

# US&R STRUCTURES SPECIALIST FOG6 EQUIPMENT OPERATING PROCEDURES

## INTRODUCTION to SECTION 5

This section contains instructions for the operation of various instruments that may be used by the Structures Specialist during a US&R deployment.

Instructions and operating information are provided for the following instruments:

- Global Positioning System (60CSx)
- Garmin MapSource Software
- Total Station (Nikon Model NPL 325)
- Wireless Building Monitoring System (WBMS)
- Laser Range Meter (Hilti PD32)
- Electronic Metal Locator (Zircon MT 6)
- Digital Electronic Levels (SmartLevel and SmartTool)

This information was developed to provide a quick refresher during deployment and is not meant as a substitute for formal training courses for each instrument. Additionally, the provided information is limited to functions and usage most common to US&R operations and is not meant as a complete documentation of each instrument's functionality.

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### NOTES

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# US&R STRUCTURES SPECIALIST FOG6 EQUIPMENT OPERATING PROCEDURES

## GLOBAL POSITIONING SYSTEM (60CSx)

### General Information

- Provides a position accuracy of +/- 20 ft. under normal conditions, +/- 10 ft with WAAS enabled.
- Operates with 2-AA alkaline batteries. Each set should last approximately 24 hours of normal usage. Stored data is not lost when the batteries are removed or replaced.
- Remove the battery cover on the back of the unit by turning the metal D-ring 1/4 turn ccw.
- The 60CSx unit provides expanded memory through the use of a microSD card which is accessed by removing the batteries and sliding the metal locking clip toward the top of the unit.

### Keypad Buttons

#### Using the GPSMAP 60CSx Keypad

##### POWER Key

- Press and hold to turn the unit on or off.
- Press and release to adjust the backlighting.

##### IN/OUT Zoom Keys

- Press to zoom in or out on the Map Page.
- Press to scroll up or down a list on any other page.

##### FIND/MOB Key

- Press and release at any time to view the Find Menu.
- Press and hold for MOB\*

##### MARK Key

- Press and release at any time to mark your current location.

##### QUIT Key

- Press and release to cancel data entry or exit a page.

##### ROCKER Key

- Press up, down, left, or right to highlight options and to enter data, or move the map panning arrow.

##### PAGE/COMPASS Key

- Press and release to cycle through the main pages.
- Press and hold to turn the compass on or off

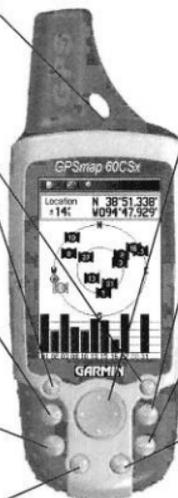
##### MENU Key

- Press and release to view page options.
- Press twice to view the Main Menu.

##### ENTER Key

- Press and release to enter highlighted options, data or confirm on-screen messages.

\* Man Overboard (MOB) feature stores a waypoint and then navigates back to it.



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## Start-Up and Satellite Acquisition

Before turning the 60CSx on, find a location that provides a clear view of the sky and allow for the acquisition of a proper number of satellites.

To turn on the 60CSx, press and hold the **POWER** key. At least three satellites are required to provide 2-dimensional location information and four are required to provide 3-dimensional (Lat-Long-Elevation)

The two circles on the satellite page represent satellites located on the horizon (outer circle) and 45-degrees from the current position (inner circle).

Once a sufficient number of satellites have been located, the accuracy of the position data will be provided at the top of the Satellite Status Page.

If no satellites can be acquired, a dialog will appear that requests if the user desires to use the 60CSx indoors. This provides limited functionality for position but enables the unit to be loaded with maps and waypoint sets. With the Satellite Status Page Options displayed, use the **ROCKER** keypad to highlight "Use Indoors" and press **ENTER**.

To turn the 60CSx off, press and hold the power key.

## Adjusting Screen Contrast and Backlighting

If lighting conditions make it difficult to see the display screen, you can adjust the contrast or turn on the backlight. To adjust screen contrast and/or backlighting:

1. Press the red power key momentarily. A pop-up window appears for screen settings.
2. Use the Left/Right portion of the **ROCKER** to adjust screen contrast.

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3. Use the Up/Down portion of the **ROCKER** to adjust backlighting.
4. Press **ENTER** or **PAGE**, to return to the previous screen. Or, press **QUIT** to cancel the settings.

### Main Display Pages

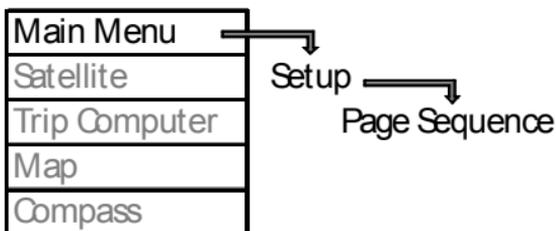
The Garmin 60CSx uses different main display pages to provide information. The pages that are useful for US&R are:

1. Satellite Page – Provides the satellite signal status. At power up, this page is displayed as satellites are acquired. Three satellites are required for a two-dimensional fix (no altimeter) and four satellites are required for a three-dimensional fix.
2. Trip Computer Page – Provides trip and navigation data such as Trip Odometer, Maximum Speed, and Elevation. The fields can be changed by pressing the **MENU** key and using the **ROCKER** to highlight the Change Fields option. Use the **ROCKER** and **ENTER** keys to bring the available information for each field.
3. Map Page – Provides a detail map of the area surrounding the current location. Details maps are provide by preloading them using MapSource. Descriptive information fields provided on this page can be changed by pressing the **MENU** key and using the **ROCKER** to highlight the Change Fields option. The descriptive information fields can be assigned for both modes of the Map Page (Navigating and Not Navigating). Use the **ROCKER** and **ENTER** keys to bring the available information for each field.
4. Compass Page – Provides an electronic graphical compass and indicates direction to go and direction of travel.
5. Main Menu – This page provides a directory of advanced features and settings.
6. Active Route Page – When the 60CSx is navigating, information on this page is presented dependent on the type of navigation:

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- If “Follow Roads” or “Shorter Distance” is selected for navigation, the Turn by Turn route page is displayed. The **ROCKER** can be used to highlight each leg of the route. Pressing the **ENTER** key displays the turn associated with that leg.
- If the “Off Road” option was selected for navigation (over Land, Sea or Air) the Electronic Compass page is displayed indicating required and current heading. When you are traveling off course the inner arrow (indicating required heading) will point in a different direction.
- The internal electronic compass of the 60CSx will only work when it is actually turned on. Otherwise it will only relate your moving position. Therefore when the compass is off you must travel at least ten feet in order for the unit to provide accurate heading information.

To add or delete main display pages:



(Press **MENU** key twice to display the Main Menu page)

### Electronic Compass Calibration

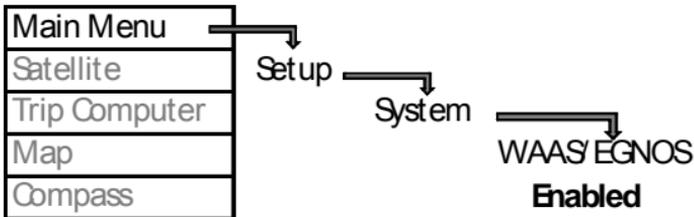
It is a good idea to calibrate the electronic compass periodically. This accomplished by pressing the **MENU** key while displaying the compass page. Use the **ROCKER** to select the “Calibrate Compass” and press **ENTER**. Follow the instructions and rotate the 60CSx. Press **ENTER** when complete

### Initial Setup of the 60CSx

There are several options that should be set or checked prior to using the 60CSx:

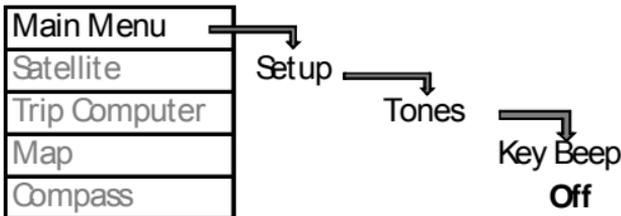
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Ensure that WAAS/EGNOS is enabled:



(Press **MENU** key twice to display the Main Menu page)

