

8. Select an attenuator that is as close to the value calculated in step 7 as possible. Select a value that will adjust the signal level of the composite input signal to fall within the specified range.
9. Install the external attenuator in the coaxial cable that is connected to the FORWARD RF IN port at the HU.
10. Subtract the value of the external attenuator used in step 9 from the total composite signal power (P_{tot}) and record the result. This value will be required when setting the attenuation of the HU's internal forward attenuator.

2.4 Enter Site Number and Site Name

All HU's and RU's are programmed with the same site number and site name. It is therefore necessary to assign a unique site name and site number to the HU and RU before they can be connected to the same CAN. Use the following procedure to assign a unique site number and name to each HU and RU system:

1. Click on the **HOST Config** tab and on the **REMOTE Config** tab. The **HOST Config** display and the **REMOTE Config** display will open within the EMS main window as shown in [Figure 4-6](#).

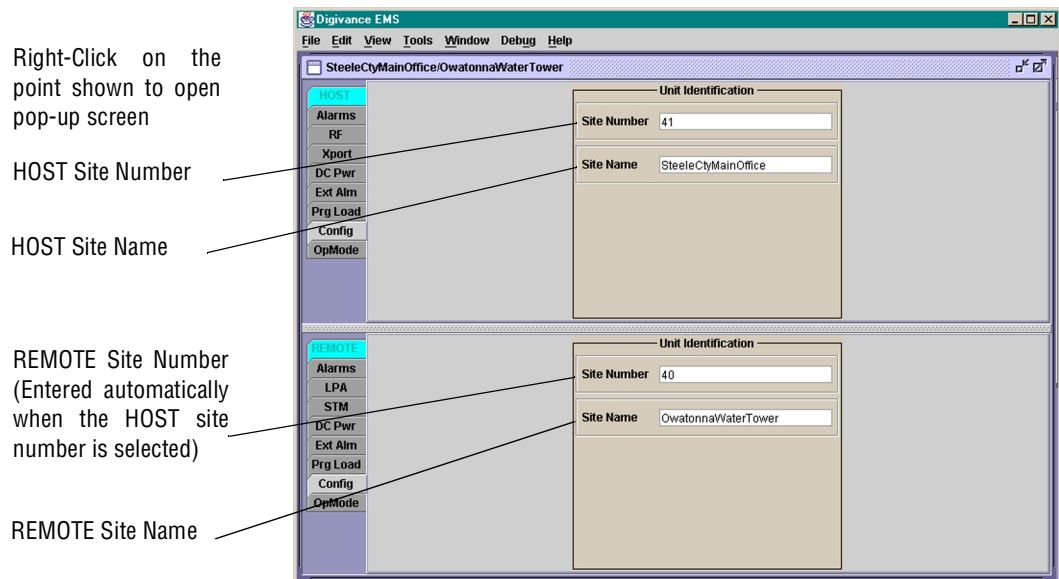


Figure 4-6. HOST and REMOTE Config Displays

2. Right-click on the **HOST Site Number** (see [Figure 4-6](#)). The **Site Number** pop-up screen will open as shown in [Figure 4-4](#). Enter any odd number between 33 and 61 and then click on OK to close the screen and make the changes take effect.

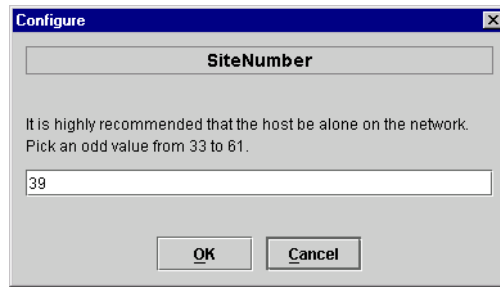


Figure 4-7. HOST Site Number Pop-Up Screen

3. Right-click on the HOST **Site Name** field (see [Figure 4-6](#)). The **Site Name** pop-up screen will open. Enter a unique name for the HOST. The name may be up to 32 characters long and must not contain any spaces. The name may include numbers, punctuation, and upper or lower case letters and must always begin with a letter. Click on OK to close the screen and make the changes take effect.
4. Check the REMOTE **Site Number** field (see [Figure 4-6](#)). The REMOTE Site Number does not have to be entered. When the HOST Site Number is entered, the system will subtract 1 from the HOST Site Number and automatically enter the result for the REMOTE Site Number.
5. Right-click on the REMOTE **Site Name** field (see [Figure 4-6](#)). The **Site Name** pop-up screen will open. Enter a unique name for the REMOTE. The name may be up to 32 characters long and must not contain any spaces. The name may include numbers, punctuation, and upper or lower case letters and must always begin with a letter. Click on OK to close the screen and make the changes take effect.

2.5 Enter Host Forward Attenuation

The HU internal forward path attenuator setting determines the maximum composite output signal level at the STM antenna port. The appropriate attenuation value for any particular system is based on the number of channels the system is transporting and the signal level of the composite forward path input signal input at the HU's FORWARD RF IN port. The maximum output power that can be provided by the system is 40.85 dBm (12 watts). The total forward path gain that is provided by the system (with host and remote forward attenuators set to 0 dB) is 80.85 dBm. Use the following procedure to set the forward path attenuation to provide the maximum composite output signal level:

1. Click on the HOST **RF** tab. The HOST **RF** display will open within the EMS main window as shown in [Figure 4-8](#).
2. Right-click on the **Host Fwd Att** section of the display (see [Figure 4-6](#)). The **Host Fwd Att** pop-up screen will open as shown in [Figure 4-9](#).
3. Obtain the value of the total composite input signal level as determined in step 10 of [Section 2.3](#).

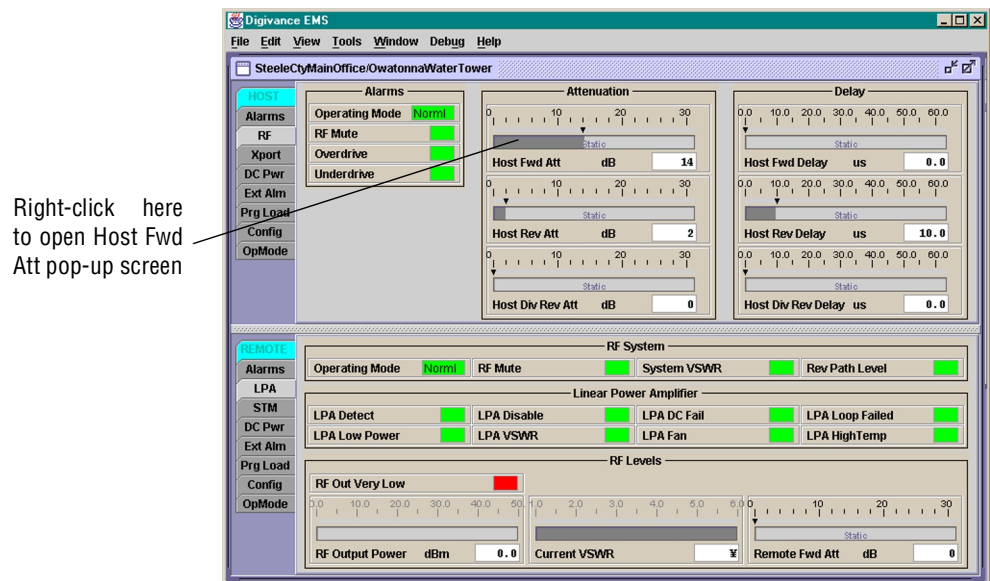


Figure 4-8. HOST RF Display

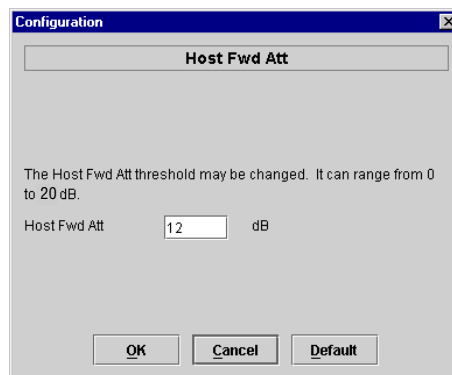


Figure 4-9. Host Fwd Att Pop-Up Screen

4. Determine the appropriate value to enter for the Host forward path attenuator by subtracting the required system output level (per system design plan) from 80.85 (the total system gain) and then adding the composite input signal level. The result (see sample calculation) is the amount of attenuation required.

$$\text{Atten Required} = 80.85 - (\text{Required System Output Power}) + (\text{Composite Input Power})$$

5. Enter the attenuation value and click OK to close the pop-up screen and to make the changes take effect.

2.6 Determine Output Signal Level at DDS Antenna Ports

The RF output signal level should be measured at the DDS ANTENNA ports to verify that maximum composite signal level is at the required level. Use the following procedure to determine the power level:

1. Verify that RF ON/OFF switch on the LPA in the **OFF** position.
2. Disconnect the antenna cable from the DDS ANTENNA 1 port.
3. Connect a spectrum analyzer or RF power meter to the DDS ANTENNA 1 port. (Check the input rating of the test equipment and insert a PAD if necessary.)
4. Place the RF ON/OFF switch on the LPA in the **ON** position.
5. Measure the RF level of a single carrier, such as the control channel, in dBm. Make sure the resolution bandwidth of the spectrum analyzer or power meter is narrow enough to measure the power of the single 30 kHz channel only.
6. Calculate the total composite signal power using the following formula:

$$P_{\text{tot}} = P_c + 10\text{Log } N$$

Where,

P_{tot} is the total composite power in dBm

P_c is the power per carrier in dBm as measured in step 2, and

N is the total number of channels.

