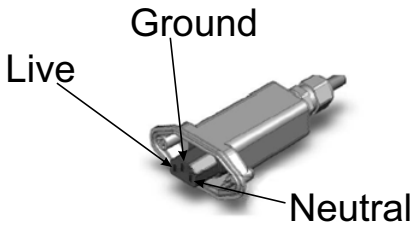
AC Power Input

The Bird remote only comes with an AC input option. The voltage range will support 120VAC or 240VAC, 50 or 60 Hz. The remote ships with a weather proof C13 connector and weather proof strain relief housing. The unit does not ship with a power cord - only the power connector. The installation contractor will need to provide a power cable of at least 14AWG, 3 conductor cable.

Figure 45 Weatherproof AC Input Connector



WARNING
Electrical installation should only be performed by a licensed electrician.

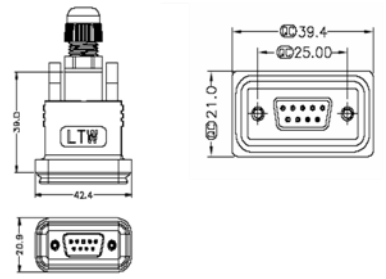
External Alarm Connection

The external alarm port on the Bird remote requires an IP 67 D-sub connector (not supplied by Bird).

Table 63 Alarm Definitions

Alarm Input	Level	Alarm Text
1 (Pin 9)	Error	Battery voltage low
2 (Pin 4)	Critical	Loss of main AC power
3 (Pin 8)	Warning	External alarm 3
4 (Pin 3)	Error	External alarm 4

Figure 46 External Alarm Connector



Use an IP 67 D-Sub connector for External connections

Table 64 External Alarm Connector Pinout

Pin	Function
1	Alarm relay output NC
2	Alarm relay output NO
3	Alarm input 4
4	Alarm input 2
5	Alarm input ground
6	Alarm relay output NC
7	Alarm relay output NO
8	Alarm input 3
9	Alarm input 1

Grounding

The remotes are furnished with a ground lug to be used if chassis grounding is required to meet local code or installation requirements. The external grounding lug must be used when the remote is installed in applications where it is susceptible to lightening strikes.

If the remote is mounted in areas with high EMF such as near high amperage transformers, turbines or broadcast antennas, properly grounding the chassis will provide reduce the likelihood interference.

Figure 47 Remote Ground Connection

Remote Unit Verification

Once the remote has been properly installed and all connections made the unit may be powered up. The unit is automatically powered up once power is applied to the AC plug on the bottom of the unit.

The typical power cycle of the remote is approximately 90 seconds. The red and green LED on the bottom of the remote will flash during the boot cycle.

- Once the boot cycle is complete, a solid red LED indicates there is no fiber connection or communication to the DAS head end.

Installing the DHR Repeater

The repeaters units are factory configured and should not be opened in the field.

WARNING

The Repeaters are heavy , use care and always properly support units during installation. If allowed to fall a Repeater can cause injury or death.

CAUTION

Ensure the surfaces being used to mount the Repeater can safely support the full weight of the Repeater.

The remotes must be mounted in a vertical position. There are two recommended methods for Remote Unit installation, wall mounting or pole mounting. Regardless of the mounting style selected, the remotes must be mounted so that airflow over the external heat sink is not obstructed.

Single Repeater Wall Mounting

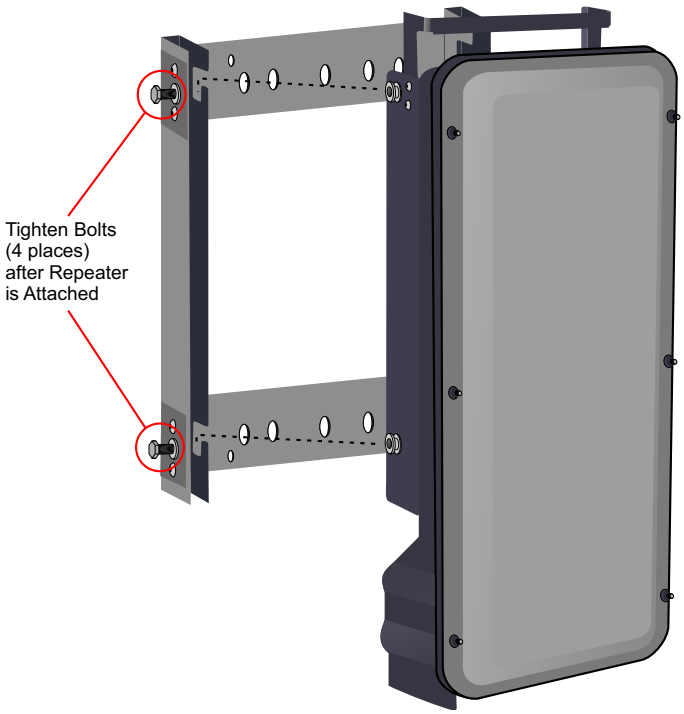
The repeaters are shipped with standard wall mounting brackets. These brackets can be used indoors and outdoors.

- Mount the bracket without the repeater attached.

  Note: Always check local building codes for proper mounting techniques.

- Once the bracket is properly mounted, the repeater easily slides into the mount. See Figure 48.

Figure 48 Repeater Wall Mount

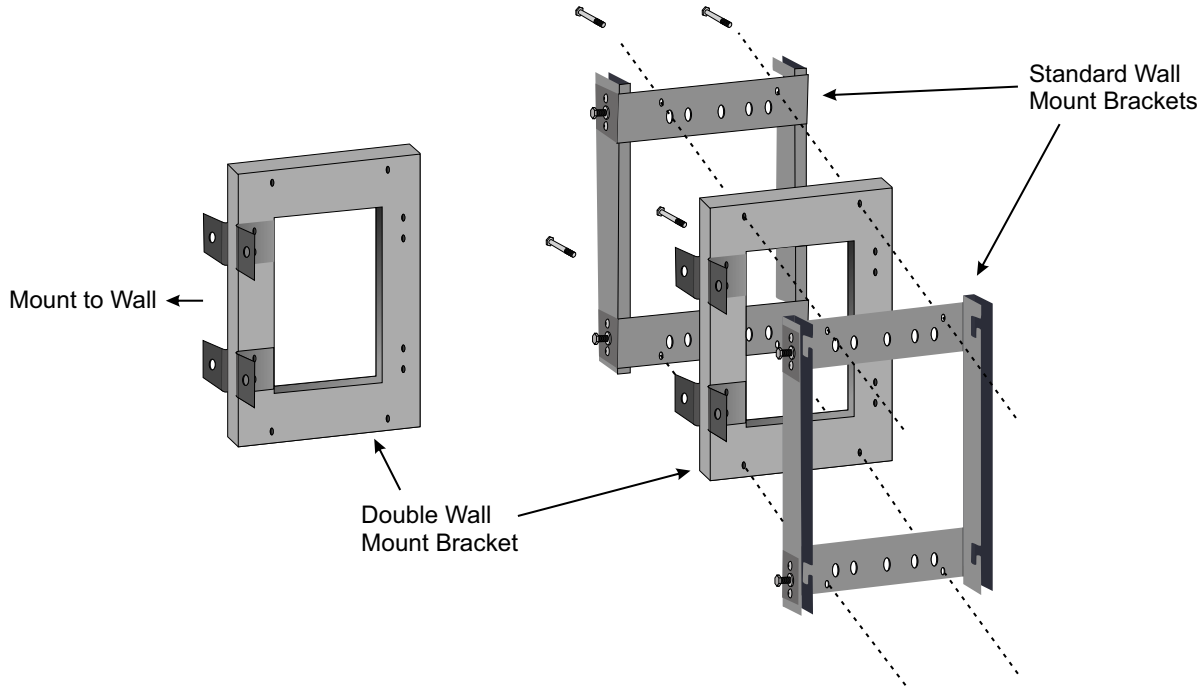


- Once the repeater is attached to the wall mount, the repeater must be properly secured to the mount by tightening bolts at each mounting point.

Double Repeater Wall Mounting

Bird Technologies offers a bracket that allows two wall mount racks to be mounted back to back. This reduces the amount of wall space required when two repeaters are located together. The bracket is stainless steel and can be used indoors or outdoors.

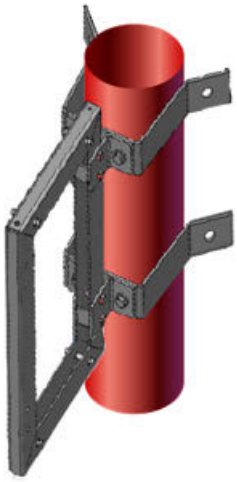
Figure 49 Double Wall Mounting Bracket



Repeater Pole Mounting

Bird Technologies also offers a pole mounting option. The pole mount brackets are designed to be used with the Double Wall Mount bracket.

Figure 50 Repeater Pole Mounting Option



Solar Shield

Direct exposure to sun light can cause temperatures of the repeater to exceed the 55 °C (131°F) rating. A simple solution offered by Bird is to attach an optional solar shield to the affected repeaters. The solar shields are sold separately.

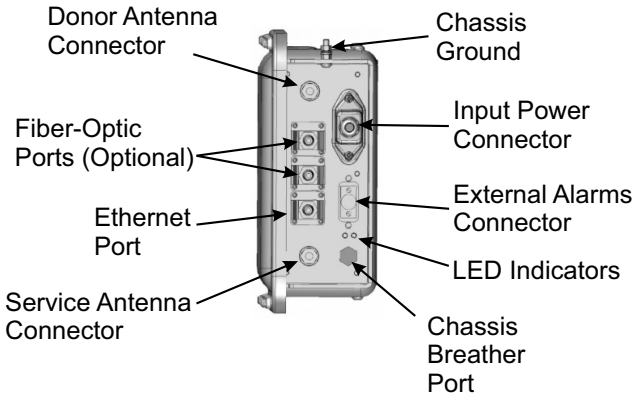
Figure 51 Remote Unit Solar Shield

Cabling

There are many options for the Bird repeaters which can affect the number of connections on the bottom of each repeater. The standard connections are:

- Ethernet port
- RF Ports (N-Type standard)
- Input Power
- External alarm port
- Grounding
- Fiber Optic (optional)

Figure 52 Repeater Cabling Connectors



Ethernet Port

The RJ45 Ethernet port is located on the bottom panel of the repeater unit. Connection of the Ethernet port is not required for normal operation of the repeater. The port offers convenient access to the system GUI during installation, commissioning and troubleshooting. Ensure the provided IP67 rated protective cap is replaced when the Ethernet port is not in use.

If the Ethernet connection is to be long term or permanent, ensure that the appropriate Ethernet patch cable is utilized to prevent the ingress of moister into the port.

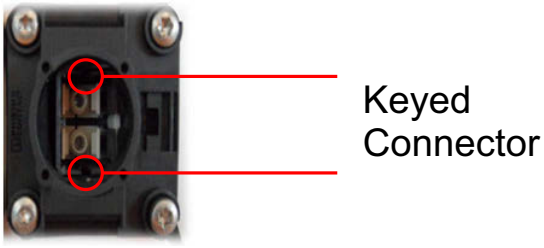
Fiber Optic Connection

If the fiber optic option is ordered, the fiber connection on the bottom of the repeater has an IP67 rated protective cap. The protective cap must remain in place until the fiber is to be inserted. This will help prevent foreign particles from degrading performance of the fiber.

The fiber connection has a keyed slot SC/APC connection. Care must be taken to ensure the fiber is installed correctly. It is possible to force the connection so that the fiber is installed at a 180 degree rotation causing performance issues.

Note: *The SC/APC key is at the top and bottom on the connection on the* repeater.

Figure 53 Remote Fiber-Optic Connector



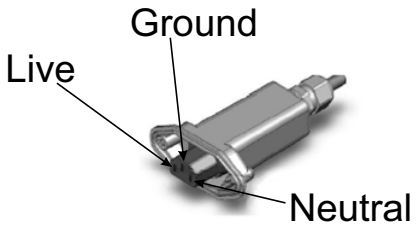
It is **highly recommended** that only the SCRJ fiber cables be used with the repeaters. Not only does the SCRJ cable prevent the ingress of moisture and dust into to the fiber port but the cable also insures the fibers are correctly aligned in the connector. SCRJ fiber cables are ordered separately from Bird Technologies.

Figure 54 SCRJ Connector

AC Power Input

The Bird repeater only comes with an AC input option. The voltage range will support 120VAC or 240VAC, 50 or 60 Hz. The remote ships with a weather proof C13 connector and weather proof strain relief housing. The unit **does not ship with a power cord** - only the power connector. The installation contractor will need to provide a power cable of at least 14AWG, 3 conductor cable.

Figure 55 Weatherproof AC Input Connector



WARNING
Electrical installation should only be performed by a licensed electrician.

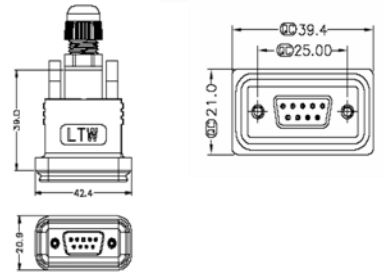
External Alarm Connection

The external alarm port on the repeater requires an IP 67 D-sub connector (not supplied by Bird).

Table 65 Alarm Definitions

Alarm Input	Level	Alarm Text
1 (Pin 9)	Error	Battery voltage low
2 (Pin 4)	Critical	Loss of main AC power
3 (Pin 8)	Warning	External alarm 3
4 (Pin 3)	Error	External alarm 4

Figure 56 External Alarm Connector



Use an IP 67 D-Sub connector for External connections

Table 66 External Alarm Connector Pinout

Pin	Function
1	Alarm relay output NC
2	Alarm relay output NO
3	Alarm input 4
4	Alarm input 2
5	Alarm input ground
6	Alarm relay output NC
7	Alarm relay output NO
8	Alarm input 3
9	Alarm input 1

Grounding

The repeaters are furnished with a ground lug to be used if chassis grounding is required to meet local code or installation requirements.

Figure 57 Remote Ground Connection

This section is focused on the GUI interface and initial software setting of the DAS. No special software is require to access the Bird DAS. Access is provided via most web browsers such as Mozilla Firefox or Google Chrome.

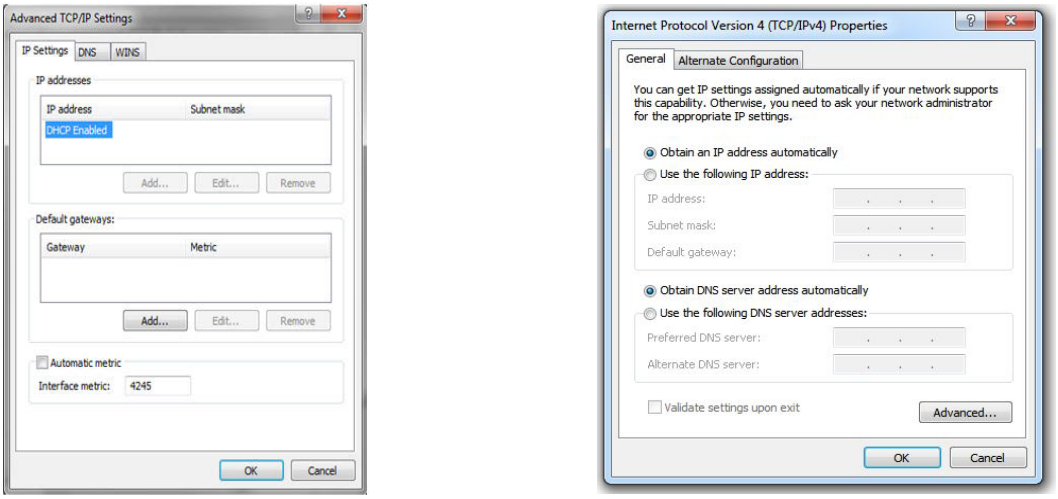
The BGW should be powered up and allowed about 5 minutes to fully boot prior to applying power to the Master Unit. The BGW will assign IP addresses to the Master Unit components. If the Master Unit is powered up prior to the BGW then it could take up to 30 minutes for the Master Unit components to get assigned an IP address. Master Unit cards will show a quick flash of the green LED when an IP address has been assigned.

Special Note: The following is based on version 3.5 software.

Ethernet Connection

1. Connect a laptop to any open port on the Headend Ethernet switch.
2. Ensure the laptop network settings have DHCP enabled and the “Obtain an IP address automatically” radio button checked.

Figure 58 Windows TCP/IP Settings



3. Using an Internet browser go to https://172.22.0.1 to access the BGW. A successful entry will show access to the login page.
4. Login to the BGW.
   - Username: "extended"
   - Password: "admin"

Figure 59 BGW Login page

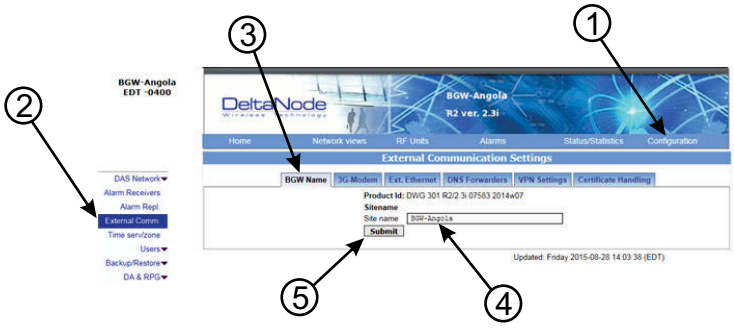
BGW Configuration

BGW Naming

1. Select **Configuration** in top right corner. See Figure 60.
2. Select **External Comm** in left menu.
3. Select **BGW Name** tab in top menu.
4. Enter site name:
    a. You may use any combination of alphanumeric characters and the special character of dash "-". Do not use any other special characters or space.
        - ✓ 0 through 9
        - ✓ a through z
        - ✓ A through Z
        - ✓ -
        - ✓ Limit of 56 characters
    b. Use a site name that is descriptive enough to distinguish the BGW from other sites. Generic names may delay troubleshooting efforts.
5. Click **Submit**.

