KEMPPI
The Joy of Welding

SERVICE MANUAL
Minarc Evo 150

CONTENTS

1. READ THIS FIRST

230VAC 50/60Hz and 390VDC or higher are inside the machine

Before removing any covers or commencing any testing or measurement disconnect the power source from the mains voltage

Dangerous DC voltage may still exist after the removal of the input voltage. Machine discharges the voltage while it is turned off, but it is always better to ensure this by measuring the voltage

Wait at least one minute for the capacitors to become discharged.

Digital multimeters (later DMM) may give different values depending the specifications they have. For example diode measuring values may vary between the DMM models. In this manual Fluke 179 DMM is used.

This machine has all the control circuits in the primary side and special attention must be considered while working with the internal parts.

The device may be repaired only by a person legally authorized to perform electric work.

2. GENERAL

Minarc Evo is new generation small MMA machine. It is not based on any existing machine. It is totally new design electrically and mechanically. Machine has a power factor correction in the primary side to meet the latest European regulations.

The Minarc Evo machines are for MMA-welding and lift-TIG can be used as well. MMA open circuit voltage is 90VDC or 30VDC with VRD activated.

Minarc Evo can be connected to the mains supply of 230VAC 1~. PFC makes possible to weld with the full power (MMA 140A) even when modern circuit breakers are used.

Minarc Evo control card software cannot be reprogrammed in the field.

Overvoltage watch is 300VAC and under voltage watch is 110VAC; voltage must be increased back to 160VAC to get the inverter back to full operation after the under voltage situation.

Current range is 10-140A in MMA and 10-150A in TIG mode.

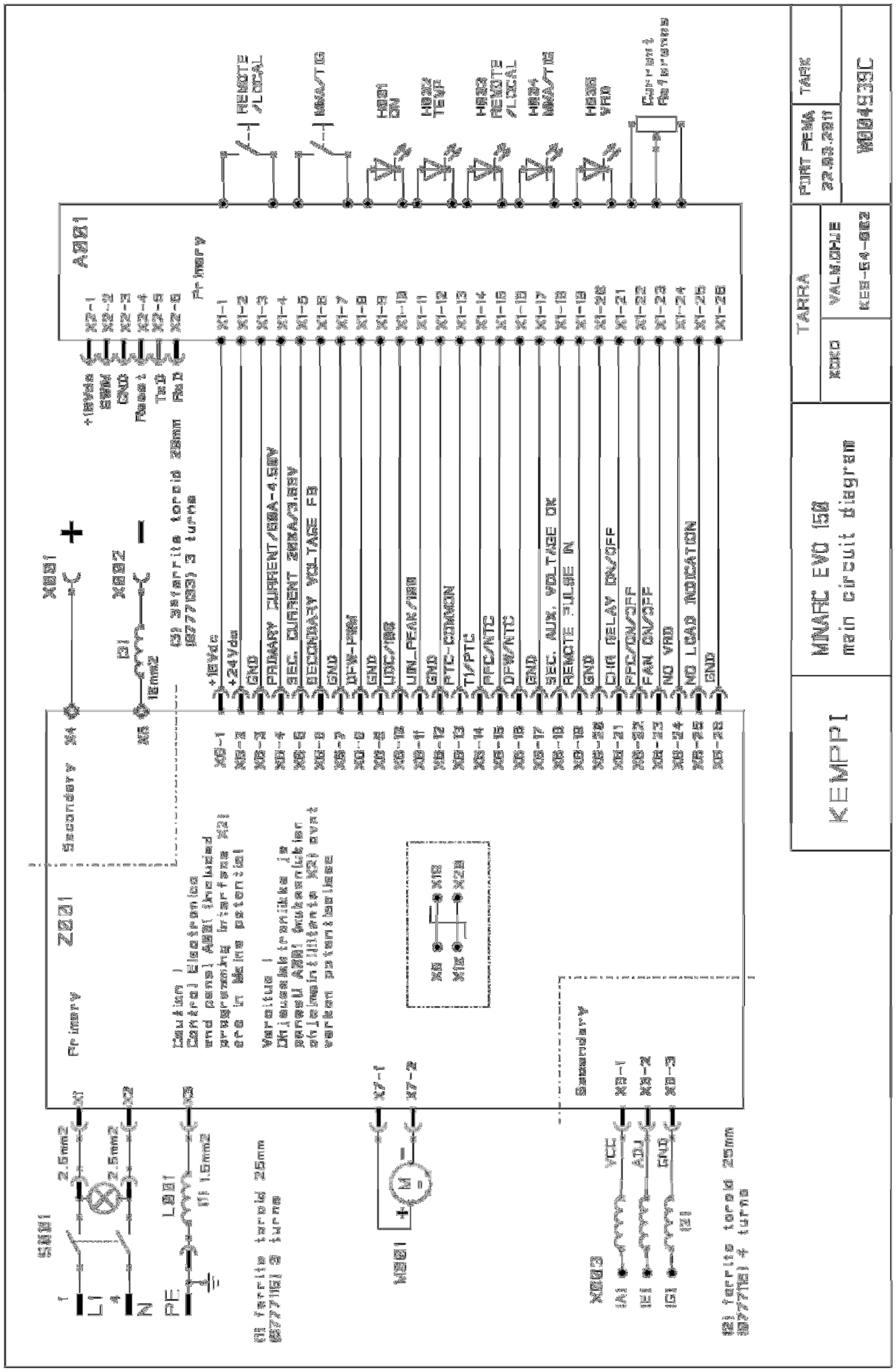
Minarc Evo discharges the DC link voltage after switching the main switch off by running the cooling fan as long as the control electronics is wake.

3. TECHNICAL INFORMATION

3.1. Technical data

Minarc Evo 150		
Connection voltage	1~50/60 Hz	230V ± 15%
Rated power	35 % ED MMA	140 A/4.5 kVA
	35 % ED TIG	150 A/ 3.2 kVA
Supply current	35 % ED I_{1max}	19.7 A
	100 % ED I_{1eff}	12.9 A
Connection cable	HO7RN-F	3G1.5 (1.5mm^2, 3m)
Fuse	Type C	16A: 140A ED 35% 10A: 140A ED 28%
Duty cycle 40°C	35 % ED MMA	140 A/25.6 V
	100 % ED	100 A/24.0 V
	35 % ED TIG	150 A/16.0 V
	100 % ED	110 A/14.4 V
Welding range	MMA	10 A/15 V - 140 A/37 V
	TIG	10 A/1 V - 150 A/36 V
No-load voltage; peak		90 V (VRD 30V)
Idle power		17 W
Voltage steps		stepless
Power factor at 100 % ED		0.99
Efficiency at 100 % ED	MMA	82 %
Stick electrodes	Ø	1.5mm – 3.25 mm, and some 4mm
External dimensions LxWxH	Height with handle	361x139x267 mm
Weight	Without connection cable	5.4 kg
	With connection cable	5.85 kg
Temperature class		B (130º C)
EMC class		A
Degree of protection		IP23S
Operating temperature range		-20…+40º C
Storage temperature range		-20…+60º C
Standards IEC60974-1 IEC60974-10 IEC60974-3-12		

3.2. Wiring diagrams



Latest version with better quality is available at Kemppi Channel.

