TeraXion

An indie Semiconductor Company

Product Selection Guide
Pulse Stretchers for Ultrafast Lasers

Building a chirped-pulse amplification (CPA)-based ultrafast laser? Choose the right pulse stretcher for your system requirements from TeraXion's fiber Bragg grating-based product portfolio for ultrashort pulse generation (USP). To ensure that lasers meet end-application requirements, pulse stretchers are chosen based on lasers' pulse duration, pulse energy and sensitivity to self-phase modulation (SPM).

PSR

The PSR is a **cost-effective solution for picosecond lasers.**

- **Wavelength**: 1 µm, 1.5 µm and 2 µm
- **Total stretching window**: 1 200 ps
- **Dispersion profile**: Customizable

HPSR

The HPSR is a fixed-dispersion pulse stretcher that provides **high-phase accuracy for femtosecond lasers.**

- **Wavelength**: 1 µm
- **Total stretching window**: 1 200 ps
- **Dispersion profile**: Customizable

TPSR

The TPSR is a versatile solution that combines the HPSR's benefits **with an added tuning feature to enhance SPM compensation.**

- **Wavelength**: 1 µm, 1.5 µm and 2 µm
- **Total stretching window**: Single FBG: 800 ps; Double FBG: 1 600 ps
- **Dispersion profile**: Customizable & tunable over $ß_2$, $ß_3$ and $ß_4$

TPSR-XTENDED

The TPSR-Xtended is a great addition to **high-energy systems and any laser architectures that are sensitive to SPM.**

- **Wavelength**: 1 µm, 1.5 µm and 2 µm
- **Total stretching window**: Single FBG: 1 200 ps; Double FBG: 2 400 ps
- **Dispersion profile**: Customizable & tunable over $ß_2$, $ß_3$, $ß_4$ and $ß_5$

CM-V

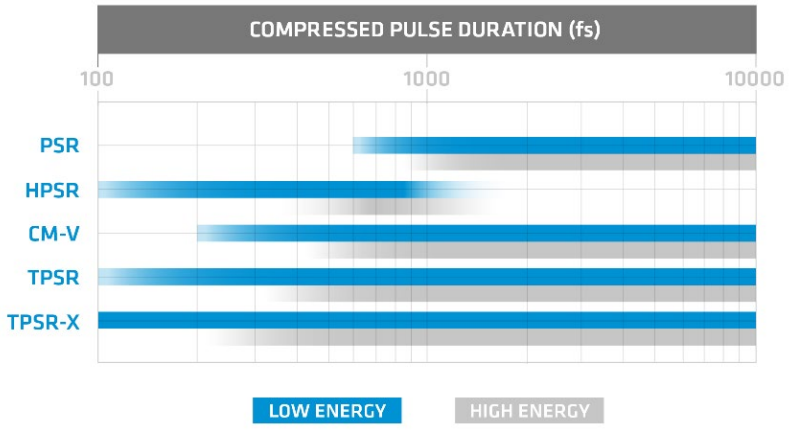
The CM-V is a pair composed of a TPSR and a matched in-house VBG compressor. This pair is **perfect for building compact lasers.**

- **Wavelength**: 1 µm
- **Total stretching window**: 500 ps
- **Dispersion profile**: Customizable & tunable over $ß_2$, $ß_3$ and $ß_4$

Note that the PSR, HPSR, TPSR and TPSR-X can be paired with a specific customer-provided volume Bragg grating (VBG) or diffraction grating (Treacy) compressor.

Pulse Stretcher Selection vs. Pulse Duration (fs) and Pulse Energy

The shorter the pulse duration, the more accurate the phase dispersion match must be.



EVERY ULTRAFAST LASER HAS A **MATCH**

PICOSECOND VS. FEMTOSECOND LASER

Picosecond lasers are mature technologies facing cost pressure. Their narrow linewidth makes them less sensitive to dispersion perturbations. The PSR is a proven cost-effective solution deployed in thousands of picosecond lasers.

