SVM 3147
Rev.00 05-2021

SPEEDTEC® 400SP, 500SP

For use with machines having code numbers: 50547, 50548

SERVICE MANUAL

LINCOLN ELECTRIC EUROPE
www.lincolnelectric.eu

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TECHNICAL SPECIFICATIONS

NAME	INDEX
SPEEDTEC® 400SP	**K14258-1**
SPEEDTEC® 500SP	**K14259-1**

INPUT			
	Input Voltage U_1	EMC Class	Frequency
400SP	400V ± 15% 3-phase	A	50/60Hz
500SP			
	Input Power at Rated Cycle	Input Amperes I_{1max}	PF
400SP	20 kVA @ 100% Duty Cycle (40°C)	28 A	0,93
500SP	25 kVA @ 60% Duty Cycle (40°C)	36 A	

RATED OUTPUT					
		Open Circuit Voltage	Duty Cycle 40°C (based on a 10 min. period)	Output Current	Output Voltage
400SP	GMAW	65Vdc	100%	420A	35Vdc
	FCAW		100%	420A	35Vdc
	SMAW		100%	420A	36,8Vdc
	GTAW		100%	420A	26,8Vdc
500SP	GMAW	65Vdc	60%	500A	39Vdc
			100%	420A	35Vdc
	FCAW		60%	500A	39Vdc
			100%	420A	35Vdc
	SMAW		60%	500A	40Vdc
			100%	420A	36,8Vdc
	GTAW		60%	500A	30Vdc
			100%	420A	26,8Vdc

WELDING CURRENT RANGE				
	GMAW	FCAW	SMAW	GTAW
400SP	20A÷420A	20A÷420A	15A÷420A	15A÷420A
500SP	20A÷500A	20A÷500A	15A÷500A	15A÷500A

WELDING VOLTAGE REGULATION RANGE		
	GMAW	FCAW
400SP	10V÷ 45V	10V÷ 45V
500SP		

RECOMMENDED INPUT CABLE AND FUSE SIZES		
	Fuse Type gR or Circuit Breaker Type Z	Power Lead
	400V	
400SP	25A	4 Conductor, 4mm^2
500SP	32A	4 Conductor, 4mm^2

DIMENSION				
	Weight	Height	Width	Length
400SP	53,5 kg	550 mm	295 mm	625 mm
500SP	54,5 kg	550 mm	295 mm	625 mm
OTHERS				
	Protection Rating		Operating Humidity (t=20°C)	
400SP	IP23		≤ 90 %	
500SP				
	Operating Temperature		Storage Temperature	
400SP	from -10 ºC to +40 ºC		from -25 ºC to +55 ºC	
500SP				

ECO design information

The equipment has been designed in order to be compliant with the Directive 2009/125/EC and the Regulation 2019/1784/EU.

Efficiency and idle power consumption:

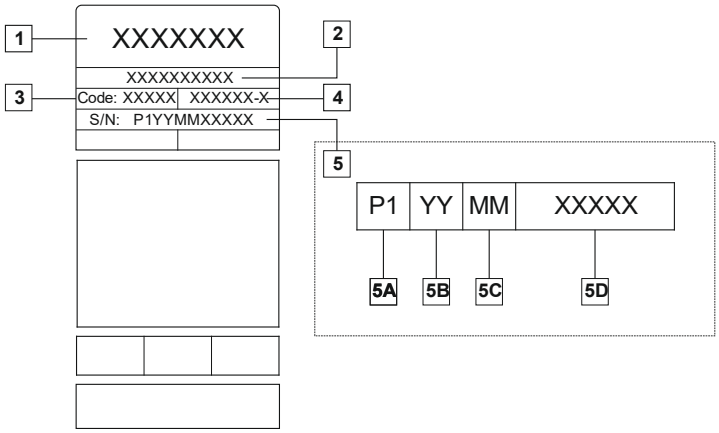
Index	Name	Efficiency when max power consumption / Idle power consumption		Equivalent model
K14258-1	**SPEEDTEC® 400SP**	85%	Level I: 39W	No equivalent model
			Level II: 2,5W	No equivalent model
K14259-1	**SPEEDTEC® 500SP**	85%	Level I: 39W	No equivalent model
			Level II: 2,5W	No equivalent model

Idle state occurs under the condition specified in below table

IDLE STATE		
Condition	**Presence**	
	Level I	**Level II**
MIG/TIG/STICK modes	X	X
Water Cooler off	X	X
Fan off	X	X
Wire Feeder / Remote Control off	-	X
After X* minutes of non-working	X	X
* - adjusted in range of 10÷300 minutes		

The value of efficiency and consumption in idle state have been measured by method and conditions defined in the product standard EN 60974-1:20XX.

Manufacturer's name, product name, code number, product number, serial number and date of production can be read from rating plate.



Where:

- **1-** Manufacturer name and address
- **2-** Product name
- **3-** Code number
- **4-** Product number
- **5-** Serial number
  - **5A-** country of production
  - **5B-** year of production
  - **5C-** month of production
  - **5D-** progressive number different for each machine

Typical gas usage for **MIG/MAG** equipment:

Material type	Wire diameter [mm]	DC electrode positive		Wire Feeding [m/min]	Shielding Gas	Gas flow [l/min]
		Current [A]	Voltage [V]			
Carbon, low alloy steel	0,9 ÷ 1,1	95 ÷ 200	18 ÷ 22	3,5 – 6,5	Ar 75%, CO_2 25%	12
Aluminium	0,8 ÷ 1,6	90 ÷ 240	18 ÷ 26	5,5 – 9,5	Argon	14 ÷ 19
Austenic stainless steel	0,8 ÷ 1,6	85 ÷ 300	21 ÷ 28	3 - 7	Ar 98%, O_2 2% / He 90%, Ar 7,5% CO_2 2,5%	14 ÷ 16
Copper alloy	0,9 ÷ 1,6	175 ÷ 385	23 ÷ 26	6 - 11	Argon	12 ÷ 16
Magnesium	1,6 ÷ 2,4	70 ÷ 335	16 ÷ 26	4 - 15	Argon	24 ÷ 28

Tig Process:

In TIG welding process, gas usage depends on cross-sectional area of the nozzle. For comonnly used torches:

Helium: 14-24 l/min
Argon: 7-16 l/min

Notice: Excessive flow rates causes turbulence in the gas stream which may aspirate atmospheric contamination into the welding pool.

Notice: A cross wind or draft moving can disrupt the shielding gas coverage, in the interest of saving of protective gas use screen to block air flow.

End of life

At end of life of product, it has to be disposal for recycling in accordance with Directive 2012/19/EU (WEEE), information about the dismantling of product and Critical Raw Material (CRM) present in the product, can be found at https://www.lincolnelectric.com/en-gb/support/Pages/operator-manuals-eu.aspx

Electromagnetic Compatibility (EMC)

01/11

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

This machine has been designed to operate in an industrial area. The operator must install and operate this equipment as described in this manual. If any electromagnetic disturbances are detected the operator must put in place corrective actions to eliminate these disturbances with, if necessary, assistance from Lincoln Electric.
This equipment does not comply with IEC 61000-3-12. If it is connected to a public low-voltage system, it is responsibility of the installer or user of the equipment to ensure, by consultation with the distribution network operator if necessary, that the equipment may be connected.

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

Input and output cables, control cables, and telephone cables that are in or adjacent to the work area and the machine.

Radio and/or television transmitters and receivers. Computers or computer controlled equipment.

Safety and control equipment for industrial processes. Equipment for calibration and measurement.

Personal medical devices like pacemakers and hearing aids.

Check the electromagnetic immunity for equipment operating in or near the work area. The operator must be sure that all equipment in the area is compatible. This may require additional protection measures.

The dimensions of the work area to consider will depend on the construction of the area and other activities that are taking place.

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

Connect the machine to the input supply according to this manual. If disturbances occur if may be necessary to take additional precautions such as filtering the input supply.

The output cables should be kept as short as possible and should be positioned together. If possible connect the work piece to ground in order to reduce the electromagnetic emissions. The operator must check that connecting the work piece to ground does not cause problems or unsafe operating conditions for personnel and equipment.

Shielding of cables in the work area can reduce electromagnetic emissions. This may be necessary for special applications.

WARNING

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

WARNING

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

Safety

11/04

WARNING

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

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

	WELDING SPARKS CAN CAUSE FIRE OR EXPLOSION: Remove fire hazards from the welding area and have a fire extinguisher readily available. Welding sparks and hot materials from the welding process can easily go through small cracks and openings to adjacent areas. Do not weld on any tanks, drums, containers, or material until the proper steps have been taken to insure that no flammable or toxic vapors will be present. Never operate this equipment when flammable gases, vapors or liquid combustibles are present.
	WELDED MATERIALS CAN BURN: Welding generates a large amount of heat. Hot surfaces and materials in work area can cause serious burns. Use gloves and pliers when touching or moving materials in the work area.
	CYLINDER MAY EXPLODE IF DAMAGED: Use only compressed gas cylinders containing the correct shielding gas for the process used and properly operating regulators designed for the gas and pressure used. Always keep cylinders in an upright position securely chained to a fixed support. Do not move or transport gas cylinders with the protection cap removed. Do not allow the electrode, electrode holder, work clamp or any other electrically live part to touch a gas cylinder. Gas cylinders must be located away from areas where they may be subjected to physical damage or the welding process including sparks and heat sources.
	MOVING PARTS ARE DANGEROUS: There are moving mechanical parts in this machine, which can cause serious injury. Keep your hands, body and clothing away from those parts during machine starting, operating and servicing.
	SAFETY MARK: This equipment is suitable for supplying power for welding operations carried out in an environment with increased hazard of electric shock.

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

Introduction

SPEEDTEC® 400SP&500SP are multi-process inverter power sources that work with digital wire feeders and the ArcLink® protocol is used for communication.
Power source with wire feeder allows the welding of:
GMAW (MIG/MAG)
FCAW-GS / FCAW-SS
SMAW (MMA)
GTAW (arc ignition using lift TIG).
GOUGING CAG

SPEEDTEC® 400SP&500SP work with the water cooler **COOLARC® 60**.

The complete packaging includes the following items:
Power source
USB with Operator's Manual
Welding cable with ground clamp- 3m
Slow-blow fuse – 2A (2 units)
Slow-blow fuse – 6,3A (1 unit)
Slow –blow fuse – 12.5A (1 unit).
Gas hose -2m

Recommended option and accessories, which can be bought separatelly by user, you can find in the chapter "Accessories".

Installation and Operator Instructions

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

Location and Environment

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

Do not place or operate this machine on a surface with an incline greater than 15° from horizontal.

Do not use this machine for pipe thawing.

This machine must be located where there is free circulation of clean air without restrictions for air movement to and from the air vents. Do not cover the machine with paper, cloth or rags when switched on.

Dirt and dust that can be drawn into the machine should be kept to a minimum.

This machine has a protection rating of IP23. Keep it dry when possible and do not place it on wet ground or in puddles.

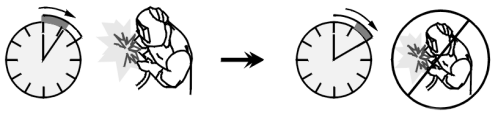
Locate the machine away from radio controlled machinery. Normal operation may adversely affect the operation of nearby radio controlled machinery, which may result in injury or equipment damage. Read the section on electromagnetic compatibility in this manual.

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

Duty cycle and Overheating

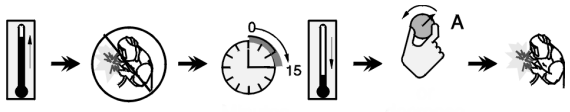
The duty cycle of a welding machine is the percentage of time in a 10 minute cycle at which the welder can operate the machine at rated welding current.

Example: 60% duty cycle



Welding for 6 minutes. Break for 4 minutes.

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



Minutes or decrease duty cycle

Input Supply Connection

⚠ WARNING

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

Check the input voltage, phase, and frequency supplied to this machine before turning it on. Verify the connection of grounding wires from the machine to the input source. **SPEEDTEC® 400SP&500SP** can only be connected to a mating grounded receptacle.
Input voltages is 3x400V 50/60Hz. For more information about input supply refer to the technical specification section of this manual and to the rating plate of the machine.

Make sure that the amount of mains power available from the input supply is adequate for normal operation of the machine. The type of protection and cable sizes are indicated in the technical specification section of this manual.

⚠ WARNING

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

⚠ WARNING

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

Refer to points [1], and [8] of the images below.

Output Connections

Refer to points [5], [6] and [7] of the Figures below.

Controls and Operational Features

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

2. Status Light: A two color light that indicates system errors. Normal operation is steady green light. Error conditions are indicated, per Table 1.

NOTE: The status light will flash green, and sometimes red and green, for up to one minute when the machine is first turned on. When the power source is powered it can take as long as 60 seconds for the machine to be ready to weld. This is a normal situation as the machine goes through initialization.

Table 1.

LED Light Condition	Meaning Only machines which using ArcLink® protocol for communication
Steady Green	System OK. Power source is operational, and is communicating normally with all healthy peripheral equipment.
Blinking Green	Occurs during power up or a system reset, and indicates the power source is mapping (identifying) each component in the system. Normal for first 1-10 seconds after power is turned on, or if the system configuration is changed during operation.
Alternating Green and Red	If the status lights are flashing any combination of red and green, errors are present in the power source. Individual code digits are flashed in red with a long pause between digits. If more than one code is present, the codes will be separated by green light. Read the error code before the machine is turned off. If occurs, to clear the error 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 authorized technical service center or Lincoln Electric and report the error code read.
Steady Red	Indicate no communication between the power source and device which has been connected to this power source.

3. Thermal Overload Indicator: It indicates that the machine is overloaded or that the cooling is not sufficient.

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

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

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

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

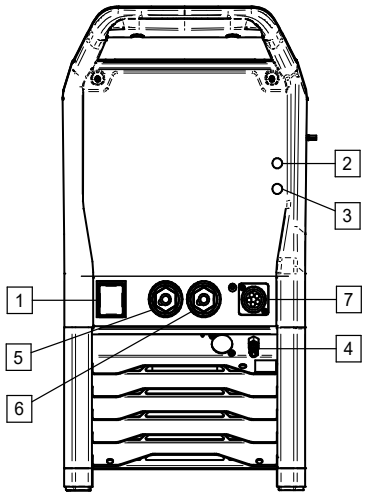


Figure 1.

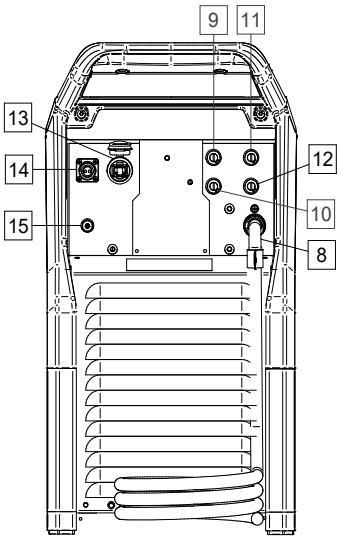


Figure 2.

8. Power lead (5m without plug): Connect the supply plug to the existing input cable that is rated for the machine as indicated in this manual, and conforms to all applicable standards. This connection shall be performed by a qualified person only.

9. Fuse F3: Use the 12,5A/400V (6,3x32mm) slow-blow fuse. See "Spare Parts" chapter.

10. Fuse F4: Use the 6,3A/400V (6,3x32mm) slow-blow fuse. See "Spare Parts" chapter.

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

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

13. Ethernet Socket: Allows to connect the power source directly to a computer or to a network for software updates , diagnostics (Power Wave Manager) or production monitoring (CheckPoint®).

14. Gas Heater Socket: U_{sup} = 24VAC, P_{max} = 80W.

15. Gas Connector: For connection a gas hose from cylinder.

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

Welding Cables Connection

Insert the plug of the work lead into the socket [5]. The other end of this lead connects to the work piece with the work clamp.

Connect the wire feeder to the power source:
Insert the positive welding cable into the output socket [6].
Insert the wire feeder control cable into the socket [7] (see "Accessories" chapter, Source/wire feeder cable K10198-PG-xM or K10199-PGW-xM).

Use the shortest possible cable lengths.

Water Cooler Connection

SPEEDTEC® 400SP&500SP work with the water cooler **COOLARC® 60** (see "Accessories" chapter).

⚠ WARNING

Read and understand the cool er manual before connecting it to the power source.
Before connecting cooler, refer to the manual of wire feeder.

The **COOLARC® 60** is supplied by welding power source using 10-PIN socket.
Input voltages is 400V, 50/60Hz. Connect the cooler in accordance with the instructions supplied with COOLARC® 60.

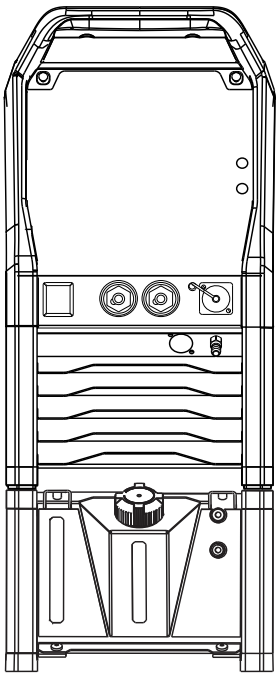


Figure 3.

Connection to the Ethernet network

SPEEDTEC® 400SP&500SP is equipped with an ethernet communication interface (RJ45 socket).

Default power source settings are designated to Direct Connection where PC IP address is set to range 169.254.0.

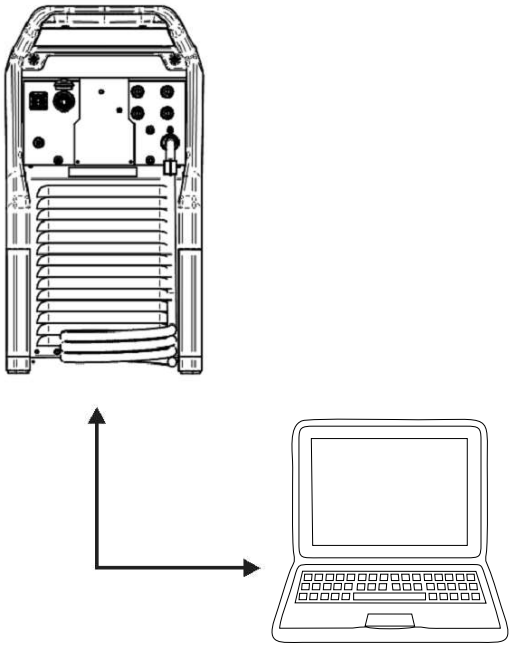
SPEEDTEC® default factory settings	
DHCP	off
IP Address	**169.254.0.2**
Subnet Mask	255.255.255.0
Default gateway	169.254.0.1

SPEEDTEC® with PC Connection

According to network infrastructure we can distinguish 2 different connection types:

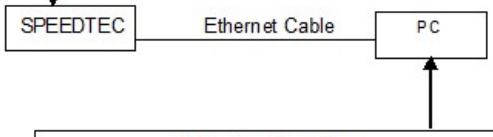
1. Direct Connection
2. Local Area Network
   a) with static IP addresses
   b) with dynamic IP addresses (DHCP server, e.g. Router)

Direct Connection



The simplest case where SPEEDTEC® is connected to PC with one, common ethernet cable.

SPEEDTEC default factory	
DHCP	off
IP Address	**169.254.0.2**
Subnet Mask	255.255.255.0
Default gateway	169.254.0.1



PC network settings	
DHCP	off
IP Address	**169.254.0.3**
Subnet Mask	255.255.255.0
Default gateway	169.254.0.1

Use above network settings for your PC.
Please refer guide how to change TCP/IP settings (IP address) in your PC operating system available in your system help or internet.

WARNING

Sometimes 5 minutes delay is require after ethernet cable was connected to establish the connection between SPEEDTEC® and PC (especially when your PC was set to Obtain an IP address automatically" from DHCP server before).

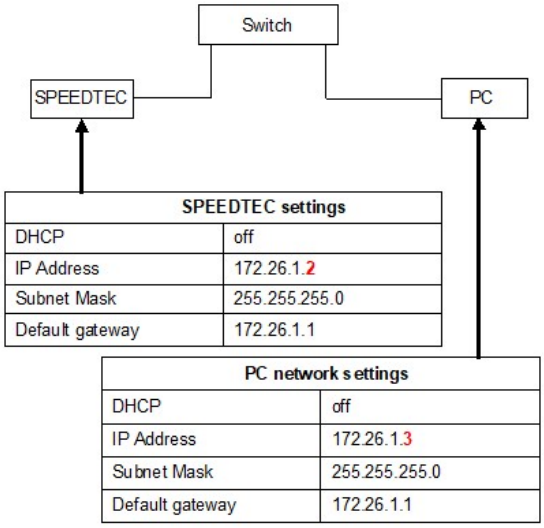
2. Local Area Network

a) Static IP Addresses

When SPEEDTEC® is connected to the network which is equipped with a Hub or Switch (no DHCP server) it is required to set proper IP address from the actual subnetwork range to SPEEDTEC® and PC.

