Service Manual

Transsonic Analog

Transsonic LC

Ultrasonic Cleaning Units

• english •

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Content

1 General

Carefully read the Service Manual before you carry out any repair works, in particular the *Important safety warnings, section 1.4*.

We reserve the right to carry out technical modifications on the units due to advanced development.

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The copy right remains with the editor.

1.1 How to use the Service Manual

For trouble shooting we recommend to use the table of possible faults on the relevant type of unit (*section 4*).

Further useful information on initial operation, trial runs and standard operation can be found in *section 2, Important operation instructions and section 17, Putting into operation / Trial runs*.

In case of any further queries ELMA will be glad to assist. For our technical support and contact address please see the last page.

1.2 Contents of the Service Manual

Safety warnings	Carefully read and observe before you carry out any repair works.
Product description	Description of operating elements and unit features.
Operation	Instructions on the intended use and operation of the present unit.
Trouble shooting	Table of faults, possible causes and remedies for the different unit types (no guarantee on completeness).
Repair	Easy-to-follow instructions on the replacement of faulty components; individual unit types are listed separately where necessary.
Putting into operation / Trial run	Instructions on initial operation / putting into operation, cleaning media, heating of the cleaning liquid, etc.
Circuit diagrams	Annex A contains circuit diagrams for each unit type showing the relevant data (mains voltage, ultrasonic frequency).
Spare parts lists	Annex B contains the spare parts lists, divided into separate lists for each unit type. The lists show the standard spare parts. Should you require any further components, please contact the manufacturer.

1.3 Demands on the service staff

The present Service Manual is intended for authorized service points and specialized service staff.

Legitimate users of the Service Manual are persons who do not require to be specifically instructed on the risks caused by electric equipment.

Special knowledge on electric units and safety-relevant knowledge are prerequisite for carrying out any repair works on ultrasonic cleaning units.

1.4 Important safety warnings

Authorized specialized staff

Repair and maintenance works which require the unit to be connected and openend must be carried out by authorized and specialized staff only.

Mains connection

For safety reasons, the unit must be connected to a correctly grounded socket only. The technical data indicated on the nameplate must correspond with the available mains connection data, in particular those concerning the mains voltage and the current connected value.

Prevention of electrical accidents

Pull the mains plug before you open the unit.

In order to prevent damage from persons and equipment the open unit and all mains-operated measuring instruments must be connected via mains interrupting transformer.

During operation parts of the ultrasonic generator and the transducer system carry a high-frequency a.c. voltage.

During replacement of the transducer disks, piezoelectric effects can cause high voltages. In order to prevent damage from persons these voltages must be branched off.

Original spare parts

Compliance with the valid safety regulations and the CE conformity can only be guaranteed if faulty parts are replaced by original spare parts.

Exclusion of liability

The manufacturer cannot be held liable for damages on persons, unit or shop equipment caused by improper use of the unit or wrong repair works.

1.5 Testing equipment, tools and measuring instruments

All testing and measuring tools and instruments must be connected to a grounded socket only.

Apart from the standard electromechanical tools the following measuring and testing equipment is required for the measuring and repair works described in the present Service Manual:

Multimeter	For electric measuring inside the unit, e.g. resistance and throughline measuring.
Torque wrench	For tests and repair works which require the opening of the transducer system. After opening, the transducer system must be screwed with the correct torque (see *section 10, Faulty PXE transducer disks*). The wrong torque can cause malfunctions and a breakdown of the unit.
Wattmeter	For checking the power consumption of the ultrasonic generator and the heating (can be used for units with 1 phase / N mains supply).
Adjustable interrupting transformer	For the separation of the unit from the mains and for the safe and controlled upward-adjustment of the mains voltage (can be used for units with 1 phase / N mains supply).
Oscilloscope	For the adjustment of the generator and for trouble shooting. Double-beam oscilloscope with minimum 20 MHz elementary frequency.
Probes	Two probes 1:1 and/or 1:10.
Interrupting transformer	For the connection between mains and oscilloscope. Required for the galvanic separation of the oscilloscope from the mains. Nominal power approx. 50VA.

2 Important operating instructions

Carefully read and observe before reoperation and inspection of the unit!

Intended use The present Elma ultrasonic cleaning unit has been designed for the treatment of **items** and **liquids** only.

Check for damage Check the unit and the mains cable for transport damages. In case of visible damage do not operate the unit!

Placement Place the unit on a dry and solid surface; ensure that the workplace is sufficiently ventilated. Keep workplace, unit housing and operating elements dry. Protect the unit from entering humidity!

Cleaning liquid Fill the cleaning tank with a sufficient quantity of a suitable cleaning liquid before switch-on. Do not use flammable liquids directly in the cleaning tank: risk of fire and explosion!

Voltage variants 100 – 120V / 220 – 240V

Mains connection 1 phase / 1 N / 1 PE shockproof grounded socket

For any queries please contact the manufacturer.

3 Organizational details

3.1 Warranty

The warranty covers all claims based on material and manufacturing faults. Excluded from the warranty are:

- Transport damages; these must be reported to the forwarding agent.
- Damages caused by improper use of the unit:
  e.g. damages on the transducer tank caused by wrong cleaning media, cleaning items placed directly on the tank floor, dry running of the unit, etc.
- Damages caused by humidity which has entered the unit from outside.
- Unauthorized repair works on the unit.
- Improper use and/or operation against the Operating Instructions.
- Wear and tear; example: the transducer tank is a wear part with regard to the cavitational erosion around the sound-giving surfaces.

3.2 Warranty period

New units The limitation period for warranty claims is 2 years (from the date of purchase). If no proof of purchase can be produced, Elma can find out the date of manufacturing by means of the serial number (nameplate).

Repair Elma grants a limitation period of 2 years on all exchange parts and on any repair works carried out.

Please make sure that all documents on any service works that might have been carried out are safely stored.

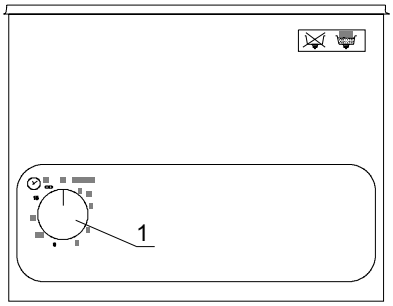
3.3 Spare parts

Elma guarantees the availability of spare parts according to the valid regulations over a period of 10 years after the production and sale of a unit has stopped. Standard spare parts will be available for older units.

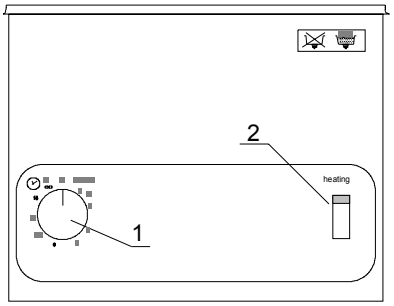
For your spare parts order we need to know the following data:

- Type of unit
- Voltage (115V or 230V)
- Serial number (nameplate)

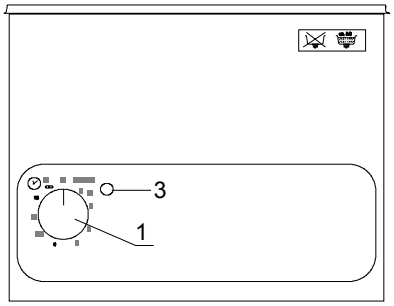
4 Description of operating elements



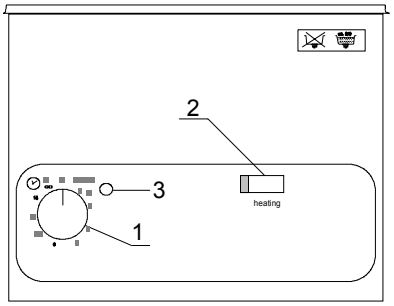
Modell: T310



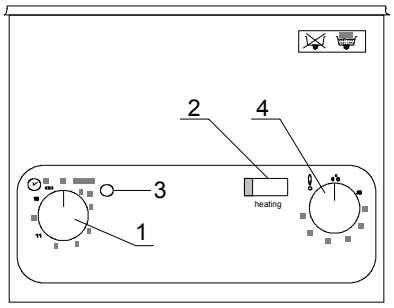
Modell: T310/H



Modelle: T420, T460, TS540, T570, TP690
T700, T780, T890, LC30



Modelle: LC20/H, LC30/H, LC60/H, LC130/H



Modelle: T460/H, T470/H, T570/H, T660/H,
T700/H, T780/H, T820/H, T880/H, T890/H,
TP1000/H, T1040/H, T1060/H, T1200/H
T1700/H

1 Timer for ultrasonic operation

Operating modes: 1 - 15 min for short-period operation
permanent operation ∞ (manual switch-off required).

2 Heating switch

On / Off switch for heating.

3 Pilot lamp ultrasound

Turns on when ultrasound is activated.

4 Thermostat

Stepless regulation of the heating temperature.

5 Technical details

	Power consumption total approx. (W)	Ultrasonic power effective approx. (W)	Power consumption heating approx. (W)	Weight approx. (kg)
T310	35	35	0	1.7
T310H	95		60	1.8
T420	35	35	0	2.2
T420H	95		60	2.3
T460	85	85	0	2.8
T460H T470H	285		200	2.9 / 3.2
TS540	160	160	0	4.5
T570	160	160	0	3.8
T570H	360	360	200	3.9
T660H	360	160	200	4.8
TP690	160	160	0	5.5
TP690H TP695H	760		600	5.8 / 7.4
T700	160	160	0	6.7
T700H	560		400	6.9
T780	250	250	0	8.6
T780H	650		400	8.9
T820H	1050	250	800	10.2
T890	300	300	0	12.2
T890H	1100		800	12.7
T1040H	2000	400	1600	24.6
T1060H	2800	800	2000	38.5
LC20H	95	35	60	2.3
LC 30	35	35	0	2.6
LC 30H	95		60	2.7
LC60H	285	85	200	4.5
LC130H	560	160	400	6.5

6 Trouble shooting / List of malfunctions

Find out if the malfunction is caused by a fault on the unit or by improper use. Examples for malfunctions due to improper use:

Improper use

- The cleaning result is not satisfactory:
  The cleaning medium, the cleaning temperature or the duration of the cleaning cycle are not suitable for the cleaning task.
  The cleaning result can also be impaired by a wrong or insufficient filling level and/or very dirty cleaning liquid.
- The unit does not heat up correctly:
  For an efficient heating up of the cleaning liquid switch on the ultrasound and use a cover. Please find further instructions in *sections 8.5 and 9*.

Faulty unit

Check and find out if the fault is in the heating or in the ultrasonic system.

Check the housing and the bottom plate of the unit for any visible damage and check the tank for leaks before you connect the unit to an interrupting transformer.

Then connect the unit to an adjustable interrupting transformer for a functional check. You can easily and safely check the unit for a short circuit by slowly adjusting the mains voltage upwards and observing the current consumption. At the same time you can find out which functions of the unit have broken down.

No ultrasound, no heating

If the unit does not indicate any current consumption although the operating elements are switched on, or if the pilot lamp for the ultrasound is not turned on and the heating remains cold, the fuses of the interference filter are probably blown. A fault due to a heating short circuit is very probable. Possibly, there is also an interruption of the power supply of the mains cable or the interference filter.

Ultrasound

If the pilot lamp for the ultrasound is turned on but there is no ultrasonic activity, the fault is on the generator pcb or in the transducer system. For further information please see the relevant sections and the following table of malfunctions and remedies.

Heating

The PTC heating elements can only break down in case of a short circuit which causes the total breakdown of the heating. An insufficient heating temperature or incorrect temperature regulation are generally caused by an unsuitable heating process. Please find further information in *sections 8.5 and 9*.

6.1 T310(H)

Malfunction	1. Check: Heating switch - if lighted	2. Check: Fuse printed board	Possible causes	Remedy
	Check the unit for possible damages and traces of liquid inside (e.g. leak in the tank, liquid/humidity entering from outside)			
No ultrasound (Heating OK)	OK	OK	• interference filter coil • timer	• replace component • replace complete interference filter
No ultrasound / weak ultrasound (Heating OK)	OK	OK	• output transformer • output capacitor 6.8nF • scorching in transducer system	• replace component • replace complete printed board • open/check transducer system
No ultrasound No heating	OFF	faulty	• faulty printed board (BZW diode; transistors; diodes mains and HF)	• replace component • replace complete printed board • disconnect heating cable, check unit again (new fuses) if short circuit does not occur again, the heating is faulty • replace faulty heating
No ultrasound No heating	OFF	OK	• interference filter • mains cable	• replace complete printed board • replace mains cable

Malfunction	1. Check: Heating switch - if lighted	2. Check: Fuse printed board	Possible causes	Remedy
Fuse automatic (building) released; No heating; No ultrasound	OFF	faulty	• short circuit in heating	• disconnect heating cable, check unit again (new fuses) if short circuit does not occur again, the heating is faulty: • replace faulty heating
No heating (Ultrasound OK)	OFF	OK	• faulty heating switch	• replace component
No heating (Ultrasound OK)	OK	OK	• faulty thermostat button (check with ohmmeter)	• replace component

6.2 T420(H); LC20H

Malfunction	1. Check: pilot lamp ultra-sound	2. Check: heating switch - if lighted	3. Check: fuse printed board	Possible causes	Remedy
	Check the unit for possible damages and traces of liquid inside (e.g. leak in the tank, liquid/humidity entering from outside)				
No ultrasound / weak ultrasound (Heating OK)	OK	OK	OK	• output transformer • output capacitor • scorching in transducer system	• replace component • replace complete printed board • open/check transducer system
No ultrasound (Heating OK)	OFF	OFF	faulty	• faulty printed board (BZW diode; transistors; diodes) • short circuit in heating disconnect heating cable; check again)	• replace component • replace complete printed board • replace heating
No ultrasound (Heating OK)	OFF	OK	OK	• interference filter coil • timer	• replace component • replace complete interference filter
No ultrasound (Heating OK)	OFF	OFF	OK	• interference filter • mains cable	• replace complete interference filter • replace mains cable
No heating; No ultrasound	OFF	OFF	OK	• scorched interference filter • faulty mains cable	• replace complete printed board • replace mains cable

Malfunction	1. Check: Pilot lamp ultra-sound	2. Check: Heating switch - if lighted	3. Check: Fuse printed board	Possible causes	Remedy
Fuse automatic (building) released; No heating; No ultrasound	OFF	OFF	faulty	• short circuit in heating	• disconnect heating cable, check unit again (new fuses) if short circuit does not occur again, the heating is faulty: • replace faulty heating
No heating (Ultrasound OK)	OK	OFF	OK	• faulty heating switch	• replace component
No heating (Ultrasound OK)	OK	OK	OK	• faulty thermostat (no „click“)	• replace component

6.3 T460 – T 700H; LC 30 – LC 130H

Malfunction	1. Check: Pilot lamp ultra-sound	2. Check: Heating switch - if lighted	3. Check: Fuse inter-ference filter	4. Check: Fuse printed board	Possible causes	Remedy
	Check the unit for possible damages and traces of liquid inside (e.g. leak in the tank, liquid/humidity entering from outside)					
No ultrasound / weak ultrasound (Heating OK)	OK	OK	OK	OK	• printed board • output transformer • output capacitor • scorching in transducer system	• replace component • replace complete printed board • open/ check transducer system
No ultrasound (Heating OK)	OK	OK	OK	faulty	• printed board: (transistors in diodes)	• replace compo-nents • replace complete printed board
No ultrasound (Heating OK)	OFF	OK	OK	OK	• interference filter coil • timer	• replace inter-ference filter • replace timer
No ultrasound No heating	OFF	OFF	OK	OK	• interference filter • mains cable	• replace compl. Inter-ference filter • replace mains cable • replace component

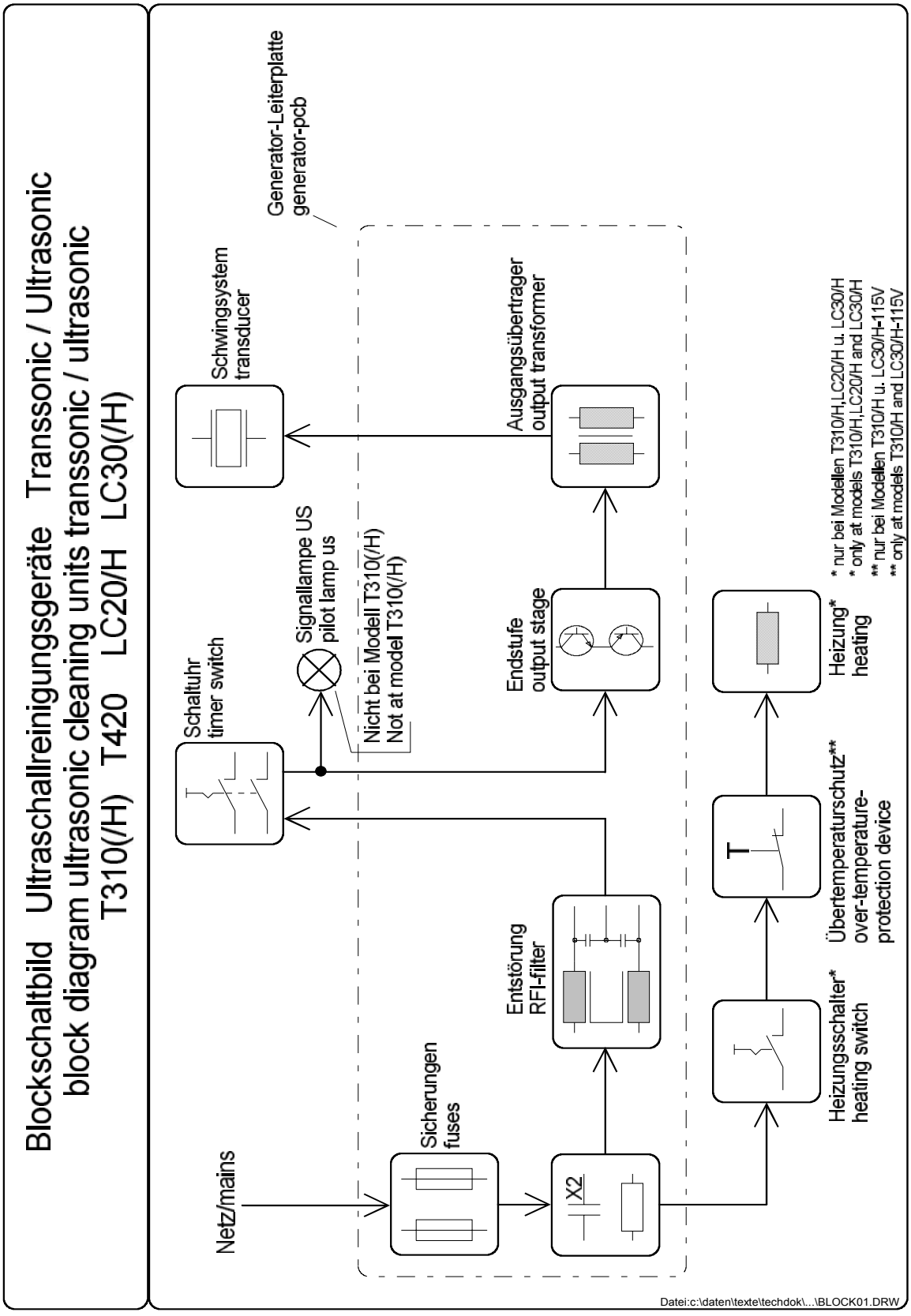
Malfunction	1. Check: Pilot lamp ultra-sound	2. Check: Heating switch - if lighted	3. Check: Fuse inter-ference filter	4. Check: Fuse printed board	Possible causes	Remedy
No heating; No ultrasound	OFF	OFF	faulty	OK	• short circuit in heating: (disconnect heating – check again) • short circuit in inter-ference filter	• replace heating
No heating; No ultrasound; Fuse automatic (building) released	OFF	OFF	faulty	OK	• short circuit in heating • short circuit in interferencef ilter (e.g. liquid)	• disconnect heting, if faulty replace
No heating Ultrasound OK	OK	OFF	OK	OK	• faulty heating switch (perm. interrupted)	• replace component
No heating Ultrasound OK	OK	OK	OK	OK	• faulty thermostat (no „click“; perm. interrupted)	• replace component

6.4 T780 – T1060H

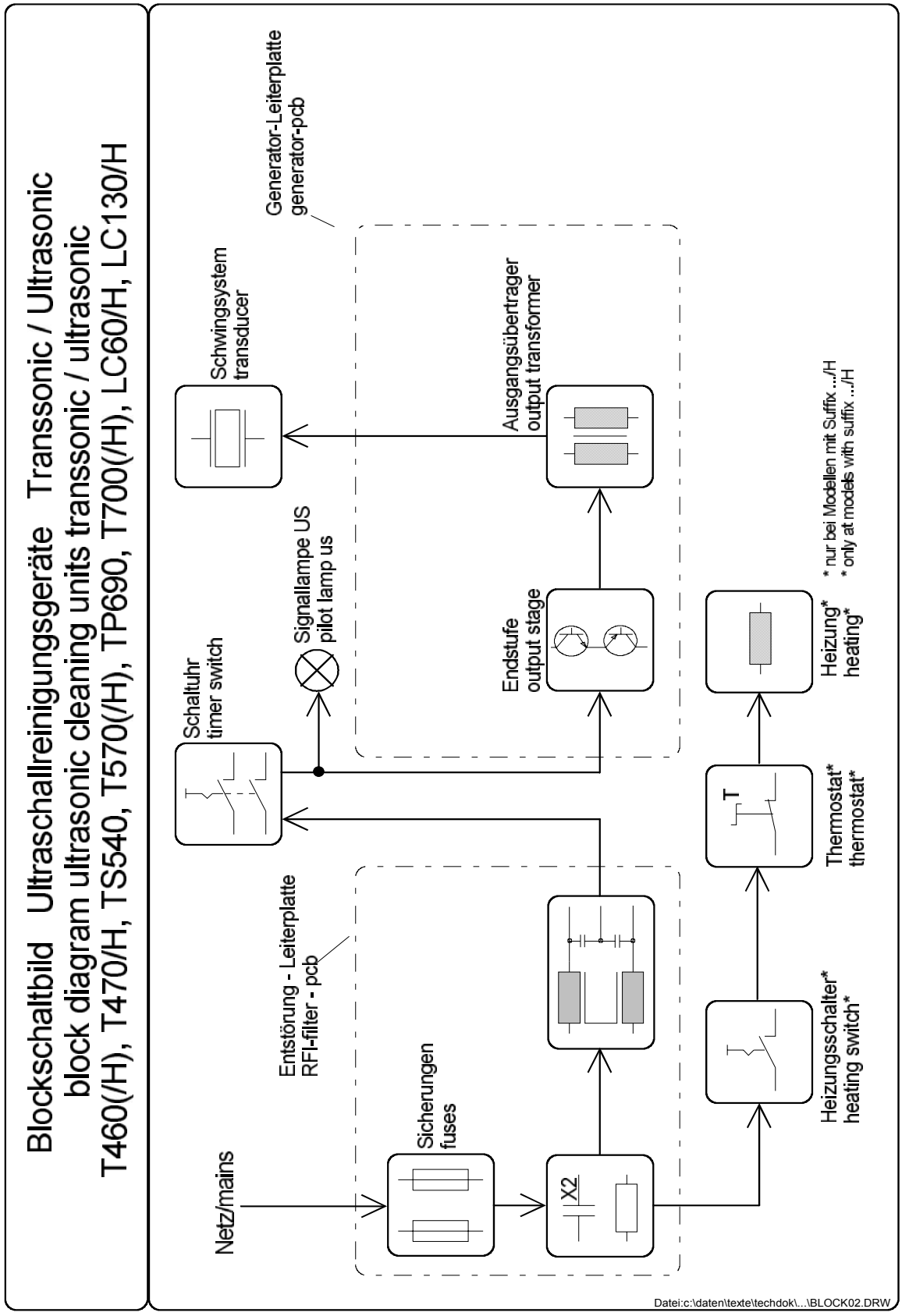
Malfunction	1. Check: Pilot lamp ultra-sound	2. Check: Heating switch - if lighted	3. Check: Fuse inter-ference filter	4. Check: Fuse printed board	Possible causes	Remedy
	Check the unit for possible damages and traces of liquid inside (e.g. leak in the tank, liquid/humidity entering from outside)					
No ultrasound / weak ultrasound (Heating OK)	OK	OK	OK	OK	• secondary transformer coil • output capacitor • scorching in transducer system	• replace component • replace compl. printed board • open/ check transd. system
No ultrasound (Heating OK)	OK	OK	OK	faulty	• printed board: (transistors diodes)	• replace component • replace compl. printed board
No ultrasound (Heating OK)	OFF	OK	OK	OK	• interference filter • timer	• replace component • replace compl. interf. filter
No ultrasound No heating	OFF	OFF	OK	OK	• interference filter • mains cable	• replace component • replace compl. interf. filter • replace mains cable

Malfunction	1. Check: Pilot lamp ultra-sound	2. Check: Heating switch - if lighted	3. Check: Fuse inter-ference filter	4. Check: Fuse printed board	Possible causes	Remedy
No ultrasound No heating	OFF	OFF	faulty	OK	• short circuit in heating: (disconnect heating, check again) • short circuit in interf. filter	• replace heating
No heating; No ultrasound; Fuse automatic in building released	OFF	OFF	OK / faulty	OK	• short circuit in heating • short circuit in interf. filter (e.g. liquid)	• disconnect heating, if faulty replace
No heating Ultrasound OK	OK	OFF	OK	OK	• faulty heating switch (perm. interrupted)	• replace component
No heating Ultrasound OK	OK	OK	OK	OK	• faulty thermostat (no „click“; perm. interrupted)	• replace component

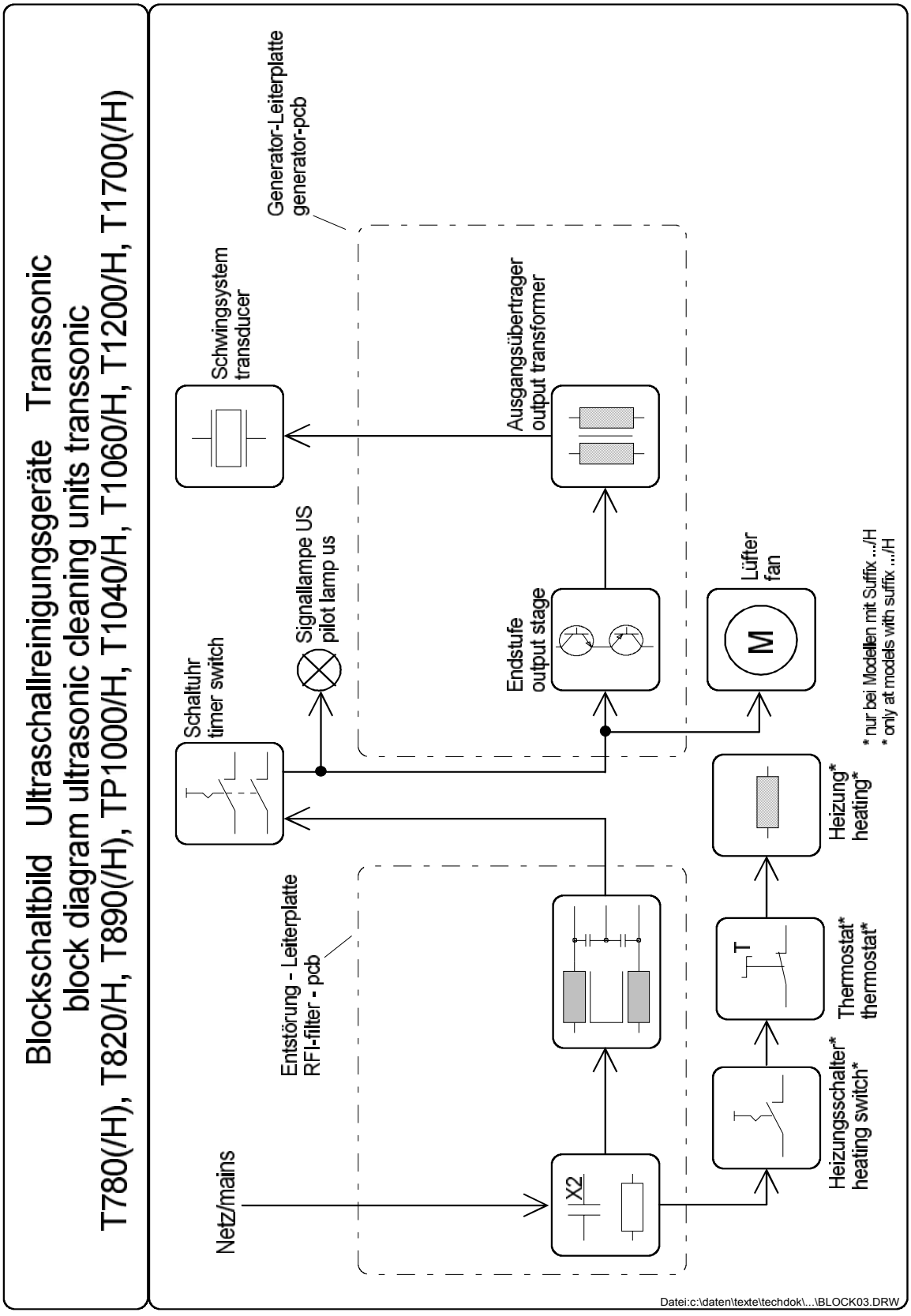
6.5 Block diagram T310 – T420H; LC20H – LC30H



6.6 Block diagram T460 – T700H; LC60H – LC130H



6.7 Block diagram T780 – T1060H



7 How to open the unit

DANGER

Live parts inside the unit!

