TELEDYNE MARINE
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Wayfinder DVL Integration Guide for Blue Robotics BlueROV2

Visit Wayfinder online:

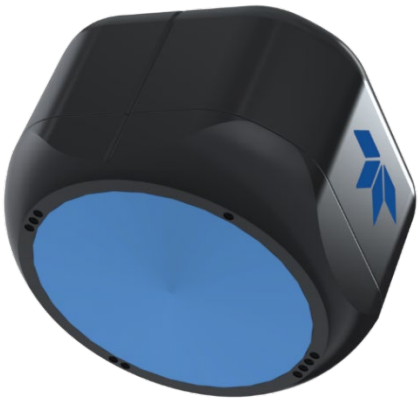
teledynemarine.com/en-us/products/Pages/Wayfinder.aspx

Overview/Introduction

This guide shows how to integrate a Wayfinder DVL onto a BlueROV2 Heavy Configuration ROV.

Weighing in at less than 1 kg, and only 10 cm x 10cm, 7cm, the Wayfinder DVL is the smallest DVL made by Teledyne, making it ideally suited for micro ROVs.

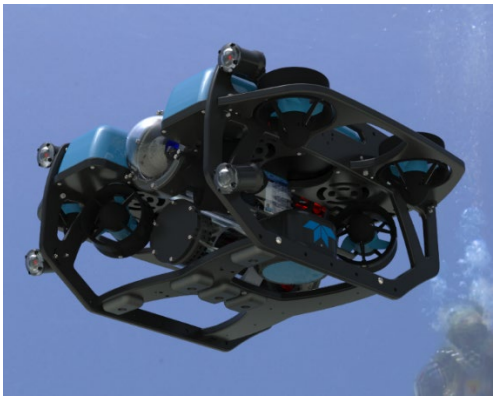
The Wayfinder is designed for quick and easy installation and operation. With our comprehensive online support, tools and documentation, your DVL will be installed and ready to go in no time.



The BlueROV2 is the world's most affordable high-performance ROV. It's the perfect ROV for inspections, research, and adventuring. The BlueROV2 uses the open-source ArduSub software and PixHawk autopilot.

For this integration with the Wayfinder DVL, TRDI selected the **BlueROV2 Heavy Configuration** version. This kit provides the components needed to upgrade a BlueROV2 with four vertical thrusters, 6 degree-of-freedom control, increased buoyancy, and external thruster guards.

Visit https://bluerobotics.com/



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Required components and tools

Several parts and tools are needed to integrate the Wayfinder DVL onto the BlueROV2 Heavy Configuration.

- BlueRobotics 8mm cable penetrator (https://bluerobotics.com/store/cables-connectors/penetrators/penetrator-10-25-a-8mm-r2/),
- Potting compound (https://bluerobotics.com/store/tools/potting-thx-80a-r1/). For optimum dispensing and application, it is recommended to use with the BlueROV2 Potting Cartridge Dispenser, Mixing Tips, and Acetone Cable Preparation Wipes.
- USB to RS232 adapter (https://www.digikey.com/product-detail/en/ftdi-future-technology-devices-international-ltd/USB-RS232-WE-1800-BT_0.0/768-1065-ND/2402469)
- #6 ring terminals for ground and power wires
- Wayfinder DVL mounting bracket (solid model available on request) and four M5 sets of mounting hardware, see step 3 of the step-by-step guide for details on hardware required
- Four M5 x 0.8mm x 6mm with flat washers and split washers to attach the Wayfinder DVL to the mounting bracket
- Four M5 isolating bushings and washers (recommended for saltwater environments)

The BlueROV2 system does not include the following required components:

Laptop/tablet
TRDI recommends a medium to high-end model or Windows Surface tablet with Windows 10 or Linux operating systems.

Gamepad Controller
Use an Xbox One controller or the Logitech F310 or F710 controllers.

Battery
Recommended BlueRobotics 14.8v, 18Ah lithium-ion battery for the best battery life, but there are a number of other compatible batteries that can be used as well. It is recommended to have several batteries for extended operation.

Battery Charger
BlueRobotics has a recommended charger, but any lithium-ion battery charger that can handle your battery will work.

