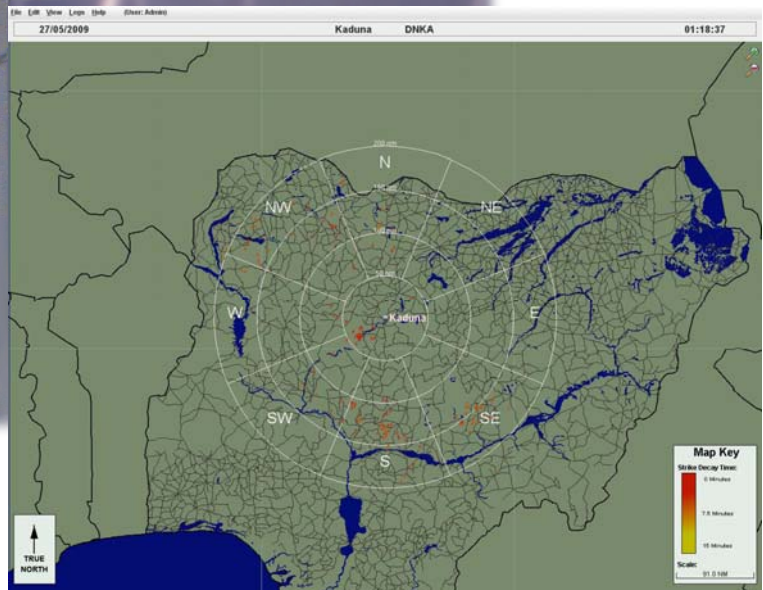
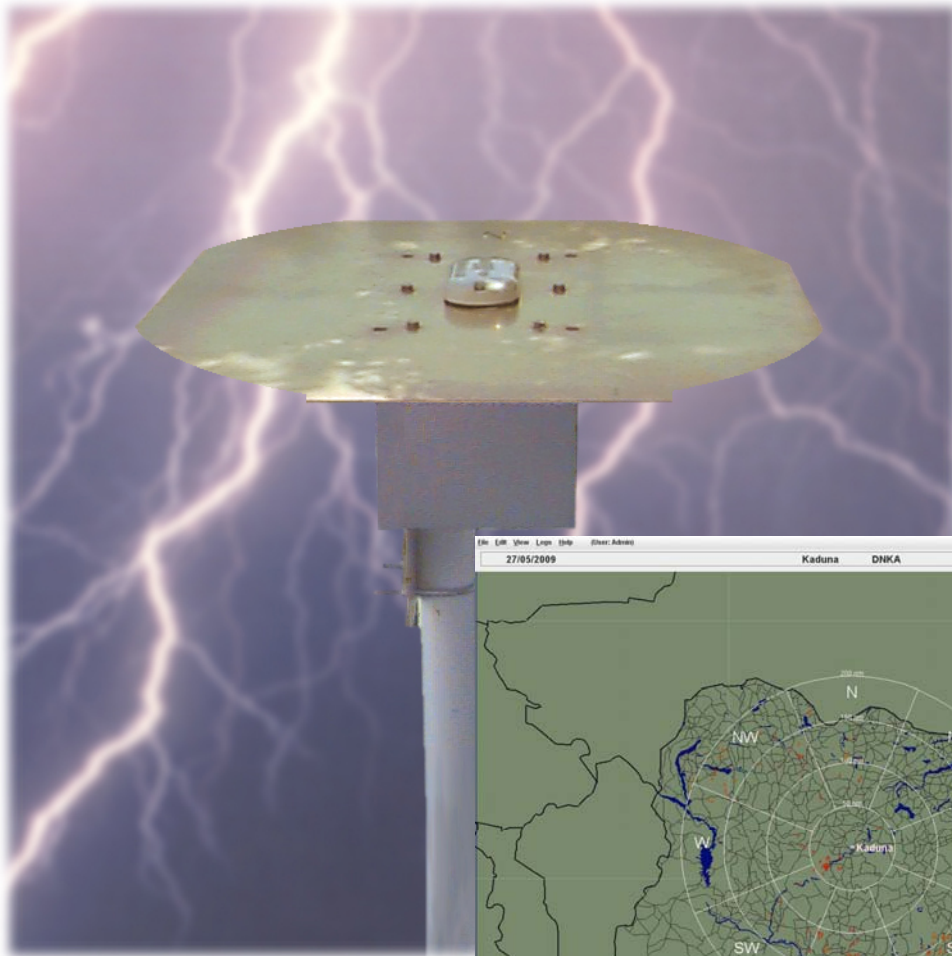




Thunderstorm/Lightning Sensor and Graphic Display User's Manual



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Introduction

The Model 6502 Thunderstorm/Lightning Sensor detects electrical discharges associated with thunderstorms within a 200 nautical mile (nm) radius of the system. The Model 6502 is a passive sensor that listens for electromagnetic signals with a receiving antenna. There is no transmitter, and so no harmful transmissions.

The entire package (consisting of an antenna mounted to a 28" x 32" ground plane, and a processor and interface board housed in a NEMA 4X enclosure) mounts simply to a 2½" pipe (2.875" O.D.) using two U-bolts.

The Graphic Display shows detected strikes overlaid onto a map of the monitored area. A set of pull-down menus allows the user to configure the display and to add labeled locations to the map.

Sensor Theory of Operation

Detection

The Model 6502's antenna is a combined crossed-loop and sense antenna, which can correlate the electric and magnetic signatures of lightning strikes better than other systems due to its patented sense channel technology. The antenna has been designed to help filter out pulsed noise from sources other than atmospheric electrical discharges.

The antenna detects the electrical and magnetic fields generated by intra-cloud, inter-cloud, or cloud-to-ground electrical discharges that occur within a 200 nm radius of the antenna, and sends the resulting 'discharge signals' to the processor. The processor digitizes, analyzes, and converts the discharge signals into range and bearing data, then stores the data in memory.

Processing

The Model 6502's processor is housed inside the sensor enclosure along with the Interface Board. The processor includes data acquisition circuitry and circuitry to process strike data. The Interface Board provides a data buffer and handles communication.

The sensor transmits a data package consisting of strike data and status information every five seconds. When errors are detected, the errors are recorded in an error log.

Reporting

The Model 6502 detects the presence of a thunderstorm or lightning event within 200 nm from the point of installation.

1. Range and Direction

Reports thunderstorms/lightning within a 200 nm radius from the installation point.

2. Resolution

Location of thunderstorm is ± 1 nm from actual location of the thunderstorm/ lightning.

4. False Reports

Not more than 2%.

Sensor Installation & Checkout

The Thunderstorm/Lightning Sensor package (consisting of an antenna mounted to a 28" x 32" ground plane and a processor housed in a NEMA 4X enclosure) mounts to a 2½" pipe (2.875" O.D.) using two U-bolts. A section of 2.5" (64 mm) I.D. standard galvanized steel pipe can be used as a mast with no drawbacks or special adaptation. Refer to the site preparation instructions and applicable drawings for foundation, grounding, conduit, and junction box installation details.

CAUTION

The Thunderstorm/Lightning Sensor's ground plane extends well beyond the edges of the sensor enclosure. Be aware of this hazard when working around the sensor.

RFI/EMI Precautions

The Model 6502's antenna is sensitive to static charges, so care must be taken to ensure that the antenna and ground plane are as far removed as possible from composite materials (e.g., plastic materials or fiberglass), since these materials have a tendency to build up static charge.

The sensor should be mounted as far as possible from devices that emit high levels of radio frequency interference (RFI) and electromagnetic interference (EMI), such as VHF and UHF radios, RF modems, fluorescent lamps, and ballasts, air conditioner and heater blowers, as well as any current-carrying cables. General clearance guidelines are:

- Strobe lamps and power supplies - 5 ft (1.5 m)
- Fluorescent lamps and ballasts - 5 ft. (1.5 m)
- Air conditioners and heater blowers - 5 ft. (1.5 m)
- Telephone antennas - 4 ft. (1.2 m)
- VHF communication antennas - 1 ft. (0.3 m)
- Any current-carrying cable - 2 ft. (0.6 m)

In addition to the above restrictions, certain site installations may have to be scrutinized more carefully from an RFI/EMI perspective. Finding locations to mount the ground plane and antenna that will minimize interference from RFI/EMI sources can be enhanced by the use of standard RFI measuring equipment. The recommended equipment for monitoring the proposed installation area is a typical spectrum analyzer with a broadband conical antenna. The spectrum analyzer should be set up to scan the frequencies of concern (100-500 MHz) for the typical VHF and UHF radio links near the installation. Once it has been determined that there is significant interference, it is imperative that the lightning sensor be moved to a location as far from the interfering device as possible. *Under no circumstances should the lightning sensor antenna and ground plane be placed within one foot of either a VHF or UHF transmitting antenna.*

Sensor Installation

After installing the mast, conduit, and junction box, follow the instructions below for assembling and installing the sensor.

- 1 If the signal and power cables have not already been installed between the signal and power distribution boxes and the sensor pad, pull the required lengths of cable through conduit to the junction boxes at the sensor pad.
- 2 (See **Figure 1**). The mounting bracket attaches to the underside of the 6502 enclosure with 4 bolts. Position the bracket against the underside of the enclosure so that the mounting holes in the bracket and enclosure align.
- 3 Apply RTV 162 to the threads of the four 5/16" hex mounting bolts.
- 4 Fasten the bracket to the enclosure with the four 5/16" hex bolts, flat washers, and lock washers.
- 5 Tighten the bolts.

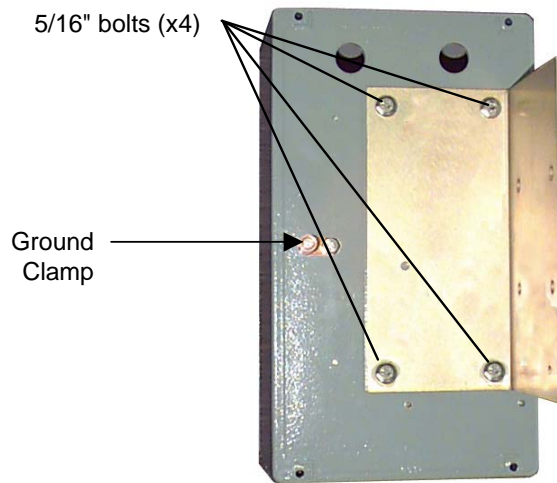


Figure 1. Bracket installation

- 6 Set the sensor package (antenna, ground plane, enclosure, and bracket) on the mast, and fasten loosely with two U-bolts, lock washers, and flat washers as shown in **Figure 2**.

