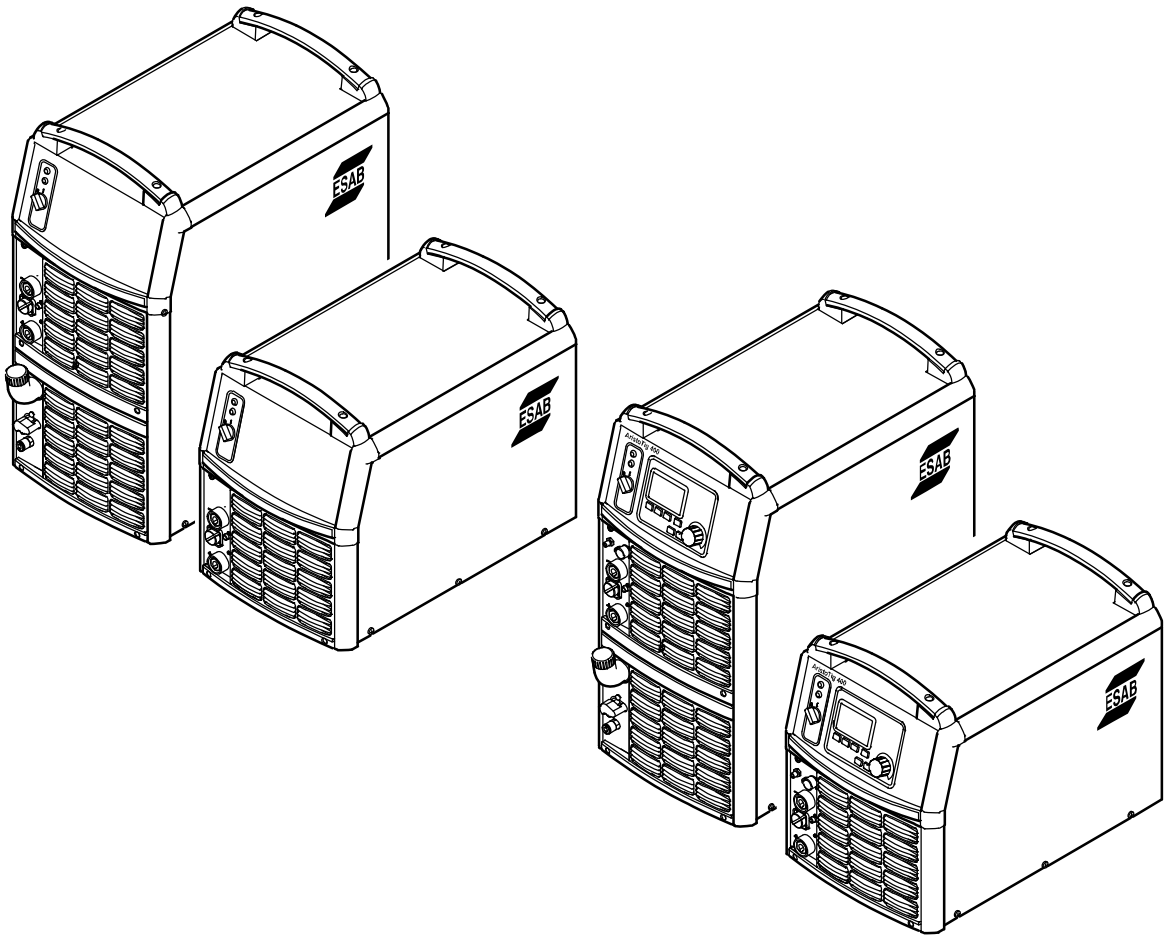
ESAB

Aristo™ Origo™

Arc 4000i, Mig U4000i, Mig 4000i, Tig 4000i



Service manual

0740 800 191 100629

Valid for serial no. 803-xxx-xxxx to 950-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 77.

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

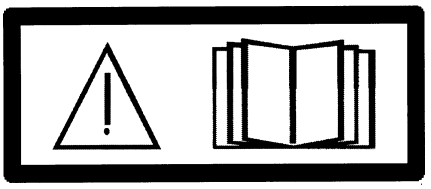
The manual is valid for:
Arc 4000i with serial no. 803-xxx-xxxx.
Mig U4000i, Mig 4000i and Tig 4000i with serial no. 803-xxx-xxxx and 950-xxx-xxxx.

Note! *Mig U4000i, Mig 4000i, Tig 4000i and Arc 4000i with serial number 105-xxx-xxxx to 802-xxx-xxxx differ from the description in this manual. For those machines there is another service manual with file name 0740 800 166*

The Mig U4000i, Mig 4000i, Tig 4000i and Arc 4000i 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!

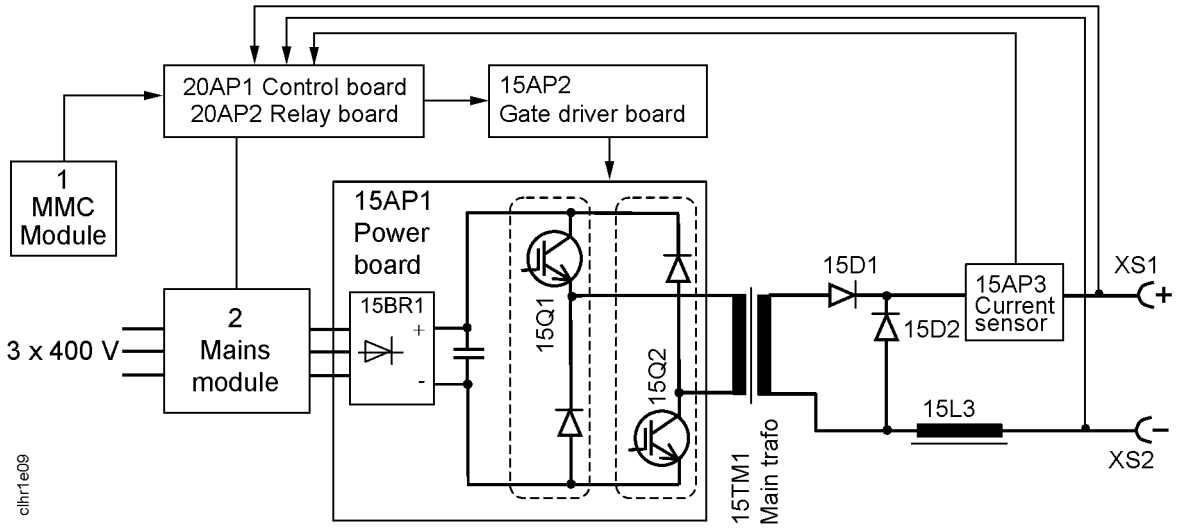
Read and understand the instruction manual before installing or operating.



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

INTRODUCTION

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.



Block diagram of the power source

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.

TECHNICAL DATA

Mig U4000i

Mains voltage	400V ± 10%, 3~ 50/60 Hz
Mains supply	$S_{sc\ min}$ 2.0 MVA
Primary current	
I_{max} MIG/MAG	25 A
I_{max} MMA	27 A
I_{max} TIG	20 A
No-load power demand when in the energy-saving mode, 6.5 min. after welding	60 W
Setting range	
MIG/MAG	20 A / 15 V - 400 A / 34 V
MMA	16 A / 21 V - 400 A / 36 V
TIG	4 A / 10 V - 400 A / 26 V
Permissible load at MIG/MAG	
35 % duty cycle	400 A / 34 V
60 % duty cycle	320 A / 30 V
100 % duty cycle	250 A / 27 V
Permissible load at MMA	
35 % duty cycle	400 A / 36 V
60 % duty cycle	320 A / 33 V
100 % duty cycle	250 A / 30 V
Permissible load at TIG	
35 % duty cycle	400 A / 26 V
60 % duty cycle	320 A / 23 V
100 % duty cycle	250 A / 20 V
Power factor at maximum current	0.90
Efficiency at maximum current	86 %
Open-circuit voltage	See page 38
without VRD function **1)** MIG/MAG	55 - 70 V
without VRD function **1)** MMA, TIG	78 - 90 V
VRD function deactivated **2)**	58 V
VRD function activated **2)**	< 35 V
Operating temperature	-10 to +40° C
Transportation temperature	-20 to +55° C
Continual sound pressure at no-load	<70 db (A)
Dimensions, lxbxh	625 x 394 x 496 mm
with cooling unit	625 x 394 x 776 mm
Weight	63.5 kg
with cooling unit	83.5 kg
Insulation class	H
Enclosure class	IP 23
Application class	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.

Mig 4000i

Mains voltage	400V ±10%, 3~ 50/60 Hz
Mains supply	$S_{sc\ min}$ 2.0 MVA
Primary current I_{max} (MIG/MAG) I_{max} (MMA)	 25 A 27 A
No-load power demand when in the energy-saving mode, 6.5 min. after welding	60 W
Setting range MIG/MAG MMA	 20 A / 15 V - 400 A / 34 V 16 A / 21 V - 400 A / 36 V
Permissible load at (MIG/MAG) 35 % duty cycle 60 % duty cycle 100 % duty cycle	 400 A / 34 V 320 A / 30 V 250 A / 27 V
Permissible load at (MMA) 35 % duty cycle 60 % duty cycle 100 % duty cycle	 400 A / 36 V 320 A / 33 V 250 A / 30 V
Power factor at maximum current	0.90
Efficiency at maximum current	86 %
Open-circuit voltage without VRD function **1)** MIG/MAG without VRD function **1)** MMA VRD function deactivated **2)** VRD function activated **2)**	See page 38 55 - 70 V 78 - 90 V 58 V < 35 V
Operating temperature	-10 to +40° C
Transportation temperature	-20 to +55° C
Dimensions, lxbxh with cooling unit	625 x 394 x 496 mm 625 x 394 x 776 mm
Continual sound pressure at no-load	<70 db (A)
Weight with cooling unit	59.5 kg 79.5 kg
Insulation class	H
Enclosure class	IP 23
Application class	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.

Tig 4000i

Mains voltage	400V ±10%, 3~ 50/60 Hz
Mains supply	$S_{sc\ min}$ 2.0 MVA
Primary current I_{max} (TIG) I_{max} (MMA)	 20 A 27 A
No-load power in the energy-saving mode, 6.5 min. after welding	60 W
Voltage/current range (TIG) (MMA)	 8 - 60 V / 4 - 400 A 16 - 400 A
Permissible load at TIG 35 % duty cycle 60 % duty cycle 100 % duty cycle	 400 A / 26 V 320 A / 23 V 250 A / 20 V
Permissible load at MMA 35 % duty cycle 60 % duty cycle 100 % duty cycle	 400 A / 36 V 320 A / 33 V 250 A / 30 V
Power factor at maximum current	0.90
Efficiency at maximum current	86 %
Open-circuit voltage without VRD function [1] VRD function deactivated [2] VRD function activated [2]	See page 38 78 - 90 V 58 V < 35 V
Operating temperature range	-10 to + 40° C
Transportation temperature	-20 to +55° C
Dimensions, lxbxh with cooling unit	625 x 394 x 496 625 x 394 x 776
Continual sound pressure at no-load	<70 db (A)
Weight with cooling unit	61.5 kg 81.5 kg
Insulation class	H
Enclosure class	IP 23
Application class	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.

Cooling unit

Cooling power	2.0 kW at 40° C temperature difference and flow1.5 l/min
Coolant	50 % water / 50% mono-ethylen glycol
Coolant quantity	5.5 l
Maximum water flow	2.0 l/min
Maximum number of water-cooled welding guns/torches that may be connected: Two MIG welding guns or one TIG torch and one MIG welding gun	

Arc 4000i

Mains voltage	400 V ± 10%, 3~ 50/60 Hz
Mains supply	$S_{sc\ min}$ 2.0 MVA
Primary current I_{max}	27 A
No-load power in energy-saving mode 6.5 min. after welding	50 W
Setting range	16 A - 400 A
Maximum permissible load at	
35 % duty cycle	400 A / 36 V
60 % duty cycle	320 A / 33 V
100 % duty cycle	250 A / 30 V
Power factor at maximum current	0.90
Efficiency at maximum current	86%
Open-circuit voltage	78 - 90 V
Temperature range	-10 till + 40° C
Transportation temperature	-20 to +55° C
Dimensions, l x b x h	625 x 294 x 492 mm
Continual sound pressure at no-load	<70 db (A)
Weight	47.5 kg
Insulation class	H
Enclosure class	IP 23
Application class	S

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.

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.

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

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

CAUTION !

STATIC ELECTRICITY can damage circuit boards and electronic components.

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

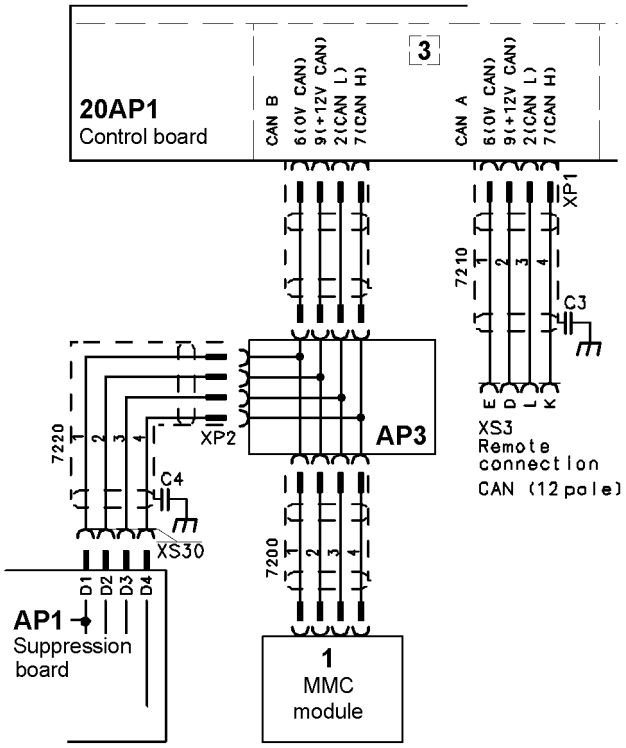
Component description

Component	Description
AP1	Connection board for communication with the wire feed unit and remote control device.
AP2	Interference suppressor board. See diagram on page 22.
AP3	CAN bus distribution board. Accessory, included in the MMC kit for the MIG machines, see page 13.
C3	Capacitor, 100 nF 250 V.
C4	Capacitor, 100 nF 250 V.
D1	LED, orange, for overtemperature indication.
D2	LED, white. Indicates Power On.
XP..	Plug connectors.
XS..	Socket connectors.
XT..	Terminal blocks.

Component	Description
1	**MMC module**. Wire numbers 100-199. See description on page 22.
2	**Mains module**. Wire numbers 200-299.
2AP1	EMC suppressor board. See diagram on page 23.
2FU1	Fuse, 4 A slow blow (anti-surge).
2FU2	Fuse, 6.3 A, slow blow (anti-surge).
2FU3	Fuse, 3.15 A, slow blow (anti-surge).
2FU4	Fuse, slow blow (anti-surge), different rating depending on machine type. Mig U4000i and Mig 4000i: 8 A. Tig 4000i: 0.5 A Mig U4000i: from serial no. 803-903-5789, the 8 A glass-tube fuse is replaced by a 10 A Micro Circuit Breaker, fitted to the rear panel of the power source, see page 69.
2FU5	Fuse, 2 A, slow blow (anti-surge).
2KM1	Main contactor. See 20AP2:3 on page 44.
2QF1	Mains switch. See 20AP2:3 on page 44.
2TC1	Auxiliary transformer.
2TC2	Auxiliary transformer. If the mains voltage exceeds 427 V, the link on terminal 2XT2 must be moved from the 400 V terminal to the 428 V terminal. Delivered with fuses 2FU4 and 2FU5. There are two versions of the transformer, see page 69.
3	**Primary inductor module**. Wire numbers 300-399.
3L1	Primary inductor.
5	**Water cooling module**. Wire numbers 500-599. The wiring diagram for the cooling module is on page 24. 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 45.
10	TIG module. Wire numbers 1000-1199.
10AP1	HF starting device. See the description of 20AP2:7 on page 48.
10C1	Interference suppression capacitor, 47 nF 250V.
10TV1	HF transformer.
10YV1	Gas valve. See the description of 20AP2:6 on page 48.
15	**Power module**. Wire numbers 1500-1699. See the schematic diagram and description on page 25.
15AP1	Power board.
15AP2	Driver board.

Component	Description
15AP3	Current sensor. See the description of 20AP1:8 on page 37.
15BR1	Rectifier bridge. See the description of 15AP1:1 on page 26 and the assembly instructions on page 59.
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 59 for assembly instructions for the diode modules.
15EV1, 15EV2	Fans, 24 V DC. See the description of 20AP1:2 on page 33.
15L1, 15L2	2 + 2 ferrite rings. Reduce transient voltages produced when the diode modules 15D1 and 15D2 turn off.
15L3	Inductor.
15Q1, 15Q2	IGBT transistors. See the description of 15AP1:2 on page 27 and the installation instructions on page 59.
15ST1	Thermal overload cutout, in the winding of main transformer TM1. See the description of 20AP1:4 on page 36.
15ST2	Thermal overload cutout, mounted on the heat sink for the IGBT modules. See the description of 20AP1:4 on page 36 and the installation instructions on page 59.
15TM1	Main transformer.
20AP1	Controller circuit board.
20AP2	Relay board.

