Fox

manual version 4.4

OPERATIONAL TIPS - BEFORE YOU START

1) The GPS antenna has a magnetic mount. For this reason, all possible care must be taken to not get it in close proximity to the enclosed PCMCIA memory card once data has been collected.

2) When using external power (AC or DC), connect to the **FOX** before turning ON. **DO NOT** remove external power while the unit is running.

3) It is possible that you will not need all of the cables supplied with the unit. Any unused cables are to be kept in a safe place for possible future use.

4) Even though the **FOX** is made to be rugged and for field use, it is not water resistant. Do not attempt taking measurements in the rain.

5) The PCMCIA card is an electronic device. As such, it is susceptible to electro-static shock. It should be kept in the soft foam padded carrying case when not in use.

6) Be very careful to be familiar with and follow the instructions for exiting the Fox and turning it off. If you do not, you can jeopardize the integrity of the data stored on the PCMCIA card. This is because the 'ESC' key instructs the Fox to record the selection made, and therefore must preceed turning off the unit.

7) It is recommended that you set the unit up to take the fewest number of measurements per reading period in order to reduce the final size of the data file. For example, approximately 1.7 Mbytes of data taken from the PCMCIA card will expand to over 7.0 Mbytes of file size once the information is converted to tab delimited ASCII. The ASCII format data can be saved as an Excel spread sheet for post measurement analysis by following the instructions in the Fox.MAN file previously printed out. Therefore, in the screen where you select the number or samples per measurement, you should select 4096 (approx 1 record per second) as opposed to 64 (approx 22 records per second).

8) The FOX's charger has three different LED indications:
blinking LED-battery in unit is trickle charging
solid LED-battery in unit is fast-charging
LED off-battery in unit is fully charged

9) If the PC used to download the PCMCIA was running Windows, reenter Windows before downloading from a DOS screen. Use the system select to change COM PORT flow control to "Hardware." If the computer used to download the PCMCIA card boots up in Windows (3.1 or 95), do the following BEFORE attempting to download the Fox PCMCIA card:

1) Enter WINDOWS®
2) Select the MAIN menu (win 95 "Mycomputer")
3) Select CONTROL PANEL, when in, select PORTS (win 95 system/device manager)
4) Set COM 1 or COM 2 (depending on which is to be used) FLOW CONTROL to "HARDWARE" or "OFF". The nor mal setting for this option is "XON-XOFF". Flow Control MUST be set to the "HARDWARE" or "OFF" option for download to work reliably.
5) Enter MS-DOS® and use Fox.EXE to download PCMCIA.

Also note that when using laptops, POWER MANAGEMENT control MUST be turned OFF. This feature is usually found in the CONTROL PANEL, set it to OFF for at least to 15 minutes. IF the power management control software puts the laptop in low power mode DURING download, data WILL be lost.

INTRODUCTION

Overview

FOX is a hand-held, battery powered signal strength meter convenient for finding RF "shadows" in indoor wireless systems or for drive-around studies to detect RF leakage and propagation coverage. **FOX** is designed to be powered from either AC, a cigarette lighter, or to run for up to 8 hours on its internal, rechargeable NiCad (Nickel Cadmium) battery.

General Features

- **FOX** has a 240 x 64 graphic Liquid Crystal Display (LCD) with electroluminescent back lighting and can display up to 160 channels (frequencies) at one time. The unit can resolve signal levels to 1 dB accuracy in real-time and display dBm in either bar graph or scrolling X axis with a 1 second tick mark format. The sampling rate for Receive Signal Strength Indication (RSSI) is user-programmable. Display contrast may be adjusted via the up and down arrow keys while in the greeting screen. Each of these settings are then stored in non-volatile memory. The keypad is used for menu selection and includes full numeric entry for which channels to scan, along with other user programmable functions.

- The keypad has 20 alpha-numeric keys for user entry.

- RS-232 serial interface is supported for use with Seiko DPU-411 thermal printer.

- Auto calibration feature utilizes a unique on-board program to calibrate the **FOX** without operator assistance (using either Marconi 2957/2960 or HP 8920 communication test sets). The calibration values are automati cally stored in nonvolatile EEROM.

- The audio (speaker) volume is adjustable using the up and down arrow keys while in the CHAN screen.

- A built-in real-time clock (RTC) is used in connection with the MARKER feature to log time stamp vs. positional information with the collected data.

- An internal NiCad battery is employed for up to 8 hours of operation before recharging is necessary.

- Battery backup storage static random access memory (SRAM) is available for permanently saving screen setups and favorite channel numbers, as well as collected measurements.

- Fast battery charger

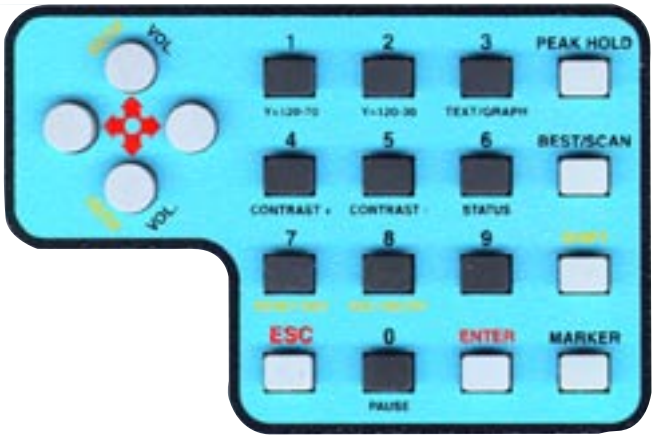
- Internal differential GPS 8 channel receiver uses an active antenna, which can magnetically attach to the roof of a vehicle

Options

- PCMCIA mass non-volatile storage RAM cards (128k - 2 MBytes are supported)
- BER demodulation: bit, byte, packet and burst error counts (where applicable)
- Printer: Seiko, Inc. DPU-411 Type 11 with cable

Keypad

Certain keys take on different meaning depending on the current operation mode. During MAIN MENU mode, the arrow keys are used to select menu options (measurements). During the RF MEASUREMENT MODE the arrow keys are used to increment/ decrement a channel number; or to change the frequency up or down (channel number), use the cursor left and right arrow keys.



KEY	FUNCTION
0	Pause the measurement.
1	Y axis -120 to -70 dBm.
2	Y axis -120 to -30 dBm.
3	Text/Graph (Survey CHAN, 1 MHz sweep)
4	Increase display contrast.
5	Decrease display contrast.
6	Display marker,date/time and battery gauge, Lat-Lon, odometer and PCMCIA gauge.
ENTER	Enter frequency (or channel #) for position marked by cursor (CO, ADJ, 20 CHAN) or change I CHAN measurement frequency (or channel #).
Shift + 7	Reset odometer.
Shift + 8	Toggle PCMCIA record on-off.
Shift + 9	Toggle between CHANNEL NUMBER and FREQUENCY display and entry.
Up arrow	Increase volume (1 CHAN measurement).
Down arrow	Decrease volume (1 CHAN measurement).
Right arrow	Increase Frequency (1 CHAN measurement) or Move Cursor (SURVEY measurements)
Left arrow	Decrease Frequency (1 CHAN measurement).
MARKER	Increment marker number, print if PRINT ON MARK is selected.
PEAK HOLD	Toggle highest dBm latch on-off (all SURVEY).
BEST/SCAN	Move cursor to BEST (strongest) frequency (Survey measurements) or SCAN for strongest frequency (1 CHAN).
SHIFT + BEST/SCAN	Seek next higher freq >100 dBm
SHIFT + BEST/SCAN	Seek next lower freq >100 dBm
SHIFT + BEST/SCAN	(Var Sweep) Transfers the strongest 20 frequencies to 20 channel measurements
SHIFT and then Up arrow	Seeks next highest frequency greater than 100 dBm in RSSI
SHIFT and then Down arrow	Seeks next lowest frequency greater than 100 dBm in RSSI

Note: Certain **FOX** features are accessed by pressing SHIFT and another key at the same time while other features are accessed by first pressing SHIFT, depressing SHIFT and then pressing another key.

Fox Rear Panel

1 Receiver RF input (- 120 dBm to -30 dBm max) for measurement and calibration. (TNC type connector 50 Ω)

2 Serial port used with supplied cables to download PCMCIA card, collect measurements with laptop or PC (RF Dump mode on), printer output and Marconi or HP calibration

3 Differential GPS antenna input (SMB Connector)

4 DC power input

5 Odometer 4 pin male input (12 volt pulse) from vehicle

Charging/Fast Charging

FAST CHARGING LED (yellow) - When lit, indicates **FOX** is connected to supplied fast charge power supply. Fast charge time is about 1-2 hours dependent upon initial voltage level at the start of the fast charge.When the charge light is on, the unit's internal batteries are fast charging (charging in 1-2 hours). This can only be accomplished by using the supplied 18 VDC transformer. Once the Fox's internal batteries are fully charged, the charge light will go off.

LOW BATT LED (red) - When lit, indicates battery is low and the **FOX** needs charging. Data collected while LOW BATT LED is on will not be accurate (RSSI error > 1 dB). DO NOT COLLECT data while LOW BATT LED is on. When using **FOX** in vehicle, power with supplied cigarette lighter cable for unlimited run time. In addition, there are two charging methods. The first is trickle charge, and the second is fast charge. The low battery light will come on when the **FOX**'s internal batteries need charging. As soon as the LOW BATT light comes on, you should stop making measurements and plug the Fox into the appropriate charging jack.

Trickle Charge: Charges the **FOX**'s internal batteries overnight (approx. 8 hours).If the FAST CHARGING light is off and the **FOX** is plugged into either the vehicle (via the 12 Volt supplied cigarette lighter adapter) or into the AC outlet (via the supplied switching DC transformer) the **FOX**'s internal batteries will trickle charge (charge overnight).

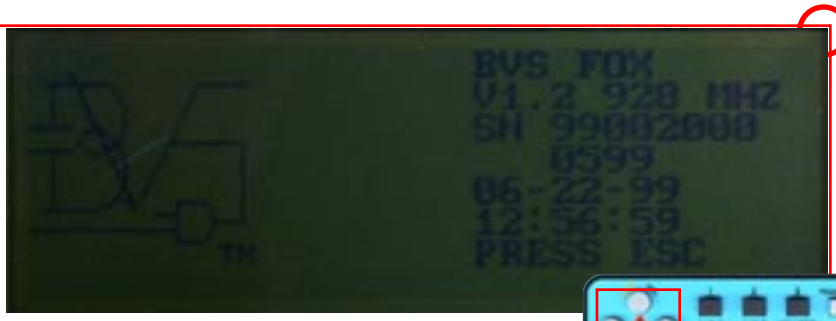
This input will both charge the internal NiCad battery and run the unit regardless of the initial state of the internal battery. The rate of charging is about 10 times faster with the unit off.

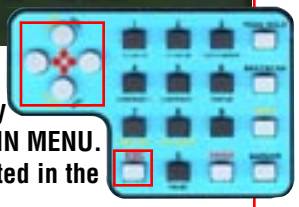
Ignition noise must be filtered out externally. Some filtering is provided by the unit, but not as much as needed for a very noisy vehicle due to space considerations.

GPS Power Switch

Use this switch to turn on or off the internal GPS sensor. Running the unit with this switch in the OFF position doubles battery run-time. It is recommended that if LAT/ LON positions are not required, the GPS switch should be left in the OFF position.

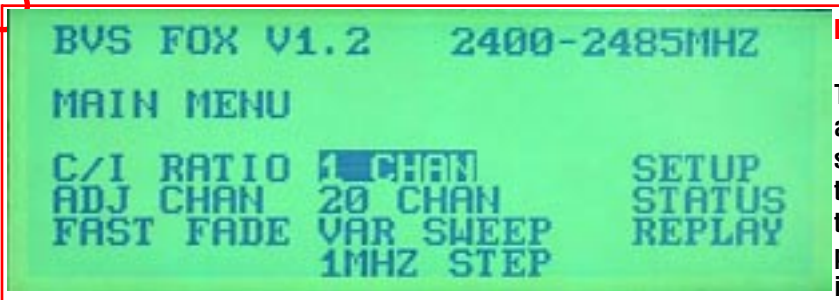
FOX POWER-UP SCREEN

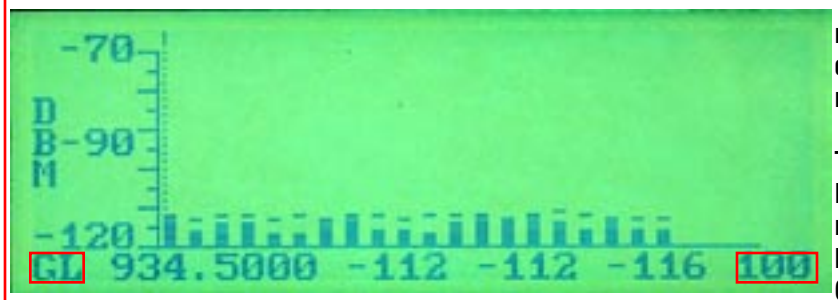




After power switch is turned to the ON position, the POWER UP screen is displayed on the LCD. There is no backlight for this screen. The backlight will activate as soon as any key is pressed. Use the UP and DOWN ARROW keys to adjust contrast while in this screen. If, after power on, the screen is too dark, press the DOWN ARROW key to reduce contrast. If the screen is too light, press the UP ARROW key to increase the contrast. Once out of the power up screen, you may adjust contrast at any time by using the 4 / CONTRAST+ and 5 / CONTRAST- keys instead of the arrows. Press ESC to enter MAIN MENU. After pressing ESC from power up screen, the ONE CHAN measurement option is automatically highlighted in the MAIN MENU.

MAIN MENU





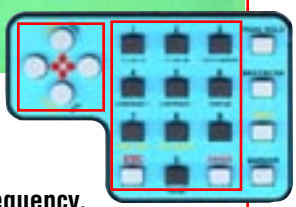
MAIN MENU

This screen is displayed after the power up screen and is used to select the RF desired measurements, setups or unit status. To select any menu item, use the right,left,up and down arrow keys to highlight the item. When the item required is highlighted, press the ENTER key to execute the highlighted item. Remember that MAIN MENU screens and their sub-menus can vary depending upon which model of FOX you have purchased. This manual covers all FOX models (except for EAMPS) so some menus may not apply to your own custom Fox.

The current GPS status is displayed in the lower lefthand comer of the display. If GL appears, it means the GPS is locked to at least 3 satellites and LAT/LON is valid. If "DL" appears, it means the GPS is DIFFERENTIAL locked to at least 3 satellites and LAT/LON is valid. If "??" is displayed, it means the internal GPS receiver cannot track the required number of satellites required to provide valid LAT/LON. The percentage of card storage remaining (0-100) is displayed as a number in far lower righthand corner.

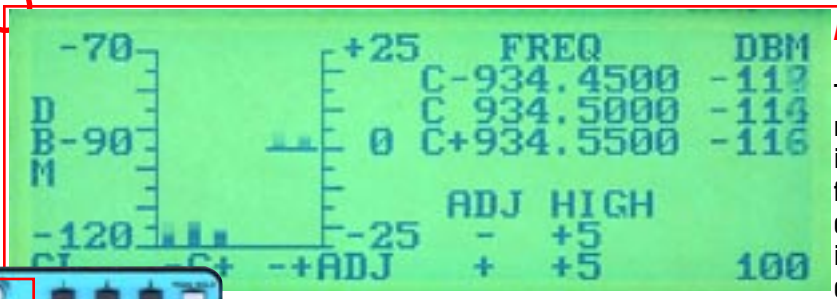
C/I RATIO

C / I RATIO



This measurement is used to compare (Carrier / Interferer) two frequencies against each other. To enter the "C" frequency, use the RIGHT or LEFT ARROW keys to move the dotted line cursor over the "C" column. When the cursor is positioned, press ENTER and enter the "C" frequency. To enter the "I" frequency, use the RIGHT or LEFT ARROW keys to move the dotted line cursor over the "I" column. When the cursor is positioned, press ENTER and enter the "I" frequency.