Risk of electrocution.

Always pull the mains plug before you open the unit.

For checks requiring the unit to be connected use a mains interrupting transfomer.

How to remove the bottom plate

Proceed as follows:

1. Place the unit onto the workplace upside down.
2. Pull off the timer turning knob.
3. Remove the recessed head screw (*Illustration 7.1.1.*)

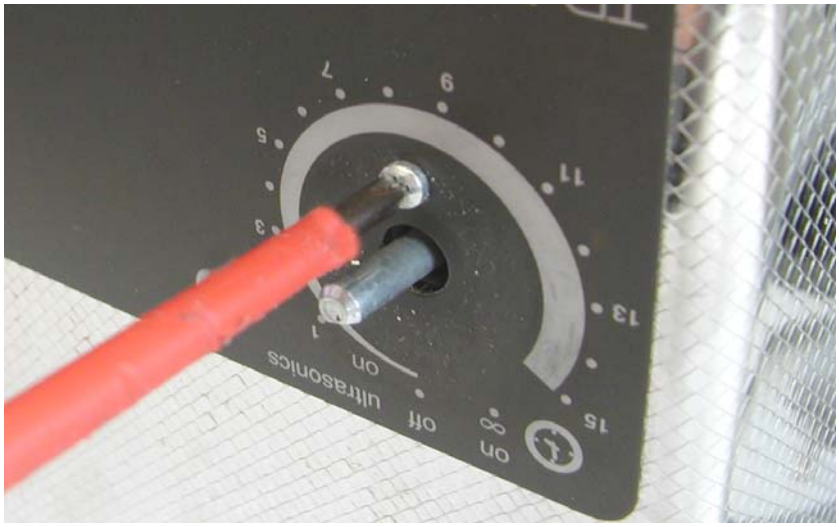


Illustration 7.1.1. Remove the recessed head screw (under the turning knob)

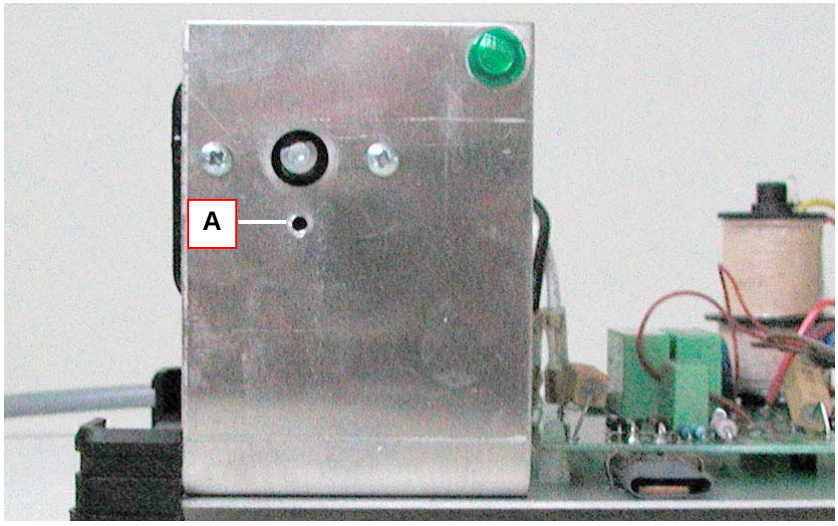


Illustration 7.1.2. Timer angle with thread (A) for recessed head screw

T310 T420 T460 T470 TS540 T570 T660 TP690 TP695	Since 1997 T310 T420 T460 T570 LC20 LC30	T700 T780 T820 T890 TP1000 T1040 T1060 LC60/LC130
Unit feet glued	Unit feet clipped in	Uni feet screwed
Remove the four – six screws at the bottom of the unit.	Loosen the bottom plate by levering it out, e.g. with a screw driver inserted between bottom plate and housing.	Remove the four – eight screws at the bottom of the unit. Some of the screws hold the unit feet.
The bottom plate complete with electronics can now easily be removed by slightly lifting the mains cable.	The bottom plate complete with electronics can now easily be removed by slightly lifting the mains cable.	The bottom plate complete with electronics can now easily be removed by slightly lifting the mains cable.

4. Carefully take out the bottom plate and place it onto the unit upside down, or separate it completely from the unit by cutting off the electric cables.

You can now check and replace most of the components without removing all connecting cables.

How to mount the bottom plate

Follow the above steps in reverse order. When closing the bottom plate ensure that all electric contacts are correctly plugged and no cables are pinched.

How to fix the support angle for the timer

Carefully screw in the recessed head screw. Overturning will easily destroy the thread in the support angle.

If this has happened, it is difficult to plug the turning knob onto the shaft of the timer. Use a screw driver to press the support angle against the housing in order to prevent the angle from receding. For this insert the screw driver between bottom plate and housing.

8 Faulty operating and switch elements

8.1 How to remove or replace the turning knobs

The turning knobs consist of the round knob shell (silver) and the integrated knob base.

The coding of the shaft between timer and thermostat varies.

Elma Order No.

Turning knob timer T310 – TP695H LC20H – LC60H
200 000 5123

Turning knob timer T700 – T1060H / LC130H
200 000 5327

Turning knob thermostat: T460H – TP695H
200 000 5060

Turning knob thermostat: T700H – T1060H / LC130H
200 000 5328

To replace a damaged turning knob or to remove the knob to allow replacement of a faulty operating element proceed as follows:

Remove the turning knob

Pull the turning knob from the unit.

Mount the turning knob

Plug the turning knob vertically onto the shaft of the operating element and carefully push onto the shaft.
Caution: Do not press the timer turning knob excessively as this might damage the thread in the support angle.

Illustration 8.1.1. Coding of shaft for timer turning knob

8.2 How to replace the timer

The timer is a 2-pole switch element. Parallel connected at the timer output there is the ultrasound pilot lamp. The design was modified in 1997. For replacement of the timer make sure that all electric cables are connected correctly (risk of short circuit). *Please see Illustrations. 8.2.1. and 8.2.2.*

Cause of breakdown

If the timer does not automatically run down when the unit operates in timer operating mode, or if the timer cannot be set into permanent operating mode, there is probably a mechanical fault in the timer component.

If the pilot lamp is lighted when the timer is switched on there is no electric fault in the timer.

Elma Order No.

(for all mains voltages) 200 000 5114.

To replace the component the bottom plate must be opened. Proceed as follows:

How to proceed

1. Open the unit as described in *section 7*.
2. Pull off the turning knob.
3. Loosen the plug contacts of the four electric cables of the timer (mark the plug connections).
4. Cut the cover foil around the fastening screws.
5. Loosen the two fastening screws on the front and remove the timer.
6. Mount the new timer following the described steps in reverse order.
7. Replug the contacts at the timer.
   CAUTION: If you replace a timer of the formerly used type (Diehl) by a new one (Coupatan), please observe the modified connection scheme; *see Illustration 7.2.1*
   RISK OF SHORT CIRCUIT!
   Mains input of timer contacts **1A** and **2A**; mains output contacts **1** and **2**.
8. Mount the turning knob as described in *section 8.1*.
9. Mount the bottom plate; close the unit. Make sure that all plug connections are correct and that no cables are pinched.

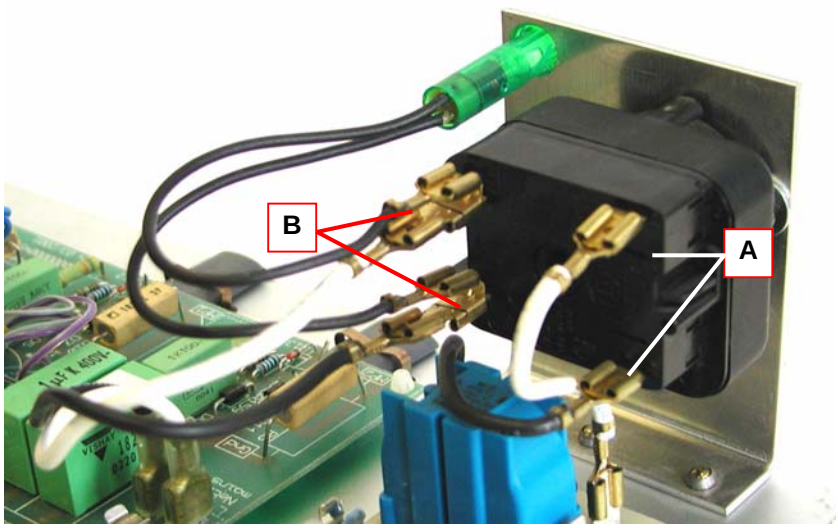


Illustration 8.2.1. Wiring of timer on models made since 1997

A Cable from interference filter (polarization irrelevant). Supply timer.

B Output timer to voltage supply of printed board. Parallel connected pilot lamp for ultrasound operation.

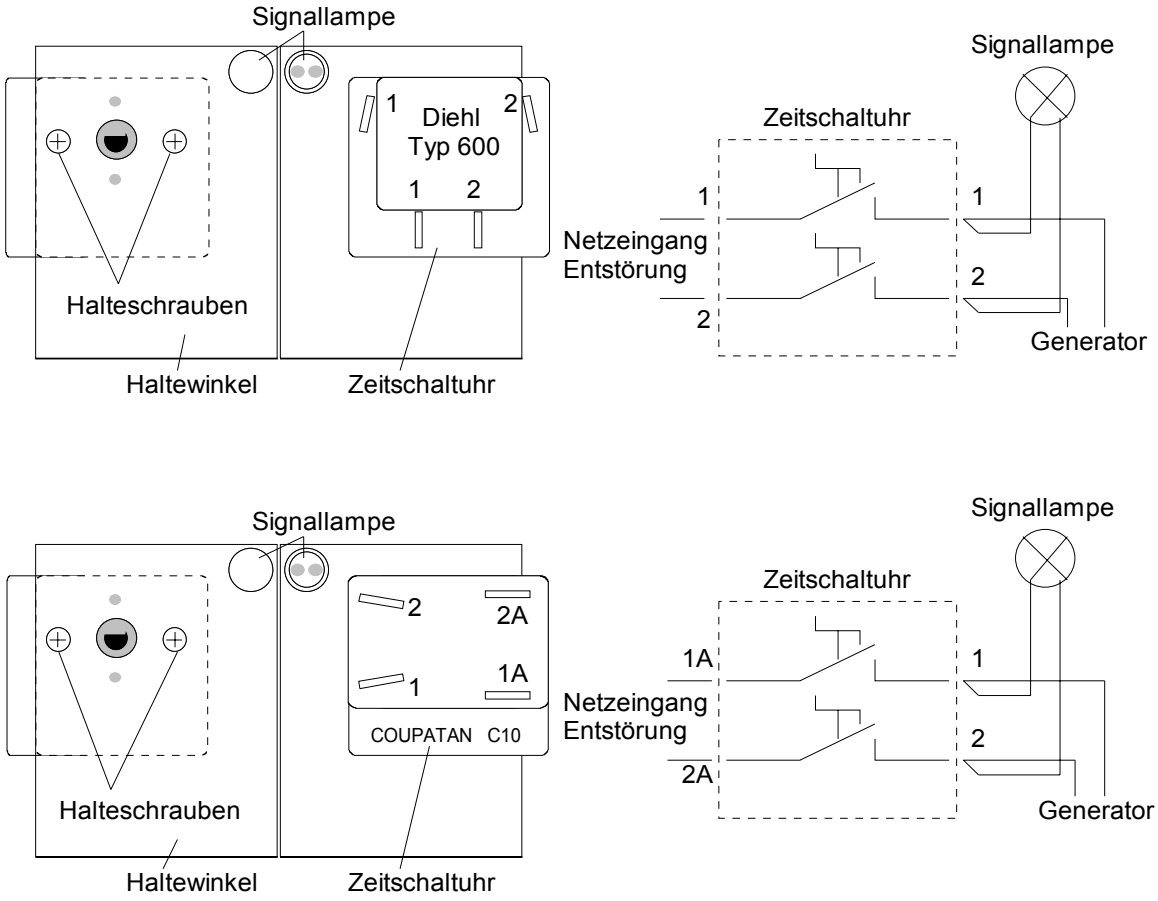


Illustration 8.2.2. top: timer type DIEHL in units made before 1997
bottom: timer type COUPATAN in units made since 1997, this timer is delivered as spare part

8.3 How to replace the heating switch

The heating switch is a single-pole switch element. The heating switch used in the models made since April 2002 is made of chemical-resistant PP. Therefore, the switch is not lighted in these models.

The former heating switch was lighted and had 3 connection contacts; the new one has only 2 connection contacts. The twin contact pin 3 on the old switch is no longer required and is bridged with the included plug connector.

Cause of breakdown The component can be damaged or destroyed by entering humidity or mechanical stress. Replace the component as soon as any damage is visible, or in case of an electric fault.

Elma Order No. (for all mains voltages) 200 000 1455

How to proceed There are two ways to replace the heating switch:

Variant A Remove the switch from inside; for this the unit must be opened. Proceed as follows:

A mistaking of the two supply cables has no consequence on the functioning of the unit.

1. Open the unit as described in *section 7*.
2. a. The switch is **unlighted**:
   Loosen the two electric connections at the heating switch contacts.
   b. The switch is **lighted**:
   Loosen the three electric connections at the heating switch contacts.
3. The heating switch is fastened to the front plate by a snap-in device:
   Push the switch off the plate by pressing the plastic clasp together.
4. Fix the new heating switch into the plate from the front.
   CAUTION: Observe the position of the marking on the switch. In the „on“ position the green marking must be visible. Press the switch into the front plate (“click” sound).
5. a. The unit had been equipped with an **unlighted** heating switch:
   Connect the two electric connections with the heating switch (*Illustration 8.3.1.*). Polarization of the cables is irrelevant.

   b. The unit had been equipped with a **lighed** heating switch:
   Connect the two electric cables which had been plugged to contact 1 and 2 with the two available plug contacts. Polarization of the cables is irrelevant.

The two cables which had been connected with a brass distributor must be connected with an insulated plug contact. (Delivered with heating switch)

6. Before closing the unit check again that no cable has come lose or is pinched.

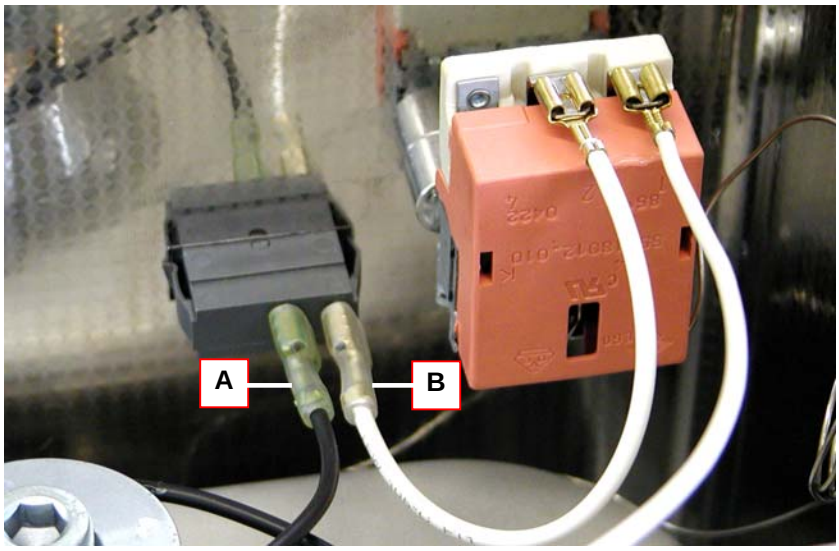


Illustration 8.3.1. Wiring of heating switch, unlighted model

A Supply cable from interference filter

B Output to control thermostat

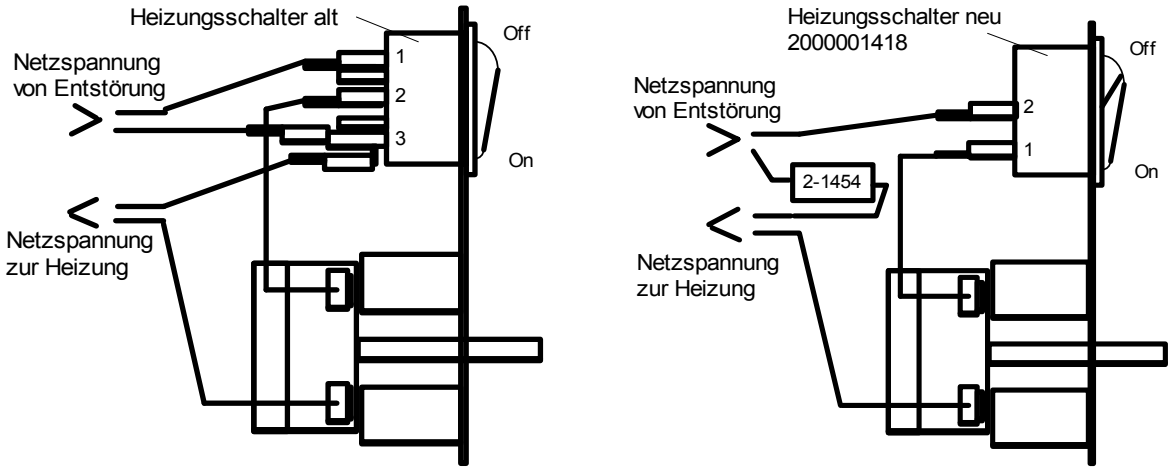


Illustration 8.3.2.
left: heating switch before March 2002 (lighted)
right: heating switch since March 2002 (unlighted)

Variant B Without opening of the unit:

Lever the heating switch out of the plate from the front; use a suitable tool, e.g. screw driver, knife. Then follow the steps 2, 4 and 5.

Lever out the heating switch

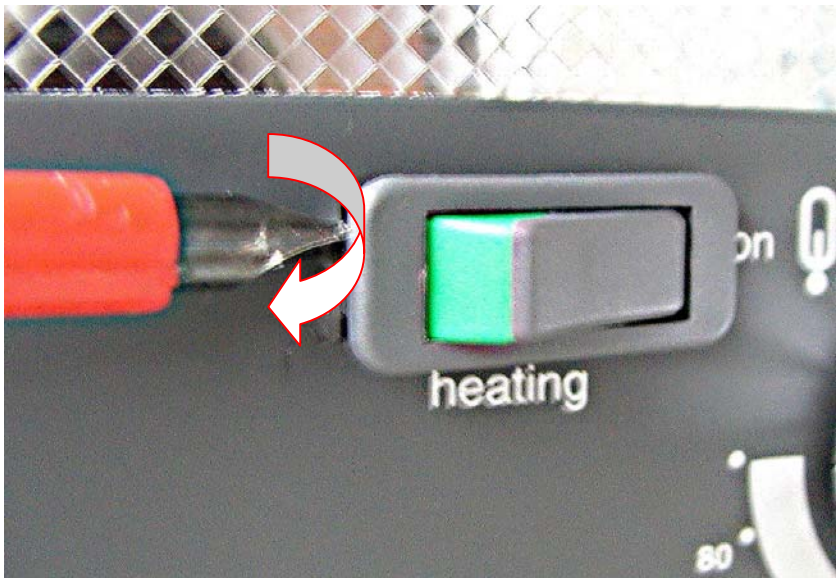


Illustration 8.3.3. Levering the heating switch out of the front plate

A Use a suitable narrow tool to lever the switch out from the side

B Carefully pull the switch out of the housing. Ensure that the cables do not come lose and remain inside the unit.

Secure the cables against sliding back

Illustration 8.3.4. Secure the cables

8.4 How to replace the control thermostat T420H-T1060H

The control thermostat is a single-pole switch element. The correct functioning of the control thermostat can easily be checked: turn the knob. Around the ambience temperature of the capillary probe (bath / tank temperature) there must be a clicking sound in the component (break-over point).

The thermostat operates perfectly only if the cleaning liquid is evenly heated. Without a thorough mixing of the liquid, e.g. by operating the ultrasound, there will be zones of different temperatures in the bath. The difference of temperature between the surface and the bottom of the tank can be up to 40°C.

The user may get the impression that the thermostat is faulty, as the temperature of the liquid on the surface exceeds the set temperature by far.

Due to an insufficient mixing of the liquid and the heat accumulation around the heating element, heat bubbles will be produced inside the tank. The noise caused by this process increases the impression that the liquid is already boiling.

Cause of breakdown

A breakdown of the control thermostat is very rare. In case of a breakdown of the PTC heating, the short circuit current can damage the component. The same happens in case of a mechanical damage to the probe cable. In this case the break-over point of the component does not work anymore and there will be no clicking sound when you turn the knob.

Elma Order No.

(for all mains voltages) 200 000 5127

To replace the component open the bottom plate and carefully pull off the foil around the thermostat. Proceed as follows:

How to proceed

1. Open the unit as described in *section 7*.
2. Pull off the turning knob as described in *section 8.1*.
3. Loosen the plug contacts of the electric cables at the control thermostat (*Illustration 8.7.1.*).
4. Carefully cut the silicone around the capillary probe with a knife (*Illustration 8.7.2.*).
5. Carefully pull off the foil around the fastening screws (*Illustration 8.7.3.*).
6. Loosen the two fastening screws (*Illustration 8.7.3.A*) at the front plate and remove the control thermostat.
7. Pull out the temperature probe which is fixed to the metal clamp on the tank outside. If required, cut the silicon (*Illustration 8.7.2*.).

8. Insert the new themostat into the housing with the connection contacts pointing to the bottom plate and position the distance bushings. Then fix the fastening screws (A).
   Press the front plate back onto the housing.
9. Press the capillary probe back into the clamp and secure with silicone.
10. Reconnect the electric cable at the thermostat (*Illustration 8.7.1.*), polarization is irrelevant. Before closing the housing check again that no cable has come loose or is pinched.

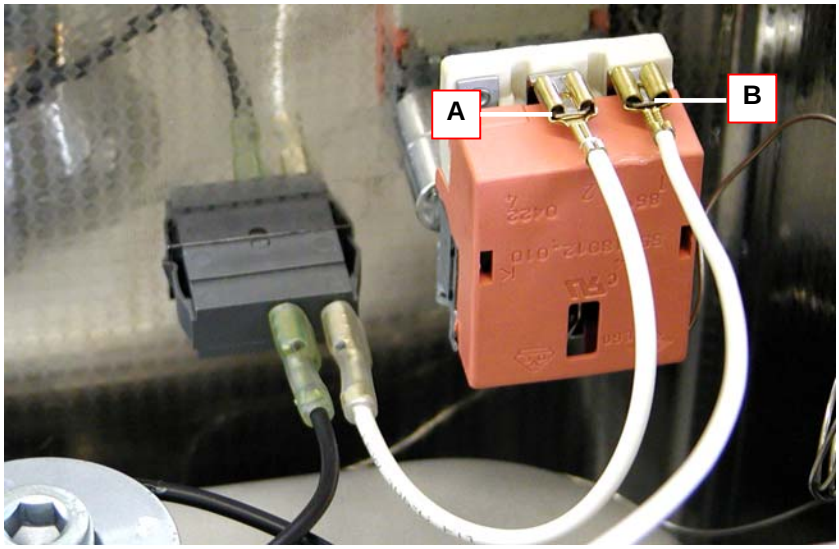


Illustration 8.7.1. Electric connections at control thermostat

A Supply cable from heating switch

B Cable to heating

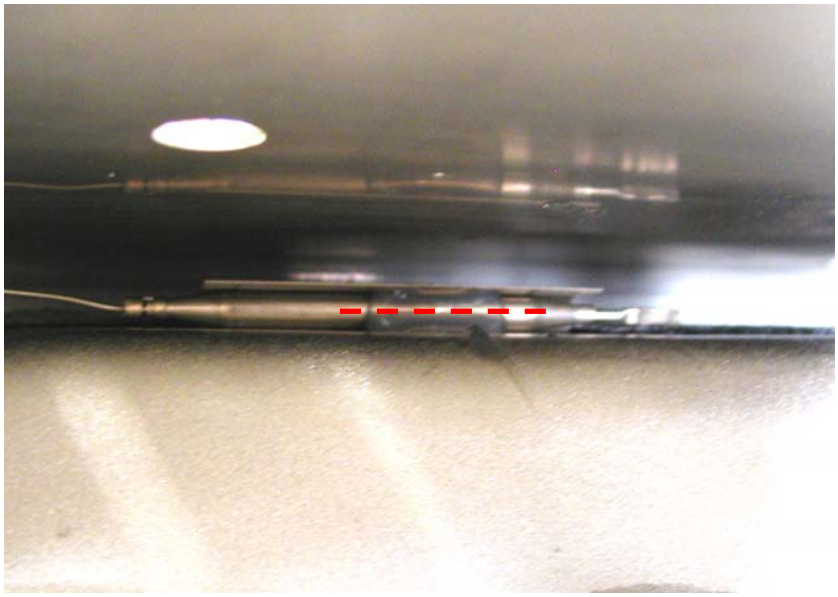


Illustration 8.7.2. Clamped-in capillary probe secured with silicone
red dotted line: cut silicone here to remove the probe

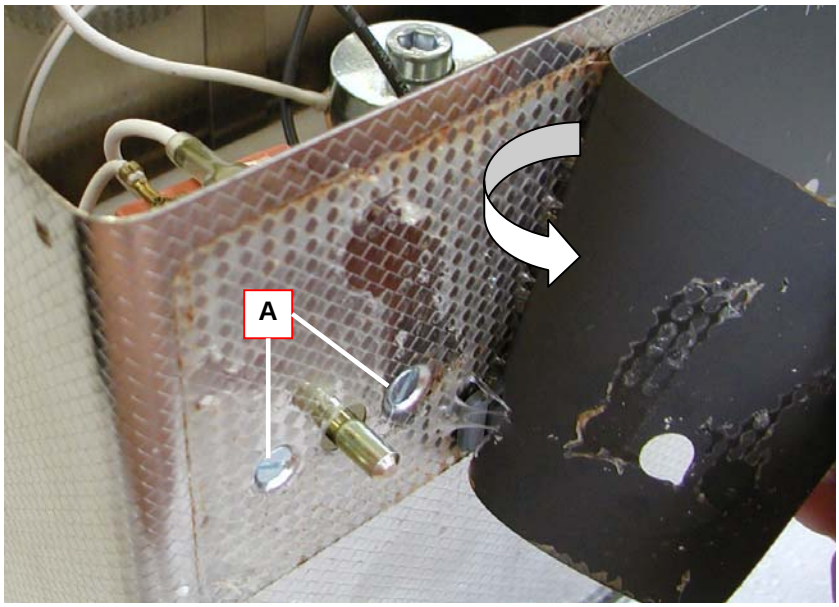


Illustration 8.7.3. Pull off the foil around the control thermostat

A Fastening screws for control thermostat

8.5 How to replace the overheating protection on T310/H

This unit type is equipped with a preset thermostat as overheating protection. The component is fixed to the side of the tank. The preset switch-off temperature is approx. 60°C.

