BALZERS

OPERATING INSTRUCTIONS

Ion source supply IS 420

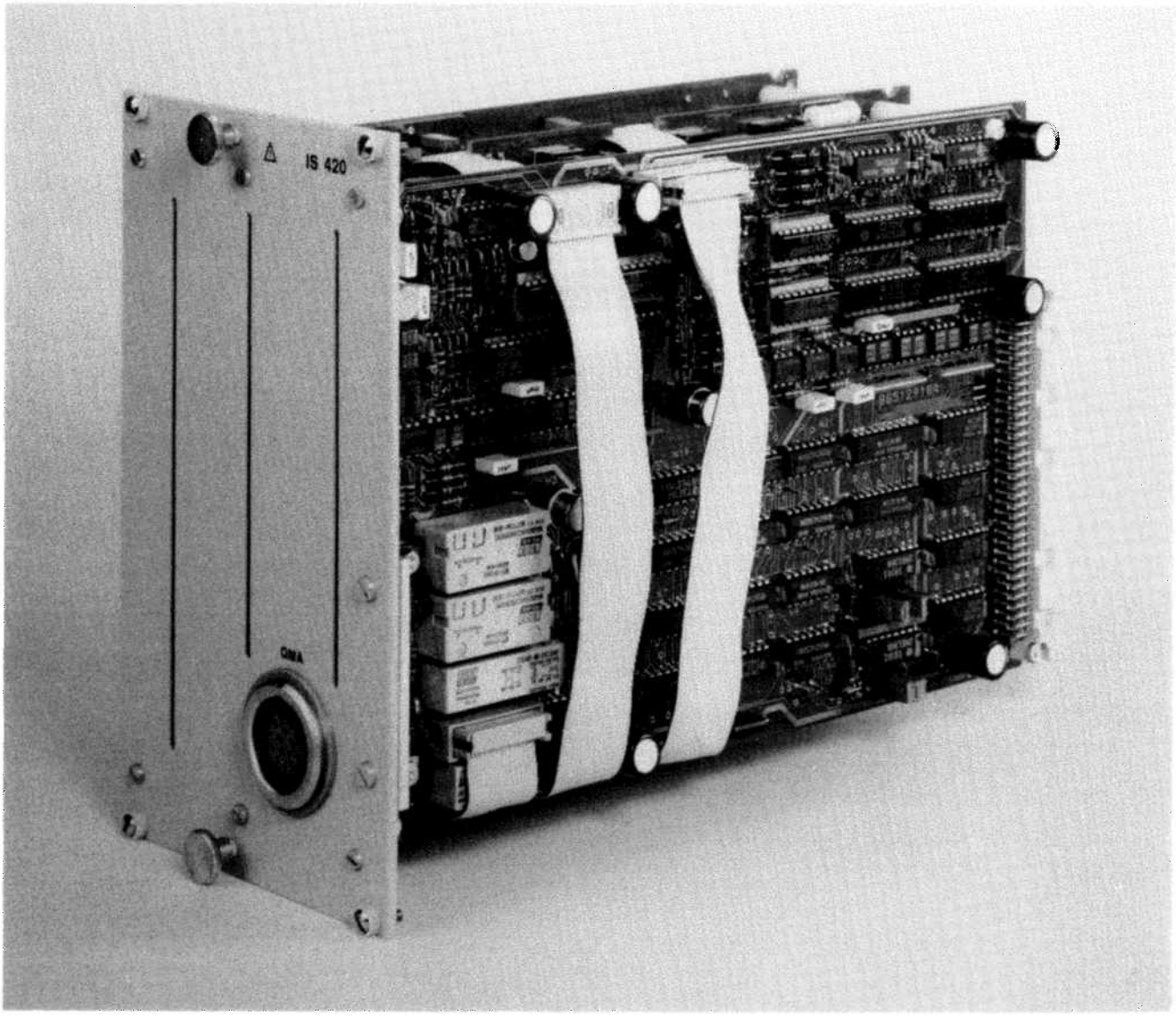

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Table of contents

1. GENERAL

The IS 420 is a power supply for the different ions source voltages and the filament current for a quadrupole mass spectrometer. It conforms to the BS 420 bus.

All ion source supply voltages are galvanically isolated from the bus. The voltages for all potentials and the emission can be programmed by the computer.

