



# **Turf Guard<sup>TM</sup>**

Wireless Soil Monitoring System

*Installation & Setup Manual*

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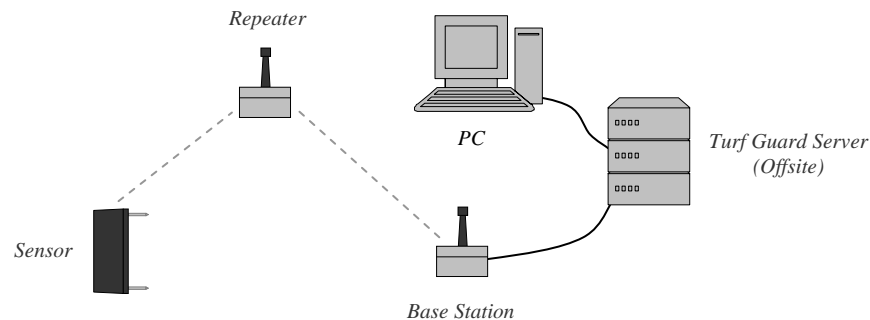
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## System Overview

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Turf Guard utilizes a communication system consisting of sensors and repeaters which relay information to a base station, which is normally located in an office location near the irrigation central control computer. Utilizing Ethernet access, the base station transfers the field sensor data to the Turf Guard server where the information is referenced, stored, and available to the user through their existing computer.



## Setting Up a Customer Account

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This process can be completed off-site. Before beginning, you will need to collect the following information from the superintendent:

- 1) Course and superintendent contact information
- 2) Course GIS information (latitude & longitude)
- 3) Quantities of sensors and repeaters to be installed
- 4) Type of internet connection at the course (e.g. DHCP Ethernet connection)

### Creating a Distributor Account

Prior to the first time a distributorship installs a Turf Guard system, they will need to set up a distributor account. **THIS IS A ONE-TIME PROCESS.** To do this, simply email the desired username and password to [tgaccount@toro.com](mailto:tgaccount@toro.com). Distributors may set up multiple accounts if they wish (for example, one per branch, one per sales rep, etc.). You will get an email notification if the username is already taken.

### **Finding a Course in the System**

Go to [install.turfguard.net](http://install.turfguard.net) (no “www.”) and click on the link for the *Pre-Install worksheet*. To find the course in the system, you’ll need to search the Turf Guard database by course name, state, or five-digit zip code. Users DO NOT need to enter in all fields to run a search. As is the case with any database, the more search criteria entered (and the more specific that criteria is), the narrower the search will be. If at first the desired course doesn’t appear, try using less specific criteria. For example, try using “Toro” for the course name instead of “Toro Country Club”.

Once the course is found, click on its link. For courses already set up in the database, Turf Guard automatically fills in some of the information on this form, but you will need to fill in the rest. For now, only complete the *Course Information*, *Superintendent Information*, and *Installation Information* sections. Make sure the superintendent’s address entered on this form is at the course and NOT their home address, as this is the address Toro will use to send replacement sensors, etc.

### **Establishing a Course NOT in the System**

If you could not find the course in the database, click on *Add New Course*. Complete the *Course Information*, *Superintendent Information*, and *Installation Information* sections. Make sure the superintendent’s address entered on this form is at the course and NOT their home address, as this is the address Toro will use to send replacement sensors, etc.

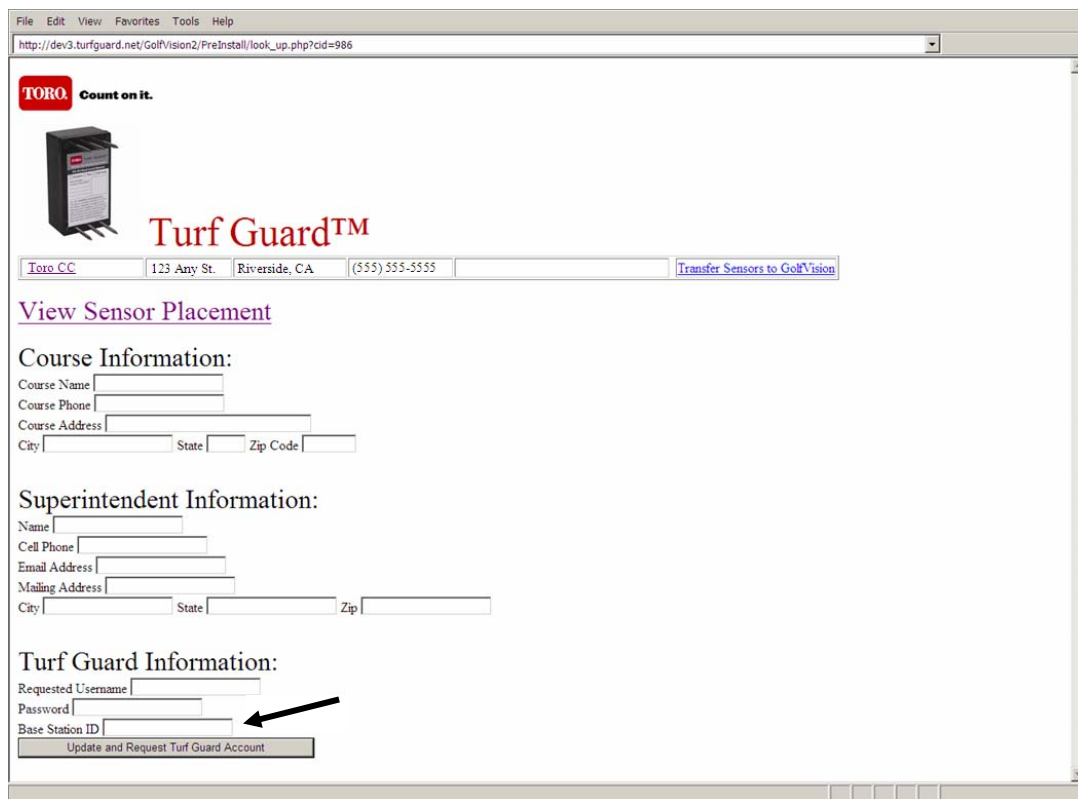
### **Making Corrections**

If you need to start the Pre-Installation Worksheet over but the entered data cannot be undone, start over by creating a new course with the same name, and contact NSN to have them delete the erroneous record(s). NSN can also help with updating incorrect addresses in the database.