The C/I RATIO screen displays in both text and as a bar graph, the dBm level of both the "C" and "I" frequency. The compare value in dBm of I-C is also displayed. If C > 1, this compare value (in dBm) is plus (+). If I > C, the compare value is negative



ADJACENT CHANNEL

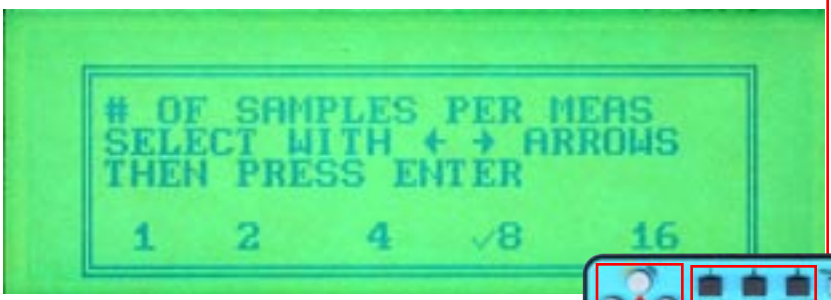
The adjacent channel measurement is used to measure any frequency and the two frequencies immediately adjacent to it. To select the center frequency, press ENTER and enter the center frequency. This measurement displays the dBm readings of all three frequencies in both bar graph and digital formats. It also displays the comparison of the center frequency against both adjacent frequencies. If the center is greater than either of the adjacent frequencies, this value is plus (+). If either of the adjacent are greater than the center, this value is negative (-). The difference between the center frequency and the adjacent frequency is determined by the last setting of the FREQ STEP in the VAR SWEEP measurement screen. Starting from current frequency, push SHIFT + UP ARROW key to seek next highest frequency greater than 100 dBm in RSSI and SHIFT + DOWN ARROW keys to seek next lowest frequency greater than 100 dBm in RSSI.

FAST FADE (optional)

Fast Fade saves blocks of 64 consecutive samples of dBm in PCMCIA card records. Also included in each block is the time, date and GPS position of the measurement.

Measurement Rates

FOX RSSI measurements are performed by a high-speed 8-bit A/D converter. The actual sample is made rapidly, in about 200 microseconds. This is not, however, the amount of time to record a single signal strength. Due to variations in the instantaneous amplitude of RF signals, some averaging must be applied to the readings to "normalize" the measurements. Therefore, multiple A/D samples are added together and divided by the number of samples to provide an integrated value and a 'smoother' measurement. These parameters are under user control, as shown in the tables on the next page. They prevent measurement errors which may be caused by noise or fast changes in amplitude due to local reflections and attenuations. A brief explanation follows so you can choose the optimum rate of integration.



Each one of the 64 signal strength samples is the average of 1,2,4,8 or 16 A to D measurements (selected by the user.)

The dBm value that is displayed on the FOX screen is the average of the 64 samples (A/D samples) saved on the PCMCIA card (also displayed is PCMCIA storage and GPS status.)

Each AD sample of RSSI takes the FOX receiver 150usec, so that an average of 64 samples takes about 10msec to accumulate. The time between samples is fixed (150usec), only the # of samples is currenly adjustable (1 CHAN measurement).

NOTE: The FOX display update and PCMCIA read/write overhead is about 60 msec, so that when using sample rates of 1,2 or 4, the number of measurements per second is limited by this overhead time.

FAST FADE

Fast Fade saves blocks of 64 consecutive samples of dBm in PCMCIA card records. Also included in each block is the time,date and GPS position of the measurement.

Each one of the 64 dBm samples is the average of 1,2,4,8 or 16 A to D measurements selected at the start of the measurement.

The dBm value displayed on the FOX display is the average of the 64 samples saved on the PCMCIA card (also displayed is PCMCIA storage and GPS status).

Note: FOX display and PCMCIA overhead is about 60 msec, so that when sample rates of 1,2 or 4 are selected, the number of measurements per second is limited by this overhead time.

Fox Sample Conversion Times

# of A/D samples selected	Time (msec) per measurement (includes overhead)	# 64 dBm measurements saved per second
1	67	15*64=960
2	67	15*64=960
4	67	15*64=960
8	91	11*64=704
16	167	6*64=384

# of samples selected	Storage Time (minutes) 2 Meg PCMCIA card (saving GPS LAT and LON, 83 bytes saved per measurement)
1	28
2	28
4	28
8	38
16	70

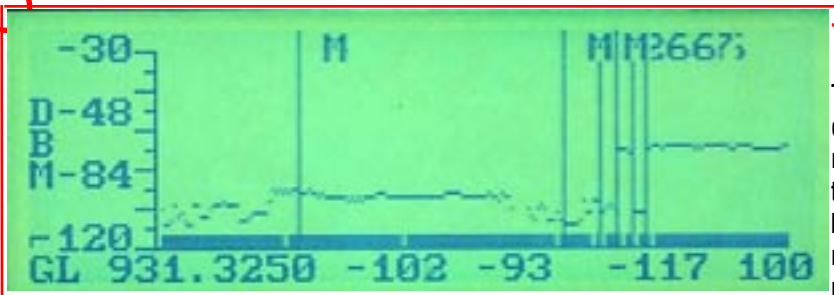
One CHAN (ATA Save On, RF Dump Off) (Times include display and PCMCIA save overhead)

# A/D samples selected	Time (msec) per measurement	# measurements/sec saved (a single 8 bit value/measurement)
64	60	17
128	70	14
256	90	11
512	140	7
4096	800	1

# A/D samples selected	Storage Time in minutes 2 Meg PCMCIA card (saving GPS LAT and LON, 24 bytes of data saved per measurement)
64	85
128	104
256	132
512	208
4096	1456

This feature is only available for the following measurements:

20 CHAN, VAR SWEEP, 1 MHZ SWEEP



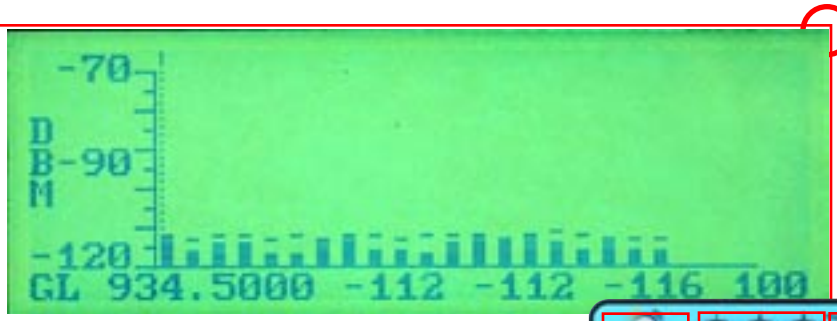
1 CHANNEL MEASUREMENT

This measurement is used to monitor one frequency on the display in "oscilloscope" fashion. Before the measurement begins, select the number of samples taken for each reading. Use the right or left arrow key to place the check mark next to the desired number of samples (64, 128, 256, 512, or 4096) per each measurement. The smaller this number is, the faster data is displayed on the screen and written to the PC card. i.e., 64 = 22 records/sec but 4096 = 1 record/sec. Press ENTER at anytime and use the keypad to enter the RSSI signal threshold number in dBm. Only measurement dBm values greater than or equal to the entered value are saved on the PC card. In addition, any dBm value below the threshold causes the audio to be muted until the dBm value returns to a value greater than or equal to the threshold.

Press the BEST/ SCAN key during the measurement to scan the entire band and change the measurement frequency to the strongest frequency found by the scan. The display graphs each dBm reading from left to right and also digitally below the X-axis. On the X-axis each second of elapsed time is marked with a 'tick' mark. Any function that causes the display to pause or be hidden (pause, print, status) is marked with a vertical line to indicate a discontinuity in time. Starting from current frequency, push SHIFT and then UP ARROW key to seek next highest frequency greater than 100 dBm in RSSI and SHIFT and then DOWN ARROW key to seek next lowest frequency greater than 100 dBm in RSSI.

NOTE: If the PCMCIA save is turned OFF in the PCMCIA setup menu, the threshold will be used only to MUTE-UNMUTE the audio. When save is turned ON, the only data records saved on the card will be measurements where the measured dBm values are greater than or equal to the threshold. The start and end records are recorded regardless of the threshold setting. Setting the threshold to 120 dBm will cause all data to be saved on the card as in prior versions of the FOX's ROM.

20 CHANNEL MEASUREMENTS



These measurements are used to measure and display up to 20 frequencies in either bar graph (all frequencies are displayed) or text mode (7 strongest). To go between bar graph display and text, press the 3 key.

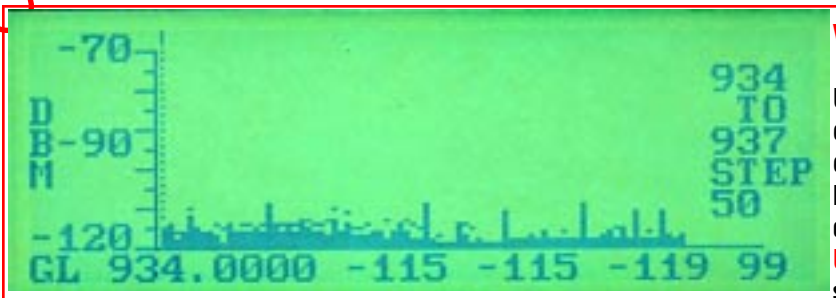
NOTE: To enter which frequencies to measure, the display must be in the bar graph mode. Move the dotted line cursor to the position on the X axis where the new frequency should be displayed and press ENTER and then type in the frequency to be measured.

When using the bar graph screen, all 20 selected frequencies are displayed along the X axis in the order that they were entered. In addition, the frequency 'marked' by the vertical dotted line cursor is displayed in text below the X axis. This cursor can be moved by either left or right arrow keys. Data relevant to where the cursor is pointing will always be shown on the bottom line of the LCD display.

When in the text screen, the strongest 7 frequencies are displayed with the strongest on the top of the display, weakest on the bottom.

HIGHEST dBm LATCH

The highest dBm reading for each frequency is held or "latched". If the unit is left on for a period of time in one location, this feature will show all of the highest readings for this time period. Use this feature when trying to determine frequency traffic at the location of the measurement. To turn "latching" on and off, press the PEAK HOLD key during the measurement. During the SURVEY measurements, pressing the BEST/SCAN key will move the dotted line cursor to the strongest frequency currently being displayed.

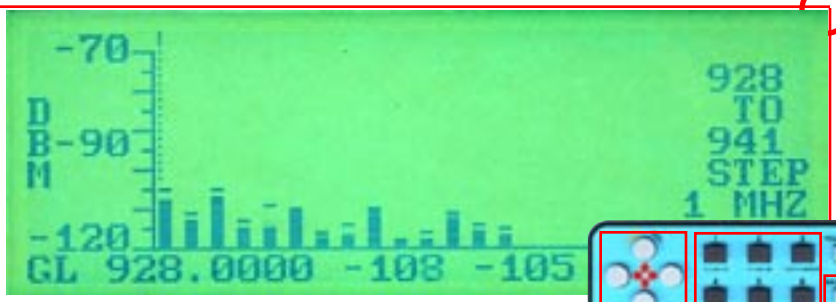


VARIABLE SWEEP

Use this measurement to display a selected portion of the frequency band. Enter the start frequency of the sweep, the end is automatically calculated based on the frequency step. The frequency step can be adjusted during the measurement using the UP and DOWN ARROW keys. The current sweep start, end and frequency steps are displayed on the right side of the screen.

Note: The last step selected in the VAR SWEEP menu is used in determining the ADJ CHAN measurement. (see ADJACENT CHANNEL in this manual.)

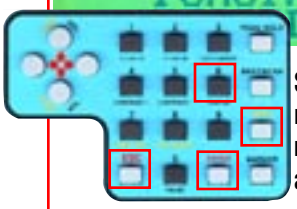
1 MHZ STEP MEASUREMENT (optional)



This measurement sweeps the entire band from start to end frequency at a fixed 1 MHz step. All frequencies are displayed along the X axis, with the start frequency at the origin (left side of graph), and increasing by the step frequency towards the right side of the graph. The frequency marked by the dotted line cursor is displayed digitally below the X axis. Use the RIGHT ARROW and LEFT ARROW keys to move the cursor position and change the frequency displayed numerically.

RECEIVER STATUS

Use this screen to monitor unit status during measurement by pressing the 6 key. The measurement continues while the status is displayed (but is invisible). To restore measurement display, press 6 key again. While status is displayed during measurement, all keys but ESC and 6 are ignored.

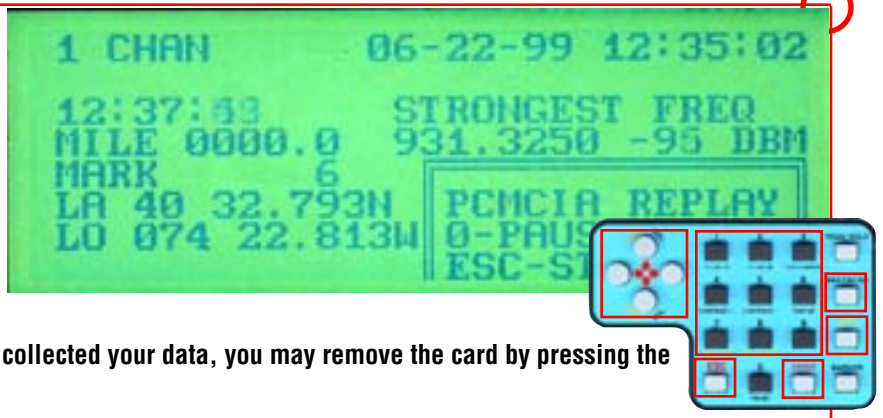


Status is also available by selecting the STATUS item in the main menu. The display shows current marker, odometer, GPS LAT/LON and GPS status as well as the number of satellites (1-7) that are currently being tracked by the GPS receiver in the FOX. Current time, date, battery and PCMCIA state are also displayed below.

MARKER:	current user marker value
ODOMETER:	if using the odometer option, shows current trip mileage.
LA	GPS latitude (if ?, unknown)
LO	GPS longitude (if ?, unknown)
GPS STATUS-LOCKED 5	GPS position is ok, 5 satellites
GPS STATUS - NO LOCK	GPS position is unknown
GPS STATUS - D LOCK 4	Differential Lock, GPS position is OK, 5 satellites
GPS STATUS-OFF	GPS power switch in OFF position
HH:MM:SS	real time (hour, minute, second, 24 hour)
MM-DD-YY	date (month, day, year)
BATTERY	empty / full gauge
PCMCIA	empty / full gauge

Both gauges show state of battery or PCMCIA card from empty to full. When battery is empty, it needs to be charged. When PCMCIA is full, there is no more room in the card to save measurements. The PCMCIA gauge is only displayed if a card is in the socket and the PCMCIA option 'SAVE ON' is selected.

PCMCIA REPLAY



The FOX comes standard with a 8 Megabyte SRAM memory card. To view data collected on the FOX PCMCIA memory card, select the MAIN MENU replay function. Before taking measurements, you must install the PCMCIA SRAM memory card. Insert the memory card with the text facing up, and the arrow at the bottom of this side of the card facing the unit. Push the card into the slot until the ejector button on the front pops out. After you have collected your data, you may remove the card by pressing the same ejector button.

