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789 Robotic Sample Processor XL
778 Sample Processor

Program version 5.789.0020
and 5.778.0020

Short Introduction and Tutorial

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Although all the information given in these instructions has been checked with great care, errors cannot be entirely excluded. Should you notice any mistakes, please inform the author at the address given above.

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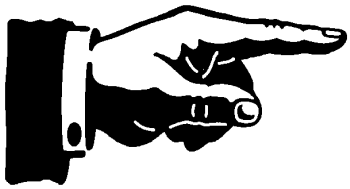


1 Introduction

This tutorial describes initial steps when using a Sample Processor. It introduces you to the most important operating controls and work steps required for processing series of samples.

1.1 Overview

A brief overview is intended to familiarize you with the most important features of a Sample Processor.

Please refer to the detailed Instructions for Use of the Sample Processor for the procedures for installing the individual components and accessories.

This will be followed by a brief overview of purpose and mode of operation of the most important components of the instrument.

1.1.1 Overall view

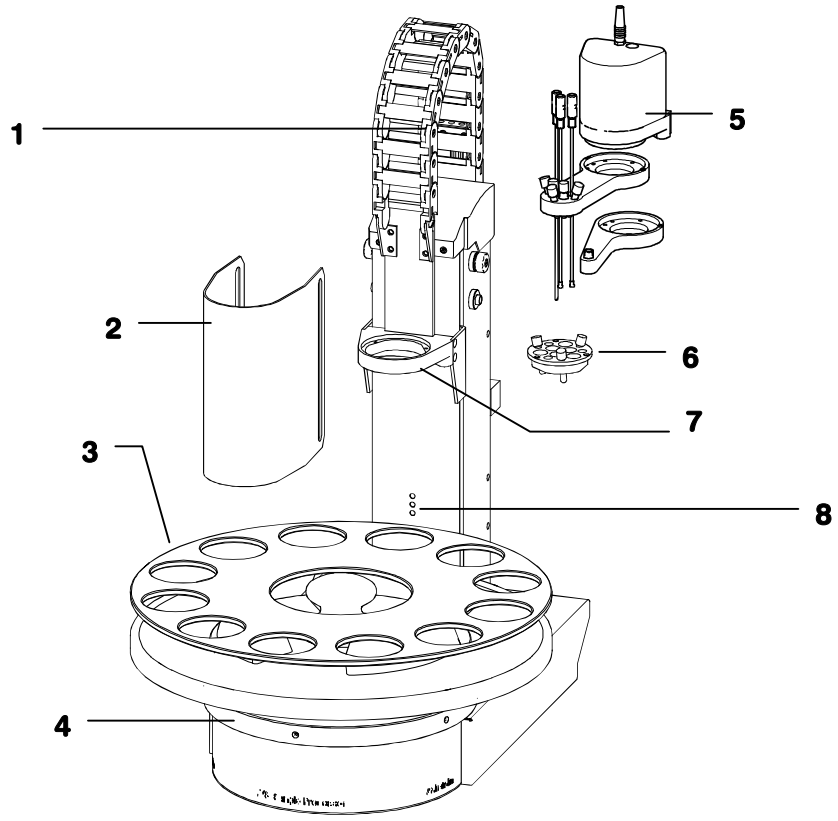


Figure 1 Overall view

1 Tubing and electrode cables are laid in the **guide chain**.

2 It is absolutely essential that the **safety shield** which also serves as a **splash protection** is attached. This is the only way of eliminating the risk of injury when operating the Sample Processor. Safety shields are available in various designs.

3 The **sample rack** is detachable. Sample racks with optimized arrangement and various numbers of positions are available for an extremely wide variety of vessel sizes. The various types of sample racks are detected automatically by the Sample Processor when you press the **<RACK>** key.

4 Magnetic stirrers (model 741) or other accessories, such as stand supports (6.2001.070), can be attached to the **stirrer rail**.

5 A **786 Swing Head** with a robotic arm can be mounted on any lift in place of a titration head. This allows you to use even multi-row sample racks and extends the scope of application of the Sample Processor since a robotic arm also allows positions outside the rack to be reached. Various robotic arms are available for various applications.

6 Electrodes, dosing tips, rod stirrers and other accessories can be attached in the **titration head**.

7 A Sample Processor is available as a single-tower or twin-tower model, each with one **lift** per tower. Different working positions and shifting positions etc. can be predefined for each lift, depending on sample rack or vessel size. Depending on requirements, various titration heads can be mounted on the **titration head holder**. It is also possible to install a Swing Head drive (Model 786) with robotic arm on the lift, see **5**.

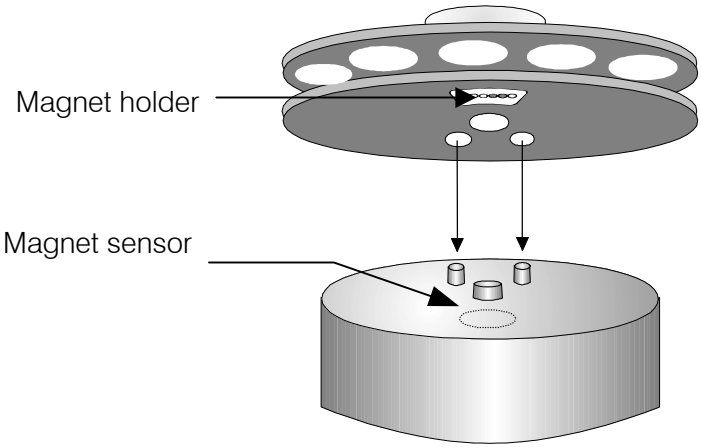
8 The **beaker sensor** (infrared sensor) on the front side of the tower is able to detect the presence of a sample vessel. This allows to prevent "flooding" if a vessel is missing. If a 786 Swing Head is used, a robotic arm with touch sensor is able to perform this task. The behaviour of the Sample Processor if a vessel is missing can be defined.

1.1.2 Sample racks

Various types of sample racks are available for the Sample Processor Models 778 and 789.

- Sample racks with **42 cm diameter** can be used for all Sample Processor models. A 786 Swing Head with robotic arm is required on the 789 Robotic Sample Processor XL.
- Sample racks with **48 cm diameter** are suitable only for the 789 Robotic Sample Processor XL with 786 Swing Head.

The various sample racks also differ in respect of the number, arrangement and diameter of the sample positions on the rack. Please refer to the Instructions for Use of your instrument for a list of available standard sample racks.



Each rack features a type-specific magnetic code allowing a Sample Processor to automatically detect the type of rack attached.
The adjacent drawing indicates how to fit a sample rack onto the turntable.
Then press the **<RACK>** key on the keypad to initialize the sample rack. The instruments are able to detect the magnetic code (the coding of the rack type) in initial position.

1.2 Rear panel

The rear panel of the Sample Processor may have a differing arrangement, depending on the model. The rear panel of the standard model 2.778.0010, with one tower, a membrane pump and a connection for an external pump is shown below.

