

# CAMAG DBS-MS 500

ONLINE EXTRACTION SYSTEM FOR LC-MS, MS  
OR SAMPLE COLLECTOR COUPLING



“The DBS-MS 500 handles the unattended analysis of up to 2000 DBS samples which is particularly beneficial when very large numbers of samples need to be analyzed routinely and expeditiously.”

Jack Henion, Emeritus Professor Cornell University and VP of R&D.  
at Quintiles Bioanalytical and ADME Labs, USA

**CAMAG<sup>®</sup>**



» Newborn Screening

„Using the DBS-MS 500, analytical results are available much faster and traceability of each DBS is guaranteed via a barcode assignment.“

Ralph Fingerhut, Children Hospital Zürich,  
Head of Swiss Newborn Screening, Switzerland

## CONVENTIONAL DBS WORKFLOW

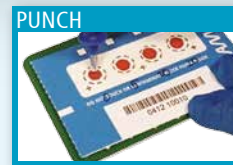
**Dried blood spot (DBS)** analysis has been known for more than five decades. It is an easy way of collecting, shipping and storing blood samples. In recent years the usage of dried blood spots (DBS) has gained increasing importance since this method shows strong advantages compared to the conventional collection and analysis of blood or plasma samples. These advantages include the need for remarkably lower blood volumes and easier shipping and storage, often at ambient temperatures. This leads to a simplification of the blood collection process and a significant reduction of the costs involved.

The blood sample needs to be extracted from the DBS card prior to the analysis. This was a major drawback of DBS since sample extraction from a high number of DBS cards was very tedious and required many process steps to be performed manually. The conventional processing of DBS is illustrated in the workflow (left arrow). Hence, analysis of DBS was time-consuming and costly before the introduction of the CAMAG DBS-MS 500.

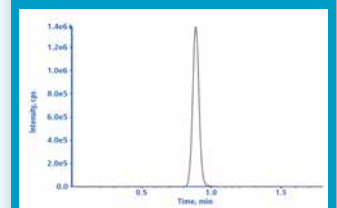
Typical fields of applications are **newborn screening (NBS)**, where only a very small amount of blood is available. Every newborn in modern countries is screened for inborn errors via DBS. Also **therapeutic drug monitoring (TDM)** is a major field for the DBS technology, since drawing blood samples can be performed by the patients themselves and it is minimally invasive. Samples can be shipped to centralized laboratories via the standard mail delivery. For those reasons DBS is also applied in **clinical studies**. Furthermore, in **preclinical studies** the number of test animals can be reduced (due to the need for lower blood volumes) which is in accordance with the 3R requirement of animal studies (replacement, reduction, refinement). **Personalized healthcare** analysis of metabolites via automated DBS analysis is more affordable for the end user and represents a growing market. **Regulated substance abuse testing** is performed via DBS as well.

## MANUAL VS. AUTOMATED

45  
MINUTES



## TYPICAL CHROMATOGRAM

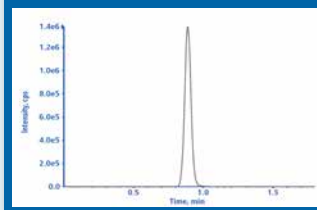


## Automated Handling



2  
MINUTES

## TYPICAL CHROMATOGRAM



## + ADDITIONAL INFORMATION FOR QUALITY ASSURANCE AND TRACEABILITY

### BARCODE ASSIGNMENT



### QUALITY ASSURANCE IMAGE OF CARDS AFTER EXTRACTION



### RUN PARAMETERS OF THE ANALYSIS



## CAMAG DBS-MS 500 WORKFLOW

The fully automated DBS-MS 500 from CAMAG is state of the art technology to analyze DBS. The DBS are directly eluted in a designed extraction chamber and guided online to an analysis system. Sample processing is automated, including the application of an internal standard through a high precision sprayer and barcode assignment. In addition to the analysis results, a picture of each DBS card before and after extraction and the run parameters are reported to maintain high traceability and quality.

## FEATURES OF THE DBS-MS 500:

- High throughput analysis of up to 500 DBS cards per run
- Integrated optical card recognition and barcode reading module
- Automated internal standard application module
- Unique extraction module with wash station to eliminate carry-over
- Online coupling to analysis system (LC-MS, MS or Sample Collector)
- Full control through Chronos software

The fully automated CAMAG DBS-MS extraction system makes DBS analysis remarkably easy and has strong advantages compared to both the manual and semi-automated punching techniques. With the CAMAG DBS-MS 500 extraction procedure DBS analysis is an economical alternative to conventional blood sampling. It represents a time- and cost-saving technique for analyzing pharmacological samples and is less invasive for participants or animals.

