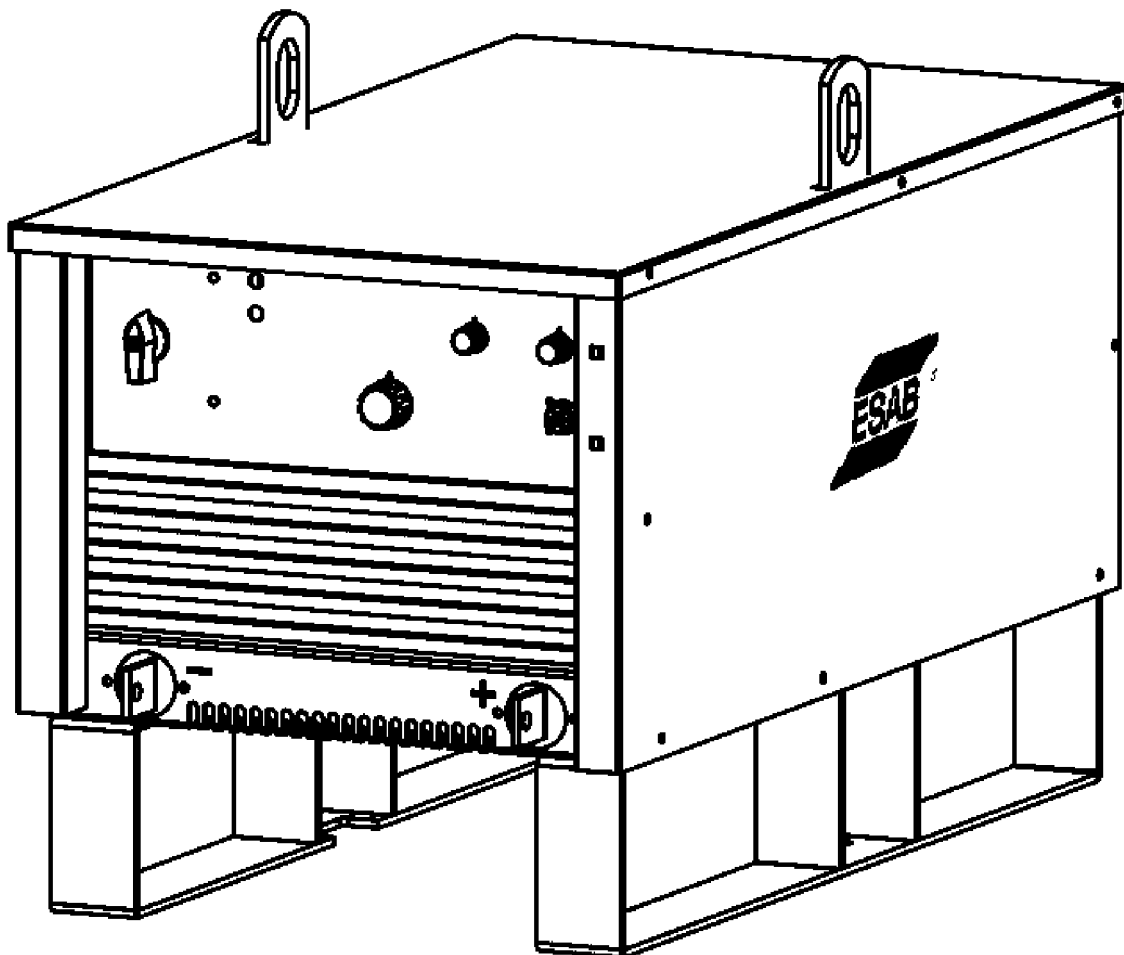


LHF 405 PIPEMASTER



Service manual

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READ THIS FIRST

Maintenance and repair work should be performed by an experienced person, and electrical work only by a trained electrician. Use only recommended replacement parts.

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

Use the wiring diagram as a form of index for the description of operation. 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 wiring diagram are listed in the component description.

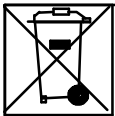
This manual contains details of all design changes that have been made up to and including October 2007.

**The LHF 405 PIPEMASTER is designed and tested in accordance with international and European standard IEC/EN 60974-1.
On completion of service or repair work, it is the responsibility of the person(s) etc. performing the work to ensure that the product does not depart from the requirements of the above standard.**

INTRODUCTION

LHF 405 PIPEMASTER is thyristor controlled welding rectifier designed for welding with coated electrodes and arc air gouging.

The welding rectifiers can be used with the following remote control devices:
AT1, AT1 Coarse Fine.



Do not dispose of electrical equipment together with normal waste!

In observance of European Directive 2002/96/EC on Waste Electrical and Electronic Equipment and its implementation in accordance with national law, electrical equipment that has reached the end of its life must be collected separately and returned to an environmentally compatible recycling facility. As the owner of the equipment, you should get information on approved collection systems from our local representative.

By applying this European Directive you will improve the environment and human health!

TECHNICAL DATA

LHF 405 PIPEMASTER	
Maximum load	
35 % duty cycle	400 A/36 V
60 % duty cycle	310 A/33 V
100 % duty cycle	240 A/30 V
Setting range	10A/20V–400A/36V
Open circuit volt.	75 V
Open circuit output	
at 400 V	330 W
Power factor	
(max current)	0,80
Efficiency	
(max current)	70 %
Enclosure class	IP 23
Application class	S
Weight	194 kg
Dimens. lxwxh	915/515/630

Duty cycle

The duty cycle refers to the time as a percentage of a ten-minute period that you can weld at a certain load without overloading.

Enclosure class

The **IP** code indicates the enclosure class, i. e. the degree of protection against penetration by solid objects or water. Equipment marked **IP23** is designed for indoor and outdoor use.

Application class

The symbol **S** indicates that the power source is designed for use in areas with increased electrical hazard.

WIRING DIAGRAM

Component description



WARNING !