2. FEATURES

- Output voltages for axial, cross beam, grid, SIMS and plasma ion sources
- 9 potentials, all computer programmable
- All ion source voltages are short–circuit protected and galvanically isolated from the bus.
- Filament 1/2 switchover by computer control
- Preheating operation by computer control (Filament 1 in operation, Filament 2 preheated)
- Switchover to degas by computer control
- The deflection plates (Defl. I and Defl. 0) can be grounded by computer control
- The reference point V0 (usually GND) can be set to an external potential
- Drive signal for remote relay (switchover to external potential)

3. SPECIFICATION

General

Designation

Designation	Parts list Order Nr.	Schematic Nr.	Drawing Nr.
IS 420	BG 512 900 -T	BG 541 352 -S	BG 512 901 -Z
IC 420	BG 512 920 -T	BG 541 190 -S	BG 512 921 -Z
IV 420	BG 512 890 -T	BG 541 189 -S	BG 512 891 -Z
FC 420	BG 512 910 -T	BG 541 188 -S	BG 512 911 -Z

Dimensions

Board format	SC 420 format
Slots used	5 slots
Bus load	1 DC load 1 AC load
Voltage supply	5 V ± 5% 0.6 A typical ± 24 V ± 3% Normal operation 2.0 A max.* Degas 2.4 A max.* * At max. filament power Derating 0.25 A / 10 W.
Fuses	F1, F2: 2.5 AT, 5 x 20 mm, inside on the FC 420

Bus interface

Addressing range	Whole I/O page
Register	Command "ISOCMR" DAC number "ISODAC" Data buffer "ISODBR" Status "ISISTR"
Data format	8 bit (low byte only) for all 4 registers
Data transfers	"ISOCMR", "ISODAC", "ISODBR": DATO only reads "ISISTR" at DATI "ISISTR": DATI only writes "ISODAC" at DATO

Ion source potential	See Appendices A and B	
Filament supply		
Power at output connector	50 W max. (40 W during preheating)	
Voltage	0...10 V (0...8 V for preheating) Ripple at f=100 kHz:	4 mV_{pp} max.
	Voltage at filament 2 for preheating:	1.4 ..2.0 V
Output current	0...5 A	
Protection	Setting range: Resolution: Linearity error: Gain error: Zero point error: Zero point drift: Gain drift:	0..5 A 20 mA ± 10 mA max. ± 6% max. ± 40 mA typ. ± 0,5 mA/°C typ. ± 100 ppm/°C typ.
Normal emission	Setting range: Resolution: Linearity error: Gain error: Zero point error: Zero point drift: Gain drift:	0..2 mA 10 µA ± 1,5 µA max. ± 3% max. ± 2µA typ. ± 0,03 µA/°C typ. ± 40 ppm/°C typ.
Degas emission	Setting range: Resolution: Linearity error: Gain error: Zero point error: Zero point drift: Gain drift:	0..20 mA 100 µA ± 15 µA max. +1%, –5% max. ± 20 µA typ. ± 0,3 µA/°C typ. ± 40 ppm/°C typ.
Faraday operation	Outputs V6 and V7 are switched to QMA GND by relay contacts. Series resistor: 100 Ohm	
Drive signal for remote relay	Idle voltage: Internal resistance: Load: not galvanically isolated	23,2 V min. 110 Ohm 70 mA max.
Potential separation	V0 (reference point for V1...V9) may be applied to an external potential of max. ± 200 V Load: ± 2 mA max.	

Ion source cable

	Connector	Cable
Isolation Temperature	PEEK +260 °C	FEP –100..+200 °C

Pin design

Refer to appendix C and IS 420 schematic.

4. DESCRIPTION

(see principle diagram in Appendix C)

The IS 420 consists of the following boards: IC 420, IV 420, FC 420 and back panel board.

4.1 IC 420 ion source controller

The IC 420 contains the bus interface, the address decoder, the DATA, DAC–NR, COMMAND and STATUS registers, an optical isolation and the D/A converters for V1...V11 plus the relay switches.

The D/A conversion of the set points for V1 ... V9, the protection (V10), and the emission (V11) is made on the IC 420. It also generates the corresponding REF–V1...V11 reference voltages. The DAC's are isolated from the bus by optocouplers. The desired operating mode is written in the COMMAND register. Status reports can be queried from the STATUS register. Relays bypass the filaments connected in series as selected and also effect the emission or the deflection potential switchover.

4.2 IV 420 ion source supply

The IC 420's reference voltages REF–V1...V9 are amplified to the output voltages V1...V9 (see Appendices A and B). If one of the amplifiers (V1 ... V8) should fail, an ERROR message is generated on the IV 420. A second ERROR signal is generated if the V9 amplifier fails.

4.3 FC 420 filament controller

The FC 420 consists of a DC/DC converter, the filament supply and the emission current control.

The IC 420 supplies reference voltage REF–V10 (PROTECTION) to the filament current controller as the maximum permissible filament current.

The IC 420 supplies reference voltage REF–V11 (EMISSION) to the filament current controller, which then regulates the emission current to this value.

When the emission deviates from this value during operation, an ERROR signal is generated and the filament supply is turned off.

When a break occurs in the filament current circuit at EMISSION ON an additional ERROR signal is generated.

The DC/DC converter generates the operating voltages for the circuits isolated from the bus.

4.4 Back panel board

The back panel board is the link to the output connector. It contains interference filters.

