Product Manual

CSI Bi-Directional Amplifier

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Product Certification/Registration Information

The serial number may be found on the label on the rear panel of the unit. For your convenience, note this number below. Retain this manual, along with proof of purchase, to serve as a permanent record of your purchase for future reference or in the event of theft.

MODEL NUMBER	SERIAL NUMBER	DATE OF PURCHASE

POINT OF SALE COMPANY

Safety Guidelines

The general safety information in this guideline applies to both operating and service personnel. Specific warnings and cautions will be found in other parts of this manual where they apply, but may not appear in this summary. Failure to comply with these precautions or specific warnings elsewhere in the manual violates safety standards of design, manufacture, and intended use of equipment. Cellular Specialties, Inc. assumes no liability for the customer's failure to comply with these requirements.

Grounding

This amplifier system is designed to operate from 120 Vac @ 1.3A maxpower and should always be operated with the ground wire properly connected. Do not remove or otherwise alter the grounding lug on the power cord.

Explosive Atmospheres

This product has an integral circuit breaker, which may cause an electrical flash if the breaker should reset. To avoid explosion or fire, do not operate this product in the presence of flammable gases or fumes.

Lightning Danger

Do not install or make adjustments to this unit during an electrical storm.

No User Serviceable Parts Inside

HAZARDOUS VOLTAGES ARE PRESENT WHEN THE COVER IS REMOVED. Opening the chassis will void your warranty. If you suspect a malfunction with this product, call your dealer or the Cellular Specialties Support Line at (603) 626-6677.

DISCLAIMER: All information and statements contained herein are accurate to the best of the knowledge of Cellular Specialties, Inc. (CSI), but Cellular Specialties makes no warranty with respect there to, including without limitation any results which may be obtained from the products described herein or the infringement by such products of any proprietary rights of any persons. Use or application of such information or statements is at the users sole risk, without any liability on the part of Cellular Specialties, Inc. Nothing herein shall be construed as license or of recommendation for use, which infringes upon any proprietary rights of any person. Product material and specifications are subject to change without notice. Specialties' standard terms of sale and the specific terms of any particular sale.

Product Description

Cellular Specialties, Inc. (CSI) developed the LCD Model Bi-Directional Amplifier (BDA) for use in enclosed structures where sufficient signal from local cell sites to operate cell phones was unavailable within the building. It is necessary that sufficient signal be available on the roof of the structure. The BDA is connected to an external antenna, usually on the roof, and to one or more internal antennas placed strategically throughout the area where phone service is desired.

The external antenna is usually a directional type such as a “yagi”. Internal antennas are usually omnidirectional, although various other types may be used for certain installations. The BDA amplifies both the “uplink” (phone to tower) and “downlink” (tower to phone) signals thus facilitating communications to and from the local cell site.

There are seven amplification stages on the downlink and seven on the uplink for a total of +62 to +80 dB nominal gain for each link. Gain can be set using the LCD display and select/up/down switches. There are also LED indicators on the top cover for power overload and gain reduction to prevent oscillation.

LED Indicators

Warning:	The unit has sensed instability due to insufficient isolation between the inside antenna and the outside antenna, and has reduced the gain of the amplifier. This is done to prevent oscillation, which can interfere with the handsets in the covered area and/or the wireless service provider’s base station.
Fault:	The gain of the unit has been reduced to a minimum in order (Red) to prevent very strong input signals from overloading the amplifier. The amplifier will attempt to recover from this condition, initially at fifteen second intervals and then at four-minute intervals.

An automatic amplifier safety shutdown circuit is also incorporated that will disable the transmitters should the uplink or downlink overloads be reached to prevent excessive intermodulation and oscillation. The amplifier will periodically attempt to recover from this condition.