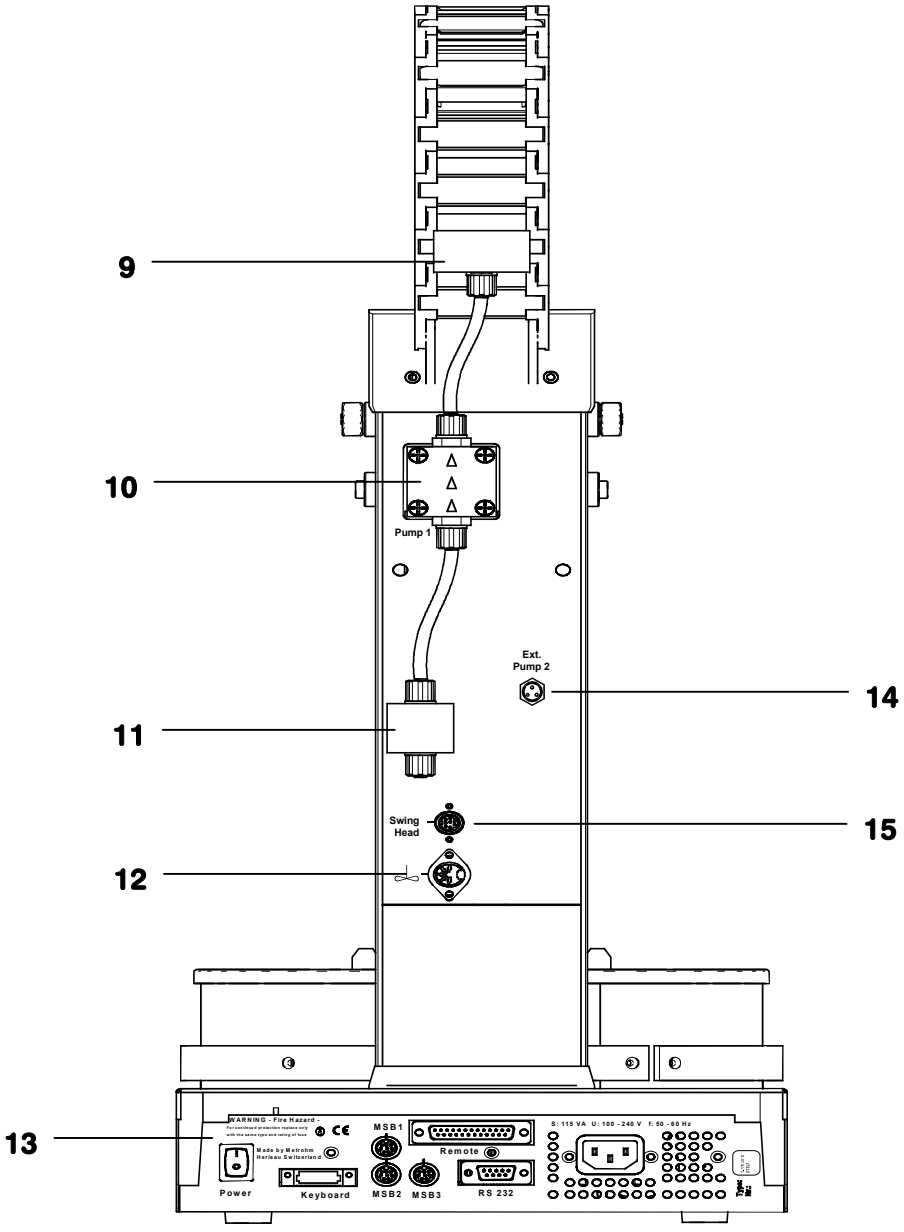


Figure 2 Rear panel

9 If you wish to use the pump 1 for rinsing electrodes and tubing, connect the tubing to the rinsing nozzles on the **manifold**.

10 The built-in pumps are **membrane pumps**. They are suitable for rinsing with spray nozzles and for aspirate processed aqueous sample solutions by suction. If you intend to use organic solvents or

aspirate aqueous samples with solid components (precipitations) by suction, you must connect a peristaltic pump.

11 The electrical **valve** ensures that no fluid is able to drip when rinsing or aspirating by suction.

12 A rod stirrer (e.g. model 802) or a magnetic stirrer (model 741) can be connected to the **stirrer connection**.

13 All **electrical connections** are located on the rear panel of the Sample Processor. They are protected against spilled fluid.

14 An additional pump (e.g. a peristaltic pump, model 772) can be connected to the **external pump connection**.

15 If a **Swing Head** drive is connected to the corresponding **connection socket**, it is detected automatically by the Sample Processor.

1.3 Electrical connections

The electrical connections are the same on all models of the 778/789 Sample Processors.

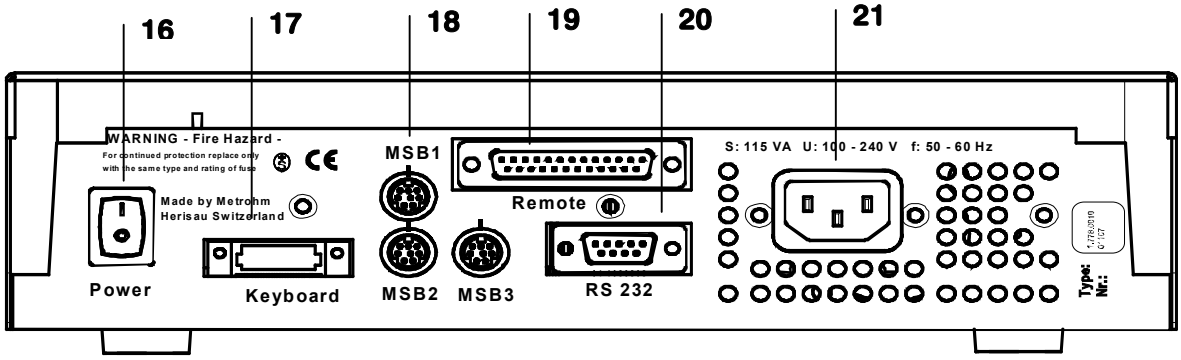


Figure 3 Connection panel

16 The **power switch** ('Power') for switching the instrument on and switching it off is located on the instrument rear panel, as are the electrical connections, for reasons relating to safety.

17 **Keyboard connection**. Press the plug firmly together at the sides in order to disconnect the cable.

18 Various Metrohm devices can be connected to the three **MSB sockets**. The 801 Magnetic stirrer and the dosing drives 805 Dosimat and 800 Dosino are best suited for this. If an 801 Magnetic stirrer is connected to an MSB socket, a dosing drive of one of the types mentioned can also be attached to its MSB connector. This means that only one MSB socket is used to control various peripheral devices (daisy chain).

The 685 Dosimat and the 700 Dosino can also be connected to an MSB socket but not with the combined configuration mentioned above.

19 Metrohm titrators (e.g.: Titrinos) or other instruments which can be controlled via remote signals can be connected to the **remote interface**.

20 The serial **RS232 port** is used for data transmission if the Sample Processor is controlled with the aid of a computer software for instance.

21 **Mains connection**. The power supply to the Sample Processor is best connected via the supplied mains cable which is connected to a mains distributor.

1.4 Installing accessories

Install all the accessories required for your work on the Sample Processor. The Instructions for Use provide you with all information required for this.

In order to perform the exercises in this brief introduction, you will require only the keypad and any sample rack with a few appropriate sample vessels. If you have available a titrator from the Metrohm Titrino series, please connect both units with the remote cable (6.6.2141.020). Plug the cable into each Remote socket on the instrument's rear panel.

1.5 Installing a 786 Swing Head

If your system has a Swing Head drive with robotic arm, please install it in accordance with the Instructions for Use of the 786 Swing Head (Chapter 2 **Installation**) and connect the cable to the 'Swing Head' socket on the rear panel of the Sample Processor's tower.

