

# 884 Professional VA



Universal system solution for voltammetry and CVS

## 884 Professional VA and viva – flexible, convenient, and secure!

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The 884 Professional VA in combination with **viva** software is currently the most modern and most flexible analysis system for voltammetry and polarography.

### More flexibility

The 884 Professional VA is outstanding for its unique flexibility. Due to its modular design, the system can be expanded at any time with additional components such as dosing devices, pumps, and sample changers. This flexibility is supported by the **viva** PC software. **viva** gives users unlimited freedom to program their own application-oriented methods. Commonly used methods are already available as templates to facilitate familiarization with the system. Access to all method parameters is a matter of course.

### More convenience

Another key benefit of **viva** is the integrated database. In addition to automatic data acquisition and evaluation, **viva** also enables convenient management of the measuring results.

### More security

User administration with freely definable access rights as well as automatic backup functions ensure a high level of data security. Even better: to ensure that the solutions, and electrodes are checked at regular intervals, they can be monitored with the GLP (Good Laboratory Practice) functions.

### The most important applications

- Determination of transition metals using polarography or stripping voltammetry
- Speciation analysis
- Determination of organic additives (brighteners, levelers, suppressors) in electroplating baths using CVS





## The most important benefits at a glance

### 884 Professional VA

- Compact, space saving design
- Maximum flexibility due to easily exchangeable measuring head
- Trace analysis and CVS in one instrument
- Customized measuring system with versatile automation options
- Guaranteed accuracy and trueness due to the integrated calibrator

### viva

- Maximum flexibility due to individualized, task-focused method programming
- Intelligent user support based on logical decisions, e.g. proportional standard addition, measuring with or without preconcentration
- Reliable and reproducible calculations of the results
- Data security and traceability of the measurement results
- Database with numerous functions for convenient viewing and assessment of measurement results

# Application 1 – Trace analysis

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## Analysis of heavy metals using voltammetry

Voltammetry is outstanding for its combination of low detection limits and low sensitivity to interferences arising from high concentrations of dissolved solids. Moreover, it is a quite affordable technology and operating costs are low – especially in comparison with spectroscopic methods such ICP-MS.

### Total concentration and speciation

Spectroscopic methods can determine only the total metal concentration. In contrast, voltammetry can also be used to differentiate between different oxidation states of metal ions or between free and bound metal ions. This allows statements to be made on the biological availability and on the toxicity of heavy metals, e.g., in environmental research.

### High ion concentrations? Not a problem with VA!

Samples with high ion concentrations are not a problem for voltammetry. Hence, voltammetry is ideal for the analysis of:

### Typical limits of detection

Antimony	Sb <sup>III</sup> /Sb <sup>V</sup>	200 ppt
Arsenic	As <sup>III</sup> /As <sup>V</sup>	100 ppt
Bismuth	Bi	500 ppt
Lead	Pb	50 ppt
Cadmium	Cd	50 ppt
Chromium	Cr <sup>III</sup> /Cr <sup>VI</sup>	25 ppt
Cobalt	Co	50 ppt
Iron	Fe <sup>II</sup> /Fe <sup>III</sup>	50 ppt
Copper	Cu	50 ppt
Molybdenum	Mo	50 ppt
Nickel	Ni	50 ppt
Platinum	Pt	0.1 ppt
Rhodium	Rh	0.1 ppt
Mercury	Hg	100 ppt
Selenium	Se <sup>IV</sup> /Se <sup>VI</sup>	300 ppt
Thallium	Tl	50 ppt
Uranium	U	25 ppt
Tungsten	W	200 ppt
Zinc	Zn	50 ppt

- Seawater, salts, pure chemicals
- Electroplating baths



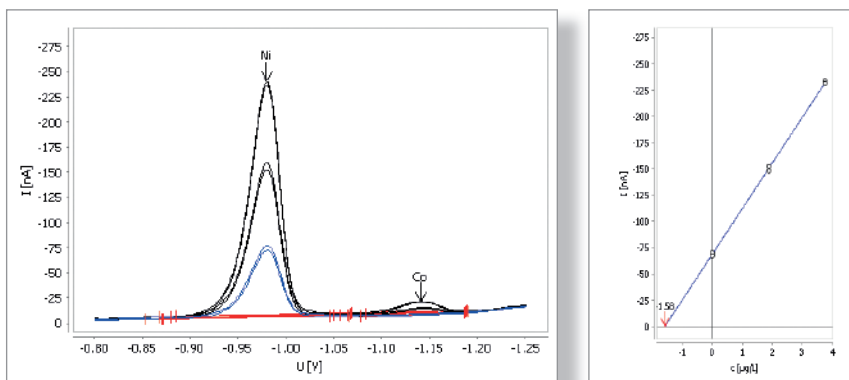
### Determination of organics, anions, and elements

Voltammetry is not just limited to metal determination. It may also be used to determine a wide variety of organic compounds by polarography. Voltammetry thus permits a simple determination of impurities in organic synthesis, e.g., 4-carboxybenzaldehyde in terephthalic acid or free styrene in polystyrene. Active pharmaceutical ingredients, e.g., thiomersal in storage solutions for contact lenses, can be quantified by polarography.

