Long Ranger Installation Guide

RD Instruments
Acoustic Doppler Solutions

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1 Introduction

This book is a *guide* for installing the Long Ranger on a buoy or bottom mount. Use this section to plan your installation layout.

NOTE. When an addition or correction to the manual is needed, an Interim Change Notice (ICN) will be posted to our web site on the Customer Service page (www.rdinstrument.com). Please check our web site often.

CAUTION. Always use caution when mounting the Long Ranger. Never rest the transducer head on a rough surface. Use foam padding to protect the transducer during handling.

2 Bottom Mounts

Bottom mounts can range from simple PVC frames to Trawl Resistant Bottom Mounts. Below is a sample of some of the types of bottom mounts available for WorkHorse ADCPs.

Figure 1. RD Instruments Bottom Mount

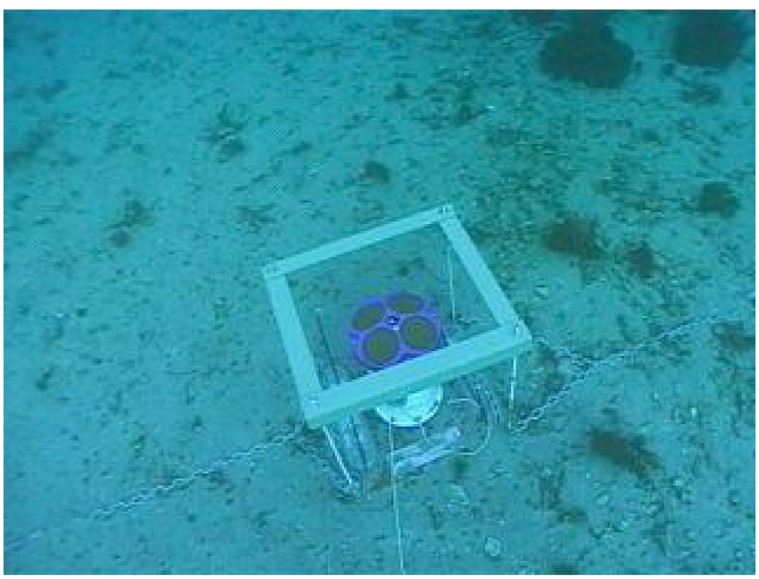

Figure 2. View from the Bottom

Photo courtesy of John Skadberg, US Navy SPAWAR System Center in San Diego, CA. Sent to RDI by Steve Monismith.

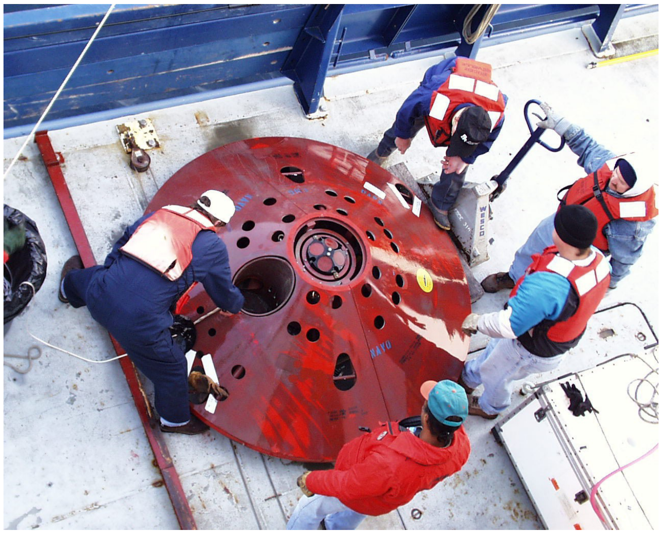

Figure 3. Trawl Resistant Bottom Mount

Photo courtesy of Maureen Wieler, Mooring Systems.

3 Buoy Mounts and Load Cages

Buoy mounts and load cage frames are designed to allow the Workhorse to profile unobstructed by the mooring hardware. Below is a sample of some the types of buoy and load cage mounts available for WorkHorse ADCPs.

