

Quantum & Cold-Atom Experiments

Many synchronized, low-jitter channels to sequence cooling lasers, trapping fields, microwave and RF pulses, and detection in quantum and cold-atom experiments.



APPLICATION BRIEF · PULSE & DELAY GENERATORS · dc-62022201

The Mission

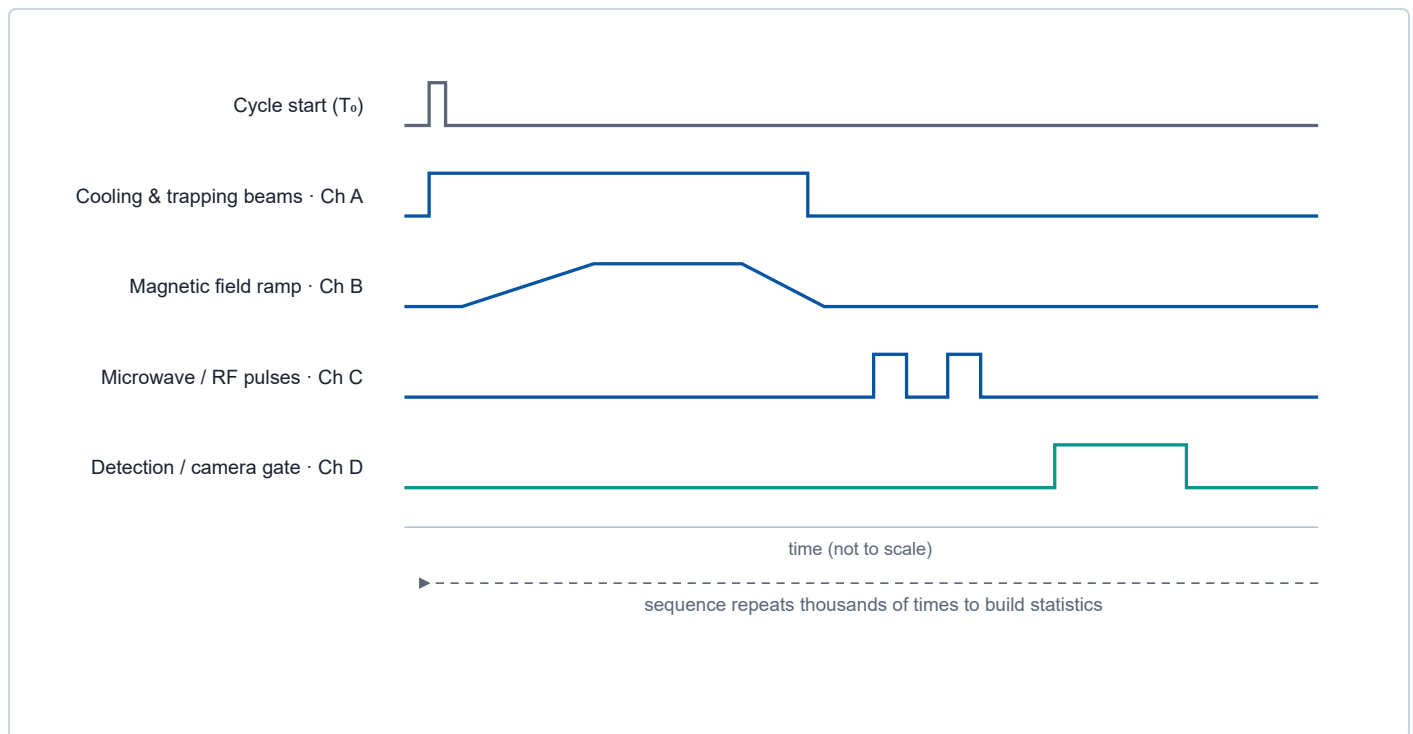
A cold-atom or trapped-ion experiment is an orchestrated sequence. Cooling and trapping beams switch on and off, magnetic fields ramp, microwave and RF pulses drive transitions, and a camera or detector reads out the result. Each step has to happen in a precise order with precise spacing, and the whole sequence repeats thousands of times to build statistics. The timing system is the backbone of the apparatus.

A pulse and delay generator provides that backbone, fanning one reference into many independently timed gates that shutter beams, trigger drivers, and arm detection, all phase-locked to the lab clock.

The Challenge

Channel count is the first hurdle. A single experimental cycle can call for many simultaneous, independently delayed gates, more than a typical four-channel box provides, and spreading the work across multiple unsynchronized units introduces skew. Jitter is the second. Coherent operations and narrow detection windows are sensitive to timing noise, so channel-to-channel jitter has to stay well below the shortest pulse in the sequence.

Locking to a house reference is essential so the timing system shares a timebase with RF synthesizers and the rest of the lab. Stable, repeatable sequences that can be stored and recalled keep long data runs consistent. Figure 1 shows one such cycle.



■ **SCHEMATIC** **Figure 1.** Representative cold-atom cycle: beam shutters, field ramps, interrogation pulses, and the detection gate all referenced to one cycle start. Sequence and durations are illustrative.

Recommended Berkeley Nucleonics Solutions

The **Model 588B** answers the channel-count problem directly, with 12 or 24 independent channels (up to 24 outputs) in a 2U rack, 250 ps delay resolution, and channel-to-channel jitter of 50 ps RMS, plus an external clock reference input so it shares the lab timebase. One unit can sequence an entire cooling, trapping, and detection cycle.

Where individual transitions demand the lowest timing noise, the **Model 745T** contributes 1 ps delay resolution and about 5 ps RMS jitter at delays below 100 ns, locked to a 10 MHz clock, for the most timing-critical microwave or optical pulses. The benchtop **Model 577** rounds out a setup with 4 or 8 channels, deep gating, and selectable 10 to 100 MHz clock in and out for a subsystem or a smaller table.

Why It Works

A high-channel master like the 588B keeps the whole sequence on one clock and one box, eliminating inter-unit skew, while the 745T supplies the lowest-jitter timing where coherence depends on it. External clock locking ties the timing system to the lab's RF and optical references, and stored configurations make thousand-cycle data runs reproducible. The result is a sequence that stays identical from the first shot to the last.

Getting Started

Berkeley Nucleonics application engineers help match channel count, edge speed, jitter budget, and output module to your timing diagram before you order. Send a block diagram or a short description of the events you need to synchronize, and we will return a configuration recommendation.

Email info@berkeleynucleonics.com or call 800-234-7858. Browse the full Pulse & Delay Generator documentation for datasheets, manuals, and ordering guides.

Berkeley Nucleonics Corp.

Test, Measurement and Nuclear Instrumentation since 1963

For details: info@berkeleynucleonics.com or 800-234-7858

Application Brief

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