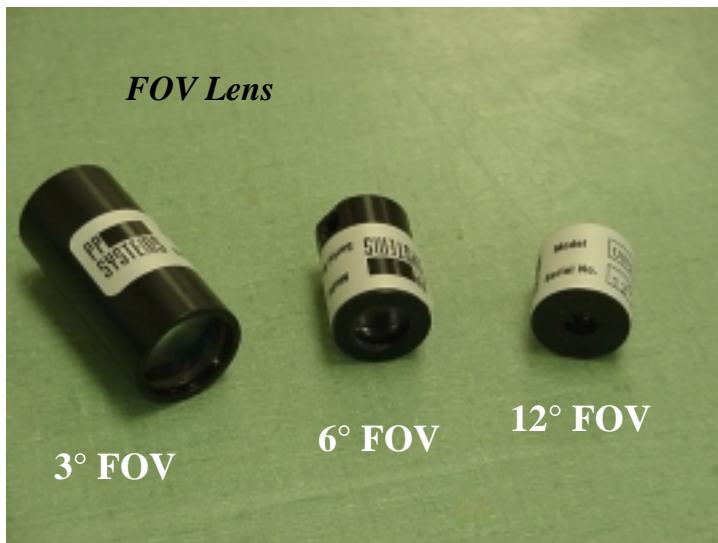


Application Note

Measurement of Canopy/Vegetation Reflectance With The *UniSpec-DC*

A good method for sampling reflectance of vegetation canopies is to connect a flexible, lightweight fiber optic cable (also referred to as “Foreoptic”) of a desired length to the detector. This requires a fiber optic with an SMA type connector at one end (to thread on to the detector) and a foreoptic with a defined field-of-view (FOV) at the other end (to limit the field of view to a defined region of the target). The FOV can be limited one of two ways:

- 1) A lens with a defined FOV. For example, PP Systems can provide a lens with a defined FOV (3° , 6° or 12°) that can thread on to an SMA connector. Therefore, it conveniently connects to a fiber optic having SMA connections at both ends.



Field of View (FOV) Lens Ordering Information:

UNI700 3° FOV Lens Assembly
UNI705 6° FOV Lens Assembly
UNI710 12° FOV Lens Assembly

PP Systems offers a range of different length straight foreoptics with SMA connectors on both ends (custom lengths also available on request), stainless steel protective cover, 50 μm randomized glass fibers and 2.1mm diameter tips. This range of foreoptics are designed specifically for use with our FOV lens.



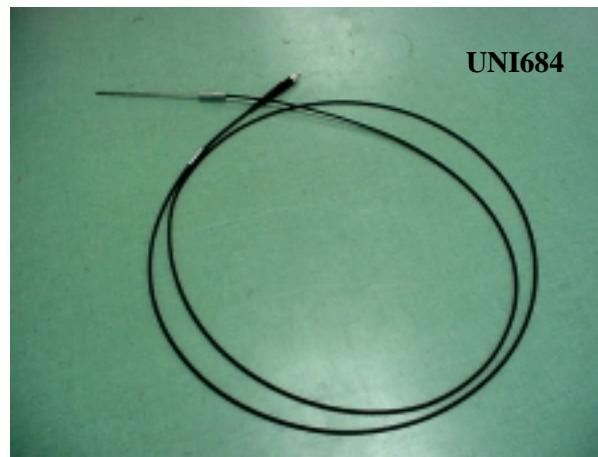
Ordering Information For Standard Lengths:

- UNI650 Straight Foreoptic, 0.5 meter, 2.1mm D (Glass)
- UNI660 Straight Foreoptic, 1 meter, 2.1mm D (Glass)
- UNI670 Straight Foreoptic, 2 meters, 2.1mm D (Glass)

Note. Custom lengths are also available on request. Consult with PP Systems.

- 2) A metal ferrule covered with a longer metal sleeve. For example, PP Systems offers a different range/style of foreoptics that have the following features:
 - Fiber Type: HCS LOH glass (low water)
 - Fiber Diameter: 600 μm core
 - Protective Coating: 1/8 (0.125") PVC Monocoil (stainless steel covered in PVC)

One foreoptic (UNI684) has an SMA connection at one end, and a 100mm stainless steel ferrule (made from a hypodermic needle) covering a polished fiber tip at the other end.



In this form, the ferrule provides a FOV determined by the acceptance angle of the fiber (approximately 25° full angle). A simple way to reduce this FOV is to slip over the ferrule a piece of metal tubing that is slightly longer than the ferrule itself. For example, a piece of 1/8" (0.125" OD) hardware store tubing can be cut to a desired length. Aluminum tubing is acceptable and easy to cut, but stainless steel tubing is preferable (because it will resist bending and weathering). A piece of tubing that is about 9mm longer than the 100mm ferrule will provide a FOV (full angle) of approximately 20 degrees.

Checking The FOV

Because nominal FOV values may not exactly match actual FOV values, it is a good idea to check the FOV. The FOV can be easily checked either by passing a light through the fiber at a dark target (i.e. black paper). The diameter of the bright spot on the target at a given distance can be used to calculate a rough estimate of the FOV. Alternatively, the fiber can be attached to the detector, and pointed at a suitable target (i.e. white panel positioned perpendicular to the fiber tip). Using a laser beam (e.g. laser pointer) pointed at the target, determine the FOV by plotting the detector response as a function of angle. **Do NOT point the laser directly into the fiber or detector itself (this can saturate the detector).**

Special Notes On Foreoptics

Note that monocoil is relatively lightweight and flexible, but provides reasonable protection from reasonable crushing (lateral forces). For a lighter coating, another option may be "PVC furcation tubing," which is very strong under tension (contains Kevlar), but less crush-proof than monocoil. For an exceptionally sturdy coating, "BX cable with furcation tubing" is a good choice. This has a metal telephone-style cable coating on the outside, which is very rugged, but heavy and a bit more expensive.

Note that for most hand-held applications and short vegetation (e.g. grasslands shorter than 1 meter tall), a 2 meter fiber optic is probably sufficient. This can be readily extended to longer lengths by inserting a fiber optic "patch cord" (similar to UNI685, having SMA connectors at both ends) between the end fiber and the detector using a simple SMA adapter (UNI687). When using silicon photodiode detectors (i.e. type used in the standard UniSpec-DC), it is possible to add many meters of fiber optic patch cord and still have sufficient signal to get a good reflectance spectrum.

Foreoptic Ordering Information:

Catalog Number/Description	Photograph
UNI684 Straight Foreoptic, 2 meters, 600 μm HCS LOH, SMA-Custom Ferrule-100mm	
UNI685 Straight Foreoptic, 2 meters, 600 μm HCS LOH, SMA-SMA	
UNI686 Straight Foreoptic, 2 meters, 600 μm HCS LOH, SMA-Custom Ferrule-25mm (For use with UNI435 Cosine Receptor)	
UNI687 Adapter SMA-SMA (Male-Male) If fiber optics need to be extended, a simple adapter can be used to join two fiber optics with standard SMA type connectors on both ends.	

Note. Custom lengths foreoptics are also available on request. Consult with PP Systems.

Cosine Receptor

PP Systems produces a cosine head that can be used with the UniSpec-DC for sky irradiance measurements when used with the UNI686 fiber optic described above.

Ordering Information:

Catalog Number/Description	Photograph
UNI435 Cosine Receptor	

A special thanks to **Dr. John A. Gamon** (Dept. of Biological Sciences, California State University, 5151 State University Drive, Los Angeles, CA 90032) for his technical assistance and input in creating this application note.

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