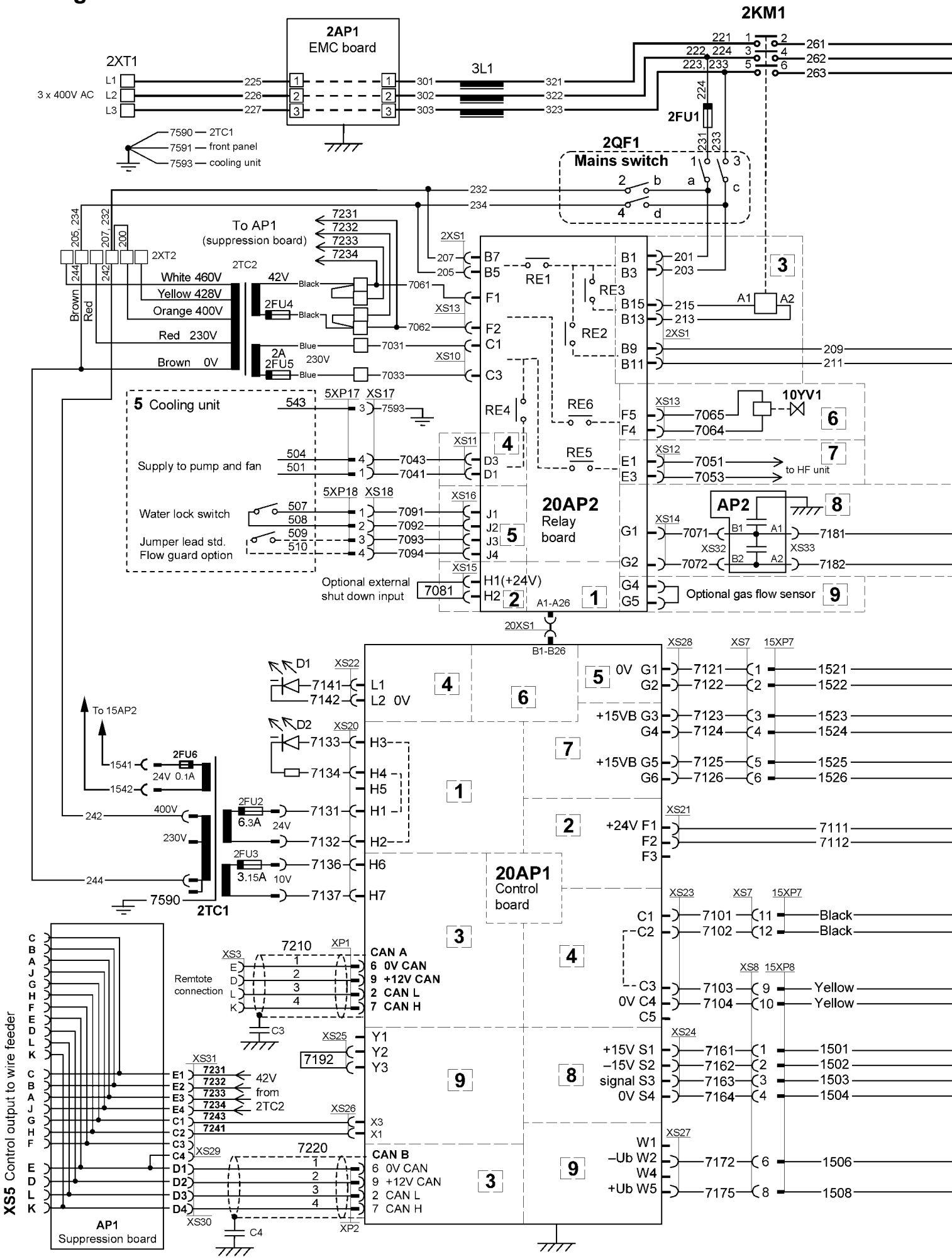
MMC option for MIG machines

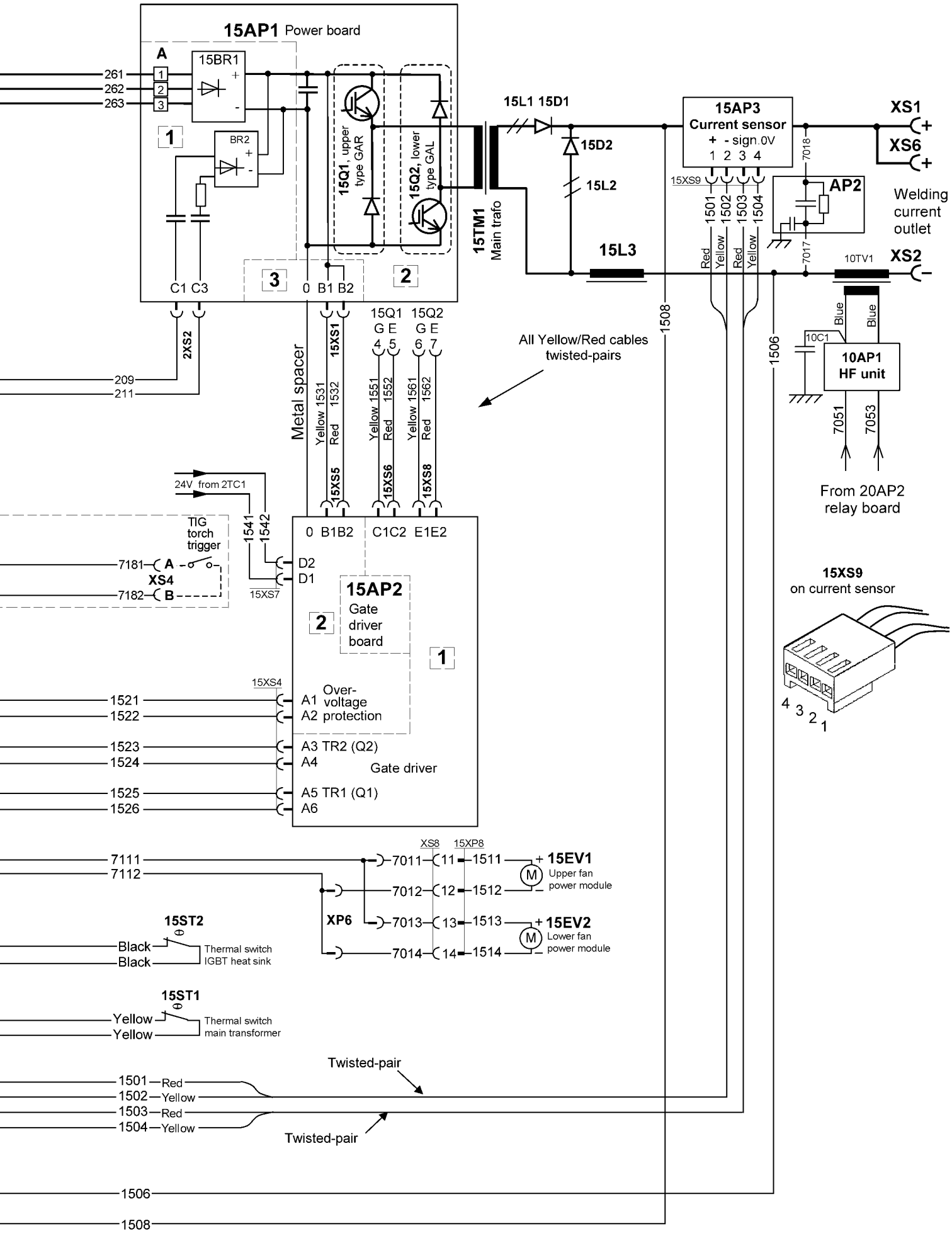


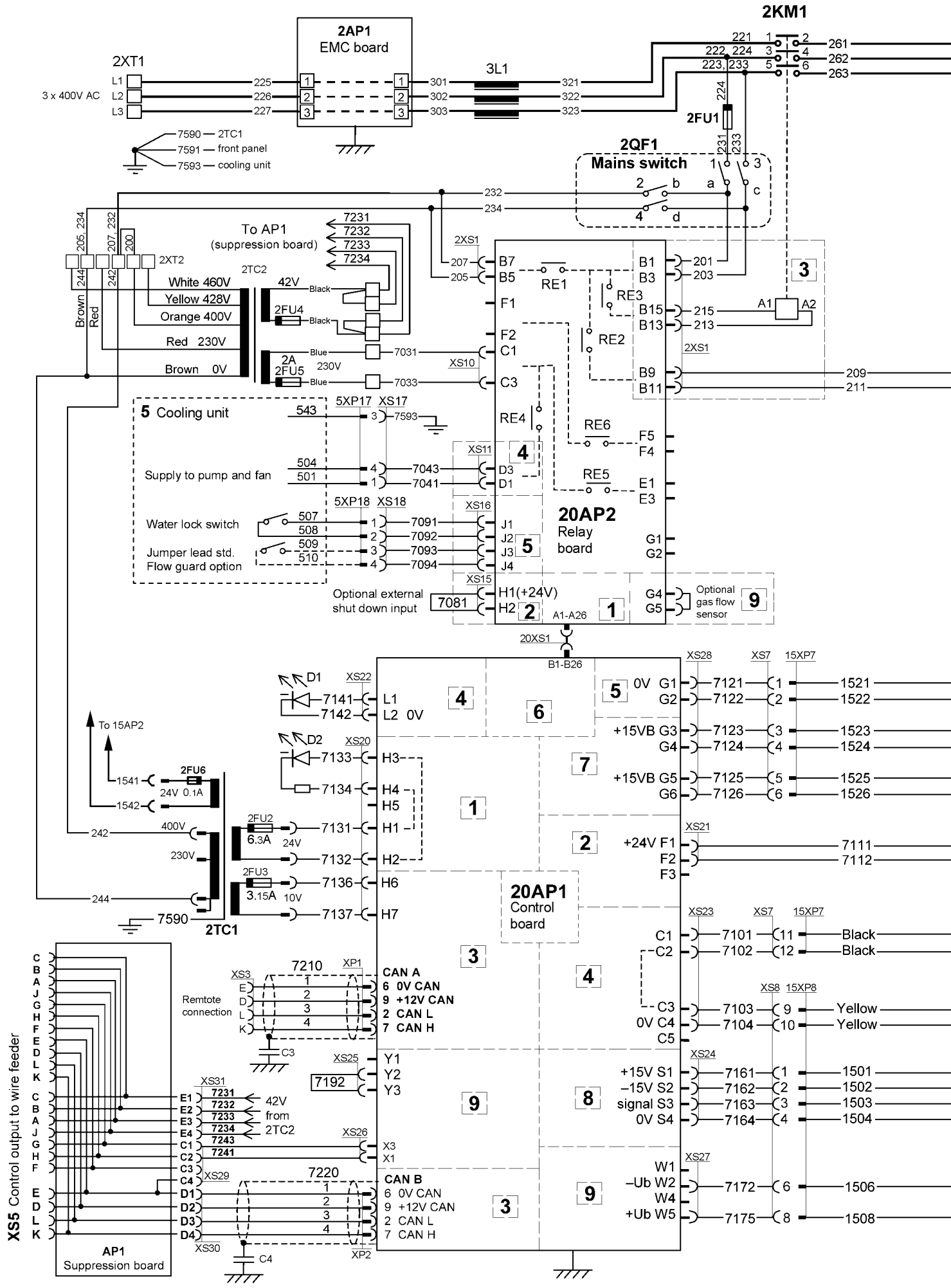
CAN bus distribution board AP3 connected to Mig 4000i

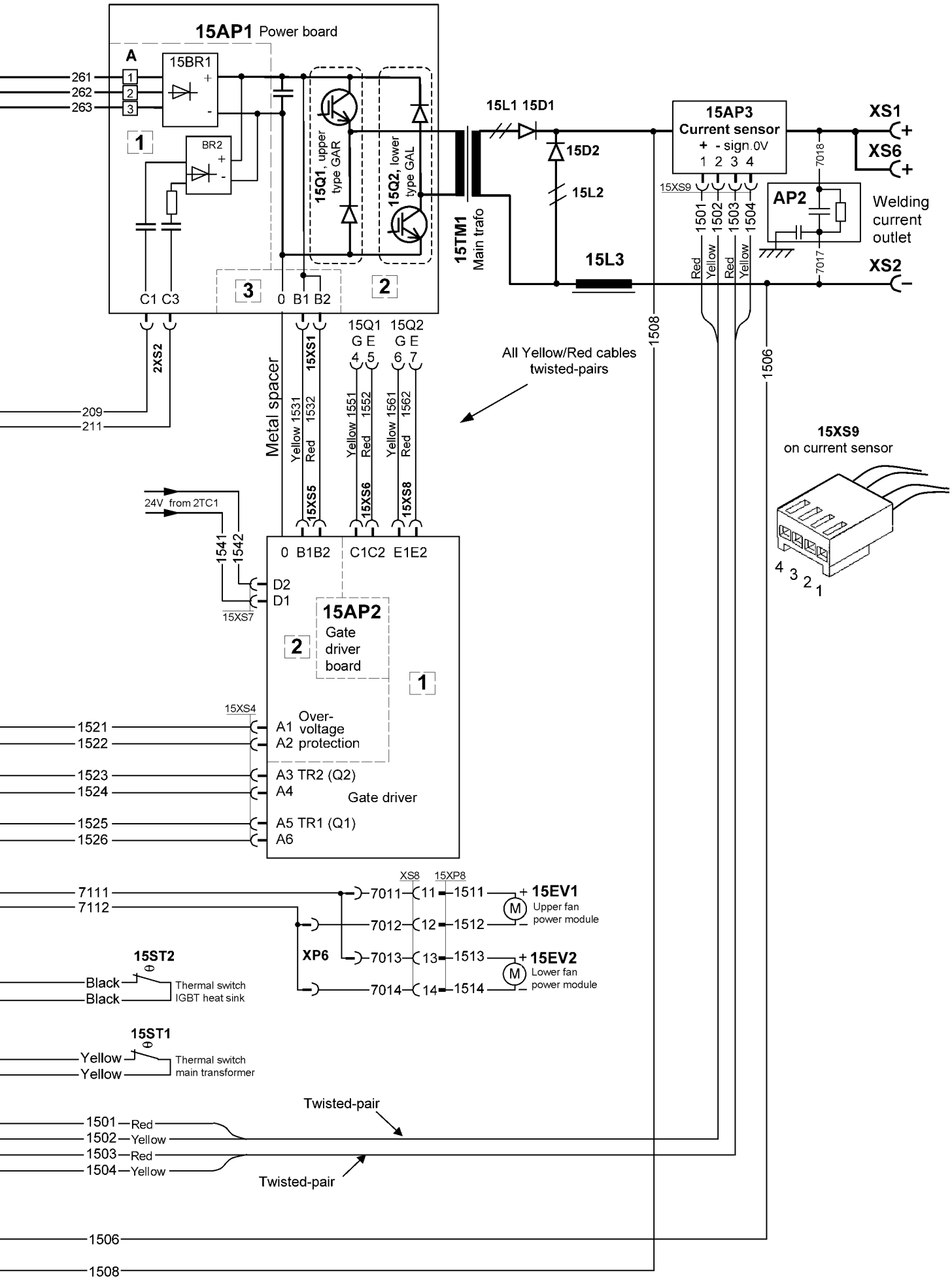
The MIG machines are normally delivered without MMC module. If the accessory 'MMC kit' is used, the MMC module can be moved from the wire feed unit to the power source.

Mig U4000i valid from serial number 803-xxx-xxxx

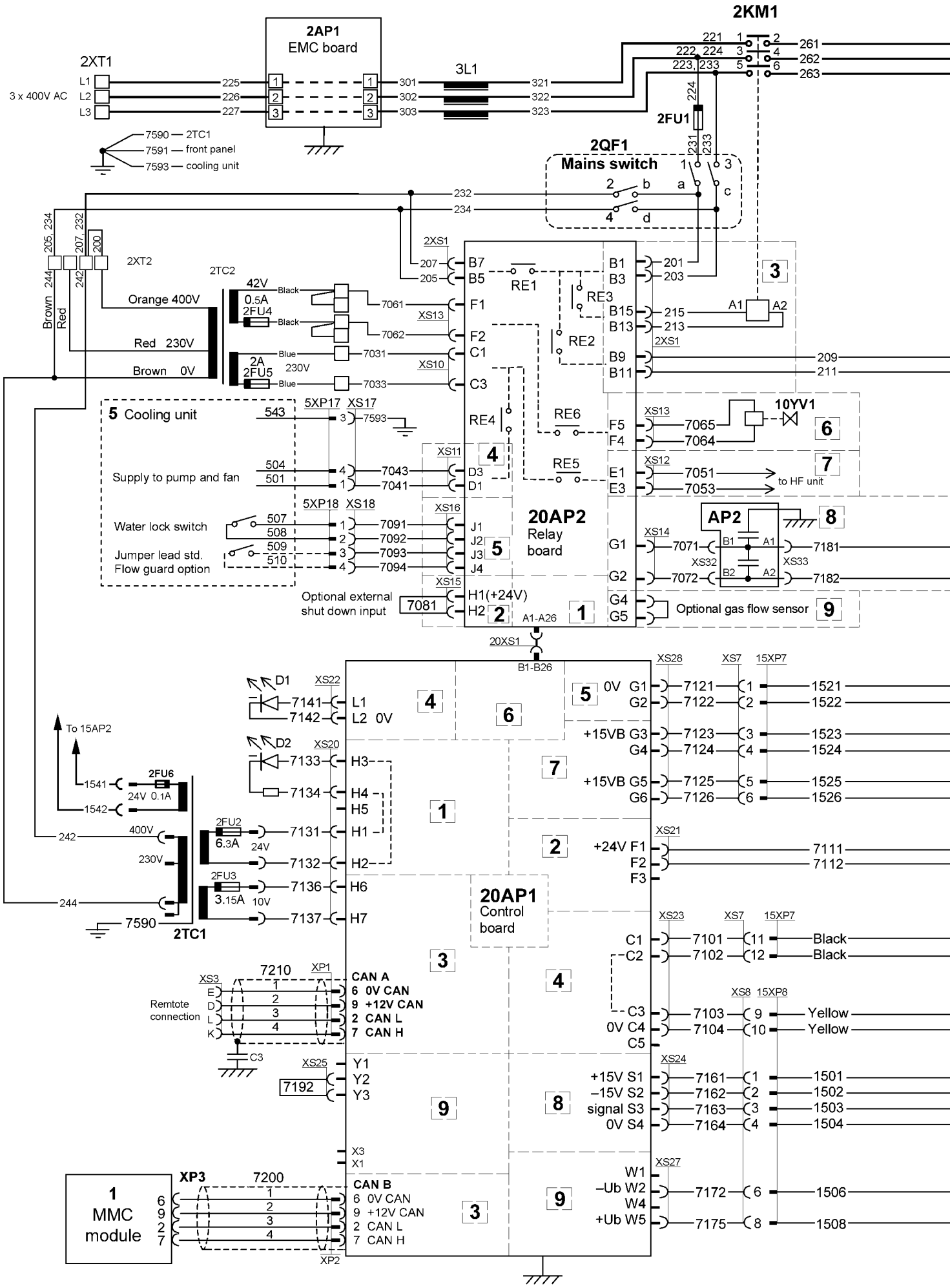


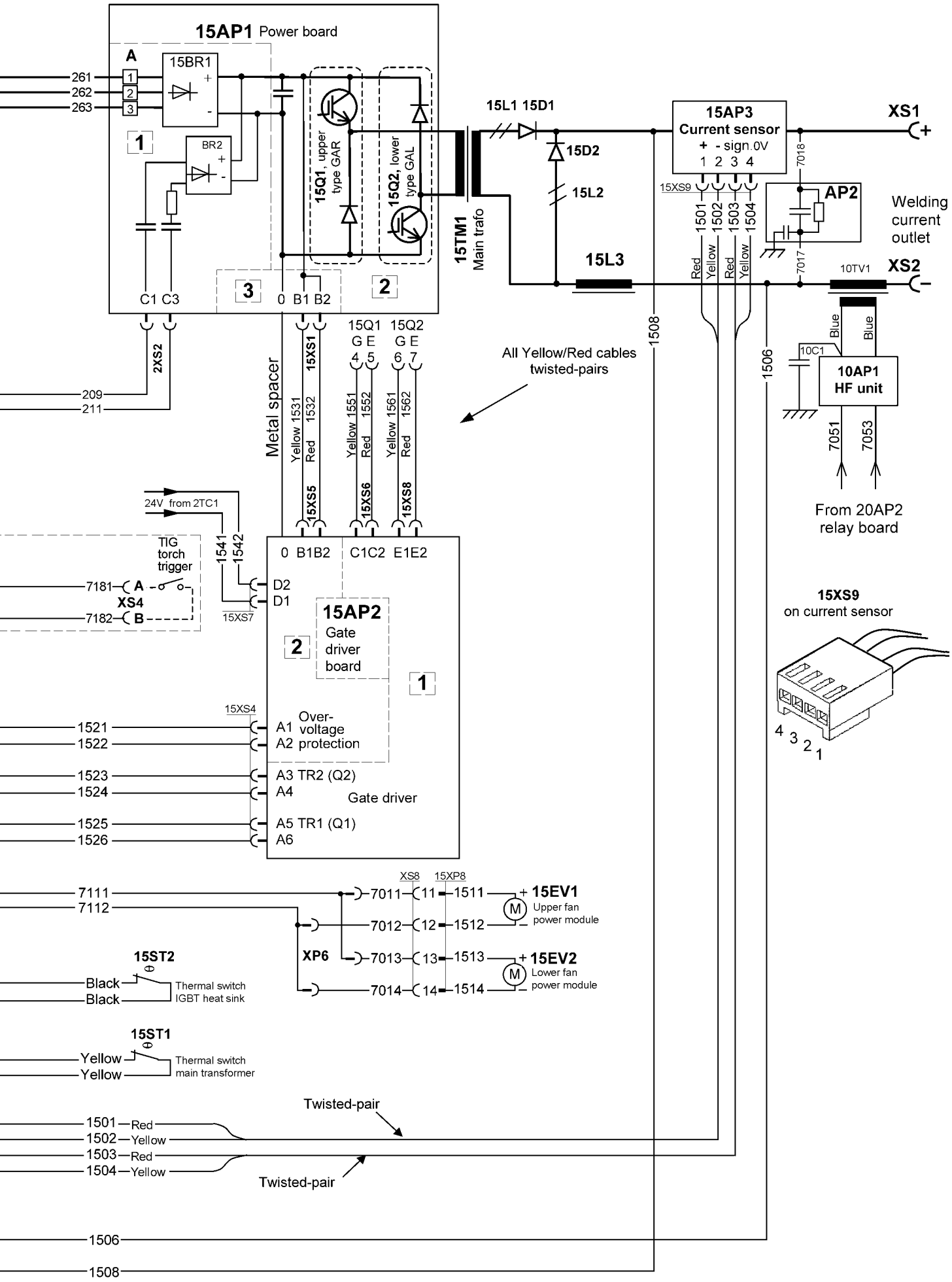

15AP1 Power board
A
15BR1
BR2
1
2
3
261
262
263
15Q1, upper type GAR
15Q2, lower type GAL
15L1 15D1
15D2
15L2
15L3
15TM1 Main trafo
15AP3 Current sensor
+ - sign.0V
1 2 3 4
15XS9
1501 1502 1503 1504
Red Yellow Red Yellow
7018
7017
AP2
XS1
XS6
Welding current outlet
XS2
10TV1
1508
1506
Blue Blue
10C1
10AP1 HF unit
7051 7053
From 20AP2 relay board
All Yellow/Red cables twisted-pairs
C1 C3
0 B1 B2
2XS2
209
211
Metal spacer
15Q1 15Q2
G E G E
4 5 6 7
15XS1
Yellow 1531 Red 1532
Yellow 1551 Red 1552
Yellow 1561 Red 1562
15XS5
15XS6
15XS8
24V from 2TC1
1541 1542
TIG torch trigger
7181 A
XS4
7182 B
15XS7
0 B1B2 C1C2 E1E2
D2
D1
15AP2
Gate driver board
15XS4
A1 Over-voltage
A2 protection
A3 TR2 (Q2)
A4
Gate driver
A5 TR1 (Q1)
A6
1521
1522
1523
1524
1525
1526
15XS9
on current sensor
4 3 2 1
XS8 15XP8
7111
7112
7011 11 1511
7012 12 1512
7013 13 1513
7014 14 1514
XP6
15EV1
Upper fan power module
15EV2
Lower fan power module
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


2KM1
2AP1
EMC board
2XT1
3 x 400V AC
L1
L2
L3
225
226
227
3L1
301
302
303
321
322
323
221
222
223
224
233
261
262
263
2FU1
2QF1
Mains switch
231
232
234
7590 — 2TC1
7591 — front panel
7593 — cooling unit
To AP1
(suppression board)
7231
7232
7233
7234
2XT2
2TC2
White 460V
Yellow 428V
Orange 400V
Red 230V
Brown 0V
42V
2FU4
2A
2FU5
230V
Black
Blue
7031
7033
XS10
2XS1
RE1
RE2
RE3
RE4
RE5
RE6
A1
A2
209
211
5 Cooling unit
543
5XP17
XS17
7593
Supply to pump and fan
504
501
7043
7041
XS11
Water lock switch
Jumper lead std.
Flow guard option
5XP18
XS18
507
508
509
510
7091
7092
7093
7094
XS16
20AP2
Relay
board
Optional external
shut down input
7081
H1(+24V)
H2
XS15
A1-A26
20XS1
B1-B26
Optional
gas flow
sensor
To 15AP2
1541
1542
2FU6
24V 0.1A
242
244
400V
230V
2FU2
6.3A
24V
2FU3
3.15A
10V
7590
2TC1
D1
D2
XS22
XS20
7141
7142
7133
7134
7131
7132
7136
7137
H1
H2
H3
H4
H5
H6
H7
20AP1
Control
board
XS28
XS7
15XP7
0V G1
G2
+15VB G3
G4
+15VB G5
G6
7121
7122
7123
7124
7125
7126
1521
1522
1523
1524
1525
1526
XS21
+24V F1
F2
F3
7111
7112
XS23
C1
C2
C3
0V C4
C5
7101
7102
7103
7104
Black
Black
Yellow
Yellow
XS8
15XP8
XS24
+15V S1
–15V S2
signal S3
0V S4
7161
7162
7163
7164
1501
1502
1503
1504
XS27
W1
–Ub W2
W4
+Ub W5
7172
7175
1506
1508
XS3
7210
XP1
Remtote
connection
CAN A
6 0V CAN
9 +12V CAN
2 CAN L
7 CAN H
C3
XS25
7192
Y1
Y2
Y3
XS31
7231
7232
7233
7234
7243
7241
42V
from
2TC2
XS26
X3
X1
XS29
7220
CAN B
6 0V CAN
9 +12V CAN
2 CAN L
7 CAN H
XS30
C4
XP2
XS5 Control output to wire feeder
AP1
Suppression board

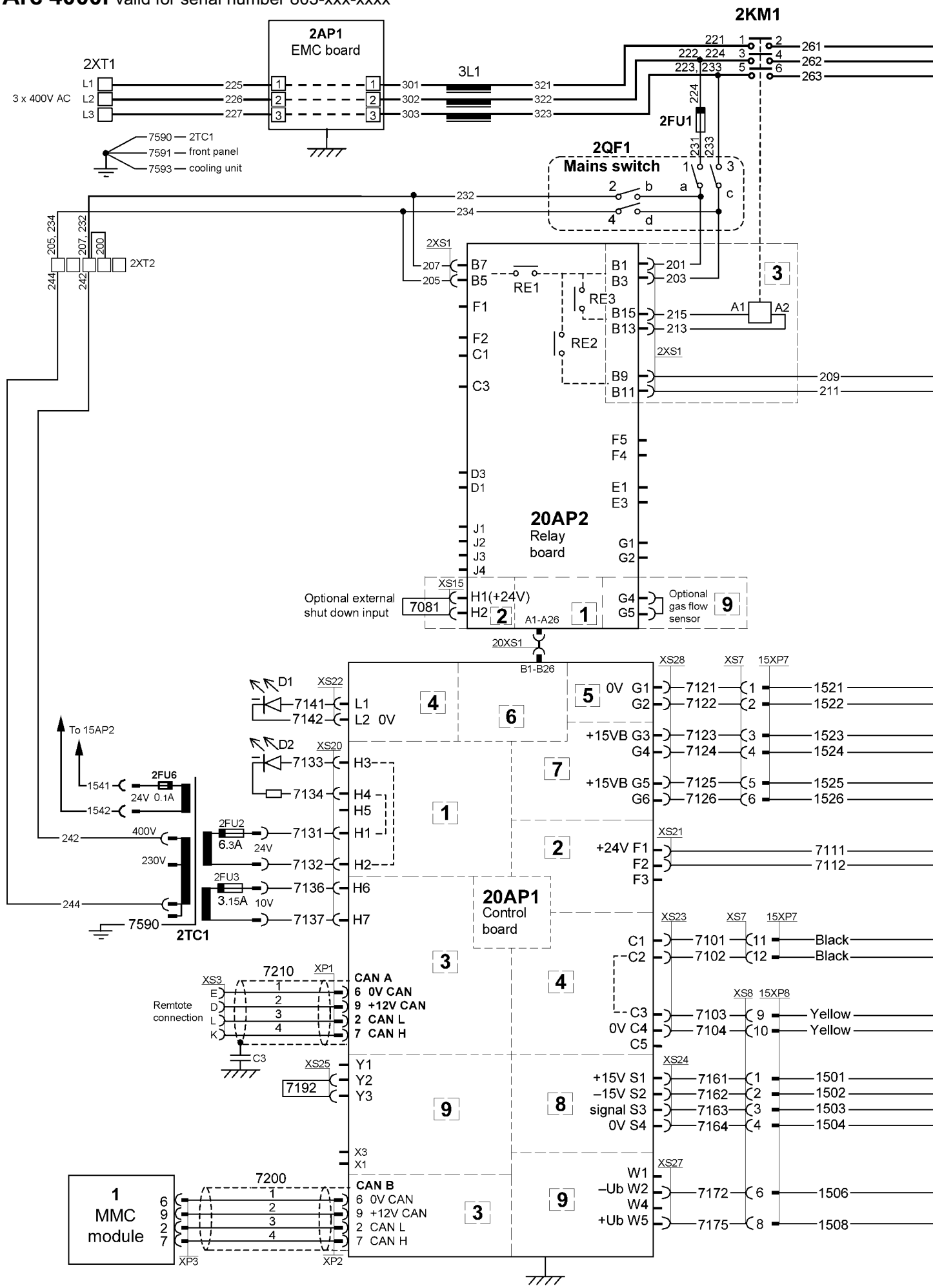

15AP1 Power board
A
15BR1
BR2
261
262
263
1
2
3
15Q1, upper type GAR
15Q2, lower type GAL
15L1 15D1
15D2
15L2
15L3
15TM1 Main trafo
15AP3 Current sensor
+ - sign.0V
1 2 3 4
15XS9
XS1
XS6
XS2
AP2
7018
7017
Welding current outlet
1501 1502 1503 1504
Red Yellow Red Yellow
1508
1506
C1 C3
3
0 B1 B2
2
2XS2
209
211
Metal spacer
15Q1 15Q2
G E G E
4 5 6 7
15XS1
15XS5
15XS6
15XS8
Yellow 1531
Red 1532
Yellow 1551
Red 1552
Yellow 1561
Red 1562
All Yellow/Red cables twisted-pairs
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 11 1511
7012 12 1512
7013 13 1513
7014 14 1514
XP6
15EV1
Upper fan power module
15EV2
Lower fan power module
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