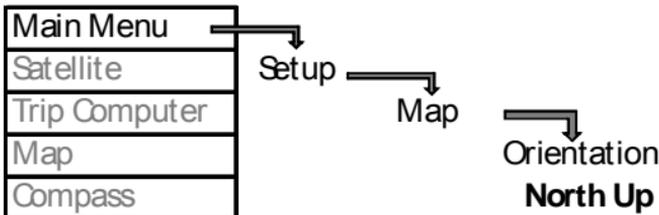
Turn of key beep (this will turn of the key beep option and help to conserve battery life):



(Press **MENU** key twice to display the Main Menu page)

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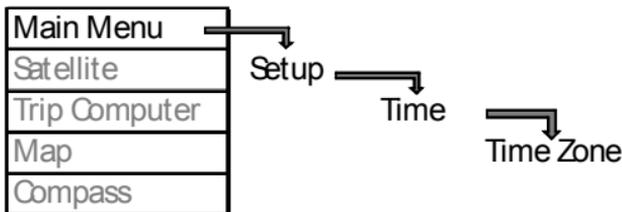
Set map page orientation North Up:



(Press **MENU** key twice to display the Main Menu page)

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Set Local Time Zone:

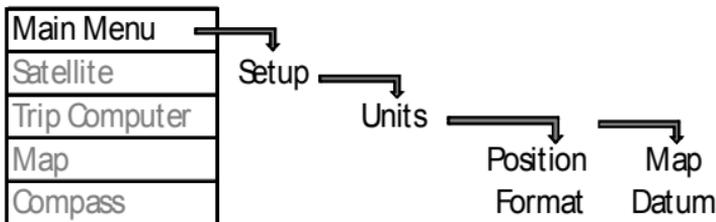


(Press **MENU** key twice to display the Main Menu page)

The Time Format can also be set at this menu (12-hr vs. 24-hr).

## Changing/Converting Position Format

It is important the 60CSx be set to the correct Position Format (confirm the format in use with your team leader).



(Press **MENU** key twice to display the Main Menu page)

Position coordinates can be given in several different formats. Typical formats for FEMA US&R operations are:

- Latitude/Longitude (Hdd.mm.ss or Hdd.mm.mmm)
- USNG

The correct Map Datum must also be selected. WGS84 is used for for both Lat/Long and USNG.

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### Marking a Waypoint

To establish a Waypoint for your current position:



Use the **ROCKER** to highlight each of the dialogue options. When the name or position options are selected the Garmin keypad input dialogue will be displayed. Use the **ROCKER** to highlight the desired letter and press the **ENTER** key to input that letter or numeral.

To establish a Waypoint for a set of given coordinates:



Use the **ROCKER** to highlight the coordinate position and press **ENTER**. Use the **ROCKER** to highlight the desired letter and press the **ENTER** key to input the letters and numbers of the given coordinates.

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To establish a Waypoint from a Recently Found location or Point of Interest:



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## Navigation

There are three methods of navigating with the 60CSx:

- Following Roads by Fastest Time
- Following Roads by Shorter Distance
- Off Road (Land, Sea or Air)

The 60CSx will navigate to several types of locations. Without MapSource detailed maps installed, the 60CSx can navigate to Cities, Interstate Exits, Waypoints, and Recently Found places. With MapSource detailed maps installed; Points of Interest, Addresses, or Intersections are also available.

To navigate to any of the above mentioned locations:



- A small icon will appear in the bottom left corner of the Map Display page while the 60CSx is calculating the route.
- Press the **IN** key to zoom in close enough to see the route.
- If either of the Follow Road options was selected, and the detailed maps for that area are not installed, there may be a significant gap in the routing directions shown on the Map Display page.
- Press the **PAGE** key to display the turn by turn directions for the Follow Road route.
- If the Off Road preference was selected a dark line will appear on the Map Display page indicating the course you should follow.
- Traveling direction is indicated by the small black arrow located in the Map Display page.
- The 60CSx compass is only activated while the unit is moving. It is suggested to move in one straight line for approximately ten feet noting the direction of the black arrow.
- Try to align direction of travel (the tip of the black arrow) to the dark line displayed.

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- Press the **PAGE** key to display the heading/course compass display page.
- The dark arrow displayed indicates the direction of travel to reach desired location. Again it is suggested to move in one straight line for approximately ten feet noting the direction of the black arrow.

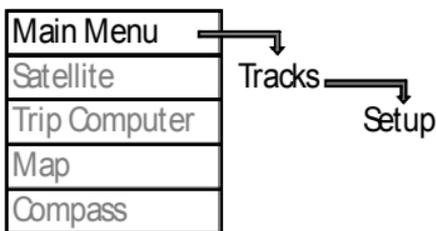
### Using a Track Log

The path that the 60CSx unit takes can be recorded as a Track Log and includes information about points along the path, including time and position. This is accomplished by the 60CSx automatically recording its position at predefined intervals of time or distance. This feature is very useful for documenting travel in a given time period. (i.e. Houses searched in a neighborhood for a specific day).

The track log can also be used to measure the area of any space encompassed by a path as well as retracing, or Tracking Back along a recorded path.

The 60CSx has memory for 20 separate saved track logs. The memory used for each depends on the preselected recording intervals. The interval chosen should depend on the anticipated amount of overall travel. For example: Searching a two-mile square area encompassing several city streets for the entire day may best be recorded using Time at an interval of five minutes. While documenting a City block area encompassing a large debris pile may best be recorded using Time at an interval of 5-seconds.

To setup a Track Log:



(Press **MENU** key twice to display the Main Menu page)

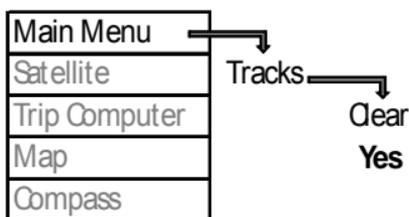
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- Use “Record Interval” to select the desired interval option (Distance, Time, or Auto).
- Use “Value” (or “Resolution”) to enter the desired value.
- Use “Wrap When Full” to check or uncheck this feature. (When unchecked, the track log is recorded until the available memory is full and then stops.)

### To Record a Track Log:

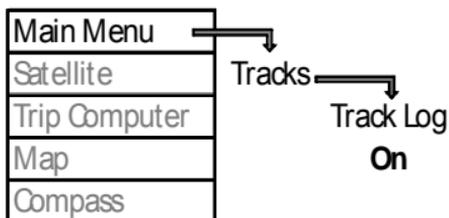
The 60CSx shares the data card memory with the loaded detail maps. Therefore it is suggested to remove as many unused tracks as possible. This requires that the previous tracks be uploaded through the Garmin software onto a computer having more memory. It is also suggested that the track log be “Cleared” prior to recording to ensure that only the desired data be recorded.

### To Delete a Track Log:



(Press **MENU** key twice to display the Main Menu page)

### To Delete a Track Log:



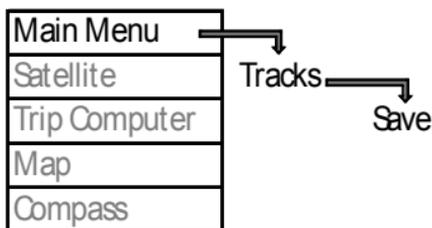
(Press **MENU** key twice to display the Main Menu page)

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Use the **ROCKER** to highlight the “Off” option and press **ENTER** once the desired path has been completed.

To Save a Track Log:

(As the 60CSx has limited memory available for recording Tracks, it is suggested to remove as many unused tracks as possible. See method for this above).



(Press **MENU** key twice to display the Main Menu page)

- The track log is saved using the current date. A different name can be input by using the **ROCKER** to highlight the Name option and press **ENTER**.
- Use the **ROCKER** to highlight the desired letters and press the **ENTER** key to input that letter or numeral.
- Information (distance, number of points, and enclosed area) for the track log is presented on this page.
- The units used for calculating area can be adjusted by using the **ROCKER** to highlight the unit and pressing **ENTER**.
- Other options available on this page are: Show On Map – permanently displays a dotted line on the Map Display page. Delete – deletes the recorded log. Map – temporarily displays the recorded log on the Map. Track Back – provides a point by point set of directions for following the recorded track back to its origin.



## US&R STRUCTURES SPECIALIST FOG6 EQUIPMENT OPERATING PROCEDURES

### GARMIN MAPSOURCE® SOFTWARE

- Necessary to interface a Garmin GPS unit (including the GPS V and 60CSx) with a computer.
- Used to upload geographical data, such as detailed maps, as well as downloading waypoints, routes, tracks, and associated information obtained in the field.
- Data transfer is via a serial cable (GPS V), USB cable (Garmin 60CSx), or storage card (Garmin 60CSx).
- Various mapping products are available for use with MapSource and include:
  - City Select
  - City Navigator (more detailed than City Select)
  - BlueChart
  - USA TOPO

The following information is provided primarily for the City Select mapping product (see p. 5-32 for typical MapSource window display with the City Select – North America product).