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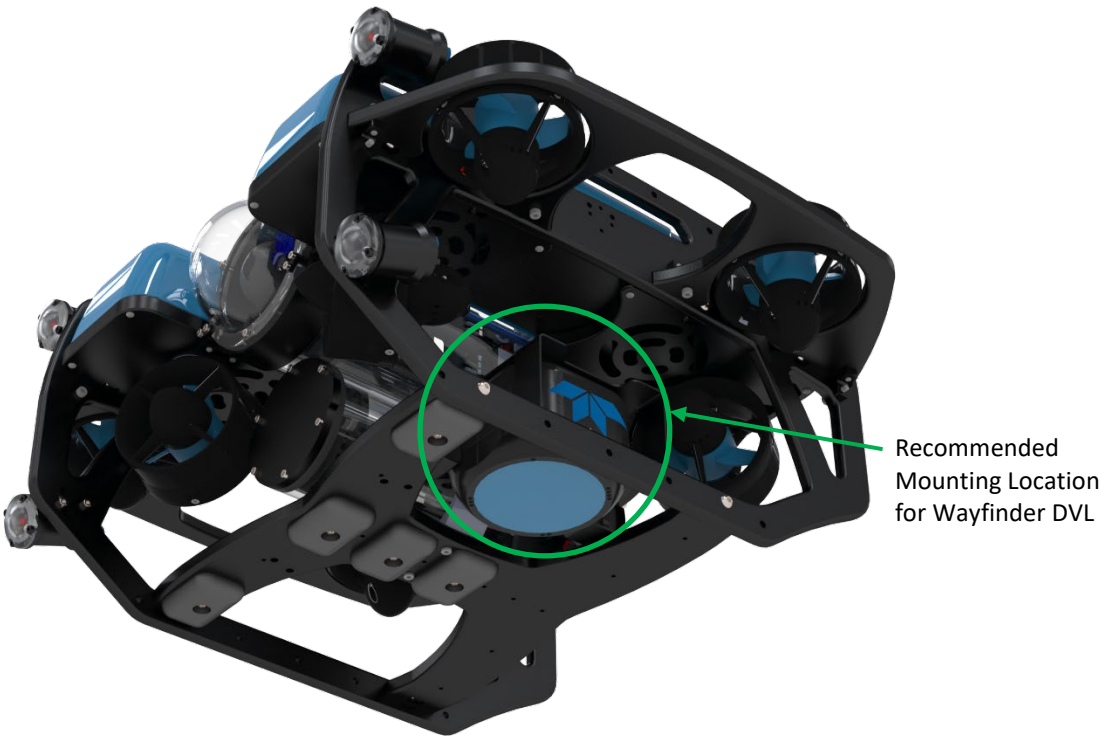
Step-by-Step Guide

1. Assemble the BlueROV2 Heavy Configuration ROV.
2. The mounting location chosen was to the port side of the BlueROV2 Heavy Configuration battery housing. If you are using the BlueROV2 base system, then TRDI highly recommends using the Payload Skid and mounting the Wayfinder DVL in a similar location. Although it is preferable to mount the Wayfinder on the centerline, this was not possible on the BlueROV2 Heavy Configuration ROV. This was an acceptable tradeoff as the chosen location provided all the other mounting criteria:
   - **Location on centerline** – Mechanically mount the center of the Wayfinder as close as possible to the vehicle's fore-to-aft centerline.
   - **Level pitch/roll** – Mount the Wayfinder as level as possible using the vehicle's roll and pitch references.
   - **Beam clearance** – Clear the Wayfinder beams of any acoustic obstacles. A 90-degree cone around the face of the Wayfinder should be observed to account for each beam acoustic spread (see the Outline Installation Drawing).
   - **Bottom strike protection** – Ensure there is a section on the hull/platform that is lower than the Wayfinder location to protect from bottom strikes.
   - **X Y axis alignment** – Typical alignment is Beam 3 (instrument Y-axis) rotated 45° relative to the vehicle forward axis or Beam 3 facing forward. For more information, see the Wayfinder DVL guide, chapter 2.
   - **Cable routing** – Tight mounting spaces next to bulkheads may require rotating the Wayfinder to prevent sharp bends in the cable.
   - **Flow noise/cavitation** – May need a fairing to reduce flow noise and/or cavitation.
   - **Isolation Hardware** – Use M5 isolating bushings and washers when mounting the Wayfinder to a metal structure. Isolation hardware is not required for use in freshwater environments; strongly recommended for saltwater environments.



