

# **Aircraft Detection Sight Solution**

## **Doppler Radar System**

### **Product Manual**

<b>Date</b>	<b>Revision</b>	<b>Detail</b>	<b>Author</b>
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1-20-14	3	Mechanical Specs Update	MC

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## 1. Manufacturer









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## 2. Safety Information

The purpose of this manual is to provide safety and operating information for persons using the Laufer Wind Pulse Doppler Radar. The Pulse Doppler Radar is designed to operate unattended for long periods of time. Periodic maintenance or service should only be performed by Laufer Wind-approved service personnel.

The following symbols and terms may be found on the product or used in this manual.

### 2.1 Warning Label and Safety Marking Explanation

	This symbol indicates general warning or caution.
	This symbol indicates the present of high voltages in or around the unit.
	This symbol indicates the present of microwave or rf radiation in or around the unit.
	This symbol indicates the present of x-radiation in or around the unit.
	This symbol indicates the present of rotating equipment in or around the unit.
	This symbol indicates the present of magnets in or around the unit.
	This symbol indicates a protective earth ground connection point.
	This symbol indicates read user manual before operating or servicing.

## 2.2 General Safety Instructions



### READ SAFETY INSTRUCTIONS

**Servicing:** This radar product is not customer serviceable. Laufer Wind and their authorized agents only are permitted to carry out repairs.

**Product Usage:** This radar product is designed to use within the Aircraft Detection Sight Solution System, which restricts access to authorized competent personnel.

**Environmental:** This radar product is IPX0, and chemical/solvents, cleaning agents and other liquids must not be used.

**Input Parameters:** This radar product must be operated with the input parameters stated in the product limitation in this manual.

**End of Life Disposal:** This radar product contains components that require special disposal. Make sure the unit is properly disposed of at the end of its service life and in accordance with local regulations.

**Lifting Instructions:** This radar product is heavy (~125 lbs for the radar housing, plus another ~96 lbs for the radome mounting ring and radome.) Only users that are knowledgeable and capable of lifting such weight safely should attempt to lift or move the radar assembly. The Pulse Doppler Radar housing should only be lifted by mounting bars provided on either side of the housing.

**Safety Protection Impairment:** This radar product is designed to operate safely with its control computer and communication links to the radar in an active (operational) state. Electrical power should be turned off to the Pulse Doppler Radar if the control computer or communications links become inoperable. A service call should be placed with Laufer Wind, to insure user safety.



### RISK OF ELECTRICAL SHOCK

**High Voltage Warning:** Dangerous voltages are present within the radar product. A professional installer must protect service personnel from inadvertent contact with these dangerous voltages.

This radar product must be reliably earthed and professionally installed in accordance with the prevailing local electrical wiring regulations and safety standards.



### RISK OF MICROWAVE RADIATION

**Microwave Warning:** Dangerous microwave radiation is emitted by this radar product when connected to its microwave antenna. Personnel must stay at least 5 meters away from the radar when it is radiating.



#### RISK OF X-RAY RADIATION

**X-Ray Warning:** X-Radiation may be present if the radar is operated with its sides off. Laufer Wind and their authorized agents only are permitted to operate the radar with sides removed.



#### RISK OF CRUSH and CLOTHES HAZARD

**Crush and Clothes Hazard Warning:** The radar operates with a rotating antenna that can pose a crush and clothes hazard when the radome is removed from the radar.

### 3. Radar Description and Specifications

The purpose of the ADSS Pulse Doppler Radar is to detect and track aircraft and other objects that are flying within specified ranges of a Wind Turbine Park. Doppler Radar measurements are used by the ADSS Central Controller to determine if aircraft are approaching the Wind Park, and to turn- on Obstruction Light Modules to warn-off incoming aircraft that are approaching too close to the Wind Park.

