



# FEMTOCHROME<sup>®</sup> RESEARCH, INC.

2123 4<sup>th</sup> Street, Berkeley, CA 94710  
Tel: 510-644-1869, Fax: 510-644-0118  
e-mail: tech@femtochrome.com; http: [www.femtochrome.com](http://www.femtochrome.com)

## FR-103XL RAPID SCANNING AUTO/CROSSCORRELATOR



### Specifications:

- Resolution: < 5fs
- Wavelength Range: 410-1800nm
- Minimum Pulse Width: < 5fs
- Maximum Pulse Width: 90ps
- Scan Range: > 175ps
- Sensitivity:  $(P_{av}P_{pk})_{min} = (10)^{-7}W^2$
- Fiber Coupled/Free Space
- Interferometric/Noncollinear
- Low Rep Rate Option
- Computer Data Acquisition Option
- VGA Display Option

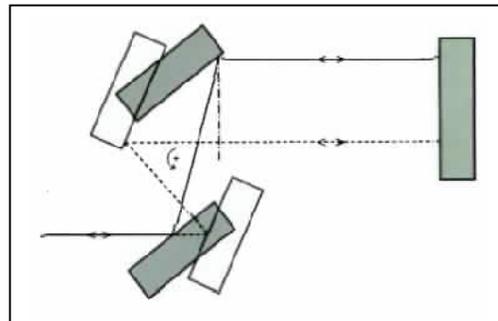
The FR-103XL is a dispersion-free auto/crosscorrelator for monitoring the temporal width of ultrashort optical pulses. Offering unsurpassed sensitivity and resolution, it is compact and easy to operate. The FR-103XL is ideally suited for the measurement weak signals as common in optical communications, as well as pulses from other mode-locked lasers such as Ti-Sapphire.

### DISPERSION-FREE, HIGH RESOLUTION

Material dispersion is nonexistent in the FR-103XL. Using high reflective metallic-coated optics [the only transmissive element is an ultrathin ( $\sim 1\mu\text{m}$ ) pellicle beam splitter], an unprecedented resolution of < 5fs [limited only by the NL crystal thickness] is attained.

### ROTATING PARALLEL MIRROR ASSEMBLY

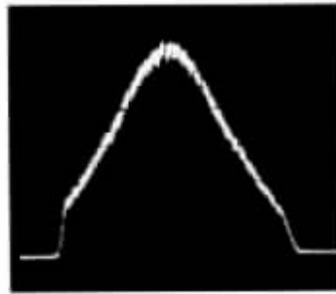
Periodic delay is introduced by means of a rotating parallel (//) mirror assembly\*. This unique mechanism results in reliable and error-free delay generation. Large delays are easily generated, with dispersion-free interferometric resolution.



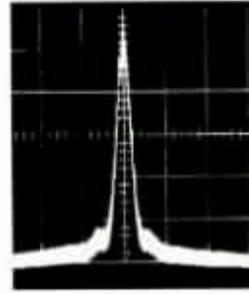
\* Z.A.Yasa and N.M.Amer, Optics Commun., V36,406 (1981)

## WIDE SCAN RANGE/LINEARITY

The delay generated by the // mirror assembly is an exact sinusoidal function of time. The entire scan range occurs for small angles, for which the linear approximation is excellent. The error in the measured autocorrelation FWHM is <0.5%, even for pulses as long as 100ps. With its high resolution and wide scan range, the FR-103XL is ideally suited for simultaneously monitoring fs pulses and satellite pulses that may trail by many psecs. The wide scan range is also critically useful to observe adjacent pulse correlations and pulse extinction ratios in > 10GHz optical telecommunication signals.



90ps pulse from a Nd-Yag laser(30ps/div)



Compressed by FR-403 PULSE COMPRESSOR(15ps/ div)

## CROSSCORRELATION

The FR-103XL has a built-in auxiliary port for crosscorrelation. Two spatially separate synchronized beams can readily be set for crosscorrelation. No additional optics is needed for this mode of operation.