## Assigning the Base Station

Each Turf Guard base station has a unique ID located on the bottom of the unit. The Turf Guard system uses this ID to route data inside its servers. Enter the ID number in the *Base Station ID* field under *Turf Guard Information* on the Pre-Install Worksheet as shown in **Figure 1.** below. NOTE: Each base station can be assigned to only one course, however, multiple base stations can be assigned to a course. Record the base station ID in the Installation Log under *Base Station/Repeater Information.*

**Figure 1. – Pre-Install Worksheet**



The screenshot shows a web browser window displaying the Turf Guard Pre-Install Worksheet. The browser's address bar shows the URL: `http://dev3.turfguard.net/GolfVision2/PreInstall/look_up.php?cid=986`. The page features the TORO logo with the slogan "Count on it." and an image of a Turf Guard base station. Below the logo, the text "Turf Guard™" is displayed. A form contains several input fields: "Toro.CC", "123 Any St.", "Riverside, CA", "(555) 555-5555", and a button labeled "Transfer Sensors to GolfVision". A link "View Sensor Placement" is also present. The form is divided into three sections: "Course Information:" with fields for Course Name, Course Phone, Course Address, City, State, and Zip Code; "Superintendent Information:" with fields for Name, Cell Phone, Email Address, Mailing Address, City, State, and Zip; and "Turf Guard Information:" with fields for Requested Username, Password, and Base Station ID. A black arrow points to the Base Station ID field. At the bottom of the form is a button labeled "Update and Request Turf Guard Account".

## Requesting the Account


Enter the desired username and password under *Turf Guard Information* (neither the username nor password can contain any spaces), then click *Update and Request Turf Guard Account*. Record this information on the first page of the Installation Log. These will be used later to access the course's sensor data in Golf Vision on [www.turfguard.net](http://www.turfguard.net). If at any time the username or password needs to be changed, contact NSN.

After clicking *Update and Request Turf Guard Account*, you will be taken to a confirmation page, shown in **Figure 2.** below. Make sure the map on this page is centered on the course and verify all other information is correct – it’s particularly important to ensure the proper time zone is selected. Click *Update and Request Turf Guard Account* when finished – the course account is now set up.

**Figure 2. – Confirming Account Information**

File Edit View Favorites Tools Help  
http://dev3.turfguard.net/ColVision2/PreInstall/look\_up.php?cid=986

## Confirm Account Creation:

Your Course ID will be:   
Please Confirm:  
Course Name:   
Choose Course Lat/Lon using map (Zoom to precise location)  
  
Course Lat:  Lon:   
Course Zip:   
Course Time Zone:   
New User Name:   
New Password:   
Base Station ID:

### Turf Guard Information:

Requested Username:   
Password:   
Base Station ID:

## Sensor Activation

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Each sensor needs to be activated by the installer BEFORE delivery to the course. From the factory, sensors are set to transmit approximately once every hour – the activation process changes this transmission rate to approximately once every five minutes. Sensors can be activated via the web interface – search for the course again on [install.turfguard.net](http://install.turfguard.net), and click on the *Sensor Activation* link next to the course name. You will need to enter in each sensor's ID on this page (see **Figure 3.** below).

Sensor activation must be done with the sensor located next to the course's base station; **SENSORS CANNOT BE ACTIVATED IN THE FIELD.** The base station must be connected (both the power and Ethernet cable) in proximity to the sensors. Record each sensor's ID in the Installation Log on the *Sensor Activation* page.

**Figure 3. – Activating Sensors**

File Edit View Favorites Tools Help  
http://dev3.turfguard.net/GolfVision2/CourseSetup/transfer\_sensors.php?site=20314&dbid

[lookup existing](#)

### Activate Sensors

Course ID:   
Sensor ID:

### Communication Check

Course ID:

## Verifying Activation

After one hour, return to the Sensor Activation page and request a Comm Check by activating the *Submit/Refresh* button. The information box will display the following type of information indicating that sensors have been activated and continue to communicate:

course: ToroCC  
host: dev1.turfguard.net  
Communication Events

Communication Time:2008-03-11 05:44:36

NodeID:0	Age:62	MAX(RSSI):0	CNT:17
NodeID:18	Age:221	MAX(RSSI):0	CNT:21
NodeID:1998	Age:57	MAX(RSSI):48	CNT:16
NodeID:2395	Age:292	MAX(RSSI):45	CNT:14
NodeID:2448	Age:54	MAX(RSSI):40	CNT:10
NodeID:2501	Age:136	MAX(RSSI):47	CNT:11
NodeID:2519	Age:274	MAX(RSSI):60	CNT:18

Turf Guard uses the term “node” to refer to base stations, repeaters, and sensors. A Node ID of 0 is assigned to the base station. Repeaters have a Node ID number of less than 256, any number above this is a sensor. The “Age” is equal to the number of seconds that has passed since the last reading. This number should remain under 400 seconds if the sensor is activated and working properly; if it exceeds 1000, the sensor is not communicating reliably; if it ever exceeds 2000, the sensor may not have been activated or the battery may be dead.

The “MAX(RSSI)” shows the signal strength; a sensor RSSI of 30 or more is considered a good signal. It’s not important that you understand how to read the CNT, but simply put, it is a measurement of the time interval (or frequency).