    Note: *After the new host name is entered, the unit must be restarted. This is the only change that requires a restart. Select the physical restart button on the left side of the BGW.*

Figure 60 BGW Site Name



EXT Ethernet

In order for the BGW to be able to communicate outward, the Ext Ethernet connection has to be programmed. Consult with your Internet service provider or IT department for the IP address, Netmask and Gateway IP address settings.

Figure 61 BGW External Communications

VPN Settings

On occasions, the BGW will be set up behind a firewall. To be able to access the BGW from external locations the Primary BGW settings will need to be configured to allow access. Consult with your IT department for these parameters.

Bird Technologies offers monitoring services. When these services are contracted, enter the Bird parameters in the Secondary BGW settings so that system alarms are correctly forwarded to the Bird NOC.

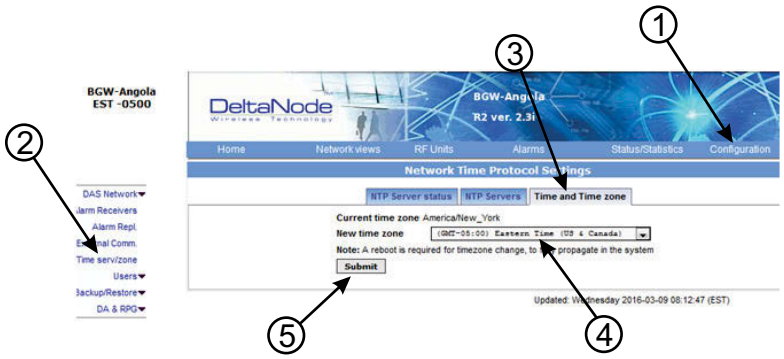
Figure 62 BGW VPN Settings

Time Zone

To ensure that alarms are correctly labeled with the local time the time zone for the BGW will need to be set.

1. Select **Configuration**. See Figure 63.
2. Click **Time serv/zone**.
3. Select the **Time and Time zone** Tab.
4. Select the local time zone from the drop-down menu.
5. Click **Submit**.

Figure 63 BGW Time Zone Settings



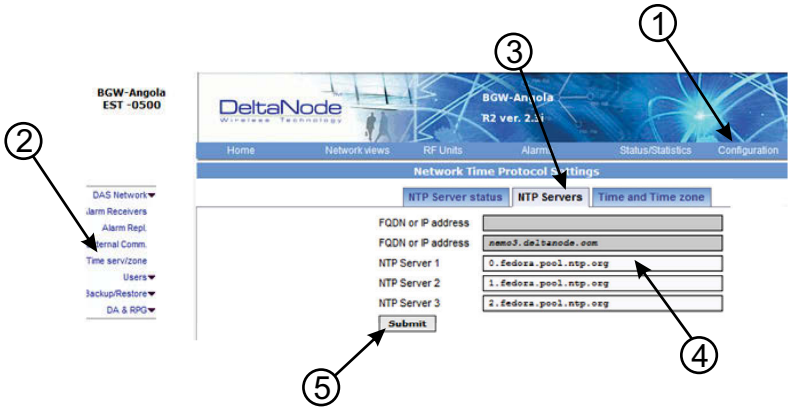
NTP Servers

NTP servers provide accurate clocks for the BGW. Utilizing multiple sources prevents clock issues as a result of one server becoming corrupt or dropping out of contact. The BGW is compatible with NTP version 4 servers. The NTP settings in the image below are the default for Redhat servers.

1. Select **Configuration**.
2. Click **Time serv/zone**.
3. Select the **NTP Servers** Tab.
4. Enter the NTP Server information. The FQDN settings are reserved for deployments utilizing the CGW.
5. Click **Submit**.

If no Internet access is available, the BGW will create its own clock to give the sub-nodes of the system a valid NTP service.

Figure 64 NTP Server Settings



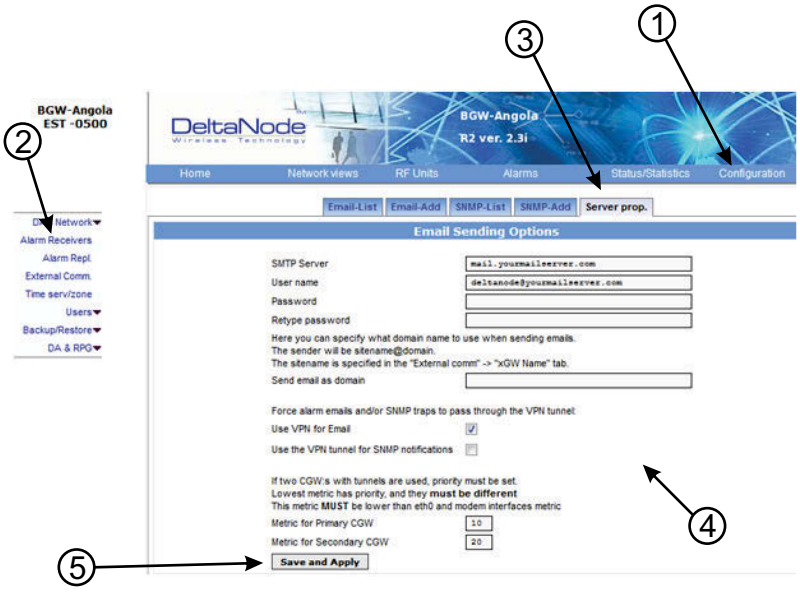
Email Server

The BGW is capable of emailing alarms directly to select email addresses. Access the set up function via Configuration, Alarm Receivers and Server Prop.

Consult with your IT department for configuration settings.

1. Select **Configuration**.
2. Click **Alarm Receivers**.
3. Select the **Server Prop.** Tab.
4. Enter the Email Server information. Consult with your IT department for configuration settings.
5. Click **Save and Apply**.

Figure 65 Email Server Settings

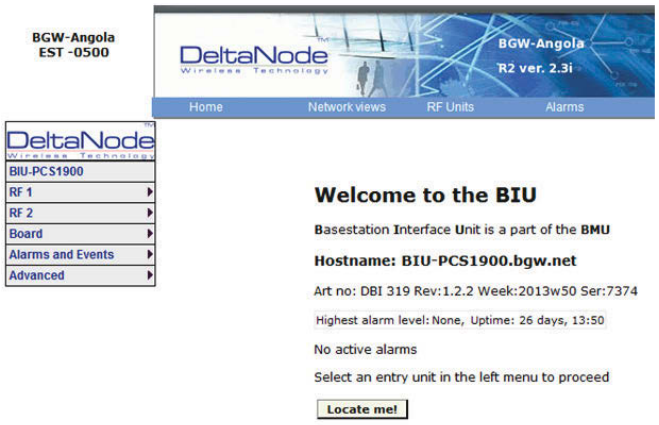


BIU Configuration

The initial screen for the BIU provides basic information such as name, serial number, part number and active alarms. The Locate me! button causes an LED to flash on the unit so that the module can be identified in the chassis.

In the left menu, notice the RF 1 and RF 2. The BIU has two RF paths or strips that are correlated to the two RF inputs on the BIU card. Each RF path has independent settings that can be accessed via the appropriate selection.

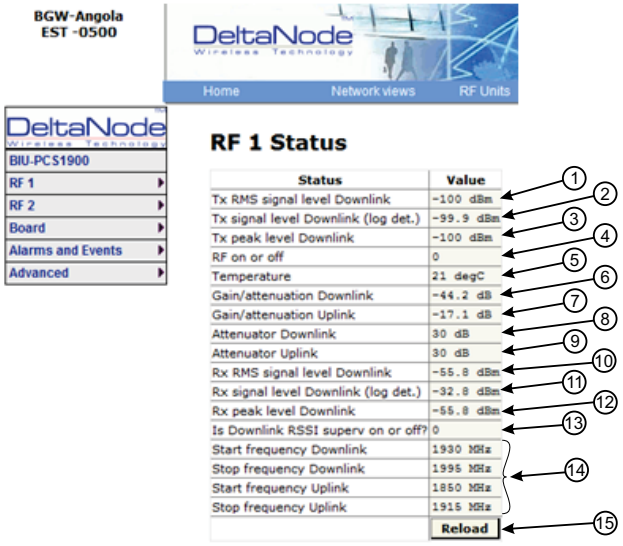
Figure 66 BIU Welcome Screen



BIU RF1 Status

This page shows the current status and configuration of the BIU.

Figure 67 BIU RF1 Status

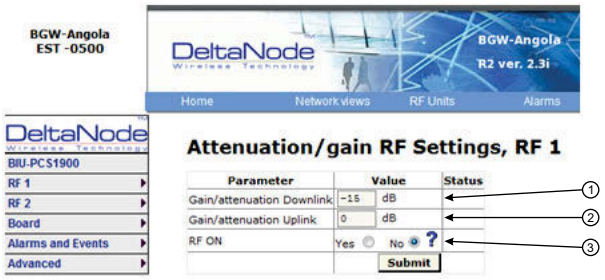


Item	Description
1	Downlink RMS value leaving the BIU card to the ICU/FOI. Good for measuring GSM and UMTS levels.
2	Downlink log detector signal leaving the BIU card to the ICU/FOI.
3	Peak downlink RF value exiting the BIU card on the select path.
4	0=RF is set to Off (attenuation is set to maximum). 1= RF is set to On. **Note**: This is only in reference to one of the two BIU RF paths/strips.
5	Temperature of the BIU card.
6	This measurement is the actual loss of the downlink RF signal in the BIU taking into account raw or inherent loss of the card plus the adjustable attenuator.
7	This measurement is the actual gain or loss on the uplink RF signal in the BIU taking into account raw or inherent gain of the card plus the uplink adjustable attenuator.
8	Adjustable downlink attenuator setting for the selected RF path. **Note**: If the downlink path is turned off (see #4) the attenuator value is automatically set to maximum attenuation. When RF is turned on, the setting of the adjustable attenuator will be shown.
9	Adjustable uplink attenuator setting for the selected RF path. **Note**: If the downlink path is turned off (see #4) the attenuator value is automatically set to maximum attenuation. When RF is turned on, the setting of the adjustable attenuator will be shown.
10	Calculated downlink RMS value entering the BIU card from the BTS. **Note**: This is the downlink into the BIU card and not an uplink value.
11	Calculated downlink value entering the BIU card from the BTS . **Note**: This is the downlink into the BIU card and not an uplink value.
12	Peak downlink RF value entering the BIU card on the select path. **Note**: This is the downlink into the BIU card and not an uplink value.
13	0=Downlink alarm is set to Off. 1= Uplink alarm is set to On.
14	Bandwidth of the BIU card
15	Pressing Reload will refresh the page

BIU RF1 Settings

This page will allow the user to change the attenuator values in the BIU for the path selected.

Figure 68 BIU RF1 Settings

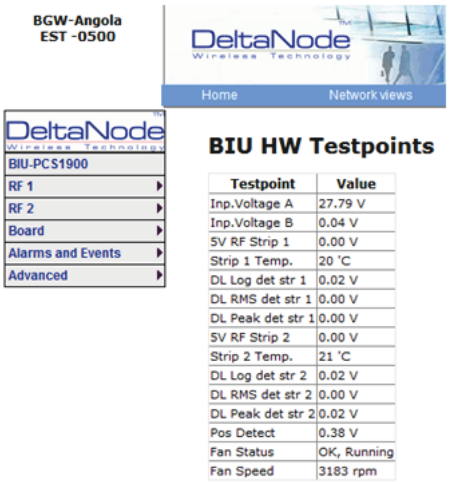


Item	Description
1	Attenuator setting for the downlink path. Enter a value from -14 to -44 (range varies depending of frequency band). **Note**: Click Submit after entering value.
2	Attenuator/Gain setting for the uplink path. Enter a value from -17 to 12 (range varies depending of frequency band). Note that the BIU has raw gain in the uplink path on certain BIU types (gain can be determined by positive value in the setting range. A selection of 12 indicates full gain of 12dB in the BIU. A selection of 9 will decrease the BIU uplink output by 3dB. A selection of 0 will decrease the BIU uplink output by 12dB. A selection of -17 will decrease the BIU uplink output by 29dB. **Note**: Click Submit after entering value.
3	This selection turns the uplink path On or Off (maximum attenuation setting).

BIU Hardware Test Points

This page shows various test point measurements used for status and troubleshooting purposes.

Figure 69 BIU Hardware Test Points

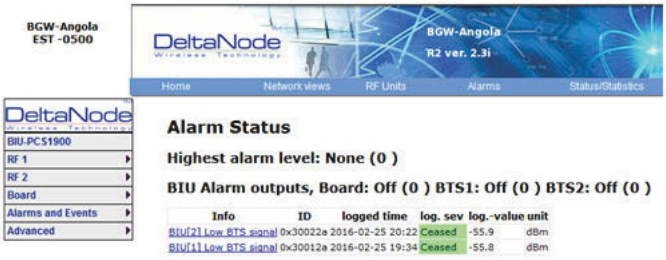


BIU Alarm List

This page show all current and past alarms.

- Green indicates that the alarm has cleared.
- Yellow indicates a warning alarm.
- Red indicates a service affecting alarm.

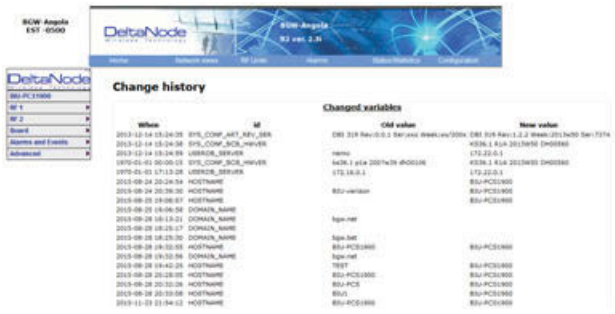
Figure 70 BIU Alarm List



BIU Change History

This page shows a history of all setting changes.

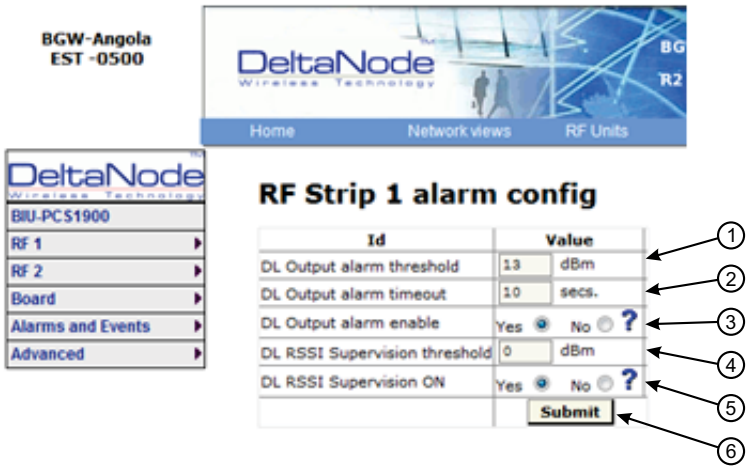
Figure 71 BIU Change History



BIU Alarm configuration RF1

This page allows for certain alarm thresholds of the BIU to be changed.

Figure 72 BIU Alarm configuration



Item	Description
1	Set the value in dBm that the BIU downlink output has to exceed in order to create an alarm
2	Set the value in seconds for the amount of time that the BIU downlink output has to be above the threshold level in order to create an alarm.
3	Enables or disables BIU threshold/high power alarm.
4	Set the value in dBm that the BIU downlink output has to drop below in order to create an alarm.
5	Enables or disables BIU supervision/low level alarm.
6	Click Submit after entering value(s).

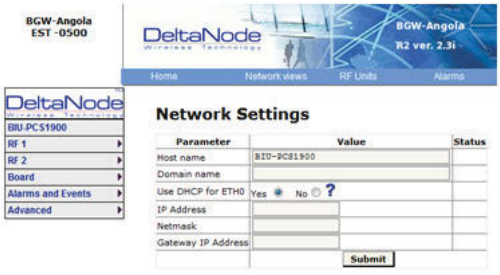
BIU Advanced Network Setup

This page allows for manual override of network settings.

Default configurations should be used with DHCP set to Yes.

> **Note:** *Changing DHCP to "No" can cause loss of communications to the BIU and should only be used in very specific situations.*

Figure 73 BIU Network Setup



BIU Advanced Menus

These menus provide information only status and settings of the BIU that are typically used by the manufacturer.

BIU > Advanced>HW config

BIU > Advanced>AD-values RF1

BIU > Advanced>AD-values RF2

BIU > Advanced>ADC raw

BIU > Advanced>Software status

BIU > Advanced>Process status

BIU > Advanced>System status

BIU Application Handling

The application handling page allows for stopping software functions and rebooting software programs.

Alarm Handler: Selecting Reboot (circular icon) will clear all the alarms in the history for the card selected. This is helpful after turning a system up and wanting to clear alarm log created during the installation and turn up.

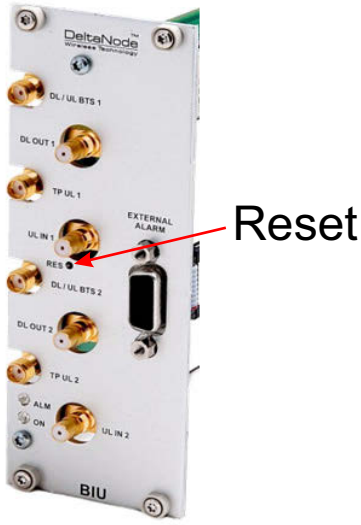
> **Note:** *Only the Reboot command should be used by the technician. All other functions should only be used under supervision of Bird engineering as they may cause data corruption if not initiated properly. The radio button will stop a process and can have negative affects on the function of the DAS.*

Figure 74 BIU Application Handling

BIU Reset to Factory Default

To reset the BIU to factory default, carefully press the “Reset” button [located below the **UL In 1** QMA connector] for 10 seconds. This is helpful when a card fails to appear in the Configuration menu.

