Omron Adept Lynx Platform

User's Guide

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Chapter 1: Introduction

This manual covers the setup, operation, and user maintenance of the Adept Lynx™ platform.

Other than the basics, this manual does not cover configuration performed using the software that comes with the platform. That is covered in the *Adept Motivity® User's Guide*.

Definitions

Platform: The most basic part of the robot. It includes the chassis, drive assemblies, suspension, wheels, battery, safety scanning laser, sonar, an on-board Lynx core with a built-in gyroscope, software needed to navigate, connectors for interfacing with and powering the payload structure, and the platform covers.

Payload Structure: Anything you attach to the Lynx platform. This could be as simple as a box for holding parts or documents that you want transported, or as complicated as a robotic arm that will be used to pick up parts to transport.

AIV (Autonomous Intelligent Vehicle): The Lynx platform with a payload structure attached to it. This is your complete mobile robot, which will transport your products, parts, or data.

When referring to the initial setup, configuration, and connections, we will refer to the platform.

When talking about controlling or monitoring the full mobile robot, with a payload structure attached, we will refer to the AIV.

1.1 Product Description

The Adept Lynx platform is a general-purpose, mobile robot platform, designed and sized to carry loads up to 60 kg (132 lb) while working around people. It is self-guided and self-charging, with an automated docking station. The platform's size and drive assembly are designed to work in any wheelchair-accessible environment.

The platform combines hardware and mobile-robotics software to provide an intelligent, mobile platform to support and transport your payload structure. The platform comes complete with the ability to know where it is within a workspace, and to navigate safely and autonomously to any accessible destination within that workspace, continuously and without human intervention.

Its primary guidance uses a safety scanning laser to navigate, comparing the laser readings to a digital map stored on the platform. The laser is backed up by two front- and two rear-facing sonar pairs, a front sensing bumper, a gyroscope mounted on the internal Lynx core, and encoders and Hall sensors on each drive wheel.

For situations which are so dynamic that laser localization becomes difficult, Adept offers the Acuity Localization option, which localizes the platform using an upward-facing camera to recognize overhead lighting patterns. This is covered in detail in the Adept Lynx Platform Peripherals Guide. This would apply to areas where objects, such as pallets or carts, are moved so frequently that they can't be mapped, or where they block the laser's view of the mapped features.

For most applications, you will want to customize the Lynx platform with a payload structure, attached to the top of the platform, to hold, carry, or handle your parts, samples, or documents. Refer to Payload Structures on page 43 for guidelines on designing a payload structure.

The Adept Lynx platform provides a variety of interfaces and power connections to support your application-specific sensors and accessories, mounted on your payload structure. Refer to Connectivity on page 51, for information on the available connectors on the Lynx platform.

Body and Drive

The Adept Lynx platform is relatively small, lightweight, and highly maneuverable. It has a strong aluminum chassis and solid construction that makes it very durable. It has an IP rating of IP-40.

The platform is a two-wheel, differential-drive vehicle, with spring-loaded passive casters front and rear, and independent drive-wheel spring-suspension for balance. Its solid, foam-filled wheels are at the mid-line of the platform, so that the platform can turn in place.

What's Included - Basic Components

- One fully-assembled Lynx platform

  The platform includes a safety scanning laser, front bumper with two sonar pairs, and two rear-facing sonar pairs. Each pair is one transmitter and one receiver.

- One fully-charged battery

  This is shipped separately from the platform, due to air shipping regulations.

- Lynx core, which includes an integrated computer, running Advanced Robotics Automation Management (ARAM™) and a microcontroller with MARCOS™ firmware. The core is housed inside the Lynx platform. It also runs the SetNetGo™ OS.

  ARAM and MARCOS firmware and the SetNetGo OS are pre-loaded on the platform.

  A gyroscope is mounted on the Lynx core, and each drive wheel has an encoder and a Hall sensor to complement the safety scanning laser.

- Operator Panel

  This includes a screen, an E-Stop button, ON and OFF buttons, a brake-release button, and a keyswitch, which can be locked, and key removed, in either position. This will usually be mounted on the user-designed and -built payload structure.

  An optional touchscreen is available. See Options on page 89.

- Automated docking station

  Allows the platform to charge itself, without user intervention. This includes a wall-mount bracket and a floor plate, for a choice of installation methods. See Installing the Docking Station on page 31.

  A manual charging cord is included, so you can charge the battery or a spare battery outside of the platform.

- Joystick

  Used for manually controlling the platform, mostly when making a scan to be used for generating a map.

- User documentation

Optional Components and Attachments (partial list)

- Adept Enterprise Manager™ 1100 system

  This is a system that manages a fleet of AIVs, for multi-AIV coordination and job management. It includes the Enterprise Manager appliance running the Mobile Robot software.

- Spare batteries
- Vertical-mount object-detection lasers

  Option for payload structure development.

- Payload structure sonar kit

  Includes four sonar emitter/receiver pairs and one sonar controller, which handles the eight sonar units.

- Cleanroom version

  The platform is available in a cleanroom-suitable version.

- Call Buttons/Door boxes

  Allow an AIV to be requested from a remote location, or allow the Adept system to control an automated door, so the AIV can pass through it.

  Refer to the *Adept Lynx Platform Peripherals Guide* for details on these.

User-Supplied Components / System Requirements

PC with Microsoft Windows®

- Ethernet (wireless preferred)
- 100 megabytes of available hard-disk storage

Software Overview

A fair amount of software is involved in setting up and running an Adept Lynx platform.

The platform comes with the following software:

Mobile Software Suite

The Mobile Software suite includes all of the software used for the Lynx platform, with the exception of the SetNetGo OS.

ARAM

The Advanced Robotics Automation Management software (ARAM™) runs on the Lynx platform core. It operates ranging sensors like the safety scanning laser and sonar, and performs all the high-level, autonomous robotics functions, including obstacle avoidance, path planning, localization, navigation, and so on, culminating in motion commands to the MARCOS firmware. ARAM also controls the battery and light discs, and manages digital and analog I/O, which, along with Lynx platform power, provide for integration of application-specific sensors and effectors (user-supplied).

ARAM manages wired and wireless Ethernet communications with offboard software, for external monitoring, development, and systems coordination, including coordination of a fleet of AIVs through the optional Adept Lynx Enterprise Manager 1100™ system. It also manages integration with other systems, as well as external monitoring, setup, and control with the MobileEyes™ and MobilePlanner™ applications.

ARAMCentral

ARAMCentral is the software that powers the Adept Lynx Enterprise Manager 1100 appliance.

For a fleet, the ARAMCentral software manages:

- the map that all AIVs use
- the configuration that all AIVs use
- traffic control of the AIVs

  This includes multi-robot avoidance, destination, standby, and dock control.
- queuing of jobs for the AIVs
- remote I/O, if you are using it

MobilePlanner (licensed)

In order to have your AIV perform autonomous mobile activities, you need to make a map of its operating space, and configure its operating parameters. The MobilePlanner™ software is used to make this map and perform this configuration.

Refer to the separate *Adept Motivity® User's Guide* for details on how to map a working space and prepare the virtual elements, goals, routes, and tasks for your application. In particular, refer to:

> **Working With Map Files > Editing a Map File > Using the Drawing Tools > Adding Goals and Docks**

The MobilePlanner software requires a license to run. You will need at least one license for MobilePlanner for each fleet of AIVs. Once you generate a map for an area, it can be shared between multiple AIVs in one fleet.

MobileEyes

The MobileEyes software is used to monitor one or more AIV's activities and have them perform mobile tasks in the mapped space. Refer to the separate *Adept Motivity® User's Guide* for details.

MARCOS

At the lowest level, a microcontroller running MARCOS firmware handles the details of mobility, including maintaining the platform's drive speed and heading, as well as acquiring sensor readings, such as from the encoders and gyroscope, and managing the platform's emergency stop systems, bumper, and joystick. The MARCOS firmware computes and reports the platform's odometry (X, Y, and heading) and a variety of other low-level operating conditions to ARAM.

Lynx Touchscreen Support

Whenever the Mobile Software suite is downloaded, it includes support software for the Lynx touchscreen.

Call/Door Box Support

Call/Door boxes use a variety of scripts, which are loaded onto the boxes. These include Host, Bridge, WiFi, and RF scripts.

ARCL Protocol

ARCL isn't included as part of the Mobile Software suite, but it's used often enough that it warrants a definition.

The Advanced Robotics Command Language, or ARCL, is a simple text-based command and response server for integrating a Lynx platform (or fleet of Lynx platforms) with an external automation system.

ARCL allows you to operate and monitor the Lynx platform, its accessories, and its payload devices over the network, with or without MobileEyes.

SetNetGo

The SetNetGo OS runs on the Lynx platform core. It is usually accessed through the SetNetGo interface in the MobilePlanner software. It can also be accessed through the maintenance Ethernet port or, when enabled, wirelesly over the network. It is used for the original wireless Ethernet configuration of the platform, and to perform systems diagnostics, such as retrieving log files. It is also used to update ARAM.

> **NOTE**: It is possible to connect directly to the SetNetGo OS on a Lynx platform through a web browser. The main intent of this is to allow your IT support to set up the network for you, without using MobilePlanner, which requires a license.

1.2 Installation and Setup Overview

Most of the steps in setting up a Lynx platform are straightforward. The design and construction of the payload structure needs to be tailored to your application.

- Install the docking station. See Installing the Docking Station on page 31.
- Install the battery in the platform. See Installing the Battery on page 25.
- Set up the wireless Ethernet for the platform. See Settings and Configuration on page 40.
- Design, build, and install a payload structure, to suit your application. See Payload Structures on page 43.

  This is the most involved task in getting your AIV working the way you want.
- Configure the AIV for your environment, so it can perform useful tasks.

  This includes generating the map that the AIV will use for its navigation. The configuration is covered in the *Adept Motivity® User's Guide*.

1.3 Dangers, Warnings, Cautions, and Notes

There are five levels of special alert notation used in Adept manuals. In descending order of importance, they are:

DANGER: This indicates an imminently hazardous electrical situation which, if not avoided, will result in death or serious injury.

DANGER: This indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING: This indicates a potentially hazardous electrical situation which, if not avoided, could result in serious injury or major damage to the equipment.

WARNING: This indicates a potentially hazardous situation which, if not avoided, could result in serious injury or major damage to the equipment.

CAUTION: This indicates a situation which, if not avoided, could result in minor injury or damage to the equipment.

NOTE: Notes provide supplementary information, emphasize a point or procedure, or give a tip for easier operation.

1.4 Safety Precautions

Read the installation and operation instructions, as well as the *Adept Robot Safety Guide*, before using the equipment.

- Do not ride on the Lynx platform.
- Do not exceed the maximum weight limit.
- Limit operation to a 1:12 slope.

- Do not drop the platform, run it off a ledge, or otherwise operate it in an irresponsible manner.
- Do not allow the platform to drive through an opening that has an automatic gate/door unless the door and platform are configured correctly with the Lynx Door Box option.

  Refer to the *Adept Lynx Platform Peripherals Guide* for details on the Adept Lynx Door Box.
- Do not get the platform wet. Do not expose the platform to rain or moisture.
- Do not use power extension cords with the docking station unless properly rated.
- Do not continue to run the platform after hair, yarn, string, or any other items have become wound around the platform's axles or wheels.
- Never access the interior of the platform with the charger attached.
  Immediately disconnect the battery after opening the battery compartment door.
- Do not use parts not authorized by Adept.
- Do not use any charger not supplied by Adept.

1.5 What to Do in an Emergency

Press the E-Stop button (a red push-button on a yellow background/field) and then follow the internal procedures of your company or organization for an emergency situation. If a fire occurs, use a type D extinguisher: foam, dry chemical, or CO_2.

1.6 Additional Safety Information

Adept provides other sources for more safety information:

Manufacturer's Declaration of Conformity (MDOC)

This lists all standards with which the Lynx platform complies. See Manufacturer's Declaration on page 15.

Adept Robot Safety Guide

The *Adept Robot Safety Guide* provides detailed information on safety for Adept robots. It also gives resources for more information on relevant standards.

It ships with each robot, and is also available from the Adept Document Library. Refer to Adept Document Library on page 18.

1.7 Manufacturer's Declaration

The Manufacturer's Declaration of Incorporation and Conformity (MDOC) for Adept robot systems can be found on the Adept website, in the Download Center of the Support section.

http://www.adept.com/support/downloads/file-search

The Download Center requires that you be logged in for access. If you are not logged in, you will be redirected to the Adept website Login page, and then automatically returned to the Download Center when you have completed the login process.

1. From the Download Types drop-down list, select Manufacturer Declarations.
2. From the Product drop-down list, select Adept Mobile Robots.
3. Click Begin Search. The list of available documents is shown in the Search Results area, which opens at the bottom of the page. You may need to scroll down to see it.
4. Use the Description column to locate the document for your Adept robot, and then click the corresponding Download ID number to access the Download Details page.
5. On the Download Details page, click Download to open or save the file.

1.8 How Can I Get Help?

Refer to the How to Get Help Resource Guide (Adept P/N 00961-00700) for details on getting assistance with your Adept software and hardware. Additionally, you can access information sources on Adept's corporate website:

http://www.adept.com

For details on getting assistance with your Adept software or hardware, you can access the following information sources on the Adept corporate website:

- For contact information:
  http://www.adept.com/contact/americas
- For product support information:
  http://www.adept.com/support/service-and-support/main
- For user discussions, support, and programming examples:
  http://www.adept.com/forum/
- For further information about Adept Technology, Inc.:
  http://www.adept.com

Related Manuals

This manual covers the installation, setup, operation, and maintenance of a Lynx platform. There are additional manuals that cover configuring the platform. See the following table. These manuals are available on the software media delivered with your system, and on the online Adept Document Library.

Table 1-1. Related Manuals

Manual Title	Description
Adept Robot Safety Guide	Contains general safety information for all Adept robots.
Adept Motivity® User's Guide	Covers MobileEyes and MobilePlanner software, the SetNetGo OS, and most of the configuration of a Lynx platform.
Adept Lynx Enterprise Manager 1100 User's Guide	Covers the Adept Lynx Enterprise Manager 1100 system, which is hardware and software used for managing a fleet of Lynx AIVs.
Adept SmartFleet EX	Covers the legacy Adept Enterprise Manager system, which ran

Manual Title	Description
Appliance User's Guide	on an Adept SmartFleet EX Appliance, for managing a fleet of Lynx AIVs.
Adept Lynx Platform Peripherals Guide	Covers Lynx peripherals, such as the Lynx Touchscreen, Call/Door boxes, and Acuity Localization options.
How to Get Help Resource Guide	Covers general information for getting information on Adept products. Gives WEEE information.

Adept Document Library

The Adept Document Library (ADL) contains documentation for Adept products. You can access the ADL from the Adept website. Select **Support > Document Library** from the Adept home page. To go directly to the Adept Document Library, use the following URL:

http://www.adept.com/Main/KE/DATA/adept_search.htm

To locate information on a specific topic, use the Document Library search engine on the ADL main page. To view a list of available product documentation, use the menu links located above the search field.

Support

If, after reading this manual, you are having problems with your Adept Lynx platform, contact us at:

support@adept.com

- In the body of your e-mail message, provide your platform's serial number and describe the problem you are having in as much detail as possible.
- Attach your debuginfo file to the email. Refer to the next section for details on retrieving your debuginfo file.

Tell us when and how we can best contact you. We will assume e-mail is the best format, unless otherwise notified. We will try to resolve the problem through communication. If the platform must be returned to the factory for repair, obtain a Repair Authorization Code and shipping details from us first.

Including a Debuginfo File

If the Lynx platform has been set up on a wireless network, skip to SetNetGo Access on page 19.

Network Setup

If the Lynx platform has not been set up on a wireless network, a local area network will have to be set up on a separate PC, and configured to talk to the Lynx platform over a TCP/IP port. The IP address should be set to: 1.2.3.5. The Subnet Mask should be 255.255.255.0.

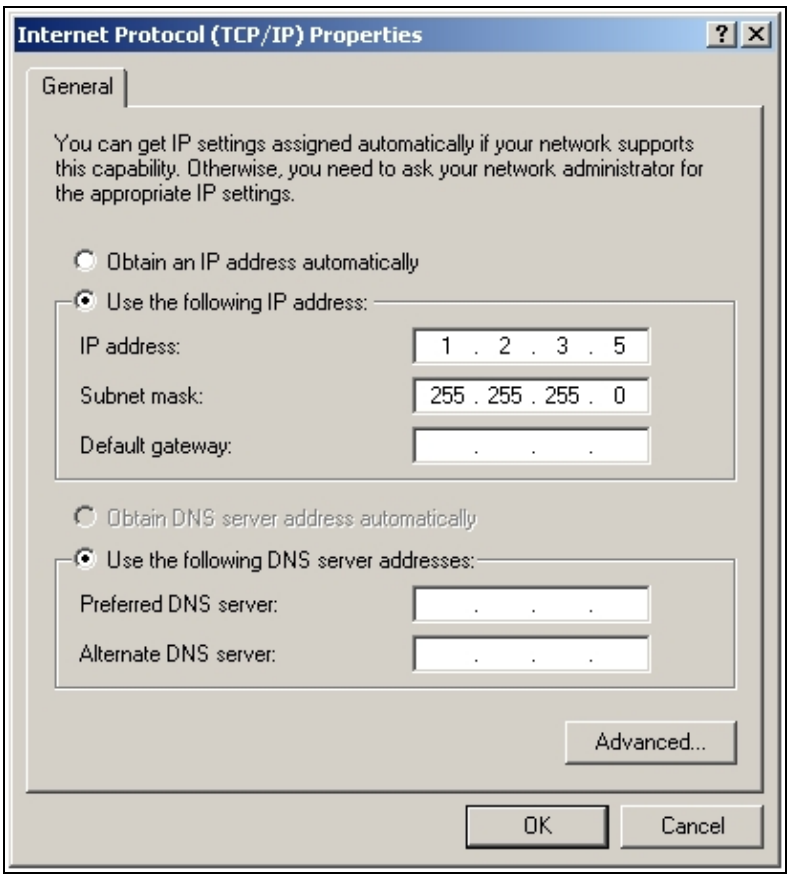
(XP) **Start > Control Panel > Network Connections**

Right-click on the LAN Connection. Select Properties.

(Windows 7) **Start > Control Panel > (Network and Internet >) Network and Sharing Center > Change adapter settings**

Right-click on the LAN Connection, and click on Properties.

For both XP and Windows 7, from the Properties dialog, scroll to and double-click the Internet Protocol (TCP/IP or TCP/IPv4) option. In Internet Protocol Properties, click both 'Use the following…' radio buttons to enable them, and then type in the IP and netmask values.



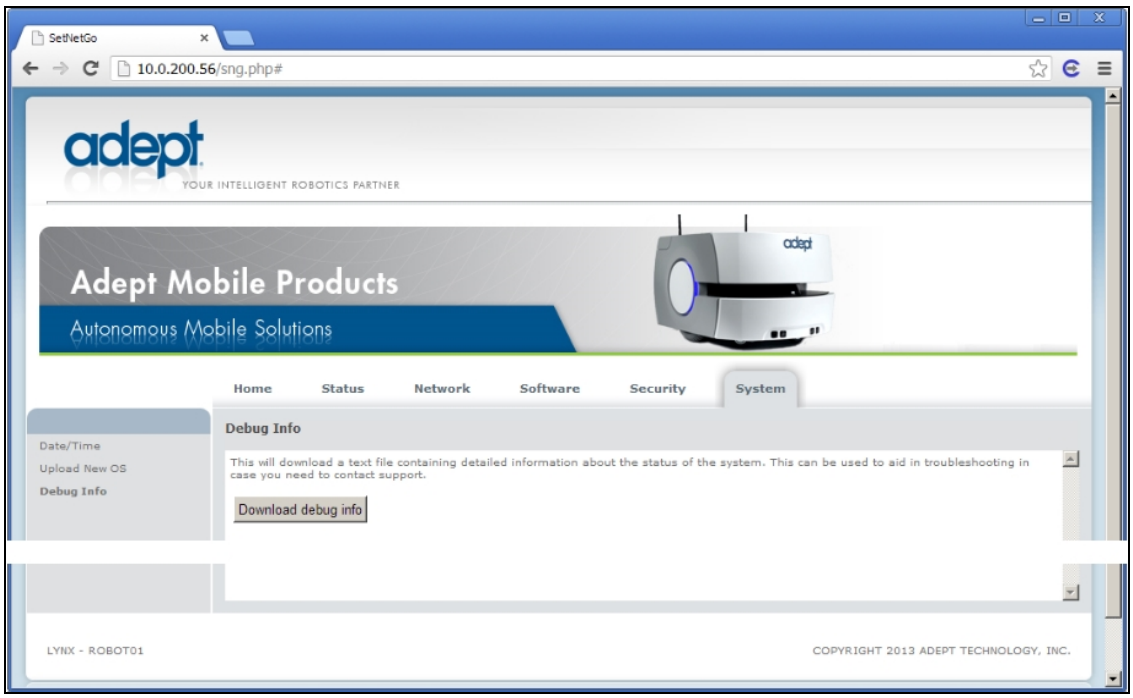
Connect the network port of your computer to the platform's maintenance port. See the figure Location of Parts on the Platform on page 91.

SetNetGo Access

If the MobilePlanner software is available, use the SetNetGo interface within that software to access SetNetGo. Otherwise, open a web browser and enter the URL: https://1.2.3.4:

You will be requested to confirm security certificates.

Regardless of how you accessed SetNetGo, you should now have a window similar to the following:



1. From the SetNetGo screen, select:

   System > Debug Info

   This will display the "Download debug info" button.

2. Click Download debug info.

3. Save the downloaded file, and attach it to your support request.

Chapter 2: Setup

In general, setup is the physical and logical preparation of the platform, configuration of the wireless network, and the installation of the docking station. The physical preparation of the platform includes attaching your payload structure to the platform.

Setup includes generation of the map that the platform will use for navigation. This manual only provides an overview of that process, which is covered in detail in the *Adept Motivity®* *User's Guide*.

2.1 Transport and Storage

Lynx Platform

The Adept Lynx platform must be shipped and stored in a temperature-controlled environment, from 5° to 70° C (41° to 158° F). The recommended humidity range is 5 to 95%, non-condensing. It should be shipped and stored in the Adept-supplied shipping crate, which is designed to prevent damage from normal shock and vibration. You should protect the crate from excessive shock and vibration.

Use a forklift, pallet jack, or similar device to move the shipping crate.

The platform must always be stored and shipped in an upright position in a clean, dry area that is free from condensation. Do not lay the crate on its side or any other non-upright position. This could damage the platform.

The crate with pallet for the platform measures 1441 x 787 x 762 mm (56.75 x 31 x 30 in.), and weighs 70 kg (152 lb).

Battery

NOTE: If you purchased spare batteries, this section applies to them, also.

The battery is shipped in a separate container, not inside the Lynx platform. Its crate with pallet measures 457 x 279 x 406 mm (18 x 11 x 16 in.), and weighs 27 kg (60 lb).

If the battery needs to be stored, the manufacturer recommends 5° to 70° C (41° to 158° F).

The battery should start storage fully-charged. If the battery will be stored for an extended period, it should be recharged periodically to avoid total discharge, which will damage the battery. Recharging a battery every six months is sufficient to keep it charged enough to avoid damage.

2.2 Before Unpacking the Platform

Carefully inspect all shipping containers for evidence of damage during transit. If any damage is indicated, request that the carrier's agent be present at the time the container is unpacked.

2.3 Unpacking

Before signing the carrier's delivery sheet, compare the actual items received (not just the packing slip) with your equipment purchase order. Verify that all items are present and that the shipment is correct and free of visible damage.

- If the items received do not match the packing slip, or are damaged, do not sign the receipt.
- If the items received do not match your order, please contact Adept immediately.

Retain the crates and packaging materials. These items may be necessary to settle claims or, at a later date, to relocate the equipment.

The Adept Lynx platform and battery come packed in wooden crates. They are mounted on pallets, with wooden covers. See the following figures.

Battery

The battery is shipped separately from the Lynx platform. Locate the crate that contains the battery before continuing. Refer to the following figure.

Figure 2-1. Battery Shipping Crate

1. Remove the screws from the top of the battery crate.

   Lift off the crate top.

2. Remove the battery.

Lynx Platform

The docking station, joystick, and platform are shipped in the same crate.

Retain all parts removed for possible reassembly.

1. Remove the lag screws holding the front of the crate cover to the pallet.

   The front can be identified by the four spring-loaded latches holding it to the rest of the crate cover.

2. Undo the four spring-loaded latches and remove the front of the crate cover.

   Set the front aside. This will be used as a ramp later in this procedure.

3. Remove the lag screws that attach the remainder of the crate cover to the pallet.

4. Lift and slide off the crate cover to reveal the crate, pallet, and contents.

5. Unscrew both eyebolts that screw down through the front and rear braces and into the chassis support board. There is one at each end of the Lynx platform.

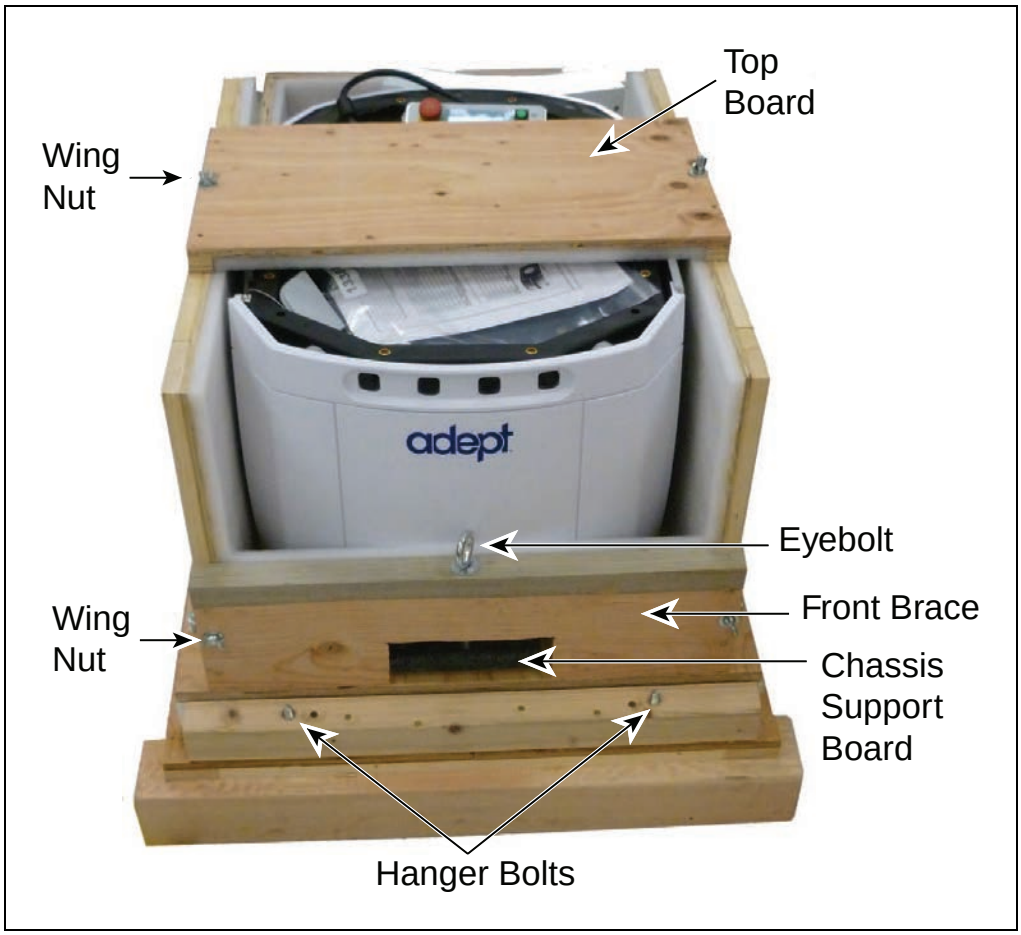


Figure 2-2. Front of Crate, Showing Front Eyebolt and Hanger Bolts

This will lower the platform body so its full weight is on its wheels and casters.

