HIDEX

TECHNICAL SPECIFICATION
Hidex 300 SL
Automatic TDCR LSC Super Low Level w/Guard

Code #	Description
425-020	**300SL Super Low Level automatic TDCR liquid scintillation counter with low level PMTs and guard.** 100-240V AC and 24V/8.3A DC. **Features Model (425-020)** Hidex 300SL automatic TDCR liquid scintillation counter with active guard detector, digital Pb shield and low level photomultiplier tubes for detection of low level beta and alpha radiation, suitable especially well for low level environmental radioisotope monitoring, radiocarbon dating, biofuel verification, direct DPM counting without External radioactive standard source, and for detection of extremely low levels of alpha activity when equipped with high resolution alpha/beta separation electronics (option). The counter is equipped with unique 3 Low Level PMT technology to support low level TDCR counting, active guard detector for subtracting environmental background and modern MS Windows software for user-friendly operation. The design with small footprint and low weight allows integration into small laboratories and makes the system truly transportable. Instrument is delivered with dedicated laboratory table with wheels. The instrument has min. 70 mm extended internal Pb shielding design for low background. Results can be obtained automatically as DPM using TDCR quench correction method without radioactive standard source. The TDCR method reduces the need for preparation and maintenance of quench curves almost completely. Transportation and movement of standard instrument does not require licenses for handling radioactivity and decommissioning is easy and low cost. External standard method using Eu-152 standard source, temperature control (cooling) and high-resolution alpha/beta separation electronics are available as options. External std option is suggested to consider for measurement of environmental level activities with variable quench. Cooling is suggested for low level measurements to maintain the samples stable throughout the whole run. High resolution alpha/beta separation option is suggested for specific detection of alpha activity with ultra-low background. The Hidex 300 SL liquid scintillation analyzer is intended for professional laboratory research use by trained personnel, who understand the nature of liquid scintillation analysis. **Isotopes** Detection of beta and alpha radiation by Liquid Scintillation Counting (LSC) ▪ beta-emitters on LSC mode up to 2,000 keV. ▪ alpha-emitters on LSC mode up to 10,000 keV ▪ Preset protocols: H-3 (unquenched, high water load and low water load), C-14, S-35, P-33, P-32, Fe-55, I-125, Ni-63, Sr-/Y-90 and Free. Other nuclides and Cerenkov counting can be easily defined. ▪ Up to 4 energy regions (ROI) can be defined in same measurement ▪ Ready-made measurement template library for detection of various most common isotopes as well as for double and triple label counting. **Analysis of data** ▪ Multi-Channel Analysis ▪ 4 x logarithmic MCA with 1024 channels each ▪ Beta and alpha spectrum analysis using MikroWin user interface software or Excel based spectrum analysis tools: Report Render and HighRes AB Excel Template. ▪ Quench curve analysis on MikroWin 300SL data reduction software. ▪ Quench correction by TDCR method, TDCR core function method, TDCR-quench curve method, and External Eu-152 standard method with quench curves (option) **Counting modes** ▪ Beta (all coincidences), beta triple (triple coincidences), and alpha counting (a/b-separation, option)

▪ Direct measurement of beta efficiency by triple to double coincidence ratio - applicable for all beta and alpha isotopes with continuous spectra, for monoenergetic isotopes and for detection of Cerenkov radiation.

▪ Triple counting mode for true luminescence free counting (Luminescence free mode) and for low level counting

Physical Dimensions

▪ Table: 1000 mm (Width) x 700 mm (Depth) x 590-770 mm (Height, adjustable).
▪ 300 SL: 520 mm (Width) x 630 mm (Depth) x 680 mm (Height); Depth 820 mm with cooling option.
▪ Total weight 200 kg

Operating conditions

▪ +10°C – +40°C; maximum relative humidity 80% for temperatures up to 31°C decreasing linearly to 50% relative humidity at 40°C.
▪ Indoor use only
▪ Dust during operation: The system shall function in normal laboratory environment.
▪ Light during operation: The system shall function normally in normal ambient laboratory illumination

Storage and transport conditions

▪ Transportation conditions -40°C to +70°C, humidity 5 – 90 %, packed in transport packaging
▪ Storage conditions -25°C to +50°C, humidity 5 – 90 %, packed in transport packaging

Electrical Connections

▪ Voltage: 100 ~ 240 VAC
▪ Frequency: 50 – 60 Hz
▪ Normal Power Consumption: <100W
▪ Max. Power Consumption: 200W
▪ Silent operation.