#### **Comments on the Use of Garmin Software**

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- Most of the Garmin software must be unlocked with a 25-digit code in order for it to be installed on a computer.
- Unlocked software may be associated with up to 2 Garmin GPS units. Therefore, Map Sets cannot be uploaded to Garmin GPS units that are not unlocked to the specific software. (2008 City Navigator can only be unlocked to one Garmin GPS unit.)
- Software unlocked to a particular Garmin GPS unit can be installed on an unlimited number of computers.
- Uploading Map Sets to a GPS V can require more than one hour when using a serial connection.
- Uploading of information to a Garmin GPS unit should be done prior to mobilization, if at all possible.

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## Graphic Maps

The Graphic Map is the display of the currently selected geographical information within MapSource. The view can be changed by either zooming in or out, or by panning in all directions. These view changes can be done using the on-screen scroll bars, the keyboard's arrow keys, or the Hand tools.

## Creating Map Sets

Geographical information must be contained in a Map Set in order to be uploaded to a GPS unit. A Map Set is one or more detailed area maps that have been selected from the Graphic Map. City Select divides the United States into detailed area maps of varying geographical size depending on the population and development densities. To create a Map Set in MapSource:

1. Select a zoom scale that allows viewing of the map area boundaries.
2. Select "Map" from the Tools menu or the "Map" tool icon in the Tools toolbar. The map area boundaries will be outlined in yellow when the Map tool is located with a detailed map. 
3. Click the left mouse key in the selected area. To select several map areas, drag the mouse to draw a box through the different areas. Selected map areas are shaded in pink.
4. Selected map areas are given in listed in the Maps tab on the left of the screen along with the memory requirements for each map area.
5. Ensure that the total member requirement, given at the bottom of the Map tab does not exceed the memory capacity of the GPS unit (Garmin V = 19 Mb, Garmin 60CS = 56 Mb, Garmin 60CSx = func of storage card).
6. Save Map Set by selecting "Save" in the File menu. Map Sets, along with associated waypoints, routes, etc., are saved as GPS data files have the .gdb file extension.

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### Creating a Waypoint on the Graphic Map

Waypoints can be created within the MapSource program using geographical information for later uploading to a GPS unit:

1. Select "Waypoint" from the Tools menu or the "Waypoint" tool icon in the Tools toolbar. 
2. Position the mouse pointer at the desired location for the waypoint on the Graphic Map.
3. Left-click the mouse, or right-click the mouse and select "New Waypoint." In either case, the "Waypoint Properties" dialog box will open.
4. Make any desired changes to the "Waypoint Properties," then click "OK" to save the new waypoint.

### Creating a Waypoint using Know Coordinates

A waypoint can be created within the MapSource program using the known coordinates of a location for later uploading to a GPS unit:

1. Select "Waypoint" for the Tools menu. The "Waypoint Properties" dialog box will open.
2. Edit the waypoint name and enter a description, if desired. Note that Garmin GPS units can only display a limited number of characters. Names that are too long are truncated for display on the GPS unit. Other properties of the waypoint can also be edited.

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### Creating a Waypoint using Know Coordinates (continued)

3. Enter the coordinates of the new waypoint. Only a single space is used to separate the N and E decimal coordinates.
4. The new waypoint can be shown on the Graphic Map by clicking the “Show on Map” key at bottom right of dialog box.
5. Click “OK” to record the waypoint.

### Waypoint Right-Click Menu

The following options may appear by clicking the right mouse key on a waypoint on the Graphic Map or a waypoint in the Waypoints tab list:

**Move Waypoint** – Activates the Selection tool and allows you to move the selected waypoint to another location on the Graphic Map.

**New Waypoint, Begin Route, Begin Measurement, Find Nearest Places** – for finding places and creating routes.

**Remove Waypoint from Route** – Selecting this option removes the selected waypoint from the route, but does not delete the waypoint (if waypoint is a route waypoint).

**Cut/Copy/Paste** – Allows one to cut, copy, and paste waypoints from one active MapSource document to another.

**Delete Waypoint** – Delete the selected waypoint

**Show Selected Waypoint on Map** – Zooms to the selected waypoint and centers it on the Graphic Map.

**Waypoint Properties** – Activate the “Waypoint Properties,” allowing for their review and editing for the selected waypoint.

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### Creating Routes

Routes can be created in MapSource for uploading to a GPS unit. Routes are either direct (straight-line) or an automatic route (turn-by-turn) (default for City Select).

1. Select "Route" from the Tools menu or the "Route" tool icon in the Tools toolbar. 
2. Click on waypoints or map locations on the Graphic Map in the sequence required for the route. If a waypoint does not exist on the map, a new waypoint will be created. Route legs are created as direct lines between waypoints.
3. After end point of route has been entered, press **Esc** or right-click the end point and select "Cancel." The route is created and automatically named using the names of the first and last waypoints.
4. The total distance of the route is given in Route tab list.
5. Properties of the route can be edited by right-clicking the route in the Route tab list and selecting "Route Properties..."

### Determining Distance/Bearing Between Two Waypoints

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The straight-line distance and bearing between two points can be determined using MapSource:

1. Select "Distance/Bearing" from the Tools menu or the "Distance/Bearing" tool icon in the Tools toolbar. 
2. Click on the point of origin waypoint or map location then move mouse cursor to termination point. Distance and bearing to the termination point is displayed at the bottom of the MapSource window.
3. By clicking on the termination point, additional points can be added but the bearing is measured from the beginning point while the distance is measure along the series of segments

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### Transferring MapSource Data to a GPS Unit

Map Sets, with their associated waypoints, routes, and tracks can be uploaded to a Garmin GPS unit (or storage card) from the MapSource program:

1. Attach serial or USB cable between computer and GPS unit.
2. Select “Save To Device ...” in the Transfer menu or click on the “Send To Device” icon in the Tools toolbar and choose the device type. A different dialog box will appear depending on the attached GPS unit. 
3. In the “What to Save” dialog box, select the date type for transfer by placing a check mark in the box(es) next to the type of data to be transferred.
4. If saving to a storage card, select the drive letter in the “Storage Card Reader” dialog box.
5. Click “Save” to begin transfer of data. The GPS unit can automatically turned off upon completion of the date transfer by placing a check mark in the box just above the “Save” key.

Note: Map Sets currently saved on Garmin GPS unit are replaced with the new Map Sets.

### Transferring MapSource Data from a GPS Unit

Maps, waypoints, routes, and tracks can be downloaded from a Garmin GPS unit (or storage card) to the MapSource program:

1. Attach serial or USB cable between computer and GPS unit.
2. Select “Receive From Device ...” in the Transfer menu or click on the “Receive From Device” icon in the Tools toolbar and choose the device type. A different dialog box will appear depending on the attached GPS unit. 

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3. In the “What to Save” dialog box, select the date type for transfer by placing a check mark in the box(se) nest to the type of data to be transferred.
4. If transferring from a storage card, select the drive letter in the “Storage Card Reader” dialog box.
5. Click “Save” to begin transfer of data. The GPS unit can automatically turned off upon completion of the date transfer by placing a check mark in the box just above the “Save” key.

### **Real-Time Tracking**

MapSource can read information for a GPS unit in real time. The location of the GPS unit is shown as a red triangle on the Graphic Map, tracking data is displayed on the GPS tab and the track is recorded.

1. Attach serial or USB cable between computer and GPS unit.
2. Set the “Serial Data Format” of “USB Data Format” on the GPS unit to either Garmin or NMEA format.
3. Select the GPS tab in MapSource and click “Select Device.” Select the proper connection type.
4. Check the “Record Track” box and MapSource will begin to track the movement of the GPS unit.
5. To have MapSource automatically adjust the Display Map to keep the GPS unit visible on the Graphic Map, check the box next to “Keep Vehicle Visible on Map.”

