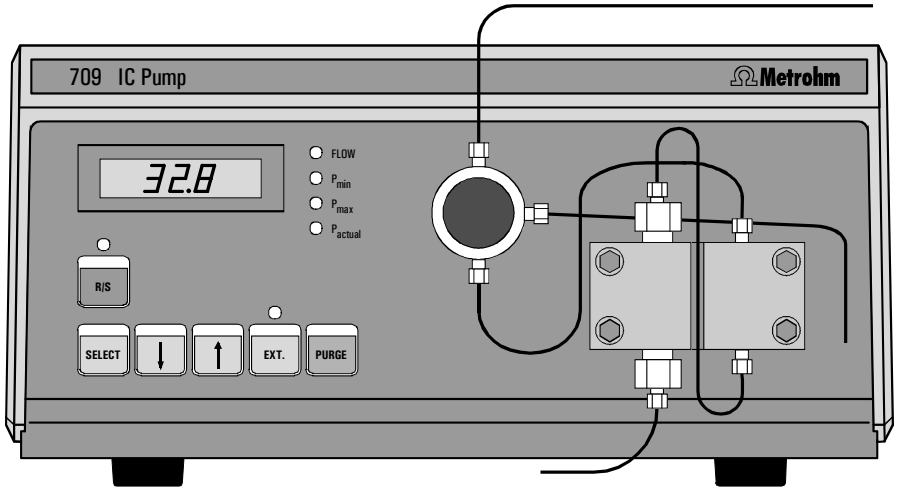
709 IC Pump



Metrohm
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Instructions for Use
8.709.1033

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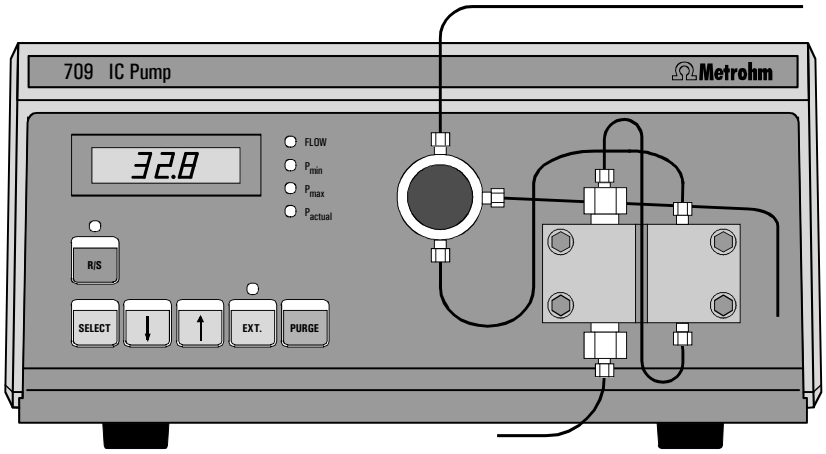
709 IC Pump



8.709.1033 Instructions for Use

16.10.2003 / chs

Table of contents

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List of numbered parts and controls

1 Introduction

1.1 Instrument description

The **709 IC Pump** is a serial dual piston pump especially developed for ion chromatography and optimized for use with Metrohm ion chromatographic instruments (e.g. 732 IC Detector and 733 IC Separation Center). The 709 IC Pump operates with minimal residual pulsation and has an excellent flow constancy. In addition to the **2.709.0010 Standard version** with parts made of sapphire, ruby, ceramics, Kel-F, Teflon or stainless steel, the totally **metal free 2.709.0110 version** is available.

All functions can be set simply at the front of the unit. The current and entered data are indicated on the LED display. To assure optimum operational reliability, both lower and upper pressure limit values can be set. If such a limit is reached, the pump switches itself off automatically. An additional purge valve allows rapid removal of air from the pump system.

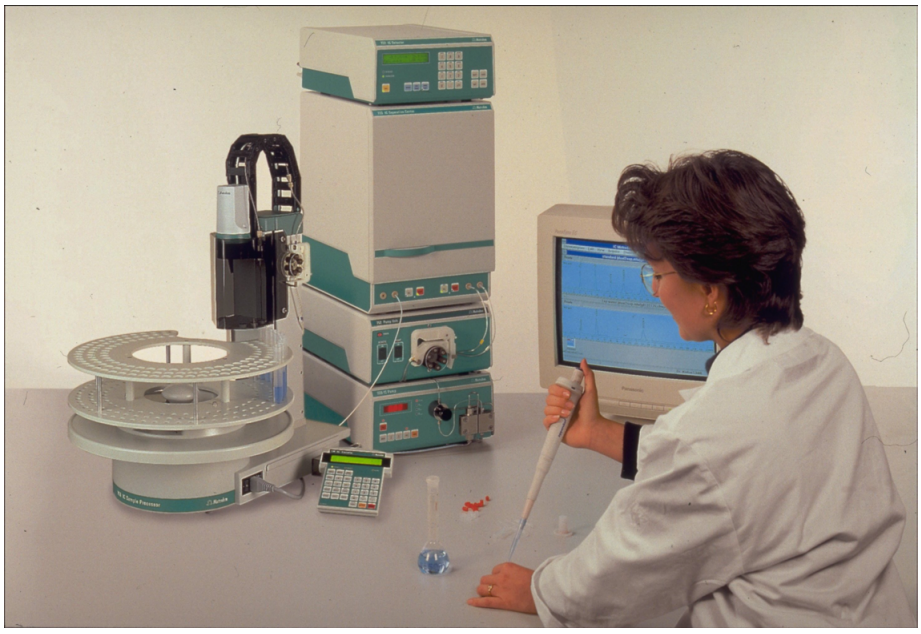


Fig. 1: ***IC system with 732 IC Detector, 733 IC Separation Center and 766 IC Sample Processor***

1.2 Parts and controls

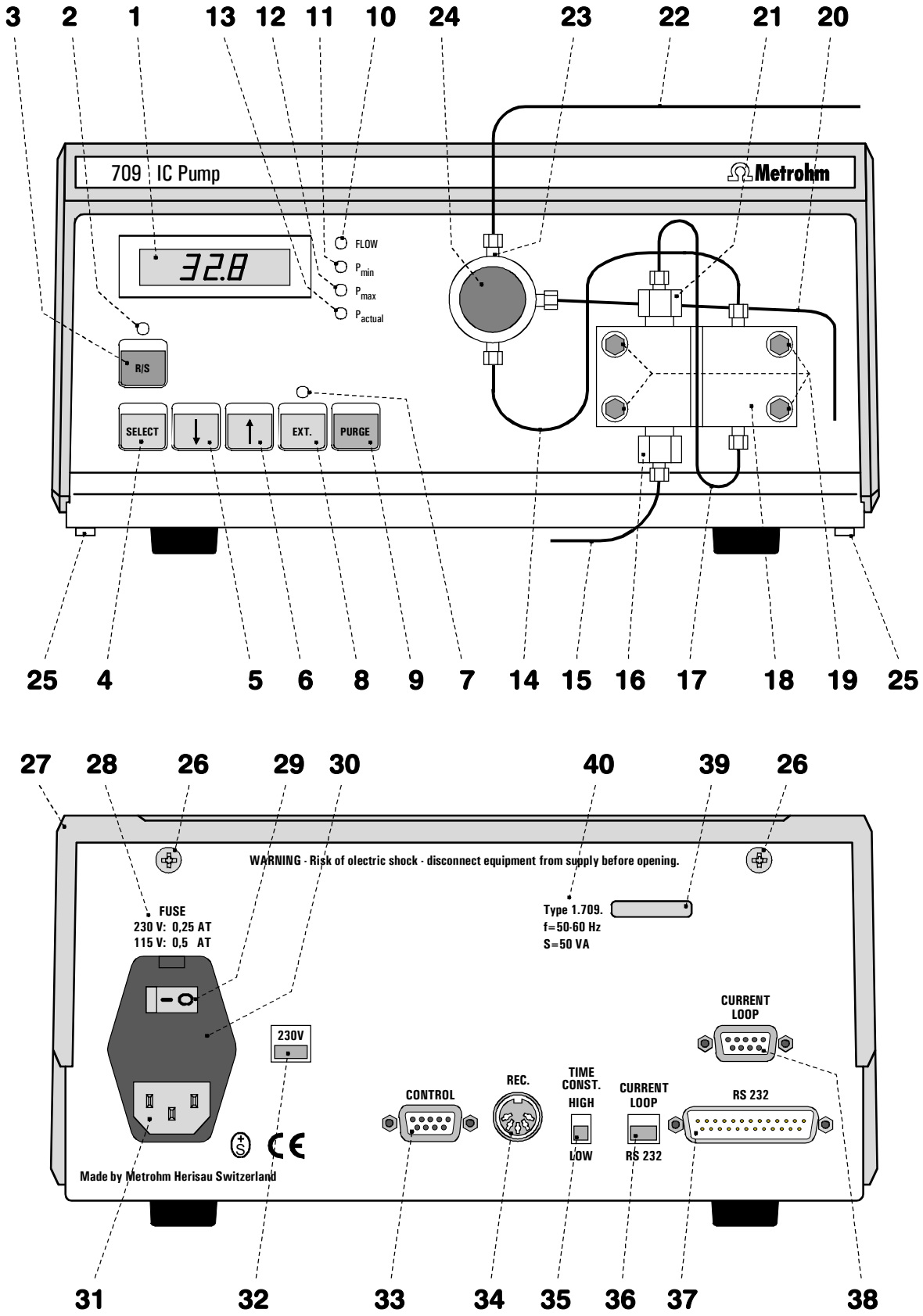


***Fig. 2:** Front and rear of 709 IC Pump*

1 **Display (LED)**

2 **LED "R/S"**
Lights up when pump drive switched on

3 **Key <R/S> (Run/Stop)**
On/off switching of the pump drive

4 **Key <SELECT>**
Switching display **1** to "Flow", "P_{min}", "P_{max}" or "P_{actual}"

5 **Key < ↓ >**
Continuous decrement of the displayed digital values

6 **Key < ↑ >**
Continuous increment of the displayed digital values

7 **LED "Ext."**
Lights up when external control is switched on

8 **Key <EXT.>**
On/off switching of external control via RS232 or current loop interface

9 **Key <PURGE>**
Deaeration of pump

10 **LED "FLOW"**
Lights up when flow rate is shown in display **1**

11 **LED "P_{min}"**
Lights up when lower pressure limit value for automatic shutoff of the pump is shown in display **1**

12 **LED "P_{max}"**
Lights up when upper pressure limit value for automatic shutoff of the pump is shown in display **1**

13 **LED "P_{actual}"**
Lights up when current pressure is shown in display **1**

14 **Connection capillary** between purge valve and pump head

15 **Aspirating capillary**

16 **Inlet valve screw connection**

17 **Connection capillary**
in pump head (integral)

18 **Pump head (6.2824.040/6.2824.100)**

19 **Fastening screws** for pump head **18**

20 **Outlet capillary** of purge valve

21 **Outlet valve screw connection**

22 **Connection capillary** to 733 IC Separation Center

23 **Attachment** for connection capillary to 733 IC Separation Center

24 **Purge valve**

25 **Screw** for housing cover

26 **Screw** for housing cover

27 **Housing cover**

28 **Fuse data**

29 **Mains switch**
Switch for on/off switching of the unit:
I = ON 0 = OFF

30 **Fuse cover**
Changing the fuses, see *section 2.6.2*

31 **Mains connection plug**
Mains connection see *section 2.6*

32 **Mains voltage selector**
115V: 100...120 V ± 10%
230V: 220...240 V ± 10%

33 **Control interface**
see *section 5.2*

34 **Recorder output socket**
Recorder output: 1 mV/MPa

35 **Sliding switch "Time Constant"**
Time constant for the recorder output:
HIGH ≈ 1 s; LOW ≈ 20 ms

36 **Sliding switch for external control**:
RS232 / **Current Loop**

37 **RS232 interface**

38 **"Current Loop" interface**
(details on request)

39 **Manufacturing number**

40 **Instrument data**
Type number, mains frequency, power consumption

1.3 Information about the Instructions for Use

Please read through these Instructions for Use carefully before operating the 709 IC Pump. The Instructions for Use contain information and warnings to which the user must pay attention in order to assure safe operation of the instrument.

1.3.1 Organization

These **8.709.1033 Instructions for Use** for the 709 IC Pump provide a comprehensive overview of the installation, startup procedure, operation, fault rectification and technical specifications of this instrument. The Instructions for Use are organized as follows:

Section 1 Introduction
Description of the instrument, parts and controls, safety notes

Section 2 Installation
Mounting the pump head, electrical connections, tubing connections, mains connection

Section 3 Operation
Detailed description of operation, explanation of all key functions

Section 4 Notes – Maintenance – Faults
Practical notes, maintenance, fault rectification, diagnosis, validation

Section 5 Interfaces
Description of RS232 interface, remote control language, control interface

Section 6 Appendix
Technical data, standard equipment, options, warranty, declaration of conformity, index

To find the information you require about the instrument please use either the **Table of contents** or the **Index** at the back.

As a supplement to the Instructions for Use, the **Metrohm Monograph 8.732.2003 "Ion chromatography"** is also supplied. This provides an introduction to the theoretical fundamentals and general information on separating columns and sample pretreatment. You will find detailed information on the separating columns available from Metrohm and on special IC applications in the relevant "**Application Bulletins"**, which are available on request free of charge from your Metrohm agency.

1.3.2 Notation and pictograms

The following notations and pictograms (symbols) are used in these Instructions for Use:

<SELECT>	**Key**
"0.0"	**Entry value**
25	**Part or control** (see *section 1.2*)
	**Hazard** This symbol draws attention to a possible danger to life or injury if the associated directions are not followed correctly.
	**Warning** This symbol draws attention to possible damage to instruments or instrument parts if the associated directions are not followed correctly.
	**Caution** This symbol marks important information. Read these directions before continuing.
	**Comment** This symbol marks additional information and tips.