The chassis support board runs between the two Lynx platform drive wheels, and is used to support the platform during transit.

Completely remove the eyebolt at the front brace (Lynx battery end).

6. Remove the two wing nuts and washers holding the front brace to the crate.

   The front brace is on the end of the crate that houses the Lynx platform, rather than the docking station and accessories.

7. Install the battery in the Lynx platform.

   Refer to Installing the Battery on page 25.

8. Remove the two wing nuts from the top board, which spans the width of the crate, over the platform.

   Remove the top board.

9. Place the front of the crate cover in front of the Lynx platform, to serve as a ramp.

   Two holes in one end of the ramp go over hanger bolts that stick up from the crate base. The other end of the ramp has a short taper at its end.

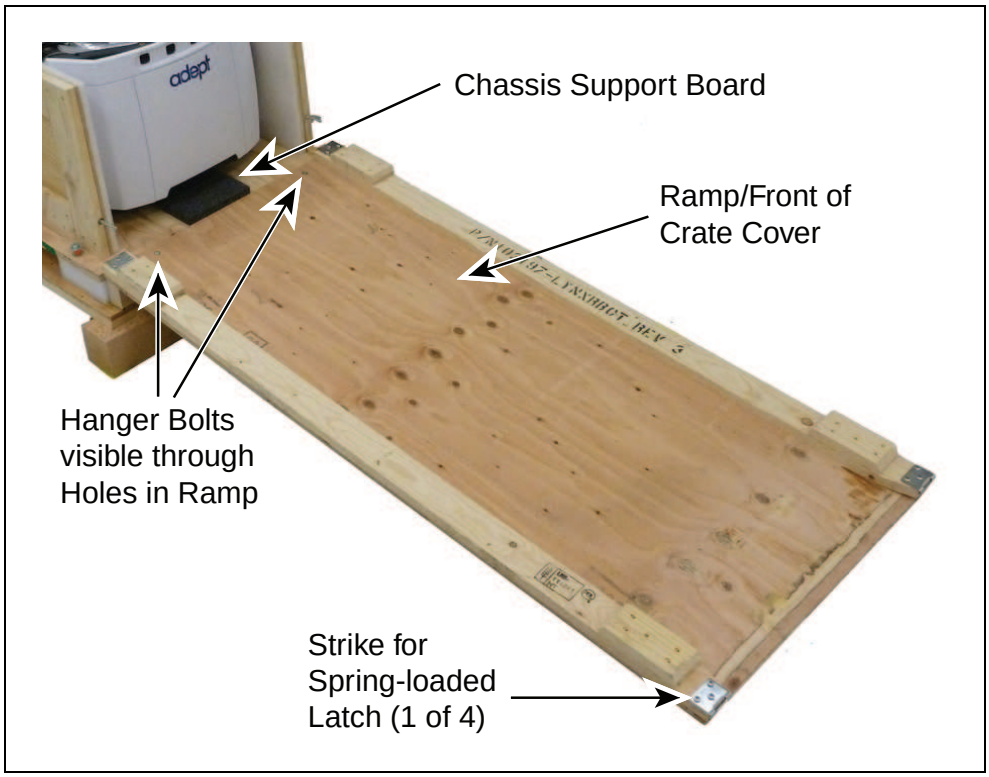


Figure 2-3. Crate with Ramp Attached

10. Press the E-Stop on the Operator panel, then press and hold the brake release button.

    Roll the platform onto the ramp and onto the floor.

2.4 Repacking for Relocation

If the platform or other equipment needs to be relocated, reverse the steps in the installation procedures in this chapter. Reuse the original packing crate and materials and follow all safety notes used for installation. Improper packaging for shipment will void your warranty.

The platform must always be shipped in an upright orientation.

2.5 Operating Environment

The Adept Lynx platform is designed to operate in an environment that is wheelchair accessible. Care must be taken to avoid:

- glass doors and walls
- pits without railings or low bumpers
- floors with access panels removed
- loose cables, hoses, etc.
- large, highly-reflective objects

Floors must provide good traction, typical of good walking conditions.

- Slope up to 1:12
- Step traversal up to 15 mm (0.6 in.)
- Gap traversal up to 15 mm (0.6 in.)
- Temperature 5° to 40° C (41° to 104° F)
- Humidity 5 to 95%, non-condensing

The Adept Lynx platform is not intended for use in hazardous environments (explosive gas, water, dust, oil mist). It has an IP rating of IP-40.

WARNING: Do not allow the platform to drive through an opening that has an automatic gate/door unless the door and platform are configured correctly with the Lynx Door Box option.

Refer to the *Adept Lynx Platform Peripherals Guide* for details on the Adept Lynx Door Box.

2.6 Installing a Lynx System

Installing the Battery

Your Adept Lynx platform comes fully-assembled, battery fully-charged.

NOTE: Air shipping regulations require that the platform be shipped without the battery installed.

Refer to Removing and Installing Covers in the Maintenance section for cover removal and installation.

1. Remove the inner rear platform cover.
    a. Pull the bottom of the cover away from the platform chassis.

       This is easiest if you grip it with two hands, toward the center.

    b. Lower the cover down, so its top tab clears the rear outer cover.
2. Unlatch and open the battery compartment door, at the back of the platform.

   The battery compartment door is capable of being locked. You may need to unlock it.

Figure 2-4. Battery Compartment, Connectors

3. Lift and slide the new battery into the platform body.

   The battery weighs 20 kg (44 lbs).

   There are recesses at the front and the back of the battery, to aid in lifting it.

Figure 2-5. Battery Recesses, for Gripping

The battery is designed to be lifted and replaced by one person, using one hand in each of the grips, as shown in the following figure.

Figure 2-6. Lifting the Battery

The connectors for power and data go toward the rear of the platform.

4. Attach the battery power and data cables to the connectors at the rear of the battery.
5. Close the battery compartment door to secure the battery in place.

The battery compartment is designed to hold the battery tightly, so that it will not move within the compartment, once the door is closed.

6. Reinstall the inner rear platform cover.

Attaching the Payload Structure and Options

You may need to attach any accessories that were shipped separately or detached for safety. You will also have to attach your payload structure. See Payload Structures on page 43.

NOTE: Either an E-Stop jumper or a user-supplied E-Stop button needs to be attached to the E-STOP port (User Interface) for the platform to function. The jumper is provided as part number 12730-000L. An E-Stop button would be user-supplied.

See the following figure.

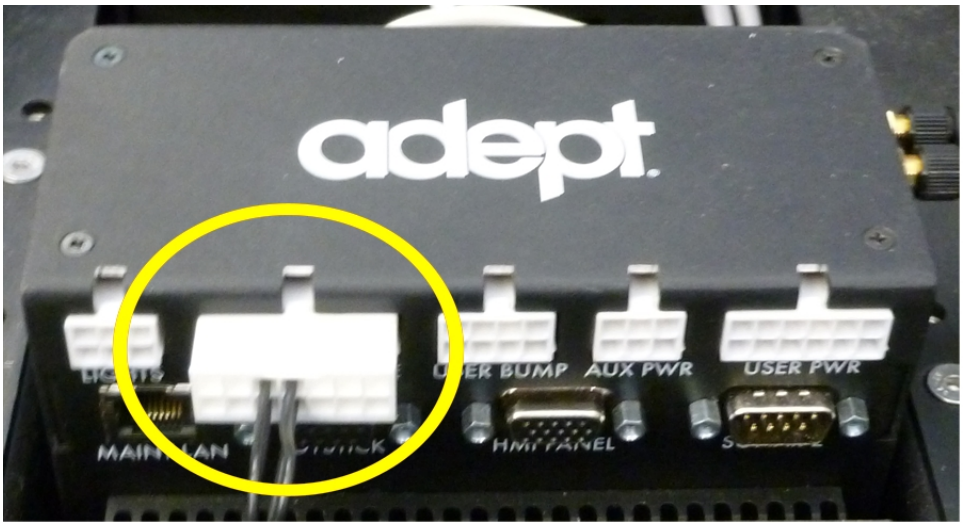


Figure 2-7. E-Stop Jumper on Lynx Core

Setting Up Wireless Ethernet

NOTE: The Adept Lynx AIV is capable of working without wireless Ethernet. If there are no other AIVs that it needs to know about (and to avoid), you can have an installation in which the AIV simply uses its map, knows its patrol route, and performs without human intervention.

For example, you could set up a AIV to make stops, and wait for a specified period of time, and then continue on its patrol.

NOTE: For all of the following settings, work with your IT group to verify the correct IP, radio, and security settings.

The following applies to the wireless Ethernet supported by the Adept Lynx platform.

Access the SetNetGo OS through the MobilePlanner software:

MobilePlanner > SetNetGo > Networking

NOTE: It is also possible to connect directly to the SetNetGo OS on a platform through a web browser. The main intent of this is to allow your IT support to set up the network for you, without using MobilePlanner, which requires a license.

IP Address, Netmask, Gateway, DNS1

Choose Static (DHCP is not recommended), and fill in the IP address, netmask, gateway, and DNS1, as supplied by your network administrator.

NOTE: The following settings have to be provided by your IT department.

Radio Settings

- SSID (e.g. AGV)

  Fill in the appropriate wireless SSID for your wireless network.
  The SSID is case sensitive.

- Mode

  Managed/STA, Ad-Hoc, or Master/AP

- Radio Mode

  Auto, 802.11a, 802.11b, 802.11g

- Channel Set
- Wireless Watchdog IP Address
- Wireless Watchdog Max Count

  0 disables this.

Security Settings

Encryption:

- Disabled
- WEP 64-bit
- WEP 128-bit
- TKIP/RC4
- CCMP/AES
- TKIP/CCMP/AES

Authentication:

- OPEN
- WPA-PSK
- WPA2-PSK

WEP

- WEP Key Number (Key 1 - Key 4)
- WEP Keys

WPA/WPA2-PSK

- PSK
- PSK-Type (Passphrase or Raw Hex)

Click Apply for your changes to take effect.

Wireless Coverage

The Adept Lynx AIV must have wireless coverage for multi-AIV installations, or in areas where you wish to send new commands to or receive status updates from the AIV.

Ensure that, in such cases, you have adequate wireless coverage. Because of the variation possible in different environments, Adept doesn't specify what components or techniques should be used to obtain this coverage.

Adept suggests that you conduct a comprehensive site survey to ensure adequate wireless coverage. You can test the coverage of your wireless setup by trying to ping it from various locations.

>= -40 dBm is the ideal WiFi signal strength, -60 dBm is the recommended minimum.

Bandwidth Considerations

The typical bandwidth in a fleet will average about 50 Kbps/AIV. This would increase if the AIV is connected to the Enterprise Manager, and is actively viewed by MobileEyes. This number can increase or decrease depending on the types of commands and debugging tools that are enabled in MobileEyes. In any case, the bandwidth is not likely to exceed 500 Kbps per AIV (0.5 Mbps).

0.5 Mbps per AIV would easily fit within the capabilities of access points (>=54 Mbps). If you have multiple access points, this number becomes even less of a concern.

Also, other factors will affect the bandwidth requirements, such as if the AIV supports a camera on top and streams the video through the AIV's WiFi interface. Based on such possibilities, the bandwidth usage will vary by application.

Installing the Docking Station

The automated docking station can be used for either manual or automated charging of your platform's battery.

The docking station sits on the floor. It can be attached to a wall with the wall bracket, attached directly to the floor with screws through its base, or can sit stand-alone on the floor

with the floor plate, all of which will keep the docking station from moving when the platform docks. Both the wall bracket and floor plate are included with each docking station.

CAUTION: It is very important that the docking station be mounted with one of these methods, or the platform will simply move the docking station when it tries to dock, rather than docking successfully.

For all mounting methods:

- Locate the docking station near an AC outlet with 1 - 2 meters (3.25 - 6.5 ft) of clear space in front to ease the platform's maneuvers, especially automated ones, onto the docking station.
- The top of the docking station foot is spring-loaded, and lifts off of the bottom of the foot slightly to accommodate variations in the floor surface. The weight of the Lynx platform will push the top of the foot down.

Requirements

- 100 to 240 VAC, 50 to 60 Hz, 8 A

  The station's power converter automatically detects the source voltage.
- Ambient operating temperature: 5° to 40° C (41° to 104° F)
- 5 to 95% humidity, non-condensing

Wall Bracket Mount

1. Attach the docking station mounting bracket to a wall, with the bottom edge of the bracket 98 ± 20 mm (3.8 ± 0.8 in.) above the floor, using user-supplied anchors and screws. There is leeway, so you can adjust the height a little bit.

   Refer to the following figure:

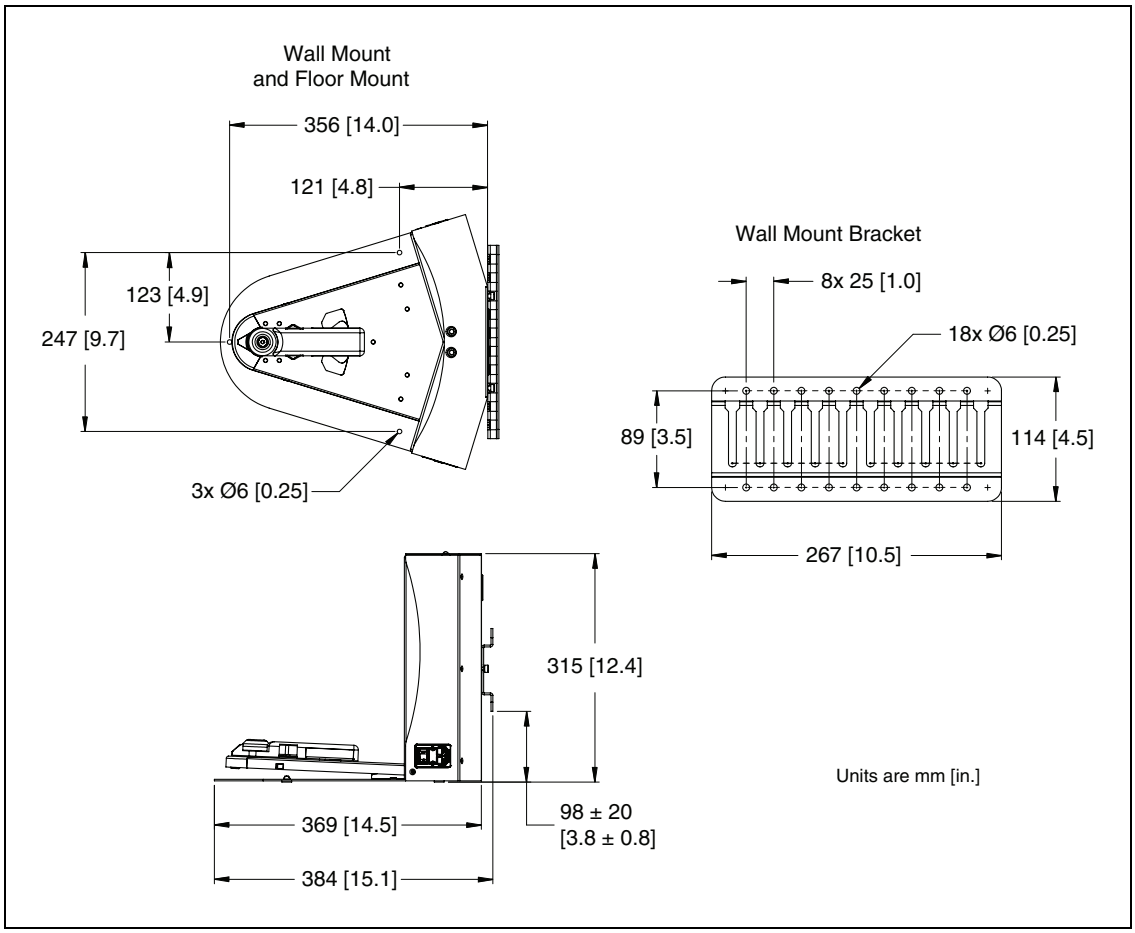


Figure 2-8. Docking Station, Wall Mount

2. Screw the two shoulder bolts, each with a washer, into the rear of the docking station. The shoulder bolts are M5 x 4, stainless steel. Their locations are shown in the following figure. Tighten to 9 N-m (80 in-lb).

Figure 2-9. Rear View of Docking Station with Wall Bracket

3. Lower the docking station down, so the two bolts on the back of the docking station slide into the bracket, to secure the docking station to the wall.

Floor-mount, without Floor Plate

Screw the base of the docking station directly to the floor, using three user-supplied screws. For dimensions of the available holes in the base, refer to Figure 2-8. Adept recommends M5 self-tapping or M4 sheet rock screws for this.

Floor-mount, with Floor Plate

This mounting method uses the floor plate. The floor plate is not shipped attached to the docking station, so you must attach it for this type of mount. It will be in the crate with the platform, right behind the docking station.

Attaching the Floor Plate

Refer to the following figures.

1. Tip the docking station onto its back, so you can access the underside.
2. Remove the two lowest screws (M4 x 12 flat-head), if present.

   In the following figure, these screws are circled. The location of the third screw hole is also circled.
3. Attach the floor plate to the base of the docking station with three M4 x 12 flat-head stainless steel screws.

   The floor plate comes with three screws, so you will have two spares.

The docking station and floor plate do not need to be attached to the floor, as the weight of the AIV on the floor plate will keep the docking station from moving.

Figure 2-10. Underside of Docking Station Foot, Showing Screw Locations

NOTE: These are the three locations for the M4 x 12 flat-head screws. Two are already in place, and need to be removed before attaching the plate.

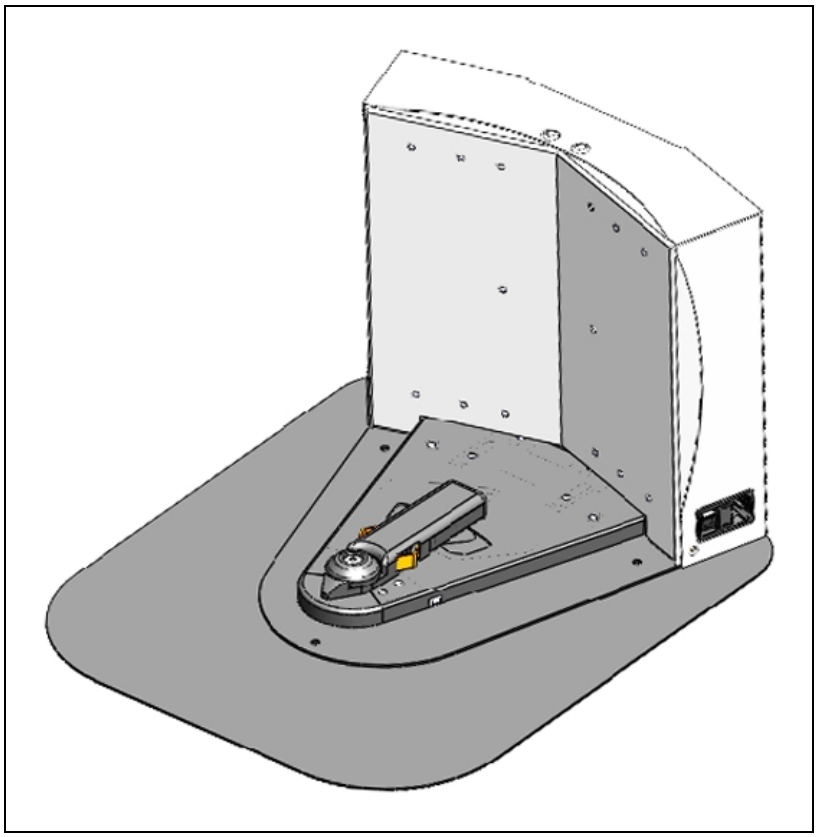


Figure 2-11. Docking Station, Mounted on Floor Plate

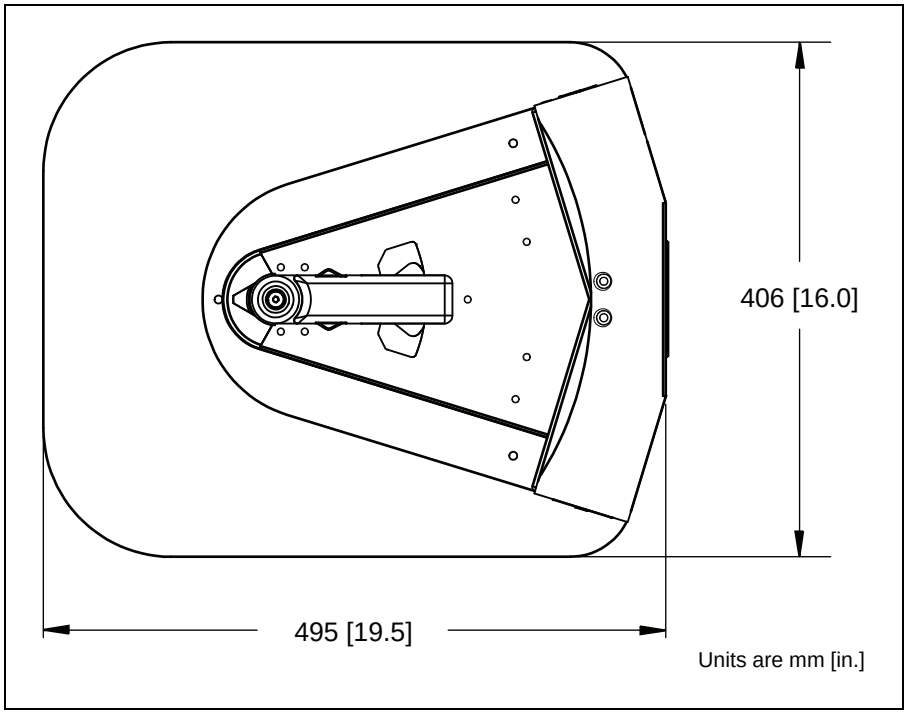


Figure 2-12. Docking Station Floor Plate Dimensions

All mounting methods

Install the power cord and turn the power switch to ON. The power switch is next to the power plug. The blue power LED indicator should light.

Docking Station Contact Adjustment

The contacts on the docking station have five height settings. The station is shipped with the height in the middle setting, which should be correct in most cases. The height can be changed by tilting the station enough to see the bottom of the base, making the adjustment accessible.

> **NOTE**: Squeeze and keep the platform foot against the bottom of the foot to make this adjustment easier.

Adjust the height of the contacts by using the pull-knob on the bottom of the dock. The height changes by 4 mm (0.15 in.) for each notch. See the following figure.

The height of the contacts should be set so that the roller is high enough to stay in contact with the platform as it is docking, but low enough so that the bi-level of the roller guides the paddle under the platform.

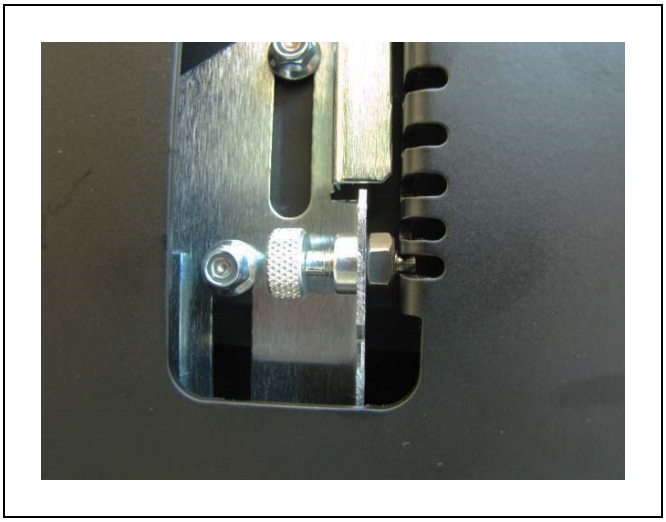


Figure 2-13. Docking Station Contact Adjusting Pull-Knob

Chapter 3: Getting Started

The Adept Lynx platform comes with firmware and onboard software installed.

The configuration of parameters is performed with the MobilePlanner software, covered in the *Adept Motivity® User's Guide*.

Other setup, mostly for communication, is handled by the SetNetGo OS, which is accessed through the MobilePlanner software. It can also be accessed through a direct connection, so your IT support can set up your wireless without needing the MobilePlanner license.

The Adept Lynx platform navigates using a map, generated with the MobilePlanner software. The operation of this software, as well as the downloading of the resultant map to the platform, is covered in the *Adept Motivity® User's Guide*.

> **NOTE**: The map must be generated and downloaded to the platform before you can perform the steps covered in the Operation chapter of this manual.

The Adept Lynx platform is autonomous, but can be monitored and manually controlled through the MobilePlanner or MobileEyes software. These are covered in the *Adept Motivity® User's Guide*.

This chapter describes how to quickly start up, configure, and operate your new Adept Lynx platform. For mapping and integration details, refer to the *Adept Motivity® User's Guide*.

3.1 Startup

Press and hold the power ON button for half a second, then release. It takes about a minute for all the systems to start up and make their various interconnections. If the platform doesn't start up, try power OFF, check your connections, and then power ON.

Startup is complete when the light discs stop indicating boot (two blue light segments, moving in opposite directions from 6 o'clock to 12 o'clock and back).

Out-of-the-box, the platform does not have a working map, nor are its wired or wireless network settings likely to match your network. Consequently, it will not do anything autonomously, but you can drive it with the joystick or have it follow you around, in Follow Mode. Adept recommends that you drive it to and position it onto its automated docking station in preparation for the next steps. (Installation of the automated docking station was covered in the previous chapter.)

Joystick

The joystick lets you quickly move the platform to its destination. This can be used to drive it from the shipping dock to an automated docking station.

