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TOMAHAWK® 1025 & 1538

For use with machines having code numbers: 52076, 52095

SERVICE MANUAL

LINCOLN ELECTRIC EUROPE
www.lincolnelectric.eu

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TECHNICAL SPECIFICATIONS

INPUT		
Input Voltage 400V ±15% Three Phase	Input Power at Rated Output **TH1025** 4.3kW @ 100% Duty Cycle 7.1kW @ 40% Duty Cycle **TH1538** 7.1kW @ 100% Duty Cycle 13.7kW @ 40% Duty Cycle	Frequency 50/60Hz

RATED OUTPUT AT 40°C		
Duty Cycle (Based on a 10 min. period)	Output Current	Output Voltage
TH1025 100%	40A	96VDC
60%	50A	100VDC
40%	60A	104VDC
TH1538 100%	60A	104VDC
60%	85A	114VDC
40%	100A	120VDC

OUTPUT RANGE		
Cutting Current Range	Maximum Open Circuit Voltage	Pilot Arc Current
TH1025 20 - 60A	**TH1025** 320VDC	**TH1025** 20A
TH1538 20 - 100A	**TH1538** 320VDC	**TH1538** 25A

COMPRESSED AIR or GAS	
Required Flow Rate	Required Inlet Pressure
TH1025 130 ±20% l/min @ 5.5bar **TH1538** 180 ±20% l/min @ 5.5bar	6.0bar ÷ 7.5bar

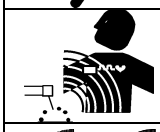
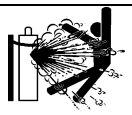
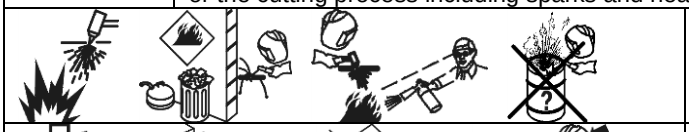
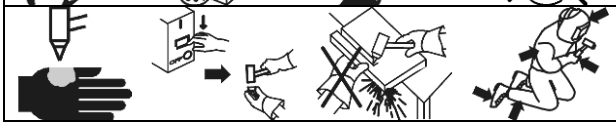
RECOMMENDED INPUT CABLE AND FUSE SIZES	
Fuse (delayed) or Circuit Breaker ("D" characteristic) Size	Input Power Cable
TH1025 20A	**TH1025** 4 x 2.5mm^2
TH1538 32A	**TH1538** 4 x 4mm^2

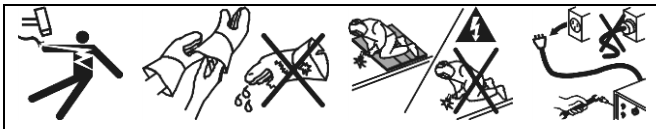
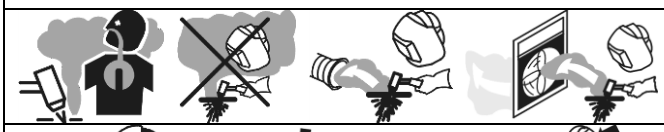
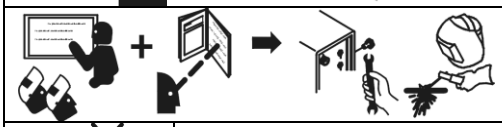
PHYSICAL DIMENSIONS			
Height	Width	Length	Weight
TH1025 389mm	**TH1025** 247mm	**TH1025** 510mm	**TH1025** 22kg
TH1538 455mm	**TH1538** 301mm	**TH1538** 640mm	**TH1538** 34kg
Operating Temperature -10°C to +40°C		Storage Temperature -25°C to +55°C	

02/05

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. Plasma cutting or gouging can be hazardous. Failure to follow the instructions in this manual could cause serious personal injury, loss of life, or damage to this equipment.
	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.
	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.
	WORK MATERIALS CAN BURN: Cutting 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.
	SAFETY MARK: This equipment is suitable for supplying power for cutting operations carried out in an environment with increased hazard of electric shock.
	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 torch, 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 cutting process including sparks and heat sources.
	Cutting sparks can cause explosion or fire. Keep flammables away from cutting. Do not cut near flammables. Have a fire extinguisher nearby, and have a watch person ready to use it. Do not cut on drums or any closed container.
	The plasma arc can cause injury and burns. Keep your body away from nozzle and plasma arc. Turn off power before disassembling torch. Do not grip material near cutting path. Wear complete body protection.

	Electric shock from torch or wiring can kill. Wear dry insulating gloves. Do not wear wet or damaged gloves. Protect yourself from electric shock by insulating yourself from work and ground. Disconnect input plug or power before working on machine.
	Breathing cutting fumes can be hazardous to your health. Keep your head out of the fumes. Use forced ventilation or local exhaust to remove the fumes. Use ventilating fan to remove fumes.
	Arc rays can burn eyes and injure skin. Wear hat and safety glasses. Use ear protection and button shirt collar. Use welding helmet with correct shade of filter. Wear complete body protection.
	Become trained and read the instructions before working on the machine or cutting.
	Do not remove or paint over (cover) the label.

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 IP23. Keep it dry when possible and do not place it on wet ground or in puddles.

• Locate the machine away from radio controlled machinery. Normal operation may adversely affect the operation of nearby radio controlled machinery, which may result in injury or equipment damage. Read the section on electromagnetic compatibility in this manual.

• Do not operate in areas with an ambient temperature greater than 40°C.

Duty Cycle

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

Example: 60% duty cycle means that is possible cut for 6 minutes, then the machine stops for 4 minutes.

Refer to the Technical Specification section for more information about the machine rated duty cycles.

⚠ WARNING

Always turn OFF the machine when working on the torch.

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 amount of power available from 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.

This machine is designed to operate on engine driven generators as long as the 400Vac auxiliary can supply adequate power as indicated in the technical specification section of this manual. The auxiliary supply of the generator must also meet the following conditions.

• The AC waveform peak voltage is below 700V.

• The AC waveform frequency is between 50 and 60 Hz.

• The RMS voltage of the AC waveform is always equal to 400Vac ±15%.

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

Output Connections

⚠ WARNING

Use ONLY the torch supplied with this machine. For a replacement refer to the Maintenance section of this manual.

⚠ WARNING

TORCH PROTECTION: The torch delivered with the power source is equipped with a safety device that prevents the operator from accidental contact with electrically live parts.

⚠ WARNING

Do not remove the work clamp during cutting, plasma cutting generates high voltages that can kill.

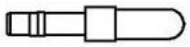
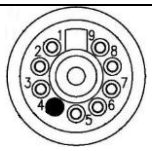
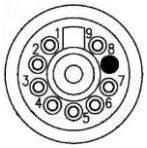
⚠ WARNING

Open Circuit Voltage **U_0 > 100VDC**. For more information refer to the Technical Specification section.

Torch Connector:
Connect here the cutting torch. The torch connection to the power source is very easily performed through a quick-connector carrying the torch trigger circuit, the gas line and the torch power cable.

Positive Quick Disconnect:
Positive output connector for the cutting circuit. As far the ground connection, this is to be connected to the work piece and to a "DINSE" connector on the front of the power source.

Torch Connector Polarization Key:
This Plasma Cutting Machine shall be used with its specific torch. The polarized torch connector avoid the risk to use the machine with a not proper torch model. The position of the polarized key is shown in the table below.

 Polarization Key	 For 60A machines	 For 100A machines

Controls and Operational Features

Machine Auto-Test:

When the machine is turned ON, an auto-test is executed; during this test all of the LEDs of the Commands Front Panel lights up. If one or some LED remains OFF, contact the nearest technical service center or Lincoln Electric and report the LED Status found on the machine Front Panel.

Front Panel Controls

	Output Current Knob: Potentiometer used to set the output current used during cutting. Refer to the Technical Specification section for more information about the machine rated current range. Gas Purge: The Output Current Knob completely rotated counterclockwise enables the gas purge function.
	Power ON/OFF LED: It lights up when the machine is ON. Blinking LED: Mains out of range condition. The machine is disabled: when the mains returns in the correct range, the machine restart automatically. Note: The Fan could be automatically switched OFF if the error condition persist for more than 2seconds.
	Output LED: The cutting torch is energized. Blinking LED: Internal auxiliary undervoltage condition. The machine needs to be turned OFF then ON again to restart.
	Thermal LED: The machine is overheated and the output has been disabled. This usually occurs when the duty cycle of the machine has been exceeded. Leave the machine ON to allow the internal components to cool. When the thermal LED turns off, normal operation is again possible.
	Low gas pressure condition LED: With this LED ON the machine stops cutting or gouging operations. The machine restart automatically when a correct gas pressure is detected. To check / adjust the primary gas pressure (see recommended values in the Tecnical Specifications of this manual): • When this LED lights up, for 10 seconds the machines goes automatically in Purge mode. • During Purge time check and adjust the gas pressure through the manometer and primary gas pressure regulator knob. • If necessary, check and adjust also the inlet gas pressure through the commands of the inlet primary gas.
	PIP LED: Part in place condition: the torch retaining cap (or the torch connector) is not properly screwed on the torch head (or in the machine torch connector). To restore the machine: • Screw firmly the torch retaining cap (or the torch connector). • After the torch is restored, the machine cannot restart for about 5 seconds. During this time the PIP LED blinks. (Note: When the LED is blinking, if another PIP error occours or if the Torch Trigger pushbutton is pressed the machine returns to the error condition: PIP LED returns steady ON and the restoring procedure begins again). • When the PIP LED turns OFF the machine is ready to operate.

 TH1025  TH1538	<u>Primary Gas Pressure Gauge and Regulator Knob:</u> Allow to regulate and monitoring the primary gas pressure. The inlet primary gas pressure is limited by this pressure regulator, set at factory at 5.5bar. In case to adjust the gas pressure, put the machine in Purge mode.
	<u>Cutting Operating Mode Selection:</u> Press the pushbutton to select the desired operating mode (the "ON" LED indicates the selected mode): • CUT (top LED ON): for cutting or piercing operations on a solid work piece. • GRID (middle LED ON): for cutting operations on a grid work piece. • GOUGE (bottom LED ON): for removing material from a solid work piece (e.g.: removing a failed welded bead). It is possible change the Operating Mode with the machine at idle and also during the Purge, Post Flow and Cooling time. Pressing the pushbutton during Pilot Arc or Cutting time has no effects.

Error condition list.

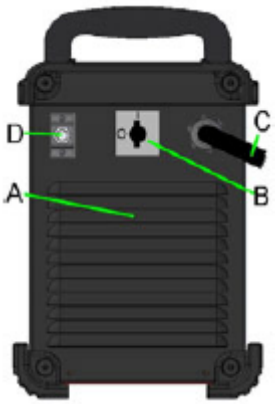
If occurs, try to turn Off the machine, wait for a few seconds, then turn ON again. If the error remains, a maintenance is required. Please contact the nearest technical service center or Lincoln Electric and report the LED Status found on the machine Front Panel.

	 On	 Blink	 Blink
Head Torch	This occurs if after 4seconds the Pilot Arc isn't transfered to the workpiece. The machine stops the pilot arc to avoid overheating on the Torch Head. To restore the machine: • Release the Torch Trigger pushbutton. The blinking LEDs are now permanently ON • Press again the release the Torch Trigger push button.		

	 On	 On	 On
No pilot arc estabilished	The Torch Trigger pushbutton is pressed. During this period the machine try to start the pilot arc for 4 times. If the pilot arc doesn't start the machine automatically goes in a safe condition that allow to check as necessary. To restore the machine: • Turn OFF the Power switch. • Check the correct placement of the Torch Head consumables and parts. • Check the Torch electrical connections. • Turn ON again the machine.		

	 On	 On	 On	 On
Trigger Pushed	This occurs if the machine is switched ON (or if it restart after cooling time) with the Torch Trigger pushbutton hold. This status avoids unsafe operating conditions: manual cutting or gouging processes must be started ONLY under the direct control of the operator. To restore the machine: • Release the Torch Trigger pushbutton. • Press again the Torch Trigger pushbutton. If this error condition persist check for eventual malfunctions of the the Torch Trigger pushbutton.			

Rear Panel Controls and Connections



A. <u>Fan:</u> 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 torch trigger pushbutton is pressed. If the torch trigger pushbutton is released for more than five minutes, the fan will turn OFF.
B. <u>Power Switch:</u> It turns ON / OFF the input power to the machine.
C. <u>Input cable:</u> Connect it to the mains.
D. <u>Gas Inlet:</u> Connect here the hose carrying the gas to the machine.

⚠ WARNING

A clean, dry primary gas (air or nitrogen) must be supplied to the machine. A pressure setting above 7,5bar could damage the torch. Failure to observe these precautions could result in excessive operating temperatures or damage to the torch.

Cutting Process

The air plasma cutting process uses air or nitrogen as primary cutting gas and as torch cooling gas.

The pilot arc is struck as follow: the torch button energize an electrovalve (solenoid valve). This valve lets the gas flow during the cutting and the post-flow stages.

The design concept at the basis of these power sources is to have available a current which remains constant at the set value, independently from the length of the plasma arc.

When preparing to operate, make sure you have all materials needed to complete the job and have taken all safety precautions. Install the machine as instructed in this manual and remember to attach the work clamp to the work piece.

- With the machine switched OFF, prepare the torch with the consumables adequate to the desired process (CUT / GRID / GOUGE). Refer to the Torches Instruction Manual to select the correct combination of consumables.
- Connect the Torch and the worck cable to the machine.
- Turn ON the Power Switch placed on the back of the machine; the Power ON/OFF LED on the front panel will turn ON. The unit is now ready to operate.
- Check that the primary gas is available through the Gas Purge function.
- Select the desired Operating Mode process.
- Set the desired current value with the Output Current knob.

To start the selected process just press the torch button, making sure you are not aiming the torch gas blow towards people or foreign objects. During the process it is possible to hold the torch away from the work piece for an extended period of time.
Once the process is terminated releasing off the torch button will cause the plasma arc to be turned off; the gas flow will continue to allow the cooling down of the torch. The Post Flow time is proportional to the selected cutting current and it is divided into 4 time ranges:

Selected Cutting Current	Post Flow Time
Less than 30A	15seconds
Between 30A and 40A	20seconds
Between 40A and 50A	25seconds
Greater than 50A	30seconds

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.

Cutting Speed

The cutting speed is a function of:

- Thickness and of material to be cut.
- Value of set current. The current setting affects the quality of the cut edge.
- Geometrical shape of the cut (whether straight or curved).

In order to provide indications on the most suitable setting, the following table was established, based on tests performed on an automatic test-bench; the best results however can only be achieved from direct experience by the operator in his actual working conditions.

	TH1025				TH1538			
		Speed (cm/min.)				Speed (cm/min.)		
Thickness	Current (A)	MILD STEEL	ALUMINUM	STAINLESS STEEL	Current (A)	MILD STEEL	ALUMINUM	STAINLESS STEEL
4 mm	---	---	---	---	---	---	---	---
6 mm	---	---	---	---	---	---	---	---
¼"	---	---	---	---	---	---	---	---
8 mm	---	---	---	---	---	---	---	---
10 mm	60	119	206	105	---	---	---	---
½"	60	91	157	77	---	---	---	---
15 mm	60	72	122	55	100A	180	223	147
¾"	60	48	75	40	100A	117	152	99
20 mm	60	43	65	36	100A	106	140	91
25 mm	60	26	36	17	100A	70	98	63
1"	60	25	35	16	100A	68	95	61
30 mm	60	---	22	---	100A	50	73	46
1 ¼"	60	---	16	---	100A	45	66	42
35 mm	---	---	---	---	100A	38	55	36
1 ½"	---	---	---	---	100A	32	48	31

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

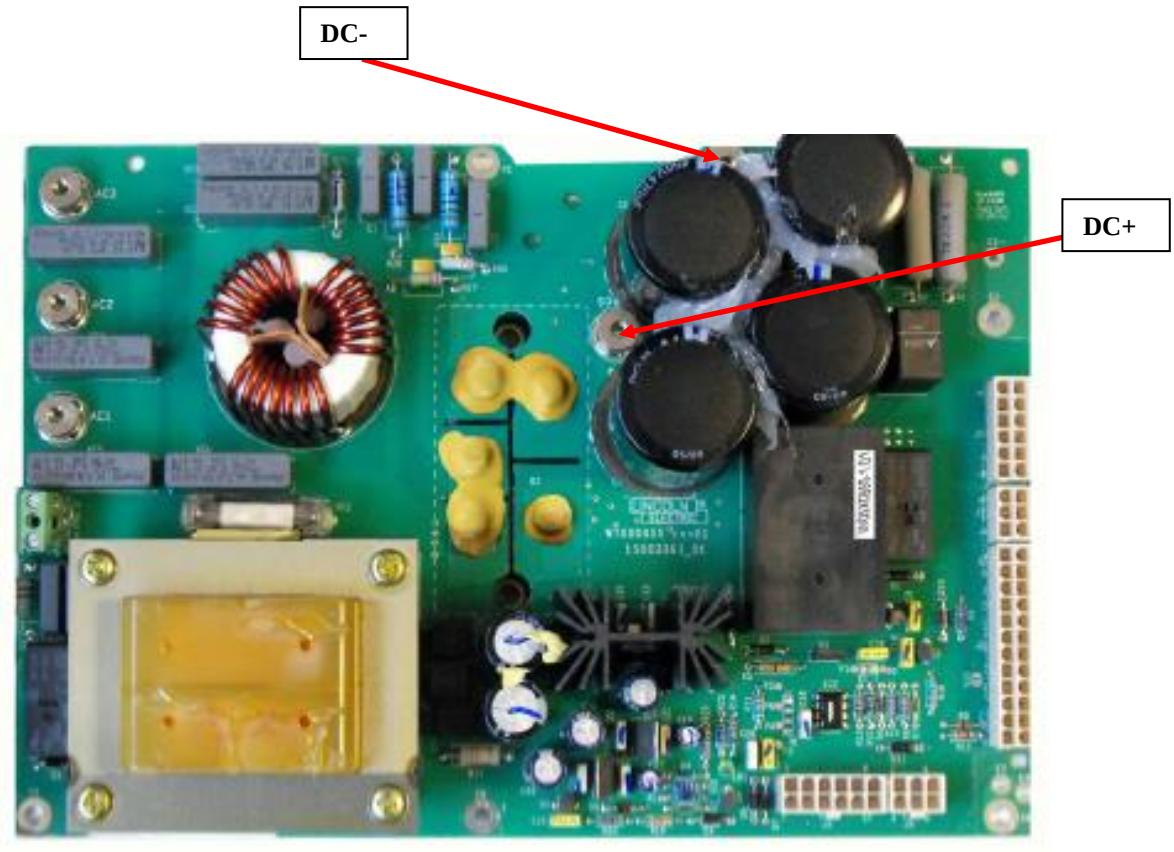
WARNING

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 Tomahawk 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 TH1025 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.

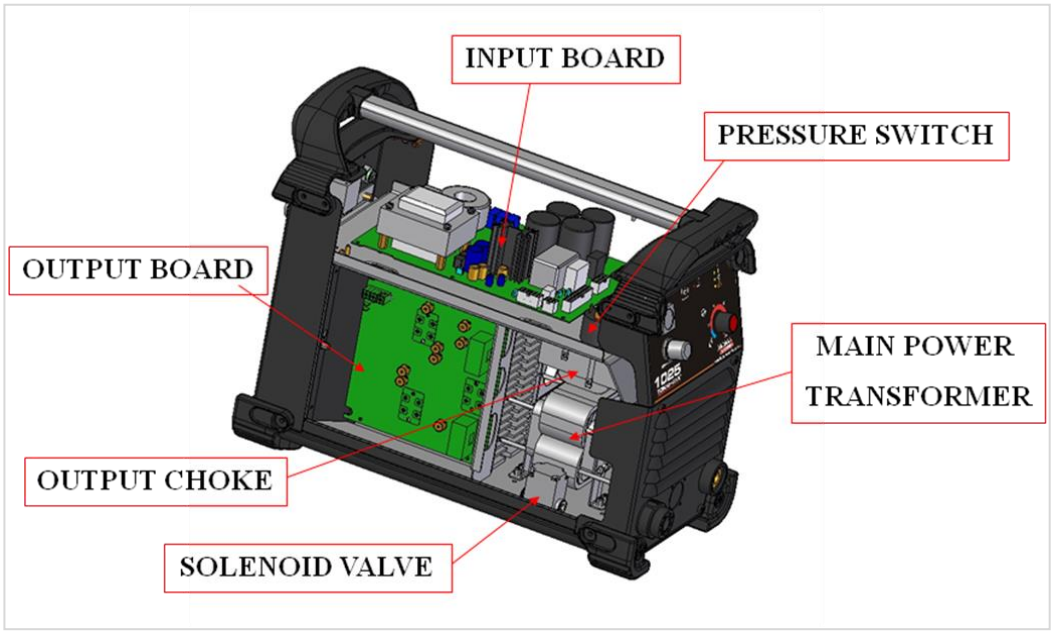
THERMAL PROTECTION

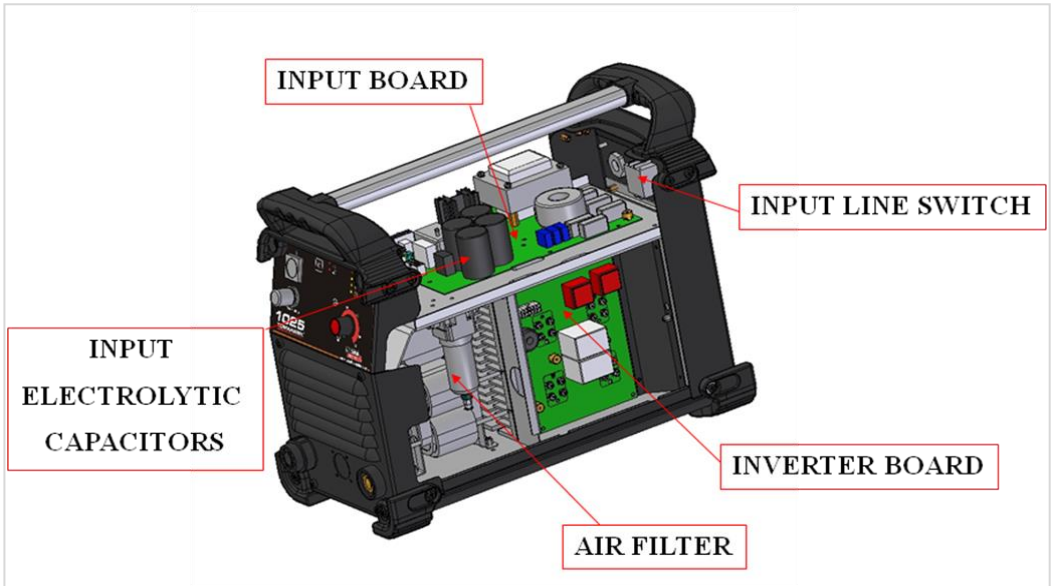
Thermal detection device protect the machine from excessive operating temperatures. Excessive temperatures may be caused by a lack of cooling air or operating the machine beyond the duty cycle and output rating. If excessive operating temperatures should occur, the yellow LED will light and the detection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

