



LAD 1000/ 1400

Welding rectifier

Instruction manual

LAD 1000 and LAD 1400

Presentation

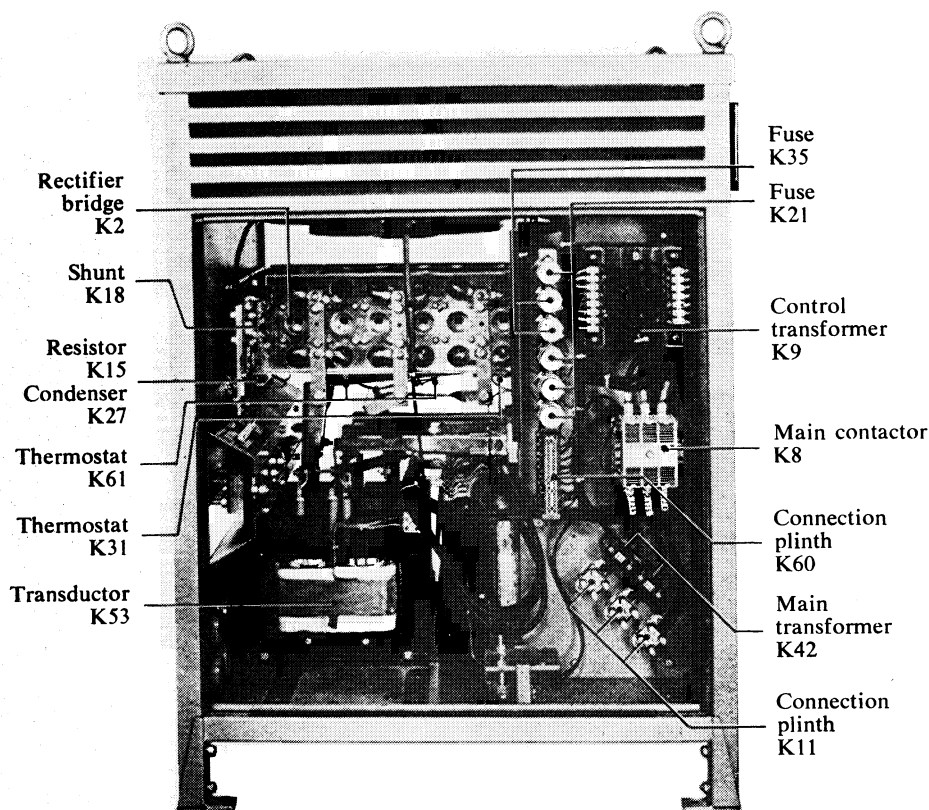
Technical description	1—2
Technical data	3—4
Installation and connecting instructions	4—5
Circuit diagrams LAD 1000 and LAD 1400	6—7
Function and operation	8
Function description of regulator K 58	9
Parallel connection of 2 LAD 1000's or LAD 1400's	10—11
Maintenance and service	12
Replacement parts	12
Check of diodes	13
Replacing diodes	13

PRESENTATION

The LAD 1000 and LAD 1400 are automatic welding rectifiers of the constant voltage type intended for submerged arc welding, inert gas metal-arc welding and air/arc gouging. These ESAB rectifiers are stationary and are suitable for use with the A6 and A2-series of ESAB automatic welders. Special versions of the LAD rectifiers are available for gas-metal arc welding up to 600 A at 100 % duty cycle and feature an inductor in the arc voltage circuit. The LAD rectifiers have a thyristor regulator to ensure a constant arc voltage irrespective of any mains fluctuations. The rectifiers also have a thermostatically-controlled ventilating fan and are both of the multi-voltage type designed to cover the 50 and 60 Hz ranges. The rectifiers are adaptable to all normal mains voltages.

The LAD 1000 and LAD 1400 have a 2 mm thick steel plate casing which is built round a framework of square steel members. Both side panels are removable and fitted with efficient seals. The front panel carries the electronic equipment and controls. The panel is withdrawable and can be easily removed to simplify service and maintenance. The remainder of the components are fitted within the casing where they are well protected. The top cover is manufactured of 3 mm steel plate and is fastened by four eyelet bolts which enable the LAD rectifiers to be moved by a hoist or an overhead crane. The rectifiers can also be transported by a fork-lift truck. An optional kit of components, the K 67, is available which enables two LAD 1000 or LAD 1400 rectifiers to be connected in parallel.

The LAD rectifiers are tamper and drip-proof, both conforming with the IP 22 international specification.



Main components of the LAD rectifiers are as follows:

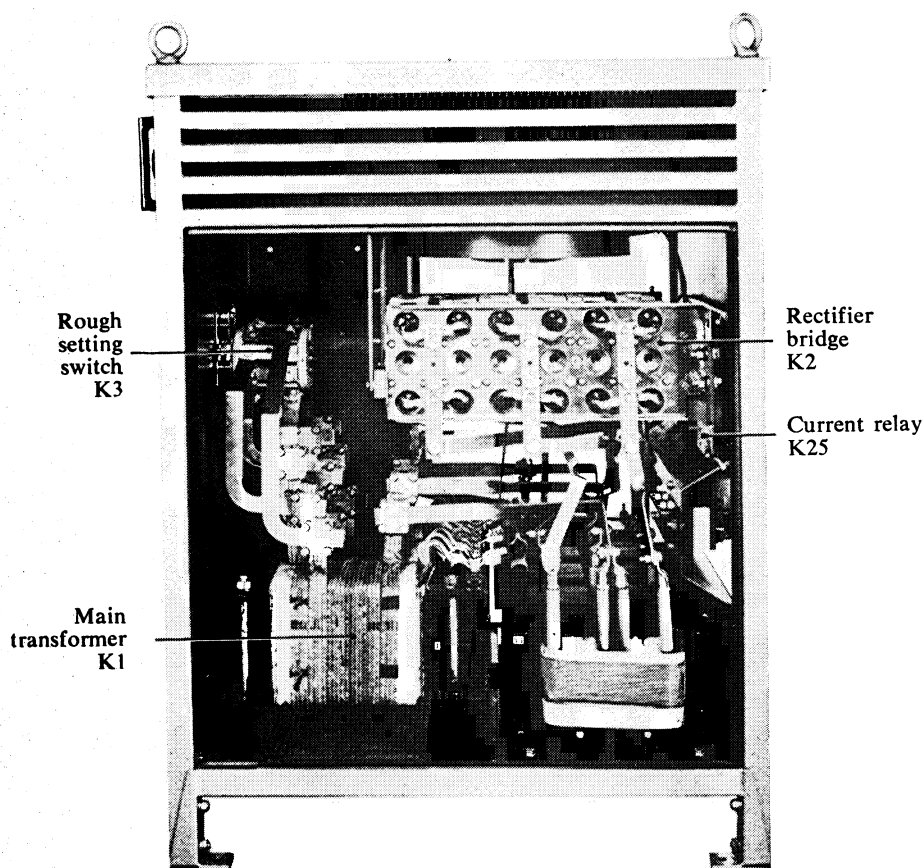
Main transformer K1

Transducer K53. For infinitely variable adjustment of the required voltage settings.

Silicon rectifier K2. Bridge connected.

All main components are robustly dimensioned with regard to both voltage and current capacities. As an example can be mentioned that the diodes permit an inverse voltage of 400 V but under normal operation are only called on to deal with a maximum peak voltage of 80 V.

