QCD-90XL

(QCD-900L and QCD-905L)

Log Quantum Cosine Collector

User's Manual

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Photosynthetic rate measurements based on natural fluorescence techniques represent the leading edge of ocean sciences technology. As with any new method, refinements will occur as it becomes more widely used and discussed. We urge you to keep in touch with Biospherical Instruments' staff in reporting any anomalies you encounter. As we have not tested this technology under all conditions, we suggest that you obtain independent estimates where possible.

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LIMITED WARRANTY

BIOSPHERICAL INSTRUMENTS INC. warrants this instrument system or software (the Product) to be in good working order for a period of one (1) year parts and good for a period of ninety (90) days labor from the date of purchase. Should this Product fail to be in good working order at any time during the above stated warranty period, Biospherical Instruments Inc. will, at its option, repair or replace this Product at no additional charge except as set forth below. Repair parts and replacement Products will be furnished on an exchange basis and will be either reconditioned or new. All replacement parts and Products become the property of Biospherical Instruments Inc. This limited warranty does not include service to repair damage to the Product resulting from accident, disaster, misuse, abuse or non-Biospherical Instruments Inc. modification of the product.

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THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, AND YOU MAY ALSO HAVE OTHER RIGHTS WHICH MAY VARY FROM STATE TO STATE.

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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. Check the instrument for proper operation as outlined in this manual. If there is damage or deficiency, see the 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 UNDERWATER CABLE AND CONNECTOR. Properly clamp the cable onto the lowering frame. Avoid any sharp bend in the cable. Make sure the cable is tightly clamped. A loose clamp will result in the cable slipping and possibly kinking under the small radius bend. On more than one occasion, cables have been damaged by failure to secure the cable. The underwater 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 it, 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 over 10,000 Volts. The resulting discharge can destroy an integrated circuit. Use standard anti-static equipment any time the instrument is opened up 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.

1. INTRODUCTION

The QCD-90XL Logarithmic Output Quantum Cosine Sensor was designed to allow the oceanographer to measure the widely variant light fields found in the ocean while taking measurements with an STD (salinity-temperature-depth), CTD (conductivity-temperature-depth), current meter, or other fixed range data acquisition system.

The QCD-90XL was designed expressly for compatibility with standard oceanographic data acquisition systems. Its logarithmic output correlates with the inherently depth-dependent exponential decay of light in the ocean. This exponential decay of light level places special demands on the design of light sensing systems, especially where accurate measurements are required at light levels ranging from 0.01 to 100% of full sunlight. To meet these demands, the QCD-90XL's logarithmic output allows four decades of accurate measurement of light intensity with a 12 bit fixed range data acquisition system, which is normally limited to two decades.

The QCD-90XL uses a cosine collector to measure irradiance. The instrument's spectral response is designed to measure PAR (Photosynthetically Available Radiation) between 400 nm and 700 nm with a cosine response. The QCD-90XL is calibrated with constants for microEinsteins/(cm^2sec) or quanta/(cm^2sec). Its power requirements are compatible with most CTDs and data acquisition systems. The standard pressure housing for the QCD-900L is tested to 10,000 meters, and the QCD-905L housing is tested to 7,000 meters.

It is important that this operating manual be read carefully since there are several precautions that should be taken to extend the inherent accuracy of the instrument itself to the desired measurement. These precautions include avoiding shadows during the deployment of the instrument and avoiding temperature extremes.

2. SPECIFICATIONS

HOUSING:

- Material:
  QCD-900L: Titanium and PET (Polyethylene Terephthalate).
  QCD-905L: Aluminum, hard black anodized, and PET.
- Diameter: See assembly diagrams in the Appendix.
- Height: See assembly diagrams in the Appendix.
- Weight:
  QCD-900L: 5 lb. (2.3 kg.)
  QCD-905L: 3 lb. (1.4 kg.)

COSINE COLLECTOR: 1.15 cm (.45") diameter x .5 cm (.2") high cylindrical solid translucent acrylic collector fused to transparent Plexiglas support. O-ring seal to main housing.

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

DIRECTIONAL RESPONSE: QCD-90XL directional response is designed to produce a cosine response curve when fully immersed in water.

SENSITIVITY: Consult the Calibration Certificate for the actual calibration factors. Normal output range is -1 to 6 volts with 1 volt per decade. Typically, the QCD-90XL outputs 5 volts for full sunlight and has a minimum output of 0.001% full sunlight, where typical noon solar irradiance is 1.5 to 2 X 10^{17} quanta cm^{-2} sec^{-1}.

CALIBRATION: The QCD-90XL sensor is calibrated using a National Institute of Standards and Technology traceable 1000 watt type FEL Standard of Spectral Irradiance. Annual recalibration is strongly recommended.

OPERATING TEMPERATURE: -2 to 35°C.