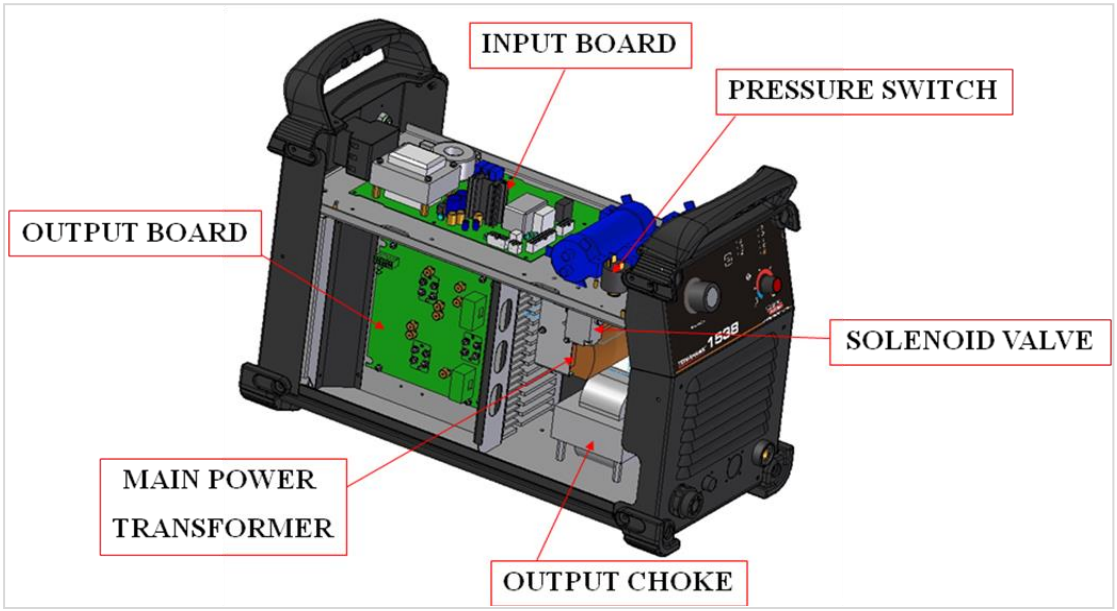
MAJOR COMPONENTS LOCATION

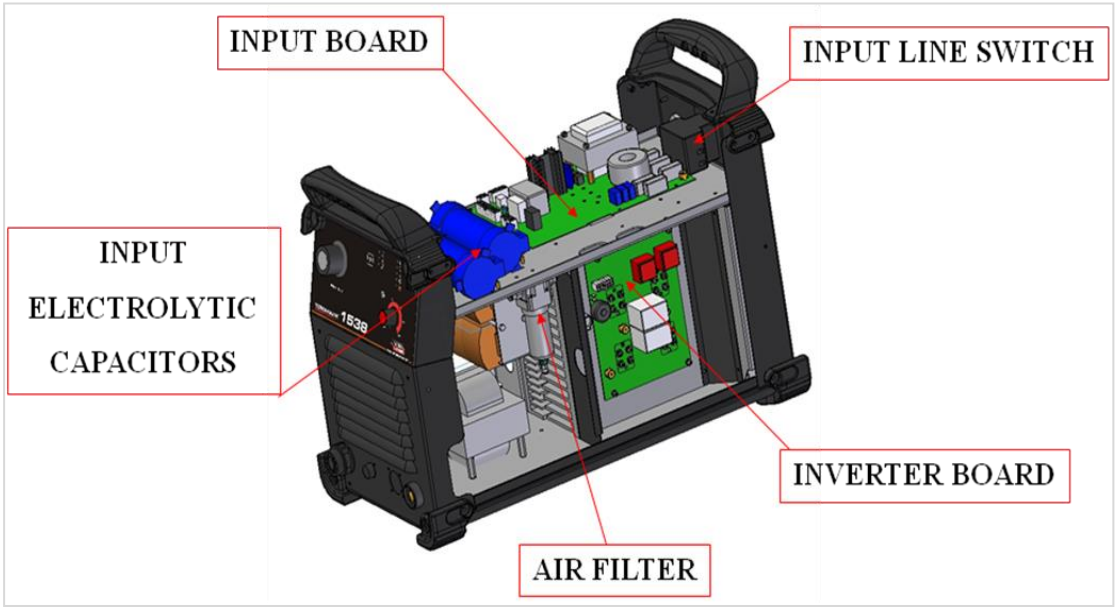
TOMAHAWK 1025





TOMAHAWK 1538

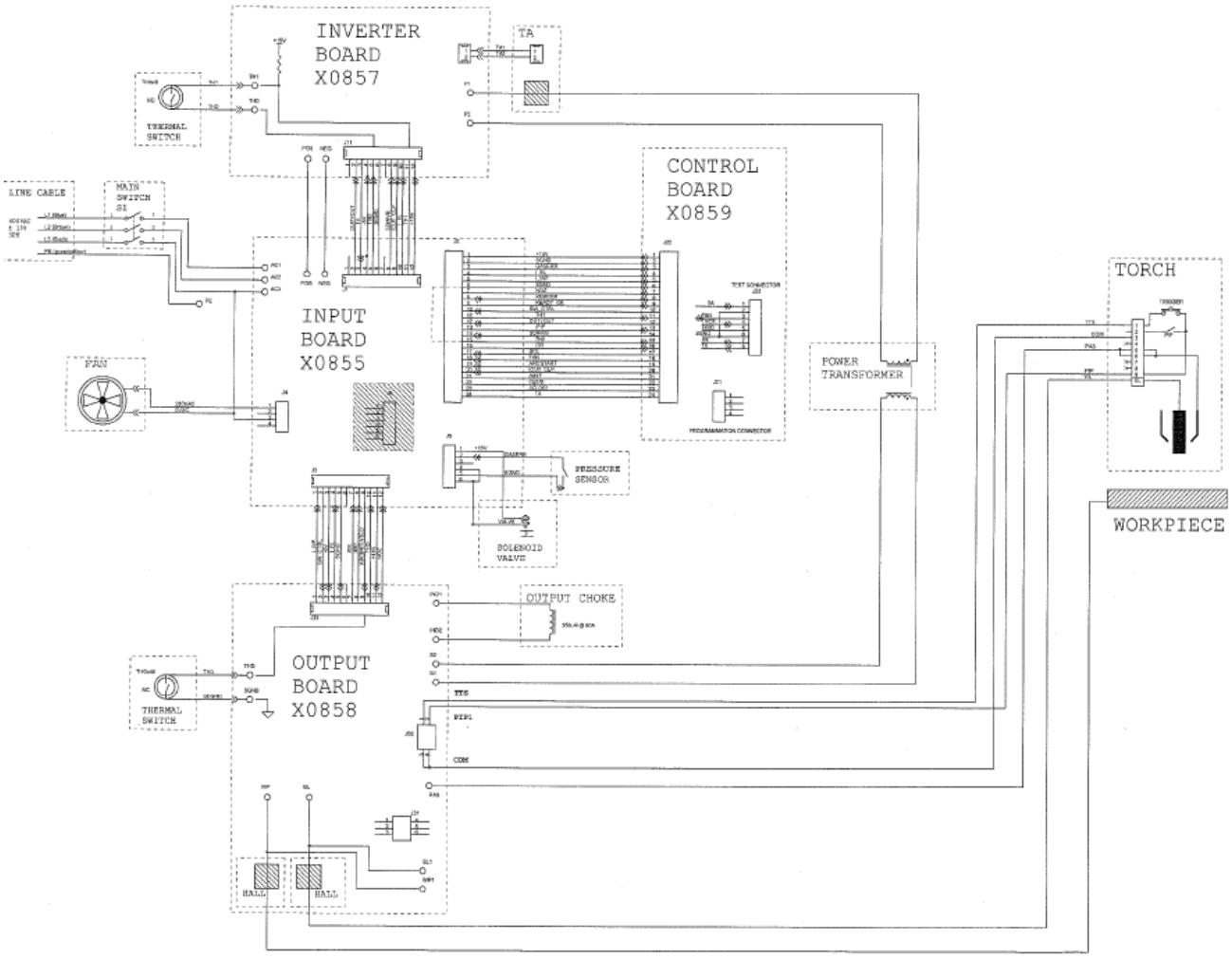




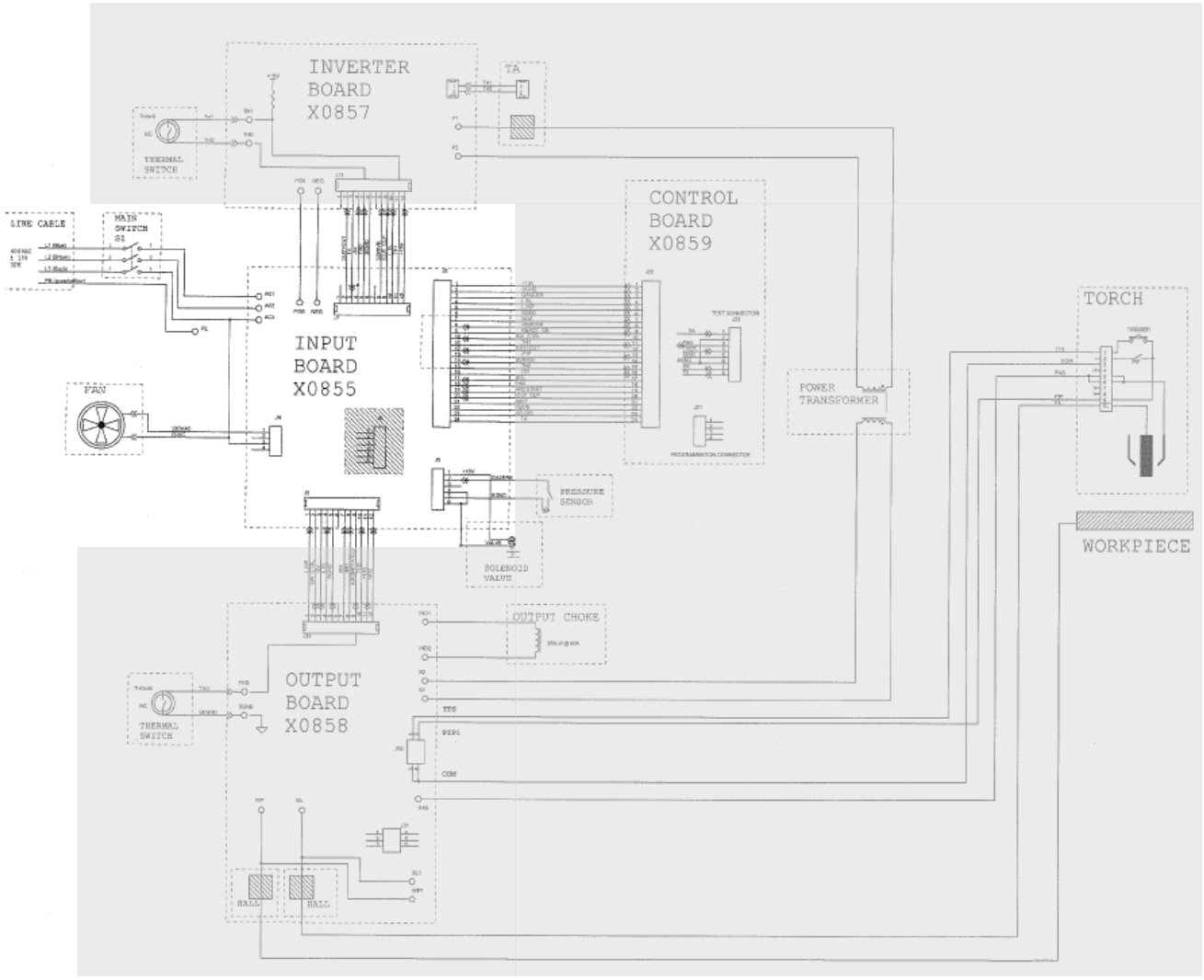
THEORY OF OPERATION

- General description
- Input Line Voltage, Auxiliary Voltage, Precharge
- Inverter Board , Main Transformer, Output Rectifier and Choke
- Control Board
- Air System
- Protection Circuits
- IGBT operation

BLOCK DIAGRAM



INPUT SECTION



GENERAL DESCRIPTION

The Tomahakw 1025 and 1538 are inverter based plasma cutting power sources that offers standard cut, grid cut and gouging. The control system has a safety mechanism to insure that the nozzle and electrode are in place before cutting or gouging. The TOMAHAWK 1025 and 1538 initiate the plasma arc with a simple, yet reliable, touch start mechanism. This system eliminates many of the problems associated with hi-frequency type start systems.

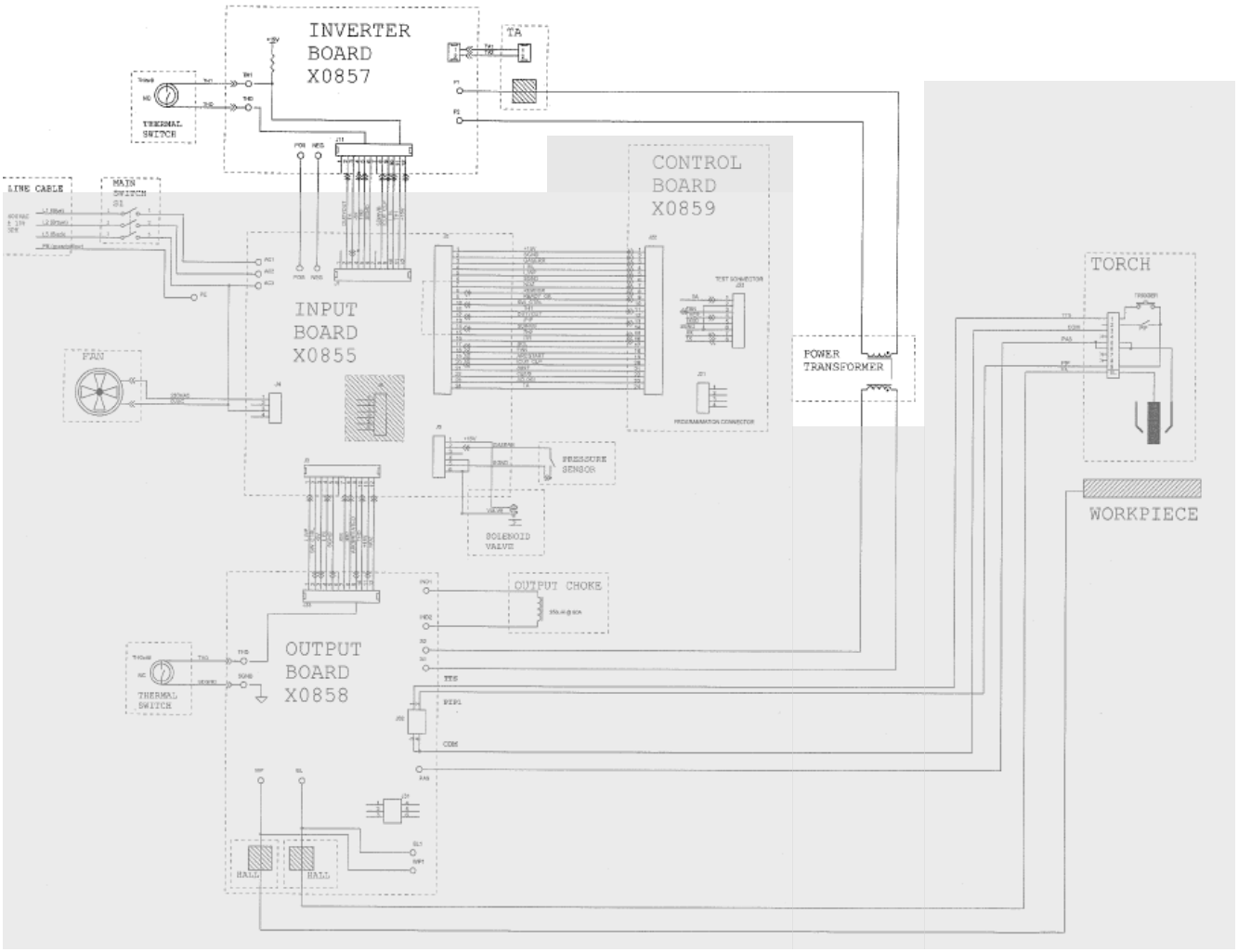
INPUT LINE VOLTAGE, AUXILIARY VOLTAGE AND PRECHARGE

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 TH1025, -2 version for the TH1538):

- 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

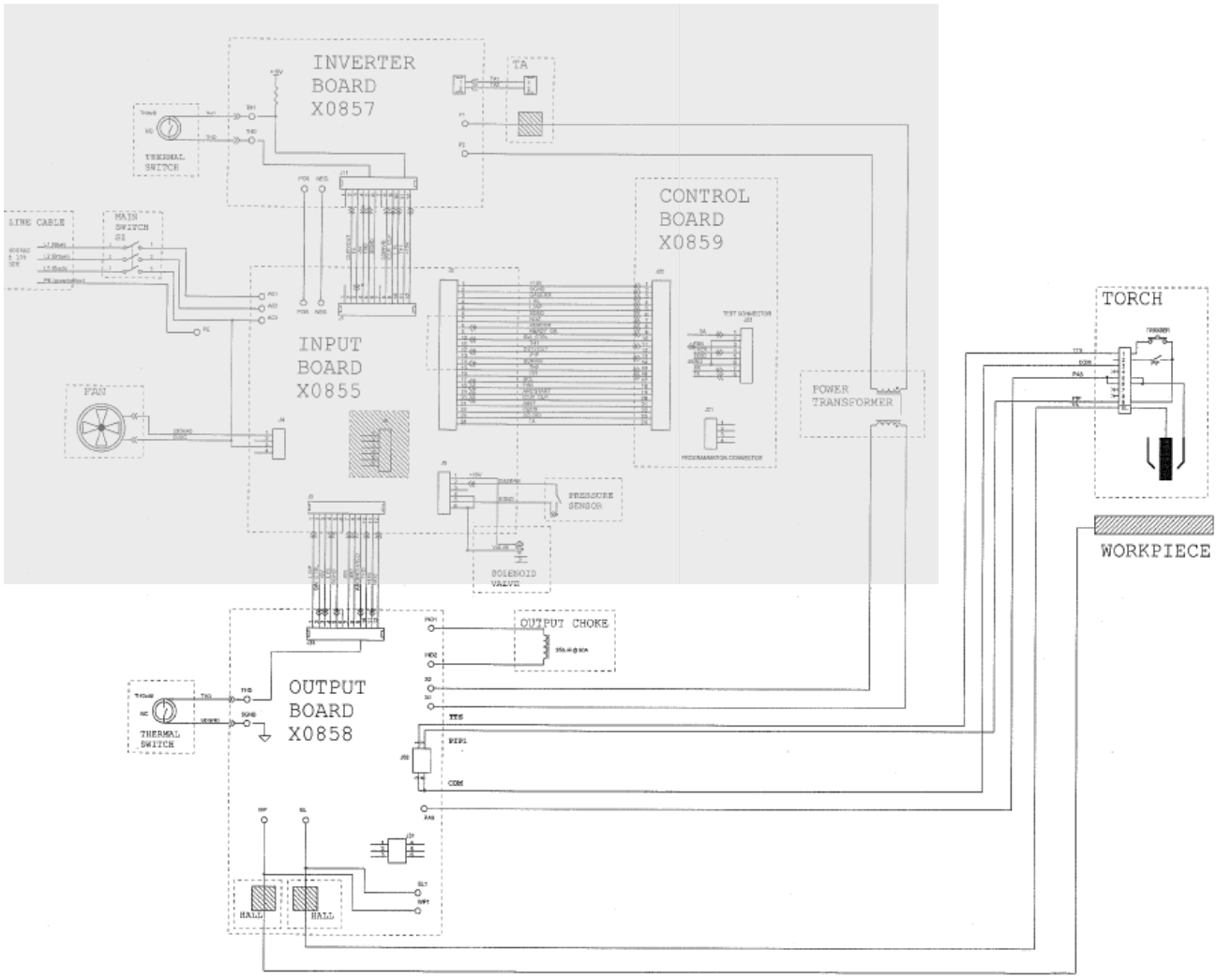


Inverter and Main Transformer

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. Ratio of main transformer is 1:2.

OUTPUT SECTION AND TORCH

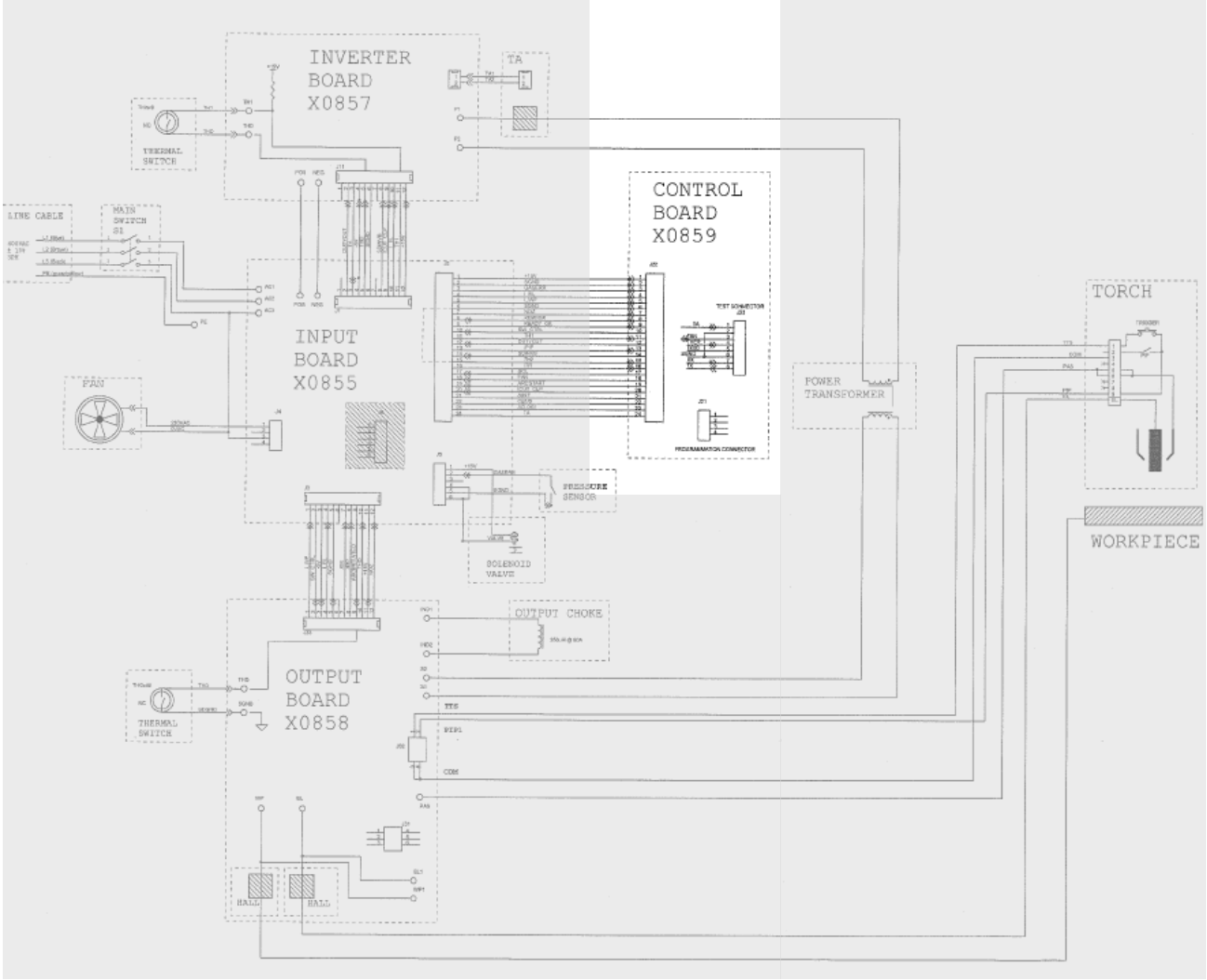


Output section and Torch

The output section contains a static switch, upon receiving a pilot signal from the control board will enable the operation of a pilot arc or a cutting arc. The pilot arc is controlled and regulated by an hall effect current sensor installed on the output board. The output choke, provides current filtering to enhance arc stability.

The torch uses a mechanic touch start mechanism that provides superior starting performance over other touch start systems. The torch head consists of 3 major parts: torch body, insulator and piston. The insulator provides an electrical barrier between the piston and torch body. The piston provides a path for electrical current to the electrode. The piston also drives the electrode to the nozzle for arc initiation. A copper nozzle is used to focus the arc. A small, precise hole in the end of the nozzle constricts the arc and increases the current density. As the air enters the torch head, it is directed between the electrode and nozzle for maximum electrode cooling. A portion of the cooling air exits in the chamber through the side of the nozzle. Plasma arc initiation occurs as follows: first, in the idle state, a spring inside the torch head pushes the piston and electrode forward to make continuity with the nozzle. When the trigger is pulled, air flow begins and creates enough back force on the electrode to overcome the force of the spring. After this continuity has been verified, output current is established and regulated. The back pressure drives the piston and electrode away from the nozzle, creating the plasma arc. The air stream forces the arc out the orifice of the nozzle. This appears as a pilot arc, which can then be transferred for cutting.

