The Fox

FLEX/POCSAG

manual version 4.0

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 the 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 fol lowing 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) 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 down load 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 down-load 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 automatically 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

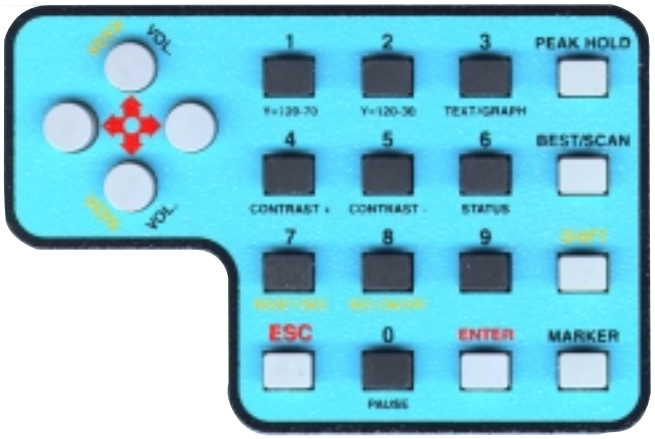
- Internal differential GPS 8 channel receiver uses an active antenna, which can magnetically attach to the roof of a vehicle

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).

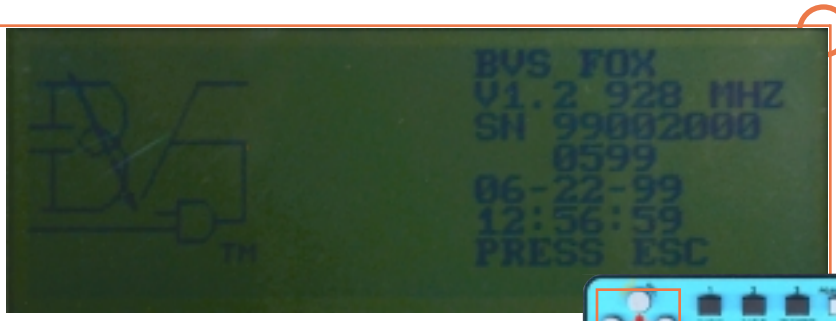
This input will both charge the internal NiCad battery and run the unit regardless of the initial state of the internal battery. The rate of charging is about 10 times faster with the unit off.

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

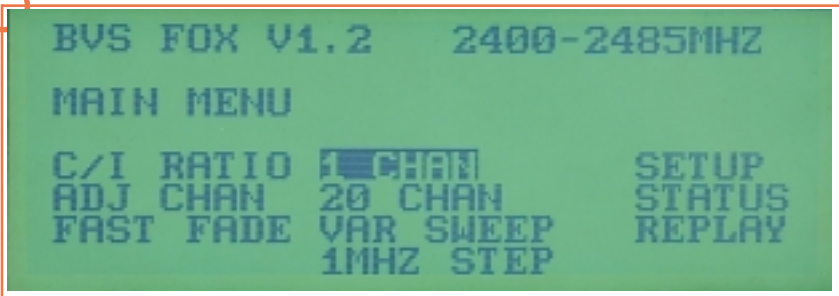
Use this switch to turn on or off the internal GPS sensor. Running the unit with this switch in the OFF position doubles battery run-time. It is recommended that if LAT/ LON positions are not required, the GPS switch should be left in the OFF position.

