magnettech
by Freiberg Instruments

Catalogue 2018

EPR/ESR Spectrometer

Catalogue for EPR-Spectrometer, Accessories & Glassware

Content

Bench top EPR/ESR Spectrometer (MS 5000)

Module **# E1000**

compact size

the ideal 'everywhere' spectrometer

45 kg, 397 x 262 x 192 mm

sensitivity & stability

outstanding sensitivity and magnetic field stability, extended data detection schemes

detection limit of 10 nM in PBS

versatile options

automated goniometer for measurement of angular dependencies, low temperature measurements, big collection of specialized sample holders and glassware, comfortable software for data handling and evaluation

autosampling for liquids, powder and solid samples

Facts

- compact, bench top spectrometer at highest sensitivity
- g-factor representation of EPR spectra
- kinetic measurements, time resolution down to 1 ms
- excellent field stability
- extremely stable AFC (automatic frequency control), ns response time
- frequency counter and g-factor evaluation"

Magnet system

- automatic field readjustment according to microwave frequency
- extreme stability of all measurement parameters allowing for long range accumulation up to weeks

RF system and signal channel

measurement frequency stability better ± 3 Hz @ 10 GHz

Technical Specifications

Microwave	MS 5000	MS 5000X
Operating frequency	X-band	X-band
Sensitivity	5 x 10^{10} spins/mT (5 x 10^{9} spins/G)	3 x 10^{10} spins/mT (3 x 10^{9} spins/G)
Signal to noise ratio	(600:1)	(1000:1)
Microwave power	1 µW – 100 mW	1 µW – 100 mW
Concentration sensitivity	50 pM	10 pM
Field sweep range	0 to 625 mT (0 to 6250 G)	0 to 625 mT (0 to 6250 G)
Field homogeneity	± 5 µT (50 mG) within sample region	± 5 µT (50 mG) within sample region
Field stability	1.0 µT/h (10 mG/h)	1.0 µT/h (10 mG/h)
Sweep resolution (field and time)	≥ 125,000 points	≥ 250,000 points
Reference standard	optional: Integrated and motorized	optional: Integrated and motorized
Magnetic field range	0 to 650 mT (0 to 6500 G)	-10 to 650 mT (-100 to 6500 G, wider ranges on request)
Modulation frequency	10 kHz and 100 kHz	10 kHz and 100 kHz

Wide field of applications

Life sciences
nitric oxide measurement, reactive oxygen species, oxidative stress, radical generating systems, photo dynamic therapy

Food Chemistry and Pharmacy
antioxidative features of foodstuff, radicals in foodstuff, radiation-induced radicals

Petrochemistry
living polymers, nitroxide quantification, radicals in varnish, UV stability of scratch resistant varnish

Environmental Toxicology
generation of radicals by particles

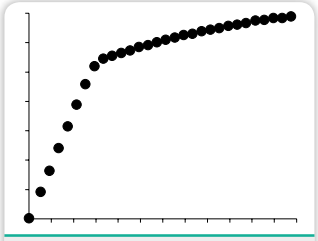
Alanine Dosimetry
Alanine dosimetry (tablets, thin films)

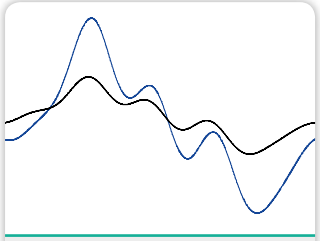
Separation of Radicals
EPR/HPLC coupling

Biophysical Features
oxymetry, membrane fluidity, pH in microenvironment, viscosity, phase partition

Bioinorganic Chemistry
bioinorganic transition metal compounds, fenton chemistry, effect of heavy metal ions on living tissue

Cosmetic
radical protection factor, protection features of UV-filters in creme, shampoo, etc.