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**MapSource**  
 File Edit Find Transfer View Tools Utilities Help

700 mi

Maps | Waypoints | Routes | Tracks | GPS

Name	Area	Size

0 Map(s) - 0 KB

- Include route calculation data.  
(Recommended if your GPS supports auto-routing)
- Include terrain shading data.  
(Recommended if your GPS supports terrain shading)

Map Set Name: \_\_\_\_\_

0 Items Selected Lat/Lon hddd°mm.mmm(WGS 84)

## US&R STRUCTURES SPECIALIST FOG6 EQUIPMENT OPERATING PROCEDURES

### TOTAL STATION (Nikon NPL 352)

- A Total Station measures distances in addition to the usual capabilities of a theodolite (measurement of both horizontal and vertical angles).
- Distances up to 5000 ft can be measured using a continuous laser signal with either a prism or reflector-type target.
- Distances can also be measured reflectorless using a timed-pulse infrared signal but at a reduced maximum distance of approx. 300 ft. (Type of surface measurement is taken to will influence maximum measurable distance.)
- This capability allows for the monitoring of building movement over time.
- Can spot check an individual point on a damaged structure, such as Falling or Collapse Hazards (Total Stations can measure and determine XYZ coordinates).
- The instrument also performs data logging and calculations.

#### Initial Setup Procedure

1. Set tripod over the station point without the Total Station attached:
  - With legs together, extend to chin height.
  - Spread legs so tripod mounting surface is approx. level and over the station point.
  - Set far leg first, spacing other two legs to level.
  - Ensure all leg clamps are securely fastened (do not over-tighten).
2. Remove Total Station from carrying case and mount on tripod. Insert the tripod mounting screw into the center hole of the base plate of the instrument, snug the screw (do not over-tighten).
3. While looking through the optical plummet, align the reticle with the station point by moving the position of the legs. Bring the optical plummet reticle (sighting circle) into sharp focus first then focus the optical plummet on the ground. (Note that

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### Initial Setup Procedure (continued)

leveling of the instrument is not critical at this point.) Only two legs should be moved, the other leg remains planted.

4. Level the instrument by loosening a tripod leg clamp and adjusting the leg length until the air bubble is in the center of the circular level. Lengthening a leg moves the bubble towards that leg. Retighten leg clamp.
5. The instrument can be leveled further by using the procedure described in the Leveling section below.
6. Use optical plummet to check that the image of the station point is still in the center of the sighting circle. If station point is slightly off center, loosen the tripod mounting screw and slide instrument on tripod top surface by pushing on instrument base plate.
7. Turn on Total Station. The start-up screen will appear showing the current temperature, pressure, date, and time. To change the temp or pressure, use the ▲ or ▼ keys to move the cursor to the field requiring change and press the **ENT** key. Use the numeric key pad to enter the new value (note that the **MODE** key toggles between numeric and alpha characters.
8. Tilt the telescope to initialize the vertical angle.
9. Check level compensators (appear automatically after the telescope is tilted or **0** – key). The level compensators electronically adjust the measurements for out-of-plumb instruments, up to 3 minutes vertical. This error is only approx. 1/32-inch for a 3 minute vertical error.
10. The Total Station can now be used in theodolite mode with no further setup.

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# US&R STRUCTURES SPECIALIST FOG EQUIPMENT OPERATING PROCEDURES

## Creating a New Job (Total Station Mode)

To use the instrument to create or check coordinates, a new job must be created (or an existing job can be selected):

1. Press the **MENU** key and select "1. Job" by pressing the (1) key or scroll to highlight "Job" and press **REC/ENT** key to get to the Job Manager screen. Press the "Creat" softkey (MSR1).
2. Enter a job name. The default job name can be used (the date (YYMMDD) followed by a dash and a sequential digit) or enter a new job name using the keypad. Press the **REC/ENT** key.
3. Check the job setting by pressing the "Sett" softkey or use the current job settings by pressing **REC/ENT** or the "OK" softkey. The default US&R settings (\* indicates important for US&R) are:

Scale:	1.000000
T-P corr:	ON
Sea Level:	OFF
C&R Corr:	0.132
* Angle:	DEG
* Distance:	US-Ft (Decimal)
Temp:	°F
Press:	inHg
* VA zero:	Zenith
* AZ zero:	North
* Order:	ENZ
* HA:	Azimuth

4. Configure **MSR1** and **MSR2** keys. Hold each key down for 3 seconds to enter/check parameters (use the **ENT** key to exit out of this option):

MSR1:	Target:	Prism
	Prism Constant:	18mm (or for prism used)
	Mode:	Precise
	AVE:	3

## US&R STRUCTURES SPECIALIST FOG6 EQUIPMENT OPERATING PROCEDURES

REC MODE: MSR Only

### Creating a New Job (continued)

MSR2:	Target:	N-Prism
	Prism Constant:	0
	Mode:	Normal
	AVE:	1
	REC MODE:	MSR Only

5. For XYZ coordinate data collection, use BMS screen 4/4. For theodolite operations (angle measurements), BMS screen 1/4.

### Creating a New Station

1. Select a station point location that does not interfere with other US&R operations yet provides sight lines to potential monitoring points on the structure.
2. Set up instrument as described previously (create new job).
3. Establish the station point as the Control Point. Press the STN (7) key. Select "Known" by pressing the 1 key. Input the Station Point Number. Input the station coordinates (use X = 1000 ft, Y = 100 ft, and Z = 10 ft).
4. Enter the instrument height (HI) when prompted.
5. The next screen to be displayed is the Backsight Menu screen. In general, a backsight is used to establish horizontal (azimuth) control and may be a temporary sighting. Point the telescope so its line of sight is approximately perpendicular to the face of the building (this will align the XYZ grid with the building layout). Select "2. Angle" and press **REC/ENT**. Number the BS as 15, press **REC/ENT**. Enter zero for the azimuth angle (AZ), press **REC/ENT**. Press **REC/ENT** again. Note that with this method, the BS is used only to establish azimuth. The distance to the sighted point is not measured and the coordinates of the BS are not determined.

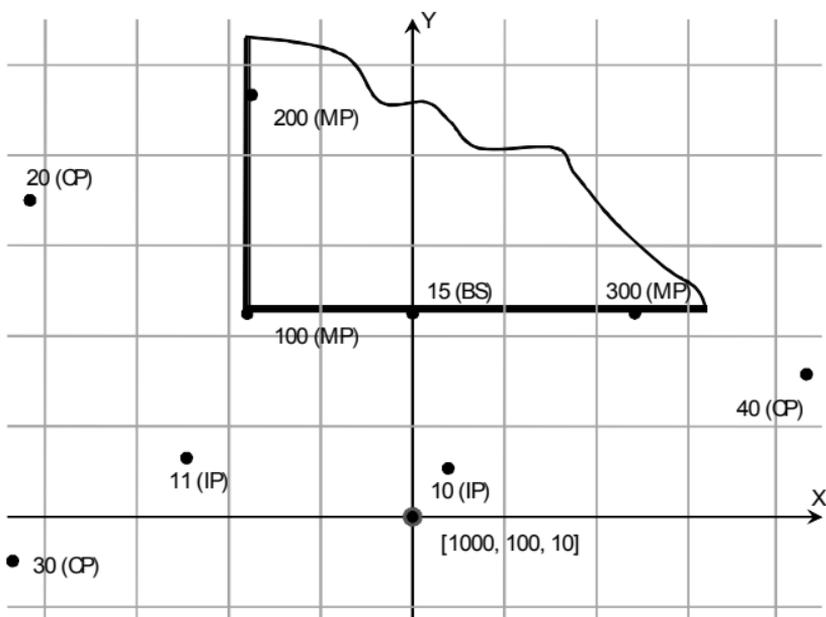
## US&R STRUCTURES SPECIALIST FOG EQUIPMENT OPERATING PROCEDURES

- At the prompt for the target height (HT), enter zero if measuring to a point without a prism pole.
- The instrument can now measure and record point coordinates.

### Building Monitoring Setup

Building movement should be monitored with the coordinate system or grid oriented with the building plan.

Control points, including instrument locations, should be numbered using two digits (10, 20, etc.). Monitoring points should be numbered using three digits (100, 200, etc.). When a reading is taken on a monitoring point, its number should be incremented (101, 102, etc.).



## US&R STRUCTURES SPECIALIST FOG6 EQUIPMENT OPERATING PROCEDURES

### Building Monitoring Setup (continued)

Sight and record monitoring points on the building to begin the monitoring process. Establish a minimum of 3 control points removed from the building site. Continue re-sighting the monitoring points at appropriate intervals. Ensure all sightings are properly recorded. Control points should be established immediately after the first set of monitoring points have been recorded and the monitoring process has begun.