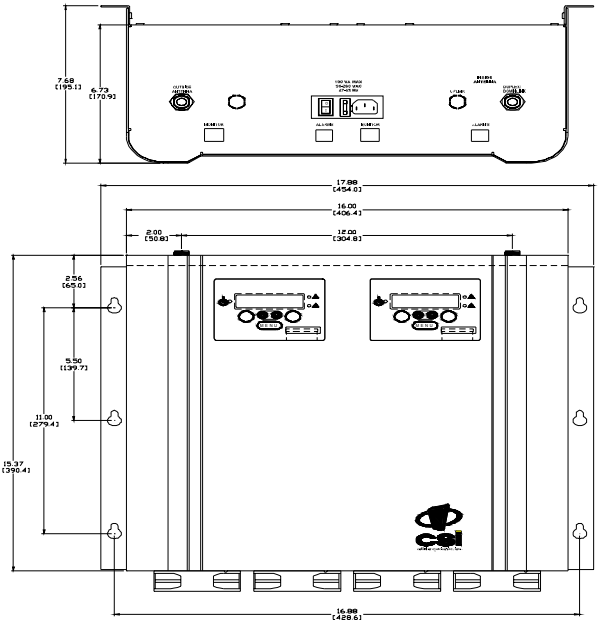
The BDA is equipped with an interface connector (RJ-15) designed for use with an optional remote monitor. A second Connector (RJ-11) is used for remote monitoring and shutdown. The RJ-11 pin-out is listed here.

- Pins 3 & 4 will toggle from open to closed with faults.
- Pin 1 (5 Volts) can be tied to Pin 5 to shut the unit down.

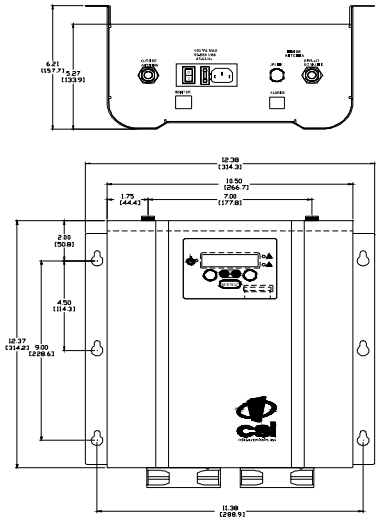
Pin-Out Chart

Pin	Description
1	5 Volts
2	Center Contact Alarm Relay
3	Alarm Contact-Open
4	Alarm Contact-Closed
5	Shut Down
6	Ground

LCD Model Mechanical Drawing



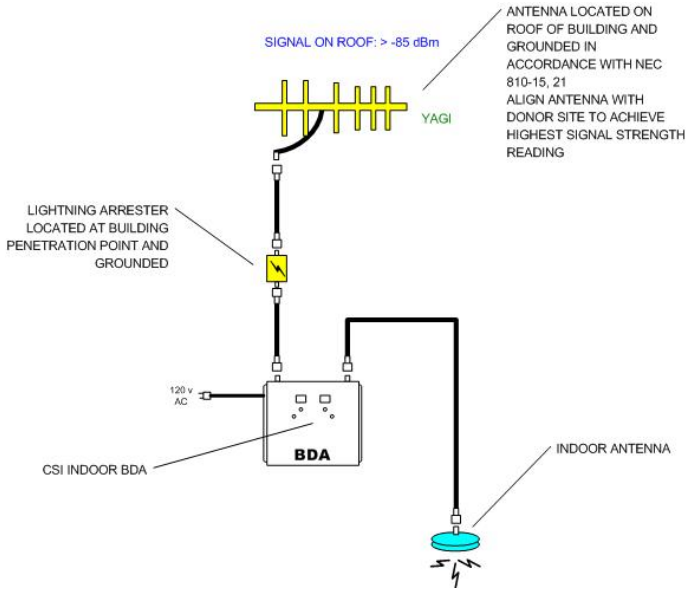
Dual Band BDA



Single Band BDA

Installation

Example: Standard Single Internal Antenna System Design



Optional Accessories

Accessories are available directly from Cellular Specialties, Inc. or any of CSI's distributors.

