

# PRELIMINARY

## 6.3.6 Rooftop Antenna Placement Tool

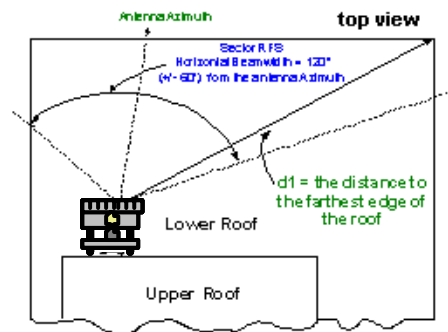
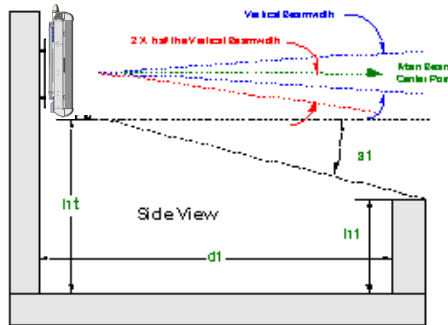
Reference: Rooftop Antenna Placement Tool

This is a picture of the worksheet in the Antenna Placement Tool for a quick visual identification (Figure 6-17); this appendix does not include the entire tool. Please use the electronic copy of the tool to datafill the site information. This form can be found on the following LiveLink site:

<https://tools.cisco.com/cws/livellink?func=ll&objid=4353291&objaction=browse>

The Tool is updated periodically. If you are not sure that you have the latest version, please contact Cisco Technical Services and request that the latest version of the tool be sent to you.

Figure 6-17 Rooftop Antenna Placement Tool



Legend  
 User input required  
 Calculated Value

Cisco Antenna Beam Widths (3dB point)		
	Vertical	Horizontal
RF S8 Panel	5°	120°
RF S2	7°	120°

Cisco Antenna Fixed Electrical Downtilt (@ 0 degrees mechanical tilt)	
RF S8 Panel	-6°
RF S2	0°

### BWX Rooftop Antenna Placement Tool

1. Are the measurements in feet or meters? Feet
  2. What type of antenna is being used? RF S8
  3. How many sectors are being used? 1
  4. What is farthest distance (d1) on the roof within the sector antenna's horizontal beamwidth? 55.0
- For a single sector antenna on a rooftop the actual antenna pattern will extend to ±90° to the left/right of the antenna centerline, although at a reduced signal level relative to the 3dB beam width. If more than 120° of coverage is desired, then d1 should be the farthest distance to the roof edge within ±90° of the antenna centerline.*
3. What is the height of the obstruction or parapet wall (h1)? 10.0
  4. What is the built-in electrical downtilt of the antenna in degrees? -6  
*(See electrical downtilt choices for Cisco supplied antennas)  
 (Use a negative number for all entries)*
  4. What is the planned mechanical tilt of the antenna in degrees? 0  
*(See RF Planning documents) (+ = up tilt and - = down tilt)*  
 (Net Downtilt = Fixed Electrical Downtilt + Mechanical Up/Down Tilt)  
 (Negative for a net downtilt and positive for a net up tilt)
  5. What is the 3dB vertical beam width of the antenna? 5  
*(See Vertical Beam width choices for Cisco supplied antennas)*
  6. The Required Clearance Angle (θ1) is the sum of the downtilt + two times half the vertical beam width + 3 extra degrees to allow for any additional downtilt for future network optimization. 8
  7. This is the minimum required antenna height from the rooftop (ht) necessary to provide sufficient signal clearance 17.73 ft

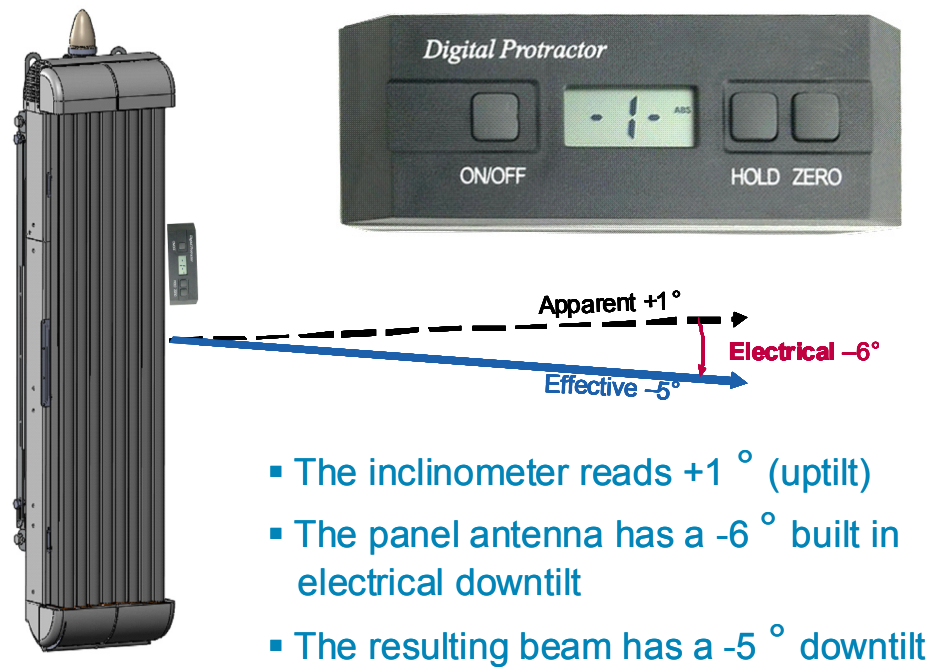
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### 6.3.7 Set the Downtilt