Example:

no DHCP server in the network	
DHCP	off
IP Addresses range	172.26.1.**[2..255]**
Subnet Mask	255.255.255.0
Default gateway	172.26.1.1



SPEEDTEC settings	
DHCP	off
IP Address	172.26.1.2
Subnet Mask	255.255.255.0
Default gateway	172.26.1.1

PC network settings	
DHCP	off
IP Address	172.26.1.3
Subnet Mask	255.255.255.0
Default gateway	172.26.1.1

Please refer guide how to change TCP/IP settings (*IP address*) in your PC operating system available in your system help or internet.

In order to change SPEEDTEC® IP address use Direct Connection first (see chapter 1) to change SPEEDTEC® configuration.

connect to SPEEDTEC® by Direct Connection

run Power Wave Manager software on your PC (available on www.powerwavesoftware.com)

Step 1: choice “I do not know the IP address of the welder”

Step 2: click on row with SPEEDTEC® IP Address and Model Name

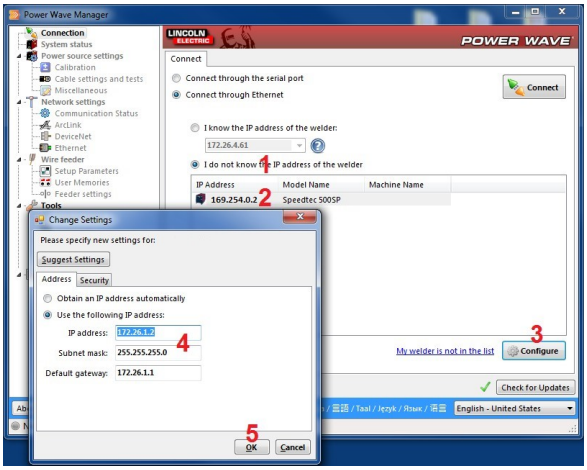
Step 3: click on “Configure” button

Step 4: change IP address, Subnet mask, Default gateway

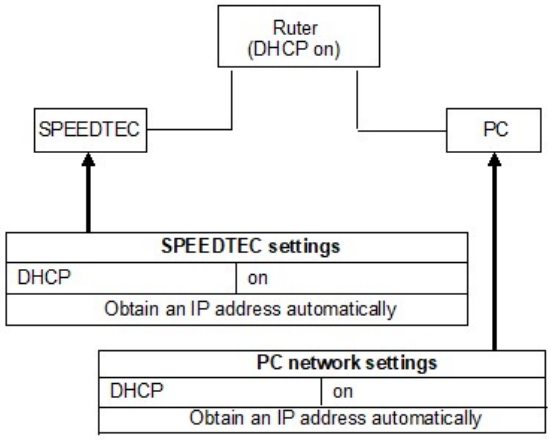
Step 5: click “OK” button

Confirm new settings by clicking “Yes”. Machine will be restarted.

Connect SPEEDTEC® to Network Switch back.

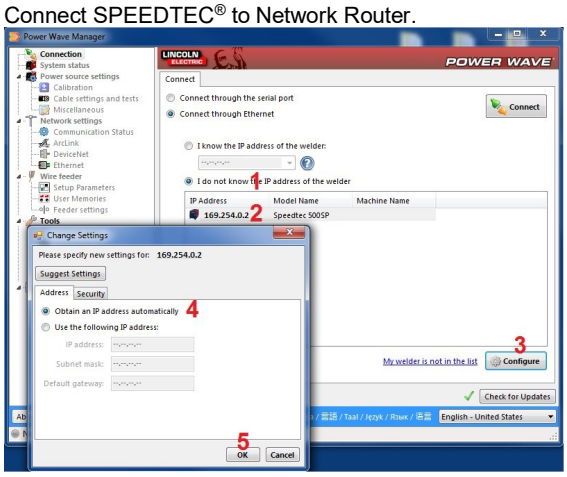


b) Dynamic IP Addresses (DHCP Server, e.g. Router)
When SPEEDTEC® is connected to the network which is equipped with a DHCP server it is required to set proper configuration of the SPEEDTEC® and PC.



Please refer guide how to change TCP/IP settings to *Obtain an IP address automatically* in your PC operating system available in your system help or internet.

In order to switch SPEEDTEC® to "Obtain an IP address automatically" use Direct Connection first (see chapter a) to change SPEEDTEC® configuration.
connect to SPEEDTEC® by Direct Connection
run Power Wave Manager software on your PC (available on
www.powerwavesoftware.com)
Step 1: choice "I do not know the IP address of the welder"
Step 2: click on row with SPEEDTEC® IP Address and Model Name
Step 3: click on "Configure" button
Step 4: choice "Obtain an IP address automatically"
Step 5: click "OK" button
Confirm new settings by clicking "Yes". Machine will be restarted.
Connect SPEEDTEC® to Network Router.



Machine and Circuit Protection

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

If the machine is overheated, the thermal protection circuit will decrease the output current to 0. The thermal protection indicator [3] will turn on.

The Power Source is also electronically protected against overload and accidental short-circuit. The overload and short-circuit protection circuit automatically reduces the output current to a safe value when it detects an overload.

Transport & Lifting

⚠ WARNING

Falling equipment can cause injury and damage to unit.

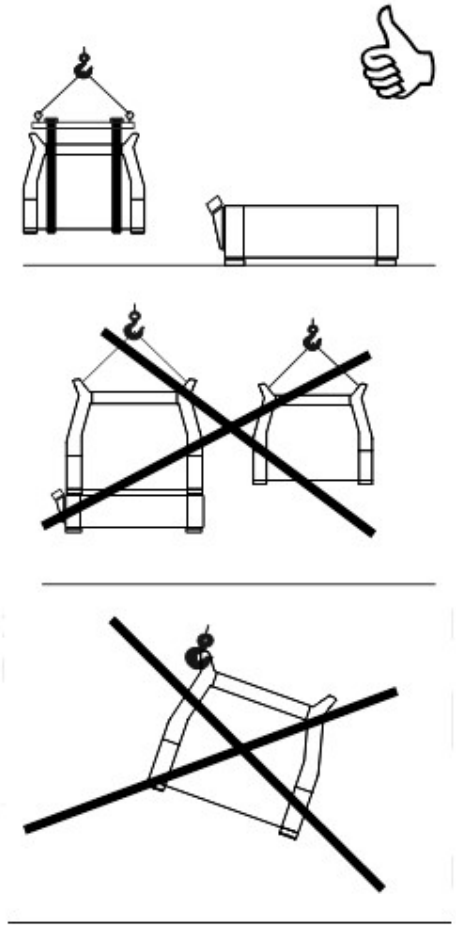


Figure 4

During transportation and lifting with a crane, adhere to the following rules:

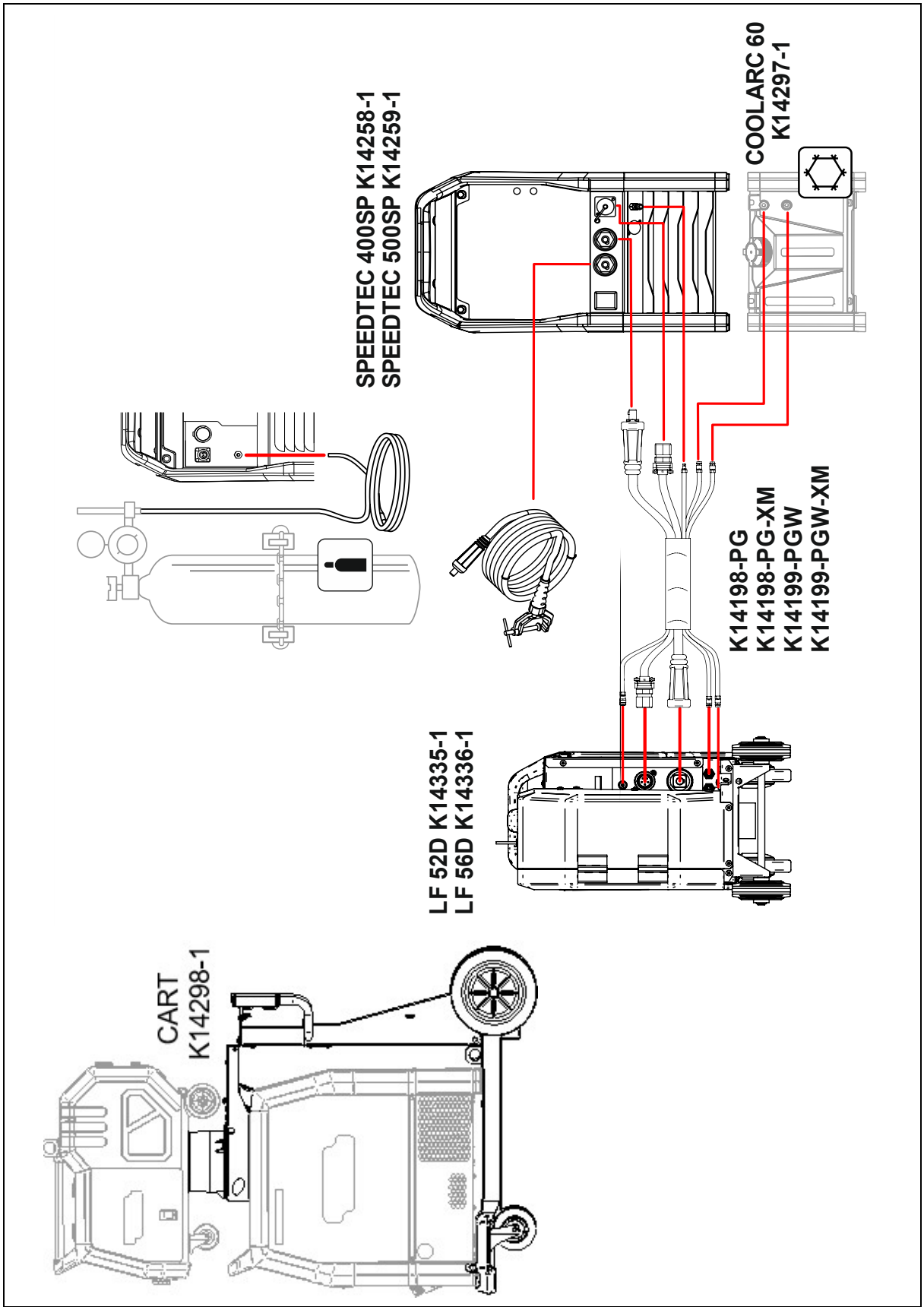
Power source does not include the eye bolt which can be used to transport or lifting the machine.

To lift use of suitable lifting equipment capacity.

To lifting and transport use a travers and minimum two belts.

Lift only power source without gas cylinder, cooler and wire feeder, or/and any other accessories.

Connection configuration



MAINTENANCE

⚠ WARNING

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

Any noticeable damage should be reported immediately and repaired.

ROUTINE MAINTENANCE (everyday)

- Check condition of insulation and connections of the work leads and insulation of power lead. If any insulation damage exists replace the lead immediately.
- Remove the spatters from the welding gun nozzle. Spatters could interfere with the shielding gas flow to the arc.
- Check the welding gun condition: replace it, if necessary.
- Check condition and operation of the cooling fan. Keep clean its airflow slots.

PERIODIC MAINTENANCE

(every 200 working hours but at list once every year)

Perform the routine maintenance and, in addition:

- Keep the machine clean. Using a dry (and low pressure) airflow, remove the dust from the external case and from the cabinet inside.
- If it is required, clean and tighten all weld terminals.

The frequency of the maintenance operations may vary in accordance with the working environment where the machine is placed.

⚠ WARNING

Do not touch electrically live parts.

⚠ WARNING

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

⚠ WARNING

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

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.

WARNING

ELECTRIC SHOCK can kill

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

DC BUS CAPACITORS DISCHARGE PROCEDURE

1. Remove input power to the SPEEDTEC® 400/500 SP
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 Switch Board on the right side of the machine (**See Figure 1**).
5. Use electrically insulate gloves and insulated pliers. Hold the body of the resistor and connect the resistor leads across the two terminals. Hold the resistor in place for 10 seconds. DO NOT TOUCH CAPACITOR TERMINALS WITH YOUR BARE HANDS.
6. Check the voltage across the two terminals. Voltage should be zero. If any voltage remains, repeat this procedure.

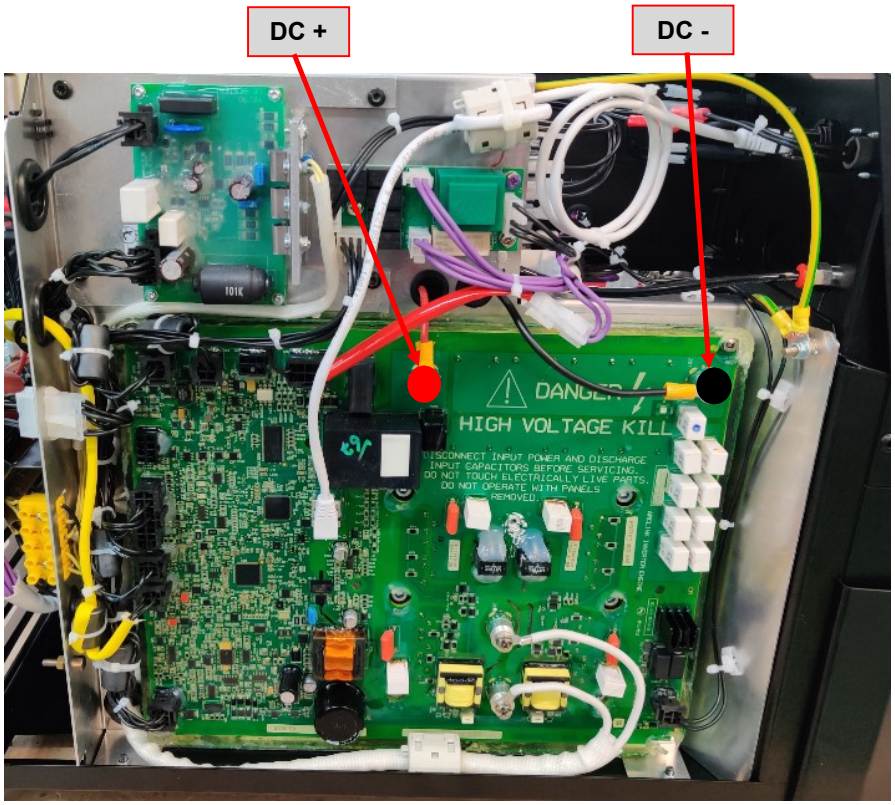
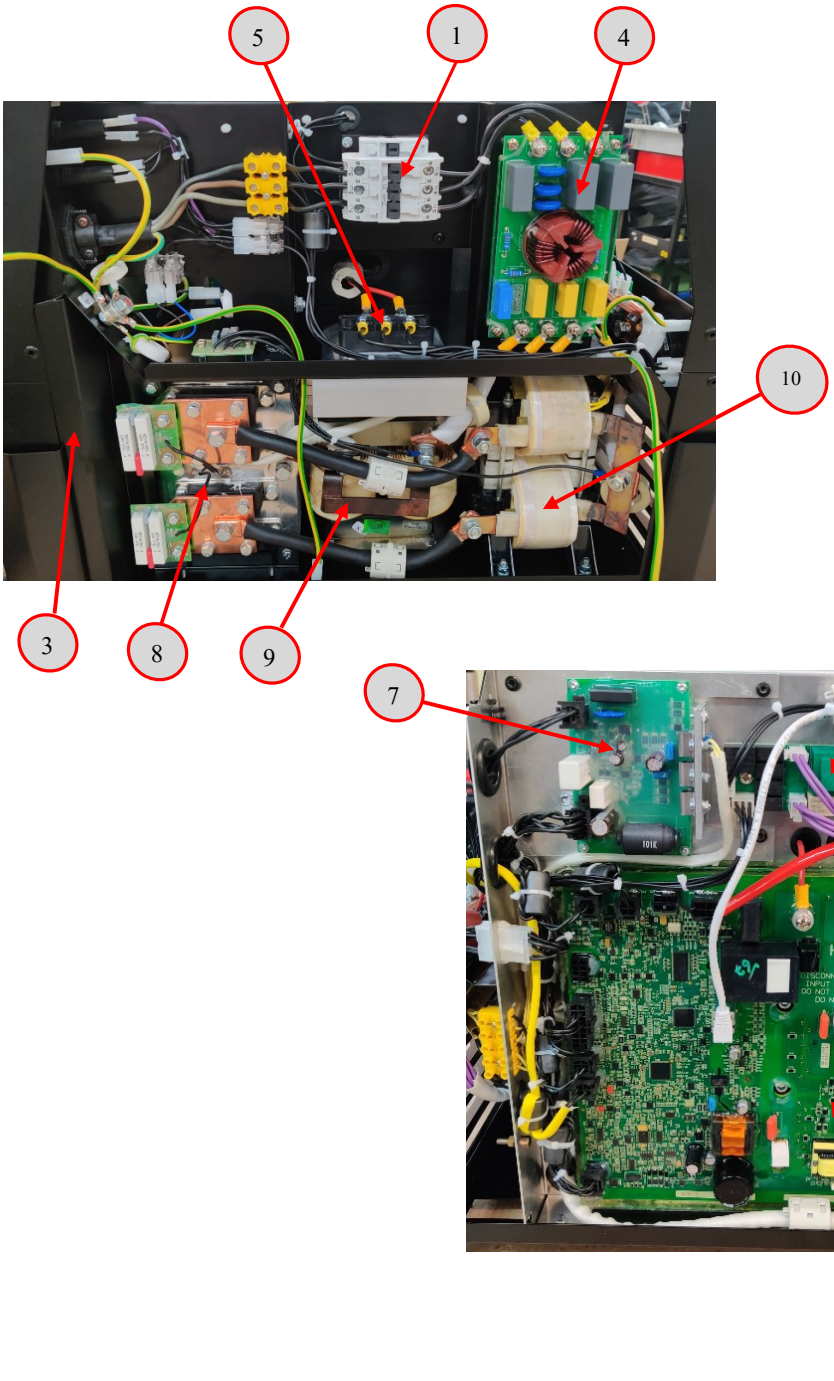


Figure 1
Showing machine right side

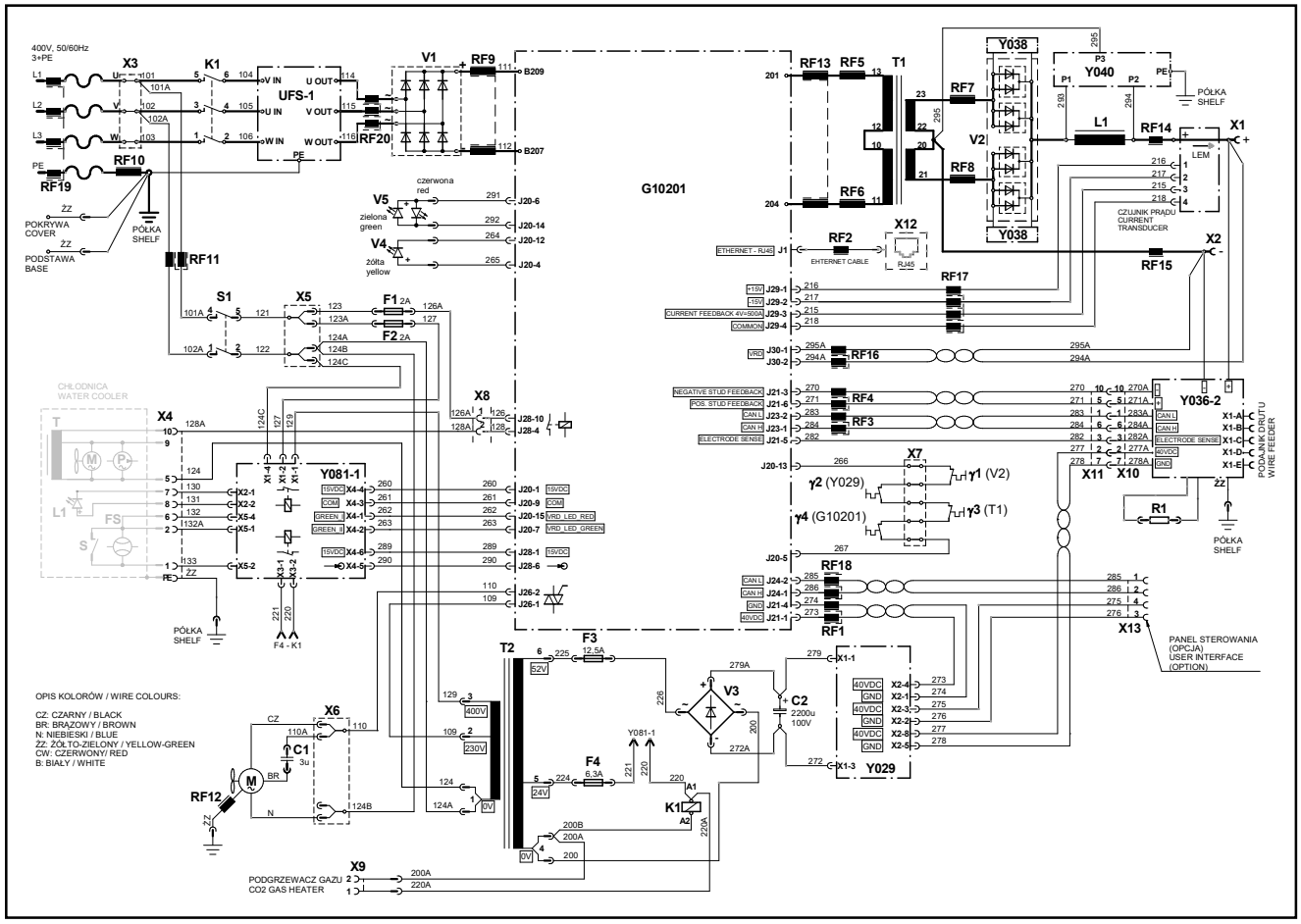
MAJOR COMPONENTS LOCATION

SPEEDTEC 400 – 500 SP

1. Main Contactor (K1)
2. Auxiliary transformer (T2)
3. Fan
4. EMC Filter Board (UFS-1)
5. Input Rectifier (V1)
6. Switch Board
7. 40Vdc BUS Board (Y029)
8. Output Diodes
9. Output Choke (L1)
10. Output Transformer (T1)
11. Green Mode Board



