Rotating Shadowband Irradiometer
CSPS Twin-RSI

Measurement sensor for DNI, GHI and DHI

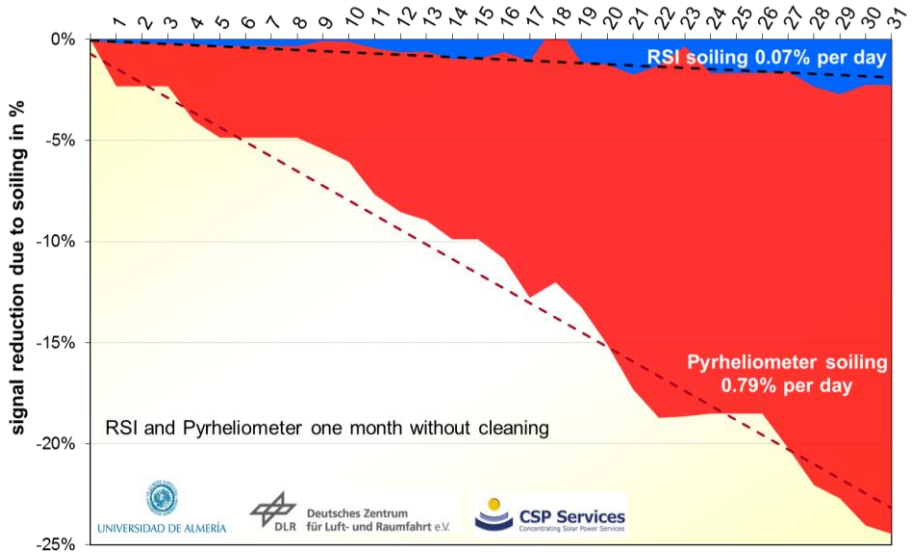
The Rotating Shadowband Irradiometer (RSI) is an innovative meteorological measurement instrument for quantitative solar irradiance assessment. It consists of two horizontally leveled silicon photodiode radiation detectors, situated in the center of a spherically curved shadowband. While the shadowband is in its rest position below the sensor, the photodiodes measure Global Horizontal Irradiance (GHI). Usually once per minute, the shadowband rotates around the radiation sensors for approximately one second. During the rotation, the shadowband blocks the direct beam irradiation from the sun within a brief instant. This causes a momentary drop of the photodiode signals and thus allows the determination of the Diffuse Horizontal Irradiance (DHI) and the subsequent calculation of the Direct Normal Irradiance (DNI) from GHI, DHI and the known solar incidence angle.

CSP Services Twin-Sensor Rotating Shadowband Irradiometer (RSI) in rest position (left) and during the rotation (right)

The outstanding innovative features of the CSPS Twin-RSI are the utilization of a rotation speed controlled shadowband and of two independent sensing elements LI-200 from LI-COR, Inc. The speed control guarantees uniform rotation speed throughout the year independently of location and temperature. This permits improved off-site calibrations and advanced features like sunshape measurements. The sensor redundancy ensures statistically higher accuracy, detection of potential individual sensor drifts as well as easier discovery of outliers, potential failures and irregularities. Furthermore, the Twin-RSI has a minimized risk of sensor failure and thus improves availability. Its sensor head is designed for quick alignment and simple exchange for recalibration purposes. Additionally, RSIs have proven a superior performance with respect to soiling compared to usual thermopile sensors (see graph below).

The Twin-RSI is designed to withstand harsh climatic conditions such as dust, rain, heat, intense sun, snow and ice. It has proven its operability at multiple sites and it is the system of choice for accurate solar resource assessment at sites with the following characteristics:

- Remote sites, where daily inspection visits are not feasible
- Locations without access to the electricity grid
- Sites with increased presence of dispersed and airborne dust



Sensor soiling test at the University of Almería in May 2008. The DNI measured by an RSI showed a ten times lower sensitivity to soiling (0.07 % per day) as a pyrheliometer (0.79 % per day)

To reach utmost accuracy, a thorough calibration of the RSI sensor is required. It is performed by scientific staff of the German Aerospace Center (DLR) at the Spanish Plataforma Solar de Almería (PSA). Special correction functions, which compensate for spectral and temperature dependence of the photodiode sensor, were developed by DLR and are applied by CSP Services to the raw measurement data.

Measurement quantities and uncertainties of the Twin-RSI sensor

Measured Quantity	**Uncertainty**
Global Horizontal Irradiance (GHI)	annual sum: < 2% instantaneous values: < 4%
Diffuse Horizontal Irradiance (DHI)	annual sum: < 2% instantaneous values: < 6%
Direct Normal Irradiance (DNI)	annual sum: < 2% instantaneous values: < 4%

Environmental and further specifications

Temperature range:	-30 to +65 °C	Power supply:	U: 12 V DC (10.5 - 14 V) I_{max}: 3 A at rotation startup
Humidity:	0 to 100 %Rh	Power demand:	< 1 W at average
Dimensions:	500×100×200 mm	Output signal:	≈90 µA per 1000 W/m²
Weight:	2.1 kg	Response time:	10 µs

COLOGNE
CSP Services GmbH
Friedrich-Ebert-Ufer 30
51143 Cologne, Germany
Phone +49 2203 959 0030

ALMERIA
CSP Services España, S.L.
Paseo de Almería 73
04001 Almeria, Spain
Phone +34 950 274350

info@cspservices.de
www.cspservices.de