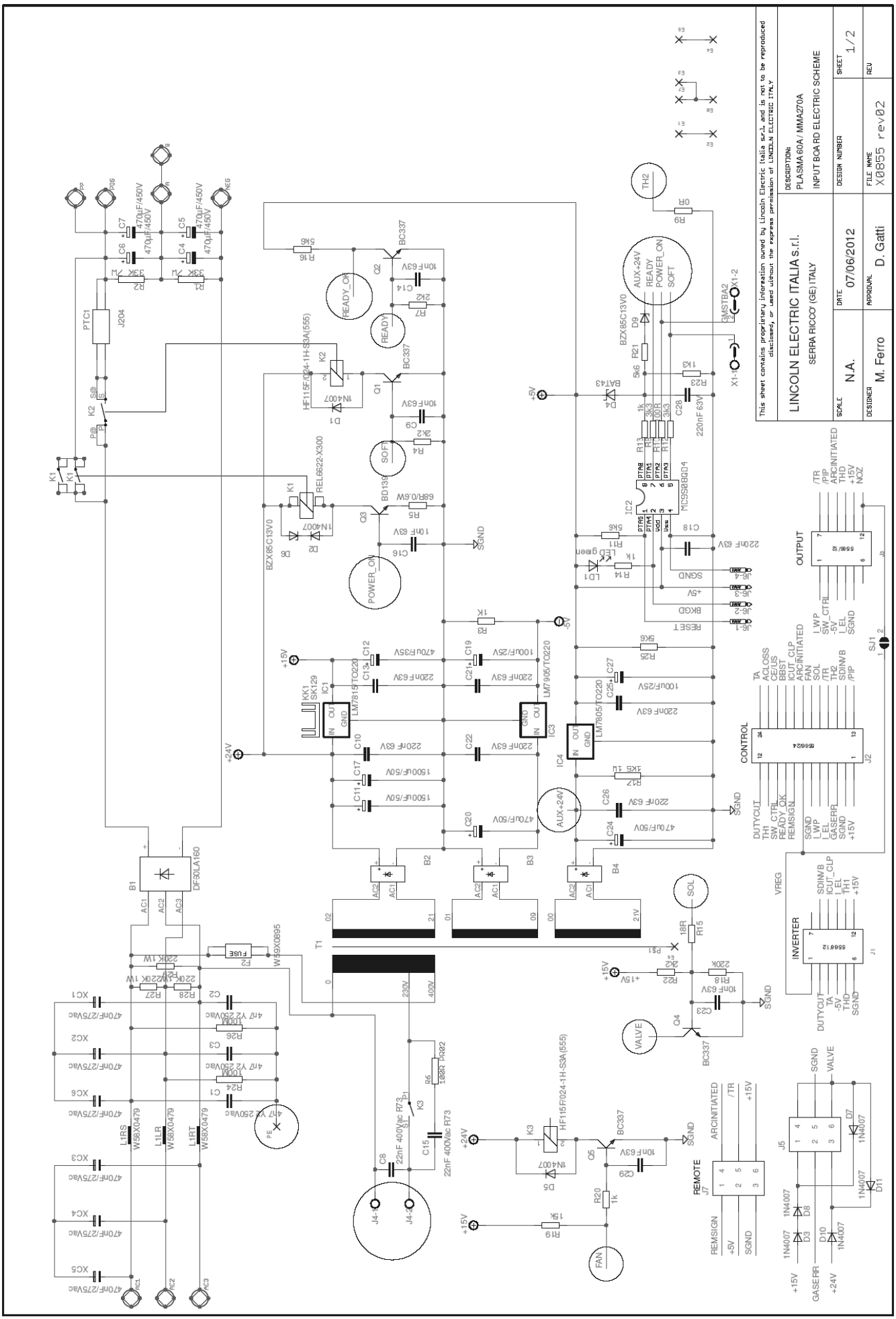
INVERTEC® 270SX



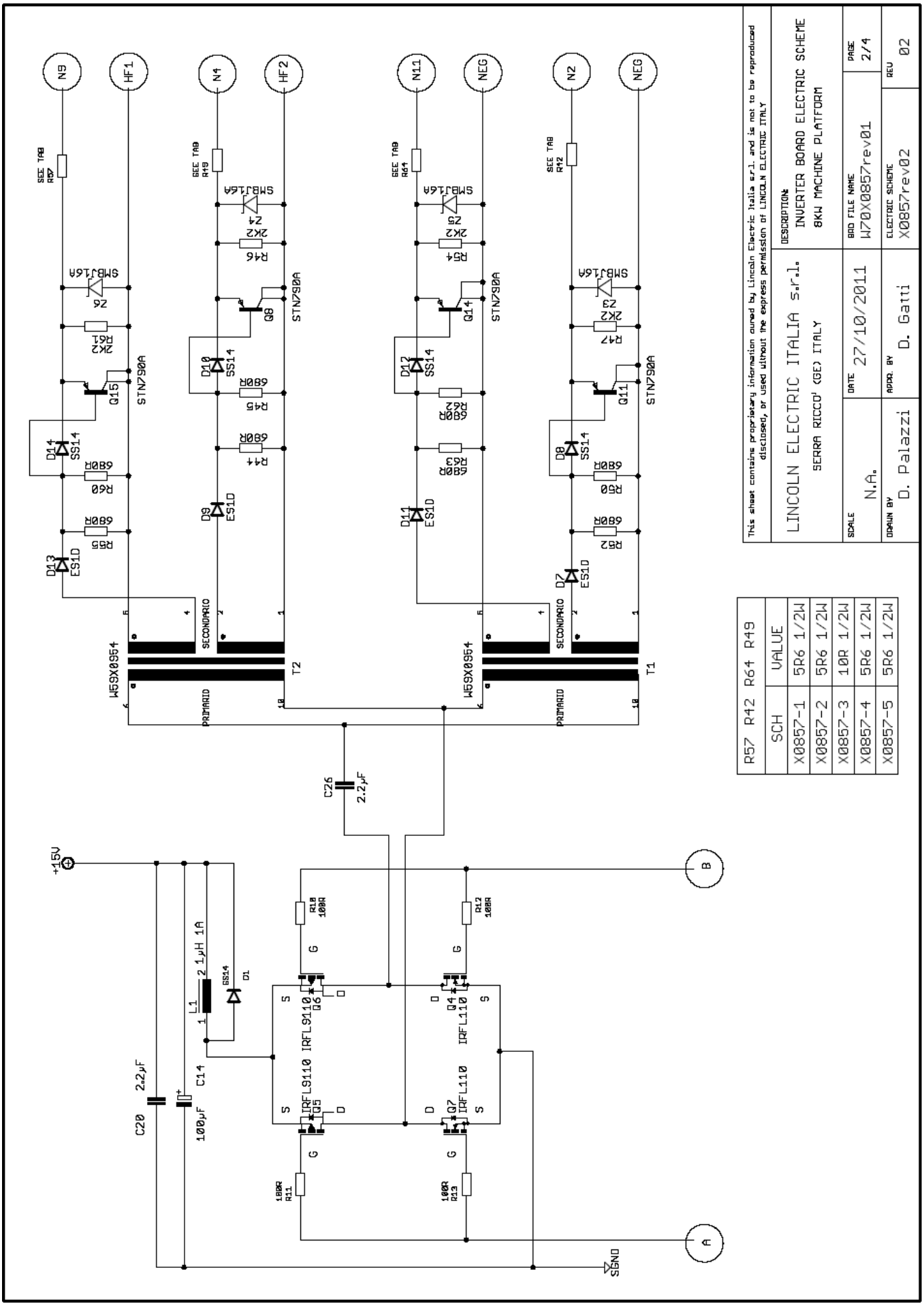
INVERTEC® 400SX



