



# Portable Laser Guidance System

## Users Manual

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2014

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# 1.0 Introduction to Portable Laser Guidance System

## 1.1 Overview

This guide describes the features of the Portable Laser Guidance System as intended for use with CLASS IIIb lasers during celestial tours of the night sky. The main components of the system are the Laser Housing, multi-axis Camera Turret, Adjustable Tripod, Power Supply, and Joystick Controller (not pictured), as seen in Figure 1 below.

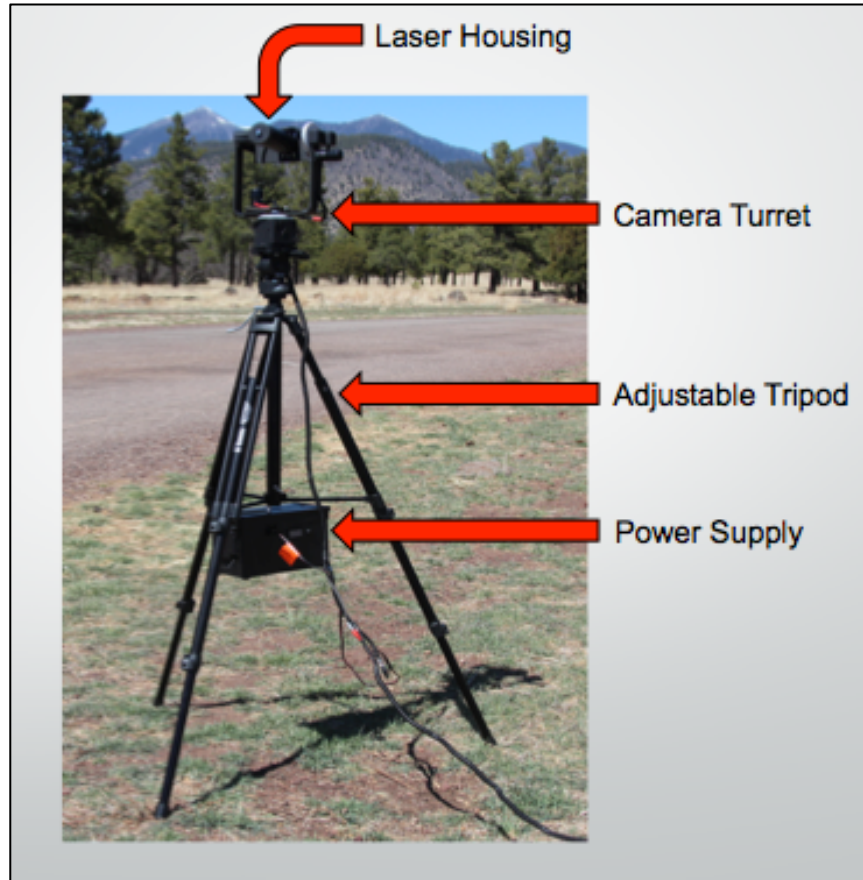


Figure 1 – System Overview

This product is designed for use of a 20 mW Green Laser Pointer during star talks and mitigates the risk of human harm to audience members if assembled properly (see 3.3 Critical Specifications). The system is designed to accommodate multiple laser models with different on / off button positions.

## 1.2 Specifications

The Portable Laser Guidance System specifications are as follows:

Component	Function	Details
Laser	View Distance	Up to 1000 meters
	Operating Range	Between 15-35 Degrees Celcius
	Wave Length and Power	532 nm and 20 mW
Turret	Weight Capacity	5 lbs
	Degrees of Rotation	Pan=360 degrees, Tilt=360 degrees
	Max Rotational Speed Pan & Tilt individually	6 revs/min
	Max Rotational Speed Pan & Tilt Together	4.5 revs/min
Tripod	Weight Capacity	18 lbs
	Maximum Height	96 in or 8 ft
	Minimum Operating Height	78 in or 6.6 ft
Power Supply	Charging Time	~ 8 hrs
	Run Time	~ 8 hrs

This system is designed for theoretical continuous use for up to approximately 8 hours. Actual operating time may vary depending on weather conditions and operation.