#### 3.1 Electrical Specifications

Description	Specifications
AC input voltage	100-240 VAC, single phase, neutral with ground
AC line frequency	50/60 Hz nominal
AC input power	550VA/500W (maximum)
Microwave output power	12 kW (peak)
Microwave pulse duration	500 nanoseconds
Microwave pulse recurrent frequency	2000 pulses per second
Microwave average power	12 W
Microwave frequency	9.4 GHz nominal (X-Band)

#### 3.2 Control Signal and Electrical Connections

Description	Specifications
Ethernet control cable	CAT/6 cable and connector, supplied by Laufer Wind
AC input power	3 conductor, 16 GA SO cable and 9 pin Amphenol, supplied by Laufer Wind

### 3.3 Mechanical Specifications

Description	Specifications
Size	13 in wide x 15.5 in deep x 35 in high (33 cm x 39 cm x 89 cm)
Weight	Radar: 120 lbs (54.4 kg) Mounting Ring: 62 lbs (28.1 kg) Radome: 34 lbs (15.4 kg)
Antenna	48.6 in wide x 17.0 in deep x 10.5 in high (123 cm x 43 cm x 27 cm)
Mounting	Vertical in radome ring assembly
Cooling	Ambient air cooling
Radome	59 in dia x 45 in high (hemisphere) (150 cm dia x 114 cm high)
Warning labels:	<ul style="list-style-type: none"> <li>• Hazardous voltage</li> <li>• Hazardous microwave radiation</li> <li>• Hazardous x-radiation</li> <li>• Crush and clothes hazard</li> </ul>

### 3.4 Environmental Specifications

Description	Specifications
Operating ambient temperature	-40 degC to +50 degC
Operating humidity	5-85 % humidity (non-condensing, no ice formation)
Operating pressure	75 to 105 kPa (-1000 ft to 8000 ft MSL )
Storage and transport temperature	-40 degC to +70 degC
Storage and transport humidity	5-95 % humidity (non-condensing, no ice formation)
Storage and transport pressure	75 to 105 kPa (-1000 ft to 8000 ft MSL )

## 4. Maintenance

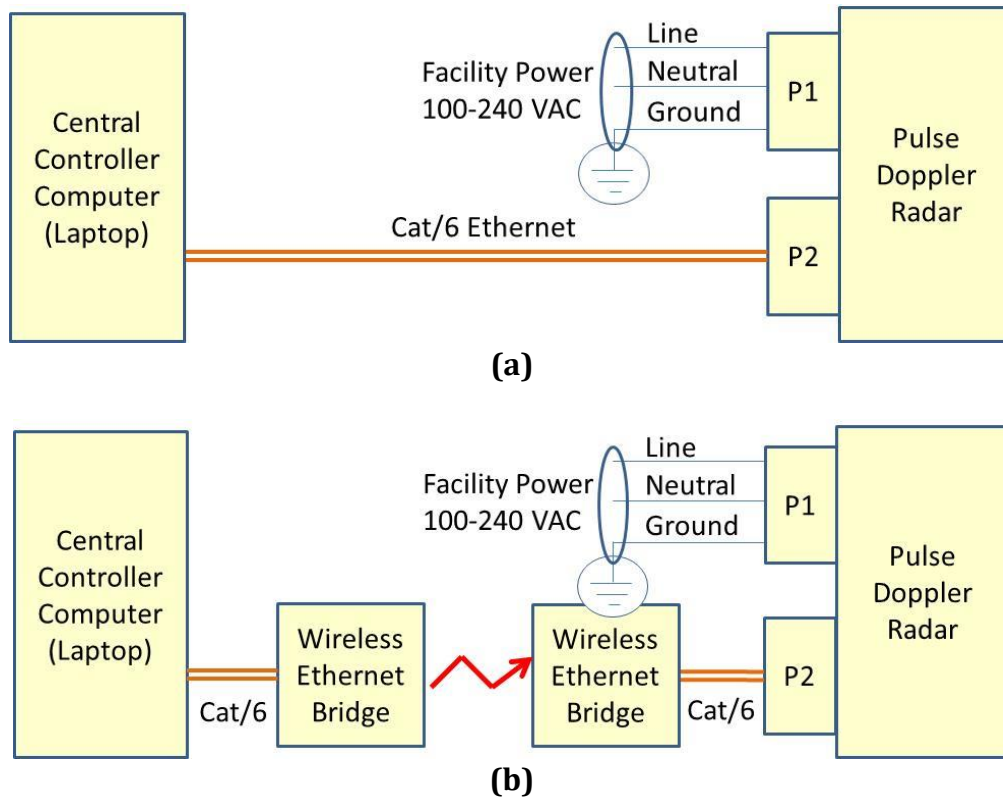
The Pulse Doppler Radar is designed to operate unattended for long periods of time. Periodic maintenance or service should only be performed by Laufer Wind-approved service personnel.