If the temperature rises above 70°C during operation without cover (contact permanently closed), or if the unit does not heat at all (contact permanently opened), the thermostat is probably faulty.

Cause of breakdown

A short circuit in the heating element can damage the thermostat. The breakdown can also be caused by material fatigue due to the ultrasonic activity.

Measure the component

At room temperature, the switch contacts are closed, i.e. an ohm throughput can be measured.

Elma Order No.

200 000 0452

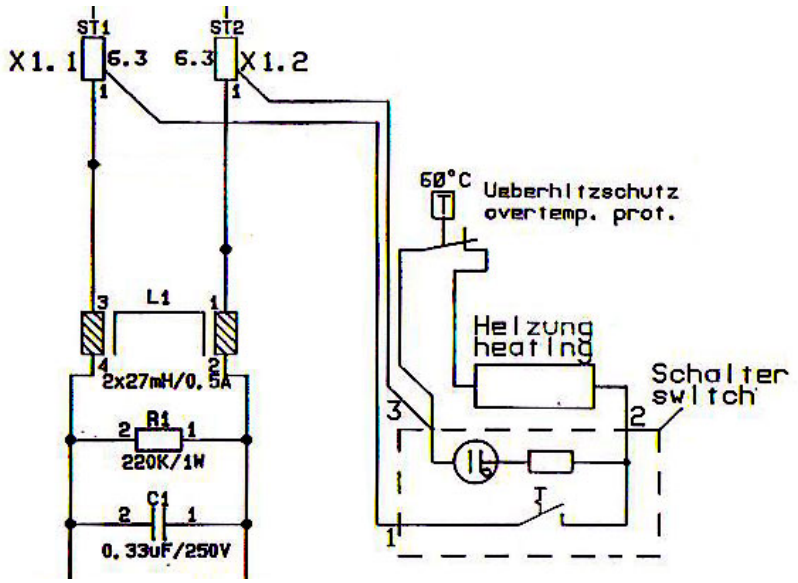
How to proceed

To replace the component proceed as follows:

1. Open the unit as described in *section 7*.
2. Cut the silicone fixation of the component with a knife.
3. Loosen the electric contacts.
4. Place the new component on the tank wall and fix it with silicone. If necessary secure it against sliding out of its position until the silicone has hardened.
5. Connect the electric contacts. Polarization is irrelevant.
6. After the silicone has hardened check if all connections are correct and close the unit.

Illustration 8.5.1 Position and silicone fixation of overheating

protection
red dotted line: cut silicone here to remove the overheating protection



interference filter **heating**

Illustration 8.5.2. Wiring of heating switch, here lighted model. For the unlighted heating switch connection 3 is irrelevant.

8.6 How to remove the overheating protection on LC 20H – LC 130H

These units are equipped with a preset thermostat as overheating protection. The thermostat is fixed on the front side or on the bottom of the tank. The preset switch-off temperature is approx. 60°C.

If the temperature rises above 70°C during operation without cover (contact permanently closed), or if the unit does not heat at all (contact permanently opened), the thermostat is probably faulty.

Cause of breakdown

A short circuit in the heating element can damage the thermostat. The breakdown can also be caused by material fatigue due to the ultrasonic activity

Measure the component

At room temperature, the switch contacts are closed, i.e. an ohm throughput can be measured. In order to check of the contacts are permanently closed and do not open above the switch-off temperature, the unit must be connected to a wattmeter.

Elma Order No.

200 000 1412

How to proceed

To replace the component proceed as follows:

1. Open the unit as described in *section 7*.
2. Remove the tank as described in *section 11*.
3. Use a hot air fan to remove the glue fixation of the component and separate it from the transducer tank. Remove the glue remains e.g. with emery paper and clean the area with alcohol etc.
4. Rub the glueing spot of the overheating protection with emery paper and clean it with alcohol etc.
5. Put a thin silicone layer on the glueing spot.
6. Place the component and press it on the correct spot, fix with silicone if necessary.
7. Connect the electric cables and insulate the connections. Polarization is irrelevant.
8. Reinsert the tank as described in *section 11*.
9. Connect all remaining electric cables.
10. Close the unit.

Overheating protection since Feb. 2002

Illustration 8.6.1. Overheating protection (since Feb 2002) mounted and connected

Position of probe in models since Feb. 2002

Illustration 8.6.2. Capillary probe clamped-in and secured with silicone (since Feb 2002)
red dotted line: cut silicone here to remove the probe

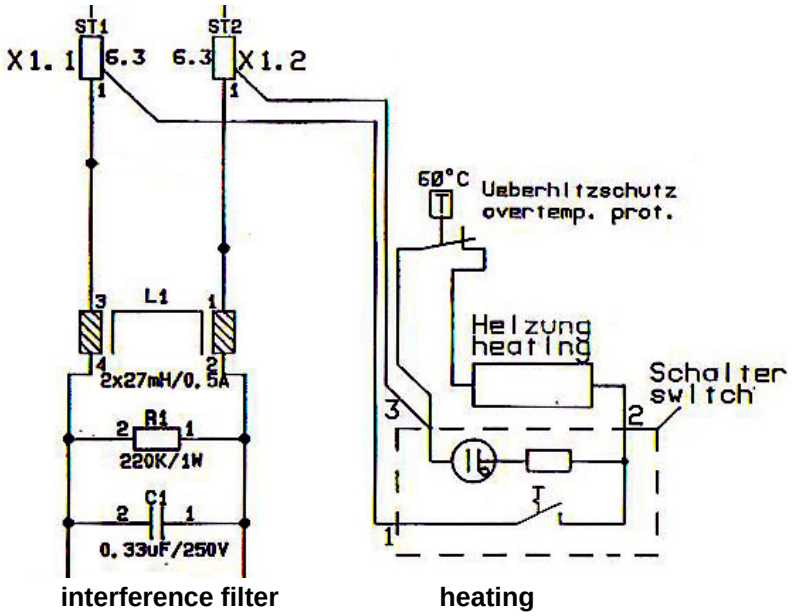


Illustration 8.6.3. Wiring of heating switch, here lighted model. For the unlighted heating switch connection 3 is irrelevant.

8.7 How to replace the front plate

The front plate is a self-adhesive foil. There is no additional glue required.

If damaged or to allow replacement of certain components it is necessary to remove the front plate foil partly or completely.

How to proceed

To remove and exchange the front plate please proceed as follows:

1. Pull off the turning knobs (A) and loosen the recessed head screw (B) which holds the timer angle. Remove the felt rings (*see Illustration 8.7.1.*).
2. Units with heating: lever off the heating switch with a suitable tool (*see Illustration 8.7.2.*).
3. Units with heating: loosen the electric cables at the heating switch. Secure the cables against sliding back into the housing (*see Illustration 8.7.3.*).
4. Carefully pull off the foil (*see Illustration 8.7.2.*).
5. Put on the new self-adhesive foil.
6. Mount the heating switch, polarization of cables at heating switch with 2 contacts irrelevant. Observe the correct position of the green marking on the rocker switch (*see also section 8.3.*).
7. Mount all remaining switch elements (*see also section 8.1.*). Carefully screw in the screw, do not damage the thread in the timer angle.

Pull off the turning knobs and loosen the screw

Illustration 8.7.1. Unit with turning knobs pulled off

Lever out the heating switch

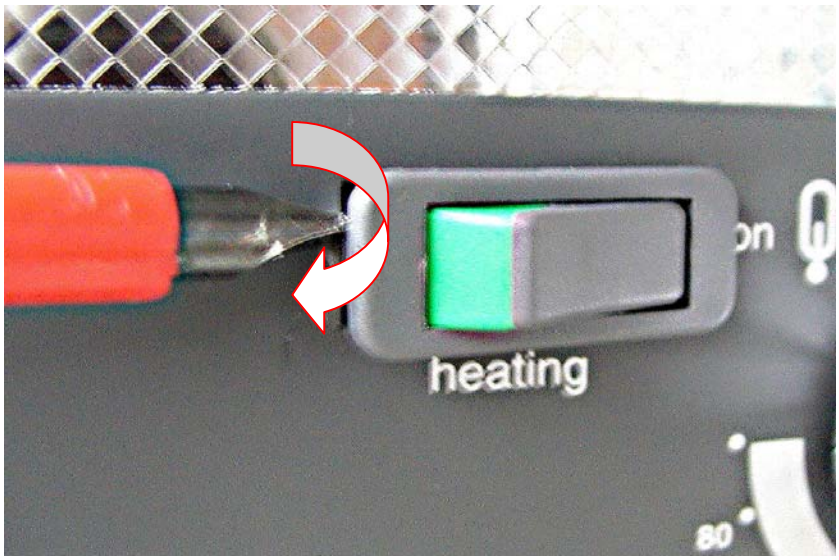


Illustration 8.7.2. Levering the heating switch out of the housing

Pull off the foil

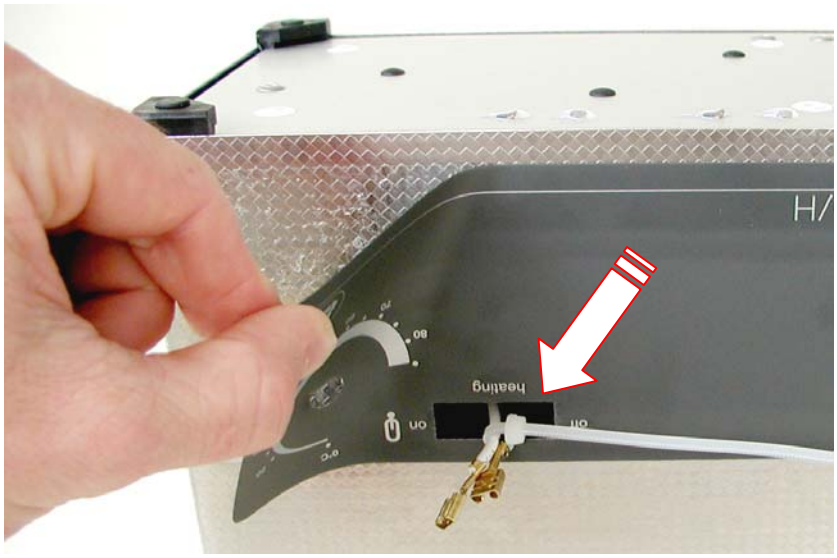


Illustration 8.7.3. Secure the electric cables, carefully remove the foil.

9 How to replace the heating

The PTC heating element is safe to run dry. If the level of the liquid falls below the position of the heating element, it automatically reduces the current consumption and thereby reduces the heating energy.

After switch-on the current consumption of cold heating elements is very high for a short period; on units with more than one heating element the elements must be activated one after the other (for 230 V). Otherwise the accumulating currents could cause the release of the fuse in the building.

Cause of breakdown

The performance of the heating element does not change during its service life.
The only possible cause of a breakdown of this type of heating is a short circuit in the component (humidity, faulty insulation, etc.). In most cases the fault current breaker or the fuse automatic of the relevant socket is released. The fuses on the interference filter (if available) are faulty.

Wrong operation

As mentioned above, the PTC heating element automatically limits the current consumption if the temperature is high. In order to achieve an efficient heating up, it is necessary to mix the cleaning liquid thoroughly during the heating period. This can be done by stirring the liquid from time to time or by operating the ultrasound. This will allow the high temperature around the heating element to be carried into the bath.

Also, the formation of lime deposits in this part of the tank is reduced. Any lime deposits that might already be there and which usually have the colour of the contamination that has been cleaned away can be removed with acetic cleaners or industrial decalcifyers (*see Illustration 9.1*.). Caution: Do not use any sharp tools to scratch off the deposits.

Lime deposits around the heating element

Illustration 9.1. Lime deposits due to insufficient stirring

Without thorough stirring of the liquid the temperature inside the bath cannot be measured reliably. *See also section 8.4. Control thermostat.*

Elma Order No. **230 V** 200 000 7157 / **115 V** 200 000 7216

In most units, the heating element can be replaced without removal of the tank. Exceptions are the units T310H, T420H, T780H, T820H: In these units the transducer tank must be removed as described in *section 11.*

For all other units please proceed as follows:

How to proceed

1. Open the unit as described in *section 7*.
2. Find the faulty heating element (A) (in units with more than one heating element), e.g. by connecting each heating element separately.
3. Loosen the cables from the faulty heating element.
4. Cut the silicone fixation (which secures the heating element against displacement) in the area between the heating profiles *see Illustration 9.3.C*. and the heating rail *see Illustration 9.3.B*.
5. Push the aluminum profile of the heating element horizontally out of the guiding rails, e.g. with a large fork wrench, a wood block, etc. and a plastic hammer.
6. Use a file to round off the two edges of the aluminum profile of the new heating element where it will enter the guiding rails (B).
7. Put the heating element to the guiding rails and carefully position it.
8. Secure the heating against displacement with silicone.

Position of heating elements on T700H, T820H, T890H, LC130H

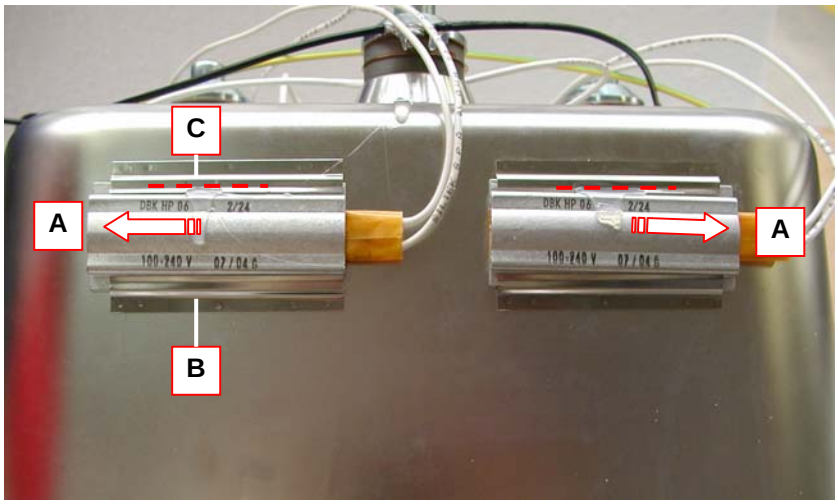


Illustration 9.2.Removed tank with horizontally mounted heating elements

Red dotted lines: Cut silicone fixation here to remove the heating elements
Push the heating element(s) out of the guiding rails in the marked direction

A Push the heating element out of the guiding rails toward (A).

The new heating element can be pushed into position more easily if the edges of the aluminum profile are rounded off with a file.

B Put the new heating element into the guiding rails. Carefully push it into the guiding rails without jamming.
Then secure against displacement with silicone.

Position of heating elements on T1040H, T1060H

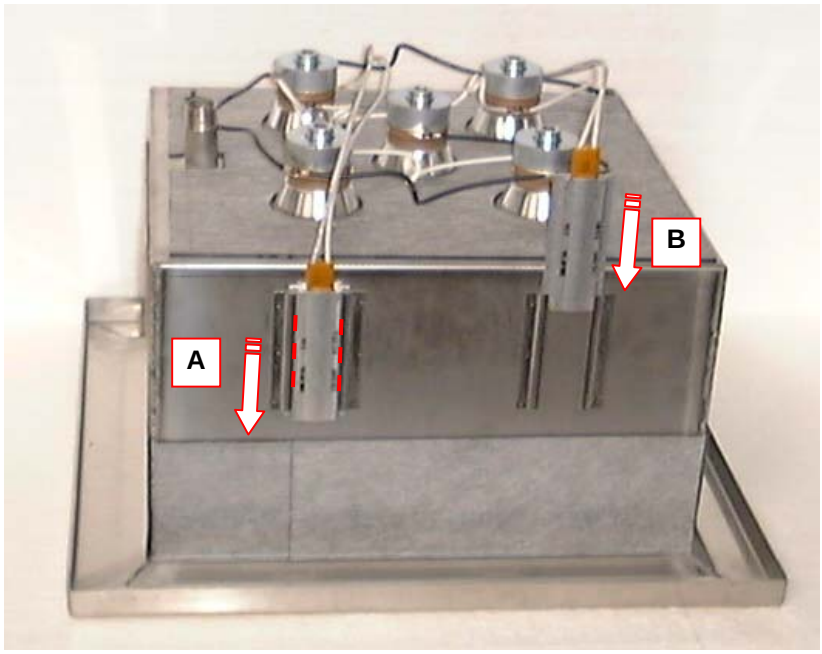


Illustration 9.3. Removed tank with vertically mounted heating elements
Red dotted lines: Cut silicone fixation here to remove the heating elements
Push the heating element(s) out of the guiding rails in the marked direction.

A Push the heating element downward out of the guiding rails.

B Put the new heating element into the guiding rails from above. Carefully push it down into the guiding rails without jamming.

Insert the heating vertically

Illustation 9.4. Mounted tank with vertically fixed heating elements. Push the new heating element(s) into the guiding rails into the marked direction.

Insert the heating horizontally

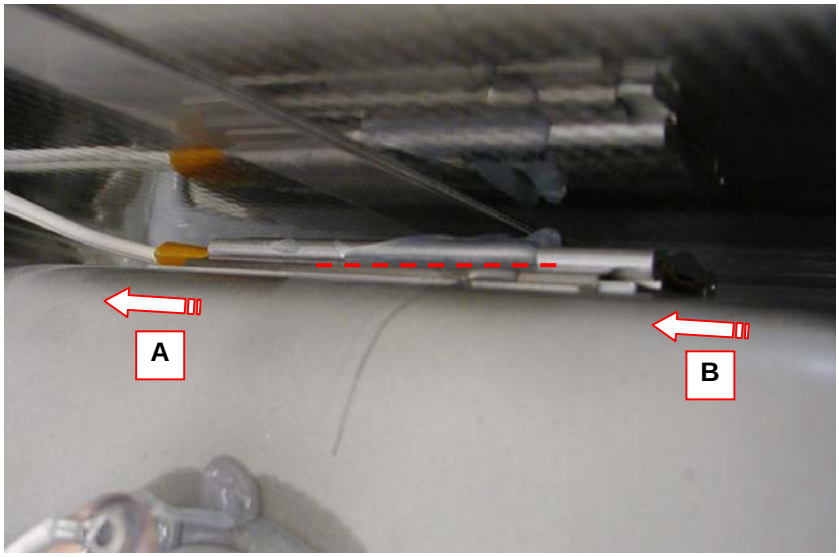


Illustration 9.5. Mounted tank with horizontally fixed heating element. Red dotted line: Cut silicone fixation here to remove the heating element.

A Push the heating element toward its connected side (A) out of the guiding rails.

The new heating element can be pushed in more easily if the edges of the aluminum profile are rounded off with a file.

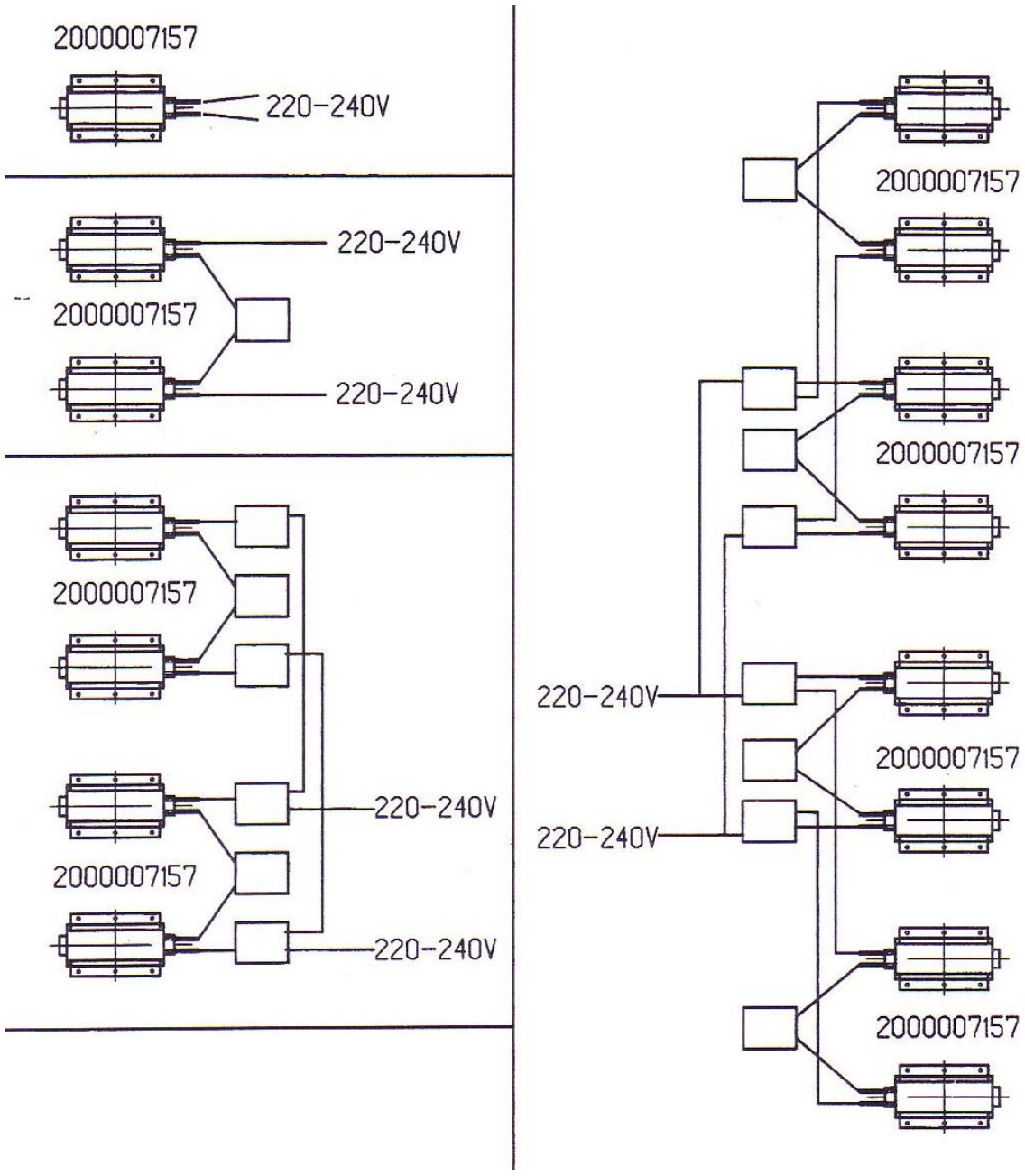
B Put the new heating element into the guiding rails in the marked direction (B). Carefully push it into the guiding rails without jamming. Then secure against displacement with silicone.

9.1.1 Wiring 230V

2 Heating elements Both heating elements are wired in a line.

3 Heating elements 2 heating elements are wired in a line. The third element is connected parallel to the two other elements.

4 and more heating elements 2 elements each are wired in a line and connected parallel with the other element pairs.

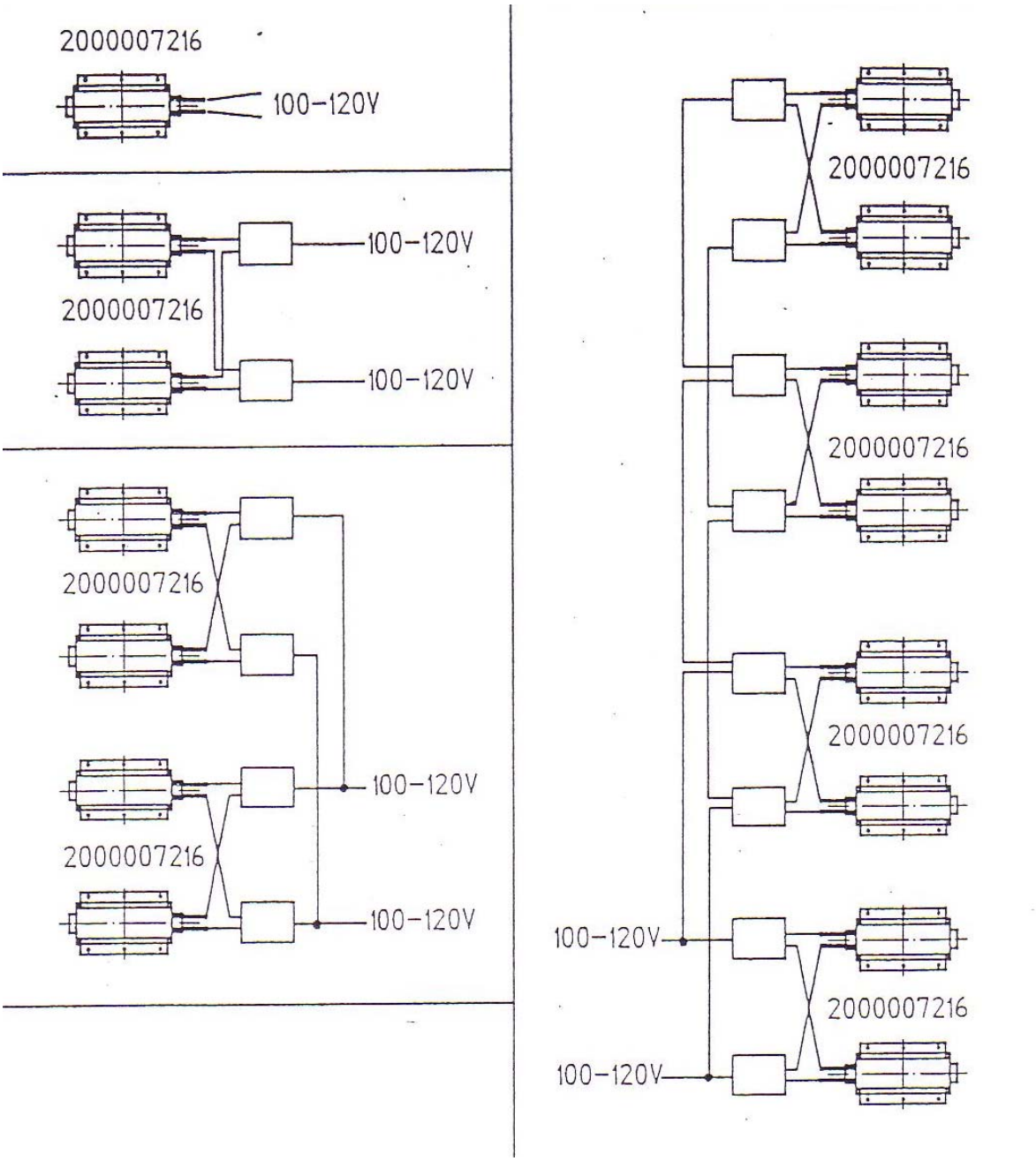


9.1.2 Wiring 230V

2 Heating elements Both heating elements are wired in a line.

3 Heating elements 2 heating elements are wired in a line. The third element is connected parallel to the two other elements.

