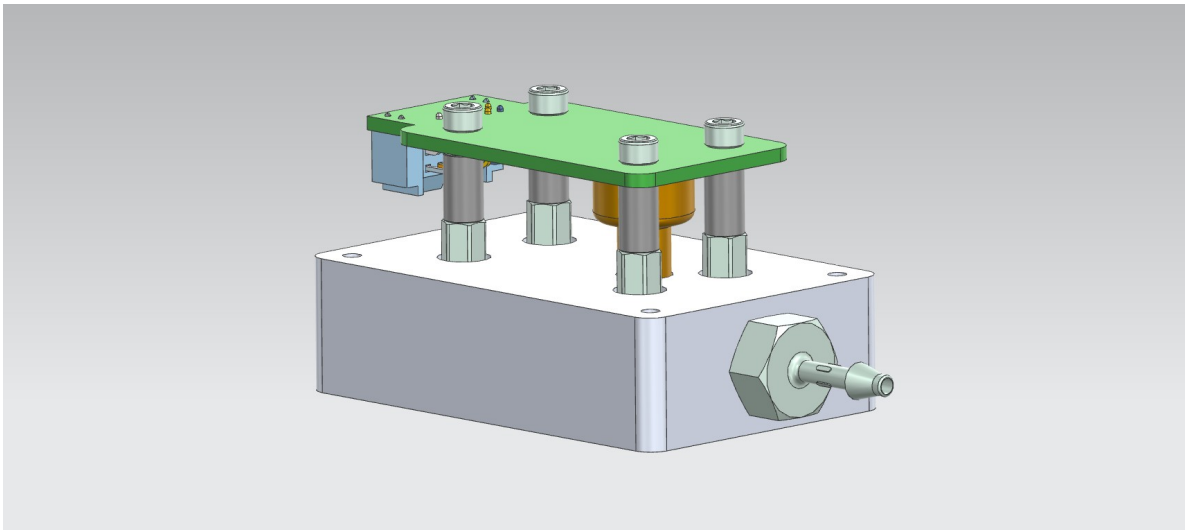
PACIFIC GYRE | ENGINEERING DESIGN REPORT

Atmospheric Pressure Sensor Redesign

System Integration, Mechanical Sealing, PCB Development, and Qualification



Prepared by Diego Niiler
Supervisor: Andy Sybrandy, President
Internship period: June 15-August 7, 2026

Contents

1. Executive Summary
2. Project Context, Requirements, and Methods
3. Timeline/Gantt Chart
4. Key Architecture Decisions
5. Material Selection and Trade Study
6. Adhesive Selection and Trade Study
7. PCB and Mechanical Integration
8. Firmware Integration
9. Bill of Materials and Cost Status
10. Manufacturing and Assembly Plan
11. Verification and Qualification Plan

Appendix A - Major Engineering Decision Register
Appendix B - Superseded Concepts and Lessons Learned
Appendix C - Selected Technical References
Appendix D - Closeout Status and Remaining Work
Appendix E - Current Mechanical Drawing Package

1. Executive Summary

This project began as a replacement effort for the Honeywell IPT atmospheric-pressure sensor used in an SVP/SVPB drifter. The existing Honeywell device remained the baseline standard, but its approximate $800 cost and roughly nine-month lead time created a strong reason to qualify a modern, lower-cost Bosch MEMS sensor. The project was treated as a reverse-engineering and integration effort: preserve the existing drifter, water trap, and pressure path.

The design evolved repeatedly. It moved from a small, isolated sensor board in a valve chamber, to a one-board BMP581 design, briefly back to a two-board daughterboard architecture, then to a one-board arrangement with the sensor on the underside under a machined C464 naval-brass stepped tube. That tube used four tabs through routed PCB cutouts and was intended to be soldered to an exposed copper ring.

Late in July, the sensor changed from BMP581 to BMP384. The current mechanical direction then changed more substantially: eliminate the soldered brass interface and bond a rigid plastic tube directly to the PCB. The chosen material is unplasticized PVC (U-PVC) with 3M Scotch-Weld DP420NS toughened epoxy, applied as a continuous annular bond line between the tube's flat contact face and the underside of the PCB. The joint is mechanically sheltered inside the buoy, but the assembly must survive repeated saltwater wet/dry transitions as the internal water level rises and falls. It must keep adhesive away from the BMP384 pressure port, preserve the pressure path, and pass coupon-level bond, leak, and long-duration environmental testing before production release. Taken together, the project demonstrates full-cycle engineering ownership across requirements capture, reverse engineering, circuit and PCB design, mechanical sealing, material and adhesive trade studies, supplier communication, firmware planning, and qualification.

Supporting evidence is organized for direct use with the main report: Appendix A records the major engineering decisions; Appendix B preserves superseded concepts and lessons learned; Appendix C lists the principal technical references; Appendix D tracks closeout status and remaining work; and Appendix E contains the current mechanical drawing package.

2. Project Context, Requirements, and Methods

The project record establishes the following design drivers:

- Measure atmospheric pressure on a long-duration surface drifter; the sensor is not intended for deep-water pressure measurement.
- Preserve the existing pressure path and water-trap layout.
- Keep the electronics dry while allowing atmospheric pressure to reach the pressure port.
- Fit within the existing design space. The assembly is installed upside down, and the replacement cannot extend deeper than the existing water trap.
- Reuse the existing mounting holes, board geometry, and power architecture, where doing so reduces risk.
- Produce a repeatable pressure response across the valve or pressure interface.
- Reduce component cost and supply risk relative to the Honeywell IPT while retaining scientifically defensible atmospheric-pressure performance.
- Make the design manufacturable and inspectable for an internal buoy installation.



Figure 1. Functional pressure path. Atmospheric pressure passes through the existing water trap and protected tube path to the BMP384, while the bonded PVC-U interface maintains the dry electronics boundary.

2.1 SVPB Assembly Context



Figure 2. SVPB manufacturing and deployment context. Left: drifters undergoing assembly with batteries and housings exposed. Right: staged drogue assemblies, which deploy below the buoy to provide drag and stabilize the drifter in the water column.

2.2 Engineering Methods and Tools

- Mechanical CAD: Onshape supported rapid part and assembly iteration; Siemens NX was used for final assembly integration, section views, and production drawings.
- Electrical and PCB design: Altium was used for controlled board geometry, custom keep-outs and cutouts, DRC, and 3D review.
- Firmware and integration: STM32 extension on Visual Studio Code supported BMP bring-up and established porting plan.
- Engineering decision methods: requirements decomposition, material and adhesive matrices, supplier RFQs, drawing revision control, and a qualification plan centered on leak integrity and long-duration saltwater cycling.

3. Timeline/Gantt Chart

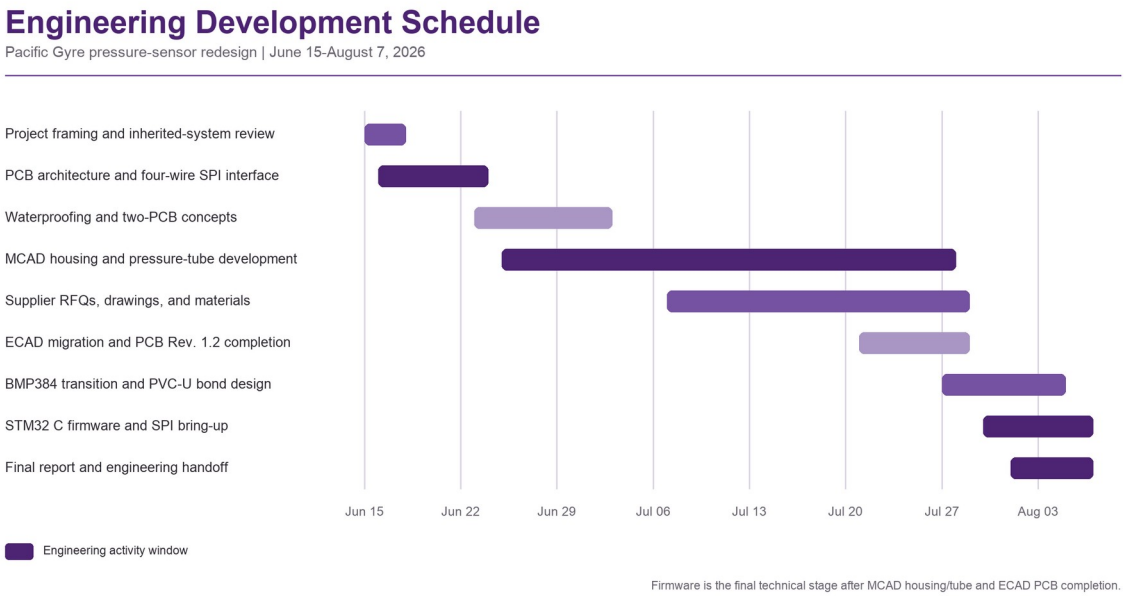


Figure 3. Engineering development schedule, June 15–August 7, 2026. Firmware is shown as the final technical stage after the housing and pressure-tube MCAD and PCB ECAD work were completed.