### Menu Key

The MENU screen is used to access important functions and settings of the Total Station. To display the MENU screen, press the **MENU** key. The following options are given in the MENU screen:

1. Job (Job Manager) – Used to create and manage stored jobs.
2. Cogo – Coordinate geometry calculations.
3. Settings – Used to change various settings (use the left or right arrow keys (◀/▶) to toggle between the available selections.
4. Data – Used to view data (Use **DSP** to view toggle between RAW and XYZ data).
5. Comm. (Communication) - Transfer data to and from a computer.
6. 1sec-Key – 5 keys (illumination key, REC/ENT, MSR1, MSR2, and DSP) have additional functionality if held down for 1 second.
7. Calibrat. (Calibration) – Used to make corrections to the instrument to assure correctly measured data.
8. Time – Edit date and time.

## US&R STRUCTURES SPECIALIST FOG EQUIPMENT OPERATING PROCEDURES

### Leveling – (Additional)

1. Loosen the horizontal tangent screw.
2. Rotate the alidade until the plate level is parallel with any two of the three leveling screws.
3. Use these two leveling screws to move the bubble to the center of the level. Note: bubble moves in direction of left thumb.
4. Rotate the alidade clockwise approximately 90°.
5. Use the third screw to move the bubble into the center of the level. Do not move one of the other two screws while adjusting the third screw.
6. Repeat Steps 1 thru 5 to center the bubble in both positions.
7. Use the electronic level key (0) to fine tune the leveling process, adjusting the leveling screws as described above. It will not be necessary to rotate the instrument.

### Sighting Adjustments

To measure distances accurately, the instrument must be properly adjusted and focused on the target.

- To adjust the diopter, aim the telescope at a blank area, such as the sky or a piece of paper. Looking through the telescope, rotate the diopter ring (small ring at the end of the eyepiece) until the reticle crosshairs are in sharp focus.
- To check for parallax, aim the telescope at the target image. Rotate the focusing ring (large ring between the eyepiece and the telescope body) until the target image is in sharp focus on the reticle crosshairs. Move your eye vertically and laterally to check whether the target image moves relative to the reticle crosshairs. Readjust the diopter if relative movement is detected.

**US&R STRUCTURES SPECIALIST FOG6  
EQUIPMENT OPERATING PROCEDURES**

## US&R STRUCTURES SPECIALIST FOG EQUIPMENT OPERATING PROCEDURES

### Sighting and Measuring

1. Loosen both the horizontal and vertical tangent screws.
2. Ensure that the telescope focuses properly.
3. Use the optical sight on top of the telescope to roughly point the telescope to the target.
4. Tighten the horizontal tangent screw.
5. Look through the eyepiece and move the telescope vertically until the target is in view.
6. Tighten the vertical tangent screw.
7. While looking through the telescope, use the horizontal and vertical tangent screws to sight the telescope crosshairs on the center of the target.
8. Rotate the focusing ring to bring the target into sharp focus on the reticle crosshairs.
9. Use the horizontal and vertical tangent screws to fine tune the sight to the target.
10. Press either **MSR1** or **MSR2** to take measurement (see Item 4, p. 5-35).
11. When the distance is displayed on the SD line, press the **REC/ENT** key. The Record RT Data Input screen is displayed.
12. Use the default Point Number (PT) or input a new number. Input Point Code (CD) if necessary.
13. Press the **REC/ENT** key to record the point.

## US&R STRUCTURES SPECIALIST FOG6 EQUIPMENT OPERATING PROCEDURES

### Establishing a New Station within an Existing Coordinate Sys

There are several methods available to move the instrument to a new location and tie it back into the established coordinate system. These methods are accessed by pressing the **STN** (7) key and selecting from a list of options. Two of these options are recommended below for US&R building monitoring.

**Option No. 1.** To set up on a known station point within an established coordinate grid:

1. Set up and level the instrument on a point with known coordinates within the current coordinate system.
2. After pressing the **STN** (7) key, highlight the “1. Known” and press **REC/ENT**.
3. Input the number (or name) of the known station point and press **REC/ENT**. If it has been established within the current job, it will be displayed on the screen. Press **REC/ENT** to accept the displayed point. Otherwise, input the known coordinates by inputting the name and pressing **REC/ENT**. Once the HI is entered, press **REC/ENT**.
4. Backsight on another known point on the grid. Input this known point’s number (or name) and then press **REC/ENT** to input its coordinates. If sighting directly to the point, enter 0.0 for the target height (HT). If the backsight has been established within the current job, it will only be necessary to enter its number (or name).

**Option No. 7.** To set up at a new location and tie back into an existing coordinate system by sighting two known points (referred to as PT1 and PT2 during station setup):

1. Set up and level the instrument at desired location. It is not necessary to establish a physical instrument point (IP) for building monitoring but rather have the instrument’s internal axes intersection as a temporary station (the HI is zero).
2. After pressing the **STN** (7) key, highlight the “7. Known Line” and press **REC/ENT**.

## US&R STRUCTURES SPECIALIST FOG EQUIPMENT OPERATING PROCEDURES

3. Input the number (or name) of the known point to be used as PT1 and press **REC/ENT**. If it has already been established within the current job, its will be displayed on the screen. Press **REC/ENT** to accept the displayed point. Otherwise, input the known coordinates by inputting the name and pressing **REC/ENT**, enter the known coordinates, and press **REC/ENT**.
4. Enter the target height (HT) if using a prism or enter 0.0 if directly sighting the point. Press **REC/ENT**.
5. Sight the known point and Press either **MSR1** or **MSR2** and then press **REC/ENT** once the instrument has taken the distance measurement.
6. Select Option "1. By Coord." and press **REC/ENT**.
7. Input the number (or name) of the known point to be used as PT2. If the point has already been entered in the current job, its coordinates will be displayed once **REC/ENT** is pressed. Otherwise, input the point's number (name), press **REC/ENT**, enter the known coordinates, and press **REC/ENT**.
8. Enter the target height (HT) if using a prism or enter 0.0 if directly sighting the point. Press **REC/ENT**.
9. Sight the known point and Press either **MSR1** or **MSR2** and then press **REC/ENT** once the instrument has taken the distance measurement.
10. The new location of the instrument is now shown. Press **REC/ENT**.
11. A new station number is displayed with default settings for the instrument height (0.000) and backsight (PT1). Press **REC/ENT** four times to accept defaults (this does not establish a permanent station).
12. The instrument is now oriented in the original coordinate grid.

## **US&R STRUCTURES SPECIALIST FOG6 EQUIPMENT OPERATING PROCEDURES**

### **Instrument Handling**

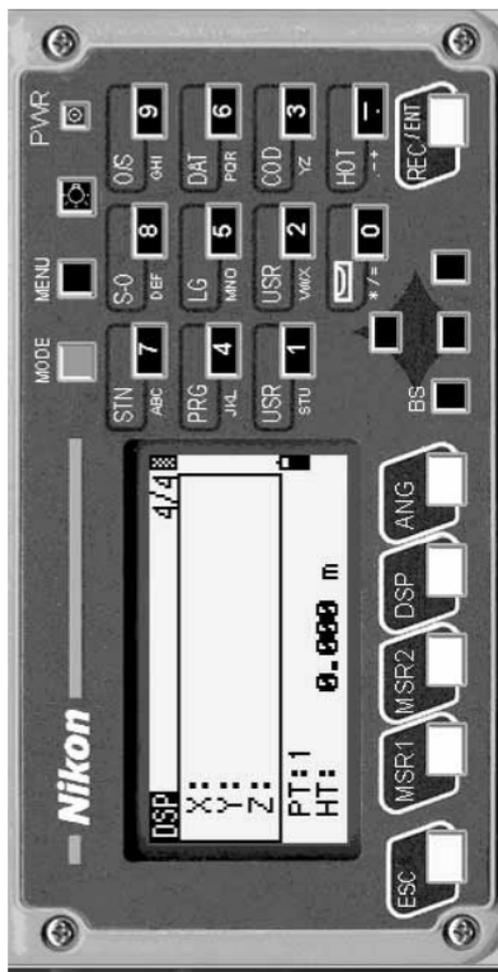
- Always carry the instrument in its case.
- Never place the instrument on the ground.
- Do not hold the two standards to carry the instrument.
- When leaving the instrument set up, place the lens cap on and cover the whole instrument with the vinyl cover.
- Protect the instrument against the elements (rain, strong direct sunlight, etc).
- During transportation always place accessories in their correct position to prevent displacement.