Kinetic of ROS generation by xanthine / xanthine oxidase


Basal (black) and stimulated (blue) NO generation by rat aorta


TEMPO in a two phase system oil/water


Spectrum of an Alanine pellet irradated with 5 Gy

I. Included articles

Glassware starter kit
Module #**E4904**

Consisting of:

- E4200, E4202, E4203 & E4204
- Standrad sample holders PH-3; 4; 5 & 6 mm for sample tubes
- E4304, E4305, E4306 & E4307
- Sample tubes P 135/3; 4; 5 & 6 mm

Capillary measurement kit
Module #**E4905**

Consisting of:

- E4005 Guidance tube F-120/1.5
- E4009 Disposable capillaries 50 µL, 250 pieces
- E4010 Capillary sealing kit
- E4201 PH-3.6 for guidance tubes

II. Temperature controllers

Bio Temperature Controller
Module #**E1102**

for temperature stabilization of biological systems like tissue samples.
Temperature range:
293 K – 350 K.
Requires E2103
Small Rack.

Fully Integrated Bio Temperature Controller
Module #**E1108**

for temperature stabilization of biological systems to measure in situ. Temperature range: 293 K – 350 K

Vessel for flushing resonator
Module #**E1103**

liquid nitrogen evaporates, flushing resonator and preventing the condensation of humidity, optional accessory in connection with fixed temperature dewar.

Temperature Controller (TC HO4) Complete Package
Module #**E1104**

temperature range: 93 – 473 K
PC controlled (control/registration software included)
Optional: Software for automatic data acquisition for temperature measurements.

III. Liquid Helium Flow Cryostat

Liquid Helium Flow Cryostat
Module #**E1109**

the Liquid Helium Flow Cryostat is specifically designed for X-band EPR, and ESR measurements. The sample is cooled by a jet of liquid helium inside a quartz cuvette.

IV. Autosampler

Autosampler for powder and solid samples

Module **#E1201**

automated handling of up to 23 samples in quarz tubes 3–6 mm diameter, precise height positioning within resonator for highest reproducibility.

Autosampler for liquids

Module **#E1205**

suitable for,

- liquids up to 43 ml
- liquids down to 1 ml
- beer and beverage quality control and shelf-time analysis

Optional add-on for autosampler

Two pump system, Reaction Chamber

Module **#E1206**

Autosampler Rack

Module **#E1207**

for continuous flow systems

Peristaltic Pump

Module **#E1208**

very uniform pump behaviour, suitable for kinetics measurements.

Thermostat Block

Module **#E1209**

max. temperature 130° C

- adapted sample tubes for optimum heat transition
- interchangeable metal block for different sample vessels

V. Continuous Flowsystem

Continuous Flow System

Module **#E1218**

- single channel flow system
- peristaltic pump (#E1208) offers constant flow or pulsed injection
- stable rack (#E2105) of massive steel incl. 4 glass beaker
- flat cell cuvette (#E4503) included as well as SH-P holder (#E4500) and holder for flat cells (#E4501)
- tube connector for flat cell cuvette and 15 m flexible precision tube (#E1219)
- external irradiation unit (optional)

Flexible precision tube

Module **#E1219**

- Length: 15 m

Tube adapter

Module **#E1220**

- connecting tube and flat cell

Hard-wearing precision tube

Module **#E1221**

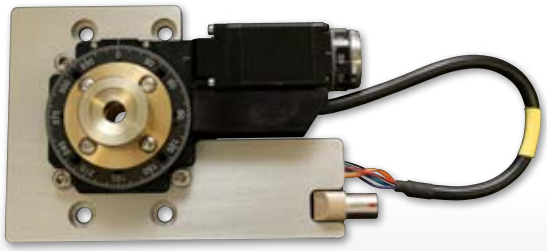
- Length: 5 m
- durable and opaque

VI. Goniometer

Automated Goniometer

Module **#E1301**

- fully automated angular rotation of sample
- step size 0.1 to 180°
- each measurement of a new spectrum starts with an automated readjustment of the spectrometer for best measurement performance
- special adaption for Autosampler (available on request)



