

TABLE I: Average number of inserted auxiliary gates and average running time on the RevLib benchmark per device.

Device	<i>EffectiveQM</i>	<i>ILS</i>	<i>FiDLS</i>	<i>Qiskit</i>	$t ket\rangle$	<i>QMAP</i>	<i>TB-OLSQ2</i>	<i>SAHS</i>
TOK-gate	858.9	1054.5	1021.5	2416.5	1716.0	2483.4	2289.2	1343.1
TOK-time	130.7	37.8	38.9	4.3	0.8	7.8	2497.1	94.3
SYC-gate	2639.3	2772.9	4921.8	4303.2	2969.9	3995.9	4243.9	3796.6
SYC-time	297.4	23.5	23.0	5.1	1.1	8.5	2711.1	267.4
GUA-gate	3659.7	3857.5	6784.9	5574.7	4299.6	6073.8	5498.9	5710.6
GUA-time	145.4	21.7	5.4	5.3	0.8	9.7	2610.2	212.6
ROC-gate	3495.8	3693.1	6821.2	5358.5	4206.4	5863.5	5265.5	5209.1
ROC-time	193.2	22.7	5.3	5.0	0.9	9.3	2676.4	230.0
Q16-gate	1015.9	1149.8	1054.7	2571.1	1523.0	2308.2	2260.4	1428.2
Q16-time	112.5	40.7	29.0	4.5	0.6	7.6	2452.1	214.1
TOR-gate	3487.5	3691.5	7693.8	5364.7	4182.4	6133.3	5251.6	5350.9
TOR-time	174.1	66.4	8.98	5.2	0.9	9.8	2970.2	313.6

TABLE II: Average number of inserted auxiliary gates and average running time of *EffectiveQM*, *EffectiveQM-short* and two alternative versions of *EffectiveQM* on the RevLib benchmark per device.

Device	<i>EffectiveQM</i>	<i>EffectiveQM-short</i>	<i>Alt-1</i>	<i>Alt-2</i>	<i>Alt-3</i>
TOK-gate	858.9		889	876.4	979.9
TOK-time	130.7		37.8	51.5	53.6
SYC-gate	2639.3		2680.6	2663.6	2656.4
SYC-time	297.4		23.5	99.7	115.0
GUA-gate	3659.7		3702.9	3667.1	3713.5
GUA-time	145.4		21.7	73.1	81.5
ROC-gate	3495.8		3549.6	3520.4	3529.4
ROC-time	193.2		22.7	69.2	95.6
Q16-gate	1015.9		1070.2	1031.5	1119.2
Q16-time	112.5		40.7	45.5	49.6
TOR-gate	3487.5		3556.8	3512.1	5121.4
TOR-time	174.1		66.4	115.9	157.6

TABLE III: Average number of inserted auxiliary gates and average running time of *EffectiveQM* with various hyper-parameter settings of λ on the RevLib benchmark per device.

Device	$\lambda = 50$	$\lambda = 100$	$\lambda = 500$	$\lambda = 1000$
TOK-gate	906.9	888.3	858.9	844.4
TOK-time	14.6	28.5	130.7	263.1
SYC-gate	2673.8	2660.4	2639.3	2630.3
SYC-time	30.7	64.7	297.5	596.7
GUA-gate	3709.6	3684.1	3659.7	3641.1
GUA-time	18.2	37.2	145.4	337.1
ROC-gate	3549.5	3534.1	3495.8	3479.6
ROC-time	20.8	41.1	193.2	403.3
Q16-gate	1051.7	1037.8	1015.9	1005.8
Q16-time	12.0	24.8	112.5	238.1
TOR-gate	3556.1	3534.8	3487.5	3477.9
TOR-time	52.2	99.1	174.1	384.3

TABLE IV: Average number of inserted auxiliary gates and average running time of *EffectiveQM* with various hyper-parameter settings of δ on the RevLib benchmark per device.

Device	$\delta = 1$	$\delta = 3$	$\delta = 5$	$\delta = 7$	$\delta = 9$
TOK-gate	878.7	862.6	858.9	854.3	845.8
TOK-time	40.7	87.6	130.7	181.5	242.1
SYC-gate	2665.1	2646.4	2639.3	2636.2	2632.8
SYC-time	97.2	203.6	297.5	390.3	478.0
GUA-gate	3685.6	3660.5	3659.7	3650.4	3651.3
GUA-time	44.3	115.4	145.4	234.4	288.3
ROC-gate	3527.4	3517.6	3495.8	3494.3	3492.3
ROC-time	60.8	128.1	193.2	273.6	321.2
Q16-gate	1030.1	1016.6	1015.9	1009.1	1006.7
Q16-time	37.2	80.2	112.5	154.8	179.3
TOR-gate	3530.3	3509.9	3487.5	3483.6	3475.6
TOR-time	43.6	108.3	174.1	231.6	258.9

TABLE V: Average number of inserted auxiliary gates and average running time of *EffectiveQM* with various hyper-parameter settings of θ on the RevLib benchmark per device.

Device	$\theta = 1$	$\theta = 3$	$\theta = 5$	$\theta = 7$	$\theta = 9$
TOK-gate	834.3	849.2	858.9	891.2	885.9
TOK-time	102.6	107.7	130.7	147.9	167.3
SYC-gate	3033.5	2726.4	2639.3	2608.0	2587.7
SYC-time	277.9	254.7	297.5	303.2	360.9
GUA-gate	4804.3	3825.3	3659.7	3605.1	3634.2
GUA-time	132.8	120.9	145.4	195.5	187.4
ROC-gate	4600.3	3683.0	3495.8	3478.6	3510.7
ROC-time	141.4	143.0	193.2	231.8	220.6
Q16-gate	1012.1	1028.5	1015.9	1030.1	1032.2
Q16-time	90.0	106.6	112.5	143.2	148.0
TOR-gate	4600.6	3678.3	3487.5	3475.8	3508
TOR-time	125.7	121.3	174.1	198.8	195.7

TABLE VI: Statistical information of adopted benchmarks. ‘QUEKNO- \ast ’ denotes the QUEKNO benchmark constructed for the corresponding device.