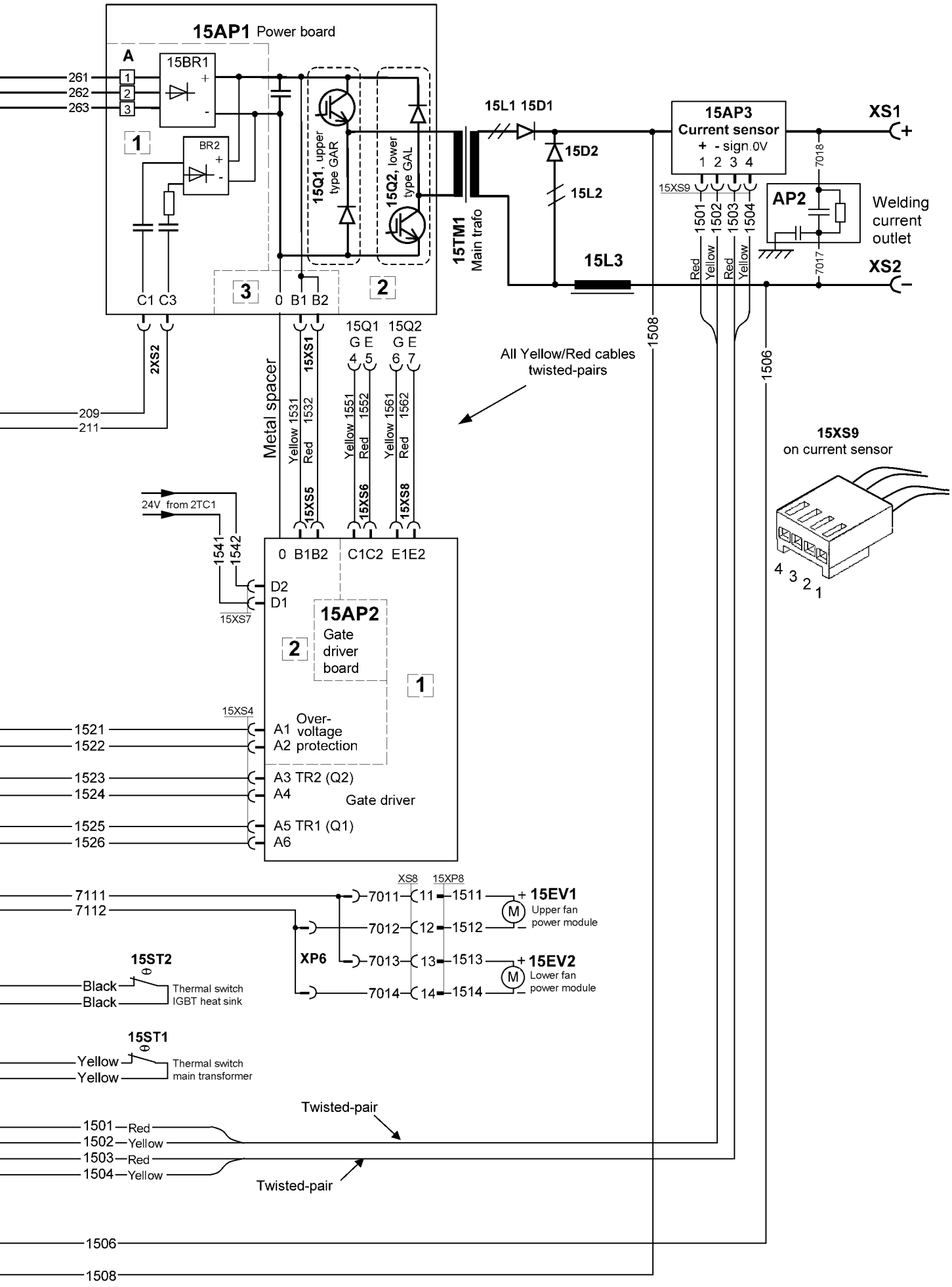
Tig 4000i valid from serial number 803-xxx-xxxx




15AP1 Power board
A
15BR1
BR2
261
262
263
1
2
3
15Q1, upper type GAR
15Q2, lower type GAL
15TM1 Main trafo
15L1 15D1
15D2
15L2
15L3
15AP3 Current sensor
+ - sign.0V
1 2 3 4
XS1
XS2
15XS9
1501 1502 1503 1504
Red Yellow Red Yellow
7018
7017
AP2
Welding current outlet
10TV1
Blue Blue
10C1
10AP1 HF unit
7051
7053
From 20AP2 relay board
1508
1506
All Yellow/Red cables twisted-pairs
C1 C3
0 B1 B2
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
TIG torch trigger
7181
A
XS4
7182
B
15XS7
0 B1B2 C1C2 E1E2
D2
D1
15AP2
Gate driver board
2
1
15XS4
1521
1522
A1 Over-voltage
A2 protection
1523
1524
A3 TR2 (Q2)
A4
Gate driver
1525
1526
A5 TR1 (Q1)
A6
15XS9
on current sensor
4 3 2 1
XS8
15XP8
7111
7112
7011 11 1511
7012 12 1512
XP6
7013 13 1513
7014 14 1514
15EV1
Upper fan power module
15EV2
Lower fan power module
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

Arc 4000i valid for serial number 803-xxx-xxxx

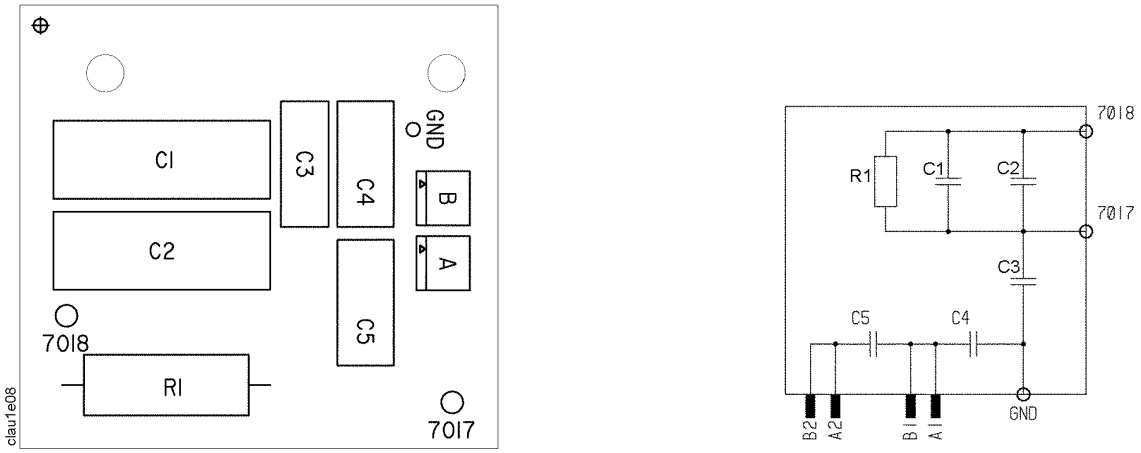



15AP1 Power board
A
15BR1
BR2
261
262
263
1
2
3
15Q1, upper type GAR
15Q2, lower type GAL
15TM1 Main trafo
15L1 15D1
15D2
15L2
15L3
15AP3 Current sensor
+ - sign.0V
1 2 3 4
XS1
XS2
15XS9
1501
1502
1503
1504
Red
Yellow
Red
Yellow
AP2
Welding current outlet
7018
7017
1508
1506
C1 C3
0 B1 B2
2XS2
15XS1
15Q1 15Q2
G E G E
4 5 6 7
Metal spacer
Yellow 1531
Red 1532
Yellow 1551
Red 1552
Yellow 1561
Red 1562
15XS5
15XS6
15XS8
All Yellow/Red cables twisted-pairs
209
211
15XS9
on current sensor
4 3 2 1
24V from 2TC1
1541
1542
15XS7
D2
D1
0 B1B2
C1C2 E1E2
15AP2
Gate driver board
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
Twisted-pair
1501 Red
1502 Yellow
1503 Red
1504 Yellow
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 module

The MMC module consists of an operator's control panel and a welding data board.

The power source, the wire feed unit and the control panel each have their own microprocessor for control, with the control panel 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.

Setting the welding data
Man-machine communication (MMC) is assisted by the modular architecture of the equipment. It is possible to choose systems with the emphasis on the simplest possible operation, or those that can provide more optimised settings for the best welding performance.

The MMC modules are described in separate manuals

MMC modules for the Mig U4000i and Mig 4000i

The MMC module can either be a control panel fitted to the wire feed unit or a control pendant connected to the remote connection of the power source or the feed unit.

Mig U4000i: control panel U6 and control pendant U8 or $U8_2$.

Mig 4000i: control panels MA4, MA6 and contol pendant U8.

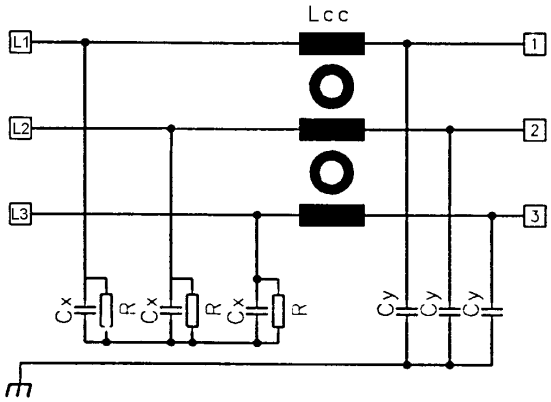
MMC modules for the Tig 4000i

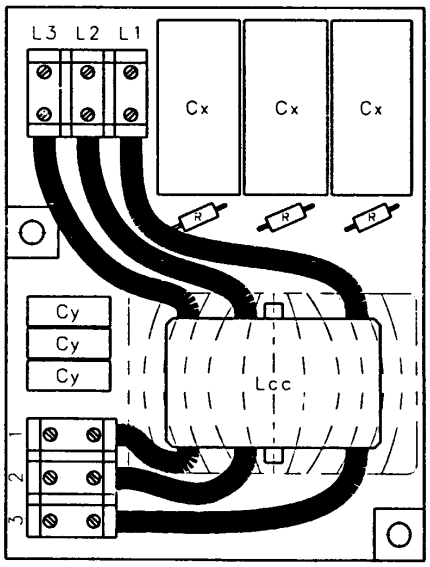
The power source is supplied with control panel TA4 or control panel TA6.

MMC modules for the Arc 4000i

The power source is supplied with control panel A2 or control panel A4.

2AP1 Interference suppressor board (EMC board)





Circuit diagram and component positions, 2AP1

5 Cooling unit

Component description, water cooling unit

5C1 Start and run capacitor for the fan motor, 5 µF 450 V AC.

5C2 Start and run capacitor for the pump motor, 3 µF 400V.

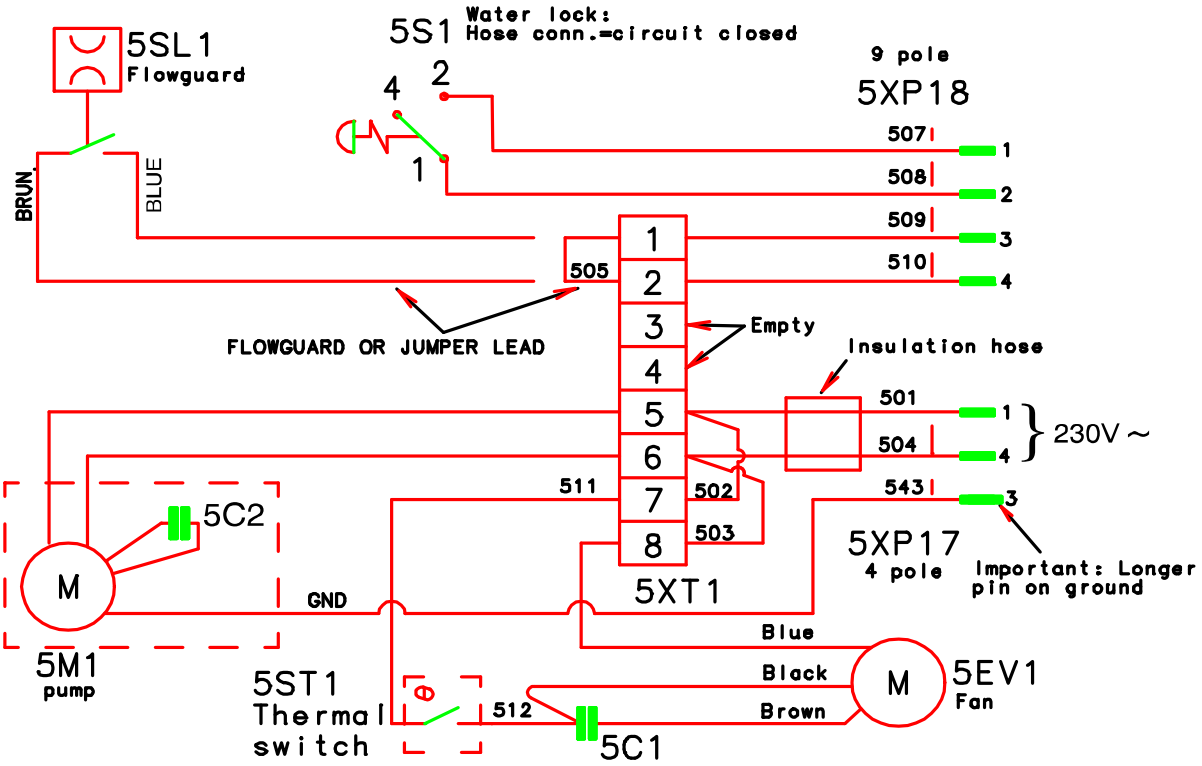
5EV1 Fan motor, 230 V AC.

5M1 Pump motor, 230 V AC.

5S1 Microswitch for the water lock connection.

5SL1 Water flow guard. The contact closes for flow rates of 0.7 l/min and over.
Note! *This is an accessory.*

5ST1 Temperature sensor switch. Closes at 45 °C, opens at 35 °C.



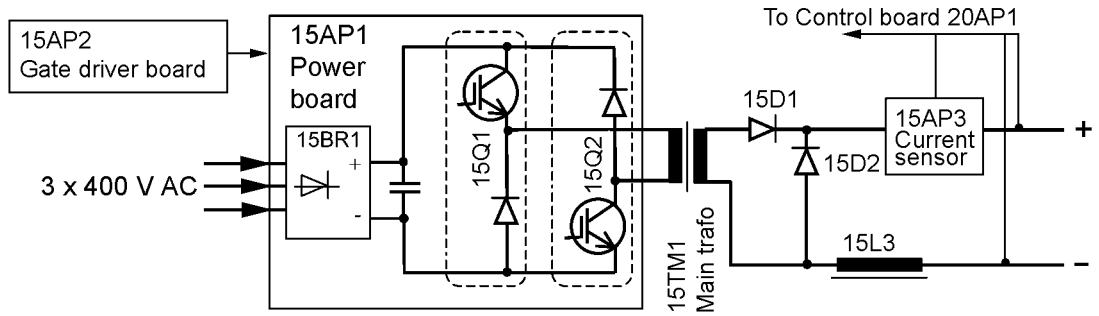
Wiring diagram for the cooling unit

The power supply to cooling water pump 5M1 and fan 5EV1 is controlled by the machine software in the welding data unit. See 20AP2:5 on page 47. The fan is connected in parallel with the pump, and is controlled by temperature sensor switch 5ST1.

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 60.

See the instructions on page 59 concerning mounting of the components on the heat sink (15Q1, 15Q2, 15BR1, 15D1 and 15D2).

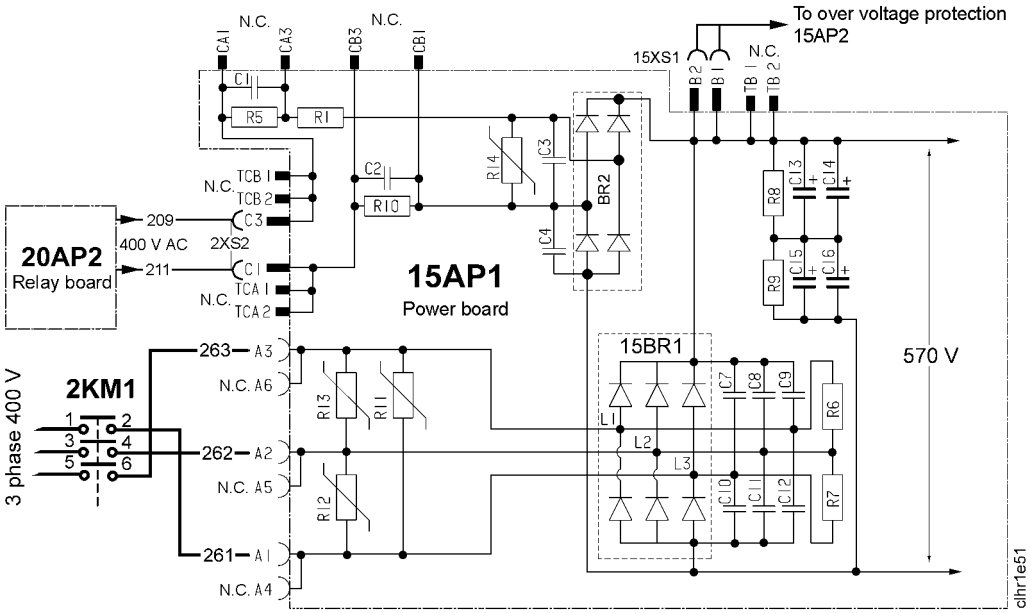
WARNING!
The power module is live at mains voltage.
0 V in the power module is connected to mains voltage.

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

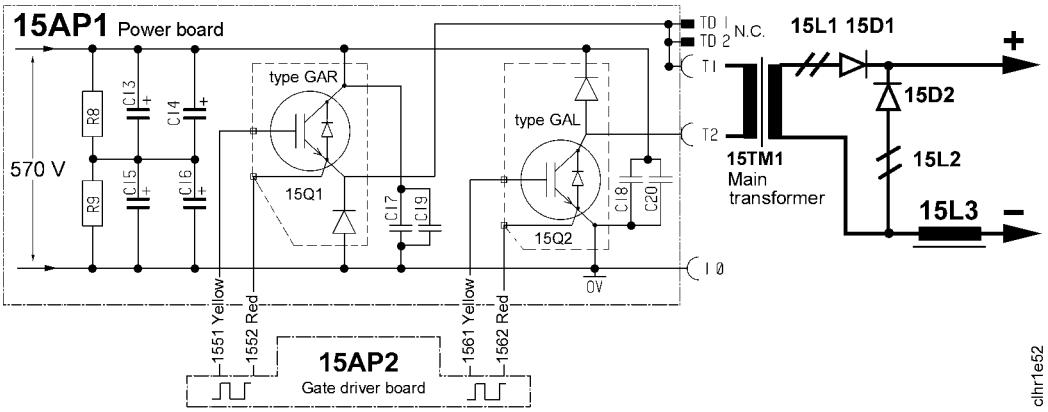


When the mains power supply is turned on, smoothing capacitors C13-C16 are charged via rectifier bridge BR2. Contactor 2KM1 closes after about twelve seconds and connects the mains supply to rectifier bridge 15BR1. See page 44 for a more detailed description of the starting sequence.

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



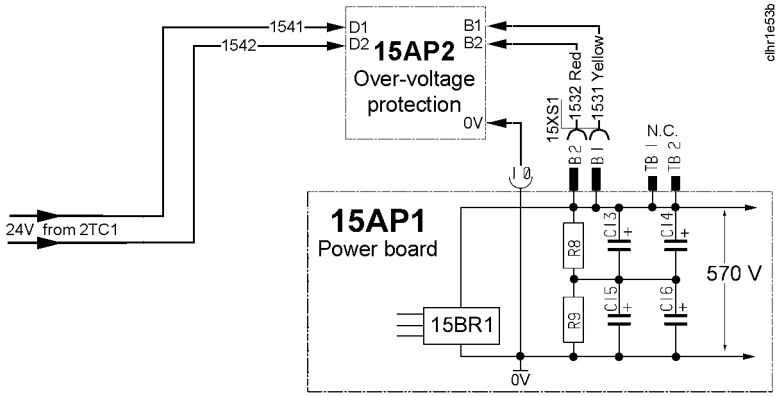
The power module switching components consist of IGBT transistors 15Q1 and 15Q2, operating at a switching frequency of 27 kHz. The transistors must never be energised when the gate connections are removed.

The gate pulse waveforms and duration are vital for correct operation. See also page 29.

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 58 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 59.