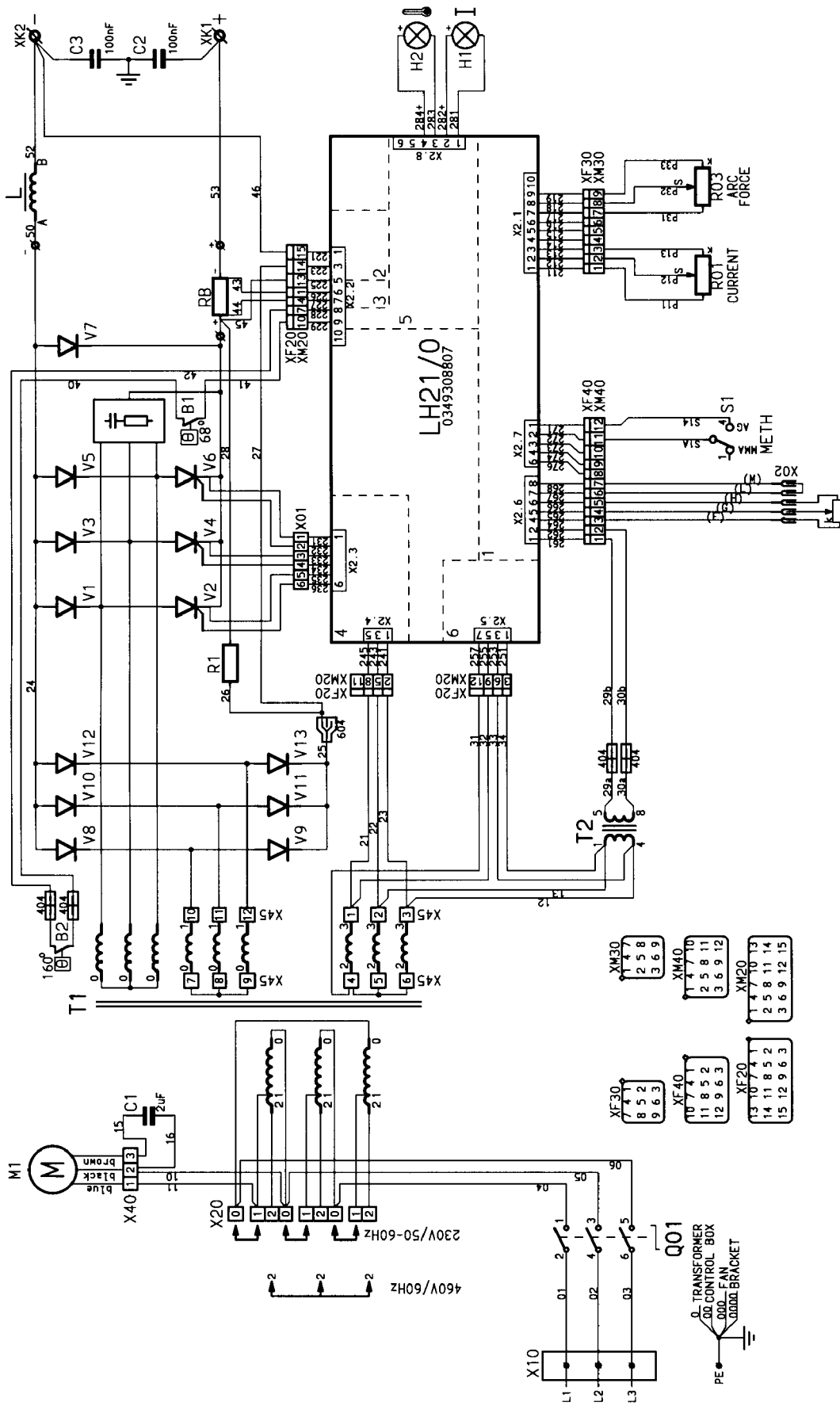
STATIC ELECTRICITY can damage circuit boards and electronic components.

- Observe precautions for handling electrostatic sensitive devices.
- Use proper static-proof bags and boxes.

B1	Thermal switch: breaks at 68°C, resets at 59°C; fitted on the thyristor heatsink
B2	Thermal switch: breaks at 160°C
C1	Capacitor 2μF, for cooling fan
C2,C3	Capacitor 0,1μF
H1	Indicating lamp, white
H2	LED, yellow; on when thermal overload is activated, i.e. when one or both of thermal switches B1 and B2 are open
L	Inductor
LH21/0	Circuit board
M1	Fan
Q01	Mains switch
R01	Potentiometer 2kΩ, for controlling the welding current
R03	Potentiometer 10kΩ, for ARC FORCE
R1	Base current resistor, 100Ω
RB	Shunt, 120mV@400A
S1	Selector switch, MMA/Air-Arc Gouging
T1	Main transformer
T2	Control transformer, supplied at 35V from X45, secondary 19V supplies circuit board LH21/0
V1,V3,V5	Main diodes
V2,V4,V6	Main thyristors

V7	Freewheel diode
V8,V9,V10, V11,V12,V13	Base current diodes
X01	Contact, 6 pole, male
X02	Remote control socket
X10	Mains terminal block
X20	Terminal block
X40	Terminal block
X45	Terminal block
XF20	Contact, 15 pole, female
XF30	Contact, 9 pole, female
XF40	Contact, 12 pole, female
XK1,XK2	Welding current terminals
XM20	Contact, 15 pole, male
XM30	Contact, 9 pole, male
XM40	Contact, 12 pole, male