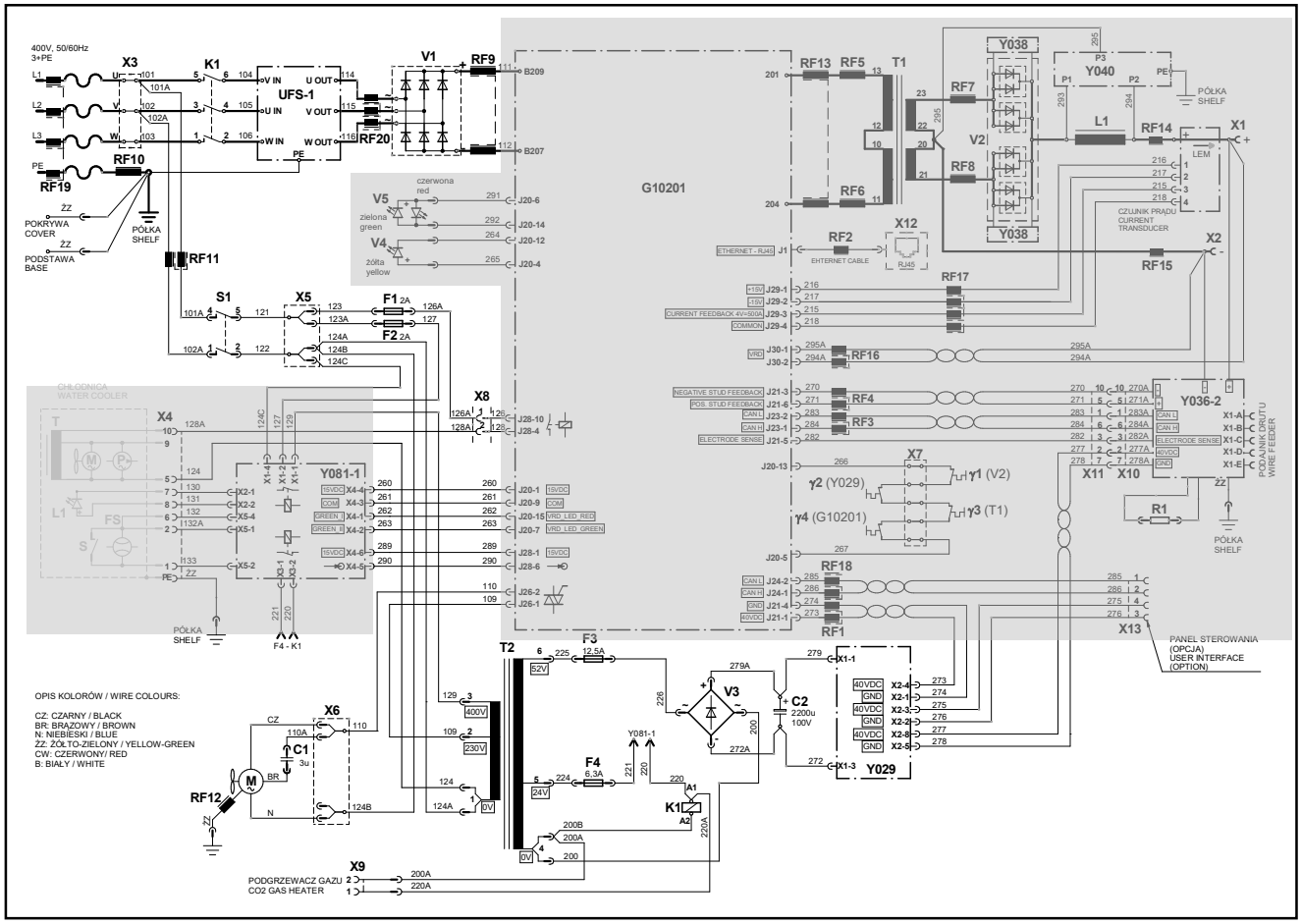
SPEEDTEC 400 – 500 SP – SCHEMATIC DIAGRAM



GENERAL DESCRIPTION

The **SPEEDTEC® 400 and 500 SP** are multi-process CC/CV DC inverter based welding power sources. The welding response of SPEEDTEC 400 and 500 has been optimized for GMAW-FCAW-LIFT TIG-STICK and CAG.
SPEEDTEC 400 and 500 SP have pulse welding capability with maximum peak output up to 500A/60V for ST 400SP and 600A/60V for ST 500SP. These units can operate with input voltage 400Vac 50/60Hz, three phases only.
Thanks to their IP23 rating and fully potted power board these power sources can be used in both factory or field operations. Using the Arclink protocol, they can be used with any Arclink feeder.
Water Cooler is available as an option and has to be installed on the bottom of the machine.

INPUT SECTION



INPUT SECTION

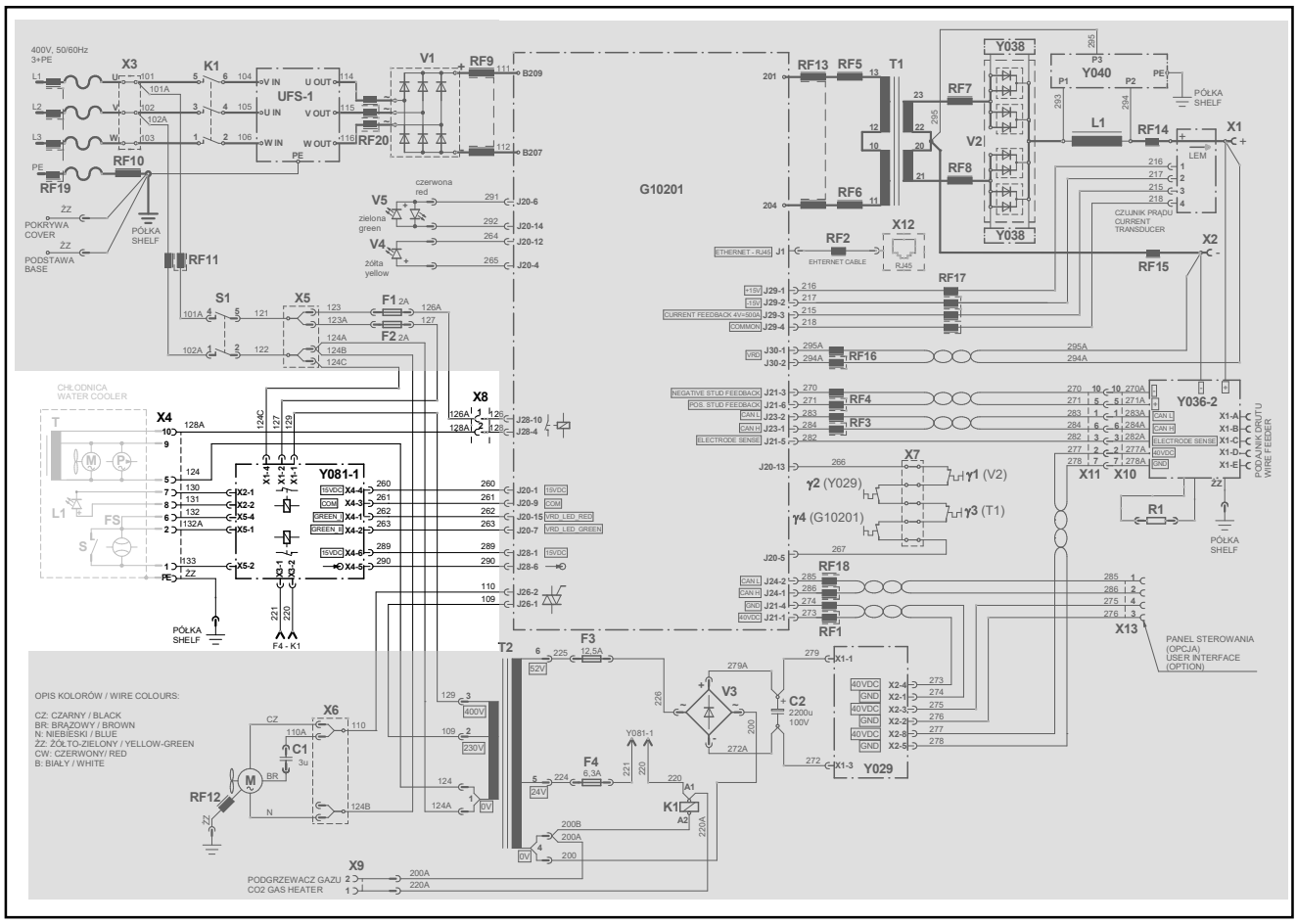
When the three phase input voltage 400Vac is applied to the SPEEDTEC® 400-500 SP and the input switch S1 is closed the auxiliary transformer T2 provides the 24Vac power supply for the input contactor coil.
When K1 closes, the three phases are applied directly to the EMC filter circuit.

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

The three phases coming out from the EMC filter board are rectified by the input rectifier bridge and the resultant 565VDC voltage is applied to the switch board.
The auxiliary transformer T2 develops also the appropriate AC voltages to operate the cooling fan, the 40VDC BUS board and the optional CO2 gas heater.

The 40VDC BUS board receives about 75VDC from the rectifier V3 and regulates it to a 40VDC supply. This regulated 40VDC is applied to the Switch board (to supply the control circuitry), to the wire feeder connector and to the optional UI connector (X13).

GREEN MODE PCB



GREEN MODE PCB

The Y081 provides following functionalities:

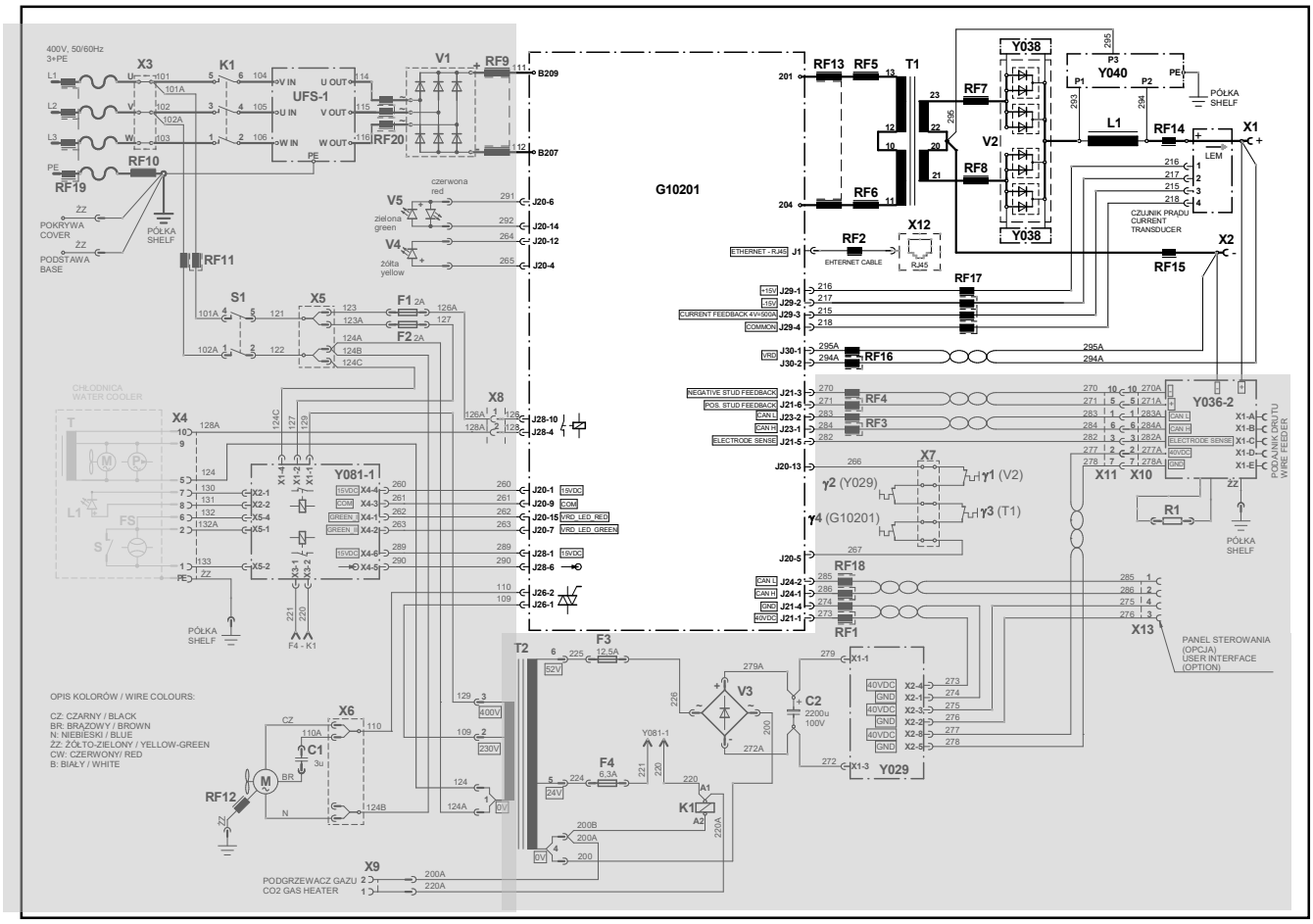
- Informs the machine about COOLARC presence
- Provides ON/OFF information about coolant flow
- Controls COOLARC LED lighting
- Provides control over Green Mode I and Green Mode II

The 2 green modes allow the welding machine to reduce power consumption in idle state. The 2 green modes work as follows:

When enabled, the *Green Mode I* disrupts the 3-phase power supply to the PFC circuit of the switch board. In this mode the auxiliary transformer T2 is still operating and low power electronics is fully functional. When woken up from this state, switch board has to restore high state to G.MODE1 input. The machine operates as usual and welding can be performed.

When enabled, the *Green Mode II* disrupts the 3-phase power supply to the PFC circuit of the switch board and auxiliary Transformer T2. In this mode the machine is in deep sleep and the Y081-1 will keep machine in Green Mode II until machine is restarted with power switch.

SWITCH/CONTROL BOARD AND OUTPUT SECTIONS



SWITCH/CONTROL BOARD, MAIN TRANSFORMER AND OUTPUT SECTIONS

The switch board receives the rectified primary power from the input rectifier bridge (565Vdc) and it converts this power from DC to AC high frequency that can be applied to the primary windings of the main welding transformer. The operating frequency of the switch board used inside the SPEEDTEC® 400-500 SP is 20KHz. The switch board monitors also the voltage and current feedback and compares these to the signals received from its control circuits section. The switch board then sends the appropriate Pulse Width Modulated power to the main welding transformer.

The primary winding of the main welding transformer receives the Pulse Width Modulated power from the switch board. The 20KHz. AC output that is created on the secondary windings is applied to the output rectifier.
The resultant rectified DC+ power is applied, through an output choke, to the positive output terminal.

The output choke is an inductor that provides filtering to enhance the arc performance and accurate waveform response.

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

The control circuits section on the switch board processes the information received, through the Arclink communication protocol, from the User Interface located on wire feeder or connected directly on the front panel of the machine (optional).
The Switch board control circuits also receives signal from the thermal sensors located inside the machine. There are 4 thermal sensors:

- on Output diodes heat sink (V2)
- on Output Transformer (T1)
- on 40Vdc BUS board heat sink (Y029)
- on Switch board heat sink (G10201)

OVERLOAD PROTECTION

SPEEDTEC® 400-500 SP are electrically protected from producing higher output currents. An electronic protection circuit limits the current to within the capabilities of the machine 500A for ST 400SP and 600A for ST 500SP.

THERMAL PROTECTION

Thermal Protection Devices protect the machine from excessive operating temperatures.

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

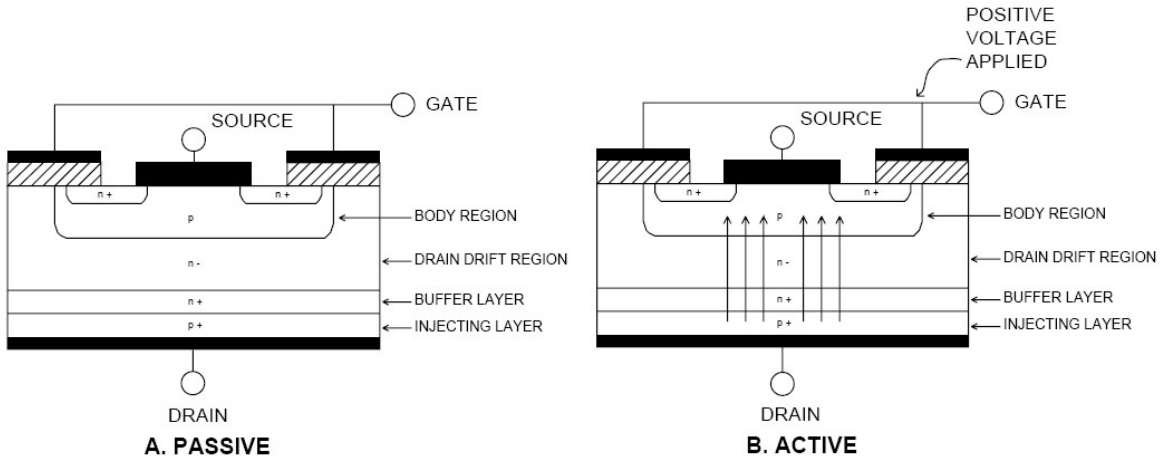
The thermal protections are self-resetting once the machine cools sufficiently. If the shut down was caused by excessive output or duty cycle and the fan is operating normally, the power switch may be left on and the reset should occur within about 15 minute period. If the fan is not turning or the air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

INSULATED GATE BIPOLAR TRANSISTOR (IGBT) OPERATION

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

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

IGBT



TROUBLESHOOTING AND REPAIR SECTION

- How to use troubleshooting Guide
- Troubleshooting Guide
- Case cover removal and capacitor discharge procedure
- Main Contactor K1 and Auxiliary Transformer T2 test
- EMC Filter Board test
- Input Rectifier test
- 40VDC BUS Power Supply Board test
- Switch Board Resistance and Voltage test
- Fan and Fan Circuit test
- Water Cooler Detection Board test
- Output Rectifier Modules Resistance test

HOW TO USE TROUBLESHOOTING GUIDE

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

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

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

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

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

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

WARNING

ELECTRIC SHOCK can kill

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

---

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

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

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

5. Remove the replacement PC board and substitute it with the original PC board to recreate the original problem.
   - If the original problem does not reappear by substituting the original board, then the PC board was not the problem. Continue to look for bad connections in the control wiring harness, junction blocks, and terminal strips.
   - If the original problem is recreated by the substitution of the original board, then the PC board was the problem. Reinstall the replacement PC board and test the machine.
6. Always indicate that this procedure was 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 / ERROR DESCRIPTION	RECOMMENDED COURSE OF ACTION
A VISUAL DAMAGE IS EVIDENT WHEN YOU OPEN THE COVER	----------	• REPLACE THE BROKEN PART AND PERFORM THE TESTS FOR THE OTHER MACHINE COMPONENTS
MACHINE IS DEAD, NO STATUS LED	• MAKE SURE THAT THE INPUT LINE IS PRESENT • CHECK THE MACHINE ON/OFF SWITCH • CHECK THE FUSE F2 and F3 ON THE REAR PANEL OF THE MACHINE	• CONNECT THE INPUT LINE • REPLACE THE MACHINE ON/OFF SWITCH IF NECESSARY • PERFORM THE T2 AUXILIARY TRANSFORMER TEST AND THE Y029 PCB TEST
THE MAIN INPUT FUSES REPEATEDLY FAIL OR THE INPUT LINE CIRCUIT BREAKER TRIPPING	• MAKE CERTAIN THE FUSES OR BREAKERS ARE PROPERLY SIZED FOR THE INPUT DRAW OF THE MACHINE. SEE MACHINE RATING PLATE OR TECHNICAL SPECIFICATION AVAILABLE IN THIS SERVICE MANUAL • A SHORT CIRCUIT MAY BE PRESENT INSIDE THE MACHINE	• PERFORM THE 3PH INPUT RECTIFIER BRIDGE • PERFORM THE SWITCH BOARD TEST
THERE IS NO WELDING OUTPUT	• MAKE SURE THAT THE RECTIFIED VOLTAGE IS APPLIED TO THE SWITCH BOARD, UNDERVOLTAGE ERROR SHOULD BE DISPLAYED • ONE OF THE MACHINE THERMAL SENSOR MAY HAS TRIPPED, CHECK TERMAL STATUS LED. • MAY BE ONE OF THE OUTPUT RECTIFIER MODULE IS IN SHORT CIRCUIT • CHECK SHUNT CONNECTIONS TO SWITCH BOARD	• CHECK THE PRESENCE OF THE INPUT 3 PHASES AT CONTACTOR K1, PERFORM THE CONTACTOR , EMC FILTER BOARD AND INPUT RECTIFIER BRIDGE TESTS • DO NOT TURN THE UNIT OFF, ALLOW THE MACHINE TO COOL DOWN, THE THERMAL PROTECTION CIRCUITS WILL RESET THEMSELVES, IF NOT CHECK THE THERMAL SENSORS AND THERMAL SENSORS CIRCUIT • PERFORM THE T2 AUXILIARY TRANSFORMER AND FAN TEST • PERFORM THE OUTPUT RECTIFIER MODULES TESTS
THE THERMAL LAMP IS ON, THE MACHINE OVERHEAT VERY FREQUENTLY	• THE WELDING CURRENT USED MAY EXCEED THE MACHINE DUTY CYCLE • DUST MAY HAVE CLOGGED THE COOLING HEAT-SINK • LOUVERS MAY BE BLOCKED BY INADEQUATE CLEARANCE AROUND THE MACHINE • MAY BE THE FAN IS NOT WORKING	• CHECK AND FOLLOW THE MACHINE DUTY CYCLE • CLEAN THE MACHINE USING DRY COMPRESSED AIR • REMOVE ANY PARTS AROUND THE MACHINE THAT MAY BLOCK THE AIR FLOW AND THE LOUVERS • PERFORM THE FAN TEST
THE WIRE FEEDER CONNECTED TO THE MACHINE IS COMPLETELY OFF	• MAY BE THE 40VDC POWER SUPPLY IS NOT PRESENT • THE CONTROL CABLE MAY BE DEFECT	• CHECK THE FUSE F3 AND PERFORM THE 40VDC BUS POWER SUPPLY BOARD TEST • CHECK FOR 40VDC BETWEEN PIN D AND E ON WIRE FEEDER ARCLINK CONNECTOR LOCATED ON THE MACHINE FRONT PANEL • CHECK CONTROL CABLE CONTINUITY
THE STATUS LAMP ON THE FRONT PANEL IS BLINKING GREEN AND RED	• SYSTEM FAULT. DECODE THE ERROR NUMBER USING THE STATUS LAMP FLASHING SEQUENCE	• REFER TO THE ERROR CODE LIST AVAILABLE ON THIS MANUAL FOR INFORMATION ABOUT THE TYPE OF ERROR.