- Outside High Gain Yagi Antennas
  - PCS – model number (CSI-AY/1.85-1.99/10)
  - SMR and Cellular – model number (CSI-AY/806-960/11) and (CSI-AY/806-960/14)
- Inside Omnidirectional Antennas
  - PCS – model number (CSI-AS/1.85-1.99/2)
  - SMR – model number (CSI-AS/806-866/4)
  - Tri-Band – model number (CSI-AO/800/2.5K/3)
- Power Dividers
  - 2:1 - model number (CSI-S2BSC)
  - 3:1 - model number (CSI-S3BSC)
  - 4:1 - model number (CSI-S4BSC)
- Grounding Kit - model number (CSI-GKIT)
- Lightning Arrestor - model number (CSI-CAP)
- Directional Couplers and Cross Band Couplers are also available

Important Installation Notes

- A high degree of isolation must be afforded to prevent any re-generative feedBack in the system. FeedBack of this nature causes the amplifier to emit a continuous signal of maximum amplitude and could, in some cases, interfere with normal operation of the cell site. The use of window mounts or other non-rooftop mountings should be avoided.
- The Installer should refer to the *Safety Precautions,* in the following section, for proper antenna selection and installation

WARNING! AMPLIFIER OR HANDSET DAMAGE **MAY** OCCUR IF A HANDSET IS CONNECTED DIRECTLY TO THE BDA OR THE COAX THAT LEADS TO THE BDA.

Important Safety Information

For INDOOR use, an omni-directional antenna with a *maximum* gain of 3 dBi is authorized for use with this unit. Inside antennas must be positioned to observe minimum separation of 20 cm. (~ 8 in.) from all users and bystanders. For the protection of personnel working in the vicinity of inside (downlink) antennas, the following guidelines for minimum distances between the human body and the antenna must be observed.

The installation of an INDOOR antenna must be such that, under normal conditions, all personnel cannot come within 20 cm. (~ 8.0 in.) from any inside antenna. Exceeding this minimum separation will ensure that the employee or bystander does not receive RF-exposure beyond the maximum permissible exposure according to section 1.1310 i.e. limits for General Population/Uncontrolled Exposure.

For OUTDOOR use, a directional antenna up to a *maximum* gain of 11dBd is authorized for use with this unit.The outside antenna must be positioned to observe minimum separation of 120 cm. (~ 4 ft.) from all users and bystanders. For the protection of personnel working in the vicinity of outside (uplink) antennas, the following guidelines for minimum distances between the human body and the antenna must be observed.

The installation of an OUTDOOR antenna must be such that, under normal conditions, all personnel cannot come within 120 cm. (~ 4 ft.) from the outside antenna. In all installations, the antenna should never be mounted such that the main beam is directed toward an area where workers or bystanders may be present. Exceeding this minimum separation will ensure that the worker or bystander does not receive RF-exposure beyond the Maximum Permissible Exposure according to section 1.1310 i.e. limits for General Population/Uncontrolled Exposure.

Performance Adjustment

The menu system can be navigated with five buttons: *UP*, *DOWN*, *EDIT*, *SAVE*, and *MENU*. Feedback is given to the operator through the LCD panel.

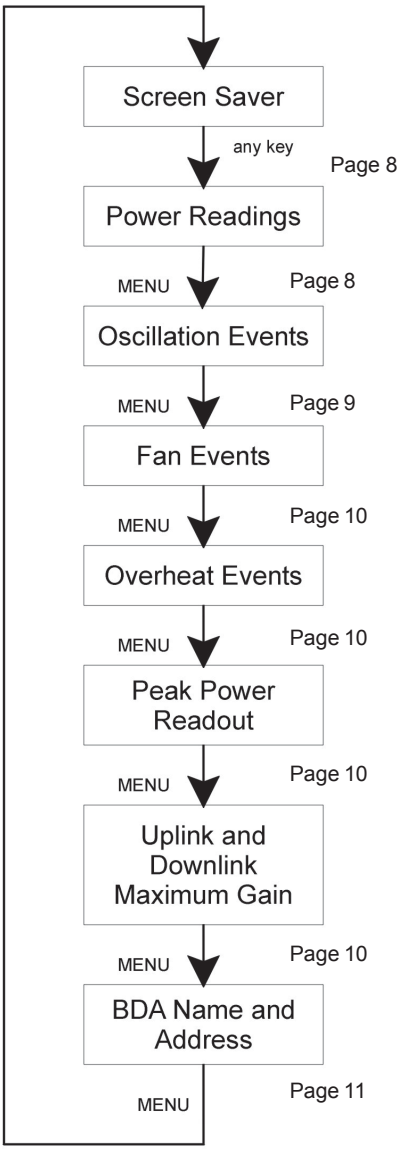
The LCD Command Interface offers two distinct series of menus: the *View Menu Series*, which allow a user to view, but not alter, certain bits of data the unit maintains; and the *Edit Menu Series*, which permit the alteration of this information. The *Edit Menu Series* are kept secure from general use by a password, if password control is invoked, so that curious or malicious people cannot randomly alter data. However, this unit is shipped with this feature disabled. See page 16 for further details.