1.4 Safety notes

1.4.1 Electrical safety

While electrical safety in the handling of the 709 IC Pump is assured in the context of the specifications IEC 1010-1 (protection class 1, degree of protection IP40), the following points should be noted:

- **Mains connection**

*Set the **mains voltage** and check the **mains fuse** and **mains connection** in accordance with the instructions in section 2.6.*

- **Opening the 709 IC Pump**

*To avoid all danger of coming into contact with live components do not open the instrument or remove any parts when the 709 IC Pump is connected to the power supply. Always disconnect the instrument from all voltage sources before you open it and ensure that the **mains cable is disconnected from mains connection plug 31** !*

- **Protection against static charges**

Electronic components are sensitive to static charging and can be destroyed by discharges. Before you touch any of the components inside the 709 IC Pump, you should earth yourself and any tools you are using by touching an earthed object (e.g. housing of the instrument or a radiator) to eliminate any static charges which exist.

1.4.2 General safety rules

- **Handling of solvents**

Check the pump tubing and all input and output leads periodically for possible leaks. Follow the relevant instructions regarding the handling of flammable and/or toxic solvents and their disposal.

2 Installation

2.1 Setting up the 709 IC Pump

2.1.1 Packaging

The 709 IC Pump is supplied together with the separately packed accessories in special packagings containing shock-absorbing foam linings designed to provide excellent protection. The actual instrument is packed in an evacuated polyethylene bag to prevent the ingress of dust. Please store all these special packagings as only they assure transport of the instruments free from damage.

2.1.2 Check

After receipt, immediately check whether the shipment is complete and has arrived without damage (compare with delivery note and list of accessories in *section 6.2*). In the case of transport damage, see instructions in *section 6.4.1* "Warranty".

2.1.3 Location

Position the 709 IC Pump in the laboratory at a location convenient for operation, free from vibrations and protected against a corrosive atmosphere and contamination by chemicals.

To avoid disturbing temperature influences on the insulated column compartment, the pump and eluent reservoir must be protected against direct sunlight.

2.1.4 Arrangement of the instruments

In one-channel operation, the 709 IC Pump, 733 IC Separation Center and 732 IC Detector are best stacked on top of one another in this order.

In two-channel operation (733.0X20 IC Separation Center), the optimum arrangement (1, 2 or 3 towers) depends on the laboratory space available. However, the 709 IC Pumps should be set up at the very bottom and the 732 IC Detectors at the very top.

2.2 Mounting the pump head

To ensure that the pump drive is not damaged during transport a black plastic block is mounted in place of the pump head on the right side of the 709 IC Pump front panel. This transport safeguard block has to be removed after undoing the four screws.

To avoid any damage to the pump head, the protective block must be remounted if the pump has to be moved any great distance.

Next, the 6.2824.040 Pump Head **18** (6.2824.040 or 6.2824.100) with integrated piston units is unpacked and fixed in place of the transport safeguard block with the four hexagon screws **19** as shown in *Fig. 2*.

To ensure that the pump head is not positioned wrongly, the holes at the rear for the clamping bolts have different depths, i.e. 1 clamping bolt is longer than the rest. The deepest hole must naturally accommodate the longest bolt. If this is not the case, the pump will not function properly.

The connection capillary **14** fastened to purge valve **24** is screwed onto pump head **18** as shown in *Fig. 2*.

The 2.709.0110 IC Pump MF (metal-free version) should only be operated in the pressure range of 0…25.0 MPa (0…250 bar). With higher pressure, the 6.2824.100 PEEK pump head can be damaged.

So make sure that the maximum shutoff pressure P_{max} *of the pump is always set to* $\leq$ ***25.0 MPa*** *(see section 3.4.2).*

2.3 Attaching the accessories

2.3.1 Capillaries

Some of the connections under high pressure between the 709 IC Pump and the IC system must be set up by the user. For the pressure range 0…25 MPa (0…250 bar) the **6.1831.010 PEEK capillary** (i.d. = 0.25 mm, e.d. = $^1/_{16}$", length = 3 m) supplied in the accessories of the 709 IC Pump can be used for both pump versions. For the pressure range 25…50 MPa (250…500 bar), which is permissible only for the not metal-free 2.709.0010 version, the **6.2620.020 Steel capillary** (i.d. = 0.25 mm, e.d. = $^1/_{16}$", length = 3 m) must be used.

With PEEK capillaries the connection is made preferably with the 6.2744.010 PEEK connectors (see *section 2.3.2*), with steel capillaries, the 6.2620.000 and 6.2620.010 steel connectors should be used (see *section 2.3.3*).

*Capillaries fitted with new connectors must have a perfectly flat cut surface. For PEEK capillaries it is best to use the **6.2621.080 Capillary tubing cutter**, for steel capillaries the **6.2621.040 Capillary tubing cutter**.*

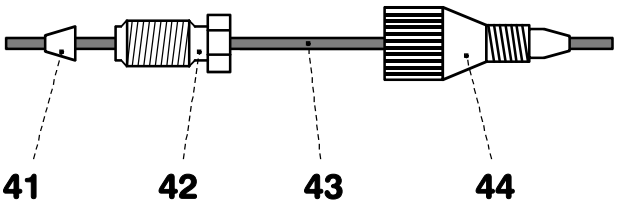


Fig. 3: Connectors for capillaries

41	**Ferrule (6.2620.010)**
42	**Pressure screw (6.2620.000)**
43	**Capillary** 6.2620.020 Steel capillary or 6.1831.010 PEEK capillary
44	**Compression fitting (6.2744.010)**

2.3.2 PEEK connectors

For the connection of 6.1831.010 PEEK capillaries or of 6.1822.010 PTFE Microcapillaries (i.d. = 0.3 mm), the supplied **6.2744.010 PEEK Compression fittings** are used. It is best to proceed as follows:

1 Mount compression fitting

Slide a compression fitting **44** (6.2744.010) over the end of the capillary **43** to be fastened as shown in *Fig. 3*.

2 Insert capillary in connection

Push capillary end in the corresponding connection as far as it will go (to avoid dead volume).

3 Tighten compression fitting

Tighten compression fitting **44** by hand (never use tools).

2.3.3 Steel connectors

For the connection of steel capillaries, the steel connectors **6.2620.010 Ferrule** and **6.2620.000 Pressure screw** available as an option are used. Proceed as follows:

1 Mount connectors

Slide a pressure screw **42** (6.2620.000) and a ferrule **41** (6.2620.010) over the end of the capillary **43** to be fastened as shown in *Fig. 3*.

2 Insert capillary in connection

Push capillary end into the corresponding connection as far as it will go (to avoid dead volume).

3 Tighten pressure screw

Tighten pressure screw **42** with the open-end spanner 1/4" (6.2621.010) supplied.

2.3.4 Pulsation dampener

To protect the column material against pressure drops caused by the injector, the use of a pulsation dampener connected between the pump and the injection valve of the 733 IC Separation Center is recommended. The optional **6.2620.150 Pulsation dampener MF** is very well suited to this purpose (see *section 6.3*).

The metal-free 6.2620.150 Pulsation dampener is supplied fully assembled and has two connections for capillaries, for which the connectors supplied or two 6.2744.010 PEEK compression fittings can be used. The flow direction is arbitrary. The pulsation dampener is positioned in the interior of the 733 IC Separation Center on the base below the injection valve (see *732/733 Instructions for Use*).

2.3.5 Filter unit PEEK

The **6.2821.100 Filter unit PEEK** supplied (see *Fig. 4*) serves to avoid contamination of the piston seals by abrasive particles and can be used in the pressure range 0…25 MPa (0…250 bar). The filter unit consists of the housing **46** and the two connectors **45** (with filter) and **47** (without filter) to be screwed into the housing **46**. For the connection of capillaries **43**, PEEK compression fittings **44** (6.2744.010) must be used.

New connectors **45** with filter are available as an option with the ordering number 6.2821.110 (10 pieces).

For the connection of the filter unit, please note the flow direction arrow printed on the housing.

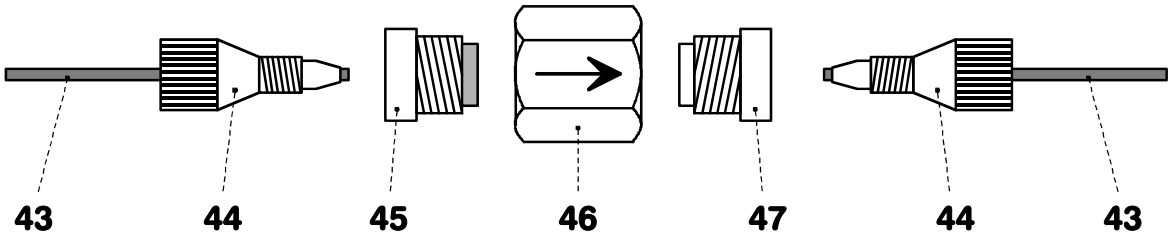


Fig. 4: Filter unit PEEK (6.2821.100)

43	**Capillary** 6.1831.010 PEEK capillary	**46**	**Housing for filter unit** Part of 6.2824.100 Filter unit
44	**Compression fitting (6.2744.010)**	**47**	**Connector without filter** Part of 6.2824.100 Filter unit
45	**Connector with filter (6.2824.110)** Part of 6.2824.100 Filter unit		

2.3.6 Filter unit Manufit

The **6.2821.000 Filter unit Manufit** available as an option (see *section 6.3*) serves to avoid contamination of the piston seals by abrasive particles and can be used in the pressure range 0…50 MPa (0…500 bar) together with steel capillaries. It is installed as follows (see *Fig. 5*):

1 Prepare Manufit housing

- Insert outlet capillary **55** with steel mesh holding end **53** into Manufit housing **54**.
- Insert the 4 steel meshes **52** provided into the steel mesh holding end **53**.
- Press the PTFE gasket **51** into the steel mesh holding end **53**.

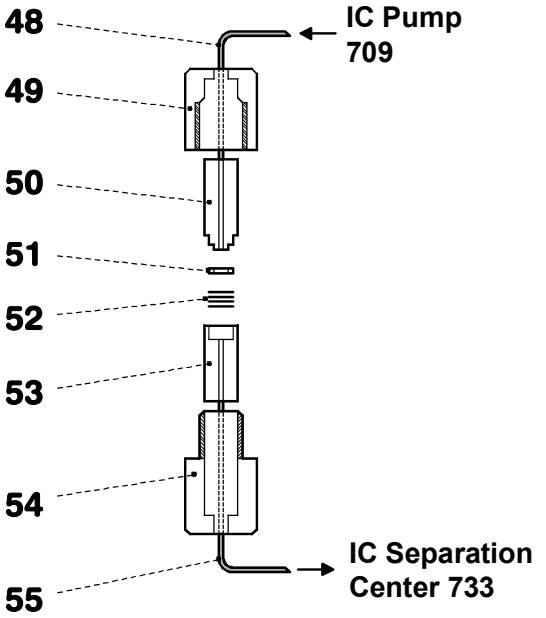
2 Prepare Manufit pressure screw

- Insert inlet capillary **48** with counterpart end **50** into Manufit pressure screw **49**.

3 Assembly

- Fit the two capillary end pieces **50** and **53** together.
- Screw Manufit pressure screw **49** and Manufit housing **54** firmly together.

To replace contaminated steel meshes, proceed in the reverse order.



48	**Inlet capillary**
49	**Manufit pressure screw**
50	**Counterpart end**
51	**PTFE gasket (6.2821.010)**
52	**4 Steel meshes (6.2821.020)**
53	**Steel mesh holding end**
54	**Manufit housing**
55	**Outlet capillary**

Fig. 5: Filter unit Manufit (6.2821.000)

2.4 Connecting the tubing

2.4.1 Connection to injection valve with PEEK capillaries

For the pressure range 0…25 MPa (0…250 bar), it is recommended to use 6.1831.010 PEEK capillaries, a 6.2620.150 Pulsation dampener (see *section 2.3.4*), and a Filter unit PEEK (see *section 2.3.5*) to connect the 709 IC Pump to the injection valve of the 733 IC Separation Center. Proceed as follows:

1 Connection to 709 IC Pump

- Cut connection capillary **22** (6.1831.010 PEEK capillary) to the required length and equip it with connectors.
- Attach connection capillary **22** to connection **23** of the 709 IC Pump (see *Fig. 2*).

2 Connection of filter unit PEEK

- Attach the other end of connection capillary **22** at the connector **45** (with filter) of the filter unit **56** (see *Fig. 6*).
- Connect a PEEK capillary **43** cut to the required length and equipped with connectors to the connector **47** of the filter unit **56**.

3 Installation of the capillary in the IC Separation Center

- Procedure, see *732/733 Instructions for Use, section 2.6.5*.

4 Connection of the pulsation dampener

- Procedure, see *732/733 Instructions for Use, section 2.6.5.*

5 Connection to the injection valve

- Procedure, see *732/733 Instructions for Use, section 2.6.5*.

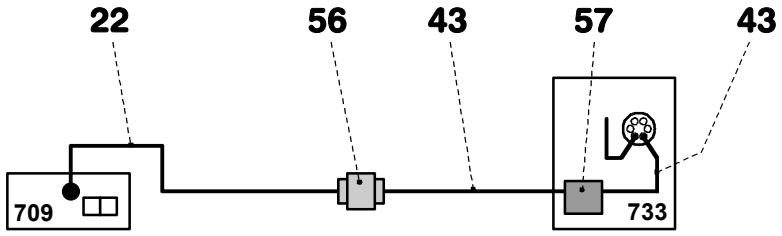


Fig. 6: Connection to injection valve with PEEK capillaries

22	**Connection capillary** 6.1831.010 PEEK capillary	**56**	**Filter unit PEEK (6.2821.100)**
43	**PEEK capillary (6.1831.010)**	**57**	**Pulsation dampener (6.2620.150)**

2.4.2 Connection to injection valve with steel capillaries

For the pressure range 25…50 MPa (250…500 bar), it is recommended to use 6.2620.020 steel capillaries, a 6.2620.150 Pulsation dampener (see *section 2.3.4*), and a Filter unit Manufit (see *section 2.3.6*) to connect the not metal-free 2.709.0010 IC Pump to the injection valve of the 733 IC Separation Center. Proceed as follows:

1 Connection of filter unit Manufit

- Attach inlet capillary **48** of the filter unit Manufit **58** to connection **23** of the 709 IC Pump (see *Fig. 2*).
- Attach outlet capillary **55** of the filter unit Manufit **58** using a coupling **59** to a steel capillary **43** cut to the required length and equipped with connectors (see *Fig. 7*).