Certain special anions can also be determined by voltammetry. Of particular interest is the analysis of environmentally relevant species such as cyanide, sulfide, nitrite, and nitrate. The polarographic determination of elemental sulfur in gasoline is an application that is particularly used in vehicle construction and in petrochemistry.

## Typical applications

- Metal ions, e.g., Cd, Pb, Ni, Co, Fe, As in water samples
- Additives and impurities in electroplating baths and in electrolytic metal refining
- Corrosion indicators (Cu, Fe, etc.) in boiler feed water
- Ultratrace determination of metal species (Fe(II), Fe(III), Cr(III), Cr(VI), Cd, Pb, Co, etc.) in seawater
- Fe(II) in iron sucrose injection solutions
- Iodide and iodate in sodium chloride solutions and glacial acetic acid



Typical voltammogram nickel (1.7 µg/L) and cobalt (n/a) in seawater

## Application 2 – Determination of organic additives with CVS

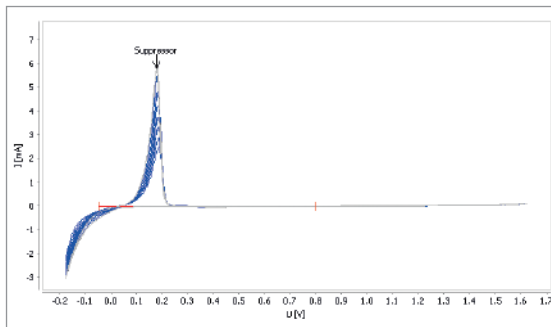
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«Cyclic Voltammetric Stripping» (CVS) and «Cyclic Pulse Voltammetric Stripping» (CPVS) are important methods used in the electroplating industry for the determination of organic additives in electroplating baths. This method plays a crucial role in production control for many types of technical coatings, particularly in the manufacturing of printed circuit boards and semiconductors. Quantitative determination of the additives takes place indirectly via their influence on the plating of the principal component of the electroplating bath. Since the measurement is based on an electrode reaction that corresponds to the production process, the activity of the additives and thus

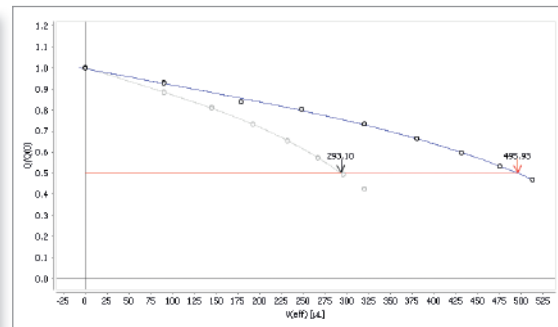
their efficiency in the electroplating process is measured. Due to the different effects of the additives in the electroplating process, different measuring and calibration techniques are available for the analysis.

### Dilution Titration (DT)

The well-established Dilution Titration (DT) technique can be used to determine the concentration of the suppressor component. Using the innovative smartDT, the execution of this determination is now even faster and more efficient than before.



