KEMPPI
The Joy of Welding

SERVICE MANUAL
Mastercool 30

CONTENTS

1. READ THIS FIRST

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

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.

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

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

2. GENERAL

Mastercool 30 is membrane pump type cooler for water cooled mig guns. Membrane pump can generate up to 10 bar pressure so it needs electronically limited control logic.

Control logic and pump motor both uses low voltage power (+24VDC) and cooler does not have any high voltage inside. Secondary side +24VDC is generated in Mastertig MLS 3000/3003 ACDC

Mastercool 30 can have several different control cards depending the manufacturing time. First type was SP002447 (card number W002447, versions A, B and C). This card has trimmer for adjusting the under pressure limit and jumpers for several configuration options. In production from the beginning to 6/2009.

Second control card type was SP004736 (card number W004736, versions A and B) and had updated motor current measuring. This card did not have any trimmers, only jumpers. In production from 7/2009 to end of 2010.

Third card type is SPW006214 (card number W004736), it has same control logic as Mastercool 20. Main idea compared to earlier cards is that motor has lower running speed and better ability to tolerate long water hoses and cold temperatures. In production from the beginning of 2011.

This manual is mostly for coolers with third type card SPW006214. In the end of manual there are some information and jumper settings for old cards. There is also instructions how to adjustment trimmer in card SP002447. For more information please see the following old manuals found in Kemppi net:

- Servicemanual_Fast_Master_Kempact10_Master30.VX.X_EN.pdf (original manual for Hydrocool pump coolers with first type control card)
- Servicemanual_membrane_pump_coolers.VX.X_EN.pdf (second version for Hydrocool pump coolers with second type card)

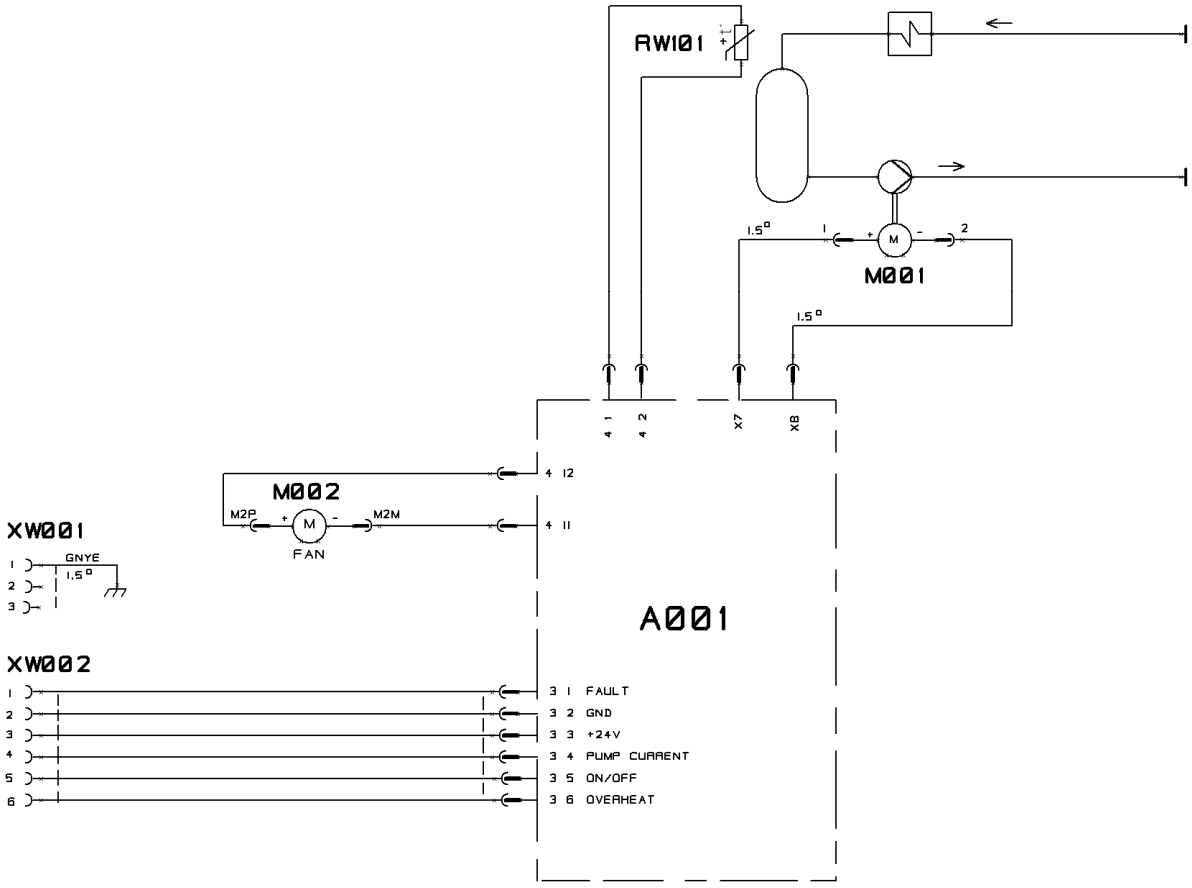
Mastercool 30 has been made with two different types of pressure dampening systems. Originally cooler had a dual component hose in pump output. This was replaced in 3/2010 by normal rubber output hose with copper pressure damper. *NOTE! These two different types of pressure dampening systems are meant to use separately not together.*

