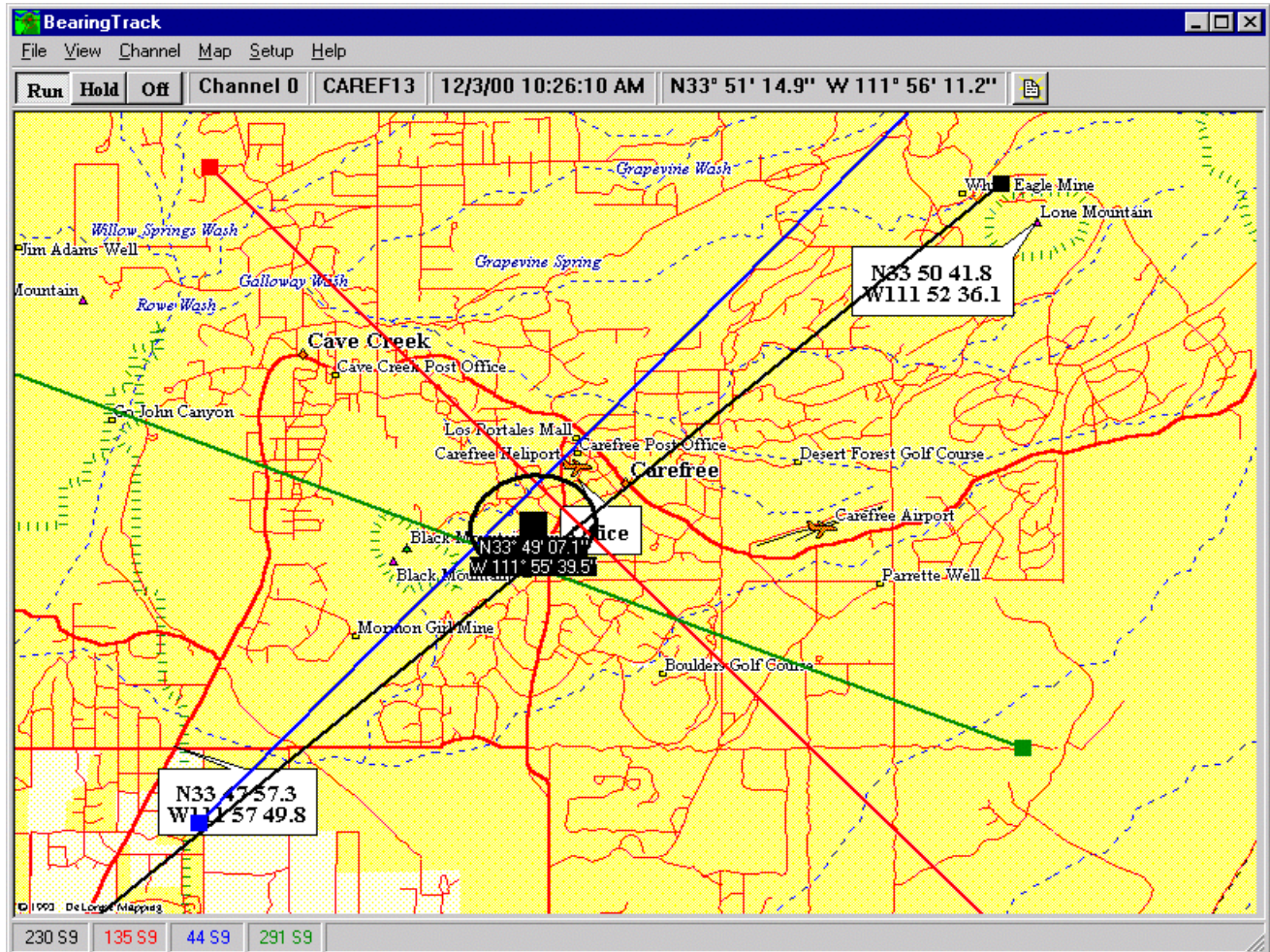


BearingTrack



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CHAPTER 1

Introduction

The BearingTrack program suite is designed for use with the Doppler Systems DDF6000 direction finder. BearingTrack collects information from a network of direction finders, displays the lines of bearing from the direction finder sites to a RF source, and predicts the location of the RF source. Direction finders are connected to the computer via a modem, a radio modem, or via the Internet or an intranet.

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Overview of the Programs	4
Computer Requirements.....	5

Using this Manual

This manual is organized to get you up and running as quickly as possible. Following the introduction, chapter 2 will lead you through the installation process and guide you in configuring the programs. Chapter 3 instructs you on using BearingTrack. Chapter 4 describes the creation of maps for BearingTrack using the MapFix utility program. Chapter 5 briefly describes the networking of direction finders for BearingTrack. Chapter 6 guides you in the use of BearingTrack Server, a utility program designed to interface a DDF 6000 to the Internet or an intranet. Chapter 7 defines error messages and their potential source.

Overview of the Programs

BearingTrack

BearingTrack collects information from a network of direction finders, displays the lines of bearing from the direction finder sites to a RF source, and predicts the location of the RF source. Direction finders are connected to the computer via a modem, a radio modem, the Internet, or an intranet. You can use BearingTrack to change your direction finder settings and if you use a programmable ICOM receiver BearingTrack will automatically set the receiver to any desired frequency.

LogViewer

LogViewer reads log files written by BearingTrack and displays the latest information first. LogViewer can be run from within BearingTrack or as a separate program.

MapFix

MapFix converts maps stored in bitmap format into a .map file that is used by BearingTrack to display the direction finder data. Any graphic can be used as a map allowing maps to be hand drawn, scanned in, or captured from one of several commercially available map programs.

BearingTrack Server

BearingTrack Server connects a single direction finder to the Internet or an intranet. A computer at the direction finder site is connected to the direction finder via the serial port. The computer can be connected to the Internet via a dedicated line such as a digital subscriber line, or cable modem, a cellular digital packet data connection, or a dial up connection. BearingTrack Server allows multiple TCP/IP connections so the computer at the site can run BearingTrack using a local IP address (typically 127.0.0.1) while any number of computers at remote locations can use BearingTrack to monitor and control the direction finder.

Computer Requirements

BearingTrack requires a Pentium class processor based computer with at least 32 Mbytes of RAM, a serial port and Windows 98, Windows NT 4.0, Windows 2000, Windows Me or Windows XP. To use the warning sounds a Windows compatible sound card must be installed. A monitor with at least 800 x 600 resolution is needed. BearingTrack Server requires a 486 class processor or better, 8 Mbytes of RAM, a serial port, Windows 95, Windows 98, Windows NT 4.0, Windows 2000, Windows Me or Windows XP, and an Internet or intranet connection. Installation requires a CD drive. Contact the factory for floppy disks if needed.

CHAPTER 2

Getting Started

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Installing BearingTrack, MapFix, and LogViewer	7
Using the BearingTrack Program Suite	8

Installing BearingTrack, MapFix, and LogViewer

Place the installation CD into your CD drive. An installation program should start. If it does not start, press the start menu button in the lower left corner of the screen. Select Run. Type D:\setup in the text box and press **Ok**. The installer will start and provide instructions to complete the installation.

IMPORTANT NOTE: UPGRADING FROM A PREVIOUS VERSION OF BEARINGTRACK

If you are upgrading from a previous version of BearingTrack, make a copy of the brgtrack.ini file prior to installing the new software. Remove any old versions of BearingTrack using the Remove Programs application in Windows. After you install the new version and prior to running it, copy brgtrack.ini into the installation folder (directory). All your settings will then be transferred to the new version.

Using the BearingTrack Program Suite

BearingTrack requires some setup in order to use it with your direction finder network. First your network needs to be in place (Chapter 5). Next you must create maps of the area or areas you want to cover with your network (Chapter 4). Then you must enter data into BearingTrack describing the following

- the name and location of your direction finder sites
- how you are communicating with your sites
- the CIV address of the direction finder and receiver at each site
- the name and frequencies of the channels you will use

Once the data is entered BearingTrack is ready for use.

CHAPTER 3

Using BearingTrack

This chapter describes the setup and operation of BearingTrack. BearingTrack is designed to communicate with and collect data from a network (see "Designing Your Direction Finding Network" on page 41) of direction finders. Each direction finder and receiver (if applicable) on the network must be set to a unique CIV address prior to running BearingTrack. See your DDF6000 manual for instructions on setting its CIV address.

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Setting Up BearingTrack

Before you use BearingTrack you must enter data for each of the direction finder sites and if you are using a programmable ICOM receiver you will also enter the channels you will be using. Launch BearingTrack by selecting it from the Start menu. If you have maps saved in the MAP subdirectory of BearingTrack a screen similar to Figure 1 will appear. If the map you wish to use is not displayed go to the Map menu and select it.