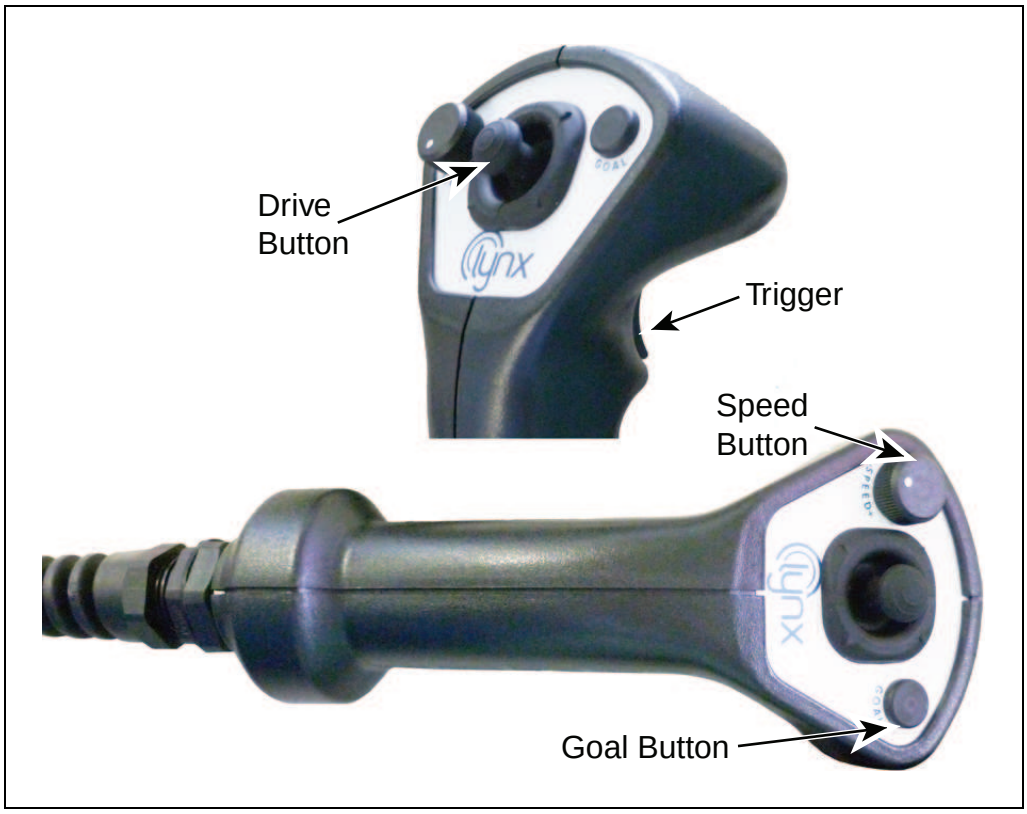


Figure 3-1. Joystick

The joystick plugs into the left side of the Lynx platform, under the small access panel at the upper right corner of the platform. (The Maintenance Ethernet port is also there.) The access panel is held in place with a push-push latch, and retained by a lanyard. See Figure 8-1.

CAUTION: The Lynx platform safety scanning laser is not tied into the E-Stop chain when driven using the joystick. The platform will still avoid obstacles detected by the safety scanning laser. The sonar, on the other hand, are disabled entirely when driving with the joystick.

Follow Mode

Connect the joystick, start up normally, then press the joystick GOAL button. Step in front of the platform and it will now follow you wherever you go. Actually, it follows your legs or the legs of anyone else who may step in front and capture its attention. This is useful if you need to transport it to a different location.

Driving with the joystick, activation of an E-Stop, or any other mobility interaction, such as through MobileEyes, stops Follow Mode.

3.2 Settings and Configuration

Preparing your Adept Lynx platform for autonomous mobile operation is very easy and takes just a few moments. You attach a PC to the platform's maintenance Ethernet port, and connect with the SetNetGo OS through the MobilePlanner SetNetGo interface. If you do not have

wireless yet, you can connect MobileEyes and MobilePlanner through the wired Ethernet port (Maintenance LAN) and set up the wireless network later.

Maintenance Ethernet Connection

Attach a pass-through or cross-over CAT5 (or better) Ethernet cable between the PC and the Maintenance Ethernet port of the Adept Lynx platform. The Lynx Ethernet is Auto-MDIX, and will detect the type of cable you are using. Set your computer's IP address to 1.2.3.x, where x is any number from 1 through 254, except 4. Manually set the net mask to 255.255.255.0. No special DNS or gateway settings are needed.

The Maintenance Ethernet plugs into the left side of the Lynx platform, under the small access panel at the upper right corner of the platform. (The joystick port is also there.) The access panel is held in place with a push-push latch, and retained by a lanyard. See Figure 8-1.

The platform's Maintenance Ethernet port is always enabled, and permanently set to IP address 1.2.3.4, with a netmask of 255.255.255.0, for direct, wired access to the onboard systems.

Start the Network Connections:Local Area Connection dialog for the ETH 0 Ethernet port:

(Windows) **Start > Settings > Network Connections > Local Area Connection**

Select Properties, and, from its dialog, scroll to and double-click the Internet Protocol (TCP/IP) option. In the Internet Protocol (TCP/IP) Properties dialog, click both 'Use the following…' associated radio buttons to enable them, and then type in the IP and netmask values.

SetNetGo Configuration

The SetNetGo OS is used to configure the Adept Lynx platform wireless Ethernet, among other things. Refer to the *Adept Motivity® User's Guide* for details.

Mapping

In order to have your Adept Lynx platform perform autonomous mobile activities, you need to make a map of its operating space. Use the MobilePlanner application to make maps. Refer to the *Adept Motivity® User's Guide*.

The tasks involved are:

- Make a floor plan scan while driving the platform with the joystick.
- Load that floor plan scan into MobilePlanner, on your PC, to make and edit the map.
- Add goals and docks to your map. In particular, refer to:

  Working With Map Files > Editing a Map File >
  Using the Drawing Tools > Adding Goals and Docks

  in the *Adept Motivity® User's Guide*.

- Transfer the working map to the Enterprise Manager, or back to the platform, if you have only one platform, to perform autonomous mobile actions.

  The Enterprise Manager will automatically download the new map to each AIV in your fleet as soon the AIV becomes idle.

- Save map collections and deploy your platform in any of your working spaces by selecting the appropriate map file.

NOTE: It is a good idea to have the automated docking station installed prior to creating the map scan. Its distinctive diagonal face will be useful in locating and setting it up in the map.

Chapter 4: Payload Structures

Everything that you attach to the Lynx platform is referred to as the payload structure.

In some custom cases, Adept designs and builds the payload structure. In most cases, you will need to design a payload structure that suits your application. This chapter discusses considerations to be aware of when you design a payload structure for your Lynx platform.

The Lynx platform provides the mobility and navigation you will need, as well as power and I/O connections between the platform and your payload structure, so the two can work effectively together.

4.1 Considerations

The main factors to consider in designing a payload structure are the size, weight, and center of gravity of the payload structure, and power requirements. Adding weight to the Lynx platform tends to have less effect on run-time than adding electrical power requirements. Additional weight will have more effect on carpet than on hard surfaces.

Weight

Increased payload structure weight will decrease your AIV's run-time. This will be most noticeable if you are driving the AIV up an incline. On level ground, a certain amount of extra weight will not shorten the AIV's run-time very much. When adding a payload structure with substantial weight, the center of gravity of the entire AIV needs to be considered. This is particularly important if you intend to equip the Lynx platform with a robot arm, which would be lifting items off-center from the Lynx platform.

A heavy payload structure, with most of its weight concentrated just above the Lynx platform, will be much more stable than the same weight payload structure in which the weight is either off-center or high above the top of the platform.

> **NOTE**: The weight of your payload structure added to the weight of the parts it is carrying must not exceed the rated capacity of your platform.

Power Consumption

Using devices on your payload structure that consume significant power will noticeably shorten the run-time of the AIV. You should try to minimize such power consumption whenever possible.

Examples of power-consuming payload structures would be one with a robot arm attached, or any motorized fixture, such as a conveyor, as part of the payload structure. The standard Operator screen and light discs consume some power, but are not significant compared to the rest of the platform.

The battery is rated at 1500 W*hr (1.5 kWh). Unloaded, the platform uses from 80 - 107 W. With a full load, this increases to 94 - 125 W. (The range for each reflects the speed at which the platform is driven.) You can use the wattage of any accessories you add to your payload structure, added to these typical values, to calculate the expected run-time per charge.

NOTE: In the following table, 50% is 900 mm/sec., 100% is 1800 mm/sec.

Table 4-1. Typical Watts Drawn

	% Speed	
kg	**50**	**100**
0	80	107
60	94	125

To calculate your estimated run-time:

1. Find the closest match to your payload structure weight and average driving speed, as a percentage of full speed.

   This will be a value in Watts.

2. Add the power used by all electrical devices on your payload structure, in Watts.

   It is unlikely that any electrical device on your payload structure will operate continuously, so you need to figure out what average percent of the time it will operate, and multiply that by the Watts of the drain to get an average drain factor.

3. Divide 1500 W*hr by that value, in Watts.

   This will yield your estimated run-time, in hours.

Example Calculation

If your payload structure weighs 60 kg, and you expect to run at an average of 50% full speed, you would use the value of 94 from the table.

If your payload structure includes a device that draws 150 watts half of the time, add 75 (150*50%) to 94, to get 169 Watts, total.

Dividing 1500 W*hr by 169 Watts yields:

1500 W*hr/169 W = 8.87 hr of estimated run-time.

Payload Bay Access

The area between the Lynx platform and your payload structure is the payload bay. You will occasionally need to access the Lynx platform and the connectors in the payload bay. This is where you can access all of the platform power and I/O connectors. It's a good idea to provide for access to this when designing your payload structure.

If the payload structure is small and light enough, it can just be lifted off of the platform to access the connectors in the payload bay. Care should always be taken not to damage any wiring between your payload structure and the platform.

A larger, heavier payload structure may need some form of hinge, so that the payload structure can be tilted out of the way while you access the payload bay. Consideration should be given to harness length and position so that this can be accomplished without disconnecting or damaging any connectors or harnesses.

Dimensions

You must keep your payload structure no wider and no longer than the Lynx platform. The most common payload structure is a vertical extension of the platform, adding whatever features are needed by your application above the platform itself.

Take care to keep all of the payload structure higher than the top of the Lynx platform. If any of the platform's sensors get blocked, it won't be able to function normally. This is critical in the case of the safety scanning laser.

If you purchased the optional vertical-mount lasers for your payload structure, you need to make sure that the payload structure will not interfere with the view of those lasers. Typically, the vertical lasers are mounted on the sides of the payload structure, so that they protrude enough to miss the payload structure itself with the laser beam. Some customers have found it prudent to build a protective guard over the vertical lasers, to protect the lasers from impact. Ensure that any such guard does not block the laser beam.

The height of your payload structure will affect the center of gravity, covered in the next section.

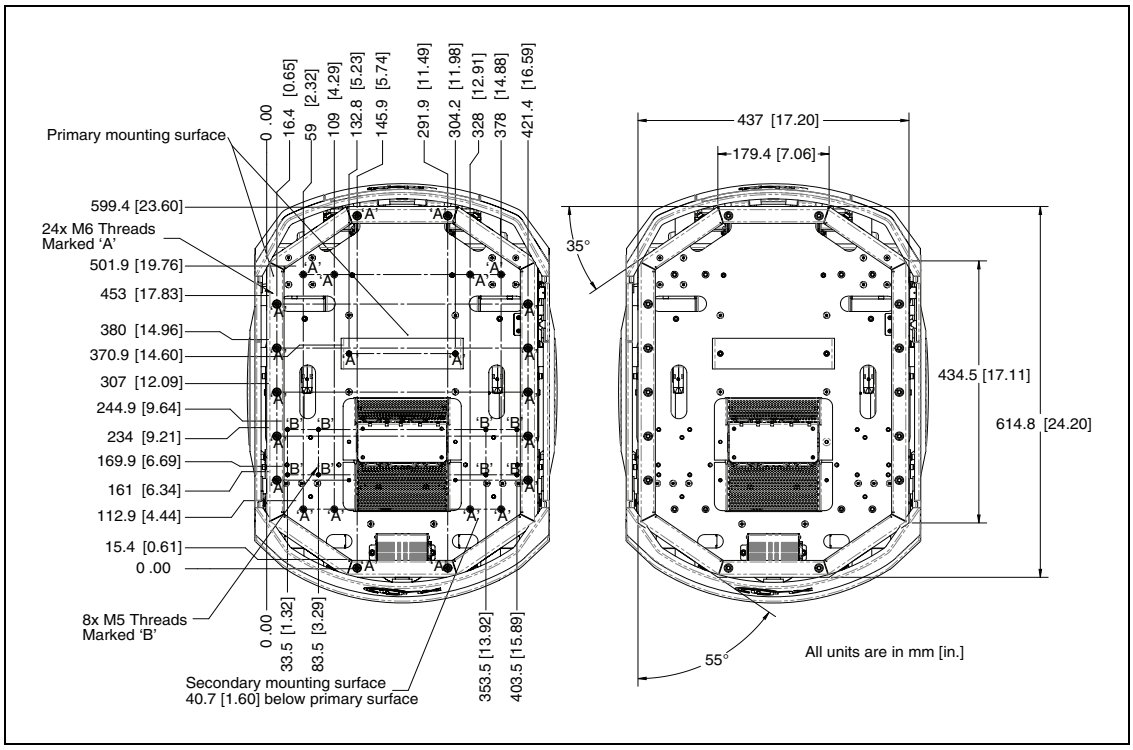


Figure 4-1. Platform Deck Dimensions, for Attaching Payload Structure

Center of Gravity

As much as possible, you should keep the payload structure center of gravity centered on the Lynx platform, and as low (close to the platform top) as possible. This will give you the best stability, particularly when crossing thresholds or irregularities in the floor.

The following figure shows the center of gravity of the platform, without payload structure.

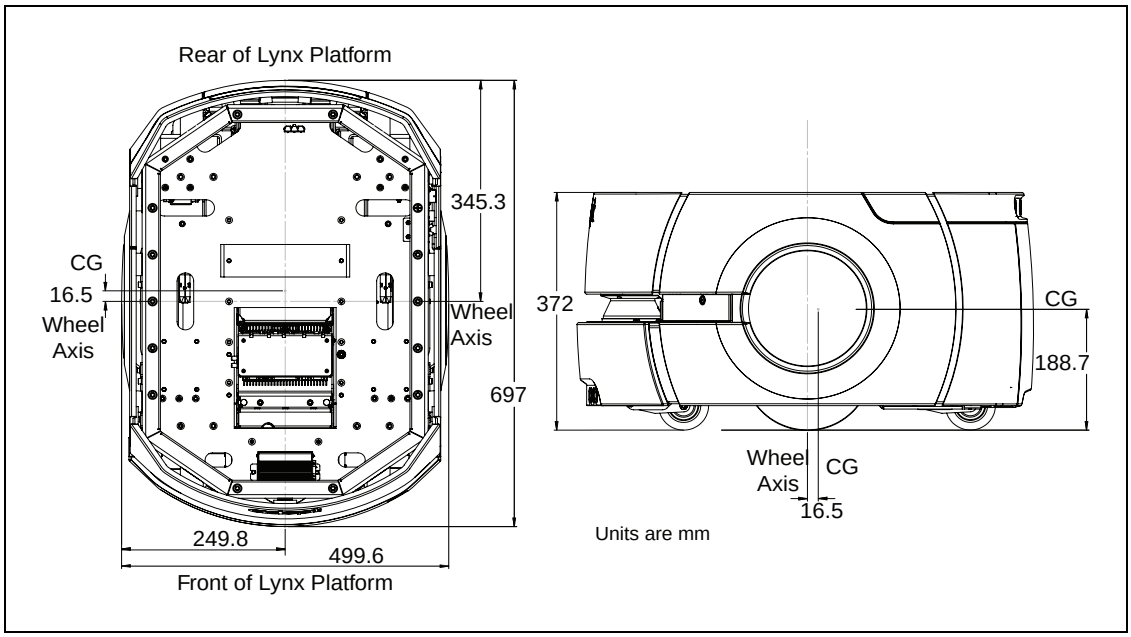


Figure 4-2. Center of Gravity of Platform

The three following figures show the calculations of safe placements for the center of gravity for payload structures with the weights listed. The center of gravity, in each instance, needs to be within the area shown. All units are mm.

> **NOTE**: These figures show the limits of where the payload structure center of gravity can be placed. You should try to keep your CG as close to the center of these figures as possible.

In the following three figures, light blue represents the payload structure, while dark (Adept) blue represents the Adept Lynx Platform.

10 kg

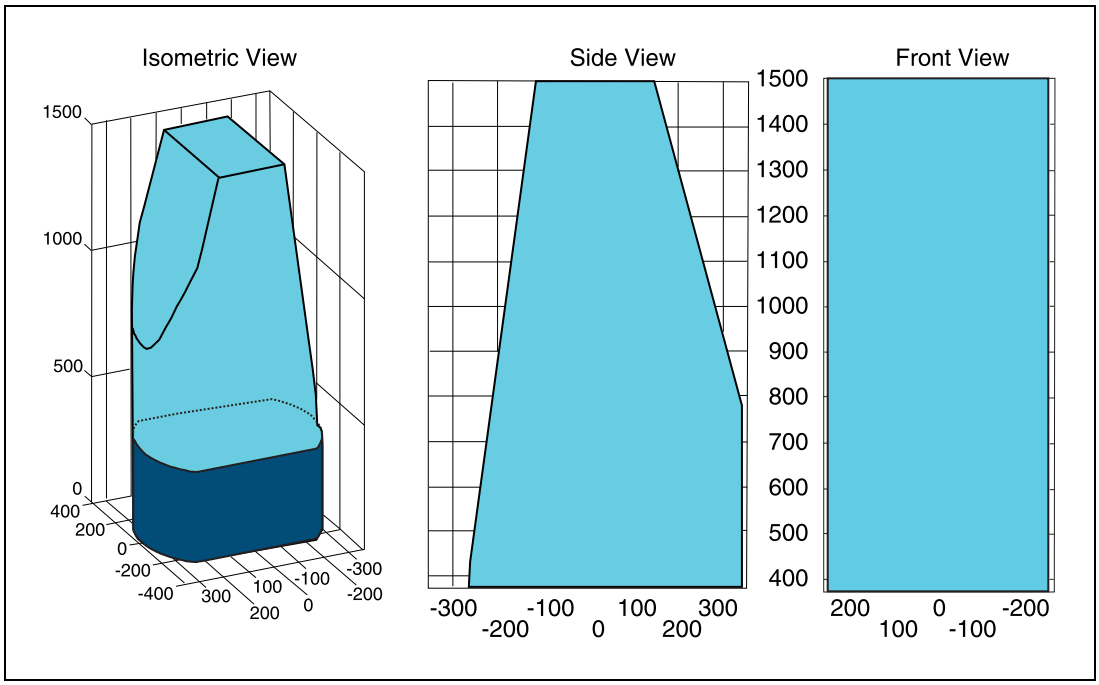


Figure 4-3. Center of Gravity Graphs, 10 kg

30 kg

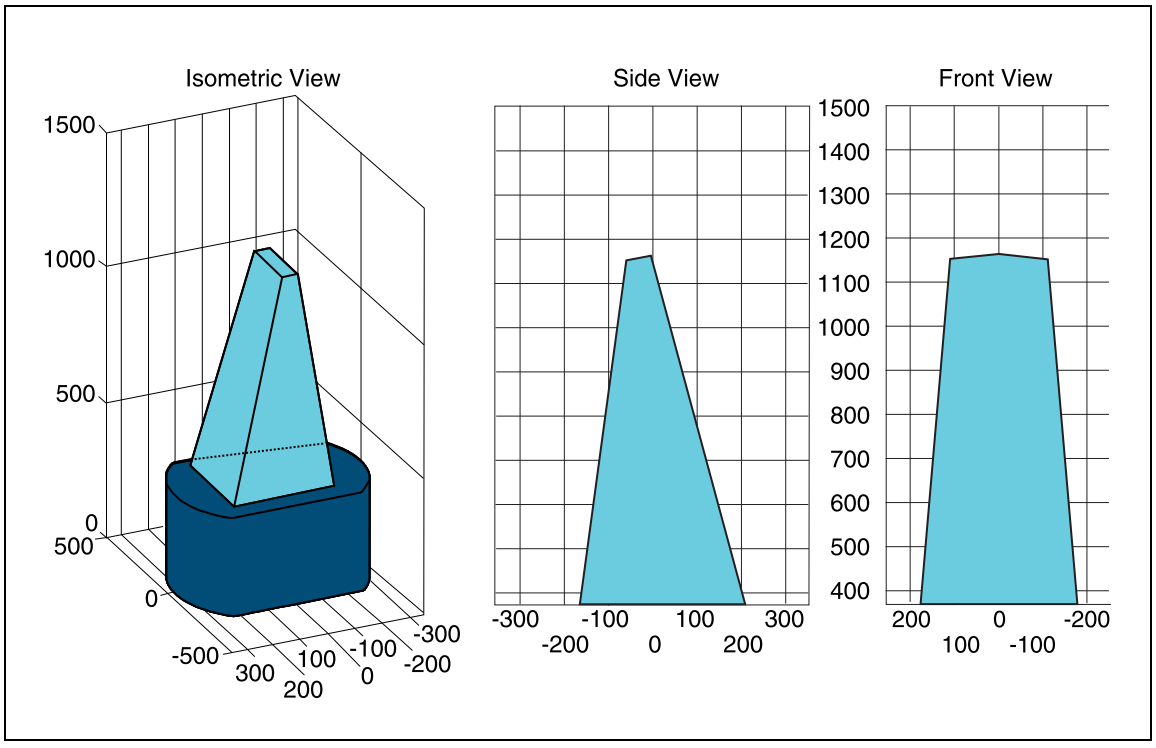


Figure 4-4. Center of Gravity Graphs, 30 kg

60 kg

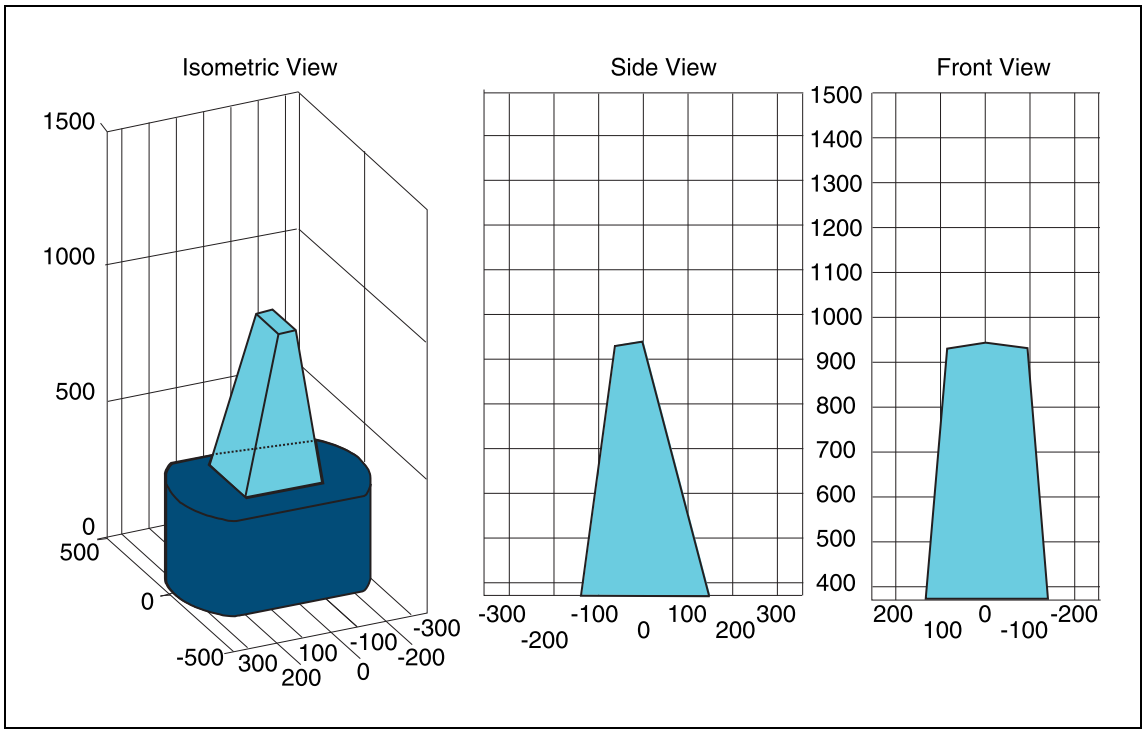


Figure 4-5. Center of Gravity Graphs, 60 kg

4.2 Connections Between Platform and Payload Structure

The Lynx platform provides a variety of I/O and power connections, which you can use to make your AIV more effective.

Operator Panel

The Operator screen, E-Stop, Brake-release, ON, and OFF can be "moved" using a single connector (the HMI Panel connector). This allows you to put many of the more common operator controls somewhere on your payload structure with just one cable.

The cutout needed for mounting the Operator interface is shown in the following figure:

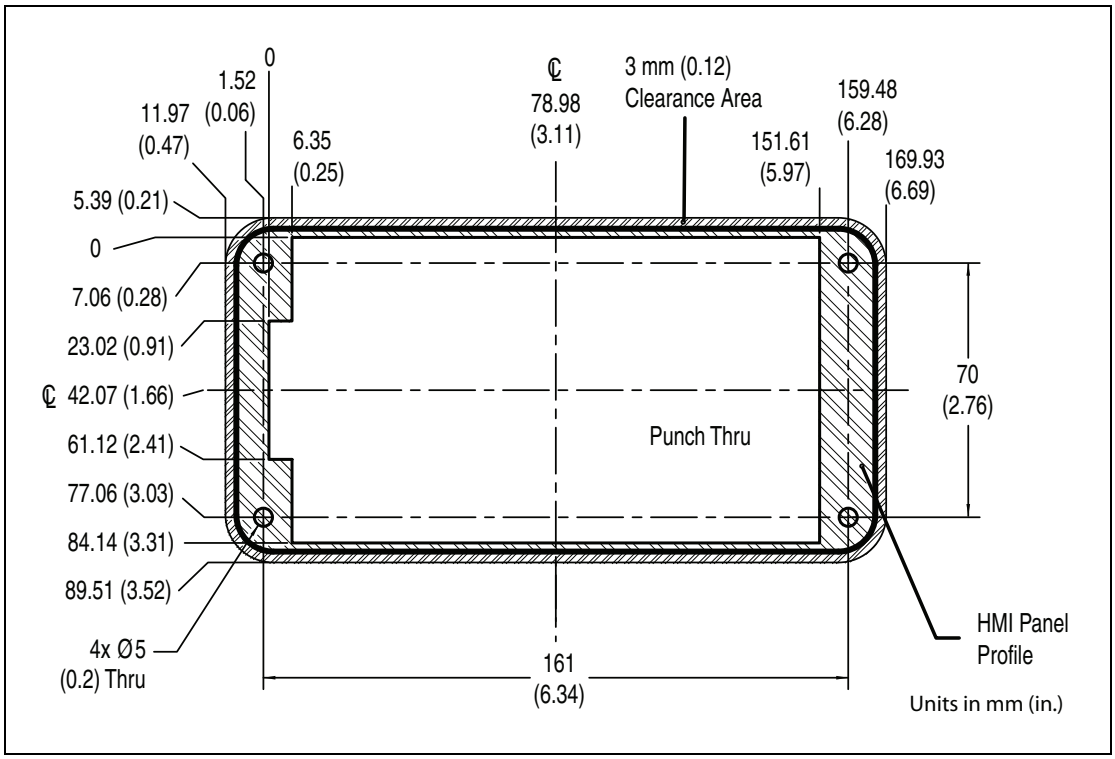


Figure 4-6. Operator Interface Cutout Dimensions

Many other options are available. Details and specifications of the connections available are covered in Connectivity on page 51.