The electronics and control equipment are grouped on the draw-type instrument panel mounted high up on the front of the rectifier casing. Electrical connections are made via the K45 plug plinth which enables fast connection and disconnection for servicing or maintenance.



The main transformer and transducer windings have a silicone impregnated non-organic insulation which gives efficient protection against dampness and corrosive gases. The windings are dimensioned and designed to withstand temperatures of up to 225° C. Both models are fitted with a fuse K7, which protects the main transformer K1, against continuous overloading. They are fed by two K42 current transformers which supply suitable voltages for welding, from the primary current of the main transformer. If the overloading relay is activated, the control voltage to the coil of K8 main contactor is interrupted and the main transformer K1 cuts out. Should this happen, it is re-set manually by pushing in the black button on the relay. The relay is located in the apparatus box behind the control panel.

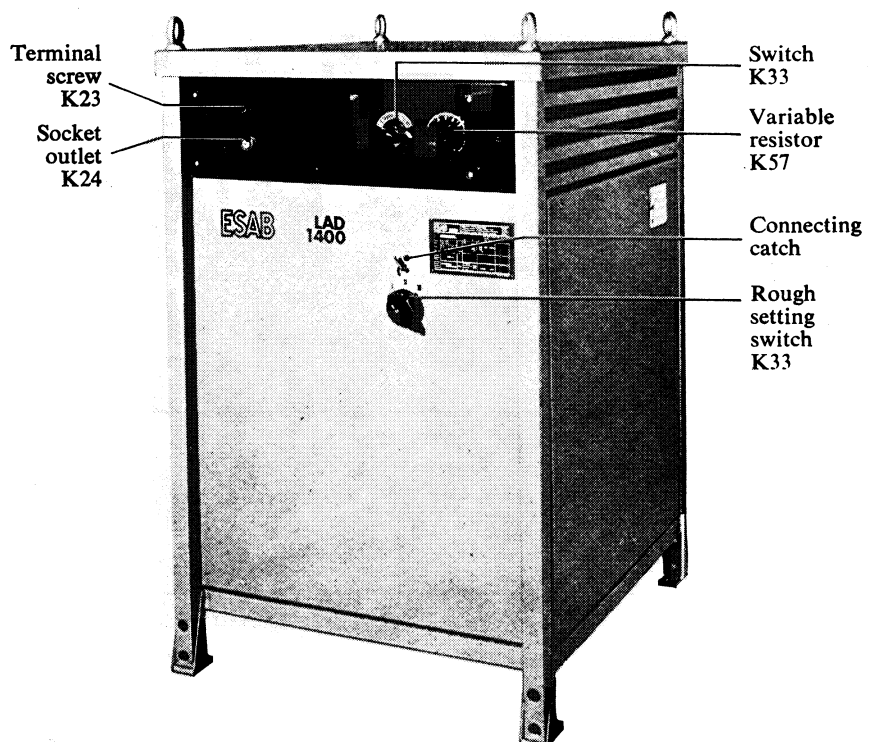
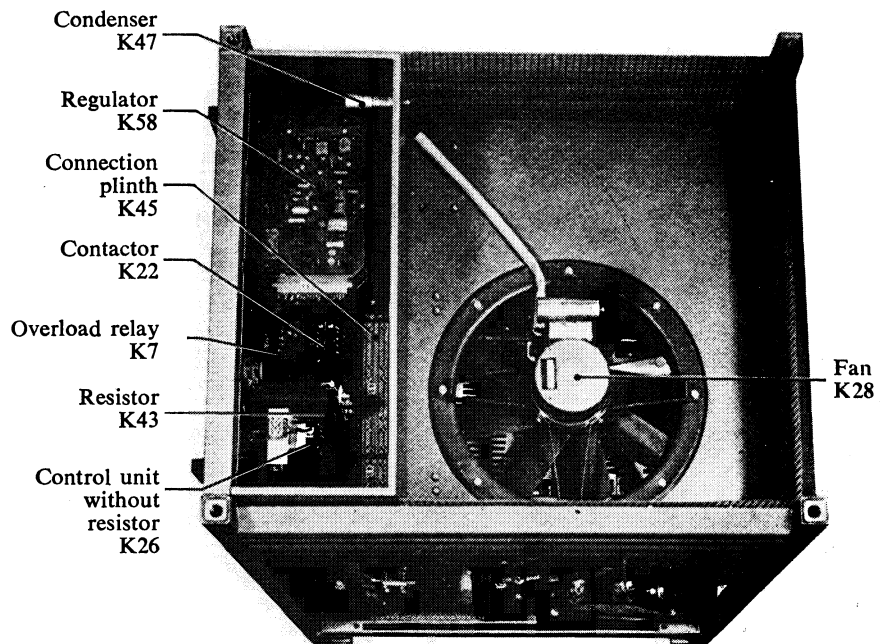
The arc voltage stabilizer K58 consists of a circuit board and four thyristors. K58 is also located in the apparatus box. The thyristors and their cooling sinks are located below the circuit board. The regulator casing is transparent and removable.

Technical description

The K2 rectifier section of the LAD 1000 consists of 18 silicon diodes, bridge-coupled, three in parallel. The LAD 1400 has 24 silicon rectifiers, is also of bridge-coupled type, four in parallel. The diodes are mounted in cooling sinks of aluminium and connected to a three-phase bridge. In-line with the welding current circuit is a K36.2 fuse which protects the diodes against short circuiting.

Both rectifiers feature a thermostatically-controlled fan K28, which is automatic in operation and does not switch on until forced cooling is required. This is only required periodically. This thermostatically-controlled operation means that the amounts of dust settling inside the rectifier are held at the lowest possible level and that the rectifier operates noiselessly when the ventilating fan is switched off. The fan is located below the top cover of the casing, air being drawn in through the side grilles and forced out through a grid in the bottom.

Switch K3 with positions "I-II-III" is located on the front plate and is used for coarse settings of the arc voltage. This coarse setting can only be carried out after a connecting catch has been released and the primary voltage of the main transformer has been interrupted. Fine adjustment of the welding current can be carried out during welding from the automatic welding unit or by operating the control knob of the K57 variable resistor. This knob is located on the control panel. The front panel carries switch K33 with positions: "0-I-Start". When this switch is turned from "0" to "Start" the control transformer K9 is live. Releasing the switch allows it to return automatically to position "I". The control current is interrupted when the switch is positioned at "0". The apparatus cabinet contains two K43 resistors which are brought into circuit when the K3 control switch is turned from position "0" to position "I". These resistors generate heat and thus dispel condensation. An eight-pole socket K24 for connection of the automatic welder control cable is also fitted to the control panel.



Technical data

TECHNICAL DATA

Working range, voltage stabilizer

LAD 1000 and LAD 1400	3-phase, 50 Hz					3-phase, 60 Hz			
	220	380	415	440	500	208	220	440—460	550
Voltage V									
Permissible voltage variation %	±10	±10	+13 —7	+7 —13	+13 —7	+15 —5	±10	+3 —17	+4 —16

Within the limits of the above table welding data will not be influenced by mains fluctuation.