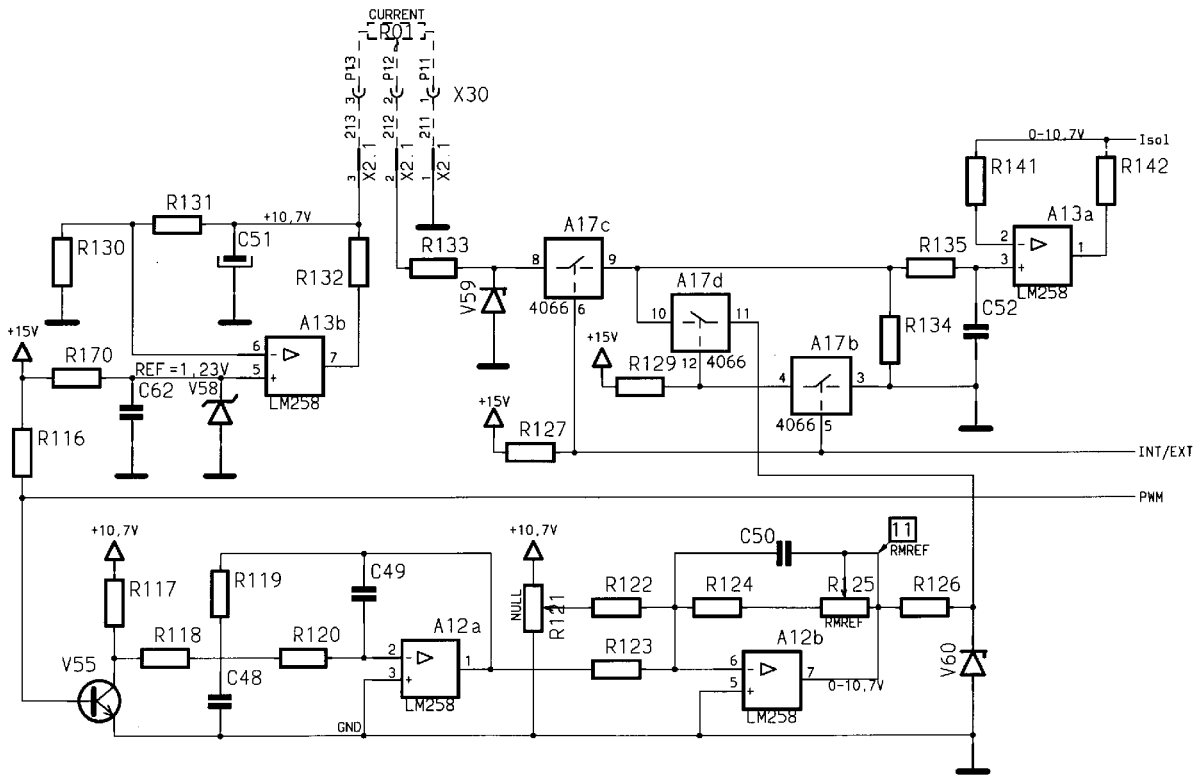
LHF 405 PIPEMASTER



DESCRIPTION OF OPERATION

LH21/0 control board

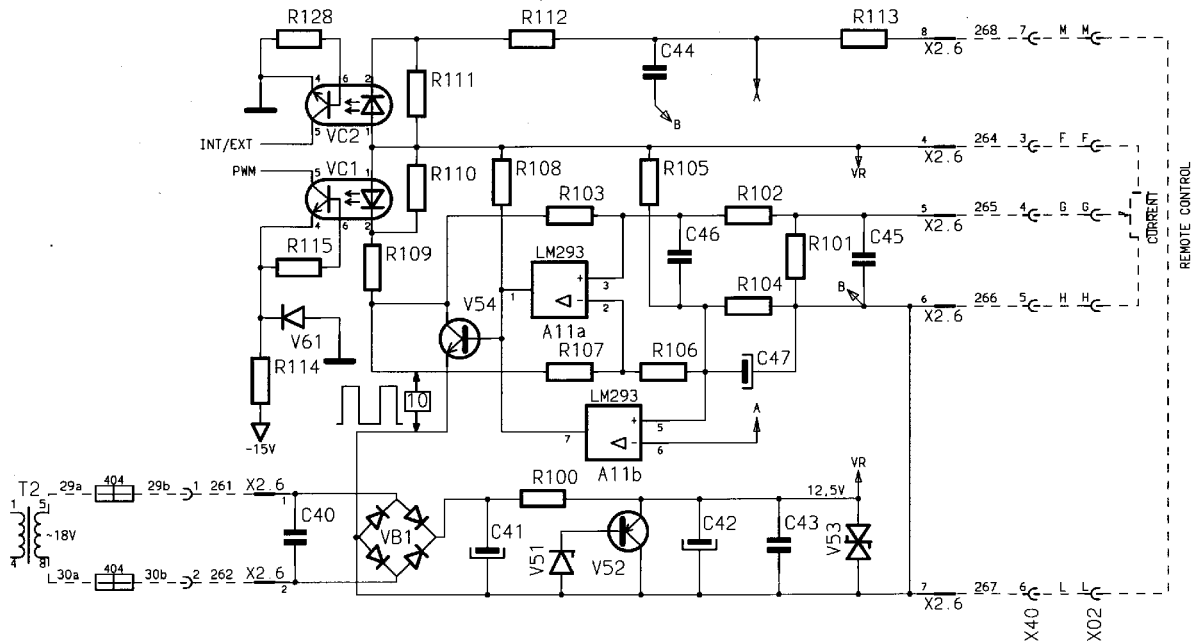
LH21/0:1 Current setting



The bandgap reference 1,23V diode V58 on LH21/0 PCB makes up a primary voltage reference. Another reference voltage 10,7V is created by the amplifier made of A13b, R132, C51, R131, R130. The +10,7V voltage reference powers local current setting potentiometer R01 and provide the for the cable remote controller.

Switching between local and remote setting source is made by means of analog switches included in the A17. Local setting voltage from the potentiometer R01, through the switch A17c and RC filter is given to the input of the voltage follower A13a.

The remote control setting is activated automatically, after connecting the remote controller to the socket. The cable remote control circuit is galvanically separated from the rest of the circuit.