Option Connections

The platform provides connectors for a user-supplied payload bumper and additional sonar units that can be placed on the payload structure.

Chapter 5: Connectivity

Most of the connections that are available to the user are in the payload bay, which is the space between the platform and any payload structure placed on top of it. These include I/O and power connections. Some are required; others are available if needed. The two exceptions are the Joystick port, and the Maintenance Ethernet port, which are located under a small access panel on the left side of the Lynx platform, in the upper-right corner. Both of these ports have a second, connected port inside the payload bay. See Figure 8-1.

5.1 Required Connections

- **Joystick port** — In order to generate maps with the Adept Lynx platform, you need to connect a joystick to its Joystick port.

  The Joystick port is located under a small access panel on the left side of the platform, in the upper-right corner.

  This is internally connected to another Joystick port in the payload bay.

- **Maintenance Ethernet** — The Maintenance Ethernet port is located under a small access panel on the left side of the platform, in the upper-right corner.

  Its IP address is 1.2.3.4, with Netmask 255.255.255.0.
  Access to the SetNetGo OS is always enabled on this interface, and does not require a password or a license.

  This is internally connected to another Maintenance Ethernet port in the payload bay.

- **Wireless Ethernet** — For multi-AIV installations, or where you wish to send new commands or receive status updates from the AIV, you need to have wireless Ethernet.

- **Docking Station** — The AIV needs access to a docking station so it can charge itself. The docking station needs access to AC power.

5.2 Payload Bay Connections

These connections are available for use with Adept- and user-supplied accessories. The antennas and joystick come with the platform.

NOTE: Standard connectors, such as Ethernet and audio, are not covered here. This includes all of the connectors on the right side of the core, shown in the following figure:

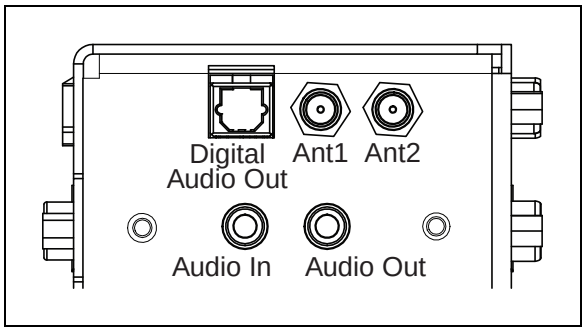


Figure 5-1. Right Side of the Core

Lynx Core Front, Upper

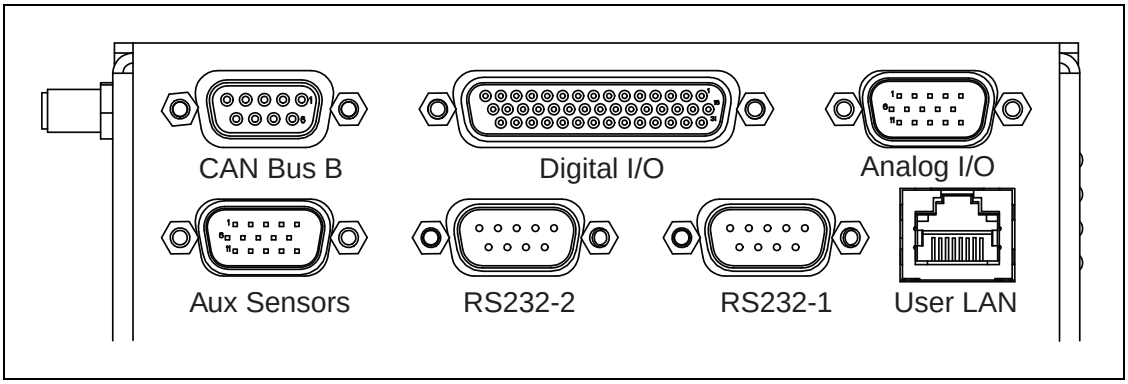


Figure 5-2. Front Upper Core

Connection	Type	Description
User LAN	RJ45, Shielded	General Ethernet, Auto-MDIX.
Aux Sensors	HDB15M	Optional vertical lasers
RS-232 x 2	DB9M	Port 1 and Port 2, general use
CAN Bus B	DB9F	Consult Adept for use.
Digital I/O (HDB44F)	HDB44F	16 digital inputs, in 4 banks of 4. Each bank can be wired as active high or active low depending on the connection of the BANK# terminal. V_{IN} range for each input is 0 to 30 V. The input is ON when V_{IN} > 4 V, OFF when V_{IN} < 1.3 V.
		16 digital outputs, protected low-side drivers. These outputs should be wired to positive voltage through the load. Output is open when OFF and grounded when ON. Each open-drain output is capable of sinking 500 mA. May be used with loads connected to VBAT, AUX_20V, _12V, or _5V. You must stay within the allowed current capacity of the VBAT or AUX power supplies.

Connection	Type	Description
Analog I/O	HDB15M	General use

CAN Bus B

Connector type DB9F

Use CAN Bus

Pin No.	Designation	Notes
1, 4, 8	No Connection	
2	CANL_B	CAN Communication differential pair
3, 6	GND	Direct GND
5	SHIELD GND	Bead filter to GND
7	CANH_B	CAN Communication differential pair
9	CANB_12V_OUT_SW	12 V @ 0.5 A Max (switched in SW)

Digital I/O

Connector type HDB44F

	Designation		
Pin No.	Hardware	Software	Notes
1	INPUT_1.1	Input_1.1	0 – 30 V Range, R_{in} = ~3.9 kΩ
2	INPUT_1.2	Input_1.2	0 – 30 V Range, R_{in} = ~3.9 kΩ
3	INPUT_1.3	Input_1.3	0 – 30 V Range, R_{in} = ~3.9 kΩ
4	INPUT_1.4	Input_1.4	0 – 30 V Range, R_{in} = ~3.9 kΩ
5	BANK1		Common for INPUT_1.X
6	INPUT_2.1	Input_2.1	0 – 30 V Range, R_{in} = ~3.9 kΩ
7	INPUT_2.2	Input_2.2	0 – 30 V Range, R_{in} = ~3.9 kΩ
8	INPUT_2.3	Input_2.3	0 – 30 V Range, R_{in} = ~3.9 kΩ
9	INPUT_2.4	Input_2.4	0 – 30 V Range, R_{in} = ~3.9 kΩ
10	BANK2		Common for INPUT_2.X
11	INPUT_3.1	Input_3.1	0 – 30 V Range, R_{in} = ~3.9 kΩ
12	INPUT_3.2	Input_3.2	0 – 30 V Range, R_{in} = ~3.9 kΩ
13	INPUT_3.3	Input_3.3	0 – 30 V Range, R_{in} = ~3.9 kΩ
14	INPUT_3.4	Input_3.4	0 – 30 V Range, R_{in} = ~3.9 kΩ

	Designation		
Pin No.	**Hardware**	**Software**	**Notes**
15	BANK3		Common for INPUT_3.X
16	INPUT_4.1	Input_4.1	0 – 30 V Range, R_{in} = ~3.9 kΩ
17	INPUT_4.2	Input_4.2	0 – 30 V Range, R_{in} = ~3.9 kΩ
18	INPUT_4.3	Input_4.3	0 – 30 V Range, R_{in} = ~3.9 kΩ
19	INPUT_4.4	Input_4.4	0 – 30 V Range, R_{in} = ~3.9 kΩ
20	BANK4		Common for INPUT_4.X
21	OUTPUT_1	Output_1	
22	OUTPUT_2	Output_2	
23	OUTPUT_3	Output_3	
24	OUTPUT_4	Output_4	
25	OUTPUT_5	Output_5	
26	OUTPUT_6	Output_6	
27	OUTPUT_7	Output_7	
28	OUTPUT_8	Output_8	
29	OUTPUT_9	Output_9	
30	OUTPUT_10	Output_10	
31	OUTPUT_11	Output_11	
32	OUTPUT_12	Output_12	
33	OUTPUT_13	Output_13	
34	OUTPUT_14	Output_14	
35	OUTPUT_15	Output_15	
36	OUTPUT_16	Output_16	
37	VBAT_IO_OUT4		VBAT @ 0.5 A Max (shared with light pole)
38	VBAT_IO_OUT3		VBAT @ 0.5 A Max
39	VBAT_IO_OUT2		VBAT @ 0.5 A Max
40	VBAT_IO_OUT1		VBAT @ 0.5 A Max
41, 42, 43, 44	GND		

Digital Input Specifications

Parameter	Value
Operational voltage range	0 to 30 VDC
OFF state voltage range	0 to 1.3 VDC
ON state voltage range	4 to 30 VDC
Operational current range	0 to 7.5 mA
OFF state current range	0 to 0.5 mA
ON state current range	1.0 to 7.5 mA
Impedance (V_{in}/I_{in})	3.9 kΩ minimum
Current at V_{in} = +24 VDC	$I_{in} \leq 6$ mA

NOTE: The input current specifications are provided for reference. Voltage sources are typically used to drive the inputs.

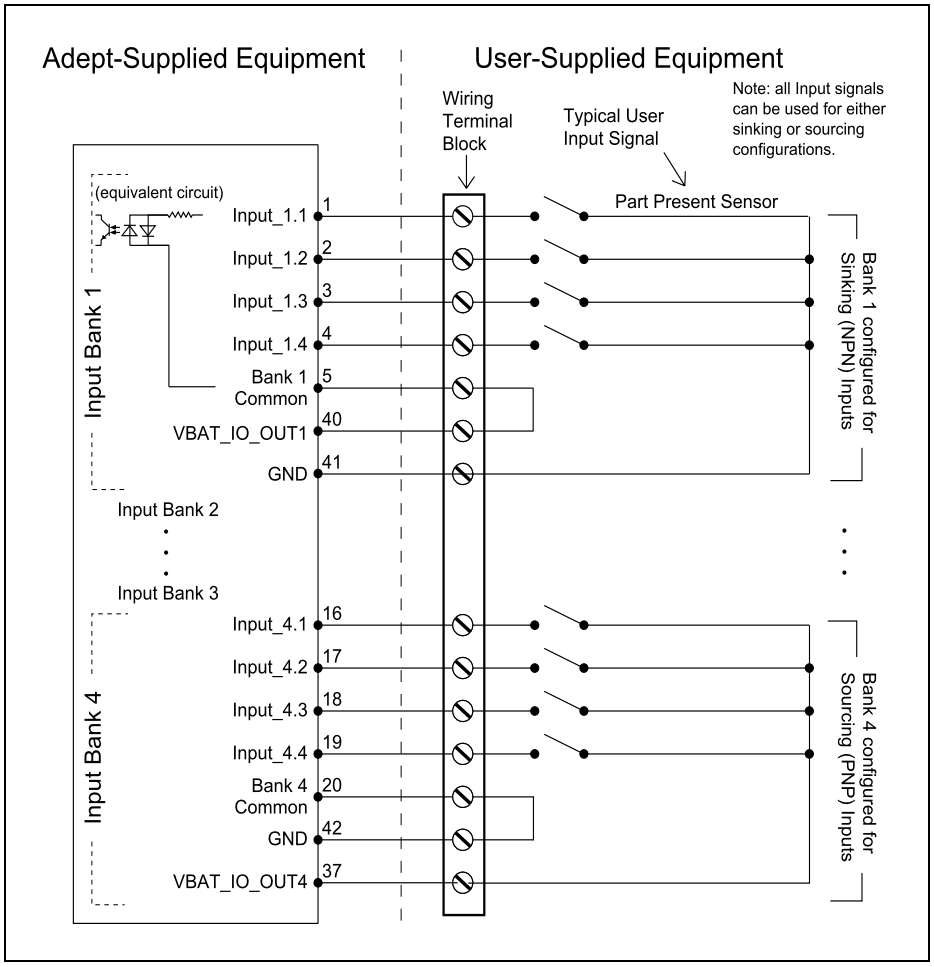


Figure 5-3. Typical Digital Input Wiring Example

Table 5-1. Digital Output Specifications

Parameter	Value
Power supply voltage range	5 - 30 VDC
Operational current range, per channel	$I_{out} \leq 500$ mA
ON state resistance (I_{out} = 0.5 A)	$R_{on} \leq 0.14\ \Omega$ @ 85° C
Output leakage current	$I_{out} \leq 5\ \mu A$
DC short circuit current limit	$0.7\ A \leq I_{LIM} \leq 1.7\ A$

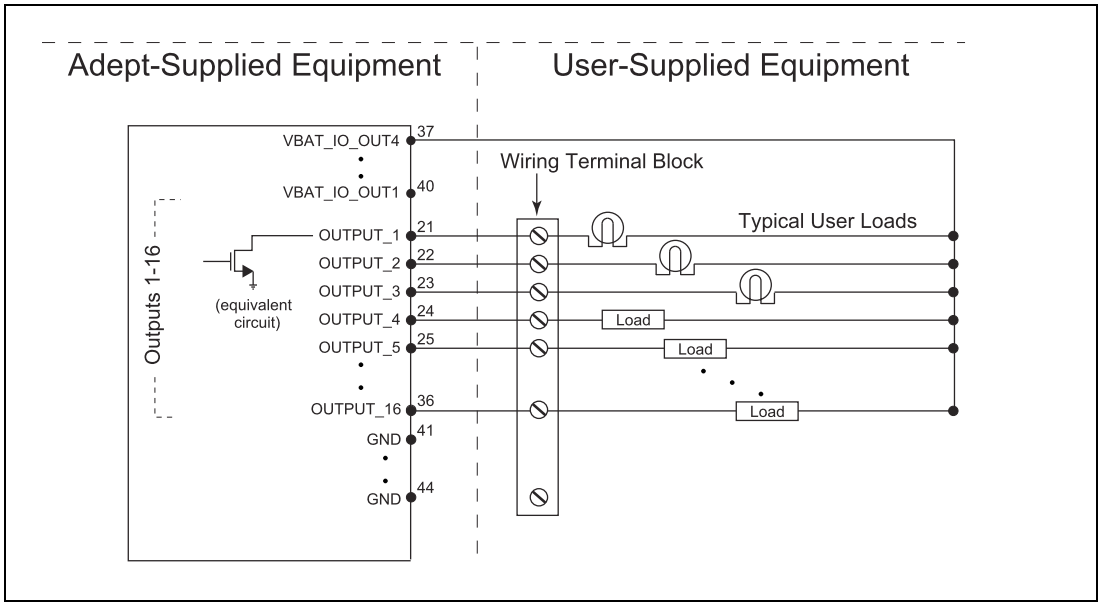


Figure 5-4. Typical Digital Output Wiring Example

Analog I/O

Connector type HDB15M

Pin No.	Designation	Notes
1	ANALOG_IN1	0 – 10 V Range, R_{in} = ~35 kΩ
2	ANALOG_IN2	0 – 10 V Range, R_{in} = ~35 kΩ
3	ANALOG_IN3	0 – 10 V Range, R_{in} = ~35 kΩ
4	ANALOG_IN4	0 – 10 V Range, R_{in} = ~35 kΩ
5	ANALOG_IN5	0 – 30 V Range, R_{in} = ~110 kΩ
6	ANALOG_IN6	0 – 30 V Range, R_{in} = ~110 kΩ

Pin No.	Designation	Notes
7	ANALOG_IN7	0 – 30 V Range, R_{in} = ~110 kΩ
8	ANALOG_IN8	0 – 30 V Range, R_{in} = ~110 kΩ
9	ANALOG_OUT1	0 – 20 V Range, +/-10 mA, Ro = ~200 Ω
10	ANALOG_OUT2	0 – 20 V Range, +/-10 mA, Ro = ~200 Ω
11	ANALOG_OUT3	0 – 20 V Range, +/-10 mA, Ro = ~200 Ω
12	ANALOG_OUT4	0 – 20 V Range, +/-10 mA, Ro = ~200 Ω
13, 14, 15	GND	

Aux Sensors

Connector type HDB15M

Use Optional vertical lasers

	Designation		
Pin No.	Hardware	Software	Notes
1	RS232_VERT1_TXD		
2	RS232_VERT2_TXD		
3	RS232_FOOT_TXD		
4	5V_SW1	USB_1_and_2_Power	5 V @ 1 A (shared with USB port 1)
5, 10	SW_20V_VERT	Vertical_Laser_Power	20 V @ 300 mA
6, 7, 8	GND		
9	5V_SW2	USB_1_and_2_Power	5 V @ 1 A (shared with USB port 2)
11	RS232_VERT1_RXD		
12	RS232_VERT2_RXD		
13	RS232_FOOT_RXD		
14	5V_SW3	USB_3_Power	5 V @ 1 A (shared with USB port 3)
15	SW_20V_FOOT	Foot_Laser_Power	20 V @ 150 mA

RS232 1 & 2

Connector type DB9M

Use Port 1 and 2, General Use

Pin No.	Designation	Notes
1, 4, 6, 9	No Connection	
2	RS232_USR#_RXD	#=1 or 2
3	RS232_USR#_TXD	#=1 or 2
5	GND	
7	RS232_USR#_RTS	#=1 or 2
8	RS232_USR#_CTS	#=1 or 2

Lynx Core Rear, Upper

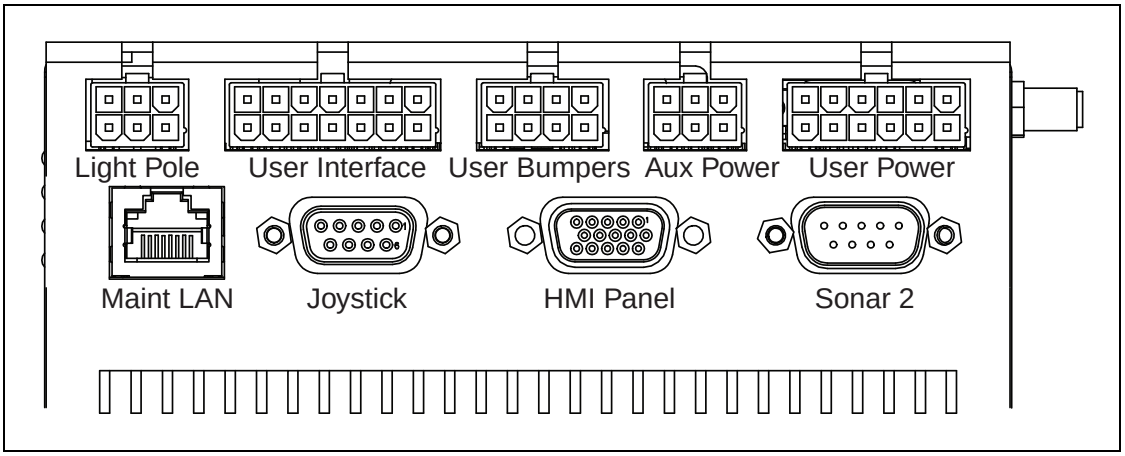


Figure 5-5. Rear Upper Core

Connection	Type	Description
Light Pole	Mini-Fit 2 x 3	Connects to a user-supplied light tower with 3 lights and 1 buzzer, using a default configuration
NOTE: The following four functions are pins on the User Interface connector.		
Brake-release	Mini-Fit 2 x 7	Pins for user-supplied brake release
ON		Pins for user-supplied ON button; same function as Operator Panel ON
OFF		Pins for user-supplied OFF button; same function as Operator Panel OFF

Connection	Type	Description
ESTOP		Pins for user-supplied E-Stop (must be used or jumpered)
User Bumpers	Mini-Fit 2 x 4	Payload structure bumpers, user-supplied, connected between ESTOP_SRC and USER_BMP# (for each of the 6 inputs). Contacts should be 12 V @ 10 mA.
Aux Power	Mini-Fit 2 x 3	5, 12, and 20 VDC Outputs
User Power	Mini-Fit 2 x 6	Battery and switched battery power
Maint LAN	RJ45, Shielded	Directly connected to the externally-mounted Maintenance Ethernet, Auto-MDIX.
Joystick	DB9F	Directly connected to the externally-mounted Joystick port
HMI Panel	HDB15F	Operator screen, E-Stop, Brake_Rel, ON, OFF
Sonar 2	DB9M	Optional sonar (4 emitter/receiver pairs) for payload structure

Power Connections

The Lynx platform provides conditioned 5, 12, and 20 VDC, and raw (battery) 22 - 30 VDC power to the platform's and accessory electronics, including the onboard Lynx core and safety scanning laser LIDAR (Light Detection And Ranging).

All power connectors are Mini-Fit®.

Nominal	Qty	Actual	Maximum Current	Description
5 VDC	1	5 VDC	1 A	Switched Aux power
12 VDC	1	12 VDC	1 A	Switched Aux power
20 VDC	1	20 VDC	1 A	Switched Aux power
22 - 30 VDC	2	battery	4 A	Switched
22 - 30 VDC	1*	battery	10 A	Switched
22 - 30 VDC	1*	battery	10 A	Safe, Switched
* 10 A Switched and 10 A Safe, Switched share the 10 A of current.				

Each supply has an associated LED which, when lit, indicates that the port is actively powered. See Lynx Core Indicators on page 85.

The Safe 22 - 30 VDC supply automatically gets disconnected when the E-Stop button is pressed, an obstacle is detected, or the bumper touches something.

Light Pole

Connector type	Mini-Fit® 3 x 2
Use	Light tower (user-supplied)

Pin No.	Designation	Notes
1	GND	Cable shield
2	LIGHT_P1	Red
3	LIGHT_P2	Yellow or orange
4	VBAT_IO_OUT4	VBAT @ 0.5A Max (shared with DIO)
5	LIGHT_P3	Green
6	LIGHT_P4	Buzzer

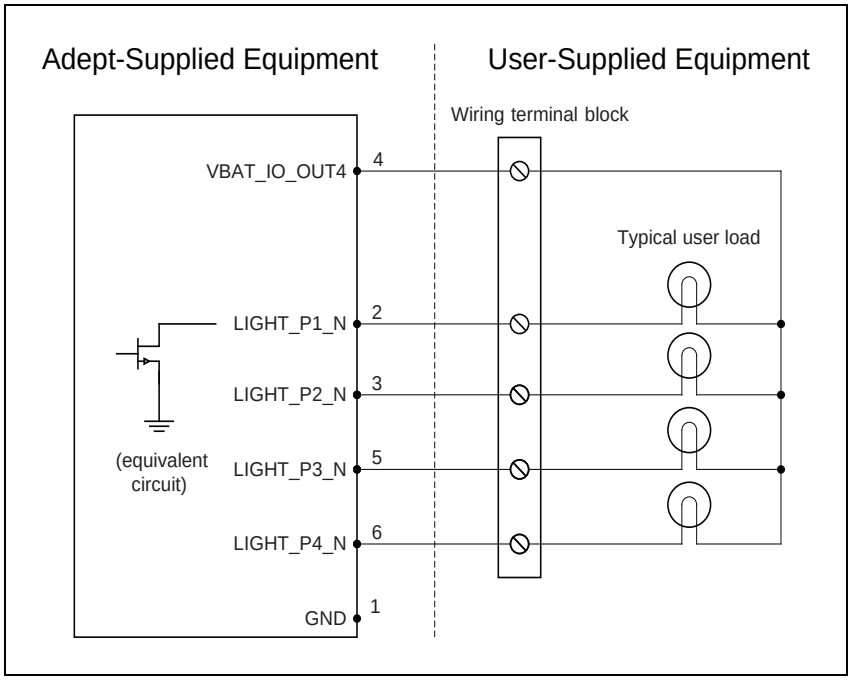


Figure 5-6. Sample Light Pole Diagram

User Interface

Connector type Mini-Fit® 7 x 2

Use Brake release, ON, OFF, E-Stop

Pin No.	Designation	Notes
1, 2, 3	FBAT_ALWAYS	Fused VBAT @ 500 mA
4	ESTOP_USR_1L	Short 4 & 11 to close ESTOP_USR_1
5	ESTOP_USR_2L	Short 5 & 12 to close ESTOP_USR_2
6	ESTOP_OUT_1L	Pins 6 & 13 short when ESTOP_CH1 is closed
7	ESTOP_OUT_2L	Pins 7 & 14 short when ESTOP_CH2 is closed

Pin No.	Designation	Notes
8	OFF_BUTTON	Short to FBAT_ALWAYS to signal OFF (min 1 s pulse)
9	START_BUTTON	Short to FBAT_ALWAYS to signal ON (min 1 s pulse)
10	MOTOR_BRAKE	Short to FBAT_ALWAYS for manual brake release
11	ESTOP_USR_1H	Short 4 & 11 to close ESTOP_USR_1
12	ESTOP_USR_2H	Short 5 & 12 to close ESTOP_USR_2
13	ESTOP_OUT_1H	Pins 6 & 13 short when ESTOP_CH1 is closed
14	ESTOP_OUT_2H	Pins 7 & 14 short when ESTOP_CH2 is closed

NOTE: An E-Stop jumper or a user-supplied E-Stop button needs to be attached to the E-STOP port on the User Interface connector for the platform to function. The jumper is provided as part number 12730-000L. An E-Stop button would be user-supplied.