## Installation

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The basic steps of installation are as follows: 1) Set-up the base station, 2) Check communication, 3) Install the repeaters, 4) Install the sensors and measure to landmarks. You will need to bring the following:

- Bucket/Keeper of the Greens
  - 3" Scraper Tool/Putty Knife
  - Turf Guard Installation Book
  - Pen and Notebook for Use in Field
  - Survey Grade Tape Measure
  - Ice Pick
  - Cordless Drill w/Screw Bits
  - 7' Ethernet Cable
  - Ethernet Switch (Splitter)
- Tool Pack
    - #2 and #3 Philips head screw driver
    - #2 Standard screw driver
    - Standard pliers
    - Long-nose pliers
    - Diagonal cutters
    - Zip-ties

### Selecting Installation Locations

Select installation locations that will not interfere with regular cup locations. It's also recommended that sensors are located in representative regions of turf, such as dry spots, wet spots, heavy traffic areas, or disease-stressed areas. Avoid areas within 7' of the collar of the green.

When placing sensors, it's important to remember that the maximum sensor-to-repeater range is 500 feet line-of-sight (not "as the crow flies"). Any obstructions, such as vegetation or terrain, will decrease this range. Similarly, the recommended repeater-to-repeater range is 2,000 feet, with a maximum range of 5,000 feet (if true line-of-site, without vegetation). The base station's range depends on the structure of the building in which it's located – it doesn't necessarily need to be located in a maintenance facility.

### Base Station Installation

*Time: 30 minutes*

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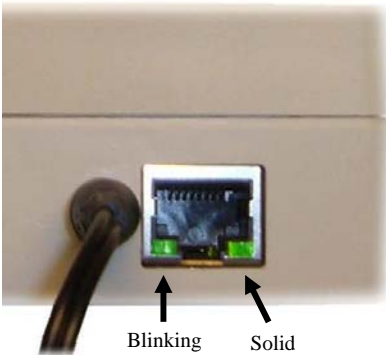
The base station connects to the internet via an Ethernet port, so it will need to be installed near a high-speed internet connection. Plug in the power cable to a 120v outlet and connect the base station to the Ethernet port using an Ethernet cable. If all Ethernet ports are currently being used, use an Ethernet cable switch like the one pictured at right to "split" one of the cables already plugged in.



It's important to note that the building in which the base station is installed, and its location *within* that building, may decrease its range (for example, if it's installed in a basement or in a building with thick, brick walls). Wherever you ultimately decide to install it, make sure to record the installation location in the Installation Log.

### Verifying Base Station Operation

Base station connectivity can be confirmed via the web or a web-enabled cell phone. To do this, return to [install.turfguard.net](http://install.turfguard.net), search for the course in the database, then click on the *Comm Check* link next to the course's name (just as was done in the *Sensor Activation* section). Remember, the base station has a Node ID of 0. NOTE: It may take up to five minutes after the base station is first hooked up before it begins communicating with the website.



### Troubleshooting

If the base station fails to connect to the Turf Guard servers, try the following:

1. Make sure the power cable is pushed into the base station all the way. Confirm power connection by looking for two green lights on the Ethernet jack, shown in the figure to the left.
2. Verify that the correct base station ID number was entered in the *Creating the Customer Account* section.
3. Verify internet connectivity on the computer sharing the same port as the base station.
4. If none of the above work, there may be a firewall blocking communication. This firewall may have to be reconfigured to allow proper functionality of the system. Contact Toro NSN for assistance, or give the below information (i.e. the "Technical Note") to an IT professional so they may reconfigure as needed.

**TECHNICAL NOTE:** *The base station expects DHCP automatic address assignment and creates an outbound TCP/IP connection to the Turf Guard servers (Server Name: devX.turfguard.net; ports: 3389, 8081, 9080, 8888, 3399). This process generally does not require ANY configuration. The installation tool is linked from [install.turfguard.net](http://install.turfguard.net) under "Lantronix Device Install Tool".*

## Repeater Installation

*Time: 20 minutes each*

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There are three different types of repeater installations (all of which run on 6 to 9 VDC): Internal Network VP, Internal Non-Network VP, and External Repeater. With all installation types, always power down the satellite before beginning.

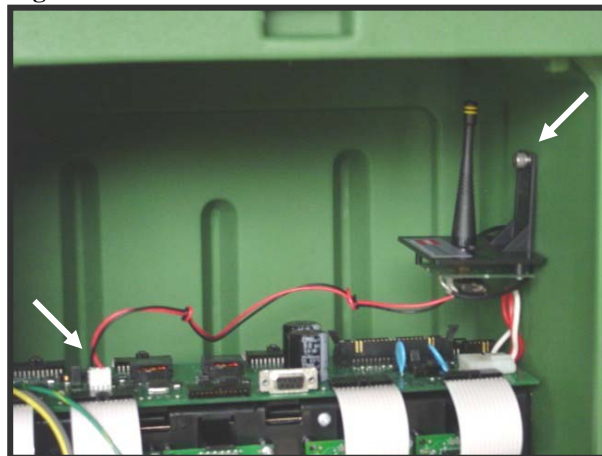
The internal repeater is currently set up for use only on Toro Network VP, Network LTC Plus, and E-OSMAC satellites (plastic pedestal models only) – all other satellite models will require the external repeater. Install repeaters in the pedestal locations identified by the superintendent, making sure to record the repeater ID and location in the Installation Log.

### Toro Network VP Satellites (Plastic)

To complete this installation, you will need an internal repeater and a ¼” - 20 x 5/8” socket-head cap screw.

1. Power down the unit.
2. Mount the repeater on the inside wall of the pedestal (on either side) using a ¼” - 20 x 5/8” socket-head cap screw.
3. Plug in the power connector cable as shown in **Figure 4.** below.
4. Power the unit back up.
5. Record the repeater ID and location in the Installation Log.
6. Proceed to the *Internal Repeater Startup Procedure* section on Page 12 of this manual when finished.

