OFC Update

March 2024

PHOTON KINETICS

Production Testing of Multicore Optical Fibers Enabled by New, Automated Single Fiber Aligner

Last October, Photon Kinetics announced the multicore-capable 2300 Fiber Analysis System, which performs two of the most common "short length" fiber production measurements – geometry and cut-off wavelength - in less than 45 seconds for a 4-core multicore fiber. At this year's OFC, Photon Kinetics is introducing a new configuration of its Full-Length Station (FLS), that is able to perform the most common "full-length" fiber production measurements on multicore optical fibers: bi-directional OTDR, chromatic dispersion and polarization mode dispersion. Together, the MCF-capable 2300 and FLS offer comprehensive, automated characterization of virtually all critical geometric and transmission properties of multicore fibers, without the need for fan-out assemblies, splicing, or optical switches; and using the same, industry-standard fiber prep tools used for conventional fiber testing.

Full Length Station (FLS-3)

The key component of the multicore FLS that enables high-speed MCF testing is another new product being introduced at OFC - the 1050F Automated Fiber Aligner. In the multicore FLS configuration, a pair of 1050Fs are used to automatically couple the station's top and bottom buffer fibers simultaneously to both ends of a MCF core. The FLS then performs fiber length and bi-directional OTDR measurements and, depending on the FLS configuration, chromatic dispersion and polarization mode dispersion as well. Once the first core measurements have been completed, the system automatically couples the FLS buffer fibers to the next MCF core, performs all measurements, and then continues this process until every core of the MCF has been tested. Complete bi-directional, 4-wavelength OTDR characterization of a four-core MCF can now be accomplished with the "multicore" FLS in just 2.5 minutes, with chromatic dispersion and PMD measurements adding just 5 seconds each per core.

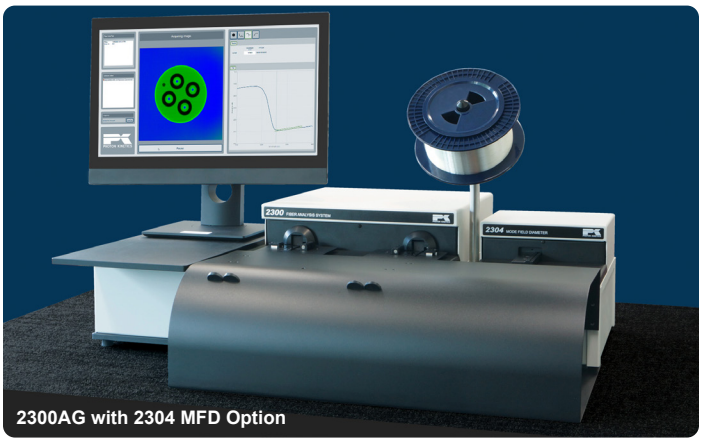
	Short-Length Station (2300AG) w/Options for MCF	Full-Length Station (FLS) w/Options for MCF
Fiber Geometry	✓	✗
Coating Geometry	✓ 2302 Option	✓ 2302 Option
Fiber Curl	✓ 2311 Option	✓ 2311 Option
Fiber Length	✗	✓
Cut-off Wavelength	✓	✗
Mode Field Diameter	✓ WAVAU Option	✓ by OTDR
Mode Field Uniformity	✗	✓
Spectral Attenuation	✓ by Cutback	✓ by OTDR
Attenuation Uniformity	✗	✓
Chromatic Dispersion	✗	✓ FLS-2 and FLS-3 only
Polarization Mode Disp.	✗	✓ FLS-3 only

✓ Included or optional ✗ Not applicable

In This Issue

New Fiber Geometry and Spectral Loss Options for Industry-Leading Test Platform

The 2300 Series Fiber Analysis System was introduced in 2015. Since then, configurations of the 2300 including the 2300AG, the fiber industry's first combined geometry and spectral loss test platform, plus the specialized 2300A and 2300G configurations, have continued to add new, optional measurement capability. Some of these options have simply been developed to give fiber manufacturers more choices for how they test standard multimode fibers. However, most of the capability we've recently introduced has been to provide specialty fiber manufacturers with the fiber characterization tools they need to develop the next generation of fiber sensors, fiber lasers, and new fibers for telecoms applications. The new options described below clearly demonstrate that the 2300 is not just the highest performing optical fiber measurement platform available, but arguably one of the most versatile.



