

STABILIZED FIBER LINK (SFL)

MenloSystems

The Stabilized Fiber Link (SFL) is a length-stabilized, dispersion-compensated optical link for the timing distribution system, comprising the subunits Fiber Link Stabilization Unit (FLS) and Link Fiber Connection-Receiver (LFC-Receiver). With an attosecond precision phase detector, actuators, and SYNCRO locking electronics, the FLS unit on the system reference side includes all

necessary components to stabilize the length of the optical fiber link. The LFC-Receiver on the client side consists of a dispersion compensation module and a bi-directional optical amplifier. The amplifier at the end of the link ensures the level of output power as required for the clients. Part of the signal is reflected back through the link to provide feedback on any length changes.

APPLICATIONS

- Low-drift and low-jitter distribution of optical signals over larger distances



STABILIZED FIBER LINK (SFL)

SPECIFICATIONS:

Optical link stabilization unit:

Parameter	Value	Comment
GENERAL SPECIFICATIONS		
Fundamental design frequency	50 – 250 MHz	to be specified prior to system order
Added timing jitter	<10 fs*	RMS [3 Hz, 10 MHz]
Added timing drift	<10 fs	RMS over eight hours, measured with balanced cross correlator, out-of-loop measurement
Timing resolution	<300 as	detection noise floor of integrated timing jitter [1Hz,10MHz]
OPTICAL INPUT		
Optical power	>20 mW	
Pulse duration	<200 fs	FWHM, Gaussian, interferometric autocorrelation
Input connector	SC/APC	
OPTICAL OUTPUT AT CLIENT SIDE		
Wavelength	1560 nm	
Central wavelength tolerance	±20 nm	
Average power	>10 mW	
Pulse duration	<300 fs	FWHM, Gaussian, interferometric autocorrelation
Output port type	Free space or fiber coupled	
ELECTRICAL OUTPUT		
High sensitivity error signal	>100 mV	SMA connector
UTILITY AND ENVIRONMENTAL REQUIREMENTS		
Ambient temperature	20 – 25 °C	
Temperature variation	±100 mK	for full specifications; pertains to FLS unit only
Length of connecting cable	10 m	Between FLS unit and SYNCRO-FLS
Integrated feedback	SYNCRO-FLS	Menlo SYNCRO Platform, optimized for fiber link stabilization
Auto lock	yes	Automatic (re-)lock algorithm in SYNCRO-FLS
REMOTE CONTROL		
Control system interfaces front-end	USB/RS232	Interface to SYNCRO-FLS
Control system interfaces back-end	USB/RS232/Ethernet	Interface to LFC-receiver

*full specifications only if the temperature stability of the environment is within specified range

Optical fiber link:

Parameter	Value	Comment
GENERAL SPECIFICATIONS		
Input/output connectors	SC/APC	
Fiber optic specifications	ITU-T G.652.D compliant	SMF28+
Effective link length	<400 m	
Dispersion compensation	DCF spool	matched lengths of DCF and SMF**
DCF spool connectors	SC/APC	
In-loop link amplifier		Er-doped amplifier to compensate for link losses
Monitor output port	<1 mW	fiber-coupled (SC/APC), suitable to measure the optical spectrum of the laser by an external OSA

UTILITY AND ENVIRONMENTAL REQUIREMENTS

Ambient temperature	20 – 25 °C	
Temperature variation	±2 °C	for full specifications; pertains to all link components except the FLS unit

** The compensation of the optical links has to be done “in the field“. The length of the DCF spools will be prepared based on link length measurement data to be provided.

