Step by step instructions for installation of a SICK LMS 200 Laser Range Finder on an ActivMEDIA ROBOTICS’ Pioneer 2 DX or AT Mobile Robot.

Please read through this manual carefully before you attempt to attach a SICK LMS 200 Laser Range Finder to your Pioneer 2 Mobile Robot. If for any reason you do not wish to perform the work yourself, contact ActivMedia ROBOTICS (robots@activmedia.com) and make arrangements to have the assembly installed at the factory.

**Required Tools and Parts:**

- SICK LMS 200 Laser Range Finder
- Pioneer 2 DX or AT Mobile Robot with onboard PC
- Laser Integration Kit (includes mounting bracket, power and signal cabling, software)
- PTZ Robotic Camera owners get extension cabling and new mounting bracket
- Hex wrenches that accompanied the robot
- Pioneer 2 Operation Manual

**Step 1: Power OFF**

Switch Main power off. On the DX and AT models, for extra safety, you might reach in through the back door and remove the automotive spade-type fuse from its socket on top of the battery box.

**Step 2: Remove Nose**

Use the hex wrenches that come with your robot to remove the two 3mm button-head screws that fasten the robot’s Nose to the underside of the sonar ring and to the underside of the Body. Swing the unfastened Nose towards the left side of the robot, and carefully unplug the following cables, noting the orientation of each connector:

- Fan
- Speaker
- Hard-Disk Drive

![Figure 1. Screws that affix the Top Plate on the Pioneer 2 DX](image-url)

Figure 1. Screws that affix the Top Plate on the Pioneer 2 DX
Step 3: Remove Top Plate.

**DX Model:**

Using the hex wrenches that came with your robot, remove the six 3mm flat-head screws that attach the top plate of the Pioneer 2 DX to the sides of its Body. They are the three rear-most screws on each side. Do not remove the screws that attach the microcontroller board and the front sonar ring to the top plate (see Figure 1).

Also remove the eight 4mm screws from the two wheel struts and remove the struts from the wheel axles.

**AT Model:**

Remove the sixteen 3mm flat-head screws that attach the top plate to the Body. All of the screws are to the rear of the robot, along the sides and around the Accessory door. Do not remove the screws at the front of the robot or around the Console.

**PTZ Robotic Camera Owners:**

Remove the VISCA, power, and video signal cables from the rear of the camera. Then, remove the three 3mm flat-head hex screws that attach the camera mounting plate to the robot's Top Plate. Lift the camera and mounting plate away and set aside.

**All Models:**

Lift the top plate a few centimeters from the robot's body and carefully unplug the following cables after noting their position on the robot (see Figure 2):

- 10-wire twisted-pair flat-cable from the rear sonar ring (if present)
- All of the cables attached to the rear of the microcontroller board, including the 20-wire ribbon cable and any 10-wire ribbon cable(s) to the serial port(s).

![Pioneer 2 Microcontroller Connectors and Controls](image)

Figure 2. Pioneer 2 Microcontroller Connectors and Controls
Step 4: Wiring

Power

Connect the two forked terminals of the 20” laser power cable (yellow and black twisted-pair wires) to the screw terminals located on the battery board at the back, right side of the robot (the terminals nearest the robot's main fuse). Route the wires to the center of the robot, near where the access portal is on the Top Plate.

Signal

Working through the robot's Nose section, insert the accessory serial cable for the laser into the 20-position COM3/COM4 header on the onboard PC (Figure 3). If you have a DX, route the wire through one of the slots on either side of the computer. With an AT, route the serial cable over the top of the computer to avoid possible entanglement with the power train.

Lay the power and serial cables together near the center of the robot.

Figure 3. Serial COM3/4 connector on the AmPro P5e Littleboard®

PTZ Robotic Camera Owners:

You need to extend the camera's power and signal cables to reach to the top of the laser. First, unplug the 12-position auxiliary power connector from the robot's Motor/Power board. Use a pointed instrument to press down the locking tabs in the connector and pull out the two wires for camera power from the brown 12-position connector. Note the exact locations from which you removed the wires—you will need to reinstall the extension cable in the same locations.

Carefully bend the locking tabs back out of the metal connectors. Insert the contacts into the two-position brown connector included with your kit. Be sure the polarity (color coded yellow and black) matches the connector on the power extension cable provided in your kit. Finally, insert the metal connectors of the extension into the brown power connector that you had originally removed from the robot. Polarity is critical!
Step 5: Remount the Top Plate and Nose

First remove the plug from the access portal in the center of the robot's Top Plate. And on the AT, remove the accessory door.