VII. X-ray irradiator

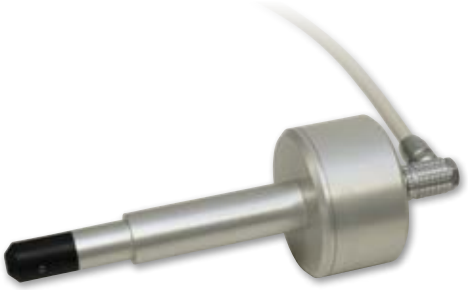
Xray Dose Module **#E1403**

- benchtop X-ray irradiator
- tungsten X-ray tube, 50 kV, 1 mA
- compatible with ESR quartz tubes (Ø = 3–6 mm, 135 mm long)
- exchangeable hardening filter: 20 µm Al (default)

VIII. Optical Stimulation Unit

Integrated Light Source Module **#E1501**

single wavelength light source for sample treatment or for triggerring kinetic experiments. Available wavelengths (select one): 365 nm (default), 462 nm, 523 nm, 590 nm, 625 nm, 850 nm.



Mercury-xenon Lamp (Hamamatsu)

External Irradiation Unit Module **#E1502**

wavelength range: 240–400 nm

External Irradiation Unit Module **#E1503**

wavelength range: 400–700 nm

IX. Trigger Box

Trigger Box Module **#E4909**

- switch to trigger external unit (X-Ray, light irradiation, etc.)
- automated recording of treatment data in measurement file

X. Clime Reader

Fully automated weather station Module **#E4910**

- 2 external sensors for monitoring temperatures
- integrated humidity monitoring
- automated recording together with ESR measurement data

XI. Special rack for horizontal orientation

Special rack

Module **# E2104**

Place the spectrometer upended
to keep viscous media in the tissue cell

XII. Optional packages for Special Applications

Alanine pellet package

Module **# E1604**

Consisting of:

- E2203 alanine pellets
- E4000 pellet holder for precise sample positioning
- E4001 alanine sample tube
- E4209 special holder for alanine sample tube

Alanine blister package

Module **# E1605**

Consisting of:

- E2207 alanine blister
- E4140 barcode reader
- E4600 blister holder type A

Alanine-reference-dosimeter

Module **# E2208**

The reference dosimeter set contains 5 dosimeter, each consisting of 4 Alanine pellets. One order of magnitude in dose range (e.g. from 100 Gy to 1 kGy) is covered.

Several reference dosimeter sets can be combined to cover a wider dose range. Calibration occurs after ISO/ASTM 51261:2013 "Practice for calibration of routine dosimetry systems for radiation processing".

Software for Alanine dosimetry (select one):

- Option 1: E1805 Calibration curves
- Option 2: E1807 Certified Alanine Dosimetry Software

see also XIV. Optional Software Extensions

NO-Fe(II)DETC (Fixed temperature dewar for N2 liquid)

Module **# E1602**

Consisting of:

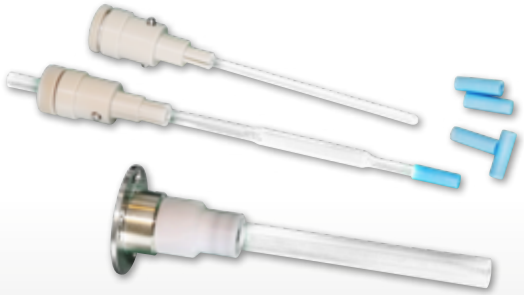
- E4130 fixed temperature dewar for spectrometer of the line MiniScope
- E4100 holder fit to the device with adjustable altitude for fixed temperature

Reactive Oxygen Species (ROS)

Module **# E1603**

Consisting of:

- flat cell cuvette FZK 160-7x0.3
- special holder SH-P for flat cell cuvettes, guidance tubes, tissue cells and special cuvettes
- fixed holder with fitting for flat cell cuvettes FZK 160-7x0.3
- fixed holder with fitting for guidance tube F 120/1.5
- optional: Software for automatic data acquisition and evaluation of kinetic measurements using disposable glass capillaries.



XIII. Standards

Holder and positioning system for Standard Samples in 3 mm Sample Tubes

Module **#E1701**

allows simultaneous measurement of analytic sample and standard sample

Secondary standard Chromium Cr^{3+} in MgO

Module **#E1703**

with protocol on g-factor

note: Module #E1701 is required.

Secondary standard Manganese Mn^{2+} in ZnS

Module **#E1704**

with protocol on g-factor and peak distances

note: Module #E1701 is required.