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

CASE COVER REMOVAL AND DC BUS CAPACITOR DISCHARGE PROCEDURE

WARNING

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

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

……

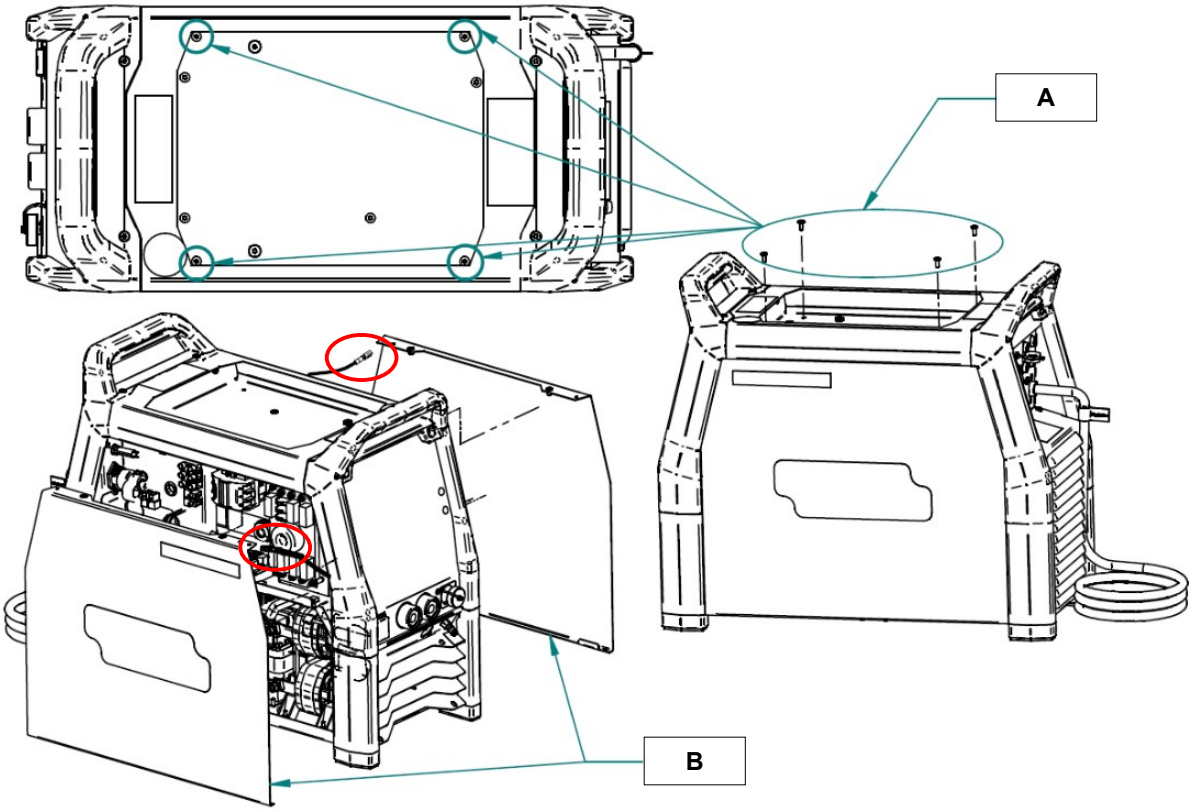
DESCRIPTION

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

MATERIALS NEEDED

TORX wrench TX-25 driver

SPEEDTEC® 400-500 SP - CASE COVER REMOVAL



Procedure:

1. Turn ON/OFF switch to OFF position.
2. **Disconnect Input Power from the machine !**
3. Using the TORX wrench TX-25 driver, remove the 4 screws on the top of machine (**A**)
4. Remove the two side panels (B), taking care to disconnect the two ground wires (indicated by the two red circles)
5. Follow the next page for **DC BUS capacitors discharge procedure !**

DC BUS CAPACITORS DISCHARGE PROCEDURE

WARNING

ELECTRIC SHOCK can kill

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

DC BUS CAPACITORS DISCHARGE PROCEDURE

1. Remove input power to the SPEEDTEC® 400/500 SP
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 Switch Board on the right side of the machine (**See Figure 1**).
5. Use electrically insulate gloves and insulated pliers. Hold the body of the resistor and connect the resistor leads across the two terminals. Hold the resistor in place for 10 seconds. DO NOT TOUCH CAPACITOR TERMINALS WITH YOUR BARE HANDS.
6. Check the voltage across the two terminals. Voltage should be zero. If any voltage remains, repeat this procedure.

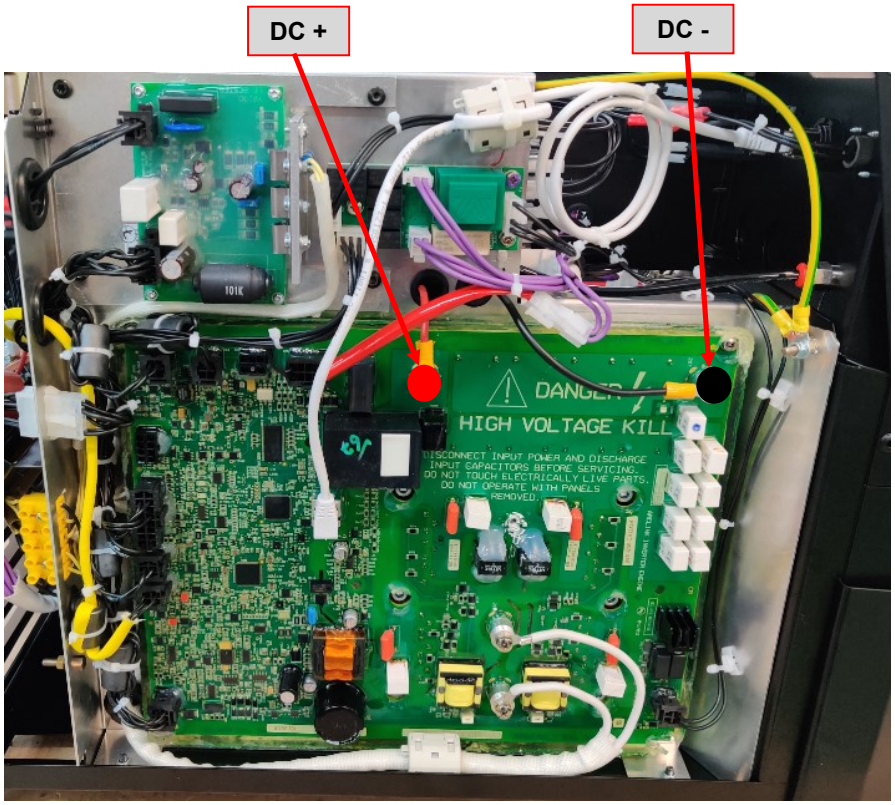


Figure 1
Showing machine right side

MAIN CONTACTOR (K1) AND AUX. TRANSF. (T2) TEST

WARNING

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

……

TEST DESCRIPTION

This test will determine if the main contactor (K1) or components on the main contactor supply circuit have failed.

MATERIALS NEEDED

Multimeter
Machine Wiring diagram

MAIN CONTACTOR (K1) AND AUX. TRANSF. (T2) TEST (continued)

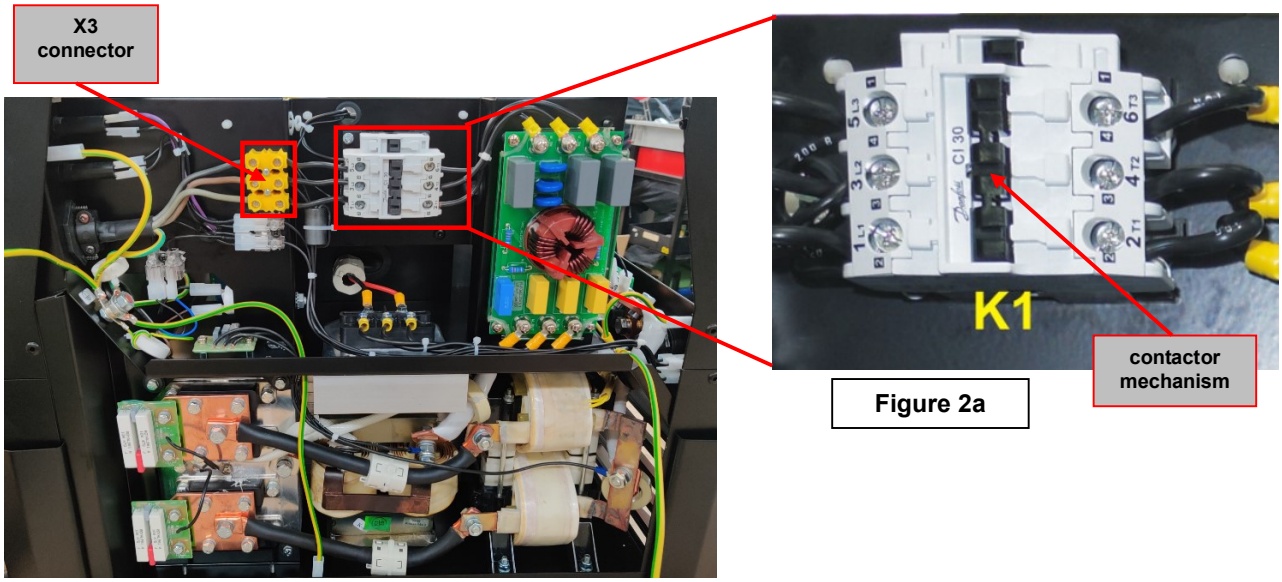


Figure 2a

Figure 2

TEST PROCEDURE

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

1. Remove main input power to the SPEEDTEC® 400/500 SP
2. Perform the **Case removal** and **Discharge procedure**
3. Visually check for burned or damaged components. If any components are physically damaged they have to be replaced
4. Using the multimeter (ohm mode) perform the tests as indicated in **Test Table 1**. See **Figure 2a** for correct test points location.

Test table 1 – Main Contactor contacts test

Machine condition	*Positive Probe (RED)*	*Negative Probe (BLACK)*	*Value*
Machine disconnected from input voltage and capacitors discharged.	5 (L3)	6 (T3)	Open
	3 (L2)	4 (T2)	Open
	1 (L1)	2 (T1)	Open
Machine disconnected from input voltage and capacitors discharged. **Contactor mechanism manually pressed**	5 (L3)	6 (T3)	0 Ohm
	3 (L2)	4 (T2)	0 Ohm
	1 (L1)	2 (T1)	0 Ohm

5. Check with ohmmeter the K1 coil resistance (disconnect cables from A1 and A2 coil terminals) correct resistance value should be between 5 – 6 ohms
6. Carefully apply the correct input voltage 400Vac/3ph +/-15% via the input cable to the SPEEDTEC® 400/500 SP.
7. Switch to ON position the main switch S1, wait until the status LED on front panel is steady green.
8. Using the multimeter in VAC mode perform the tests as indicated in **Test Table 2**. See **Figure 2a** for correct test points location.

Test table 2 – Main Contactor contacts test

Machine condition	*Test Points*	*Expected reading*
Machine supplied 400Vac 3ph Main switch ON position	6 (T3) to 4 (T2)	400Vac +/-15%
	4 (T2) to 2 (T1)	400Vac +/-15%
	6 (T3) to 2 (T1)	400Vac +/-15%

MAIN CONTACTOR (K1) AND AUX. TRANSF. (T2) TEST (continued)

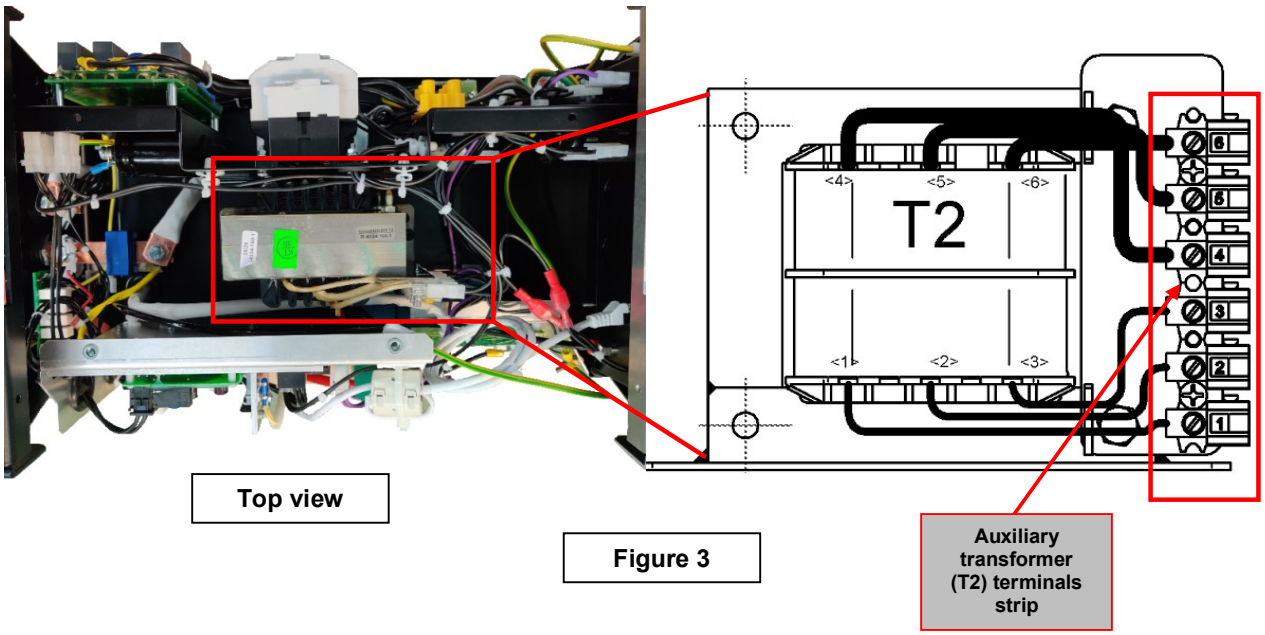


Figure 3

If the main contactor does not close when machine's main swich is to ON position perform the auxiliary transformer (T2) test as indicated in **Test Table 3**. See **Figure 3** for correct test points location.

Test table 3 – Auxiliary transformer (T2) test

Machine condition	***Test Points (aux transf terminal strip)***	***Expected reading***
Machine supplied 400Vac 3ph +/- 15% Main switch ON position	n° 1 to n° 3	400Vac +/-15%
	n°1 to n° 2	230Vac +/-15%
	n°4 to n° 5	24Vac +/-15%
	n° 4 to n° 6	52Vac +/-15%

9. If 400 Vac are not present between n° 1 and n° 3 of terminal strip, check the presence of the 3 phases on connector X3, check the main switch S1 and the fuse F2 on the machine rear panel. See **Figure 2** for connector X3 location.
10. Check between main contactor A1 & A2 coil power supply terminals for 24Vac +/-15%.
11. If 24 Vac voltage is present but contactor does not close, go to the next point, if voltage is not present check the fuse F4 on the machine rear panel. Failure on fuse F4 can be due to an overload on the gas heater socket (if present) or main contactor coil short circuit.
12. Disconnect the lead from A1 or A2 main contactor coil terminal and check the main contact coil resistance, correct value is 6 ohms +/- 10%. If resistance value is low, the coil is shorted and the main contactor has to be replaced.

EMC FILTER BOARD TEST

WARNING

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

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TEST DESCRIPTION

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

MATERIALS NEEDED

Multimeter
Machine wiring diagram

EMC FILTER BOARD TES (continued)

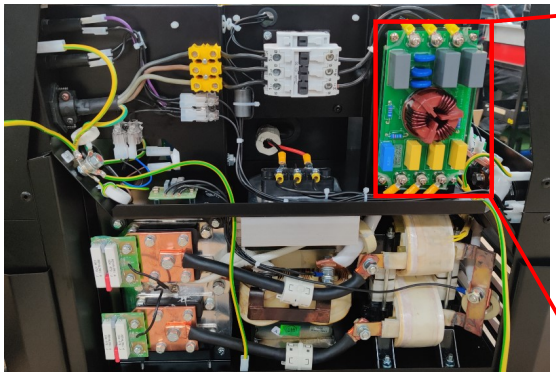

Figure 4 – EMC Filter board location

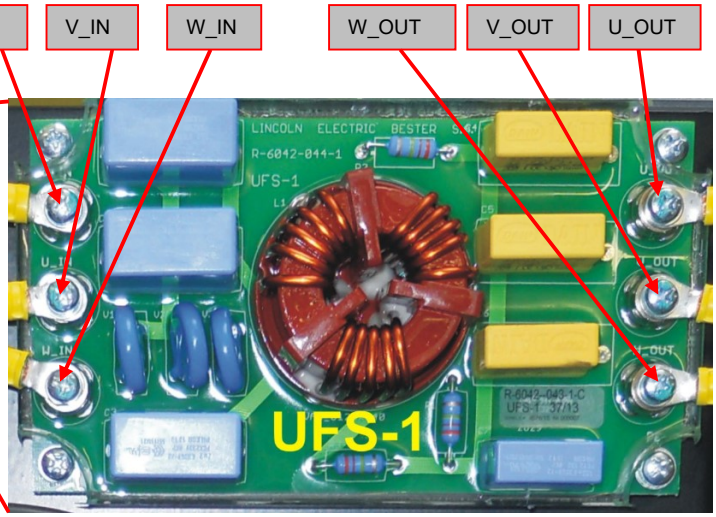

Figure 4a – EMC FILTER BOARD test points

TEST PROCEDURE

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

1. Remove main input power to the SPEEDTEC® 400/500 SP.
2. Perform the **Case removal** and **Discharge procedure**
3. Locate the EMC Filter Board. See **Figure 4**.
4. Visually check for burned or damaged components. If any components are physically damaged the EMC Filter board should be replaced.
5. Using the multimeter (ohm mode) perform the tests as indicated in **Test Table 4**. See **Figure 4a** for correct test points location.
6. Carefully apply the correct input voltage 400Vac/3ph +/-15% via the input cable to the SPEEDTEC® 400/500 SP.
7. Switch to ON position the main switch S1, wait until the power LED on front panel is steady green.
8. Using the multimeter in VAC mode perform the tests as indicated in **Test Table 5**. See **Figure 4a** for correct test points location.

