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Appendix D: Firmware Upgrades

The most recent version of firmware may be made available by contacting CommScope.

MICROCONTROLLER FIRMWARE UPGRADE

To download a new firmware from a computer to the AP microcontroller, it is necessary to have a TFTP client capable of sending a binary file. The parameters to send the firmware are:

Target filename: **APP**

Transfer mode: **binary (octet)**

Target port: **70**

Block size: **512**

Note: The file to be downloaded must be the .bin (binary) image, not the hex version! File size should be 69,376 bytes.

ETHERNET CONTROLLER FIRMWARE UPGRADE

To download a new firmware from a computer to the AP Ethernet interface controller, it is necessary to have a TFTP client capable of sending a binary file. The parameters to send the firmware are:

Target filename: **X1**

Transfer mode: **binary (octet)**

Target port: **69**

Block size: **512**

Note: The file to be downloaded must be the .ROM (binary) image, not the hex version! File size should be 32768 or 65536 bytes.

C.5 Private IP networks and the Internet

If your network is not connected to the Internet and there are no plans to make such a connection, you may use any IP address you wish. However, if you are not connected to the Internet and have plans to connect to the Internet, or you are connected to the Internet and want to operate your SNMP interface on an Intranet, you should use one of the following sub-networks for your network:

- Class A 10.x.x.x
- Class B 172.16.x.x
- Class C 192.168.0.x

These network numbers have been reserved for such networks. If you have any questions about IP address assignment ask your Network Administrator.

Appendix C: IP Addresses, Netmask, Etc.

C.1 IP Addressing

An IP address is a 32-bit value, divided into four octets of eight bits each. The standard representation is four decimal numbers (in the range of 0...255), divided by dots. Example: 192.2.1.123. This is called decimal-dot notation. The IP address is divided into two parts: a network and a host part. To support different needs, three “network classes” have been defined. Depending on the network class, the last one, two or three bytes define the host, while the remaining part defines the network. In the following text, ‘x’ stands for the host part of the IP address:

Class A network

IP address 1.x.x.x to 127.x.x.x

Only 127 different networks of this class exist. These have a very large number of potential connected devices (up to 16777216).

Example: 10.0.0.1, (network 10, host 0.0.1)

Class B network

IP address 128.0.x.x to 191.255.x.x

These networks are used for large company networks. Every network can consist of up to 65534 devices.

Example: 172.1.3.2 (network 172.1, host 3.2)

Class C network

IP address 192.0.0.x to 223.255.255.x

These network addresses are most common. Most smaller companies’ networks are class C networks. These networks can consist of a maximum number of 254 hosts.

Example: 192.7.1.9 (network 192.7.1, host 9)

Class D network

IP address 224.x.x.x to 239.x.x.x

These addresses are used as multicast addresses.

Example: 224.7.1.9 (network 224, host 7.1.9)

Class E network

IP address 240.x.x.x to 254.x.x.x

These addresses are reserved.

C.2 Network Address

An address with all host bits set to "0" is used to address the network as a whole (in routing entries, for example).

C.3 Broadcast Address

An address with the host part bits all set to "1" is the broadcast address, meaning “for every station.” Network and Broadcast addresses must not be used as a host address (e.g. 192.168.0.0 identifies the entire network, 192.168.0.255 identifies the broadcast address).

C.4 IP Netmask

The netmask is used to divide the IP address differently from the standard defined by the classes A, B, C. By entering a netmask, it is possible to define how many bits from the IP address are to be taken as the network part and how many bits are to be taken as the host part.

Standard IP Network Netmask: Class A 8 (network) 24 (host) 255.0.0.0 (mask)
 Class B 16 (network) 16 (host) 255.255.0.0 (mask)
 Class C 24 (network) 8 (host) 255.255.255.0 (mask)

Appendix B: Setting Auto Mute Threshold

The upstream mute threshold is limited by the SNR. At lower levels, the noise level becomes closer to the signal level. Therefore, as the threshold level is dropped, the muting will start to be activated by the noise. This happens closer to the signal level when the signal is lower.

The upstream noise level is proportional to the receive gain setting. With a high enough gain and a low enough mute threshold setting, the noise may be high enough to prevent the detection circuitry in the AP from muting. To ensure this does not happen, the threshold should be set no lower than 30 dB below the gain setting (i.e. Gain - 30 dB). So for gains of 36/46/56/66/76 dB, the threshold should be set no lower than 10/16/26/36/46 dBmV. This puts a lower limit on the threshold for a given gain setting.

The upper limit of the threshold is based on the upstream signal level. While a setting of 45 dBmV is guaranteed to work with an output level of 45 dBmV, the signal level may change due to CATV plant gain variations. Note that upstream gain variations of the RF link have little effect since the CMTS causes the CM to compensate for upstream gain changes. So it would be recommended to set the threshold at least 3 or 4 dB below the desired output.

For example, for a gain of 55 dB and an output level of 35 dBmV, the threshold should be set to between 25 (55 - 30) and 31 dBmV (35 - 4).

Appendix A: Specifications

AP5800 Specifications

DOWNSTREAM

Transmit RF frequency band	5799 to 5823 MHz
Transmit EIRP	+15 to +28 dBm rated maximum
IF input frequency range	91 to 857 MHz (channel center frequencies)
IF input level range	0 to +20 dBmV per channel
Downstream modulation	One 6 MHz 64QAM or 256QAM channel, typical
Downstream flatness	1 dB p-p over 5 MHz, typical

UPSTREAM

Receive RF frequency band	5727 to 5751 MHz
Noise figure (at RF connector)	6 dB max at max gain
Image rejection	90 dB minimum
IF output frequency band	18 to 42 MHz
Gain range	36 ± 2 dB to 76 ± 2 dB at mid band
IF level	17 to 50 dBmV
Gain flatness (frequency response)	±0.5 dB over 3.2 MHz, 2.5 dB p-p full band
Spectral inversion	No spectral inversion
Return loss (IF)	13 dB min: 5 to 42 MHz and 88 to 860 MHz

GENERAL

Upstream ingress mitigation	Automatic upstream IF mute Upstream gain control Upstream mute control via remote access Upstream power detector
IF connector	F female, 75 ohms, SCTE compliant
IF connector torque	20 in-lb
Power requirements	35 to 90 VAC, 60 Hz
Power consumption	27 W maximum
Management	Remote and local status monitoring and control SNMPv1.1 remote access RS232 command line local interface
Operating temperature range	-40 to +60 °C
Antenna	Integrated ("Normal" configuration), 60° horizontal and 30° vertical beamwidth
EMC compliance	FCC CFR 47, Part 15, Subparts A and B FCC Part 15, Subpart E, Section 15.401 FCC 47 CFR, Part 76, Subpart K (76.605)
Configurations	Strand mount, utility pole mount, pipe mount (options STRAND, POLE, PIPE)
Size	60.2 x 22.3 x 12.4 cm (23.7" x 8.8" x 4.9")
Weight	7.1 kg (15.6 lbs)

Specifications subject to change without notice.

