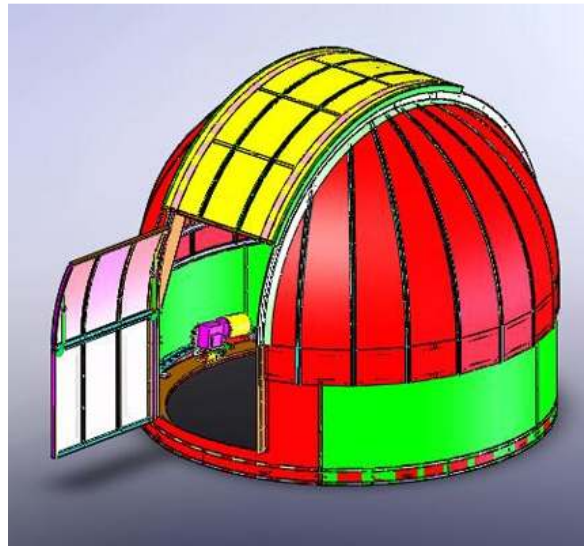


DCS (Dome Control System) Version 1.0 User's Guide



PTD1



PTD2

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Introduction

The Pier-Tech DCS (Dome Control System) is an automation system designed specifically for Pier-Tech Dome 1 and Pier-Tech Dome 2 observatories. The controller provides automatic control of the dome's shutters (Aperture) and rotation (Azimuth) – both locally and remotely with a PC.

The system consists of the following two main components:



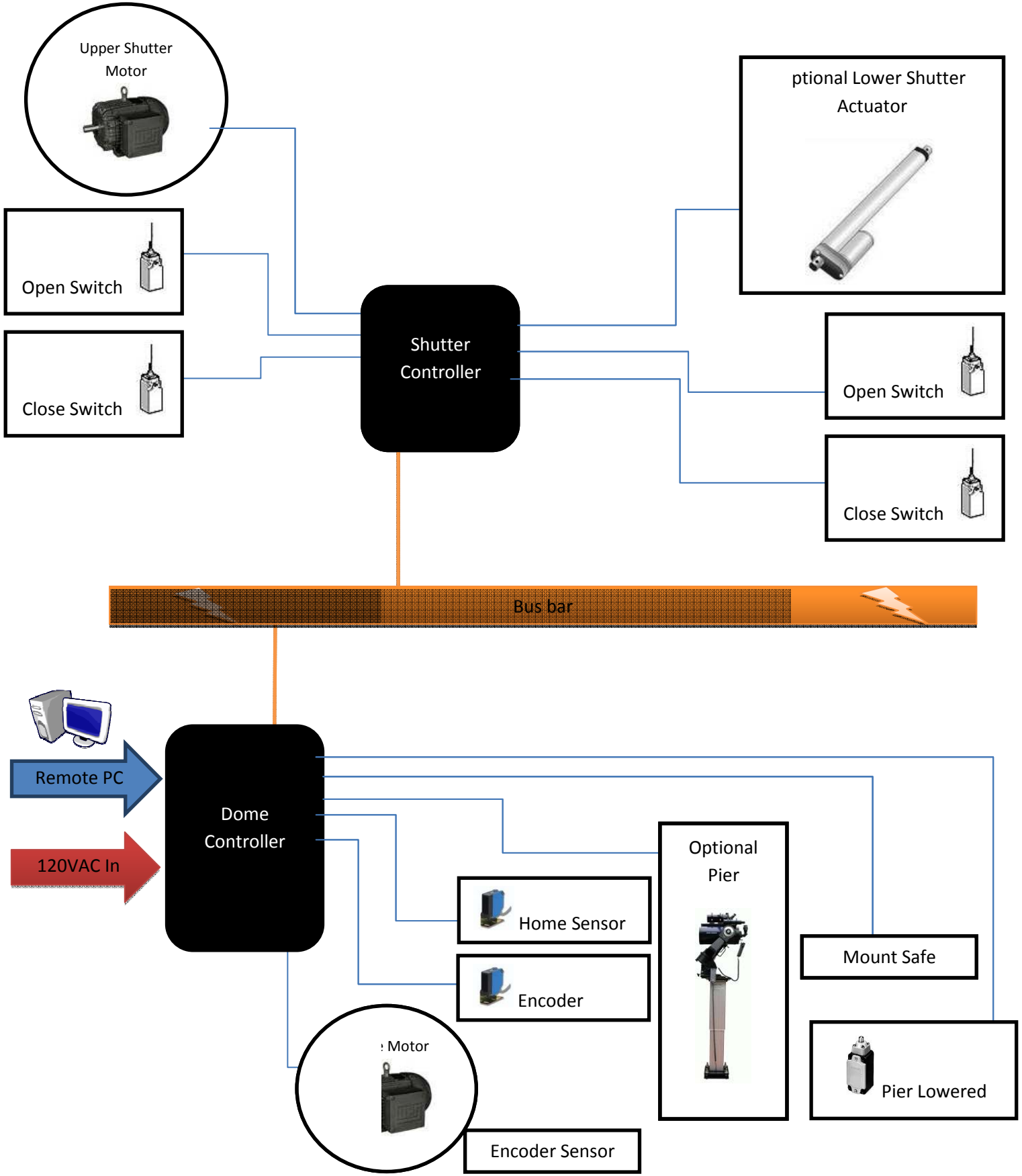
Dome Controller – The main control center and power module: this facilitates power to the entire system and a touch screen for local control.



