In [1]:
```
import pulser
import pulser_simulation
import numpy as np
import qutip
```

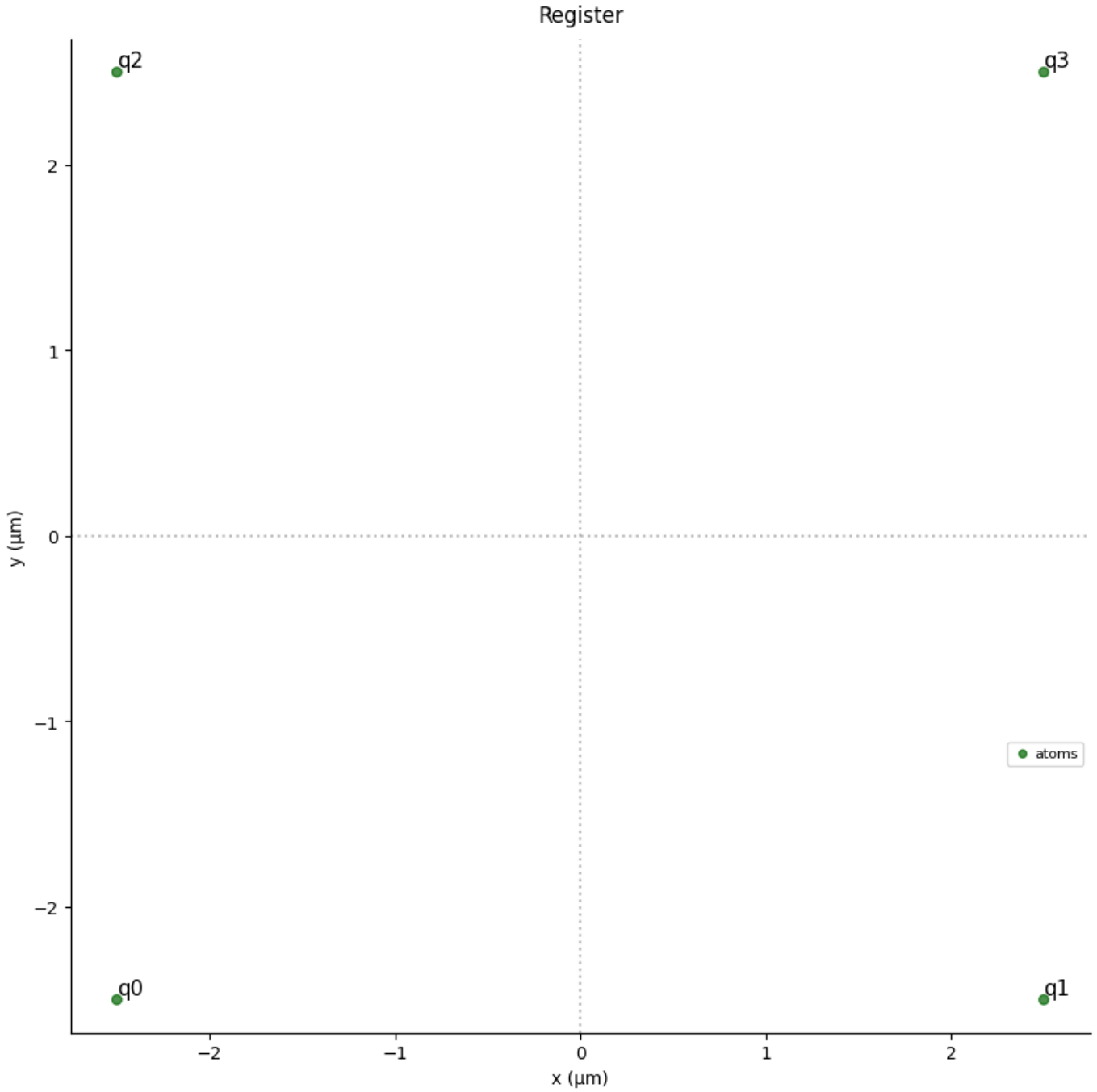
In [2]:
```
pulser.AnalogDevice.to_abstract_repr()
```