3.3. Construction

Left side

Front

Right side

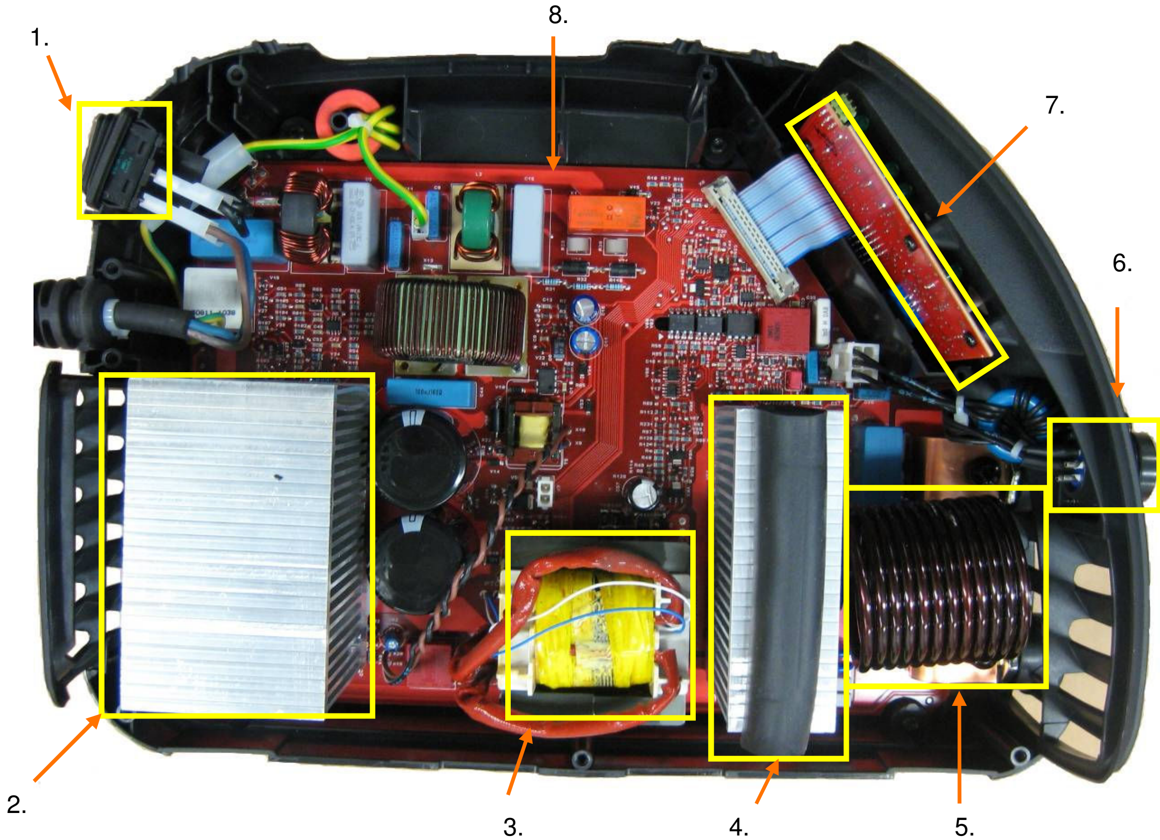
Back

Left side, side plate removed

Left side plate with cooling fan

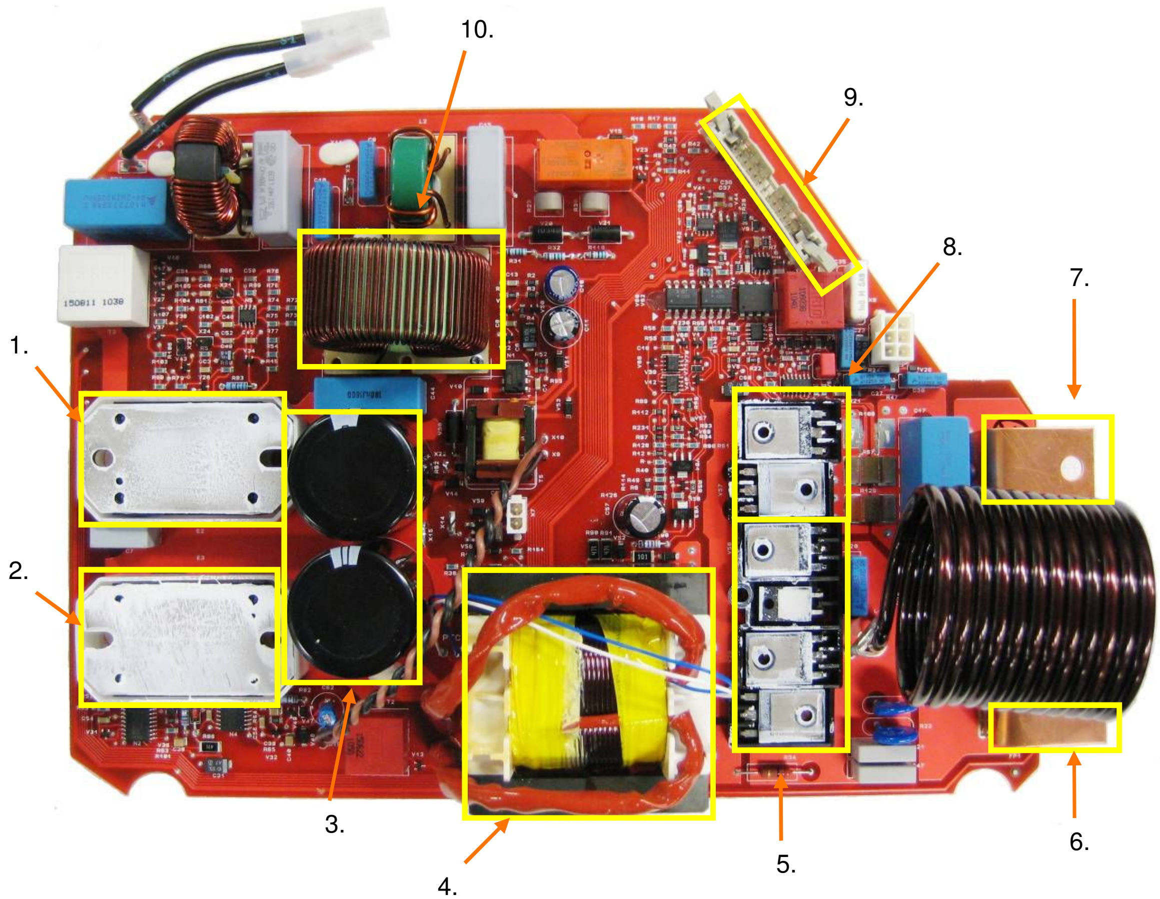
The cooling fan is installed so that the air flows from the left side plate to Z001 card. Air comes out through the front and the back plate grills.

3.3.1. Inner structure



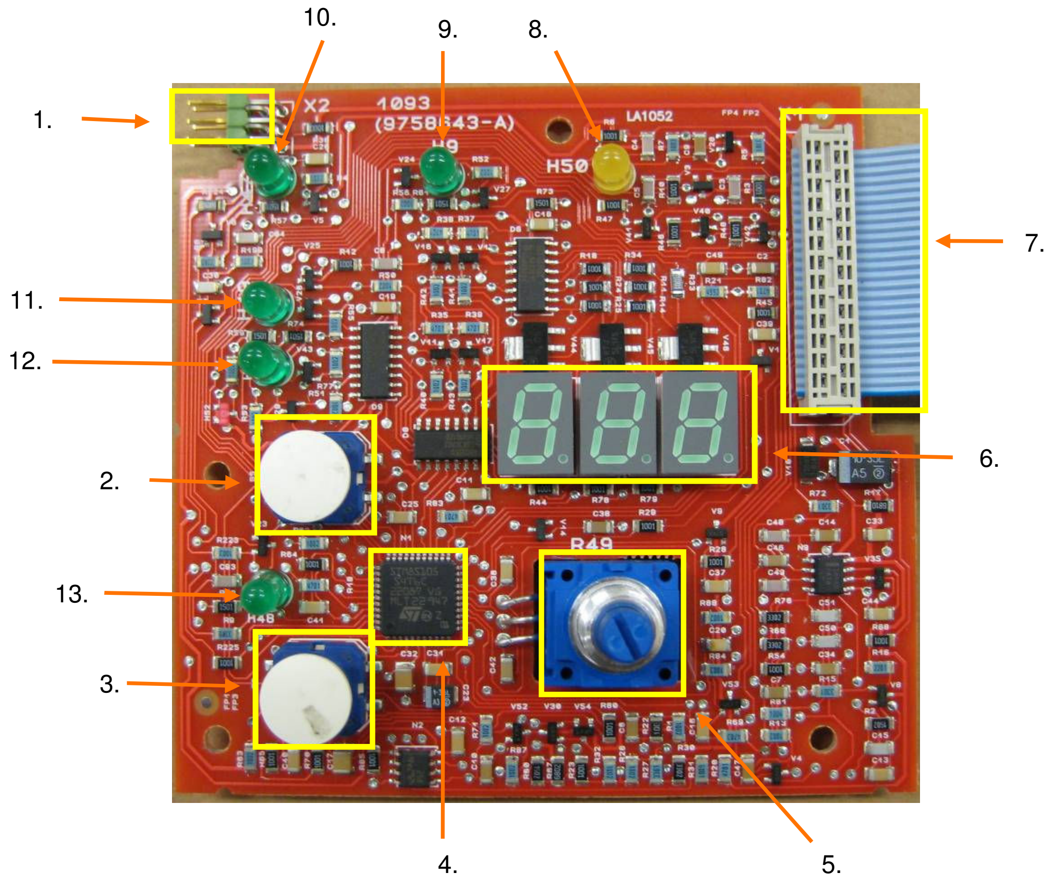
1. Main switch
2. Primary heat sink
3. T001 main transformer
4. Secondary heat sink
5. Secondary choke
6. Remote control socket
7. A001 control card
8. Z001 main circuit card