4 and more heating elements 2 elements each are wired in a line and connected parallel with the other element pairs.



10 Faulty PXE transducer disks

The PXE transducer disks must be replaced if one ore more of the disks are torn or damaged by scorchings.

The transducer system should be opened only when all other possible causes of a malfunction have been checked and if both the knowhow and the required tools are available.

The PXE transducer disks are selected capacitively in each unit and are mounted in full sets only. This means that all PXE transducer disks in one transducer system must show the exact electric behaviour in order to guarantee a homogeneous ultrasonic performance of the transducer systems. The consequence of an asymmetric charge of the transducer systems would be a higher risk of breakdown and an increased cavitational erosion on one side of the tank. (This does not apply to units with a single transducer system).

Therefore, all transducer disks should be replaced even if only individual PXE transducer disks are faulty. Elma deliver preselected sets of transducer disks.

Cause of breakdown

PXE transducer disks can be damaged for different reasons (mostly tears): e.g. by heavy cleaning items put directly onto the tank floor, excessive bath temperatures with intensive ultrasonic operation (> 85°C).

High relative humidity of air or liquid inside can cause scorchings on and inside the transducer system.

Illustration 10.1. Torn and broken PXE transducer disk

Trouble shooting

In some cases torn disks or scorchings can be visible without opening the unit. However, to make sure it is necessary to open and examine the PXE transducer disk and the insulating duct.

Another possibilty to check the transducer system is to test-operate the generator at the transducer system, *see section 15.1.*

In case of a short circuit the measured graph (oscilloscope) can look like the current graph in *Illustration 15.2.4* in *section 15*.

Torn PXE transducer disks can remain undetected as output, transducer behaviour and current diagram are normal.

Another hint concerning a fault of the transducer system can be an overheated (dark) secondary coil of the output transformer. This can also be caused by improper loading of the tank (cleaning items directly on the tank floor) or a running dry of the tank.

Tool

To carry out this repair work a torque wrench is indispensable!

Elma Order No.

PXE transducer disk: 200 000 5046

Aluminum washer: 200 000 5050

Elektric load

Caution! Risk of electrocution due to high amount of electricity on PXE disks!
The PXE transducer disk is charged with a high amount of electricity when opened or tightened. This can be branched off by short circuiting between two terminal lugs, e.g. with a screw driver. For the same reason, also short circuit the plug contacts of the electric cables of the transducer system.

The electric charge is also built up by a temperature change, i.e. cooling of a PXE disk.

Do not touch charged PXE disks!

How to open the transducer system

Replace PXE transducer disks as follows:

1. Place the unit upside down on a solid surface and secure it against displacement (e.g. with screw clamps and wood ledges).
2. Open the unit as described in *section 7*.
3. Open the transducer system screw(s) with the torque wrench.
   Caution! Do not tear the transducer system by jamming the torque wrench.
   The torque wrench must be held vertically to the transducer system during the complete process of unscrewing. The power given to the handle of the tool must be exactly countered by the hand that centers the tool (*see Illustration 10.1.*).

4. Check each transducer disk for hair cracks and scorchings, check the insulating sleeves for scorchings. Always change the aluminum washers when you open the system.

How to assemble the transducer system

For assembly of the transducer system ensure that all contact surfaces are clean.
The transducer disk must be poled correctly. Observe the markings on the PXE transducer disks, *see Illustration 10.1.5.*

1. Put a drop of Loctite or similar onto the thread of the coupling piece (to lock the screw).
2. Assemble the individual parts of the transducer system exactly as shown in the illustration.
3. Important! The black markings must point to the PLUS terminal lug.
4. Screw in the transducer system screw and fix it with the torque wrench.

   Systems with 1 PXE disk at **46 Nm**.

   Systems with 1 PXE disk at **58 Nm**.

   Caution: The transducer disk is charged with electricity when the transducer system screw is tightened. Branch off the electric charge by short circuiting between two terminal lugs, e.g. with a screw driver.

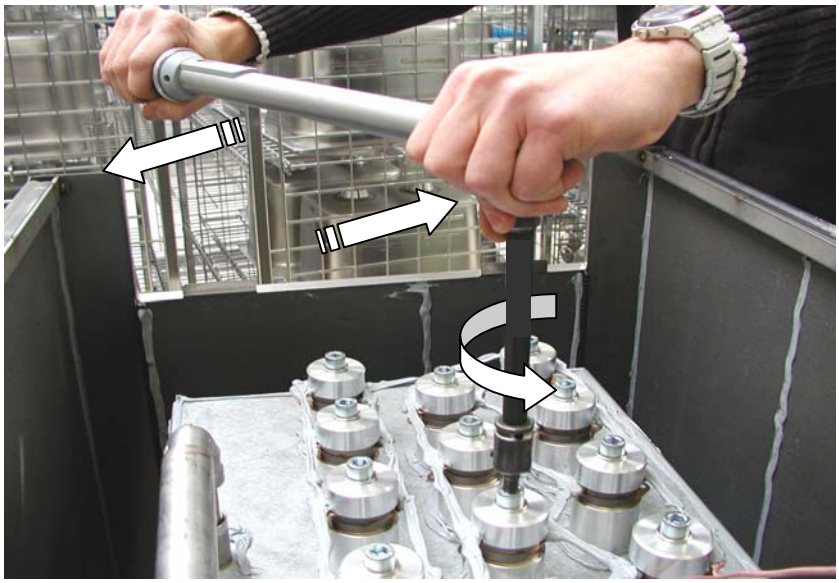


Illustration 10.1.1. Always hold the torque wrench vertically. Do not tilt the tool!

Structure of transducer system with 1 PXE disk (E 35)

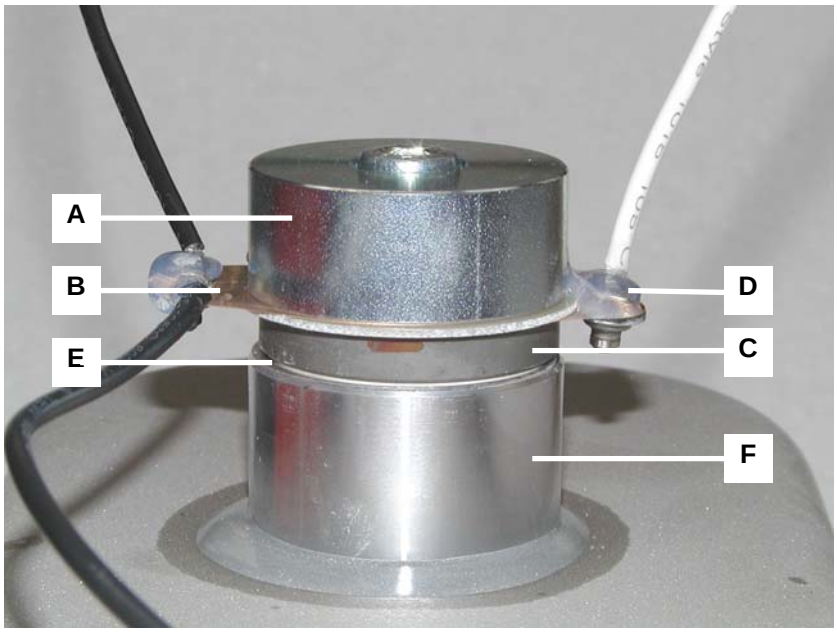


Illustration 10.1.2. Transducer system with 1 PXE transducer disk

Structure of transducer system with 2 PXE disks (W 35)

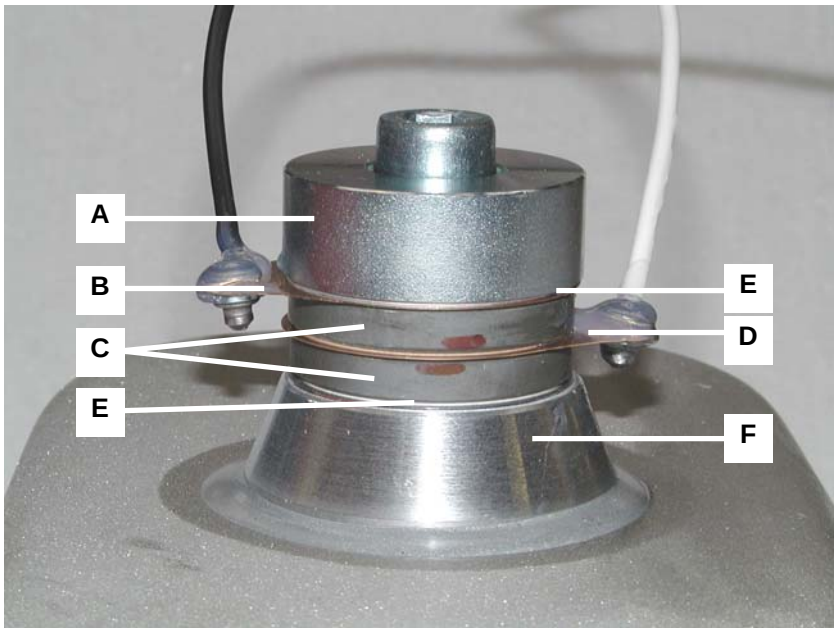


Illustration 10.1.3. Transducer system with 2 PXE transducer disks 35 kHz

Structure of transducer system with 2 PXE disks (W 40)

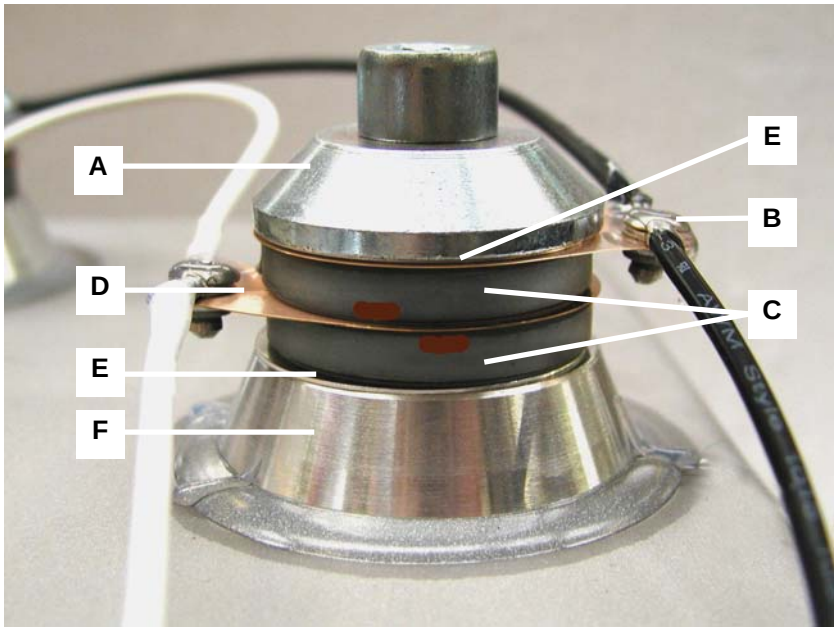


Illustration 10.1.4. Transducer system with 2 PXE transducer disks 40 kHz

A Pressure piece (shape depending on frequency of the system)

B Terminal lug MINUS connection

C PXE transducer disk

D Terminal lug PLUS connection

E Aluminum washer

F Aluminum coupling piece

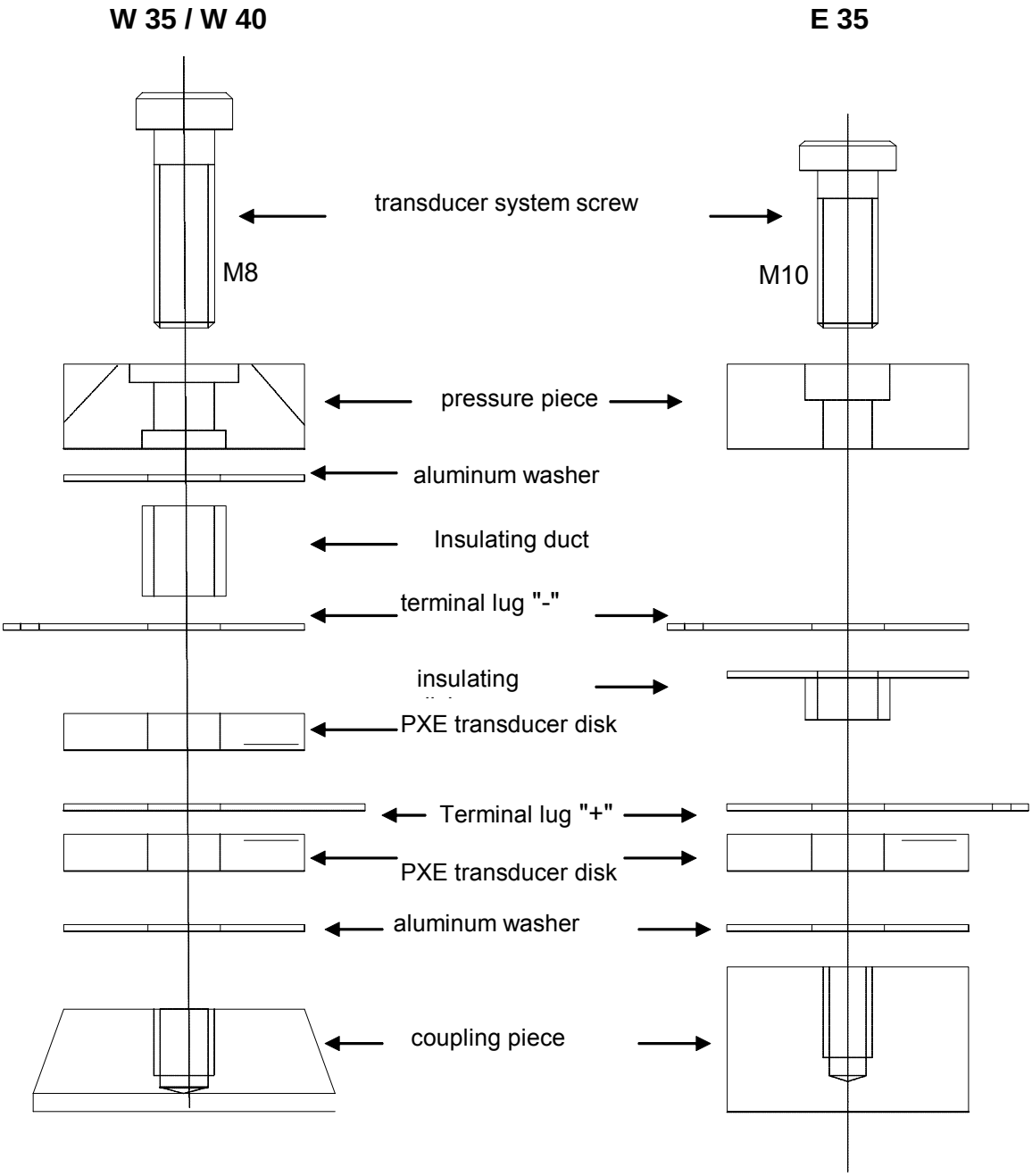


Illustration 10.1.5.
left: structure of 2-disk transducer system
right: structure of 1-disk transducer system

11 How to replace the transducer tank

If the tank floor is heavily damaged by cavitational erosion or due to leaks the tank must be replaced.

The transducer tank is a wear part due to the cavitational erosion around the sound-giving surfaces. This process is increased by improper use (aggressive cleaning media, cleaning items put directly on the tank floor, deposits and remains on the tank floor, etc.).

Cavitational erosion

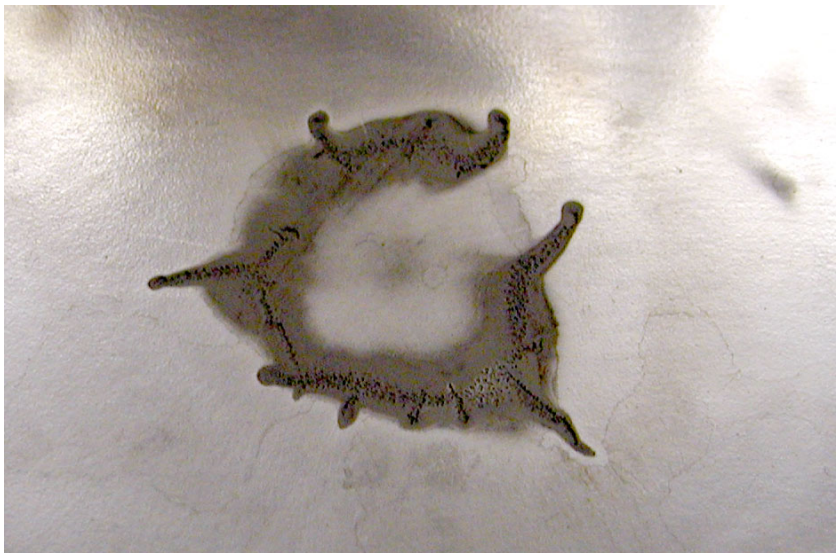


Illustration 11.1. Heavy cavitational erosion at the spot where the transducer system is fixed

Illustration 11.2. Leaking tank floor with traces of liquid

There are two ways to replace the transducer tank:

Tank complete with transducer system

Replacement by a complete transducer tank with mounted transducer system (and heating, if required). We recommend to use a complete tank if the transducer system is damaged and if you do not have the necessary knowhow for a replacement of the PXE transducer disks.

Tank without transducer system

Replacement by a preassembled tank with coupling piece(s) for the mounting of the transducer system and the support for the heating element(s), but without transducer system. We recommend to use the preassembled tank if the transducer system on the old tank is without fault and can be mounted on the new tank. For this you need a torque wrench. We recommend to carry out this repair only if you have the required knowhow for replacing the PXE disks.

For instructions on the replacement of the transducer system and / or the PXE transducer disks please *see also section 10*.

Elma Order No.

See spare parts list in Annex B; selection according to type of unit and voltage.

How to proceed

To replace the transducer tank proceed as follows:

1. Place the unit upside down on a solid workplace.
2. Open the unit as described in *section 7*.
3. Interrupt the electric supply to the transducer tank::
   Mark all electric supply cables to the tank and loosen them. The marking of the cables is important for the correct reassembly in order to avoid damage due to wrong connections.
4. On units with drain duct: Loosen the screw connections of the drain duct. Note: The screw connections are secured with Loctite 586. The screw connections can be loosened more easily after heating the duct in the threaded area with a hot air fan. Ensure that no other component in the unit is damaged (s*ee also section 12.*).
5. Remove the transducer tank from the housing:
   Carefully heat the tank edge around the silicone sealing with a hot air fan to make the silicone flexible (*see Illustration 11.1.1*).
6. Cut the silicone sealing between the tank edge and the housing with a narrow and flexible knife (*see Illustration 11.1.1*).
7. Carefully lever the tank out of the housing (*see Illustration 11.1.2*).
8. Remove the silicone remains on the tank and the edge of the housing with a knife.

9. Degrease and clean the glueing surfaces of the housing edge and the edge of the (new) transducer tank with alcohol.
10. Fill new silicone sealing (e.g. Teroson) along the tank edge.
11. Position the unit housing in the sealing mass. Ensure correct front and backside positioning.
12. Let the sealing mass harden (approx. 12 h / or according to the instructions of the manufacturer).
13. On units with drain duct:
    Mount the drain duct: Wipe all duct threads with a wire brush to remove any sealing remains and clean with alcohol. Seal the thread e.g. with Loctite 586 or Teflon tape (*see also section 12*).
14. Reconnect all electric cables.

Heat up silicone sealing and cut

Illustration 11.1.1. Heat up the silicone sealing in the tank edge and cut with a knife.

Lever the housing from the tank

Illustration 11.1.2. Carefully lever the housing from the tank at different spots

12 How to replace the ball valve

The ball valve is screwed onto the drain duct and sealed with Loctite. On the units of type T700 and LC130H and bigger there is a lock nut inside the unit. Unscrewing the ball valve without prior heating of the Loctite and/or loosening of the lock nut can damage the sealing of the internal drain duct.
Therefore, observe the following instructions on the replacement of the ball valve.

Cause of breakdown

Deposits of dirt particles in the drain system can damage the Teflon sealing in the ball valve. Damage can also be caused by aggressive cleaning media.

Elma Order No.

2-way ball valve 1/2": 200 000 6039

2-way ball valve 3/4" : 200 000 0484

2-way ball valve 3/8“: 200 000 0608

How to proceed

To replace the ball valve proceed as follows:

1. Open the unit as described in *section 7.*
2. Loosen the lock nut (if available); *see Illustration 12.1.4*.
3. Heat the drain around the screw connection with a hot air fan to resolve the Loctite sealing (*Illustration 12.1.1 / 12.1.5*).
4. Use a suitable fork wrench to unscrew the drain duct. Secure the drain duct with a pipe wrench to avoid an unintentional removal of the sealing in the duct angle (*Illustration 12.1.3 / 12.1.6*).
5. Remove any remains of Loctite from the thread of the drain duct and clean the thread e.g. with alcohol.
6. Clean the inner thread of the new ball valve e.g. with alcohol.
7. Prepare the thread of the drain duct with Teflon tape or Loctite. Observe hardening period of sealing media (before filling the transducer tank with water).
8. Mount the ball valve and tighten the lock nut if available.

Note: Several unit types have a lock nut which secures the drain duct inside the unit; this can cause the handle of the ball valve to be positioned other than horizontally when the end of the thread is reached. If this is a problem, loosen the lock nut again and adjust the ball valve accordingly.

Mounting of the 3/8“ drain duct

Illustration 12.1.1. 3/8“ drain duct: Heat the Loctite thread sealing with a hot air fan

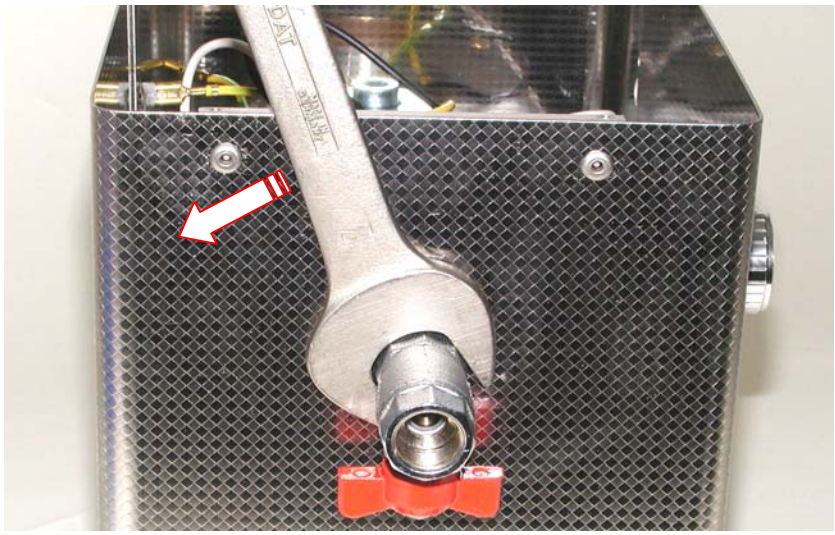


Illustration 12.1.2. 3/8“ drain duct: Open the ball valve with a 19 mm fork wrench anti-clockwise

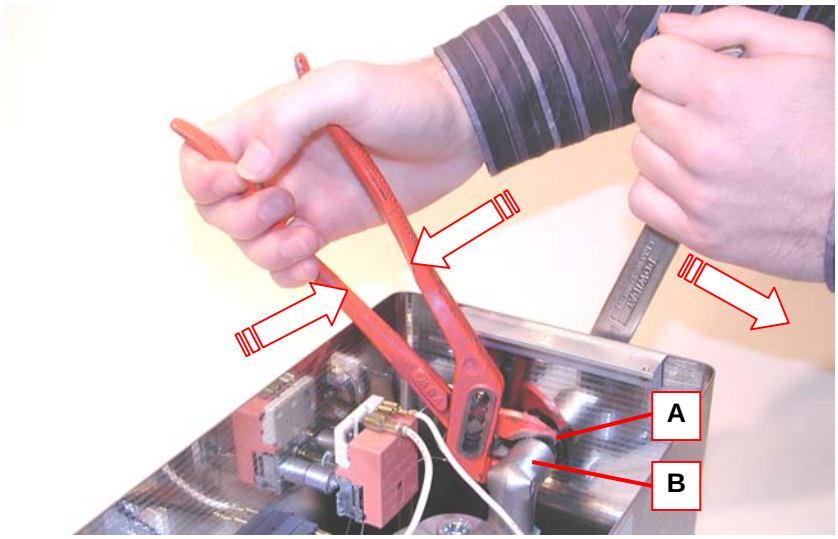


Illustration 12.1.3. 3/8“ drain duct: Secure the duct nipple (A) with a pipe wrench to avoid an opening of the sealing in the duct angle (B).