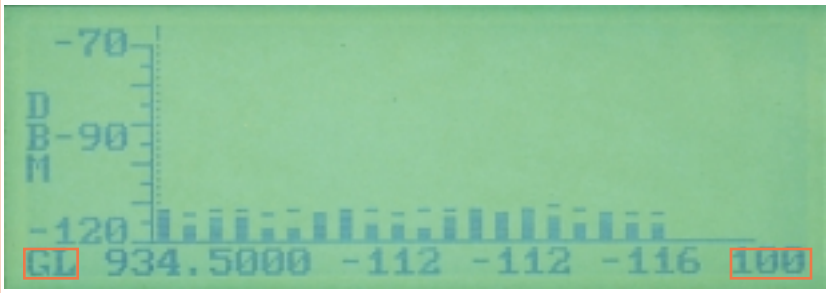
FOX POWER-UP SCREEN



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





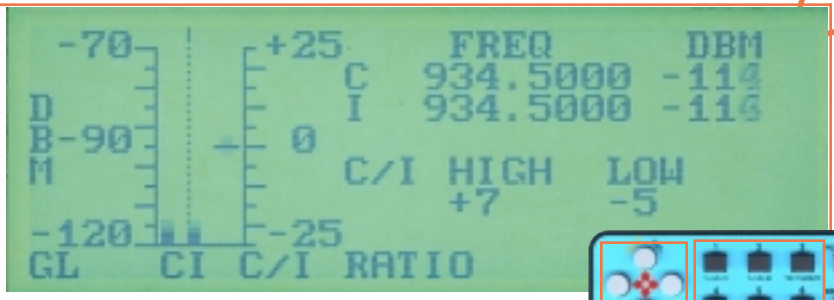
MAIN MENU

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.

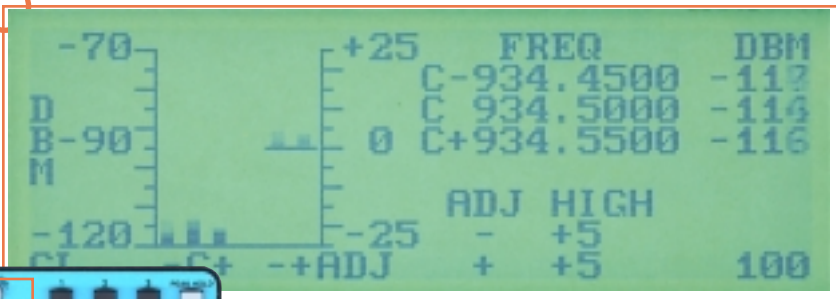
C/I RATIO

C / I RATIO



This measurement is used to compare (**C**arrier / **I**nterferer) 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.

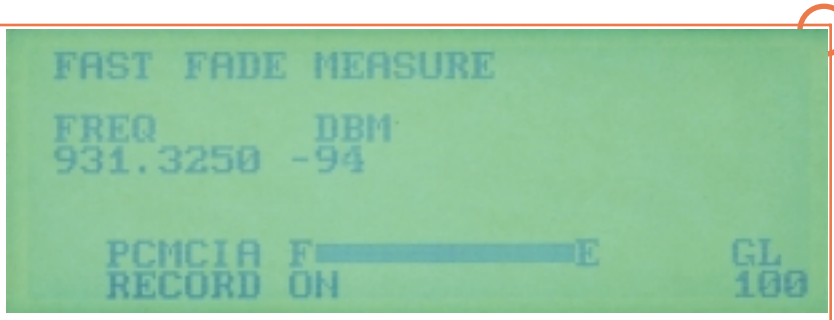
The C/I RATIO screen displays in both text and as a bar graph, the dBm level of both the "C" and "I" frequency. The compare value in dBm of I-C is also displayed. If C > 1, this compare value (in dBm) is plus (+). If I > C, the compare value is negative



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

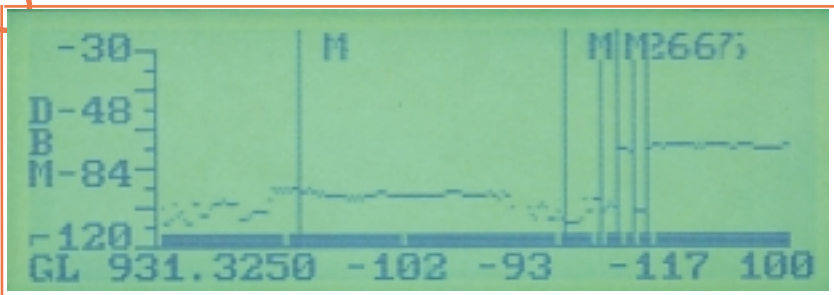
One CHAN (ATA Save On, RF Dump Off) (Times include display and PCMCIA save overhead)