Figure 75 BIU Reset

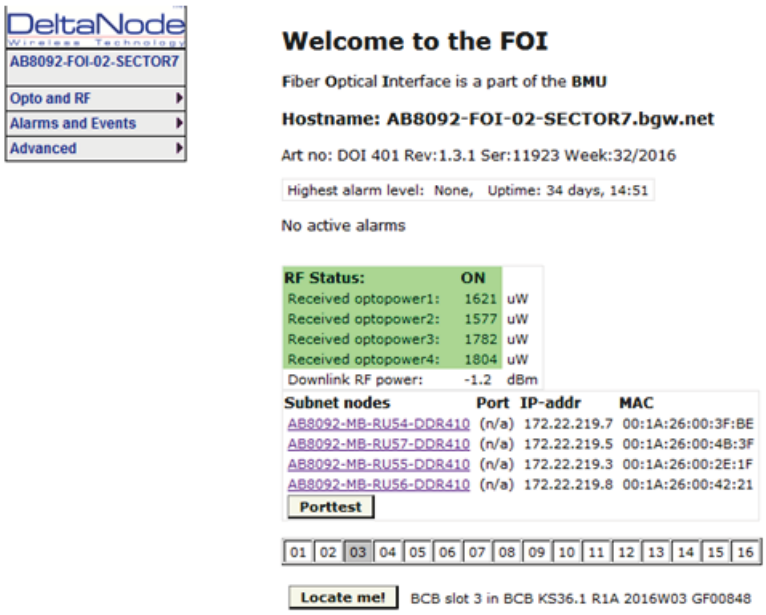


FOI Configuration

The initial screen for the FOI provides basic information such as name, serial number, part number and active alarms. The **Locate me!** button causes an LED to flash on the unit so that the module can be identified in the chassis.

Figure 76 FOI Welcome Screen

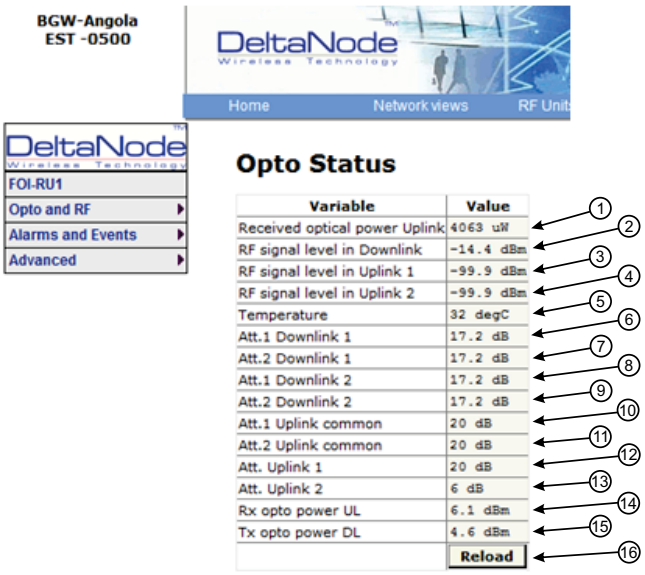
Figure 77 FOI Welcome Screen SW Version 3.9, DOI401



FOI Opto Status

This page will show the current status and configuration of the FOI.

Figure 78 FOI Opto Status



Item	Description
1	Fiber optic received optical power from the remote unit. See item 1 in Figure 79 for measurement location.
2	RF downlink power to the remote. See item 2 in Figure 80 for location on the FOI circuitry. Note that with no RF power into the BIU the FOR will still show signal in the downlink. This is the sub-carrier that is typically 10 dB below the anticipated RF level.
3	RF path 1 input power from the remote. See item 3 in Figure 79 for location on the FOI circuitry.
4	RF path 2 input power form the remote. See item 4 in Figure 79 for location on the FOI circuitry.
5	Temperature of the FOI card
6	Downlink path 1 attenuator #1 setting. See item 6 in Figure 80 for location on the FOI circuitry. Value may be slightly different than the value in Settings due to changes in temperature compensation.
7	Downlink path 1 attenuator #2 setting. See item 7 in Figure 80 for location on the FOI circuitry. Value may be slightly different than the value in Settings due to changes in temperature compensation.
8	Downlink path 2 attenuator #1 setting. See item 8 in Figure 80 for location on the FOI circuitry. Value may be slightly different than the value in Settings due to changes in temperature compensation.
9	Downlink path 2 attenuator #2 setting. See item 9 in Figure 80 for location on the FOI circuitry. Value may be slightly different than the value in Settings due to changes in temperature compensation.
10	Uplink common path attenuator #1 setting. See item 10 in Figure 79 for location on the FOI circuitry. Value may be slightly different than the value in Settings due to changes in temperature compensation.
11	Uplink common path attenuator #2 setting. See item 11 in Figure 79 for location on the FOI circuitry. Value may be slightly different than the value in Settings due to changes in temperature compensation.
12	Uplink path #1 attenuator setting. See item 12 in Figure 79 for location on the FOI circuitry. Value may be slightly different than the value in Settings due to changes in temperature compensation.
13	Uplink path #2 attenuator setting. See item 13 in Figure 79 for location on the FOI circuitry. Value may be slightly different than the value in Settings due to changes in temperature compensation.
14	Calculated uplink optical input from the remote unit. See item 14 in Figure 79 for location on the FOI circuitry.
15	Calculated downlink optical output. See item 9 in Figure 80 for location on the FOI circuitry.
16	Pressing Reload will refresh the page

Figure 79 FOI Uplink Measurement Locations

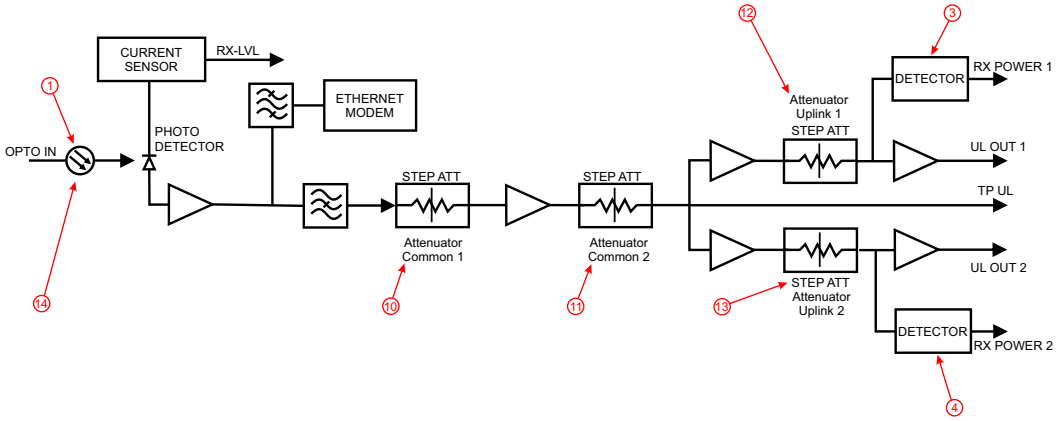


Figure 80 FOI Downlink Measurement Locations

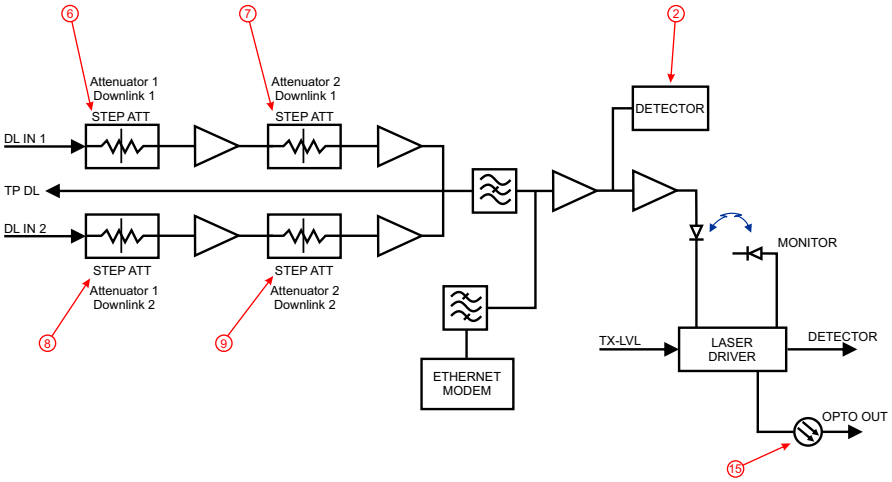
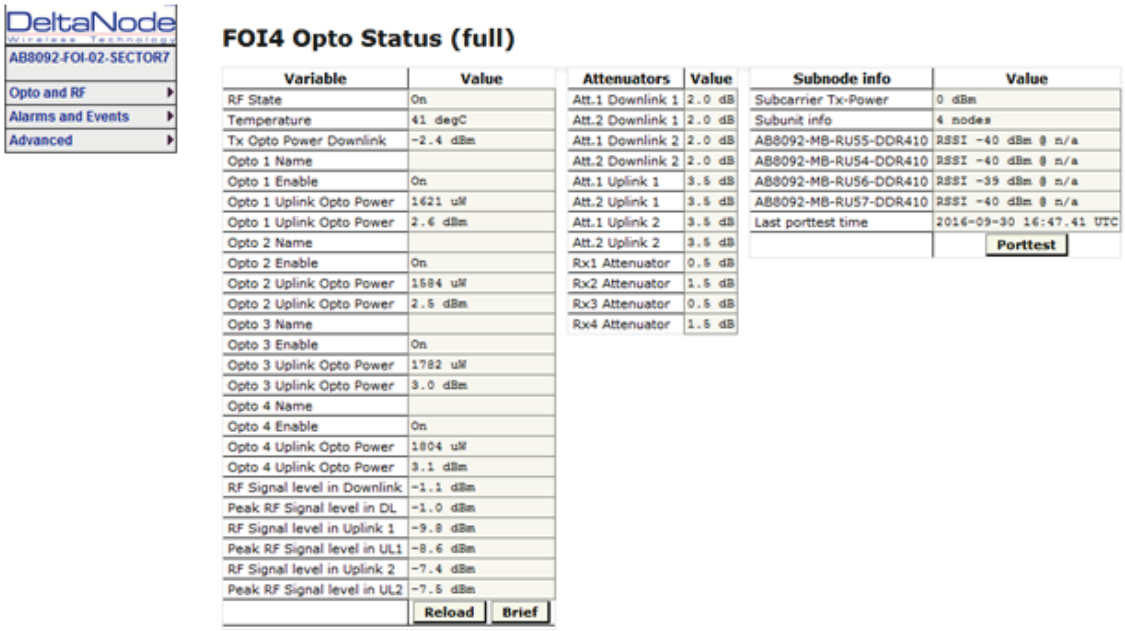


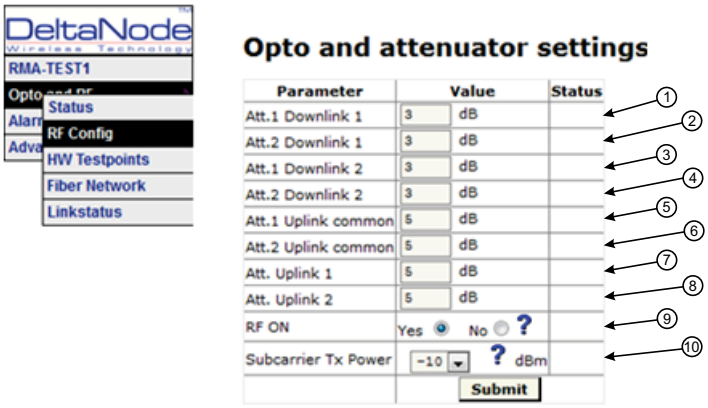
Figure 81 FOI Opto Status DOI401



FOI Opto and Attenuator Settings

This page will allow changes to be made to the FOI values

Figure 82 FOI Opto and Attenuator Settings



Item	Description
1	Downlink path 1 attenuator #1. See item 1 in Figure 83 for measurement location.
2	Downlink path 1 attenuator #2. See item 2 in Figure 83 for location on the FOI circuitry.
3	Downlink path 2 attenuator #1. See item 3 in Figure 83 for location on the FOI circuitry.
4	Downlink path 2 attenuator #2. See item 4 in Figure 83 for location on the FOI circuitry.
5	Uplink common path attenuator #1. See item 5 in Figure 84 for location on the FOI circuitry.
6	Uplink common path attenuator #2. See item 6 in Figure 84 for location on the FOI circuitry.
7	Uplink path 1 attenuator. See item 7 in Figure 84 for location on the FOI circuitry.

Item	Description
8	Uplink path 2 attenuator. See item 8 in Figure 84 for location on the FOI circuitry.
9	RF ON Yes set the UL values as selected above. RF No turns off laser. **Note:** *Setting to "No" will disconnect connectivity to the remote(s)*
10	Subcarrier TX Power is used for the communications and control signaling of the DAS. • Default setting is -10dBm for single port FOI cards and 0dBm for the 4-port FOI card. • The value may need to be changed in situations where fiber loss is near the maximum and communications issues arise. Unnecessarily increasing the subcarrier TX power may affect RF performance of the DAS.

Figure 83 Downlink Opto and Attenuator Settings

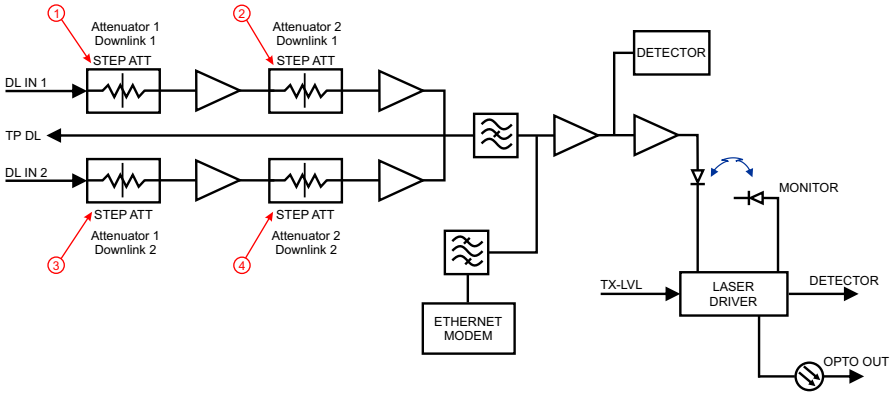


Figure 84 Uplink Opto and Attenuator Settings

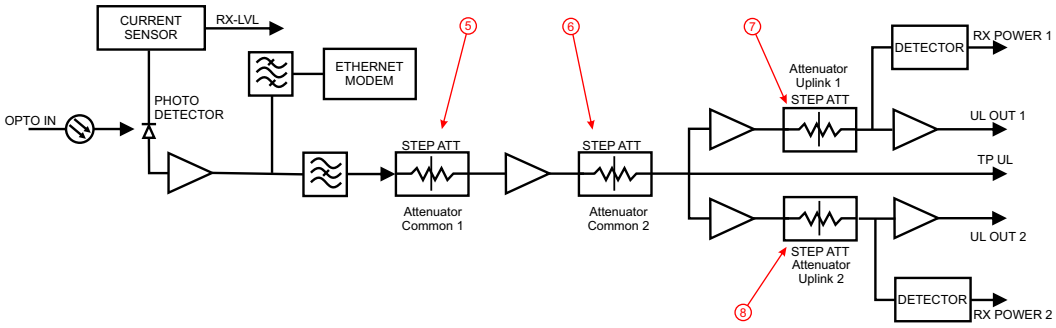
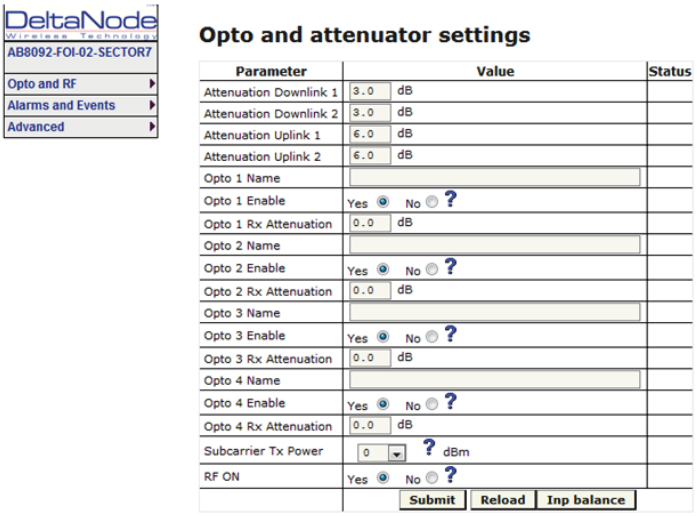


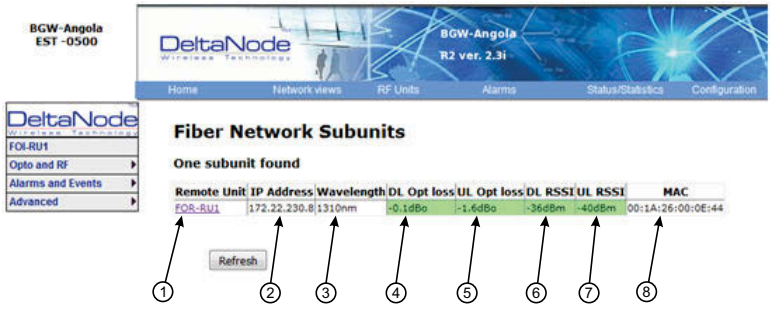
Figure 85 DOI401 FOI Opto and Attenuator Settings



FOI Fiber Network Subunits

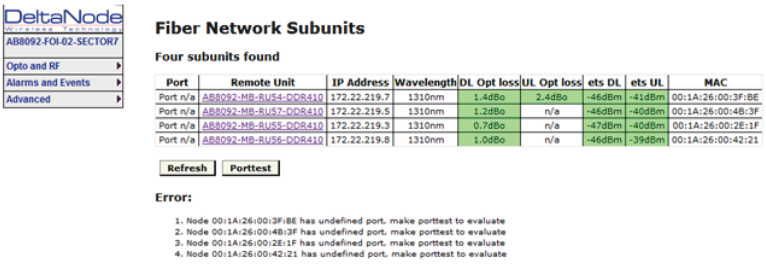
This page provides a visual indication on the fiber link status for each connection to the FOI.