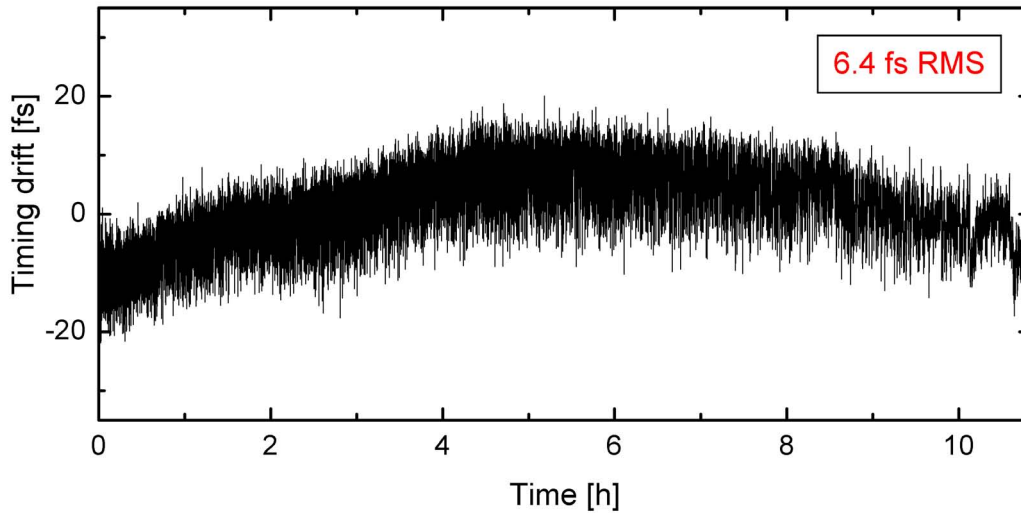
Optical fiber link output on client side:

Parameter	Value	Comment
GENERAL		
Link end point		partially reflective Faraday rotating mirror
VERSION 1: OPTICAL FREE SPACE OUTPUT***		
Pulse length	<300 fs	FWHM
Average output power	>10 mW	
Optical amplitude stability	<0.1 %	RMS [1kHz-10 MHz]
Optical bandwidth	>10 nm	
Central wavelength	1560 nm	
Central wavelength tolerance	±20 nm	
Beam diameter	>1 mm	
VERSION 2: OPTICAL OUTPUT FIBER COUPLED***		
Pulse length	<300 fs	FWHM; the real value has to be the same for all lines
Average output power	>10 mW	
Optical amplitude stability	<0.1 %	RMS [1 kHz, 10 MHz]
Optical bandwidth	>10 nm	
Central wavelength	1560 nm	
Central wavelength tolerance	±20 nm	
Output connector	SC/APC	

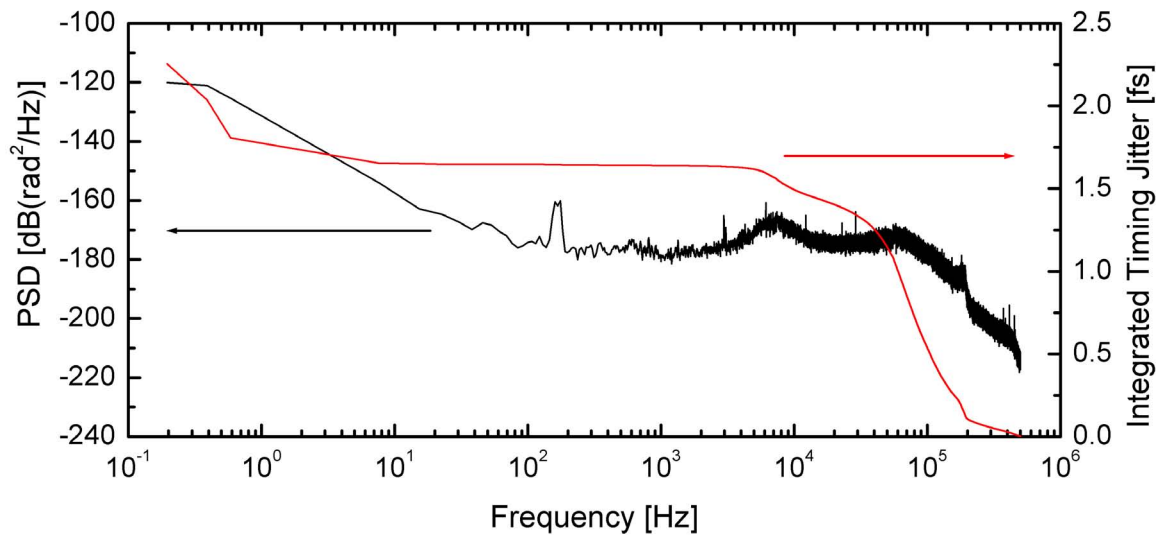
***Decision on either Version 1 or 2 for each of the links has to be made eight weeks prior to the start of manufacturing

MEASUREMENT DATA:

Out-of-loop long term timing drift between two stabilized fiber links:



Out-of-loop power spectral density (PSD) (black line) and integrated timing jitter (red line) between two stabilized fiber links:



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