Spin quantified standard Chromium Cr3+ in MgO

Module **#E1707**

- with protocol on g-factor
- standard certified for spin density measurement of inorganic materials

XIV. Optional Software extensions

Sequence Editort

Module **#E1803**

Sequence editor for free programming of automation functionality

Calibration curves

Module **#E1805**

Software capability for storage of calibration curve as requirement for quantitative concentration measurements and dosimetry.
-> Basic software for dosimetry applications.

DC rapid passage measurement

Module **#E1806**

Measurement requirement for investigation of ultra rapid kinetics with a limit of 10 µs

Certified Alanine Dosimetry Software

Module **#E1807**

Certified dosimetry software „Aer'EDE" (Validated and Compliant FDA 21 CFR Part 11, ISO 11137-3, EN552, …), provided by Aérial CRT
-> advanced software especially designed for alanine dosimetry (optional)

XV. PC with monitor

Description

- front: 2 USB ports
- back: 3 USB ports, 1 Ehternet, 1 VGA-port
- CPU: 3M Cache, 3.4 GHz
- RAM: 4 GB DDR4
- 500 GB HDD
- Intel HD Graphics 630
- Gigabit Ethernet
- 2x USB-Ethernet adapter
- USB-keyboard
- LCD-Monitor (23.6")
- Windows 10 Pro (software includes TeamViewer for remote services)

for MS 5000 and MS 400 ESR spectrometers

How to choose the appropriate sample vessel for your sample?

For measurement of samples in the EPR spectrometer you have the choice between the following sample vessels:

- capillary
- sample tube
- flat cell
- tissue cell
- special cuvette
- fixed temperature dewar

Some general remarks

The active volume in the vertical direction of the MiniScope rectangular resonator is 23 mm. Over this 23 mm you have a Gauss distribution of the intensity. This means in the centre you measure 100 % intensity. 1.65 mm top and bottom of the centre the intensity is 95 %. 2.5 mm top and bottom of the centre the intensity is 90 %. This means you have two possibilities to get reproducible and comparable measurements:

[1] You fill the sample vessel over the whole active volume of the resonator.

[2] You fill 5 mm of your sample vessel. In this case you have to make sure that the sample is positioned absolutely in the centre of the resonator. A further requirement is that in the case you are using different sample vessels of the same kind, that they are selected for the same intensity or that you have compared them using a standard solution introducing correction factors.

In the case you are using sample vessels with a flat section you can orientate the flat section parallel or perpendicular to the front panel of your spectrometer. Please try, which orientation gives the higher intensity.

Capillaries are standardized calibrated sample vessels. They are cheap one way items and allow an easy sample exchange. Usually capillaries are used together with a matching guidance tube. For aqueous solutions the maximum volume of capillaries is 50 µl.

In the case you use organic solvents with a lower dielectric constant; you can use capillaries with a higher volume or sample tubes.

Sample tubes are used for liquid and solid samples. We offer sample tubes of different diameters and length. The dielectric constant of the solvent of your liquid sample lays down the diameter of the sample tube. For example radicals in hydrocarbons can be measures using a 4 mm or 5 mm sample tube. Concerning the solid samples the humidity of the sample restricts the diameter of the sample tube. The length 135 mm is used in general. The length 240 mm is adapted to the finger dewars, we offer. In the case a sample is not tunable you can either choose a sample tube with a smaller diameter or you reduce the amount of sample inserted into the resonator.

Flat cells are used for liquid samples in solvents with a high dielectric constant. The ideal sample distribution in the resonator leads to a 2 – 2.5 fold higher intensity compared to 50 µl capillaries. The crucial point, when using a flat cell is the orientation of the flat section, the vertical position and the filled volume of the flat cell. Therefore we recommend using the special holder SH-P as the system to achieve always the same sample positioning.

Tissue cells can be used to measure skin sections, paste and emulsions. The same requirements have to be fulfilled that are valid for flat cells.

A special cuvette we offer for alanine dosimetry of thin film test strips. This cuvette has a flat section too. Furthermore we offer special tubes for alanine tablet dosimeters.