Based on coverage objectives determined by previous RF planning, the AU may need adjusting upward or downward once mounted on the pole, tower, roof, building, or other structure. **The panel antenna has a  $-6^\circ$  built-in electrical downtilt.**

You will use an inclinometer to read the mounted position and to determine what adjustments, if any, need to be made. For example, if the inclinometer reads  $+2^\circ$  (uptilt) and you are mounting an AU, the resulting beam has a  $-4^\circ$  downtilt (Figure 6-18).

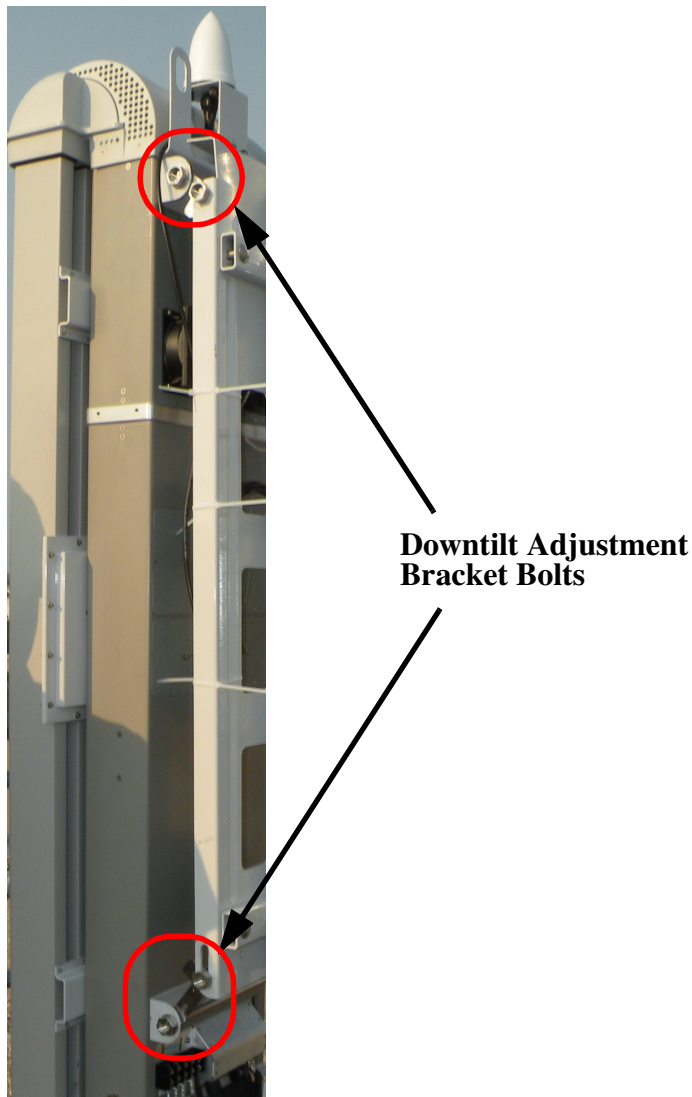
**Figure 6-18** Downtilt Adjustment Example



The downtilt can be adjusted per the assembly shown in Figure 6-19

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Figure 6-19 Downtilt Adjustment Assembly



