QSR-2200
QCR-2200

Analog Quantum Reference Sensor

User's Manual

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INITIAL INSPECTION AND SHIPPING PROCEDURES

This instrument was carefully inspected mechanically and electrically, and was calibrated before shipment. It should be free of mars or scratches and in perfect operating condition upon receipt. To confirm this, the instrument should be inspected for physical damage incurred in transit. If the instrument was damaged in transit, file a claim with the carrier. See Warranty in the preface of this manual.

> ***WARNING: Read the sections on installation, operation and maintenance before attempting to operate or disassemble the instrument.***

Retain original packing material for shipment to the factory. The instrument must be carefully wrapped and cushioned with appropriate packing material before it is shipped.

PRECAUTIONS

PROTECT THE CABLE AND CONNECTOR. Avoid any sharp bends in the interconnect cable. To ensure cable safety, secure the cable in place during instrument usage. The connector is the most vulnerable part of the system. Protect the connector contacts from moisture, both during use and while in storage. Do not step on the connector, or strike it while it is plugged into the instrument.

PROTECT THE INTEGRATED CIRCUITS. A person walking across a carpet on a dry day can generate a static charge of more than 10,000 volts. The resulting discharge can destroy an integrated circuit. Therefore, use standard anti-static equipment any time the instrument is opened and the components are removed.

AVOID SHADOWS AND REFLECTIONS. During deployments or installations, be careful to keep the instrument away from reflections and shadows caused by surrounding structures. An underwater instrument package should be positioned for lowering on the side of the ship toward the sun. If the instrument is lowered into the shadow created by the ship, this shadow will contaminate measurements for depths up to 100 meters. When positioning a ship and deploying an underwater sensor, the wind direction is also a factor since the wind or wind-driven currents can push the ship over the sensor when it is being lowered, thereby causing shadowing. A surface sensor should be mounted so that it will not be shaded by or experience reflections from surrounding structures.

MAINTAIN PROPER CALIBRATION. The proper conversion factors for the sensor voltages to engineering units are contained on the calibration certificate issued with the instrument, and are updated on subsequent recalibrations. It is ultimately the user's responsibility to ensure that the proper calibration factors are used during data analyses. Any calibration factors published in this manual are for example only; valid entries may be found on the calibration certificate issued with each BSI instrument.

CARRY SPARE CABLE. For extended operations, it is prudent to carry spare cables.

PROTECT THE COLLECTOR. The Teflon diffuser is a critical optical component of the collector which is easily scratched or damaged. If you suspect damage, consult the factory. Keep the irradiance diffuser as clean as possible by periodically wiping it with a damp cloth.

1.0 INTRODUCTION

Biospherical Instruments Inc's Analog Quantum Reference Sensors (QSR-2200 or QCR-2200) are designed as a surface (non-submersible) instrument for monitoring total incident **PAR** (photosynthetically active radiation, 400 nm to 700 nm) from the sun and sky. They are designed to be used primarily with CTD's and dataloggers that require an analog voltage as signal input. Biospherical Instruments also offers computer hardware and software packages suitable for data logging and analysis using this series of instruments – contact factory for details.

QSR-2200-The QSR-2200 is a hemispherical scalar reference sensor. It shares the scalar directional response of Biospherical Instruments' QSP-2000 series of sensors, but it includes a field-of-view cutoff plate that transforms its response to a hemispherical one. The sensor produces an analog voltage output that is directly proportional to the irradiance incident upon the sensing plane of the collector. This sensing plane lies halfway between the equator and upper pole of the spherical collector. Due to geometric differences, data collected with a scalar sensor is not easily compared with cosine irradiance measurements.

QCR-2200-The QCR-2200 is a PAR reference sensor that utilizes a flat cosine collector design. It shares the cosine directional response of Biospherical Instruments' QCP-2000 series of aquatic sensors. The sensor produces an analog voltage output that is directly proportional to the cosine of irradiance incident upon the collector. Note: Due to geometric differences, data collected with this cosine sensor is not easily compared with scalar irradiance measurements.

In order to fully understand the capabilities of the QSR-2200 and QCR-2200, the user should read this manual carefully and thoroughly. The manual includes operating instructions, precautions, and compatibility notes that can help the user adapt the instrument to a specific application.