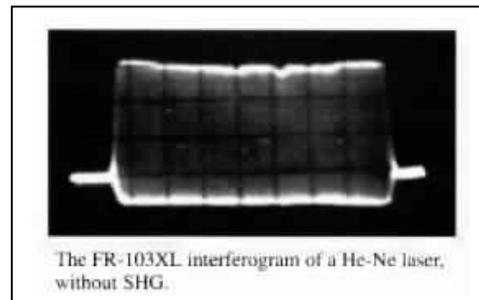
## OPTIONS:

### WAVELENGTH RANGES (/KDP/BBO/IR)

Three optimum NL crystals provide operation over a range of 410-1800nm. The standard unit includes a KDP crystal (0.3mm) [530-1100nm](/KDP). The addition of a BBO (0.3mm)[410-900nm] extends the short wavelength range(/BBO). A LiIO<sub>3</sub> crystal (1mm)[700-1800nm], a red extended PMT and an IR beam splitter extend the long wavelength range (/IR). Crystals are AR coated and include fundamental blocking filters, covering their operation range. For long term reliability, a desiccator is provided to protect the crystals when not in use. NL crystals of any type, thickness (<25μm) and cut can be provided for a specific application.

### INTERFEROMETRIC OPTION (/IO)

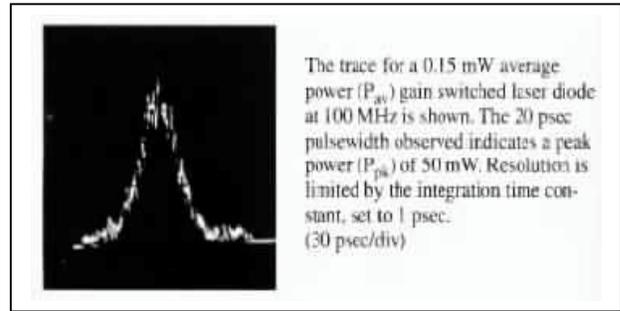
The FR-103XL's standard configuration uses the non-collinear (background-free) SHG method. As an option, a plane mirror/mount is provided for collinear autocorrelation with background. Using the highest resolution setting (1fs) of its integration-time switch, the interferometric response of the FR-103XL is revealed, leading to fringe resolved autocorrelation. [This mode is of low gain/integration, requiring higher input intensity].



The FR-103XL interferogram of a He-Ne laser, without SHG.

### **HIGH SENSITIVITY OPTION (/HS)**

The FR-103XL is perfectly suited to monitor pulses from low power lasers. The standard noise-equivalent signal level of  $P_{av}P_{pk} = 0.5(10)^{-6}W^2$  [using a 1mm LiIO<sub>3</sub>, and 1ps integration] is further improved using the High Sensitivity Option (/HS) to  $(P_{av}P_{pk})_{min} = 10^{-7}W^2$ .



### **FIBER ADAPTER OPTION (/FA)**

An optional mount is attached on the input variable aperture of the FR-103XL, for easy connection of fiber-coupled beams. Factory aligned, repeated connections without realignment is facilitated. Connector options other than the standard FC/PC or FC/APC are available. This option can also be applied to the crosscorrelation port.

### **FIBER COUPLED OPTION (/FC)**

For telecommunication applications, a fixed fiber input is provided rather than the removable (/FA). This option with all alignment controls eliminated renders the instrument utmostly robust and plug-and play. The optics is optimized for 1300-1600nm. Input connectors can be customer specified [FC/PC, FC/APC or others].

### **LOW REPETITION RATE OPTION (/LRR)**

The rotation rate of the // mirrors is locked to the repetition rate (or submultiple) of the input beam, with linear phase modulation. Using this option in conjunction with the /CDA or /VGA options, autocorrelation traces are collected in typically < 30 secs for any rep rate (as low as 4Hz), and continuously monitored on the display.

