HYDAC INTERNATIONAL

FluidControl Unit
FCU 2110 - 5
FCU 2210 - 5

Operating and Maintenance Instructions

Ed. 1.1/12.2000

I.I General Remarks

Trademarks

The trademarks used herein of other companies exclusively designate the products of these companies.

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The contents of this manual is subject to change without notice.

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I.II Contents

1 Explanation of Symbols and Warnings, etc.

The following designations and symbols are used in this manual to designate hazards, etc.:

	This symbol designates safety instructions whose non-observance may result in injury to individuals.
	This symbol designates safety instructions whose non-observance may result in the injury of individuals by high voltages.
	This symbol provides important instructions and tips for the proper handling and operation of the FCU. Non-observance of these instructions may result in damage to the FCU or to damage to the surrounding systems or equipment and the environment.
	This symbol designates tips for usage and other particularly useful information. It helps you to optimally utilize all the features offered by your FCU.

2 General Safety Precautions and Remarks

Observe and follow the instructions contained herein

The basic prerequisite for the safe and proper handling and operation of the FCU is knowledge of the safety instructions and warnings. These operating instructions contain the most important instructions for properly and safely operating the FCU.
The safety precautions contained herein are to be followed by any and all persons operating the FCU. In addition, local accident prevention regulations are to be adhered to as well.

Hazards Posed by Using the FCU

The FCU has been designed and constructed in accordance with the current state of the art and recognized safety regulations. Nevertheless, hazards may be posed to the life and limb of the individual operating the unit or to third parties.
In addition, the FCU may incur damage, e.g. in transit or as the result of improper handling.
In any event it has to be ensured that the FCU is not operated unless it is in perfect working order from the point of view of safety. Any faults or malfunctions, e.g. loose screwed connections or exposed wires or cables which might impair safety are to be properly attended to *immediately*.

Safety Devices

	***Prior to starting up the FCU each time, make sure that all the safety devices are properly installed in the hydraulic facility to be monitored and are in proper working order.***

Informal Safety Precautions

Make sure to always keep the operating instructions in the vicinity of the FCU.
Apart from the operating instructions, any and all generally applicable and local regulations pertaining to accident prevention and environmental protection are to be made available and observance to be maintained to them.
Make sure to keep the safety and hazard symbols and warnings on the FCU in a readable condition.

Hazards Posed by Electrical Power

	***Any work involving the power supply may only be performed by a properly trained, certified electrician.*** ***Make sure to check the electrical equipment of the FCU on a regular basis. Replace any loose connections or damaged cables immediately.*** ***If work to live components is required, make sure to disconnect the unit from the power supply first.***

Maintenance, Servicing and Troubleshooting

The prescribed adjustment, maintenance/servicing and inspection work is to be conducted in a timely fashion. Operating personnel is to be informed prior to performing any maintenance and servicing work.

INSTRUCTIONS TO BE FOLLOWED IN THE EVENT OF AN EMERGENCY

	***In the event of an emergency, immediately disconnect the FCU from the power supply!***

Modifications to the FCU

Do not make any modifications (including retrofitting, extensions) to the FCU without the prior approval of the manufacturer.
No modifications or extensions may be made without HYDAC Filtertechnik GmbH's express prior written approval.
Immediately replace any unit components which are not in perfect condition.
Only use original replacement parts. When using non-OEM components it cannot be ensured that they have been designed and manufactured so as to comply with loading and safety requirements.
Please also refer to *9 Maintenance and Servicing of the FCU* for information on maintenance and servicing of the FCU.

Cleaning the FCU and Disposal of the Media and Agents Used

	***Some cleaning agents may pose a health hazard, especially when undiluted.***

Properly use and dispose of the cleaning agents and flushing oil used.
In so doing, make sure to follow the manufacturer's instructions:

- with regard to wearing protective clothing and gear
- concerning proper disposal

Summary of the General Safety Precautions

- Maintenance work may only be performed by properly trained personnel using the right tools for the job.
- No maintenance or servicing work may be done on the FCU unless it has been shut down and disconnected from the power supply and the hydraulic facility.
- When connecting the FCU to the power supply system (including when using the unit in connection with a filter pump unit), adherence is to be maintained to local power company safety regulations and provisions.
- The operator/owner is to ensure adherence to the National Water Resources Act as well as local water resource laws and other related regulations.
- Adherence is to be maintained to statutory accident prevention regulations, safety regulations and safety data sheets for fluids.
- When working directly on or in the vicinity of hydraulic systems, there is to be no smoking or open flames/fire, with every effort being taken to prevent the generation of sparks.
- Collecting basins, suction/extraction equipment and binding agents are to be made available.
- Hydraulic media and water-polluting fluids must not be allowed to soak into the soil, seep into bodies of water or the sewage system. Ensure that hydraulic media are disposed of in an environmentally safe manner. Adherence is to be maintained to pertinent national and local regulations pertaining to groundwater protection and the disposal of waste/spent oil and (hazardous) waste.
- Work on hydraulic systems may involve leaking hot oil which may cause injury and scalding as result of its high pressure and/or temperature.

3 SCOPE OF DELIVERY

The FCU fluid control unit comes packed and factory-assembled. Before commissioning it, please check the contents of the package to make sure everything is present.

The scope of delivery extends to the following:

Pos.	Pieces	Designation
1	1	FluidControl Unit FCU 2110-5 or FCU 2210-5
2	2	Line Adapter
3	1	High pressure hose ID 4, with Minimess connector 1604 – 1620, 2000 mm long
4	1	Suction hose ID 5,with CPC quick disconnect, 1000 mm long
5	1	Suction hose ID 5,with CPC quick disconnect, ~200 mm long
6	1	Return hose ID 7,with quick disconnect, 2000 mm long
7	1	Operating and Maintenance Instructions
8	1	Calibration Certificate

Figure 1: Scope of delivery

4 Restrictions Pertaining the Use of the FCU

	***It is recommended that the FCU only is used in connection with mineral oils (or mineral-oil-based raffinates). Please contact us first before using the FCU with other operating media.***

5 Technical Description

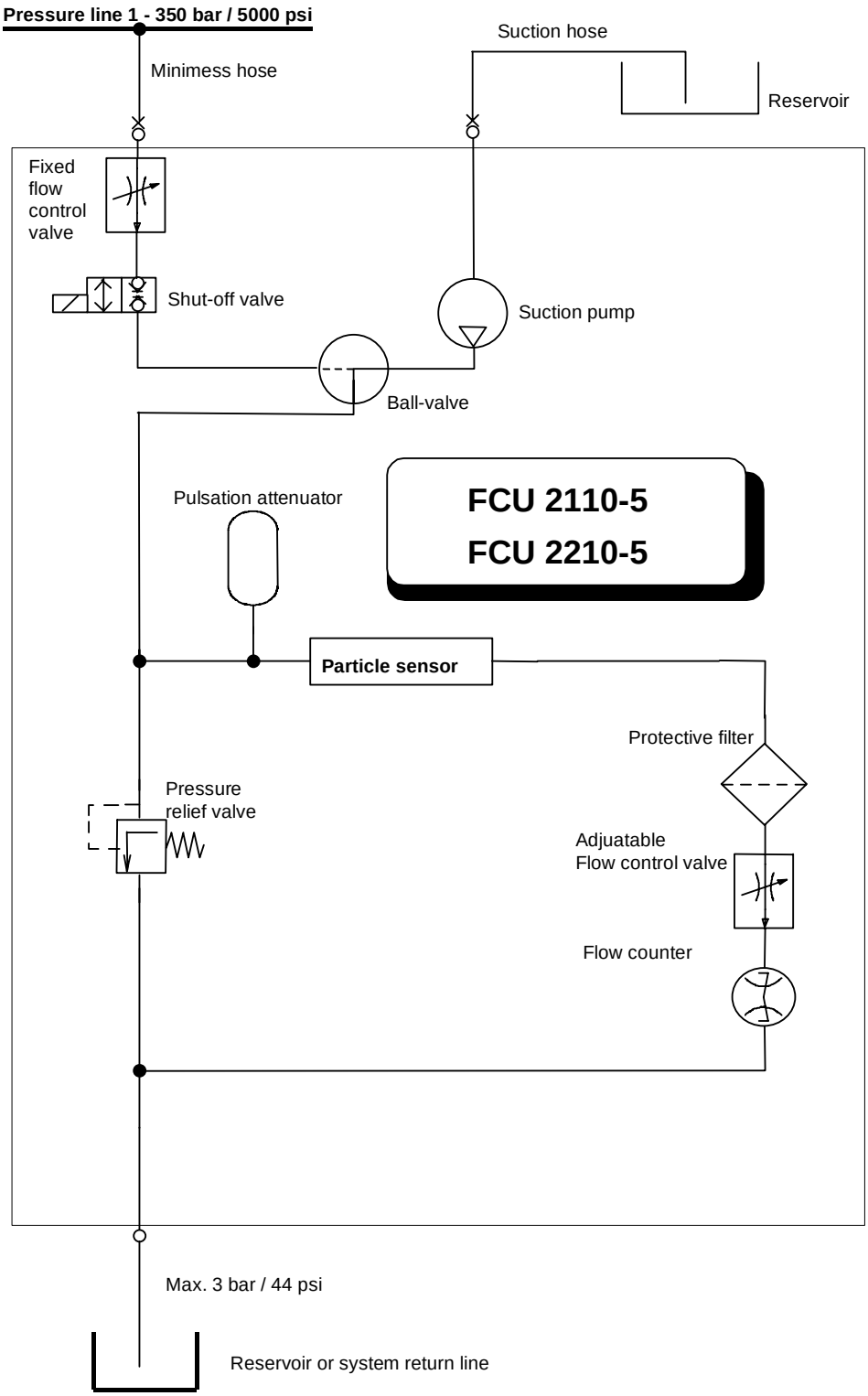
5.1 Performance Features

- The FCU Fluid Control Unit is used to continuously monitor the solid particle loading of mineral oils.
- The FCU enables the purity ratings according to NAS 1638 (only for FCU 2110-5) or ISO-4406 to be recorded, saved and displayed fully automatically during continuous operation.
- The measured values can be outputted in the form of a table or a graphic online via an integrated printer or transmitted to a PC via a serial interface (standard RS232, optional : RS485).
- Control of filter pump units is enabled via relay outputs.
- The FCU can be connected directly to pressure lines or, with the integrated pump, the FCU is able to measure oil cleanliness of reservoirs.
- The FCU has rechargeable batteries for mains-independent operation for measurements on high pressure lines (not with the prototype, will be with the series products). For operation with the integrated pump, an external line adaptor or a 24VDC supply is necessary.

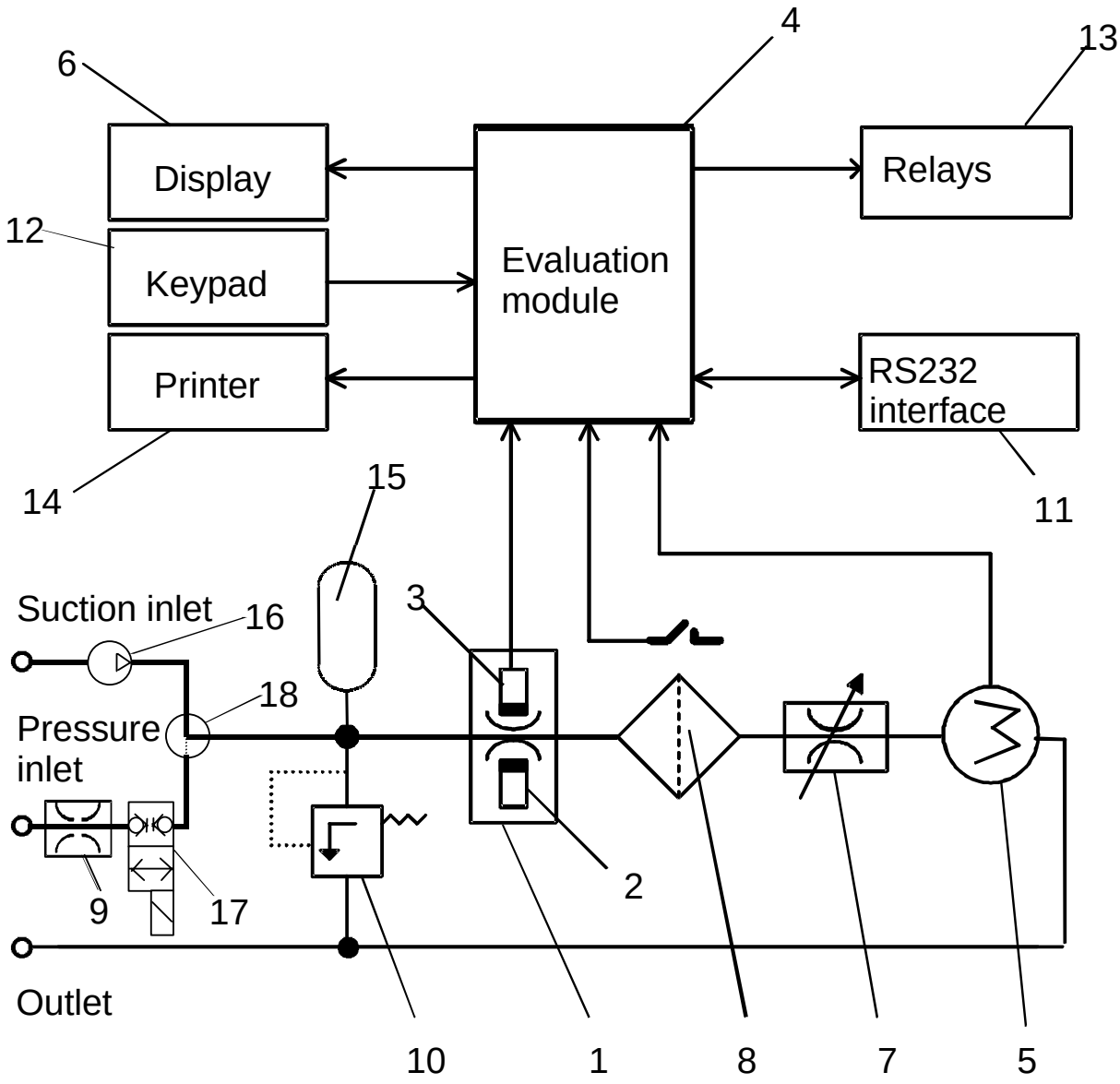
5.2 Design Features

The FCU features a keyboard, a liquid crystal display (LCD), a dot-matrix printer, control relay outputs and a serial RS 232 interface. The unit possesses a high pressure Minimess connector input (system 1604) enabling connection to the hydraulic system, a quick disconnect suction inlet for connection to reservoirs and a quick disconnect coupling as a return flow output.
A flow control valve enables to adjust the measurement current flow. The flow control valve is protected against contamination by a hydraulic filter. The housing features 19” subrack modules and a carrying handle.