2.0 SPECIFICATIONS

QSR-2200 SCALAR IRRADIANCE COLLECTOR: 1.9 cm (3/4") diameter solid Teflon® sphere optically connected to the main housing by a 2.5 cm, stainless-steel encased quartz fiber.

QCR-2200 COSINE IRRADIANCE COLLECTOR: 1.15cm (.45") diameter, solid acrylic collector that is o-ring sealed.

QSR DIRECTIONAL RESPONSE: Each instrument's directional response is optimized before final calibration. The response is a constant ±7%, between 0^{o} to approximately 135^{o} in zenith angle, with response falling off to zero as the light field is obscured by the instrument housing. Individual detector response plots are available upon request.

QCR DIRECTIONAL RESPONSE: Each instrument's directional response is optimized before final calibration. From zenith angles of 0° to 85°, the instrument's directional response follows the cosine law to ±6%.

2.1 QSR-2200 and QCR-2200

PHOTODETECTOR: Blue-enhanced high stability silicon photovoltaic detector with dielectric and absorbing glass filter assembly.

SPECTRAL RESPONSE: Constant (better than ±10%) quantum response from 400 to 700 nm with response sharply attenuated above 700 nm and below 400 nm. Spectral response induced errors will cause less than ±5% errors in naturally occurring light fields.

SENSITIVITY: When purchased alone, the sensor is calibrated in quanta /(cm^2sec). Nominal sensitivity is 1 Volt = 6 x 10^{17} quanta/(cm^2sec) (slightly less than full sunlight). Noise level is typically 1 mV (standard deviation).

OUTPUT POLARITY: Goes more positive as irradiance increases, and has a small positive offset (dark voltage).

CALIBRATION: Calibrated using a National Institute of Standards and Technology traceable 1000 watt type FEL Standard of Spectral Irradiance. Annual recalibration is recommended.
OUTPUT IMPEDANCE: 100 ohms.

ENVIRONMENTAL: Fully sealed and water resistant, and it has a special weather-proof connector. Its operating temperature range is -15 to 35°C.

POWER REQUIREMENTS: 6-15 Volts DC and 0.9 to 4 mA is required. Typically, power is supplied by the user's CTD or data acquisition system. An external battery pack may also be used.

CABLE: QSC-2200 shielded, weather resistant cable (ordered separately) is supplied with appropriate connectors.

3.0 INSTALLATION, OPERATION, AND MAINTENANCE PROCEDURES

3.1 INSTALLATION

The sensor should be installed in a place that is free of obstacles that might block its field of view. The sensors have a large mounting base with several holes so that it may be secured to a variety of mounting platforms. When it is operated in high seas, it may be necessary to gimbal mount the sensor to prevent the data from changing rapidly, making it difficult to read and analyze.

Note that the QSR-2200 features a circular irradiance shield or "cut-off plate" that blocks irradiance from the lower hemisphere of the collector so as to permit monitoring of only total irradiance from the sun and sky. The plane of the shield must be level with the horizon and there should be no physical obstructions (buildings, masts, etc.) above this plane. For special applications this shield may be removed without otherwise affecting operation.

NOTE: Do not attempt to remove the QSR's irradiance collector sphere.

When you initially receive your sensor and before leaving for the field, you should fully connect the instrument and data acquisition system you intend to use. Make certain that the system runs properly. If it does not, consult the factory for assistance.

3.2 OPERATION

Before deploying the sensor, you should place a dark cloth over the sensor and take a "dark" or "zero" reading. With this information, you can correct your data for any zero offsets.

If you are using a third-party device for collecting data, remember that these sensors require 6-15 VDC at 0.9-4 mA. The sensor normally outputs an analog signal between 1 and 5 volts for full sunlight. Make sure that your data acquisition system meets these requirements.

We strongly recommend that, whenever the instrument's calibration is in question for any reason, the instrument should be returned to Biospherical Instruments for recalibration and examination at a nominal charge.

3.3 MAINTENANCE

QSR-2200 When the sensor is mounted outside for long periods of time, it is important to periodically clean the collector. While cleaning the QSR-2200 scalar sphere and shield, **do not attempt to rotate or remove the collector sphere or the calibration of the sensor will be altered.** To clean the spherical collector, simply wipe it gently using a soft tissue or towel and warm water, soap or alcohol. Do not use any other solvents such as acetone, MEK, or Trichlor because these can dissolve the coatings on the shield. Also, do not use acids, abrasive cleaners, or brushes as this will mar the surface of the sphere and void the instrument's calibration. Should the sphere become damaged or heavily soiled, return the instrument to the factory for service and recalibration.