5. CONFIGURATION

5.1 Factory configuration

Jumpers A3, A4, A5, A7 and A10 are inserted in the IC 420 (see Appendix D).

Addressing:

```
Base addresses "ISOCMR":  175 500
               "ISODAC":  175 502
               "ISODBR":  175 504
               "ISISTR":  175 506
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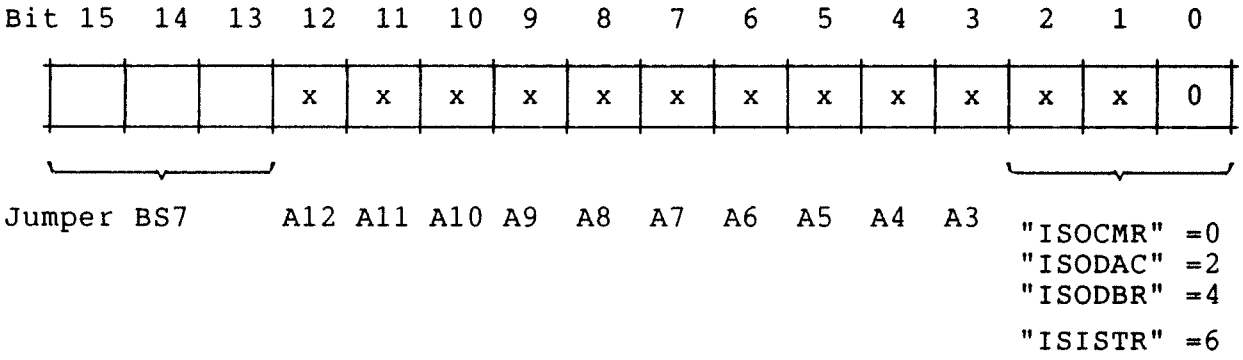
Service jumpers:
Jumpers B1 and B2 on the FC 420 are closed.

5.2 Addressing

The IS 420 can be allocated to the entire I/O address range (160 000..177 770). The allocated addresses are entered by inserting jumpers A3 ... A12. The block size equals 4 words.



Address bit = 0 → Jumper inserted
Address bit = 1 → Jumper removed

6. INSTALLATION

6.1 Installation in the SC 420

The IS 420 can be installed in any slot in the SC 420. Refer to the INSTALLING THE MODULES section of the SC 420 operating instructions.

CAUTION

The IS 420 must be screwed into the SC 420 bus chassis using all four fixation screws, both to prevent interference and for safety purposes.

WARNING

The assembly works on fatal levels of high voltage. For this reason empty slots must be covered with blank boards which function as contact protection.

6.2 Connections

IS 420 output connector (refer to appendix C and diagram IS 420)