5.6.4 Community Strings

The SNMP read and write communities are user definable strings. SNMP community strings are like a user ID or password that allows access to a device's statistics. An SNMP Manager sends the community string along with all SNMP requests. If the community string is correct, the device responds with the requested information. If the community string is incorrect, the device simply discards the request and does not respond. Refer to Section 4.6.6 for information on viewing and changing the SNMP community strings.

which you are working. Once there is at least one entry in the ARP table, use the commands shown above to ARP an IP address to the AP interface.

b) Open a Telnet connection to port number 1. This connection will fail, but the AP Ethernet interface will change its IP address to the IP address assigned to the MAC address used by the `arp -s` command. The following example opens a Telnet connection to IP address 10.10.10.11 port 1:

```
telnet 10.10.10.11 1
```

c) Open a Telnet connection to port 23 and set all required parameters. The following example opens a Telnet connection to IP address 10.10.10.11 port 23:

```
telnet 10.10.10.11
```

d) When the Telnet connection is established, navigate through the menus until the Ethernet Settings menu is reached (See Section 4.5 for navigating menus). Enter Ethernet IP address, netmask and gateway. Refer to Section 4.6.6 for further information on the Ethernet parameters available. The temporary IP address set in the above procedure is cleared after every power cycle of the AP Ethernet interface. Be sure to enter configuration data as described in Section 4.6.6 to make the change permanent! The AP Ethernet interface configuration is stored in nonvolatile memory and is retained without AC power. The configuration can be changed any time.

5.5 Telnet

The steps required to enable Telnet operation are as follows:

1. Configure the Network Interface as described in Section 5.4 above.
2. Login remotely using a shell, terminal, browser, or Telnet application window, refer to Section 4 for further information on using the command line interface via Telnet.

5.6 SNMP

5.6.1 Operation

The steps required to enable SNMP operation are as follows:

1. Configure the Network Interface as described in Section 5.4 above.
2. Configure SNMP settings using the command line interface (as described in Section 4.6.6) either locally or remotely via Telnet.

The steps required for configuring an SNMP Management Station to manage an SNMP enabled access point are as follows:

1. Load and compile the 2 supplied MIB files (supplied on disk) into the MIB database on the Management station. The supplied MIB files are described in Section 5.6.2.
2. Refer to the documentation that accompanied the Management station for information on Compiling Private MIB files, adding devices to manage, etc.

5.6.2 Supplied MIBs

There are 2 Private MIB files that are used by the SNMP agent. These files are provided on disk. These files must be compiled into the MIB used in the SNMP management station that will be managing the AP unit. The two files must be added in order. The file named `csGlobal.mib` must be added first followed by the file named `csAP5800.mib`. These MIB files have been tested with SNMPc V5.0 from Castlerock software, MG-SOFT MIB Browser Professional, and with HP OpenView from Hewlett Packard.

5.6.3 Configuration

SNMP can be enabled or disabled via the AP interface (locally or remotely), refer to section 4 for details.

5.0 Remote Access

5.1 Description

Remote access of the AP is available through Telnet and SNMPv1. TFTP is available for remote firmware upgrades.

5.2 Supported Network Protocols

The AP Ethernet interface uses several TCP/IP protocols for network communication. The supported standards are ARP, UDP, TCP, ICMP, Telnet, TFTP and SNMP. The electrical interface is fully compliant with IEEE 802.3 10-Base-T Ethernet and 100BASE-TX (auto-sensing).

5.3 Network Hardware Address

The hardware address of the AP Ethernet interface is printed on a label on the unit. This address is unique for each unit and consists of 6 two digit hexadecimal values. The hardware address can also be obtained via the interface (See Section 4.6.6). An example address is: 00:20:4A:52:3A:34

5.4 Assigning an IP Address

The unit's IP address must be configured before a network connection is available. You have the following options for assigning an IP to the unit:

- 1) Local Interface
- 2) DHCP
- 3) ARP and Telnet

LOCAL INTERFACE

The unit's Ethernet IP address, netmask, and gateway IP address can be assigned via the local interface, refer to section 4.6.6 for further information on configuring available Ethernet parameters.

DHCP

The unit ships with a default IP address of 0.0.0.0, which automatically enables DHCP. Provided a DHCP server exists on the network, it will provide the unit with an IP address, gateway address, and subnet mask when the unit boots up or the Ethernet interface is renewed (See Section 4.6.6 for enabling DHCP mode and renewing the Ethernet interface).

ARP AND TELNET

The following procedure sets a temporary IP address so that setup over the network can be done:

- a) Set a static ARP route with the desired IP address using the hardware address of the AP Ethernet interface, which is printed on a label on the module. In Windows, a static route can be set from the DOS prompt using the ARP command. The following example command sets a default route to the IP address 10.10.10.11 via hardware address 00-20-4A-52-3A-34:

```
arp -s 10.10.10.11 00-20-4A-52-3A-34
```

-The IP address 10.10.10.11 is used here as an example only. This address must be replaced by one that is valid for the target network in order for this procedure to function properly. The IP address assigned must be on the same subnet as the computer doing the initial configuration. A network administrator can supply the proper values for these parameters. Refer to Appendix C, IP Addresses, Netmask, etc. for more information on IP address selection.

-In order for the ARP command to work in Windows, the ARP table on the PC must have at least one IP address defined other than its own. Type "arp -a" at the DOS command prompt to verify that there is at least one entry in the ARP table. If there is no other entry besides the local machine, ping another IP machine on your network to build the table. This has to be a host other than the machine on

Enter the new IP address or press ENTER to use the current value.

Renew Ethernet Interface In order to activate any changes to the Ethernet settings, the interface needs to be restarted. To Renew the Ethernet Interface, type “4”. The prompt will change to:

```
Renew Ethernet Interface [Y/N](N)>_
```

Enter Yes to renew the Ethernet interface or enter No or press ENTER to abort.

