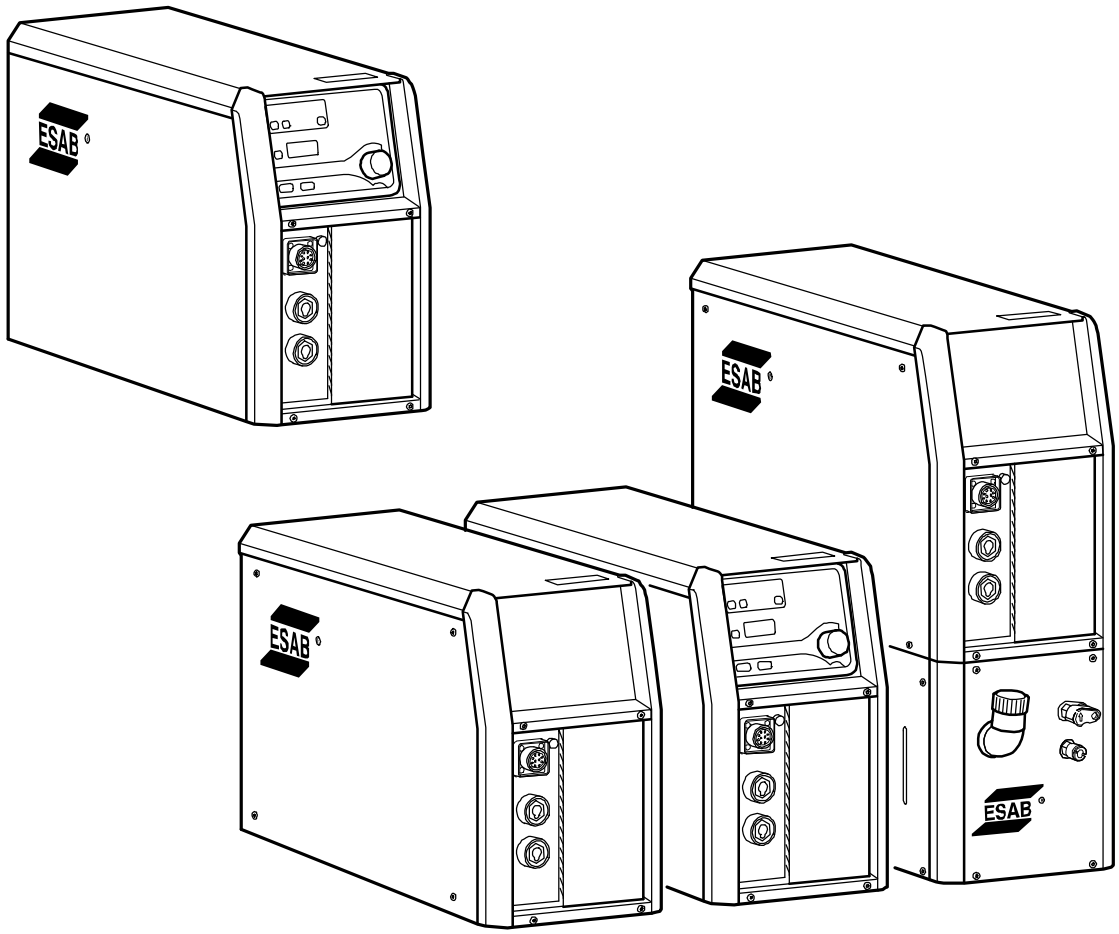
Aristo™ Origo™

Arc 4001i
Mig 4001i



Service manual

0740 800 197 100621

Valid for serial no. 833-xxx-xxxx 852-xxx-xxxx

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 boards are divided into numbered blocks, which are described individually in more detail in the description of operation. Component names in the wiring diagram are listed in the component description.

Use the spare parts list as a guide to where the components are located in the equipment. The spare parts list is published as a separate document, see page 73.

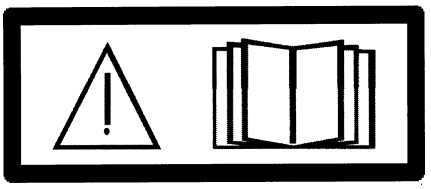
This manual contains details of design changes that have been made up to and including June 2010.

The manual is valid for:
Arc 4001i and Mig 4001i with serial number 833-xxx-xxxx and 852-xxx-xxxx.

The Arc 4001i and Mig 4001i are designed and tested in accordance with international and European standards IEC/EN 60974.
On completion of service or repair work, it is the responsibility of the person(s) performing the work to ensure that the product still complies with the requirements of the above standard.

CAUTION!

Read and understand the instruction manual before installing or operating.



WARNING!
Many parts of the power source are at mains voltage.

INTRODUCTION

Mig 4001i is a welding power source intended for MIG/MAG welding, as well as for welding with powder filled cored wire (FCAW-S), TIG welding and for welding with coated electrodes (MMA).

Mig 4001i can be supplied with or without cooling unit. The cooling unit can be retro fitted.

Arc 4001i is a welding power source intended for welding with coated electrodes (MMA welding) and TIG welding (Live TIG-start). Further, the power source with the control panel A24 can be used together with the wire feed unit MobileFeed. The wire feed unit uses the arc voltage as control voltage.
A simpler control panel A22, may also be used for the Arc 4001i.

Control panels, welding process parameters are controlled via the control panel. See the separate instruction and service manuals for a detailed description of the panels.

Design structure of the power source

The power source is transistor-controlled, operating on the inverter principle. It consists of a number of function modules, as shown in the schematic diagram below. Each module has a module number, which is always included as the first part of the name/identification of components in the module.

The modules have the following main functions:

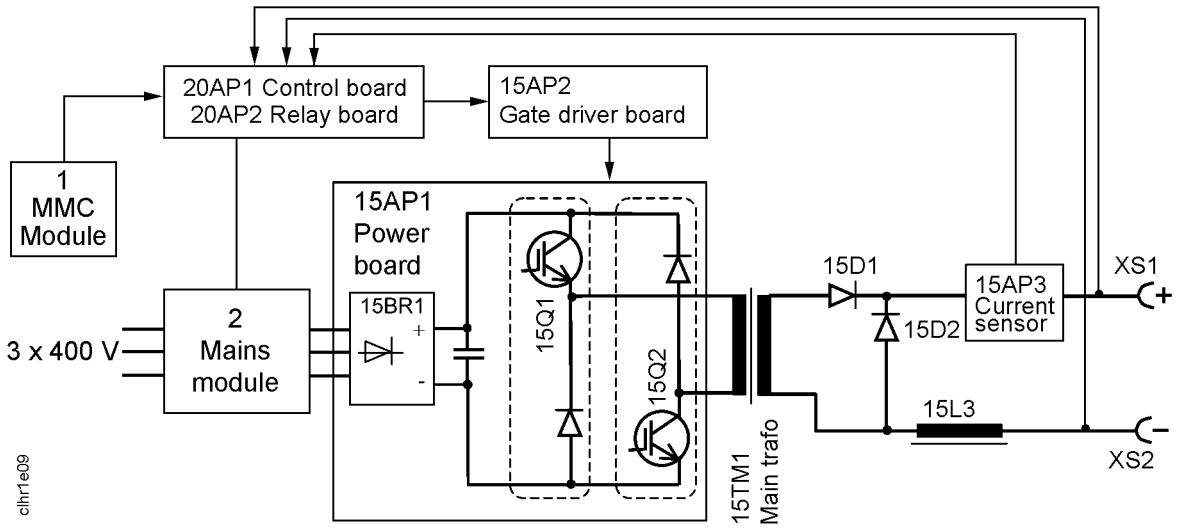
1 MMC module
The control panel and welding data unit, which control the machine functions.

2 Mains module
Mains interference suppressor, mains switch, control power transformer, contactor.

15 Power module
This module is a forward converter inverter, operating at a switching frequency of 27 kHz. IGBT transistors are used as the switching elements. All power semiconductors are built into modules in order to ensure a robust design suitable for use in the demanding welding environment.

20 Processor board module (controller module)
This is the controller board, 20AP1, with a microprocessor, that monitors and controls the voltage and current. It is served by relay board 20AP2, which handles input and output signals to/from the controller board.

Further information on the modules can be found in the component and function descriptions.



Block diagram of the power source

TECHNICAL DATA

	Mig 4001i	Arc 4001i
Mains voltage	400 V ± 10%, 3~ 50/60 Hz	400 V ± 10%, 3~ 50/60 Hz
Mains supply	$S_{sc\ min}$ 2.2 MVA	$S_{sc\ min}$ 2.2 MVA
Primary current		
I_{max} MIG/MAG	26 A	26 A
I_{max} TIG	20 A	20 A
I_{max} MMA	27 A	27 A
No-load power in energy-saving mode		
6.5 min. after welding	60 W	60 W
Setting range		
MIG/MAG	20 A / 15 V - 400 A / 34 V	20 A / 15 V - 400 A / 34 V
TIG	4 A / 10 V - 400 A / 26 V	4 A / 10 V - 400 A / 26 V
MMA	16 A / 21 V - 400 A / 36 V	16 A / 21 V - 400 A / 36 V
Permissible load at MIG/MAG		
35% duty cycle	400 A / 34 V	400 A / 34 V
60 % duty cycle	320 A / 30 V	320 A / 30 V
100% duty cycle	250 A / 26.5 V	250 A / 26.5 V
Permissible load at TIG		
35% duty cycle	400 A / 26 V	400 A / 26 V
60 % duty cycle	320 A / 22.8 V	320 A / 22.8 V
100% duty cycle	250 A / 20 V	250 A / 20 V
Permissible load at MMA		
35% duty cycle	400 A / 36 V	400 A / 36 V
60 % duty cycle	320 A / 32.8 V	320 A / 32.8 V
100% duty cycle	250 A / 30 V	250 A / 30 V
Power factor at maximum curren		
MIG/MAG	0.89	0.89
TIG	0.91	0.91
MMA	0.89	0.89
Efficiency at maximum curren		
MIG/MAG	85 %	85 %
TIG	81 %	81 %
MMA	85 %	85 %
Open-circuit voltage		
without VRD function **1)**	91 V	91 V
VRD function deactivated **2)**	58 V	58 V
VRD function activated **2)**	< 35 V	< 35 V
Operating temperature	-10 to +40° C	-10 to +40° C
Transportation temperature	-20 to +55° C	-20 to +55° C
Continual sound pressure at no-load	<70 db (A)	<70 db (A)
Dimensions lxwxh	652 x 249 x 423 mm	652 x 249 x 423 mm
with cooling unit	714 x 249 x 693 mm	-
Weigt	43.5 kg	40 kg
with cooling unit	63.5 kg	
Insulation class	H	H
Enclosure class	IP 23	IP 23
Application class	S	S

1) Valid for power sources without VRD specification on the rating plate.

2) Valid for power sources with VRD specification on the rating plate. The VRD function is explained in the instruction manual for the control panel.

Mains supply, $S_{sc\ min}$
Minimum short circuit power on the network in accordance with IEC 61000-3-12

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. The duty cycle is valid for 40° C.

The duty cycle is valid for 40° C.

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

The power source consists of a number of function modules, which are described in the component descriptions on the following pages. Wire numbers and component names in the wiring diagrams show to which module each component belongs.

Wires/cables within modules are marked 100 - 6999.

Wires/cables between modules are marked 7000 - 7999.

Components outside modules - e.g. capacitors - are named such as C1 - C99, connection (plug/socket) XS1 - XS99 (S = sleeve), XP1 - XP99 (P = pin) etc.

Circuit boards within each module have names such as 20AP1 - 20AP99.

20 = module association, 1-69
AP = circuit board
1 = individual identification number, 0-99

Transistors within particular modules have identification numbers such as 15Q1 - 15Q99.

15 = module association, 1-69
Q = transistor
1 = individual identification number, 0-99

Component description

Component	Description
AP2	Interference suppressor board. See diagram on page 14.
C3	Capacitor, 100 nF 250 V.
XP..	Plug connectors. (Pin)
XS..	Socket connectors. (Sleeve)

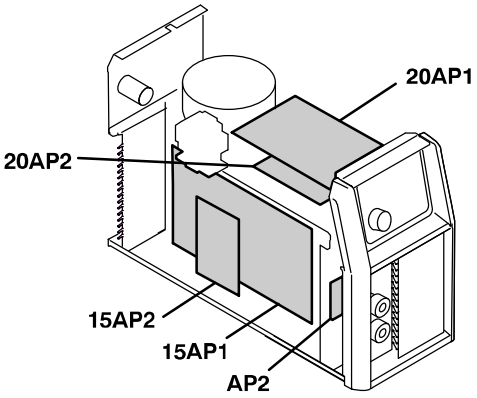
Component	Description
XT..	Terminal blocks.
1	**MMC module**. Wire numbers 100-199. See description on page 14.
2	**Mains module**. Wire numbers 200-299.
2AP1	EMC suppressor board. See diagram on page 15.
2FU1	Fuse, 0.5 A slow blow (anti-surge).
2FU2	Fuse, 3.15 A slow blow (anti-surge).
2FU3	Fuse, 4 A slow blow (anti-surge).
2FU4	Fuse, 10 A slow blow (anti-surge).
2KM1	Main contactor. See 20AP2:3 on page 36.
2QF1	Mains switch. See 20AP2:3 on page 36.
2TC1	Auxiliary transformer.
3	**Primary inductor module**. Wire numbers 300-399.
3L1	Primary inductor.
5	**Water cooling module**. Wire numbers 500-599. The power supply to the cooling water pump and fan is controlled by the machine software. See the description of the 20AP2:5 on page 37.
7L1, 7L2	Ferrite rings, fitted to each end of cable 7200.
15	**Power module**. Wire numbers 1500-1699. See the schematic diagram and description on page 16.
15AP1	Power board.
15AP2	Gate driver board.
15AP3	Current sensor. See the description of 20AP1:8 on page 28.
15BR1	Rectifier bridge. See the description of 15AP1:1 on page 17 and the assembly instructions on page 49.
15D1, 15D2	Rectifier and freewheel diode modules. Each module consists of two diodes. 15D1 rectifies the welding current. During the time interval between two voltage pulses from transformer 15TM1, the freewheel diodes 15D2 maintain the welding current from inductor 15L3. See page 49 for assembly instructions for the diode modules.
15EV1, 15EV2	Fans, 24 V DC. See the description of 20AP1:2 on page 24.
15L1, 15L2	2 + 2 ferrite rings. Reduce transient voltages produced when the diode modules 15D1 and 15D2 turn off.
15L3	Inductor.

Component	Description
15Q1, 15Q2	IGBT transistors. See the description of 15AP1:2 on page 18 and the installation instructions on page 49.
15ST1	Thermal overload cutout, in the winding of main transformer TM1. See the description of 20AP1:4 on page 27.
15ST2	Thermal overload cutout, mounted on the heat sink for the IGBT modules. See the description of 20AP1:4 on page 27 and the installation instructions on page 49.
15TM1	Main transformer.
20AP1	Control circuit board.
20AP2	Relay board.

CAUTION !

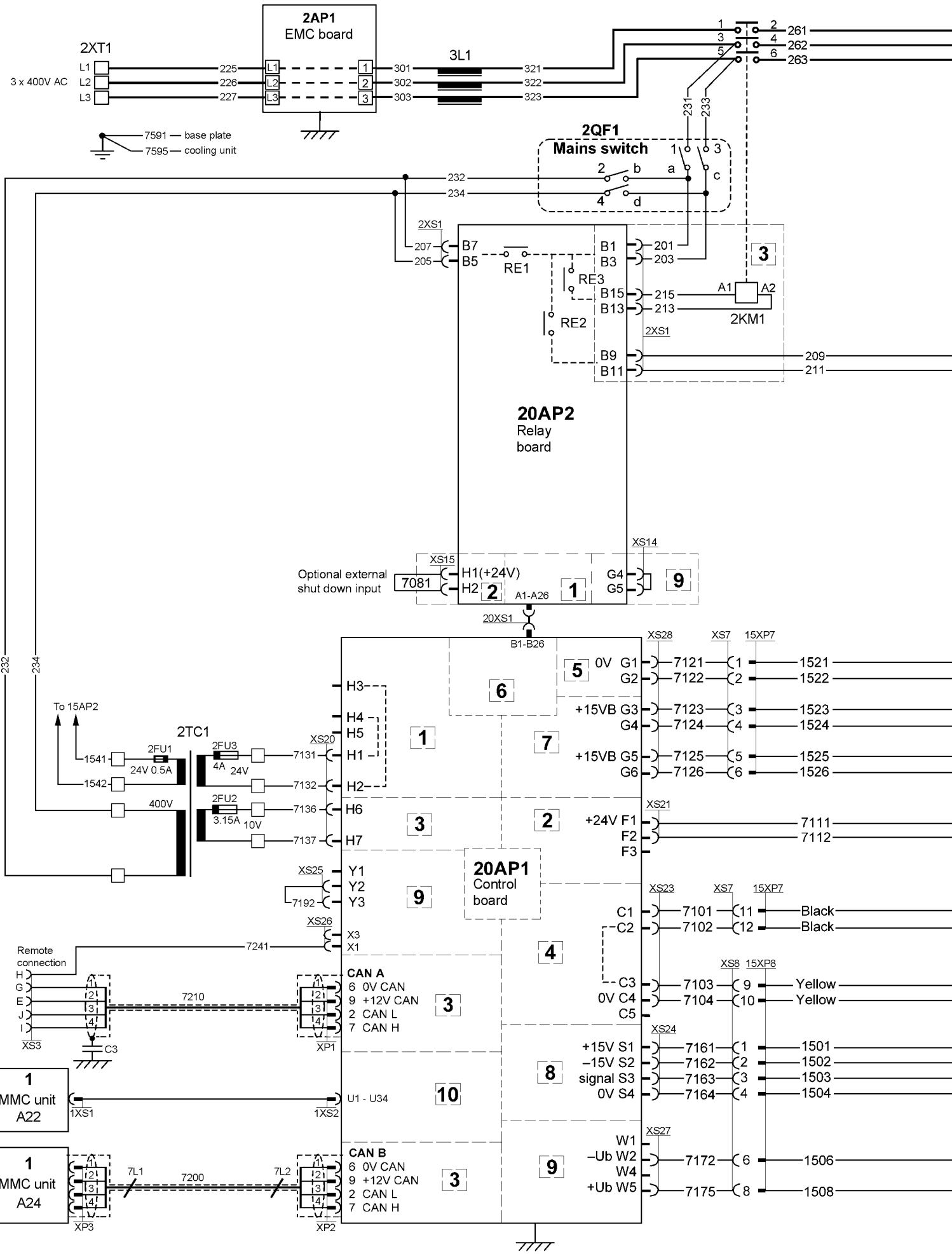
STATIC ELECTRICITY can damage circuit boards and electronic components.

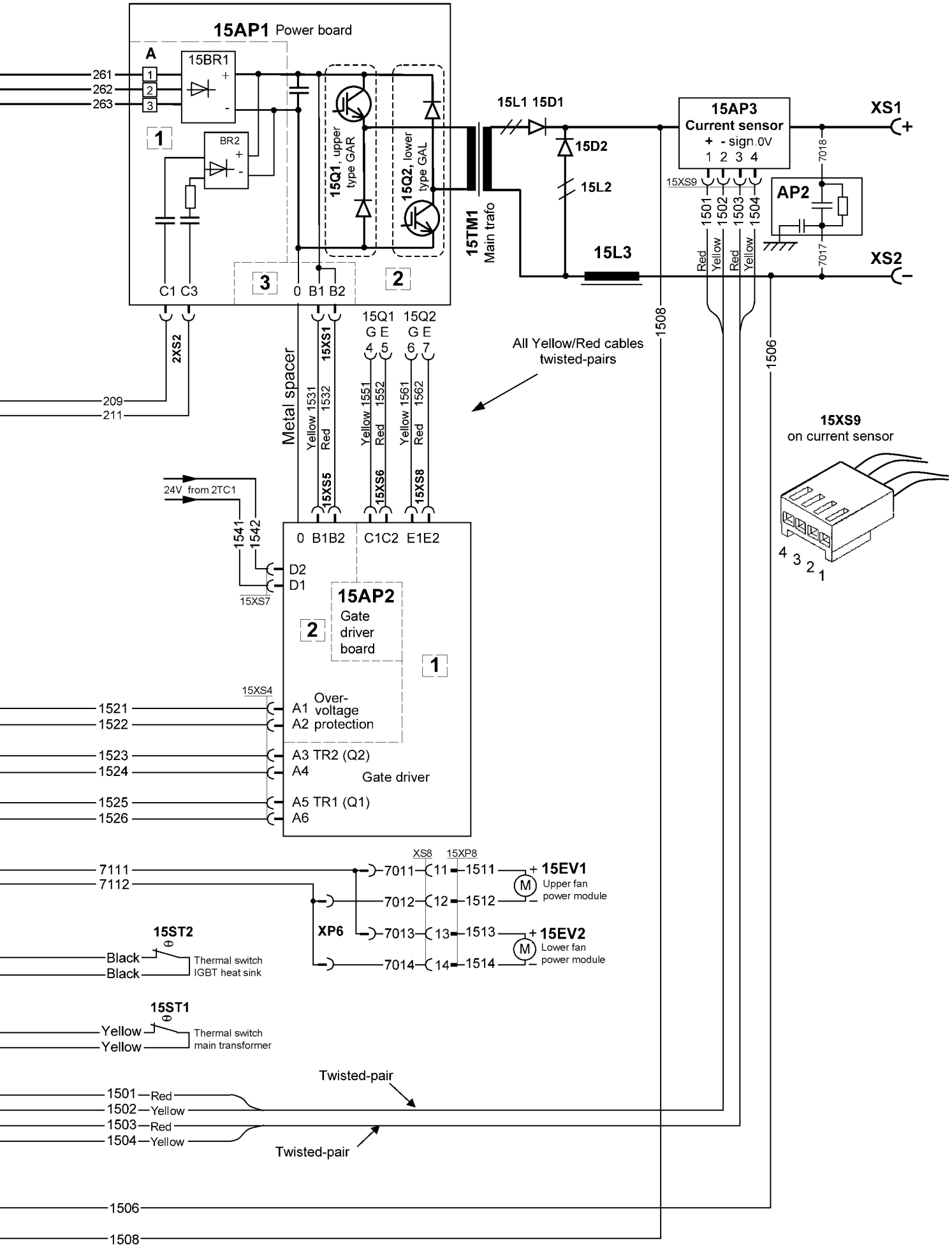
- **Observe precautions for handling electrostatic-sensitive devices.**
- **Use proper static-proof bags and boxes.**



