Service manual
Mastertig MLS 2300 ACDC

Version 1.3.1

Technical data

Connection voltage, 1~ 50/60 Hz	230 V ± 15%
Loadability TIG	
40% ED	230 A / 19,2 V (5,7 kVA)
60% ED	200 A / 18,0 V (4,8 kVA)
100% ED	170 A / 16,8 V (3,9 kVA)
Loadability MMA	
40% ED	180 A / 27,2 V (6,0 kVA)
60% ED	150 A / 26,0 V (4,8 kVA)
100% ED	120 A / 24,8 V (3,7 kVA)
Supply cable / fuse	2,5 mm² S - 3,3 m / 16 A slow
Adjustment range	
TIG	3 A (AC 5 A) / 10,0 V…230 A / 19,2 V
MMA	10 A / 20,4 V…180 A / 27,2 V
Maximum welding voltage	32 V / 180 A
OCV	50 V
Efficiency	0,8
Power factor	0,99
Open circuit power	
TIG	6 W
MMA	180 W
Degree of protection	IP 23C
Measures	
Length	500 mm
Width	180 mm
Height	260 mm
Weight	15 kg

8 kVA generator can provide maximum output power for the power source however recommended generator size is 10 kVA

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

User interface

1	Gas connector for TIG torch
2	Welding current connection (negative)
3	Operation panel
4	Remote controller connection
5	TIG -torch control connection
6	Welding current connection (positive)
7	Main switch
8	Gas connector

Setup functions

Entering the advanced setup press and hold the setup and Return buttons at the same time. Changing the level press Setup button shortly

Welding current upslope time *	A1	ON	The upslope time depends on the welding current
		OFF	The upslope time is fixed
Welding current downslope time *	A2	ON	The downslope time depends on the welding current
		OFF	The downslope time is fixed
TIG Antifreeze *	A3	ON	TIG Antirfeeze is ON
		OFF	TIG Antifreeze is OFF
MMA Antifreeze *	A4	ON	MMA antifreeze is ON
		OFF	MMA antifreeze is OFF
VRD * (MMA open circuit voltage)	A7	ON	VRD-function: MMA open circuit voltage < 35 Vdc
		OFF	Normal open circuit voltage is 50 Vdc
2T-function´s downslope cutoff	A8	ON	On 2T-function the downslope is cut off by a quick press on the start switch
		OFF	Quick press on the start switch has no function
Tacking automatics	A9	ON	Tacking automatics is ON; no downslope, if the weld is shorter than 3 s
		OFF	Tacking automatics is OFF
Current upslope speed	A10	ON	If upslope time is 0,0 s, it goes to 0,2 s from the halfway of currents > 100 A.
		OFF	Maximum current upslope speed
Method selection by remote controller *	A12	ON	Method selection; TIG: minimum end of the range of the remote controller, MMA: the maximum end of the remote controller range
		OFF	The remote controller works as a normal current adjustment

* Setting is always on ** Adjustable also by the Quick Setup

Setup functions

Start current level	A13	ON	Start current level in use
		OFF	Start current level not in use
Current ”freezing”	A14	ON	During downslope the current can be ”frozen” onto a certain level, using the start switch
		OFF	”Freeze” function is OFF
TIG -torch auxiliary switches (RTC 20) *	A15	ON	Torch auxiliary switches are used to select memory channels
		OFF	Torch auxiliary switches adjust welding current
TIG -torch auxiliary switches (RTC 20) activation *	A16	ON	Auxiliary switches are always active
		OFF	Auxiliary switches are active only when torch control is selected
Cooling unit flow control *	A17	ON	Flow control is active
		OFF	Flow control is not active
Cooling unit control *	A19	ON	Controlled run
		OFF	Continous run
Coolant temperature watch *	A20	ON	Temperature watch is active
		OFF	Temperature watch is not active
Remote controller automatic detection *	A21	ON	Automatic detection is ON
		OFF	Automatic detection is OFF
End current level	A22	ON	4T-LOG: End current level is in use
		OFF	MINILOG: End current level is not in use

* Setting is always on ** Adjustable also by the Quick Setup

Setup functions

Contact ignition current *	B1	20	Factory setting 20 A
		3…230	Adjustment range 3…230 A
Spark ignition duration *	B2	1.0	Factory setting 1,0 s.
		0.2…2.0	Adjustment range 0,2…2,0 s.
Downslope cutoff level *	B3	10	Factory setting 10 % of the welding current
		5…40	Adjustment range 5…40 % of the welding current
Factory settings recall *	B5	OFF	Factory setting
		PAN	Recalls factory settings to the panel, but keeps memory channels
		ALL	Recalls factory settings and empties the memory channels
Downslope interruption – upslope angle *	B6	1	Upslope speed maximum
		2	According to the upslope setting
		3	According to the downslope
Non-linear downslope (Current drop in the beginning of downslope)	B7	OFF	Factory setting
		0…50	Adjustment range 0…50 % of welding current
Torch switch long press *	B8	0.4	Factory setting 0,4 s.
		0.3…1.0	Adjustment range 0,3…1,0 s.
Cooling unit post running time *	B9	OFF	Factory setting 4 min.
		ON	Post-running time 30 s.

* Setting is always on ** Adjustable also by the Quick Setup

Setup functions

Spot welding spot-time *	B10	OFF	Factory setting 0,0…15,0 s.
		ON	0…150 s.
MMA dynamics **	B11	0	Factory setting
		-9…0…9	Adjustment range -9 = soft arc, 9 = rough arc
MMA ignition pulse **	B12	0	Factory setting
		-9…0…9	Adjustment range -9 = minimum overrun, 9 = maximum overrun
Start current level *	B13	10	Factory setting 10 % of the welding current
		OFF	Minimum current
		5…40	Adjustment range 5…40 % of the welding current
Display recovery time	B14	5.0	Factory setting 5,0 s.
		1.0…20,0	Adjustment range 1,0…20,0 s.
2T Hot Start duration **	B15	1.0	Factory setting 1,0 s.
		0.1…5.0	Adjustment range 0,1…5,0 s.

* Setting is always on ** Adjustable also by the Quick Setup

Setup functions

Pregas time minimum *	C1	0.0	Factory setting 0,0 s.
		0.0 …2.0	Adjustment range 0,0…2,0 s.
Postgas time minimum *	C7	1.0	Factory setting 1,0 s.
		0…10	Adjustment range 0…10 s.
AC balance minimum *	C16	-80	Factory setting -80 %
		-80…-10	Adjustment range -80…-10 %
Pregas time maximum *	D1	1	Factory setting 1 s.
		0…10	Adjustment range 0…10 s.
Postgas time maximum *	D7	30	Factory setting 30 s.
		15…150	Adjustment range 15…150 s.
AC balance maximum *	D16	10	Factory setting 10 %
		0…20	Adjustment range 0…120 %

* Setting is always on ** Adjustable also by the Quick Setup

Setup functions

AC frequency **	E1	60	Factory setting 60 Hz
		50…250	Adjustment range 50…250 Hz
AC waveform **	E2	Sqr	Square wave
		Sin	Sinus wave
Half cycle AC	E3	5	Factory setting 5 A
		5…20	Adjustment range 5…20 A
AC balance **	E4	-25	Factory setting -25 %
		-50…10	Adjustment range -50…10 %
Negative ignition current *	E5	100	Factory setting 100 %
		100…500	Adjustment range 100…500 % (Limited by the max. of the power source)
Positive ignition current *	E6	50	Factory setting 50 %
		30…150	Adjustment range 30…150 % (Limited by the max. of the power source)
Positive ignition sequence time *	E7	10	Factory setting 10 = 0,01 s
		0…20	Adjustment range 0…20 = 0,0…0,02 s
Ignition cycle total time *	E8	0.20	Factory setting 0,2 s (up to 0A8) / 0,01 s (since 0A9).
		0.01…1,0	Adjustment range 0,01…1,0 s.
MIX TIG cycle time **	E9	0.6	Factory setting
		0.1…1,0	Adjustment range 0,1…1,0 s.

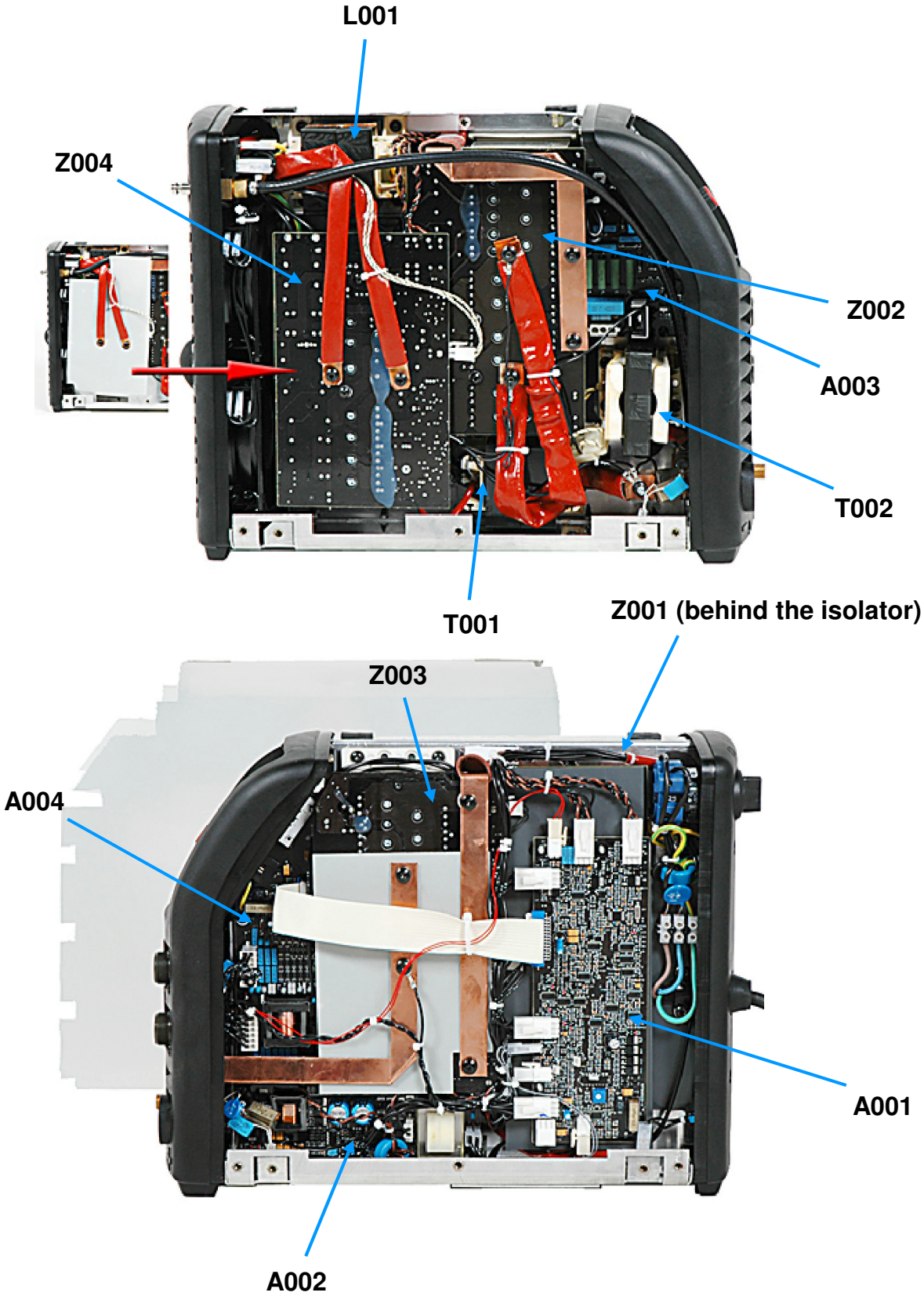
*Setting is always on
**Adjustable also by the Quick Setup
***Note panel software version