5.3 Hydraulic Diagram



5.4 Principle of Operation



A continuous oil current flows through an optical sensor (1), the sensor consisting of an infrared semiconductor LED (2) and a receiver diode (3) opposite of it. The contaminant particles contained in the oil current dampen the light beam in a pulse-like manner, this being classified and counted as measurement signals according particle diameter by an evaluation module (4).

The measurement of the flow rate required to determine the purity rating is performed by an integrated flow rate meter (5), whose signals are also routed to the electronic evaluation module (4).

The electronic evaluation module (4) continuously measures the particle counts, computes the NAS (only for FCU 2110-5) or ISO purity ratings for the prescribed reference volume of 100ml on the basis of the measurement signals of the optical sensor and the flow rate meter.

The measurement results (up to 3,000) are continuously stored in the evaluation module along with the date and time in a manner providing for protection in the event of a power outage. This is ensured by a battery-buffered real-time clock and memory

A flow control valve (7) is featured for adjusting the oil current independently of the line pressure and pressure fluctuations.

A hydraulic filter (8) featuring an electric clogging indicator is integrated upstream of the flow control valve to protect it against outage as the result of contaminant particle buildup.

A ball valve (18) allows to switch between the suction inlet and the pressure inlet.

The permanently set valves (9) (800 ml/min max) and (10) (30 bar max.) and the diaphragm accumulator (15) enable connection to sampling points for a pressure range of 1 - 350 bar at the pressure inlet. The shut-off valve (17) only opens when a measurement is ongoing.

The pump (16) allows to measure from non-pressurized reservoirs via the suction inlet.

The FCU can be operated via the keypad (12). Measurement parameters can be modified and various items selected in the LCD (6).

Unless a different setup is entered, the following is continuously shown during measurement by default:

- **Current flow rate**
- **Current ISO rating classification**
- **Tendency reading of ISO rating classification (↑=rising level, ↓= falling level)**
- **Error messages, only in the event of a fault or malfunction (see chapter Error Messages)**

In addition, the FCU features 3 integrated relays providing for the following functions:

Relays 1 and 2 Limit contacts (normally open contacts)

For example, a filter pump unit can be controlled using relays 1 and 2.

Relay 3 DEVICE READY signal (normally closed contact)

Relay 3 is used for unit self-monitoring.

The integrated microprocessor provides for continuous monitoring of the following:

- particle sensor
- filter clogging indicator

- flow rate meter
- supply voltage
- internal evaluation module

Relay 3 (normally closed contact) thus functions as a DEVICE READY contact:

	***During normal (fault-free) operation, these contacts are always closed, meaning they only open when a fault is detected.***

When a fault or malfunction occurs, an error message automatically appears in the display and data recording/saving is interrupted.

As soon as the error is remedied, this is recognized by the microprocessor, which resets the error message completely automatically, thus causing the contacts of relay 3 to close and measurement and data saving to be resumed.

This ensures that, in the event malfunction occurs during continuous online operation, e.g. as the result of a power outage, flow errors as the result of pressure loss, etc., measurement operation is resumed without any operating personal being required after the fault has been remedied.

All the measured values taken and recorded can be outputted via the RS232 interface (11) , e.g. using a PC.

The integrated printer (14) is used to document the measurements in the form of a table or graphic.

5.5 Description of the Display and Control Elements

5.5.1 Front View

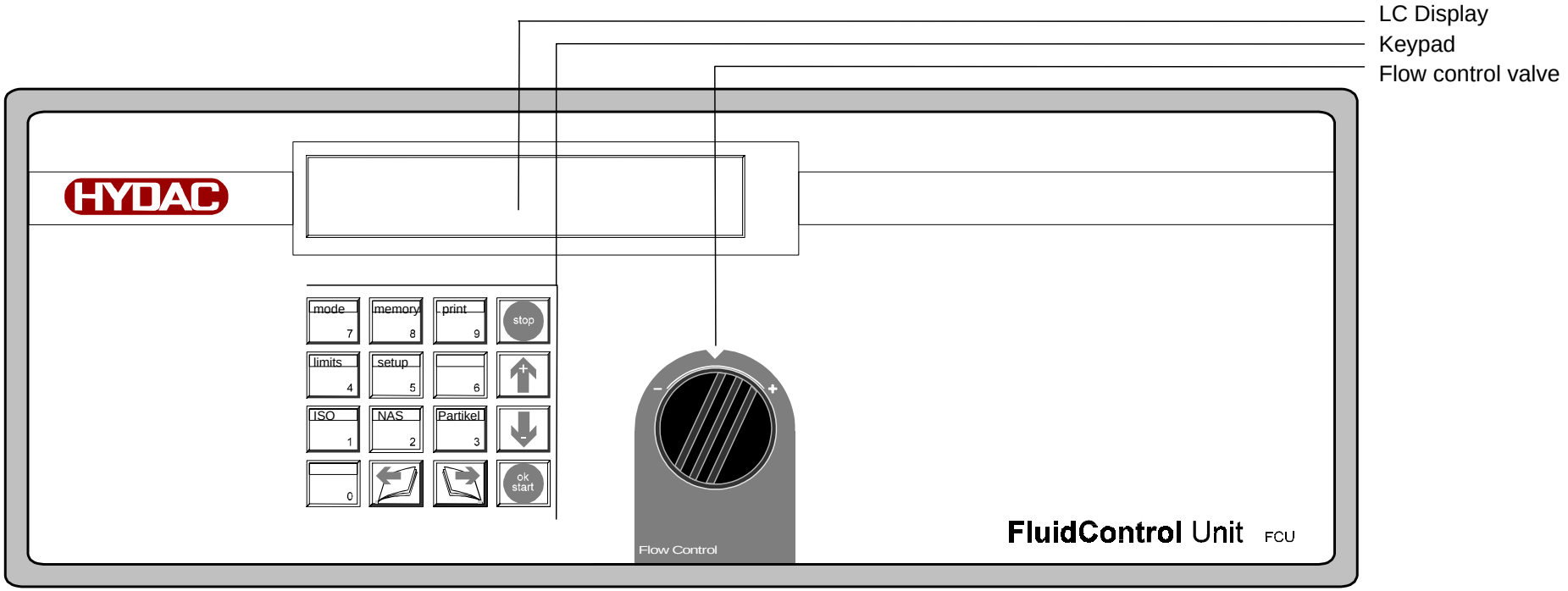


Figure 2 : Front View

5.5.2 Rear View

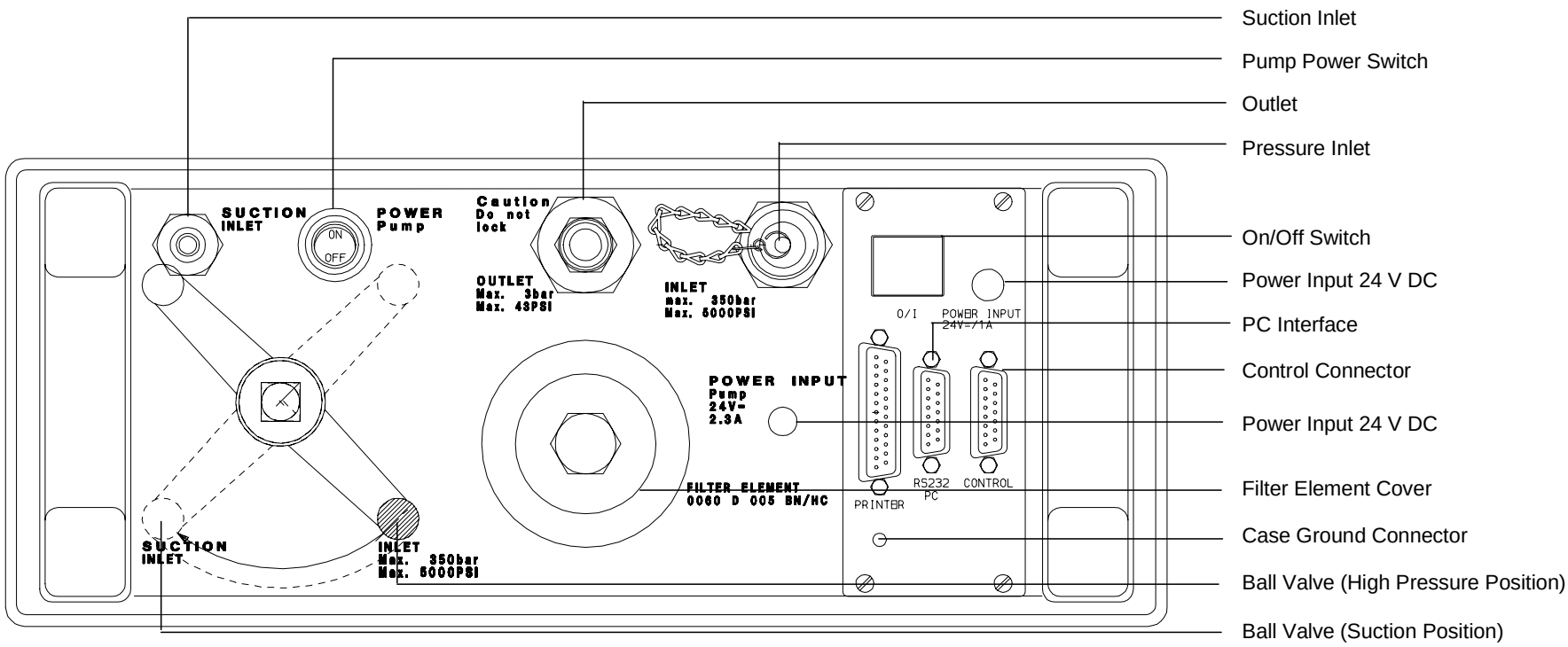
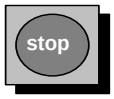


Figure 3 : Rear View

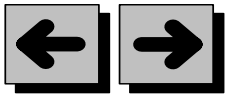
5.5.3 Function of Keys

5.5.3.1 Control keys (gray)

Confirm entries,
Start measurement



Cancel entries,
Stop measurement

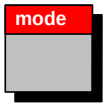


Scroll through menus
Toggle particle counts display (C or D)

Raise/lower number/letter (in input mode)

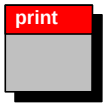
Scroll through particle size channels during measurement

5.5.3.2 Menu and number keys (red)



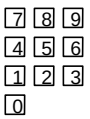
select measuring mode
(with/without relay control)

edit log memory
(name of measuring point,
averaging period, deletion etc.)



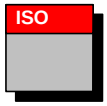
print-out
(Online, stored logs etc.)

edit limit switches for control of filter pump units or as universal control signals



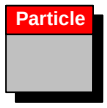
For directly entering multi-digit numbers (in input mode only)

edit setup
(autostart, date / time etc.)