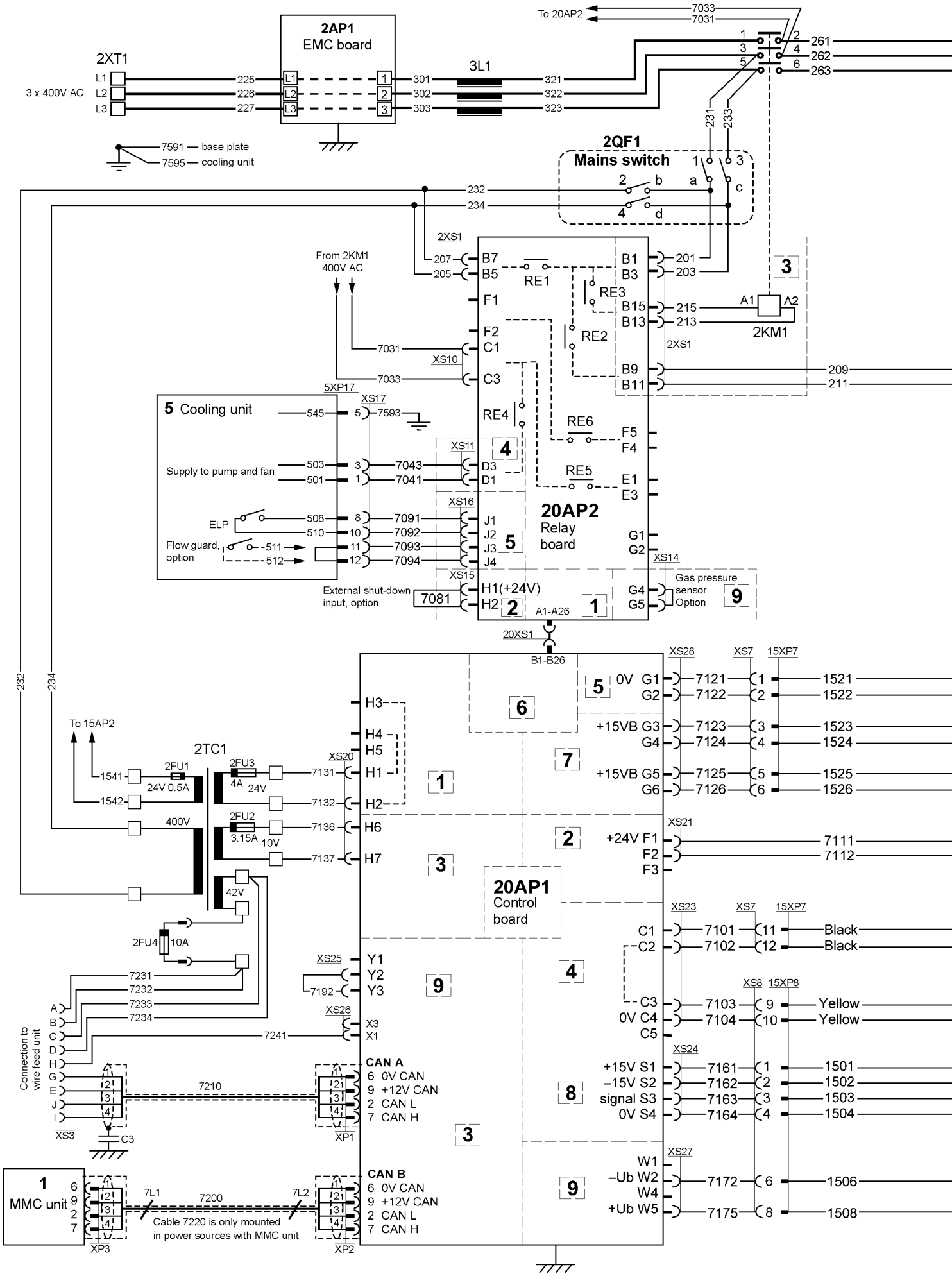
Placement of the circuit boards

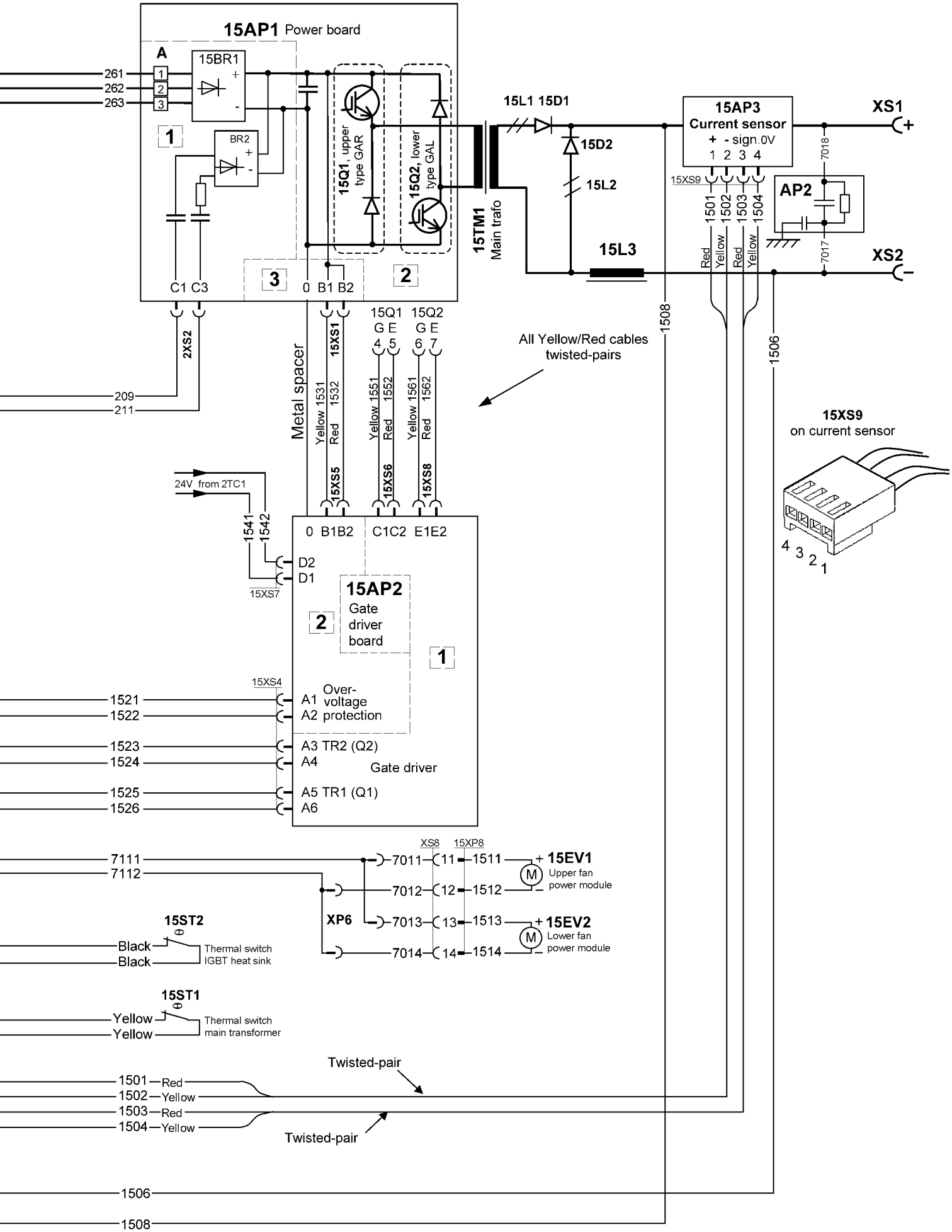
Arc 4001i


2AP1
EMC board
2XT1
3 x 400V AC
L1
L2
L3
225
226
227
3L1
301
302
303
321
322
323
261
262
263
7591 — base plate
7595 — cooling unit
2QF1
Mains switch
231
233
232
234
2XS1
207
205
B7
B5
RE1
RE3
RE2
B1
B3
B15
B13
201
203
215
213
A1
A2
2KM1
3
B9
B11
209
211
20AP2
Relay
board
XS14
XS15
Optional external
shut down input
7081
H1(+24V)
H2
2
A1-A26
1
G4
G5
9
20XS1
B1-B26
To 15AP2
2TC1
1541
1542
400V
2FU1
24V 0.5A
2FU3
4A 24V
2FU2
3.15A 10V
XS20
7131
7132
7136
7137
H1
H2
H3
H4
H5
H6
H7
6
1
3
5
0V G1
G2
+15VB G3
G4
+15VB G5
G6
7121
7122
7123
7124
7125
7126
XS28
XS7
15XP7
1521
1522
1523
1524
1525
1526
7
2
XS21
+24V F1
F2
F3
7111
7112
20AP1
Control
board
XS25
7192
Y1
Y2
Y3
9
XS26
7241
X3
X1
4
XS23
C1
C2
C3
0V C4
C5
7101
7102
7103
7104
11
12
9
10
Black
Black
Yellow
Yellow
XS8
15XP8
Remote
connection
H
G
E
J
I
XS3
7210
C3
XP1
CAN A
6 0V CAN
9 +12V CAN
2 CAN L
7 CAN H
3
XS24
+15V S1
–15V S2
signal S3
0V S4
7161
7162
7163
7164
1
2
3
4
1501
1502
1503
1504
8
1
MMC unit
A22
1XS1
U1 - U34
1XS2
10
XS27
W1
–Ub W2
W4
+Ub W5
7172
7175
6
8
1506
1508
9
1
MMC unit
A24
7L1
7200
7L2
XP3
XP2
CAN B
6 0V CAN
9 +12V CAN
2 CAN L
7 CAN H
3


15AP1 Power board
A
15BR1
BR2
261
262
263
1
2
3
15Q1, upper type GAR
15Q2, lower type GAL
15L1 15D1
15D2
15L2
15L3
15TM1 Main trafo
15AP3 Current sensor
+ - sign.0V
1 2 3 4
XS1
XS2
7018
7017
AP2
15XS9
1501
1502
1503
1504
Red
Yellow
Red
Yellow
1508
1506
All Yellow/Red cables twisted-pairs
15XS9 on current sensor
4 3 2 1
C1 C3
3
0 B1 B2
2
2XS2
209
211
Metal spacer
15XS1
15Q1 15Q2
G E G E
4 5 6 7
Yellow 1531
Red 1532
Yellow 1551
Red 1552
Yellow 1561
Red 1562
15XS5
15XS6
15XS8
24V from 2TC1
1541
1542
15XS7
D2
D1
0 B1B2 C1C2 E1E2
15AP2
Gate driver board
2
1
15XS4
1521
1522
1523
1524
1525
1526
A1 Over-voltage
A2 protection
A3 TR2 (Q2)
A4
Gate driver
A5 TR1 (Q1)
A6
XS8
15XP8
7111
7112
7011
7012
7013
7014
11
12
13
14
1511
1512
1513
1514
15EV1
Upper fan power module
15EV2
Lower fan power module
XP6
15ST2
Black
Black
Thermal switch IGBT heat sink
15ST1
Yellow
Yellow
Thermal switch main transformer
Twisted-pair
1501 Red
1502 Yellow
1503 Red
1504 Yellow
Twisted-pair
1506
1508

Mig 4001i

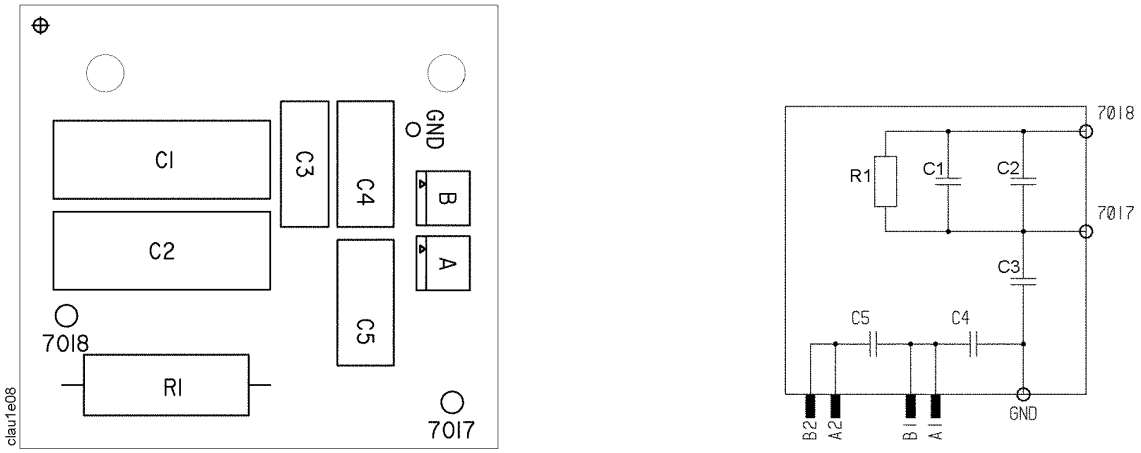

2AP1
EMC board
2XT1
3 x 400V AC
L1
L2
L3
225
226
227
3L1
301
302
303
321
322
323
To 20AP2
7033
7031
261
262
263
7591 — base plate
7595 — cooling unit
2QF1
Mains switch
231
233
232
234
2XS1
From 2KM1
400V AC
207
205
B7
B5
RE1
RE3
RE2
F1
F2
C1
C3
XS10
7031
7033
B1
B3
201
203
A1
A2
2KM1
B15
B13
215
213
B9
B11
209
211
5XP17
XS17
5 Cooling unit
545
5
7593
RE4
RE6
RE5
F5
F4
E1
E3
XS11
4
Supply to pump and fan
503
501
3
1
7043
7041
D3
D1
XS16
20AP2
Relay
board
ELP
508
510
8
10
7091
7092
J1
J2
5
Flow guard,
option
511
512
11
12
7093
7094
J3
J4
G1
G2
XS14
XS15
External shut-down
input, option
7081
H1(+24V)
H2
2
A1-A26
1
G4
G5
Gas pressure
sensor
Option
9
20XS1
B1-B26
XS28
XS7
15XP7
6
5
0V G1
G2
7121
7122
1
2
1521
1522
To 15AP2
2TC1
XS20
+15VB G3
G4
7123
7124
3
4
1523
1524
1541
2FU1
24V 0.5A
2FU3
4A 24V
7131
H3
H4
H5
H1
7
1
+15VB G5
G6
7125
7126
5
6
1525
1526
1542
7132
H2
400V
2FU2
3.15A 10V
7136
7137
H6
H7
2
3
XS21
+24V F1
F2
F3
7111
7112
42V
20AP1
Control
board
XS23
XS7
15XP7
2FU4 10A
C1
C2
7101
7102
11
12
Black
Black
XS25
Y1
Y2
Y3
7192
9
4
7231
7232
7233
7234
XS8
15XP8
C3
0V C4
C5
7103
7104
9
10
Yellow
Yellow
XS26
X3
X1
7241
XS24
CAN A
6 0V CAN
9 +12V CAN
2 CAN L
7 CAN H
+15V S1
–15V S2
signal S3
0V S4
7161
7162
7163
7164
1
2
3
4
1501
1502
1503
1504
8
Connection to
wire feed unit
A
B
C
D
H
G
E
J
I
7210
XS3
C3
XP1
3
XS27
W1
–Ub W2
W4
+Ub W5
7172
7175
6
8
1506
1508
9
1
MMC unit
6
9
2
7
7L1
7200
7L2
Cable 7220 is only mounted
in power sources with MMC unit
CAN B
6 0V CAN
9 +12V CAN
2 CAN L
7 CAN H
XP3
XP2


15AP1 Power board
A
15BR1
BR2
261
262
263
1
2
3
15Q1, upper type GAR
15Q2, lower type GAL
15L1 15D1
15D2
15L2
15L3
15TM1 Main trafo
15AP3 Current sensor
+ - sign.0V
1 2 3 4
XS1
XS2
15XS9
AP2
7018
7017
1501
1502
1503
1504
Red
Yellow
Red
Yellow
C1 C3
3
0 B1 B2
2
2XS2
209
211
Metal spacer
15XS1
15Q1 15Q2
G E G E
4 5 6 7
Yellow 1531
Red 1532
Yellow 1551
Red 1552
Yellow 1561
Red 1562
15XS5
15XS6
15XS8
All Yellow/Red cables twisted-pairs
1508
1506
15XS9
on current sensor
4 3 2 1
24V from 2TC1
1541
1542
15XS7
0 B1B2
C1C2 E1E2
D2
D1
15AP2
Gate driver board
2
1
15XS4
1521
1522
1523
1524
1525
1526
A1 Over-voltage
A2 protection
A3 TR2 (Q2)
A4
Gate driver
A5 TR1 (Q1)
A6
XS8
15XP8
7111
7112
7011
7012
7013
7014
11
12
13
14
1511
1512
1513
1514
15EV1
Upper fan power module
15EV2
Lower fan power module
XP6
15ST2
Black
Black
Thermal switch IGBT heat sink
15ST1
Yellow
Yellow
Thermal switch main transformer
Twisted-pair
1501 Red
1502 Yellow
1503 Red
1504 Yellow
Twisted-pair
1506
1508

DESCRIPTION OF OPERATION

This description of operation describes the function of circuit boards and other components in the equipment. It is divided into sections, numbered to correspond to the circuit board numbers and divisions into function blocks.

AP2 Interference suppressor board



Component positions and circuit diagram for circuit board AP2

The circuit board removes interference signals.

1 MMC unit

The MMC unit can either be fitted to the wire feed unit and/or the power source.

The MMC unit consists of an operator's control panel and a welding data board with a welding data unit. In some applications the welding data unit is a part of the power source control board, then there is no welding data board included in the MMC unit.

The power source, the wire feed unit and the welding data unit each have their own microprocessor for control, with the welding data unit being the central unit in the system. In addition to storing and issuing welding data, it also exercises overall control of the system as a whole.

MMC units for the Arc 4001i

A22 is a MMC unit without welding data board. The welding data unit is a part of the power source control board.

A24 is a MMC unit with welding data board.

MMC unit for the Mig 4001i

A24 is a MMC unit with welding data board.

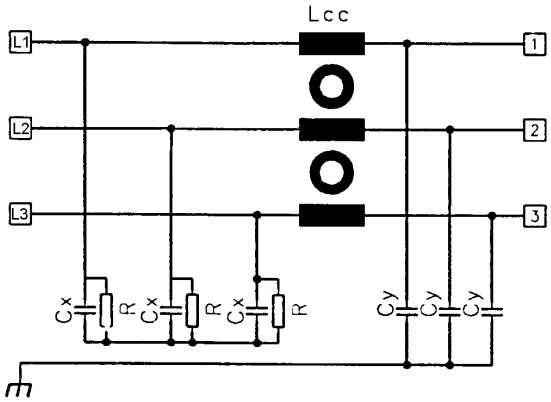
The Mig 4001i can also be delivered without MMC unit.

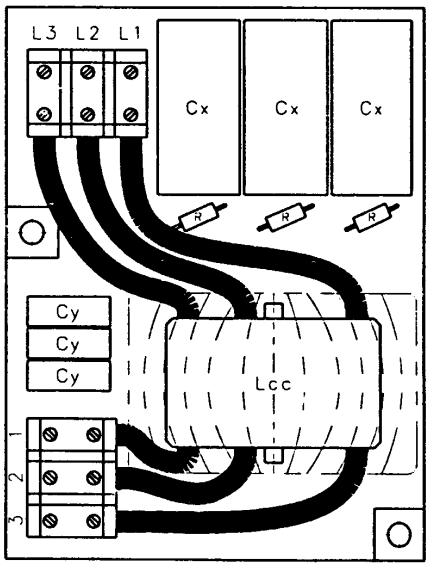
The MMC units are described in separate instruction and service manuals.

MMC unit A22

MMC unit A24

2AP1 Interference suppressor board (EMC board)



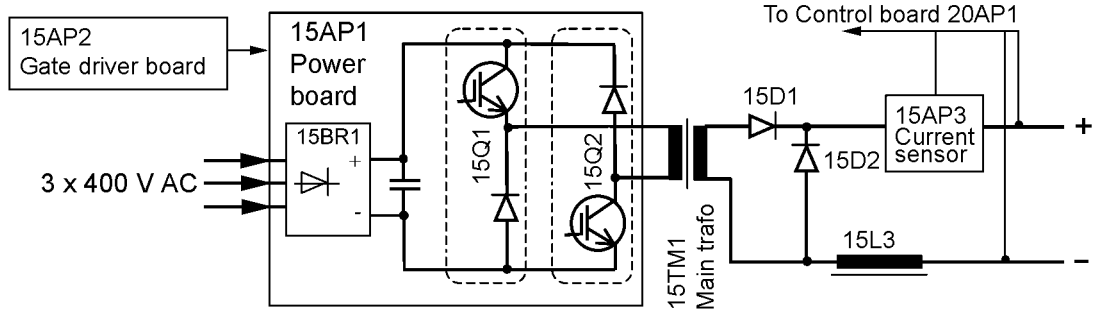


Circuit diagram and component positions, 2AP1

15 The power module

The power module converts 3-phase 400 V to the welding voltage. It consists of a single forward inverter, operating at a switching frequency of 27 kHz.

The mains rectifier bridge 15BR1, the IGBT transistors 15Q1 and 15Q2 and the diode modules 15D1 and 15D2 are all mounted on a heat sink. Circuit board 15AP1 links them together. It also carries a smaller circuit board, 15AP2, which provides the functions for the gate drivers and overvoltage and undervoltage protection.



Block diagram of the power module

If the IGBT transistors 15Q1 and 15Q2, or circuit boards 15AP1, 15AP2 or 20AP1, are replaced, the gate pulse waveforms must be checked afterwards and the machine must be soft-started. See page 50.

See the instructions on page 49 concerning mounting of the components on the heat sink (15Q1, 15Q2, 15BR1, 15D1 and 15D2).

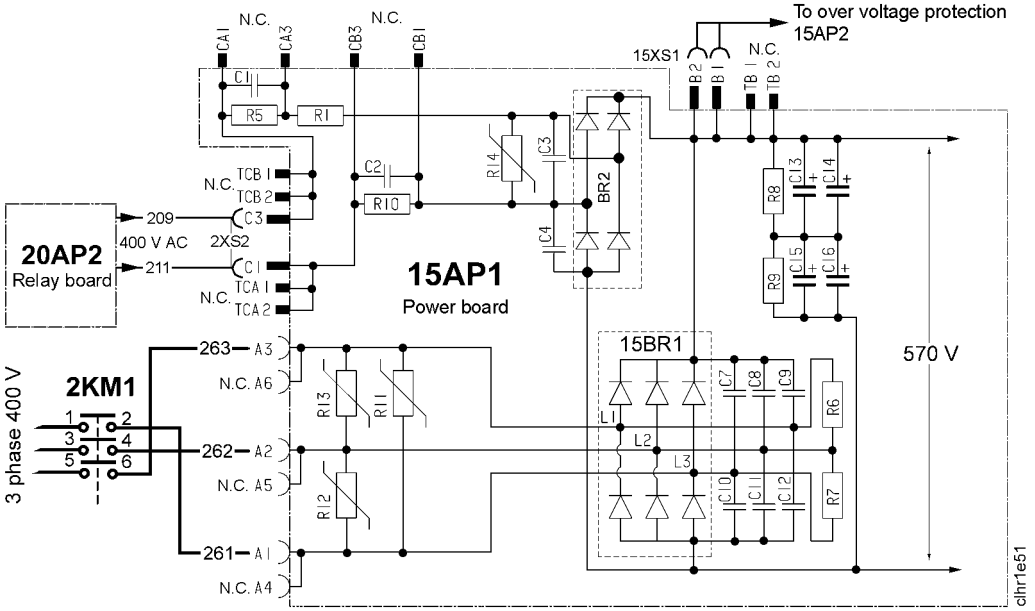
WARNING!
The power module is live at mains voltage.
0 V in the power module is connected to mains voltage.

15AP1 Power board

The power board carries the mains rectifier, the smoothing capacitors, the charging circuit and the switching circuit.

Circuit board connectors marked NC are not connected.

15AP1:1 Mains rectifier bridge and charging circuit

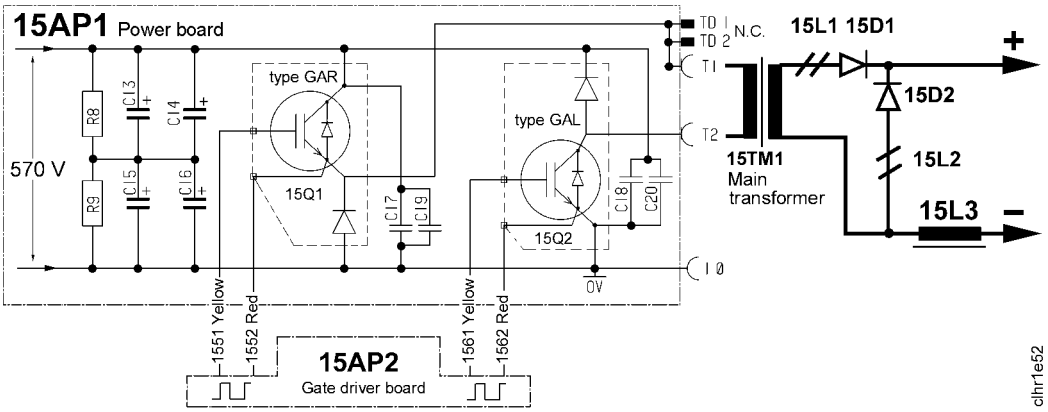


When the mains power supply is turned on, smoothing capacitors C13-C16 are charged via rectifier bridge BR2. Contactor 2KM1 closes after about twelve seconds and connects the mains supply to rectifier bridge 15BR1. See page 36 for a more detailed description of the starting sequence.

Component description:

BR2	Rectifier for charging current.
C1, C2	Capacitors, restricting the inrush charging current to rectifier bridge BR2. The current while capacitors C13 - C16 are charging is about 0.7 A.
C13 - C16	Smoothing capacitors, with a total capacitance of 1000 μF.
R5, R10	Discharging resistors for C1 and C2.
R1	Load-limiting resistor (10 Ω) for the charging current to C13 - C16.
R8, R9	Potential divider and discharge resistors for C13 - C16.
R11 - R13	Varistors. Limit voltage peaks that exceeds about 1000 V. The varistors do not conduct when the voltage is below 480 V AC RMS, this corresponds to a peak voltage of 680 V.
R14	Varistor.
15BR1	Main rectifier for mains voltage.