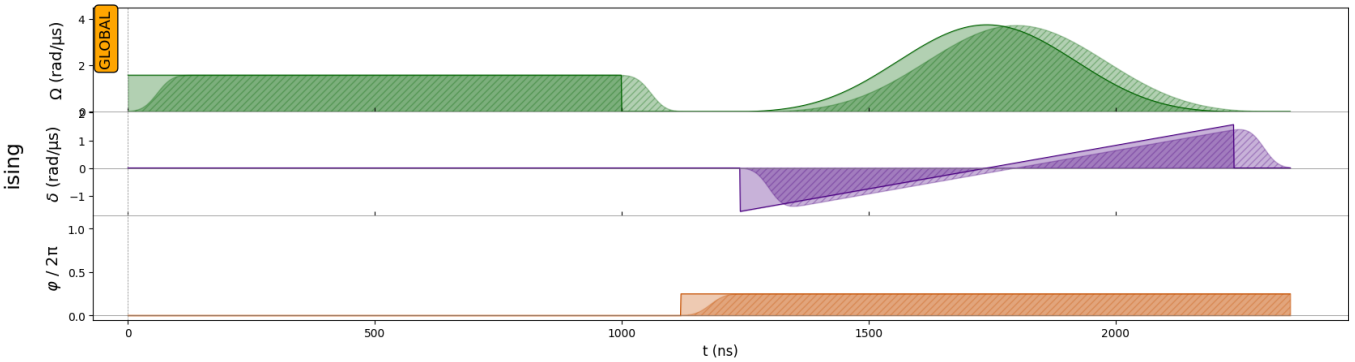
Out[2]:

```
'{"name": "AnalogDevice", "dimensions": 2, "rydberg_level": 60, "min_atom_distance": 5, "max_
atom_num": 25, "max_radial_distance": 35, "interaction_coeff_xy": null, "supports_slm_mask":
false, "max_layout_filling": 0.5, "max_sequence_duration": 4000, "max_runs": 2000, "reusable_
channels": false, "pre_calibrated_layouts": [{"coordinates": [[-20.0, 0.0], [-17.5, -4.33012
7], [-17.5, 4.330127], [-15.0, -8.660254], [-15.0, 0.0], [-15.0, 8.660254], [-12.5, -12.99038
1], [-12.5, -4.330127], [-12.5, 4.330127], [-12.5, 12.990381], [-10.0, -17.320508], [-10.0,
-8.660254], [-10.0, 0.0], [-10.0, 8.660254], [-10.0, 17.320508], [-7.5, -12.990381], [-7.5,
-4.330127], [-7.5, 4.330127], [-7.5, 12.990381], [-5.0, -17.320508], [-5.0, -8.660254],
[-5.0, 0.0], [-5.0, 8.660254], [-5.0, 17.320508], [-2.5, -12.990381], [-2.5, -4.330127],
[-2.5, 4.330127], [-2.5, 12.990381], [0.0, -17.320508], [0.0, -8.660254], [0.0, 0.0], [0.0,
8.660254], [0.0, 17.320508], [2.5, -12.990381], [2.5, -4.330127], [2.5, 4.330127], [2.5, 12.9
90381], [5.0, -17.320508], [5.0, -8.660254], [5.0, 0.0], [5.0, 8.660254], [5.0, 17.320508],
[7.5, -12.990381], [7.5, -4.330127], [7.5, 4.330127], [7.5, 12.990381], [10.0, -17.320508],
[10.0, -8.660254], [10.0, 0.0], [10.0, 8.660254], [10.0, 17.320508], [12.5, -12.990381], [1
2.5, -4.330127], [12.5, 4.330127], [12.5, 12.990381], [15.0, -8.660254], [15.0, 0.0], [15.0,
8.660254], [17.5, -4.330127], [17.5, 4.330127], [20.0, 0.0]], "slug": "TriangularLatticeLayou
t(61, 5.0\\u00b5m)"}], "accepts_new_layouts": false, "version": "1", "pulser_version": "1.2de
v1", "channels": [{"id": "rydberg_global", "basis": "ground-rydberg", "addressing": "Global",
"max_abs_detuning": 125.66370614359172, "max_amp": 12.566370614359172, "min_retarget_interval
": null, "fixed_retarget_t": null, "max_targets": null, "clock_period": 4, "min_duration": 16
, "max_duration": 100000000, "mod_bandwidth": 8, "eom_config": {"limiting_beam": "RED", "max_
limiting_amp": 188.49555921538757, "intermediate_detuning": 2827.4333882308138, "controlled_b
eams": ["BLUE"], "mod_bandwidth": 40, "custom_buffer_time": 240}}], "is_virtual": false}'
```