Mounting of the 1/2“ drain duct

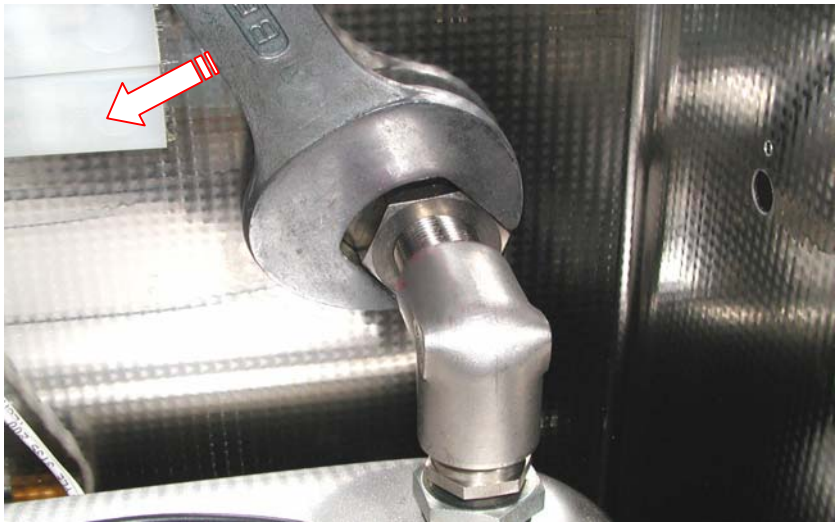


Illustration 12.1.4. Loosen the lock nut with a 32 mm fork wrench anti-clockwise

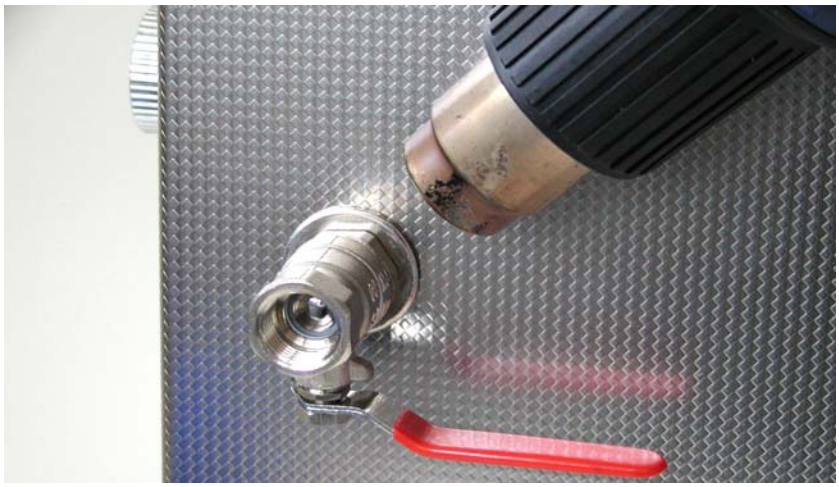


Illustration 12.1.5. Heat the Loctite thread sealing with a hot air fan

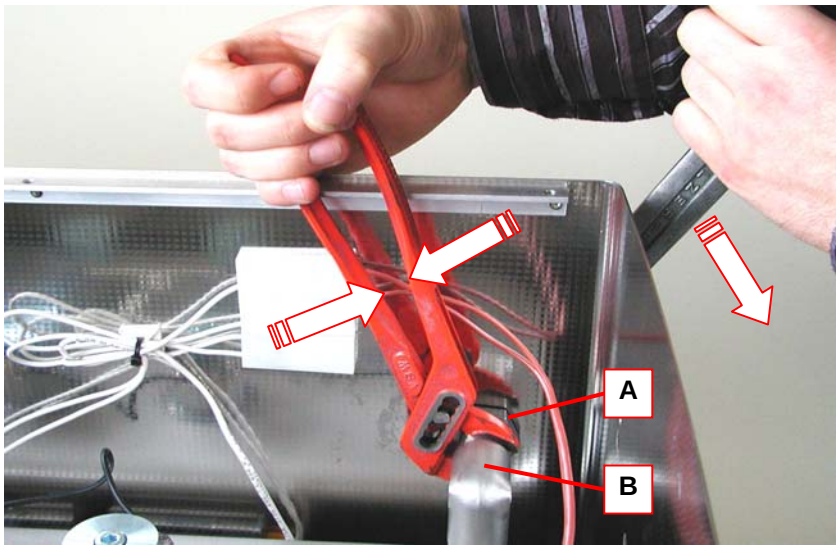


Illustration 12.1.6. Secure the duct nipple (A) with a pipe wrench to avoid an opening of the sealing in the duct angle (B).

13 How to replace the interference filter

A fault on the interference filter (pcb) is very rare. In most cases, the cause of a malfunction is a blown fuse or fuses.

As a rule, faulty fuses are caused by a short circuit in a heating element or by humidity inside the unit. The units T310, T420, LC20 and LC30 do not have a separate interference filter, in these units the breakdown can be caused by a fault on the generator.

On older units without fuse it is possible that a short circuit current has interrupted the interference filter coil.

13.1 Interference filter on T310,T420, LC20 and LC30

The interference filter is integrated on the generator pcb. A breakdown of the fuse can be caused by a short circuit in the heating element or the final stage of the generator.

In order to find the cause we recommend to interrupt the cables of the heating and to test the unit again with new fuses.

Interference filter section on the generator pcb

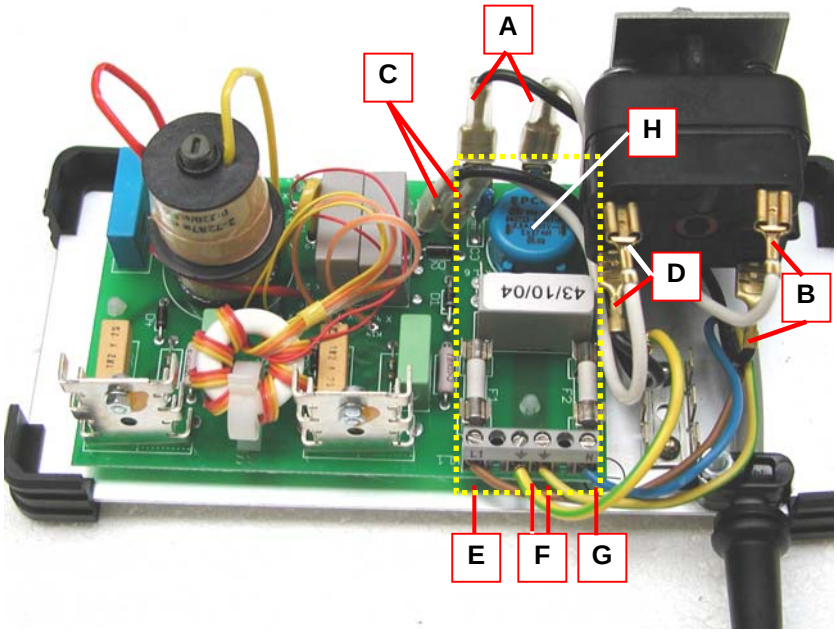


Illustration 13.1.1 Generator pcb complete with interference filter (section marked yellow)

A-B Supply cable interference filter >> timer input.
Polarization irrelevant. On units with heating the cable for the heating is connected to the twin contacts.

C-D Supply cable timer output >> generator.
Polarization irrelevant.

E Mains supply phase (brown).

F Earthing contacts.

G Mains supply zero (blue).

H Interference filter coil.

13.2 Interference filter on T460 – T700H

The interference filter is arranged on a separate printed board. On units made since 1992, there are fuses integrated on the interference filter. If the fuses are blown there is usually a short circuit in the heating element.

In order to find the cause we recommend to interrupt the cables of the heating and to test the unit again with new fuses.

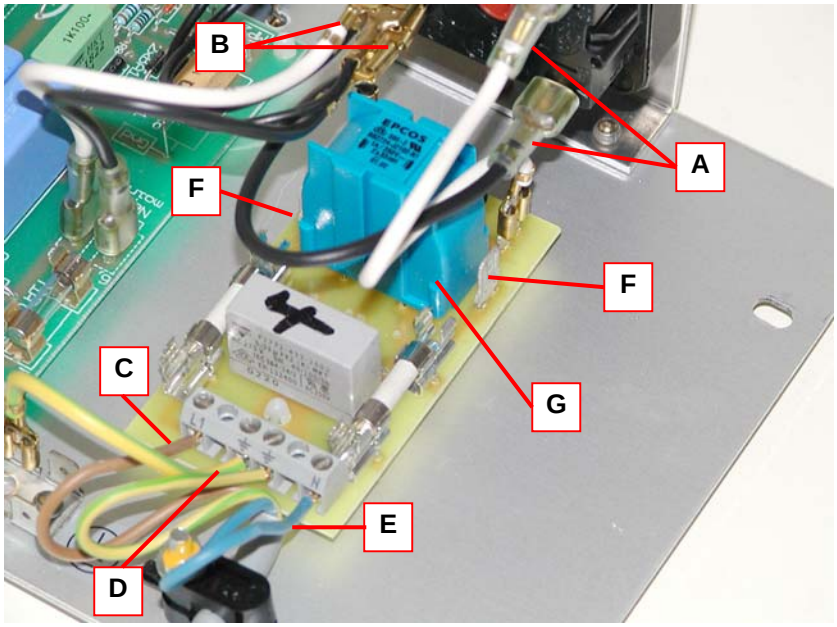


Illustration 13.3.1. Mounted and connected interference filter

A Supply cables interference filter >> timer input.
Polarization irrelevant. On units with heating the cable for the heating is connected to the twin contacts.

B Supply cables timer output >> generator.
Polarization irrelevant.

C Mains supply phase (brown).

D Earthing contacts.

E Mains supply zero (blue).

F Mains supply heating.

G Interference filter coil.

13.3 Interference filter on T780 – T1040/H

The interference filter is arranged on a separate printed board. Older units have no fuses. The interference filter coil can be interrupted in case of a short circuit.

If the fuses are blown there is usually a short circuit in the heating element.

In order to find the cause we recommend to interrupt the cables of the heating and to test the unit again with new fuses.

Interference filter on old units

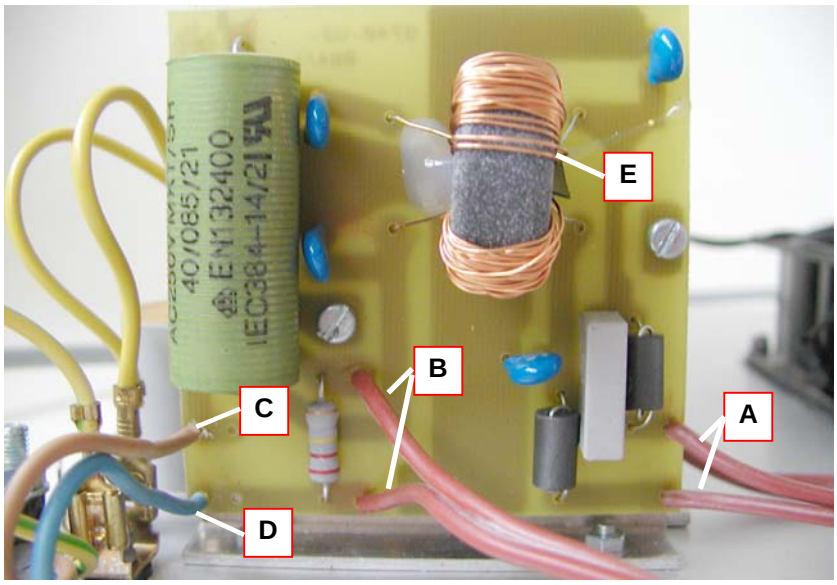
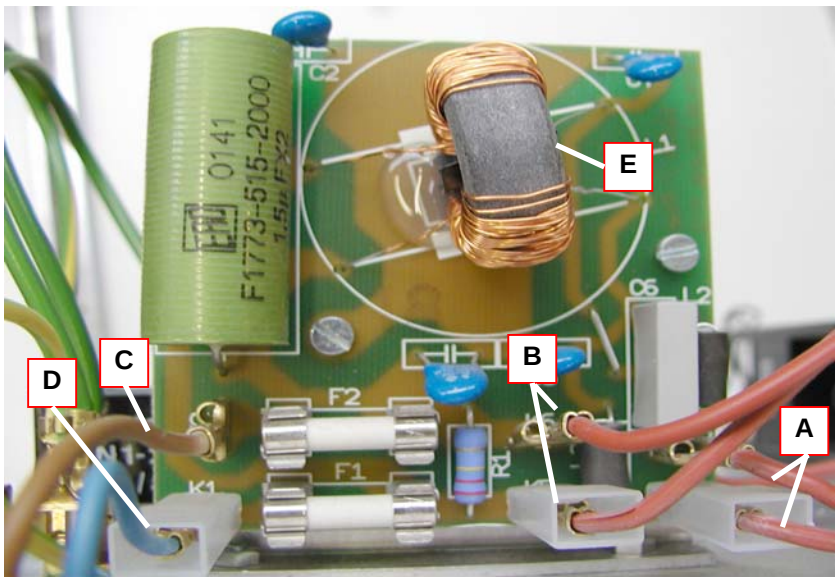


Illustration 13.3.1. Interference filter on units made before 2002

Interference filter on new units



Illusration 13.3.2. Interference filter on units made since 2002

A Supply cables interference filter >> timer input.

On units as shown in Illustration 13.3.2. connections K3 and K4. The lower contact is insulated because of its closeness to the bottom plate.

B Supply cables heating.

On units as shown in Illustration 13.3.2. connection K5 and K6. The lower contact is insulated because of its closeness to the bottom plate.

C Mains supply phase (brown).

On units as shown in Illustration 13.3.2. connection K2.

D Mains supply zero (blue).

On units as shown in Illustration 13.3.2. connection K1. The lower contact is insulated because of its closeness to the bottom plate.

E Interference filter coil.

14 How to replace the ultrasonic generator

Replacement generators are available for units made since 1991. Older units can be modified to operate with the new generators (mechanical and electrical modifications); however, in most cases this presents an uneconomical effort.

Find the cause

Check if the ultrasound pilot lamp (next to the timer) is lighted when the timer is switched on.

For further instructions on how to locate the fault please see *section 7* (Trouble shooting), the block diagrams in *sections 6.5. – 6.7.* and the circuit diagrams.

Pilot lamp lighted

There is voltage up to the generator print: fault in generator print and/or possibly in the transducer system.

Pilot lamp dark

No voltage from the timer. The fault is caused by an interrupted current supply cable from the generator.

Cause of breakdown

The breakdown of an ultrasonic generator can be due to several causes, e.g. humidity inside, extreme differences of voltage, extreme voltage peaks from the mains, fault in the transducer system, fault in a component, thermic overload of the semiconductors, etc.

Primary fault

Certain indicators of a breakdown imply a fault in the transducer system, such as faulty (visibly deformed) capacitors in the output circle, dark or scorched coil of the output transformer, heavy cavitational erosion in the tank. The faulty generator print is a consequence of the primary fault which must also be detected and remedied.

How to recognize a primary fault

- Check the generator print for traces of liquid.
- If there are traces of liquid find its origin (unit leaks or liquid has entered from outside).
- If there are traces on the tank floor, examine them more closely.
- If the silicone sealing has become loose, remove the tank and renew the sealing.
- If the tank is leaking replace the complete tank.
- Check if any scorchings or torn transducer disks are visible in the transducer system.
  The glue must not be brown (overheated). Brown glue indicates a dry running of the tank: replace the complete tank.
- Check if all cables are connected correctly.
- If the fuse on the generator print is blown there usually is a short circuit in the semiconductors and/or there is a short circuit caused by humidity inside.

- If the fuse is intact (but no ultrasonic activity) the fault can be in the output transformer, in the output capacitor(s) or in the transducer system.

How to repair If a generator print is faulty we recommend to replace the complete component.

Elma Order No. See spare parts list in *Annex B*; selection according to unit type and voltage.

How to proceed Please see the following pages to find instructions on each unit type.

General procedure:

1. Open the unit.
2. Remove the generator print from the bottom plate.
3. Mark and loosen the electric cables.
4. Mount the new generator print on the bottom plate.
   On units T460 – T700:
   Ensure that the transistors are mounted correctly. Use new insulating sleeves (delivered with transistors MJE 13009) and fix the transistors on the bottom plate.
   Caution! Check the insulating sleeves for damage. Remove any dirt particles on the insulating disk.
   The black insulating sleeve for the screw connection must point with its flat side to the cooling body, as otherwise there would be no connection between the transistor housing (collector) and the generator print.
5. Adjustment of the generator as described in *section 16.ff*. Wrong adjustment can destroy the generator and the transducer disks.
6. Reconnect all other cables.
   Caution! Observe correct polarization.
7. Reassemble the unit and ensure that all cables are connected correctly.

14.1 T310 – T420H; LC20H – LC30H

The following instructions apply to units made since 1991. See also *section 16.4*. and the Illustrations therein.

Generators on units made before 1991 cannot be replaced or repaired.

How to proceed

1. Open the unit as described in *section 7.*
2. Remove the generator print from the bottom plate.
   (On units made since 1997 the generator print is snapped in, on units made before 1997 it is screwed.)
3. Mark and loosen the electric cables. See also illustration on the next page.
4. Mount the new generator.
5. Adjust the generator (*as described in section 16.4.*). Wrong adjustment can destroy the generator and the transducer disks.
6. Reconnect all other cables.
   Caution! Observe correct polarization.
7. Reassemble the unit and ensure that all cables are connected correctly.
8. Trial operation approx. 2 – 3 h.

Electric connections

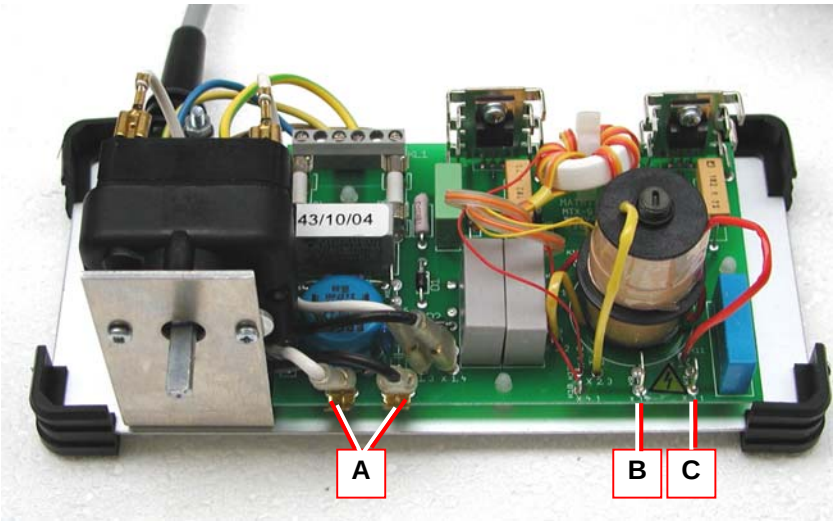


Illustration 14.1.1. Generator print mounted onto bottom plate (front view)

A Supply cable to heating (on units with heating); polarization irrelevant

B Plug contact 6.3 mm: HF output (-) to transducer system

C Plug contact 4.8 mm: HF output (+) to transducer system

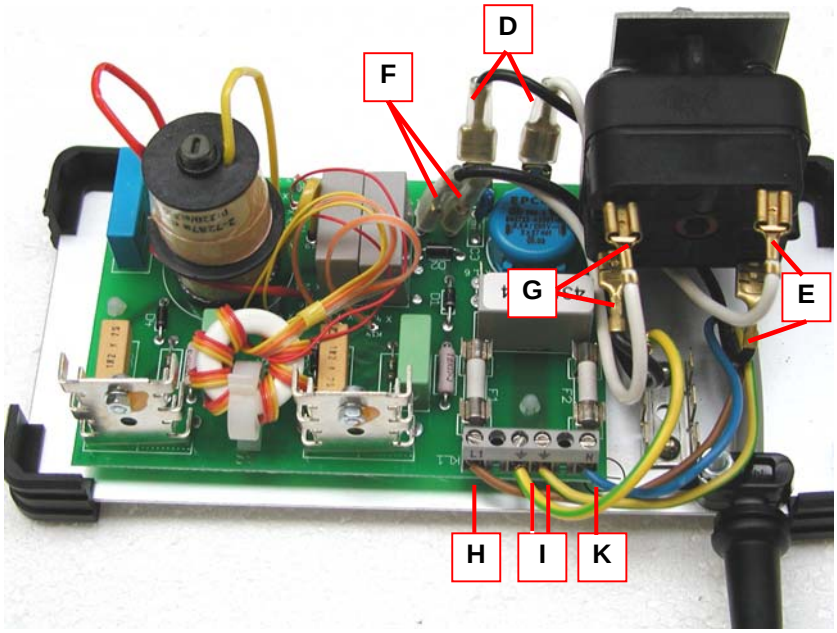


Illustration 14.1.2 Generator print mounted onto bottom plate (back view)

D-E Supply cables generator >> timer input.
Polarization irrelevant.

F-G Supply cables timer output >> generator.
Polarization irrelevant.

H Mains supply phase (brown).

I Earthing cables.

K Mains supply zero (blue).

14.2 T460 – T470H; LC60H

The following instructions apply to units made since 1992. See also *section 16.5*. and the Illustrations therein.

Generators on units made before 1992 cannot be replaced or repaired.

How to proceed

1. Open the unit as described in *section 7.*
2. Remove the generator print from the bottom plate.
   (On units made since 1997 the generator print is snapped in, on units made before 1997 it is screwed.)
3. Mark and loosen the electric cables.
4. Mount the new generator print. Ensure that the transistors are mounted correctly: Use new insulating sleeves (delivered with transistors MJE 13009) and fix the transistors in the clamps on the bottom plate.
   Caution: There must not be any dirt particles between the transistors and the bottom plate / cooling body. The cooling surface of the transistors must lie evenly on the bottom plate / cooling body.
5. Adjust the generator (*as described in section 16.5.*). Wrong adjustment can destroy the generator and the transducer disks.
6. Reconnect all other cables.
   Caution! Observe correct polarization.
7. Reassemble the unit and ensure that all cables are connected correctly.
8. Trial operation approx. 2 – 3 h.

Electric connections and fixation of transistors

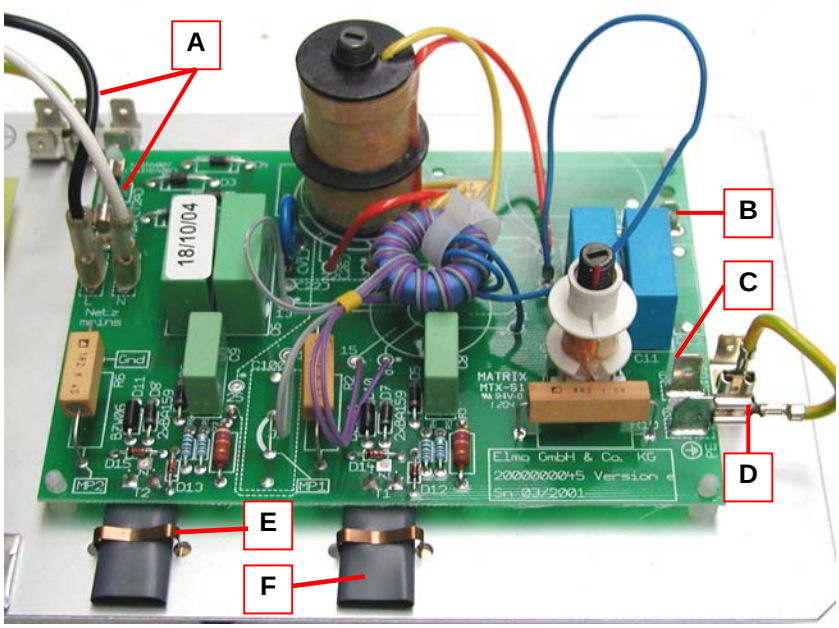


Illustration 14.2.1. Generator print T460 – T470H; LC60H

A Supply cables timer >> generator print.
Polarization irrelevant.

B Plug contact 4.8 mm: HF output (+) to transducer system.

C Plug contact 6.3 mm: HF output (-) to transducer system.

D Earthing connection generator print >> earthing point bottom plate (units made since 2000).

E Holding clamps for transistors.

F Insulating sleeves for transistors.

14.3 TS540 – T700H; LC130H

The following instructions apply to units made since 1992. See also *section 16.6*. and the illustrations therein.

Generators on units made before 1992 cannot be replaced or repaired.

How to proceed

1. Open the unit as described in *section 7.*
2. Remove the generator print from the bottom plate. (On units made since 1997 the generator print is snapped in, on units made before 1997 it is screwed.)
3. Mark and loosen the electric cables.
4. Mount the new generator print. Ensure that the transistors are mounted correctly: Use new insulating sleeves (delivered with transistors MJE 13009) and fix the transistors in the clamps on the bottom plate.
   Caution: There must not be any dirt particles between the transistors and the bottom plate / cooling body. The cooling surface of the transistors must lie evenly on the bottom plate / cooling body.
5. Adjust the generator (*as described in section 16.6.*). Wrong adjustment can destroy the generator and the transducer disks.
6. Reconnect all other cables.
   Caution! Observe correct polarization.
7. Reassemble the unit and ensure that all cables are connected correctly.
8. Trial operation approx. 2 – 3 h.

Electric connections and fixation of transistors

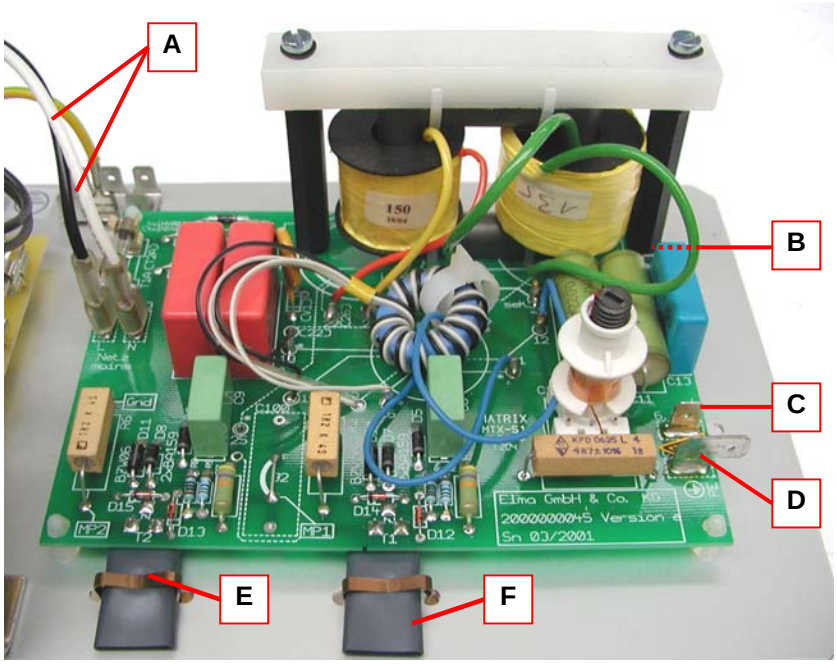


Illustration 14.3.1. Generator print TS540 – T700H; LC130H

A Supply cables timer >> generator print.
Polarization irrelevant.

B Plug contact 4.8 mm: HF output (+) to transducer system.

C Plug contact 6.3 mm: HF output (-) to transducer system.

D Earthing connection generator print >> earthing point bottom plate (units made since 2000).

E Holding clamps for transistors.

F Insulating sleeves for transistors.

14.4 T780 – T1060H

The generator is delivered complete with output transformer and aluminum cooling angle.

See also Illustrations on page 74.

How to proceed

1. Open the unit as described in *section 7.*
2. Unscrew the faulty generator print from the bottom plate.
3. Mark all electric connections before loosening and reconnection 1:1 on the new generator.
   Caution! Ensure that in particular the supply cable to the transducer system is connected correctly!
   Plug the cable with the yellow sleeve (mass) onto the point on the bottom plate (*see Illustration 14.4.1.*).
   Connect the other cable (HF) to the generator:
   T780H-T820H to the lower plug contact (*see Illustration 14.4.2.C*)
   T1040H-T1060H to one of the contacts in the centre (s*ee Illustration 14.4.2.F*).
4. Mount the new generator print.
5. Adjust the generator (*as described in section 16.7.*). Wrong adjustment can destroy the generator and the transducer disks.
6. Reconnect all other cables.
   Caution! Observe correct polarization.
7. Reassemble the unit and ensure that all cables are connected correctly.
8. Trial operation approx. 2 – 3 h.

