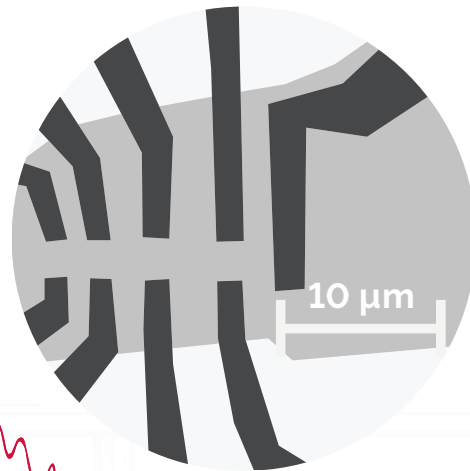# **Teslatron**PT Plus

Open-Architecture Low Temperature Measurement System

Introducing
TeslatronPT Plus

Measurement.
Made Simple

Fast transition from installation to measurement. Focus your time and your funding on the experiment, not the set up.
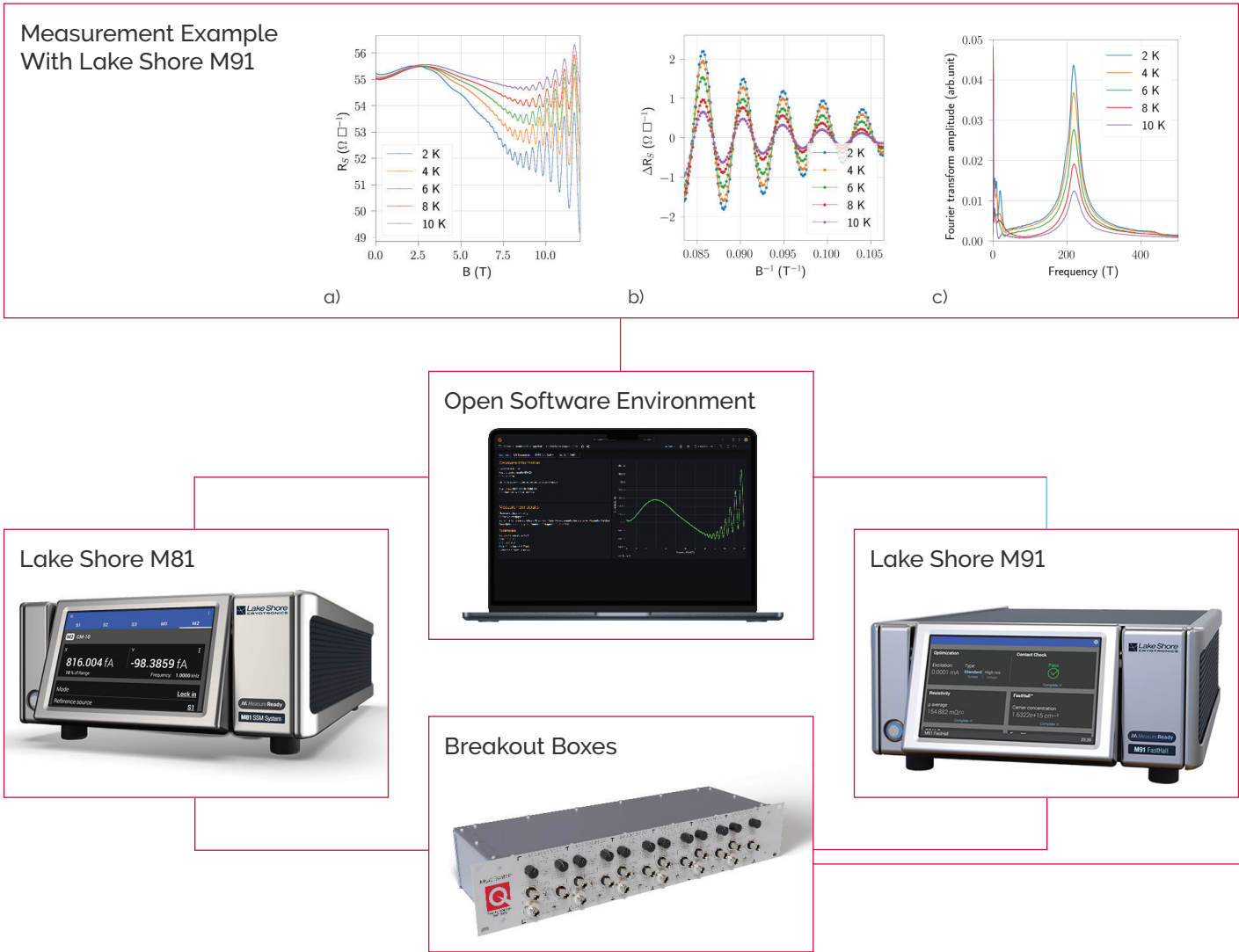
Measurement.
Made Flexible