Setup functions

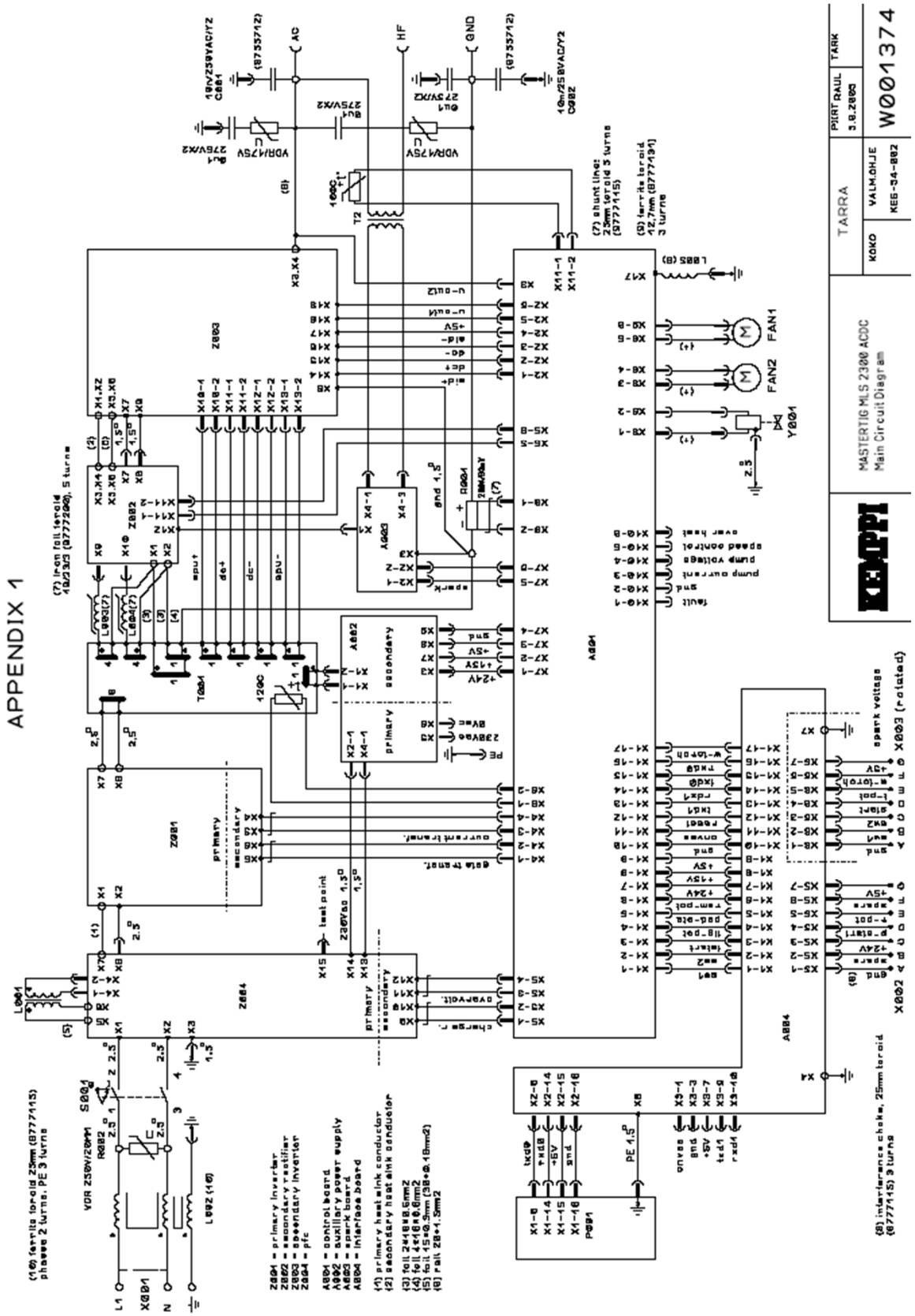
MIX TIG AC pulse ratio **	E10	50	Factory setting 50 %
		10…90	Adjustment range 10…90 %
MIX TIG DC level **	E11	100	Factory setting 100 %
		50…150	Adjustment range 50…150 %
Spotwelding time *	E12	10	Factory setting 10 ms.
		1…200	Adjustment range 1…200 ms.

* Setting is always on ** Adjustable also by the Quick Setup

Construction

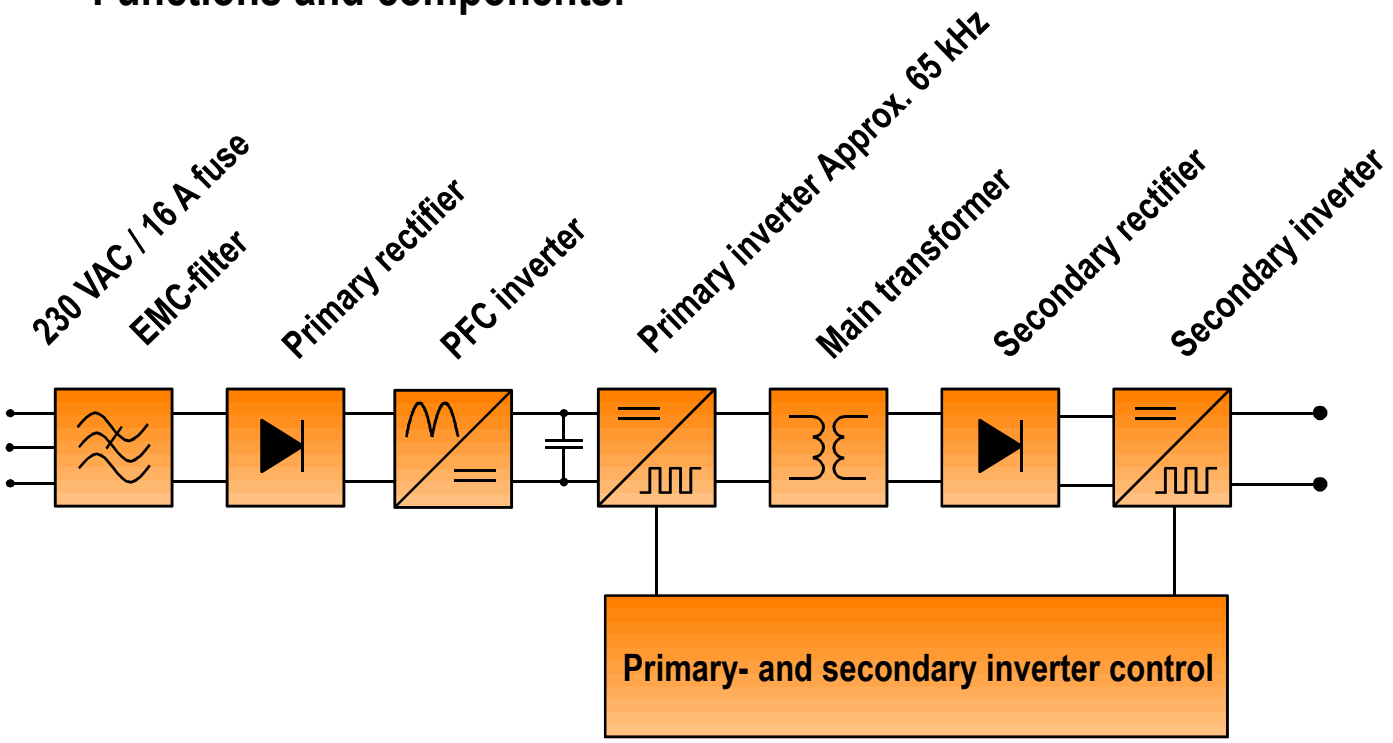


Main circuit diagram



Operation principle

Functions and components:



This is the block diagram of an AC TIG -power source with active power factor correction. A power source based on this principle can be loaded in TIG -process with 230 A current by a duty cycle of 40 % (1~ 230 Vac / 16 A slow fuse).

Error code	Description
Err 3	Over/Undervoltage
Err 4	Overheating
Err 6	Internal fault, secondary voltage over the limit.
Err 8	Maximum overheat time, machine doesn't cool down fast enough. Only machine shutdown and restart removes error.
Err 61	Water cooled gun connected but no water cooler in the system.
Cooler	Cooler error: - Cooling liquid over- / under pressure state - Overheated alarm
BuS Err	Communication between panel and power source isn't possible
Err rSt	System error, machine makes reset itself.

