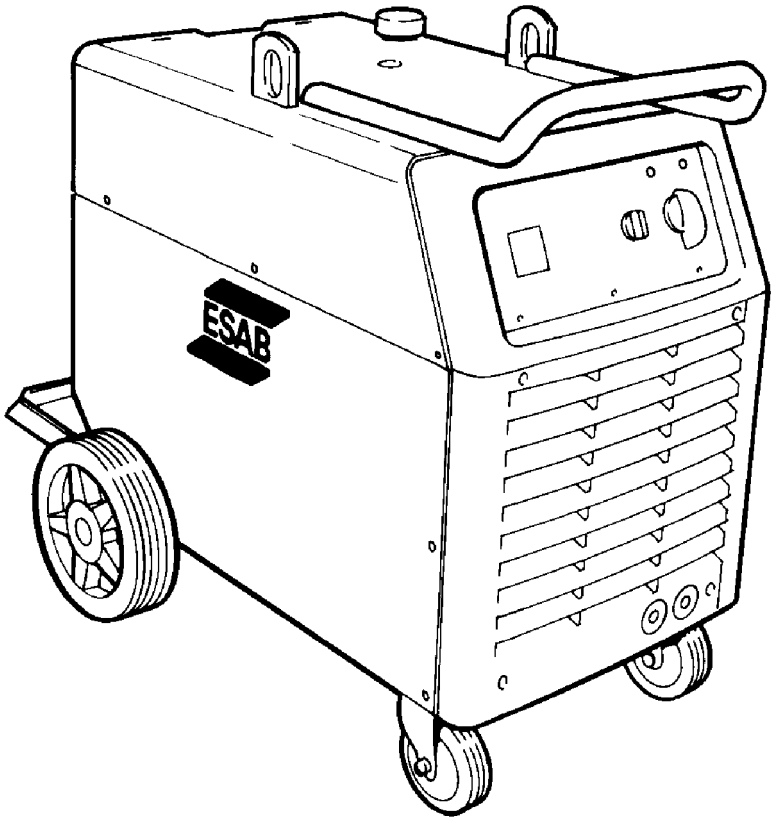
LAW 400/500
LAW 410/510

Welding rectifier



Service manual

0740 800 025 9708

LIST OF CONTENTS Page

READ THIS FIRST

This service manual is intended for use by technicians with electrical/electronic training, for help in connection with fault-tracing and/or repair.

Use the connection diagram as a form of index for the description of operation and the component description. The circuit board is divided into numbered blocks, which are described individually in more detail in the description of operation. All component names in the connection diagram are listed in the component description.

This manual contains details of all design changes that have been made up to and including August 1997.

The LAW 400/500 and 410/510 are designed and tested in accordance with international standard
EN 60 974-1 (IEC 974-1).
On completion of any service or repair, it is the responsibility of the person or organisation performing the service to ensure that the product still complies with the above standard.

WARNING

ARC WELDING AND CUTTING CAN BE INJURIOUS TO YOURSELF AND OTHERS. TAKE PRECAUTIONS WHEN WELDING. ASK FOR YOUR EMPLOYER'S SAFETY PRACTICES WHICH SHOULD BE BASED ON MANUFACTURERS' HAZARD DATA.

ELECTRIC SHOCK - Can kill
- Install and earth the welding unit in accordance with applicable standards.
- Do not touch live electrical parts or electrodes with bare skin, wet gloves or wet clothing.
- Insulate yourself from earth and the workpiece.
- Ensure your working stance is safe.

FUMES AND GASES - Can be dangerous to health
- Keep your head out of the fumes.
- Use ventilation, extraction at the arc, or both, to keep fumes and gases from your breathing zone and the general area.

ARC RAYS - Can injure eyes and burn skin.
- Protect your eyes and body. Use the correct welding screen and filter lens and wear protective clothing.
- Protect bystanders with suitable screens or curtains.

FIRE HAZARD
- Sparks (spatter) can cause fire. Make sure therefore that there are no inflammable materials nearby.

NOISE - Excessive noise can damage hearing
- Protect your ears. Use ear defenders or other hearing protection.
- Warn bystanders of the risk.

MALFUNCTION - Call for expert assistance in the event of malfunction.

READ AND UNDERSTAND THE INSTRUCTION MANUAL BEFORE INSTALLING OR OPERATING.

PROTECT YOURSELF AND OTHERS!

COMPONENT DESCRIPTION LAW 400/500

The LAW welding rectifiers 500 are 6-pulse thyristor rectifier units intended for semi-automatic welding. They are available for different mains voltages and with or without integral cooling units: see the table in the spare parts list on page 55. The component description below refers to the electrical circuit diagrams on page 6 to 12.

AP1 Circuit board with control electronics: see the function description on page 18.

AP2 Suppression circuit board, see circuit diagram on page 30. AP2 has been fitted with effect from machine no. 550 . . . . . .

C1 Capacitor, 3 µF 400 V. Start and run capacitor for fan motor EV1.

C2-C4 Suppression capacitors 0.1 µF 250 V.

C5 Capacitor, 5 µF 400 V. Start and run capacitor for pump motor M1. Only in machines with water cooler.

C6 Capacitor, 6 µF 400 V. For speed reduction of the cooling fan. This capacitor has been fitted with effect from machine no. 512 . . . . . .

EV1 Fan

FU1 Circuit breaker, 10 A. Protects the 42 V supply to the wire feed unit.

HL1 Indicating lamp, 42 V, white. Lights when switch QF1 is in the ON position.

KM2 Contactor 42 V 50 Hz. For speed control of the fan: see ST2 below. This capacitor has been fitted with effect from machine no. 512 . . . . . .

L1 Interphase transformer. **When connecting the interphase transformer to the inductor, it is important that all parts are fitted exactly as shown in Figure A on page 49.**

L2 Inductor. **When connecting the inductor, it is important that all parts are fitted exactly as shown in Figures A, C and D on page 49.**

M1 Pump motor, 230 V 50 Hz 0.2 kW. Only in machines with water cooler.

P1 Digital display. Accessory, see the list on page 40. The instrument is described in the service manual for the MEK 4.

QF1 Main ON/OFF switch.

QF2 Cooling water pump switch. Only on machines with water cooler.

R1 Resistor, 0.43 Ω

RS1 Shunt, 60 mV / 600 A

ST1 Thermal overload cutout. Protects the machine against excessive temperature. See the function description, item 6, on page 21.

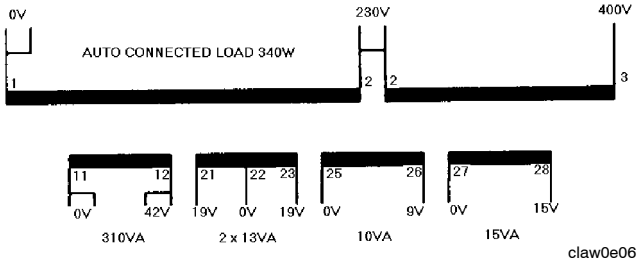
ST2 Thermal switch. Controls the speed of fan motor EV1. The switch closes when the temperature exceeds 80 °C, energising contactor KM2. This short-circuits capacitor C6, allowing the fan to run at full speed. The switch opens when the machine temperature has fallen to 60 °C.

LAW 400/410: ST2 is fitted in the interphase transformer winding, L1.

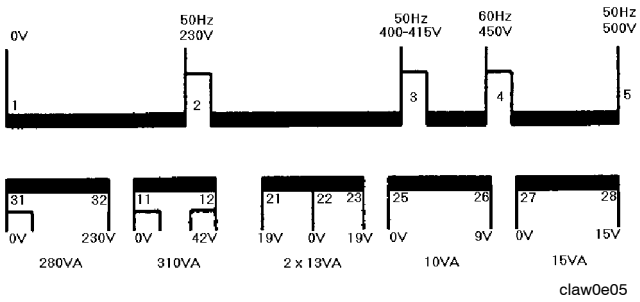
LAW 500/510: ST2 is fitted in the inductor winding, L2.

Thermal switch ST2 is fitted from machine no. 512 . . . . . .

TC1 Control power supply transformer for LAW with 400-415V mains voltage.



TC1 Control power supply transformer for LAW with 230-500V mains voltage.



TM1 Main transformer. Connection instructions for the LAW 400/500 and LAW 410/510 with 230 - 500 V mains connection are on page 38.

V1-V6 Thyristor module. See the fault-tracing instructions on page 26 and the fitting instructions on page 33.

V7 LED, yellow. Lights to indicate operation of the thermal cutouts.

XS1 Connector, 23-pole. For connection to/from the wire feed unit.

XS2-XS4 Main welding current contact, single-pole.

XS5-XS8 Sleeve contacts

XS9 4-pole contact. Only on the LAW 500/510.

XS10-XS15 Sleeve contacts

XT1 9-pole terminal block. Only on machines with 230 - 500 V mains connection. See the connection instructions on page 38.

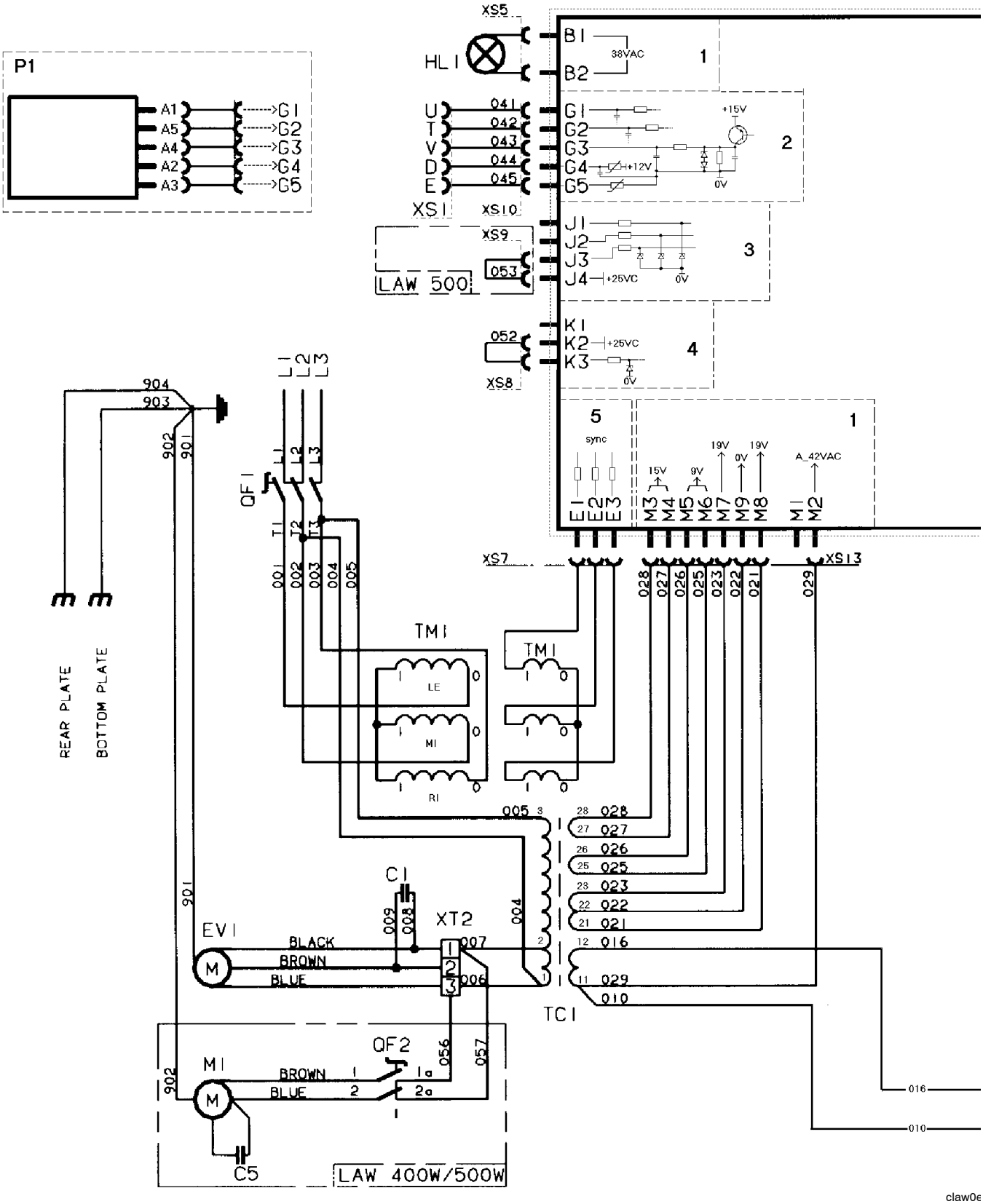
XT2 3-pole terminal block.

Z1-Z6 RC filter.

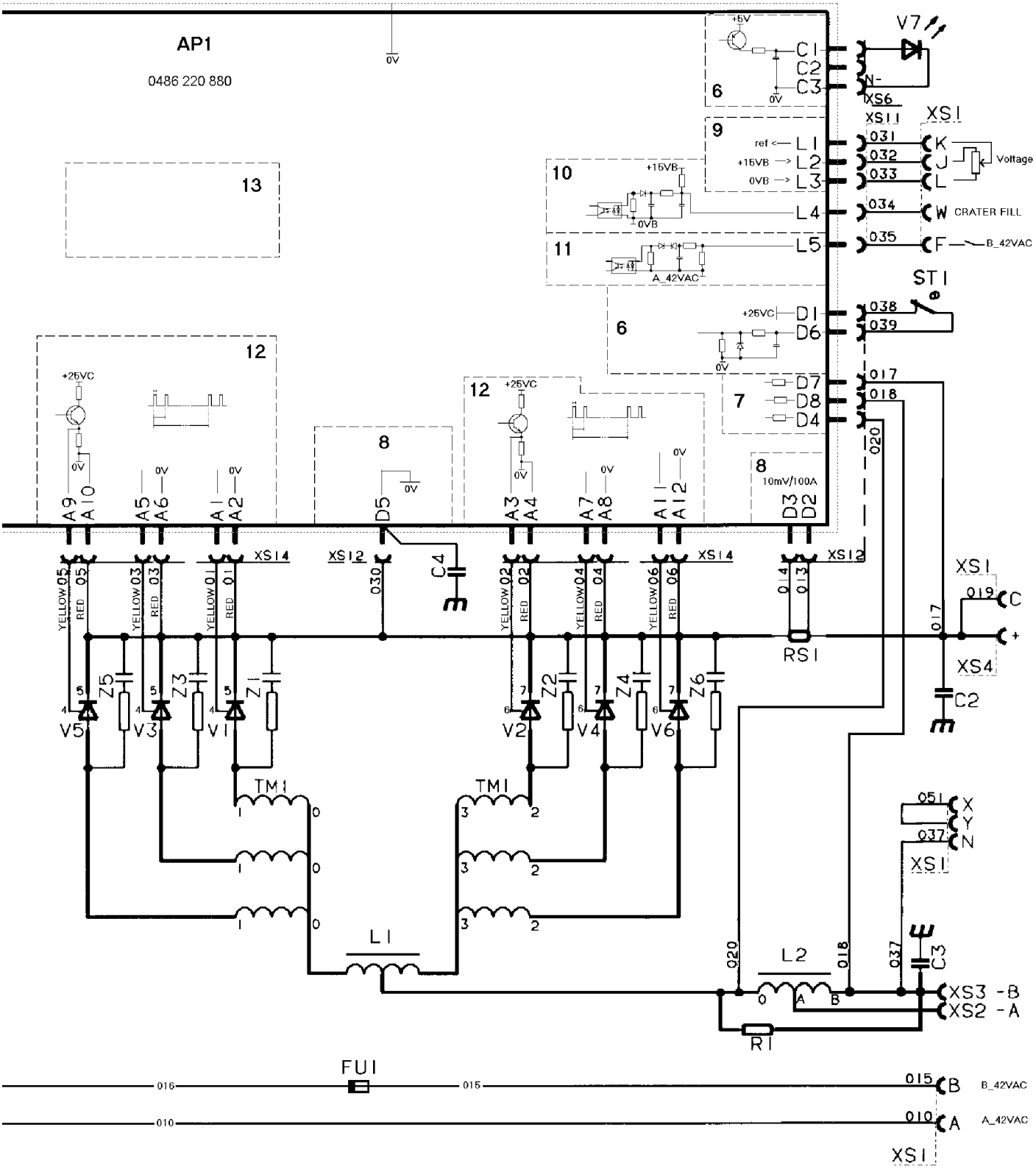
CONNECTION DIAGRAM, LAW 400/500 400-415 V

Valid for machine number 434 . . . . . .

469 686-S1



claw0de1



1 POWER SUPPLY
2 DISPLAY OUTPUT
3 MACHINE TYPE / TEST INPUT
4 CONTROLLED / FIXED FIRING ANGLE
5 SYNCHRONISING
6 THERMAL OVERLOAD CUTOUT
7 ARC VOLTAGE
8 SHUNT INPUT
9 VOLTAGE REFERENCE
10 CRATER FILL
11 START / STOP
12 THYRISTOR CIRCUITS
13 PROCESSOR

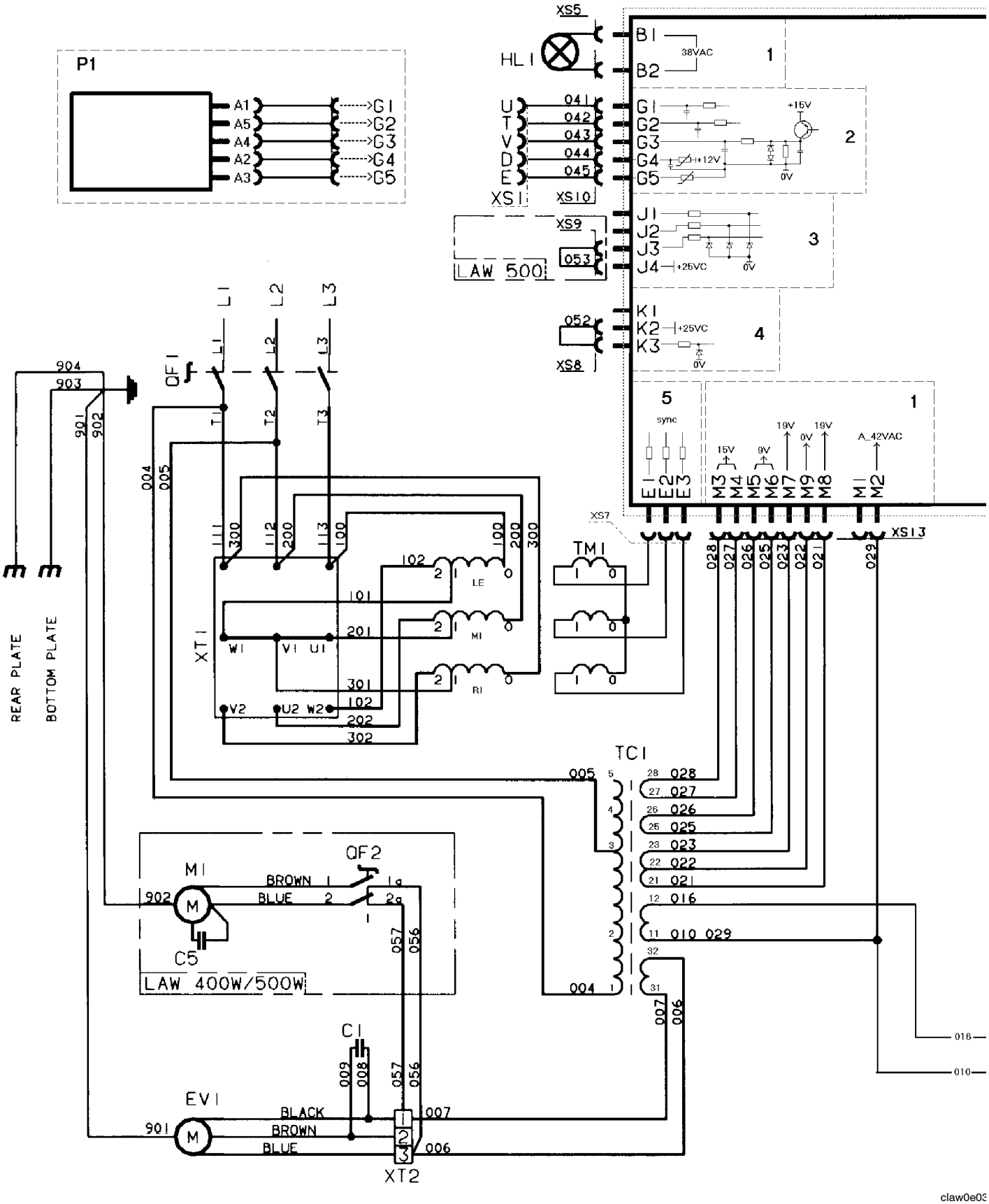
claw0e02

The numerals 1 – 13 refer to the function description on page 18.

CONNECTION DIAGRAM, LAW 400/500 230-500 V

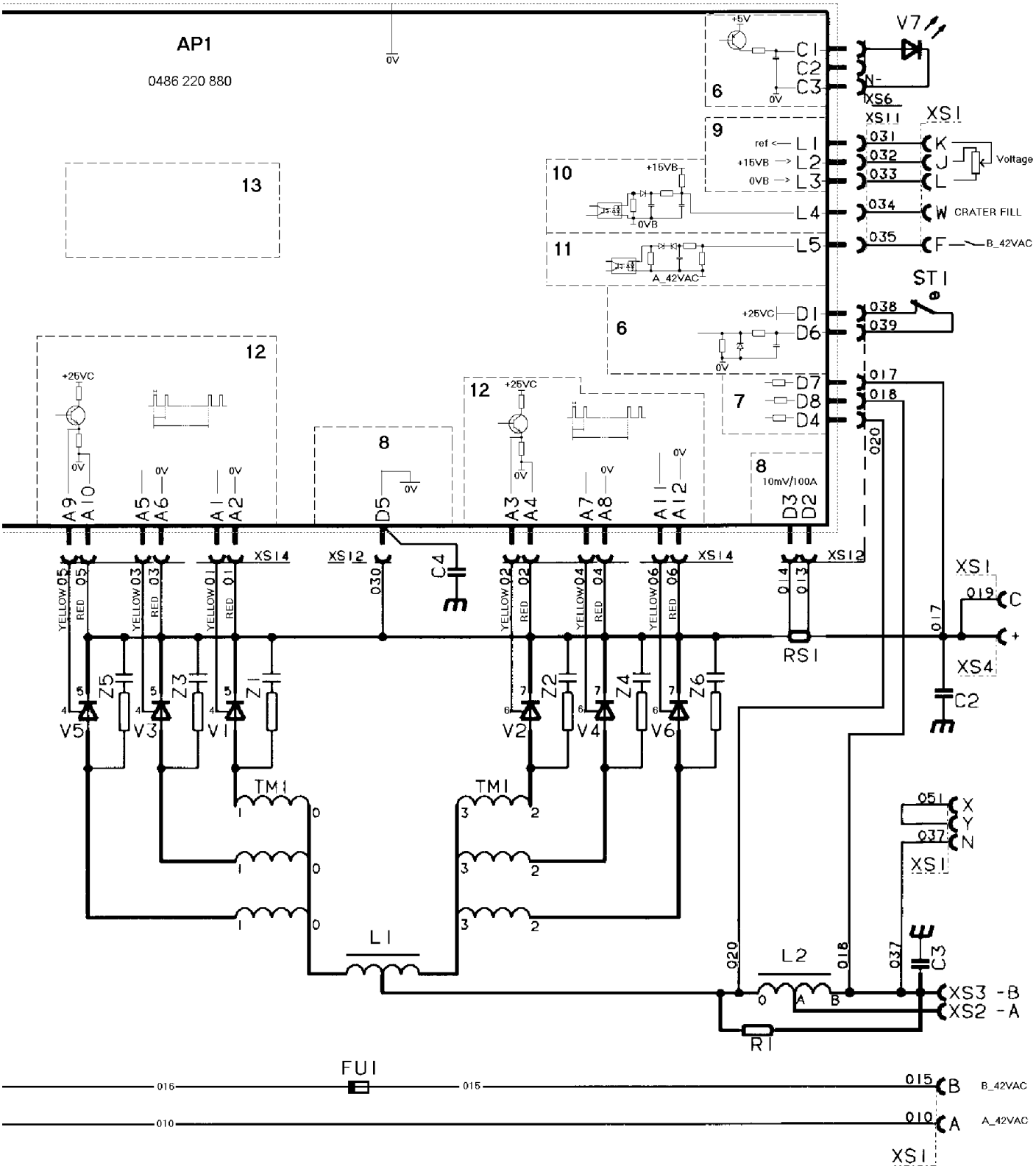
Valid for machine number 434 . . . . . .

469 687-S1



claw0e03

Terminal block XT1 and transformer TC1 are connected for 400 - 415 V 50 Hz: see the connection instructions on page 38.