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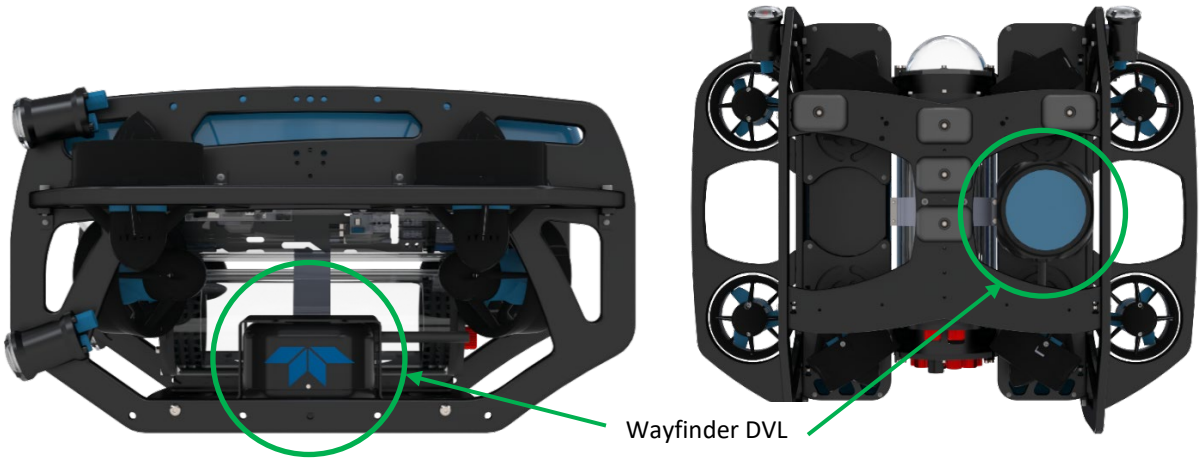
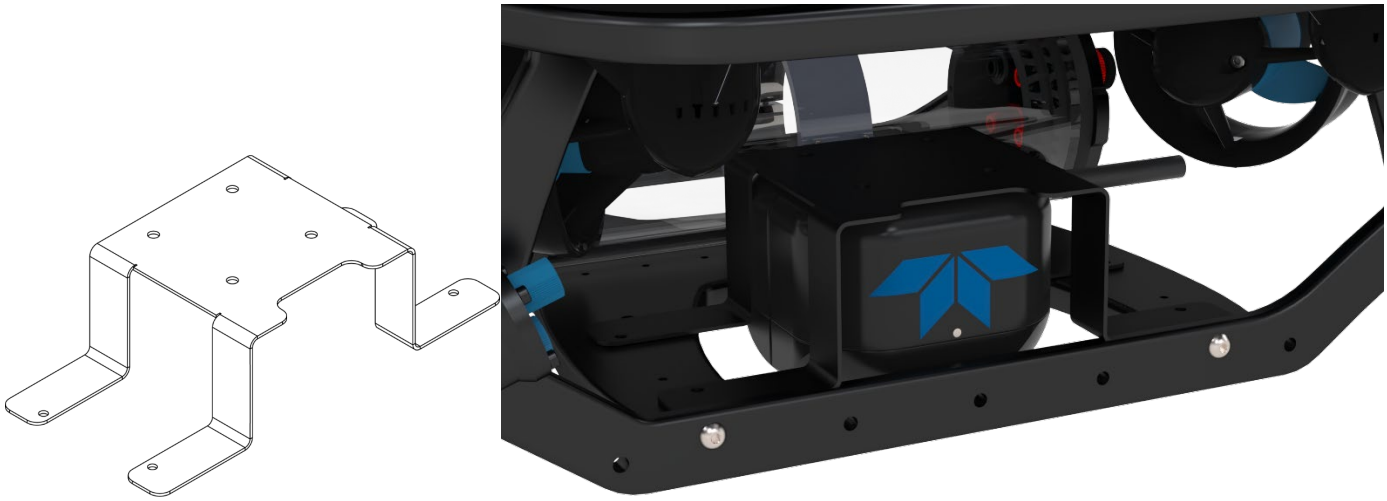


3. Mount the WayFinder mounting bracket to the ROV's chassis. The user has two options:

a) Tap the four plastic holes with a M4x0.7 tap.
   a. 4X M4x0.7x12 L socket head machine screw.
   b. 4X M4 Washers
   c. 4X M4 Split Washers

b) The recommended method is to drill a M4 clearance hole, 4.5mm OD. Add a counter sink in the plastic, bottom side.
   a. 4X M4x0.7x20 L flat head machine screws.
   b. 8X M4 Washers
   c. 4X M4 Split Washer
   d. 4X M4 Nut or Locknut



4. Mount the Wayfinder DVL to the mounting bracket using four M5 x 0.8mm x 6mm screws (socket head recommended) with 4x M5 flat washers and 4x M5 split washers. Isolation hardware is not required for use in freshwater environments, strongly recommended for saltwater environments.
5. Remove the Electronics Tray from the BlueROV2 chassis.
6. Remove the Electronics Tray Endcap from the Electronics Tray.
7. Remove a single blank penetrator from the Electronics Tray Endcap.
8. Determine the appropriate WayFinder cable length and trim/strip the cable. This is approximately 21 inches (53.3cm) from the WayFinder to the penetrator. The WayFinder cable should extend four inches (10.1cm) beyond the penetrator and the USB to Serial Adapter cable extends four inches (10.1cm) from the USB plug (allow a one-inch overlap for the solder joint).
9. Pot the WayFinder cable into the penetrator.
10. Install the WayFinder cable penetrator into the Electronics Tray Endcap.