Mains connections LAD 1000

	3-phase, 50 Hz					3-phase, 60 Hz		
Voltage V	220	380	415	440	500	208—220	440—460	550
Rating kVA	65	65	62.5	66	62	65	69	68
Current A	170	98	87	87	72	170	87	72
Fuse, slow A	160	100	100	100	80	160	100	80
Cables, cross-section area mm ²	3×70+35	3×35+25	3×35+25	3×35+25	3×25+16	3×70+35	3×35+25	3×25+16

Mains connections LAD 1400

	3-phase, 50 Hz					3-phase, 60 Hz		
Voltage V	220	380	415	440	500	208—220	440—460	550
Rating kVA	88	88	82	88	83	83—92	91	91
Current A	230	132	114	114	96	230	114	96
Fuse, slow A	250	160	125	125	100	250	125	100
Cables, cross-section area mm ²	2//3×50+35 or 3×120+70	3×70+50	3×50+35	3×50+35	3×35+25	2//3×50+35 or 3×120+70	3×50+35	3×35+25

The recommended fuses and cable areas are in accordance with Swedish regulations for rubber-sheated and insulated leads. Changes may be necessary to satisfy the regulations applying in other countries.

Permitted load:

LAD 1000: 900 A/44 V continuous
1000 A/44 V at 80 %
duty cycle

LAD 1400: 1250 A/44 V continuous
1400 A/44 V at 80 %
duty cycle

Setting range:

LAD 1000: 200 A/24 V—1000 A/44 V
LAD 1400: 200 A/24 V—1400 A/44 V

Open circuit voltage:

Coarse setting	LAD 1000	LAD 1400
I	44 V	44 V
II	55 V	55 V
III	66 V	66 V

Open circuit rating:

LAD 1000: approx. 1400 W
LAD 1400: approx. 1700 W

Efficiency and Power Factor

LAD 1000: At 900 A/44 V $\eta = 0.82$
and $\cos \varphi = 0.75$
LAD 1400: At 1250 A/44 V $\eta = 0.81$
and $\cos \varphi = 0.78$

Fan:

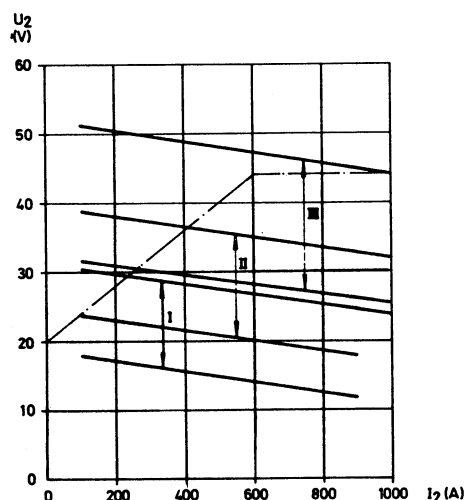
Rating: 300 W
Air capacity: 96 m³/min.

Dimensions and weights:

	LAD 1000	LAD 1400
Width:	870 mm	870 mm
Length:	1020 mm	1020 mm
Height:	1434 mm	1434 mm
Weight:	770 kg	830 kg
Weight including inductor:	840 kg	900 kg
Tamper and drip-proof conforming to IP 22.		

Technical data, installation and connecting instructions

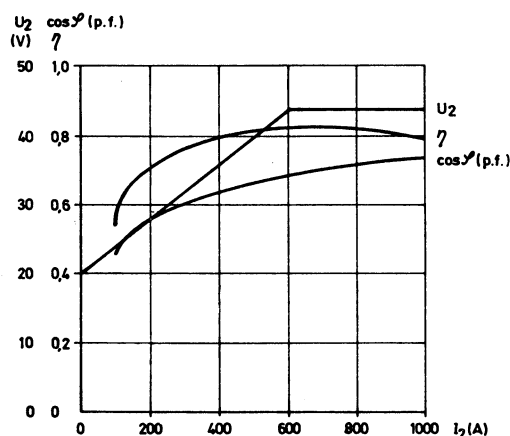
Static characteristics LAD 1000: 3×380 V 50 Hz



— $U_2 = f(I_2)$ acc. to ISO-Norm R 700

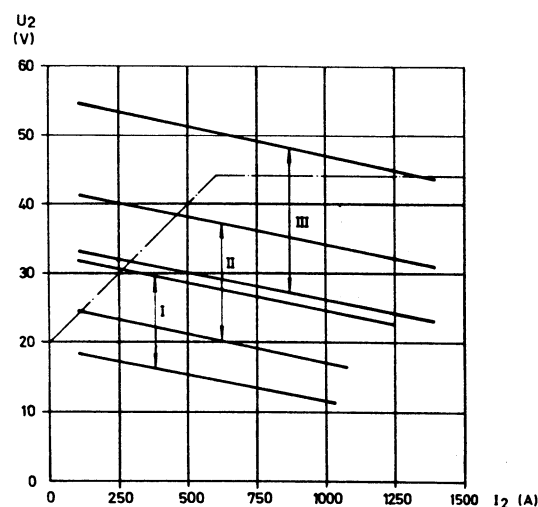
$U_1 = 3 \times 380 \text{ V}$ $U_{20} = 66 \text{ V}$ III
 $U_{20} = 55 \text{ V}$ II
 $U_{20} = 44 \text{ V}$ I

Efficiency and Power Factor LAD 1000:
3×380 V 50 Hz



Working voltage acc. to ISO-Norm R 700

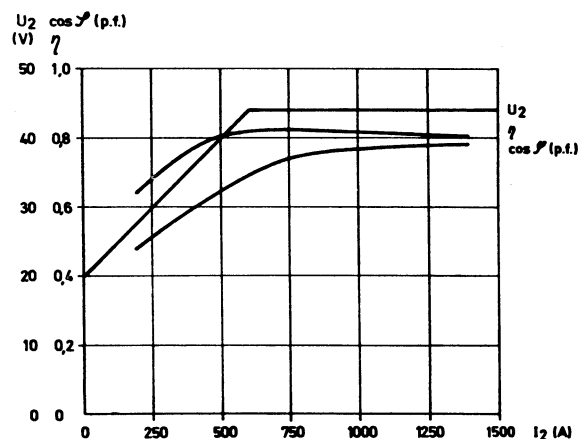
Static characteristics LAD 1400: 3×380 V 50 Hz



— $U_2 = f(I_2)$ acc. to ISO-Norm R 700

$U_1 = 3 \times 380 \text{ V}$ $U_{20} = 66 \text{ V}$ III
 $U_{20} = 55 \text{ V}$ II
 $U_{20} = 44 \text{ V}$ I

Efficiency and Power Factor LAD 1400:
3×380 V 50 Hz



Working voltage acc. to ISO-Norm R 700

Installation

The LAD 1000 and LAD 1400 conform with the IP 22 tamper and drip-proof specifications. In outdoor use and exceptionally bad weather conditions we recommend some form of rain protection. If covers or tarpaulins are used care must be taken not to block the air intake.