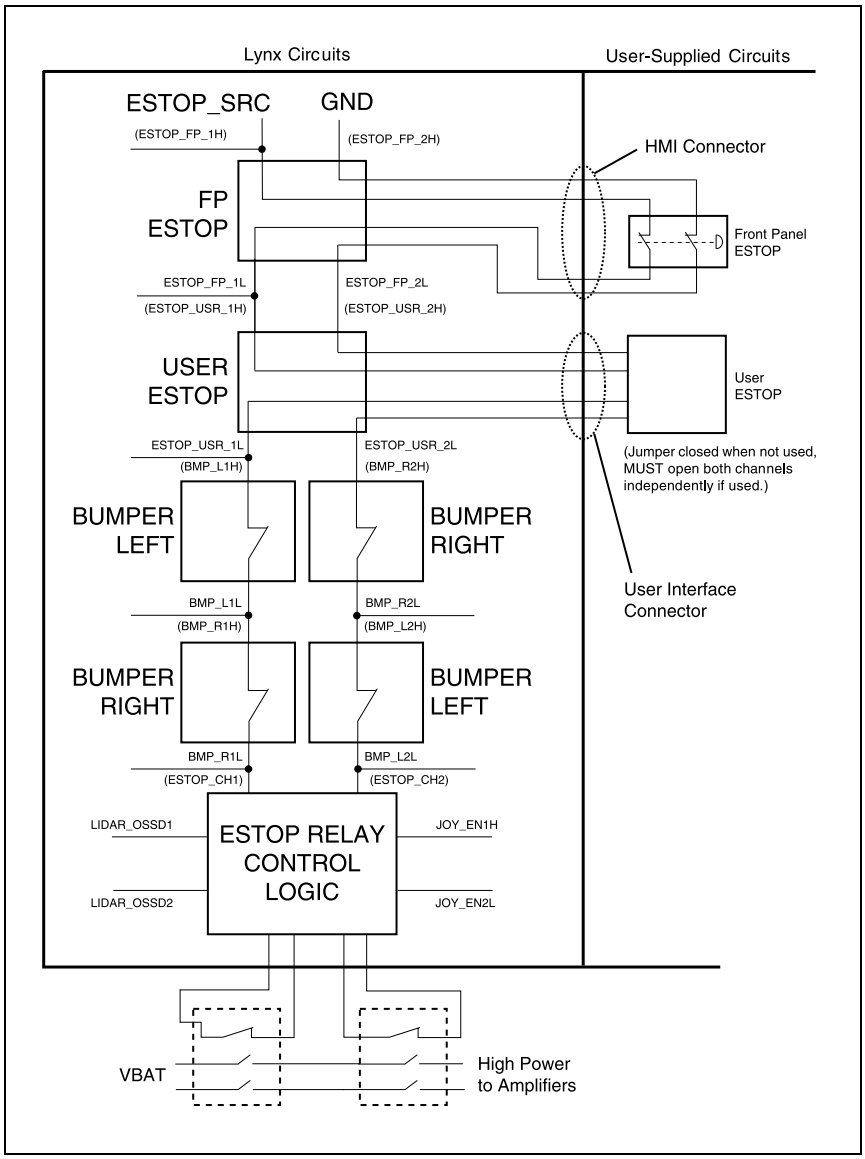


Figure 5-7. E-Stop Chain Diagram

User Bumper

Connector type Mini-Fit® 4 x 2

Use Optional bumper (x8) for payload structure

Pin No.	Designation	Notes
1	USER_BUMPER_1	Short to ESTOP_SRC to signal bumper hit
2	USER_BUMPER_2	Short to ESTOP_SRC to signal bumper hit
3	USER_BUMPER_3	Short to ESTOP_SRC to signal bumper hit
4	USER_BUMPER_4	Short to ESTOP_SRC to signal bumper hit
5	USER_BUMPER_5	Short to ESTOP_SRC to signal bumper hit
6	USER_BUMPER_6	Short to ESTOP_SRC to signal bumper hit
7, 8	ESTOP_SRC	12 V ESTOP Source Output @ 10 mA

Aux Power

Connector type Mini-Fit® 3 x 2

	Designation		
Pin No.	Hardware	Software	Notes
1, 2, 3	GND		
4	AUX_5V_OUT	Aux_5V	5 V @ 1 A max
5	AUX_12V_OUT	Aux_12V	12 V @ 1 A max
6	AUX_20V_OUT	Aux_20V	20 V @ 1 A max

User Power

Connector type Mini-Fit® 6 x 2

	Designation		
Pin No.	**Hardware**	**Software**	**Notes**
1, 2, 3, 4, 5, 6	GND		Limit to < 5 A per pin
7	SW_VBAT_OUT1	Battery_Out_1	VBAT @ 4 A max (switched in SW)
8	SW_VBAT_OUT2	Battery_Out_2	VBAT @ 4 A max (switched in SW)
9, 10*	SW_VBAT_OUT34	Battery_Out_3_and_4	VBAT @ 10 A max (switched in SW). Limit to < 5 A per pin.
11, 12*	SAFE_VBAT_OUT		SW_VBAT_OUT34 gated by dual-channel ESTOP relays.
*9,10 and 11,12 share the 10 A of current.			

Joystick

Connector type DB9F

Use Joystick

Pin No.	Designation	Notes
1	JOY_XAXIS	Analog X input
2	JOY_YAXIS	Analog Y input
3	JOY_SPEED	Analog SPEED input
4	JOY_GOAL	Goal Button Input
5	JOY_EN_1H	Enable channel 1
6	JOY_EN_2L	Enable channel 2
7	No Connection	
8	GND	
9	5V	5 V @ 100 mA

HMI Panel

Connector type HDB15F

Use Operator screen, E-Stop, Brake_Rel, ON, OFF

	Designation		
Pin No.	**Hardware**	**Software**	**Notes**
1	RS422_HMI_TX+		Connections to Adept HMI Panel If the optional touchscreen is used, rather than the HMI panel, the RS422_HMI connectors are not needed, but the user will have to provide buttons for ON (Start), OFF, Brake Release, and E-Stop functions.
2	RS422_HMI_TX-		
3	MOTOR_BRAKE		
4, 5	ESTOP_FP_1H, _2H		
6	RS422_HMI_RX+		
7	RS422_HMI_RX-		
8	START_BUTTON		
9, 10	ESTOP_FP_1L, _2L		
11	HMI_5V_SW	HMI_Power	
12, 14	GND		
13	OFF_BUTTON		
15	FBAT_ALWAYS		

Sonar 1 & 2

Connector type DB9M

Use Platform sonar & optional sonar for payload structure

NOTE: Sonar 1 is part of the Internal Lynx Core connections.

	Designation		
Pin No.	**Hardware**	**Software**	**Notes**
1, 4, 8	No Connection		Connections to Adept Sonar Module # = 1 or 2
2	RS422_SNR_RX+		
3	RS422_SNR_TX+		
5	GND		
6	RS422_SNR_RX-		
7	RS422_SNR_TX-		
9	SW_12V_SNR	Sonar_#_Power	

5.3 Internal Lynx Core Connections

The following connections are internal (under the platform's top deck), and not normally available for the user. They are listed here so that you can reconnect them in the event that they need to be disconnected for parts replacement.

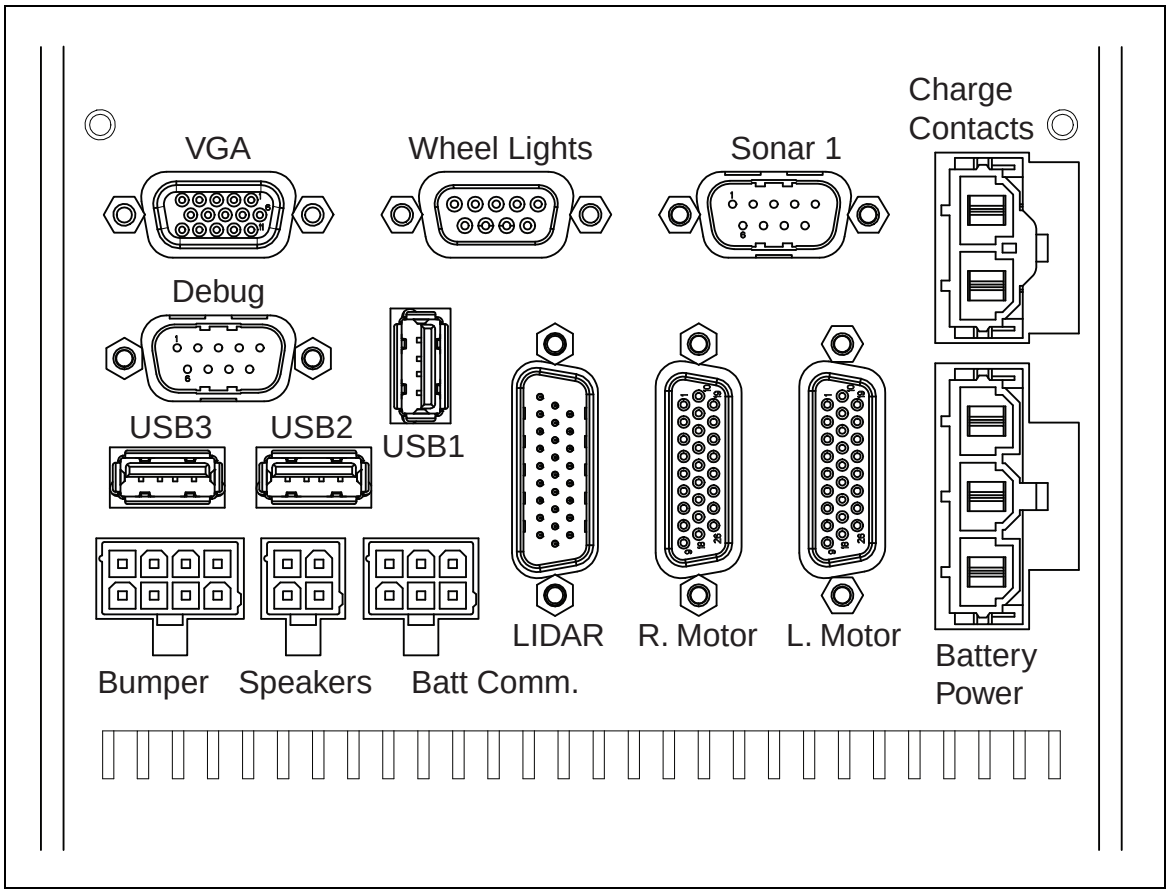


Figure 5-8. Internal Connectors on the Lynx Core (Front)

Connection	Type	Description
VGA	HDB15F	Reserved
Wheel Lights	DB9F	Motion and status indicator light discs on the platform sides
Sonar 1, RS-422	DB9M	Connection to Adept Sonar Module (Front bumper and rear sonar sensors)
Charge Contacts	Mini-Fit Sr., 2-pin	
Debug RS-232	DB9M	Reserved
USB x 3	USB Type A	Reserved
LIDAR	HDB26M	Safety Scanning Laser

Connection	Type	Description
Right Motor	HDB26F	**NOTE**:The Right and Left Motor connectors use the same type of plug. Take care not to reverse them.
Left Motor	HDB26F	
Battery Power	Mini-Fit Sr., 3-pin	Battery VDC; connects to battery
Bumper Switches	Mini-Fit 2 x 4	Connect to standard bumper contacts
Speakers	Mini-Fit 2 x 2	Drives built-in speakers
Battery Comm.	Mini-Fit 2 x 3	Battery communication/control

Lynx Internal Data Pinouts

Wheel Lights (Light Discs)

Connector type DB9F

Use Motion and status indicator light discs on the platform sides

	Designation		
Pin No.	**Hardware**	**Software**	**Notes**
1, 2	CANL_A		CAN Communication differential pair
3, 4	GND		Direct GND
5	SHIELD GND		Bead filter to GND
6, 7	CANH_A		CAN Communication differential pair
8, 9	SW_12V_WHEEL	WheelLight_Power	12 V @ 1 A Max (switched in SW)

NOTE: Sonar 1 is covered at the end of Core, Upper Rear.

LIDAR (Light Detection And Ranging)

Connector type DB26M

Use Front safety scanning laser

	Designation		
Pin No.	**Hardware**	**Software**	**Notes**
1	RS422_LIDAR_RX+		Connections to Adept-Supplied LIDAR
2	RS422_LIDAR_RX-		
3	OSSD1		
4	OSSD2		
5	WF_OUT		
6	O3_OUT		
7	STANDBY		
8	EDM		
9	No Connection		
10, 18	SW_20V_LIDAR	Main_Laser_Power	
11 thru 17	GND		
19	RS422_LIDAR_TX+		
20	RS422_LIDAR_TX-		
21	IN_A1		
22	IN_A2		
23	IN_B1		
24	IN_B2		
25	IN_C1		
26	IN_C2		

Pin 10 + 18: Current < 600 mA

Lynx Internal Power Pinouts

Bumper

Connection Mini-Fit® 4 x 2

Connector type DB9F

Use Front bumpers

NOTE: The single front bumper uses four sensors for operation.

Pin No.	Designation	Notes
1	BUMPER_R2L	Right, Channel 2, Low
2	BUMPER_R1L	Right, Channel 1, Low
3	BUMPER_L2L	Left, Channel 2, Low
4	BUMPER_L1L	Left, Channel 1, Low
5	BUMPER_R2H	Right, Channel 2, High
6	BUMPER_R1H	Right, Channel 1, High
7	BUMPER_L2H	Left, Channel 2, High
8	BUMPER_L1H	Left, Channel 1, High

Speakers

Connector type Mini-Fit® 2 x 2

Use Speakers

Pin No.	Designation	Notes
1	RIGHT+	Right Speaker
2	RIGHT-	
3	LEFT+	Left Speaker
4	LEFT-	

Batt Comm.

Connector type Mini-Fit® 3 x 2

Use Battery control

Pin No.	Designation	Notes
1	GND	Connections to the Adept-Supplied Battery
2	RS232_BATT_RXD	
3	RS232_BATT_TXD	
4	FBAT_ALWAYS	
5	START_BUTTON	
6	OFF_BUTTON	

Chapter 6: Operation

Before proceeding, you need to have performed the steps covered in the Setup and Getting Started chapters, so your platform has a map to work from.

6.1 Operating Environment

The Adept Lynx platform is designed to operate in an environment that is wheelchair accessible. Care must be taken to avoid:

- glass doors and walls
- pits without railings or low bumpers
- floors with access panels removed
- loose cables, hoses, etc.
- large, highly-reflective objects

Floors must provide good traction, typical of good walking conditions.

- Slope — up to 1:12
- Step traversal — up to 15 mm (0.6 in.)
- Gap traversal — up to 15 mm (0.6 in.)
- Temperature — 5° to 40° C (41° to 104° F)
- Humidity — 5 to 95%, non-condensing

The Adept Lynx platform is not intended for use in hazardous environments (explosive gas, water, dust, oil mist). It has an IP rating of IP-40.

WARNING: Do not allow the platform to drive through an opening that has an automatic gate/door unless the door and platform are configured correctly with the Lynx Door Box option.

Refer to the *Adept Lynx Platform Peripherals Guide* for details on the Adept Lynx Door Box.

6.2 Typical Operation

During normal startup, your Adept Lynx platform powers all its onboard systems[1] and runs its onboard software and your integrated processes automatically to provide an application-ready AIV. If it has been given a map of its workspace and knows where it is within that environment (localized), your AIV is ready to perform on startup and will operate autonomously, without human intervention.

[1] As configured either by the factory or through your own parameter changes.

The following applications are covered in detail in the *Adept Motivity® User's Guide*.

There are many options for configuring and tuning your Adept Lynx platform to best suit your application.

Maps are developed with the MobilePlanner software. These may contain a variety of virtual elements which act to modify the behavior of an AIV. Virtual elements include forbidden lines and areas, speed zones, preferred-direction zones, and more, all working to help you configure your workspace for efficient and safe performance of your mobile application. You can also create your own virtual elements for application-specific AIV-workspace interactions.

Maps contain a variety of goals, routes, and tasks that comprise the destinations and activities of the AIV in the workspace.

Paths are not pre-programmed, but instead are generated dynamically onboard the platform. Paths are updated many times per second to maintain a smooth trajectory and to account for any obstacles that are detected by the onboard sensors. Navigational parameters are stored onboard the platform, and can be viewed and modified using the MobilePlanner software, which is covered in the *Adept Motivity® User's Guide*.

The MobilePlanner application, running on your computer, is used to configure the many high-level operating characteristics of the platform, including speeds and accelerations, sensor safety zones, minimum battery level allowed before docking for recharging, which map to use, and many other parameters. The MobilePlanner software typically communicates with the platform over the wireless network. A direct connection, through the maintenance Ethernet port on the platform, is also possible.

6.3 Power and Charging

The Lynx battery is sealed. It supplies ample power for the motors, electronics, and accessories.

The platform ships separately from the battery. The battery is shipped fully-charged. You should have installed the battery in the platform in Install the battery in the Lynx platform. on page 24.

Battery recharging is typically managed by the platform. With ample power, as is provided by the automated docking station, all onboard systems function continuously while the battery recharges.

The Operator screen shows % state-of-charge (SOC) remaining for battery.

Run-time, with no load, is approximately 13 hours. This will vary significantly depending on use and accessory power consumption.

Recharge time is approximately 3.5 hours.

Battery Indicators and Controls

The battery has one push-button and four LEDs. From left to right, they indicate:

LED	Color	Meaning
1	Red	Error condition
	Green	25% state of charge
2	Green	50% state of charge

LED	Color	Meaning
3	Green	75% state of charge
4	Green	100% state of charge

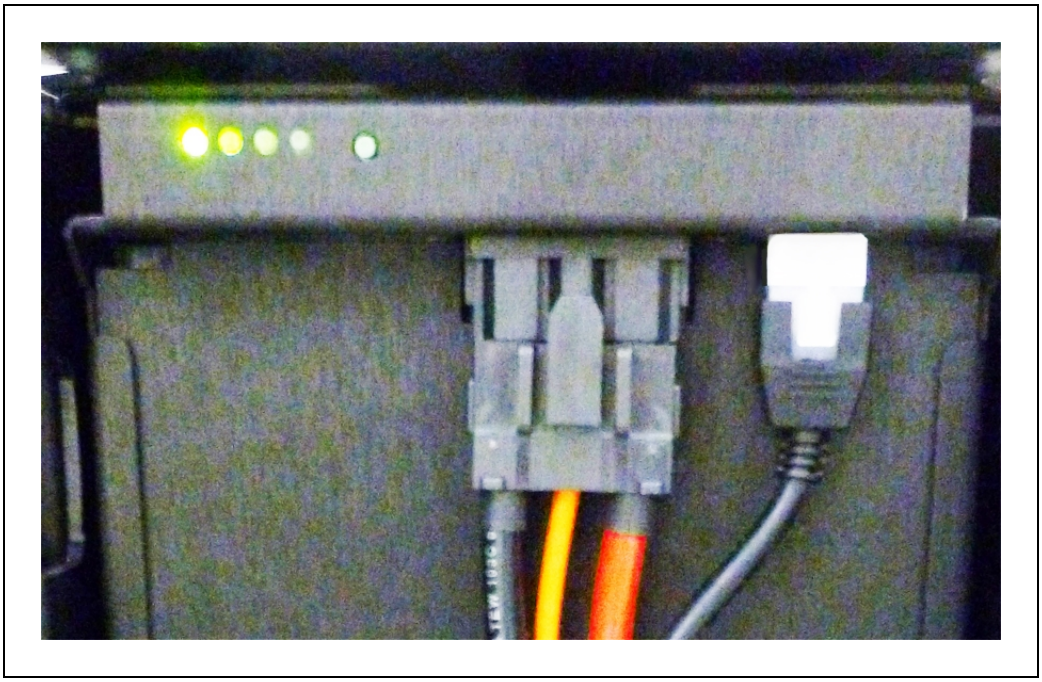


Figure 6-1. Battery LEDs, Push-Button, Power Cable, and Data Cable

The push-button "wakes up" the battery, so it displays its state of charge. This can be useful when a battery is in storage, and you want to know its state of charge.

Docking Station

The automated docking station is both a manual and an automated means for recharging your Adept Lynx platform battery.

Autonomous Charging

During normal, autonomous operation of the Adept Lynx AIV in the workspace, the AIV manages charging automatically through the automated docking station. The AIV will approach the docking station frontward, and then turn around and back onto the docking station to charge. There is about a 10-second delay between when an AIV docks and when the charging LED turns on.

Powering ON or OFF the AIV, or connecting and disconnecting the AIV with network and onboard clients will not disturb the charging state. (Moving the AIV will, of course.) The station supplies ample power for all onboard systems while charging its battery, so you can continue operating those systems while charging.

If the AIV is powered off, it will turn on automatically when it is pushed onto the docking station. An AIV cannot be turned off while on the docking station.

Battery Swapping

In some cases, users opt to manually charge a spare battery outside of the platform, and swap the charged battery for the battery that is inside the platform. This is covered in Standalone Battery on page 75.

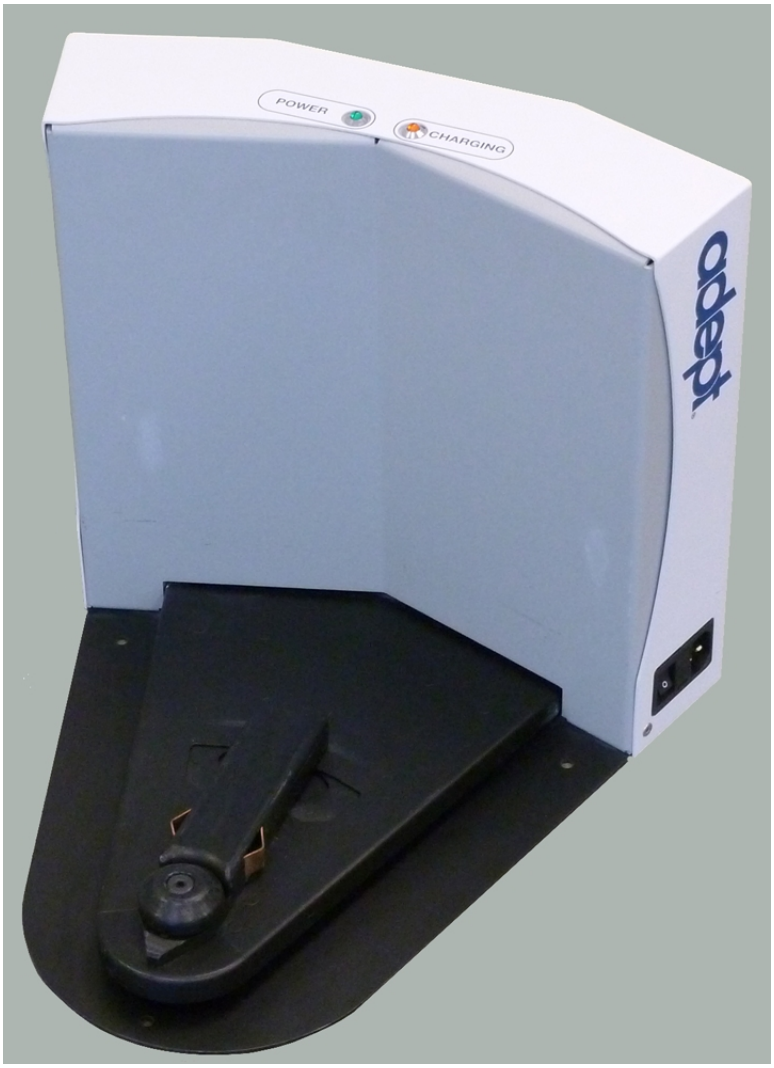


Figure 6-2. Docking Station

Indicators, Controls, and Connections

The docking station has a power switch and two LEDs:

- blue indicates that power is available.
- yellow indicates that a charge is in progress.

The power plug for AC supply is on the right side of the station, as viewed from the front. Power requirements are 100 - 240 VAC, 50 - 60 Hz, and 8 A.

The plug for connecting the manual charging cable is on the left side of the station, as viewed from the front.

Environmental Requirements

- Ambient temperature range: 5° to 40° C (41° to 104° F)
- Humidity: 5 to 95% non-condensing

Maintenance

The docking station contacts should be cleaned quarterly with isopropyl alcohol. See Docking Station Contacts on page 93.

The guide roller can be replaced in the field. See Docking Station Roller and Bearing on page 103.

If necessary, the height of the docking station contacts can be adjusted. See Docking Station Contact Adjustment on page 37.

Manually Charging the Battery

Battery in Platform

To manually charge a battery inside the platform, push the AIV backwards, with E-STOP engaged, so that the rear of the platform slides over the contacts of the docking station.

> **NOTE**: You will need to press the brake release button first.

Standalone Battery

The battery can be charged, outside of the platform, by using the connector on the left side of the docking station (viewed from the front) with the provided charging cable. This will most likely to be used for charging a spare battery, while the second battery is still in the platform, and the platform is in use.

There is about a 10-second delay between when you connect the battery cable and when the charging LED turns on.

> **NOTE**: The docking station cannot charge a platform and a separate battery at the same time. If a platform is on the station, the power to the manual charge connector is cut off.

Some users choose to manually charge a spare battery, and swap that for the battery inside the platform. This is often done at the start of each workshift, to make the AIV available for the entire shift without recharging.

Balancing the Battery

The Adept Lynx battery is composed of multiple cells, which need to stay balanced in order to maintain maximum run-time.

There are three ways for managing battery balancing:

- Set the AIV's DockUntilDoneCharging parameter to True. In this case, the battery will balance before saying it's done charging, so the battery will get balanced every time the AIV docks. You do not have to do anything extra to balance the battery.

  In this mode, the battery will typically take about 10 minutes to balance after charging.

  > **NOTE**: This is the mode that Adept recommends for AIVs that aren't doing battery swapping.

- Exchange the in-service battery, periodically, with a fully-charged spare battery.

  A spare battery that remains plugged into a docking station will be balanced. In this mode, you don't have to worry about battery balancing, although it does add the task of manually swapping batteries.

  The interval between battery swaps depends on how the AIV is used. This includes the weight it carries, the electrical load of any accessories, and what percent of the time it is in service. You will need to determine the best interval for your situation. Swapping the battery at every shift change is a commonly-used interval.

  > **NOTE**: This is the mode that Adept recommends for battery swapping, if you are not charging the battery while it is inside the AIV.

- Set the AIV's DockUntilDoneCharging parameter to False, to let the AIV get a partial charge by docking. The StateOfChargeToChargeTo and MinutesToChargeFor parameters need to be set to appropriate (non-zero) values. You would then do a battery swap with a fully-charged and balanced battery periodically, such as once a week.
  - StateOfChargeToChargeTo determines the state of charge the battery needs to attain before the AIV can stop charging.

    A 90% value here would get the battery mostly charged, but not balanced.
  - MinutesToChargeFor determines the number of minutes the battery needs to charge before the AIV can stop charging.

    The AIV will stop charging when the battery reaches either of these parameter values.

    CAUTION: If both of these parameters are left at the default of 0, and DockUntilDoneCharging is set to False, the AIV will dock, and never undock.

  Adept recommends that you do a battery swap weekly, at a minimum. If you see a reduction in run-time, you should do a swap more often than that.

  > **NOTE**: The longer you wait to balance a battery, the longer it will take to balance. A battery that is badly out of balance can take well over 10 hours to balance after charging.

6.4 Operator Panel

The Operator panel comprises a screen, an E-Stop button, ON and OFF buttons, a brake-release button, and a keyswitch. The panel will typically be mounted on the payload structure, so that

it is easily reached by an Operator.

Screen

The screen is a color TFT, 320 x 240 pixels, 3.5 in. diagonal. It can display 256K colors, and is backlit.

> **NOTE**: Tapping lightly on the screen will turn on the backlight, in case it has timed out.

Default/Sample Screen Contents

The first screen, during boot-up, will be the following:

Figure 6-3. Initial Boot Screen

Once the Lynx platform is booted, you will see the main screen:

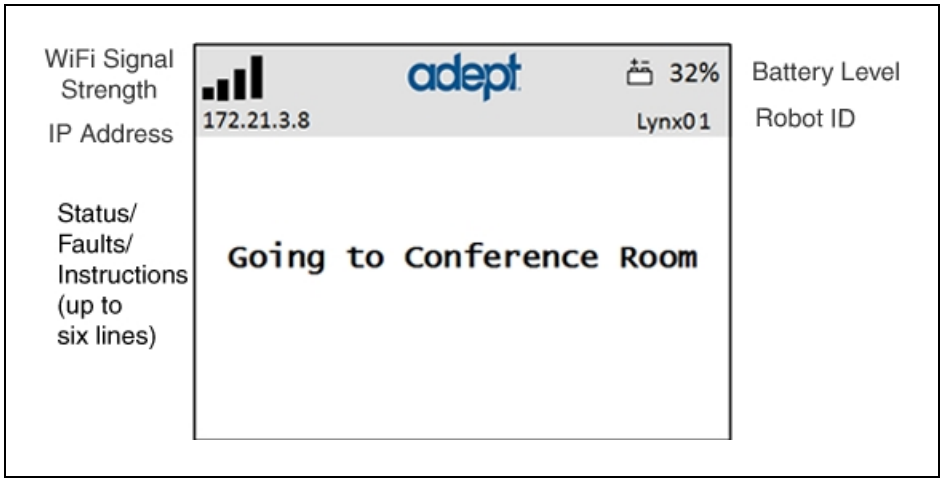


Figure 6-4. Fields of the Main Screen

- Up to six messages will be displayed in the main screen, in order of importance.
- Only one fault at a time will be displayed.
- Any event or condition that causes an ARAM restart or AIV shut down will be displayed, giving the cause of the restart or shut down.