Typical voltammogram



Calibration curve and determination with smartDT

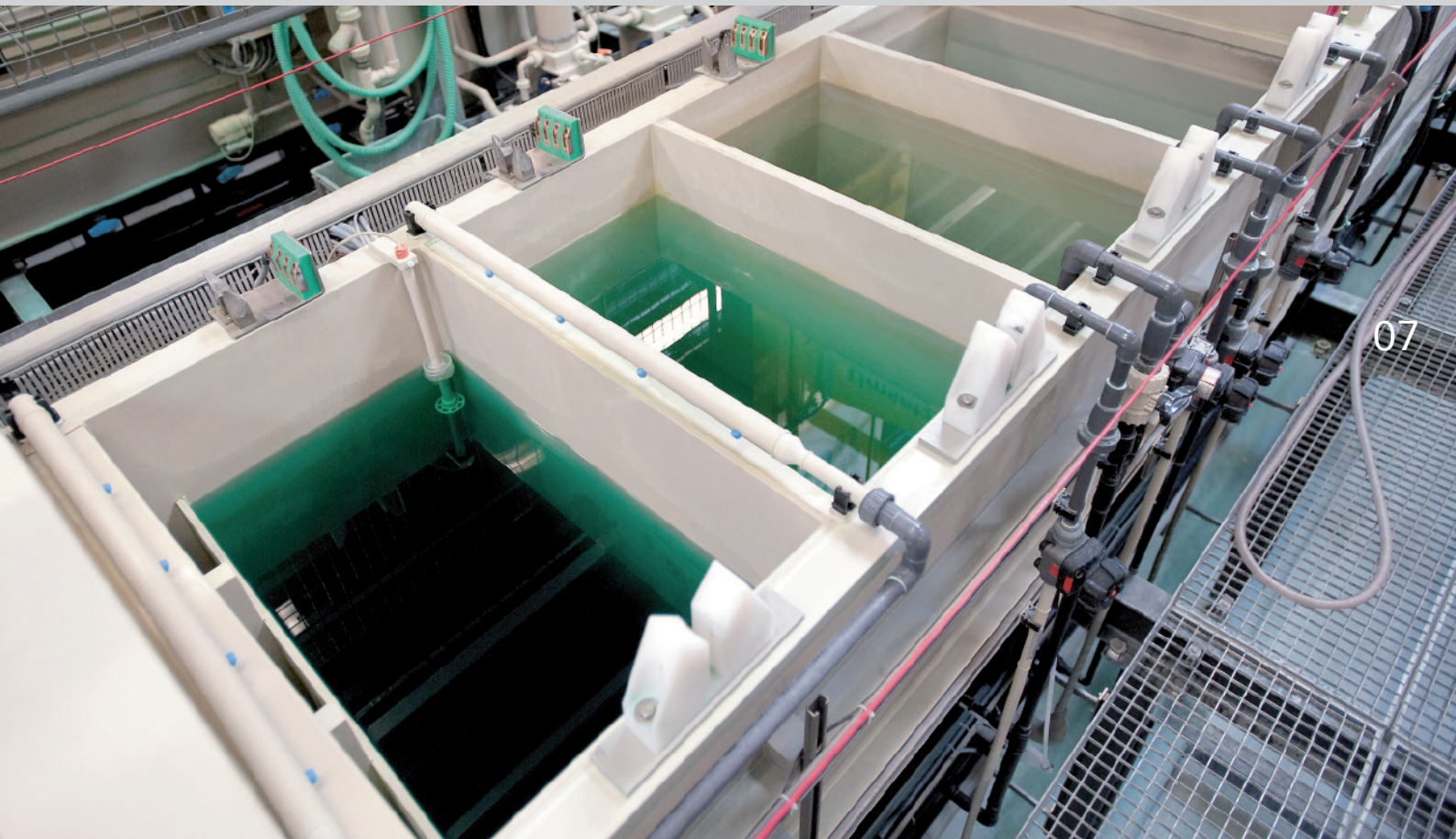


### (Modified) Linear Approximation Technique (M)LAT

MLAT or LAT is the calibration technique of choice when it comes to brightener determination. A wide array of electroplating baths can be analyzed by using either CVS or CPVS measurement techniques (for pulse-plating procedures or electrolytes containing iron).

### Response Curve (RC)

The Response Curve is used for the determination of levelers, which are increasingly popular as a third additive component in modern electroplating baths.



## Save time and money with the 884 Professional VA

In order to reduce cost of ownership per determination, it is possible with the 894 Professional VA to reduce the amount of reagents needed significantly\* in comparison

with other systems. Furthermore, the duration of the analysis can also be reduced. This increases sample throughput and helps keeping cost of ownership low.

## The most important applications

- Suppressor determination with DT (Dilution Titration)
- Brightener determination with MLAT (Modified Linear Approximation Technique)
- Brightener determination with LAT (Linear Approximation Technique)
- Leveler determination with RC (Response Curve)
- Chronopotentiometric measurement (CP)

\*Up to 70% of the quantity normally used

## The 884 Professional VA in detail

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The basic configuration of the 884 Professional VA consists of the instrument, the separately available electrode kit for the respective application, and the matching measuring head. This already makes a full-fledged analysis system. An integrated calibrator and the newly designed potentiostat that is extremely accurate in all measuring ranges provide for superior accuracy and sensitivity of measurements.







#### **Fast method change due to detachable measuring head**

The new detachable measuring head means that the measuring system can be refitted for a different application in a matter of seconds. All the electrodes and tubing connections can be replaced quickly and simply.



#### **Wide selection of sensors**

There is a versatile selection of suitable electrodes available for the different applications.



#### **Superior reliability of measurements due to integrated calibrator**

The 884 Professional VA has an integrated, certified calibrator. It is used to readjust the potentiostat before each measurement. Even in the case of fluctuating ambient conditions (temperature, humidity, etc.), this ensures that the measurement is always accurate and reliable.



#### **High performance on a small footprint**

With its footprint of only 18.8 cm × 45.2 cm, the 884 Professional VA takes up very little space on the laboratory bench. The modular design provides the highest convenience and maximum flexibility to suit your requirements.



#### **Powerful communication**

4 MSB connectors permit the operation of several 800 Dosino-type dosing devices. The 884 Professional VA is connected to the computer via USB. An integrated USB hub provides connections for additional PC peripheral devices, e.g., printers or barcode readers.

# Metrohm VA systems – flexible automation

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## Flexible and modular

Due to the modular concept, a manually operated 884 Professional VA can be easily upgraded to a fully automated analysis system. The 884 Professional VA grows with the requirements of your laboratory.

