

## **A Novel Platform for the Modular Integration of Forensic Assay Setup and Medium- to High-Throughput Purification of Nucleic Acids**

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There is increasing demand for optimized forensic laboratory processes. Requirements include minimization of manual interactions, scalable throughput formats, and comprehensive audit trail logging and process documentation,

A novel, modular system has been developed that integrates medium- to high-throughput purification of DNA, RNA, or proteins with forensic downstream assay setup. An extraction module (SP module) and an assay setup module (AS module) each are equipped with independent robotic work-heads allowing multitasking and both, independent or connected processing of samples. Sample extraction and assay setup areas are individually contained with external touch screen controls. An eluate transfer “tunnel” facilitates full interoperability between modules. The fully air pipetting system allows processing of any number of samples between 1 and 96 in multiple, scalable batches. Reagents and plastic consumables are administered through a novel drawer concept. Barcode reading of samples, reagents, eluates and assay components provides comprehensive tracking throughout the process. The SP module facilitates extraction of molecular targets from a range of reference and casework sample types, using standardized protocols to ensure optimized processing of samples. The platform utilizes proven magnetic-particle technology. Buffers required for nucleic acid extractions are contained in a sealed ready-to-run reagent cartridge. This cartridge is opened automatically by the instrument when used for the first time. Dedicated protocols were designed to provide maximal DNA yield from casework samples. Sample input volumes ranging from 200 µl to 1 ml lysate for casework samples can be combined with a relatively broad range of elution volumes down to 30 µl for sample input and output flexibility. The AS module integrates reaction setup of commonly used assays for forensic DNA quantification and STR analysis, facilitating multi-channel precision pipetting and Peltiers based active cooling. Two workflows are supported by the SP and AS module – integrated or independent. For integrated operation eluates from extractions are directly transferred to the assay setup module, reducing manual steps and documentation.

The extraction module has been evaluated for sensitivity processing a range of typical casework samples, like surface swabs, hairs, stains, cigarette butts or chewing gum. Success rates obtained in profiling of those samples during the evaluation were compared to statistic records of the corresponding sample category and found to be at least equivalent or better. Exclusion of sample carry-over was tested for the casework protocols using saliva samples of different donors arranged in a checkerboard pattern alternating with negative extraction controls. No mixed profiles were observed, and none of the negative controls showed a profile.

The AS module was tested for setup of a commonly used forensic quantification assay. Preliminary validation results will be shown.

Conclusion: The integrated system of extraction and assay setup modules provides a highly flexible solution for processing casework or reference samples in a medium- to high-throughput scale. It minimizes manual interactions and thereby increases efficiency and process safety of a laboratory workflow.