

# AMF / ALF SERIES

Albedometer mounting and levelling fixtures: combine 2 pyranometers into 1 albedometer with our AMF03 and AMF02 albedometer kits

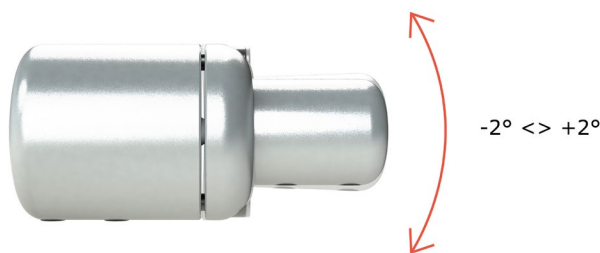
*Hukseflux offers a practical range of mounting and levelling fixtures to construct albedometers from its popular pyranometers and make installation and levelling easy. Albedometers are increasingly popular in bifacial PV module monitoring. AMF03 allows you to combine two SR30-M2-D1 spectrally flat Class A pyranometers or two SR15 series Class B pyranometers into one albedometer. AMF02 does so for two SR11 or two SR20 series pyranometers. The modular design facilitates maintenance and calibration of the pyranometers. Both albedometer kits include a mounting fixture and a glare screen. ALF01 is a levelling fixture that may be combined with AMF03, AMF02 or SRA series albedometers, and helps levelling the instrument.*

## Introduction

Hukseflux offers a full range of dedicated, ready-to-use **albedometers** for measuring albedo. Alternatively, with the AMF03 or AMF02 mounting fixture in AMF / ALF series, you may choose to construct albedometers from popular Hukseflux **pyranometers** yourself. AMF03, AMF02 and SRA series albedometers can be levelled with ALF01 levelling fixture.



**Figure 1** AMF02 or AMF03 albedometer kits are used to mount both an up- and a downfacing pyranometer, and construct an albedometer. The image shows the AMF02 mounting fixture and its rod. A glare screen for the downfacing sensor is also included.



**Figure 2** ALF01 albedometer levelling tool, can be rotated around the axis of the crossarm to which it is connected, and tilted over  $\pm 2^\circ$ .

## Albedo and Albedometers

Albedo, also called solar reflectance, is defined as the ratio of the reflected to the global radiation. The solar albedo depends on the directional distribution of incoming radiation and on surface properties at ground level. Albedos of typical surfaces range from about 4 % for fresh asphalt, and 15 % for green grass to 90 % for fresh snow. An albedometer is an instrument composed of two pyranometers, the upfacing one measuring global solar radiation, the downfacing one measuring reflected solar radiation. You can then derive the solar albedo, or solar reflectance and net solar radiation. Albedometers are increasingly popular in bifacial PV module performance monitoring.

You may use one **AMF03** albedometer kit and two model SR30 pyranometers to construct an albedometer of spectrally flat Class A, the highest accuracy class according to ISO 9060 (formerly known as 'secondary standard'). AMF03 may also be combined with model SR15 pyranometers to construct a spectrally flat Class B albedometer. The modular design facilitates maintenance and calibration of the pyranometers. By taking the instrument apart you can use normal indoor calibration facilities for instrument calibration. SR30-M2-D1 and SR15 series pyranometers (SR15-A1, SR15-D1 and SR15-D2A2) are supplied with several outputs; analogue millivolts, 4-20 mA current loop and Modbus over RS-485 are the most commonly used. Likewise, **AMF02** albedometer kit may be used to construct an albedometer out of two SR20(-D2) or SR11 pyranometers.

### AMF03

AMF03 is easy to use. It allows you to combine two separate SR30-M2-D1 or SR15 series pyranometers, creating one **SRA30-M2-D1** or **SRA15 series** albedometer. All you need are two suitable pyranometers and the AMF03 kit. Mounting instructions and a set of hex keys are delivered with AMF03. AMF03 also includes a glare screen. A glare screen is a metal ring, mounted on the downfacing sensor. At solar elevations of  $< 5^\circ$ , when the sun is just above the horizon, the glare screen prevents that direct solar radiation is measured by the downfacing sensor. This is important, because it would lead to unrealistic albedo measurements. Modern data quality assurance can also attain the data quality by calculating solar elevation and rejecting any data at solar elevations below a certain value, for example  $< 10^\circ$ .

### AMF02

**AMF02** is easy to use as well. It allows you to combine two separate SR11 or SR20(-D2) pyranometers into one albedometer. Mounting instructions and a set of hex keys are delivered with AMF02. AMF02 also includes a glare screen.

### ALF01

**ALF01** is a levelling tool that can be used with AMF02, AMF03 or SRA series albedometers such as SRA20 to easily level the instrument. ALF01 is mounted on a 1 inch outer diameter crossarm, and can be rotated around the tube axis for  $360^\circ$  as well as tilted over  $\pm 2^\circ$ .

### Standards

Applicable instrument-classification standards are ISO 9060 and WMO-No. 8. Calibration is according to ISO 9847 and ASTM G207.