E-Stop

When pressed, the red, latching push-button removes power from the platform's motors and from the E-Stop power port after a 1 second delay, giving the software time to stop the platform safely. To reset the E-Stop, twist the button slightly, so it pops up.

The motors must also be explicitly enabled, either with the dialog box that will pop up or with the ON button. (This is not the case if the AIV is docked or experienced a critical driving fault.) This can be done either with the MobilePlanner (with **Map > Show Robot** on) or MobileEyes software, or with an ARCL command. See the following figure:

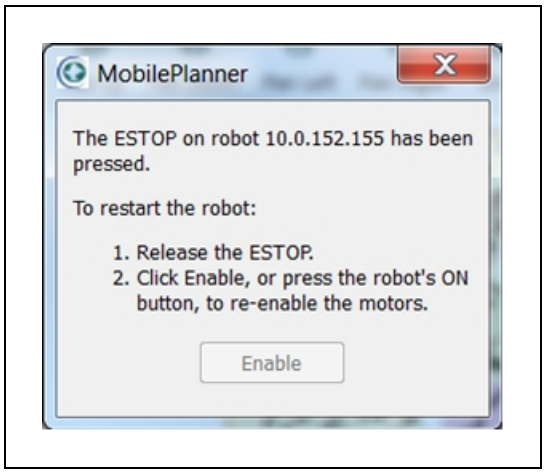


Figure 6-5. Motor Enable Pop-up Dialog

There is a second pop-up that will say the E-Stop has been cleared, and you need to click Enable to re-enable the motors.

ON Button

The ON button is used for restoring power after the OFF button has been pressed, and the software has finished shutting down the AIV.

It can also be used to restore power after an E-Stop has been pressed.

OFF Button

The red OFF button removes power from all systems except the charging hardware circuits. The platform's software systems prevent loss of data on shutdown, and save the platform's last known location so it automatically localizes when it is next powered on.

NOTE: The OFF button can be disabled by the keyswitch, which can be locked.

Brake-release Button

The brake-release is used when you need to manually move the platform.

Battery power is required to release the brakes.

Keyswitch

The keyswitch can be used to disable the OFF button. The key can be removed in either the locked or unlocked positions.

6.5 Other Controls and Indicators

When sold by itself, the Lynx platform does not come with a beacon or light tower. These would need to be user-supplied. Adept-supplied Lynx-based AIVs often include a beacon. The Lynx core has a Light Pole port that supports the beacon behavior described here.

Light Discs and Beacon

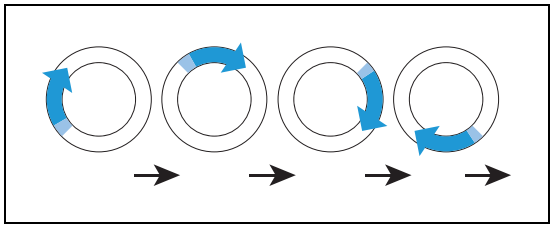
Circular lights on the sides of the Lynx platform are used to indicate motion, turns, and several other states.

A user-supplied beacon, usually on the AIV dome, can be used for extra signaling. A beacon is used to indicate movement and to signal an Operator that the AIV is waiting for assistance.

Their states are described here, and summarized in the following tables.

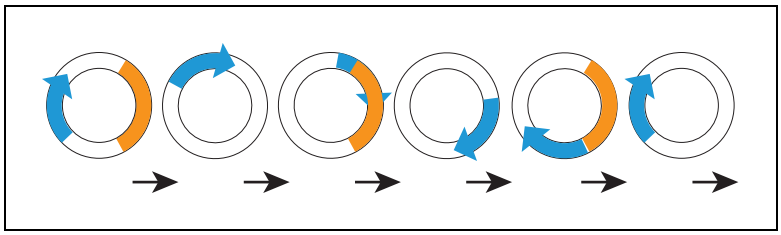
Driving Straight

Blue arcs on each side of the platform will appear to rotate in the direction of the platform's travel, to let nearby people know that it is moving (or about to move). Beacon blinks green.



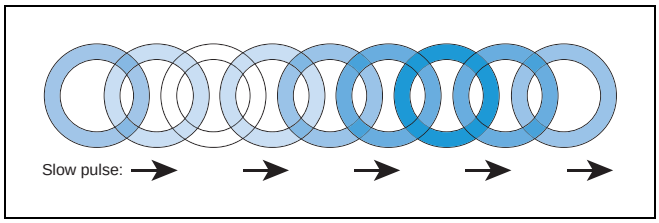
Turn Signal (for turns >30 degrees)

The blue drive indicators will include a blinking orange segment at the front of one light disc to indicate that the platform is about to turn in the direction of the signal.
Beacon blinks green.



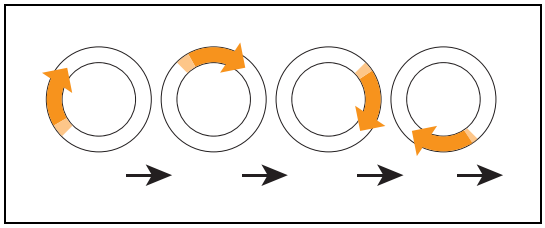
Stopped, no errors (ready)

Entire light disc on each side pulses blue slowly (0.25 Hz). Beacon is steady green.



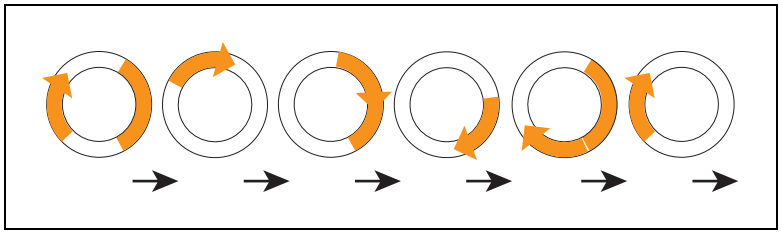
Driving with Warning (doesn't prevent driving, such as low battery)

The light discs will be orange instead of blue for Stopped, Driving, and Turn Signals.
Beacon alternates green then yellow.



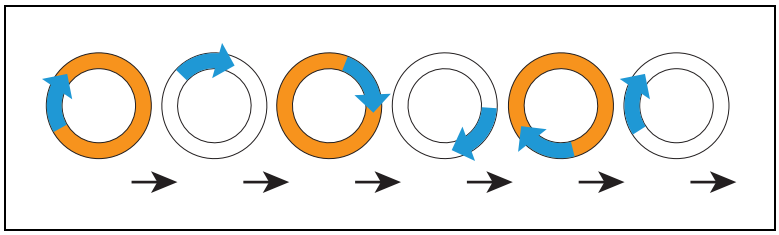
Turn Signal with Warning (doesn't prevent driving, such as low battery)

Same as Turn Signals, but both the blue rotating arc and blinking segment are orange. The moving arc and the blinking segment have independent timing.



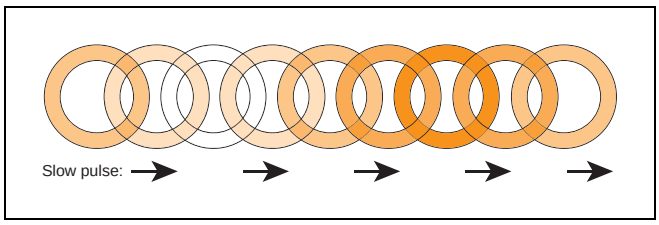
Driving Slowly, Safety Inactive

Under 300 mm/sec, the Lynx platform stops safety checking. The pattern is essentially the same as driving, except the background blinks orange. The moving arc and the blinking segment have independent timing.



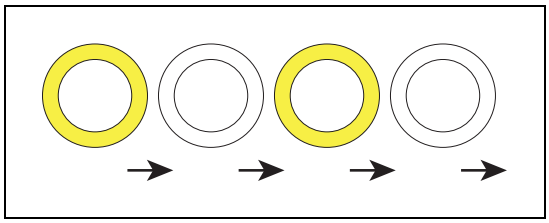
Stopped with Warning (such as low battery)

The light discs will be orange instead of blue for Stopped with Warning. Beacon alternates long green with short yellow.



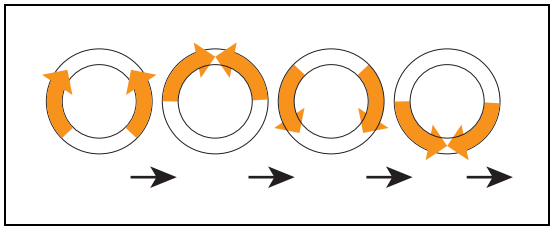
Obstacle Detected

The light discs will blink yellow if the AIV is stopped for an object in its safety zone. Beacon blinks yellow.



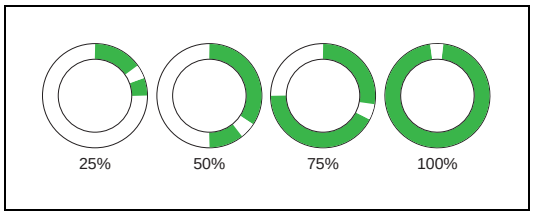
Lost

When the AIV is lost, the light discs will each display two orange arcs, traveling from the 6 o'clock to the 12 o'clock position and back, in opposite directions. Beacon blinks yellow.



Charging

When docked, a green arc will indicate the current state of charge (SOC), showing steady green from the top of the disc to the current SOC. A small white arc travels back and forth between the two ends of the green arc. Beacon blinks green (red if E-Stopped).

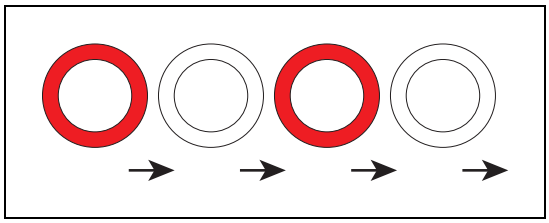


Lynx Left Side	Lynx Right Side	State of Charge
0 to 90 cw	0 to 270 ccw	25%
0 to 180 cw	0 to 180 ccw	50%
0 to 270 cw	0 to 90 ccw	75%
full circle	full circle	100%

NOTE: The state of charge displayed is continuous, not limited to 25% increments.

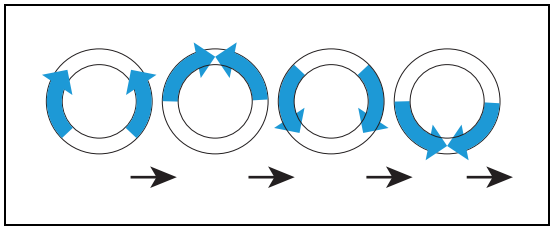
E-Stop

The light discs will blink red in an E-Stop condition. Beacon blinks red.



Booting

When booting, the light discs will display two blue arcs, traveling from the 6 o'clock to the 12 o'clock position and back, in opposite directions. Beacon alternates green, yellow, then red.



In the following table:

- Blink indicates that a disc or light is on for a period, then off for a period.
- Pulse indicates a 0.25 Hz fade on and off.

- Circle indicates that the lights appear to be going in a circle.
- Half-circles indicates two arcs, moving opposite each other between the top and bottom.
- Solid indicates that a light is on continuously.
- Alt indicates that the beacon switches between different lights, with no pause. Two lights with Alt means one light is always on, but not two at once.

Table 6-1. Indicator Meanings

Light Disc		Beacon		Meaning
Color	**Pattern**	**Color**	**Pattern**	
Blue	Moving Circle	Green	Blink	Driving straight, all ok
Blue/ Orange @front	Moving Circle/ Blinking signal	Green	Blink	Turning > 30 degrees in direction of orange turn signal, all ok
Blue	Pulse	Green	Solid	Stopped, all ok
Orange	Moving Circle	Green /Yellow	Alt	Drive with warning, doesn't prevent driving e.g. low battery
Orange/Orange @front	Moving Circle/ Blinking signal	Green /Yellow	Alt	Turn with warning
Blue/ Orange	Moving Circle/ Blinking signal	Green	Blink	Driving slowly, <300 mm/sec
Orange	Pulse	Green/Green/Green /Yellow	Alt	Stopped with warning
Yellow	Blink	Yellow	Blink	Object detected in safety zone
Orange	Left+Right Half-circles	Yellow	Blink	Lost
Green/White arc	Partial Circle/- moving small arc	Green normally, Red if E-Stopped	Blink	Charging
Red	Blink	Red	Blink	E-Stop, stops driving
Blue	Left+Right Half-circles	Green/Yellow/Red	Alt	Booting

Joystick

The joystick plugs into the left side of the Lynx platform, under the small access panel at the upper-right corner of the platform. See Location of Parts on the Platform on page 91. This is

internally connected to the joystick port located on the rear side of the Lynx core in the payload bay.

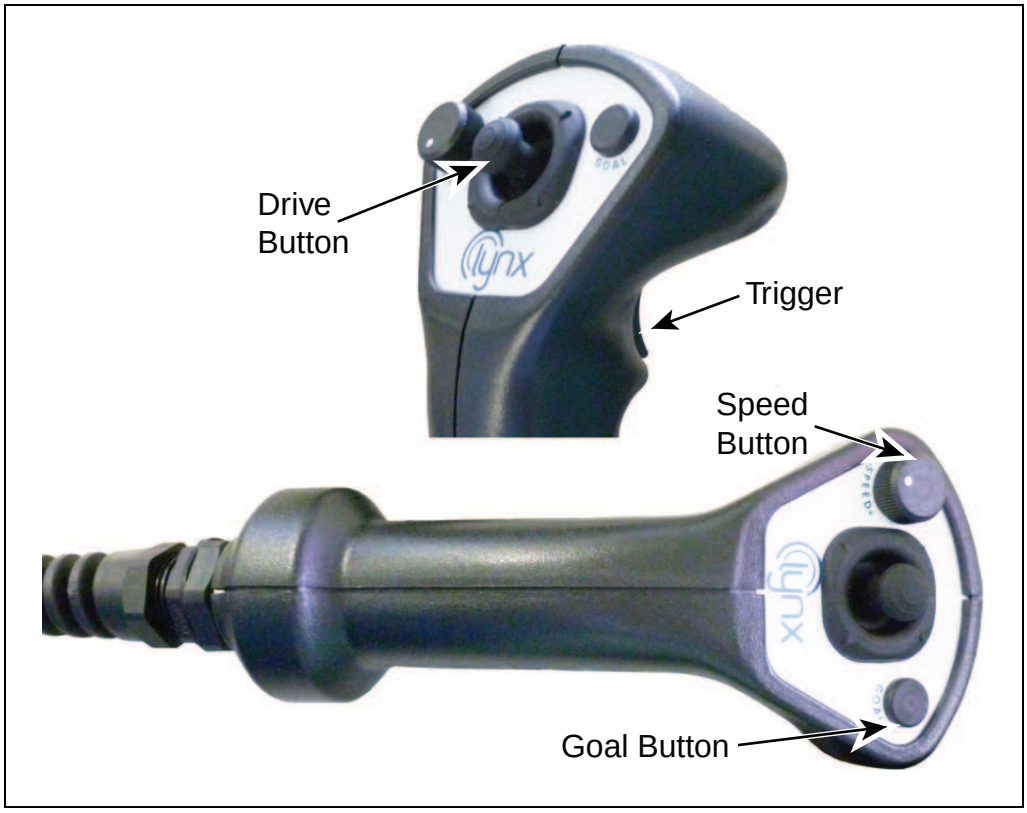


Figure 6-6. Joystick Buttons and Trigger

Use the joystick to drive the Lynx platform manually. Squeeze the trigger to enable the drive button.

Push the drive button forward or back to make the platform move in that direction. Push the drive button to the side to make the platform rotate in that direction. Diagonal positions of the drive button move the platform in an arc.

The Adept Lynx platform slows to a stop when you release the trigger. To stop more quickly, continue to squeeze the trigger and pull or push the drive button to its limit in the opposite direction of the platform's travel.

The joystick's GOAL button is for marking positions while making a map scan. When not making maps, press GOAL to enter Follow Mode. See Follow Mode on page 40.

WARNING: The Adept Lynx Platform Safety Scanning Laser is not tied into the E-Stop chain when driven using the joystick. The platform will still avoid obstacles detected by the Safety Scanning Laser. The sonar, on the other hand, are disabled entirely when driving with the joystick.

Maintenance Ethernet

The Maintenance Ethernet port is on the left side of the Lynx platform, under the small access panel at the upper-right corner of the platform. This is internally connected to the Ethernet port located on the rear side of the Lynx core in the payload bay.

The Maintenance Ethernet port is permanently set to IP address 1.2.3.4, with a netmask of 255.255.255.0, for direct, wired access to the onboard systems. Accordingly, when accessing the port, manually set the offboard computer's Ethernet to an IP 1.2.3.x, where x is any number 1 through 254 except 4, and with a netmask of 255.255.255.0. No special DNS or gateway settings are needed.

Lynx Core Indicators

The left end of the Lynx core has 12 indicator lights. The following table gives their meanings:

Indicator	Meaning
Left Column	
LOGIC	The microcontroller has power
PC	The Lynx core and the servo controller are communicating
DRIVE	The drive wheels are under servo control
ESTOP	An E-Stop has been activated
Middle Column	
20V	20 V power is available
12V	12 V power is available
5V	5 V power is available
VBAT	Raw battery power is available
Right Column	
LAN USER	The USER LAN connector is showing activity
LAN MAINT	The Maintenance Ethernet connector is showing activity
WLAN	The WiFi is showing activity
HD	The hard drive is showing activity

6.6 Sensors

Safety Scanning Laser

The onboard safety scanning laser is a very precise scanning sensor. The laser provides 500 readings in a 250 degree field of view, with a typical maximum range of 15 m (49.2 ft). The laser operates in a single plane, positioned at about 200 mm (7.9 in.) above the floor. In most environments, the sensor will provide highly-accurate data.

Glass, mirrors, and other highly-reflective objects cannot be reliably detected by the laser. Caution must be exercised when operating the platform in areas that have these types of objects. If the platform will need to drive in close proximity of these objects, Adept recommends that you use a combination of markings on the objects, such as tape or painted strips, and also use forbidden sectors in the map, so that the platform knows to plan paths safely around these objects.

Sonar

Rear-Facing

The Adept Lynx platform's two rear-facing sonar pairs are for obstacle-sensing while backing up. The range is up to 5 m (16 ft), though the typical accurate range is only up to 2 m (10 ft). Each pair consists of one emitter and one receiver. The sonar emitters and receivers are identical physically, but the platform uses them differently.

The only two times the platform will back up is when docking on the docking station, or when the bumper has hit an obstacle. In the latter case, the platform will back up just enough so that it can rotate without touching the obstacle.

Front-Facing

The platform's front bumper houses two sonar pairs, for detecting low obstacles. Each pair consists of one emitter and one receiver.

Other Sensors

Encoders and Gyroscope

Each wheel has an encoder that tells the navigation system how far the wheel has turned, and in which direction. Each wheel also has a Hall sensor.

The Lynx core has a gyroscope mounted on it, to track the platform's rotation.

The combination of rotation and distance traveled are used by the platform to back up the safety scanning laser during localization. These limit the area on the platform's map that the platform needs to search.

Bumper

One bumper, with two pairs of sensors, is mounted at the front of the platform, should the obstacle-avoidance systems fail to detect an obstacle.

Optional user (payload structure) bumpers can be added using the User Bumper connector on the rear upper core, in the payload bay.

6.7 Startup

By default, the Lynx core, safety scanning laser, and some auxiliary power start automatically when you press ON. To change that behavior, or to assign AUX power to your own accessories, modify their related parameters from the MobilePlanner software. You can also control power from a client connected with the Lynx core.

Networking

The Lynx core is preset and tested on a Class-C network (netmask for all ports 255.255.255.0). The Maintenance Ethernet port is set to IP address 1.2.3.4 and the wireless IP comes set with an AP-based ("managed") SSID of "Wireless Network", unsecured. Consult with your network systems administrator before modifying these network details through the SetNetGo OS.

The User LAN port is set to IP address 10.10.10.10.

Refer to the *Adept Motivity® User's Guide*.

Chapter 7: Options

The Lynx platform is available with a number of options to enhance its performance and abilities.

- Adept Lynx Enterprise Manager 1100, for multi-AIV coordination

  This is a network appliance that runs the Mobile Software suite.

  It is covered in the *Adept Lynx Enterprise Manager 1100 User's Guide*.

- MobilePlanner™ software (licensed)

  In order to have your AIV perform autonomous mobile activities, you need to make a map of its operating space, and configure its operating parameters. The MobilePlanner software is used to make this map and perform this configuration.

  Refer to the separate *Adept Motivity® User's Guide* for details on how to map a working space and prepare the virtual elements, goals, routes, and tasks for your application.

  The MobilePlanner software requires a license to run. You need at least one MobilePlanner license for each fleet of AIVs. Once a map is generated, it can be shared with multiple AIVs working in the same space.

- Spare Batteries

  At least one spare battery is needed if you opt to swap the platform's battery, rather than having it charge itself at a docking station. See Manually Charging the Battery on page 75.

- Vertical-mount Lasers

  This is an option for payload structure development. The two lasers mount on the sides of the payload structure to detect obstacles that protrude into the AIV's path, but may not be detected by the safety scanning laser.

  This is useful when the payload structure is tall enough that it might run into obstacles not detected by the safety scanning laser.

  The optional vertical lasers connect to the RS-232 Aux Sensors connector on the Lynx core.

- Payload Structure Sonar

  This is in addition to the two standard front and two rear sonar pairs, and includes four sonar pairs and a controller, which mounts in the payload bay. Each sonar pair consists of one emitter and one receiver.

- Call Buttons/Door Boxes

  Call buttons are used to issue a request for an AIV to go to the goal associated with the button. There may be multiple call buttons, even in an installation where there is only one AIV.

Door Boxes are used to open an automated door, so the AIV can pass through. See *Adept Lynx Platform Peripherals Guide*.

- Cleanroom version

  The platform is available in a cleanroom-suitable version.

- Acuity Localization

  Adept's Acuity localization uses an upward-facing camera to localize the platform using overhead lights, which it compares with lights stored in its map. This can be used in circumstances where laser localization is difficult, either because the environment has too many changing features or simply not enough features for laser localization. If there are many objects, such as pallets or carts, which change location frequently, they may not be on the platform's map, and may also block the laser's view of features that are on the map. In such cases, Acuity localization may be a better choice than using the safety scanning laser for localization.

- Adept Touchscreen

  This is a full-color touch-sensitive screen for displaying information to the Operator, as well as receiving input from the Operator. It is covered in detail in the *Adept Lynx Platform Peripherals Guide*.

Chapter 8: Maintenance

This chapter covers periodic maintenance and user-serviceable parts replacement for the Lynx platform and the docking station. It does not cover maintenance of the payload structure, which is the user's responsibility.

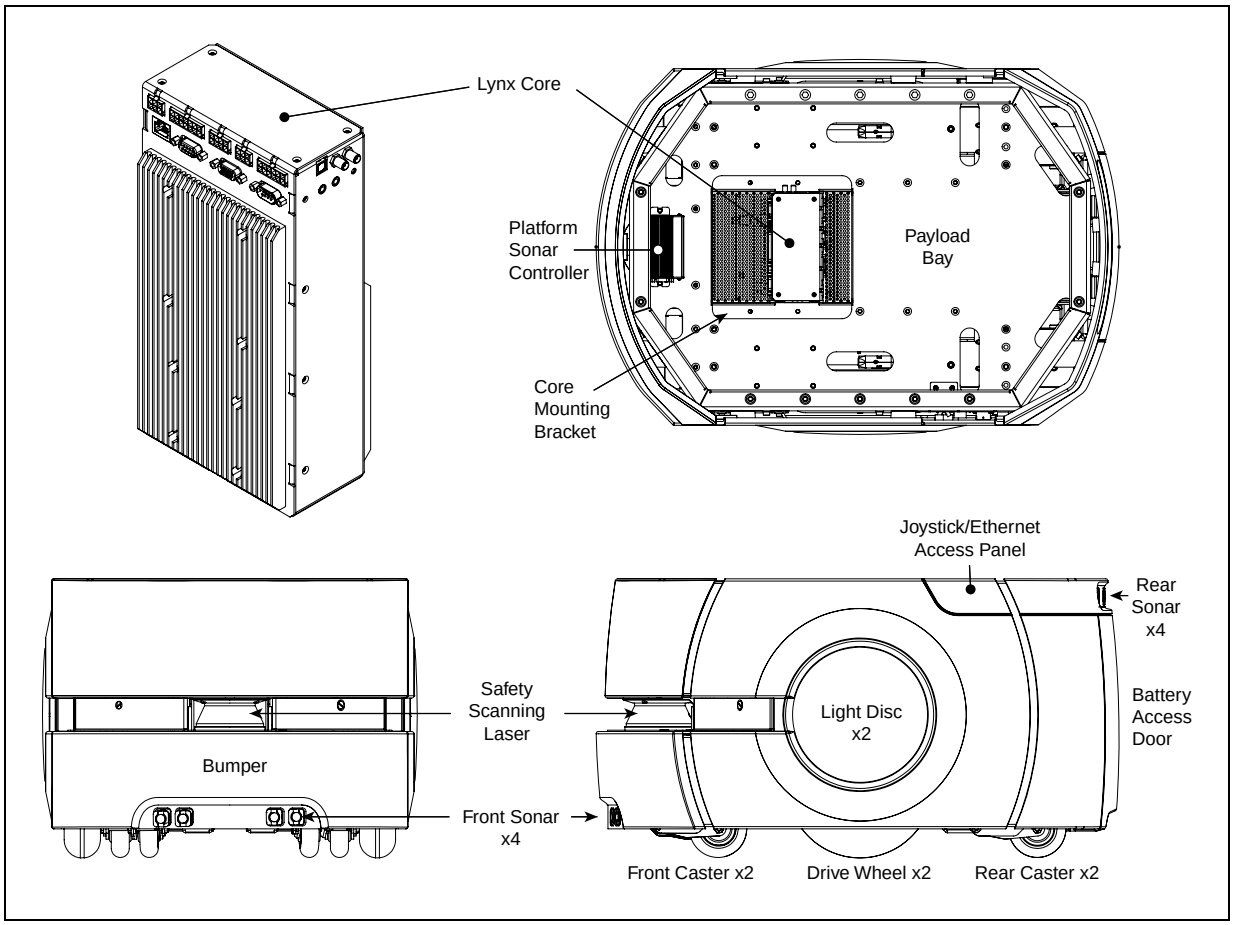


Figure 8-1. Location of Parts on the Platform

8.1 Safety Aspects While Performing Maintenance

DANGER: During maintenance and repair, the power to the docking station must be turned off. Remove and lock up the power cord to prevent unauthorized third parties from turning on power. The access covers on the docking station are not interlocked.

DANGER: Only skilled or instructed persons, as defined in the *Adept Robot Safety Guide*, should perform the procedures and replacement of parts covered in this section.

DANGER: During maintenance and repair of the platform, disconnect the battery as soon as possible. Avoid shorting the terminals of the battery.

8.2 Periodic Maintenance Schedule

The drive motors and gearbox are sealed and permanently lubricated, so they do not require periodic maintenance.