CONTROL BOARD



Control Board (User Interface)

The control board receives status and analog feedback signals from the inverter board, input board and various sensors. The control circuitry interprets these signals, makes decisions and changes the machines mode and output to satisfy the requirements as defined by the circuitry or user.

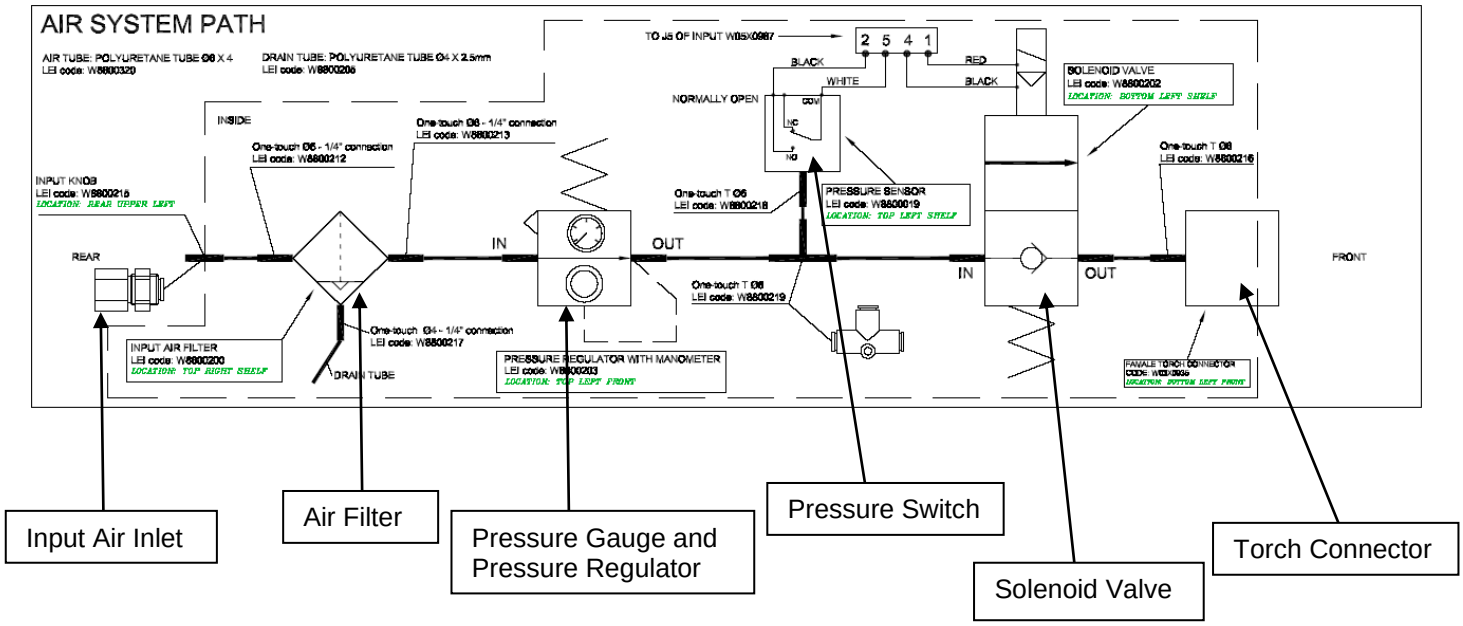
The control board sends a signal to the inverter board to control the output current but the actual regulation circuits are on the inverter board.

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

AIR SYSTEM

The air system is integrated inside the machine. Air system circuit is composed by the following major components:

- Air Filter: it has two functions, it filters the small pollution (5um) that goes to the torch and it eliminates the 90% of the moisture contained in the air that supplies the torch.
- Pressure Gauge and Regulator: located on the front panel, allow to regulate and monitoring the air pressure.
- Pressure Sensor: setted at 4 bar by factory. Below this value the machine stop working and the yellow low gas pressure LED on the front panel will be ON. Do not change setting! This can damage the plasma torch.
- Solenoid Valve: it open and close the air flow following the trigger condition and control board instructions.



OVERLOAD PROTECTION

Tomahawk 1025 and 1538 are electrically protected from producing higher than normal output currents. An electronic protection circuit limits the current to within the capabilities of the machine.

SAFETY PARTS-IN-PLACE (PIP) PROTECTION

The Tomahawk 1025 and 1538 have a protection circuit (PIP) to detect the proper installation of the consumables and the torch. If an error is detected with either of these two items, the Safety status LED will be turned on and the output of the machine will be disabled. The Tomahawk 1025 and 1538 must be turned off and the problem must be corrected before normal operation can occur.

LOW GAS PRESSURE CONDITION

The machine stops cutting or gouging operations when the gas pressure is below limit. The machine restart automatically when a correct gas pressure is detected.

THERMAL PROTECTION

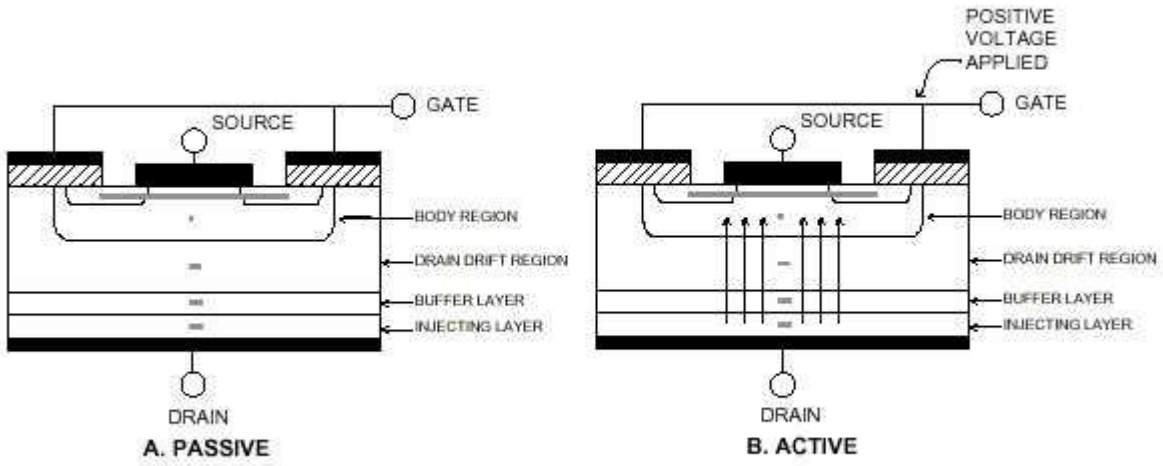
There are one thermal device located on the output diodes heatsink;it protect the machine from excessive operating temperature.
Excessive temperature may be caused by a lack of cooling air or by operating the machine beyond the duty cycle and output rating. If excessive operating temperature should occur, 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.

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

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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 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 MACHINE POWERS UP PROPERLY, BUT THERE IS NO RESPONSE(NO AIR FLOW OR PILOT ARC) WHEN THE TORCH TRIGGER IS PRESSED. ONLY THE POWER LED IS LIT.	• MAKE SURE THE TORCH HANDLE OR CABLE IS NOT DAMAGED OR OUT OF PLACE FROM THE MACHINE.	• CHECK ALL CONNECTORS AND WIRES FOR LOOSE OR FAULTY CONNECTIONS • CHECK THE GAS SOLENOID AND GAS SOLENOID POWER SUPPLY • THE CONTROL BOARD MAY BE FAULTY
THE MACHINE POWERS UP PROPERLY, BUT ONLY AIR FLOWS WHEN TRIGGER IS PRESSED; NO PILOT ARC IS ESTABLISHED.	• MAKE SURE THE TORCH CONSUMABLE ARE IN GOOD CONDITION. REPLACE IF NECESSARY. • MAKE SURE THERE ARE NO KINKS OR RESTRICTIONS FOR AIR FLOW IN THE TORCH CABLE.	• CHECK ALL CONNECTORS AND WIRES FOR LOOSE OR FAULTY CONNECTIONS. SEE WIRING DIAGRAM. • CHECK THE TORCH CONTINUITY • PERFORM THE MAIN INVERTER BOARD VOLTAGE AND RESISTANCE TESTS.
THE CUTTING ARC STARTS BUT THE QUALITY OF CUT IS BAD	• MAKE SURE THE WORK CLAMP IS CONNECTED TIGHTLY TO THE WORKPIECE. • MAKE SURE THE AIR PRESSURE IS SET CORRECTLY AT 5.5 BAR. • MAKE SURE THE AIR SUPPLY IS NOT CONTAMINATED WITH OIL OR EXCESSIVE WATER.	• REPLACE THE WORK CABLE OR WORK CLAMP IF DAMAGED OR IN BAD CONDITION • REPLACE THE CONSUMABLES IF DAMAGED • REPLACE AIR REGULATOR MAY BE REQUIRED • ENSURE THAT AIR IS CLEAN AND DRY EXTERNAL FILTERS MAY BE USED.
THE AIR BEGINS TO FLOW WHEN THE TORCH TRIGGER IS PRESSED BUT THERE IS A VERY BRIEF PILOT ARC.	• CHECK THE INPUT VOLTAGE AT THE MACHINE. INPUT VOLTAGE MUST MATCH THE RATING PLATE. • MAKE SURE THE TORCH CONSUMABLE PARTS ARE IN PLACE AND IN GOOD CONDITION. REPLACE IF NECESSARY. • TRY TO BY-PASS THE PRESSURE SWITCH	• REPLACE PRESSURE SWITCH MAY BE REQUIRED • THE CONTROL BOARD MAY BE FAULTY
MACHINE DECREASE THE CUT PERFORMANCE AND NOZZLE LIFE TIME IS SHORTER THAN USUAL	• MAKE SURE THAT THE QUALITY OF THE AIR IS GOOD, NO HUMIDITY OR OIL • MAKE SURE THAT THE AIR PRESSURE IS CORRECT • MAKE SURE THAT THERE ARE NO AIR LEAKS IN THE AIR CIRCUIT OR TORCH • THE STATIC SWITCH ON OUTPUT BOARD CAN BE DAMAGED	• CHECK AND CLEAN THE INTERNAL AIR CIRCUIT AND THE AIR FILTER • SET THE CORRECT PRESSURE • REPLACE PART THAT IS CAUSING AIR LEAKS • PERFORM THE STATIC SWITCH TEST
THE PILOT ARC IS NORMAL, BUT THE ARC WILL NOT TRANSFER TO THE WORK PIECE.	• MAKE SURE THE WORK CLAMP IS CONNECTED TIGHTLY TO THE WORKPIECE. • THE WORK PIECE MUST BE ELECTRICALLY CONDUCTIVE MATERIAL, AND THE WORK CLAMP MUST MAKE A GOOD ELECTRICAL CONNECTION WITH THE WORK PIECE.	• PERFORM THE STATIC SWITCH TEST • PERFORM THE INPUT BOARD TEST (CHECK CAREFULLY THE “I-WP” SIGNAL ON J2/5) IF THERE IS NO SIGNAL OR BAD SIGNAL THE HALL EFFECT PROBE HCS1 ON OUTPUT BOARD CAN BE DAMAGED.

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.

……

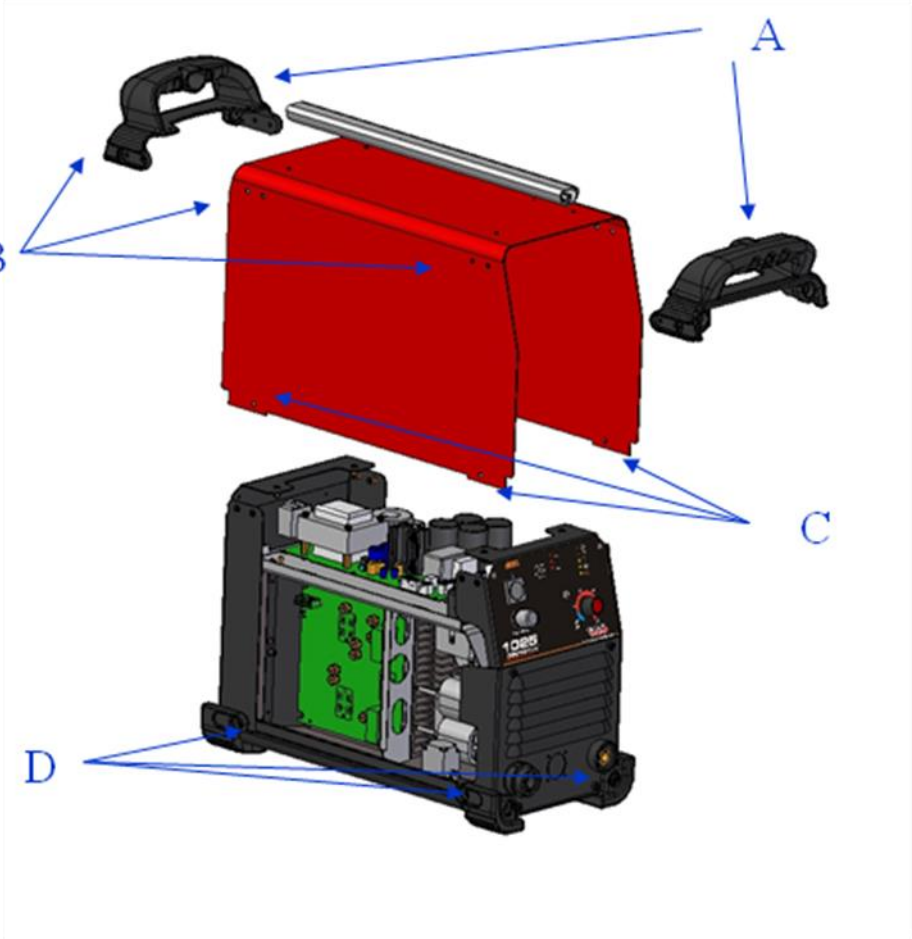
DESCRIPTION

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

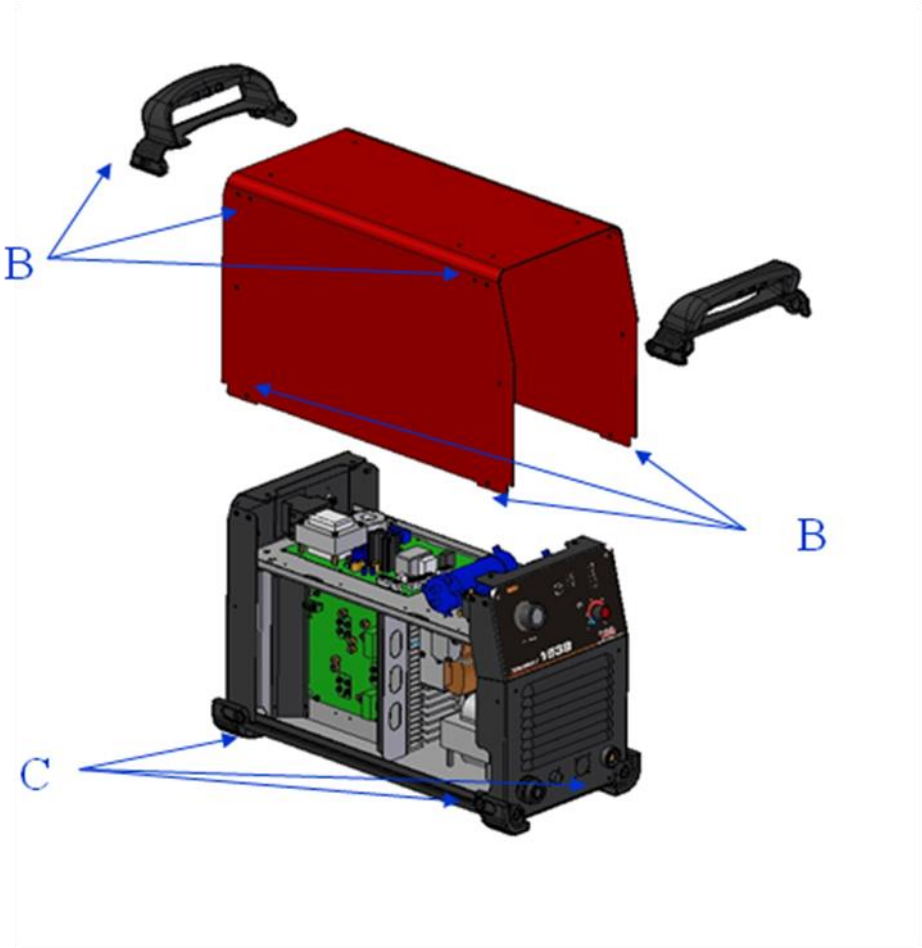
TOMAHAWK 1025 - CASE COVER REMOVAL



Procedure:

1. Disconnect Input Power from the machine!
2. Turn on/off switch to off position.
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 rubber corners (D).
7. Follow the next session to **perform the input filter discharge procedure**

TOMAHAWK 1538 - CASE COVER REMOVAL



Procedure:

1. Disconnect Input Power from the machine!
2. Turn on/off switch to off position.
3. Remove the 16 screws of the plastic handle (B).
4. Remove the 4 screws on the rubber corners (C).
5. Don't remove the 4 rubber corners (D).
6. Follow the next session to **perform the input filter discharge procedure**

DC LINK CAPACITORS DISCHARGE PROCEDURE

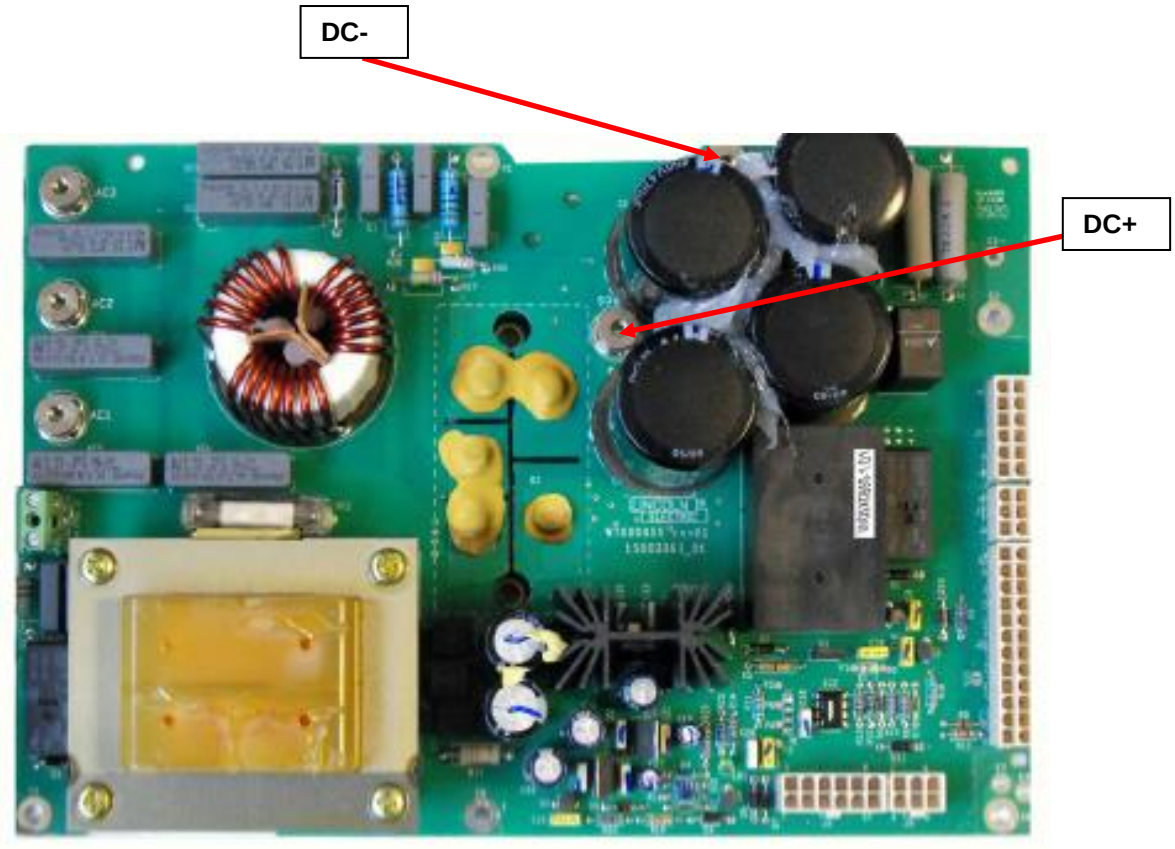
WARNING

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 Tomahawk 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 TH1025 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

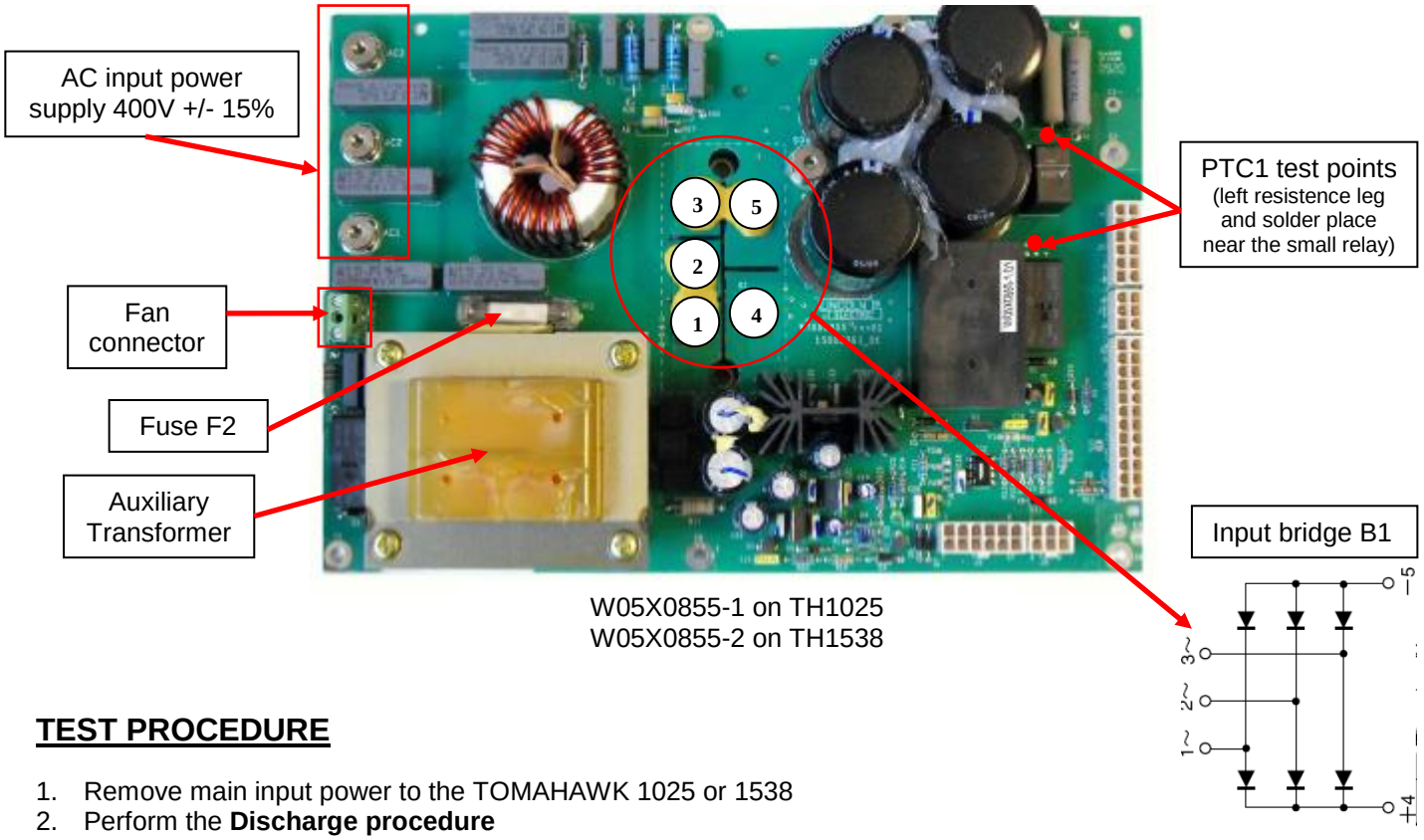
This test will determine if the input board has any " shorted " or "open" components.