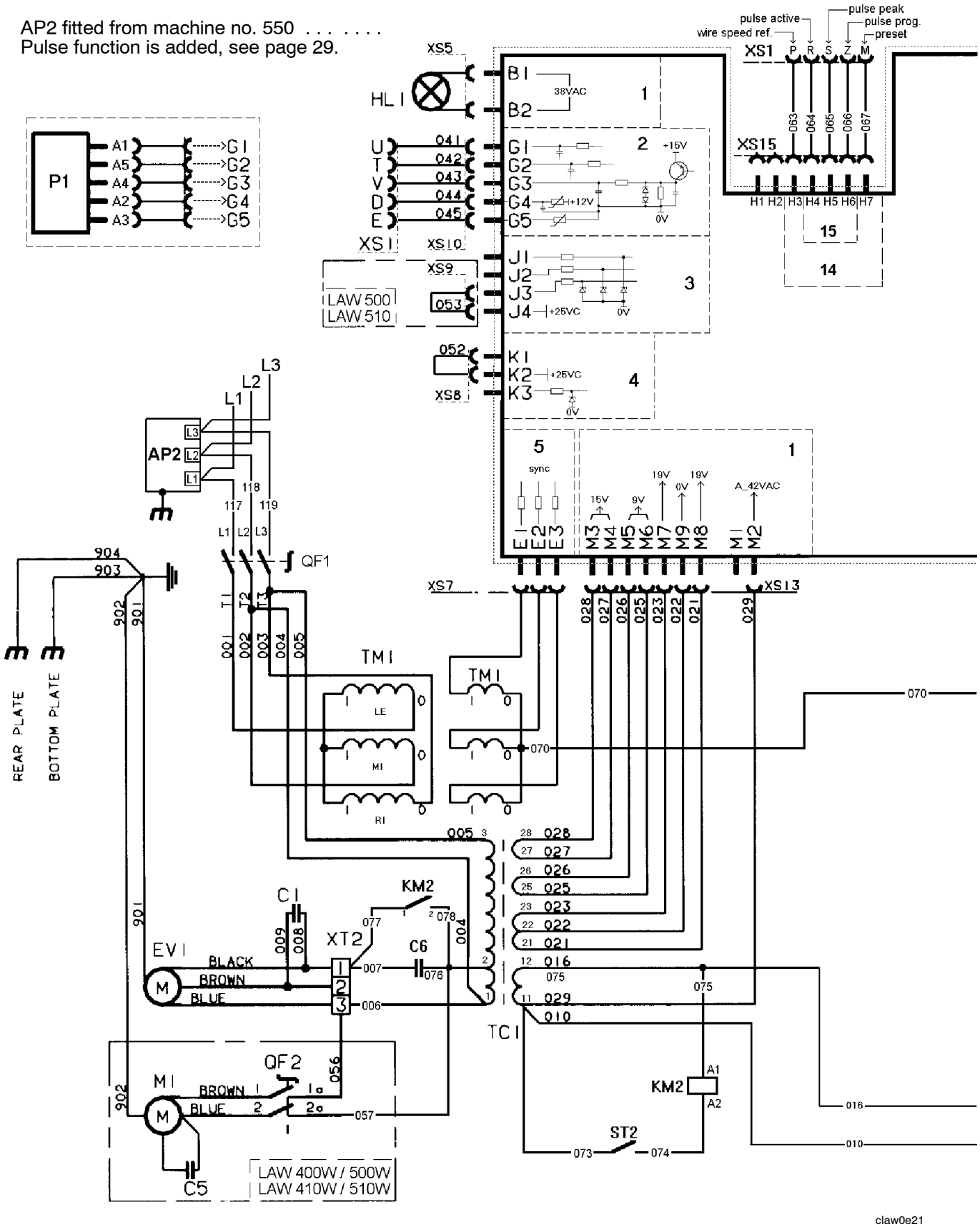
1 POWER SUPPLY
2 DISPLAY OUTPUT
3 MACHINE TYPE / TEST INPUT
4 CONTROLLED / FIXED FIRING ANGLE
5 SYNCHRONISING
6 THERMAL OVERLOAD CUTOUT
7 ARC VOLTAGE
8 SHUNT INPUT
9 VOLTAGE REFERENCE
10 CRATER FILL
11 START / STOP
12 THYRISTOR CIRCUITS
13 PROCESSOR

The numerals 1 – 13 refer to the function description on page 18.

CONNECTION DIAGRAM, LAW; 400-415 V

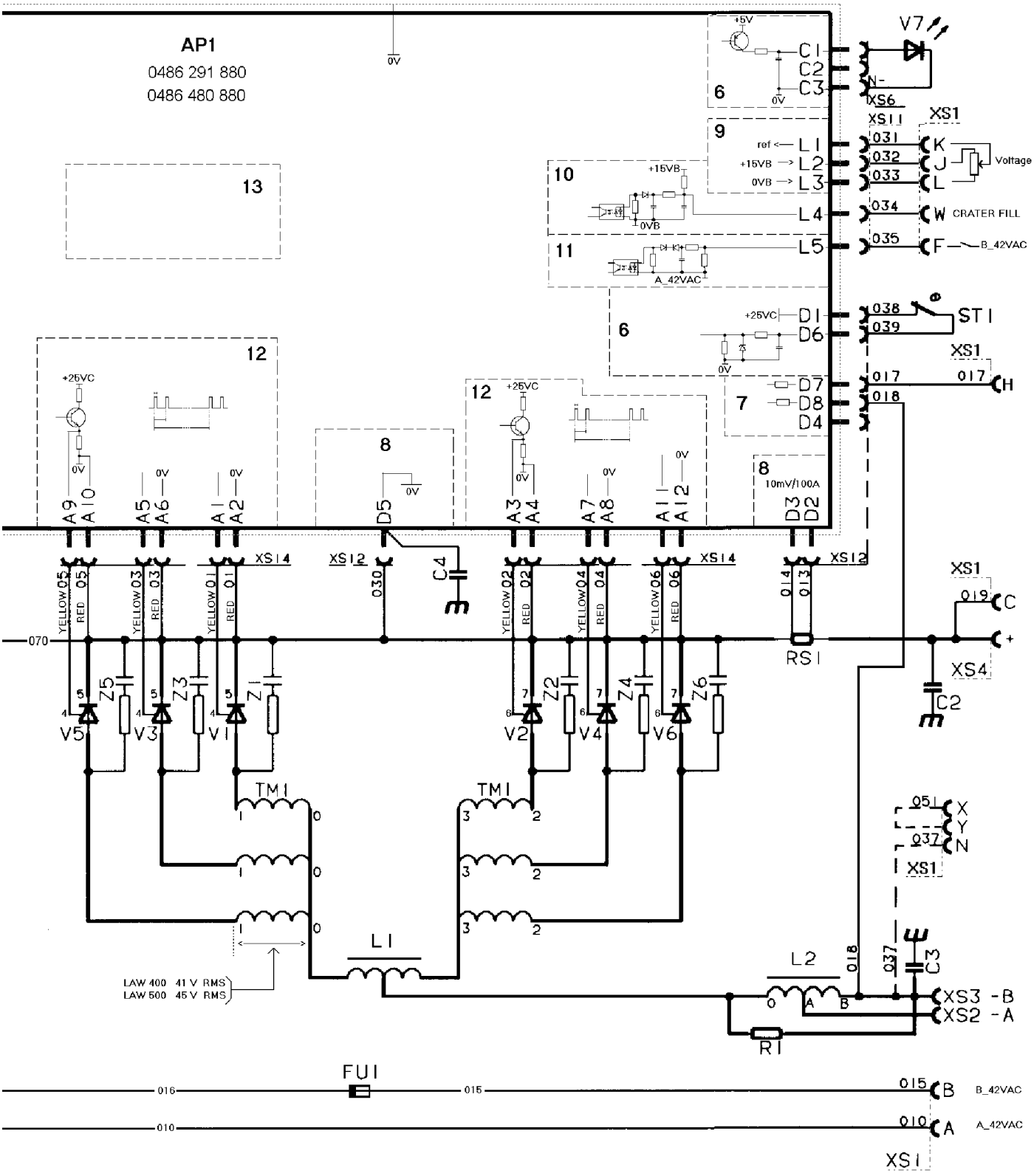
Valid from machine number 512 . . . . . .

AP2 fitted from machine no. 550 . . . . . .
Pulse function is added, see page 29.



claw0e21

claw0de1



1 POWER SUPPLY
2 DISPLAY OUTPUT
3 MACHINE TYPE / TEST INPUT
4 CONTROLLED / FIXED FIRING ANGLE
5 SYNCHRONISING
6 THERMAL OVERLOAD CUTOUT
7 ARC VOLTAGE
8 SHUNT INPUT
9 VOLTAGE REFERENCE
10 CRATER FILL
11 START / STOP
12 THYRISTOR CIRCUITS
13 PROCESSOR
14 PRESET
15 PULSE

The numerals 1 – 15 refer to the function description on page 18.

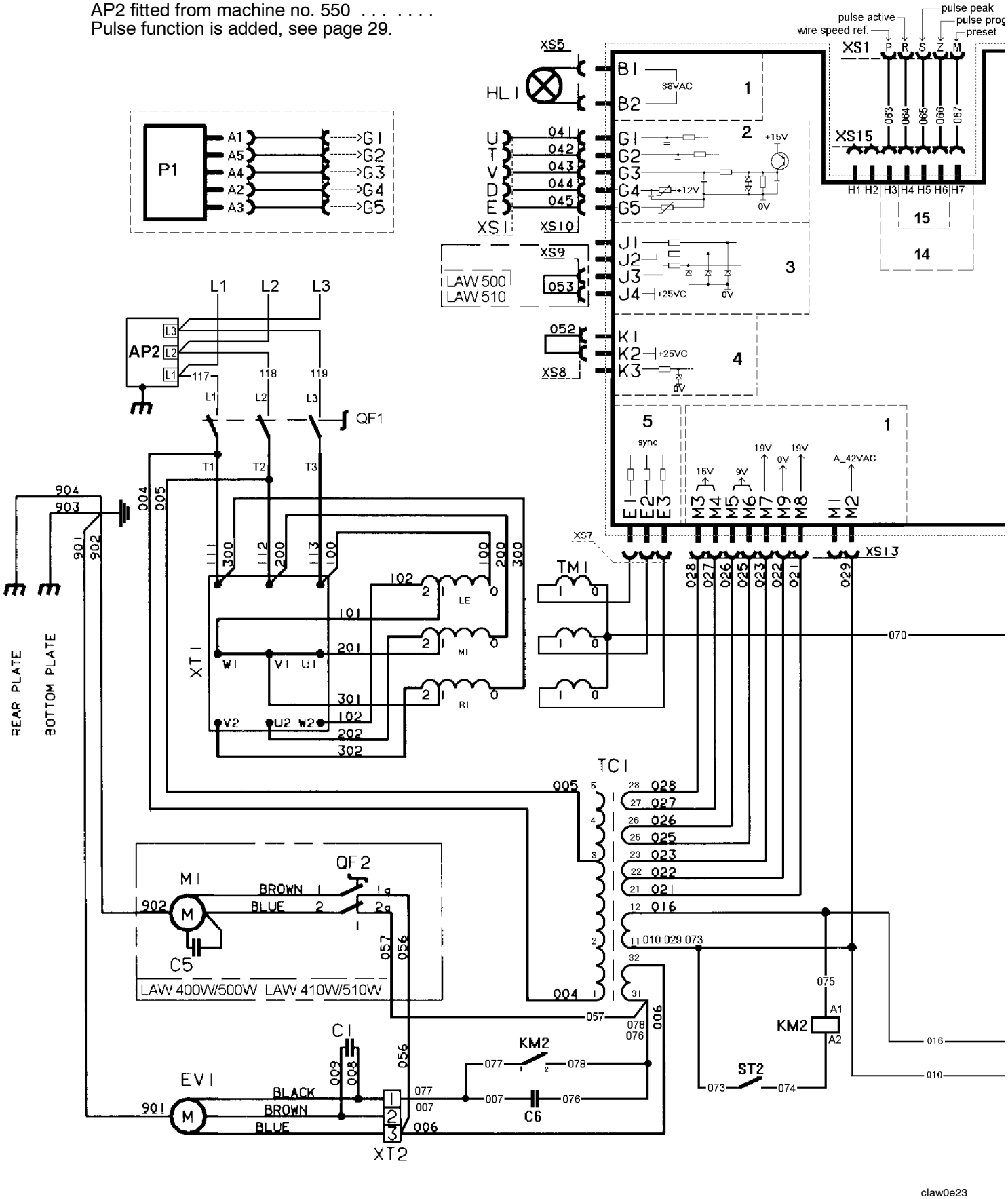
claw0e22

claw0de1

CONNECTION DIAGRAM, LAW; 230-500 V

Valid from machine number 512 . . . . . .

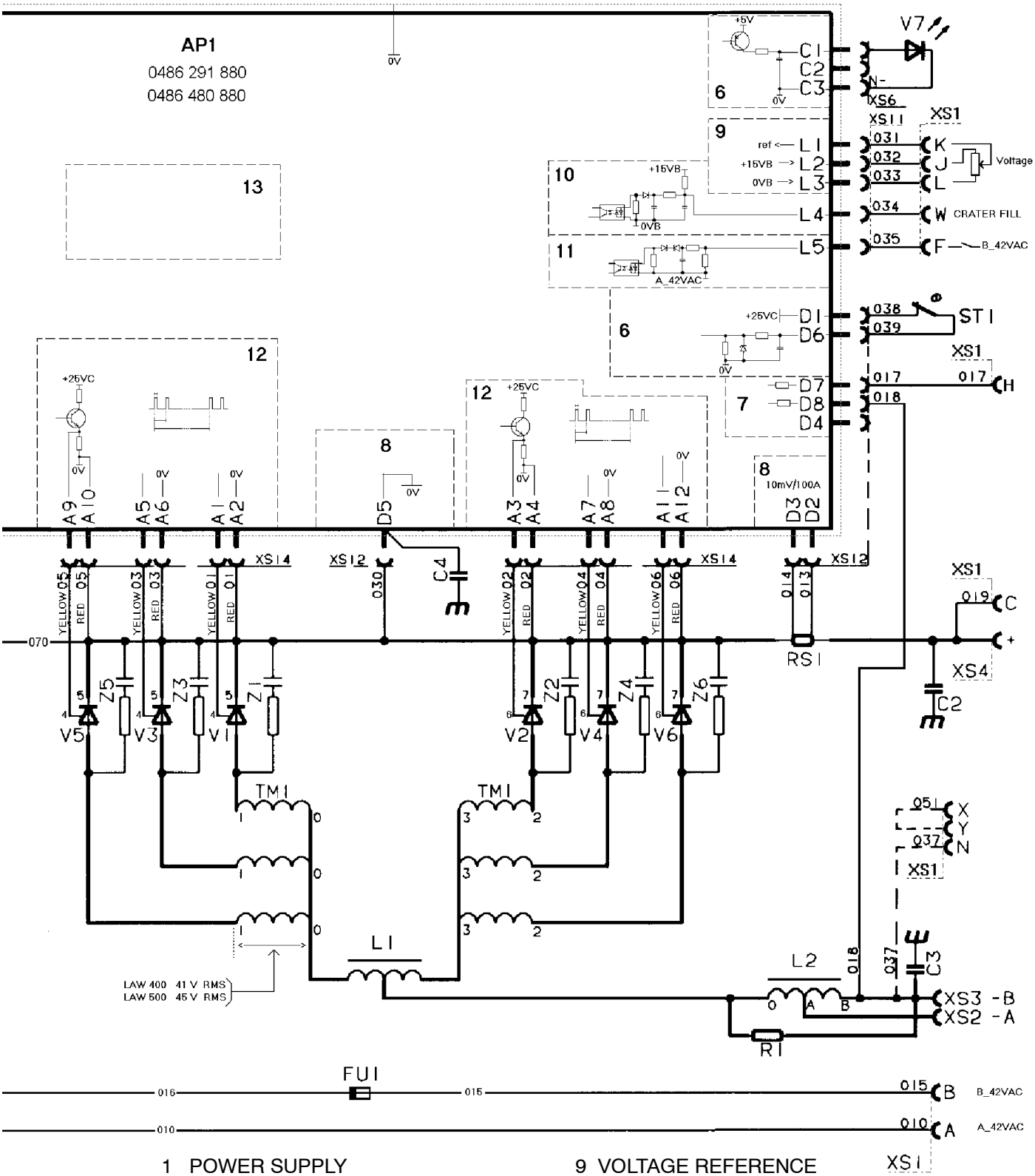
AP2 fitted from machine no. 550 . . . . . .
Pulse function is added, see page 29.



claw0e23

Terminal block XT1 and transformer TC1 are connected for 400 - 415 V 50 Hz: see the connection instructions on page 38.

claw0de1



1 POWER SUPPLY
2 DISPLAY OUTPUT
3 MACHINE TYPE / TEST INPUT
4 CONTROLLED / FIXED FIRING ANGLE
5 SYNCHRONISING
6 THERMAL OVERLOAD CUTOUT
7 ARC VOLTAGE
8 SHUNT INPUT
9 VOLTAGE REFERENCE
10 CRATER FILL
11 START / STOP
12 THYRISTOR CIRCUITS
13 PROCESSOR
14 PRESET
15 PULSE

The numerals 1 – 15 refer to the function description on page 18.

claw0e22

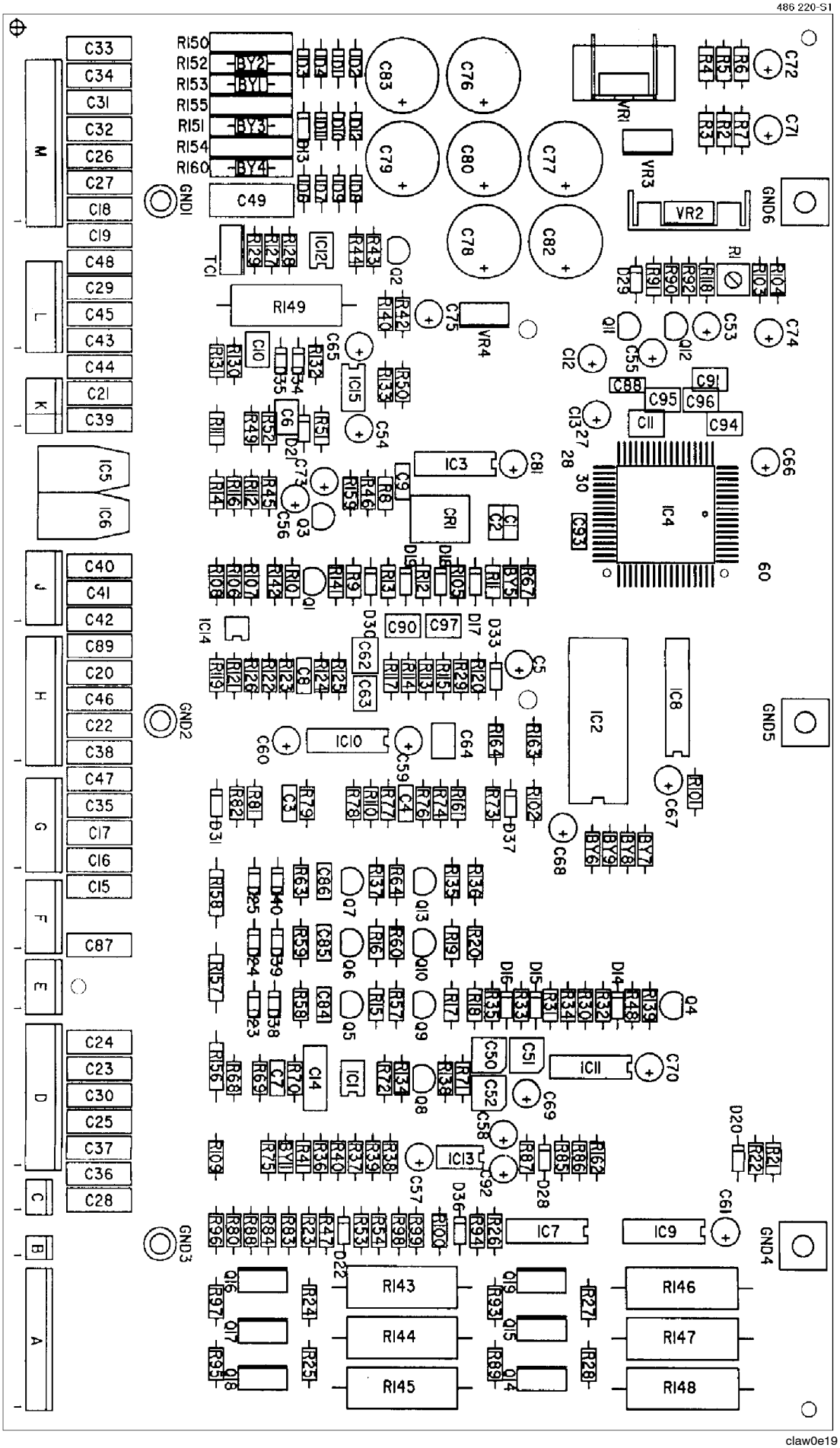
claw0de1

claw0de1

AP1 COMPONENT POSITIONS

Circuit board with part no. 0486 220 880

Points GND1 – GND6 are connected to the screen casing and to the electronic neutral, 0V

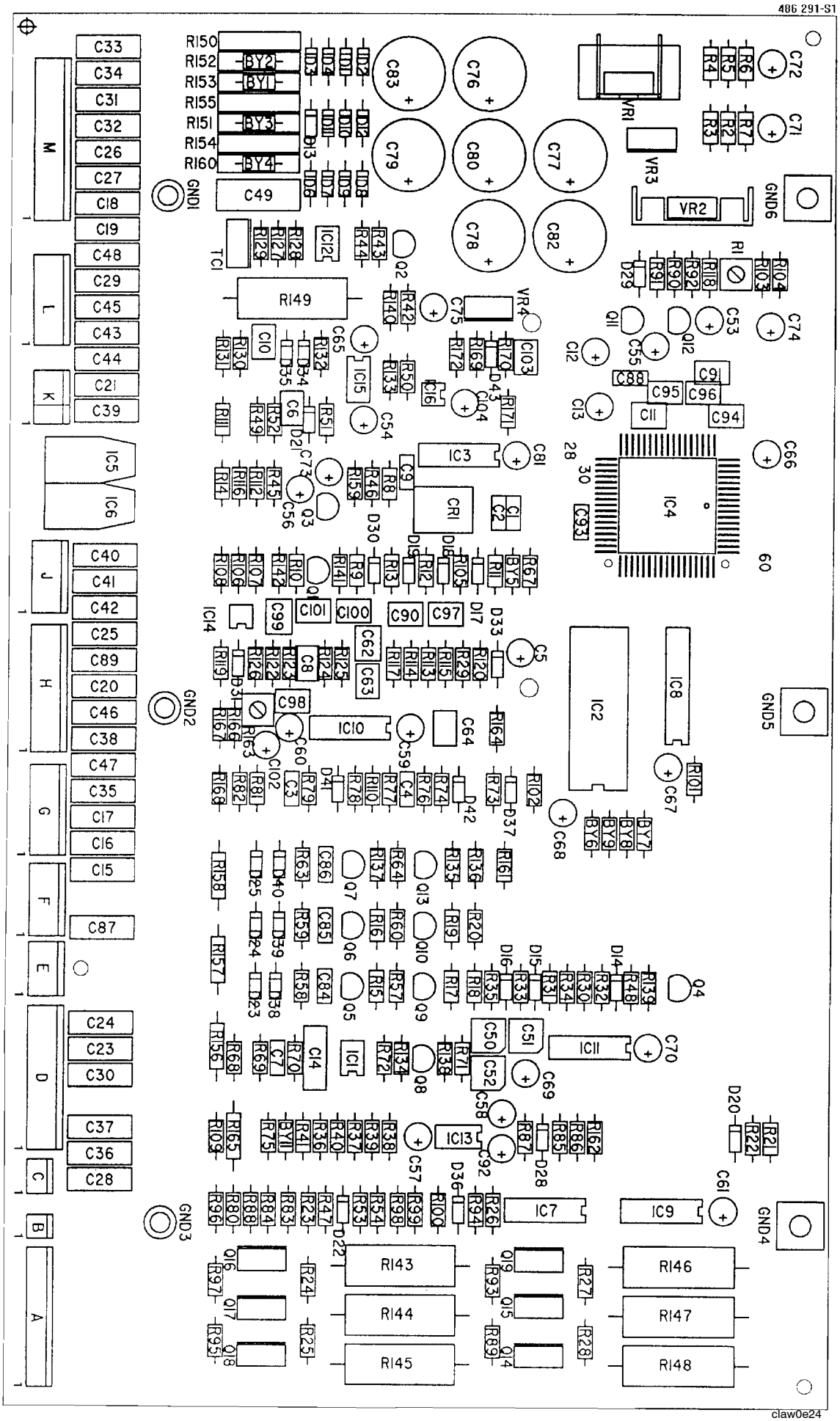


claw0de1

AP1 COMPONENT POSITIONS

Circuit board with part no. 0486 291 880

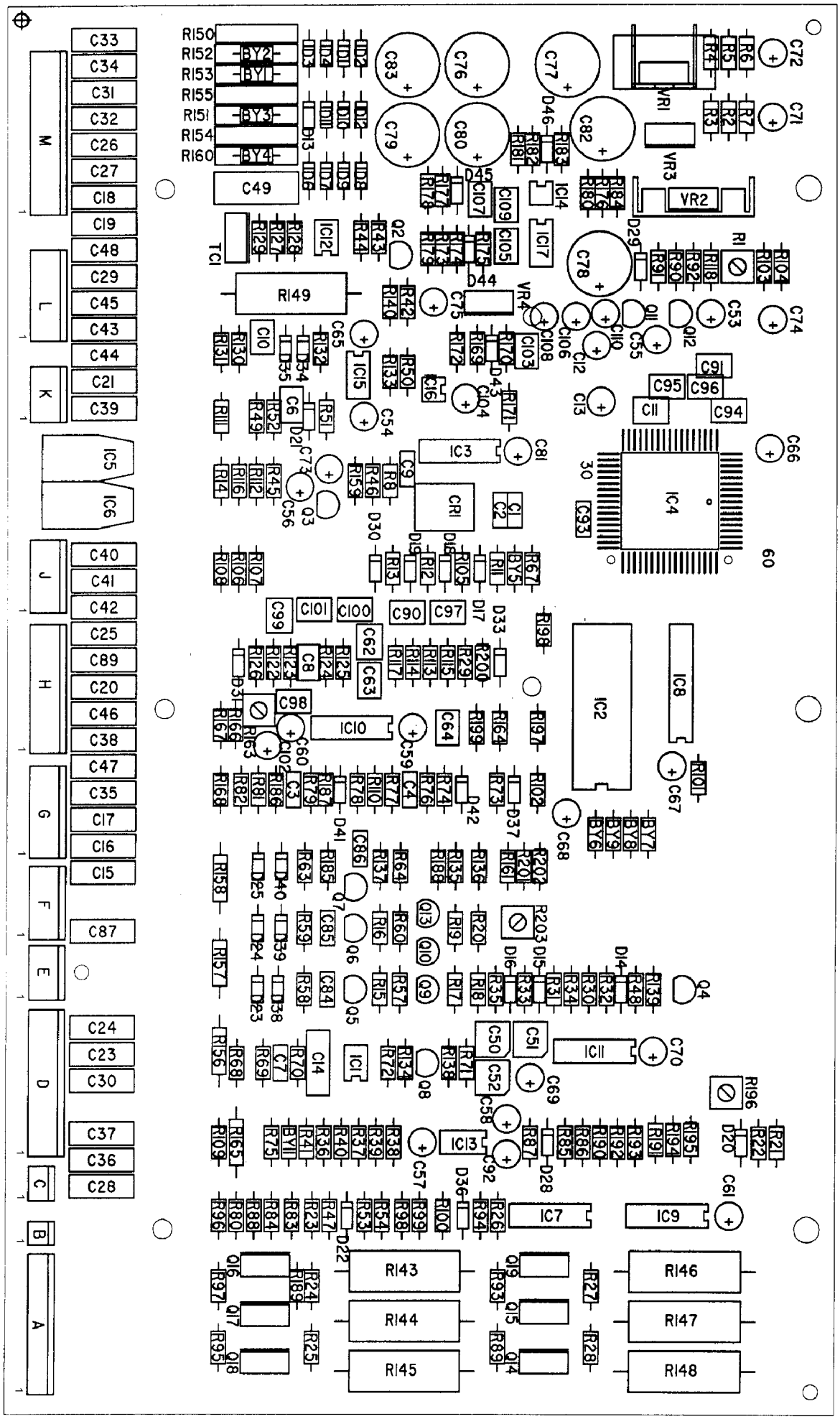
Points GND1 - GND6 are connected to the screen casing and to the electronic neutral, 0V.