INPUT BOARD SCHEMATIC X0855

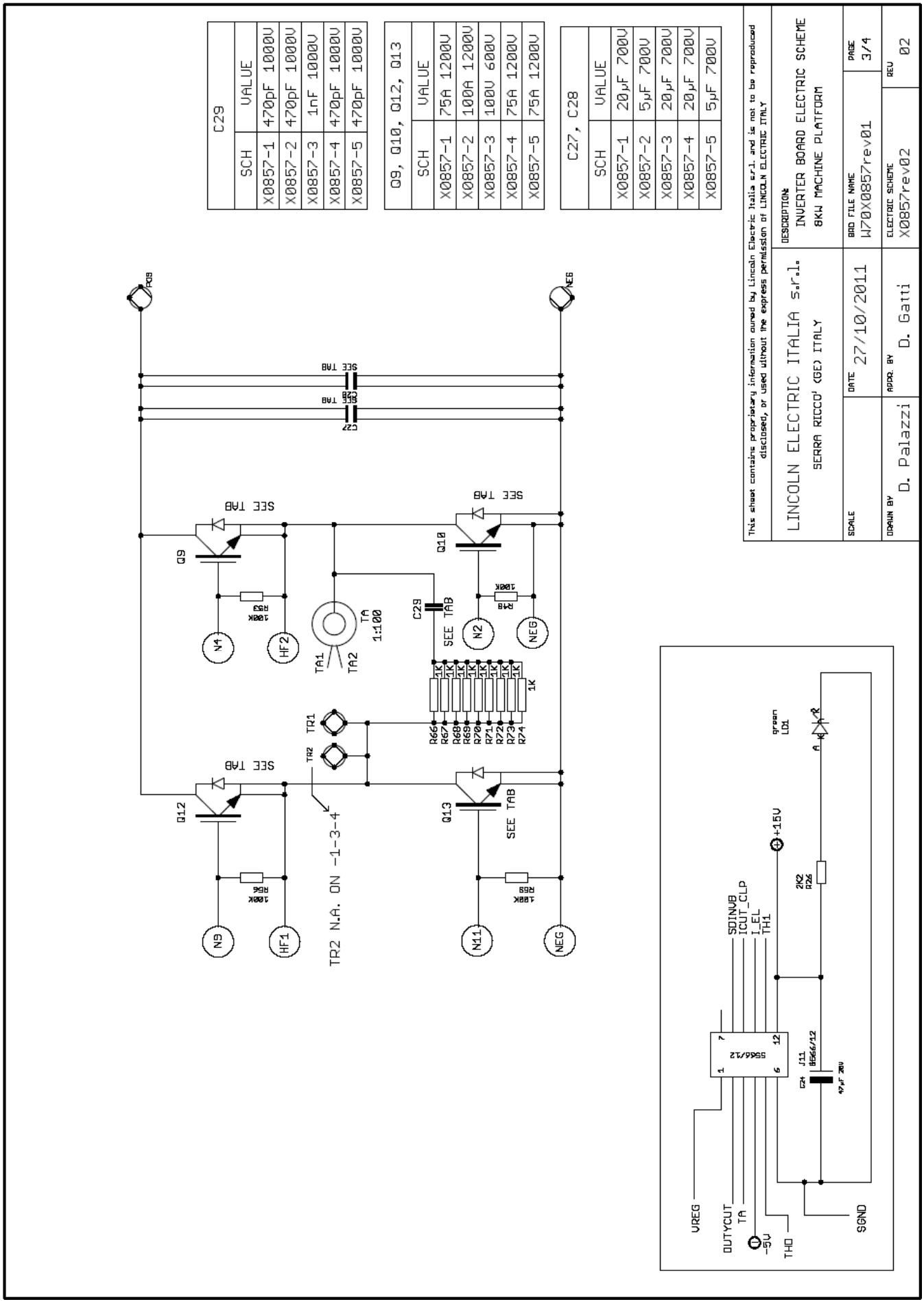


INVERTER BOARD SCHEMATIC X0857 – IGBT DRIVER SECTION