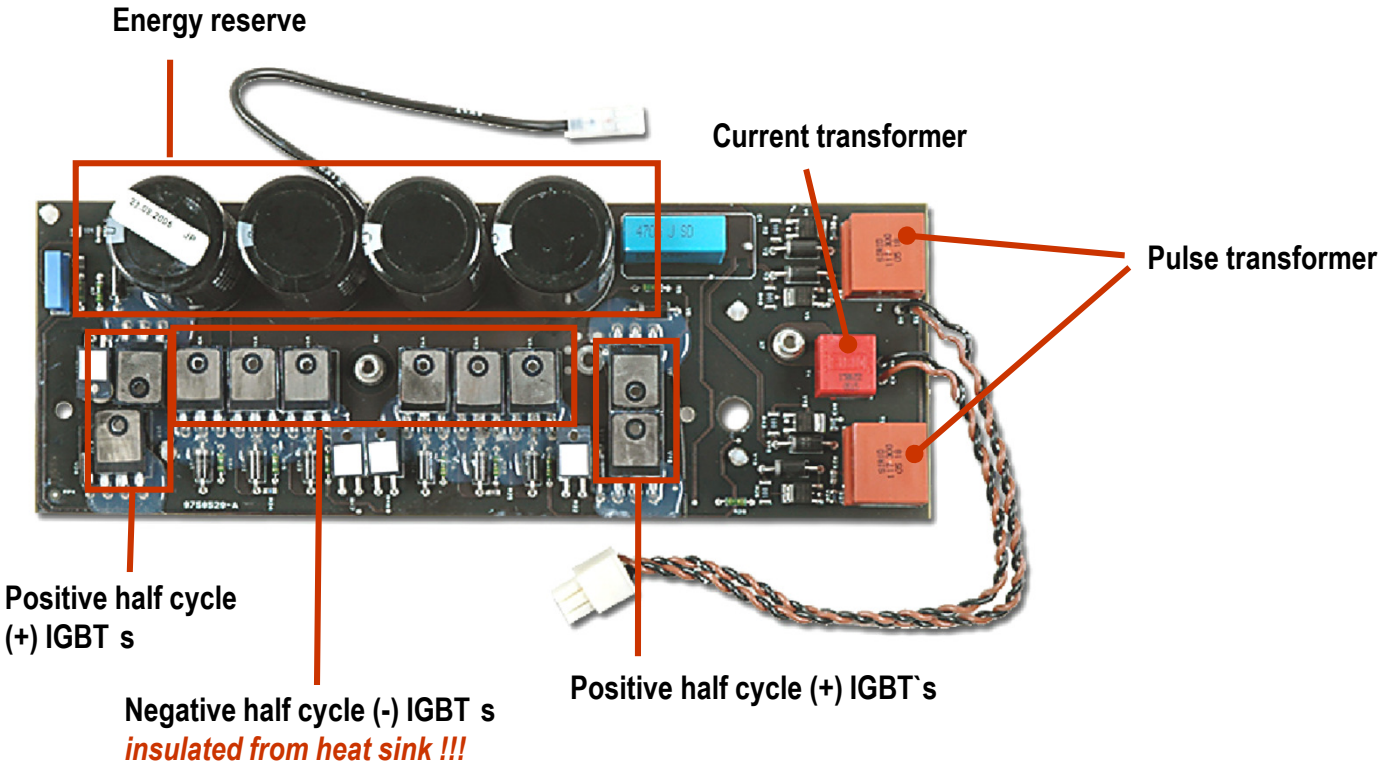
Main circuit card Z001

Functions and components:

Main circuit card Z001 includes following operational blocks:

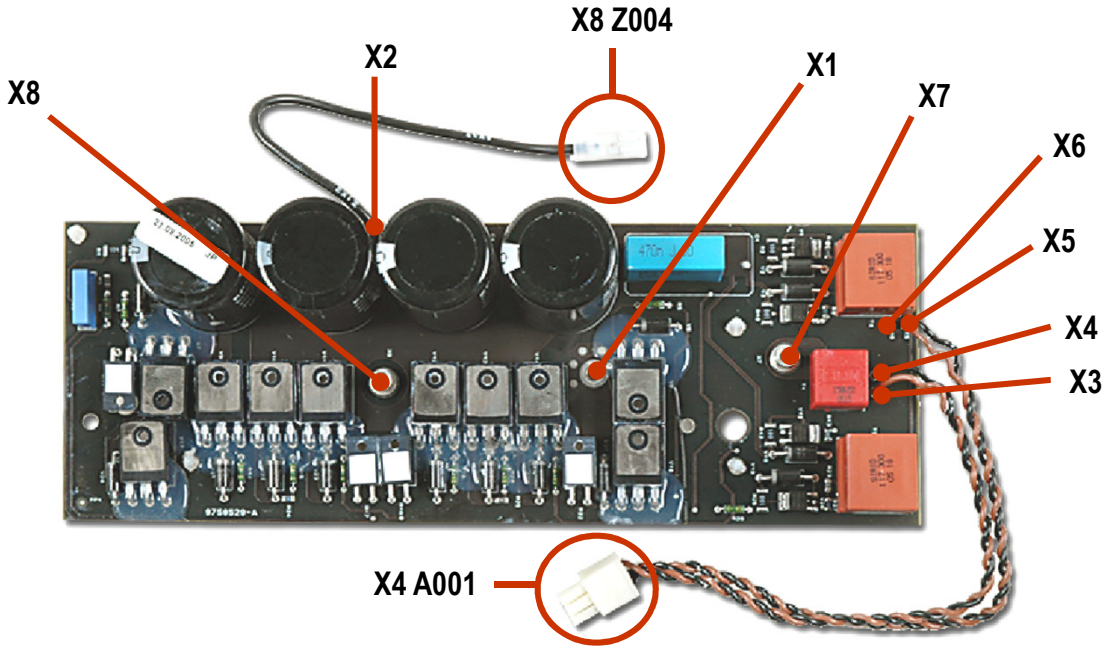
- **Energy reserve**
- **Power stage (full bridge)**
- **Damping circuits**
- **Gate buffers**

- **Electrolyte capacitors C2, C3, C4 and C5 (470µF/450V) provide the energy storage**
- **Power stage is a traditional full bridge, where the power switches are parallel connected discrete IGBTs (30A/600V).**
- **The current transformer T1 measures the primary current**
  Note ! IGBTs V12 – V14 and V9 – V11 are insulated from the heat sink!
- **Primary inverter's operating frequency is constant, being approx. 65 kHz (cycle time is about 15,3 µs) throughout the whole power range. Power is controlled by changing the IGBT's conductivity timings.**



Main circuit card Z001

Connectors:



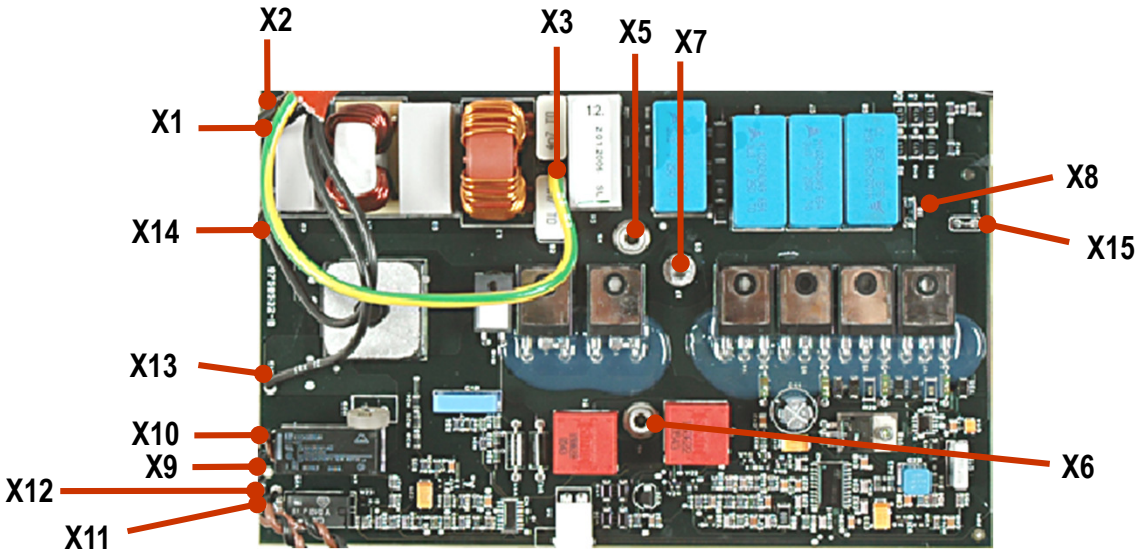
PFC card Z004

Functions and connectors:

The PFC -card Z004 includes these operational blocks:

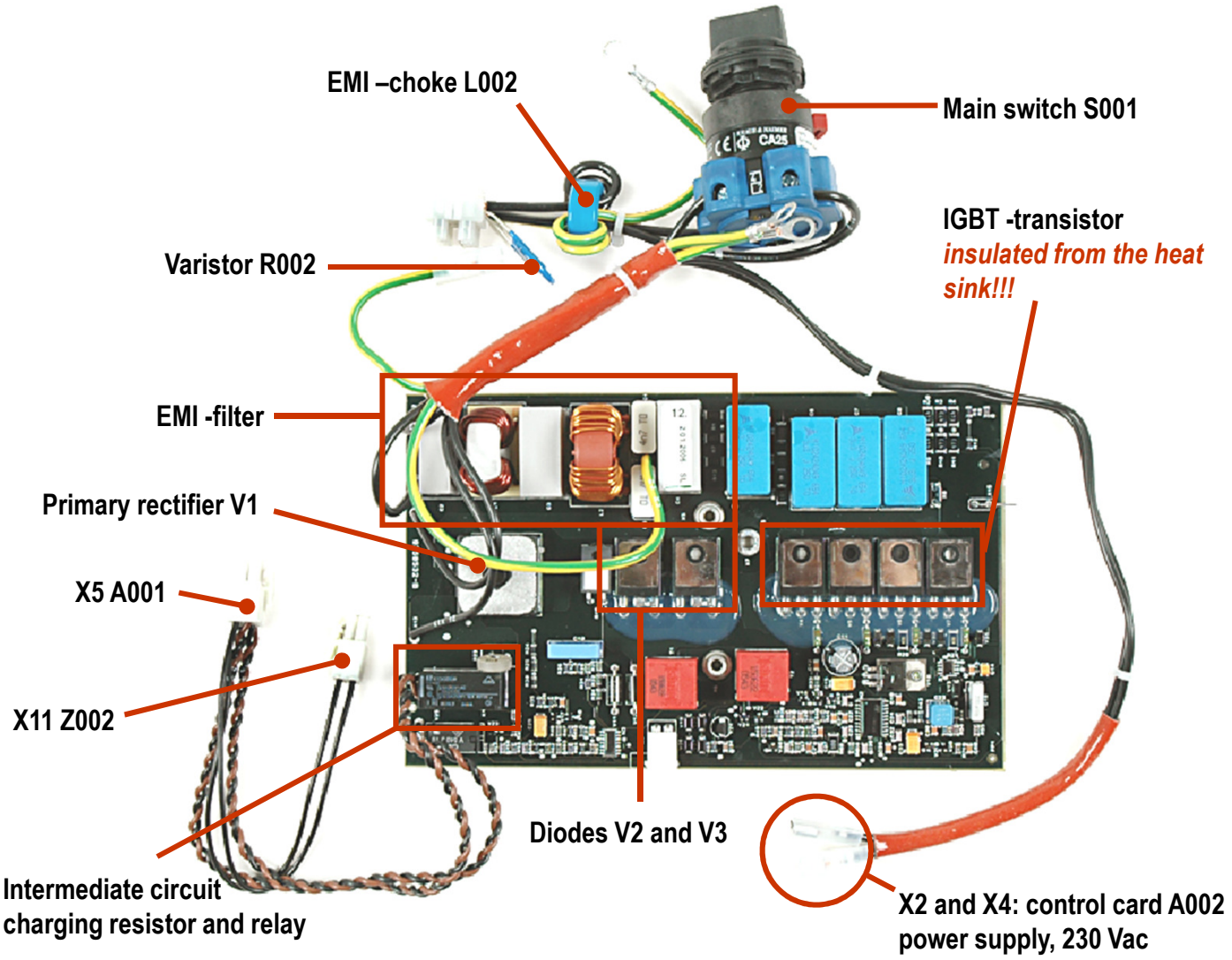
- **EMI -filter**
- **Net connecting transient damping**
- **Primary rectifier**
- **PFC -power stage**
- **PFC -power stage control**
- **Net overvoltage watch**
- **Auxiliary voltages developing**