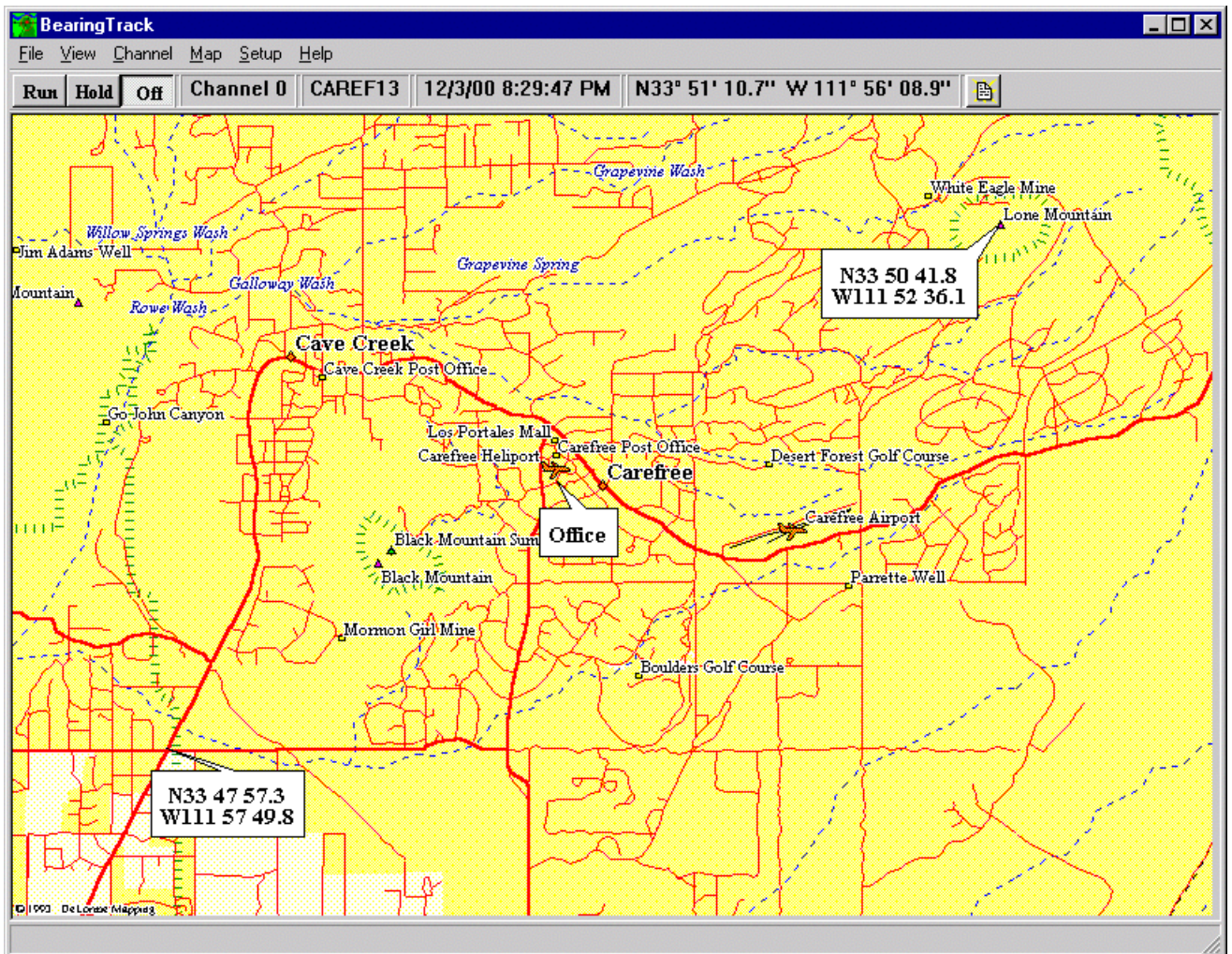


Figure 1: Typical Startup Bearing Track Display

Entering Site Data

In order for BearingTrack to display the sites it must know the location of the sites (latitude and longitude) and the address of the direction finder and the receiver at each site. To enter the data, select **Sites...** from the **Setup** menu. The dialog in Figure 2 will appear. Press the New button and enter the site name in the name dialog box.

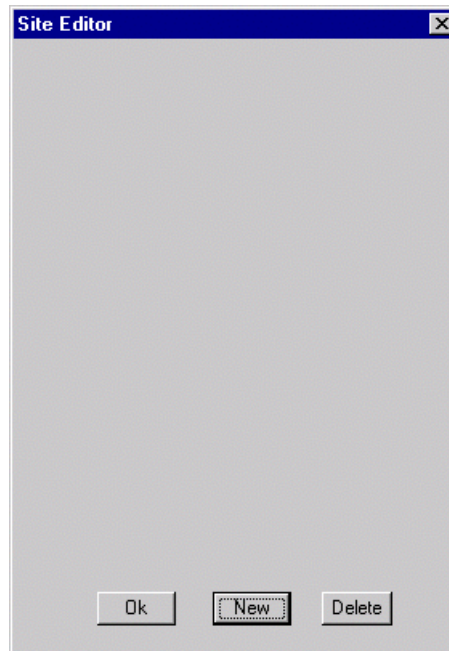


Figure 2: Site Dialog

A tabbed dialog, Figure 3, appears in the dialog box. To enter the latitude and longitude of the site, either enter the coordinates directly or simply move the mouse onto the map. When you move the mouse onto the map a small square will appear. Move the square to the desired site location (the coordinates are displayed in the position box in the dialog) and then left click the mouse button to enter the position of the site. Next select the type of receiver you are using. If you do not intend to use BearingTrack to tune the receiver at the site different frequencies select None; otherwise select the type of receiver you are using. BearingTrack works with ICOM receivers that use CIV serial communications and AOR receivers that use RS-232 communications. Now set the CIV address of the direction finder and if you selected ICOM set the CIV address of the receiver. (Note: that if you are using an AOR receiver the direction finder automatically assigns a CIV address for the receiver that is the DF address plus 32.) Use the combo boxes to set the color and the size of the squares representing the sites. The width of the bearing line can also be selected. If you are using Bearing Track with dial up modems click Enable Modem Connection and enter the site's phone number. If you are using BearingTrack Server click Enable Internet Connection and enter the TCP/IP address and IP port number.

Continue pressing the New button and entering the site data until all sites in your network are included. To change the name of a site, simply double click on the tab and enter the new name. The site editor can be used at any time to modify the site data

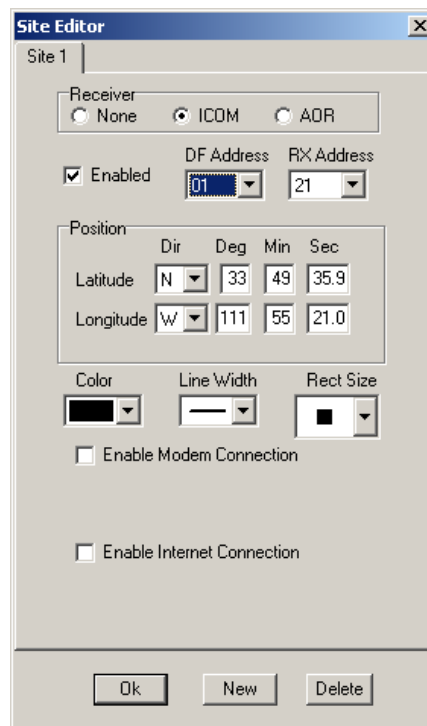


Figure 3: Site Data Entry Dialog

Entering Channel Data

If you are using an ICOM programmable receiver you can use BearingTrack to remotely tune the receiver to any number of channels. To accomplish this you must enter channel names and frequencies into BearingTrack. Select **Channels...** from the **Setup** menu. The dialog in Figure 4 will be displayed. In the frequency column enter the frequency of the channel. In the Name column enter the name you would like to appear in the menu. If you leave it blank the frequency will be used in the **Channel** menu. If you want to disable the channel, click in the disabled column or use the arrow keys to move to the column and press the **Enter** key. The Ant column automatically selects the proper antenna to use if a DDF6071 or DDF6076 antenna switch is installed.

The import feature allows a user to import channel data from a comma separated variable (.csv) file. The format of the file must be as follows

```
fff.ffff,nnnnn<CR><LF>
```

where fff.ffff is the channel frequency, nnnnn is the channel name, and <CR><LF> are the carriage return and line feed characters respectively. A simple way to make a .csv file is to use Microsoft Excel and save the file as .csv.

To import the channels from a file press the Import button and a file open dialog will open. Select the desired file and the frequencies will be imported. BearingTrack will give you an option to delete the current frequencies or add the imported channels to the current list.

When you've entered all the channels you wish to use click OK. Now you can use the **Channel** menu to select the channel you wish to use. Note the frequency of the receiver will not be set to the channel until the **Run** button is pressed.

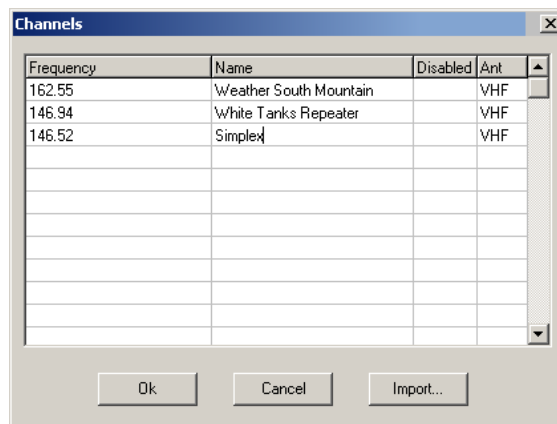


Figure 4: Channel Dialog

Configuring the Direction Finder

Once you've configured the sites, you can use BearingTrack to change the direction finder settings. Select **DF Settings...** from the **Setup** menu. A dialog similar to the direction finder front panel, Figure 5, will be displayed. Select the site you wish to configure using the site tabs. The current settings of the direction finder will be displayed. Use the mouse to push the buttons to make any desired changes to the settings. All the settings are identical to the direction finder settings as explained in the DDF6000 manual except the **Cal BRG to** button. The **Cal BRG to** button can be used to set the direction finder to a particular bearing. A typical use for this function would be to tune the receiver to a beacon frequency. Knowing the location of the beacon relative to the direction finder site the bearing can be calculated and entered into the text box next to the **Cal BRG to** button. Next push the button and the direction finder is calibrated to that beacon location.