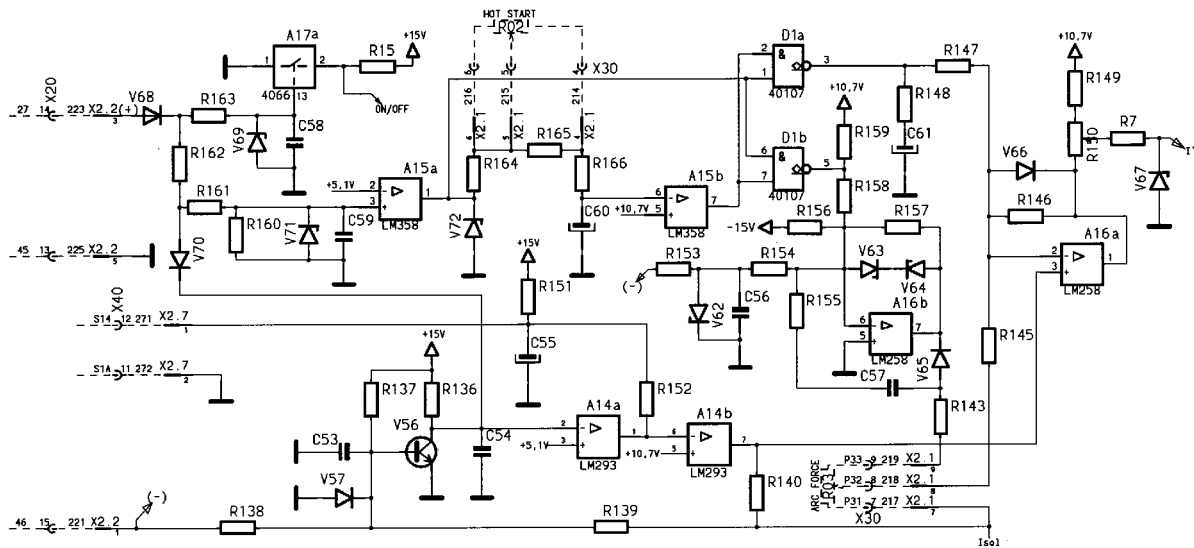


The optocoupler VC2 carries a signal which switches off the A17c switch, and switches on the A17d switch, connecting the signal from output of the A12b to the input of the voltage follower A13a, thus activating the remote control setting.

The VC1 optocoupler transmits a signal of actual welding current setting in a form of the PWM square wave, with duty cycle proportional to the position of the knob in the remote controller. The circuit made of the comparator A11a and transistor V54, generates the PWM signal. The A11b comparator disables the generator if the unit is disconnected.

Parts VB1, C41, R100, V51, V52, C42, C43 make up a supply for the galvanically separated part of the circuit. The signal of the stable amplitude and variable duty cycle is created on the collector of the V55 transistor. This signal is then averaged by means of the low-pass filter made on the A12a operational amplifier. The range of the remote setting voltage is then set in the next amplifier A12b. The R121 potentiometer sets null offset at minimum setting of the remote control potentiometer, and the R125 potentiometer sets the maximum setting voltage at maximum setting of the of the remote control potentiometer. Calibration procedure is described in chapter "Checking and calibration procedures of the LHF 405 PIPEMASTER welding power source" in detail.

LH21/0:2 Functional control circuit ANTISTICK, HOTSTART, ARCFORCE

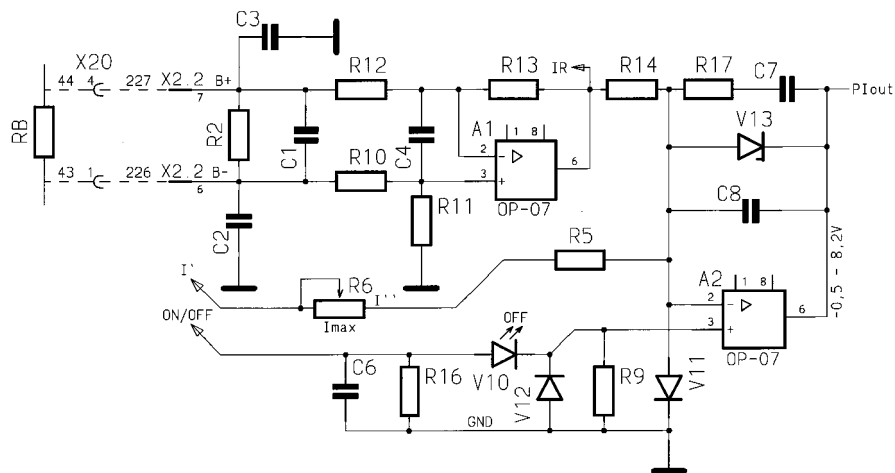


The ANTISTICK function is carried out by the circuit made of the A14 IC and the transistor V56. If the output voltage falls down below the ANTISTICK threshold, transistor V56 switches on, consequently switches off the output transistor of the A14a comparator. After delay, defined by values of C55 and R151, the output transistor of the A14b comparator switches on. It pulls down the current setting signal on the A16a to the minimum value, and consequently, it causes the limiting of the output current of the power supply. It works that way in the MMA mode. In electrogouging mode the ANTISTICK function is disabled by short-circuiting of the C55 capacitor.

The HOT START function is carried out by the circuit made of the A15 IC and D1. When the welding starts and the arc is created, the +12V signal shows up on the non-inverting input of the A15a operational amplifier. The capacitor C60 is charged via resistors R164, R165, R166 (or the potentiometer of the HOT START time setting). Time required for charging the C60 to +10,7V is the time of the HOT START. If the voltage on the C60 remains less than 10,7V, there is a high level on the A15b output, and the output transistor of the D1b, connects resistor R147 to the ground. It causes the approximately 30% voltage rise on the A16a operational amplifier's output, and the adequate rise of the current setting value.

The ARC FORCE function is carried out by the circuit made of the A16 operational amplifier. From the moment of crossing the ARC FORCE threshold, further decreasing of the output voltage causes decreasing of the voltage on the A16b output. Consequently, the voltage on the slider of the R03 potentiometer decreases, voltage on the A16a output increases, thus increasing the welding current. The maximum current increase caused by the arc shortening, may be adjusted by means of the R03.