4. Key Architecture Decisions

Table 1. Major architecture stages and reasons for each design change.

Stage	Architecture	Reason for the change
June 15	One small BMP581 daughterboard in a protected low-profile housing; valve/diaphragm and membrane in the pressure path.	Separate wet pressure interface from electronics and reuse the existing drifter envelope.
June 16-18	Single PCB based on the original IPT carrier geometry; BMP581 added directly; SPI, LP2985, headers, bus switch, and jumpers retained where useful.	Reuse the original SPI-oriented design and minimize mechanical/electrical disruption.
June 23	Second PCB containing only the BMP581 and its local capacitors, connected by soldered pins/header to the main board.	Improve water isolation and make the sensor module very small and replaceable.
By July 14	Return to one PCB. BMP581 mounted on the underside beneath a naval-brass tube that connects to the existing housing.	Reduce board count and connector/assembly complexity while preserving the existing housing.
July 27-28	Sensor changed from BMP581 to BMP384; mechanical tube concept initially retained.	The decision to change sensors is explicit, but the accessible record does not state the selection rationale.
July 29	Rigid plastic tube bonded directly to the PCB; no solder. PVC-U and DP420NS selected in screening.	Reduce machining and selective-plating complexity; create a controlled polymer-to-PCB seal suitable for in-house assembly.

5. Material Selection and Trade Study

Table 2. Material trade study for the bonded pressure-tube interface.

Rank	Material	Marine resistance	Bonding	Durability	Production fit	Overall fit
1	**PVC-U**	**5**	**5**	**4**	**4**	**4.6**
2	PC/ASA	4	4	5	4	4.2
3	ASA	4	3	4	4	3.8
4	PBT-HR GF15	4	3	5	3	3.7
5	ABS	3	4	3	4	3.6
6	PVDF	5	1	5	2	3.4
7	PA12	3	2	4	3	2.9

Decision: PVC-U provides the best balance of marine durability, bondability, dimensional stability, availability, and small-batch manufacturability. PC/ASA remains the backup if the installed part is later exposed to greater impact or direct sunlight.

Matrix rationale: Marine wet/dry resistance and bondability received the greatest weight because the internal tube must survive a six-month saltwater cycling program while maintaining a leak-resistant bond to the PCB solder mask. Durability and production fit were secondary discriminators. The scores are engineering screening judgments based on the cited material data and assembly constraints; they are not qualification results.

6. Adhesive Selection and Trade Study

Table 3. Adhesive trade study for the PVC-U-to-PCB sealing joint.

Rank	Adhesive	PVC-U / PCB bond	Wet/dry durability	Leak barrier	Assembly control	Overall fit
1	**3M DP420NS**	5	5	5	4	4.8
2	Loctite E-40FL	4	5	5	4	4.5
3	3M DP8010	4	4	4	4	3.9
4	Dow 3145 silicone	3	5	2	4	3.7
5	JB Weld MarineWeld	3	4	4	2	3.5
6	JB Weld Plastic Bonder	4	2	3	4	3.3

Decision: 3M Scotch-Weld DP420NS Black is the preferred production candidate because it combines structural toughness, non-sag dispensing, a 2:1 cartridge mix, and a controlled barrier-forming bond. Loctite E-40FL remains the backup. The recommendation is based on manufacturer data and must still be qualified on the selected PVC-U stock and the production PCB solder mask.

Matrix rationale: PVC-U-to-solder-mask bonding, repeated wet/dry durability, and continuity of the leak barrier were the primary criteria. Assembly control separated cartridge-dispensed structural adhesives from hand-mixed alternatives that are harder to meter and inspect around the BMP pressure-port keep-out. These rankings select coupon-test candidates; they do not replace qualification.

6.1 DP420NS Bond Process

Apply DP420NS as one continuous annular bead on the tube contact face; a separate adhesive groove is not required for the first controlled build.

Target a cured bond line of approximately 0.006 in—about half the tube-wall thickness—and control it with fixture hard stops or verified spacer beads rather than operator pressure.

Prepare the PVC-U with an isopropyl-alcohol wipe, light abrasion, and a final wipe. Begin with an isopropyl-alcohol-only clean on the PCB solder mask, use the specified 2:1 static mixer, fixture immediately, maintain alignment through handling strength, and cure at least 24 hours at room temperature (approximately 72°F) before leak testing or immersion.

7. PCB and Mechanical Integration

7.1 Bonded Tube-to-PCB Interface Requirements

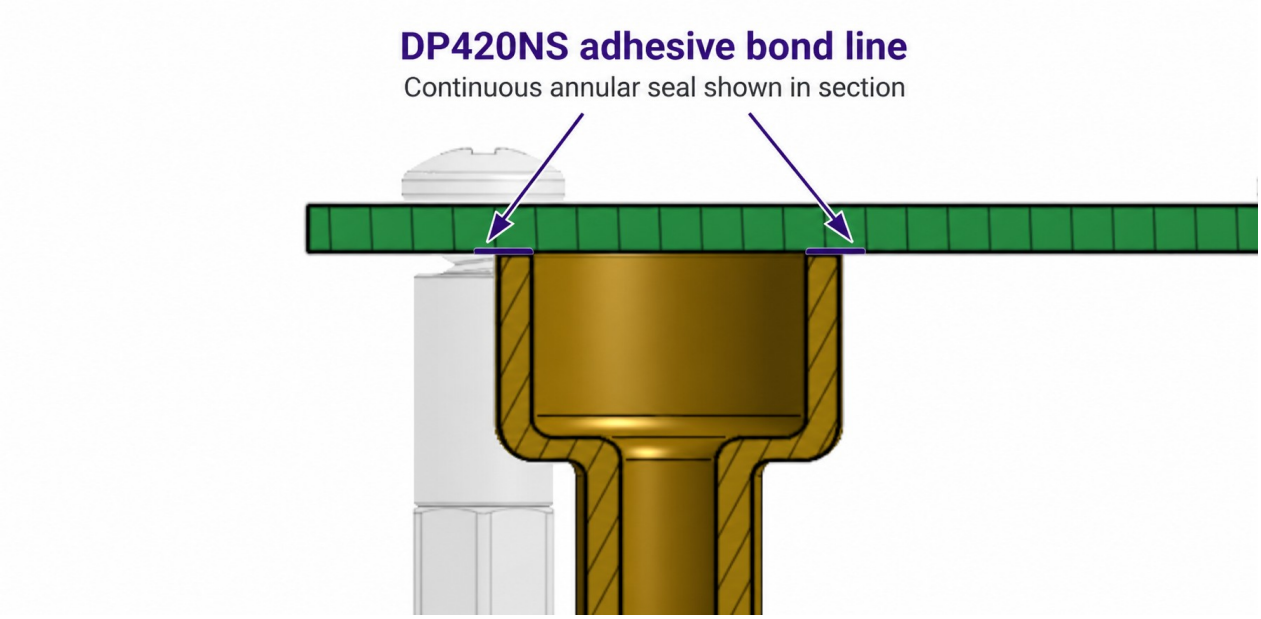


Figure 4. Annotated section view of the U-PVC tube-to-PCB interface. The purple layers and leader arrows identify the two visible sections of one continuous annular DP420NS bond line.