### 6.3.8 Antenna Orientation

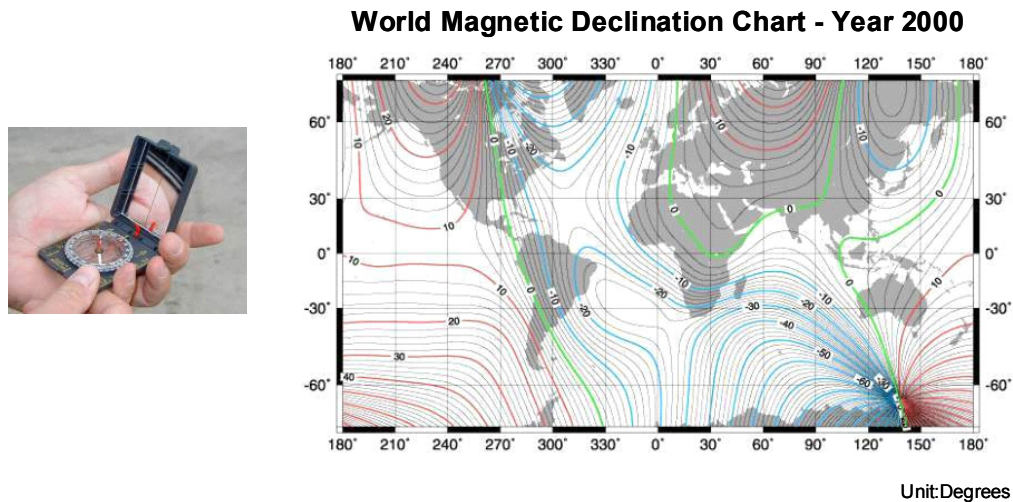
The magnetic declination, which is the angular difference between observed magnetic north on a compass and geographic (or “true”) north, shifts from year to year. Panel antennas must be oriented appropriately as required by the RF plan.

Adjustments that will need to be made are based on the Magnetic Declination Chart (Figure 6-20), which provides values to correct the compass reading and determine the true geographic East. Always check for the latest chart information, which may be found at the following web address: [www.thecompassstore.com/decvar.html](http://www.thecompassstore.com/decvar.html).

Since this is not the year 2000 any more, you will want to check this reference chart to learn how your magnetic declination may have shifted since then. Notice that the map measures annual shifts in minutes. Since it takes 60 minutes to equal 1 degree, if you notice that your location has a declination shift of 5 minutes per year, this means it will be another 12 years before your declination adjustment changes by one whole degree.

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Figure 6-20 Magnetic Declination Chart – Example



- Use a compass to determine the magnetic East
- Use a Magnetic Declination chart to correct the compass reading and determine the true geographic East



### Note

It is better to convert the “true” azimuth (which way the antenna should point in the horizontal plane) as required by the RF Plan to the magnetic value that will be read on the compass **before** sending the installer to the field. This way the installer will go by the reading on the compass, not having to worry about magnetic declination corrections.

## 6.4 Power and Ground Cabling

### 6.4.1 Overview

The BS will operate at an input voltage of - 48 V DC, as measured at the input terminals to the BS.

General power and grounding information was covered in [Chapter 5, “Pre-installation.”](#) Please refer there for information about power and ground cabling.

### 6.4.2 System Ground Cabling

The BS must be grounded prior to connecting power.



### Warning

**This equipment must be externally grounded using the supplied ground wire before power is applied. Contact the appropriate electrical inspection authority or an electrician if you are uncertain that suitable grounding is available.** Statement 366

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**Warning**

**Read the installation instructions before connecting the system to the power source.** Statement 1004

  
**Warning**

**When installing or replacing the unit, the ground connection must always be made first and disconnected last.** Statement 1046



**Note**

It is strongly recommended that no switch or disconnect device be installed in the ground cabling.

In all installations and when powering the BS, you must follow these instructions to properly ground the BS:

- Step 1** Strip the insulation as required for the grounding lug.
- Step 2** Use the appropriate crimping tool to crimp the supplied 6-AWG grounding lug to the bare copper ground wire.
- Step 3** Apply heat shrink to the grounding lug.
- Step 4** Open the electrical joint compound (supplied), and apply a liberal amount over the metal surface where the grounding connectors are located.
- Step 5** Connect the ground cable to the BS ground using the supplied nuts with lock washers. Tighten the nuts to 48 in-lbs. (5.4 Nm). Refer to [Figure 6-21](#).

**Figure 6-21**      **Ground Cable Installed**



- Step 6** If necessary, strip the other end of the ground wire, and connect it to a reliable earth ground such as a grounding rod or an appropriate grounding point on the pole/mast that is grounded.

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## 6.4.2.1 Lightning Protection

Lightning protection information is covered in [Chapter 5, “Pre-installation.”](#) Please review that section before continuing with the installation process.

### 6.4.2.1.1 Surge Arrestors

The BWX 8415 Basestation contains primary lightning protection on the GPS cable and the -48V power cable. A DC primary lightning protector is also recommended at the output of the main power supply.

