

Application Note

Driving Pockels Cells with BNC PVX Series High-Voltage Bipolar Pulse Generators

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1. Overview

Speed matters. In electro-optic systems, the difference between a clean laser pulse and a compromised one comes down to nanoseconds and kilovolts. Pockels cells are the gatekeepers. They use the linear Pockels effect to rotate the polarization of light the instant an electric field is applied, switching beams on and off with precision no mechanical shutter can match.

The applications are broad: Q-switching in high-power pulsed lasers, pulse picking, beam steering, optical isolation, and high-speed shuttering. The electrical requirement is simple but demanding. The driver must push fast, high-voltage pulses into a capacitive, high-impedance load with virtually no resistive component. Rise time and peak current define the result, not sustained current. Get those right, and the cell performs.

This application note shows exactly how the BNC **PVX Series** bipolar high-voltage pulse generators are configured to drive single and multiple Pockels cells in parallel, drawing on real deployments at defense and research institutions.

2. Why the PVX Series



The PVX series was built for this. Capacitive loads, high impedance, bipolar high-voltage switching. It is not a compromise solution adapted from another product class. It is purpose-designed for the job.

Here is what sets it apart:

- **Bipolar output:** Drives the cell to the half-wave voltage (V_{π}) in both polarities. Full on/off polarization control without any passive return path dependency.
- **High peak voltage:** Models span ± 1.5 kV to ± 10 kV, covering the V_{π} range of virtually every commercially available Pockels cell.
- **Fast rise time:** Nanosecond-class switching into low-capacitance loads. The PVX-4151 achieves less than 25 ns. The PVX-4110 delivers less than 60 ns at full 10 kV swing.
- **Built-in power protection:** Internal average power monitoring (150 W on the PVX-4151, 100 W on the PVX-4110) guards both the pulser and the cell. Thermal runaway is not a concern.

Each PVX unit pairs with an external BNC **EVO series** high-voltage DC supply and accepts a standard TTL gate input. Integration with any pulse/delay generator or timing system is clean and immediate.

3. Electrical Characteristics of Common Pockels Cells

Most transverse and longitudinal Pockels cells present the following electrical characteristics to the driver:

Parameter	Typical Value
Load capacitance per cell	3 - 20 pF
Required switching voltage (V_{π})	1 kV - 10 kV depending on crystal and wavelength
Required pulse width	5 ns - CW
Rise time requirement	< 10 ns (pulse picking), relaxed for slower applications
Load impedance	Very high (capacitive only, essentially open circuit in steady state)

Example from field deployment (defense laser system):

Three Pockels cells, 10 pF each, driven in parallel. Total load: **30 pF**. Required drive voltage: ± 10 kV. The PVX-4110 handled it without modification.

4. Single-Cell Configuration

One cell, one cable. The PVX output connects directly to the high-voltage electrode. The low-voltage electrode ties to the EVO supply ground return. It is a two-wire hookup, and it works.

Recommended setup: 1. Connect the EVO positive HV output to the PVX **+HV Input** 2. Connect the EVO negative HV output to the PVX **-HV Input** (bipolar operation) 3. Connect the PVX pulse output to the cell HV electrode via the supplied RG-11 or custom HV coax 4. Apply a TTL gate signal to the PVX gate input

(BNC Model 525, 575, or equivalent)

Note: Keep the output cable short. Every foot adds capacitance. Each PVX model carries a different internal capacitance and a different cable capacitance per foot. Both go into the total capacitance budget, and both affect rise time and average power. See the specifications table in Section 10.

5. Multi-Cell Parallel Configuration



Driving one cell is straightforward. Driving three simultaneously requires a different approach, but it is not complicated. The answer is a distribution bus: a single PVX output split and delivered to all cells in parallel through equal-length cables.

From a defense laser system deployment (PVX-4110, 3x Pockels cells):

BNC Applications Engineering recommended:

"The best method would probably be to connect the output of the PVX-4110 to a main bus that is connected to all 3 Pockels cell inputs."

The customer initially considered a dedicated output for each cell. BNC engineering confirmed that approach would require a custom chassis and would compromise calibration. The better solution was a **custom 1-to-3 HV splitter**:

- One PVX-4110 output feeds a compact passive HV splitter (~3" x 6" x 9")
- Three equal-length RG-11 runs deliver synchronized pulses to all three cells

Equal cable lengths matter. The cells switch together or they do not work as intended.

Key design rule for parallel cells:

Total capacitive load seen by the PVX is the sum of everything in the signal path:

$$\begin{aligned}
 C_{total} &= C_{cells} + C_{internal} + C_{cable} \\
 &= (N \times C_{cell}) + C_{internal} + (C_{cable_per_ft} \times L_{ft})
 \end{aligned}$$

Internal and cable capacitance values vary by model. See Section 10 or the individual datasheet.