- Provide a flat, continuous annular contact face on the tube so the adhesive forms a uniform bond line against the PCB underside.
- Control dispense volume and fixture pressure so adhesive squeeze-out cannot enter the BMP384 cavity or pressure-port keep-out.
- Inspect the inner and outer bond-line edges for complete wetting, voids, and discontinuities; do not depend on an oversized exterior fillet to create the seal.
- Keep the central area around the BMP384 completely free of adhesive, conformal coating, cleaner residue, and loose particles.
- Define a dedicated PCB solder-mask annulus with no vias, exposed copper, silkscreen, or test pads under the adhesive.
- Validate the actual solder-mask chemistry and surface preparation; a generic FR-4 result is not enough.

7.2 PCB Revision Development

PCB Rev. 1.1 records the preceding brass-tube/solder interface. A continuous copper annulus and four tube-tab openings surround the BMP sensor location. Rev. 1.2 removed those attachment features when the design changed to a bonded PVC-U tube while retaining the board outline, mounting pattern, connector, and four-wire SPI architecture.

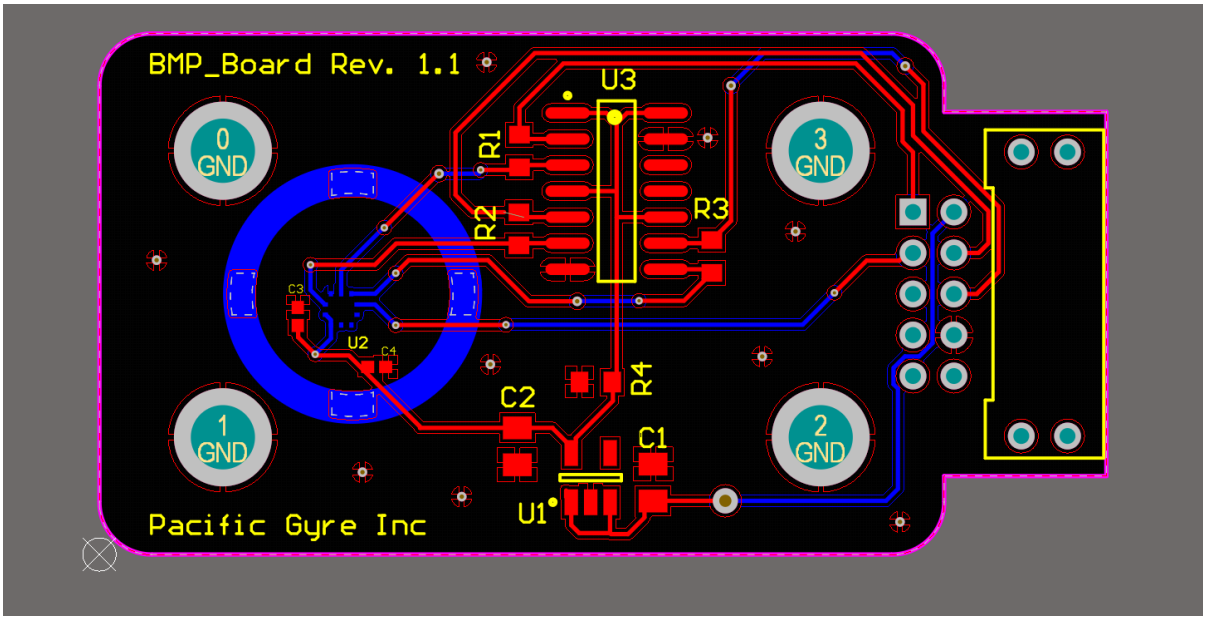


Figure 5. BMP Board Rev. 1.1 PCB layout. The circular copper region and four tube-tab openings document the earlier soldered brass-tube interface that preceded the bonded PVC-U design in Rev. 1.2.

PCB Rev. 1.2 closes the earlier C46400 (C464) naval-brass/solder architecture. The continuous exposed-copper solder annulus and four routed tube-tab openings were removed. The BMP384 remains centered within a controlled sensor keep-out, while the wide foot of the rigid unplasticized PVC tube (PVC-U, commonly written uPVC) is bonded to a prepared, via-free solder-mask annulus. This separates the environmental seal and structural attachment from PCB copper features and removes the prior selective-finish and brass-solderability requirements.

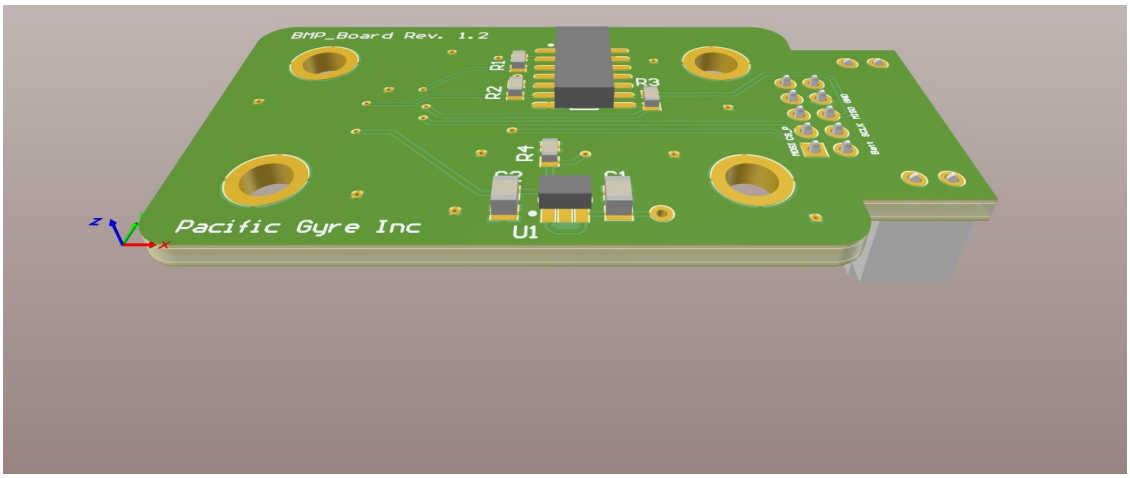


Figure 6. PCB Rev. 1.2 top-side render. The legacy copper solder annulus and four tube-tab cutouts are absent from the PVC-U adhesive-bond design.

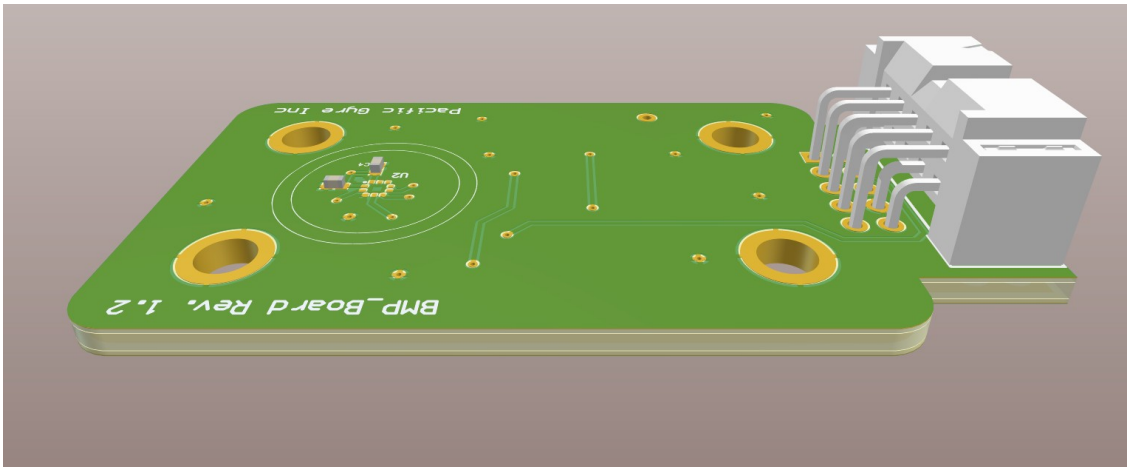


Figure 7. PCB Rev. 1.2 sensor-side render. The BMP384 is centered inside the circular tube-interface region; the production bond annulus is reserved for the wide-foot PVC-U tube and must remain free of exposed copper and contamination.