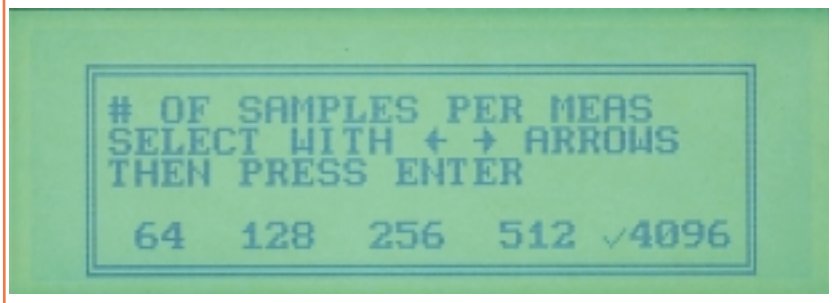
# A/D samples selected	Time (msec) per measurement	# measurements/sec saved (a single 8 bit value/measurement)
64	60	17
128	70	14
256	90	11
512	140	7
4096	800	1

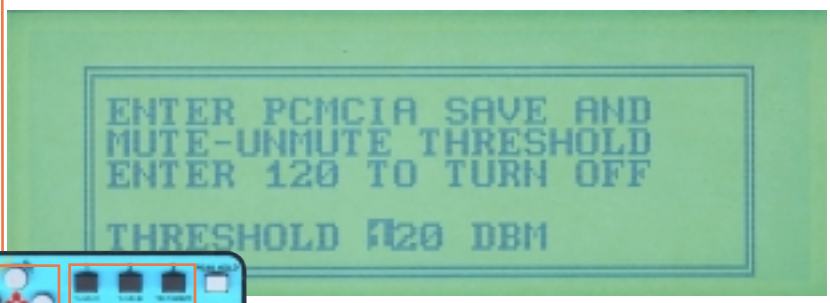
# A/D samples selected	Storage Time in minutes 2 Meg PCMCIA card (saving GPS LAT and LON, 24 bytes of data saved per measurement)
64	85
128	104
256	132
512	208
4096	1456

This feature is only available for the following measurements:

20 CHAN, VAR SWEEP, 1 MHZ SWEEP







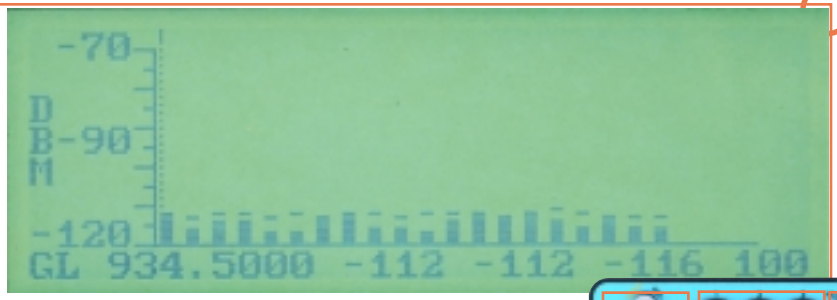
1 CHANNEL MEASUREMENT

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.

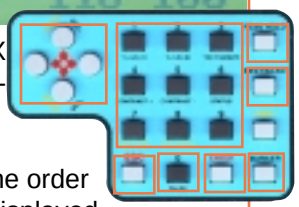
NOTE: If the PCMCIA save is turned OFF in the PCMCIA setup menu, the threshold will be used only to MUTE-UNMUTE the audio. When save is turned ON, the only data records saved on the card will be measurements where the measured dBm values are greater than or equal to the threshold. The start and end records 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.



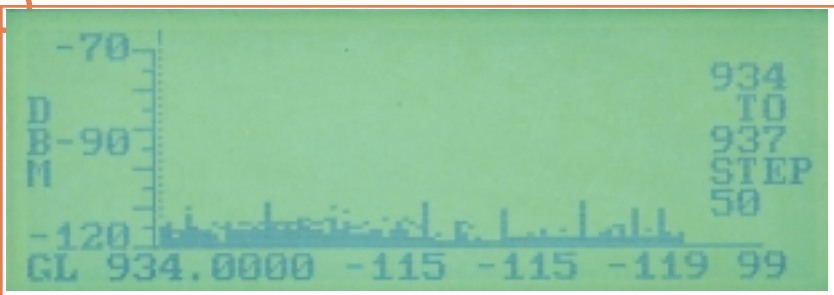
When using the bar graph screen, all 20 selected frequencies are displayed along the X axis in the order that they were entered. In addition, the frequency 'marked' by the vertical dotted line cursor is displayed in text below the X axis. This cursor can be moved by either left or right arrow keys. Data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