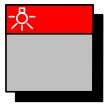


display results in ISO-Code
(this key only acts during a running measurement)

display results in NAS-Code
(this key only acts during a running measurement)



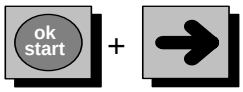
display results as particle counts
(this key only acts during a running measurement)



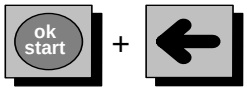
display - illumination on
1 x auto off after 30 s
2 x permanently on
1 x to switch off

5.5.3.3 Special key combinations

To edit the measuring point:

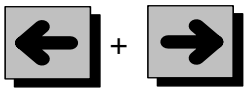


Press keys ok/start and scroll right simultaneously :**Insert character** when editing measurement point in memory menu



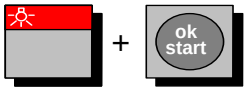
Press keys ok/start and scroll left simultaneously :**Delete character** when editing measurement point in memory menu

To enter the power up menu:



Press keys scroll right and scroll left simultaneously.

To lock keypad:



Press keys illumination on and ok/start simultaneously: key lock on / off

To switch LCD illumination permanently on:

2 x 

During operation: Press key illumination on twice: illumination remains switched on until switched off again by pressing the illumination on key once.

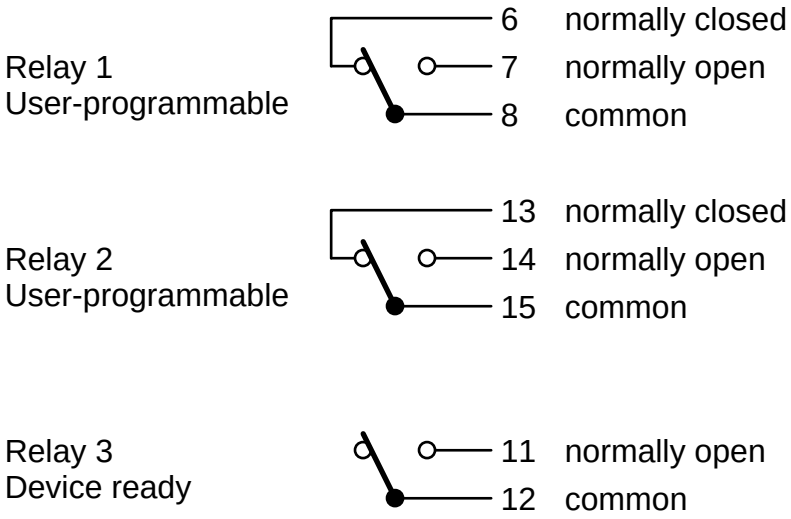
5.6 Connector Pin Assignments

On the rear of the FCU are various electrical connectors whose function and pin assignments are described in this section

5.6.1 PC Connector: (Subminiature D, 15-pin, male)

Pin	Signal function
1	Shield
2	TXD transmit line
4	RXD receive line
8	GND ground

5.6.2 Control Connector (Relays) (Subminiature D, 15-pin, female)



Maximum load : 2A (max. 24 VDC / 50 V AC, max. 30W / 50 VA)

Pin 1 : 24V Supply Voltage, max. 200 mA

Pin 4 : Ground

5.6.3 Relay Functions

Function mode	Relay 1	Relay 2
M1: Measure	Contacts 7 and 8 are closed when measurement has started and is ongoing. Contacts 6 and 8 are closed when the FCU is not in service.	Contacts 14 and 15 are closed when a flow rate error has been detected
M2: Measure + switch	Has to be set to flow rate / fall below / ↓149 ml ↑150ml to open internal shut-off valve !	Contacts 14 and 15 are closed when the user has programmed valid setting values. Contacts 13 and 15 are closed when the user has programmed invalid setting values.
M3: Filter to	Contacts 7 and 8 are closed when measurement has been started and the measured values (purity ratings) are not within the range (limits) programmed by the user. Contacts 6 and 8 are closed when 5 measurements in a row are identical to the limit programmed by the user or are below it.	Not in operation
M4: Filter from to	Contacts 6 and 8 are closed when 5 measurements in a row are identical to the limit programmed by the user or are below it. Contacts 7 and 8 are closed when: – Measurement has been started and the measurement results of the purity rating are below the lower limit specified by the user. – Measurement cycle is in progress and the measurement results of the purity ratings are above the upper limit specified by the user.	Not in operation

M5: Measure+autostop	Contacts 7 and 8 are closed when measurement has started and is ongoing. Contacts 6 and 8 are closed when the FCU not in service.	Not in operation

5.6.4 Supply Voltage Plug:

Hollow plug	5.5 mm
Internal contact:	+ 24V DC
External contact:	GND

5.6.5 Programmable Relay- Limits

FCU 2110-5

	Min	**Max**
Mode M2		
2 µm Channel NAS	2	15
5 µm Channel NAS	2	15
15 µm Channel NAS	4	15
25 µm Channel NAS	6	15
2 µm Channel ISO	12	25
5 µm Channel ISO	10	23
15 µm Channel ISO	9	21
Durchfluß	0	150
Mode M3		
ISO	12 / 10 / 9	25 / 23 / 21
NAS	2 / 2 / 4	15 / 15 / 15
Mode M4		
ISO	12 / 10 / 9	25 / 23 / 21
NAS	2 / 2 / 4	15 / 15 / 15
Test cycle time	0	1440

FCU 2210-5

	Min	**Max**
Mode M2		
4 $\mu m_{(c)}$ Channel ISO	12	25
6 $\mu m_{(c)}$ Channel ISO	10	23
14 $\mu m_{(c)}$ Channel ISO	9	21
Durchfluß	0	150
Mode M3		
ISO	12 / 10 / 9	25 / 23 / 21
Mode M4		
ISO	12 / 10 / 9	25 / 23 / 21
Test cycle time	0	1440

6 Installation and Operation of the FCU

6.1 Electrical Installation

The rear of the FCU features two sockets for connection to 24 V DC voltage supply.
The FCU can be connected to either :

- Mains voltage via the supplied line adapters
- 24 V DC from a vehicle battery

Connect the hollow plugs of the line adapters as shown in Figure 4 : Power Supply Sockets. The line adapters themselves have to be connected to mains voltage.

Because the shut-off valve for measurements with high pressure inlet and the pump for measurements with suction inlet need 24 V DC supply, FCU 2110-5 / FCU 2210-5 can not be operated independently of an external power supply.

	***FCU electronics and shut-off valve are supplied by the socket "Power Input", so you don't have to use a second line adapter for high pressure measurements.*** ***The pump is supplied by the socket "Power Input Pump". If batteries are charged it's possible to perform measurements with suction inlet only with this line adapter connected.***

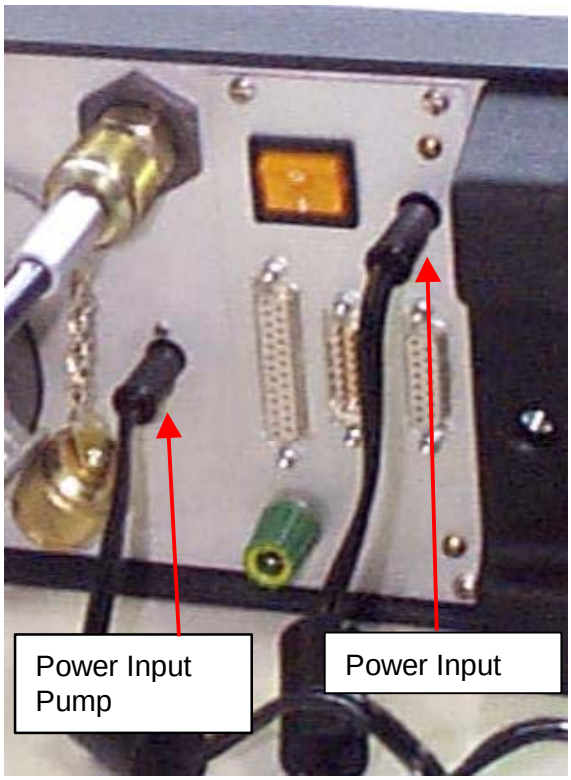


Figure 4 : Power Supply Sockets

6.2 Hydraulic Installation and Commissioning

6.2.1 Measurements with Suction INLET

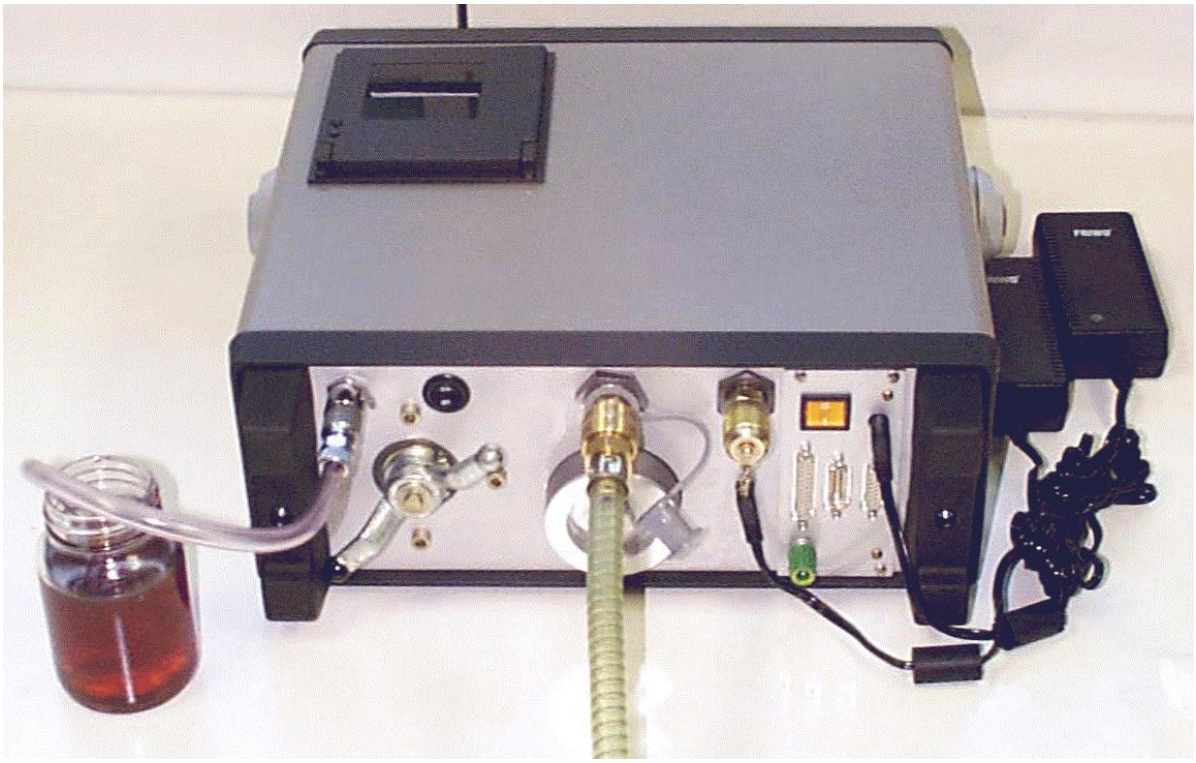


Figure 5 : Setup for measurements with suction inlet

	After measurements with high pressure inlet you should wait some minutes before switching to position SUCTION to be sure that the internal accumulator has reliefed its pressure to the Outlet

A Plug the return hose (DN 7) onto the "Outlet" connector on the back panel and route it into a suitable container, e.g. hydraulic tank or any other container.

B Switch the pump switch on the rear panel to ON position (refer to Figure 3 : Rear View) and turn the flow control valve on the front panel clockwise to end position .

C Set the ball valve on the rear of the FCU to position SUCTION (refer to Figure 6 : Ball Valve Position "Suction").

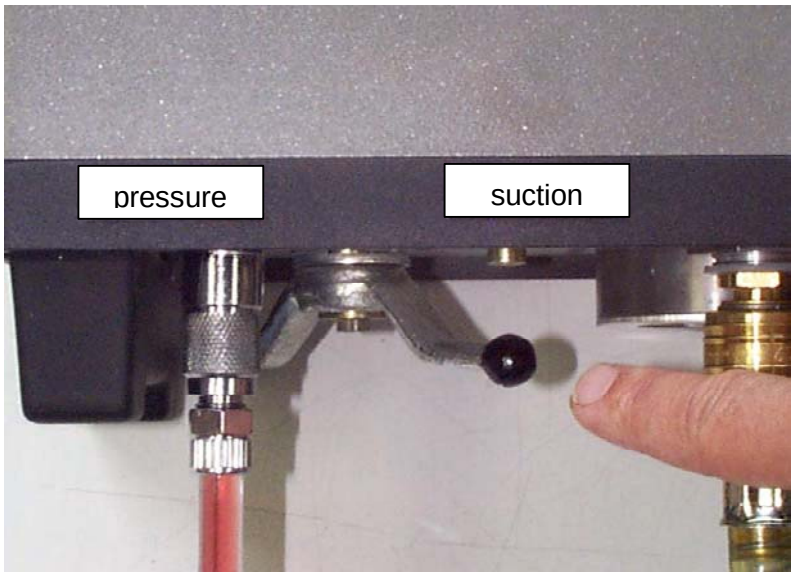


Figure 6 : Ball Valve Position "Suction"

D Plug the suction hose onto the connector on the back panel (suction) and route it into the reservoir.