2 Installation of the capillary in the IC Separation Center

- Procedure, see *732/733 Instructions for Use, section 2.6.5*.

3 Connection of the pulsation dampener

- Procedure, see *732/733 Instructions for Use, section 2.6.5.*

4 Connection to the injection valve

- Procedure, see *732/733 Instructions for Use, section 2.6.5*.

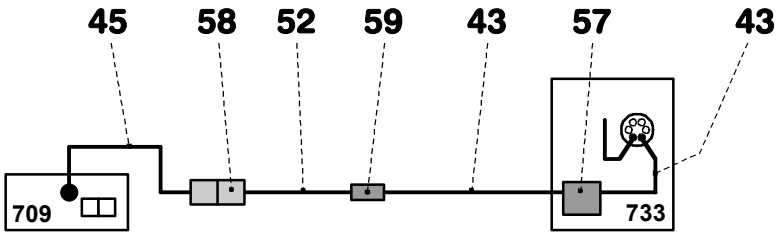


Fig. 7: Connection to injection valve with steel capillaries

43	**Capillary** 6.2620.020 Steel capillary	**57**	**Pulsation dampener (6.2620.150)**
48	**Inlet capillary** of filter unit Manufit **58**	**58**	**Filter unit Manufit (6.2824.000)**
55	**Outlet capillary** of filter unit Manufit **58**	**59**	**Coupling (6.2620.060)**

2.4.3 Connection to eluent container

The 6.1834.000 Aspirating tubing (i.d. = 1.5 mm, e.d. = 2.5 mm, length = 1.2 m) supplied is slid over the aspirating capillary **15**. The 6.2821.090 Aspirating filter supplied is screwed onto the other end of the tubing. The end of the tubing with the aspirating filter is then introduced in the eluent container.

Only degassed (with N_2, He or vacuum) and microfiltered (0.45 µm filter) eluents may be used!

It must be ensured that the eluent used is freely miscible with any residual solvent in the pump head (the pump head is filled with isopropanol or methanol/water in the factory). If this is not the case, the pump must first be rinsed with a solvent that is miscible with both the previous and subsequent eluent (e.g. acetone).

If you use the optional available 6.5324.000 Bottle rack, the 6.1834.010 Aspirating tubing (accessory of the bottle rack, length = 2.5 m) must be installed instead of the 6.1834.000 Aspirating tubing. The end of the tubing with the screwed-on 6.2821.090 aspirating filter is then fixed in the eluent vessel according to the instructions on the leaflet supplied with the bottle rack.

2.5 Electrical connection

The **connection of the 709 IC Pump** at the 732 IC Detector is made acc. to *Fig. 8* using the 6.2125.060 cable or another RS cable specified as a "null modem" cable. To ensure proper functioning of the communication between the 732 IC Detector and 709 IC Pump, the sliding switch **36** on the IC pump must be set to "RS 232" and the external control switched on with <EXT.> key **8** (see *section 3.6*).

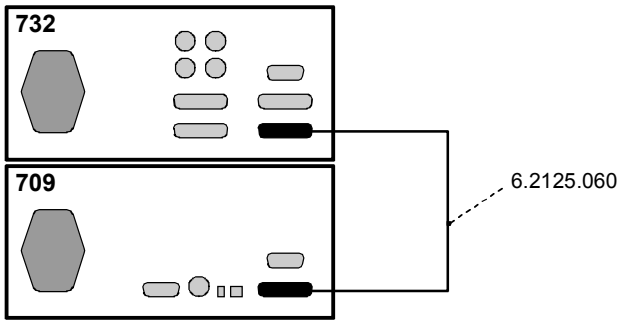


Fig. 8: Connection at 732 IC Detector

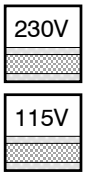
2.6 Mains connection

Follow the instructions below for connecting to the power supply. If the instrument is operated with a mains voltage set wrongly and/or wrong mains fuse, there is a danger of fire!

2.6.1 Setting the mains voltage

Before switching on the 709 IC Pump for the first time, check whether the mains voltage set on the instrument (can be read in the mains voltage selector **32**) matches the local mains voltage. If this is not the case, you must switch the mains voltage by pushing the mains voltage selector **32** with a screwdriver:

Position of the mains voltage selector **32**:



230V: 220…240 V ± 10%

115V: 110…120 V ± 10%

2.6.2 Fuses

The 709 IC Pump contains two fuses built in as standard, either of type 0.25 AT (for 230 V: 0.25 A, slow-blow, Metrohm ordering number U.600.0010) or 0.5 AT (for 110 V: 0.5 A, slow-blow, Metrohm ordering number U.600.0013). Ensure that the two fuses correspond to the fuse type specified for the local mains voltage (see fuse data **28**). To change wrong or blown fuses, proceed as follows:

Ensure that the instrument is never put into operation with fuses of another type, otherwise there is danger of fire!

1 Disconnect mains cable

Disconnect mains cable from mains connection plug **31** of the 709 IC Pump.

2 Remove fuse cover

Using a screwdriver, lever out fuse cover **30** forwards until it opens.

3 Check and change fuses if necessary

Carefully take the fuses installed for the desired mains voltage out of the fuse holder and check its specifications:

100…120 V 0.5 A (slow-blow) Metrohm No. U.600.0013

220…240 V 0.25 A (slow-blow) Metrohm No. U.600.0010

Change fuse if necessary and reinsert in fuse holder.

4 Install fuse holder

Reinsert fuse holders in the instrument (the arrows printed on the holders must point in the same direction as the arrows on the inside of fuse cover **30**).

5 Install fuse cover

Push in fuse cover **30** firmly until it clicks into place.

6 Connect mains cable

Plug mains cable into mains connection plug **31**.

2.6.3 Mains cable and mains connection

Mains cable

The instrument is supplied with one of three mains cables:

- 6.2122.020 with plug SEV 12 (Switzerland, …)
- 6.2122.040 with plug CEE(7), VII (Germany, …)
- 6.2133.070 with plug NEMA 5-15 (USA, …)

which are three-cored and fitted with a plug with an earthing pin. If a different plug has to be fitted, the yellow/green lead (IEC standard) must be connected to protective earth (protection class 1).

Any break in the earthing inside or outside the instrument can make it a hazard!

Mains connection

Plug the mains cable into mains connection plug **31** (see *Fig. 2*).

2.6.4 On/off switching of the instrument

The 709 IC Pump is switched on and off using mains switch **29**. When the instrument is switched on, all segments of display **1** and all LEDs light up for a few seconds. The instrument is then in the standby mode ("ready" status).

2.7 Deaerating the pump

The purge valve **24** is opened by turning anticlockwise and the pump can now be deaerated by pressing the <PURGE> key **9**.

The solvent bottle should be located somewhat above the pump, but at least at the same level as the pump head **18** (never below the pump). When the <PURGE> key is pressed the pump operates at the maximum flow rate (5 mL/min).

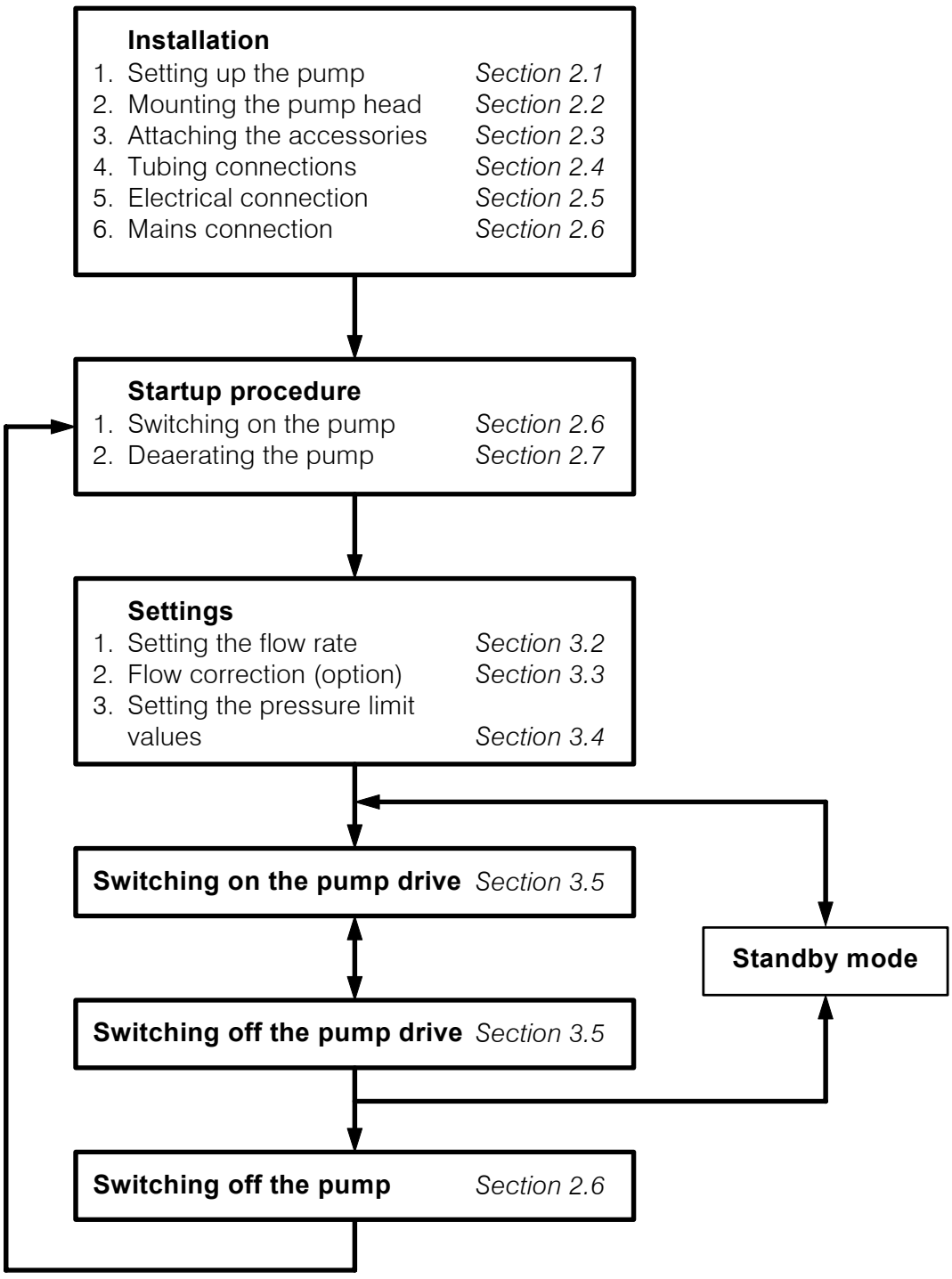
*For safety reasons the <PURGE> key **9** functions only in the stop mode of the pump, i.e. the <PURGE> key is disabled when the pump is running in normal operation.*

Should the pump not prime by itself, the 6.2816.020 syringe supplied is used to siphon off solvent via the outlet capillary **20** with opened purge valve through the pump head until there are no more bubbles in the solvent entering the syringe. The pump can then again be purged briefly by pressing the <PURGE> key **9**.

On completion of this procedure, the purge valve **24** is closed by turning clockwise. The pump is now ready for operation.

3 Operation

3.1 Sequence of operations



3.2 Flow rate

The flow rate can be set in the range of 0.05…5.00 mL/min with the pump drive switched on or off as follows:

1 Select "FLOW"

Press <SELECT> key **4** until the "FLOW" LED **10** lights up.

2 Set flow rate

Press < ↓ > key **5** or < ↑ > key **6** until the desired flow rate (in mL/min) appears in display **1**.

3 Store flow rate

Release < ↓ > key **5** or < ↑ > key **6**: the value shown in display **1** at the time of release will be stored.

3.3 Flow correction

Since the difference between displayed and actual flow rate can be maximum 3 % owing to unavoidable tolerances in the manufacture of mechanical parts, there is a possibility to adjust the 709 IC Pump after installation of a new pump head. For this, a correction factor of 0.9…1.1 can be entered in the 709 IC Pump.

The correction factor is determined by measurement of the actual flow rate with the aid of a measuring cylinder:

$$\textit{Correction factor} = \frac{\textit{Displayed flow rate (in mL/min)}}{\textit{Measured flow rate (in mL/min)}}$$

In the entry of the correction factor, proceed as follows:

1 Select flow correction

Press <SELECT> key **4** for ca. 3 s until all LEDs (**10**...**13**) go out and the correction factor appears in display **1**.

2 Set flow correction

Press < ↓ > key **5** or < ↑ > key **6** until the desired flow correction appears in display **1**.

3 Store flow correction

Release < ↓ > key **5** or < ↑ > key **6**: the value shown in display **1** at the time of release will be stored.

4 Return to standby mode

Press <SELECT> key **4** briefly, the pump is again in the standby mode.

3.4 Pressure limit values for safety shutdown

3.4.1 Minimum pressure limit

The minimum shutoff pressure of the pump can be set in steps of 0.1 MPa from 0.1…50 MPa with the pump drive switched on or off. Proceed as follows:

1 Select "P_{min}"

Press <SELECT> key **4** until the "P_{min}" LED **11** lights up.