3.3.2. Z001 main circuit card structure



1. Primary rectifier and PFC module
2. IGBT module
3. DC-link capacitors
4. Main transformer
5. Secondary diodes, zero side + stress reduction resistor
6. Negative output connector
7. Positive output connection
8. Secondary diodes, positive side
9. X9 connector to A001 card
10. PFC choke

3.3.3. A001 control card structure



1. X2 service connector (not field programmable, serial bus connection is in the primary side)
2. MMA/TIG selection
3. Remote ON/OFF
4. Microcontroller
5. Analogic potentiometer
6. 7-segment display
7. X1 connector to main circuit card (flat cable)
8. Overheat LED
9. VRD LED
10. Welding machine ON LED
11. TIG mode LED
12. MMA mode LED
13. Remote ON LED

3.4. Description of operation

Minarc Evo 150 can be divided to two parts: Z001 main circuit card and A001 control/panel card

- Z001 main circuit card
  - Input rectifier and PFC circuit
  - IGBT module
  - Main transformer
  - Secondary rectifier
  - Secondary choke
  - Auxiliary switching power supplies
  - Current measuring
- A001 control card
  - Inverter control
  - Panel display
  - Current set value adjustment
  - Panel buttons functions
  - Panel LEDs
  - Remote control functions

3.4.1. Z001 Main circuit card

Main circuit card; coil components and their functions:

- Main transformer turn ratio is 4:1; its primary winding is 20 turns (wire) and secondary 5 (foil). Transformer has 140°C PTC for over heat protection. While temperature rises the resistance stays under the 100Ω until the breakdown point (140°C), then the PTC goes to high-resistance mode (>10kΩ). Control logic stops inverter when the resistance value rises over the 1,5kΩ.
- Secondary choke L3 inductance is 5µH and its winding has13 turns. Choke slows the secondary voltage changes and works as energy storage in the long short circuits.
- PFC choke works together with PFC circuit. It has 66 turns.

Main circuit card itself provides the following functions:

- DC-link soft start charging and over voltage protection circuit. It avoids full power connection if the primary has a short circuit or main supply voltage rises over the safety limit.
- EMC filtering circuit filters EMC disturbances from main supply voltage to machine and vice versa.
- The single-phase rectifier/PFC module rectifies the mains voltage (nominal 230VAC) to PFC circuit, approx. nominal value of 320VDC. Rectifier holds four power diodes. PFC circuit is integrated in the same module with rectifier diodes. PFC circuit (two parallel IGBTs, two diodes in series and PFC choke) keeps the primary voltage and current in the same phase. This rises the power factor up to 0,99. PFC is boost type and raises the DC-link voltage up to 390VDC.
- Power section is based on dual forward architecture with 63 kHz switching frequency. It has two stages: ON and OFF/demagnetizing. OFF-stage must last longer time than ON-stage because main transformer needs to be demagnetized. Otherwise it goes to saturation.

- Both modules have integrated NTC resistors for over heat protection: In 0-40° C environment temperature range, resistance varies between the 60-15kΩ if the machine is cool. In the overheat situation NTC resistance lowers down to 2kΩ and even lower. Machine stops the inverter in the 2kΩ point. Note that NTC has descending nominal curve: When temperature rises resistance lowers.
- Z001 card has an auxiliary power supply which delivers auxiliary voltages to Z001 and A001 cards. Primary side: +16VDC for the upper IGBT gate buffer, floating +16VDC and floating GND for the lower IGBT gate buffer, and +24VDC for the cooling fan and charging relay. Secondary side: +12VDC (tolerance ±1V) for the remote controller and reference GND.
    - *Note! Voltages are in the primary side (except +12VDC) so be careful while measuring the voltages.*
- DC-link with two 470µF electrolytic capacitors. Machine current is measured in the DC-link and feedback goes to the A001 card. DC-link is discharged by cooling fan while main switch is turned off.
- Secondary rectifier has two working and three demagnetizing diode cases. Each case holds two diodes so total quantity is doubled.
- OCV (open circuit voltage) adjustment circuit keeps the voltage stable and at a safe level.
- Secondary shunt resistor is only for measuring the secondary current for the displays. Machine uses primary current measuring for inverter feedback.
- Remote control connection circuit with galvanic isolation. Remote controller reading is in the A001 card.
- Cooling fan control circuit. Control signal comes from the A001 card.
- Dual forward inverter gate driver circuit. Control signal comes from the A001 card.
- Secondary voltage monitoring in VRD mode. Limit is 32VDC and if voltage is higher VDR led is off in A001 card.

3.4.2. A001 Control card

- Microcontroller controls e.g. current and voltage measuring and adjustment, protection circuits, remote control function, panel button function, panel LEDs, provides serial bus and saves calibration data.
    - Note that calibration and service connection is in the primary side without galvanic isolation. This is meant only for production use
- Control card has control buttons for remote control ON/OFF and TIG/MMA selection. It has analogue potentiometer for welding current set value. These buttons and potentiometer are used for the machine calibration also.
- Card LEDs have following functions: Machine ON, TIG/MMA selected, overheat protection ON and VRD activated. VRD LED lights only when it is activated, so in TIG mode and during the welding in MMA mode it is off.
- 7-segment display shows the current set value while not welding. During the welding it shows actual welding current value. In calibration mode is shows the measured current value of machine.
- A001 card has auxiliary voltages +16VCD (X1-1) and +24VDC (X1-2) from the Z001 main circuit card PSU. A001 card makes +5VDC.

- *Note! Voltages are in the primary side so be careful while measuring them.*

4. SERVICE INSTRUCTIONS

4.1. Programming

Minarc Evo 150 has a microprocessor on the A001 card. This can only be reprogrammed in Kemppi production because great care must be taken, because the connection is in the primary potential and without galvanic isolation.
Normally there is no need for reprogramming, but in a special case, the only possibility is to fit a replacement control card that is factory programmed. In these cases please contact: technicalservice@kemppi.com

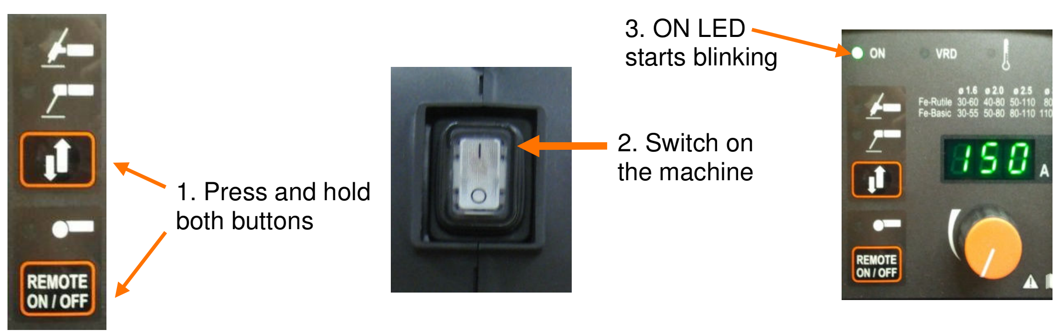
4.2. Calibration

Minarc Evo must always be calibrated if an A001 control card or a Z001 main circuit card is replaced with a new one. Otherwise machine maximum/minimum current and/or panel display may be out of range. There are only two buttons and three LEDs to be used in calibration procedure. See the following example and guide on how to use the different functions in calibration mode.