15AP1:3 Overvoltage and undervoltage protection

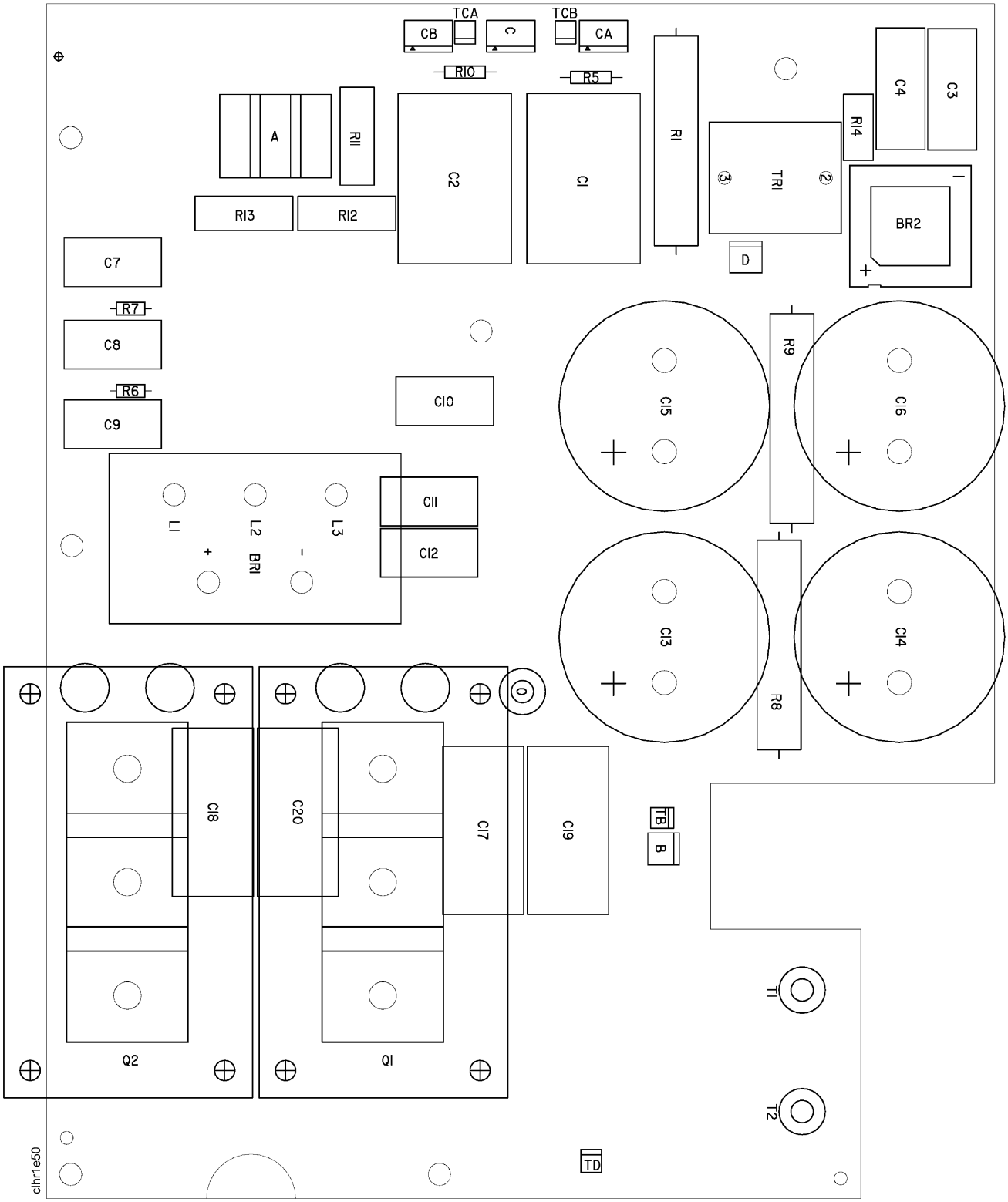


The voltage protection function monitors the voltage across smoothing capacitors C13-C16. See page 30 for a description of operation.

CAUTION!

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

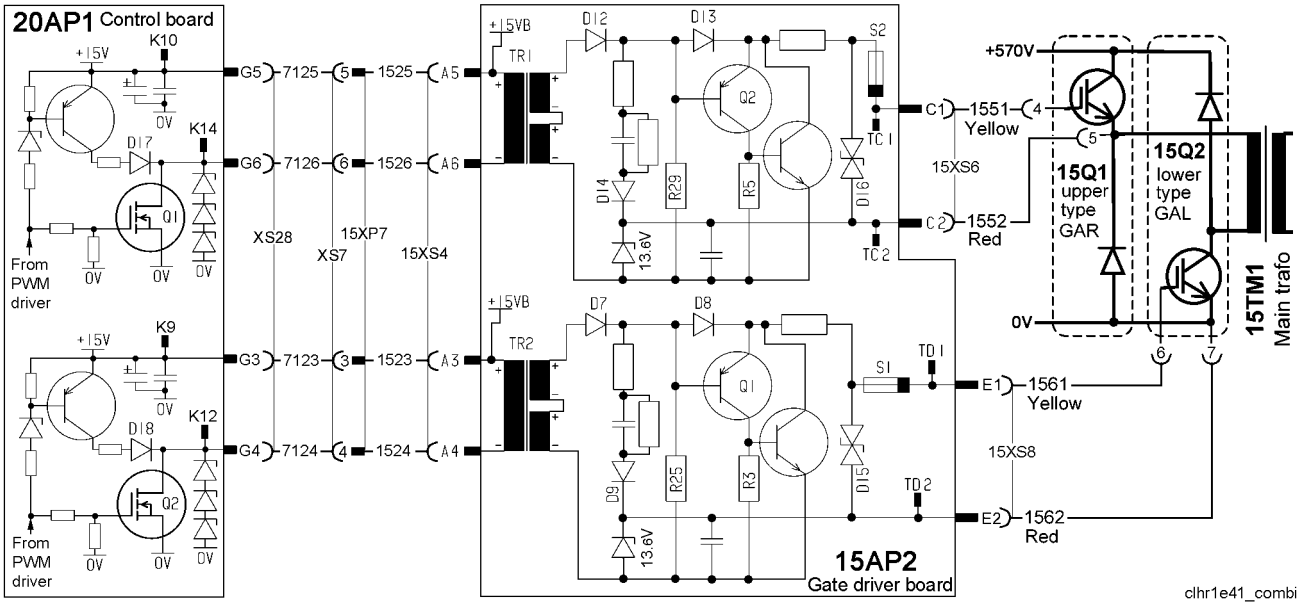
15AP1 Component positions



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 60 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.

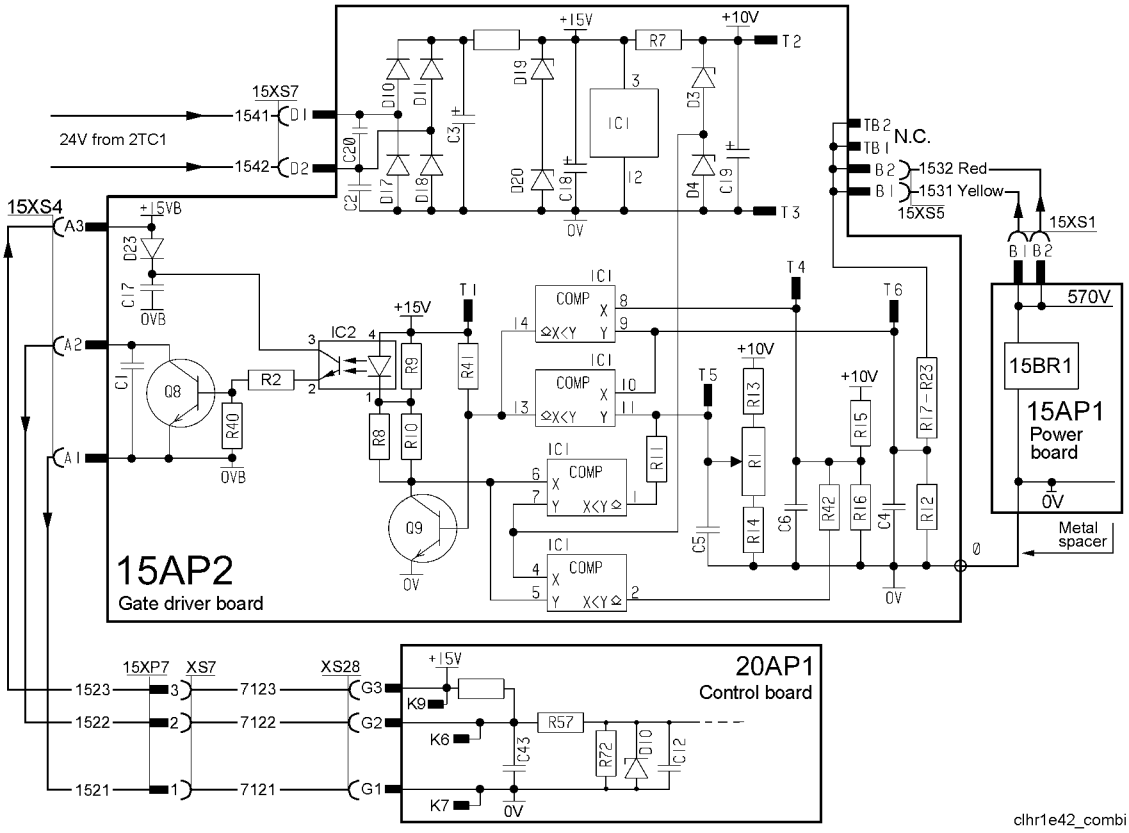
15AP2:2 Overvoltage and undervoltage protection

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.

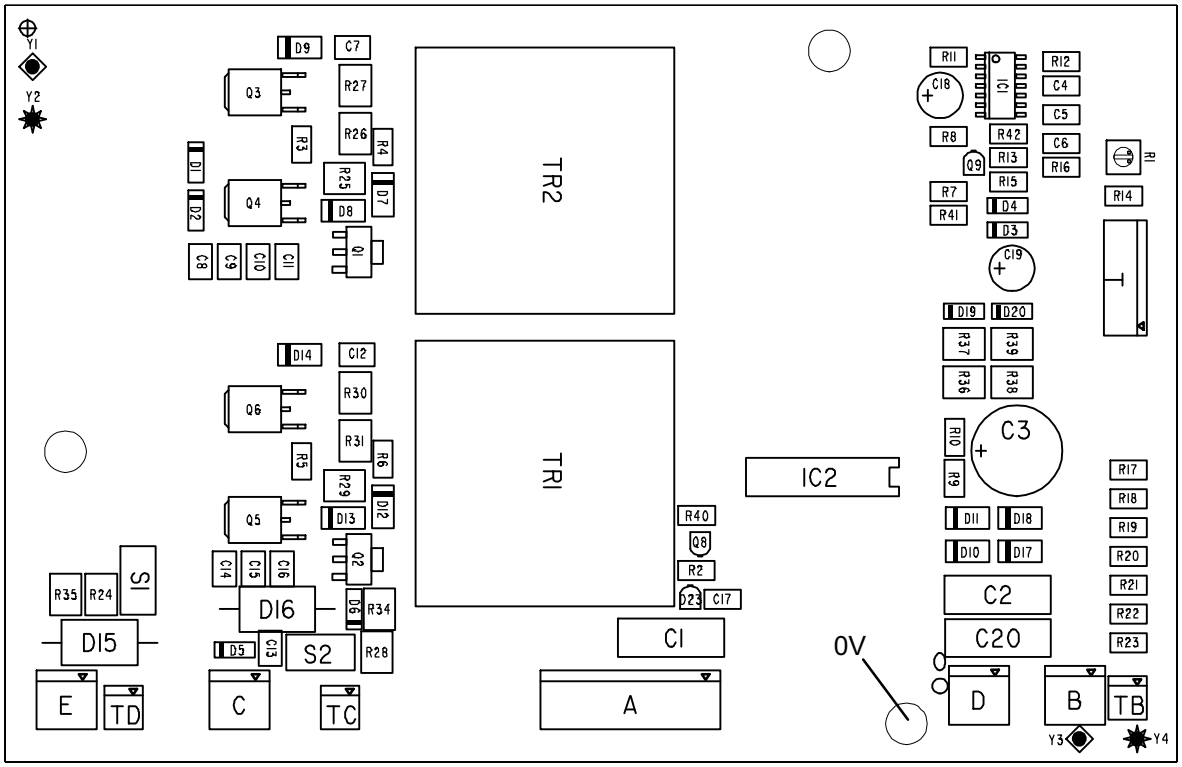
In the event of a fault, the charging relay RE2 and the contactor 2KM1 will open, as described in the starting sequence on page 44. Fault code 5 will be displayed by the control panel.

See page 64 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

This description is valid for power sources supplied with circuit board 0487 201 xxx.
Mig U4000i, Mig 4000i, Tig 4000i and Arc 4000i are supplied with this circuit board from serial no. 803-xxx-xxxx and there above.

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.

Spare part boards

There are two hardware versions of the control board, for identification see page 40.

When replacing the board, do not forget to move the “terminal D jumper” and the “Y2-Y3 jumper” to the new board. See pages 36 and 38.

CAUTION!

This circuit board looks identical to the control board used in other power sources, but there are differences in both 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

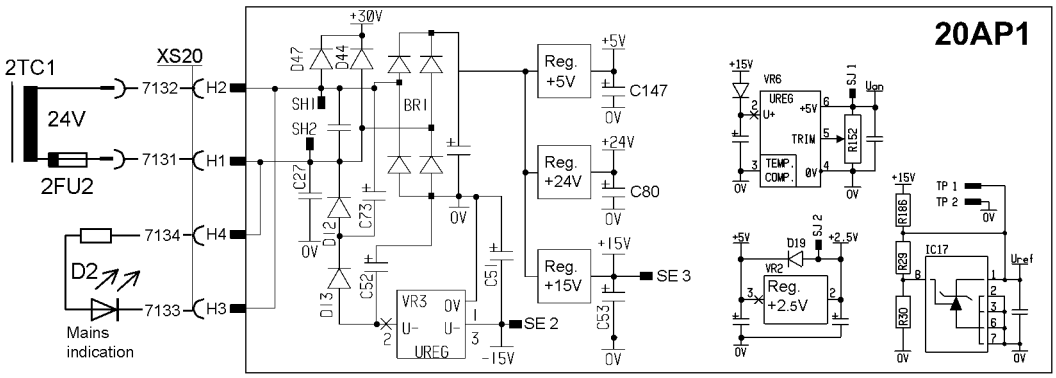
The control board has a machine ID, a hardware ID and a unit type number. To read this you need the **ESAT** service kit, see page 56.

- 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 Mig U4000i, Mig 4000i, Tig 4000i and Arc 4000i are:

Machine ID = 11
Hardware ID = 3 valid for version 1 of 20AP1.
Hardware ID = 9 valid for version 2 of 20AP1.
Unit type = 2

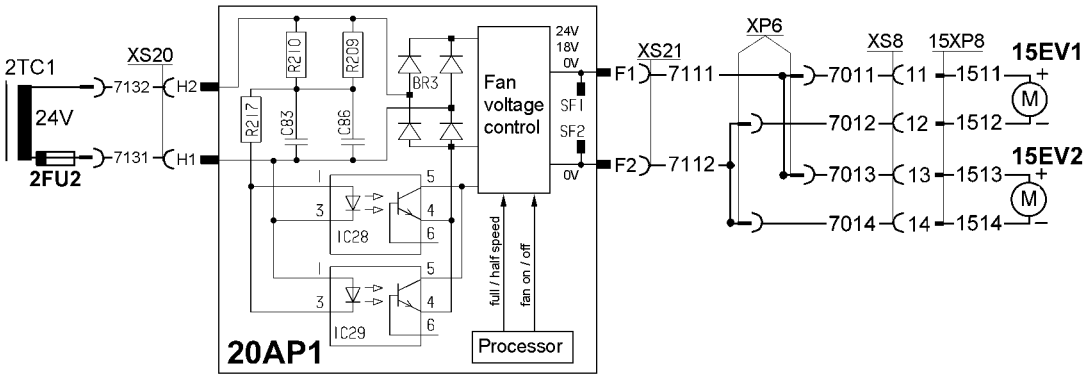
20AP1:1 Power supply



+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.

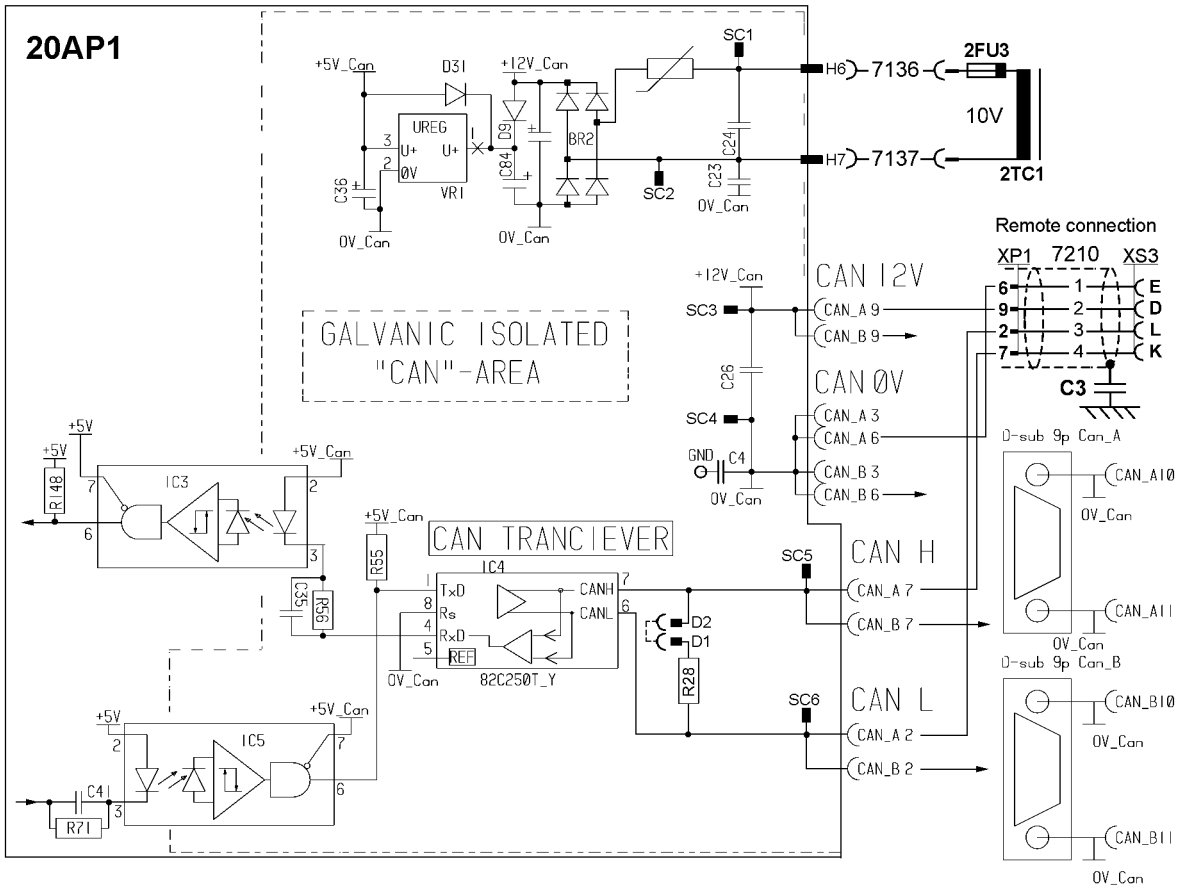
20AP1:3 The CAN bus

A standardised communication (CAN - **C**ontroller **A**rea **N**etwork) bus is used for communication between the units of the equipment. 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.

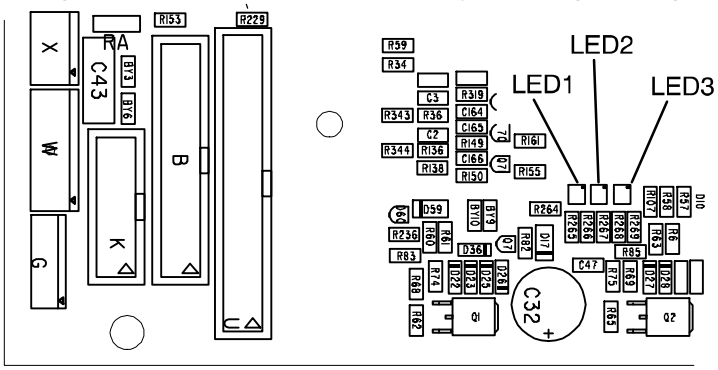


Bus communication circuits to and from the control board

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

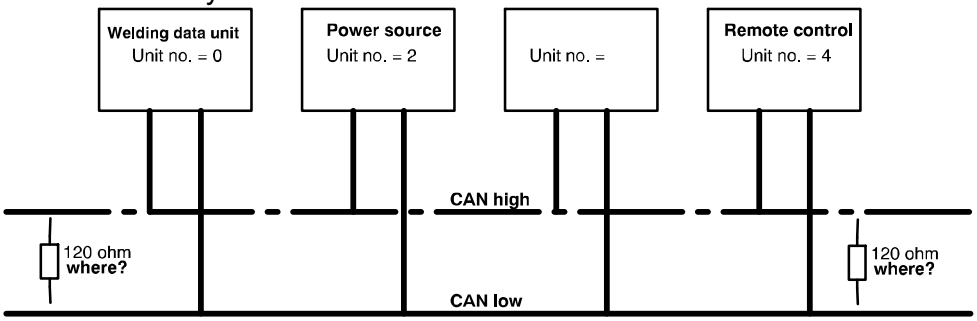
If the CAN bus fails, the control panel will normally generate a fault message.

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 L and K 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 twinned 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.

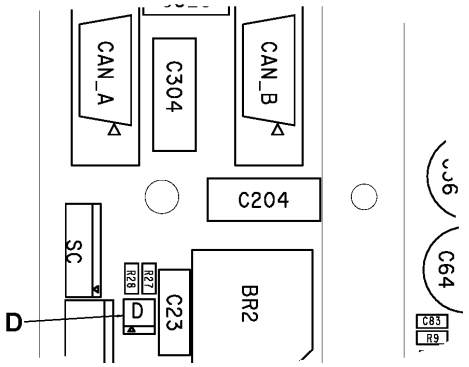
Terminating resistors

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

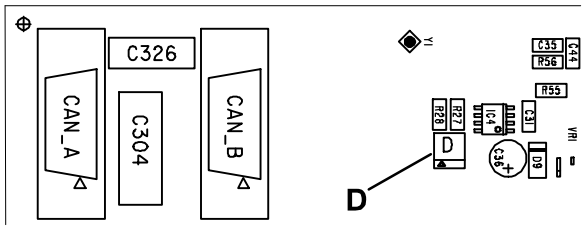


Principal diagram of the CAN bus and connecting up of the terminating resistors

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 34. If a CAN remote control with terminating resistor, or an external terminating resistor, is connected to the power source, the internal terminating resistor must be disconnected from the power source.
To disconnect the terminating resistor: remove the jumper from terminal D.



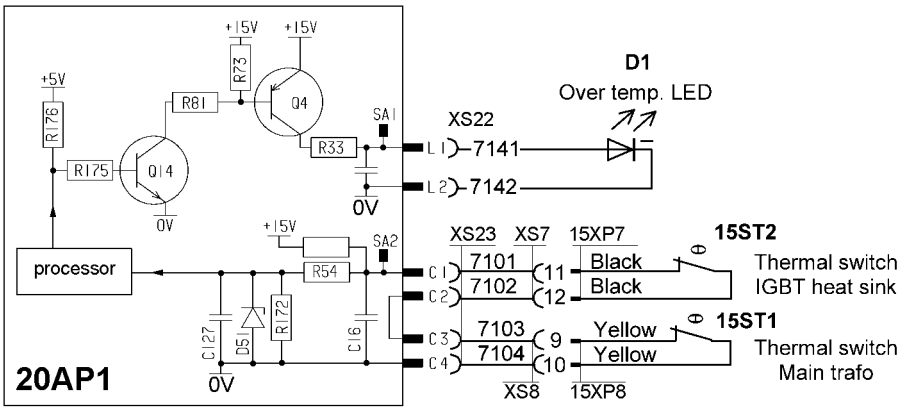
Terminal D, version 2 of 20AP1



Terminal D, version 1 of 20AP1

The CAN remote controls and CAN adapters have a built-in terminating resistor. This resistor can be disconnected or connected by moving a jumper: See the service manual for the CAN based remote controls.

20AP1:4 Temperature monitoring



Principal 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 59 for fitting instructions.

If either of the switches operates, the power source is stopped and LED D1 on the front panel lights. 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 30.