Samples

▪ Vials: 5 mL, 7 mL and 20 mL (minivials such as Eppendorf tubes with adapters available as option)
▪ Vials require cap with flat surface to enable pneumatic gripping.
▪ Minimum dimensions of the vials: height 55 mm / Ø 14 mm.
▪ Vial compatibility must be confirmed with Hidex.
▪ Vials are placed in a tray with 40 x 20 mL vials, 96 x 7ml vials and 96 x 5 ml vials (option)

Counting time

▪ 1 second – 168 h (7 d) /sample.
▪ Max number of repeats in one measurement protocol is 1024 (either by vial or by range of vials)

▪ Counting can be terminated 1) by the counting time set 2) by max counts number or 3) by counting uncertainty thresholds, facilitating different counting times for samples with different activities in same run.

Vial transport

▪ Robotic loading arm with pneumatic mechanism removes the need for a complex elevator mechanism.

Static electricity

▪ By deionizer prior the movement of the vial to detector.
▪ Deionization time can be defined by user at 1 second intervals

Quench correction by

The instrument has automatic color, chemical and luminescence (quenching) detection and correction. Quench correction can be done using:

1. TDCR method
▪ Allows automatic direct DPM counting of single beta emitters without the use of External standard source or quench curves
▪ Allows automatic direct DPM counting of samples labeled with dual beta emitters, and with constant quench, without the use of external radioactive standard source or quench curve method
▪ Deviation from true DPM is +/- 10 % depending on the isotope and the degree of quenching
▪ Accuracy of TDCR method can be increase down to below +/- 2 % by fitting TDCR to TDCR-quench curve or mathematically using Core Functions

2. External Eu-152 standard (option)
▪ suggested to consider for low activity beta samples and for double and triple labeled samples with variable quenching – not needed for alphas or samples with constant quench.
▪ requires fitting of External standard quench parameter (QPE) on standard curve

3. Instant DPM
▪ by TDCR method

Luminescence correction

▪ ChemiCPM value that can be used for automatic luminescence correction is measured for each sample

▪ Luminescence free counting mode (by special MikroWin parameter file templates)

- Adjustable "protocol start time delay" and adjustable "measurement chamber delay" to stabilize the samples before starting the measurement.

Measurement modes

- Low
  - for normal beta measurements
  - CPM data printed out with decimals
- Standard
  - for high activity samples - above 200 000 CPM
  - faster singnal processing/shorter DeadTime than in Low mode
  - CPM data printed without decimals
  - Active guard is disabled
- Alpha
  - activates alpha/beta separation
- Beta/BetaTriple/Alpha/AlphaTriple
  - prints out all betas/alphas or beta triples/alpha triples only
  - data from up to 4 adjustable ROIs can be printed out

Spectra and Replay function

- User can choose to store and print out beta, beta triple, alpha, alpha triple and 2D spectra.
- Allows viewing the spectra and Replaying the data in new ROIs after completing the measurement.
- Live spectra during the measurement

Instrument operation and software

Counter can be operated using:

- MS Windows based MikroWin 300SL user interface software
- Hidex Commfiler 2020 (for service use only)

Data reduction by:

- Excel based tools: Report Render spectral analysis software and HighRes AB Excel Template.
- User definable export format (txt, xls, csv, etc.) to any other data reduction software or data base.

MikroWin 300SL parameter-files for measurement for most typical isotopes and applications are available at parameter library included in all instrument deliveries.

The parameter files include predefined settings for running the assay and calculation formulas for printing out and export desired data. MikroWin 300SL software includes capabilities for biological assays, immunoassays, screening type assays, data validation and control history.

Random access counting:

- Possibility to add vials with new parameter templates during the measurements
- Priority measurement
- Editing the protocols and analysis of previous data during the measurements

Analysis of data includes features such as automatic calculation of activity, normalization of results, background subtraction, precision, error of measurement, minimum detectable activity, analysis of kinetic data, analysis of dual- and triple label data, half-life correction, etc. Also sample identification with sample number, position in the rack and with user definable ID is facilitated.