4.2.1. Functions and buttons

To enter the calibration mode press and hold TIG/MMA and Remote buttons and switch on the machine. Keep pressing the buttons until calibration mode activated: On LED is pulsing at the rate 0,1s ON and 0,9s OFF.

Entering the calibration mode:



Picture1. Entering the calibration mode.

Moving from parameter to parameter can be done by combining the Remote ON/OFF and TIG/MMA buttons in the following sequence.

Moving to next parameter:

2. Press to go to the next parameter

1. Press and hold

Parameter 2: Current multiplier (150A)

Parameter 3: Display current offset min. (10A)

Moving to previous parameter:

1. Press and hold

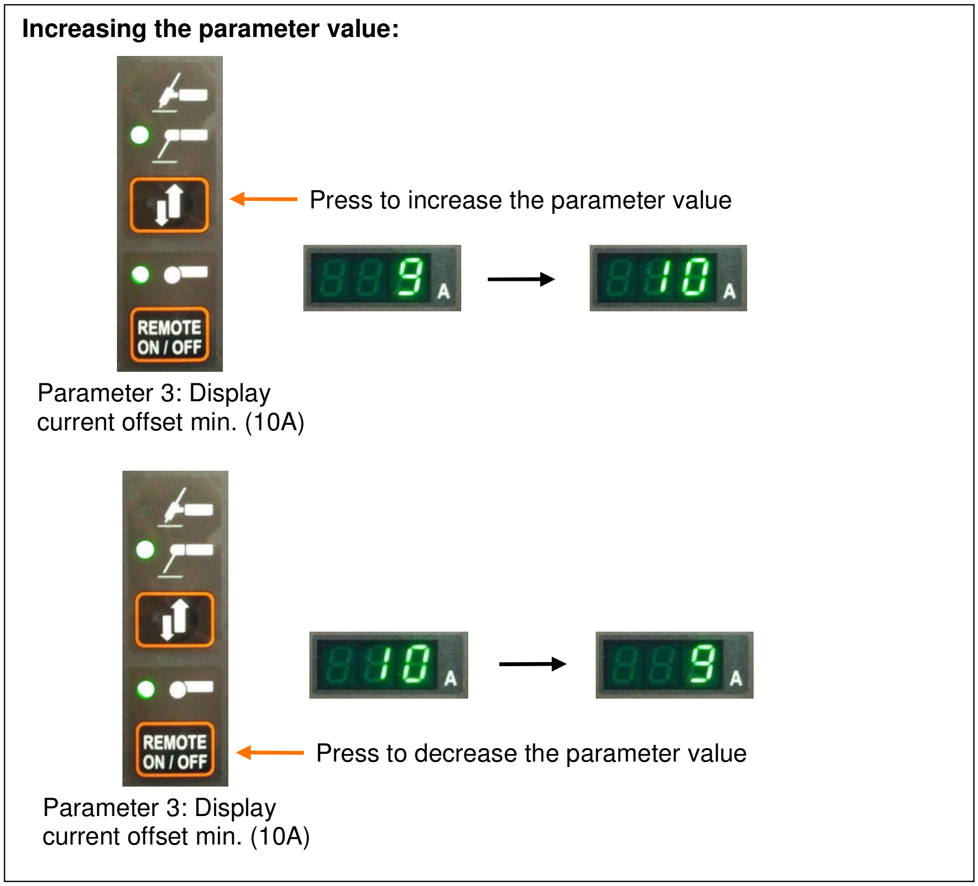
2. Press to go to the next parameter

Parameter 3: Display current offset min. (10A)

Parameter 2: Current multiplier (150A)

Picture2. Moving between parameters.

Parameter values can be changed by using the buttons Remote ON/OFF and TIG/MMA separately.



Picrute3. Changing parameter value.

Increasing or decreasing the parameter value, affects the machine in different ways depending on the parameter. Example above is for illustration only, see the chapter “Calibration procedure” to get the step by step instructions on how to proceed.

4.2.2. Calibration parameters

0. Reset the calibration data (all LEDs off)

1. Current offset min. (10A)

2. Current multiplier (150A)

3. Display current offset min. (10A)

4. Display current multiplier (150A)

5. Remote controller offset min (10A)

6. Remote controller MMA multiplier (140A)

7. Remote controller TIG multiplier (150A)
(all LEDs on)

Picture4. All calibration parameters.

4.2.3. Calibration procedure

If the parameter values go out of range or some other problems occur, use the parameter 0 to reset the calibration data. Then it is easier to start from the beginning of calibration.

- Switch off the machine and disconnect the welding cables
- Enter the calibration mode (procedure on picture1)
- Move to parameter 0 above (procedure on picture2)
- Change its value (procedure on picture3). ON LED starts to cycle 0,9s ON and 0,1s OFF.
- Once machine is switched off, restart the machine to get the parameter values reset.

Note! This parameter is only for resetting the calibration data; this is not the factory settings recall as in the other Kemppi machines. After resetting the values, procedure must be carried out to ensure the machine working properly.

To get satisfactory and reliable calibration result welding current must be measured. A current clamp meter is easiest and accurate enough for this purpose. If a clamp meter is not available, a standard shunt resistor and multimeter can be used. In this case two welding cables are needed and the shunt should be connected between them. Kemppi shunts have been stamped with the current-voltage relation, so it is easy to use a standard multimeter with low voltage function (mV) for measuring the current value.

The following example uses a clamp meter. See the previous two chapters to study button configurations (Pictures 2 and 3) and parameter info (Picture4).

1. Switch off the machine. If a resistive load is available, this is the best option, connect the resistive load via welding cables between the machine output Dix connectors. The machine must be switched off to avoid arcing while connecting the cable. If a resistive load is not available, it is possible to use a long welding cable (4 to 10 meters if possible) the longer the cable the more accurate the current measuring.
2. Enter the calibration mode, ON LED starts plinking (procedure on picture1).
3. Move to the calibration parameter 1 (procedure on Picture2). Turn the potentiometer to minimum and check the measured current in the clamp meter value. Adjust parameter value (procedure on Picture3) as close to 10A as possible, below 10A is better than above it.
4. Move to parameter 2 (procedure on Picture2). Turn the potentiometer to maximum and check the measured current in the clamp meter value. Adjust parameter value (procedure on Picture3) as close to 150A as possible, above 150A is better than below it.
5. Move to parameter 3 (procedure on Picture2). Turn the potentiometer to minimum and check the panel display value. Adjust parameter value (procedure on Picture3) as close to 10A as possible, exact value is ideal. If this is not possible, select the one below 10A.
6. Move to parameter 4 (procedure on Picture2). Turn the potentiometer to maximum and check the panel display value. Adjust parameter value (procedure on Picture3) as close to 150A as possible, exact value is ideal. If this is not possible, select the one above 150A.
7. Switch off the machine, disconnect the welding cable or load and connect the remote controller.
8. Enter the calibration mode (procedure on Picture1) and move to parameter 5 (procedure on Picture2). Turn the remote controller potentiometer to minimum and check the panel display value. Adjust parameter value (procedure on Picture3) so that it is three steps below the point where it changes from 11A to 10A.
9. Move to parameter 6 (procedure on Picture2). Turn the remote controller potentiometer to maximum and check panel display value. Adjust parameter value (procedure on Picture3) so that it is three steps above the point where it changes from 139A to 140A.
10. Move to parameter 7 (Picture2). Turn the remote controller potentiometer to maximum and check the current set value in the panel display. Adjust parameter value (procedure on Picture3) so that it is three steps above the point where it changes from 149A to 150A.
11. The calibration is now completed and once machine is switched off and restarted, the parameters are saved.