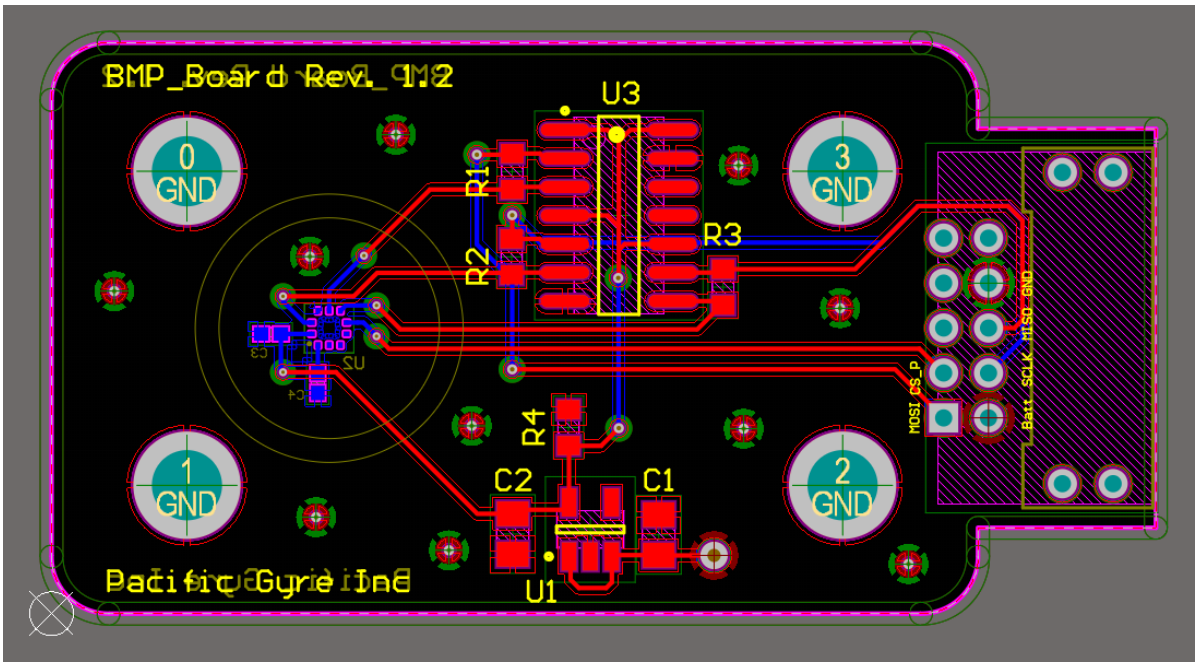


Figure 8. Altium layout view of PCB Rev. 1.2. The center sensor interface has no exposed copper solder annulus or routed tube-tab slots; concentric outlines define the tube-interface and sensor keep-out geometry.

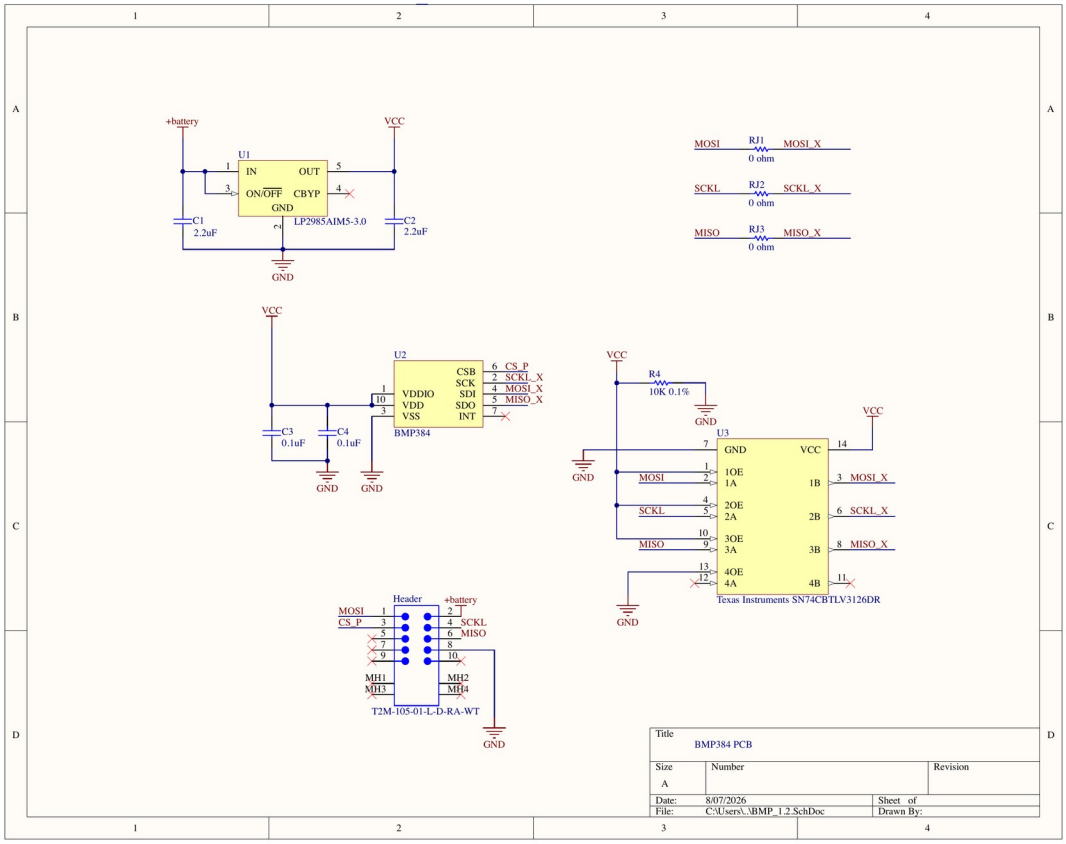


Figure 9. BMP 1.2 schematic. The BMP384 connects through the four-wire SPI signal path (MOSI, MISO, SCLK, and CS) with regulated 3.0 V power, local decoupling, series jumpers, and the SN74CBTLV3126 bus-switch interface.

7.3 Current Mechanical CAD Assembly

The current sensor-assembly CAD model captures the PCB, standoffs, housing, pressure-tube adapter, and pneumatic fitting as one integrated stack. The revised drawing identifies the PVC-U tube as BOM Item 8. Appendix E contains the complete drawing package: the sensor assembly (Figure E-1), pressure-tube adapter (Figure E-2), and Delrin housing (Figure E-3).