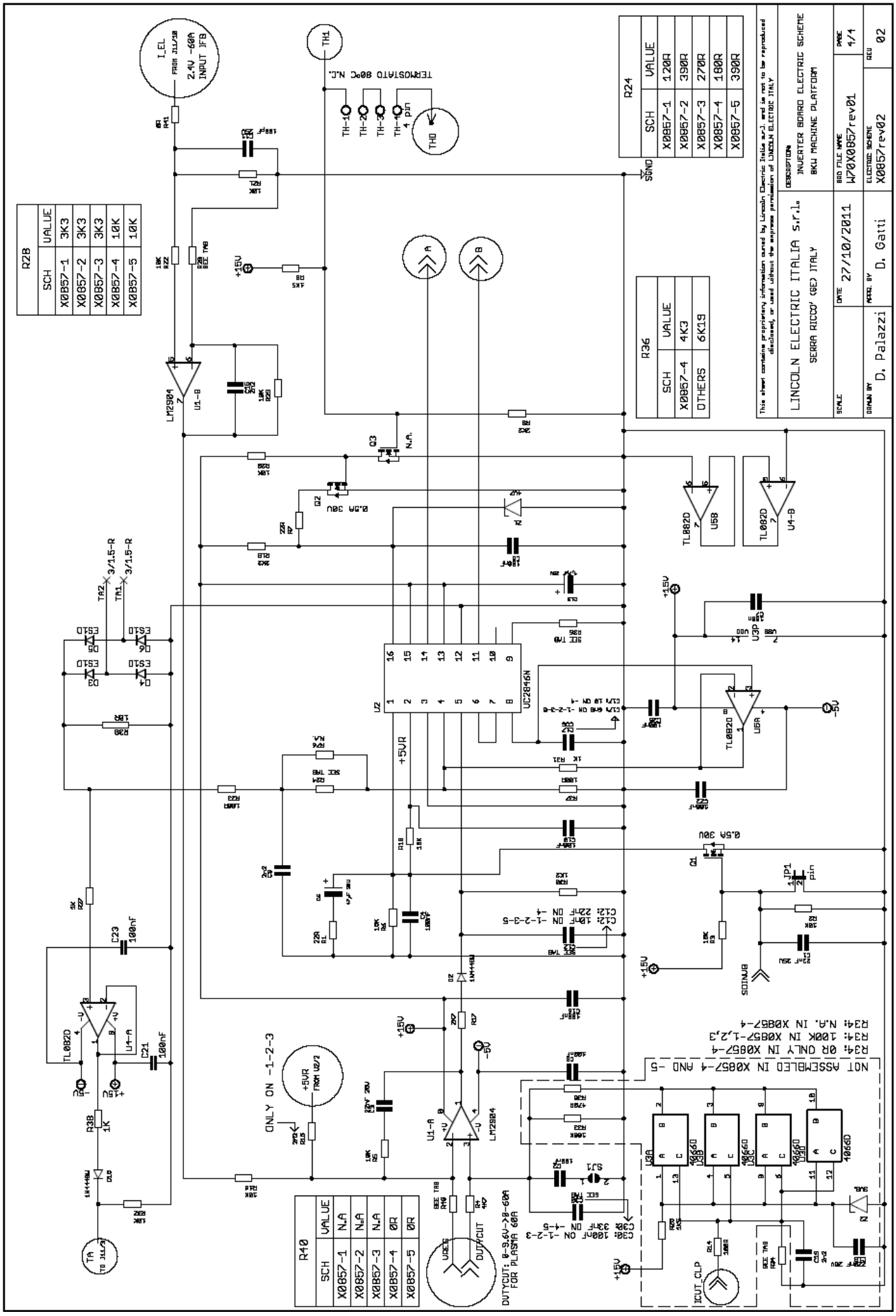


R57 R42 R64 R49	
SCH	VALUE
X0857-1	5R6 1/2W
X0857-2	5R6 1/2W
X0857-3	10R 1/2W