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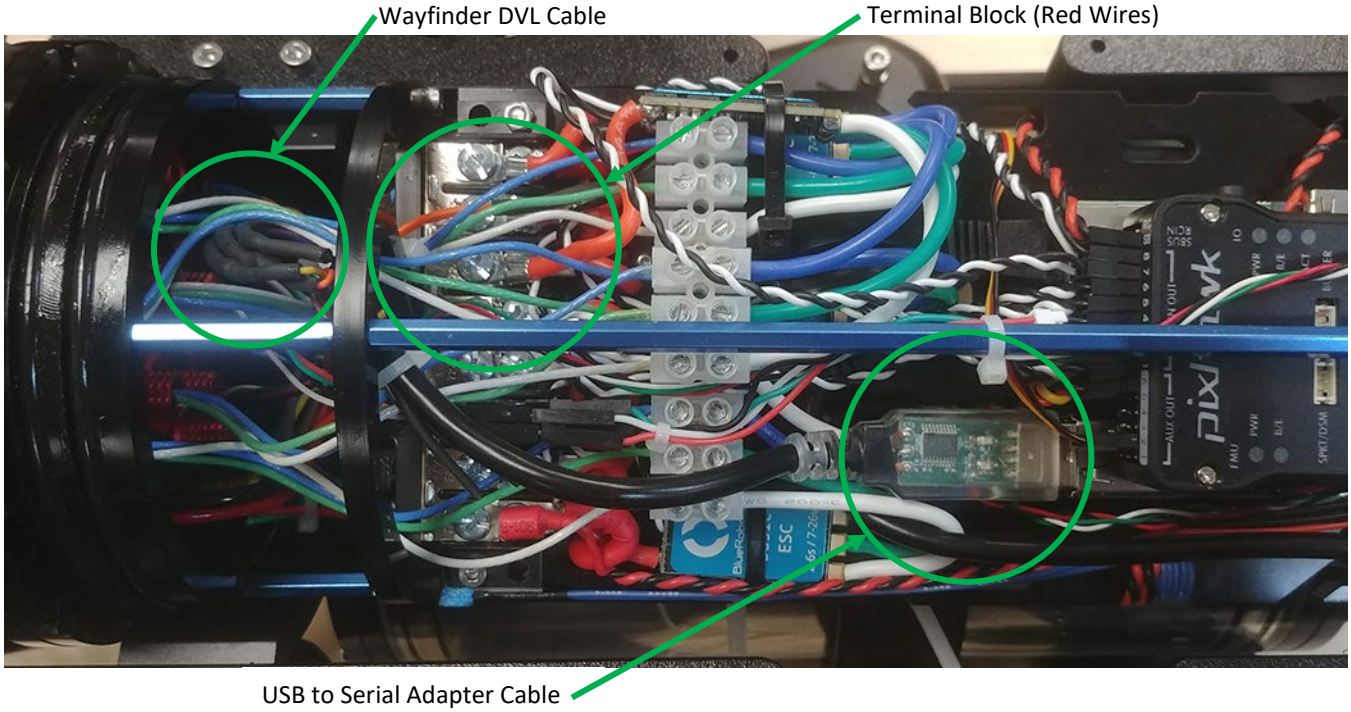
11. Cut the USB to Serial Adapter cable to five inches (12.7cm) length (this allows for a one-inch overlap). Solder the USB to Serial Adapter cable to the Wayfinder DVL cable as shown in the Wiring Diagram. Use heat shrink on all wires.
12. Connect the USB to Serial Adapter to the Raspberry Pi.
13. Solder/connect ring terminals to the WayFinder Cable power wires.
14. Connect the ring terminals to the Power Distribution Block. The terminal blocks are located on the port and starboard sides of the electronics container. PWR (red wire) is on the starboard side, GND (Black wire) is on the port side.



15. Reassemble the Electronics Tray.
16. Reinstall the Electronics Tray on the chassis.
17. Install the battery in the ROV.
18. Ensure the vehicle is properly balanced. To get the longest battery life and the best driving experience, it is important to have the ROV balanced in roll and pitch in water and close to neutrally buoyant.
19. Log into the companion computer using Secure Shell (PuTTY on Windows, command line ssh on Mac/Linux).
20. Install the WayFinder Python Driver on the companion computer.
    a. User may need to connect the ROV to a wireless access point.
    b. User may need to manually install Python 3.6 on the companion computer.
21. Add the line `tcp:127.0.0.1:14777` to `~/mavproxy.params` on the companion computer.
22. Add the integration script. This script is responsible for feeding the bottom velocity data from the WayFinder DVL to the autopilot as visual odometry data using the VISION_POSITION_DELTA message. Axis alignment is done in the integration script – velocities need to be rotated to the appropriate reference frame. For information, see the online Wayfinder API Guide.
23. Install ArduSub 4.1.0 or later onto the PixHawk autopilot.
24. Configure the following autopilot parameters:
    a. EK3_GPS_TYPE=3
    b. GPS_TYPE=0

