QRM-RF / 2-18.5 GHz
Qubit Readout Module | Cluster Series 19” Rack Mounted

Release April 2023_V1.6.1

Description

The QRM-RF combines all the multiplexed sequencing power of the qubit control module with internal downconversion stages to directly input and output signals over a wide frequency range from 2 GHz up to 18.5 GHz. Combining inputs and outputs in one module makes reflectometry/transmission readout schemes convenient as the readout pulse and acquisition can be triggered from the same sequence processor and use the same LO for guaranteed phase stability.

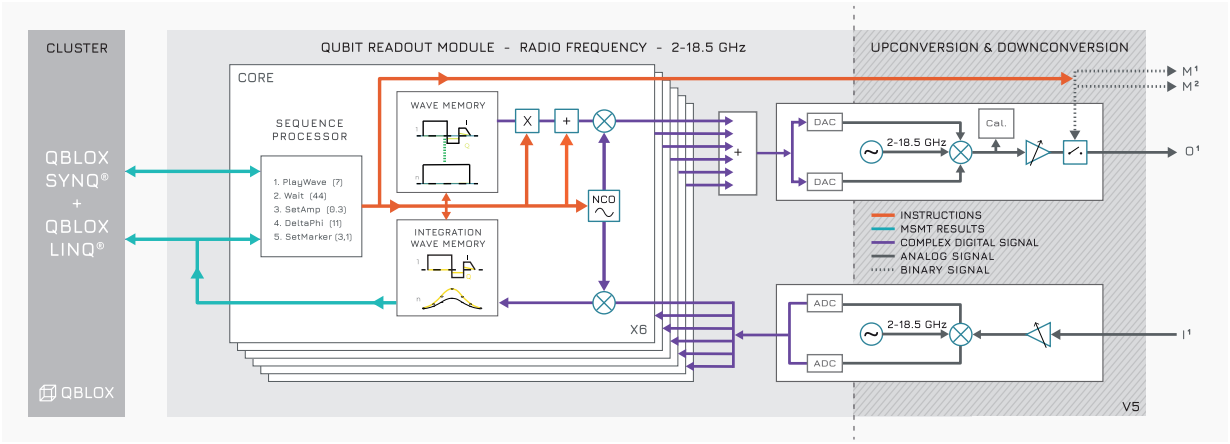
The module is made for frequency-multiplexed readout of up to 6 frequencies over a wide band of 750 MHz without compromising on its state-of-the-art spurious-free dynamic range of > 50 dB (within analog bandwidth).

Measurements on up to 6 qubits can be multiplexed, however, their timing is completely independent, allowing arbitrary scheduling of measurement operations. Arbitrary pulse shapes and arbitrary complex integration functions can be uploaded to suppress crosstalk and optimize measurement efficiency under dynamic readout conditions.

Up to 131.072 IQ shots can be stored. Onboard averaging (and binning) can be used to reduce data transfer overhead for averaged experiments.

Features

- Real-time control of amplitude offset and modulation phase.
- Multiplexed readout of up to 6 frequencies.
- Synchronized to all other modules via SYNQ protocol.
- 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 within 364 ns.
- On-board averaging and binning of measurement results with up to 131.072 IQ bins.
- External instrument triggering via 2 marker outputs.



Specifications QRM-RF

Frequency Range (-3 dB)	2 - 18.5 GHz
Analog output/input channels	1/1
Analog bandwidth (-3dB)	750 MHz
DAC/ADC sample rate	1 GS/s (for I and Q)
DAC/ADC resolution (vertical)	12 bit (for I and Q)
Binary output markers	2 (3.3V LVTTL)
Max. Output power (into 50 Ω)	-40 to +5 dBm (settable)
Spurious-free dynamic range	> 50 dB (within analog bandwidth)
Phase noise (@3 GHz, 10 kHz offset)	-115 dBc/Hz

Max. input power (into 50 Ω)	-26 to 0 dBm (settable)
Frequency resolution (Input and Output)	0.25 Hz (IF), 1 Hz (LO)
Measurement result memory (IQ shots)	131.072 (48 bit wide)
Ethernet data rate	1 Gbit/s
Driver/API	SCPI / Python / QCoDeS
Max. power consumption (via Cluster)	48 W
Input/Output connector type	SMA
Marker connector type	SMP
Dimensions single module	269 x 130 x 20 mm³
Weight	0.322 kg