Benchmark	#circuits	#qubits			
		maximum	minimum	average	median
RevLib	26	20	4	11.2	11.5
RW	66	100	10	38.8	30
QV	60	30	5	17.5	17.5
QUEKNO-TOK	80	20	20	20	20
QUEKNO-SYC	80	53	53	53	53
QUEKNO-GUA	80	16	16	16	16
QUEKNO-ROC	80	53	53	53	53
QUEKNO-Q16	80	16	16	16	16
QUEKNO-TOR	80	133	133	133	133

TABLE VII: Average number of inserted auxiliary gates and average running time on the RW benchmark per device.

Device	<i>EffectiveQM</i>	<i>ILS</i>	<i>FiDLS</i>	<i>Qiskit</i>	$t ket\rangle$	<i>QMAP</i>	<i>TB-OLSQ2</i>	<i>SAHS</i>
TOK-gate	275	303.1	459.5	596.6	554.3	810.3	503.2	459.6
TOK-time	182.9	8.8	6.3	1.4	0.2	3.7	2356.8	76.9
SYC-gate	1006.7	1104.1	2112.7	1497.3	1388.9	1960.9	1379.9	1465.6
SYC-time	748.0	125.4	32.8	1.3	0.6	4.1	2760.4	87.1
GUA-gate	2506.3	2649.4	5098.9	5568.6	3000.8	4949.3	5634.4	3723.5
GUA-time	181.6	10.2	1.5	2.8	0.3	7.5	2270.8	128.9
ROC-gate	1628.6	1720.3	4098.1	2485.1	2680.7	3256.4	2216.1	2690.1
ROC-time	696.5	133.2	14.6	1.6	0.9	4.1	2941.9	74.7
Q16-gate	318.2	351.9	510.0	797.0	638.4	858.8	634.1	598.4
Q16-time	138.5	4.2	5.6	1.8	0.2	5.5	2251.5	111.3
TOR-gate	3191.1	3461.2	11351.5	4650.5	5051.8	6630.6	4013.9	5567.1
TOR-time	555.9	142.5	393.2	4.2	3.3	8.3	3049.6	1267.9

TABLE VIII: Average number of inserted auxiliary gates and average running time on the QV benchmark per device.

Device	<i>EffectiveQM</i>	<i>ILS</i>	<i>FiDLS</i>	<i>Qiskit</i>	$t ket\rangle$	<i>QMAP</i>	<i>TB-OLSQ2</i>	<i>SAHS</i>
TOK-gate	125.0	141.9	174.1	153.3	184.0	209.9	142.9	162.9
TOK-time	276.3	9.7	32.2	2.0	0.2	4.3	2704.1	6.6
SYC-gate	562.6	617.4	1231.2	661.5	864.0	832.3	617.9	699.4
SYC-time	834.2	66.4	32.1	4.0	1.0	9.5	3004.7	33.1
GUA-gate	155.8	166.9	281.8	179.0	232.1	247.9	165.0	221.7
GUA-time	161.2	3.5	0.3	1.3	0.1	2.8	2407.1	4.0
ROC-gate	1068.0	1105.7	1894.3	1184.3	1536.5	1478.3	1080.2	1281.9
ROC-time	808.3	81.6	10.0	4.1	1.4	9.6	3009.1	31.5
Q16-gate	50.5	56.5	72.5	65.0	84.5	90.5	57.5	69.0
Q16-time	139.7	2.6	7.8	1.2	0.1	2.8	2404.2	3.9
TOR-gate	1041.2	1091.5	2796.8	1165.9	1576.6	1673.2	1076.6	1321.8
TOR-time	527.4	26.4	28.9	2.7	1.2	10.3	3076.8	65.3

TABLE IX: Average number of inserted auxiliary gates and average running time on the QUEKNO benchmark per device.

Device	<i>EffectiveQM</i>	<i>ILS</i>	<i>FiDLS</i>	<i>Qiskit</i>	$t ket\rangle$	<i>QMAP</i>	<i>TB-OLSQ2</i>	<i>SAHS</i>
TOK-gate	27.6	35.6	171.6	80.2	124.3	144.0	36.6	97.1
TOK-time	15.0	18.9	26.6	0.4	0.1	0.3	2188.9	3.8
SYC-gate	53.2	121.6	676.9	202.8	290.2	362.9	108.1	283.9
SYC-time	1177.0	195.0	114.6	0.5	0.2	0.7	2194.3	10.7
GUA-gate	24.1	28.0	198.2	49.7	120.2	92.7	25.2	64.0
GUA-time	2.5	3.4	0.3	0.3	0.1	0.2	617.6	2.6
ROC-gate	80.3	133.1	1035.8	237.8	295.4	433.4	119.7	369.4
ROC-time	1120.1	195.9	13.8	0.5	0.2	0.6	1807.9	8.1
Q16-gate	20.2	23.8	86.0	37.4	65.6	72.6	24.5	47.0
Q16-time	4.8	4.0	7.0	0.3	0.1	0.2	1572.7	2.6
TOR-gate	842.1	1245.8	7263.8	1905.3	3055.0	3498.7	1160.1	3104.0
TOR-time	1459.6	315.8	2753.2	2.0	3.7	404.5	3441.4	690.7