WARNING

Only connect and disconnect plug when the unit is turned off.

Use cable according to safety regulations.

7. PROGRAMMING

Refer to the engineering handbook for the IS 420.

8. DETAILED DESCRIPTION

Refer to the engineering handbook for the IS 420.

9. MAINTENANCE

The IS 420 requires no maintenance. However, accumulated dust should be blown off from time to time.

9.1 Error messages

These can only be made when the CPU is functioning properly.

The error messages described in the following apply to a QMG 420 with CS 420 console and the BG 528 810 –T program.

9.1.1 Error messages on the display

IS ERR #1	One of the ion source supplies (V1...V8) is overloaded
IS ERR #2	Ion source supply V9 is overloaded.
EMISS ERR	Filament protection (PROTECTION) has responded and turned off the filament current
FIL 1 DEF	Filament 1 is defective or there is a break in the connection to it
FIL 2 DEF	Filament 2 is defective or there is a break in the connection to it

9.1.2 Procedure for IS ERR #1 / IS ERR #2

1. Push any key
   - If the display disappears, the overload was only temporary
2. Turn the unit off
3. Pull the QMA connector on the IS 420
4. Turn the unit on
5. Push the ION SRC key
   - If the IS ERR display remains, push the ION SRC key again. If the display still remains, the malfunction is in the IS 420 assembly
   - If the IS ERR display disappears, check the connection cable to the QMA, the connections at the QMA and the QMA itself for low isolation resistances and short circuits (Refer to the data on the maximum load for V1...V9, Appendix A).

9.1.3 Procedure for EMISS ERR

1. Turn the emission off
   - The display should disappear
2. Turn the emission on
   - When the display disappears after approx. 3s, the overload was only temporary
   - If the display reappears again after approx. 3s, the following malfunctions could be the cause:
     - Poor vacuum
     - PROTECTION set point too low
     - Bad combination of set points
       (refer to the operating instructions for the ion source)
     - Isolation fault or break in the cable or the ion source
     - The transport spacer has not been removed from a new filament
     - A malfunction in the IS 420

> **CAUTION**
>
> When a setpoint has been changed, PROTECTION must also be readjusted.

9.1.4 Procedure for FIL 1 DEF / FIL 2 DEF

1. Turn off the emission
   - The display should disappear
2. Turn off the unit
3. Pull the QMA connector on the IS 420