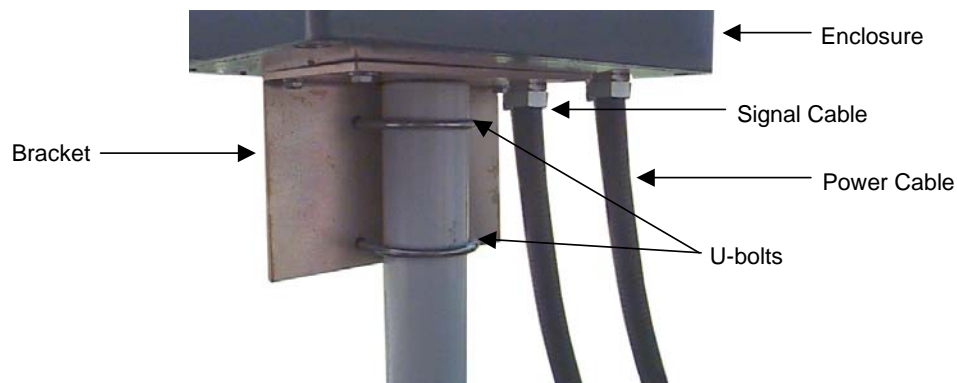


Figure 2. Sensor package mounting

- 7 Align the antenna to **True North**.
- 8 Tighten the two U-bolts.

- 9 Open the sensor enclosure by loosening the four countersunk bolts shown in **Figure 3**. **Do not remove** the six bolts holding the ground plane to the enclosure lid.

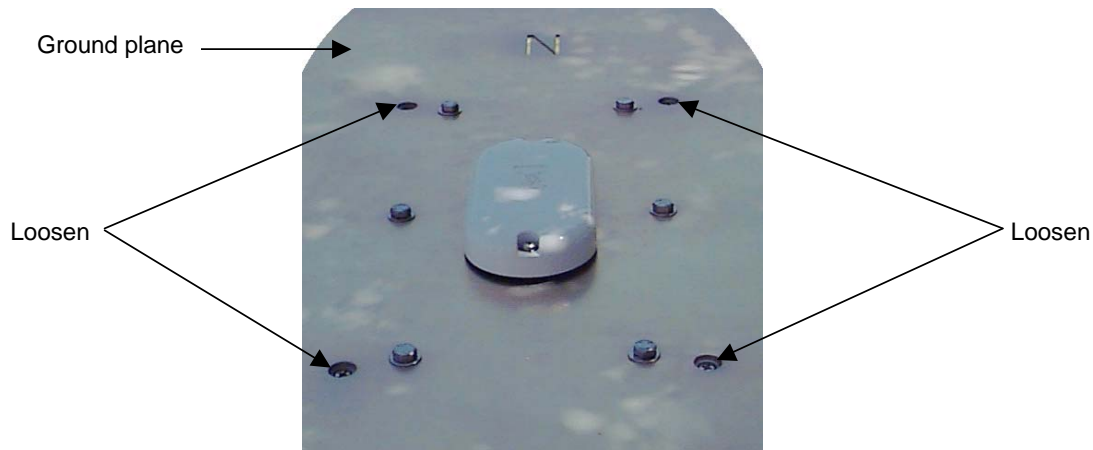


Figure 3. Opening the sensor enclosure

- 10 The sensor enclosure lid is equipped with hinged bolts (see **Figure 4**) to allow the box to be opened with the ground plane attached. Grasp both sides of the ground plane and lift straight up as far as possible (about 3"), then tilt the ground plane and lid over carefully to gain access to the enclosure interior. When fully open, the ground plane will rest against the side of the enclosure.



Figure 4. Enclosure hinges

- 11 Connect the incoming AC power wires to the AC interface board inside the enclosure (**Figure 5**) according to **Table 1**.
- 12 Close the enclosure lid and tighten the four countersunk bolts.
- 13 Fasten a ground wire between the ground cable installed during site preparation and the ground clamp on the underside of the enclosure (see **Figure 1**).

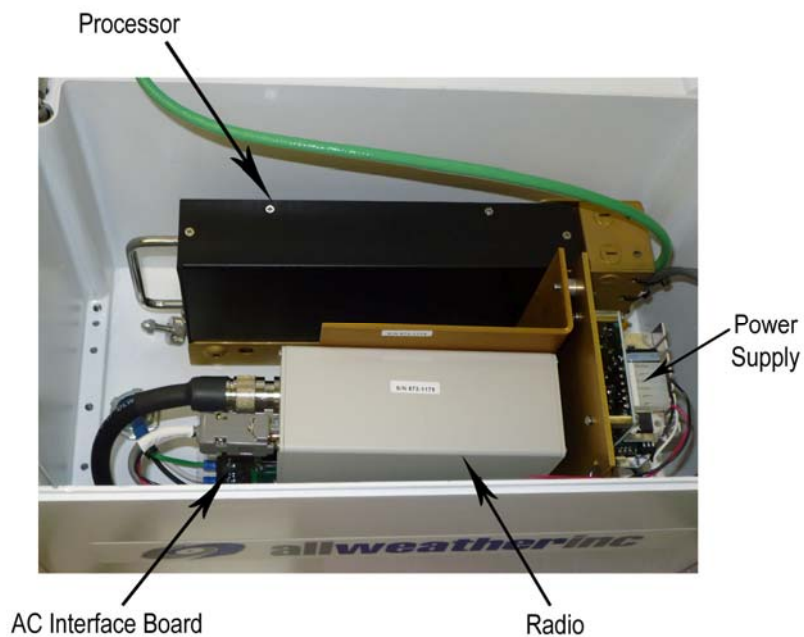


Figure 5. Interface board

Table 1. Lightning detector power wiring.

AC Interface Board TB1 Pin	Function	Color
1	HOT	BLACK or BROWN
2	NEUTRAL	WHITE or BLUE
3	GROUND	GREEN

AC Interface Board TB1

1	○	HOT (BLACK or BROWN)
2	○	NEUT (WHITE or BLUE)
3	○	GND (GREEN)

220V	AC
Neutral	
Ground	

Or

AC Interface Board TB1

1	○	HOT (BLACK or BROWN)
2	○	NEUT (WHITE or BLUE)
3	○	GND (GREEN)

110V	AC
110V	
Ground	

Checkout

To verify the sensor is working properly, power the sensor up and verify that, after one minute of operation, data is reported from the sensor. *(Bear in mind that, in the absence of lightning in the measuring area, the data screens will report no strikes.)*

Graphic Display

Lightning data is viewed on a graphic display that shows detected strikes overlaid onto a map of the monitored area (Figure 6). A set of pull-down menus allows the user to configure the display and to specify areas of interest for display on the map.

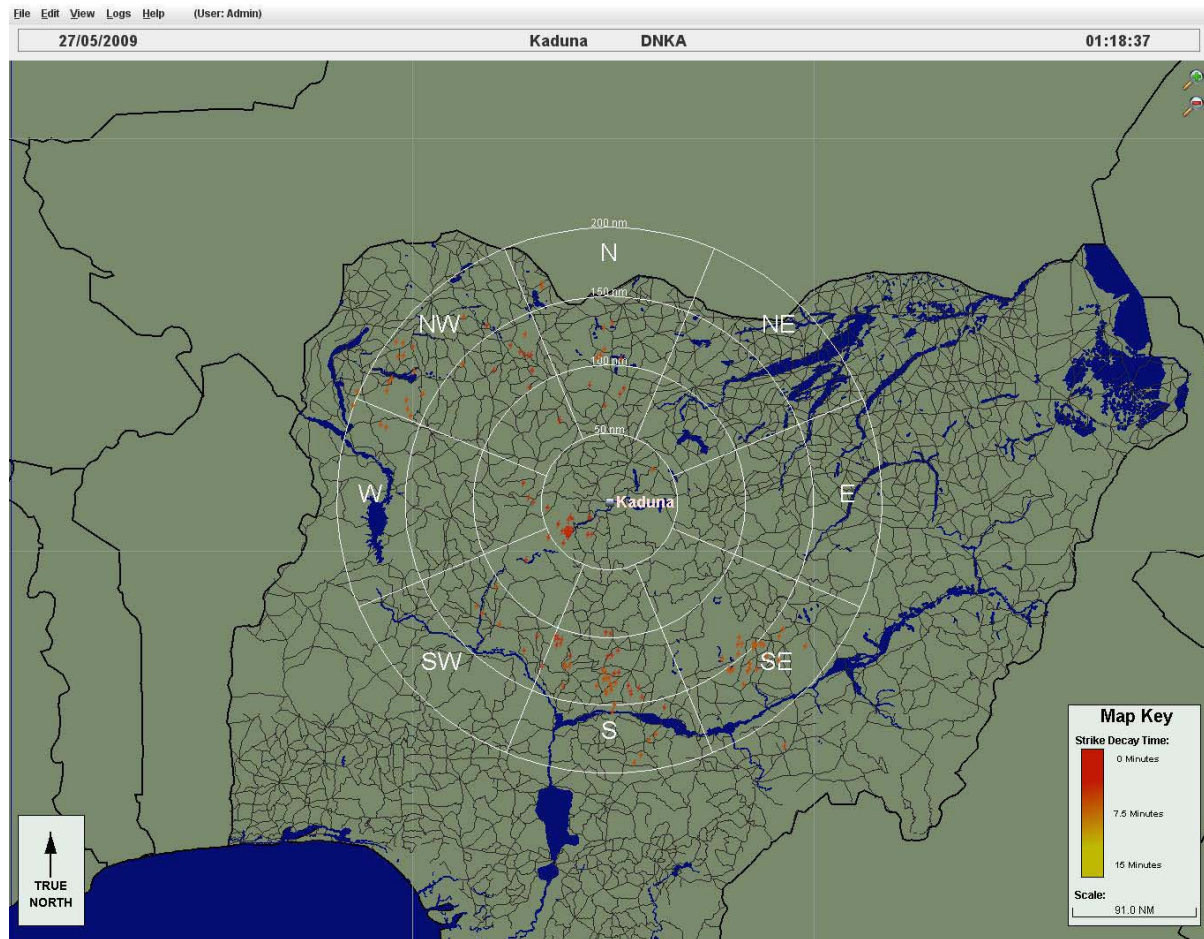


Figure 6. Lightning Graphic Display

The graphic display provides a strike locator overlaid on a map of the area being monitored. The strike locator indicates both distance and direction of strikes using a grid of four concentric rings (representing distance ranges from the center point) combined with directional octants. The center point of the locator is normally the site of the lightning sensor, and is entered by the user through the **Lightning** tab on the *Edit>Configuration* menu.