X0857-4	5R6 1/2W
X0857-5	5R6 1/2W

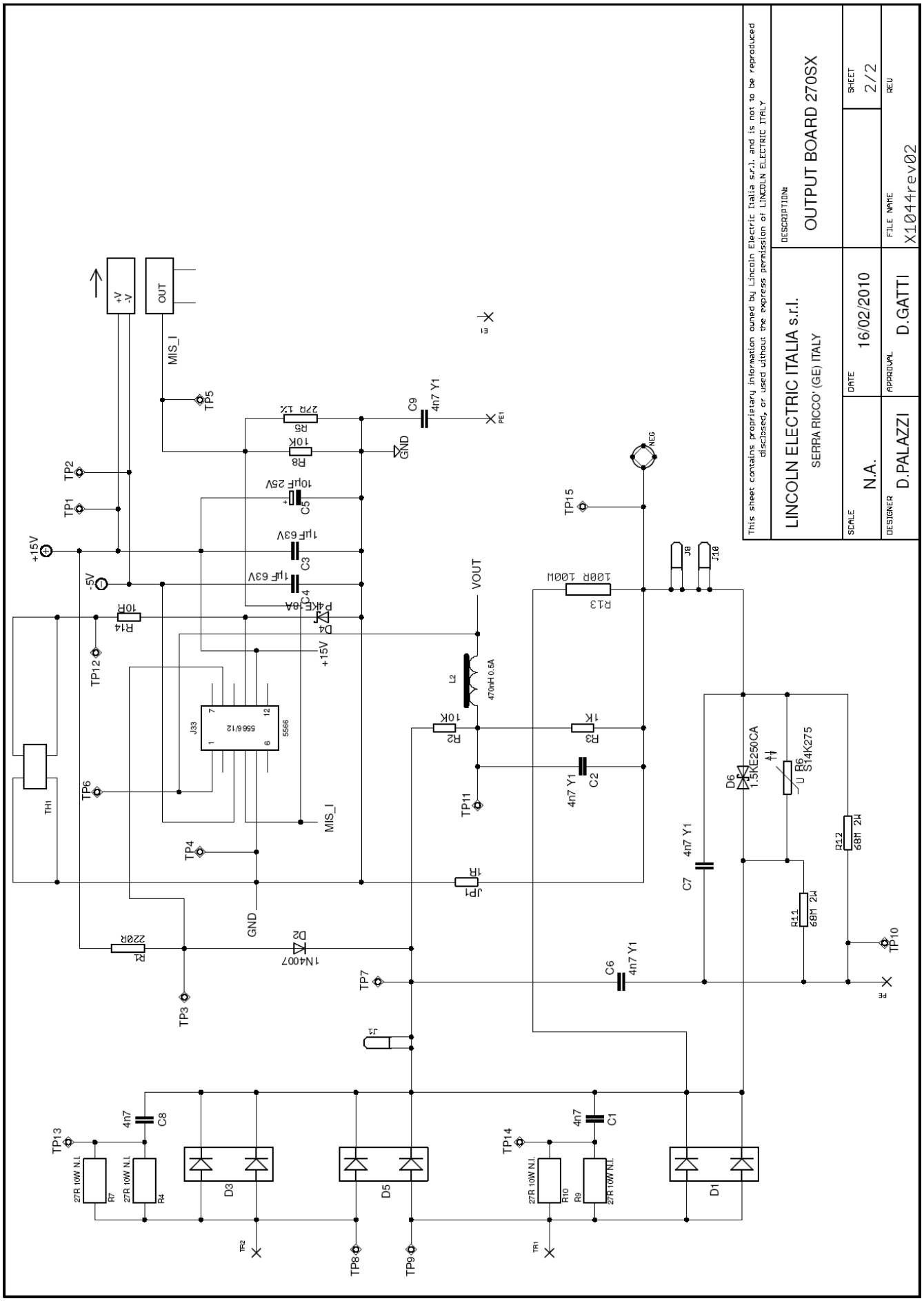
INVERTER BOARD SCHEMATIC X0857 – IGBT SECTION