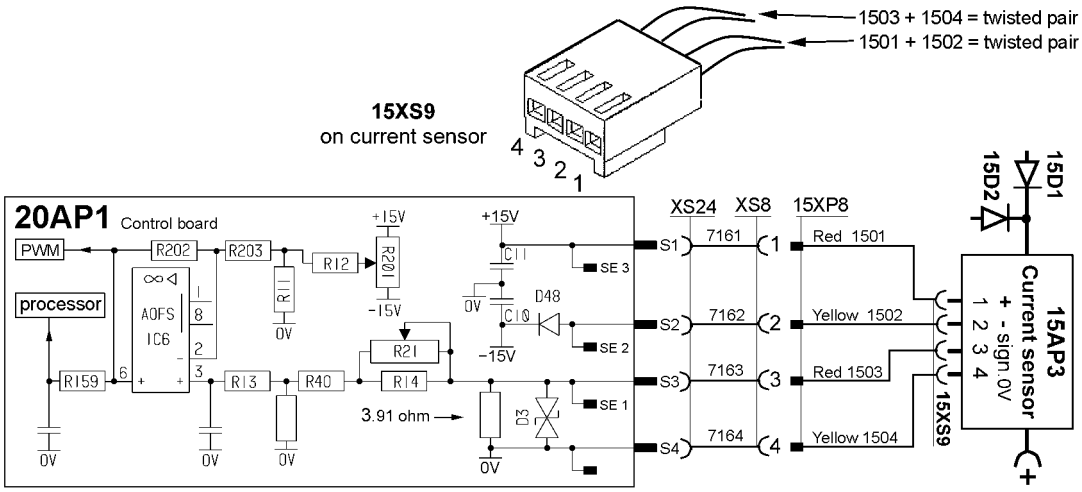
20AP1:6 Communication with relay board 20AP2

See page 43, 20AP2 relay board.

20AP1:7 Gate pulses

See page 29, 15AP2:1 gate driver stage.

20AP1:8 Current sensor



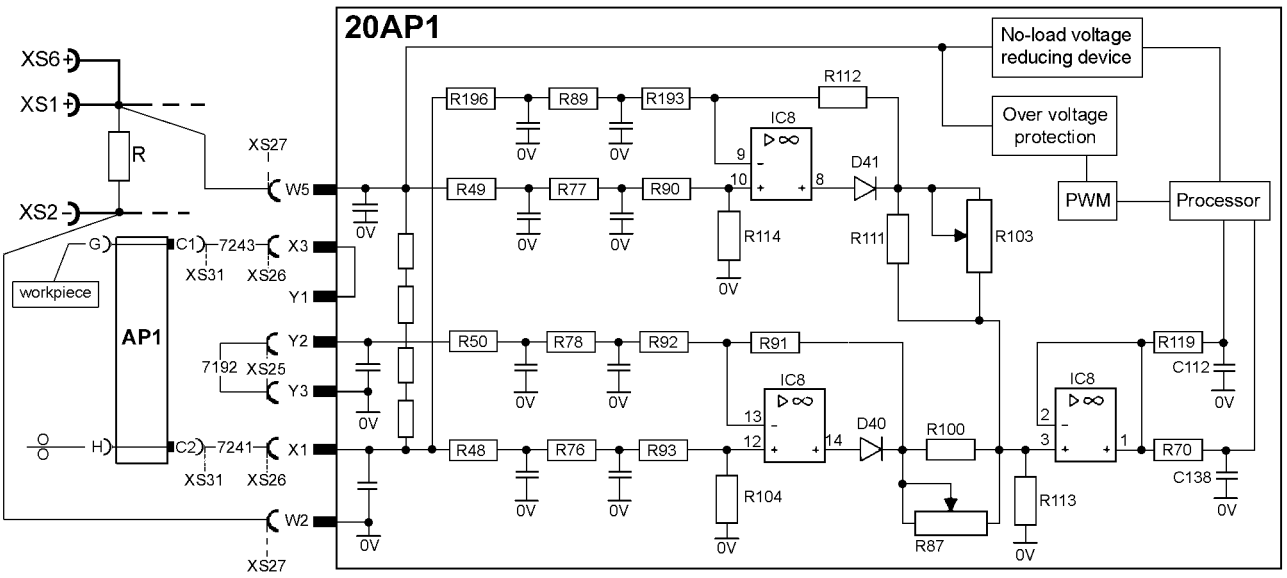
The current signal supplied to contact S3 on circuit board 20AP1 is 200 mA at 400 A, and is linearly proportional to the current. Measuring the voltage between contacts S3 and S4 on circuit board 20AP1 must show 0.195 V at 100 A welding current. (U = R x I ⇒ 3.91 x 0.05 = 0.195)

If circuit boards 20AP1 or 15AP3 are replaced, the power source must be recalibrated. See page 65 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. 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 66 to 68 for calibrating instructions.

Methods of measuring the arc voltage

Various methods of measurement are available by transferring a link between contacts Y1, Y2 and Y3. When delivered, the link is fitted between Y2 and Y3. **The link must be connected between Y2 and Y3 for MMA or TIG welding.**

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

  Y2 - Y3 must be linked. 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**

  Y2 - Y3 must be linked. 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.**

  Y2 - Y3 must be linked. 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.

- **Welding with the filler wire positive: voltage sensing from the wire and workpiece.**

  Y1 and Y2 must be linked. This method compensates for the voltage drop in both the supply and return conductors. The input signal is measured between X1 and X3. Amplifier IC8:14 is active.

  CAUTION! *If the voltage signal connection to X3 is lost, the power source loses control of the arc voltage.*

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 55 to 70 V in MIG mode and at 78 to 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 56. 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 40 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

HF start

For TIG welding with HF starting, the open circuit voltage is about 140 V, while the starting function is active. This is normally a maximum of 0.5 seconds.

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 Circuit board versions

There are two hardware versions of the control board. See 'Open-circuit voltage control' on page 39 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 56.
The print number is to the right in the component positions diagrams on pages 41 and 42. (The print number is **NOT** the same as the ordering number of the board.)

Version 1 of 20AP1:

Hardware ID 3. Print numbers up to and including 487200-003.
Power sources with serial no. 803-xxx-xxxx are delivered with version 1 of 20AP1.

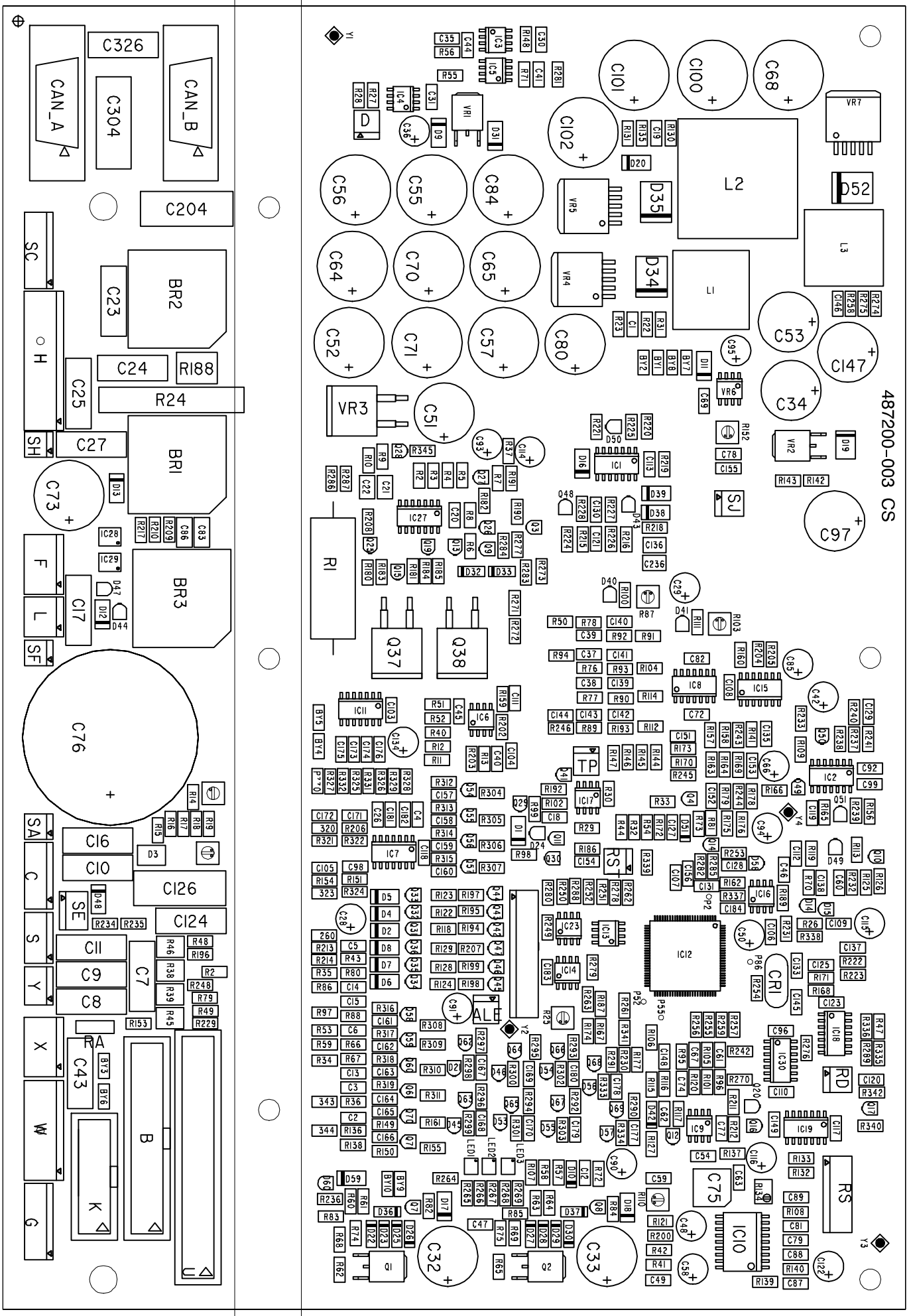
Version 2 of 20AP1:

Hardware ID 9. Print numbers from 487200-004 and there above.
Power sources with serial no. 950-xxx-xxxx and there above are delivered with version 2 of 20AP1.

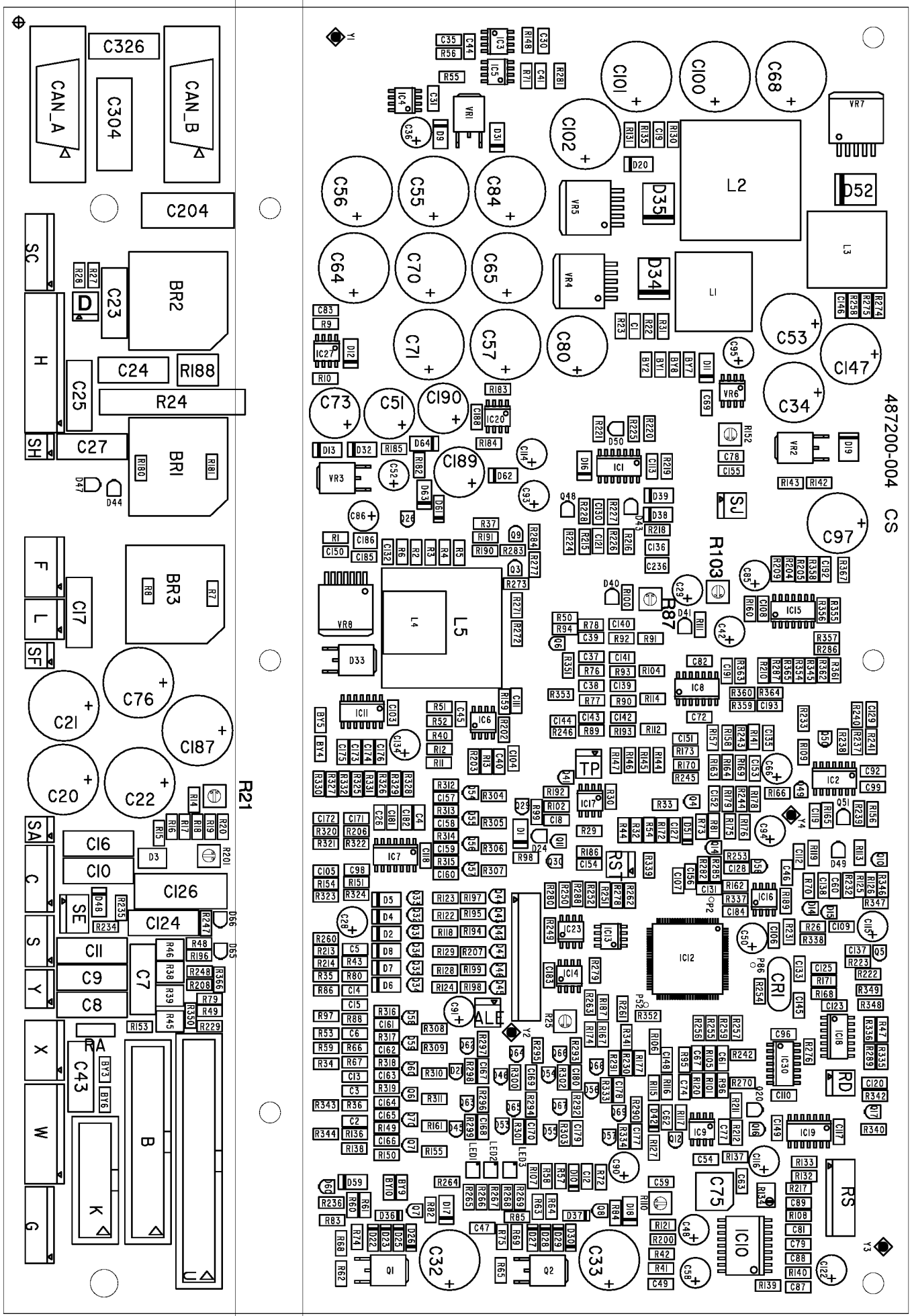
Spare parts:

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

20AP1 Component positions, version 1



20AP1 Component positions, version 2


487200-004 CS
R21
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R87
C326
CAN_A
CAN_B
C304
C204
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BR1
BR3
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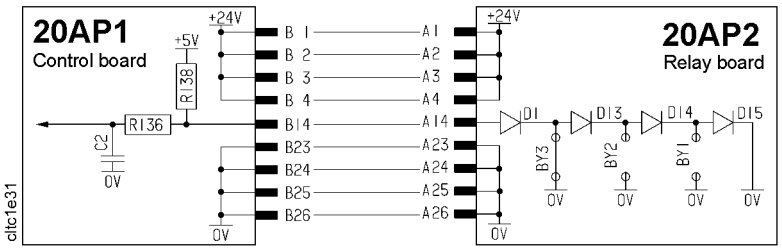
20AP2 Relay board

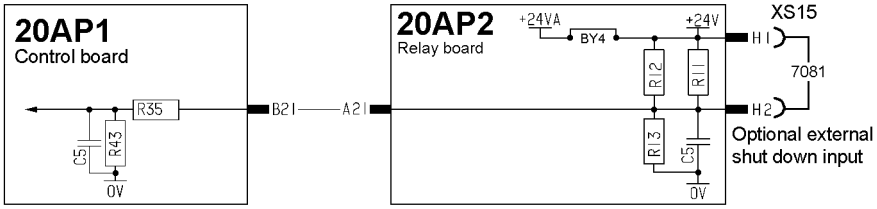
The relay board handles hardware-connected inputs and outputs to/from control board 20AP2. The relays provide the necessary galvanic insulation. In the event of a relay fault, the entire board must be replaced.

20AP2:1 Power supply



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

20AP2:2 External shutdown

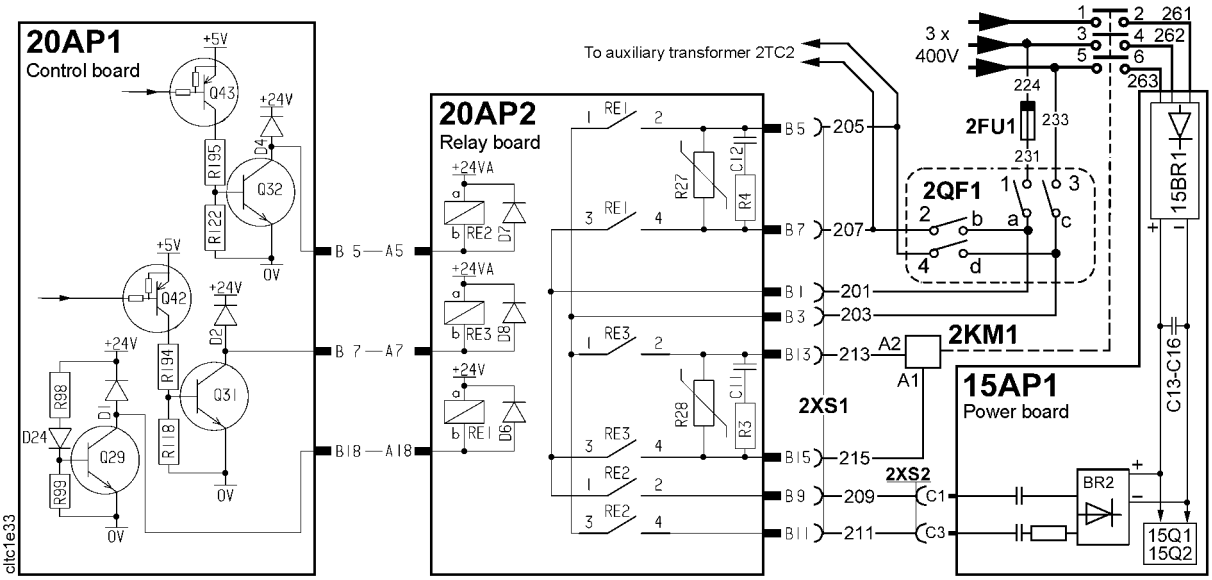


Contacts H1 and H2 must be linked if the power source is to work. If there is no link, the processor and PWM circuit on the control board are disabled.

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 50.

20AP2:3 Starting sequence



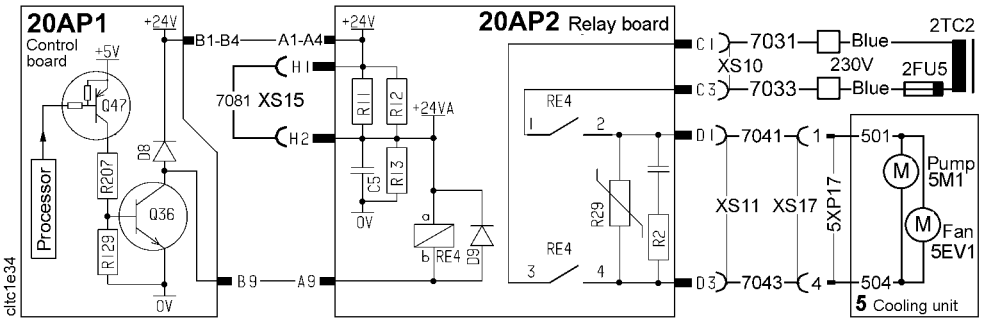
Schematic diagram of the power source starting circuits

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 controller 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 controller 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.

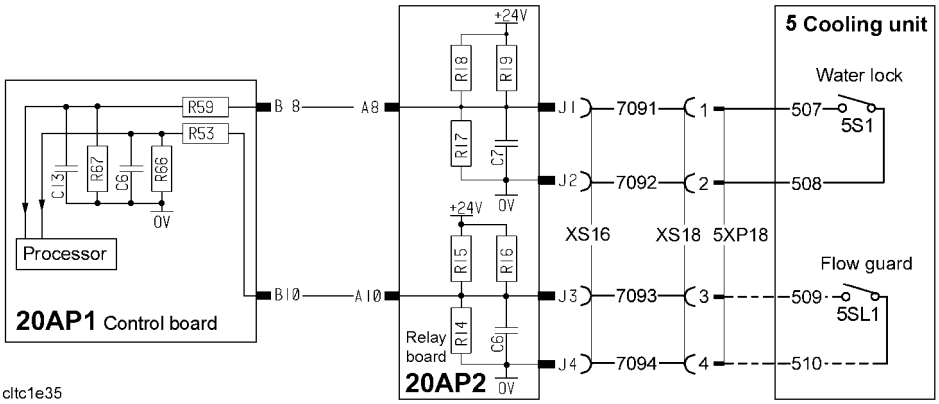
    If the voltage is outside the tolerance range, the starting sequence is interrupted at this point. Contactor 2KM1 does not close, and relay RE2 drops off. Machines having an MMC-panel with dispay show fault code 5.
13. RE3 energises main contactor 2KM1, which closes and connects 3-phase 400 V to main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

20AP2:4 Power supply to the cooling unit



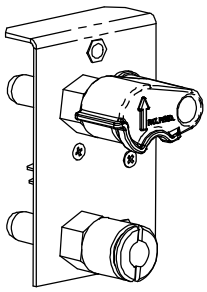
The cooling water pump is controlled by the software in the welding data unit via circuit board 20AP1. The wiring diagram of the cooling unit is shown on page 24.

20AP2:5 Cooling water monitoring in MIG welding mode



Water lock and flow guard in a MIG machine

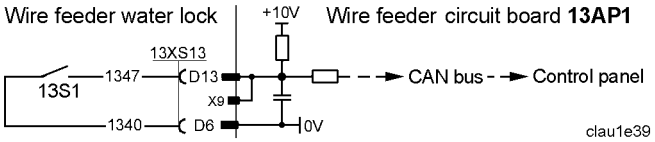
Microswitch 5S1 in the water lock connector closes when a cooling water hose is connected to the blue water connector on the front of the cooling unit. The pump stops if the switch opens.



Water lock

In MIG welding mode, the cooling water connection on the front of the cooler is not used: instead, the water connections on the back of the unit, which have no water locks, must be connected to the wire feed unit. However, the cooling water connections on the front of the wire feed unit **do** have a water lock, within which microswitch 13S1 senses if a cooling water hose is connected, see the diagram below.

Contact 5SL1 in the flow guard closes when the water flow rate exceeds 0.7 l/minute. **The flow guard is an accessory**: if no flow guard is fitted, connections XS18:3 and XS18:4 are linked.
The following description refers to cooling units with a flow guard: machines without a flow guard behave as if cooling water is always flowing.



Water lock in the wire feed unit

Starting the welding equipment

1. The MMC panel senses whether microswitch 13S1 in the wire feed unit is closed.
2. If 13S1 is closed, the panel 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 fault indication lamp on the MMC will flash. Machines with a display panel show fault code 29.

The pump is stopped if microswitch 13S1 opens.

Starting to weld

1. The welder presses the trigger switch on the welding gun.
2. The water pump starts if microswitch 13S1 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.

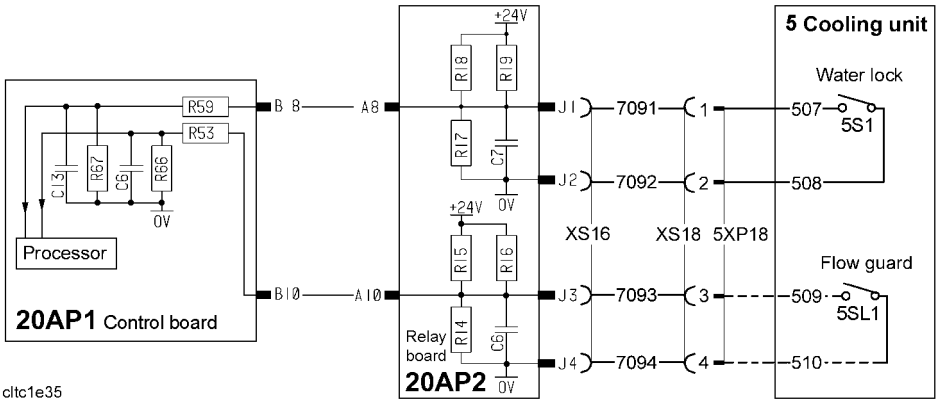
If the water flow stops during welding, welding will be interrupted and the fault indication lamp on the MMC panel will flash. Machines with a display show fault code 29.

Stopping welding

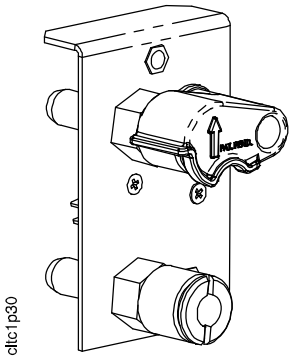
1. The welder releases the welding gun trigger switch.
2. Welding stops.
3. The water pump continues to run for a further 6.5 minutes.