MATERIALS NEEDED

Volt/Ohmmeter
Wiring Diagram X0855

INPUT BOARD RESISTANCE TEST (continued)

Picture is related to TOMAHAWK 1025 Input board . TOMAHAWK 1538 input board is the same only without the four black snap-in capacitors



W05X0855-1 on TH1025
W05X0855-2 on TH1538

TEST PROCEDURE

1. Remove main input power to the TOMAHAWK 1025 or 1538
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 Tomahawk 1025 fan resistance should be 260 ohm +/- 20%, while for Tomahawk 1538 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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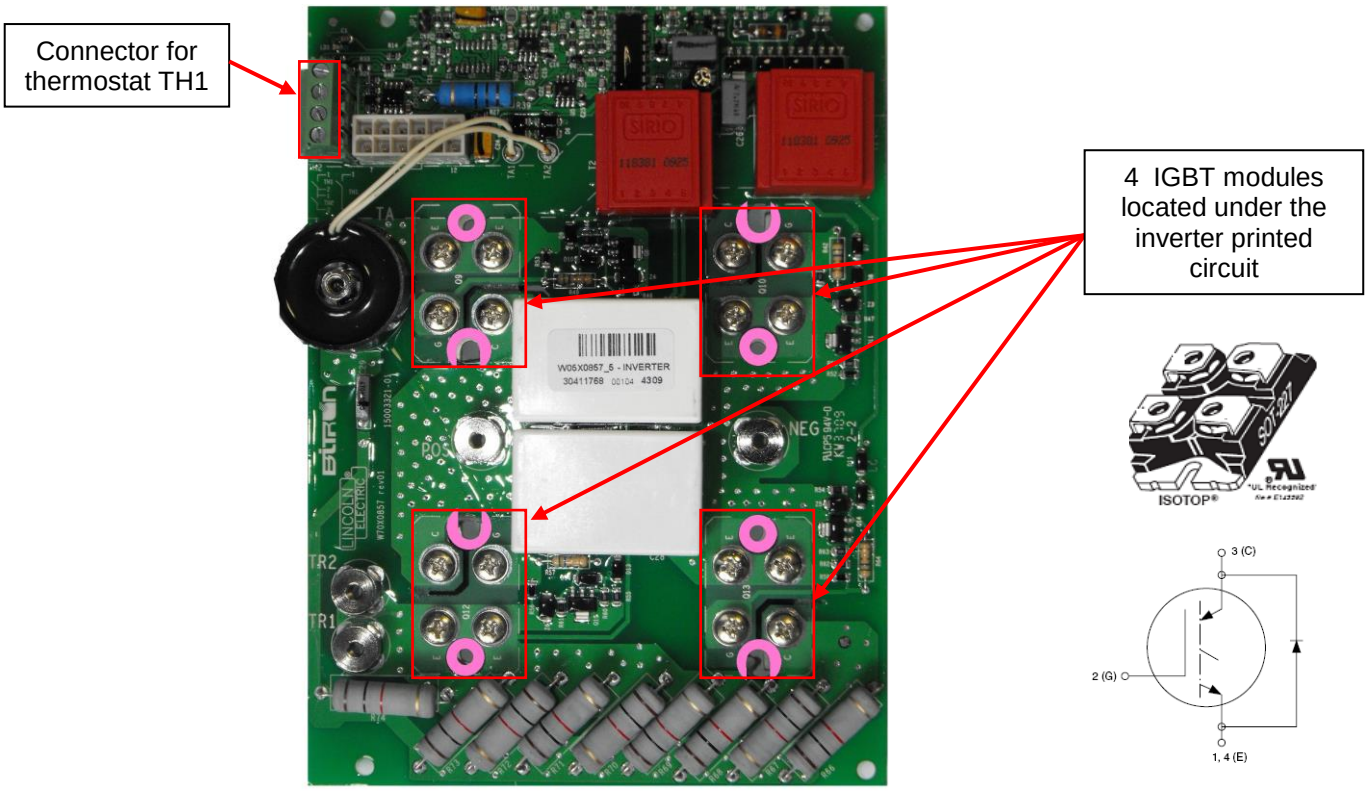
TEST DESCRIPTION

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
Wiring Diagram X0857

INVERTER BOARD RESISTANCE TEST (continued)



W05X0857-1 on TH1025
W05X0857-2 on TH1538

TEST PROCEDURE

1. Remove main input power to the TOMAHAWK 1025 or 1538
2. Perform the **Discharge procedure**
3. Visually check for burned or damaged components. If any components are physically damaged the inverter 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.

……

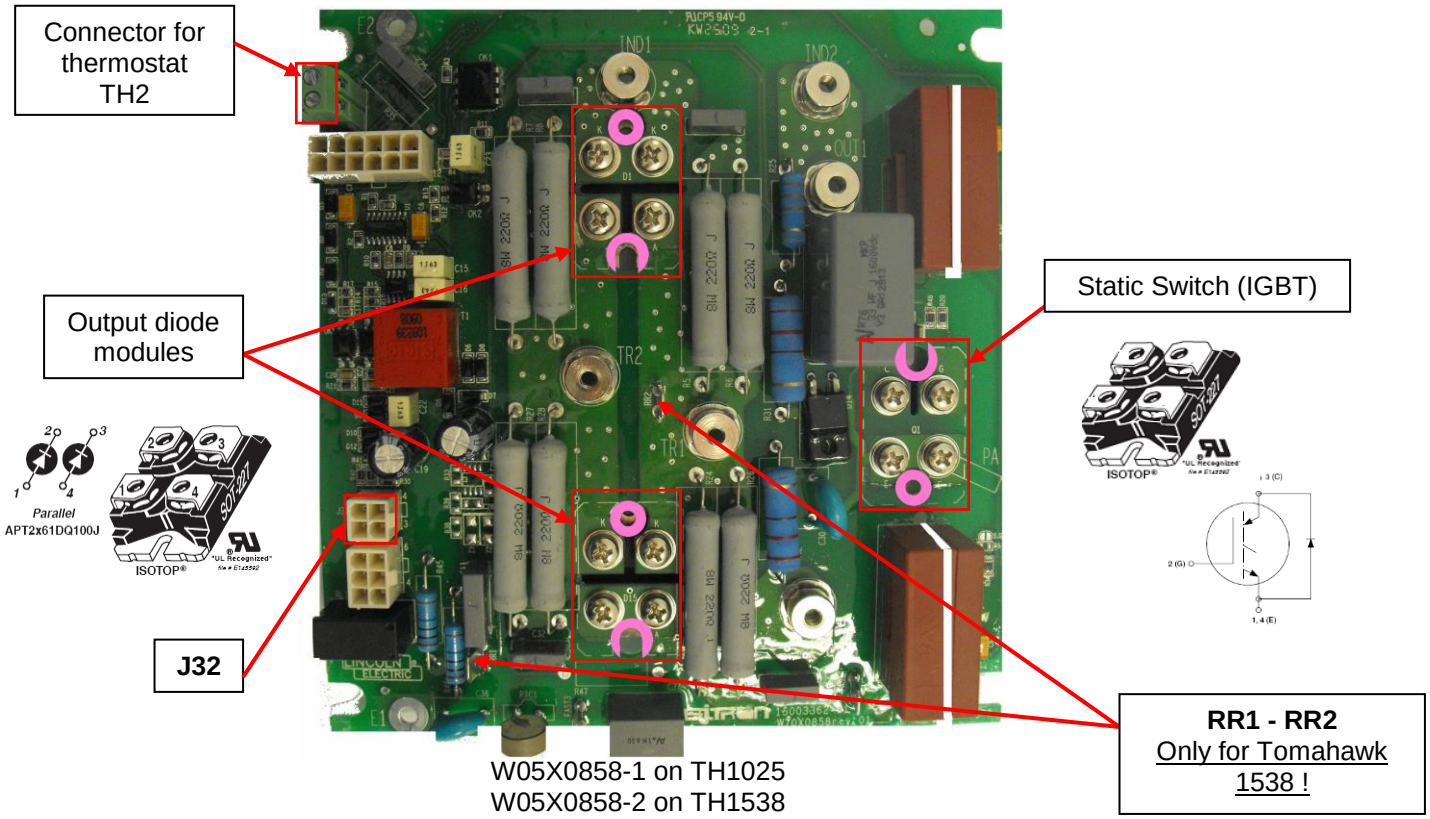
TEST DESCRIPTION

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
Wiring Diagram X0858

OUTPUT BOARD RESISTANCE TEST (continued)



W05X0858-1 on TH1025
W05X0858-2 on TH1538

TEST PROCEDURE

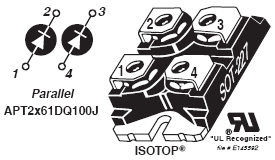
1. Remove main input power to the TOMAHAWK 1025 or 1538
2. Perform the **Discharge procedure**
3. Visually check for burned or damaged components. If any components are physically damaged the output board should be replaced
4. Check the thermostat TH2, connected to the green connector (see picture above), with ohmmeter; correct value is 0 (zero) ohms (short)
5. ONLY for Tomahawk 1538, check resistor connected to RR1 and RR2 value is 47 ohms +/- 10%
6. Follow the below tables to perform the remaining tests:

J32: Trigger/PIP connector (plasma torch must be connected to the machine with all parts in place)

Pin#	Description	Value
1	Pip contact respect to pin 3 or 4	10 ohm +/- 20%
2	Trigger contact respect to pin 3 or 4	3K ohm +/- 20%
3 & 4	PIP & Trigger common	-

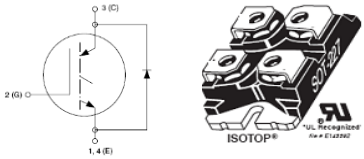
Output Diode modules (D1 – D15)

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



Static Switch IGBT (Q1)

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



INPUT BOARD VOLTAGE TEST

WARNING

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……

TEST DESCRIPTION

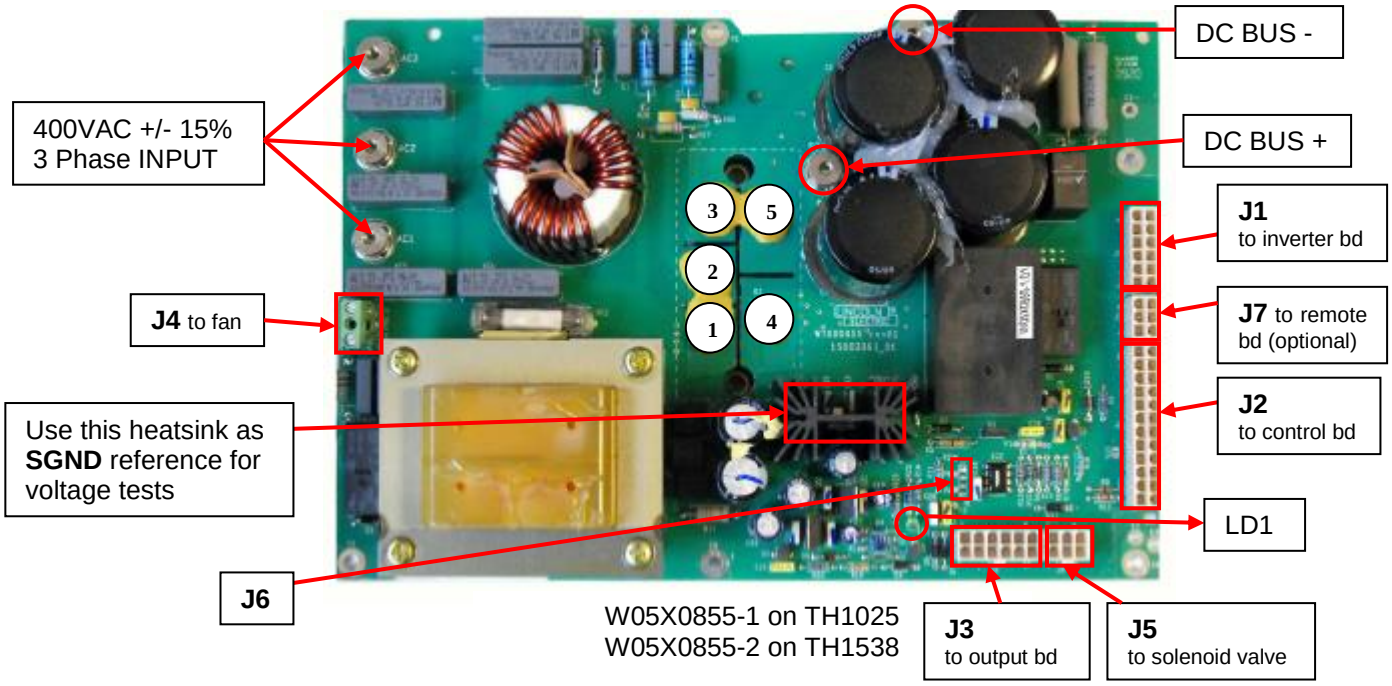
This test will help to determine if the correct input voltage is being applied to the input board and also if the correct voltages are being processed on the input board.

MATERIALS NEEDED

Volt/Ohmmeter
Wiring Diagram X0855

All the tests mentioned into this section must be done with machine in “CUT” operating Mode

INPUT BOARD VOLTAGE TEST (continued)

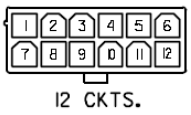


TEST PROCEDURE

1. Apply 400V +/- 15% to the TH1025 or 1538
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

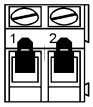
Pin#	Description	Value (use SGND as 0V ref.)	Notes
1	VREG	+5Vdc	Always present (idle,pilot arc,cut mode)
2	DUTY CUT	• 3,22Vdc during pilot arc • From 3,22Vdc to 10Vdc during cut (from min to max output regulation)	Output current set signal
3	TA	-	Inverter TA signal (only for factory test)
4	-5V	-5Vdc	-5V power supply generated by the input board.
5	THD	• 0V=normal value • 15Vdc +/- 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	• 7,35 Vdc = inverter OFF • -5Vdc = inverter ON	Shut down inverter signal
9	ICUT_CLP	-	Grid mode signal
10	I_EL	• 2,4Vdc=60A for TH 1025 • 2,4Vdc=100A for TH 1538	Electrode Current feedback from HCS2
11	TH1	• 0V=normal value • 15Vdc +/- 10% = thermic activated on inverter board	Thermostat on the inverter heat sink signal
12	+15V	+15Vdc	+15V power supply generated by the input board.



INPUT BOARD VOLTAGE TEST (continued)

J4: Fan connector

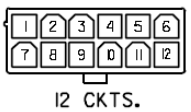
Pin#	Description	Value	Notes
1	Fan	15 Vac in idle mode 230Vac when fan ON	Fan is switch ON by signal coming from control board
2			



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	• 0V=normal value • 12,5Vdc= gas/air error	Air pressure signal
4	I_EL	• 2,4Vdc=60A for TH 1025 • 2,4Vdc=100A for TH 1538	Electrode Current feedback from HCS2
5	I_WP	• 2,2Vdc=60A for TH 1025 • 2,2Vdc=100A for TH 1538	Workpiece Current feedback from HCS1
6	SGND	SGND	Secondary GND for power supply (0V ref.)
7	VREG-NOZ	+5Vdc	Not used
8	REMSIGN	-	Remote control signal (optional item)
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	• -1,3Vdc= idle and pilot arc condition • +15Vdc =during cutting condition	Pilot arc static switch signal
11	TH1	• 0V=normal value • 15Vdc +/- 10% = thermic activated on inverter board	Thermostat on the inverter heat sink signal
12	DUTYCUT	• 3,22Vdc=during pilot arc • From 3,22Vdc to 10Vdc during cut (from min to max output regulation)	Output current set signal
13	/PIP	• 0,18Vdc=normal value • 13,5Vdc= PIP error	Part In Place secondary side signal
14	SDINVB	• 7,35 Vdc = inverter OFF • -5Vdc = inverter ON	Shut down inverter signal
15	TH2	-	Not used
16	/TR	• 13,5Vdc= trigger released • 0,2Vdc= Trigger activated/pressed	Trigger torch secondary signal
17	SOL	• 0V=Gas solenoid OFF • 0,8Vdc=Gas solenoid ON	Solenoid gas signal
18	FAN	• 0V=Fan OFF • 1,6Vdc=Fan ON	Fan signal
19	ARCINITIATED	• 15Vdc= idle and pilot arc condition • 0V=Arc transfered (cutting condition)	Arc initiated signal
20	ICUT_CLP	-	Grid mode signal
21	BBST	-	Not Used.
22	CE/US	• 5 Vdc= CE version	Hi level = CE version
23	ACLOSS	-	Not Used.
24	TA	-	Inverter TA signal (only for factory test)

J3: Input/Output connector

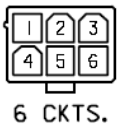


Pin#	Description	Value (use SGND as 0V ref.)	Notes
1	I_WP	• 2,2Vdc=60A for TH 1025 • 2,2Vdc=100A for TH 1538	Workpiece Current feedback from HCS1
2	SW_CTRL	• -1,3Vdc= idle and pilot arc condition • +15Vdc =during cutting condition	Pilot arc static switch signal
3	-5V	-5Vdc	-5V power supply generated by the input board
4	I_EL	• 2,4Vdc=60A for TH 1025 • 2,4Vdc=100A for TH 1538	Electrode Current feedback from HCS2
5	SGND	SGND	Secondary GND for power supply (0V ref.)
6	Not Used	-	-
7	/TR	• 13,5Vdc= trigger released • 0,2Vdc= Trigger activated/pressed	Trigger torch secondary signal
8	/PIP	• 0,18Vdc=normal value • 13,5Vdc= PIP error	Part In Place secondary side signal
9	ARCINITIATED	• 15Vdc= idle and pilot arc condition • 0V=Arc transfered (cutting condition)	Arc initiated signal
10	THD	• 0V=normal value • 15Vdc +/- 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

INPUT BOARD VOLTAGE TEST (continued)

J5: Gas/Air Solenoid Valve connector

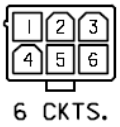
Pin#	Description	Value (use SGND as 0V ref.)	Notes
1	+15V	+15Vdc	+15V power supply generated by the input board.
2	GASERR	• 0V=normal value • 12,5Vdc= gas/air error	Air pressure signal
3	+24V	+24Vdc	Not used
4	VALVE	• +15Vdc=Gas/Air solenoid OFF • 0V=Gas/Air solenoid ON	Line to switch on solenoid valve
5	SGND	SGND	Secondary GND for power supply (0V ref.)
6	VALVE	• +15Vdc=Gas/Air solenoid OFF • 0V=Gas/Air solenoid ON	Line to switch on solenoid valve



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

J7: Remote Connector (this connector is not used if the optional remote board is not installed on the machine)

Pin#	Description	Value (use SGND as 0V ref.)	Notes
1	REMSIGN	-	Remote control signal (optional item)
2	+5V	+5Vdc	+5V power supply generated by the input board.
3	SGND	SGND	Secondary GND for power supply (0V ref.)
4	ARCINITIATED	• 15Vdc= idle and pilot arc condition • 0V=Arc transfered (cutting condition)	Arc initiated signal
5	/TR	• 13,5Vdc= trigger released • 0,2Vdc= Trigger activated/pressed	Trigger torch secondary signal
6	+15V	+15Vdc	+15V power supply generated by the input board.



INVERTER BOARD VOLTAGE TEST

WARNING

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TEST DESCRIPTION

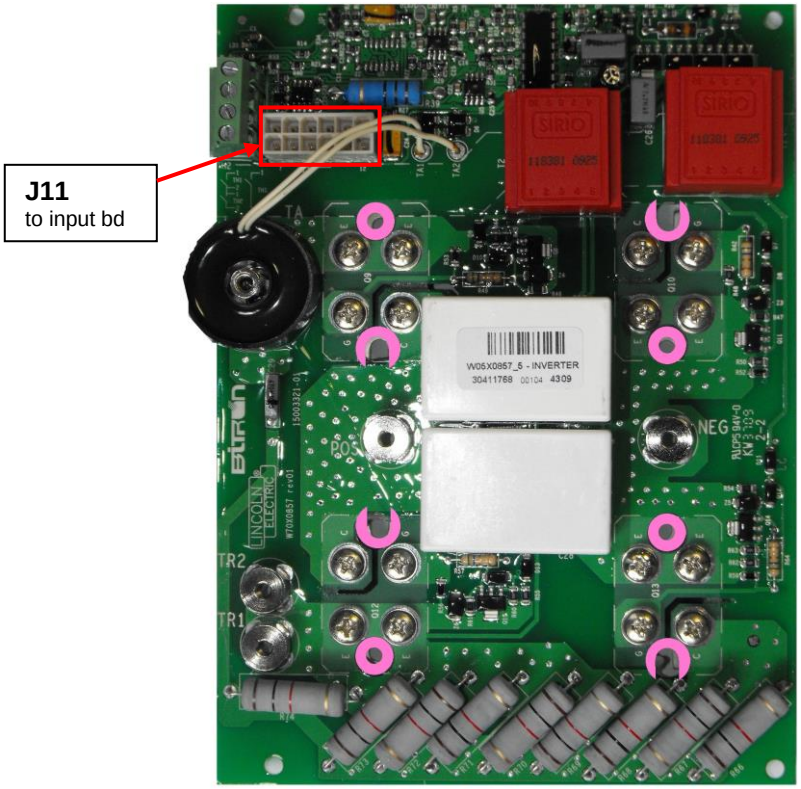
This test will help to determine if the main inverter board is receiving the correct input voltages and if the correct regulated voltages are being processed and maintained by the inverter.