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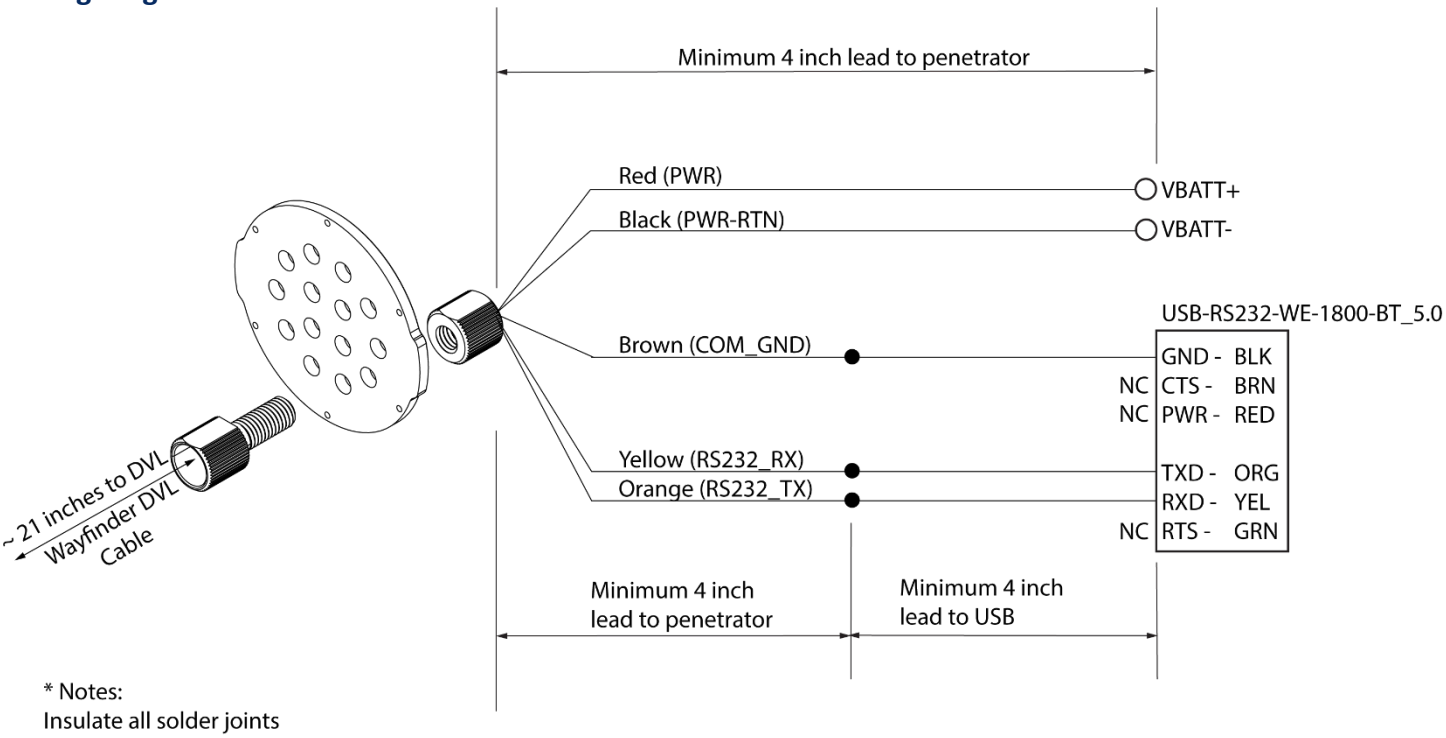
c. VISO_TYPE=1
d. PSC_POSXY_P=1.5
e. PSC_VELXY_D=0.4
f. PSC_VELXY_I=0.3
g. PSC_VELXY_P=14
h. PSC_VELZ_P=5
i. VISO_DELAY_MS=10
b. VISO_ORIENT=0

25. Use the WayFinder Python API to access the streamed data or send commands.

Diagrams and Drawings

Wiring Diagram



* Notes:
Insulate all solder joints
Twist Red/Black power lines with ~ 4 twists per inch