Cleaning

The following table gives a summary of cleaning procedures for the Adept Lynx Platform.

Table 8-1. Cleaning

Item	Period	Reference
Clean docking station contacts	3 months	Docking Station Contacts on page 93
Clean axles and tires	As needed	Tires on page 93
Clean safety scanning laser lens - wipe clean	6 months/ as needed	Lasers on page 93
Clean vertical lasers	6 months/ as needed	Lasers on page 93

NOTE: The frequency of these procedures will depend on your particular system, its operating environment, and the amount of usage. Operating in an environment with a lot of dust or dirt will require more frequent cleaning. Use the intervals in this section as guidelines, and modify the schedule as needed.

Tires

Occasionally clean the tires with a mild soapy solution. Remove any dirt or debris that may accumulate on the tires, because these can degrade the AIV's performance.

This applies to both the drive wheels and to the casters.

Axles

Keep the axles free of carpet, hair, string, or anything that may wrap around and bind up the platform's drive.

Lasers

Occasionally clean the lenses of the safety scanning laser and the vertical lasers, if used. Use only alcohol-based, non-abrasive cleaners, and wipe thoroughly.

Docking Station Contacts

The two docking station contacts occasionally need to be cleaned. The suggested interval is 3 – 6 months, depending on frequency of charging.

WARNING: Unplug power from the docking station before starting.

Remove the power cord at the charger.

Clean the contacts with isopropyl alcohol.

CAUTION: Do not lubricate the docking station paddle. Lubrication will reduce the life of the paddle.

8.3 Accessing the Payload Bay

Access to the payload bay will be dependent on how you have designed your payload structure. A small, light payload structure may be easily disconnected and simply lifted off, taking care not to damage any of the wires connected to the platform.

A taller or heavier payload structure may have hinges, so that it can be tilted off of the platform after being mechanically disconnected. For most payload structures, this will enable a single technician to access the payload bay without assistance. Care must be taken, when accessing the payload bay, that the wires and connections between the platform and the payload structure are not disturbed when the payload structure is tilted.

8.4 Removing and Installing Covers

Many of the maintenance procedures require removing some of the platform's covers. Most covers are held in place with just magnets. The rear cover has an additional brace for support, the bumper cover uses screws and magnets, and the access panel uses a push-push latch.

CAUTION: Pinch hazard. The magnets holding the covers in place are strong enough to pinch you if you are not careful.

NOTE: In general, it is better to install the payload structure first, and then the covers.

The covers are:

- Rear Inner (Battery)
- Access Panel
- Left Side

  Both side covers include a light disc and cover.
- Right Side
- Front Upper
- Bumper
- Rear Outer

With the exception of the bumper cover, no tools are needed for either the removal or installation of the covers.

Cover Removal

NOTE: After removing covers, place them inner-side down, so the outer surfaces don't get scratched.

The covers can be removed in the order in which they are listed above.

- The rear outer must wait for the rear inner and the two side covers.
- The front upper must wait for the two side covers.
- The two sides, the rear inner, and the bumper cover can all be removed without removing any other covers, except that the left cover must wait for the access panel.

NOTE: The light disc covers are not covered here because they are only removed from the side covers to replace one of the light disc controllers.

Rear Inner Cover (Battery)

This provides access to the battery compartment door.

1. Pull the bottom of the cover away from the platform chassis.

   This is easiest if you grip it with two hands, toward the center.
2. Lower the cover down, so its top tab clears the rear outer cover.

Access Panel

This provides access to the Maintenance Ethernet and the Joystick ports.

1. Push the left (front) side of the panel in, and the latch will release it.

   Pushing the panel a second time will reattach it to the platform.

2. Pull the left side out, and slide the panel to the left.

   The panel is attached with a lanyard, to prevent getting lost.

You will need to place this panel out of the way when removing the left side cover.

Side Covers

1. For the left side cover, put the access panel out of the way.
2. Pull the bottom of the cover, near both sides, away from the chassis.
3. Work your way up the edges of the cover, pulling it away from the chassis as you go.
4. Remove the cover a few inches from the chassis.

   The light disc wires plug into connectors on the inner side of each side cover.

5. Unplug the light disc connector, and move the side cover away from the platform.

Repeat for the other side cover.

Front Upper Cover

This cover is held onto the chassis the most tightly of any of the covers.

1. Grip the cover at the two outer edges.
2. Pry the cover away from the chassis.

Bumper Cover

This is the only cover that requires tools to remove.

1. Remove the screws at the sides of the cover.

   Retain the screws for installing the new bumper cover.

2. Pull the cover off of the bumper.

   It is held on with magnets, as well as screws.

Rear Outer Cover

This cover houses the two rear sonar pairs, which must be disconnected once the cover is part-way off the chassis. Each pair consists of one emitter and one receiver.

1. Pull the top of the cover away from the chassis a few inches.

   The cover will pivot on the metal brace at its bottom edge.

2. Pull the four sonar wires, with their connectors, out of the chassis holes.

Refer to the following two figures.

Figure 8-2. Sonar Leads, with Connectors Still in Chassis

3. Unscrew all four sonar connectors.

   Ensure that both sides of all connectors are labeled, and match. If not, label them.

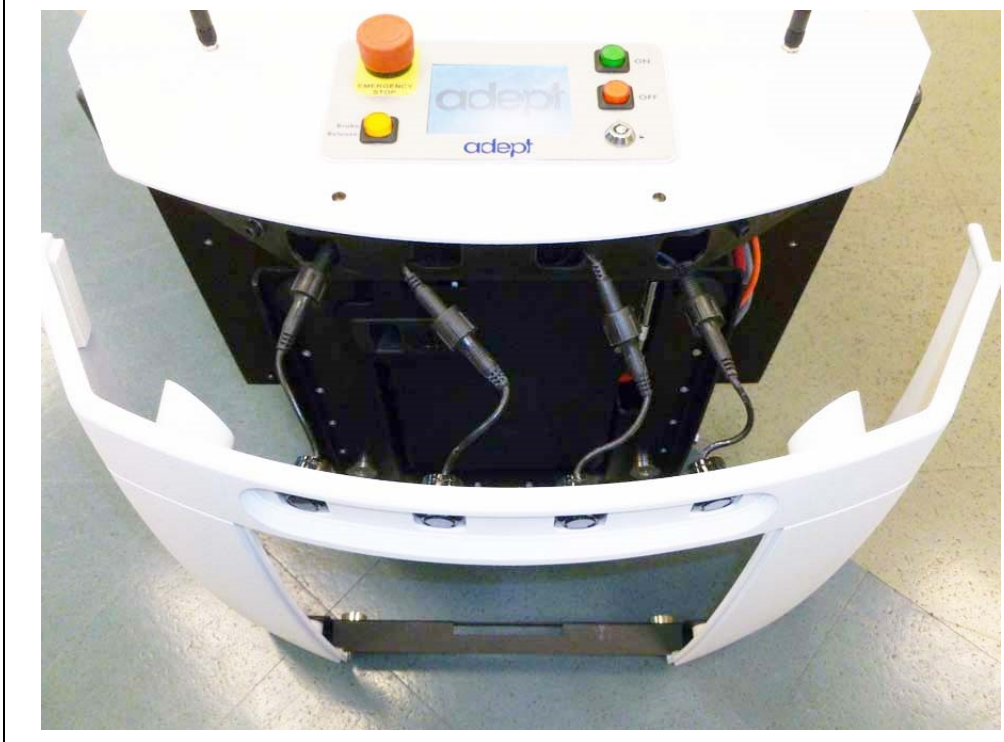


Figure 8-3. Sonar Connectors, with Connectors Exposed

4. Tilt the cover down to about 45°, and slide the brace on the bottom of the cover out of its clip.

   This will separate two pairs of magnets, so you will feel some resistance at first.

Cover Installation

The covers can be installed in the reverse of the order in which they are listed above.

- The front upper and rear outer covers must be installed first and second.
- The access panel must wait for the left side cover.

Bumper Cover

This is the only cover that requires tools to install.

1. Place the cover on the bumper.

   It is held on with magnets, as well as screws.

2. Install the screws, removed during the cover removal, at the sides of the cover.

Front Upper Cover

1. Grip the cover at the two outer edges.
2. Align the bottom edge of the cover so it slides under the chassis support.
3. Tilt the top of the cover into position.

Rear Outer Cover

Because this cover houses the rear sonar units, they must be reconnected once the metal brace across the bottom is in the clip just below the battery access hole.

1. Slide the metal brace into the clip in the chassis.

   Watch the two magnets on the bottom of the cover, to align them with their mating magnets on the chassis. This is your best guide for getting this cover in its proper place.

   These are inboard of the clip holding the brace, so you will have to look on each side of the cover to check their alignment.

2. When the magnets at the bottom are lined up, tilt the cover up to within a few inches of the chassis.
3. Pull the sonar connectors out of the chassis, if they are not already out.
4. Screw the four sonar connectors to their corresponding sonar leads.

   Ensure that the labels for the connectors and leads match.

5. Tuck the connectors into the four holes in the chassis, until just an inch of sonar lead is sticking out.
6. Tilt the top of the cover up to meet the chassis.

Side Covers

1. Move the cover to within a few inches of the chassis, and plug in the light disc connector.

   The light disc is connected to a connector, accessible on the inner side of the side cover.

2. Place the top edge of the cover on the chassis, so the magnets hold it there.

   Make sure the gaps on each side of the cover are the same width.

3. Tilt the bottom edge of the cover down.

4. Check each side of the cover to ensure that the cover edges on each side of the gap stick out the same amount away from the chassis.

   This is most likely to be uneven near the top of the cover.

5. If either edge sticks out more than the neighboring cover, pull the neighboring cover away from the side cover slightly, and release.

   This should allow the side cover to snap into place, so both sides of the gap stick out the same amount.

Repeat for the other side cover.

Figure 8-4. Right Side Cover, Showing Even Gaps at Edges

NOTE: The gaps between the side covers and the bumper cover will be smaller than the other gaps, and will not be even.

Access Panel

1. Slide the panel to the right, so its tab goes under the left side cover.

   The panel is attached with a lanyard, to prevent getting lost.

2. Press the left (front) side of the panel in, and the latch will hold it.

   This is a toggle latch - pressing it once engages it, pressing it a second time releases it.

Rear Inner Cover (Battery)

1. Slide the cover up, so its top tab fits under the rear outer cover.

CAUTION: Pinch hazard. This cover is the most likely to pinch you if you are not careful, particularly at its bottom edge. Hold the cover at the bottom, in the center, with two hands.

2. Holding the cover near the center, with both hands, tilt the bottom of the cover down, towards the platform chassis.

8.5 Battery Replacement

The battery is expected to last for approximately 7 years of 16 hours/day, 5 days/week. Life expectancy for 19/7 is 4 years. (19 hours/day is full-time, with time-out to recharge.)

NOTE: There are no serviceable parts inside the battery case. Do not open it.

WARNING: Replace the battery only with an Adept battery.

Dispose of the battery according to all local and national environmental regulations regarding electronic components. Refer to:
http://www.adept.com, under Contacts.

DANGER: Follow appropriate ESD procedures during the removal/replacement phases.

Removal

WARNING: The battery is heavy (20 kg/44 lbs). Observe safe lifting practices when removing or installing the battery.

1. Remove the inner rear platform cover.
   a. Pull the bottom of the cover away from the platform chassis.

      This is easiest if you grip it with two hands, toward the center.

   b. Lower the cover down, so its top tab clears the rear outer cover.
2. Unlatch and open the battery compartment door, at the back of the platform.

The battery compartment door is capable of being locked. You may need to unlock it before opening.

3. Disconnect the power and data cables before removing the battery.

   See the following figure.

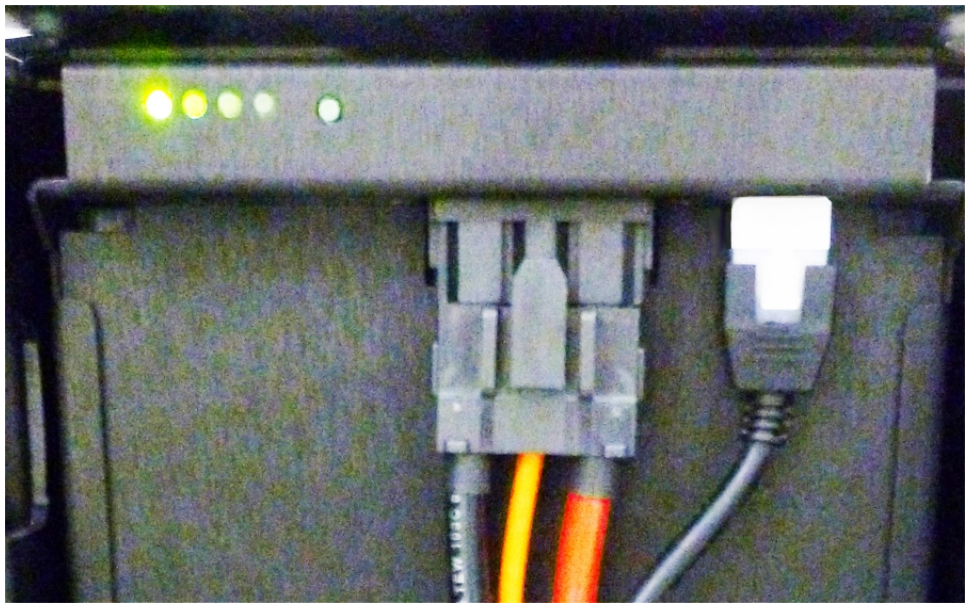


Figure 8-5. Battery Cable Connectors

4. Slide the battery back and out of the platform.

   There is a hand grip at the front and the rear of the battery, to help you lift it.

Installation

Refer to Removing and Installing Covers in the Maintenance section for cover removal and installation.

1. Remove the inner rear platform cover.
   a. Pull the bottom of the cover away from the platform chassis.

      This is easiest if you grip it with two hands, toward the center.

   b. Lower the cover down, so its top tab clears the rear outer cover.
2. Unlatch and open the battery compartment door, at the back of the platform.

   The battery compartment door is capable of being locked. You may need to unlock it.

Figure 8-6. Battery Compartment, Connectors

3. Lift and slide the new battery into the platform body.

   The battery weighs 20 kg (44 lbs).

   There are recesses at the front and the back of the battery, to aid in lifting it.

Figure 8-7. Battery Recesses, for Gripping

The battery is designed to be lifted and replaced by one person, using one hand in each of the grips, as shown in the following figure.

Figure 8-8. Lifting the Battery

The connectors for power and data go toward the rear of the platform.

4. Attach the battery power and data cables to the connectors at the rear of the battery.
5. Close the battery compartment door to secure the battery in place.

The battery compartment is designed to hold the battery tightly, so that it will not move within the compartment, once the door is closed.

6. Reinstall the inner rear platform cover.

8.6 Replacing Non-Periodic Parts

All of the following parts are replaced on an as-needed basis.

Docking Station Roller and Bearing

The roller, which guides the AIV onto the docking station, may be subject to wear after extended use. The time to replace the roller should be based on your visual inspection and judgment of when it is too worn. Adept does not specify a quantitative measure for this.

Refer to the following figure for the location of the roller.

WARNING: Unplug power from the docking station before starting.

Remove the power cord at the charger.

The roller is held to the docking station with a shoulder bolt.

1. Remove the shoulder bolt from the center of the roller. Retain the shoulder bolt.
2. Remove the roller and bearing from the docking station.

3. Install the new roller and bearing, using the retained shoulder bolt.

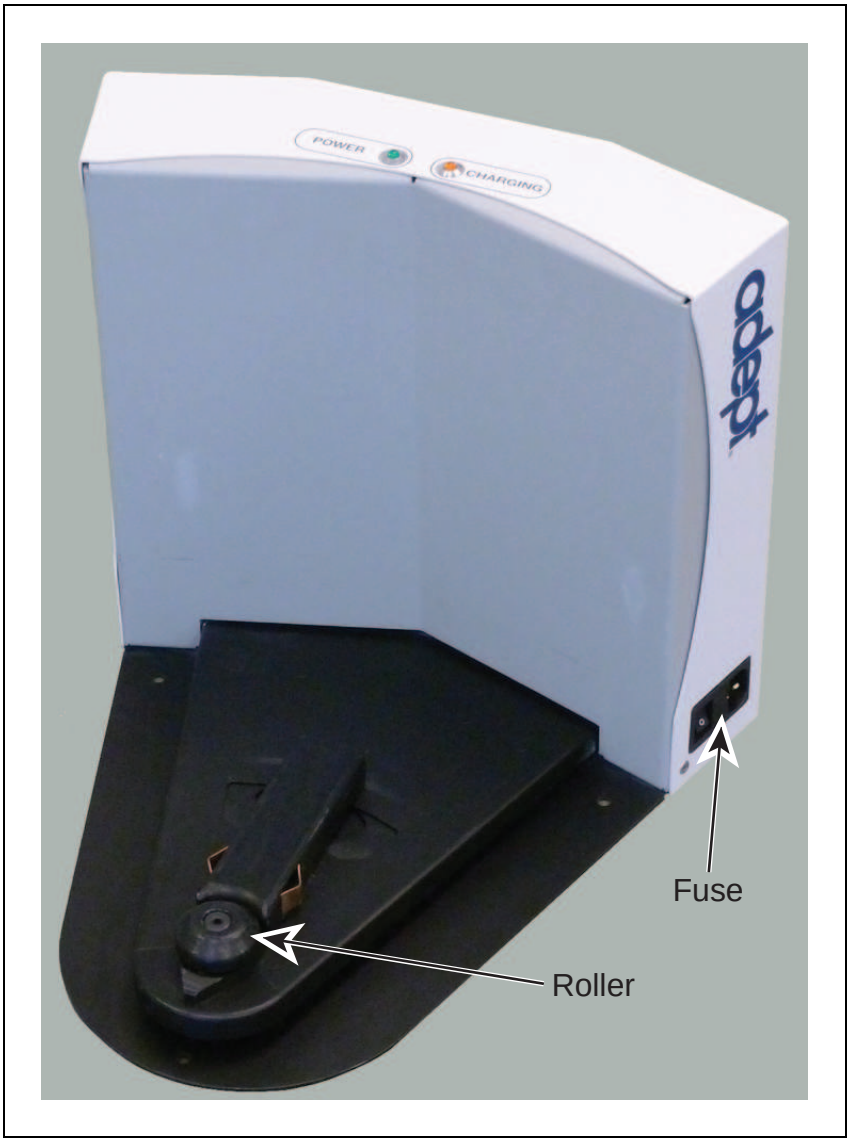


Figure 8-9. Docking Station Roller and Fuse Locations

Docking Station AC Power Fuse

The only user-serviceable fuses are in the docking station. The two external AC fuses are located between the power switch and the AC power plug.

Symptoms: When the docking station is switched on, the blue power light does not come on. (Verify that the unit is plugged into AC power.)

WARNING: Unplug power from the docking station before starting.

Remove the power cord at the charger.

The fuse assembly can be removed by squeezing the two tabs toward each other, and pulling it away from the docking station. See the following figure.

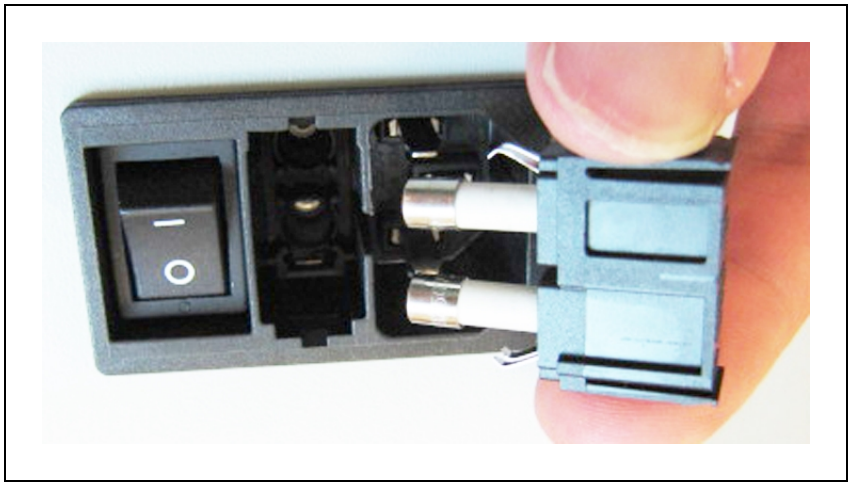


Figure 8-10. Docking Station Fuse

The fuses are available from Adept as p/n 02212-000L. Equivalent fuses are available generically. The fuses need to be 250 V, 10 A, and Time-lag. An example of a fuse that meets this is:

LittelFuse 0215010.XP, 5x20 mm cartridge type

Docking Station Internal Fuse

Symptoms: When the docking station is switched on, the blue power light does not come on, but the docking station can charge a battery manually.

WARNING: Unplug power from the docking station before starting.

The docking station cover is NOT interlocked. Remove the power cord at the charger.

1. Remove the ten screws from the back cover of the docking station.

   Two of these are on the sides, near the bottom.

Figure 8-11. Docking Station Rear Cover Screws (8 of 10)

Retain the screws for reassembly.

2. Remove the rear cover of the docking station.
3. Locate the in-line fuse.

   It will be near the top of the docking station, just to the right of the central terminal bar.
4. Remove the old fuse, and replace it with a new fuse.

   The fuse is p/n 13091-000.
5. Reinstall the docking station rear cover, and secure with the ten screws previously removed.

Rear Sonar Units

The platform's four rear sonar units can be replaced individually. All four sonar units are identical, although two are used as emitters and two as receivers, in pairs.

1. Remove the inner and outer rear covers from the platform. Refer to Removing and Installing Covers on page 93.
2. Unscrew the connection between the sonar cable and the sonar unit's lead.

   Ensure that both the connectors and leads are labeled, and match. If not, label them.
3. Compress the two flat springs holding the sonar unit, and remove it from the cover.
4. Press the new sonar unit through the hole in the rear outer cover, from the outside.
5. Connect the sonar cable to the new sonar unit's lead.
6. Reinstall the rear covers.

Front Sonar Units

The front sonar units are housed in the bumper. They can be replaced, individually, without removing the bumper or its cover. No tools are required for this replacement. All four sonar units are identical, although two are used as emitters and two as receivers, in pairs.

1. Reach under the bumper cover, and compress the two flat springs holding the sonar unit.

   Push it out of the bumper cover, away from the chassis, to remove it from the cover.

2. Unscrew the connection between the sonar cable and the sonar unit's lead.

   Ensure that both the connector and lead are labeled, and match. If not, label them.

3. Connect the sonar cable to the new sonar unit's lead.

4. Tuck the cable and lead through the sonar unit's hole in the bumper cover, and press the new sonar unit through the hole, from the outside.

Sonar Controllers

The sonar controllers are located in the payload bay. One is used for the standard front/rear sonar. A second controller is only present if you purchased the optional payload structure sonar kit.

1. Move the payload structure out of the way, so you have access to the payload bay.

2. Locate the sonar controller that you need to replace.

   Payload structure sonar controller

   - The payload structure sonar controller is plugged into the Sonar 2 connector on the Lynx core. This connector is accessible from the payload bay.
   - The controller will be on one side of the payload bay, screwed into the payload bay deck with two screws.

   a. Unscrew the controller from the payload bay deck by removing two screws.

      Retain the screws for mounting the replacement controller.

   b. Unplug the larger cable from the controller (coming from the Lynx core).

   c. Unplug the eight sonar units from the sonar controller.

      These are the smaller cables that go to the individual sonar units.

      Make sure these are labeled, and are tied up so they can't slip into the chassis.

   d. Replace the old controller with the new one.

   e. Plug the eight sonar unit cables into the new controller.

      Ensure that the cable labels match the controller labels.

   f. Plug the cable from the Lynx core into the new controller.

g. Screw the new controller to the payload bay deck, using the two screws you removed from the old controller.

Platform sonar controller.

- This controller is plugged into the Sonar 1 connector on the Lynx core. This connector is not accessible from the payload bay, but does not need to be unplugged for this procedure.
- The controller will be at the very front of the payload bay, screwed into the payload bay deck with two screws.

a. Unscrew the controller from the payload bay deck by removing two screws.

Retain the screws for mounting the replacement controller.

b. Unplug the larger cable from the sonar controller.

Be careful not to let the cable end slip into the chassis.

c. Unplug the eight sonar unit cables from the controller.

These are the smaller cables that go to the individual sonar units.

Make sure these are labeled and tied up, so they can't slip into the chassis.

d. Remove the controller from the payload bay, and replace it with the new one.

e. Connect the eight sonar unit cables to the new controller.

Ensure that the cable labels match the controller labels.

f. Plug the larger cable into the new controller.

g. Screw the new controller to the payload bay deck, using the two screws removed from the old controller.

3. Reinstall the payload structure.
4. Dispose of the old controller according to local and national regulations concerning electronic components.

Light Discs

The two light disc assemblies and their controllers are single units, so replacing a controller also replaces all of the lights on that side of the platform.

1. Remove the side cover, on the side that needs the light disc assembly replaced.

Refer to Removing and Installing Covers on page 93.

2. Unscrew the four screws holding the light disc PCA to the side cover.

Retain the screws and round cover for installing the new assembly.

3. Remove the light disc PCA.
4. Screw the new assembly and retained round cover to the side cover, using the screws retained from the old assembly. The PCA is keyed so that it can only be installed in one orientation.
5. Reinstall the side cover, connecting the cable to the new light disc PCA.

6. Dispose of the old light disc PCA according to local and national regulations concerning electronic components.

Operator Panel

The Operator panel will typically be located on a user-supplied payload structure, so the removal and replacement of this will vary from one AIV to another. It plugs into the HMI Panel connector on the Lynx core.

Wheels and Tires

The wheels and tires can be replaced if the tires have significant wear. Refer to the following figure.

The wheel and tire assembly is Adept P/N 11210-000.

Figure 8-12. Samples of Tire Wear

Removal

1. Remove the side cover a small distance from the platform on the side where you want to replace the wheel and tire. Refer to Removing and Installing Covers on page 93.

   The light disc PCA cable will still be attached.

2. Disconnect the cable from the light disc PCA, so the side cover can be moved completely away from the platform.

   This will fully expose the wheel and tire.

3. Lift the drive wheel up, compressing its springs, enough so that you can insert a Ø6 x 10 mm (Ø0.24 x 0.4 in.) pin into the hole on the rear side of the assembly (there is a hole on each side). This will keep the springs compressed (the wheel will be in the up

position), and make wheel replacement easier. An M5 x 10 screw works well for this. See the following figure.

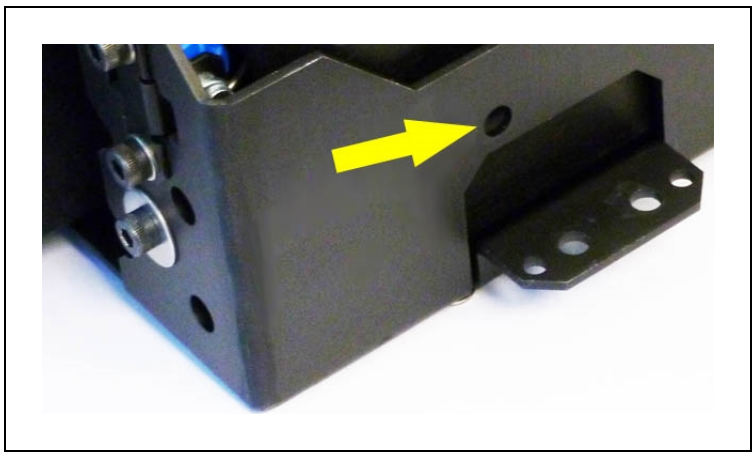


Figure 8-13. Spring-Compression Hole

4. The wheel is held in place with a single screw through the center.

   NOTE: The screw is secured with threadlocker.