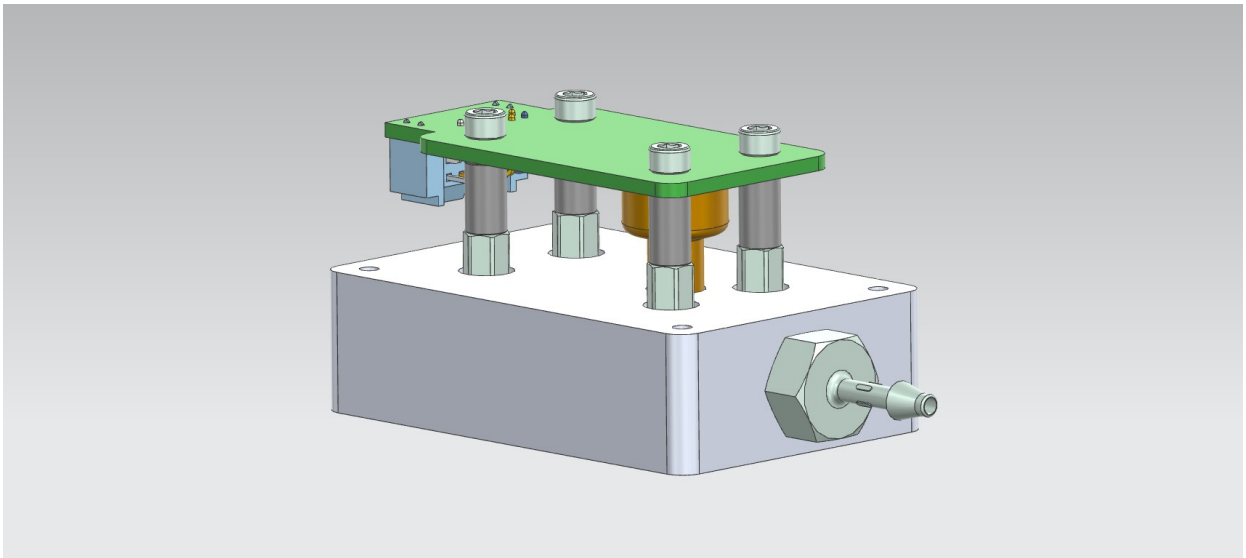


Figure 10. Sensor-assembly CAD model

7.4 Housing and Pressure-Path Integration

The housing locates the PCB, supports the pressure-tube adapter, provides the pneumatic connection, and maintains a sealed sensor cavity while avoiding unnecessary parts or machining features. The released geometry and dimensional evidence are shown in Appendix E, Figure E-3.

- Low-profile envelope: the installed housing could not be taller than the existing water-trap height. Preserving that vertical relationship keeps the water trap as the protective high point in the pressure path and reduces the likelihood that water can advance into the sensor housing. The installed water-trap/valve assembly is visible on the internal electronics disc in Figure 12 (left).
- Static seal: the AS568-010 O-ring at the interface provides the tight local seal. The machined groove controls O-ring location and compression while the four screw, spacer, and standoff stacks maintain repeatable PCB positioning.
- Pneumatic connection: the side barbed fitting mates with the tubing that runs to the top of the SVPB drifter. This fitting completes the protected atmospheric-pressure path while allowing the sensor assembly to remain compact and serviceable.

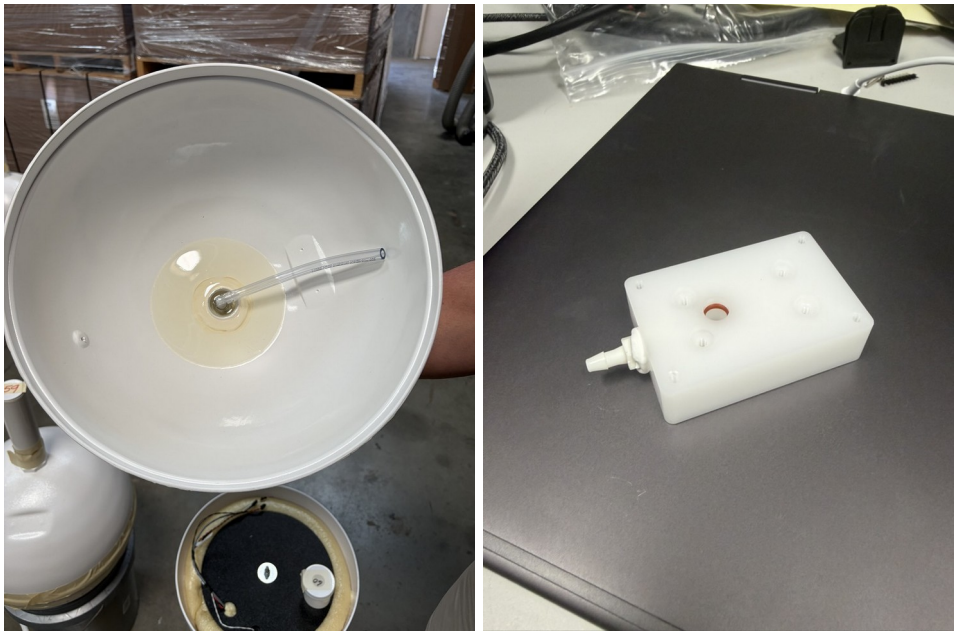


Figure 11. Pressure-path and housing prototype. Left: the clear barometer tube installed in the upper half of the drifter. Right: the printed BMP housing prototype with its side barbed fitting and visible orange O-ring. Appendix E, Figures E-2 and E-3, provides the controlled pressure-tube and housing geometry.

8. Firmware Integration

Firmware development was the final technical phase, beginning after the housing and pressure-tube MCAD and the PCB ECAD work were completed. The implemented BMP581 path is written in C for an STM32U5 using the STM32 HAL and four-wire SPI. The application configures SPI1 as an 8-bit, MSB-first master in mode 0 with software-controlled chip-select and an approximately 500 kHz clock, initializes and validates the BMP581, performs one-second pressure and temperature sampling, and reports measurements and diagnostic status over a 115200-baud serial connection. The BMP581-to-BMP384 change requires a driver-layer rewrite but did not require new PCB routing or a footprint revision because the devices retain the same ten pin functions and 2.0 x 2.0 mm LGA footprint.

The firmware project was configured and developed in Visual Studio Code with the STM32 extension, STM32Cube-generated project configuration, CMake/Ninja build presets, the GNU Arm embedded toolchain, and integrated build, flash, and serial-monitor tasks. The custom bmp581.c/bmp581.h driver handles SPI register transactions, reset and chip-ID checks, oversampling and output-data-rate configuration, data-ready timeout handling, raw-data conversion, and explicit error reporting. Appendix C provides the Bosch sensor references used for this work, while Appendix D identifies BMP384 firmware validation as a remaining closeout item.

8.1 Physical Integration and Firmware Bring-Up

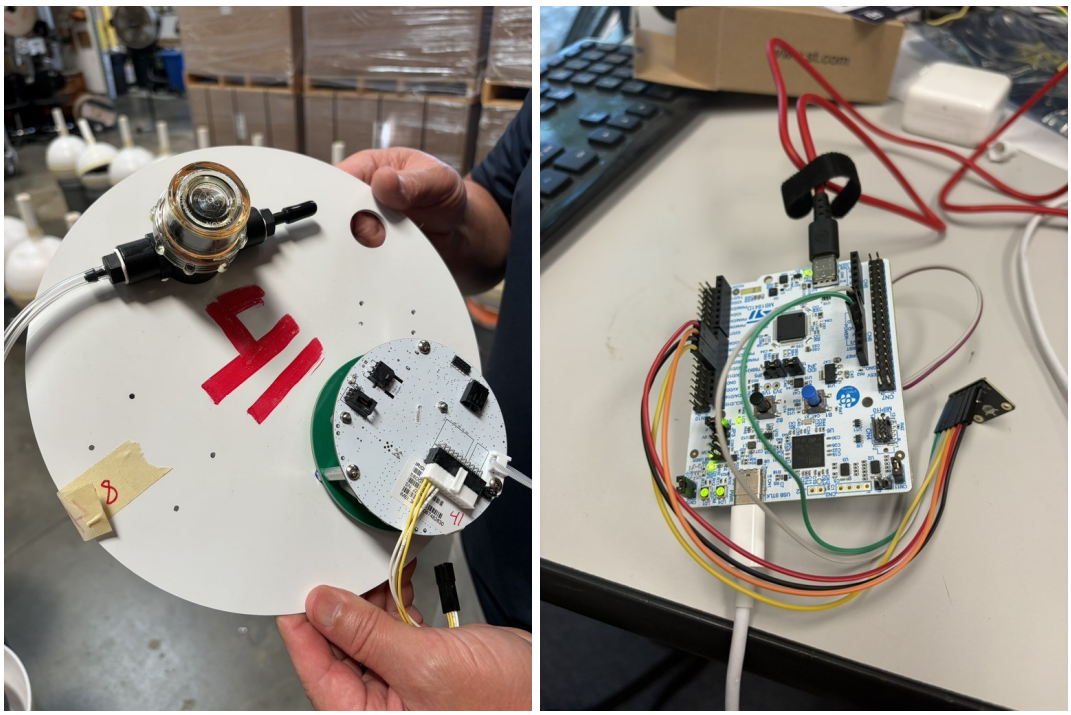


Figure 12. Physical integration and firmware bring-up context. Left: the SVPB internal electronics disc with the STM32 electronics stack, water-trap valve, pressure tubing, and tape marked 8; the nearby drilled-hole pattern is the barometer mounting location. Right: the STM32U5 development-board setup used to flash and exercise the BMP581 four-wire SPI firmware. Appendix D records BMP384 porting and validation as remaining work.