## 2.0 Components

### 2.1 Tripod

The tripod model used for this product is a ProVista 18 Tripod and is manufactured by Davis & Sanford.



Figure 2 – Tripod [1]

The Davis & Sanford tripod is a three-section tripod made with black anodized aluminum. The top section is a self-locking center column, designed for maximum rigidity and no-drift during operation. The legs of the tripod

are telescopic and include quick flip leg locks for fast setup and quick takedown. For the system to be used as intended, the quick connect should be aligned parallel with the ground, the tilt handles removed, and the legs fully extended.

## 2.2 Turret

The multi axis camera turret is manufactured by Camera Turret Technologies, Inc and was modified for this system. Modifications include rewiring from BNC to AV connections, repositioned pan motor, and the addition of a limited angle slip ring. The final iteration of the Camera turret used in the system is shown in Figure 3 below.

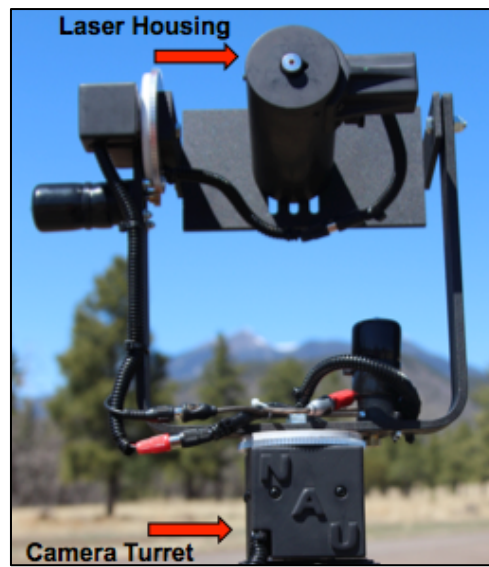


Figure 3 – Turret and Laser Housing

## 2.3 Laser Housing

The Laser Housing was designed in order to mechanically depress the power button on the laser and to insulate the laser so that it remains in the optimal operating temperature range from 15-35° Celsius. The laser housing is made out of Delrin because of the low thermal conductivity. It comes fully assembled and is ready for the laser to be inserted and to be mounted on the camera turret as seen in Figure 3 above. The entire assembly for the laser housing, in an exploded view, is shown in Figure 4 below.

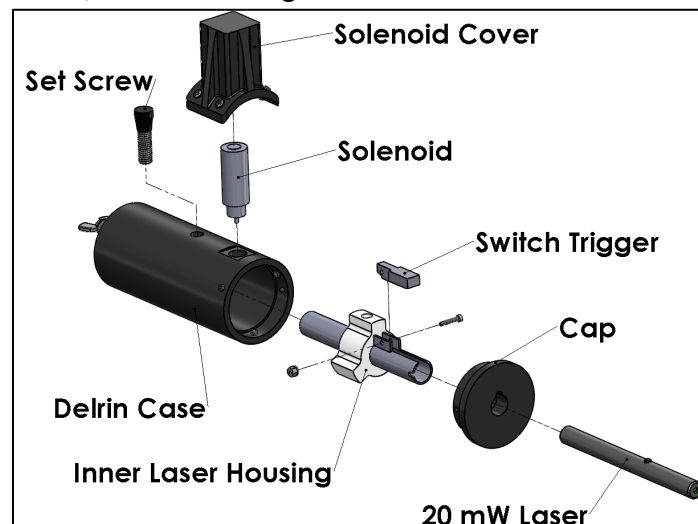


Figure 4 – Exploded View of Laser Housing

Starting from the top: The solenoid is a device that turns the laser on and off by thrusting the switch trigger forward and engaging the lasers power button. The solenoid is protected from the elements using the solenoid cover. The inner laser housing holds the laser in the center of the case, which is made out of delrin because of the low thermal conductivity and high resistance to heat loss in the system.