# WORKFLOW AND FEATURES OF THE DBS-MS 500

## 1 ROBOTICS



Highly reliable robotics handles the DBS cards from 5 separate racks, each with a capacity of 100 cards. The gripping tool picks up cards and moves them to all of the subsequent processes in the corresponding modules and back into their original position after the extraction. All DBS cards in the standard format of 84.67 mm × 53.2 mm can be used, independent of the brand.

## 2 OPTICAL CARD RECOGNITION

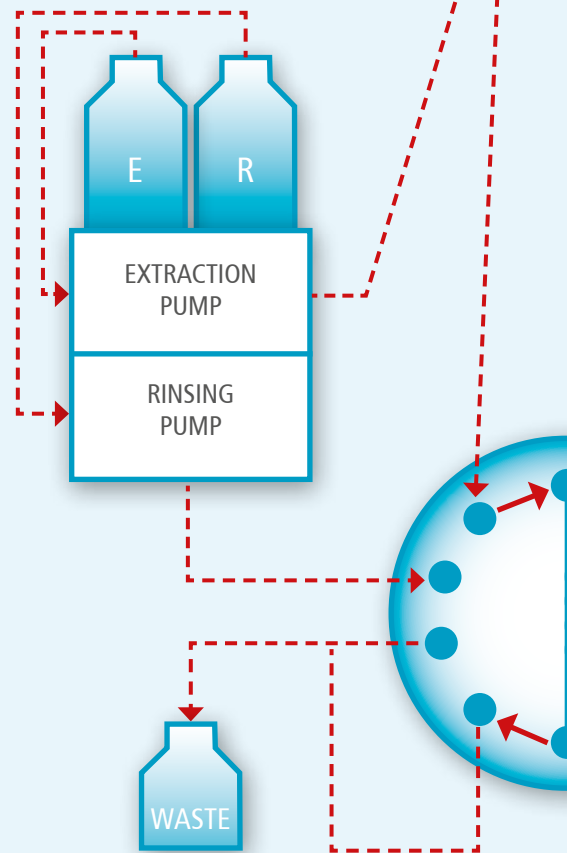


The spot number and position, checkbox status, and barcode information are determined by a camera module with integrated firmware and adapted sensors. The connection between a DBS and its barcode is ensured throughout the whole process. CAMAG has incorporated its know-how of more than a decade of optical HPTLC image analysis to build this precise and reliable camera module.

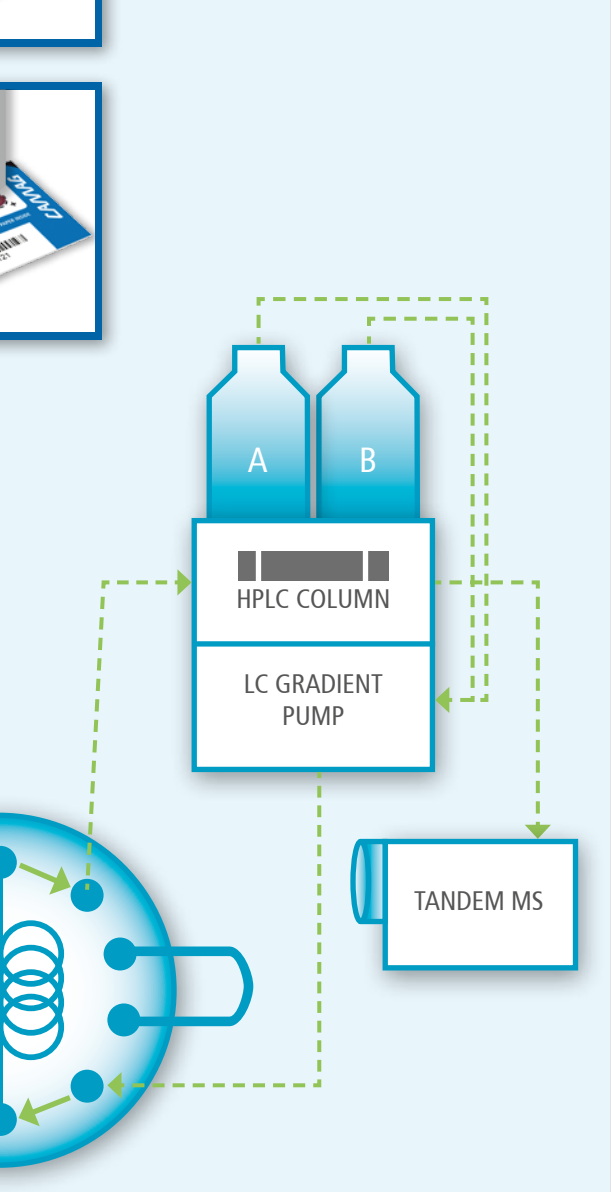
## 3 INTERNAL STANDARD APPLICATION



The extraction efficiency and analysis quality is ensured via the application of an internal standard prior to the extraction. The internal standard solution is applied with a high precision sprayer onto the DBS. CAMAG has been manufacturing high precision application instruments for HPTLC for a long time and has used this experience to build this module.