- **EMI -filter reduces the electromagnetic disturbances conducting to the net (EN50199).**
- **The net connecting transient is damped by the PTC-resistor R23 and relay K1 together. The rectifier unit V1 rectifies the net voltage to DC, which can fluctuate between + 260…380 V. Power supply to the power supply card A002 via connectors X13 and X14.**
- **PFC's power stage (boost converter) increases the full-wave rectified net voltage up to +400 V DC and forces the net current into sinus form.**
- ***Note. IGBT -transistors V4…V7 are insulated from the heat sink! Diodes V2 and V3 are not insulated, so diode cathodes and heat sink share the same potential approx. + 400 V!***



PFC card Z004

Components:



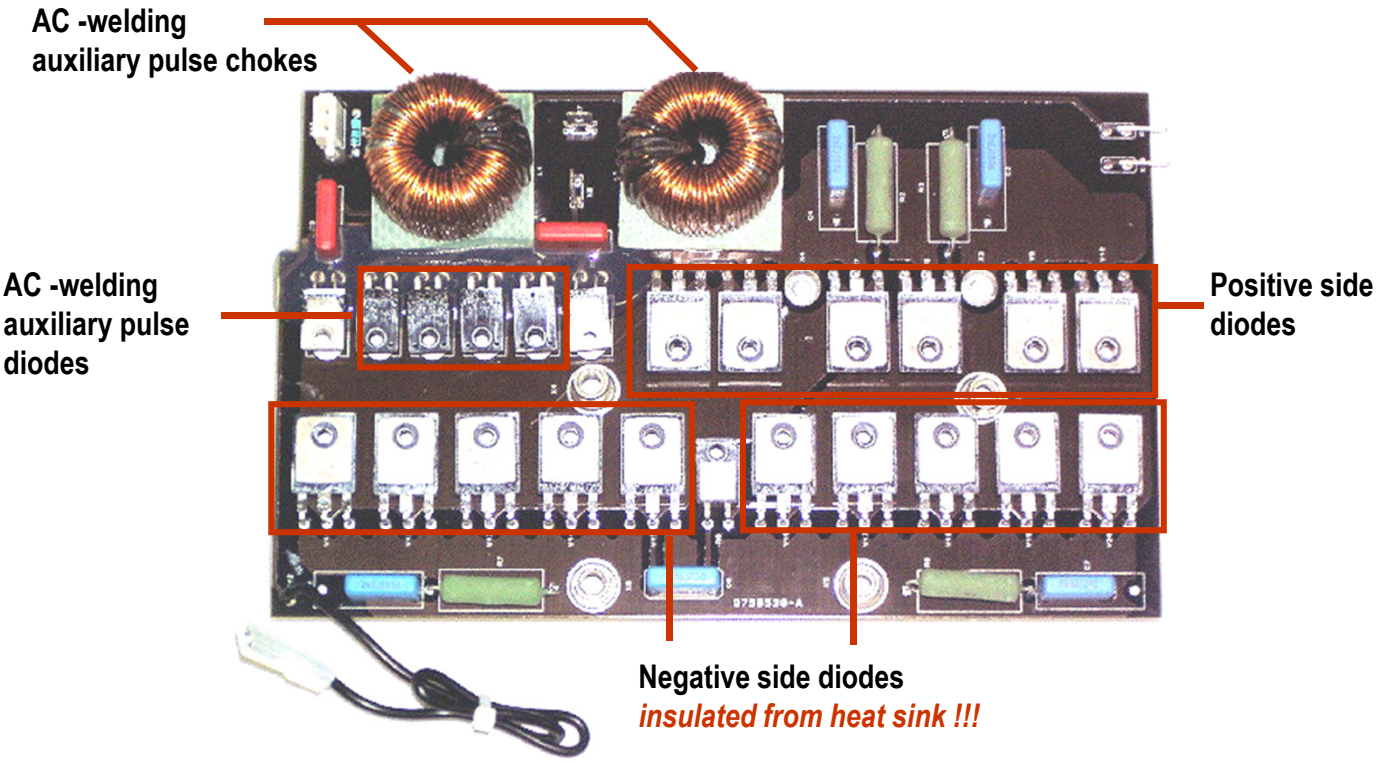
Secondary rectifier Z002

Functions and main components

Secondary diode card Z002 includes the following operational blocks:

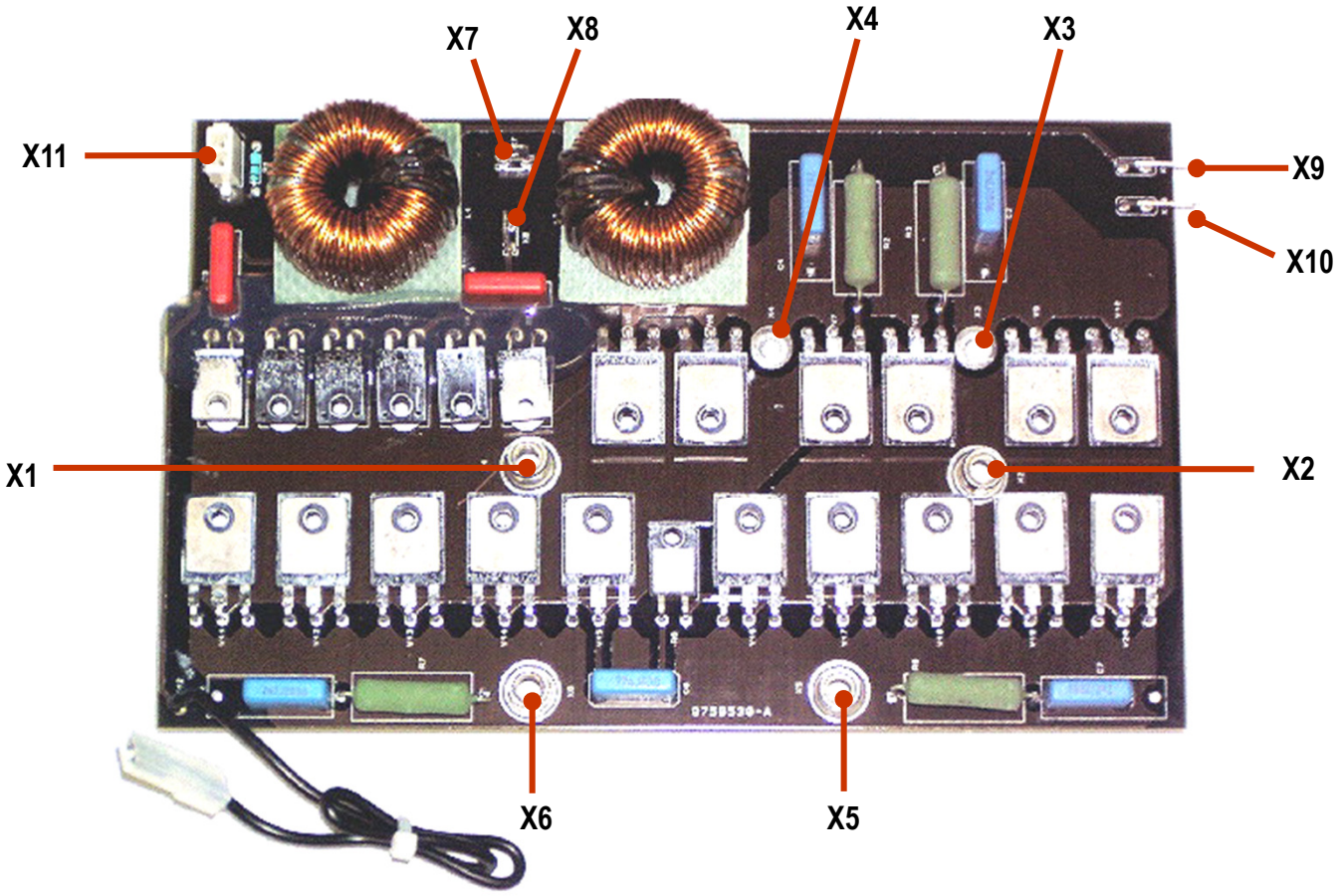
- Full wave rectifying for secondary
- AC –welding auxiliary pulse rectifying
- Damping circuits
- Machine size code

- Voltages of the main transformer's secondary are rectified by a full wave rectifier, which consists of parallel connected diodes (60A/600V). *Note ! Diodes V11 – V15 and V16 – V20 are insulated from the heat sink !!!*
- Damping circuits (RC) reduce the voltage stress of secondary diodes. The machine size is coded by resistor R1 s value.
- AC –welding auxiliary pulses are developed from the voltages of the auxiliary coils of the main transformer T001. AC –welding auxiliary pulses stabilize the AC -arc by increasing secondary voltage up to +/- 350 V (max. about 500 µs) at the beginning of the half cycle. Chokes L1 and L2 limit the current to a few amps.