## 2.4 Laser

The Portable Laser Guidance System is designed for 20mW Green Laser Pointers and can accommodate multiple models that have different power button locations. These lasers require 2 AAA batteries to operate and are considered Class IIIB lasers. A typical 20mW laser design is shown in Figure 5 below.



Figure 5 – Green Laser Pointer [2]

## 2.5 Power Supply

The Portable Laser Guidance System is powered by a 12Volt battery and is housed in a black box for convenience and system mounting. The power supply features a digital voltmeter and power switch for the meter in order to monitor battery power during use. Voltage in the battery will remain relatively constant until it is nearly dead where it will drop voltage rapidly. There is an access port in the power supply that is used for charging and for normal use. A spring action, aluminum post, is located at the top of the power supply and is used to mount to the system with a dowel pin. The power supply can be seen in Figure 6 below.

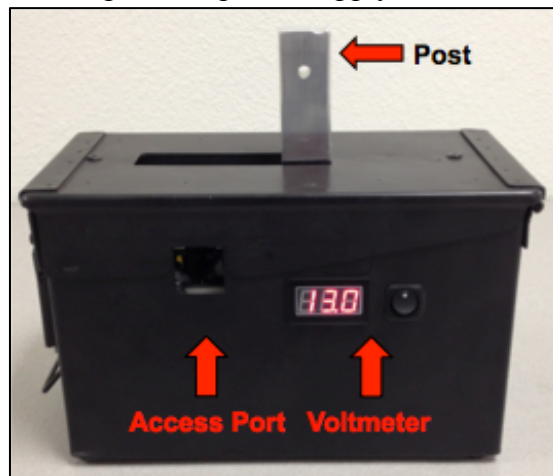


Figure 6 - Power Supply

## 2.6 Wiring

In order to power the system, wires are provided to connect the motors and solenoid to the power supply. There is also a charger that can be plugged into any wall outlet to charge the power supply. More details are described in the assembly portion of this manual, section 3.2.

## 2.7 Joystick

A wired handheld joystick controller is provided with the system to control the laser beam. The controller functionality is described in detail in the laser operation, section 4.4

## 3.0 Getting Started

### 3.1 Unboxing

The system is stored in three containers. The duffle bag contains the tripod and the black ammo box is the power supply and also serves as additional storage. The Bosch container stores the turret, laser housing, laser, controller, and required wires. See Figure 7 for details of the system containers.

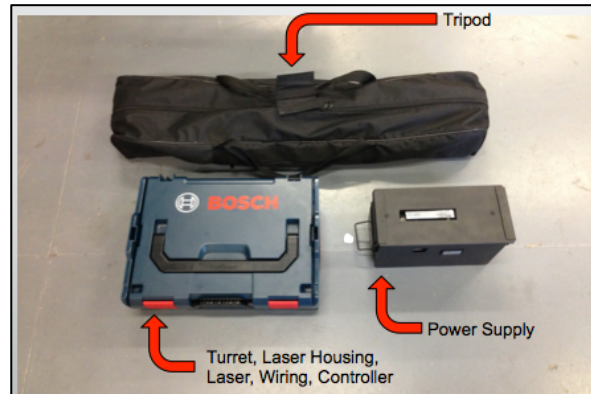


Figure 7 – Storage Containers

### 3.2 Assembly

- Step 1) Remove tripod, fully extend tripod legs, and lock legs in place.
- Step 2) Attach laser housing to the turret, secure in place with wing nuts, and connect AV wires together. **NOTE: Connect the Black AV connections together and Red-Silver AV connections together.**
- Step 4) Insert laser into the laser housing with the on/off button orientated with the notch in the lid. **NOTE: Ensure laser is fully inserted at maximum depth and secure laser with set screw on laser housing.**
- Step 5) Attach turret to tripod using the camera quick connection. Lock into place using lock lever on tripod. Raise laser to desired height using the crank lever and lock into place. **NOTE: Min height = 6.5 ft and Max height = 8 ft.**
- Step 6) Mount the power supply by inserting aluminum post into center post of tripod and lock into place with pin and clip.
- Step 7) Connect wiring harness to joystick according to Figure 8 below. Connect remaining three AV connections from turret to the system wires that run to the camera turret. **NOTE: Connect the Black AV connections together and Red-Silver AV connections together.**