Mains connections

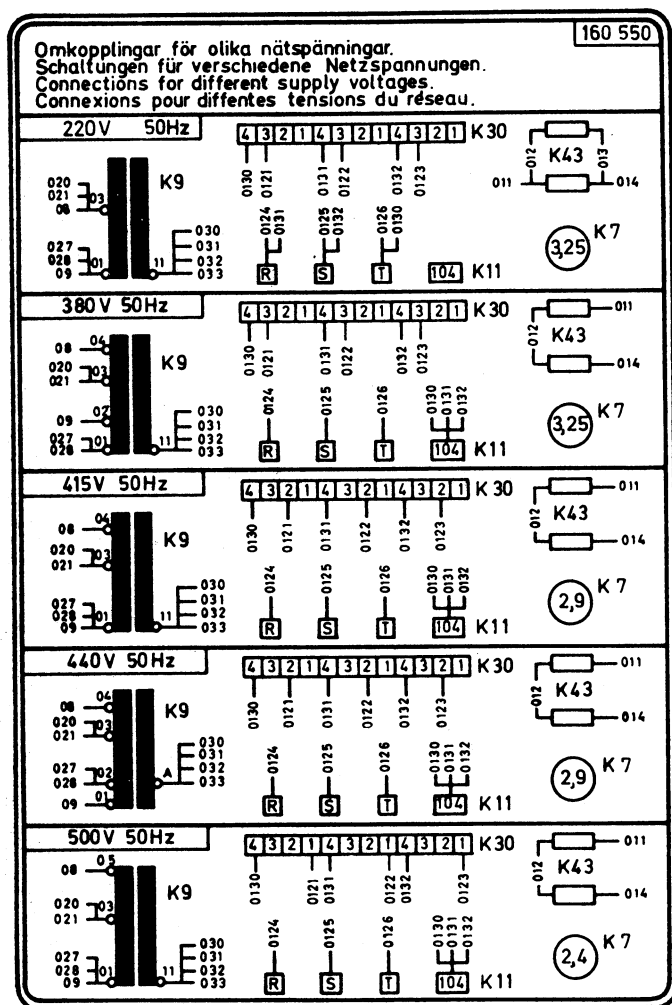
1. Check that the rectifier is set for the mains voltage available.
2. Refer to the table, page 3, concerning cable area and fuse ratings.
3. Connect the rectifier to three phases, using R, S and T terminals on plinth K11.
4. See connection instructions on page 5 to ensure that the mains plinth K11, main transformer plinth K30 and control transformer K9 are set at the correct voltage and frequency. The overload relay K7 must also be set in accordance with the connecting instructions.
5. The rectifier must be earthed in accordance with the applicable regulations. The welding cables which are fitted with 13 mm terminal heads are connected to

the K13 busbars on the rear of the rectifier. If the welding current exceeds 600 A, two parallel cables each of 120 mm² should be used. If the rectifier is fitted with the K12 inductor and K15 resistor for gas metal-arc welding, the negative terminal should be connected to the centre socket of the three welding current sockets on the rear of the rectifier.

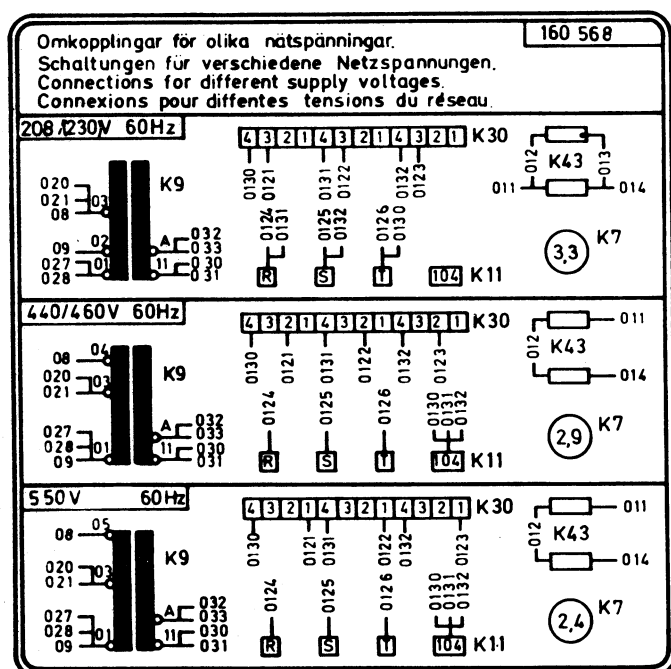
To reduce voltage drop and keep arc voltage at the required setting when extra-long welding cables are used, it may be necessary to increase the cable area. Feed rails can be used instead of welding cables. The voltage reference cable has a 6 mm² area and is connected between terminal screw K23 on the rectifier control panel and the workpiece.