2 Set shutoff pressure

Press < ↓ > key **5** or < ↑ > key **6** until the desired minimum shutoff pressure (in MPa) appears in display **1**.

3 Store shutoff pressure

Release < ↓ > key **5** or < ↑ > key **6**: the value shown in display **1** at the time of release will be stored.

Entry of the value "**0.0**" switches off the lower pressure limit monitoring. The set limit value should lie far enough below the particular operating pressure. If the pump pressure falls below this preset lower limit during operation, the microprocessor checks whether this violation persists for several revolutions of the cam or whether it was a temporary drop in pressure due to an air bubble or a brief leak in the valves. If the cause is a temporary loss of pressure, the pump is not switched off. In the case of a pressure drop due to leaks or interrupted inflow of the eluent, the pump drive is switched off and disabled.

If the pump has been shut off by the minimum pressure monitoring, the LED **11** flashes, the shutoff pressure can be requested in the display "P_{actual}" (see *section 3.7*). The safety shutdown is not active during the first two minutes after the pump drive has been switched on with the <R/S> key **3**.

Pressing the <R/S> key **3** re-enables the pump drive, the LED **11** no longer flashes and the pump is in the standby mode. Pressing the <R/S> key **3** again puts the pump back into operation.

3.4.2 Maximum pressure limit

The maximum shutoff pressure of the pump can be set in steps of 0.1 MPa from 0.1…50 MPa with the pump drive switched on or off. Proceed as follows:

1 Select "P_{max}"

Press <SELECT> key **4** until the "P_{max}" LED **12** lights up.

2 Set shutoff pressure

Press < ↓ > key **5** or < ↑ > key **6** until the desired shutoff pressure (in MPa) appears in display **1**.

3 Store shutoff pressure

Release < ↓ > key **5** or < ↑ > key **6**: the value shown in display **1** at the time of release will be stored.

The set limit value should lie between 5.0 and 10.0 MPa above the particular operating pressure or the maximum admissible operating pressure of the column. If the pump exceeds the preset limit value during operation, the pump drive is switched off within 1 pump cycle and disabled. If the pump has been switched off by the maximum pressure limit monitoring, the LED **12** flashes, the shutoff pressure can be requested in the display "P_{actual}" (see *section. 3.7*).

Pressing the <R/S> key **3** re-enables the pump drive, LED **12** no longer flashes and the pump is in the standby mode. Pressing the <R/S> key **3** again puts the pump back into operation.

The 2.709.0110 IC Pump MF (metal-free version) should only be operated in the pressure range of 0…25.0 MPa (0…250 bar). With higher pressure, the 6.2824.100 PEEK pump head can be damaged.

So make sure that the maximum shutoff pressure ***P_{max}*** *of the pump is always set to* ***≤25.0 MPa****.*

3.5 Switching the pump drive on and off

Switching on Pressing the <R/S> key **3** switches on the pump drive. While the pump drive is running, LED **2** above the <R/S> key **3** lights up.

Switching off To switch off the pump drive, press the <R/S> key **3** again. LED **2** goes out.

3.6 On/off switching of the external control

Switching on Pressing the <EXT.> key **8** switches on the external control. The interface (RS232, see *section 5.1* or "Current Loop", details on request) is selected with sliding switch **36**. With active external control the LED **7** above the <EXT.> key **8** lights up. All keys with the exception of <SELECT> **4** (selection of display function) are blocked.

Switching off To switch off the external control, the <EXT.> key **8** is pressed again. The LED **7** goes out and all functions are once more accessible manually via the keypad.

3.7 Inquiry of the current pressure

The current pressure of the pump can be queried at any time when the pump drive is switched on. Proceed as follows:

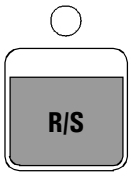
1 Select "P_{actual}"

Press <SELECT> key **4** until the "P_{actual}" LED **13** lights up.

2 Read pressure

The current pressure (in MPa) is shown in display **1**.

3.8 Overview of the key functions



On/off switching of the pump drive

When the pump drive is switched on, the LED above the key is on.

Selecting the display function

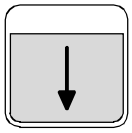
FLOW Current flow rate in mL/min
Range: 0.01...5.00 mL/min

P_{min} Minimum shutoff pressure for automatic shutdown of the pump drive
Range: 0.1... 50 MPa (1...500 bar)
($P_{min} < P_{max}$)
0.0: no shutoff

P_{max} Maximum shutoff pressure for automatic shutdown of the pump drive
Range: 0.1...50 MPa (1...500 bar)
($P_{max} > P_{min}$)

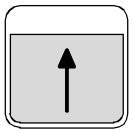
P_{actual} Current pressure

NX Correction factor for flow rate (see *section 3.2*). The <SELECT> key must be pressed for ca. 3 s.
Range: 0.90 ... 1.10



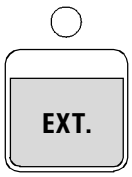
Input key for continuous lowering of the value selected with the <SELECT> key. When the key is released the current value is stored.

Pressing this key briefly changes the displayed value by one digit, if the key is pressed longer the value is changed continuously and increasingly faster.



Input key for continuous raising of the value selected with the <SELECT> key. When the key is released the current value is stored.

Pressing this key briefly changes the displayed value by one digit, if the key is pressed longer the value is changed continuously and increasingly faster.



On/off switching of the external control of the pump via RS232 or current loop interface.

On/off switching of the maximum delivery rate (5 mL/min) to purge the pump.

This key is active only in the standby mode.

4 Notes – Maintenance – Faults

4.1 Practical notes

4.1.1 Protection against foreign particles

To protect the column against foreign particles which could have an adverse influence on the separation efficiency, we advise you to subject both the eluents and all samples to **microfiltration** (0.45 µm filter) and to siphon the eluent through the **6.2821.090 Aspirating filter**.

To avoid contamination by abrasive particles arising from piston seals of the 709 IC Pump, it is advantageous to install an **in-line filter** between the pump and the 733 IC Separation Center. We recommend to use either the **6.2821.100 Filter unit PEEK** for the standard operation with PEEK capillaries (see *section 2.3.5*) or the **6.2821.000 Filter unit Manufit** for the operation in the pressure range > 25.0 MPa (> 250 bar) with steel capillaries (option, see *section 2.3.6*).

4.1.2 Pulsation dampener

To protect the column material against pressure shocks caused by injection we recommend to use a pulsation dampener between the 709 IC Pump and the 733 IC Separation Center. The optional **6.2620.150 Pulsation dampener MF** (see *section 2.3.4*) is eminently suitable for this purpose.

4.1.3 Eluents

Treatment

For the preparation of the eluents one should use chemicals of a purity degree of at least "**p.a.**". For dilution please use only **high purity water**.

Fresh eluents should always be **microfiltered** (0.45 µm filter) and **degassed** (with N_2, He or vacuum). The eluent should be continuously **stirred** with a magnetic stirrer, particularly when the recycling procedure is employed or when alkaline eluents are used. For alkaline eluents and eluents with low buffering capacity one should preferably use **CO_2 absorbers**.

The supply vessel containing the eluent must be closed as tightly as possible to avoid excessive evaporation. This is primarily important with eluents containing organic solvents (e.g. acetone), the evaporation of which can lead to drifts in the long term. If work is performed in a very sensitive range, even if one drop of condensate falls back in the eluent this can cause a noticeable change in the background conductivity.

Precipitates

Salt crystals between the piston and the seal are the cause of abrasive particles, which can enter the eluent. These lead to contaminated valves, pressure rise and in extreme cases to scratched pistons. It is thus essential to ensure that **no precipitates** can appear, e.g. when the eluent is changed. Solutions used in direct succession must therefore be miscible. If the system has to be rinsed with an organic solution, several solvents with increasing or decreasing lipophilic character may possibly have to be used (e.g. water ↔ acetone ↔ chloroform).

4.2 Maintenance and servicing

4.2.1 General information

Care

The 709 IC Pump requires proper care and attention. Excessive contamination of the instrument could possibly lead to malfunctions and a shorter service life of the inherently rugged mechanical and electronic parts.

Spilled chemicals and solvents should be wiped up immediately. It is especially important to protect the plug connections at the rear of the instrument (particular the mains plug) against contamination.

Although constructional measures have been designed to virtually eliminate such a situation, should corrosive media penetrate the interior of the instrument the mains plug of the 709 IC Pump must be immediately disconnected to prevent extensive damage to the instrument electronics. Inform Metrohm service if your instrument has been damaged in such a way.

The instrument must not be opened by untrained personnel. Please comply with the safety notes in section 1.4.1.

Maintenance by Metrohm service

Maintenance of the 709 IC Pump is best done as part of an annual service performed by specialists from the Metrohm company. If work is frequently performed with caustic and corrosive chemicals, it may be necessary to shorten the interval between servicing.

The Metrohm service department is always willing to offer expert advice on the maintenance and servicing of all Metrohm instruments.

4.2.2 Maintenance work at the pump head

In many cases, an unstable baseline (pulsation, flow fluctuations) can be traced to contaminated valves or faulty, leaky piston seals. For cleaning contaminated valves and/or replacement of wear parts such as pistons, piston seals and valves, proceed as follows:

1 Detach pump head

Unscrew connection capillary **14** from the pump head **18** with the aid of the ¼" wrench (see *Fig. 2*). Then remove the pump head **18** from the pump housing by loosening the 4 hexagon screws **19** using the 6.2621.030 hexagon key. The main piston is on the left (when viewed from front), the auxiliary piston on the right.

2 Disassemble pump head

Strip down pump head **18** in accordance with *Fig. 9*. Main and auxiliary pistons are identical with the following exceptions:

- The spring **63** of the auxiliary piston (right piston) is more powerful (longer) than that of the main piston (left piston).
- Inlet and outlet valve are not present in the secondary cylinder.

*To prevent the piston **61** suddenly jumping out of the piston cartridge **64**, the screw **60** must be undone very carefully by hand.*

3 Cleaning/replacement of piston 61

Pistons contaminated by abrasive particles or deposits are cleaned with scouring powder and rinsed free of any particles with dist. water. Relatively badly contaminated or scratched pistons must be replaced (spare part: 6.2824.070 Zircon piston).

4 Replacement of piston seal 68

To remove damaged piston seals **68** the special tool **72** is used. This is screwed into the seal **68**, which can then be pulled out (see *Fig.10A*).

*When the special tool **72** is screwed into the piston seal **68** the latter is completely destroyed!*

If you use only aqueous eluents the 6.2741.000 piston seal can be replaced by the 6.2741.010 PE piston seal available as an option.

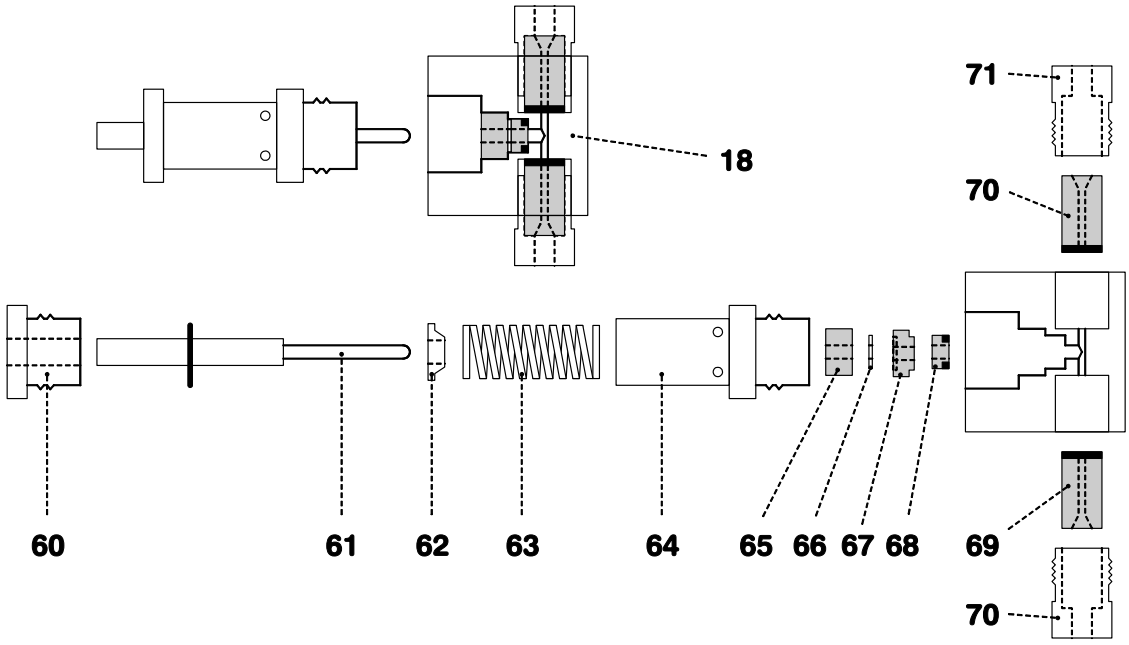


Fig. 9: Components of the pump head

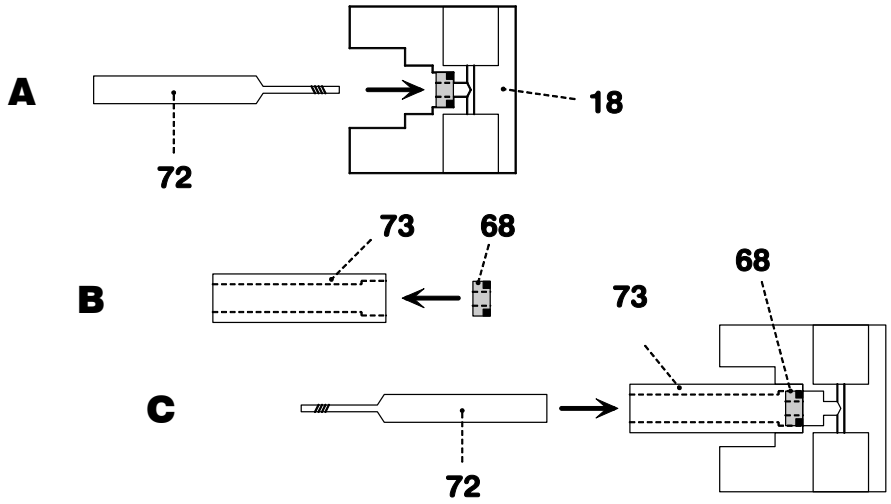


Fig. 10: Replacement of the piston seal 68

18	**Pump head (6.2824.040/6.2824.100)**	**67**	**Piston guide sleeve (4.709.4370)**
60	**Screw** for piston cartridge **64**	**68**	**Piston seal (6.2741.000/6.2741.020)**
61	**Piston** with piston shaft (6.2824.070 zircon piston or 6.2824.000 sapphire piston)	**69**	**Inlet valve (6.2824.020/6.2824.090)**
62	**Spring retainer**	**70**	**Outlet valve (6.2824.010/6.2824.080)**
63	**Spring (6.2824.050)** for main piston or **Spring (6.2824.060)** for auxiliary piston	**71**	**Screw holder** for valve
64	**Piston cartridge (4.709.0760)**	**72**	**Special tool (6.2617.010)** to remove the piston seal **68**
65	**Piston guide sleeve (4.709.4380)**	**73**	**Special tool (6.2617.010)** to install the piston seal **68**
66	**Sapphire supporting ring (6.2824.030)**		

To install a new piston seal **68** the special tool **73** is used:

- First the new seal is inserted firmly in the recess of tool **73** by hand (see *Fig. 10B*). The seal spring must be located on the outside.
- The tool **73** together with the seal is then inserted in the pump head **18** and the seal pressed into the pump head recess with the aid of tool **72** (see *Fig. 10C*).