7. Record the result calculated in step 6.
8. Place the RF ON/OFF switch on the LPA in the **OFF** position.
9. Disconnect the spectrum analyzer or RF power meter from the DDS ANTENNA 1 port.
10. Re-connect the antenna cable to the DDS ANTENNA 1 port.
11. Repeat procedure for the DDS ANTENNA 2 port.

► **Note:** To comply with Maximum Permissible Exposure (MPE) requirements, the maximum composite output from the antenna(s) cannot exceed 1000 Watts EIRP and the antenna(s) must be permanently installed in a fixed location that provides at least **6 meters** (20 feet) of separation from all persons.

2.7 Enter Remote Forward Attenuation

The STM internal forward path attenuator setting is used to increase or reduce the power level of the composite output signal level at the DDS antenna ports. The maximum composite output signal level at the DDS antenna ports is set using the Host internal forward attenuator (see Section 2.4). However, component variations may result in the output power at the DDS antenna ports being slightly above or below the required power per channel. If this is the case, the STM forward attenuator may be used in conjunction with the Host forward attenuator to add or remove attenuation to produce the required output signal level. If less power is required, the STM forward attenuator may be used to reduce the power level. The default setting is 0 dB. Use the following procedure to change the STM forward attenuation:

1. Click on the **REMOTE LPA** tab. The **REMOTE LPA** display will open within the EMS main window as shown in [Figure 4-10](#).

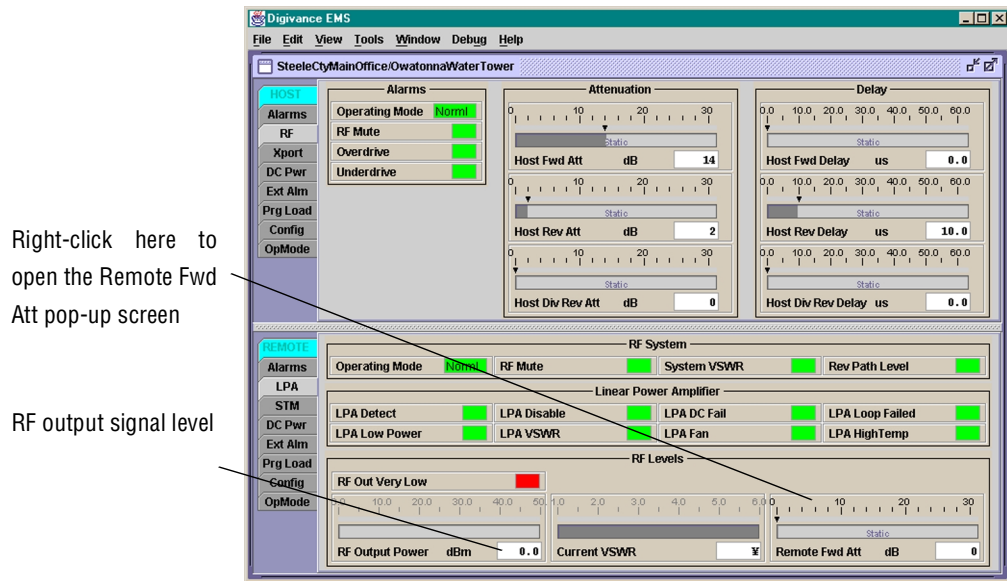


Figure 4-10. REMOTE LPA Display

2. Check the level of the RF output signal (as determined in [Section 2.6](#)) against the system design plan specifications. [Table 4-1](#) shows the output signal level required to provide 5 watts per channel. The maximum output signal level provided by the system is 40.85 dBm (12 watts) at each DDS antenna port.
3. Determine if more or less attenuation is required to produce the required output signal level.
4. Right-click on the **Remote Fwd Att** section of the display (see [Figure 4-10](#)). The **Remote Fwd Att** pop-up screen will open as shown in [Figure 4-11](#).

Table 4-1. Composite Output Signal Levels

NUMBER OF CHANNELS	OUTPUT SIGNAL LEVEL REQUIRED TO PROVIDE 5 WATTS PER CHANNEL
1	37 dBm
2	40 dBm
When there are three or more channels, each channel will always be less than 5 watts per channel because the system has a maximum power output of 12 watts (40.85 dBm) per DDS antenna port.	

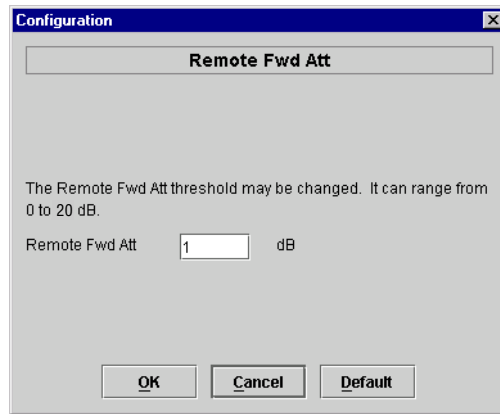


Figure 4-11. Remote Fwd Att Pop-Up Screen

5. Enter the required attenuation value and click OK to close the pop-up screen and to make the changes take effect.
 6. Verify that the appropriate RF output signal level appears in the **RF Pwr-VSWR Low** section (see [Figure 4-10](#)). This is primarily a reference value and should not take the place of external test equipment when determining the power level of the composite RF output signal. Depending on the modulation type and number of channels, the EMS software may report a power level that is higher or lower than the actual RF output signal.
- **Note:** To comply with Maximum Permissible Exposure (MPE) requirements, the maximum composite output from the antenna(s) cannot exceed 1000 Watts EIRP and the antenna(s) must be permanently installed in a fixed location that provides at least **6 meters** (20 feet) of separation from all persons.

2.8 Enter Host Reverse Attenuation

The level of the RF signal that should be input to the EBTS will vary depending on the type of EBTS, the receive distribution, and the number of channels present. To interface with the EBTS, the reverse path signal level must be adjusted to provide the signal level required by the EBTS. The HU provides from 10 to 30 dB of gain in the reverse path. Use the following procedure to set the reverse path gain:

1. Check the EBTS manufacturer's specifications to determine the composite signal level required at the EBTS reverse path input port.
2. Determine the overall gain and loss imposed on the signal by the antenna, antenna cable, and by the cables that connect the HU to the EBTS.
3. Determine the amount of gain required to raise the reverse path signal to the level required at the EBTS.
4. Click on the HOST **RF** tab. The HOST **RF** display will open within the EMS main window as shown in [Figure 4-12](#).

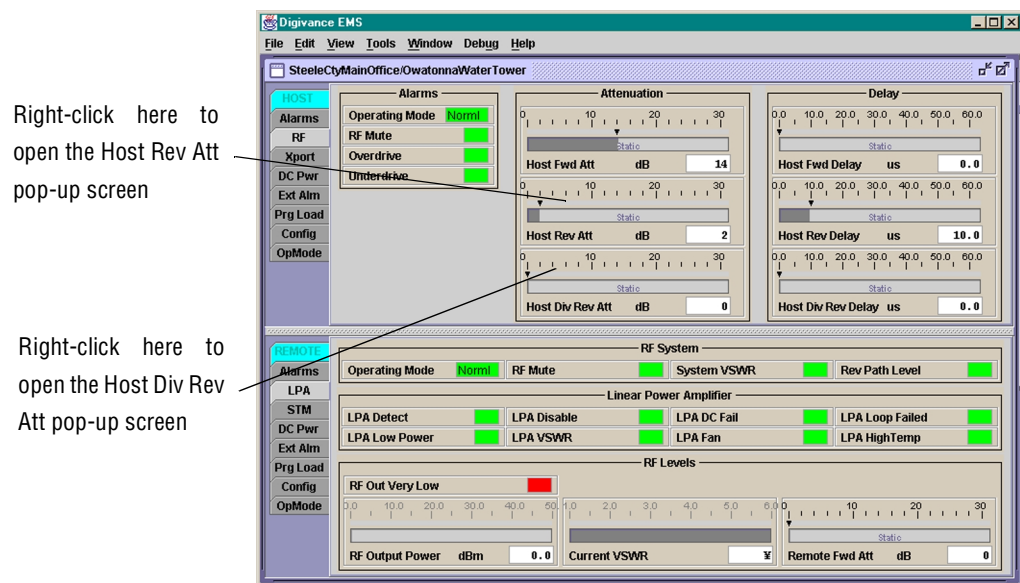


Figure 4-12. HOST RF Display

5. Right-click on the **Host Rev Att** section of the display (see Figure 4-12). The **Host Rev Att** pop-up screen will open as shown in Figure 4-13.