15AP1:2 Switching circuit



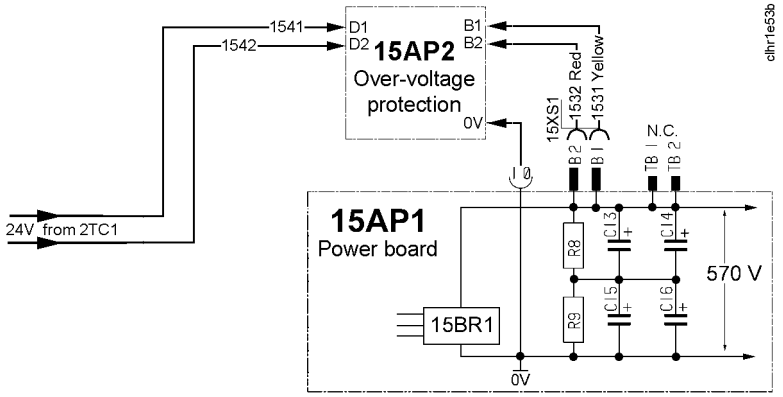
The power module switching components consist of IGBT transistors 15Q1 and 15Q2, operating at a switching frequency of 27 kHz. The transistors must never be energised when the gate connections are removed.

The gate pulse waveforms and duration are vital for correct operation. See also page 20.

If an IGBT transistor (15Q1, 15Q2) has failed, both transistors must be replaced. Failure of either transistor always subjects rectifier bridge 15BR1 to a high current surge, which substantially reduces its life. We therefore recommend that the rectifier bridge should also be replaced if the transistors have failed. See page 48 for instructions on checking the IGBT transistors.

Diode modules 15D1 and 15D2 each contain two diodes. Both they and the IGBT transistors must be mounted in accordance with the instructions on page 49.

15AP1:3 Overvoltage and undervoltage protection

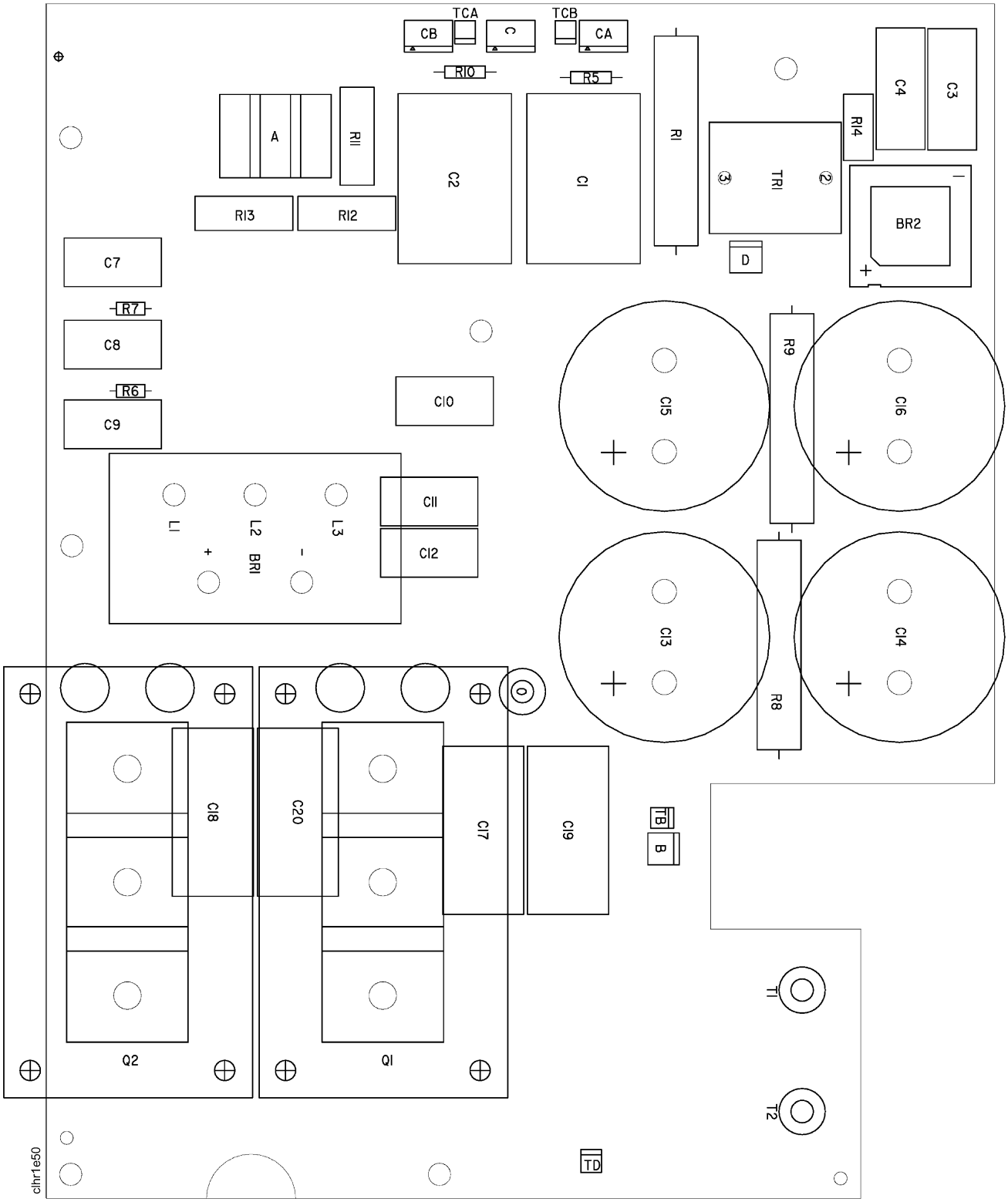


The voltage protection function monitors the voltage across smoothing capacitors C13-C16. See page 21 for a description of operation.

CAUTION!

*Do not mix up contacts **B** and **D** on circuit board 15AP2.*

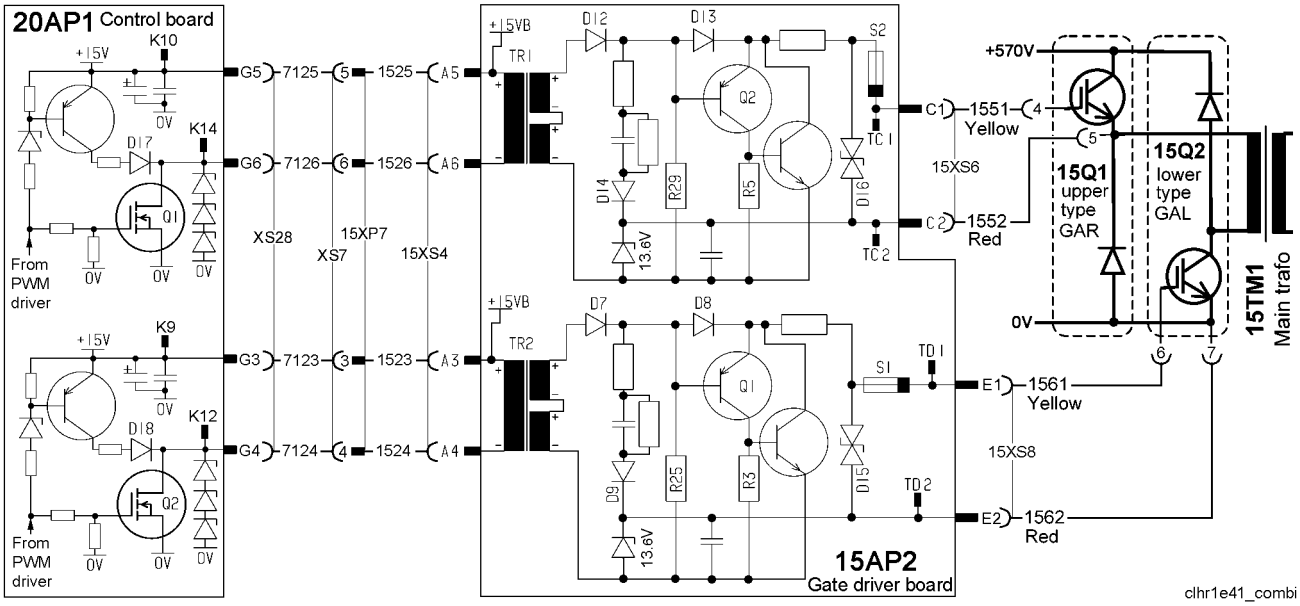
15AP1 Component positions



15AP2 Gate driver board

The gate driver board carries circuitry for gate driving and overvoltage and undervoltage protection.

15AP2:1 Gate driver stages



WARNING!

Dangerous voltage - mains voltage. Never measure the gate signals when the power source is connected to the mains supply.

The pulse frequency is 27 kHz, with a maximum pulse width of 39.0 - 40.8 % of the cycle width. See page 50 for screen traces of waveforms and measurement instructions.

Transformers TR1 and TR2 are gate driver transformers for galvanic isolation of the drive circuits from controller board 20AP1. Fuses S1 and S2 protect the gate driver circuit if the IGBT transistors fail.

Transistor module 15Q1 has a diode connected in series with its emitter: this transistor has the identification 'GAR' on its case. Transistor 15Q2 has a diode in series with its collector, and is identified by 'GAL' on its case.

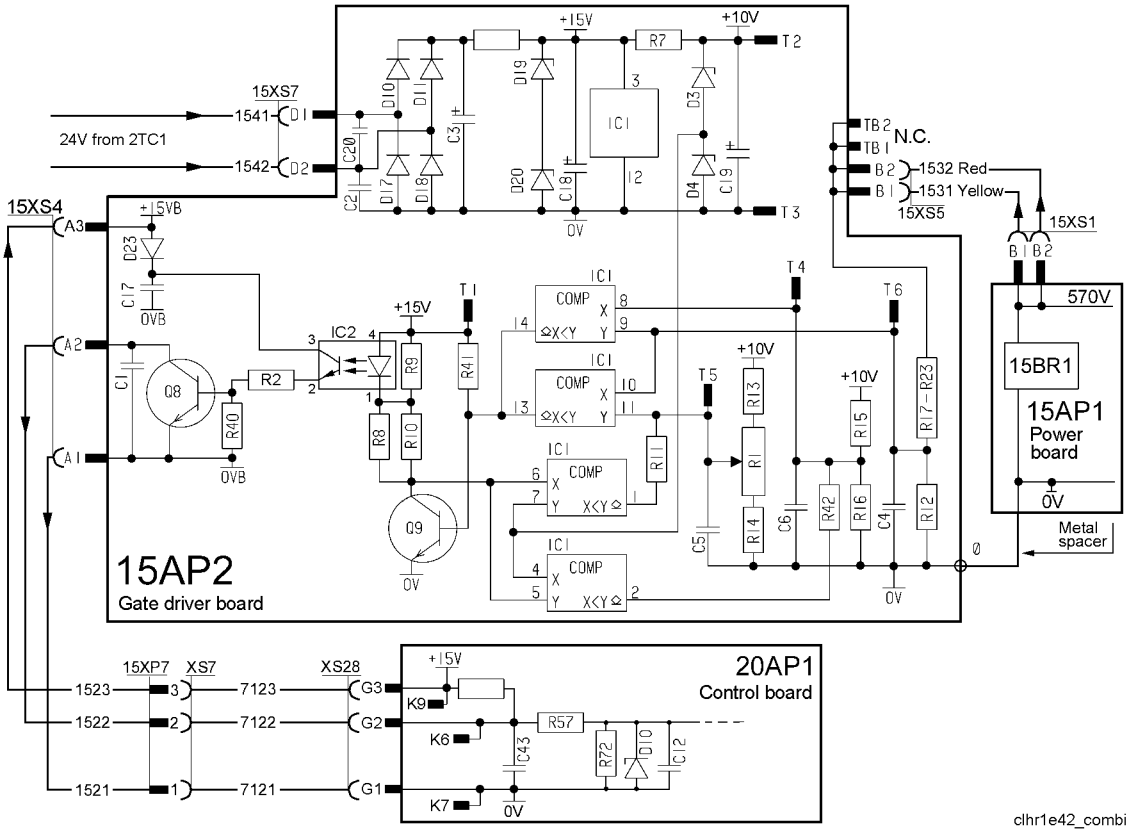
15AP2:2 Overvoltage and undervoltage protection

WARNING!
Dangerous voltage. Mains voltage on circuit boards 15AP1 and 15AP2 when connected to the 400 V supply.

0 V on power board 15AP1 and gate driver board 15AP2 is connected to the mains supply. 0 V on the power board and gate driver board is galvanically isolated from 0 V on controller board 20AP1.

The overvoltage and undervoltage protection generates a fault signal if the output voltage across rectifier bridge15BR1 falls outside the permitted interval of 330 - 680 V DC, which is equivalent to 235 - 495 V AC input voltage. The lower voltage limit is fixed, while the upper voltage limit can be adjusted by potentiometer R1. The neutrals (0V) on the power board and the gate driver board are connected to each other by a metal spacer screw.

During normal operating conditions, the voltage across pins A1 and A2 on circuit board 15AP2 is about 0.1 V. Optocoupler IC2 is used for galvanic isolation of the voltage monitoring circuit from control board 20AP1.



Circuit diagram for over- and undervoltage protection

A break in any of the conductors to/from 15AP2, as shown in the diagram above, will result in a fault state.

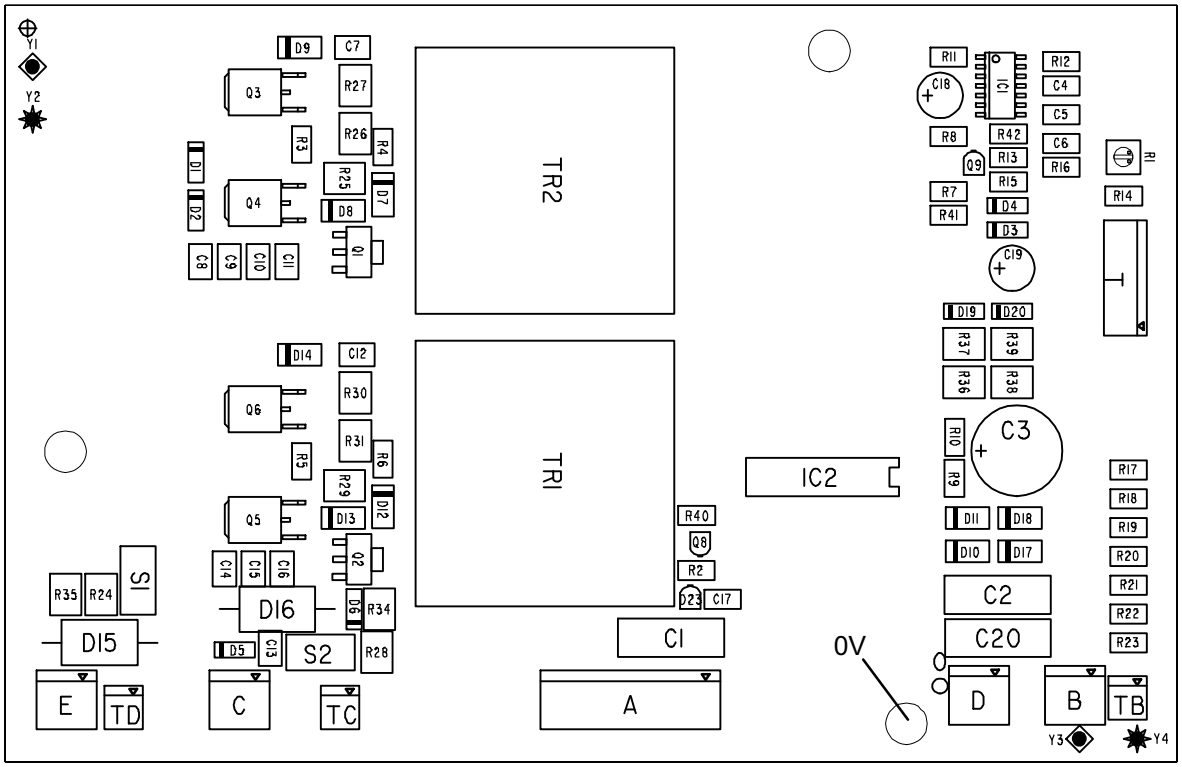
In the event of a fault, the charging relay RE2 and the contactor 2KM1 will open, as described in the starting sequence on page 36. Fault code 5 will be displayed by the control panel.

See page 54 for instructios on how to check the voltage levels.

15AP2 Component positions

WARNING!

0 V on this circuit board is at mains voltage.



20AP1 Control board

The processor on the control board monitors and controls the various functions of the power source. It obtains information on welding data and welding processes from the welding data unit.

Depending on the type of control panel, the power source control board is set up for combi mode or power source mode.
In combi mode the board handles the control of the power source, the welding data unit and the MMC panel.
In power source mode it handles the control of the power source. The MMC panel and welding data unit is controlled by a board fitted in the MMC panel.

There are two hardware versions of the control board, for identification see page 31.

Spare part boards

There are two boards, one for power source mode and one for combi mode.

When replacing the board, do not forget to move the “terminal D jumper” and the “Y2-Y3 jumper” to the new board. See pages 27 and 29.

CAUTION!
This circuit board looks identical to the control board used in other power sources, but there are differences both in hardware and software. If wrong board is used, it might cause serious damage to the power source. Make sure that the replacement board has correct article number, see the spare parts list.

Circuit board identity

Arc 4001i and Mig 4001i, power source unit

The control board has a machine ID, a hardware ID and a unit type number. To read this you need the **ESAT** service kit, see page 46.

- The machine ID defines which type of power source the board is intended for.
- The hardware ID shows design and type of circuit board.
- The unit type is used for identification on the CAN bus.

The ID numbers of the Arc 4001i and Mig 4001i are:

Machine ID = 43
Hardware ID = 5 valid for version 1 of 20AP1.
Hardware ID = 9 valid for version 2 of 20AP1.
Unit type = 2

Arc 4001i A22, welding data unit and MMC

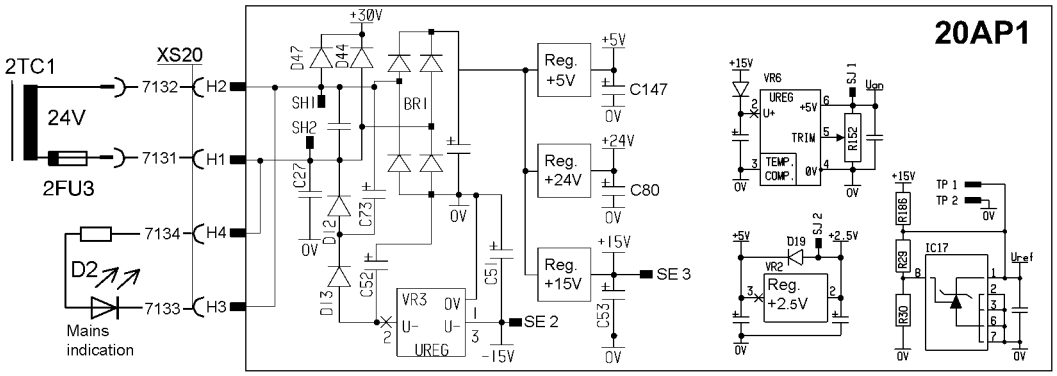
The ID numbers above refers to the power source control and are valid for power sources both in combi mode and power source mode. For the Arc 4001i with MMC unit A22 there are additional ID numbers:

- The machine ID for the MMC part of the board determines which type of control panel that is used. The machine ID can be changed by ESAT.

The ID numbers of the MMC unit are:

Machine ID = 38
Hardware ID = 5 valid for version 1 of 20AP1.
Hardware ID = 9 valid for version 2 of 20AP1.
Unit type = 0

20AP1:1 Power supply



+24 V Power supply to relay board 20AP2.

+15 V Internal power supply on 20AP1 and power supply to the pulse transformers on 15AP2.

-15 V Internal power supply on 20AP1.

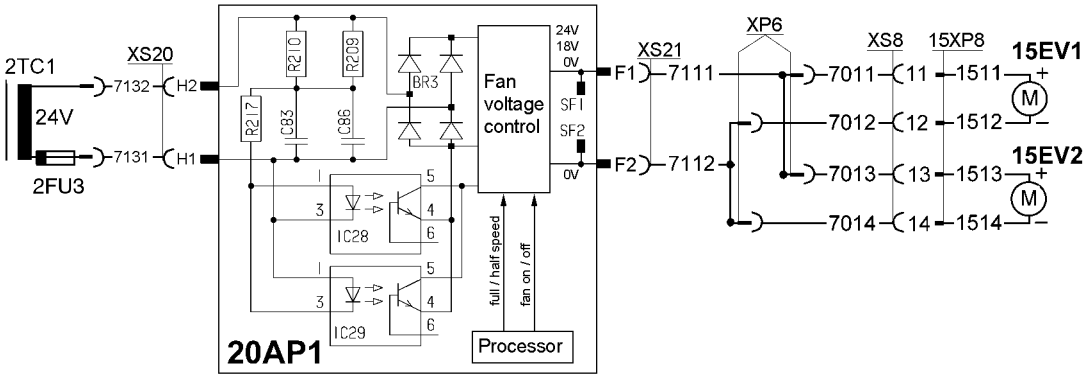
+5 V Internal power supply on 20AP1.

+2.5 V Internal power supply on 20AP1.

Uan 5 V internal reference voltage on 20AP1.

Uref 2.5 V internal reference voltage on 20AP1.

20AP1:2 Fan control



When the mains power supply is turned on, the fans are off. After about 4 seconds they start and run at full speed, for a short moment, before shutting down until welding starts.

The fan speed depends on the welding current. For loads up to 146 A, the fans run at low speed, supplied at about 18 V. At load currents above 146 A, the fans are supplied at 24 V and run at full speed. On conclusion of welding, the fans continue to run for 6.5 minutes.

If the welding current is above 146 A and then is recuced to a lower value, the fans continue to run at full speed for 6.5 minutes, before dropping to the lower speed.

If overtemperature is detected, the fans run at high speed until the power source has cooled down to normal temperature.

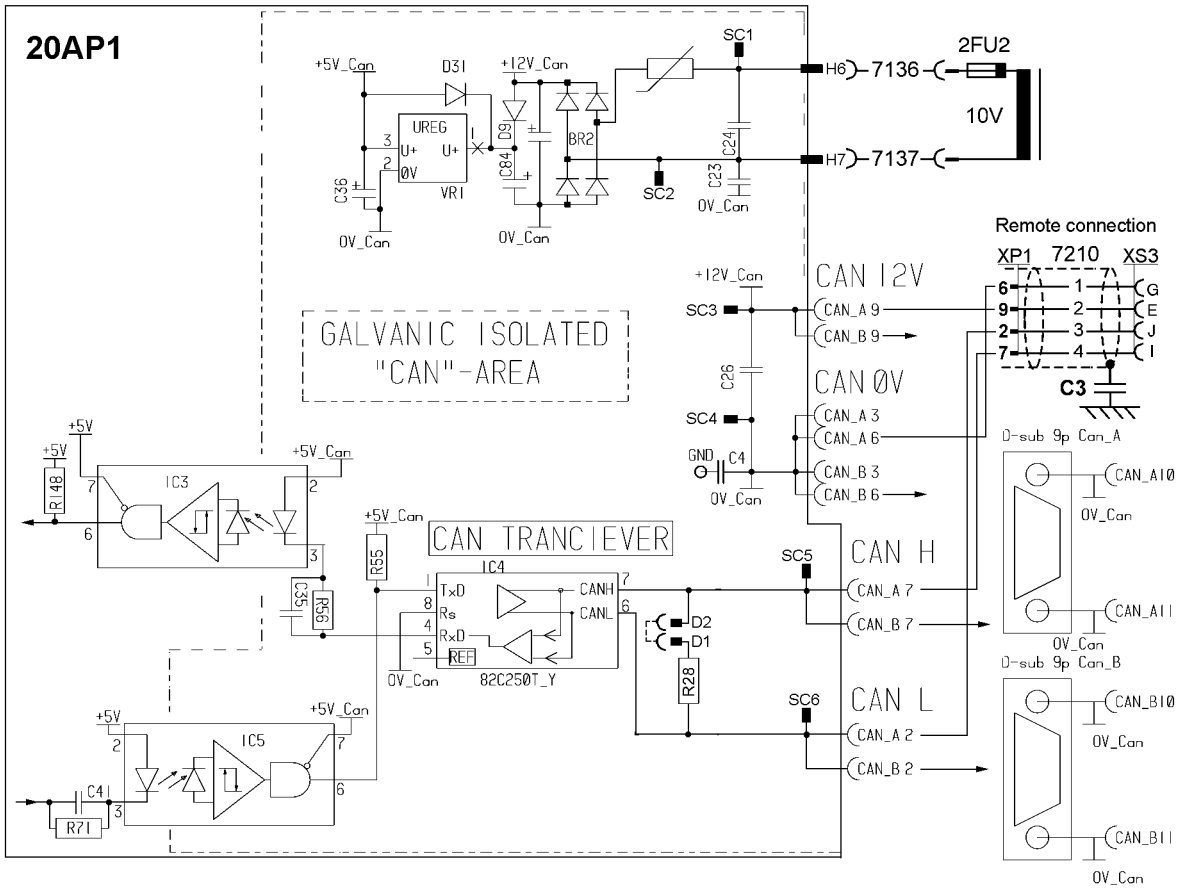
20AP1:3 The CAN bus

A standardised communication (CAN - **C**ontroller **A**rea **N**etwork) bus is used for communication between the welding equipment units. Communication speed is 400 kbit/s.