Secondary rectifier Z002

Connectors



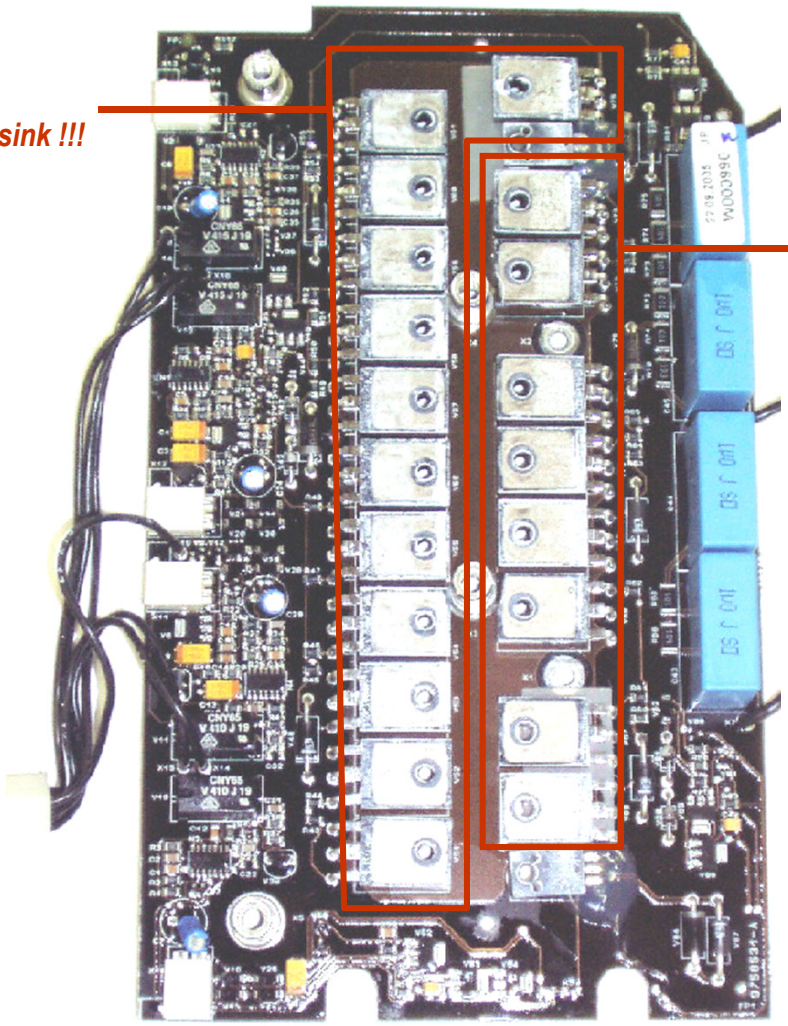
Secondary inverter Z003

Functions and main components

The secondary inverter card Z003 includes these following operational blocks:

- **Power supply for control circuits**
- **Gate control circuits**
- **Under voltage watches**
- **Secondary overvoltage protection**
- **Secondary inverter s power stage**

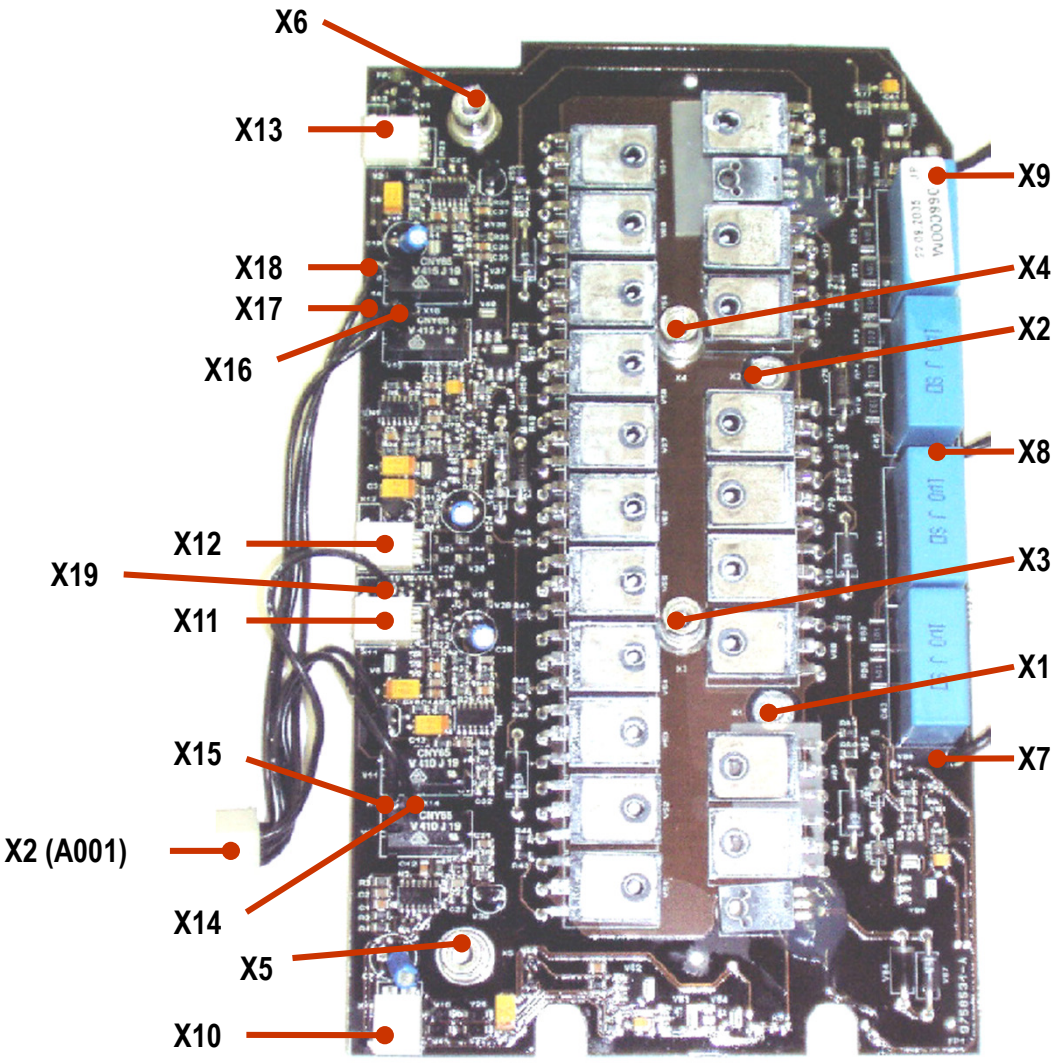
Negative side IGBTs
insulated from heat sink !!!



Positive side IGBTs

Secondary inverter Z003

Connectors



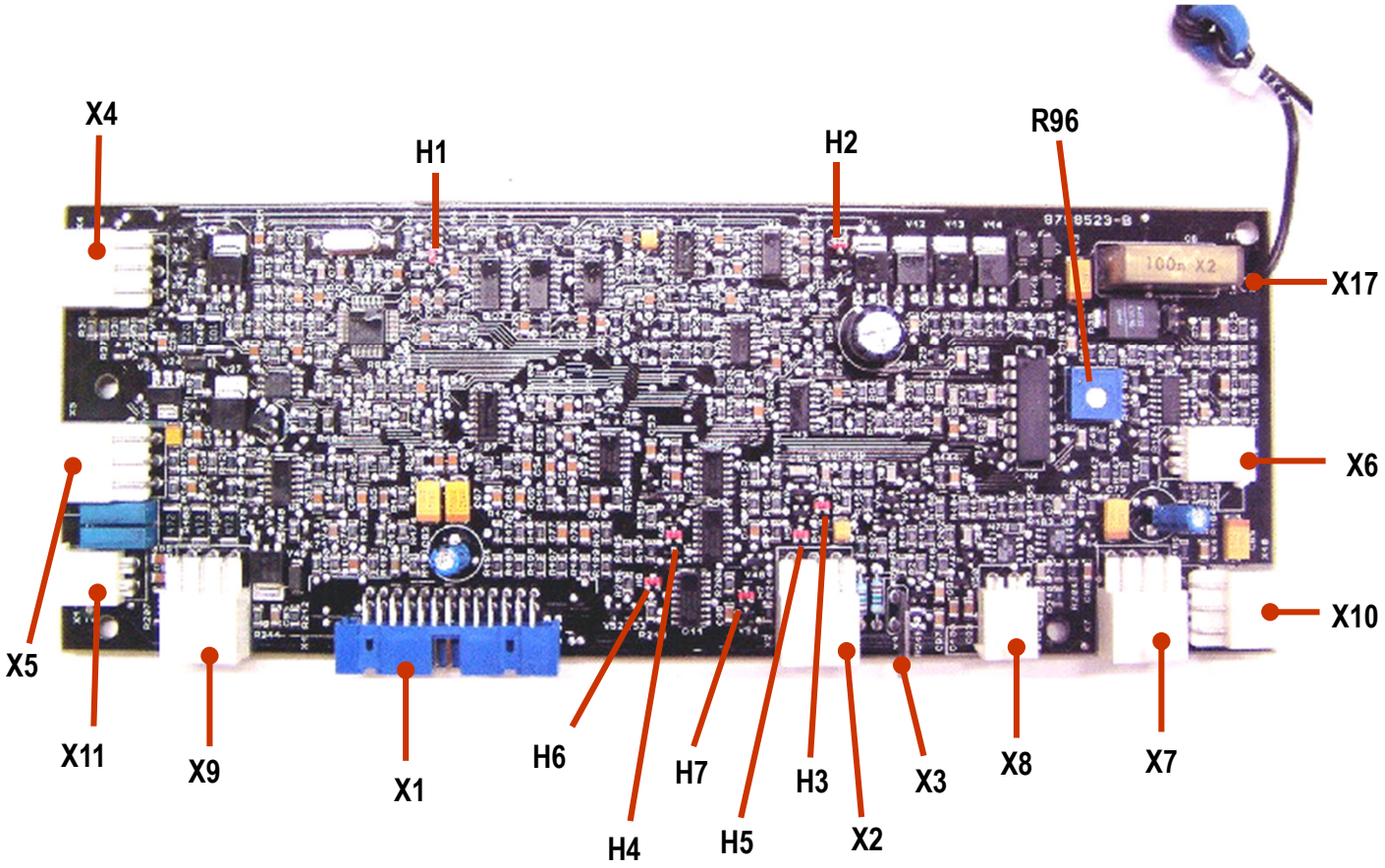
A001 Control card

Functions and connectors

The control card A001 includes these following operational blocks:

- Micro controller (Renesas M30262)
- PWM -control
- Shunt amplifier
- Supply overvoltage watch
- Under voltage watch
- Over temperature watch
- Secondary inverter control
- Spark generator control
- Secondary voltage watch
- Secondary overvoltage watch

H1	Secondary voltage watch, active
H2	Primary inverter PWM -control
H3	DC+ mode
H4	DC- mode
H5	AC- auxiliary pulse, DC+
H6	Spark control
H7	AC- auxiliary pulse, DC-
R96	Inverter frequency adjustment