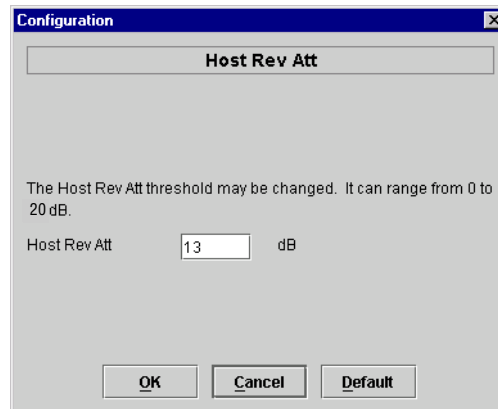


Figure 4-13. Host Rev Att Pop-Up Screen

6. Enter the attenuation value that will provide the required gain. Refer to Table 4-2 for the attenuation values and the corresponding gain values.
7. Click OK to close the pop-up screen and to make the changes take effect.
8. Repeat the process for the diversity reverse path by right-clicking on the **Host Div Rev Att** section (see Figure 4-12) and then entering the required attenuation value in the **Host Div Rev Att** pop-up screen.
9. Click OK to close the pop-up screen and to make the changes take effect.

Table 4-2. Reverse Path Setting

ATTENUATION SETTING	GAIN PROVIDED	ATTENUATION SETTING	GAIN PROVIDED
0 dB →	30 dB	11 dB →	19 dB
1 dB	29 dB	12 dB	18 dB
2 dB	28 dB	13 dB	17 dB
3 dB	27 dB	14 dB	16 dB
4 dB	26 dB	15 dB	15 dB
5 dB	25 dB	16 dB	14 dB
6 dB	24 dB	17 dB	13 dB
7 dB	23 dB	18 dB	12 dB
8 dB	22 dB	19 dB	11 dB
9 dB	21 dB	20 dB	10 dB
10 dB	20 dB	-	-

2.9 Enter Host Forward and Reverse Delay

The forward and reverse delay function allows entry of from 0 to 63 μ sec of delay in the forward and reverse paths. This feature is used when multiple systems are used to transport the same channel and there is a significant difference in the path delay between systems. Additional delay may be entered to balance the overall system delay. The amount of delay required must be calculated by the RF engineer and should be included in the system design plan. The default setting is 0 μ sec. Use the following procedure to change the forward and reverse path delay:

1. Click on the HOST **RF** tab. The HOST **RF** display will open within the EMS main window as shown in Figure 4-14.

Right-click here to open the Host Fwd Delay pop-up screen

Right-click here to open the Host Rev Delay pop-up screen

Right-click here to open the Host Div Rev Delay pop-up screen

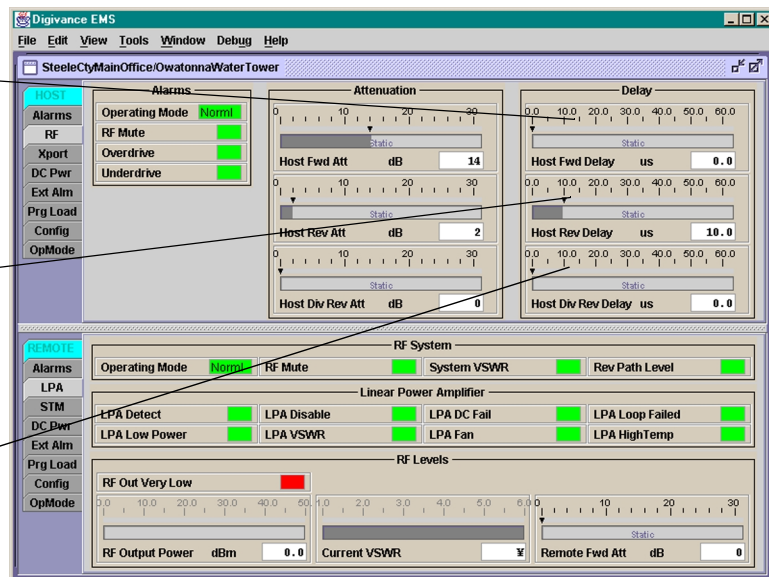


Figure 4-14. HOST RF Display

2. Right-click on the **Host Fwd Delay** section of the display (see [Figure 4-14](#)). The **Host Fwd Delay** pop-up screen will open as shown in [Figure 4-15](#).
3. Obtain the value of the forward delay as specified in the system design plan.
4. Enter the forward path delay value and click OK to close the pop-up screen and to make the changes take effect.
5. Repeat the process for reverse delay and diversity reverse delay by right-clicking on the appropriate delay section (see [Figure 4-14](#)) and then entering the required delay value in the pop-up screen.
6. Click OK to close each pop-up screen and to make the changes take effect.

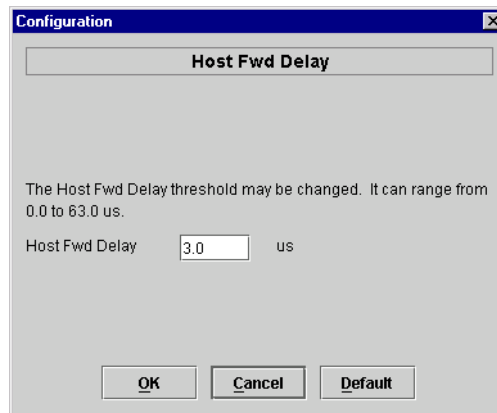


Figure 4-15. Host Fwd Delay Pop-Up Screen

Blank

SECTION 5: MAINTENANCE

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1 SYSTEM MAINTENANCE OVERVIEW

This section explains the Digivance LRCS fault detection and alarm reporting system, provides a method for isolating and troubleshooting faults, and provides test and maintenance procedures. The Digivance LRCS requires minimal regular maintenance to insure continuous and satisfactory operation. Components that require regular replacement, cleaning, or testing include the HU and RU fans and the RU air-filter and back-up battery,

Maintenance also includes diagnosing and correcting service problems as they occur. When an alarm is reported, it will be necessary to follow a systematic troubleshooting procedure to locate the problem. Once the source of the problem is isolated, the appropriate corrective action can be taken to restore service. The only internal components that can be replaced are the cooling fans which mount in the HU, STM, and LPA. The failure of any other component within a unit will required replacement of that unit.

1.1 Tools and Materials

The following tools and materials are required in order to complete the procedures in this section:

- ESD wrist strap
- IR filtering safety glasses
- Patch cords with SC connectors
- 10 dB in-line SC optical attenuators
- Optical power meter (1550 and 1310 nm)
- Laser light source
- TORX screwdriver (with T10 bit)

- Battery maintenance tools (see PRC-SERIES OPERATING AND FIELD SERVICE MANUAL for tool recommendations)

2 FAULT DETECTION AND ALARM REPORTING

The Digivance LRCS on-board embedded software detects various unit and system faults and reports them as either Major or Minor alarms. A major alarm indicates that the system has failed in a way that directly affects RF transport performance. This usually means that some calls or perhaps all calls cannot be made over the system. A Minor alarm means that system performance is not affected or in some cases, that the performance may no longer be optimal. Four types of faults cause a minor alarm to be reported: overtemperature, fan failure, diversity path failure, and an external minor fault (user defined fault). All other faults are reported as a Major alarm.

Reporting of Major and Minor alarms is accomplished through the HU alarm contacts, the unit front panel LED's, the EMS software Maintenance Interface (MI), and the Network Operations Center - Network Element Manager (NOC/NEM) interface.

The HU is equipped with a set of both normally open (NO) and normally closed (NC) alarm contacts which are used to report both Major and Minor alarms to an external alarm system. The alarm contacts summarize the inputs so that any Major or Minor alarm will trigger an alarm report to the external alarm system.

The HU, STM, and LPA front panel LED indicators are used to indicate unit and system status and to convey alarm information. In addition to LED indicators, the LPA is also equipped with a Digital Display that provides status messages. A description of the Host Unit, Spectrum Transport Module, and Linear Power Amplifier LED indicators is provided respectively in [Table 5-1](#), [Table 5-2](#), and [Table 5-3](#).

The EMS software MI provides both a summary and a more detailed list of alarm information that includes unit and module level faults, circuit faults, and measured value faults such as voltages, RF power, and temperature. A summary showing a list of all systems and their current alarm status is presented through the Alarm OverView display. A detailed list of alarm information is presented through the HOST alarm display and the REMOTE alarm display. All the inputs that the system reports as alarms are shown in the HOST and REMOTE alarm displays.

The NOC/NEM interface provides the same summary and detailed list of alarm information as the EMS software MI but in an ASCII text string format. Sending the command GET ALARMSUMMARY produces a list of all systems and their current alarm status. Sending the command GET ALARM ALL for a specific system will produce a detailed list of alarm information for the specified system.

Table 5-1. Host Unit LED Indicators

INDICATOR	COLOR	DESCRIPTION
POWER	Green Off	Indicates if the HU is powered or un-powered. The DC power source is on. The DC power source is off.
STANDBY	Green (blinking) Yellow (blinking) Red (blinking) Off	Indicates if the HU is in the standby, normal, test, or program load mode. The HU is in the standby mode. The HU is in the program load mode. The HU is in the test mode. The HU is in the normal mode.
HOST UNIT	Green Yellow Red	Indicates if the HU is normal, overheated, or faulty. The HU is normal. High temperature detected in HU. Internal fault detected in the HU.
REMOTE UNIT	Green Yellow Red	Indicates if an alarm is detected at the RU. No alarms detected at the RU. A minor alarm is detected at the RU. A major alarm is detected at the RU.
DRIVE	Green Yellow Red	Indicates if the forward path RF signal level is normal, above overdrive threshold, or below underdrive threshold. The RF signal level is normal The RF signal level is below the underdrive threshold. The RF signal level is above the overdrive threshold.
PORT 1/PORT 2	Green Red	Indicates if the reverse path optical signal received from the RU is normal, if no signal is detected, or if errors are detected. The reverse path optical signal is normal. No reverse path optical signal is received or excessive errors are detected.
PORT 3 (diversity units only)	Green Yellow	Indicates if the diversity reverse path optical signal received from the RU is normal, if no signal is detected, or if errors are detected. The diversity reverse path optical signal is normal. No diversity reverse path optical signal is received or excessive errors are detected.

