QBLOX

QSM

Quantum Source and Measurement Module

Release: V26.07



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DESCRIPTION

The Quantum Source and Measurement (QSM) module is developed for DC transport experiments, qubit characterization and qubit operations with DC pulses. It integrates sourcing and measurement capabilities in a single instrument.

The QSM module is supported by the DC Cluster mainframe, guaranteeing ground-loop-free operation, interference isolation, and long-term stability.

Scalable and modular

With 8 channels per QSM and up to 20 modules in the DC Cluster, a maximum of 160 reconfigurable input/output channels are available for DC transport experiments and qubit operation.

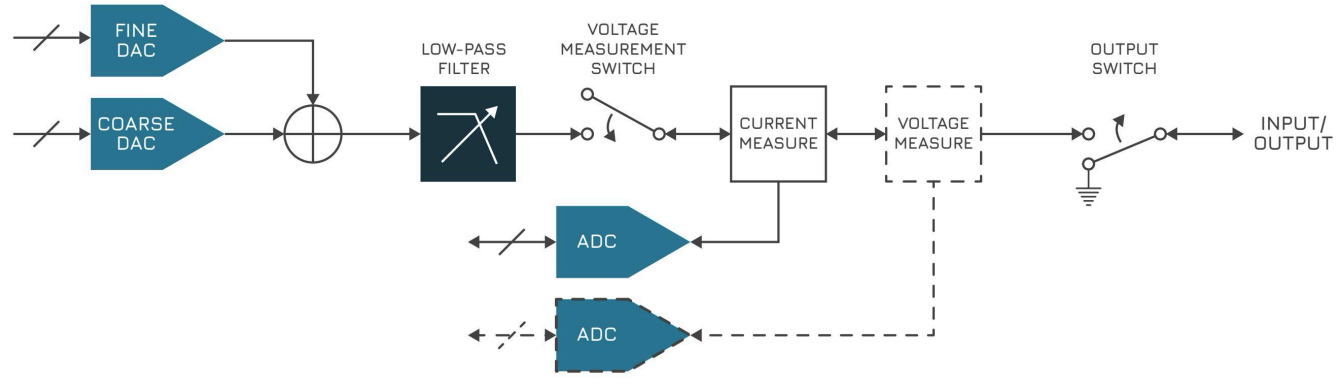
Excellent performance

The QSM and DC Cluster are designed to provide long-term stable output at ultra-low noise level. Thanks to its dedicated mainframe, DC-optimized Cluster completely avoids interferences and ground loops.

Fast time to results

QSM modules seamlessly operate together with other Qblox baseband modules within the DC cluster ensuring rapid transition to experiments.

Input/output diagram of QSM



FEATURES

8 re-configurable DC input and output channels for current source/measure and voltage sourcing.

28-bit resolution with <0.6 µV step size.

+/- 10 V voltage sourcing range.

Up to 50 mA current sourcing.

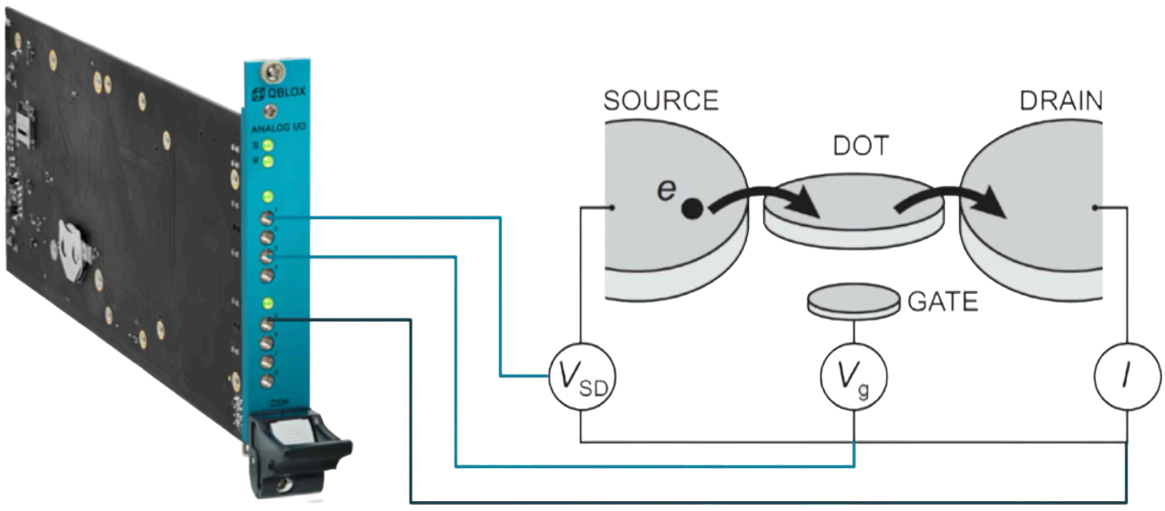
0.5 pA to 50 mA current measurement range.

Simultaneous (gate) leakage current monitoring.