Shutter Controller – The remote power module for controlling the upper and lower shutters. This gets power and communications from the dome's Bus Bar.

Wire and Cable Connection Diagram

The following is a general connection overview of the DCS:



120 or 220 VAC In:

The Dome Controller requires one 120VAC input. This circuit should be protected using a 15 Amp circuit breaker.

Remote PC:

The Dome Controller has one RS-232 PC connection for use with external control.

Dome Motor:

A 3-phase 220V motor is used to rotate the dome. A 4 pole quick disconnect plug is used to connect the motor to the bottom of the Dome Controller. **DO NOT DISCONNECT/CONNECT WHILE THE DOME IS POWERED.** The size of the motor (HP) can vary based on the size of the dome. The speed of the motor can be adjusted only from inside the Dome Controller enclosure. *Consult Pier-Tech directly for more information.*

Home Sensor:

A photoelectric sensor is used to indicate that the dome is at its Home position. It is aimed at the Dome's internal wall – with a reflector placed at some point long the wall. This signal is used when *Homing* the dome. Homing the dome is used to realign all reference points (True North or Park) after a motor replacement or any mechanical change to the dome's alignment. Note that the home position is set at the factory.

Encoder Sensor:



A photoelectric sensor is used to monitor the position of the Dome. It is aimed down thru the Dome's rack, with a reflector on the other side. The sensor will turn on/off as the dome rotates. More on the encoder sensor on the pages that follow.

Pier & Pier Lowered (optinal):

Two internal relay type outputs are used to drive the Pier up and down. The Lowered switch is monitored during the process.

Mount Safe:

The Mount Parked input is an optional input that can be used to indicate to the controller that the telescope is in a safe position to be lowered. By default – a jumper is used to wire the input directly to 24v. This jumper can be removed and replaced with a compatible sensor if desired. Note that the mount parked position is set by the user.

Bus Bar (optional):

A 3 pole bus bar provides power to the Shutter Controller. The Dome Controller communicates over the Bus Bar as well (using Ethernet over Power).

Upper Shutter Motor:

Like the Dome Motor, a 3-phase 220V motor is used to open and close the Upper Shutter. A 4 pole quick disconnect plug is used to connect the motor to the bottom of the Shutter Controller. **DO NOT DISCONNECT/CONNECT WHILE THE DOME IS POWERED.** The size of the motor (HP) can vary based on the size of the dome. The speed of the motor can be adjusted only from inside the Shutter Controller enclosure. *Consult Pier-Tech directly for more information.*

Upper Shutter Opened and Closed Switches:

Two switches are used to detect the position of the Upper Shutter. These switches communicate back to the Dome Controller, but also switch power to the motor (in case of a loss of communication – the motor will not drive too far).