No more black box environments. Open-architecture. Scripts when you need them, freedom when you don't.

Measurement.
Made Future-proof

Scale and adapt with your research. Open Python programming. No locked-in measurement hardware.

Validated Electrical Transport Signal Chain

Measurement Example With Lake Shore M91

a)   b)   c)

Open Software Environment

Lake Shore M81

Lake Shore M91

Breakout Boxes

Applications

In the new **Teslatron**PT Plus measurement system, Oxford Instruments' leading **Teslatron**PT integrated **Cryofree** low temperature system has been significantly upgraded with automated operation and environmental control. Quantum Design Oxford has partnered with Lake Shore to integrate their flagship measurement instrumentation in an open architecture.

The **Teslatron**PT Plus open-source Python programming environment, easy instrument management and secure data capture and presentation offer improved ease of use, flexibility and data confidence in advanced electrical transport measurement at low temperatures and high magnetic fields.

TeslatronPT Plus measurement capabilities include low and high resistance, Hall effect in Hall bar and van der Pauw geometries, and I-V characterisation. These enable critical characterisation and investigation of fundamental materials physics – for example, the quantum Hall effect and Mott insulator transition in 2D materials, strongly correlated systems, superconductors, topological insulators, and spintronics.

> Fast experimental start-up with pre-written measurement scripts

> Full programming and instrument flexibility via Python and QCoDeS

> Protection from reliance on 'spaghetti code'

> Real-time data visualisation

> Data integrity and security with measurement server
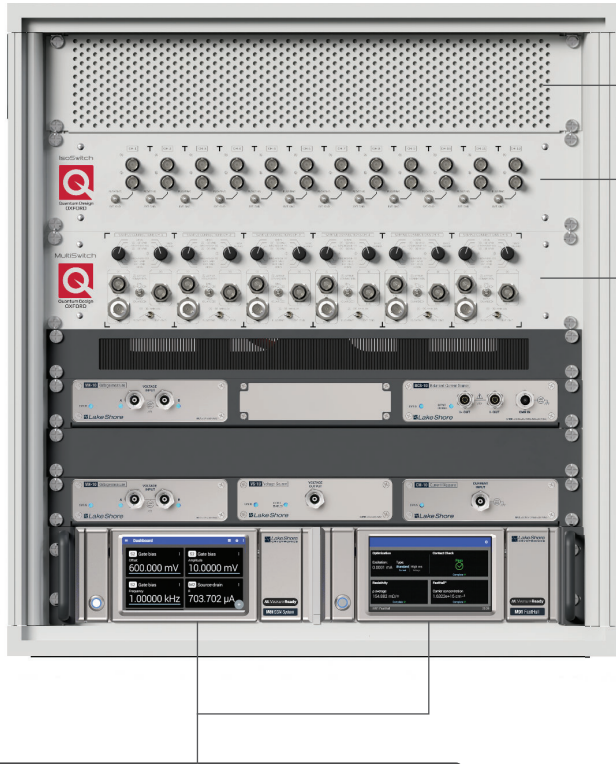
TeslatronPT Plus
Cryosystem

Sample Probes & Holders

Figure: Shubnikov-de Haas oscillations for a AlN/GaN heterostructure at different temperatures.
a) Sheet resistivity, R_S, as a function of magnetic field, B.
b) Background subtracted data plotted as a function of inverse magnetic field.
c) Fourier transform (FT) of ΔR_S vs B^{-1}.