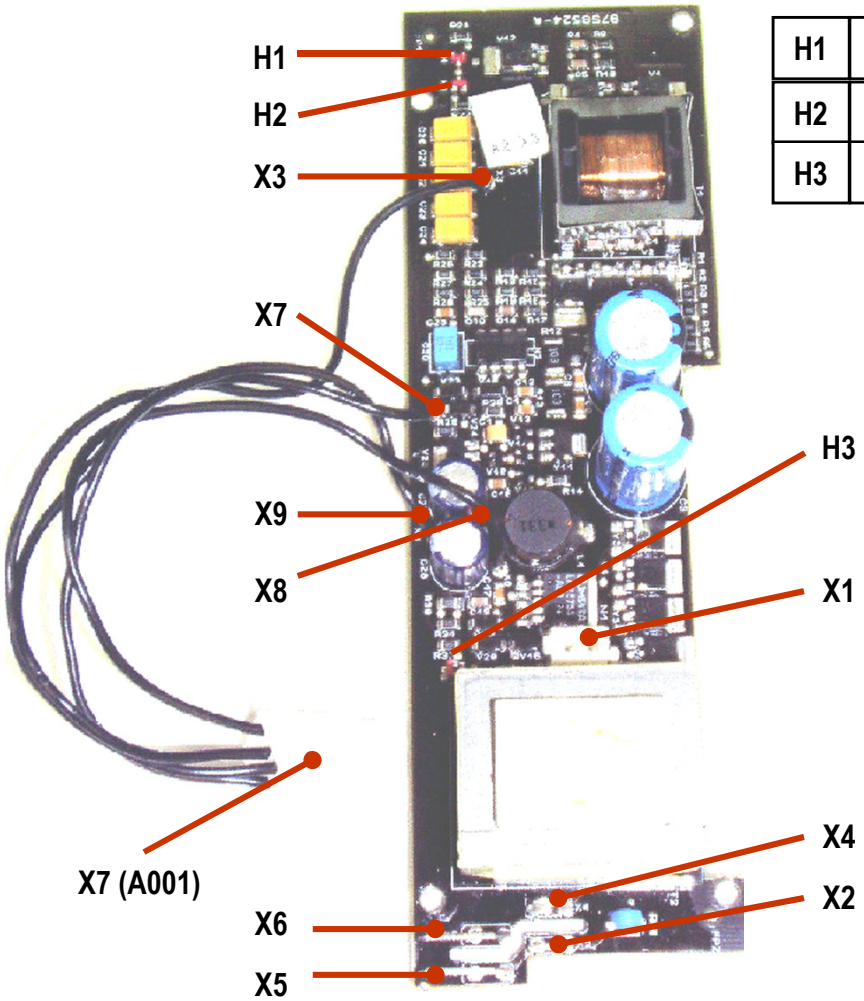


A002 Auxiliary power card

Functions and connectors

Auxiliary power supply card A002 includes the following operational blocks :

- + 5 V (continuous)
- + 24 V and + 15 V from main transformer T001 s auxiliary coils (Flyback chopper)
- About + 20 V start power for the primary inverter's gate buffers
- Cooling unit ~ 230 V power supply



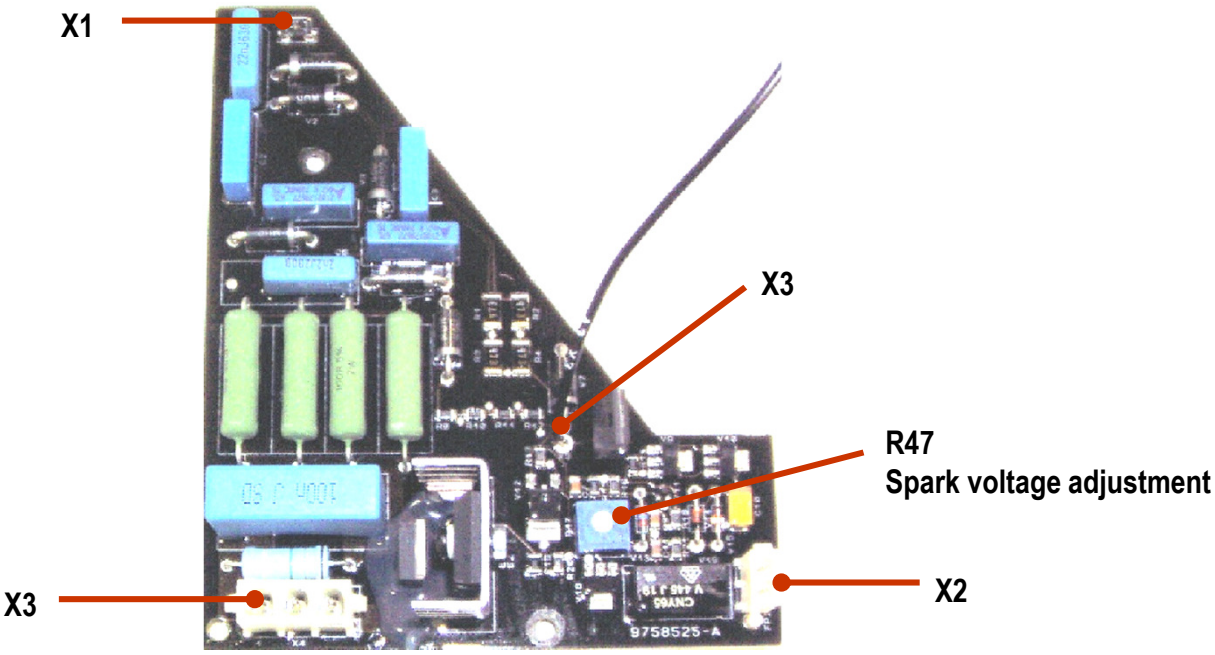
H1	+ 15 V (lighted when power stage is on)
H2	+ 24 V (lighted when power stage is on)
H3	+ 5 V (lighted all the time)

A003 Spark card

Functions and connectors

HF spark card A003 includes these following operational blocks:

Voltage multiplier
Spark on/off -control
Spark voltage control

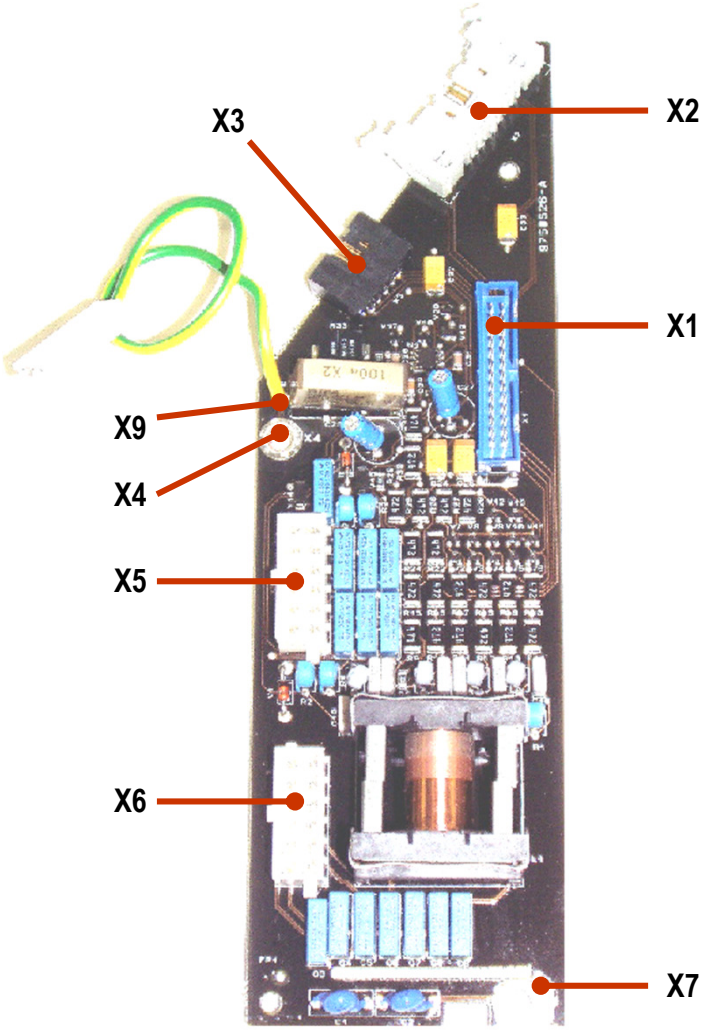


A004 Interface card

Functions and connectors

Filter card A004 includes following operational blocks:

Remote/foot control interface
TIG –torch interface
Panel interface
Filtering of control lines