E Switch the FCU on, wait until it is ready, select Mode M5 (see chapter 7.1 Measurement Operation), then press the ***START*** key. Set the flow rate to approx. 70ml/min. (shown in LCD). If an error message appears in the LCD, turn the flow control valve in the direction indicated until the error message disappears and measurement operation starts automatically.

	Measurements with suction Inlet may run continuously with viscosities up to 150 cSt. ***For higher viscosities you must limit measuring time to 10 .. 15 minutes. Between two measurements you then must pause for at least the same time (duty cycle 50%)***

6.2.2 Measurements with High Pressure Inlet, (max. 350 bar)

Figure 7 : Setup for measurements with high pressure inlet

A Plug the return hose (DN 7) onto the "Outlet" connector on the back panel and route it into a suitable container, e.g. hydraulic tank or any other container.

B Switch the pump switch on the rear panel to OFF position (refer to Figure 3 : Rear View) and turn the flow control valve on the front panel to position 5.

	***If the pump is not switched off, it can be damaged !***

C Set the ball valve on the rear of the FCU to position INLET (refer to Figure 7).

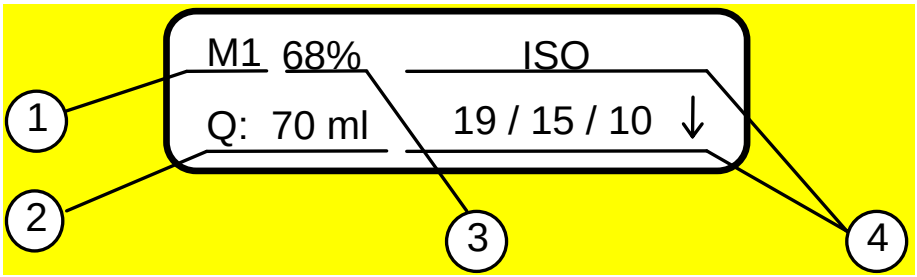
D Determine the system pressure of the test point to be checked and see whether it is within the permissible range for the pressure connection (inlet, 1 - 350 bar).

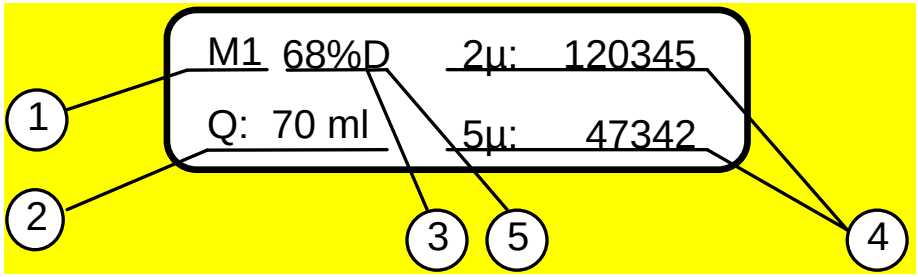
E First connect the high pressure measuring hose to the FCU and then to the Minimess connector of the hydraulic test point.

	***As soon as the pressure connection has been made to the system and a measurement is started (remind: autostart function !), the oil flows through the FCU. That is why it is important that connection be done in the sequence indicated above. The outlet must never be blocked or closed off!***

F Switch the FCU on, wait until it is ready, select Mode M5 (see chapter 7.1 Measurement Operation), then press the ***START*** key. Set the flow rate to approx. 70ml/min. (shown in LCD). If an error message appears in the LCD, turn the flow control valve in the direction indicated until the error message disappears and measurement operation starts automatically.

6.3 The Display of the FCU





① The FCU is working in mode M1 (purity rating measurement).

② Measured flow rate displayed (70 ml/min is recommended).

③ Signals the elapsed measurement time as a percentage. Begins at 0%, with the purity rating being shown again at 100%.
C (cumulative) or D (differential) is displayed behind % sign when particle counts notation is used.

④ Shows the current purity rating, with each particle size being shown separately when NAS (not available with FCU 2210-5) or particle counts notation is being used. The “tendency arrow” (↓ or ↑) shows very slight changes which would not otherwise be reflected by the purity rating reading.

⑤ Shows the current particle count display mode:

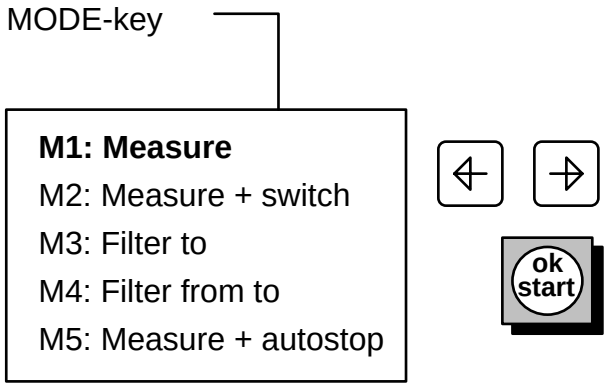
FCU 2110-5
D : differential mode : 2..5µm, 5..15µm, 15..25µm, >25µm
C : cumulative mode : >2µm, >5µm, >15µm, >25µm

FCU 2210-5
D : differential mode : 4..6µm, 6..14µm, 14..21µm, >21µm
C : cumulative mode : >2µm, >6µm, >14µm, >21µm

7 Using the FCU

7.1 Measurement Operation

7.1.1 M1: “Measure” Function



Purpose

Mode **M1 "Measure"** is used for conveniently measuring oil purity without using the control functions.

Typical Application

Fast measurement of system purity rating according to NAS (only FCU 2110-5) or ISO.

Operation

Start measurement:

Stop measurement:

7.1.2 M2: "Measure + Switch" Function

Purpose

Mode **M2 "Measure + Switch"** is used for measuring the purity of the oil in the hydraulic system, at the same time offering the possibility of controlling the limit value relay for signaling purposes. This means that this menu enables the user to have external devices switched by two relays for warning purposes (Alarm), e.g. an alarm indicator lamp on a control panel.

Possible reference values for triggering a switching sequence:

1. Sensor flow rate

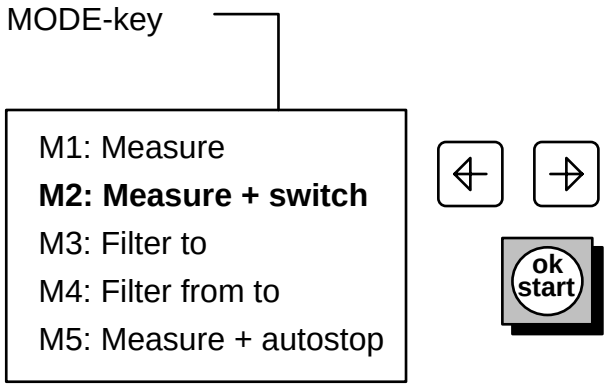
2. Purity rating of the hydraulic fluid (indicated according to NAS (only FCU 2110-5) or ISO)

Typical Application

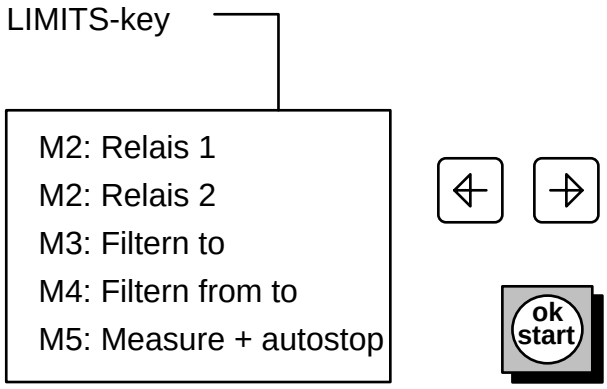
Signal switching relayed to a control panel of fully automatic test stands.

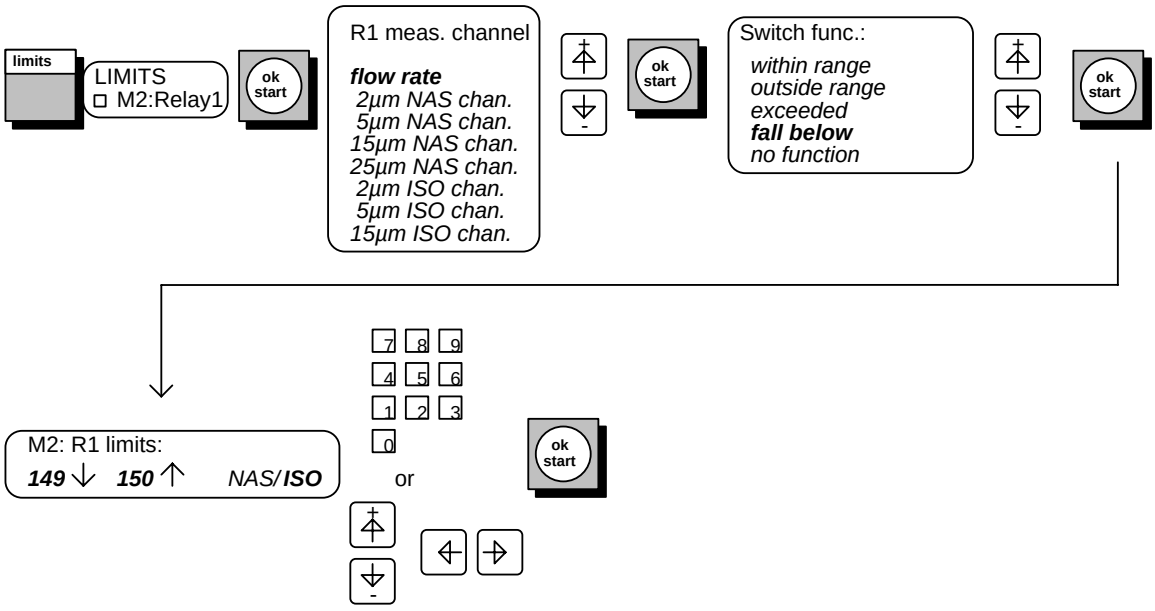
Operation

Various setting examples are shown below for the purpose of illustrating how the “measure switch” function works. (Examples are shown for relay 1 of FCU 2110-5. Procedure is the same for relay 2 and both relays of FCU 2210-5. On FCU 2210-5 the NAS channels are not available)



To enter the switching limits, select the submenu (M2, M3, M4 via the MODE key) followed by the *Limits* menu

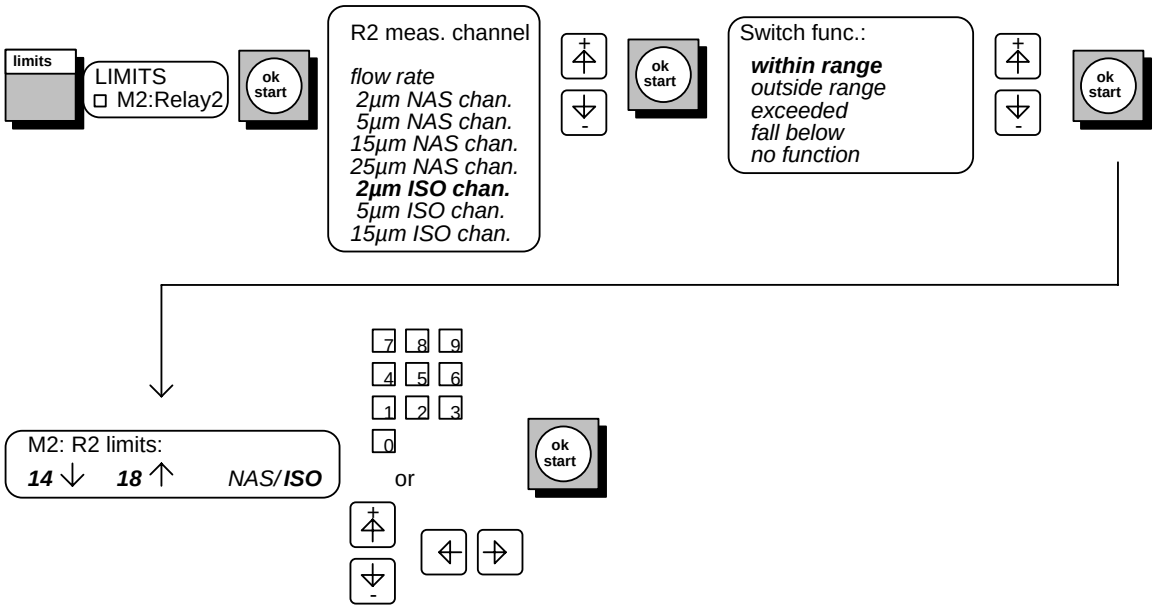




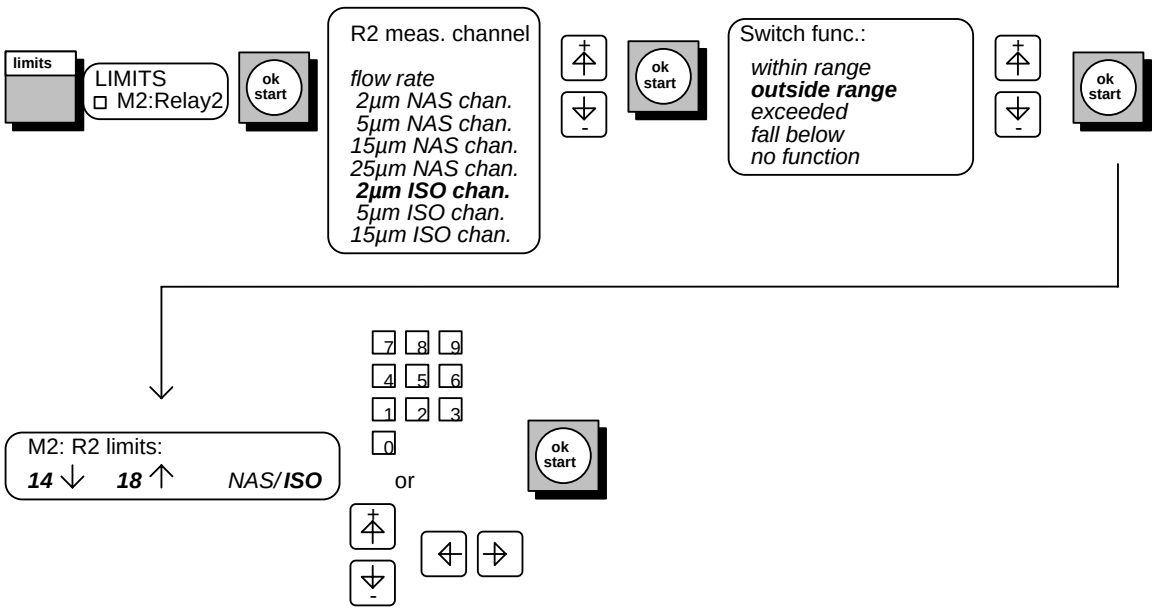
Operation

Setting the Limits (relay 2)