### **Drying a wet instrument**

- Wipe the instrument carefully, remove the foam inserts and let them dry out completely. Never place the instrument on the ground.
- Allow instrument to air-dry before instrument is returned to its container. This prevents the telescope from fogging.

# US&R STRUCTURES SPECIALIST FOG EQUIPMENT OPERATING PROCEDURES

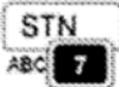
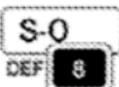
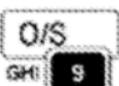
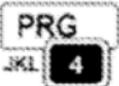
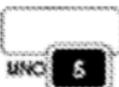
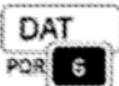
## Nikon NPL 352 Keyboard and Display



## US&R STRUCTURES SPECIALIST FOG6 EQUIPMENT OPERATING PROCEDURES

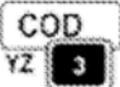
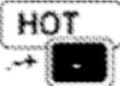
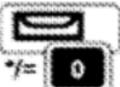
Key	Function
	Turns the instrument on or off.
	Illumination key. Turns the backlight on or off. Provides access to the 2-switch window if held down for one second.
	Displays the MENU screen.
	Changes the key input mode between alphanumeric and numeric if pressed when you are in a PT or CD field. Activates Qcode mode if pressed when you are in the Basic Measurement Screen (BMS).
	Records measured data, moves on to the next screen, or confirms and accepts the entered data in input mode. You have the option to record the measurement as a CP record instead of an SS record, if you hold this key down for one second in the Basic Measurement Screen (BMS). The instrument outputs the current measurement data (PT, HA, VA, and SD) on the COM port if you press this key in the BMS or in a Stakeout observation screen. (The Data Rec settings must be set to COM.)
	Returns to the previous screen. In numeric or alphanumeric mode, deletes input.
	Starts distance measurement, using the measure mode settings for the <b>MSR1</b> key. Displays measurement mode settings, if held down for one second.

## US&R STRUCTURES SPECIALIST FOG EQUIPMENT OPERATING PROCEDURES

Key	Function
	Starts distance measurement, using the measure mode settings for the <b>MSR2</b> key. Displays measurement mode settings, if held down for one second.
	Moves to the next available display screen. Changes the fields that appear on the DSP1, DSP2, and DSP3 screens, if held down for one second.
	Displays the Angle menu.
	Displays the Station Setup menu. In numeric mode, enters 7. In alphanumeric mode, enters A, B, C, or 7.
	Displays the Stakeout menu. Shows stakeout settings, if held down for one second. In numeric mode, enters 8. In alphanumeric mode, enters D, E, F, or 8.
	Displays the Offset Point Measurement menu. In numeric mode, enters 9. In alphanumeric mode, enters G, H, I, or 9.
	Displays the Programs menu, which contains additional measuring programs. In numeric mode, enters 4. In alphanumeric mode, enters J, K, L, or 4.
	In numeric mode, enters 5. In alphanumeric mode, enters M, N, O, or 5.
	Displays RAW, XYZ, or STN data, depending on your setting. In numeric mode, enters 6. In alphanumeric mode, enters P, Q, R, or 6.

# US&R STRUCTURES SPECIALIST FOG6 EQUIPMENT OPERATING PROCEDURES

## Nikon NPL 352 Keyboard and Display

Key	Function
	Executes the function that is assigned to the [USR1] key. In numeric mode, enters 1. In alphanumeric mode, enters S, T, U, or 1.
	Executes the function that is assigned to the [USR2] key. In numeric mode, enters 2. In alphanumeric mode, enters V, W, X, or 2.
	Opens a window where you can enter a code. The default code value is the last code entered. In numeric mode, enters 3. In alphanumeric mode, enters Y, Z, a space, or 3.
	Displays the (HOT) menu, which includes Height of Target, Temp-Press, Target, Note recording, and Default PT settings. In numeric mode, enters - (minus). In alphanumeric mode, enters . (period), - (minus), or + (plus).
	Displays the Bubble indicator. In numeric mode, enters 0. In alphanumeric mode, enters *, /, =, or 0.

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### NOTES

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# US&R STRUCTURES SPECIALIST FOG EQUIPMENT OPERATING PROCEDURES

## WIRELESS BUILDING MONITORING SYSTEM (WBMS)

The Wireless Building Monitoring System (WBMS) allows monitoring and detection of the tilt angle of various building structures. It is intended to provide a remote sensor for use at an emergency rescue site where these structures may be unstable. The system displays angular tilt information on a Personal Digital Assistant (PDA) or laptop computer.

### Shipping Container Contents

There are 2 shipping containers for each system. Each container has the following equipment:

- 1) 2 Sensor Units
- 2) 1 Receiver Units
- 3) 2 Sensor Battery Units
- 4) 2 AC Charging Cables
- 5) 2 Battery Unit to Sensor Unit Power Cables
- 6) 1 PDA, Charger, and 128 Mb SD memory card (w/ WBMS software) – iPAQ h2210 for USACE Units and h2110 for FEMA Units – all have Pocket PC 2003 Operating Sys
- 7) 1 Extended-life PDA battery
- 8) 1 PDA Earpiece
- 9) Users Guide and Software

### System Pre-Test

Prior to mounting the Sensor Units to structural members, a system pre-test is highly recommended.

1. Unpack the system shipping container.
2. Verify that the PDA, Receiver Unit, and Sensor Unit batteries are fresh or fully charged. The PDA uses its own battery (an extended life battery may be available). The Receiving Units operates on 8 – AA batteries. The Sensor Units operate on an external battery (USACE WBMS sensor units have an optional internal battery).

## US&R STRUCTURES SPECIALIST FOG6 EQUIPMENT OPERATING PROCEDURES

### System Pre-Test (continued)

3. If using external Battery Units, connect the Sensor Unit to Battery Unit power cable for the Sensor Units to be used. If the Sensor Units are to be operated on internal batteries, connect the dongle to the external power plug.
4. Turn on the power switch for one of the Receiver Units (prior to powering on the PDA).
5. Turn on the PDA. Perform a soft reset by pressing the reset key near the bottom of the backside of the PDA. Verify that the Bluetooth symbol in the lower right hand corner of the PDA screen does not have a small red circle containing an 'X' next to it. If not, the Bluetooth is enabled by going to the PDA Start Menu and selecting the Bluetooth Manager.
6. Select the WBMS application from the Start Menu (upper left hand corner of the PDA screen. If the WBMS application does not appear on the Start Menu, restore the application from the memory card as described later in this section.
7. Once the WBMS application starts, you will be prompted to enter a System ID. This ID is the System number of the 2 Sensor Units (e.g. "4"). (Note: any active system can be monitored by selecting its ID number.)
8. Select the appropriate Receiver Unit from the Bluetooth Manager screen. If both Receiver Units are powered on, both units will appear on the screen. (Note: both receiving units can monitor all 4 sensor units at the same time. Alarm triggering is initiated by the PDA.) A PDA can monitor only one Receiver Unit at a time.
9. The WBMS application should now be running. Verify that all the desired Sensor Units for the system show a connection and that you hear the PDA pinging noise. If less than 4 units are being used go into Settings and uncheck the unused units. This will eliminate the confirmation beep for the inactive sensor unit. This will help with both the PDA and receiver battery life.

## US&R STRUCTURES SPECIALIST FOG EQUIPMENT OPERATING PROCEDURES

10. Verify that the Alarm Thresholds for the desired Sensor Units are set correctly. To view the Alarm Thresholds, click the Setup key.
11. If the alarm thresholds need to be adjusted, tap on the appropriate box under the correct axis and unit designation, and use the keyboard to input the proper alarm thresholds.
12. Tilt each Sensor Unit by hand and verify that the alarm sounds, then replace to its prior orientation to stop the alarm.
13. Once proper operation is confirmed, the Sensor Units are ready to be mounted (see Sensor Unit Mounting section below). Disconnect the power cable from the Sensor Units and install Sensor Units in the desired locations. Re-attach the power cable (if using external Battery Unit) or plug in the power dongle to activate the internal battery pack.
14. Verify communications with the appropriate Sensor Units. This box indicates the Alarm Threshold for Sensor Unit A, Axis 2. Note that the 'Error' message is an indication of sensor data beyond the calibration limits of the sensors (see Exponent WBMS Operation Manual).
15. If there are any alarm conditions that appear immediately after powering-up the Sensor Units, use the 'Zero All' key found on the main screen. This will zero both of the sensors in all of the system Sensor Units. There should be no system alarms at this point.
16. The system is ready for monitoring. Note however that readings may fluctuate for the first few minutes as the sensors come to equilibrium. In normal operation, readings may occasionally fluctuate +/- 0.05 degrees. Larger fluctuations can occur due to normal movement of the structure, such as those associated with wind or temperature changes. These conditions may require increasing the Alarm Thresholds.