Installation and connecting instructions

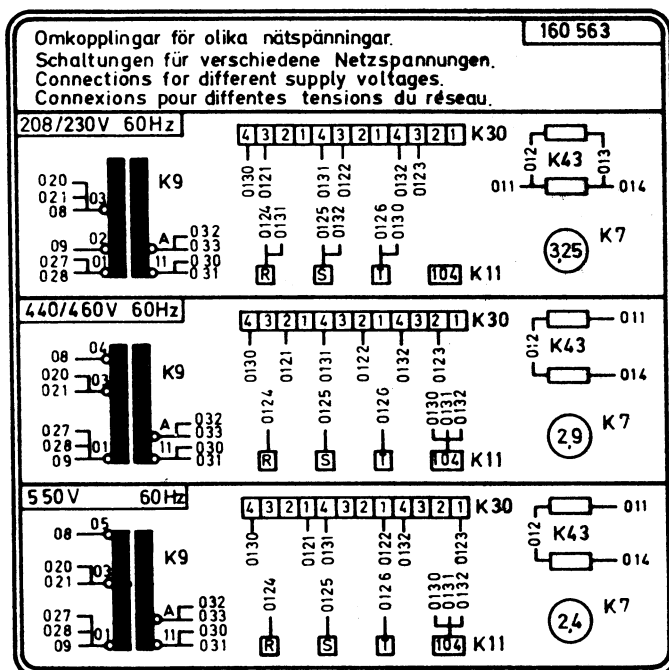
Connecting instructions LAD 1000: 50 Hz



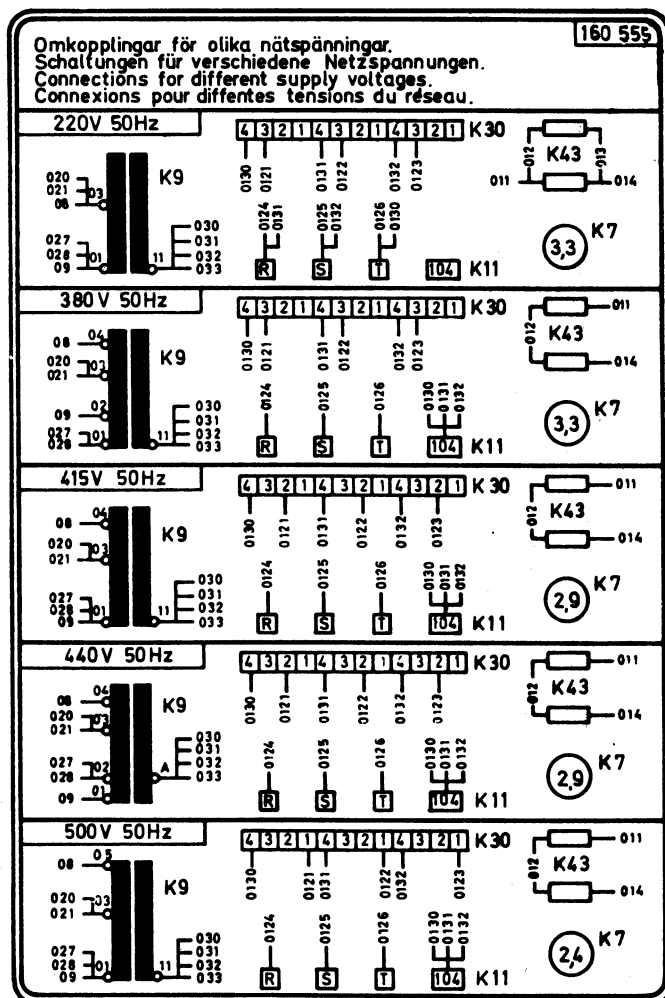
Connecting instructions LAD 1400: 60 Hz



Connecting instructions LAD 1000: 60 Hz

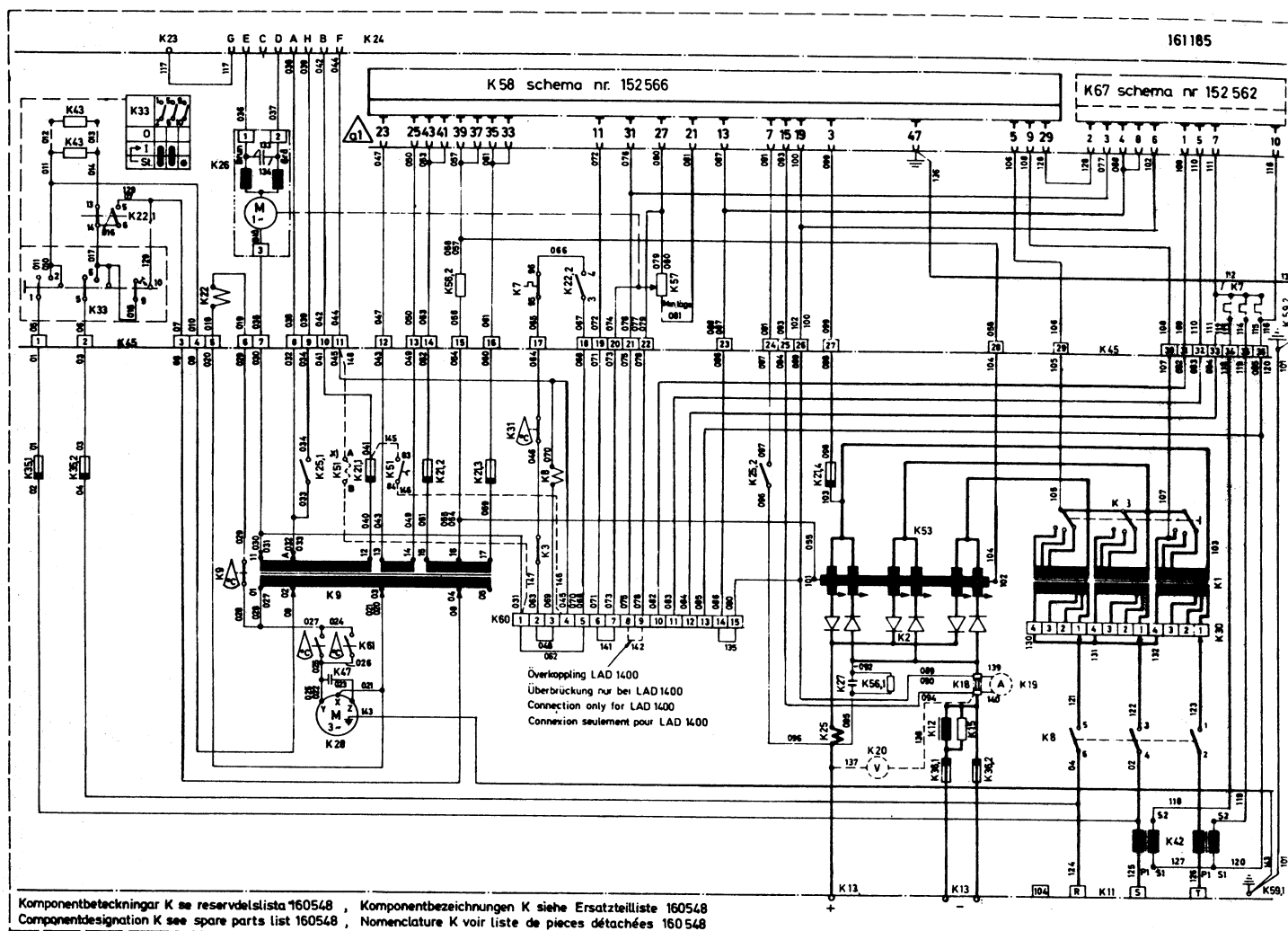


Connecting instructions LAD 1400: 50 Hz



Circuit diagram

LAD 1000, LAD 1400



The LAD rectifiers consist of the following components:

(designations correspond to those used on circuit diagram):

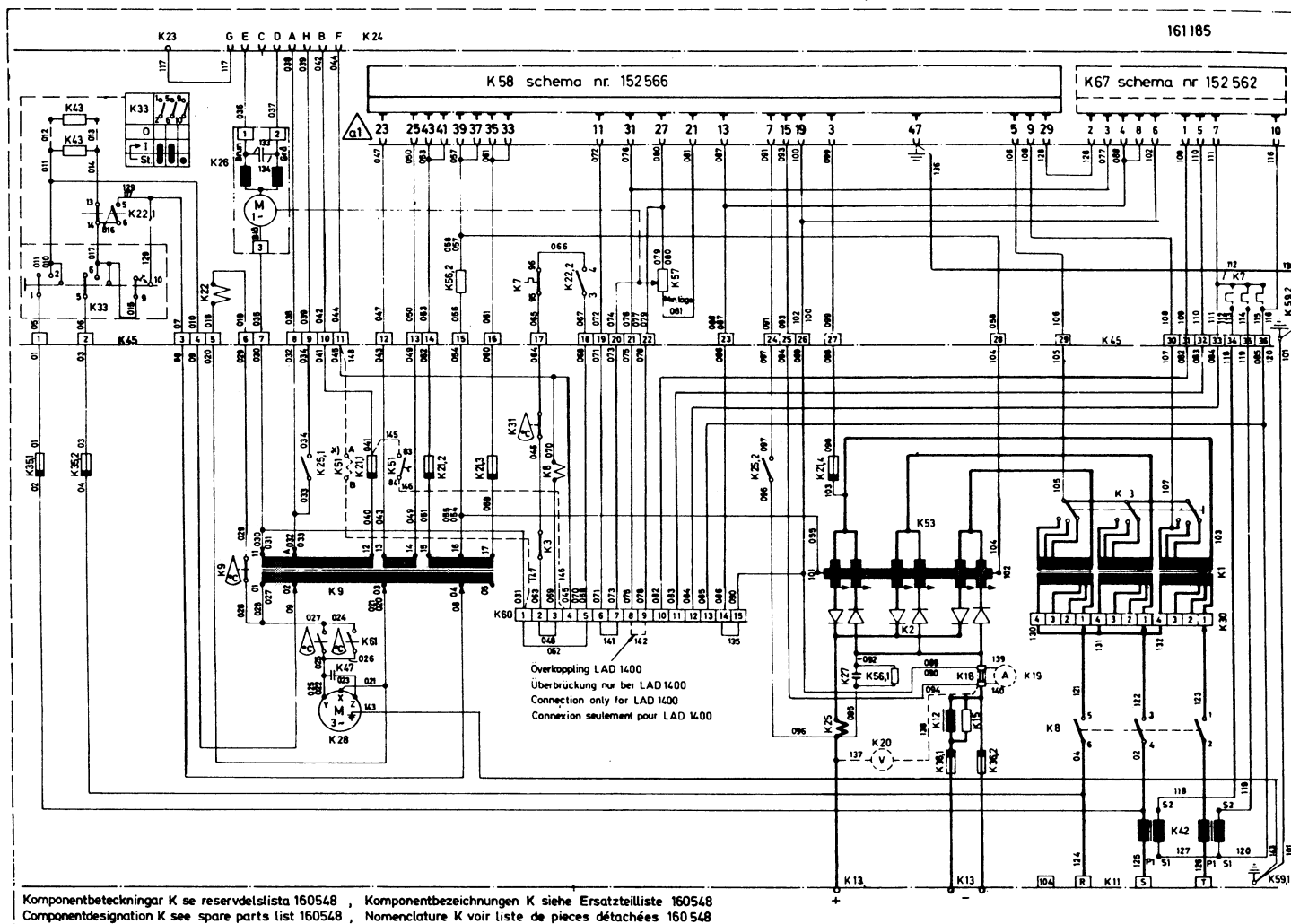
K1	Main transformer	K25	Current relay
K2	Rectifier bridge	K26	Control unit, without resistor
K3	Coarse setting switch	K27	Condenser
K7	Overload relay	K28	Fan
K8	Main contactor	K29	Overload relay
K9	Control transformer	K30	Connecting plinth
K11	Connecting plinth	K31	Thermostat
K12	Inductor	K33	Switch "0—I—Start"
K13	Welding current plug	K35	Fuse
K15	Resistor	K36	Fuse
K18	Shunt	K42	Current transformer
K19	Ammeter	K43	Resistor
K20	Voltmeter	K45	Plinth
K21	Fuse	K47	Condenser (fan motor)
K22	Contactor	K53	Transducer
K23	Terminal screw	K56	Resistor
K24	Socket outlet	K57	Variable resistor (rheostat)
		K58	Regulator
		K60	Plinth
		K61	Thermostat
		K67	Parallel control unit