Measurement Hardware

TeslatronPT Plus offers a high-integrity signal chain from your current or voltage source to your sample, with measurement return through high-quality shielded wiring to our breakout boxes and measurement instruments.

Lake Shore M81 Synchronous Source Measure System

> Fully integrated with our open-architecture measurement software

> A versatile and modular tool designed for electrical transport measurements

> Patented real-time sampling architecture for synchronous sourcing and measuring

> Designed for scientific-grade low-level measurement applications

> Gain the precision of DC plus the lock-in detection sensitivity of AC up to 100 kHz in a single instrument

Lake Shore M91 FastHall Measurement Controller

> Fully integrated with our open-architecture measurement software

> Provides complete Hall analysis

> Up to 100× faster for low-mobility materials

> Improves accuracy by minimising thermal drift

Measurement server

> Dedicated measurement Linux server complete with SQL database and measurement software modules.

Breakout Boxes

Breakout boxes are a critical element of the signal chain for electrical transport measurements, offering a reliable interface to manage multiple electrical signals with minimal noise and interference. Quantum Design Oxford's **IsoSwitch**, **MultiSwitch**, and **SampleProtect** breakout boxes ensure signal integrity, with versatile grounding options.

> Simplified connections between sample probe and measurement instruments

> Efficient access to sample wiring and rapid troubleshooting during experiments

> Select floating ground or ground bus connection for each measurement channel

	IsoSwitch	MultiSwitch	SampleProtect
Number of Channels	24	12, incl 6 Triax	24, incl 12 Twinax
Cabling	BNC	BNC/Triax	BNC/Twinax
Recommended Frequency Range	DC up to 100 kHz	DC up to 100 kHz	DC up to 100 kHz
Mutual Capacitance	160 pF	370 pF	210 pF
Line inductance	< 2.3 µH	< 3.0 µH	< 2.5 µH
Electrostatic Discharge Protection	No	Yes	Yes

Values provided for breakout box plus room temperature measurement cable

Sample Probes & Holders

> Low-noise, ESD-protected Universal Measurement Probe, electrically isolated from cryostat

> Shielded twisted pairs with additional driven-guard triax option

> Standard LCC20, LCC40, DIL16 sample holders, parallel or perpendicular to the magnetic field