The extraction solvent is pumped through the card and loaded into a loop (red cycle). By switching the 10-port valve, the loop volume is connected to the LC-MS flow path (green cycle) and guided to the column and after separation to the tandem MS. Meanwhile, the extraction head is cleaned by a rinsing cycle to avoid carry over.



» Regulated Substance Abuse Testing

#### 4 EXTRACTION MODULE



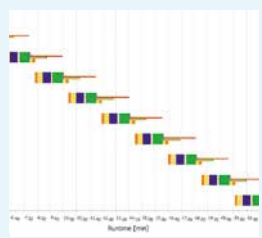
The extraction unit seals the DBS card and solvent is guided horizontally through the DBS into a sample loop. The loop volume can be of various sizes and configurations according to the application. The extract is guided online to the analysis system and is independent from the extraction solvent cycle.

#### 5 WASH STATION



A designated wash station cleans all parts that are in contact with the DBS cards and additionally flushes the entire tubing to avoid any carry-over. Using this system, independent user tests confirm that carry-over is not an issue.

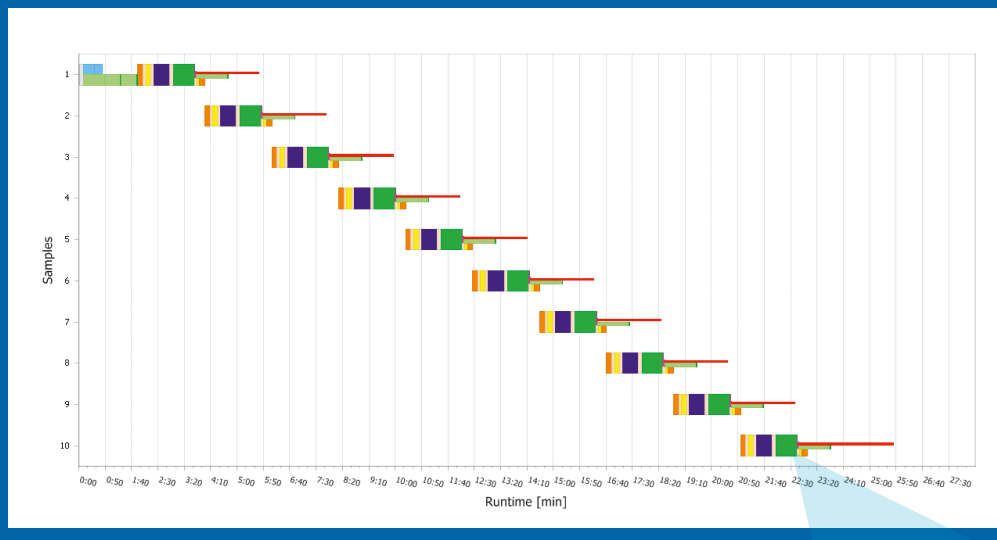
#### 6 MASTER CONTROL SOFTWARE CHRONOS



Chronos is a sophisticated master software that manages your analytical system in addition to controlling the DBS-MS 500. Sample lists are programmed in Chronos, where sample processing, extraction and analysis parameters are brought together. Chronos is compatible with the majority of common mass spectrometers and allows data exchange between those programs.

# CHRONOS - ANALYSIS CONTROL

## OVERLAPPED SCHEDULE FOR 10 SAMPLES AND SYSTEM INITIALIZATION



## OPTIMIZATION FOR HIGH THROUGHPUT

An overlap of workflows is Chronos' core feature. The software measures the time for each work step in real-time and adapts the sample schedule accordingly even while an analysis is still ongoing.

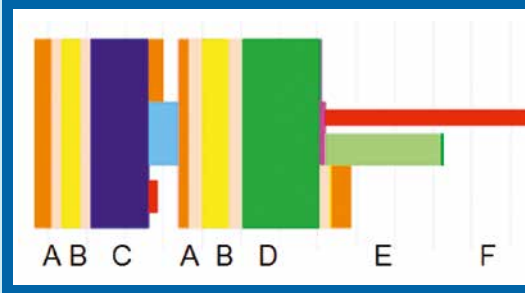
This enables the DBS-MS 500 to prepare the next sample in time and therefore avoid delays due to idle time. As a result Chronos increases the active measuring time of the devices and considerably raises the efficiency of the laboratory.

## REAL TIME ANALYSIS MONITORING

The sample schedule is visualized in a chart which can be monitored in real-time.