In [3]:
```
seq = pulser.Sequence(pulser.Register.square(2, 5, "q"), pulser.AnalogDevice)
seq.declare_channel("ising", "rydberg_global")
seq.add(pulser.Pulse.ConstantPulse(1000, np.pi/2, 0, 0), "ising")
seq.delay(100, "ising")
seq.add(pulser.Pulse(pulser.BlackmanWaveform(1000, np.pi/2), pulser.RampWaveform(1000, -np.pi/
```

In [16]:
```
seq.draw(draw_register=True)
```





In [5]:
```
backend = pulser_simulation.QutipBackend(seq)
```

In [6]:
```
%timeit backend.run()
```

```
129 ms ± 5.47 ms per loop (mean ± std. dev. of 7 runs, 10 loops each)
```

In [7]:
```
mod_backend = pulser_simulation.QutipBackend(
    seq,
    pulser.EmulatorConfig(
        with_modulation=True
    )
)
```

In [8]:
```
%timeit mod_backend.run()
```

```
129 ms ± 5.14 ms per loop (mean ± std. dev. of 7 runs, 10 loops each)
```

In [9]:
```
t_backend = pulser_simulation.QutipBackend(
    seq,
    pulser.EmulatorConfig(
        with_modulation=True,
        noise_model=pulser.NoiseModel(
            temperature=0.1,
            runs=10,
            samples_per_run=1,
        )
    )
)
```

In [10]:
```
%timeit t_backend.run()
```

```
2.89 s ± 114 ms per loop (mean ± std. dev. of 7 runs, 1 loop each)
```

In [11]:
```
relax_backend = pulser_simulation.QutipBackend(
    seq,
    pulser.EmulatorConfig(
        with_modulation=True,
        noise_model=pulser.NoiseModel(
            relaxation_rate=0.1,
        )
    )
)
```

In [12]:
```
%timeit relax_backend.run()
```

```
87 ms ± 3.64 ms per loop (mean ± std. dev. of 7 runs, 10 loops each)
```

In [13]:
```
qutip.Qobj(np.array([[0, 0, 1], [0, 0, 1], [1, 1, 0]]))
```

Out[13]:

Quantum object: dims = [[3], [3]], shape = (3, 3), type = oper, isherm = True

$$\begin{pmatrix} 0.0 & 0.0 & 1.0 \\ 0.0 & 0.0 & 1.0 \\ 1.0 & 1.0 & 0.0 \end{pmatrix}$$

In [14]:
```
leakage_backend = pulser_simulation.QutipBackend(
    seq,
    pulser.EmulatorConfig(
        with_modulation=True,
        noise_model=pulser.NoiseModel(
            with_leakage=True,
            eff_noise_opers=[qutip.Qobj([[0, 0, 1], [0, 0, 1], [1, 1, 0]])],
            eff_noise_rates=[0.1]
        )
    )
)
```

In [15]:
```
%timeit leakage_backend.run()
```

```
1.06 s ± 13.3 ms per loop (mean ± std. dev. of 7 runs, 1 loop each)
```