APPLICATIONS

Semiconductor Devices and Spin Qubits

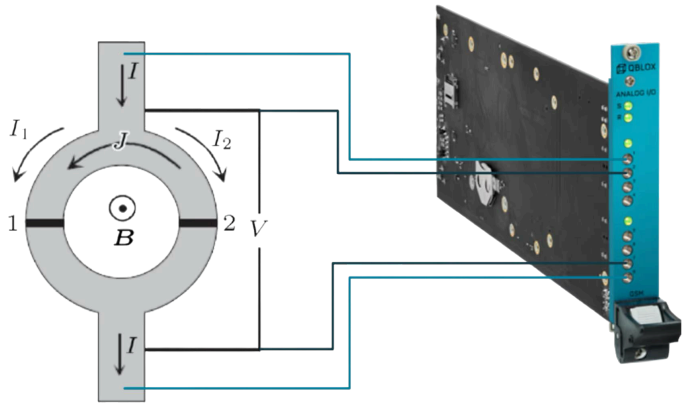
- Source and measurement of gated micro/nanostructures and devices (transistors, quantum dots) from a single module.
- Up to 10 V gate voltages for high-k gate dielectrics.
- Monitoring leakage current upon a gate breakdown on voltage output channel, simultaneously.
- In spin-qubit experiments, static DC voltage source for tuning quantum dot potentials in long-term operations.



APPLICATIONS

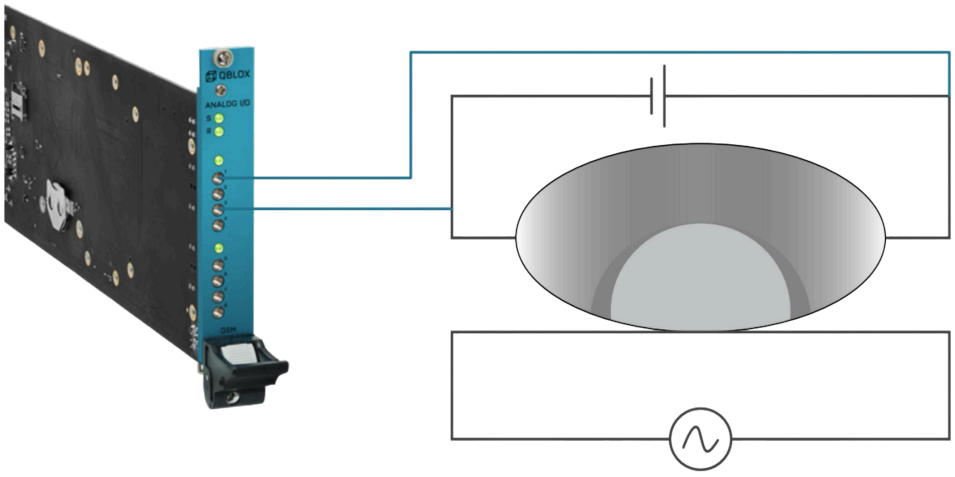
Superconductor Devices and Superconducting Qubits

- Complete I/V characterization of (hybrid) superconducting materials and devices (JJs, SQUIDs).
- Precise source biasing through the charge transport channel with 28-bit output resolution.
- Multi-gate operation for tuning the device properties up to 10 V.
- Monitoring leakage current upon a gate breakdown on voltage output channel, simultaneously.
- In flux-tunable transmon qubit experiments, QSM can be used as bias source for the SQUIDs.



Semiconductor Devices and Spin Qubits

- Controlling the electrostatic environment and fine-tuning the drive frequency of NV center qubits.
- Driving optical elements such as modulators, deflectors, piezos, coils to generate an anti-Helmholtz magnetic field, H-bridge, current control of the lasers, etc.



SPECIFICATIONS

SPECIFICATIONS QSM

Number of I/O channels:	**8 I/O**

SOURCING / OUTPUT

Voltage and current sourcing:	**All channels**
Output voltage range:	**+/- 10 V**
Output current range (into 50 Ω load):	**+/- 50 mA**
DC resolution:	**28 bits (effectively)**
Step size:	**< 0.6 µV**
Selectable filter settings:	**10 Hz, 10 kHz, 250 kHz**
Rise time (0 - 1 V step):	**32 ms @ 10 Hz / 34 µs @ 10 kHz / 1.3 µs @ 250 kHz**
Temperature coefficient:	**0.05 ppm / °C of range / +0.45 ppm / °C of output**
Voltage and current update time:	**5 ms**
1/f noise @ 100 Hz Output: 1V, filter: 250 kHz:	**15 nV/√Hz**

MEASUREMENT / INPUT

Current measure:	**All channels**
Current measure range:	**0.5 pA to 50 mA**
Current measure resolution:	**0.5 pA @ 0.5 pA - 10 nA range** **1 nA @ 1 nA - 10 µA range** **1 µA @ 1 µA - 50 mA range**
Current measure sample rate (for 1 nA - 50 mA range):	**200 ksps**
Compliance current:	**50 mA**
Compliance voltage:	**10 V**
Input impedance:	**High-Z**
Temperature coefficient current:	**pA range: 80 ppm/°C** **nA range: 15 ppm/°C** **mA range: 20 ppm/°C**

SPECIFICATIONS

GENERAL SPECIFICATIONS

Connector type:	**SMP**
Power consumption:	**27 W**
Power supply:	**via DC Cluster**
Data connection to host PC:	**1 Gbit/s via DC Cluster**
Driver/API:	**QCoDeS / Python**
Weight:	**0.322 kg**