Figure 86 FOI Fiber Network Subunits



Item	Description
1	Selecting the remote link will direct the browser to the Remote Unit page.
2	Network IP address of the FOI card.
3	Optical wavelength of the transmit laser in the FOI card.
4	Subcarrier optical loss between the FOI and FOR in the downlink path.
5	Subcarrier optical loss between the FOR and FOI in the uplink path.
6	Subcarrier power to the modem in the downlink path of the FOR - Range should be -30 to -60. If the level is too high or too low communication and other system problems may occur.
7	Subcarrier power to the modem in the uplink path of the FOI - Range should be -30 to -60. If the level is too high or too low communication and other system problems may occur.
8	MAC address of the FOI card

Figure 87 DOI401 FOI Fiber Network Subunits

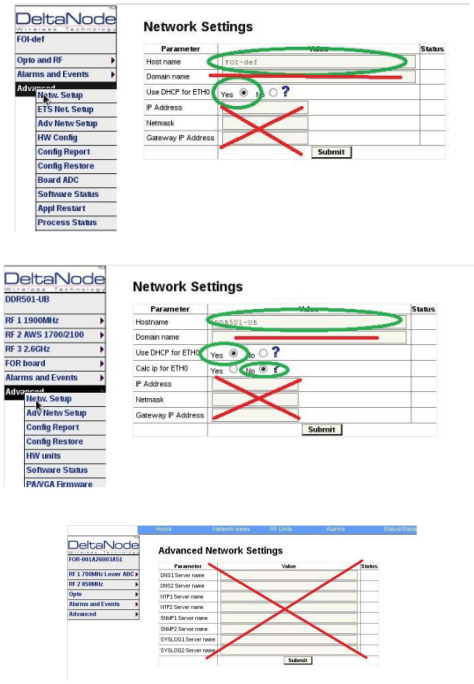


FOI Network Setup

This page allows for manual override of network settings. Default configurations should be used with DHCP set to Yes.

> **Note:** *Changing DHCP to "No" can cause loss of communications to the BIU and should only be used in very specific situations. Do not enter IP configuration data in other associated settings.*

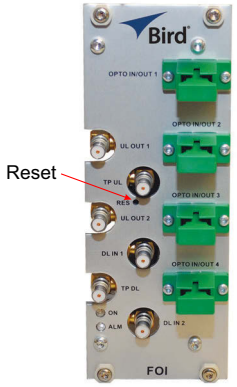
Figure 88 FOI Network Settings



FOI Reset to Factory Default

To reset the FOI to factory default, carefully press the “Reset” button (see Figure 89) for 10 seconds. This is helpful when a card fails to appear in the Configuration menu.

Figure 89 FOI Reset Button



FOR

The initial screen for the FOR provides basic information such as name, serial number, part number and active alarms. The Locate me! button causes an LED to flash on the chassis so that the unit can be identified in the field.

> **Note:** *If the fiber is just now connected to the FOI card, it could take up to 30 minutes for the FOI to assign an IP address to the FOR. See section for* "Moving Remotes to Different FOI Port" on page 92 *for details on how to quicken the IP assignment.*

Figure 90 FOR Welcome Screen

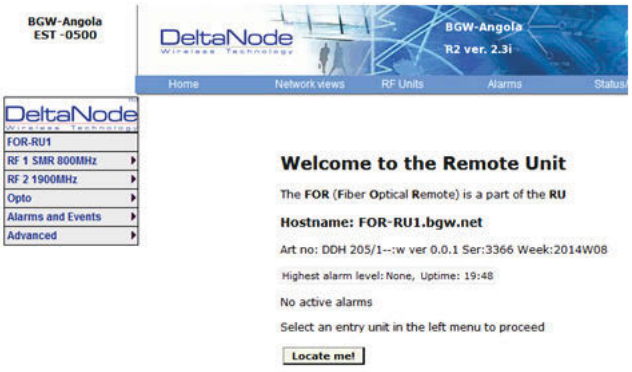
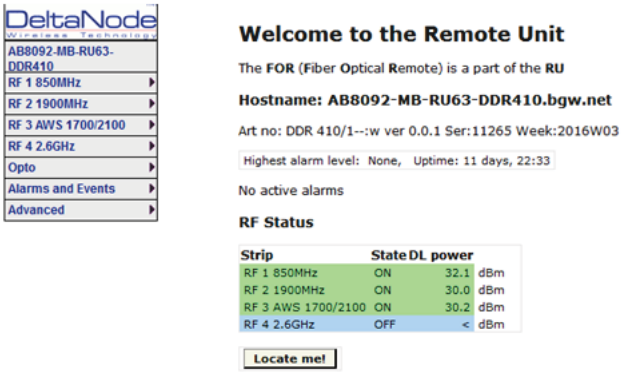
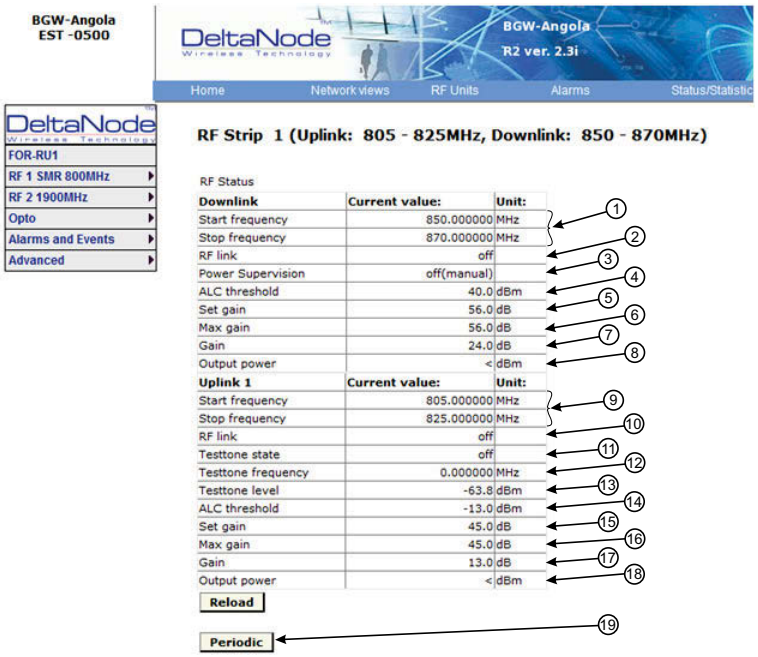


Figure 91 FOR Welcome Screen



RF Strip 1 XXX MHz Status

Figure 92 FOR RF 1 Status

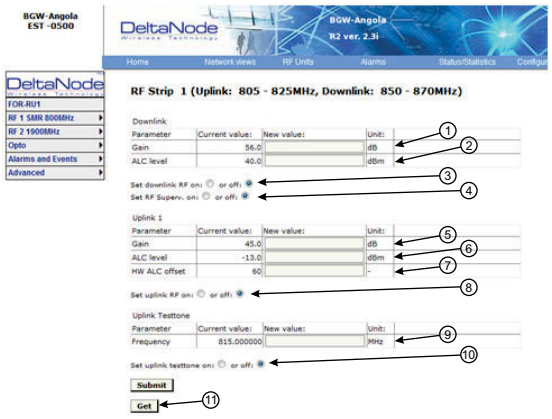


Item	Description
1	Downlink frequency band for the RF path/strip selected
2	RF link setting for the downlink path: On or Off.
3	Setting of the downlink ALC threshold.
4	Downlink low power alarm turned On or Off.
5	Gain setting for the RF path under review.
6	Maximum allowed gain will always be the same as the set gain except in special builds.

Item	Description
7	The amount of actual gain used by the system. Might not achieve max gain setting if ALC is in operation. If the set gain is 56 as it is above, RF is turned on and the actual gain in line 7 is less than 56 then the system is being overdriven and ALC is kicking in. Reduce gain. Suggest starting with the value displayed in line 7 since this is the most gain that is being used.
8	Output power of the amplifier for the path under review.
9	Uplink frequency band for the RF path/strip selected
10	RF link setting for the uplink path: On or Off.
11	Status of uplink test tone signal. Test tone automatically turns off after 60 minutes.
12	Uplink test tone frequency setting.
13	Uplink test tone level. Not adjustable. Accounts for losses in internal duplexers, if any.
14	Uplink ALC threshold setting.
15	Gain setting in the uplink path.
16	Maximum allowed gain set by the system.
17	Actual gain being used in the uplink path. The figure might not match gain setting if ALC is in operation.
18	Uplink output to the FOI. **Note:** *If the uplink path is set to Off a reading of "<" is returned.*
19	Periodic enables a constant update of the status screen.

RF Strip 1 XXX MHz Configuration

Figure 93 FOR RF 1 Configuration



Item	Description
1	Downlink gain setting for RF path under review.
2	Downlink ALC setting for RF path under review. The factory default is set at the rated power of the remote unit (i.e. DDH is set to 43dB). The level could be set lower for specific situations. Note that the factory level is set at the antenna port. If remote is shutting down due to being over driven it is suggested to reduce the ALC level by one or two dB to reduce the number of alarms.
3	Turns downlink RF on or off.

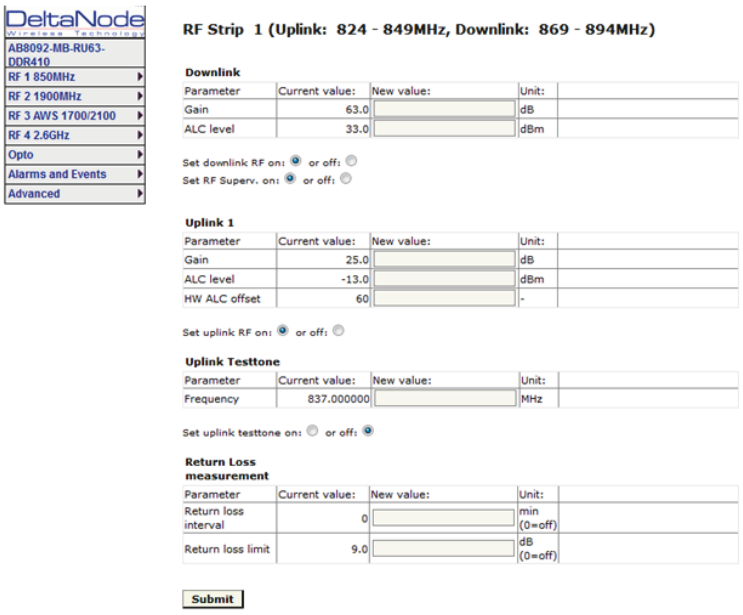
Item	Description
4	Turns downlink low power alarm on or off.
5	Uplink gain setting for RF path under review.
6	Uplink ALC setting for RF path under review. This is the threshold at which the system will start reducing further gain to prevent increases in uplink RF to the FOI. After 10dB decrease in gain an uplink alarm will be triggered **Note:** *Should be left a factory default. Only change if FOR uplink gain is changed. If gain is increased on FOR uplink then the same value should be decreased on the ALC.* **Example:** Changing the UL FOR gain from 12 to 17 would require ALC to be changed from -13 to -18.
7	Hardware ALC offset measured in tenths of a dB. Default setting of 60 (6dBm) should be used for most applications. Should the software not be able to reduce uplink gain fast enough after the ALC threshold has been exceed, hardware attenuation will be added to protect the uplink path. In the example above, the hardware attenuation will trigger at -7dBm (-13dBm ALC threshold minus 6dBm HW ALC offset = -7dBm)
8	Turns uplink RF on or off.
9	Sets uplink test tone frequency. Must be within uplink frequency limits of the RF module.
10	Turns on uplink test tone. Test tone times out after 60 minutes.
11	Retrieves current FOR settings from system.

RF Strip 1 XXX MHz Configuration Software Version 3.9

Software release 3.9 introduces settable Return Loss measurements and control over alarms. The default interval setting is “0” indicating the return loss alarm feature is turned off. Return loss alarms are often disabled when there is a passive antenna network installed beyond the remote.

The default Return Loss setting is "9". The remote will start shutting down and/or PA damage can result with a return loss of lower than 6.

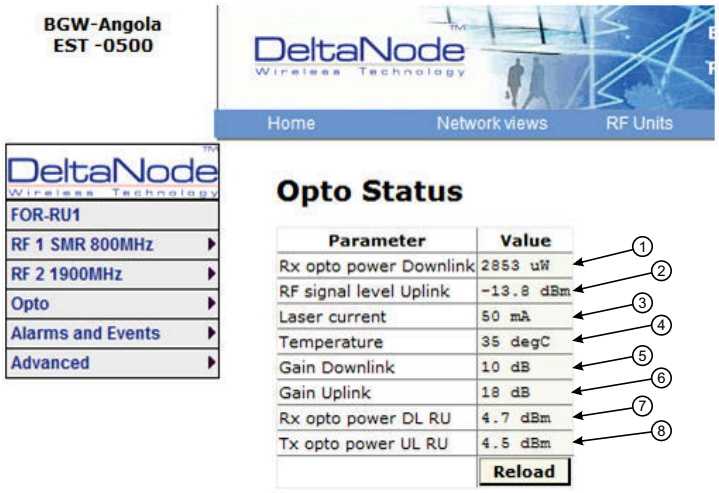
Figure 94 FOR RF 1 Configuration, Software Version 3.9



Return Loss (db)	VSWR
9.542	2.00
9.262	2.05
8.999	2.10
8.752	2.15
8.519	2.20
8.299	2.25
8.091	2.30
7.894	2.35
7.707	2.40
7.529	2.45
7.360	2.50
7.198	2.55
7.044	2.60
6.896	2.65
6.755	2.70
6.620	2.75
6.490	2.80
6.366	2.85
6.246	2.90
6.131	2.95
6.021	3.00

FOR Opto Status

Figure 95 FOR Opto Status



Item	Description
1	Optical power received from the FOI. See item 1 in Figure 96 for measurement location.
2	Uplink signal being fed into the FOR uplink laser circuit. See item 2 in Figure 97 for measurement location.
3	Laser current for the Remote Unit FOR. Should be less than 50mA.
4	Temperature of the Remote Unit FOR board.
5	Total gain of the FOR in the downlink. Note that RF Out 1 and 2 are wide band (FM to 2600MHz) that feed band specific RF amplifiers in the following VGA stage.
6	Total gain of the FOR in the uplink path. Note that RF In1 and In2 are wide band (FM to 2600MHz) that are signals from the uplink frequency specific amplifiers.
7	Calculated downlink signal being received from the FOI. See item 1 in Figure 96 for measurement location. Takes into consideration optical wavelength and temperature compensation.
8	Calculated uplink signal being transmitted to the FOI (FOR input from VGA + FOR uplink gain/attenuation). See item 3 in Figure 97 for measurement location.

Figure 96 FOR Downlink Schematic

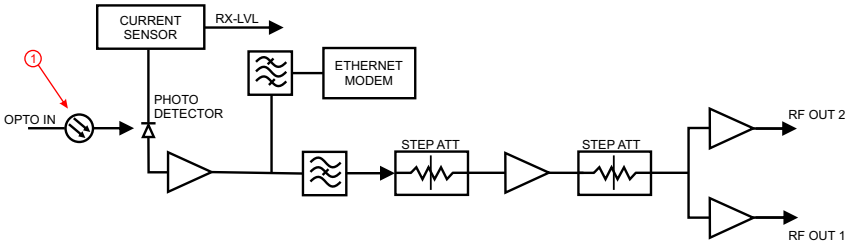
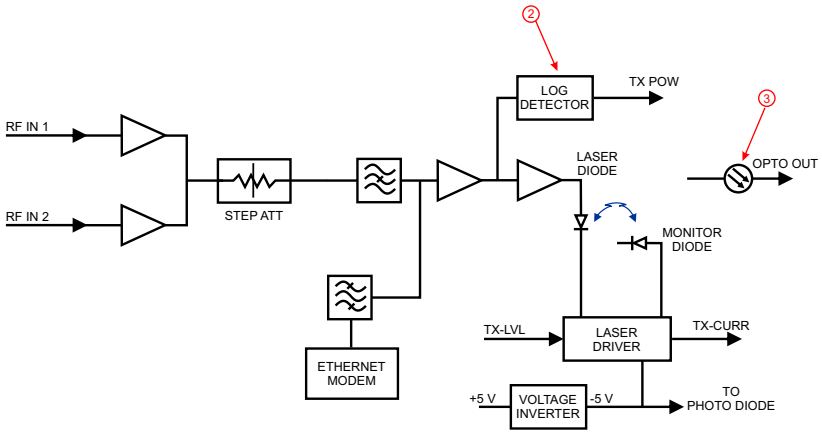
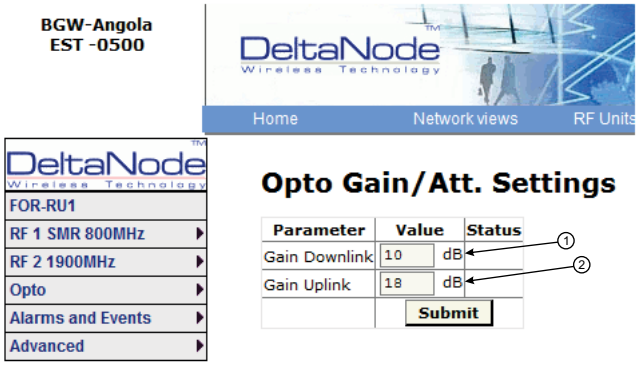


Figure 97 FOR Uplink Schematic



FOR Opto Gain and Attenuation Settings

Figure 98 FOR Opto Gain Settings



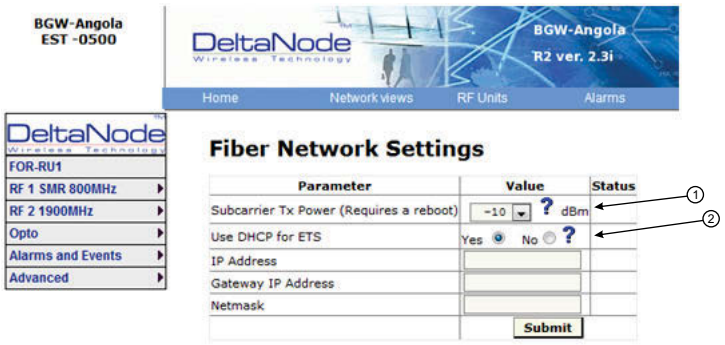
Item	Description
1	FOR gain in the downlink path. Range is typically from -20 to +20. FOR downlink path has inherent/raw gain of +20dB (FM to 2600MHz). • A setting of +20 indicates no attenuation so FOR will have +20dB gain (+20dB gain minus 0dB attenuation). • A setting of +10 will have 10 of attenuation so this stage will have 10dBm of gain (+20dB gain minus 10dB of attenuation). • A setting of 0 will have 20dB of attenuation so this stage will have unity gain (+20dB gain minus 20dB of attenuation). • A setting of -10 will have 30dB of attenuation so this stage will have 10dB of loss (+20dB gain minus 30dB of attenuation). • A setting of -20 will have 40dB of attenuation so this stage will have 20dB of loss (+20dB gain minus 40dB of attenuation).
2	FOR gain in the uplink path. Range is typically from 0 to +20dBm (FM to 2600MHz). • A setting of +20 will have full gain of +20dBm. • A setting of +10 will have +10dB gain. • A setting of 0 will have no gain. • Factory default should be used unless high loss in fiber. Note that changes in Gain uplink will require changes in the FOR UL ALC level.

