QBLOX

QRM

Qubit Readout Module

Release: V26.07



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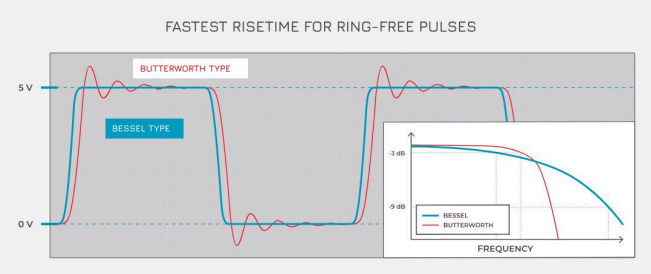
DESCRIPTION

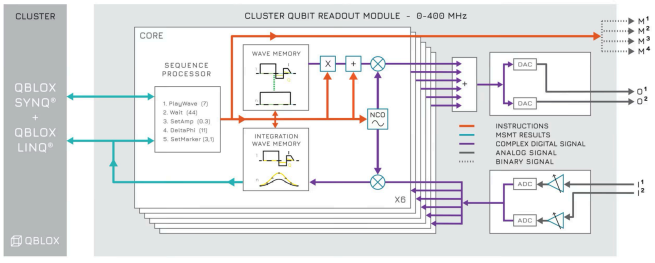
The QRM module has been designed for frequency-multiplexed readout of quantum systems. Combining inputs and outputs in one module makes reflectometry/transmission readout schemes ultimately convenient as the readout pulse and acquisition can be triggered from a single instruction.

Arbitrary pulse shapes and arbitrary complex integration functions can be uploaded to suppress crosstalk and optimize measurement efficiency under dynamic readout conditions.

Measurements on up to 6 qubits can be multiplexed, however, their timing is completely independent, allowing arbitrary scheduling of measurement operations.

Up to 131,072 IQ shots can be stored. Onboard averaging (and binning) can be used to reduce data transfer overhead for averaged experiments that loop over parameters in multiple dimensions.





Cluster modules are equipped with Bessel type filters to generate ring-free pulses with fast rise time as required by quantum computing applications.

The commonly used Butterworth type filters (higher -3dB point) need further filtering to overcome the overshoot and ringing effects, which in turn results in longer rise times. Bessel type filters provide the sharpest step responses with a larger bandwidth beyond -3 dB point as illustrated in the figure.

FEATURES

Multiplexed readout of up to 6 frequencies.

Synchronized to all other modules via SYNQ protocol.

Arbitrarily Long pulse and integration times can be achieved by constructing them from sequencer instructions (for instance for spectroscopy).

On-board integration and state assignment. LINQ protocol and all-to-all connectivity of the Cluster system allow the measurement outcomes to be distributed to all other modules

On-board averaging and binning of measurement results with up to 131.072 IQ bins.

External instruments can be controlled from its 4 marker outputs.

SPECIFICATIONS

Analog input channels:	**2**
ADC sample rate:	**1 GSPS**
ADC resolution:	**12 bit**
ADC bandwidth:	**350 MHz (-3 dB) / 450 MHz (-5 dB)**
Input range (in a 50 Ω load):	**0.1 to 2 Vpp (controllable)**
Analogue output channels:	**2**
DAC sample rate:	**1 GSPS**
DAC resolution:	**12 bit**
DAC bandwidth:	**300 MHz (-4 dB) / 400 MHz (-7 dB)**
Output range (in a 50 Ω load):	**1 Vpp**
Measurement result memory (IQ shots):	**3,000,000 (48 bit wide)**
Frequency resolution (Input and Output):	**0.25 Hz (IF)**

Ethernet data rate:	**1 Gbit/s**
Driver/API:	**SCPI / Python / QCoDeS**
Max. power consumption (via Cluster):	**32 W**
Input/Output connector type:	**SMA**
Marker connector type:	**SMP**
Dimensions single module:	**269 × 130 × 20 mm³**
Weight:	**0.303 kg**