Table 5-2. Spectrum Transport Module LED Indicators

INDICATOR	COLOR	DESCRIPTION
AC POWER	Green Red	Indicates if the STM is powered by the AC power source or the back-up battery system. The STM is powered by the AC power source. The STM is powered by the back-up battery system.
STANDBY	Green (blinking) Yellow (blinking) Red (blinking) Off	Indicates if the STM is in the standby, normal, test, or program load mode. The STM is in the standby mode. The STM is in the program load mode. The STM is in the test mode. The STM is in the normal mode.
HOST UNIT	Green Yellow Red	Indicates if an alarm is detected at the HU. No alarms detected at the HU. A minor alarm is detected at the HU. A major alarm is detected at the HU.
STM	Green Yellow Red	Indicates if the STM is normal or faulty. The STM is normal. The STM is over temperature or the fan has failed. Internal fault detected in the STM.
PA	Green Yellow Red	Indicates if the LPA is normal, over temperature, has a fan failure, or is faulty. The LPA is normal. The LPA is over temperature or the fan has failed. Internal fault detected in the LPA.
VSWR	Green Red	Indicates if the forward path VSWR is above or below the threshold. The VSWR is below the threshold. The VSWR is above the threshold.
PORT 1/PORT 2	Green Red	Indicates if the forward path optical signal received from the HU is normal, if no signal is detected, or if errors are detected. The forward path optical signal is normal. No forward path optical signal is received or excessive errors are detected.
PORT 3 (diversity units only)	Green Yellow	Indicates if the diversity reverse path optical signal received by the HU is normal, if no signal is detected, or if errors are detected. The diversity reverse path optical signal is normal. No diversity reverse path optical signal is received or excessive errors are detected.

Table 5-3. Linear Power Amplifier LED Indicators and Digital Display

INDICATOR	COLOR	DESCRIPTION
FAIL	Off Yellow	Indicates if the LPA is normal or faulty. The LPA is normal. Internal fault detected in the LPA.
SHUTDOWN	Off Red	Indicates if the LPA has an RF output or if the RF output is shutdown. The LPA RF output is on. The LPA RF output is shutdown.
DISPLAY MESSAGE		DESCRIPTION
ADC850 0 ALARMS NORMAL OPERATION		The LPA is normal.
HUNG CHANG ADC-850M		Appears every time power is turned on.
RESTART AT STAND ALONE MODE		Appears when LPA is reset.
ADC-850S		Appears when an alarm has turned off and the LPA is restarting after the RESET button has been pressed or the reset command has been supplied from an external source.
PLEASE WAIT WHILE RESTARTING		Appears while the LPA processor is rebooting.
DC +12V: +12.0V DC +27V: +27.0V DC +32V: +32.0V DC -12V: -12.0V		Alternately displays the voltage flow in each part of the LPA.
TEMPER 100.0 °C		Indicates the current temperature of the LPA heat sink.
OVER POWER ALARM		Output power has exceeded 100 W.
HIGH TEMPERATURE		Alarm: Temperature of LPA exceeds 85 °C.
VSWR ALARM		Reflected LPA power exceeds 20 W.
LOOP FAIL		General fault occurred in the LPA loops.
FANFAIL		One or more fans have failed.
FORCED SHUTDOWN		The RF ON/OFF switch is in the OFF position or the LPA was set in the disable mode through the EMS computer.
Alternating FORCED SHUTDOWN and alarm message		An alarm has remained for over 5 seconds.
DC FAIL +12V -12V +32V		Voltage is outside the preset ranges: +11 to +13V -13 to -11V +30 to +34V

3 FAULT ISOLATION AND TROUBLESHOOTING

Alarm information may be accessed and faults isolated using the information provided by the unit front panel LED indicators, the EMS software MI alarm displays, or the NOC-EMS interface. Because the alarm information provided by the EMS software MI and the NOC-EMS interface is very detailed, refer to [Table 5-4](#) or [Table 5-5](#) to determine the unit LED indicator (Host Unit or Remote Unit) that corresponds to the indicated alarm. Then refer to [Table 5-6](#) or [Table 5-7](#) to identify the problem, check out the possible causes, and take corrective action.

Table 5-4. Host Unit Major and Minor Alarms

MAJOR ALARM	LED INDICATOR	MAJOR ALARM	LED INDICATOR
Operating Mode	(Does not apply)	Fwd Synth Lock	HOST UNIT
3.8 Volt	HOST UNIT	Sec Rev Synth Lock	HOST UNIT
Pri Laser Fail	HOST UNIT	Overdrive	DRIVE
Pri Errors	PORT 1/PORT 2	MINOR ALARMS	LED INDICATOR
Pri Fwd Mux Lock	HOST UNIT	Underdrive	DRIVE
Pri Rev Synth Lock	HOST UNIT	Temperature	HOST UNIT
RF Mute	(Does not apply)	Sec Errors	PORT 3
8 Volt	HOST UNIT	Sec No Light	PORT 3
Pri No Light	PORT 1/PORT 2	Major Extern Output	(Does not apply)

Table 5-5. Remote Unit Major and Minor Alarms

MAJOR ALARM	LED INDICATOR	MAJOR ALARM	LED INDICATOR
Operating Mode	(Does not apply)	Pri Rev Synth Lock	STM
Converter	STM	RF Mute	(Does not apply)
Pri Laser Fail	STM	LPA Detect	PA
Pri Rev Mux Lock	STM	LPA Low Power	PA
Reference Synth Lock	STM	Major Extern Alarm Inp	(Does not apply)
System VSWR	VSWR	MINOR ALARM	LED INDICATOR
LPA DC Fail	PA	Sec Rev Synth Lock	STM
LPA Over Power	PA	Rev Path Level	(Does not apply)
AC Fail	AC POWER	Temperature	STM
3.8 Volt	STM	Sec Laser Fail	STM
Pri No Light	PORT 1/PORT 2	Sec Rev Mux Lock	STM
Fwd Synth Lock	STM	LPA Disable	SHUTDOWN (LPA)
LPA Loop Failed	PA	LPA Fan	PA
LPA VSWR	PA	LPA High Temp	PA
Battery Voltage	STM	Minor Extern Alarm Inp	(Does not apply)
8 Volt	STM	RF Out Very Low	(Does not apply)
Pri Errors	PORT 1/PORT 2	—	—

During normal HU operation, all LED's should be **green** except the STANDBY LED which should be **Off**. When a **Minor** alarm occurs, one or more of the LED's will turn **yellow**. When a **Major** alarm occurs, one or more of the LED's will turn **red**.

Table 5-6. Host Unit Fault Isolation and Troubleshooting

Alarm Type	LED	Color
Minor	HOST UNIT	Yellow
PROBLEM: The HU is overheating.		
POSSIBLE CAUSE		CORRECTIVE ACTION/COMMENTS
1. Air intake or exhaust opening to HU chassis is blocked		1. Remove cause of air-flow blockage.
2. Ambient temperature > 50° C/122° F.		2. Reduce ambient temperature.
3. Faulty fan.		3. Replace HU fan (See Section 5.3).
Alarm Type	LED	Color
Minor	REMOTE UNIT	Yellow
PROBLEM: A minor alarm is detected at the RU.		
POSSIBLE CAUSE		CORRECTIVE ACTION/COMMENTS
1. The STM or LPA is overheating.		1. Check RU for alarms and refer to Table 5-7
Alarm Type	LED	Color
Minor	DRIVE	Yellow
PROBLEM: The RF input signal level is below the underdrive threshold.		
POSSIBLE CAUSE		CORRECTIVE ACTION/COMMENTS
1. Faulty coaxial connection between the HU and the EBTS.		1. Check forward path signal level at the HU.
2. Incorrect attenuation in forward path RF coaxial link.		2. Check Host Forward Attenuator setting and adjust if attenuation is too high.
Alarm Type	LED	Color
Major	HOST UNIT	Red
PROBLEM: Internal fault detected in HU.		
POSSIBLE CAUSE		CORRECTIVE ACTION/COMMENTS
1. The HU has failed.		1. Replace the HU.
Alarm Type	LED	Color
Major	REMOTE UNIT	Red
PROBLEM: A major alarm is detected at the RU.		
POSSIBLE CAUSE		CORRECTIVE ACTION/COMMENTS
1. The STM or LPA has failed, the STM is not receiving a forward path optical signal, or the RU cabinet door is open.		1. Check RU for alarms and refer to Table 5-7 .