MikroWin enables also calibration of optimum a/b discriminator (PLI) and energy regions (ROI) for your application. The feature includes Replay of the data with new PLI and ROIs after the measurement. Replay function enables sample specific calibration of the PLI and ROIs after the measurement without separate calibration or misclassification run.

Measured data can be printed out or exported in various formats e.g. to Excel.

Excel based tools: Report Render spectral analysis software and HIghRes AB Excel Template enables easy-to-use tools for optimizing FOM, analysis of spectra and background spectral subtraction in familiar Excel environment. HighRes AB Excel Templates enables also useful two-dimensional alpha-beta separation graph for validating ab separation performance of high-resolution ab data.

MikroWin 300SL software is compatible with Windows 7, 8 and 10 – Win 10 suggested to confirm functionality of all features.

Results data-file is saved automatically in the PC after completing the run

A security copy of data is stored after measurement of each sample.

Communication connections

- USB port allows communication with PC.

Detectors

Three low background PMTs provide optimum measurement geometry and facilitate TDCR counting

- 3 x Low Level Single Photon Counting Photo Multiplier Tube (PMT)
- Spectral range from 300 nm to 630 nm
- PMTs 120 degrees apart from each other

Detector shielding

- Optimal Pb shield design with an extended 4-pi 70 mm shielding of PMTs in all directions provides low background and minimizes instrument weight.
- Lead shutter provides optimum shielding from cosmic radiation
- Copper shielding around the measurement chamber eliminates x-rays from Pb shield.
- Active guard detector for subtracting environmental background
- Digital Pb shield to be used with predefined measurement templates for detection of H-3 in water and other isotopes in constant quench conditions.
- Measurement chamber with high reflective opaque paint maximizes light collection.

Performance Specifications**

All the measurements are performed at temperature of 22°C ± 2°C and at normal humidity conditions of Hidex laboratory, Turku, Finland (relative humidity not measured). Background may vary locally depending on natural environmental radiation.

Counting efficiency:

- Counting efficiency typical > 70 % for H-3 and typical > 96 % for C-14 with unquenched samples.
- > 35 % for H-3 quenched (8 mL water sample + 12 mL AquaLight cocktail)
- α's (Po-210, U-234/238, Am-241, Rn-222, Ra-226) > 95 %
- Cerenkov: typical >70 % in open Y-90 Cerenkov ROI

Typical background:

- 3 CPM with 8 mL water + 12 mL AquaLight Low Level cocktail.

*Background value measured using window with 25 % counting efficiency.

- < 0.3 CPM for alphas (with a/b separation option)
- Cerenkov: < 3 CPM in optimized Y-90 ROI

FOM (E^2/B):

- H-3 in water, optimized settings > 220
- H-3 in water, with Digital Pb shield > 300
- H-3 unquenched Low Level standards, optimized settings > 700
- C-14 unquenched Low Level standards, optimized settings > 1150
- C-14 Benzene 3.5 ml in a mini glass vial > 2000

(> 3000 using optimization of instrument settings)

Stability:

- < 1 % variation (gross beta, 10 x 1000 min)
- < 2.5 % variation (10 Bq/L H-3 in water, 10 x 600 min)

Count Rate

- up to 3 000 000 CPM, with MCA

Resolution: 0.02 keV - 12.5 keV, unquenched conditions.

- H-3 ROI (18,6 keV) covered with 300 channels, equal to 0.06 keV/channel in average
- C-14 ROI (156 keV) covered with 600 channels, equal to 0,26 keV/channel in average

Detection Limit (Ld) according to ISO 11929

- Depends on factors such as the isotope, sample matrix, counting time and accepted uncertainty.
- Lowest limit of detection for H-3 in water, typica values:

- 6.1 Bq/l, 1 h counting time, Optimized ROI, ka=kb=1.645
- 7.3 Bq/l, 1 h counting time, Luminescence free ROI, ka=kb=1.645
- 2.7 Bq/l, 6 h counting time, Optimized ROI, ka=kb=1.645

*8 mL water + 12 mL AquaLight+ Ultra Low Level cocktail in 20 mL plastic vial.

