Pulse Compression and Pulsed Lasers

White Paper

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Overview

Calmar's Pulse Compressors use soliton-shaping and dispersion decreasing fiber (DDF) to reduce pulse widths. Pulse widths as narrow as 250 fs can be achieved when pulse compression is applied to 3 ps wide pulses.

The advantages of using dispersion decreasing fiber and soliton-shaping to compress pulses include the following:

- Input pulse energy can be lower, making this technique a better alternative for pulse compression at repetition rates of 10 GHz, and higher.
- Greater control over dispersive and non-linear effects ensures that output pulse pedestals are lower, and pulse quality is higher.

Calmar's Pulse Compressor, shown in Figure 1, is a two-stage device. In the first stage, an EDFA boosts the strength of the input signal. Stage one provides sufficient optical power for non-linear effects to drive soliton-shaping. In the second stage, DDF narrows pulse width. DDF is inherently lossy, but sufficiently high amplification in stage one ensures that signal strength at the output of the Pulse Compressor is higher than at the input to the Pulse Compressor.

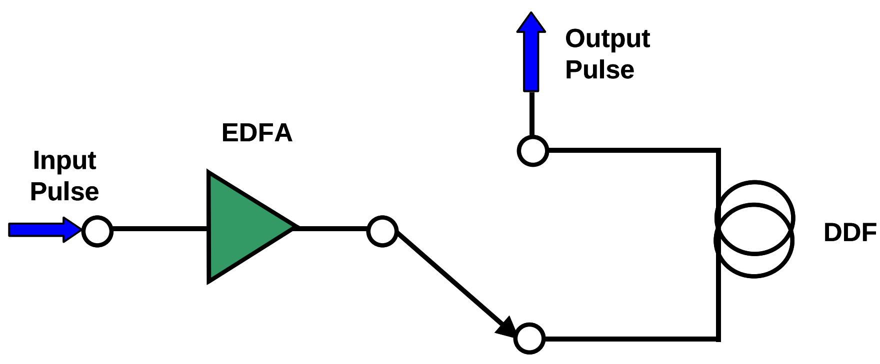


Figure 1 – Schematic of Pulse Compressor

The output of stage two will be chirp free when the input to stage one is chirp free.

Calmar's Pulse Compressor has been designed so that the EDFA can be used independently of the DDF, if required. Maximum saturated output power from the EDFA is over 100 mW.

Features

- Pulse compression to 1/12 input pulse width
- Post-compression spectral widths > 8 nm
- Post compression output powers 100 mW
- Pedestal after compression < 3%
- Wavelength range 1545 - 1560 nm
- Easy configuration and operation
- Long term stability

Applications

Engineers working at the leading edge of telecom research are often restricted by a lack of test and measurement equipment capable of probing at ultra high speeds. While solutions exist at speeds lower than 10 Gb/s, there is a shortage of test equipment that can adequately support research at 10 Gb/s, 40 Gb/s and higher.

The high extinction ratio, short pulse width, and low chirp make fiber lasers an ideal source for Optical Time Division Multiplexing (OTDM). Optical Code Division Multiple Access (O-CDMA), an emerging technique used in high bandwidth data transmission, requires a stable spectral comb as well as very short pulse width. Calmar's lasers provide the highly stable spectrum and high quality pulses that this application demands.

Optical Analog-to-Digital (A/D) conversion greatly expands the capabilities of A/D conversion beyond what is achievable using electronics, because optical pulses widths are an order of magnitude narrower than the pulse widths attainable using electronics. Fiber lasers, in particular, are ideally suited to this application due to their low amplitude noise, along with very narrow pulse widths.

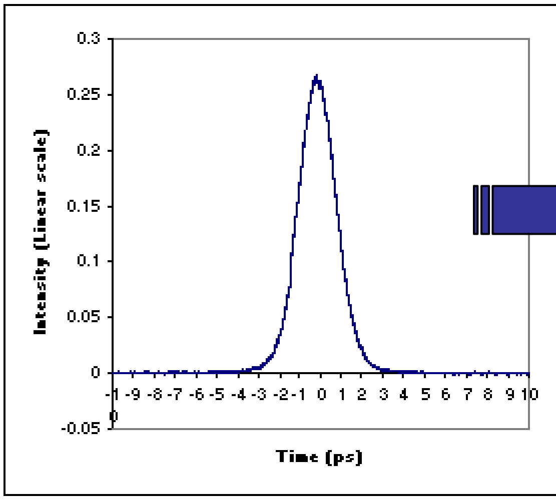
The following table provides specifications for Calmar's Pulse Compressor series. These specifications are subject to change without notice.