SNMP Enable This setting allows the user to enable Simple Network Management Protocol. To change the SNMP Enable, type “5”. The prompt will change to:

```
SNMP Enable[0 disable, 1 enable](1)>_
```

Enter the new values or press ENTER to use the current value.

SNMP Manager IP Address This address is used to send SNMP traps. To change the SNMP Manager IP address, type “6”. The prompt will change to:

```
SNMP Manager IP Address [] (10.10.10.10)>_
```

Enter the new IP address or press ENTER to use the current value.

SNMP Read Community To change the SNMP read community string, type “7”. The prompt will change to:

```
SNMP Read Community [32 chars max] (public)>_
```

Enter the new community string or press ENTER to use the current value.

SNMP Write Community To change the SNMP write community string, type “8”. The prompt will change to:

```
SNMP Write Community [32 chars max] (private)>_
```

Enter the new community string or press ENTER to use the current value.

gain cannot be set by the user.

4.6.6 Ethernet Settings

The Ethernet Settings Menu provides access to the Ethernet settings and options. To access this menu from the Main Menu, type "6" to display the Ethernet Settings Menu. Note: These settings would normally come from your Network Administrator or IT Department.

Figure 4.10: Ethernet Settings Menu

```
*** AirBridge AP Ethernet Settings ***
```

```
MAC Address          00:20:4A:52:3A:34
1) IP Address        10.10.10.11
2) Netmask           255.255.255.0
3) Gateway IP Address 10.10.10.10
4) Renew Ethernet Interface
5) SNMP Enable       Enabled
6) SNMP Manager IP Address 10.10.10.10
7) SNMP Read Community public
8) SNMP Write Community private
X) Exit
ENTER) Refresh
Select>_
```

MAC Address This address is unique for each unit and consists of 6 two digit hexadecimal values.

IP Address The IP address must be set to a unique value in your network. Refer to Appendix C if you are not familiar with IP addresses. If set to 0.0.0.0, DHCP mode is automatically enabled. Provided a DHCP server exists on the network, it will provide the unit with an IP address, gateway address, and subnet mask when the unit boots up. To change the IP address, type "1". The prompt will change to:

```
IP Address [] (10.10.10.11)>_
```

Enter the new IP address or press ENTER to use the current value.

Netmask A netmask defines how many bits from the IP address are to be taken as the network part and how many bits are to be taken as the host part (Reminder: standard class A 8/24 (net/host), class B 16/16, class C 24/8 bits). The netmask is shown in standard format "255.255.xxx.xxx". To change the netmask, type "2". The prompt will change to:

```
Netmask [] (255.255.255.0)>_
```

Enter the new netmask or press ENTER to use the current value.

Gateway IP Address The router/gateway address is needed to communicate to other LAN segments. The default gateway must be set to address the router that connects these segments. This address must be within the local network. If in doubt, your network administrator should be consulted. To change the Gateway IP address, type "3". The prompt will change to:

```
Gateway IP Address [] (10.10.10.10)>_
```

From your terminal emulator program send the modulator file using Xmodem protocol with CRC or press CONTROL-D to abort. In HyperTerminal, you send the modulator file by going to “Transfer” → “Send File...” Upon successful upgrade, the unit will reset and the password> prompt will be displayed. In general, the firmware and modulator upgrades are independent unless it is otherwise indicated. That means that one may be upgraded without changing the other.

Reset Unit The reset menu option does a software reset of the AP (i.e. reboot). To reset the unit, type “5”. The prompt will change to:

```
Reset Unit [Y/N](N)>_
```

Enter Yes to reset the unit or enter No or press ENTER to abort.

Load Factory Defaults The Load Factory Defaults allows the user to put all the radio settings into a known state. The settings are:

Downstream Settings

RF Frequency (MHz)	5802.000
Output EIRP (dBm)	28.0
Downstream Modulation	256QAM
Downstream Interleaver	16,8
Output Mute	Unmuted

Upstream Settings

Gain (dB)	50.0
Output Mute	Muted (Manual)
Output Auto Mute Threshold (dBmV)	30.0
Output Alarm Threshold (dBmV)	50.0
Output Alarm Threshold Enable	Disabled

General Settings

Change Password	[no password]
User Message	[no message]

Ethernet Settings

IP Address	0.0.0.0
SNMP Enable	Disabled
SNMP Manager IP Address	192.168.0.1
SNMP Read Community	public
SNMP Write Community	private

To load the factory defaults, type “6”. The local interface prompt will change to:

```
Load Factory Defaults [Y/N](N)>_
```

Enter Y to load factory defaults or press ENTER to select No.

Antenna Gain (dB) The antenna gain line shows the current antenna gain. It is factory set to 12 dBi for the internal antenna. These values reflect the effective gain and include cable and radome loss. The

```
3) Upgrade Firmware          2.16b
4) Upgrade Modulator         0.22
5) Reset Unit
6) Load Factory Defaults
    Antenna Gain (dB)      12.0
X) Exit
ENTER) Refresh
Select>_
```

Change Password The access password is user settable and restricts unauthorized access to the AP interface. To change the access password, type “1”. The prompt will change to:

```
Change Password [0 = empty string](***)>_
```

Enter the new password or press ENTER to use the current value.

If a new password is entered, the user will be prompted to re-enter the same password (for verification).

```
Confirm Password [0 = empty string](***)>_
```

User Message The user message is a user definable string that is displayed at the password menu. To change the user message, type “2”. The prompt will change to:

```
User Message [32 chars max](112 Pine Street)>_
```

Enter the new message or press ENTER to use the current value.

Upgrade Firmware The upgrade firmware menu option allows upgrading the application and bootloader flash areas via the interface. Remote upgrades cannot be done through a Telnet session but can be accomplished via TFTP over Ethernet. Note: Ethernet controller firmware can only be upgraded by TFTP. See Appendix D for information on upgrading firmware via TFTP. To upgrade the firmware, type “3”. The prompt will change to:

```
Upgrade Firmware [Y/N](N)>_
```

Upon selecting Yes, the unit will wait for the firmware image. The prompt will change to:

```
Waiting For Data [Ctrl-D to Abort]...>_
```

From your terminal emulator program send the firmware file using Xmodem protocol with CRC or press CONTROL-D to abort. In HyperTerminal, you send the firmware file by going to “Transfer” → “Send File...” Upon successful upgrade, the unit will reset and the `password>` prompt will be displayed.