3. TECHNICAL INFORMATION

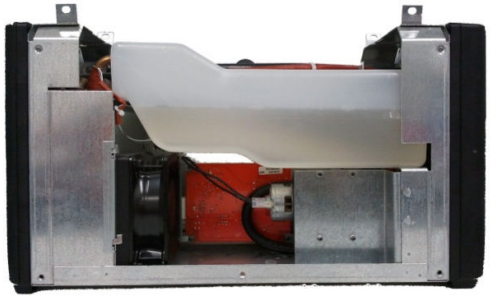
3.1. Technical data

Mastercool 30		
Operating voltage		24VDC
Cooling power		1.0 kW
Connection capacity	100% ED	50W
Maximum pressure		4.0 bar
	100 % ED I_{1eff}	12.9 A
Cooling liquid		20% - 40% glycol-water
Tank volume		Approx. 3 l
External dimensions	LxWxH	500x180x260mm
Weight		8 Kg

3.2. Wiring diagram



3.3. Construction



Left side

Front

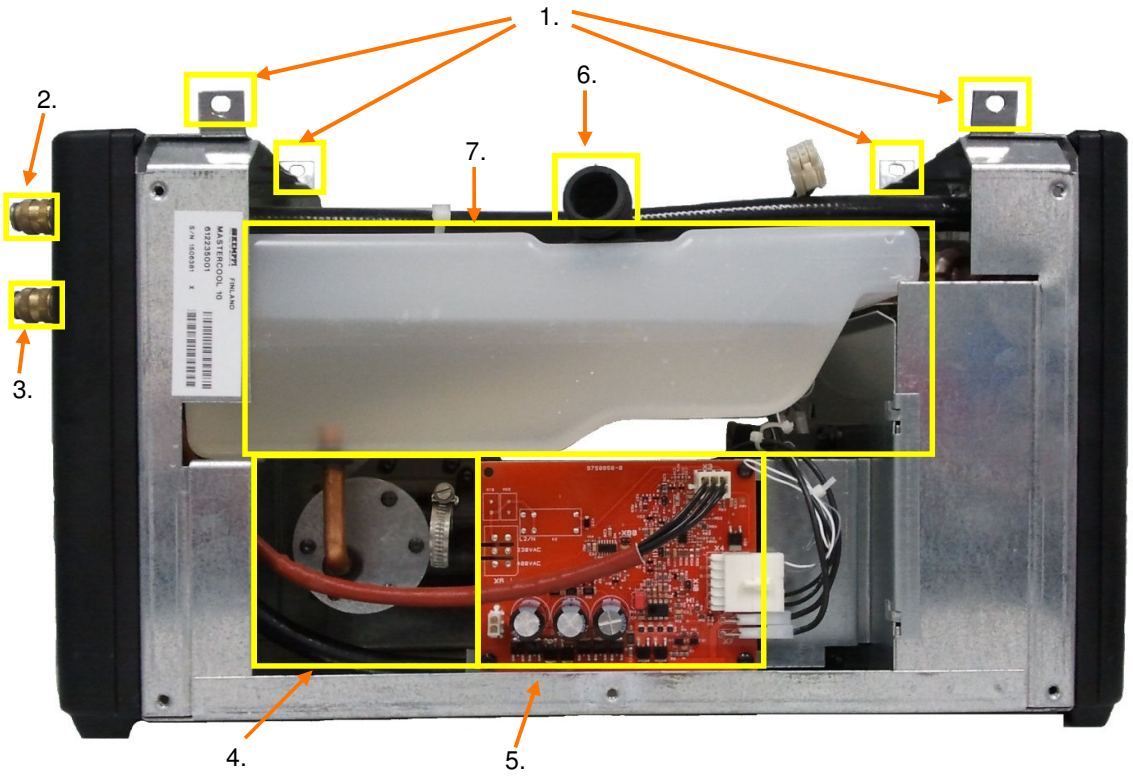
Back

Right side

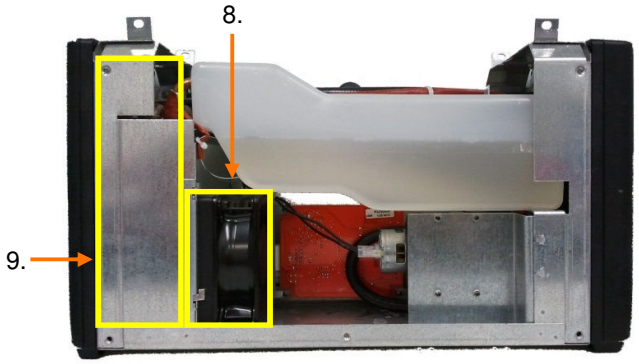
Up

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.