## 6.4.3 System Power Cabling

Install the power cable to the power connectors on the RU. Always refer to the regulatory standards for power and grounding.



**Warning**

**Read the installation instructions before connecting the system to the power source.** Statement 1004



**Warning**

**A readily accessible two-poled disconnect device must be incorporated in the fixed wiring.** Statement 1022



**Warning**

**Connect the unit only to DC power source that complies with the safety extra-low voltage (SELV) requirements in IEC 60950 based safety standards.** Statement 1033

Follow these instructions to properly connect the power cabling to the BS:

- Step 1** If using insulated 6-AWG or 8-AWG copper wire, strip the insulation as required for the power lugs.
- Step 2** Use the appropriate crimping tool to crimp the supplied 6-AWG or 8-AWG power lugs to the bare copper wires.
- Step 3** Apply heat shrink to the power lugs.
- Step 4** Open the electrical joint compound (supplied), and apply a liberal amount over the metal surface where the power connectors are located.
- Step 5** Connect the power cable leads (2 RTN and 2 -48V) to the BS using the supplied nuts with lock washers. Tighten the nuts to 48 in-lbs. (5.4 Nm). Refer to [Figure 6-22](#).



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Figure 6-22 Power Cable Leads Installed



## 6.5 Fiber-Optic Cabling



**Class 1 Laser product.** Statement 1008

General fiber cable information was covered in [Chapter 5, “Pre-installation.”](#) Please refer to [5.8 Fiber-optic Cable Selection](#) and [5.11 Confirm AAA, BWG, and Backhaul Network Availability](#) for information about the required fiber-optic cable and the backhaul connectivity.

To connect a fiber-optic cable to the access point, follow these steps:

- Step 1** Ensure that the power source has been disconnected from the BS.
- Step 2** Attach the Amphenol connector on the fiber-optic cable to the fiber-optic port on the BS and hand tighten.

## 6.6 Complete the BWX 8415 Installation

### 6.6.1 Install the I/O cable Cover

Perform the following steps to install the I/O cable cover.

- Step 1** Install the I/O cable cover over the power, ground, fiber-optic, and GPS cable connections on the BWX 8415. Refer to [Figure 6-23](#).

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Figure 6-23 I/O Cable Cover



**Step 2** Tighten the screws on the I/O cover securely to prevent water from leaking into the unit.

### 6.6.2 Test the Backhaul Connection

If required in the Responsibility Assignment Matrix (RAM) or project plan, test the backhaul to the customer demarcation point.



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## 7.7 Calibration

### 7.7.1 What it Means to Calibrate

Performing a calibration on the BS detects the phase differential between the antenna elements and matches the output power across all antenna elements in the BWX 8415 Antenna Unit. On a new installation, the calibration procedure should be performed at least 3 times to verify consistency of the returned values. Ensure that the BS has been powered on, with the Power Amplifiers on, for at least 15 minutes to allow them to warm up and stabilize.

**Caution**

Do not attempt to calibrate the basestation while performing a software upgrade or downgrade. Calibrating during an upgrade or downgrade can interfere with the loading of files into system components and may produce faults or other problems.

### 7.7.2 Types of Calibration

Assuming the BS has been powered up and left on for at least 15 minutes, and that all alarms have been cleared, you can now run a calibration. There are 2 types of calibration:

- Full Calibration
- Online Calibration

Typically, only the Full Calibration is done manually by the service provider. For the **initial installation**, the Full Calibration will be run at least 3 times.

**Note**

Cisco recommends that a Full Calibration be performed on each BS, at least once every 4 weeks.

When a Full Calibration is invoked, the BS is out of service for about 2 minutes. After installation, commissioning, and acceptance testing, Cisco recommends that a Full Calibration be run every 4 weeks during off hours. During Full Calibration the Digital card pre-calibrates itself and the BS closes any ongoing sessions with modems that are currently registered. The transmit gain in the IF section is adjusted for each of the 8 transmit paths individually so that the level of power delivered at the base of each antenna element is exactly the value specified by the Antenna Power parameter.

The receive gain is adjusted for each of the 8 receive paths individually so that when the level of power specified by the Rx Sensitivity parameter is received at the base of each antenna element, it will correspond to the maximum voltage that the card can handle. If the card is unable to adjust either the TX gain or the RX gain for a particular antenna element, both gain values are set to zero (0) and this antenna element is taken out of service.

Then, all paths are turned on using the gain settings just determined by the calibration, and the phase and amplitude changes introduced in each sub-carrier between the BS and the base of each antenna path are determined, both in the transmit and receive directions. This is done with power applied to all antenna paths and using the TX and RX gains in the card, as determined in the previous step, in order to achieve the power levels specified by the Antenna Power and Rx Sensitivity parameters.