FOR Fiber Network Settings

This page allows for manual override of network settings. Default configurations should be used with DHCP set to Yes.

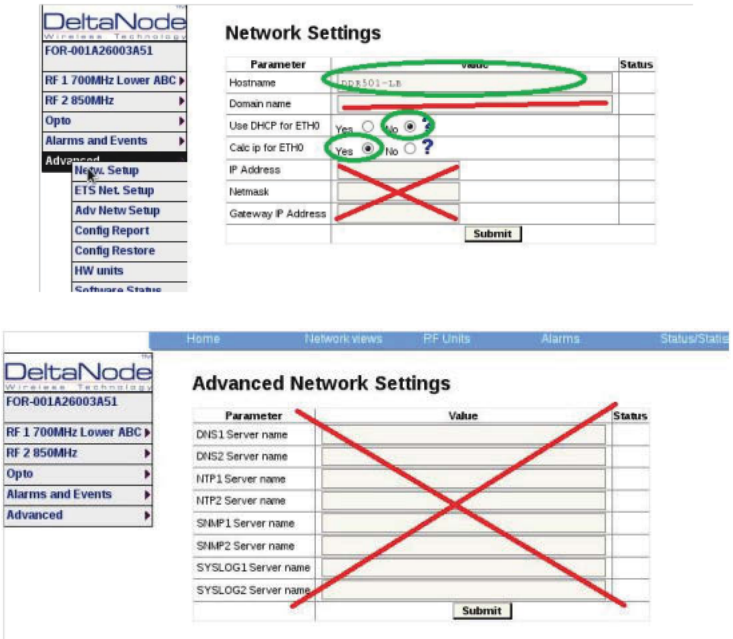
Note: *Changing DHCP to "No" can cause loss of communications to the BIU and should only be used in very specific situations. Do not enter IP configuration data in other associated settings.*

Figure 99 FOR Network Settings



ITem	Description
1	Subcarrier Tx Power is used for the communications and control signaling of the DAS. Default setting is -10. The value may need to be changed in situations where fiber loss is near the maximum and communications issues arise. Unnecessarily increasing the subcarrier TX power may affect RF performance of the DAS.
2	Default seeing of Yes should be used except for special applications.

Figure 100 More FOR Network Settings



FOR Application Handling

The application handling page allows for software reset and rebooting functions.

Note: *Only the Reboot command should be used by the technician. All other functions should only be used under supervision of Bird engineering as they may cause data corruption if not initiated properly.*

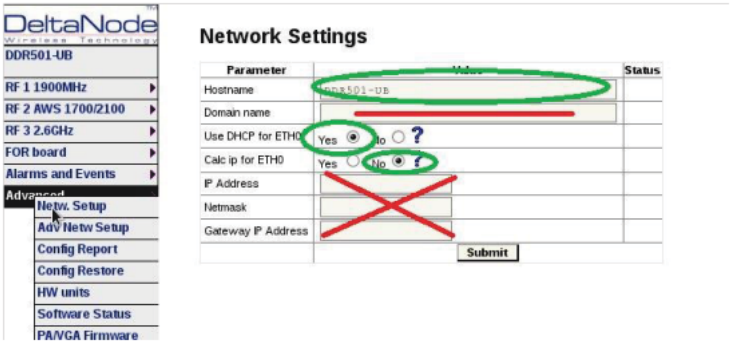
Figure 101 FOR Application Handling

Slave FOR

A Slave FOR is when a remote has a second FOR installed. The Slave FOR is most likely to be used when the remote is configured for MIMO or has multiple amplifiers in the same band or has redundant fiber.

Settings for the Slave FOR is the same as the main FOR except, “Calc ip for ETH0 is set to “No”.

Figure 102 Slave FOR Network Settings



Naming Components

Proper naming of individual components in the DAS is critical to troubleshooting. A recommendation is to start all component names with their function such as "BIU", "FOI" or "FOR". For example: "BIU-850Sector1".

You may use any combination of alphanumeric characters and the special character of dash "-". Do not use any other special characters or space.

- 0 through 9
- a through z
- A through Z
- -

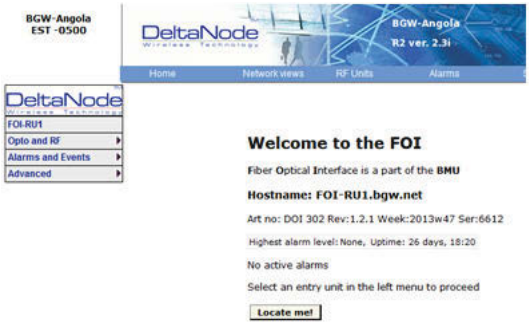
Component names are limited to 56 characters.

1. Select the component to be named from the Configuration menu.

Figure 103 Component Selection

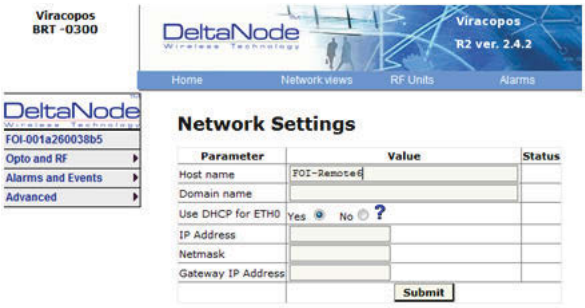
2. Use the Locate Me button to verify which cards is being accessed.

Figure 104 Locate Me Button



3. Go to Advanced>Netw Setup
4. Enter the new card name in the Host Name field. See Figure 105.
5. Select submit.

Figure 105 Unit Naming



6. Go to Advanced > Appl restart.
7. Select the Reboot icon at the bottom of the menu. See Figure 106.
8. Select "YES- Restart Process"

Note: *After rebooting, it can take up to 5 minutes before the unit shows up in the GUI.*

Figure 106 Naming Reboot

9. After all the units have been renamed, go to the Configuration menu and select the correct card type.
10. Highlight all the cards in the right column that had name changes and then select “<<“. Select “Submit” This will remove the old names from the DAS Configuration.
11. Highlight all the cards in the left column with the new names and then select “>>”. Select “Submit”. This will move the new card names into the DAS configuration.

Table 67 Submit Newly Named Units

12. Select Network Views > All to confirm that all cards are now part of the configuration.

Moving Remotes to Different FOI Port

All DAS components are assigned IP addresses by the BGW. The FOR in the Remote is the assigned an IP address as a subunit of the FOI to which it is connected. When the Remote is moved to a different FOI one of several actions must take place:

1. The lease on the Remote IP address must be given time to expire. This could take up to 30 minutes. Once the current IP lease expires, the new FOI will then assign the correct IP address to the Remote.
2. Manually power cycle the Remote. During the reboot process, the Remote will release the old IP address and have the correct IP address assigned by the new FOI.
3. Communications to the remote can only occur when the remote has the correct IP address. Before moving the fiber, access the FOR via the GUI. In the advanced settings, reboot the FOR. As soon as the reboot has been initiated, quickly move the head end fiber to the new FOI port. When the Remote finishes the rebooting process, the new FOI will assign the correct IP address.

Replacing Master Unit Cards

All DAS components are assigned IP addresses by the BGW. When a card is replaced, the card must be assigned a new IP address by the BGW. On rare occasions, the BGW may have not be able to assign an IP address to the new card. This is easily corrected by removing the card from the Master Unit chassis (with ESD strap attached) and then re-install the card. The BGW will then assign the correct IP address.

Moving Master Unit Cards

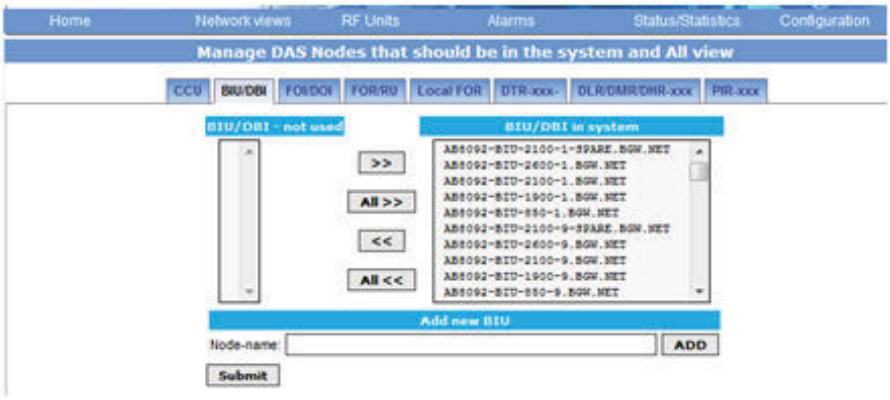
Occasionally, cards need to be moved to different slots in the Master Unit.

CAUTION

Always use an ESD strap when installation and removing cards. Failure to comply may result in permanent disabling damage to the module.

1. Move the card to the new slot.
2. Ensure there is an Ethernet connection for the new card location on the backplane of the Master Unit.
3. Wait for the card to complete the boot process. If the card remains in the boot process (Green LED remains on for approximately 2 seconds and then off for one second) then the IP address may not have been assigned. Check Ethernet connection.
4. Log into the GUI to confirm software connectivity. On occasions the card will not show up after being moved.
    a. Go to the Configuration menu and remove the card (move from right to left) and then Submit. See Figure 107 on page 93.
    b. Select the card from the left menu and then add it back to the system on the right and then submit.
    c. Go to the Home menu. Log out of the BGW and then log back in.
    d. Go to Network Views and log into the card to verify GUI connection.

Figure 107 Manage System Modules



Preparations

The minimum of preparations necessary are to have the system documentation which should include the following items at least:

- The system layout and block schematic
- A connection diagram for the head-end Master Unit
- The type of connectors and tappers used to interface to the base station ports
- The number of carriers for each of the BIU that the base stations connects via
- Maximum output power for each service from the base stations
- Fiber losses should be documented beforehand so that you can compare what the system actually measures
- Sectorization information, which sectors should go to which remotes
- DAS calculator sheets showing the expected settings for each of the RF chains in uplink and downlink.
- Information about Ethernet connection if the system should be monitored by remote. How to connect it to the Internet for remote viewing unless you are using a modem.

Necessary tools

The tools necessary to commission the system includes:

- One laptop for changing the system settings, checking any alarms and status. Only software needed is a web browser. Operating system can be Windows, Linux or Mac as you prefer.
- Spectrum analyzer to measure the uplink. The system relies on test tone measurements in the uplink and therefore it is important to have equipment to measure them.
- SMA tool to be able to connect or disconnect BTS cables from the BIU.
- QMA adapter so you can measure signals directly on the head-end units such as the FOI, BIU, ICU and so on.

Software

No particular software is necessary except a modern graphical based web browser.

System Commissioning

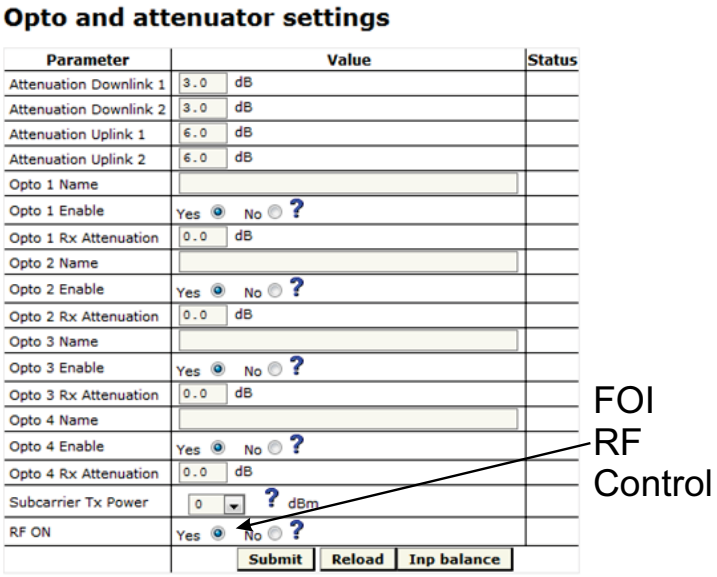
Pre-requisites

- Establish Ethernet connection between the BGW and all cards
- Power up all equipment
- Ensure IP addresses have been assigned
  Cards will briefly flash green. Solid green indicates waiting for IP assignment
- Verify remote unit fibers are connected to correct FOI ports
- Set names for all components and add components to the system - See “Naming Components” section
- Connect BTS to the BIU ensuring proper attenuation for the BIU card being used

Commissioning Process

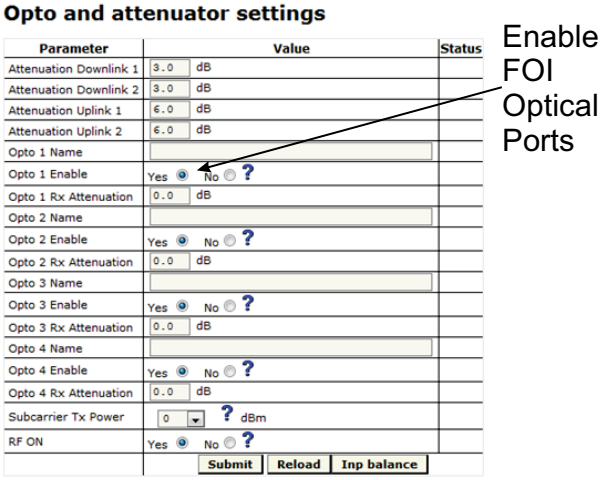
1. Once the fiber is connected and verified, turn FOI RF power on.
   Connect only one fiber port at a time and complete naming of remote. Otherwise, a second person will be needed at the remotes to identify the remote when “Locate Me” is enabled. This can be eliminated with good project management and labeling during the installation process.

Figure 108 FOI RF On



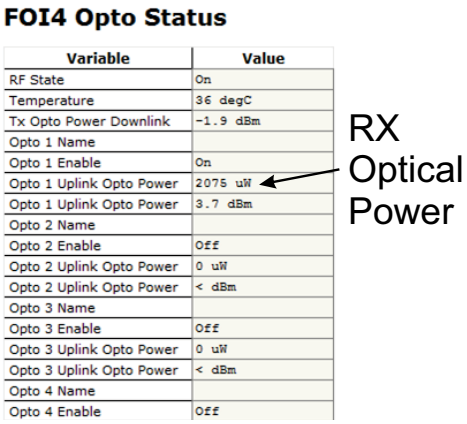
2. Enable the appropriate optical ports on the 4-port FOI
   Only enable the optical ports that are being used. Otherwise, the system will alarm with low optical levels on the unused ports.

Figure 109 Enable FOI Optical Ports



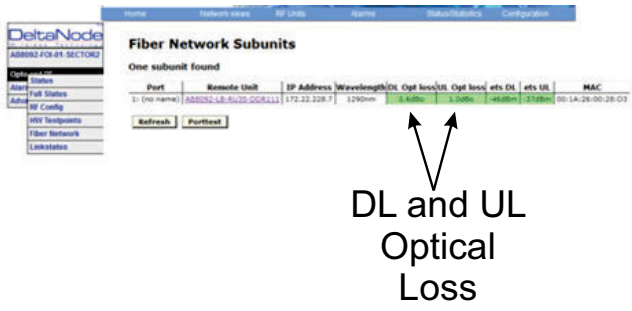
3. Go to FOI status and note RX Opto power UL.
   The laser transmits at 5000 uW. The difference between the 5000 uW transmit level and the receive level is the loss on the fiber.

Figure 110 RX Optical Power



a. Starting with software release 3.9, there is an option to have the GUI calculate the fiber loss.