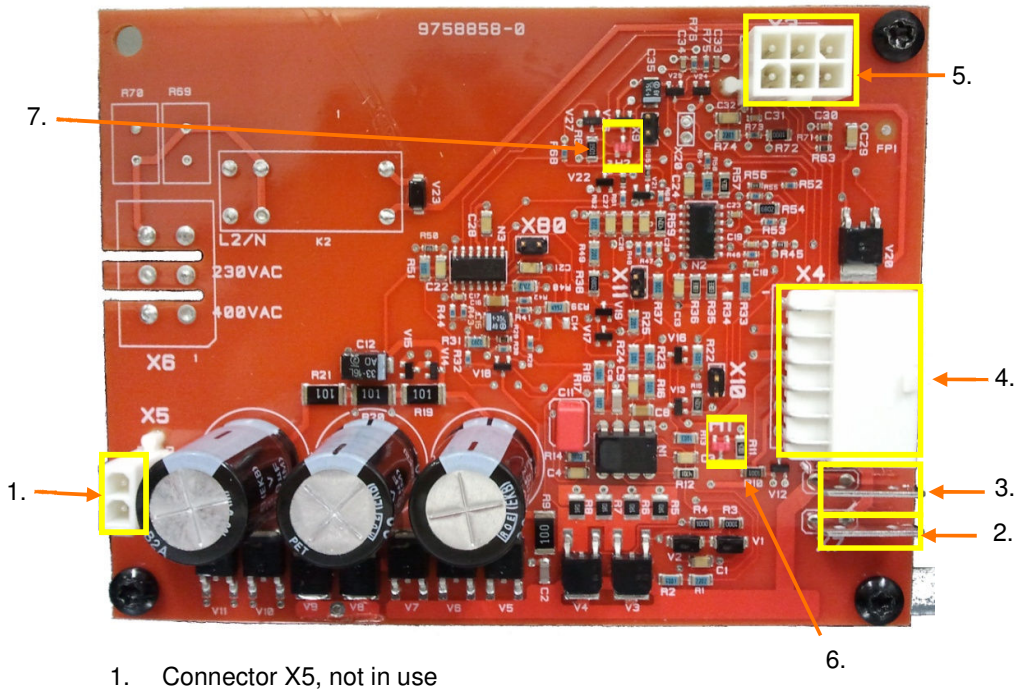
3.3.1. Inner structure



1. Fastening points to power source
2. Hot water/return snap connector (red)
3. Cool water/output snap connector (blue)
4. Hydrocool pump
5. A001 control card
6. Water tank filling hose
7. Water tank
8. Cooling fan
9. Radiator (inside the chassis)



3.3.2. A001 control card structure



1. Connector X5, not in use
2. Connector X7, Positive output for pump motor
3. Connector X8, Negative output for pump motor
4. Connector X4, PTC and cooling fan connector
5. Connector X3, Control connector to power source
6. LED H1
7. LED H2

3.4. Description of operation

Mastercool 30 can be divided to three parts: A001 control card, pump with motor and water circulation components.

Note that Mastercool has had two different principles for pressure dampening and three different types of control cards depending the manufacturing time.

3.4.1. A001 control card

- Control card controls the pump start and stop. This is made by the start signal of power source control card.
- It monitors the water temperature. PTC resistor is +60 degrees of Celsius.
- A001 card monitors water pressure by measuring the pump current. If pressure goes over or under the limit card give fault-signal to power source via X3-1
- Card controls cooling fan. Its start is related to pump running and has shut down delay
- Card has several jumpers to activate alternative characteristic functions in problem cases. Jumpers are described in next chapter.

3.4.2. Pump-motor assembly

- Pump works by membrane principle (like piston) and can develop up to 10 bar pressure. This is limited electronically to 5 bars to avoid internal damage and to protect water hoses. Motor runs piston that moves the membrane. Membrane develops pressure that is hold with two pressure valves. Piston type movement has a vibration as a side effect and it must be filtered with damper. Pump can have water flow up to 0,8l/min.
- Pressure valves keep the pressure high and water flow in right order
- Motor runs the membrane pump piston. It uses voltage +5,2VDC.
- Pump input is connected to the copper pipe from the tank and output has integrated spindle for output water hose.
- Note that motor should be connected to A001 control card with two wires with flat connectors X7 and X8. If old connection (A001 X4) is used with motor wires, it should be replaced.