MATERIALS NEEDED

Volt/Ohmmeter
Wiring Diagram X0857

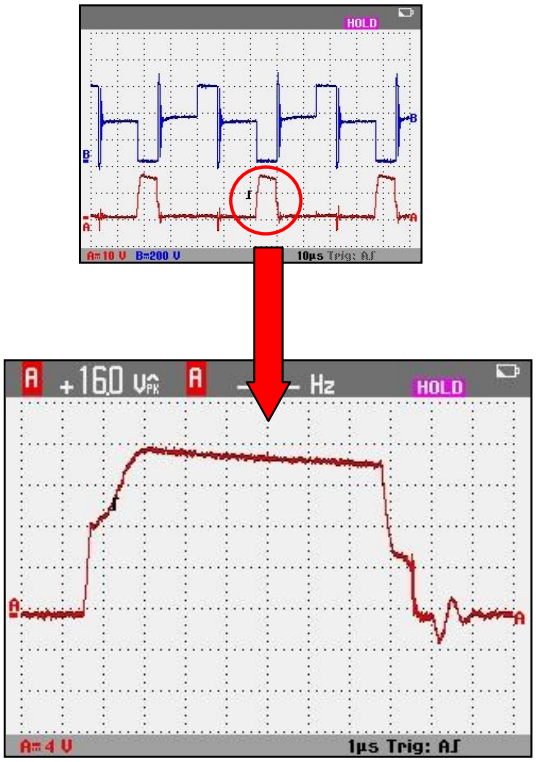
All the tests mentioned into this section must be done with machine in “CUT” operating Mode

INVERTER BOARD VOLTAGE TEST (continued)



W05X0857-1 on TH1025
W05X0857-2 on TH1538

BLUE= V_{CE} at 60A/105V output
RED = V_{GE} at 60A/105V output

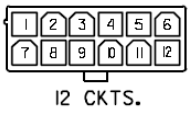


TEST PROCEDURE

1. Apply 400V +/- 15% to the TH1025 or 1538
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	+5Vdc	Always present (idle,pilot arc,cut mode)
2	DUTY CUT	• 3,22Vdc during pilot arc • From 3,22Vdc to 10Vdc during cut (from min to max output regulation)	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 • 15Vdc +/- 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	• 7,35 Vdc = inverter OFF • -5Vdc = inverter ON	Shut down inverter signal
9	ICUT_CLP	-	Grid mode signal
10	I_EL	• 2,4Vdc=60A for TH 1025 • 2,4Vdc=100A for TH 1538	Electrode Current feedback from HCS2
11	TH1	• 0V=normal value • 15Vdc +/- 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

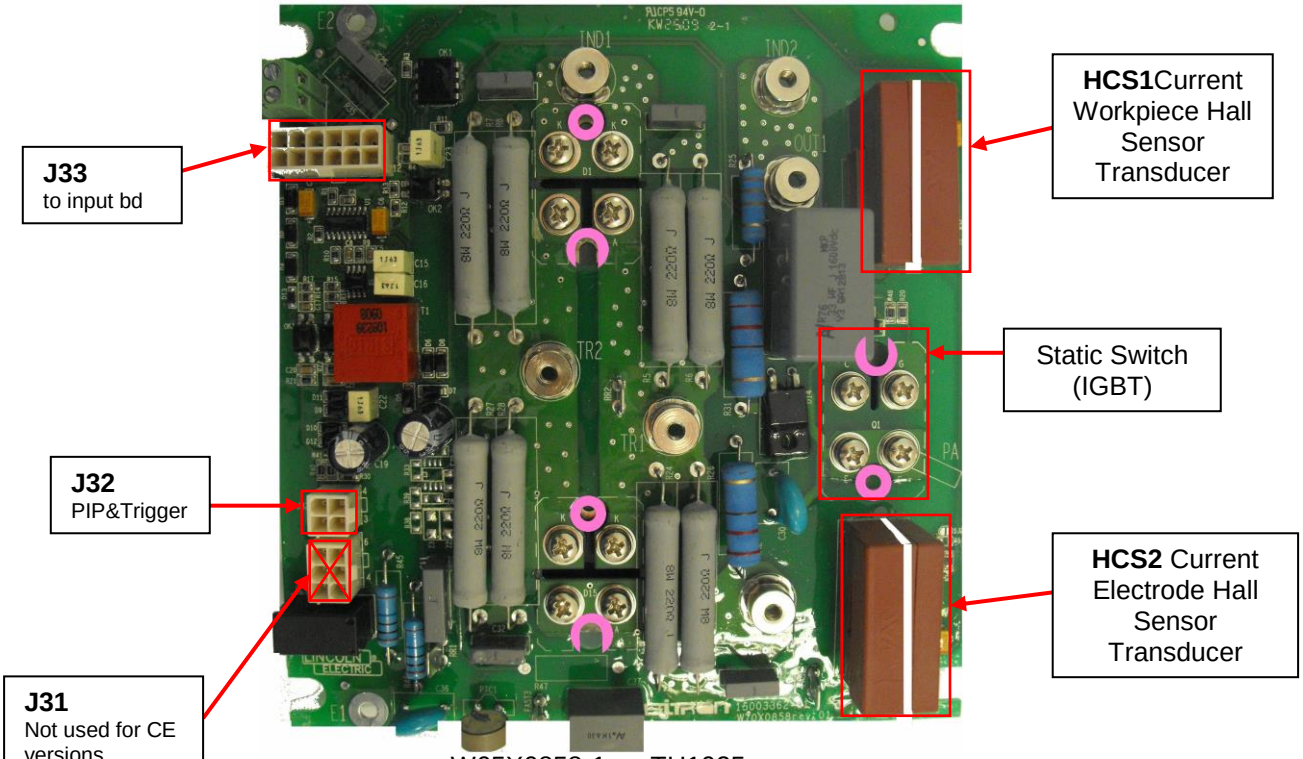
This test will help to determine if the output module is faulty.

MATERIALS NEEDED

Volt/Ohmmeter
Wiring Diagram X0858

All the tests mentioned into this section must be done with machine in “CUT” operating Mode

OUTPUT BOARD VOLTAGE TEST (continued)



W05X0858-1 on TH1025
W05X0858-2 on TH1538

TEST PROCEDURE

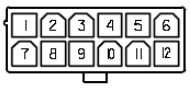
1. Apply 400V +/- 15% to the TH1025 or 1538
2. Turn the machine input swith to ON position, and wait till the power LED on front panel is stady green.
3. Follow the below tables test to perform the voltage tests on connectors and Static Switch IGBT:

J32: PIP/Trigger connector

Pin#	Description	Value (use pin 3 or 4 as common ref.)	Notes
1	PIP	16,5 Vdc	Machine ON in stand by condition and torch disconnected from the machine
2	Trigger	16,5 Vdc	Machine ON in stand by condition and torch disconnected from the machine

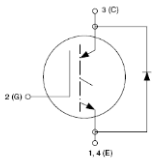
J33: Output/Input connector

Pin#	Description	Idle Value/Ref	Notes
1	I_WP	• 2,2Vdc=60A for TH 1025 • 2,2Vdc=100A for TH 1538	Workpiece Current feedback from HCS1
2	SW_CTRL	• -1,3Vdc= idle and pilot arc condition • +15Vdc =during cutting condition	Pilot arc static switch signal
3	-5V	-5Vdc	-5V power supply generated by the input board
4	I_EL	• 2,4Vdc=60A for TH 1025 • 2,4Vdc=100A for TH 1538	Electrode Current feedback from HCS2
5	SGND	SGND	Secondary GND for power supply (0V ref.)
6	Not Used	-	-
7	/TR	• 13,5Vdc= trigger released • 0,2Vdc= Trigger activated/pressed	Trigger torch secondary signal
8	/PIP	• 0,18Vdc=normal value • 13,5Vdc= PIP error	Part In Place secondary side signal
9	ARCINITIATED	• 15Vdc= idle and pilot arc condition • 0V=Arc transfered (cutting condition)	Arc initiated signal
10	THD	• 0V=normal value • 15Vdc +/- 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



Static Switch IGBT (Q1)

Emitter (E)	Gate (G)	*14,5 Vdc*	Machine ON in stand by condition or during pilot arc
Emitter (E)	Gate (G)	*0 Vdc*	Machine ON during cutting operation



CONTROL BOARD TEST

WARNING

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TEST DESCRIPTION

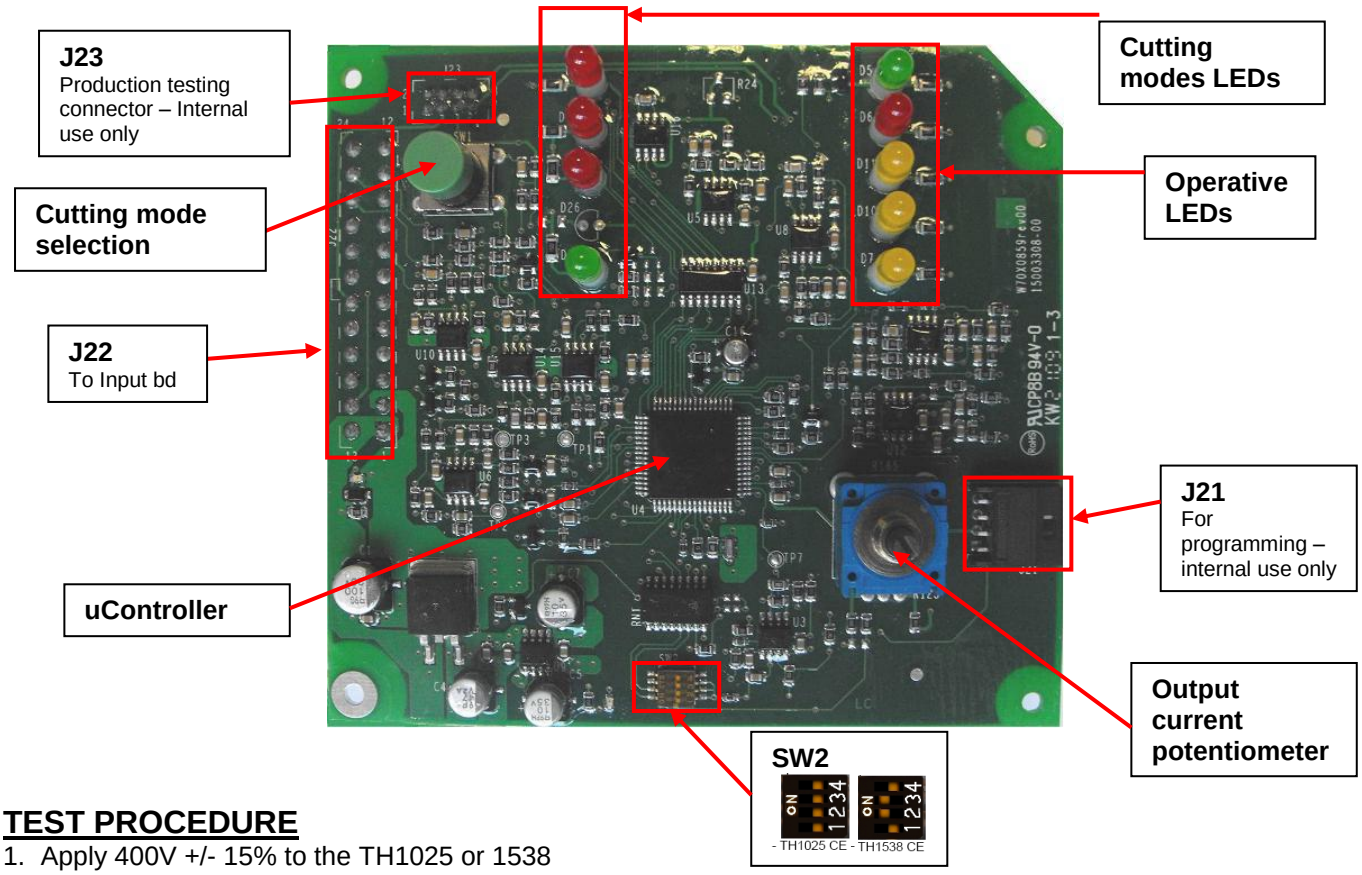
The control board is not easy to be checked, as it works mainly with software; this section will help, as best as possible, to determine if the control board is faulty and how to interpret error codes.

MATERIALS NEEDED

Volt/Ohmmeter
Wiring Diagram X0859

All the tests mentioned into this section must be done with machine in “CUT” operating Mode

CONTROL BOARD TEST (continued)



TEST PROCEDURE

1. Apply 400V +/- 15% to the TH1025 or 1538
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	• 0V=normal value • 12,5Vdc= gas/air error	Air pressure signal
4	I_EL	• 2,4Vdc=60A for TH 1025 • 2,4Vdc=100A for TH 1538	Electrode Current feedback from HCS2
5	I_WP	• 2,2Vdc=60A for TH 1025 • 2,2Vdc=100A for TH 1538	Workpiece Current feedback from HCS1
6	SGND	SGND	Secondary GND for power supply (0V ref.)
7	VREG-NOZ	+5Vdc	Not used
8	REMSIGN	-	Remote control signal (optional item)
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	• -1,3Vdc= idle and pilot arc condition • +15Vdc =during cutting condition	Pilot arc static switch signal
11	TH1	• 0V=normal value • 15Vdc +/- 10% = thermic activated on inverter board	Thermostat on the inverter heat sink signal
12	DUTYCUT	• 3,22Vdc=during pilot arc • From 3,22Vdc to 10Vdc during cut (from min to max output regulation)	Output current set signal
13	/PIP	• 0,18Vdc=normal value • 13,5Vdc= PIP error	Part In Place secondary side signal
14	SDINVB	• 7,35 Vdc = inverter OFF • -5Vdc = inverter ON	Shut down inverter signal
15	TH2	-	Not used
16	/TR	• 13,5Vdc= trigger released • 0,2Vdc= Trigger activated/pressed	Trigger torch secondary signal
17	SOL	• 0V=Gas solenoid OFF • 0,8Vdc=Gas solenoid ON	Solenoid gas signal
18	FAN	• 0V=Fan OFF • 1,6Vdc=Fan ON	Fan signal
19	ARCINITIATED	• 15Vdc= idle and pilot arc condition • 0V=Arc transfered (cutting condition)	Arc initiated signal
20	ICUT_CLP	-	Grid mode signal
21	BBST	-	Not Used.
22	CE/US	• 5 Vdc= CE version	Hi level = CE version
23	ACLOSS	-	Not Used.
24	TA	-	Inverter TA signal (only for factory test)
1	+15V	+15Vdc	+15V power supply generated by the input board

ERROR CODES

LED → / ERROR ↓	POWER ON	OUTPUT ENERGIZED	THERMAL ERROR	GAS ERROR	P.I.P. ERROR
Input voltage out of range	BLINKING	OFF	OFF	OFF	OFF
Head Torch (1)	ON	BLINKING	N.I.	N.I.	BLINKING
No pilot arc	ON	OFF	OFF	ON	ON
Trigger pushed	ON	OFF	ON	ON	ON
Internal voltage lockout (2)	ON	BLINKING	OFF	OFF	OFF
Thermal alarm	ON	OFF	ON	OFF	OFF
Gas alarm	ON	OFF	OFF	ON	OFF
Part in Place alarm	ON	OFF	OFF	OFF	ON

(1) Error appears if after 4 seconds of pilot arc the cutting process has not started
(2) Error appears when internal +15Vdc goes down the limit tolerance

	**Power ON/OFF LED:** It lights up when the machine is ON. **Blinking LED:** Input voltage line out of range condition. The machine is disabled: when the mains returns in the correct range, the machine restart automatically. Note: The Fan could be automatically switched OFF if the error condition persist for more than 2seconds.
	**Output LED:** The cutting torch is energized. **Blinking LED:** Internal auxiliary undervoltage condition. The machine needs to be turned OFF then ON again to restart.
	**Thermal LED:** The machine is overheated and the output has been disabled. This usually occurs when the duty cycle of the machine has been exceeded. Leave the machine ON to allow the internal components to cool. When the thermal LED turns off, normal operation is again possible.

	**PIP LED:** Part in place condition: the torch retaining cap (or the torch connector) is not properly screwed on the torch head (or in the machine torch connector). To restore the machine: • Screw firmly the torch retaining cap (or the torch connector). • After the torch is restored, the machine cannot restart for about 5 seconds. During this time the PIP LED blinks. (Note: When the LED is blinking, if another PIP error occours or if the Torch Trigger pushbutton is pressed the machine returns to the error condition: PIP LED returns steady ON and the restoring procedure begins again). • When the PIP LED turns OFF the machine is ready to operate.

ERROR CODES (continued)

No pilot arc estabilished

The Torch Trigger pushbutton is pressed. During this period the machine try to start the pilot arc for 4 times. If the pilot arc doesn't start the machine automatically goes in a safe condition that allow to check as necessary.

To restore the machine:

- Turn OFF the Power switch.
- Check the correct placement of the Torch Head consumables and parts.
- Check the Torch electrical connections.
- Turn ON again the machine.

<u>Low gas pressure condition LED:</u>
With this LED ON the machine stops cutting or gouging operations. The machine restart automatically when a correct gas pressure is detected.

To check / adjust the primary gas pressure (see recommended values in the Tecnical Specifications of this manual):

- When this LED lights up, for 10 seconds the machines goes automatically in Purge mode.
- During Purge time check and adjust the gas pressure through the manometer and primary gas pressure regulator knob.
- If necessary, check and adjust also the inlet gas pressure through the commands of the inlet primary gas.

Trigger Pushed

This occurs if the machine is switched ON (or if it restart after cooling time) with the Torch Trigger pushbutton hold. This status avoids unsafe operating conditions: manual cutting or gouging processes must be started ONLY under the direct control of the operator.

To restore the machine:

- Release the Torch Trigger pushbutton.
- Press again the Torch Trigger pushbutton.

If this error condition persist check for eventual malfunctions of the the Torch Trigger pushbutton.

Head Torch

This occurs if after 4seconds the Pilot Arc isn't transfered to the workpiece. The machine stops the pilot arc to avoid overheating on the Torch Head.

To restore the machine:

- Release the Torch Trigger pushbutton. The blinking LEDs are now permanently ON
- Press again the release the Torch Trigger pushbutton.

⚠ 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

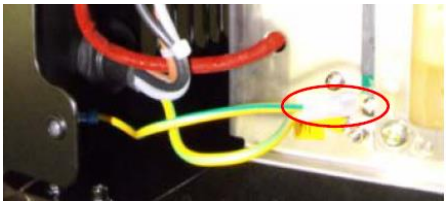
Necessary tool:
- Phillips screwdriver PH02;

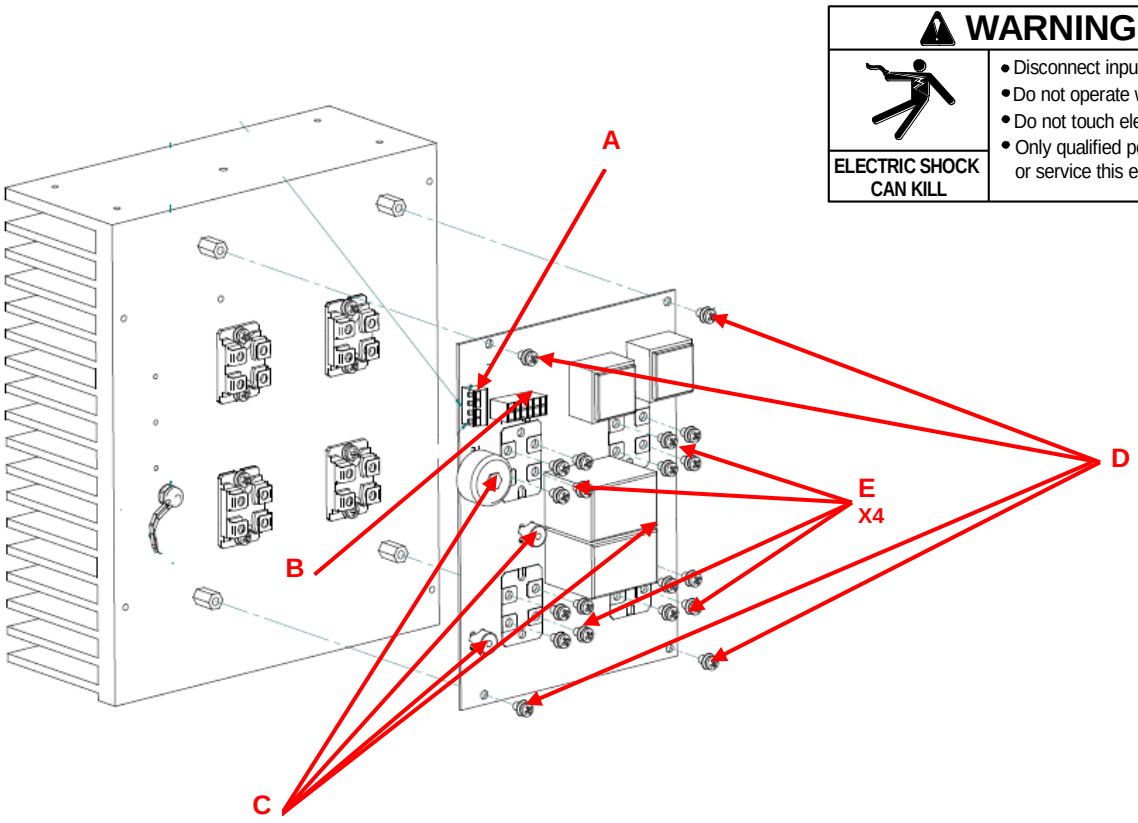
1. Unscrew the line cord from the AC1, AC2 and AC3 stand off (**A**);
2. Unplug the caBles of the connectors (**B**);
3. Unscrew the DC+ and DC- cables (**C**);
4. Unscrew the 2 screws of the input rectifier (**D**);
5. Unscrew the 6 screws that fix the board to the metal stand offs (**E**);
6. Unscrew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

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

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.

⚠ **WARNING: Remember to connect ground lead to the male faston on the input board corner, see the following picture**



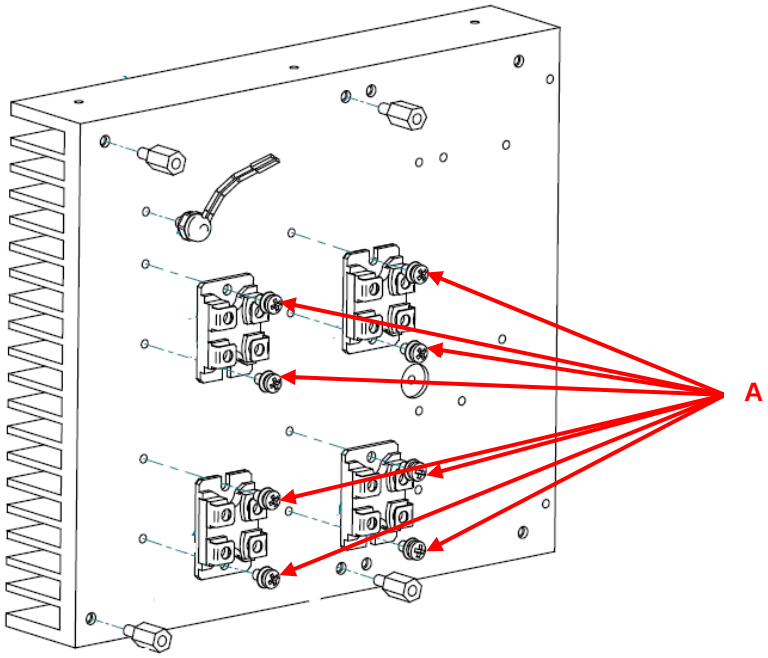


REMOVAL PROCEDURE

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

1. Remove the thermostats harnesses (**A**), signal harnesses (**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. Unscrew the 16 screws that fix the board to the IGBTs (**E**)

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



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

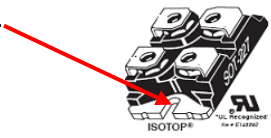
Necessary tools:
- Phillips screwdriver PH02

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.

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.



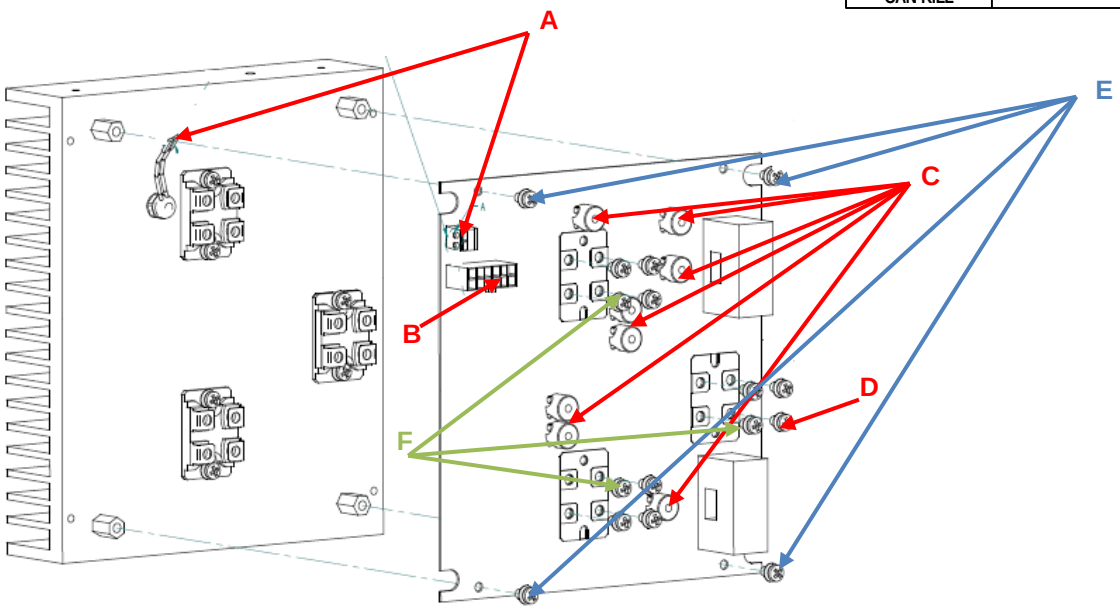
DISASSEMBLY OPERATIONS

OUTPUT BOARD REMOVAL AND REPLACEMENT PROCEDURE

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.