Test Table 4 - EMC Filter Board resistance Tests

Positive Probe (RED)	Negative Probe (BLACK)	Value
U_IN	U_OUT	0 (zero) ohm
V_IN	V_OUT	0 (zero) ohm
W_IN	W_OUT	0 (zero) ohm

Test Table 5 - EMC Filter Board Voltage Tests

Positive Probe (RED)	Negative Probe (BLACK)	Value
U_IN	V_IN	400Vac +/- 15%
V_IN	W_IN	400Vac +/- 15%
U_IN	W_IN	400Vac +/- 15%
U_OUT	V_OUT	400Vac +/- 15%
U_OUT	W_OUT	400Vac +/- 15%
U_OUT	W_OUT	400Vac +/- 15%

9. If one or more input voltages between U_IN, V_IN, W_IN are not present, perform the main contactor test.
10. If input voltages are correct but one or more output voltages between U_OUT, V_OUT, W_OUT are not present, the EMC filter is defect and have to be replaced.

INPUT RECTIFIER TEST

WARNING

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

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TEST DESCRIPTION

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

MATERIALS NEEDED

Multimeter
8mm nut driver
Machine Wiring Diagram

INPUT RECTIFIER TEST (continued)

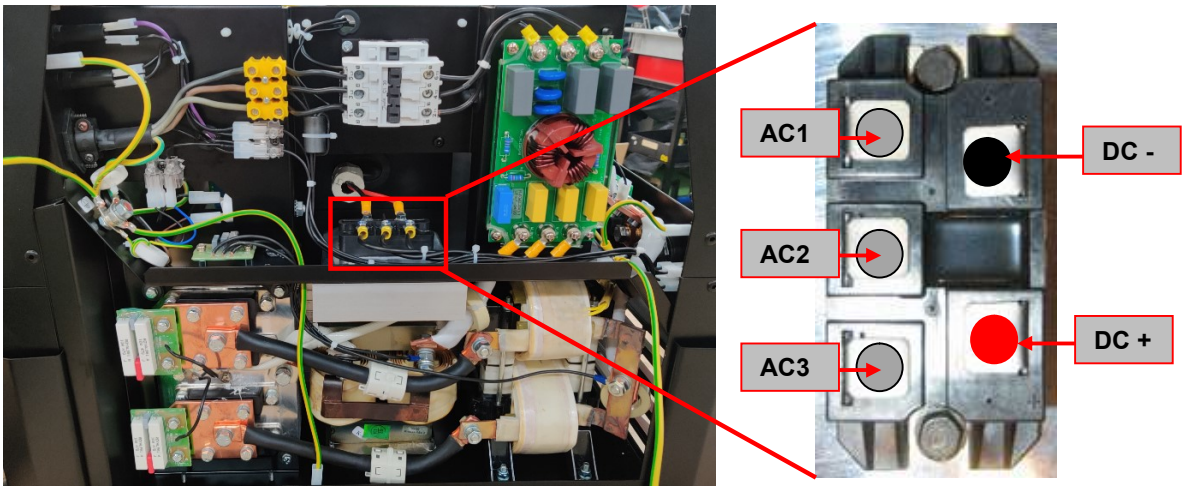

Figure 5 – Input Rectifier Bridge location and Test Points

TEST PROCEDURE

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

1. Remove main input power to the SPEEDTEC® 400/500 SP.
2. Perform the **Case removal** and **Discharge procedure**
3. Locate the Input Rectifier Bridge. See **Figure 5**.
4. Using the multimeter (diode test mode) perform the tests as detailed in **Test table 6**. See also **Figure 5** for terminals locations.
5. If the tests results are questionable, label and remove all of the leads from the Input Rectifier Bridge and re-test*.
6. If any portion of the test fails, the input rectifier may be faulty and must be replaced.

Test table 6 – Input Rectifier Bridge Test

Positive Probe (RED)	*Negative Probe (BLACK)*	*Value*
Terminal AC1-AC2-AC3	Terminal DC+	0.2 – 0,7V Forward Diode Drop
Terminal DC-	Terminal AC1-AC2-AC3	0.2 – 0,7V Forward Diode Drop
Terminal DC+	Terminal AC1-AC2-AC3	Open
Terminal AC1-AC2-AC3	Terminal DC-	Open

7. Carefully apply the correct input voltage 400Vac/3ph +/-15% via the input cable to the SPEEDTEC® 400/500 SP.
8. Switch to ON position the main switch S1, wait until the status LED on front panel is steady green.
9. Using the multimeter in VAC and VDC mode perform the tests as indicated in **Test Table 7**. See **Figure 5** for correct test points location.

Test table 7 – Input Rectifier Bridge Voltage Test

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

*If leads are removed from the rectifier bridge follow the input rectifier bridge replacement procedure available on this manual for the correct screw torque values

40VDC BUS POWER SUPPLY BOARD TEST

WARNING

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

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TEST DESCRIPTION

This test will determine if the 40VDC BUS power supply board is receiving and processing the correct voltages.

MATERIALS NEEDED

Multimeter
Machine Schematic Diagram

40VDC BUS POWER SUPPLY BOARD TEST (continued)

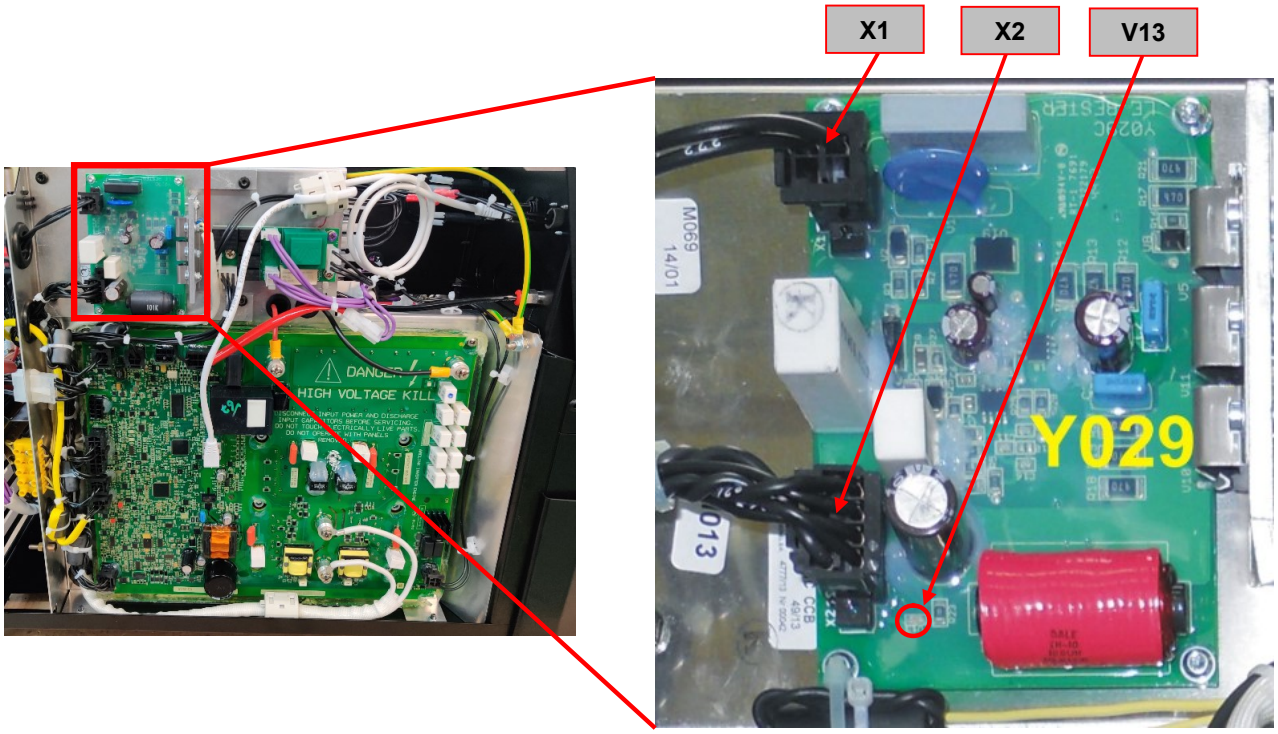


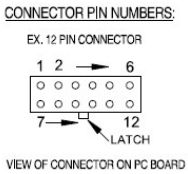
Figure 6 – 40VDC BUS power supply board location and Test Points

TEST PROCEDURE

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

1. Remove main input power to the SPEEDTEC® 400/500 SP.
2. Perform the **Case removal** and **Discharge procedure**
3. Locate the 40VDC BUS power supply board. See **Figure 6**.
4. Visually check for burned or damaged components. If any components are physically damaged the 40VDC power supply board should be replaced
5. Carefully apply the correct input voltage 400Vac/3ph +/-15% via the input cable to the SPEEDTEC® 400/500 SP.
6. Switch to ON position the main switch S1, wait until the status LED on front panel is steady green.
7. Using the multimeter in VDC mode perform voltage tests detailed in **Test Table 8**. See **Figure 6** for Test Point locations

Test table 8 – 40VDC BUS power supply board test



X1: V_IN

Pin#	Description	Value	Notes
1	INPUT	65 -75Vdc	Power supply for 40VDC BUS Board
3	GND	GND	GND

X2: V_OUT

Pin#	Description	Value	*LEDs status and color*	Notes
1	GND	GND	V13 ON Red	GND
4	OUTPUT	+40Vdc +/- 1V		40Vdc supply for Switch board Control Circuit
2	GND	GND		GND
3	OUTPUT	+40Vdc +/- 1V		40Vdc supply for optional UI supply
5	GND	GND		GND
8	OUTPUT	+40Vdc +/- 1V		40Vdc supply for wire feeder

Note: If voltage is not present at X1 connector, check fuse F3 on the machine rear panel. See **page 8** on this manual for correct fuse F3 location. Failure on fuse F3 can be due to: rectifier bridge V3 or Capacitor C2 short circuit or failure on 40VDC BUS power supply board.

SWITCH BOARD RESISTANCE AND VOLTAGE TEST

WARNING

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

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TEST DESCRIPTION

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

MATERIALS NEEDED

Multimeter
Machine schematic
8mm wrench/nut driver

SWITCH BOARD RESISTANCE AND VOLTAGE TEST (continued)

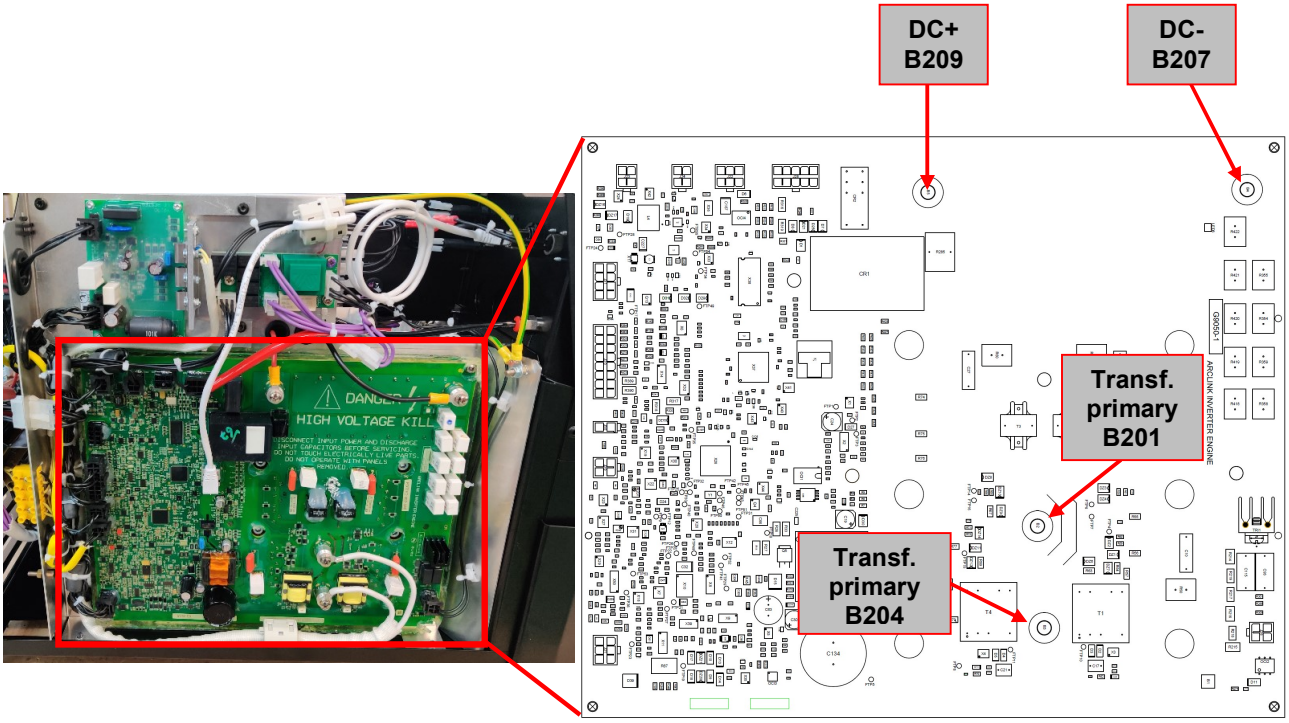

Figure 7 – Switch/Control board location and Test Points

TEST PROCEDURE

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

1. Remove main input power to the SPEEDTEC® 400/500SP.
2. Perform the **Case removal** and **Discharge procedure**
3. Locate the Switch/Control board. See **Figure 7**.
4. Visually check for burned or damaged components. If any components are physically damaged Switch/Control board should be replaced
5. Using the multimeter in diode test mode perform the tests detailed in **Test Table 9**. See **Figure 7** for Test Point locations.
6. If the test results are questionable, proceed to the next point.
7. Using the 8mm wrench or nut driver,disconnect and label DC+ (B209), DC- (B207) and the two transformer primary leads (B201 and B204) from the switch board. See **Figure 7** for leads location.
8. Perform the tests detailed in **Test Table 9**. See **Figure 7** for Test Point locations.

Test table 9 – Switch board resistance test

Positive Probe (RED)	*Negative Probe (BLACK)*	*Value*
B207	B201	0.2 – 0.7V Forward Voltage Drop
B201	B207	Open
B209	B201	Open
B201	B209	0.2 – 0.7V Forward Voltage Drop
B207	B204	0.2 – 0.7V Forward Voltage Drop
B204	B207	Open
B209	B204	Open
B204	B209	0.2 – 0.7V Forward Voltage Drop

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

SWITCH BOARD RESISTANCE AND VOLTAGE TEST (continued)

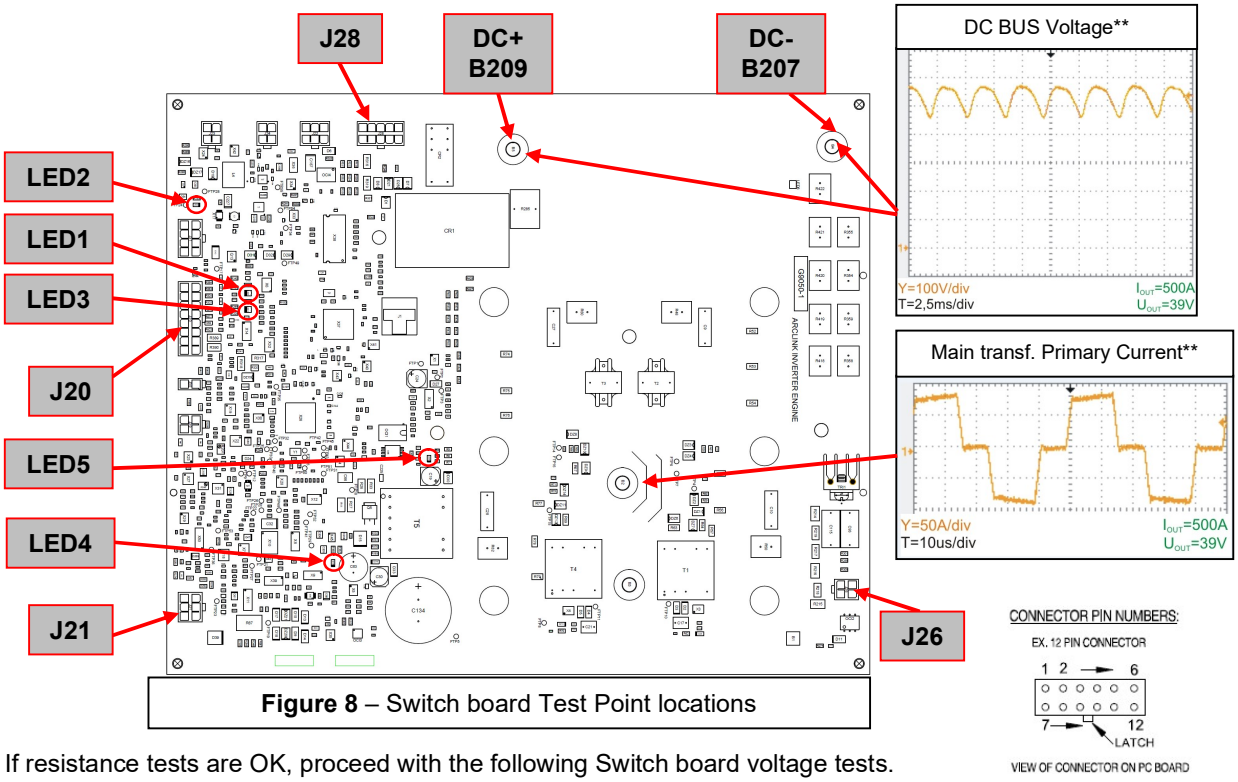

Figure 8 – Switch board Test Point locations

9. If resistance tests are OK, proceed with the following Switch board voltage tests.
10. If previously removed, reconnect the B207,B209, B204 and B201 leads. Follow the switch board replacement procedure available on this manual for the correct screw torque values.
11. Carefully apply the correct input voltage 400Vac/3ph +/-15% via the input cable to the SPEEDTEC®400/500 SP.
12. Switch to ON position the main switch S1, wait until the power LED on front panel is steady green.
13. Using the multimeter perform the tests detailed in **Test Table 10**. See **Figure 8** for Test Point locations

Test table 10 – Switch board voltage tests

Test Points	*Expected reading*	*PCB LEDs status and color*	*Note*
B209(+) to **B207**(-)	565Vdc +/- 15%	-	Rectified input voltage, if not correct perform the input rectifier and EMC filter tests
-	-	LED1 ON Green	DSP Controller Status LED.
-	-	LED2 ON Green	+5Vdc insulated CAN communication power supply generated by the switch board
-	-	LED3 ON Green	Arclink Status LED. No errors=steady green. If error is present it blinks alternately red and green*
-	-	LED4 On Green	+15V power supply generated by the switch board
-	-	LED5 ON Green	+5Vdc primary circuits power supply generated by the switch board
J26 pin 1 to pin 2	230Vac = fan OFF 0Vac = fan ON	-	The fan runs when MIG gun trigger is pushed or when machine is in stick mode with OCV enabled.
J21 pin1(+) to pin 4(-)	40Vdc +/- 2V	-	Control circuit power supply from 40VDC BUS board
J28 pin 1(+) to pin 6(-)	0Vdc= water OK 15Vdc =water error	-	Coolarc water error circuit. When coolarc is not connected voltage is about 6Vdc
J28 pin 4 to pin 10	400Vac= Coolarc OFF 0Vac= Coolarc ON	-	Coolarc Fan and Pump activation
J20 pin 5(+) to pin 13(-)	0Vdc= thermal sensors circuit OK 15Vdc= thermal sensor circuit open	-	Thermal sensor circuit

* **Read the error code before the machine is powered off**. Error code interpretation through the status LED is detailed at the end of this Manual. Individual code digits are flashed in red with a long pause between digits. If more than one code is present, the codes will be separated by a green light.
** Waveforms are refered to Speedtec 500SP @ 500A/39V output. Primary current has to be measured with a current transducer probe.

FAN AND FAN CIRCUIT 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 fan and fan circuitry is working properly.