Please always comply with the following sequence:

1. Mount and connect the Swing Head drive with the instrument switched off.

2. Switch on the instrument, press the **<CONFIG>** key and keep it pressed. Then configure the robotic arm data.

3. Mount the robotic arm.

1.6 Keypad

A brief overview of the key functions in manual mode of the Sample Processor is provided below.

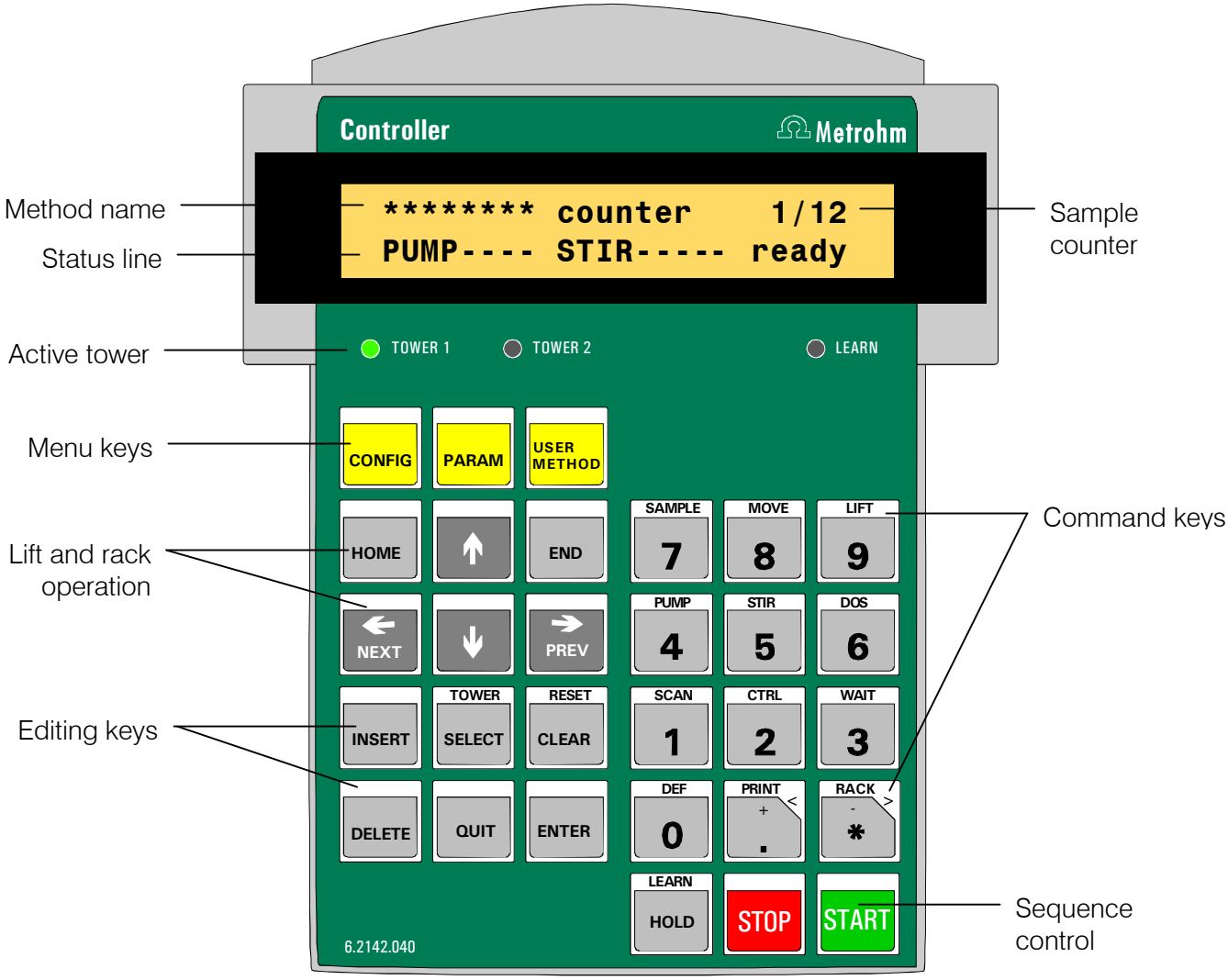


Figure 4 Keypad

Please work through the following chapter to familiarize yourself with the procedures for operating the Sample Processor.

2 Operation

2.1 Preliminary remarks

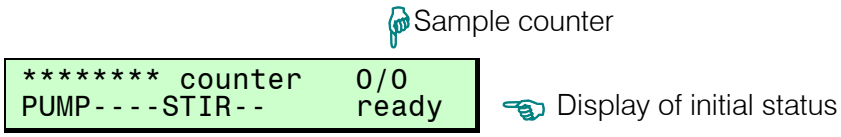
Depending on model (single-tower or twin-tower model) and equipment (with or without Swing Head) of the Sample Processor, the procedures for operating the instrument may differ slightly. What is said below describes operation of a twin-tower model with Swing Head drive and robotic arm.

On a single-tower model, there is no selection of the active tower; thus, the **<SELECT>** key does nothing in manual mode. If no Swing Head is mounted, no external position can be reached.

2.2 Switching and initialising

Please first detach the sample rack from the Sample Processor in order to demonstrate the procedure for rack detection. Switch the instrument off.

1	Switching on
Mains switch on	Operate the mains switch to switch on the Sample Processor. The mains switch is located on the instrument rear panel at the far right. If a Swing Head drive with robotic arm is mounted, the robotic arm will swing first towards the centre of the rack and adjust its initial position (0° axis). The robotic arm will then be swivelled fully out. The turntable of the Sample Processor then starts to turn, also serving the purpose of adjustment. When doing this, the instrument is attempting to detect the type of mounted rack.



The status of the sample counter **0 of 0** indicates that no rack has been detected. In this status, it is not possible to move the turntable since no rack data is available.

2 Setting the dialog language

<CONFIG>
<ENTER>

If you wish to set a dialog language other than English, you can set this language easily.

Press the **<CONFIG>** key and then press **<ENTER>**.

```
>auxiliaries
dialog:          ■ english
```

Language selection

<SELECT>
<ENTER>

Select **german, french** or **spanish** with the **<SELECT>** key and confirm your selection with **<ENTER>**.

<QUIT>
<QUIT>

Pressing **<QUIT>** twice returns to display of the initial status.

This tutorial is written in English. This is why you should set the dialog language back to English.

3 Initialising the rack

Put on a sample rack. Turn it so that the Metrohm logo on the rack points towards the tower or towards the centre between the towers (in the case of a twin-tower model). The rack must lock into position when mounted.

<RACK>

Press the **<RACK>** key on the keypad so that the rack is detected.

The rack will be rotated again (possibly after initialization of the Swing Head). As soon as the rack is in initial position, the rack's magnetic code is determined and the corresponding position table in the instrument is activated.

Sample counter

```
******** counter    0/12
PUMP----STIR--     ready
```

The sample counter displays **0 of 12** or another value depending on the number of available sample positions on the sample rack.

Whenever you put on a rack other than that which was mounted on the Sample Processor, always press the ***<RACK>*** *key or switch the instrument off and back on again.*

2.3 Configuring lift positions and rack data

1 Setting lift positions

Before working with the Sample Processor, you should make a few important basic settings. These include lift positions or rack positions for special beakers.

<RACK>, <➔> Put on a rack with sample vessels and initialize it with **<RACK>**. Turn the rack to reach a valid sample position with the arrow key **<➔>**.