*The seal surface in the pump head **18** must not be damaged (avoid contact with tool)!*

5 Cleaning/replacement of inlet valve 69 and outlet valve 70

Different valves are used depending on the pump version. In the 2.709.0010 IC Pump, the 6.2824.020 Inlet valve and the 6.2824.010 Outlet valve are built-in, in the metal-free 2.709.0110 IC Pump, the 6.2824.090 Inlet valve and the 6.2824.080 Outlet valve are built-in..

Contaminated or blocked valves are cleaned by rinsing with dist. water, RBS solution or acetone. The rinsing effect can be reinforced by brief treatment in an ultrasonic bath (max. 20 s; if longer the sapphire sphere of the valve can be damaged).

If this does not have the desired effect, the valves can be disassembled as shown in *Fig. 11*. The valve components are pushed out with the aid of a syringe needle inserted through the upper opening in the valve housing **74**. The individual components are rinsed with dist. water and/or acetone, and the sapphire sphere cleaned with a paper towel. The valve is then reassembled in accordance with *Fig. 11*. The components of the inlet and outlet valves are identical, they are distinguished only by the positioning of the sapphire sleeve **77** and the ceramic holder **79** (see *Fig. 11*).

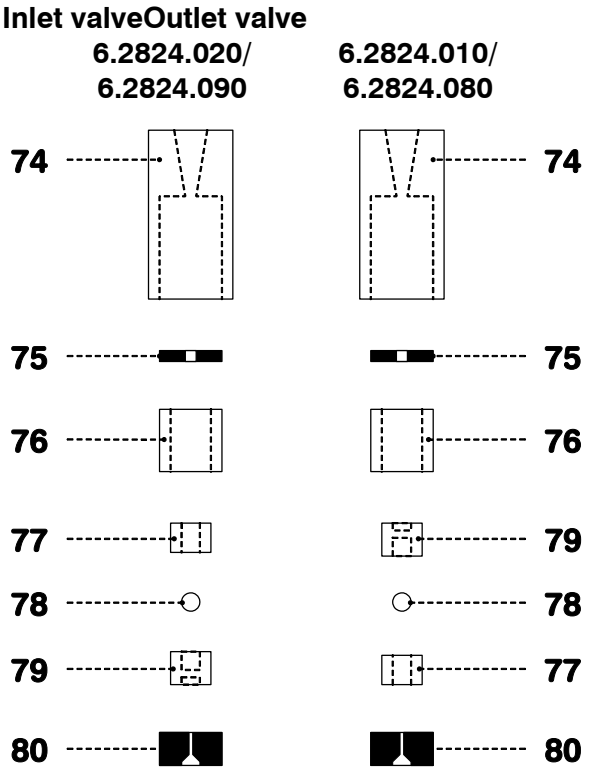
Valves that fail to function faultlessly after such cleaning must be replaced.

In the reinstallation of the inlet valve **69** or the outlet valve **70** on no account must the two outwardly identical valves be interchanged. To determine which valve is which, note that the liquid flows through the pump head from the bottom up. The flow direction of the valves can be checked simply by blowing through the clean valve. Both valves are installed with the black face in the direction of the pump head (see *Fig. 9*).

*If by mistake an inlet valve **69** is installed instead of the outlet valve **70**, an extreme pressure buildup occurs within the working cylinder, which is not detected by the pressure transducer and will destroy the piston seal **68**!*

6 Mounting the pump head

The components of the pump head **18** are reassembled as shown in *Fig. 9*. The screw **60** and the piston cartridge **64** may be tightened only by hand. On the other hand, the two valve screw holders **71** are tightened with a wrench. The pump head is then remounted on the pump (see *section 3.2*).



74	**Valve housing**
75	**Sealing ring** (black)
76	**Sleeve**
77	**Sapphire sleeve** The bright side must point towards the sapphire sphere
78	**Sapphire sphere**
79	**Ceramic holder for sapphire sphere** The large recess must point in the direction of the sapphire sphere
80	**Seal** The larger opening must point outwards

Fig. 11: Components of inlet valve 69 and outlet valve 70

4.3 Faults and malfunctions

If difficulties appear with the IC system during analyses, their causes are best investigated in the order **separating column → 709 IC Pump → eluent → 732/733 IC System** (see *732/733* Instructions for Use, *section 5.3.2*). Several of the malfunctions which may appear with the 709 IC Pump are listed in the following table with details of possible causes and countermeasures.

Malfunction	*Cause*	*Rectification*
• **Dark or undefined display** • **Pump does not respond to key-stroke** • **Pump drive is switched on auto-matically after switching on the instrument without keystroke**	• Battery of Zero Power RAM discharged	• Inform Metrohm service
Baseline with high noise level, pulsation	• Contaminated pump values • Faulty piston seals • Quality of the pump does not suffice for the selected sensitivity	• Clean the valves (see *section 4.2.2*) • Replace the piston seals (see *sec-tion 4.2.2*) • Use pulsation dampener, use more powerful pump or lower the sensitivity
Drift of the baseline	• Thermal equilibrium not yet reached • Leak in system • Evaporation of organic solvent in eluent	• Condition system with heating switched on • Check connections and make leakproof • Ensure better closure of eluent supply vessel
Considerable pressure drop	• Leak in system	• Check connections and make leakproof
Considerable pressure rise	• Contamination of the filter in the 6.2821.000 Filter unit Manufit • Contamination of the filter in the 6.2821.100 Filter unit PEEK	• Clean or replace 6.2821.020 Steel mesh(es) • Replace 6.2821.110 connector with filter
Error message "E01" **in the display**	• RS232 receive error	• Inform Metrohm service
Error message "E02" **in the display**	• ROM test error	• Inform Metrohm service
Error message "E03" **or** "E05" **in the display**	• RAM test error	• Inform Metrohm service

4.4 Diagnosis

4.4.1 General information

The 709 IC Pump is a very precise and reliable instrument. Thanks to its rugged construction it is virtually impossible for external mechanical or electrical influences to have an adverse effect on its functions.

Although the occasional fault in the instrument can not be excluded completely, it is certainly much more likely that malfunctions are caused by wrong operation or handling or through improper connections and operation with non-Metrohm instruments.

It is thus advisable in each case to isolate the fault with the rapid and easy to perform diagnostic tests. The customer thus need not call Metrohm service until there is a true fault in the instrument. In addition, with the aid of the numbering in the diagnostic program he can provide the service engineer with much more accurate information.

In inquiries always quote the manufacturing number **39** of the 709 IC Pump (see *Fig. 2*), program version (see *section 4.4.2*) and specify possible error messages.

Procedure

The diagnostic steps must be performed in sequence and compared with the reactions of the 709 IC Pump (indented). In the "yes" case, continue with the next instruction.

If the instrument does not show the expected reaction ("no" case), the appropriate diagnostic step must be repeated to exclude an operating error. With repeated wrong reactions, however, there is a strong possibility that a malfunction exists.

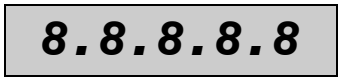
Equipment needed

3.496.8480 Test plug (*Necessary only if external required functions (RS 232) should also be checked).*

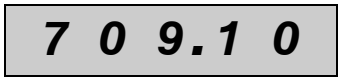
4.4.2 Entry of diagnostics with automatic display test

1. Power off.
2. Disconnect all external connections (cables at rear) except mains cable.
3. Press and hold <R/S> key **3** (keep pressed) and power on.

   The display **1** shows for about 3 s the switch-on test pattern and all 6 LEDs are switched on for visually checking.

   The display **1** shows for about 3 s the number of the installed program version.

4. Release <R/S> key **3**.

4.4.3 Keyboard test

1. Press <R/S> **3**.

2. Press <SELECT> **4**.

3. Press < ↓ > **5**.

4. Press < ↑ > **6**.

5. Press <EXT> **8**.

6. Press <PURGE> **9**.

(x x) = not relevant

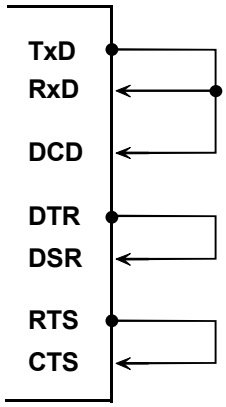
4.4.4 RS232 Test

This test is meaningful only if the 709 IC Pump is used interconnected with other instruments via RS 232 connection. In addition, a 3.496.8480 Test plug normally used in the repair service is required for this test. However, this plug can also be purchased by customers under the above number.

For the sake of completeness, the procedure is described here.

(If a diagnostic test of the RS232 interface is not required, continue with section 4.4.5)

Connections in the 3.496.8480 plug



1. Power off.
2. Insert 3.496.8480 plug in port "RS232" **37**.
3. Sliding switch **36** on rear panel to setting "RS232".
4. Press and hold <SELECT> key **4** (keep pressed) and power on.

5. Release <SELECT> key **4**.

*The test runs automatically and checks several functions in succession. If one of these functions is faulty, the display "**2 0 0**" does not appear directly but some value is shown briefly. If, e.g., no test plug is plugged in, the following appears:*

6. Power off.
7. Remove test plug.

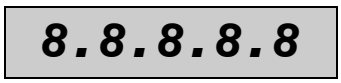
4.4.5 Initialize and test RAM

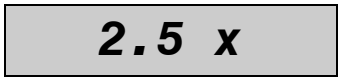
On the odd occasion large disturbing signals (e.g. mains spikes, lightning, etc.) can have an adverse effect on the processor functions and hence lead to a system crash. After such a crash the RAM area must be initialized. Although the basic instrument data remain stored, the RAM initialization should be performed only when necessary since the stored user data (flow rate, P_{min}, P_{max} etc.) are cleared as a result.

1. Power off.
2. Press and hold < ↓ > key **5** (keep pressed) and power on.

3. Release < ↓ > key **5**.

RAM is tested and initialized.





The "FLOW" LED lights up.

4. The lost data of the user must now be reentered.

4.5 Validation / GLP

The requirements of **GLP** (**G**ood **L**aboratory **P**ractice) include a periodic check of analytical measuring instruments with regard to their reproducibility and accuracy using **S**tandard **O**perating **P**rocedures, **SOP**).

The 709 IC Pump as part of the complete ion chromatography system, whose most important components also include separating column, 732 IC Detector, 733 IC Separation Center, and evaluation system, must be incorporated in its comprehensive validation.

Testing of the electronic and mechanical function groups of Metrohm instruments can and should be performed as part of a regular service by trained personnel of the manufacturing company (see *section 4.2.1*). All Metrohm instruments are equipped with start-up-test routines which check for perfect functioning of the relevant assemblies when the instrument is switched on. If no error message is displayed, it may be assumed the instrument is operating without faults.

The Metrohm company also supplies its instruments with an integrated diagnostic program (see *section 4.4*) which, in the case of possible malfunctions or faulty behavior, allows the user to check the functioning of certain assemblies and localize the fault. Diagnostic programs can also be integrated in a validation procedure.

5 Interfaces

5.1 RS232 interface

5.1.1 General rules for remote control

The 709 IC Pump is equipped with the comprehensive Metrohm remote control language, which allows full control over the instrument via an RS232 interface, i.e. the 709 IC Pump can receive data from an external device or send data to an external device. The 709 IC Pump sends $2\times C_R$ and L_F as the terminator of a requested **data block.** In contrast, C_R and L_F are used as the terminator of a **data line**. On receipt of data from an external device, this must always close its commands with C_R and L_F. If more than one command is sent on a line, '**;**' must be used as a delimiter between the individual commands.