Example 1: **Switching of a lamp ("good" indicator) within a certain oil purity range (upper and lower limit)**

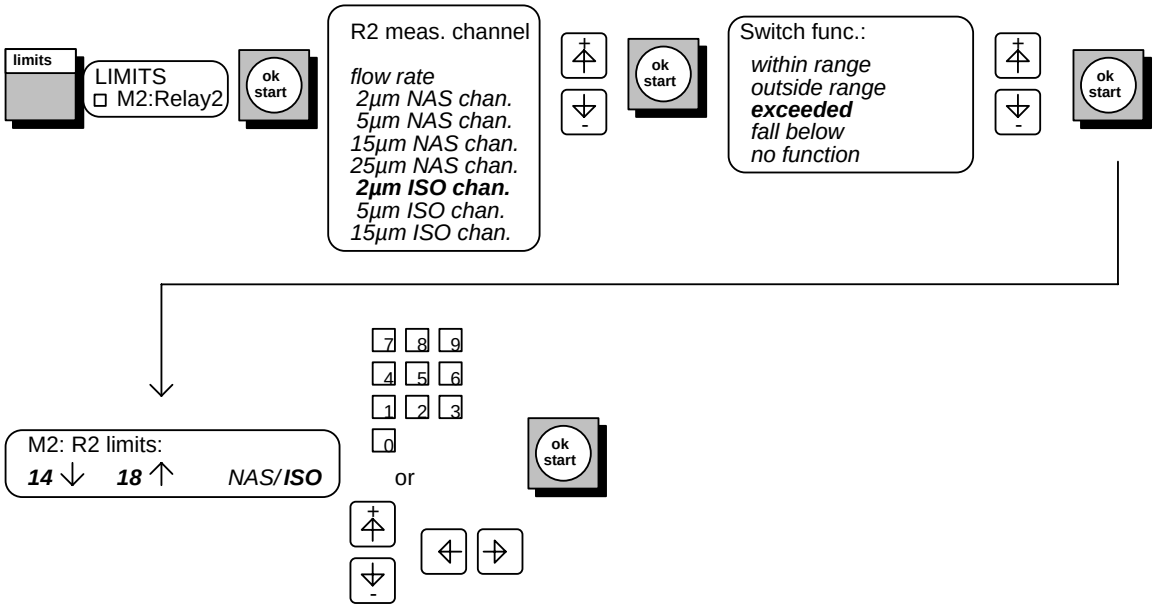


Example 2: **Switching of a lamp ("bad" indicator) outside of a certain oil purity range (upper and lower limit)**



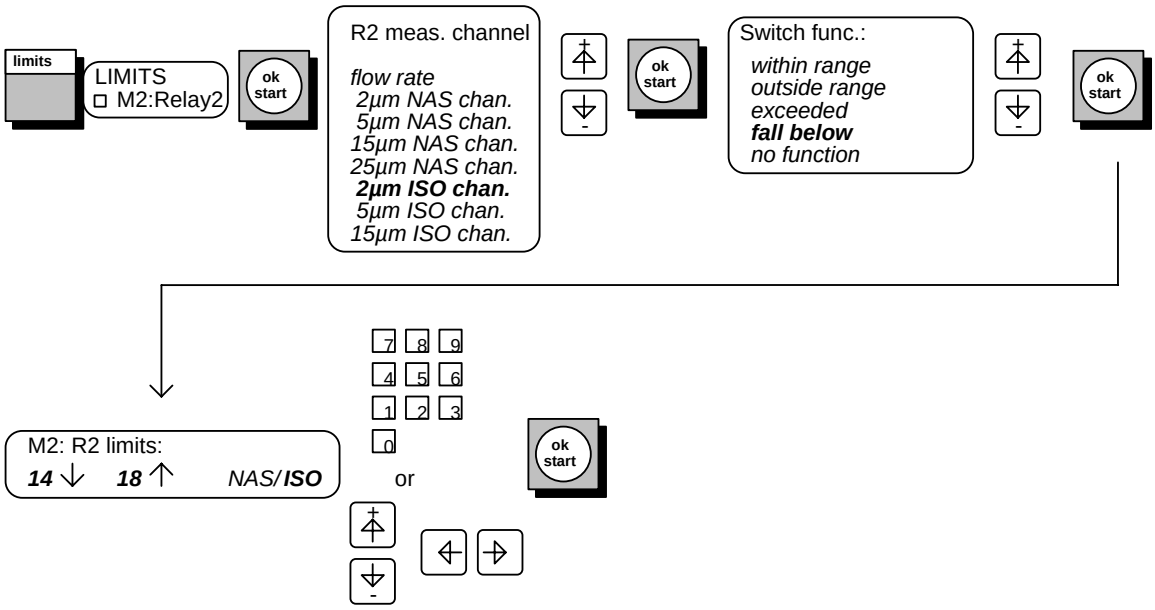
Example 3: **Switching of a lamp ("bad" indicator) when <u>exceeding</u> a certain oil purity rating (upper and lower limit)**

Contacts 14 and 15 are closed when ISO Code >2µm is higher than 18, they are opened again when ISO Code is smaller than 14.

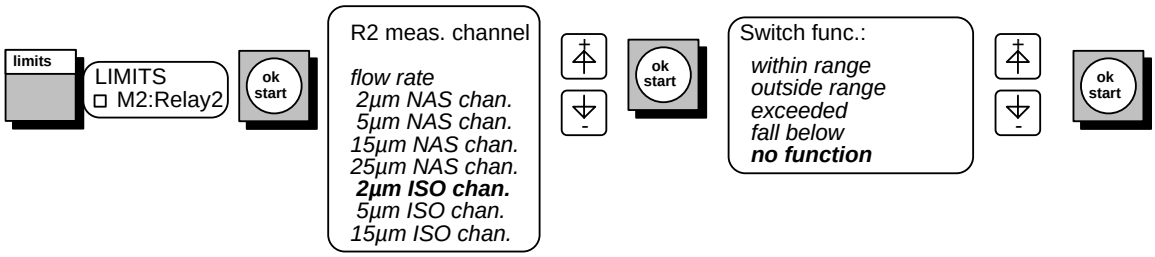


Example 4: **Switching of a lamp ("good" indicator) when <u>falling short of</u> a certain oil purity rating (upper and lower limit)**

Contacts 14 and 15 are closed when ISO Code >2µm is smaller than 14, they are opened again when ISO Code is higher than 18.



Example 5: **Disabling the switching functions of relay 1**



7.1.3 M3: "Filter to" Function (performing automatic cleaning/flushing)

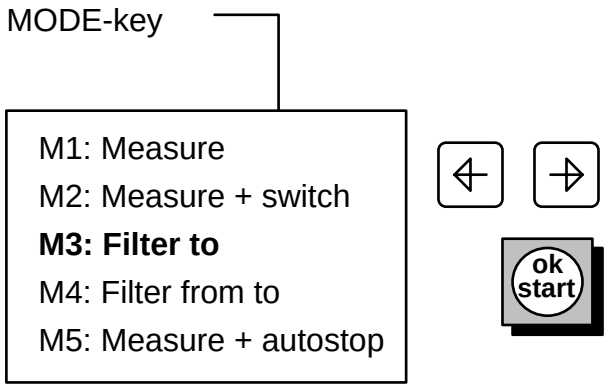
Purpose

This function of the MODE menu enables immediate control of an external filter pump unit (e.g. OF5C) to be performed without the switching relays. This is illustrated by the following example.

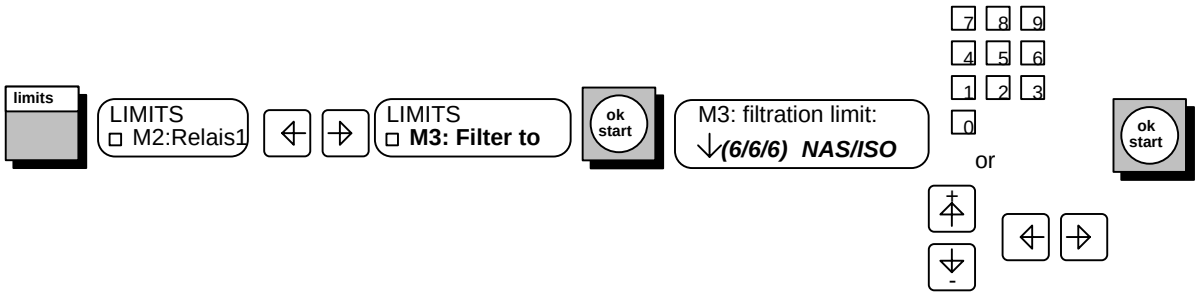
Typical Application

Flushing of hydraulic systems and documentation of the oil purity rating achieved by way of an online printout.

Operation



Example 1: **Programming OF 5 C operation (single flushing/cleaning action)**



7.1.4 M4: "Filter from to" Function (performing automatic cleaning/flushing)

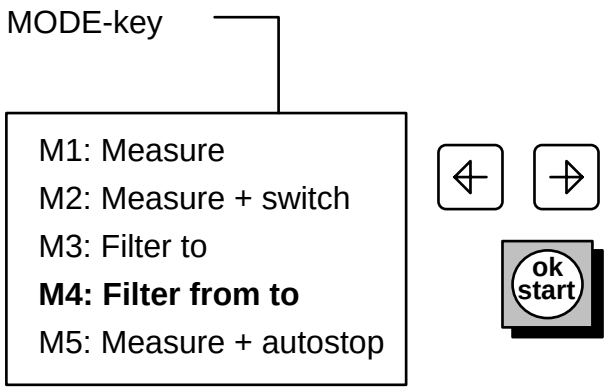
Purpose

This function of the MODE menu also enables immediate control of an external filter pump unit (e.g. OF5C) to be performed, also without the switching relays. This is illustrated by the following example.

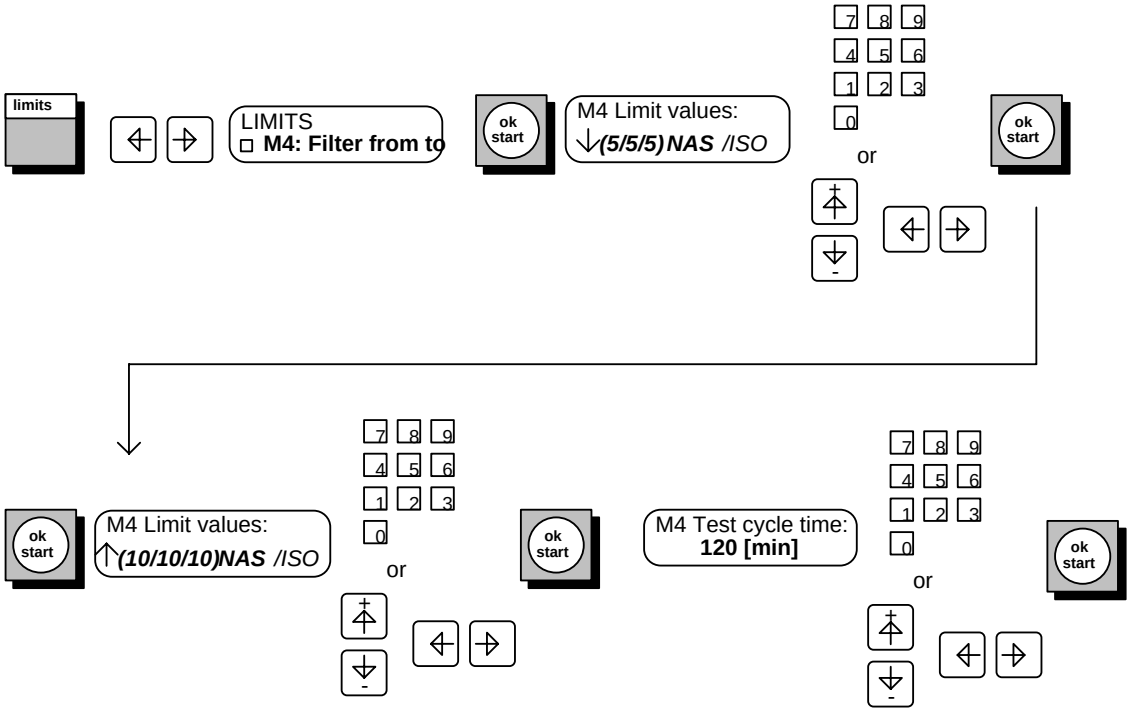
Typical Application

Long-term monitoring of the oil purity rating in hydraulic systems and documentation thereof by way of an online printout.