Once the new phase change values are determined, they are compared with previous results kept in the BS's memory. If there is a large discrepancy with the previous results, an alarm is generated and the BS uses the most likely correct set of values. Otherwise, the new results are sent to the EMS and kept in the BS's memory for future comparisons.

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When the BS is calibrated, the measured values are stored in the BS and then reported to the EMS to be stored under *Air Interface > Layer 1*. The Digital card pre-calibration values are placed in the *General* tab. The TX and RX gain values are placed in the *Antenna Table*.

### 7.7.3 Calibration Procedure

Before you can calibrate, ensure the following requirements are met:

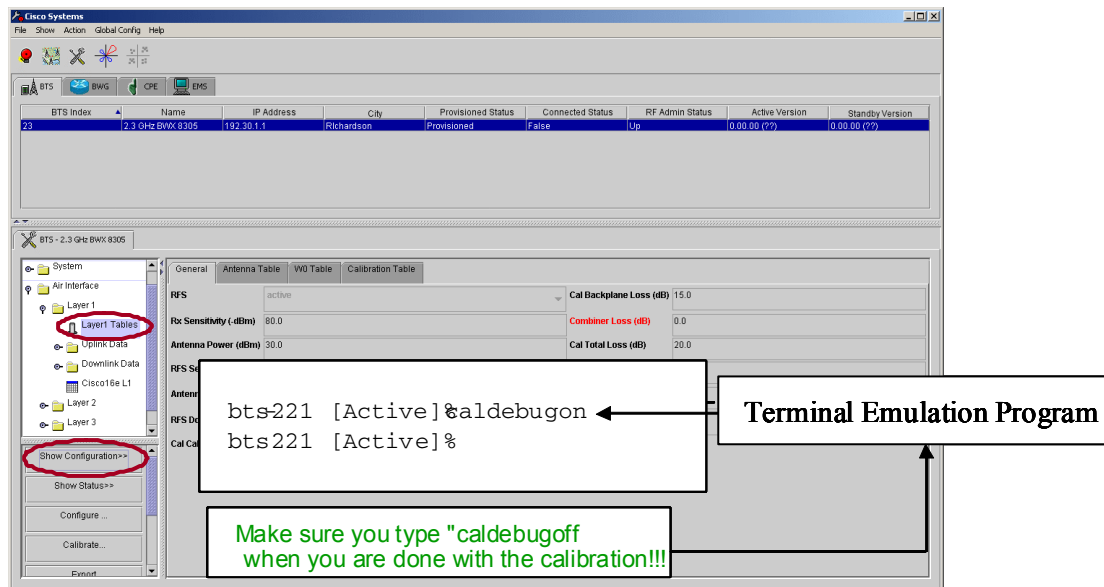
- The BS must have been previously added and configured in the EMS database
- The BS must be powered up for at least 15 minutes, booted properly, stable (not resetting) and all alarms cleared before running the calibration
- Select the BS on the EMS CAM by clicking on the BS


**Note**

The BS must be provisioned before you can calibrate. If the BS is not provisioned, refer to [7.6.3 Provision the BWX 8415 Basestation](#) for the steps to perform the provisioning.

- Step 1** Select *Air Interface > Layer 1 > Layer 1 Tables*.
- Step 2** Click on *Show Configuration*.
- Step 3** From a terminal emulation program type in the command, *caldebugon* and hit *<Enter>* (Figure 7-42).