OPERATING DEPTH:

- QCD-900L: 10,000 m.
- QCD-905L: 7,000 m.

POWER REQUIREMENTS: +5 to +20 volts DC at typically 100 mA.

CONNECTOR:

- Type: XSG-4-BCL-HP.

- Wiring:
  Pin 1 = Power Common
  Pin 2 = Signal Output
  Pin 3 = Signal Common
  Pin 4 = Power Input

3. OPERATION AND MAINTENANCE

3.1. OPERATION

Do not leave the instrument sitting in the sun prior to deployment.

Avoid the ship's shadow during deployment. It is very important that the instrument be lowered so that the sensor does not pass through the ship's shadow. The ship's orientation and drift are crucial. The optimum combination of wind and sun angle to avoid deployment in the ship's shadow has the wind coming from the direction of the sun. To trail the sensor away from the ship and its shadow, keep the bow of the ship in the direction of the sun, deploy the instrument from the bow, and meanwhile back the ship away from the sun. Otherwise, point the bow away from the sun, deploy from the stern, and have the ship move forward away from the sun.

The normal output of the QCD-90XL is a positive voltage ranging between +6 volts at the maximum irradiance level and a minimum voltage near zero where the sensor has insufficient irradiance to generate a proper signal to bias the internal log amplifier. Note, however, that negative voltages are possible. (Consult the calibration sheet for the voltage output in full sunlight.)

The QCD-90XL should be connected to a data acquisition system that will correctly digitize the voltage output. When data are analyzed from this data acquisition system, the transfer function should be applied and the correct irradiance reading recovered.

After a vertical profile, the QCD-90XL should be washed off with fresh water. The protective cap should be installed after the irradiance collector has dried.

3.2. MAINTENANCE

After each use, rinse the cable and underwater sensors with fresh water. If the instrument is installed in a lowering frame, check the frame fasteners for tightness before and after each deployment.

The cosine collector may become dirty during normal use. It may be cleaned with warm water, soap or a solvent such alcohol using a soft tissue or towel. Do not use acids or abrasive cleaners or brushes as this will dissolve the plate. Should the collector become damaged or heavily soiled, return the instrument for service and recalibration.

The QCD-90XL underwater sensor requires no other maintenance except that O-rings should be replaced yearly when the instrument is recalibrated (consult factory for details). The optical section of the instrument should not be disassembled since this will void the calibration of the instrument.

NOTE: *If the underwater bulkhead connector must be removed from the housing for any reason, do not re-tighten to over 15 inch-pounds of torque or breakage may occur.*

3.3. LEAKAGE OR FLOODING: WHAT TO DO

The instrument has been engineered to be water-proof to a depth of 10,000 meters (QCD-900L) or 7,000 meters (QCD-905L). In the event that the instrument leaks, do not panic, the instrument can usually be saved if the proper procedures are followed.

3.3.1. Instrument Disassembly

1. Remove the 6 screws at the top of the instrument and open the housing. Be sure to keep track of these screws for reassembling the instrument.

2. Remove the two screws retaining the photodiode to the upper housing.

3. BRIEFLY rinse with distilled water or equivalent.

4. Rinse briefly with 70-90% ethyl or isopropyl alcohol. Do not use methanol, as it may damage the electronics.

5. Dry, preferably vacuum desiccate (40-50°C for 24 hours is recommended).

6. Carefully package all components and return to manufacturer for inspection and recalibration.

NOTE: *Any disassembly of the optical components will change the calibration of the instrument.*