Table 5-6. Host Unit Fault Isolation and Troubleshooting, continued

Alarm Type	LED	Color
Major	DRIVE	Red
PROBLEM: The RF signal is above the overdrive threshold.		
POSSIBLE CAUSE		CORRECTIVE ACTION/COMMENTS
1. Incorrect attenuation in forward path RF coaxial link.		1. Check Forward Attenuator setting and adjust if attenuation is too low.
Alarm Type	LED	Color
Major	PORT 1/PORT 2	Red
PROBLEM: No reverse path optical signal is received or excessive errors are detected.		
POSSIBLE CAUSE		CORRECTIVE ACTION/COMMENTS
1. Faulty reverse path optical link.		1. Test optical fiber. Clean connector if dirty. Repair or replace optical fiber if faulty. (See Section 4.1).
2. Faulty optical transmit port at the HU or faulty optical receive port at the STM.		2. Test optical ports. Replace HU or STM if port is faulty (See Section 4.2).
Alarm Type	LED	Color
Minor	PORT 3	Yellow
PROBLEM: No diversity reverse path optical signal is received or excessive errors are detected.		
POSSIBLE CAUSE		CORRECTIVE ACTION/COMMENTS
1. Faulty diversity reverse path optical link.		1. Test optical fiber. Clean connector if dirty. Repair or replace optical fiber if faulty. (See Section 4.1).
2. Faulty optical transmit port at the HU or faulty optical receive port at the STM.		2. Test optical ports. Replace HU or STM if port is faulty (See Section 4.2).

During normal STM operation, all LED's should be green except the STANDBY LED which should be **Off**. When a **Minor** alarm occurs, one or more of the LED's will turn **yellow**. When a **Major** alarm occurs, one or more of the LED's will turn **red**.

During normal LPA operation, all LED's should be **Off**.

Table 5-7. STM and LPA Fault Isolation and Troubleshooting

Alarm Type	LED	Color
Minor	STM	Yellow
PROBLEM: The STM is overheating.		
POSSIBLE CAUSE		CORRECTIVE ACTION/COMMENTS
1. Air intake or exhaust opening to the remote unit cabinet is blocked		1. Remove cause of air-flow blockage.
2. Ambient temperature > 50° C/122° F.		2. Reduce ambient temperature.
3. Faulty fan.		3. Replace STM fan (See Section 5.4).

Table 5-7. STM and LPA Fault Isolation and Troubleshooting, continued

Alarm Type	LED	Color
Minor	HOST UNIT	Yellow
Problem: A minor alarm is detected at the HU.		
POSSIBLE CAUSE		CORRECTIVE ACTION/COMMENTS
1. The HU is overheating.		1. Check HU for alarms and refer to Table 5-6
Alarm Type	LED	Color
Minor	PA	Yellow
PROBLEM: The LPA is overheating.		
POSSIBLE CAUSE		CORRECTIVE ACTION/COMMENTS
1. Air intake or exhaust opening to the remote unit cabinet is blocked		1. Remove cause of air-flow blockage.
2. Ambient temperature > 50° C/122° F.		2. Reduce ambient temperature.
3. Faulty fan.		3. Replace LPA fan (See Section 5.5).
Alarm Type	LED	Color
Major	AC POWER	Red
PROBLEM: The RU is powered by the back-up battery system		
POSSIBLE CAUSE		CORRECTIVE ACTION/COMMENTS
1. The AC power system circuit breaker is open or the AC power has failed.		1. Check the AC power system, repair as needed, and reset circuit breaker.
Alarm Type	LED	Color
Major	HOST UNIT	Red
PROBLEM: A major alarm is detected at the HU.		
POSSIBLE CAUSE		CORRECTIVE ACTION/COMMENTS
1. The HU has failed.		1. Check HU for alarms and refer to Table 5-6 .
Alarm Type	LED	Color
Major	STM	Red
PROBLEM: Internal fault detected in STM.		
POSSIBLE CAUSE		CORRECTIVE ACTION/COMMENTS
1. The STM has failed.		1. Replace the STM.
Alarm Type	LED	Color
Major	PA	Red
PROBLEM: Internal fault detected in LPA.		
POSSIBLE CAUSE		CORRECTIVE ACTION/COMMENTS
1. The LPA has failed.		1. Replace the LPA.

Table 5-7. STM and LPA Fault Isolation and Troubleshooting, continued

Alarm Type	LED	Color
Major	VSWR	Red
PROBLEM: The forward path VSWR is above the threshold.		
POSSIBLE CAUSE	CORRECTIVE ACTION/COMMENTS	
1. Faulty antenna.	1. Check the antenna circuit for shorts or opens (including lightning protector).	
Alarm Type	LED	Color
Major	PORT 1/PORT 2	Red
PROBLEM: No forward path optical signal is received or excessive errors are detected.		
POSSIBLE CAUSE	CORRECTIVE ACTION/COMMENTS	
1. Faulty forward path optical link.	1. Test optical fiber. Clean connector if dirty. Repair or replace optical fiber if faulty. (See Section 4.1).	
2. Faulty optical transmit port at the STM or faulty optical receive port at the HU.	2. Test optical ports. Replace HU or STM if port is faulty (See Section 4.2).	
Alarm Type	LED	Color
Minor	PORT 3	Yellow
PROBLEM: No diversity reverse path optical signal is received by the HU or excessive errors are detected.		
POSSIBLE CAUSE	CORRECTIVE ACTION/COMMENTS	
1. Faulty diversity reverse path optical link.	1. Test optical fiber. Clean connector if dirty. Repair or replace optical fiber if faulty. (See Section 4.1).	
2. Faulty optical transmit port at the STM or faulty optical receive port at the HU.	2. Test optical ports. Replace HU or STM if port is faulty (See Section 4.2).	
Alarm Type	LED	Color
Major	FAIL	Yellow
PROBLEM: Internal fault detected in the LPA.		
POSSIBLE CAUSE	CORRECTIVE ACTION/COMMENTS	
1. The LPA has failed.	1. Replace LPA	
Alarm Type	LED	Color
Major	SHUTDOWN	Red
PROBLEM: The RF output from the LPA is shutdown.		
POSSIBLE CAUSE	CORRECTIVE ACTION/COMMENTS	
1. The RF ON/OFF switch is in the OFF position or the LPA was set in the disable mode through the EMS computer.	1. Place RF ON/OFF switch in the ON position or enable the LPA.	
2. Breaker switch on LPA is open	2. Reset breaker switch.	
3. The LPA is faulty.	3. Replace LPA.	

4 TEST PROCEDURES

This section provides procedures for common troubleshooting and maintenance tests. Refer to these procedures as needed when specified in the Fault Isolation and Troubleshooting tables in [Section 3](#).

4.1 Optical Power Test

A break in an optical fiber or a fault with the optical connector will interrupt communications between linked components or generate excessive errors. Use the following procedure to isolate a problem with an optical fiber or connector.



Danger: *This equipment uses a Class 1 Laser according to FDA/CDRH rules. Laser radiation can seriously damage the retina of the eye. Do not look into the ends of any optical fiber. Do not look directly into the optical transmitter of any unit or exposure to laser radiation may result. An optical power meter should be used to verify active fibers. A protective cap or hood **MUST** be immediately placed over any radiating transmitter or optical fiber connector to avoid the potential of dangerous amounts of radiation exposure. This practice also prevents dirt particles from entering the connector.*

1. Put on the IR filtering safety glasses.
2. Notify the NOC or alarm monitoring system operator that the system is going offline.
3. At the HU and at the STM, place the On/Off switch in the **OFF** position (press **0**).
4. Disconnect the optical fiber connectors for the fiber to be tested at the HU and at the STM.
5. Inspect the optical connectors. Verify that each connector is clean and that no scratches or imperfections are visible on the fiber end. Clean and polish the optical connector if necessary.
6. Connect a laser light source to one end of the optical fiber and an optical power meter to the other end.
7. Verify that the power loss is within specifications. The optical loss budget for 9/125, single-mode, dark fiber is **17 dB** (typical). The optical power level should not exceed **-7 dBm** to avoid overdriving the optical receiver. If the power loss is not within specifications, repair or replace the optical fiber and/or connector per local practice.
8. Repeat steps 3 through 6 for each optical fiber that requires testing.
9. Reconnect the optical fibers at the HU and the STM.
10. When ready to put the system back into service, place the On/Off switch in the **ON** position (press **1**) at both the HU and STM.
11. Notify the NOC or alarm monitoring service that the system is going back online.

4.2 Optical Loopback Test

A faulty optical port, a break in an optical fiber, or a fault in an optical connector will interrupt communications between fiber linked components. The following procedures provide tests to determine if a fault exists with the primary optical ports (PORT 1/PORT 2) or with the secondary optical port (PORT 3).