The CAN bus is connected in parallel to the connectors CAN_A and CAN_B. The +12V_Can and 0V_Can power supply is unregulated and is galvanically isolated from other parts of the control board.

The shell of the CAN-connectors is connected to 0V_Can. GND in the diagram below is connected to the power source chassis.

Voltage regulator VR1 supplies a 5 V power supply to the CAN circuits on 20AP1.

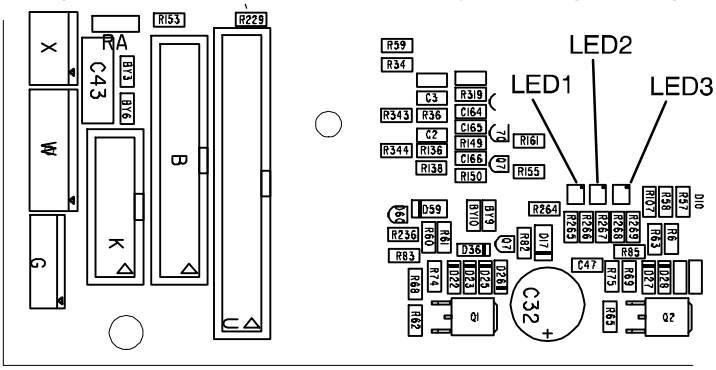


Bus communication circuits to and from the control board

Starting sequence

On power-up, the board's CAN controller reads in the bus speed from the micro processor: 400 kbit/s.

The circuit board displays the starting sequence from power-up.
LED1 lights red. Then LED1, LED2 and LED3 lights green.
When the board has been initiated, and the power source is in the application program, LED1 flashes continously with a green light.



LEDs on circuit board 20AP1

Communication interruptions

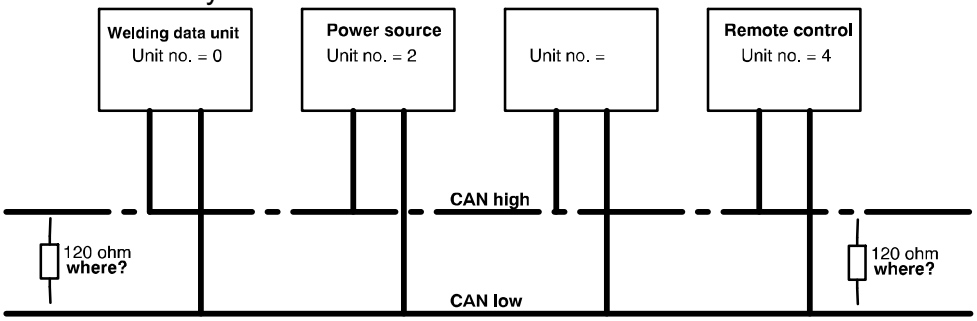
If the CAN bus fails, the control panel will normally generate a fault message.

Check the following points in the event of problems with CAN communications:

- The terminating resistor. The CAN bus resistance must lie in the range 50-130 ohm the optimum value is 60 ohm. To check the resistance, turn off the power source and measure the resistance between pins I and J in connector socket XS3 on the front of the power source.
- The connection cable between units. Check that the correct type of cable is being used. Check that each signal is being carried by the correct core. CAN H and CAN L must be carried by the twisted pair.
- All screen connections must be sound.
- Good contact with the chassis connections from/to the control board, suppressor board and suppressor capacitors. See the main circuit diagram.

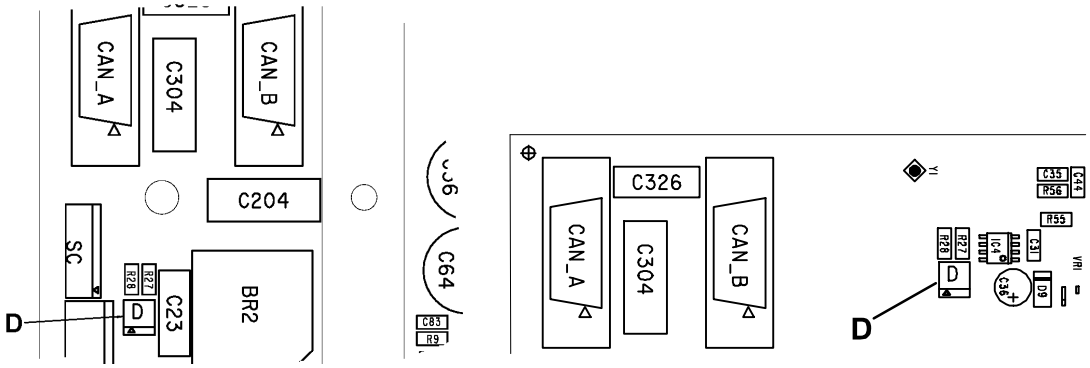
Terminating resistors

In order to avoid communication interference, the ends of the CAN bus must be terminated by resistive loads.



Principle diagram of the CAN bus and connecting up of the terminating resistors

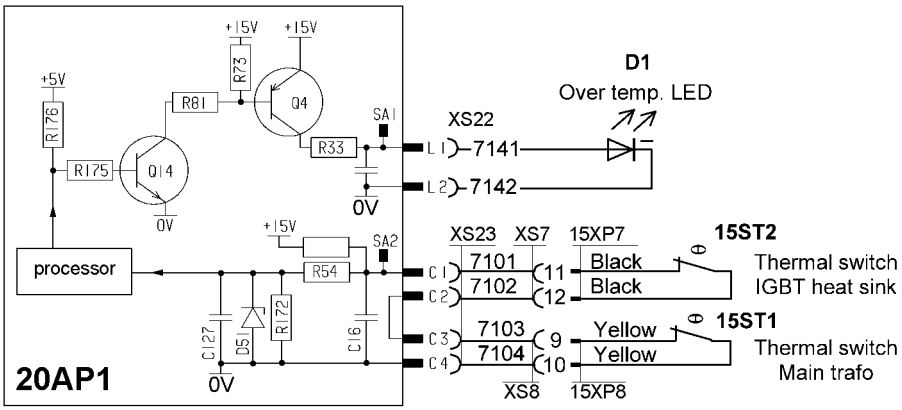
One end of the CAN bus is in the power source and it must be fitted with a terminating resistor, R28 in the circuit diagram on page 25. The terminating resistor can be disconnected by removing the jumper from terminal D.



Terminal D, version 2 of 20AP1 *Terminal D, version 1 of 20AP1*

See page 59 for examples on how to connect the terminating resistors in different equipment configurations.

20AP1:4 Temperature monitoring



Principle diagram of the temperature monitoring circuits

Thermal cutout switch 15ST1 is fitted under the winding of main transformer 15TM1, and opens at a temperature of 130°C.

Thermal cutout switch 15ST2 is mounted on the heat sink, beside the IGBT transistors, and opens at a temperature of 80°C. See page 49 for fitting instructions.

If either of the switches operates, the power source is stopped and fault code 6 is displayed. The power source cannot be restarted until it has cooled sufficiently for the switch(es) to reclose.

20AP1:5 Overvoltage and undervoltage protection

See 15AP2:2 on page 21.

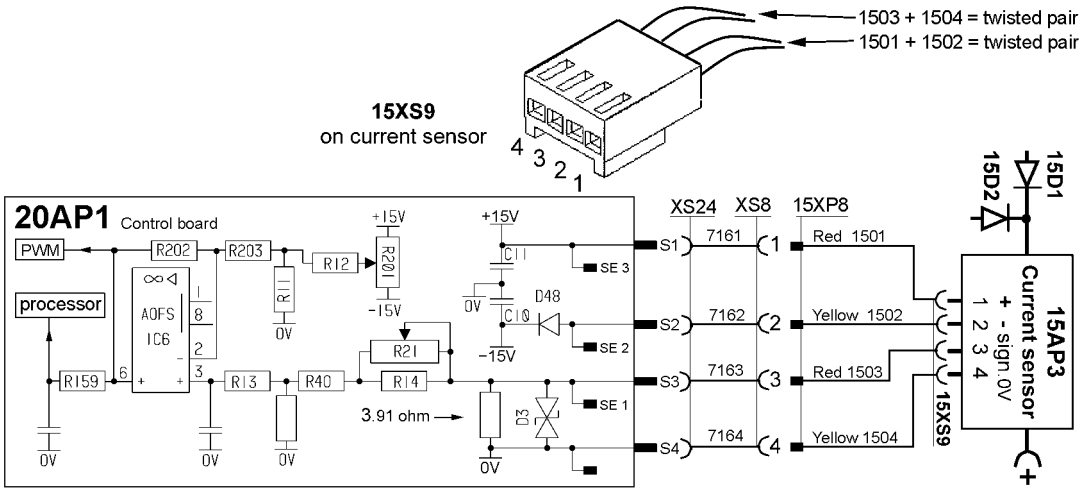
20AP1:6 Communication with relay board 20AP2

See page 35, 20AP2 relay board.

20AP1:7 Gate pulses

See page 20, 15AP2:1 gate driver stage.

20AP1:8 Current sensor



The current signal supplied to contact S3 on circuit board 20AP1 is 200 mA at 400 A, and is linearly proportional to the current. Measuring the voltage between contacts S3 and S4 on circuit board 20AP1 must show 0.195 V at 100 A welding current. (U = R x I ⇒ 3.91 x 0.05 = 0.195)

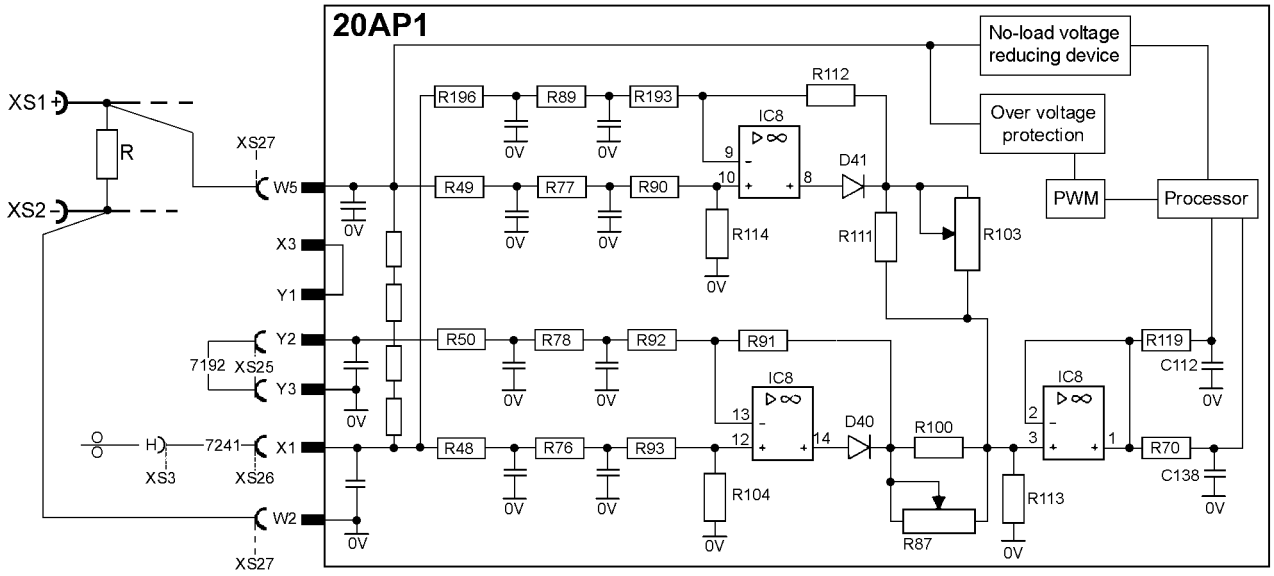
If circuit boards 20AP1 or 15AP3 are replaced, the power source must be recalibrated. See page 55 for calibration instructions.

Offset potentiometer R201 is not mounted on circuit board 20AP1. The offset adjustment is carried out by fixed resistors.

On no load, there must be a voltage of 0 V ±2 mV at input S3 of circuit board 20AP1. If the current sensor gives an incorrect value on no load, it must be replaced.

Note! *The sensor must be connected to 20AP1 when making the measurement.*

20AP1:9 Arc voltage feedback



Circuit diagram of the arc voltage input

The arc voltage input senses the welding voltage regardless of the welding polarity or welding method. If sensing via the welding filler wire is connected, it is this voltage that will be used: if not, the voltage at the power source's terminals is used.

The signal from the arc voltage input is used as an input signal to the welding process controller: from it, the controller calculates in real time how much current must flow in the circuit in the next instant. The controller activates/deactivates the no-load voltage reduction function.

The arc voltage signal provides a voltage signal to the display panel. See pages 56 to 58 for calibrating instructions.

Methods of measuring the arc voltage

Various methods of measurement are available. The jumper between contacts Y2 and Y3 must always be connected.

- **Welding with the filler wire positive: voltage sensing from the wire**. This is the most common arrangement for MIG welding.

  This method of measurement compensates for the voltage drop in the supply conductor (= to the welding torch). The input signal is measured between inputs X1 and W2. Amplifier IC8:14 is active.
- **Welding with the filler wire negative: voltage sensing from the wire**

  This method of measurement compensates for the voltage drop in the supply conductor. The input signal is measured between inputs X1 and W5. Amplifier IC8:8 is active.
- **Welding with the filler wire positive or negative, without external sensing from the wire or workpiece.**

  The input signal is measured between inputs W5 and W2 (= the voltage at the power source terminals), as there is no connection to X1. Amplifier IC8:14 is active.

Open-circuit voltage control

The open-circuit voltage control is **active** when:

- there is an open welding circuit and no arc.

The open-circuit voltage control is **inactive** when:

- the HF ignition is activated during TIG welding with HF.
- there is contact between electrode and workpiece.
- there is an arc.

Version 1 of 20AP1:
The open-circuit voltage control holds the voltage at about 70 V in MIG mode and at about 90 V in MMA and TIG mode.

Version 2 of 20AP1
High level control:
The mean value of the open-circuit voltage is 58 V (55 - 59 V).

Low level control:
The open-circuit voltage is < 35 V (25 - 30 V). The low level control can only be activated or deactivated by the ESAT, see page 46. The low level control is also named the VRD function, **V**oltage-**R**educing **D**evice.

Monitoring:
The processor monitors the open-circuit voltage (OCV). If the mean value of the OCV exceeds the actual limit for more than 0.3 seconds after conclusion of welding, the output voltage is turned off and the display shows fault code 16.

- OCV limits before software version 1.15: 60 V respectively 30 V.
- OCV limits from software version 1.15: 62 V respectively 32 V.

All welding methodes, all versions of 20AP1
If the welding arc extinguishes the open circuit voltage is about 140 V, peak voltage. Within 0.3 seconds the open-circuit voltage is at a level controlled by the open-circuit voltage control or at a lower level.

Note! *Spare part boards are delivered with the VRD function deactivated.*

See page 31 for identification of circuit board versions.

No-load overvoltage protection

This disables the PWM circuit if the no-load voltage exceeds 113 V for more than one second. The power source cannot then be restarted until the mains switch has been turned off and then on again. The display shows fault code 16 if this protection operates.

This overvoltage protection function operates independently of the welding process controller.

MIG welding mode

1. The torch switch is depressed.
2. The power source generates open-circuit voltage.
3. Welding starts, the open-circuit voltage control is inactive.
4. Welding stops, the open-circuit voltage control is activated and then the output voltage is shut down.

MMA welding mode

1. The power source generates open-circuit voltage.
2. Contact between electrode and workpiece. When the open-circuit voltage goes below 45 V (16 V when VRD is active), the open-circuit voltage control is disabled.

3. When the current exceeds 8 A the hot start current is activated.
4. When the arc voltage exceeds 52 V, welding stops and the open-circuit voltage control is activated.

TIG welding mode

Live TIG start

1. The power source generates open-circuit voltage.
2. When there is contact between electrode and workpiece. The power source produces a current of about 24 A.
3. When the electrode is lifted from the workpiece.
   The arc strikes, the open-circuit voltage control is deactivated and the current increases to 30 A.
4. When the arc voltage exceeds 8 V, the current increases / decreases to the set current.
5. If the arc voltage is above 45 V for more than 100 milliseconds the open-circuit voltage control is activated.

20AP1:10 Control panel interface circuits

These circuits are only used by the Arc 4001i with control panel A22. See the service manual for the A22 control panel.

20AP1 Circuit board versions

There are two hardware versions of the control board. See 'Open-circuit voltage control' on page 30 for description of the difference in function between the two versions.

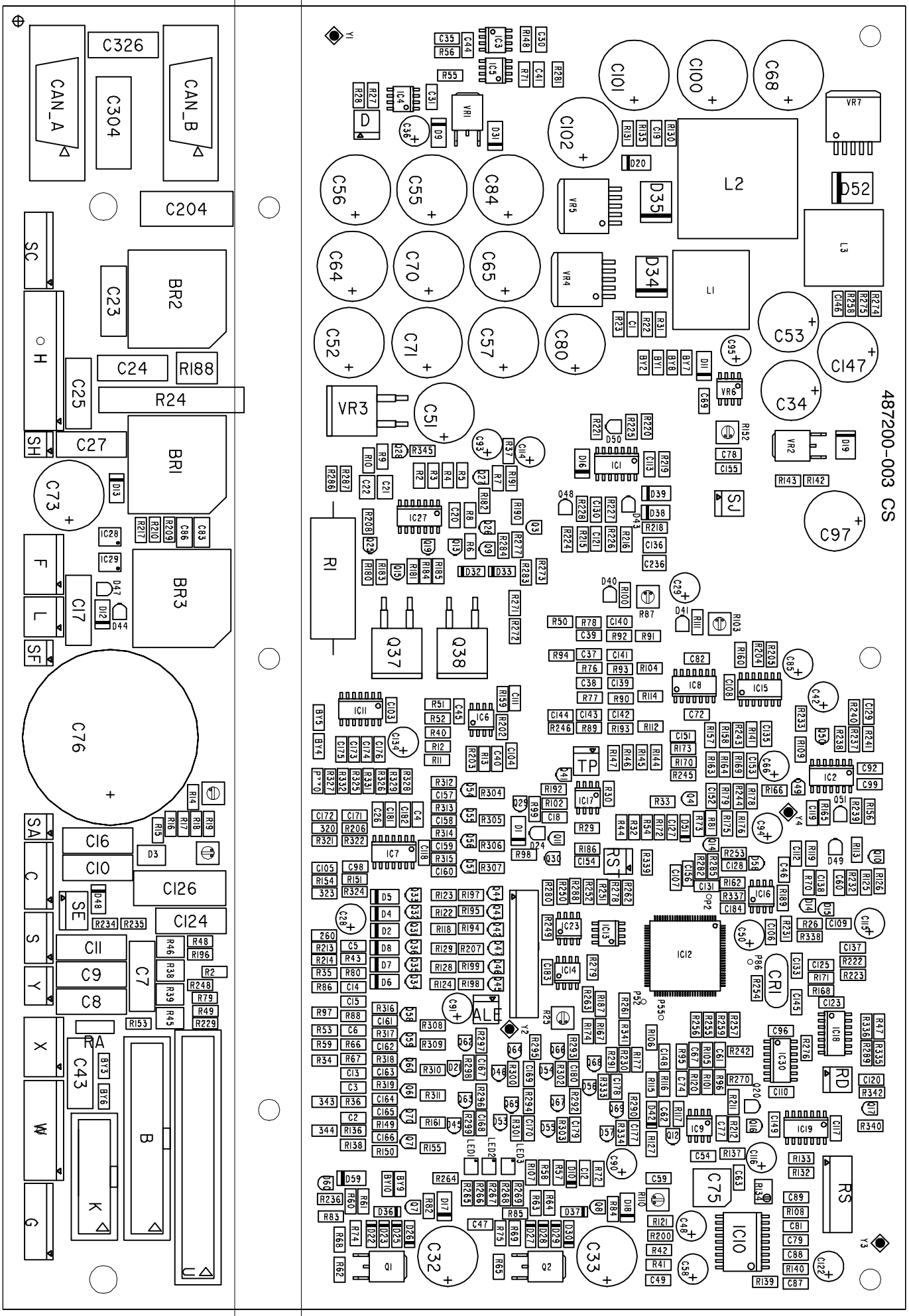
The hardware ID and/or the print number of the circuit board is used to identify the hardware version of the board.
To read the hardware ID you need the **ESAT** service kit, see page 46.
The print number is to the right in the component positions diagrams on pages 32 and 33. (The print number is **NOT** the same as the ordering number of the board.)

Version 1 of 20AP1:
Hardware ID 5. Print numbers up to and including 487200-003.
Power sources with serial no. 833-xxx-xxxx are delivered with version 1 of 20AP1.

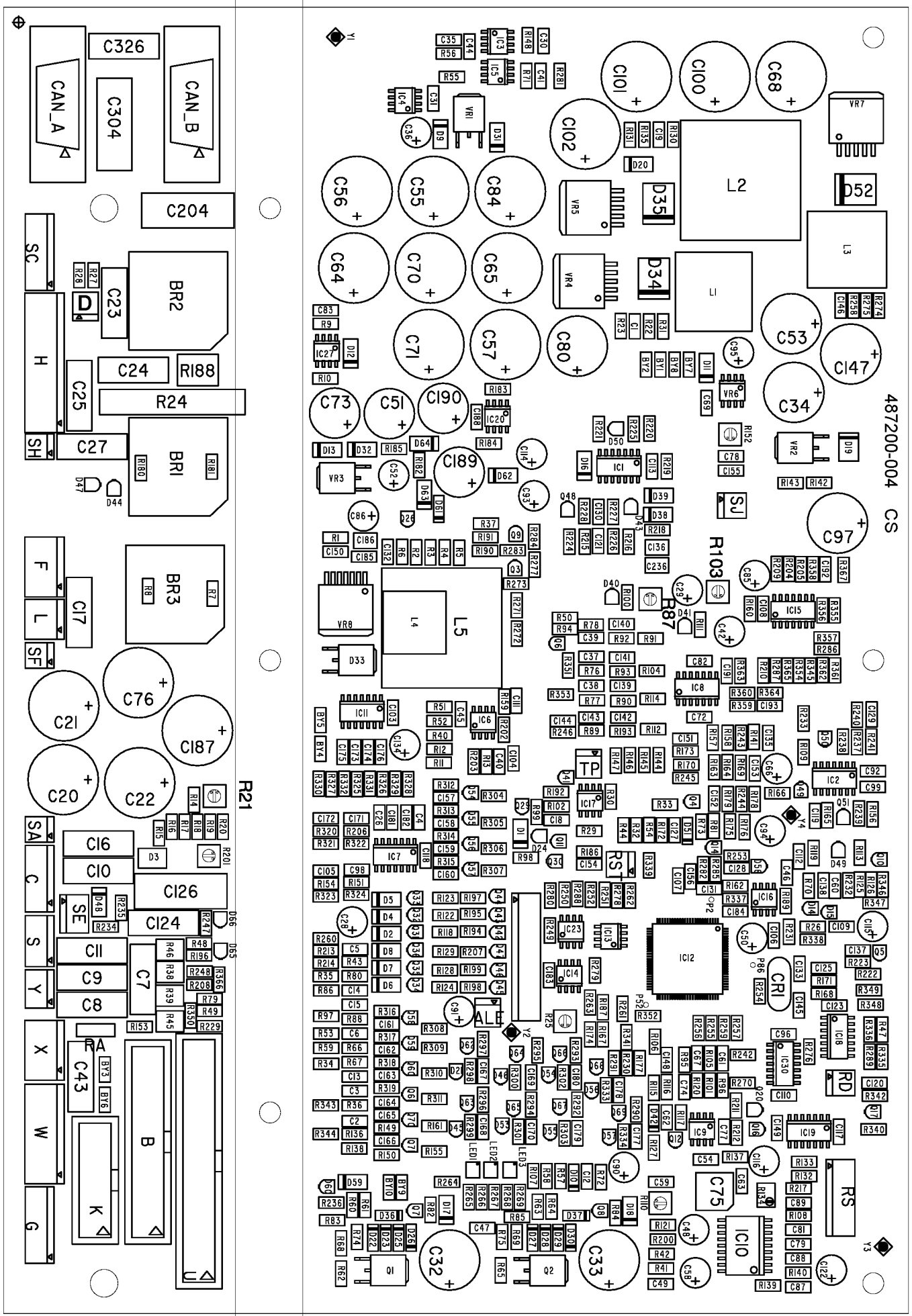
Version 2 of 20AP1:
Hardware ID 9. Print numbers from 487200-004 and there above.
Power sources with serial no. 852-xxx-xxxx and there above are delivered with version 2 of 20AP1.