In both menu systems the *MENU* button is used to maneuver between menus in a sequential fashion. *EDIT* is generally used to enter the *Edit Menu Series*, and *SAVE* is generally used to exit it. (Pressing *SAVE* in all menus except the one that allows you to alter the Edit BDA Name menu (explained below) will force any changes made while in the *Edit Menu Series* to be saved in non-volatile memory. The BDA will then exit the *Edit Menu Series*; if the user needs to edit more information, they will need to press *EDIT* and enter a password again.) The *UP* and *DOWN* buttons are usually used to scroll through options within a given menu, if several options exist.

What follows is an exploration of each menu series in detail, and how each menu represents and interprets data.

The View Menu Series

View Menu Tree



This series of menus will allow the user to view, but not alter, the information stored in the BDA. Pressing the ***EDIT*** button will cause the BDA to ask for a *password* if password control is invoked. Password control is invoked by pressing ***EDIT*** and ***MENU*** simulatneously. The password is a five-button sequence that secures the ability to change the information within the BDA. Keys in this password can consist of any button except ***MENU***.

This password defaults to the following sequence until changed by the user:

UP, DOWN, DOWN, UP, UP

Screen Saver Display
Upon powering up the BDA, a display resembling this will appear on the LCD panel:

```
AMPS007
      CSI
```

The first row contains the network name of the BDA; this allows the user to determine which BDA they are looking at. This name can be changed to whatever the user desires, and can contain blank spaces, capital letters, lowercase letters, and numerals. It is limited to seven characters to facilitate communication with a Web Monitor, should one be desired.

This screen is known as the *Screen Saver Display* because it is the screen that the BDA will revert to showing if there has been no activity detected on the keypad for at least ten minutes. If this occurs, the LCD backlight will shut off to save power and prevent the backlight from burning out. Pressing any key other than *EDIT* while in the *Screen Saver Display* will turn the backlight back on, and advance the menu to the *Power Readout Display*. Pressing the *EDIT* key will advance you to the *EDIT* menu series.

Power Readings Display
This menu shows the instantaneous power readings in the BDA, as well as whether or not the gain is being actively attenuated by Automatic Gain Control.

A typical Power Readings Display might appear as below:

```
UL  19  dBm  AGC  00
DL  27  dBm  AGC  02
```

This shows that the composite power is currently 19 dBm on the output of the uplink pass band; 27 dBm on the output of the downlink pass band; and Automatic Gain Control has attenuated the signal 2 dB on the downlink pass band.

It should be noted that when the power through a channel is less than 0 dBm, the display will show “<0” in the location where the reading usually appears. This prevents spurious power readings from occurring because of random noise.

The *UP*, *DOWN*, and *SAVE* buttons have no effect in this menu. Pressing the *MENU* button, however, will advance the user to the Event Readout displays.

Event Readout Displays

Three performance measures are tracked within the BDA, and are recorded and displayed as events. Up to 999 of each type of event is recorded. If more than this number of events are detected, the menu system will continue to display 999.