If the surface of the irradiance shield becomes soiled and its reflectance changes, the calibration of the instrument will be altered. Therefore, the user should keep the irradiance shield as clean as possible by periodically wiping it with a damp cloth. Remember to avoid moving or scratching the Teflon® diffuser.

QCR-2200 The QCP's acrylic cosine collector may **only** be cleaned using a soft tissue or towel and warm water. Do not use any solvents such as acetone or alcohol. These chemicals will discolor and soften the acrylic collector.

The only other maintenance procedures required by the instrument are annual optical recalibrations and biannual preventive maintenance checks. Consult your factory for details.

APPENDIX: THEORY OF OPERATION

THEORY OF OPERATION

QSR-2200 The Teflon® sphere on the instrument serves as the irradiance collector. Light penetrating the surface of the sphere is diffused as it passes toward the center. A quartz optical conductor is inserted into the sphere to collect the diffuse light from the sphere and guide it to the filter and detector assembly. The light travels through a special filter assembly and onto a low noise silicon photodiode.

QCR-2200 The acrylic cosine collector diffuses light and directs it to a special filter assembly and to a low noise blue-enhanced silicon photodiode.

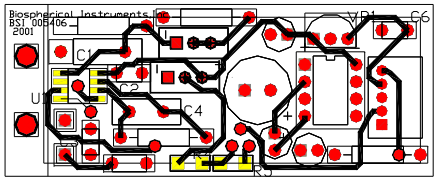
In both models, an optical filter assembly adjusts the overall spectral response of the detector and collector to give the instrument a constant quantum response between 400 nm and 700 nm with negligible response outside this region.

The current from the photodiode is amplified and converted to a voltage by a high stability electrometer amplifier in the sensor housing. The instrument also contains power conditioning circuitry for generating the required amplifier supply voltages. The signals from the amplifier are transmitted through the connector to your cable. Output voltages from the sensor are DC voltages. Consult your calibration certificate for specific calibration factors.

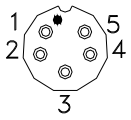
TECHNICAL DRAWINGS

Wiring arrangement for the Switchcraft connector used in these sensors

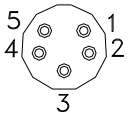
REV	DESCRIPTION	DATE	BY
A	PROD. RELEASE	3/26/02	McGUIRE
–	–	–	McGUIRE



BULKHEAD FACE VIEW



BULKHEAD SOLDER VIEW



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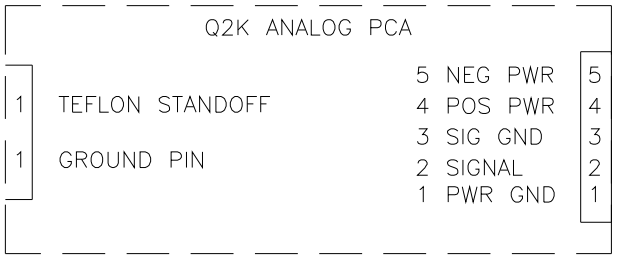
5x 80.400010



28 AWG TEFLON WIRE 6" LONG

NOTES: UNLESS OTHERWISE SPECIFIED.

MATERIAL: – –	FINISH: – – –
DRAWN McGUIRE	DATE 5/4/91
CHECKED	
PRODUCTION LIND	04/06/2001
DO NOT SCALE DRAWING	

DIMENSIONS ARE IN INCHES
UNLESS OTHERWISE SPECIFIED
TOLERANCES:
.X ±.050
.XX ±.010
.XXX ±.005
ANGLES ±.5°
MACHINED SURFACE FINISH 63

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CABLE: "BIOSPHERE"

Q2K ANALOG SWITCHCRAFT CONNECTOR WIRING DIAGRAM

SIZE	DWG.NO.	PREVIOUS:	REV.
B	005706WA	005468WB	A
SCALE NONE	DATE 04/06/2001	SHEET 1 OF 1	