Measurements

Low voltage and secondary overvoltage watch tests

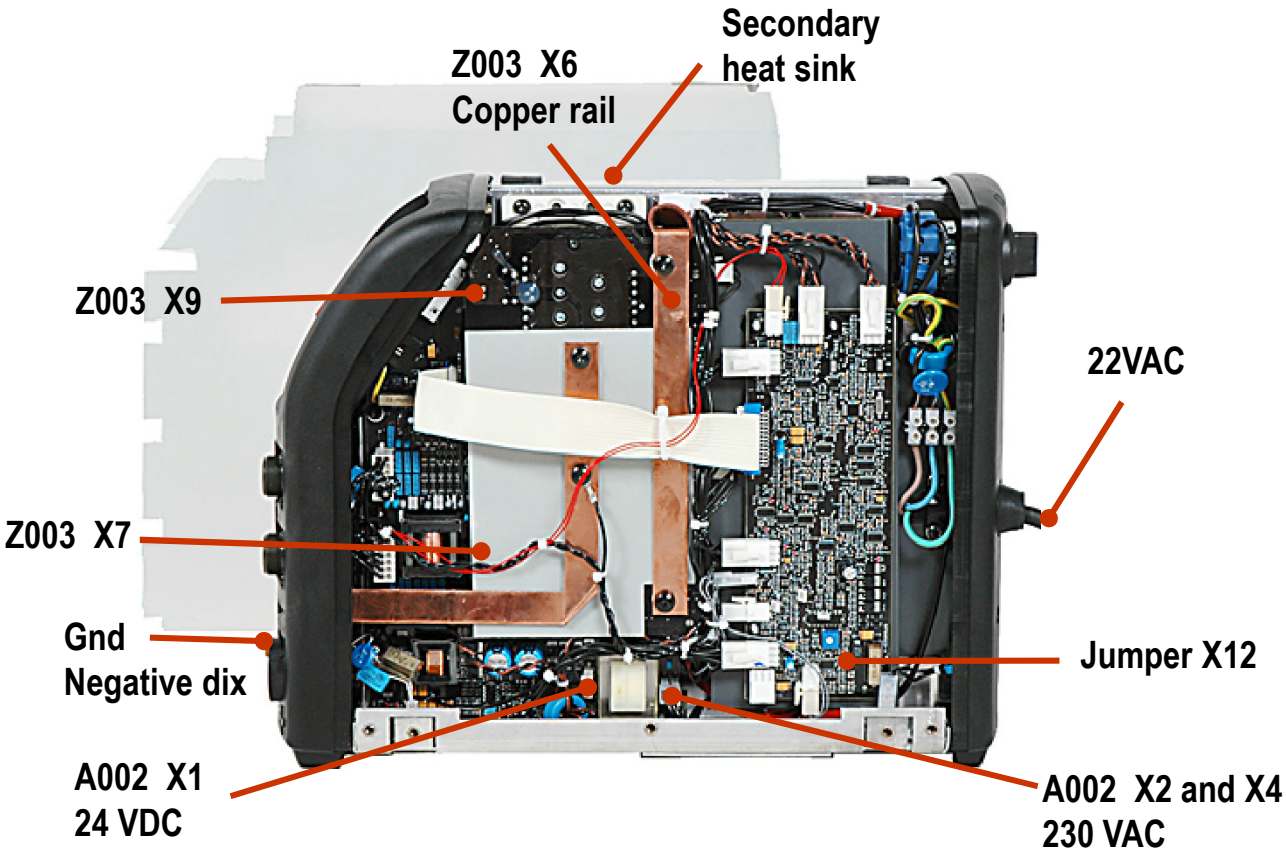
Tests in the following pages (three tests) have to be done after replacing any primary or secondary units or cards. It absolutely important because possible short circuit (e.g. improperly installed mica insulator) may damage the machine heavily.

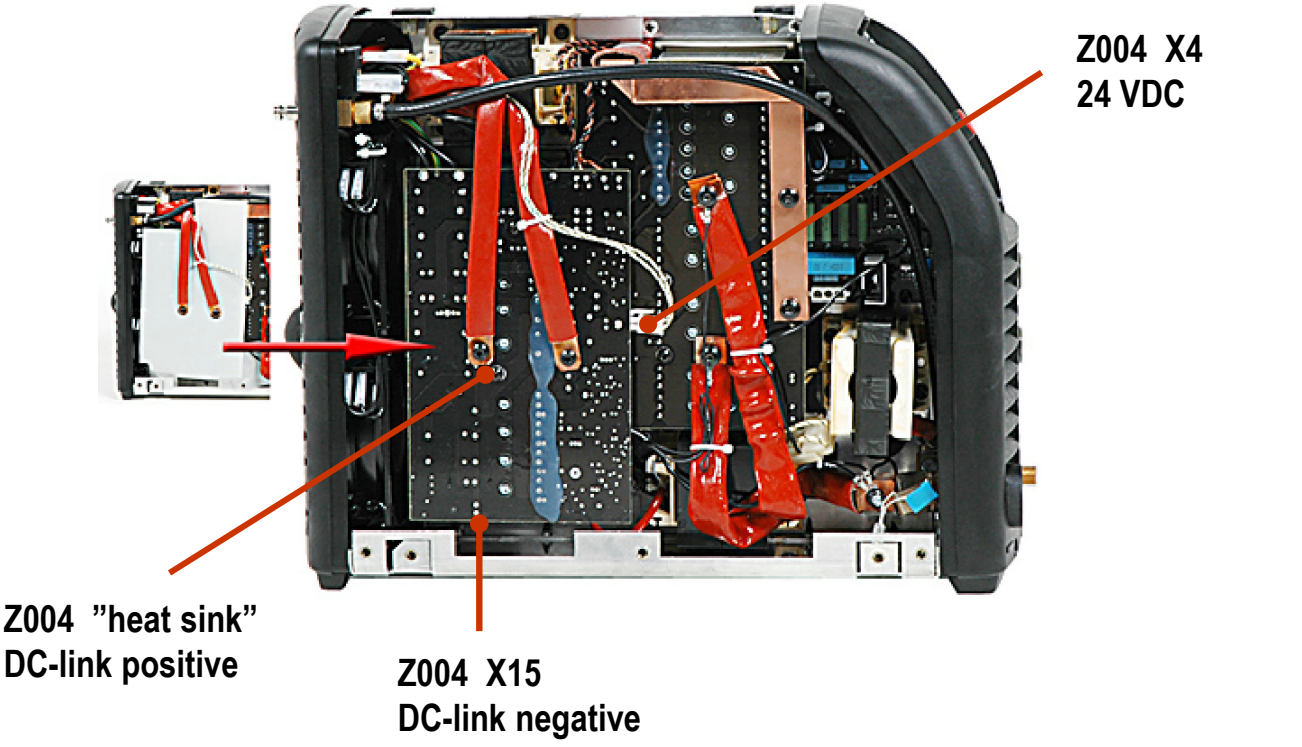
To execute following low voltage tests, Kemppi Multipower (and wire set) and digital multimeter is required.

Be very careful and follow the instructions set by step to make everything in right order. Otherwise you may damage the machine or the testing equipment.

Remember to measure DC-link is not charged while making any connections. In the case it is in high voltage state you may injure yourself or damage the Kemppi multipower.

Measurements





Measurements

Test 1: power state, main transformer and secondary rectifier

1. Disconnect cooling fans.
2. Auxiliary power supply card A002:
    - Disconnect wires from connectors X2 and X4 and connect 230 VAC connector to the X2 and X4 (Do not connect it to the main supply voltage). Use the wire delivered with the multipower wire set.
    - Disconnect connector X1 and connect 24 VDC from Kemppi Multipower to the X1 (polarity is not important).
3. Connect 50 VDC from Kemppi Multipower to the DC-link circuit. Measure DC-link voltage before connecting PSU to the DC link. Voltage must be under 10VDC, otherwise it may destroy the Multipower. Connections can be found on Z004 card:
    - +50V to the heat sink via screw.
    - GND to the connector X15.
4. Switch on the Kemppi Multipower and connect the 230VAC plug to the main supply voltage.
5. ERR 3 should appear, if not machine cannot recognize the over/under voltage state. Connect jumper to the control card A001 jumper block X12 to mask off the Over/under voltage detection.
6. Set machine to the MMA mode.
7. Measure voltages from following points (GND = minus terminal of machine):
    - Z003 X7 voltage should be **approx**. +40V…+58V
    - Z003 X9 voltage should be **approx**. -40V…-58 V
    - Z003 X6 (copper rail) voltage should be **approx.** -6…-10 V
    - Secondary heat sink voltage should be **approx**. +6V…+10 V
        - VRD machine has +22VDC
8. If voltages are OK -> power stage is OK.
9. Switch OFF the Kemppi Multipower and **disconnect 230VAC test wire main supply voltage plug**.
10. Remove testing wires from DC-link (+50V in the heat sink screw and GND in the connector X15)
11. If making Test 2. jump to Test 2 step 4 otherwise disconnect testing test wires.
12. Connect back disconnected wires to the A002.
13. **Disconnect jumper from the control card A001 jumper block X12.**
14. **Connect cooling fans**

Next test ⟶

Measurements

Test 2: PFC card

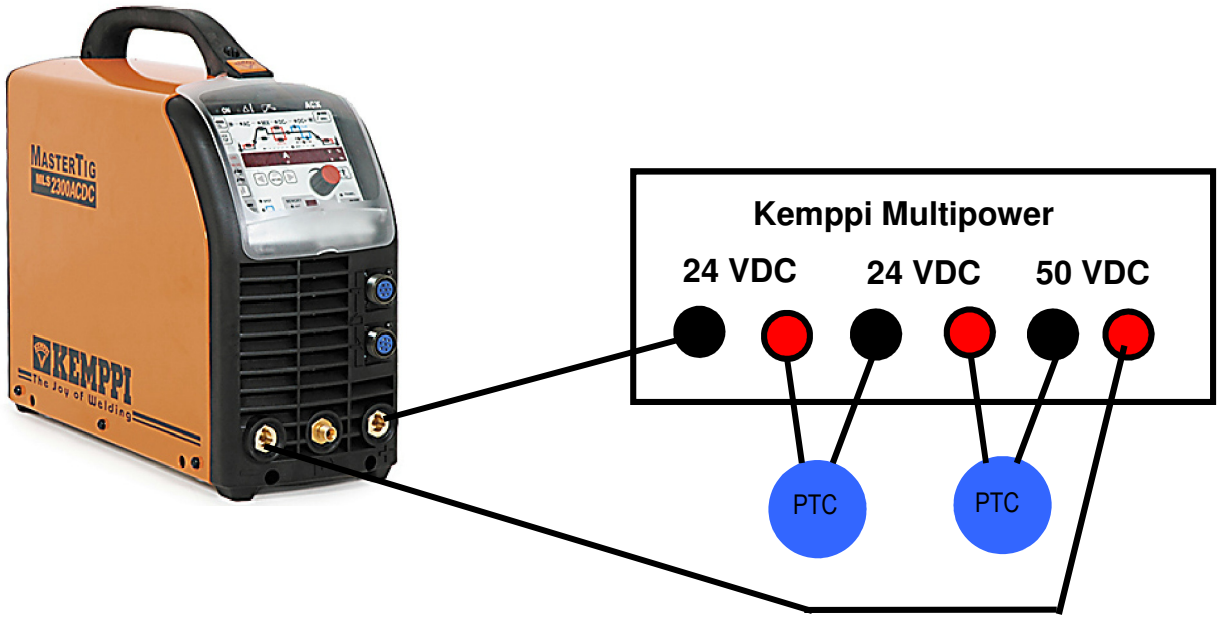
1. Disconnect cooling fans.
2. Connect jumper to the control card A001 jumper block X12. If not connected -> ERR 3
3. Auxiliary power supply card A002:
    - Disconnect wires from connectors X2 and X4 and connect 230 VAC connector to the X2 and X4 (Do not connect it to the main supply voltage). Use the wire delivered with the multipower wire set.
    - Disconnect connector X1 and connect 24 VDC from Kemppi Multipower to the card connector X1.
4. PFC card Z004:
    - Disconnect connector X4 and connect 24 VDC from Kemppi Multipower to the PFC card connector X4.
5. Connect Multipower 22VAC to the main supply cable.
    - Current limit must be set to 2,5A
6. Connect test wires to DC-link and DMM. Connections can be found on the Z004 card:
    - DC-link positive in the heat sink via screw.
    - GND to the connector X15.
7. Turn main switch to the OFF position.
8. Switch on the Kemppi Multipower and connect the 230VAC test wire plug to the main supply voltage.
9. Set machine to the TIG mode.
10. Switch on the main switch (22VAC goes to the machine primary)
    - DC-link voltage should raise up to approx. 400 VDC.
    - NOTE!! 430 VDC is maximum value. If the voltage rises higher switch off the main switch -> PFC-circuit is not working correctly.
    - If voltage is OK -> PFC is working correctly.
11. Switch off the machine main switch.
12. Switch the machine to MMA mode to discharge the DC-link.
13. Switch OFF the Kemppi Multipower **and disconnect 230VAC main supply voltage plug.**
14. Disconnect the testing wires and connect back A002 and Z004 wires.
15. **Disconnect jumper from the control card A001 jumper block X12.**
16. **Connect cooling fans**