3.4.3. Water circulation components (Radiator, water hoses, tank and pressure damper system)

- Radiator cools the heated water while it runs through it.
- Tank holds the cooling liquid and the volume is approximately 3 liters.
- Via Output water hose the cooling liquid runs to the snap connector.
- Pressure damper system:
    - Dual type Water hose works as a pressure damper in old coolers manufactured up to 4/2010. Inner hose was made of silicon to enlarge and diminish when pressure changes. Outer hose was made of reinforced rubber to limit the enlarging inner silicon hose. Together these makes generation 1 pressure damper system.

- Generation 2 pressure damper system has a normal rubber single output water hose and it is connected to disk-like pressure damper. It is made of copper and has a single chamber to reduce the pressure variations. This type damping circuit is used since 4/2010.

3.5. Control card jumpers

Jumpers control several functions and their behavior can be changed if faced frequent problems. Normally Hydrocool pump system may have two types of malfunctions: pressure is rising to abnormal level or coolant level is too low.

In some cases high pressure is consequence of very long water cables or cold temperature. In these cases jumpers X11 and X10 can be used to get more tolerance to keep cooler running.

While coolant level is too low the only possibility is to add more of it. Jumper X9 is only to check if the cooler alert is because of low pressure.

See service instructions to get more information how to use jumpers to rectify problems.

X80	For test use only ***Open** – Keep always open
X9	Pump motor current over and under pressure alarm. ***Open** – Alarm is possible Closed – Alarm disabled
X10	Pump motor current over pressure alarm. ***Open** – Alarm is possible Closed – Alarm disabled
X11	Pump motor current over pressure alarm level. ***Open** – Alarm level is normal Closed – Alarm level is raised

3.6. Control card LEDs

H1 = Over temperature

H2 = Over and under pressure alert. This LED goes on also if temperature alert is given

4. SERVICE INSTRUCTIONS

4.1. Cooling liquid

With Mastercool 30 it is possible to use two kind of cooling liquids: Water mixed with ethanol or glycol. Ethanol based coolant is recommended for better torch durability. It also keeps the pump clean and smoothly running. Ethanol can be mixed with water up to 40% vol, higher volume gets flammable. Lower % vol (no less that 15% vol) may be used if cooler is not running in subzero temperatures.

Cooler is tested with glycol based coolant and system can stay fully operational. The problem is that glycol may corrode torch metal parts because of electricity (welding voltage in torch). Another thing is that glycol builds up small particles in the long run and these might get the pump pressure valves stuck if coolant is not changed frequently.

4.2. Cooler maintenance

Water cooler needs maintenance to keep it running in long term use. Water tank and pump should be cleaned frequently. Time frame depends on the used coolant and coolers working hours. Ethanol keeps system more clear than glycol. It is best to check in certain periods of time the coolant condition and change if needed. Once water tank is getting dirty it should be flush with clean water.

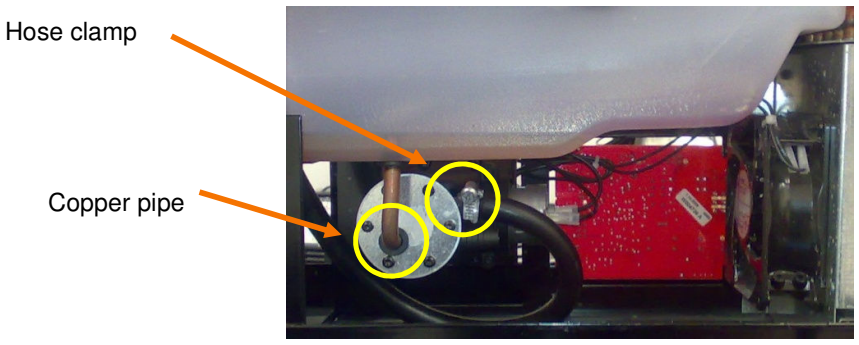
Pump has pressure valves ant they may get dirty as well. If water circulation is slowing down and errors are faced even with short water hoses, it is preferred to maintain the pump itself. See the following chapters for more information.

4.2.1. Detaching and fastening the pump

Detaching the pump:

- Open the side panel
- Disconnect the pump motor connectors
- Detach the copper pipe
- Detach the water hose clamp
- Note! Additional support by finger is needed while losing the hose clamp screw to avoid damaging the nib
- Detach the pump from the cooler frame

Attaching the pump back to the cooler is made in the opposite rule. Note that additional support is needed while the water hose clamp is tightened. If used dual component water hose see the next chapter to get reliable connection.