<CONFIG> Press key **<CONFIG>**.

```
configuration
>auxiliaries
```

Configuration menu

Choose the **>rack definitions** sub-menu. In order to this, press the arrow key **<🡻>** until you see the following display.

```
configuration
>rack definitions
```

Edit rack data

<ENTER> Press **<ENTER>**.

```
>rack definitions
>>recall rack
```

Load rack data

<ENTER> Press **<ENTER>**.

```
>>recall rack
name:        6.2041.310
```

Rack selection

The designation (order number) of the mounted rack is displayed. It is also possible at this point to select from the stored standard racks with **<SELECT>**.

<ENTER> Press **<ENTER>**.

```
>>recall rack
code              000001
```

Display or change the rack code

This is the magnetic code of the rack, i.e. the arrangement of the magnetic pins on the underside of the sample rack. This six-digit code serves to detect the rack.

<🡻> Press **<🡻>**.

```
>>recall rack
work position T1    0 mm
```

Working height of the lift on tower 1

This is the working height of the lift, i.e. the lift position at which the actual determination process is to be performed. The position can either be entered in mm (measured as of the upper stop position of the lift) or, more conveniently, it can be set with the so-called **LEARN** function.

<LEARN> Press **<LEARN>**.

```
>>recall rack
press ↑ or ↓ or ENTER
```

Manual lift operation

<↑> , <↓>
<ENTER>

You can operate the lift with the arrow keys. Set the position of the lift so that the titration head on the lift with electrodes and dosing tips is immersed in a sample vessel. When you have set the position, press **<ENTER>**.

```
>>recall rack
work position T1  101 mm
```

Set working height

The set lift position is displayed and can still be corrected if necessary.

<ENTER>

Press **<ENTER>**.

```
>>recall rack
work position T2    0 mm
```

Working height of the lift on tower 2

<LEARN>
<↑> , <↓>
<ENTER>

The working height of lift 2 can be set only if you have a twin-tower model of a Sample Processor. Proceed as described above.

```
>>recall rack
rinse position T1   0 mm
```

Rinsing height of the lift on tower 1

<LEARN>
<↑> , <↓>
<ENTER>

This is the height of the lift scheduled for rinsing. The position can also be entered at this point manually in mm or it can be set with the **LEARN** function, see above

```
>>recall rack
shift position T1   0 mm
```

Shifting height of the lift on tower 1

<LEARN>
<↑> , <↓>
<ENTER>

This is the minimum height of the lift required when the rack is rotated. The position can be entered manually in mm or set with the **LEARN** function, see above.

```
>>recall rack
special pos. T1     0 mm
```

Special height of the lift on tower 1

<LEARN>
<↑> , <↓>
<ENTER>

This is a further, freely defined height of the lift which can be used for any purpose. The position can be entered manually in mm or set with the **LEARN** function, see above.

```
>>recall rack
beaker radius       * mm
```

Radius of the sample beakers

This is where you can enter the radius of the sample beakers so that the Sample Processor can check whether the size of the sample beakers is suitable for processing with a titration head.

<↓>

The default "*****" indicates no specific beaker radius. Retain the setting. Press **<↓>.**

```
>>recall rack
beakersensor        Tower
```

Selection of the beaker sensor

The Sample Processor is able to automatically detect whether a sample vessel is present at the current rack position. Two different types of sensors are available. An optical IR sensor allowing larger vessels in front of the tower to be detected by reflection is installed in each tower of the Sample Processor. If using a 786 Swing Head, it is possible to

install a robotic arm with piezo-resistive sensor. This touch-sensitive sensor detects a sample vessel by the process of lowering the robotic arm on the rim of the vessel (in working position).

<SELECT>
<ENTER>

Select the tower sensor with the **<SELECT>** key and press **<ENTER>**.

```
>>recall rack
rack offset        0.00°
```

Correct the angle of rotation

The rack offset offers the option of correcting the angle of rotation of the rack. This is normally not required.

<🡻>

Press **<🡻>**.

```
>>recall rack
>>>special positions
```

Define special positions on the rack

The Sample Processor offers the option of reserving positions for special vessels (e.g. rinsing beakers) on the sample rack. Up to 16 such special beaker positions are possible.

<ENTER>

Press **<ENTER>**.

```
>>>special positions
special beaker          1
```

Number of the special beaker

Enter the number of the special beaker to which you wish to assign a rack position at this point.

<1>
<ENTER>

Press **<1>** and **<ENTER>**.

```
>>>special positions   1
rack position         12
```

Rack position of special beaker 1

Whenever possible, choose the highest rack positions on the rack for special beakers.

<12>
<ENTER>

Enter **<12>** and press **<ENTER>**.

```
>>>special positions   1
work position T1    0 mm
```

Working height of lift 1 for special beaker 1

We now move on to the various settings, such as working height and beaker radius etc., which apply exclusively to this special beaker position. Each special beaker may have its own settings.

...

Enter the corresponding data as you did beforehand for the sample positions (see above).

After selecting the beaker sensor, you are prompted to overwrite the existing rack data.

```
>>>special positions   1
overwrite 6.2041.310 ?
```

Confirm change of rack data

<ENTER>
<QUIT>

Accept the new setting with **<ENTER>**. If you do not wish to accept the new settings, press **<QUIT>**.

<QUIT>

Press **<QUIT>** to quit , the Configuration menu.

The new settings come into effect only when the rack is initialized.

<RACK> Press **<RACK>**.

2.4 Configuring lift and robotic arm

1 Lift settings

There are two safety settings for each lift which you should make before working with the Sample Processor. If you have mounted a 786 Swing Head drive, you must define additional settings for control of the robotic arm.

It is assumed that you have made the basic configuration of Swing Head and robotic arm when they were installed; see Instructions for Use for the 786 Swing Head.

<SELECT>
<🡐>, <🡒> Use **<SELECT>** to choose the tower on which you wish to make settings and turn the rack to a valid rack position by pressing one of the keys **<🡐>** or **<🡒>** for instance.

<CONFIG>
<🡓>
tower 1
<ENTER> Press the **<CONFIG>** key and choose sub-menu **tower 1** or **tower 2**.

```
configuration
>tower 1
```

Configuration menu

<ENTER> Open this sub-menu with **<ENTER>**.

```
>tower 1
max. stroke path  235 mm
```

Lowest lift position

The maximum stroke path defines how far the lift is allowed to move down. This is a safety setting intended to prevent glass breakage on electrodes or other damage owing to the lift.

On the one hand, you may enter a value in mm at this point or, on the other hand, it is possible to use the **LEARN** function.

<LEARN>
<🡓>
<ENTER> Press **<LEARN>** and carefully move the lift downwards with the **<🡓>** key. When the lift reaches the lowest possible position for the rack, accept this position with **<ENTER>**.

```
>tower 1
min. beak. radius   * mm
```

Minimum permitted beaker radius

The minimum beaker radius is a further safety setting which should be selected so that the items on the titration or transfer head on the tower can still be immersed safely in a sample vessel.

The standard setting "*" means that this function is switched off. Do not change this setting for the time being.

<🡓> Advance with **<🡓>**.

```
>tower 1
>>Swing Head 1
```

Settings of the Swing head and the robotic arm

<ENTER> Open the **Swing Head 1** sub-menu with **<ENTER>** if you have mounted a Swing Head with robotic arm.

```
>>Swing Head 1
rinse position      0 mm
```

Rinsing height for external positions

The following settings apply for external positions which can be reached with the robotic arm in spite of the rack type.