3.3.2. Instrument Reassembly

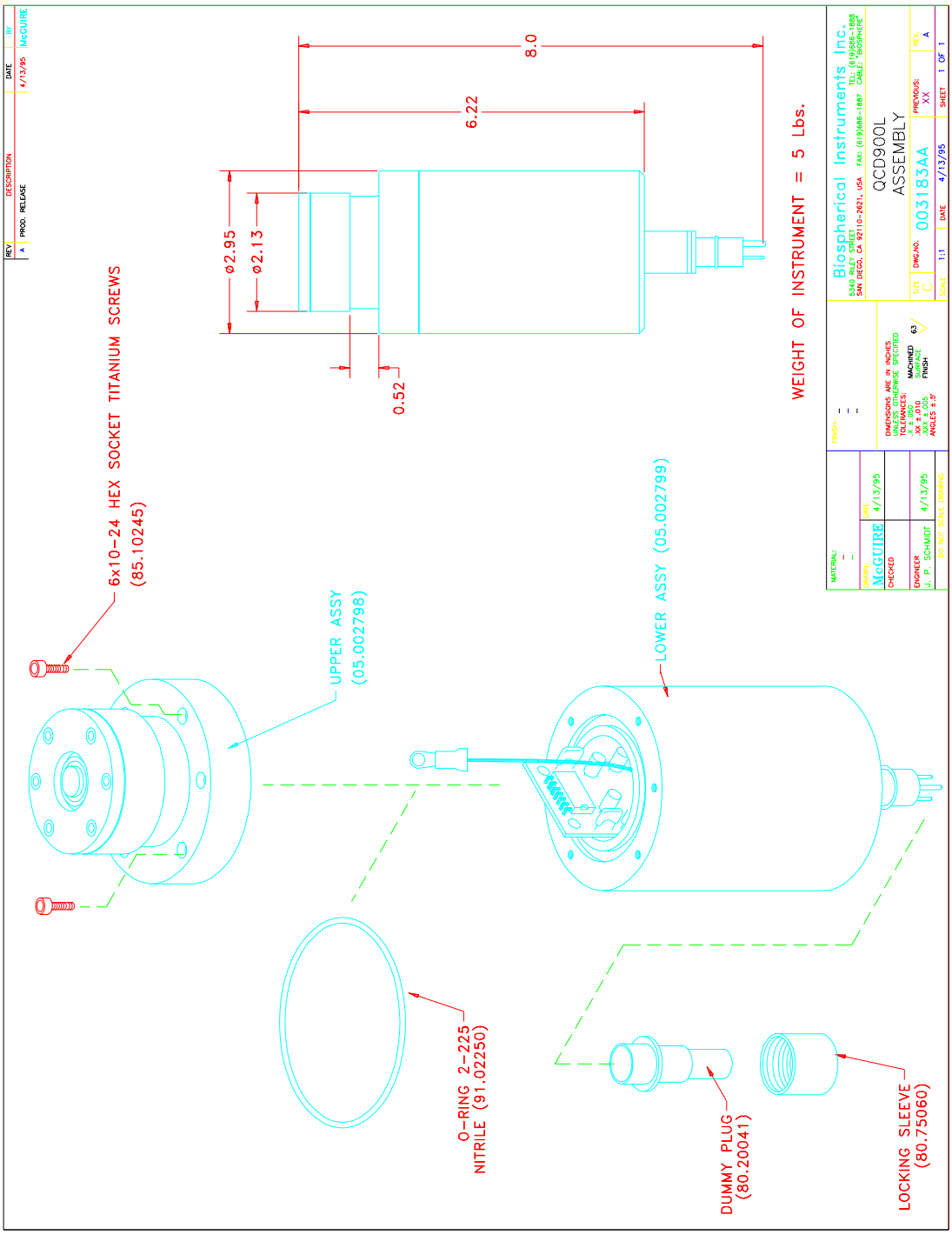
If you have disassembled the instrument, but have not disassembled any of the optical components, simply reconnect the top of the sensor to the main body. Turn the six screws until they just contact the main housing. Then, tighten each screw 1/4 turn in a crisscross pattern across the instrument until all screws are snug. This ensures even pressure around the o-ring. The screws are relatively fragile and can be broken if over-tightened. If a screw is broken, contact the factory for replacement.

Deployment of the instrument with broken or missing screws will result in flooding when used at depths over a few meters.

APPENDIX: TECHNICAL DRAWINGS

Title	Number/Type*
QCD-900L Assembly	003183A
QCD-900L Top Assembly	002798A
QCD-900L Bottom Assembly	002799A
QCD-905L Assembly	003187A
QCD-905L Top Assembly	003188A
QCD-905L Bottom Assembly	003189A
QSP-200L4S Single Ended Power PCA	002007E