Regulator LAD 1000, LAD 1400



Function and operation

LAD 1000, LAD 1400



FUNCTION AND OPERATION

When the LAD 1000 and LAD 1400 rectifiers are connected to the mains supply, the main contactor K8 and the starting switch K3 are alive.

1. Turn switch K33 to position "start". Control transformer K9 is now live. When the switch is released it returns automatically to position "I".
2. Set the coarse setting switch K3 to the required setting of either "I", "II" or "III".
3. Fine adjustment of the arc voltage can be carried out on the automatic welder with the switch marked "Increase—0—Reduce". Synchro motor K6 then powers the variable resistor K57 and the arc voltage alters accordingly.

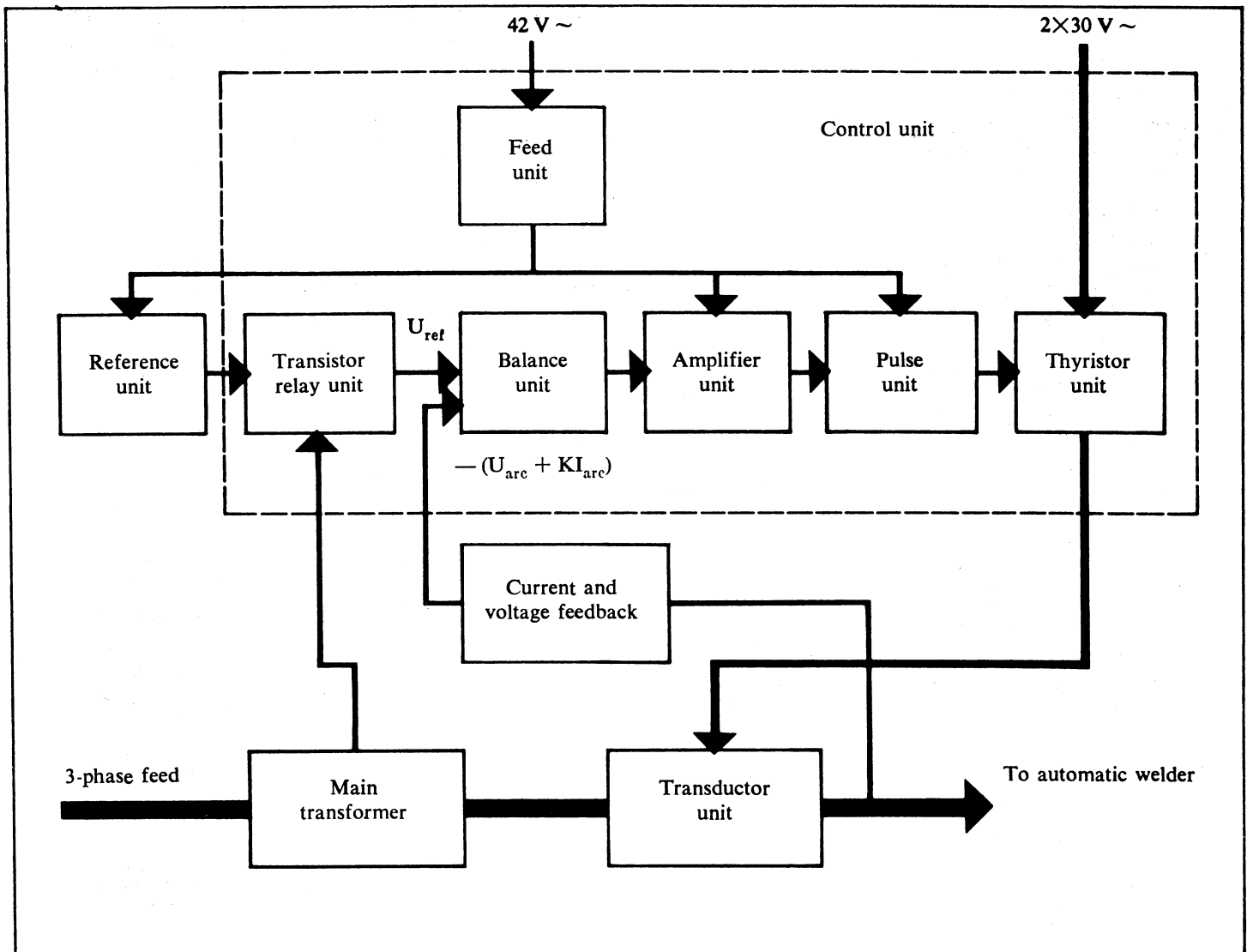
When the switch on the automatic welder is positioned at "start" the main contactor K8 is activated and the electrode commences to be fed. The starting switch on

the automatic welder is then held on until the electrode has made connection with the workpiece. The control circuit is then made and relay K25,1 is activated and main switch K8 remains on. This gives the desired electrode feeding speed. Regulator K58 is then fed a reference voltage from rheostat K57 and the secondary side of the main transformer. The current relay K25, 2 gives an impulse to the automatic welder so that the required arc voltage is made available.

Air/arc gouging

When the rectifier is used for air/arc gouging, fine setting of the welding current is done manually via rheostat K57 on the control panel. B and F terminals on the control outlet K24 must be coupled in order for the main switch to hold "on".