> Sample-in-gas and sample-in-vacuum options

> Basic probe option for user adaptation
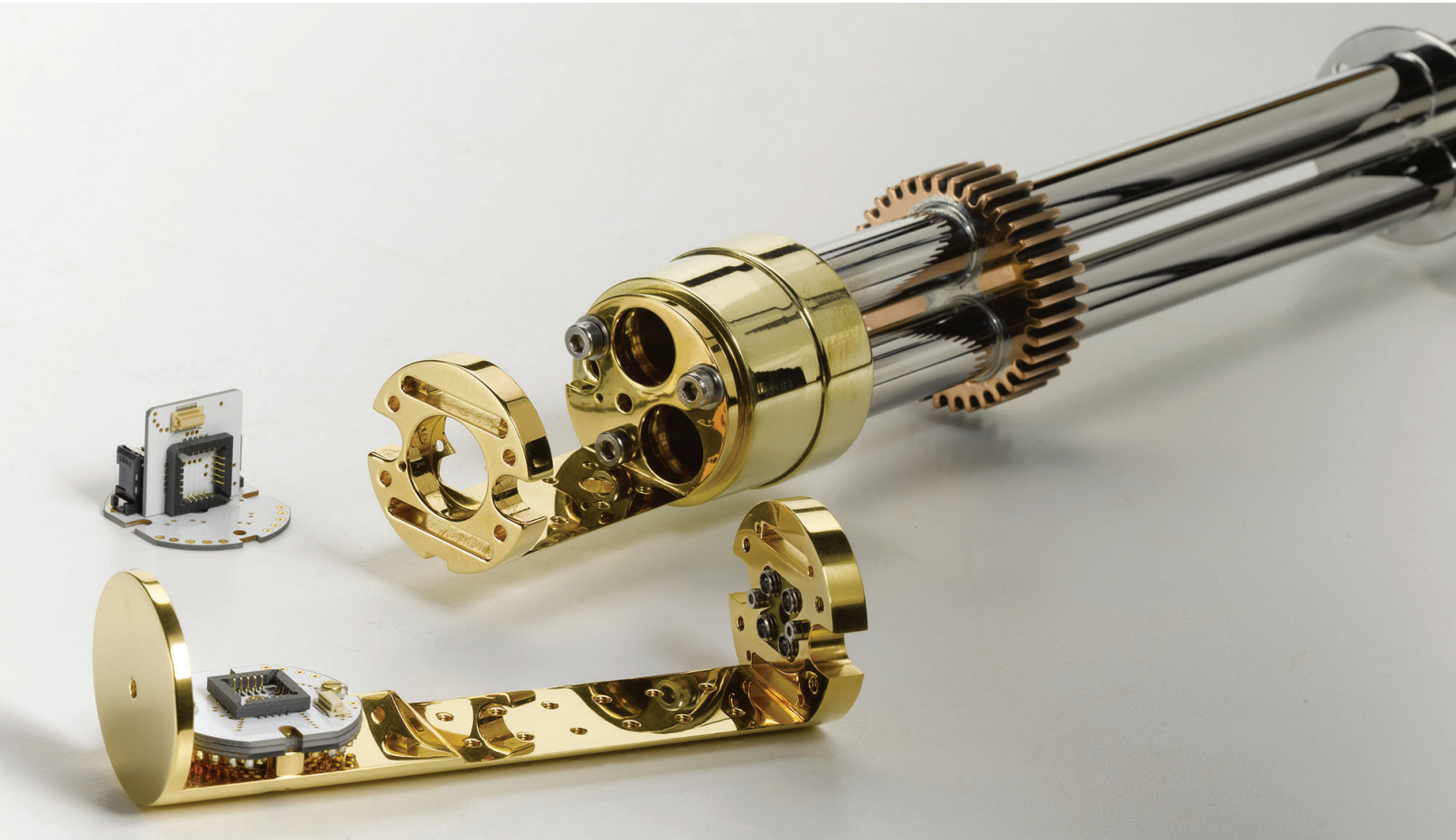
Cryosystem

The **Teslatron**PT Plus cryosystem continues Quantum Design Oxford's leading technology in **Cryofree** superconducting magnets and system integration.

> Automated workflows for system cool down and sample exchange with user-step wizards

> Browser-based control interface and time-stamped integration to measurement data

Superconducting Magnet
High performance **Cryofree** superconducting magnets including field vector rotation option.

> Fine filament Nb_3Sn superconducting wire offers minimum field hysteresis via low remnant field, and minimises flux jumping at low fields

Magnetic Field Options	8 T, 12 T, 14 T and 6/1/1 T vector rotation

Variable Temperature Insert
Integrated variable temperature insert (VTI) with large sample space and static exchange gas.

> Sample space and cooling circuit fully separated to prevent blocking

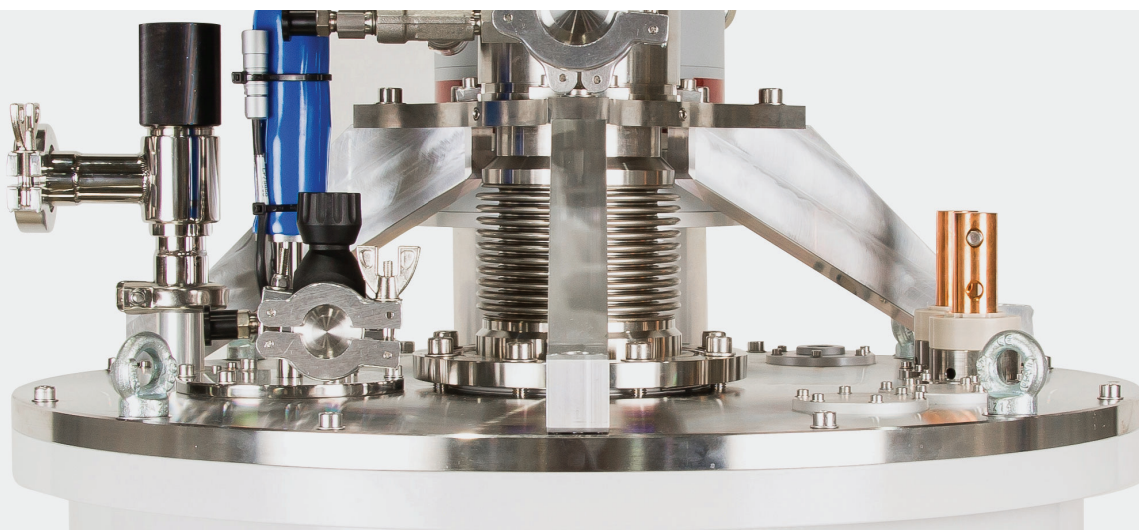| Sample Space Diameter	50 mm
Temperature Range	1.5 to 300 K
Temperature Stability	± 50 mK
Sample Cooldown	< 2 h from room temperature to 2 K for basic sample probe loaded into cold VTI

