

EF (ENCIRCLED FLUX) ANALYSIS SYSTEM & EAF (ENCIRCLED ANGULAR FLUX) ANALYSIS SYSTEM

Rapid evaluation of encircled flux and encircled angular flux parameter of multi-mode optical fiber.

EF (Encircled Flux) and EAF (Encircled Angular Flux) measurement system is to measure the mode diffusion of GI/SI type multimode optical fibers with image processing of NFP and FFP images. NFP measurement optics **M-Scope type S/L** and FFP measurement optics **M-Scope type F/FW** are used as measurement optics. EF/EAF measurement can be performed quickly and easily by optical beam analysis software **Optometrics BA Standard**.

Technical information [EF (Encircled Flux) · EAF (Encircled Angular Flux) analysis]

○EF/EAF analysis

Since the loss of multimode optical fiber changes depending on the launch condition, it is necessary to specify the launch condition during measurement. EF/EAF analysis is used as a new measurement method to define its launch condition. In particular, EF/EAF analysis plays an important role in high-speed multimode optical fiber transmission.

○EF (Encircled Flux) analysis

'EF' is the value obtained by analyzing the NFP image of the end face of optical fibers and integrating the distribution of beam intensity from the center toward the outer periphery. It is an index that shows what proportion of the mode distribution to the total intensity exists in the range from the center to the radius(r), and is shown in the following figure, calculation formula, and graph.

○EAF (Encircled Angular Flux) analysis

'EAF' is the value obtained by analyzing output FFP image of optical fibers and integrating the intensity distribution of the output angle from the center toward the spread direction (N.A.) of the output angle, and is shown in the following figures, formulas and graphs.

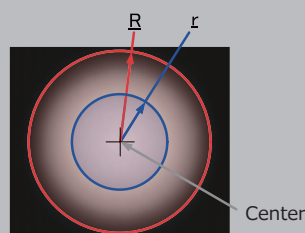
○EF/EAF analysis and type of optical fiber to be measured

Generally, EF analysis is applied to GI type (graded index type optical fiber), and EAF analysis is applied to SI type (step index type optical fiber).

○Measurement standard

In order to support high-speed transmission such as 10 Gbps, encircled flux measurement method is specified by IEC61280-1-4 as a new method for defining the excitation conditions for GI type multimode optical fibers. On the other hand, regarding SI type multimode optical fiber, encircled angular flux measurement method is specified in IEC61300-3053.

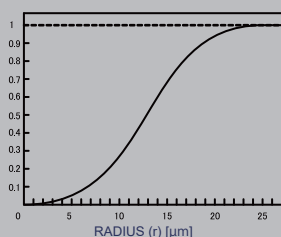
[Figure, formula, graph of EF/EAF analysis]



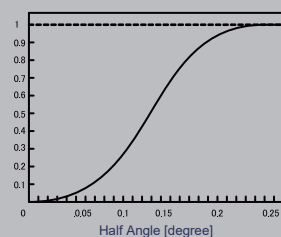
● EF/EAF analysis

$$EF = \frac{\int_0^r x \cdot I(x) dx}{\int_0^R x \cdot I(x) dx}$$

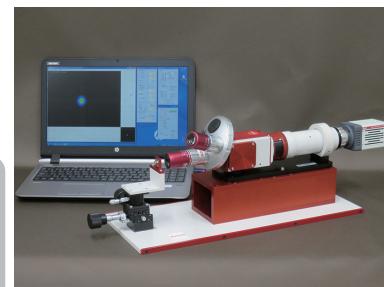
● EF/EAF formula



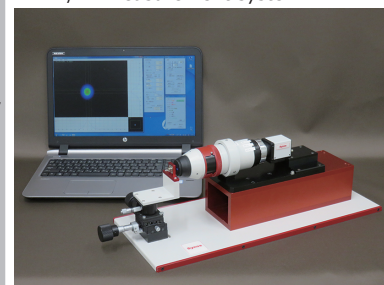
● EF graph
*horizontal axis: radius(r)



● EAF graph
*horizontal axis: half angle(degree)



● NFP/EF measurement system

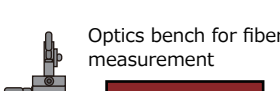


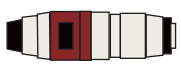
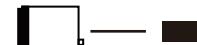




● FFP/EAF measurement system

[Features]

- Realization of quick and easy EF/EAF measurement by dedicated optics and image processing method
- Possible to measure in 400nm to 1700nm wavelength range by selecting detector.
- Optical beam analysis module **AP013**, specially designed high functional image processing software for beam profile analysis
 - All-in-one package of PC, optical beam analysis software, detector driver, correction data.
 - High-performance image processing software for optical beam profile measurement **Optometrics BA Standard** is pre-installed. In addition to the general-purpose beam profiler analysis function, EF/EAF measurement function is enhanced and standardized parameter measurement function is installed.
- Optional special launch system (underfilled launch optics, mode-selective launch system), mode conditioner, and various light sources are also available

[Component selection of EF/EAF measurement system]

<p>○ Stages · optics bench</p>  <p>Optics bench for fiber measurement</p> <p>○ Light source etc.</p> <ul style="list-style-type: none"> ● Underfilled launch optics ● Mode-selective launch optics ● Mode conditioner  <p>SLD light source LD light source etc.</p>	<p>○ Optics selection</p> <ul style="list-style-type: none"> ● for EF measurement  <p>Sophisticated NFP meas. optics M-Scope type S</p> <ul style="list-style-type: none"> · option Coaxial epi-illumination port MS-OP011-CEP ● for EAF measurement  <p>FFP measurement optics M-Scope type F</p>	<p>○ Detector selection</p> <ul style="list-style-type: none"> ● for visible~1100nm  <p>High resolution CMOS detector ISA071</p> ● for 950~1700nm  <p>InGaAs high sensitivity NIR detector ISA041H2</p> ● for 400~1700nm  <p>InGaAs high resolution NIR detector ISA041HRA/HRVA</p>	<p>○ Optical beam analysis module AP013</p> <ul style="list-style-type: none"> ● Personal computer <ul style="list-style-type: none"> · Main unit · Accessories ● Optical beam analysis software Optometrics BA Standard ● Detector driver ● Calibration data ● USB licence key <p>○ Accessories</p> <ul style="list-style-type: none"> ● Objective lens (M-Scope type S) ● Coaxial epi-illumination system (M-Scope type S) ● ND filter
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