claw0de1

AP1 COMPONENT POSITIONS

Circuit board with part no. 0486 480 880 (version A)



claw0de1

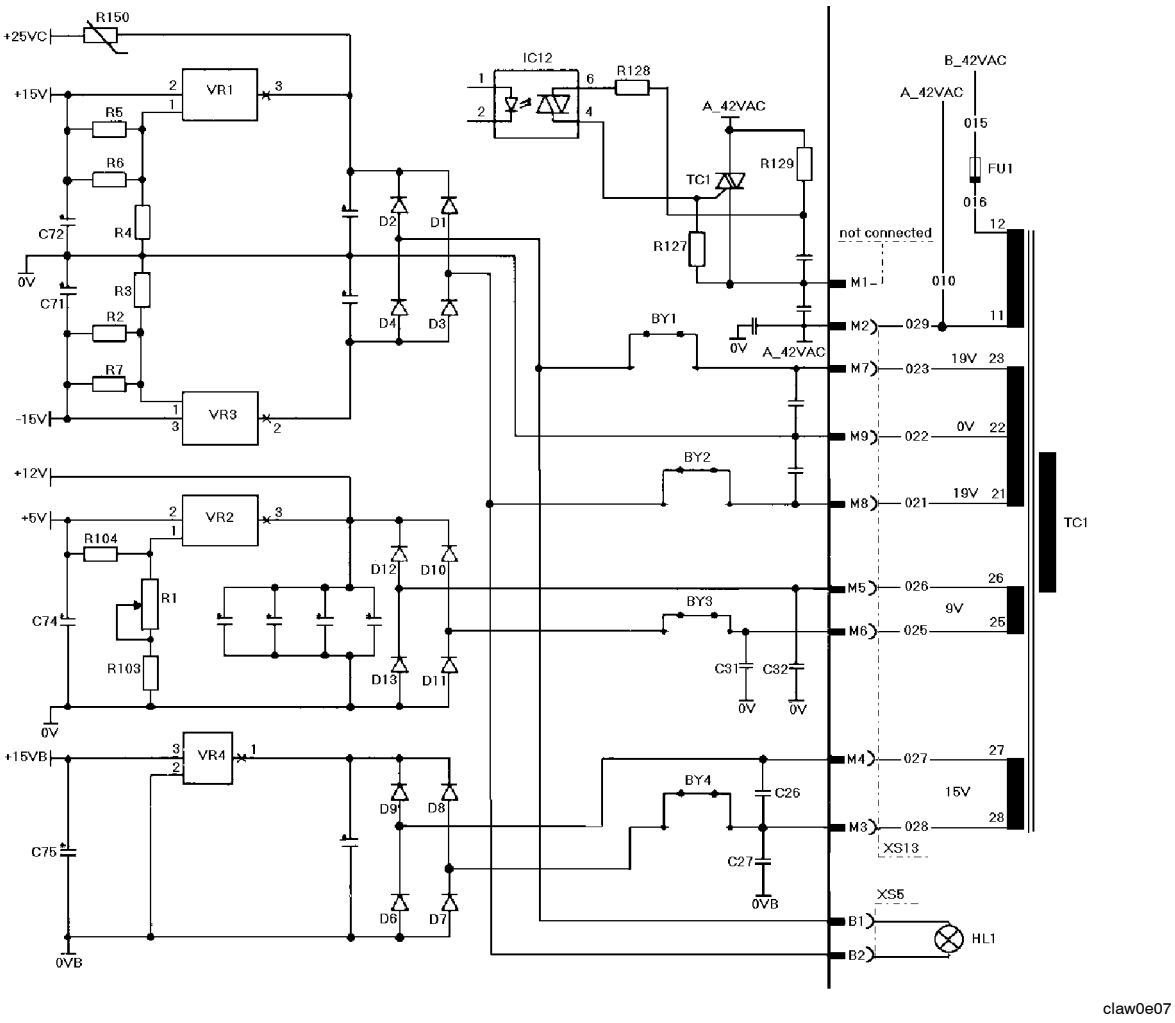
FUNCTION DESCRIPTION

Sections 1 - 15 below refer to the diagrams on page 6 to 12.

The circuit board is screened by a screened enclosure that is connected to 0 V on the circuit board.

The component position drawings on page 15 to 17 also shows components that are not fitted to the circuit board. These components are not used in the LAW power units.

1 POWER SUPPLY, CIRCUIT BOARD AP1



claw0e07

The power supplies from transformer TC1 to the circuit board are prepared for fitting PTC resistors, but are now fitted with links BY1 - BY4.

DC power supplies

The power supply supplies the following DC voltages :
+25 VC, ±15 V, +15 VB, +5 V and +12 V.

+5V
Internal power supply on the circuit board. Voltage regulator VR2 is adjustable: the voltage is adjusted to 5.00 ±0.01 V when the board is manufactured.

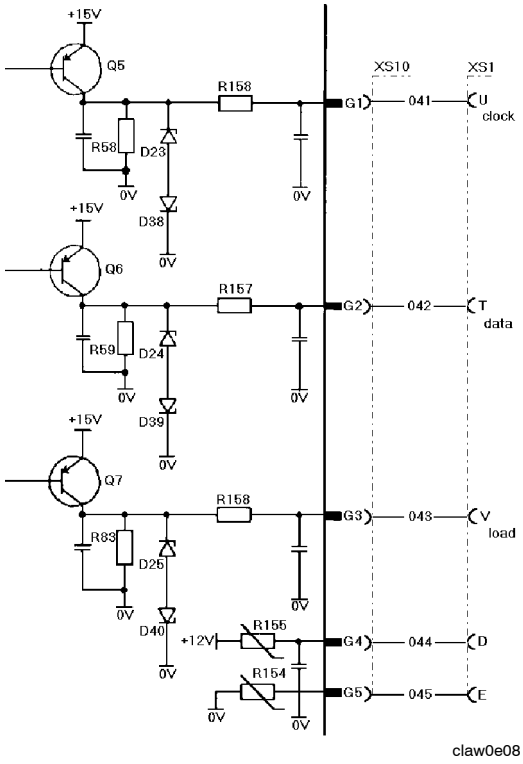
+12V
Power supply to the display board and for loss of voltage detection.
See also Items 2 and 13 below.

+15VB
Power supply to circuits that are galvanically or high- resistance separated from other electronics on the circuit board.

+/-15V
Internal power supply for the circuit board.

+25VC
Internal power supply for the circuit board, protected by a PTC resistor, R150.
The resistance value of this resistor increases in the event of current overload.

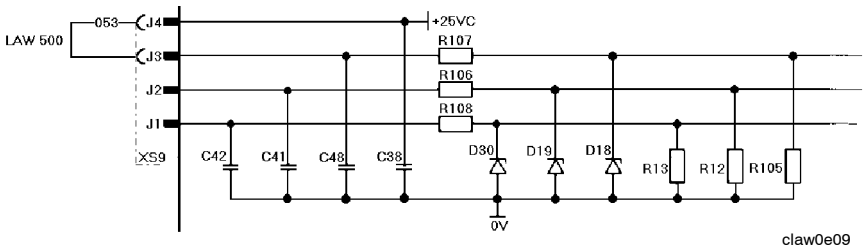
2 DISPLAY OUTPUT



Outputs G1 - G3 are used for serial data transfer of the welding current and arc voltage to a digital display instrument, which may be fitted either in the power unit or in the wire feed unit. The instrument is described in the service manuals for the wire feeders MEK 4/4S/4SP.

Outputs G4 and G5 supply +12 V to the instrument. This supply is protected by PTC resistors R155 and R154. The resistors protect the circuit board against short circuits to arc voltage or against other voltages occurring in the control cable to the wire feed unit.

3 MACHINE TYPE / TEST INPUT

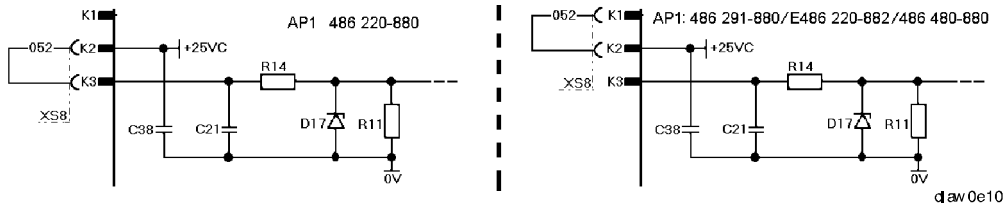


J3 and J4 must be linked in the LAW 500/510: if the link is removed, the machine will operate as an LAW 400. **But never link J3 and J4 in an LAW 400/410.**

Test input

Use the test inputs to test the performance of several input and output signals on the circuit board. See the description on page 31.

4 FIXED / CONTROLLED FIRING ANGLE



When K2 and K3 are linked, the machine operates with a fixed thyristor firing angle. When K1 and K2 are linked, the machine operates with a controlled (variable) thyristor firing angle.

A fixed thyristor firing angle means that the thyristor output is affected only by the setting of the voltage control potentiometer.

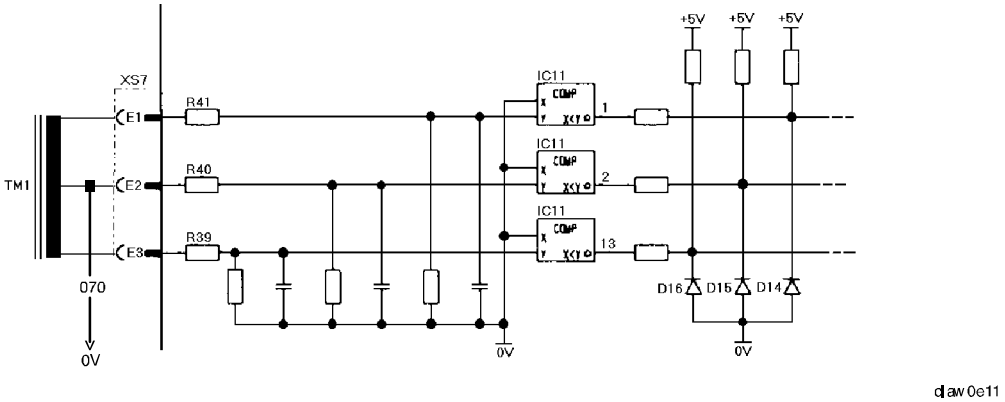
A controlled (variable) thyristor firing angle means that the thyristor output is also affected by the actual value of the arc voltage (arc voltage control). This means that the machine compensates for variations in mains supply voltage.
It is only possible to change between controlled and fixed thyristor firing angle when the machine is switched off.

Circuit board 0486 220 880 must be used **only** with **fixed** thyristor firing angle. Circuit boards 0486 291 880 and 0486 480 880 are to be used with controlled thyristor firing angle.

LAW machines with serial numbers of 512 . . . . . and above are supplied with controlled thyristor firing angle.

For machines with circuit board 0486 220 880 there is an exchange circuit board with controlled thyristor firing angle.
The ordering number for the exchange board is: E486 220 882.

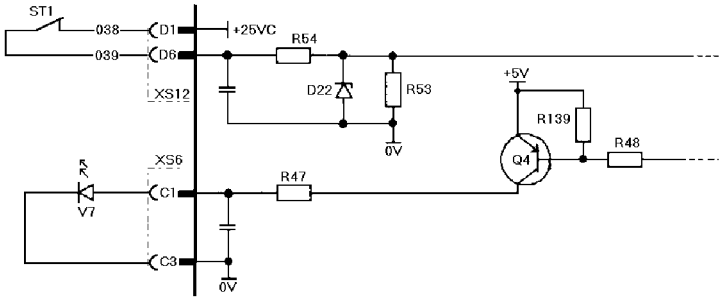
5 SYNCHRONISING



claw0e11

Firing is synchronised to the mains by three zero crossing detectors, IC11;1, IC11;2 and IC11;13. The voltage between the phases at inputs E1, E2 and E3 is about 19 V in the LAW 400/410 and about 25 V in the LAW 500/510.

6 THERMAL OVERLOAD CUTOUT



claw0e12

LED V7 lights if the cutout operates. The current through the LED is about 16 mA. When the cutout operates the thyristor ignition pulses will be blocked.

LAW 400/500 with serial numbers of 434 . . . . . .
The thermal overload cutout, ST1, is fitted to the thyristor heat sink (= cooling fins). In the LAW 400, the cutout operates at a temperature of 60 °C, while in the LAW 500 it operates at 70 °C. It resets at 50 °C in both machines. See page 33 for fitting instructions.

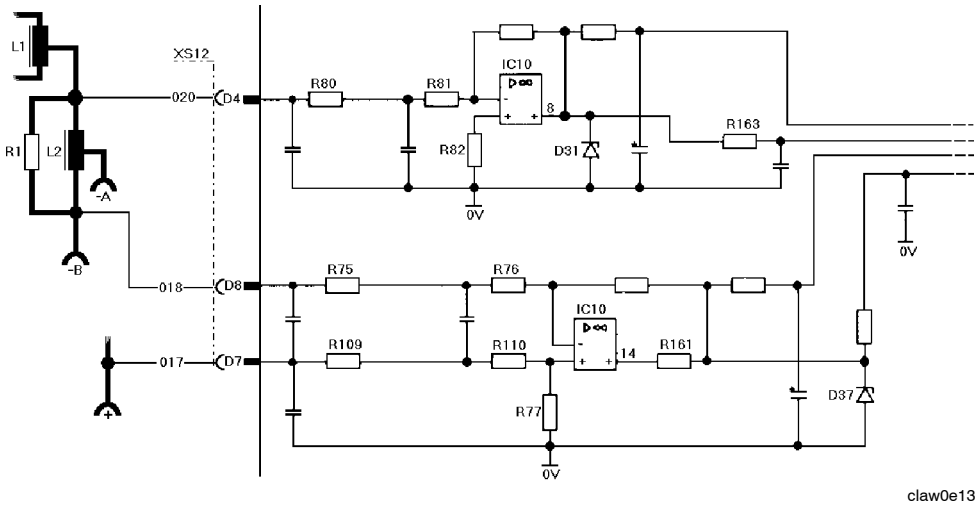
LAW 400/410 with serial numbers of 512 . . . . . and above
The thermal overload cutout, ST1, is fitted in the interphase transformer winding, L1. It opens at a temperature of 140 °C, and closes at 110 °C.

LAW 500/510 with serial numbers of 512 . . . . . and above
The thermal overload cutout, ST1, is fitted in the inductor winding, L2. It opens at a temperature of 160 °C, and closes at 130 °C.

7a ARC VOLTAGE

Applies to machines with serial numbers of 434 . . . . . .

Circuit board AP1 486 220-880



Inputs D7 and D8 measure the voltage between the positive and negative (-B) welding current terminals.

The arc voltage is used with two different time constants :

- A time constant of 0.5 s for voltage indication on the digital display.
- A time constant of 1 ms for detection of cessation of short-circuiting.

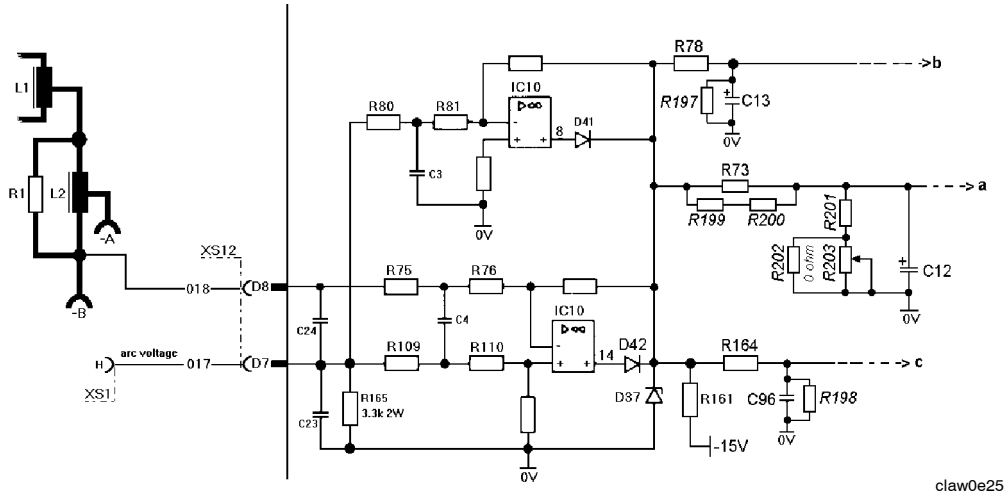
Circuit board connector D4

This signal is not used.

7b ARC VOLTAGE

Applies to machines with serial numbers of 512 . . . . . and above.

Circuit boards AP1 0486 291 880 / 0486 480 880



claw0e25

Inputs D7 and D8 measure the arc voltage between the welding wire and one welding terminal on the power unit, regardless of the polarity of the welding wire (positive or negative).

If the welding wire is negative:
The upper amplifier in IC10 is active, measuring the arc voltage between the positive terminal of power unit (0 V) and the welding wire (XS1;H).

If the welding wire is positive:
The lower amplifier in IC10 is active, measuring the arc voltage between the negative terminal of power unit (inductor terminal B) and the welding wire (XS1;H).

If there is no connection between D7 and the welding wire, the arc voltage will be measured between the positive terminal of power unit (0 V) and inductor terminal B.

Time constants are as follows:

- **a** 0.5 s for arc voltage readout on the digital display.
- **b** 22 ms, arc voltage feedback, for control purposes.
- **c** 1 ms for detection of cessation of short-circuiting.

If circuit board 0486 291 880 is being used in machines with serial numbers 434 . . . . . , the arc voltage circuit operates as described above, exept that the arc voltage signal is taken from the positive welding current terminal on the power unit and inductor terminal B.

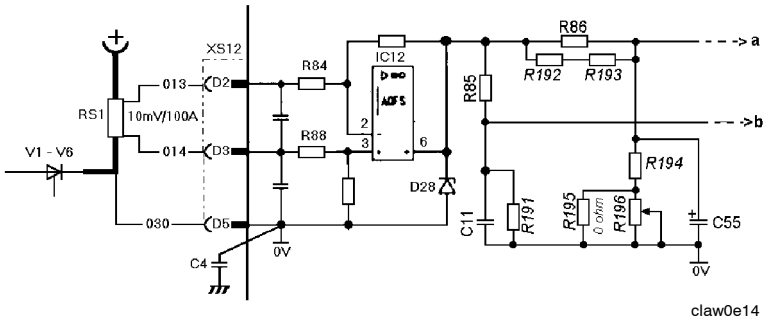
Circuit board 0486 480 880

Components marked in *italics* are fitted only to version A and later versions of this circuit board.

You can find out the version from the number (486 479-001A), which is printed on the board. Each time the print is changed there will be a new version letter. The first version of the board has no letter after the number.

From version A it is possible to adjust signal **a** to the digital instrument. When trimming signal **a**, first remove R202 (0 Ω), then you can adjust the signal with potentiometer R203. If you want to decrease the signal, you also have to remove R200.

8 SHUNT INPUT



claw0e14

Shunt RS1 provides a 10 mV signal at 100 A. The shunt voltage is linear in relation to the current through the shunt. IC12 amplifies the shunt signal voltage.
The shunt signal voltage is connected to the processor via two different time constants:

- **a** A time constant of 0.5 s, for indication of the welding current on the digital display.
- **b** A time constant of 7.26 ms for overcurrent protection.
  See below under Item 13.

The electronic neutral, 0 V, is connected to the positive welding current pole via contact D5. Capacitor C4, which is connected to the case screen, decouples interference to the machine case.

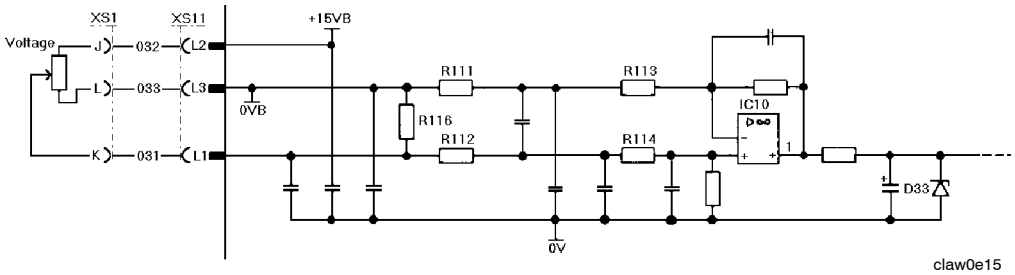
Circuit board 0486 480 880

Components marked in *italics* are fitted only to version A and later versions of this circuit board.

You can find out the version from the number (486 479-001A), which is printed on the board. Each time the print is changed there will be a new version letter. The first version of the board has no letter after the number.

From version A it is possible to adjust signal **a** to the digital instrument. When trimming signal **a**, first remove R195 (0 Ω), then you can adjust the signal with potentiometer R196. If you want to decrease the signal, you also have to remove R193.

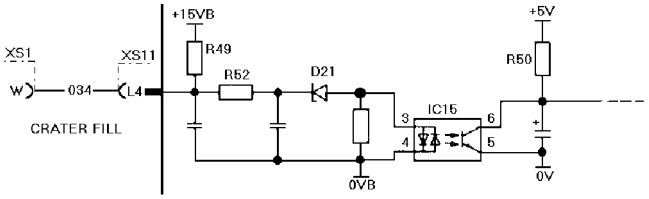
9 VOLTAGE REFERENCE



claw0e15

The voltage reference potentiometer is fitted in the wire feed unit. The power supply to the potentiometer, +15 VB, is protected against short circuits to the arc voltage.

10 CRATER FILLING



claw0e16

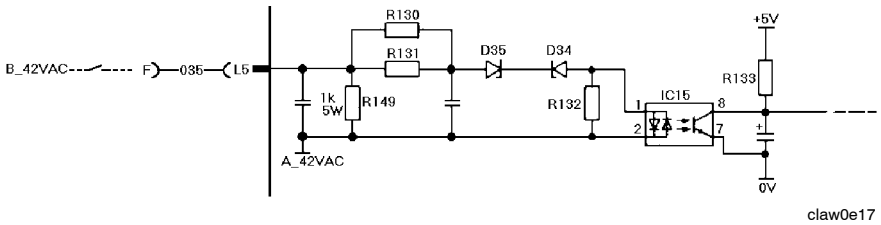
The crater filling function can be used only with an MEK 4, 4S or 4SP wire feed unit. When the wire feed unit sends a crater fill signal to the power unit, input L4 switches high and low four times. Each time that the voltage changes, the welding voltage is reduced. The table below shows the percentage of the set voltage at each step, together with the corresponding L4 signal levels.

Normal crater filling			**Crater filling during pulse welding** **(only with MEK 4SP)**					
Phase	**L4**	**%**	**Phase**	**L4**	**%Utop**	**Phase**	**L4**	**%Ub**
1	low	90	1	low	80	1	low	87
2	high	72	2	high	62	2	high	70
3	low	65	3	low	55	3	low	63
4	high	58	4	high	40	4	high	55

In the table above Utop is the pulse voltage and Ub is the background voltage.

Each step lasts for a maximum of 1.27 seconds.
See the MEK 4 and MEK 4S/SP service manual for further information.

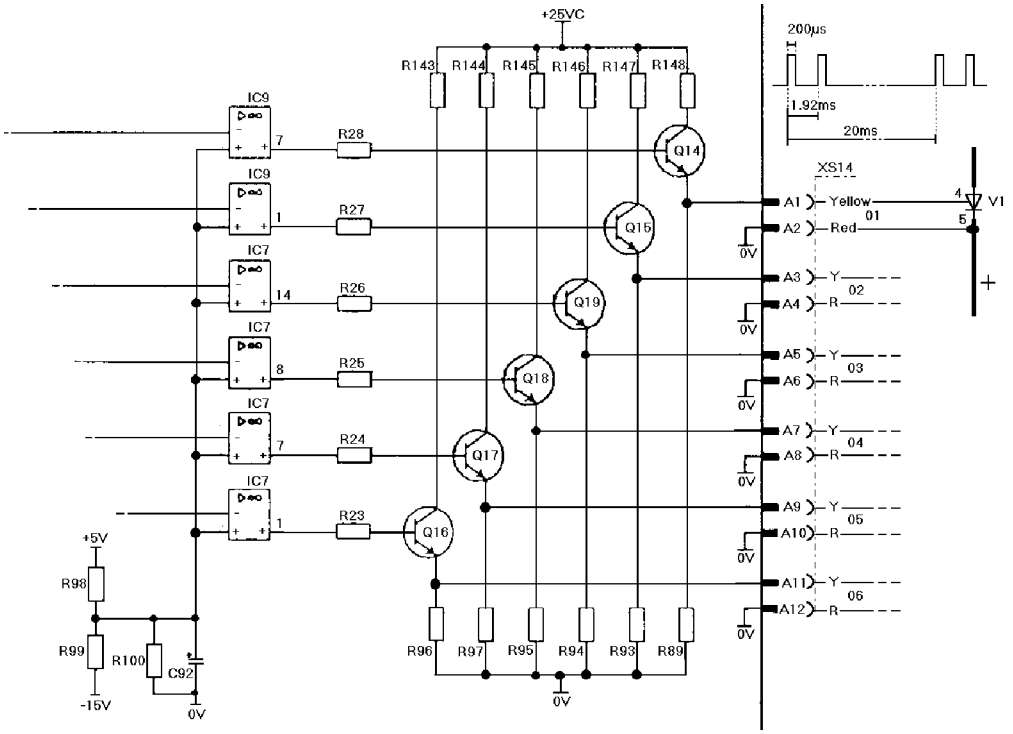
11 START / STOP



claw0e17

The closing contact in the MEK wire feeders that activates the power unit start input is a triac. In order to ensure that it has sufficient holding current, resistor R149 provides a load of 1 kΩ 5 W at input L5.