Operation



Example 1: **Programming OF 5 C operation (flushing/cleaning between a lower and upper limit)**



7.1.5 M5: "Measure+autostop" Function

Purpose

This function of the MODE menu is especially useful for repeated testing of oil cleanliness on different machines.

The user can program a number of measurements (from 1 to 255) that are performed automatically.

Switch Pump button on back panel to "ON" Position and press the Start button.

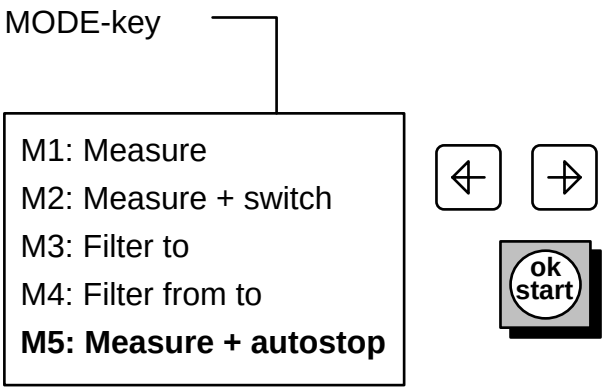
After the start delay time (necessary to deaerate and flush the FCU) is elapsed, the first measurement starts automatically.

After the last measurement is done, the measurement stops automatically. Switch Pump button on back panel to "OFF" Position.
The results are printed out both in ISO/NAS codes and particle counts. (NAS with FCU 2110-5 only)

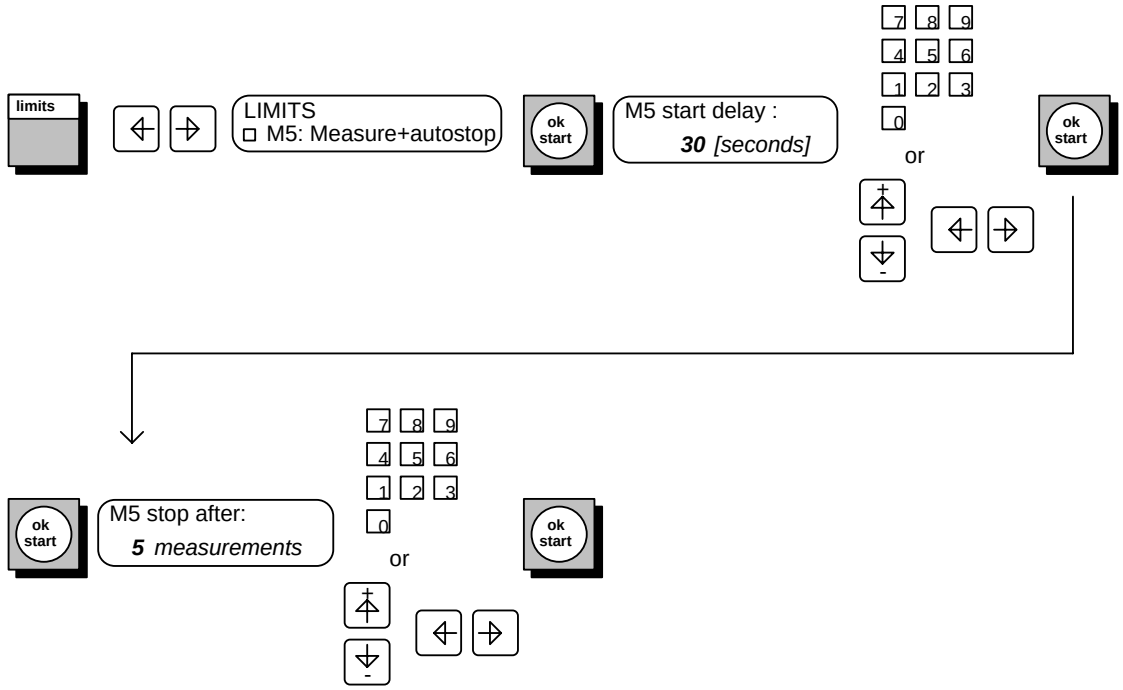
Typical Application

Roll off cleanliness testing in production.

Operation



Example 1: **Programming 5 measurements after a start up delay of 30 seconds**



7.2 Using the MEMORY Functions

7.2.1 Entering the Measurement Point and Initiating Measurement <u>without</u> Averaging

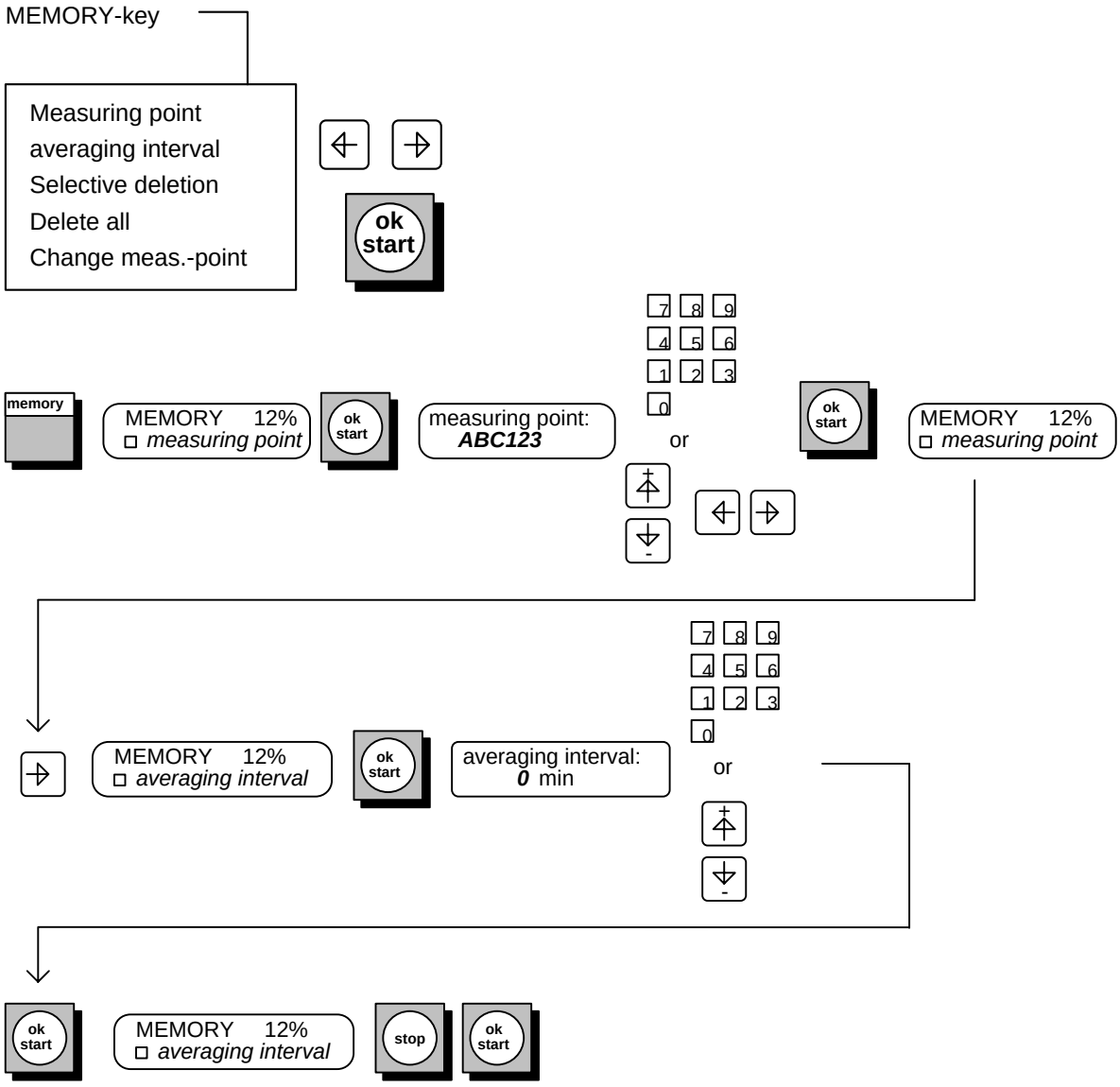
Purpose

In this operating mode, new measured values are shown immediately in the display on the front of the FCU step by step, followed by their being saved and printed out. *In this continuous operating mode, the "Averaging interval" function has to be set to zero in order for the measured values to be outputted.*

Typical Application

Monitoring of the oil purity of hydraulic assemblies with the possibility of performing comparative measurements at the same measurement point over an extended period of time.

Operation



7.2.2 Entering the Measurement Point and Initiating Measurement with Averaging

Purpose

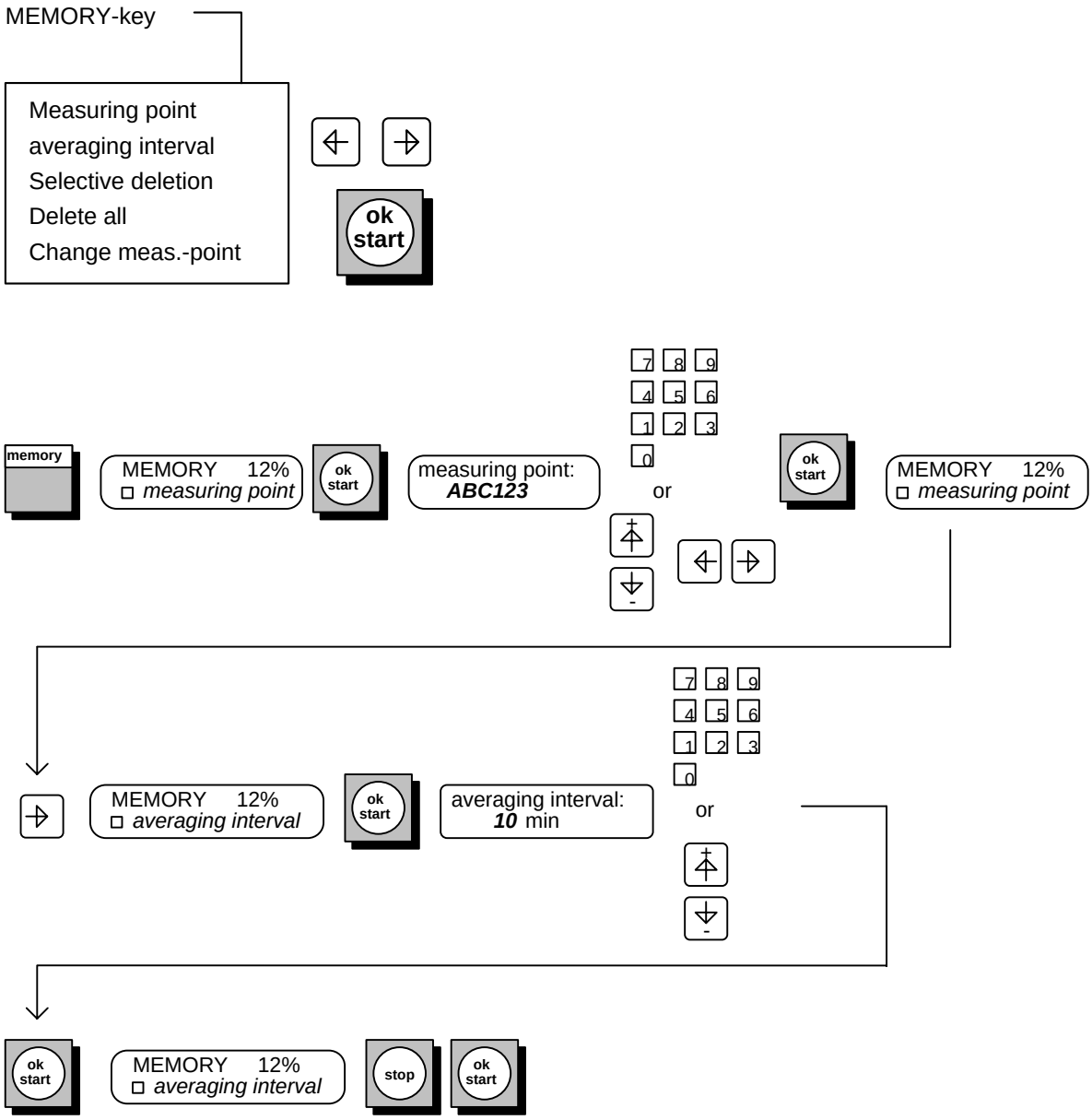
In contrast to the procedure described in section 10.2.1, an averaging interval can be indicated as well. That means reference values from 1 min. to 1440 min. (= 24 hrs.) can be programmed.