Figure 111 Calculated Optical Loss, Software version 3.9



Uplink

1. Set all values at default (factor setting may vary due to individual testing before shipping) for all bands
    a. BIU: -10dB
    b. FOI: -6, -6, -6
    c. FOR: +12
    d. Amp: +35 for low loss fiber, +45 for high loss fiber
2. Start with adjusting the high frequency band.
3. Turn RF on at the BIU. Ensure that only the RF strips being used have RF turned on.
4. Go to the FOR and turn the UL test tone on. Note the level being transmitted and the frequency. The level is set at the factory to compensate for losses between the RU output port and the amplifier. Levels will vary unit by unit.
5. Connect spectrum analyzer to the BIU BTS port and tune to the UL test tone frequency.
6. Measure the test tone level. Initial goal should be to set the UL test tone at the BIU BTS port to the same level as being transmitted at the RU (zero dB system gain).
    a. To reduce gain, it is recommended to adjust the attenuators in the BIU UL path. This will further reduce UL noise.
    b. To increase gain, it is recommended to adjust the gain in the RU UL path.

        Note: *Do not drive the FOR UL laser with more than 0dBm RF input. Recommended FOR UL input level is approximately -5dBm.*

    c. The BIU UL input will be permanently damaged with signals stronger than +13dBm.
7. Record UL test tone level received in the spectrum analyzer. After all remote units on the sector have UL levels set, the remotes will need to be balanced against each other (all are hitting the BTS UL at the same level). Levels should be within about 1dB of each other.

Downlink

1. Set all values at default (factor setting may vary due to individual testing before shipping)
    a. BIU: -15dB
    b. FOI: -3, -3
    c. FOR: +10
    d. Amp: To be set based on actual input
2. Suggestion: Set FOR DL ALC level to one dB less than amp rating if unit alarms on DL.
    a. A 43dB amplifier would have an ALC level set to +42.
3. Set BIU DL level to compensate for ICU interconnection loss. Do not exceed +10dB output of the BIU in the DL path (will cause IM).
    a. Suggest setting at maximum of +5dB output of the BUI.
    b. Note there is 13 dB of inherent loss in the BIU. With 0dB settings in the BIU DL attenuators a 30dB input signal will have an output of +17dB (30dB input minus 13dB inherent loss = 17dB). Adjust attenuators so that BIU is approximately +5dB as a start.
    c. Variations in the BTS input levels for loading must be taking into consideration. Full load and no load power levels differ greatly. Do not allow the BTS to overdrive the BIU.
4. Adjust FOI attenuator levels in the DL path so that the RF input into the DL laser is approximately -5dB.
    a. Note that the 0dB max into the laser is a composite level for all bands. By setting each band at -5dB then total composite should not exceed 0dB.
    b. Take into consideration that each BIU has two RF strips/paths. These must be taken into consideration when setting the FOI levels.
    c. Calculate full load conditions for all bands being fed into the FOI. Incorrectly setting the levels will impact the system during times of most usage.
5. Set the desired gain in the remote.

6. Apply RF signal to the BIU BTS port.
7. Check Remote Unit FOR status "Set Gain", "Gain" and "Output Power".
8. Adjust "Set Gain" so that desired output power is achieved.
    d. If "Gain" level is lower than "Set Gain" level in the status screen then the system is being over driven and ALC is limiting the gain of the system. Reduce gain setting to the level displayed in "Set Gain". Submit change and the review status screen. "Set Gain" and "Gain" levels should now be identical.

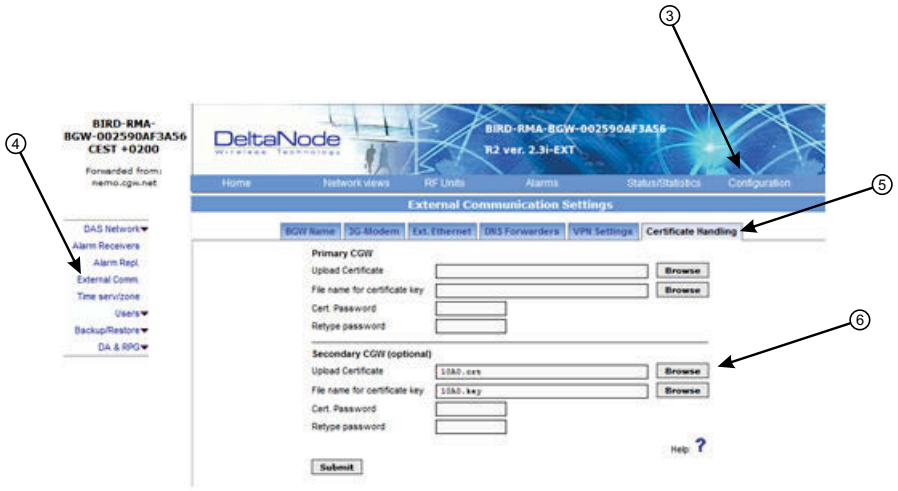
Bird VPN Access

Establishing secure VPN access for Bird/DeltaNode will allow for remote monitoring and advanced technical support. The BGW is designed to communicate directly with the Bird/DeltaNode NOC via cloud access.

VPN Settings

1. Connect laptop to an open port on the DAS switch. Do not connect to the Console port.
2. Log into the BGW at 172.22.0.1.
    Login Name: “extend”
    Password: “admin”
3. Click “Configuration,” see Figure 112.
4. Click “External Comm.”

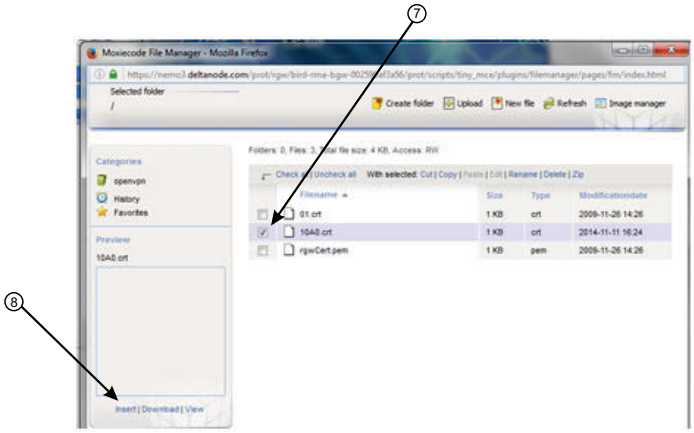
Figure 112 Certificate Entry



5. Click “Certificate Handling.”
6. Click “Browse” next to upload Certificate for Secondary CGW.
Only make setting changes to the Secondary CGW. The Primary CGW is reserved for customer CGW access.

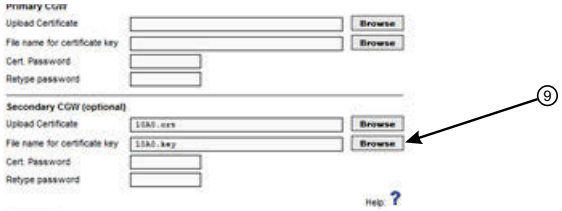
7. Select the check box next to the 10##.crt file. See Figure 113.
8. Click"Insert"

Figure 113 Certificate Selection



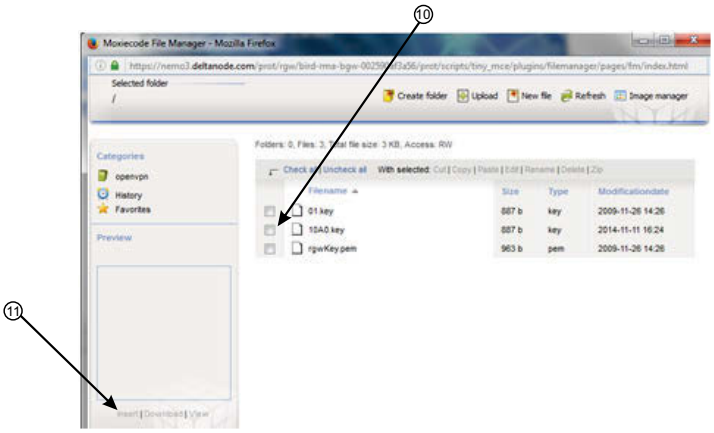
9. Select "Browse" for the File name for certificate key. SeeFigure 114.

Figure 114 Key Entry



10. Select the check box next to the "10##.key" file. See Figure 115.
11. Select "Insert"

Figure 115 Key Selection



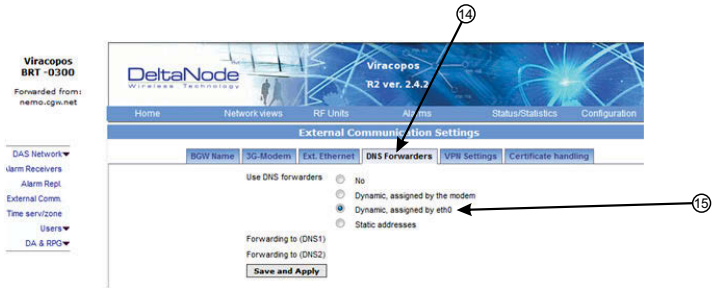
12. Select Ext. Ethernet Tab
13. Select the check box for “Use eth0 for Internet (WAN).”
    This ensures external Ethernet connections are allowed.

Figure 116 External Ethernet

14. Select DNS Forwarders tab.
15. Select radio button for “Dynamic, assigned by eth0.”

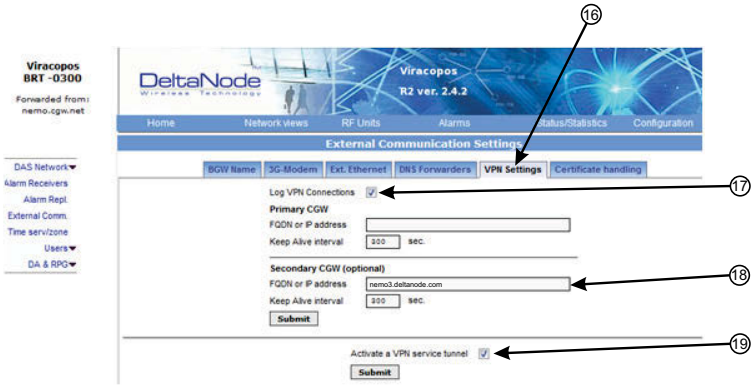
> **Note:** *The Bird maintained CGW is not able to hostname check a DNS2 IP address of 8.8.2.2, 4.2.2.4 or 4.2.2.25. Please change to something like Google's 8.8.4.4 or 8.8.8.8*

Figure 117 DNS Forwarders



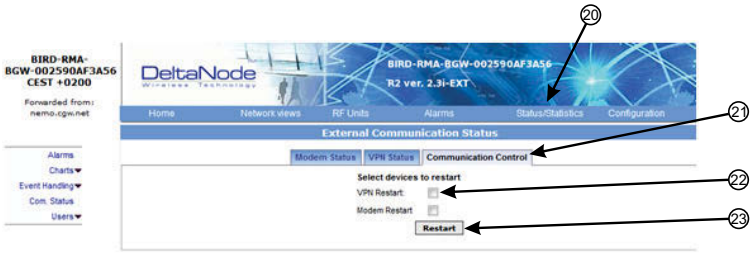
16. Select VPN Settings tab to verify that the VPN settings are correctly set.
17. Select check box “Log VPN Connections”
18. Type “nemo3.deltanode.com” into the Secondary CGW setting for FQON or IP address.
19. Select check box “Activate a VPN service tunnel.” This selection is only on available on older software versions.

Figure 118 VPN Settings



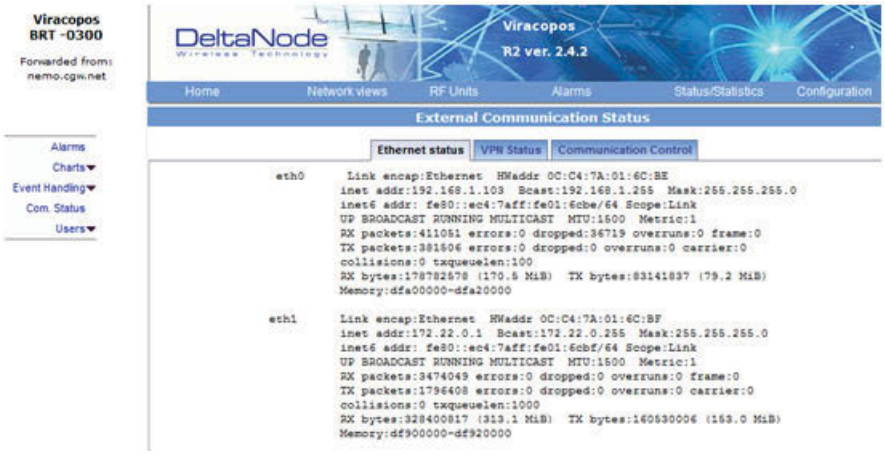
20. Click on “Status/Statistics.”
21. Select the “Communication Control” tab.
22. Select the check box next to “VPN Restart.”
23. Click “Restart.”

Figure 119 VPN Restart



24. After about 10 minutes, the BGW should start communicating with the Bird/DeltaNode CGW.
25. Click on Status/Statistics
26. Select the Ethernet Status tab.
    Both "eth0" and "eth1" should show connectivity. Figure 120 shows good communications in "eth0" between the BGW and a 3G modem. "eth1" shows good communications between the 3G modem and the Bird/DeltaNode CGW.

Figure 120 Ethernet Status



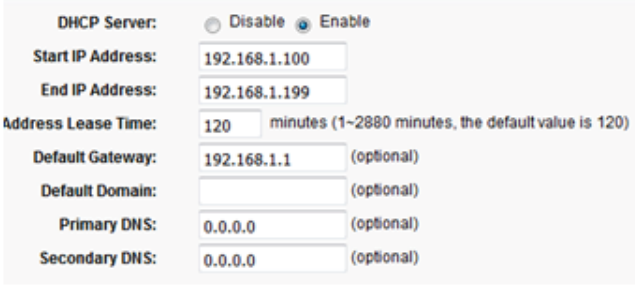
Wireless Modem Setup

Due to variances with different wireless modem manufacturers, settings may vary from modem to modem. A general understanding of network settings is required. Below are a few typical settings that will need to be configured.

Modem DHCP

DHCP will need to be enabled so that the wireless modem can assign an IP address to the BGW. Be sure to enter the stop and end IP address as seen in the image.

Figure 121 Modem DHCP Configuration



Modem VPN Tunnels

The BGW communicates back to the CGW via a VPN tunnel. The wireless modem must enable VPN pass through.

Figure 122 Modem VPN Settings

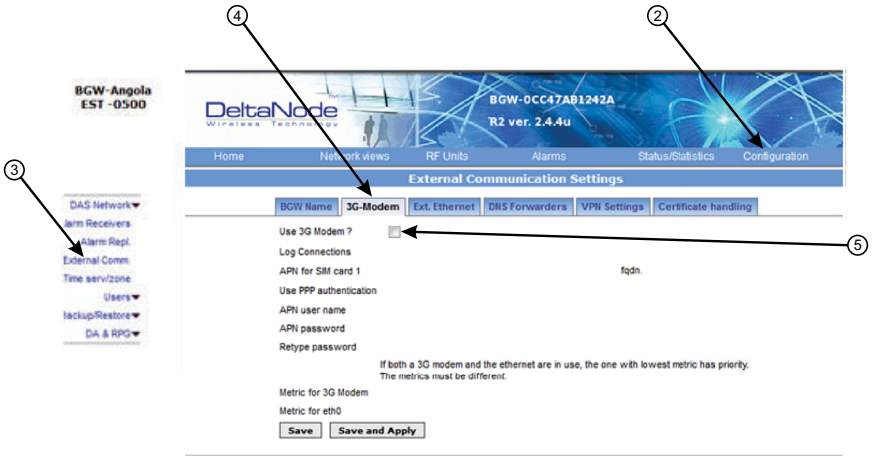
Modem Port Forwarding

Set up the modem so that it forwards TCP port 443.

BGW Configuration

1. Connect IP modem to the External WAN port on the BGW.
2. Click Configuration. See Figure 123.
3. Click External Comm.
4. Select 3G-Modem tab.
5. Select the “Use 3G Modem” check box.

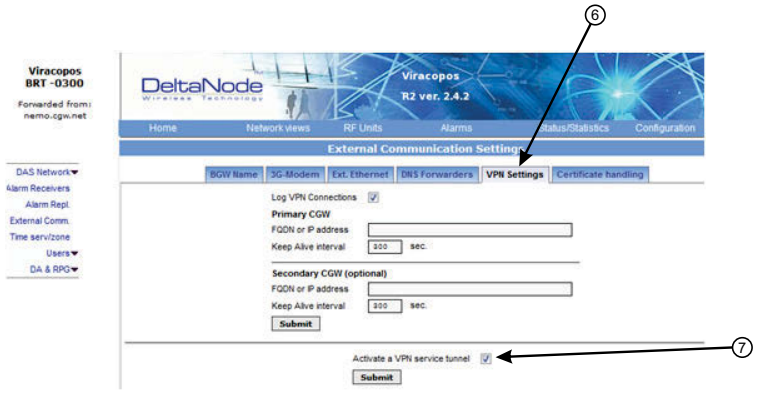
Figure 123 BGW Configuration - 3G Modem Setup



6. Select the VPN Settings tab.
7. Select the “Activate a VPN service tunnel” check box, if not already selected.

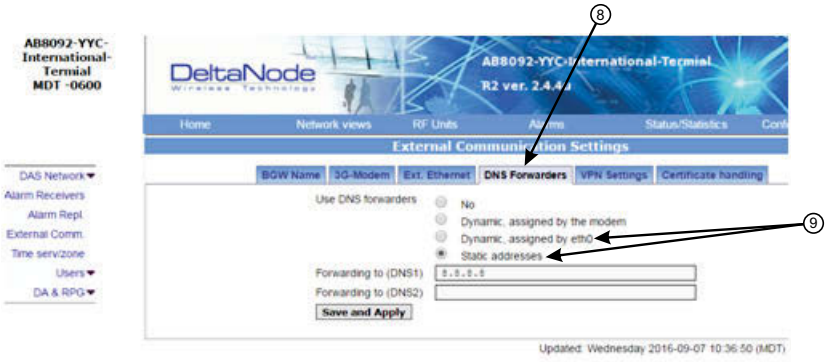
   Note: *Older software versions of the BGW do not offer VPN service tunnels. Contact Bird to order a replacement BGW.*

Figure 124 BGW Configuration - VPN Setting



8. Select the DNS Forwarders tab. See Figure 125 on page 104.
9. Select either:
   - "Dynamic, assigned by eth0" or
   - "Static addresses". Enter 8.8.8.8 in the Forwarding to (DNS1).

