



**FEMTOCHROME®
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FR-103 WS AUTO/CROSSCORRELATOR



Specifications:

- * Resolution: < 5fs
- * Minimum Pulsewidth: < 15fs
- * Maximum Pulsewidth: ~ 250ps
- * Scan Range: > 400ps
- * Sensitivity: $[P_{av}P_{pk}]_{min}=10^{-7}W^2$ "
- * Wavelength Range: 410-5000nm
- * Background-free (non-collinear SHG)
- * Crosscorrelation
- * Fiber Coupled/ Free Space
- * Computer Data Acquisition Option
- * LCD Display Option
- " w/ PMT [410-1700nm]

The **FR-103WS** is a dispersion-free, NL crystal auto/crosscorrelator for continuous '**real-time**' monitoring of temporal width of ultrashort laser pulses. Offering unsurpassed sensitivity, wide scan range and dynamic range, it is easy to operate. The **FR-103WS** is ideally suited for long pulsewidths (> 100ps), but it is also capable to measure pulses as short as ~ 10fs, from any mode-locked laser over a wide spectral range, for input pulse rep rates > 500Hz* .

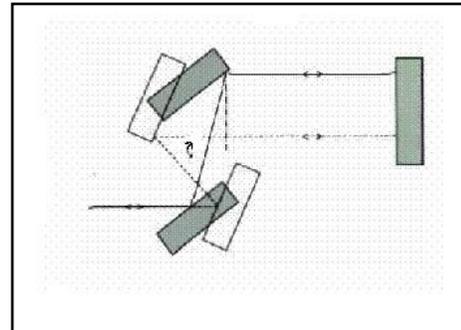
*input pulse rep rates > 4Hz w/ CDA option

DISPERSION-FREE, HIGH RESOLUTION

Dispersion is negligible in the **FR-103WS** for pulsewidths down to ~ 10 fs. Using high reflective metallic-coated optics [the only transmissive element is an ultrathin ($< 1\mu\text{m}$) pellicle beamsplitter], an exceptional resolution < 3 fs [limited only by the NL crystal thickness] is attained.

PARALLEL (//) MIRROR ASSEMBLY

Rapid scan, periodic optical delay is introduced by means of a parallel (//) mirror assembly.* Large delays are easily generated, with dispersion-free interferometric resolution.



WIDE SCAN RANGE/LINEARITY

With its wide scan range (~ 450 ps), the **FR-103WS** is ideally suited for measuring longer pulsewidths > 100 ps. Its unique mechanism is designed to correct for any delay nonlinearity over such a wide scan range, resulting in an exceptional linear delay.

SLOW SCAN OPERATION

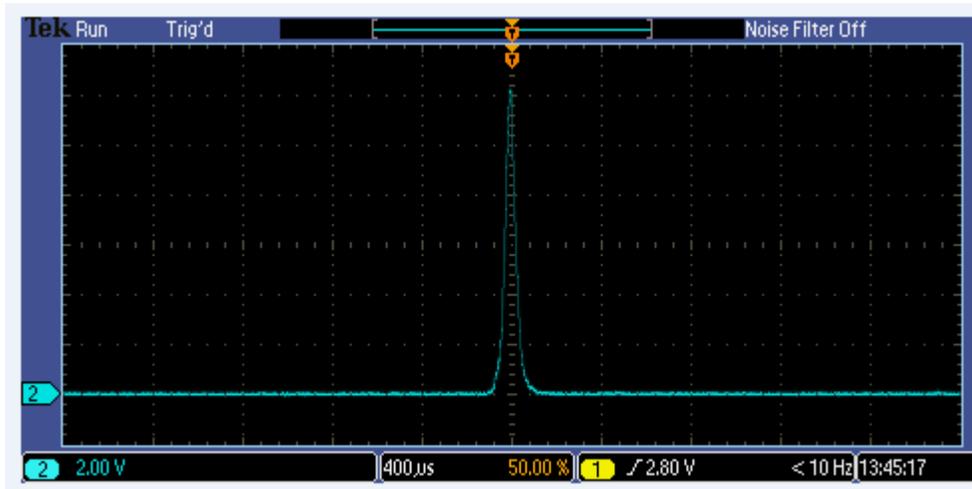
In this mode of operation of the **FR-103WS**, the // mirrors slow down greatly (3 selectable speeds) over a period when the pulses on the two arms of the Michelson Interferometer set-up are overlapping. The // mirrors speed up beyond this range, to return quickly for a repetition of the cycle. This mode renders the unit suitable for '**real-time**' autocorrelation of lasers with any rep rate > 500 Hz. [Input rep rates can be as low as 4Hz w/ CDA option].