Lower Shutter Actuator:

The Lower Shutter is moved with a linear DC actuator. An additional DC power supply is located inside the Shutter Controller. The speed of this actuator is not adjustable.

Lower Shutter Opened and Closed Switches:

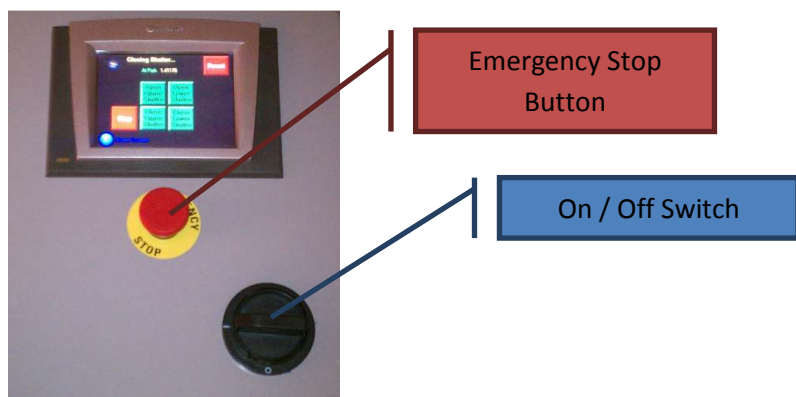
Two switches are used to detect the position of the Lower Shutter. These switches communicate back to the Dome Controller, but also switch power to the actuator (in case of a loss of communication – the motor will not drive too far).

Dome Controller User Guide

The front of the Dome Controller provides a touch screen that allows parameter changes, mode changes, and manual control of the Dome.

An Emergency Stop button is located on the front of the Dome Controller. Use this button to immediately stop all motions. Power to the touch screen will remain active. Rotate the button until it pops back out, and the controller will automatically reset.

A Black rotary On / Off switch is located on the front of the Dome Controller. This will shut off power to the entire Dome Control System (Dome Controller and Shutter Controller). The on/off switch is also a interlock, which will not allow the door of the control panel to open unless the switch is moved to the off position.