Figure 125 BGW Configuration - DNS Forwarders Setting



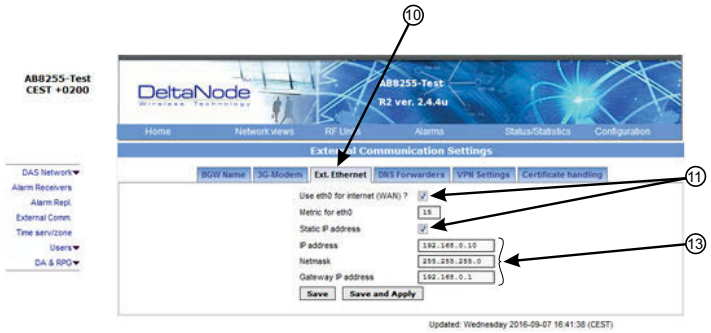
10. Select the Ext. Ethernet tab
11. Select "Use eth0 for internet" and "Static IP address" check boxes.
12. Record the existing IP setting in case rolling back to original settings is required.
13. Enter the IP addresses information:

    IP Address: 192.168.0.10

    Netmask: 255.255.255.0

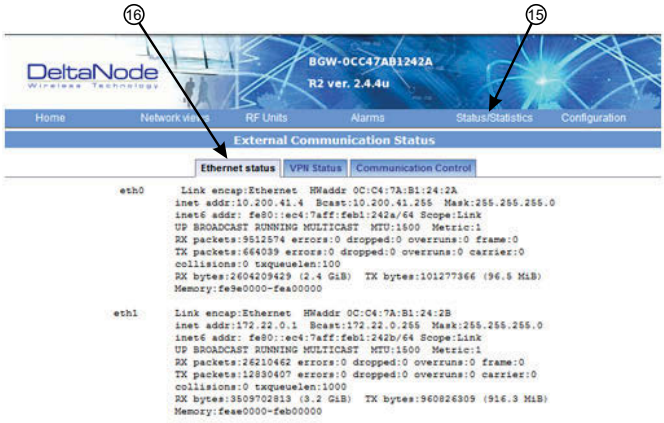
    Gateway IP Address: 192.168.0.1

Figure 126 BGW Configuration - External Ethernet Setting



14. After all the setting have been configured, power cycle the wireless modem.
15. Click on "Status/Statistics." See Figure 127 on page 105.
16. Select the "Ethernet Status" tab.
    Verifiy that "etho" has been assigned a valid IP address.

Figure 127 BGW Configuration - Ethernet Status

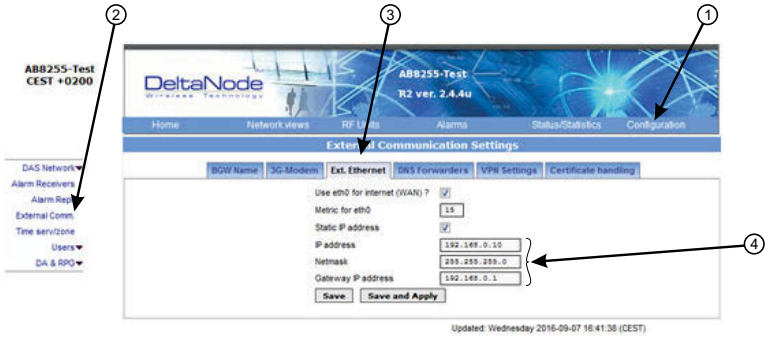


Rolling Back Modem Configuration

If the external modem is no longer required the configuration can quickly be rolled back.

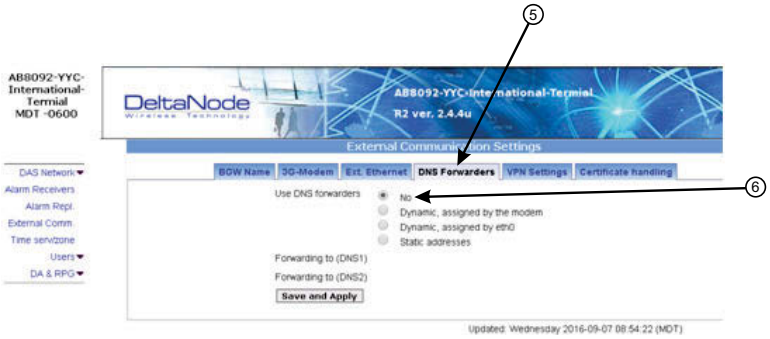
1. Click on Configuration. See Figure 128.
2. Click on External Comm.
3. Select the Ext Ethernet tab.
4. Enter original IP addresses that used prior to installing the modem.

Figure 128 Rollback Modem IP Addresses



5. Select the DNS Forwarders tab. See Figure 129 on page 105.
6. Select the "No" radio button.

Figure 129 Stop DNS Forwarding



Setup local Network UDP Ports for CGW Access

In order for the Bird/DeltaNode CGW to be able to make contact with the BGW ensure that the customer IT department has OpenVPN with UPD ports 1194 to 1199. This allows Bird/DeltaNode static IP address to access the BGW.

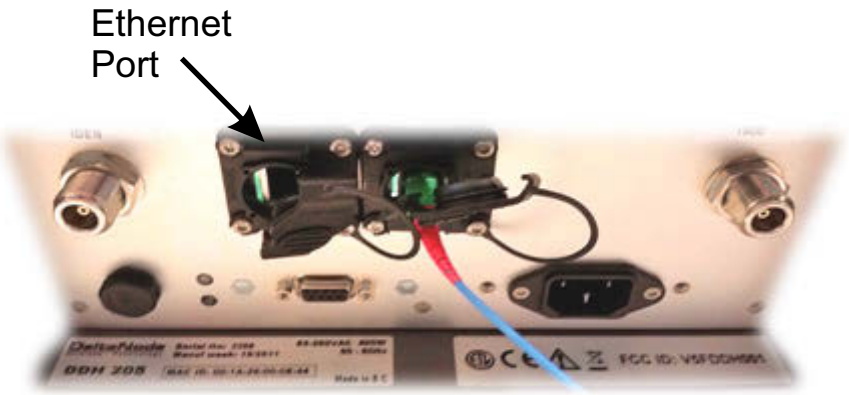
Local Connection to Remote Unit

A technician can directly connect a laptop to the remote unit. This is useful when the technician is at the remote unit troubleshooting. The direct connection is also very useful when there is no fiber connectivity to the remote unit and the installer needs to test and program the remote unit during the installation process.

> **Note:** *By directly logging in the remote unit and programming the name of the remote there is less chance of confusion when all the remotes are connecting to the Master Unit.*

1. Set laptop to a static IP address; something along the lines of
   - IP address 169.254.48.11
   - Subnet Mask 255.255.0.0
   - Gateway 169.254.0.1
2. Connect RJ45 Ethernet cable to the laptop and the Ethernet port on the remote.

Figure 130 Remote Unit Ethernet Port



3. Use any web browser to connect to the remote unit starting with http://169.254.48.1.
   The remote unit has a default IP address of 169.254.48.1 to .10. If the login menu does not appear try the next sequential IP address (http://169.254.48.2). Continue trying the next IP address until the login menu appears.

Figure 131 Remote Unit Login Screen

4. When the login menu appears type in the default credentials:
   - Username: “extended”
   - Password: “admin”
5. The GUI menus will be the same as when connecting to the remote through the BGW.

Local Connection to Remote Unit with Two FOR's

Some remote units are built with 2 FOR boards. This would occur in applications where one chassis contains: MIMO paths, multiple amplifiers of the same band, amplifiers fed from different FOI cards or other special applications. The 2 FOR boards share the one Ethernet connector on the remote unit. A standard Ethernet cable will only access FOR [0]. A custom cable is required to access FOR [1] board.

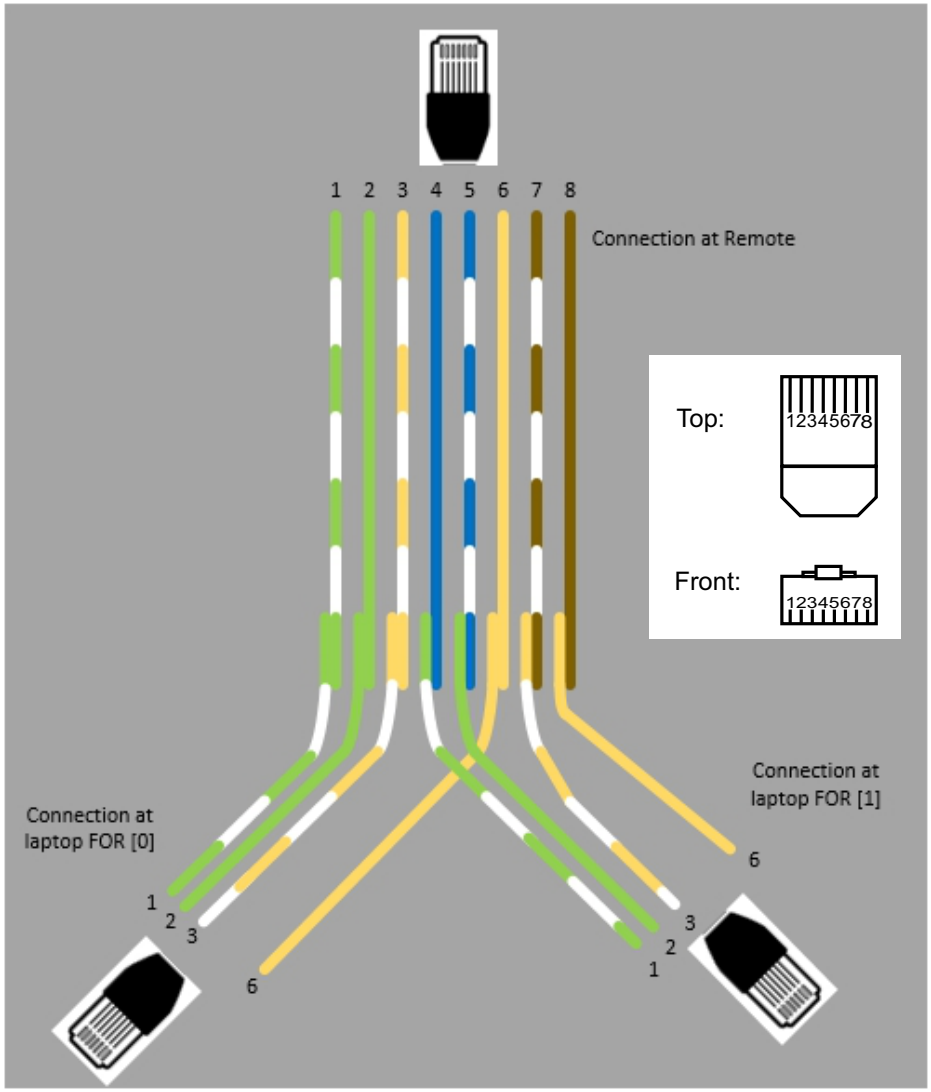
To build a cable to access both FOR units you will need the following items.

- Wire cutters
- Wire strippers
- Electrical tape
- Two Ethernet cables with RJ-45 Connectors

Build a Custom Cable

1. Cut both Ethernet cables in half.
   Three sections will be needed.
2. Strip back the insulation on each wire about 0.5 inch/13mm.
3. Twist the color pairs together as shown in Figure 132 on page 108.
4. Use electrical tape to cover the connections so bare wire do not touch.
   Unused cable strands can be cut.
5. Secure the splice with electrical tape so that stress does not pull the wire pairs apart.
6. Clearly mark each connector to distinguish which connector is attached to the remote and which connector plugs into the laptop for FOR [0] and FOR [1].

Figure 132 Custom Cable for Connecting to two FOR systems



Connection to BGW from Remote Unit

The technician has the ability to connect to the BGW from the remote unit. This eases troubleshooting and programming by not having to return to the BGW location for direct access.

1. Enable the laptop DHCP settings.
2. Connect RJ45 Ethernet cable to the Ethernet port on the remote.

   The FOI will detect that a device has connected to the FOR and will assign an IP address to the the laptop in the range of 172.22.108.49-62.

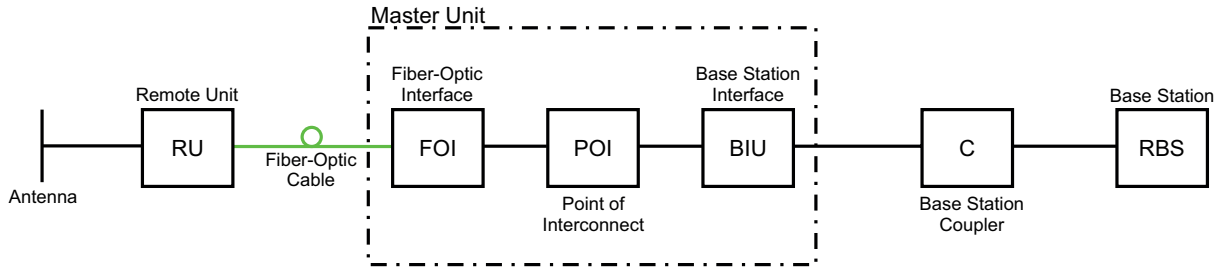
   Note: *It may take up to 15 minutes for the FOI to assign an IP address to the laptop.*
3. Using an Internet browser connect to 172.22.0.1
4. When the login menu appears type in the default credentials:
   - Username: "extended"
   - Password: "admin".

In order to make the process more clear for this part of the manual we will consider setting up a fictitious system, but based on a standard approach at doing Fiber-DAS. The system that we are considering will have two frequency bands, let's assume GSM 900 MHz and UMTS 2100 MHz. The example will have 2 sectors with two remotes in each sector. Of course your system may look different, be more or less complex but in order to make it clear how the system is set up this should provide you with a starting point.

Setting up the uplink

Setting up the uplink means to adjust the system for an optimal working point from the antenna port of the Remote Unit to the actual input on the Radio Base Station. This can be done in different ways depending on how the system is designed. We will here discuss a standard set-up starting with a small block schematic showing how the system is connected.

Figure 133 System Interconnect Diagram



The main parameter that we will be discussing is the "net gain" of the system. This means the total change in signal from the Remote Unit antenna port to the receiver port on the base station. There are different ways of setting this system up but we will look at a 0 dB net gain system which is a good starting point for most systems.

The system gain can be calculated as the gain in the Remote Unit – Loss on fiber + FOI gain – ICU loss + BIU gain – coupler loss. Basically this takes form of a link budget and here is an example:

Table 68 Example Link Budget

Unit/Component	Gain/Loss (dB)	Accumulated Gain/Loss (dB)
Remote Unit (RU)	40	40
Fiber-Optic Cable	-10	30
FOI	20	50
ICU	-35	15
BIU	0	15
Coupler	-15	0

Basically this means that whatever is input at the antenna will also be seen at the same level for the Radio Base Station receiver. This is not a bad starting point but does not take into account the noise load on the base station which will increase somewhat with this setup.

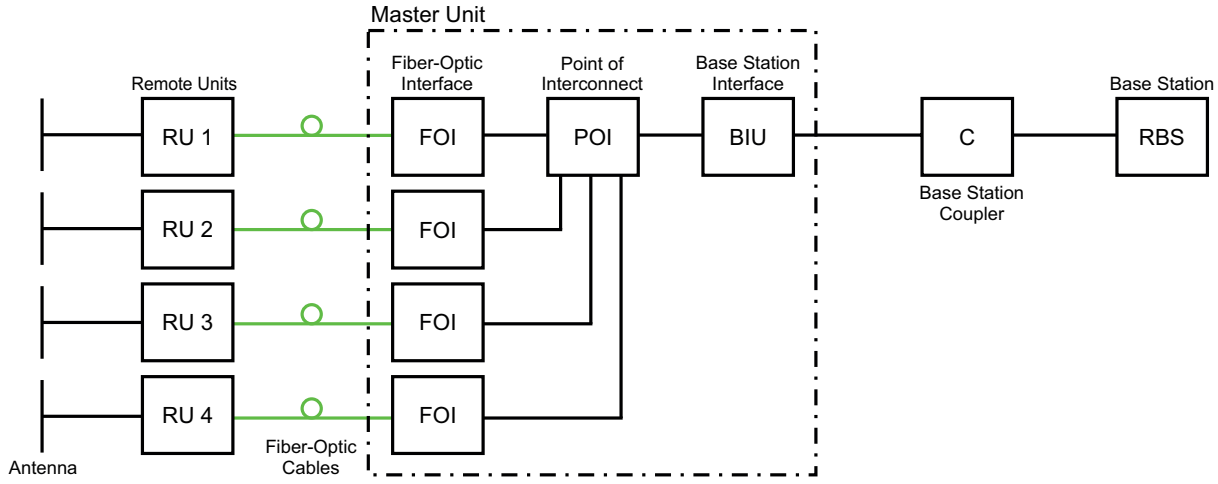
Noise load on Radio Base Station

The system will inevitably add some noise to the receiver. When properly set up the noise figure in a system like this will be better than 3 dB. However, if the gain is improperly set up (i.e. not enough gain in the remote, too much gain in the head-end) it is possible to create a very bad noise figure. In order to avoid this the Fiber-DAS Calculator should be used to calculate the noise figure of the system in the uplink.

If you have not familiarized yourself with the Fiber-DAS Calculator, do so before moving on in this manual. The figures in the Fiber-DAS calculator relate to the settings of all steps in the chain. By using the calculator, you can determine the proper settings once you know the fiber loss between the Remote Unit and the headend.