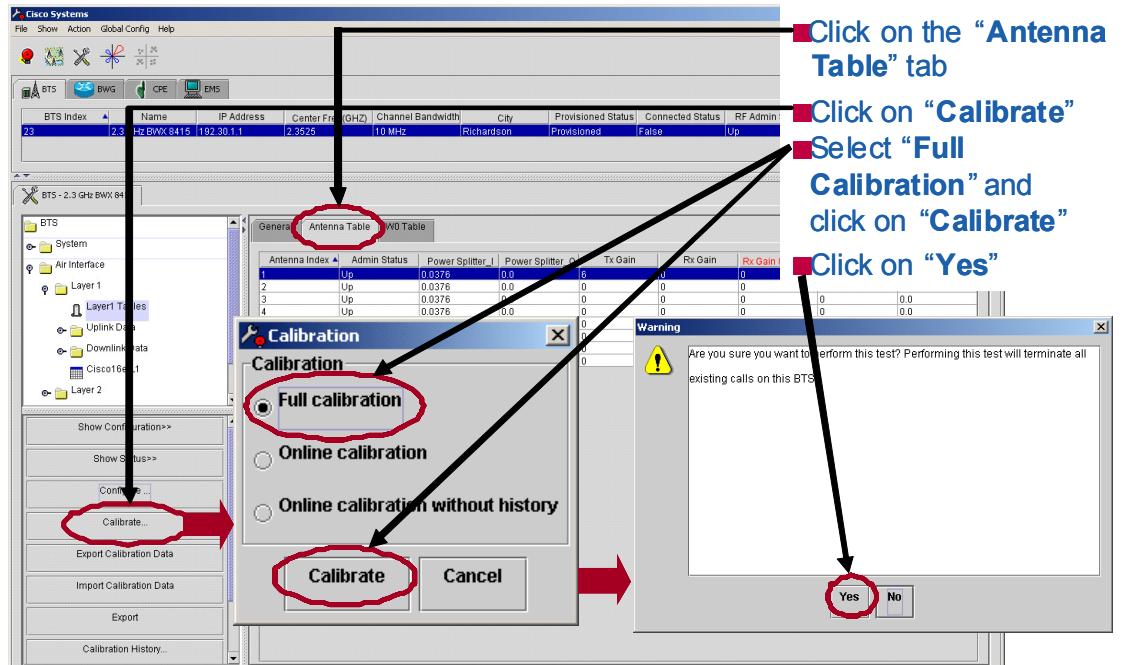
**Figure 7-42 Show Configuration**



- Step 4** With the *Antenna Table* tab selected, click on *Calibrate*
- Step 5** Select *Full Calibration* and *Calibrate* and then click on *Yes*. Refer to [Figure 7-43](#).

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**Figure 7-43 Full Calibration**



- Click on the “Antenna Table” tab
- Click on “Calibrate”
- Select “Full Calibration” and click on “Calibrate”
- Click on “Yes”



**Note**

If you forgot to provision the BS in the EMS database, you will see the error shown in Figure 7-44. Click on *Ok* and refer to 7.6.3 Provision the BWX 8415 Basestation.

**Figure 7-44 Provision Error**

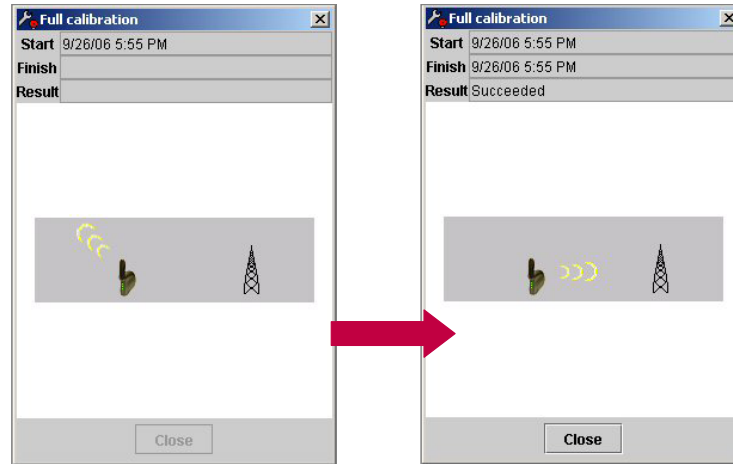


When the calibration is complete, the Full Calibration window changes and displays the finish time and the result. **Note that the result of “Succeeded” means that the calibration finished, not that the calibration results were successful (Figure 7-45).**

**Step 6** Click on *Close* to close the *Full Calibration* window

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**Figure 7-45** Calibration Results



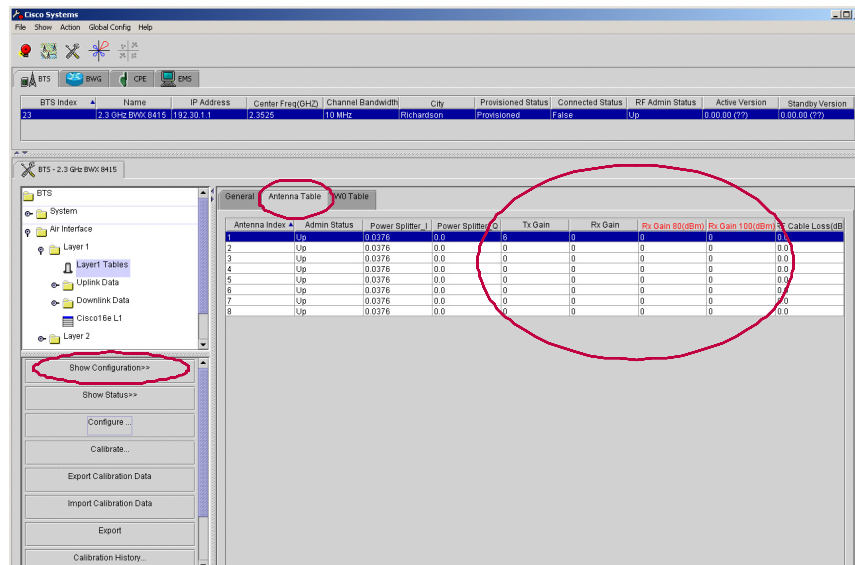
**Step 7** Click on *Show Configuration* to see if the calibration is successful. In the EMS CAM highlight the BS and check the *Antenna Table* transmit and receive gain values (Figure 7-46).