12 THYRISTOR CIRCUITS



claw0e18

The thyristor firing circuits consist of operational amplifiers IC7 and IC9. Their inverting inputs are connected to the processor and their non-inverting inputs are connected to a fixed voltage of 1.35 V.
If the +5 V power supply is lost, potential divider R99 - R100 pulls the input voltage to the non-inverting inputs down to -0.3 V, thus disabling the firing pulses.

Resistors R143 - R148 limit the thyristor gate currents to about 1.3 A.

In order to make sure that the thyristors always fire, each firing pulse is duplicated. The peak value of the firing voltage is about 22 V when the thyristors are disconnected. **Never** disconnect individual thyristors, as this can unbalance the thyristor bridge and destroy other thyristors.

If a thyristor fails, always check the gate pulses before starting up the new thyristors. If a thyristor has short-circuited, the other thyristors will also have been damaged, which can reduce their lives. If one thyristor has failed, all should be replaced.

Checking the thyristors

Remove connector XS14 from the circuit board. Open the cover over the thyristors (see item 401 on page 51). Remove the screws that connect the shunt (= the cathode connection) to the thyristors and insert a piece of paper between the shunt and the thyristor cathodes. Measure the resistance of the thyristors with a DMM. The gate and cathode can be tested at connector XS14.

Make each measurement in both directions of polarity (i.e. reverse the test connections from the DMM). The measured values must be in the range as shown below, regardless of polarity.

- Gate - cathode: 5 - 40 Ω
- Anode - cathode: not less than 10 kΩ
- Anode - gate: not less than 10 kΩ

13 PROCESSOR

In addition to the features already described, the processor performs the following functions :

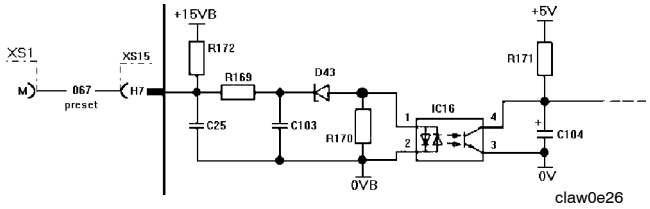
- *Frequency measurement*
  Measures the mains frequency when the unit is turned on. If the frequency is either 50 ±4 Hz or 60 ±4 Hz, the processor starts the main program. If the frequency is not within the tolerances, the main program that controls the machine will not start.
- *Voltage monitoring*
  By sensing that the power supply, +12 V, to the main electronics board is present, the processor monitors the power supply to the board. If the supply is lost, the main program stops. When the supply returns, the program starts. See 'Frequency measurement', above.
- *Overload protection*
  The LAW 400/410 and LAW 500/510 have average current limits, known as slow overload trips, at 412 A and 516 A respectively.
- *Short-circuit protection*
  Both machines incorporate short-circuit protection (fast current trip), set at 750 A.
- *Firing pulses*
  The processor generates firing pulses as required by the set welding voltage. Pulses are duplicated in order to prevent any misfiring of the thyristors.
- *Display management*
  The processor supplies information on the welding voltage and welding current to the digital display instrument.
- *Crater filling*
  Reduces the arc voltage when the wire feed unit calls for crater filling.
- *Test routine*
  Controls the test routines, described on page 31.
- *Elevated starting voltage (Hot Start)*

  Applies to machines with serial numbers 512 . . . . . and above:
  These machines are supplied with controlled thyristor firing angle in operation. With this arrangement, the starting voltage in the LAW 400/410 is 30% higher than the set voltage, and in the LAW 500/510 is 20% higher than the set voltage. Arc voltage control comes into operation 300 ms (50 ms when pulsing) after the arc strikes, which reduces the arc voltage to the set value. If the machine is operating with a fixed thyristor firing angle, the hot start feature is inactive.

  Machines with serial numbers 434 . . . . . and circuit board 0486 220 880:
  These machines can be operated only with a fixed firing angle.
  Starting voltages are as follows:
  If the set value of arc voltage is less than 21 V, starting voltage will be 20% higher. If the set value of arc voltage is over 21 V, starting voltage will be 50% higher. The elevated starting voltage ceases 100 ms after starting.

  For these machines there is an exchange circuit board available, E486 220 882, which has controlled thyristor firing angle and the same starting voltages as circuit board 0486 291 880.

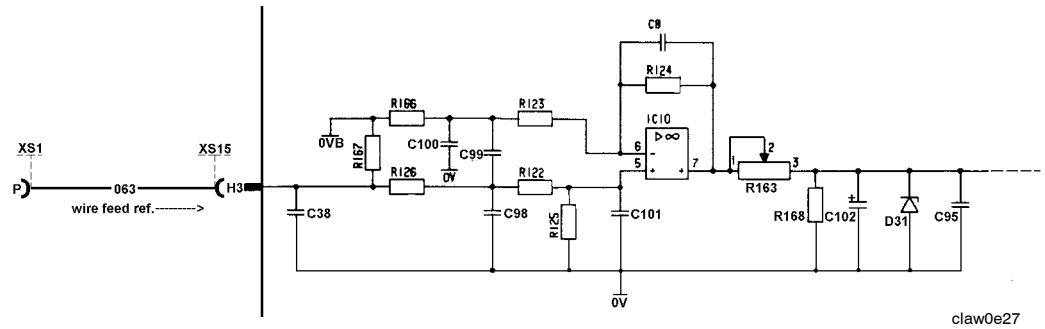
Preset XS1;M



This input is used only when an MEK 4S or MEK 4SP wire feed unit is connected to the LAW power unit.

The wire feed unit has a switch that the welder uses when he want to see set values for wire feed speed and voltage instead of measured values of welding current and arc voltage. When the switch on the wire feed unit is closed, circuit board input H7 is shorted to 0 VB.

Wire feed speed reference XS1;P



This input is used only when an MEK 4S or MEK 4SP wire feed unit is connected to the LAW power unit.

The wire feeder sends an analogue wire feed speed signal to the LAW for display in the digital display.

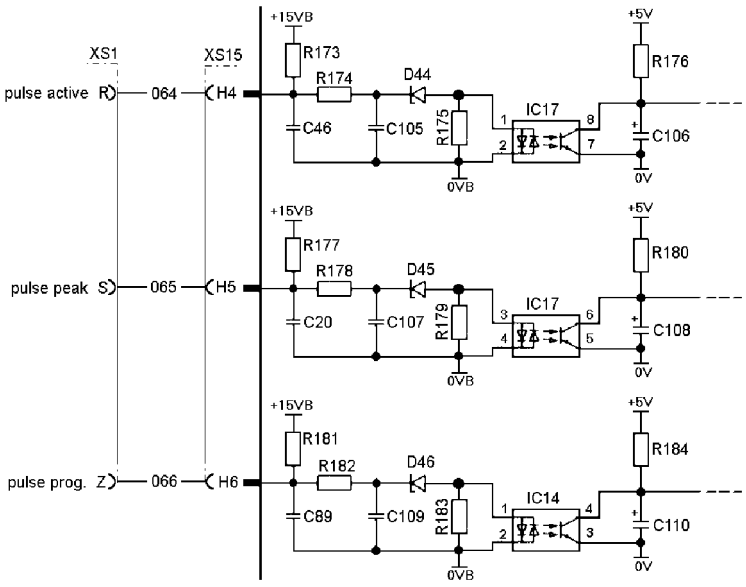
The input is also used to sense whether an MEK 4S/SP is connected. Scaling of the voltage reference changes if an MEK 4S/SP is connected, relative to the scaling used if some other wire feed is connected.

The input on the circuit board is adjusted by means of potentiometer R163 so that a voltage of 12.40 V at terminal H3 produces a voltage of 5.00 ± 0.005 V across diode D31.

15 PULSE WELDING

Pulse welding can only be performed with the LAW 400/410 when used together with wire feed unit MEK 4SP.
The LAW 400 must have circuit board AP1 with part no. 0486 480 880 to perform pulse welding. And additional wires 064, 065 and 066 between connectors XS1 and XS15.

There is only one voltage reference from the wire feed unit to the power source. However, two different voltage reference signals are needed for pulsing: one for the peak voltage (Utop) and one for the background voltage (Ub).
As Utop is always the same within the same synergy line, the wire feed unit sends the peak voltage reference signal to the power unit immediately when a pulsed synergy line has been selected, and it is then stored in memory in the power unit.
The wire feed unit then transmits Ub continuously to the power unit as long as welding continues on the same synergy line.
Utop is transmitted from the feed unit for about 300 ms, when a pulsed synergy line is selected.
The pulse frequency is 42.8 Hz and controlled by the power source.



Input H4 pulsing signal

The pulsing signal, H4, tells the power unit that pulsing has been selected.
H4 goes low (0 VB) when pulsing has been selected.

Input H5 pulse voltage signal

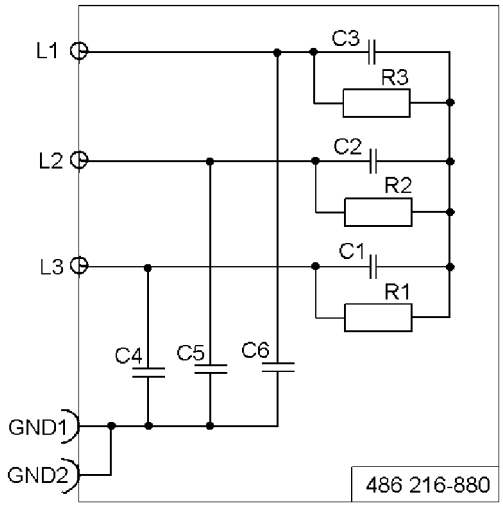
H5 goes low (0 VB) for about 300 ms when the Utop voltage reference signal is transmitted from the feed unit.

Input H6 pulse programming signal

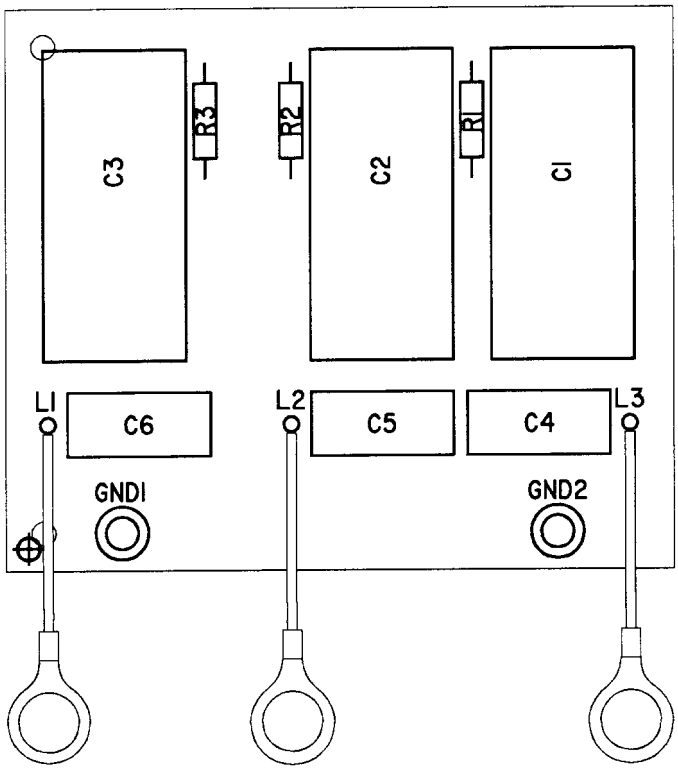
H6 goes low (0 VB) when custom synergy lines are being constructed in the pulse mode. See the programming description in the MEK 4SP service manual.

AP2 SUPPRESSION CIRCUIT BOARD

Circuit diagram



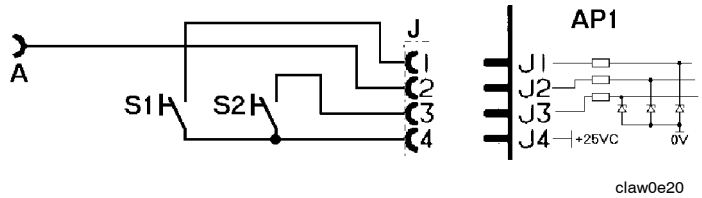
Component positions



TEST ROUTINE

The test routine can be used if either the power unit or the wire feed unit has a digital instrument. It must **not** be used when the gate connections are connected to the circuit board.

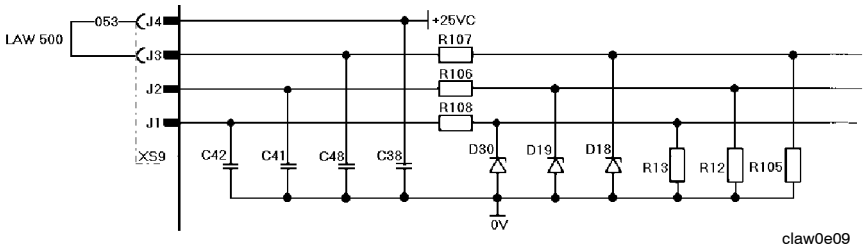
Activate the test routine by linking contacts J1 and J4 before energising the machine.



The test device

Do the following to activate the test routine.

- Turn off the machine.
- **Disconnect connection XS14, carrying the gate pulses, from the circuit board.**
- If the machine is an LAW 500/510, disconnect connection XS9, machine type.
  See the diagram below.
  Connect the test device plug J to contacts J1 - J4 on the circuit board.



Machine type / test input

- Close switch S1 on the test device.
- Start the machine.

The first test is of the display itself. All segments of the display should be visible and then extinguished for one second.
If you close switch S2, between J3 and J4, the display will be extinguished.
Open S2 again.

Alternately open and close switch S1 to step through the test routine.

Change over S1 (i.e. from closed to open). The top line of the display now shows LL.1. Each time that the switch changed, the count will increment by one. The explanations of the various tests are as follows :

Test no.

LL.1 - LL.7 These tests are not relevant here.

LL.8 Voltage setting.
Turn the potentiometer on the wire feed unit to adjust the voltage setting between its upper and lower limits. The display must show 0 - 255.

LL.9 - L.11 Measurement of the synch pulses at contacts E1-E3.
The display shows 50 if the synch voltage frequency is 50 Hz.

L.12 Welding gun switch.
The display shows 1 1 1 when the welding gun switch is closed and 0 0 0 when it is open.

L.13 - L.14 These tests are not relevant here.

L.15 Firing pulses on outputs A1 - A12.
Connect contact A of the test device to pin A1 on the circuit board. If firing pulses are present on A1, the display will show 0 1 0. Test outputs A3, A5, A7, A9 and A11 in a corresponding way.
Disconnect contact A of the test device from the circuit board.

L.16 The thermal overload cutout.
When the circuit from the thermal overload cutout (at connections D1-D6) is closed, the display will show 0 0 0.
If the cutout contacts are open, the display will show 1 1 1.

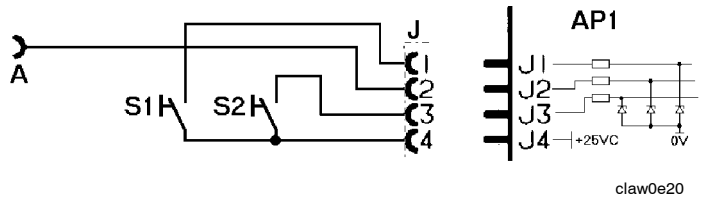
L.17 Crater filling.
When the crater filling input L4 is open, the display shows 1 1 1.
When input L4 is low (= connected to 0VB at board contact L3), the display shows 0 0 0.

L.18 Fixed firing angle / controlled firing angle.
K2-K3 closed = fixed firing angle. The display shows 0 0 0.
K2-K3 open = controlled firing angle. The display shows 1 1 1.

L.19 Machine type.
J3-J4 closed = LAW 500/510. The display shows 5 0 0.
J3-J4 open = LAW 400/410. The display shows 4 0 0.

L.20 Preset, board connector H7.
Test number L.20 is not available on circuit board 0486 220 880.
This test facility is used only with an MEK 4S and MEK 4SP wire feed unit. With terminal H7 open, presetting is not selected, and the display indicates 0 0 0.
With terminal H7 connected to 0 VB, presetting is active, and the display indicates 1 1 1.

Turn off the machine and refit the connections to the circuit board as they were originally.



claw0e20

The test device

FITTING INSTRUCTIONS, THERMAL OVERLOAD CUTOUT

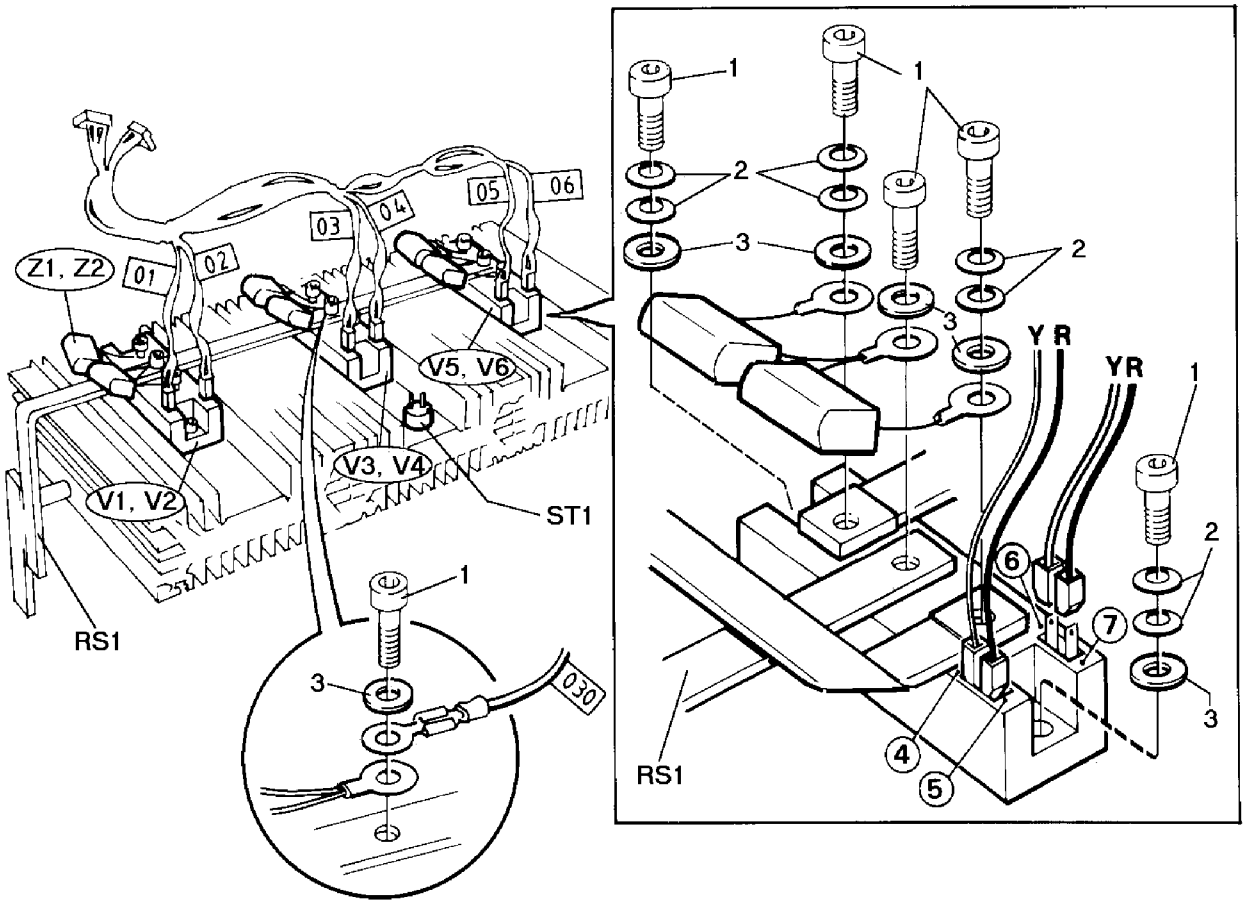
These instructions apply only to machines with serial numbers 434 . . . . . .

1. Remove all dirt from contact surface of the cooling fins where they contact the thermal overload cutout ST1.
2. Apply a thin layer of thermal paste to the contact surfaces. See item 418 on page 50 for the order number of this paste.
3. Fit and tighten the thermal overload cutout to a torque of 1.5 Nm ±0.5 Nm.

FITTING INSTRUCTIONS, THYRISTOR MODULES

These instructions do **not** apply to LAW 400/410 with serial numbers 512 . . . and above, instructions for those machines are on next page.

1. Remove all dirt from the contact surfaces of the cooling fins where they contact the thyristor module.
2. Apply a thin layer of thermal paste to the contact surfaces. See item 418 on page 50 for the order number of this paste.
3. Fit the screws and washers as shown in the diagram below, and tighten the screws to a torque of 2 Nm.
4. Make a second pass and tighten all the screws to a torque of 5 Nm.
5. Connect the wires from the circuit board as shown in the diagram below:
   Y = yellow, R = red. Note the markings, 4 - 7, on the thyristor module.
6. Warm up the units by running the LAW 400/410 at 280 A and the LAW 500/510 at 380 A for ten minutes.
7. Retighten the screws to 5 Nm ±0.7 Nm.



claw0p17

1. Screw, M6 x 16
2. Spring washer, Ø 12.5/6.2 x 0.7 mm
3. Washer, Ø 12/6.4 x 1.5 mm

FITTING INSTRUCTIONS, THYRISTOR MODULES, LAW 400/410

These instructions apply only to machines with serial numbers 512 . . . . . and above.

The machines are originally delivered with thyristor modules according to the descriptions below.
When ordering a thyristor module as a spare part, thyristor module Semikron SKMT 91/04D, with the part number 0456 536 001, is delivered. From the end of 1997 the LAW 410 will be equipped with Semikron SKMT 92/04D thyristor modules, these modules will then also be delivered as spare parts (the same part number as above).

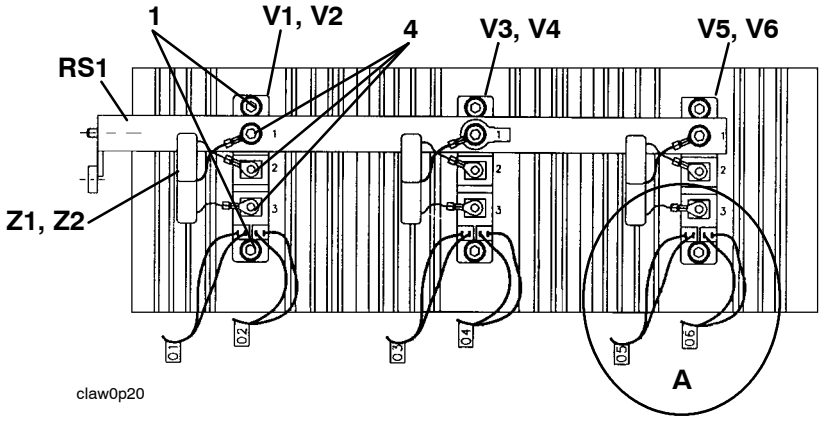
Fit the thyristor modules in accordance with items 1-7 on the previous page, noting the following differences:

- The screws for the anode and cathode connections (item 4 below) are of a different size from the screws for item 1. The washers and spring washers are also differntly sized.

THYRISTOR MODULE 0455 156 001 (Eupec)

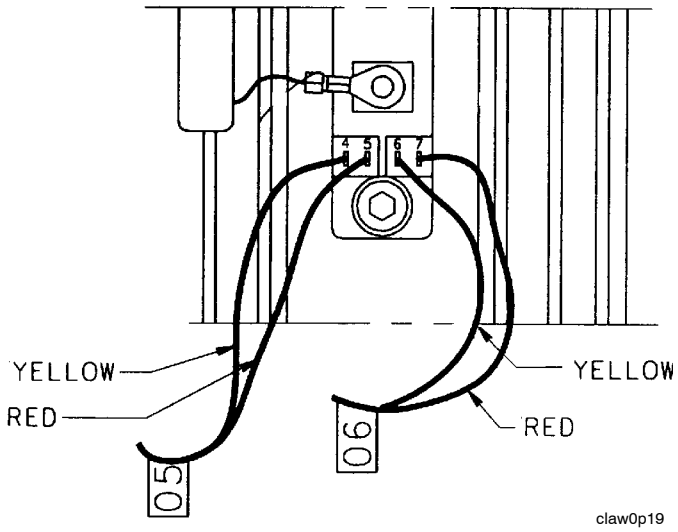
From machine number 512 . . . . . to machine number 550 644 . . . .

The cathode busbar (shunt RS1) is connected differently to the arrangement shown in the other pictures.