Model Number	**PCS-1**	**PCS-2**
Pulse Width Pre-Compression (ps)	3	1.5
Pulse Width Post-Compression (fs)	250	300
Input Wavelength Range (nm)	1545 - 1560	1545 - 1560
Input Repetition Rate Range (GHz)	2 - 20	10 - 50
Spectral Width (nm)	> 8.0	> 7.0
Output Power (mW)	100 @ 20 GHz	100 @ 50 GHz
Pedestal (%)	< 3	< 3
Operating Temp (°C)	5 - 40	5 - 40
Operating Voltage (V)	85 - 264 AC	85 - 264 AC
Dimensions (cm)	48(w) x 42(d) x 9(h)	48(w) x 42(d) x 9(h)

Table 1 – Specifications for Calmar's Pulse Compressor

Performance

The following test results give an indication of the performance of Calmar's Pulse Compressor.



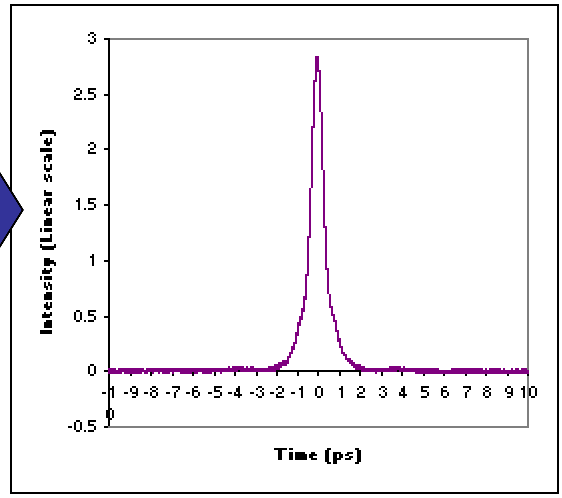
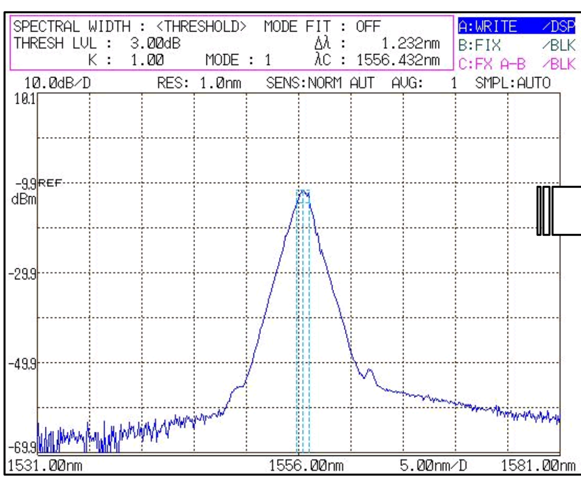


Figure 2 – Autocorrelation trace showing input pulse width of 1.5 ps, and peak pulse power 30 mW

Figure 3 – Autocorrelation trace showing output pulse width of 350 fs, and peak pulse power 100 mW



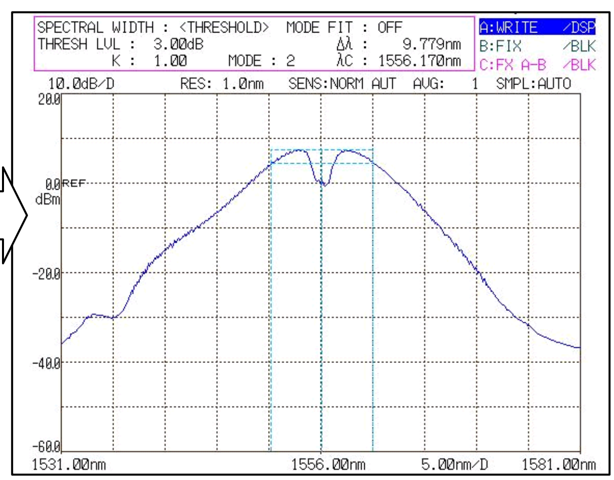


Figure 4 – Spectral width of input pulse of 1.2 nm FWHM, measured using OSA with 0.1 nm resolution

Figure 5 – Spectral width of output pulse of 9.8 nm FWHM, measured using OSA with 0.1 nm resolution

For more information on our Picosecond Fiber Laser series, Femtosecond Fiber Laser series, or any other Calmar products, please contact us.

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