At this point it is good to check that the current set value can be adjusted from 10A to 140/150A with both panel potentiometer and remote controller.

4.3. Measurements and tests

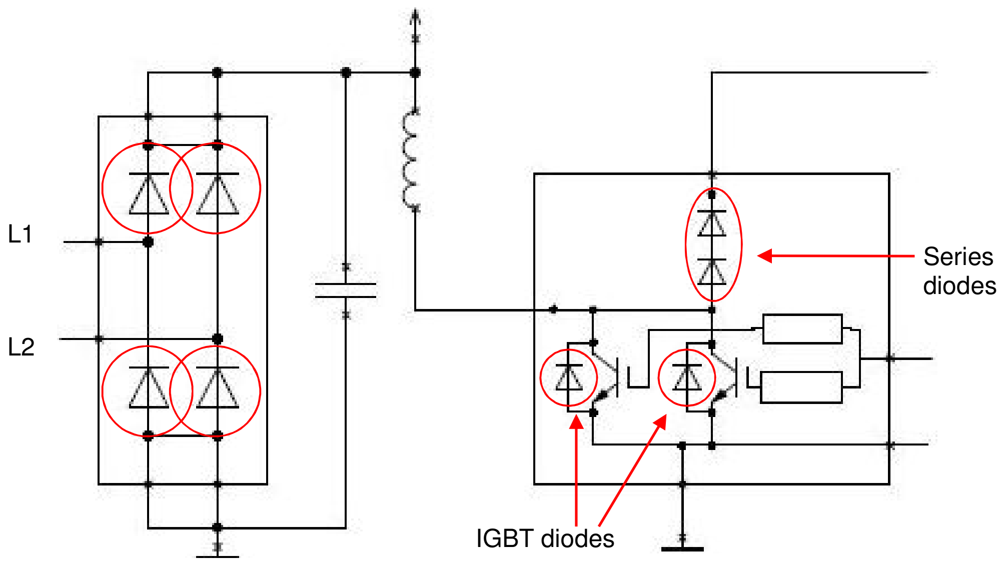
4.3.1. Z001 Main circuit card

Power stage is divided in to two parts: rectifier/PFC module and IGBT module. They can be tested separately by using simply digital multimeter.

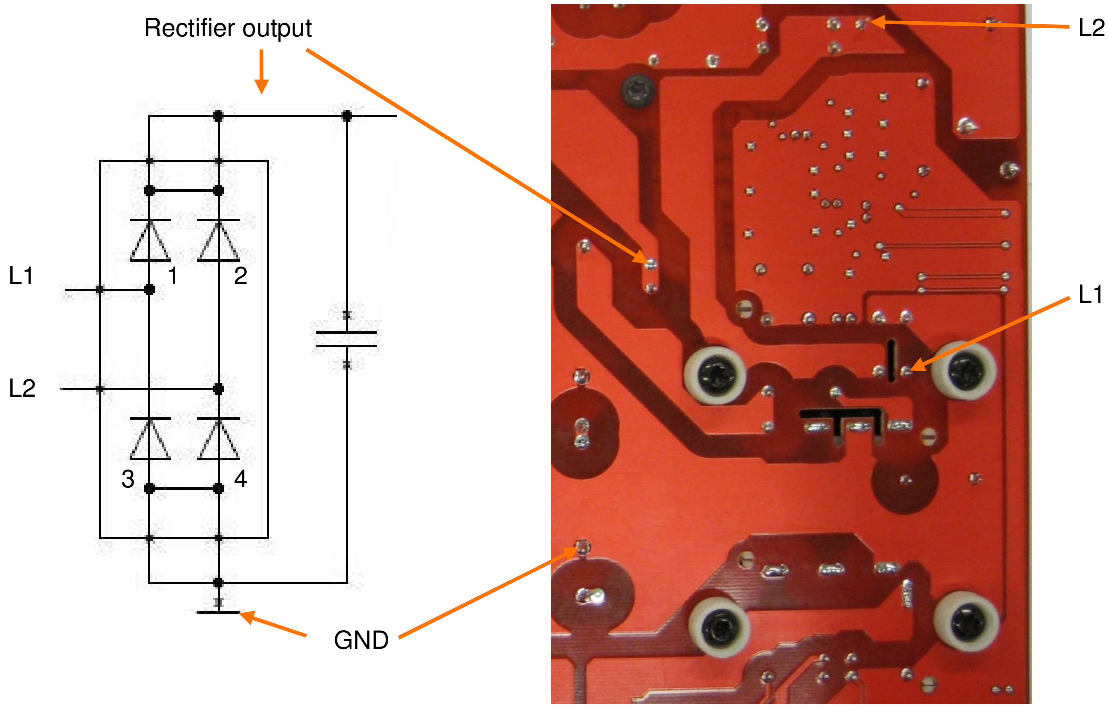
4.3.1.1. Input rectifier and PFC circuit

Mains supply voltage must ***not*** *be connected during the rectifier/PFC module diode measuring.*

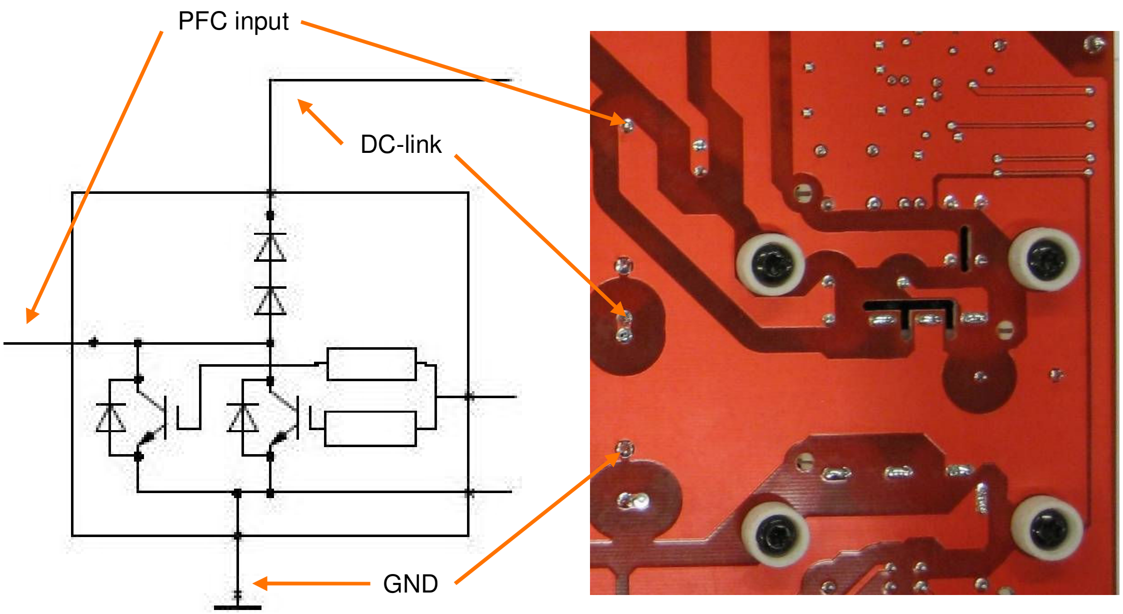
In many cases of primary side failures input rectifier or the PFC circuit diodes may be broken. Rectifier diodes can be measured one by one, but PFC circuit diodes only in two groups, because they are internally connected parallel and in series. Two diodes between the PFC IGBT collector and emitter are in parallel with IGBTs and the other two diodes are in series from PFC input to the DC-link positive.



Check the diodes using a multimeter diode function to measure their threshold voltage. Diodes must be measured both forward bias and reverse bias condition to make sure they are satisfactory. See the following pictures and table to make all the necessary measurements.