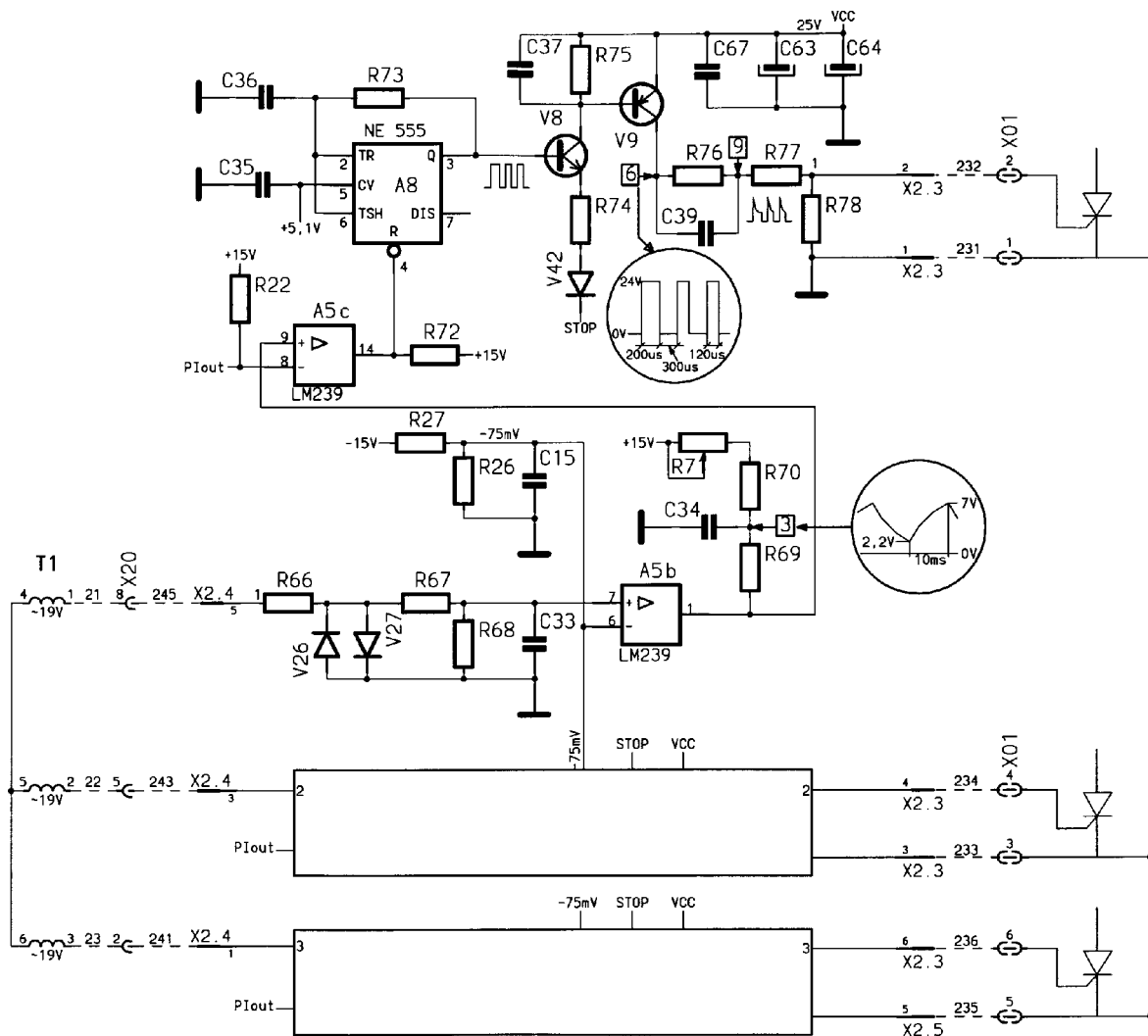
LH21/0:3 Regulator and current shunt amplifier



The feedback signal from the current shunt is amplified by the rate of 50 in the differential amplifier made of the A1 operational amplifier and resistors R12, R13, R10, R11. Then, through the resistor R14, signal is given to the PI regulator made of the operational amplifier A2 and R17, C7, C8 parts.

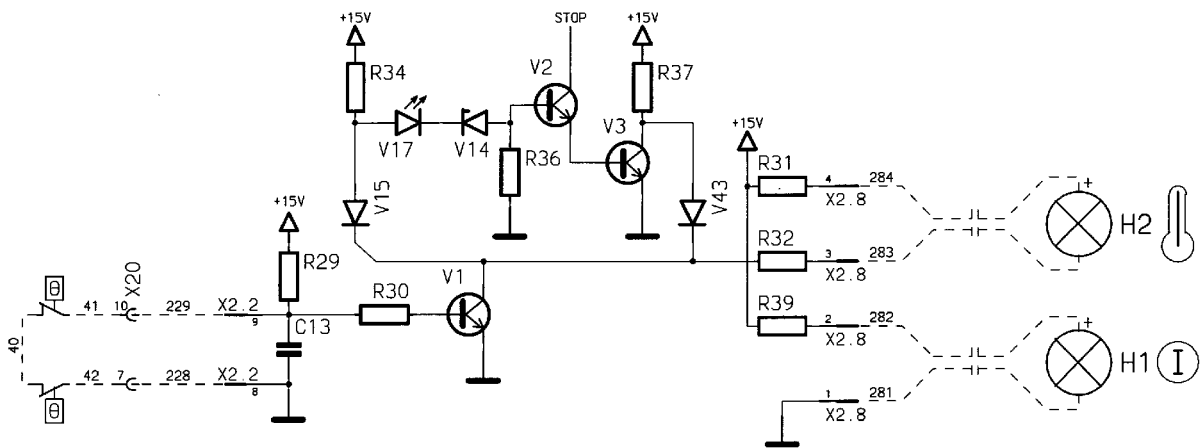
The Zener diode V13 limits the output voltage of the regulator. The current setting signal is given to the regulator summing point (inverting input of the A2 OA), via potentiometer R6 and resistor R5. The power supply may be disabled by the setting positive voltage through the resistor R16 and thus achieving the regulator output voltage that blocks thyristor's firing circuit.