1. Screw, M6 x 16
4. Screw, M5 x 16
Washer, Ø 10/5.6 x 1 mm
Spring washer, Ø 10/5.2 x 0.5 mm

VIEW A

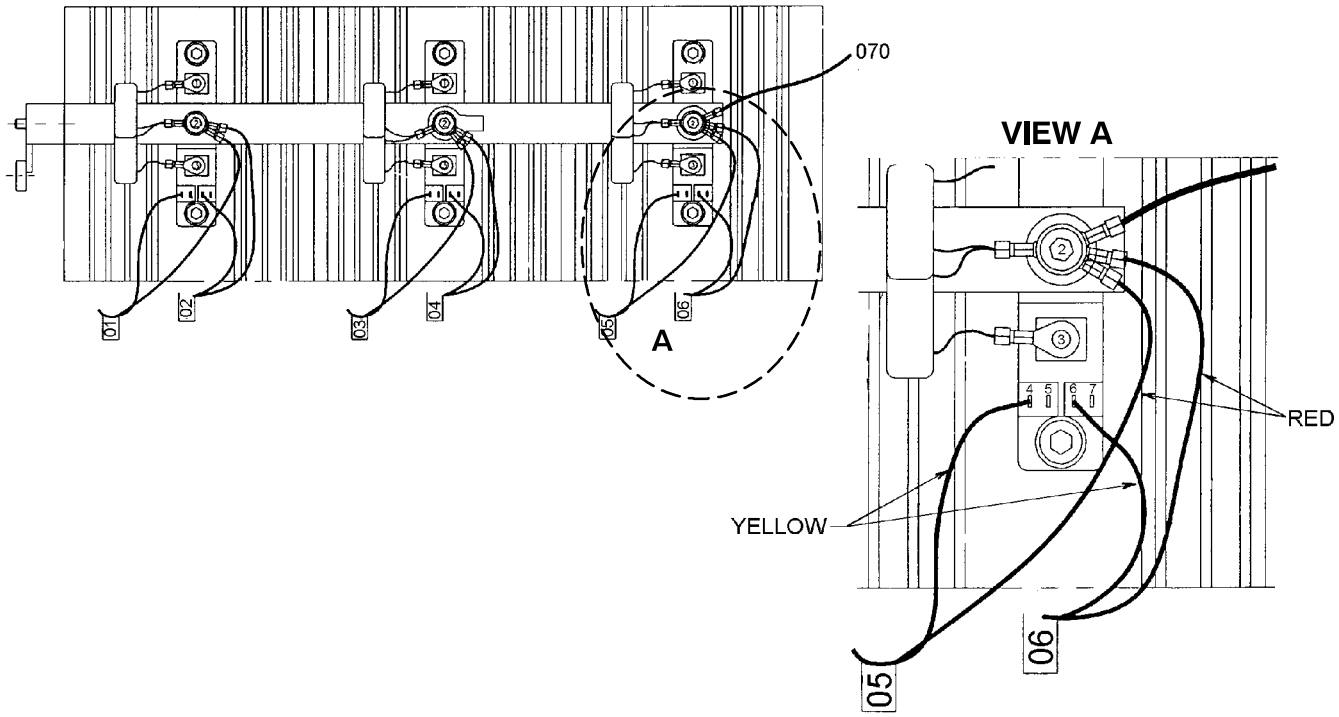


claw0de1

THYRISTOR MODULE 0456 536 001 (Semikron SKMT 91/04D)

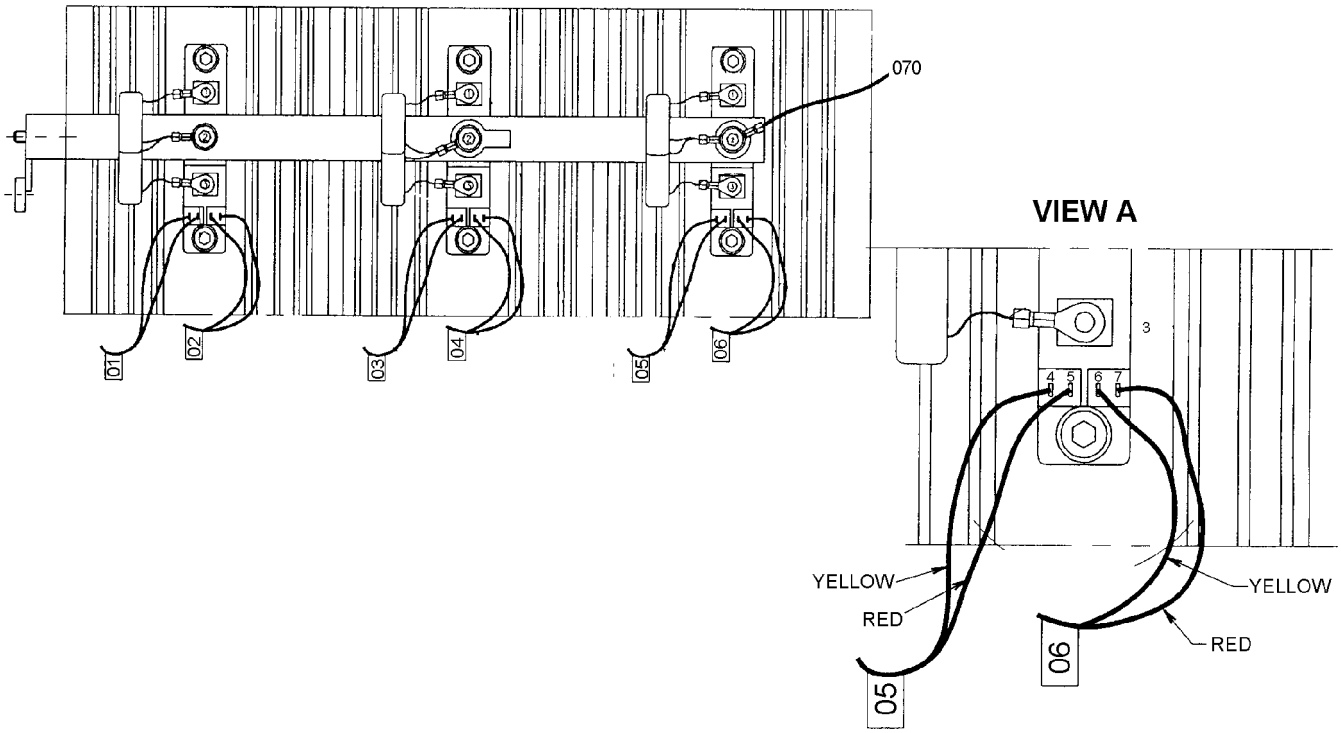
From machine number 550 644 . . . .

The red cathode cables are connected to the cathode copper bar.



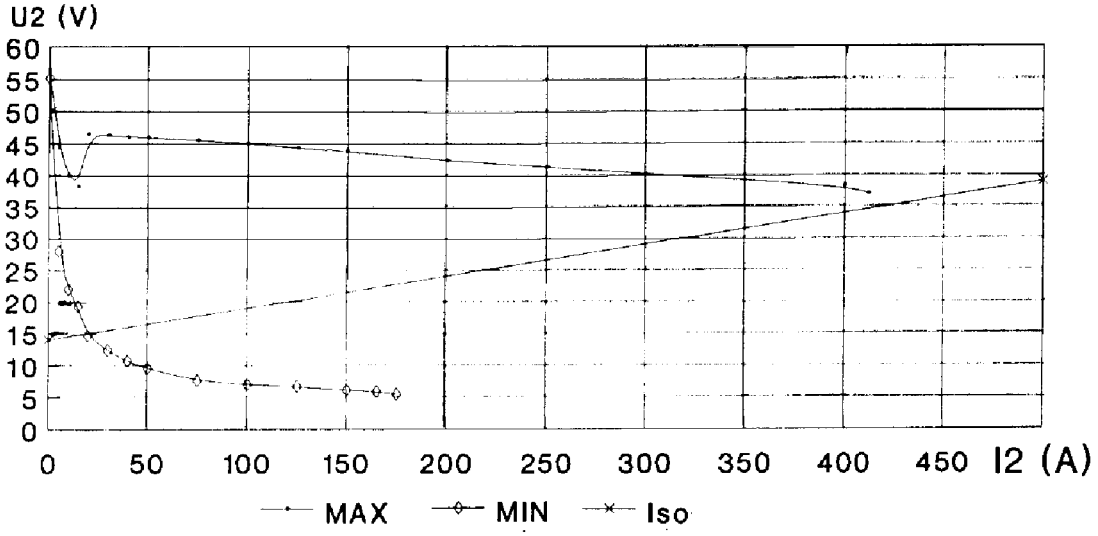
THYRISTOR MODULE 0456 536 001 (Semikron SKMT 92/04D)

From machine number . . . . . .



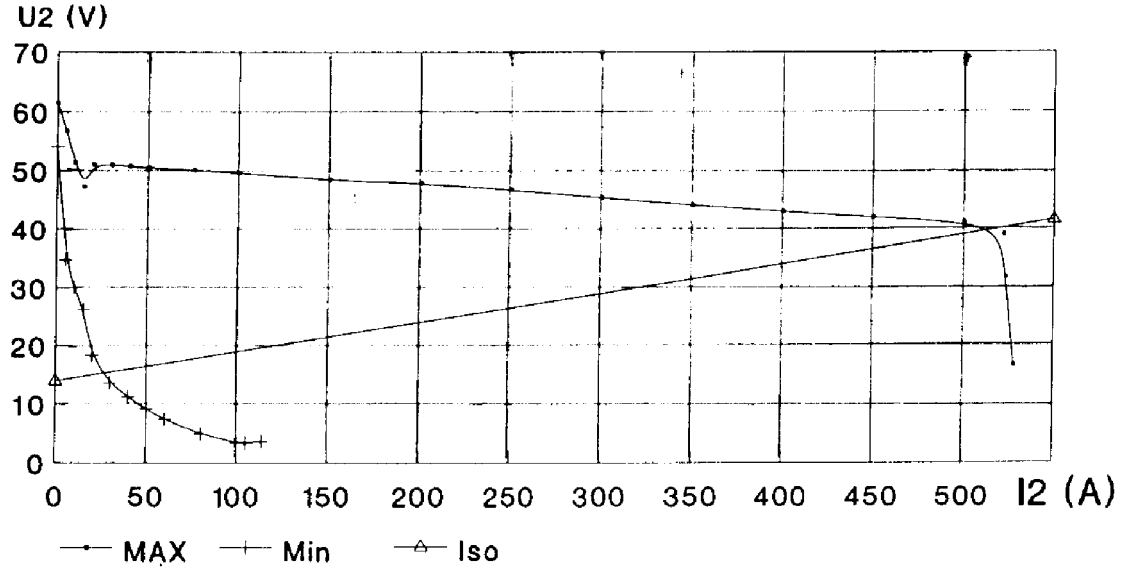
LOAD CHARACTERISTIC

LAW 400/410, connected to 400 V mains power supply



claw0p08

LAW 500/510, connected to 400 V mains power supply



claw0p09

claw0de1

TECHNICAL DATA

	LAW 410/410W LAW 400/400W 400 - 415 V	LAW 410/410W LAW 400/400W 230 - 500 V	LAW 510/510W LAW 500/500W 400 - 415 V	LAW 510/510W LAW 500/500W 230 - 500 V
Mains voltage	400-415V 3 ~ 50Hz	230/400-415/500V 3 ~ 50Hz 230/440-460V 3 ~ 60Hz	400-415V 3 ~ 50Hz	230/400-415/500V 3 ~ 50Hz 230/440-460V 3 ~ 60Hz
Load capacity				
At 45% duty cycle	400A/34V	400A/34V		
At 60% duty cycle	350A/32V	350A/32V	500A/39V	500A/39V
At 80% duty cycle			450A/37V	435A/36V
At 100% duty cycle	280A/28V	280A/28V	400A/34V	390A/33.5V
Operating range	60A/17V-400A/34V	60A/17V-400A/34V	60A/17V-500A/39V	60A/17V-500A/39V
Open-circuit voltage	53-58V	53-58V	53-60V	53-60V
Open-circuit power	590/790W	640/840W	670/870W	720/920W
Power factor	0.86	0.84	0.90	0.90
Efficiency	0.74	0.76	0.78	0.78
Control voltage	42V 50/60Hz	42V 50/60Hz	42V 50/60Hz	42V 50/60Hz
Enclosure class	IP 23	IP 23	IP 23	IP23
Electrical protection class	S	S	S	S
Weight	200/214kg	201/215kg	225/239kg	227/241kg
Dimensions l x b x h	800x640x835mm	800x640x835mm	800x640x835mm	800x640x835mm

These welding power units fulfil the requirements of IEC 974-1

The S symbol indicates that the power units have been designed for use in areas of elevated electrical danger.
Units of Class **IP 23** are intended for indoor and outdoor use.

PRIMARY CURRENT, MAINS FUSE RATING AND MAINS CABLE CROSS-SECTIONAL AREA

LAW 400/410

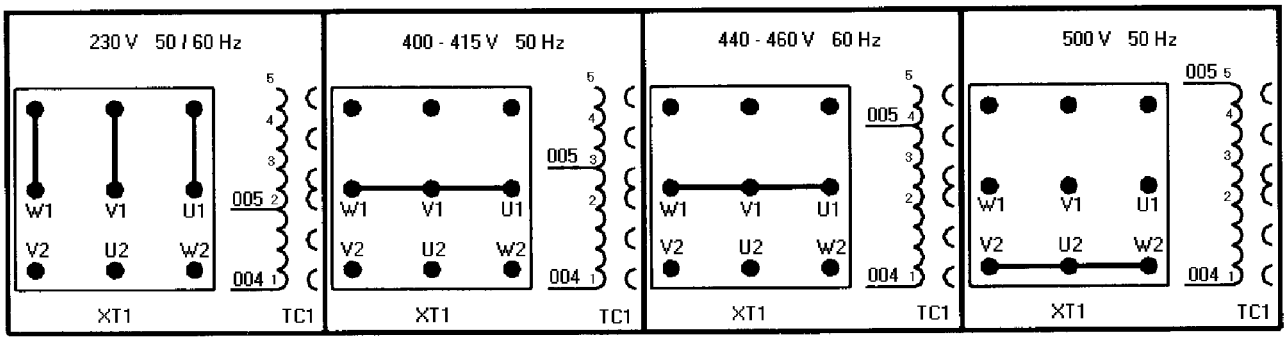
	* 400-415V 400-415V 50Hz	** 230-500V 230V 50Hz	** 230-500V 400-415V 50Hz	** 230-500V 500V 50Hz	** 230-500V 230V 60Hz	** 230-500V 440-460V 60Hz
Primary current at:						
45% duty cycle	31A	51A	31A	25A	51A	30A
60% duty cycle	28A	47A	28A	22A	45A	27A
100% duty cycle	23A	39A	23A	19A	37A	22A
Cable CSA mm^2	4x4	4x10	4x4	4x4	4x10	4x4
Fuse rating, slow blow	25A	35A	25A	20A	35A	20A

LAW 500/510

	* 400-415V 400-415V 50Hz	** 230-500V 230V 50Hz	** 230-500V 400-415V 50Hz	** 230-500V 500V 50Hz	** 230-500V 230V 60Hz	** 230-500V 440-460V 60Hz
Primary current at:						
60% duty cycle	42A	69A	42A	31A	69A	42A
80% duty cycle	38A	63A	38A	29A	61A	37A
100% duty cycle	34A	59A	34A	27A	56A	33A
Cable CSA mm^2	4x6	4x16	4x6	4x6	4x16	4x6
Fuse rating, slow blow	35A	63A	35A	35A	50A	25A

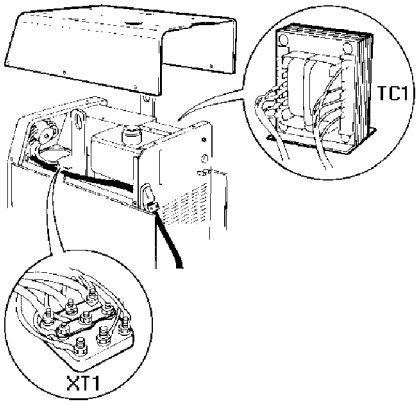
***** = Power unit suitable only for a single supply voltage, 400-415V 50Hz.
****** = Power unit suitable for various supply voltages.

PRIMARY CONNECTIONS LAW; 230 - 500 V



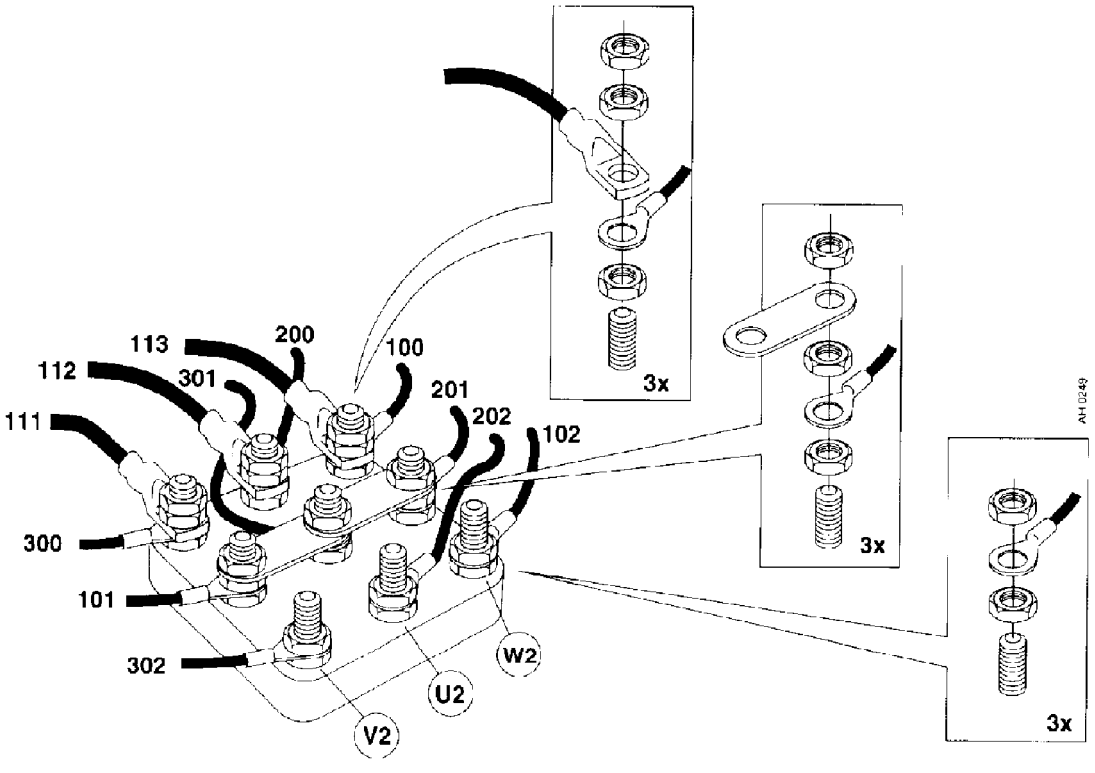
claw0e04

Terminal block XT1 and transformer TC1 are fitted as shown below.



claw0p13

The machine is delivered connected for 400 - 415 V.
If it is to be connected to a 230 V supply, the mains supply cable cross-sectional area must be increased, as shown in the table on the previous page.

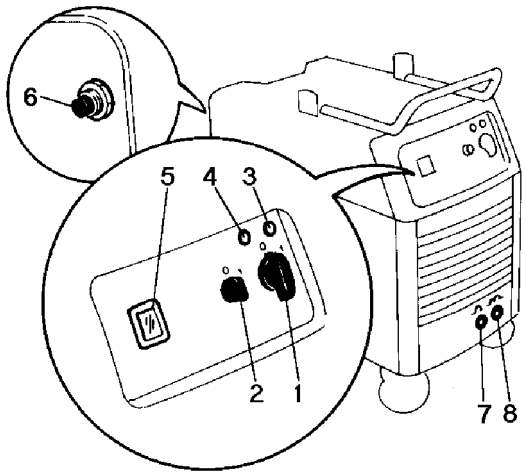


claw0p06

Terminal block XT1 as shown above is connected for 400-415V 50Hz | 440-460V 60Hz

claw0de1

CONTROL PANEL AND CONNECTIONS



claw0p11

1. Mains supply ON/OFF.
2. Cooling unit ON/OFF, only LAW with water cooler.
3. Indicating lamp, mains supply ON.
4. Indicating lamp, thermal overload.
5. Digital display (accessory).
6. Circuit breaker for 42 V power supply to the wire feed unit.
7. Welding current terminal -A.
8. Welding current terminal -B.
9. The positive polarity welding terminal, the socket for the control cable to the wire feed unit and the cooling water connections are on the back of the machine.

MAINTENANCE

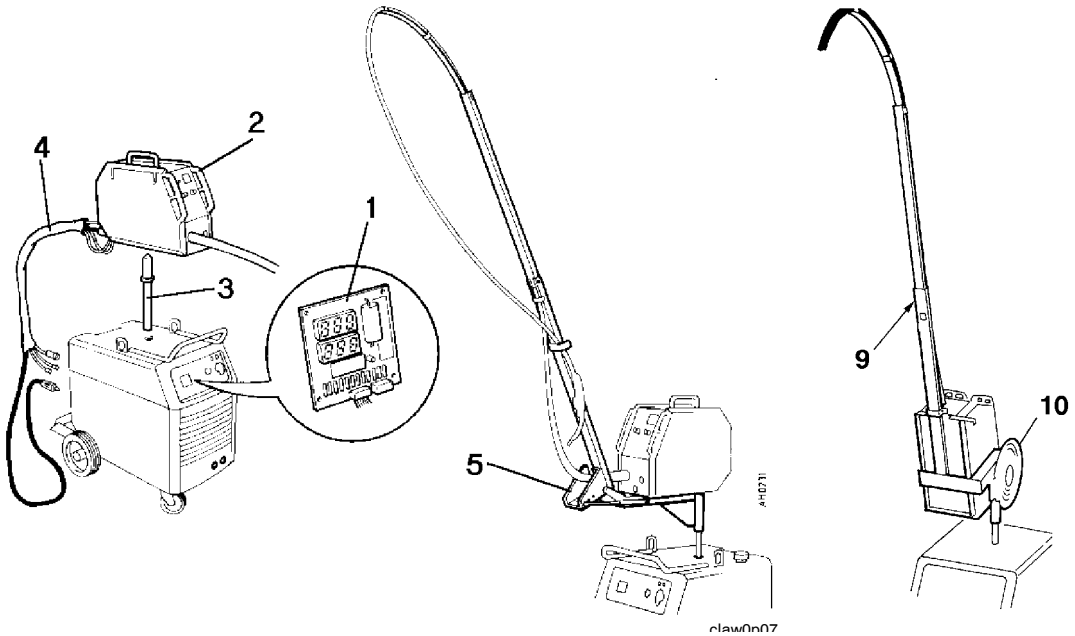
Blow the power unit clean with dry compressed air at reduced pressure at regular intervals.

Check the coolant level in power units incorporating water cooling. When topping up, use a mixture of 50% glycol and 50% water.

ACCESSORIES

Item no.	Order no.	Designation
1	0455 173 881	Digitalinstrument
3	0156 654 883	Mounting post (supplied with LAW)
5	0469 792 881	Holder with support arm
9	0156 746 880	Mast
10	0456 693 880	Counter balance device, sprung coil

Item no.	Order no. when connected to LAW 400/410	Order no. when connected to LAW 400W/410W	Order no. when connected to LAW 500/510	Order no. when connected to LAW 500W/510W	Benämning
2	0469 962 880	- - -	0469 962 880	- - -	Feed unit MEK 4
	0469 962 881	- - -	0469 962 881	- - -	Feed unit MEK 4 with instrument
	- - -	0469 962 882	- - -	0469 962 882	Feed unit MEK 4 with water connection
	- - -	0469 962 883	- - -	0469 962 883	Feed unit MEK 4 with instr. and water conn.
	0455 175 880	- - -	0455 175 880	- - -	Feed unit MEK 4S
	- - -	0455 175 881	- - -	0455 175 881	Feed unit MEK 4S with water connection
	0455 815 881	0455 815 881	- - -	- - -	Feed unit MEK 4SP with water connection
4	0469 836 880	0469 836 885	0469 836 890	0469 836 895	Cables/hoses set 1,7 meter
	0469 836 881	0469 836 886	0469 836 891	0469 836 896	Cables/hoses set 8 meter
	0469 836 882	0469 836 887	0469 836 892	0469 836 897	Cables/hoses set 16 meter
	0469 836 883	0469 836 888	0469 836 893	0469 836 898	Cables/hoses set 25 meter
	0469 836 884	0469 836 889	0469 836 894	0469 836 899	Cables/hoses set 35 meter



DESIGN CHANGES

Below is a short description of design changes made to the LAW machines. The details you find in the previous chapters of this manual.

Changes introduced with effect from machine no. 512 . . . . . .

1. Speed control of the fan: see items C6, KM2, and ST2 in the component description and items 324 and 325 in the spare parts list.
2. The position of the thermal overload cutout has been changed: see item 6 in the component description and items 303, 307 and 413 in the spare parts list.
3. Seals have been incorporated in screw holes: see item 118 in the spare parts list.
4. The design of the mains cable bushing has been changed: see item 119 in the spare parts list.
5. A seal has been fitted to the cooling water filler: see item 223 in the spare parts list.
6. The digital display instrument accessory now contains necessary connection components for the LAW and the MEK 4. The part numberof the display instrumenthas been changed: see accessories list item 1 and item 213 in the spare parts list.
7. A new thyristor bridge has been introduced for the LAW 400: see the fitting instructions for the thyristor modules and items 410, 413-416 and 418-421 in the spare parts list.
8. A new circuit board carrying program version P1.02 has been introduced, with the following feature changes:
   * Mains voltage compensation has been introduced: see item 4 in the function description.
   * The hot start function has been changed: see item 13 in the function description.
   - The arc voltage input has been changed to enable the arc voltage to be measured between the welding wire and one welding terminal. Compare items 7a and 7b in the function description
   - Functions for the MEK 4S:
     - An input for a wire feed reference has been introduced (board connector H3).
     - A presetting input has been introduced (board connector H7).

     See item 4 in the function description.
   * Test routione L20 has been introduced: see the test routine description.

   Machines with serial numbers 434 . . . :

   The new circuit board (part no. 0486 291 880) can be used in these machines. Functions marked with an asterisk (*) will operate when the board is replaced. If the functions marked with a bullet (•) are to work, changes must be made to the machine's wiring.

   Machines with serial numbers 512 . . . :

   The old circuit board (part no. 0486 220 880) should not be used in these machines.

Three new drawings have been introduced to take account of the design changes:

- Wiring diagram LAW 400/500 400-415 V, for machines from and including no. 512 . . .
- Wiring diagram LAW 400/500 230-500 V, for machines from and including no. 512 . . .
- Component positions diagram for circuit board AP1 486 291-880

Changes introduced with effect from machine number 550 . . . . . .

Suppression circuit board AP2 introduced in LAW 400 and LAW 500.

Changes introduced with effect from machine number . . . 642 . . . .

New mounting position for the water pump introduced in all machines with water cooler.

Changes introduced to LAW 400 with effect from machine number 550 644 . . .

New thyristor module 0456 536 001 (Semikron SKMT 91/04D).

Changes introduced with effect from machine type LAW 410 and LAW 510

New design of the main transformer, new ordering number for the main transformer, see the spare parts list.

LAW 400/500 is repalced by LAW 410/510

The new main transformer has to be used as a spare part for LAW 400 and LAW 500.

Changes introduced to LAW 400/410 with effect from machine number 701 . . .

New circuit board (0486 480 880) for pulse welding together with wire feed unit MEK 4SP

Changes introduced to LAW 500/510 with effect from machine number 652 . . .