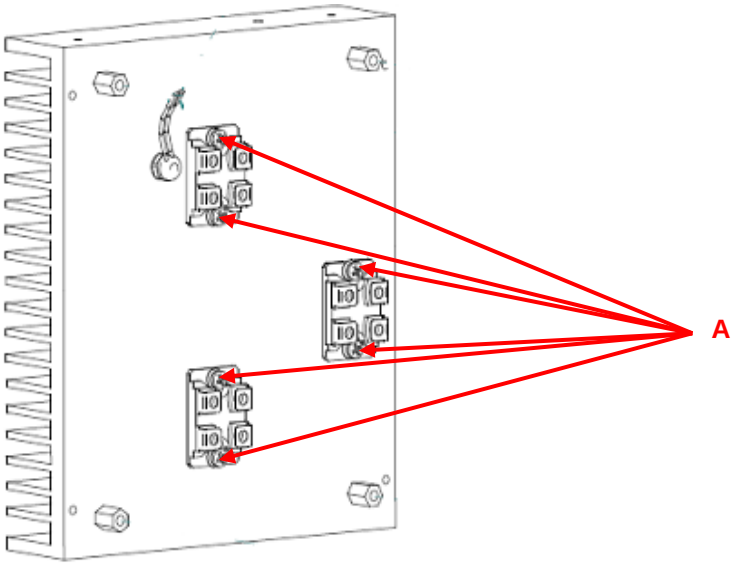
REMOVAL PROCEDURE

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

1. Remove the thermostats harnesses (**A**), signal harnesses (**B**) and unscrew the power harnesses (**C**)
2. Unscrew the pilot current harness (**D**)
3. Unscrew the 4 screws in the corner of the board that fix it to the metal stand offs on the heat sink (**E**)
4. Unscrew the 12 screws that fix the board to the IGBT and DIODE modules (**F**)

DISASSEMBLY OPERATIONS

OUTPUT BOARD DIODE AND IGBT MODULES 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

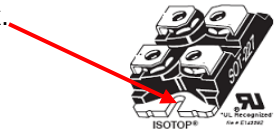
Necessary tools:
- Phillips screwdriver PH02

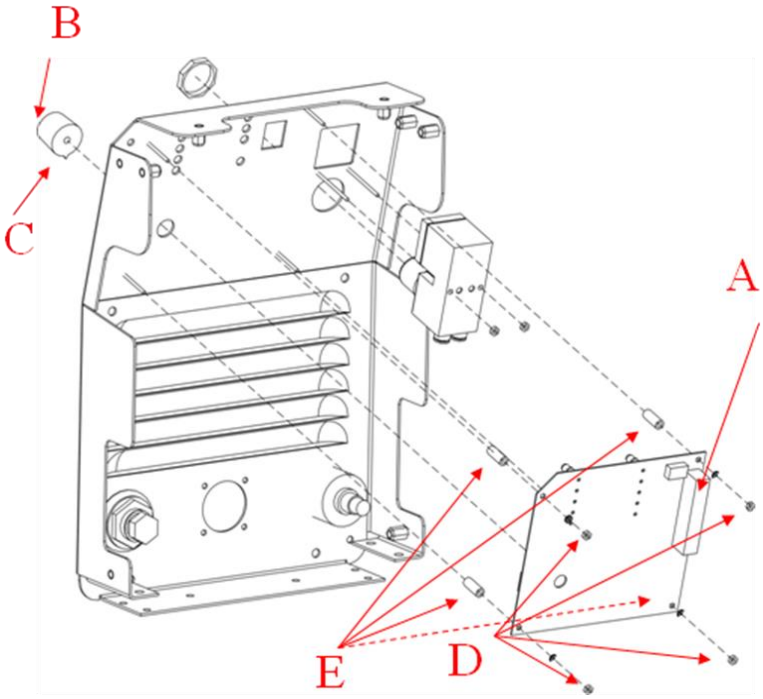
1. Unscrew the 8 screws (2 for each IGBT/DIODE) between every IGBT/DIODE and heat sink (**A**)
2. Remove the IGBT/Diodes and clean the heat sink from the thermal compound

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

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.





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
- socket wrench Ø 5,5
- socket wrench Ø 6

1. Remove the signal harness (**A**)
2. Remove the cork of the front panel Knob(**B**)
3. Using a socket wrench Ø 6 remove the knob (**C**)
4. Remove the 4 nuts in the corners of the board using a socket wrench Ø 5,5 ;Keep the nuts and washers apart (**D**)

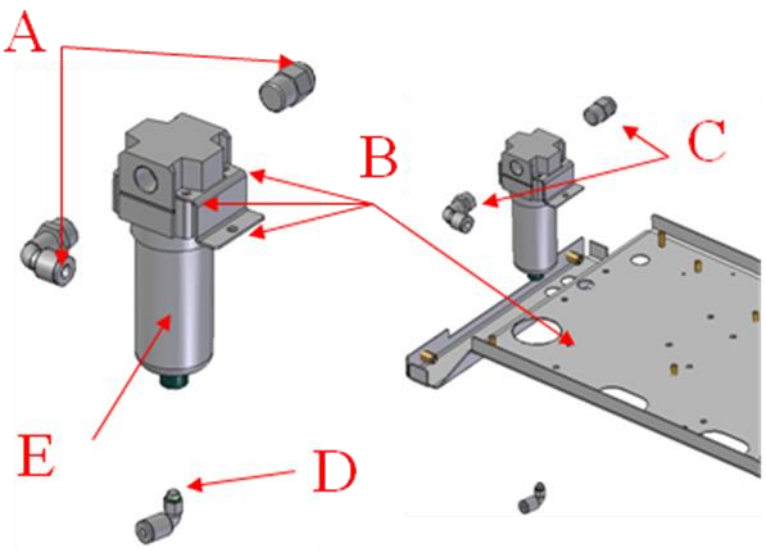
NOTE: keep the 4 plastic stand offs apart (**E**).

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

⚠ **WARNING: Remember to connect ground lead from the corner of control board to the central machine frame as indicated by the pictures**

TH1025

TH1538



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.

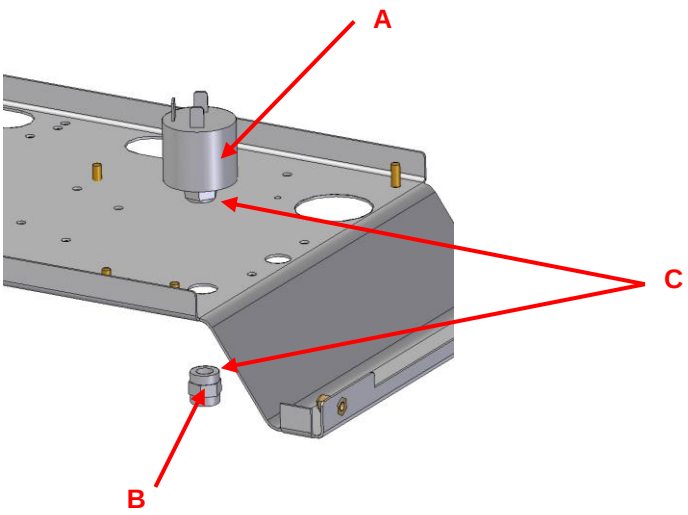
REMOVAL PROCEDURE

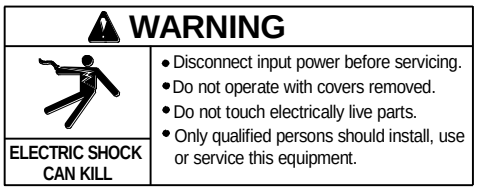
Necessary tools:
- Phillips screwdriver PH02
- Wrench 13 mm
- Wrench 17 mm

1. Unplug the air tube from the internal part of the air inlets (**A**); this operation can be done by hand (no tool is necessary);
2. Unscrew the sheet metal bracket from the shelf and from the filter; keep the screws apart (**B**)
3. Unscrew the air inlets from the filter using the 17 mm wrench (**C**)
4. Unscrew the air inlet for the water from the filter using the 13 mm wrench (**D**)
5. if necessary the glass part of the filter can be unscrewed by hand (**E**)

For the re-assembly operations, make the previous steps in the reverse order (look at the machine schematics also).

NOTE: put a drop of glue (Loktite type) on the thread of the inlet and after screw the inlet parts on the back panel;





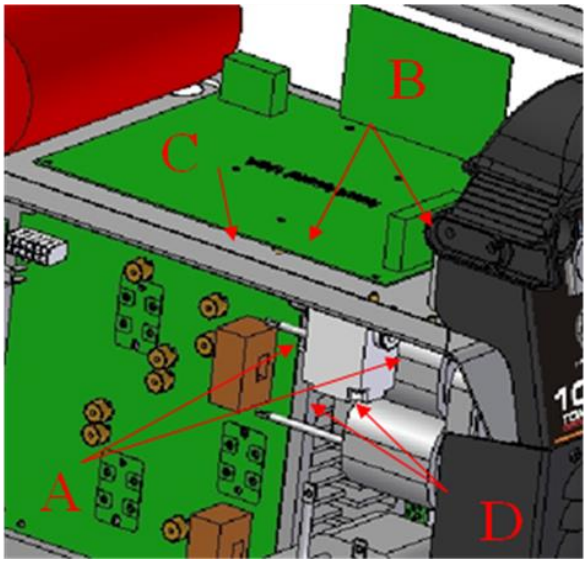
REMOVAL PROCEDURE

Necessary tools:
- two wrenches 17 mm

1. Unplug the harnesses on the top of the pressure switch (**A**)
2. Unplug the air tube from the air inlet under the shelf (**B**)
3. Unscrew the air inlet from the pressure switch using the two wrenches (**C**)

For the re-assembly operations, make the previous steps in the reverse order; make sure that the black or white harness is connected on the **NO** Faston on the pressure switch and the white or black on the **COM** Faston.

NOTE: put a drop of glue (Loktite type) on the thread of the pressure switch before the assembly the air inlet keeping the shelf in the middle as in the picture.



⚠ 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

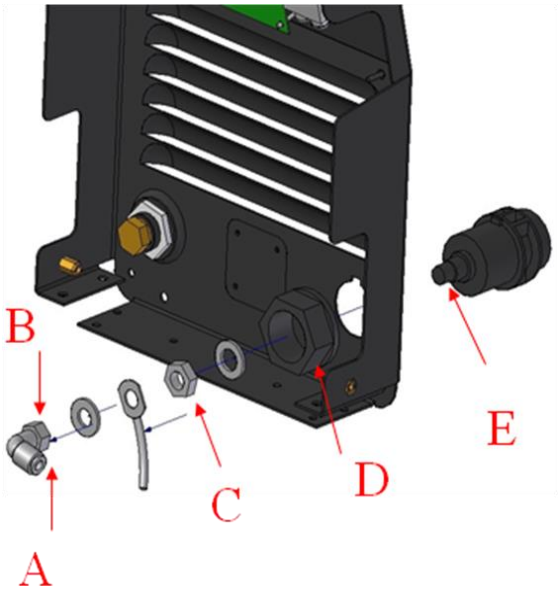
1. Unplug the air tube from the in/out position of the solenoid valve (**A**); this operation can be done by hand (no tool is necessary)
2. Unplug the harnesses from the J5 connector on the input board for the solenoid valve and unplug the harness on the pressure switch(wires for solenoid valve and pressure switch are together on the same J5 molex connector) (**B**);
3. Slip off the harness through the hole on the shelf (**C**)
4. Unscrew the two screws that fix the solenoid valve to the shelf (**D**)

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

NOTE: for the harness of the solenoid vale and pressure switch take a look at the machine schematics.

DISASSEMBLY OPERATIONS

AIR SYSTEM REMOVAL AND REPLACEMENT PROCEDURE
TORCH CONNECTOR DISASSEMBLY 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.

Necessary tools:
- Phillips screwdriver PH02
- wrench 13 mm;
- wrench 17 mm;
- adjustable wrench

1. Unplug the air tube from the the air inlet (**A**); this operation can be done by hand (no tool is necessary)
2. Unplug the torch molex connector J32 on the output board (look at the output board section)
3. Unscrew the pilot cable from the output board (see output board removal procedure)
4. Unscrew the air inlet using the wrench 13 mm (**B**)
5. Unscrew the copper nut with the wrench 17 mm (**C**)
6. Unscrew the plastic nut with the adjustable wrench (**D**)

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

NOTE: put a drop of glue (Loktite type) on the thread of the torch connector (**E**) before to assembly the air inlet.

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

Tomahawk 1025

Input Voltage	Input Current	Rated Output
400Vac/3ph/50Hz	14A	60A @ 40% duty cycle

Output current range	20 – 60 Amps

Maximum Open Circuit Voltage	320 Vdc

Pilot Current	20 Amps

Tomahawk 1538

Input Voltage	Input Current	Rated Output
400Vac/3ph/50Hz	30A	100A @ 40% duty cycle