The REPLAY screen displays the following data saved on the PCMCIA card:

1 Measurement type, start time and date of measurement.

2 Time and strongest frequency (in dBm) found during measurement.

3 Mile marker (odometer).

4 User marker.

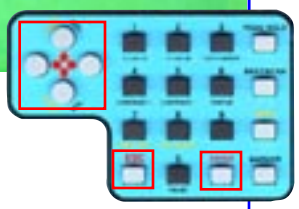
5 GPS LAT and LON. A "?" is displayed for LAT/LON if GPS status was UNLOCKED during measurement.

During card replay, press 0 KEY to pause the display. Press the ESC key to stop the replay.

SETUP MENU

The SETUP MENU can be reached from the MAIN MENU and should be accessed before you begin to receive signals on your **FOX**. You can re-enter the MAIN MENU at any time from the SETUP MENU by pressing **ESC**. Use the 4 **ARROW** keys to navigate through this menu and press **ENTER** to choose a highlighted selection.

PCMCIA MENU



Before collecting data using the **FOX** in the field, record some test data on the PCMCIA card. Then verify download using the PC that will be used later for downloading field data.

SAVE ON: This option MUST be ON for measurement data to be saved on the card. Use the **UP** or **DOWN ARROW** key to put the check mark next to 'ON' and press **ENTER**.

SAVE OFF: When this option is checked, no measurements are saved on card.

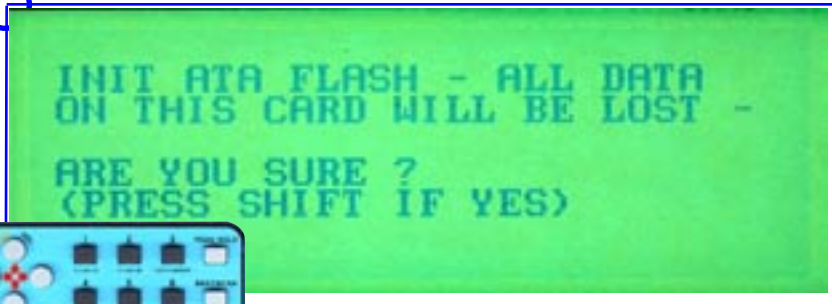
If the PCMCIA SAVE ON option is checked ON, the key sequence **SHIFT+8** can be used during any measurement to toggle the PCMCIA save on and off. The status of PCMCIA save can be determined by looking at the lower right hand corner of the measurement display as follows:

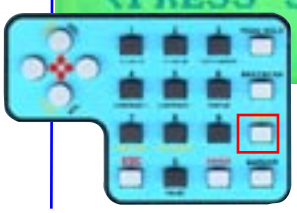
1) If nothing is displayed, PCMCIA SAVE OFF is selected in the PCMCIA MENU. No data is recorded.

2) A number between 0 and 100 is displayed. This number represents the percentage of space remaining on the card for data storage (100 means entire card is available for data, 0 means card is full).

3) OFF is displayed. This indicates that recording has been temporarily stopped using the **SHIFT+8** key sequence. To continue recording, press the **SHIFT+8** key sequence again and the display will return to displaying the percentage of space remaining.

4) During measurement, recording status can also be determined by pressing the **6** key. If PCMCIA save is selected OFF in the setup menu, nothing is displayed below the battery gauge. If PCMCIA save is selected ON in the setup menu, a gauge of storage available from E (empty-0%) to F (full-100%) is displayed. In addition, RECORD ON or RECORD OFF is displayed below the gauge. RECORD OFF indicates recording has been temporarily stopped (see 3 above). **Be sure to press the ESC key before turning off the unit. Measurements will not be recorded until ESC is pressed and the FOX is shut down properly.**





INITIALIZE PCMCIA CARD

It is recommended that the user initialize the PCMCIA card before each use to ensure no corrupt data remains on the card during measurements.

NOTE: Be sure to use the supplied PCMCIA card or same brand of device. Use only Delkin Flash and Compact Flash (with provided adaptor) PCMCIA storage cards. Other brands prove to be unreliable in the **FOX** receiver.

DOWNLOAD

INITIALIZE PCMCIA CARD

It is recommended that the user initialize the PCMCIA card before each use to ensure no corrupt data remains on the card during measurements.

NOTE: Be sure to use the supplied PCMCIA card or same brand of device. Use only Delkin Flash and Compact Flash (with provided adaptor) PCMCIA storage cards. Other brands prove to be unreliable in the FOX receiver.

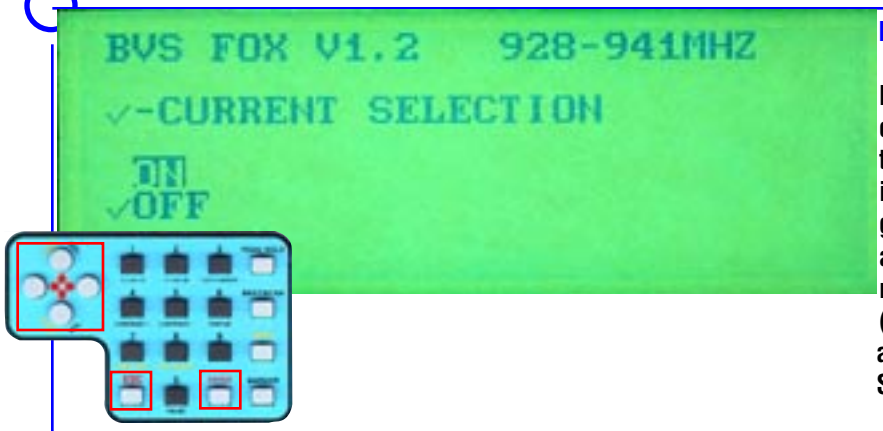
DOWNLOAD DATA

Use this menu option when you are ready to download your collected data from the FOX to your PC. If the PC used to download the PCMCIA was running Windows, reenter Windows before downloading from a DOS screen. Use the system select to change COM PORT flow control to "Hardware." If the computer used to download the PCMCIA card boots up in Windows (3.1 or 95), do the following BEFORE attempting to download the FOX PCMCIA card:

1) Enter WINDOWS®
2) Select the MAIN menu (win 95 "Mycomputer")
3) Select CONTROL PANEL, when in, select PORTS (win 95 system\device manager)
4) Set COM 1 or COM 2 (depending on which is to be used) FLOW CONTROL to "HARDWARE" or "OFF". The nomal setting for this option is "XON-XOFF". Flow Control MUST be set to the "HARDWARE" or "OFF" option for download to work reliably.
5) Enter MS-DOS® and use Fox.EXE to download PCMCIA.

NOTE: When using laptops, POWER MANAGEMENT control MUST be turned OFF. This feature is usually found in the CONTROL PANEL, set it to OFF or at least to 15 minutes. IF the power management control software puts the laptop in low power mode DURING download, data WILL be lost.

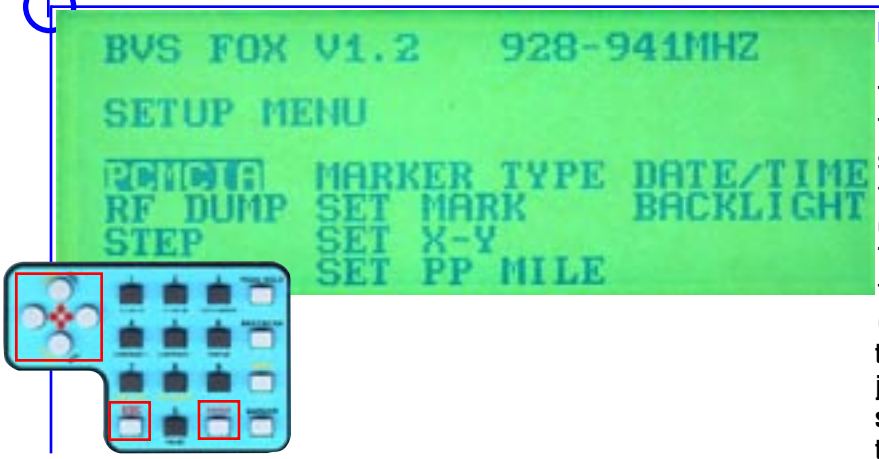
RF DUMP



RF DUMP TO PC

RF DUMP is used to save real time data on a PC compatible computer via the serial connection on the FOX. All of the data for current measurements is saved in a disk file using the "Fox.EXE" PC program. The RF dump mode can be used to provide a backup to the PCMCIA data or in situations where more than 32 Megabyte of data is being collected (the present limit of PCMCIA storage). See more about RF Dump menu in the following section (PC Software) of this manual for more details.

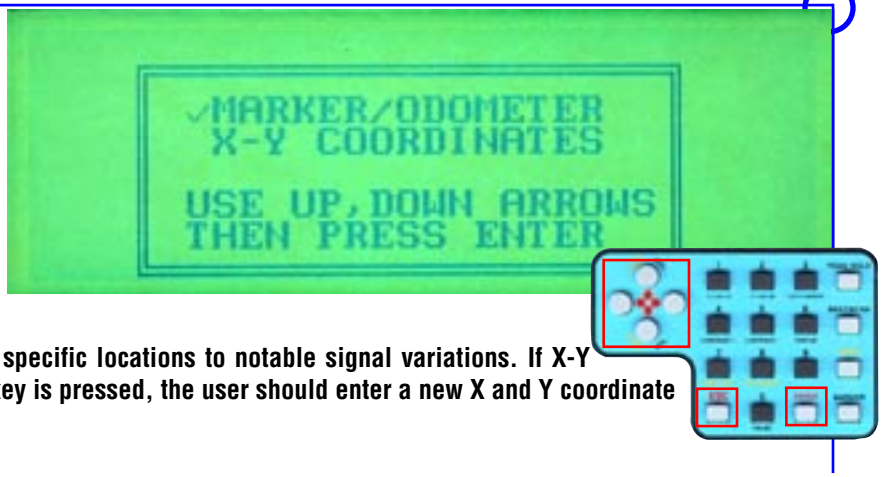
STEP



RF STEP

The STEP selection is below the RF DUMP selection. To change the RF step, highlight the STEP menu selection and press enter. The possible RF steps for the installed receiver will be displayed with a check mark to the left of the currently selected step. To change the step, use the up or down arrow key to highlight the desired step and then press enter (the check mark will move to the new step). Press the esc key until back in the main menu. The step just selected will be used for the next measurement started. Note that when a new step is selected, the last channels used for that step are restored, including the 20 channels loaded from the PC.

MARKER TYPE

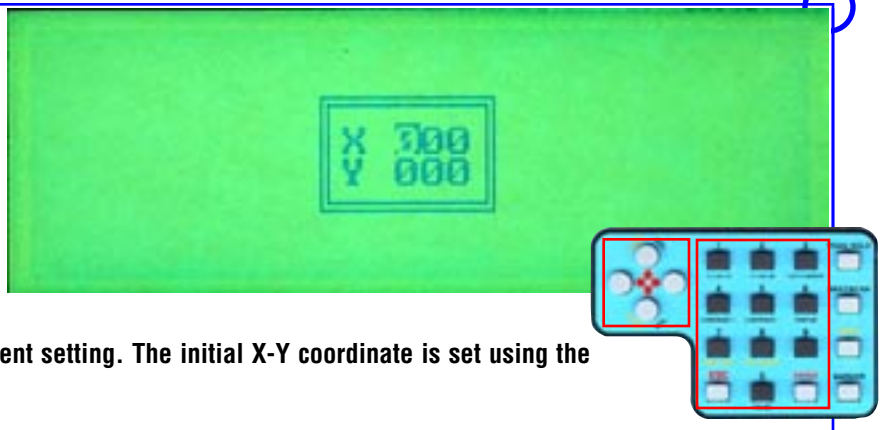


Use this selection under the SETUP MENU to determine the way in which you plan to log your events. When MARKER / ODOMETER is selected, a mark may be attached to a study based upon PP MILE settings. In this setting the MARKER key works as in prior versions during measurements and the odometer reading is saved according to the current PP MILE setting. Use the ARROW keys to select X-Y COORDINATES if you wish to attach specific locations to notable signal variations. If X-Y COORDINATE is selected, each time the MARKER key is pressed, the user should enter a new X and Y coordinate for the current measurements.

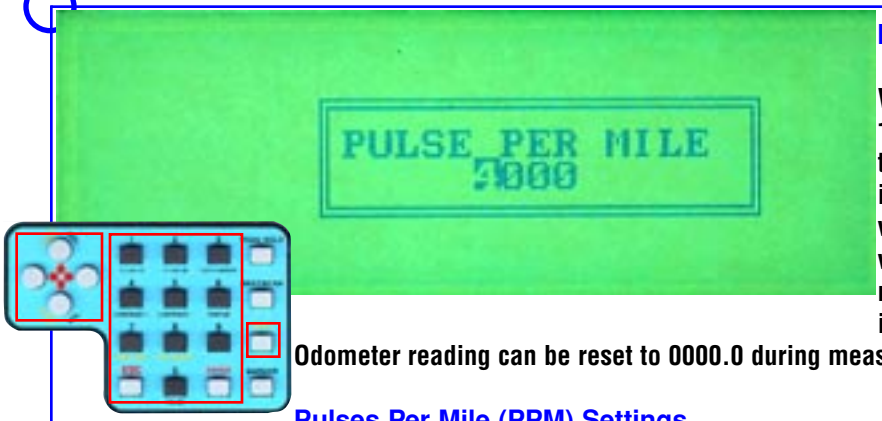
SET MARK

To set a new starting marker number, select MARKER in the setup menu, and press ENTER. Enter the marker number (0-9999) and press ENTER. Use the FOX keypad to enter the new starting MARKER number in conjunction with printer MARK option. Marker numbers can be used to manually log events such as low signal levels. When an notable event occurs, press the MARKER key and write down the event in a log. When later reviewing data, use the marker number to locate data records (printed, RF dump or PCMCIA) where logged events occurred. The MARKER is displayed during measurement regardless of the the setting of the PRINTER options. The MARKER is also incremented AFTER being displayed.

Set X-Y COORDINATES



The measurement X-Y coordinates are saved (both RF DUMP and PCMCIA) in place of the original user marker/odometer readings. A flag is set in the RF DUMP header and ATA RECT1 to indicate to the PC software which marker type has been selected by the operator. Use the numeric keys and bottom command keys on the FOX keypad to configure the X-Y coordinates. Pressing the ENTER key for either X or Y coordinate will leave the current setting. The initial X-Y coordinate is set using the setup menu option SET X-Y.



PP MILE ODOMETER SETTING

When using the odometer option, the number of 12-volt pulses per mile traveled is entered using this setup menu item. Select PP MILE SETUP MENU item and press ENTER. Enter the number of 12-volt pulses per mile (this will vary from vehicle to vehicle) and press ENTER. The current odometer reading can be viewed using the main menu STATUS item or by pressing the 9 key during measurement. Odometer reading can be reset to 0000.0 during measurements using SHIFT+7 sequence.