# US&R STRUCTURES SPECIALIST FOG6 EQUIPMENT OPERATING PROCEDURES

## WBMS Operation

To monitor a structure such as a column or beam, the Sensor Unit would be attached securely to the structure via some form of strapping (rope, bungee cords, tie downs, etc.) The Sensor Units are color-coded and have a standard alphabetic designation that corresponds to the Sensor Unit color. This color corresponds to the PDA or Laptop screen where the angular data is displayed.

Data from the sensors contained in the Sensor Unit is broadcast every five seconds under normal operation, and broadcast every second when a Sensor Unit is in an alarmed state. The alarm is triggered when either clinometer measures an angular change greater than the limit specified by the user. The allowable range for the alarm threshold is from 0.01 degrees to 60 degrees. The sensitivity of the clinometers is  $0.01^\circ$  with a full-scale range of  $\pm 60$  degrees.

The following information is shown on the main screen of the PDA or Laptop software:

- System ID number.
- Angle information for four Sensor Units.
- Sensor connection status.
- Sliding indicator that represents how close the current data is to the alarm condition.

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## Sensor Unit Mounting

The Sensor Units must be mounted on structural elements that will realize rotation in at least one of the monitored axes during an impending collapse. Mounting a Sensor Unit to structural elements that only translate during the early stages of a collapse may not provide enough advanced warning. It may be necessary to mount multiple Sensor units in the same region of the structure to insure the appropriate rotation is captured.

## **US&R STRUCTURES SPECIALIST FOG EQUIPMENT OPERATING PROCEDURES**

The Sensor Unit case must be firmly attached to a surface, in an upright position with the arrows on the sides of the Sensor Unit pointing up (the Sensor Unit handle will be pointing down). A cargo strap, bungee cord, or other suitable strapping material can be used to securely attach the Sensor Unit to the structure. The units should not be mounted loosely to the structure because vibration or incidental contact could trip the alarms of either axis. If mounting to a structure where vibration is unavoidable, the alarm thresholds may have to be increased.

### **PDA Power Settings**

The iPaq h2210 factory default power setting turns the PDA off after 3 minutes with no user input. This feature must be disabled to keep the PDA from turning off while the WBMS software is active. To disable the automatic power down:

1. Click on Start, then click Settings.
2. Select the System tab (found near the bottom of the screen) by clicking on it.
3. Click on the Power icon, then select the Advanced tab (found near the bottom of the screen.)
4. Remove the check in the box found below 'On battery power:' by clicking on the checkbox, or clicking on the text to the right of the checkbox.
5. Click on 'ok' found in the top right corner of the screen.

The PDA contains enough battery power for four hours of continuous operation before it will need to be recharged. To charge the PDA, place it in the charging cradle or plug in the smaller charger. Note that the PDA can be operated while in the charging cradle or the smaller charger, and the battery will be charging at the same time.

The PDA screen back-lighting can be toggled on and off by depressing the power key for at least 1-second.

## US&R STRUCTURES SPECIALIST FOG6 EQUIPMENT OPERATING PROCEDURES

### WBMS Sensor Unit Operation

Each of Sensor Unit contains a pair of inclinometers accurate to approximately  $0.05^\circ$  over a range of +/- 60 degrees) that measure the angular change, in degrees, in two orthogonal planes. A 900 MHz radio transceiver broadcasts the sensor readings and accepts user commands. The Sensor Unit is powered either by 8 or 16 AA cell (internal) or from an external Battery Unit. Battery life with both internal battery packs fully charged is over 24 hours, and the external Battery Unit provides over seven days of normal (non-alarmed) operation.

### Restoring Software (based on Pocket PC 2003 operating sys)

Ideally, the iPAQ h2210 should be plugged into the charger when not in use. If the battery drains, the software will be erased from memory, and will need to be restored from the SD memory card. You can tell when this happens if you turn on the PDA and you have to re-initialize the touch screen (you see the message 'Tap the screen to setup up your Pocket PC.'). Perform the following steps to restore software from the SD card:

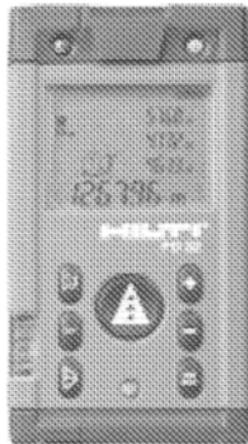
1. Follow the onscreen instructions to setup the PDA
2. Open the iPAQ h2210 Backup software: Click on Start, Programs, and then iPAQ Backup
3. Click on the Restore tab, then click the Restore... key followed by the Start key.
4. You will be notified to perform a soft reset. Upon doing this, the WBMS software will be restored.

**NOTE:** For later model PDA, such as hp2190 with **Mobile 5 Operating System**, the WBMS Program will not be dropped. Therefore, no Backup Software is included and no Backup and Restore is needed

## US&R STRUCTURES SPECIALIST FOG EQUIPMENT OPERATING PROCEDURES

### LASER RANGE METER (Hilti PD32)

- Allows for accurate measurement of distances using emitted visible laser beam with measuring waves, which are reflected back to the range meter with a phase shift.
- The measuring range depends on the reflectivity and the surface structure of the target surface.
- Calculations of area and volume can be performed with multiple distance measurements, as well as the addition and subtraction of distances.
- Powered by 2-AA Alkaline batteries with a life of approx. 15,000 single measurements.



#### Operation – Direct Measurements

The normal maximum measurable distance is approximately 50 ft. Longer distances may be possible depending on the target reflectivity. A special target plate (Hilti PDA 50) is available to extend the maximum distance that can be measured to over 100 ft.

Distance measurements generally improve with darker lighting conditions. Shading the instrument from direct sunlight also increases the measuring range. Measurement ranges are reduced by very bright ambient light or when measuring through glass.

The Hilti PD32 has a magnified viewer that can be used to locate the laser dot on the target.

The display can be illuminated by pressing the illumination key located near the rear of the instrument. Shorter battery life can be expected with frequent use of the display illumination.



## US&R STRUCTURES SPECIALIST FOG6 EQUIPMENT OPERATING PROCEDURES

1. Turn range meter on using the “On / Off” key located near the top right corner of instrument. The range meter is ready to use. 
2. To take a single distance measurement, place the range meter measuring reference at desired location. Press the “Measuring” key (large circular key). Red laser dot will be active. 
3. Position red laser dot on surface to which distance is to be measured.
4. Press the “Measuring” key again to take the distance measurement. The distance is displayed on the screen.

The measuring reference defaults to the rear edge of the instrument. The measuring reference can be changed to the front edge of the instrument by pressing the “Reference Point Shift” key located in the upper left-hand corner of the instrument. A spike can be extended from the rear of the instrument for measuring from inaccessible corners. The additional distance of the spike is incorporated into the measured distance. 

The screen will display up to four successive measurements with the last measurement taken displayed at the bottom of the screen in large type.

Continuous measurements can be taken by pressing the “Measure” key for approximately 2 seconds. Distances are updated in the result line between 8 and 15 times a second, depending on the target reflectivity. A continuous measurement is indicated by a beeping when the beep signal is switched on. The continuous measuring process is stopped by pressing the “Measure” key again. The last valid distance measurement is displayed.

## US&R STRUCTURES SPECIALIST FOG EQUIPMENT OPERATING PROCEDURES

Two distance measurements can be added together by pressing the “+” key (located to the right of the “Measure” key) between the first and second measurements.



Two distance measurements can be subtracted from each other by pressing the “-” key. Pressing either the “+” or “-” activates the red laser dot for the second measurement.



Area or Volume measurements are taken by first pressing either the “Area Function” or “Volume Function” keys to the left of the “Measure” key.



The “Measure” key is then pressed once for each measure. The area or volume is given in the display line with individual distance measurements displayed above.