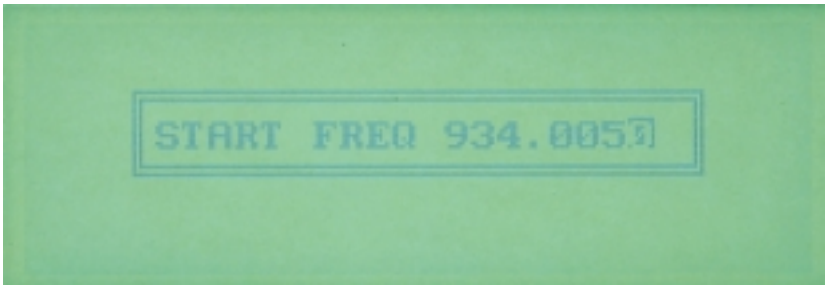
When in the text screen, the strongest 7 frequencies are displayed with the strongest on the top of the display, weakest on the bottom.

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.

VAR SWEEP

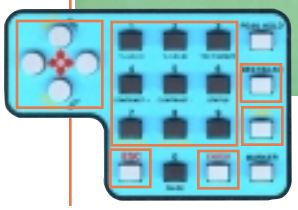




VARIABLE SWEEP

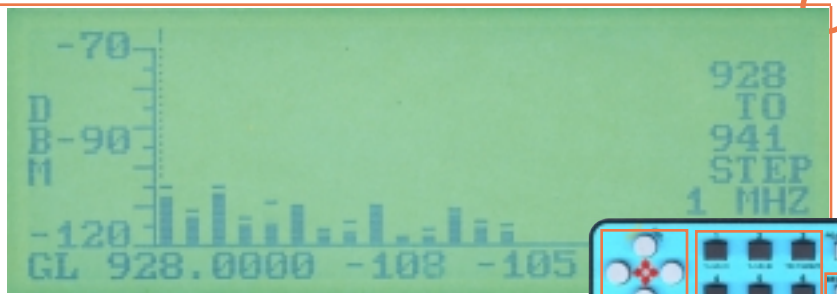
Use this measurement to display a selected portion of the frequency band. Enter the start frequency of the sweep, the end is automatically calculated based on the frequency step. The frequency step can be adjusted during the measurement using the UP and DOWN ARROW keys. The current sweep start, end and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