Danger: *This equipment uses a Class 1 Laser according to FDA/CDRH rules. Laser radiation can seriously damage the retina of the eye. Do not look into the ends of any optical fiber. Do not look directly into the optical transmitter of any unit or exposure to laser radiation may result. An optical power meter should be used to verify active fibers. A protective cap or hood **MUST** be immediately placed over any radiating transmitter or optical fiber connector to avoid the potential of dangerous amounts of radiation exposure. This practice also prevents dirt particles from entering the connector.*

4.2.1 PORT 1/PORT 2 Loopback Test

1. Put on the IR filtering safety glasses.
2. Notify the NOC or alarm monitoring system operator that the system is going offline.
3. At the HU or STM (whichever unit is being tested), place the On/Off switch in the **OFF** position (press **0**).
4. Disconnect the optical fiber connectors from the PORT 1 and PORT 2 optical ports and place a dust cap over each connector.
5. Plug a 10 dB in-line optical attenuator into the PORT 1 optical port.
6. Connect a patch cord between the optical attenuator and the PORT 2 optical port.
7. Place the On/Off switch in the **ON** position (press **1**) and observe the PORT 1/PORT 2 LED indicator.
8. The PORT 1/PORT 2 LED indicator will turn either red or green. If the LED turns red, the primary optical transmitter or receiver is faulty. Replace the unit and then recheck system operation. If the LED turns green, the optical ports are good.
9. Place the On/Off switch in the **OFF** position (press **0**).
10. Remove the optical attenuator from the PORT 1 optical port.
11. Remove the dust caps from the optical fiber connectors.
12. Clean each connector (follow connector supplier's recommendations) and then insert each connector into the appropriate optical port.
13. When ready to put the unit back into service, place the On/Off switch in the **ON** position (press **1**).
14. Notify the NOC or alarm monitoring service that the system is going back online.

4.2.2 PORT 3 Loopback Test

1. Put on the IR filtering safety glasses.
2. Notify the NOC or alarm monitoring system operator that the system is going offline.
3. At the HU or STM (whichever unit is being tested), place the On/Off switch in the **OFF** position (press **0**).
4. Disconnect the optical fiber connectors from the **PORT 1** and **PORT 3** optical ports and place a dust cap over each connector.
5. Plug a 10 dB in-line optical attenuator into the **PORT 3** optical port.
6. Connect a patch cord between the optical attenuator and the **PORT 1** optical port.
7. Place the On/Off switch in the **ON** position (press **1**) and observe the PORT 3 LED indicator.
8. The PORT 3 LED indicator will turn either red or green. If the LED turns yellow, the secondary optical transmitter or receiver is faulty. Replace the unit and then recheck system operation. If the LED turns green, the optical ports are good.
9. Place the On/Off switch in the **OFF** position (press **0**).
10. Remove the optical attenuator from the PORT 3 optical port.
11. Remove the dust caps from the optical fiber connectors.
12. Clean each connector (follow connector supplier's recommendations) and then insert each connector into the appropriate optical port.
13. When ready to put the unit back into service, place the On/Off switch in the **ON** position (press **1**).
14. Notify the NOC or alarm monitoring service that the system is going back online.

5 MAINTENANCE PROCEDURES

This section specifies the system maintenance requirements and provides the procedures for the required maintenance tasks. Refer to these procedures as needed when specified in the Scheduled Maintenance table.

5.1 Scheduled Maintenance

[Table 5-8](#) lists the items that require regular maintenance and the recommended maintenance interval. Refer to the section specified in the table for the required maintenance or test procedure.

Table 5-8. Scheduled Maintenance

INTERVAL	ITEM	REQUIREMENT
1 month	Battery*	Check float voltage. Check system ambient temperature. Check system float current.
6 months	Battery*	Perform 1 month scheduled maintenance tasks. Check individual battery terminal temperature. Check individual battery float voltages.
12 months	Battery *	Perform 1 and 6 month scheduled maintenance tasks Complete detailed physical inspection. Re-torque terminal connections. Perform general system maintenance. Perform cabinet maintenance.
	RU cabinet filter**	Remove and clean the RU cabinet filter. Refer to Section 5.2 for the required procedure.
24 months	Battery*	Perform 1, 6, and 24 month scheduled maintenance tasks. Test battery system for rated capacity.
60 months	HU Fans STM Fan LPA Fans	Remove and replace the cooling fans in the HU, STM, and LPA. Refer to specified section for the required procedures: HU see Section 5.3 , Section 5.4 , and LPA see Section 5.5 .
* Refer to the PRC-SERIES OPERATING AND FIELD SERVICE MANUAL (provided with the back-up battery system) for the specified battery maintenance procedures. **Though it is not recommended that the RU be installed in a salt-air environment, if done so, clean the cabinet filter on a monthly basis instead of on a 12 month basis. In addition, the RU should be inspected for corrosion due to salt, particularly near the fans and around the connectors. The MTBF of the RU may be impacted if the RU is exposed to salt-air.		

5.2 Remote Unit Cabinet Filter Cleaning Procedure

The RU cabinet filter cleans the RU intake air before it enters the cabinet. The filter should be cleaned approximately once per year and more often in extremely dirty environments. If the cabinet temperature gradually rises over a long period of time and there are no fan failures, it is possible that the filter is dirty and requires cleaning. Use the following procedure to clean the RU cabinet filter:

1. Open the RU cabinet door as shown in [Figure 5-1](#).
2. Loosen the hex nuts that secure the left and right filter brackets to the cabinet door.
3. Pull the filter upward and away from the cabinet door. Be careful not to damage the gasket that provides the air seal.
4. Gently tap the filter against your hand to dislodge the dirt. If necessary, use compressed air or a vacuum cleaner to remove the dirt.
5. Re-install the filter in the door and tighten the hex nuts that secure the left and right brackets to the door.

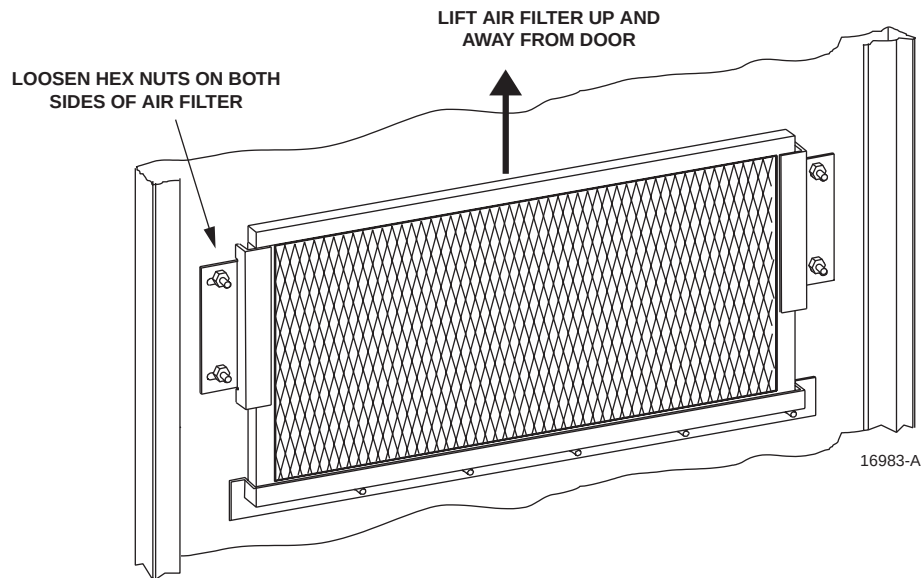


Figure 5-1. Air Filter Removal and Replacement

5.3 Host Unit Fan Replacement Procedure

The HU is equipped with two cooling fans which are located on the right side of the HU enclosure. The cooling fans blow cool air into the enclosure. Heated air is exhausted through the vent openings on the left side of the enclosure. Replacement of the fans requires that the HU be turned off for a short period of time. Use the following procedure to remove and replace the HU cooling fans:

1. Before working on the HU or handling a fan, slip on an Electro-Static Discharge (ESD) wrist strap and connect the ground wire to an earth ground source. Wear the ESD wrist strap while completing each section of the fan installation procedure.



Warning: *Electronic components can be damaged by static electrical discharge. To prevent ESD damage, always wear an ESD wrist strap when working on the HU, STM, or LPA and when handling electronic components.*

2. Notify the NOC or alarm monitoring system operator that the system is going offline.
3. Place the **HU** On/Off switch in the **OFF** position (press **0**).
4. Remove the six flat-head screws (requires TORX screwdriver with T10 bit) that secure the fan/grill assembly to the right side of the HU enclosure as shown in [Figure 5-2](#). Save screws for reuse.

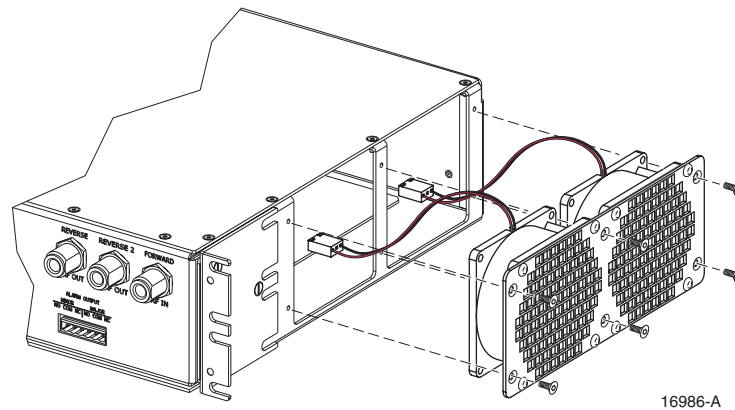


Figure 5-2. Host Unit Fan/Grill Assembly Removal

5. Carefully withdraw the fan/grill assembly from the enclosure until the wiring harness is exposed and the connectors are accessible.
6. Lift the small latch on each wiring harness connector and carefully unplug each connector from the circuit board connector.
7. Remove the plastic rivets that secure each fan to the grill by pushing outward on the rivet center post until the rivet can be withdrawn from the grill as shown in [Figure 5-3](#).