## 5. Operating Instructions

The instructions below describe how to connect AC power and communications to the Pulse Doppler Radar, and how to turn on and off, and control Radar operation through a Central Controller computer and software

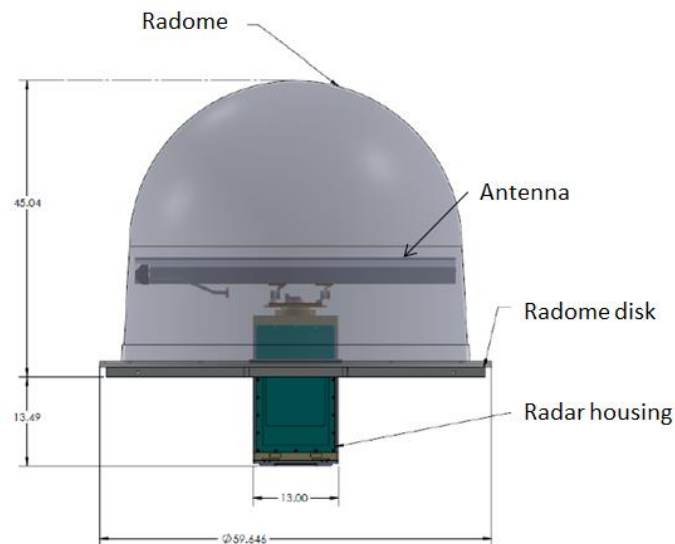
### 5.1 Power and Ethernet Connections

The Pulse Doppler Radar is operated and controlled by a Central Controller computer through its graphical user interface (GUI). A CAT/6 (shielded) Ethernet communication cable connects the Radar to the Central Controller computer (typically a laptop). The Figure 1 block diagram shows how the Pulse Doppler Radar and Central Controller computer can be connected, either (a) directly via a CAT/6 (shielded) Ethernet communication cable, or (b) remotely via a wireless Ethernet bridge. The Radar is connected to a single-phase (line-neutral-ground) 100-240V AC power source through connector P1.

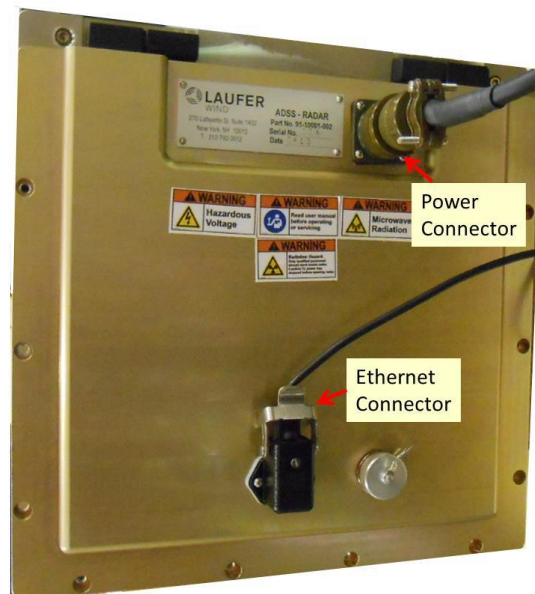


**Figure 1. Block diagram showing AC power and Ethernet connections needed to operate the Pulse Doppler Radar with a Central Controller computer. (a) Central Controller can communicate directly with the Radar through a CAT/6 Ethernet, or (b) remotely using a wireless Ethernet bridge.**

Figure 2 shows a drawing of the Pulse Doppler Radar housing and antenna, and radome assembly. The Radar housing and it's antenna is designed to mount on a Radome/disk assembly. Figure 3 shows the input AC power cord and CAT/6 Ethernet cable connections at the bottom of the radar housing. Once AC power and Ethernet are connected, the Radar can be controlled by the Central Controller GUI.