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.

20AP2:5 Cooling water monitoring in TIG welding mode



Microswitch 5S1 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.



Water lock

Contact 5SL1 in the flow guard closes when the water flow rate exceeds 0.7 l/minute. **The flow guard is an accessory**: if no flow guard is fitted, connections XS18:3 and XS18:4 are linked.
The following description refers to cooling units with a flow guard: machines without a flow guard behave as if cooling water is always flowing.

Starting the welding equipment

1. The MMC panel senses whether microswitch 5S1 is closed.
2. If 5S1 is closed, the panel 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 fault indication lamp on the MMC will flash. Machines with a display panel show fault code 29.

The pump is stopped if microswitch 5S1 opens.

Starting to weld

1. The welder presses the trigger switch on the welding gun.
2. The water pump starts if microswitch 5S1 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.

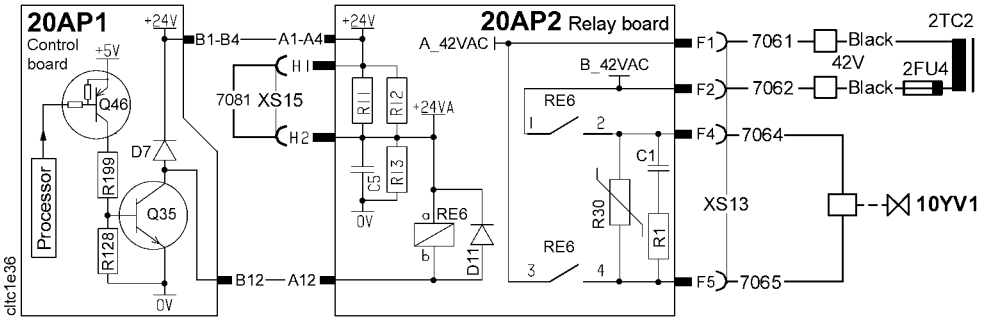
If the water flow stops during welding, welding will be interrupted and the fault indication lamp on the MMC panel will flash. Machines with a display show fault code 29.

Stopping welding

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

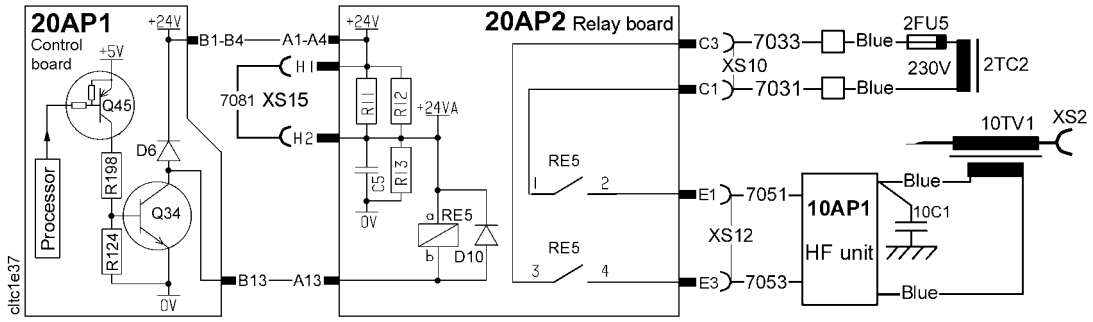
If welding is restarted while the pump is still running, the pump will continue to run as required, i.e. the 6.5 minute shutdown countdown is interrupted.

20AP2:6 TIG Gas valve



Gas valve 10YV1 is controlled by the processor on circuit board 20AP1. It can be activated via service function no. 10.

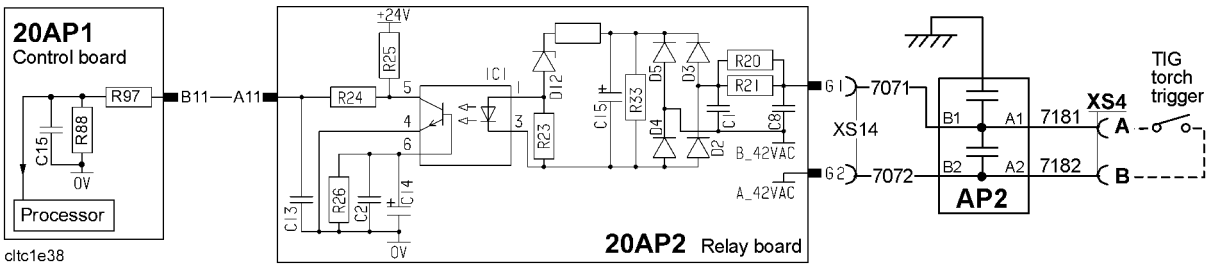
20AP2:7 TIG HF starting device



The 10AP1 HF starting device is controlled by the processor on circuit board 20AP1. It is activated during the starting sequence until the arc strikes, or for a maximum of 0.7 seconds. The voltage on the primary side of transformer 10TV1 is about 500 V, producing a secondary voltage of 10 - 12 kV, if a 4 metre long welding torch is connected. If the welding torch is 16 metre the HF spark is about 8 kV.

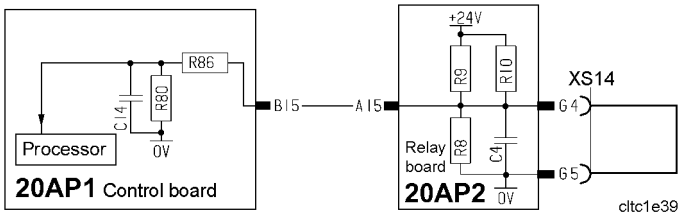
Due to electromagnetic interference regulations the energy in the HF ignition spark is limited. The HF spark weakens with increasing length of the torch. The HF ignition is satisfactory for welding torches up to 16 metres.

20AP2:8 TIG Starting



The welding torch trigger switch is supplied at 42 V AC. Closing the contact activates IC1 and supplies a Low signal to 20AP1.

20AP2:9 Gas flow monitor



MIG and TIG machines

Terminals G4 and G5 are intended for use with a gas flow monitor. The processor reacts to voltage flanks from the input.
The MIG and TIG machines are not normally fitted with gas flow monitors, which means that this input must be short-circuited by a link. If the link is open the control panel shows fault code 32.

MMA machines

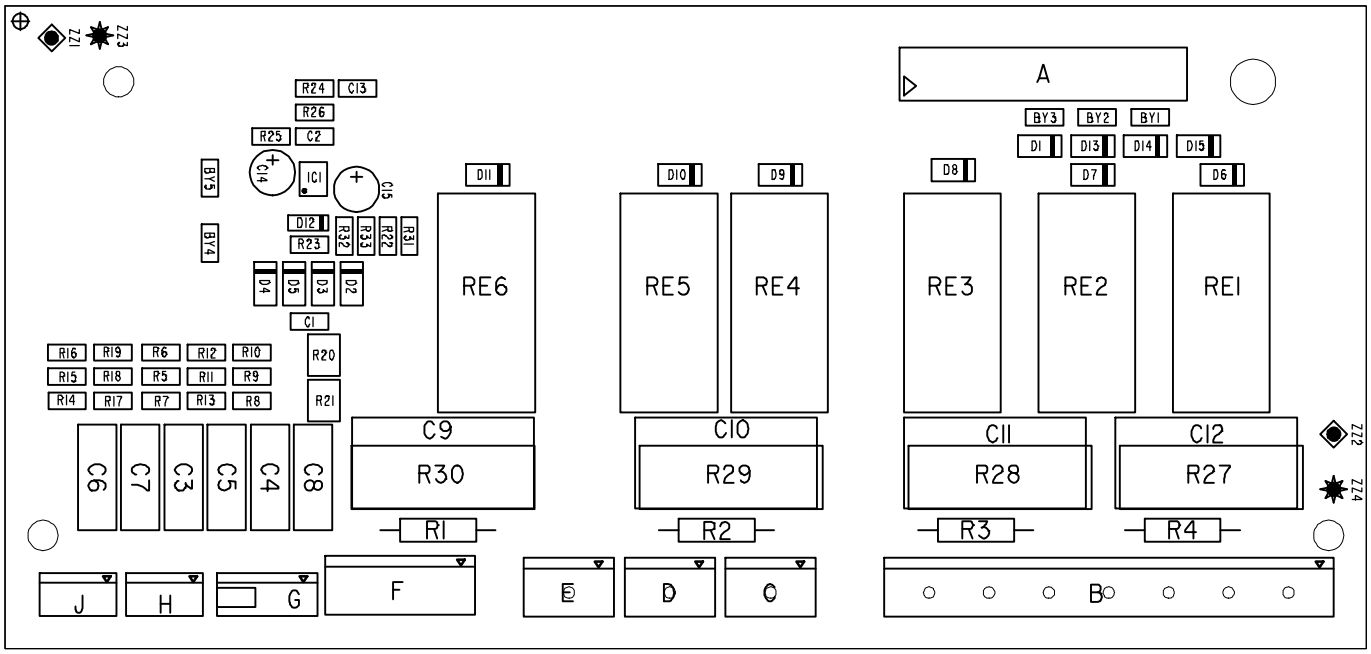
Terminals G4, G5 and resistors R8 - R10 are not mounted on the board that is delivered with the machine.

Spare part circuit boards are delivered with all components fitted. Terminals G4 and G5 are intended for use with a gas flow monitor. MMA machines are not fitted with gas flow monitors, which means that G4 - G5 must be short-circuited by a link. If the link is open the control panel shows fault code 32.

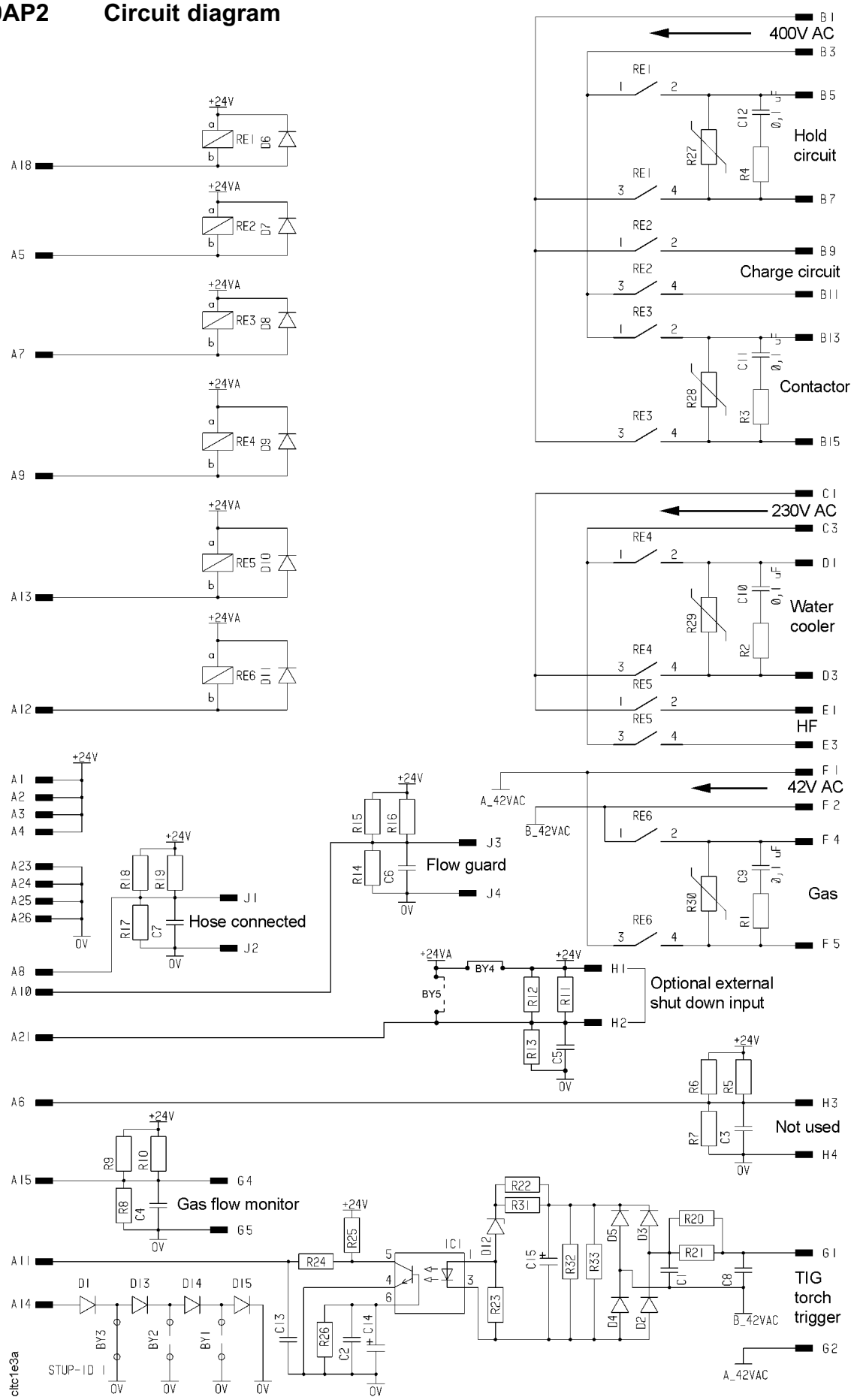
20AP2 Component positions

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 56.

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 27 and section 15AP2:2 on page 30.
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 34 to 36.
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 34 to 36.
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.

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

Special tools

Soft-starting tool SST 2

The SST 2 is originally made for the 3000i machine series. It is now delivered with an adapter cable so that it also can be used for the 4000i and 5000i machine series.

The ordering number for the SST 2, including adapter cable for the 4000i and 5000i machine series, is: 0460 040 880.

If you have an SST 2 without adapter cable for the 4000i and 5000i machine series, the ordering number for the adapter cable is: 0460 042 881.

Dismantling

When dismantling the power source, start as follows:

1. Remove the screws securing the cover and the rear handle.
2. Pull the cover backwards and lift it off.
3. Remove the side plates.

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.

Terminal block, 2XT2

Don't mix up the wires connected to terminal block 2XT2: take care to connect them as shown in the circuit diagram. If the wires 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.

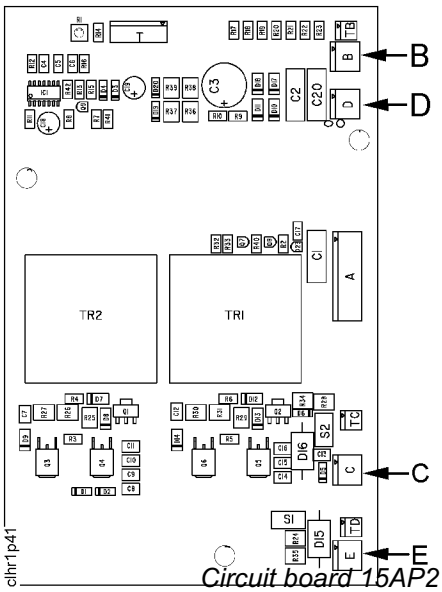
Contact 15XS7 is marked **D**, and must be connected to terminal strip D on circuit board 15AP2.

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 59.

Checking the IGBT transistors

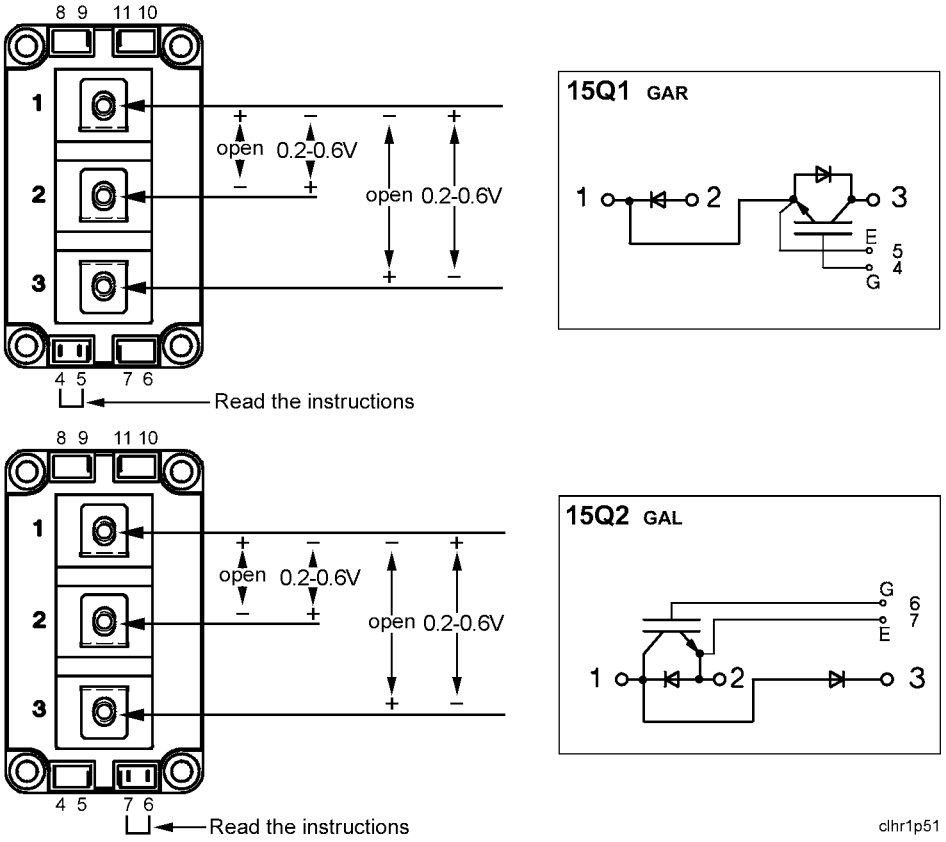
Check the IGBT transistors with the diode test mode of a multimeter.

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 machine. Short circuit the gate connections, contact TC1 and TC2 respectively TD1 and TD2 on circuit board 15AP2, see diagram on page 29. 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 27.

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 machine 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.

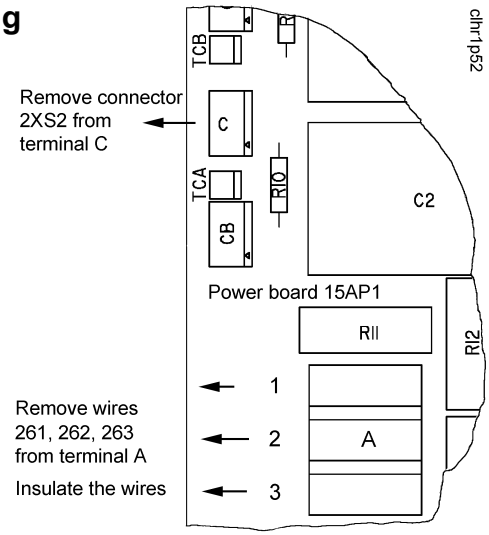
It is a good idea to use soft starting when fault tracing in the power module.

Special equipment

To soft-start the machine you need soft-starting tool SST 2 and the ESAT service kit, this is described on page 56.

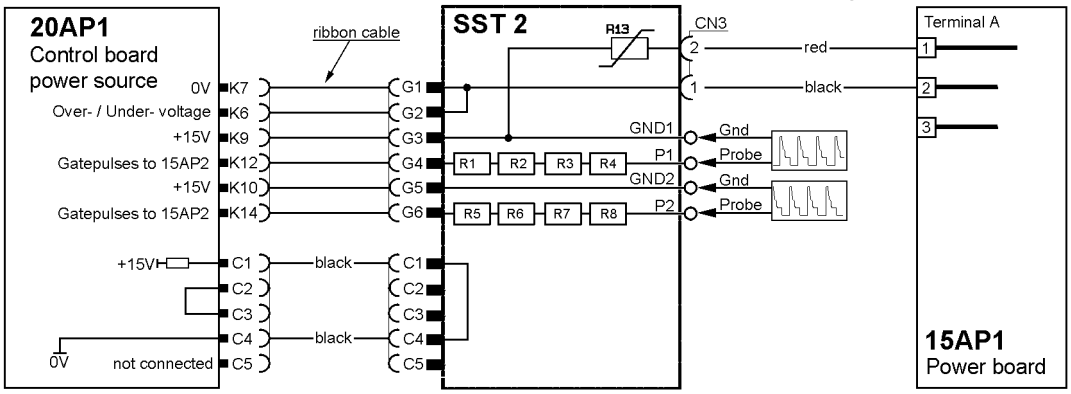
Changing wire connections prior to soft starting

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.**
4. **Mig U4000i** or **Tig 4000i:**
   Disconnect the HF starting unit by removing fuse 2FU5 from transformer 2TC2: see the wiring diagram on page 14 or 18.



5. 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.
6. 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.

Disconnect connector C on soft starting



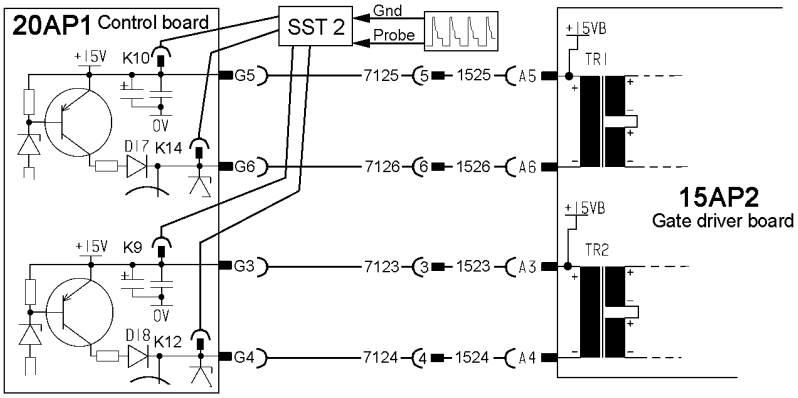
SST 2 connected to 20AP1 and 15AP1

Checking the gate pulses from circuit board 20AP1

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

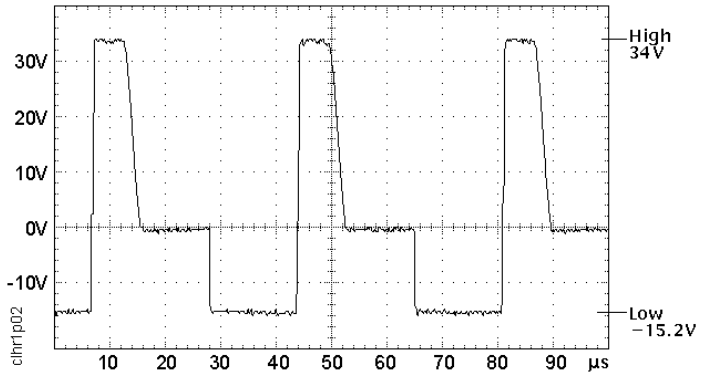
1. Start the power source and set a current reference.

2. Connect an oscilloscope to the SST 2 across terminals GND2 and P2, as shown on page 60.



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.

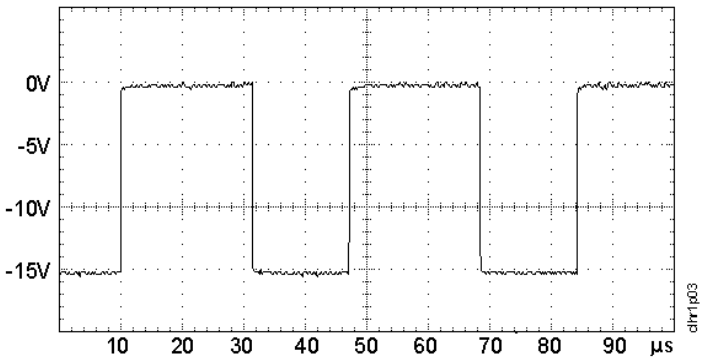


Pulses from 20AP1 to 15AP2 when the output of 20AP1 is connected to 15AP2.