Figure 4. Long Ranger being Deployed

Photo courtesy of Paul Devine, RD Instruments

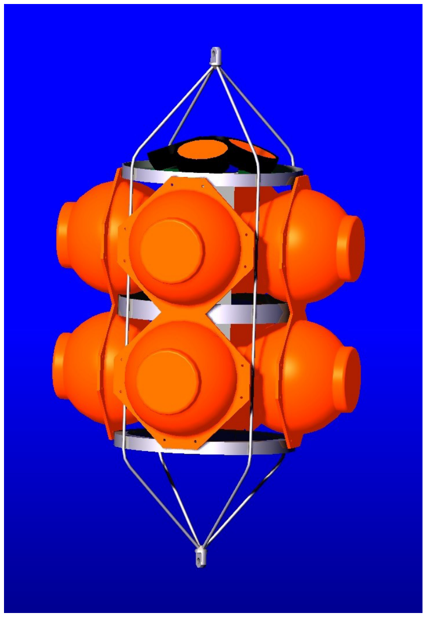

Figure 5. Deep-Water Mount with Long Ranger

Photo courtesy of the Oceanscience Group.

Figure 6. Buoy Mount with External Battery

Photo courtesy of Maureen Wieler, Mooring Systems.

4 Over-the-Side Mounting

The over-the-side mount is common if you want the ability to move the ADCP from one platform to another. You must make the mount as rigid as possible to limit the amount of pitch and roll applied to the ADCP. Although the tilt sensor can measure a ±20° influence, anything beyond 15° will cause bias to the data that cannot be removed. No matter what mounting type used, the ADCP must be below the bubble layer. Bubbles will cling to the urethane faces of the ADCP and reduce the range to almost nothing. Usually a mount somewhere aft of amidship is used. A stern mount will cause all sorts of problems due to propeller wake, bubbles, and turbulent water conditions.

> **NOTE.** Avoid using ferro-magnetic materials in the mounting fixtures or near the ADCP. They affect the compass. Use 304 stainless steel for fresh water and 316 stainless steel for salt-water applications.

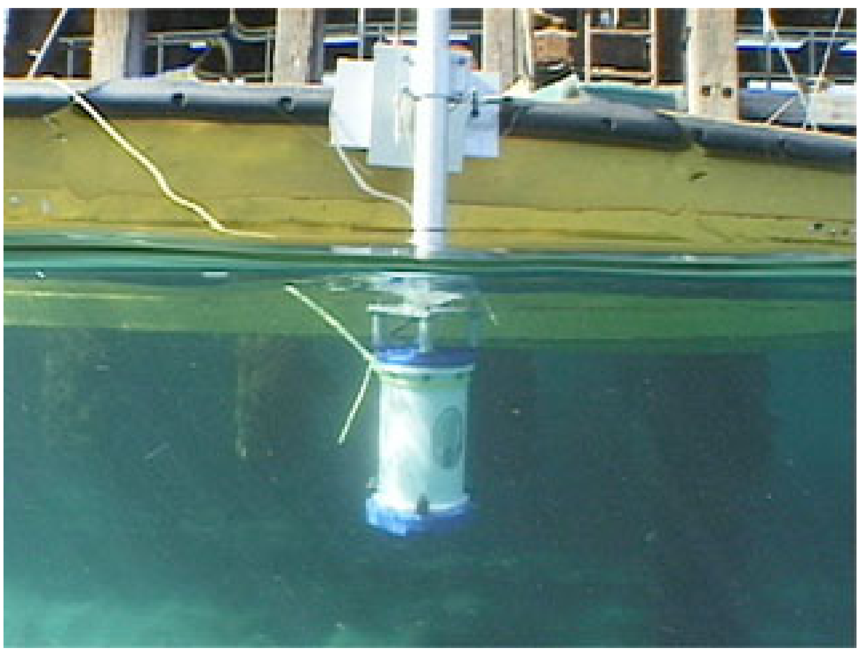

Figure 7. Over-the-Side Mount

Photo courtesy of John Skadberg, US Navy SPAWAR System Center in San Diego, CA. Sent to RDI by Steve Monismith.

4.1 Example of an Over-the-Side Mount

When mounting the ADCP to a platform, use the following sequence.

- Test the ADCP
- Align the compass
- Mount to the platform (see Figure 8).