**Figure 2. Pulse Doppler Radar assembly drawing.**



**Figure 3. Photograph showing how AC power and Ethernet cables are connected to the Pulse Doppler Radar.**

## 5.2 Radar Operation

These instructions cover the steps needed to operate the Pulse Doppler Radar system with a Central Controller computer. These are general user oriented instructions, and it is assumed that the system has been correctly configured for network communications.

### System Requirements

1. A single Central Radar Controller computer
2. One or more Pulse Doppler Radars

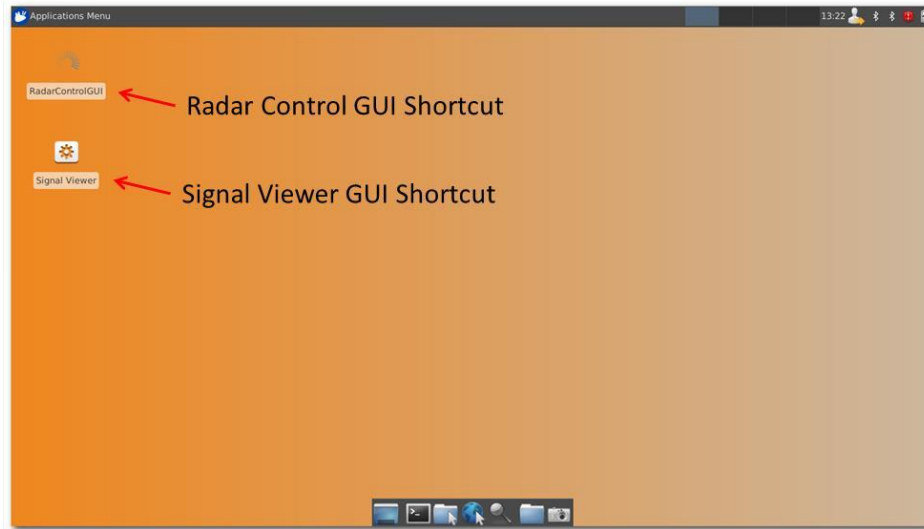
#### 5.2.1 Radar Control GUI Operation Procedure

The discussion below provides a step-by-step procedure for launching the Central Controller software for controlling the Radar.

1. Power up and log into the Central Radar Controller computer.
  - a. User name is “*radar*”.
  - b. Password is “*radar*”.
2. For hard-wired network interface connections (similar to Figure 1a):
  - a. If a single Radar is used, an Ethernet communication link can be connected directly to the Central Radar Controller network interface.
  - b. If multiple Radars are used, individual Radars will be configured with unique IP addresses. The Ethernet cables to the Radars should be connected to a network switch, along with the Central Controller.
3. For wire-less network interfaces (similar to Figure 1b):