Electric connections

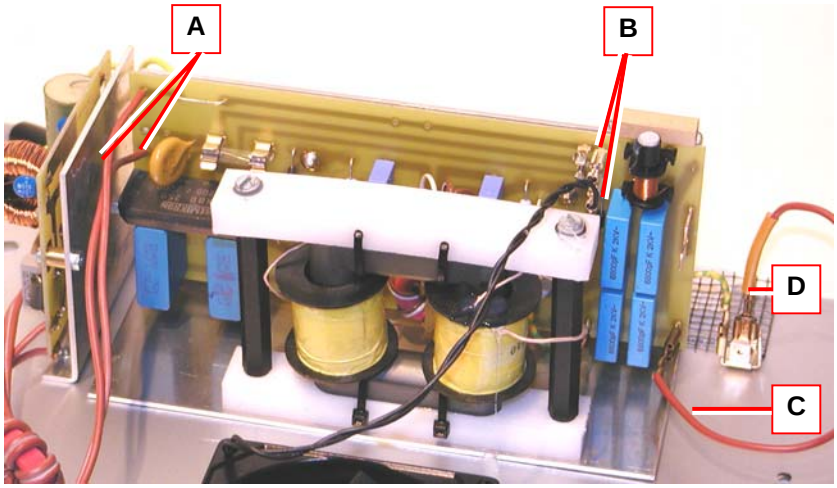


Illustration 14.4.1. Generator T780 – T1060H

A Mains supply timer >> generator print.
Polarization irrelevant.

B Supply cable to fan (2 plug contacts 2.8 mm).

C HF (+) supply to transducer system.

D Mass (-) supply to transducer system.

E Earthing connection generator print >> earthing point on bottom plate.

HF output T780 – T890

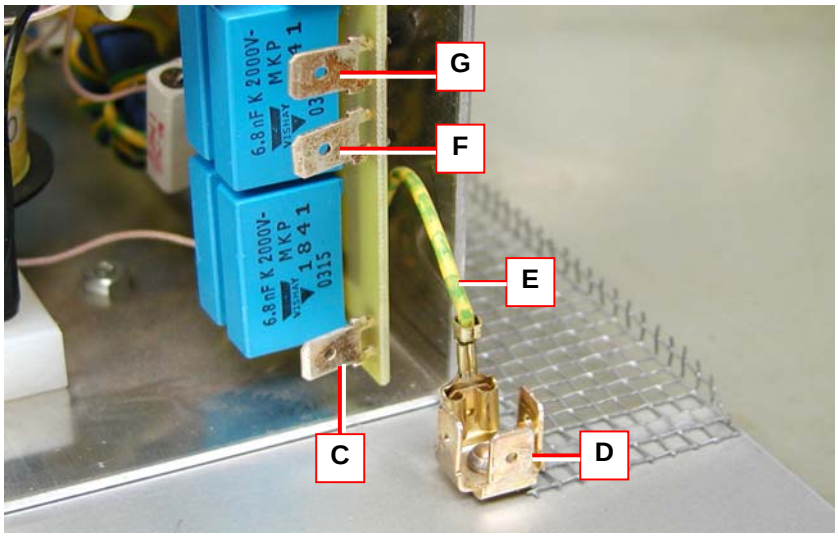


Illustration 14.4.2. Detailed view HF output

C HF (+) output (plug ocntact 6.3 mm).

D Earthing point (plug contacts 6.3 mm).

E Mass connection (-) generator >> earthing point (D).

HF (+) output >> supply transducer system.

Additional capacitor T1040H T1060H

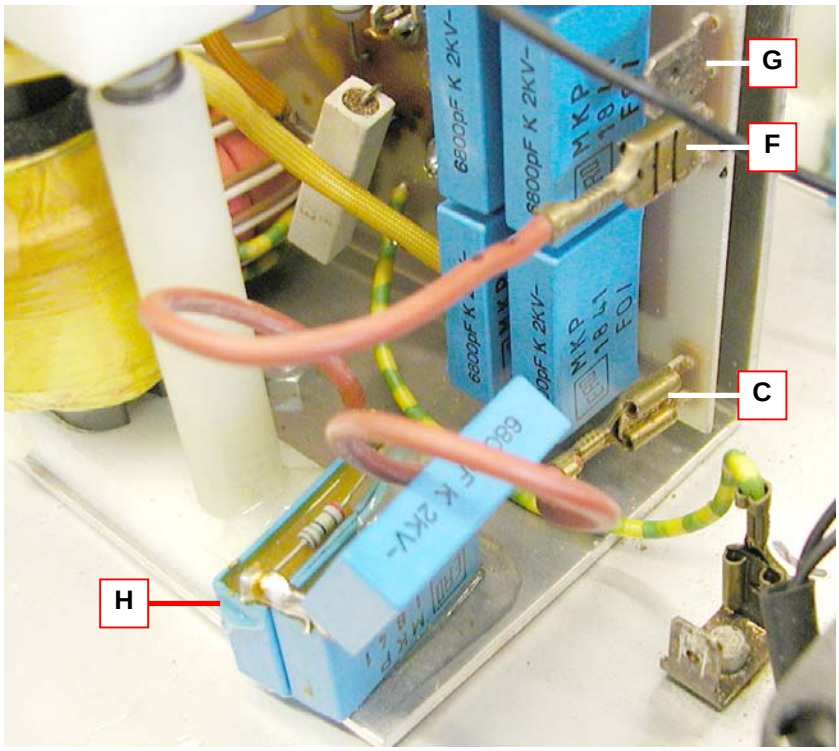


Illustration 14.4.2. Additional capacitor

C HF output >> supply additional capacitor.

F Output additional capacitor (bridged with G).

G HF (+) output >> supply transducer system (bridged with F).

H Additonal capacitor.

15 How to replace components on the generator print

15.1 T310 – T420H; LC20H – LC30H

Transistors If the fuse is blown there usually are faulty transistors (short circuit).

Elma Order No. 200 000 5002

How to proceed

1. Loosen the generator print from the bottom plate.
2. Unsolder the transistors.
3. Loosen the M3 nut on the cooling body.
4. Remove the transistors.
5. Check the diodes for short circuits; replace if necessary.
6. Check the resistances 100 Ohm and 1.2 Ohm for throughline; replace if necessary.
7. Screw and solder in new transistors.
8. Adjust the generator (*see section 16.4.*).

BZW diode There can be a short circuit in mains diode BZW 06 due to extreme voltage peaks or a mains overvoltage (fuse and BZW diode faulty). In this case, no other components are faulty.

Elma Order No. 200 000 0353

Diodes The diodes (BA 159 or 1N4007) can be faulty due to a short circuit of the transistors.

Elma Order No. BA 159: 200 000 6123

1N 4007: 200 000 5001

Capacitor The capacitor in the output circle (2kV) can be destroyed due to a fault in the transducer system or through wrong operation (cleaning items directly on the tank floor). The ultrasonic frequency is undefined around 50kHz.

Elma Order No. 200 000 0015

Resistances The resistances 1.2 Ohm / 4W; 100 Ohm / 0.5W or 18 kOhm / 1W can be faulty due to a short circuit of the transistors.
Check with ohmmeter.

Elma Order No. 1,2 Ohm / 4W: 200 000 5004

100 Ohm / 0,5W: 200 000 5005

18 kOhm / 1W: 200 000 5033

Output transformer

There can occur a short circuit in the coil of the secondary output transformer, or the coil can be overheated / scorched due to a fault in the transducer system or through wrong operation (cleaning items directly on the tank floor). The fuse on the generator print is intact if the fault is limited to the output transducer.

Check the transducer system (the transducer disks might be torn).

The oscilloscope can detect this fault by measuring the collector current (same measuring points as for adjustment see *section 16.4.*). The graph remains flat (*see section 16.2.4.*).

Elma Order No.

T310 115V/230V; LC20H 230V : 200 000 1458

LC 20H 115V: 200 000 1564

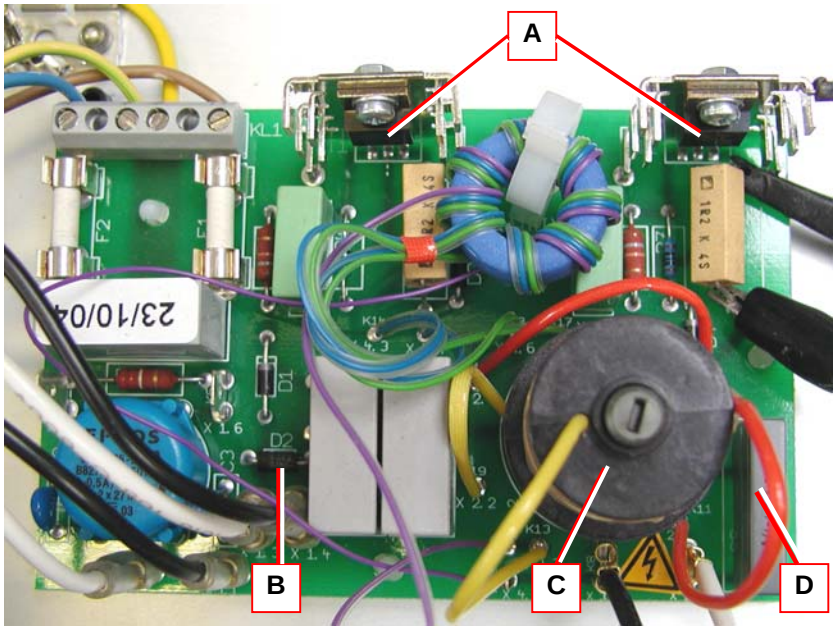


Illustration 15.1.1. Generator print with relevant components

A Transistors

B BZW diode

C Output transformer

D Output capacitor

15.2 T460 – T470H; LC60H

Transistors

Units made since 1997 are fitted with transistors of the type MJE 13009.

The old BUW41B transistors in units made before 1997 can be replaced by the new MJE 13009.

In case of a short circuit of the transistors always replace both transistors. The transistors must have the same amplification factor, as otherwise the unequal charging of the transistors can overheat and destroy them.
The transistors are preselected by Elma. Spare part deliveries always contain transistors with equal amplification factor.

If the fuse on the generator print is blown check the transducers.

Elma Order No. 200 000 8098

How to proceed

1. Loosen the holding clamps of the transistors.
2. Remove the generator print from the bottom plate.
3. Unsolder and remove the transistors.
4. Check the diodes for short circuits; replace if necessary.
5. Check the resistances 100 Ohm and 1.2 Ohm for throughline; replace if necessary.
6. Solder in new transistors.
7. Mount the generator back onto the bottom plate.
8. Fasten the transistors to the clamps on the bottom plate.
   Caution: Use new insulating sleeves for the transistors.
   The transistors must lie evenly on the bottom plate.
9. Adjust the generator (*see section 16.ff*).

Varistor

There can occur a short circuit in the varistor due to extreme peak voltages or to a mains overvoltage (fuse and varistor faulty). The varistor is visibly broken and black. Usually, no other components are faulty.

Elma Order No. **115V**: 200 000 6132 / **230V**: 200 000 5064

Diodes

The diodes (BA 159 or 1N4007) can be faulty in case of a short circuit of the transistors.

Elma Order No. BA 159: 200 000 6123

1N4007: 200 00 5001

Resistances

The resistances 1 Ohm / 0.5W; 100 Ohm / 0.5W or 47 kOhm / 1W can be faulty due to a short circuit of the transistors.
Check with ohmmeter.

Elma Order No. 1 Ohm / 0.5W: 200 000 5225

100 Ohm / 0,5W: 200 000 5005

47 kOhm / 1W: 200 000 0446

Capacitor The capacitor in the output circle (2kV) can be destroyed due to a fault in the transducer system or through wrong operation (cleaning items directly on the tank floor). The ultrasonic frequency is undefined around 50kHz.

Elma Order No. 200 000 0042

Output transformer There can occur a short circuit in the coil of the secondary output transformer, or the coil can be overheated / scorched due to a fault in the transducer system or through wrong operation (cleaning items directly on the tank floor). The fuse on the generator print is intact if the fault is limited to the output transducer.

Check the transducer system (the transducer disks might be torn).

The oscilloscope can detect this fault by measuring the collector current (same measuring points as for adjustment see *section 16.4.*). The graph remains flat (*see section 16.2. Illustration 16.2.4.*).

Elma Order No. **115V**: 200 000 1460 / **230V**: 200 000 1459

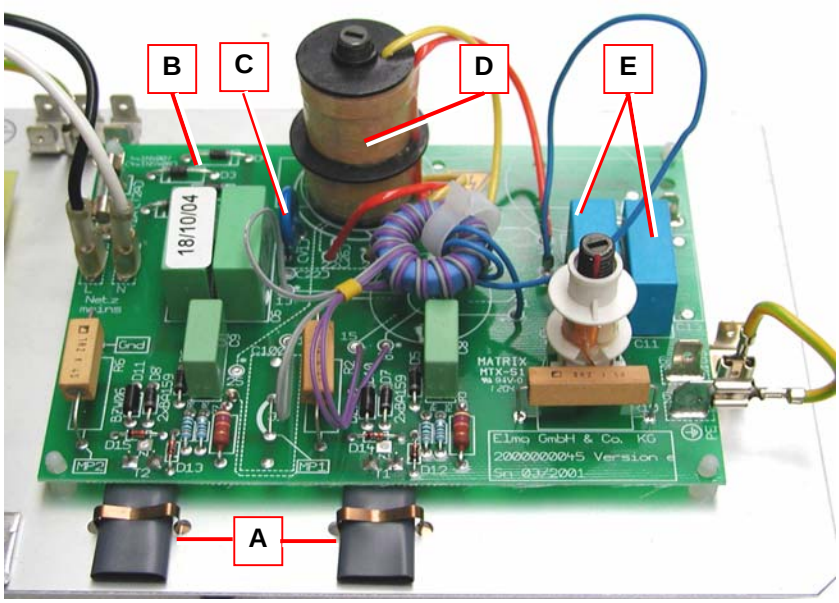


Illustration 15.2.1 Generator print with relevant components

A Transistors

B Mains rectifyer diodes 1N4007 (4 pieces)

C Varistor

D Output transformer

E Output capacitors

15.3 TS540 – T700H; LC130H

Transistors

Units made since 1997 are fitted with transistors of the type MJE 13009.

The old BUW41B transistors in units made before 1997 can be replaced by the new MJE 13009.

In case of a short circuit of the transistors always replace both transistors. The transistors must have the same amplification factor, as otherwise the unequal charging of the transistors can overheat and destroy them.
The transistors are preselected by Elma. Spare part deliveries always contain transistors with equal amplification factor.

If the fuse on the generator print is blown check the transducers.

Elma Order No. 200 000 8098

How to proceed

1. Loosen the holding clamps of the transistors.
2. Remove the generator print from the bottom plate.
3. Unsolder and remove the transistors.
4. Check the diodes for short circuits; replace if necessary.
5. Check the resistances 100 Ohm and 1.2 Ohm for throughline; replace if necessary.
6. Solder in new transistors.
7. Mount the generator back onto the bottom plate.
8. Fasten the transistors to the clamps on the bottom plate. **Caution:** Use new insulating sleeves for the transistors. The transistors must lie evenly on the bottom plate.
9. Adjust the generator (*see section 16.ff*).

Varistor

There can occur a short circuit in the varistor due to extreme peak voltages or to a mains overvoltage (fuse and varistor faulty). The varistor is visibly broken and black. Usually, no other components are faulty.

Elma Order No. **115V**: 200 000 6132 / **230V**: 200 000 5064

Diodes

The diodes (BA 159 at 230 V / BA 5408 at 115V or 1N4007) can be faulty in case of a short circuit of the transistors. Check with ohmmeter.

Elma Order No. BA 159: 200 000 6123

BA 5408: 200 000 5300

1N4007: 200 00 5001

Capacitor

The capacitor in the output circle (2kV) can be destroyed due to a fault in the transducer system or through wrong operation (cleaning items directly on the tank floor). The ultrasonic frequency is undefined around 50kHz.

Elma Order No.

22nF / 2KV: 200 000 0079

10nF / 2 KV: 200 000 5425

Output transformer

There can occur a short circuit in the coil of the secondary output transformer, or the coil can be overheated / scorched due to a fault in the transducer system or through wrong operation (cleaning items directly on the tank floor). The fuse on the generator print is intact if the fault is limited to the output transducer.

Check the transducer system (the transducer disks might be torn).

The oscilloscope can detect this fault by measuring the collector current (same measuring points as for adjustment see *section 16.5.*). The graph remains flat (*see section 16.2. Illustration 16.2.4.*).

How to proceed

1. Open the screw connection of the output transformer.
2. Cut the silicone fixation of the coil with the core.
3. Remove the upper U ferrite core with its support.
4. Unsolder the secondary coil (coil to the output side).
5. Replace the coil.
6. Solder the connections of the new coil.
   Observe polarization: The output connection of the coil (outer connection) must be soldered to the contact on the generator print (to output).
7. Put the U ferrite core on the two coils.
   Make sure that the washers between the upper and the lower U core are inserted.
8. Screw the upper U ferrite core with its suport.
   Do not tighten the screws to much to prevent the ferrite core from tearing.
9. Secure the coil with silicone.
   Ensure that all cables are free so that no short circuit can occur.

Elma Order No.

Secondary coil 115V 200 000 7211

Secondary coil 230V 200 000 7205

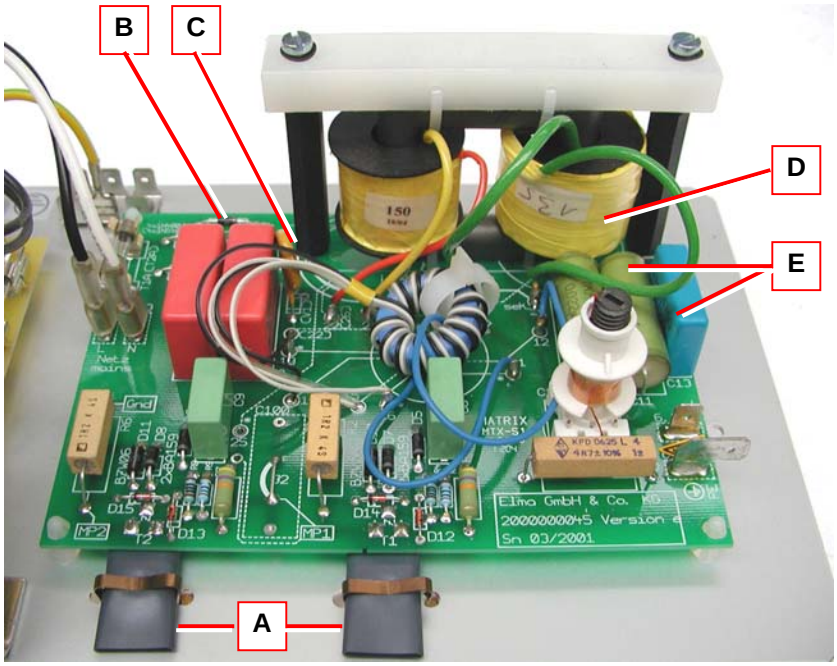


Illustration 15.3.1 Generator print with relevant components

A Transistors

B Mains rectifyer diodes 1N4007 (4 pieces)

C Varistor

D Output transformer (secondary coil)

E Output capacitors

15.4 T780 – T1060H

Transistors

Units made since 1991 are fitted with transistors of the type BUX48A.

The old BUS13A transistors in units made before 1997 can be replaced by the new BUX48A.

In case of a short circuit of the transistors always replace both transistors. The transistors must have the same amplification factor, as otherwise the unequal charging of the transistors can overheat and destroy them.
The transistors are preselected by Elma. Spare part deliveries always contain transistors with equal amplification factor.

If the fuse on the generator print is blown check the transducers..

Elma Order No.

200 000 5062

How to proceed

1. Unscrew the transistors.
2. Unsolder and degrease the transistors.
3. Check the diodes BA159 for short circuits; replace both if necessary.
4. Check resistances 100 Ohm and 0.47 Ohm for throughline; replace if necessary.
5. Screw in the new transistors.
   Caution: Check the insulating disk (A) for damage.
   Remove dirt particles if any.
   The flat side of the black insulating sleeve (B) for the screw connection must lie on the cooling body as otherwise there will be no connection between transistor housing (collector) and generator print.
   The washer is fitted outside.
6. Adjust the generator (*see section 16.6.*).

Correctly prepared transistor

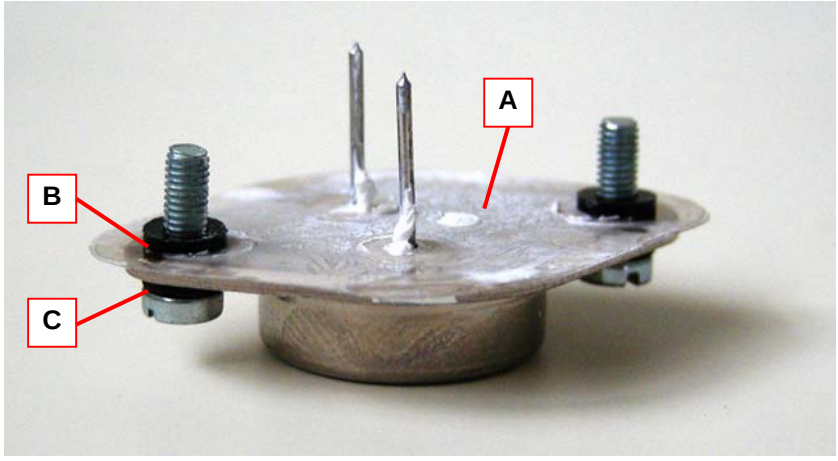


Illustration 15.4.1. Transistor with insulating disk and insulating sleeve

Bad soldering at transistor socket

On older units or in a humid ambience the brass rings (A) and the brass contacts can become oxidized. As a consequence the connection between the emitter and the basic connection with the generator print can be interrupted. This fault usually causes a tottering contact.

Typical for this fault is the lighted pilot lamp for the ultrasound and an intact fuse on the generator print.

Knocking on the housing or on the cooling angle of the generator print can cause the generator to stop and start functioning.

Remedy

Deoxidize the brass rings and contacts with a knife or a glass fiber brush (scratch them clean) and solder the contacts new.

Correct functioning can be checked by means of an insulated bar which is carefully levered between the cooling body and the generator print.

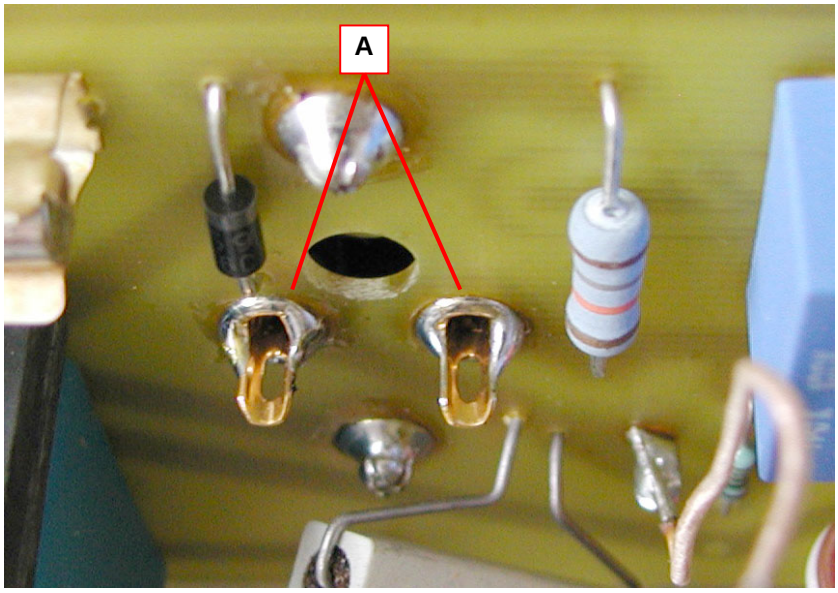


Illustration 15.4.2. Position of transistor contacts

Varistor

There can occur a short circuit in the varistor due to extreme peak voltages or to a mains overvoltage (fuse and varistor faulty). The varistor is visibly broken and black. Usually, no other components are faulty.

Elma Order No.

115V: 200 000 6132

230V: 200 000 5064

Diodes

The diodes (BA 159 or DSEI8-06A on T1040-T1060 115V) can be faulty in case of a short circuit of the transistors.

Elma Order No.

BA 159: 200 000 6123

DSEI8-06A: 200 000 5149

Resistances

The resistances 100 Ohm / 0.5W or 0.47 kOhm / 4W can be faulty due to a short circuit of the transistors.
Check with ohmmeter.

Elma Order No.

100 Ohm / 0.5W: 200 000 5005

0.47 Ohm / 4W: 200 000 5282

Capacitor

The capacitor in the output circle (6.8 nF / 2kV) can be destroyed due to a fault in the transducer system or through wrong operation (cleaning items directly on the tank floor). The ultrasonic frequency is undefined around 50kHz.

Elma Order No.

200 000 0015

Output transformer

There can occur a short circuit in the coil of the secondary output transformer, or the coil can be overheated / scorched due to a fault in the transducer system or through wrong operation (cleaning items directly on the tank floor). The fuse on the generator print is intact if the fault is limited to the output transducer.

Check the transducer system (the transducer disks might be torn).

The oscilloscope can detect this fault by measuring the collector current (same measuring points as for adjustment see *section 16.7.*). The graph remains flat (*see section 16.2. Illustration 16.2.4.*).

How to proceed

1. Open the screw connection of the output transformer.
2. Cut the silicone fixation of the coil with the core.
3. Remove the upper U ferrite core with its support.
4. Unsolder the secondary coil (coil to the output side).
5. Replace the coil.
6. Solder the connections of the new coil.
   Observe polarization: The output connection of the coil (outer connection) must be soldered to the contact on the generator print (to output).
7. Put the U ferrite core on the two coils.
   Make sure that the washers between the upper and the lower U core are inserted.
8. Screw the upper U ferrite core with its support.
   Do not tighten the screws to much to prevent the ferrite core from tearing.
9. Secure the coil with silicone.
   Ensure that all cables are free so that no short circuit can occur.

Elma Order No.

Secondary coil (120 wraps) T780; T820H: 200 000 7096

Secondary coil (110 wraps) T890: 200 000 7133

Secondary coil (102 wraps) T1040H; T1060H: 200 000 7112

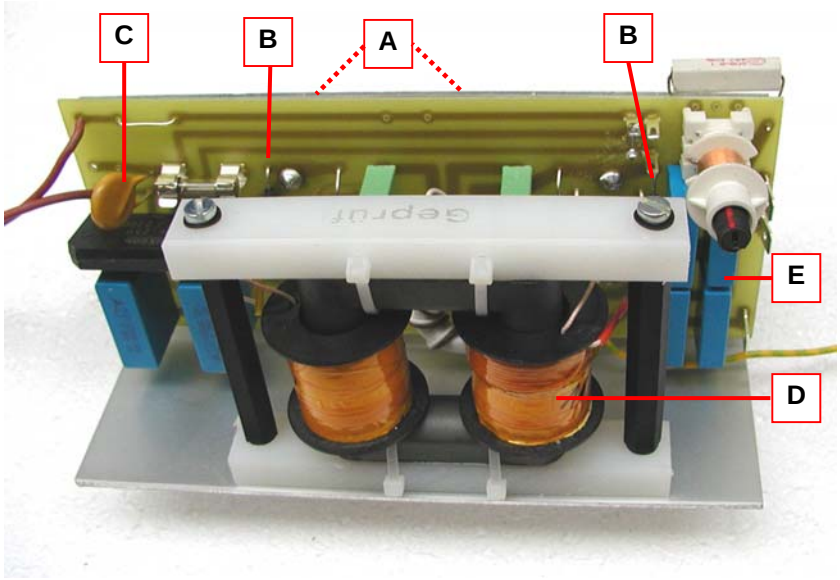


Illustration 15.4.3. Generator print with relevant components

A Transistors

B HF diodes (BA 159 or DSEI8-06A on T1040-T1060 115V)

C Varistor

D Output transformer (secondary coil)

E Output capacitor (4 pieces)

16 Adjustment of the generators

An adjustment of frequencies is required after replacement of the following components:

- tank with complete mounted transducer system
- transducer disks
- complete generator print
- transistors
- coils and output transformer

Wrong adjustment can destroy the generator and the transducer disks.