Each distance ring represents an increased distance from the locator's center point of 50 nautical miles:

- The innermost ring of the locator shows strikes detected within 50 nautical miles of the center point.
- The next ring out shows strikes within 100 nautical miles of the center point.
- The third ring out shows strikes within 150 nautical miles of the center point.
- The outermost ring shows strikes within 200 nautical miles of the center point.

The directional octants divide the strike locator into eight distinct compass directions, making it simple to quickly identify the direction and distance of detected lightning strikes.

Zooming In and Out

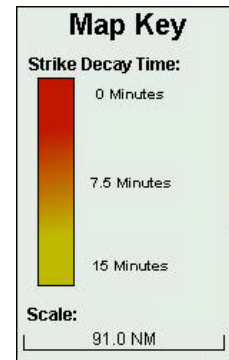
The zoom icons in the upper right of the display allow you to zoom the map view in and out.

- Click the  icon to zoom in to view a smaller area of the map.
- Click the  icon to zoom out for a wider picture.

Map Key

Once a strike has been detected, it remains visible on the screen for the length of time specified in the **Decay Time** option on the *Configuration* menu (*see page 18*). In order to provide a graphic view of strikes over time, the color of the strike changes as it ages. As the **Map Key** in the lower right corner of the display shows, new strikes are shown in red. As they age, they become progressively lighter in color, changing to orange, then yellow, until they finally disappear from the map. In the example, the *decay time* has been set to 15 minutes.

The *Scale* indicator at the bottom of the key shows the distance scale for the currently displayed map.



Menus

File Menu



The ***File*** menu contains options for logging in and out, printing, and window control.

Login

The ***Login*** option is used to log in to the system as a User. Each User has access to specific screens and functions, as set by the administrator through the ***User Authorizations*** and ***Group Authorizations*** options on the ***Edit*** menu. The use of these options is explained in detail in the next section.

- To log in, select a User from the pull-down menu.
- Enter your password in the **Password** field, then click **OK**.
- The User name under which you are logged in will be shown in parentheses at the top of the screen, and all applicable menu options will now be available.

Use the area below to record your system's username and password:

Username _____

Password _____

Logout

To log out of the current group, click **Logout**. All menu options requiring login will be grayed out.

Print

The **Print** option lets you print the current lightning display. When you click **Print**, the standard Windows print screen will be displayed.

Print Preview

The **Print Preview** option lets you see a preview before printing of what the **Print** command will output to the printer.

Page Setup

The **Page Setup** option lets you set printing preferences. Clicking **Page Setup** will call up the standard Windows printing options screen.

Minimize

Click the *Minimize* option to minimize the display. The software will continue running when minimized. To restore the display to full screen, click the **AWI MetObserver** icon on the application toolbar at the bottom of the screen.

Exit

Click the *Exit* option to close the software. After exiting, the software will continue to run as normal.

Edit Menu



The ***Edit*** menu contains options for setting up group and user authorizations, configuring the display, configuring ports, and setting “points of interest”.

Group and User Authorizations

The display software is highly configurable through a series of user menus. Often, though, configuration changes may best be restricted to authorized users. The Group and User structure of the software allows permission to be allocated as required to control access and maintain the integrity of system operations. Authorization menus are generally only available to Administrators, though those permissions can be given to other groups as well.

- **Group Authorizations** allow administrative functions to be enabled or disabled, and access to the three data views to be assigned.
- **User Authorizations** grant group membership to individual users. A user can belong to one or more groups. On logging in, the user will be granted access to all the functions allowed for each group in which he has membership.
- Authorization changes take effect immediately on exiting a configuration dialog and returning to the main display.

Group Authorizations

The **Group Authorizations...** option allows administrators to set group permissions.

- To configure group permissions, log on as an authorized user with Admin rights and select *Edit>Group Authorizations* to call up the screen shown in Figure 7.



Figure 7. Group Authorizations Screen

The Group Authorizations screen lists all current groups and the authorized features available to each. The **Authorization Name** shows the name of the group, followed by a series of checkboxes that shows the functions a group is authorized to access. A function is accessible when it is checked. The table below explains each of the functions.

Function	When Checked
Admin	Gives the group administrative privileges, including Group and User Authorization
Config	Lets the group change configuration settings (<i>Edit>Configuration</i>)
Logs	Lets the group view and retrieve data logs (<i>Logs</i> menu)
Lightning View	Lets the group select the Lightning view from the <i>View</i> menu

Adding a Group

To add a new group, click the **New** button at the bottom of the screen. The screen shown in Figure 8 will be displayed.

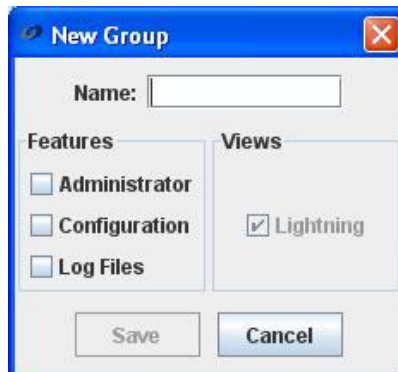


Figure 8. New Group Screen

- Enter a name for the group.
- Select all the features from the **Features** panel that you want the group to have access to.
- Select all the views from the **Views** panel that you want the group to have access to.
- Click **Save** to add the group.
- Click **Cancel** to return to the Group Authorizations screen without adding the group.

Editing a Group

To edit a group's authorizations, highlight a group on the list and click the **Edit** button at the bottom of the screen. The screen shown in Figure 9 will be displayed.



Figure 9. Edit Group Screen

- Check or uncheck **Features** and **Views** to enable (check) or disable (uncheck) access.
- Click **Save** to save the changes.
- Click **Cancel** to return to the Group Authorizations screen without saving the changes.

Deleting a Group

To delete a group, highlight the group name on the Group Authorizations screen and click the **Delete** button at the bottom of the screen. The group will be deleted immediately.

*Note: You cannot delete a group that has a user associated with it. The **Administrator** group cannot be deleted.*

User Authorizations

The **User Authorizations...** option allows authorized users to define new users and associate them with the appropriate groups.

- To configure user permissions, log on as an authorized user with Admin rights and select *Edit>User Authorizations* to call up the screen shown in Figure 10.

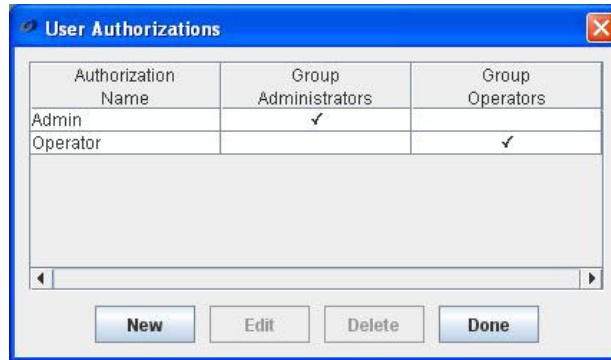


Figure 10. User Authorizations Screen

The User Authorizations screen lists all current users along the left side and all existing groups along the top. The **Authorization Name** shows the name of the user, followed by a checkbox for each available group. A checkmark beneath a group indicates that the user is a member of that group with access to all the features associated with the group.

Adding a User

To add a new user, click the **New** button at the bottom of the screen. The screen shown in Figure 11 will be displayed.

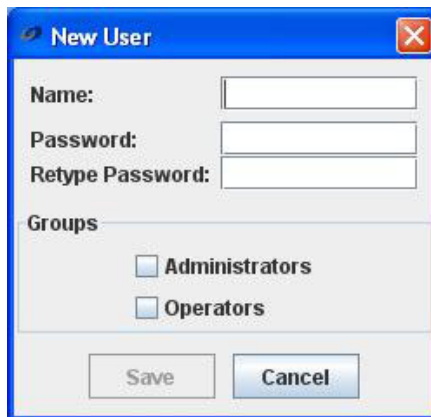


Figure 11. New User Screen

- Enter a name for the user.
- Enter a password for the user.
- To confirm the password, re-enter it in the **Retype Password** field.
- Select each of the groups in the **Groups** panel to which the user will belong.
- Click **Save** to add the user.
- Click **Cancel** to return to the User Authorizations screen without adding the user.

Editing a User

To change a user's password or change the groups the user belongs to, highlight the user's name on the list and click the **Edit** button at the bottom of the screen. A screen similar to that shown in Figure 12 will be displayed.



Figure 12. Edit User Screen

- To change the user's password, enter a new password in the **Password** field.
- To confirm the password, re-enter it in the **Retype Password** field.
- Check or uncheck groups in the **Groups** panel to set the groups to which the user will belong.
- Click **Save** to save the changes.
- Click **Cancel** to return to the User Authorizations screen without saving the changes.

Deleting a User

To delete a user, highlight the user's name on the User Authorizations screen and click the **Delete** button at the bottom of the screen. The user will be deleted immediately.

Configuration

When you select **Configuration** from the *Edit* menu, the main configuration screen (Figure 13) appears. This screen contains a series of tabs that provide access to the various configuration functions.