## 884 Professional VA manual

Even the manual version of the 884 Professional VA enables reliable analysis. The solutions necessary for the determination are added manually. Of course, all the available calibration and current measuring techniques are supported without limitation.

## 884 Professional VA semiautomated

Routine analysis is much more user-friendly when the solutions are added automatically. The 884 Professional VA semiautomated is recommended for routine determination of trace metals or organic additives in individual samples. Determinations can be carried out easily with minimum intervention by laboratory personnel. All auxiliary solutions and, if necessary, the sample are added automatically with an 800 Dosino.

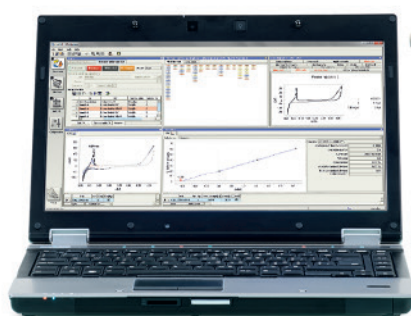
The basic version includes two 800 Dosinos for two auxiliary solutions. An optional accessory kit allows simple expansion to four or more dosing devices. The optional 843 Pump Station can be used to rinse the measuring vessel automatically after each determination. This enhances both user convenience and measuring accuracy because the need for user intervention is reduced to a minimum.

## MVA-22 884 Professional VA automated for VA

The MVA-22 884 Professional VA automated is a fully automated system with a sample changer for the voltammetric determination of heavy metals in routine laboratory work. If an MVA-22 is used, the samples are automatically transferred by a 919 IC Autosampler plus for VA using the integrated peristaltic pump. Up to 28 samples can be determined in a series.

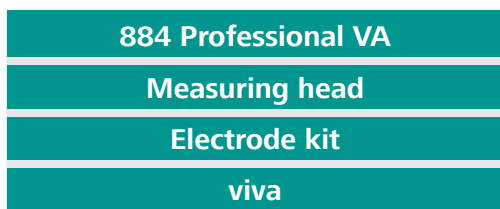
## MVA-23 884 Professional VA automated for CVS

The MVA-23 884 Professional VA automated for CVS is the fully automated solution for CVS determinations. Using an 858 Professional CVS Sample Processor, up to 56 samples for a suppressor determination or up to 28 samples for a brightener determination can be analyzed for their additive content. An unlimited combination of different calibration techniques is also possible. Depending on the chosen method, the sample is transferred with an 800 Dosino or a peristaltic pump that is integrated in the sample changer. The possibility of recalibrating methods during a sample series guarantees the highest accuracy.



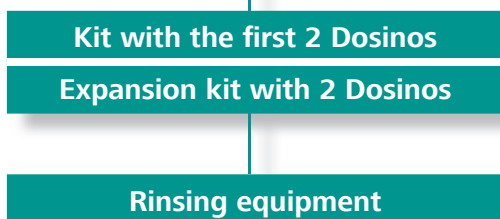
# System modules

## Manual



The 884 Professional VA is the core component of the voltammetry system. When combined with the appropriate measuring head for rotating disk electrodes or for the Multi-Mode Electrode pro, the corresponding electrode kit and the **viva** software, it is a fully functioning manual measurement system.

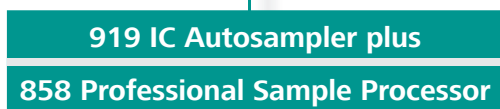
## Semiautomated



Dosinos are used for the convenient, automated addition of solutions. Corresponding kits containing the necessary accessories make it easy to set up the connections.

The rinsing equipment is used to empty and rinse the measuring vessel automatically after each measurement.

## Automated



Sample changers enable automatic processing of sample series. The 919 IC Autosampler plus is suitable for small sample series, whereas the 858 Professional Sample Processor with its robotic arm is used for larger-sized series.