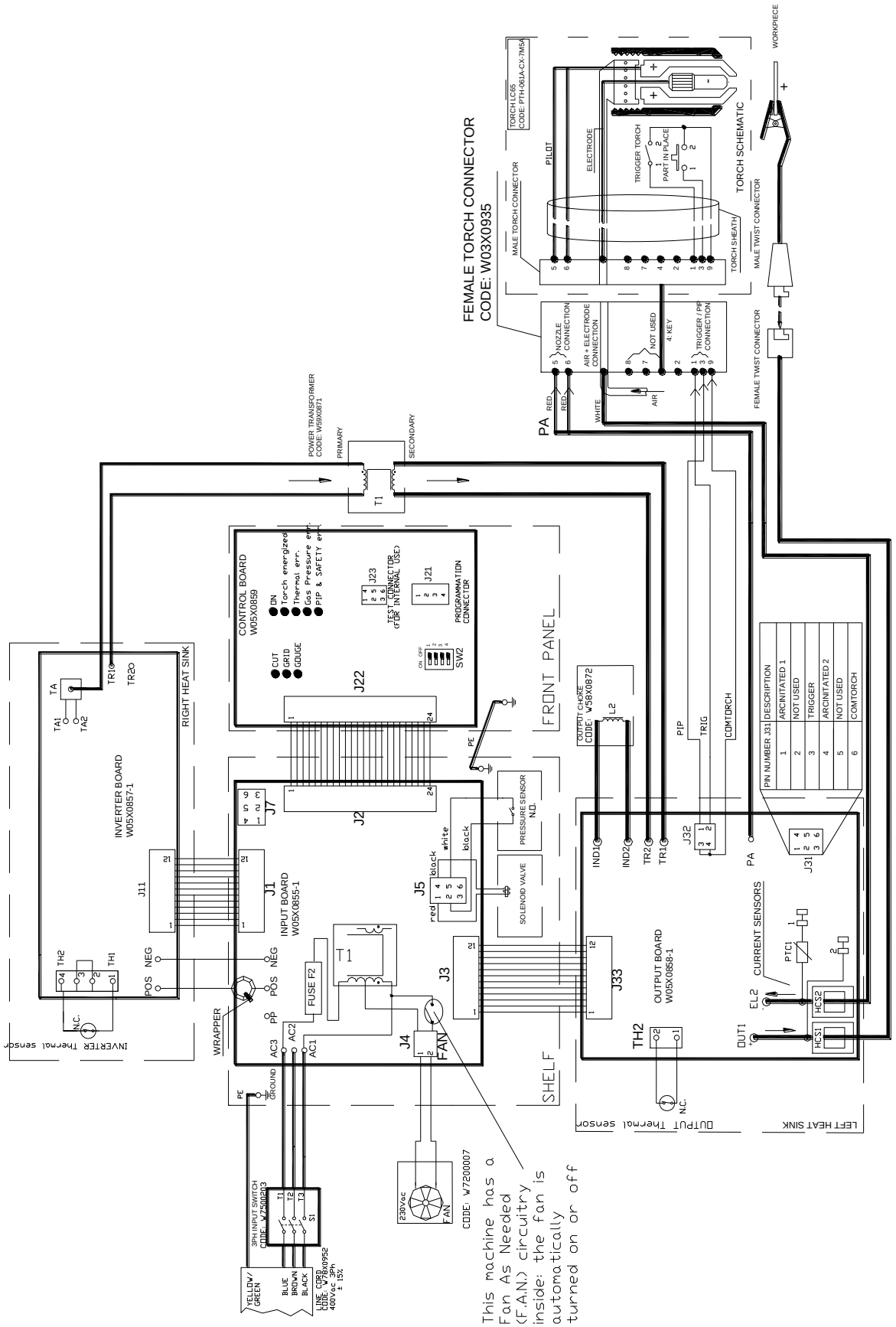
Output current range	20 – 100 Amps

Maximum Open Circuit Voltage	320 Vdc

Pilot Current	25 Amps

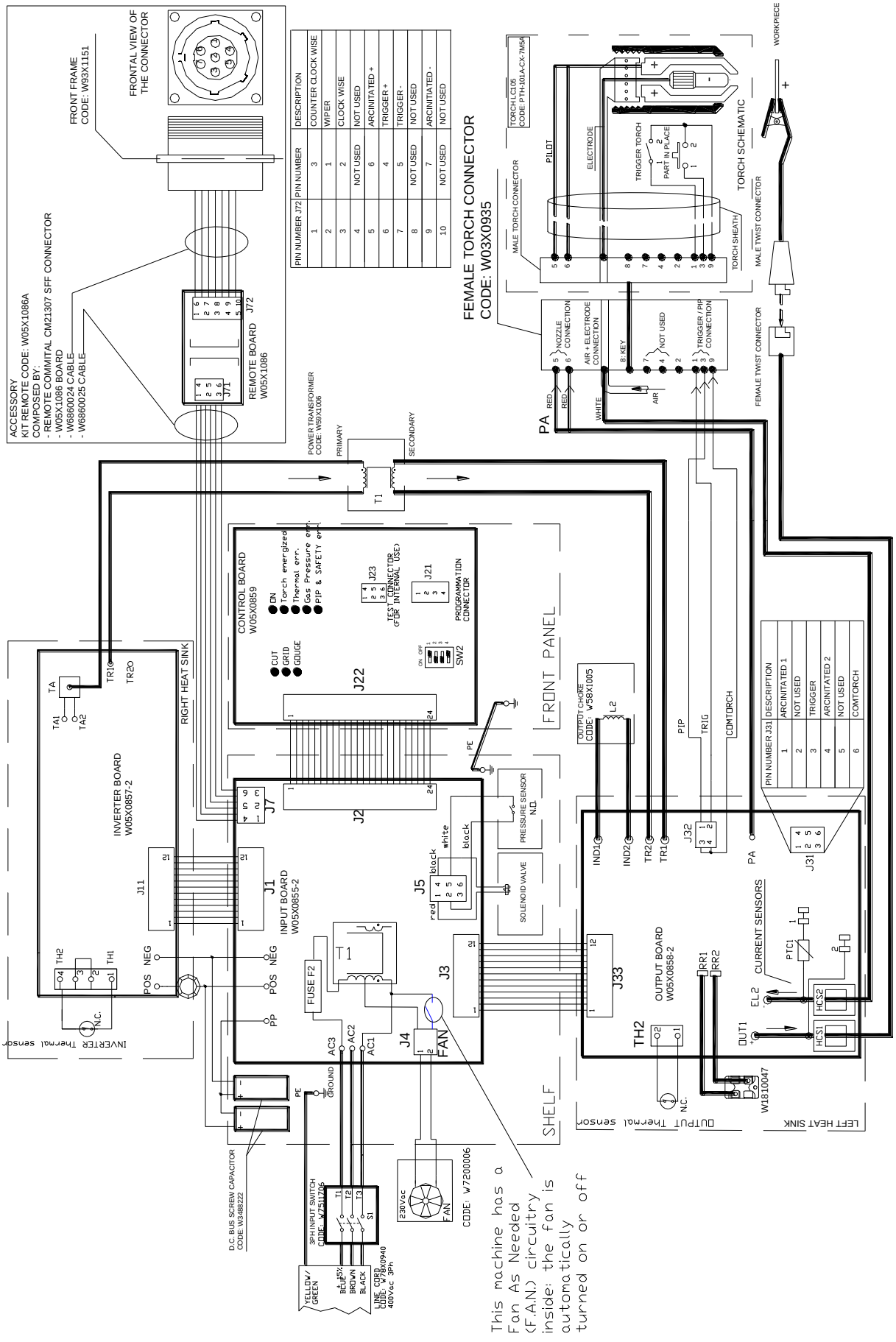
ELECTRICAL DIAGRAMS

TH1025 Code 52095



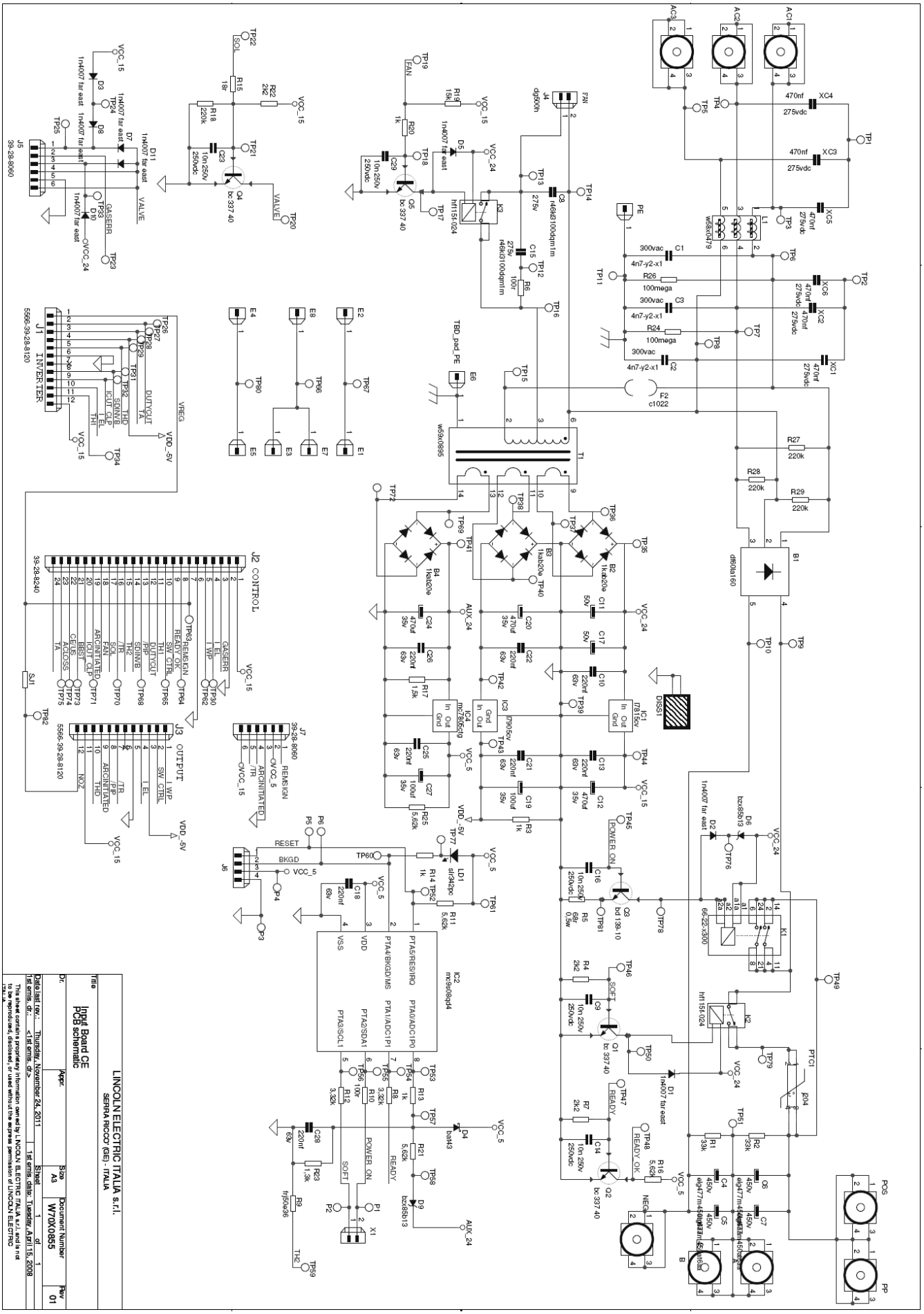
ELECTRICAL DIAGRAMS

TH1538 Code 52076

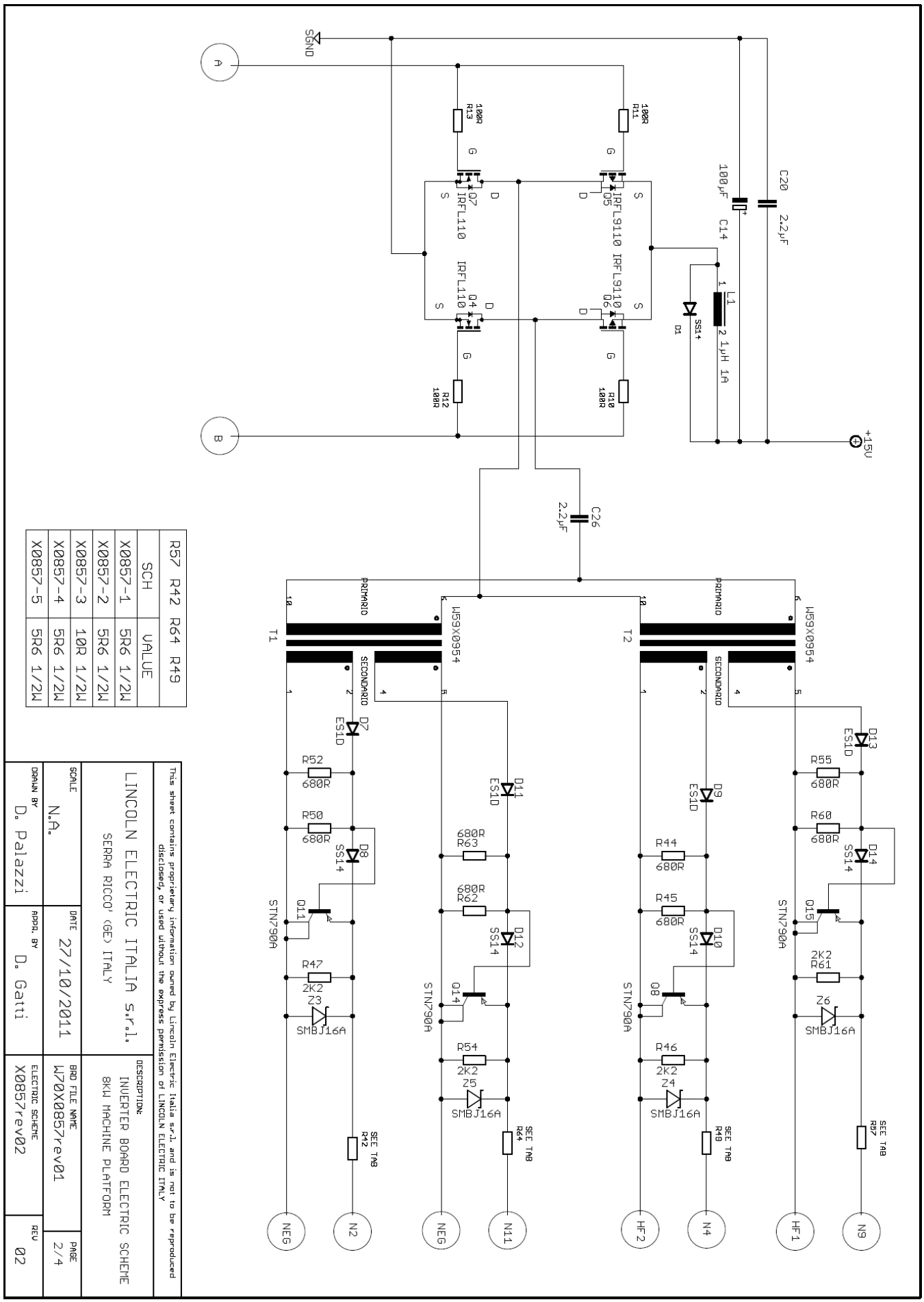


ELECTRICAL DIAGRAMS

INPUT BOARD SCHEMATIC X0855



INVERTER BOARD SCHEMATIC X0857 – IGBT DRIVER SECTION



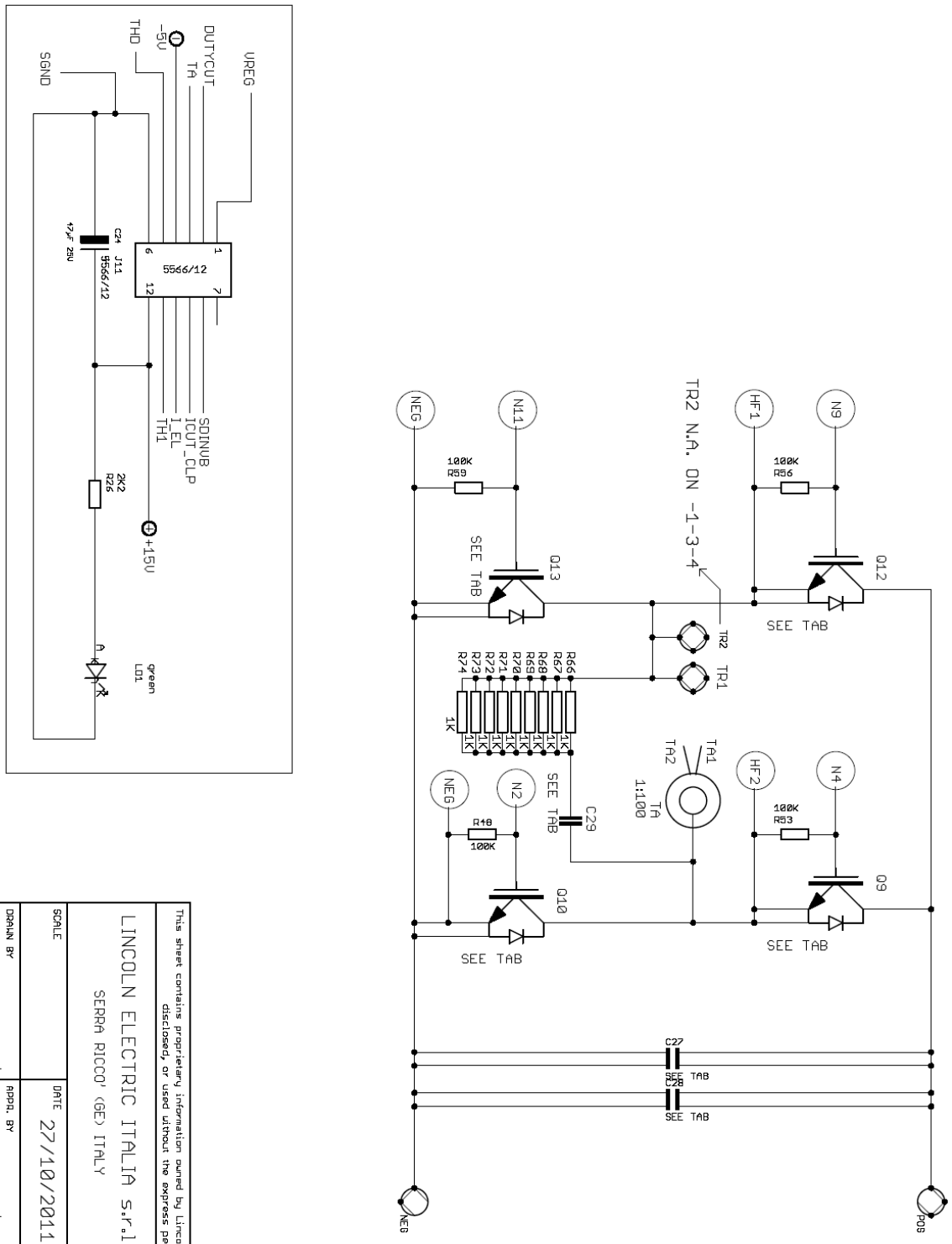
R57 R42 R64 R49	
SCH	VALUE
X0857-1	5R6 1/2W
X0857-2	5R6 1/2W
X0857-3	10R 1/2W
X0857-4	5R6 1/2W
X0857-5	5R6 1/2W

LINCOLN ELECTRIC ITALIA s.r.l.
SERRA RICCO' (GE) ITALY

DESCRIPTION:
INVERTER BOARD ELECTRIC SCHEME
8KW MACHINE PLATFORM

DRAWN BY	SCALE	DATE	APPR. BY	BRD FILE NAME	PAGE
D. Palazzi	N.A.	27/10/2011	D. Gatti	W70X0857rev01	2/4
ELECTRIC SCHEME: X0857rev02				REV: 02	

INVERTER BOARD SCHEMATIC X0857 – IGBT SECTION



C29	
SCH	VALUE
X0857-1	470pF 1000V
X0857-2	470pF 1000V
X0857-3	1nF 1000V
X0857-4	470pF 1000V
X0857-5	470pF 1000V

Q9, Q10, Q12, Q13	
SCH	VALUE
X0857-1	75A 1200V
X0857-2	100A 1200V
X0857-3	100V 600V
X0857-4	75A 1200V
X0857-5	75A 1200V

C27, C28	
SCH	VALUE
X0857-1	20µF 700V
X0857-2	5µF 700V
X0857-3	20µF 700V
X0857-4	20µF 700V
X0857-5	5µF 700V

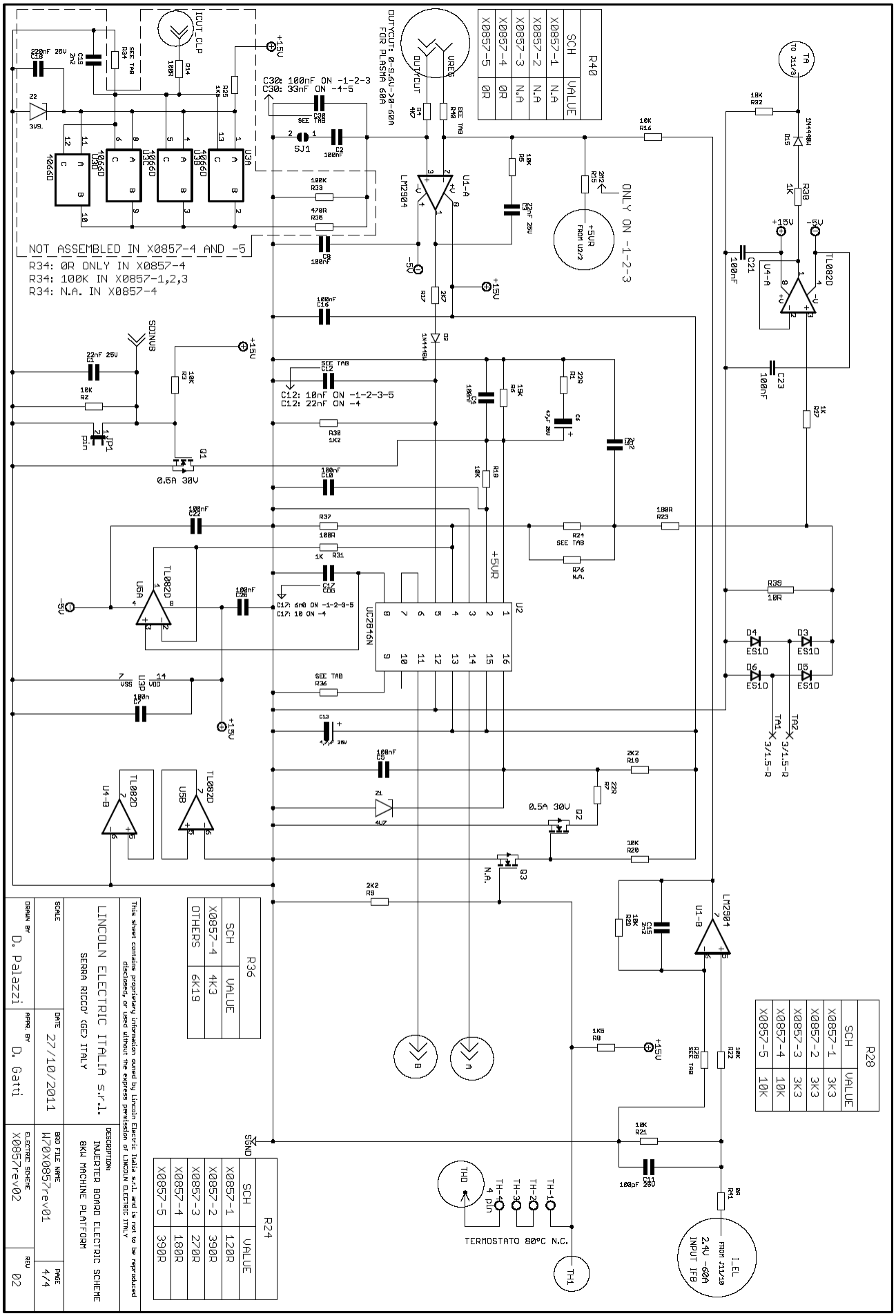
LINCOLN ELECTRIC ITALIA S.r.l.
SERRA RICCO' (GE) ITALY

DESCRIPTION:
INVERTER BOARD ELECTRIC SCHEME
8KW MACHINE PLATFORM

SCALE	
DATE	27/10/2011
DRAWN BY	D. Palazzi
APPR. BY	D. Gatti
BRD FILE NAME	W70X0857rev01
ELECTRIC SCHEME	X0857rev02
PAGE	3/4
REV	02

ELECTRICAL DIAGRAMS

INVERTER BOARD SCHEMATIC X0857 – CONTROL CIRCUIT SECTION



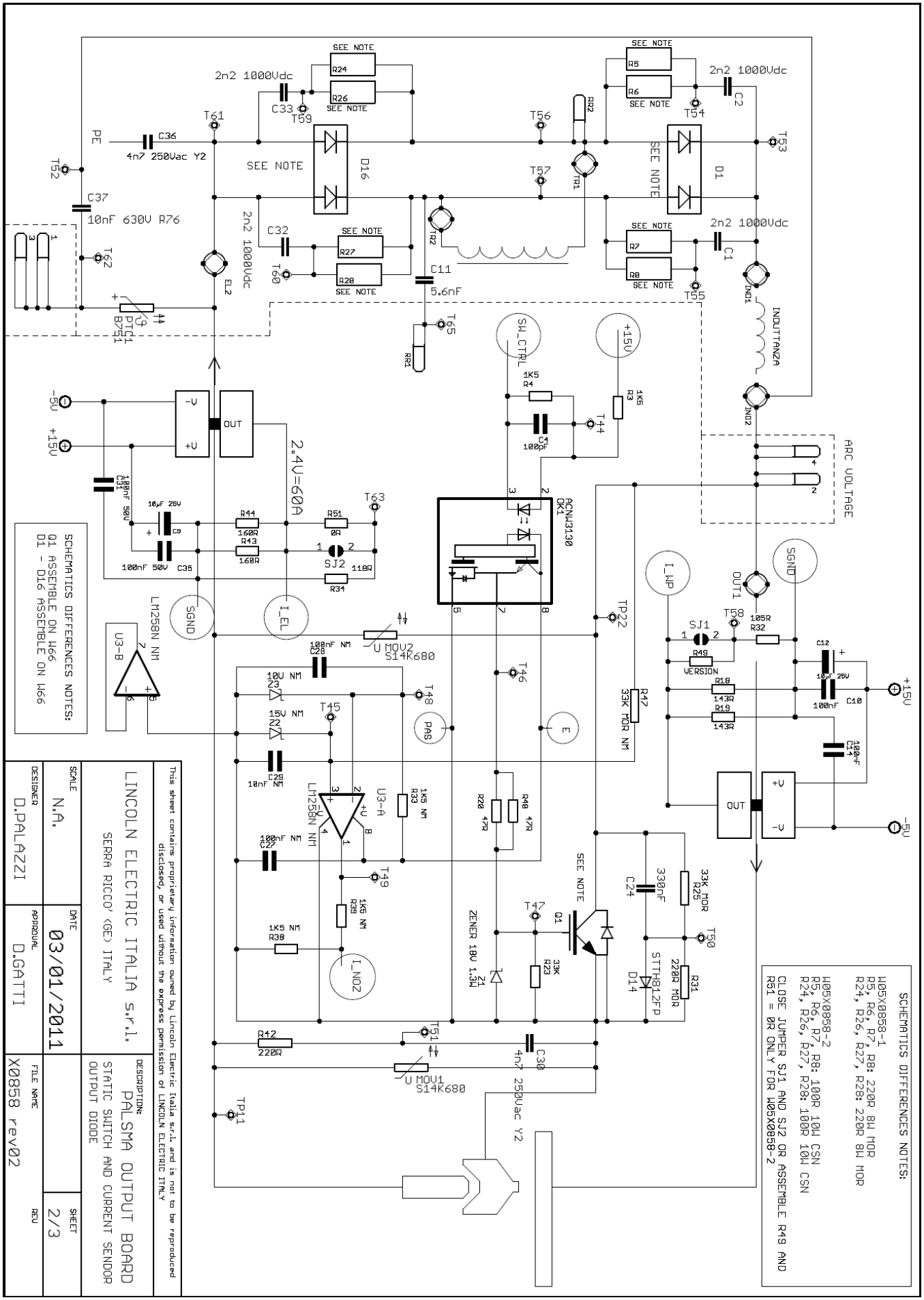
R40	
SCH	VALUE
X0857-1	N.A
X0857-2	N.A
X0857-3	N.A
X0857-4	0R
X0857-5	0R

R36	
SCH	VALUE
X0857-4	4K3
OTHERS	6K19

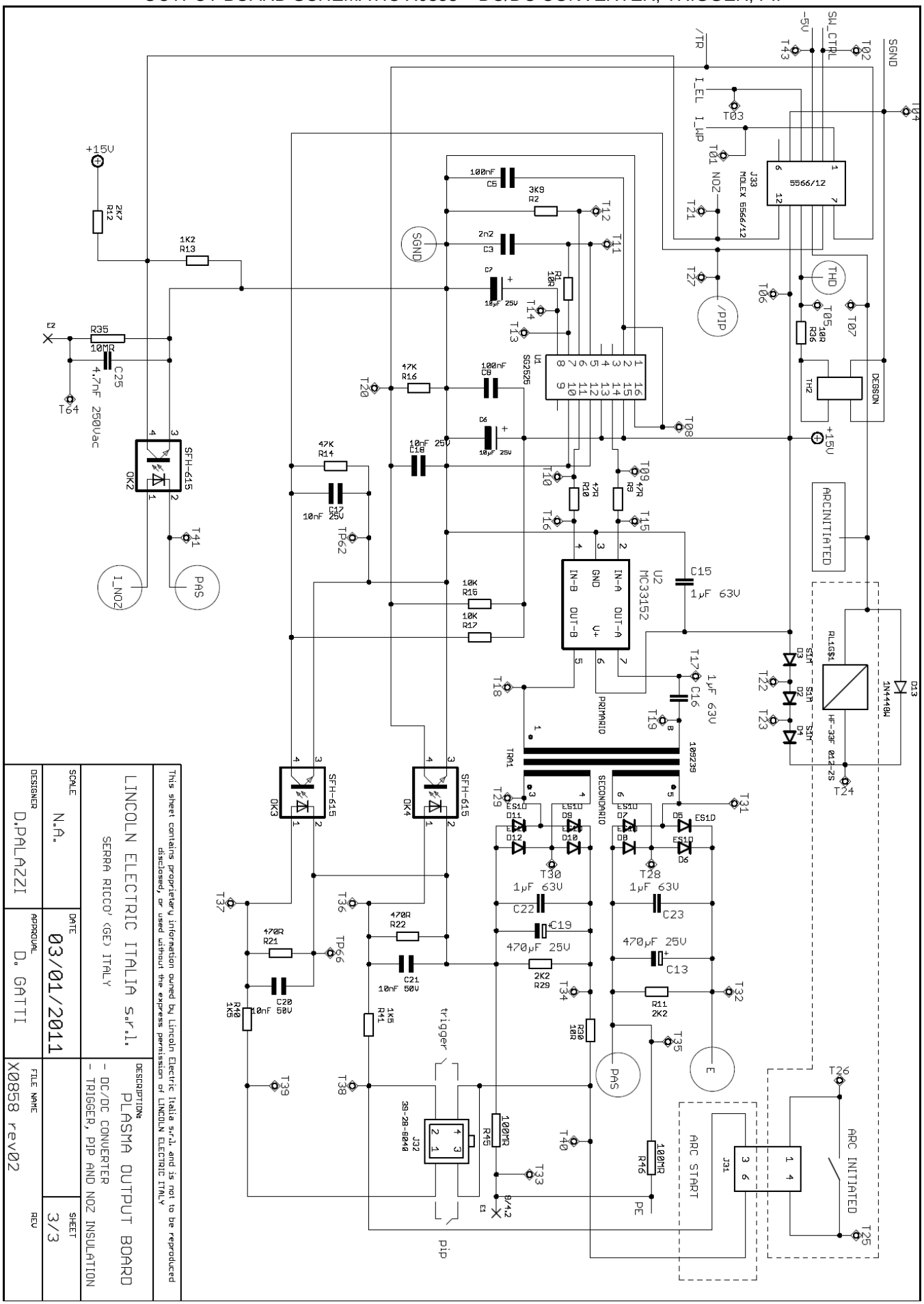
R24	
SCH	VALUE
X0857-1	120R
X0857-2	390R
X0857-3	270R
X0857-4	180R
X0857-5	390R