Function description Regulator K58



Function Description, regulator K58

As previously mentioned, the thyristor regulator ensures a constant arc voltage independent of mains voltage variations within the tolerances shown on page 3. In short, its function is as follows (see block diagram above):

The reference unit is fed a direct current stabilized voltage (feed unit). Part of this voltage is used as a reference voltage and fed via the transistor relay unit to the balance unit.

The transistor relay unit is controlled by the secondary side of the main transformer and is dependent on the position of the coarse setting switch.

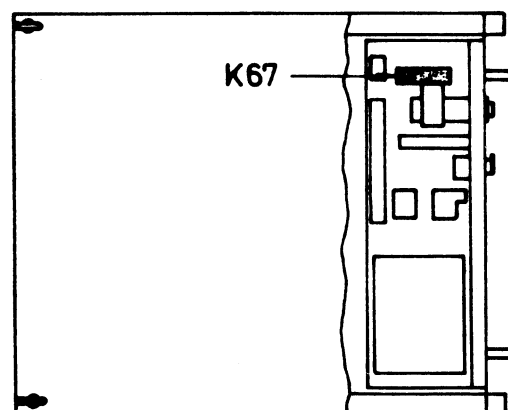
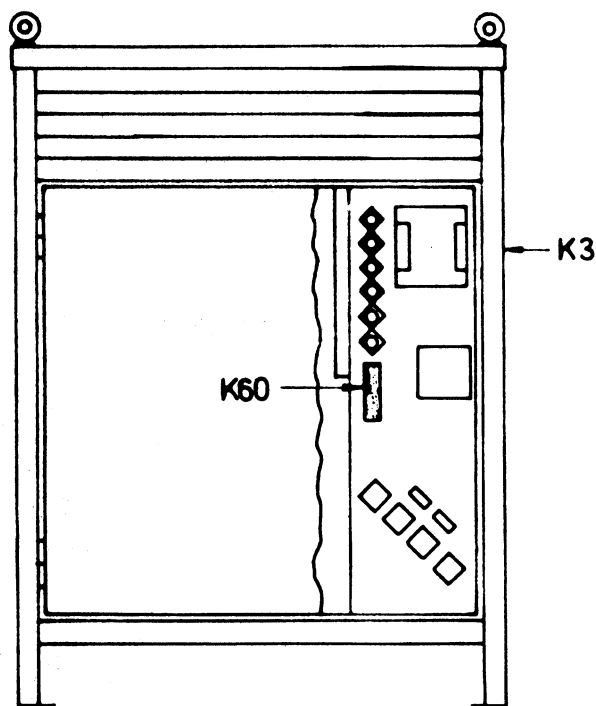
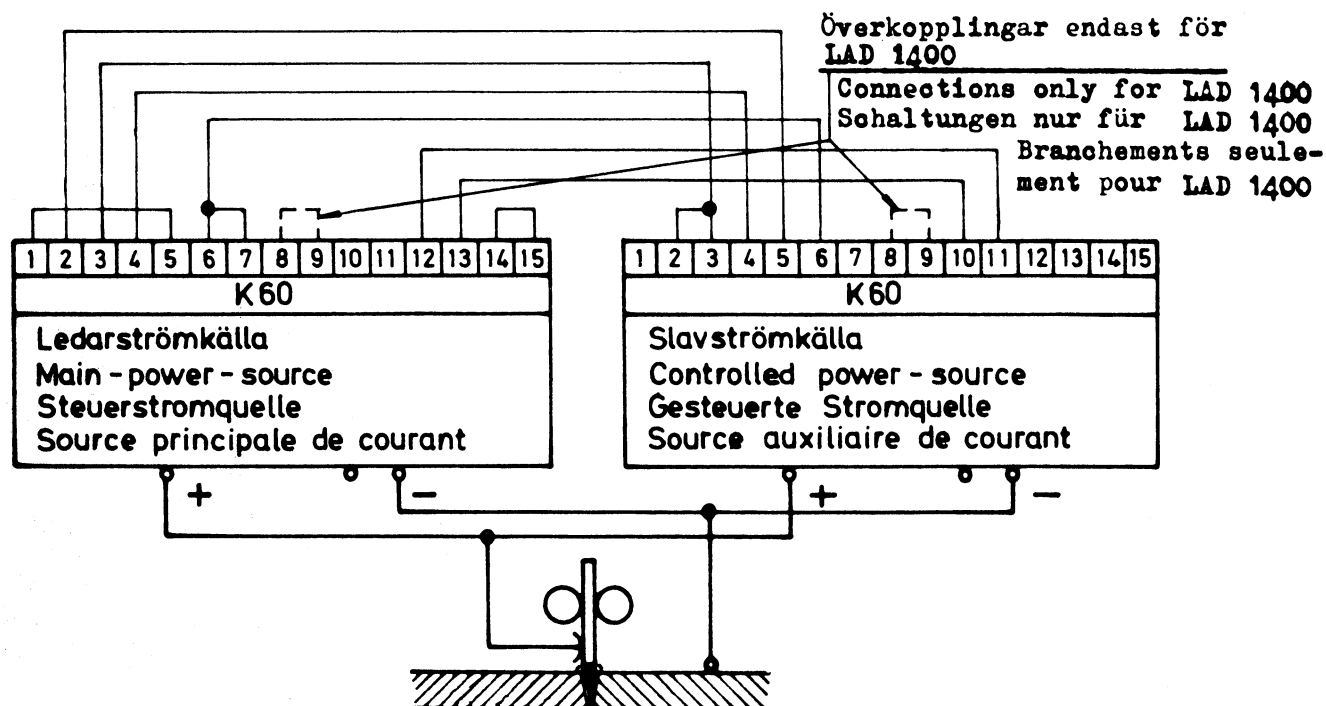
The balance unit compares the reference voltage (U_{ref}), the returned arc voltage (U_{arc}) and the voltage over the shunt which the welding current has given: (kI_{arc}). This in turn gives the balance voltage $U_{ref} - (U_{arc} + kI_{arc})$ which is boost-

ed in the amplifier unit, (k =character slope V/A).

The amplified balance voltage then goes to the pulse unit which controls this voltage so that correctly sloped control pulses reach the thyristors. The transducer will then receive a control current which will give $U_{ref} - (U_{arc} + kI_{arc}) = 0$. Should the main voltage fluctuate, the balance voltage from the amplifier will alter, in turn altering the "ignition angle" from the pulse unit which changes the control current to the transducer. The arc voltage and welding current are thus held constant.

Parallel connection of 2 LAD 1000's or LAD 1400's

Connecting instructions for parallel operation



Parallel operation of 2 LAD 1000's or 2 LAD 1400's

If a higher welding current than 1000 or 1400 A is required, two rectifiers of the LAD 1000 or LAD 1400 type can work in parallel.

Maximum permissible loading current for two parallel connected welding rectifiers:

LAD 1000: 1650 A continuous
1850 A at 80 % duty cycle

LAD 1400: 2250 A continuous
2550 A at 80 % duty cycle

Connecting instructions

Please refer to connecting instructions and diagram for parallel connection above.

1. Connect plinths K60 as per diagram with 1.5 mm² area leads.
2. Fit the parallel control unit K67 to the controlled power source.
3. Phase connect the rectifiers.
4. Parallel connect the welding cables as shown in the diagram.
5. The operating current cable from the automatic welder should be connected to control outlet K24 of the main power source.