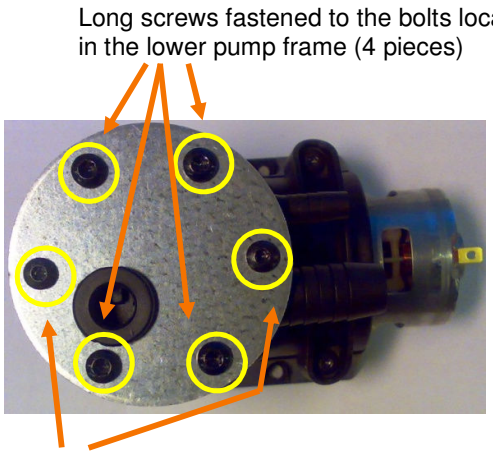
4.2.2. Fastening the Generation1 dual water hose to the pump

It is important to make connection right way because otherwise connection may leak or even hose slip away. While attaching the two component water hose to the pump nib, first carefully install the inner hose to the nib and then the outer hose upon the inner hose. Only then you can be sure to get the reliable fastening. Use your index finger to support the pump nib to avoid bending it while tightening the hose clamp. Be sure to tight clamp enough.

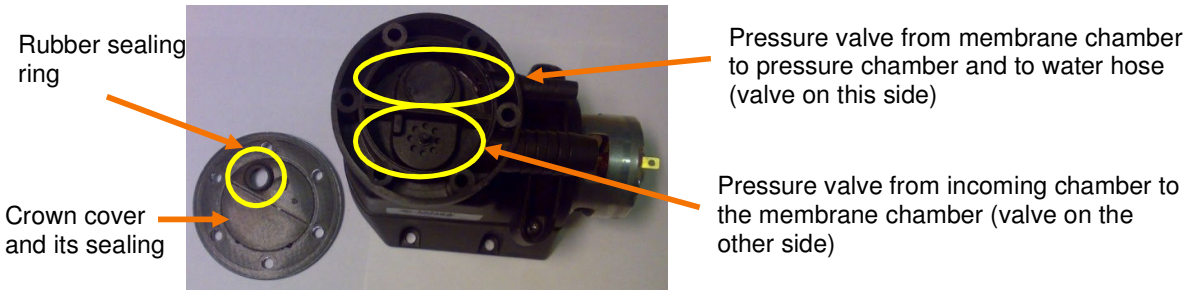
4.2.3. Pump maintenance

To maintain the pump:

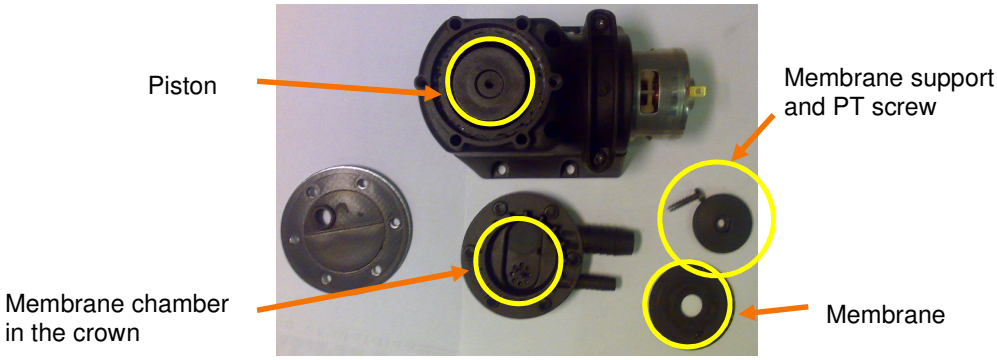
- Open the 6 screws in the top of the pump
- Two screws are PT and four are normal



- Open the pump crown and check the pressure valves if they are clean and intact
- Clean the area around the valves and replace valves if needed
- Note! Be careful while installing valves, they must be in right sides, if not pressure won't rise at all



- Detach membrane support from piston and check the condition, replace if needed
  - Note! When assembling the pump, be careful NOT to over tighten PT screw to avoid damaging the parts
- Before attaching the crown cover be sure the rubber sealing ring is fully escorted through the crown cover and its sealing
- While attaching the crown cover, be careful NOT to over tighten two PT screws to avoid damaging the pump frame



4.3. Measurements and tests

4.3.1. Troubleshooting in error cases

The next two chapters may give ideas how to rectify possible cooler error cases. Before making further actions to cooler it is best to change another TIG torch to be sure it is not the source of problems. Check also that coolant level is high enough and add if needed. See the LED information in the A001 control card.