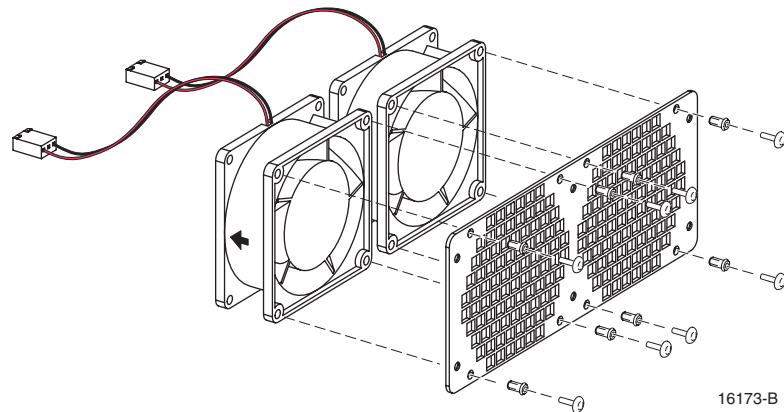


Figure 5-3. Removing Host Unit Fans From Grill

8. Remove both fans from the grill
9. Use the rivets removed in step 7 to secure the replacement fans to the grill. Orient each fan so the wiring harness is on the top and the arrow on the fan points **into** the enclosure.
10. Connect the two wiring harness connectors to the circuit board connectors.
11. Secure the fan/grill assembly to the side of the enclosure (see [Figure 5-2](#)) using the six flat-head screws removed in step 4.

12. Place the HU On/Off switch in the **ON** position (press **I**).
13. Verify that the fans run properly following power-up.
14. Notify the NOC or alarm monitoring system operator that the system is going back online.

5.4 Spectrum Transport Module Fan Replacement Procedure

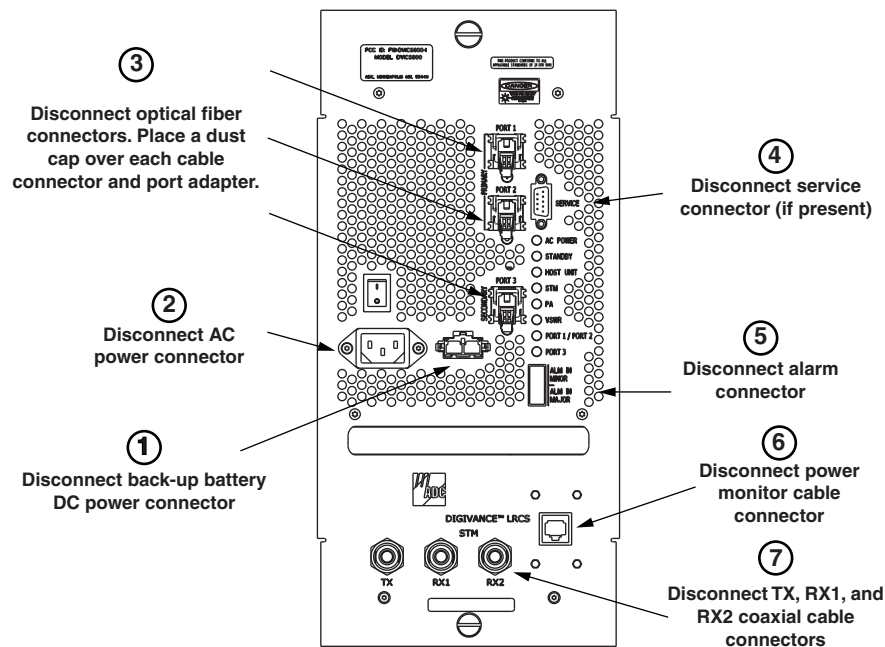
The STM is equipped with a rear cooling fan that exhausts heated air from the STM enclosure. Cool air enters the STM through vent openings on the side of the enclosure. Replacement of the fan requires that the STM be turned off for a short period of time and that the STM be removed from the cabinet. Use the following procedure to remove and replace the STM cooling fan.

1. Before working on the STM or handling a fan, slip on an Electro-Static Discharge (ESD) wrist strap and connect the ground wire to an earth ground source. Wear the ESD wrist strap while completing each section of the fan installation procedure.



Warning: Electronic components can be damaged by static electrical discharge. To prevent ESD damage, always wear an ESD wrist strap when working on the HU, STM, or LPA and when handling electronic components.

2. Notify the NOC or alarm monitoring system operator that the system is going offline.
3. Place the **STM** On/Off switch in the **OFF** position (press **0**).
4. Disconnect the various power, fiber optic, service, alarm wiring, and coaxial cable connectors from the STM front panel as specified in [Figure 5-4](#).



17617-A

Figure 5-4. Spectrum Transport Module Cable Connections

5. Loosen the captive screws that secure the STM to the RU cabinet mounting shelf and carefully withdraw the STM from the cabinet.
6. Remove the four pan-head screws (requires TORX screwdriver with T10 bit) that secure the fan/grill assembly to rear side of the STM enclosure as shown in [Figure 5-5](#). Save screws for reuse.

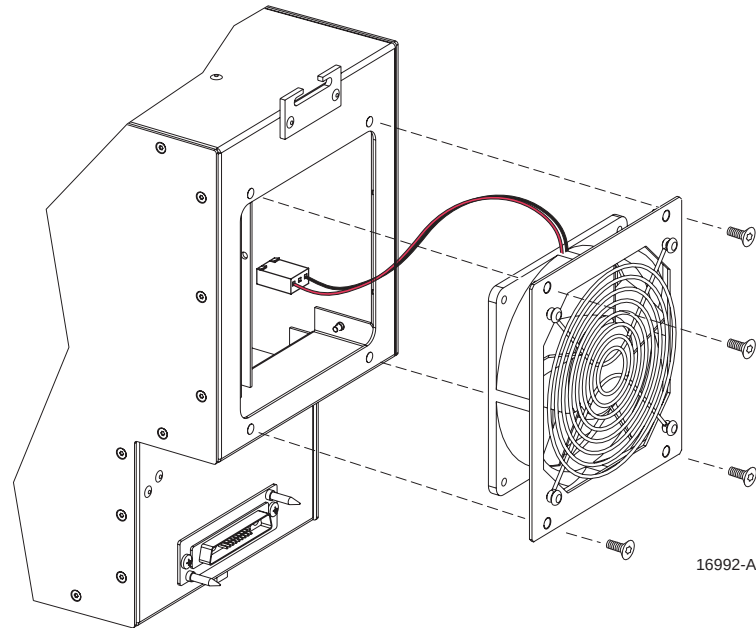


Figure 5-5. STM Fan/Grill Assembly Removal

7. Carefully withdraw the fan/grill assembly from the enclosure until the wiring harness is exposed and the connector is accessible.
8. Lift the small latch on the wiring harness connector and carefully unplug the connector from the circuit board connector.
9. Remove the plastic rivets that secure the fan to the mounting plate and grill by pushing outward on the rivet center post until the rivet can be withdrawn as shown in [Figure 5-6](#).
10. Separate fan from the mounting plate and grill
11. Use the rivets removed in step 9 to secure the replacement fan to the mounting plate and grill. Orient the fan so the wiring harness is on the top and the arrow on the fan points **away** from the enclosure. Make certain the rubber grommets are left in place on the mounting plate.
12. Connect the wiring harness connector to the circuit board connector.
13. Secure the fan/grill assembly to the back of the enclosure (see [Figure 5-5](#)) using the four pan-head screws removed in step 6. Do not overtighten the screws. The screw threads can be easily stripped if too much torque is used to tighten the screws.

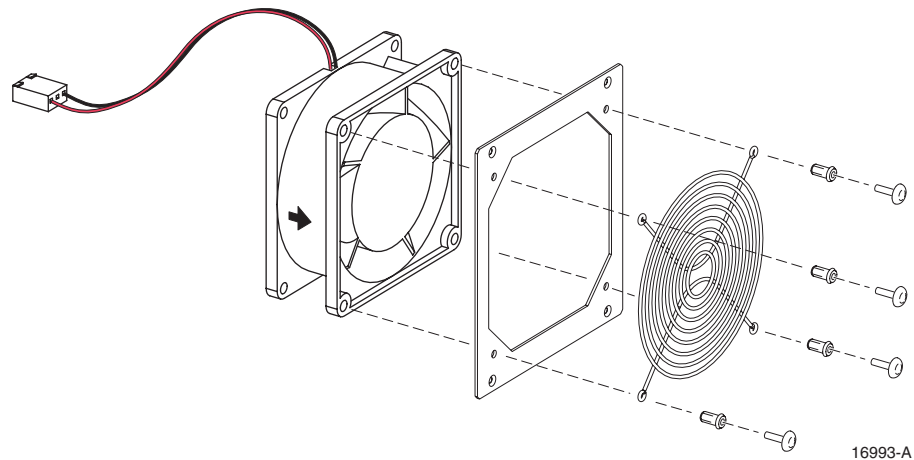


Figure 5-6. Removing STM Fan From Mounting Plate and Grill

14. Re-install the STM in the cabinet and then re-connect all cables in the reverse order in which they were disconnected (see [Figure 5-4](#)).
15. Place the STM On/Off switch in the **ON** position (press **I**).
16. Verify that the fan runs properly following power-up.
17. Notify the NOC or alarm monitoring system operator that the system is going back online.