A typical display might look like this:

```
EVENTS  RECORDED:
Overheat:  008
```

Three types of service affecting events that the BDA records can be viewed within separate windows. Pressing the MENU button will sequence through these displays. The first window in the sequence displays isolation control events, the next fan performance events, and finally abnormal temperature events. A fourth menu press will display a recording of the UL and DL peak power.

After a window has been bypassed, all windows selectable thru menu presses must be viewed in order to return to the last viewed display.

Any event will cause a yellow (WARNING) LED to illuminate. The warning LED can be extinguished by resetting the appropriate event counter(s) via the EDIT menu or by cycling the primary power. Cycling primary power will reset the counters as well. Events capable of being recorded are:

- *Isolation Control:* This event is recorded whenever insufficient isolation exists between the Donor and DAS antennae. When that condition occurs, the Oscillation Event counter will be incremented. Oscillation control is implemented in the BDA control system. If an oscillation condition is detected, the BDA control circuitry will attempt to stabilize the system by immediately reducing the gain 3 dB. A warning will also be immediately displayed that shows the accumulated change on the affected link(s) e.g. [UL (003 dB attn). After a period of time, the system will recheck itself and continue to reduce the gain in 3 dB increments until the oscillation conditions no longer exists. Each gain reduction is counted as an event. At some point, if stability cannot be reached, the BDA amplifier on the affected link will be shut down. After shutdown, or at any point after stability is reached, the system will attempt to fully recover lost gain. Until the system can recover to the original gain setting, the warning LED will remain illuminated.

- *Fan Limits:* The BDA system firmware monitors fan performance. If either fan speed exceeds specified limitations, a fan event will be

recorded for each instance. A yellow LED will remain illuminated until the event counter is reset to zero. (This feature is not available in frimware version 1.1.0 and prior releases)

- *Over Temperature Limit:* Amplifier junction temperature is monitored continuously. If the temperature rises above a factory determined limit, an Overheat Event will be recorded. If the event is transitory, each excursion above the limit will increment the Overheat counter. A yellow LED will remain illuminated until the counter is reset to zero.

Event counters serve as diagnostic tools for maintenance and system health assessments. Only isolation control will alter the intended performance of the system. Fan and Overheat events have no effect on the BDA.

Pressing *MENU* within at this display will advance the user to the Peak Power Display.

Peak Power Readout Display

This display shows the highest readings that have registered on the BDA since power-up or reset.

A typical display might look like this:

```
UL  Pk  Pwr:  25
DL  Pk  Pwr:  27
```

Note that since AGC cannot act instantaneously, the peak power seen on the output might be higher than the power the unit is capable of sustaining. This is not an error, but an indication that the power did exist – briefly – at the output port. This is meant to aid in diagnostics if necessary.

Pressing the *MENU* button will advance the user to the Downlink Gain display.

Gain Display

This display indicates the gain applied to the uplink or downlink pass band. These values might differ if an offset has been applied.

A typical gain display might look like this:

```
UL  Gain:  67  dB
DL  Gain:  67  dB
```

Pressing the *MENU* button will advance the user to the BDA Name Display.

BDA Name and Address Display

In addition to its name, a BDA can be uniquely identified on a network with a Web Monitor by its name. The name here is identical to the one in the Screen Saver Display. The BDA name is limited to seven characters. Each BDA accesible by a single Web Monitor on the network must have a unique address within that network between one and seven, inclusive. This display also shows the current BDA's network address.

A typical BDA name and address display might look like this:

```
Name:  AMPS007
Addr:  1
```

Pressing the *MENU* button will return the user to the Screen Saver display.