2300AG with 2304 MFD Option

Fiber Geometry Options

Illumination - A choice fiber illumination options for the 2300G and 2300AG, i.e., standard or backlit (2300-BLI) , enables geometry characterization of a wide variety of fiber designs, including designs that have auxiliary, non-waveguide, structures such as the stress rods commonly found in polarization-maintaining (PM) fibers, the markers sometimes included in multicore fibers designs, or the secondary cladding layers found in several fiber designs including bend-insensitive and double-clad fibers.

Large Diameter Fibers - These options provide the ability to measure the geometry of fibers having cladding diameters larger than the upper limit of our standard systems. Currently, two large diameter fiber geometry options are available for the 2300G: the 2300-LDF option for large diameter fibers and 2300-XLDF option for extra-large diameter (2300-XLDF) fibers.

Image Analysis - A variety of image analysis software licenses are now available for analyzing the fiber end-face images obtained during a 2300G or 2300AG geometry measurement. These include licences for analyzing several types of PM fibers, multicore fibers (both with and without markers), as well as fiber designs having multiple cladding layers, secondary core boundaries, air holes or other structures. Custom geometry analysis licenses are also available for proprietary fiber designs.

Spectral Loss Options

Recently we have added several new Launch Options to the spectral loss configurations of the 2300 (i.e., 2300A and 2300AG). These options now include:

Limited Phase Space (LPS) Launch - The 2300-LPS option provides the standards-approved, LPS or "70/70" launch conditions necessary for measuring the cutback attenuation measurement of standard 50, 62.5, and 100 µm core multimode fibers with restricted launch spot and NA. The fully-automated LPS launch offers a more efficient option for multimode fiber launch control than the Automated Serpentine Mandrel (2300-MAN) option.

Multicore Fiber Launch - The measurement of multicore fiber transmission properties such as attenuation, cut-off and mode field diameter requires that light from the 2300's tunable, broadband source is launched into only one core of the fiber at a time. The 2300-MCL option, with automated launch spot restriction and positioning, provides this capability and enables selective launching into each individual cores of a MCF regardless of the number of cores in the fiber or their geometrical configuration.

Custom, Automated Launch Restrictors - These options were primarily developed for specialty fiber manufacturers who want to measure their fibers with either launch spot restriction (2300-ASR), NA restriction (2300-ANR) or both. These two options allow the customer to define their own launch spot diameters, and/or launch NAs for their specific requirements. (Note that customers are provided with the ability to define the launch location on the fiber end face via the 2300 system software). Some manufacturers may find these custom launch restrictors useful for characterizing the loss associated with specific structures in their fiber designs.

The new spectral loss options summarized above supplement previously announced options for low wavelength measurements (2300-WR1), large diameter single-mode fiber measurements (2300-LDS), and the automated serpentine mandrel (2300-MAN) used for launch conditioning for multimode fiber measurements.

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Single Fiber and Ribbon Aligners Join Automated Fiber Aligner Product Line

At OFC 2018, we introduced the 1050C Cable Aligner, the first member of the 1050 Series automated fiber aligner product line. The 1050C provides high-volume cable manufacturers with the ability to mass prepare and cassette load up to eight fiber loose tubes or ribbons, and then automatically align and sequentially couple each of the fibers in the tube/ribbon to an OTDR buffer fiber with both low loss and reflectance. The 1050C, under the control of our OASYS.net OTDR Automation Software, enables unattended cable testing and as a result can virtually double production output. At this year's OFC, Photon Kinetics is introducing two new members of the 1050 Series Automated Fiber Aligner product line - the 1050F Fiber Aligner and the 1050S Subunit Aligner.