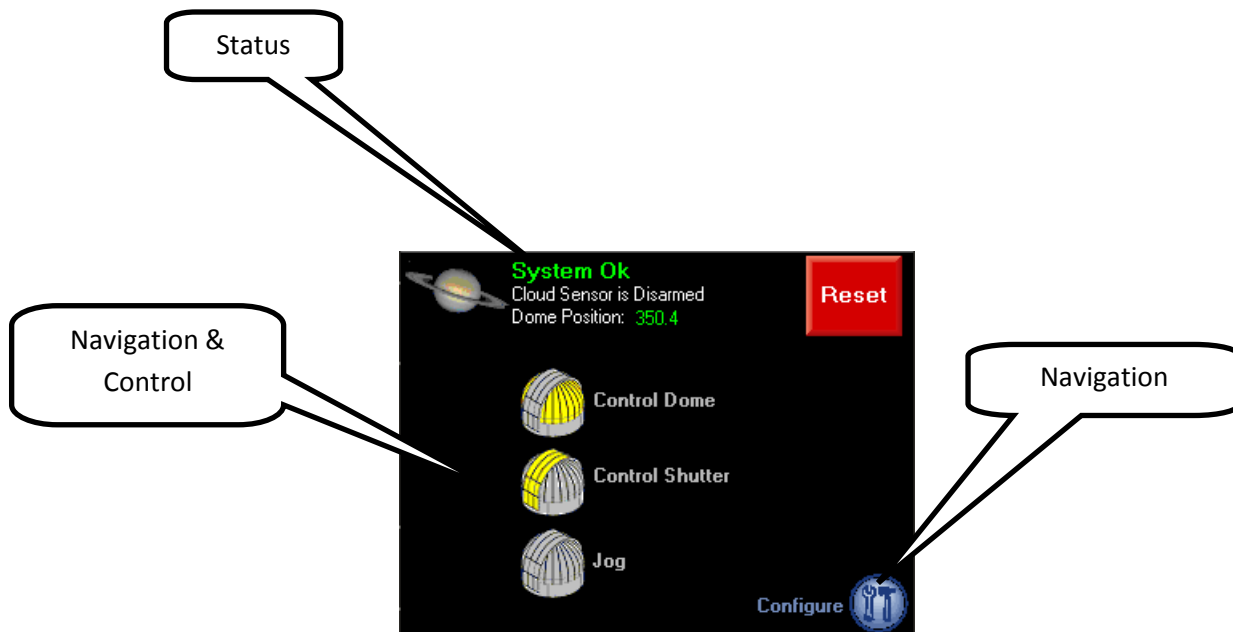
General Touch Screen Navigation

The top portion of each screen's layout indicates mode status, system status, and facilitates the Reset button for clearing error messages.

The bottom portion always includes navigation buttons.

In some cases, middle button will function as navigation buttons as well.

The lower right configure button will take you to the timer configuration page.



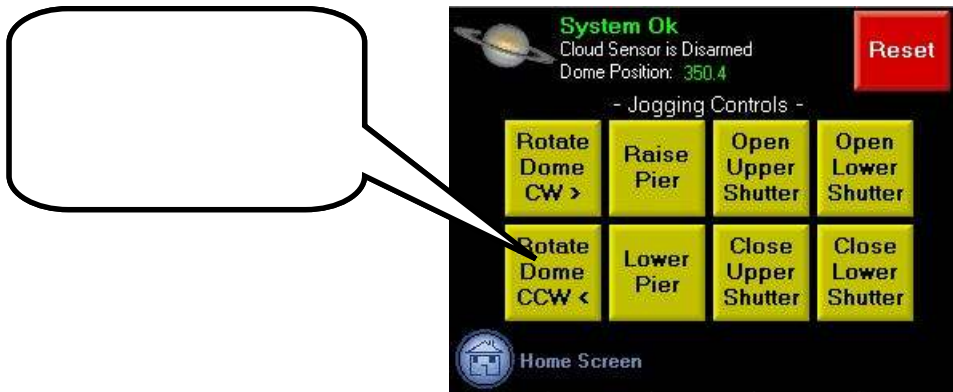
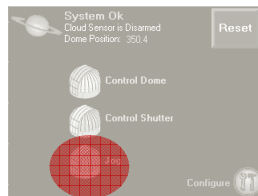
General Operation

Using the touchscreen, the dome's rotation (or Azimuth) can be controlled various ways. First time users should get familiar with the motion using the Jog controls.

Jogging Motions

While pressing the Rotate Dome buttons, the dome motor will run. The motor will stop when the button is released. The dome's position will be tracked during the motion. Upper and Lower Shutter buttons will act the same way (hold the button down to move and release to stop).

How to get here: Main Screen > Lower middle Jog button



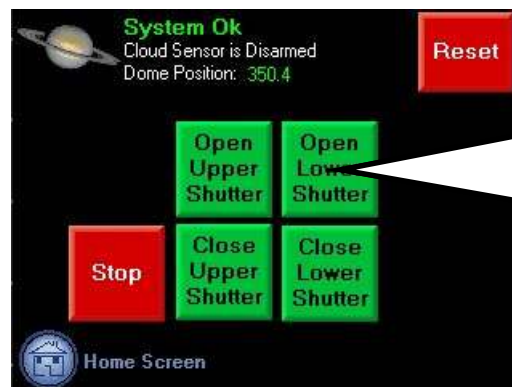
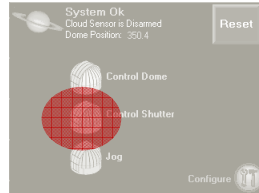
WARNING!!

When rotating the dome with the lower shutter open, special care must be taken to insure that the open door does not crash into any exterior structures while the dome is rotating.

Shutter

The Shutter screen facilitates buttons to send Shutter(s) either open or close.

How to get here: Main Screen > Middle Control Dome button



Pressing these buttons
moves the shutter
until it reaches its
destination.