**Note**

A value of zero indicates that a proper value for the gain for that path (either in the TX or Rx direction) could not be found.

**Figure 7-46** Check Antenna Table Values



**Step 8** Check the calibration results for the Transmit and Receive Gain Values.



**Note**

The BS system has a Transmit Gain value range of 1-64 and a Receive Gain value range of either 115-255 or 0-140. When evaluating calibration gain words, it is important to remember that the size of the value does not determine if a problem exists.

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To determine if a problem exists, use the following information:

- At the BS console, look at the cal error message. The calibration should pass without any errors.
- Look at the Transmit Gain values. They should be relatively close to each other (values: 1 - 64).
  - Find the median Transmit Gain value. The median is the value that falls in the middle of the lowest to highest values. Example: If you ordered the values 9, 8, 8, 7, 7, 6, 5, 4, 3, 3, 3, 2, 1, 1....the median would be 5 because 5 falls midway from the top or bottom of the ranked values.
  - Compare all the other Transmit Gain values to the median value. All Transmit Gain values should be within a plus or minus range of 6 units from the median. Therefore, if the median is 50, values from 44 to 56 would be acceptable.
- Look at the Receive Gain values. (values: 115 – 255)
  - Find the median Receive Gain value.
  - Compare all the Receive Gain values to the median value. All Receive Gain values should be within a plus or minus range of 8 units from the median.

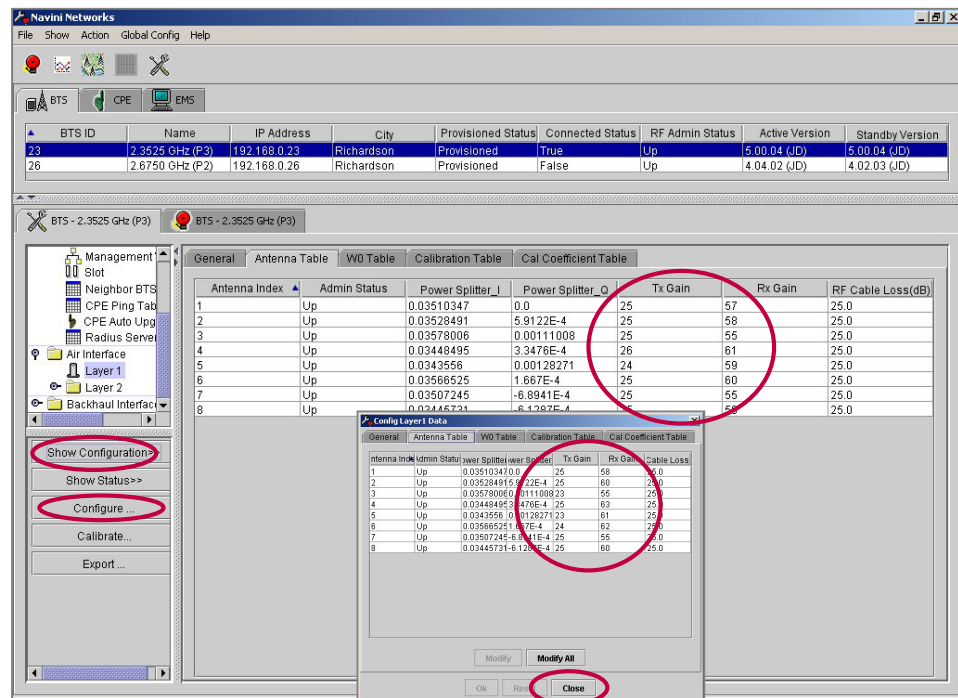
### Criteria:

**Transmit Gain Words +/- 6 from the median value**

**Receive Gain Words +/- 8 from the median value**

If this is a new installation (or a problem is found), repeat the calibration procedure (Steps 4-8). This will be the second of three calibrations you will perform. Click on the Configure button for this BS, and a new window appears (Figure 7-47). The main “Show” window still shows the results of the first calibration. The Configuration window shows the values corresponding to the second calibration.