As a result, new measured values are continuously shown in the FCU's display step by step for information purposes, however, storage and printout of the measured values take place as averaged values only upon the preprogrammed time elapsing.

Typical Application

Continuous long-term monitoring and documentation of the oil purity in hydraulic systems.

Operation



7.2.3 Deleting Data from Memory

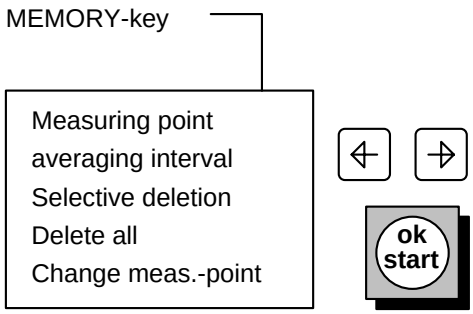
Purpose:

This operating mode enables the user to delete old logs of previous measurements from the FCU's memory.

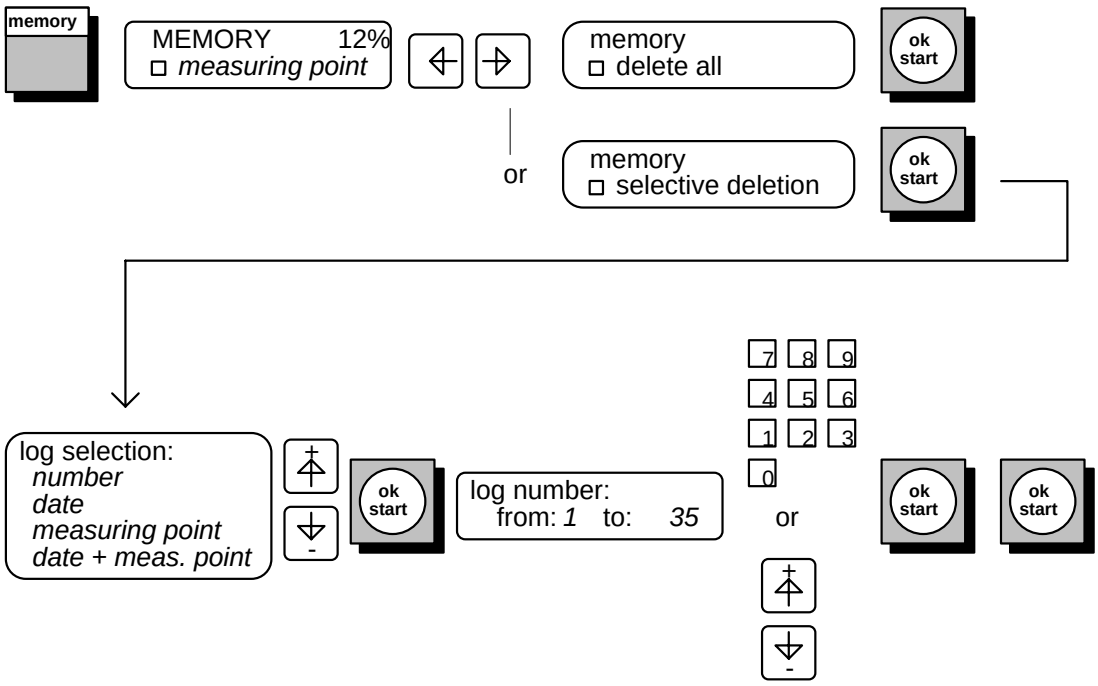
Typical Application:

Sample measurements are conducted by the user whose archiving are of no practical use for subsequent documentation purposes or comparative measurements.

Operation



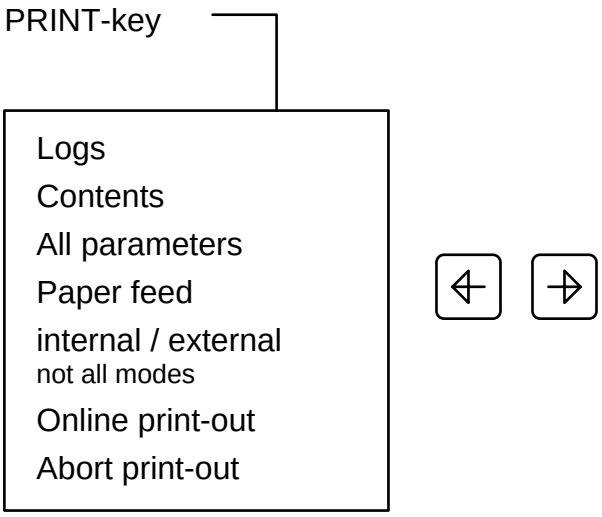
Example 1: **Deleting logs from memory**



7.3 Printing

Purpose

This function enables the user to print out measured results immediately after the measurement is conducted, for example, or to print out existing values in the form of logs.



7.3.1 Printing Online Logs (***only when measurement is in progress***)

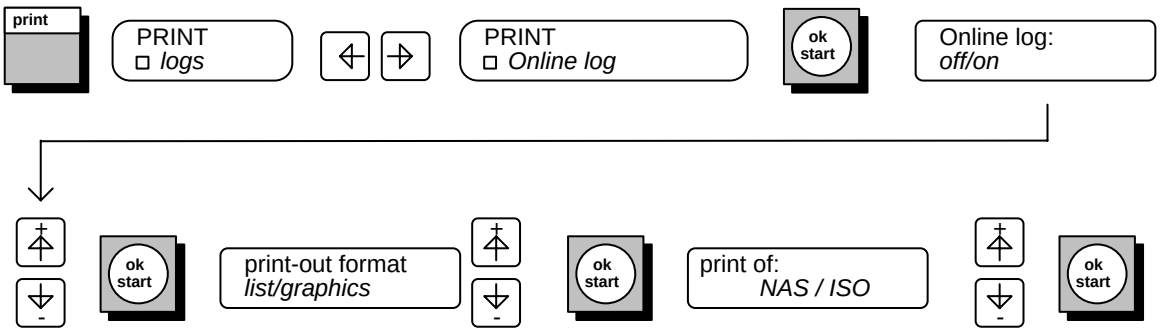
Purpose

Documenting continuous measurement by outputting the measured results via the integrated printer.

Typical Application

Flushing of an hydraulic assembly is to be documented during the entire cleaning procedure until a certain oil purity rating is achieved.

Operation



7.3.2 Printing Logs Stored in Memory

Purpose

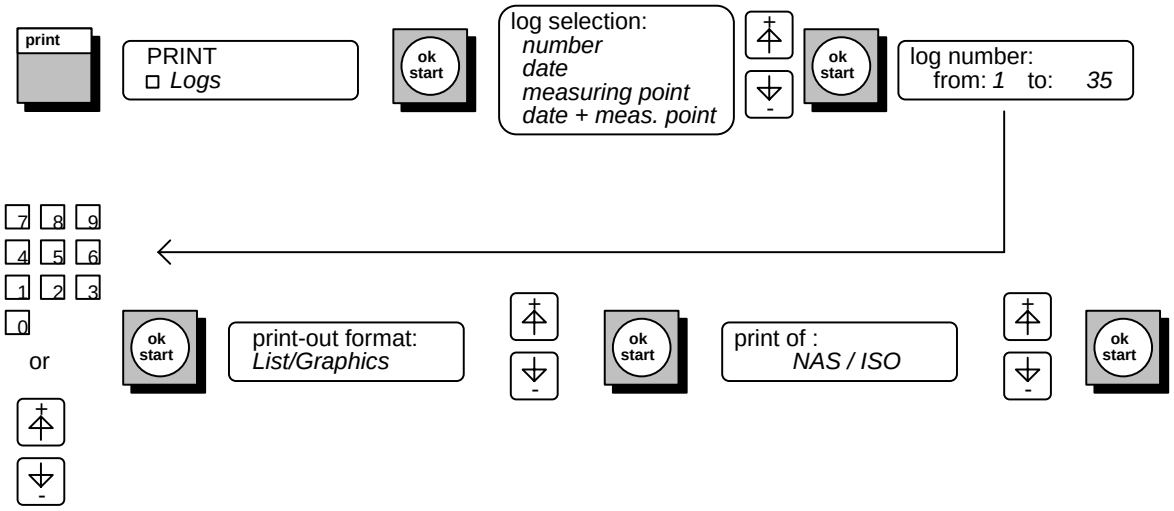
This function enables the user to retrieve measurements previously performed and print them out. The submenu provides selection to be made according to various search functions.

1. Log number (continuously saved as a consecutive number)
2. Date (automatically saved along with the measurement)
3. Measurement point (has to be entered by the user)
4. According to date and measurement point

Typical Application

Data collected for previous measurements have to be referred to in order to compare the current oil purity data of a hydraulic system.

Operation

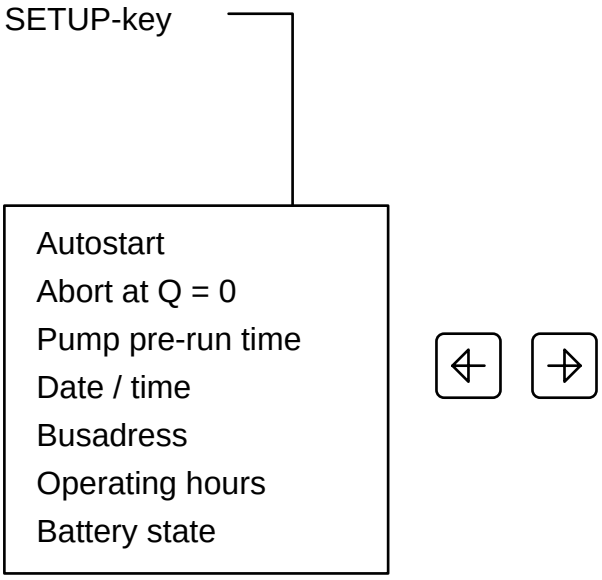


7.4 SETUP Menu

Purpose

This menu enables the user to enter basic settings or change them. The settings marked in the figure below are preset in the factory and should not be subsequently changed by the user.

Operation



Autostart:

Abort at Q=0: (mode M1, M5 only)

→ **yes** If the current flowing through the sensor drops to “0”, measurement is discontinued and the FCU switched off.

→ **no** If the current flowing through the sensor drops to “0”, measurement is discontinued, however the FCU remains switched on and resumes measurement as soon as the flow rate is sufficient again.

Pump pre-run time When conducting measurements with the aid of the KE1310 conditioning unit or when using an external filter pump unit (e.g. OF5C), this function enables the user to operate the pump until the pressure and flow rate are stabilized and the FCU is to resume measurement. The setting time may range from 1 to 200sec.

Recommended: 60 sec.

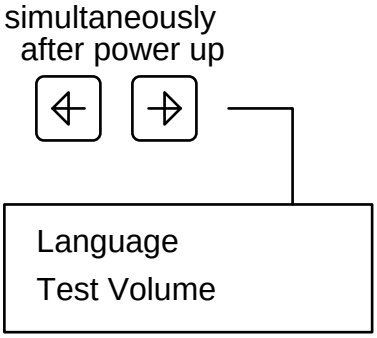
A setting of 0 sec disables this function.

7.5 "POWER UP" Menu

Purpose:

This menu enables the user to enter settings which are not to be changed, also by other users of the unit.

The menu is selected by simultaneously pressing both SCROLL keys upon switching the unit on.

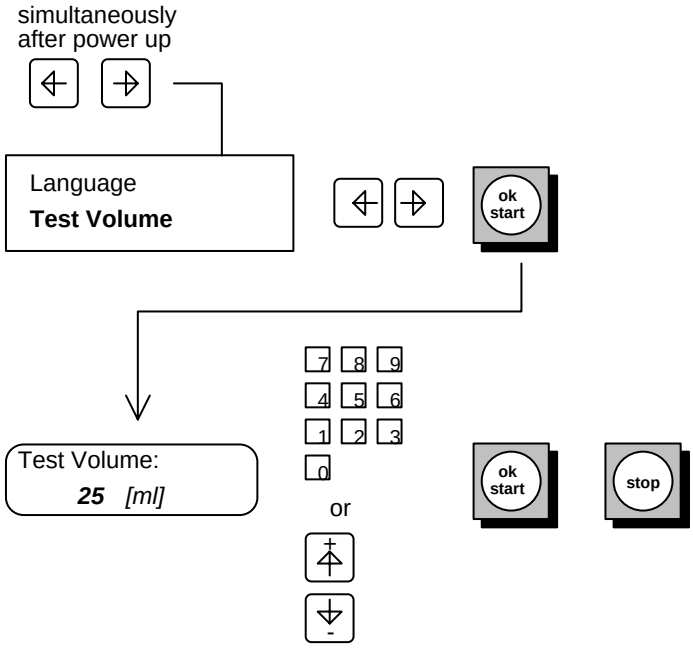


The user can select between English, German, French and a programmable language (via FCUDESK software package)

The test volume for one single measurement can be set between 10 and 100 ml.