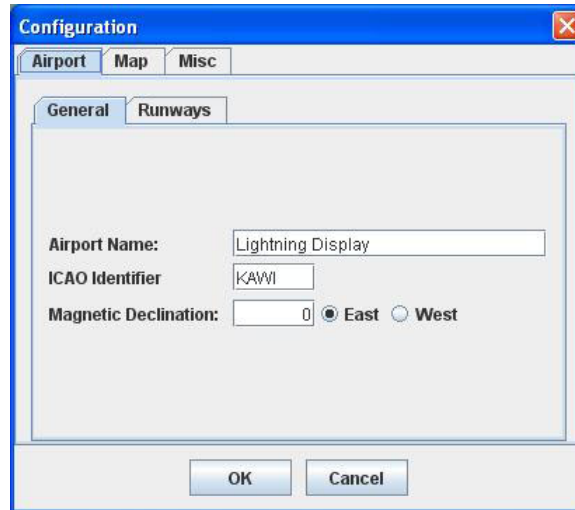


Figure 13. Configuration Menu – Airport General Tab

- To access a configuration category, click the appropriate tab at the top of the screen.
- The *Airport* and *Misc* categories also provide secondary tabs that group similar options under a common heading.

Airport Tab

The **Airport** tab (Figure 13) contains two sub-tabs: *General* and *Runways*.

General

The *Airport>General* tab contains several options unique to the airport location.

General	
Airport Name	The name entered here will be shown at the top of the display.
ICAO Identifier	The four-letter ICAO airport identifier or three-digit airport identifier.
Magnetic Declination	The display map is oriented to True North; this option allows you to enter a site's magnetic declination, so that the strike locator is oriented to Magnetic North. When a value is entered here, the strike locator will rotate on the screen to a Magnetic North orientation. When entering a magnetic declination, you must also specify East or West declination by selecting the <i>East</i> or <i>West</i> button.

Runways

The *Airport>Runway* tab (Figure 14) contains a single field for specifying the ID of the runway where the lightning sensor is installed.

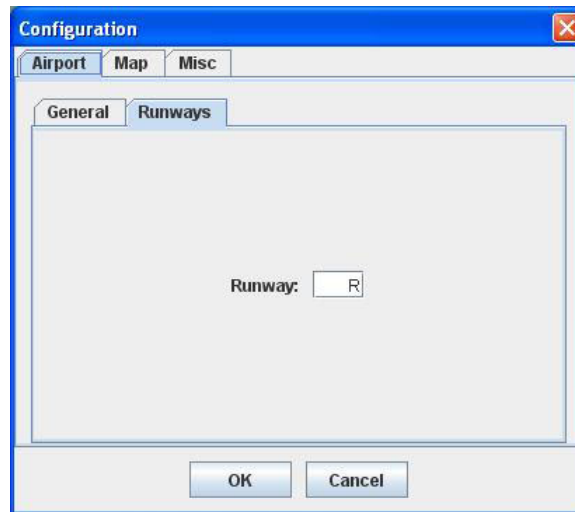


Figure 14. Airport Runway Tab

Runways	
Runway	Enter the number/designation of the runway associated with the lightning sensor. The value can consist of a 2-digit number from 1-36, or up to four text characters. When a numeric value is entered, it can be followed by an optional auxiliary designator (R or L, for example).

Map Tab

The **Map** tab (Figure 15) lets you specify the center point of the lightning display and set the decay time for strikes.

	Degrees	Minutes	Seconds
Latitude:	7.0	7.0	60.0
Longitude:	4.0	13.0	0.0

Decay Time

15 Minutes

Figure 15. Lightning Tab

- In the **Center Point** panel, enter the latitude and longitude of the location you would like to set as the center of the lightning map.
- In the **Decay Time** field, enter the number of minutes for a strike indicator to remain on the screen. As the strike ages over this time period, it will change color. When the decay time period has elapsed, the strike will be erased. The value entered here will be reflected in the map key.
- When done, click **OK**.

Misc Tab

The **Misc** tab lets you specify the number of days to retain logs in the system before deleting them, and set the system time.

General Tab

In the text box under the **General** tab (Figure 16), enter the number of days the system should maintain log files before overwriting them. The value can be anywhere in the range of 4 days to 999 days.

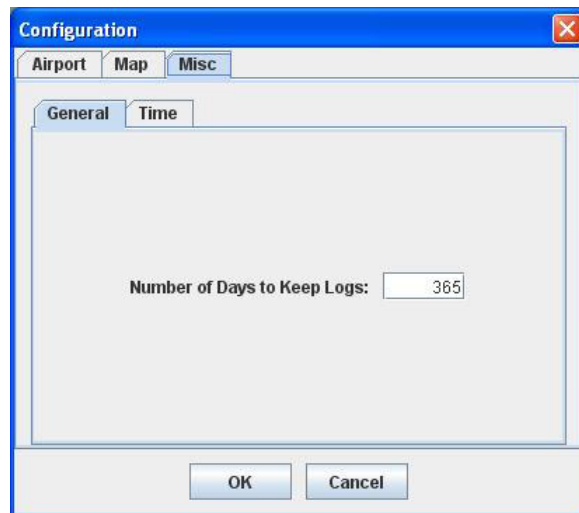


Figure 16. Logs Tab

Time Tab

Use the **Time** tab (Figure 17) to set the GPS receiver as the time source for the software or to manually enter the time and date. **Use GPS Time** should be selected in normal operation; disable only if the GPS Receiver fails or is not installed.

- Select **Use GPS Time** to obtain time and date data from the GPS Receiver.
- To specify the time and date manually, uncheck the **Use GPS Time** box and enter the date and time in the corresponding fields. To change the date, click the calendar icon to call up a monthly calendar, then click the appropriate date. To change the time, click within each time field and manually enter a value. This option will use the computer's built-in clock, which is less accurate than the GPS Receiver.

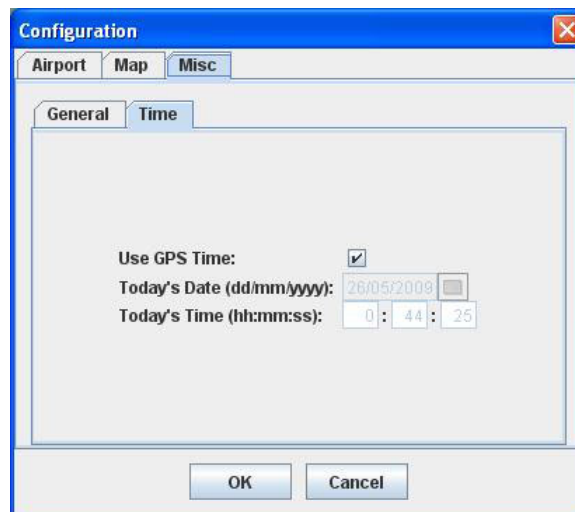


Figure 17. Time Tab

Port Configuration

The **Port Configuration** option (Figure 18) is used to specify the communication ports used by the lightning sensor and GPS. It also provides the option of scanning a range of ports periodically.

- In the **Lightning Sensor Port** field, enter the number of the port the lightning sensor is connected to. Enter only the number; if the sensor is connected to COM 1, for instance, enter “1”.
- In the **Port** field of the **GPS** panel, enter the number of the port the GPS is connected to. This is a USB port, so the number is assigned automatically by the operating system and will always be at least 1 greater than the number of physical ports. To see the assigned port number, follow the steps below with the GPS connected:
 - Go to *Start>Control Panel>Performance and Maintenance>System*, select the *Hardware* tab, then click **Device Manager**.
 - On the device list, click the + sign beside the **Ports (COM & LPT)** heading to expand it and show the list of serial ports.
 - Note the port number for the GPS.
- The **Scan Ports** option initiates a periodic scan of serial ports to detect the GPS if its port number has changed. This can happen if the GPS has been plugged into a different USB port or if another USB device has been connected. In the **Scan Start Port** field, enter the lowest USB port number (1 greater than the number of physical ports). In the **Scan End Port**, enter the highest port number to scan. The maximum is 255.
- When done, click **OK** to save the settings.

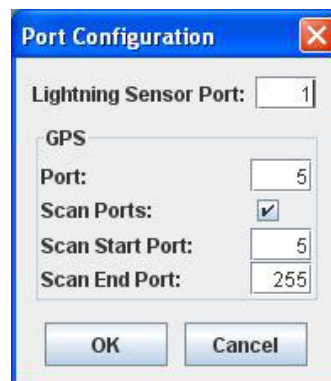


Figure 18. Port Configuration

Points of Interest

The **Points of Interest** option (Figure 19) on the *Edit* menu lets you add reference locations to the map on the main display. Once entered, the names of the points of interest will be shown on the main display at their specified locations.

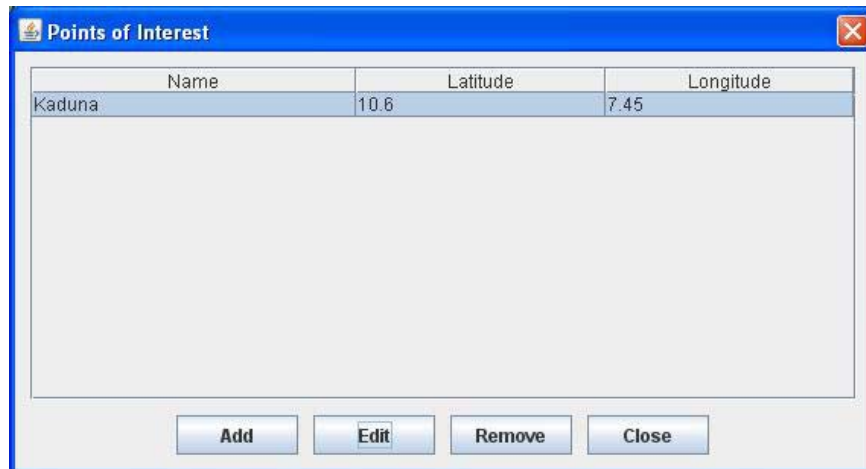


Figure 19. Points of Interest Option

Adding a Point of Interest

To add a point of interest, click the **Add** button at the bottom of the *Points of Interest* dialog. The screen shown in Figure 20 will be displayed.

Add Item

Latitude: Degrees Minutes Seconds

Longitude: Degrees Minutes Seconds

Name:

Figure 20. Add Point of Interest Dialog

1. Enter the latitude of the desired reference point in degrees, minutes, and seconds in the **Latitude** text boxes.
2. Enter the longitude of the desired reference point in degrees, minutes, and seconds in the **Longitude** text boxes.
3. Enter a name for the point of interest in the **Name** text box. This is the name that will appear on the main display.
4. Click **OK** to save the point of interest, or click **Cancel** to exit the dialog without saving the point of interest.