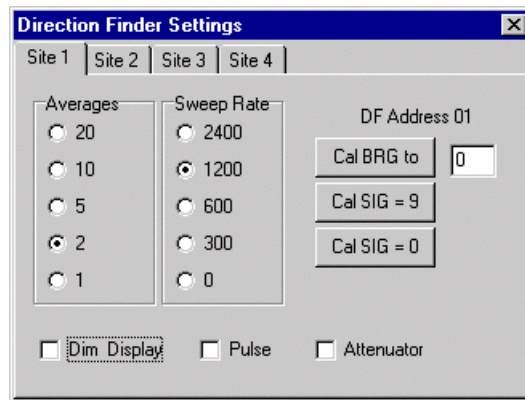


Figure 5: Direction Finder Dialog

Selecting the Serial Port

If you are using the serial port to communicate with the direction finders you must tell BearingTrack which COM port you are using. Select the COM port from the **Serial Port** menu under the **Setup Menu**.

Options

BearingTrack has a number of options that can be set by the user. Factory defaults are set by clicking the **Defaults** button.

General

Figure 6 shows the General parameter page. The Serial poll time sets minimum time between polling events. Polling is used when the direction finder sites are connected to BearingTrack using a serial device such as a telephone or radio modem. Faster polling yields the most bearing data and uses the most network resources. The minimum poll time is 500 ms.

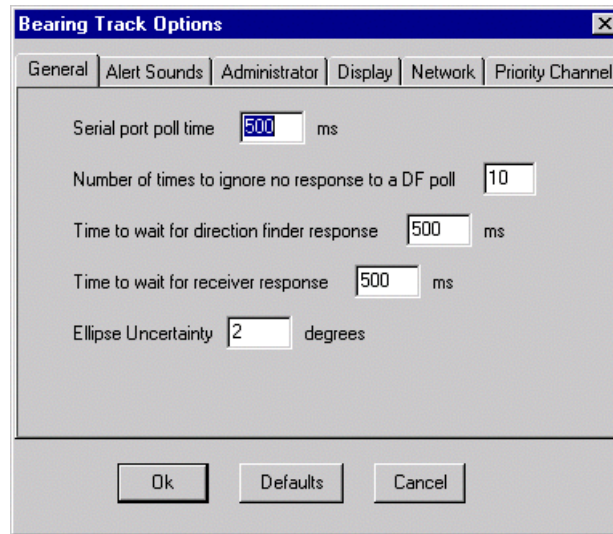


Figure 6: General Options Page

The number of times to ignore no response to a DF poll sets the number of times the program will poll the sites without receiving a response before declaring the site down.

The time to wait for a direction finder response sets the maximum time BearingTrack will wait after polling to receive a response before polling the next site and logging a no response received event.

The time to wait for receiver response sets the maximum time BearingTrack will wait after sending a set frequency command.

The ellipse uncertainty is set to the expected standard deviation of the direction finder errors. This should always be set to 2 degrees unless the direction finders are in very poor locations which would increase their expected error. This parameter determines the dimensions of the **95% ellipse** (see "95% Confidence Ellipse" on page 48).

Alert Sounds

Alert sounds are used to warn the user if communication with a site has failed. If a site fails it is indicated in the bottom status bar by a down indication. If the alert sounds are enabled, the program then produces a periodic sound alerting the operator that the site is not responding. If two or more sites fail to respond, a different sound is produced to alert the operator of a more serious situation. You can use the **Alert Sounds** tab to enable the alert sound and to set the frequency at which you would like to be alerted.

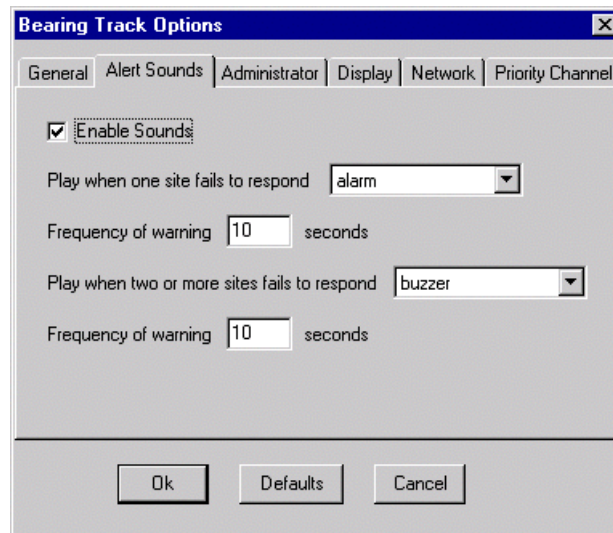


Figure 7: Alert Sound Dialog

Administrator

Access to the program options may be limited by the administrator. Enabling the administrator option password protects access to the items selected in the dialog shown below. Selecting any of the checked menus requires entry of the proper password, in order to have the menu selection accepted.

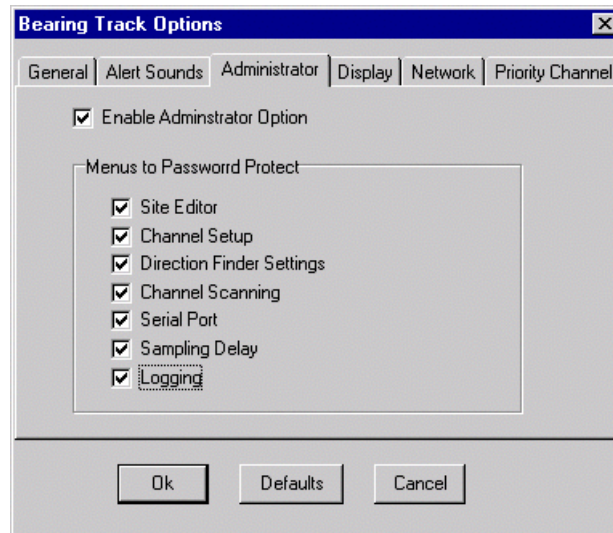


Figure 8: Administrator Dialog

To set the password, simply check the Enable Administrator Option. The program will prompt you to enter the password. To change the password simply uncheck the Enable Administrator Option box and then check it again.

Display

During operation, BearingTrack collects and displays lines of bearing on the map. At any time if a direction finder is operating normally but is not receiving a bearing, a **Normal** message will be displayed in the status bar at the bottom of the display in the color selected for the site. If a new bearing is not received within a certain time frame, the bearing will first turn to gray and then disappear from the display. The **Display** tab allows you to set the time to hold the bearing before dimming and also before disappearing.

The **Display** tab also allows you to set the way the latitude and longitude are displayed.

The virtual site color and width determines how virtual sites will be displayed on the screen. (See Virtual Site on page 31 for instructions on using virtual sites.)

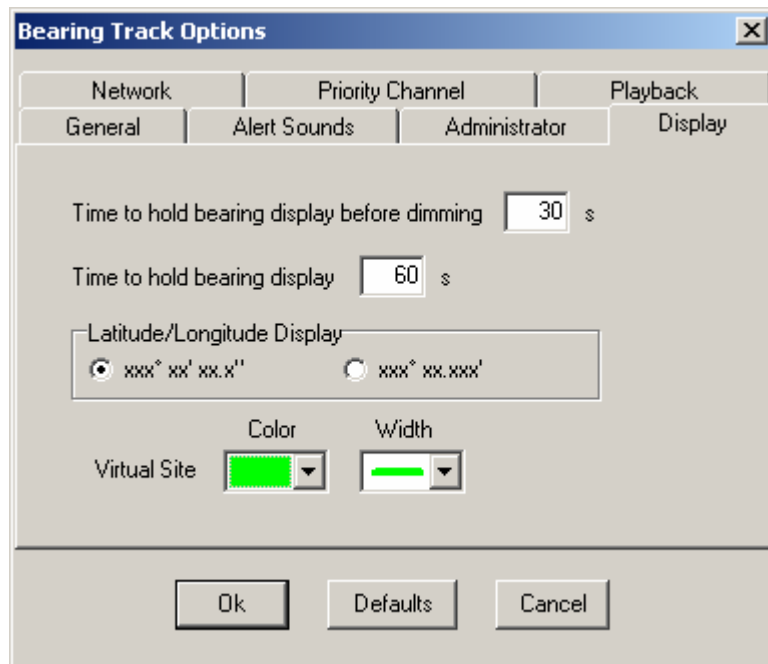


Figure 9: Display Dialog

Priority Channel

During the operation of BearingTrack the operator can change channels at any time by selecting the channel name from the **Channel** menu. If there is one particular channel that you want BearingTrack to monitor, you can set it as a priority channel. If a priority channel is set and the operator selects a different channel, the program will go to the selected channel but it will return to the priority channel after a preset time. Use the **Priority Channel** tab to select the priority channel and the time to remain on any channel other than the priority channel.