**Figure 4. - VP**

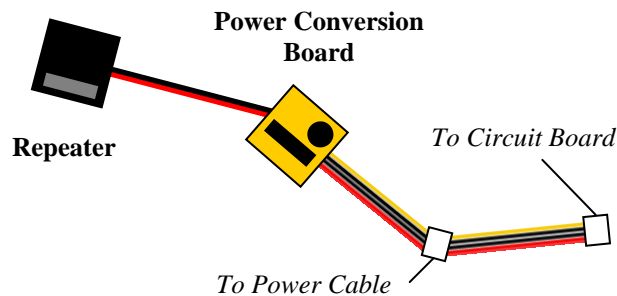
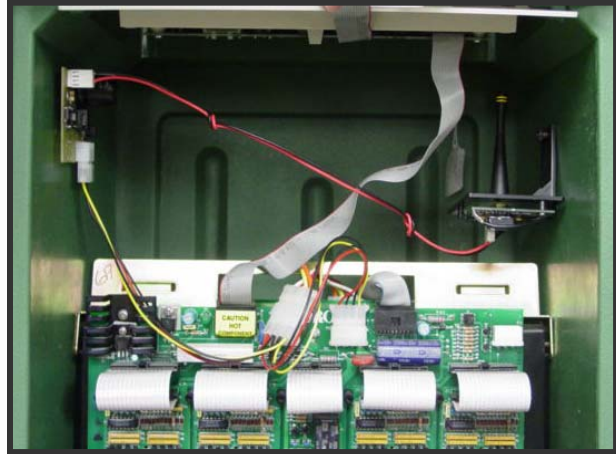


## Toro Network LTC Plus Satellites (Plastic)

To complete this installation, you will need an internal repeater, a power conversion board (to tie into the LTC Plus' 13 VAC power supply), and a 1/4" - 20 x 5/8" socket-head cap screw.

1. Power down the unit.
2. Mount the repeater on the inside wall of the pedestal (on either side) using a 1/4" - 20 x 5/8" socket-head cap screw.
3. Mount the power conversion board on the inside of the satellite opposite the repeater using the adhesive back (see **Figure 5.** at right for the configuration).
4. Connect the power conversion board to the power source.
5. Connect the power conversion board to the repeater using the power connector cable.
6. Power the unit back up.
7. Record the repeater ID and location in the Installation Log.
8. Proceed to the *Internal Repeater Startup Procedure* section on Page 12 of this manual.

**Figure 5. – LTC Plus**

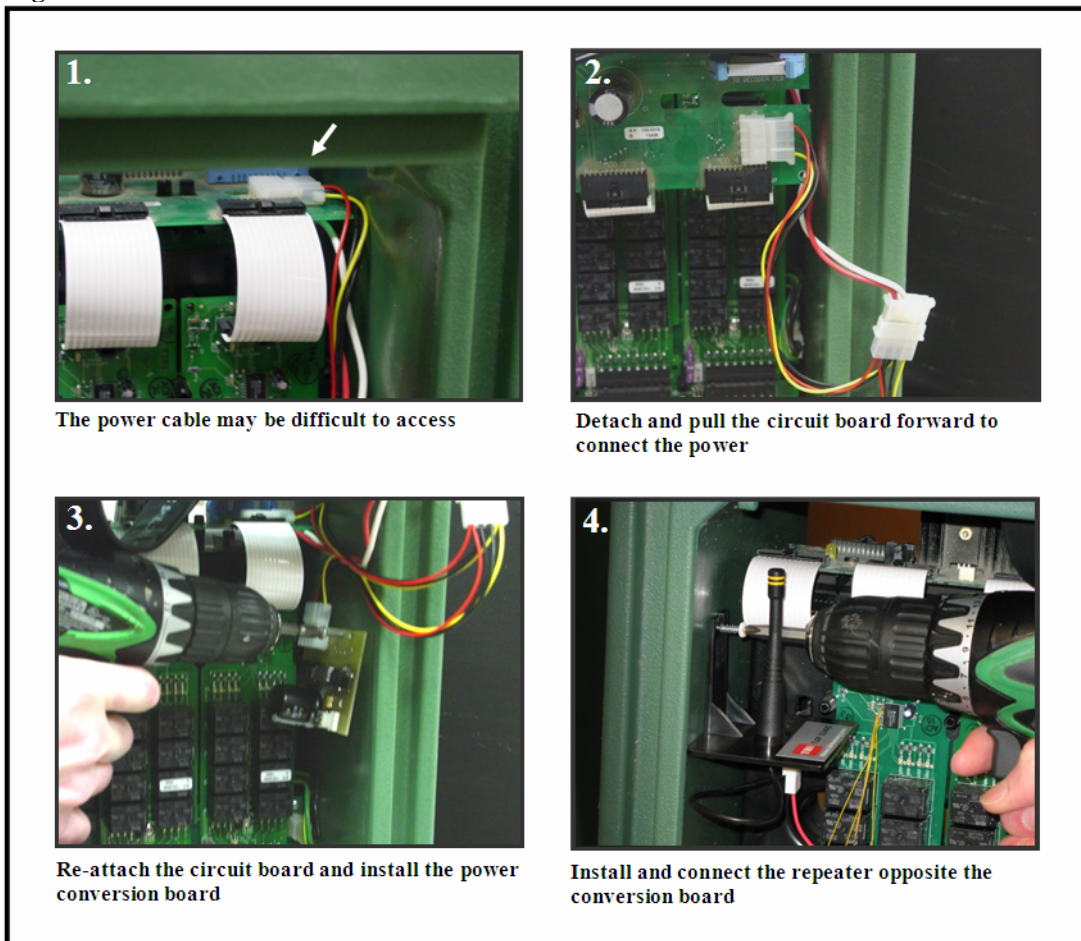


## Toro E-OSMAC Satellites (Plastic)

To complete this installation, you will need an internal repeater, a power conversion board (to tie into the E-OSMAC's 13 VAC power supply), and a 3/4" #10 sheet metal screw.