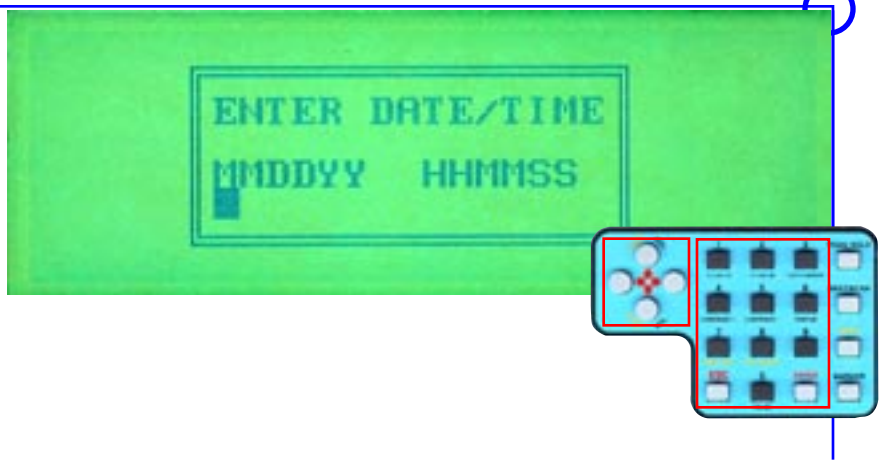
Pulses Per Mile (PPM) Settings

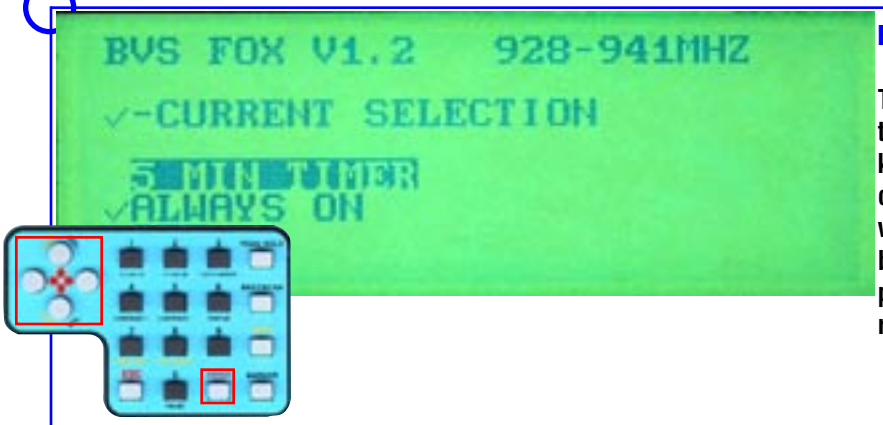
Note: Fox setup parameter, Pulses Per Mile (PPM), must be set to a minimum value of 10.
Tested:
Signal source: pulse generator (0-12v) pulses.

PPM (set on Fox)	Rate (Generator)	Duty Cycle (Generator)	Time per 1 mile (Measured)
100	1 Hz	80%	100 sec
100	1 Hz	20%	100 sec
100	2 Hz	80%	50 sec
10	100 MHz	80%	100 sec
10	100 MHz	20%	100 sec

DATE/TIME SETTING

To enter the date and time, select DATE/TIME in the setup menu, and press ENTER. Enter current date and time and press enter. The FOX begins using the new date and time the instant ENTER key is pressed. Make sure date and time are entered before making measurements since all data is tagged with date and time. Date and time can be verified using the STATUS menu item.





BACKLIGHT CONTROL

To control the LCD Backlight, select BACKLIGHT in the setup menu and press ENTER. Use the ARROW keys to place the check mark next to the desired option and press ENTER. The backlight is required when using Fox in a dim or dark environment. The backlight requires a significant amount of battery power, so using the backlight will reduce battery run time.

5 MIN TIMER	**Backlight stays on for 5 minutes after the last key press.**
ALWAYS ON	**Backlight stays on till unit shut off.**
OFF	**Backlight stays off till turned on.**

Introduction

The Fox Data Logger (DL) application software is the PC interface that enables a user of the Fox Signal Strength Meter to collect and display valuable Fox scan data through a serial cable.

Fox DL was designed to allow the user to see full color displays of the scanned information while also having the option to collect the data real-time. This data can then be converted and filtered by Chameleon CW.

Channel tables can also be uploaded for use with the 20-channel measurement on the Fox. The following sections of this document outline the various features of the DL.

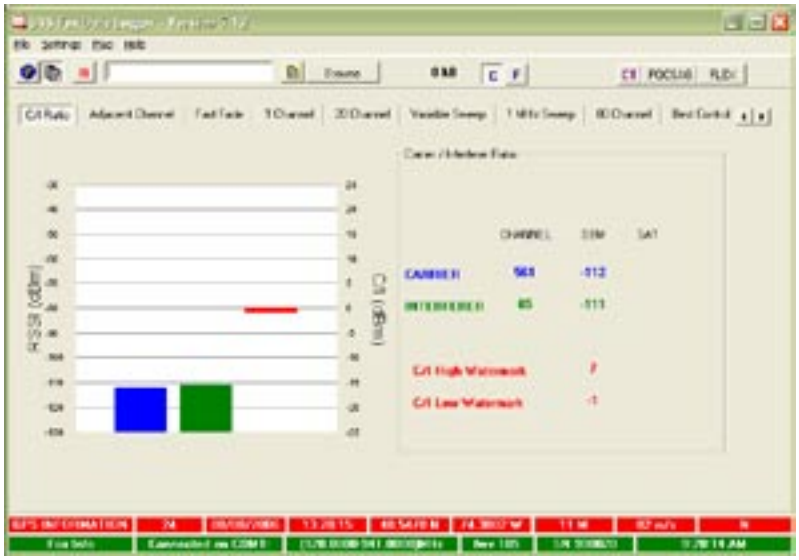


FIGURE 1 - Fox Data Logger main screen with C/I measurement

Starting the Application

To begin using DL, make sure that you are connected to the Fox with the serial cable that shipped with the Fox. Also, the Fox needs to be setup to send data.

Look for the RF download option under the setup menu on the Fox. Make sure that this option is checked. Once the Fox is sending information through the serial cable, start the DL application.

When the application starts, a prompt appears for entering the correct serial port. There is also an option for choosing whether or not to use the Fox internal GPS or from an external source connected to a serial port. The external source must output Magellan GPRMC records.

FIGURE 2 – Choosing ports

After the ports have been selected, a message will show up in the Fox information status bar stating that a connection has been made. The DL will switch to a display representing the current data type coming through the serial port.

Main Screen

The main screen contains the main menu, toolbar, real-time viewing area, GPS information bar, and the Fox information bar. The real-time viewing area will display the appropriate information based on the data coming through the serial port from the Fox.

For instance, if the Fox is in C/I ratio mode, the same screen will be displayed in the DL. The real-time viewing area can be toggled with the GPS satellite screen by pressing the button located in the toolbar.

Toolbar

The toolbar is located directly underneath the main menu.

The first button has a globe icon. This is a button that allows toggling to the GPS satellite screen. To toggle back to the main viewing screen, choose the next button.

The next button has an R on it and this resets the watermarks on certain measurement screens.

Next is the log filename and whether or not logging is enabled. If the enabled button is pressed, any real-time data will be logged to the corresponding filename. To browse for a file, choose the browse button.

The size of the log file will increment next to the browse button when logging is enabled.

Next to that are ‘C’ and ‘F’ buttons. Choosing the ‘C’ button forces all of the screens to display channels. The ‘F’ forces all of the screens to display frequencies.

Finally, the rightmost buttons activate editors for channel or CAPCODE tables. See the individual sections later in this manual to explain the use of these editors.

FIGURE 3 – Paging Screen

GPS Information Status Bar

The top status bar on the main screen is the GPS Information status bar. This will contain valid information when the GPS receiver is locked. When the GPS receiver is locked, the background color of the data capture bar and the GPS Information status bar will be green. If the receiver is not locked, the color will be red.

The information from left to right is: Satellites (V=visible, T=tracked), Date, GPS Time, Latitude, Longitude, Altitude (meters from sea level), Velocity (MPH), and Heading (degrees from North).

GPS Satellite Screen

The GPS satellite screen contains information from the GPS receiver concerning certain flags and status of the satellites. The receiver can track up to 12 satellites at any one given time. Information such as satellite ID and status flags are shown on this screen. The receiver generally needs 3 to 4 satellites tracked in order to achieve a lock condition.

FIGURE 4 – GPS satellite screen

Fox Information Status Bar

The second status bar on the main window contains general information on the Fox. Any status messages will appear here. The PC system time is also displayed. The serial number, frequency range of the receiver, and the firmware version number are also displayed.

Thresholds

When the bars on displays are at a certain level, they will turn green. This is due to the user selectable threshold value. Any bar below this value will appear red. To change this value, look for “Threshold” in the Settings menu.

20 Channel Table

The user may configure a channel table for upload to the Fox. To choose, select the ‘CT’ toolbar button. A dialog box appears which allows the user to select up to 20 frequencies to scan. If the channel is left as –1, the Fox will not scan I this position of the table.

Choosing a channel will adjust the frequency column. Choosing a frequency will adjust the channel in the channel column. These tables may be stored as a disk file by choosing the save option. They may be restored using the open option. Press the upload button to send the table to the Fox.

Be sure not to be in 20-channel mode on the Fox. In this situation, the table will not be overwritten.

FIGURE 5 – Channel Table Screen

Paging CAPCODE Table

The user of the Fox DL application may upload or download tables of CAPCODES used for

matched mode. This mode is used on the POCSAG and FLEX screens. Use the POCSAG or FLEX button on the toolbar to pull up the editor.
Choose the CAPCODES to match and then upload or download accordingly using the options given. The tables can be saved and retrieved to disk for later use as well.

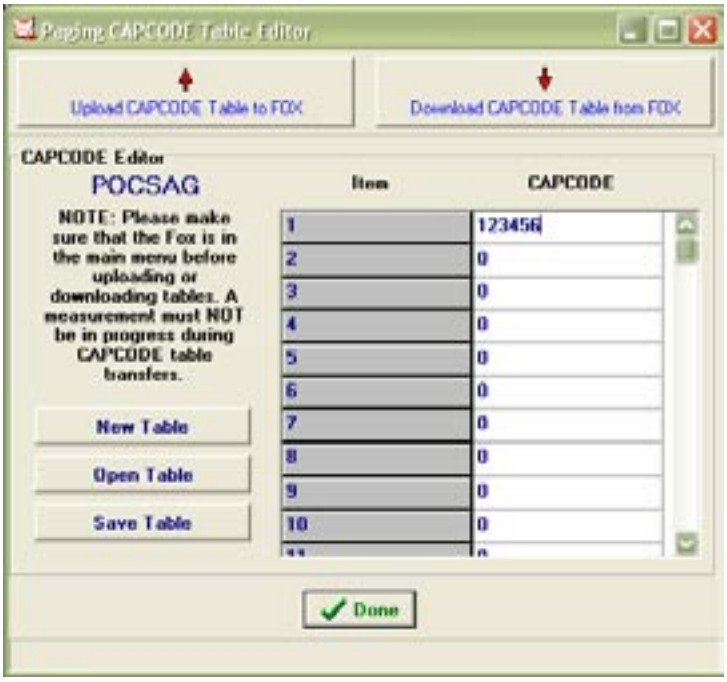


FIGURE 6 – Paging CAPCODE Table Screen

BVS Fox Download Utility (v5.00)
Application Software

PC Requirements
Pentium II
500 MHz
64MB RAM
100MB free on Hard Drive
Serial Port between COM1: and COM4:

Introduction
The Fox Download Utility (FDU) application software is the Windows 95/98 interface that enables a user of the BVS Fox to download data from a PC card inserted in the Fox. The main screen for the FDU is shown in Figure 1.

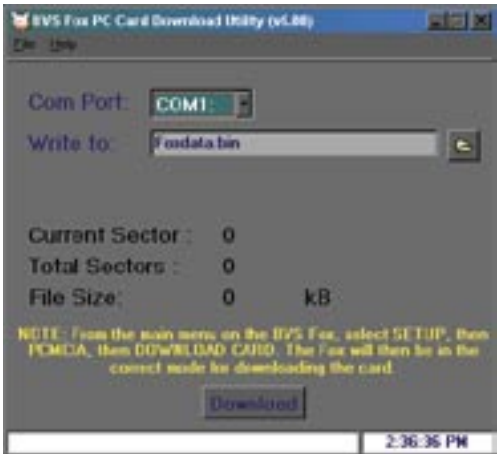


FIGURE 1 – BVS Fox Download Utility

Installing the Application
The application is installed by placing the CD provided into an appropriate drive. If the CD's main program does not come up within 15-20 seconds, run AUTORUN.EXE from the root directory on the CD. From the main screen, select PC Software/Drivers. Choose the Fox DU button and InstallShield will prompt for further installation questions. After the installation is completed, an icon will be created in the folder specified during the installation process.

Using the Application
Make sure that the Fox is connected to the PC using the serial cable that shipped with the unit. Then use the following steps to download the PC card data. FDU is the Fox Download Utility on the PC. FOX is the Fox unit itself.

1. FDU: Choose the serial port to which the Fox is connected (COM1: - COM4:).
2. FDU: Select the name of the file that will hold the data on the PC from the Fox.
3. FOX: Go to the main menu.
4. FOX: Choose SETUP.
5. FOX: Choose PCMCIA.
6. FOX: Choose DOWNLOAD CARD.
7. FDU: Press the DOWNLOAD button.

Depending on the amount of data stored on the card, the download will take from seconds to minutes and is measured by the progress bar on the FDU. When the download is complete, exit the application on the PC and press any key on the Fox.

Introduction

The Chameleon application software is the universal data conversion and filtering tool for BVS Receivers. The Chameleon was designed to greatly simplify the transfer of receiver data to many popular post-processing applications such as MapInfo and MSI Planet. In addition to the ability of this application to convert data into custom formats, different filtering capabilities are available to facilitate the extraction of useful data needed for network analysis.

The following sections of this document outline the various features of the Chameleon software.

Installation

Installation of Chameleon is straightforward. Insert the CD provided with the product purchased into the computer. Wait a few seconds for the auto-run program on the CD to boot up. Choose Chameleon CW from the list of applications to install. This will load the installation program. Next, follow the steps outlined by this application. After the installation has been completed, an icon will be placed in the chosen folder (default is “BVS”).

Running the Application

After starting the application, the main screen will appear. There are four steps to conversion which are outlined in the following sections.

Main Menu

The main menu contains options to save and retrieve configurations. The “Save Configuration” option under the APPLICATION menu will save information stored in all fields on all notebook pages. This allows the user to save custom configurations for use on a number of different files. Any saved configuration can be restored using the “Open Configuration” option in the APPLICATION menu. The configuration files are stored in ASCII form. DO NOT modify these configurations manually! Any manual change to the configuration files may result in the loss of configuration information.

Step 1 – Select Input / Output

Choose the data file that is to be converted. Chameleon will automatically determine which product created the file. Chameleon will display the product type next to the filename. A default output filename will be chosen with the .OUT extension. This may be modified to suit the users needs.

Step 2 – Choose Formatting Options

This step enables the user to specify which data is to be converted. This section also contains various filters that can be used to reduce the amount of information being converted into the output file.

Choose which receivers are to be converted. Different CW products have a different amount of receivers. Chameleon will only convert data from the receivers which are selected here.

Choose the Data Reduction Type. Either all of the data will be converted or just the data for the strongest server (RSSI), depending on the choice chosen here.

Choose the Average Type. Depending on the product, different options will be available here. Certain products will have the choice of 40 lambda averaging (Panther for example).

One of the powerful features of Chameleon is its ability to convert data into a large number of formats. By selecting the appropriate post-processing application, the correct fields will be selected and placed in the selected field box in the appropriate order. If the format selected requires information that is not ASCII-delimited, no fields will show as selected in the selected field box. The data for these non-ASCII formats is fixed thus the user will not be able to adjust the order or the number of fields to be converted.

The user may also choose a custom ASCII format of a type that is not represented by any of the supported post-processing applications. This is accomplished by choosing "Custom Configuration". As stated above, these configurations can be saved in configuration files by using the "Save Configuration" option found in the APPLICATION menu.