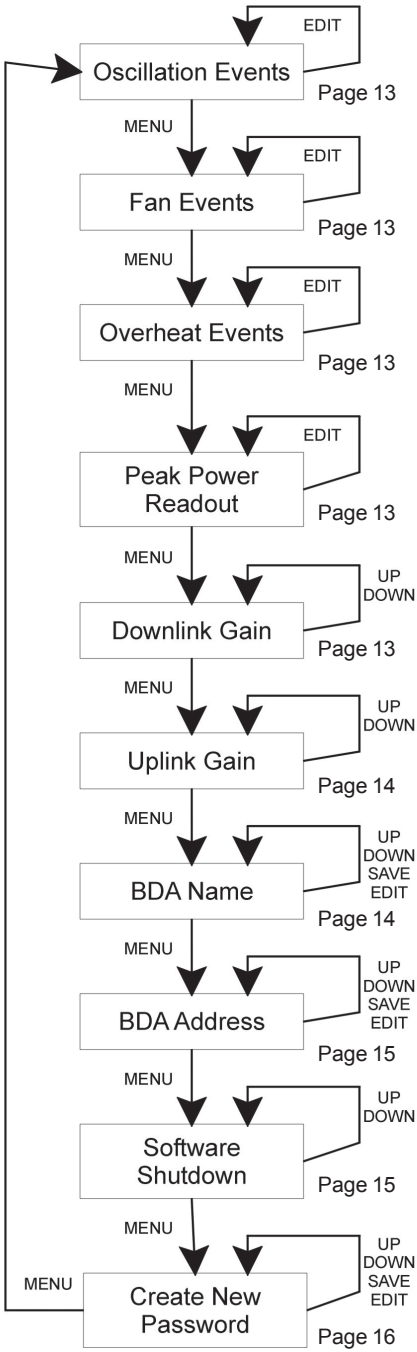
Note that pressing the *EDIT* button in any of these displays will cause the BDA to enter the EDIT menu series. A password will be requested from the user if password control has been invoked. Successful password entries will permit the user to enter the Edit Menu Series; unsuccessful entries will cause the BDA to revert to the Screen Saver display. The password menu does not belong to either the View Menu Series or the Edit Menu Series. It is shown here for completeness.

A typical password entry display might look like this:

```
Enter  Password:
1  2  3
```

Each password consists of a series of five button presses. None of the buttons can be *MENU*. Pressing the menu button or entering an invalid key in the password key sequence will cause an immediate exit to the Screen Saver display. In order to keep the password masked as it is entered, the bottom row reveals how many keys have been entered in the password thus far. In the example shown, then, three out of the five-key presses have been received and validated. Regardless of which display the user was viewing prior to entering the password mode, successful password entry will take them to the Edit Oscillation Events display.

The Edit Menu Series



Edit Menu Tree

This series of menus will allow the user to alter the information stored in the BDA. These menus are only accessible if the user has a *password* if password control is invoked. After getting into this sequence of menus, the user can save all changes made by pressing ***SAVE***. Pressing this button exits the Edit Menu Series, however, so it is advisable to make all changes desired beforehand. (The Edit BDA Name menu is an exception; refer to the documentation for details.) If no button is pressed within ten minutes of the last press, these menus will be exited and no changes made will be saved.

Note the documentation to determine the function of the buttons in each of the menus.

The password to enter the Edit Menu Series defaults to the following sequence until changed by the user:

UP, DOWN, DOWN, UP, UP

Edit Events Display

These displays will show you the number of events recorded in each of three categories (Oscillation, Fans, Overheat). Each MENU button press will move to the next display. At any event category, pressing *EDIT* will clear the counter and rest the number of events to zero.

To indicate that you are currently in the EDIT series, the first word in the top line of the display will always be EDIT followed by the name of the display.

A typical EDIT EVENTS display might resemble the following:

```
EDIT EVENTS:
Overheat:  008
```

Edit Peak Power Readout Display

This display will show the same information indicated in the View Menu Series, however, pressing *EDIT* clears the peak power readings and captures the current values.

A typical display might look like this:

```
Edit UL Pk:  25
Edit DL Pk:  27
```

Pressing *MENU* at this point will cause the BDA to enter the Edit Downlink Gain display.

Edit Downlink Gain Display

In this window the downlink gain can be altered, however it cannot be adjusted lower than the difference between the calibrated maximum output minus 30 dB (max gain -30 dB). The range of the attenuators in either the uplink or the downlink imposes this constraint. Within that permissible range, the values can be changed in 1 dB increments by pressing the UP or DOWN keys. If an attempt is made to change the gain value beyond a 30 dB range, the value will increment to the highest or lowest acceptable value depending on which end of the constraint the attempt is initiated.