(Results are always referred to 100 ml)

	*Measuring accuracy as indicated in chapter **15 Technical Data and Specifications** is only guaranteed for a test volume of 100 ml*



8 Error Messages and Troubleshooting

Displayed Error Message	Cause(s)	Remedy
Invalid parameter	You have entered a value which is outside the allowed value range (i.e. ISO 40).	check the allowed value range with the arrow keys +↑ and -↓ by scrolling above the maximum values. Then the minimum value is automatically displayed. This works forward and backwards.
Check parameters **Defective parameter:** **no. XX**	The self monitoring function of the FCU has detected a checksum error at one or more parameters. Cause: a strong electromagnetic disturbance has changed the parameters.	• adjust all parameters again with the FCU keypad. • alternatively download all parameters again with the FCUDESK PC software package.
Number of defective logs:	The self monitoring function of the FCU has detected a checksum error at one or more stored logs. Cause: • a strong electromagnetic disturbance has changed the parameters. • the internal back up battery is down.	• The defective logs are automatically deleted. That means after the next power up this message is not displayed again if this was just a short disturbance. • If this message is displayed several times, the internal back up battery is down. -> Ship FCU to HYDAC for repair.
no logs stored !!	You have tried to print logs, but the memory is empty.	Perform new measurements.
not enough points	You have tried to print a graph, but the selected log has not enough measurement values (at least 3) to show a graph.	print log as a list.
Charge battery	The rechargeable batteries are low.	You still can perform measurements, but you should connect the line adapter, especially for printing.
use power supply	The rechargeable batteries are discharged.	• You have to charge the batteries with the line adapter for approx. 11 hours. • With the line adapter connected, you still can perform measurements.

Flow rate error! **Correct: 0 ml**	• There is no oil flowing through the particle sensor (i.e. only air). • The flow rate counter is damaged.	1. Turn flow control valve fully clockwise. 2. Check hydraulic connections. 3. Check pressure. With pressure > 30bar/420psi oil must flow through the OUTLET hose in any case, because the internal pressure relief valve must be open (see hydraulic circuit diagram in manual). 4. Ship FCU to HYDAC for repair.
Flow rate error! **Correct: 15 ml**	The flow through the particle sensor is lower than the necessary value of 50 ml/min to perform measurements.	Turn flow control valve clockwise (+ direction) until measurement starts.
Flow rate error! **Correct: 250 ml**	The flow through the particle sensor is higher than the necessary value of 150 ml/min to perform measurements.	Turn flow control valve counterclockwise (- direction) until measurement starts.
Filter contaminated	The internal protection filter for the flow control valve of the FCU is clogged.	Replace FCU filter element.
ext. Input activated (this message only occurs with the OF5C filtration unit)	The clogging indicator of the OF5C is activated, the OF5C filter is clogged.	Replace OF5C filter element.
Internal printer not ready	• Paper roll empty. • Printer damaged.	• Replace with new paper roll. • Ship FCU to HYDAC for repair.
Fehler in gewählter Sprache **or** **Error in selected language**	• the internal memory for the selected language has been changed by a disturbance. • The internal back up battery is down. Because of the defective language the FCU selects German language as a default.	• Download the FCU languages again with the PC-software package FCUDESK. • If this error message repeats -> Ship FCU to HYDAC for repair.
Reload languages	• the internal memory for the languages has been changed partially by a disturbance. • The internal back up battery is down.	• Download the FCU languages again with the PC-software package FCUDESK. • If this error message repeats -> Ship FCU to HYDAC for repair.
Calibration defect	Internal calibration data in EEPROM are lost by a disturbance.	Ship FCU to HYDAC for repair in any case.

Device ID defect	Internal designations in EEPROM are lost by a disturbance.	• This is not a critical error, because these designations do not influence the proper function of the FCU. • Ship FCU to HYDAC for repair eventually.

9 Maintenance and Servicing of the FCU

The FCU is maintenance free, except for the filter. The filter clogging is monitored by a clogging indicator (2 bar). If the filter is clogged, a warning message shows up in the LC-display.

Other useable items are:

- Printer paper
- Printer Ink ribbon

9.1 Filter Element Exchange:

When clogging of the filter element results in a differential pressure of 2 bar, the integrated clogging indicator gives the signal for outputting a message on the FCU's display. This presupposes that the flow control valve is not closed, meaning a flow is shown in the display. In addition, the inlet pressure has to be correspondingly high, i.e. at least 1 bar. When the inlet pressure is insufficient, the flow rate becomes increasingly smaller, even when the flow control valve has been opened completely.

In these cases the element has to be changed.

Before changing the element, the Fluid Control Unit is to be isolated from the system. Undo the contamination retainer (filter bowl) sealing screw at the rear of the unit using a size 12 Allen screw wrench.

Note:

Collect any residual oil in the housing using a suitable container. Pull the filter element out of the housing by the strap, then insert a new filter element, model: 0060 D 005 BN 3 HC, article no.: 1260 891. Lubricate the O ring on the filter element somewhat and insert it by turning it at the same time. Then check the O ring at the sealing screw to make sure that it is intact, slightly lubricate it, reinsert the sealing screw, and tighten it until it is hand tight.

9.2 Changing the ink ribbon cartridge

a) Lift printer cover and fold back fully

b) On the right side of the ribbon cartridge, push where marked "Push" until the cartridge is released.

c) Remove old ribbon cartridge.

d) When fitting the new ribbon cartridge, the "Push" label must be on the top of the right. Feed paper strip through the ribbon cartridge (between ribbon and plastic cartridge).

e) Place the left side (ribbon drive) of the ribbon cartridge in first, then push where marked "Push" on the right hand side until the ribbon cartridge clicks in.

f) Re-align paper and close printer cover. Approximately 0,5 cm of paper should emerge from the cover.

9.3 Inserting a new paper roll

a) Switch off FCU

b) Carry out instructions 9.2 Changing the ink ribbon cartridge a) to c)

c) Lift out old paper roll, remove plastic spindle and place it inside new paper roll.

d) Place new paper roll in the printer so that the paper unrolls from the bottom.

e) Feed paper edge until it stops between the two metal guide plates beneath the feed roller.

f) Press and hold down green button (LF) while switching on the FCU and wait until approximately 3 cm of printer paper feeds through.

g) Carry out instructions 9.2 Changing the ink ribbon cartridge d) to f)

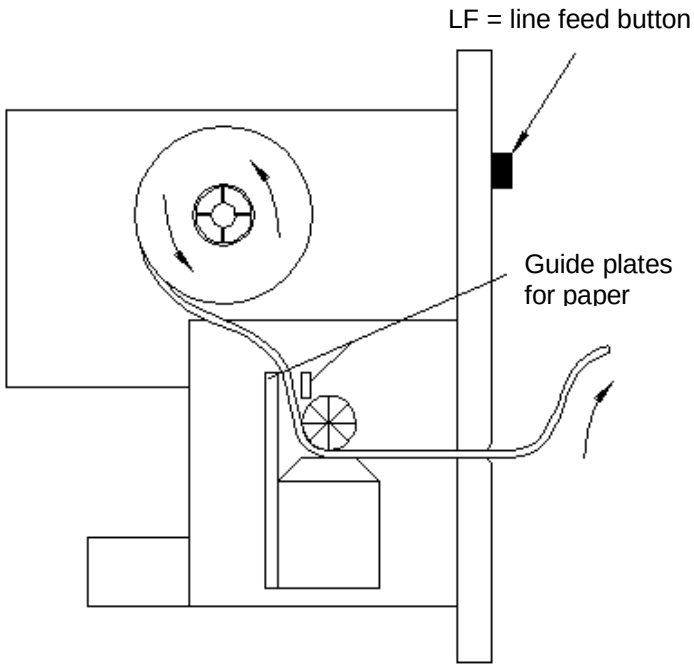


Figure 8 : Side view of FCU Printer

10 Recalibration

HYDAC recommends recalibration once a year.

11 Spare Parts

Article number	Article designation
126 0891	Filter element for FCU
349 154	filter element – replacement set • filter element, FCU • O ring, cover, 48 x 3, 80 Shore hardness rating, NBR • bearing ring, cover
349 155	Set of paper rolls for printer (5 rolls) Roll diameter: 50 mm Roll width: 58 mm
349 156	Ink ribbon for printer, Epson ERC-09-P
1251 557	High-pressure measuring hose, ID 4, 5000 mm long
349 150	High-pressure measuring hose, ID 4, 2000 mm long
3036 098	Suction hose ID 5,with CPC quick disconnect, 1000 mm long
349 151	Return hose, ID 7, 2000 mm long
1251 558	Return hose, ID 7, 5000 mm long
	Line adapter 230 V, European model
	Line adapter 120 V, U.S. model
	Line adapter 240 V, Australian model

12 FCU, Accessories

Article number	Designation
3040 814	Transport case, incl. Filter element replacement set, 2 rolls of paper, 1 ribbon for integrated printer
349 632	Software package FCU DESK 21XX
306 6739	Software package FCU DESK 22XX

13 Decommissioning and Final Disposal

When decommissioning and/or disposing of the FCU, adherence is to be maintained to local guidelines and regulations pertaining to occupational safety and environmental protection. This applies in particular to the oil in the unit, components covered with oil and electronic components.

14 Explanation of Terms Used in Measurement and Instrumentation Systems

Measurement point: The name of the location at which the FCU is connected to the hydraulic system. This designation (max. 20 characters) can be entered in the FCU for documentation purposes.

Example: pump press W3

Measured value: The current purity rating value.

Example: ISO 19/16/13

Measurement: A measurement sequence begins immediately after pressing the OK/START key. Typically, a new measured value of the purity rating is shown in the display once a minute (depending on the flow rate).

Averaging interval: The time interval set by the user (in minutes) for which the FCU's measured values are averaged and saved.

Example: 1 minute (24 hrs. also possible, for example)

Log memory: Once started a measurement sequence is continuous, i.e. new values are continuously present which are sequentially stored in the memory as log lines. When the memory is full the oldest measured values are overwritten by the latest ones (rolling-map memory). This ensures that no current measured values are lost.

Log: To prevent measurements taken at various measurement points from being stored as one long continuous difficult-to-manage column of numbers, the FCU automatically compiles measured values to form *logs* and administers them independently using so-called *log headers.*

Log header: Containing the log number (a sequential log number is automatically generated every time a measurement sequence is initiated).

The name of the *measurement point* (can be entered by the user) *date + time of the beginning and end of the measurement sequence* (generated automatically)

Averaging interval
Number of log lines (measured values)
Duration of the measurement series

Example:

Memory log: 6
D10 1234
from: 20 Oct 1996 8:32
to: 20 Oct 1996 10:39
Averaging interval: 0 [min]
Number of log entries: 3
length of log: 0:02

15 Technical Data and Specifications

Continuous measured value indication via LCD

Self-diagnosis:	Continuous self-monitoring error indication in LCD
Measurement range (calibrated):	ISO 13/11/10 ... 23/21/18 NAS 2 ... 12 (only FCU 2110-5)

The unit is calibrated in these ranges. In addition, values can be indicated above this up to a rating of ISO 25/23/21 or NAS 15 (NAS only with FCU 2110-5).

Battery-buffered log memory:	3,000 measurements	
Inlet operating pressure:	Pressure connection Suction connection Return-flow connection	Inlet: 1 - 350 bar Suction: ± 0,5 bar Outlet: max. 3 bar
Connectors:	Inlet: Minimess coupling, system 1604 Suction Inlet: CPC quick disconnect Outlet: quick disconnect coupling, ID 7	
Return (outlet) flow rate	app. 800 ml/min at 300 bar	
Measurement flow rate:	50 - 100 ml/min	
Permissible viscosity range:	5 ... 1000 mm^2 / s for Pressure connection 5 ... 350 mm^2 / s for suction connection (measuring time up to 10 min.) 5 ... 150 mm^2 / s for suction connection (continuous measurement)	
Media temperature range:	0 ... +70° Celsius	
Supply voltage:	24 V DC, ± 25%	
Power consumption:	25 W max.	
Battery-powered operating duration:	app. 4 hours	
Integrated printer:	dot-matrix printer	
Serial port:	RS 232, with 15-pin Sub D plug	
Ambient temperature range:	0 ... +55° Celsius	
Storage temperature range:	-20 ... +85° Celsius	
Relative humidity:	Max. 90%, non-condensing	
Safety class:	II double insulated	
Protection type:	IP 40	
Weight:	Approx. 14 kg	