Table 1 Timing results for benchmark circuit instances with $n = 3$ qubits. Obtained with the following parameter setting: λ **= 0.25, NumReads 150, Annealing Time 150.**

Benchmark	# SWAPSQ	TimeQ	QPU Time	Embedding T	QUBO Time
3_17_13	3	0.14	0.05	0.07	0.02
3_17_14	3	0.13	0.05	0.06	0.02
3_17_15	2	0.1	0.05	0.03	0.01
ex-1_166	2	0.09	0.05	0.02	0.01
fredkin_5	1	0.09	0.05	0.03	0.01
fredkin_6	3	0.16	0.06	0.08	0.02
fredkin_7	1	0.09	0.06	0.02	0.02
ham3_102	1	0.1	0.05	0.03	0.01
ham3_103	2	0.09	0.05	0.03	0.01
miller_11	4	0.15	0.05	0.07	0.02
miller_12	2	0.1	0.05	0.04	0.02
peres_10	1	0.06	0.05	0.01	0.01
peres_8	1	0.06	0.05	0.0	0.01
peres_9	1	0.07	0.05	0.02	0.01
QFT_QFT3	1	0.06	0.05	0.0	0.0
toffoli_1	1	0.13	0.05	0.06	0.01
toffoli_2	1	0.11	0.05	0.05	0.01

Table 2 Timing results for benchmark circuit instances with $n = 4$ qubits. Obtained with the following parameter setting: λ **= 0.25, NumReads 150, Annealing Time 150.**

Benchmark	# SWAPSQ	TimeQ	QPU Time	Embedding T	QUBO Time
decod24-v0_38	4	0.56	0.06	0.43	0.07
decod24-v0_39	5	0.47	0.05	0.38	0.04
decod24-v0_40	3	0.29	0.06	0.2	0.03
decod24-v1_42	2	0.28	0.05	0.2	0.03
decod24-v2_43	5	0.5	0.06	0.4	0.05
decod24-v2_44	3	0.24	0.05	0.15	0.04
decod24-v3_46	3	0.34	0.06	0.24	0.04
QFT_QFT4	3	0.25	0.06	0.17	0.02
rd32-v0_66	3	0.46	0.06	0.37	0.04
rd32-v0_67	2	0.25	0.05	0.17	0.03
rd32-v1_68	3	0.45	0.05	0.36	0.05
rd32-v1_69	2	0.25	0.05	0.17	0.03
toffoli_double_3	1	0.26	0.05	0.19	0.02
toffoli_double_4	2	0.34	0.05	0.25	0.04

Table 3 Timing results for benchmark circuit instances with $n = 4$ qubits. Obtained with the following parameter setting: λ **= 0.35, NumReads 1250, Annealing Time 450.**

Benchmark	# SWAPSQ	TimeQ	QPU Time	Embedding T	QUBO Time
4_49_17	12	1.45	0.73	0.58	0.14
aj-e11_168	13	0.93	0.79	0.05	0.1
decod24-v1_41	7	1.22	0.72	0.43	0.08
decod24-v3_45	15	1.38	0.78	0.5	0.1
hwb4_52	8	2.38	0.71	1.55	0.11

Table 4 Timing results for benchmark circuit instances with $n = 4$ qubits. Obtained with the following parameter setting: λ **= 0.35, NumReads 1250, Annealing Time 450.**

Benchmark	# SWAPSQ	TimeQ	QPU Time	Embedding T	QUBO Time
4_49_16	34	16.25	0.79	15.25	0.22
aj-e11_165	26	5.4	0.72	4.51	0.17
mod10_171	33	4.51	0.75	3.6	0.16
mod10_176	19	3.42	0.76	2.5	0.16

Table 5 Timing results for benchmark circuit instances with $n = 4$ qubits. Obtained with the following parameter setting: λ **= 0.50, NumReads 1250, Annealing Time 450.**

Benchmark	# SWAPSQ	TimeQ	QPU Time	Embedding T	QUBO Time
hwb4_49	37	18.71	0.81	17.68	0.22
hwb4_50	35	12.29	0.83	11.24	0.23
hwb4_51	64	14.22	0.82	13.15	0.25
mini-alu_167	43	15.12	0.82	14.1	0.21

Table 6 Timing results for benchmark circuit instances with $n = 5$ qubits. Obtained with the following parameter setting: λ **= 0.19, NumReads 1250, Annealing Time 450.**

Benchmark	# SWAPSQ	TimeQ	QPU Time	Embedding T	QUBO Time
4mod5-v0_19	3	15.97	0.8	15.02	0.15
alu-v0_27	5	17.79	0.7	16.94	0.15
alu-v1_29	4	11.02	0.76	10.14	0.13
alu-v2_33	4	18.44	0.78	17.5	0.16
mod5mils_65	4	32.39	0.75	31.51	0.12
QFT_QFT5	8	36.48	0.68	35.68	0.12

Table 7 Timing results for benchmark circuit instances with $n = 5$ qubits. Obtained with the following parameter setting: λ **= 0.19, NumReads 250, Annealing Time 250.**