Do not cause motion

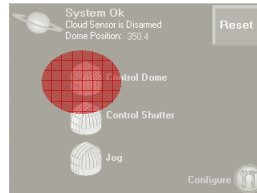
WARNING!!

When opening the lower shutter door, special care should be taken to ensure that the lower shutter does not open onto any exterior structures.

Rotate

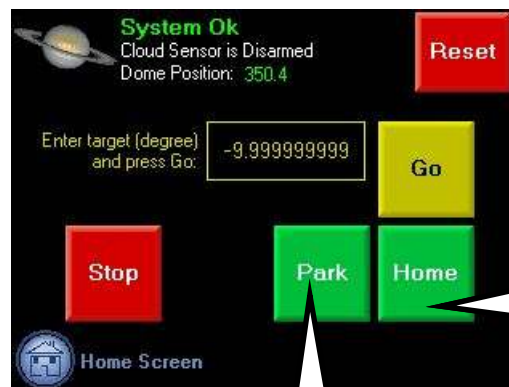
The dome can be positioned to *Go To* a specified location using the Dome Control screen. A user can enter a location in degrees (Azimuth), and press Go. This will begin motion to that location and will not stop until it gets there.

How to get here: Main Screen > Upper middle Control Dome button



WARNING!!

When opening the lower shutter door, special care should be taken to ensure that the lower shutter does not open onto any exterior structures.



Park

Send the dome to the preset Park position

Will cause motion

Home

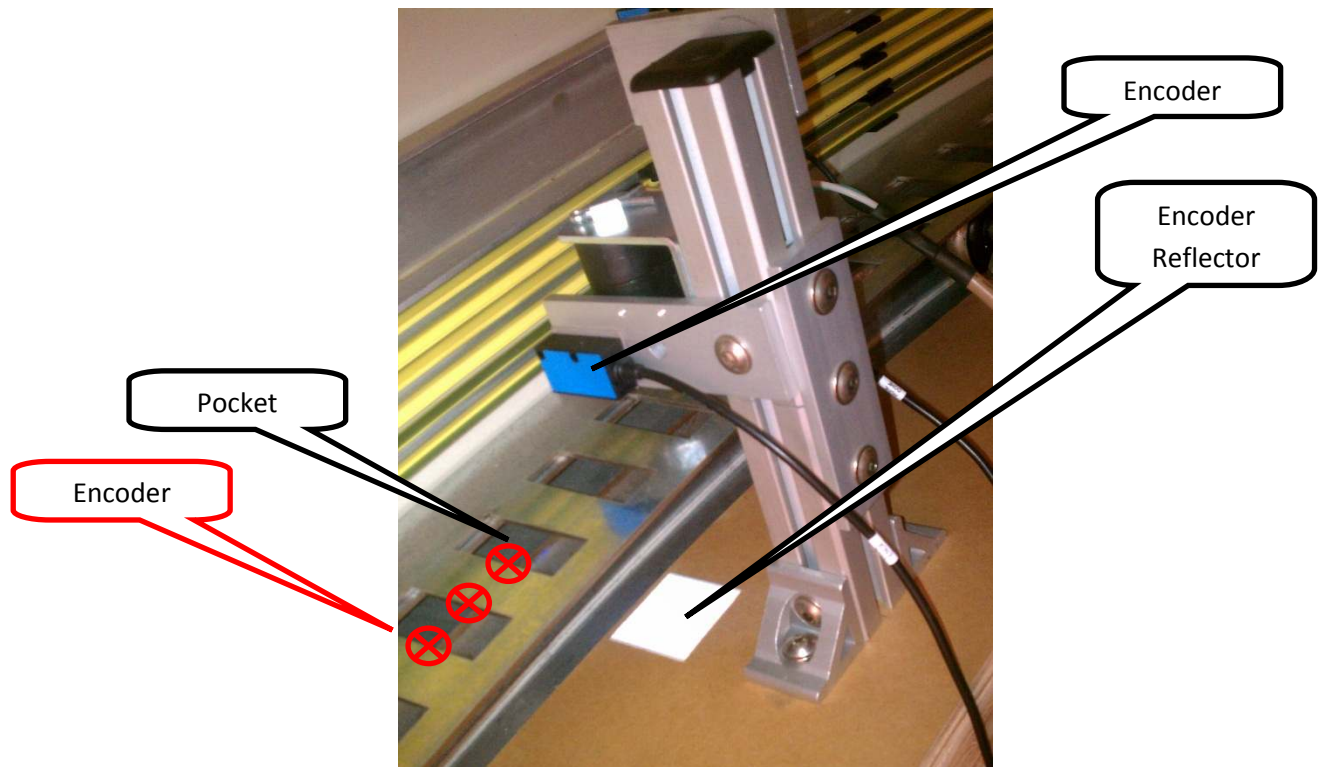
The Dome will rotate until the Home sensor is turned on.