1. Hand winch with cable or rope.
2. Boat cleat to tie off the lower end of the channel.
3. Aluminum channel, 5" base x 2" high x 3/16" thick. You need to determine how long the channel needs to be as the drawing is not to any scale. The channel should be notched for the end-cap flange of the Housing Assembly. This will give the system a positive lock after the ADCP has been strapped to the channel.
4. Pivot housing - This could be a very heavy one-piece bent housing, or a three-piece assembly. Bolt the pivot housing to the deck of the boat (or buoy).
5. Nylon strap clamps - Two clamps are needed. Place some rubber or foam between the housing and the aluminum channel before clamping to protect the ADCP.

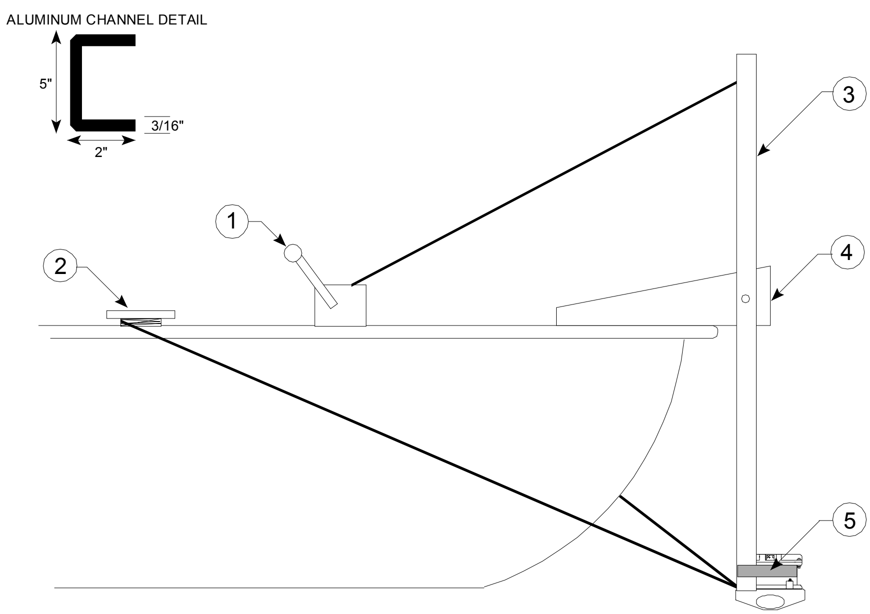

Figure 8. Mounting an ADCP to a Platform

4.2 Over-the-Side Mounting Special Considerations

Use the following suggestions when mounting the ADCP to a platform.

- It is desirable to rigidly mount the ADCP to the platform. You want to avoid the free spinning of the ADCP in this application. The ADCP must stay in the water at all times.
- The ADCP must be mounted deep enough so that turbulence caused by its movement through the water does not allow air bubbles to be attached to the transducer faces.
- Avoid mounting the ADCP near motors and thrusters. They cause air bubbles and will cause bias to the internal compass.
- Avoid mountings that will cause the ADCP to see severe accelerations.

5 Specifications and Dimensions

A brief review of Long Ranger operation may help you understand the specifications listed in this section.

> **NOTE.** The specifications and dimensions listed in this section are subject to change without notice.

The Long Ranger emits an acoustic pulse called a *ping*. Scatterers that float ambiently with the water currents reflect some of the energy from the ping back to the Long Ranger. The Long Ranger uses the return signal to calculate a velocity. The energy in this signal is the *echo intensity*. Echo intensity is sometimes used to determine information about the scatterers.

The velocity calculated from each ping has a *statistical uncertainty*; however, each ping is an independent sample. The Long Ranger reduces this statistical uncertainty by averaging a collection of pings. A collection of pings averaged together is an *ensemble*. The Long Ranger's maximum *ping rate* limits the time required to reduce the statistical uncertainty to acceptable levels.

The Long Ranger does not measure velocity at a single point; it measures velocities throughout the water column. The Long Ranger measures velocities from its transducer head to a specified range and divides this range into uniform segments called *depth cells* (or *bins*). The collection of depth cells yields a *profile*. The Long Ranger produces two profiles, one for velocity and one for echo intensity.