*Background counting time 1000 min.

Performance Assessment

- Using standard samples
- OQ parameter file with history log
- Standards with OQ history log can be included in all measurements

Data recovery

The data of every sample is stored automatically in computer hard disk after completing the run. Security backup data-file is stored after measurement of each sample.

Vial recovery

Automatic return of sample vials after power failure.

Power up diagnostics

- Automatic power up diagnostics of instrument settings.

Safety Standards

- CE marked

▪ External power UL/CSA approved

Warranty

▪ 12 months

Maintenance

▪ No recommended spared during the warranty period

▪ Extended warranty and maintenance & service program available on request.

▪ Hidex is suggesting annual preventive maintenance plan to maintain the counter in good working condition.

21 CFR Part11 compliancy

▪ Included with Mikrowin 300SL software delivery

▪ 21 CFR Part11 compliancy features include e.g. addition of Password protected User Accounts and Log System, recording entries and performed tasks. Raw data, including sample IDs, cannot be changed after starting the run.

**Performance data measured at Hidex factory in Turku, Finland. Background may vary locally depending on natural environmental radiation.

Equipment included in the delivery

- 425-020 Automatic Liquid Scintillation Counter
- 525-202 Trolley table with 429-090 Active Guard
- 425-018 Low level PM Tubes
- 429-188 Digital Pb shield
- 410-001 Owner's Handbook (pdf-version)
- 431-320 rack for 40 x 20 ml vials
- 431-307 Rack for 96 x 7ml vials
- 431-208 Power supply 100-240V/24V
- 529-017 USB communication cable, 2 m
- QA Report

Software

- 426-140 MikroWin 300 SL Full Data reduction/instrument control 21CFR part 11 software

Includes TDCR-Quench curves for H-3 and C-14 as well as Measurement template library (par-file templates).

- 431-103 CommFiler 2020 service software
- MS Excel analysis tools: 450-010 Report Render and 450-011 HighRes AB Exel template

Options for 425-020 Hidex 300SL automatic TDCR liquid scintillation counter

Code #	Description
425-019	External standard with EU-152 souce, 74 kBq* Low activity 74 kBq Eu-152. Under the IAEA free limit Suggested for counting of low activity samples with variable quench. Requires preparation and measurement of QPE quench curves
425-019UPG	External standard with EU-152 souce, 74 kBq * UPGRADE
525-003	Alpha/Beta separation High Resolution alpha beta separation. Easy to use two- and three-dimensional alpha beta separation plot for convenient separation optimization. No need to use pure standards to optimize separation conditions before counting Replay function allows calculation and print out of the results with new PLI and ROIs after the measurement Ultra low misclassification at 0.5 % on 100 000 CPM of activity Alpha background typically 0.3 CPM for Gross Alpha Alpha background typically < 0.1 CPM for specific energies Resolution 300 keV at 5 MeV Teflon coated vials
525-003UPG	Alpha/Beta separation UPGRADE Includes electronics and instructions Installation & Calibration by local service engineer, source not included Availability depends on the instrument configuration Please provide instrument s/n in advance to confirm combatibility and the deliver
425-2003	Temperature control For temperature stabilization inside the unit down to max 5 - 10 C below ambient temp. Adjustable target temperature with +/- 1 C accuracy. Minimum target 15 C. Extends the depth of the counter by 190 mm.
4252003UPG	Temperature control for 300 SL UPGRADE Upgrade for 300 SL avilabe for s/n 2201000 or higher.

425-016	Low Level option for 300 SL and 600 SL Included in the delivery of 425-020
429-188	Digital Pb shield Included in the delivery of 425-020
426-004	PC Includes: MS Windows, Office pack English version, MikroWin 300 SL installation, parameter library, CommFiler service software and Excel spectrum analysis tools. Connection w/Hidex 300 SL configured. Delivery with the instrument only. Do not include printer - must be obtained locally.
Code #	**Software**
426-140	MikroWin 300 SL Included in new Hidex 300 SL deliveries
431-103	CommFiler 2020 service software Included in new Hidex 300 SL deliveries
450-010	Report render Spectrum Analysis software Included in new deliveries
450-011	HighRes AB Excel Template Included in new Hidex 300 SL deliveries