1. Power down the unit.
2. Detach the top circuit board (see **Figure 6.** below).
3. Connect the power conversion board to the power source.
4. Reattach the circuit board.
5. Mount the conversion board on the inside wall of the pedestal using the adhesive back.
6. Mount the repeater on the inside wall opposite the conversion board using a 3/4" #10 sheet metal screw.
7. Connect the repeater to the conversion board.
8. Power the unit back up.
9. Record the repeater ID and location in the Installation Log.
10. Proceed to the *Internal Repeater Startup Procedure* section on Page 12 of this manual.

**Figure 6. – E-OSMAC**



### Rain Bird Par+ Satellites (Plastic)

To complete this installation, you will need an EXTERNAL repeater, a power conversion board (to tie into the unit's 24 VAC power supply), and two ¾" #10 sheet metal screws.

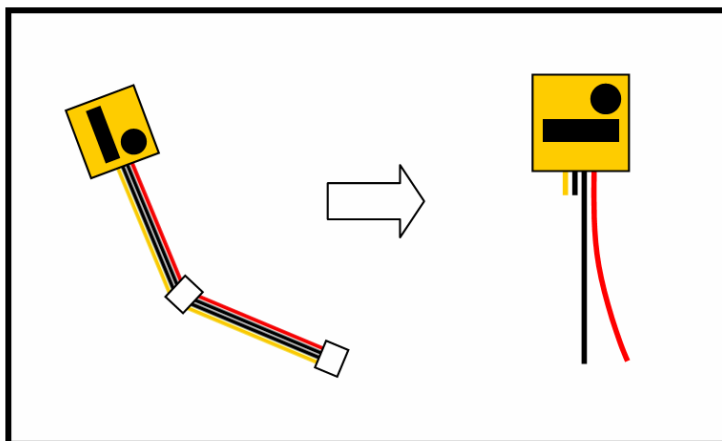
The conversion board will first have to be modified before it can be installed: you will need to cut the red and black wires just before the first plug. Then cut the yellow and other black wire from the board as shown in **Figure 7**. below.

1. Power down the unit.
2. Mount the conversion board on the front of the satellite using the adhesive back as shown in **Figure 8**. on the next page.

**Note:** *Older Rain Bird models may require attaching the power conversion board in a different location due to space constraints – NEVER MOUNT THE POWER CONVERSION BOARD TO THE OUTSIDE OF THE PEDESTAL.*

3. Connect the red wire running from the conversion board to the *Power Interconnect*, using the number 8 slot, labeled *Valve Hot*. Connect the black wire to any of the open common slots.

**Figure 7.**

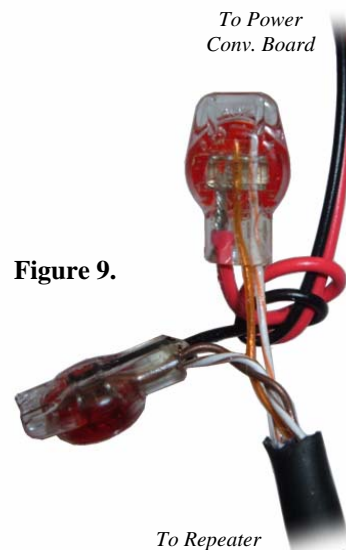




**Figure 8. – PAR+ ES**



4. Mount the repeater on the side of the pedestal using two  $\frac{3}{4}$ " #10 sheet metal screws as shown in **Figure 8.** above.
5. Using a  $\frac{1}{4}$ " drill bit or larger, drill a hole through the sidewall of the pedestal and pull the repeater cable through to the inside.
6. Strip the end of this repeater cable so an inch or more of the two wires inside is exposed.
7. Next, locate the *power connector cable* (the cable that would otherwise connect the power conversion board to an internal repeater) and cut one end just below the white plug, cutting both black and red wires.
8. Using pliers and two of the splice connectors provided, splice the cables together, as shown in **Figure 9.** Notice the red wire on the power connector cable attaches to both the solid orange and orange-striped wires on the repeater cable; the black wire connects to the solid brown and brown-striped wires.
9. Seal all the remaining holes in the pedestal with sealing tape and/or foam gaskets. The repeater is now tying into a 24 VAC power supply.
10. Power the unit backup.
11. Record the repeater ID and location in the Installation Log.



**Figure 9.**

## Toro Network 8000 Satellites (Plastic)

To complete this installation, you will need an EXTERNAL repeater, a power conversion board, and two ¾” #10 sheet metal screws.

1. Power down the unit.
2. Mount the power conversion board on the inside wall of the pedestal using the adhesive back.
3. Mount the repeater on the outside wall of the pedestal using two ¾” #10 sheet metal screws as was demonstrated on the Rain Bird Par+ installation in the previous section.
4. Using a ¼” drill bit or larger, drill a hole through the sidewall of the pedestal and pull the repeater cable through to the inside.
5. Strip the end of the cable coming from the repeater so an inch or more of the two wires inside is exposed.
6. Locate the *power connector cable* (the cable that would otherwise connect the power conversion board to an internal repeater) and cut one end just below the white plug, cutting both black and red wires.
7. Using pliers and two of the splice connectors provided, splice the cables together, as shown in **Figure 9**. on the previous page. Notice the red wire on the power connector cable attaches to both the solid orange and orange-striped wires on the repeater cable; the black wire connects to the solid brown and brown-striped wires.
8. Connect the power conversion board in the same way as was done in the LTC Plus installation (see **Figure 10**. below for the power cable location).
9. Seal all the remaining holes in the pedestal with sealing tape and/or foam gaskets.
10. Power the unit back up.
11. Record the repeater ID and location in the Installation Log.

**Figure 10.** – NW8000





## **Stainless Steel Pedestals**

For all stainless steel pedestals, attach the external repeater to the outside of the unit as outlined above in the Rain Bird Par+ installation. Once the repeater cable has been pulled through to the inside of the unit, installation will be the same as on the plastic model equivalent (the internal components of the plastic and stainless steel models are identical). Note that unlike on the plastic pedestals, however, the screw holes will need to be pre-drilled into the pedestal wall before mounting the external repeater.