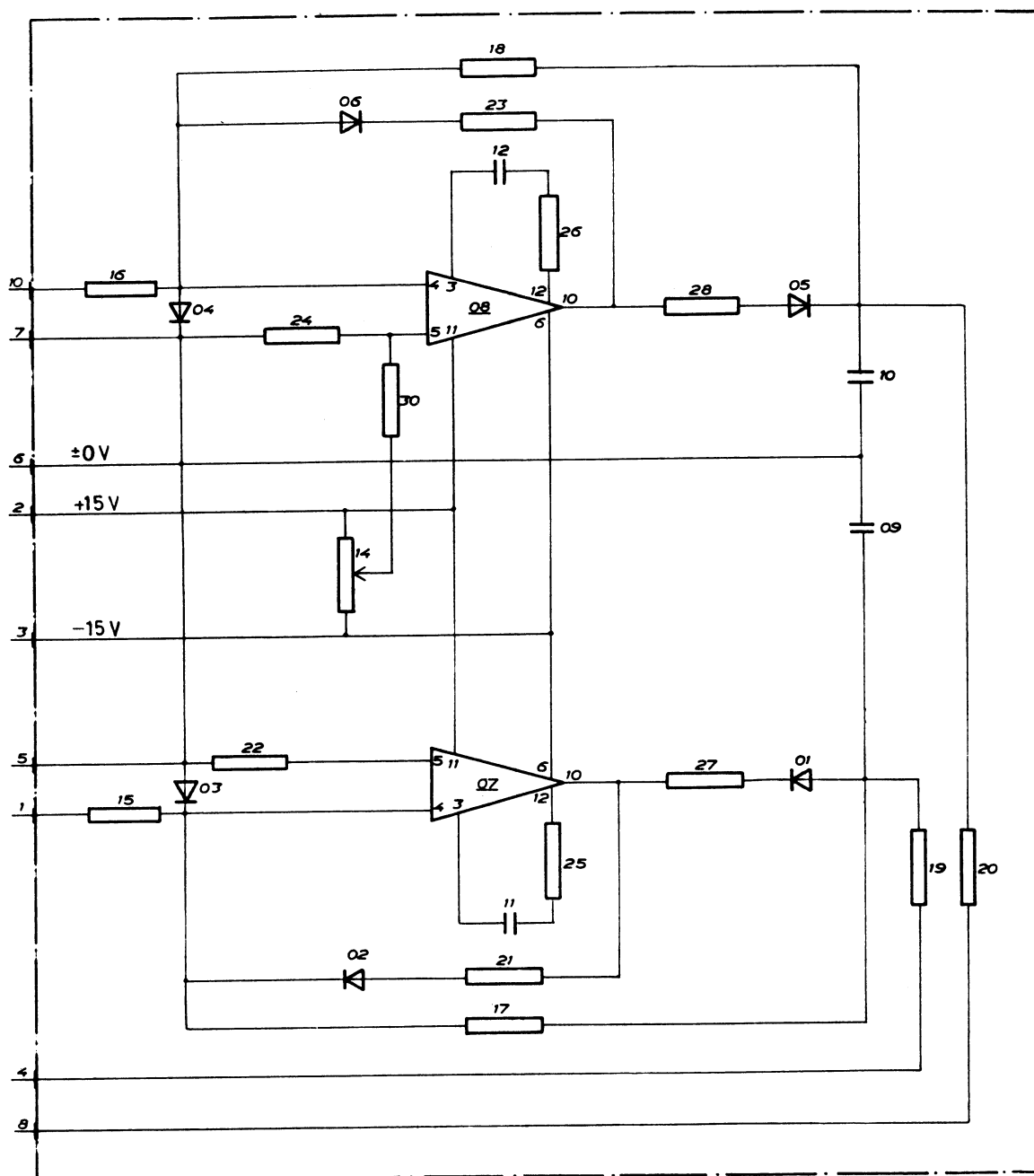
Start of welding rectifiers

1. Turn the main power source switch K33 to position "start". The controlled power source is then started in the same manner.
2. Before commencing to weld select a coarse setting with the coarse setting switch K3. NOTE: Both switches must have the same setting.
3. Fine adjustment of the welding current is carried out by the switch on the automatic welder marked "Increase—0—Reduce".

The control motor K26 and variable resistor K57 for the main power source also provide a reference voltage to the regulator of the controlled power source. The setting of variable resistor K57 on the controlled power source has no effect on the welding result since it is not influenced by the "Increase—0—Reduce" switch on the automatic welder.

Function and operation

Circuit diagram, parallel control unit LAD 1000, LAD 1400



Maintenance and service

MAINTENANCE AND SERVICE

The LAD 1000 and LAD 1400 require very little maintenance. Normally it is quite sufficient if the rectifiers are blown clean with dry compressed air once per year. If used in dusty or dirty conditions, this cleaning should be done more often.

The side panels can be removed with the key provided. After releasing the covers they can be lifted straight up and removed. The panel with the instruments and control units can be easily removed for maintenance. The panel is first loosened and then pulled out. The components on the control panel are coupled through a harness via the K45 plug plinth to another harness which supplies the remaining components. To remove the panel, loosen the male plug from the female socket/plinth using a screwdriver. This allows the panel to be removed from the rectifier.

NOTE: Switch K33 and main contactor K8 are on mains voltage when switch K33 is positioned "0". When working on the inside of the rectifier it must be disconnected from the mains.

For more extensive maintenance or repairs the entire casing can be removed.

REPLACEMENT PARTS

Parts for the LAD 1000 and LAD 1400 can be ordered from your nearest ESAB representative. A list of these representatives is given on the last page of the replacement parts list. To ensure that you receive the correct parts for your ESAB equipment please make sure that you give the correct type designation when ordering parts, i. e. LAD 1000 or LAD 1400, and use only the specified order numbers and designations used in the parts lists. This will simplify our work and ensure your satisfaction.

Check and replacement of diodes



Check of diodes

NOTE: When checking diodes, do not use a buzzer or bell tester!

The rectifier bridge K2 in the LAD 1000 holds 18 diodes and the LAD 1400 has 24 diodes. These diodes can be easily checked without removing them from their cooling sinks by using ESAB's diode tester ZPB, order number 160 115-880.

1. Connect the diode tester plug to a 220V AC mains feed.
2. Check the diode tester by short circuiting the two crocodile clips. Both signal lamps should light up.
3. Loosen the top connection of the diode.
4. Connect the two crocodile clips to the top connection of the diode and the cooling sink respectively.

- a. If one lamp lights up the diode is in order.
 - b. If both lamps light up the diode is short circuited.
 - c. If no lamps light up there is a breakdown in the diode.
5. Repeat items 3 and 4 above on the other diodes.

Replacing diodes

The LAD 1000 and LAD 1400 use diodes of ASEA or IR make. These diodes have a tightening torque of 4.3 kpm. NOTE: Only genuine diodes of the above specification must be used. When replacing faulty diodes or a diode that has loosened, it is vital that the correct tightening torque is used. Insufficient tightening torque will give greater resistance and lesser heat dis-

sipation which will result in a rise in temperature and, eventually, overheating. Excessive tightening can damage the semiconductor elements inside the diode. For ASEA diodes, a special torque key with order number 161 564-880 is available.

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