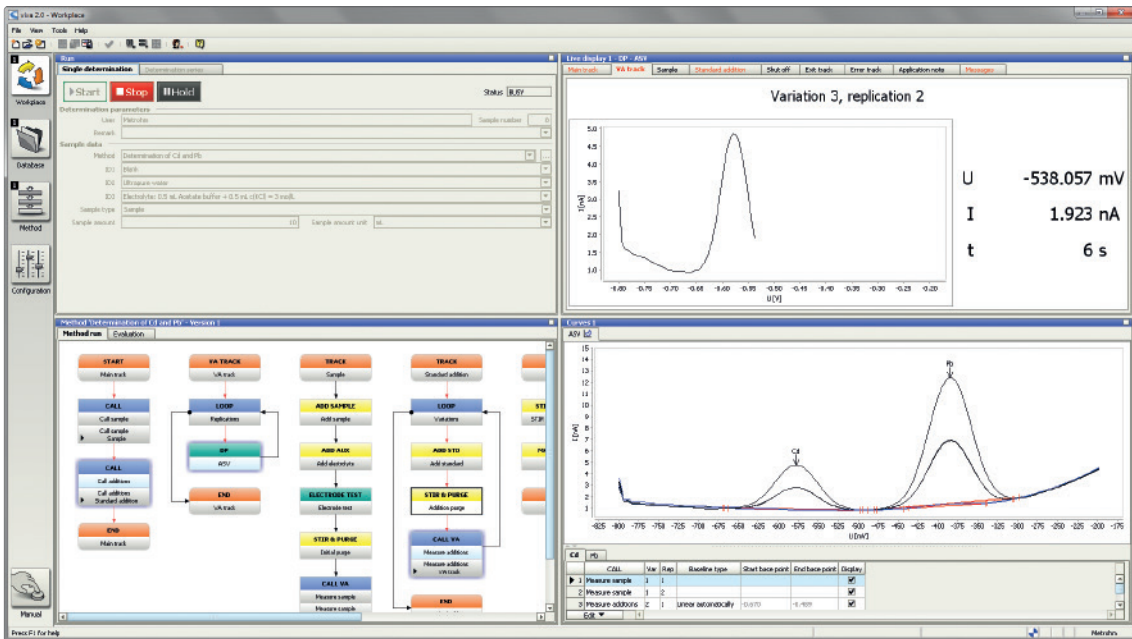
# viva – the new Metrohm software for voltammetry

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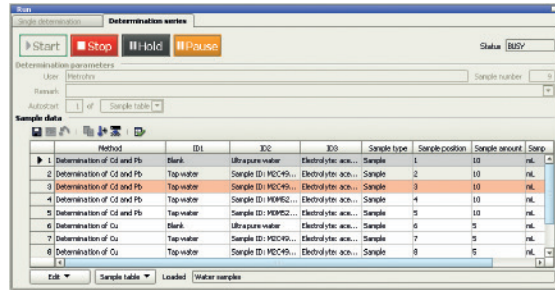
**viva** is the most powerful software for VA and CVS determinations. Easy to use and highly flexible, **viva** enables individual and task-focused method programming for voltammetry and CVS.



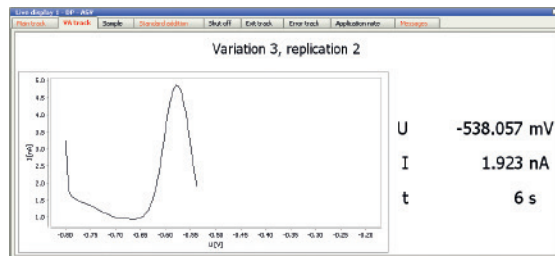
The userfriendliness of the software is evident in the «Workplace» of the user interface. All of the information required for the determination is presented here. It goes without saying that the «Workplace» can be individually configured so that only the data relevant to the user is displayed.



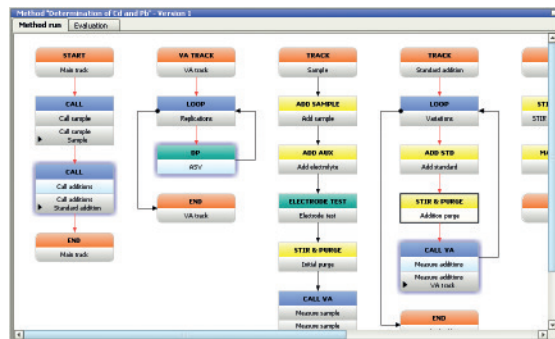
The «Run» window is the «cockpit» of **viva** software, from here to the user controls all measurements. The appropriate method, any sample identification data, and the sample quantities, among other things, are defined here. With just a few mouse clicks, a sample table for executing a determination series can be compiled and then saved to any available storage medium for later use.



Animated graphics and text information in the «Live display» window provide the user with an overview of the progress of the current measurement. The voltammogram in progress, the remaining measuring time, and the status of any pumps or Dosinos are additional real-time information available to the user there.



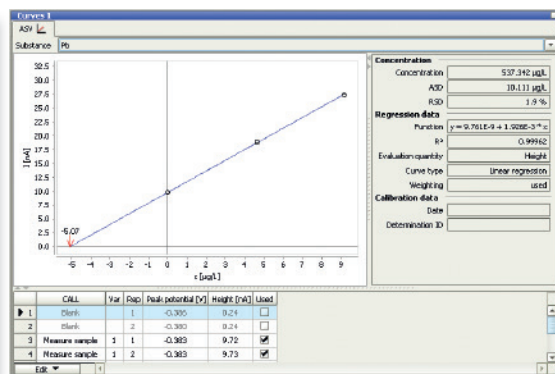
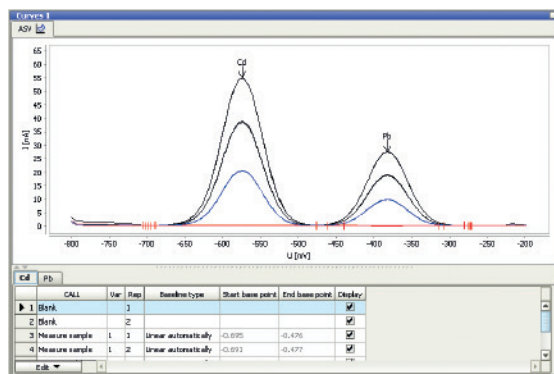
The method used and the associated evaluation parameters are logically structured and clearly displayed in the «Method» window. The current command is highlighted in color during a measurement.