***** A note regarding Biospherical Instruments Inc. drawing and part numbering scheme. BSI uses a system which integrates part and drawing numbers for those parts or assemblies that we specify or build. End items have a slightly different numbering scheme. A standard BSI part number has a 9-digit alpha-numerical code. It consists of a two digit class code prefix, a six digit sequence number suffix, and a single letter revision code. An example would be: 05.123456C. The drawings associated with this part consist of the same six digit suffix number but have two appended letters. The first indicates the drawing type (electronic schematic (E), assembly diagram (A), mechanical drawing, etc.), and the second letter is the revision level. For example, if the sub-assembly 05.123456C was a printed circuit assembly, it should have at least two drawings associated with it, 123456AC and 123456EC, which are the assembly diagram and electronic schematic, respectively, for revision level C (i.e., third revision). In drawings which include components numbered in this way, the revision level for the components is omitted so that the drawing does not need to be changed when a component is revised (the definition of a revision is that the new part is functionally and mechanically interchangeable with the original part).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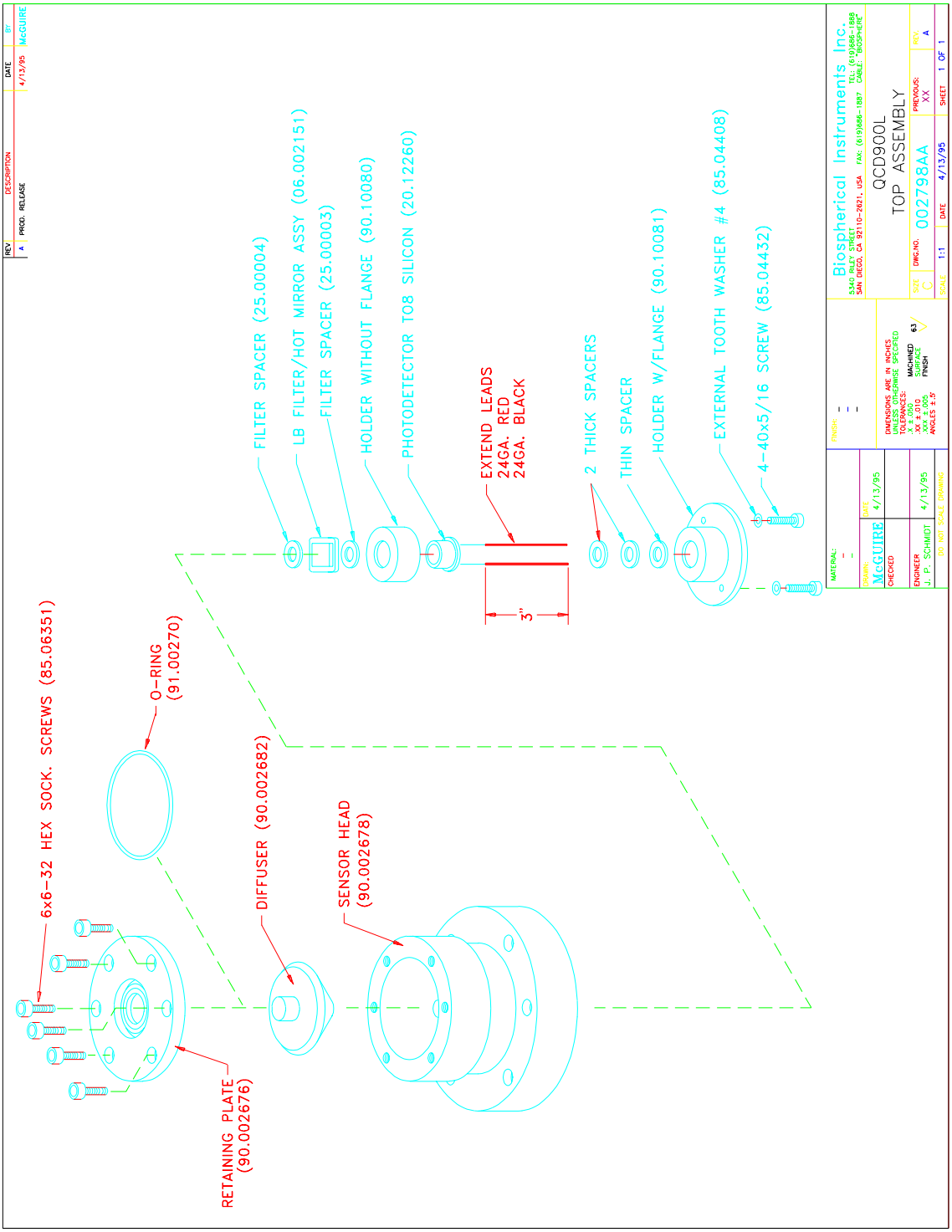
UPPER ASSY