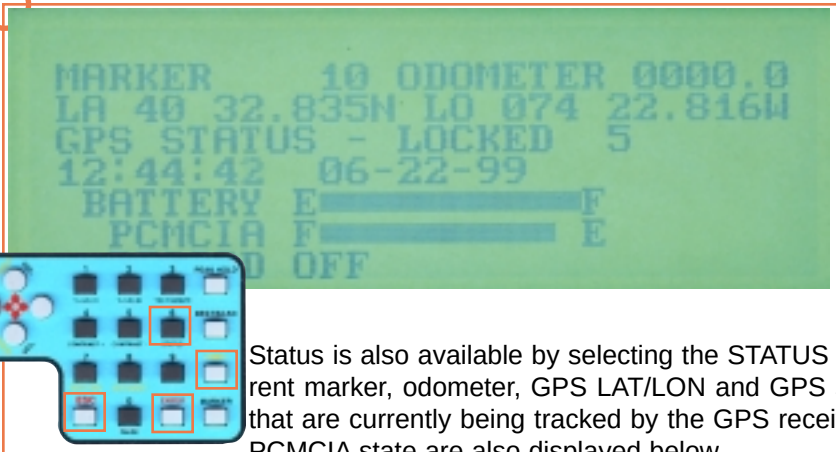


1MHZ STEP

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

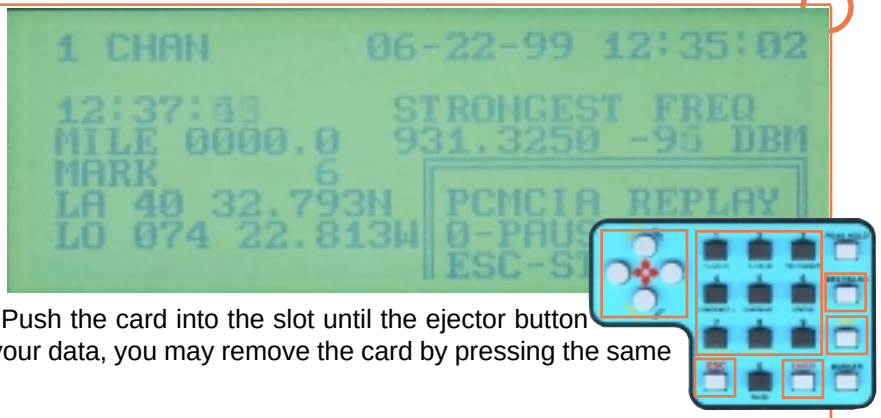
Use this screen to monitor unit status during measurement by pressing the 6 key. The measurement continues while the status is displayed (but is invisible). To restore measurement display, press 6 key again. While status is displayed during measurement, all keys but ESC and 6 are ignored.

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.

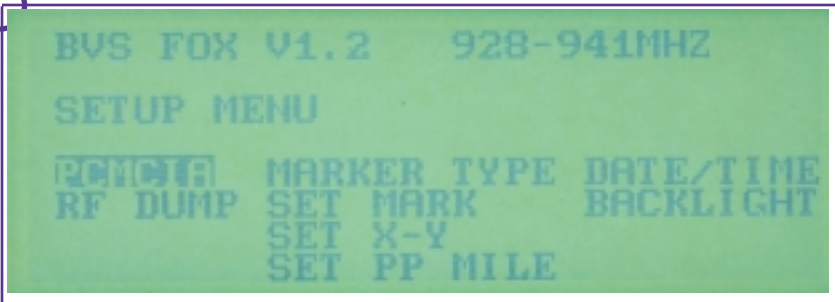
2 Time and strongest frequency (in dBm) found during measurement.

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.

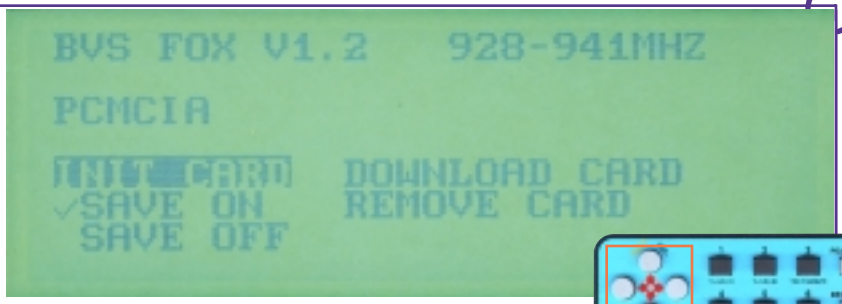
During card replay, press 0 KEY to pause the display. Press the ESC key to stop the replay.



SETUP MENU

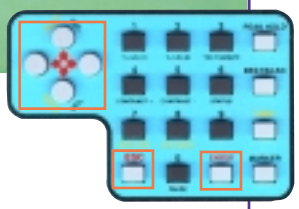
The SETUP MENU can be reached from the MAIN MENU and should be accessed before you begin to receive signals on your **FOX**. You can re-enter the MAIN MENU at any time from the SETUP MENU by pressing ESC. Use the 4 ARROW keys to navigate through this menu and press ENTER to choose a highlighted selection.

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.

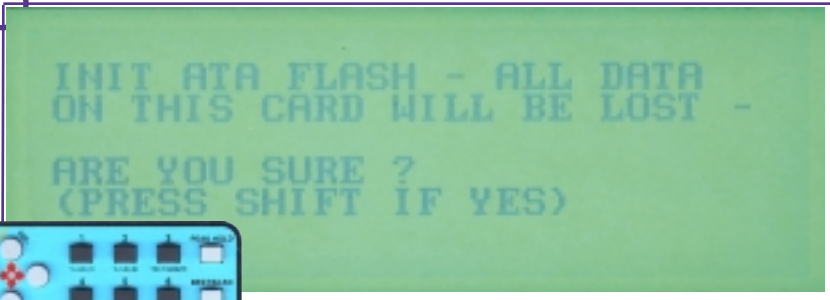
If the PCMCIA SAVE ON option is checked ON, the key sequence SHIFT+8 can be used during any measurement to toggle the PCMCIA save on and off. The status of PCMCIA save can be determined by looking at the lower right hand corner of the measurement display as follows:

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).