Fixed temperature dewars are used to measure samples at liquid nitrogen temperature of 77 K. You can either drop the sample into the liquid nitrogen and the frozen drops are collected in the finger for measurement.
A further possibility is to freeze a cylinder of 4 mm diameter matching to the size of the inner finger of the dewar. In the case you like to measure solid samples you can use sample tubes of 3 or 4 mm outer diameter and 240 mm length.

I. Standard Sample Holder

For the alignment of sample tube within the standard sample holder for ESR measurements.

PH-3 for sample tubes 3 mm — Module # **E4200**

PH-3.6 for guidance tubes 3.6 mm — Module # **E4201**

PH-4 for sample tubes 4 mm — Module # **E4202**

PH-5 for sample tubes 5 mm — Module # **E4203**

PH-6 for sample tubes 6 mm — Module # **E4204**

Autosampler tube grip for sample tubes 3 mm — Module # **4205**

other sizes are available on request

Resonator protection tubes

Resonator protection tube — Module # **E4003**

II. Sample Tubes and Closing Caps

Sample tube, synthetic quartz P 165 / 3 — Module # **E4300**

length: 165 mm, Outer diameter: 3 mm, Wall thickness: 0.4 ± 0.1 mm (Requires Module # E4200)

Sample tube, synthetic quartz P 165 / 4 — Module # **E4301**

length: 165 mm, Outer diameter: 4 mm, Wall thickness: 0.7 ± 0.1 mm (Requires Module # E4202)

Sample tube, synthetic quartz P 165 / 5 — Module # **E4302**

length: 165 mm, Outer diameter: 5 mm, Wall thickness: 0.7 ± 0.1 mm (Requires Module # E4203)

Sample tube, synthetic quartz P 165 / 6 — Module # **E4303**

length: 165 mm, Outer diameter: 6 mm, Wall thickness: 0.5 ± 0.05 mm (Requires Module # E4204)

Sample tube P 135 / 3 — Module # **E4304**

length: 135 mm, Outer diameter: 3 mm, Wall thickness: 0.4 ± 0.1 mm

Sample tube P 135 / 4 — Module # **E4305**

length: 135 mm, Outer diameter: 4 mm, Wall thickness:0.7 ± 0.1 mm

Sample tube P 135 / 5 — Module # **E4306**

length: 135 mm, Outer diameter: 5 mm, Wall thickness: 0.7 ± 0.1 mm

Sample tube P 135 / 6 — Module # **E4307**

length: 135 mm, Outer diameter: 6 mm, Wall thickness: 0.5 ± 0.1 mm

Sample tube P 260 / 3
Module # **E4400**

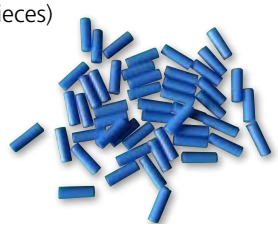
length: 260 mm, Outer diameter: 3 mm,
Wall thickness: 0.4–0.5 mm
ideal for low temperature measurements, e.g. with dewar #E4130

Sample tube P 260 / 4
Module # **E4401**

length: 260 mm, Outer diameter: 4 mm,
wall thickness: 0.4–0.6 mm
ideal for low temperature measurements, e.g. with dewar #E4130

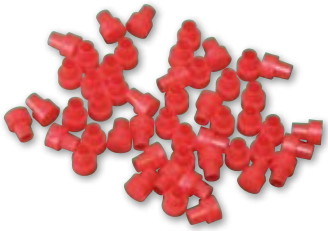
1 Set closing caps 4 mm
Module # **E4310**

(50 pieces)



1 Set closing caps 5 mm
Module # **E4311**

(50 pieces)



III. Capillary measurements for liquid samples

Guidance tubes

Guidance Tube F-120 / 1.5
Module # **E4005**

to geometrically align the capillary in the center of the resonator. Outer diameter: 3.6 mm.
See Module #E4009, requires Module #E4201.