9. Bill of Materials and Cost Status

Table 4. Preliminary sensor-assembly bill of materials and estimated cost.

No.	Component	Part number / source	Qty	Unit cost	Extended cost
1	Socket-head cap screw, 4-40 × 9/16 in, 316 stainless steel	HWSC-50 / McMaster 92185A124	4	$0.1675	$0.67
2	Barbed fitting for 1/8 in tube	PG00-031 / McMaster 5463K438	1	$1.47	$1.47
3	Spacer, No. 4 x 5/16 in, aluminum	HWSP-03 / McMaster 92510A694	4	$0.3075	$1.23
4	Male-female hex standoff, 4-40, 1/4 in body, aluminum	HWST-12 / McMaster 93505A101	4	$0.35	$1.40
5	IPT / BMP housing	PMI71 (Pacific Gyre)	1	$7.70	$7.70
6	PCB assembly, Rev. 1.2	JLCPCB quote	1	$23	$23
7	O-ring, AS568-010	PG00-128 / McMaster 9396K15	1	$0.25	$0.25
8	CNC-machined PVC-U pressure tube	BMP-Tube-3 / Shenzhen Jucheng Precision Model Co., Ltd.	1	$15.62	$15.62

Estimated listed-component cost: approximately $51.34 per sensor ($28.34 mechanical assembly, including one $15.62 quoted PVC-U tube, plus approximately $23 for the PCB assembly). The BOM unit-cost roll-up excludes freight, taxes, adhesive consumption, labor, tooling, and setup unless already included in a quoted line item.

10. Manufacturing and Assembly Plan

In-house assembly is feasible because the tube and sensor are small, but it should be treated as a controlled process rather than hand-applied craft work.

1. Incoming inspection: verify certified PVC Type I, Grade I, ASTM D1784 12454-B stock; verify the Ø0.470/Ø0.387 in contact annulus, PCB solder-mask bond annulus, and absence of damage or contamination.
2. Surface preparation: IPA-wipe, lightly abrade, and IPA-wipe the PVC-U contact face. Start with IPA-only cleaning on the PCB solder mask and qualify any abrasion separately so copper is not exposed. Use lint-free wipes and allow both surfaces to dry before dispensing.
3. Fixture setup: use a keyed alignment jig that centers the tube on the BMP384 without touching the sensor.
4. Dispense: use a dual-cartridge static mixer and a defined bead mass or dispense time. Apply a continuous annular bead to the tube contact face without gaps.
5. Seat and inspect: lower the tube vertically onto the PCB and close the fixture to hard stops that establish a 0.006 in nominal bond line. Verify continuous inner and outer wetting with no squeeze-out into the sensor cavity.
6. Cure: maintain alignment for at least the approximately two-hour handling-strength period and allow at least 24 hours at 72°F (22°C) before leak testing or immersion. Record actual time and temperature; use a longer controlled conditioning period for qualification coupons when specified by the test plan.
7. Inspection: verify fillet continuity, tube height, concentricity, absence of bubbles, and no adhesive in the pressure-port keep-out.
8. 100% leak check: use a defined pressure-decay, vacuum-decay, or tracer method with documented pass/fail limits.
9. Functional check: confirm BMP384 communication, pressure response, and recovery after the leak test.
10. Traceability: record adhesive lot, mix nozzle, operator, cure time/temperature, and inspection result.

11. Verification and Qualification Plan

The following work is required before the PVC-U/DP420NS system can be called production-ready. Because the joint is mechanically sheltered inside the buoy, detailed structural simulation is not a priority unless testing reveals deformation, cracking, or debonding. The dominant risk is environmental durability, so qualification should prioritize physical leak testing and a representative long-duration saltwater wet/dry test.

11.1 Material and Bond Coupons

- Use the exact PVC-U grade and exact production PCB solder mask.
- Compare cleaned-only, abraded, and any manufacturer-approved primer condition.
- Measure initial lap-shear or pull-off strength and inspect failure mode.
- Run saltwater immersion and repeated wet/dry cycling that reproduces salt films, condensation, drying, and rewetting; retain separate coupons for periodic bond-strength and failure-mode checks.
- Run thermal cycling across the expected drifter internal range and remeasure bond strength.
- Check for PVC cracking, adhesive whitening, edge lift, solder-mask delamination, and swelling.

11.2 Assembly-Level Tests

- Pressure- or vacuum-decay leak test on every assembly.
- Dye or tracer study during development to identify microchannels at the solder-mask interface.
- Functional pressure response and time-constant comparison against the reference system.
- Run the complete assembly in the representative vertical water-column fixture for six months before ocean deployment. Vary the water height to reproduce ocean-current-driven level changes and repeated wet/dry exposure across the installed components.
- Mechanical push, pull, torsion, and handling tests on the tube.
- A/B comparison of DP420NS, E-40FL, and MarineWeld prototype coupons if schedule permits.

11.3 System Validation

- Side-by-side pressure logging against the Honeywell IPT or another calibrated reference.
- Validate absolute offset, noise, drift, temperature response, and pressure-path delay.
- Validate in-water/out-of-water detection thresholds and hysteresis over repeated transitions.
- At predetermined checkpoints and after the six-month saltwater cycling test, confirm leak integrity, stable BMP384 readings, an uncontaminated pressure port, and no adhesive softening, cracking, edge lift, swelling, salt bridging, or solder-mask delamination.

11.4 Six-Month Predeployment Water-Column Test

The assembled sensor will be installed in the representative vertical water-column fixture before ocean deployment. The water height will be varied to simulate current-driven changes at the barometer port and to cycle the pressure path through wet and dry conditions. The planned endurance run is six months, with scheduled pressure-response, leak-integrity, contamination, and visual inspections.



Figure 13. Predeployment validation hardware. Left: the barometer port installed on an assembled SVPB drifter. Right: the vertical water-column fixture selected for the six-month variable-water-height endurance test before ocean deployment.

Appendix A - Major Engineering Decision Register

Table 5. Major engineering decision register.

Period	Decision	Engineering basis	Status
June 15	Preserve inherited interfaces	Retain the water trap, pressure path, mounting envelope, regulated power, and STM32 boundary to reduce integration risk.	Current constraint
June 16-18	Use SPI	SPI matched the inherited carrier and simplified electrical and firmware integration.	Current
June 23-July 14	Return from two PCBs to one	Removing the daughterboard reduced connector count, stack height, and assembly complexity.	Current architecture
July 7-24	Develop brass tube and solder interface	Four tabs, PCB cutouts, and a copper annulus created a manufacturable metal attachment concept.	Superseded
July 21	Move PCB work to Altium	Altium provided better control of curved geometry, cutouts, keep-outs, DRC, and 3D review.	Current toolchain
July 27-28	Change BMP581 to BMP384	The BMP384 retained the ten pin functions and 2.0 x 2.0 mm footprint, allowing PCB Rev. 1.2 to remain unchanged.	Current sensor
July 29	Replace soldered brass with bonded polymer	The change removed selective plating, solder tabs, routed PCB slots, and the exposed copper annulus.	Current interface
July 29-August 6	Select U-PVC and DP420NS	Trade studies favored marine wet/dry durability, bondability, dimensional stability, and controllable in-house dispensing.	Qualification candidate
August 6	Set a 0.006 in bond-line target	A controlled annular bond line and pressure-port keep-out support repeatable sealing and inspection.	Process baseline
August 6-7	Correct hardware and cost baseline	CAD, drawing balloons, and BOM were aligned to the 4-40 x 9/16 in screws, 4-40 standoffs, and the received PCB estimate.	Current BOM
August 7	Prioritize physical qualification	The sheltered joint makes leak integrity, material aging, and six-month saltwater wet/dry cycling more important than structural simulation.	Planned validation

Appendix B - Superseded Concepts and Lessons Learned

- Four-wire SPI was used for sensor communications, matching the inherited carrier interface and the implemented STM32 firmware.
- Tall or standalone sensor canister - replaced by a low-profile module constrained by the water-trap depth.
- Two-PCB BMP-only daughterboard - replaced by a one-board design to remove connector and assembly complexity.
- U-shaped/open metal-tube feature - removed after damaging the O-ring.
- C360 free-machining brass - replaced by C464 naval brass for the marine-humidity environment.
- Bare or gold-only brass solder interface - broadened to supplier-recommended selective solderable finish.
- BMP581 - replaced by BMP384.
- C464 four-tab soldered stepped tube and matching slotted/copper-annulus PCB - replaced by a continuous-base PVC-U tube bonded directly to an unslotted solder-mask annulus.
- Marine JB Weld as a possible sealant - retained only as a prototype option, not the production winner.