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.



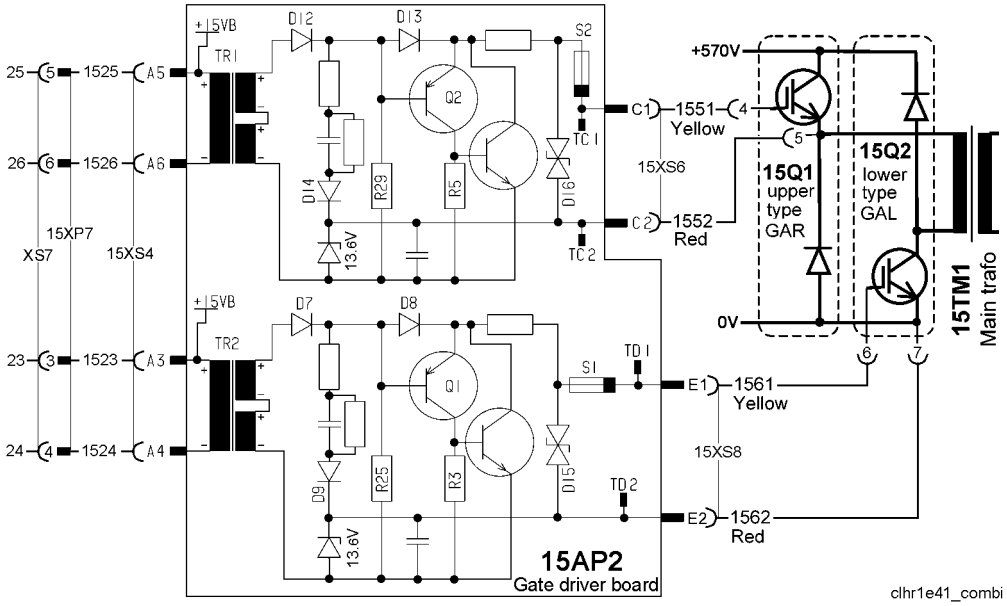
*Pulses from 20AP1 when the output from 20AP1 is **not** connected to 15AP2.*

Checking the gate pulses from circuit board 15AP2

WARNING!

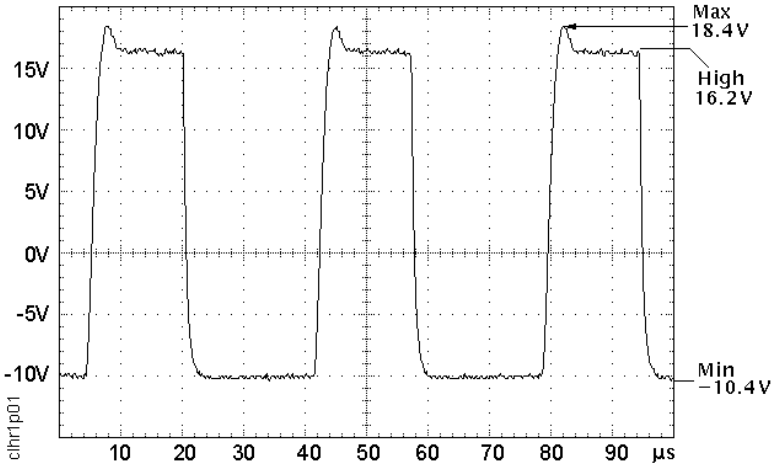
During normal operation there is mains voltage on circuit board 15AP2. The machine must be in soft starting mode when checking the gate pulses, see page 60.

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.



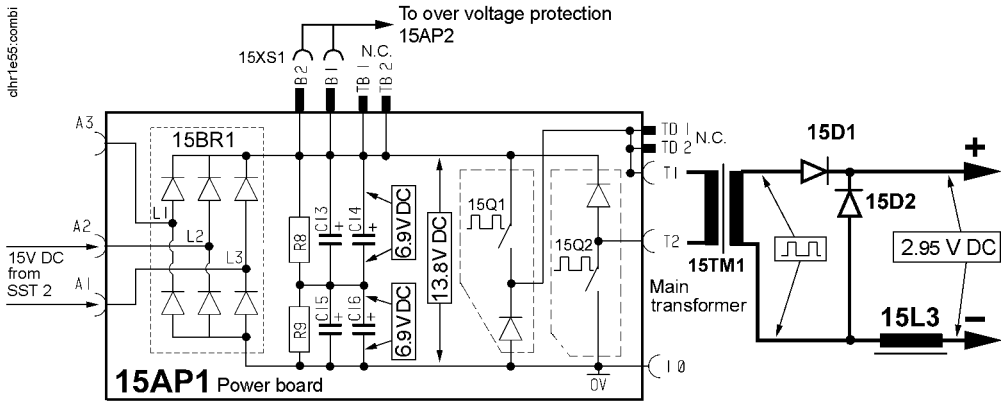
Gate pulses from 15AP2 to 15Q1 and 15Q2

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.

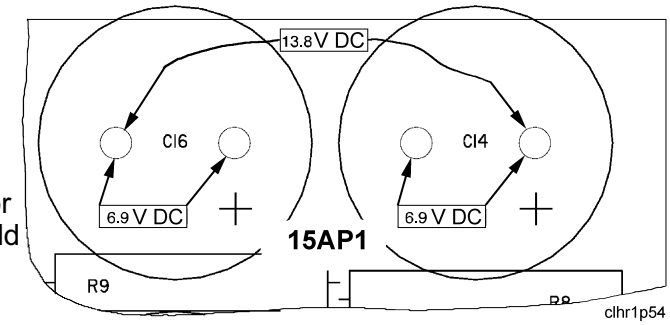
Pulse frequency and duration are controlled by circuit board 20AP2: rise and fall times are controlled by gate driver board 15AP2.

Measurements



Circuit diagram for soft starting measurements

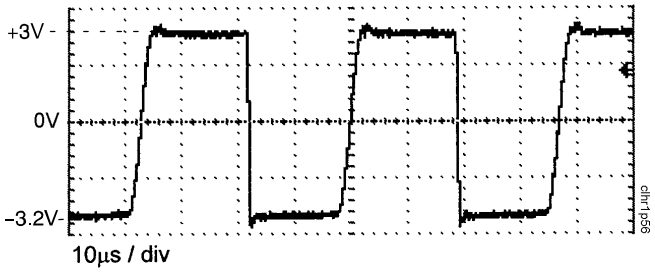
1. Start the power source.
2. Measure the voltage on 15BR1. It should be about 15 V DC. See the circuit diagram above.
3. Measure the voltage between the negative terminal on capacitor C16 and the positive terminal on capacitor C14, on circuit board 15AP1. It should be about 13.8 V DC.



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

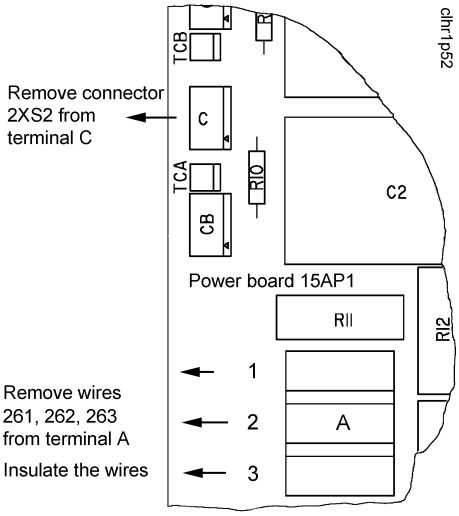
7. Using a multimeter, check that the DC voltage at the welding terminals is about 2.9 V.
8. If all the measurements are as described above, reconnect the wires to restore the power source to normal operation mode and make a test weld.

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.

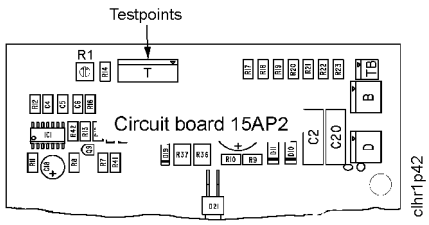


Disconnection of the 400 V supply to the power board

Disconnection from the mains supply

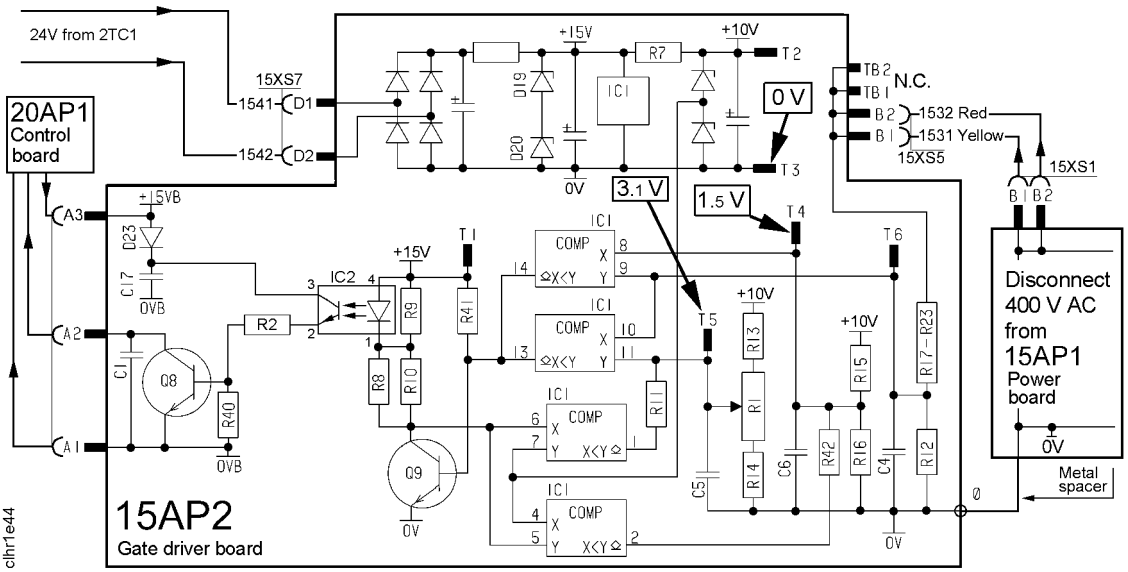
1. Remove wires 261, 262 and 263 from terminal block A on circuit board 15AP1.
2. Unplug contact 2XS2 from 15AP1.
3. **Insulate the wires that have been removed from each other and from all other parts.**

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.



Test points on the circuit board

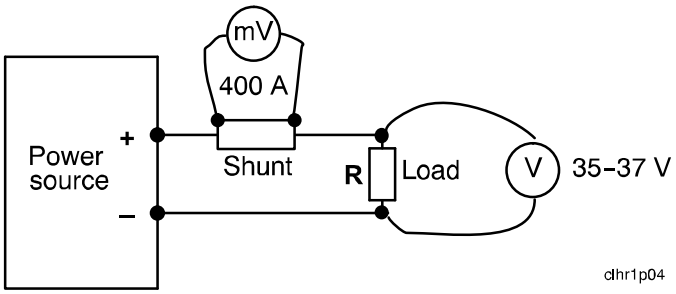
Note! *The circuit board and the test points are varnished. Before measuring, remove the varnish from the test points.*



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

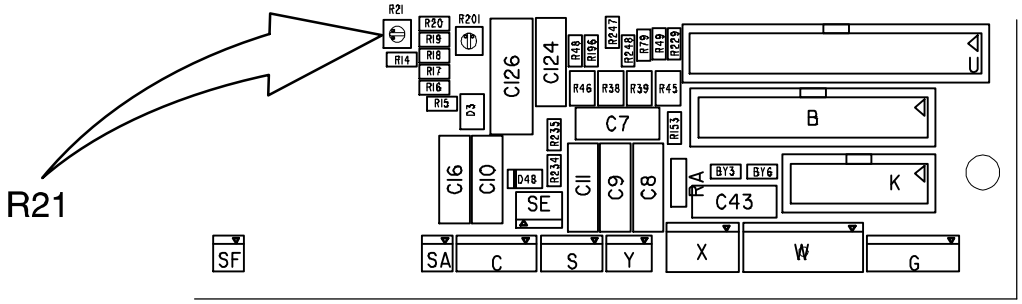
Calibrating the current sensor signal

1. If the power source has a TIG function, **remove fuse 2FU5** from transformer 2TC2. This disconnects the supply to the HF ignition unit (see the wiring diagram).
2. Connect the power source to a resistive load.
3. Connect a **calibrated shunt** in series with the load.
4. Set the power source to MMA mode, or use ESAT to set a current reference.
5. Set a welding current of 400 A.
6. Load the power source so that the voltage across the load is 35 - 37 V.



Circuit diagram for current calibration

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

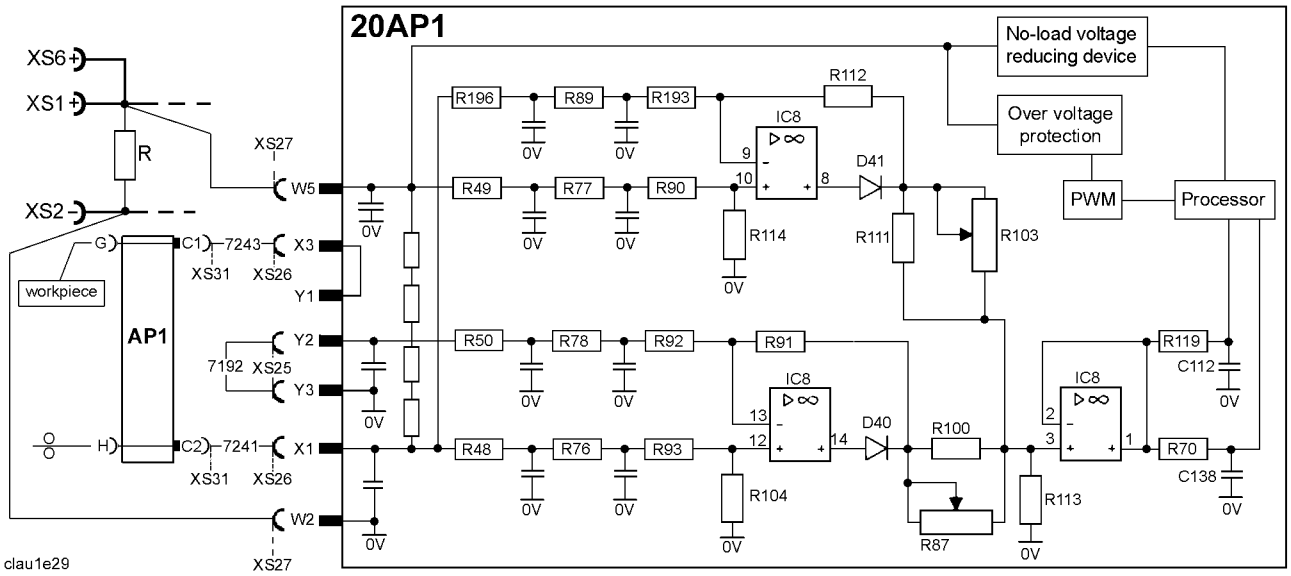


Position of potentiometer R21 on circuit board 20AP1.

9. 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.

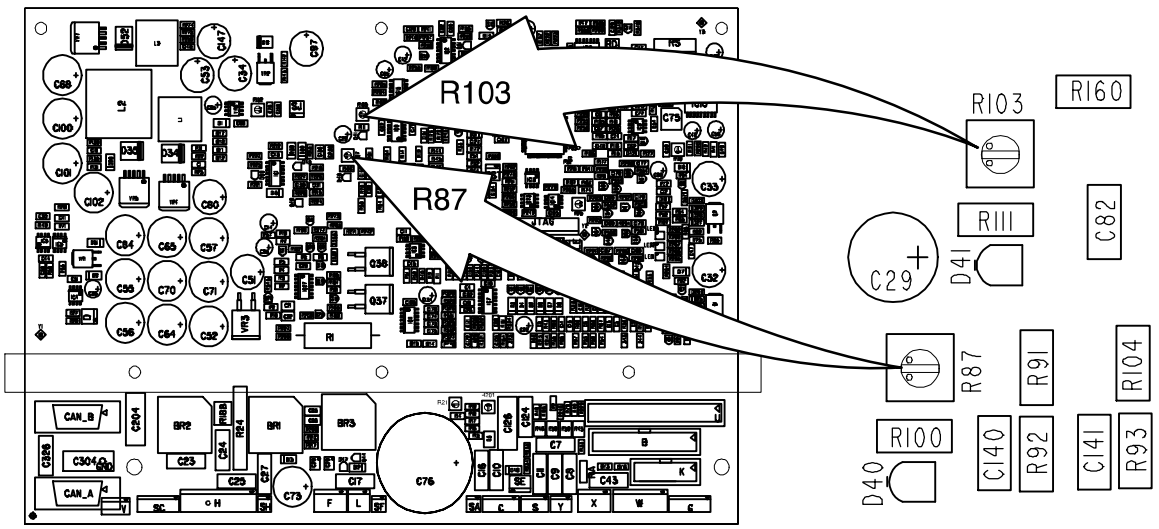


Circuit diagram of the arc voltage input

Check that there is a short-circuiting link across connectors Y2 - Y3: see the circuit diagram above. 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.

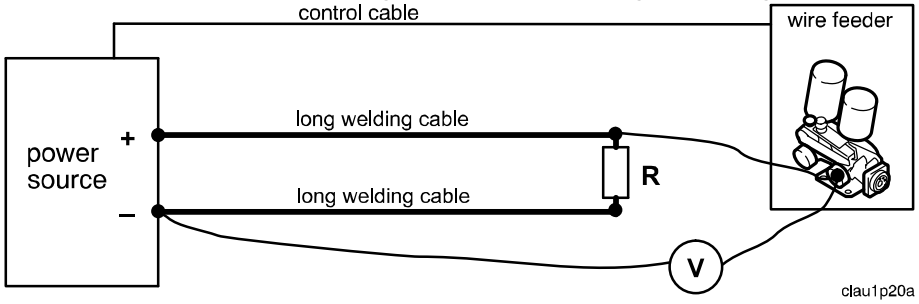
Start the power source from the welding gun trigger contact and adjust the current by changing the wire feed speed setting. Adjust the voltage by varying the load resistor.

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

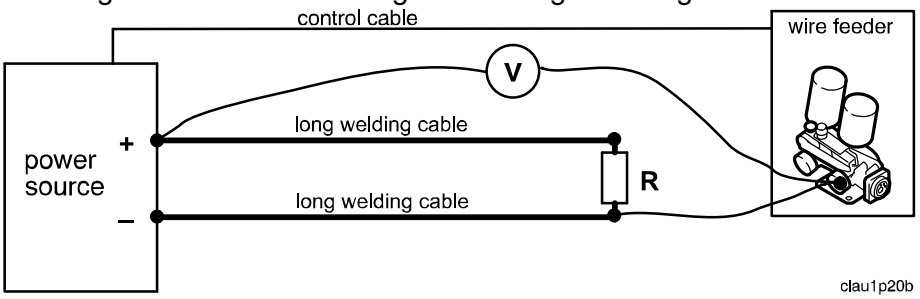
1. Welding with the filler wire positive: voltage sensing from the wire
   This is the commonest arrangement of arc voltage sensing.



***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.

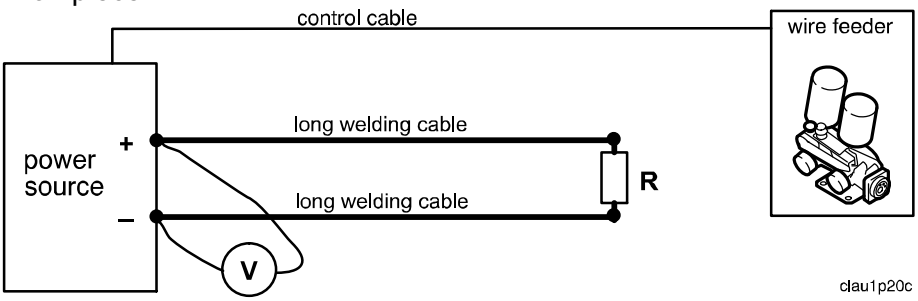
2. Welding with the filler wire negative: voltage sensing from the wire



***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.

4. Check measurement of the connection for voltage sensing from the workpiece
   Measure the resistance between connector pin G on AP1 and input X3 on the circuit board. See the circuit diagram on Page 66.

MMA and TIG 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.

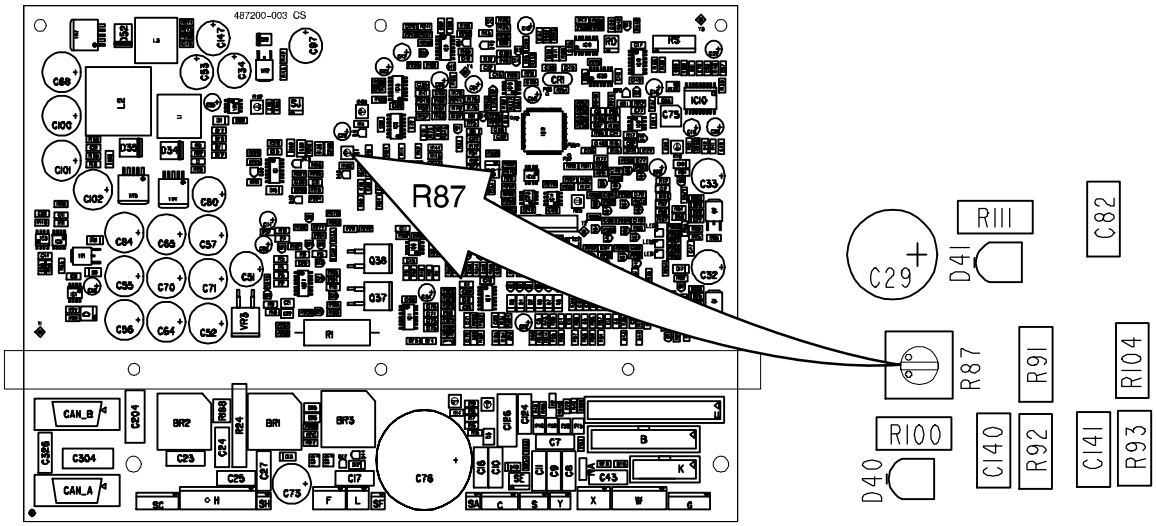
Use an accurately calibrated external voltmeter to measure the voltage at the welding current terminals.

TIG power sources

Disconnect the power supply to the HF starting function by removing fuse 2FU5 from transformer 2TC2: see the circuit diagram on Page 18. Set the power source to the MMA welding mode.