1050F Automated Fiber Aligner

While the new 1050F is used to align individual optical fibers like PK's 1100 and 1120 Single Fiber Aligners, it provides fully-automated rather manual alignment of a test instrument launch buffer to the fiber under test. Besides being automated, the 1050F also features several unique capabilities. First, it utilizes video profile alignment and does not rely on physical contact like ferrule or V-groove aligners. This makes it capable of automatically coupling a SMF launch buffer to each core of a multicore optical fiber (MCF). Given this unique ability, the 1050F is the key component of the MCF-capable Full-Length Station (see front page). Second, by not relying on alignment of the fiber claddings in order to couple fibers, the 1050F is also able to couple a launch buffer to fibers having cladding diameters either larger or smaller than the buffer fiber.

The second new 1050 aligner being introduced this week is the 1050S Subunit Aligner. The 1050S shares much of the 1050F's design, but provides the ability to automatically align the fibers (up to 16) of a single loose tube or ribbon to the OTDR or other test instrument launch buffer. Under the control of the OASYS.net software, the 1050S is a useful tool for improving the efficiency of in-process loose tube or ribbon fiber testing, and even final QC testing of low fiber-count cables.

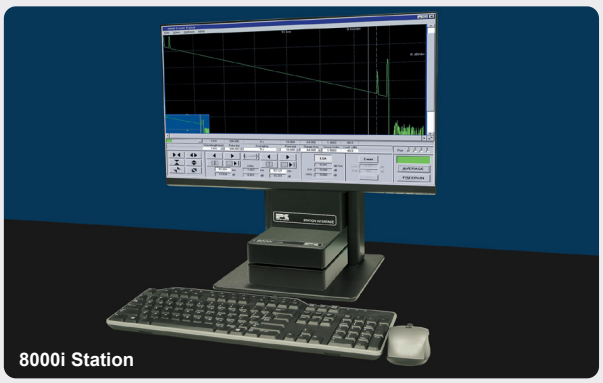
All 1050 Series Aligners feature automated video profile alignment, plus automated index matching oil application for reflection minimization. For OTDR-based applications, OTDR-guided optimization of the profile alignment coupling is also optionally available. The speed, performance, and ease of use of these aligners eliminates the need for skilled operators to perform tedious, manual fiber alignment using tools, methods or equipment not designed for production testing, and helps to maximize the productivity any testing application requiring high-speed, low loss, fiber-to-fiber coupling.

Station Interface Takes Control of PK Measurement Systems

Photon Kinetics products are durable. So durable in fact that many of our measurement systems remain in active service for 20 years or more. However, one critical component of our test systems whose life-span has consistently fallen short of our expectations are the commercially-available PCs that used to run our system software, control our system hardware, and even powers some of our products. In an effort to improve the overall life-span of our measurement systems, including our controllers, we recently developed the new Station Interface

The Station Interface is a built-for-purpose user-interface and high-performance measurement system controller composed of an industrial microprocessor running Windows IoT and a wide, touchscreen display. With an industrial, rather than commercial processor, the Station Interface is expected to deliver considerably longer service life than the desktop tower PCs previously used with many of our products. As a result, we have made the Station Interface the default controller for virtually all PK measurement systems.

And because the Station Interface also features multiple USB ports, and a standard, modular dc power supply, it is also capable of housing and powering up to two, current USB-design, 8000i OTDR modules. This means that any Station Interface can be converted into a compact, transportable 8000i OTDR Station for in-process cable testing.


8000i Station

Single-mode Fiber Cut-off Wavelength Measurement Developments

Despite being routinely measured by virtually every fiber manufacturer for decades; cut-off wavelength remains challenging. Cut-off curves can often be highly irregular and these irregularities can come and go from measurement to measurement for a given fiber. As a result, the cut-off wavelength calculated from the curves can also be inconsistent, varying by 10 nm or more.