Editing a Point of Interest

To edit a point of interest:

1. On the list of points of interest, highlight the name of the location you want to edit.
2. Click the **Edit** button at the bottom of the screen. The **Add Item** screen (Figure 20) will be displayed.
3. Adjust the latitude, longitude, and name as needed.
4. Click **OK** to save the new values, or click **Cancel** to exit the dialog without saving the changes.

Removing a Point of Interest

To remove a point of interest, highlight its name on the list and click **Remove**. The point of interest will be deleted.

Logs Menu

The Lightning Display software records each strike detected, and stores the complete data for one day in a daily strike log. If no lightning is detected, no log will be generated for that day. The length of time that log files are maintained is set by the user via the Edit>Configuration>Misc>Logs menu option. Log files older than the time set through that screen are automatically deleted.

Viewing Logs

Clicking **Daily** on the *Logs* menu calls up an *Open Log* screen such as the one shown in Figure 21.



Figure 21. *Open Log* Screen Example

Log files use the naming format: **DLYStrike.yyyymmdd.log**, where *yyymmdd* represents the date the data was recorded. In the example above, for instance, the file **DLYStrike..20090414.log** contains strike data for April 14, 2009.

1. To open a log file, click the desired file to highlight it, then click **Open**.
2. You can view the file on-screen, or select **Print** to print the data log. When done, click **OK** to close the window.

Data Format

The lightning sensor data format is described below.

Communications is RS232 9600 8N1

Output data format is : <STX><i d ><ddd><CR>(<id><ddd><CR>) . <cc ><ETX>

- STX: is the ASCII Start-of-Text Character (02h)
 id: is the item designator from the table below
 ddd : is the value of the data item in the Item Format column in the table below
 CR: Carriage Return
 cc : checksum - summing all data between STX and “.”, then masking all but the lower 8 bits.
 ETX: is the ASCII End-of-Text Character (03h)

Item Designator	Item Format	Field Width (bytes)	Item Description																		
%I	dmch	4	<p>System Status, where d is "F" = fatal fault , "R" = recoverable fault, "P" = O.K.</p> <p>Display Mode m is transmitted as follows:</p> <p>"A" Weather</p> <p>"B" Noise Monitor</p> <p>"C" Strike Test</p> <p>"D" Demo</p> <p>"E" Pilot Initiated Self-Test</p> <p>Configuration data c is sent as 010:B4:B3:B2:B1:B0 where</p> <table><tr><td></td><td>Heading_Config</td><td>Synchro</td><td>Stepper</td><td>Serial</td><td>None</td></tr><tr><td>B4</td><td>HdgFormat1_Input</td><td>1</td><td>0</td><td>1</td><td>0</td></tr><tr><td>B3</td><td>HdgFormat2_Input</td><td>0</td><td>1</td><td>1</td><td>0</td></tr></table> <p>B2 Heading Flag Input Sense; 0 if a High level signal on Heading Flag+ (pin P2-24) with respect to Heading Flag- (pin P2-25) indicates Valid Heading</p> <p>B1 Antenna. Mount 0=Bottom, 1=Top</p> <p>B0 Spare</p> <p>Heading Flag h is sent as 010:B4:B3:B2:B1 :B0 where</p> <p>B4 Heading Stabilization 1=Enabled</p> <p>B3 Heading Flag Input 1=Valid</p> <p>B2 Heading Valid 1=Valid</p> <p>B1 Synchro Reference Flag 1=Valid</p> <p>B0 Synchro Angle Flag 1=Valid</p> <p>Heading Stabilization state defaults to last state when powered up.</p> <p>Synchro Reference Flag and Synchro Angle Flag will be zero when configured for Stepper or Serial heading input.</p> <p>Transmitted once per message.</p>		Heading_Config	Synchro	Stepper	Serial	None	B4	HdgFormat1_Input	1	0	1	0	B3	HdgFormat2_Input	0	1	1	0
	Heading_Config	Synchro	Stepper	Serial	None																
B4	HdgFormat1_Input	1	0	1	0																
B3	HdgFormat2_Input	0	1	1	0																
%S	cccbbrrr	9	<p>ccc=Range to strike ("001" - "200" NM) Cell mode (a value of 201 indicates invalid); bbb=Bearing to strike, clockwise in degrees "000" - "359" deg).</p> <p>rrr=Range to strike ("001 - "200" NM) Strike mode. This Item Designator may appear from 0 to 40 times per message depending on thunderstorm activity. Invalid Cell mode range indicates the strike is not displayed in Cell mode view. In Noise Monitor Mode, ccc will always indicate 201 and rrr will have a range of 001 - 400.</p>																		
%A	rrrbbb	6	<p>Test strike range and bearing. rrr=Range to strike ("001" - "200" NM); bbb=Bearing to strike, degrees clockwise("000" - "359" deg). Transmitted once per message block. Only transmitted when in Strike Test Mode.</p>																		

%E	dd	2	Fault code ("00" – "99"), more than one possible (%E for each code up to 5 codes), see table. Transmitted each message only when System Status (%I) indicates fault or degraded operation.
%V	Xxxxxx	6	X="B", xxxxx=S/W version string, padded on right with "spaces" if needed. Transmitted at least 2 times per minute.
%T	ddddd	5	ddddd="00000" – "99999", number of triggers detected since power on. Pressing "Clear" resets counter to "00000". Used for installation verification and troubleshooting.
%B		0	Clear message indicates that the data buffers are cleared.
%H	dddd	4	Aircraft heading x10 (0000 - 3599). Heading outside valid range indicates heading not available or "flagged" (e.g., 9999). When configured for Stepper heading, this message contains relative heading angle.
%D	14 lines (24 columns +CR)	350	System Data Screen text requested by the host. The System data is sent in addition to the standard communications block prefixed by its own STX and followed by its own ETX. The System data screens may contain software versions, environmental parameters or the fault log. One of the System Data Screens is transmitted in response to a System Data Screen request.
%L	emmtbbb	variable	BFG Logo - generally requested only once during the power up sequence for display. The logo is a bitmap image of the BFG logo. e=Encoding type character (always "1"), mm=Msg number, tt=Total messages, bbb=Number of bytes of logo data in message, *=bbb bytes of logo.

A message is sent from the sensor once every two seconds. Each message includes at least the sensor orientation and status. If strikes are detected, they are shown between the orientation data and the status data. Up to 40 strikes may be included in a single two-second message. If errors are detected, they will be included in the message as well.

Below is a sample of the sensor output data stream that includes a description of the data immediately following the data.

```

%VB1.03      (Software Version, sent at least twice per minute)
%IPAG@       (Status = OK, Weather Mode)
----- 2 seconds -----
%H0000      (Sensor Orientation 0 - North)
%IPAG@       (Status = OK, Weather Mode)
----- 2 seconds -----
%H0000      (Sensor Orientation 0 - North)
%S026276026 (Lightning Strike = 26NM, 276 degrees)
%S026278026 (Lightning Strike = 26NM, 278 degrees)
%S027277027 (Lightning Strike = 27NM, 277 degrees)
%S025279025 (Lightning Strike = 25NM, 279 degrees)
%S027279027 (Lightning Strike = 27NM, 279 degrees)
%S201279031 (Invalid Lightning Strike = 31NM, 279 degrees; "201" indicates an invalid strike)
%IPAG@       (Status = OK, Weather Mode)
----- 2 seconds -----
%E16        (Error 16 – Antenna Fault)

```

Error Messages and Troubleshooting

The Model 6502 continuously runs a series of self-tests to check sensor operation and returns error messages when a fault is detected. Any detected errors are identified by "E" and a two-digit number ("E00" during normal operation) in the sensor's raw data output. **Table 2** lists all the possible error codes, along with the probable cause of the fault and possible corrective action. In many cases, a persistent error will require returning the sensor to All Weather Inc. for service.

Table 2. Model 6502 error codes

ERROR	PROBABLE CAUSE	CORRECTIVE ACTION
ERROR 01. Processor Fault.	Main processor	Continued operation is not possible. Contact Field Service.
ERROR 05. Processor Fault.	Main processor memory	Continued operation is not possible. Contact Field Service.
ERROR 06. Processor Fault.	Main processor memory	Continued operation is not possible. Contact Field Service.
ERROR 07. Processor Fault.	Main processor memory	Continued operation is not possible. Contact Field Service.
ERROR 08. Processor Fault.	Main processor memory	Continued operation is not possible. Contact Field Service.
ERROR 09. Processor Fault.	DSP processor memory	Continued operation is not possible. Contact Field Service.
ERROR 10. Processor Fault.	DSP processor memory	Continued operation is not possible. Contact Field Service.
ERROR 11. Processor Fault.	DSP processor memory	Continued operation is not possible. Contact Field Service.
ERROR 12. Processor Fault.	DSP processor memory	Continued operation is not possible. Contact Field Service.
ERROR 14. Processor Fault.	DSP processor	Continued operation is not possible. Contact Field Service.
ERROR 15. Processor Fault.	DSP processor	Continued operation is not possible. Contact Field Service.
ERROR 16. Antenna Fault.	Antenna or antenna wiring	Weather mapping is inhibited. a. Check antenna wiring for opens and shorts. b. Contact Field Service.
ERROR 17. Processor Fault.	No test strikes, antenna in noisy location, or faulty antenna	Weather mapping is inhibited. a. Check antenna wiring for opens and shorts. b. Fault will clear automatically if interference subsides. c. Contact Field Service.