Table 1 through Table 9 lists the specifications for the Long Ranger Workhorse ADCPs. About the specifications:

a. All these specifications assume minimal Long Ranger motion - pitch, roll, heave, rotation, and translation.

b. Except where noted, this specification table applies to typical setups and conditions. Typical setups use the default input values for each parameter (exceptions include Pings Per Ensemble and Number of Depth Cells). Typical conditions assume uniform seawater velocities at a given depth, moderate shear, moderate Long Ranger motion, and typical echo intensity levels.

c. The total measurement error of the Long Ranger is the sum of:

- Long-term instrument error (as limited by instrument accuracy).
- The remaining statistical uncertainty after averaging.
- Errors introduced by measurement of Long Ranger heading and motion.
- Because individual pings are independent, the statistical uncertainty of the measurement can be reduced according to the equation:

$$\frac{\text{Statistical Uncertainty for One Ping}}{\sqrt{\text{Number of Pings}}}$$

5.1 Specifications

Table 1: Water Velocity Profiles

Item	Specification
Depth cell size	4 to 32 m
Number of depth cells	1 to 128 cells
Velocity range	±5 m/s default (±10 m/s max)
Ping rate	>1 Hz (typical)
Accuracy	± 1% ± 5 mm/s

Table 2: Measurement Performance

Mode	Depth cell size (m)	Standard Dev (mm/s)[1]	First cell range (m)[2]	Max Range (m)[4, 5]	
				Low Power	Hi Power
Long-range	4	260	10	300	490
	8	140	14	350	520
	16	60	22	350	550
	32	40	38	430	600
Broad band	4	130	10	170	400
	8	60	14	200	430
	16	30	22	280	470
	32	20	38	370	510

Notes:

1) Standard deviation is ADCP uncertainty given a single-ping.
2) The first cell range is the distance from the transducer to the center of the first cell.
3) The minimum depth assumes one good depth cell.
4) Maximum range is a nominal value based on 5°C and typical oceanic backscatter; actual range will vary depending on environmental conditions.
5) Assuming the ADCP is pointed vertically (0º tilt), the maximum range is limited to 94% of the distance to the surface.

Table 3: Echo Intensity Specifications

Item	Specification
Sampling	Uses same depth cells and time intervals as velocity
Uncertainty	±1.5 dB
Dynamic range	80 dB

Table 4: Transducer and Hardware Specifications

Item	Specification
Frequencies	76.8 kHz
Bandwidths	
Broadband mode	19 kHz
Long Range mode	5 kHz
Beam width	4°
Ceramic Diameter	150 mm
Beam angle	20°
Configuration	4-beam, convex
Max tilt	20°
Housing and transducer material	6061 Aluminum
Transducer facing	Polyurethane
External connector	7-pin wet-mateable

Table 5: Data Communication Specifications

Item	Specification
Interface	RS-232 (default) or RS-422 serial communications
Baud rate	300 to 115,200 (9600 is default)
Input data format	ASCII commands (see Appendix-C)
Output data format	Binary or ASCII
Internal data storage	Capacity 16, 20, 40 (Standard), 85 and 220 megabytes PCMCIA flash memory cards (2). Total storage available = 440 megabytes.

Table 6: Power Specifications

Item	Specification
DC input	20 to 50 VDC
Batteries	
No. of packs	4
Cells	28 Alkaline D-cells (each pack)
Construction	Welded, degaussed
Voltage	42 VDC (new), 28 VDC (depleted)
Capacity @0°C	400 watt-hours (each pack)
Power required	
Process	2.2 W
Standby	6 mW
Transmit power @ 35 V	
High Power	1000 W
Long Range mode, low power	80 W
Broadband mode, low power	20 W

Table 7: Environmental Specifications

Item	Specification
Weight in air	See Outline Installation Drawing
Weight in water	See Outline Installation Drawing
Maximum depth	1500 m
Operating temperature	-5 to +45°C
Storage temperature	-30 to +75°C
Battery storage temperature	0 to 21 °C
Battery shelf life	Use within one year
Humidity	Must be non-condensing
Vibration	IEC 1010, MIL-STD-167-1, type 1
Shock	IEC 1010

Table 8: Sensors Specifications

Pressure Sensor [(1)]	
Max. pressure	2250 psi (1500 m)
Short-term uncertainty	±0.1%
Max. drift	±0.25%
Temperature (Transducer Mounted)	
Range	-5° to 45° C
Uncertainty	±0.4° C
Resolution	0.01°
Tilt	
Range	±15°
Uncertainty	±0.5° (up to 15°)
Resolution	0.01°
Compass [(2)]	
Type	flux gate
Long-term accuracy	±5° @ 60° magnetic dip angle
Resolution	0.01°
Max tilt	20°

NOTES

(1) Other pressure ratings may be special-ordered. Offset and scale factor can be set by the user.