R28	
SCH	VALUE
X0857-1	3K3
X0857-2	3K3
X0857-3	3K3
X0857-4	10K
X0857-5	10K

OUTPUT BOARD SCHEMATIC X0858 – STATIC SWITCH AND CURRENT SENSOR

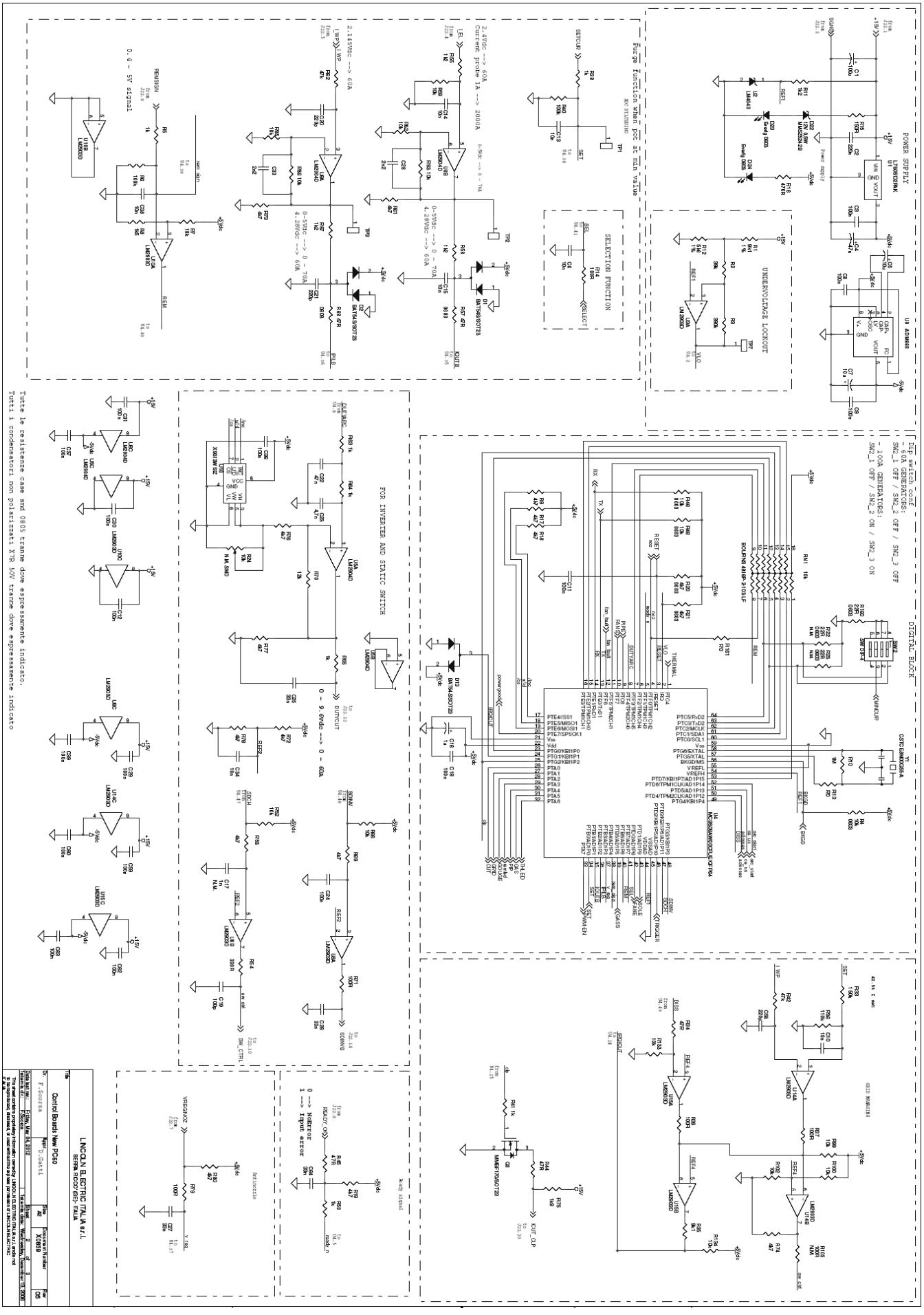


OUTPUT BOARD SCHEMATIC X0858 – DC/DC CONVERTER, TRIGGER, PIP



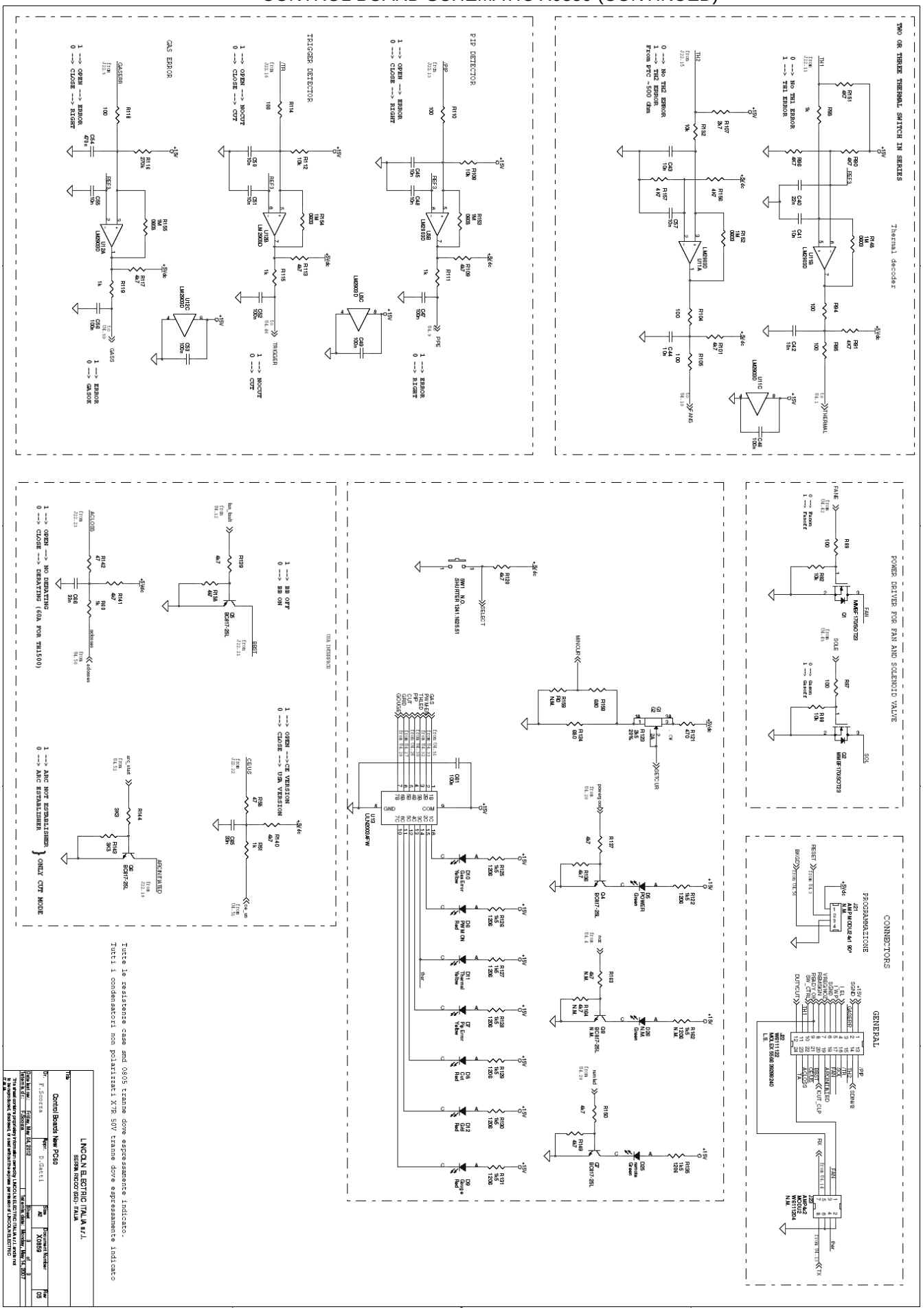
ELECTRICAL DIAGRAMS

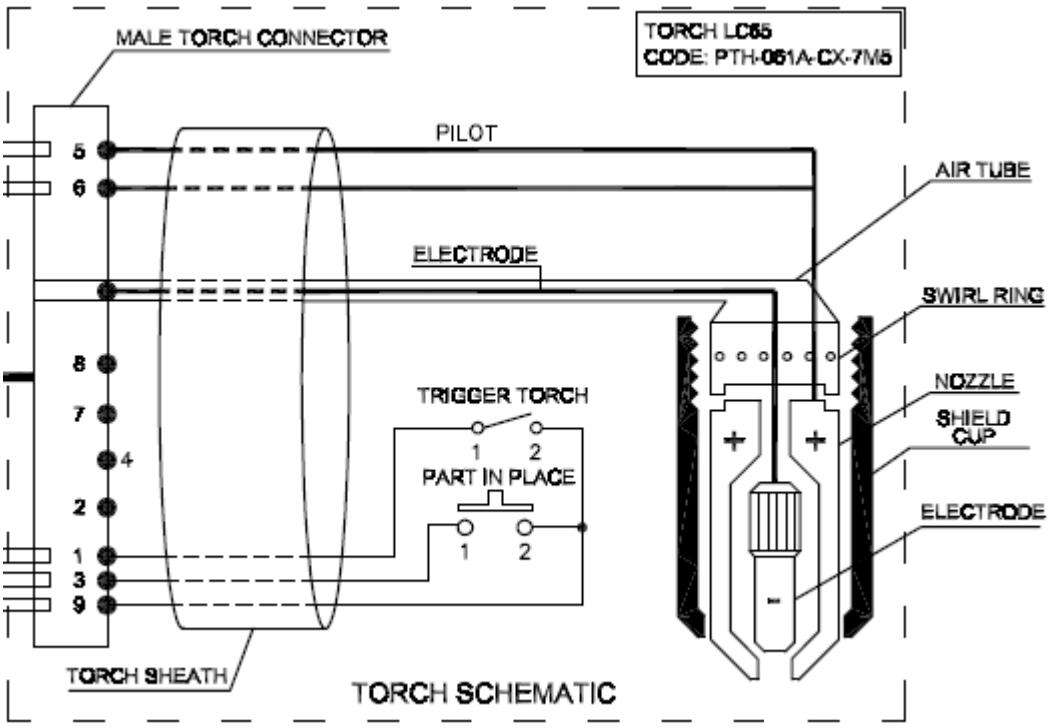
CONTROL BOARD SCHEMATIC X0859



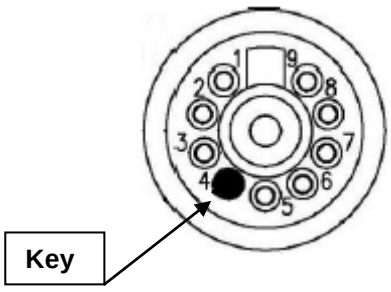
ELECTRICAL DIAGRAMS

CONTROL BOARD SCHEMATIC X0859 (CONTINUED)

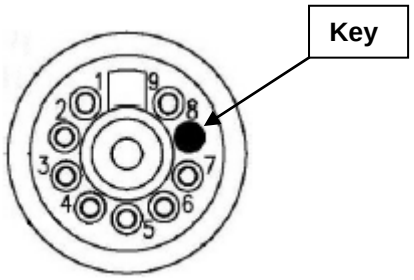




TORCH CONNECTOR - POLARIZATION KEY FOR TOMAHAWK 1025



TORCH CONNECTOR - POLARIZATION KEY FOR TOMAHAWK 1538

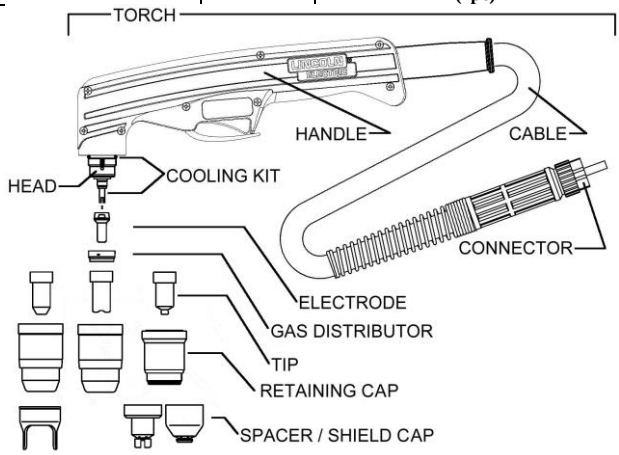


PLASMA TORCHES – LC65, LC65M, LC105 & LC105M

LC65

Torch (Hand 7.5m) (1pc)	PTH-061A-CX-7M5A
Torch (Hand 15m) (1pc)	PTH-061A-CX-15MA
Handle (1pc)	W0300609R
Head (1pc)	W0300608R

Cooling Kit (blister 1pc)	W03X0893-49R
Cable (7.5m) (1pc)	W0300604R
Cable (15m) (1pc)	W0300606R
Connector (1pc)	W03X0934-4R



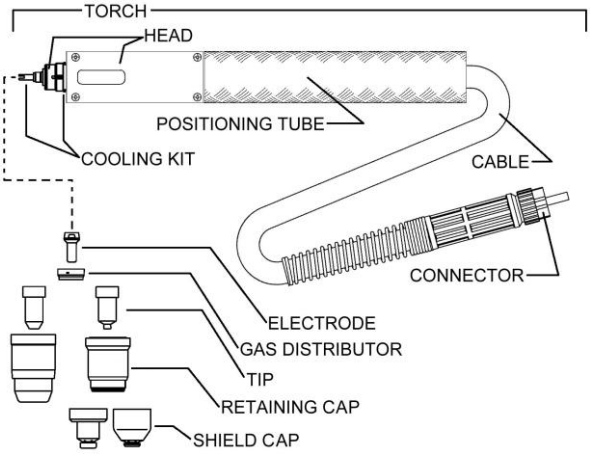
Cutting process	Electrode (blister 5pcs)		Gas Distr. (blister 3pcs)	Tip (blister 5pcs)			
40A	W03X0893-25A		W03X0893-50R	W03X0893-27A			
50A	W03X0893-25A		W03X0893-50R	W03X0893-28A			
60A	W03X0893-25A		W03X0893-50R	W03X0893-29A			
Dir Contact 40A	W03X0893-25A		W03X0893-50R		W03X0893-26A		
Contact 50A	W03X0893-25A		W03X0893-50R			W03X0893-33A	
Contact 60A	W03X0893-25A		W03X0893-50R			W03X0893-34A	
Ext Contact 40A		W03X0893-53A					W03X0893-40A
Ext Contact 60A		W03X0893-53A					W03X0893-54A
Gouging	W03X0893-25A		W03X0893-50R			W03X0893-39A	

Cutting process	Retaining Cap (blister 1pc)		Spacer (blister 2pcs)	Shield Cap (blister 2pcs)		
40A	W03X0893-41A		W03X0893-14R			
50A	W03X0893-41A		W03X0893-14R			
60A	W03X0893-41A		W03X0893-14R			
Dir Contact 40A	W03X0893-41A					
Contact 50A		W03X0893-43A		W03X0893-44A		
Contact 60A		W03X0893-43A		W03X0893-44A		
Ext Contact 40A					W03X0893-21A	
Ext Contact 60A					W03X0893-21A	
Gouging		W03X0893-43A				W03X0893-48A

LC65M

Torch (Machine 7.5m) (1pc)	PTM-061A-CX-7M5A
Torch (Machine 15m) (1pc)	PTM-061A-CX-15MA
Positioning tube (1pc)	W0300603R
Positioning tube (Gear Rack) (1pc)	W0300624R
Head (1pc)	W0300610R

Head (1pc)	W0300610R
Cooling Kit (blister 1pc)	W03X0893-49R
Cable (7.5m) (1pc)	W0300605R
Cable (15m) (1pc)	W0300607R
Connector (1pc)	W03X0934-4R



Cutting process	Electrode (blister 5pcs)	Gas Distr. (blister 3pcs)	Tip (blister 5pcs)	
40A	W03X0893-25A	W03X0893-50R	W03X0893-27A	
50A	W03X0893-25A	W03X0893-50R	W03X0893-28A	
60A	W03X0893-25A	W03X0893-50R	W03X0893-29A	
Shielded 40A	W03X0893-25A	W03X0893-50R		W03X0893-52A
Shielded 50A	W03X0893-25A	W03X0893-50R		W03X0893-33A
Shielded 60A	W03X0893-25A	W03X0893-50R		W03X0893-34A
Gouging	W03X0893-25A	W03X0893-50R		W03X0893-39A

Cutting process	Retaining Cap (blister 1pc)		Shield Cap (blister 2pcs)	
40A	W03X0893-41A			
50A	W03X0893-41A			
60A	W03X0893-41A			
Shielded 40A		W03X0893-43A	W03X0893-46A	
Shielded 50A		W03X0893-43A	W03X0893-46A	
Shielded 60A		W03X0893-43A	W03X0893-46A	
Gouging		W03X0893-43A		W03X0893-48A

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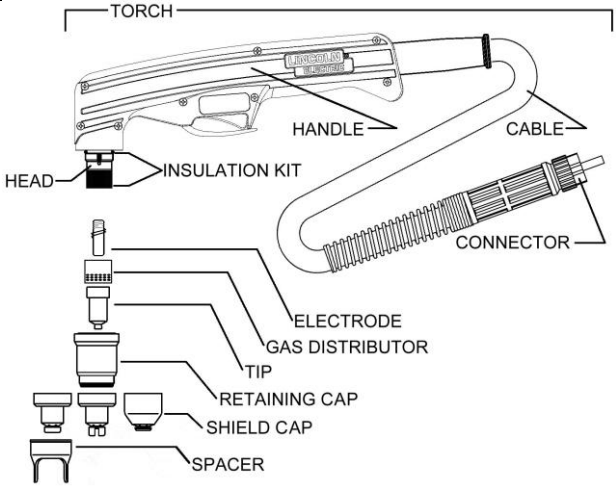
Torch (Hand 7.5m) (1pc)	PTH-101A-CX-7M5A
Torch (Hand 15m) (1pc)	PTH-101A-CX-15MA
Handle (1pc)	W0300609R
Head (1pc)	W0300618R

Insulation Kit (blister 1pc)	W03X0893-71R
Cable (7.5m) (1pc)	W0300620R
Cable (15m) (1pc)	W0300622R
Connector (1pc)	W03X0934-8R



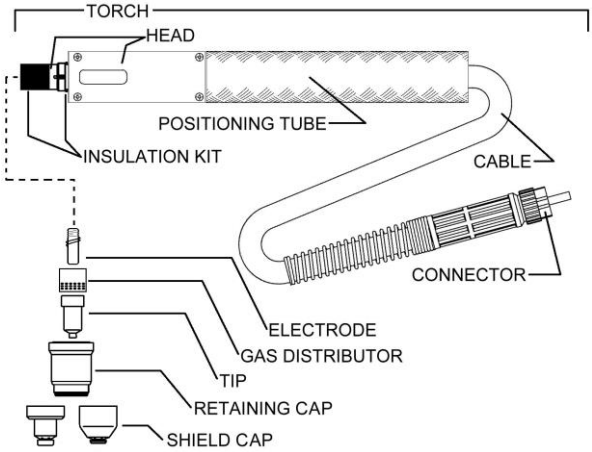
Cutting process	Electrode (blister 5pcs)		Gas Distr. (blister 2pcs)	Tip (blister 5pcs)	
40A	W03X0893-60A		W03X0893-70R	W03X0893-61A	
60A	W03X0893-60A		W03X0893-70R	W03X0893-62A	
80A	W03X0893-60A		W03X0893-70R	W03X0893-63A	
100A	W03X0893-60A		W03X0893-70R	W03X0893-64A	
Contact 40A	W03X0893-60A		W03X0893-70R	W03X0893-61A	
Contact 60A	W03X0893-60A		W03X0893-70R	W03X0893-62A	
Contact 80A	W03X0893-60A		W03X0893-70R	W03X0893-63A	
Contact 100A	W03X0893-60A		W03X0893-70R	W03X0893-64A	
Ext Contact 40A		W03X0893-57A			W03X0893-58A
Ext Contact 60A		W03X0893-57A			W03X0893-59A
Ext Contact 80A		W03X0893-57A			W03X0893-72A
Ext Contact 100A		W03X0893-57A			W03X0893-73A
Gouging	W03X0893-60A		W03X0893-70R	W03X0893-65A	

Cutting process	Retaining Cap (blister 1pc)	Spacer (blister 2pcs)	Shield Cap (blister 2pcs)			
40A	W03X0893-66A	W03X0893-14R	W03X0893-68A			
60A	W03X0893-66A	W03X0893-14R	W03X0893-68A			
80A	W03X0893-66A	W03X0893-14R	W03X0893-68A			
100A	W03X0893-66A	W03X0893-14R	W03X0893-68A			
Contact 40A	W03X0893-66A			W03X0893-67A		
Contact 60A	W03X0893-66A			W03X0893-67A		
Contact 80A	W03X0893-66A			W03X0893-67A		
Contact 100A	W03X0893-66A			W03X0893-67A		
Ext Contact 40A					W03X0893-74A	
Ext Contact 60A					W03X0893-74A	
Ext Contact 80A					W03X0893-74A	
Ext Contact 100A					W03X0893-74A	
Gouging	W03X0893-66A					W03X0893-69A

LC105M, LC105M GEAR RACK

Torch (Machine 7.5m) (1pc)	PTM-101A-CX-7M5A
Torch (Machine 15m) (1pc)	PTM-101A-CX-15MA
Positioning tube (Machine) (1pc)	W0300603R
Positioning tube (Gear Rack) (1pc)	W0300624R

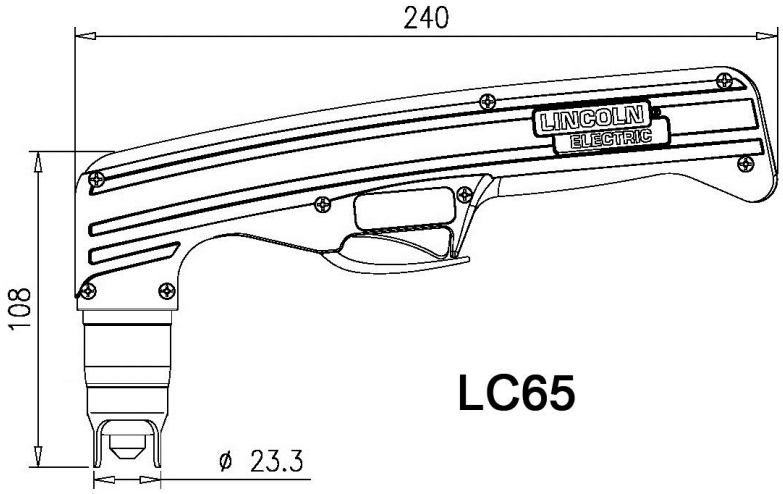
Head (1pc)	W0300619R
Insulation Kit (blister 1pc)	W03X0893-71R
Cable (7.5m) (1pc)	W0300621R
Cable (15m) (1pc)	W0300623R
Connector (1pc)	W03X0934-8R



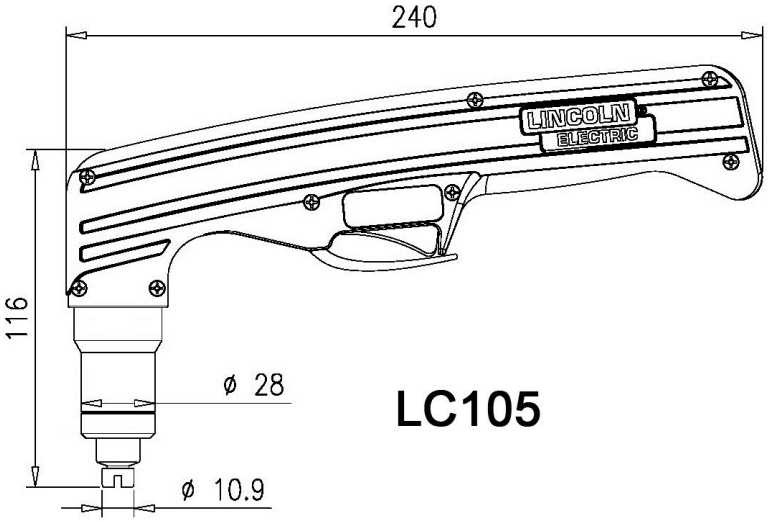
Cutting process	Electrode (blister 5pcs)	Gas Distr. (blister 2pcs)	Tip (blister 5pcs)
40A	W03X0893-60A	W03X0893-70R	W03X0893-61A
60A	W03X0893-60A	W03X0893-70R	W03X0893-62A
80A	W03X0893-60A	W03X0893-70R	W03X0893-63A
100A	W03X0893-60A	W03X0893-70R	W03X0893-64A
Gouging	W03X0893-60A	W03X0893-70R	W03X0893-65A

Cutting process	Retaining Cap (blister 1pc)	Shield Cap (blister 2pcs)	
40A	W03X0893-66A	W03X0893-68A	
60A	W03X0893-66A	W03X0893-68A	
80A	W03X0893-66A	W03X0893-68A	
100A	W03X0893-66A	W03X0893-68A	
Gouging	W03X0893-66A		W03X0893-69A

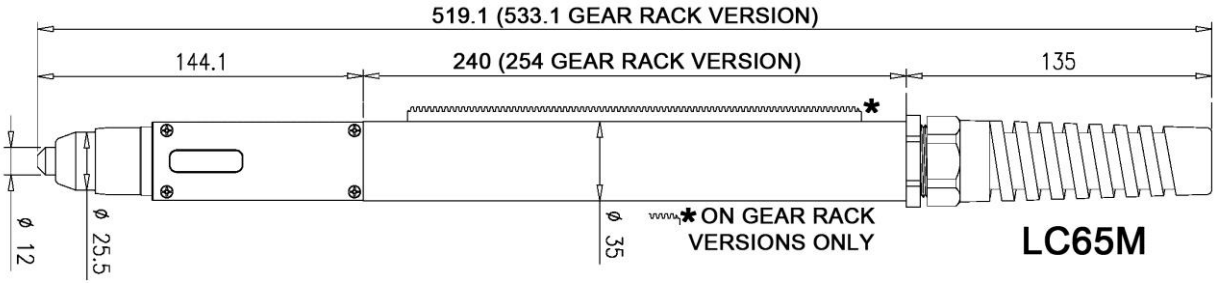
TORCHES DIMENSIONS



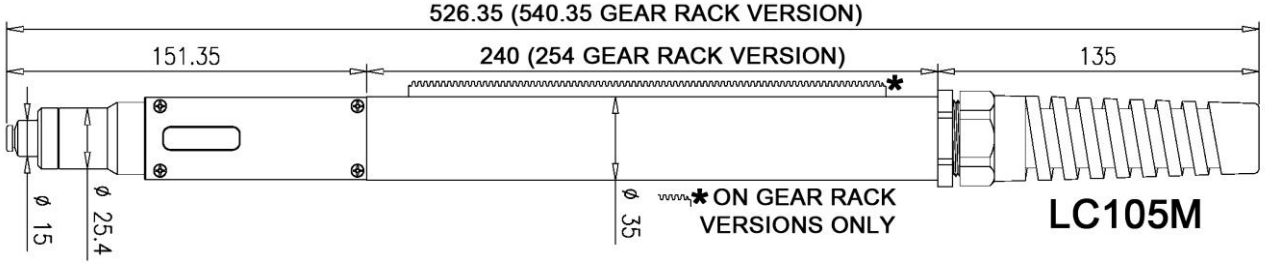
LC65



LC105



LC65M



LC105M

NOTE