4. Measure the resistance of one or both of the filaments through the cable and connector (refer to appendix C and the diagram for the IS 420 for pin assignment). The resistance must not exceed 2 Ohm.
   - If the resistance is > 2 Ohm, the cable and all the connections must be checked for excessively high contact resistance.
   - If the resistance is > MOhm, the filament and all the connections must be checked for breaks.
   - If the resistance < 2 Ohm, the malfunction is very probably in the IS 420 assembly

9.2 Troubleshooting

If there is a malfunction in the IS 420 assembly, fuses F1 and F2 on the FC 420 must be checked (refer to Appendix D).

9.2.1 Procedure

1. Disconnect the QMS 420 from the mains power supply
2. Remove the IS 420 assembly and check the fuses
   - If the fuses are ok, then the general rule is to replace the entire assembly

WARNING

Because the IS 420 works on fatal levels of high voltage, only properly trained specialists may troubleshoot on it. In addition, it is difficult to take measurements on it, and incorrect handling can destroy sensitive components.

For further information refer to the engineering handbook.

10. SPARE PARTS

When ordering be sure to state the model name and the serial number as given on the nameplate.

Spare parts	Order Nr.
Apparatus fuses F1, F2 250 V, 2.5 AT, 5 x 20 mm	BG 4666 444