Spare parts:
Version 2 of 20AP1 is delivered as spare part to all power sources.

20AP1 Component positions, version 1



20AP1 Component positions, version 2

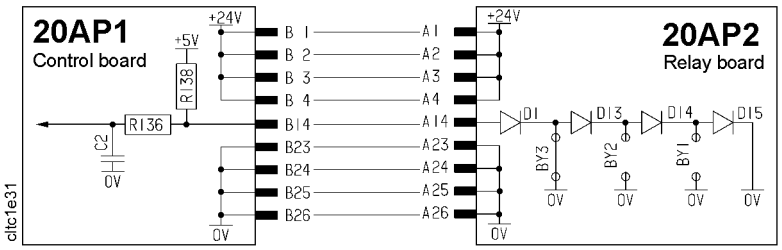


emptypage

20AP2 Relay board

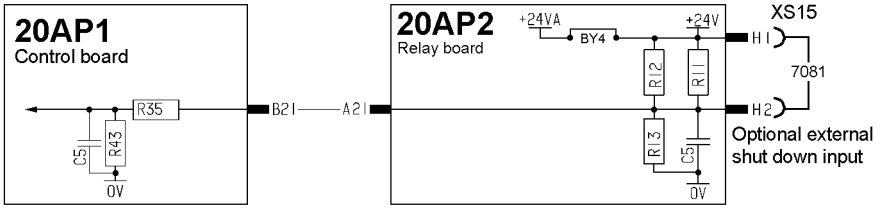
The relay board handles hardware-connected inputs and outputs to/from control board 20AP2. The relays provide the necessary galvanic insulation. In the event of a relay fault, the entire board must be replaced.

20AP2:1 Power supply



The relay board is supplied at +24 V from control circuit board 20AP1. Link BY3 tells the processor on the control board what version of the relay board is in use.

20AP2:2 External shutdown

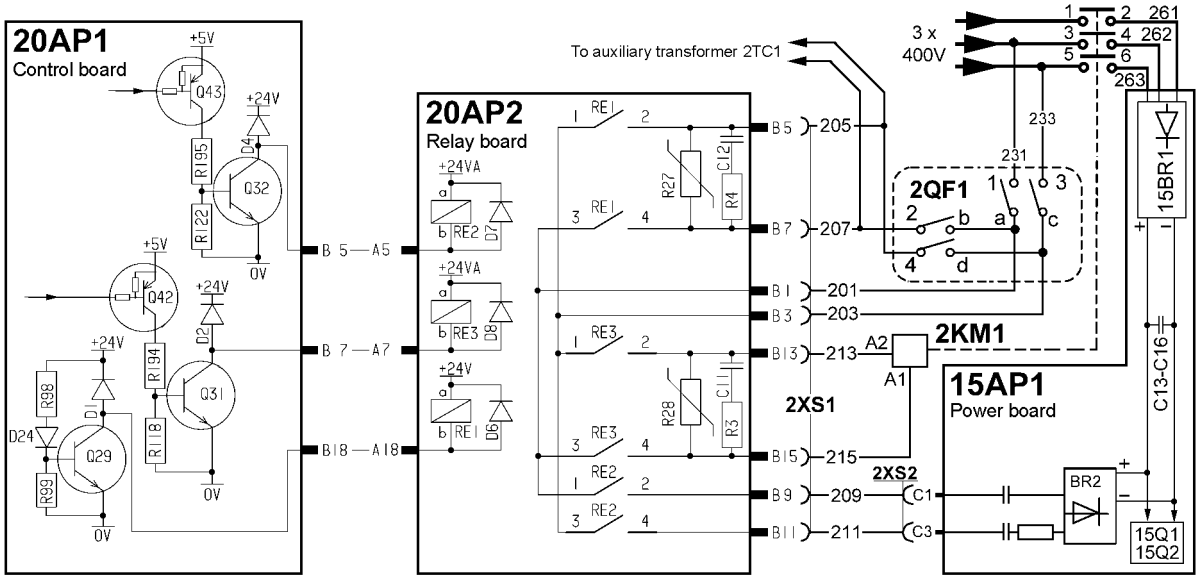


Contacts H1 and H2 must be linked if the power source is to work. If there is no link, the processor and PWM circuit on the control board are disabled.

The H1 - H2 inputs are used in connection with mechanised welding to provide On/Off control of the welding power source.

See also the circuit diagram on page 40.

20AP2:3 Starting sequence



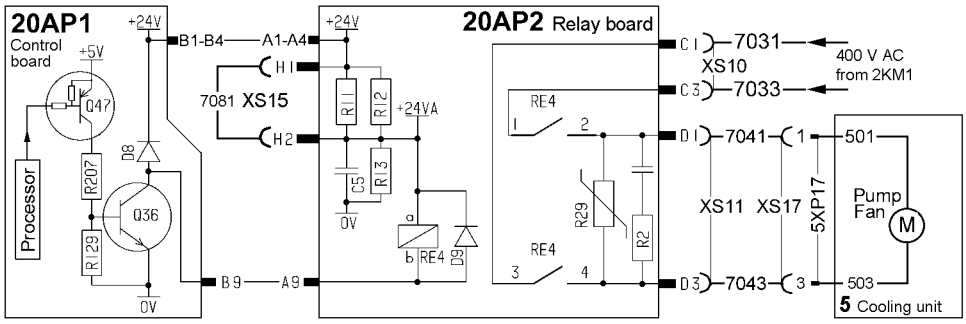
Schematic diagram of the power source starting circuits

Starting sequence:

1. Turning main switch 2QF1 from 0 to 1 closes contacts a-1 and c-3, this energises the relay contacts on RE1 - RE3.
2. Turning 2QF1 to the START position closes contacts 2-b and 4-d.
3. The control board is energised from the control current transformer.
4. Relay RE1 is energised by transistor Q29.
5. The control power transformer is supplied via contacts 1-2 and 3-4 on relay RE1. The relay is held in via the control circuit board.
6. When released from the START position, the main switch returns to Position 1.
7. The software in the MMC module is initiated for about nine seconds.
8. Relay RE2 is activated by transistor Q32.
9. RE2 connects 400 V AC to rectifier bridge BR2 on circuit board 15AP1.
10. After about three seconds, the voltage across smoothing capacitors C13 - C16 is about 440 V.
11. The overvoltage and undervoltage protection senses whether the voltage across capacitors C13 - C16 is within the tolerance range of 330 - 680 V.
12. If the voltage is within the tolerance range, relay RE3 is activated by transistor Q31.

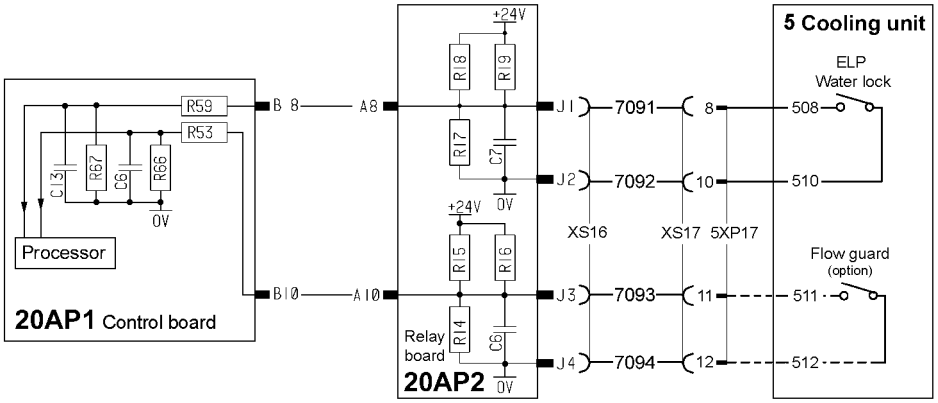
    If the voltage is outside the tolerance range, the starting sequence is interrupted at this point. Contactor 2KM1 does not close, and relay RE2 drops off. Machines having an MMC-panel with dispay show fault code 5.
13. RE3 energises main contactor 2KM1, which closes and connects 3-phase 400 V to main rectifier 15BR1.

20AP2:4 Power supply to the cooling unit



The cooling water pump is controlled by the software in the welding data unit via circuit board 20AP1.

20AP2:5 Cooling water monitoring in MIG welding mode



The ELP switch in the water lock connector closes when a cooling water hose is connected to the blue water connector on the front of the cooling unit. The pump stops if the switch opens. (ELP stands for ESAB Logic Pump.)

Starting the welding equipment

1. The welding data unit senses whether the ELP switch is closed.
2. If the ELP switch is closed, the welding data unit generates a command to start the pump. If water flow is not detected within 15 seconds, the pump is stopped.
3. If welding does not start within 6.5 minutes, the pump is stopped.

If the water flow stops when the pump is started, the display shows fault code 29.

The pump is stopped if the ELP switch opens.

Welding start

1. The welder presses the trigger switch on the welding torch.
2. The water pump starts if the ELP switch is closed.
3. If water flow is achieved within three seconds, welding starts.

If water flow is not detected within three seconds, the pump is stopped.

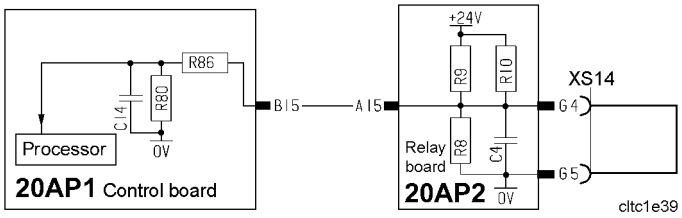
If the water flow stops during welding, welding will be interrupted and the display shows fault code 29.

Welding stop

1. The welder releases the welding torch trigger switch.
2. Welding stops.
3. The water pump continues to run for a further 6.5 minutes.

If welding is restarted while the pump is still running, the pump will continue to run as required, i.e. the 6.5 minute shutdown countdown is interrupted.

20AP2:9 Gas pressure monitoring



Terminals G4 and G5 are intended for use with a gas pressure sensor monitor. The processor reacts to voltage flanks from the input.
The power sources are not normally fitted with gas pressure monitors, which means that this input must be short-circuited by a jumper. If the jumper is open, fault code 32 is displayed.

MMA power sources

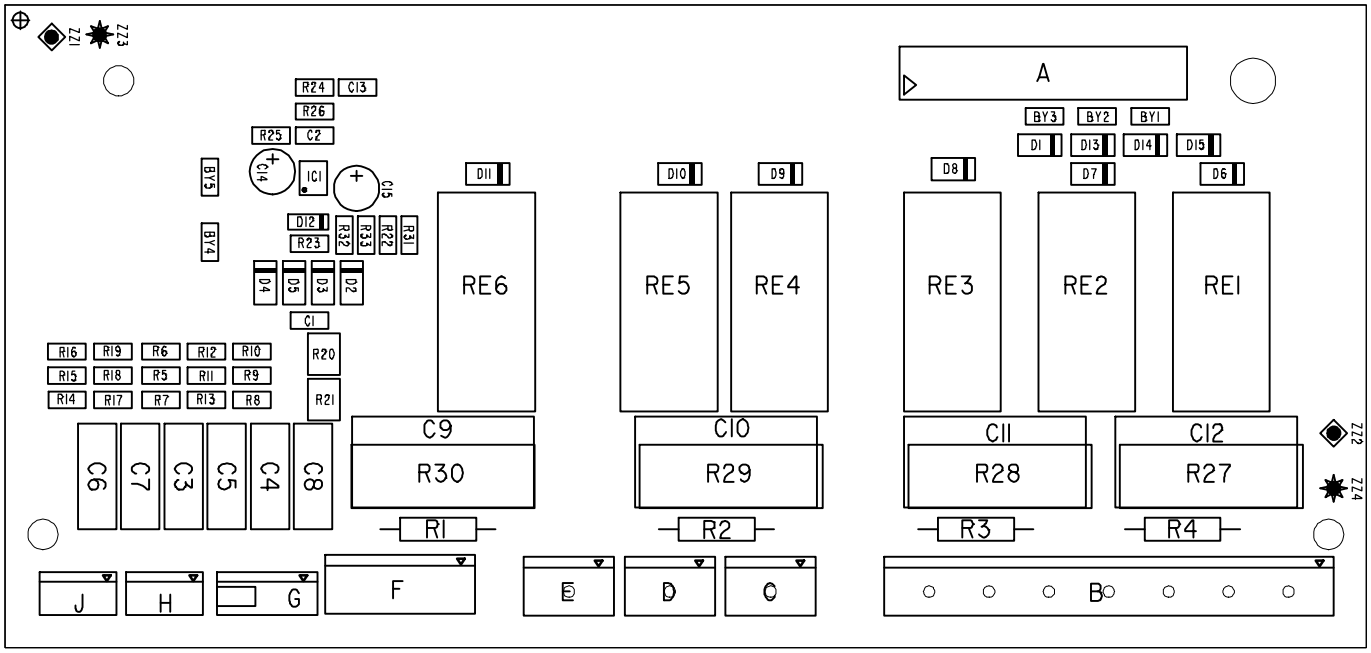
Terminals G4, G5 and resistors R8 - R10 are not mounted on the board that is delivered with the power source.

Spare part circuit boards are delivered with all components fitted. Terminals G4 and G5 are intended for use with a gas pressure monitor. MMA power sources are not fitted with gas pressure monitors, which means that G4 - G5 must be short-circuited by a jumper. If the jumper is open, fault code 32 is displayed.

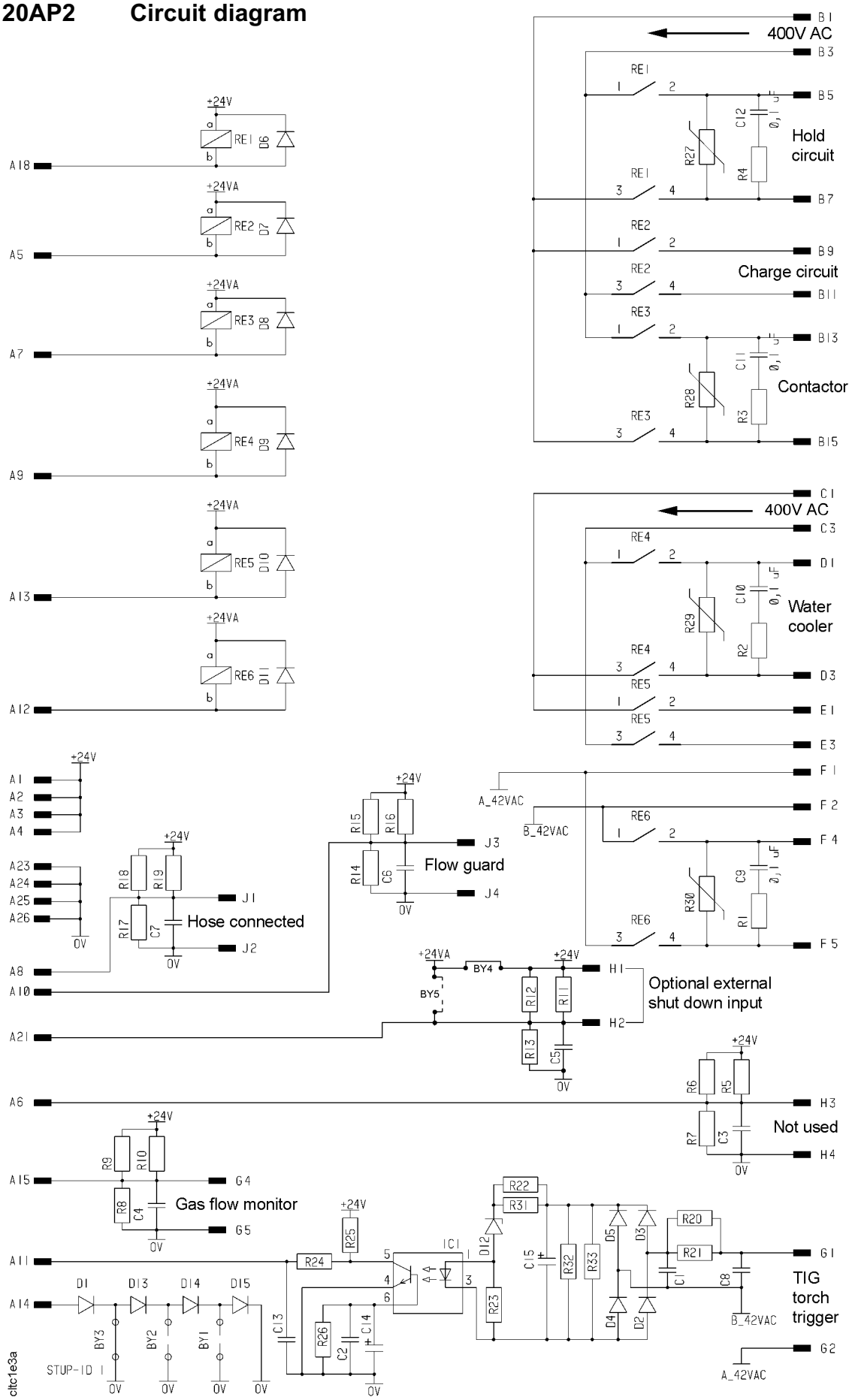
20AP2 Component positions

The circuit diagram and component positions shows all the components with which the board may be fitted: the exact choice of components varies, depending on in which machine the board is used.

Spare part circuit boards are delivered with all components fitted.



20AP2 Circuit diagram



REMOTE CONTROLS

A number of remote control units can be connected to the power sources, these are described in a separate service manual.

FAULT CODES

Fault codes are used in order to indicate and identify a fault in the equipment.

Fault log

All faults that occur when using the welding equipment are documented as error messages in the fault log. When the fault log is full, the oldest message will automatically erase when the next fault occurs.

Only the most recent fault message is displayed on the control panel. To read the entire fault log, the power source must be connected to the ESAT: see service tools on page 46.

Faults are monitored/detected in two ways: by test routines that are run on initiation and by functions that can detect a fault when it occurs.

The control panel displays a unit number to indicate which unit has generated the fault. The following unit numbers are used:

U0 = welding data unit **U2** = power source
U3 = wire feed unit **U4** = remote control unit

Summary of fault codes

Fault code	Description	Welding data unit	Power source	Wire feed unit	Remote control unit
1	Memory error, EPROM	x	x	x	x
2	Memory error, RAM	x	x	x	
3	Memory error, external RAM	x	x		
4	+5 V power supply	x	x		
5	Intermediate DC voltage outside limits		x		
6	High temperature		x		
8	Power supply 1	x	x	x	x
9	Power supply 2		x	x	x
10	Power supply 3		x		
11	Wire feed speed			x	
12	Communication error (warning)	x	x	x	x
14	Communication error (bus off)	x			
15	Lost messages	x	x		x
16	High open-circuit voltage		x		
17	Lost contact with the wire feed unit	x			
18	Lost contact with the power source	x			
19	Memory error in data memory	x			

Fault code	Description	Welding data unit	Power source	Wire feed unit	Remote control unit
20	Memory allocation error	x			
22	Transmitter buffer overflow	x	x	x	
23	Receiver buffer overflow	x	x	x	
26	Program operating fault	x	x		
27	Out of wire			x	
28	Stack overflow	x	x	x	
29	No cooling water flow		x		
31	No reply from the display unit	x			
32	No gas flow		x	x	
40	Incompatible units	x			

Fault code description, power source

This manual describes the fault codes for the power source. The fault codes for other units are described in the manuals for these units.

Code	Description
1	**EPROM check sum error - program memory error** Check sum test of the program memory, which is run only when initiating the power source after power-up. This fault does not disable any functions. The program memory is damaged. This is a serious fault, that can have unforeseen effects. **Action:** Restart the power source. If the fault persists, load new software via ESAT. If the fault still persists, replace circuit board 20AP1, which carries the memory chip.
2	**Microprocessor RAM error** The microprocessor is unable to read/write from/to a particular memory address in its internal memory. This test is performed only on initiation after power-up. This fault does not disable any functions. **Action:** Restart the power source. If the fault persists, replace circuit board 20AP1, which carries the microprocessor chip.
3	**Memory error, external RAM** The microprocessor is unable to read/write from/to a particular memory address in its external memory. This test is performed only on initiation after power-up. This fault does not disable any functions. **Action:** Restart the power source. If the fault persists, replace circuit board 20AP1, which carries the microprocessor chip.
4	**5 V power supply too low** The unregulated power supply voltage is too low: the smoothing capacitors cannot keep the voltage up enough for the processor to continue to operate. The processor stops all normal activities, expecting to be shut down. **Action:** Turn off the mains power supply to reset the unit. If the fault persists, check the power supply to circuit board 20AP1.

Code	Description
5	**Intermediate DC voltage outside limits** The DC voltage from the main rectifier, 15BR1, is too high or too low. Too high a voltage can be due to severe transients on the mains power supply or to a weak power supply (high inductance of the supply). The power source is stopped immediately, and cannot be restarted until the voltage has returned to within the limit values. **Action:** Turn off the mains power supply to reset the unit. See also section 15AP1:3 on page 18 and section 15AP2:2 on page 21.
6	**High temperature** Thermal overload cutout 15ST1 or 15ST2 has operated. The power source is stopped, and cannot be restarted until the cutout has reset. **Possible causes:** Overloading, fan not working properly, cooling air inlets or outlets blocked or obstructed or dirt on the heat exchanger.
8	**+15 V power supply on circuit board 20AP1** The voltage is too high or too low: it must be within the range 14.1 to 15.9 V. This fault does not disable any functions.
9	**-15 V power supply on circuit board 20AP1** The voltage is too high or too low: it must be within the range -14.2 to -16.4 V. This fault does not disable any functions.
10	**+24 V power supply on circuit board 20AP1** The voltage is too high or too low: it must be within the range 22.1 to 26.0 V. For sofware version 2.46Q and 2.46R the upper limit is 24.8 V, for later versions the limit is 26.0 V.
12	**Communication error (warning)** The load on the system CAN bus is temporarily too high, or there is electric noise on the bus. **Action:** Check the equipment to ensure that only one wire feed unit and/or remote control unit is connected. See also section 20AP1:3 'The CAN bus' on pages 25 to 27.
15	**Lost messages** The bus CAN controller indicates that a message has been lost. No functions are disabled by this fault. **Action:** Check that all units are correctly connected to the CAN bus. See also section 20AP1:3 'The CAN bus' on pages 25 to 27.
16	**High open-circuit voltage** The output voltage is turned off and cannot be restarted. **Cause** All power sources: The open-circuit voltage has exceeded 113 V for more than one second. Power sources with version 2 of 20AP1: The mean value of the open-circuit voltage exceeds 60 V respectively 30 V for more than 0.3 seconds after welding has ceased. **Action:** Turn off the mains power supply to reset the unit. If the fault persists check the arc voltage feedback.

Code	Description
22	**Transmitter buffer overflow** The control board is unable to transmit information to the other units at a sufficiently high speed. **Action:** A break in the bus line can cause this fault. Check the CAN cabling. Turn off the mains power supply to reset the unit.
23	**Receiver buffer overflow** The control board is unable to process information from the other units at a sufficiently high speed. This fault is caused by abnormal loading of the microprocessor. **Action:** Turn off the mains power supply to reset the unit.
26	**Program operating fault** Something has prevented the processor from performing its normal program duties. The program restarts automatically. The current welding process will be stopped. This fault does not disable any functions. This fault should never occur in reality. Contact ESAB if the fault does occur.
28	**Stack overflow** The stack memory is full. This fault should never occur in reality: the fault code is intended as an aid during development work. Contact ESAB if the fault does occur.
29	**No cooling water flow** The flow monitor switch has operated. The current welding process will be stopped, and cannot be restarted. **Action:** Check the cooling water circuit and pump. Water flow monitoring is an option.
32	**No gas pressure / flow** **Action:** Check the gas valve, hoses and connectors. Gas monitoring is fitted only to special versions of the power sources.