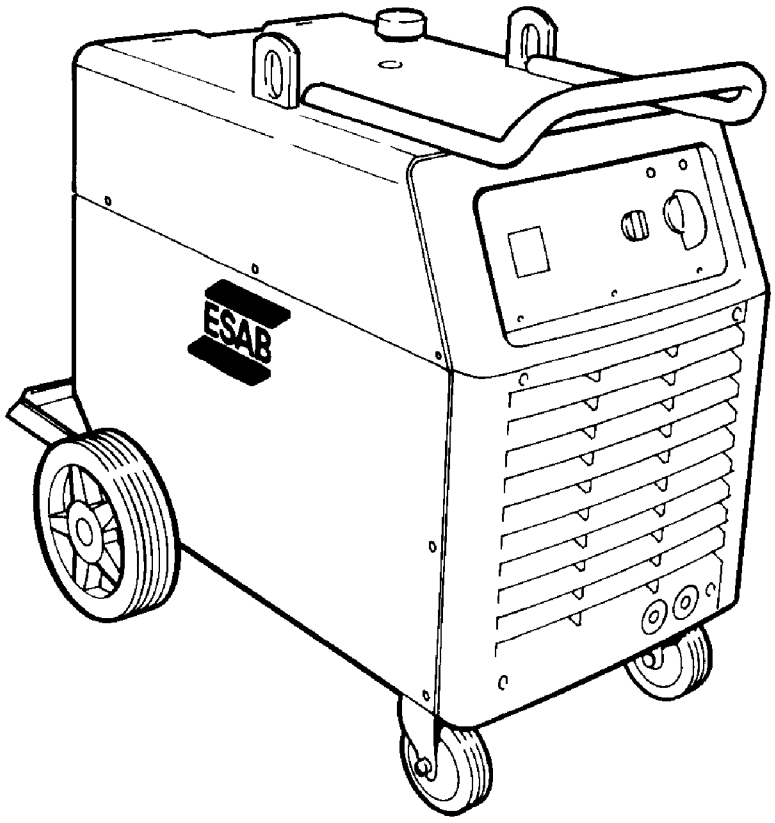
New circuit board (0486 480 880), no change in function, can not be used for pulse welding with LAW 500/510.

Changes introduced to LAW 400 with effect from machine number . . . . . .

New thyristor module 0456 536 001 (Semikron SKMT 92/04D).

SPARE PARTS LIST LAW 400/500

Edition 9708



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Spare parts list - Reservdelsförteckning - Ersatzteilverzeichnis - Liste de pièces détachées

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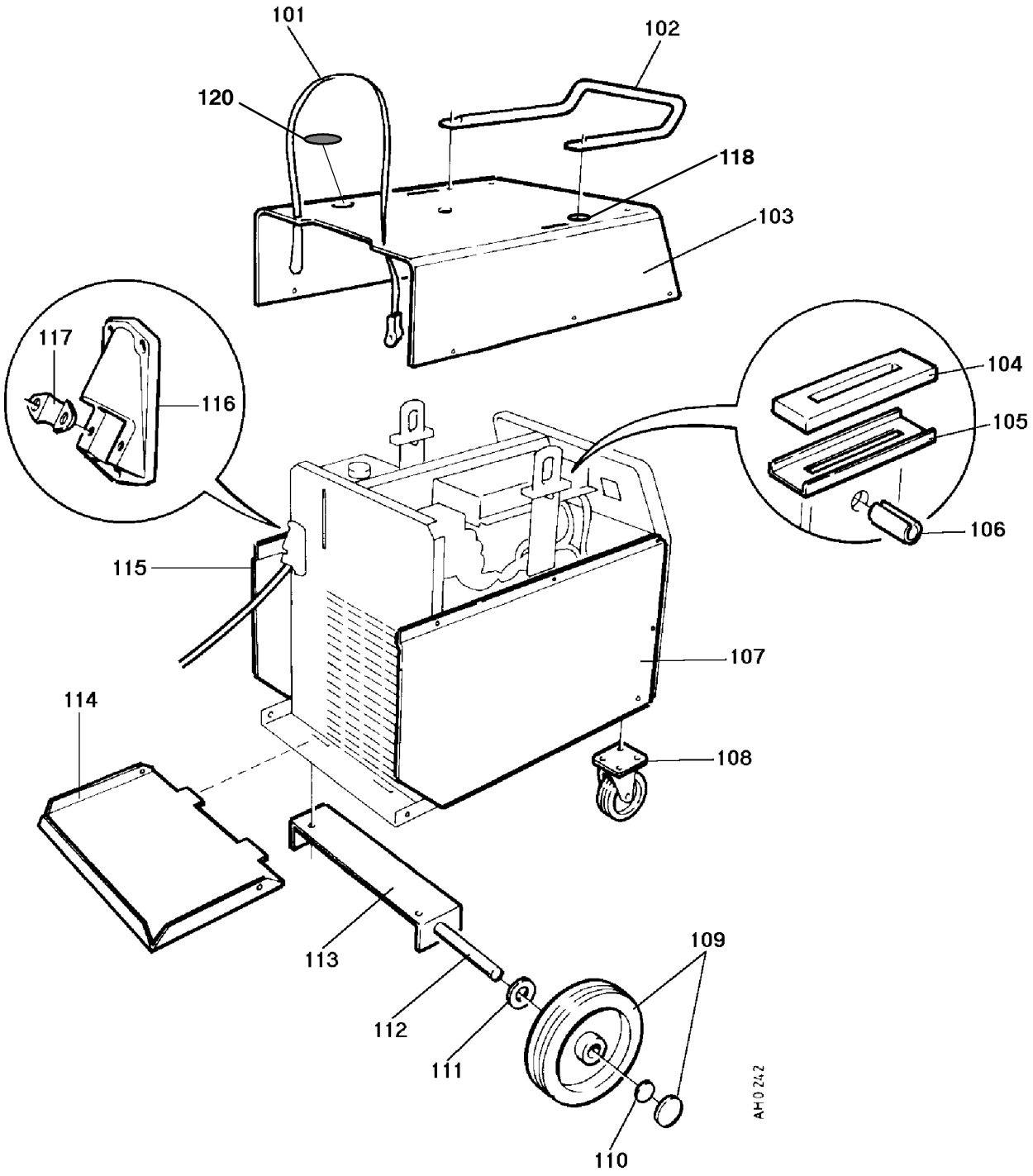
Spare parts list - Reservdelsförteckning - Ersatzteilverzeichnis - Liste de pièces détachées

Item no.	Qty	Ordering no.	Denomination	Notes
101	1	0368 265 002	Securing strap	Before machine no 550 646 . . . .
	1	0321 173 001	Securing chain	From machine no 550 646 . . . .
102	1	0469 868 001	Handle	
103	1	0469 681 001	Cover	
104	2	0468 797 001	Seal	
105	2	0468 796 001	Support plate	
106	2	0211 103 005	Roll pin	⊘ 8x28
107	1	0455 209 001	Side panel with text	Left
108	2	0469 873 001	Castor wheel	⊘ 125mm h=150mm
109	2	0469 872 001	Wheel	⊘ 250mm
110	2	0192 859 126	Locking washer	
111	2		Washer	⊘ 36/21x3
112	1	0469 516 002	Shaft	
113	1	0469 685 001	Clamp	
114	1	0456 683 001	Shelf	
115	1	0455 209 002	Side panel with text	Right
116	1	0158 117 880	Cable inlet	Machine No 434 . . . . .
117	1	0468 486 001	Cable clip	Machine No 434 . . . . .
118	4	0366 481 002	Seal	From machine No 512 . . . . .
119	1	0469 950 880	Cable inlet	From machine No 512 . . . . .
120	1	0192 230 120	Cover	Only for machines without water cooler



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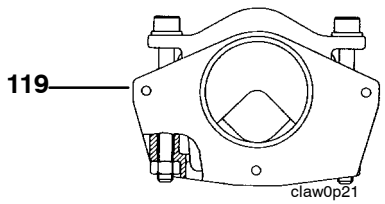

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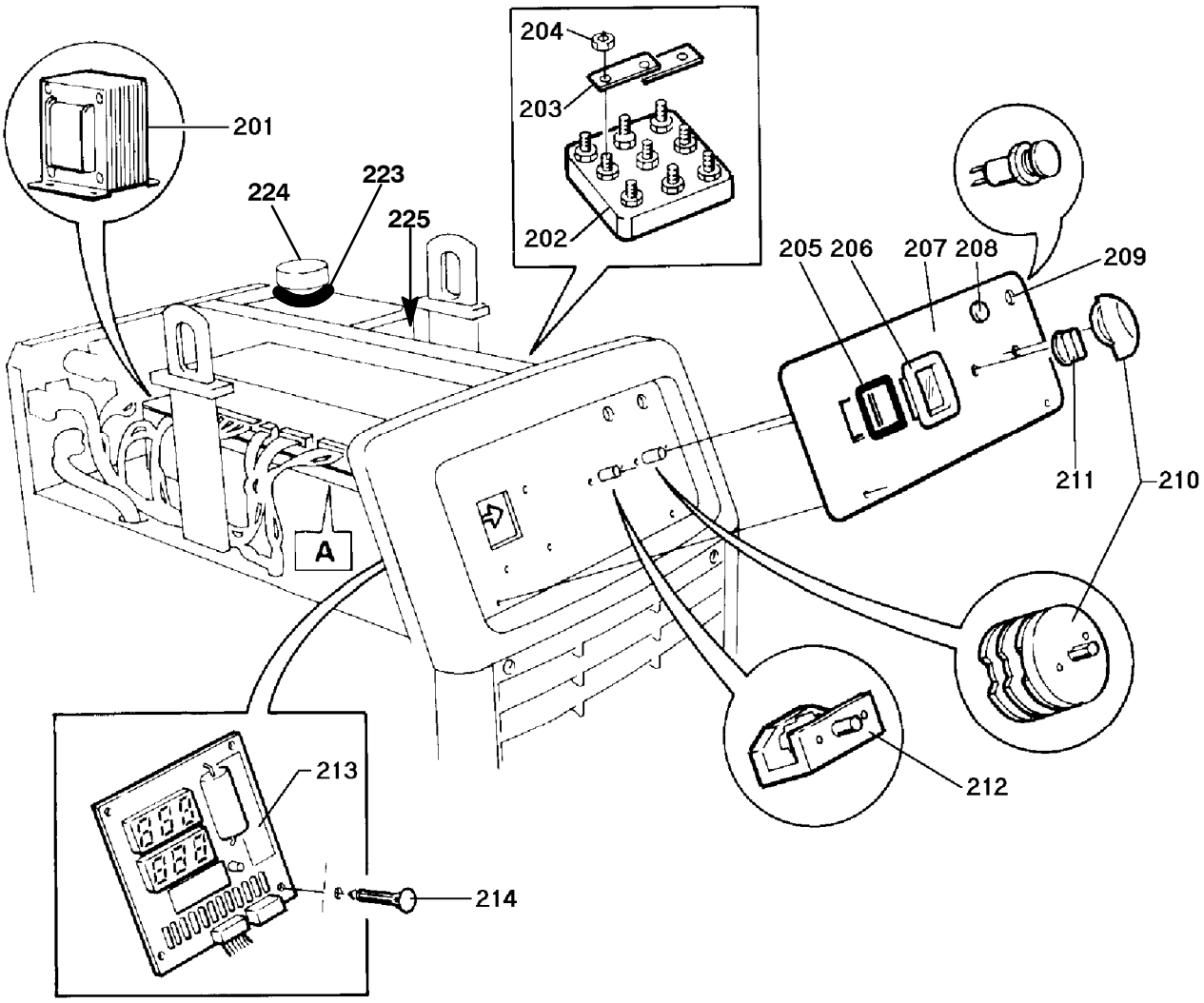
C = component designation in the circuit diagram

Item no.	Qty LAW 400	Qty LAW 500	Ordering no.	Denomination	Notes	C
201	1	1	0469 882 001	Control transformer	400-415 V mains voltage	TC1
	1	1	0455 306 001	Control transformer	230-500 V mains voltage	TC1
202	1	1	0469 899 001	Terminal	230-500 V mains voltage	XT1
203	2	2	0469 899 002	Jumper		
204	24	24		Nut	M8	
205	1	1	0455 174 001	Seal		
206	1	1	0455 172 001	Protection glass		
207	1	-	0455 203 001	Panel with text	LAW 400	
	1	-	0455 204 001	Panel with text	LAW 400W	
	-	1	0455 206 001	Panel with text	LAW 500	
	-	1	0455 207 001	Panel with text	LAW 500W	
208	1	1	0455 201 002	Light-emitting diode	Yellow	V7
209	1	1	0455 201 001	Indicating lamp	42 VAC, white	HL1
210	1	-	0455 158 001	Switch	32A 19kW 500VAC, 400-415 V mains voltage	QF1
	1	-	0455 159 001	Switch	40A 26kW 500VAC, 230-500 V mains voltage	QF1
	-	1	0455 159 001	Switch	40A 26kW 500VAC, 400-415 V mains voltage	QF1
	-	1	0455 160 001	Switch	63A 42kW 500VAC, 230-500 V mains voltage	QF1
211	1	1	0366 296 003	Knob	Only LAW with water cooler	
212	1	1	0455 307 002	Switch	Only LAW with water cooler	QF2
213	1	1	0455 173 881	Digital instrument	Option, complete	PI
	1	1	0486 212 880	Circuit board	For digital instrument	
214	3	3	0455 226 010	Spacer	For circuit board	
215	1	1	0455 211 001	Cover		
216	1	1	0193 260 061	Connector	2-pole	XS5
	1	1	0193 260 062	Connector	3-pole	XS6
	2	2	0193 260 151	Connector	3-pole	XS7, XS8
	-	1	0193 260 152	Connector	4-pole	XS9
	2	2	0193 260 153	Connector	5-pole	XS10, XS11
	1	1	0193 260 156	Connector	8-pole	XS12
	1	1	0193 260 157	Connector	9-pole	XS13
	1	1	0193 260 071	Connector	12-pole	XS14
	1	1	0193 260 155	Connector	7-pole	XS15
217	1	1	0486 291 880	Circuit board	Replacing circuit board 0486 220 880	AP1
	1	-	0486 480 880	Circuit board	From machine No 701	AP1
	-	1	0486 480 880	Circuit board	From machine No 652	AP1
218	4	4	0153 043 002	Insulating washer	Before machine no. 550 642	
218b	3	3	0194 019 005	Insulating washer	From machine no. 550 642	
	2	2	0193 517 344	Screw	From machine no. 550 642	
219	1	1	0455 210 001	Box		
220	1	1	0467 911 882	Capacitor	0.1 µF 250 V, with cable lugs	C4
221	3	3	0394 516 031	Spacer screw	M5	
222	1	1	0191 193 118	Tape	To be ordered per meter, 0.31 meter as delivered	
223	1	1	0366 481 003	Seal	From machine No 512 . . . . . . Only for machines with water cooler	
224	1	1	0469 689 002	Cover	For machines with water tank	
225	1	1	0486 216 880	Circuit board	Suppressor board, from machine No. 550 . . .	AP2
	1	1	0162 772 001	Terminal	3-pole, for connection of L1, L2, L3 to AP2	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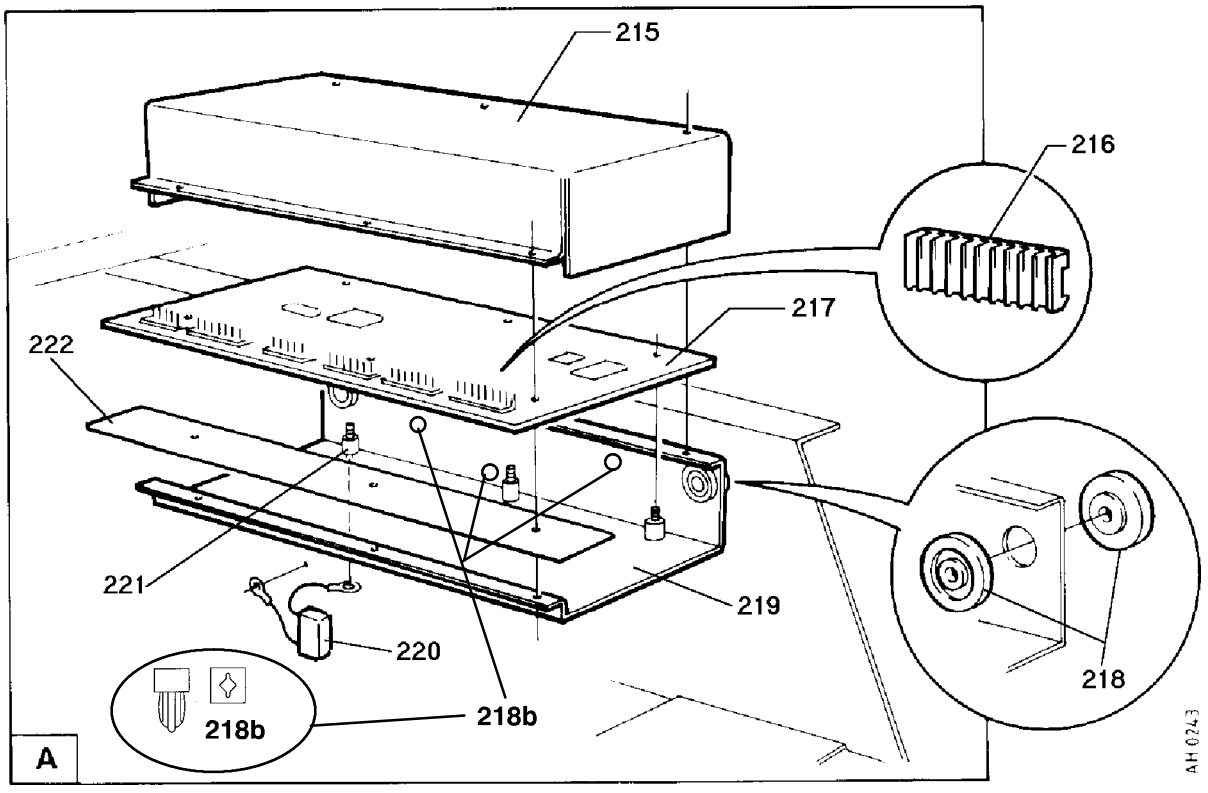
215
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218b
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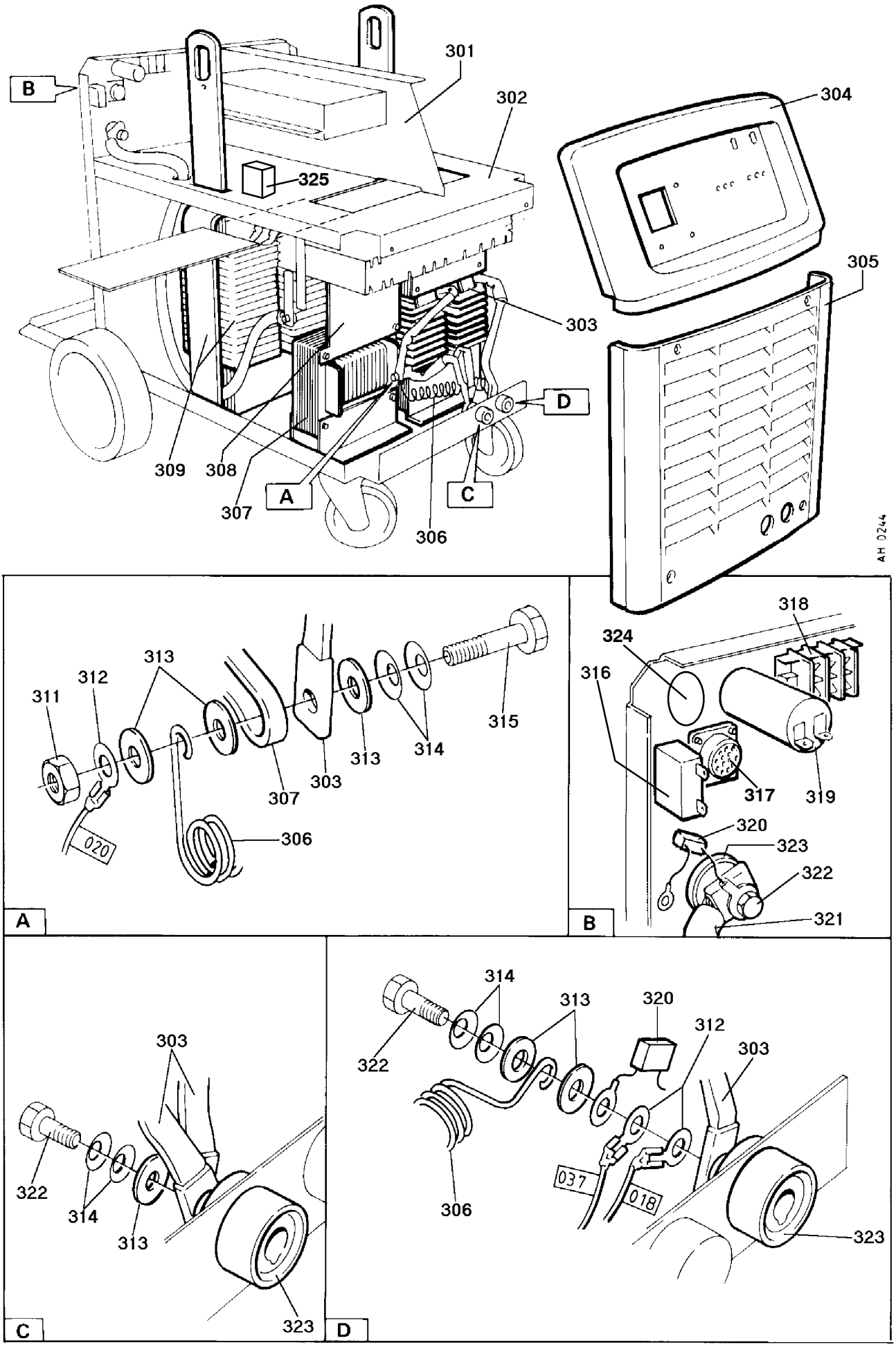
AH 0243

C = component designation in the circuit diagram

Item no.	Qty LAW 410	Qty LAW 510	Ordering no.	Denomination	Notes	C
301	1	1	0469 678 001	Centre plate		
302	1	1	0469 675 001	Intermediate plate		
303	1	-	0469 876 880	Inductor		L2
	-	1	0469 876 881	Inductor	With thermal cutouts from machine No 512	L2, ST1, ST2
304	1	1	0469 704 001	Front panel		
305	1	1	0469 703 001	Front grill		
306	1	1	0469 888 001	Resistor	0.43Ω	R1
307	1	-	0469 696 880	Inductor	Interphase transformer. With thermal cutouts	L1, ST1, ST2
	-	1	0469 697 880	Inductor	Interphase transformer from machine No 512	L1
308	1	1	0455 217 001	Attachment		
309	1	-	0457 100 880	Transformer	400-415 V mains voltage	TM1
	1	-	0457 102 880	Transformer	230-500 V mains voltage	TM1
	-	1	0457 104 880	Transformer	400-415 V mains voltage	TM1
	-	1	0457 106 880	Transformer	230-500 V mains voltage	TM1
311	1	1		Nut	M10	
312	3	3		Washer	With flat pin connection 6.3x0.8, M10	
313	6	6		Washer	⊘ 22/10.5x2	
314	6	6	0219 504 307	Spring washer	⊘ 20/10.2x1.1	
315	1	1		Screw	M10x40	
316	1	1	0193 586 102	Circuit breaker	10 A	FU1
317	1	1	0368 544 005 0323 945 003	Sleeve socket Sleeve	23-pole	XS1
318	1	1	0466 884 003	Connection block	3-pole	XT2
319	1	1	0191 085 203	Capacitor	3 μF 400 V	C1
320	2	2	0467 911 881	Capacitor	0.1 μF 250 V, with cable lugs	C2,C3
321	1	-	0469 879 880	Cable set	A=50mm^2	
	-	1	0469 879 881	Cable set	A=95mm^2	
322	3	3		Screw	M10x30	
323	3	3	0160 362 881	Current terminal	1-pole	XS2-XS4
324	1	1	0191 085 206	Capacitor	400 V 6 μF From machine No 512	C6
325	1	1	0193 927 001	Contactor	From machine No 512	KM2