Over pressure:

In some cases high pressure is consequence of very long water cables or cold temperature. In these cases jumpers X11 and X10 can be used to get more tolerance to keep cooler running.

- Close X11 to get more tolerance for over pressure alarm

- If problems continue close X10 to disable over pressure alarm

If these do not help, the problem is not the over pressure, see the next section (Under pressure or no water circulation).
Under pressure or no water circulation:

If coolant level is fine and jumpers X11 and X10 do not solve the cooler error, jumper X9 can be used to check if the cooler alert given is because of the air bubble in the pump or leakage of pressure valves or membrane. Before closing the X9 check that jumpers X11 and X10 are closed.

Note! Jumper X9 should be kept open and closed only for test purposes, because lack of the disturbed water circulation alert may affect the TIG torch to burn.

Checking the water circulation:

- Disconnect the blue snap connector and use screwdriver to unlock it (by pressing inside the connector).
- Try to run some water to container; if water flows circulation is ok.
- Check that pump can raise the pressure while water hoses are connected (See the next section “Normal operational pressure”).

4.3.2. Operational tests

During the maintenance it is always good idea to check some basic operations of the cooler. To be sure control electronics and pump itself works as designed, there is basically four tests to execute. Pressure meter is a nice tool to make reliable operational tests (suppressed meter is better because of the variable pressure). Best place for pressure meter is just after the output snap connector behind the cooler (blue mark).

Note! Remember to close the water circulation with hose loop or TIG torch, otherwise the pressure will rise to the maximum and snap connector might start to leak.

Pressure meter connection to the output snap connector, marked as blue

4.3.2.1. Under pressure alarm

When water tank is empty or pressure is under 1 bar, control electronics activate the alarm

- It can be seen by led H2 illuminating
- If under pressure lasts over 7 seconds, cooler gives error message (X3-1 goes to 0)

4.3.2.2. Over pressure alarm

When water circulation is blocked or resistance is too high, control electronics activate alarm

- If pressure is over approx. 5 bars led H2 illuminates
- This can be simulated by bending output water hose just after the snap connector
- If over pressure lasts several seconds cooler gives error message (X3-1 goes to 0)

4.3.2.3. Normal operational pressure

Working pressure for this cooler is depending on the length of the cables and environment temperature. Normally pressure is between 1,5 and 5 bars.

- E.g. while using 16 meter long torch and/or working in temperatures under 0 pressure can be up to 4 bars.
- If normal working pressure is near 1 bar, there can be problem in pump membrane and/or pressure valves. See next pages to maintain the pump.
- Water cooled gun adds approx. 0,5 bars and this should be noticed when making simulated pressure measurements. If using water hose loop in the end of the feeder connection instead of a gun, working pressure will be lower than in real welding situation.

4.3.2.4. Water flow test

- Get a container with a scale for the water volume
- Run water from cooler to the container and use stop watch to have exact time = t
- See the result in the container scale = V1
- Use formula below to calculate water flow per minute

$$V_{total} = V_1 \cdot \frac{60}{t}$$

Example 1:

$$V_1 = 4dl$$

$$t = 30s$$

$$V_{total} = V_1 \cdot \frac{60}{t} = 4dl \cdot \frac{60s}{30s} = 4dl \cdot 2 = 8dl$$

Acceptable water flow per minute is more than 5dl/min. If water flow is less, this can be a mark of problems in the pump.

4.3.3. Cooler voltages

Voltage measuring gives basic information of possible problems. Mastercool 30 requires +24 VDC for control electronics, pump motor and cooling fan.

Input voltage from the power source:

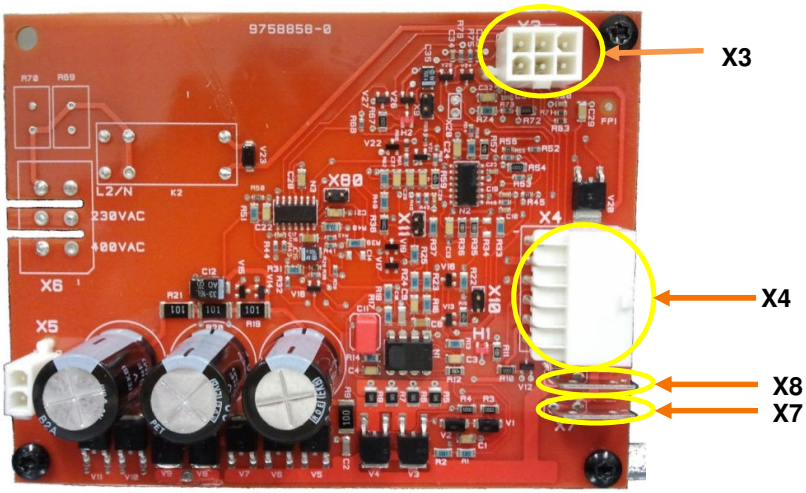
- +24VDC X3-3
- Ground X1-3

Pump motor voltage:

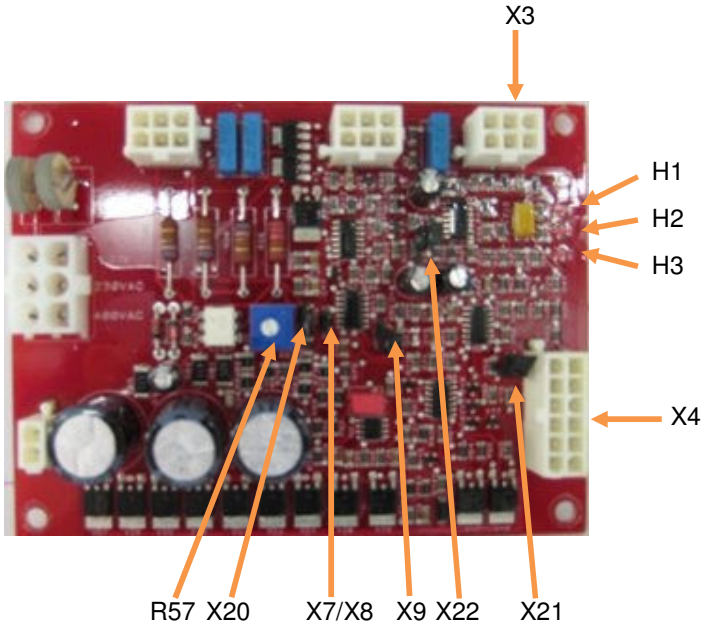
- +5-6VDC X7
- Ground X8

Cooling fan:

- +24VDC X4-12
- Ground X4-11



5. FIRST GENERATION CONTROL CARD SP002447



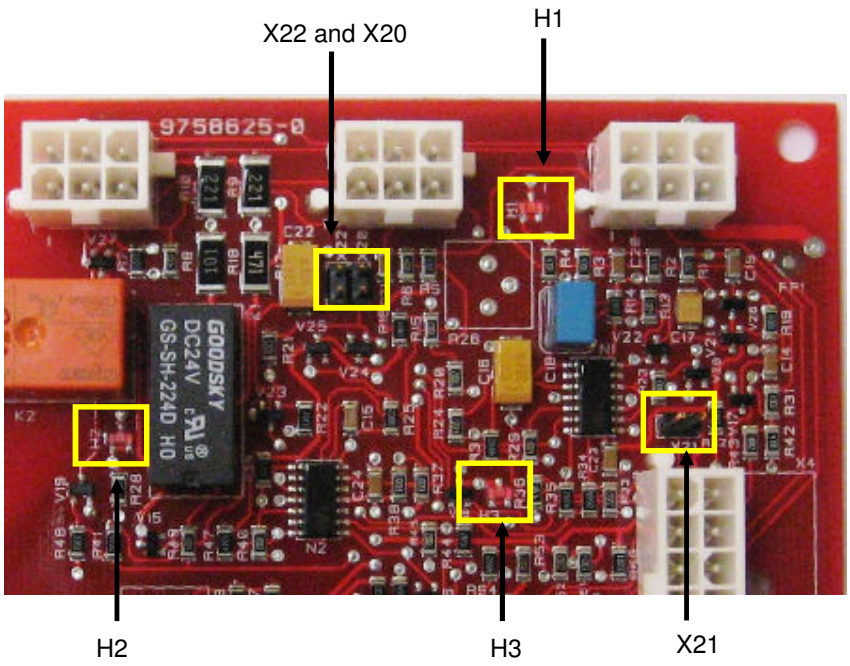
X9	Change machine pressure-/flow characteristic curve. **Open** - the pressure is lower closed – higher pressure
X20	Cooling unit start ***Open** – waiting for start signal Closed – Continuous run
X21	Liquid temperature alarm. ***Open** – PTC monitoring by cooler Closed – PTC monitoring by power source
X22	Pump motor current minimum limit alarm, pressure low or no water. ***Open** – alarm on Closer – alarm off.

H1	Cooling liquid temperature too high.
H2	Pump motor current too low, no water. Alarm level can be adjusted by trimmer R57 (Default 230mV – 1,4A)
H3	Pump motor current too high. Blocked water hoses, no circulation.

Adjusting pump motor current minimum: measuring points X7 and X8, adjust voltage using R57 to 230mV (current limit will be then 1,4A). When adjusting the current limit pump should not be running.

Operational voltages and used connectors are the same as in the card SPW006214.