(05.002798)
LOWER ASSY (05.002799)
O-RING 2-225
NITRILE (91.02250)
DUMMY PLUG
(80.20041)
LOCKING SLEEVE
(80.75060)
Biospherical Instruments Inc.
QCD900L
ASSEMBLY
003183AA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PHOTODETECTOR TO8 SILICON (20.12260)
EXTEND LEADS
24GA. RED
24GA. BLACK
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2 THICK SPACERS
THIN SPACER
HOLDER W/FLANGE (90.10081)
EXTERNAL TOOTH WASHER #4 (85.04408)
4-40x5/16 SCREW (85.04432)
6x6-32 HEX SOCK. SCREWS (85.06351)
O-RING
(91.00270)
DIFFUSER (90.002682)
SENSOR HEAD
(90.002678)
RETAINING PLATE
(90.002676)
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McGUIRE
Biospherical Instruments Inc.
5340 RILEY STREET
SAN DIEGO, CA 92110-2621, USA
TEL: (619)686-1888
FAX: (619)686-1887
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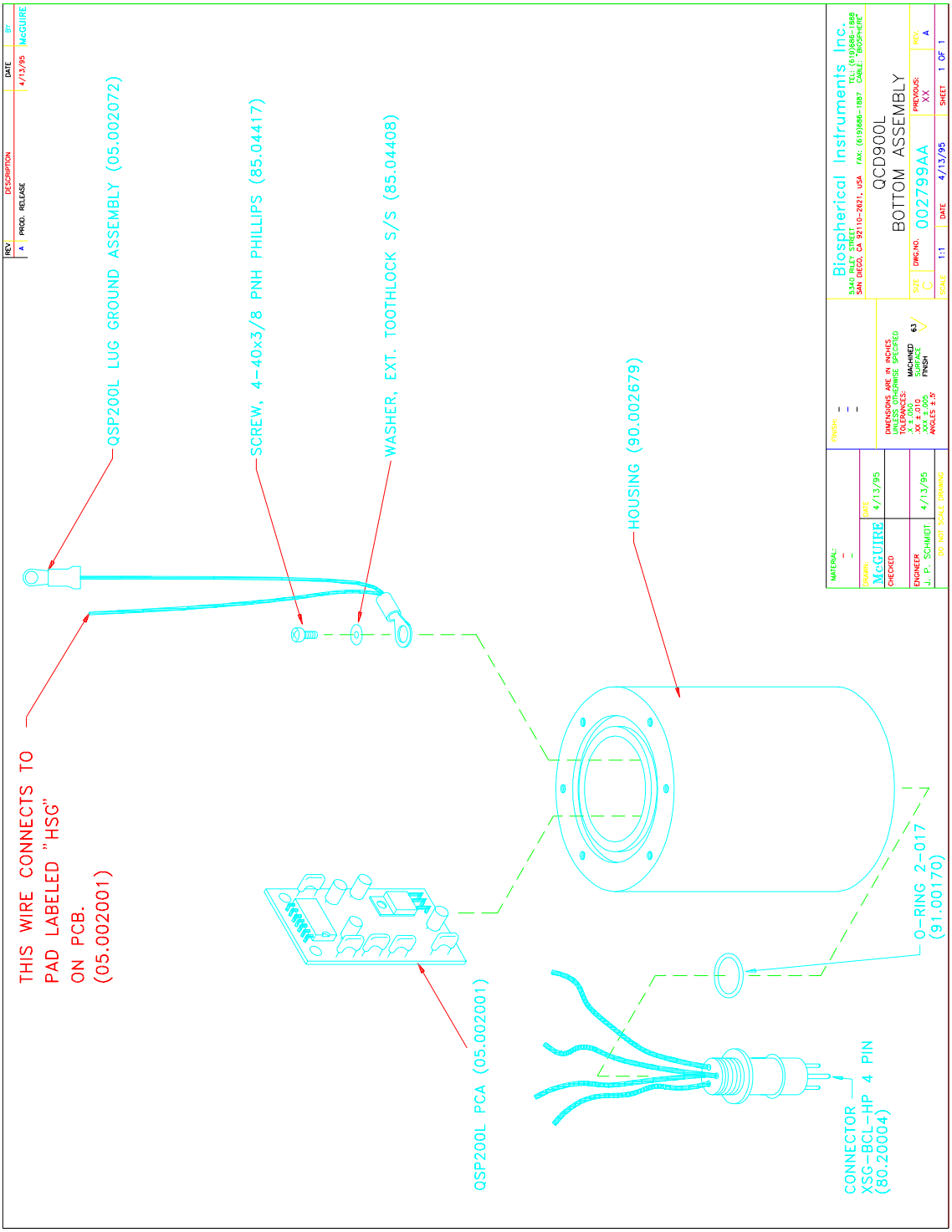
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WASHER, EXT. TOOTHLOCK S/S (85.04408)
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THIS WIRE CONNECTS TO PAD LABELED "HSG" ON PCB. (05.002001)
QSP200L PCA (05.002001)
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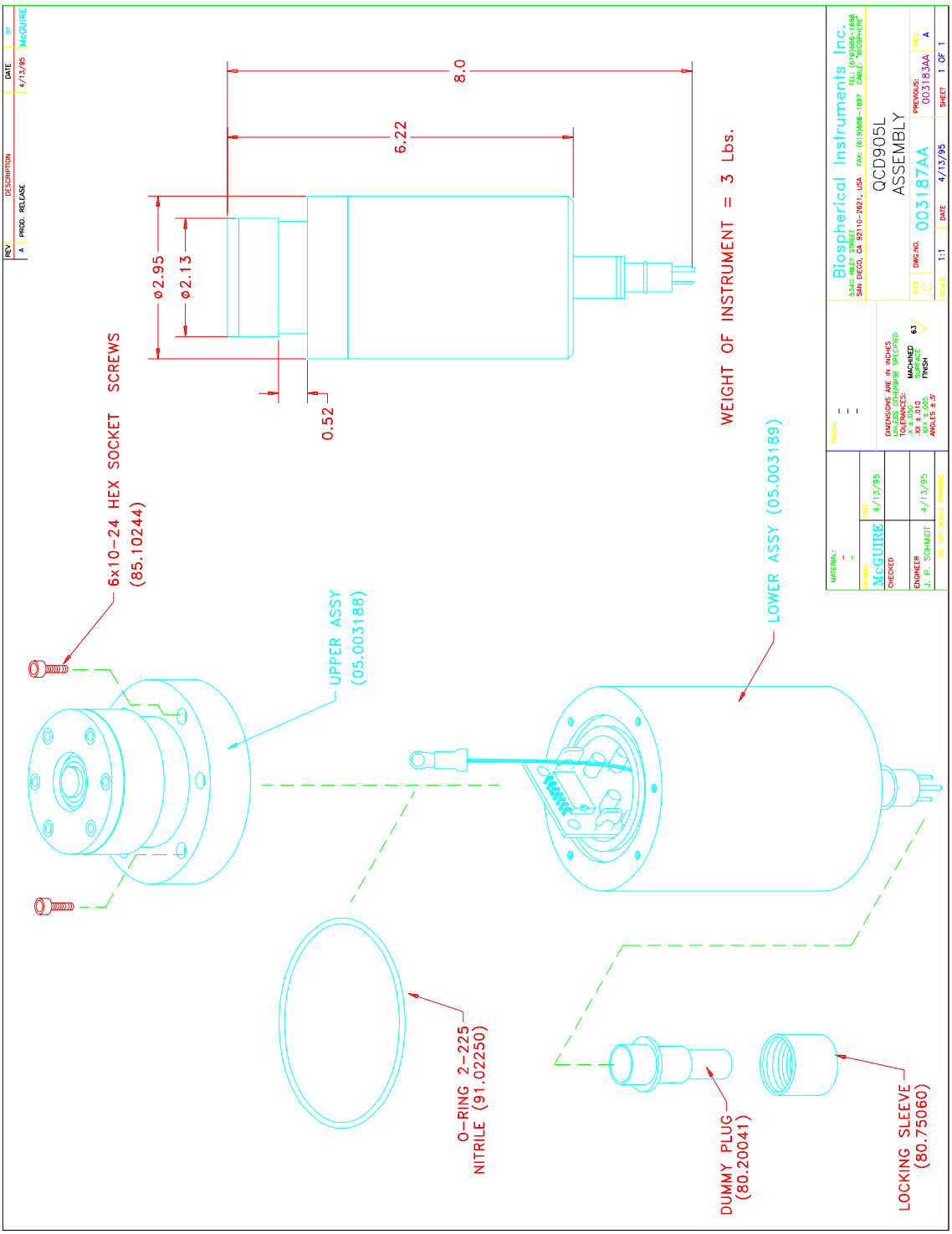
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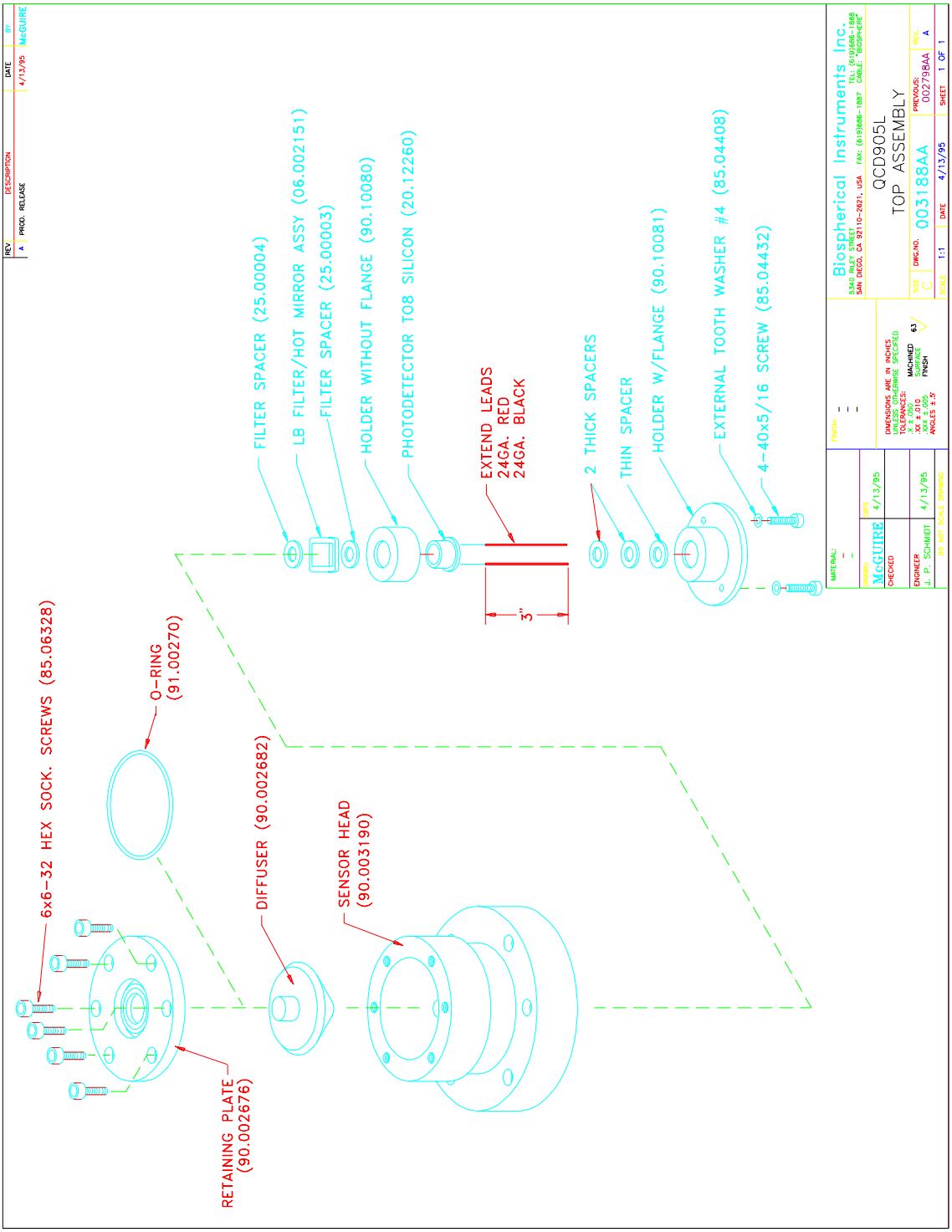
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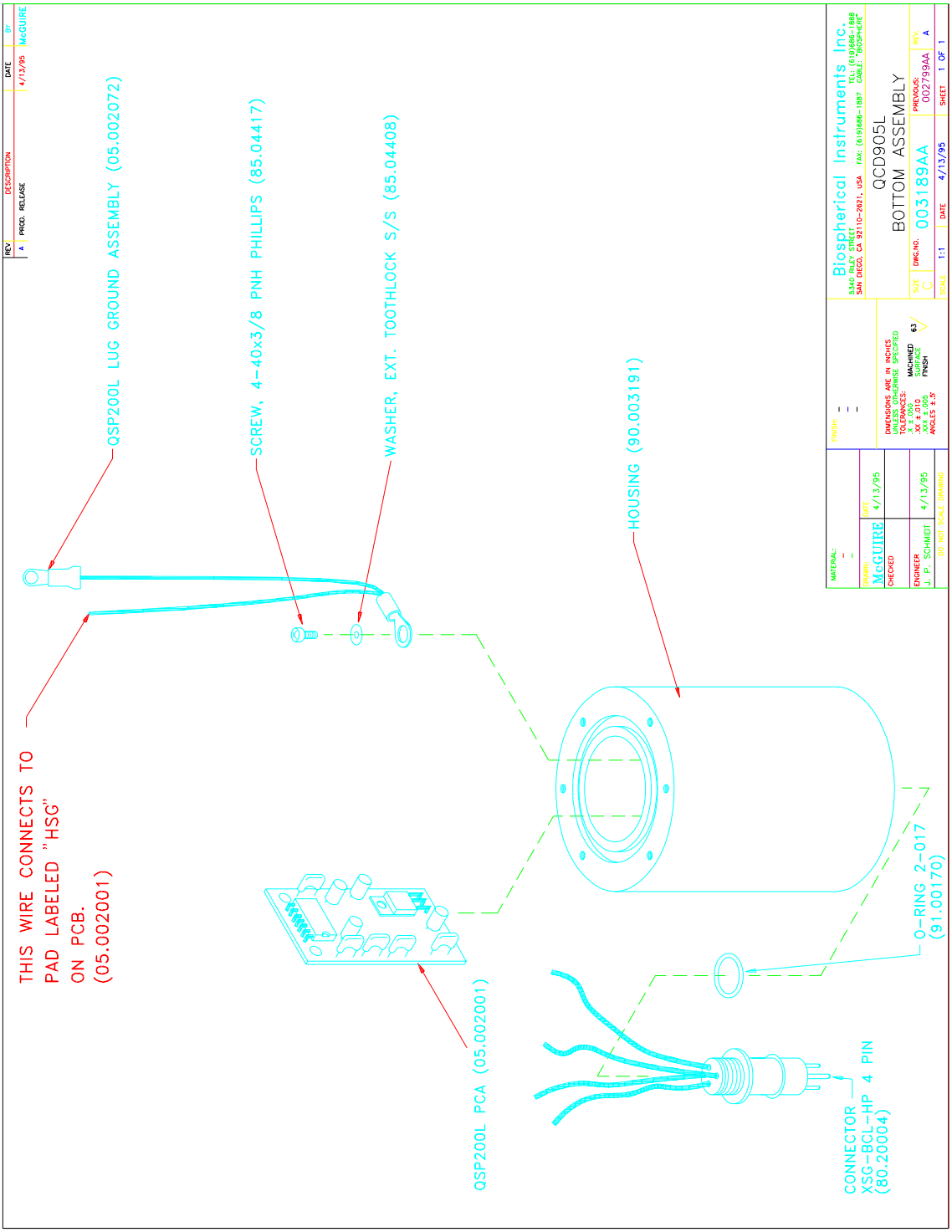