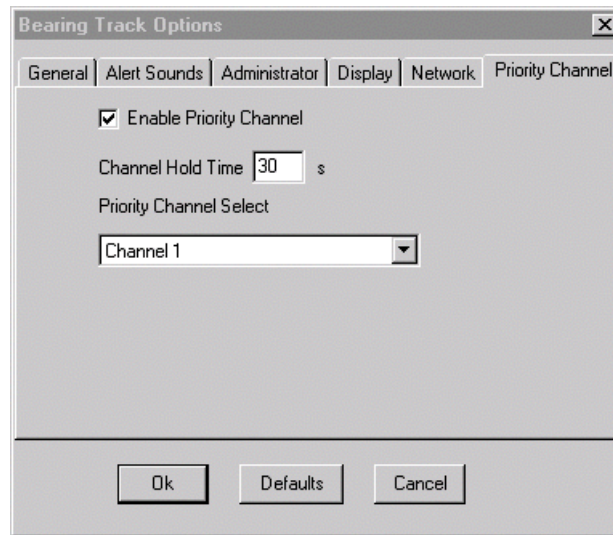


Figure 9: Priority Channel Dialog

Network

When the direction finder sites are connected to BearingTrack via the Internet or an intranet, the direction finders send data over the network as they obtain it. However, direction finder setting and channel setting requires the direction finder and the receiver to respond to the commands sent to them. The **Network** tab is used to set acceptable delay for the site to respond to a command. If the site does not respond to the command an error dialog box will be displayed.

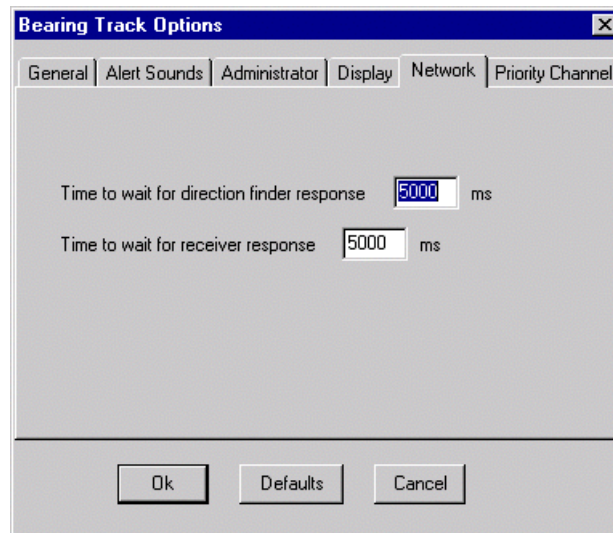
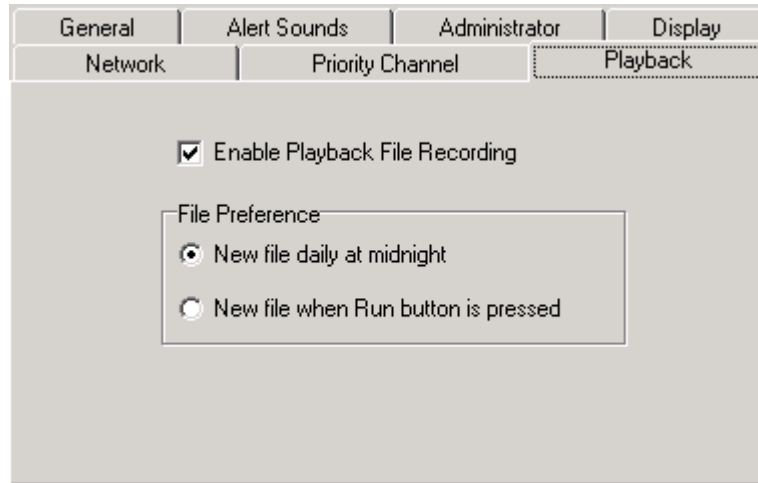


Figure 10: Network Dialog

Playback

The Playback File Options tab allows you to enable the recording of a playback file. Once a playback file is recorded Playback can be selected from the File menu and the data recorded can be viewed.



Check the Enable Playback File Recording to make BearingTrack write a Playback file whenever it is in the Run mode.

Select New file daily at midnight if you want all the data collected for a certain day to be written into a file

Select New file when Run button is pressed to start a new file each time the Run button is pressed.

Running BearingTrack

Figure 11 shows the major areas of the BearingTrack Display. At the top of the display is the main menu. The main menu is used to

- configure the program (as described previously),
- to select the channel and map you wish to use
- to manipulate the display,
- to log the incoming data,
- and to print the displayed data

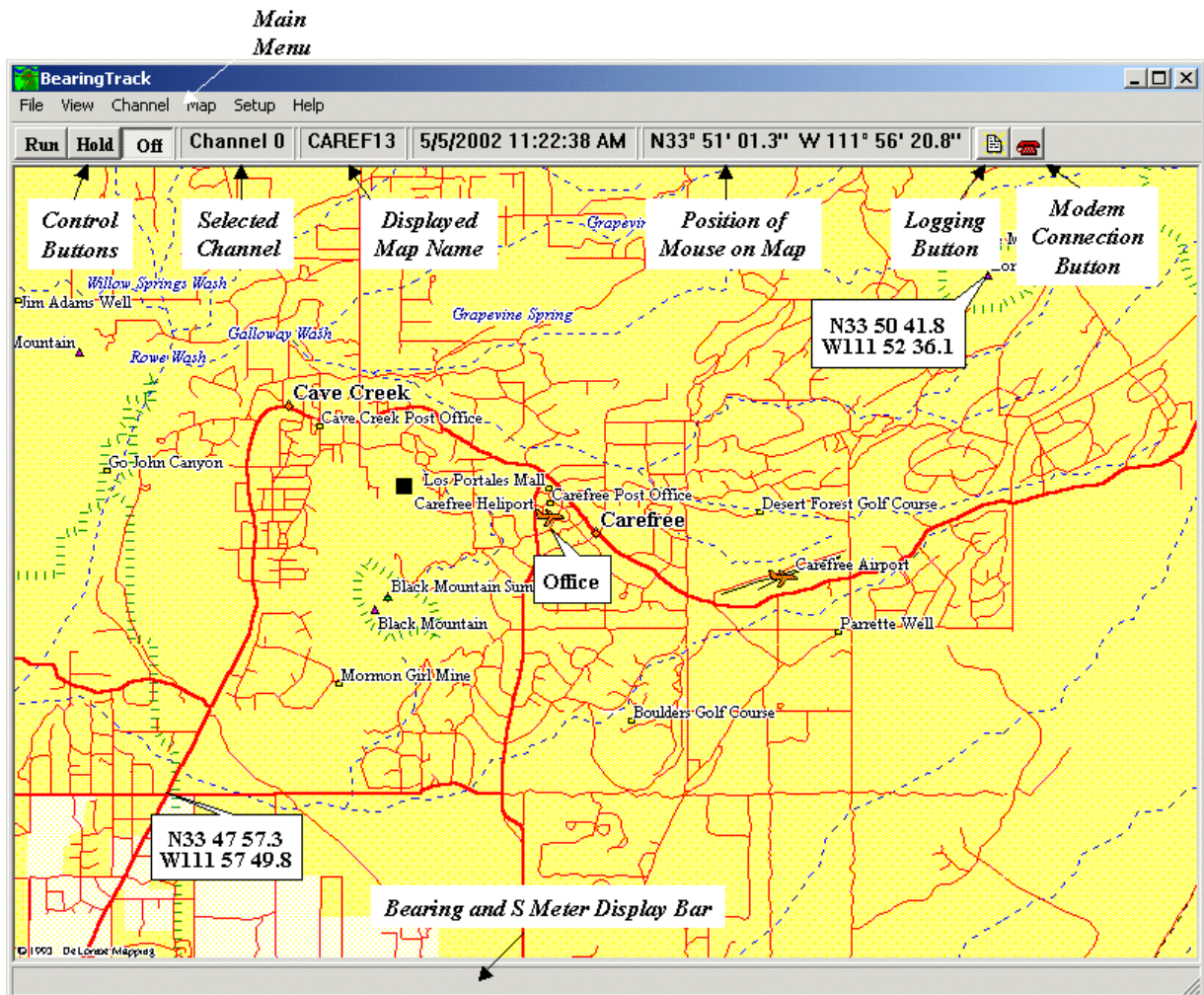


Figure 11 : BearingTrack Display

The control buttons are used to control BearingTrack's mode of operation. The Off mode is used to set up the program and no data is displayed when in the Off mode. In the Run mode, all incoming data is displayed on the screen. The program regularly samples the DF sites and displays the results. The Hold mode is used to suspend the display of incoming data and holds the last data collected enabling the operator to print the screen.

The Status display bar displays the currently selected channel, the currently selected map name, and the current time and date.

At the far right of the status display bar there are two buttons. The first button is used to turn logging on and off and display the status of the logging. If the button is down, Log Bearing Data is enabled. The second button only appears if one or more of the sites requires a dial up connection to connect it to bearing track. If the button is up, pressing it starts the connection process. If it is down, pressing it will hang up the modems.

The center portion of the screen displays the map and graphically displays the location of the sites and lines of bearing from the sites to the RF source being tracked.

At the very bottom of the screen, the bearing and S meter display shows the bearings measured at the direction finder locations and the signal strength of each received signal. The bearing or status of each site is displayed in the same color text as the bearing site displayed on the screen.