The data are grouped logically and readily understandable. For example, to select the flow rate the command

```
&Parameter.A.Flow"1.5"
```

must be sent with entry of the boldface characters sufficing, in other words

```
&Pa.A.F"1.5"
```

All quantities of the 709 IC Pump are collected in **groups**. The entries for the parameters, for example, are located in the group

```
&Parameter
```

The 'Parameter' group contains sub-groups, e.g. for setting the parameter for the Metrohm pump head

```
&Parameter.A
```

This subgroup in turn contains the individual inquiries for the settings, e.g. the inquiry regarding the flow rate

```
&Parameter.A.Flow
```

or regarding the setting of the minimum shutoff pressure

```
&Parameter.A.Pmin
```

The data have a hierarchical structure (tree structure). The quantities which appear in this tree are called **objects** in what follows. The flow rate is that object which is called up with the command

```
&Parameter.A.Flow
```

Once you are at the desired location in the tree, you can request the value of the object:

```
&Parameter.A.Flow  $Q      Q for Query
```

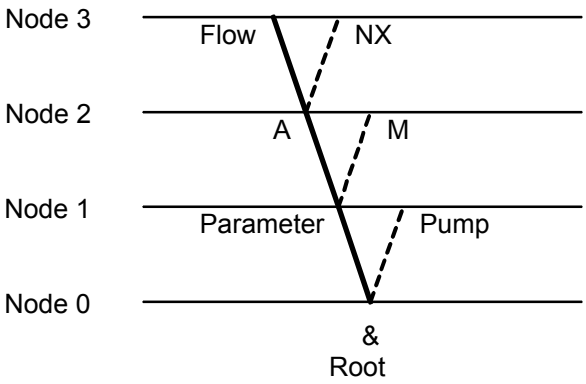
The inquiry '$Q' initiates the output of the value on the instrument, in other words the value output is triggered. Entries which begin with the character '$' always trigger something and are hence referred to as **triggers** in what follows.

However, values of objects can not only be requested, they can also be modified. Values are always inputted in inverted commas, e.g.

```
&Parameter.A.Flow"1.5"
```

5.1.2 Call-up of objects

A section from the object tree is shown below:



The following **rules** apply to the call-up of objects:

Rules	*Examples*
The root of the tree is designated by '&'.	
For the call-up of an object, the nodes (levels) of the tree are marked by a point (.).	
For the call-up of the objects, as many characters as necessary to allow unambiguous allocation of the object suffice. If the call-up is not unambiguous, the first object in the series is identified.	Call up of the minimum shutoff pressure: **&Parameter.A.Pmin** or **&Pa.A.Pmi**
Uppercase and lowercase letters can be used.	**&PA.A.PMI** or **&pa.a.pmi**
A value can be assigned to an object. Values are marked at both their beginning and end by inverted commas ("). They can contain maximum 8 ASCII characters. Numeric values can contain up to 3 digits and a decimal point. Numbers with more than 3 digits are not accepted. With numbers <1, leading zeros must be entered.	Entry of "1.5" for the flow rate: **&Parameter.A.Flow"1.5"** Correct numeric entries: "38.5", "0.97" Incorrect numeric entries: "1,5" or "+3" or ".13"

Rules	*Examples*
Until a new object is called up, the old object remains in force.	
New objects can be addressed relative to the old object: **A leading point** leads one node **forwards** in the tree. **More than one leading point** leads one node **backwards** in the tree. n nodes backwards require n+1 leading points.	From the root to the node `'A'`: **`&Pa.A`** Forwards from the node `'A'` to `'Flow'`: **`.F`** Jump from Flow onto the node `'A'` and selection of a new object `'NX'` at this node: **`..NX`**
To return to the root, enter a leading `'&'`.	Jump from the node `'M'` via the root into the node `'Pump'`: **`&Pu`**

5.1.3 Trigger

Triggers initiate an action at the 709 IC Pump, e.g. starting of a mode or sending of data. Triggers are marked by the introducer `'$'`.

The following triggers are possible:

`$G`	Go	Starts processes, e.g. starting the pump
`$S`	Stop	Stops processes
`$Q`	Query	Used to request all information from the current node in the tree forwards up to and including the values
`$Q.P`	Path	Used to request the path from the root of the tree up to the current node
`$Q.H`	Highest Index	Used to request the number of daughter nodes of the current node
`$Q.N"i"`	Name	Used to request the name of the daughter node with index i, i = 1...n
`$D`	Detail-Info	Used to request detailed status information

The triggers `'$G'` and `'$S'` are linked to particular objects, see Overview table in *section 5.1.5*.

All other triggers can always be used at all locations in the data tree.

Examples:

Inquiry of the value of the pressure: **`&I`**`nfo.`**`A`**`ctual.`**`P`**`ressure `**`$Q`**

Start of the pump: **`&P`**`ump.`**`S`**`tart `**`$G`**

Inquiry of the detailed status: **`$D`**

5.1.4 Status messages

To ensure appropriate control of an external control unit is possible, it must also be possible to request status conditions which provide information on the status of the 709 IC Pump. The output of a status message is triggered by the trigger `'$D'`. Status messages consist of the global status, the detailed status and eventual error messages, e.g. '`$S.P.S;E32`'. The global status informs on the activity of the process, while the detailed status conditions show the exact activity within the process.

The following **global status conditions** are possible:

`$G`	Go	The pump is running.
`$R`	Ready	The pump is ready.
`$S`	Stop	The pump has been stopped by "unnatural means".

Detailed status conditions

Status conditions of the global $G:

`$G.P.S`	The pump has been started with normal start.

Status conditions of the global $R:

`$R.P.S`	The pump is ready, inactive.

Status conditions of the global $S:

	The instrument gives the status from which it has been stopped, e.g. `$S.P.S;E32;`

5.1.5 Error messages

Error messages 'EXXX' are added to the status messages and separated from them by the sign ";". The following error messages are possible:

Error	*Meaning*	*Exit/Corrective action*
E29	Wrong value or no value allowed.	Send correct value or call up new object.
E30	Wrong value or no value allowed.	Send correct value or call up new object.
E31	Wrong trigger, this trigger is not allowed or carrying-out of action not possible.	Send correct trigger (exception: $D) or call up new object.
E32	Pump stopped by automatic pressure shutdown (P_{min} or P_{max} violated).	First press <EXT.> key, then <R/S> key.
E39	RS232 receive error; overflow of internal receive buffer (>82 characters).	First press <EXT.> key, then <R/S> key.

5.1.6 RS232 error rectification

Problem	*Questions for corrective action*
No data transmission occurs and an error message appears in the display of the 709 IC Pump.	⇒ **E01**: Transmission error. Is the cable used properly wired and plugged in? Is the printer switched on and set to "on-line"? ⇒ **E01**: Receive error. Are the RS232 data transmission parameters of the third-party device and the pump the same?
The received characters are garbled.	⇒ Are the RS232 data transmission parameters of the third-party device and the pump the same? ⇒ Does the baud rate of the two devices have the same setting?

5.1.7 Remote control commands

Object	*Meaning*	*Entry range*
&	**Root**	
. **P**ump	**Pump**	
. **S**tart	Start the pump	$G, $S
. **So**ft	Soft start the pump (within 5 s)	$G, $S
. **I**dentifier	Instrument identification	up to 8 ASCII characters
. **Pa**rameter	**Parameters**	
. **A**	Metrohm pump head	
. **F**low	Flow rate	0.01…5.00 mL/min
. **P**max	Upper shutoff pressure	P_{min}…50.0 MPa
. **Pmi**n	Lower shutoff pressure	0.1…P_{max} MPa
. **N**X	Correction factor	0.90...1.10
. **P**	Parameter for prep. head	
. **F**low	Flow rate	read only
. **P**max	Upper shutoff pressure	read only
. **Pmi**n	Lower shutoff pressure	read only
. **N**X	Correction factor	read only
. **M**	Parameter for micro head	
. **F**low	Flow rate	read only
. **P**rnax	Upper shutoff pressure	read only
. **Pmi**n	Lower shutoff pressure	read only
. **N**X	Correction factor	read only
. **R**	Parameter for reserve head	
. **F**low	Flow rate	0.01...5.00 mL/min
. **P**max	Upper shutoff pressure	0.1…50.0 MPa
. **Pmi**n	Lower shutoff pressure	0.1…50.0 MPa
. **N**X	Correction factor	0.90…1.10
. **I**nfo	**Current configuration**	
. **H**ead	Pump head	
. **A**ctual	Current data	
. **P**ressure	Pressure	
. **F**low	Flow rate	
. **Pm**ax	Upper shutoff pressure	
. **Pmi**n	Lower shutoff pressure	
. **N**X	Correction factor	
. **M**axPmax	Maximum possible upper shutoff pressure	
. **Mi**nPmax	Minimum possible upper shutoff pressure	
. **MaxPmi**n	Maximum possible lower shutoff pressure	
. **MinPmi**n	Minimum possible lower shutoff pressure	
. **S**etup	**Instrument settings**	
. **T**race	Message if values or paths change	ON,OFF
. **A**utoinfo	Automatic message on changes:	
. **P**	when power switched on	ON,OFF
. **R**	when instrument in "ready" status	ON,OFF
. **S**	when instrument in "stop" status	ON,OFF
. **E**	for error message	ON,OFF
. **Pr**essure	on every change of measured pressure value	ON,OFF

5.1.8 Data transmission protocol

The RS232 interface of the 709 IC Pump is configured as DTE (Data Terminal Equipment) with the following technical specifications:

- *Standard* — Data interface in accordance with EIA standard RS 232C (DIN 66020, page 1)
- *Baud rate* — 9600 (300, 600, 1200, 2400, 4800 can be set with jumpers on main board, see *section 4.1.8*)
- *Data Bits* — 8
- *Stop Bits* — 1
- *XON/XOFF* — off
- *Control characters* — C_R DEC 13 HEX 0D; L_F DEC 10 HEX 0A
- *Max. line length* — 80 characters + C_R L_F
- *Cable* — For interconnections of the 709 IC Pump with non-Metrohm units, only a shielded data cable (e.g. Metrohm D.104.0201) may be used. The cable shielding must be faultlessly earthed at both units (pay attention to current loops; always use star-head earthing). Only connectors with adequate shielding may be used (e.g. Metrohm K.210.0001 with K.210.9004).
- Cable length — max. ca. 15 m

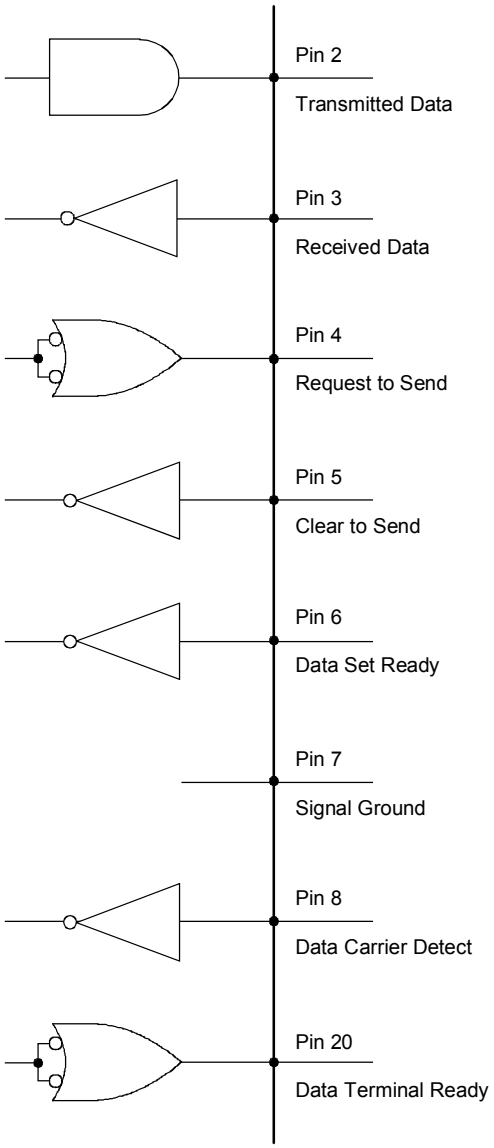
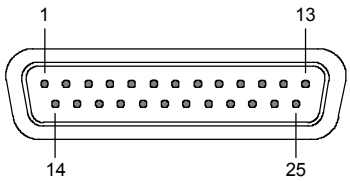
As only the baud rate of the RS232 parameters of the IC pump can be set by hardware, all other RS232 parameters of the third-party device must be matched to those of the pump.

5.1.9 Handshake

The handshake outputs (DTR, RTS) are set by the 709 IC Pump, the handshake inputs (CTS, DSR, DCD), on the other hand, are not tested. In practical operation with third-party devices, this has the following consequences:

- XON/XOFF must be switched off in the third-party device.
- With inquiries of the third-party device to the pump, the response of the pump must be waited for before the next inquiry can be started.

5.1.10 Pin assignment

RS232C interface	*external*
Transmitted Data (TxD) If no data transmission takes place, the line is maintained in the "ON" condition. Data are sent only when CTS and DSR are in the "ON" condition and DCD is in the "OFF" condition.	
Received Data (RxD) Data are received only when DCD is "ON".	
Request to Send (RTS) ON condition: 709 IC Pump is ready to send data.	
Clear to Send (CTS) ON condition: Remote station is ready to receive data.	
Data Set Ready (DSR) ON condition: The transmission line is connected.	
Signal Ground (GND)	
Data Carrier Detect (DCD) ON condition: The received signal level is within the tolerance range (remote station is ready to send data).	
Data Terminal Ready (DTR) ON condition: 709 IC Pump is ready to receive data.	
Protective earth Direct connection from cable connector to protective earth of the device. **Polarity assignment of the signals** • Data lines (TxD, RxD) Voltage negative (<–3 V): signal status "ONE" Voltage positive (>+3 V): signal status "ZERO" • Control or message lines (CTS, DSR, DCD, RTS, DTR) Voltage negative (<–3 V): OFF status Voltage positive (>+3 V): ON status In the transition region from +3 V to –3 V, the signal status is undefined. **Driver 14C88** to EIA RS 232C specification **Receiver 14C89** to EIA RS 232C specification	**Contact arrangement at the connector (female) for socket "RS 232" (male)**  Connection cables to external devices must have an appropriate 25-pin connector (female). Metrohm offers connector sockets (K.210.9004) and the associated housing (K.210.0001) as an option for the preparation of such cables.
No liability whatsoever will be accepted for damage arising from the improper connection of devices.	