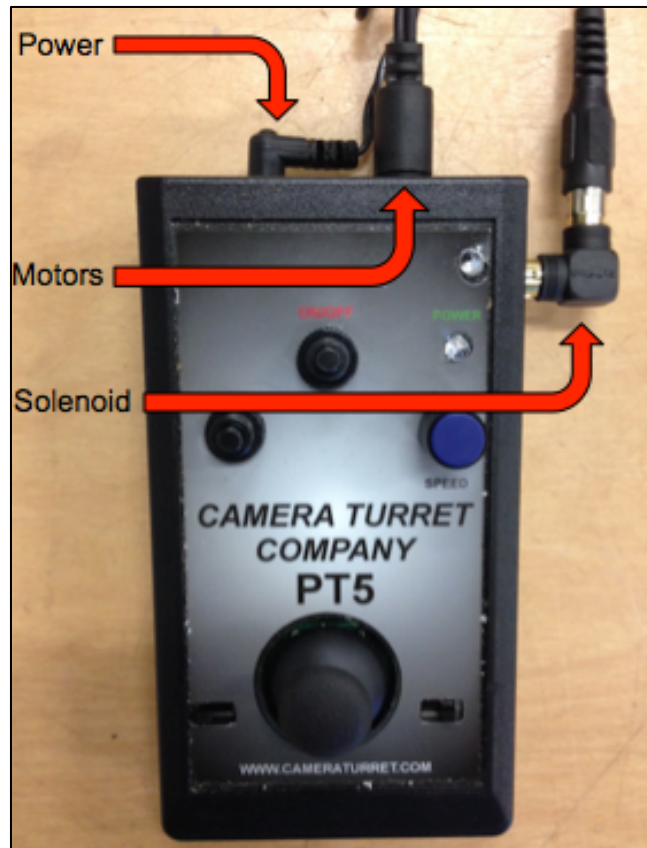


Figure 8 – Joystick Controller Wiring

### 3.3 Critical Specifications

To mitigate the risk of human harm during use of a class 3IIIB laser, ensure the following specifications are met:

- 1) The tripod legs need to be fully extended in order for the laser to be at minimum the minimum height of 6.5ft for safe operation.
- 2) Ensure the camera turret is orientated upwards relative to the ground and locked into place with the locking lever.
- 3) Ensure safety cap is installed on the laser or a finger is placed over the emission hole when installing or removing laser from the housing. The laser can power on during installation and the cover will protect observers and or the installer from inadvertent harm.

## 4.0 Operation

Once the system is fully assembled and the critical specifications in section 3.3 are met, the product is ready for use. Reference Figure 9 below for sections 4.1 through 4.4 when describing the Portable Laser Guidance System operation.





Figure 9 – Laser Operation

#### 4.1 Power On

The system power button is located at the top of the controller. A green light will illuminate indicating that power is being supplied to the system. **NOTE: The joystick MUST be in the neutral position for approximately three seconds after the system is powered on.**

#### 4.2 Laser On/Off Toggle

The laser power button is located at the upper left section of the joystick controller and will illuminate another LED light when the laser is in the power on position. When the laser is orientated in the operating range, at least 20° above the horizon, the laser will toggle on and off using this button. If below the 20° threshold, the button will not function and the laser will remain powered off, thus eliminating the risk of eye damage.

#### 4.3 Speed Control

The dial located on the upper right section of the controller adjusts the speed of the multi axis camera turret motors, making the laser travel faster or slower. Clockwise increases speed to a max of 6.5 revolutions per second and counterclockwise decreases speed to a minimum of 0 revolutions per second.

#### 4.4 Joystick Control

The joystick controls the two axis of rotations: The up and down movement or tilt rotation and the left and right direction or pan rotation. The switches on the lower left and right of the controller invert each axis to accommodate user preference.