Diode	Positive test lead	Negative test lead	Result
Diode 1 forward bias	L1	Rectifier output	0,2-0,7VDC
Diode 3 reverse bias	L1	GND	No value
Diode 1 reverse bias	Rectifier output	L1	No value
Diode 3 forward bias	GND	L1	0,2-0,7VDC
Diode 2 forward bias	L2	Rectifier output	0,2-0,7VDC
Diode 4 reverse bias	L2	GND	No value
Diode 2 reverse bias	Rectifier output	L2	No value
Diode 4 forward bias	GND	L2	0,2-0,7VDC



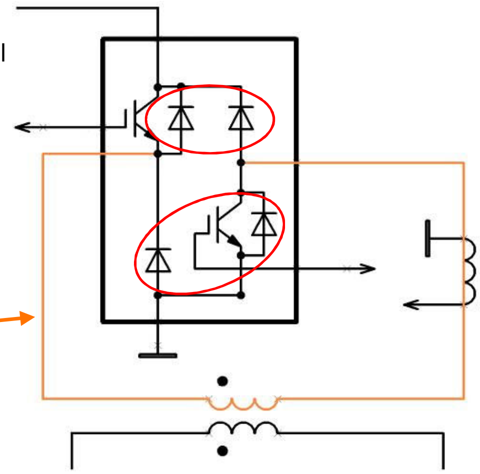
Diode group	Positive test lead	Negative test lead	Result
Series diodes forward bias	PFC input	DC-link positive	0,2-0,5VDC
IGBT diodes reverse bias	PFC input	GND	No value
Series diodes reverse bias	DC-link positive	PFC input	No value
IGBT diodes forward bias	GND	PFC input	0,3-0,7VDC

4.3.1.2. IGBT

*Mains supply voltage must **not** be connected during the IGBT module diode measuring.*

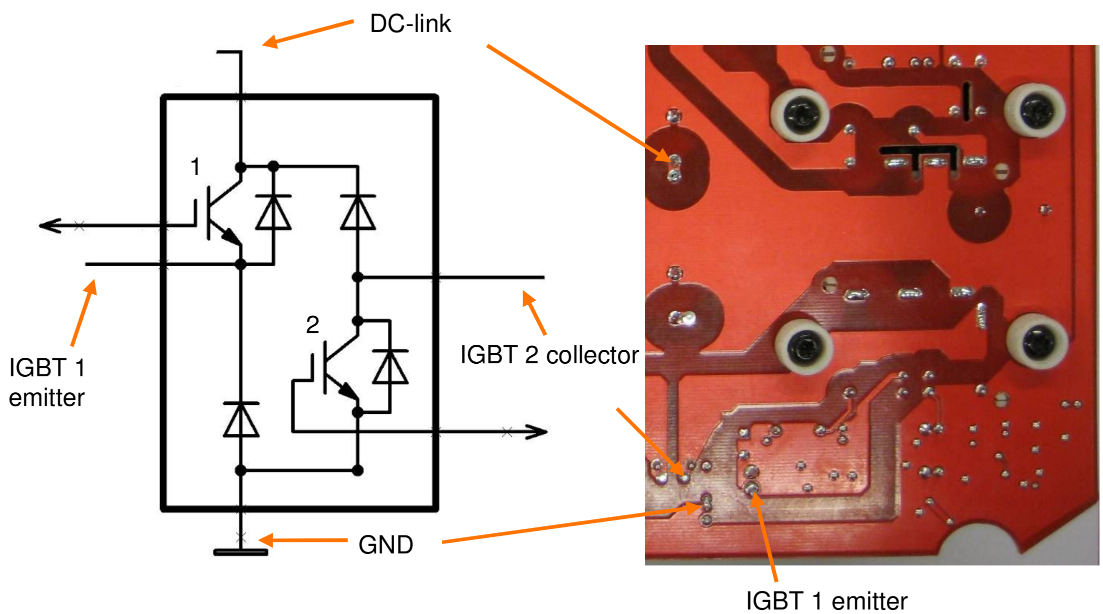
IGBT module can be tested by a multimeter when using the diode tester function. The module holds four diodes and if IGBT is damaged, in many cases these will be defective. They can be measured only in pairs if main transformer primary is connected, if it is removed all the four diodes can be measured separately.

IGBT 1 emitter and IGBT 2 collector are connected via main transformer; it is not possible to measure all the four diodes separately without disconnecting the transformer primary.



Main transformer primary winding

Check the diode groups using the multimeter diode function to measure their threshold voltage. Diodes must be measured both forward bias and reverse bias condition to make sure they are satisfactory. See following pictures and table to make all the necessary measurements.



IGBT	Positive test lead	Negative test lead	Result
IGBT 1 diode + upper separate diode; forward bias condition	IGBT1 emitter/IGBT 2 collector	DC-link positive	0,2-0,7VDC
IGBT 2 diode + lower separate diode; reverse bias condition	IGBT1 emitter/IGBT 2 collector	GND	No value
IGBT 1 diode + upper separate diode; reverse bias condition	DC-link positive	IGBT1 emitter/IGBT 2 collector	No value
IGBT 2 diode + lower separate diode; forward bias condition	GND	IGBT1 emitter/IGBT 2 collector	0,2-0,7VDC

If the transformer primary is disconnected, IGBT 1 emitter and IGBT 2 collector connection points can be used separately to measure diodes one by one. In this case the table must checked twice: first using the IGBT 1 emitter point only and then the IGBT 2 collector point.

4.3.1.3. Secondary rectifier

*Mains supply voltage must **not** be connected during the secondary rectifier diode measuring.*

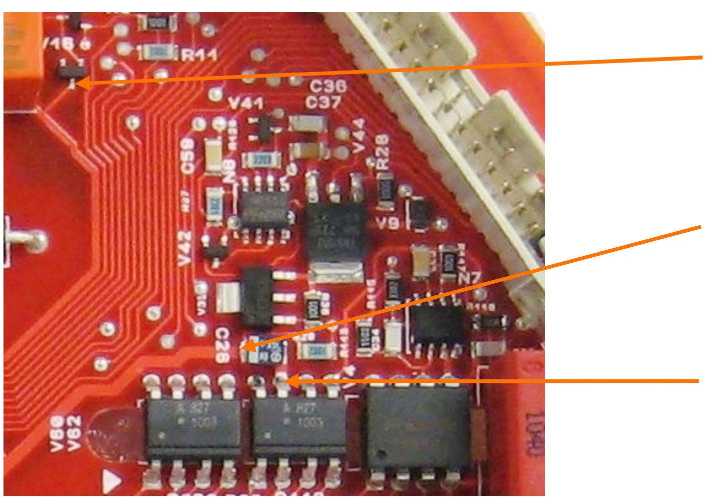
Use a digital multimeter to test the secondary diodes. Diodes are in groups, so it is not possible to measure them one by one unless they removed from the board and measured separately.

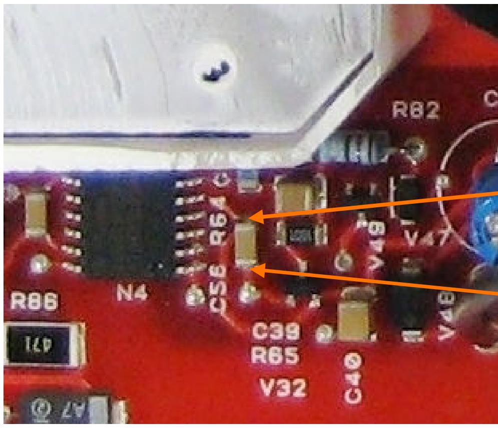
Diode	**Positive test lead**	**Negative test lead**	**Result**
Forward bias	Negative output terminal	Positive output terminal	0,2-0,6VDC
Reverse bias	Positive output terminal	Negative output terminal	No value

4.3.1.4. Voltages

The Z001 main circuit card has the DC-link voltage after the input rectifier and several auxiliary voltages made by the auxiliary PSU. Floating point voltage and remote control reference voltage need their own ground points to get right values.

Note! Most voltages are in the primary side. Even touching the ground level may affect electric shock because there is up to 120VDC between the ground and protective earth.