Appendix C - Selected Technical References

Manufacturer and Material Data

- 3M DP420NS Black technical data sheet: https://multimedia.3m.com/mws/media/2522970O/3m-scotch-weld-epoxy-adhesive-dp420ns-black.pdf
- Bosch Sensortec BMP384 datasheet: https://www.bosch-sensortec.com/media/boschsensortec/downloads/datasheets/bst-bmp384-ds003.pdf
- Bosch Sensortec BMP581 datasheet: https://www.bosch-sensortec.com/media/boschsensortec/downloads/datasheets/bst-bmp581-ds004.pdf
- Professional Plastics PVC Type I typical properties (ASTM D1784 12454-B): https://www.professionalplastics.com/professionalplastics/PVCType1Properties.pdf
- Curbell Type I gray PVC rod source: https://www.curbellplastics.com/product/w02-01907/
- Shenzhen Jucheng Precision Model Co., Ltd., Quotation Sheet Contract No. 20260805: BMP-Tube-3, PVC-U, CNC machining and deburring, 10-piece quotation baseline.

Appendix D -
Closeout Status and Remaining Work

Table 6. Internship closeout status and supporting evidence.

Status	Item	Disposition / evidence
Closed - not required	Superseded two-PCB CAD	No CAD/Altium model was produced before the concept was abandoned; none is required for the final package.
Quoted	PCB cost	JLCPCB estimate received at approximately $23 per assembly; confirm inclusions before purchase release.
Quoted	PVC-U pressure-tube procurement	Shenzhen Jucheng Precision quoted 10 BMP-Tube-3 parts at $15.62 each ($156.20 parts plus $80 shipping). Confirm the final 3D file, PVC-U material certificate, and production lot before release.
Pending	Drawing release	Add adhesive bond line, wet/dry boundary, pressure-port keep-out, drawing numbers, approvals, and released revisions.
Pending	Electrical archive	Archive released Altium schematic, Gerbers, drill/rout files, BOM, DRC results, and final 3D model.
Future update	BMP384 firmware validation	Procure a BMP384 breakout board, port the driver, verify SPI and pressure output, and add measured results.
Partially closed	Process and system photographs	Figures 2 and 11–13 now document drifter context, pressure-path hardware, integration, and the water-column fixture. Add dispensing and cured-bond inspection photographs during the pilot build.
Future addendum	Qualification results	Add leak, pressure, humidity, salt, temperature, mechanical, and six-month wet/dry results under a controlled revision.

Appendix E - Current Mechanical Drawing Package

The following development drawings record the current mechanical configuration. The revised sensor-assembly drawing identifies the CNC-machined PVC-U tube as BOM Item 8 and retains the corrected 4-40 screw and standoff hardware. Adhesive geometry, wet/dry boundary, pressure-port keep-out, approvals, and drawing-control fields should be completed before formal production release.

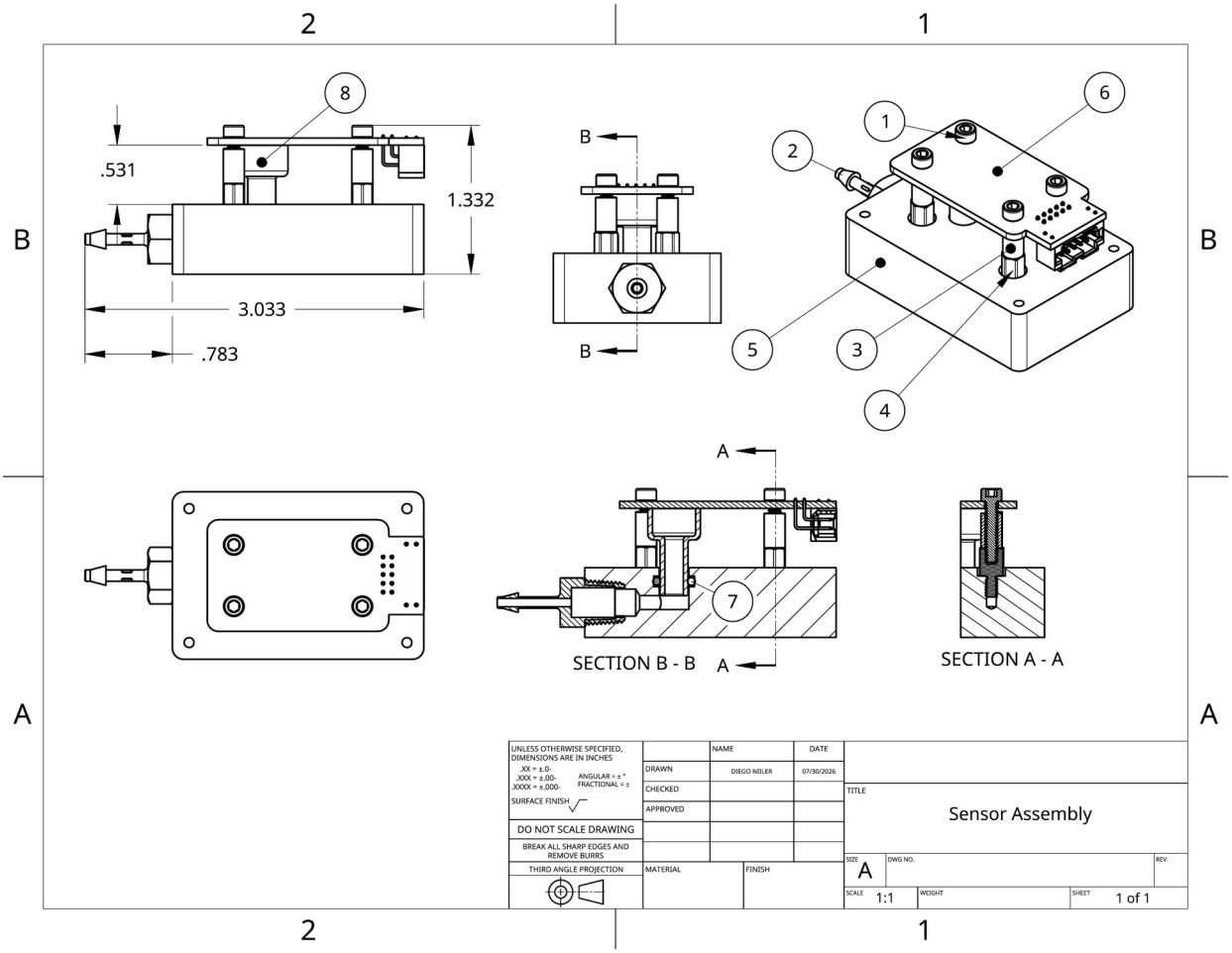


Figure E-1. Revised sensor-assembly drawing with orthographic, isometric, and section views. Balloons correspond to BOM Items 1–8: 4-40 × 9/16 in socket-head screws, barbed fitting, No. 4 spacers, 4-40 male-female standoffs, BMP housing, PCB, AS568-010 O-ring, and CNC-machined PVC-U pressure tube.