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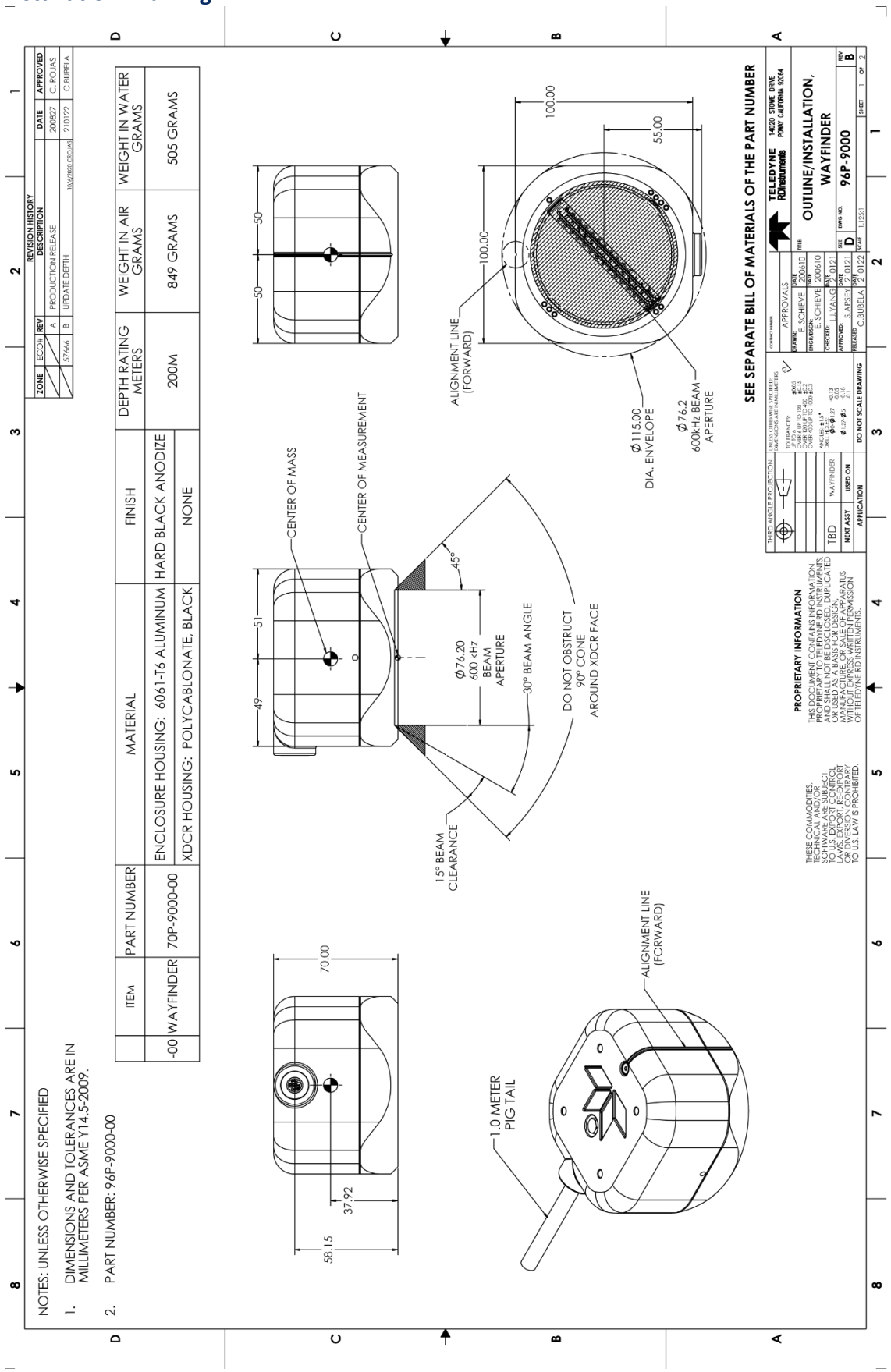