Table 2. Model 6502 error codes

ERROR	PROBABLE CAUSE	CORRECTIVE ACTION
ERROR 18. Processor Fault.	Invalid test strikes, antenna in noisy location, or faulty antenna	Weather mapping is inhibited. a. Check antenna wiring for opens and shorts. b. Fault will clear automatically if interference subsides. c. Contact Field Service.
ERROR 19. Processor Fault.	Main Processor or Antenna in noisy location	Weather mapping is inhibited. a. Fault will clear automatically if interference subsides. b. Contact Field Service.
ERROR 20. Configuration Changed.	Antenna location (top/bottom, determined by processor wiring) changed since system was last powered up.	This may occur the first time the system is powered on in a new installation. Power the sensor off and back on again. If the error persists, contact Field Service.
ERROR 21. Processor Fault.	Main processor	Continued operation is not possible. Contact Field Service.
ERROR 22. Invalid XYZ Input.	n/a	n/a
ERROR 23. Invalid Heading Ref.	n/a	n/a
ERROR 24. MIC KEY STUCK.	Mic key (inhibit line) has been asserted for at least 60 seconds	Weather mapping is inhibited. a. Contact Field Service.
ERROR 25 - 34. Processor Fault.	Main processor	Continued operation is not possible. Contact Field Service.
ERROR 35. Processor Fault.	Main or DSP processor	Continued operation is not possible. Contact Field Service.
ERROR 36. Processor Fault.	Main or DSP processor	Continued operation is not possible. Contact Field Service.
ERROR 40. Processor Fault.	Main processor	Continued operation is not possible. Contact Field Service.
ERROR 41. Processor Fault.	Main or DSP processor	Continued operation is not possible. Contact Field Service.
ERROR 42. Processor Fault.	Main processor	Continued operation is not possible. Contact Field Service.
ERROR 43. Invalid request.	n/a	Message error will clear once processed a. Excessive noise on communication lines, check wiring. b. If error occurs frequently, contact Field Service

Table 2. Model 6502 error codes

ERROR	PROBABLE CAUSE	CORRECTIVE ACTION
ERROR 44 - 49. Serial Communication.	n/a	Message error will clear once processed a. Improper baud rate. b. Excessive noise on communication lines, check wiring. c. If error occurs frequently, contact Field Service.
ERROR 50. Illegal Serial Heading Value.	n/a	Message error will clear once processed a. Excessive noise on communication lines, check wiring. b. If error occurs frequently, contact Field Service.
ERROR 51. Invalid Message.	n/a	Message error will clear once processed a. Excessive noise on communication lines, check wiring. b. If error occurs frequently, contact Field Service.
ERROR 52. Invalid Antenna Change Request.	n/a	Message error will clear once processed a. A request was received to change the antenna mount to a location that does not match the configuration jumpers. Request is ignored. b. If error occurs frequently, contact Field Service.
ERROR 53 - 54. Communications Buffer Overload.	n/a	Message error will clear once processed a. Excessive noise on communication lines, check wiring. b. If error occurs frequently, contact Field Service.

Table 3 lists some common problems that may arise and the corrective action to take.

Table 3. Troubleshooting

PROBLEM	CORRECTIVE ACTION
Computer will not run	Check power cable to computer; make sure power switch is ON.
Computer runs, but no display	Check cables to display; make sure display power switch is ON
Display software does not start automatically	Double-click AWI Lightning Display icon on desktop OR restart computer
Application runs, but no lightning data	Check all connections Check radio status (refer to radio manual) Check power to the lightning sensor At lightning sensor: Check lightning sensor status LEDs; check radio lights inside lightning sensor cabinet check AC power board, replace if faulty
If the problem persists, contact your local representative or AWI Customer Service.	

Processor LEDs

The processor (housed within the enclosure) is equipped with a series of LEDs on its front panel (see **Figure 22**) that can be used to monitor certain basic functions. Table 4 explains how to interpret the LEDs.

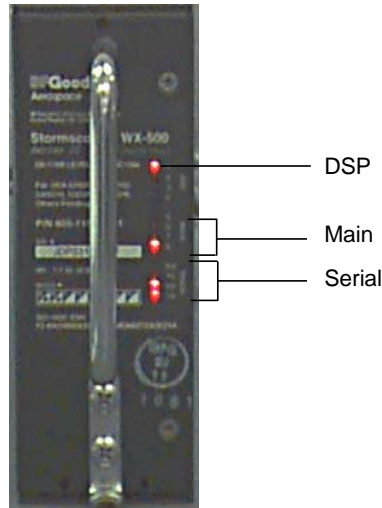


Figure 22. Processor front panel LEDs

Table 4. Processor LED functions

COMMUNICATION	LED	NORMAL OPERATION	FAILED OPERATION
DSP	1	ON	OFF
MAIN	6	Toggles ON/OFF when strike detected	Does not toggle ON/OFF when strike detected
	7	OFF	ON
	8	Toggles ON/OFF once per second	Stays ON or OFF (does not toggle)
SERIAL	T	Reserved for future use	Reserved for future use
	RX	Reserved for future use	Reserved for future use
	TX	ON (pulses when TX occurs) *	Stays OFF or ON (does not pulse)
	RX	ON (pulses when RX occurs) *	Stays OFF or ON (does not pulse)

* Serial communication occurs every 2 seconds, causing LEDs to pulse rapidly. Due to transmission speed, LEDs may appear not to change conditions during TX/RX operation.

Maintenance

Periodic Maintenance

Equipment Required

Equipment required for periodic maintenance of the Model 6502 consists of:

- RTV 162 (as necessary)

Monthly Maintenance

No monthly maintenance is required with this sensor.

Triannual Maintenance

Perform the following maintenance tasks three times per year:

- Check the antenna for dents, cracks, or punctures.
- Remove all dirt and grease from surface areas using a soft cloth moistened with mild soap and water.
- Check the sealant around the antenna base and mounting bolts, and reapply as necessary (use RTV 162).
- Check all hardware for corrosion and ensure that all bolts and connectors are tight.
- Ensure that the cable connections are sound between the sensor and the display station.

Annual Maintenance

Annual maintenance consists of performing the quarterly maintenance tasks.

Specifications

Measuring Range:	0-200 nautical miles
Internal Voltage:	11-32 volts dc
Current:	0.82 A (maximum) @ 12 volts dc 0.38 A (maximum) @ 28 volts dc
Operating Temperature:	-60 to +70° C
Relative Humidity:	up to 100%
Communication:	RS-485, 4800 baud
Mounting:	2½" pipe (2.875" O.D.)
Weight:	40 lbs. (18 kg)

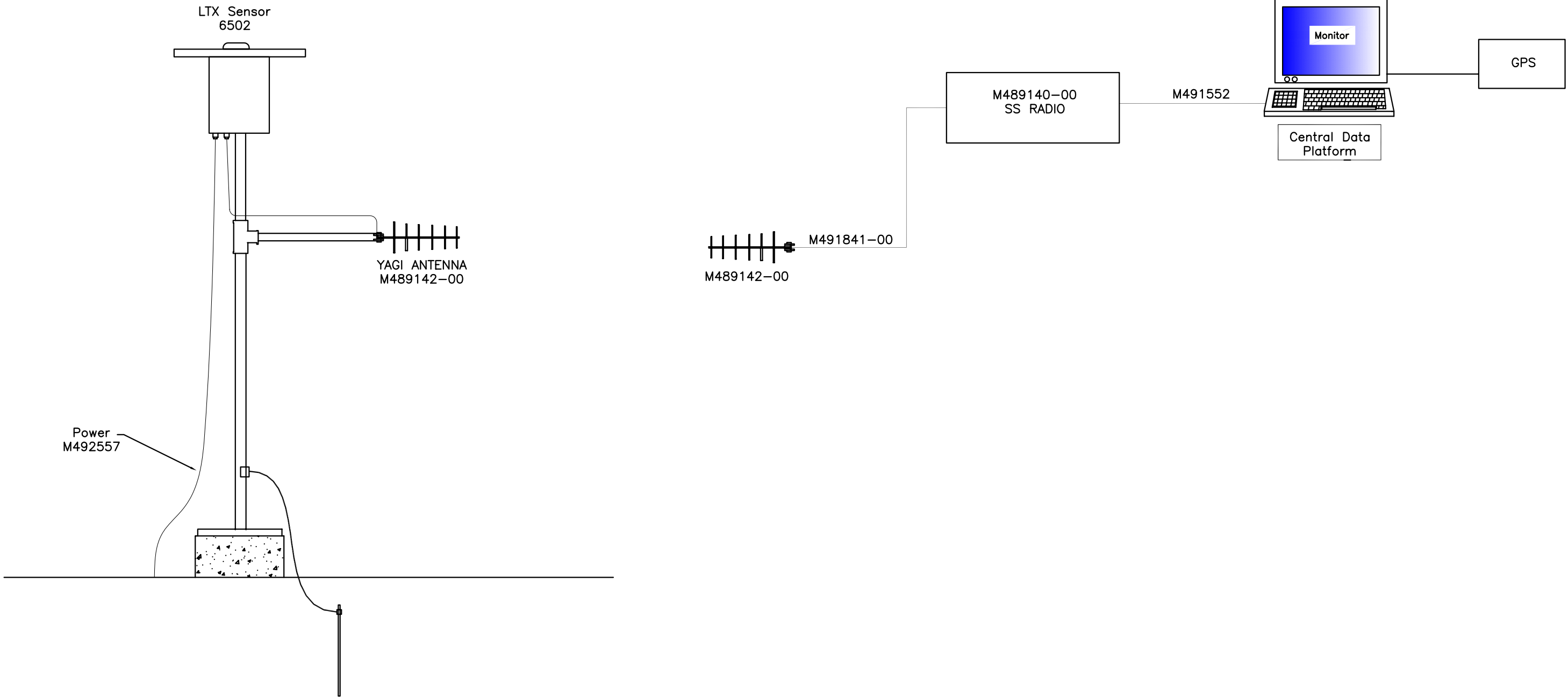
Warranty

Unless specified otherwise, All Weather Inc. (the Company) warrants its products to be free from defects in material and workmanship under normal use and service for one year from date of shipment, subject to the following conditions:


- (a) The obligation of the Company under this warranty is limited to repairing or replacing items or parts which have been returned to the Company and which upon examination are disclosed, to the Company's satisfaction, to have been defective in material or workmanship at time of manufacture.
- (b) The claimant shall pay the cost of shipping any part or instrument to the Company. If the Company determines the part to be defective in material or workmanship, the Company shall prepay the cost of shipping the repaired instrument to the claimant. Under no circumstances will the Company reimburse claimant for cost incurred in removing and/or reinstalling replacement parts.
- (c) This warranty shall not apply to any Company products which have been subjected to misuse, negligence or accident.
- (d) This warranty and the Company's obligation thereunder is in lieu of all other warranties, express or implied, including warranties of merchantability and fitness for a particular purpose, consequential damages and all other obligations or liabilities.