Upgrade Modulator The Upgrade Modulator menu option allows upgrading the firmware for the QAM modulator via the local interface. Remote upgrades cannot be done through a Telnet session but can be accomplished via TFTP over Ethernet. To upgrade the modulator, type “4”. The local interface prompt will change to:

```
Upgrade Modulator [Y/N](N)>_
```

Upon selecting Yes, the unit will wait for the modulator file. The local interface prompt will change to:

```
Waiting For Data [Ctrl-D to Abort]...>_
```

Unmuted – force the output to be enabled

Muted – force the output to be disabled

Auto – output is controlled by the system based upon received upstream signal level. Note that the Output Mute setting will be overridden by active alarm conditions (i.e. output will be muted when an alarm condition is active)

To change the Upstream Output Mute state, type “2”. The prompt will change to:

```
Output Mute [0 unmute, 1 mute, 2 auto](2)>_
```

Enter the new value or press ENTER to use the current value.

Output Auto Mute Threshold (dBmV) This setting allows the user to set the upstream output auto mute threshold level. When the upstream output state is set to “Auto” the detection circuitry will unmute the output when a level has been detected above the set threshold. There is some hysteresis with this function so that once the output is unmuted it will stay unmuted until the output level drops a few dB lower than the output mute threshold. Valid levels are multiples of 0.5 dBmV. If the level is within the setting limits but the step size is not correct, the level will be rounded to the nearest valid step size boundary. To change the Upstream Output Auto Mute Threshold, type “3”. The prompt will change to:

```
Output Auto Mute Threshold [10.0 to 55.0 dBmV](30.0)>_
```

Enter the new threshold or press ENTER to use the current value.

Output Alarm Threshold (dBmV) This setting allows the user to set the upstream output alarm threshold level. Thresholds are used to provide an alarm indication that the level is no longer within an acceptable range. Should the signal level exceed the specified threshold level, an alarm condition will be triggered and the upstream output muted. Valid levels are multiples of 0.5 dBmV. If the level is within the setting limits but the step size is not correct, the level will be rounded to the nearest valid step size boundary. To change the Upstream Output Alarm Threshold, type “4”. The prompt will change to:

```
Output Alarm Threshold [17.0 to 50.0 dBmV](40.0)>_
```

Enter the new threshold or press ENTER to use the current value.

Output Alarm Threshold Enable This setting allows the user to enable threshold detection on the upstream output. Thresholds are used to provide an alarm indication that the level is no longer within an acceptable range. Should the signal level exceed the specified threshold level and threshold is enabled, an alarm condition will be triggered and the upstream output muted. To change the Upstream Output Threshold Enable, type “5”. The prompt will change to:

```
Output Alarm Threshold Enable[0 disable, 1 enable](1)>_
```

Enter the new values or press ENTER to use the current value.

4.6.5 General Settings

The General Settings Menu provides access to the general settings and options. To access this menu from the Main Menu, type “5” to display the General Settings Menu.

Figure 4.9: General Settings Menu

```
*** AirBridge AP General Settings ***
```

1)Change Password

2)User Message

112 Pine Street

either let the internal cable modem lock on to a channel by itself, or the configuration file for the modem used by the CMTS may be written to direct the cable modem to a specific downstream channel. If the cable modem is not locked to a valid channel, the CATV Frequency will indicate "No Channel".

Downstream Demod\Mod Status Indicates the lock status of the downstream demodulator. It will display Locked or Not Locked. If the demodulator is not locked, this may indicate that there is no valid signal or the signal quality is too low for proper operation. Check also that the modulation (64 QAM or 256 QAM) is set to the correct value.

Downstream Demodulator SNR Indicates the estimated downstream Signal to Noise Ratio as seen by the demodulator. The best signals will result in SNR values of 35 dB or more, however good operation will be maintained to SNR values of 30 dB or less. Lower SNR values indicate poor signal conditions, which may include interference or low signal level. The indicated SNR is an instantaneous reading, so the value of the SNR will vary from reading to reading.

4.6.4 Upstream Settings

The Upstream Settings Menu provides access to the settings used to configure the upstream chain. To access this menu from the Main Menu, type "4" to display the Upstream Settings Menu.

Figure 4.8: Upstream Settings Menu

```
*** AirBridge AP Upstream Settings ***

1)Gain (dB)          46.0
    Output Level (dBmV) 23.0 (Stale)
2)Output Mute          Auto
3)Output Auto Mute Threshold (dBmV) 20.0
4)Output Alarm Threshold (dBmV) 30.0
5)Output Alarm Threshold Enable Disabled
X)Exit
ENTER)Refresh
Select>_
```

Gain (dB) This setting allows the user to set the upstream gain level. Valid levels are multiples of 0.5 dB. If the gain setting is within the setting limits but the step size is not correct, the setting will be rounded to the nearest valid step size boundary. To change the Upstream Gain, type "1". The prompt will change to:

```
Gain [36.0 to 76.0 dB](46.5)> _
```

Enter the new gain or press ENTER to use the current value.

Output Level (dBmV) This level gives an indication of the peak upstream output level. Because upstream signals are time-division multiplexed, the measured level is only valid while the signal is present. As a result, the peak measured level of the current signal will be latched and will remain the same until the signal is detected again. Upon detection of the new signal, the peak level will be measured and a new value returned. If a signal is not detected in 30 seconds, the value returned will remain unchanged, but will be marked "(Stale)" to indicate that a signal has not been detected in 30 seconds. The range of values returned is 17 dBmV to 50 dBmV.

Output Mute This setting allows the user to set the upstream output mute state. There are three valid output states:

frequency of the carrier). Valid frequencies are 5802.000, 5808.000, 5814.000, and 5820.000 MHz. If the frequency is within the setting limits but the step size is not correct, the frequency will be rounded to the nearest valid step size boundary. To change the Downstream Output Frequency, type "1". The prompt will change to:

```
RF Frequency [5802.000 to 5820.000 MHz](5802.000)>_
```

Enter the new frequency or press ENTER to use the current value.

Output EIRP (dBm) This setting allows the user to set the downstream output EIRP (Effective Isotropic Radiated Power). Valid levels are multiples of 0.5 dBm. If the level is within the setting limits but the step size is not correct, the level will be rounded to the nearest valid step size boundary. To change the Downstream Output EIRP, type "2". The prompt will change to:

```
Output EIRP[15.0 to 28.0 dBm](26.0) _
```

Enter the new level or press ENTER to use the current value.