CAUTION !

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.

Service aid

We can offer a number of service tools that will simplify the service.

Soft-starting tool SST 2

Ordering no. 0460 040 880.

The SST 2 is made for the 3000i machine series. (From March 2008 it is delivered with an adapter cable so that it also can be used for the 4000i, 4001i and 5000i machine series, from serial no. 803-xxx-xxxx and there above.)

Adapter cable for the 4000i, 4001i and 5000i machine series, ordering no. 0460 042 881.

Test box TB 1

Ordering no. 0460 868 880

To be used for in-service inspection and testing.

CAN splitter adapter box

Ordering no. 0460 772 880

To be used when external equipment and ESAT has to be connected to the remote connection. The box is equipped with:

- One 10 pole cable plug
- One 12 pole cable plug
- Two 12 pole panel sockets
- One 10 pole panel socket

Antistatic service kit

Ordering no. 0740 511 001

The kit makes it easier to protect sensitve components from electrostatic discharge.

Contents:

- A conductive mat (size 610 x 610 mm)
- A 1.5 metre long ground cable with a crocodile clip
- An adjustable wrist strap and cable with an inbuilt protective resistor

Antistatic service kit

ESAT service kit

The software update is made from a PC, it has to be managed by a trained serviceman. For this a PC program called ESAT, ESAB Software Administration Tool, is needed. The PC is connected to the welding equipment by a cable connector and a CAN reader. From the ESAT it is possible to update the software. ESAT also contains service functions by which it is possible to control, change or read the different functions of the equipment.

For the installation and use of the ESAT you need a PC with operating system Windows.

The ESAT service kit contents:

- CAN adapter with connection cables
- CD with software
- Instruction manual for ESAT

Ordering no:

0458 847 880 PPCAN for connection to the print port of the PC
0458 847 881 USB2CAN for connection to the USB port of the PC

Service traps

The following are a number of points where it is easy to make a mistake and damage the equipment.

Main On/Off switch, 2QF1

Don't get the cable cores mixed up. Connect all the cores to the switch in accordance with their numbers and the terminal numbers on the switch, all as shown in the circuit diagram for the power source. If the cores are mixed up and connected to the wrong terminals, there is a risk of short-circuiting and burning up relay board 20AP2.

Overvoltage and undervoltage protection

Don't mix up contacts 15XS7 and 15XS5: if you do, you write off circuit board 15AP2.

Contact 15XS5 is marked **B**, and must be connected to terminal strip B on circuit board 15AP2.

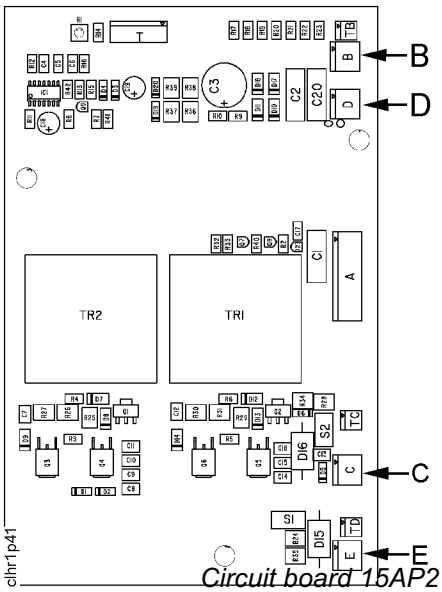
Contact 15XS7 is marked **D**, and must be connected to terminal strip D on circuit board 15AP2.

The gate contacts

Make sure that gate contacts 15XS6 and 15XS8 are connected to terminal strips C and E on circuit board 15AP2 **before** the power source is energised.

If the contacts are not connected, the IGBT transistors will fail.

As the signals from contacts C and E are the same, mixing them up will not cause a fault.



Circuit board 15AP2

The current sensor

Check that current sensor 15AP3 is connected to control circuit board 20AP1. If it is not, then there will be no current limit protection, and the power source can fail.

Power components

Follow the instructions for fitting components to the heat sink. Use thermal contact paste, and tighten all bolts to the correct torque. Incorrectly mounted components can cause breakdowns. See the instructions on Page 49.

Checking the IGBT transistors

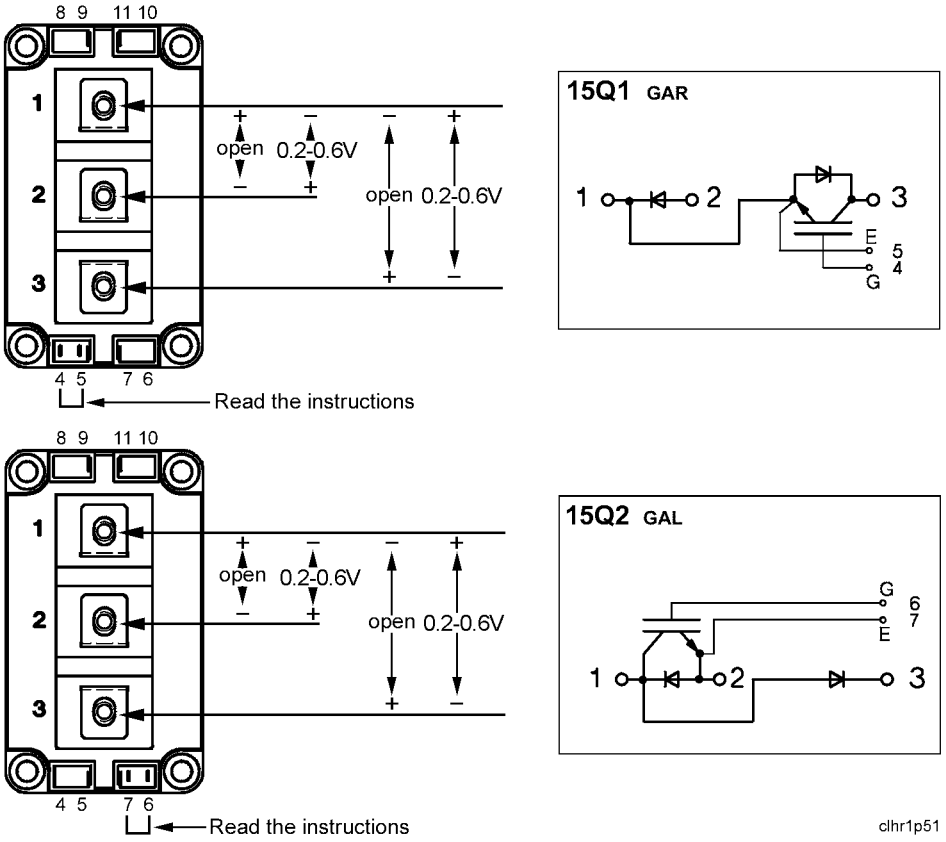
Check the IGBT transistors with the diode test mode of a multimeter.

CAUTION!

These components are very sensitive to static electricity (ESD). ***Use protective equipment to protect against ESD.*** *Place the transistors on a conducting and grounded surface. Never touch the gate connections.*

Short-circuit the gate and emitter connections (terminals 4 - 5 and 6 - 7 respectively) before making the measurements.
Make sure that you and the short-circuiting link are not statically charged relative to the IGBT transistor. Touch your hand and the short-circuiting link to terminals 1, 2 and 3 on the transistor before fitting the link.
Without the short-circuiting link, the measurements will be incorrect.

Measure the transistor voltages as shown in the diagram below.



Voltage measurement for IGBT transistors. ***CAUTION! Beware of ESD!***

It is also possible to check the IGBT transistors when they are mounted in the power source. Short circuit the gate connections, contact TC1 and TC2 respectively TD1 and TD2 on circuit board 15AP2, see diagram on page 20. Measure on the screws that connect the IGBT transistors to power board 15AP1. The measuring result will be almost the same as above, the voltages are lower: 0.1 - 0.5 V.

If an IGBT transistor has failed, both transistors must be replaced. See also the description on page 18.

Mounting components on the heat sink

Thermal paste

Apply thermal conducting paste to the following components before fitting them.

Start by cleaning the heat sink, and then apply a **very thin**, even layer of thermal paste to the contact surfaces of the components. The purpose of the paste is to fill out any hollows in the surfaces of the components and the heat sink. Those parts of the component and the heat sink that are in true metallic contact may have such contact.

Mount the components as described below. See the spare parts list for the order number for thermal paste. Use only the paste recommended by us.

Fitting instructions

15Q1, 15Q2 IGBT transistors

Clean the heat sink and apply thermal conducting paste as described above. Fit the transistor and tighten the screws alternately to a torque of 2.5 Nm, and then further tighten them to 4.5 Nm. **NB:** The screws must be tightened diagonally.

Tighten the screws that connect the IGBT transistors to circuit board 15AP1 to a torque of 4.5 Nm.

CAUTION!
Incorrectly fitted IGBT transistors can cause failure. Do not tighten the screws to more than 4.5 Nm.

15D1, 15D2 Diode modules

Clean the heat sink and apply thermal conducting paste as described above. Fit the module and tighten the screws to a torque of 1 Nm, and then further tighten them to 2.5 Nm.

Tighten the connections to the busbars to 4.5 Nm.

15BR1 Rectifier bridge

Clean the heat sink and apply thermal conducting paste as described above. Fit the bridge and tighten the screws to a torque of 1 Nm, and then further tighten them to 4.5 Nm.

Tighten the screws that connect the bridge to circuit board 15AP1 to 4.5 Nm.

15ST2 Thermal overload cutout

Clean the heat sink and apply thermal conducting paste as described above. Fit the thermal overload cutout.

Soft starting

We recommend soft starting of the power source after replacing control circuit board 20AP1, relay board 20AP2 or circuit boards or components in the power module. This supplies the power module with a low DC voltage in order to avoid injury to persons or damage to components.

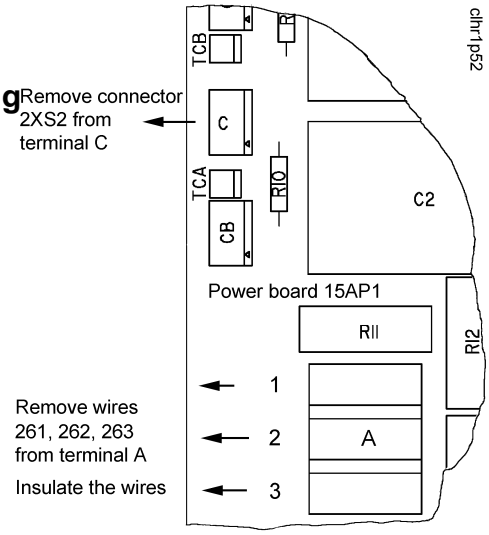
It is a good idea to use soft starting when fault tracing in the power module.

Special equipment

To soft-start the power source you need soft-starting tool SST 2 and the ESAT service kit, this is described on page 46.

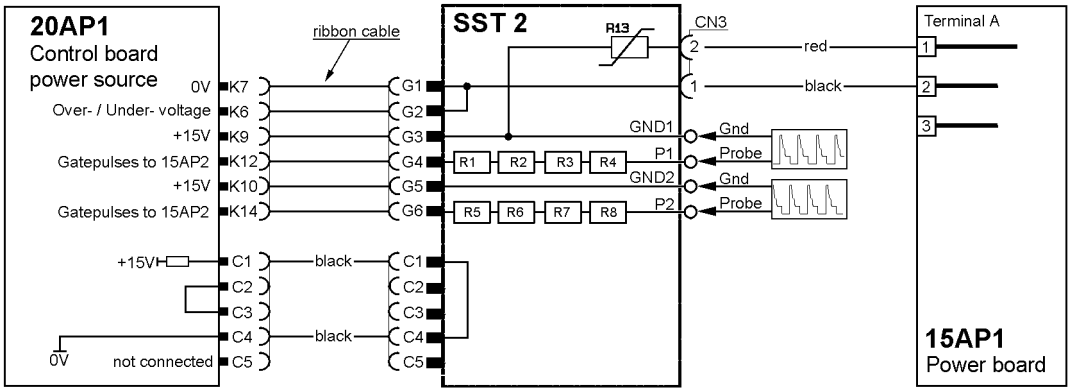
Changing wire connections prior to soft starting

1. Disconnect wires 261, 262 and 263 from terminal block A on circuit board 15AP1.
2. Unplug contact 2XS2 from 15AP1.
3. **Insulate the wires that have been removed from each other and from all other parts.**



Disconnections prior to soft starting

4. If the power source does not have a control panel that can be used in MMA mode: connect a PC with ESAT to the power source.
5. Connect the SST 2 to 20AP1 and 15AP1 as shown below. Connector C must only be connected if there is an interuption in the temperature monitoring circuits.

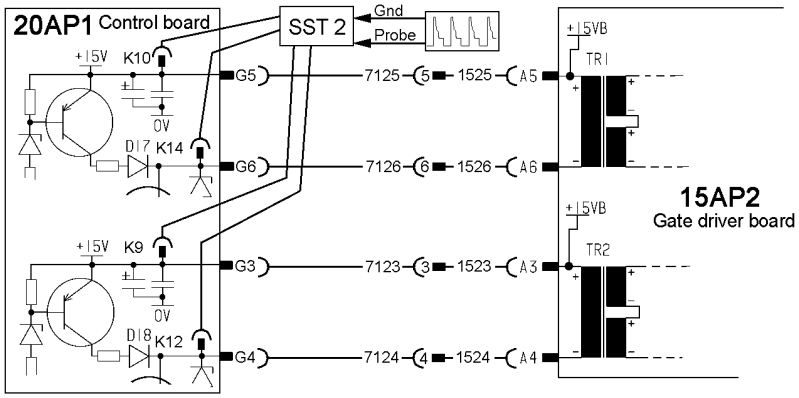


SST 2 connected to 20AP1 and 15AP1

Checking the gate pulses from circuit board 20AP1

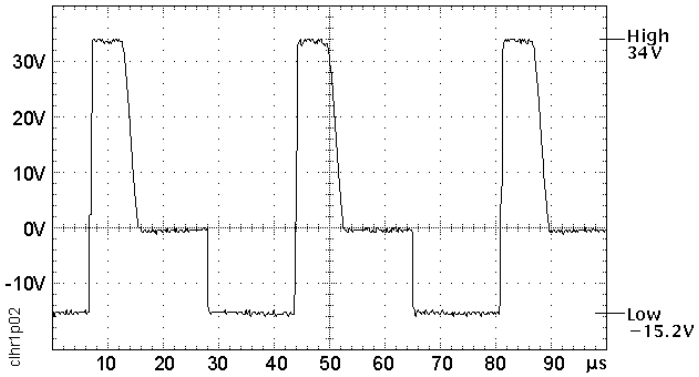
Note! *The power source must be in soft starting mode when checking the gate pulses.*

1. Start the power source and set a current reference.
2. Connect an oscilloscope across terminals GND2 and P2 of the SST2, as shown on page 50.



Test points for gate pulses from 20AP1

3. Compare the waveform of the gate pulses with the diagram below.
   The waveform shape must be as in the diagram.

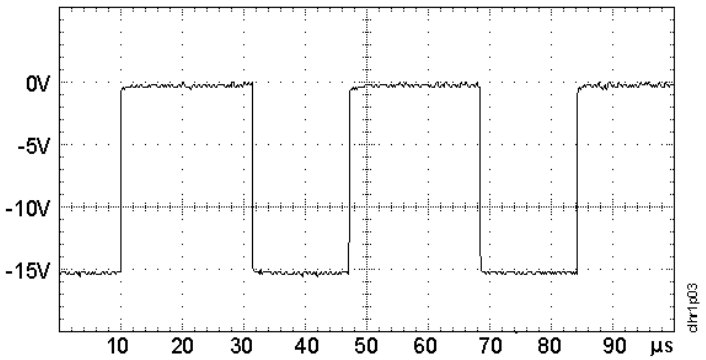


Pulses from 20AP1 to 15AP2 when the output of 20AP1 is connected to 15AP2.

4. Measure the pulse frequency, it must be 27 kHz ±0.5 kHz.
5. Measure the pulse duration, it must be 41 - 43 % of the cycle time, measured at -10 V on the negative pulse, as shown in the diagram above.
6. Measure the maximum pulse voltage, it must be in the range 30 - 38 V.
   The minimum voltage must be in the range from -14 to -16 V.
7. Connect the probe to terminal P1 and the screen to GND1 of the SST 2.
8. Repeat the measurements in item 3 to 6 above.

The pulses on P1 and P2 are in phase with each other.

If the pulse transformer on circuit board 15AP2 is not connected, or if there is a break in the transformer primary, the pulses will look as shown in the figure below.



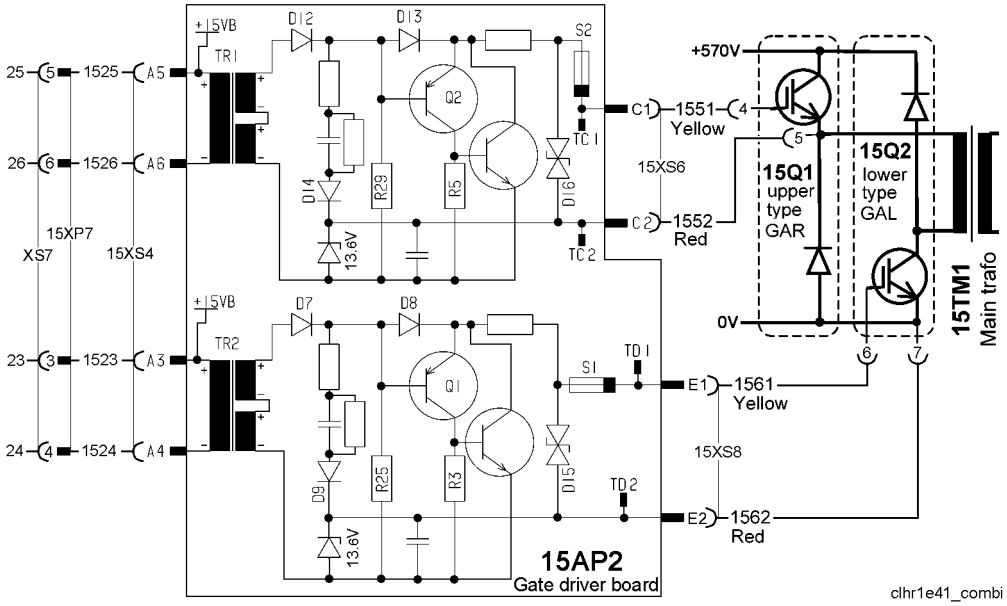
*Pulses from 20AP1 when the output from 20AP1 is **not** connected to 15AP2.*

Checking the gate pulses from circuit board 15AP2

WARNING!

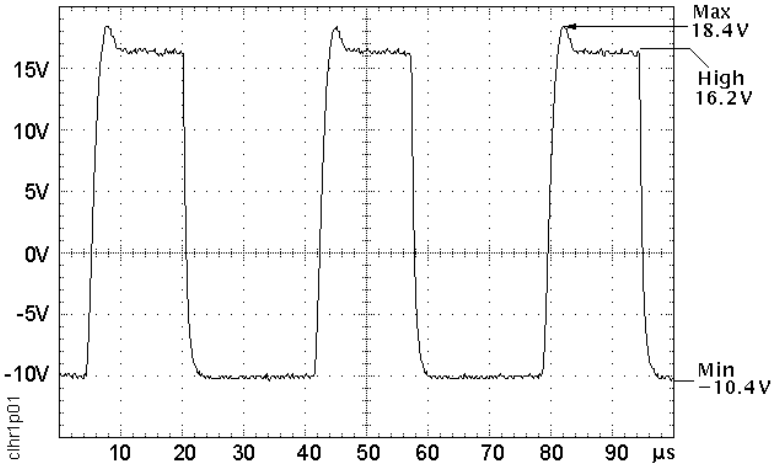
During normal operation there is mains voltage on circuit board 15AP2. The power source must be in soft starting mode when checking the gate pulses, see page 50.

1. Connect an oscilloscope with the probe to TC1 and the screen to TC2.
   CAUTION! *If you short circuit TC1 and TC2, the gate driver board will be destroyed.*



Test points for gate pulses from 15AP2

2. Start the power source and set a current reference.
3. Compare the waveform of the gate pulses with the diagram below.
   The waveform shape must be as in the diagram.
4. Measure the pulse frequency, it must be 27 kHz ±0.5 kHz.
5. Measure the pulse duration, it must be 39.0 -40.8 % of the cycle time, measured at a voltage level of +5 V.
6. Measure the maximum pulse voltage, it must be in the range 14 - 17 V (High in the diagram above). The minimum voltage must be in the range from -9 to -12.5 V.



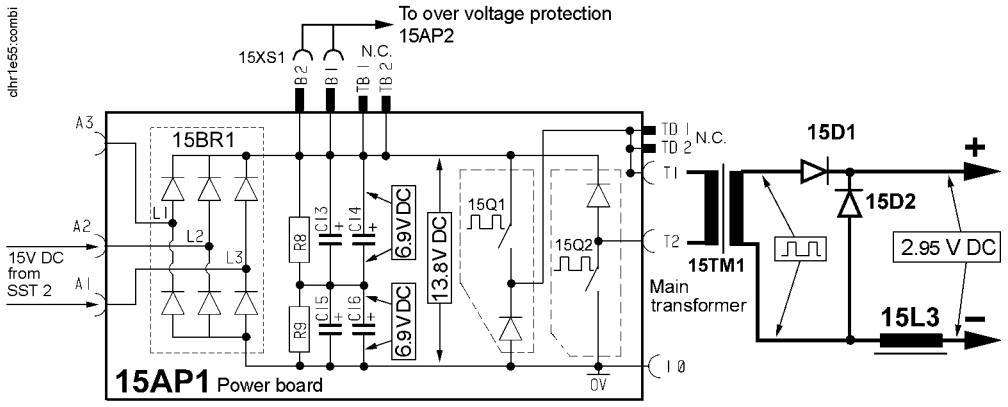
Gate pulses from 15AP2 to 15Q1 and 15Q2

7. Connect the oscilloscope with the probe to TD1 and the screen to TD2.
   CAUTION! *If you short circuit TD1 and TD2, the gate driver board will be destroyed.*
8. Repeat the measurements in item 3 to 6 above.

The pulses on terminals TC1, TC2 and TD1, TD2 are in phase with each other.

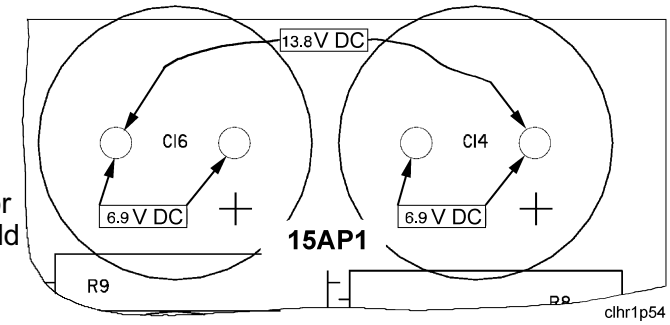
Pulse frequency and duration are controlled by circuit board 20AP2: rise and fall times are controlled by gate driver board 15AP2.

Measurements



Circuit diagram for soft starting measurements

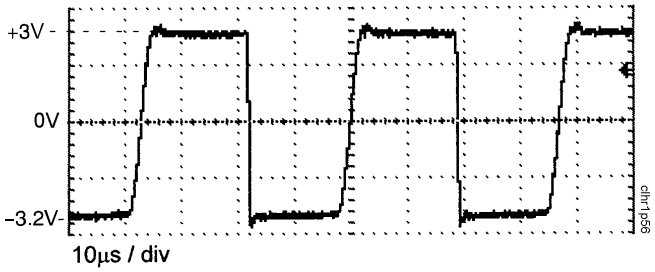
1. Start the power source.
2. Measure the voltage on 15BR1. It should be about 15 V DC. See the circuit diagram above.
3. Measure the voltage between the negative terminal on capacitor C16 and the positive terminal on capacitor C14, on circuit board 15AP1. It should be about 13.8 V DC.



Measure the voltage across the smoothing capacitors

4. Measure the voltage across capacitors C16 and C14 respectively. It should be about 6.9 V DC.
5. Set a current reference.
6. Using an oscilloscope, examine the waveforms on the secondary side of TM1, at the inputs to diodes 15D1 and 15D2. Make the connection as shown in the picture on the right.