<LEARN>
<↓> <↑>
<ENTER>

The rinsing height can be set with the **LEARN** function. Press **<LEARN>** and use keys **<↓>** and **<↑>** to set the required height. Confirm with **<ENTER>**.

```
>>Swing Head 1
shift position      0 mm
```

Shifting height for external positions

<LEARN>
<↓> <↑>
<ENTER>

The shifting height is the lift position which must be complied with if you move from one external position to another external position. You can set this with the **LEARN** function, as you can the rinse position, see above.

```
>>Swing Head 1
external pos.1    84.00°
```

Swing angle for external position 1

You can now set the first of four possible external positions of the robotic arm (swing angle and working height).

<LEARN>
<←> <→>
<ENTER>

All settings for the external positions can be set with the **LEARN** function, see above.

```
>>Swing Head 1
work position 1     0 mm
```

Working height for external position 1

<LEARN>
<↓> <↑>
<ENTER>

The working height can be set separately for each external position of the robotic arm.

Use the **LEARN** function for this.

```
Configuration
>tower 2
```

Configuration menu

<QUIT>

After the settings have been made for all external positions, you will return to the configuration menu where you can make further settings. Press **<QUIT>** to quit the configuration menu.

2.5 Moving rack and lift

1 Selecting the tower

On a twin-tower model of a Sample Processor, the functions presented below each refer to one of the two lifts.

<TOWER/SELECT> Using the **<TOWER/SELECT>** key, you can switch over from tower 1 to tower 2 and vice versa. The LEDs TOWER 1 and TOWER 2 on the keypad indicate the selected tower.

● TOWER 1 ● TOWER 2 ☜ Active tower 2

2 Moving the rack

The sample rack is still in initial position after the rack has been initialized (or after being switched on). This is generally not a valid rack position.

<🡐/NEXT> **<🡒/PREV>** Press keys **<🡐/NEXT>** or **<🡒/PREV>.** This turns the rack so that the next rack position up or down stops in front of the active tower. If a Swing Head is installed, the robotic arm is moved automatically to the centre of the rack position.

Note the numbering of the rack positions.

<MOVE> If you wish to approach a specific rack position, press the command key **<MOVE>**.

```
manual operation
MOVE  1          :■ sample
```

☜ Select the rack position

☝ Active tower

10 <ENTER> Enter the number of any rack position, e.g. **10**, and press **<ENTER>**. The direction of rotation of the rack is automatically selected by the Sample Processor so as to ensure the shortest possible path.

Further options for operating the rack include approaching the current sample beaker or a special beaker. The current sample is defined by a counter which is used for an automatic sequence. This counter can be set as required.

<SAMPLE> Press key **<SAMPLE>**.

```
manual operation
SAMPLE       =        ■  5
```

☜ Set **SAMPLE** variable

5 <ENTER> <MOVE> Enter any value, e.g. **5** and press **<ENTER>**.

You can enter a new rack position with the command key **<MOVE>**.

```
manual operation
MOVE  1          :■ sample
```

Select the rack position with **<SELECT>**

<SELECT>
<CLEAR>

sample

Instead of pressing the key **<SELECT>** several times, you can also use the **<CLEAR>** key. This key does not simply delete an entry but sets the default value for the relevant command. And in this case, this is the default value **sample**, standing for the above-mentioned **SAMPLE** variable or the current sample position.

<ENTER>

Pressing **<ENTER>** executes the command. The rack turns to the pre-selected position **5**.

Other options of the **MOVE**-command:

<MOVE>

spec.1
<ENTER>

You can approach a special beaker position simply by pressing the **<MOVE>** key and selecting (**<SELECT>** key) **spec.1**. Do not forget to press **<ENTER>**. Overall, it is possible to manage 16 special beaker positions.

After installing a Swing Head drive, it is possible to also reach positions not defined on the sample rack with a robotic arm. If the robotic arm has a corresponding shape and length, this allows external positions outside of the rack to be approached, e.g. a separate titration cell. The **MOVE** command is also used for this.

<MOVE>

Ext.1
<ENTER>

In order to do this, choose: **<MOVE>** **ext.1** and press **<ENTER>**.

The rack is not moved. Only the robotic arm swings to the pre-defined position. The lift may be moved to the turning height beforehand.

3 Moving the LIFT

A lift can be moved only if a defined rack position or external position is reached at the corresponding tower.

This may not be the case, depending on rack type under the following conditions:

- *Directly after switching on or after initializing the rack*
- *In the case of a twin-tower model with multi-row racks if using both towers*

<←>,<→>

Turn the rack to a valid rack position with an arrow key **<←>** or **<→>**.

<↓>
<↑>

Press the arrow key **<↓>** several times. The lift of the active tower moves downwards. The lift moves up when you press the arrow key **<↑>**.

<HOME>
<END>

Using the **<HOME>** key, you can move the lift to home position. The **<END>** key moves the lift to the pre-defined work position.

<LIFT>

You can also use the **LIFT** command. Press the **<LIFT>** key.

```
manual operation
LIFT: 1      :■    work mm
```

☜ Enter the lift position

<SELECT>
<ENTER>

Here as well, as with the **MOVE** command, you can select various positions with the **<SELECT>** key. If you have defined a work position in the configuration, choose **work** and press **<ENTER>**. The lift moves to the selected work position.

<LIFT>
100
<ENTER>

It is also possible to select the lift height accurate to the millimeter. Press **<LIFT>** and enter a numerical value between 0 and 200, e.g. 100 mm. Press **<ENTER>**.

```
manual operation
LIFT: 1      :■     100 mm
```

☜ Lift position in mm

<TOWER/SELECT>
<←><→>

If you are using a twin-tower model, change the active tower with **<TOWER/SELECT>**. First approach a specific rack position in front of the corresponding tower with **<←>** or **<→>**. You can move the lift only when a valid rack position is located in front of the selected tower or precisely below the robotic arm.

You can also execute the above-listed **LIFT** commands on this tower.

4 Pumps and stirrers

The status (on or off) is shown on the display in initial status of instrument.

```
******** counter    0/12
PUMP-+--STIR+---+ ready
```

☜ Status of pumps, stirrers and Sample Processor.

Pumps or stirrers which have been switched on are indicated by a '+' sign. The above example means:

Pump 2 on tower 1 and the stirrer on tower 1, in addition to the stirrer on MSB connector 3 are switched on.

<SELECT>
<PUMP>

Use the **<SELECT>** key to select a tower and press **<PUMP>**.

```
manual operation
PUMP on/off       no. ?
```

☜ Select the pump

Each tower has two pumps, two pump connections or a combination with one pump and one pump connection.

<1>/<2>

Press key **<1>** or **<2>**, depending on which pump or which connection you wish to activate.

<PUMP>
<1>/<2>

Follow the same procedure to switch off. Press key **<PUMP>** or **<1>** or **<2>**.

The stirrers can be controlled very flexibly. Up to five stirrers can be connected. Rod stirrers of model 802 or 722 and the magnetic stirrer model 741 must be plugged in at the stirrer connection on the rear panel of a tower. The magnetic stirrer 801 and the titration stand 804 are connected to the MSB connectors on the rear panel.

<STIR> Press the command key **<STIR>**.

```
manual operation
STIR:■T1       :     1 s
```

Switching on the stirrer

The **STIR** command allows not only single stirrers but also several stirrers to be switched. Besides switching the stirrers on and off, it is also possible to set a stirring time.