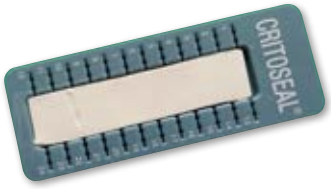
Capillary and Sealing Kit

Disposable glass capillaries 50 µl, 250 pieces
Module # **E4009**

volume 50 µl with ring,
accuracy < ± 0.25 %,
precision < 0.5 %
(capillaries with higher volumes are available upon request)

Sealing kit for disposable glass capillaries
Module # **E4010**

none drying out vinyl kit on one plastic plate for secure sealing of more than 75 capillaries



IV. Accessories for temperature controller

Guidance Tube F-120 / 1.5T
Module # **E4006**

Sample Holder for TC H04 (Top)
Module # **E4102**

Sample Holder for TC HO4 (Bottom) Module # **E4103**

Resonator Dewar for Temperature Controller TC HO4 Module # **E4104**

Resonantor Dewar for Temperature Controller TC HO3 & TC HO2 Module # **E4106**

Dewar and holder to fit to the device

to manually cool the samples

Dewars for spectrometer of the line MiniScope Module # **E4130**

- volume 50 ml
- outer finger: outer diameter 10.5 mm, length 178 mm
- inner finger: inner diameter 5.4 mm, length 105 mm
- storage time 2 h

Models with larger volume and different sizes of the finger upon request.

Sample tubes E4400 & E4401 are recommended for low-temprature applications.

Holder fit to the device with adjustable altitude for fixed temperature dewar suitable for MiniScopes. Module # **E4100**

V. Holder and accessories for alanine dosimetry

Holder for precise sample positioning with adjustable altitude (e.g. alanine tablets) Module # **E4000**

also see Special Holder: Module # 4500

Optional accessories

Sample Tubes for Dosimetry Pellets

for alignment of dosimetry tablets

Type 1: Inner diameter 4,0 mm Module # **E4001**

Type 2: Inner diameter 4,8 mm Module # **E4002**

Blister Holder

Blister Holder, Type A Module # **E4600**

VI. Sample Holders, Flat Cell Cuvette and Tissue Cells

Special holder SH-P for flat cell cuvettes, guidance tubes, tissue cells and special cuvettes

Module # **E4500**

- holder mounted at the device with fixation and protection tube for spectrometer of the line MiniScope allows a definite sample exchange

Note: Module #E4501 is required.

Fixed holder with fitting for flat cell cuvettes, guidance tubes, tissue cells and special cuvettes

Module # **E4501**

especially adapted to the following sample vessels:

- flat cell cuvette FZK 160
- flat cell cuvette FZK 200
- tissue cell GZ 170
- special cuvette FFZK 130-4,5x0,8

adapted to special holder SH-P

Fixed holder for guidance tube

Module # **E4512**

VII. Flat Cell Cuvette

For Aqueous solutions

Standard Flat cell cuvette 160-7x0.3

Module # **E4502**

width of flat section 7.0 mm,
width of gap 0.3 mm, including 5 closing caps 4 mm and 5 closing caps 5 mm

Flat cell cuvette 200-5x0.3

Module # **E4503**

recommended for continuous flow systems.
Width of flat section 5.0 mm, width of gap 0.3 mm.
Useful add-on: Module # E1205 or E1208

Special cuvette FFZK 130-4,5x0.8 for dosimetry test strips

Module # **E4505**

the special cuvette consists of a tube of 95 mm length, whose bottom end has a flat part of a length of 35 mm with one open side and a gap of 0.8 mm. The width of the flat section and the inner diameter of the tube can be chosen in dependency on the width of the test strip. For exact positioning of the cuvette we recommend our special holder SH-P.

Tissue Cells

for tissue samples

the tissue cell consists of a flat part (sample holder) with the dimensions 65 x 7 x 2 mm having two holders in axial direction (bottom length of holder 20 mm, upper length 85 mm). The flat part has a milled deepening (length 30 mm, width 5 mm, depth in general 0.3 mm) which serves to hold the sample. The delivery includes one cover slide and two clamps for fixing the cover slide. Additional cover slides and clamps can be ordered separately.