MATERIALS NEEDED

Multimeter
Machine schematic
Jumper wire
Flat head screwdriver

FAN AND FAN CIRCUIT TEST (continued)

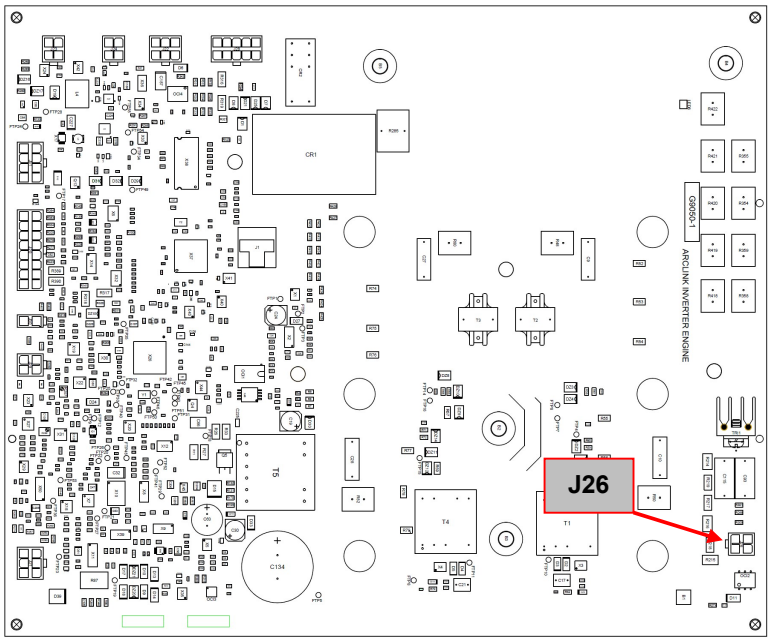

Figure 9 – Switch board J26 location

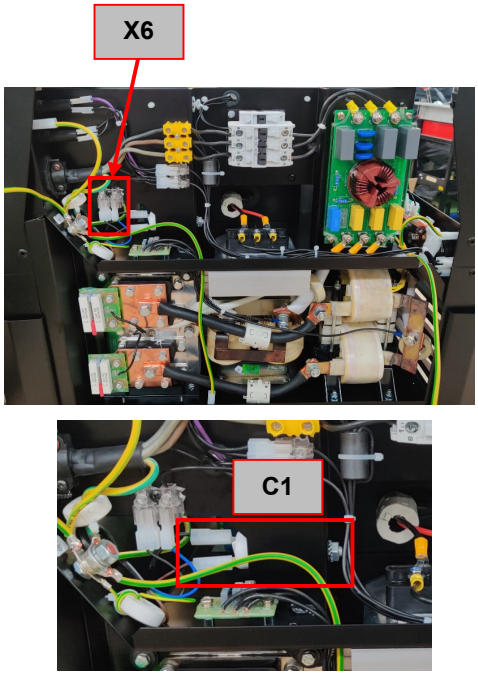

Figure 10 – X6 and C1 location

TEST PROCEDURE

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

1. Remove main input power to the SPEEDTEC® 400/500 SP.
2. Perform the **Case removal** and **Discharge procedure**
3. Locate the plug **J26** on the switch board and unplug it. See **Figure 9**.
4. Carefully insert a jumper wire on the connector to short wires n°110 and n°109 together.
5. Carefully apply the correct input voltage 400Vac/3ph +/-15% via the input cable to the SPEEDTEC®400/500 SP.
6. Switch to ON position the main switch S1, the fan should run as long as the S1 switch is in ON position.
7. If the fan runs properly this means that the fan, the fan power supply and the fan capacitor are OK.
8. If the fan does not run, check the 230Vac at terminal strip of auxiliary transformer T2 between point 1 and 2. If voltage is present and the **J26** leads are jumped, the fan or the fan capacitor may be faulty. Correct value for fan capacitor **C1** is 3uF +/-5%. See **Figure 10** for C1 location.
9. If the previous checks results in a fan working, remove the jumper between wires n°110 and n°109 and plug J26 back into the switch board.
10. Using the flat head screwdriver remove one of the wires from connector **X6**. See **Figure 10** for X6 location. This will simulate the activation of one of the thermostats.
11. If removing the wire from **X6** machine flashes error 36 and the thermo lamp to turns ON but the fan still does not start the switch board may be defect.

GREEN MODE BOARD TEST

WARNING

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

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TEST DESCRIPTION

This test will help determine if the green mode board is working properly.

MATERIALS NEEDED

Multimeter
Machine schematic

GREEN MODE BOARD TEST (continued)

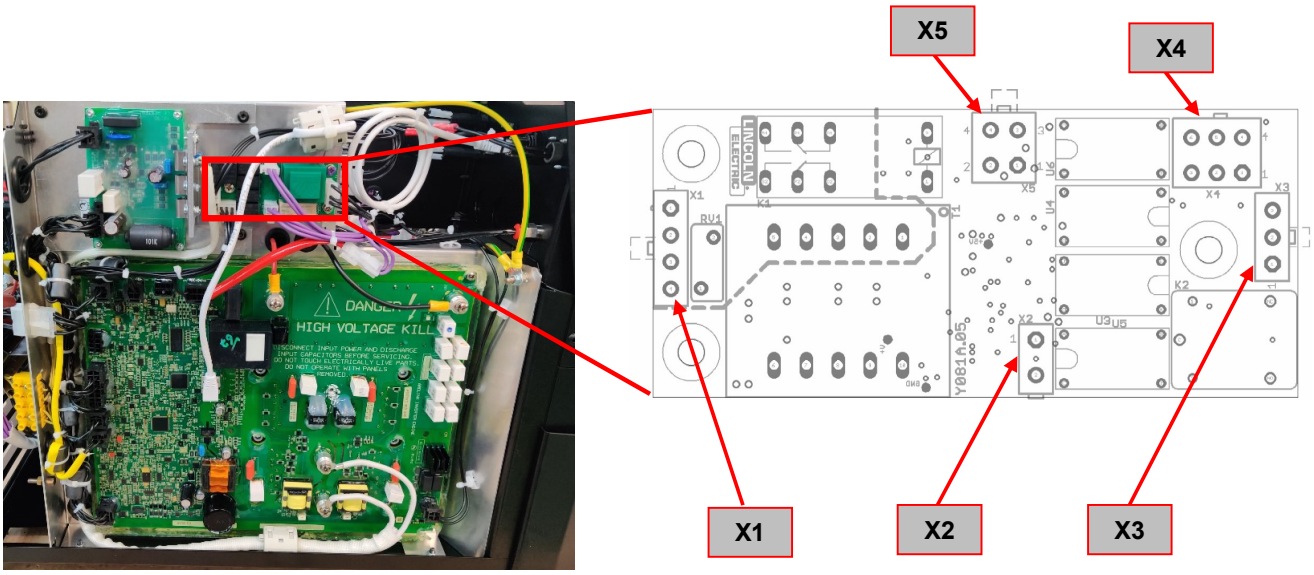
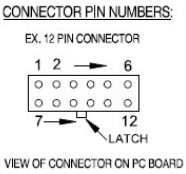


Figure 11 – Y081-1 Green Mode board location and test points



TEST PROCEDURE

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

1. Remove main input power to the SPEEDTEC® 400/500 SP.
2. Perform the **Case removal** and **Discharge procedure**
3. Locate the Y081-1 water cooler detection board. See **Figure 11**.
4. Carefully apply the correct input voltage 400Vac/3ph +/-15% via the input cable to the SPEEDTEC®400/500 SP.
5. Switch to ON position the main switch S1, wait until the status LED on front panel is steady green.
6. Using the multimeter in Vdc mode perform the tests detailed in **Test Table 11**. See **Figure 11** for Test Point locations

Test table 11 – Water cooler detection board tests

Test Points	*Expected reading*	*Note*
Plug X1 pin 2 to pin 4	400Vac +/- 15%	When main switch S1 is closed.
Plug X4 pin 6 (+) to pin 5 (-)	0Vdc= water OK 15Vdc =water error	Coolarc water error circuit. When coolarc is not connected voltage is about 6Vdc
Plug X3 pin 1 to pin 2	24Vac +/- 15% = green mode I not active 0 Vac = green mode I active	Green mode I
Plug X1 pin 4 to pin 1	400Vac +/- 15% = green mode II not active 0 Vac = green mode II active	Green mode II

OUTPUT RECTIFIER MODULES RESISTANCE TEST

WARNING

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

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TEST DESCRIPTION

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

MATERIALS NEEDED

Multimeter
Machine schematic
10 mm wrench

OUTPUT RECTIFIER MODULES RESISTANCE TEST (continued)

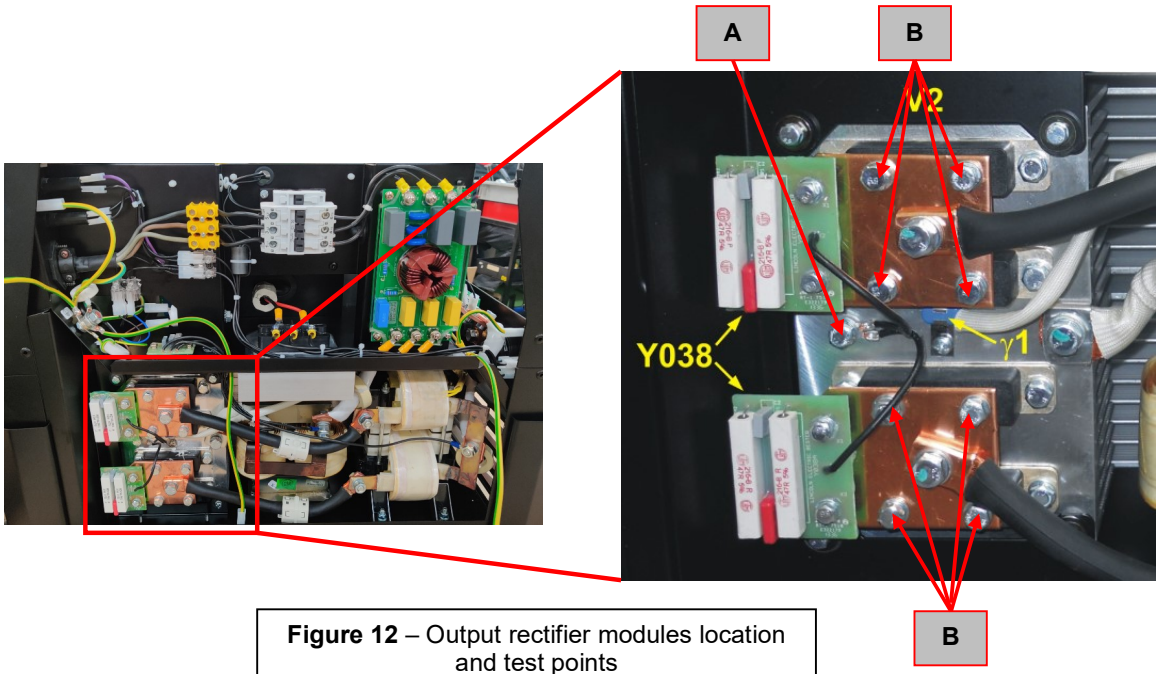
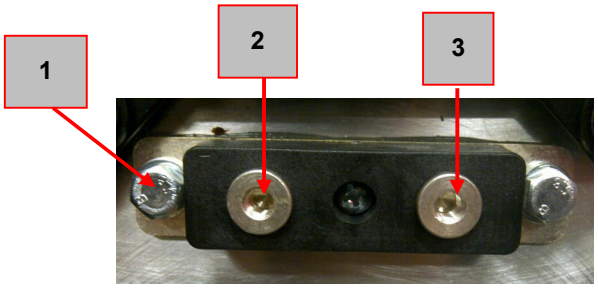


Figure 12 – Output rectifier modules location and test points

TEST PROCEDURE

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

1. Remove main input power to the SPEEDTEC® 400/500 SP.
2. Perform the **Case removal** and **Discharge procedure**
3. Locate the Output rectifier modules. See **Figure 12**.
4. Visually check for burned or damaged components. If any components are physically damaged should be replaced.
5. Using the 10mm wrench remove the bolt (**A**) and disconnect the two snubber board wires. See **Figure 12**.
6. Using the 10mm wrench unscrew the 8 screws (**B**) from the two copper plates. See **Figure 12**.
7. Remove the two copper plates and using the multimeter in diode test mode check each rectifier module following the tests below:



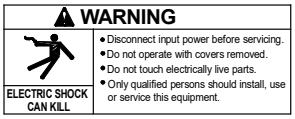
Test table 12 – Output diode module Test

Positive Probe (RED)	*Negative Probe (BLACK)*	*Value*
2	**1**	0,2V-0,7V
3	**1**	0,2V-0,7V
1	**2**	Open
1	**3**	Open

8. If the tests determine that one or more rectifier modules are shorted or open, replace them with new modules following the disassembly and replacement procedure available in this service manual.
9. Refer to the output rectifier module replacement procedure available on this manual also for the correct 8 screws (**B**) torque values.

DISASSEMBLY OPERATIONS

INPUT CONTACTOR REMOVAL AND REPLACEMENT PROCEDURE



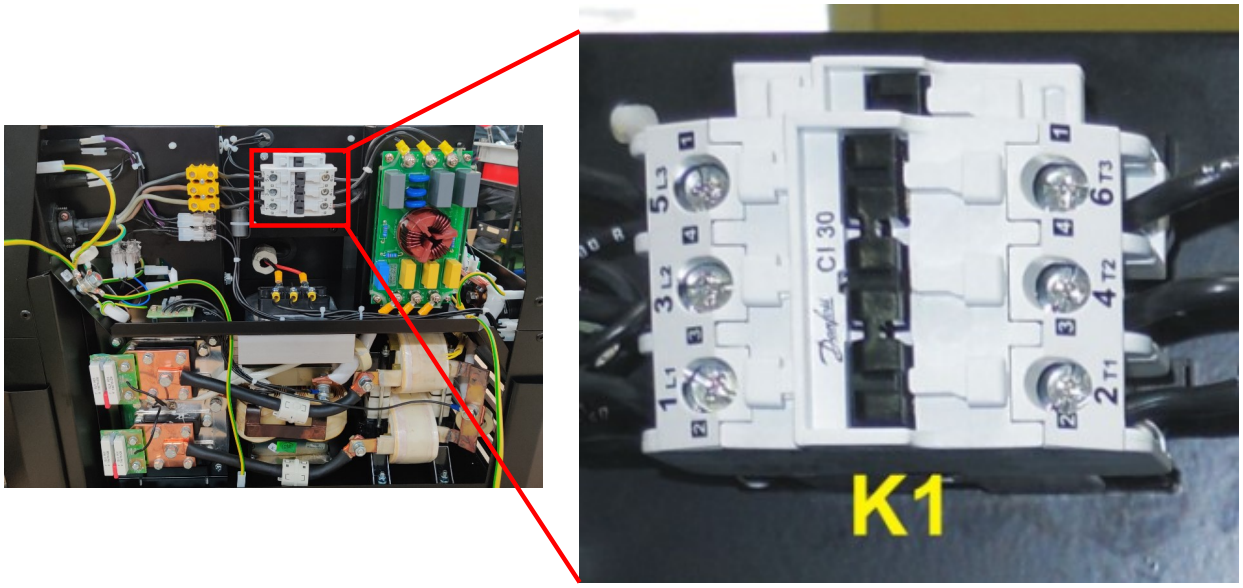


Figure 13

REMOVAL PROCEDURE

Necessary tool:

- Phillips screwdriver PH02
- 7mm wrench

1. Remove main input power to the SPEEDTEC® 400/500 SP.
2. Perform the **Case Removal** and **Discharge procedure**
3. Locate the input contactor K1. See **Figure 13**
4. Using Phillips screwdriver PH02 remove and label the 3 input cables connected to the contactor terminals **1L1, 3L2, 5L3** and the 3 output cables connected to the contactor terminals **2T1, 4T2, 6T3**. See **Figure 13**
5. Using the Phillips screwdriver PH2 remove and lable the leads connected to the contactor coil terminals **A1** and **A2.**
6. Using the Phillips screwdriver and the 7mm wrench remove the 4 screws that are fixing the contactor **K1** to the machine frame.
7. Remove the contactor **K1** from the machine.
8. **For the new contactor K1 re-assembly operations,** make the previous steps in the reverse order

DISASSEMBLY OPERATIONS

EMC FILTER REMOVAL AND REPLACEMENT PROCEDURE

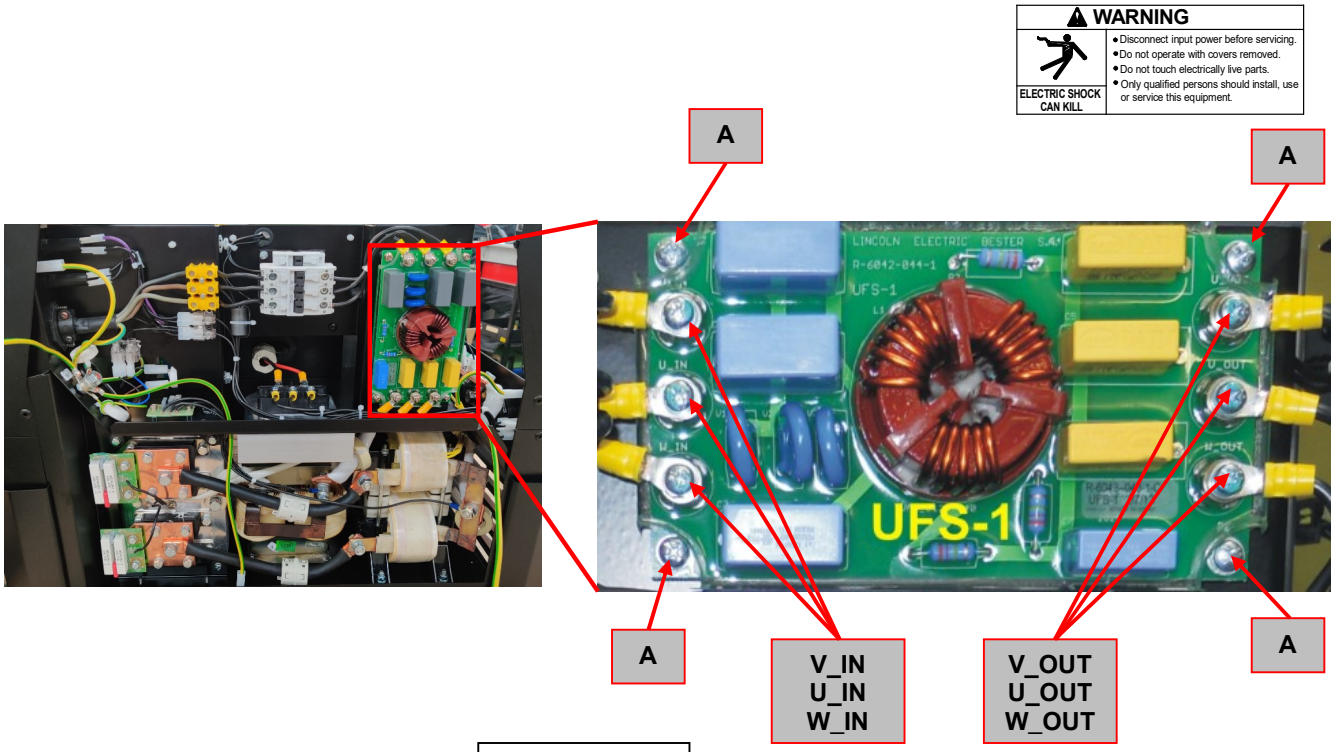


Figure 14

REMOVAL PROCEDURE

Necessary tools:

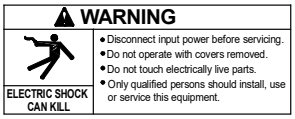
- Phillips screwdriver PH02

!! During performing the following steps take note of the size and type of screws being removed and associated washers. Upon re-assembly, the same type and size screw and washers MUST be used.

1. Remove main input power to the SPEEDTEC® 400/500 SP.
2. Perform the **Case Removal** and **Discharge procedure**
3. Locate the input contactor K1. See **Figure 14**
4. Using Phillips screwdriver PH02 remove and label the 3 input cables **V_IN, U_IN, W_IN** and the 3 output cables **V_OUT, U_OUT, W_OUT**. See **Figure 14**
5. Using Phillips screwdriver PH02 remove the 4 EMC board corner screws (A) and carefully remove the EMC Filter Board from the machine.
6. **For the new EMC board re-assembly operations,** make the previous steps in the reverse order

DISASSEMBLY OPERATIONS

3 PHASES INPUT RECTIFIER BRIDGE REMOVAL AND REPLACEMENT PROCEDURE



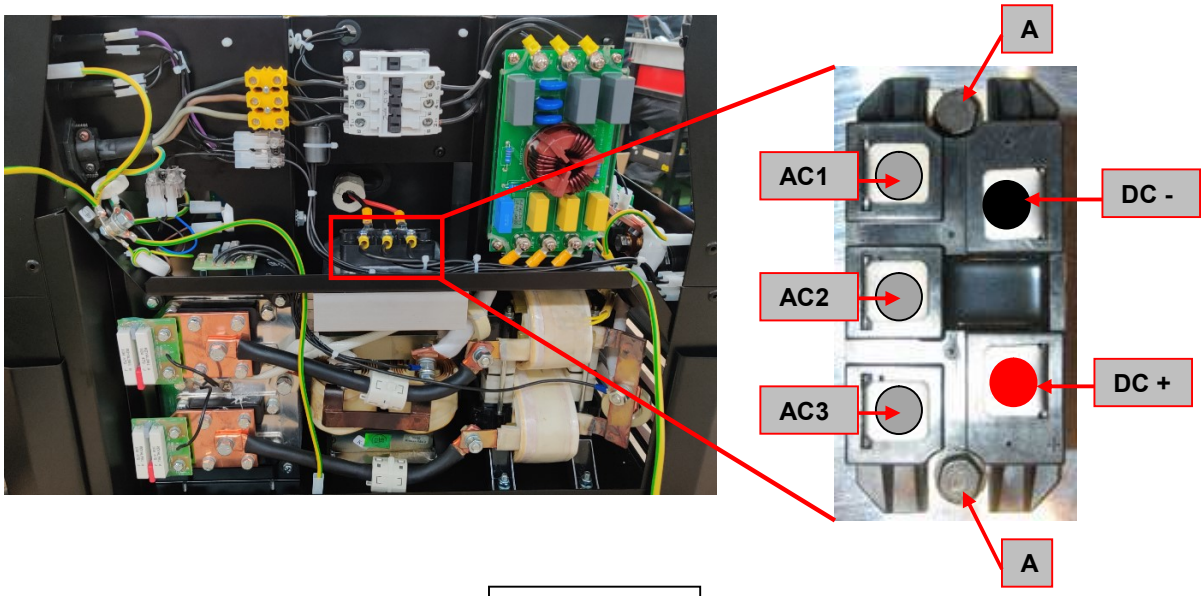


Figure 15

REMOVAL PROCEDURE

Necessary tools:

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

!! During performing the following steps take note of the size and type of screws being removed and associated washers. Upon re-assembly, the same type and size screw and washers MUST be used.