LH21/0:4 Synchronisation and thyristors firing



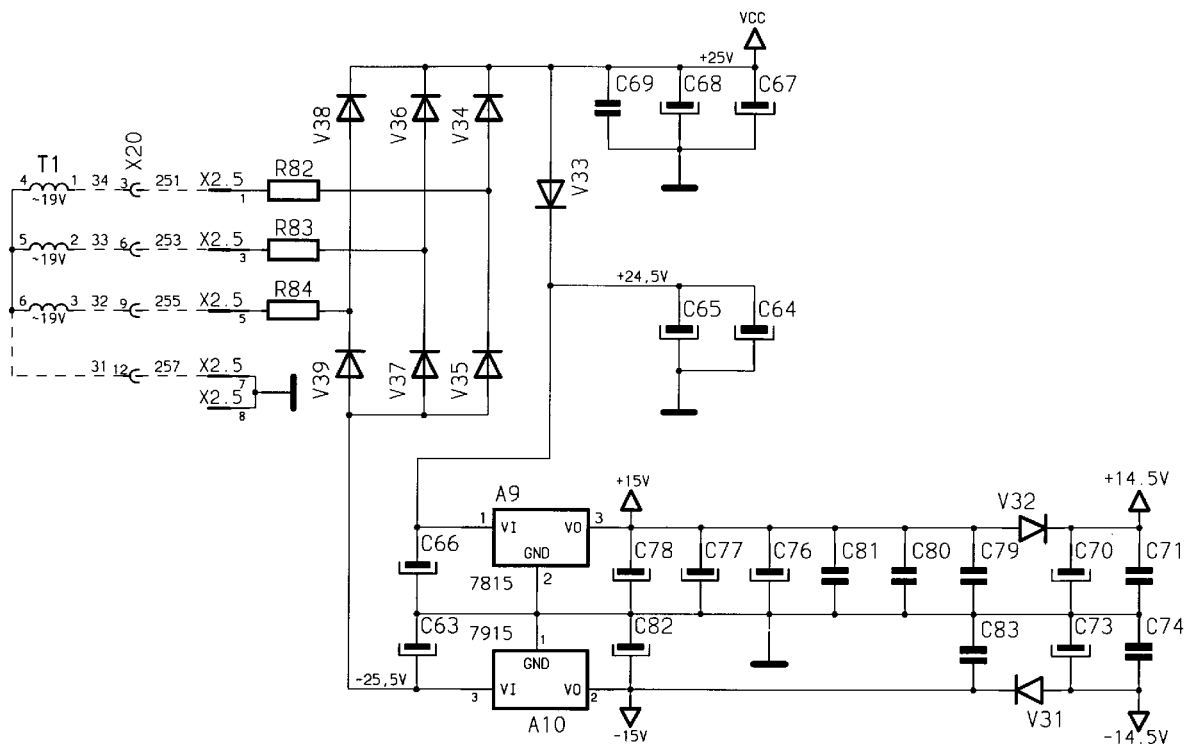
The synchronisation circuit consists of synchronised ramp generators, comparators, and firing pulse forming circuit. Signal from the synchronising winding goes via R66(53)(40) and diode limiter made V26(23)(20) and V27(24)(21) diodes, and then through divider R67(54)(41), R68(55)(42) to non-inverted input of the comparator A5b(A4b)(A3b). The R69(56)(43), R70(57)(44), C34(26)(18), R71(58)(45) parts connected to the output of this comparator make up synchronised ramp generator. The amplitude of the ramp is adjusted by means of the R71(58)(45) potentiometer. Ramp voltage is compared with the output voltage of the regulator in comparator A5c(A4c)(A3c). Thus the firing phase shift is created. The signal from the comparator enables the pulse generator A8(A7)(A6). Generator output controls the output driver made on transistors V8(6)(4), V9(7)(5). Driver may be disabled by the positive signal on the cathode of the V42(41)(40) in a case of thermal overload or the lack of synchronisation.

LH21/0:5 Thermal overload circuit



The circuit co-operates with NC thermal switches connected in series. Opening of the any of them (placed on the transfer or the rectifier) switches the V1 transistor on. Closed the V1 transistor powerises the H2 indication lamp and switches off the V2 transistor, thus disables thyristor firing.

LH21/0:6 Power supply

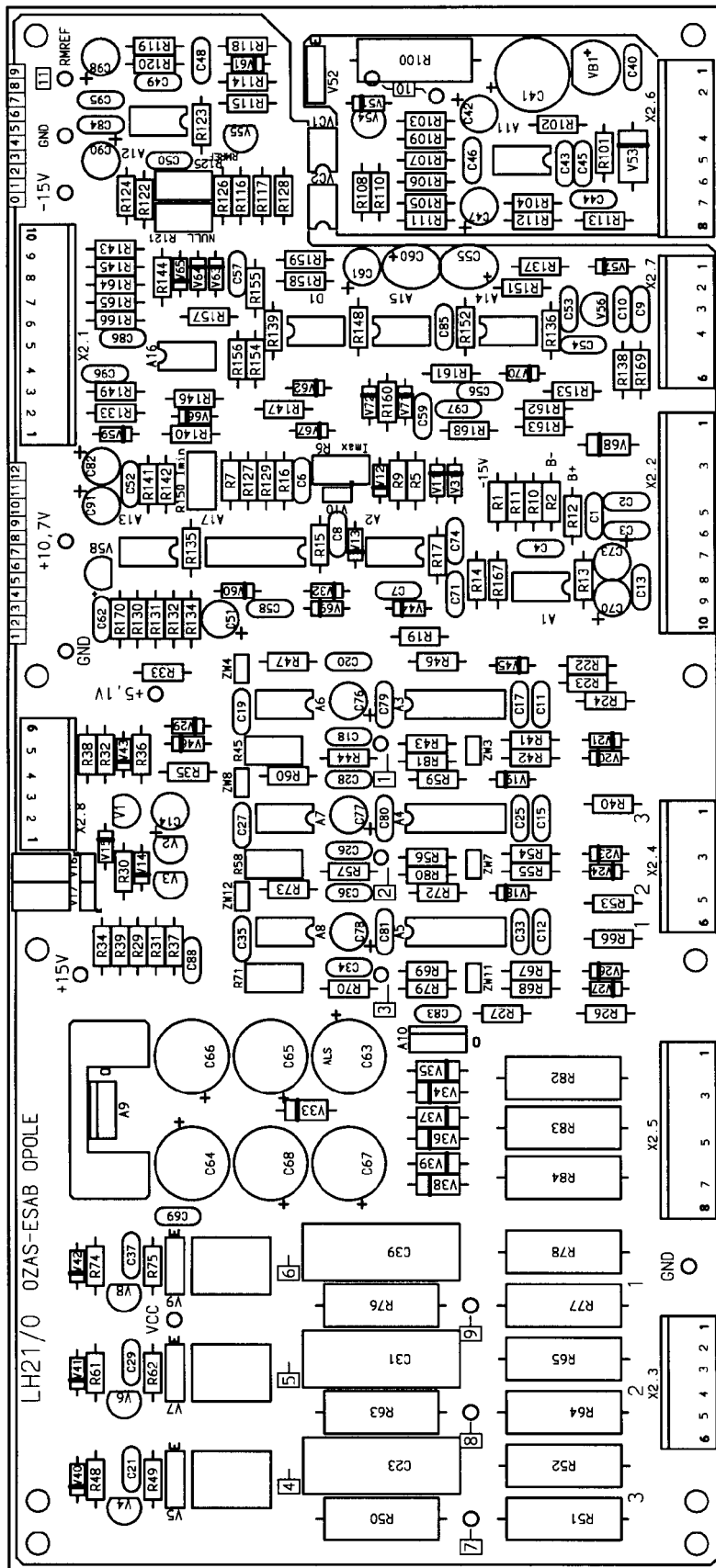


Positive and negative voltage supplies are located on the LH21/0 PCB.