Tracking an RF Source

Once BearingTrack is configured, use the mouse to press Run. Next select the channel you wish to monitor from the **Channel** menu. Selecting the channel name sets the receivers at the DF locations to the selected channel frequency and begins monitoring the direction finders for bearing data. The direction finder sites will be displayed as colored squares on the map (see Figure 12 below). If a RF source is present at the channel frequency, lines of bearing will be displayed emanating from the site location. Selecting the **Estimated Position** item in the **View** menu will display the estimated position of the RF source as a black square with the estimated latitude and longitude displayed below the site. Selecting the **95% Confidence Ellipse** item from the **View** menu will display an ellipse centered on the estimated position. Given the bearing measurements, there is a 95% chance that the RF source is somewhere within this ellipse.

When BearingTrack is receiving a bearing from a site the measured bearing and the receiver S meter reading will be displayed in the Bearing and S-meter display bar near the bottom of the display. After a source stops transmitting, the bearing will be held for the time set in the Display Options dialog. When the bearing is being held, it will be displayed in italics. If for some reason the site does not respond to a poll, the bearing will be crossed out. During times when no bearing is displayed and communications with the site are normal, the word Normal will be displayed. If there is no bearing to display and the site does not respond to polling commands from BearingTrack the word Down will be displayed.

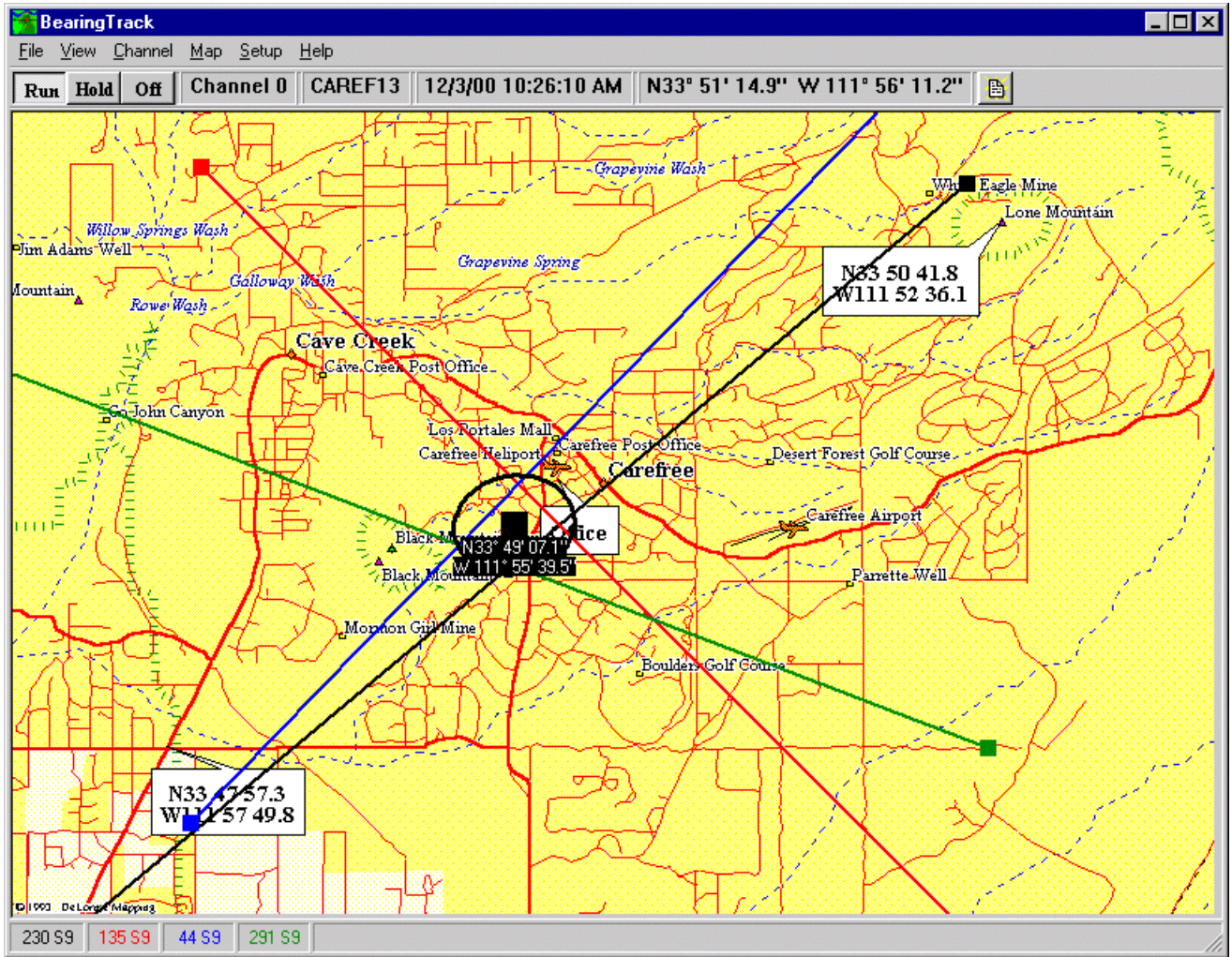


Figure 12: Typical Bearing Track Display

Adjusting the Display

The **View** menu is used to adjust the display. Select **Bearing Lines** to display lines of bearing at each site using the measured bearing data. Selecting **Estimated Position** causes Bearing Track to calculate the estimated position of the RF source from the collected bearing data and the known site locations. The estimated position is displayed as a small black square near where the lines of bearing intersect. Below the square the latitude and longitude of the estimated position is displayed. Note that if only two sites are used, the estimated position will always be at the intersection of the two lines of bearing. Selecting **95% Confidence Ellipse** causes BearingTrack to draw an ellipse centered on the estimated position. Given the Direction Finder rms error (typically 2 degrees) and the measured bearings there is a 95% chance that the RF source is within this ellipse.

If some part of the map is not visible on the screen you can use the scroll bars for panning. You can also zoom in or out with commands in the View menu or by pressing the right mouse button and selecting **Zoom In** or **Zoom Out**.

Changing Maps and Channels

While running BearingTrack the map you are using and the channel can be changed at anytime. Simply select the desired map or channel from their respective menus. In order for the available channels to be in the menu they must be enabled. When in the Run mode the channel frequency will be changed immediately to the selected channel frequency. In any other mode the frequency will not be changed until the Run button is pressed.

Logging the Data

To log the incoming data select **Log Bearing Data** from the **File** menu or press the Logging button. A file named **yyyyddmm.log** will be created in the log directory where **yyyyddmm** is the year, month, and day the file was created. As long as **Log Bearing Data** is checked the time, date, site name, measured bearing, S meter reading, and the selected channel are written into the file. If **Log Bearing Data** is enabled and the program is running at midnight, Bearing Track will close the file it is using and create a new file for the current day. An example of a log file is shown below

Time	Date	Site	Channel	Frequency	Brg	S
10:07:56 AM	12/3/00	Site 1	Channel 0	146.1111	256	9
10:07:56 AM	12/3/00	Site 2	Channel 0	146.1111	153	9
10:07:56 AM	12/3/00	Site 3	Channel 0	146.1111	32	9
10:07:56 AM	12/3/00	Site 1	Channel 0	146.1111	256	9

10:07:56 AM	12/3/00	Site 2	Channel 0	146.1111	153	9
10:07:56 AM	12/3/00	Site 3	Channel 0	146.1111	32	9
10:07:57 AM	12/3/00	Site 1	Channel 0	146.1111	257	9
10:07:57 AM	12/3/00	Site 2	Channel 0	146.1111	154	9
10:07:57 AM	12/3/00	Site 3	Channel 0	146.1111	33	9
10:07:57 AM	12/3/00	Site 1	Channel 0	146.1111	258	9

The contents of the file can be displayed by any program capable of reading a text file (e.g. WordPad or Microsoft Word.) or by the LogViewer utility application provided with BearingTrack.

Logging Events

Event logging can be useful to determine if sites are responding as expected. Simply select Log Events from the **File** menu and BearingTrack will record each the program transitions state. It will also record any times a site is polled via the serial port but no response was received. This data can be used to set the program delays and sampling times to achieve optimal operation. It also can be used to spot a site the repeal fails to respond to messages sent to it.

Printing

When you have frozen the sampling, using the Hold button, you can send the screen image to your printer. Simply select the **Print** command from the **File** menu. The time and date, the channel name, and the map name also appear on the printout. When in the **Run** mode you can obtain a screen shot by simply pressing the F1 key.

Setting the Sampling Delay

If you are using BearingTrack with a direction finder network consisting of a combination of radio modems and direct serial connections, it may be necessary to set the Sampling Delay. To determine if you need to set the Sampling Delay, use the **Setup** menu to set the sampling delay to Auto and then press the Run button. If you get an error stating that the Direction finder at a site with a radio modem is not responding, increase the sampling delay by selecting **Sampling Delay** from the **Setup** menu and press Run again. Continue to increase the sampling delay until you achieve reliable operation. It is important to use the minimum sampling delay possible to achieve optimum operation of the direction finder network.