1. Remove main input power to the SPEEDTEC® 400/500 SP.
2. Perform the **Case Removal** and **Discharge procedure**
3. Locate the 3 phases input rectifier bridge. See **Figure15**
4. Using the 8mm nut driver label and remove the 3 AC input cables and the 2 output DC+ and DC- cables from the 3 phases input rectifier bridge. See **Figure 15**
5. Using 8mm nut driver remove the 2 screws (**A**) that fix the 3 phases input rectifier bridge to the heat sink. See **Figure 15**
6. Carefully remove the 3 phases input rectifier bridge from the machine.

REASSEMBLY PROCEDURE

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

DO NOT USE CORDLESS SCREWDRIVERS FOR THE POWER MODULEs!

DISASSEMBLY OPERATIONS

SWITCH 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.

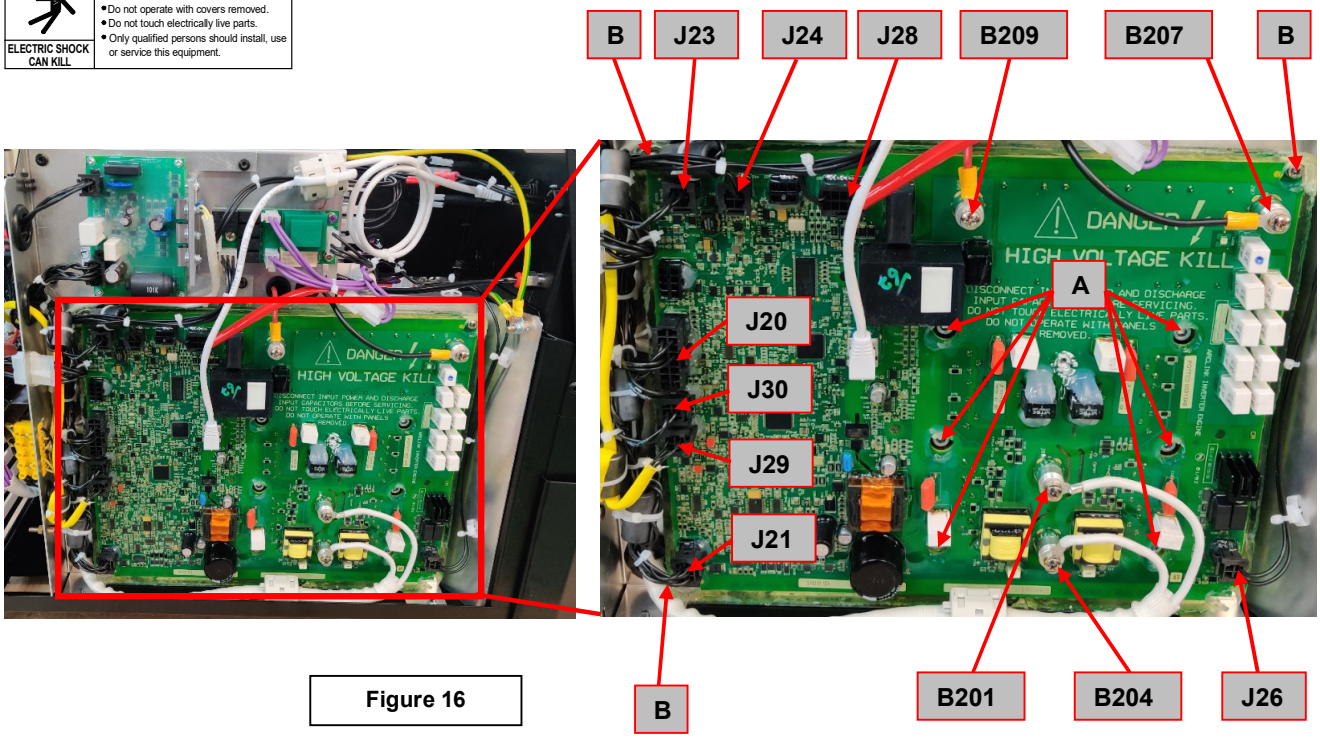


Figure 16

REMOVAL PROCEDURE

Necessary tools:

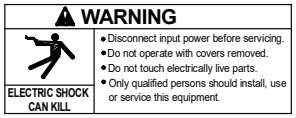
- Phillips screwdriver PH02
- 5mm allen wrench
- KERATHERM KP92 Heat Sink Compound
- Torque wrench

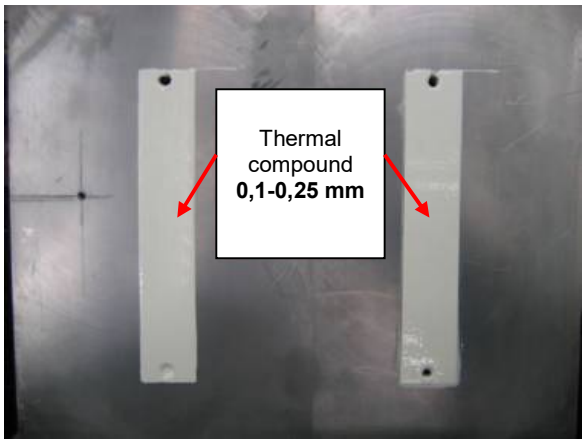
!! During performing the following steps take note of the size and type of screws being removed and associated washers. Upon re-assembly, the same type and size screw and washers MUST be used.

1. Remove main input power to the SPEEDTEC® 400/500 SP.
2. Perform the **Case Removal** and **Discharge procedure**
3. Locate the switch board. See **Figure16.**
4. Using the Phillips screwdriver PH02 label and remove the cables from terminals **B201, B204, B207** and **B209.**
5. Remove the plugs from the connectors **J20, J21, J23, J24, J26, J28, J29** and **J30**. See **Figure16.**
6. Using the 5mm allen wrench unscrew the 6 screws (**A**) that are fixing the IGBT power modules to the switch board heat-sink. See **Figure16.**
7. Using the Phillips screwdriver PH02 remove the 3 screws (**B**) that are fixing the switch board to the machine. See **Figure16.**
8. Carefully remove the Switch board from the machine.

DISASSEMBLY OPERATIONS

SWITCH BOARD REMOVAL AND REPLACEMENT PROCEDURE (continued)





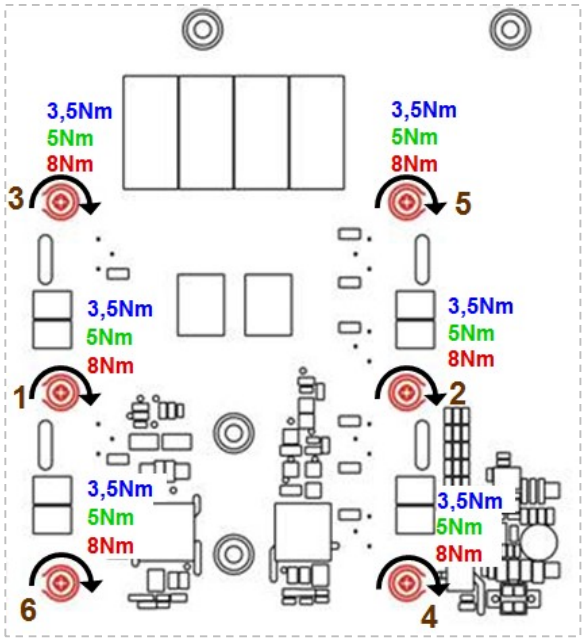


Figure 17

SWITCH BOARD REASSEMBLY PROCEDURE

1. Clean the heat sink mounting surface from the old thermal compound.
2. Clean the copper bars on the backside of the switch board with a rag and alcohol. These mating surfaces to the heatsink must be clean and free of debris to ensure good contact and proper thermal transfer
3. Apply a thin layer of new thermal compound (0,1-0,25 mm) to the heat sink mating surfaces (KERATHERM KP92). See **Figure 17.**
4. Assemble the new Switch board to the heat sink using the 6 screws (**A**) previously removed following the below torque sequence:
    a. Torque 3,5Nm -> screw sequence 1,2,3,4,5,6
    b. Torque 5Nm -> screw sequence 1,2,3,4,5,6
    c. Torque 8Nm -> screw sequence 1,2,3,4,5,6
5. Reassembly the 4 screws (**B**) previously removed. See **Figure 16.**
6. Reconnect the cables to terminals **B201, B204, B207** and **B209** (torque 3,5Nm). See **Figure 16.**
7. Reconnect all plugs previously removed to the switch board. See **Figure 16.**

DO NOT USE CORDLESS SCREWDRIVERS FOR THE POWER MODULEs!

DISASSEMBLY OPERATIONS

40VDC BUS BOARD REMOVAL AND REPLACEMENT PROCEDURE

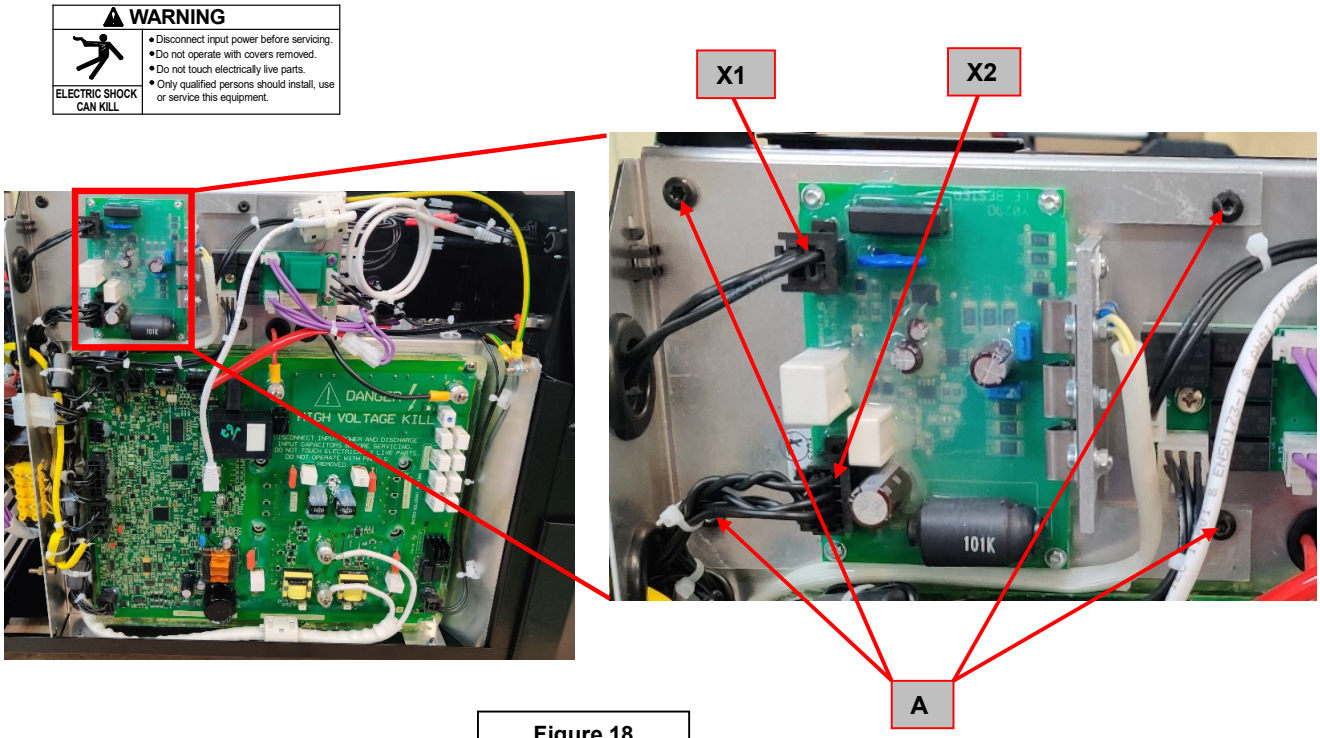


Figure 18

REMOVAL PROCEDURE

Necessary tools:

- TORX wrench TX-25 driver
- Phillips screwdriver PH02

1. Remove main input power to the SPEEDTEC® 400/500 SP.
2. Perform the **Case Removal** and **Discharge procedure**
3. Locate the 40VDC BUS board. See **Figure18.**
4. Using the Phillips screwdriver remove the screw that is fixing the thermal sensor **Y2**. See **Figure 18.**
5. Unplug the connectors **X1** and **X2** from the board. See **Figure 18**.
6. Using the TORX wrench TX-25 driver remove the 4 screws (**A**) that are fixing the 40VDC BUS board assembly to the machine.See **Figure 18.**
7. Carefully remove the 40VDC BUS board from the machine.
8. **For the new 40VDC BUS board re-assembly operations,** make the previous steps in the reverse order

DISASSEMBLY OPERATIONS

OUTPUT RECTIFIER MODULES REMOVAL AND REPLACEMENT PROCEDURE

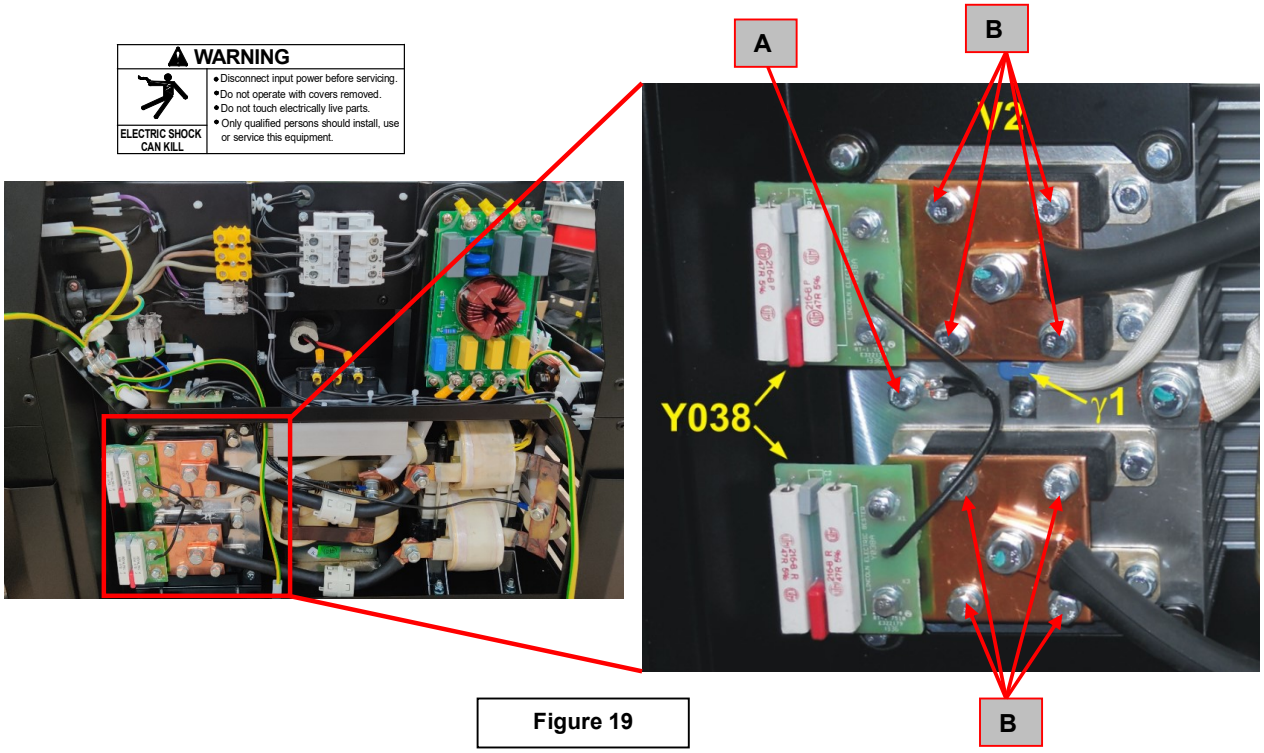


Figure 19

REMOVAL PROCEDURE

Necessary tools:

- 10mm wrench or nut driver
- Torque wrench
- KERATHERM KP92 Compound

!! During performing, the following steps take note of the size and type of screws being removed and associated washers. Upon reassembly, the same type and size screw and washers MUST be used.

1. Remove main input power to the SPEEDTEC® 400/500 SP.
2. Perform the **Case Removal** and **Discharge procedure**
3. Locate the output diode modules. See **Figure19.**
4. Using the 10 mm nut driver unscrew the bolt (**A**) and remove the two leads coming from the Y038 boards. See **Figure 19.**
5. Using the 10mm wrench remove the 8 bolts (**B**) that are fixing the two square copper plates to the output diode modules. See **Figure 19.**
6. Using the 10mm wrench remove the 2 bolts that are fixing the defect output diode module/s to the heat-sink.
7. Remove carefully the defect output diode module/s from the machine.

OUTPUT DIODE MODULE REASSEMBLY PROCEDURE

1. Clean the heat sink mounting surface from the old thermal compound.
2. Clean carefully the new output diode module mounting surface with a rag and alcohol.
3. Apply a thin layer of thermal compound (0,1 - 0,25 mm) to the new output diode module mounting surface (KERATHERM KP92).
4. Carefully apply the new output diode module into place.
5. Using the 2 bolts previously removed fix the output diode module to the heat-sink. Tight the two bolts by hand only during this step.
6. Reassembly the two square copper plates on the top of the output diode modules using the 8 bolts previously removed. Tight them by hand during this step.
7. Finish to tight the 2 bolts that are fixingthe output diode modules to the heat-sink, torque 3,5Nm
8. Finish to tight the 8 bolts (**B**) that are fixing the two square copper plates on the output diode modules, torque 3,5Nm.
9. Reconnect the two leads coming from the Y038 boards to the heat sink using the bolt (**A**) previously removed.

DO NOT USE CORDLESS SCREWDRIVERS FOR THE POWER MODULEs!

RETEST AFTER REPAIR

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

Machine input and output

SPEEDTEC® 400 SP

Input Voltage	Max Input Current	Rated Output	OCV (open circuit voltage) Peak
400Vac-3ph-50/60Hz	28A	Stick Mode 420A/36,8V@100%	65 Vp

Output Current range	
SMAW & GTAW	15A - 420A
GMAW & FCAW	20A– 420A

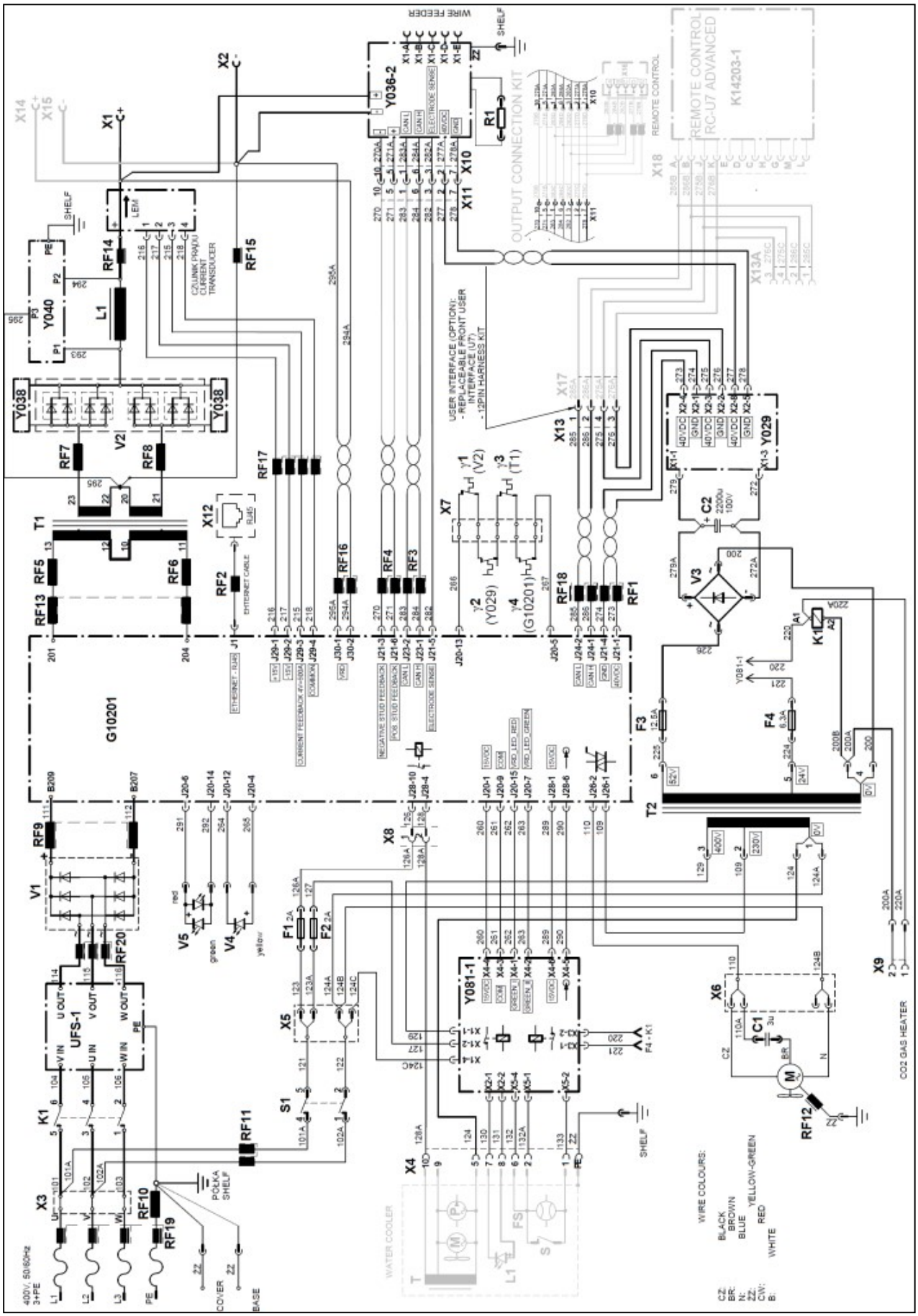
SPEEDTEC® 50 SP

Input Voltage	Max Input Current	Rated Output	OCV (open circuit voltage) Peak
400Vac-3ph-50/60Hz	36A	Stick Mode 500A/40V@60%	65Vp

Output Current range	
SMAW & GTAW	15A - 500A
GMAW & FCAW	20A– 500A

ELECTRICAL SCHEMATICS

Schematic Diagram: SPEEDTEC® 400-500 SP



ERROR CODES

A two color light that indicates system errors. Normal operation is steady green light. Error conditions are indicated, per Table.