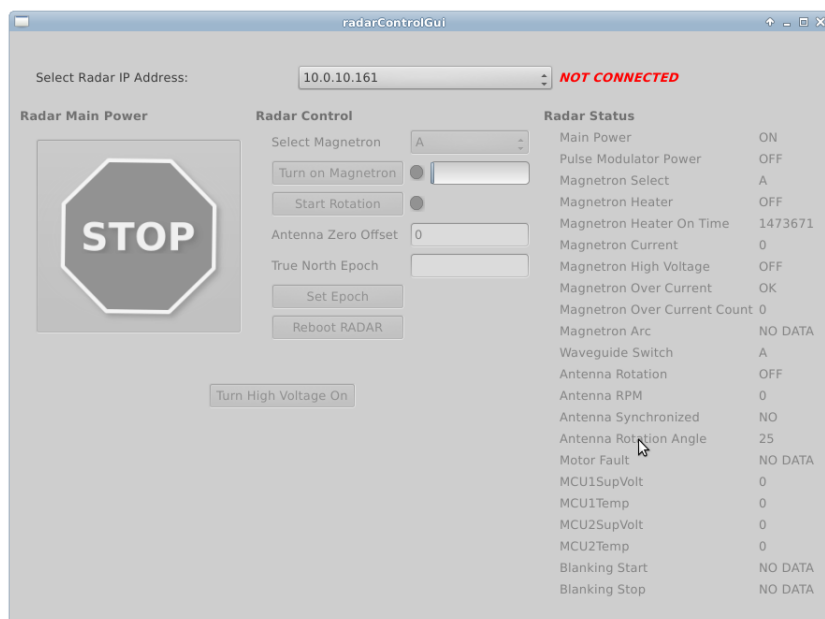


- a. The Central Controller can control multiple Radars remotely through a wireless Ethernet bridge. The network configuration will support multiple Radar IP addresses through the wireless Ethernet, and Central Controller will be able to communicate with individual Radars by select their respective IP addresses.
4. Start the Radar Control GUI.
  - a. On the Central Radar Controller desktop screen shown in Figure 4, double click the icon labeled ***"RadarControlGUI"***.



**Figure 4. Central Controller desktop screen shot.**

- b. The program will initially display a new Radar Control GUI screen similar to Figure 5, with status as ***"Not Connected"*** until a Radar Processor connects.



**Figure 5. Screen shot showing the Radar Control GUI before it makes communications connection with a Radar.**

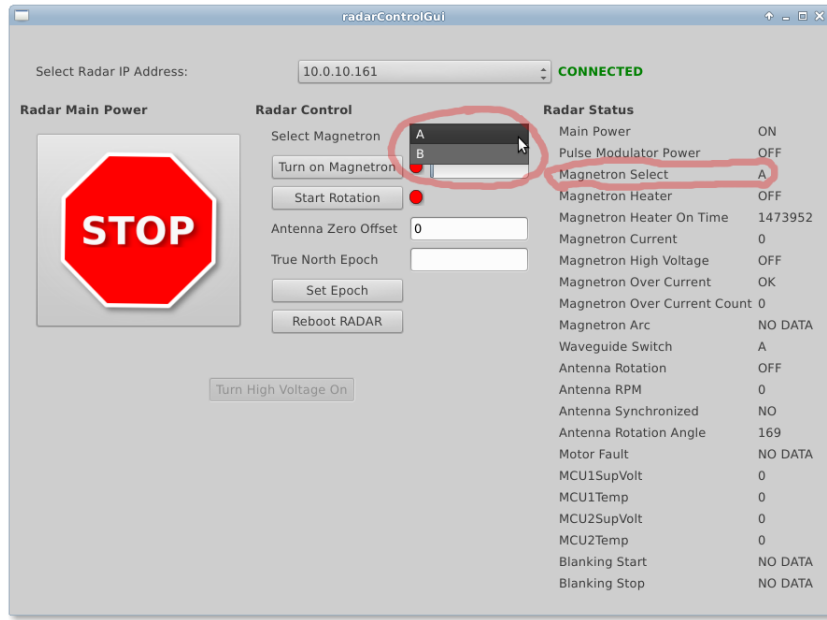
5. When the Radar Control GUI has connected to the Radar Processor, the GUI should resemble that shown in Figure 6. Note that the Radar Status values in the right-hand column are updated periodically.

**IMPORTANT:** If for any reason, it is necessary to quickly shut down the radar, clicking the big “Red” stop button will shut it down, as long as the communication status is connected. Otherwise, remove AC power to the radar if necessary.



**Figure 6. Radar Control GUI when connected to a Pulse Doppler Radar.**

6. Once the Radar Control GUI has connected, select the Radar to use by choosing its IP address in the “Select Radar IP Address” drop-down box.
  - a. If only one Radar Processor is connected to the Central Controller, it will be selected by default.
7. Now select a Magnetron (either A or B) for the microwave source, by choosing from the “Select Magnetron” drop box.
  - a. The selected magnetron should match the *Magnetron Select* field in the status column (Figure 7).