TIG and MMA power sources

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

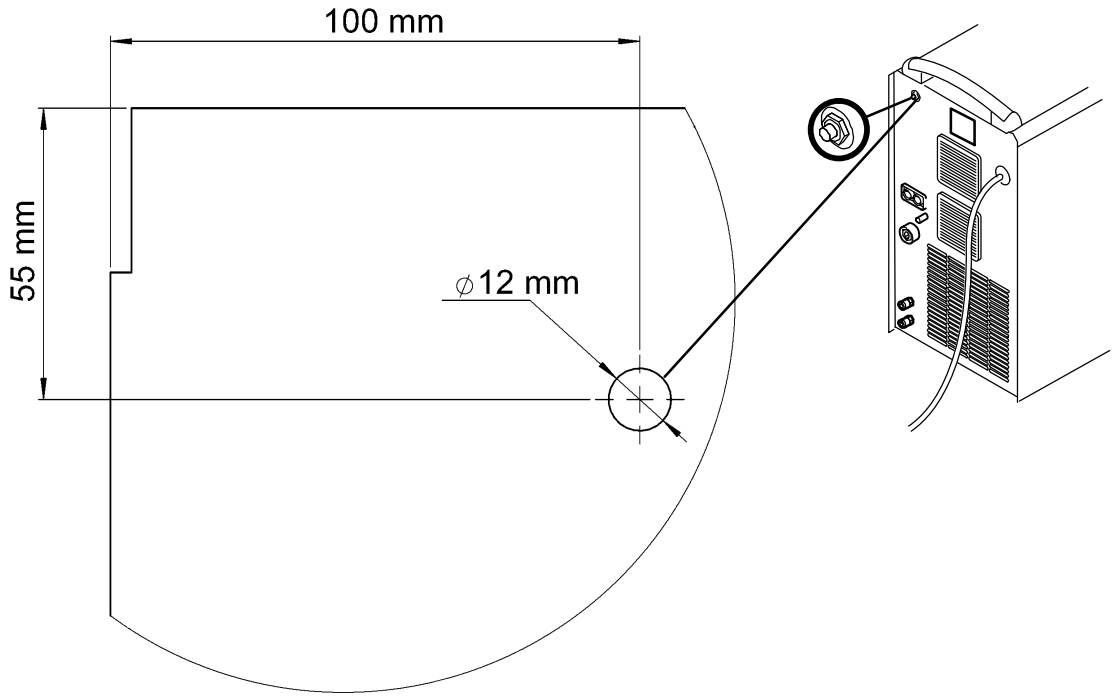
2TC2, auxiliary transformer with 10 A MCB

Mig U4000i from serial no. 803-903-5789

The 8 A glass-tube fuse, 2FU4 fitted to auxiliary transformer 2TC2, is replaced by a 10 A Micro Circuit Breaker, fitted to the rear panel of the power source.

Spare parts for Mig U4000i & Mig 4000i

The transformer with the 8 A fuse will be phased out and replaced by the new transformer. When the circuit breaker is fitted to Mig U4000i or Mig 4000i with serial number prior to 803-903-5789 a hole must be drilled in the rear panel, see the drawing below.



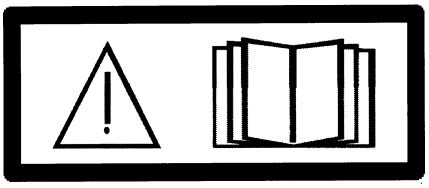
INSTRUCTIONS

This chapter is an extract from the instruction manuals for the Mig U4000i, Mig 4000i, Arc 4000i and Tig 4000i.

SAFETY

CAUTION!

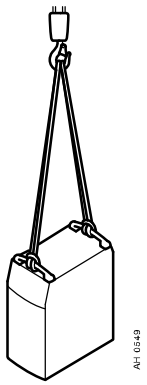
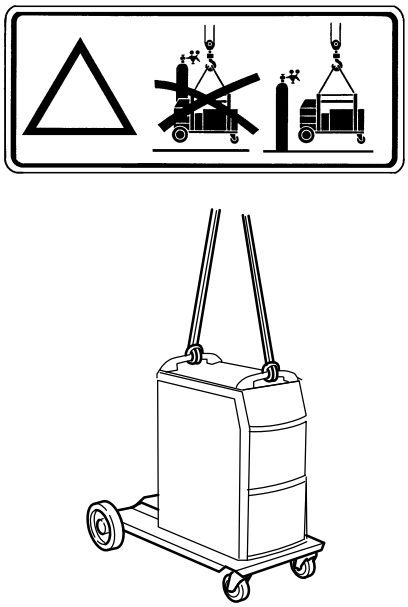
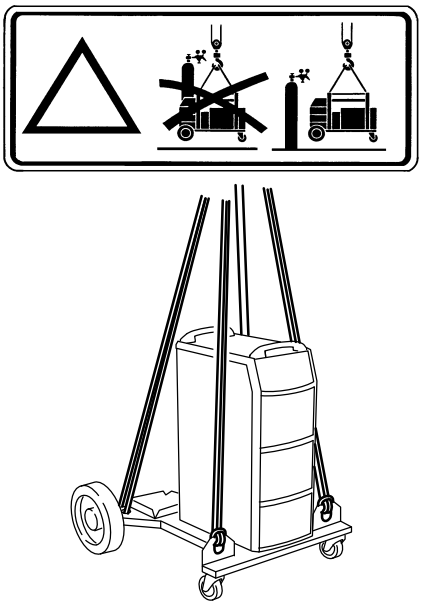
Read and understand the instruction manual before installing or operating.



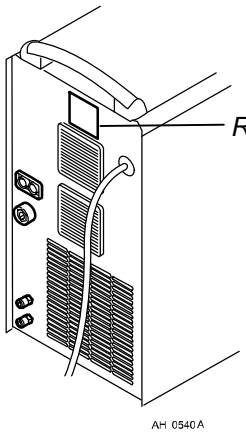
INSTALLATION

The installation must be executed by a professional.

Lifting instructions

Power source	Trolley and power source	Trolley2 and power source
		

Mains power supply



Rating plate with supply connection data

Check that the unit is connected to the correct mains power supply voltage, and that it is protected by the correct fuse sizes. A protective earth connection must be made, in accordance with regulations.

Recommended fuse sizes and minimum cable area

Mains voltage	400 V 3~ 50 Hz
Mains cable area mm²	4G4
Phase current, I_{1eff}	(22 A) 16 A
Fuse	
Anti-surge	(25 A) 20 A
Type C MCB	(32 A) 20 A

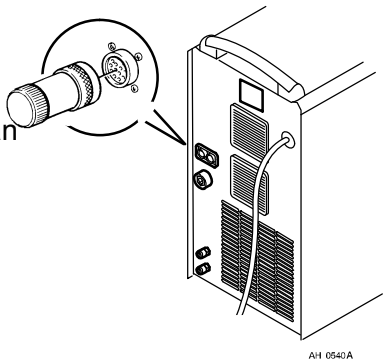
Note! *Data in brackets (xxxx) are valid for power sources without primary inductor.*

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

Terminating resistor, MIG machines

In order to avoid communication interference, the ends of the CAN bus must be fitted with terminating resistors.

One end of the CAN bus is at the control panel, which has an integral terminating resistor. The other end at the power source must be fitted with the terminating resistor, as shown on the right.



Connection of multiple wire feed units, MIG machines

With control unit U8 and wire feed units without control panel it is possible to manage up to 4 wire feed units from one power source.

It is possible to choose between the following connections:

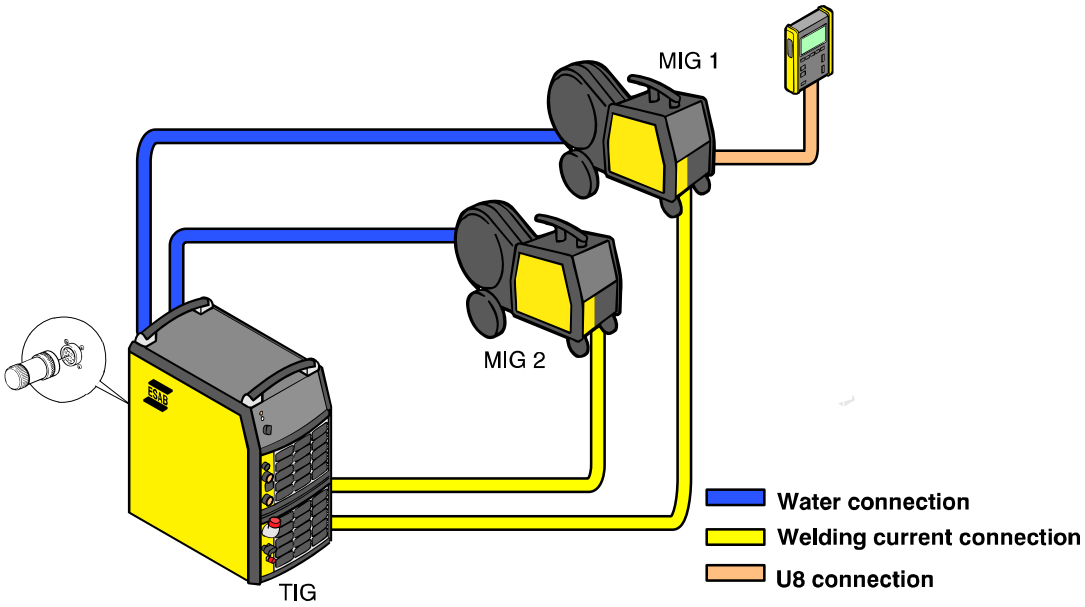
- 1 TIG-torch and 1 MIG-gun (Universal power source required)
- 2 MIG/MAG-guns
- 1 TIG-torch and 3 MIG/-guns (Universal power source required)
- 4 MIG/-guns

When welding with water-cooled MIG/-guns on all wire feed units, it is recommended to connect a separate cooling unit for the 2 extra guns.

We recommend connecting the guns in parallel.

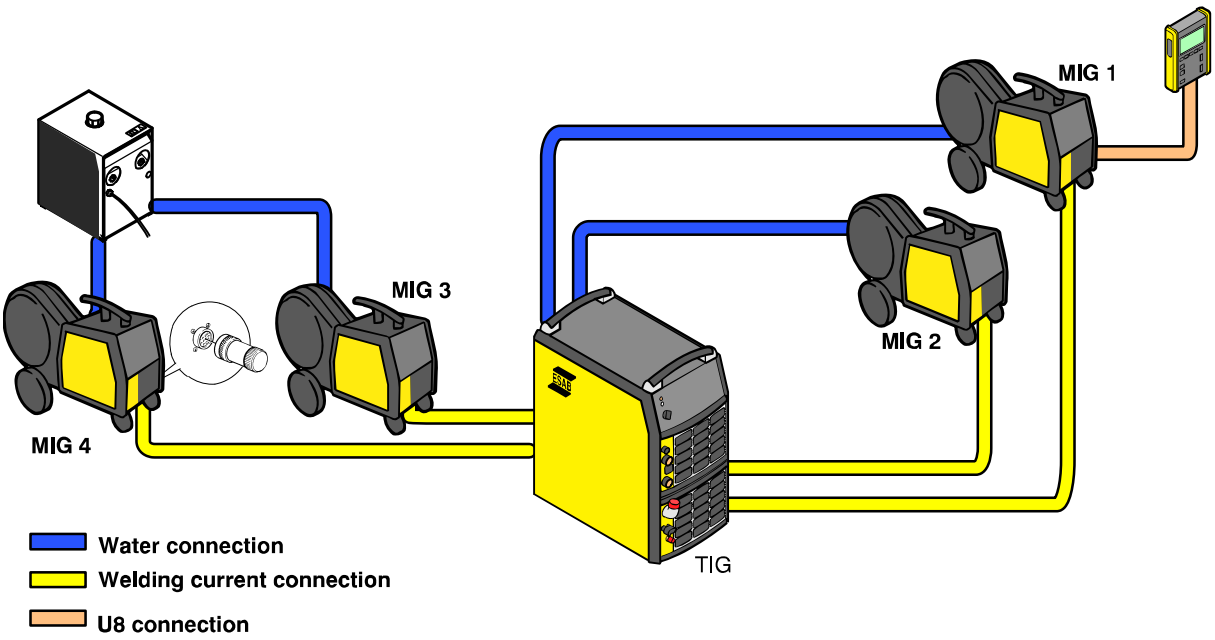
Two wire feed units

A connection kit is required when connecting two wire feed units, see accessory part of the spare parts list.



Four wire feed units

Two connection kits and an extra cooling unit are required when connecting four wire feed units, see accessory part of the spare parts list.



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 U4000i

1 Connection for cooling water from the TIG torch - RED

2 Connection with ELP* for cooling water to the TIG torch - BLUE

3 Cooling water filler

4 Connection for welding current cable (+) at MMA welding or for return cable at TIG welding

5 Connection for remote control adapter

6 Connection for return cable (-) or for welding current cable at TIG welding

7 Connection for start signal from the torch.

8 Connection for gas to the TIG torch

9 Main power supply switch, 0 / 1 / START

10 White indicating lamp - Power supply ON

11 Orange indicating lamp - Overheating

12 Connection for control cable to the wire feed unit or to the terminating resistor

13 Connection for gas hose

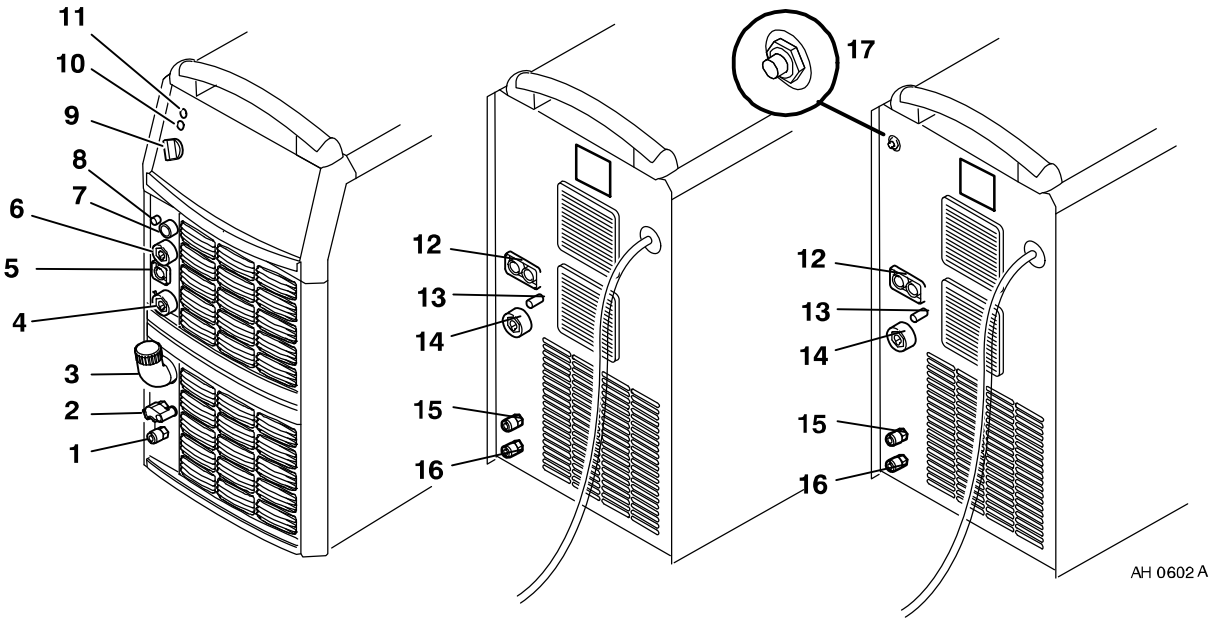
14 Connection for welding current to the wire feed unit

15 Connection for cooling water to the wire feed unit - BLUE

16 Connection for cooling water from the wire feed unit - RED

17 Fuse for 42 V supply to the wire feed unit

* ELP = ESAB Logic Pump, see **Cooling unit** on page 76.



Connections and control devices, Mig 4000i

1 Connection for cooling water. *Not used on this model.*

2 Connection for cooling water. *Not used on this model.*

3 Cooling water filler

4 Connection for welding current cable (+) (MMA welding)

5 Connection for remote control adapter

6 Connection for return cable (-)

7 Main power supply switch, 0 / 1 / START

8 White indicating lamp - Power supply ON

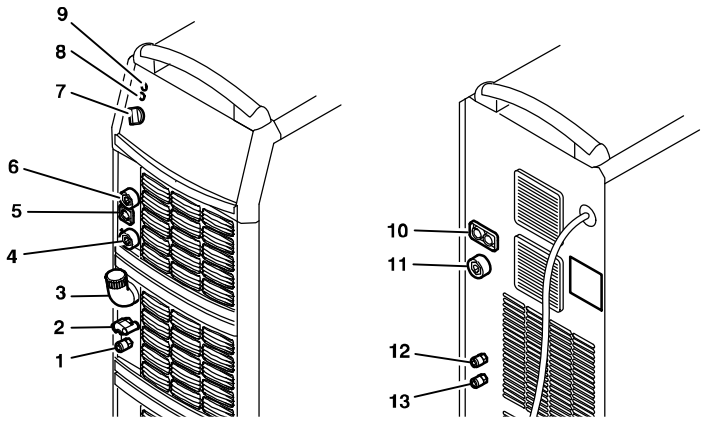
9 Orange indicating lamp - Overheating

10 Connection for control cable to the wire feed unit or terminating resistor

11 Connection for welding current to the wire feed unit

12 Connection for cooling water to the wire feed unit - BLUE

13 Connection for cooling water from the wire feed unit - RED



Connections and control devices, Arc 4000i

1 Welding current cable connector (+)

2 Connector for remote control adapter

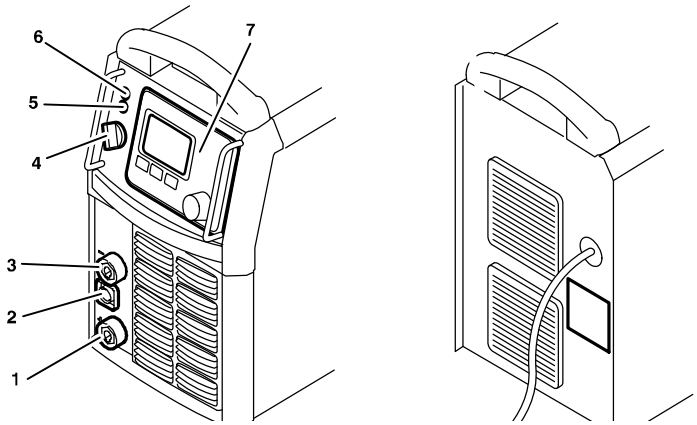
3 Return welding current cable connector (-)

4 Main power supply switch, 0 / 1 / START

5 White indicating lamp, mains power supply ON

6 Orange indicating lamp, overheating

7 Control panel
(see respective instruction manual)



Connections and control devices, Tig 4000i

1 Connection for cooling water from the TIG torch - RED

2 Connection with water lock for cooling water to the TIG torch - BLUE

3 Cooling water filler

4 Connection for return cable (+)

5 Connection for remote control adapter

6 Connection for welding cable (-)

7 Connection for start signal from the welding torch

8 Connection for gas to the TIG torch

9 Main power supply switch, 0 / 1 / START

10 White indicating lamp - Power supply ON

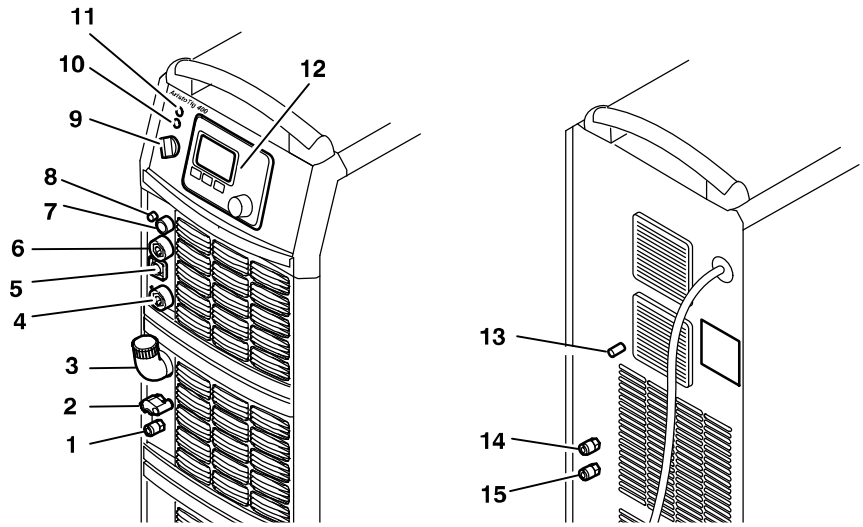
11 Orange indicating lamp - Overheating

12 Control panel
(see the respective instructions)

13 Connection for gas hose

14 Connection for cooling water. *Not used on this model.*

15 Connection for cooling water. *Not used on this model.*



Turning on the power source

Turn on the mains power by turning the main power supply switch 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 source 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 in the event of a loss of power supply or of turning the power source 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 fans continue to run for 6.5 minutes after welding has stopped, and the unit switches to energy-saving mode. They 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 power source has two thermal overload trips which operate if the internal temperature becomes too high, interrupting the welding current and lighting the orange indicating lamp on the front of the unit. They reset automatically when the temperature has fallen.

Cooling unit

Water connection (TIG welding)

The cooling unit is equipped with a detection system **ELP** (**E**SAB **L**ogic **P**ump) which checks that the water hoses are connected.

The power source On/Off switch must be in the “0” position (Off) when connecting a water-cooled TIG torch.

If a water-cooled TIG torch is connected, the water pump starts automatically when the main On/Off switch is turned to ”START” and/or when welding starts. After welding, the pump continues to run for 6.5 minutes, and then switches to the energy-saving mode.

Function when welding

To start welding, the welder presses the welding gun trigger switch. The power source turns on and starts the wire feed and the cooling water pump.

To stop welding, the welder releases the welding gun trigger switch. Welding ceases, but the cooling water pump continues to run for 6.5 minutes, after which the unit switches to energy-saving mode.

Water flow guard

The water flow guard interrupts the welding current in the event of loss of coolant, and displays an error message on the control panel. The water flow guard is an accessory.

Remote control unit

The remote control unit must be a CAN based remote control unit or it must be connected via a remote control adapter.

The power source and wire feed unit are set to remote control mode and buttons and dials are blocked when the remote control is connected. Functions can only be adjusted via the remote unit.

If the remote control unit is not to be used, the remote control unit must be disconnected from the power source / wire feed unit, as otherwise it will remain in remote control mode.

For more information about the operation of the remote control unit, see the operating instructions for the control panel.

MAINTENANCE

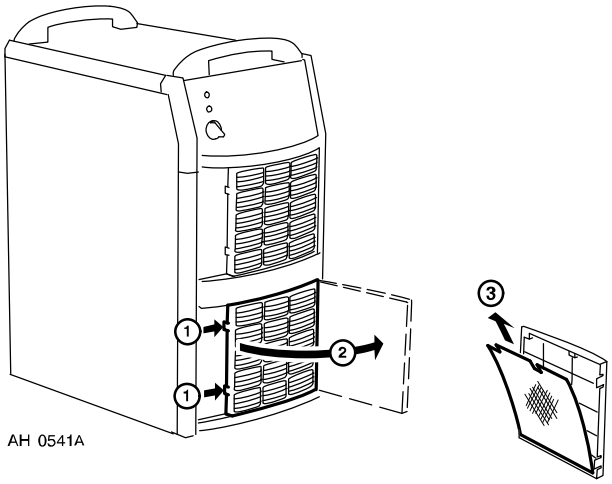
Regular maintenance is important for safe, reliable operation.

Only those persons who have appropriate electrical knowledge (authorized personnel) may remove the safety plates.

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

Cleaning the air filter

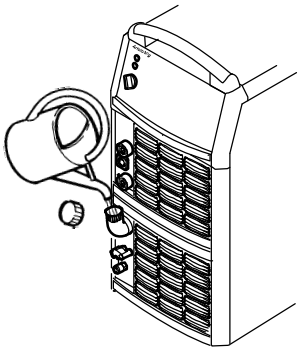
- Release the cover plate with the dust filter (1).
- Swing out the cover plate (2).
- Remove the dust filter (3).
- Blow it clean with compressed air at reduced pressure.
- Replace the filter with the finer mesh on the side against the cover plate (2).
- Replace the cover plate with the filter.



Topping up the coolant

We recommend a 50/50 % mixture of water and ethylene glycol.

Top up with coolant until it is up to the level of the filling hole.



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 U4000i & Mig 4000i	0459 839 019
Tig 4000i	0459 839 022
Arc 4000i	0459 839 023

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