### Curves

The measured voltammograms are superimposed on each other in the curve window. The associated calibration

curve and the measurement results can be displayed by simply switching between the two.



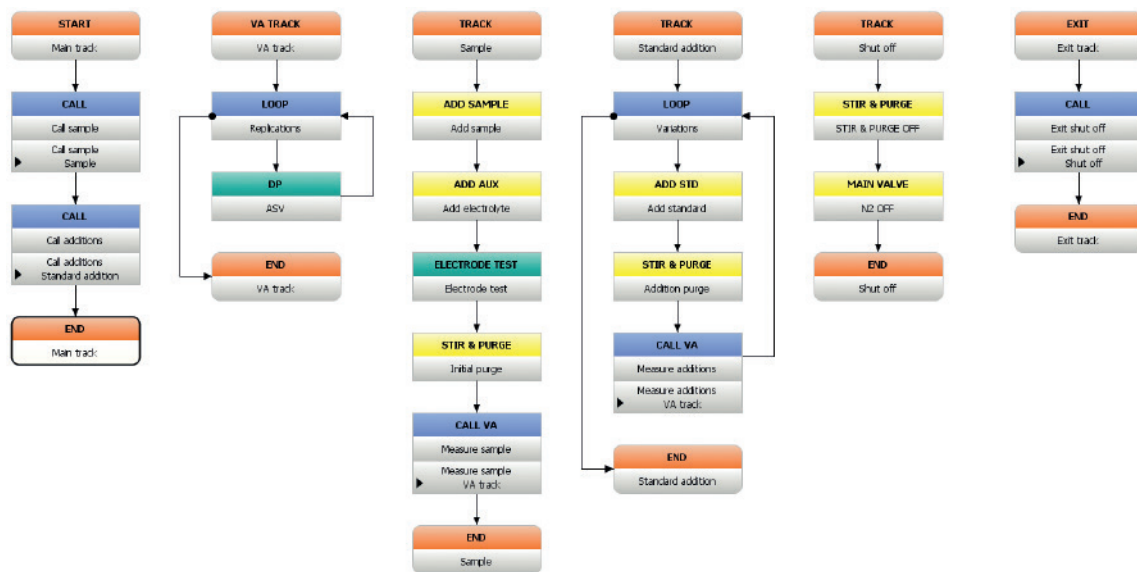
# viva – smart features for superior usability

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**viva** is the first and only voltammetry software that enables individual, task-focused method programming.



**viva** does not force the user to follow rigid, predefined measuring sequences. Instead, methods can be programmed step by step adding command by command and following the logic of the application at hand – it is that simple! It is even possible to have commands executed simultaneously!

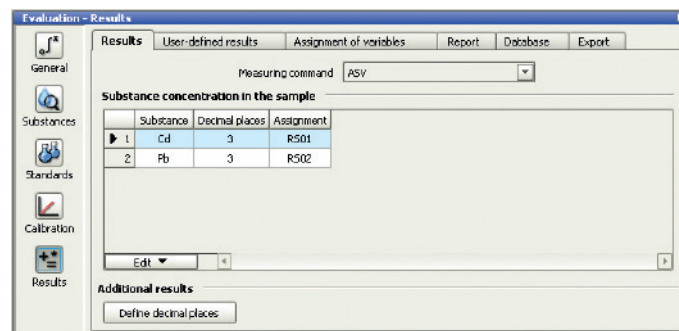


Commonly used method runs are already available as templates to facilitate familiarization with the system. These can be adapted and expanded as required.

**viva** supports the user with numerous smart assist functions. The optimum standard addition volumes, for example, can be calculated automatically by **viva** for each determination.

With **viva**, users no longer have to think about calculating results – that is all done automatically. Volumes, too are automatically calculated according to the settings of

the method. and even the appropriate prefix for the units of the result ( $\mu\text{g/L}$ ,  $\text{mg/L}$ , etc.) are determined automatically by **viva**.



# viva – user-friendly data management and maximum security

All determinations are stored in the **viva** database.

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The determinations can be viewed in the «Database» program part, along with all of the parameters for the determination, the method, and the instrument.