(2) Includes built-in field calibration procedure. Compass uncertainty is for tilts less than 15°.

5.2 Dimensions

Table 9: Outline Installation Drawings

Description	Drawing Number
Workhorse Long Ranger, 75kHz	967-6021
Long Ranger External Battery Case	967-6051

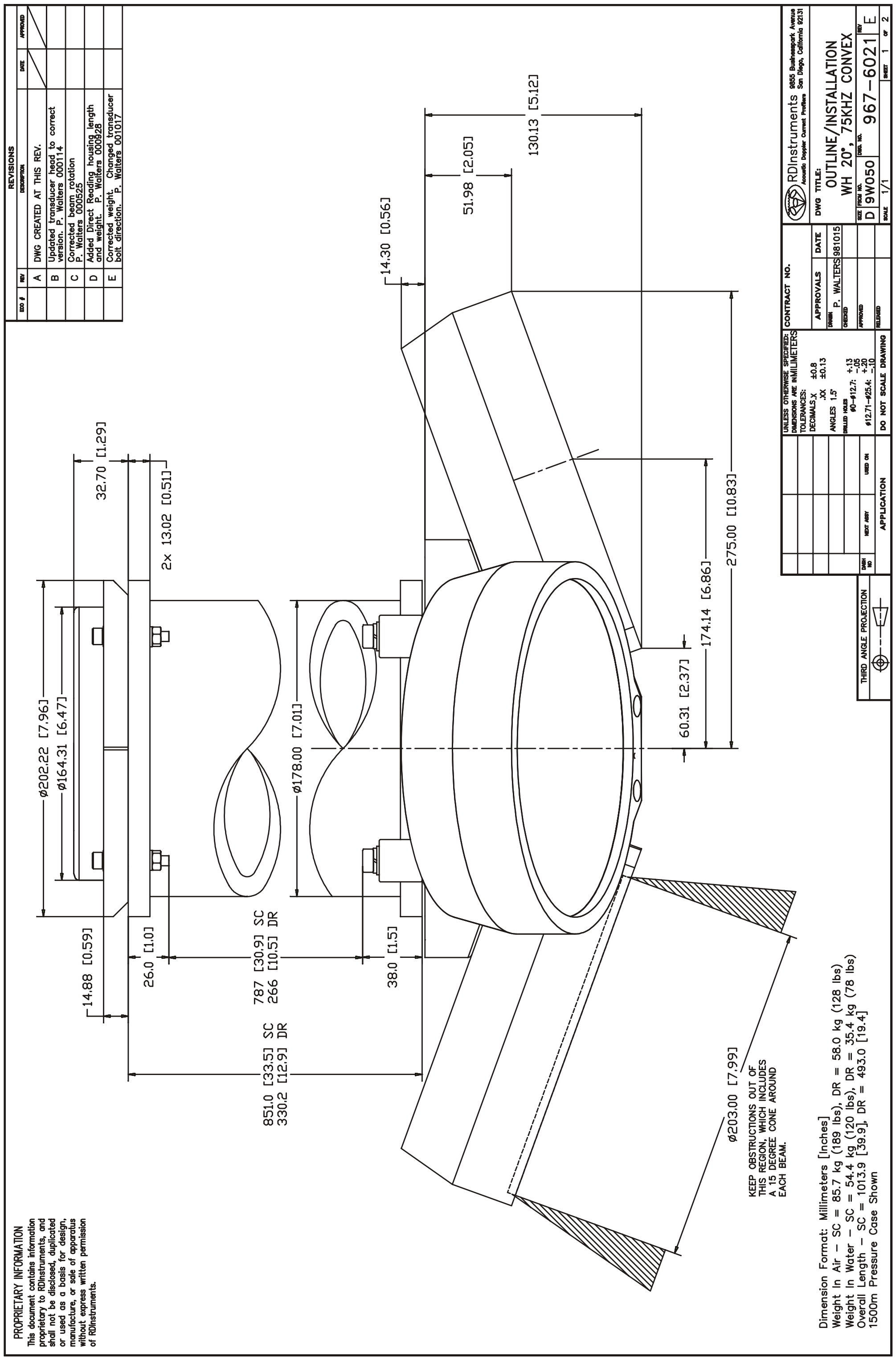

Figure 9. **967-6021 (Sheet 1 of 2)**

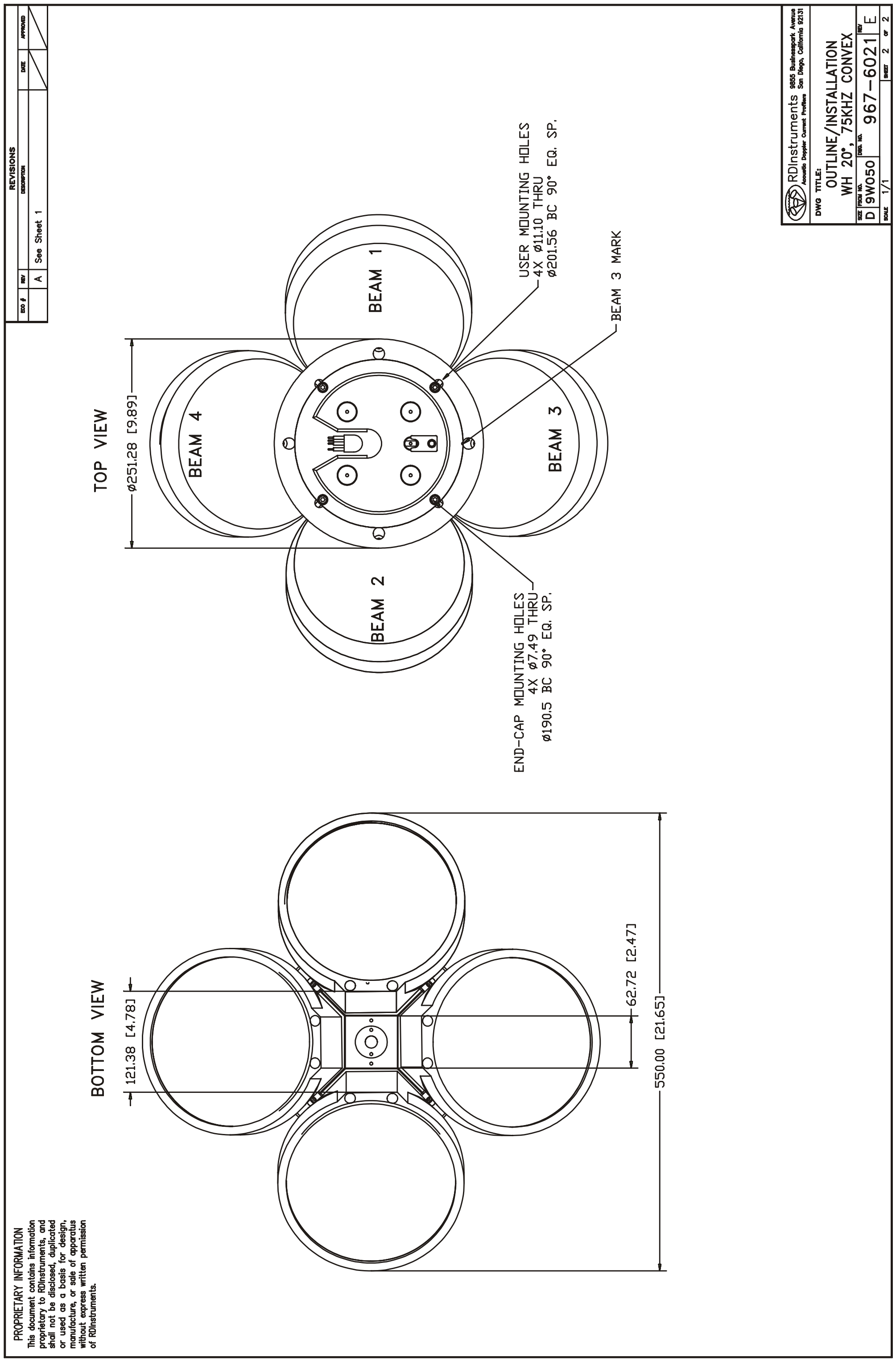

Figure 10. 967-6021 (Sheet 2 of 2)