5.1.11 Setting the baud rate

The baud rate of the RS232 interface of the 709 IC Pump is set to 9600 as standard. If you wish to set a lower baud rate, proceed as follows:

The electronic circuitry of the 709 IC Pump is sensitive to electrostatic charges. You should thus take the appropriate measures (earthing, e.g. by touching metal) before opening the instrument.

1 Disconnect cables

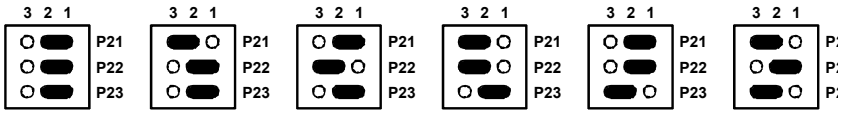
Disconnect mains cable from mains connection plug **31** of the 709 IC Pump, also unplug all other cables connected to the rear of the instrument.

2 Remove housing cover

Unscrew the two fastening screws **25** at the bottom of the instrument and the two fastening screws **26** at the rear of the instrument, remove housing cover **27**.

3 Set baud rate

Change over blue jumpers at positions P21, P22 and P23 of the main board (on right side of instrument when viewed from back) using tweezers or flat-nosed pliers to match the baud rate you wish:



4 Replace housing cover

Replace housing cover **27** and fasten with fastening screws **25** and **26**.

5 Plug in cables

Connect mains cable to mains connection plug **31** and also plug in all other cables.

5.2 Control interface

5.2.1 Functions

The 709 IC Pump has the following control inputs and outputs, which are accessible via the control interface:

Inputs Reduce flow rate (possible via contact or TTL signal)
Stop pump (possible via contact or TTL signal)

Outputs Signal when pump has been stopped or
Signal when pump is running

You will find detailed information on these functions in *section 5.2.3*, possible changeover of the jumpers is described in *section 5.2.2*.

5.2.2 Settings for the control interface

If you wish to change the default settings for the control inputs and outputs (see *section 5.2.3*), proceed as follows:

The electronic circuitry of the 709 IC Pump is sensitive to electrostatic charges. You should thus take the appropriate measures (earthing, e.g. by touching metal) before opening the instrument.

1 Disconnect cables

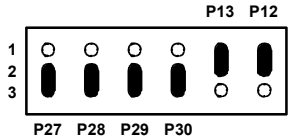
Disconnect mains cable from mains connection plug **31** of the 709 IC Pump, also unplug all other cables connected to the rear of the instrument.

2 Remove housing cover

Unscrew the two fastening screws **25** at the bottom of the instrument and the two fastening screws **26** at the rear of the instrument, remove housing cover **27**.

3 Change settings

Change over blue jumpers at positions P12, P27, P28, P29 and P30 of the main board (on left side of instrument when viewed from back) using tweezers or flat-nosed pliers to match the settings you wish (settings, see *section 5.2.3*):



Default settings

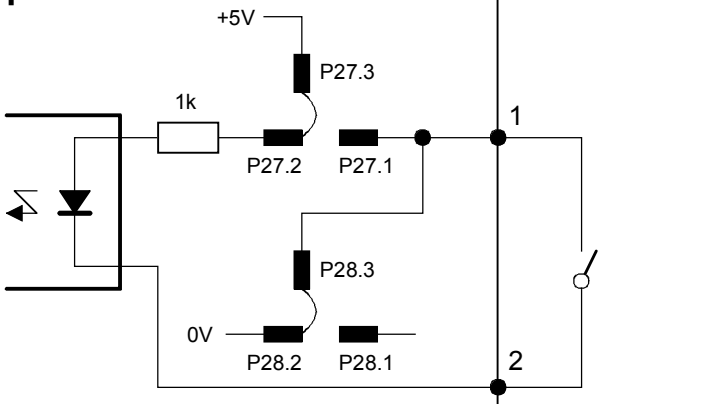
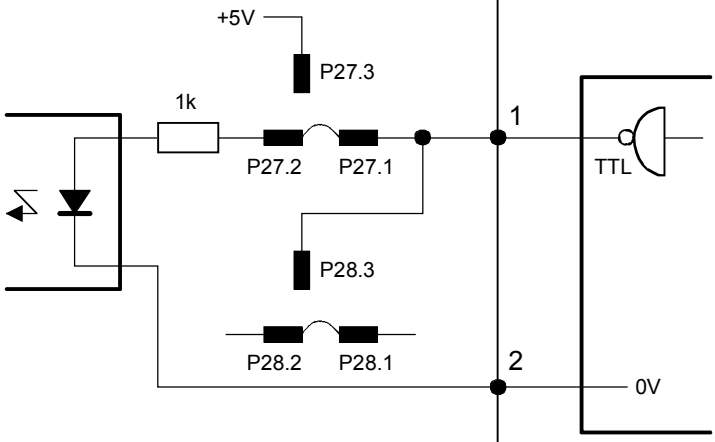
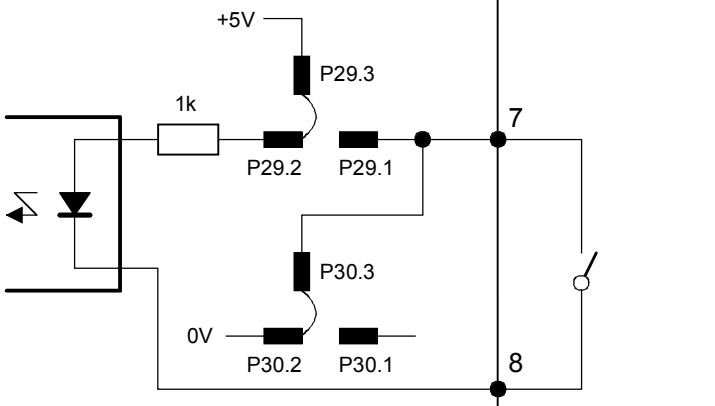
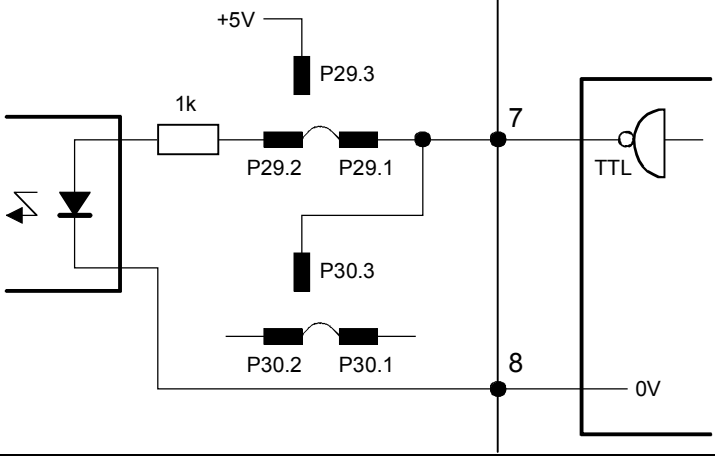
4 Replace housing cover

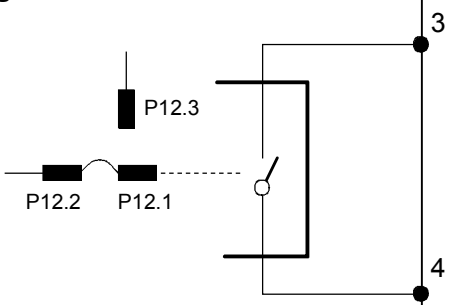
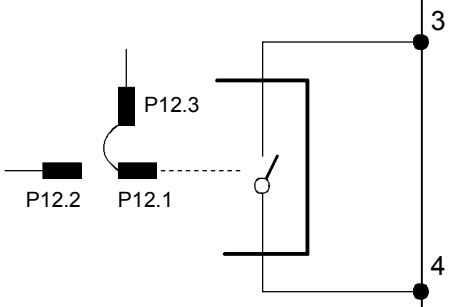
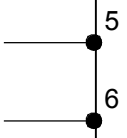
Replace housing cover **27** and fasten with fastening screws **25** and **26**.

5 Plug in cables

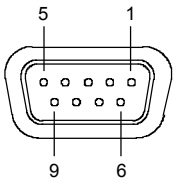
Connect mains cable to mains connection plug **31** and also plug in all other cables.

5.2.3 Control inputs and outputs

709 IC Pump	*external*	*Function*
Inputs 		**Reduced flow rate (Reduced Flow) with contact** (default settings) Contact open: Flow rate 100% Contact closed: Flow rate 10% With reduced flow, the "FLOW" LED **10** flashes.
		**Reduced flow rate (Reduced Flow) with TTL logic signal** (Position of jumpers P27 and P28 must be changed, see *section 5.2.2*) Signal Low (L): Flow rate 100% Signal High (H): Flow rate 10% With reduced flow, the "FLOW" LED **10** flashes.
		**Stop pump with contact** (default setting) Contact closed: Pump is stopped Following a stop, the pump must be restarted manually with the <R/S> key.
		**Stop pump with TTL logic signal** (Position of jumpers P29 and P30 must be changed, see *section 5.2.2*) Signal High (H): Pump is stopped Following a stop, the pump must be restarted manually with the <R/S> key.

709 IC Pump	*external*	*Function*
Outputs  		**Pump stopped** (default setting) Contact open: Pump stopped Contact closed: Pump running
 		**Pump stopped** (Position of jumper P12 must be changed, see *section 5.2.2*) Contact open: Pump stopped Contact closed: Pump running
 		**Display of suction phase** *This function can not be used with the 709 IC Pump.*
 		**Connection not in use**

Contact arrangement at connector (male) for socket "Control" (female)



No liability whatsoever will be accepted for damage arising from the improper connection of devices.

6 Appendix

6.1 Technical specifications

Type

Serial dual piston with two valves

Pump capacity

Flow range	0.05...5.00 mL/min
Flow accuracy	< 3.5 % (at 150 bar and 1 mL/min)
Flow constancy	< 0.5 % (after unit warmed up)
Reproducibility of eluent flow	± 0.1 %

Pressure

Pressure range	2.709.0010: 0...50.0 MPa (0...500 bar) 2.709.0110 (metal-free): 0...30.0 MPa (0...300 bar)
Resolution for pressure indicator	0.1 MPa (1 bar)
Pressure measurement	Piezoresistive measurement principle Response time: 3 ms Measurement volume: ca. 50 µL
Accuracy of pressure measurement	< 3 %
Residual pulsation	2.709.0010: < 7 % 2.709.0110 (metal-free): < 10 % (measured at pump head at 2 mL/min and 100 bar)
Recorder output for pressure indication	1 mV/MPa (1 mV/10 bar) Time constant switchable: HIGH = 20 ms LOW = 1 s

Safety shutdown

Function	Automatic shutdown when upper and lower pressure limits violated
Maximum pressure limit	Adjustable between 0.1...50.0 MPa (1...500 bar) Response time: 1 pump cycle
Minimum pressure limit	Adjustable between 0.1 ... 50.0 MPa (1...500 bar), inactive at 0 bar Response time: 3 pump cycles The cutoff function first becomes active 2 min after the pump flow has been switched on with the <R/S> key.

Pump head

Pump head volumes	Main piston: 40 µL Priming piston: 20 µL

Pump displacement volumes	Main piston:	28.5 µL
	Priming piston:	14.25 µL
Length of stroke	Main piston:	3.6 mm
	Priming piston:	1.8 mm

Display

Type	5 digit LED display each with 7 segments 6 LED indicators
Displayed parameters	Flow rate (in mL/min) Pressure (in MPa)

Function keys

Number	6
Identification	by LED indicators

Programming

Keyboard	Flow rate Maximum and minimum pressure limit values Correction factor for pump head
Remote control	Flow rate Maximum and minimum pressure limit values Correction factor for pump head Start/Stop

Remote control

Interfaces	RS232 (syntax Metrohm, see *section 5.1*) Current Loop (details on request) Control (see *section 5.2*)

Storage of entries

Type	Non-volatile (RAM)
Duration	max. 10 years (lithium battery)

RS232 interface

Standard	EIA RS232C, CCITT V.24, ISO 2110, DIN 66020	
Plug	D-Sub 25 pins	
Mode	Full duplex (simultaneous sending and receiving)	
Parameters	Baud rate:	300,600,1200,2400,4800,9600 (adjustable by hardware)
	Handshake:	no Handshake (see *section 5.1.9*)
	Parity:	none
	Stop bits:	1
	Data bits:	8

Mains connection

Voltage	115 V: 100...120 V ± 10 % 230 V: 220...240 V ± 10 % switchable
Frequency	50...60 Hz

Power consumption	ca. 50 VA
Fuses	Diameter = 5 mm, length = 20 mm 100…120 V: 0.5 A (slow-blow) 220…240 V: 0.25 A (slow-blow)

Safety specifications

Construction / Testing	According to IEC 1010 / EN 61010 / UL 3101-1, protection class 1, degree of protection IP40
Safety directions	This Instructions for Use include information and warnings which must be heeded by the user to assure safe operation of the instrument.