6. SECOND GENERATION CONTROL CARD SP004736

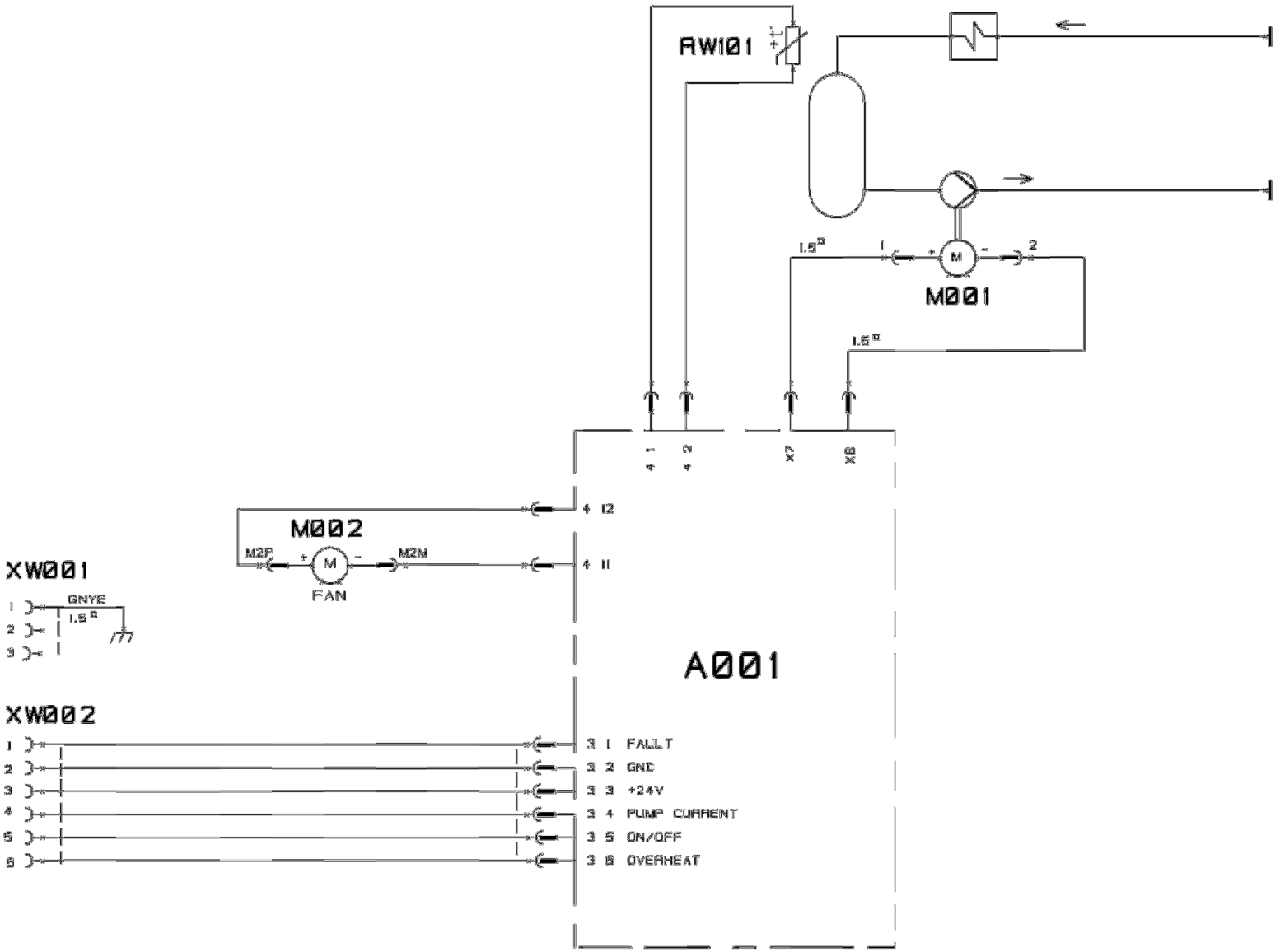


X20	Cooling unit start. ***Open** – Waiting for power source start signal Closed – Continuous run
X21	Liquid temperature alarm. ***Open** – PTC monitoring by cooler Closed – PTC monitoring by power source
X22	Pump motor current minimum alarm, pressure low or no water. ***Open** – alarm on Closed – alarm off

H1	Cooling liquid temperature too high.
H2	Pump motor current too low. Cooling liquid level too low, no liquid or air bubble in the pump.
H3	Pump motor current too high. Blocked water hoses, no circulation.

Operational voltages and used connectors are the same as in the card SPW006214.

Notes



KEMPPI	MASTERCOOL 30	TARRA		PIIRT PeHa 7.9.2009	TARK
		KOKO	VALM.OHJE KES-64-002	W002939-A	