



FT-IR SPECTROMETER

INVENIO S

Technical Specifications

The INVENIO S is a peak performance FT-IR spectrometer focused on maximum productivity in routine and advanced laboratory analysis. Its innovative beam path, and the premium quality of all components, lead to unmatched Mid-IR measurement sensitivity.

The INVENIO S offers unprecedented adaptability for any IR application. Virtually every accessory, from simple to sophisticated, fits into the large sample compartment. Instant switch between measurement techniques is provided by the optional transit channel. External accessories such as the HYPERION microscope or a TGA module can be placed to the left and right of the INVENIO S, widely expanding its capabilities. Optional aluminum optics and in-field upgradability to INVENIO R or X provide access to spectral range expansion and time-resolved spectroscopy. A second detector option provides the optimal detector type for any application.

INVENIO S permanently monitors the instrument configuration, and ensures the device's performance at all times. The long lifetime of all components guarantees permanent availability, best performance, and low running costs of INVENIO S for many years.

OPUS IR spectroscopy software is the user-interface for fast and efficient FT-IR analysis. Workflows dedicated to routine and certain advanced applications guide the operator through the IR analysis. With its comprehensive functionality for spectra processing, qualitative and quantitative evaluation, and reporting OPUS always provides the adequate tools for generating clear results.

Operating INVENIO S by OPUS-TOUCH increases the productivity as measurements and even extensive analytical protocols are accomplished in a rapid and enjoyable way. INVENIO S is compliant for being operated fully validated in regulated environment.

Optics & Electronics

Interferometer	Permanent aligned RockSolid™, cube corner interferometer for highest stability; insensitive to mirror tilt, mechanical vibrations and temperature variation; guaranteed lifetime of 10 years
Optics	<ul style="list-style-type: none">Sealed and desiccated, prepared for purgingMirrors: Gold coated for highest efficiency in the Mid-IR spectral range, option: aluminum mirrors to prepare the spectrometer for spectral range extensions (INVENIO R/X)Electronically coded windows with magnetic mountKBr windows and beamsplitter; option "High Humidity" optics with ZnSe beamsplitter and ZnSe entrance and exit windows
Electronics	Modern System on a Chip (SoC) electronics for highest performance and reliability of spectrometer control, and minimized energy consumption
Calibration Laser	Diode laser with high wavenumber accuracy and precision, long life time (10 years guaranteed) and low power consumption
IR Source	<ul style="list-style-type: none">MIR Globar with CenterGlow™ technology for continuously optimized light flux, long lifetime (5 years lifetime guaranteed).Option for second internal NIR source, software controlled selection and switch.
Detector	<ul style="list-style-type: none">High sensitivity temperature-controlled DLaTGS-detector, high stability against external temperature changes.Second detector position (option) for DigiTect™ detectors, such as many different cooled or cryocooled MCT detectors (photo conductive and photovoltaic), NIR detectors
A/D Converter	True 24-bit dynamic range for all scan velocities; Dual channel data acquisition
Aperture Wheel	13 positions, fixed diameters from 250 µm to 8 mm; customized positions optional

Performance

Spectral Range	<ul style="list-style-type: none"> 8,000 to 340 cm^{-1}, with standard KBr beamsplitter 11,000 to 350 cm^{-1}, optional, with broadband KBr beamsplitter 5,000 to 200 cm^{-1}, optional with CsI optics 6,000 to 500 cm^{-1}, optional with „High Humidity“ ZnSe optics
Signal-to-Noise	>60,000:1, 1 min sample measurement, 4 cm^{-1} , peak-to-peak >14,000:1, 5 sec sample measurement, 4 cm^{-1} , peak-to-peak
Spectral Resolution	Better than 0.4 cm^{-1} , free adjustable resolution from 0.4 cm^{-1} to 256 cm^{-1}
Wavenumber Accuracy	<0.01 cm^{-1} @ 1,554 cm^{-1}
Wavenumber Precision	Repeatability <0.0005 cm^{-1} @ 1,554 cm^{-1} (standard deviation of 10 repeated measurements)
Photometric Accuracy	Better than 0.1% T
Scan Speed	6 velocities, 1.4–51mm/sec opd

System Validation

PermaSure™ Performance Assurance	<ul style="list-style-type: none"> Automatic recognition and individual calibration of QuickLock™ accessories Automatic performance test and load of appropriate measurement parameters when changing the configuration
PerformanceGuard™ System Diagnostics	<ul style="list-style-type: none"> Continuous electronic monitoring of all spectrometer components, performance, humidity and temperature Automated customer alert if any threshold is exceeded
Reference Materials for Instrument Qualification	Reference materials are integrated in the Internal Validation Unit (IVU). They allow performing test routines for operational and performance qualification (OQ, PQ) and according to PhEur 2.2.24, PhJP 2.25, USP <854>. Certificates are available. The IVU internal validation unit allows complete qualification of all measurement modes (transmission, ATR, reflection) using official reference standard materials.
Instrument Qualification	<ul style="list-style-type: none"> Fully automated test routines for operational and performance qualification (OQ, PQ) Fully automated test routines for instrument qualification according to PhEur 2.2.24, PhJP 2.25 and USP <854> using an integrated certified reference standard (option) Validation manual and validation service for comprehensive system qualification according to GMP available
Regulatory Compliance	INVENIO complies with Good Laboratory Practice (GLP) requirements. Further validation options are available allowing operation of the INVENIO in full compliance to cGMP/GMP, US, European and Japanese Pharmacopeia and 21 CFR Part11