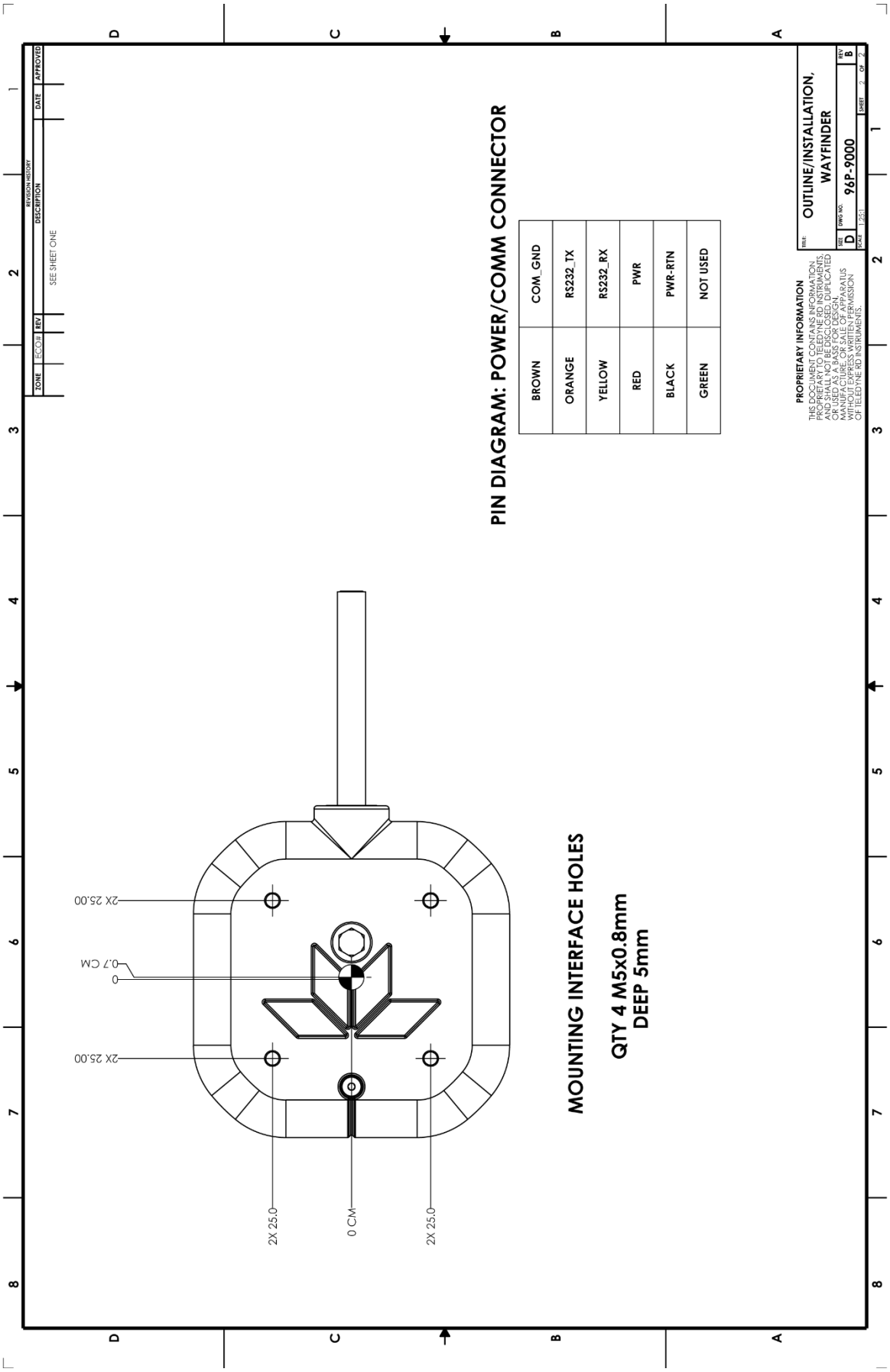
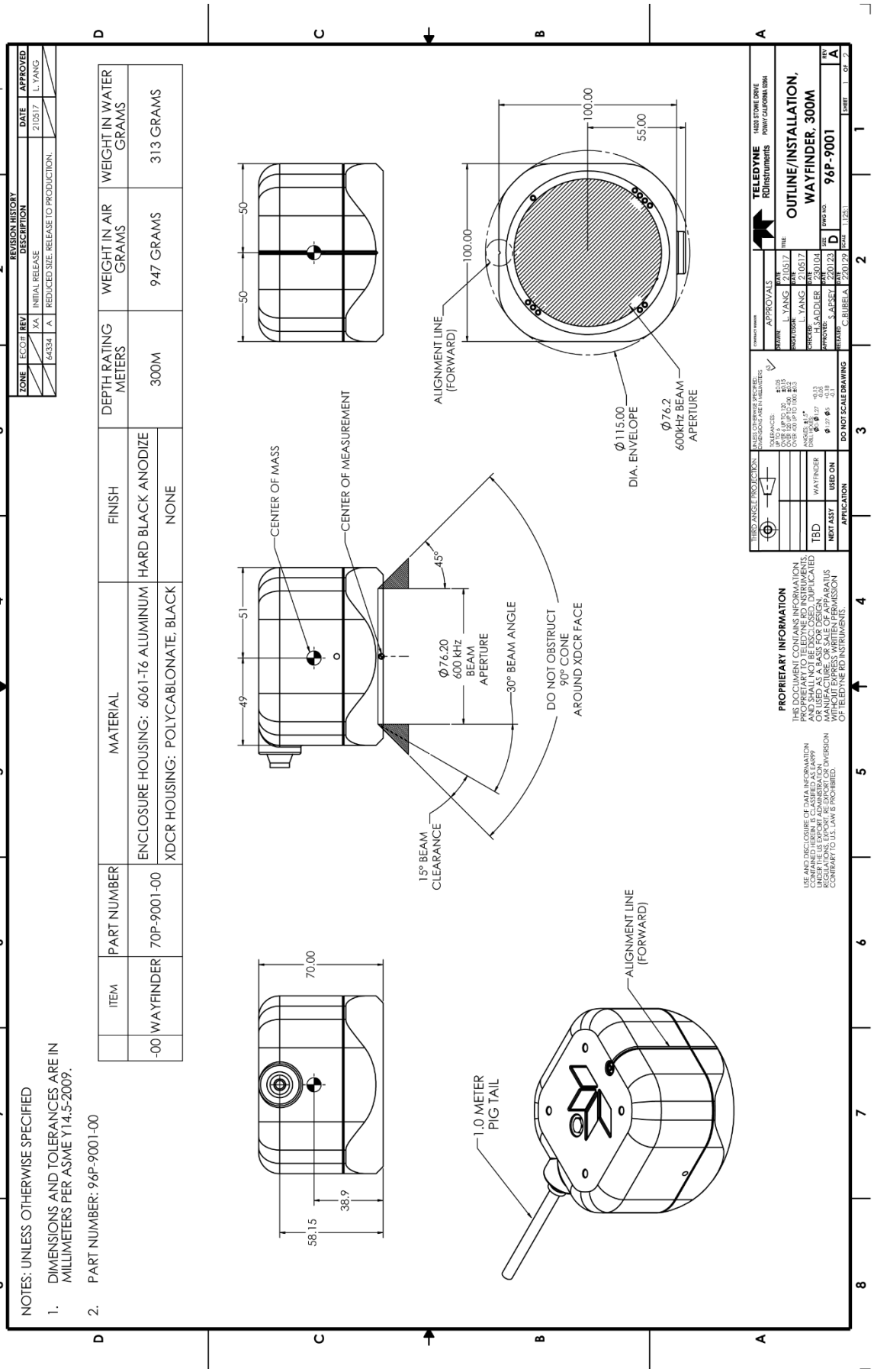
Outline Installation Drawing