   Remove the screw (and washer) holding the wheel to the drive assembly.

   Retain the screw and washer for attaching the new wheel.

5. Remove the wheel from the drive assembly.

   The motor drive shaft is keyed with the wheel. Retain the key for installing the new wheel.

Installation

1. Put the key you removed into the drive shaft keyway.
2. Install the new wheel and tire onto the drive shaft.

   Ensure that the wheel keyway lines up with the key in the drive shaft.
3. Secure the wheel to the drive assembly with the screw and washer previously removed.

   Use a threadlocker, such as Loctite® 220, on the screw.
4. Remove the pin or screw you used to hold the wheel in the up position.
5. Put the side cover next to the platform, and attach the light disc cable to the light disc PCA.
6. Reinstall the side cover.

Drive Assemblies

The platform drive assemblies have been designed to be field-replaceable. This will replace the drive motor, gearbox, encoder, and wheel/tire assembly.

Removal

1. Remove the inner rear cover.
2. Unlatch and open the battery compartment door, at the back of the platform.

   The battery compartment door is capable of being locked. You may need to unlock it before opening.
3. Disconnect battery power by unplugging the two cables at the rear of the battery.
4. Remove the side cover a small distance from the platform on the side where you want to replace the drive assembly. Refer to Removing and Installing Covers on page 93.

   The light disc PCA cable will still be attached.
5. Disconnect the cable from the light disc PCA, so the side cover can be moved completely away from the platform.

   This will expose the drive assembly.
6. Lift the drive wheel up, compressing its springs, enough so that you can insert a Ø6 x 10 mm (Ø0.24 x 0.4 in.) pin into the hole on the rear side of the assembly (there is a hole on each side). This will keep the springs compressed (the wheel will be in the up position), and make removal easier. An M5 x 10 screw works well for this.

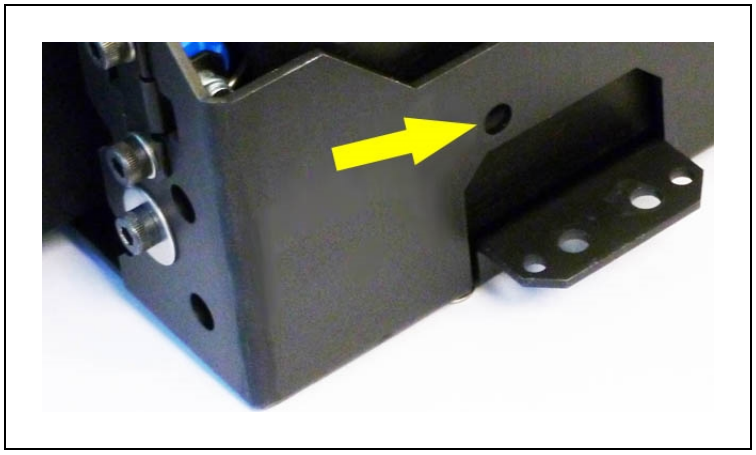


Figure 8-14. Spring-Compression Hole

7. The drive assembly is held in place with three nuts on studs across the top, and two sets of two screws at each side, near the bottom of the assembly.

   Remove the three nuts and four screws (and their washers) holding the drive assembly to the platform.

   Retain these nuts, screws, and washers for attaching the new drive assembly.

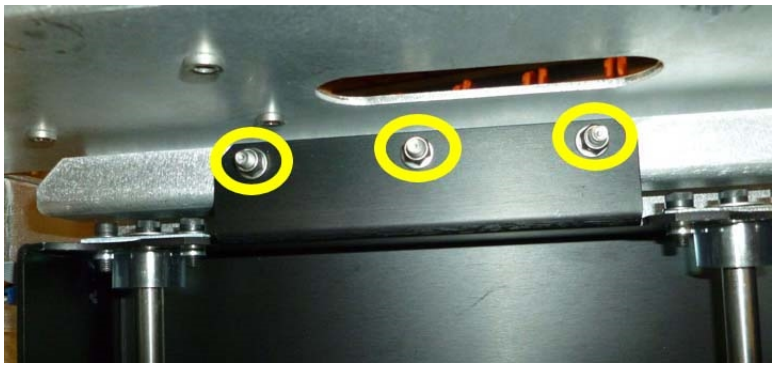


Figure 8-15. Mounting Studs and Nuts at top of Drive Assembly

Figure 8-16. Mounting Screws at Bottom-Right of Drive Assembly

8. Remove the drive assembly from the platform.

   The motor cable to the Lynx core will still be attached.

9. Disconnect the motor cable at the drive assembly.

Installation

1. Lift the new drive wheel up, compressing its springs, enough so that you can insert a Ø6 x 10 mm (Ø0.24 x 0.4 in.) pin into the hole on the rear side of the assembly (there is a hole on each side). This will keep the springs compressed (the wheel will be in the up position), and make installation easier. An M5 x 10 screw works well for this. See Spring-Compression Hole on page 111.

   NOTE: Make sure that the pin is short enough so that you can pull it out after the assembly is in place.

2. Connect the motor cable to the new drive assembly.

3. Install the new drive assembly over the three studs at the top of its bracket.

   Use the nuts, screws, and washers you removed from the old drive assembly.

4. Remove the pin or screw you used to hold the wheel in the up position.

5. Put the side cover next to the platform, and attach the cable to the light disc PCA.

6. Reinstall the side cover.

7. Connect the battery power and data cables, and close the battery compartment door.

8. Reinstall the rear cover.

Front or Rear Casters

All four casters are identical, and are mounted to the platform in the same way.

> **NOTE**: If you have a means of lifting the chassis of the platform enough to access the screws that hold on the caster, you can avoid removing the payload structure and the battery, which is only necessary to tilt the platform on its side.

1. Move the payload structure out of the way.

   If the payload structure can be completely removed, do so. This step is to enable you to tip the Lynx AIV on its side, so you have access to the casters underneath.

2. Remove the inner rear cover.

3. Unlatch and open the battery compartment door, at the back of the platform.

   The battery compartment door is capable of being locked. You may need to unlock it before opening.

4. Disconnect the battery by unplugging the two cables at the rear of the battery.

5. Remove the battery from the platform.

6. Remove the side covers.

7. Lay the body of the platform on its side, exposing the casters.

8. Remove the four screws and washers holding the caster to the platform.

   Retain these screws and washers for attaching the new caster.

Figure 8-17. Rear Caster

9. Remove the caster from the platform.
10. Put the new caster in place, and attach with the four screws and washers you removed from the old caster.

    NOTE: The casters are not centered on the sheet metal that attaches to the platform. The caster assemblies need to be mounted with the actual casters as far from the center of the platform as possible.

11. Return the platform to its upright position.
12. Reinstall the battery, connect the power and data cables, and close the battery compartment door.
13. Reinstall the inner rear cover.
14. Reinstall the side covers.
15. Reinstall the payload structure.

Safety Scanning Laser

1. While supporting the laser, unscrew the two screws and washers from the bracket holding the laser, to remove the laser from the platform chassis.

   Retain these screws and washers for installing the new laser.

2. Unscrew the four screws holding the black plate on top of the laser.

   Retain the four screws for reassembly.

   You will use this top cap on the new laser. Do not unplug it from the platform chassis.

Figure 8-18. Safety Scanning Laser

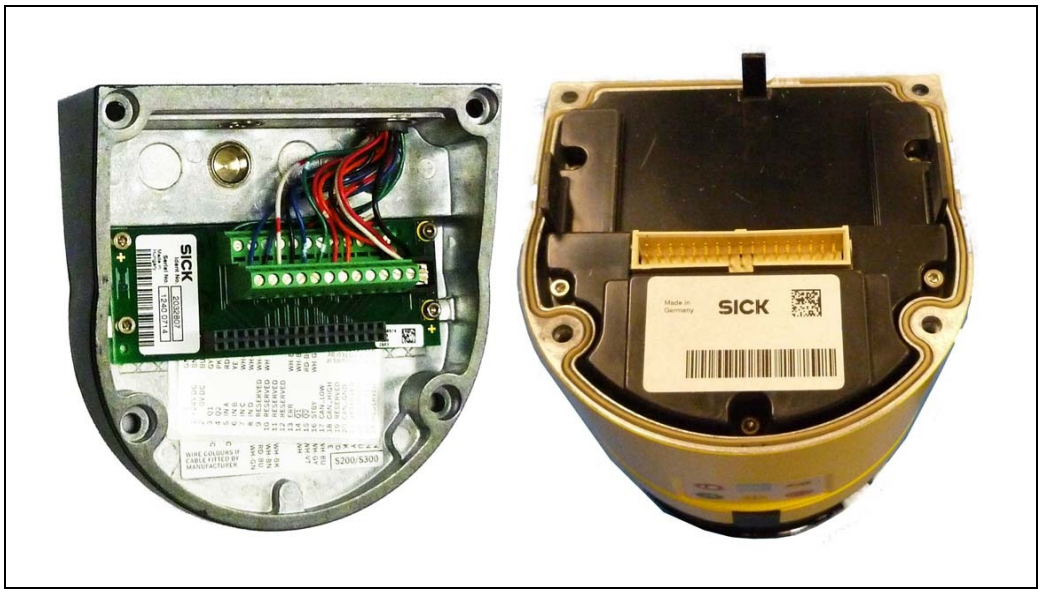


Figure 8-19. Connectors Inside Laser Cap

The underside of this plate has a connector that makes an electrical connection with a mating connector inside the laser.

3. Put the existing laser top onto the top of the new laser.

   You will feel slight resistance as the two connectors plug into each other.

4. Connect the black top plate to the new laser, using the four retained screws.

5. Attach the laser to the chassis using the two screws and washers from the old laser.

   NOTE: The laser orientation can be adjusted. Be careful to mount the laser horizontal with respect to the floor.

Lynx Core

The Lynx core is a sealed unit, with internal fans as the only moving parts.

1. Move the payload structure out of the way, so you have access to the payload bay.
2. Remove the inner rear cover.
3. Unlatch and open the battery compartment door, at the rear of the platform.

   The battery compartment door is capable of being locked. You may need to unlock it.

4. Disconnect the battery power and data cables from the rear of the battery.
5. Disconnect all of the cables that are attached to the top portion of the Lynx core.

   Refer to Payload Bay Connections on page 51.

6. Remove the core mounting bracket from around the Lynx core.

This is two pieces, held in place with four screws down into the chassis, with four more going sideways into the Lynx core itself. Retain all of these screws for installing the new Lynx core.

See the following figure:

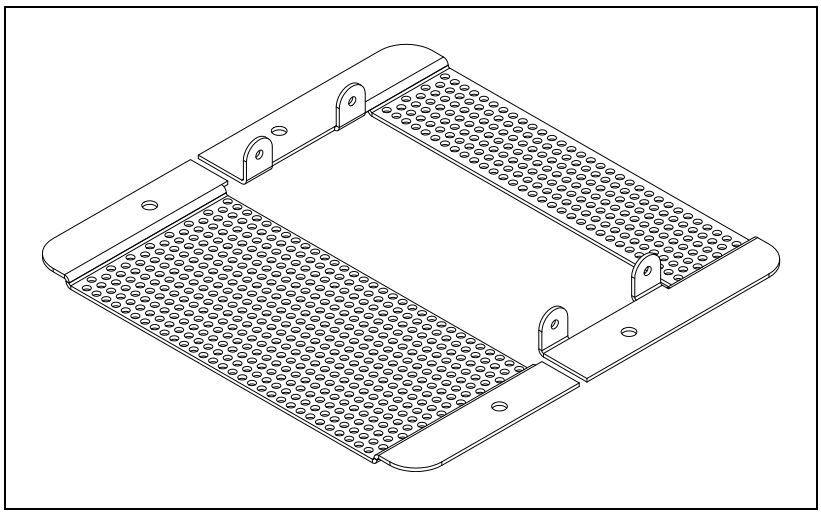


Figure 8-20. Core Mounting Bracket

7. Remove the Sonar 1 cable from the core.

   This cable is too short to allow the core to be lifted, until the cable is removed.

8. Gently lift the Lynx core up, until you have access to the internal connections.

9. Remove all of the cables that are attached to the internal Lynx core connector panel.

   The Left Motor and Right Motor connectors use the same type of plug, and can be inadvertently reversed. Ensure that you can identify the left from the right.

   See Internal Lynx Core Connections on page 66.

10. Remove the old Lynx core.

11. Connect all of the cables that were attached to the internal Lynx core connector panel to the new core internal connector panel. See Figure 5-8.

    Wait until after the next step to reconnect the Sonar 1 cable.

12. Put the core into the chassis.

13. Connect the Sonar 1 cable to the core.

14. Install the core mounting brackets around the new Lynx core.

    Using the screws and washers you removed from the old core, put four screws into the sides of the Lynx core, with four more going down into the platform chassis.

15. Reconnect all of the cables to the top portion of the Lynx core.

    Refer to Payload Bay Connections on page 51.

16. Reconnect the battery power and data cables to the battery.

17. Close and latch the battery compartment door.
18. Reinstall the inner rear cover.
19. Reinstall the payload structure.
20. Dispose of the old core according to local and national regulations concerning electronic components.

E-Stop and Safety Laser Commissioning

Under normal circumstances, the Lynx AIV is commissioned at the Adept factory, and will not need to be re-commissioned. However:

- If the core gets replaced, it will be necessary to redo the E-Stop Commissioning and the Safety Laser Commissioning procedures.
- If the hardware detects a failure, the AIV may automatically decommission itself, and the AIV will have to be re-commissioned to recover. In this event, ARAM will display a fault popup in MobilePlanner.
- Some customers have expressed a desire to perform the commissioning procedures on a regular basis as part of their preventive maintenance process.

NOTE: After performing either of these tests, you can access the other test by clicking Next Test on the final screen.

E-Stop Commissioning

This procedure verifies that the E-Stop circuitry is triggered when the E-Stop button is pressed. This is verified by ensuring that you hear the brakes activate after pressing the E-Stop button.

1. Ensure that the E-Stop button is NOT depressed before starting.
2. From the MobilePlanner software, select:

   Main Menu > Robot > Safety Commissioning
3. Follow the on-screen instructions to complete the test. You can print a certificate after successful completion of the commissioning.

Safety Laser Commissioning

This procedure verifies that the safety scanning laser reports speed zone information correctly, and that the E-Stop circuitry is tripped when an obstacle that should be detected by the laser is placed in front of the AIV. Each speed zone represents 300 mm/sec, so if the maximum speed is 1500, five zones should be reported. (When you press the Drive button in the wizard, the wizard will display the maximum AIV speed.)

1. From the MobilePlanner software, select:

   Main Menu > Robot > Safety Commissioning
2. Follow the on-screen instructions to complete the test. You can print a certificate after successful completion of the commissioning.

8.7 Spare Parts List

Part Number	Description
Bundles, Major Components	
99060-000	Bundle, Adept Lynx Main bundle (Lynx, Dock. Station, Joystick, software)
59060-000	Adept Lynx Top assembly (just the Lynx)
13558-000	Joystick assembly
11700-000	System, Adept Lynx Core
Docking Station	
12477-000	Docking Station (Dock)
13091-000	Fuse, 1 A, 3AG (¼ x 1¼), Internal Docking Station fuse
04563-000	Fuse, 10 A, Time-lag, 5 x 20 mm, External Docking Station fuses (x 2)
02212-000L	Fuse Drawer, 5 x 20 mm, Docking Station power entry side
12416-000	Roller, Docking Station
12417-000	Contact, Paddle, Docking Station (x 2)
12872-000	Assembly, Frame, Docking Funnel
Covers, Latches	
12804-100	Cover: bumper (lower front)
12804-200	Cover: front (upper front)
12804-350	Cover: Right panel + light disc
12804-450	Cover: Left panel + light disc
12804-600	Cover: Hatch (Access Panel to Maint. Ethernet, Joystick)
12855-000	Push Latch, 3 kg retaining force, Black (Access Panel latch)
12804-700	Cover: Rear
12804-800	Cover: Battery door
12168-000	Latch, locking, flush, ABS Battery latch (contains the key)
Operator Panel	
12800-000	Assembly, HMI Panel
12410-000	Push Button, Green, Panel Mount, Round
12411-000	Push Button, Red, Panel Mount, Round
12412-000	Push Button, Yellow, Panel Mount, Round
12413-000	Switch, Keylock, 2 Keypull Positions, 90° (contains HMI key)

Part Number	Description
Sonar, Laser	
11711-000	Assembly, Sonar Controller
11714-000	Sensor, Piezo Ultrasonic, 40 KHz, with Cable (Sonar Units x 8)
12170-000	Safety Laser, S300, Expert, 270 Degree
12718-000L	Cable, SICK LIDAR Laser
Suspension, Drive, and Battery	
12745-000	Assembly, Right Drive Train
12746-000	Assembly, Left Drive Train
12072-000	Assembly, Battery
13570-000	Casters, Shock Absorbing (x 4)
11210-000	Wheel and Tire assembly
Miscellaneous	
12330-000	Speaker, 3.5 in., 80 W
12312-000	Micro Switch, Positive Opening Contacts (Front Bumper x 4)
12730-000L	Jumper, User ESTOP

Chapter 9: Technical Specifications

9.1 Dimension Drawings

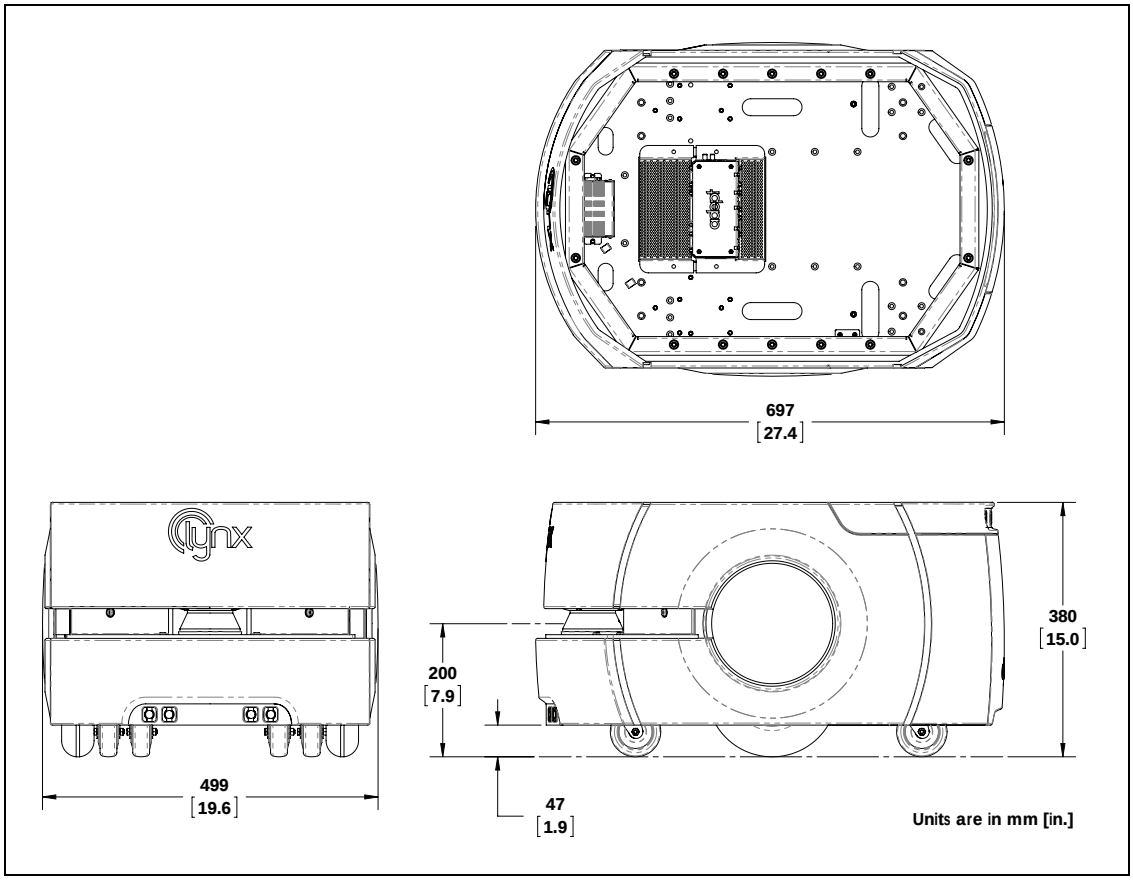


Figure 9-1. Adept Lynx Platform Top, Side, and Front Dimensions

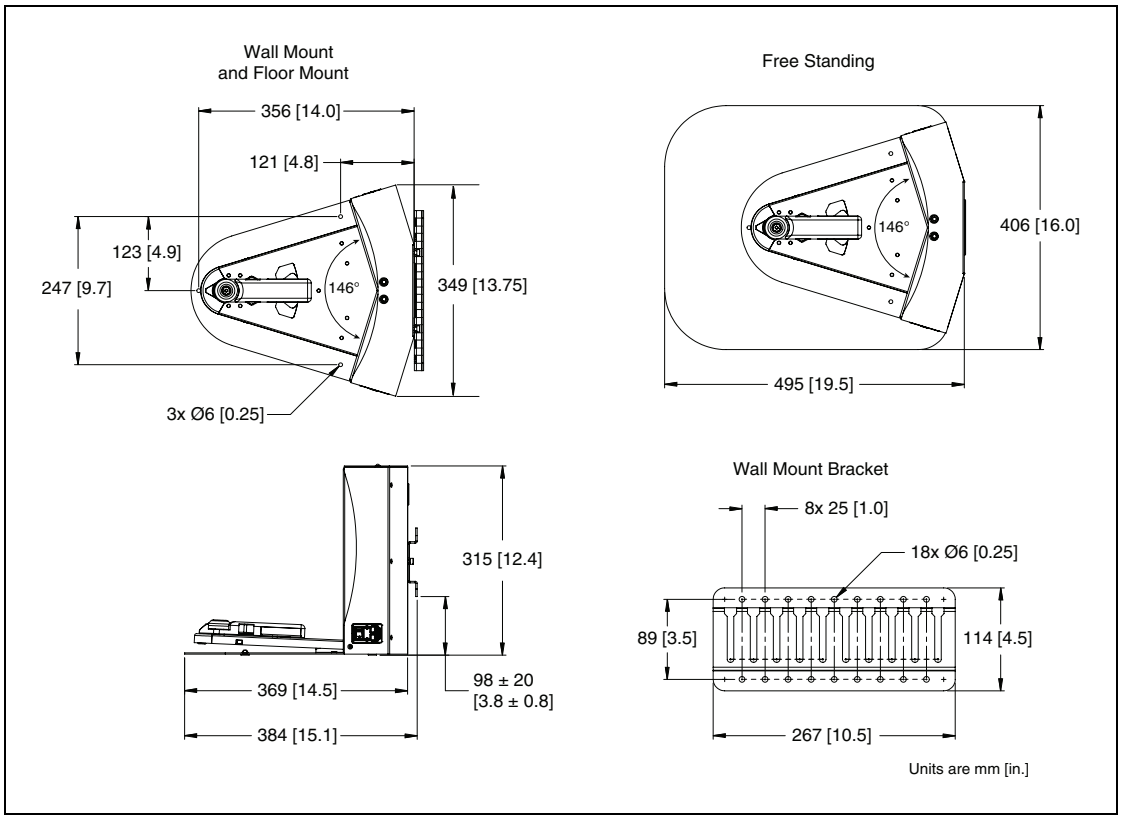


Figure 9-2. Docking Station Dimensions

9.2 Platform Specifications

Description	Specification
Physical - platform only	
Length	686 mm (27 in.)
Width	483 mm (19.0 in.)
Height (body)	371 mm (14.6 in.)
Body clearance	38 mm (1.5 in.)
Weight (with battery)	60 kg (132 lb)
Rating	
IP Rating	IP-40
Cleanroom rating	Fed Class 100, ISO Class 5
NOTE: Fed Class 10 (ISO Class 4) is attainable in many cases. Contact Adept.	
Drive Train	
Drive wheels	2 grey non-marking foam-filled rubber

Description	Specification
Wheel diameter	200 x 50 mm (7.9 x 2.0 in.) nominal
Passive Casters	2 front, 2 rear, spring-loaded
Brakes	2 (one each axle)
Steering	Differential

Description	Specification
Performance	
Max payload – level , std.	60 kg (132 lb)
Swing radius	343 mm (13.5 in.)
Turn radius	0 mm
Translational speed, max	1800 mm/sec (67 in./sec)
Rotational speed, max	300 degrees/sec
Traversable step, max	15 mm (0.6 in.)
Traversable gap, max	15 mm (0.6 in.)
Climb grade	1:12
Traversable terrain	All wheelchair accessible
Battery	
Run-time	13 hours, approx., no payload
Duty cycle	80%
Weight	20 kg (44 lb)
Voltage	22 - 30 VDC
Capacity	60 Ah
Energy	1.5 kWh nominal
Recharge time	3.5 hours, approx.
Life span	7 years, approx., 16 hrs/day, 5 days/wk 4 years, approx., 19/7 (full-time)
Sensors	
Safety Scanning Laser	1 at front of platform, 200 mm (7.9 in.) height 250°, 15 M range, Class 1, eye-safe PLd Safety per ISO-13849
Sonar (Each sonar is one emitter and	2 at rear of platform, 2 M range 2 at front of platform, in bumper, 2 M range

Description	Specification
one receiver, working together)	
Position encoders	2 x 512 quadrature (one each wheel) 2 x Hall sensors
Analog gyroscope (Lynx core)	320 degree/sec max rotation
Bumper	1 at front of platform, 2 pairs of sensors
Vertical Lasers (option)	2 on sides of payload structure, user-mounted
Upward-facing camera (Acuity option)	1 on payload structure, user-mounted
Payload Structure Sonar Sensors (option)	4 emitter/receiver pairs available, user-mounted
Payload Structure bumper (option)	6 inputs, user-designed and mounted sensors

9.3 Docking Station Specifications

Description	Specification
Current	8 A 10 A Time-lag fuse at power plug/switch
Contacts	2
Voltage	100 to 240 VAC, 50 to 60 Hz
Power consumption	800 W
Short circuit current rating (SCCR)	1500 A
Humidity	5 to 95% non-condensing
Temperature	5° to 40° C (41° to 104° F)
Dimensions - WxDxH with Floor plate	349 x 369 x 315 mm [13.75 x 14.5 x 12.4 in.] 495 x 495.5 x 317 mm [16 x 19.5 x 12.5 in.]
Weight	8.2 kg (18 lbs)
Mounting	Wall bracket, directly to floor, or on floor with floor plate
Indicators	Power on - blue Charging - yellow
Connector	For out-of-platform battery charging

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