The screenshot displays the viva software interface. The top window, titled «Database», shows a table of determinations with columns for Determination start, Method name, Sample type, ID1 Value, ID2 Value, ID3 Value, ID301 Name, ID302 Value, ID303 Line, ID302 Name, ID302 Value, and ID3. Below the table, there are sub-windows for «Curve 1» showing a chromatogram with peaks labeled 'Cd' and 'Pb', and «Results» providing a detailed overview of a specific determination, including identification, recording, and status information.

The determination overview can be configured according to preference. This means that it is easy to keep track of all measurement results. In the «Curve» and «Information» subwindows, the respective measurement curve, calibration curve, and other information on the pa-

rameters for the determination, the method, and the instrument can be displayed for the selected determination. Easy-to-operate sort, search, and filter functions simplify data retrieval.

### Central data management

There is no difference between the **viva** client-server version and local installations in terms of operation and range of functions. However, in the client-server-version, all of the methods and determinations are saved centrally on the **viva** server. The benefit of this is that the data can

be viewed and edited further from any PC that has a **viva** client installed on it, whether in the laboratory or in the office. All measured data is thus available throughout the company.

### Reprocessing a determination



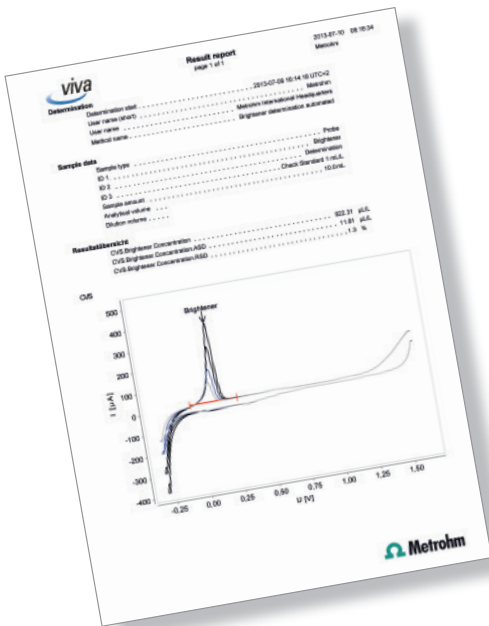
Does the voltammogram show unknown peaks? Has the concentration of the standard solutions being used changed? No problem with **viva**, as determinations

already carried out can be recalculated at any time. Retroactive recalibration with a newly measured standard solution is also possible. Of course, the original data is not lost and all versions of the determination can be archived.

### Report generation

The report generator offers a full range of options for designing the analysis report, whether it be an individual report with all relevant sample and method information or a tabular overview report containing all of the results of a

measurement sequence. **viva** offers a range of different report templates that can easily be adapted to meet the respective requirements. This means a customized report can be created very fast.



The figure shows a 'Result overview with details' report. It contains a table with columns for 'Sample', 'Determination', and 'Result'. The table lists multiple determinations with their respective IDs, sample IDs, sample types, amounts, and dilutions. The results column shows the measured concentration and the associated RSD values.

The figure shows a 'Results overview' report. It is a detailed table with columns for 'Determination start', 'Sample ID', 'Sample name', 'Sample type', 'RSD1', 'RSD2', 'RSD3', 'RSD4', 'RSD5', 'Determination duration [min]', and 'User'. The table lists numerous individual measurements with their specific parameters and results.

Individual report containing all the relevant specifications for the determination

Tabulated report (with or without curve) in portrait or landscape format provides a better overview for large measurement series



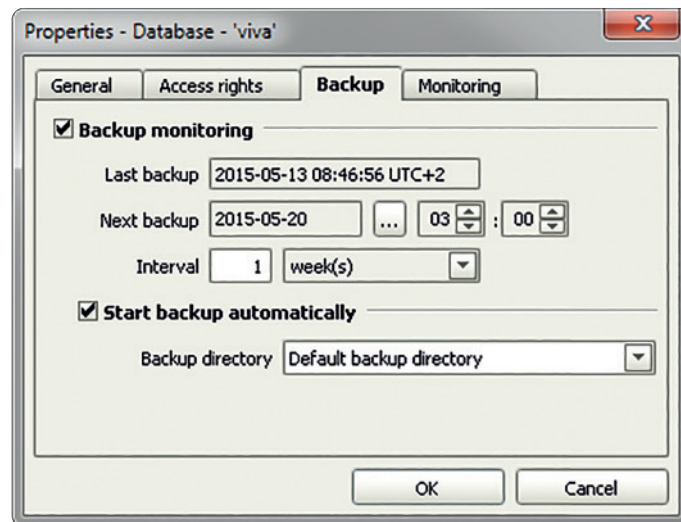
### Simple user administration

Data security and traceability of the results are becoming ever more important. Access permissions for each user can be defined in **viva** in accordance with in-house security guidelines. Unauthorized access to program parts

and data is prevented by password protection. Unnecessary program parts can thus be hidden, making operation even easier.

### Data security

**viva** also performs data backups. The entire database and all methods are backed up at freely defined intervals. Lost data can thus be quickly restored.