Table:

Light Condition	Meaning
Steady Green	System O.K. Power source comunicating normaly with wire feeder.
Blinking Green	Occurs during a reset, and indicates the power source is mapping (identyfying) each component in the systems. Normal for first 1-10 seconds after power is turned on, or if the system configuration is changed during operation.
Alternating Green and Red	Non-recoverable system fault. If the PS status light is flashing any combination of red and green, errors are present in power source. Individual code digits are flashed in red with a long pause between digits. If more then one code is present, the codes will be separated by green light. Read the error code before the machine is turned off. If occurs, to clear the error try to turn off the machine, wait for a few seconds, then turn on again. If the error remains, a maintenance is required.
Steady Red	Non recoverable hardware fault. Generally indicates nothing is connected to the power source wire feeder receptacle.
Blinking Red	Not applicable.

Event Codes

6 - Power source is not connected
11 - action database failed
12 - Attribute error
13 - non volatile attributes restore fault
14 - primary non-volatile section bad
15 - secondary non-volatile section bad
16 - non volatile attributes write bad
17 - HSL watch dog timeout
18 - ArcLink mapping failed.
19 - Excessive EEPROM saves detected for the specified attribute
21 - weld sequencer entered faulted state
22 - fault state entry caused by WCD
23 - weld sequencer error updating active state
24 - error changing mode data
25 - weld sequencer write configuration memory with state memory action failed
26 - problem with paired mapping
27 - read/write request failed during paired mapping
28 - Output locked out in the Weld Controller
29 - DSP DAC ISR dangerously close to limit - failure imminent
31 - primary over current
32 - cap bank 'A' under voltage
33 - cap bank 'B' under voltage
34 - cap bank 'A' over voltage
35 - cap bank 'B' over voltage
36 - thermal shutdown
37 - soft start failed
38 - Momentary AC dropout
39 - miscellaneous hardware fault
41 - secondary over current (long average)
42 - power down 42 (GFCI trip)
43 - cap delta voltage
44 - DSP detects host dropped HB
45 - output voltage high
46 - secondary over current (short average)
47 - miscellaneous. hw fault
48 - miscellaneous. hw fault high
49 - single phase
51 - Weld controller failed to set weld sequencer schedule memory.
52 - DSP load high
53 - voltage sense loss
54 - secondary over current (long average)
55 - Communication with DSP failed
56 - Communication with Chopper failed
57 - FGEN error
58 - Primary input power board not ready
59 - Reduced input power detected
61 - slope calculation truncated to zero
62 - sequencer Weld Cycle Data retry
63 - Problem with submerged arc Slave device
71 - Secondary over-power
72 - Unsupported hardware revision
73 - FGEN ISR Overlap
81 - wire drive Motor Overload Fault
82 - wire drive motor over current fault
83 - shutdown bit 1
84 - shutdown bit 2
85 - failed finding Arc Object for trigger command
86 - wire drive input voltage too high
87 - wire drive could not find object
88 - wire drive could not send trigger
89 - WD faild to find PM
91 - failed to update the polarity attribute
92 - Remote shutdown of Weld Controller/Water Cooler error
95 - Spool / Pull motor overload fault code
96 - Weld Controller failed to read WFS decimal places
97 - Licensed feature trial expired, or problem with licensed feature database.
98 - Tried to select an unlicensed weld procedure
99 - STT switch fault
111 - Undefined exception
111 - State memory event queue overflowed

112 - bus error
112 - Error in state timer enable access function
113 - address error
113 - DeviceNet State Enable function error
114 - illegal instruction
114 - DeviceNet Weld Mode change timed-out
115 - divide by zero math error
115 - DeviceNet Creating Change-of-State event failed
116 - Failed to get the object's ArcLink mapping address
116 - F_CHK
117 - F_TRAPV
118 - F_PRIVILEGE
118 - DeviceNet Polled connection Timeout
119 - F_TRACE
119 - DeviceNet Connection was Deallocated
121 - F_EMULA
121 - DeviceNet write database property failed
122 - F_EMULF
122 - DeviceNet read database property failed
123 - F_HW
123 - DeviceNet failed setting polled I/O digital inputs to off.
124 - F_PROTO
124 - DeviceNet Weld Mode change failed
125 - Error getting scaled trim values
125 - F_FORMAT
126 - Error getting un-scaled trim values
126 - F_UNINIT
127 - Error setting trims on a mode change
127 - F_RESVD
128 - Error in writing out an EE value
128 - Spurious Interrupt event
129 - Error in initializing DeviceNet attributes
129 - F_AUTO1
131 - F_AUTO2
131 - EE read failed or bad EE checksum
132 - F_AUTO3
132 - Write To EE failed
133 - Write ArcLink Action Failed
133 - F_AUTO4
134 - F_AUTO5
134 - DeviceNet Master got a fragmented Explicit Message Response
135 - DeviceNet Master got a Bad Explicit Message
135 - F_AUTO6
136 - DeviceNet Master could not open slave
136 - F_AUTO7
137 - DeviceNet Master lost communications to slave
137 - F_TRAP0
138 - DeviceNet Master got a bad I/O Message Response
138 - F_TRAP1
139 - F_TRAP2
139 - DeviceNet Master read a bad high limit for the set WFS
141 - F_TRAP3
141 - DeviceNet Master sending poll I/O failed
142 - F_TRAP4
142 - Error in reading modes form Weld Controller
143 - F_TRAP4
143 - Error in setting SPI panel item
144 - Error accessing Trim item
144 - F_TRAP6
145 - DeviceNet duplicate MAC address error
145 - F_TRAP7
146 - DeviceNet Bus off
146 - F_TRAP8
147 - Error in accessing an attribute over polled I/O
147 - F_TRAP9
148 - Error in switching schedules
148 - F_TRAPA
149 - time out due to zero length I/O
149 - F_TRAPB
151 - F_TRAPC
152 - F_TRAPD
153 - F_TRAPE
154 - F_TRAPF
155 - F_USER
156 - F_UNS_INSTR
157 - F_NPC_BKPNT_DEBUG_INTR
158 - F_PC_BKPNT_DEBUG_INTR
159 - Invalid IP address
159 - F_FP_BRANCH
161 - F_FP_INEXACT
161 - Ethernet Watchdog timeout
162 - F_FP_DIV_BY_ZERO
162 - Ethernet connection timer expired
163 - F_FP_UNDERFLOW
163 - Error in getting system information for email
164 - Error sending email
164 - F_FP_OPER_ERR
165 - Error accessing email memory
165 - F_FP_OVERFLOW
166 - action failed
166 - F_FP_IN_NOT_A_NUMBER
167 - Ethernet Europipe PLC
167 - F_FP_IN_DENORMALIZED
168 - Ethernet UPD port busy
169 - Ethernet connection watchdog timeout
171 - CPU Bus Problem
171 - Ethernet socket timeout
172 - Ethernet watchdog timeout
173 - Failed to create a change of state event.
174 - Failed getting ArcLink object address
175 - ArcLink message failed
176 - Error in setting up the Web Server
177 - High speed event registration failed
178 - High Speed Event Read Failed
179 - An incoming ArcLink Event queue overflowed.
181 - Failed to add object to ArcLink group.
181 - System CPU exception (F_UNALIGN)
182 - System CPU exception (F_NOCP)
182 - Could not allocate TPU timer
183 - System CPU exception (F_INVPC)
183 - Could not deallocate TPU timer
184 - System CPU exception (F_INVSTAT)
184 - Error in opening UDP listen port
185 - Non-Authorized IP address sent a UDP packet
185 - System CPU exception (F_BSTKE)
186 - System CPU exception (F_BUSTKE)
186 - Incoming UDP packet bad
187 - Could not allocate a UPD packet
187 - System CPU exception (F_IMPRE)
188 - System CPU exception (F_PRECISE)
188 - Send a UDP packet failed
189 - System CPU exception (F_IBUS)
189 - Error in updating cache memory
191 - Error in checking UDP cache item
191 - System CPU exception (F_MLSPERR)
192 - System CPU exception (F_MSTKE)
192 - Error in creating UDP cache item
193 - System CPU exception (F_MUSTKE)
193 - Error in removing an item from cache memory.
194 - System CPU exception (F_DERR)
194 - Error in sending a UDP message from an Ethernet client
195 - System CPU exception (F_IERR)
195 - Had a problem with a client socket call
196 - System CPU exception (F_HFAULT_STAT_VECT)
196 - Had a problem opening client
197 - Client detected problem with Server data
198 - Client timed out waiting for Ethernet server reply
199 - Error getting sequence cross reference attribute number
211 - DSP Illegal Instruction
212 - control board can't be found
212 - DSP/BIOS Task Creation Failed
213 - DSP/BIOS Resource Lock Creation Failed
213 - control board is offline
214 - wire drive board can't be found
214 - DSP/BIOS Mailbox Creation Failed
215 - DSP/BIOS Semaphore Creation Failed
215 - wire drive board is offline
216 - error sending message to Ethernet client
217 - arc master had a problem
218 - action to sequencer failed
219 - Ethernet board not found
221 - Error setting sequence memory
222 - Error getting sequencer cross reference
223 - Error getting arc data
224 - Error with a message to a server
225 - Bad Session Id
226 - Error with a message to a server
227 - New Arclink XT object Found
228 - Arclink XT communication problem
229 - Ethernet Transmit Error
231 - Power source is not connected
232 - arc control object write workpoint
233 - arc control object write trim
234 - arc control object write wave 1
235 - arc control object write wave 2
236 - arc control object write wave 3
237 - arc control object write wave 4
238 - arc control object write WFS
239 - arc control object write timer
241 - arc control object write state enable

242 - arc control object write timer enable
243 - arc control object read failure
244 - arc control object can not find required object
245 - arc control object non sequence write
246 - arc control object mode change
247 - arc control object latched fault
251 - Master machine detected an error with one of its slave machines.
252 - AC/DC trail arc fault
253 - Trail Arc mapping fault
259 - Loss Of Communication with the Secondary Microcontroller
261 - dual memory panel dip switches not set correctly
262 - power source is not compatible
263 - user interface found no compatible weld modes
264 - user interface tried to select non-existent weld mode
265 - selected weld mode is not supported by the user interface
266 - the user interface I/O is preventing the user interface from becoming ready
267 - user interface found too many arc control objects
268 - arc control object not enabled
269 - Arc was lost or never established
271 - user interface shutdown bit 1
272 - user interface shutdown bit 2
273 - user interface CPLD not supported
274 - the info restored from memory does not match the weld mode info (e.g. wp units)
275 - user interface write failure (could not lock user interface memory resource)
276 - user interface read failure (could not lock user interface memory resources)
277 - user interface memories were converted
278 - user interface limits were converted
279 - UI_MAPPING_DIPS_ERROR
281 - user interface failed to read attribute
282 - user interface failed to write attribute
283 - user interface failed an ArcLink action
284 - An attempt was made to update Arc Object from group/sched other than 0
285 - Bad checksum during restore of memory
286 - Block meter timer timed out because meter events did not end properly
287 - User Interface failed to find a Touch Sense mode
288 - Failed to find Spool Gun board
289 - Failed to find Tractor object
291 - input b shutdown
292 - Failed to find Flux Hopper object
293 - Output disabled from Weld Controller
294 - More weld modes found than the UI can store
295 - Push Button is Stuck
296 - Weld Set Incompatibility
297 - USB Drive Access Error
301 - write to battery backup failed (production monitoring counters)
302 - write to battery backup failed (production monitoring weld profiles configuration)
303 - write to battery backup failed (production monitoring system configuration)
304 - read from battery backup failed (production monitoring counters)
305 - read from battery backup failed (production monitoring weld profiles configuration)
306 - read from battery backup failed (production monitoring system configuration)
307 - read workpoint failed
308 - Save Production Monitoring data to battery backed RAM failed
309 - Restoring Production Monitoring data from battery back RAM failed
351 - weld profile fault I limit occurred
352 - weld profile fault V limit occurred
353 - weld profile fault WFS limit occurred
354 - weld profile fault WeldScore limit occurred
355 - weld profile fault T limit occurred
361 - weld profile alarm I limit occurred
362 - weld profile alarm V limit occurred
363 - weld profile alarm WFS limit occurred
364 - weld profile alarm WeldScore limit occurred
365 - weld profile alarm T limit occurred
371 - weld profile runt occurred
372 - consumable low
373 - Did Not Save Weld Logs
381 - weld profile latched alarm I limit occurred
382 - weld profile latched alarm V limit occurred
383 - weld profile latched alarm WFS limit occurred
384 - weld profile latched alarm WeldScore limit occurred
385 - weld profile latched alarm T limit occurred
411 - Spread Arc Limit switch error
412 - Travel Motor Overload Fault
413 - Travel motor over current fault
414 - Ground Loop Protection fault
421 - Dips override firmware
441 - Spool Gun Object Not Found
442 - Arc Object Not Found
443 - Travel Object Not Found
444 - Flux Object Not Found
511 - Request to Function Generator failed
521 - AC Switch Problem
611 - Action to restore flash attributes failed
612 - Object Not Ready
613 - Module pairing was auto-reconfigured
614 - Auto-mapping needs to be enabled
615 - Mapped Object Answered Recognition
616 - A board is in bootstrap
711 - Capacitor Fault
712 - cLink Watchdog Timeout
713 - Supply Voltage Too High
714 - Supply Voltage Too Low
715 - Switchboard Undervoltage Lockout
716 - Microcontroller Locked
717 - Machine Identity Error
718 - Interprocessor Communication Timeout
719 - Switchboard Critical Error
721 - Capacitor bank under-voltage.
722 - Capacitor bank over-voltage.

Fatal errors

1111 - boot code checksum
1112 - power on reset
1113 - forced boot
1116 - RAM failure
1117 - Data/Address failure
1118 - Mapping failure
1119 - Failed to erase flash memory
1121 - Failed to program flash memory
1122 - Flash memory programming voltage problem
1123 - Failed to unlock flash memory for programming
1213 - Timer Allocation error
1214 - Bad event queues
1215 - Bad event queues read
1216 - Watchdog time expired
1311 - Main code checksum error
1312 - Parameter file checksum error
1313 - FPGA file checksum error.
1314 - Weld Table checksum error
1315 - DSP checksum error
1316 - param file format error
1317 - hardware revision format error
1318 - Automapping failure
1319 - EEPROM Memory Allocation Error
1321 - UI parameter definition error
1322 - Bad FGEN file
1323 - FGEN load error
1324 - FGEN HPI int error
1325 - FGEN Start Error
1326 - Main execution RAM checksum error
1327 - CPLD Heart Beat Event
1328 - HPI comm error
1329 - Error in finding all the attributes in the system.
1331 - Error in reading Weld Daq data from the Fgen
1332 - First-sector flash attributes not programmed
1333 - FGEN/Weld controller data mismatch
1334 - Invalid Weld Mode pointer
1335 - Flash calibration attributes not found
1418 - cLink mapping failed
1511 - Too many objects
1521 - Task failed to register for ArcLink reset acknowledgement.
2111 - Controller Area Network(CAN) spurious interrupt
2112 - Controller Area Network(CAN) spurious interrupt
2113 - CAN spurious interrupt
2114 - CAN object allocation error
2115 - CAN weld cycle blocks out of sequence
2116 - CAN bus warning
2117 - CAN bus off
2118 - CAN receive data not new
2119 - CAN hardware did not come out of reset
3111 - HSL spurious Tx interrupt
3112 - Mail for serial download request was bad
3211 - The Cold Fire I2C bus reported busy
3212 - The Cold File I2C bus timed out
3213 - A slave on the Cold Fire I2C bus did not respond
3214 - The Cold Fire OS was not up when trying to use the I2C bus
4111 - Cannot program firmware in Main code
4211 - specified EEPROM section number is invalid
4212 - too many nonvolatile attributes found
4213 - non-Volatile EE checksum invalid after save all.
4214 - EEPROM defined sections overlap
4215 - EE defined section smaller than header size
4216 - Log section of EE is larger than allocated.
5111 - FGEN busy
5112 - Unable to initialize DeviceNet attribute
5113 - Error in loading Weld Mode 0 to the Ffen
5511 - Return buffer is not properly initialized
5512 - Return buffer is not properly initialized
6111 - F_SEQ_BADWCYC
6112 - F_SEQ_WRITE_ERR
6113 - F_SEQ_BUILD_ERR
6114 - F_SEQ_BUILD_CFG
6115 - F_SEQ_BUILD_CON
6116 - F_SEQ_MEM_OVERFLOW
6117 - F_SEQ_BUILD_PAR
6211 - Empty Weld Set
6212 - Bad weld set
6213 - F_WC_WTABLE_VER
6214 - F_WC_FPGA_FAULT
6215 - Parameter file slope is too high
6216 - Incompatible weld table.
6217 - MCU/DSP weld table data mismatch.
6218 - Error transferring weld table to DSP.
6311 - Noisy WFS input
6411 - Phase Generator mapped in system
6412 - Phase Generator failed to read ArcLink property
6413 - Phase Generator failed to write ArcLink property
6511 - More than one UI was found for the Tractor
6512 - More than one Tractor object was found
6611 - More than one lead tried to communicate with trail arcs
6612 - System Interface failed to read ArcLink attribute
6613 - System Interface failed to write ArcLink attribute
6614 - More than one trail arc with the same arc number found
6615 - Too many trail arcs
7111 - Unknown SPI panel installed
7112 - SPI panel RAM allocation err
7121 - repeated bad data read from panel 0
7122 - repeated bad data read from panel 1
7123 - repeated bad data read from panel 2
7124 - repeated bad data read from panel 3
7125 - repeated bad data read from panel 4
7126 - repeated bad data read from panel 5
7127 - repeated bad data read from panel 6
7128 - repeated bad data read from panel 7
7131 - Panel 0 is necessary and not found
7132 - Panel 1 is necessary and not found
7133 - Panel 2 is necessary and not found
7134 - Panel 3 is necessary and not found
7135 - Panel 4 is necessary and not found
7136 - Panel 5 is necessary and not found
7137 - Panel 6 is necessary and not found
7138 - Panel 7 is necessary and not found
8111 - DSP - FPGA load failure
8112 - DSP Clear Failure
8113 - DSP Set Failure
8114 - DSP program failure
8115 - DSP version changed
8116 - DSP RAM error
8117 - DSP Checksum Error
8118 - DSP Heartbeat Error
8119 - DSP Program Timeout
8121 - DSP Watchdog Timeout
8122 - DSP Depletion Error
8123 - DSP flash loader not found
8124 - DSP program loader not found
8125 - DSP main program not found
8126 - DSP timeout
8127 - DSP response incorrect
8128 - DSP flash sector empty
8211 - A user safety attribute could not be written
8212 - Operational Hardware check failed
9111 - FPGA - Bad Config
9112 - FPGA programming fault
9121 - PSoC has no main code (G4774)
9122 - PSoC watchdog timed out (G4774)
9123 - Wire drive PSoC error
9124 - Wire drive PSoC error
9125 - Wire drive PSoC error
9311 - SwitchBoard fault
9411 - Submerged arc slave error
9511 - TCP Stack
9512 - There is a hardware problem on the board

NOTE

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