Next test ⟶

Measurements

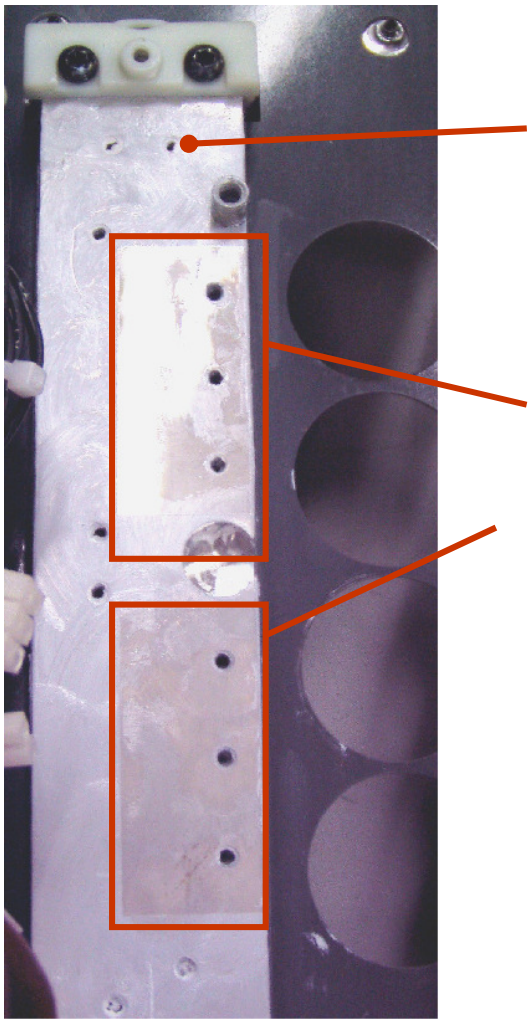
Test 3: Secondary over voltage watch (control card, secondary inverter card)

1. Connect Kemppi multipower DC outputs (50 VDC, 24 VDC and 24 VDC) in the series. Outputs must be protected by PTC-resistors (included to the cable set). See picture below.
2. Switch ON the Kemppi Multipower.
3. Switch ON the machine.
4. Set machine to the TIG-mode.
5. Touch to the machine terminals with tester wires.
6. Machine will show Err 6 on the display, if secondary voltage watch is working correctly.
7. Test secondary voltage watch with reversed polarity !
8. Disconnect the A001 X3 connector and switch the machine to MMA, error 6 should appear.
9. Connect A001 X3 connector to control card.



Installation of semiconductors

Z001 Main circuit card



Voltage of the heat sink is approx.+ 400 V

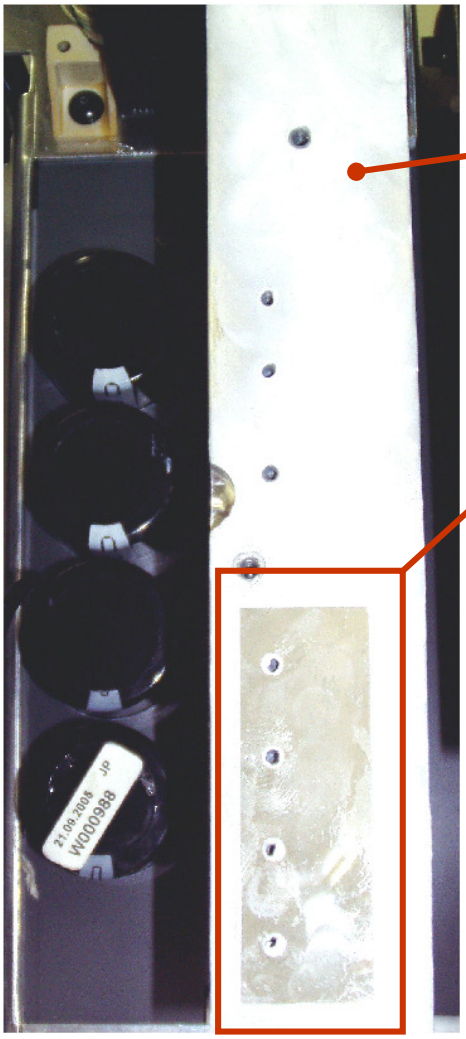
Negative side IGBTs are insulated from the heat sink by Mica/Aluminium oxide insulators. Insulators have to be replaced every time the main circuit card Z001 is separated from the heat sink !!!

Heat transferring paste is applied as thin layers on both sides of the insulators. Absolutely no impurities are allowed on surface of the insulators when mounting them between the heat sink and the IGBT!

Note!
Aluminium oxide insulators are more reliable in the primary and should be used always if any primary repair work is done. They are thicker than micas so heat sink must be replaced.

Installation of semiconductors

Z004 PFC card



Voltage of the heat sink is approx. + 400 V

IGBTs V4.. V7 are insulated from the heat sink by Mica/Aluminium oxide insulators. insulators must be replaced every time the PFC- card Z004 is separated from heat sink !!!

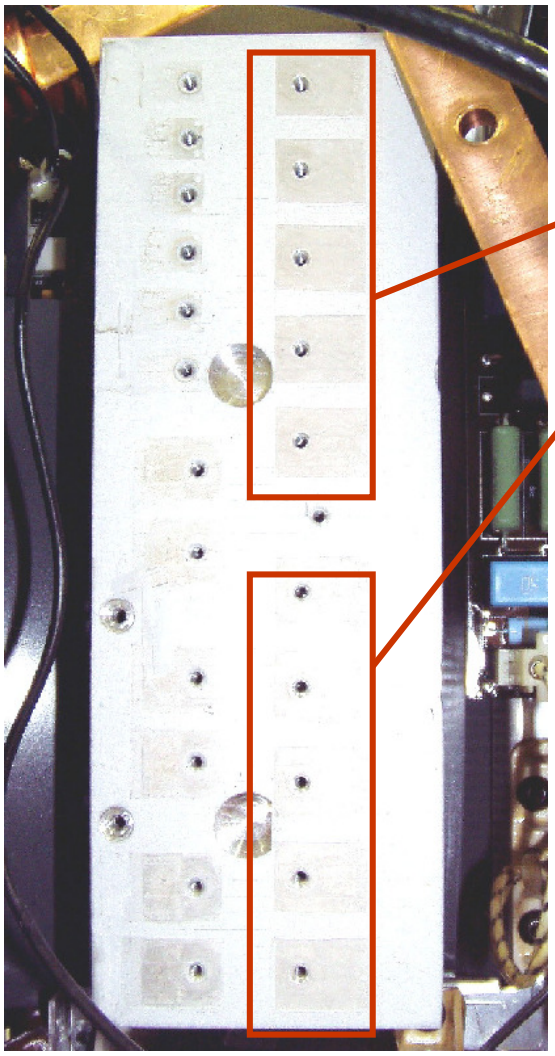
Heat transferring paste is applied as thin layers on both sides of the insulators. Absolutely no impurities are allowed on surface of the insulators when mounting them between the heat sink and the IGBT!

Note!

Aluminium oxide insulators are more reliable in the primary and should be used always if any primary repair work is done. They are thicker than micas so heat sink must be replaced.

Installation of semiconductors

Z002 Secondary rectifier

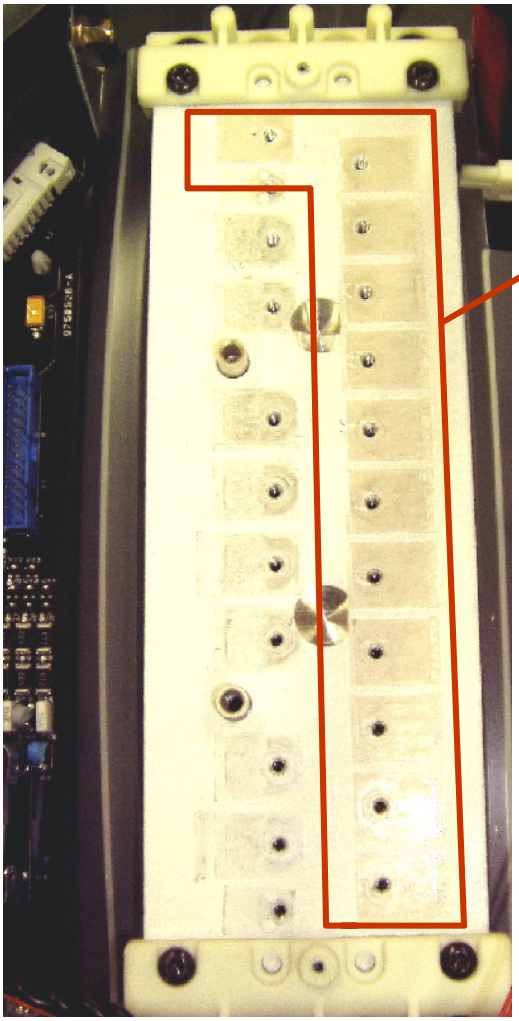


Negative side diodes are insulated from the heat sink by mica insulators. Mica insulators have to be replaced always, when the secondary diode card Z002 is separated from heat sink !!!

Heat transferring paste is applied as thin layers on both sides of the insulators. Absolutely no impurities are allowed on surface of the insulators when mounting them between the heat sink and the diodes!

Installation of semiconductors

Z003 Secondary inverter



Negative side IGBTs are insulated from the heat sink by mica insulators. Mica insulators have to be replaced every time the main circuit card Z003 is disconnected from heat sink !!!

Heat transferring paste is applied as thin layers on both sides of the mica insulators. Absolutely no impurities are allowed on surface of the insulators when mounting them between the heat sink and the IGBTs!

Notes