Downstream Modulation This setting allows the user to set the downstream modulation to either 64 QAM or 256 QAM. Valid inputs are 64 or 256. To change the Downstream modulation, type "3". The local interface prompt will change to:

```
Downstream Modulation[64, 256 QAM](64) _
```

Enter the new modulation or press ENTER to use the current value. Note that the symbol rate automatically sets along with the modulation. Symbol rates are 5.05964 Msym/sec for 64 QAM and 5.36054 Msym/sec for 256 QAM.

Downstream Interleaver This setting allows the user to set the length of the interleaver for the downstream modulation. Valid inputs are 128,1; 64,2; 32,4; 16,8; and 8,16. To change the Downstream Interleaver length, type "4". The local interface prompt will change to:

```
Downstream Interleaver[128,1 64,2 32,4 16,8 8,16](16,8) _
```

Enter the new interleaver length or press ENTER to use the current value. The values entered into the interleaver represent the I,J values in the convolutional interleaver. Longer lengths such as 128,1 provide more protection against burst errors since it spreads the errors out over a longer period of time, and it is more likely that the error correction can correct them. The cost is an increased delay time. For the longer interleaver depths, it is possible that the cable modem will be unable to lock due to delay limits set in the CMTS, so they should be used with caution. The AP is shipped with the interleaver set to 16,8 which provides adequate protection while keeping delay low. Delays from the interleaver vary (for 64/256 QAM) from 8/5.6 ms for 128,1 to 0.44/0.30 ms for 8,16. The cable modem at the subscriber side will automatically adjust to the selected interleaver value.

Output Mute This setting allows the user to mute the downstream output. If the setting is set to "Muted", the output will remain muted until the setting is changed to "Unmuted" and no alarm condition exists. To change the Output Mute state, type "5". The prompt will change to:

```
Output Mute [0 unmute, 1 mute](1)>_
```

Enter the new value or press ENTER to use the current value.

CATV Frequency (MHz) This indicates the center frequency of the downstream CATV channel to which the AP is tuned. This value is automatically configured by the AP to match the internal cable modem downstream frequency. Note that the value can not be changed directly by the user. The user may

S: Strand mount
P: Pole mount
H: Horizontal polarization
V: Vertical polarization
B: Bi-directional
R: Return path only
6: Downstream channel

Therefore, model AP5800-SHB6 is a strand-mounted, horizontally polarized, bi-directional with a 6 MHz channel.

Vendor Name Company name of AP vendor.

Serial Number Serial Number of AP unit.

Model Number Model Number of AP unit.

Hardware Revision Number Hardware Revision of AP unit.

Software Revision (Boot) Software revision number of AP unit microcontroller bootloader section.

Software Revision (App) Software revision number of AP unit microcontroller application section.

Software Revision (Mod) Software revision number of AP unit downstream modulator.

Software Revision (Eth) Software revision number of AP unit Ethernet controller.

4.6.3 Downstream Settings

The Downstream Settings Menu provides access to the settings used to configure the downstream chain. To access this menu from the Main Menu, type “3” to display the Downstream Settings Menu.

Figure 4.7: Downstream Settings Menu

```
*** AirBridge AP Downstream Settings ***

1)RF Frequency (MHz)          5802.000
2)Output EIRP (dBm)           26.0
3)Downstream Modulation        64QAM
4)Downstream Interleaver      16,8
5)Output Mute                 Unmuted
    CATV Frequency (MHz)       609.000
    Downstream Demod\Mod Status Locked\Not Locked
    Downstream Demodulator SNR  0.00 dB
X) Exit
ENTER)Refresh
Select>_
```

RF Frequency (MHz) This setting allows the user to set the downstream output frequency (center

Downstream Output Indicates current state of the downstream output. There are three valid output states: Muted (Manual) indicates that user has forced the output to be disabled, Muted (Alarm) indicates that the output has been muted by an alarm condition, Unmuted indicates that the output is enabled.

Downstream Modulation Indicates the selected downstream modulation. It will indicate 64QAM or 256QAM.

Downstream Interleaver Indicates the selected downstream interleaver setting. Valid settings are 128,1; 64,2; 32,4; 16,8; and 8,16. See the Downstream Settings menu section for details on interleaver settings.

Downstream Demod/Mod Status Indicates the lock status of the downstream demodulator. It will display Locked or Not Locked. If the demodulator is not locked, this may indicate that there is no valid signal or the signal quality is too low for proper operation.

Downstream Demodulator SNR Indicates the estimated downstream Signal to Noise Ratio as seen by the demodulator. The best signals will result in SNR values of 35 dB or more, however good operation will be maintained to SNR values of 30 dB or less. Lower SNR values indicate poor signal conditions, which may include interference or low signal level. The indicated SNR is an instantaneous reading, so the value of the SNR will vary from reading to reading.

Upstream Gain (dB) Indicates the gain setting the AP is set to.

Upstream Level (dBmV) Indicates the estimated upstream signal level. The indicated level is an instantaneous reading, so the value of the signal level will vary from reading to reading. If a signal is not detected in 30 seconds, the value returned will remain unchanged, but will be marked "(Stale)" to indicate that a signal has not been detected in 30 seconds.

Upstream Output Indicates current state of the upstream output. There are four valid output states: Muted (Manual) indicates that user has forced the output to be disabled, Muted (Alarm) indicates that the output has been muted by an alarm condition, Auto indicates that mute is controlled by the system, Unmuted indicates that the output is enabled.

4.6.2 Vendor Information

The Vendor Information Menu provides access to factory model and revision history. To access this menu from the Main Menu, type "2" to display the Vendor Information Menu.

Figure 4.6: Vendor Information Menu

*** AirBridge AP Vendor Information ***

Vendor Name	CommScope, Inc. of North Carolina
Serial Number	685517
Model Number	AP5800-SHB6
Hardware Revision	PC3B0104
Software Revision (Boot)	2.16b
Software Revision (App)	2.16b
Software Revision (Mod)	0.22
Software Revision (Eth)	5.93
X)Exit	
ENTER)Refresh	
Select>_	

Figure 4.5: Status Information Menu

```
*** AirBridge AP Status Information ***

Temperature (deg F) 81
Over Temperature Alarm OK
Hardware Failure Alarm OK
Downstream CATV Signal Validation Signal Invalid
Upstream Output Threshold Alarm OK
Downstream CATV Frequency (MHz) 543.000
Downstream RF Frequency (MHz) 5802.000
Downstream Transmit EIRP Setting (dBm) 28.0
Downstream Output Muted (Alarm)
Downstream Modulation 256QAM
Downstream Interleaver 16,8
Downstream Demod/Mod Status Not Locked\Not Locked
Downstream Demodulator SNR 0.00
Upstream Gain (dB) 36.0
Upstream Level (dBmV) 4.0(Stale)
Upstream Output Muted (Manual)

X)Exit
ENTER)Refresh
Select>_
```

Temperature Indicates the internal temperature of the AP.