11. ACCESSORIES

Accessories	Order Nr.
Ion source cable 3 x 1 mm^2 + 12 x 0,25 mm^2 3 m 10 m	BG 548 082 -T BG 548 083 -T

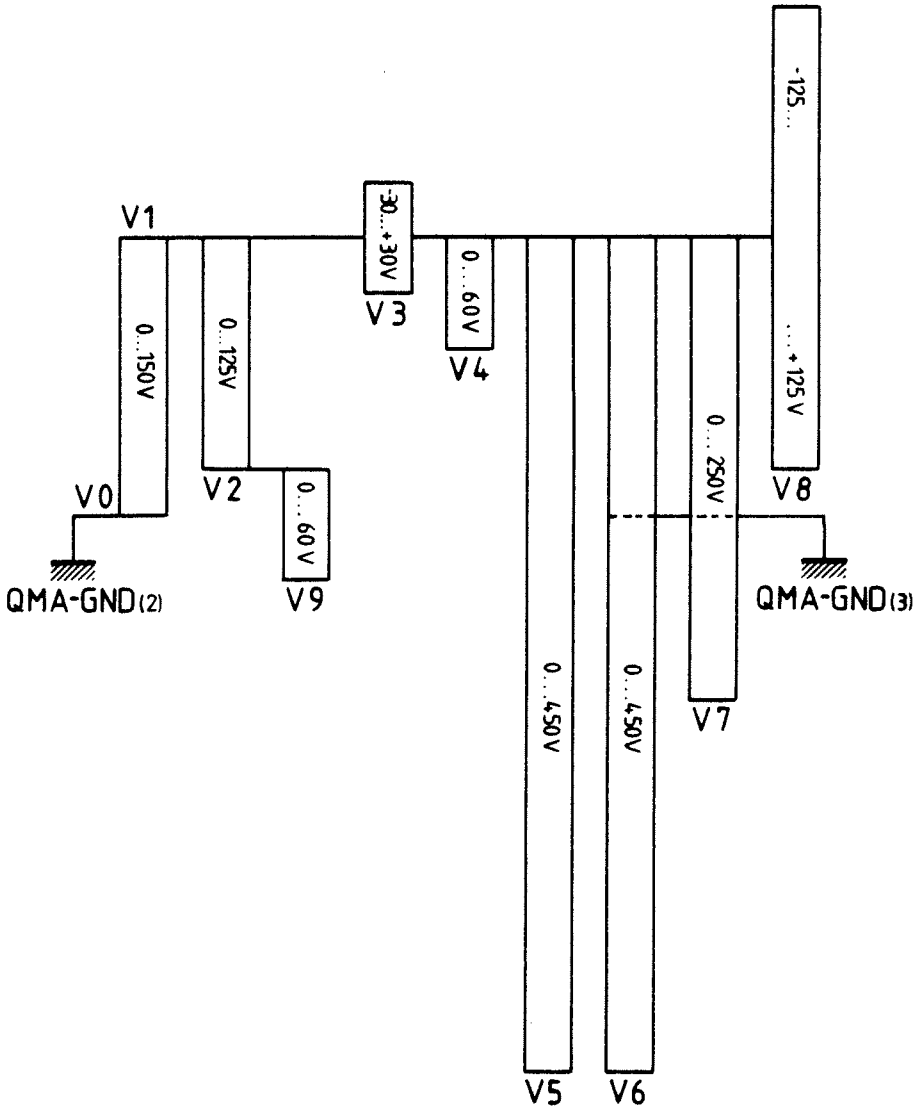
Two wire are connected in parallel for each filament.

Output	Designation	Reference potential (Normal emission)	Range [V] at positive ion polarity △)	Load current [mA] max.	Output resistance [Ω]	Ripple voltage (mVpp) typical	Resolution [V]	Linearity error [V]	Zero point error [mV] typical	Gain error [%]	0 point temperature coefficient mV/°C typical	Gain temperature coefficient ppm/°C	Potential for degas [V] referenced to V0
V1	IONREF (Anode)	V1 - V0	0...+150	± 2,0	2,0	3	1	± 0,5	± 120	1,6	± 1,5	± 100 ppm	+ 550
V2	Cathode	V1 - V2	0...+125	+ 2,0	3,3	3	0,5	± 0,25	± 60	1,6	± 1,0	± 100 ppm	+ 7
V3	Focus	V1 - V3	-30...+30	± 2,0	47,0	1	0,25	± 0,125	± 70	1,8*	± 2,0	± 150 ppm	+ 550
V4	F.A.	V1 - V4	0...+60	± 0,5	47,0	3	0,25	± 0,125	± 30	1,6	± 0,5	± 100 ppm	0
V5	Extr.	V1 - V5	0...+450	± 0,1	47,0	5	2,0	± 1,0	± 240	1,6	± 3,0	± 100 ppm	0
V6	Defl. I	V1 - V6	0...+450	± 0,1	47,0	5	2,0	± 1,0	± 240	1,6	± 3,0	± 100 ppm	0
V7	Defl. 0	V1 - V7	0...+250	± 0,1	47,0	4	1,0	± 0,5	± 120	1,6	± 1,5	± 100 ppm	0
V8	Res.	V1 - V8	-125...+125	± 0,1	47,0	3	1,0	± 0,5	± 300	1,8*	± 8,0	± 150 ppm	0