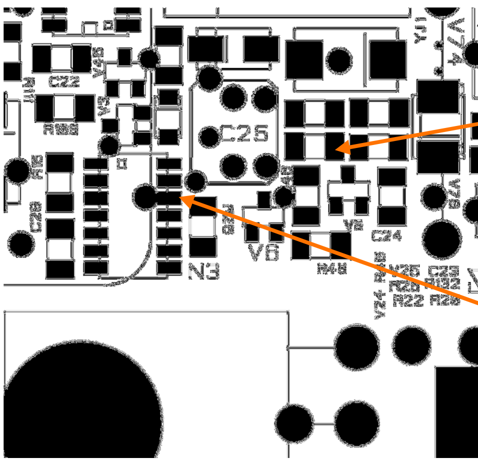




Floating +16VDC,
C56 upper connection
point

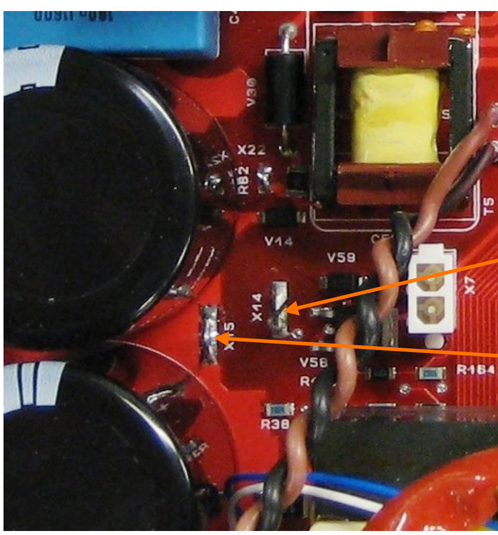
Floating GND,
C56 bottom connection point

Reference GND,



+12VDC,
Test point on the right
side of R22

Reference ground, N3
right side, third leg
from top



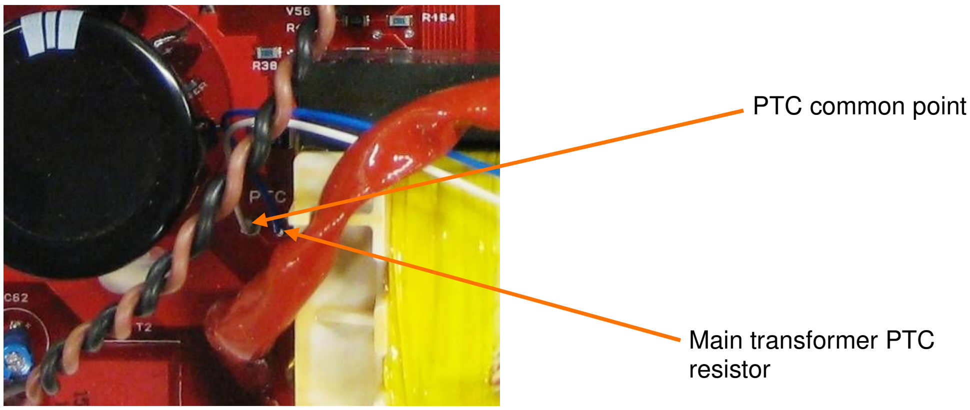
Primary GND,
TP5

+390VDC,
DC-link,
TP4

4.3.1.5. Overheat protection

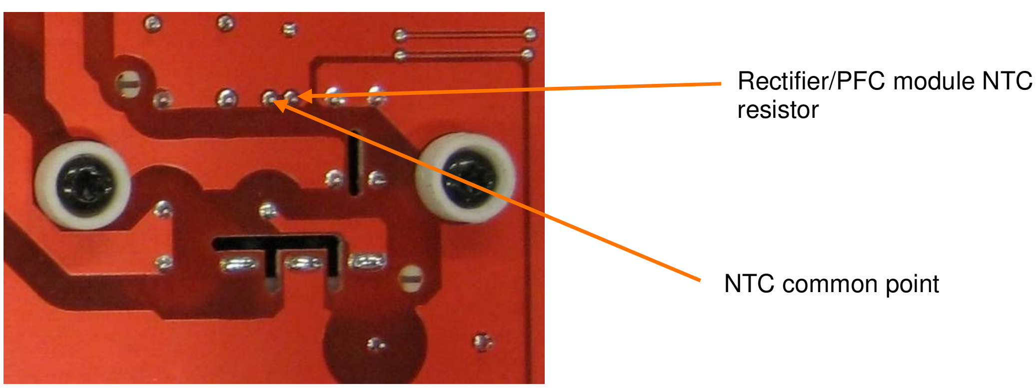
Main transformer PTC is soldered to the Z001 main circuit card:

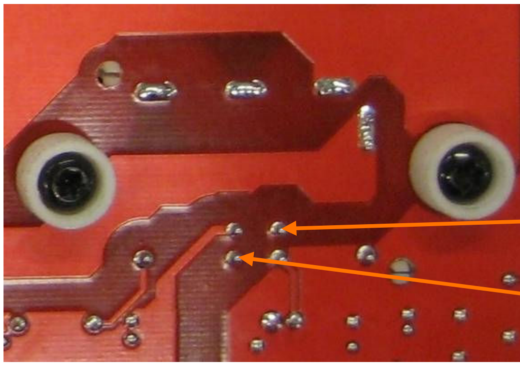
- Measure the resistance: It should be less than 100Ω
- In over temperature situation PTC goes to high-resistance mode (>10kΩ)
- Machine gives temperature alarm at 1,5kΩ
- A broken PTC has usually hundreds of kilo ohms resistance or no value at all.



Both primary modules NTCs are integrated inside the module:

- Measure the resistance, it should be between 60-15kΩ in a cool machine (in environment temperature 0-40℃)
- While temperature rises resistance lowers and at 2kΩ point the inverter stops and gives overheat alert.
- A broken NTC has usually hundreds of kilo ohms resistance, no value at all or short circuit.





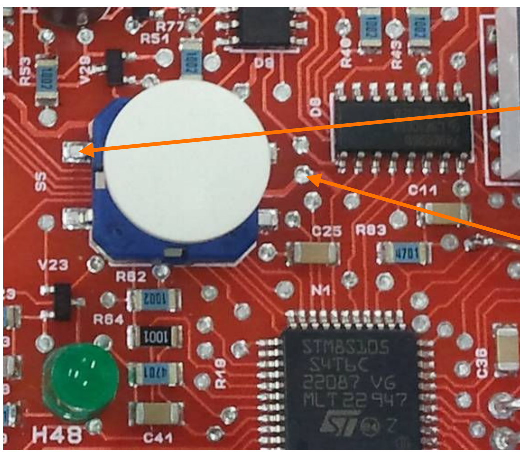
NTC common point

IGBT module NTC resistor

4.3.2. A001 control card

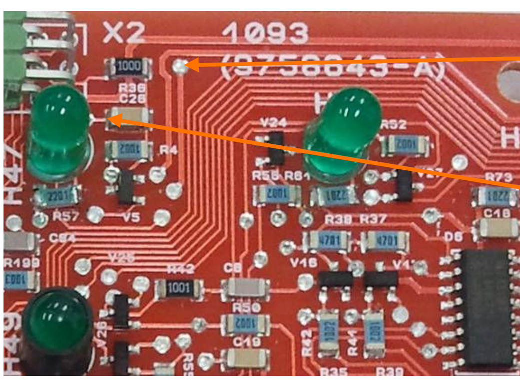
Control card voltages have common ground, on the primary side. +16VDC and +24VDC PSU are located on the Z001 card. +5VDC is made on the A001 card.

Note! Voltages are in the primary side. Even touching the ground level may affect electric shock because there is up to 120VDC between the primary ground and protective earth.