Over Temperature Alarm When active, indicates that the internal temperature exceeds the recommended operating limits for reliable operation (>75° C, 167° F).

Hardware Failure Alarm When active, indicates that a component in the AP has failed. The hardware failure alarm is the summary for unlock alarms from three local oscillators on the PC board. Contact customer support.

Downstream CATV Signal Validation The signal is “OK” when the internal cable modem is fully registered on the CMTS. The unit will be muted if it is “Signal Invalid”.

Upstream Output Threshold Alarm When active, indicates that the upstream signal level exceeds the Output Threshold Alarm level that was set under Upstream Settings.

Downstream CATV Frequency (MHz) CATV frequency that the AP is tuned to.

Downstream RF Frequency (MHz) Over-the-air frequency.

Downstream Transmit EIRP Setting (dBm) Over-the-air output power of the AP.

- Downstream settings
- Upstream settings
- General settings
- Ethernet settings

4.5 Using the Interface

4.5.1 Command Line Prompt

The command line prompt consists of one of three forms:

- 1) Password prompt, `Password>`
- 2) Option prompt, `Select>`
- 3) Setting prompt, `Setting [] ()>`, see Modifying Settings from the Interface section (Section 4.5.5) below for details of the setting prompt.

4.5.2 Entering Commands

Commands can be entered in upper or lower case. To clear typed entries or an entry mistake and start again, press CONTROL-H or the backspace key to make corrections. If you enter an invalid value, the value will be rejected and the current menu and prompt will be displayed again.

4.5.3 Conventions Used

The interface uses the following conventions:

- Ranges of permitted values are depicted with square braces “[]”.
- A letter or number followed by a parenthesis, “1)”, indicates a user-settable option.
- Fields *without* a letter or number preceding it are status/information fields.

4.5.4 Exiting from the Interface

You can exit every menu by using the “X” command. Each time you type “X”, you return to the next higher (previous) menu. At the Main Menu, typing “X” exits you from the interface and logs you off.

4.5.5 Modifying Settings from the Interface

Submenu items preceded by a letter or number followed by a parenthesis are user-settable options and allow that particular setting to be changed. Upon selecting desired setting, the interface prompt will change to a setting prompt. A setting prompt consists of the setting name, the setting limits (shown in [] braces), and the current value (shown in () parentheses). The new setting can be entered at the prompt or ENTER can be pressed to continue to use the current value. If a new setting is entered that is not within range of the limits specified, “Error” will be returned and the setting prompt will be displayed again. For example, the following figure illustrates entering an invalid Downstream RF Frequency:

Figure 4.4: Setting Prompt

```
RF Frequency [5802.000 to 5820.000 MHz](5808.000)>5790.000
Error
RF Frequency [5802.000 to 5820.000 MHz](5808.000)>_
```

4.6 Submenus

From the Main Menu, other functions such as status and configuration are accessed through the submenus.

4.6.1 Status Information

The Status Information Menu provides access to unit status and alarms. To access this menu from the Main Menu, type “1” to display the Status Information Menu.

Exiting From Telnet

Exit from the shell and close the Telnet connection by returning to the password prompt.

4.2 Logon Menu

Figure 4.2: Logon Menu

```
***CommScope, Inc. AirBridge Access Point ***
Serial Number 6855176
112 Pine Street

Password>_
```

The password prompt is: `password>` If you are accessing the AP for the first time, press ENTER at the password prompt. Until you change it, the ENTER key is the default password. If you have changed the password, type the correct password (up to sixteen characters). The screen will display placeholders (******) as you type the password. Press ENTER. The local interface Main Menu displays.

As an extra level of security to the password operation, the AP incorporates a lockout feature to make access more difficult for someone not in possession of the correct password. If five successive invalid passwords are entered in a row, the AP will enter a password lockout state. The prompt will change to:

```
Password (Lockout Active)>
```

This prompt will be active for approximately 5 minutes, during which the AP will not process any further passwords. At the end of the interval, the AP reverts back to the regular password prompt and will again accept passwords.

4.3 Timeout

The local interface will time out after 5 minutes of inactivity and automatically return to the `password>` prompt. If accessing the unit via Telnet, the session will disconnect.

4.4 The Main Menu

Figure 4.3: Main Menu

```
*** AirBridge AP Main Menu ***
1)Status Information
2)Vendor Information
3)Downstream Settings
4)Upstream Settings
5)General Settings
6)Ethernet Settings
X)Exit
ENTER)Refresh

Select>_
```

4.4.1 Interpreting the Main Menu

The Main Menu shown in Figure 4.3 provides access for:

- Status information

4.0 Accessing AP Menus

The AP may be controlled via the local RS232 interface connector or remotely via Ethernet. There are 3 modes of operation: VT100 Terminal Emulation Mode (HyperTerminal) via RS232, Telnet over Ethernet, or SNMP v.1 over Ethernet.

4.1 Setting up

The connection between an ASCII terminal and the AP may be direct or through Telnet. If you plan to use Telnet, you can first use a direct connection to set up network parameters.

4.1.1 Direct Connection

The local interface can be accessed through a direct connection to the AP. From an ASCII terminal or PC with a terminal emulator program (e.g. HyperTerminal), proceed as follows:

1. Connect the ASCII terminal to the 9-pin RS232 port located on the base plate. Use a standard 9-pin serial cable.
2. Go to the terminal settings screen of your terminal or terminal emulator.
3. Set your terminal parameters to the following values:

- 9600 bit/s baud rate
- 8 data bits
- no parity
- one stop-bit
- no flow-control
- X-ON, X-OFF disabled
- Local Echo should be disabled for the terminal (the AP will echo the characters)
- The terminal type can be TTY or VT100 or similar
- CR -> CR/LF mapping should be disabled for both inbound and outbound traffic
- The only special characters that are implemented are carriage return (0x0D, ^M), linefeed (0x0A, ^J), and destructive backspace (0x08, ^H). All other characters are processed as part of the message
- The maximum message length is 80 characters

4.1.2 Telnet

Telnet access is available for the AP. Prior to accessing the AP using Telnet, you must configure the Ethernet IP address and related network parameters. The local interface can be used to set the network parameters, DHCP can be used, or a static ARP path can be setup (see section 5.4 Assigning an IP Address).