No other person or organization is authorized to give any other warranty or to assume any additional obligation on the Company's behalf, unless made in writing and signed by an authorized officer of the Company.

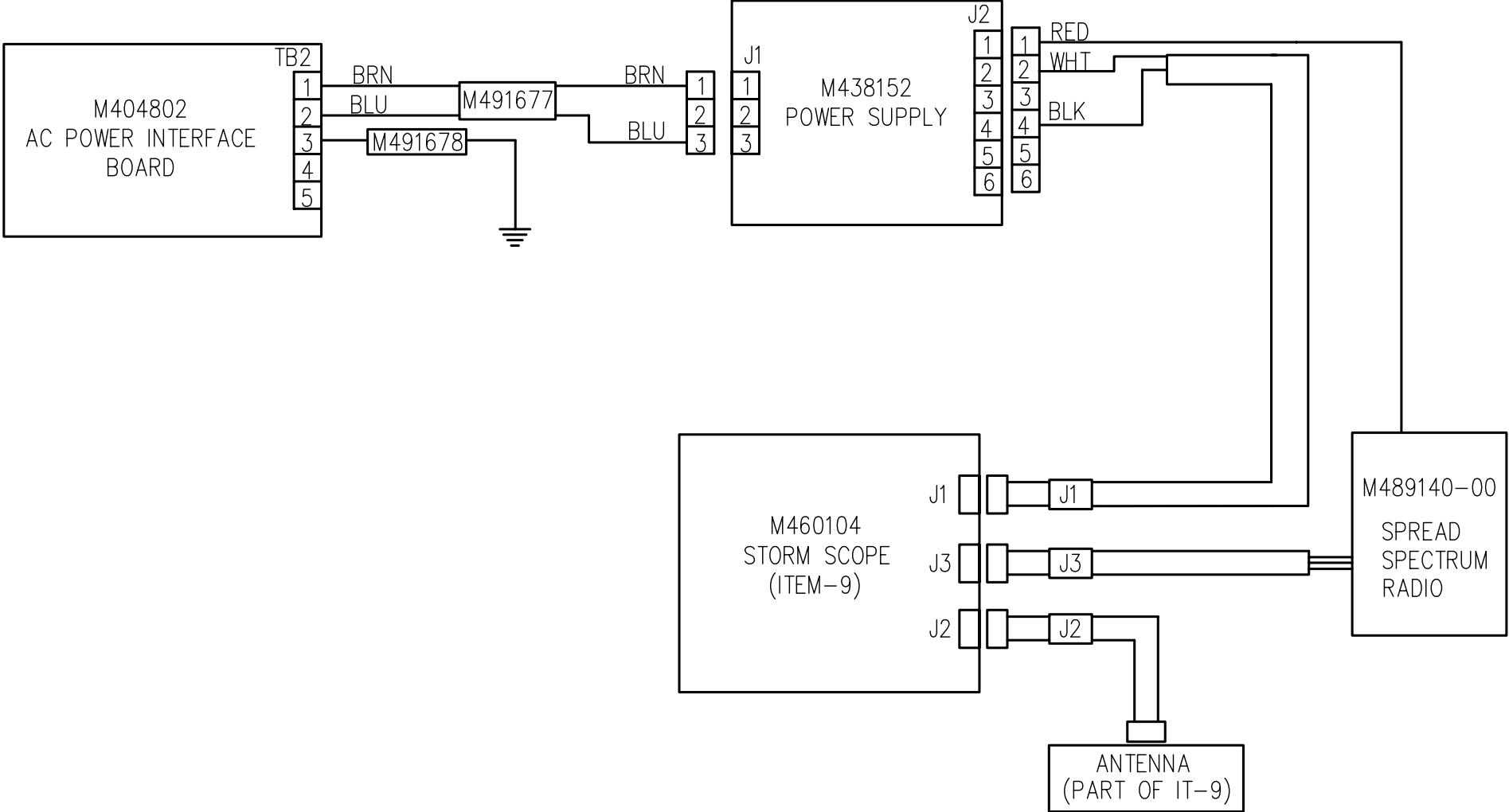
REVISIONS			DWG NO. 653761-025	
REV	ECN	DESCRIPTION	DATE	APPROVED
A	1763	INITIAL RELEASE	3-11-09	PK




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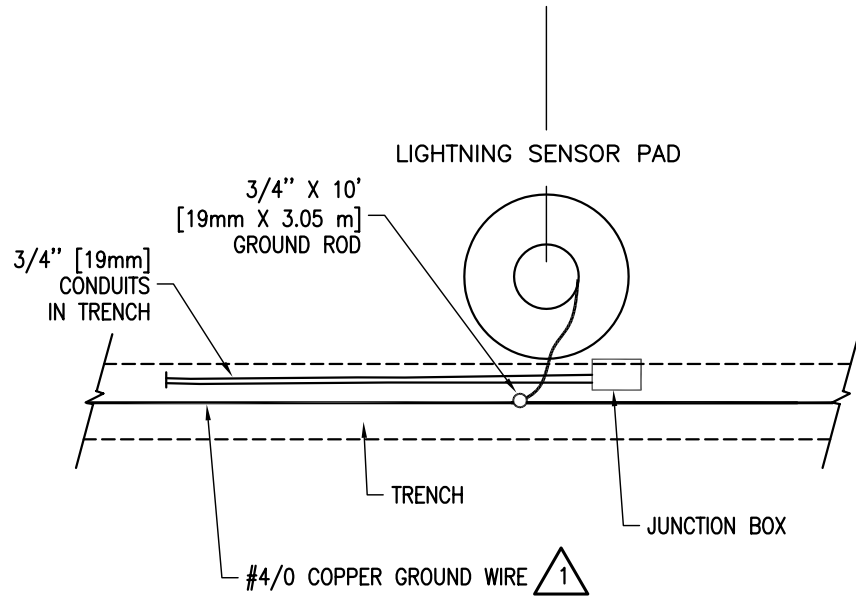
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES TOLERANCES XX=±.010 ANGLES ±1/2" XXX=±.005 FRACTIONS=±.02 DO NOT SCALE DRAWING		DRAWN BY: P KOOYMAN	3-11-09	TITLE SYSTEM DRAWING NIGERIA LIGHTNING DISPLAY		 allweatherinc	
		REVISED BY: P KOOYMAN	3-13-09				
		CHECKED BY: J PATTERSON	3-11-09				
MATL SEE BILL OF MATERIALS		DESIGN ENGINEER: J PATTERSON	3-11-09	SIZE D		DWG NO. 653761-025	
FINISH AS ISSUED		PROJECT MANAGER: B PERRIN	3-11-09				
TREATMENT		APPROVALS	DATE	SCALE NONE	RELEASE DATE	SHEET 1 OF 1	

REVISIONS			DWG NO. 6502-019	
REV	ECN	DESCRIPTION	DATE	APPROVED
A	1763	INITIAL RELEASE	01-08-09	JPATTERSON

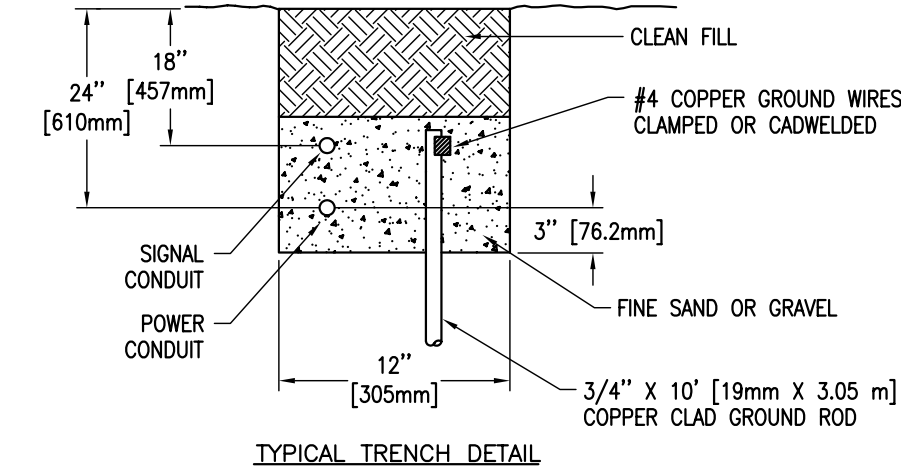


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			UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES TOLERANCES XX=±.010 ANGLES ±1/2° XXX=±.005 FRACTIONS=±.02 DO NOT SCALE DRAWING	DRAWN BY: J PATTERSON	08JAN09	TITLE INTERCONNECT DIAGRAM LIGHTNING/TS SENSOR – SS RADIO		 allweatherinc
				CHECKED BY: P KOOYMAN	3-12-09			
				DESIGN ENGINEER: J PATTERSON	08JAN09			
				PROJECT MANAGER: B PERERIN	08JAN09			
			MATL SEE BILL OF MATERIALS	PROGRAM MANAGER: B PERRIN	08JAN09	SIZE C DWG NO. 6502-019		
			FINISH					
NEXT QTY REQD	NEXT ASSY	USED ON	TREATMENT	APPROVALS	DATE	SCALE NONE	RELEASE DATE	SHEET 1 OF 1
APPLICATIONS								