Let us assume your have arrived at a Noise Figure (NF) of 3 dB for this chain. However your system may contain more remotes, perhaps connected like the system in Figure 134.

Figure 134 Multiple RU Connection Diagram



Now the noise load can be calculated by adding the noise contribution from each step of the chain. Below is an example of noise figures from each of the remotes:

Table 69 Noise Load

Chain	NF	Gain	Noise Load
RU 1	2.8	0.0	2.8
RU 2	3.2	1.0	4.2
RU 3	3.8	-2.0	1.8
RU 4	2.6	-1.0	1.6
Sum of Noise Load			8.7

Base Station	4.0
Fiber-DAS Noise Load	8.0
Total Noise into BTS	9.5
Desensitization	-5.5

Add your figures to the sheet in the Fiber-DAS calculator and it will calculate it for you.

What we see here is that if we set the system up in this fashion we will desensitize the base station with about 5,5 dB. This can be okay if the base station coverage is only through the Fiber-DAS system but if the base station is also being used for outdoor coverage it is not good. We need to change the net gain to reflect this. In general we should lower the gain so that we desensitize the BTS only about 3 dB. This value is a good compromise and similar to adding a second antenna to the same receiver port (which is kind of what we are doing with the Fiber-DAS).

Here are the new values:

Table 70 Adjusted Noise Load

Chain	NF	Gain	Noise Load
RU 1	2.8	-5.5	-2.2
RU 2	3.2	-5.5	-1.8
RU 3	3.8	-5.5	-1.2
RU 4	2.6	-5.5	-2.4
Sum of Noise Load			4.1

Base Station	4.0
Fiber-DAS Noise Load	4.1
Total Noise into BTS	7.1
Desensitization	-3.1

As you can see we should set the system up with a net gain of about -5 dB. Going back to the settings we had before which was:

Table 71 Example Link Budget

Unit/Component	Gain/Loss (dB)	Accumulated Gain/Loss (dB)
Remote Unit (RU)	40	40
Fiber-Optic Cable	-10	30
FOI	20	50
ICU	-35	15
BIU	0	15
Coupler	-15	0

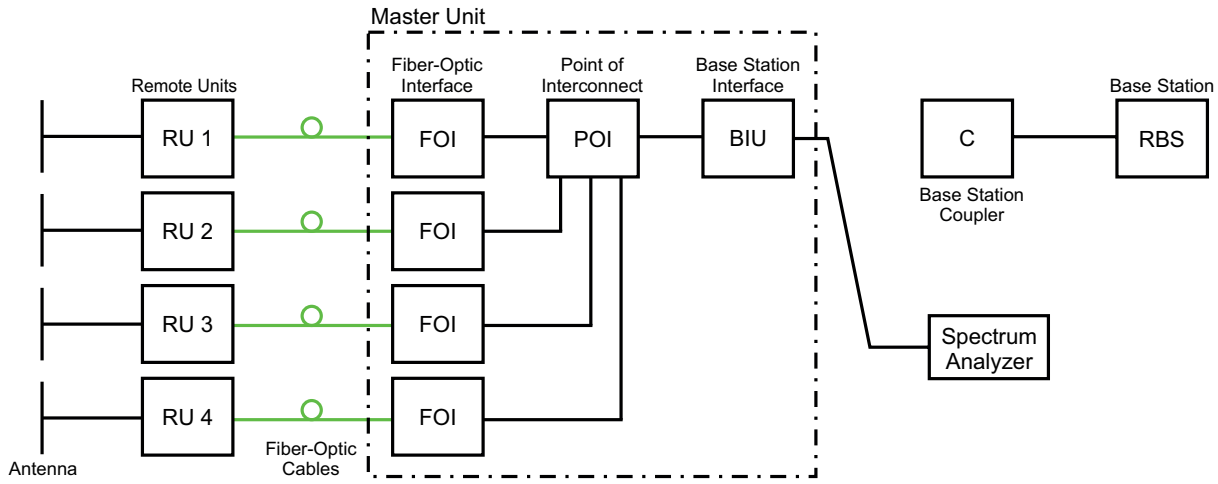
We only need to change the BIU setting using the attenuators in the BIU to lower the gain with 5 dB. This will accomplish what we need to do and the uplink should then be commissioned.

Practical approach

Now that we know what we should have we can easily set the system up. You need a spectrum analyzer to do this and it is easiest to connect it into the BIU port. Remember that when you measure here, the signal should also go through the BTS coupler before it reaches the base station receiver port. Therefore you should expect to read a value that is

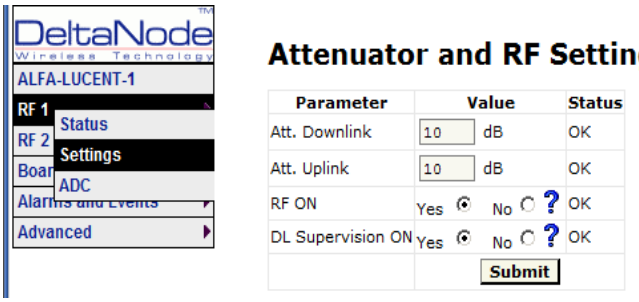
Your expected gain + the loss in your coupler

If you want a net gain of -5 dB and you have a 15 dB coupler, you should read a net gain of +10 on the BIU port. This is now what we are going to use in the following example.



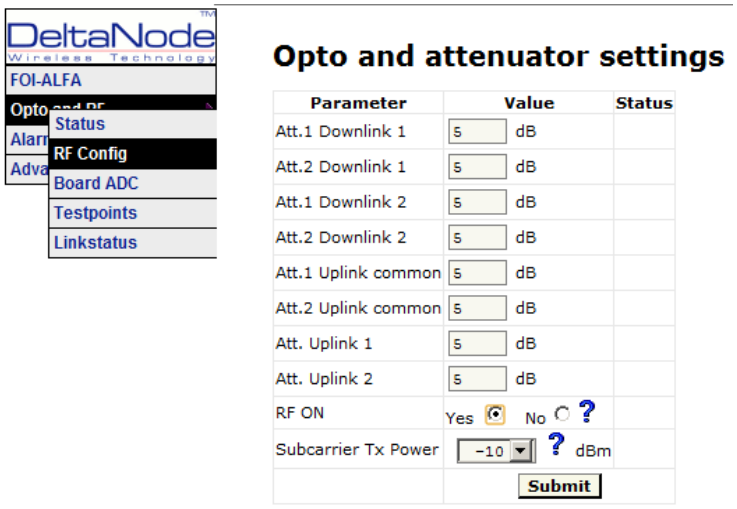
Turn on the RF

Connect to the BIU and turn on the RF. Set the attenuator in the medium range for the uplink that you are measuring. This allows you later to adjust it up and down as necessary to get the correct gain for the uplink chain.

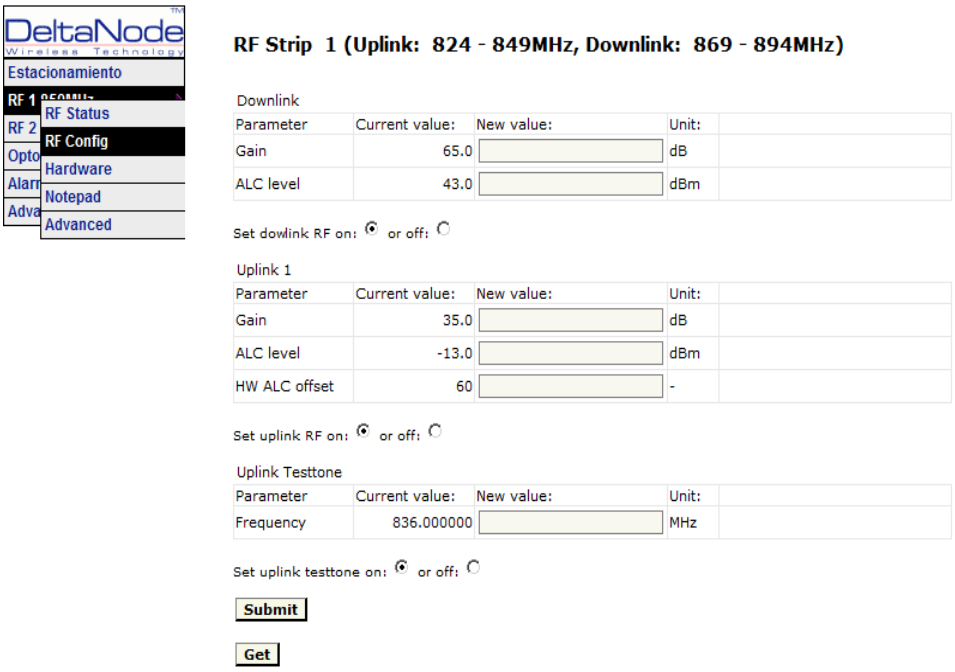


Setting them to 10 dB is a good idea. DL supervision can be left as is for now and also DL attenuation which we will set up later.

Connect to the FOI card and select Opto and RF – RF Config and set it up according to your Fiber-DAS calculator settings. Do not forget to turn RF on.

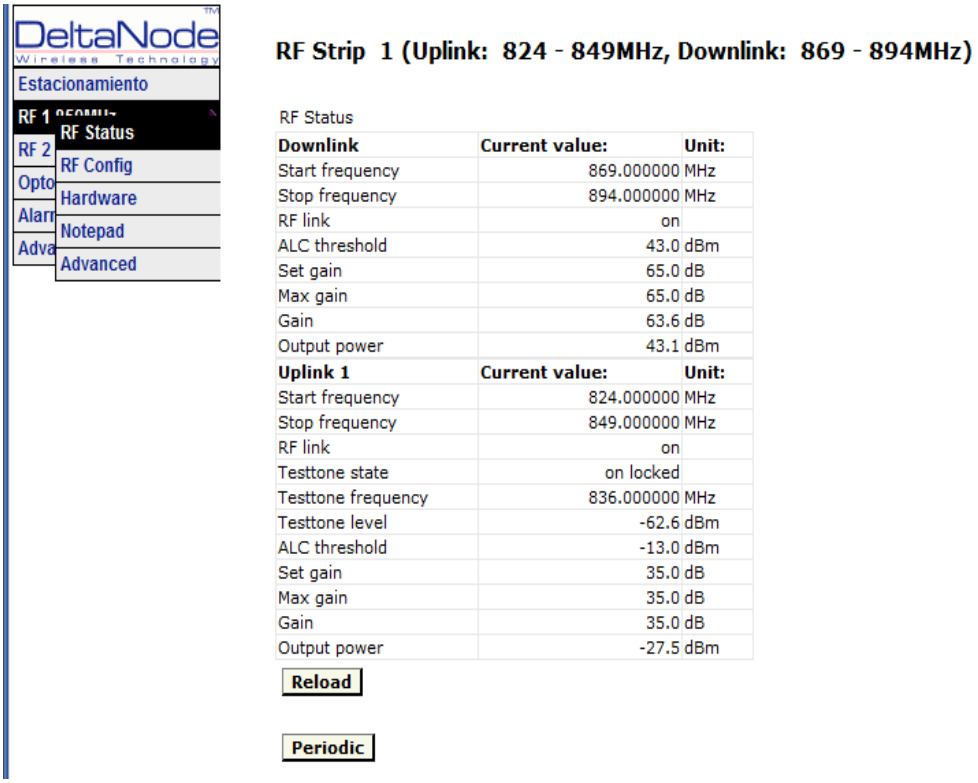


Next step is to connect to the remote unit and set it up for test measurement in the uplink.



In this screen you should also turn RF on, set the gain to about 35 dB as a starting point and then turn on the uplink test tone. Note the frequency of the test tone, this is the frequency you should be measuring on your spectrum analyzer.

Turn on the spectrum analyzer, make sure it is connected to the right port on the right BIU and then find the frequency. A reasonable span is 1 MHz and the receiver band width can be set to 30 kHz or similar. Use the marker to measure the peak of the signal. Then go to the next screen on the remote unit, the RF Status screen.



What we are looking for here is the Test tone Level. Note this down as well, next to the frequency of the test tone you noted earlier.

CAUTION

Turn Off Test Tone

Do not forget to turn off the test tone when you are done with your uplink. Better check one extra time. They will otherwise interfere with the normal operation of the system by causing noise to the base station.

Then check your spectrum analyzer. Assuming your test tone level is -62,6 dBm as in this example your spectrum analyzer may show -58,2 dBm. Calculating the net gain between the RU and the BIU will then yield -58,2 - -62,5 = 4,3 dB. Subtract the coupler between the BIU and the radio base station which in this example was 15 dB and we get -19,3 dB as our net gain.

We wanted -10 dB so we have 9,3 dB too low gain. We should then increase the gain and the best place to do this would be in the remote unit by setting the gain at 35 + 9,3 = 44,3 which we will round to 44 dB.

That uplink is now finished and we will repeat the settings for all of our uplink, one at a time.

System Model Numbers

Product Family	Sub-family	Number of Bands		Frequency	Duplexed	Frequency	Duplexed		Frequency	Duplexed	Frequency	Duplexed		Voltage	Connectors	WDM		Wavelength FOR 1	FOR 1 Band 1	FOR 1 Band 2		Wavelength FOR 2	FOR 2 Band 1	Wavelength FOR 3	FOR 3 Band 1		CWDM				Optical Split
D	D	R	4	- G	0	C	0	-	G	0	C	0	-	A	D	W	-	B	1	2	-	C	3	H	3	-	W	U	B	C	S

Family:
DDU - 46 dBm Full Band
DDH - 43 dBm Full Band
DDS - 41 dBm Single Carrier
DDR - 33 dBm Full Band
DDL - 23 dBm Full Band
DDX - Mixed Power Levels

Number of Bands:
1
2
3
4

Frequency:
R - FM Radio
V - VHF (136-174)
T - Tetra (380-400)
M - Gov (406-420)
B - Tetra (410-415/420-425)
O - Tetra (415-420/425-430)
X - CDMA450 (453-457.5/463-467.5)
U - UHF (450-470)
Q - 500MHz T-Band (470-512)
L - Lower 700
H - Higher 700
G - 700 Full Band
F - PS 700 (793-805) FirstNet & NB
S - 800 SMR
J - DD 800
C - Cell 850
N - 900 PS
Y - GSMR
Z - EGSM900
D - DCS (1800)
P - PCS
I - UMTS (1900/2100)
A - AWS (1700/2100)
K - AWS & AWS3
E - IMT-E (2600)

Duplexed or DDX Pwr Lvl:
0 - Non-duplexed
1 - Duplexed
For DDX use:
For DDX Pwr Lvl 0 - 9:
0 - Non-duplexed (DDU)
1 - Duplexed (DDU)
2 - Non-duplexed (DDL)
3 - Duplexed (DDL)
4 - Non-Duplexed (DDH)
5 - Duplexed (DDH)
6 - Non-duplexed (DDS)
7 - Duplexed (DDS)
8 - Non-duplexed (DDR)
9 - Duplexed (DDR)

Voltage:
A - Universal AC (86-264 AC/DC)
D - 48 VDC

Connectors:
N - N-type Connectors
D - 7/16 DIN
M - Mini DIN

WDM:
W - Duplexed (UL and DL on the same fiber)

Wavelength of Uplink:
(FOR2 and FOR3 are optional to support multiple fiber links)
A - 1270
B - 1290
C - 1310 (default C if omitted)
D - 1330
E - 1350
F - 1370
G - 1390
H - 1410
I - 1430
J - 1450
K - 1470
L - 1490
M - 1510
N - 1530
O - 1550
P - 1570

FOR Bands:
(if omitted than all bands on one FOR)
Bands for that fiber link (in order as appear in model #) i.e. C123 would be standard FOI driving bands 1, 2, and 3
1
2
3
4

CWDM (option):
WUxxxx - combine multiple uplink fiber interfaces onto one fiber - each x denotes a wavelength (absence of xxxx implies all UL wavelengths)
WDxxxx - split to multiple downlink fiber interfaces from one fiber - each x denotes a wavelength (absence of xxxx implies all DL wavelengths)

Optical Split (option):
Sx - split the fiber at entry - to daisy chain other remotes - x is dB split (3dB equal split if absent)

Examples:

DDR4-GC0-PA1-AD — 4 band, 33dBm power output per band, Full band 700 combined with Cell 850 non duplexed, PCS combined with AWS duplexed, AC powered, 7/16 DIN, 1310nm uplink

DDR4-GC0-PA1-AD-B12-C34-WUBCS — 4 band, 33dBm power output per band, Full band 700 combined with Cell 850 non duplexed, PCS combined with AWS duplexed, AC powered, 7/16 DIN, Bands 1 and 2 (700 and 850) 1290nm uplink, Bands 2 and 3 (PCS & AWS) 1310nm uplink, CWDM, fiber split (3dB) for daisy chained remotes

Remote End Unit Part Numbers

Note: *The remote end units are completely integrated at the factory, there is no field assembly other than mounting and cable connection. Modules should not be altered once deployed.*

Public Safety DDR Module Numbers

Part Number	Frequency Band	IC Certification Number
MOD-DDR-V	VHF - 136-174MHz	110141A-DDR1V
MOD-DDR-U	UHF - 450-470MHz	110141A-DDR1U
MOD-DDR-Q	T-Band - 470-512MHz	110141A-DDR1Q
MOD-DDR-F	700Mhz PS	110141A-DDR1F
MOD-DDR-S	800MHz PS	110141A-DDR1S

Cellular DDR Module Numbers

Part Number	Frequency Band	IC Certification Number
MOD-DDR-G	700 cell full band	110141A-DDR700FB
MOD-DDR-C	850 cell band	110141A-DDR850
MOD-DDR-P	1900 PCS	110141A-DDR1900
MOD-DDR-A	2100AWS	110141A-DDR2100
MOD-DDR-E	2600	110141A-DDR2600