V9	Wehnelt	V2 - V9	0...+60	± 0,1	47,0	3	0,25	± 0,125	± 30	1,6	± 0,5	± 100 ppm	+ 7

△ All signs reverse for negative ion polarity

* The zero point is at –32 V or –128 V

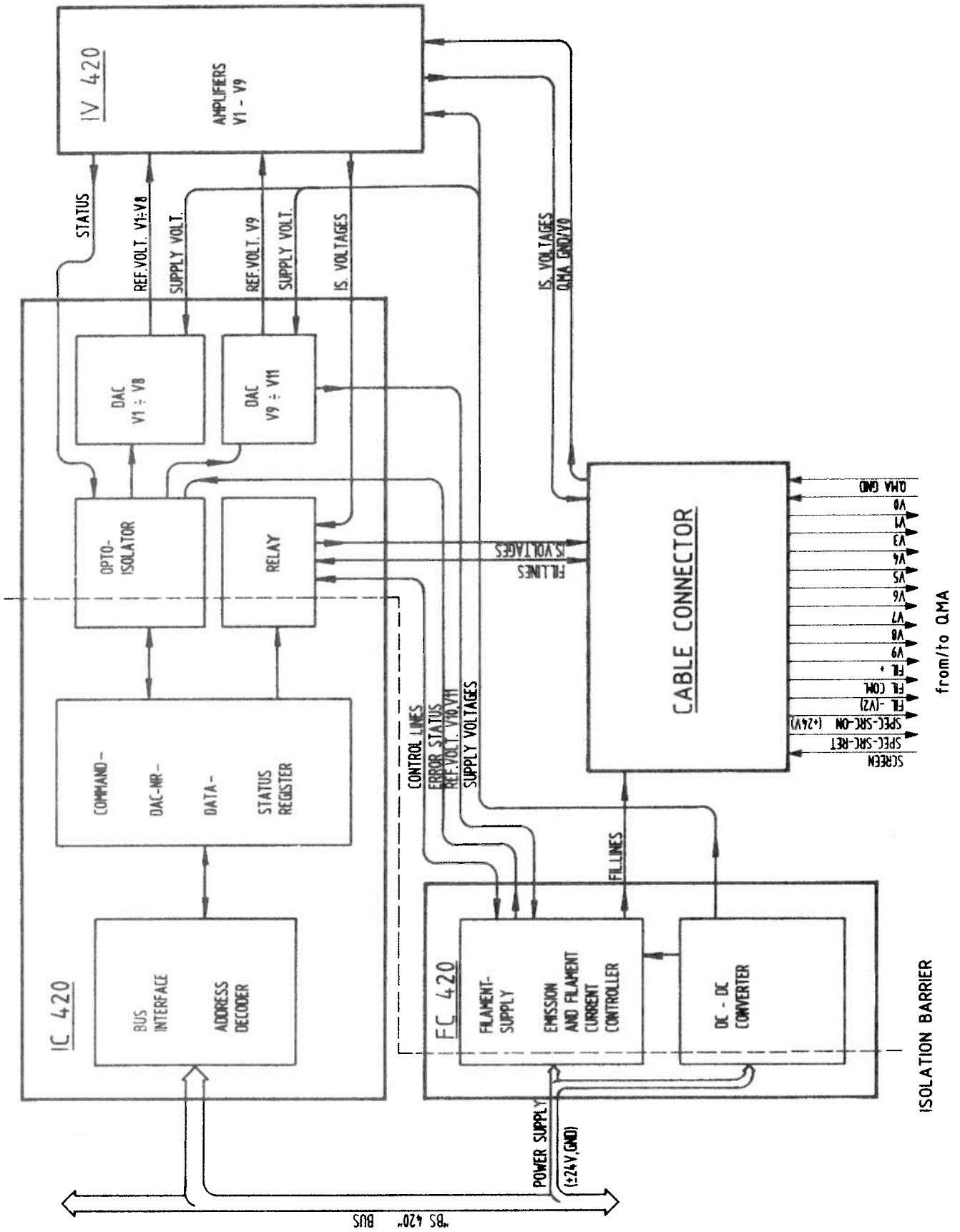
Potentials at positive polarity (1)

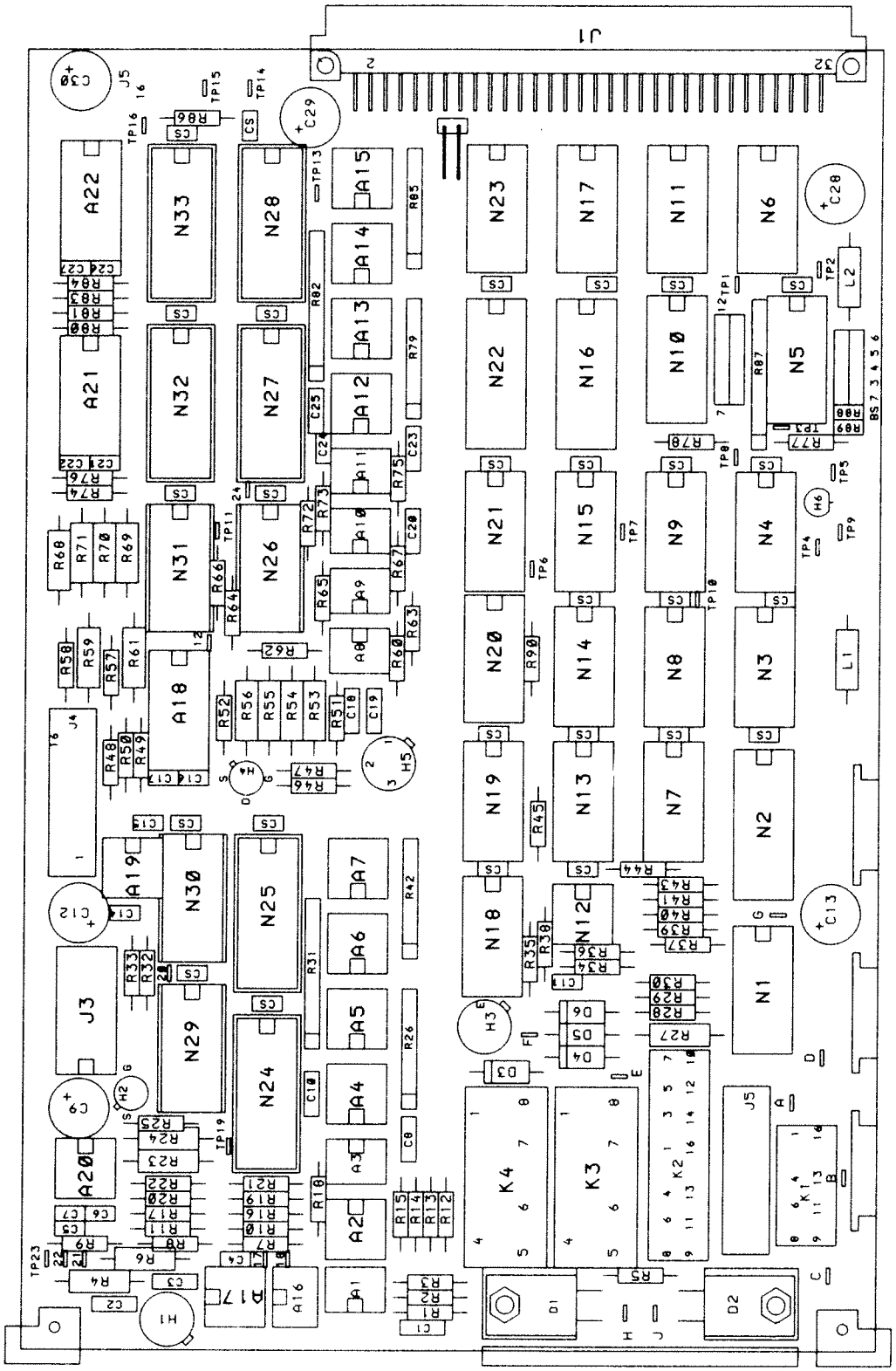


1) All signs reverse for negative ion polarity

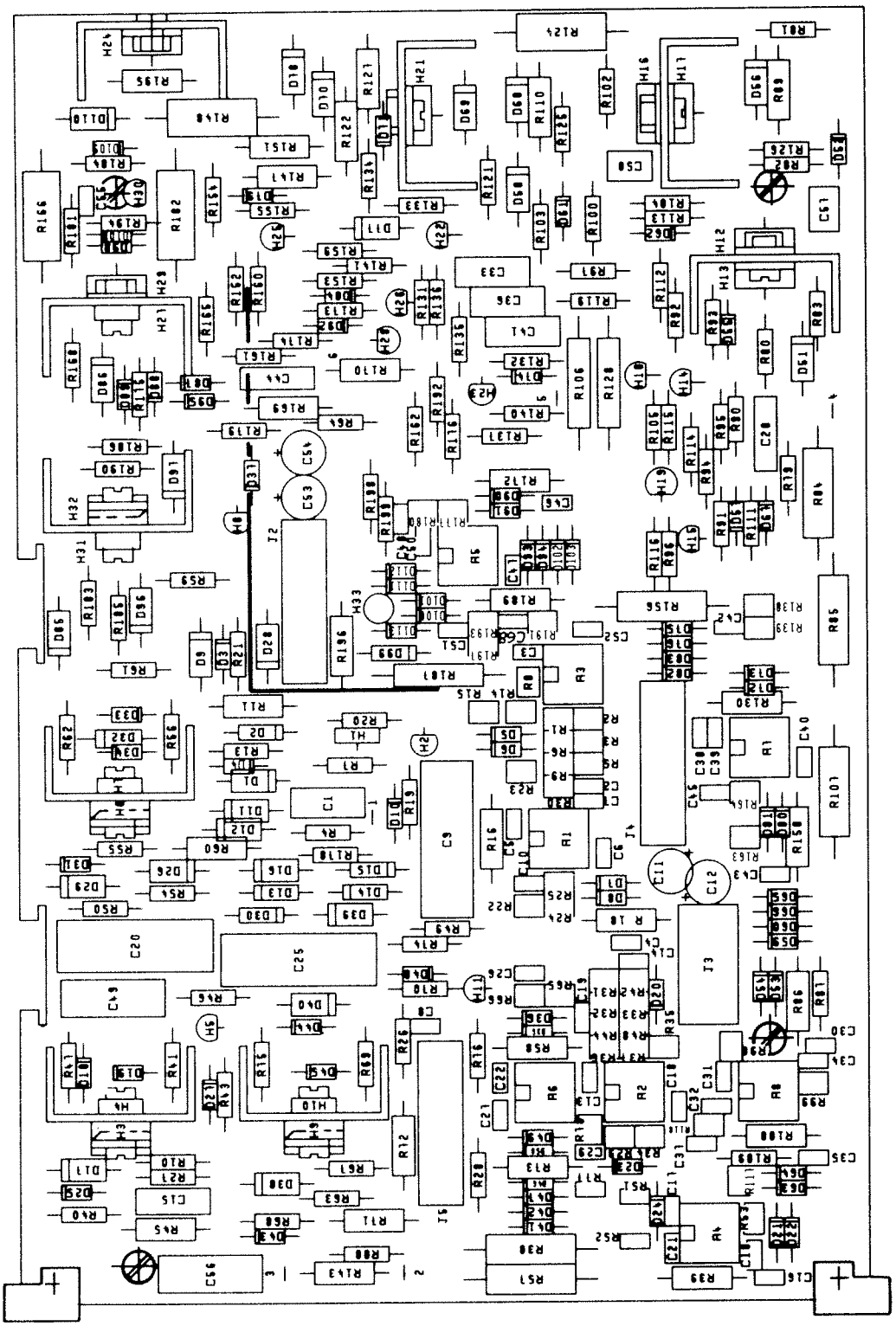
2) V0 may be applied to a maximum external potential of ± 200 V

3) V6 and V7 are switched to QMA–GND for Faraday operation

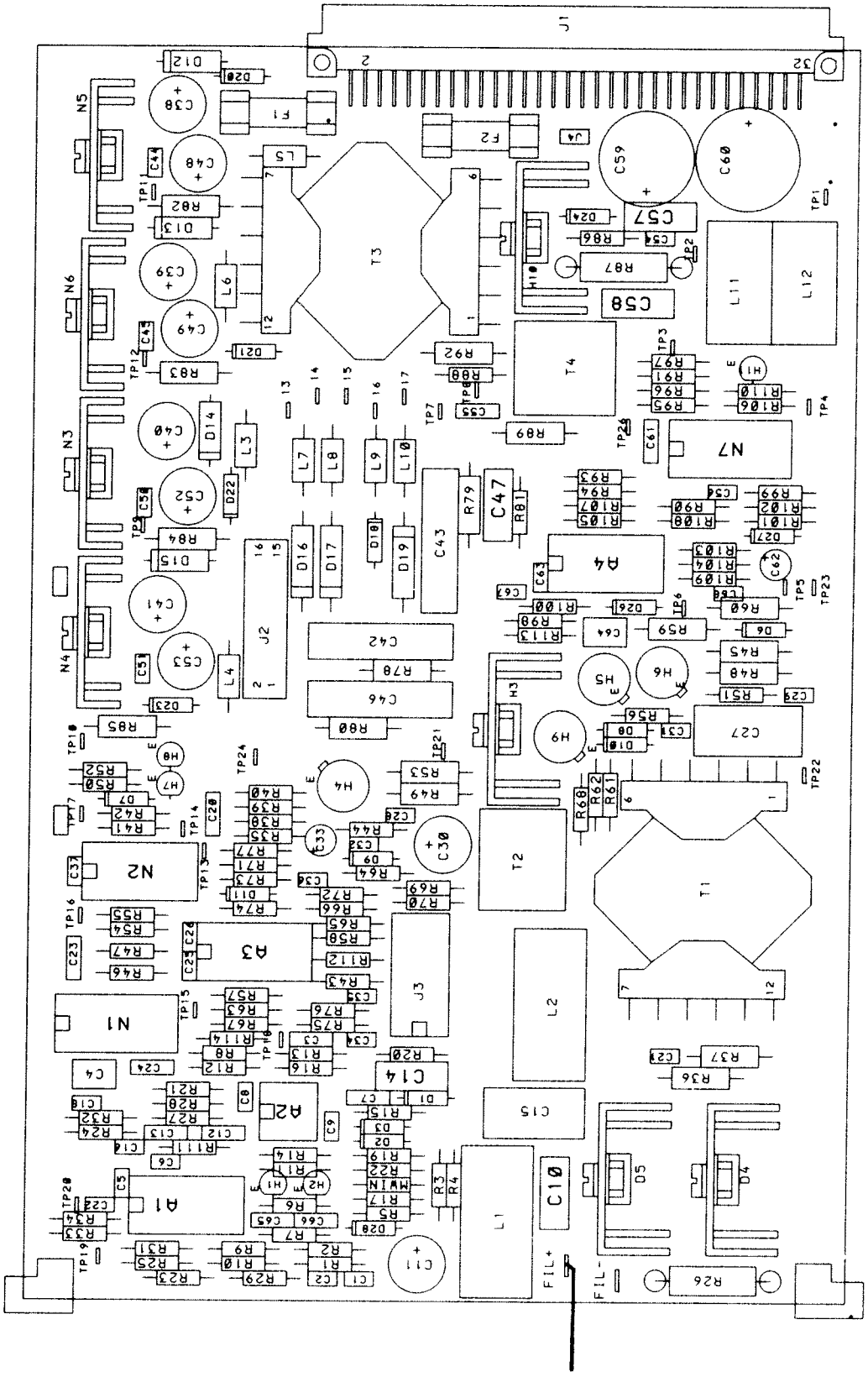

IV 420
AMPLIFIERS V1 - V9
STATUS
REF.VOLT. V1÷V8
SUPPLY VOLT.
REF.VOLT. V9
SUPPLY VOLT.
IS. VOLTAGES
IS. VOLTAGES
QMA GND/V0
DAC V1 ÷ V8
DAC V9 ÷ V11
OPTO-ISOLATOR
RELAY
CABLE CONNECTOR
FILLINES
IS.VOLTAGES
QMA GND
V0
V1
V3
V4
V5
V6
V7
V8
V9
FIL +
FIL COM
FIL -(V2)
SPEC-SRC-COM (+24V)
SPEC-SRC-RET
SCREEN
from/to QMA
COMMAND-
DAC-NR-
DATA-
STATUS REGISTER
CONTROL LINES
ERROR STATUS
REF.VOLT. V10,V11
SUPPLY VOLTAGES
FILLINES
IC 420
BUS INTERFACE
ADDRESS DECODER
FC 420
FILAMENT-SUPPLY
EMISSION AND FILAMENT CURRENT CONTROLLER
DC - DC CONVERTER
ISOLATION BARRIER
POWER SUPPLY
(±24V,GND)
„BS 420" BUS



IC 420 ion source controller **BG 512 921 -Z**



IV 420 ion source supply voltage **BG 512 891 -Z**



FC 420 filament controller BG 512 911 -Z