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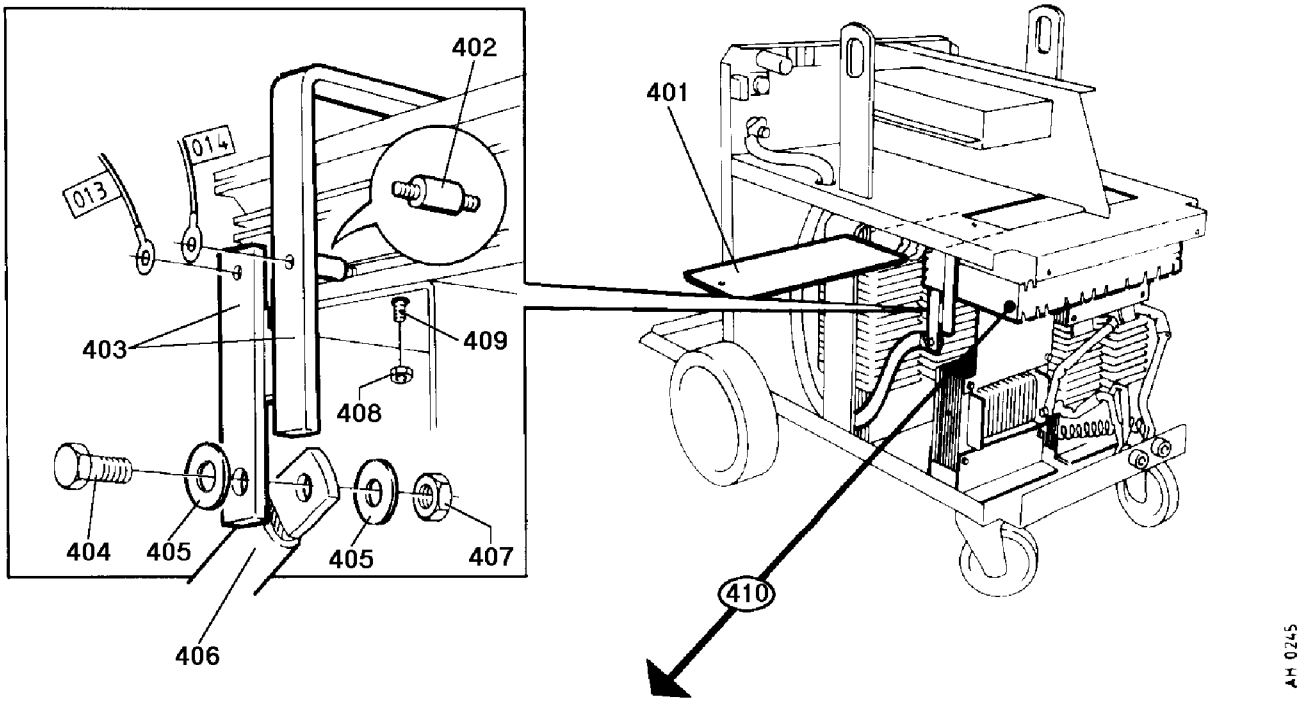
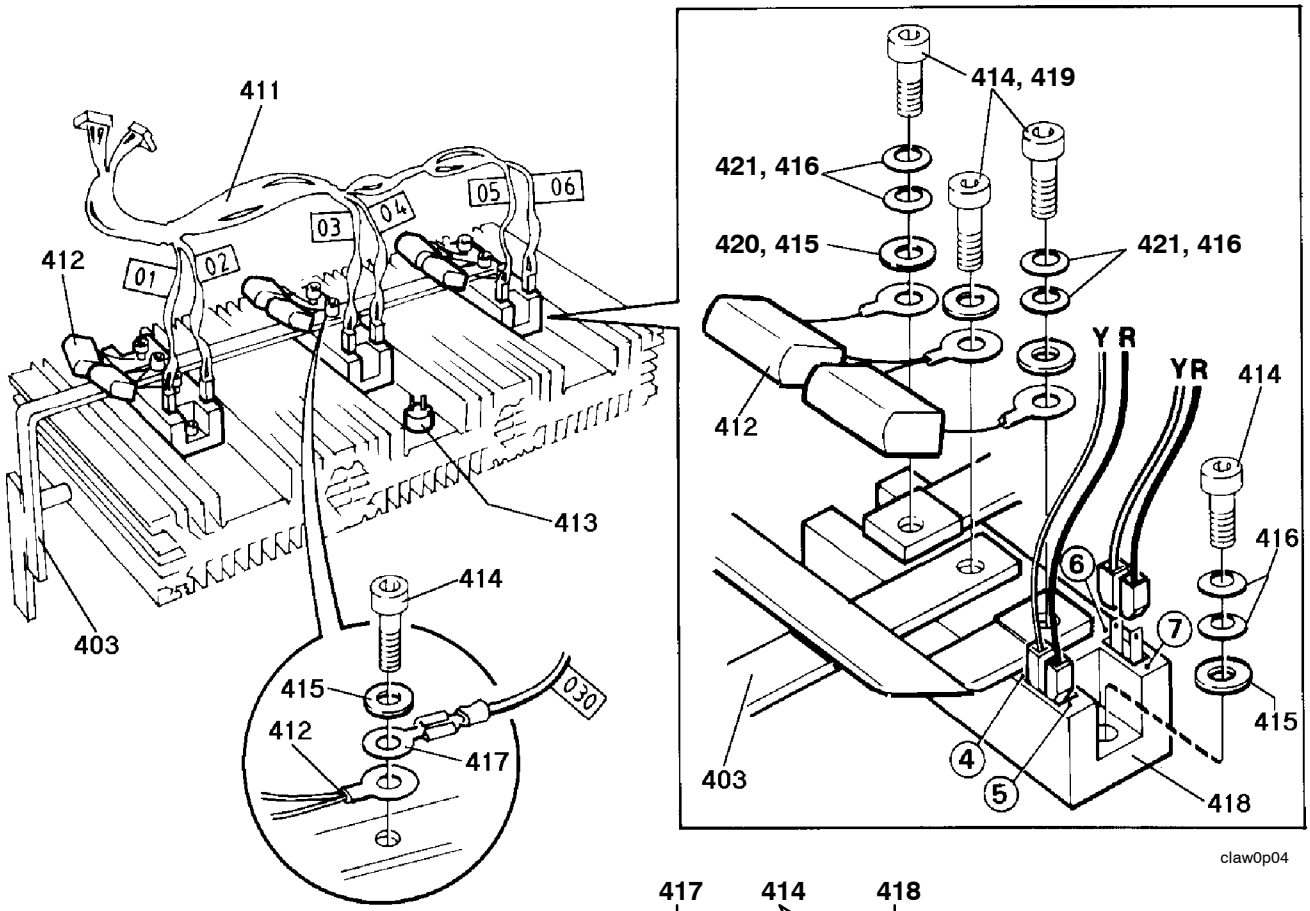
claw0se1

C = component designation in the circuit diagram

Item no.	Qty LAW 400	Qty LAW 500	Ordering no.	Denomination	Notes	C
401	1	1	0469 691 001	Cover		
402	1	1	0193 609 105	Insulator	M5	
403	1	1	0469 878 881	Shunt	60mV/600A	RS1
404	1	1		Screw	M8x25	
405	2	2		Washer	⊘ 16/8.4x1.5	
406				Cable set	See item 321	
407	1	1		Nut	M8	
408	2	2		Nut	M5	
409	2	2		Screw	M5x12	
410	1	1		Thyristor bridge	Contains items 403 and 411 - 421 The items must be ordered separately	
411	1	1	0469 861 884	Cable set		
412	3	3	0469 693 880	Suppressor	RC filter	Z1 - Z6
413	1	-	0467 864 003	Thermal cutout	60°C Machine No 434	ST1
	-	1	0467 864 005	Thermal cutout	70°C Machine No 434	ST1
414	15	15		Screw	M6x16 Machine No 434	
	6	15		Screw	M6x16 From machine No. 512	
415	15	15		Washer	⊘ 12/6.4x1.5 Machine No 434	
	6	15		Washer	⊘ 12/6.4x1.5 From machine No 512	
416	24	24	0219 504 303	Spring washer	⊘ 12.5/6.2x0.7 Machine No 434	
	12	24	0219 504 303	Spring washer	⊘ 12.5/6.2x0.7 From machine No 512 . . .	
417	1	1		Washer	With flat pin connection 6.3x0.8, M6	
418	3	3	0455 157 001	Thyristor module	Machine No 434	V1 - V6
	-	3	0455 157 001	Thyristor module	From machine No 512	V1 - V6
	3	-	0456 156 001	Thyristor module	From machine No 512 . . . . . to machine No. 550 644	V1 - V6
	3	-	0456 536 001	Thyristor module	From machine No 550 644 . . . . See the service manual for fitting instructions	V1 - V6
-			0192 058 101	Thermal compound	For fitting of thyristor modules	
419	9	-		Screw	M5x16 From machine No. 512	
420	9	-		Washer	⊘ 10/5.6x1 From machine No 512	
421	12	-	0219 504 302	Spring washer	⊘ 10/5.2x0.5 From machine No 512	





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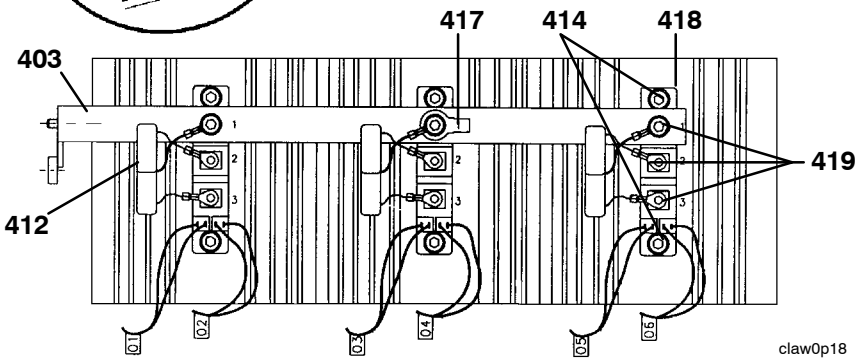

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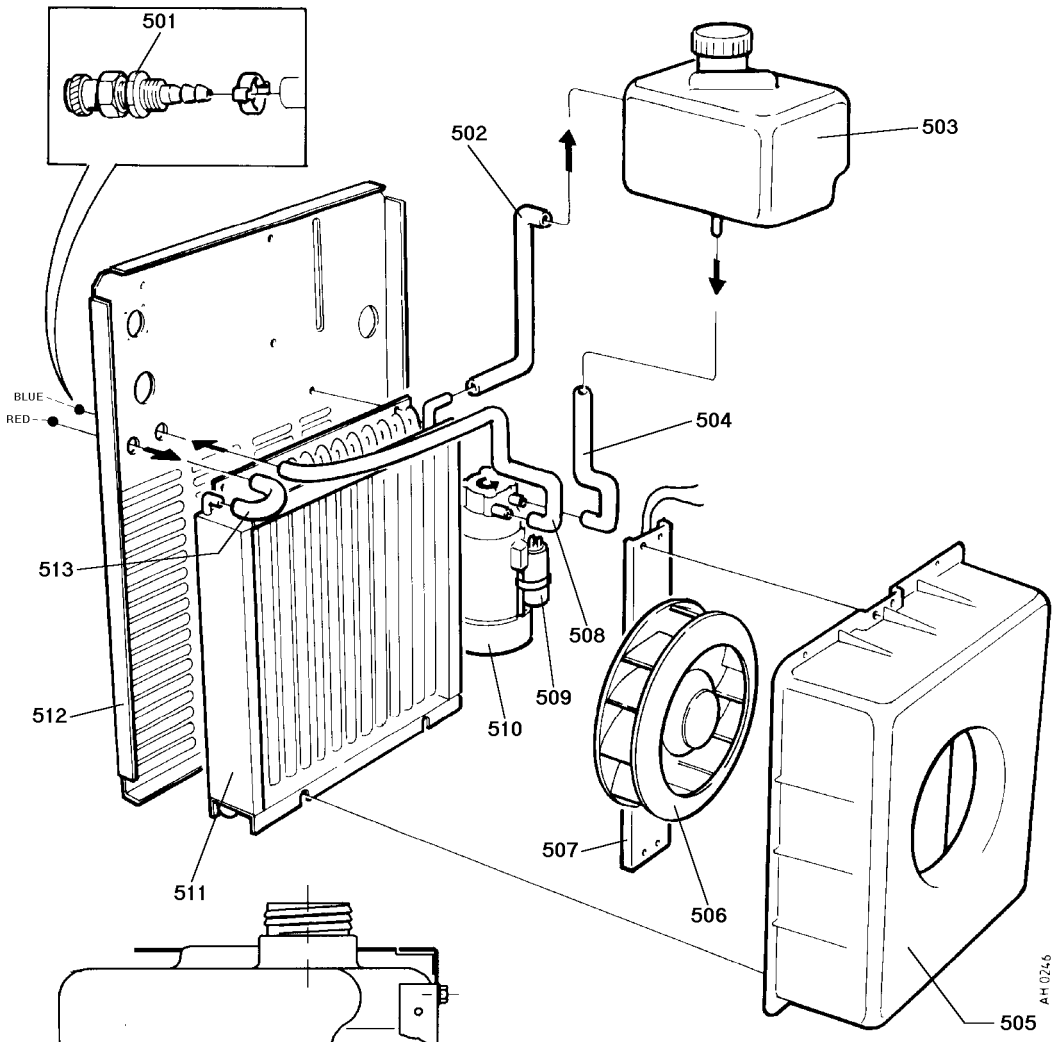
LAW 4/5 = LAW 400/500
LAW 4/5W = LAW 400W/500W

C = component designation in the circuit diagram

Item no.	Qty LAW 4/5	Qty LAW 4/5W	Ordering no.	Denomination	Notes	C
501					**Before machine no...649 ....**	
	-	1	0365 803 008	Quick connector	Female, red	
	-	1	0365 803 009	Quick connector	Female, blue	
	-	-	0365 803 004	Quick connector	Male. For connection set 8 - 35 meter	
	-	-	0365 803 010	Quick connector	Male. For connection set 1.7 meter	
					From machine no...649	
501	-	1	0365 803 011	Quick connector	Female, red, for the maleconnectors below	
	-	1	0365 803 012	Quick connector	Female, blue, for the maleconnectors below	
	-	-	0365 803 013	Quick connector	Male, with non-return valve. For connection set 8 - 35 meter	
	-	-	0365 803 010	Quick connector	Male. For connection set 1.7 meter	
502	-	1	0455 162 001	Hose		
503	-	1	0469 689 001	Water tank		
				Cover	For water tank, see item 224	
504	-	1	0455 164 001	Hose	Before machine number 550 642	
	-	1	0457 987 001	Hose	L = 340mm, to be ordered per metre From machine number 550 642	
505	1	1	0469 893 001	Fan housing		
506	1	1	0369 827 001	Fan		EV1
507	1	1	0455 165 001	Attachment		
508	-	1	0455 163 001	Hose	Before machine number 550 642 ...	
	-	1	0457 987 001	Hose	L = 620mm, to be ordered per metre From machine number 550 642	
509	-	1	0191 085 105	Capacitor	5µF 400 V	C5
510	-	1	0469 692 001	Pump	1A 0.2kW 230V 50Hz, item 509 included	M1
511	-	1	0469 688 001	Cooler		
512	1	1	0455 166 001	Rear panel with text		
513	-	1	0455 161 001	Hose		



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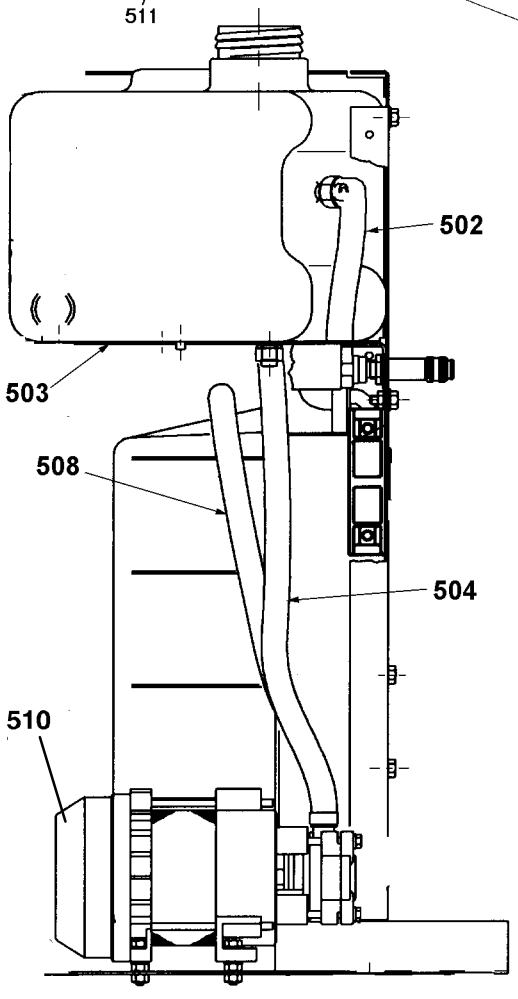

The pump motor is fitted horizontal from machine number 550 642 . .

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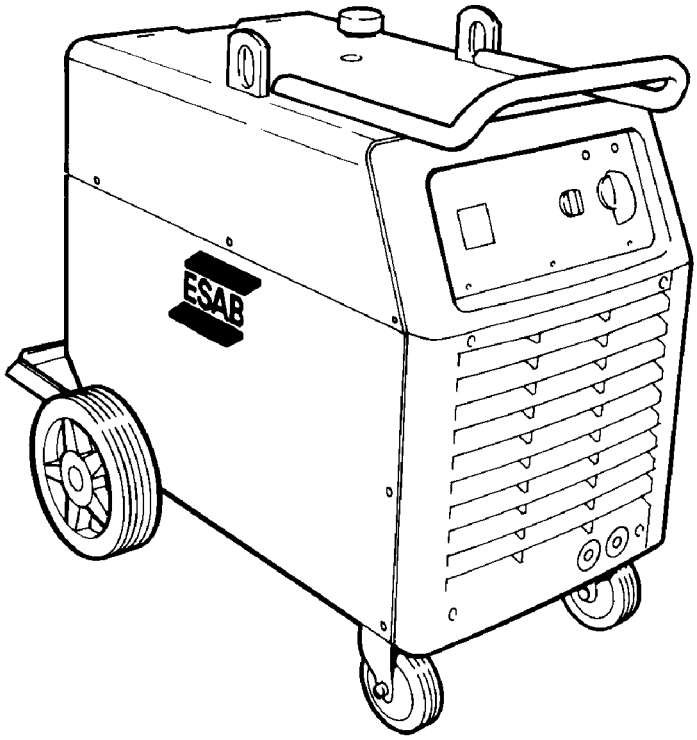
SPARE PARTS LIST LAW 410/510

Edition 9708



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Ordering numbers for LAW welding rectifiers

Ordering no.	Denomination	Notes
0457 091 880	LAW 410	400-415 V 3～ 50 Hz
0457 091 881	LAW 410	230/400-415/500 V 3～50 Hz; 230/440-460 V 3～ 60 Hz
0457 091 882	LAW 410W	400-415 V 3～ 50 Hz; with water cooler
0457 091 883	LAW 410W	230/400-415/500 V 3～50 Hz; 230/440-460 V 3～ 60 Hz, with water cooler
0457 095 880	LAW 510	400-415 V 3～ 50 Hz
0457 095 881	LAW 510	230/400-415/500 V 3～50 Hz; 230/440-460 V 3～ 60 Hz
0457 095 882	LAW 510W	400-415 V 3～50 Hz; with water cooler
0457 095 883	LAW 510W	230/400-415/500 V 3～50 Hz; 230/440-460 V 3～ 60 Hz, with water cooler

Spare parts list - Reservdelsförteckning - Ersatzteilverzeichnis - Liste de pièces détachées

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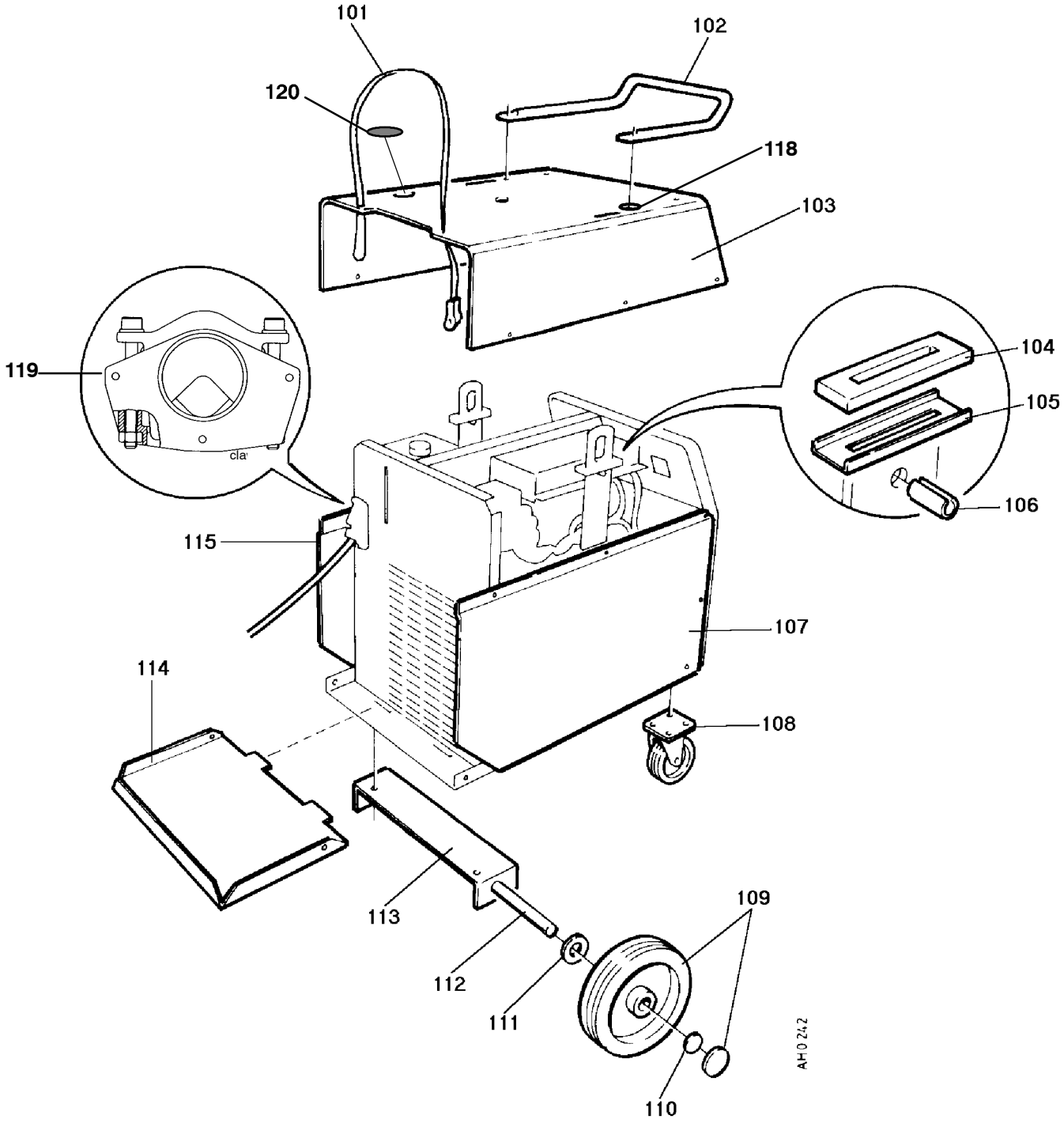
Spare parts list - Reservdelsförteckning - Ersatzteilverzeichnis - Liste de pièces détachées

Item no.	Qty	Ordering no.	Denomination	Notes
101	1	0321 173 001	Securing chain	
102	1	0469 868 001	Handle	
103	1	0469 681 001	Cover	
104	2	0468 797 001	Seal	
105	2	0468 796 001	Support plate	
106	2	0211 103 005	Roll pin	⊘ 8x28
107	1	0455 209 001	Side panel with text	Left
108	2	0469 873 001	Castor wheel	⊘ 125mm h=150mm
109	2	0469 872 001	Wheel	⊘ 250mm
110	2	0192 859 126	Locking washer	
111	2		Washer	⊘ 36/21x3
112	1	0469 516 002	Shaft	
113	1	0469 685 001	Clamp	
114	1	0456 683 001	Shelf	
115	1	0455 209 002	Side panel with text	Right
118	4	0366 481 002	Seal	
119	1	0469 950 880	Cable inlet	
120	1	0192 230 120	Cover	Only for machines without water cooler



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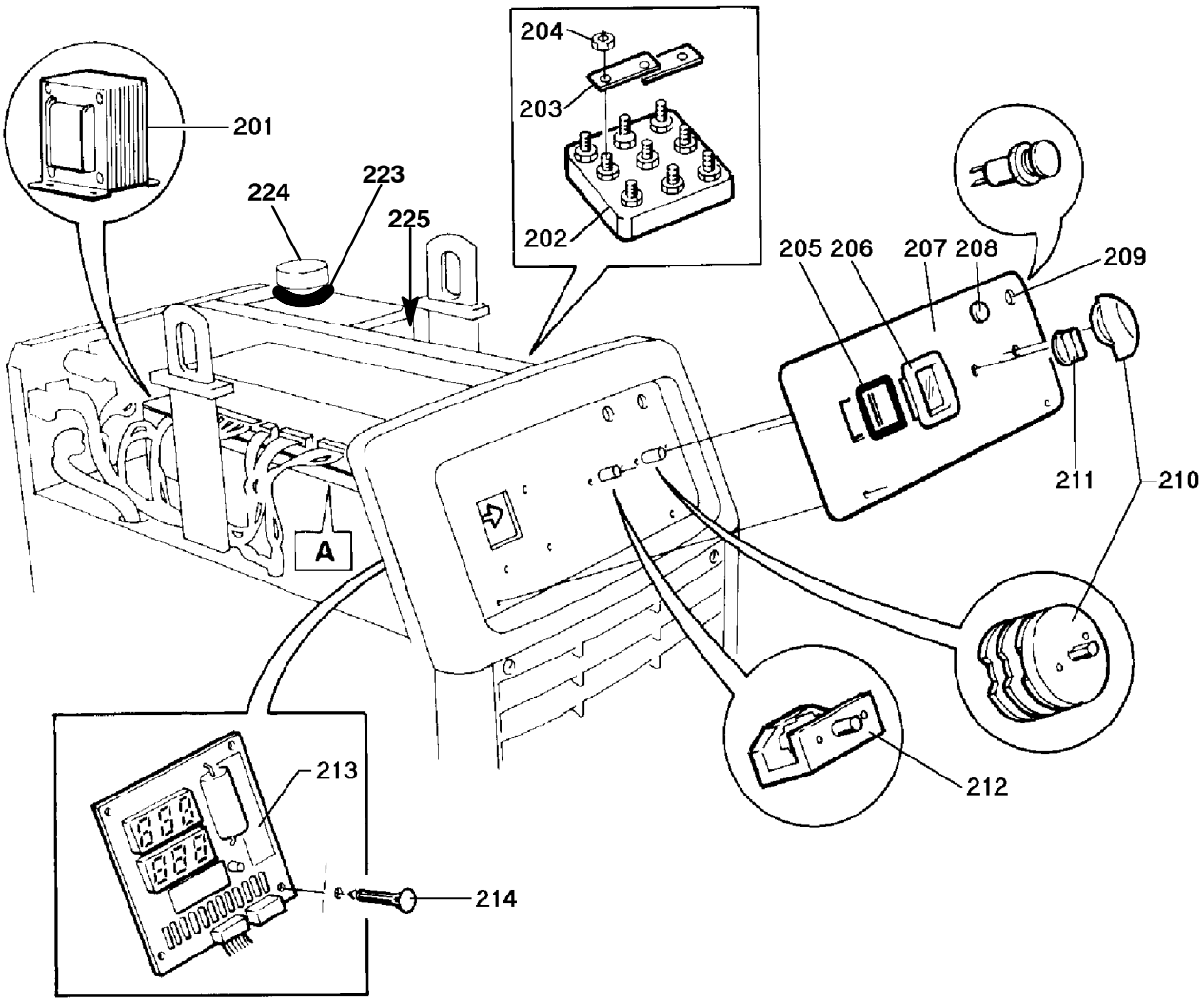
C = component designation in the circuit diagram

