

# Benchmark Circuits for IBM's Quantum Computer

## 1 Introduction

IBM's 5 qubit quantum computer [1] supports gates from the Clifford+T gate library. This repository contains some Clifford+T circuits that have been transformed to be executed on IBM's Q5.

## 2 Benchmark Circuits

The following circuits are available in the folder labeled `original`.

Name	Qubits	Gates	Depth	T-depth	Source
<code>a2x_c.qc</code>	4	31	22	5	[2]
<code>a2x_e.qc</code>	4	30	20	4	[2]
<code>Full_Adder_c.qc</code>	4	20	19	7	[2]
<code>Full_Adder_d.qc</code>	4	22	15	2	[2]
<code>Full_Adder_e.qc</code>	4	21	12	2	[2]
<code>Toffoli_c.qc</code>	3	17	16	6	[2]
<code>Toffoli_d.qc</code>	3	17	12	3	[2]
<code>Toffoli_e.qc</code>	3	17	12	3	[2]

The transformed circuits—to fit the Q5 architecture—are found in the folder labeled `IBM`. Different permutations, produce different results. Since the computer has 5 available qubits, circuits can be extended to 5 qubits at no cost. The names of the circuits are obtained by taken the original name and appending the permutation to it. A summary is given below.

Name	Qubits	Gates	Depth	T-depth
a2x_c_01234.qc	5	87		
a2x_c_02341.qc	5	59		
a2x_e_01234.qc	5	70		
a2x_e_02341.qc	5	<b>52</b>		
Full_Adder_c_01234.qc	5	60		
Full_Adder_c_01324.qc	5	<b>28</b>		
Full_Adder_d_01234.qc	5	74		
Full_Adder_d_01324.qc	5	42		
Full_Adder_e_01234.qc	5	55		
Full_Adder_e_01324.qc	5	37		
Toffoli_c_01234.qc	5	<b>17</b>		
Toffoli_d_01234.qc	5	25		
Toffoli_e_01234.qc	5	23		

## References

- [1] IBM Q. <https://www.research.ibm.com/ibm-q/>. Accessed: 2017-09-05.
- [2] D. Michael Miller, Mathias Soeken, and Rolf Drechsler. Mapping NCV circuits to optimized Clifford+T circuits. In *Reversible Computation - 6th International Conference, RC 2014, Kyoto, Japan, July 10-11, 2014. Proceedings*, pages 163–175, 2014.