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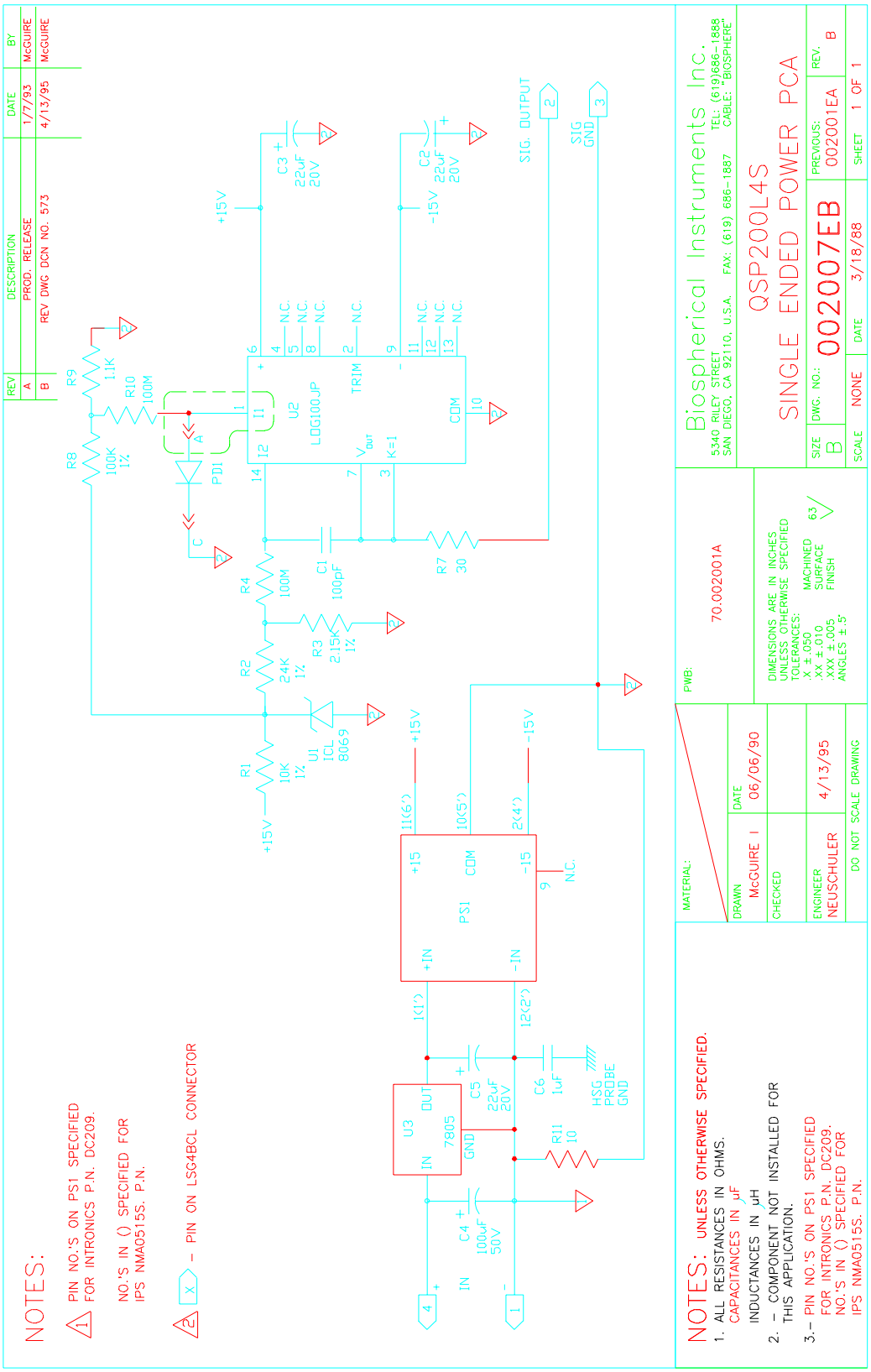
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B REV DWG DCN NO. 573 4/13/95 McGUIRE
Biospherical Instruments Inc.
5340 RILEY STREET SAN DIEGO, CA 92110, U.S.A. FAX: (619) 686-1887 TEL: (619)686-1888 CABLE: BIOSPHERE
QSP200L4S
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CAPACITANCES IN µF
INDUCTANCES IN µH
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R9 1.1K
R10 100M
R11 10
C1 100pF
C2 22uF 20V
C3 22uF 20V
C4 100uF 50V
C5 22uF 20V
C6 1uF
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U2 LOG100JP
U3 7805
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