**transmon009 measurement**

Following show experiment setup

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|  |
| Wiring |

Following shows instruments used

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| C:\Users\Richard\Desktop\QICK\ppt\2023_物理年會\poster\photos\zcu111_birdeye.jpgC:\Users\Richard\Desktop\QICK\ppt\2023_物理年會\poster\photos\zcu111_frontpanel.jpg |  |
| ZCU111 x 1 | RF source x 1 |

All instruments are synchronized to a 10MHz rubidium clock. For qubit tone, we use DAC 1 of zcu111 to directly output 4.7GHz signal without using external RF source for up-conversion. For cavity tone we use one RF source to perform up-/down-conversion. The qubit we used is transmon and it is not flux-tunable.

Following shows the qubit characterization measurement results.

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| T1 | T2 Ramsey |

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| Two tone | Time Rabi |

Following shows the Randomized benchmarking (RB) measurement results.

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Details of the RB measurement are as follow:

* Use virtual z-gate.
* Use Gaussian envelope. Gaussian pulse sigma 0.3us, total length 1.2us.
* Sequence lengths Used: [1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 15, 18, 22, 26, 32, 40, 50].
* Number of variations at each sequence length is 100.
* Gates used: [Z, X, Y, Z/2, X/2, Y/2, -Z/2, -X/2, -Y/2, I, (X, Z/2), (X/2, Z/2), (-X/2, Z/2), (Y, Z/2), (Y/2, Z/2), (-Y/2, Z/2), (X, Z), (X/2, Z), (-X/2, Z), (Y, Z), (Y/2, Z), (-Y/2, Z), (X, -Z/2), (X/2, -Z/2), (-X/2, -Z/2), (Y, -Z/2), (Y/2, -Z/2), (-Y/2, -Z/2).
* Qubit T1 ~ 11us. Gaussian pulse total length ~ 1.2us. The measured fidelity is ~ 0.95. We therefore suggests that the fidelity is limited by the coherence time of the qubit, and not by our QICK instrument. To test the limit (quality of generated pulses) of QICK, we need qubit of longer T1 time.