## **Internal Repeater Startup Procedure**

On the initial power up of the repeater, all three lights located on the repeater's circuit board should glow steadily. After approximately 10 seconds, the repeater will begin searching for a network. As it searches, the inboard light should flash at a rate of about once per second. If the repeater finds a network, the light will begin flashing faster (about twice per second) **BEFORE THE COUNT OF SLOW FLASHES REACHES FIFTY FLASHES.**

If the count of slow flashes reaches fifty flashes, the repeater has failed to find the network. In the event that this should happen, the installer can initiate a new search by powering down the repeater for approximately one minute (or until all three lights cease to be illuminated). The repeater can then be powered up again for another search. If the repeater still cannot find the network after several attempts, it is considered "out of range" and must be moved to a site that is closer to the base station or an adjacent repeater.

## **Sensor Installation**

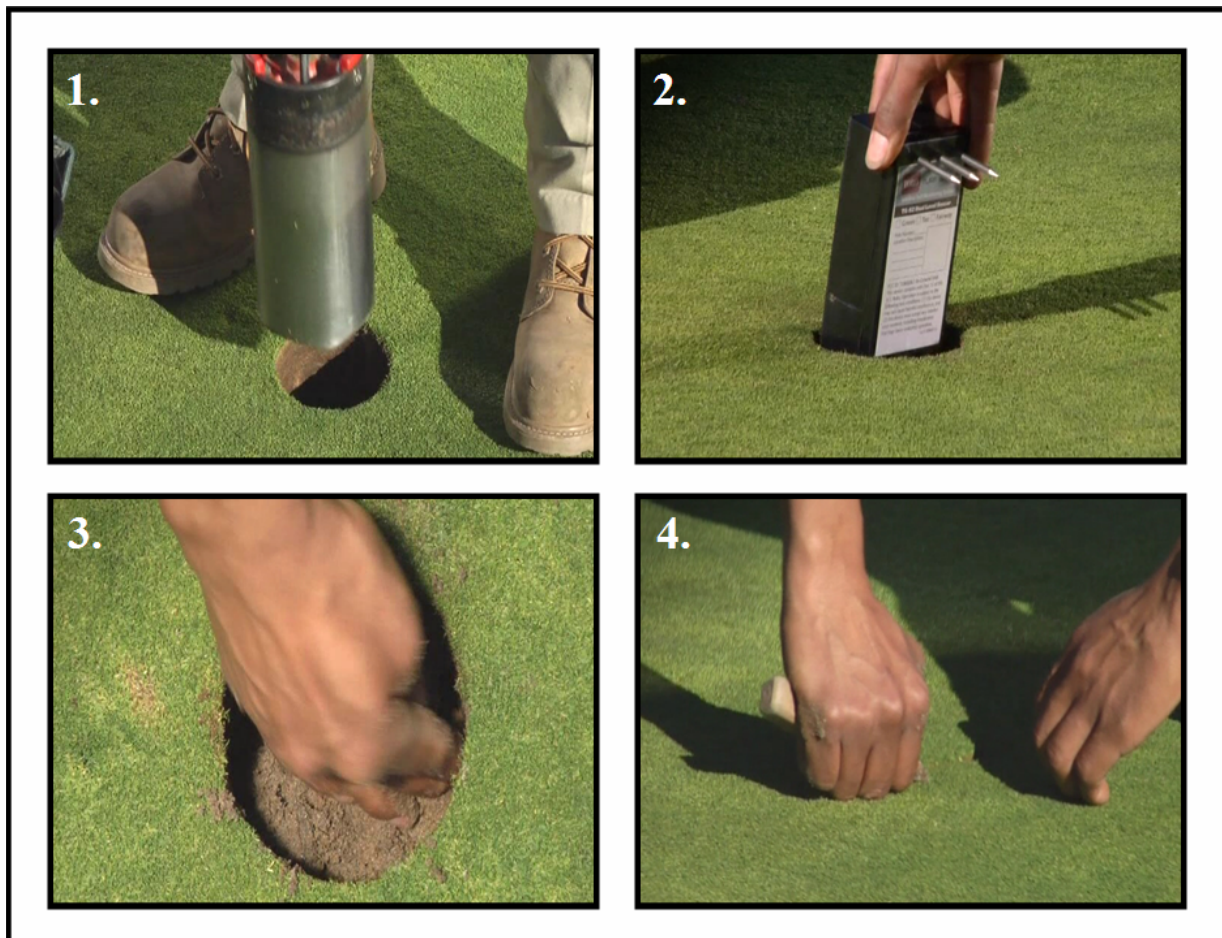
*Time: 10 minutes each*

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Install sensors in the locations identified by the superintendent. It's advisable to make sensors easy to find by placing them directly off irrigation heads, in-line with irrigation heads, or in a direct line between irrigation heads.

1. Using a standard cup-cutting tool, extract a plug from the green approximately 5.5 inches deeper than the sensor depth (for example, a desired 2-inch sensor depth would require a cup depth of 7.5 inches). Place the removed soil in a bucket.
2. Use a 3" scraper tool to square off the hole.
3. Install the sensor with the LABEL ORIENTED RIGHT-SIDE-UP, pushing the sensor probes into the undisturbed soil. The pins should face away from the repeater it will be communicating with. Avoid burial of less than 0.75 inches without warning superintendent. No matter what depth is chosen, it is important to maintain a consistent depth for every sensor.

4. Backfill the sensor, making sure to start with any space left below the sensor and pack the soil on each side of sensor – there should be as few air gaps in the hole as possible. Fully compact the greens-mix around sensor, leaving room to replace the original turf plug.
5. Replace the turf plug and mend the seam with surrounding turf.
6. Note the sensor number, date, hole number, and detailed sensor location on the *Sensor Location* and *Sketch Area* pages of the Installation Log.