Scanning Channels

BearingTrack can be programmed to scan the channels that are entered into it. To enable scanning, select **Scan Channels...** from the **Settings** menu. The following dialog box (Figure 13) will be displayed

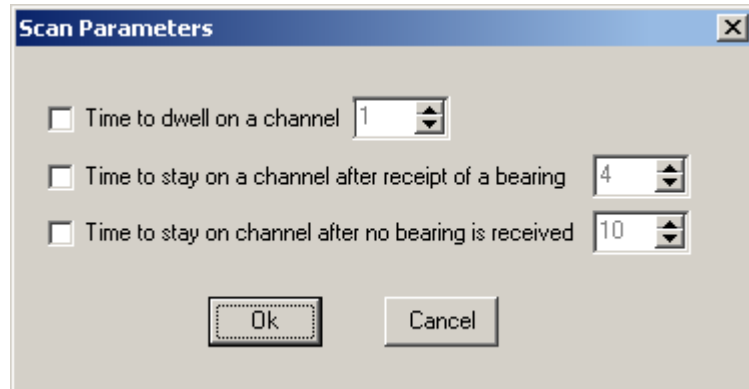
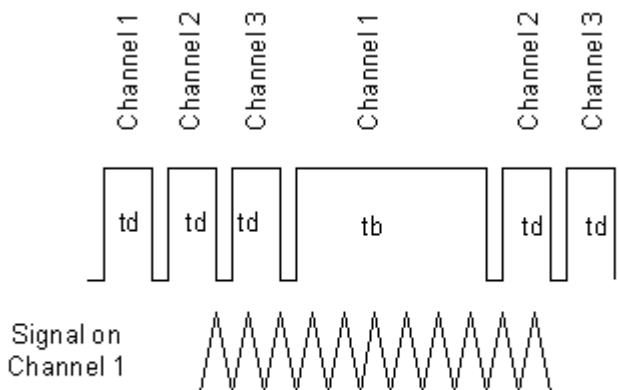


Figure 13: Channel Scanning Dialog

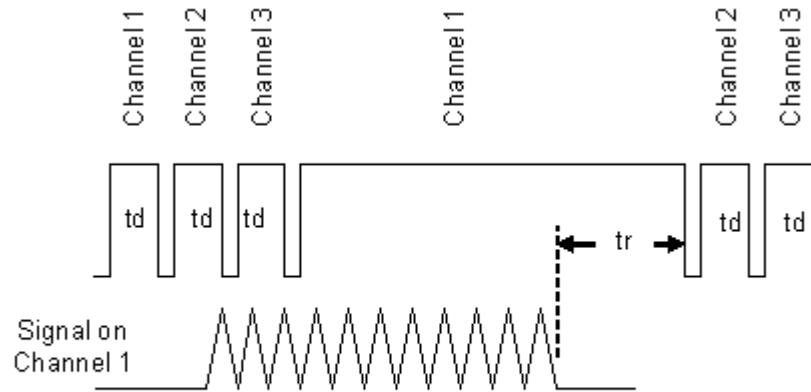
Check the **Time to dwell on a channel** check box and enter the time you would like BearingTrack to listen to a channel before changing to the next channel. This will enable channel scanning. If after receiving a bearing you would like to stay on that frequency for a fixed time and then move on, check **Time to stay on a channel after receipt of a bearing** and enter the time you want BearingTrack to stay on a channel after it receives a bearing. See the timing diagram below.



td is the dwell time

tb is the Time to stay on a channel after receipt of a bearing

If you want to stay on a channel until the signal is gone click on **Time to stay on channel after no bearing is received** and enter the time you want to dwell on the channel after the signal is gone. See timing diagram below.



td is the dwell time

tr is the Time to stay on a channel after no bearing is received

Calibrating to a Beacon

BearingTrack can be calibrated by using RF sites at known locations on known frequencies (beacons) such as weather channels. To perform the calibration put BearingTrack in the **Run** mode and select the beacon channel from the channel menu. Make sure that the sites you wish to calibrate are indicating a bearing reading. Next place the mouse pointer on the site you wish to calibrate and click the right mouse key. Select **Calibrate...** from the pop up menu and a dialog box will be displayed. Enter the bearing between the site and the beacon and then press the **Calibrate** button. Shortly after you press the Calibrate button, a new bearing will be displayed that points toward the beacon.

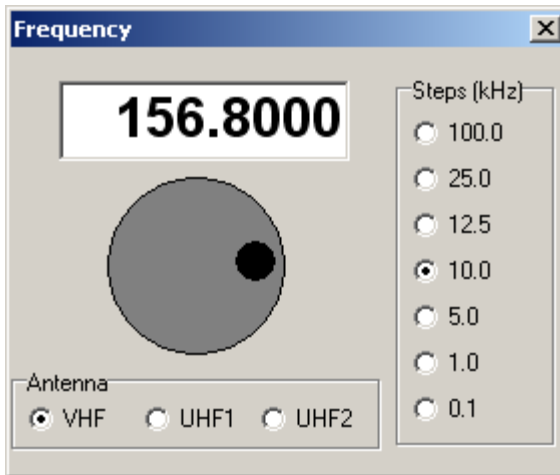
Using Dial Up Modems

BearingTrack can be used with dial up modems. A typical network of Direction Finders using modems is shown in the Designing Your Direction Finder Network section. During Site Setup the phone number of each site that uses a modem is entered. To connect cause the modems to dial the sites, first turn off all modems and then press the modem connect button at the far right of the status display bar at the top of the screen. The program will respond by providing you directions on what to do to complete the connection process. Once all the modems are connected you can then use BearingTrack to gather bearing data from the Direction Finder sites and to change the direction finder sites.

To disconnect, simply press the button again and the modems will terminate the phone line connection.

Tuning the Receiver

In BearingTrack select **Tune Receiver** from the **Options** menu or type **ctrl-T** on the keyboard. The dialog shown below will appear. To tune the receiver enter the desired frequency in the edit box, use the mouse to turn the dial, or use the up-arrow and down-arrow keys.



Virtual Site

A virtual site is a site you temporarily add to the screen to display a bearing that is taken at another mobile or fixed site. For instance if a mobile operator is using a DDF6002 he could radio in his position and a bearing reading to the BearingTrack operator. The BearingTrack operator can then enter a virtual site to aid in the location of the RF source.

To add a virtual site, right click the mouse on the map display where you want the virtual site to be located. Select **Add Virtual Site** from the popup menu. A virtual site will be displayed along with an edit box for the bearing. Using the keyboard enter the bearing and hit the **Enter** key. The virtual site will now display the location of the site and a bearing line.

To change the bearing of a virtual site, place the mouse over the site and right click it. Select **Set Bearing** from the pop up menu and enter the new bearing.

To delete a virtual site, left click on the site and press the **Delete** key.

Playback

Playback enables you to playback files you have previously recorded and display them on a map. Playback files are written by BearingTrack when Playback is enabled in the options menu.

Opening a Playback File

To Open a file to playback, select **Playback...** from the **File** menu. A standard windows dialog to open a file will appear. The file extension for a playback file is .bpb. The files are named by using the date and time they were created as follows

yyyymmddhhmmssxxx

where

yyyy is the year the file was created

mm is the month the file was created

dd is the day the file was created

hh is the hour the file was created

ss is the second the file was created

xxx is the millisecond the file was created

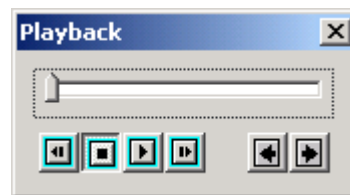
Select the desired file and press open.

Controlling Playback

Once you've opened a playback file, the playback window will appear on top of the map display. Using this control you can set the playback starting position, playback the file in real time, playback the file in fast forward, reverse the playback, and advance or go back a single record. A record consists of

- the bearing
- the date and time the bearing was recorded
- the site where the bearing was recorded
- the channel the receiver was set to when the bearing was recorded
- the S meter reading of the direction finder when the bearing was recorded

The Playback dialog is shown below.



Use the slider control to position select a certain record in the file. The bearing display on the map and the time will change as you move the slider to help you find the record you want.

Press the forward button to start playback. Playback will proceed in real time with the actual time the bearing was recorded appearing in the time display.

Use the fast forward button to speed up the playback by a factor of 10.

Use the reverse button to move backwards through the file.

Use the stop button to stop and hold the currently displayed bearing and time

Use the advance one record button to get the next record in the file and display it.

Use the go back one record button to get the previous record in the file and display it.

You can stop Playback at any time by simply clicking on the close box in the upper right hand corner of the Playback dialog box.

CHAPTER 4

Creating Maps for Bearing Track

To create a Bearing Track map use the MapFix program. MapFix is installed on your hard disk in the same directory as Bearing Track. An icon for MapFix is placed in your Bearing Track program group. With MapFix you can import an image and assign latitude and longitude coordinates to it. Then save the file and you are ready to use the map in Bearing Track.

Technically, a Bearing Track map is a pixel-based image (a bitmap) that is stored in a file together with coordinate information. To make a map, you must first create a map image and store it in a graphics file. You can create a map image by using a commercially available map program or by using a scanner. When you have such a file, you import it to Map Fix. The next step is to assign coordinates to the image. When you have assigned coordinates, you can check the coordinates of any location by moving the mouse. The latitude and longitude of the cursor location are displayed at the top of the screen. Finally, you save the image with coordinates as a map file.

There are some things you should consider when making a Bearing Track map. If the map has many details and/or is very dark, you might find it hard to see bearings on the screen. It is advisable to use a map with fairly pale colors or with limited detail.

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Creating a Map Image

To make a map you first need a graphics file containing a map image. You cannot use MapFix to create this file. A convenient way of making a graphics file is to use a map program. Alternatively, you could scan in an image from a hard copy map or obtain one from a web site such as MapBlast.com. Since graphics files consume space on your hard disk, you might want to delete them after you have used them to make Bearing Track maps.

Using a map program

If you have a map program with maps of the region you are interested in, the map program will let you save a portion of a map to a graphics file, which you can import to Map Fix. Only the image itself (without any coordinate information) will be saved to the graphics file. Thus, you must use the map program to determine the latitude and longitude of two locations on the map. You need this information to assign coordinates to the map. There are several map programs available on the market, for instance MapExpert .