Step 3 – Select Data and Fields Which Are To Be In The Output File

Select the fields that are to be placed in the output file. The delimiting character may also be chosen. Field titles may be placed in the output file by checking the appropriate box. To include data fields as specified by the "Output Filter" page, be sure to have the "<<DATA>>" field in the selected box.

When a particular post-processing format type has been chosen, fields will be displayed in the selected box. If the format chosen is a non-ASCII delimited custom format, the selection boxes will be inactive.

Step 4 – Convert The Input File

Press the CONVERT button. The progress bar will be updated as the file is being processed. The speed of conversion will vary based on the data filter chosen.

After the message appears stating that the conversion has been completed, the converted file will be ready for import into the specific post-processing application that you have chosen.

APPENDIX

Battery Charge/Discharge

BATTERY RUN TIMES - (NO DC INPUT)

1) The following conditions assume unit is turned on after the battery has been fully charged.

CONDITION 1 (worst case):
GPS on
BACKLIGHT on
ATA save on (2 Meg card)
RF dump on
RUN TIME: 3 hours

CONDITION 2 (best case):
GPS off
BACKLIGHT off
ATA save on (2 Meg card)
RF dump on
RUN TIME: 7 hours
NOTE: For best run time, always make sure GPS is OFF if LAT/LON positions are not required (such as in-building surveys). Backlight should only be used when unit is in low lighting conditions.

POCSAG Measurements

V3.3 ROM ONLY saves data when POCSAG data is present (both ATA and RF DUMP).

*** CAUTION: If saving POCSAG data on ATA card, turn RF DUMP to OFF. With BOTH ATA SAVE ON and RF DUMP ON, some POCSAG batch's may be lost. To ensure correct operation, use either ATA SAVE or RFDUMP, but not BOTH. This restriction only applies to the POCSAG measurement.**

Specifications:

Speed: 512, 1200 or 2400 Bits Per Second (BPS).
Jitter: +- .5% of selected speed. Out of spec BPS is flagged on display in reverse video.
BER: Count of bits found in error in last batch using received BCH code. Up to 2 bits per 32 bit word are corrected by BCH, if greater than 2 bits in error, the word is ignored. The higher this count is, the more suspect is the received signal.
ADDRESS TABLE: 50 entries.
Message Display: The first 18 characters or digits of a pager message is displayed on the FOX display.

Number of BATCHES: There is no limit to the number of batches that are processed following the preamble. All 7 frames of each batch are checked for BER, address's and messages.

POCSAG DECODE MENU and Measurements

1. DATA MENU SELECTIONS:
BER/JITTER
MATCH
ENTER CAP CODE
VIEW CAP CODE
ERASE CAP CODES
SELECT FC
2. BER/JITTER and MATCH measurement screen:
line:
1 FREQ DBM BPS BER
2 XXX.XXXX -xxx xxxx.x xx
3
4 ADDRESS MESSAGE

5 xxxxxxx xxxxxxxxxxxxxxxxx
6 xxxxxxx xxxxxxxxxxxxxxxxx
7 xxxxxxx xxxxxxxxxxxxxxxxx GL
8 xxxxxxx xxxxxxxxxxxxxxxxx 100

line:
1 Header
2 Frequency being measured, last RSSI reading, last measured BPS (in reverse video if >+-.5% of selected speed, BER (count of bits in error in last received batch).
4 Header
5-8 Last 4 addresses captured and their message (if any). Most recent address is line 5, oldest on line 8.
7 (far right) GL if GPS is locked, ?? if GPS not locked or off.
8 (far right) % of ATA storage available for data (100 to 0, 100 meaning card empty, 0 meaning card is full of data).

Note: ADDRESS is the address word defined in the POCSAG spec as a 21 bit number (18 bits sent over air, least significant 3 bits being the frame number (0-7)). The address displayed is the full 21 bit address (0-2,097,151).

MESSAGE is the first 18 character or digits associated with the address. The entire message (if > 18) is saved on the ATA card and sent via RF DUMP.

POCSAG DECODE Measurements

1. BER/JITTER

Use this measurement to view RSSI, BPS and BER of a selected frequency. All address's and their messages (if any) are displayed in this measurement. BER,BPS, and RSSI are updated each time a batch is received. If no POCSAG data is detected on the frequency selected, the RSSI is updated every second and BPS is displayed as'----.-'.

2. MATCH

Same as BER/JITTER but only address's and their messages that match an address in the address table are displayed. RSSI, BPS, BER are updated as in BER/JITTER measurement. Both BER/ JITTER and MATCH save ALL data from all batches captured on the ATA card and via RF DUMP if selected. The data saved is UN-CORRECTED (as received) for later analysis.

3. ENTER CAP CODE/VIEW CAP CODE

Use to enter the POCSAG pager addresses used in MATCH measurement. Enter table # (1-50) and press ENTER. The contents of that table location will be displayed, 0000000 if empty. Enter the new address
and press ENTER. The screen will automatically step to the next table #. Just press enter to skip a table location, press ESC to exit screen.

4. ERASE CAP CODES

Use to clear out all pager addresses in the address table (all
set to 0000000).

5. SELECT FC

Use this function to correctly set the POCSAG Function Code message types for the system being measured. Use the UP ARROW key to select the message type (TONE ONLY, NUMERIC ONLY or ALPHA NUMERIC) associated with each function code (00,01,10 and 11). When all selections have been made, press the ESC key. The settings are saved in battery-backed RAM, so this procedure need only be done when changing to a frequency where the function codes are different.

The default setting as shipped from the factory for the function
codes is as follows:

FCMessage Type

00Alpha-numeric
01Numeric only
10Numeric only
11Alpha-numeric

IF THE FUNCTION CODES ARE NOT SET CORRECTLY for the system under study, the messages displayed on the Fox and PC SCREEN WILL NOT BE CORRECT. If data was saved on the PC with the function codes improperly set on the Fox, use the PC SOFTWARE main menu option O (FC OVERRIDE) to correct. The setting of the function codes DOES NOT EFFECT the data saved on the ATA card or RF DUMP file. It ONLY effects HOW the message data words are interpreted and displayed.

6. SELECT DATA SPEED

Before starting BER/JITER or MATCH measurement, you will be prompted for the POCSAG DATA SPEED (BPS) to save and display. Use the right-left arrow keys to highlight a speed (512,1200 or 2400). Press ENTER to toggle the setting for the highlighted speed. When a check mark is visible next to the highlighted speed, this speed will be saved and displayed. ANY combination of speeds can be selected, but at LEAST one MUST be selected. When the speeds of interest have been selected (check marked), press the ESC key to begin the measurement. (PC SOFTWARE V2.02 and later with POCSAG)

To see the threshold value displayed as a dotted line on the display, press the A key during the measurement. To turn off this display, press the A key again.

The threshold HAS NO EFFECT on the RF DUMP function - all data is sent if RF DUMP is selected ON.

ENTERING THE ONE CHAN THRESHOLD

After entering the # of A/D samples, the following screen is displayed:

ENTER ATA SAVE AND
MUTE-UNMUTE THRESHOLD
ENTER 120 TO TURN OFF

THRESHOLD 120 DBM

Enter the DBM level that will cause data to be saved on the ATA card (if save is ON) and audio UNMUTED. Press ENTER to set 120 DBM, the level at which all data is saved and audio is UNMUTED throughout the measurement.

FOX Troubleshooting

SYMPTOM - After Fox is turned on, the display is blank.

CAUSE - The contrast is out of adjustment or battery is too low (red LED above display is on).

If the battery low led is NOT lit, turn off the FOX then turn back on. Hold down the UP ARROW key until the power up screen becomes visible. Contrast is adjusted in the power up screen using the up/down arrow keys. At all other times, the 4 key can be used to increase (make darker) the contrast, the 5 key can be used to decrease (make lighter) the contrast.

If the battery low led is on, turn off the FOX and charge the battery by plugging the supplied charger into the Fox power connector (below the odometer input). While the battery is charging, the yellow charge LED is fully on or blinking on and off (see operation tips on page 2 for details). When this LED goes out, the battery is fully charged (this will take two hours if the battery was fully depleted). Disconnect the charger and turn the FOX back on.

SYMPTOM - After FOX is turned on, the GPS does not LOCK.

CAUSE - The FOX has been moved more than 50 miles since the GPS was last locked. The greater the distance the FOX was moved, the longer it will take the GPS to re-aquire the satellite information it needs to get a “fix”. If the FOX was moved several hundred miles, this process can take up to 40 minutes. Use the STATUS display to display GPS LOCK status.

Once the lock is re-aquired, the internal GPS unit will remember the local conditions and the next time the lock process will take less than 5 minutes (depending on antenna placement and how far the Fox has been moved since being turned off).

Whenever possible, place the GPS antenna on a metal surface (such as the roof of an auto). For best results, the antenna should be able to "see" a large portion of the sky (not blocked by buildings or trees).

CAUTION: DO NOT turn the GPS power on or off while the FOX main power switch is on. When using the GPS, turn on BEFORE turning on the main power switch.

FOX Supplemental Material

FOX data file structures

NOTE:byte - 8 bit unsigned value
word - 16 bit unsigned value

Common to RF DUMP (serial) and ATA files

Fox type and measurement code:

Each file will contain an 8 bit code that identifies the type of measurement contained in the file and the type of FOX used to make the measurement. Bits 3-0 contain the measurement code as follows:

MEASUREMENT CODES

Value (bit 3-0)	Measurement
1	CO-CHAN
2	ADJ-CHAN
3	1 chan
4	Survey 20 chan
5	Var Sweep
6	1 Mhz sweep
7	POCSAG DATA
8	fast fade

Bits 7-4 (high nibble) contain the Fox Type code. Use this code to determine the channel number to frequency conversion.

Code (hex)	FOX type	Base Freq (MHz)	Step (KHz)
0x10	851-869	851	12.5
0x20	900-930	900	25
0x30	935-941	935	12.5
0x40	928-941	928	12.5
0x50	806-824	806	12.5
0x60	869-893	869	30
0x70	824-848	824	30
0x90	Reserved		
0xa0	928-941/Pocsag 928		12.5
0xb0	145-160	145	10
0xc0	220-222	220	5
0xd0	450-465	450	12.5
0xe0	1850-1890	1850	50
0xf0	1930-1970	1930	50

Freq = (Chan # - 1)*step + base

IS-136 FOX

1. IS-136 Fox DOES NOT support the FAST FADE, LMHZ SWEEP or VAR SWEEP measurements.

2. The IS-136 Fox uses the SAME cable (marked ATA DOWNLOAD) for both downloading the ATA card AND real time RF DUMP serial data logging.

3. IS-136 Fox DOES NOT support auto cal. The units are calibrated at the factory using an HP ESG-D4000A digital signal generator. For this reason, no serial calibrate cables are included with these units.

4. Audio output is not supported.

Battery run time of FOX units with DSP receiver (such as PACS and IS-136) is about one half the standard FOX battery run time (about 2 hours). There is also no battery gauge display, battery low is indicated when the top panel 'low batt' LED lights.

BER TEXT SCREEN on the IS-136 FOX

Highlight 'BER' on the Fox MAIN MENU and press enter, the BER TEXT measurement will begin.

TEXT SCREEN

To the left of the screen is a bar graph of the current signal strength of the measured frequency in dBm. To change the scale, use the 1 and 2 keys.

To the right of the bar graph is the text display of the frequency, current dBm reading and the lowest dBm reading encountered since the the measurement was started. Below this information is a text display of the # of correct bits detected, the BER %, and the # of bits in error. To reset the correct/bits in error count, press the right arrow key.

To change the frequency of measurement, press enter and enter the new frequency. To change the display to the graphic display of BER/dBm, press the 3 key.

BER GRAPH SCREEN on the IS-136 Fox

The BER/dBm graphic screen displays both dBm and BER % on the same graph. The dBm scale Is on the left side of the display, the BER scale is on the right side of the display.

To change the dBm scale, use the 1 and 2 keys.
To the right of the graphic display is the current BER % in text.
Below the graphic display Is the current frequency, current dBm and lowest dBm in text.

To change the frequency of measurement, press enter and enter the new frequency. To change the display to the text display of BER and dBm, press the 3 key.

IS-136 FOX BER MEASUREMENT

The IS-136 receiver uses the IS-136 sync codes to measure BER. When using a BVS IS-136 simulator, the data transmitted must contain at least one sync word in each timeslot for the FOX to be able to measure BER. There is no special requirement when using the FOX with base station signals (since they do contain a sync in each timeslot). The 28 bit sync words checked are as follows:

SYNC1	0A91DE4Ah
SYNC2	0A9D127Ah

SYNC3	0C7E3C0Ch
SYNC4	0342C3F3h
SYNC5	013E23D1h
SYNC6	0DC2EC1Dh

Freq range: 1930.05 - 1989.99
Channel step: 30KHz

Channel numbering:

Chan Number	Frequency (MHz)
1	1930.05
2	1930.08
.	.
1000	1960.02
.	.
.	.
1999	1989.99

BVS Fox Serial Interface – Data Responses

There are no commands to send to the BVS **FOX** receiver. Data is sent to the serial port when logging is turned on and a measurement is in progress.

Speed:38400
Parity: None
Data Bits: 8
Stop Bits: 1

Data for these measurements comes in as records. Each of these records starts off with a header structure with the following components.

HEADER STRUCTURE

# BYTES	DATA
1	Measurement Code*
2	Firmware Version
6	Serial Number
1	Navigation Status**
5	GPS Latitude
5	GPS Longitude
2	Altitude
3	GPS Time
1	Map Scheme (0=marker,odometer, 1=x-y coord)
2	Current mile marker or Y coordinate
2	Current user marker # or X coordinate
2	Low Channel
2	High Channel
2	Base Frequency MHz
2	Base Frequency KHz*10
2	Step in KHz*10
1	Receiver type code
1	Real-Time Seconds
1	Real-Time Minutes
1	Real-Time Hours
1	Real-Time Day
1	Real-Time Month
1	Real-Time Year

1	Number of data records

* - Measurement Types

Co-Channel	1
Adjacent Channel	2
1 Channel	3
20 Channel	4
Variable Sweep	5
1 MHz Sweep	6
POCSAG Data	7
Fast Fade	8
Strongest AB Control	9
CO Control	10
Group	11
Follow	12
BER	13
System	14

** - Navigation Statuses

GPS OK	0x80	
GPS OFF	0x40	
GPS INSTALLED	0x20	
GPS TYPE	0x10	(Set=Motorola,Clear=Trimble)
DIFFERENTIAL LOCK	0x08	
# OF SATELLITES	bits 0-2	

Based on the information from the header structure, N number of data structures appear in the following format:

DATA STRUCTURE

# BYTES	DATA
1	Current RSSI Value
1	Highest RSSI Value
1	Lowest RSSI Value
2	Channel Number

If the Measurement Type is “AMPS”, then the following structure follows:

AMPS STRUCTURE

# BYTES	DATA
1	SAT Value
1	Group
1	Power

If the measurement warrants “POCSAG”, the following structure will come after the data records.

POCSAG STRUCTURE

# BYTES	DATA
2	Data Count
1	Current RSSI
1	Pocsag FC message type
1 Batch Status	
1	Bits per sec
2	Bit error count for this batch
2	Sync WORD

2 Frame 1 WORD 1
2 Frame 1 WORD 2
2 Frame 2 WORD 1
2 Frame 2 WORD 2
2 Frame 3 WORD 1
2 Frame 3 WORD 2
2 Frame 4 WORD 1
2 Frame 4 WORD 2
2 Frame 5 WORD 1
2 Frame 5 WORD 2
2 Frame 6 WORD 1
2 Frame 6 WORD 2
2 Frame 7 WORD 1
2 Frame 7 WORD 2
2 Frame 8 WORD 1
2 Frame 8 WORD 2
2 Channel Number

Binary File Format

The following are the PC save (serial) and PCMCIA structures for the FOX V1.3 firware. The only change from v1.2 is the format of the GPS data and the addition of GPS velocity. Lat and Lon values are now saved as milliarcseconds (32 bit word - 4 bytes).