In a shell, terminal, browser, or Telnet application window, use a command similar to the following (substitute the IP address of the desired AP):

```
C:\> telnet 10.10.10.11
```

A message indicates you have connected to the AP:

Figure 4.1: Telnet Session Connecting

```
Establishing Connection...
```

```
*** CommScope, Inc. AirBridge Access Point ***
Serial Number 6855176
112 Pine Street
```

```
Password>_
```

3.2.3 Upstream Muting

The upstream muting has three modes: Unmuted, Muted and Automatic.

The Unmuted setting is used to bypass the upstream noise mitigation circuitry. In this mode, the upstream output is always on.

The Muted setting is used to manually turn off the AP upstream signal. This may be used, for example, if the unit is put out of service. Manually muting the upstream output does not affect the internal cable modem, so communications and control are unaffected.

The Automatic Mute setting may be used to reduce the impact of the upstream noise on the cable system. In the Automatic Mute mode, the upstream output is muted unless there is a signal above the Output Auto Mute Threshold level. When a signal above the threshold is detected, the upstream output is turned on only for the duration of the upstream burst. The Output Level reading in the Upstream Settings group indicates the approximate measured level of the upstream burst signal. The threshold is typically set near that level or up to a few dB lower. The threshold setting is important since if the threshold is set too low, noise may keep the output unmuted, while setting the threshold too high will not allow a valid signal to turn on the output. Generally, you should set the threshold 3 dB below the upstream output level. See Appendix B for more details.

3.0 Connectors & Configurations

3.1 AP Connection

The only required connection to the AP is made through the F-connector. Connect a coaxial cable, such as CommScope cable F677TSVV, from the power passing tap to the F-connector on the AP. You should use a drip loop and a coax weather boot on the connection to the AP. Note the power and voltage requirements as mentioned in the Power Requirements section (Section 2.3).

3.2 AP Configuration

The AP status and configuration may be monitored and modified either remotely via Ethernet or locally via the local interface. For local control of the radio, use the 9-pin RS232 local interface located on the base plate of the unit with settings as described in the Direct Connection section of this manual (Section 4.1.0). Since the AP is capable of providing a wide range of upstream gains and downstream transmit levels, the setting of these levels is very important to maintain optimal performance.

3.2.1 Downstream Transmit EIRP

The downstream transmit EIRP is normally set to the maximum value of 28 dBm EIRP. For very short distances, the transmit power should be reduced to prevent overdriving of the CM at the customer site. When operating normally, the status will show the downstream output as "Unmuted." The AP automatically mutes if there is a problem, such as the internal cable modem unable to register on the system, no valid signal for the downstream demodulator, or a hardware problem indicated by a Hardware Failure alarm. It will indicate "Muted (Alarm)" under these conditions. If it shows "Muted (Manual)," this indicates that the output has been manually muted by the user. It can be unmuted in the downstream menu. The downstream power may also be adjusted to optimize subscriber CM receive SNR (Signal-to-Noise Ratio) if desired. On all but the longest links, reducing the transmit EIRP by a few dB may improve downstream receive SNR by improving transmit linearity.

3.2.2 Upstream Gain

The upstream gain setting is used both to compensate for the link distances and to enable the upstream signal to meet the required level into the tap. Note that the broadband noise level in the 18 to 42 MHz upstream band is directly proportional to the upstream gain setting, so in general, it is desirable to operate with the lowest practical gain setting to minimize the noise level. The initial setup of a link should be performed with the upstream mute set to "Muted," so that excessive noise is not injected into the plant when the AP is powered on for the first time.

The CM may not be able to register with the initial gain settings. The upstream gain can be increased in 10 dB increments until the subscriber CM registers, allowing time for registration at each gain change. When registration is achieved, the upstream gain should be optimized by setting it to a value that has the subscriber CM transmitting between 40 dBmV and 50 dBmV. The optimal gain setting for a specific link will depend on both the link distance and the upstream level required at the tap. Lower upstream gain settings will cause the CM to transmit harder to maintain the same level at the tap. This may improve the SNR, but will also reduce margin to compensate for gain variations in the path between the CM and the CMTS. Conversely, higher upstream gains will cause the subscriber CM to reduce its transmit power to maintain the same level at the tap, and this may degrade the upstream SNR.

Pipe/Pole Mounting

With the pipe or pole mount option, the AP must be mounted vertically on a wooden or metal utility pole up to 14.5" in diameter or a pipe with a diameter greater than 4". Ensure the unit is oriented so that the text on the label is upright. This puts the internal antenna in the correct orientation, which is horizontal polarization. Mounting the radio with a non-vertical orientation will prevent proper operation of the system.

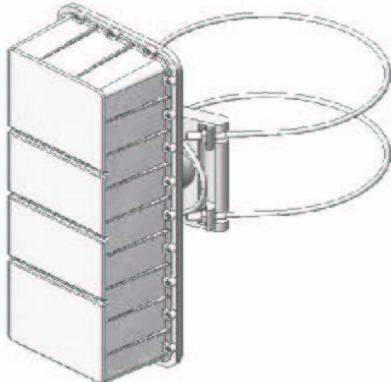
STEP 1 An adapter bracket is used to attach the AP to the pole clamp. Use a 1/2" wrench and the four hex-head bolts with lock washers to attach the adapter bracket to the pole clamp. The bolts go through the pole clamp holes, through the outside of the adapter bracket, and are secured on the inside of the bracket with the lock washers and nuts. This assembly can then be attached to the AP base plate using the two sets of four screws and lock washers. Ensure that the AP is oriented with the labels reading right-side-up.

STEP 2 A cable is used to strap the radio mount to the pole or pipe. First loosen the two 4-bolt clamps near the loop end of the cable so the cable can slide free through them. Wrap the two ends of the cable around the pole or pipe and place the ends in the two notched sections of the mount. Then pull the loop end of the cable to take up any slack and tighten the two 4-bolt clamps with a 1/2" wrench to secure the cable. The nuts at the ends of the cable can then be tightened using a 5/8" wrench to cinch the cable around the pole or pipe to the desired tension. If necessary, adjust the bracket rotation using the 5/8" wrench on the two bolt heads.