**Figure 7-47 Second Calibration (if needed)**



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Compare the values of both calibrations. The corresponding results should be within +/- 3 units. Close the Configuration window, and click on Show Configuration to move the second calibration values into the main window.

Next, perform a third calibration (Steps 4-8) and compare the results with the second calibration values. An example of successful calibration results is provided in [Figure 7-48](#). An example of calibration results with errors is shown in [Figure 7-49](#).

**Figure 7-48 Example – Successful Calibration**

```
Data received from Layer1:

antenna txGain rxGain
0      18      67
1      15      67
2      17      63
3      18      71
4      15      68
5      17      70
6      17      63
7      16      67

carrierId antenna txCalWeightX txCalWeightY rxCalWeightX rxCalWeightY rxSNR txSNR
0          0      32.0751      1167.99      8929.38      57776      14.8713      -58.0311
0          1      -51.7158      1165.44      -17116.8     -56872.4   14.6449      -49.6681
0          2      712.152      858.821      25107.3     53970      14.9417      -65.6772
0          3      970.448      649.556      2988.24     -57892.1   14.7349      -60.3216
0          4      -144.55      1162.05     -31553.2    -48341.8   14.5399      -52.7438
0          5      -1152.3     188.353     9726.92     58129.3    14.7198      -56.5888
0          6      671.034     -944.873    16581.7     55125.9    14.4144      -61.5753
0          7      -1037.14    -522.104    -14678.7    56342.4    14.4625      -59.1302
1          0      1.413      1165.16     7420.12     58477.6    17.5769      -62.3292
1          1      -15.6843    1166.71     -14542.4    -56266.7   17.8756      -55.5523

.....

23         0      13.7061      1155.41     17919.3     56372.7
23         1     -110.214     1151.74     -23078.1    -53293.6
23         2     733.771      896.972     26636.7     52430.5
23         3     980.339      603.351     2003.94     -58427.1
23         4     -81.1062     1142.55     -32936.2    -48987.9
23         5     -1150.89     97.7796     8904.14     56862.3
23         6     678.523     -942.895    14027.6     58078.8
23         7     -1064.41    -435.91     -13482.4    55363.2
TX Syn Gain : 26
RX Syn Gain : 579
SC Syn Gain : 567
SC SYN Level : 8376
Cal Error : 0
```



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Figure 7-49 Calibration With Errors

Data received from Layer1:

antenna	txGain	rxGain
0	18	67
1	15	67
2	17	63
3	18	71
4	15	68
5	17	70
6	17	63
7	0	0

Both gains and all the phase shifts for this path are set to zero.

carrierId	antenna	txCalWeightX	txCalWeightY	rxCalWeightX	rxCalWeightY	rxSNR	txSNR
0	0	32.0751	1167.99	8929.38	57776	14.8713	-58.0311
0	1	-51.7158	1165.44	-17116.8	-56872.4	14.6449	-49.6681
0	2	712.152	858.821	25107.3	53970	14.9417	-65.6772
0	3	970.448	649.556	2988.24	-57892.1	14.7349	-60.3216
0	4	-144.55	1162.05	-31553.2	-48341.8	14.5399	-52.7438
0	5	-1152.3	188.353	9726.92	58129.3	14.7198	-56.5888
0	6	671.034	-944.873	16581.7	55125.9	14.4144	-61.5753
0	7	0	0	0	0	0	0
1	0	1.413	1165.16	7420.12	58477.6	17.5769	-62.3292
1	1	-15.6843	1166.71	-14542.4	-56266.7	17.8756	-55.5523

.....

23	0	13.7061	1155.41	17919.3	56372.7		
23	1	-110.214	1151.74	-23078.1	-53293.6		
23	2	733.771	896.972	26636.7	52430.5		
23	3	980.339	603.351	2003.94	-58427.1		
23	4	-81.1062	1142.55	-32936.2	-48987.9		
23	5	-1150.89	97.7796	8904.14	56862.3		
23	6	678.523	-942.895	14027.6	58078.8		
23	7	0	0	0	0		

TX Syn Gain : 26  
 RX Syn Gain : 579  
 SC Syn Gain : 567  
 SC SYN Level : 8376  
 Cal Errorr : 80008000

Only 7 out of 8 antenna elements are working

Antenna Power = 15 Rx Sensitivity = 100 numAntenna = 7

8 0 0 0 8 0 0 0

1000 0000 0000 0000 1000 0000 0000 0000

Here is the key to interpret the calibration error code