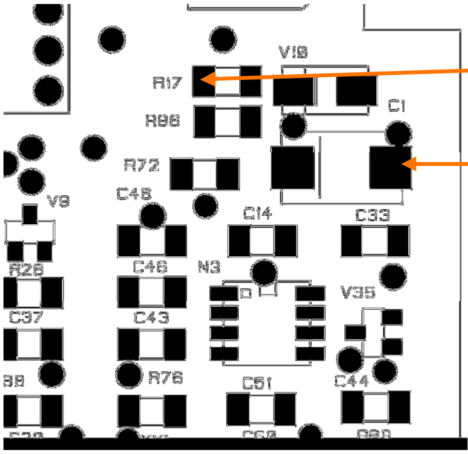
GND,
S5 upper leg

+5VDC
Test point between the S5 switch legs. Also N3 second leg from the lower left



+16VDC,
Test point

GND,
C26 left side or upper leg of S5 as shown in the previous picture



+24VDC,
R17 left side connection point

GND,
C1 right side

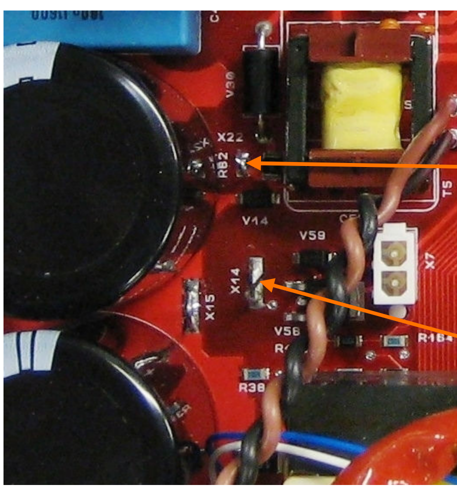
4.3.3. Cooling fan

Cooling fan gets the power from the +24VDC line. Voltage can be measured in the X7 connector (X7-1 +24VDC and X7-2 GND). Note that the cooling fan has delayed starting.

The cooling fan is installed so that the air flows from the left side plate to Z001 card. Air comes out through the front and the back plate grills.

4.3.4. Low voltage tests

Low voltage test may give some basic information where the fault might be. Machine should be fed from the MLS service power to test connection. Voltage should be 320VDC so the high voltage switch must in 230VAC mode. There are no pins to fasten the PSU hook clips to, so it is a good idea to solder some during the repair.



+320VDC test point,
X22

Primary GND,
X14

Once the connections are made, power can be switched on, the panel functions can be tested and auxiliary voltages measured both on the Z001 and the A001 cards (see the chapters for auxiliary voltage measuring on the A001 and Z001 cards).

4.3.5. Safety tests

Safety tests are made normally, but PE conductivity test cannot be tested, because there are no outer parts connected to PE. Do not use PE continuity test equipment with high testing current.

PE wire conductivity should be measured only by DMM with resistance function to continuity. Measure the resistance between the main supply cable terminal and Z001 X3.

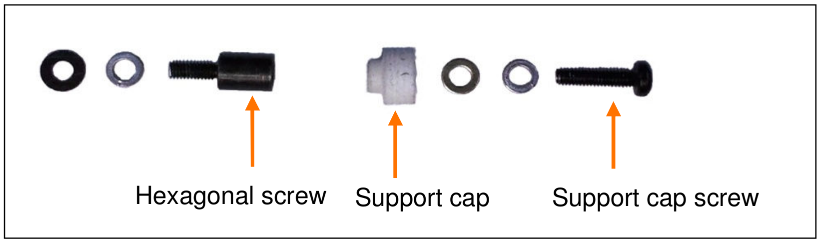
4.4. Semiconductor installation

It is a must be to use torque screwdriver while tightening any power components onto the heat sink. See following sections for tightening torques.

4.4.1. Rectifier/PFC module and IGBT

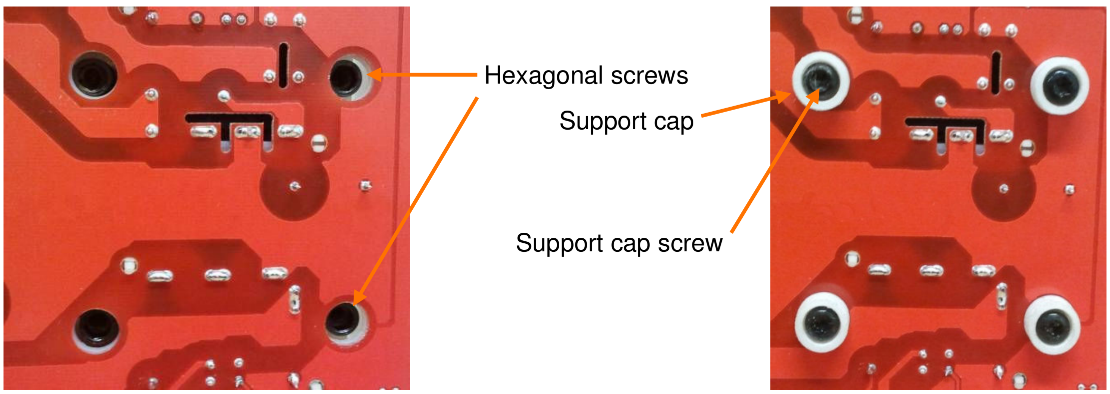
MinarcEvo 150 has soldered input rectifier/PFC and IGBT modules and it is not possible to change them separately. Only reliable way to replace the module(s) is to change the whole Z001 main circuit card.

The heat sink paste should be spread on to the modules in an even layer by using fingers. Then the card should be immediately mounted onto the heat sink, this minimizes the possibility of any contamination (dirt etc.) getting between the components.



The hexagonal fixing screws for the IGBT module are tightened (stage 1) to 1 Nm. And after few minutes the module screws can be finally tightened (stage 2) to a torque of 2,0 Nm.

Once all four hexagonal screws are tightened to right torque, the module support cap screws can be fastened. The idea is to support the module to the PCB with the plastic caps, instead of the component soldered legs. The torx screws for caps can be tightened only up to 0,5 Nm, or otherwise PCB may bend.



4.4.2. Secondary rectifier

The heat sink transfer compound should spread in an even layer onto the heat sink. Then the card should be immediately mounted onto the heat sink, this minimizes the possibility of any contamination (dirt etc.) getting between the components.

The torx fixing screws in diodes are tightened to 1,2 Nm and the resistor (a smaller case than the diodes) to 0,7 Nm.

4.5. Final testing

After the machine repair and low voltage tests, it is good practice to carry out some load tests and finish with some test welds. Only then is it possible to guarantee the machine is working correctly.

4.5.1. Load bank test

CC (MMA and TIG machines) curve's secondary voltage can be calculated when a certain current is set:

MMA mode: $U_2 = I_2 \times 0{,}04 + 20$

TIG mode: $U_2 = I_2 \times 0{,}04 + 10$

Voltage has to be set for the nominal curve to get the correct output power. E.g. when making a PTC test the correct values must be used to meet the duty cycle specified in technical specification.

Most useful tests to be made with a load bank are to check maximum and minimum current and panel display values.

The following example uses 140A so the correct voltage can be calculated using the equation below:

$$I_2 = 140A$$
$$U_2 = I_2 \times 0{,}04 + 20$$
$$= 140A \times 0{,}04 + 20 = 25{,}6V$$

Output voltage should be 25,6V.

Example: Minarc Evo 150 MMA mode load bank test, welding current 140A and output voltage 25,6V

- Turn the machines main switch OFF
- Connect machine to the load bank and check that there is no load added.
- Turn the machines main switch ON,
- Adjust machine current to desired level (this example uses 140A)
- Add some load to get the inverter operate, be fast in switching because arcing may exist between the connection surfaces of the switch
- Measure load voltage by a DMM
- Add or decrease load to get the desired voltage

If using active load bank, instead of increasing or decreasing load, it is only necessary to select MMA nominal curve and then set the test current value on the machine. The Load follows automatically the current value and the output voltage will be correct.

4.5.2. Test welding

Test welding is important for having final and reliable information, if the maintenance / repair has been made successfully.

In some cases a load bank test alone does not give the absolute truth if the machine is functioning properly or not. Test welding will show if the power source and control panel are working together in a natural state.

While carrying out test welding, it is useful to test at different current settings to see if the current is right and ignition good.

Pay attention especially to the features that were the original reason for the maintenance work.

5. NOTES