SERIAL PORT DATA HEADER

```
typedef struct pcs_head
 {
  BYTE pcscod;   /* measurement code */

  WORD pcsfvn;            // Firmware Version #
  char pcssn[6];          // Serial Number

  BYTE pcsnavs;  //* navigation status */
  BYTE gpslat[4];         // Latitude (milliarcseconds)
  BYTE gpslon[4];         // Longitude (milliarcseconds)
  BYTE gpsalt[4];         // Altitude
  BYTE gpsvel[4];         // Velocity (cm/s)
  BYTE gpstim[3];         /* @ gps time */

  BYTE pcsmxy;  /* == 0 means user marker,odometer */
                          /* != 0 means x-y coordinates */

  WORD pcsmm;             /* current mile marker or Y coordinate */
  WORD pcsmrk;            /* current user marker # or X coordinate */

  WORD pcsclo;            // rx info - chan lo
  WORD pcschi;            // chan hi
  WORD pcsfm;             // base freq MHz
  WORD pcsfk;             // base freq KHz*10
  WORD pcsfs;             // step in KHz*10
  BYTE pcsrxt;            // receiver type code --- IGNORE

  BYTE pcssec;   /* real time */
  BYTE pcsmin;
  BYTE pcshr;
  BYTE pcsday;
  BYTE pcsmon;
  BYTE pcsyr;

  BYTE pcsndr;             /* number of data records */
}PCS_HEAD;

/* nav status flags */
#define  GPSOK   0x80                    /* gps ok (locked) */
#define  GPSOFF          0x40            /* gps off */
#define  GPSINST         0x20            /* gps installed */
#define  GPSTYPE         0x10            /* set == MOTOROLA gps installed */
                                 /* clr == TRIMBLE gps installed */
#define  DIFLOCK         0x08            /* set == DIFFERENTIAL LOCK */

/* bits 0-3 == # satellites */

note: ignore gps type, gps installed, diflock (bits 3,4,5)
```

```
        PCMCIA CARD RECORD STRUCTURES

//      PC Card Structures
#define RECT1   0xa1                    /* record type 1 - start measurement */
#define RECT2   0xb2                    /* record type 2 - reserved */
#define RECT3   0xc3                    /* record type 3 - gps la,lo & rssi */
#define RECT4   0xd4                    /* record type 4 - reserved */
#define RECT5   0xe5                    /* record type 5 - end measurement */

/* @ new card records @ */
/* 2-3-95 */
#define RECT3A 0xc4             /* record type 3a - no gps & rssi */
#define RECT3B 0xc5             /* record type 3b - gps la,lo,alt & rssi */
#define RECT3C 0xc6             /* record type 3c - gps la,lo,tim & rssi */
#define RECT3D          0xc7            /* record type 3d - gps la,lo,tim,alt & rssi */


/*      id and memory map record        */
/*      NOTE: int's in this struct are NOT in INTEL format      */
/*      they require BYTE flip                                  */
struct  tc_idrec {

        BYTE tcid[16];          /* id field */
        WORD tcsiz;             /* card size in 'PAGESIZ' pages */
        WORD tcnxtp;            /* next free page */
        WORD tcnxto;            /* next free offset */
        BYTE tcidrsv[8];        /* 8 unused bytes */
        WORD tcibck;            /* id block checksum */
};


/*      PCMCIA record structs                   */
/*      record type 1 - start measurement       */
/*      contains date and channel table         */
typedef struct _tcrec1
 {
        BYTE Day;               /* day                  */
        BYTE Month;             /* month                */
        BYTE Year;              /* year                 */
        BYTE MeasureType;               /* rf measurement type     */
        BYTE PosType;           /* == 0 means user marker,odometer */
                /* != 0 means x-y coordinates */
   WORD ChannelLow;
   WORD ChannelHigh;
   WORD BaseMHz;
   WORD BaseKHz;
   WORD Step;
   BYTE RecType;

   WORD Version;
   BYTE Serial[6];

        BYTE NumChannels;               /* # of channels  */
 }TCREC1;
```

```
/*          record type 2 */
typedef struct _tcrec2
  {
   BYTE Hour;
   BYTE Minute;
   BYTE Second;
   WORD YPos;
   WORD XPos;
  }TCREC2;

/*          record type 3 (rf + gps la,lo)          */
typedef struct _tcrec3
  {
   BYTE Hour;
   BYTE Minute;
   BYTE Second;
   BYTE NumRSSI;            /* # of rssi measurements following */
  }TCREC3;

/*          record type 4 */
typedef struct _tcrec4
  {
   BYTE Hour;
   BYTE Minute;
   BYTE Second;

   BYTE NavStatus;
   BYTE Latitude[5];
   BYTE Longitude[5];
   BYTE Altitude[3];
   BYTE Time[3];
  }TCREC4;

/*          record type 4 (firmware v1.3 or later with Binary GPS... */
typedef struct _tcrec4new
  {
   BYTE Hour;
   BYTE Minute;
   BYTE Second;

   BYTE NavStatus;
   BYTE Latitude[4];        // (milliarcseconds)
   BYTE Longitude[4];       // (milliarcseconds)
   BYTE Altitude[4];
   BYTE Velocity[4];
   BYTE Time[3];
  }TCREC4NEW;

/*          record type 5 (end measurement)   */
typedef struct _tcrec5
  {
   BYTE Hour;
   BYTE Minute;
   BYTE Second;
   WORD YPos;                   /* current mile marker or Y coordinate */
   WORD XPos;                   /* current user marker # or X coordinate */
  }TCREC5;
```

BVS Fox Step-by-Step Data Collection and Conversion

Store Data on PCMCIA card

Choose "SETUP" from Main Menu

Choose "PCMCIA" from Setup Menu

Choose "SAVE ON" from PCMCIA Menu

Return to Main Menu. Select Measurement and begin scanning.

Transfer PCMCIA Data via Serial Port

FOX: Choose "SETUP" from Main Menu.

FOX: Choose "PCMCIA" from Setup Menu

FOX: Choose "DOWNLOAD CARD" from PCMCIA Menu

PC: Start Fox DL.

PC: Choose "Tools/Download Data" from Main Menu.

PC: Select filename and com port, then press the "DOWNLOAD" button.

Transfer PCMCIA Card to PC using a PCMCIA slot.

FOX: Remove PCMCIA card from slot.

PC: Insert card into PCMCIA slot on PC.

PC: If PCMCIA card driver has not been installed, load from Windows 95/98 CD.

PC: PCMCIA card will take up the first available drive letter.

PC: Copy "FOXDATA.BIN" to the PC.

PC: If needed, use BOA.EXE to reduce the filesize for transfer to another PC.

Store Real-Time Data on PC

FOX: Choose "SETUP" from Main Menu

FOX: Choose "RF Dump" from Setup Menu

FOX: Choose "ON" from RF Dump Menu

PC: Start Fox DL

PC: Choose log filename and check the "Enabled" box.

FOX: Return to Main Menu. Select Measurement and begin scanning.

Convert Data Using BVS Chameleon CW. Then Import Converted Data Into Any Post-Processing Application.

Millisecond to Degree Conversion

The primary output message of Oncore receivers is the Position/Status/Data Message (@@Ea). In this message, the latitude and longitude are reported in milliarcseconds. This note describes how to convert milliarcseconds to degrees.

One degree of latitude or longitude has 60 arcminutes, or 3600 arcseconds, or 3,600,000 milliarcseconds.

To convert the positive or negative milliarcseconds to a conventional degrees, minutes, seconds, format follow this procedure:

- **Divide the milliarcsecond value by 3,600,000**
- **The integer portion of the quotient is the degrees**
- **Multiply the remaining decimal fraction of the quotient by 60**
- **The integer portion of the product is the minutes**
- **Multiply the remaining decimal fraction of the product by 60**
- **The integer portion of the product is the seconds**
- **The remaining decimal fraction of the product is the decimal sounds**

CONVERSION EXAMPLE:

Michigan Avenue, Chicago, IL:

Latitude=150748869 mas	**Longitude=-315445441 mas**
150748869/3600000=41.87468583	**-315445441/3600000=-87.62373361**
Degrees=41	**Degrees=-87**
0.87468583*60=52.48114980	**-0.62373361*60=37.42401660**
Minutes=52	**Minutes=37**
0.48114980 * 60=28.868988800	**-0.42401660 * 60=25.44099600**
Seconds=28	**Seconds=25**
Decimal seconds=0.868988	**Decimal seconds=0.440996**
Latitude=41°52'28.869"	**Longitude=87°37'25.441"**

Conversion formula for changing Latitude and Longitude in degrees and decimal minutes for older versions of Fox:

Lat = Deg + (Dec Minutes / 60)

Lon = Deg + (Dec Minutes / 60)

ONCORE INTERNAL GPS RECEIVER

Refer to this text for: interface protocol descriptions

operational modes of your ONCORE receiver

additional customizing ca pabilities/operation

OVERVIEW

The Motorola ONCORE Receiver is an intelligent GPS sensor intended to be used as a component in a precision navigation system. The ONCORE Receiver is capable of providing autonomous position, velocity, and time information over a serial RS232 port. The minimum usable system combines the ONCORE Receiver and an intelligent system controller device.

INTERFACE PROTOCOL

The Motorola ONCORE Receiver is provided with one RS232 serial data port. The port is configured as o t L) ta communications equipment (DCE) port and provides the main control and data path between the ONCORE Receiver and the system controller. The user can customize the 1/0 protocol on the BASIC and XT RS-232 port to be one of three different formats. In order to support differential applications, the Basic and XT ONCORE receivers support various degrees of differential capabilities dependent on the selected protocol. The table below summarizes the built-in DGPS features as a function of the user-selected 1/0 protocol. The VP ONCORE 1/0 port provides a TTL interface.

Available Interface Protocols

FORMAT	TYPE	BAUD	BITS	START	PARITY	FEATURES	DIFFERENTIAL CAPABILITY
Motorola	Binary	9600	8	1/1	no	full control/all data	RTCM SC-104*
NMEA	ASCII	4800	8	1/1	no	partial control selected messages	RTCM SC-10411
LORAN ASCII	1200	8	1/1	no	little control/1 output message	none	

Notes: * RTCM SC-104 decoding of Message Type #1 exists in deoptioned units. It is available to all users at no additional cost.

Once you select a format type, the ONCORE Receiver operates in the selected protocol. The ONCORE Receiver remembers the protocol when the power is removed and initializes itself to the previous state when power is reapplied. You can switch to an alternate 1/0 protocol by issuing the valid Switch Format" input command in the currently selected format. All parameters set in one format are remembered and applied in the alternate format. The 1/0 port operates under interrupt control. Incoming data is stored in a buffer that is serviced by the ONCORE Receiver's operating program. In the Position Fix mode, this buffer is serviced every 1.0 seconds.

Motorola Binary Format

The binary data messages used by the ONCORE Receiver consist of a variable number of binary characters. These binary messages begin with the ASCII @@ characters and are terminated with the ASCII carriage return and line feed <CR><LF>. The first two bytes after the @@ characters are two ASCII message ID bytes that identify the particular structure and format of the remaining binary data. The last three bytes of all messages contain a single byte checksurn (the exclusive-or of all message bytes after the @@ and before the checksum), and a message terminating ASCII carriage return line feed character sequence.

Message Start:

@@ - (two hex 40s) denotes start of binary message.

Message ID:

(AZ)(az, AZ, 09) - ASCII upper-case letter, followed by an ASCII lower-case or upper case letter, or digit. These two characters identify the message type, and implies the correct message length and format.

Binary Data Sequence: Variable number of bytes of binary data dependent on the command type.

Checksum:

C - The exclusive-or of all bytes after the @@ and prior to the checksum.

Message Terminator:

<CR><LF> - carriage return line feed denoting end of the binary message.

Every ONCORE Receiver input command has a corresponding response message so you can verify that the input commands have been accepted or rejected by the ONCORE Receiver. The message format descriptions detail the input command and response message formats. Information contained in the data fields normally is numeric. The interface design assumes that the operator display is under control of an extemal system data processor and that display format and text messages reside in its memory. This approach gives you complete control of display format and language. The ONCORE Receiver reads the input command string on the input buffer once per second. If a full command has been received, then it operates on that command and performs the indicated function. The following logic relates to the i nput character string checks that are performed on the input commands:

A binary message is considered to be received if:

(1) It began with @@ and is terminated with a carriage return and a line feed

(2) The message is the correct length for its type

(3) The checksum validates

You must take care in correctly formatting the input command. Pay particular attention to the number of parameters and their valid range. An invalid message could be interpreted as a valid unintended message. A beginning @@, a valid checksum, a terminating carriage return line feed, the correct message length and valid parameter ranges are the only indicators of a valid input command to the ONCORE Receiver. For multiparameter input commands, the ONCORE Receiver will reject the entire command if one of the input parameters is out of range. Input and output data fields contain binary data that can be interpreted as scaled floating point or integer data. The field width and appropriate scale factors for each parameter are described in the individual 1/0 message format descriptions. Polarity of the data (positive or negative) is described via two's complement presentation.
Once the input command is detected, the ONCORE Receiver validates the message by checking the checksurn byte in the message. Input command messages can be stacked into the ONCORE Receiver input buffer, up to the depth of the message buffer (2048 characters long). The ONCORE Receiver will operate on all full messages received during
the previous 1 second interval and will process them in the order they are received. Every input command has a corresponding output response message. This enables you to verify that the ONCORE Receiver accepted the input com-mand. The ONCORE Receiver response message to properly formatted commands with at least one out-of-range parameter is to return the original nonchanged value of the parameter(s). Input commands may be of the type that change a particular configuration parameter of the ONCORE Receiver. Examples of these input conunand
types include commands to change the initial position, the ONCORE Receiver internal time and date, satellite mask angle, satellite almanac, etc. These input commands, when received by the ONCORE Receiver, change the indicated parameter and result in a response message to show the new value of the particular parameter. If the new value shows no change, then the input command was either formatted improperly, or the parameter Was Out of its valid range.

Input commands may be of the type that enable or disable the output of data or status messages. These output status messages include those that the external controller will use for measuring position, velocity, time, pseudorange, and satellite ephemeris data. Status messages are output at the selected update rate (typically, once per second) for those messages that contain position, velocity, time, or range data, or can be commanded to output the data one time upon request. Those messages that include slowly changing data, such as satellite ephemeris data, satellite visibility tables, xDOP tables, etc., are output once when the ONCORE Receiver detects a change in the data from the previous output data. For example, if the user enables the ONCORE Receiver to output ephemeris data, the ONCORE Receiver will output the ephemeris data once upon receipt of the input command, and then once upon detection of the change of the ephemeris (typically once per hour).

All of the Position/ Status/Da ta message types can be selected independently to be output in a continuous fashion (at the selected update rate), or once each time the data is requested (polled). The rate at which the data is output in the continuous output mode is dependent on the type of data in the message. The Data Message Output Rates table shows the rates at which the data messages are output for each type of message, depending on the setting of the continuous/ one-time option that is part

of the input command.