Required measuring tools

For the measuring you need the following tools:

- adjustable interrupting transformer
- wattmeter
- 2-channel oscilloscope
- 2 probes (1:1 and/or 1:10)
- mains interrupting transformer

For further description of the measuring tools *see section 1.5.*

Carefully read and observe the following safety warnings before you start the adjustment of the generator!

CAUTION

Risk of electrocution.

Live parts inside the unit. Even in the switched-off unit there are several components charged with electricity!

In order to prevent damage on persons and equipment, the mains-driven measuring instruments and the open unit must be connected via a mains interrupting transformer.

NOTE

An open generator output can damage the electronics.

The generator print must be operated with connected transducer system only.

NOTE

Risk of damage to the electronics by thermic overload

Operate the generator only with the transistors fixed to the relevant cooling body (bottom plate etc.)

16.1 Set-up of measuring instruments

In order to carry out the generator adjustment, the graphs of the voltage and the current at the transistor must be indicated parallel by the oscilloscope. Set the instruments up as follows.

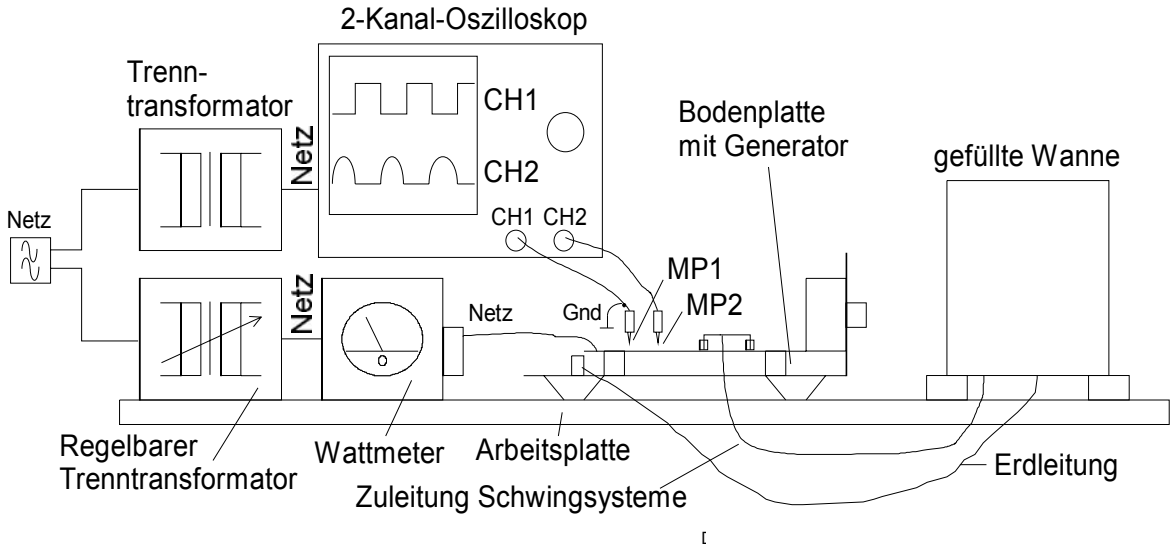


Illustration 16.1.1. Schematic set-up of measuring instruments

Set values oscilloscope

- CH (channel) 1 for the measurement of the voltage signal (clock signal at transistor base):
  voltage 10V / DIV (if a probe 1:10 is used)
- CH (channel) 2 for the measurement of the current graph (emitter output signal):
  voltage 0.1 V / DIV (if a probe 1:1 is used)
- TIME (basic): 5 µs
- Trigger CH1
- Trigger HF

16.2 Measuring process

Preparation Prepare the measuring set-up with connected transducer tank and generator.

Fill transducer tank Fill the transducer tank approx. 2/3 with water and a little cleaning medium.
(*See also* section *17. Initial operation and 17.2. Cleaning media*)

Connect the transducer system Connect the transducer system to the output of the generator print before putting any voltage on the set-up.

Slowly increase voltage

Slowly increase the voltage and observe the correct forming of the graph at the oscilloscope. Also check the current consumption in order to be able to reduce the voltage immediately should a short circuit occur.

General procedure

The adjustment process varies according to the type of unit. Please follow the instructions given specifically for the individual unit types on the following pages.
Measure the voltage and current graph at the measuring points **MP1** and **MP2** according to the generator type (*see section 15.4. – 15.7.*)

The measured graphs must be exactly in phase (*see Illustration 16.2.1.*). Exception: T780-T1060H.

Illustration 16.2.1.

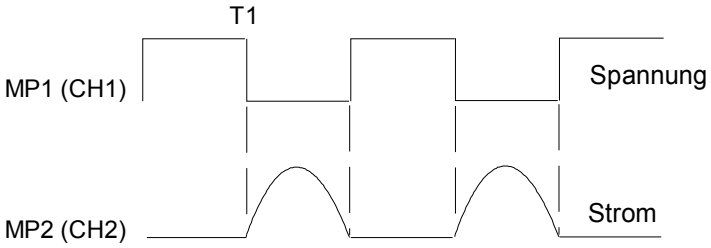
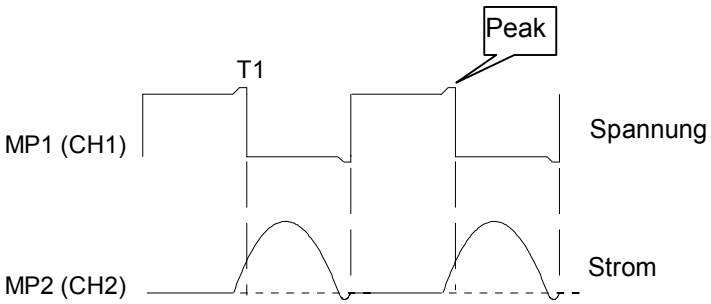
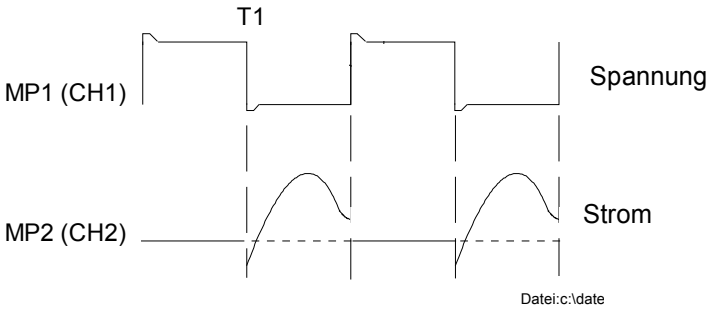


Illustration 16.2.2.



Ilustration 16.2.3.



Illustrations 16.2.1. – 16.2.3.

Adjustment outside tolerance

If the graphs do not correspond, there is a high output loss in the electronics. The transistors can be destroyed by thermic overload.

The ultrasonic effect is unsatisfactory: there are no waves on the surface of the bath, there are streamers on the tank floor, there is an unusual noise, the transistors heat up, etc.

Power consumption

Observe the power consumption of the generator during the adjustment process (*see Table of power consumption values section 16.3*). The measured value should be in the range indicated in the table.
Caution: The heating must remain switched-off.

Deviation of power

A deviation of the measured values can be caused by the following:

a. wrong liquid level:
>> correct to approx. 2/3 of the tank

b. liquid has not been degassed (liquid is too fresh):
>> wait a few minutes

c. no cleaning medium in the bath:
>> add a little cleaning medium

d. adjustment is outside tolerance (e.g. transistors are very hot):
>> optimize adjustment

e. fault inside the unit, e.g. output transformer (coil short circuit, scorching, etc.) or transducer system (PXE disks torn, scorching, etc.:
>> check components; in case of a short circuit in the output transformer or the transducer system the current graph can look as indicated in *Illustration 16.2.4.*

f. ferrite core in output transformer adjusted wrong:
>> power too high: reduce the air gap by slowly turning out the upper ferrite core; observe the power consumption during the process
Caution: The screw driver will heat up considerably due to induction!
>> power too low: increase the air gap by slowly turning in the upper ferrite core; observe the power consumption during the process
Caution: The screw driver will heat up considerably due to induction!

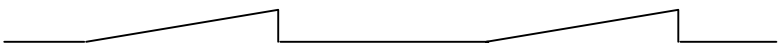


Illustration 16.2.4.: Current graph in case of short circuit in output transformer or transducer system

16.3 Table of power consumption values ultrasound

Type of unit	Power consumption ultrasound (watt)
T310(/H)	25 - 35
T420(/H)	30 - 40
T460(/H)	75 - 95
T470/H	75 - 95
TS540	140 - 150
T570(/H)	140 - 150
T660/H	140 - 150
TP690 / TP695H	140 - 150
T700(/H)	140 - 150
T780(/H)	225 - 275
T820/H	225 - 275
T890(/H)	250 - 300
T1040/H	400 - 450
T1060/H	800 - 900
LC20/H	30 - 40
LC30(/H)	30 - 40
LC60/H	70 - 85
LC130/H	140 - 150

16.4 Adjustment on T310 – T420H; LC20H – LC30H

The adjustment on these units is carried out at the control coil. The control coil (*see Illustration 16.4.1.D*) has several wraps. The ends of a wrap are soldered to a fixing point (*see Illustration 16.4.2.E*). If necessary, unsolder the relevant cable and increase or reduce the number of wraps on the control coil.

It depends on the relation between the signal graphs of the oscilloscope whether or not an adjustment is required.

See possible graphs as indicidated in *Illustrations 16.2.1 - 3*.

How to proceed

In order to check the adjustment proceed as follows:

1. Measuring set-up as described in *section 16*.
2. Connect the probes as shown in *Illustration 16.4.*
3. Slowly increase voltage; observe the oscilloscope and the current consumption during the process.
4. Check the graph and compare with possible graphs as indicated in *Illustrations 16.2.1 - 3.*
   If graph and phase are as indicated in *Illustration*. *16.2.1.*, no modification is necessary.
   a. If the current graph rises **before** T1 as shown in *Illustration 16.2.2.*:
      Reduce the number of wraps of the a.m. coil by 1 wrap at a time until the graphs correspond as shown in *Illustration 16.2.1.*
      Caution: Do not reduce the number of wraps under the minimum of 2 wraps.
   b. If the current graph rises **after** T1 as shown in *Illustration 16.2.3.*:
      Increase the number of wraps of the a.m. coil by 1 wrap at a time (observe sense of coiling) until the graphs correspond as shown in *Illustration 16.2.1.*
5. Check the generator power consumption and compare with the values indicated in the table in *section 16.3.*
   In case of deviation see instructions given in *section 16.2*.

Perfect adjustment

- The transistors do not heat up (one or both).
- There are waves on the surface of the bath.
- There are no streamers on the tank floor.
- The ultrasonic noise is uniform and not shrill.
- The performance changes only little when a beaker, etc. is immersed in the tank.
  The phases remain stable.

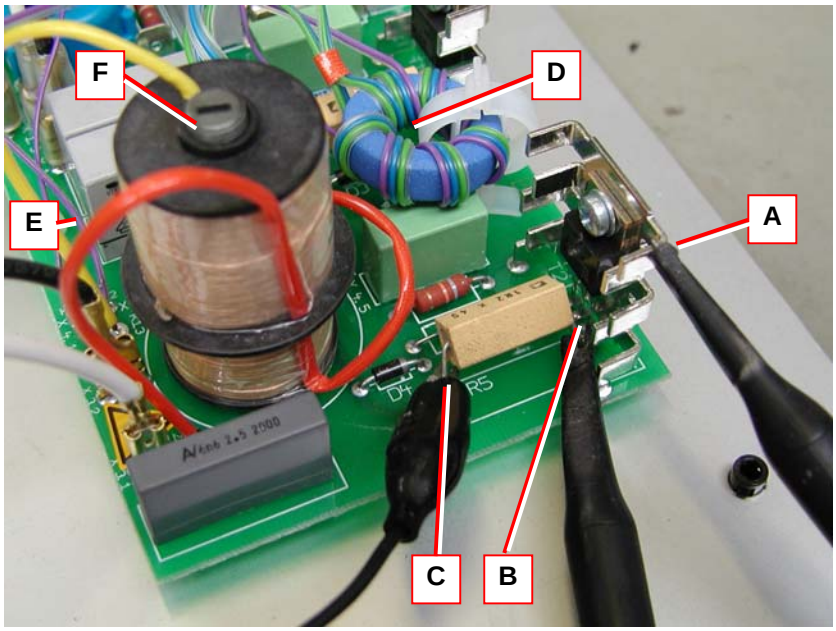


Illustration 16.4.1. Generator print: relevant points for the adjustment

A Probe channel 1 – measuring of the collector signal (connection of probe to cooling body).

B Probe channel 2 – measuring of the emitter signal (connection of probe at resistance R5 – on the transistor side).

C Mass connection of probe channel 2 (resistance R5).

D Control coil to carry out the adjustment. Adding or reducing of coil wraps.

E Cable for adjustment: Unsolder from fix point on generator print and wrap or unwrap control coil.

F Ferrite core of output transformer:
If output too high (*compare Table 15.3.*) slightly turn out ferrite core anti-clockwise.
If output too low (*compare Table 15.3.*) slightly turn in ferrite core clockwise.
Caution: The tip of the screw driver can heat up considerably by induction.

Cable for adjustment

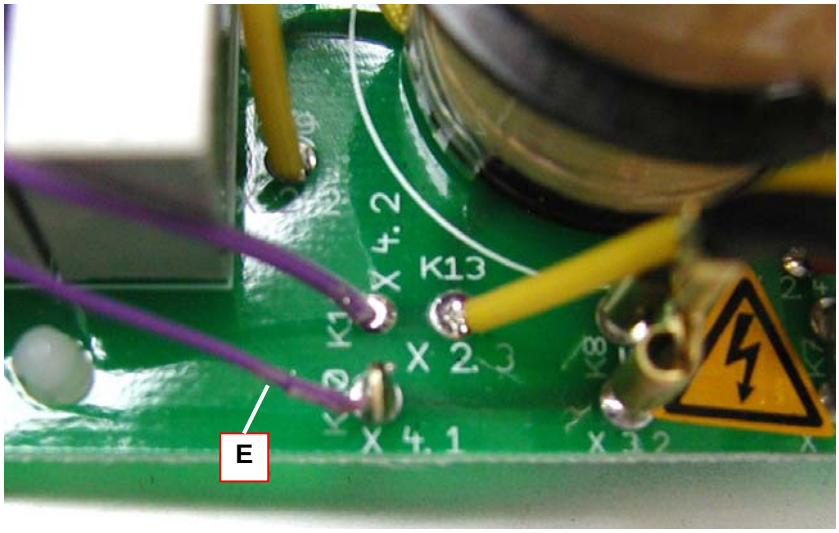
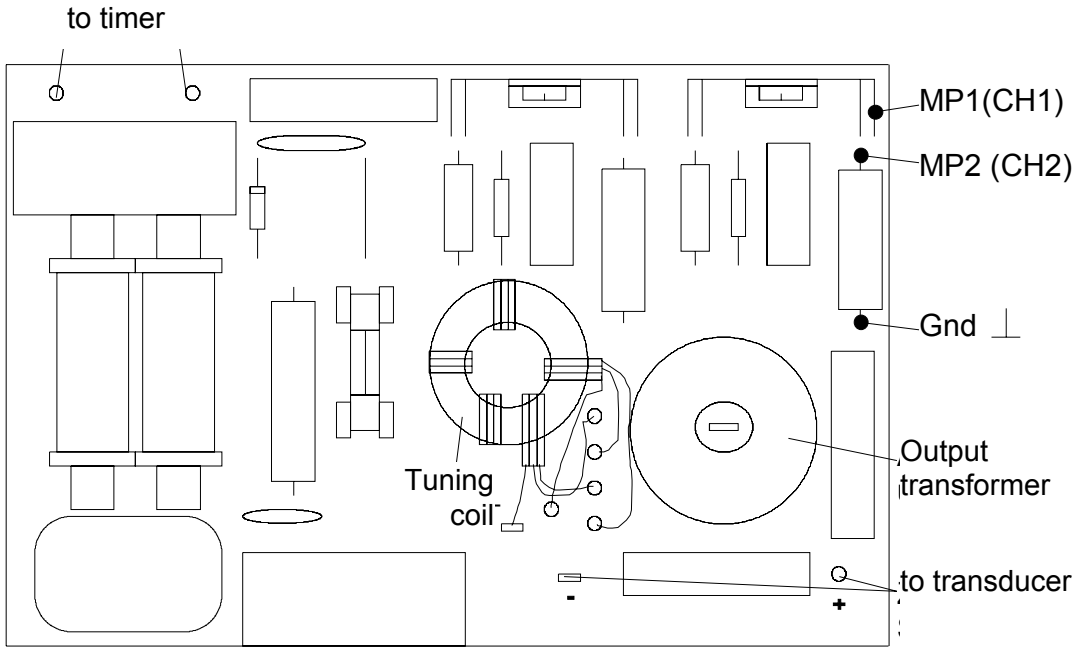
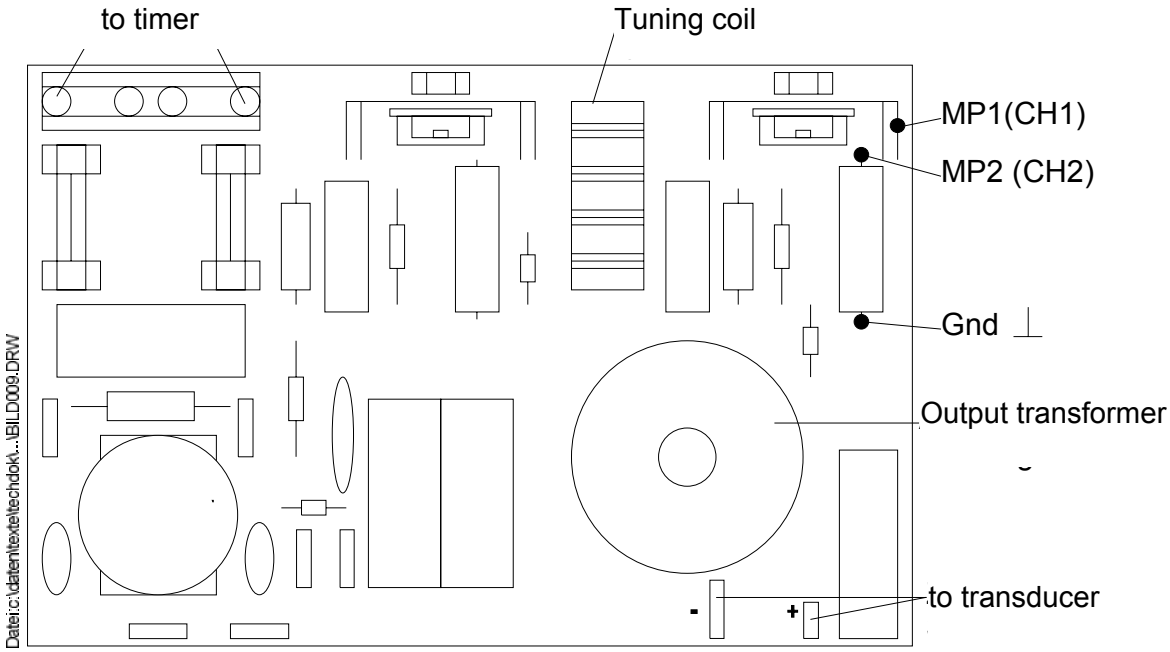


Illustration 16.4.2. Unsolder the cable of control coil for adjustment and add or reduce number of wraps at the coil.



Generatorplatine T310 bis Januar 1992



Generatorplatine T310(/H), T420, LC20/H, LC30(/H) ab Januar 1992

Illustration 16.4.3.
top: units made before February 1992
bottom: units made since February 1992

16.5 Adjustment on T460 – T470H; LC60H

Since 1997 the generators have been equipped with an adjustment coil (*see Illustration 16.5.*) which makes the adjustment of the graphs easier.

Generators made before 1997 are not equipped with an adjustment coil and must be adjusted by means of the control coil (*Illustration 16.4.1.D)* as described in *section 16.4*.

How to proceed

In order to check the adjustment proceed as follows:

1. Measuring set-up as described in *section 16*.
2. Connect the probes as shown in *Illustration 16.5.*
3. Slowly increase voltage; observe the oscilloscope and the current consumption during the process.
4. Check the graph and compare with possible graphs as indicated in *Illustrations 16.2.1 - 3.*
   If graph and phase are as indicated in *Illustration*. *16.2.1.,* no modification is necessary.
5. If there is a deviation of the graph as compared to *Illustration 16.2.1.* turn the ferrite core at the adjustment coil. Observe the change of the phase position indicated at the oscilloscope.
6. Check the generator power consumption and compare with the values indicated in the table in *section 16.3.*
   In case of deviation see instructions given in *section 16.2.*
7. Secure the ferrite core after adjustment with silicone etc.

Perfect adjustment

- The transistors do not heat up (one or both).
- There are waves on the surface of the bath.
- There are no streamers on the tank floor.
- The ultrasonic noise is uniform and not shrill.
- The performance changes only little when a beaker, etc. is immersed in the tank.
  The phases remain stable.

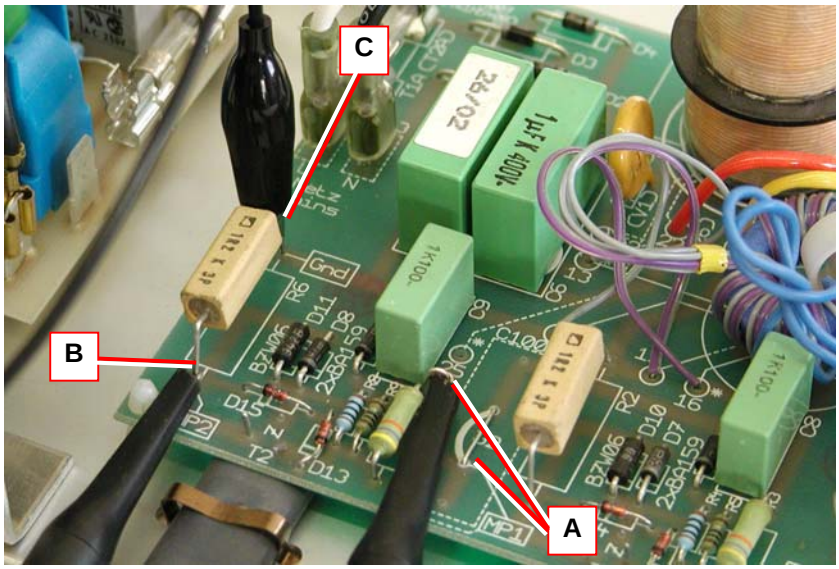


Illustration 16.5.1. Detail view connection probes

A Probe channel 1 – measurement of collector signal (connection probe at fix point / or bridge MP1).

B Probe channel 2 – measurement of emitter signal (connection probe at resistance R6 – on the transistor side MP2).

C Mass connection of probe channel 2 (resistance R6 Gnd).

D Adjustment coil for adjustment: turn ferrite core in or out (according to adjustment instructions).

E Ferrite core of output transformer:
If output too high (compare Table 14.3) slightly turn ferrite core out counter-clockwise.
If output too low (compare Table 14.3) slightly turn ferrite core in clockwise.
Caution: The tip of the screw driver can heat up considerably due to induction.