   The pulses must look like this:



Output voltage waveform from TM1 for soft starting

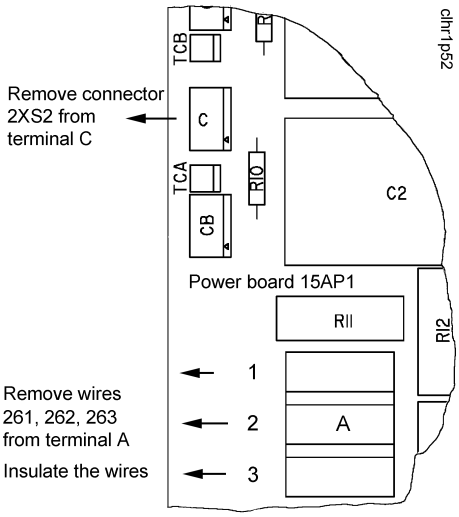
Test points for the secondary voltage from TM1

7. Using a multimeter, check that the DC voltage at the welding terminals is about 2.9 V.
8. If all the measurements are as described above, reconnect the wires to restore the power source to normal operation mode and make a test weld.

Checking the overvoltage and undervoltage threshold values

WARNING!
Dangerous voltages. Mains voltage on circuit board 15AP1 and 15AP2 when the power source is connected to the 400 V supply.

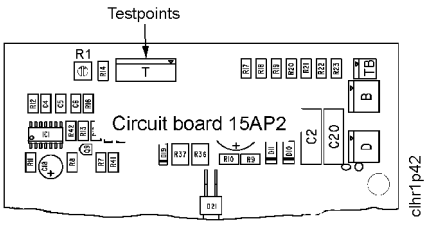
Disconnect the machine from the mains, and follow the instructions below.



Disconnection of the 400 V supply to the power board

Disconnection from the mains supply

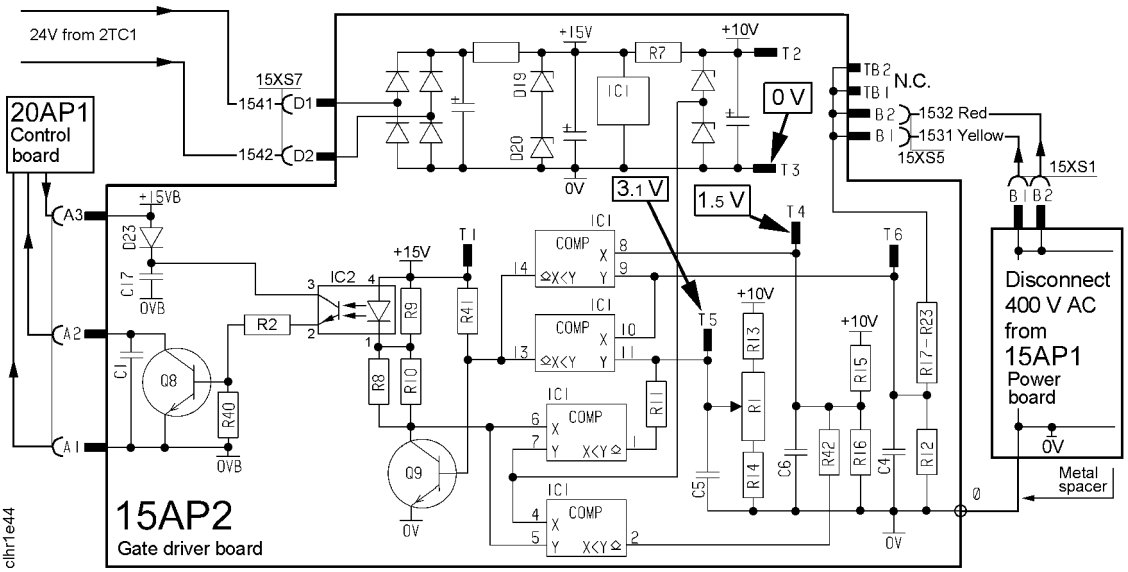
1. Remove wires 261, 262 and 263 from terminal block A on circuit board 15AP1.
2. Unplug contact 2XS2 from 15AP1.
3. **Insulate the wires that have been removed from each other and from all other parts.**



Test points on the circuit board

4. Energize the power source and measure the voltage between test point T3 (0 V) and:
   - Test point T4, threshold value for undervoltage. Must be about 1.5 V.
   - Test point T5, threshold value for overvoltage. Must be about 3.1 V.

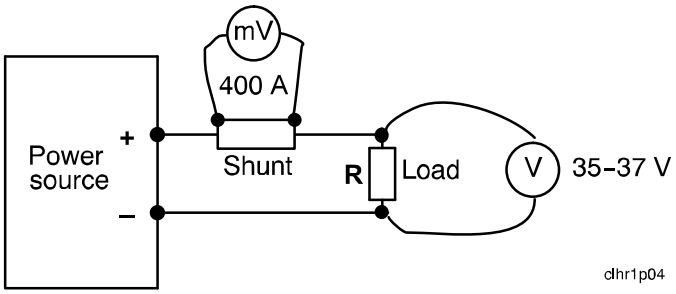
Note! *The circuit board and the test points are varnished. Before measuring, remove the varnish from the test points.*



Test points for checking the threshold values of the overvoltage and undervoltage protection

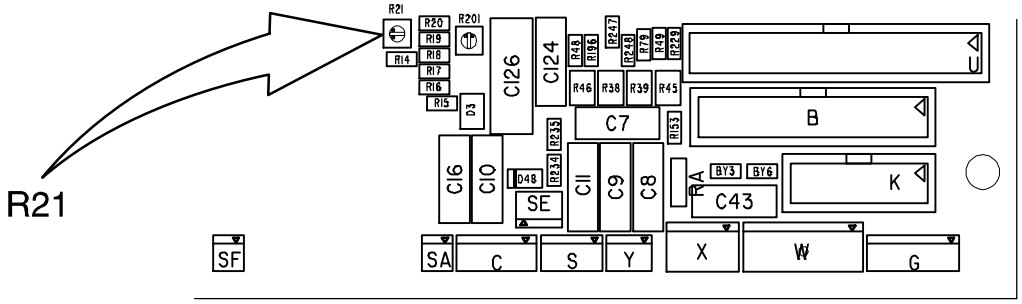
Calibrating the current sensor signal

1. Connect the power source to a resistive load.
2. Connect a **calibrated shunt** in series with the load.
3. Set the power source to MMA mode, or use ESAT to set a current reference.
4. Set a welding current of 400 A.
5. Load the power source so that the voltage across the load is 35 - 37 V.



Circuit diagram for current calibration

6. Measure the shunt voltage (current) by using a **calibrated multimeter**.
7. Use potentiometer R21 on circuit board 20AP1 to adjust the shunt voltage to correspond to 400 A ±4 A.

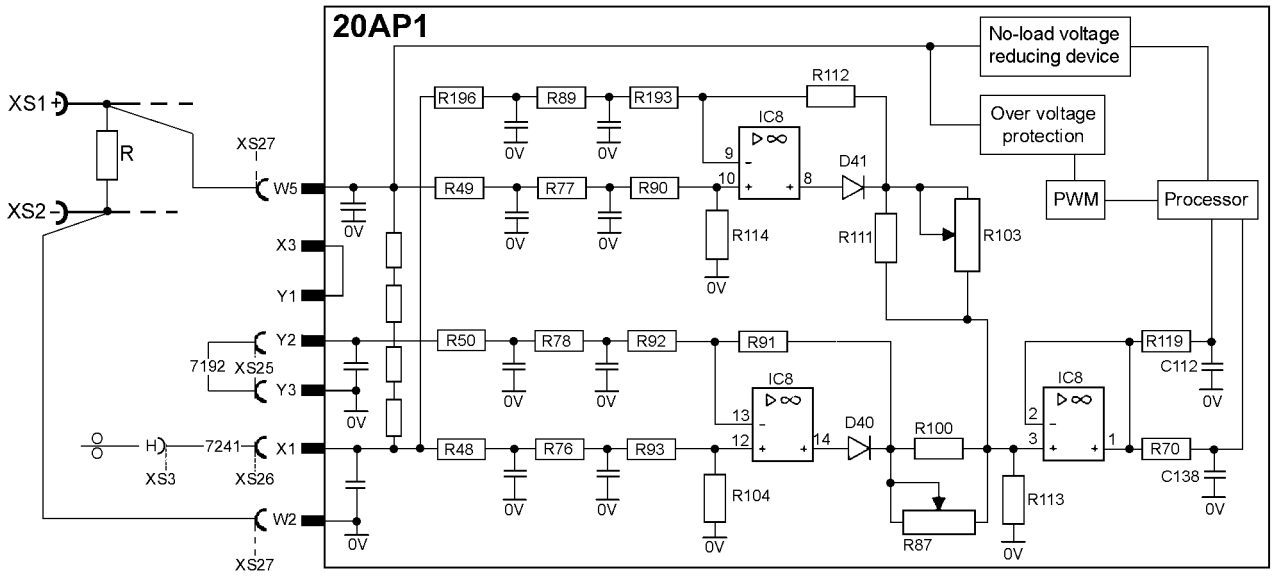


Position of potentiometer R21 on circuit board 20AP1.

8. Check the current at low values as well: 16 A at 19 - 22 V, for which the tolerance is ±1 A. If the current is outside the tolerance, replace current sensor 15AP3.

MIG power sources, calibration of the arc voltage feedback

The arc voltage input can be calibrated using trimming potentiometers R87 and R103 on circuit board 20AP1. The board has been calibrated in the factory: further adjustment should not normally be necessary.

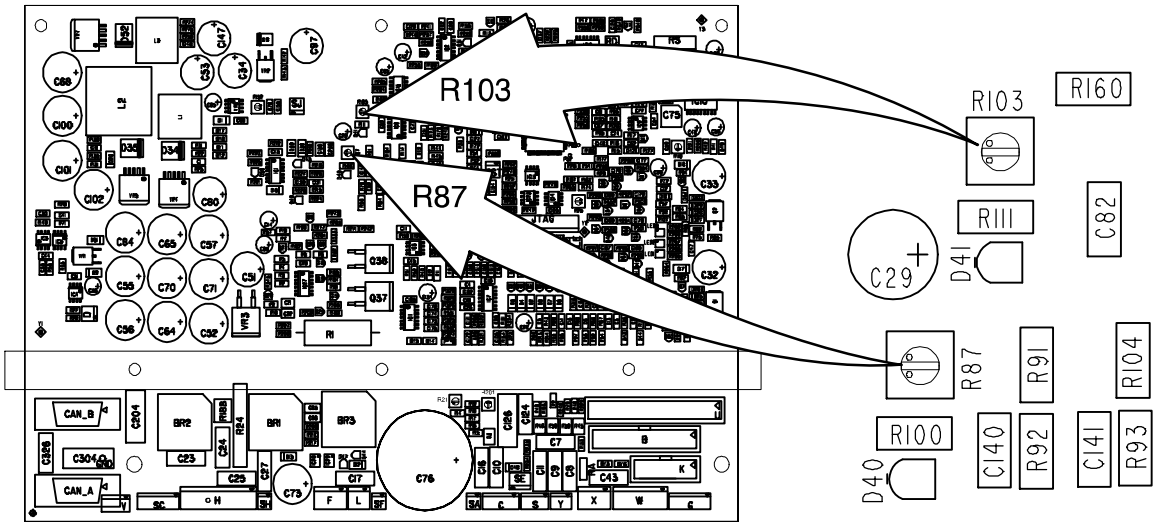


Circuit diagram of the arc voltage input

Connect a wire feed unit to the power source. Connect long welding current cables, to give an appreciable voltage drop in the cables. Connect a wire to the feed rollers, and connect an external voltmeter, as shown in the diagrams on next page. Set the power source to MIG short arc welding mode, and apply a resistive load to give a current of 100 A at 25 - 30 V.

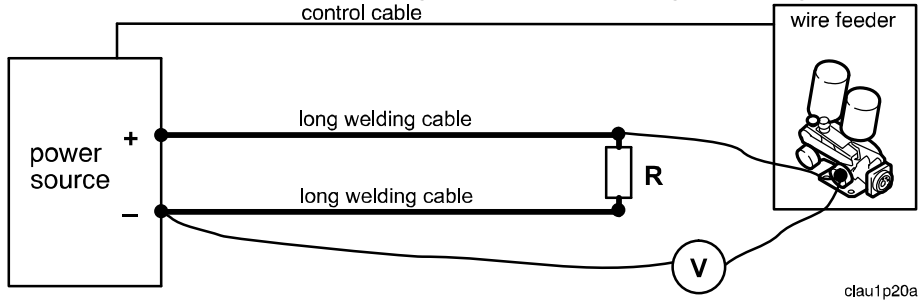
Start the power source from the welding torch trigger contact and adjust the current by changing the wire feed speed setting. Adjust the voltage by varying the load resistor.

Use an accurately calibrated external voltmeter to measure the output voltage of the power source.



Positions of potentiometers R87 and R103 on circuit board 20AP1

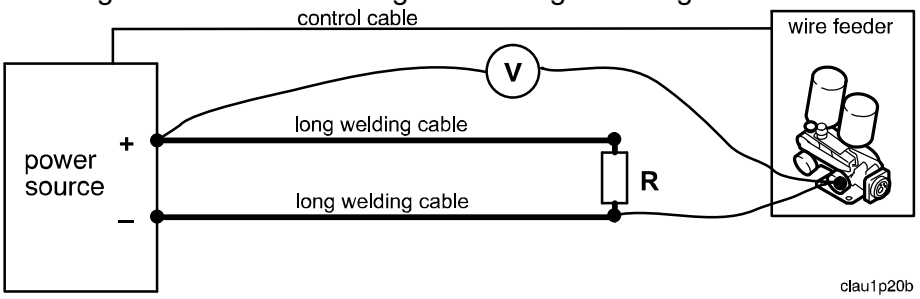
1. Welding with the filler wire positive: voltage sensing from the wire
   This is the most common arrangement of arc voltage sensing.



***V** = external voltmeter. **R** = load resistor.*

The control panel must show the same voltage value as shown on the external voltmeter ±0.6 V. Adjust the display value by means of potentiometer R87.

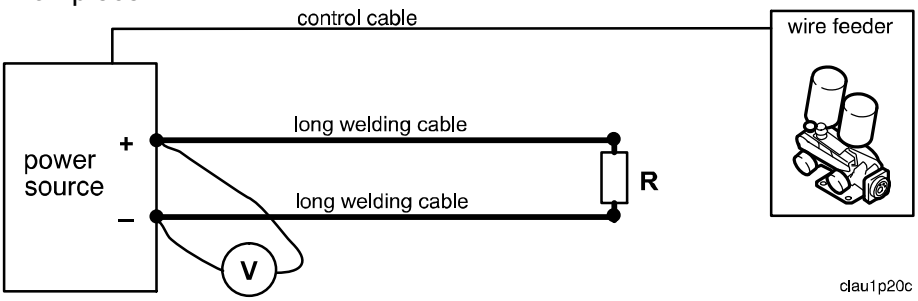
2. Welding with the filler wire negative: voltage sensing from the wire



***V** = external voltmeter. **R** = load resistor.*

The control panel must show the same voltage value as shown on the external voltmeter ±0.6 V. Adjust the display value by means of potentiometer R103.

3. Welding with the filler wire positive or negative: no external sensing from the wire or workpiece



***V** = external voltmeter. **R** = load resistor.*

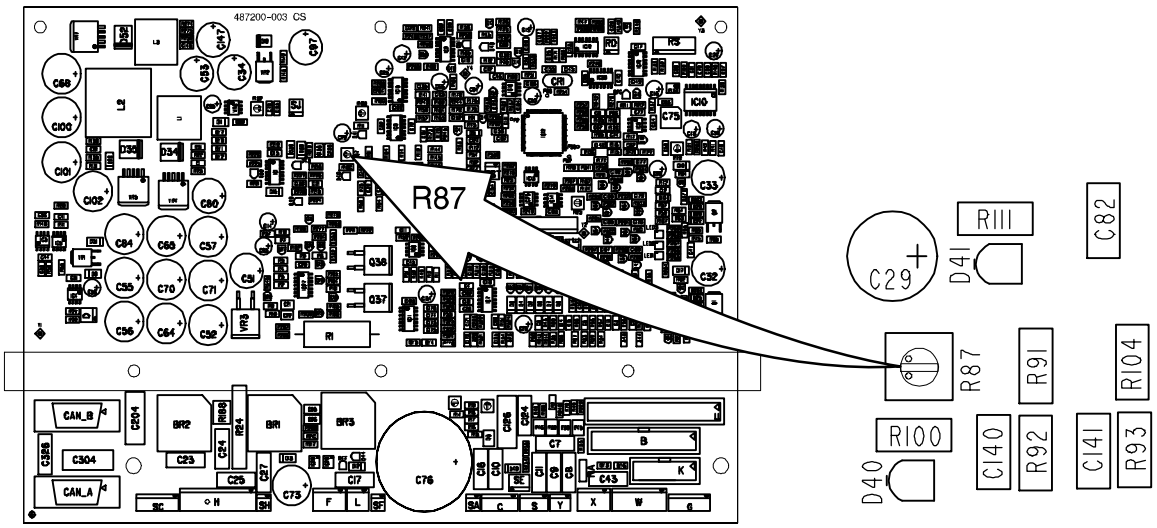
The external voltmeter shows a value 0.2 - 1.6 V higher than the value shown on the control panel. Do not adjust the value shown on the control panel: this is already adjusted from 1) above.

MMA power sources, calibration of the arc voltage feedback

The arc voltage input can be calibrated using trimming potentiometer R87 on circuit board 20AP1. The board has been calibrated in the factory: further adjustment should not normally be necessary.

Use an accurately calibrated external voltmeter to measure the voltage at the welding current terminals.

1. Set a welding current of about 100 A, supplying it to a resistive load so that the voltage is 25 - 30 V. Using an external voltmeter, measure the voltage across the welding current terminals.
2. Using the potentiometer, adjust the value shown on the display so that the voltage shown is about 0.2 - 1.6 V lower than the voltage at the welding current terminals. This difference between the measured and the displayed voltages compensates for the voltage drop in the welding current cables.



Position of potentiometer R87 on circuit board 20AP1

CONNECTION OF TERMINATING RESISTORS

Abbrevations used in this chapter

MMC = **M**an **M**achine **C**ommunication

The MMC unit is a control panel with display, in some cases it also incorporates a welding data board, see WDU below.

WDU = **W**elding **D**ata **U**nit.

The welding data unit handles the over all control of the system. The WDU is a part of the system software.

In MIG applications it is run by a separate processor on a separate board, named the welding data board. The welding data board is enclosed in the MMC unit.

In MMA and TIG applications the WDU uses a part of the processor of the power source control board.

Symbol explanation

Fixed terminating resistor on circuit board = 

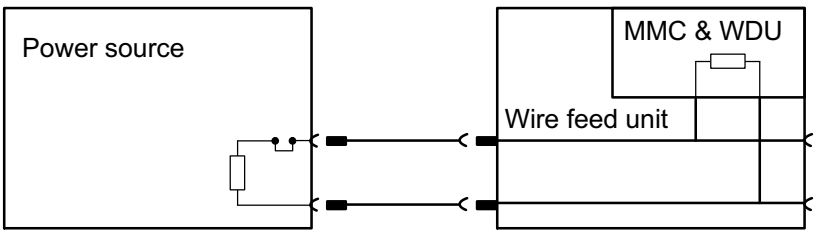
Terminating resistor on circuit board, disconnected = 

Terminating resistor on circuit board, connected by a jumper = 

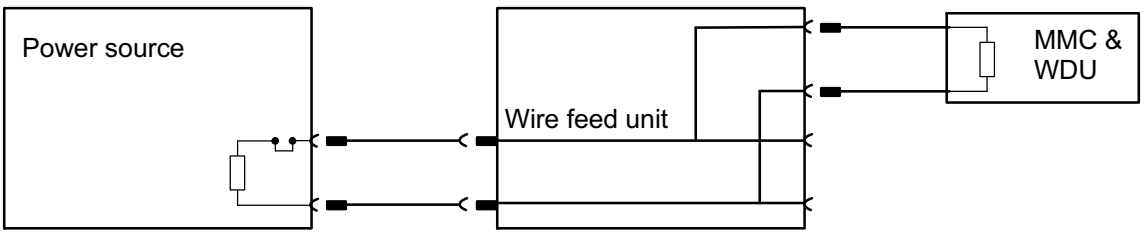
The welding data unit of MMC unit A24 has no terminating resistor.

Mig 4001i

Power source without MMC

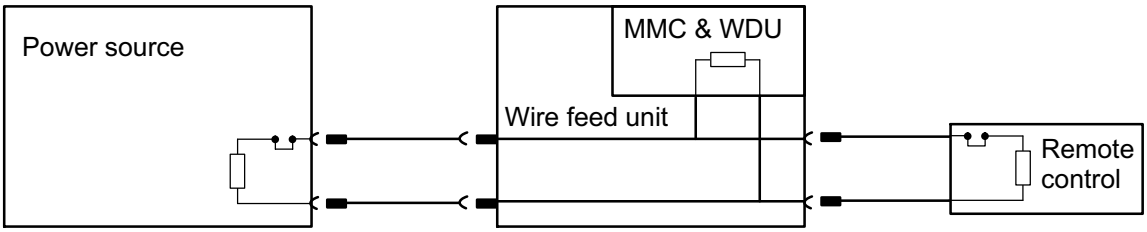


Feasible MMC units are: MA23, MA24, MA6 and U6

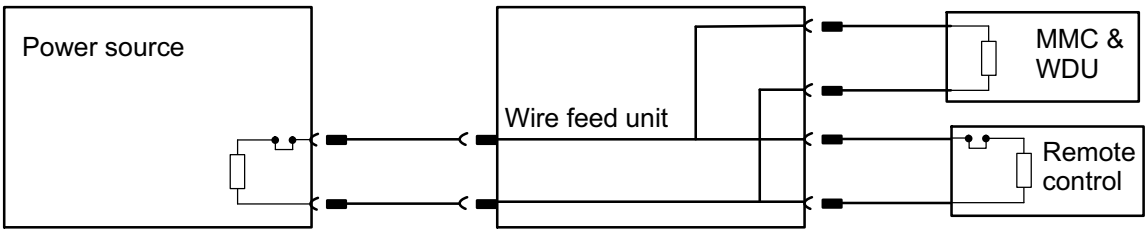


Feasible MMC unit is: U8

Power source without MMC and with remote control

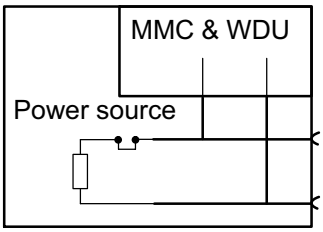


Feasible MMC units are: MA23, MA24, MA6 and U6



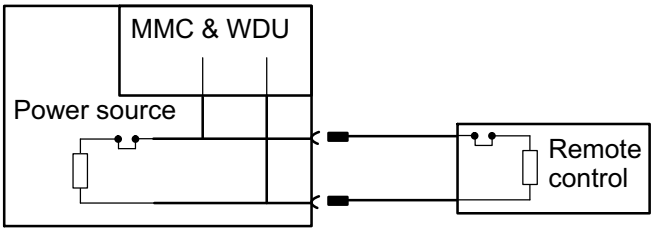
Feasible MMC unit is: U8

Power source with MMC



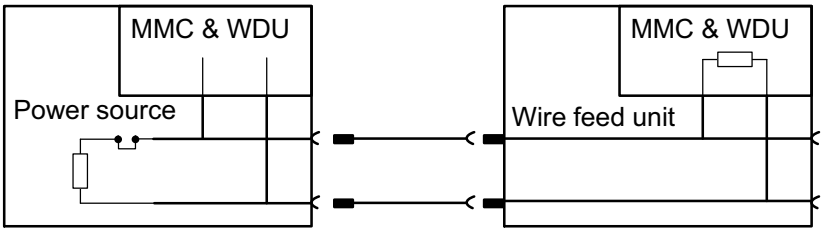
Feasible MMC unit is: A24

Power source with MMC and remote control



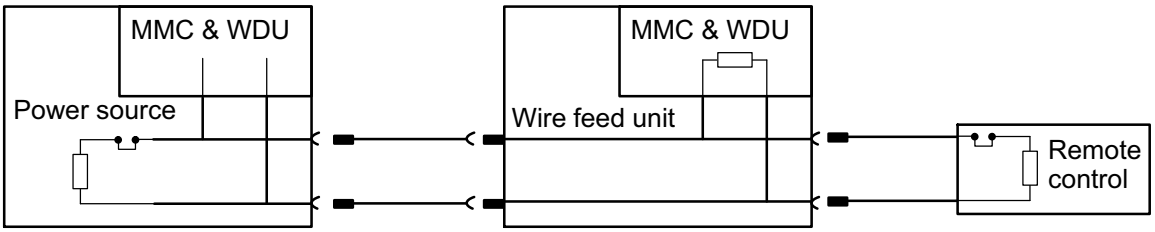
Feasible MMC unit is: A24

Power source with MMC and wire feeder with MMC



Feasible MMC unit for the power source is: A24.
Feasible MMC units for the wire feed unit are: MA23, MA24, MA6 and U6

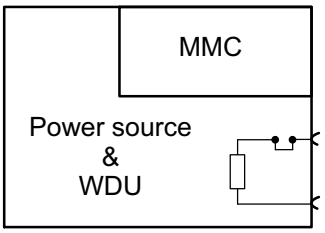
Power source with MMC, wire feeder with MMC and remote control



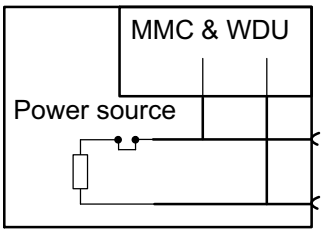
Feasible MMC unit for the power source is: A24.
Feasible MMC units for the wire feed unit are: MA23, MA24, MA6 and U6

Arc 4001i

Power source with MMC

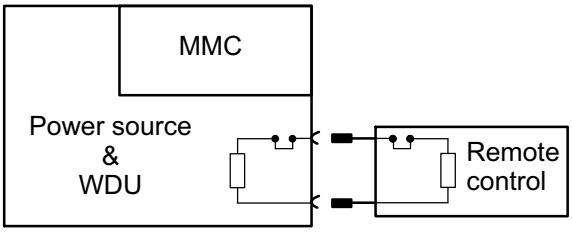


MMC = A22

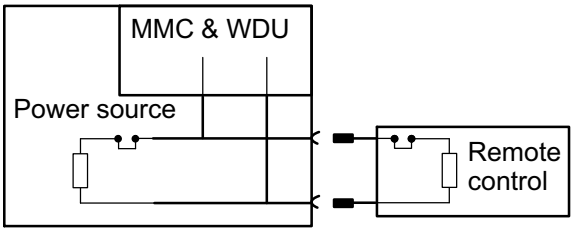


MMC = A24

Power source with MMC and remote control



MMC = A22



MMC = A24

IN-SERVICE INSPECTION AND TESTING

in accordance with IEC 60974-4.