Will cause motion

Controlling the Dome

Control Scheme

The control scheme used for rotating the dome includes a motor and a positional encoder. While the dome rotates, its position is monitored using the optical encoder sensor. This works by counting pockets of the rack while it's moving. Each transition of a pocket is considered an encoder tick. Since the size of the dome can vary, the user defines the correlation of encoder ticks to a full rotation. An optical Home sensor is used for calibration by means of detecting a single reflector that is placed on the rotating dome. This acts nothing more than a referenced position. The user defines the North (zero) position as an offset from the reflector (as described in this section).



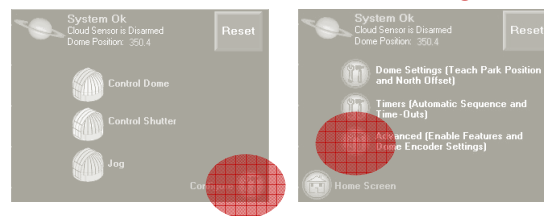
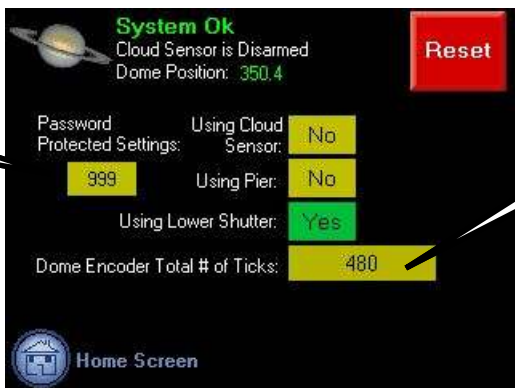
The position is always displayed as absolute 0 to 359.9 degree, where 0 equals true north.

Setting Dome Parameters

Here is how to set-up the dome parameters, or read along to get a better understanding of how the parameters work together:

- 1) The user defines how many ticks are seen in a full rotation of the dome. Each on and off transition accounts for a single tick. In other words, count the number of pockets seen on your dome and multiple by two (e.g. 240 pockets X 2 = 480 ticks). This number is typically configured before the dome will leave the factory.

How to get here: Main Screen > Lower right Configure button > bottom center Advanced Settings

System Ok
Cloud Sensor is Disarmed
Dome Position: 350.4

Reset

Protected Settings: Password: 999

Using Cloud Sensor: No

Using Pier: No

Using Lower Shutter: Yes

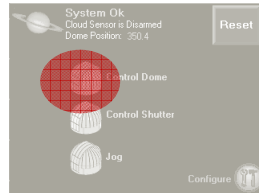
Dome Encoder Total # of Ticks: 480

Home Screen

Enter the total number of ticks.

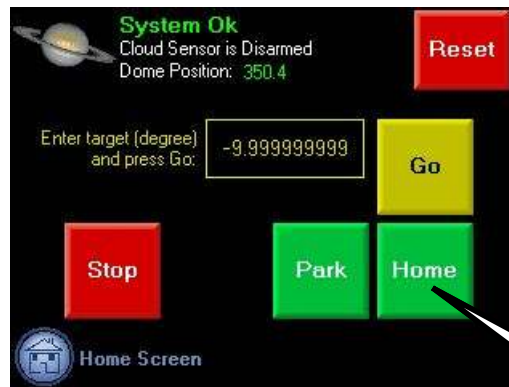
- 2) Home the Dome to calibrate. This action will rotate the Dome until the Home sensor is aligned with the reflector.