The positive voltage supply provides +25V, +15V and +14,5V voltages. Thyristor firing drivers are directly supplied from +25V the power supply made of diodes V34, V36, V38, and capacitors C67, C68, C69. Another set of capacitors C64, C65, C66 is placed after the diode V33 .and supplied in chain the A9 +15V voltage regulator. It provides supply for the pulse partition of the electronics. The +14,5V supply, separated from +15V by means of the diode, is used exceptionally for supplying the regulator and the shunt amplifier.

The negative voltage supply consists of the V35, V37, V39 diodes, the C63 capacitor and the -15V negative voltage regulator A10. The -15V supply supplies operational amplifiers on the LH21/0 PCB, except ones creating shunt amplifier and the regulator, which are powered from the -14,5V supply, taken after the diode V31.

LH21/0 - Components layout



CHECKING AND CALIBRATION PROCEDURES

1. Check whether the connection of the power transformer windings is suitable to the mains supply.
2. Switch the welder by means of the switch on the front panel. The lamp marked "I" should light.
3. Checking of the ramp amplitudes on the LH21/0 PCB.
Thorough setting of the ramp amplitudes is anticipated as the part of the fabrication process, on specialised testing post. It is also possible to make it directly in the machine, for instance during repair or in a case of suspicion that ramps are discalibrated.
To carry it out:
 - a. put the jumper ZW3 on the LH21/0 PCB. Diodes V16, V17 should light with the same intensity. If not, balance the intensity by means of the potentiometer R45,
 - b. remove jumper ZW3, and put in on ZW7; check intensity of light of diodes V16, V17 I; balance intensity, if it's not balanced,
 - c. remove jumper ZW7, and put in on ZW11; check intensity of light of diodes V16, V17 I; balance intensity, if it's not balanced. Remove the jumper.
4. Setting the current range.
 - a. set the current setting potentiometer on the maximum,
 - b. load the welding power source to achieve approximately 36V,
 - c. by means of the potentiometer R6 set the output current equal to 400A @ 36V,
 - d. turn down the setting potentiometer to minimum,
 - e. load the welding power source to achieve approximately 21V,
 - f. by means of the potentiometer R150 set the minimum output current on 25A,
 - g. Check the setting of the following values of the output current:
25A@21V; 100A@24V; 200A@28V; 400A@36V.
5. HOT START checking.
 - a. set 100A output current by means of the setting knob,
 - b. connect instantly the 0,24Ω load. Observe the output current. It should amount to 130A for 1s. Then it should fall down within another 0,2 s to 100A. Measurements should be carried out by means of the oscilloscope with memory,
 - c. disconnect the load.
6. ARC FORCE checking.
 - a. set 100A output current with the setting knob,
 - b. set the ARC FORCE knob to minimum,
 - c. gradually load the power source until output voltage is about 13V; the actual output current should be 100-103A,
 - d. set the ARC FORCE knob to maximum, load the power source to achieve 24V voltage on output,
 - e. gradually increase the load, following the voltage; starting from the threshold of 18,5V - actual output current should increase; at the 13V on the output, the actual output current should be 185A.
7. ANTISTICK checking.
 - a. set the ARC FORCE knob to minimum,

- b. set 100A output current by means of the setting knob in MMA mode,
 - c. gradually increase the load, following the voltage; after achieving 5V the actual output current should be reduced to the level $< 32A$ after 2s delay.
8. Setting and checking of the cable remote controller.
- a. connect cable remote controller to the socket X02. Remote control should be activated automatically,
 - b. set the knob on the remote controller on minimum,
 - c. set the 0,0 V between GND and RMREF (measuring point [11]) by means of the trimmer R121 on the LH21/0 PCB
 - d. set the knob on the remote controller on maximum,
 - e. set the +10,7V between GND and RMREF (measuring point [11]) by means of the trimmer R125 on the LH21/0 PCB,
 - f. check the actual current range of the welding power source. If it would be different from this achieved by local current setting, it may be corrected. Minimum value could be adjusted by means of R121 trimmer, maximum value by means of R125.
9. Thermal overload protection checking.
- a. break the circuit of thermostats disconnecting one connector on the thermostat placed on the rectifier. It should be followed by disabling of the welding power source (no capability of welding). This state should be indicated by the orange lamp ,marked with "overtemperature" mark. Closing the circuit should restore welding capability and switching off the orange indication lamp.

SERVICE INSTRUCTIONS



WARNING !

STATIC ELECTRICITY can damage circuit boards and electronic components.

- Observe precautions for handling electrostatic sensitive devices.
- Use proper static-proof bags and boxes.

What is ESD?

A sudden transfer or discharge of static electricity from one object to another. ESD stands for Electrostatic Discharge.

How does ESD damage occur?

ESD can cause damage to sensitive electrical components, but is not dangerous to people. ESD damage occurs when an ungrounded person or object with a static charge comes into contact with a component or assembly that is grounded. A rapid discharge can occur, causing damage. This damage can take the form of immediate failure, but it is more likely that system performance will be affected and the component will fail prematurely.

How do we prevent ESD damage?

ESD damage can be prevented by awareness. If static electricity is prevented from building up on you or on anything at your work station, then there cannot be any static discharges. Nonconductive materials (e.g. fabrics), or insulators (e.g. plastics) generate and hold static charge, so you should not bring unnecessary nonconductive items into the work area. It is obviously difficult to avoid all such items, so various means are used to drain off any static discharge from persons to prevent the risk of ESD damage. This is done by simple devices: wrist straps, connected to ground, and conductive shoes.

Work surfaces, carts and containers must be conductive and grounded, use only antistatic packaging materials. Overall, handling of ESD-sensitive devices should be minimized to prevent damage.

Thermal switch (thermostat) replacement procedure

1. Spare thermostat must be the same type as replaced one.
2. Spare thermostat should be mounted within radius of 10mm or less from broken thermostat. If it's possible and safe for transformer winding, broken thermostat may be removed. Then the spare thermostat is to be mounted right in place of broken one.
3. Spare thermostat should adjoin protected winding as tight as possible.
4. Spare thermostat must be secured with silicone glue of working temperature of 200°C or higher.