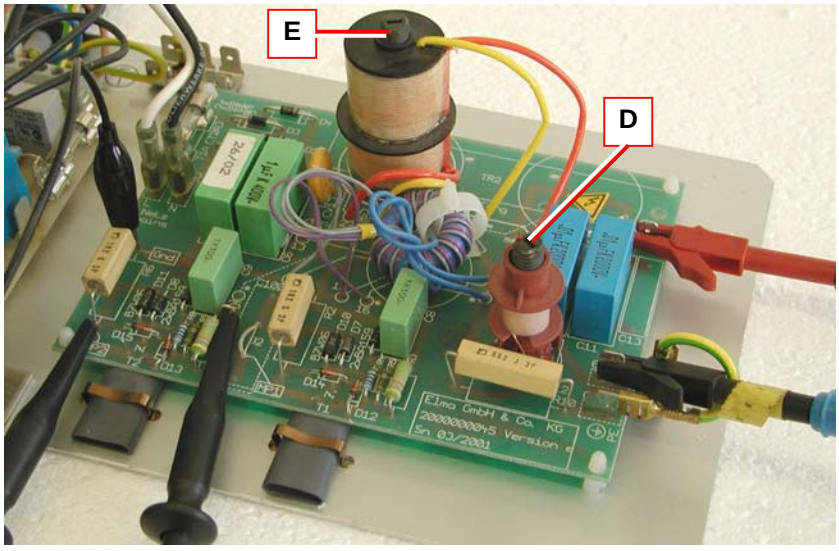
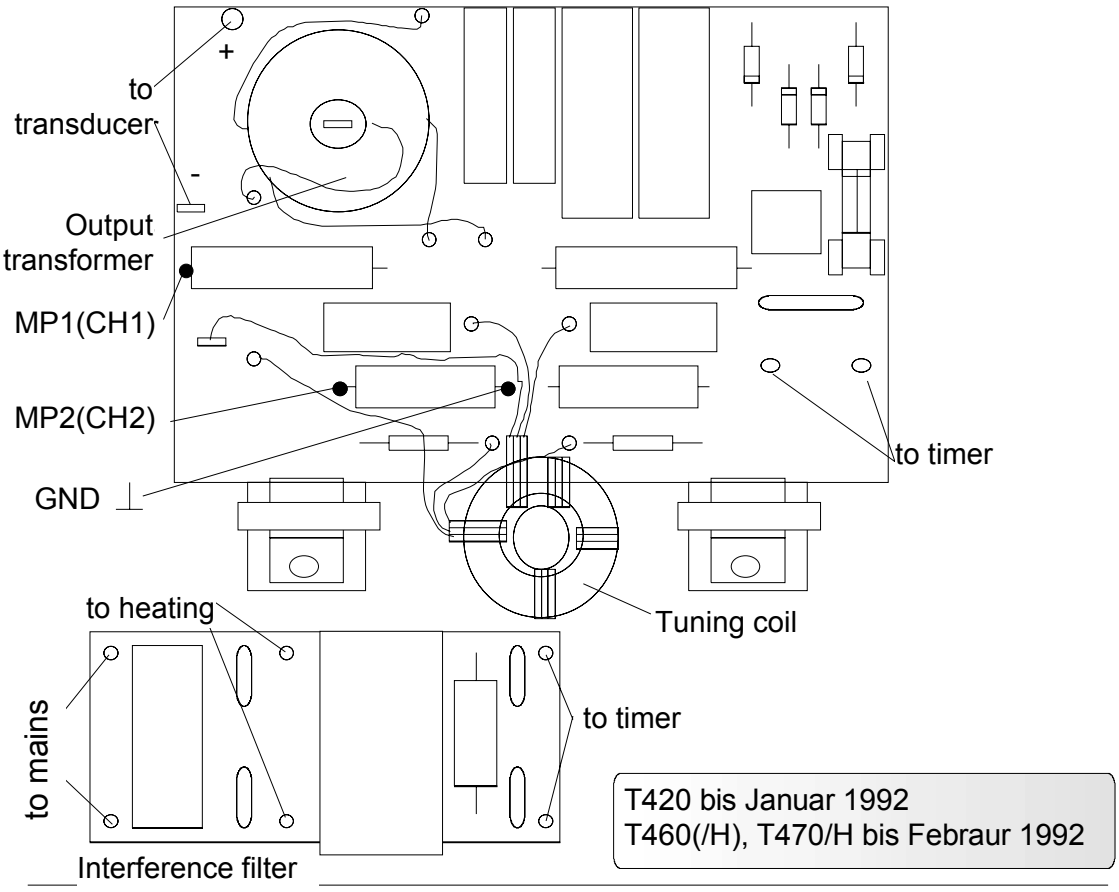


Illustration 16.5.2. Generator print: relevant adjustment points



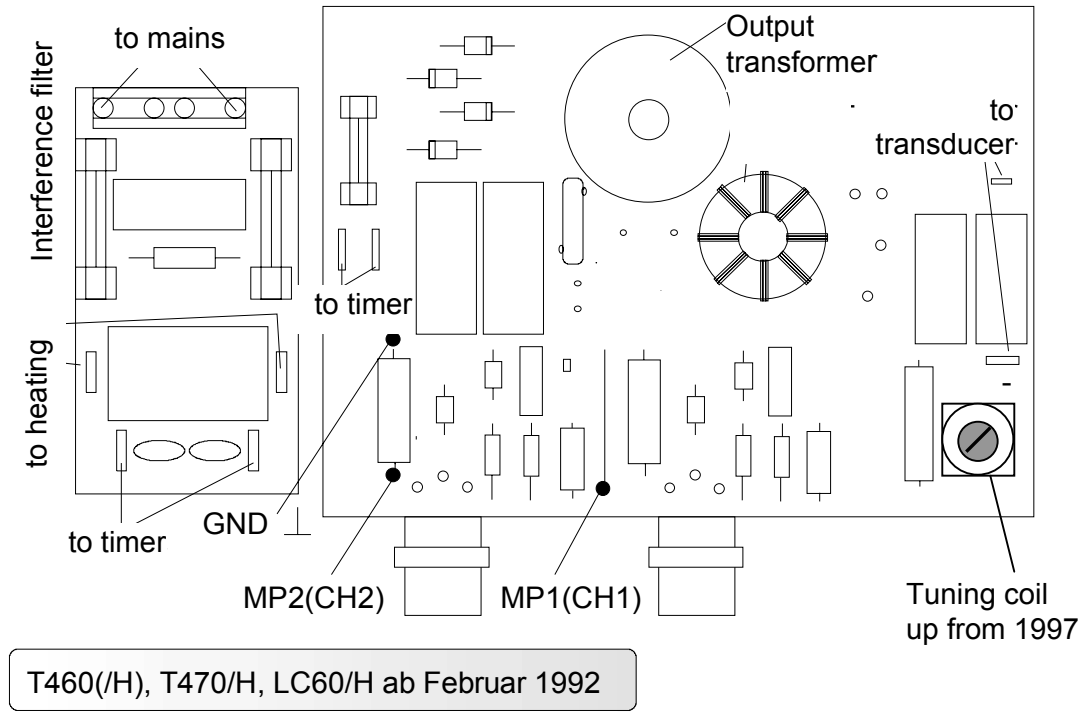


Illustration 16.5.3.
top: units before February 1992
bottom: units since February 1992

16.6 Adjustment on TS540 – T700H; LC130H

Since 1991 the generators have been equipped with an adjustment coil which makes the adjustment of the graphs easier.

Generators made before 1991 are difficult to adjust and can be instable when operated. Technical support for these generators is no longer available.

How to proceed

In order to check the adjustment proceed as follows:

1. Measuring set-up as described in *section 16*.
2. Connect the probes as shown in *Illustration 16.5.*
3. Slowly increase voltage; observe the oscilloscope and the current consumption during the process.
4. Check the graph and compare with possible graphs as indicated in *Illustrations 16.2.1 - 3.*
   If graph and phase are as indicated in *Illustration*. *16.2.1.*, no modification is necessary.
5. If there is a deviation of the graph as compared to *Illustration 16.2.1.* turn the ferrite core at the adjustmen coil. Observe the change of the phase position indicated at the oscilloscope.
6. Check the generator power consumption and compare with the values indicated in the table in *section 16.3.*
   In case of deviation see instructions given in *section 16.2.*
7. Secure the ferrite core after adjustment with silicone etc.

Perfect adjustment

- The transistors do not heat up (one or both).
- There are waves on the surface of the bath.
- There are no streamers on the tank floor.
- The ultrasonic noise is uniform and not shrill.
- The performance changes only little when a beaker, etc. is immersed in the tank.
  The phases remain stable.

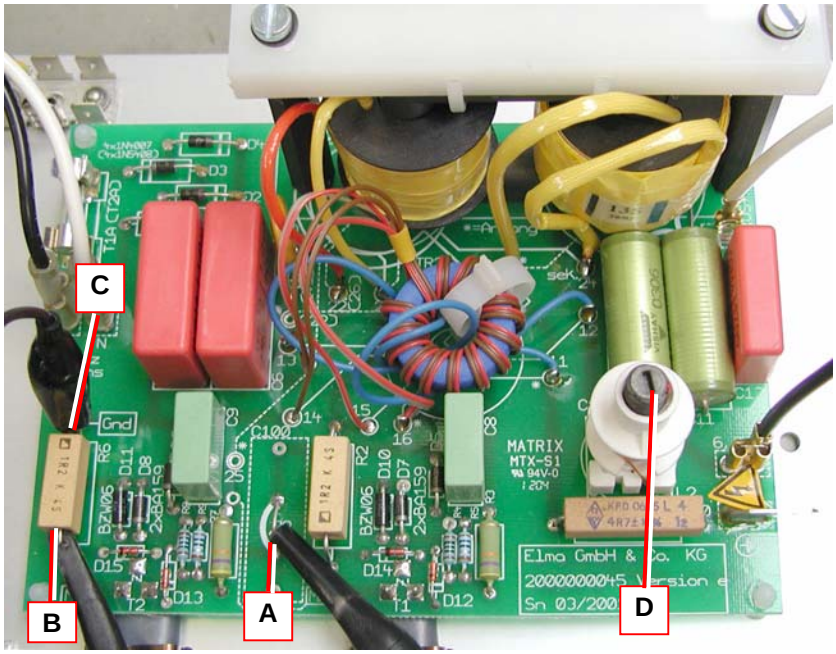


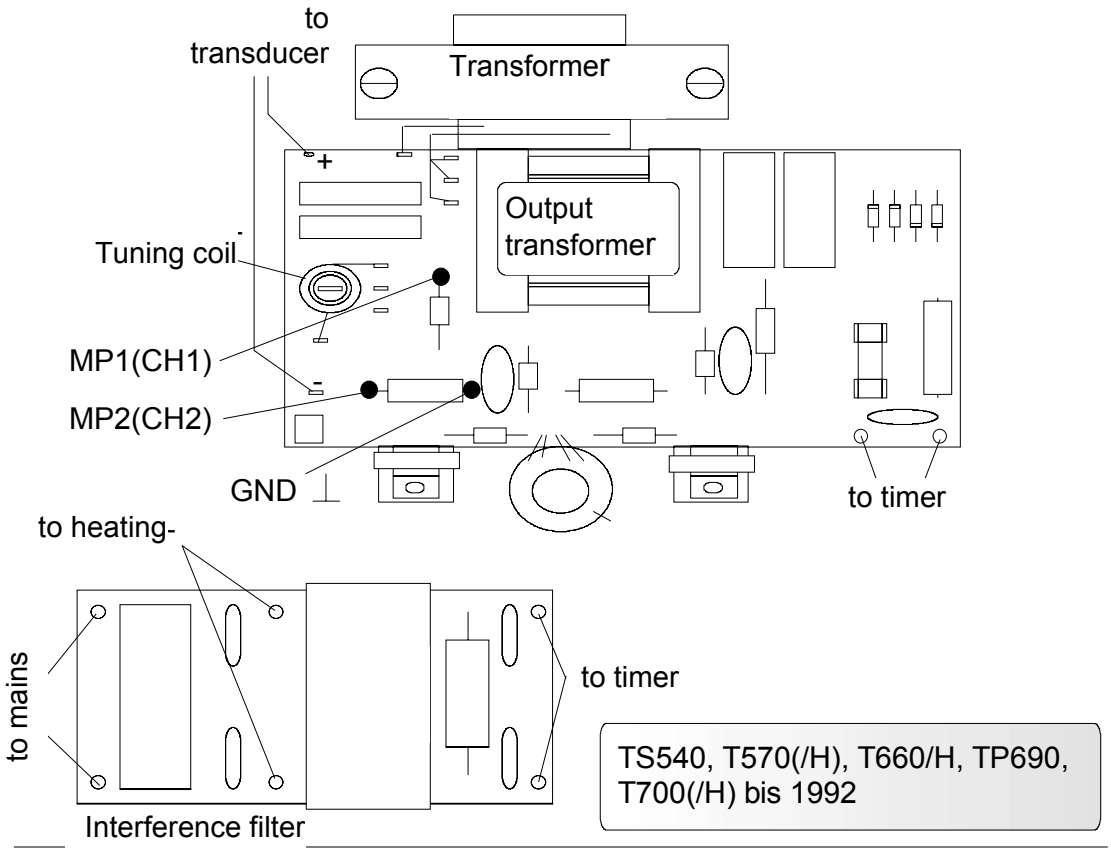
Illustration 16.6.1. Generator print: relevant adjustment points

A Probe channel 1 – measurement of collector signal (connection of probe at soldering fix point / or bridge MP1).

B Probe channel 2 – measurement of emitter signal (connection of probe at resistance R6 – on transistor side MP2).

C Mass connection of probe channel 2 (resistance R6 – Gnd).

D Adjustment coil to carry out adjustment: turn ferrite core in or out (according to instructions).



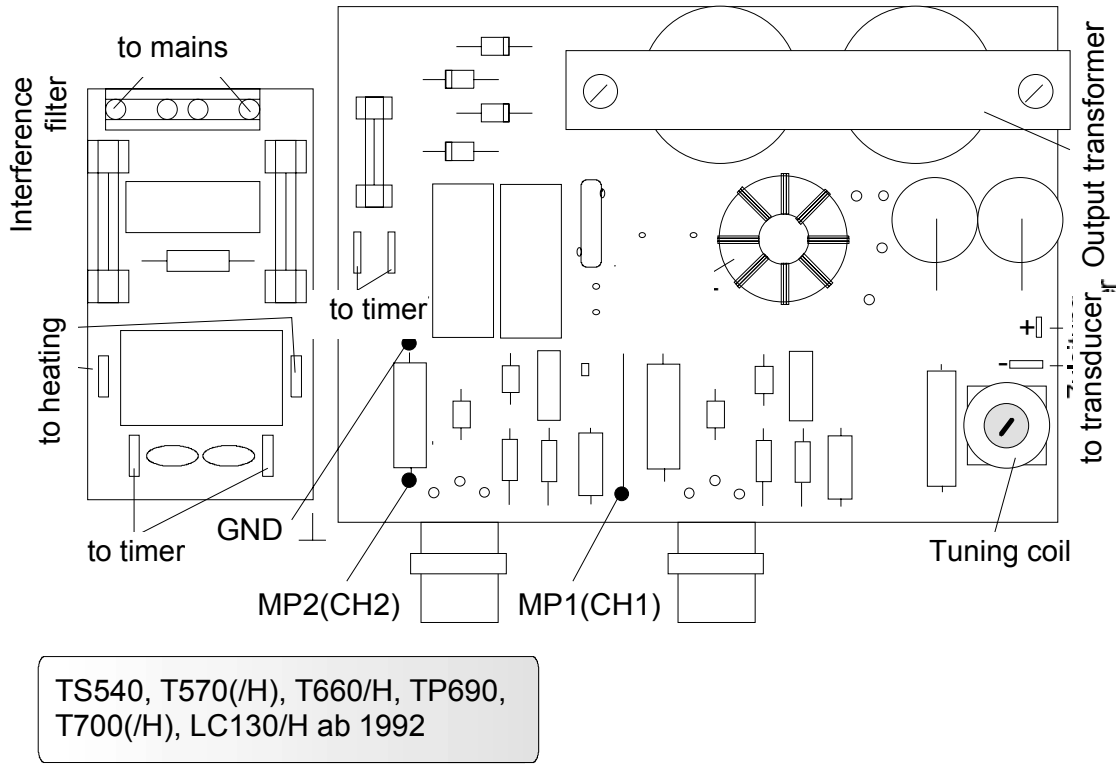


Illustration 16.6.2.
top: units made before February 1992
bottom: units made since February 1992

16.7 Adjustment on T780 – T1060H

Since 1991 the generators have been equipped with an adjustment coil which makes the adjustment of the graphs easier.

Generators made before 1991 are equipped with 4W cement resistances. We recommend retrofitting with an adjustment coil.

How to proceed

In order to check the adjustment proceed as follows:

1. Measuring set-up as described in *section 16*.
2. Connect the probes as shown in *Illustration 16.5.*
3. Slowly increase voltage; observe the oscilloscope and the current consumption during the process.
4. Check the graph and compare with possible graphs as indicated in *Illustrations 16.2.1 - 3.*
   If graph and phase are as indicated in *Illustration*. *16.2.1.*, no modification is necessary.
5. If there is a deviation of the graph as compared to *Illustration 16.2.1.* turn the ferrite core at the adjustment coil. Observe the change of the phase position indicated at the oscilloscope.
   The voltage graph should show a peak of approx. 2 mm width before the decline (*Illustration 16.2.2.*).
6. Check the generator power consumption and compare with the values indicated in the table in *section 16.3.*
   In case of deviation see instructions given in *section 16.2.*
7. Secure the ferrite core after adjustment with silicone etc.

Perfect adjustment

- The transistors do not heat up (one or both).
- There are waves on the surface of the bath.
- There are no streamers on the tank floor.
- The ultrasonic noise is uniform and not shrill.
- The performance changes only little when a beaker, etc. is immersed in the tank.
  The phases remain stable.

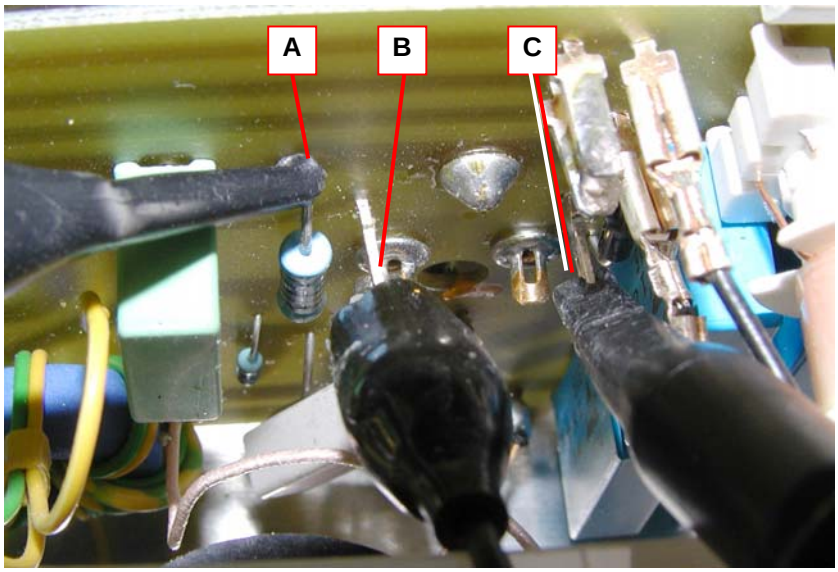


Illustration 16.7.1. Generator print: adjustment measuring points

A Probe channel 1 – measurement of collector signal (connection of probe at upper connection of collector resistance).

B Probe channel 2 – measurement of emitter signal (connection of probe at right measuring point. Caution: do not connect to transistor connection: faulty measuring result).

C Mass connection probe channel 2 (connection of probe at left measuring point. Caution: do not connect to transistor connection: faulty measuring result).

D Adjustment coil for carrying out adjustment: turn ferrite core out or in (according to instructions).

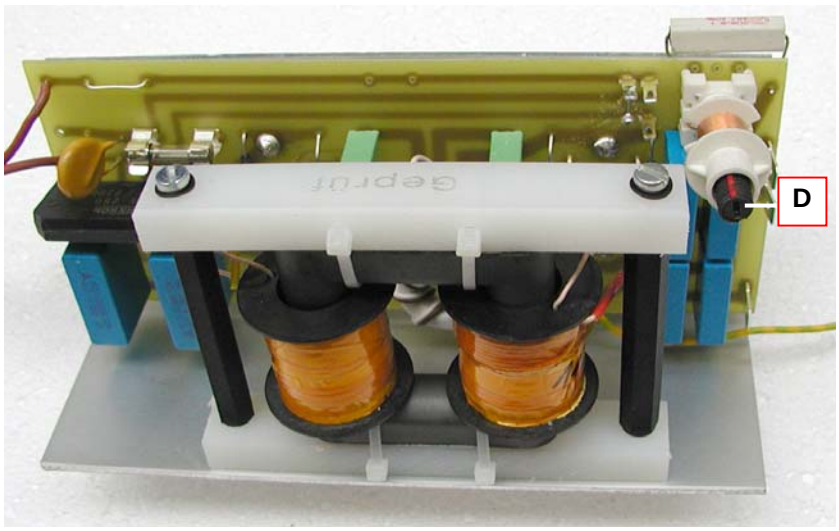


Illustration 16.7.2. Adjustment coil, latest model. Older units can be equipped with adjustment coils of the former model. The model of the coil has no influence on the functioning of the unit.

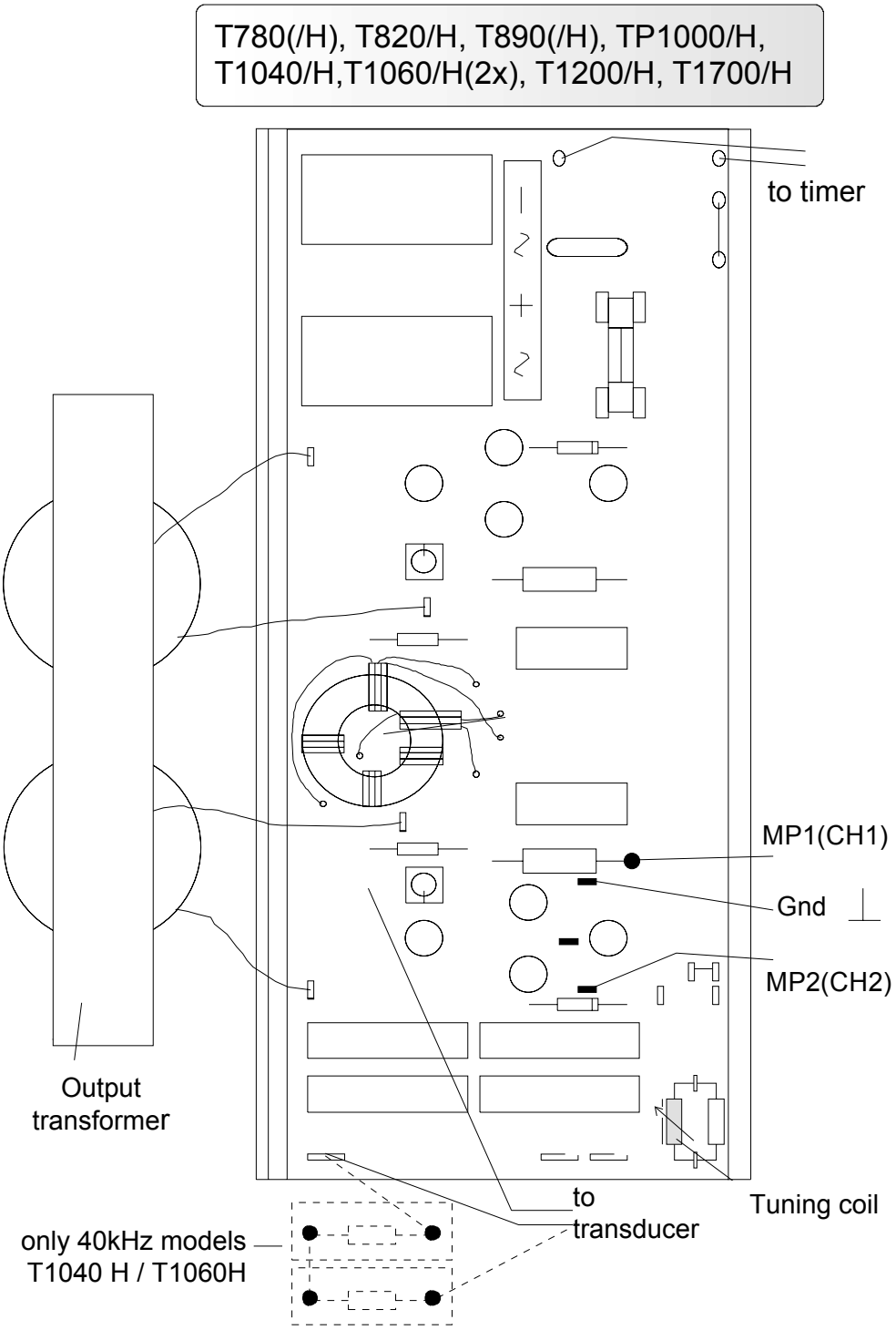


Illustration 16.7.3.
Model with and without additional capacitors.

17 Putting into operation / Trial run

For checking and trial operation of the unit after repair please observe the instructions given in this section. We recommend a trial run over several hours (approx. 3 – 4 h) after repair.

Place the unit on a dry and stable workplace. Ensure that the workplace is sufficiently ventilated!

CAUTION

Risk of electrocution due to entering humidity!
Keep the unit dry.

The unit inside is splash-proof. To prevent electrical accidents and damage keep the workplace and the unit housing dry.

Ambient conditions

- Allowed ambient temperature during operation: +5°C to +40°C
- Allowed relative humidity of air during operation: 80%
- No condensation allowed

Mains connection

The unit must be connected to a shockproof socket only.

17.1 How to fill cleaning liquid

Observe filling level

Fill the cleaning tank of the unit with a sufficient quantity of liquid before switch-on.

NOTE

Dry running of the transducer tank can damage the unit.

Ensure that the cleaning tank is correctly filled during operation (mark on the tank wall).

Suitable cleaning media

Make sure that the selected cleaning chemical is perfectly suitable for the use in an ultrasonic bath and follow the instructions on dosage and material compatibility.

Prohibited cleaning media

In general, flammable products are not allowed. Observe the safety warnings in *section 17.2.*

The sefety warnings include instructions on limitations concerning cleaning media in *section 17.2.*

How to degas the liquid

Fresh cleaning liquid is saturated with air which impairs the cleaning effect of the ultrasonic activity. Sounding the liquid over a period of several minutes before the actual cleaning process is started will eliminate the microscopic air bubbles from the liquid.

17.2 Cleaning media

When choosing the cleaning chemical ensure that it is suitable for the use in an ultrasonic bath, as wrong cleaning media can damage the transducer tank.

CAUTION

Risk of fire and explosion!

Do not use flammable liquids, e.g. solvents, directly in the ultrasonic cleaning tank.

Ultrasonic activity increases the vapourization of liquids and creates fine vapours which can ignite on any ignition source.

NOTE

Risk of damage to the transducer tank!

Do not use acid cleaners directly in the stainless-steel tank (pH value below 7), if at the same time halogenides (fluorides, chlorides or bromides) will be removed from the cleaning items or the cleaning liquid.
The same applies to solvents containing NaCl solutions.

The stainless-steel tank can be damaged by crevice corrosion within a short period. These substances can be contained in household cleaners.

If in doubt please contact your distributor or the manufacturer.

17.3 How to heat up the cleaning liquid

Depending on the kind of contamination and on the used cleaning chemical we recommend to heat up the cleaning liquid.

Turn the heating switch to position “on”

Activate the heating switch. The yellow pilot lamp „heating“ turns on.

Temperature control at thermostat

Choose the required cleaning temperature. The tank must be filled half (minimum). The optimum filling level is marked on the tank wall.

In order to achieve an even heating of the cleaning liquid switch on the ultrasound from time to time or stir the liquid by hand.

17.4 Check ultrasound

After switch-on the liquid must be degassed to remove the oxygen. With the ultrasound switched on, this takes approx. 5 – 10 minutes depending on the size of the unit.

Visual check

After degassing there should be waves visible on the surface of the cleaning bath.

There must not be any streamers on the floor of the cleaning tank (floor cavitation).

Power consumption

The power consumption of the ultrasound can be measured with a standard wattmeter (observe measuring range). Compare the measured values with the values given in the table in *section 15.3*.
For this test the heating remains switched off.

Aluminum sheet test

There is a simple method to check the ultrasonic effect in the cleaning liquid: cavitational check with an aluminum sheet.

Cut a piece of the size and shape of the transducer tank from a roll of a standard aluminum foil.

Put this sheet vertically into the liquid for 1 minute with the ultrasound switched on. The ultrasound will tear pieces out of the sheet. The size of the torn holes indicates the zones of different cleaning intensity in the cleaning tank. It is normal that the number of holes is bigger around the transducer elements.

18 Putting out of operation and disposal

The components can be given to electronic and metal recycling stations or returned to the manufacturer for the same purpose.

19 Manufacturer contact address

Elma Hans Schmidbauer GmbH & Co. KG

Kolpingstr. 1-7, D-78224 Singen
Phone:++49 (0) 7731 882-0
Fax:++49 (0) 7731 882-266
E-mail: info@elma-ultrasonic.com

Visit our homepage. Your will find helpful information on our large product range:

www.elma-ultrasonic.com

Do you have any queries or suggestions concerning the present unit, its use or the Service Manual? Please let us know. We will be glad to assist.

Technical Support

Phone: ++49 (0) 7731 882-280
Fax: ++49 (0) 7731 882-253
E-mail: support@elma-ultrasonic.com

20 Conclusion

If you have problems in finding or repairing a fault we recommend to return the unit to the supplier or manufacturer for inspection and repair.

Please include a short note describing the original cause of the malfunction and which repair works you have carried out.

21 Annex

21.1 Annex A – Circuit diagrams

Please contact the manufacturer for any circuit diagram you may require.

21.2 Annex B – Spare parts lists

Please contact the manufacturer for any spare parts list you may require.

Spare parts can be ordered from Elma or from your supplier.

Please make sure to indicate the type of unit and the serial number (nameplate).