### **COMPUTER DATA ACQUISITION OPTION (/CDA)**

An A/D converter board with an RS232 interface is incorporated into the FR-103XL, and traces are displayed on a PC using its associated software. Delay is exactly computed, eliminating any trace nonlinearity. Continuous average, running average, fitting and pulsewidth readout with standard pulse shapes are featured. Data can be stored and printed. A laptop PC (/PC) can be added to this option for a factory tested complete system.

### **VGA DISPLAY OPTION (/VGA)**

As an upgrade of the /CDA, an embedded PC and a 640x480 VGA display can be added to the FR-103XL, rendering the instrument fully complete with measurement, display and data analysis, storage and printing capability in a single, compact enclosure. [/CDA is included in this option.]

### **WIDE SCAN (WS)**

A new modified version FR-103WS, encompassing all the features of the standard FR-103XL, provides a scan range > 400ps.

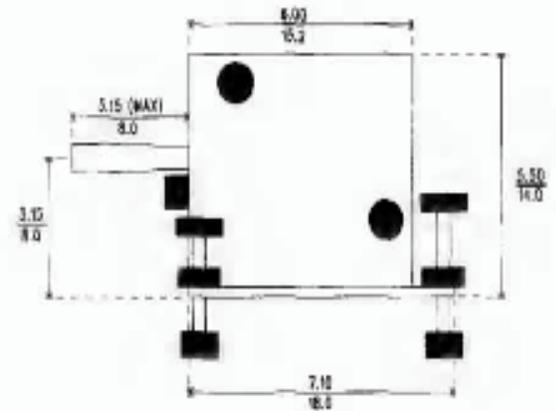
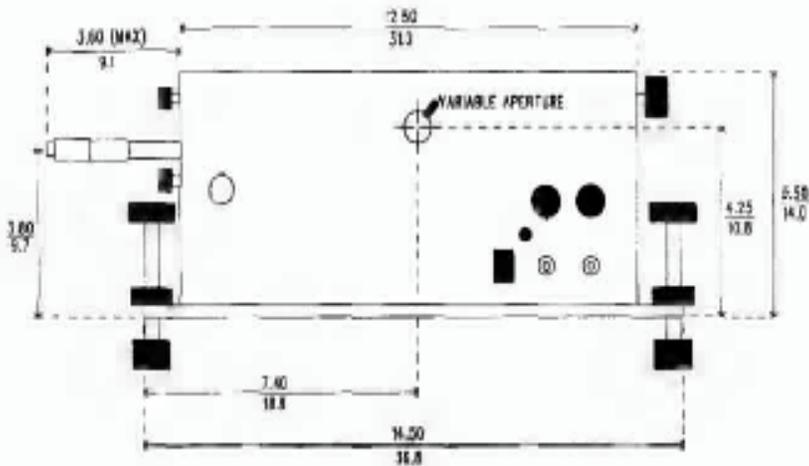
## SPECIFICATIONS

Pulse width resolution (0.05mm crystal):	< 5fs
Scan Range:	>175ps
Minimum Pulse Width:	< 5fs
Maximum Pulse Width:	90ps
Pulse width Error:	<1%
Wavelength Range:	410-1800nm
Noise Equivalent Signal (1mm LiIO3):	$P_{av}P_{pk} = 10^{-7}W^2$ (w/HS option)
Input Polarization:	Vertical
Dimensions:	6" x 6" x 12.5"

## Outline Drawings

Dimensions in  $\frac{\text{inch}}{\text{cm}}$

Model FR-103XL RAPID SCANNING AUTO/CROSSCORRELATOR



## FEMTOCHROME RESEARCH INC.

2123 4<sup>th</sup> Street, Berkeley, California, USA

Tel: (510) 644-1869, Fax: (510) 644-0118

e-mail: [tech@femtochrome.com](mailto:tech@femtochrome.com); <http://www.femtochrome.com>