INSTRUCTIONS

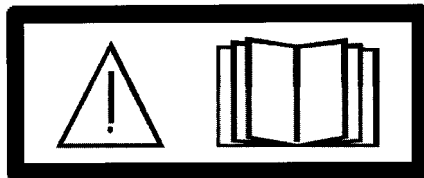
This chapter is an extract from the instructions for LHF 405 PIPEMASTER.

SAFETY

Users of ESAB welding equipment have the ultimate responsibility for ensuring that anyone who works on or near the equipment observes all the relevant safety precautions. Safety precautions must meet the requirements that apply to this type of welding equipment. The following recommendations should be observed in addition to the standard regulations that apply to the workplace.

All work must be carried out by trained personnel well-acquainted with the operation of the welding equipment. Incorrect operation of the equipment may lead to hazardous situations which can result in injury to the operator and damage to the equipment.

1. Anyone who uses the welding equipment must be familiar with:
 - its operation
 - location of emergency stops
 - its function
 - relevant safety precautions
 - welding
2. The operator must ensure that:
 - no unauthorised person is stationed within the working area of the equipment when it is started up.
 - no-one is unprotected when the arc is struck
3. The workplace must:
 - be suitable for the purpose
 - be free from draughts
4. Personal safety equipment
 - Always wear recommended personal safety equipment, such as safety glasses, flame-proof clothing, safety gloves.
 - Do not wear loose-fitting items, such as scarves, bracelets, rings, etc., which could become trapped or cause burns.
5. General precautions
 - Make sure the return cable is connected securely.
 - Work on high voltage equipment **may only be carried out by a qualified electrician.**
 - Appropriate fire extinguishing equipment must be clearly marked and close at hand.
 - Lubrication and maintenance must **not** be carried out on the equipment during operation.



WARNING!

Read and understand the instruction manual before installing or operating.

INSTALLATION

The installation must be executed by a professional.



WARNING!

This product is intended for industrial use. In a domestic environment this product may cause radio interference. It is the user's responsibility to take adequate precautions.

- Installation must be carried out by a qualified electrician.
- Check that the welding rectifier is configured for the **available mains supply** before connecting it to the mains.
- See Connecting to mains for cable rating and fuse rating.
- Connect the mains cable to the rectifier according to the relevant regulations and install a suitable fuse in the main fuse box.
- Make sure the welding rectifier is not covered or positioned so that cooling is obstructed.

Connecting to mains

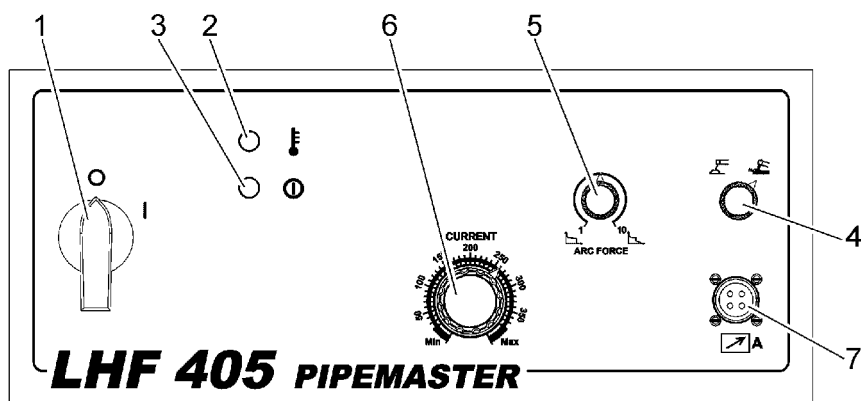
	LHF 405 PIPEMASTER	LHF 405 PIPEMASTER
Frequency	50/60 Hz	60 Hz
Voltage	230V	460V
Current at		
100% duty cycle	44 A	22 A
60% duty cycle	56 A	28 A
35% duty cycle	71 A	36 A
Fuse, slow	65 A	35 A
Cable area (4xmm²)	10	6

NB: The mains cable areas and fuse sizes as shown above are in accordance with Swedish regulations. They may not be applicable in other countries: make sure that the cable area and fuse sizes comply with the relevant national regulations.

OPERATION


- Select suitable earth and return cables and connect them to the terminals marked + and - on the front of the rectifier. Connect the return cable to the work piece.
- Set switch (1) to position "I". The fan will start.
- Select the welding method using the switch (4).
- Set the welding current:
 - a. by means of knob (6) if socket (7) remains unplugged,
 - b. by means of knob on remote control unit if plugged in socket (7),
- The rectifier is now ready for welding.

Controls and connections




1. Mains supply switch
2. Yellow lamp, thermal cut-out
3. ON/OFF lamp
4. Method selector switch: Arc Air Gouging, MMA
5. Arc Force duration setting
6. Current setting
7. Remote socket

MMA welding

Set switch (4) to . In MMA mode implicitly "anti stick" function is ON. It prevents of sticking the electrode to workpiece during arc striking.

Arc Air Gouging

Set switch (4) to . In Arc Air Gouging mode current should be set close to maximum value in order to ensure proper gouging conditions.

Overheating protection

If the internal temperature becomes too high, the welding is interrupted and disabled. This state is indicated by permanent lighting of the orange indicating lamp on the front of the unit. It resets automatically when the temperature falls down.

MAINTENANCE

Note!

All guarantee undertakings from the supplier cease to apply if the customer himself attempts any work in the product during the guarantee period in order to rectify any faults.

Only those persons who have appropriate electrical knowledge (authorised personnel) may remove the safety plates to connect or carry out service, maintenance or repair work on welding equipment.

Cleaning

Check regularly that the power source is free from dirt.

How often, and to what extent, cleaning should be carried out depends on the welding process, arc time, disposition and the surrounding environment. It will normally suffice to blow the power source clean using compressed air (reduced pressure) once a year.

If the power source is very dirty, brushing and vacuuming are recommended.

- Disconnect the welding power source from the mains current supply.
- Remove the adapter from the socket. Lock the socket to prevent unauthorised connection.

At fixed installations, the safety switch should be set to the off position. Lock the switch.

- Remove the power source's safety plates for best access.

After cleaning, all safety plates must be mounted before you connect the power source to the mains supply.

ORDERING OF SPARE PARTS

Spare parts may be ordered through your nearest ESAB dealer, see the last page of this publication.

ESAB subsidiaries and representative offices

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AUSTRIA

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ESAB international AB

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