## **4.5 Battery Status**

During operation, the user may turn on the switch that is located on the power supply to monitor the battery voltage of power supply. The voltage will remain relatively constant until it is nearly dead where it will drop voltage rapidly. The user may also choose to keep the voltmeter on and continuously monitor the voltage of the power supply, however this will reduce overall battery life slightly.

## **5.0 Maintenance**

The following section will describe how to perform routine maintenance on the Portable Laser Guidance System.

### **5.1 Laser Battery Replacement**

The laser batteries may occasionally need replacing during the lifetime of use for this system. When the batteries are ready to be changed, remove the laser from the laser housing with a safety cap or finger over the emission hole of the laser. Unscrew the back of the laser and replace the two AAA batteries. Screw on the back of the laser, cover the emission hole, and reinsert it into the laser housing with the power button orientated with the slot in the cap.

### **5.2 Charging Portable Laser Guidance System Power Supply**

After using the Portable Laser Guidance System during an astronomy talk, it is recommended that the power supply be charged. To charge the power supply, remove the system wiring from the power supply, dismount the power supply from tripod, plug the charging cable into the access port of the power supply, and then plug the adapter into a standard home outlet. Charge the system for approximately eight hours; the battery can be charged overnight.

### **5.3 Slip Ring Cleaning**

The electrical slip ring located on the tilt motor of the multi axis turret may occasionally need to be cleaned if corrosion or markings due to wear prevent the transmission of electricity to the solenoid. To clean, use a paper towel and standard household cleaner and clean the visible surface of the contact. If more cleaning is needed, rotate the tilt motor to access the remaining surface of the slip ring.

## **6.0 Troubleshooting**

### **6.1 Laser Not Illuminating**

If the laser is not illuminating during use, check the following possible issues:

Batteries in the laser are dead, the laser is oriented out of operating range (below 20° of the horizon), the power supply battery is dead, or the laser orientation in the laser housing is not correct (switch trigger not aligned to properly push the button).

### **6.2 Laser Works Intermittently**

If the laser is working but turns on intermittently during use, check the following possible issues:

Slip ring located on the tilt motor of the camera turret need cleaning, laser battery dying.

### 6.3 Turret Malfunction

If the camera turret is not working properly during use, check the following possible issues:

Joystick was not in the neutral position for at least three seconds during system power on (power the system off and power back on), Camera Turret gears not meshing properly, AV connectors not fully connected.

### 6.4 Power Supply Malfunction

If the power supply malfunctions during use, check the following possible issues:

Power supply battery dead, wiring harness plug not fully inserted, battery failure (contact manufacturer for warranty information).

### 6.5 Tripod Malfunction

If the tripod malfunctions during use, check the following possible issues:

The center column not locked into place, tri-pod legs not locked, tripod height not locked, tripod rotation not locked into place.

## 7.0 Warranty and References

In the event that a custom part has failed and needs to be replaced, contact the NAU machine shop to fabricate a replacement part. See Appendix A for CAD drawings of custom parts.

Component	Manufacturer	Address	Phone Number
Turret	Camera Turret Company	7 Nel Bonney Road Plympton, MA 02367	781-585-7400
Tripod	Davis & Sanford	90 Oser Avenue Hauppauge, NY 11788	631-273-2500
Power Supply	Wave Length and Power	P.O.Box 620978 Middleton, WI 53562	800-348-0751
Replacement Parts	NAU Machine Shop		

[1] "Davis & Sanford ProVista F12." <http://www.tiffen.com/>. Tiffen Company. Web. 9 Dec 2013. <[http://www.tiffen.com/userimages/D&S\\_Product\\_Sheets/D&S\\_ProVistaF12\\_ss.pdf](http://www.tiffen.com/userimages/D&S_Product_Sheets/D&S_ProVistaF12_ss.pdf)>.

[2] "New Products: MVN Awinda / MVN BIOMECH Awinda." Xsens : 3D Motion Tracking. N.p., n.d. Web. 09 Dec. 2013. <<http://www.xsens.com/>>.

# 8.0 APPENDIX A – CAD Drawings