By example, for an 80 dB gain amplifier the minimum gain setting is 50 dB. Pressing the DOWN key when 50 dB of gain is currently being displayed will return gain setting to 80 dB. Likewise, if the gain setting is at 80 dB, pressing the UP key will change the gain to 50 dB.

Using another illustration, an amplifier having a maximum gain of 62 dB will have a minimum gain setting of 32 dB.

A typical downlink EDIT Display may look like this:

```
Edit DL Gain:
(max 80 dB) 62
```

The *MENU* button will take the user to the Edit Uplink Gain display.

Edit Uplink Gain Display
This display is functionally identical to the Edit Downlink Gain dispaly, but alters the gain through the uplink pass band instead of the downlink pass band.

A typical uplink EDIT Display may look like this:

```
Edit UL Gain:
(max 80 dB) 62
```

Pressing the *MENU* key here will take the user to the Edit BDA Name display.

Edit BDA Name Display
This display will let the user set a new name for the BDA for identification purposes on a Web Montior network. This also changes the name shown on the Screen Saver display and the BDA Name display. A name can consist of uppercase letters, lowercase letters, numerals, and/or blank spaces.

A blinking cursor shows the user which letter they are editing; the edit process is executed from left to right. In any cursor position, characters are selected by using the UP and DOWN buttons. Once the user has selected the letter for that position, *SAVE* will lock that letter into that position and advance the cursor to the right. Pressing *EDIT* will back the cursor up one space and permit the user to edit that letter again using the same process. One cannot back up beyond the first character. Pressing *SAVE* on the seventh character will cause the BDA to advance to the Edit BDA Address display, as will pressing *MENU* at any time. Pressing *MENU*, however, will cancel any changes that the user has made to the BDA name.

A typical display for this menu might look like this:

```
Edit BDA Name:
AMP_007
```

Example: In the above display the cursor shows that the user is at the fourth character position. In the below display the user has used the UP and DOWN buttons to select “S”. The cursor at that position will blink intermittently, alternating with the character currently stored at that position:

```
Edit BDA Name:
AMPS007
```

Continuing the example, pressing *UP* at this point will illustrate the advancement of the character at the current position to “T”:

```
Edit BDA Name:
AMPT007
```

Edit BDA Address Display

This screen permits the setting of a new address for a BDA on a Web Monitor network. Valid values are from one to seven, inclusive. Care must be taken in this menu not to set the address to that of another BDA on the same Web Monitor network.

The different addresses permissible are presented in cyclical fashion.

A typical display might look like this:

```
Edit BDA Address
(Range 1-7): 1
```

Pressing *UP* and *DOWN* will scroll through the different valid addresses. Pressing *MENU* will exit to the next screen: the Software Shutdown display.

Software Shutdown display

A software shutdown will prevent the BDA from functioning and will cease data acquisition by the BDA processor. There are only two modes available, and they can be selected by pressing *UP* and *DOWN*: NORMAL, which is the regular form of BDA operation, and SHUTDOWN, which performs a software shutdown of the BDA.

A typical display might look like this:

```
BDA Operation:
   NORMAL
```

Once the BDA is shut down through software, the FAULT (red) LED will glow.

When the BDA operation mode is returned to NORMAL, the FAULT LED will extinguish.

Pressing the *MENU* button at this point will cause the BDA to display the Create New Password display.

Create New Password Display

This display will allow the user to enter a new password. The display, however, will not be viewable until password control is invoked by first pressing the proper keys simultaneously (EDIT and MENU). This operation will either enable the default password (UP, DOWN, DOWN, UP, UP) if no password change has ever been implemented, or the current password. Either password sequence will be required to authorize a new password. Pressing EDIT and MENU again will toggle the password off. This process will require the current password to complete the action.

Pressing any button after a new sequence has been entered will cause that sequence to be stored. Pressing MENU at any time during the sequence will abort the process and revert to the most recent password. If a change is successful, the new password will be required for future changes to be enabled.