## GLP – Good Laboratory Practice

With **viva**, the regular maintenance intervals of the complete analysis system, can be monitored automatically and in compliance with GLP. If the defined working life is exceeded, this automatically triggers the appropriate

measures (e.g., automatically generated e-mail, stopping the determination). Thanks to this «integrated quality assurance», expired solutions, unchecked electrodes, or un-serviced dosing units are a thing of the past.



# Technical specifications

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884 Professional VA	
Voltammetric measuring station with integrated potentiostats and galvanostats	
<b>Dimensions</b>	with measuring head and drip pan Width 188 mm Height 322 mm Depth 452 mm
<b>Weight without accessories</b>	7.4 kg
<b>Potentiostat</b>	Sweep potential range $\pm 5$ V Current range $\pm 224$ mA Current measuring ranges 200 pA...224 mA
<b>Galvanostat</b>	Potential measuring ranges 5 mV...5 V
<b>Resolution</b>	Applied potential 15 $\mu$ V Measured potential 150 $\mu$ V Applied current 0.0031% of current measuring range Measured current 0.0031% of current measuring range Current measured in the smallest current measuring range (200 pA) 6 fA
<b>Accuracy</b>	Applied current $\pm (0.2\% \text{ of current} + 0.2\% \text{ of current measuring range})$ Measured current $\pm (0.2\% \text{ of current} + 0.2\% \text{ of current measuring range})$ Applied potential $\pm (0.2\% \text{ of potential} \pm 1 \text{ mV})$ Measured potential $\pm (0.2\% \text{ of potential} \pm 1 \text{ mV})$
<b>Temperature measurement</b>	Measuring range (Pt1000) 0...+100 °C Accuracy (Pt1000) $\pm 0.5$ °C
<b>Power connection</b>	Voltage 100...240 V Frequency 50...60 Hz Power consumption 45 W
<b>Minimum requirements for the PC</b>	Processor Pentium 4; clock rate 1 GHz RAM 4 GB Hard disk space 1 GB for program Free memory for data 64 GB Operating system Windows Vista Business / Enterprise / Ultimate (32-Bit) Windows 7 Professional / Ultimate / Enterprise (32-Bit / 64-Bit) Windows 8 Professional / Enterprise (32-Bit / 64-Bit) Windows 8.1 Professional / Enterprise (32-Bit / 64-Bit) Windows Server 2003 (32-Bit) Windows Server 2008 (32-Bit) Windows Server 2008 R2 (32-Bit / 64-Bit) Windows Server 2012 (64-Bit) Windows Server 2012 R2 (64-Bit) Graphics card / monitor Min. resolution 1024 $\times$ 768 pixels or higher Connections Min. 1 USB interface (Version 1.1 or higher) for each connected instrument
<b>Client/Server operation</b>	Network Min. 10 Mbit/s, stable and permanent communication via TCP/IP

# Ordering Information

## Manual

- 2.884.0010 884 Professional VA, instrument without measuring head
- 2.884.0110 884 Professional VA manual for MME
- 2.884.0210 884 Professional VA manual for RDE/CVS

## Semiautomatic

- 2.884.1110 884 Professional VA semiautomated for MME
- 2.884.1210 884 Professional VA semiautomated for RDE/CVS

## MVA-22: Fully automated VA system for trace analysis

- 2.884.1110 884 Professional VA semiautomated for MME
- 2.919.0130 919 IC Autosampler plus for VA
- 2.843.0240 843 Membrane Pump Station for Professional CVS systems
- 6.2441.300 Remote cable
- 6.1456.210 Measuring vessel for use with sample changer operation

## MVA-23: Fully automated CVS system for organic additives

- 2.884.1120 884 Professional VA semiautomated for RDE/CVS
- 2.858.0110 858 Professional Sample Processor for VA/CVS
- 2.843.0240 843 Membrane Pump Station for Professional CVS systems
- 6.2441.300 Remote cable
- 2.800.0020 800 Dosino (2 x)
- 6.5339.500 Equipment with 2 dosing units

## Measuring heads

- 6.1256.010 Measuring head for RDE
- 6.1256.020 Measuring head for MME

## Electrode kits

- 6.5339.000 CVS electrode kit with 1 mm platinum electrode for Professional VA/CVS
- 6.5339.010 CVS electrode kit with 2 mm platinum electrode for Professional VA/CVS
- 6.5339.020 CVS electrode kit with 3 mm platinum electrode for Professional VA/CVS
- 6.5339.030 VA electrode kit with Multi-Mode Electrode pro for Professional VA
- 6.5339.040 VA electrode kit with glassy carbon RDE for Professional VA
- 6.5339.050 VA electrode kit with scTRACE Gold for Professional VA

## viva

- 6.6065.202 **viva** 2.0 Full CD: 1 License
- 6.6065.203 **viva** 2.0 Multi CD: 3 Licenses



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