PIN DIAGRAM: POWER/COMM CONNECTOR
BROWN COM_GND
ORANGE RS232_TX
YELLOW RS232_RX
RED PWR
BLACK PWR-RTN
GREEN NOT USED
MOUNTING INTERFACE HOLES
QTY 4 M5x0.8mm
DEEP 5mm
2X 25.00
0.7 CM
0
2X 25.00
2X 25.0
0 CM
2X 25.0
OUTLINE/INSTALLATION, WAYFINDER
96P-9000
PROPRIETARY INFORMATION
SEE SHEET ONE


NOTES: UNLESS OTHERWISE SPECIFIED
1. DIMENSIONS AND TOLERANCES ARE IN MILLIMETERS PER ASME Y14.5-2009.
2. PART NUMBER: 96P-9001-00
ITEM
PART NUMBER
MATERIAL
FINISH
DEPTH RATING METERS
WEIGHT IN AIR GRAMS
WEIGHT IN WATER GRAMS
-00 WAYFINDER
70P-9001-00
ENCLOSURE HOUSING: 6061-T6 ALUMINUM
HARD BLACK ANODIZE
300M
947 GRAMS
313 GRAMS
XDCR HOUSING: POLYCABLONATE, BLACK
NONE
REVISION HISTORY
ZONE
ECO#
REV
DESCRIPTION
DATE
APPROVED
XA
INITIAL RELEASE
210517
L. YANG
64334
A
REDUCED SIZE. RELEASE TO PRODUCTION.
CENTER OF MASS
CENTER OF MEASUREMENT
ALIGNMENT LINE (FORWARD)
Ø115.00 DIA. ENVELOPE
Ø76.2 600kHz BEAM APERTURE
Ø76.20 600 kHz BEAM APERTURE
30° BEAM ANGLE
45°
15° BEAM CLEARANCE
DO NOT OBSTRUCT 90° CONE AROUND XDCR FACE
1.0 METER PIG TAIL
70.00
58.15
38.9
50
51
49
100.00
55.00
TELEDYNE RDInstruments
OUTLINE/INSTALLATION, WAYFINDER, 300M
96P-9001
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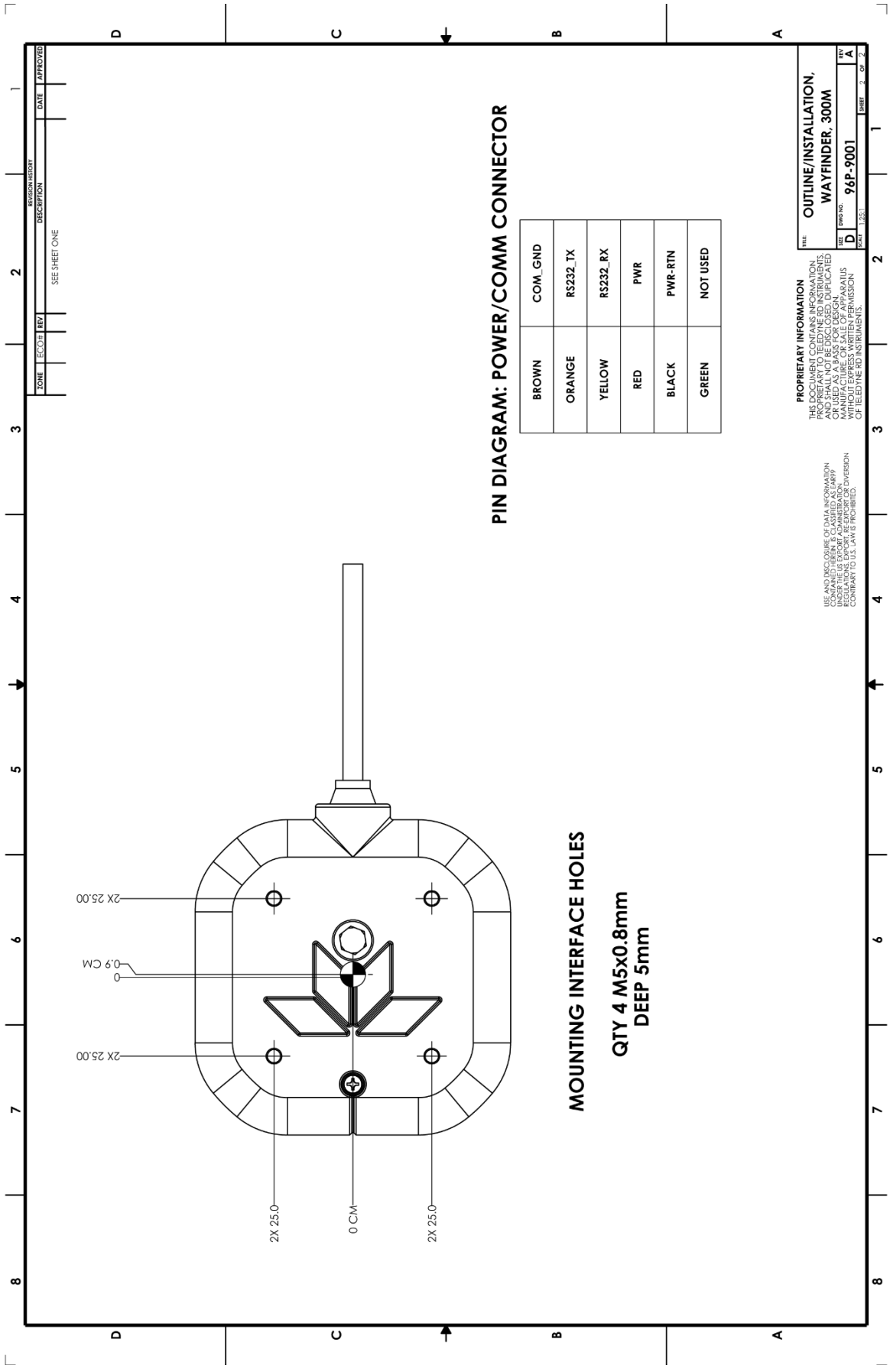

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Contact and Support

If you have technical issues or questions involving a specific application or deployment with your instrument, contact our Field Service group:

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