## AMF / ALF series specifications

### AMF03 and AMF02

Purpose	construction of an albedometer when combined with 2 pyranometers
Rod diameter	$15 \times 10^{-3} \text{ m}$
<b>Albedometer</b>	
Measurand	global solar radiation and reflected solar radiation
Optional measurand	albedo or solar reflectance
Optional measurand	net solar radiation

### AMF03

Instrument compatibility	SR30-M2-D1, SR15 series (SR15-A1, SR15-D1, SR15-D2A2)
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Included in AMF03:  
 (1 x) glare screen  
 (1 x) AMF03 fixture with rod  
 (1 x) conical positioner  
 (2 x) M5x12 socket head cap screw  
 (1 x) M6x8 socket head cap screw  
 (2 x) M8x12 set screw  
 (1 x) mounting instruction sheet

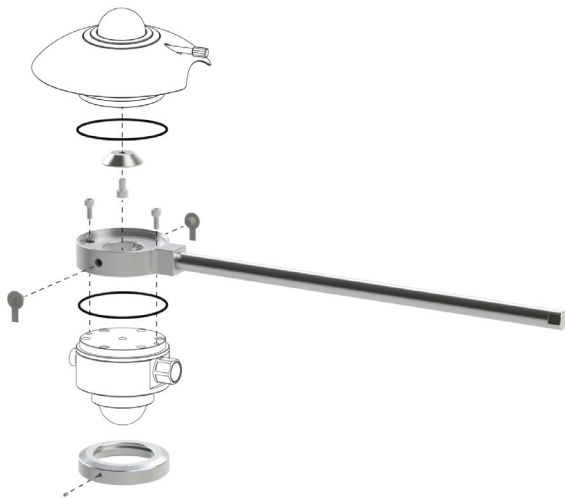
### AMF02

Instrument compatibility	SR20, SR20-D2, SR11
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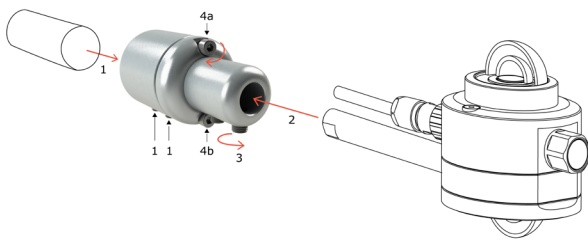
Included in AMF02:  
 (1 x) glare screen  
 (1 x) AMF02 fixture with rod  
 (2 x) o-ring  
 (1 x) conical positioner  
 (2 x) plug  
 (2 x) M5x12 socket head cap screw  
 (1 x) M6x10 socket head cap screw  
 (2 x) M6x12 set screw  
 (1 x) mounting instruction sheet

### ALF01

Instrument compatibility	AMF02, AMF03 and SRA series
Tilt angle adjustment range	$\pm 2^\circ$
Rotation angle adjustment range	$360^\circ$
Required Crossarm outer diameter	1 inch



**Figure 3** Clear instructions are included with AMF series.



**Figure 4** ALF01 allows levelling when mounting an albedometer rod onto a crossarm.

### Suggested use

- PV monitoring with bifacial solar modules
- high-accuracy meteorological observations
- building physics, roof reflectance studies
- extreme climates (tropical / polar)

### Example: AMF03 combined with SR30's

SRA30-M2-D1 albedometer consists of two identical pyranometers model SR30-M2-D1, one facing up, one facing down. The two sensors are delivered with one AMF03 fixture with rod for mounting purposes. A glare screen is part of the AMF03 delivery too. The user assembles these modular components into SRA30-M2-D1 albedometer. A mounting instruction is included with AMF03. Levelling and mounting may be completed by using ALF01 levelling fixture and **CMF01** crossarm mounting fixture to mount the crossarm to a mast.

**Table 1** Overview of versions in AMF / ALF series.

VERSIONS OF AMF / ALF SERIES	
AMF02	albedometer mounting kit for 2 x SR20 / SR11 pyranometers
AMF03	albedometer mounting kit for 2 x SR30 / SR15 pyranometers
ALF01	albedometer levelling fixture for AMF02, AMF03 and SRA series albedometers

### See also

- **SRA30-M2-D1** digital spectrally flat Class A albedometer with heating and tilt sensor
- **SRA15 series** spectrally flat Class B albedometers
- **SRA20-D2** digital spectrally flat Class A albedometer
- **SRA01** spectrally flat Class C albedometer
- **SR30-M2-D1** digital spectrally flat Class A pyranometer with heating and tilt sensor
- **SR15 series** analogue and digital spectrally flat Class B pyranometers
- alternative instrument: **NR01** 4-component net-radiometer for solar and longwave radiation balance
- **PMF01** and **PMF02** pyranometer mounting fixtures
- **CMF01** crossarm mounting fixture



### About Hukseflux

Hukseflux is the leading expert in measurement of energy transfer. We design and manufacture sensors and measuring systems that support the energy transition. We are market leaders in solar radiation- and heat flux measurement.

Customers are served through the main office in the Netherlands, and locally owned representations in the USA, Brazil, India, China, Southeast Asia and Japan.

Interested in this product?  
E-mail us at: [info@hukseflux.com](mailto:info@hukseflux.com)

**Figure 5** The end result using AMF03 and two SR30-M2-D1 pyranometers: SRA30-M2-D1 albedometer.



**Figure 6** Installation of AMF02 albedometer mounting kit and two SR20 pyranometers, mounted with ALF01 leveling fixture on a crossarm with crossarm bracket CMF01.