5.5 Linear Power Amplifier Fan Replacement Procedure

The LPA is equipped with both a front and rear cooling fan. The front fan draws cool air into the LPA enclosure and the rear fan exhausts heated air from the LPA enclosure. Replacement of the fans requires that the STM be turned off for a short period of time and that the LPA be removed from the cabinet. Use the following procedure to remove and replace the LPA cooling fans.

1. Before working on the LPA or handling a fan, slip on an Electro-Static Discharge (ESD) wrist strap and connect the ground wire to an earth ground source. Wear the ESD wrist strap while completing each section of the fan installation procedure.



Warning: *Electronic components can be damaged by static electrical discharge. To prevent ESD damage, always wear an ESD wrist strap when working on the HU, STM, or LPA and when handling electronic components.*

2. Notify the NOC or alarm monitoring system operator that the system is going offline.
3. Place the **STM** On/Off switch in the **OFF** position (press **O**).
4. Loosen the captive screws that secure the LPA to the RU cabinet mounting shelf and carefully withdraw the LPA from the cabinet.
5. Pull out the four retainers that secure the front fan to the LPA as shown in [Figure 5-7](#) and same for reuse.

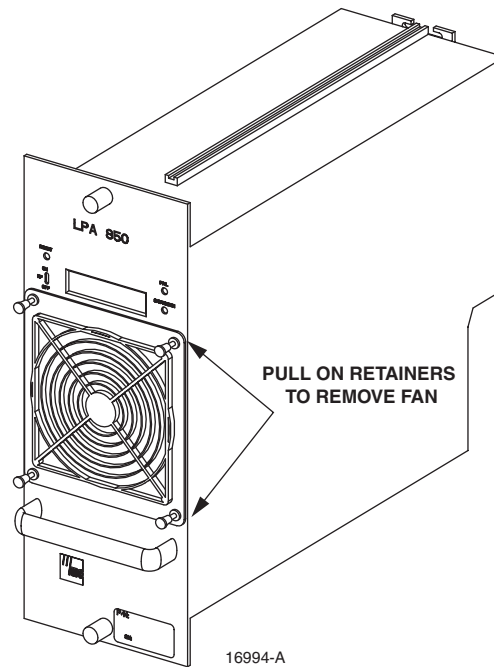


Figure 5-7. LPA Fan Removal and Replacement

6. Carefully withdraw the fan assembly from the LPA until the wiring harness is exposed and the RJ-45 wiring harness connector is accessible.
7. Disconnect the fan wiring harness connector from the LPA and lift the fan assembly away from the LPA.
8. Place a small amount of anti-corrosion gel on the connector of the replacement fan assembly.
9. Orient the fan assembly so the air-flow arrow points **into** the LPA.
10. Connect the fan assembly wiring harness connector to the LPA internal connector.
11. Secure the fan assembly to the LPA using the four retainers removed in step 5.
12. Replace the rear fan assembly using the same procedure covered in steps 5 through 11 **except** orient the rear fan so the air-flow arrow is pointing **away** from the LPA.
13. When both fan assemblies have been replaced, re-install the LPA in the cabinet.
14. Place the STM On/Off switch in the **ON** position (press **I**) and verify that both fans operate properly. The front fan should draw air into the LPA and the rear fan should blow air out of the LPA.
15. Notify the NOC or alarm monitoring system operator that the system is going back online.

SECTION 6: GENERAL INFORMATION

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1 WARRANTY/SOFTWARE

The Product and Software warranty policy and warranty period for all ADC Products is published in ADC's Warranty/Software Handbook. Contact the Infrastructure Division (ID) Technical Assistance Center at 1-800-366-3891, extension 73475 (in U.S.A. or Canada) or 952-917-3475 (outside U.S.A. and Canada) for warranty or software information or for a copy of the Warranty/Software Handbook.

2 SOFTWARE SERVICE AGREEMENT

ADC software service agreements for some ADC Products are available at a nominal fee. Contact the ID Technical Assistance Center at 1-800-366-3891, extension 73475 (in U.S.A. or Canada) or 952-917-3475 (outside U.S.A. and Canada) for software service agreement information.

3 REPAIR/EXCHANGE POLICY

All repairs of ADC Products must be done by ADC or an authorized representative. Any attempt to repair or modify ADC Products without written authorization from ADC voids the warranty.

If a malfunction cannot be resolved by the normal troubleshooting procedures, call the ID Technical Assistance Center at 1-800-366-3891, extension 73475 (in U.S.A. or Canada) or 952-917-3475 (outside U.S.A. and Canada). A telephone consultation can sometimes resolve a problem without the need to repair or replace the ADC Product.

If, during a telephone consultation, ADC determines the ADC Product needs repair, ADC will authorize the return of the affected Product for repair and provide a Return Material Authorization number and complete return shipping instructions. If time is critical, ADC can arrange to ship the replacement Product immediately. In all cases, the defective Product must be carefully packaged and returned to ADC.

4 REPAIR CHARGES

If the defect and the necessary repairs are covered by the warranty, and the applicable warranty period has not expired, the Buyer's only payment obligation is to pay the shipping cost to return the defective Product. ADC will repair or replace the Product at no charge and pay the return shipping charges.

Otherwise, ADC will charge a percentage of the current Customer Product price for the repair or NTF (No Trouble Found). If an advance replacement is requested, the full price of a new unit will be charged initially. Upon receipt of the defective Product, ADC will credit Buyer with 20 percent of full price charged for any Product to be Out-of-Warranty. Products must be returned within thirty (30) days to be eligible for any advance replacement credit. If repairs necessitate a visit by an ADC representative, ADC will charge the current price of a field visit plus round trip transportation charges from Minneapolis to the Buyer's site.

5 REPLACEMENT/SPARE PRODUCTS

Replacement parts, including, but not limited to, button caps and lenses, lamps, fuses, and patch cords, are available from ADC on a special order basis. Contact the ID Technical Assistance Center at 1-800-366-3891, extension 73475 (in U.S.A. or Canada) or 952-917-3475 (outside U.S.A. and Canada) for additional information.

Spare Products and accessories can be purchased from ADC. Contact Sales Administration at 1-800-366-3891, extension 73000 (in U.S.A. or Canada) or 1-952-938-8080 (outside U.S.A. and Canada) for a price quote and to place your order.

6 RETURNED MATERIAL

Contact the ADC Product Return Department at 1-800-366-3891, extension 73748 (in U.S.A. or Canada) or 952-946-3748 (outside U.S.A. and Canada) to obtain a Return Material Authorization number prior to returning an ADC Product.

All returned Products must have a Return Material Authorization (RMA) number clearly marked on the outside of the package. The Return Material Authorization number is valid for 90 days from authorization.

7 CUSTOMER INFORMATION AND ASSISTANCE

PHONE:

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Sales Administration: +32-2-712-65 00

Technical Assistance: +32-2-712-65 42

U.S.A. OR CANADA

Sales: 1-800-366-3891 Extension 73000

Technical Assistance: 1-800-366-3891 Extension 73475

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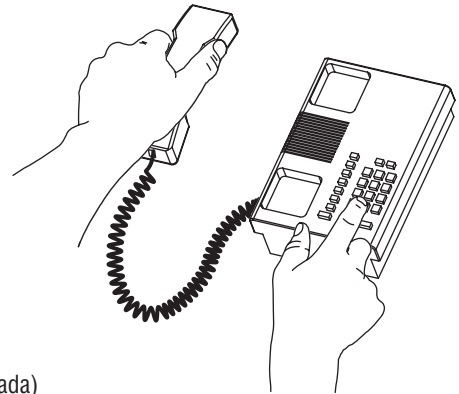
Sales Administration: +1-952-938-8080

Technical Assistance: +1-952-917-3475

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800.366.3891 (press star and choose option 4) (US & Canada)

+1-952.917.3000 Ask for Systems Integration (Direct Dial)



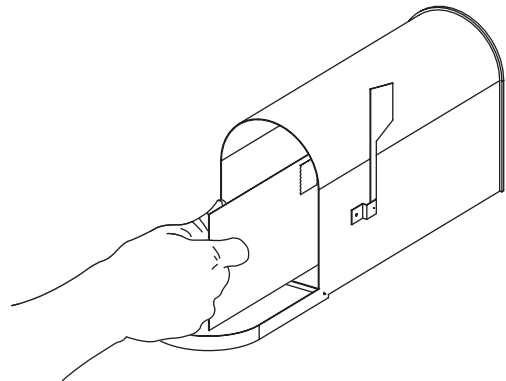
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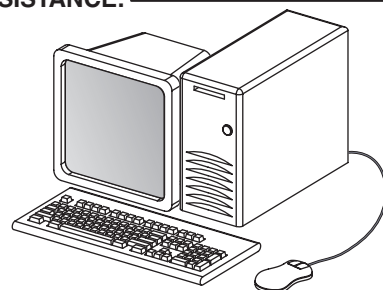
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1930 ZAVENTEM, BRUSSELS, BELGIUM



PRODUCT INFORMATION AND TECHNICAL ASSISTANCE:

WWW.ADC.COM

technical@adc.com



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