<SELECT>
T1

Press **<SELECT>** several times to select the stirrer until **T1** is shown on the display. This is the stirrer connected to tower 1. **MSB1 to MSB3** stand for the stirrers connected to the MSB connectors, **T*** stands for all stirrers on the towers and **MSB*** stands for all MSB stirrers. ***** selects all stirrers.

<ENTER>
<SELECT>
on
<ENTER>

Pressing **<ENTER>** selects the stirrer. The blinking cursor moves to the right. If you now press **<SELECT>**, you can select between switching on and switching off. By entering a numerical value (1…9999), you can set an on time in seconds. Choose switch on and press **<ENTER>**.

```
******** counter    0/12
PUMP----STIR+---- ready
```

Stirrer on tower 1 switched on

<STIR>
<ENTER>
<SELECT>
<ENTER>

The stirrer can be switched off by pressing **<STIR>** and then **<ENTER>**. Choose switch off with **<SELECT>** and confirm with **<ENTER>**.

<STIR>
<SELECT>
***
<ENTER>
<5>
<ENTER

Press **<STIR>** and choose ***** with the **<SELECT>** key. After pressing **<ENTER>** enter **5** and confirm with **<ENTER>**.

All connected stirrers are switched on for 5 seconds.

5 Dosing

Up to three dosing drives can be connected to the Sample Processor. These may be either Dosimats (Models 685 or 805) or Dosinos (Models 700 or 800). They are plugged in at the MSB connectors.

<DOS> Press the command key **<DOS>**.

```
manual operation
DOS:■1.*    :       1 mL
```

Select the dosing drive and function

Choose dosing drive and function.

Unlike Dosimats, Dosinos feature four tubing connectors which can be used as required. A specific 'port' can be selected for each dosing function.

<1>, <1>
<ENTER>

If you have connected a Dosino or Dosimat to the MSB connector 1, press **<1>** and then **<1>** again. Confirm with **<ENTER>**.

```
manual operation
DOS: 1.1    :■       1 mL
```

Select the dosing drive and port

When you selected the dosing drive, you also selected the dosing port (i.e. 1). If you enter *****, the standard port for the function is used.

<ENTER> Enter a volume e.g. **2.5** ml and confirm with **<ENTER>**.

The selected volume is output via port 1 of the dosing drive. The dosing drive then does not fill automatically.

<DOS>
<1><2>
<ENTER>

Press **<DOS>** and then **<1><2>**. This means that you have chosen port 2 (filling port) of dosing drive 1. Press **<ENTER>**.

<SELECT>
fill
<ENTER>

You can use the **<SELECT>** key to select various dosing functions. Press **<SELECT>** several times, choose **fill** and confirm with **<ENTER>**.

The dosing drive fills its dosing cylinder from the tubing connected to 'filling port' 2.

By way of example for using other dosing functions, you can prepare the dosing unit. Preparing a dosing unit means that the content of the dosing cylinder is ejected via the dosing port and then all tubing and the cylinders are filled bubble-free with the dosing fluid.

<DOS>
<1>, <*>
<ENTER>
<SELECT>
prepar.
<ENTER>

Press **<DOS>** and enter **<1>** and **<*>**. Confirm with **<ENTER>**. This means that the standard dosing port is used for ejecting the cylinder contents. Choose **prepar.** with the **<SELECT>** key and press **<ENTER>**.

```
manual operation
DOS: 1.*    :■prepar. mL
```

Select dosing drive, standard port and function

Preparation of the dosing drive is performed automatically. The required rinsing volumes for the tubing are calculated from the settings in the dosing unit configuration.

3 Methods

You can work through a simple method step-by-step, so as to familiarize yourself with the structure and capabilities of a method of a Sample Processor.

3.1 Processing methods

1 Loading methods

<USER METHOD> Press key **<USER METHOD>.**

```
methods
>recall method
```

Open the sub-menu with **<ENTER>**

<ENTER> The entry for the name of the saved methods is displayed. The colon indicates that you can make a selection here with the **<SELECT>** key.

```
>recall method
method:          ********
```

Select the method with **<SELECT>**

<SELECT>
<ENTER> Select method **Titrino** and press **<ENTER>** to load it. This is a simple standard method for series titrations which can be automated with any Metrohm Titrino and Sample Processor.

Method name

```
Titrino  counter    0/12
PUMP----STIR-----   ready
```

Basic status with loaded method

The method name ******** *stands for a blank method. If you ever wish to create a method right from the very start with standard default settings, you can press the* **<CLEAR>** *key and thus load a "blank" method.*

2 Editing/testing methods

All sequence commands and settings of a method are contained in the 'parameters' menu and can be edited there.

<PARAM> Press the **<PARAM>** key.

```
parameters
number of samples   rack
```

Scope of the series of samples (e.g., an entire rack)

This is where you can enter the number of samples to be processed. The default setting **rack** means that an entire sample rack is to be processed. Leave this entry as it is.

<↓> Press **<↓>**. This moves you to the so-called start sequence, a command string which is executed once at the start of a series of samples.

3 Start sequence

```
parameters
>start sequence
```

☜ Sub-menu of the start sequence

<ENTER> Open the start sequence with **<ENTER>**.

The individual commands of a sequence are now displayed.

```
>start sequence
1■CTL:Rm:          INIT
```

☜ Reset remote lines

The start sequence of this method contains one single command. This **CTL** command serves to deactivate (initialize) the remote lines of the Sample Processor at the start of a series of samples so that the connected Titrino is able to function correctly.

<↓> Advance with **<↓>** to the next command line.

```
>start sequence
2■NOP
```

☜ End of the sequence

NOP stands for No Operation and is a placeholder for the end of the sequence.

<QUIT> Press **<QUIT>**. This moves you back to the 'parameters' menu.

```
parameters
>start sequence
```

☜ Parameters menu

4 Sample sequence

<↓> Advance with **<↓>** to the next menu line.

```
parameters
>sample sequence
```

☜ Open the sample sequence

<ENTER> You can open the sample sequence with **<ENTER>**.

You will now see the commands of the sequence executed for each sample. Now execute the commands individually so as to familiarize with a standard sample sequence.

```
>sample sequence
 1■MOVE  1    :  sample
```

☜ Move the sample position to tower 1

This is the same **MOVE** command as you learnt for manual operation.

<START> Press the **<START>** key. The command is executed.

```
>sample sequence
 2■LIFT: 1  :    work mm
```

Move lift 1 to working height

<START>

You should also now be familiar with the **LIFT** command. Execute it. Press **<START>**.

```
>sample sequence
 3■STIR: T1    :    on s
```

Switch on the stirrer on tower 1

<➔>, <➔>

Change the stirrer command for the purposes of our exercise. The blinking cursor should be next to the line number 3. If you press the arrow key **<➔>**, the cursor will move one column to the right to the stirrer identification (**T1** is the stirrer on tower 1). Press **<➔>** again.

<5>

Enter a value of 5 seconds.

```
>sample sequence
 3 STIR: T1    : ■   5 s
```

Change the parameters

<ENTER>

The value is not accepted until you press **<ENTER>**. The next command line is displayed automatically.

<↑>
<START>

Use the arrow key **<↑>** to move back to command line 3 and you can then, in turn, execute it with the **<START>** key.

The stirrer is switched on for 5 seconds. The next command line is then displayed.

```
>sample sequence
 4 CTL:Rm: START device1
```

Set the remote lines

If you have connected a Metrohm Titrino to the Sample Processor via the remote connector, this Titrino will be started with the **CTL** command in command line 4.