Benchmark	# SWAPSQ	TimeQ	QPU Time	Embedding T	QUBO Time
4gt11-v1_85	1	29.79	0.11	29.51	0.17
4gt11_83	3	33.38	0.11	33.13	0.14
4gt11_84	1	17.94	0.11	17.77	0.06
4mod5-v0_20	2	27.81	0.11	27.61	0.08
4mod5-v1_22	1	33.52	0.1	33.32	0.11
4mod5-v1_24	3	15.88	0.12	15.63	0.13
4mod5-v1_25	1	14.6	0.12	14.38	0.11
mod5d1_63	2	17.09	0.1	16.9	0.09
mod5mils_71	2	16.8	0.11	16.55	0.14

Table 8 Timing results for benchmark circuit instances with $n = 5$ qubits. Obtained with the following parameter setting: λ **= 0.25, NumReads 1250, Annealing Time 450.**

Benchmark	# SWAPSQ	TimeQ	QPU Time	Embedding T	QUBO Time
4gt11_82	8	39.97	0.75	39.07	0.15
4gt13-v1_93	7	8.39	0.77	7.48	0.14
4gt13_92	8	32.34	0.74	31.43	0.17
4mod5-v0_21	9	24.32	0.74	23.41	0.17
alu-v1_28	4	21.15	0.74	20.24	0.16
alu-v3_34	5	28.49	0.74	27.6	0.16
alu-v3_35	6	14.79	0.78	13.87	0.14
alu-v4_37	6	13.88	0.73	13.0	0.15
mod5d2_64	13	31.25	0.78	30.25	0.22
mod5d2_70	5	14.44	0.73	13.55	0.16
rd32_272	8	29.47	0.8	28.5	0.18

Table 9 Timing results for benchmark circuit instances with $n = 5$ qubits. Obtained with the following parameter setting: λ **= 0.25, NumReads 1250, Annealing Time 450.**

Benchmark	# SWAPSQ	TimeQ	QPU Time	Embedding T	QUBO Time
4gt13_91	32	70.32	0.81	69.27	0.24
4gt5_75	11	24.1	0.74	23.18	0.18
4gt5_76	19	66.23	0.84	65.17	0.21
4gt5_77	21	43.33	0.79	42.28	0.26
4mod5-v0_18	13	39.15	0.82	38.12	0.2
4mod5-v1_23	16	64.44	0.8	63.45	0.19
alu-v0_26	12	41.69	0.74	40.77	0.17
alu-v4_36	24	73.12	0.83	72.02	0.27
one-two-three-v2_100	15	64.37	0.8	63.33	0.24
one-two-three-v3_101	11	46.62	0.78	45.69	0.16
rd32_271	24	57.2	0.78	56.2	0.22

Table 10 Timing results for benchmark circuit instances with $n = 5$ qubits. Obtained with the following parameter setting: λ **= 0.35, NumReads 1250, Annealing Time 450.**

Benchmark	# SWAPSQ	TimeQ	QPU Time	Embedding T	QUBO Time
4gt10-v1_81	50	108.69	0.82	107.54	0.34
one-two-three-v1_99	45	184.65	0.84	183.19	0.62

Table 11 Timing results for benchmark circuit instances with $n = 5$ qubits. Obtained with the following parameter setting: λ **= 0.70, NumReads 1250, Annealing Time 450.**

Benchmark	# SWAPSQ	TimeQ	QPU Time	Embedding T	QUBO Time
4gt12-v0_88	87	374.62	0.83	373.38	0.4
4gt12-v1_89	116	557.64	0.82	556.09	0.74
4gt13_90	61	258.96	0.82	257.54	0.6
4gt4-v0_79	−2	611.68	0.84	608.9	1.94
4gt4-v0_80	84	180.65	0.82	179.44	0.39
4mod7-v0_94	86	176.58	0.75	175.49	0.33
4mod7-v0_95	84	180.88	0.82	179.58	0.48
4mod7-v1_96	86	264.16	0.87	262.97	0.33
alu-v2_32	94	142.56	0.83	141.36	0.38
one-two-three-v0_98	81	206.92	0.82	205.7	0.4
sf_275	−2	381.49	0.8	380.25	0.45

Table 12 Timing results for benchmark circuit instances with $n = 6$ qubits. Obtained with the following parameter setting: λ **= 0.19, NumReads 1250, Annealing Time 450.**

Benchmark	# SWAPSQ	TimeQ	QPU Time	Embedding T	QUBO Time
ex1_226	4	72.41	0.8	71.44	0.17
graycode6_47	0	90.16	0.72	89.31	0.13
graycode6_48	2	92.85	0.74	92.0	0.12
xor5_254	8	120.46	0.7	119.43	0.32

Table 13 Timing results for benchmark circuit instances with $n = 6$ qubits. Obtained with the following parameter setting: λ **= 0.35, NumReads 1250, Annealing Time 450.**

Benchmark	# SWAPSQ	TimeQ	QPU Time	Embedding T	QUBO Time
4mod5-bdd_287	−2	898.63	0.86	896.84	0.94
alu-bdd_288	−2	999.87	0.88	997.48	1.51
decod24-bdd_294	−2	316.42	0.84	314.71	0.87
decod24-enable_124	64	150.25	0.84	148.94	0.47
decod24-enable_125	71	304.3	0.82	302.85	0.63
QFT_QFT6	65	101.91	0.83	100.52	0.57
QFT_QFT7	−2	327.79	0.86	325.81	1.12