

## Technical Specifications

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| <b>General Specifications</b>                                |  |
| type of instrument   | combined confocal (CFM) and atomic force microscope (AFM)  |
| sensor head specifics  | AFM: Akiyama probe (quartz tuning fork combined with a micromachined cantilever); CFM: attoCFM I external optics head and low temperature apochromatic objective |
| <b>Modes of Operation</b>                                    |  |
| imaging modes  | optically detected magnetic resonance (ODMR), AFM, CFM   |
| slope compensation   | 2 axis scan plane correction   |
| z feedback   | AFM: PI feedback loop for amplitude modulation (AM), phase modulation (PM) or frequency modulation (FM) using included PLL                                       |
| <b>Resolution</b>  |  |
| measured RMS z-noise (constant force @ 4 K, 5 ms pixel time) | < 0.2 nm (expected for attoLIQUID1000), < 0.5 nm (guaranteed for attoLIQUID1000)   |
| z bit resolution @ 4 K                                       | 7.6 pm at 2 µm scan range  |
| <b>Confocal Unit</b>   |  |
| configuration  | compact and modular design, two or more optical channels; standard configuration: one excitation and one detection channel                                       |
| key benefits   | quick and reliable alignment of each channel, steering mirror for combined beams long-term stability   |
| quick-exchange of optical components                         | beamsplitters, filter mounts for up to 4 filters/polarizers, (1" diameter); optional piezoelectric rotator with filter mount                                     |
| pinhole configuration  | two pinholes (fiber apertures), different illumination and collection wavelength possible  |
| pinhole size   | dependent on fibers, typically 3 .. 9 µm mode field diameter   |
| compatible LT-objective                                      | LT-APO/VIS, LT-APO/VISIR, LT-APO/NIR (see accessory section for more information)  |
| inspection unit  | sample imaging with large field of view: ~54 µm (attoDRY), ~40 µm (attoLIQUID)   |
| <b>Illumination</b>  |  |
| excitation wavelength range                                  | 400 .. 1000 nm, default 650 nm (others on request)   |
| illumination port specification                              | FC/ APC-connector for single mode fibers or free-beam configuration  |
| <b>Detection</b>   |  |
| detection mode   | e.g. optically detected magnetic resonance (ODMR), luminescence, fluorescence  |
| detection wavelength range                                   | detector upon user's choice, typically Si detector (coupling of the light to other detectors)  |
| detection port specification                                 | FC/ APC-connector for single mode fibers or free-beam configuration  |
| <b>Sample Positioning</b>                                    |  |
| total travel range   | independent degrees of freedom for tip and sample of 2 mm x 3 mm x 2.5 mm (closed loop)  |
| step size  | 0.05..3 µm @ 300 K, 10..500 nm @ 4 K   |
| fine scan range  | 30 x 30 x 4.3 µm <sup>3</sup> @ 300 K, 12 x 12 x 2 µm <sup>3</sup> @ 4 K (open loop)   |
| closed loop scanning   | optional   |
| sample holder  | Ti plate with integrated heater and calibrated temperature sensor  |
| <b>Suitable Operating Conditions</b>                         |  |
| temperature range  | 1.5 K..300 K (dependent on cryostat); mK compatible setup available on request   |
| magnetic field range   | 0..15 T+ (dependent on magnet)   |
| operating pressure   | designed for He exchange gas (vacuum compatible version down to 1E-6 mbar on request)  |
| <b>Suitable Cooling Systems</b>                              |  |
| titanium housing diameter                                    | 48 mm  |
| bore size requirement  | designed for a 2" (50.8 mm) cryostat/magnet bore   |
| compatible cryostats   | attoDRY1000/1100/2100, attoLIQUID1000/2000/3000/5000   |
| <b>Compatibility with Electronics</b>                        |  |
| scan controller and software                                 | ASC500 (for detailed specifications please see attoCONTROL section)  |
| <b>Options and Upgrades</b>                                  |  |
| closed loop scanning & global sample coordinates             | interferometric encoders for scan linearization and closed loop sample navigation  |
| in-situ inspection optics                                    | resolution approx. 20 µm (depending on cryostat, distance top-flange to field center)  |
| closed loop upgrade for coarse positioners                   | resistive encoder, range 3 mm, sensor resolution approx. 200 nm, repeatability 1-2 µm  |