The **CTL:Rm** command sets the control lines of the remote connector in accordance with predefined signal patters or freely definable bit patterns.

A Titrino is started by activating the **Input0 line** of its remote interface. This is precisely what is triggered with parameter **START device1** of the **CTL:Rm** command.

The CTL:Rm command offers certain predefined signal patterns for remote controlling Metrohm devices connected to the remote interface of the Sample Processor. The precondition for this is that you use the correct remote cable. Please refer to the Instructions for Use for the Sample Processor for further details.

If you execute this command line, the connected Titrino is started. However, you will be unable to stop it from the Sample Processor unless this is defined in the Manual Stop options (see Instructions for Use). If necessary, stop the Titrino with its keypad.

Press **<START>** on the Sample Processor. The Titrino starts.

<START>

```
>sample sequence
 5 SCN:Rm:     :    End1
```

Scanning the input lines

The **SCAN:Rm** command scans the remote input lines. The execution of the command sequence is stopped until precisely the signal pattern which was predefined is applied to the input lines 0 to 7. This may also be electrical pulses with a duration of at least 200 ms.

<START> Press **<START>**. The input lines are now monitored.

When a Titrino finishes its determination, the instrument sends an electrical pulse (**E**nd **O**f **D**etermination **EOD**) via the remote line 3. This is the signal pattern which the Sample Processor monitors.

<STOP> Stop the Titrino. The Sample Processor detects the **EOD** pulse of the Titrino and the **SCN:Rm** command is terminated. If this is not the case, press **<STOP>** on the Sample Processor.

```
>sample sequence
 6 STIR: T1    :   off s
```

Switch off the stirrer

The command in line 6 switches off the stirrer on tower 1.

<START> Press **<START>**.

```
>sample sequence
 7 LIFT: 1  :   rinse mm
```

Run the lift to rinsing position

Lift 1 is now run to the pre-defined rinsing position.

<START> Press **<START>**.

```
>sample sequence
 8 PUMP  1.1   :     5 s
```

Switch on the pump for 5 seconds

Pump 1 on tower 1 is switched on briefly to rinse the electrode and the buret tip.

<START> Press **<START>**.

```
>sample sequence
 9 WAIT:   pause     3 s
```

Delay execution

The WAIT command causes execution of the sequence to be stopped for 3 seconds so that the drips on the electrode can drain off.

<START> Press **<START>**. The next command line is displayed after 3 seconds.

```
>sample sequence
10 NOP
```

Placeholder command

<QUIT> The end of the sample sequence is reached. Pressing **<QUIT>** moves you one dialog level up to the 'parameters' menu.

5 Final sequence

```
parameters
>final sequence
```

Open the final sequence

<ENTER> Pressing **<ENTER>** opens the final sequence which is executed once at the end of a series of samples.

```
>final sequence
 1 MOVE  1     :  spec.1
```

Move to special beaker

At the end of a series of samples, the special beaker is moved as the conditioning vessel in front of tower 1. The special beaker should contain water.

<START> Press **<START>**.

```
>final sequence
 2 LIFT: 1  :    work mm
```

Move the lift to work position

The lift moves to the work position so that the electrode can immerse.

<START> Press **<START>**.

```
>final sequence
03 NOP
```

Placeholder command

The end of the final sequence is reached.

<QUIT>, <QUIT> Pressing **<QUIT>** twice moves you back to the main display.

```
Titrino  counter    0/12
PUMP----STIR-----   ready
```

Initial status with loaded method

3.2 Creating a new method

You can easily create a new method by loading a "blank" method, a template, as a method. This already contains the required (blank) sequences and all required basic settings.

For the purposes of our exercise, please create a simplified, short method for titrating samples necessitating addition of an auxiliary solution. The method does not contain a start sequence or a final sequence.

1 Loading a blank method

<USER METHOD> Press key **<USER METHOD>**.

```
methods
>recall method
```

Open the sub-menu with **<ENTER>**

<ENTER> The entry for the name of the saved methods is displayed.

```
>recall method
name:          ********
```

Choose a blank method with **<CLEAR>**

The name of the blank method is ************.

<CLEAR>
<ENTER>

If a different method name is displayed, you must delete this with the **<CLEAR>** key. If ************ is displayed, confirm with **<ENTER>**.

Method name

```
******** counter    0/12
PUMP----STIR-----   ready
```

Initial status with "blank" method

2 Creating a sample sequence

<PARAM> Press key **<PARAM>**.

```
parameters
number of samples:  rack
```

Continue with **<↓>**.

2x **<↓>** Advance to the sample sequence.

```
parameters
>sample sequence
```

Open the sample sequence with **<ENTER>**

<ENTER>

```
>sample sequence
 1 NOP
```

Blank command line

NOP (No Operation) displays a blank command line.

You should first approach the sample position. Enter a **MOVE** com-

<MOVE> mand. Press the **<MOVE>** key.

```
>sample sequence
 1■MOVE  1     :  sample
```

☜ **MOVE** command

You will see the **MOVE** command with the default parameters. These are the tower and the rack or robotic arm position to be approached. In this case, this would already be the current sample position.

<ENTER> The blinking cursor is positioned in front of the selected command. Confirm with **<ENTER>**.

```
>sample sequence
 1 MOVE ■1     :  sample
```

☜ Tower selection

<ENTER> The cursor is positioned in front of the tower selection. Accept selection Tower **1**. Press **<ENTER>** again.

```
>sample sequence
 1 MOVE  1    :■ sample
```

☜ Position selection

<ENTER> The cursor is positioned in front of the position selection. Confirm with **<ENTER>**.

This completes the command and the next, blank command line is displayed.

```
>sample sequence
 2■NOP
```

☜ Blank command line

Next, we shall lower the lift to work position.

<LIFT> Press **<LIFT>**.

```
>sample sequence
 2■LIFT: 1  :    rest mm
```

☜ **LIFT** command

You will see the **LIFT** command with the default parameters. These are the tower and the lift position to be approached.

2x <ENTER> The blinking cursor is positioned in front of the selected command. Press **<ENTER>** twice.

```
>sample sequence
 2 LIFT: 1  :■   work mm
```

☜ Position selection

The cursor is positioned in front of the position selection. Here, you can either enter an absolute lift position in mm (measured from the upper stop position of the lift) or choose from the pre-configured positions.

<SELECT> Press **<SELECT>** until you see **work** on the display. This is the working height which has been defined in the rack configuration. Confirm the selection with **<ENTER>**.

<ENTER>

This completes the command and the next, blank command line is displayed.

```
>sample sequence
 3■NOP
```

☜ Blank command line

You can now switch on the stirrer. It is assumed that the stirrer is a rod stirrer connected to the rear panel of tower 1.

<STIR> Press **<STIR>**.

```
>sample sequence
 3■STIR: T1    :      1 s
```

☜ **STIR** command

You will see the **STIR** command with the default parameters. These are the stirrer connection and the stirring time or stirrer status.

T1 stands for the stirrer connector on tower 1. If you have connected a magnetic stirrer to an MSB socket, press **<ENTER>** and choose the corresponding connection with the **<SELECT>** key. Otherwise, press **<ENTER>** twice.