The exact cause of cut-off irregularities or bumps is not exactly clear. But what is clear is that these bumps can appear or disappear depending on the exact layout of the fiber sample on the test system fiber table. The fiber design can also play a role. Features such as core trenches, and even the condition of the fiber coating, seem to be linked the appearance of cut-off bumps. Standards bodies tried in the past to reduce the effect of bumps on the cut-off wavelength calculation by developing a curve-fit to the cut-off data for the cut-off measurement standard. But this solution has proven to be less than robust.

In an effort to improve both cut-off wavelength repeatability and reproducibility for our customers, measurement engineers at Photon Kinetics recently investigated new methods for filtering or suppressing cut-off spectrum bumps. The result of that work was the development of a new fiber layout for cut-off wavelength measurements that was recently been added to latest edition of the cut-off wavelength measurement standard IEC 60793-1-44. The work also earned the engineer that carried out this work the prestigious IEC 1906 Award for helping to "advance the activities of the IEC technical committee (TC) in a significant way".

This newly-approved layout adds two large radius bends to the conventional fiber layout that together act to filter cut-off bumps and simplify determination of the cut-off wavelength without significantly changing the cut-off value. Mandrels that provide this filtering are now available as an add-on option (2300-BFM) to the catenary fiber table of the 2300 Fiber Analysis System.

Ultrasonic Cleaving Technology for Every Application

When it was introduced over 4 decades ago, the FK11 Ultrasonic Fiber Cleaver quickly became the industry-standard because of its ability to consistently produce flat, defect-free fiber end faces. The FK11 cleaver remains at the top of its class for cleave quality even today. And because exceptional cleave quality is also essential for so many applications, including optical fiber measurement such as fiber geometry, Photon Kinetics has continued to expand its cleaver product line to address those applications.

Today we produce over 20 variants of the FK cleaver platform for applications ranging from fiber connection (FK11 Series) and termination (FK12 Series) to preparing fibers for measurements on PK test systems (e.g., 2XXX-YCL Series). Variants of all three cleaver families are available for cleaving stripped fibers (bare glass), for cleaving the glass through the fiber coating, and for cleaving fibers having diameters both larger (-LDF) and smaller (-SDF) than standard 125 µm. The 2300-SCL Series, possesses all the capability of the 2XXX-YCL Series, but is also able to prepare fully, stripped short stub samples for backlit geometry measurements on the 2300 system.

The capabilities and applications for some of PK's fiber cleavers are summarized below:

Series	Application	Variant	Compatible Fibers
FK11	Flat end-faces for low loss connections and fusion splicing	Standard	Standard 125 µm fibers, 80 to 200 µm
		SDF	Small diameter fibers down to 40 µm
		LDF	Large diameter fibers up to 400 µm
		C	250 µm coated, 80 to 200 µm fibers
		LDF-C	Coated, 180 to 400 µm glass
FK12	Angled (low reflectance) end-faces for fiber termination	Standard	125 µm glass
		SDF	80 µm glass
2XXX-YCL	Fibers restrained in PK fiber holders for testing on 2300 or 2550 measurement systems	Standard	Standard 125 µm fibers, 80 to 200 µm
		C	250 µm coated, 80 to 200 µm
		LDF	Coated, 180 to 400 µm glass
		SDF	Small diameter fibers down to 40 µm
2300-SCL	Fibers restrained in PK fiber holders for testing on 2300 systems having backlit geometry option	Standard	Standard 125 µm fibers, 80 to 200 µm
		LDF	Small diameter fibers down to 40 µm
		SDF	Large diameter fibers up to 400 µm

FK11 Fiber Cleaver

Photon Kinetics includes products formerly branded as York Technology, PK Technology, GN Nettest and NetTest.

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ISO 9001:2015 certified. Printed in the USA. Specifications subject to change without notice.

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