Electromagnetic compatibility (EMC)

Emitted interference	Standards met: EN55011 (class B), EN55022 (class B), EN50081-1/2
Immunity to interference	Standards met: IEC801-2/IEC1000-4-2 (class 2), IEC801-3/ IEC1000-4-3 (class 3), IEC801-4/IEC1000-4-4 (class 3), IEC801-5/IEC1000-4-5 (class 2/3), IEC801-6/IEC1000-4-6 (class 3), EN50082-2

Ambient temperature

Nominal operating range	+5…+45°C (at 5…85 % atmospheric humidity)
Storage, transport	–40…+70°C

Diagnosis

Self-diagnostic test	Automatic self-diagnosis when instrument switched on
User diagnostic test	Built-in diagnostic program (see *section 4.4*)

Materials (in contact with solvent)

2.709.0010	V4A stainless steel, sapphire, ruby, ceramic, PCTFE, PTFE
2.709.0110 (metal-free)	Sapphire, ruby, ceramic, PCTFE, PTFE

Housing

Material of cover	Polyurethane rigid foam (PUR) with fire protection for fire class UL94VO, FCH-free
Material of base	Steel, enamelled
Width	255 mm
Height	130 mm
Depth	381 mm
Weight	10 kg (incl. accessories)

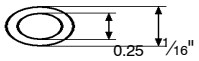
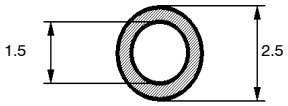
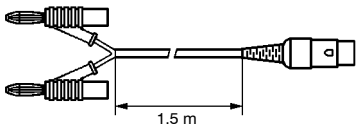
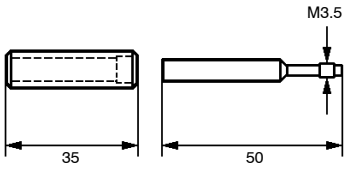
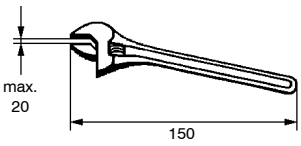
6.2 Scope of delivery

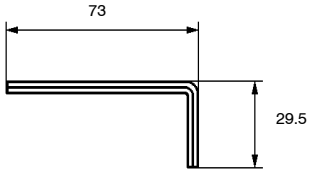
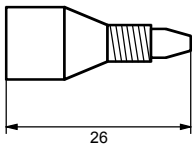
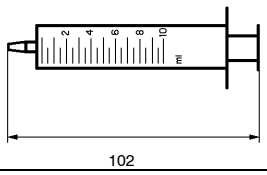
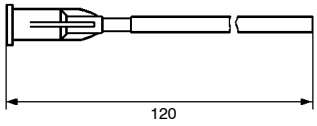
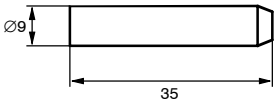
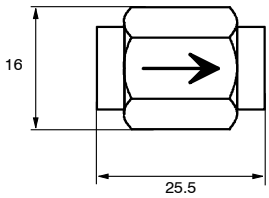
Subject to changes !
All dimensions are given in mm.

The 709 IC Pump is available in the two following versions:

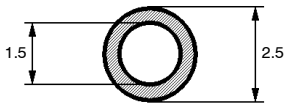
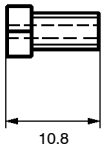
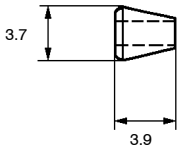
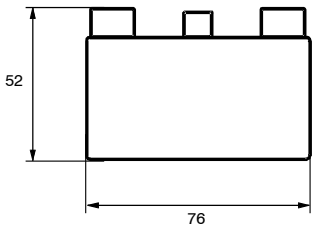
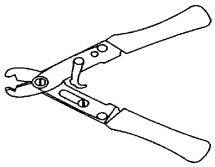
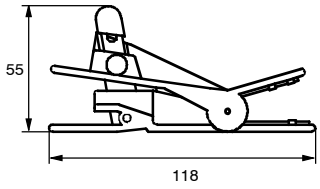
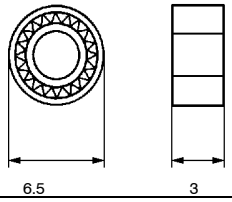
- **2.709.0010** 709 IC Pump (standard version)
- **2.709.0110** 709 IC Pump (metal-free version)

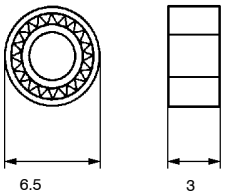
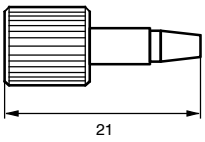
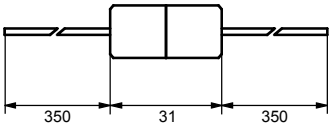
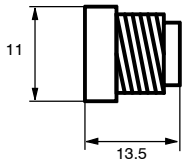
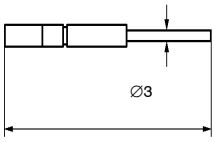
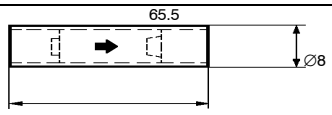
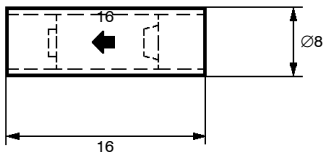
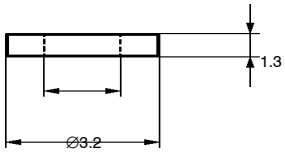
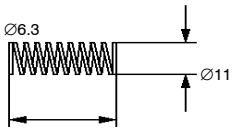
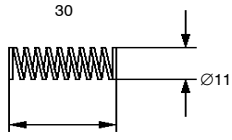
The two instruments include the following parts:

Quant.		Order No.	Description
2.709.0010	2.709.0110		
1	1	6.1831.010	**PEEK capillary** Length = 3 m 
1	1	6.1834.000	**Aspirating tubing** made of PTFE, with connector for 6.2821.090 Aspirating filter Length = 1.2 m For the connection 709 IC Pump – eluent container 
1	1	6.2115.040	**Connection cable** For the connection 709 IC Pump – recorder For plotting curves delivery vs time. 
1	1	6.2122.0X0	**Mains cable** according to customer's specification: Cable socket / Cable plug Type IEC 320/C 13 — Type SEV 12 (CH…) ..... 6.2122.020 Type IEC 320/C 13 — Type CEE (7), VII (D…) ..... 6.2122.040 Type CEE (22), V — Type NEMA 5-15 (USA…) 6.2122.070
1	1	6.2617.010	**Special tool** For removing the piston seal of the pump head 
1	1	6.2621.000	**Adjustable spanner** 

Quant.		Order No.	Description
2.709.0010	2.709.0110		
1	1	6.2621.030	**Hexagon key 4 mm** For mounting the pump head of the 709 IC Pump. 
1	1	6.2744.010	**PEEK compression fitting** For the connection of 6.1831.010 PEEK capillaries or 6.1822.010 PTFE microcapillaries Set of 5 
1	1	6.2816.020	**Syringe** made of PP, volume = 10 mL with Luer connector 
1	1	6.2816.040	**Tubule** with PTFE tubing and Luer connection For 6.2816.020 syringe 
1	1	6.2821.090	**Aspirating filter** Pore dimension 20 µm For 6.1834.000 Aspirating tubing. Set of 5 
1	1	6.2821.100	**Filter unit PEEK 2 µm** To avoid contamination due to abrasive particles of piston seals Spare part: 6.2821.110 Filter 
1	-	6.2824.040	**Pump head (standard version)** Complete, with fixation screws
-	1	6.2824.100	**Pump head (metal-free)** Complete, with fixation screws
1	1	8.709.1033	**Instructions for Use (English)** for 709 IC Pump

6.3 Optional accessories

Order No.	Description	
6.1834.010	**Aspirating tubing** made of PTFE, with connector for 6.2821.090 Aspirating filter Length = 2.5 m For the connection 709 IC Pump – eluent vessel of 6.5324.000 Bottle rack	
6.2620.000	**Pressure screw** made of steel For the connection of 6.2620.020 steel capillaries, set of 5	
6.2620.010	**Ferrule** made of steel For the connection of 6.2620.020 steel capillaries, set of 5	
6.2620.020	**Steel capillary** Length = 3 m	
6.2620.150	**Pulsation dampener MF** Metal-free pulsation dampener for reduction of pulsation and preservation of separating columns.	
6.2621.040	**Capillary tubing cutter** for 6.2620.020 steel capillaries	
6.2621.080	**Capillary tubing cutter** for 6.1831.010 PEEK capillaries and 6.1822.010 PTFE micro capillaries incl. 5 additional blades	
6.2741.000	**Piston seal** Spare part for 6.2824.040 and 6.2824.100 pump heads	

Order No.	Description
6.2741.010	**Piston seal PE** Spare part for 6.2824.040 and 6.2824.100 pump heads (only suitable for aqueous eluents) 
6.2744.070	**PEEK compression fitting (short)** Spare part for 6.2824.100 pump head Set of 5 
6.2821.000	**Filter unit Manufit** To avoid contamination due to abrasive particles of piston seals. For the pressure range 0…50 MPa with steel capillaries. 
6.2821.110	**Filter for Filter unit PEEK** Spare part for 6.2821.100 Filter unit PEEK Set of 10 
6.2824.070	**Zircon piston** Spare part for 6.2824.040 and 6.2824.100 pump heads 
6.2824.010	**Outlet valve** Spare part for 6.2824.040 pump head 
6.2824.020	**Inlet valve** Spare part for 6.2824.040 pump head 
6.2824.030	**Sapphire supporting ring** Spare part for 6.2824.040 and 6.2824.100 pump heads 
6.2824.050	**Spring for main piston** Spare part for 6.2824.040 and 6.2824.100 pump heads 
6.2824.060	**Spring for auxiliary piston** Spare part for 6.2824.040 and 6.2824.100 pump heads 

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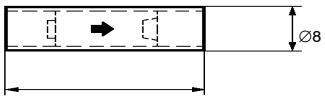
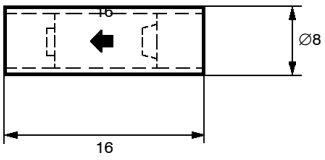
Order No.	*Description*	
6.2824.080	**Outlet valve (metal-free)** Spare part for 6.2824.100 pump head	
6.2824.090	**Inlet valve (metal-free)** Spare part for 6.2824.100 pump head	
6.5324.000	**Bottle rack** For fixing 3 supply bottles for elent, regeneration and rinsing solution, incl. accessories (bottles, siphon, etc.)	

6.4 Warranty and conformity

6.4.1 Warranty

The warranty on our products is limited to defects that are traceable to material, construction or manufacturing error which occur within 12 months from the day of delivery. In this case, the defects will be rectified in our workshops free of charge. Transport costs are to be paid by the customer.

For day and night operation, the warranty is limited to 6 months.

Glass breakage in the case of electrodes or other parts is not covered by the warranty. Checks which are not a result of material or manufacturing faults are also charged during the warranty period. For parts of outside manufacture insofar as these constitute an appreciable part of our instrument, the warranty stipulations of the manufacturer in question apply.

With the regard to the guarantee of accuracy, the technical specifications in the instruction manual are authoritative.

Concerning defects in material, construction or design as well as the absence of guaranteed features, the orderer has no rights or claims except those mentioned above.

If damage of the packaging is evident on receipt of a consignment or if the goods show signs of transport damage after unpacking, the carrier must be informed immediately and a written damage report demanded. lack of an official damage report releases Metrohm from any liability to pay compensation.

If any instruments and parts have to be returned, the original packaging should be used if at all possible. This applies above all to instruments, electrodes, burette cylinders and PTFE pistons. Before embedment in wood shavings or similar material, the parts must be packed in a dust-proof package (for instruments, use of a plastic bag is imperative). If open assemblies are enclosed in the scope of delivery that are sensitive to electromagnetic voltages (e.g. data interfaces etc.) these must be returned in the associated original protective packaging (e.g. conductive protective bag). (Exception: assemblies with built-in voltage source belong in a non-conductive protective packaging).

No warranty responsibility whatsoever will be accepted by Metrohm for damage which arises as a result of non-compliance with these instructions.

6.4.2 EU Declaration of conformity

CE

EU Declaration of Conformity

The Metrohm AG company, Herisau, Switzerland hereby certifies that the instrument:

709 IC Pump

meets the requirements of EC Directives 89/336/EWG and 73/23/EWG.

Source of the specifications

EN 50081-1/2	Electromagnetic compatibility, basic specification Emitted Interference
EN 50082-2	Electromagnetic compatibility, basic specification Interference Immunity
EN 61010	Safety requirements for electrical laboratory measurement and control equipment

Description of the instrument

Dual piston pump for use in Ion Chromatography (IC) and High Performance Liquid Chromatography (HPLC).

Herisau, December 4, 1995

Dr. J. Frank	Ch. Buchmann
Development Manager	Production and Quality Assurance Manager

6.4.3 Certificate of conformity and system validation

Certificate of Conformity and System Validation

This is to certify the conformity to the standard specifications for electrical appliances and accessories, as well as to the standard specifications for security and to system validation issued by the manufacturing company.

Name of commodity:	709 IC Pump
System software:	Stored in ROMs
Name of manufacturer:	Metrohm Ltd., Herisau, Switzerland
Principal technical information:	Voltages: 100…120, 220…240 V Frequency: 50…60 Hz

This Metrohm instrument has been built and has undergone final type testing according to the standards:

IEC801-2/IEC1000-4-2 (class 2), IEC801-3/ IEC1000-4-3 (class 3), IEC801-4/IEC1000-4-4 (class 3), IEC801-5/IEC1000-4-5 (class 2/3), IEC801-6/IEC1000-4-6 (class 3), EN50082-2, EN55011 (class B), EN55022 (class B), EN50081-1/2 — *Electromagnetic compatibility*

IEC1010, EN61010, UL3101-1 — *Security specifications*

It has also been certified by the Swiss Electrotechnical Association (SEV), which is member of the International Certification Body (CB/IEC).

The technical specifications are documented in the instruction manual.

The system software, stored in Read Only Memories (ROMs) has been validated in connection with standard operating procedures in respect to functionality and performance. The features of the system software are documented in the instruction manual.

Metrohm Ltd. is holder of the SQS-certificate of the quality system ISO 9001 for quality assurance in design/development, production, installation and servicing.

Herisau, December 4, 1995

Dr. J. Frank	Ch. Buchmann
Development Manager	Production and Quality Assurance Manager

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