### **Operation – Indirect Measurements (Triangle Method)**

Distances can be measured indirectly by recording distances to either end of the distance to be determined. This is useful for measuring distances that cannot be done so directly, such as building heights. The PD-32 uses the Pythagoras’s theorem to calculate the distance. Either two (simple version) or three (combined version) distances are recorded. For the simple version, the second recorded distance must be perpendicular to the distance to be determined. If this is not possible, then the combined version can be used with the middle recorded distance perpendicular to the distance to be determined. The angle between recorded distances must be greater than 10 degrees to avoid unreliable calculations. If not, a double beep indicates an error and the PD-32 terminates the operation.

1. Press the “Indirect Measurement” key. This activates the combined version. Pressing the key again will active the simple version. (Either a combined or single triangle symbol will be shown in the display.)



2. Aim the PD-32 at one end of the line to be determined and press the “Measure” key.

## US&R STRUCTURES SPECIALIST FOG6 EQUIPMENT OPERATING PROCEDURES

3. Aim the PD-32 to measure the perpendicular distance. The continuous measurement mode can be used to determine the point of shortest (perpendicular) distance.
4. If the simple version is use the calculated indirect distance will be displayed. For the combined version, aim the PD-32 at the other end of the line to be determined and press the “Measure” key to display the calculated distance.

### Settings

Several instrument settings can be changed in the setting menu which is accessed by pressing the “on / off” key for approximately 2 seconds with the instrument is turned off. Settings that can be changed are: beep signal and units. The setting menu is terminated by pressing the “on / off” again.

### Maintenance

Remove the range meter from its case if it becomes wet. Clean the range meter, carrying case, and accessories. Repack the equipment only after it is completely dry.

Check the accuracy of the equipment if is used after a long period of storage or transportation.

Batteries should be removed from the range meter if it is not going to be used for an extended period of time.

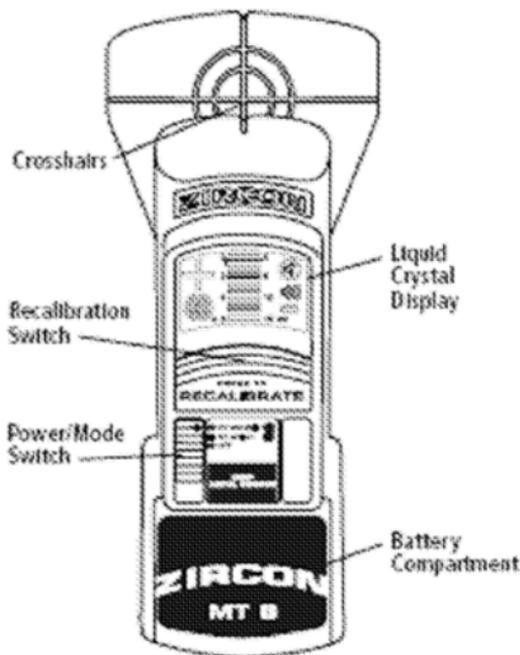
### Calibration

The calibration of the instrument can be preformed by measuring a distance of known length approximately 3 to 15 ft in length, 5 times. The mean of the deviations to the known distance should be within the specific accuracy tolerance of the range meter.

## US&R STRUCTURES SPECIALIST FOG EQUIPMENT OPERATING PROCEDURES

### ELECTRONIC METAL LOCATOR (Zircon MT 6)

- Locates metallic objects, such as reinforcing steel, embedded in concrete as well as other metallic objects, such as copper pipe, located in masonry or wood-framed walls.

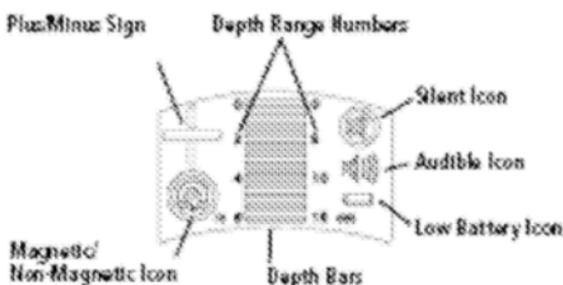


#### Operation

- Turn on the unit by moving the mode switch to either the AUDIBLE or SILENT position. This should be done in air or away from any metal (including watches, jewelry, etc.).
- The unit will calibrate itself immediately after it is turned on. If calibration fails, a long, low-pitched tone will be heard and all depth bars will be indicated in the display. Move to another area and try turning on the unit again.

## US&R STRUCTURES SPECIALIST FOG6 EQUIPMENT OPERATING PROCEDURES

- Place the unit on the scanning surface. The surface should be clean of sand and other debris. Move side to side. As a target is approached, an increasing number of depth bars will show in the display. At the point closest to metal, the plus sign will change to a minus sign and there will be a beep (if in AUDIBLE mode).



- The type of metal detected will be indicated by the magnetic/nonmagnetic icon.
- Once a target has been located, reposition the unit over it and scan perpendicular to the original scanning direction.
- Continue scanning to determine if there are multiple targets.
- If precise depth is important, recalibrate as outlined in following section. **5**
- Turn off the unit by moving the mode switch to the OFF position.

### Calibration

The MT 6 automatically calibrates when turned on. However, the depth sensitivity of the MT 6 can be increased by recalibrating in an area free of metal, through the same medium. To recalibrate:

- Locate an area that is on the surface where there is no indication of metal.
- Press and release the "Press to Calibrate" switch. All icons on the display will light momentarily during calibration.
- Rescan target areas. A more sensitive depth reading should now be obtained.

## US&R STRUCTURES SPECIALIST FOG EQUIPMENT OPERATING PROCEDURES

### **Battery Installation/Replacement**

1. Slide-open the battery compartment located at the lower front portion of the unit.
2. Connect a 9-volt battery into the battery clip.
3. Insert the battery into the battery compartment and replace the door.

One 9-volt battery should last approximately one year.

### **Additional Notes**

- The depth readings of the MT 6 are calibrated for a #4 size rebar (magnetic) and a ½ inch copper pipe (nonmagnetic).
- If scanning surface is relatively rough, a thin piece of cardboard can be placed between the unit and surface. Cardboard thickness must be subtracted from the depth reading.
- An auto power off feature turns off the MT 6 after five minutes of inactivity. After it turns off, the unit loses its calibration.

## US&R STRUCTURES SPECIALIST FOG6 EQUIPMENT OPERATING PROCEDURES

### DIGITAL ELECTRONIC LEVEL (SmartLevel & SmartTool)

Two digital electronic levels are available in the US&R cache (SmartLevel<sup>®</sup> and SmartTool<sup>™</sup>) that determine and display levelness electronically. Both levels display angle measurements in degrees, slope (%), and pitch (in./ft.). The SmartLevel also displays a simulated bubble. The operation and functions of both levels are similar.

#### Operation

1. Ensure battery is correctly installed and has sufficient voltage.
2. Turn on level by pressing the **ON/OFF** button.
3. Select the level display mode (degrees most appropriate for US&R) using the **MODE** button (SmartLevel) or **° % IN/FT** button (SmartTool).
4. Calibrate level using appropriate procedure discussed in next section. The SmartLevel uses a **RESET** button while the SmartTool uses a **Calibrate** button.

If level is to be used as a continuous monitoring device, the battery saver must be deactivated (battery life is approx. 1 week). Also, level should be secured to monitored component prior to calibration.

#### Calibration – Level

1. Place level on a flat horizontal surface (surface does not need to be level), wait 10 seconds.
2. Push and hold the **Calibrate (RESET)** button for 2 seconds. CAL1 will appear briefly on the display.
3. Rotate the level end-for-end, wait 10 seconds.
4. Push and hold the **Calibrate (RESET)** button. CAL2 will appear briefly on the display. Calibration is complete.

# US&R STRUCTURES SPECIALIST FOG EQUIPMENT OPERATING PROCEDURES

## Calibration – Plumb

1. Place level on a flat vertical surface (surface does not need to be plumb), wait 10 seconds.
2. Push and hold the **Calibrate (RESET)** button for 2 seconds. CAL1 will appear briefly on the display.
3. Rotate the level edge-for-edge so that the same end of the level is pointing down, wait 10 seconds.
4. Push and hold the **Calibrate (RESET)** button. CAL2 will appear briefly on the display. Calibration is complete.

## Calibration – To Zero Reading

The digital electronic levels can be calibrated to provide a zero reference reading on non-level or non-plumb surfaces. This is useful when monitoring components for changes in level or plumbness. To zero the reading, first secure the level on the surface to be monitored. Follow the calibrations procedures listed above, except, do not rotate level between the two calibrations. This tricks the level into thinking it is averaging two different readings.

## NOTES

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