Accessories and Extensions

Measurement Accessories	Full coverage of all typical MIR sampling and measurement techniques. Exchange by reliable QuickLock™ one-button fixing mechanism <ul style="list-style-type: none"> Platinum-ATR: Single reflection ATR with monolithic diamond, soldered in tungsten carbide hard metal for highest mechanical and chemical robustness; optional heating function; guaranteed lifetime of 10 years Single reflection ATR with ZnSe and Ge crystals Multi reflection ATR with various crystal materials, flat and trough plate options Transmission: KBr pellet & film holders and automation units, variety of liquid and gas cells with variable and fixed path length, heatable gas cells with path length from cm to meters, beam condenser Reflection: Variety of diffuse and specular reflection accessories with fixed or variable angle, providing the optimal interface for any sample Dedicated transmission cell for protein analysis in aqueous solution, Bio-ATR II unit for automated temperature ramps Photoacoustic cell
External MIR Accessories	Software selectable output port options for coupling of external modules on the right and left side of INVENIO <ul style="list-style-type: none"> HYPERION FT-IR microscope Micro- and macro-FT-IR imaging and FPA technology HTS-Xt, FT-IR microplate reader TG-FT-IR coupling Flexible external sample compartment MIR fiber coupling

Software & Data Handling

Software	<p>Data acquisition, control, evaluation and reporting with INVENIO is performed using the validated all-in-one OPUS software</p> <p>Features:</p> <ul style="list-style-type: none">▪ Guided step-by-step analysis for quality control applications▪ Spectra comparison method for material verification▪ Library search for material identification▪ Mixture analysis, information search, peak search (OPUS/AID required)▪ Free starter library with more than 350 spectra▪ User specific library set-up▪ Peak labelling▪ Quantification method (Lambert-Beer's Law)▪ Peak integration function (area, height)▪ Automated water vapor compensation▪ Data pre-processing routines, such as baseline correction▪ Multimedia FT-IR tutorial▪ Spectra interpretation tool▪ Automation capabilities▪ Macro functionality▪ Lab journal▪ Analytical report generation with predefined print layouts, customizable▪ Easy export of spectral data and evaluation results to other programs▪ Option to store spectral data and evaluation results either in an internal or a user defined database▪ Multi level user and signature management▪ Customizable work spaces▪ Online help▪ Permanent display of instrument status (PerformanceGuard™)▪ Audit trail, global and with individual spectra and method files▪ cGMP/GLP compliance, protected data pool (OPUS/VALIDATION required)▪ CFR 21p11 compliance (OPUS/VALIDATION required)
Software Option	<p>Operation of INVENIO with validated OPUS-TOUCH software for intuitive and convenient IR analysis.</p> <p>Highlights:</p> <ul style="list-style-type: none">▪ INVENIO controlled by integrated touch panel PC▪ Highest level of software and hardware integration▪ State-of-the art touch controlled user interface▪ Analysis assistant for most efficient material verification and identification▪ Spectrum viewer with data evaluation and data processing functions for in-depth▪ IR analysis▪ Self-adapting analysis report generator▪ Multiple language support▪ Adaptable user rights management▪ Comprehensive spectrometer status control▪ File-archive with smart data filter option▪ Connectivity for availability of data within networks
Connectivity	<ul style="list-style-type: none">▪ WIFI or LAN network connection▪ Remote control of spectrometer▪ Local or server database connection for spectra and results (OPUS/DATABASE required)
Spectral Databases	<p>Wide range of spectral libraries for all kinds of materials, e.g. chemicals, pharmaceuticals, polymers and plastics</p>

Other

Spectrometer Housing	Precisely CNC cut metallic optics platform with durable high quality structural foam housing.
Flexibility Options	Transit™ channel, integrated second sample compartment, provides parallel availability of two different experimental setups <ul style="list-style-type: none">▪ Automated 5 position attenuator wheel for Signal-to-Noise optimization with high sensitive detectors▪ Automatic sample compartment shutters
Sample Compartment	25.5 cm (W) x 27 cm (D) x 22.5 cm (H)
Spectrometer Size	68 cm (W) x 76 cm (D) x 32 cm (H)
Weight	Approx. 65 kg (basic configuration)
Spectrometer Power	100 - 240 VAC, 50 - 60Hz, typical 70 W, max. 120 W (without data system)
Computer Interface	Industry standard ethernet connection, TCP/IP protocol, Integrated touch panel PC (option), remote control via WLAN (option)
Operating System	Windows 10, Windows 11
Service Options	<ul style="list-style-type: none">▪ Installation by a qualified service engineer▪ Various service and maintenance contracts including re-validation services▪ Training courses and customer specific application training

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**Bruker Optics is ISO 9001, ISO 13485,
ISO 14001 and ISO 50001 certified.**

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