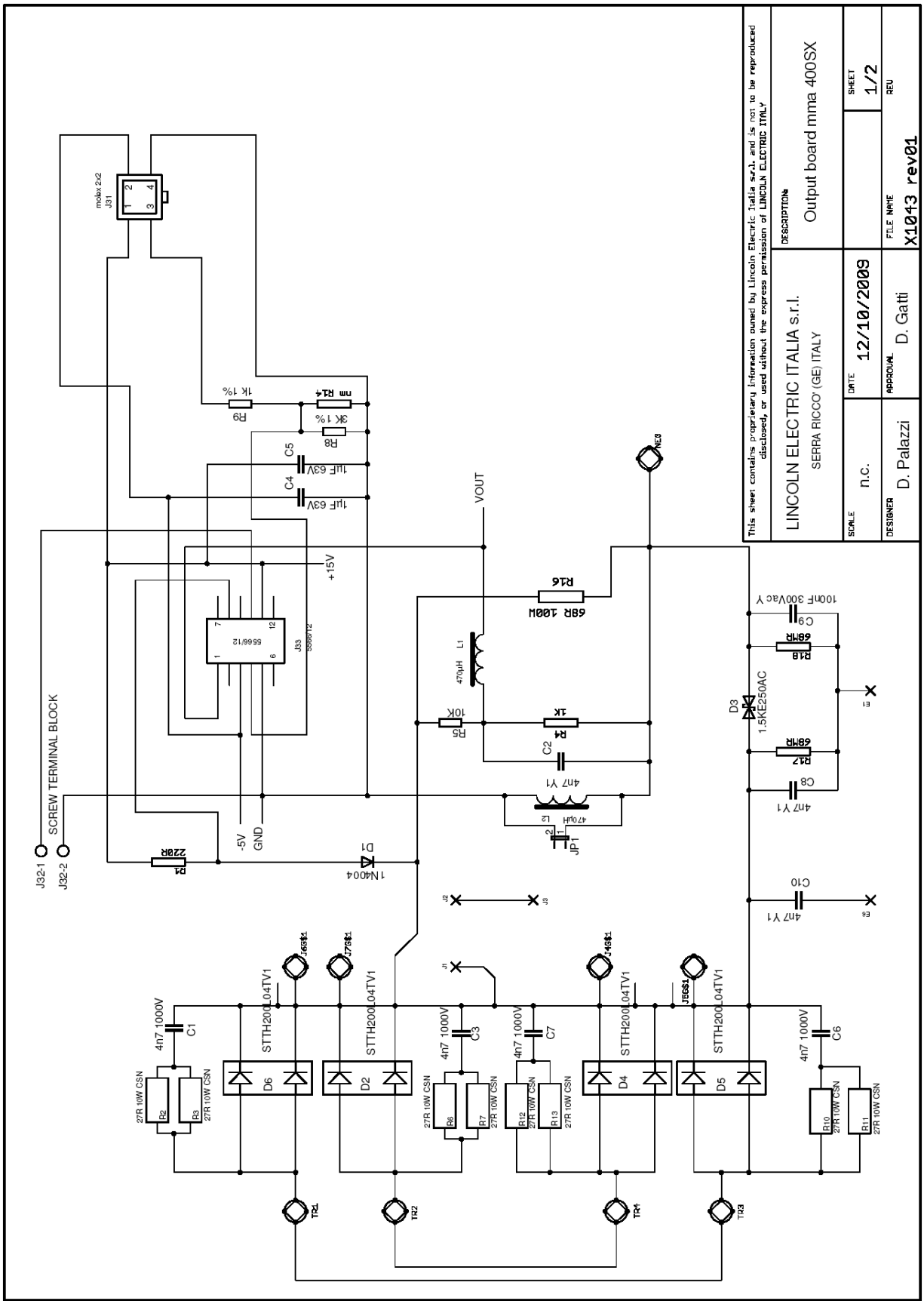
INVERTER BOARD SCHEMATIC X0857 – CONTROL CIRCUIT SECTION