How to get here: Main Screen > Upper middle Control Dome button



WARNING!!

When rotating the dome with the lower shutter open, special care must be taken to insure that the open door does not crash into any exterior structures while the dome is rotating.

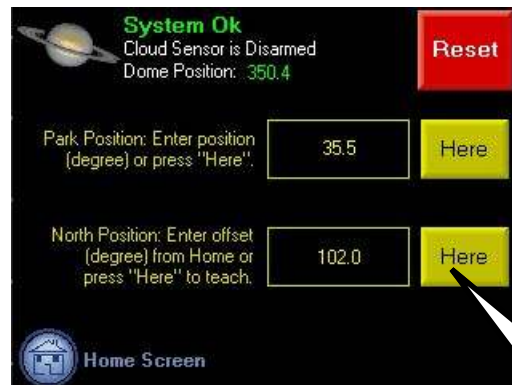
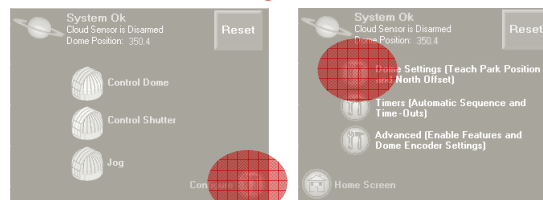


Press to Home the Dome

Will cause motion!

- 3) The North Offset is used to tell the system where Home is relative to True North. The location that is displayed (and used to slewing the dome) is always relative to true North. To define True North, either Jog the Dome manually to align the Shutter with a telescope that is aimed north, use a compass, or enter in a numeric offset.

How to get here: Main Screen > Lower right Configure Button > Dome Settings button



the Shutter is aligned with north, so press "Here" to set in the North Offset.

Troubleshooting



If a fault has occurred, most motions will stop and a message at the top of the screen will be displayed. The Reset button located on the upper right corner of the touch screen can be used to clear the condition. Note: some condition may require action – review below:

Message	Definition	Suggested Action
System Ok	All conditions are ok.	
Raise Pier Fault	The pier was commanded to rise, and the Pier Lowered Switch did not become clear.	<ol style="list-style-type: none"> 1) Check the functionality of the Pier Lowered plunger switch. It should spring back out when the Pier is not lowered on top of it. 2) If the Pier is not moving at all, check the Pier Control cable connection and power to the Pier. <i>Note: Piers require an external power source.</i> 3) Review the “Raise Pier Time-out” value on the Timer screen.
Lower Pier Fault	The Pier was commanded to lower, and the Pier Lowered switch was never made.	<ol style="list-style-type: none"> 1) Check the functionality of the Pier Lowered plunger switch. The Pier should lower on top of it and compress the plunger. 2) Be sure the sensor is plugged in. 3) If the Pier is not moving at all, check the Pier Control cable connection and power to the Pier. <i>Note: Piers require an external power source.</i> 4) Review the “Lower Pier Time-out” value on the Timer screen.
Shutter Fault	The Upper shutter was commanded to open or close and the end Limit Switches	<ol style="list-style-type: none"> 1) Check the operation of both Limits Switches. The

	where not sensed.	<p>whisker should return to the middle position when the Shutter is not in contact with it. When the Shutter does contact it, it will make a clicking sound.</p> <ol style="list-style-type: none"> 2) Be sure sensors are plugged in. 3) If the Shutter is not moving at all, check the Shutter Motor connection on the bottom of the Shutter Box. Or, check for Mechanical interference. 4) Review the "Upper Shutter Time-out" value on the Timer screen.
Lower Shutter Fault	The Lower shutter was commanded to open or close and the end Limit Switches where not sensed.	<ol style="list-style-type: none"> 5) Check the operation of both Limits Switches. The whisker should return to the middle position when the Shutter is not in contact with it. When the Shutter does contact it, it will make a clicking sound. 6) Be sure sensors are plugged in. 7) If the Shutter is not moving at all, check the Shutter Motor connection on the side of the Shutter Box. Or, check for Mechanical interference. 8) Review the "Lower Shutter Time-out" value on the Timer screen.
Park Mount Fault	The configured time to allow the Park Mount input to turn on has elapsed.	<ol style="list-style-type: none"> 1) If a Park Mount switch is not being used, a jumper should be used in its place. 2) Review the "Park Mount Time-out" value on the Timers screen.
Emergency Stop Fault	The Emergency Stop button is pressed.	<ol style="list-style-type: none"> 1) Once all conditions are safe, reset the button by rotating it until it pops back out.