Hold the Top Plate a few centimeters above the Pioneer 2 Body and reattach the 10-wire rear sonar cable (if present) to the rear sonar controller and each of the previously unplugged cables to the rear of the microcontroller. Make sure that you insert the "host" serial cable into the HOST port, and the "aux" serial connector (if present) to the AUX port. You can damage the microcontroller and an attached accessory if you get things backwards.

Draw the power and signal (serial) cables for the laser through the access portal in the center of the Top Plate.

PTZ Robotic Camera Owners:

Draw the power and video connectors through the access portal. And insert the VISCA serial cable that came with the Laser kit through the portal and plug the 20-position connector into the AUX serial port.

All Robots:

Set the Top Plate onto the robot's Body and align the 3mm mounting holes. Reattach the Top Plate to the Body with only the front 3mm hex screws—the rear ones also secure the laser to the Top Plate (see next Step 6). And reattach the wheel struts on the DX model with the 4mm screws.

Reattach the computer cable connectors and Nose hardware to the front of the Pioneer 2.

CAREFUL! Re-attaching the hard-disk drive cable incorrectly will permanently damage both the drive and the onboard PC.

Step 6: Mount the Laser

Place the laser bracket on the center of the robot's Top Plate. On the AT, it covers the accessory well. Attach the bracket to the four rear Top Plate mounting holes using the four 3x10mm flat-head hex screws provided with your laser integration kit.

Attach the white power and black signal (serial) connectors for the laser to their mating connectors on the laser bracket.

PTZ Robotic Camera Owners

Route the power, video, and VISCA cables along the back and out through the round access hole at the back of the laser mounting bracket.

On the camera, remove the retaining screw from the bottom of the mounting bracket and use it to attach the new mounting bracket that accompanies the laser kit. Then, use its original 3mm screws to mount the camera bracket and camera to the top of the laser bracket.

Insert the video and VISCA connectors, but not the power connector, into their respective sockets on the camera.

Turn the robot Main Power on and test the voltage on your camera's power plug with a voltmeter. The center pin of the connector should be +12-14 volts (battery level) and the outer housing of the connector should be ground. If the polarity got reversed when you installed the power extender, you could severely damage the camera in a fashion that will not be covered by its warranty.
Loosely position the SICK laser in the mounting bracket (laser window facing front of the robot), and install the serial and power cables into the top connectors (DB9M and DB9F). Then, slide the laser into the bracket and secure with the four 8mm button-head hex screws provided with laser integration kit.

**Step 7: Software Installation and Testing**

The Laser Integration Kit comes with a software plugin that enables the laser as a range-finding sensor with the Saphira robotics client. Both a Linux and Win32 version of the plugin come on the 3.5-inch disk. Consult the accompanying README file on that disk for detailed installation instructions.

Briefly, copy the sicklrf.tgz or sicklrf.EXE into the top-level directory of your Linux or Win32 Saphira distribution, respectively. Then, either double-click on the self-extracting archive (.EXE) under Win32, or unzip/untar the Linux file:

```
% tar -zxvf sicklrf.tgz
```

A directory containing the sicklrf plugin source and make files will be created in the `$(SAPHIRA)/devices` path, and a precompiled plugin—sicklrf.so or sicklrf.dll—gets put in the `$(SAPHIRA)/colbert` path.

To integrate the laser software with a Saphira client, load it, either through a Colbert command interactively or in the `init.act` or related start-up file:

```
> load sicklrf
```

Or, at any time while operating the Saphira client, pull down the File menu and select Load file and choose sicklrf.so or sicklrf.dll.

Once the plugin is loaded, turn on the laser power, and issue the following command to initialize/start the laser:

```
> sfStartLRF(0,"<serial port>",38400,0,0);
```

(Of course, replace `<serial port>` with the connected serial port name; normally `/dev/cua2` or COM3 for the onboard Linux- or Win32-based PC, respectively.)

The red and yellow indicator lamps on the top of the laser should blink for a moment, and then the green indicator lamp should light up persistently. If all goes well, blue artifacts should appear in the Saphira LPS (Main display) indicating laser-detected objects.

If not, check your power and signal connections, and retry the startup command.

Detailed laser operation command and code are in the README file that accompanies the disk.