Tissue cell GZ 170-5.0x0.3 — Module # **E4506**
width of deepening 5.0 mm, depth 0.3 mm

Tissue cell GZ 170-5.0x0.5 — Module # **E4507**
width of deepening 5.0 mm, depth 0.5 mm

1 Cover slide for tissue cell GZ 170 — Module # **E4508**

1 set (2 pcs.) clamps for cover slide of tissue cell — Module # **E4509**

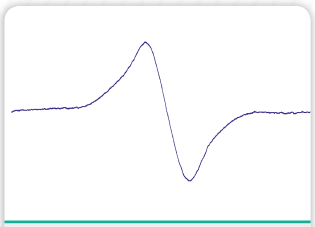
Tissue Cell GZ 170P (Plastic) — Module # **E4510**

material: plastic POM / PTFE. For fast and simple sample exchange for series measurements. The tissue cell consists of a flat part (sample holder) with the dimensions 50 x 5 x 2 mm having two holders in axial direction. The flat part has a milled deepening with dimensions 13 x 5,8 mm, depth 0,2 mm and a additional deepening with diameter 5,8 mm, depth 1 mm.

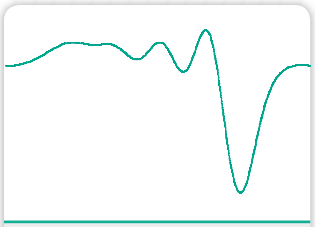
VIII. Sample storage

Sample storage — Module # **E4700**
recommended for safe and organized storage of sample tubes

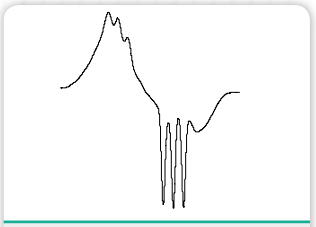
Highlights



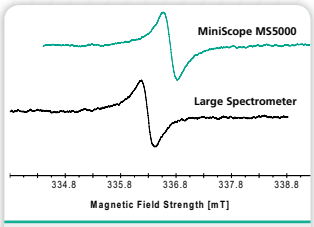
1 µM TEMPO (one line)



SOD mimetic Cu (II) complex



NO-Hemoglobin



Weak pitch: P = 12 mW, modulation = 0.2 mT

Detection limit
10 nM in PBS

Available standards
Chromium and Manganese

Wide magnetic field range
(30 – 650 mT)

Ultra fast and stable auto frequency control

No spikes due to liquid nitrogen bubbles

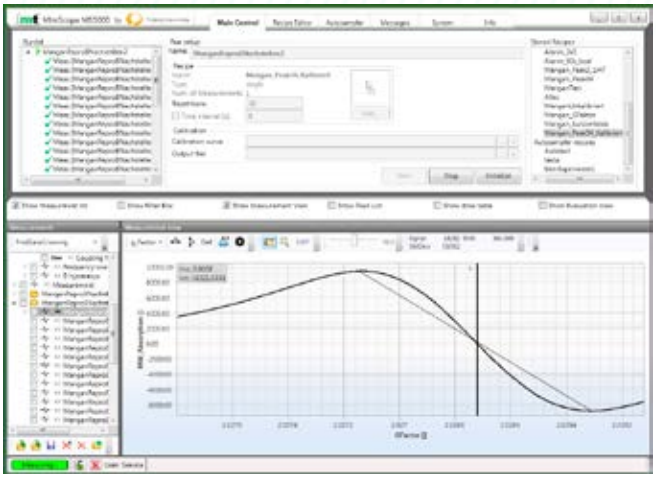
Sensitivity of MS 5000 bench top spectrometer compared to large stationary spectrometer with universal TE 102 cavity

Software – ESRStudio

ESRStudio is the most modern and dynamic software for ESR measurements with convenient workflow based user interfaces.

Highlights:

- most advanced operating and data evaluation software
- modern and user friendly user interfaces
- user/application based customization
- advanced scientific capability
- work flow for automated spectrum evaluation
- automated report generation for convenient research work
- versatile optimization of parameters like signal amplitude, phase of magnetic field modulation etc.



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VQZ Bonn Zertifiziert DIN EN ISO 9001

Europa fördert Sachsen. EFRE Europäischer Fonds für regionale Entwicklung

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