Data Message Output Rates

OUTPUT MESSAGE TYPE	CONTINUOUS (m=1 255)	ONE TIME (m=0)
Position/Channel Status	At selected update rate	When requested
Satellite Range Data Output	At selected update rate	When requested
Pseudorange Correction Output	At selected update rate	When requested
Ephemeris Data Output	When Eph data changes	When requested
Satellite Broadcast Data Msg	Once every six seconds*	One time**
Visible Satellite Status	When Vis data changes	When requested
DOP Table Status	When DOP data changes	When requested
Almanac Status	When Alm status changes	When requested
Leap Second Pending	When Requested	

*The message is sent 1 second after word 10 of the current subframe is collected.
**One time after the current subframe (word 10) of data has been collected.

For the case where more thin one output message is scheduled during the same I second interval, the GPS Receiver will output all scheduled messages but will attempt to limit the total number of bvtes transmitted each second to 750 bytes. For the case of multiple output messages, if the next message to be sent fits around the 750 byte length goal, then the message will be output. For example, if messages totaling 718 bytes are scheduled to be sent, and the user requests another 58 byte message, then 776 bytes will actually be sent. If the user requests Vet another 86 byte message, then its output will be left pending and will be scheduled when the total number of output bytes allows. The order shown in the Data Message Output Rates table is the priority order for transmitting messages. Below this priority list, the ONCORE Receiver Control Parameters response messages and the Utilities response messages have the lowest priority. You can select each of the output data messages as either one-time output (polled), or output continuously (continuous) at a selected update rate. The polled or continuous option of each output message is remembered during the power-off state in the ONCORE Receiver nonvolatile memory

NOTE: Every change-para meter type" input command has a corresponding response message showing the configuration parameter change. To request the current status of the ONCORE Receiver, enter an input command with at least one out-of-range parameter. The response message to properly formatted commands with outof-range parameters is to output the original unchanged value of the parameter.

The ONCORE Receiver is capable of supporting the following optional capability via the Motorola Binary 1/0 Format. Receivers with no options installed will not respond to, nor create, the following input/output messages listed below. In addition, the 1 PPS hardware output of the receiver 1/0 port is deactivated. You can install these options independently at any time. Contact your Motorola P. N. S. B. customer repersentative for information about option installation.

Options

Option: Thning1l PPS Capability
- Position I lold Position
- Position Hold Enable/Disable
- Measurement Epoch Offset
- 1 PPS Time Offset
- 1 PPS Cable Delay

Option: Real-Time Differential Capability (is now a standard feature)
- Position Hold Position
- Position Hold Enable/Disable
- Output Pseudorange Correction (Master Station)
- Input P-;eudorange Correction (Remote Mobile)

Available Motorola
Options: Satellite Pseudorange/Carrier Phase Data Capability
Satellite Range Data Output Message

There are three components of data in the satellite range data messagv (Carrier Phase Data, Smoothed Satellite Time data, and RAW Code Phaseand Code Discriminator Data) shown in the following table.

Three Components of Satellite Range Data Message

DATA CONTAINED IN SAT RANGE MSG	OPTION	OPTION	OPTION
Raw Code Phase & Disc Data	yes	yes	yes
Smooth Sat Time Data	yes	yes	yes
Carrier Phase Data	yes	no	no

The same format for the satellite range data message applies to all three options. The data fields that are not available in the Options are zero filled.

Input/Output Processing Time

The receiver operates in two modes: idle and position fix. When the receiver is in the idle mode, no satellites are being tracked, and only the last known receiver position is available. When the receiver is in the position fix mode, satellites are being tracked, and the current receiver position is available. In the idle mode, the receiver processes input buffer data as soon as a full command has been detected. In the position fix mode, the input buffer data is serviced once a second.

The message response time will be the time from the transmission of the first byte of input data to the transmission of the last byte of output data. For the idle mode, assuming 1 ms per transmission of a data byte, and assuming 50 ms command processing, the best case and worst case scenarios follow.

Best Case (Idle): Delete all waypoints

Thci= shortest command input + command processing +
shortest command output

= 7ms + 50 ms + 7 ms

= 64 ms

Worst Case (Idle): Output route

Twci= longest command input + command processing + longest command output

= 21 ms + 50 ms + 377 ms

= 448 ms

Input/Output Processing Time(Cont) In the position fix mode, the command processing time will be skewed since the time will be dependent on when the input message buffer is processed. For best case processing, the input command would have to arrive just before the input buffer data is processed, and the output response would have to be the first (or oniv) receiver output. For worst case processing, the input command would have to arrive just after the input buffer data had been processed, and the output response would have to be the last receiver output. Assuming 1 ms per transmission of a data byte, assuming 50 ms command processing, and assuming a uniform distribution for time of input command data entry, the best case, typical case, and worst case scenarios are shown below.

Best Case (Position Fix): Delete all waypoints

Tbcf= shortest command input + command processing +
shortest command output
= 7 ms + 50 ms + 7 ms
= 64 ms

Typical Case (Position Fix): Any command

Ttcf= input anywhere across one second period
+ command processing + output anywhere across
one second period following command processing
= 0.5 s + 0.05s + 0.475 s
= 1.025s

Worst Case (Position Fix): Any command

Twcf= input beginning of one second period + output end
of one second period
= 1 s + 1 s
= 2s

NMEA-0183 Format Description

Output of data in NMEA-0183 standard format allows interface via the RS232 port to an electronic navigation instrument that supports the specific messages that are transmitted. The ONCORE Receiver will support the following NMEA output messages per the NMEA-0183 Revision 2.0
Specification:

GPGGA	CPS Fix Data
GPGLL	Geographic Position - Latitude/ Longitude
GPGSA	GPS DOP and Active Satellites
GPGSV	GPS Satellites in View
GPRMC	Recommended Minimum Specific GPS/ TRANSIT Data
GPVTG	Track Made Good and Ground Speed
GPZDA	Time and Date

You can enable or disable each message output independently and control the update rate at which the information is output. Once enabled to output a particular message at a pirticular rate, the GI'S Receiver remembers the settings when powered off and reconfigures itself to the same state when powered up again. All NMEA messages are formatted in sentences that begin with ASCII $ (hex 24) and end with ASCII <CR><[.F> (hex OD and hex OA). A five-character address occurs after the ASCII $. The first two characters are the talker ID (which is GP for GPS equipment), and the last three characters are the sentence formatter or message ID from the table above. Any number of fields and an optional checksum can occur in the sentence as long as the total number of characters does not exceed 79. Fields within the message are delimited by the ASCII comma. The checksum is calculated by XORing the 8 data bits of each character in the sentence between, but excluding, the $ and the optional (*) or (CS) checksum. The high and low nibbles of the checksum byte are sent as ASCII characters. You control the output of the above listed messages with Motorola NMEA format messages. Input messages are allowed in the NMEA specification, and take the form $PMOTG *CS<CR><LF>. All input parameters are separated with comma delimiters. The P character identifies the message as Proprietary format, and the MOT is the manufacturer designator for Motorola Inc.

For the case where more than one output message is scheduled during the same 1 second interval, the GPS Receiver will output all scheduled messages but will attempt to limit the number of bytes transmitted each second to 375 bytes. For the case of multiple output messages, if the next message to be,sent fits around the 375 byte length goal, then the message will be output. For example, if messages totaling 334 bytes are scheduled to be sent, and the user requests another 80 byte message, then 414 bytes will actuafly be sent. If the user requests yet another 70 byte message, then its output will not be generated. The order for priority for transmitting messages is simply alphabetical.

LORAN Emulation Format Description

This particular Output message format is intended to emulate the position status message string from a LORAN receiver. This allows you to use the GPS receiver to replace the LORAN receiver in embedded positioning system applications. You can request the LORAN position status message string to be output at any update rate (from 1 second to 1 hour in 1 second increments) and can operate it in a polled mode where the host can request the receiver to output the position status message upon request. The selected rate of the output message is remembered between power on-off-on sequences.

Fox 40 Lambda Averaging in Chameleon CW

Introduction

In some instances it is desirable to reduce the effect of fading in the analysis of transmitted signal propagation. The 40 Lambda averaging technique is a known scheme for accomplishing this goal.

Berkeley Varitronics Systems, Inc. has support for this type of averaging in "Chameleon CW", the universal data conversion tool, starting with version 1.53. This tool converts data that has been collected using Berkeley's CW line of receiver equipment.

Background

It has been concluded that the sampling rate needed to suppress the Rayleigh fading of a propagated signal is:
36-50 samples/ 40 wavelengths

An explanation of this theory can be found in the book titled "Mobile Cellular Telecommunications Systems" by William C. Y. Lee. Therefore, assuming that the sampling rate of the receiving equipment is greater than the number of samples required by the 40 Lambda theory, the samples maybe reduced to the needed number of samples per second through averaging.

Example: Signal frequency = 800MHz.
Drive-study speed = 100KM/H.
l = Wavelength of signal
v = Velocity of signal
f = frequency of signal

Therefore, l=v/f. l=(300000000m/s)/(800000000/s).

l = .375 meters

Now,we will take 40 samples per 40 wavelengths. Therefore, we need the time duration for 1 wavelength.

T = time duration to drive 1 wavelength.
V = Velocity of vehicle.

V = (100km/h)(1000m/km)/(3600s/h) = 27.78 m/s
T = (l) / V = (.375m) / (27.78m/s)
T = .0135 seconds

S = Sampling rate needed.

S = 1 / .0135 s = 74.08 samples / second

Chameleon CW 40 Lambda Conversion

The BVS Chameleon CW data conversion tool has an option for averaging based on the 40 Lambda theory. This option is available for data collected via the BVS Fox Signal Strength Meter.

In the FAST mode of each piece of equipment, 512 samples per second are taken. The BVS Chameleon CW then reduces this data to the appropriate amount of samples required by the 40 Lambda criteria. The user only has to input the average drive speed of the vehicle.

FOX FAST FADE QUICK START

1) Select the PC serial port that the FOX is connected to using the dialog provided when the application is started.

2) Turn ON RF DUMP in the FOX setup menu.

3) Start a FAST FADE measurement from the FOX main menu using 4 A to D samples.

4) Data should appear on the application screen within 1 second of starting the measurement.

MAIN MENU SELECTIONS

Save File - Select the name of the file for data to be saved in. If the file selected already exists, data will be appended to the end.

Convert-Replay File - Select the name of the file to be replayed and converted to ASCII.

Lat-Lon Plot - To plot a FOX fast fade data file dBm map.

Conversion Options - Use to select the data filtering used when converting fast fade data files to ASCII or when displaying a LAT-LON map.

Help - To view this screen, click OK to return.

About - View information about this application. If the application has been used in the current session to display real time or replay data, information about the FOX is also displayed.

REPLAY A DATA FILE

Select EITHER Excel or MapInfo format, and select the data file to be replayed.

When prompted for an ASCII conversion file name, click CANCEL.

CONVERT A DATA FILE TO ASCII

1) Select the conversion option required.

2) Select the output format required (Excel or MapInfo).

3) Select the data file to be converted.

4) Provide a name for the ASCII data file and click SAVE.

NOTE: Do not provide file name extensions to the ascii conversion file. Excel files are given the extension ".xl", Mapinfo files are given the extension ".txt".

PLOT A DATA FILE

1) Select the conversion option required.

2) Select the data file to be converted.

3) The file is scanned to determine LAT-LON range.

4) Map is displayed.

BUTTONS AND CONTROLS

Display RSSI check BOX - when checked, the fast fade rssi is not plotted on the screen. Check if it is not required to view RSSI while converting a file to ASCII as this will speed the conversion.

SAVE ON - Start saving fast fade data to the file selected via the menu Save File option. File status is displayed on the lower left side of the screen. Has no effect during replay and conversion.

SAVE OFF - Stop saving data to the selected file. To continue saving, click the SAVE ON button. Has no effect during replay and conversion.

PAUSE - Pause saving data to the current save file, click pause again to resume saving data. Use this button to pause conversion or replay.

CANCEL - Stop ASCII conversion or replay.

CONVERSION OPTIONS

Distance Average - When selected, fast fade data is averaged until the entered distance has been traveled. At this point, 1 dBm value is computed that is the average of all points between this distance.

Enter the distance in either miles or kilometers. Any sample BELOW the dBm threshold entered is ignored (NOT included in the average). Use the threshold in situations where the signal being measured is not continous such as paging channels.

All Data - No averaging is done when converting to ASCII or plotting a map.

ASCII files created this way contain all 64 dBm values from each measurement.

Waveform Averaging - TBD

ASCII OUTPUT FORMAT

EXCEL TAB DELIMITED

Column	Data
1	Record Number
2	Real Time Clock
3	Date
4	Marker
5	Odometer
6	Fast Fade Code “FF”
7	GPS Status - “OK” if locked, “W” if not locked
8	Latitude
9	Longitude
10	Frequency
11	dBm
12	MPH

MAPINFO TAB DELIMITED

Column	Data
1	Longitude
2	Latitude
3	Frequency
4	dBm
5	MPH

Sending Remote Key Command to the FOX:

Set the PC serial port connected to the FOX as follows:

1) Baud Rate to 38.4K
2) 8 bit data
3) NO Parity
4) 1 Stop Bit

Send the following command string to the FOX to cause a key press:

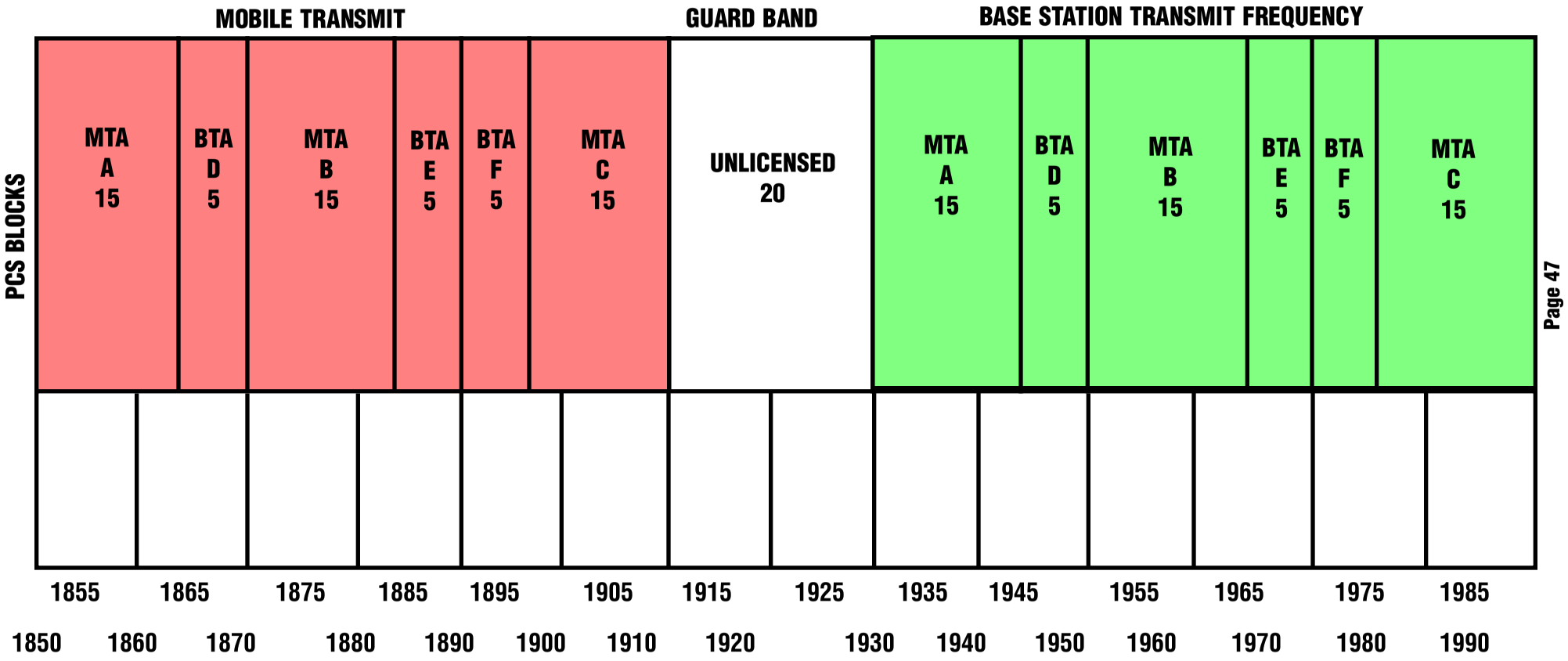
			Value (decimal)	Hex
1) Trigger byte		170	AA	
2) Number of bytes to follow trigger	2	02		
3) Remote key command		3	03	
4) Ascii Key Value		'X'	XX	

Ascii Key Value	Value (Hex)	FOX Key Pressed
'1'	31	1
'4'	34	4
'7'	37	7
'X'	58	ESC
'2'	32	2
'5'	35	5
'8'	38	8
'0'	30	0
'3'	33	3
'6'	36	6
'9'	39	9
'E'	45	Enter
'A'	41	Peak Hold
'B'	42	Best/Scan
'S'	53	Shift
'M'	4D	Marker
'U'	55	Up arrow
'L'	4C	Left arrow
'R'	52	Right arrow
'D'	44	Down arrow

Please note that the FOX DOES NOT respond to the remote key command. Add enough delay after the command for the FOX to execute the requested key press. If a measurement is started and the FOX 'RF DUMP' is on, measurement data will begin to be sent from the FOX serial port. If the PCMCIA save is on, measurement data will begin to be saved to the card.