**Figure 7. Radar Control GUI showing Magnetron Select feature.**

8. Turn on the Magnetron by clicking on the *Turn on Magnetron* button. The button command will change to *Turn off Magnetron* (Figure 8). The colored indicator beside the button will turn yellow and a timer will start counting while the magnetron heater warms up (90 seconds heating time).



**Figure 8. Radar Control GUI showing Magnetron Turn-on feature.**

9. The Antenna can be made to rotate (or turned off) at any time by selecting the “Start Rotation” button.
10. When the heating time is complete, the button, *Turn High Voltage On* will become enabled (Figure 9).

- a. **WARNING!!!**: To prevent radiation exposure, be sure that a dummy load is on the RADAR for testing. If testing with an antenna, be sure that all personnel are in a safe area before activating the high voltage. The minimum safe distance from the antenna while it is radiating is 10 meters.



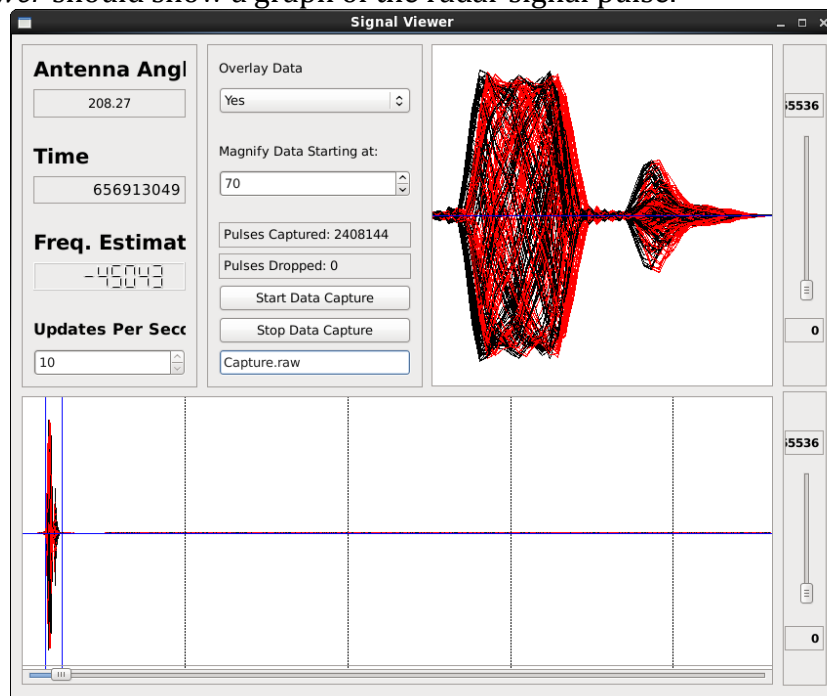
**Figure 9. Radar Control GUI showing High Voltage ready feature.**

11. Turn on Magnetron High Voltage. Click the *Turn High Voltage On* button. This will display a prominent icon that states that the Radar is radiating (Figure 10).



**Figure 10. Radar Control GUI showing High Voltage ready feature.**

12. The Radar will stop radiating when the High Voltage Off button is selected. Selecting the large red *Stop* button will deactivate the radar. This will put the system in a state described in Step 6, and the magnetron will have to go through another heating cycle before the radar can produce microwave radiation.
13. **Optional Signal Viewer Application.** Once the Radar Processor application has launched (Step 4 above) , it is possible to view the microwave pulse waveforms from the Radar. This is done by double clicking the **"Start Radar"** icon on the Central Controller desktop screen.
  - a. After double clicking the **StartRadar** icon, the *SignalViewer* should appear after a few seconds. The signal graph will initially be a flat line. Later, when the magnetron high voltage is turned on, the signal should appear similar to above (see Figure 11).
  - b. Once the RADAR high voltage has turned on and the device is radiating, the *Signal Viewer* should show a graph of the radar signal pulse.



**Figure 11. Screen shot showing the Signal Viewer GUI showing Radar microwave pulse waveforms.**

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