Femtosecond lasers require high-accuracy chromatic dispersion management. The stretcher must be matched with the compressor dispersion, which represents the largest portion of the dispersion. The remaining dispersion coming from the amplifier and all passive fiber paths must also be considered to properly recompress the pulse to its Fourier Transform limit.

FIBER VS. SOLID-STATE LASER

Fiber amplifiers are highly sensitive to self-phase modulation (SPM) and require substantial stretching to reduce the peak power within the amplification chain. The PSR, HPSR and TPSR-X are a likely match.

Solid-state amplifiers and larger gain mediums are less sensitive to SPM and require less stretching. Compact stretcher-compressor pairs such as the CM-V are the right solution.

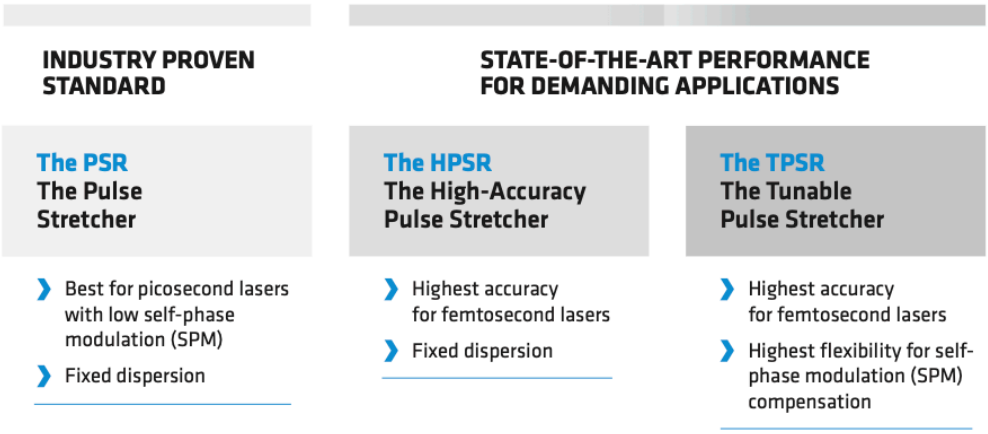
LOW-ENERGY VS. HIGH-ENERGY LASER

Low-energy lasers (e.g., for microscopy) are usually low cost and operated close to the linear amplification regime. Being in fixed operating conditions, low-energy lasers require less phase tuning. The HPSR is their best match. The TPSR offers SPM compensation *for medium energy levels* and *solid-state amplifiers* requiring less stretching.

High-energy lasers are more sensitive to SPM because amplification happens most of the time in the non-linear regime. These lasers are also operated in wide range of energy levels, which have different SPM distortion levels. The TPSR-X adds more stretching and dispersion tuning (up to β_5) to meet the requirements of demanding applications enabled at high energy levels and fiber-based amplifiers.

ALIGNED WITH INDUSTRY REQUIREMENTS

State-of-the-art dispersion management is required to ensure proper performance required for demanding applications enabled at high energy levels.



High sensitivity to unwanted distortions induced by self-phase modulation, asymmetric seed spectrum and amplification require a tunable pulse stretcher with an *extended stretching window*. The TPSR and TPSR-X are available in double FBGs – allowing for extended stretching without adding more components.

THE BENEFITS OF TUNABLE PULSE STRETCHERS

Accuracy. Tuning the stretcher provides more degrees of freedom than the compressor, allowing an effortless optimization of the output pulse of CPA-based femtosecond lasers.

Higher yield. The tunable feature enables the reduction of SPM-induced pulse degradation so that the highest pulse quality can simply and consistently be reached at any energy level– and later maintained during the lifetime of the laser.

Versatility. Tunable stretchers allow for switching between picosecond and femtosecond regimes, enabling several processes with one laser.

Support and Resources

Building an ultrafast laser is a challenging task that becomes much easier when it is done with the right partners. Please contact **ultrafast@teraxion.com** to properly select the appropriate components for specific laser and targeted market.

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