Using the MapExpert program

For your convenience, a brief description of how you can create a graphics file with the MapExpert 2.0 program follows (MapExpert is produced by DeLorme Mapping).

After starting the MapExpert program, the first step is to locate the map you want. You can do this for instance by giving a place name in the Locate Place Name dialog box (Geography menu). Next, you can adjust the scale and amount of detail by zooming in or out (Display menu). Pan the map (click with the map cursor to where you want the center of the map to be) until you are satisfied with what you see on the screen. You now need to determine the latitude and longitude of two locations, for later use with Map Fix. These locations should be relatively far apart, preferably along a diagonal of the image. Position the map cursor over a location and read off (and write down) the coordinates at the bottom of the screen.

You might want to repeat the procedure and make several graphics files. For instance, you could make one overall map of your region, and then construct four maps at higher magnification for the SW, NW, NE, and SE parts of your region.

Scanning in an Image

If you create a map image by scanning it in from an image on paper, make sure that you orient the paper image with north in the upward direction, so that latitudes become horizontal and longitudes vertical. You then use your scanning software to save the image as a graphics file.

Graphics File Formats

There are a great number of file formats for storing images. Almost all of these are pixel based. A given format can usually store several kinds of images (different numbers of colors per pixel and different compression schemes). It is also possible to store an image as graphics drawing commands (the Windows Metafile Format is of this type), but Map Fix only handles bitmap (.bmp) images. Common programs such as Microsoft Paint or Microsoft Imager can easily convert any standard graphics file into a bitmap image.

Importing the Image

To import a graphics file containing a map image to Map Fix, select the **Import** option from the **File** menu or click the **Import** button on the tool bar. A file open dialog appears. By default, the dialog box is set for import of BMP files. Then go to the directory where the graphics file is located, select the file and click OK. The map image then appears on the screen

Assigning Coordinates to the Image

Map Fix and Bearing Track use latitude and longitude to determine positions on a map. The map must be oriented so that north is in the upward direction, making latitudes horizontal and longitudes vertical.

Latitude and longitude

Using the option **Display Seconds** or **Display Minutes** in the **Display** menu you can control the format in which latitudes and longitudes are displayed.

Latitude is measured as degrees north or south of the equator. A degree is divided into 60 minutes, and a minute into 60 seconds. As an example, the latitude north 35 degrees, 22 minutes, and 30 seconds is written as N 35° 22' 30.0". Alternatively, the same latitude can be given without seconds as N 35° 22.500'. Longitude is measured as degrees east or west of the Greenwich meridian. As an example, the longitude west 108 degrees, 12 minutes, and 15 seconds is written as W 108° 12' 15.0". Alternatively, the same longitude can be given without seconds as W 108° 12.250'.

The Enter Points menu

Using commands in the **Enter Points** menu or on the tool bar, you assign coordinates to your pixel image by specifying the latitude and longitude of two locations on the image. Thus, you need to know the latitude and longitude of two points that you can identify and select with the mouse. You are free to choose any two points, except that they must define a rectangle (they cannot line up). To achieve maximum precision, you should see to it that the two points are fairly far apart, preferably along a diagonal of the image. The following commands appear in the **Enter Points** menu:

Fix Point 1: Determine the location and latitude and longitude of the first point. When you select this option, the cursor changes to a cross. Move the cross to the right location and click the mouse. Enter the latitude and longitude of the location in the dialog box that pops up. The location you have chosen is marked in red on the screen. If you are not satisfied, select **Clear Points** from the **Enter Points** menu and repeat the process.

Fix Point 2: Determine the location and latitude and longitude of the second point. When you select this option, the cursor changes to a cross. Move the cross to the right location and click the mouse. Enter the latitude and longitude of the location in the dialog box that pops up. The location you have chosen is marked in blue on the screen. If you are not satisfied, select **Clear Points** from the **Enter Points** menu and repeat the process.

Clear points: Use this option if you want to start over fixing points.

The Display menu

Seconds: Display and enter latitude and longitude as degrees, minutes, and seconds, where seconds are given with one decimal. This option is on by default.

Saving the Map File

Use the **Save map** option in the **File** menu to open a dialog where you can save the map image with coordinates to file. The file name extension for a BearingTrack or AutoTrack map file is **.MAP**. Type in the map name you wish to use in BearingTrack or AutoTrack. If you save the map to the Map subdirectory, BearingTrack will automatically load these maps when the program is first started. However, you may save the maps anywhere on your hard disk. Saving a map is available only after you have imported a graphics file and fixed the latitude and longitude of two points on the map

CHAPTER 5

Designing Your Direction Finding Network

There are a number of ways of connecting a number of direction finders to the computer running BearingTrack. This chapter discusses three of the most common techniques: radio modem, telephone line, and the Internet. It is important to note that these three connection types can be combined; so, for instance, if you had three direction finder sites one DF could be connected via a radio modem, one via a telephone line, and one via the Internet. Note: When combining direct serial connections with radio modem connections it may be necessary to set the sampling delay to something other than **Auto**. The discussion below is general in nature; for more specific instructions on networking DDF6000 direction finders with specific radio modems and telephone modems see the application notes on our web site <http://www.doppsy.com>".

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Radio Modems

Radio modems may be used to connect a PC located at a control site to remotely located direction finders and receivers. A radio modem is required at each remote site and at the control site. All radio modems must be set to the same frequency for both transmission and reception. The "host" radio modem is located at the control site and connects to the PC running BearingTrack. This modem transmits and receives data from each of the remote site radio modems. Multiple sites may be connected as shown in Figure 15. There is no limit to the number of sites that may be connected. However, the response time will be reduced as the number of sites increases since it takes about 200 milliseconds to poll each site using radio modems.

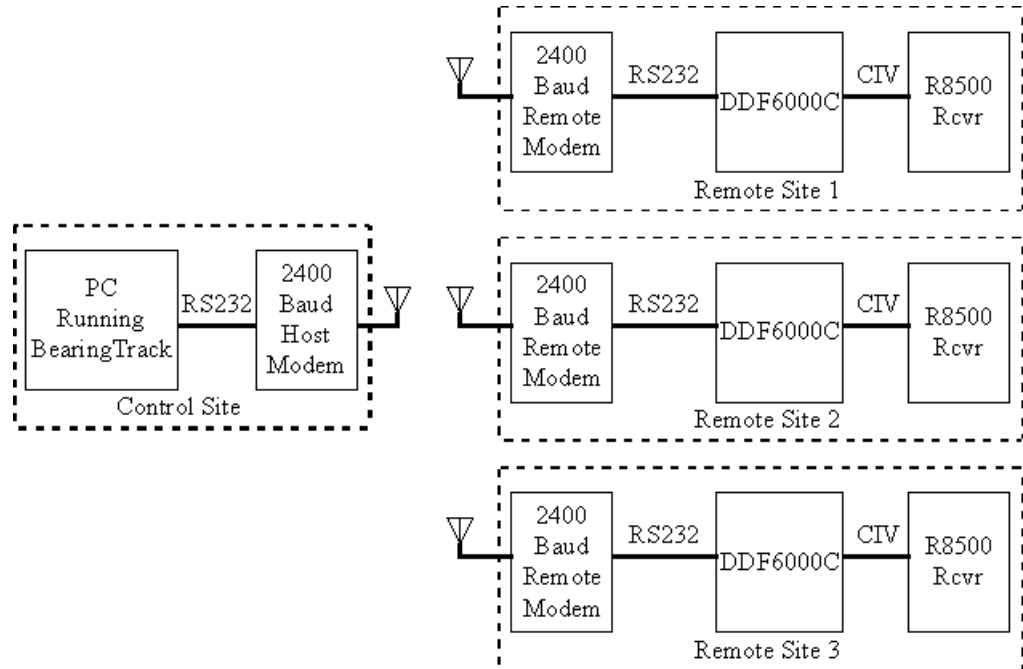


Figure 15 : Radio Modem Configuration

Telephone Modems

The BearingTrack software, allows one or more of DDF6000 direction finders to be controlled remotely over leased telephone lines. A modem pair is required for each remote site. The "calling" modem is located at the central control point where the PC running BearingTrack is located, and the "answering" modem is located at the remote site. Figure 16 shows how multiple sites are to be connected. The Serial Expander, DDF6077 is available from Doppler System. A Serial Expander will interface a single PC COM port with up to three calling modems. If more than three sites are to be connected, multiple Serial Expanders may be used. There is no limit to the number of sites that may be connected. However, the response time will be reduced as the number of sites increases since it takes about 135 milliseconds to poll each site using telephone modems.