## Superintendent Training

*Time: 30 minutes*

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When finished with the installation, it's important to walk the superintendent through the key Turf Guard tasks. This should be done on-site. Since the newly-installed sensors will need approximately 24 hours to provide stable data, instead of logging in to Golf Vision on [www.turfguard.net](http://www.turfguard.net) with the course account, log in using the demo account (username: `toro_guest`, password: `demo`).

Explain the various functions of the website (for example, moisture levels, temperature, salinity levels, and running reports). Make sure to also discuss aeration procedures with the superintendent, as well as demonstrate how to locate sensors using a metal detector (see the *Locating Buried Sensors* section at the end of this manual).

Make sure you also follow-up with the superintendent by phone within 24 to 48 hours after the installation. Verify system operation at [www.turfguard.net](http://www.turfguard.net) and answer any questions the superintendent may have. It's also recommended that a training "refresher" be conducted on-site seven to ten days after the installation. Present the superintendent with the Installation Log and the printed sensor location maps, and explain NSN's 5-year extended support plan.

## Sensor Placement/Mapping

*Time: 15 minutes*

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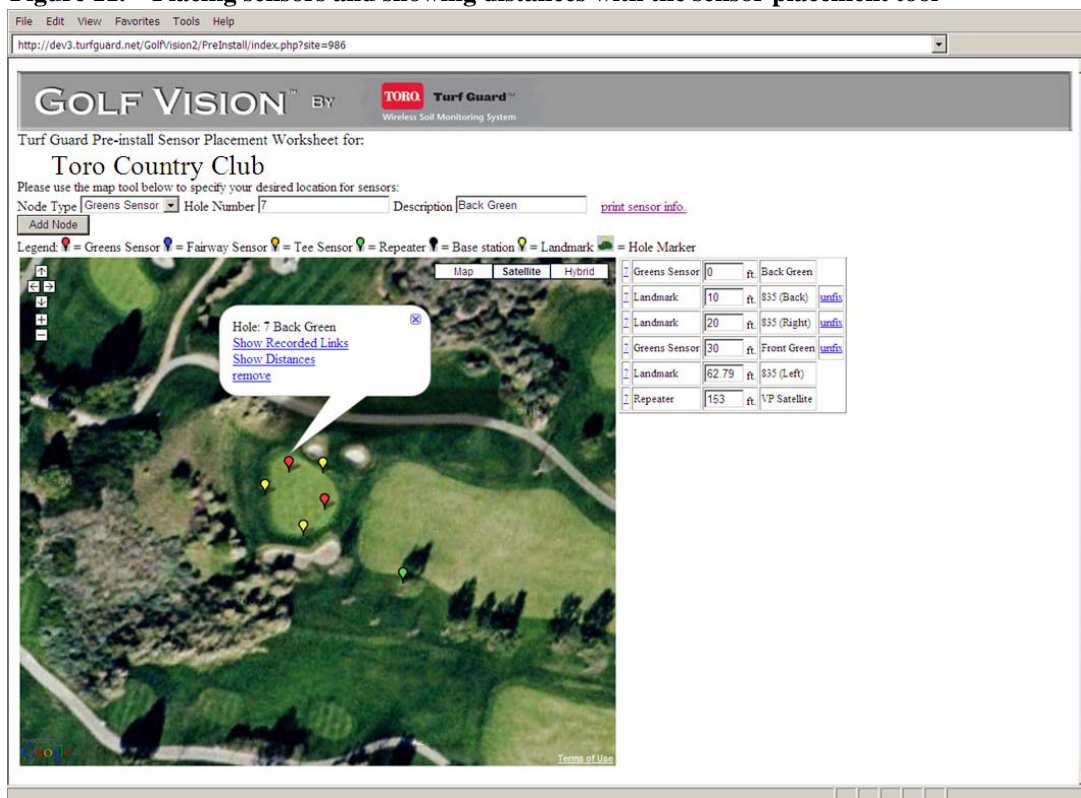
This process can be completed off-site. Return to [install.turfguard.net](http://install.turfguard.net), look up the course once more, and go to *View Sensor Placement* to layout landmarks and the installed base station, repeater(s), and sensors on the map.

**Note:** *If this is a new course, or if a satellite image of the course cannot be viewed, group the nodes by hole number on the blank map to vaguely resemble the general layout of the course. If and when a relevant map becomes available, actual locations relative to the map can then be updated.*

### Using the Placement Tool

There are seven different node types used in the placement tool: repeater, greens sensor, fairway sensor, tee sensor, internet base (base station location), hole marker, and landmark. To add a node, select a node type from the dropdown menu, then click the *Add Node* button. Users can specify hole numbers and include a brief description of the node. Landmarks are used primarily as endpoints for distance measurements. To show distances, left-click on the desired node and click the *Show Distances* link – this is a useful tool in estimating connectivity.

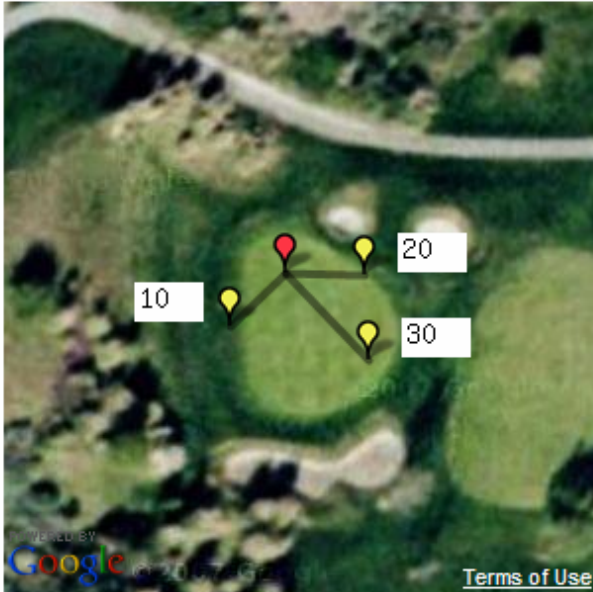
**Figure 11. – Placing sensors and showing distances with the sensor placement tool**



To ensure all node data has successfully been entered into the Turf Guard database, click the *Refresh* button in your web browser. If the data has been entered, nothing should change after refreshing. When finished, click *Print Sensor Info* to print out a close-up picture of each node's location (including distances to landmarks) to give to the superintendent after the installation is complete.