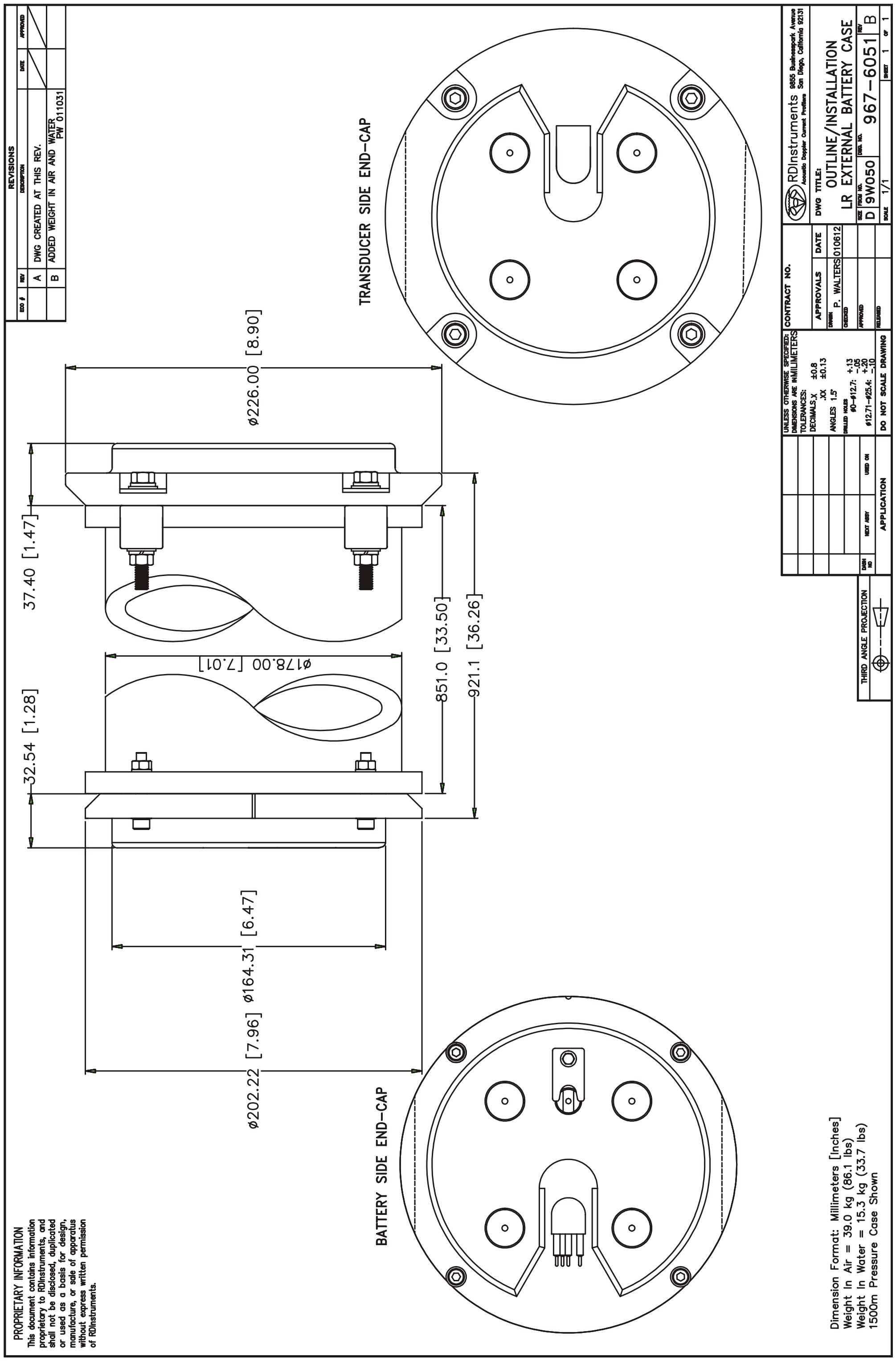

Figure 11. 967-6051

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