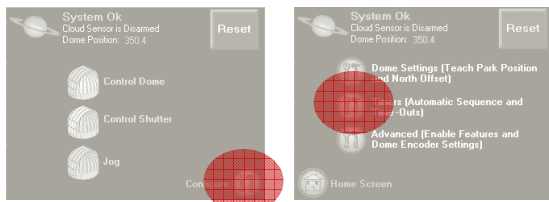
Slew Dome Time-out Fault	The Dome was commanded to rotate to a position and the time to get there has elapsed.	<ol style="list-style-type: none"> 1) Check the functionality of the Encoder. A light on the back of the sensor will blink while the Dome is in motion. Be sure that the light is ON when it is looking through a pocket and on to the reflector. 2) Be sure the Encoder is plugged in. 3) If the Dome is not moving, check the motor connection at the bottom of the Dome Control box. 4) Review the "Dome Go To Time-out" value on the Timer Screen. Note: This value is in MINUTES.
Dome Home not Found Fault	The Dome was told to Home, but the Home sensor never turned on.	<ol style="list-style-type: none"> 1) Check the functionality of the Home Sensor. Be sure that the light is ON when it is looking at the reflector on the Dome. 2) Be sure the Home Sensor is plugged in. 3) If the Dome is not moving, check the motor connection at the bottom of the Dome Control box. 4) Review the "Dome Go To Time-out" value on the Timer Screen. Note: This value is in MINUTES.
Opening Shutter...	The Shutter is opening.	None, but you should be observing motion. If not, wait and a fault message will occur.
Closing Shutter...	The Shutter is closing .	None, but you should be observing motion. If not, wait and a fault message will occur.
Raising Pier...	The Pier is being raised.	None, but you should be observing motion. If not, wait and a fault message will occur.
Lowering Pier...	The Pier is being lowered.	None, but you should be observing motion. If not, wait and a fault message will occur.

Waiting for Mount...	The system is waiting for the Park Mount switch to turn on.	None, but you should be observing motion. If not, wait and a fault message will occur.
Shutter Position Unknown	One (or both) Shutter(s) are in an unknown location.	This condition is ok and the Dome is still operable.
Cloud Alarm Detected!	The Cloud Sensor Input has been activated and the Shutters are going to Close.	None, but you should be observing motion. If not, wait and a fault message will occur.
Connecting to Shutter...	Connection to the remote Shutter box has been lost, and not attempting to be restored.	<ol style="list-style-type: none"> 1) Wait for the message to go away. 2) Cycle Power on the system using the black rotary on/off switch on the Dome Control box.
Shutter Network Error	Connection to the remote Shutter box has been lost, and the system requires a power cycle.	Cycle Power on the system using the black rotary on/off switch on the Dome Control box.

Timer Screen

All timers used during control are accessible and can be modified.

How to get here: Main Screen > Lower right Configure Button > Timers button





System Ok
Cloud Sensor is Disarmed
Dome Position: 350.4

Reset

Dome GoTo Time -Out:	Cloud Sensor On Delay:	5:00
02:00	Raise Pier Time -Out:	4:00
	Lower Pier Time -Out:	15:00
	Upper Shutter Time -Out:	30:00
	Lower Shutter Time -Out:	30:00
	Park Mount Time -Out:	30:00
	Raise Pier Time:	30:00

Home Screen

Modify a time by touching it and entering a new value. All units are in seconds except Dome Time-Out (Minutes)