Control Software

System Control and Measurement Environment

An open-architecture cross-platform control software offers an intuitive and easy-to-use browser-based interface. With automated control for consistent results, the software helps you spend less time on set up, and more time on your experiments. It also offers network-based access using any browser on any platform, so you can monitor and perform your measurements from your lab or remotely.

Cryosystem Control

> Automated workflows
> Real-time B/T monitoring and plotting
> User access management
> Cryostat dashboard
> API Integration

Measurement Set Up

> Open-architecture
> Python measurement scripting
> Editable template scripts
> Uses QCoDeS instrument drivers
> Dedicated SQL database
> LabVIEW script compatible

Data Acquisition

> Real-time plotting
> Fully time-stamped
> Open-format SQL
> Notifications
> Intuitive data export

Cryostat Control and Monitoring - full control of your system

Securely control **Teslatron**PT Plus temperatures and magnetic fields from anywhere via a GUI or API. Routine workflows are fully automated and step-through wizards are available where user input is required. Whether you want to customise your notification systems or integrate additional third-party instruments, our open-architecture software along with the availability of system drivers on QCoDeS ensure seamless compatibility.

## Measurement Extension - more time for your experiments

Full measurement solution with a dedicated server complete with:

> JupyterHub: Python platform
> Editable measurement templates
> Optimal performance with Lake Shore M81 and M91
> User access management
> Seamless integration of 3rd party instruments

Data Acquisition and Visualisation - secure access to all your real-time data

Temperature, magnetic field and measurement data visualisation and export with Grafana.

Your data is fully time-stamped, and can easily be exported or displayed with your own parameters.
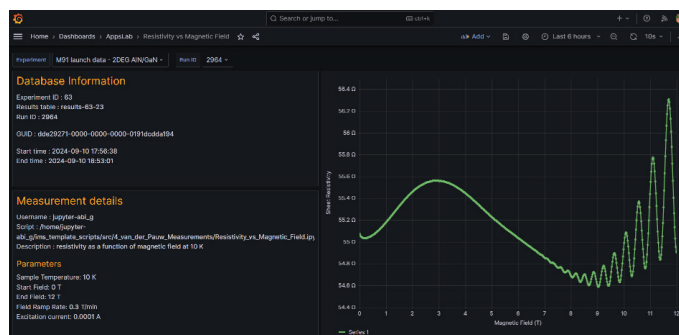
Service
and Support

Our services offer peace of mind. We tailor our support packages to suit your needs by balancing reliable support and providing tools for self-sufficiency.

Our service contracts minimise your downtime and ensure your systems are performing at their best, all while managing costs and extending the lifespan of your equipment.

> Maximise uptime and performance

> Prolong your system's lifetime

> Protect your hard   ware and mitigate unexpected costs

> Scale your ideas and unlock additional experimental possibilities with our customisable and upgradeable products

> Regular check-ups, remote support and guaranteed turnaround times

> Self-sufficiency and access to spare parts

> Customisable training modules to meet specific staff needs

> Regular software and firmware updates

> Dedicated project managers and engineers

> Save up to 30% on maintenance costs

Quantum Design
OXFORD