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

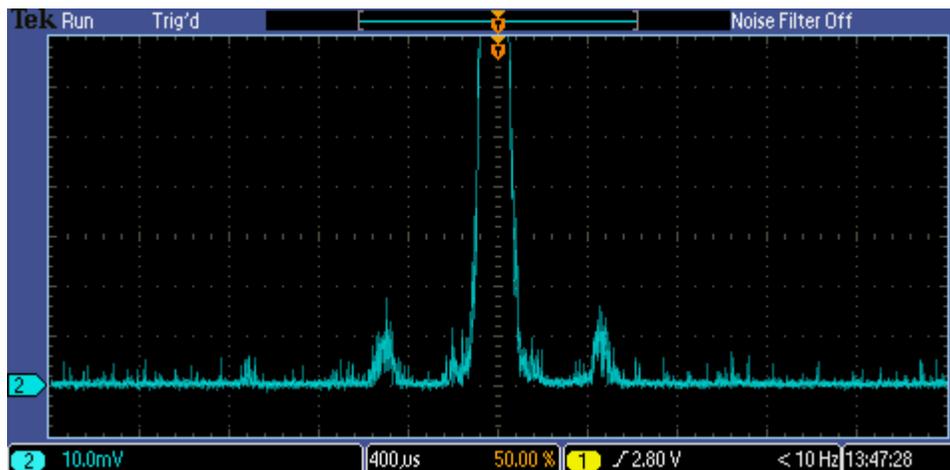
HIGH SENSITIVITY & WIDE DYNAMIC RANGE

The remarkable sensitivity of the **FR-103WS** is demonstrated by its noise equivalent signal level of $[P_{av}P_{pk}]_{min} = 10^{-7}W^2$ *. This is further augmented by an unprecedented dynamic range of $\sim 10^4$.

These remarkable figures render the **FR-103WS** powerful for the measurement of weak satellite pulses which commonly occur with modelocked lasers:



Commercial fiber laser (1552nm) pulse of 500fs duration.



A weak satellite pulse, separated from the main pulse by ~ 7 ps appears when the AC trace is expanded vertically.

* Over the wavelength range of 550-1700nm, and PMT operation w/ 1ps integration time and a NL crystal thickness of 1mm.

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

Three optimal **NL crystals** provide operation to ~ 5000nm. The standard unit comes with one customer specified NL crystal:

/BBO → 410-600nm
/KDP → 510-1100nm
/IR → 850-5000nm.

These NL crystals accept **vertically** polarized input beams, they are BBAR coated and fundamental blocking filters are provided for their operational range. For long term reliability, a desiccator is provided to protect the crystal when not in use. The standard NL crystal thickness is customer specified (0.1mm/0.3mm/1mm), with attention to the trade-off between resolution (thinner NL crystal) and sensitivity (thicker NL crystal).

Generally, a 0.3mm crystal thickness can be considered sufficient for pulsewidths down to ~30fs. With shorter pulses, a thinner crystal is necessary. For sub 10fs pulsewidths, a custom (<25µm) NL crystal thickness will need to be specified.

Two types of ultrathin pellicle **beamsplitters** are used with the **FR-103WS**, one (VS) which covers the entire wavelength range, and the second (IR) optimized for >800nm operation. When working with wavelengths < 800nm, the (VS) beamsplitter needs to be used. For wavelengths > 700nm, (IR) beamsplitter is preferable.

/xxxx PD modules for extended IR wavelengths

The photomultiplier (PMT) in the standard **FR-103WS** covers the 410-1800nm operation. This range can be extended in the IR, by plug-in photodiode (PD) modules (/xxxx) which mount in front of the PMT enclosure. The PD module selections are:

/1100 → 1100-2200nm
/2200 → 2200-3400nm
/3000 → 3000-5000nm

Sensitivity is greatly reduced when operating with these PD modules since they lack the gain as provided by a PMT. Typically, a minimum of ~ 5mW avg. power is needed for a subpicosecond modelocked pulse, over the wavelengths covered by these modules.

OPTIONS:

CROSSCORRELATION (/CC)

The **FR-103WS** has a built-in auxiliary port for crosscorrelation of two spatially separate synchronized beams. No additional optics is necessary for this mode of operation.

FIBER ADAPTER OPTION (/FA)

An optional gimbal mount with a collimator is installed over the variable input aperture of the **FR-103WS**, for easy connection of fiber-coupled beams. Factory aligned, repeated connections without a need for realignment is facilitated. The /FA is easily removable for a free-space input beam. Its standard adapter is FC [FC/PC or FC/APC]. For operation at 1550nm, a PM-DSF patchcord can be attached to the /FA. The collimator of the /FA is focus adjustable to obtain good collimation if it needs to be used at greatly different wavelengths. A $\lambda/2$ plate holder is also provided within the /FA assembly, for users to install one for their wavelength of operation, if needed for polarization control.

The /FA option can also be applied to the CC port [/FA(CC)].

COMPUTER DATA ACQUISITION OPTION (CDA)

A data acquisition board is installed in the **FR-103WS/CDA**, providing an interface (USB) with any PC w/ Windows OS. Its associated software allows traces to be displayed, analyzed [averaged and/or fit with typical pulseshapes (Gaussian and Sech²)] or saved.

LCD DISPLAY OPTION (/VGA)

As a further upgrade of the /CDA, a tablet PC w/keyboard is incorporated with the **FR-103WS/VGA**, providing a complete self-contained system.

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- * Scan Range: > 400ps
- * Sensitivity: $[P_{av}P_{pk}]_{min}=10^{-7}W^2$ [w/PMT over 550-1700nm]
- * Wavelength Range: 410-5000nm
- * Background-free (Non-collinear SHG)
- * Fiber Coupled/ Free Space
- * Crosscorrelation
- * 'real-time' autocorrelation for any input rep rate > 500Hz
- * Computer Data Acquisition Option
- * LCD Display Option



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