Average power estimate:

The PVX switches its output between +V and -V on every pulse. Both supplies deliver energy on every transition. The correct expression:

$$P_{avg} = C_{total} \times V_{swing}^2 \times f_{rep}$$

where V_{swing} is the full peak-to-peak swing ($V_{swing} = 2 \times V_{rail}$). Example: 3 cells at 10 pF each, 3 ft of cable, ± 5 kV swing, 1,000 Hz:

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C_cells      = 3 x 10 pF      = 30.0 pF
C_internal   = 50 pF          = 50.0 pF
C_cable      = 21.5 pF/ft x 3 = 64.5 pF
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C_total      = 144.5 pF

P_avg = 144.5e-12 x (10,000)^2 x 1,000 ~ 14.5 W
    
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14.5 W against a 100 W rated limit. At 1 kHz, there is ample headroom. Push toward tens of kHz and the budget tightens. Keep cables short. Watch C_{total} .

6. Power Supply Pairing (EVO Series)



Every PVX needs a clean, stable high-voltage DC source. The BNC EVO series is the match. Offered as a bundle with the PVX, it delivers low-noise bias directly to the PVX rear panel connectors with no additional hardware required.

PVX Model	Voltage Range	Recommended EVO Supply
PVX-4151	$\pm 1,500$ V	EVO 1500-1400
PVX-4141	$\pm 3,500$ V	EVO 5000

PVX-4130	$\pm 6,000$ V	EVO 10000
PVX-4110	$\pm 10,000$ V	EVO 10000-200 or EVO 10000-300

Heinzinger SHV or EVO-series HVC connectors are used throughout. BNC supplies pre-made cables. Alternatively, cables can be terminated with ring connectors and mounted directly to a busbar distribution panel.

7. Trigger and Timing Integration

The PVX gate input accepts a standard TTL signal. Any BNC pulse/delay generator can drive it.

From a university research lab deployment:

A researcher driving a semiconductor laser device with the PVX-4151 confirmed the unit's suitability for capacitive loads. BNC Applications Engineering recommended the **Model 525 pulse generator** as a companion trigger source for customers who need gate control without a dedicated timing system.

Typical triggering chain:

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BNC Model 525 (or 575/508) → TTL Gate → PVX Gate Input → HV Pulse Out → Pockels Cell
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The Model 525 gives independent control over pulse width, delay, and repetition rate. Duty cycle is fully adjustable, and with it, average power to the cell.

8. Cabling Recommendations

Item	Recommendation
PVX output to splitter / busbar	RG-11 HV coaxial cable (supplied), minimize length
Splitter to cell	Equal-length runs; keep as short as cell spacing allows
Cable termination at cell	Ring terminal connectors, crimped or soldered; bolt to HV input busbar
Grounding	Single-point ground on the EVO supply chassis; do not float the PVX chassis

On RG-11 cable: RG-11 is a 75 Ohm coaxial cable operating here in an unterminated, capacitive configuration. No impedance matching is used. The Pockels cell is a capacitive open circuit. The cable

charges into it and holds. In parallel configurations, equal cable lengths are not optional. They ensure all cells switch at the same instant.

9. Recommended Product Configuration

Single Pockels Cell (up to ± 1.5 kV)

Item	BNC Model
Bipolar HV pulse generator	PVX-4151
DC power supply	EVO 1500-1400
Trigger source (if needed)	Model 525 or 575

Single Pockels Cell (up to ± 10 kV)

Item	BNC Model
Bipolar HV pulse generator	PVX-4110
DC power supply	EVO 10000-200 (or 10000-300 for higher current)
Trigger source (if needed)	Model 525 or 575

Multiple Pockels Cells in Parallel (up to ± 10 kV, 3 cells)

Item	BNC Model / Note
Bipolar HV pulse generator	PVX-4110
DC power supply	EVO 10000-200
HV 1-to-3 splitter	Custom BNC accessory (contact sales, MOQ 10 units)
Output cables (per splitter)	3x RG-11 HV cables, equal length, ring-terminal terminated
Trigger source (if needed)	Model 525 or 575

10. Key Specifications Summary



Parameter	PVX-4110	PVX-4141	PVX-4130	PVX-4151
Output voltage	±10,000 V	±3,500 V	±6,000 V	±1,500 V
Rise/fall time	< 60 ns	≤ 25 ns	< 60 ns	< 25 ns
Max avg output power	100 W	100 W	100 W	150 W
Max PRF	10 kHz	30 kHz	10 kHz	240 kHz
Internal capacitance	50 pF	120 pF	100 pF	200 pF
Cable capacitance	21.5 pF/ft (RG-11)	21.5 pF/ft (RG-59)	30 pF/ft (RG-58)	13 pF/ft (RG-62)
Gate input	TTL, 50 Ohm	TTL, 50 Ohm	TTL, 50 Ohm	TTL, 50 Ohm
Recommended EVO supply	EVO 10000	EVO 5000	EVO 10000	EVO 1500

For complete specifications refer to the individual product datasheets available at www.berkeleyelectronics.com.

11. Summary

The PVX series does one thing exceptionally well: it drives capacitive high-voltage loads with speed, precision, and protection built in. For Pockels cell applications, that is exactly the spec that matters.

Single-cell setups are two wires and a TTL signal. Multi-cell arrays add a passive splitter and equal-length cables. Average power stays well within rated limits at any practical laser repetition rate. The EVO supply delivers clean bias. The Model 525 delivers clean timing. Together, they form a complete, field-proven switching system that engineers at defense contractors and research universities have relied on in production.

When the laser fires, it fires right. That is the point.

Contact

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For custom configurations, splitter accessories, or application-specific guidance, contact your BNC Applications Engineer.

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