Scan the Installation Log and send a copy of the file to Toro NSN (fax to 325-673-8765 or mail to Toro NSN, 500 Chestnut Street, Suite 400, Abilene, TX 79602, Attn: Turf Guard Support).

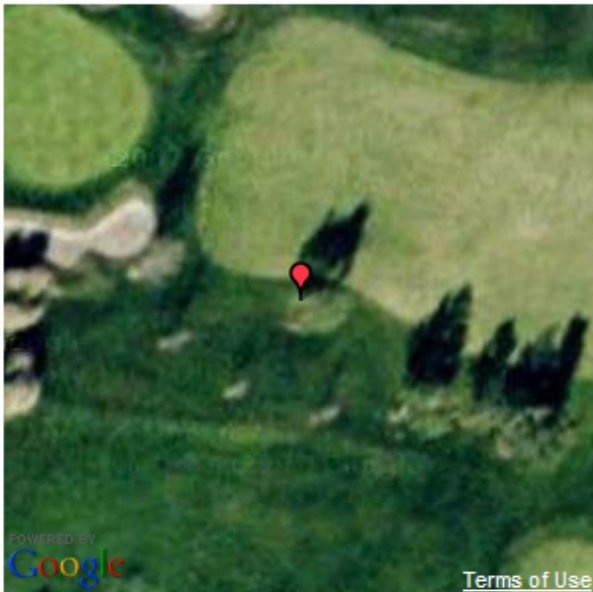
Example of a sensor map printout:



Type: Greens Sensor  
33.4485434623131 : -117.584537565708  
Hole: 7 : Back Green  
LM: 835 (Back) = 10  
LM: 835 (Right) = 20  
LM: Front Green = 30



Type: Greens Sensor  
33.4484449909303 : -117.58442491293  
Hole: 7 : Front Green  
LM: Back Green = 30



Type: Repeater  
33.4482502858215 : -117.5841781497  
Hole: 7 : VP Satellite



## Transferring Sensors to Golf Vision

The node locations will have to be transferred from the *Pre-Install* worksheet into the Golf Vision Database. Start from the *Pre-Install* link, then click on *Transfer Sensors to Golf Vision*. Fill in the Course ID and specify the sensor, repeater, and base station ID's for each installation location; click *add* to add the node (see **Figure 12.** below).

**Figure 12. – Transferring sensors to Golf Vision**

Existing Sensors for: ToroCC, on host dev1.turfguard.net

NodeID	Hole	Type	Desc	lat	lon	Date Added	action
0	0	Base	base station	27.2101844567926	-80.2936220169067	2008-05-01 08:20:28	<a href="#">remove</a>
200	10	Repeater	Ten Repeater	27.2101892275978	-80.2910712361336	2008-05-08 11:14:54	<a href="#">remove</a>
2321	12	Greens Sensor	Twelve Green	27.2113866831613	-80.2912938594818	2008-04-29 09:51:03	<a href="#">remove</a>
2361	11	Greens Sensor	Eleven Green	27.2112459470147	-80.2894592285156	2008-05-08 09:40:19	<a href="#">remove</a>
2051	10	Greens Sensor	Ten Green	27.2098695858384	-80.2924311161041	2008-04-29 09:51:30	<a href="#">remove</a>
67	0	Repeater	Cottage Repeater	27.2104945561052	-80.288812816143	2008-05-12 12:26:09	<a href="#">remove</a>

To move/alter a node property, hole number or location, first remove it from the existing sensors list.

Course ID: ToroCC

Sensor Transfer Utility

NodeID	Hole	Type	Desc	lat	lon	action
<input type="text" value="0"/>	10	Greens Sensor	Ten Green	27.2098481173318	-80.2924257516861	<a href="#">add</a>
<input type="text" value="0"/>	11	Greens Sensor	Eleven Green	27.2112483323746	-80.2894484996796	<a href="#">add</a>
<input type="text" value="0"/>	12	Greens Sensor	Twelve Green	27.2113318199388	-80.291336774826	<a href="#">add</a>
<input type="text" value="0"/>	0	Repeater	Cottage Repeater	27.2104945561052	-80.288812816143	<a href="#">add</a>
<input type="text" value="0"/>	0	Repeater	possible repeater loc.	27.2116824670258	-80.2912616729736	<a href="#">add</a>
<input type="text" value="0"/>	10	Repeater	Ten Repeater	27.2101939983227	-80.2910766005516	<a href="#">add</a>
<input type="text" value="0"/>	0	Base	base station	27.2101844567926	-80.2936220169067	<a href="#">add</a>

Status:

The Existing Sensors screen logs each of the added nodes and compiles the completed list of sensors for the site. To move or alter a node property, hole number, or the location, the node must be removed from the existing sensor list. To do this, simply click the *remove* link next to the sensor you wish to remove. The modified node must be entered on the Sensor Transfer Utility.

## Locating Buried Sensors

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If at some point a sensor needs to be removed, the following procedure is recommended for locating it. This process is also recommended for flagging sensors before aeration, allowing maintenance workers to aerate around them. Toro recommends using White's PRL-1 metal detector from White's Electronics for both of these tasks.



Check the recorded distances from sensors to landmarks in either the Installation Log or on the printed sensor location maps. Use these measurements to find the approximate area in the field.



Use the PRL-1 metal detector to close in on the exact sensor location. For best results, set the detector's sensitivity dial to *Ring*.



Remove the sensor, or if aerating, place a flag directly above the sensor until aeration is complete.