

Physics & Accelerator Timing

Multi-channel synchronization of detectors, lasers, beam kickers, and diagnostics across an accelerator or large-physics experiment, from one timing reference.



APPLICATION BRIEF · PULSE & DELAY GENERATORS · dc-62022201

The Mission

A modern accelerator or large-physics experiment runs on a single shared clock. Beam-position monitors, scintillation and silicon detectors, gated cameras, injection and extraction kickers, and pump or probe lasers all have to fire in a fixed relationship to the beam. The timing reference is the experiment. When it drifts, the data drifts with it.

The job of a pulse and delay generator here is to take one trigger or one external clock and fan it out to many channels, each with its own programmable delay and width, so every subsystem sees its event at exactly the right instant. Channel count, jitter, and the ability to lock to an external reference matter more than raw output drive.

The Challenge

Three constraints dominate. First, channel count: a single rack of detectors and diagnostics can need a dozen or more independently timed outputs, and splitting the work across several boxes adds cable skew and a second clock to worry about. Second, jitter: gated detectors and coincidence windows can be only nanoseconds wide, so channel-to-channel timing uncertainty has to be far below that window. Third, traceability to a house clock: the generator has to phase-lock to the facility 10 MHz (or a custom reference) rather than free-run on its own oscillator.

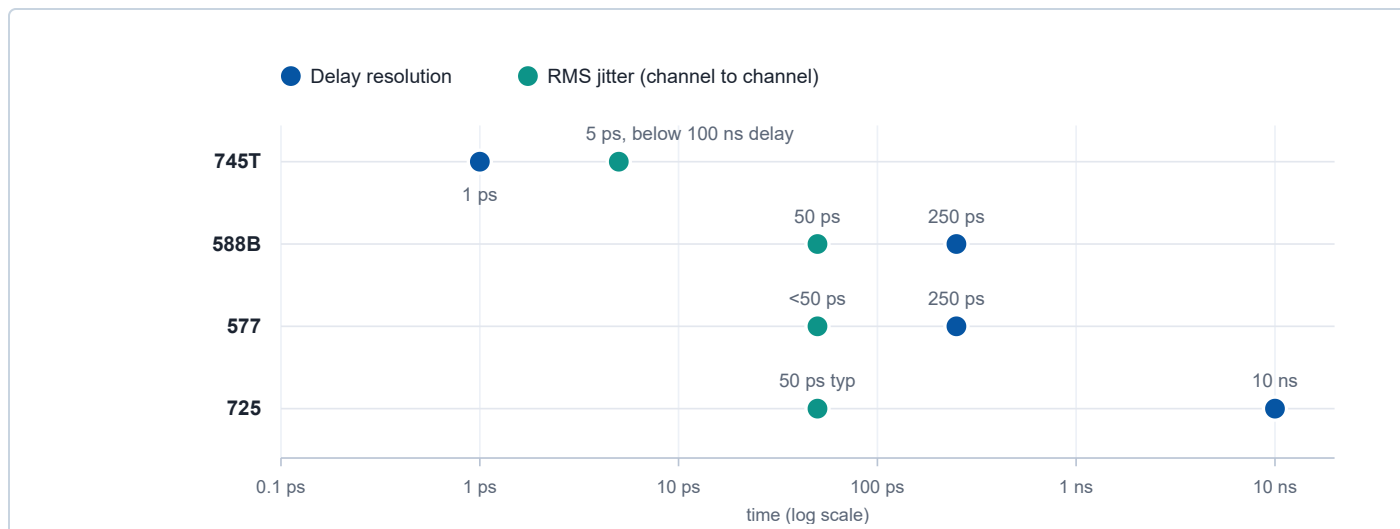
Negative delay between channels, burst and single-shot modes for machine studies, and remote control over Ethernet for a generator mounted deep in a shielded hall round out the requirement.

Recommended Berkeley Nucleonics Solutions

For the highest channel density, the **Model 588B** provides 12 or 24 independent channels (up to 24 outputs) in a 2U rackmount, with 250 ps delay resolution and channel-to-channel jitter of 50 ps RMS. It accepts an external clock reference, so one 588B can serve as the master fan-out for a whole detector rack.

Where the synchronization window is tightest, the **Model 745T** resolves 1 ps with about 5 ps RMS jitter at delays below 100 ns, and locks to a 10 MHz external clock, with faster references available as a factory option. It is the choice for pump-probe and coincidence timing that has to ride below the detector gate.

The benchtop **Model 577** gives 4 or 8 channels with 250 ps resolution, deep gating and trigger options, and selectable 10 to 100 MHz clock in and out, a practical workhorse for a single beamline or test stand. For experiments that combine several asynchronous trigger sources, the **Model 725** adds eight independent timers with programmable Boolean logic (AND, OR, XOR, negated) to coordinate multi-input events. Figure 1 places the four on one timing axis.



■ **DERIVED** **Figure 1.** Delay resolution and channel-to-channel RMS jitter of the recommended models, from the current datasheets, on a log scale (left is finer). The 745T's 5 ps applies at delays below 100 ns; the 725's 50 ps is typical jitter from an internal source.

Why It Works

Each of these instruments locks to an external reference and fans a single trigger out to many channels, so every subsystem inherits the same timebase. The 588B answers channel count, the 745T answers jitter, the 577 answers everyday flexibility, and the 725 answers logical combination of triggers. Negative delay lets you reference one detector to another in either direction, and stored configurations make it quick to recall a known-good machine state.

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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