LIDAR CALIBRATION AND CONFIGURATION MANUAL

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Classification: CONFIDENTIAL - PROPRIETARY INFORMATION

1. INTRODUCTION AND SCOPE

1. This LiDAR Calibration and Configuration Manual ("Manual") contains proprietary procedures and specifications developed by Polar Dynamics Robotics, Inc. ("Company") for the calibration and configuration of LiDAR sensors integrated into the IceNav(TM) navigation system for cold-environment autonomous mobile robots.

2. This Manual applies to all Series 4000 and 5000 IceNav(TM)-equipped autonomous mobile robots manufactured by the Company after January 1, 2024.

2. DEFINITIONS

1. "LiDAR Unit" means the Polar-HD(TM) light detection and ranging sensor assembly, including all associated mounting hardware and environmental protection components.

2. "Calibration Parameters" means the set of configuration values, offsets, and correction factors required for optimal LiDAR performance in sub-zero environments.

3. "Operating Environment" means any controlled temperature environment between -40 C and +25 C where Company robots are deployed.

3. PROPRIETARY CALIBRATION PROCEDURES

1. Initial Sensor Alignment

a) Mount LiDAR Unit using Company-approved frost-resistant mounting brackets

b) Verify vertical alignment within 0.1 using digital inclinometer

c) Confirm horizontal plane alignment using reference targets at 5m, 10m, and 15m

d) Document alignment values in IceNav(TM) configuration log

2. Temperature Compensation Protocol

a) Execute thermal stabilization procedure for minimum 45 minutes

b) Record baseline measurements at +20 C

c) Perform stepped temperature calibration at: +10 C, 0 C, -10 C, -20 C, -30 C, -40 C

d) Generate thermal compensation curve using IceNav(TM) Calibration Suite v4.2

e) Verify compensation accuracy across full temperature range

4. CONFIGURATION PARAMETERS

1. Required System Settings

- Scanning Frequency: 20Hz 0.1Hz
- Angular Resolution: 0.1 horizontal, 2.0 vertical
- Range Resolution: 5mm at 10m
- Beam Divergence: 0.3mrad
- Power Draw: 12W nominal, 18W peak
- Data Output Rate: 1.2 Mbps

2. Environmental Adjustments

- Humidity Compensation Factor: 1.15x standard
- Frost Detection Threshold: 85% reflectivity delta
- Condensation Protection Mode: Enabled
- Thermal Management: Active heating cycle when below -5 C

5. QUALITY ASSURANCE REQUIREMENTS

1. Each LiDAR Unit must pass the following validation tests:

a) Point cloud density verification

b) Range accuracy assessment

c) Angular precision measurement

d) Environmental chamber cycling

e) Vibration resistance testing

f) EMI compatibility verification

2. Calibration records must be maintained for each Unit, including:

- Serial number

- Calibration date
- Technician ID
- Test environment conditions
- Raw measurement data
- Final calibration parameters

6. SAFETY AND COMPLIANCE

1. All calibration procedures must comply with:
- IEC 60825-1:2014 (Laser Safety)
- ISO 10218-1:2011 (Robot Safety)
- Company Safety Protocol PDR-SAF-2023-08

2. Required Personal Protective Equipment:
- Laser safety glasses (Class 1M)
- ESD-safe gloves
- Temperature-appropriate protective clothing

7. PROPRIETARY RIGHTS AND CONFIDENTIALITY

1. This Manual contains trade secrets and confidential information of the Company. Recipients shall:

a) Maintain strict confidentiality

b) Limit access to authorized personnel

c) Not copy or distribute without written authorization

d) Return or destroy upon Company request

8. DOCUMENT CONTROL

1. This Manual is maintained by the Company's Technical Documentation Department.

2. Revisions require approval from:
- Chief Robotics Officer
- Quality Assurance Director
- Technical Documentation Manager

9. CERTIFICATION

The undersigned hereby certifies that this Manual has been reviewed and approved for release:

Dr. James Barrett

Chief Robotics Officer

Polar Dynamics Robotics, Inc.

Date: _