Item no.	Qty LAW 410	Qty LAW 510	Ordering no.	Denomination	Notes	C
201	1	1	0469 882 001	Control transformer	400-415 V mains voltage	TC1
	1	1	0455 306 001	Control transformer	230-500 V mains voltage	TC1
202	1	1	0469 899 001	Terminal	230-500 V mains voltage	XT1
203	2	2	0469 899 002	Jumper		
204	24	24		Nut	M8	
205	1	1	0455 174 001	Seal		
206	1	1	0455 172 001	Protection glass		
207	1	-	0457 114 001	Panel with text	LAW 410	
	1	-	0457 115 001	Panel with text	LAW 410W	
	-	1	0457 129 001	Panel with text	LAW 510	
	-	1	0457 130 001	Panel with text	LAW 510W	
208	1	1	0455 201 002	Light-emitting diode	Yellow	V7
209	1	1	0455 201 001	Indicating lamp	42 VAC, white	HL1
210	1	-	0455 158 001	Switch	32A 19kW 500VAC, 400-415 V mains voltage	QF1
	1	-	0455 159 001	Switch	40A 26kW 500VAC, 230-500 V mains voltage	QF1
	-	1	0455 159 001	Switch	40A 26kW 500VAC, 400-415 V mains voltage	QF1
	-	1	0455 160 001	Switch	63A 42kW 500VAC, 230-500 V mains voltage	QF1
211	1	1	0366 296 003	Knob	Only LAW with water cooler	
212	1	1	0455 307 002	Switch	Only LAW with water cooler	QF2
213	1	1	0455 173 881	Digital instrument	Option, complete	PI
	1	1	0486 212 880	Circuit board	For digital instrument	
214	3	3	0455 226 010	Spacer	For circuit board	
215	1	1	0455 211 001	Cover		
216	1	1	0193 260 061	Connector	2-pole	XS5
	1	1	0193 260 062	Connector	3-pole	XS6
	2	2	0193 260 151	Connector	3-pole	XS7, XS8
	-	1	0193 260 152	Connector	4-pole	XS9
	2	2	0193 260 153	Connector	5-pole	XS10, XS11
	1	1	0193 260 156	Connector	8-pole	XS12
	1	1	0193 260 157	Connector	9-pole	XS13
	1	1	0193 260 071	Connector	12-pole	XS14
	1	1	0193 260 155	Connector	7-pole	XS15
217	1	1	0486 480 880	Circuit board		AP1
218b	3	3	0194 019 005	Insulating washer		
	2	2	0193 517 344	Screw		
219	1	1	0455 210 001	Box		
220	1	1	0467 911 882	Capacitor	0.1 µF 250 V, with cable lugs	C4
221	3	3	0394 516 031	Spacer screw	M5	
222	1	1	0191 193 118	Tape	To be ordered per meter, 0.31 meter as delivered	
223	1	1	0366 481 003	Seal	Only for machines with water tank	
224	1	1	0469 689 002	Cover	For machines with water tank	
225	1	1	0486 216 880	Circuit board	Suppressor board	AP2
	1	1	0162 772 001	Terminal	3-pole, for connection of L1, L2, L3 to AP2	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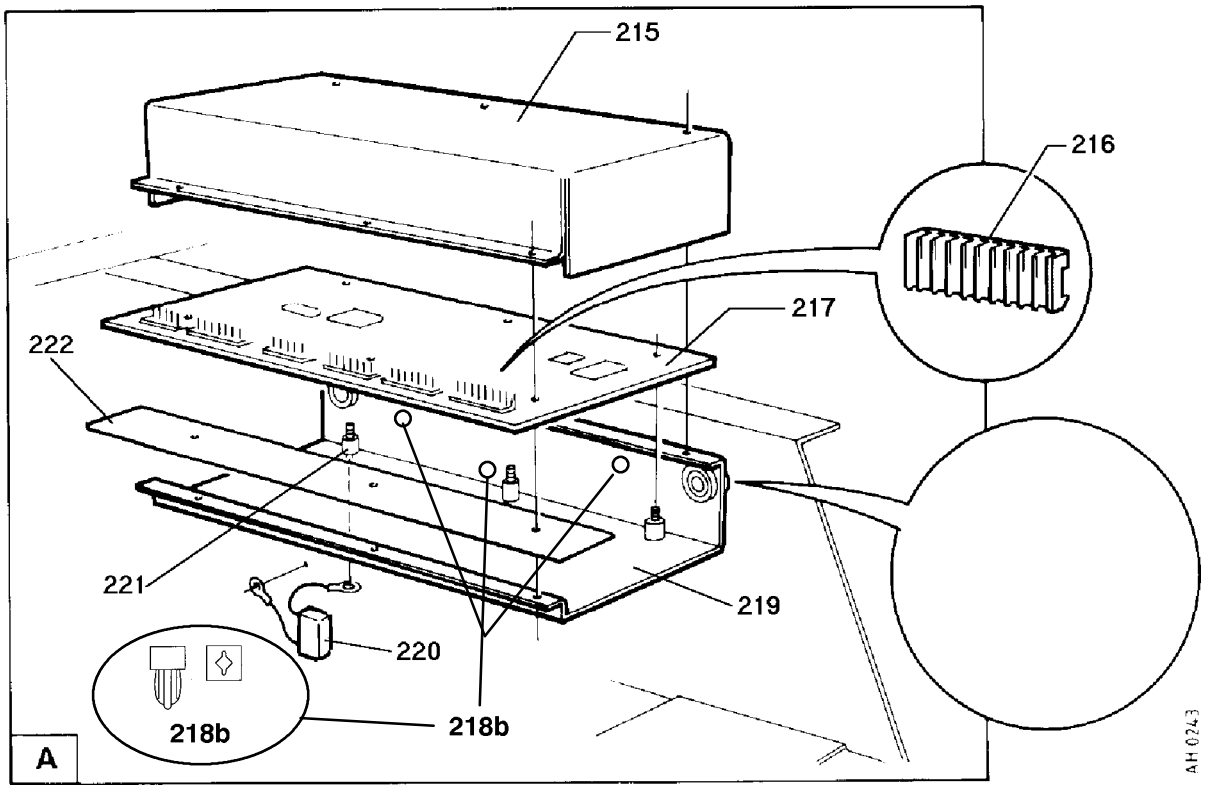
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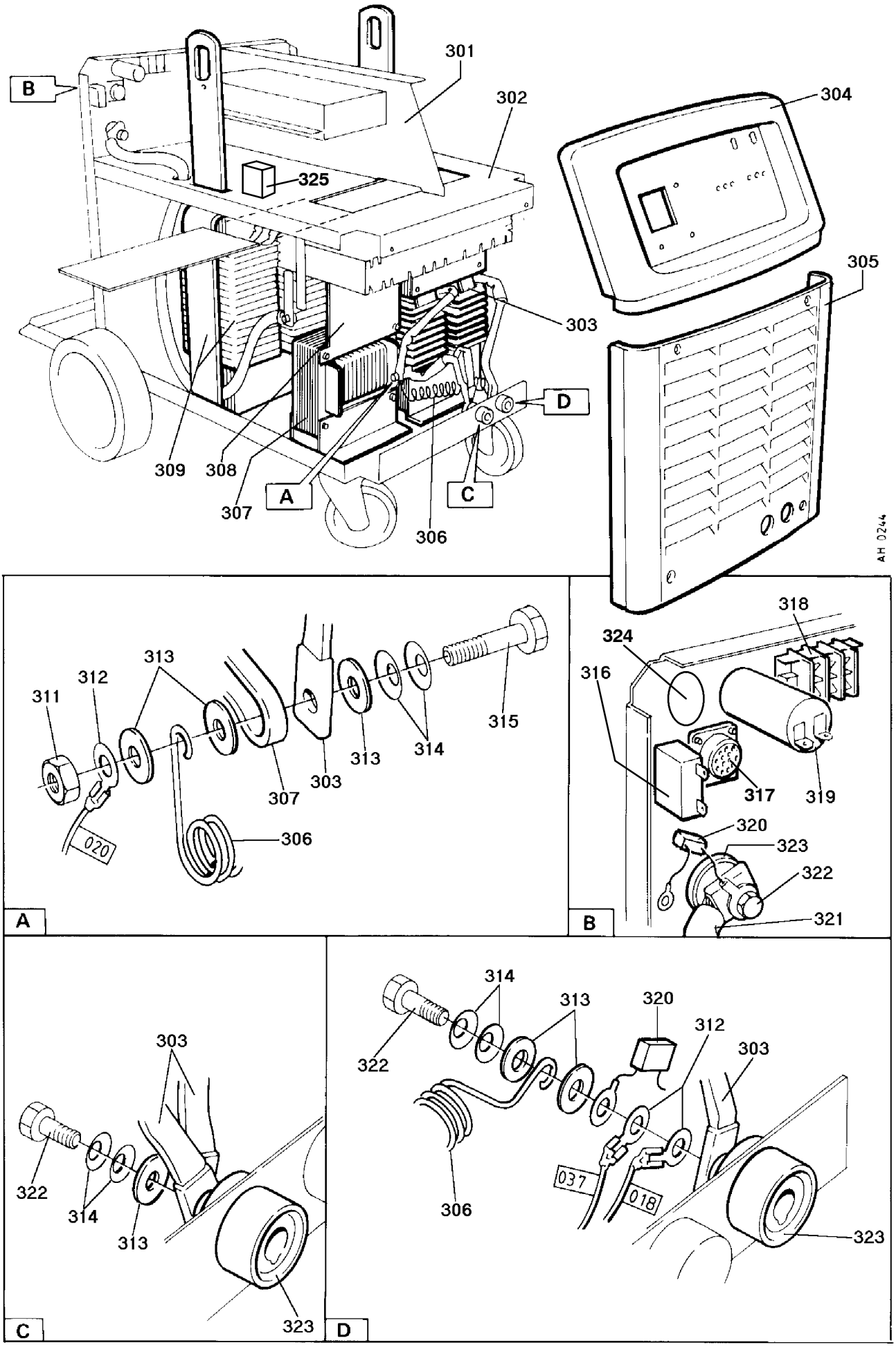
C = component designation in the circuit diagram

Item no.	Qty LAW 410	Qty LAW 510	Ordering no.	Denomination	Notes	C
301	1	1	0469 678 001	Centre plate		
302	1	1	0469 675 001	Intermediate plate		
303	1	-	0469 876 880	Inductor		L2
	-	1	0469 876 881	Inductor	With thermal cutouts	L2, ST1, ST2
304	1	1	0469 704 001	Front panel		
305	1	1	0469 703 001	Front grill		
306	1	1	0469 888 001	Resistor	0.43Ω	R1
307	1	-	0469 696 880	Inductor	Interphase transformer. With thermal cutouts	L1, ST1, ST2
	-	1	0469 697 880	Inductor	Interphase transformer	L1
308	1	1	0455 217 001	Attachment		
309	1	-	0457 100 880	Transformer	400-415 V mains voltage	TM1
	1	-	0457 102 880	Transformer	230-500 V mains voltage	TM1
	-	1	0457 104 880	Transformer	400-415 V mains voltage	TM1
	-	1	0457 106 880	Transformer	230-500 V mains voltage	TM1
311	1	1		Nut	M10	
312	3	3		Washer	With flat pin connection 6.3x0.8, M10	
313	6	6		Washer	⊘ 22/10.5x2	
314	6	6	0219 504 307	Spring washer	⊘ 20/10.2x1.1	
315	1	1		Screw	M10x40	
316	1	1	0193 586 102	Circuit breaker	10 A	FU1
317	1	1	0368 544 005	Sleeve socket	23-pole	XS1
			0323 945 003	Sleeve		
318	1	1	0466 884 003	Connection block	3-pole	XT2
319	1	1	0191 085 203	Capacitor	3 μF 400 V	C1
320	2	2	0467 911 881	Capacitor	0.1 μF 250 V, with cable lugs	C2,C3
321	1	-	0469 879 880	Cable set	A=50mm^2	
	-	1	0469 879 881	Cable set	A=95mm^2	
322	3	3		Screw	M10x30	
323	3	3	0160 362 881	Current terminal	1-pole	XS2-XS4
324	1	1	0191 085 206	Capacitor	400 V 6 μF	C6
325	1	1	0193 927 001	Contactor		KM2



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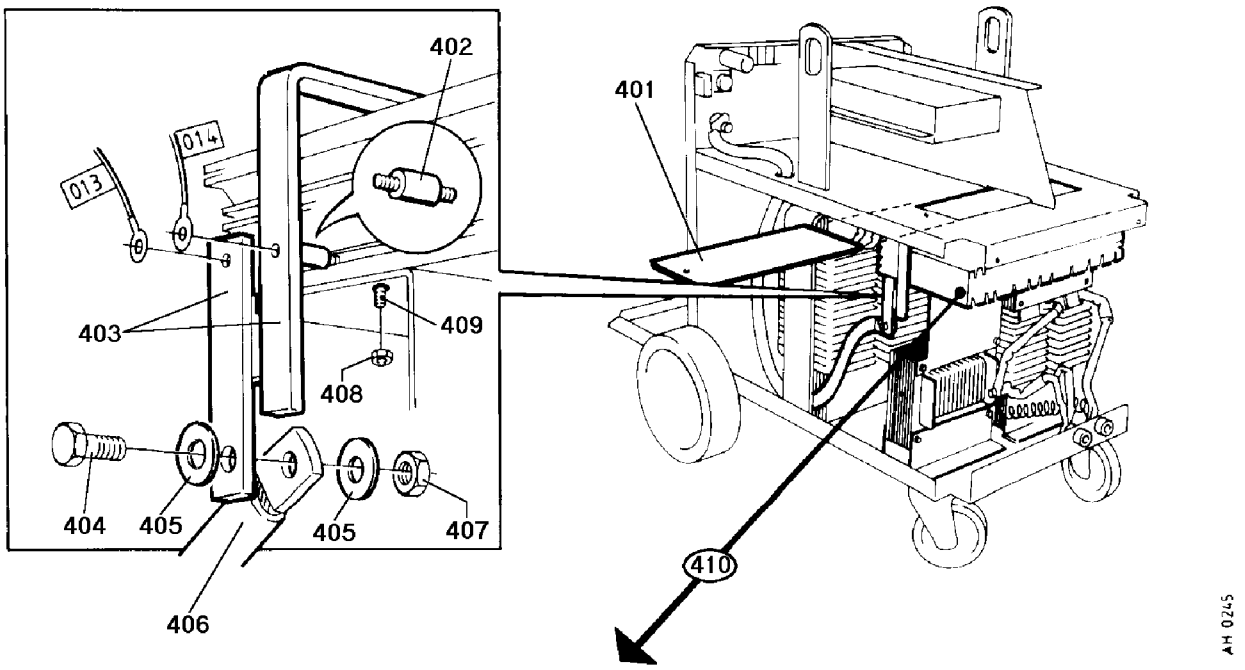
C = component designation in the circuit diagram

Item no.	Qty LAW 410	Qty LAW 510	Ordering no.	Denomination	Notes	C
401	1	1	0469 691 001	Cover		
402	1	1	0193 609 105	Insulator	M5	
403	1	1	0469 878 881	Shunt	60mV/600A	RS1
404	1	1		Screw	M8x25	
405	2	2		Washer	⊘ 16/8.4x1.5	
406				Cable set	See item 321	
407	1	1		Nut	M8	
408	2	2		Nut	M5	
409	2	2		Screw	M5x12	
410	1	1		Thyristor bridge	Contains items 403 and 411 - 421 The items must be ordered separately	
411	1	1	0469 861 884	Cable set		
412	3	3	0469 693 880	Suppressor	RC filter	Z1 - Z6
414	6	15		Screw	M6x16	
415	6	15		Washer	⊘ 12/6.4x1.5	
416	12	24	0219 504 303	Spring washer	⊘ 12.5/6.2x0.7	
417	1	1		Washer	With flat pin connection 6.3x0.8, M6	
418	-	3	0455 157 001	Thyristor module	See the service manual for fitting instructions	V1 - V6
	3	-	0456 536 001	Thyristor module	See the service manual for fitting instructions	V1 - V6
-			0192 058 101	Thermal compound	For fitting of thyristor modules	
419	9	-		Screw	M5x16	
420	9	-		Washer	⊘ 10/5.6x1	
421	12	-	0219 504 302	Spring washer	⊘ 10/5.2x0.5	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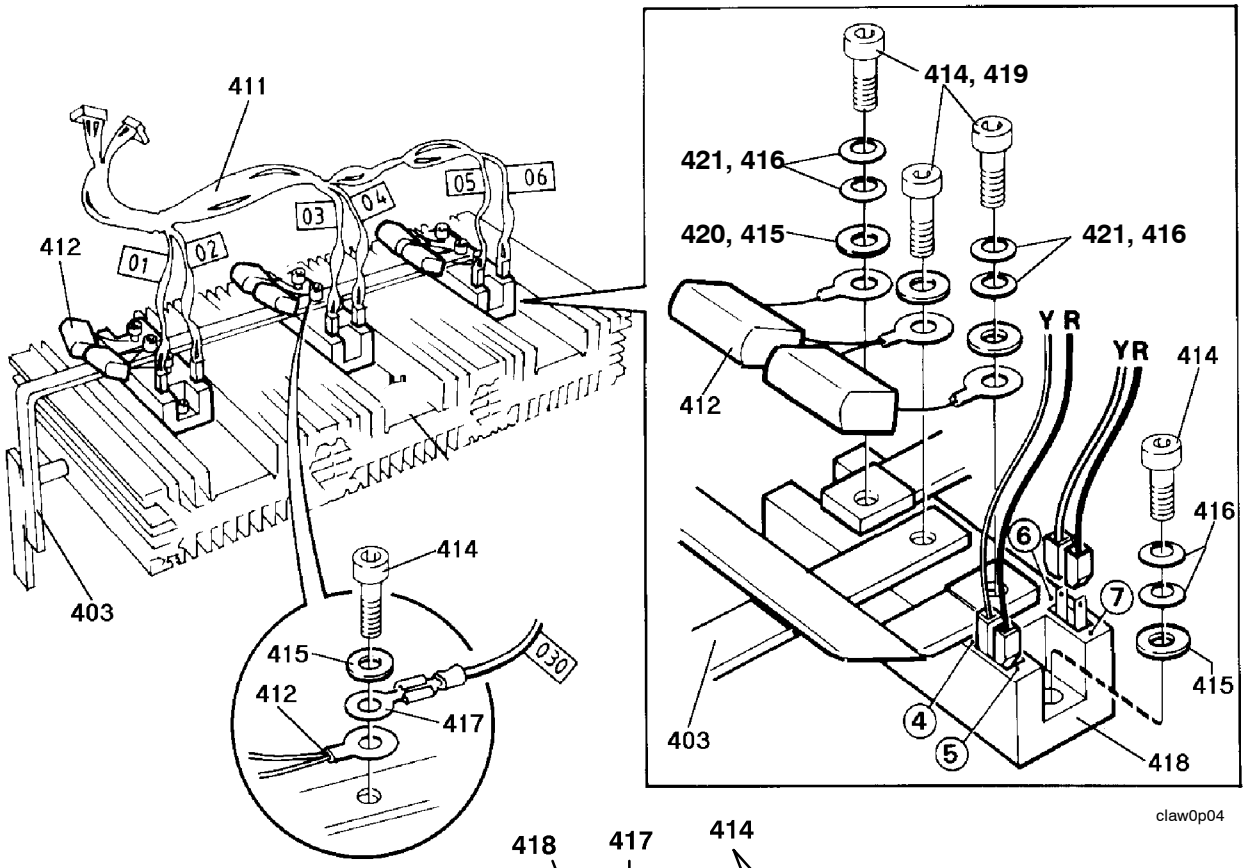
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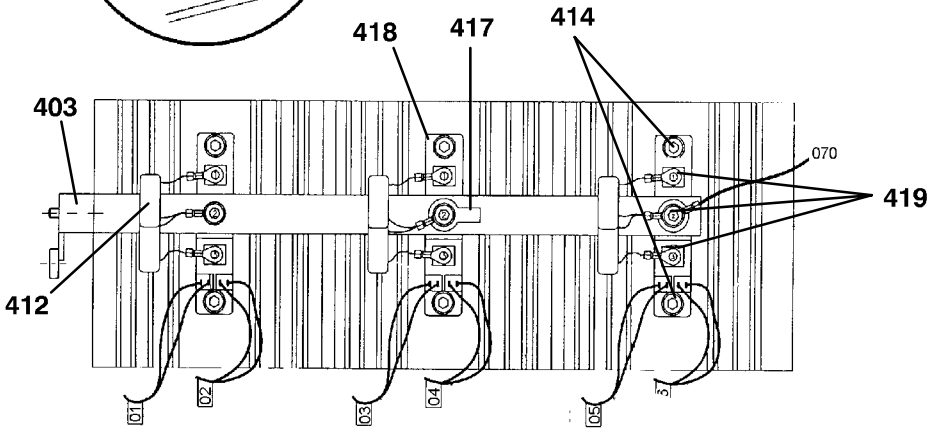
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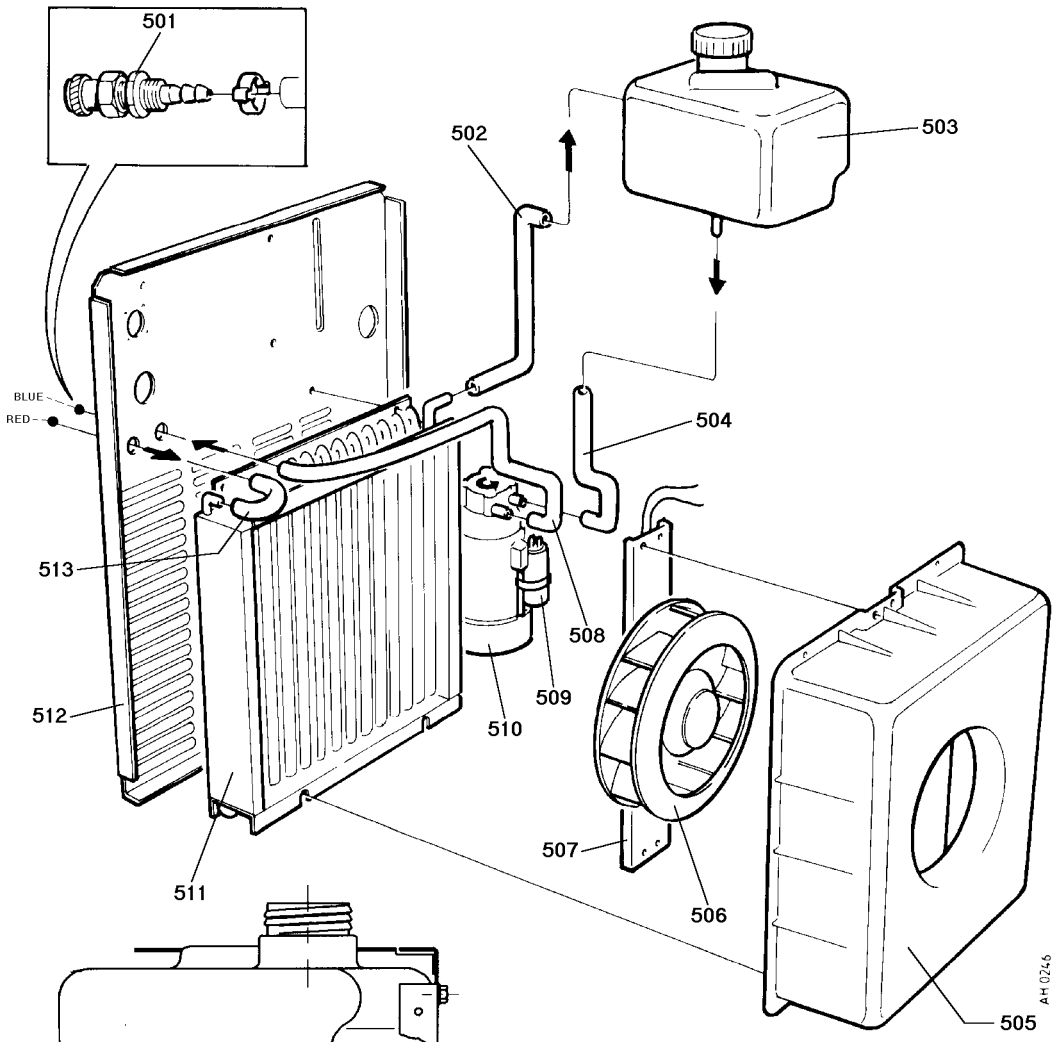
LAW 4/5 = LAW 410/510
LAW 4/5W = LAW 410W/510W

C = component designation in the circuit diagram

Item no.	Qty LAW 4/5	Qty LAW 4/5W	Ordering no.	Denomination	Notes	C
501	-	1	0365 803 011	Quick connector	Female, red, with non-return valve	
	-	1	0365 803 012	Quick connector	Female, blue, with non-return valve	
	-	-	0365 803 013	Quick connector	Male, with non-return valve. For connection set 8 - 35 meter	
	-	-	0365 803 010	Quick connector	Male. For connection set 1.7 meter	
502	-	1	0455 162 001	Hose		
503	-	1	0469 689 001	Water tank		
				Cover	For water tank, see item 224	
504	-	1	0457 987 001	Hose	L = 340mm, to be ordered per meter	
505	1	1	0469 893 001	Fan housing		
506	1	1	0369 827 001	Fan		EV1
507	1	1	0455 165 001	Attachment		
508	-	1	0457 987 001	Hose	L = 620mm, to be ordered per metre	
509	-	1	0191 085 105	Capacitor	5μF 400 V	C5
510	-	1	0469 692 001	Pump	1A 0.2kW 230V 50Hz, item 509 included	M1
511	-	1	0469 688 001	Cooler		
512	1	1	0455 166 001	Rear panel with text		
513	-	1	0455 161 001	Hose		



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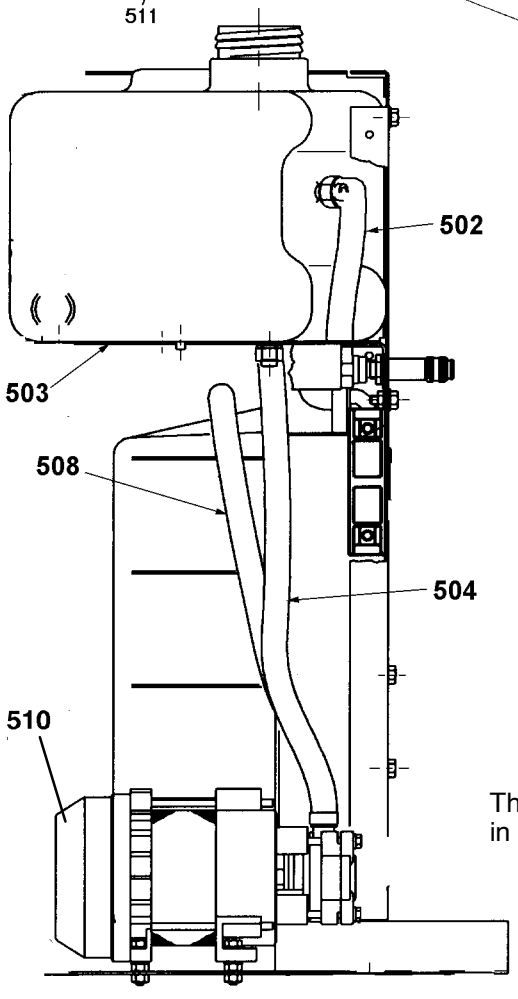

The pump motor is fitted horizontal in all LAW 410 and 510 machines

claw0se2

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