General requirements

Qualification of test personnel
Tests of welding power sources can be hazardous and shall be carried out by an expert in the field of electrical repair, preferably also familiar with welding, cutting and allied processes.

Test conditions
Tests shall be carried out at an ambient air temperature between 10 °C and 40 °C on a dry and cleaned welding power source.

Measuring instruments
The accuracy of measuring instruments shall be class 2.5 as a minimum, except for the measurement of insulation resistance, where the accuracy of the instruments is not specified but shall be taken into account for the measurement.

The voltmeter shall have an internal resistance of at least 1MΩ and indicate mean value.

Periodic inspection and test

Periodic inspection and test shall be carried out in accordance with manufacturers instructions and local regulations. The periodic inspection and test consists of:

- Visual inspection, (see Visual inspection, page 63)
- Electrical test (see Electrical test, page 64)

The inspection and test shall be documented in a test report, (see Test report, page 68).

A signed and dated label shall be attached to the equipment after an approved test.

After repair, inspection and test

After repair, inspection and test shall be carried out according to manufacturers instructions and local regulations. The after repair, inspection and test consists of:

- Visual inspection, (see Visual inspection, page 63)
- Electrical test (see Electrical test, page 64)
- Functional test (see Functional test, page 66)

The inspection and test shall be documented in a test report, (see Test report, page 68).

A signed and dated label shall be attached to the equipment after an approved test.

Visual inspection

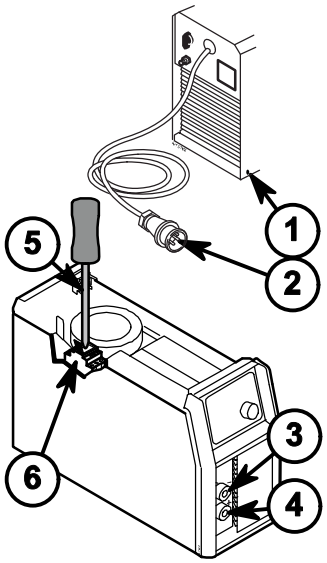
Disconnect the welding power source from the mains supply.
During visual inspection, each safety related function judged as relevant by the test personnel, shall be checked for correct operation.

During visual inspection, the following listed items shall be checked:

1. Torch/electrode holder, welding current return clamp.
   - missing or defective insulation
   - defective connections
   - defective, damaged switches
   - other damage
2. Mains supply
   - defective, damaged cable
   - deformed, faulty plug
   - broken or thermally damaged plug pins
   - ineffective cable anchorage
   - cables and plugs unsuitable for the intended use and performance
3. Welding circuit
   - defective damaged cable
   - deformed, faulty or thermally damaged coupler/sockets
   - ineffective cable anchorage
   - cables and coupler unsuitable for the intended use and performance
4. Enclosure
   - missing or damaged parts
   - unauthorised modifications
   - cooling openings blocked or missing air filters
   - signs of overload and improper use
   - missing or defective protective covers (for example, gas cylinder holder)
   - missing or defective, lifting means, holder etc.
   - conductive objects placed in the enclosure
5. Controls and indicators
   - defective switches, meters and lamps
   - incorrect fuses accesible from outside of the enclosure
6. General condition
   - cooling liquid circuit leakage or incorrect cooling liquid level
   - defective gas hoses and connections
   - poor legibility of markings and labelling
   - other damage or signs of improper use

Electrical test

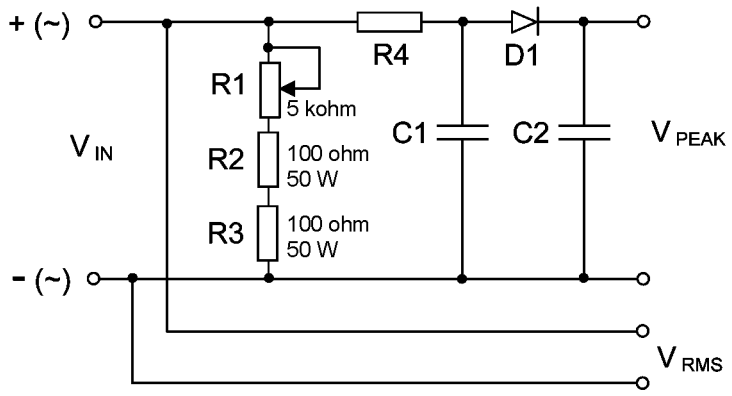
1. Disconnect the welding power source from the mains supply.
2. Check continuity of the protective circuit.
   Measure the resistance of the protective circuit from the screw (1) to the protective earth connection in the the mains plug (2).
   During the measurement the cable shall be bent, flexed and twisted along the whole length in order to detect interuptions in the protective conductor.
   - ***Required value for cables up to 5 m, max 0.3 Ω***.



3. Check the insulation resistance with an insulation tester with the measurement voltage set to 500 VDC.
   a. Open the small protective cover on top of contactor 2KM1 (6).
   b. With an isolated tool (5) press down the mechanism of contactor 2KM1 (6).
   c. Turn the mains switch of the the welding power source to START and hold it there.
   d. Measure from the supply pins in the mains plug (2) to the welding outlets (3,4).
      - ***Required value not less than 5 MΩ***.
   e. Measure from the welding outlets (3,4) to the protective earth connection in the mains plug (2).
      - ***Required value not less than 2.5 MΩ***.
   f. Measure from the supply pins in the mains plug (2) to the protective earth connection in the mains plug (2).
      - ***Required value not less than 2.5 MΩ***.
   g. Turn the mains switch of the the welding power source to OFF and release contactor 2KM1.
4. Check the no-load voltage.
   Use the ESAB testbox TB 1. If the welding power source has an activated VRD function then proceed to step 5.
   a. Connect the positive (3) and negative (4) welding outlets to the positive and negative terminals ($DC_{IN)}$ of the TB 1.
   b. Connect a voltmeter to V_{PEAK} of the TB 1.
   c. Connect the welding power source to the mains supply.
   d. Turn the control knob of the TB 1 anti-clockwise to 0.2.
   e. Turn the mains switch of the the welding power source to ON.
   f. Set welding power source to MMA.
   g. Set the welding current control on the welding power souce to maximum.
   h. Slowly turn the control knob of the TB 1 clockwise from 0.2 to 5.2 while checking the voltmeter for the highest value.
      - ***Measured value shall not exceed the allowable value 113 V_{PEAK}***
   i. Turn the mains switch of the the welding power source to OFF.
   j. Disconnect the welding power source from the mains supply.
5. Check of no-load voltage with the VRD activated.
   Use the ESAB testbox TB 1. This test is only conducted when the VRD function is activated.

a. Connect the positive (3) and negative (4) welding outlets to the positive and negative terminals ($DC_{IN)}$ of the TB 1.
b. Connect a voltmeter to V_{PEAK} of the TB 1.
c. Connect the welding power source to the mains supply.
d. Turn the control knob of the TB 1 anti-clockwise to 0.2.
e. Turn the mains switch of the the welding power source to ON.
f. Set welding power source to MMA.
g. Set the welding current control on the welding power souce to maximum.
h. Check the voltage with the voltmeter.
   - ***Measured value shall not exceed 35 V***.
i. Check that the LED indicates active VRD function by a steady green light.
j. Turn the mains switch of the the welding power source to OFF.
k. Disconnect the welding power source from the mains supply.

Test box TB 1

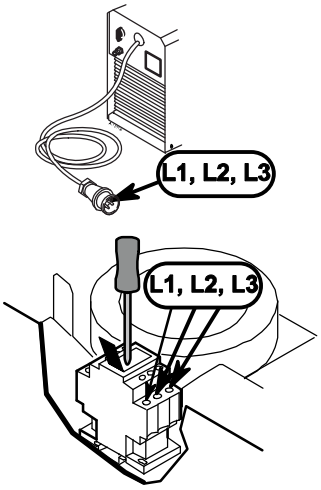


Circuit diagram of the TB 1

Functional test

1. Each safety related function judged as relevant by the test personnel shall be checked for correct operation.

   Conformity shall be checked by operating the device and by checking whether the welding power source operates correctly.
2. Check the supply circuits on/off switching devices



   a. Disconnect the welding power source from the mains supply.
   b. Remove the cover.
   c. Turn the mains switch of the the welding power source to OFF.
   d. Measure from the supply pins of the mains plug to the contactor 2KM1.
      - Measure L1 - L1 of contactor 2KM1 (wire 261).
        Required value, open circuit
      - Measure L2 - L2 of contactor 2KM1 (wire 262).
        Required value, open circuit
      - Measure L3 - L3 of contactor 2KM1 (wire 263).
        Required value, open circuit
   e. Open the small protective cover on top of contactor 2KM1 (6).
   f. With an isolated tool (5) press down the mechanism of contactor 2KM1 (6).
   g. Measure from the supply pins in the mains plug to the contactor 2KM1.
      - Measure L1 - L1 of contactor 2KM1 (wire 261).
        Required value, less than 0.5 Ω.
      - Measure L2 - L2 of contactor 2KM1 (wire 262).
        Required value, less than 0.5 Ω.
      - Measure L3 - L3 of contactor 2KM1 (wire 263).
        Required value, less than 0.5 Ω.
   h. Turn the mains switch of the the welding power source to OFF.
      - Measure L2 - L2 at mains switch 2QF1 (cable 201).
        Required value, open circuit.
      - Measure L3 - L3 at mains switch 2QF1 (cable 203).
        Required value, open circuit.
   i. Turn the mains switch of the the welding power source to ON.
      - Measure L2 - L2 at mains switch 2QF1 (cable 201).
        Required value, less than 0.5 Ω.
      - Measure L3 - L3 at mains switch 2QF1 (cable 203).
        Required value, less than 0.5 Ω.
   j. Turn the mains switch of the the welding power source to OFF.
      - Measure L2 - L2 at transformer 2TC1 (cable 232).
        Required value, open circuit.
      - Measure L3 - L3 at transformer 2TC1 (cable 234).
        Required value, open circuit.
   k. Turn the mains switch of the the welding power source to START and hold it there.
      - Measure L2 - L2 at transformer 2TC1 (cable 232).
        Required value, less than 0.5 Ω.
      - Measure L3 - L3 at transformer 2TC1 (cable 234).
        Required value, less than 0.5 Ω.

l. Turn the mains switch of the the welding power source to OFF.

m. Reassemble the cover.

3. Check signal and control lamps

   Check the function of the display indicators by turning on the unit and visually check the front panel.

   The LED test starts with all LEDs dark, then the diodes are turned on and off, one at a time, until all diodes have been tested. If the test detects a fault, no fault code will be logged.
   Then the display test is made in the same way as the LED test but for each segment of the digits in the display. If the test detects a fault, no fault code will be logged.
   Finally the software version of the welding data unit is displayed.

4. Check the function of the welding power source by welding.
5. Disconnect the welding power source from the mains supply.
6. Write the test report.

   See Test report, page 68).

7. If the unit passes all the tests, attach appropriate label with signature and date of the test.

Test report

Company:	Location:	
Equipment: **Arc welding power source**		Serial number:
Manufacturer: **ESAB** Type:		
Testing equipment:		

VISUAL INSPECTION		PASSED ☐
ELECTRICAL TEST	Limit	Measured values
Protective conductor resistance	≤ 0.3 Ω	
Insulation resistance		
Input circuit/ Welding circuit (500 V_{DC})	≥ 5 MΩ	
Welding circuit/ Protective circuit (500 V_{DC})	≥ 2.5 MΩ	
Input circuit/ Protective circuit (500 V_{DC})	≥ 2.5 MΩ	
No-load voltage		
without VRD	V_{peak} ≤113 V_{DC}	
with VRD activated	V_{peak} ≤35 V_{DC}	
Electrical test		PASSED ☐
FUNCTIONAL TEST		PASSED ☐
Remarks		
Date		
Tested by		Signature
Testing company		

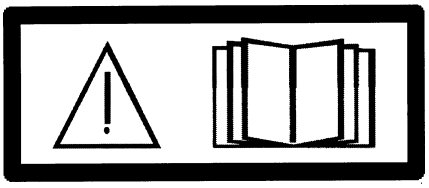
INSTRUCTIONS

This chapter is an extract from the instruction manuals for the Mig 4001i and Arc 4001i.

SAFETY

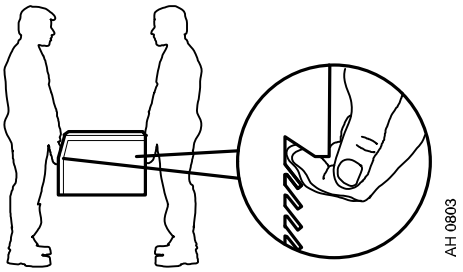
CAUTION!

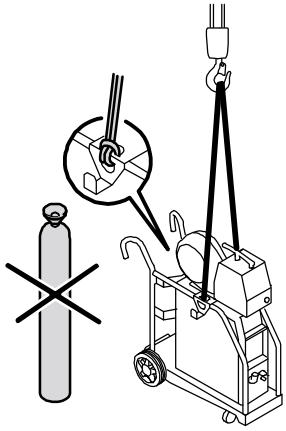
Read and understand the instruction manual before installing or operating.

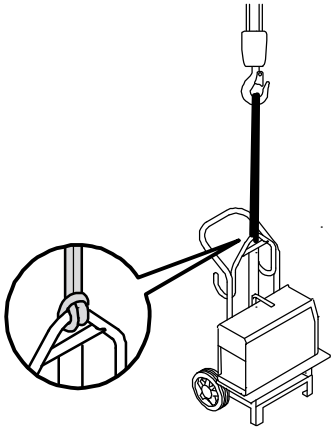


INSTALLATION

Lifting instructions







Location

Position the welding power source such that its cooling air inlets and outlets are not obstructed.

Mains supply

Note!

Mains supply requirements

High power equipment may, due to the primary current drawn from the mains supply, influence the power quality of the grid. Therefore connection restrictions or requirements regarding the maximum permissible mains impedance or the required minimum supply capacity at the interface point to the public grid may apply for some types of equipment (see technical data). In this case it is the responsibility of the installer or user of the equipment to ensure, by consultation with the distrubution network operator if necessary, that the equipment may be connected.

Make sure that the welding power source is connected to the correct supply voltage and that it is protected by the correct fuse rating. A protective earth connection must be made in accordance with regulations.

Recommended fuse sizes and minimum cable area

Mig 4001i & Arc 4001i		
Mains voltage	400 V 3 ~ 50 Hz	***NOTE!*** *The welding power source is designed for connection to a 400 volt system with four conductors.*
Mains cable area mm^2	4G4 mm^2	
Phase current I_{eff}	16 A	*If the power source is to be used in countries with a higher or lower supply voltage, the power source must be connected via a safety transformer.*
Fuse		
anti-surge	20 A	
type C MCB	20 A	

NOTE! *The mains cable areas and fuse sizes as shown above are in accordance with Swedish regulations. Use the welding power source in accordance with the relevant national regulations.*

OPERATION

General safety regulations for the handling of the equipment can be found in the instruction manual. Read through before you start using the equipment!

Connections and control devices Mig 4001i

1 Connection for wire feed unit or remote control unit

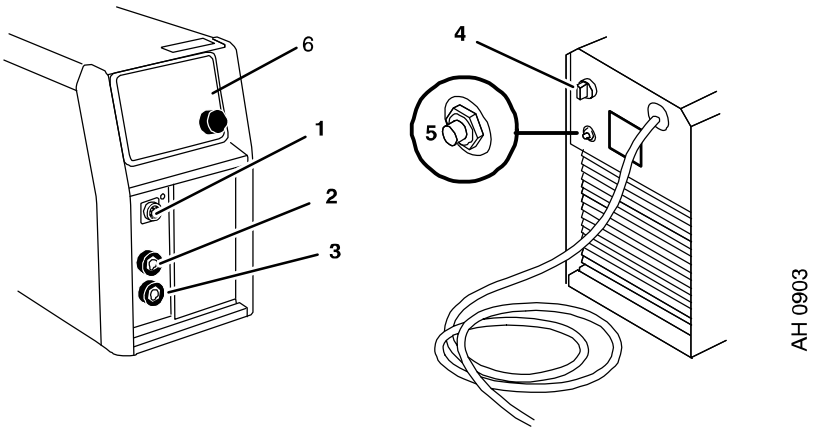
2 Connection (-): MIG/MAG: Return cable
TIG: torch
MMA: Return cable or welding cable

3 Connection (+): MIG/MAG: Welding cable
TIG: return cable
MMA: Welding cable or return cable

4 Mains power supply switch, 0 / 1 / START

5 Fuse for supply voltage, 42 V, to wire feed unit

6 Control panel, see separate instruction manual



Connections and control devices Arc 4001i

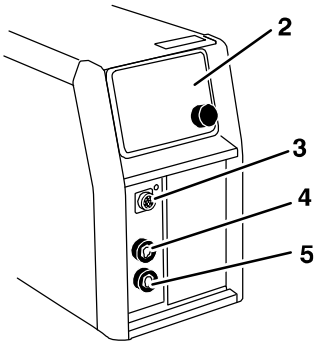
1 Mains power supply switch, 0 / 1 / Start

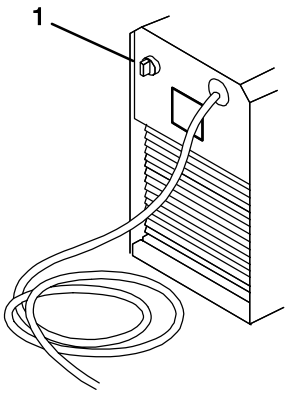
2 Control panel,
see separate instruction manual

3 Connection for remote control unit

4 Connection (-)
MMA: return cable or welding cable
TIG: torch
MIG/MAG: return cable

5 Connection (+)
MMA: welding cable or return cable
TIG: return cable
MIG/MAG: welding cable





Turning on the power source

Turn on the mains power by turning switch (4) to the ”START” position. Release the switch, and it will return to the ”1” position.

If the mains power supply should be interrupted while welding is in progress, and then be restored, the power unit will remain de-energised until the switch is again turned manually to the ”START” position.

Turn the unit off by turning the switch to the ”0” position.

Whether the mains power supply is interrupted or the power unit is switched off in the normal manner, welding data will be stored so that it is available next time the unit is started.

Fan control

The power source has a time control that means that the fans continue to run for 6.5 minutes after welding has stopped, and the unit switches to energy-saving mode. The fans start again when welding restarts.

The fans run at reduced speed for welding currents up to 146 A, and at full speed for higher currents.

Overheating protection

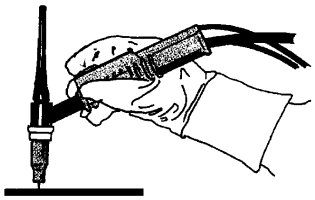
The welding power source has overheating protection that operates if the temperature becomes too high. When this occurs the welding current is interrupted and a fault code is displayed on the control panel.

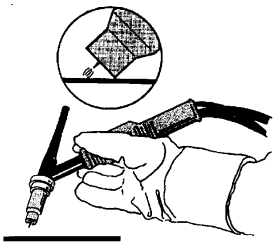
The overheating protection resets automatically when the temperature has fallen.

TIG welding

”Live TIG-start”

With “Live TIG start” the tungsten electrode is placed against the workpiece. When the electrode is then lifted away from the workpiece again the arc is struck at a limited current level. (12-15 A).





MAINTENANCE

Regular maintenance is important for safe, reliable operation. Only personnel with the appropriate electrical skills (authorised staff) may remove safety plates.

CAUTION!

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.

Power source

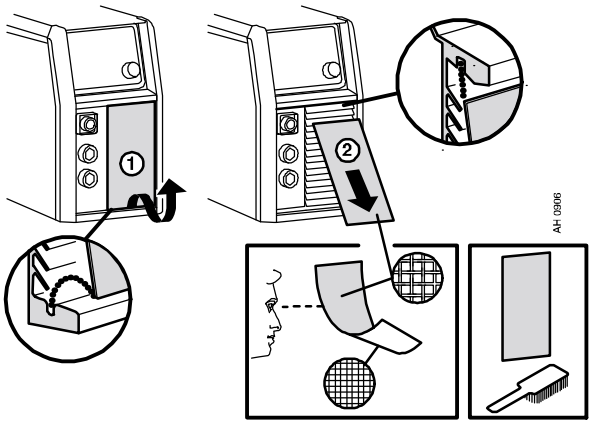
Check regularly that the welding power source is not clogged with dirt.

How often and which cleaning methods apply depend on: the welding process, arc times, placement and the surrounding environment. It is normally sufficient to blow the power source clean with dry compressed air (reduced pressure) once a year.

Clogged or blocked air inlets and outlets otherwise result in overheating.

Replacing and cleaning the dust filter

- Release the dust filter according to the figure.
- Blow the filter clean with compressed air (reduced pressure).
- Ensure that the filter with the finest mesh is placed towards the grille.
- Reinstall the filter.



Welding torch

Wear parts should be cleaned and replaced at regular intervals in order to achieve trouble-free welding.

FAULT-TRACING

Try these recommended checks and inspections before sending for an authorized service technician.

Type of fault	Corrective action
No arc.	• Check that the mains power supply switch is turned on. • Check that the welding and return cables are correctly connected. • Check that the correct current value is set. • Check the mains power supply fuses.
The welding current is interrupted during welding.	• Check whether the thermal cut-outs have tripped (a fault code is displayed on the control panel). • Check the mains power supply fuses.
The thermal cut-out trips frequently.	• Check to see whether the dust filter is clogged. • Make sure that you are not exceeding the rated data for the welding power source (i.e. that the unit is not being overloaded). • Check that the welding power source is not clogged with dirt.
Poor welding performance.	• Check that the welding current supply and return cables are correctly connected. • Check that the correct current value is set. • Check that the correct electrodes are being used.

SPARE PARTS

The spare parts list is published in a separate document that can be downloaded from the internet: www.esab.com

Product	Filename
Mig 4001i	0459 839 032
Arc 4001i	0459 839 029

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