- A) Transport the DBS card
- B) Optical card recognition
- C) Application of internal standard
- D) Extraction
- E) Rinsing the extraction unit
- F) Estimated LC-MS cycle time

## VISUALIZATION OF PROCESS STEPS



„The surge in interest in DBS techniques for supporting pharmaceutical exposure studies is due to the many advantages it offers over conventional plasma sampling“

Paul Abu-Rabie, GlaxoSmithKline, Bioanalytical Science and Development, UK ([www.bioanalyse.org](http://www.bioanalyse.org))



» Therapeutic Drug Monitoring  
» Clinical Studies  
» Personalized Healthcare

## ROBUSTNESS AND REPEATABILITY

The user can create methods with almost no limitations on parameter options. Sample lists can be generated fast and adapted to individual needs for the standard user. Robustness and reproducibility is thus ensured through software controlled automation of the complete analysis.

### SAMPLE LIST EDITOR WITH SMART AUTO-FILL OPTIONS FOR FAST SCHEDULE CREATION

	Analysis Method	Rack No	Card	Spot	Card Type	Barcode...	Spot Type	Sample Name
1	C:\Template_TDM.cam	Rack1	1	1	Camag226	ITF14	Blood	Diclofenac 001
2	C:\Template_TDM.cam	Rack1	1	2	Camag226	ITF14	Blood	Diclofenac 002
3	C:\Template_TDM.cam	Rack1	1	3	Camag226	ITF14	Blood	Diclofenac 003
4	C:\Template_TDM.cam	Rack1	1	4	Camag226	ITF14	Blood	Diclofenac 004
5	C:\Template_TDM.cam	Rack1	2	1	Camag226	ITF14	Blood	Diclofenac 005
6	C:\Template_TDM.cam	Rack1	2	2	Camag226	ITF14	Blood	Diclofenac 006
7	C:\Template_TDM.cam	Rack1	2	3	Camag226	ITF14	Blood	Diclofenac 007
8	C:\Template_TDM.cam	Rack1	2	4	Camag226	ITF14	Blood	Diclofenac 008
9	C:\Template_TDM.cam	Rack1	3	1	Camag226	ITF14	Blood	Diclofenac 009
10	C:\Template_TDM.cam	Rack1	3	2	Camag226	ITF14	Blood	Diclofenac 010
11	C:\Template_TDM.cam	Rack1	3	3	Camag226	ITF14	Blood	Diclofenac 011
12	C:\Template_TDM.cam	Rack1	3	4	Camag226	ITF14	Blood	Diclofenac 012
13	C:\Template_TDM.cam	Rack1	4	1	Camag226	ITF14	Blood	Diclofenac 013
14	C:\Template_TDM.cam	Rack1	4	2	Camag226	ITF14	Blood	Diclofenac 014
15	C:\Template_TDM.cam	Rack1	4	3	Camag226	ITF14	Blood	Diclofenac 015
16	C:\Template_TDM.cam	Rack1	4	4	Camag226	ITF14	Blood	Diclofenac 016
17	C:\Template_TDM.cam	Rack1	5	1	Camag226	ITF14	Blood	Diclofenac 017
18	C:\Template_TDM.cam	Rack1	5	2	Camag226	ITF14	Blood	Diclofenac 018
19	C:\Template_TDM.cam	Rack1	5	3	Camag226	ITF14	Blood	Diclofenac 019
20	C:\Template_TDM.cam	Rack1	5	4	Camag226	ITF14	Blood	Diclofenac 020

## SAFETY

Chronos not only controls your analytical system, it also reports a 2D barcode, the run parameters of your analytical system and pictures of each DBS card. The 2D barcode automatically assigned to each DBS simplifies handling and avoids errors which might be caused by manual working steps. Thus Chronos ensures traceability of every sample supporting a good documentation practice.

## CONTACT

Please contact us for complete application examples and further details:  
[www.camag.com/dbs](http://www.camag.com/dbs) and  
[dbs@camag.com](mailto:dbs@camag.com)

## ORDERING INFORMATION

**050.0500**

**DBS-MS 500**

Fully automated DBS workstation for 500 DBS cards.

Including wash station, optical card recognition unit and internal standard spraying module.

Master slave control unit.

Chronos software to control the extraction and analysis.

### **CAMAG (Switzerland)**

Sonnenmattstrasse 11  
4123 Muttenz  
Tel. +41 61 467 34 34  
Fax +41 61 461 07 02  
E-Mail [info@camag.com](mailto:info@camag.com)

### **CAMAG (Germany)**

Bismarckstrasse 27–29  
12169 Berlin  
Tel. +49 30 516 555 0  
Fax +49 30 795 70 73  
E-Mail [infoberlin@camag.com](mailto:infoberlin@camag.com)

### **CAMAG Scientific (USA)**

515 Cornelius Harnett Drive  
Wilmington, NC 28401  
Phone +1 800 334 3909  
Fax +1 910 343 1834  
E-Mail [tlc@camag.com](mailto:tlc@camag.com)



[www.camag.com](http://www.camag.com)

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