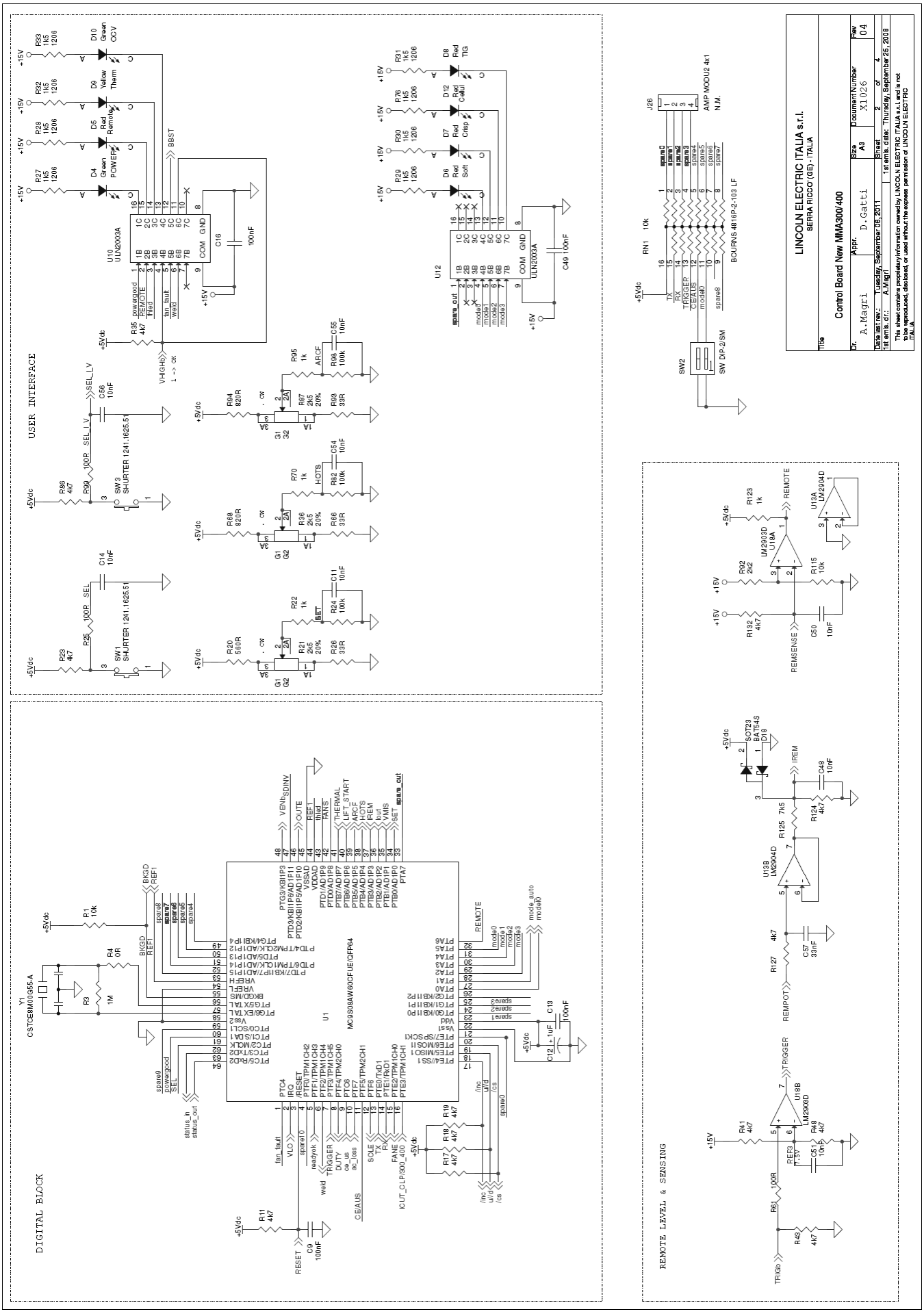
OUTPUT BOARD SCHEMATIC X1044



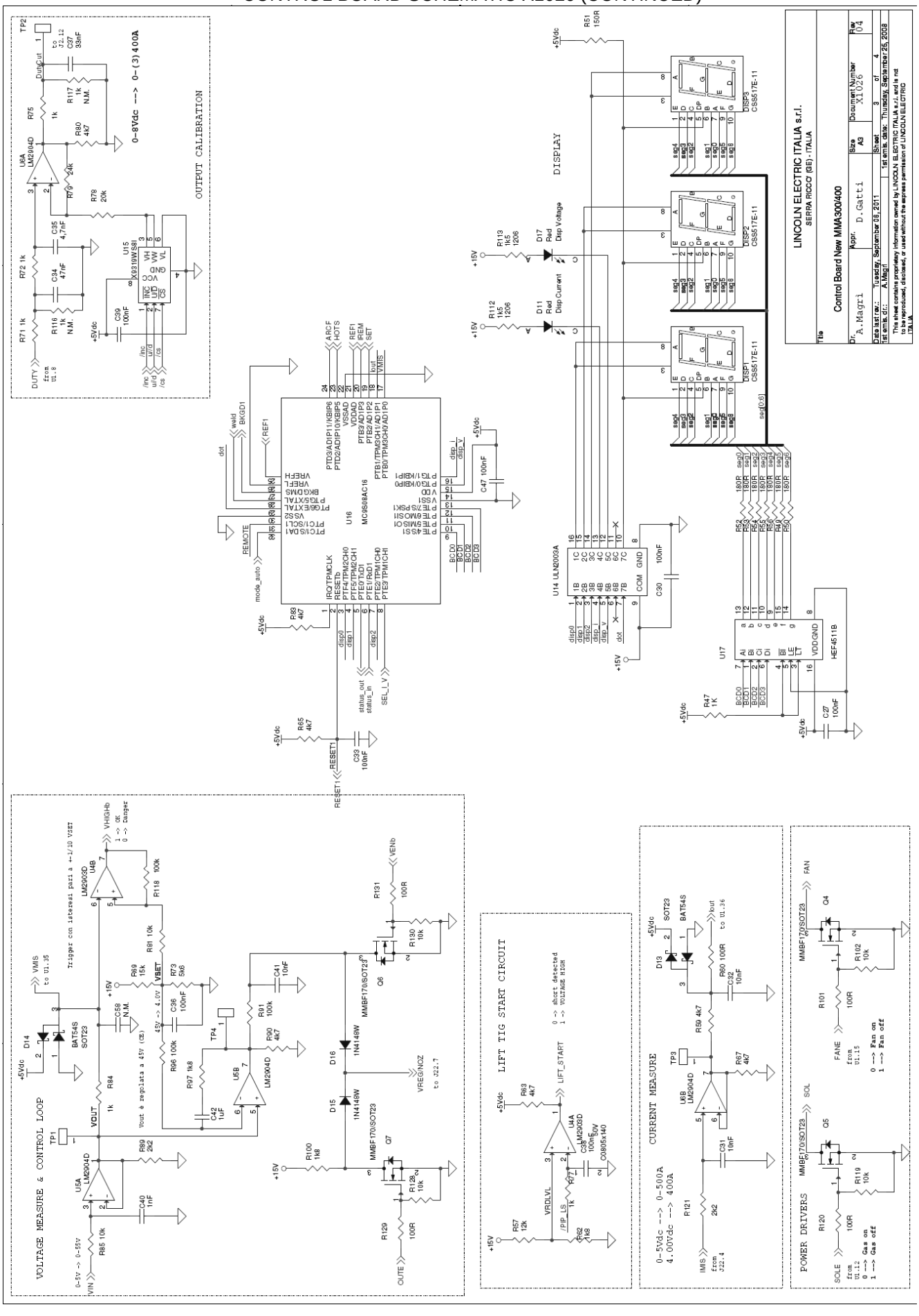
OUTPUT BOARD SCHEMATIC X1043



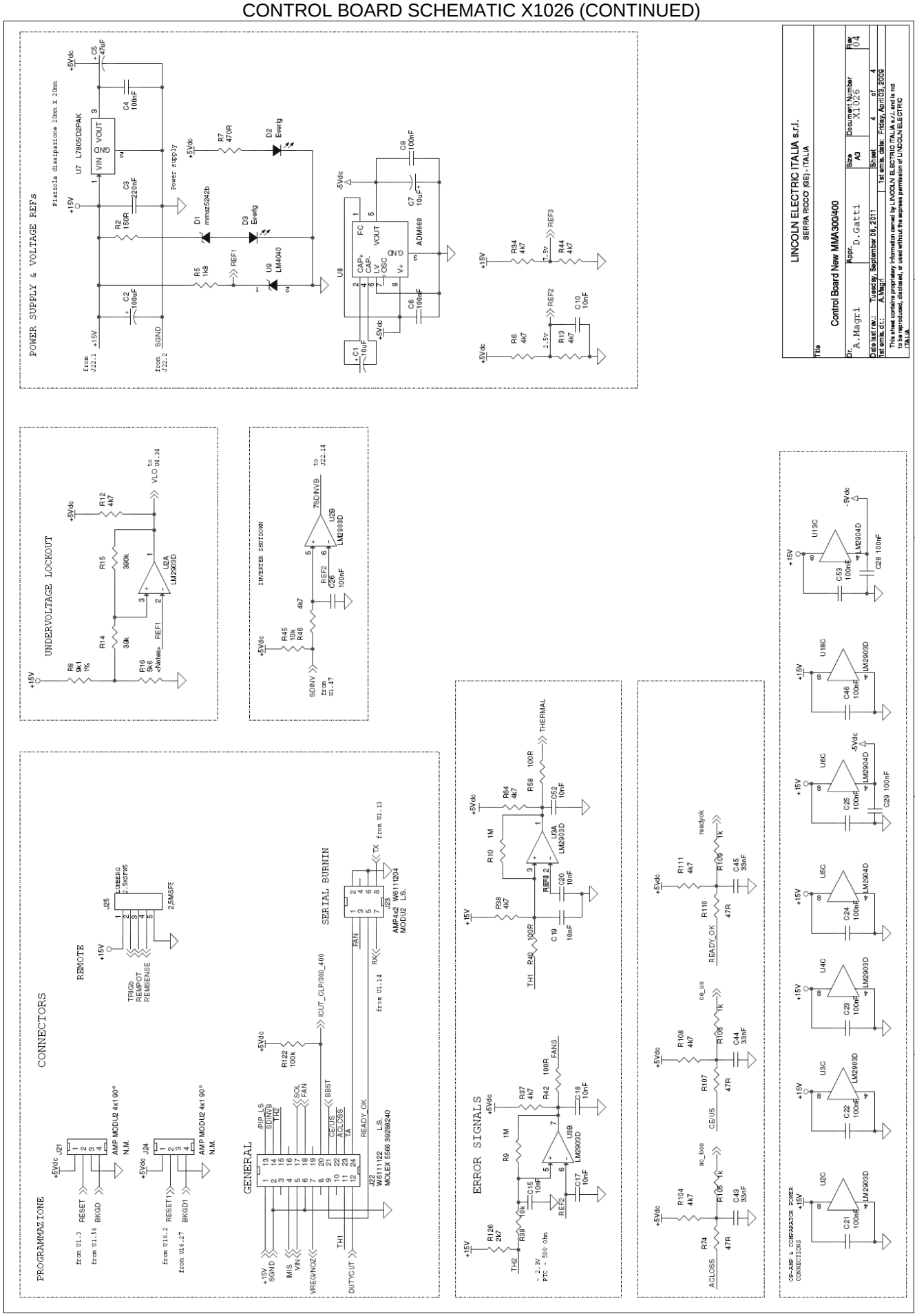
CONTROL BOARD SCHEMATIC X1026

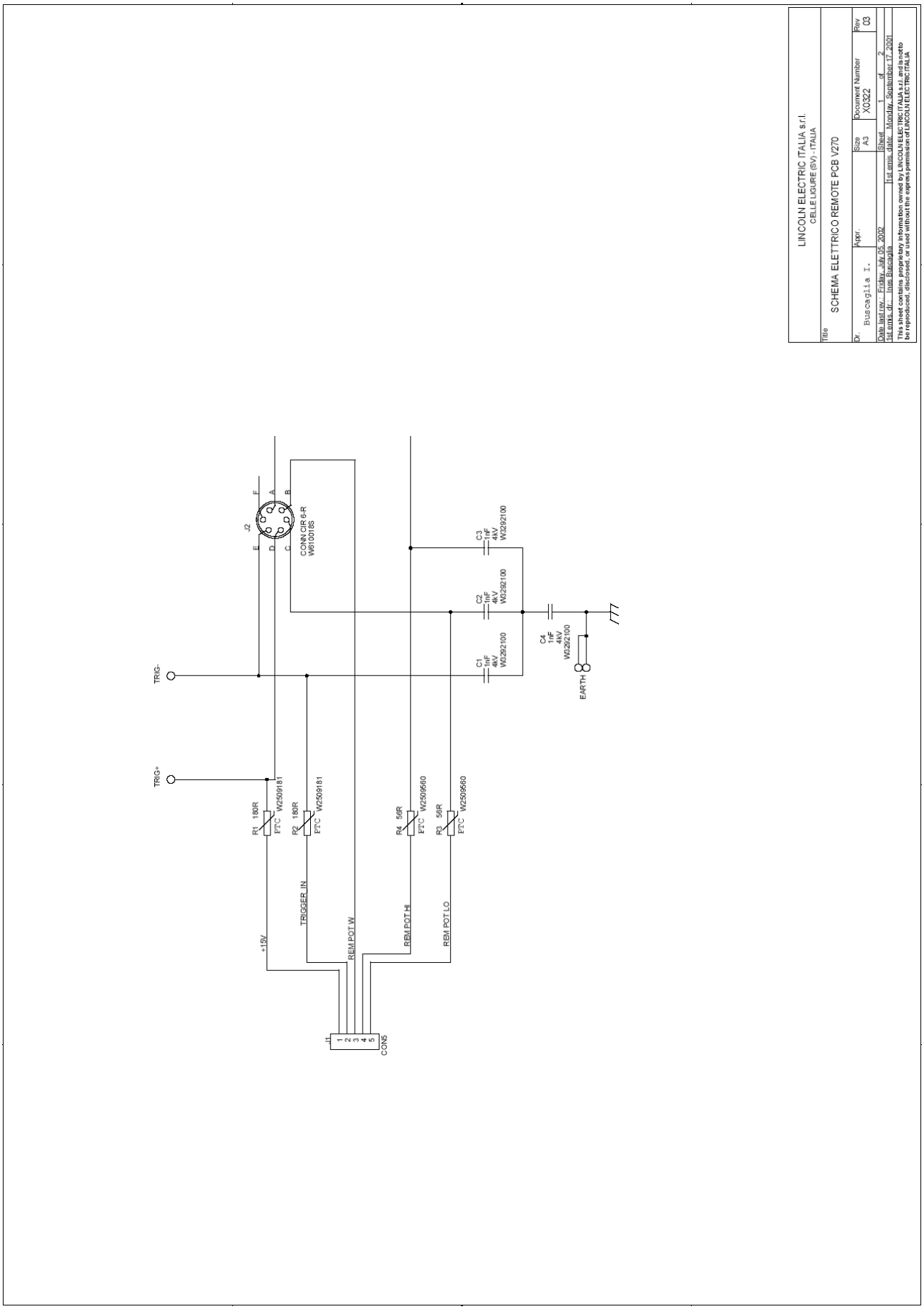


CONTROL BOARD SCHEMATIC X1026 (CONTINUED)



CONTROL BOARD SCHEMATIC X1026 (CONTINUED)

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Sheet 1 of 2
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J2
CONN CIR 6-R W6100185
TRIG-
TRIG+
R1 180R PTC W2509181
R2 180R PTC W2509181
R4 56R PTC W2509560
R3 56R PTC W2509560
C1 1nF 4kV W3292100
C2 1nF 4kV W3292100
C3 1nF 4kV W3292100
C4 1nF 4kV W3292100
EARTH
+15V
TRIGGER IN
REM POT W
REM POT HI
REM POT LO
CON5

NOTE