Ensure all bolts are tight and the cable loop will not rattle against the unit in windy conditions. If the latter is a problem, secure the loop of the cable to one of the ends of the cable with a cable-tie.

Figure 2.4B shows the AP with cables attached.

Figure 2.4B: AP Pipe or Pole Mounting



2.0 Installation

2.1 Unpacking the Unit

Carefully remove the equipment from its packing material and set it on a solid surface, such as a table or desk. If it appears damaged in any way, notify the carrier and keep all packing materials for inspection by the carrier's agent.

2.2 Operating Environment

The AP is designed to operate in an outdoor environment at temperatures ranging from -40° to $+60^{\circ}\text{C}$ (-40° to $+140^{\circ}\text{F}$). As with all electrical equipment, operation outside specified temperature ranges will accelerate the deterioration of components.

2.3 Power Requirements

The equipment has an auto-ranging internal power supply, which allows it to be powered from the 35-90 VAC 60 Hz power passing tap on the strand. This power passing tap must be capable of delivering a minimum of 27 watts per AP. The AP will also work with a 48 VDC power source or 35-90 VAC 50 Hz.

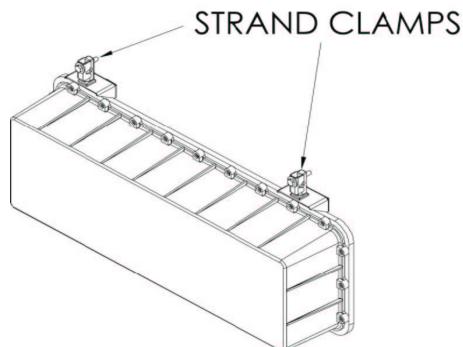
Note: Most power passing taps are current limited and will shut off when the current gets above a certain level. Care must be taken to ensure that under the worst case conditions of elevated temperature and long lines between power supply and AP, that the AP can receive enough current without tripping the overcurrent switch and shutting off the power. The AP also has an internal 2 amp slow-blow fuse.

2.4 Radio Mounting

Strand Mounting

There are two mounting brackets supplied. These are to be installed on the back of the AP using the supplied screws and lock washers. With the brackets installed to the AP, secure the AP to the strand using the two clamps provided. See figure 2.4A for details. A directional mounting bracket is also available that allows the AP to be rotated 30° in either direction while on the strand.

Figure 2.4A: Strand Mounting



Note: If the strand mount option is selected, the radio **must** be mounted horizontally on the strand as shown.

1.0 General Information

1.1 Overview

AirBridge™ is a wireless access solution designed to extend DOCSIS® or other services via strand or pole mounted access points. The radio system consists of an access point (AP) and a subscriber unit (SU). The AP mounts to the strand (CATV cable) and provides a point-to-point or point-to-multipoint radio link in the 5.8 GHz UNII (Unlicensed National Information Infrastructure) band to several SUs located about a mile away. The AP functionality includes powering from the strand, remote control and monitoring via SNMP, and transmission and reception of standard DOCSIS® or other signals at the levels found at a regular cable tap point. The SU will interface with a standard cable modem.

The AirBridge™ system provides a wireless entry point to the HFC (hybrid fiber/coax) network, extending access to locations that may, due to cost or time constraints, be unable to connect to the system.

The AP5800 includes an integrated DOCSIS 1.1 cable modem for communications and control. Note that the data passing over the wireless network does NOT pass through the cable modem, so the cable modem does not limit data rate or features available over the wireless link. In the downstream direction, the AP5800 includes a repeater that demodulates the downstream data, removes noise and errors, and remodulates. This ensures a top quality signal on the wireless link, independent of the quality of the CATV signal.

1.2 Module Features

- Average 1-mile range
- Wide upstream gain range
- Excellent upstream noise figure performance
- Downstream output mutes if there is no valid input signal
- Reports power level of burst upstream signal
- Upstream can be set to auto mode, which minimizes noise put onto the cable system by keeping the upstream output muted until there is a signal to transmit
- High reliability, state of the art design using microstrip MMIC (Monolithic Microwave Integrated Circuit) and surface mount technology
- Conservative component derating and 100% burn in help ensure reliable operation
- Automatically tunes to downstream CATV frequency
- Internal modulator/demodulator regenerates signal for optimum downstream SNR

1.3 System Features

- Local control via RS232 command line interface
- Remote control via SNMP v1.1 (Simple Network Management Protocol)
- Flash memory for easy firmware upgrades
- Firmware upgradeable via TFTP (Trivial File Transfer Protocol)
- Internal power supply requires only 35-90 VAC power supplied on strand for operation

1.4 Options

The AP is available with the following options:

Mounting:

Strand This includes brackets and clamps to mount the radio in a horizontal orientation to the cable strand. The internal antenna is mounted to produce a horizontal polarization by default.

Pole This option includes a mounting bracket and cable-based clamp to secure the radio to a wooden or metal utility pole from 4" to 14.5" diameter, in a vertical orientation. The internal antenna is mounted to produce a horizontal polarization by default.

Pipe This option is the same as the pole mount, except a shorter cable-based clamp is provided. An internal antenna is provided in the radio. The antenna is oriented based on the type of mounting selected. By default, the antenna is horizontally polarized, 60° horizontal beamwidth and 30° vertical beamwidth. The antenna has a 14 dBi nominal gain, but with cable and radome loss, the effective gain is 12 dBi.

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INFORMATION TO USER In accordance with FCC rules

"This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) This device must accept any interference received, including interference that may cause undesired operation."

"This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense."

CAUTION: Any changes or modifications not expressly approved by CommScope could void the user's authority to operate the equipment.

WARNING:

In order to comply with the FCC radio frequency exposure limits of Part 1.1310, this equipment must be installed in such a way as to provide a minimum separation distance of 2 ft. from the transmitting antenna to persons nearby.

SAFETY PRECAUTIONS

1. Before installing and operating this equipment, read all Safety, Installation and Operating sections. Retain this manual for future reference.
2. Follow all instructions — Failure to do so may result in damage to the unit or severe personal injury.
3. The user should not attempt servicing. There are no user serviceable parts inside. Refer all servicing to factory-qualified personnel.
4. Cleaning — Do not use liquid or aerosol cleaners. Use a damp cloth for cleaning.

WARNING! Do not work on the system or connect or disconnect cables during periods of lightning activity.

AirBridge™ Access Point Manual; Manual AirBridge™ AP (October 2005)

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Broadband Wireless Access Point AP5800

INSTALLATION AND OPERATION MANUAL