SITE LAYOUT, TRENCHING AND GROUNDING FOR LIGHTNING SENSOR



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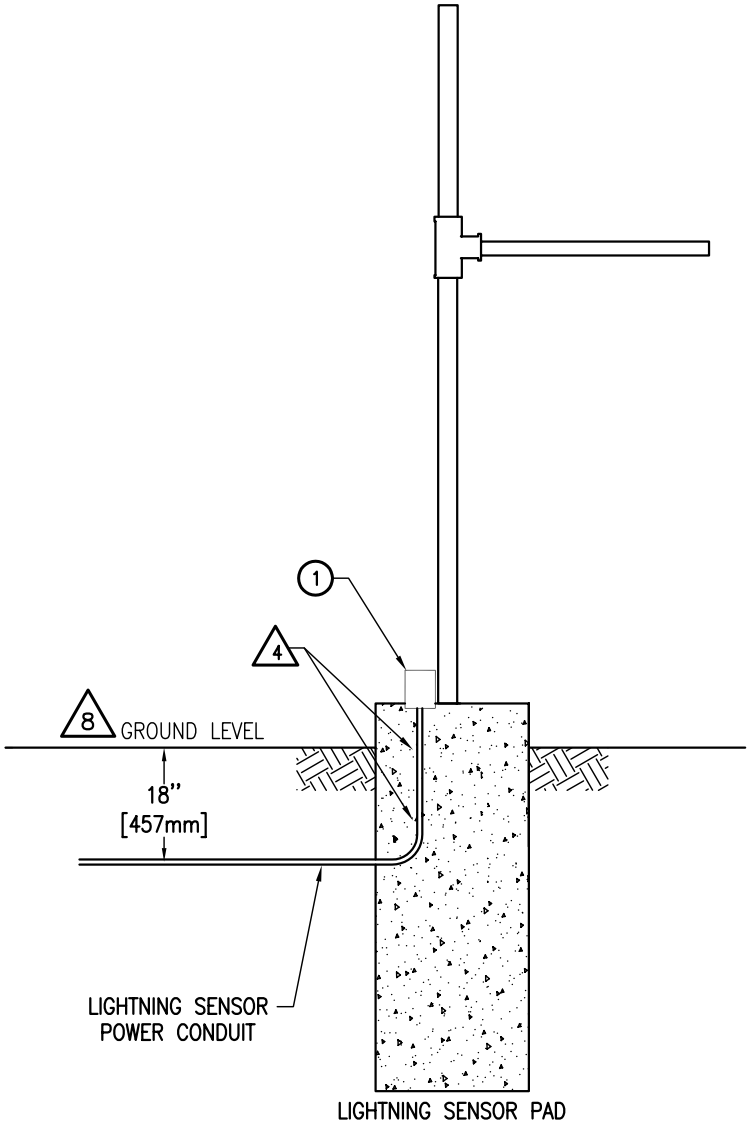
								A	A	A	A	REV	REV STATUS		
								4	3	2	1	SHEET	OF SHEETS		
APPEND THE FOLLOWING DOCUMENTS WHEN CHANGING THIS DOCUMENT:		UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES TOLERANCES XX=±.010 ANGLES ±1/2" XXX=±.005 CONCENTRICITY: .003 TIR DO NOT SCALE DRAWING		DRAWN BY: PMK		3-11-09		TITLE AWOS SITE PREPARATION DOCUMENT FOR NIGERIA LIGHTNING DISPLAY				 allweatherinc			
				REVISED BY:											
				CHECKED BY: J PATTERSON		3-11-09									
				DESIGN ENGINEER: J PATTERSON		3-11-09									
				PROJECT MANAGER: B PERRIN		3-11-09									
		APPROVALS		DATE		SCALE		NONE		RELEASE DATE		SHEET		1 OF 4	

NOTES: CONTINUED;

- 2. ALL CONDUIT SHOWN IS 3/4" [19mm] RIGID GALVANIZED STEEL OR UV RESISTANT, SCHEDULE 80 PVC IF ALLOWED BY LOCAL CODES, OR EQUIVALENT.
- 3. INSTALL PER LOCAL BUILDING CODES.
- 4. ATTACH CONDUIT TO CONCRETE WITH RIGID CONDUIT STRAPS IN 2 LOCATIONS.
- 5. INSTALL PULL ROPES IN EACH SIGNAL CONDUIT. ALL WEATHER, INC. TO INSTALL SIGNAL CABLES.
- 6. FOR LAND LINE DATA LINKS TO THE INDOOR EQUIPMENT, INSTALL JUNCTION BOX AND CONDUIT OR USE DIRECT BURIAL 6 CONDUCTOR RS485 CABLE AND TERMINATE WITH A JUNCTION BOX AT THE INDOOR LOCATION.
- 7. INSTALL 12 AWG THHN AC POWER WIRES OR EQUIVALENT FROM POWER DISTRIBUTION BOX TO AC POWER JUNCTION BOXES.

1 WEATHER TIGHT JUNCTION BOXES. APPLETON C75-M WITH COVER K75-CM AND RUBBER GASKET GK75-N OR EQUIVALENT. 1 REQUIRED. (1 COVER AND GASKET REQUIRED).

8 IT IS ASSUMED THE SENSOR SITE GROUND LEVEL IS APPROXIMATELY THE SAME ELEVATION AS THE PRIMARY RUNWAY. IF THE SENSOR SITE GROUND LEVEL IS SIGNIFICANTLY DIFFERENT THAN THE RUNWAY ELEVATION, THE MASTS SHOULD BE ADJUSTED TO OBTAIN THE CORRECT SENSOR HEIGHT ABOVE THE RUNWAY LEVEL.



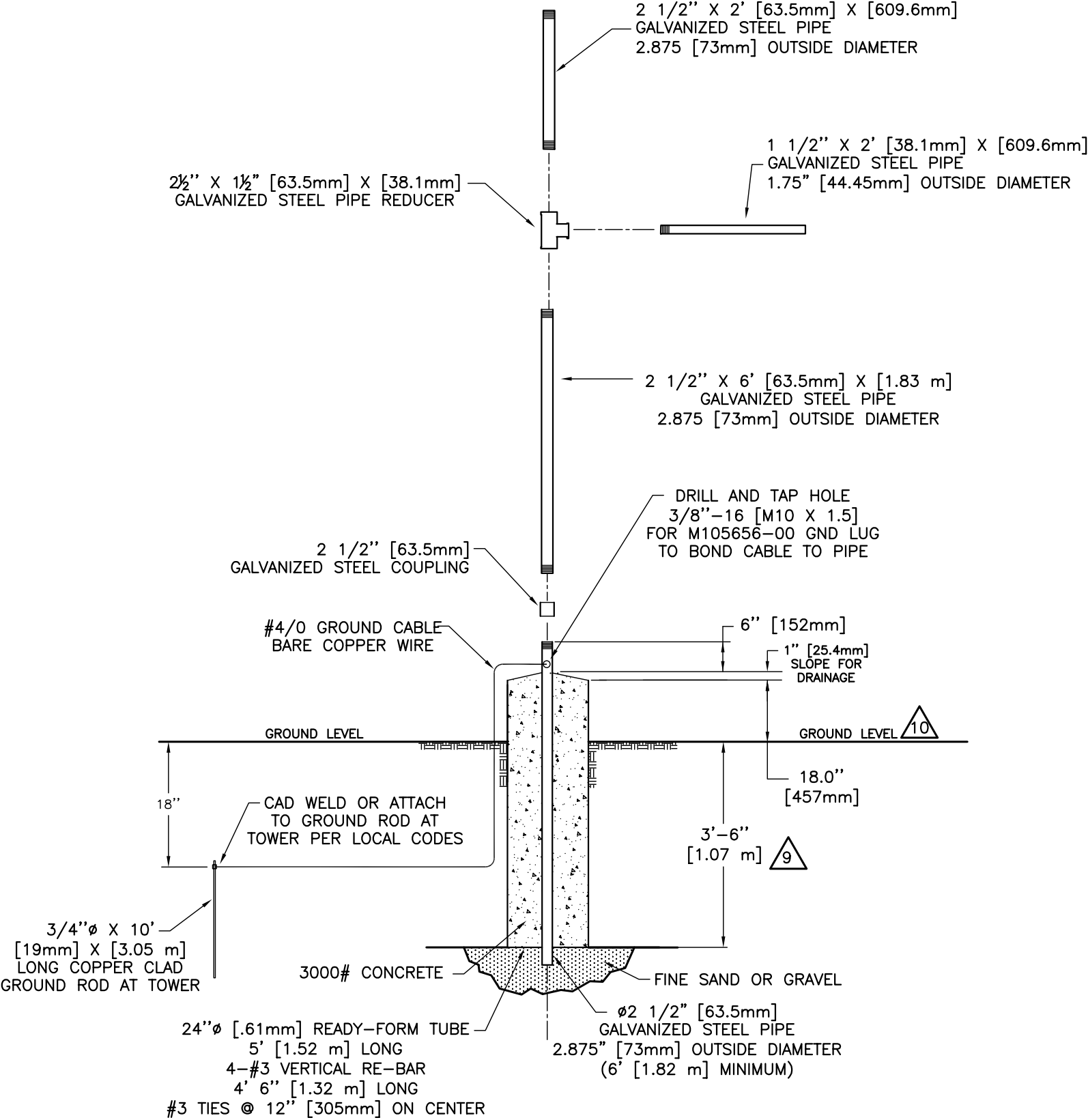
ELECTRICAL CONDUIT LAYOUT/INSTALLATION
LIGHTNING SENSOR

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SIZE	D	DWG NO.	653761-007
SCALE	NONE	REV LTR	A
SHEET	2	OF	4

NOTES: CONT'D

- 9 INCREASE FOUNDATION ACCORDINGLY WHERE FROST MAY EXCEED 36 INCHES [914mm].
- 10 IT IS ASSUMED THE SENSOR SITE GROUND LEVEL IS APPROXIMATELY THE SAME ELEVATION AS THE PRIMARY RUNWAY. IF THE SENSOR SITE GROUND LEVEL IS SIGNIFICANTLY DIFFERENT THAN THE RUNWAY ELEVATION, THE MAST HEIGHTS SHOULD BE ADJUSTED TO OBTAIN THE CORRECT SENSOR HEIGHT ABOVE THE RUNWAY LEVEL OF 2-3 METERS.



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LIGHTNING SENSOR FOUNDATION

SIZE	D	DWG NO.	653761-007
SCALE	NONE	REV LTR	A
SHEET	3	OF	4

220VAC 60Hz 1PH

SENSOR SITE		
LOCATION	LOAD	BREAKER SIZE
LIGHTNING SENSOR	400 VA MAX.	10A

CENTRAL DATA PROCESSOR		
CENTRAL DATA PROCESSING EQUIPMENT	600VA MAX.	10A

POWER REQUIREMENTS

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6502-001
Revision B
May, 2009