

Measurement and Control System of Superconducting Quantum Computer ——TJ-SQMC-300



TJ-SQMC-300 is a quantum computing control system dedicated to superconducting quantum chips. The system mainly includes RF module, digital module, DC voltage source module and synchronous control module, which can control and read multiple superconducting qubits at the same time, and can independently complete the measurement and control operation of superconducting quantum computation. The system adopts modular design with high integration, strong expansibility and convenient operation.

Our company provides measurement and control integrated machine customization services, users can according to their own needs, flexible selection of specifications and functions.

Key Features

✧ High integration , Strong performance

- Multi - functional module integration, independently completing superconducting quantum measurement and control tasks
- Low phase noise, low spurious, fast and high fidelity qubit control and readout

✧ Modular design, Strong expansibility

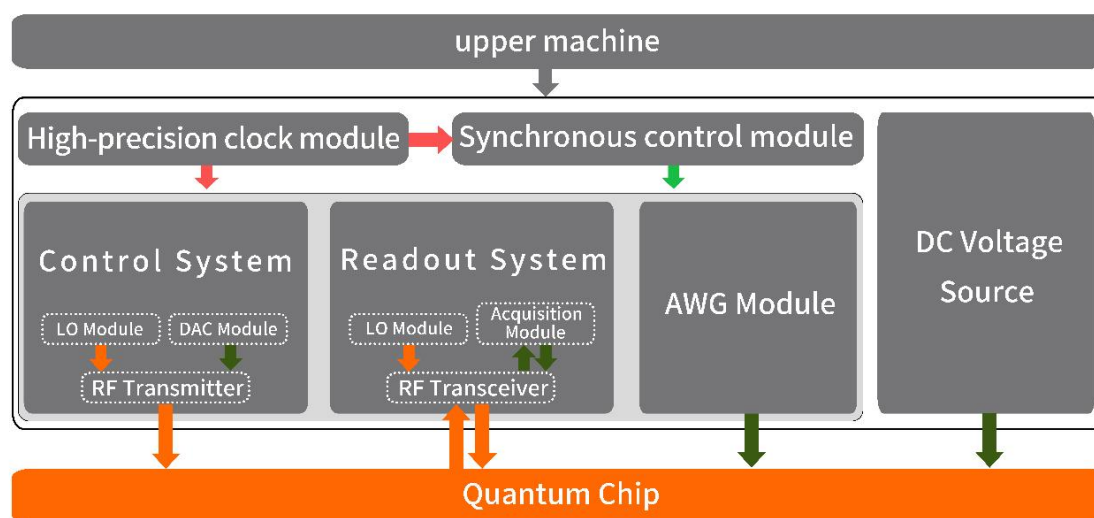
- Standard Cabinet Box Design, operation and maintenance convenient
- System specifications can be extended from 8-qubit to 100-qubit

✧ Professional Measurement and Control Software

- Visual GUI interface, easy to operate
- Parameters cycle and traversal, waveform editing and import and functions etc
- Automatic test and calibration of quantum chips

System consists

Number	Name	Module Function
1	RF Transmit Module	XY control signal provided
2	RF Transceiver Module	Readout IN/OUT signal provided
3	RF Local Oscillator Module	Provide up and down conversion local oscillator signal
4	Digital Module	Providing waveform control signals for quantum chip control and reading
5	Clock Module	100MHz clock and 1pps synchronization signal
6	CCM	To provide trigger control signals for the system
7	DC Module	DC bias signal provided
8	Pump Source Module	Pumping signals for quantum parametric amplifiers
9	Server	Provide PC software



RF Module

RF module includes RF transmitter module, RF transceiver module and RF local oscillator module, which mainly provides microwave signals for XY control and measurement of quantum chips. Detailed parameters are as follows:

Index	Parameter
Output Frequency	3.75~8.25GHz
Output Power	-50 dBm~-10 dBm
Input IF signal resolution, sampling rate	12bit, 3.2GSa/s
Analog bandwidth of input IF signal	500MHz
Harmonic suppression	$\geq 30\text{dBc}$
Spurious suppression	$\geq 65\text{dBc}$
Phase noise(@6GHZ)	$\leq -110\text{dBc/Hz}@1\text{kHz}$
	$\leq -140\text{dBc/Hz}@1\text{MHz}$

RF Transceiver Module

Index	Parameter
RF Output	
Output Frequency	3.75~8.25GHz
Output Power	-50dBm~-10dBm
Input IF signal resolution, sampling rate	12bit, 3.2GSa/s
Analog bandwidth of input IF signal	500MHz
Harmonic suppression	$\geq 30\text{dBc}$
Spurious suppression	$\geq 65\text{dBc}$
Phase noise(@6GHZ)	$\leq -110\text{dBc/Hz}@1\text{kHz}$
	$\leq -140\text{dBc/Hz}@1\text{MHz}$
IF Output	
Output Frequency	0.8~1.3GHz
Input IF signal resolution, sampling rate	12bit, 3.2GSa/s
Analog bandwidth of input IF signal	500MHz
Harmonic suppression	$\geq 30\text{dBc}$
Spurious suppression	$\geq 65\text{dBc}$

Digital Module

Digital module mainly includes AWG module, IF signal transmission and processing module, signal acquisition module, routing module, etc.

Index	Parameter
AWG Module	
Sampling rate	2.5GSa/s
Vertical resolution	16bit
Analog bandwidth	500MHz
Waveform granularity	12 samples
Minimum waveform length	12 samples
Pulse range	-2V~+2V
Square wave test	Rising edge/falling edge<1ns
Signal Acquisition Module	
Sampling rate	3.2Gas/s
Vertical resolution	12bit
Signal Frequency	800MHz~1300MHz
Analog Bandwidth	500MHz

DC Voltage Source Module

The DC voltage source module can generate a precise voltage signal of ± 10 V, which is used to generate the DC bias signal required for Z control. Each qubit needs a DC signal.

Index	Parameter
Output ranges	± 10 V, stepping 0.1mV
Voltage accuracy	≤ 0.3 mV
Noise spectrum	10Hz~1MHz: <-90dBm; 1MHz-10MHz: <-50dBm.
Vertical resolution	20bit
Voltage noise	Proportional limit of 0.1 ~ 10Hz voltage noise to voltage setting : < 1.5ppm
Long-term stability	Voltage fluctuation limit within 3 hours : < 0.01 %

Pump Source Module

The pump source module together with the DC voltage source module provides the pump signal for the quantum parameter amplifier. Its main performance indicators are as follows:

Index	Parameter
Frequency	12~16 GHz
Isolation	≥80dB
Power Range	-30~+18dBm
Harmonic suppression	≥30dBc
Spurious suppression	≥65dBc
Phase Drift	When the temperature changes within 10 °C, the phase drift does not exceed 5°
Phase noise (@14GHz)	≤-105dBc/Hz@1kHz
	≤-120dBc/Hz@1MHz

General Parameter

Index	Parameter
Size	620mm×820mm×1720mm
power	<2500W
Operation temperature	0~35°C
Operation humidity	15%~85% No condensation
Communication Interface	LAN

Note : The table above is the general parameters of the 24-qubit Measurement and Control System and the general parameters of the integrated machine vary with specifications.