

## Technical Specifications

<b>General Specifications</b>	
type of instrument	transport measurement insert for use with attoDRY cryostats with integrated atto3DR double rotator m
sensor head specifics	20 pin chip carrier based sample holder mounted on 2 combined rotators with eucentric rotation for 3
<b>Nanonis Tramea control electronics</b>	
base configuration	1x TRCe real-time controller, 1x TSC signal conversion interface and Nanonis V5e software
analog inputs	8 low-noise 18-bit analog inputs, differential BNC connectors, +/- 10V input range
analog input bandwidth	DC – 100 kHz (-3 dB), 5th-order Butterworth low-pass filter
Input noise density	< 150 nV/vHz @ 10 kHz, < 650 nV/vHz @ 10 Hz
analog outputs	8 high precision and low noise 20-bit analog outputs (22-bit with hrDAC), differential BNC connector
analog output bandwidth	DC – 40 kHz (-3 dB), 5th – order Butterworth low-pass filter
output noise density	< 25 nV/vHz @ 100 Hz, < 75 nV/vHz @ 1 Hz
software upgrade incl.	LD5-1 single lock-in generator, LD5-MF multidemodulator and multi-input option
attocube modules for Tramea	integrated control of temperature & magnetic field of an attoDRY2100 and of the two rotator axes of
additional information on Tramea specifications	see Nanonis Tramea detailed specification sheet (or contact attocube)
<b>Modes of Operation</b>	
general configuration	full flexibility (multi-terminal, 4-probe, 2-probe) via generic analog in- and outputs, software con
<b>Sample Positioning</b>	
total travel range	full 3D sphere via $\pm 90^\circ$ for both closed loop rotators (reserve: $\pm 10^\circ$ ) sensor resolution approx. 6 m°, repeatability approx. 50 m°, linearity approx. 1%
step size	approx. 1 m° @ 300 K, 0.5 m° @ 4 K
fine scan range	40 m° @ 300 K, 6 m° @ 4 K (scan resolution: $\mu^\circ$ )
sample holder	ASH/CC/20 fits 20 pin LCCC, connected to 20 wires as twisted pairs max. sample size 4.9 mm x 4.9 mm (others on request)
<b>Suitable Operating Conditions</b>	
temperature range	1.5 K..300 K (dependent on cryostat)
magnetic field range	0..15 T+ (dependent on magnet)
operating pressure	designed for He exchange gas
<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	attoDRY2100, attoLIQUID2000 (others on request)
<b>Options and Upgrades</b>	
included hardware & software	transport measurement insert for attoDRY, 2 break-out boxes, atto3DR, ASH/CC/20 chip carrier sample
TSC add-on(s)	8 additional analog in- and outputs per TSC; maximum of 3 TSCs, resulting in 24 outputs and 24 input
TSO add-on(s)	16 additional analog outputs per TSO; maximum of 2 TSOs, resulting in 50 outputs and 8 inputs togeth
Nanonis Tramea software upgrades	large range of software upgrades available: multi-channel lock-ins, HR oscilloscope and FFT, program
signal-amplifiers upgrade	several different low-noise, switchable gain amplifiers, fully integrated in the attoTMS software as
Femto DDPKA-300	trans-impedance amplifier, 0.4 fA peak-to-peak noise, switchable gain 1e4 .. 1e13 V/A, bandwidth up
Femto DLPCA-200	trans-impedance amplifier, switchable gain 1e3 .. 1e11 V/A, bandwidth DC/1 Hz ... 500 kHz, cable to
Femto DLPVA-100	voltage amplifier, switchable gain 20/40/60/80 dB, bandwidth DC .. 100 kHz, switchable to 1 kHz, 5.5
Nanonis MCVA5	differential multichannel preamplifier with 4 independent channels, Gain of 1/10/100/1000, 500 kHz b
Keysight SMU B2912A	precision Source/Measure Unit, supports two-channel configuration, minimum source resolution 10 fA/1