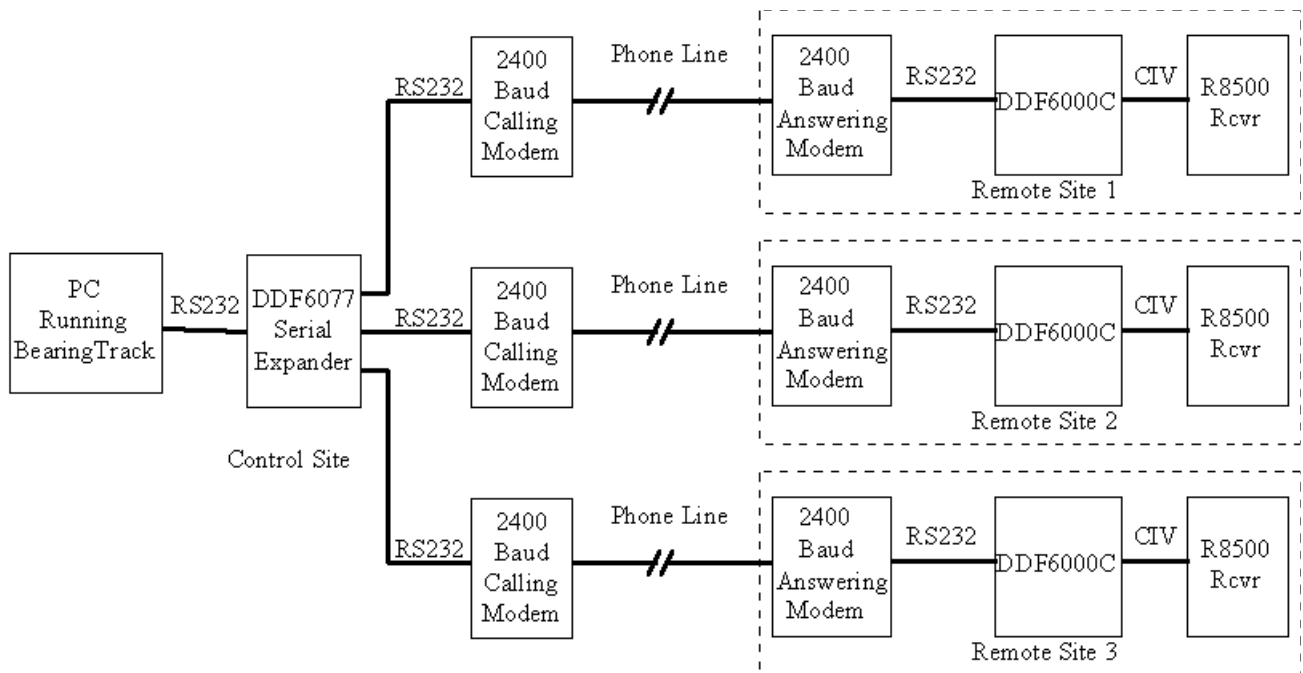


Figure 16: Telephone Modem Configuration

Internet or Intranet

BearingTrack can control and extract data from a network of DDF6000 direction finders that are connected to the Internet (see Figure 17). A minimally configured PC is required at each direction finder site. The computers at the remote sites all run BearingTrack Server to interface the direction finders to the Internet. The Internet connections at the host site and the direction finder sites can be dedicated connections such as DSL or cable modem, dial up connections, or cellular digital packet data connections. The only requirement is that the IP address of the remote connections be known. The setup and operation of BearingTrack Server is discussed in Chapter 6.

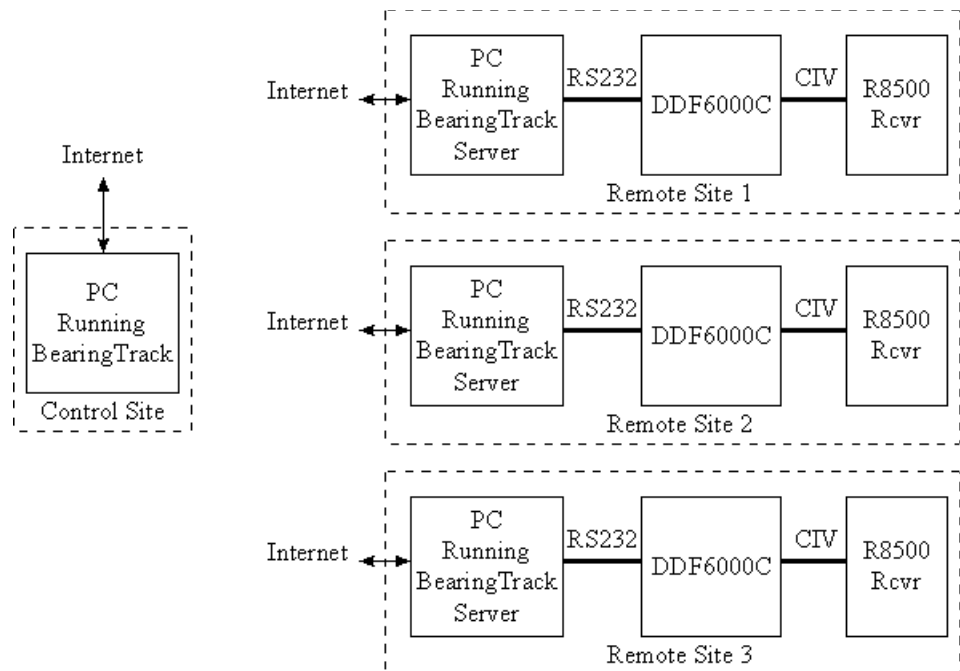


Figure 17: Internet Configuration

CHAPTER 6

Using BearingTrack Server

BearingTrack Server is a program that interfaces a DDF6000C to the Internet. To use it you must first have an Internet connection with a dedicated IP address for each remote site you are going to connect to the Internet. The Internet connection could be via a dial up connection, a digital subscriber line, a cable modem, or a cellular digital packet data connection. The IP address is of the form xxx.xxx.xxx.xxx where xxx is an integer number between 0 and 255. Contact your Internet service provider about obtaining a dedicated IP address.

When you first start BearingTrack Server, the display shown in Figure 18 will appear on the screen. Set the Serial Port to the port the direction finder is connected to. Set the DF address to the address you programmed into the DF and set the RX address to the receiver address. If you are using an AOR receiver set the receiver address to AOR 5000. Next set the Internet port that BearingTrack Server will listen to. Finally set Maximum Connections to the number of connections you will allow at this site. If your direction finders are on the Internet several computers each running BearingTrack can connect to the direction finder sites. This feature allows you to access your direction finder network simultaneously from several computers. Set the maximum connections to 1 if you want to disable simultaneous connections. Next click run and BearingTrack Server is monitoring the Internet for the BearingTrack application to connect to it.

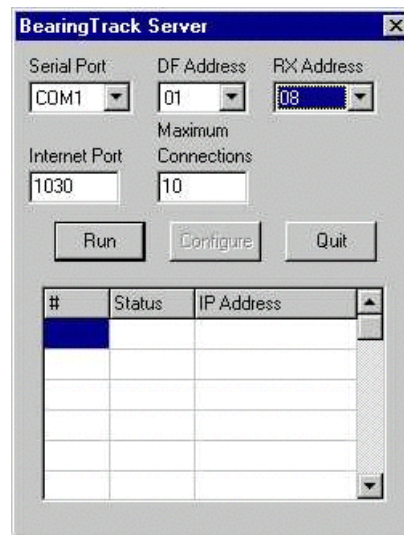


Figure 18: Bearing Track Server Display

If your system loses power and the computer at the remote site reboots you will want BearingTrack Server to restart. To properly restart, create a BearingTrack Server shortcut and place it in your startup folder. The configuration settings are automatically saved and will be used when the program restarts.

CHAPTER 7

Definitions

This section defines terms commonly used throughout this manual.

Direction Finder Site

A direction finder site is a location where a DDF6000 direction finder, a receiver, an antenna, and some type of data relay device resides

Channel

A channel is the name and frequency to which the receiver is tuned.

Lines of Bearing

Lines of bearing, are lines emanating from the direction finder site _

Estimated Position

The estimated position is the most likely position of the radio frequency source. BearingTrack collects bearing information from a network of direction finders and using this information it estimates the position of the radio frequency source.

95% Confidence Ellipse

The 95% Confidence Ellipse displays the area in which BearingTrack calculates that there is a 95% chance that the RF source resides. This ellipse is calculated based on the assumption that each direction finder has an error standard deviation of 2 degrees. Antenna mounting and location can affect direction finder errors. Contact the factory for antenna mounting advice.

CHAPTER 8

Error Messages

Some common error messages you might encounter are listed below

Error in opening communications port

The COM port is either being used by another program or device. Try using another COM port or restarting your computer.

No sites have been defined

You cannot perform any direction finder settings unless sites have been defined.

The direction finder at does not support UHF2 Antenna Selection

This error occurs if you selected the UHF2 antenna in the Channel frequency dialog and you are using a DDF6000B that does not support three antennas.

The direction finder at site xx does not support antenna selection

This error occurs if you selected the UHF2 or UHF1 antenna in the Channel frequency dialog and you are using a DDF6000A or earlier direction finder.

The receiver at site xx did not respond to the last xxx command

ICOM receivers respond with an OK message when they properly receive and execute a command. The frequency may not be set. Try again, but if you continue to get this error there is a problem with your serial or IP data connection. Check your cables and modems. If this does not fix the problem there may be something wrong at the remote site. If using an intranet or the Internet try switching to the off mode and then back to run to reestablish the connection.

The direction finder at site xx did not respond to the xxx command

The DDF6000 direction finders respond with an OK message when they properly receive and execute a command. If you receive this error, the direction finder may not have received the last command. Try again, but if you continue to get this error there is a problem with your serial or IP data connection. Check your cables and modems. If this does not fix the problem there may be something wrong at the remote site. If using an intranet or the Internet try switching to the off mode and then back to run to reestablish the connection.

The network connection at site xx has failed

A TCP/IP error has occurred in the network connection. The exact cause of the error is displayed in the dialog box. If you are unable to reconnect, chances are that the server is experiencing a problem.

Log File cannot be opened

The log file may be in use by another application.

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