2x <ENTER>

```
>sample sequence
 3 STIR: T1    : ■  on s
```

☜ Stirring time or status

<SELECT> Choose **on** with the **<SELECT>** key and confirm with **<ENTER>**.
<ENTER>

```
>sample sequence
 4■NOP
```

☜ Blank command line

Let us assume that you have to add an auxiliary solution with the aid of a Dosino or a Dosimat before the actual determination of a sample. You can use the **DOS** command for this.

<DOS> Press **<DOS>**.

```
>sample sequence
 4■DOS: 1.* :        1 mL
```

☜ **DOS** command

You will see the **DOS** command with the default parameters.

<ENTER> Press **<ENTER>**.

```
>sample sequence
 4 DOS:■1.* :        1 mL
```

☜ Select the dosing drive and port

The first parameter is a combined setting. If you are using a Dosino drive with dosing unit, you can also choose the outlet (1…4) of the dosing unit at which dosing is to be carried out, besides the dosing drive connection. ***** stands here for the standard dosing port.

<ENTER> Accept the default setting. Press **<ENTER>** again.

```
>sample sequence
 4 DOS: 1.* :■       5 mL
```

☜ Select the dosing volume or function

The second parameter is the selection of the function of the dosing drive. If you are using a Dosino drive with dosing unit, you can also select special functions with the **<SELECT>** key in addition to the dosing volume.

<5>
<ENTER>

Enter a volume (e.g. 5 ml) and confirm with **<ENTER>**.

```
 5 CTL:Rm: START device1
 6 SCN:Rm.  :  :  Ready1
 7 STIR: T1   :    off s
 8 LIFT: 1  :   rinse mm
 9 PUMP  1.1   :     3 s
10 WAIT:   pause     3 s
```

Enter further command lines with the adjacent parameters.

3 Saving the method

2x **<QUIT>**

Quit the sample sequence by pressing **<QUIT>** twice.

```
********  counter   0/11
PUMP----STIR--      ready
```

Initial status

<USER METHOD>

Press the **<USER METHOD>** key.

```
methods
>recall method
```

Method menu

<🡻>

Press the **<🡻>** key.

```
methods
>store method
```

Save the method

<ENTER>

Press **<ENTER>**.

```
>store method
name:          ■********
```

Enter the method name

The name of a method may contain 8 characters. These may be both letters and digits.

<1>
<ENTER>

In the simplest case, you may name the method with only one digit; for instance, enter **1** for this and press**<ENTER>**.

<PRINT>

If you wish to give the method an informative name, press **<PRINT>**.

```
>store method
name:          ■ABCDEFGH
```

Chose the characters

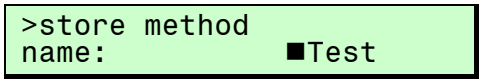
<PRINT>,<RACK>
<ENTER>

Using keys **<PRINT>** and **<RACK>** (or **<** and **>**), you can move the displayed character string to the left or right and choose the blinking character in each case with **<ENTER>**.

<QUIT>

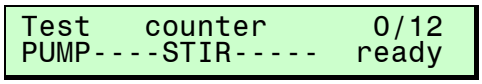
Enter **Test** as an example.

You can quit text entry with **<QUIT>**.



Quit text entry

<ENTER> Confirm the method name with **<ENTER>**.



Initial status

The method is now saved and active.

4 Executing a series of samples

4.1 Standard method "Titrino"

Familiarize yourself with the sequence of a series of samples by way of example of the "Titrino" method.

1 Loading the method

<USER METHOD> Press key **<USER METHOD>**.

```
methods
>recall method
```

Open the sub-menu with **<ENTER>**

<ENTER> You will see the entry for the name of the saved standard methods. The colon indicates that you can make a selection at this point with the **<SELECT>** key.

```
>recall method
name:              Test
```

Choose the method with **<SELECT>**

<SELECT>
<ENTER>

Choose method **Titrino** and press **<ENTER>** to load the method.

method name

```
Titrino  counter    0/11
PUMP----STIR-----  ready
```

Initial status with loaded method

2 Defining the number of samples

The number the samples of a series or the number of method runs is defined in the 'parameters' menu.

<PARAM> Press the **<PARAM>** key.

```
parameters
number of samples   rack
```

Scope of the series of samples

<3> This is where you can enter the number of samples to be processed. Enter **3** at this point.

<ENTER>
<QUIT>

Press **<ENTER>** to confirm your entry. Pressing **<QUIT>** moves you back to the main display.

3 Setting the position of the first sample

You can now also define at which rack position the series of samples is to start.

<SAMPLE> Press the **<SAMPLE>** key.

```
manual operation
SAMPLE:     =       ■  1
```

First sample position

<2>
<ENTER>

Enter **2** at this point for instance and press **<ENTER>**.

Now position one sample vessel at each of the rack positions 2, 3 and 4.

4 Starting the series of samples

<START> Now press **<START>**.

The Sample Processor is initialized first.

In order to do this, the lift is moved to home position and, if a Swing Head drive is mounted, the robotic arm is swivelled towards the centre of the rack and then fully to the outside for adjustment. The rack is then turned to the initial position, and the rack code is read. This ensures that the Sample Processor uses the rack positions belonging to the mounted rack.

```
Titrino   counter   0/3
START
```

Initialization

The start sequence is then executed. In the method selected, this consists only of initializing the remote lines.

The currently executed command lines are displayed briefly during execution of a sequence.

```
Titrino   counter   0/3
START   01 CTRL
```

Initialize the remote lines

sequence command

The active sequence and the current command are displayed during execution of a method.

The first run of the actual sample sequence follows directly after the start sequence. The actual sample sequence is then run three times.

```
Titrino   counter   1/3
SAMPLE  01 MOVE
```

Approach the sample

The procedure is initially as follows:

- Approach the first sample position
- Lower the lift on tower 1 to the work position
- Activate the stirrer on tower 1
- Start the connected Titrino via the remote lines
- Scan the remote lines

```
Titrino   counter   1/3
SAMPLE  05 SCAN
```

Scan the remote lines

When the Titrino completes a determination, it sends a so-called **EOD** signal (EOD=End of Determination).

You can either leave the titration to run to the end or you can abort it prematurely, see below.

5 Aborting the command

<QUIT>

If you do not wish for titration to be completed, stop the titration with the **<STOP>** key on the **Titrino** keypad. If no Titrino is connected, you can abort the current **SCAN** command with key **<QUIT>**.

*You can always abort an active command on the Sample Processor with the **<QUIT>** key. The command sequence is then continued.*

The sequence is continued by:

- Switching off the stirrer
- Moving the lift to the rinsing position
- Switching on the pumps for rinsing for 5 seconds and
- Allowing a 3 second pause for the drips on the electrode to drain

We have now reached the end of the sample sequence. The sample sequence is then, in turn, started again for processing the second sample.

```
Titrino   counter   2/3
SAMPLE  01 MOVE
```

Sample counter is incremented

All commands of the sample sequence are executed again and the sample sequence is then started a third time.

```
Titrino   counter   3/3
SAMPLE  01 MOVE
```

Sample counter is incremented

After the sample sequence has been run for the third time the final sequence is started.

```
Titrino   counter   3/3
FINAL   01 MOVE
```

Final sequence

The final sequence consists of:

- Approaching a rinsing beaker
- Moving the lift to the work position

In this case, electrode and buret tips are dipped into a rinsing beaker (best filled with rinsing fluid) as the last part of a series of samples. The Sample Processor is then once again in initial status.

```
Titrino   counter   3/3
PUMP----STIR--     ready
```

Initial status

5 Index