Password control cannot be disabled without authorizing the mode change using the current password.

The change password process is much the same as the PASSWORD ENTRY process described earlier.

The display that asks for the current password looks like this:

```
Old Password:
1 2 3 4
```

Once this has been entered, the request for the new password looks like this:

```
New Password:
1 2 3 4
```

A password can *only* consist of the buttons *UP*, *DOWN*, and *SAVE*, since *EDIT* and *MENU* have global functionality.

Pressing *MENU* will abort this and return to the Edit Events display.

None of the changes invoked take effect unless the user presses *SAVE*. Once this input occurs, all changes are saved to non-volatile memory and the

BDA returns to the Screen Saver display. If the BDA does not detect any key presses within ten minutes of the last key press, the BDA will discard all changes made in the Edit Menu series since the last password entry and revert to the Screen Saver display.

Final Note: If the BDA should become unstable, and none of these menu commands are operable, the processor can be reset to factory defaults by pressing and holding the *UP*, *DOWN*, and *MENU* buttons simultaneously for one second. This is a catastrophic recovery measure and should not be implemented unless all other procedures have failed.

Troubleshooting

All cables should be carefully checked for “shorts” and “opens”.

The rooftop antenna, if directional, should be checked for proper alignment along the calculated compass heading. Typically, the directional antenna should be aimed at the same site that your handset uses in the area where the outside antenna is placed.

If cables and alignment are acceptable, it may be necessary to use a spectrum analyzer to examine the signal environment in which the BDA is operating. The existence of strong analog signals within the frequency bands can cause the AGC to reduce the amplifier’s gain particularly on the downlink. In some cases additional filtering might be required to reject these unwanted signals. In some instances the directional outside antenna can be reoriented, horizontally to place the interfering source in an antenna pattern “null”. There also may be some cases where the interference from outside signals is so great that they can not be filtered or otherwise reduced or eliminated without expensive and possibly prohibitive measures. In these cases it may not be practical to use the BDA for providing coverage at these sites.

One Year Limited Warranty

Seller warrants that its products are transferred rightfully and with good title; that its products are free from any lawful security interest or other lien or encumbrance unknown to Buyer; and that for a period of one year from the date of installation or fifteen months from the date of original shipment, whichever period expires first, such products will be free from defects in material and workmanship which arise under proper and normal use and service. Buyer's exclusive remedy hereunder is limited to Seller's correction (either at its plant or at such other place as may be agreed upon between Seller and Buyer) of such defects by repair or replacement at no cost to Buyer. Transportation costs in connection with the return of products to Seller's plant or designated facility shall be paid by Buyer. The provisions of this warranty shall be applicable with respect to any product which Seller repairs or replaces pursuant to it. SELLER MAKES NO WARRANTY, EXPRESS OR IMPLIED, OTHER THAN AS SPECIFICALLY STATED ABOVE. EXPRESSLY EXCLUDED ARE THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR PURPOSE. THE FOREGOING SHALL CONSTITUTE ALL OF SELLER'S LIABILITY (EXCEPT AS TO PATENT INFRINGEMENT) WITH RESPECT TO THE PRODUCTS. IN NO EVENT SHALL SELLER BE LIABLE FOR SPECIAL, CONSEQUENTIAL OR INCIDENTAL DAMAGES, INSTALLATION COSTS, LOST REVENUE OR PROFITS, OR ANY OTHER COSTS OF ANY NATURE AS A RESULT OF THE USE OF PRODUCTS MANUFACTURED BY THE SELLER, WHETHER USED IN ACCORDANCE WITH INSTRUCTIONS OR NOT. UNDER NO CIRCUMSTANCES SHALL SELLER'S LIABILITY TO BUYER EXCEED THE ACTUAL SALES PRICE OF THE PRODUCTS PROVIDED HEREUNDER. No representative is authorized to assume for Seller any other liability in connection with the products.

Industry Certifications/Registration Numbers:
FCC: NVRCSI610-S9; NVRCSI610-S89
NVRCSI510-S9; NVRCSI510-S89

D960-1032-001 REV B ECO 1411

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