AC	Alternating Current
A/D	Analog to Digital converter
AGC	Automatic Gain Control
Applet	a small application
BER	Bit Error Rate
BPSK	Binary Phase Shift Keying
BW	Band Width
CDMA	Code Division Multiple Access (spread spectrum modulation)
DC	Direct Current
D/A	Digital to Analog
dB	decibel
dBm	decibels referenced to 1 milliwatt
DOS	Digital Operating System
DSP	Digital Signal Processing
FIR	Finite Impulse Response
GHz	GigaHertz
GPS	Global Positioning System (satellite based)
GPS diff.	GPS error correction signal which enhances GPS accuracy
IF	intermediate frequency
I and Q	In phase and Quadrature
kHz	kiloHertz
LCD	Liquid Crystal Display
LO	Local Oscillator
Mbits	Megabits
MHz	MegaHertz
modem	modulator/demodulator
PC	Personal Computer
PCS	Personal Communications Service (1.8 to 2.1 GHz frequency band)
PN	Pseudo Noise
QPSK	Quaternary Phase Shift Keying, 4-level PSK
RF	Radio Frequency
RSSI	Receiver Signal Strength Indicator
UCT	Universal Coordinated Time
VAC	Volts Alternating Current
VGA	Video graphic

PCS ALLOCATION TABLE



GPS-MM Active Mobile (Magnetic Mount) GPS Antenna

General Description:

The GPS-MM is a high performance GPS patch antenna combing a state-of-the-art low noise amplifier with a low profile, compact, fully waterproof enclosure. When connected to a GPS receiver with 3-5 VDC antenna power, the GPS-MM provides excellent signal amplification in addition to out-of-band filtering & rejection.

This data sheet specifies the basic operational characteristics of the active GPS antenna module GPS-MM under a standard test condition of 3V DC at 25°C and 50% relative humidity.

Specifications:

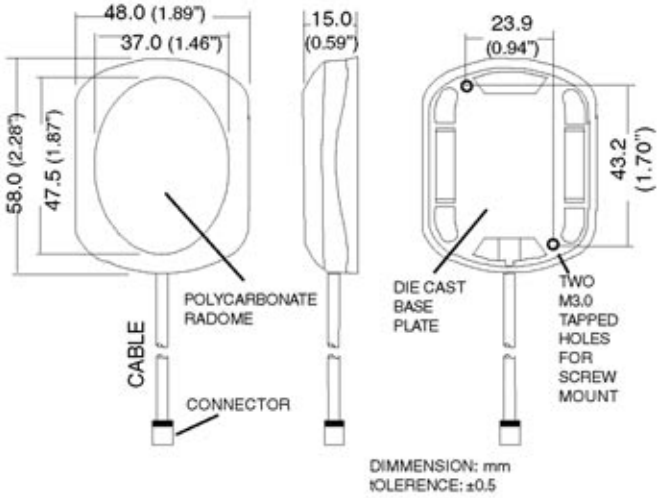
PHYSICAL	
Construction:	Dark gray Polycarbonate-radome at top, die-cast shell at bottom/ rubber gasket for water seal in between
Dimension:	58mm (L) x 48mm (W) x 14mm (H)
Weight:	65 grams (excluding cable & connector)
Standard Mounting:	Magnet mount with two magnets
ANTENNA ELEMENT	
Center Frequency:	1575.42 MHz +/- 1.023 MHz
Polarization:	R.H.C.P. (Right Hand Circular Polarization)
Absolute Gain at Zenith:	+5 dBi typically
Gain at 10o Elevation:	-1 dBi typically
Axial Ratio:	3 dB max.
Output VSWR:	1.5 max.
Output Impedance:	50 ohm
OVERALL PERFORMANCE (Antenna Element, LNA & Cable)	
Center Frequency:	1575.42 MHz
Gain:	25 dB min.
Noise Figure:	2.6 max.
Band Width:	2 MHz
Axial Ratio:	3 dB max.
VSWR:	2.0 max
Output Impedance:	50 ohm

Specifications (Continued):

LOW NOISE AMPLIFIER	
Center Frequency:	1575.42 MHz ±1.023 MHz
Gain:	25 dB typically
Band Width:	2 MHz min.
Noise Figure:	2.6 max.
Out Band Attenuation:	12dB min. @F0 ±140MHz
Supply Voltage:	3.0~5.0V DC
Current Consumption:	12 mA +/- 2 mA
VSWR:	2.0 max.
Output Impedance:	50 ohm

ENVIRONMENTAL	
Operating Temperature	-30oC~+85oC
Storage Temperature:	-40oC~+90oC
Relative Humidity:	95% non-condensing
Waterproof:	100% waterproof

Dimensional Drawing:



Ordering Information:

Model Number	Part Number
BVS-MM	10001268 with 5 m cable & R/A MMCX Plug
BVS-MMB	10001273 with 5 m cable & ST BNC Plug

IMPORTANT SAFETY INSTRUCTIONS

When using your telephone equipment, basic safety precautions should always be followed to reduce the risk of fire, electric shock and injury to persons, including the following:

1)Read and understand all instructions.

2)Follow all warnings and instructions marked on the product.

3)Unplug this product from the wall outlet before cleaning. Do not use liquid cleaners or aerosol cleaners. Use a damp cloth for cleaning.

4)Do not use this product near water, for example, near a bath tub, wash bowl, kitchen sink, or laundry tub, in a wet basement, or near a swimming pool.

5)Do not place this product on an unstable cart, stand, or table. The product may fall, causing serious damage to the product.

6)Slots and openings in the cabinet and the back or bottom are provided for ventilation, to protect it from overheating these openings must not be blocked or covered The openings should never be blocked by placing the product on the bed, sofa, rug or other similar surface. This product should never be placed near or over a radiator or heat register. This product should not be placed in a built-in installation unless proper ventilation is provided.

7) This product should be operated only from the type of power source indicated on the appliance. If you are not sure of the type of power supply to your home, consult your dealer or local power company.

8)Do not allow anything to rest on the power cord. Do not locate this product where the cord will be abused by persons walking on it.

9)Do not overload wall outlets and extension cords as this can result in the risk of fire or electric shock.

10)Never push objects of any kind into this product through cabinet slots as they may touch dangerous voltage points or short out parts that could result in a risk of fire or electric shock. Never spill liquid of any kind on the product.

11) To reduce the risk of electric shock, do not disassemble this product, but take it to a qualified service facil4 when some service or repair work is required. Opening or removing covers may expose you to dangerous voltages or other risks. Incorrect reassembly can cause electric shock when the appliance is subsequently used.

12)Unplug this product from the wall outlet and refer servicing to qualified service personnel under the following conditions:

A) When the power supply cord or plug is damaged or frayed. B) If liquid has been spilled into the product.

C)If the product has been exposed to rain or water.

D) If the product does not operate normally by following the operating instructions. Adjust only those controls, that are covered by the operating instructions because improper adjustment of other controls may result in damage and will often require extensive work by a qualified technician to restore the product to normal operation.

E) If the product has been dropped or the cabinet has been damaged. F) If the product exhibits a distinct change in performance.

13)Avoid using the product during an electrical storm. There may be a remote risk of electric shock from lightning.

14)Do not use the telephone to report a gas leak in the vicinity of the leak.

INSTALLATION INSTRUCTIONS

1. Never install telephone wiring during a lightning storm.

2. Never install telephone jacks in wet locations unless the jack is specifically designed for wet locations.

3. Never touch uninsulated telephone wires or terminals unless the telephone line has been disconnected at the network interface.

4. Use caution when installing or modifying telephone lines.

INSTRUCTION FOR BATTERIES

CAUTION: To Reduce the Risk of Fire or Injury to Persons, Read and Follow these Instructions:

1. Use only the type and size of batteries mentioned in owner's manual.

2. Do not dispose of the batteries in a fire. The cells may explode. Check with local codes for possible special disposal instructions.

3. Do not open or mutilate the batteries. Released electrolyte is corrosive and may cause damage to the eyes or skin. It may be toxic if swallowed.

4. Exercise care in handling batteries in order not to short the battery with conducting materials such as rings, bracelets, and keys. The battery or conductor may overheat and cause burns.

5. Do not attempt to recharge the batteries provided with or identified for use with this product. The batteries may leak corrosive electrolyte or explode.

6. Do not attempt to rejuvenate the batteries provided with or identified for use with this product by heating them. Sudden release of the battery electrolyte may occur causing burns or irritation to eyes or skin.

7. When replacing batteries, all batteries should be replaced at the same time. Mixing fresh and discharged batteries could increase internal cell pressure and rupture the discharged batteries. (Applies to products employing more than one separately replaceable primary battery.)

8. When inserting batteries into this product, the proper polarity or direction must be observed. Reverse insertion of batteries can cause charging, and that may result in leakage or explosion. (Applies to product employing more than one separately replaceable primary battery.)

9. Remove the batteries from this product if the product will not be used for a long period of time (several months or more) since during this time the battery could leak in the product.

10. Discard "dead" batteries as soon as possible since "dead" batteries are more likely to leak in a product.

11. Do not store this product, or the batteries provided with or identified for use with this product, in high-temperature areas. Batteries that are stored in a freezer or refrigerator for the purpose of extending shelf life should be protected from condensation during storage and defrosting. Batteries should be stabilized at room temperature prior to use after cold storage.

The Fox

RUGGED SIGNAL STRENGTH METER

This compact 5 pound hand-held, battery-powered meter is packed with exceptional capabilities. Select from models covering a wide range of frequencies.

FEATURES:

- High measurement rate, more than twice that of Dr. Lee's recommended 40 λ
- Internal eight channel differential Global Positioning System (GPS)
- Fast charge circuit (<2 hours)
- PCMCIA memory system for post processing data
- Capability to input X/Y coordinates from a floor plan
- Odometer input for correlation to distance during drive-around studies
- Weighs 5 pounds
- Optional dead reckoning available

The Fox is designed to measure RF propagation coverage and detect "RF Shadows". It is internally powered (or may be externally) and logs text measurements, or displays graphically a wide assortment of built-in real-time macro measurements. These include "follow mode", C/I, RSSI, adjacent channel, "best server", peak hold, A-band or B-band scan and BER analysis.

POST-PROCESSING

Data from The Fox Meter measurements are saved to a 2 Mbyte PCMCIA flash card and to an RS-232 serial port for direct storage to a PC (up to 38K baud, selectable).

Serial output may be binary (compressed) or in an ASCII comma delimited format.

The Fox data can be imported directly into third party software including:

- dB Planner from MapInfo
- Microsoft Excel
- TEC's Wizard
- MSI Planet

Or customize for any other post-processing application via Chameleon™, a Windows™ transfer program (included).

Available Frequencies:

PCS ■ Cellular ■ LMR ■ IVDS ■ SMR
AMPS ■ ETACS ■ PACS ■ Paging

The Fox is housed in a durable case with carry handle and removable cover. This rugged case provides protection in any weather.

Available from stock.

The Fox is just one of many exceptional design solutions from Berkeley Varitronics. Call us today for more information:

(732) 548-3737 / Fax: (732) 548-3404
Internet: www.bvsystems.com
E-mail: info@bvsystems.com

BERKELEY VARITRONICS SYSTEMS

The Fox SIGNAL STRENGTH METER

MODEL 18000 SPECIFICATIONS

DISPLAY	240 X 64 pixel Graphic Backlighted Electro-luminescence LCD (Super Twist)	
TUNING RANGE	20-40 MHz tuning range of band	
BANDS SUPPORTED	ISM:	2.400-2.485 GHz 900-930 MHz
	PCS:	Uplink (Blocks A through F) 1850-1910 MHz Downlink (Blocks A through F) 1930-1995 MHz
	LMR:	805-825 MHz
	IDEN/SMR:	850-870 MHZ
	Cellular:	824-848 MHz 868-896 MHz
	ETACS:	872-905 MHz 915-950 MHz
	Paging:	145-165 MHz 450-465 MHz 928-941 MHz
	IVDS:	218-219 MHz
	WCS:	2.30-2.36 GHz
SENSITIVITY	-118 to -30 dB ± 1 dB (@ 10 kHz IF Bandwidth)	
Adj. Chan. Rejection:	> 50 dB @ 30 kHz	
RSSI MEASUREMENTS	msec/chan	chan/sec
RSSI Measurement:	15	50
Fast Scan (Scan RX Band):	15	66
GENERAL SPECIFICATIONS		
Dual Conversion:	83 MHz first IF, 455 kHz second IF	
IF Bandwidth:	4 kHz, 10 kHz, 25 kHz or 30 kHz available (@ 5dB)	
Stability:	± 2.5 PPM from freezing to 120°F	
Phase Noise:	> 80 DBC @ 1 kHz	
Antenna:	TNC 50 ohms	
Controls:	20 button keypad	
Warm Up Time:	< 3 minutes	
Power:	(1) Internal 12 Volt Ni-Cad batteries 1.8 A.H. Internal battery run time > 8 hours	
	(2) External car cigarette lighter 12-16 VDC @ 200 mA	
	(3) External DC transformer 16V @ 500 mA, 120 or 240 VAC auto switching	
Serial Port:	RS232, 9600 baud, 8 bit. no parity, 1 stop bit	
Weight:	5 lbs.	
Dimensions:	3.5" H x 6" W x 7.75" L	
Approvals:	UL, CSA	
INCLUDES		
Antenna:	Right angle TNC (50 ohms)	
Case:	Water resistant, high impact ABS plastic	
Car Lighter Adapter:	12-16 VDC @ 200 mA to 400 mA	
Charger:	Battery charger with fast charge circuit (< 2 hours full charge)	
PC Software:	3-1/2" diskette, Windows '95 or '98 compatible	
GPS:	Internal 8 Channel Differential GPS Navigation with active antenna	
PCMCIA:	Mass (non-volatile) storage flash cards	
OPTIONS		
IF Bandwidth:	4 KHz, 10 KHz, 25 KHz, 30 KHz	
BER Demodulation:	Bit, byte, packet and burst error counts (certain models only)	

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