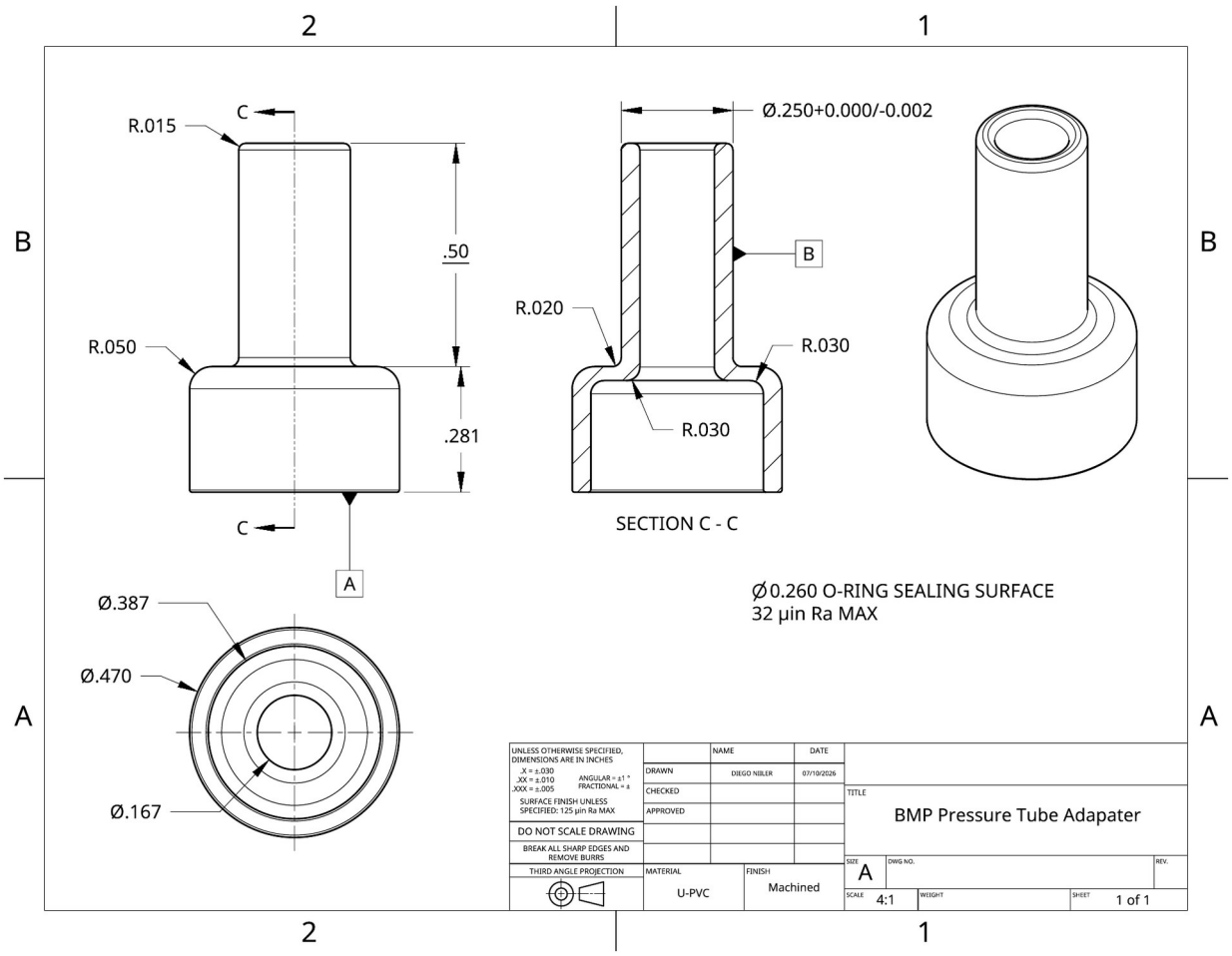


Figure E-2. Updated BMP pressure-tube adapter drawing specifying U-PVC. The final adhesive contact-face and bond-line release callouts remain pending.

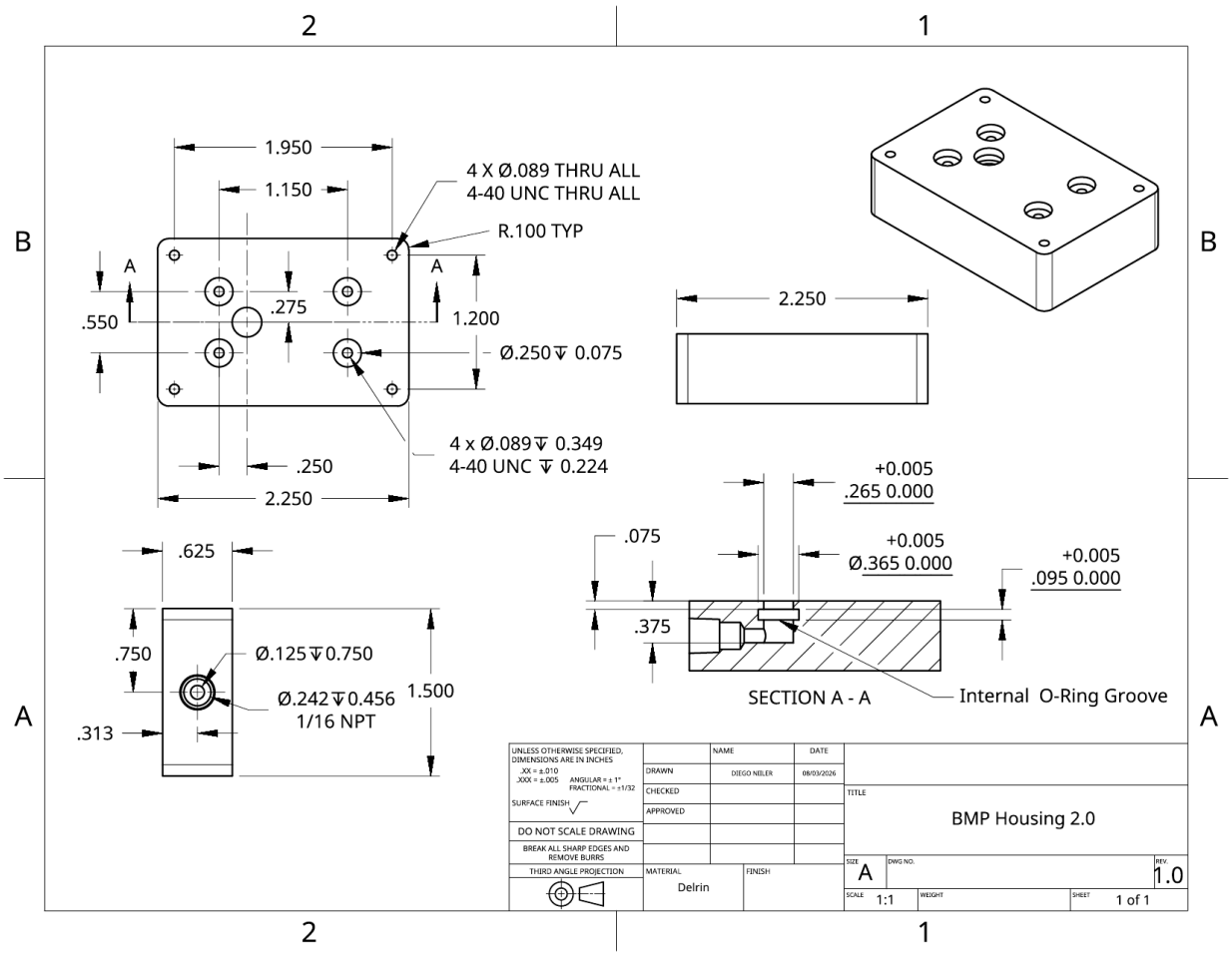


Figure E-3. BMP Housing 2.0 drawing developed by Diego Niiler. The Delrin housing defines the low-profile PCB mounting pattern, pressure-fitting interface, and internal O-ring groove.