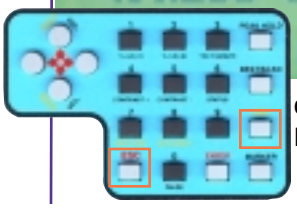
3) *OFF is displayed.* This indicates that recording has been temporarily stopped using the SHIFT+8 key sequence. To continue recording, press the SHIFT+8 key sequence again and the display will return to displaying the percentage of space remaining.

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 <u>not</u> be recorded until ESC is pressed and the FOX is shut down properly.**



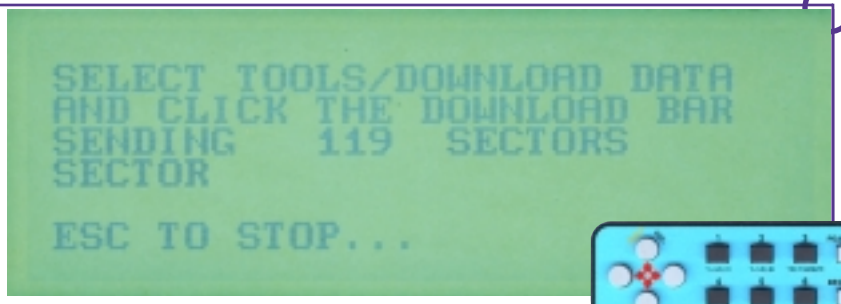
INITIALIZE PCMCIA CARD

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.

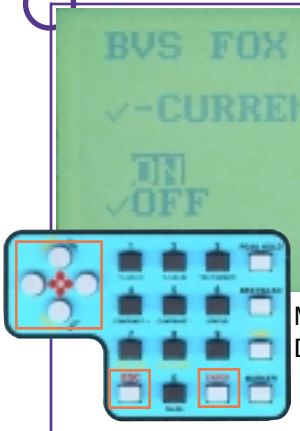
DOWNLOAD DATA



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.

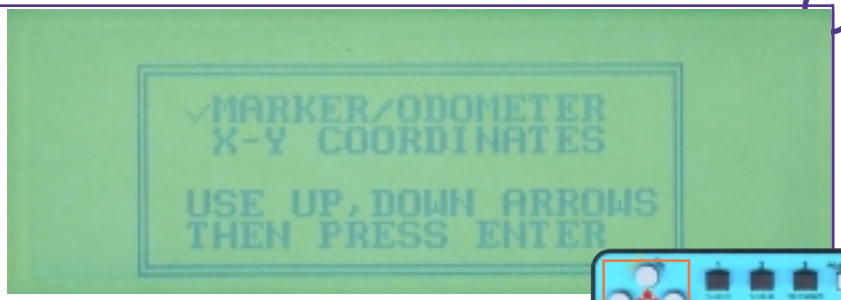
NOTE: When using laptops, POWER MANAGEMENT control MUST be turned OFF. This feature is usually found in the CONTROL PANEL, set it to OFF or at least to 15 minutes. IF the power management control software puts the laptop in low power mode DURING download, data WILL be lost.



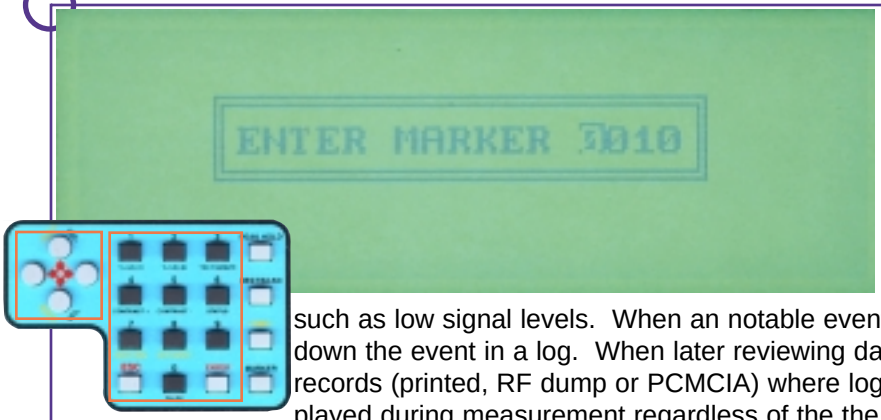
RF DUMP TO PC

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.

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.

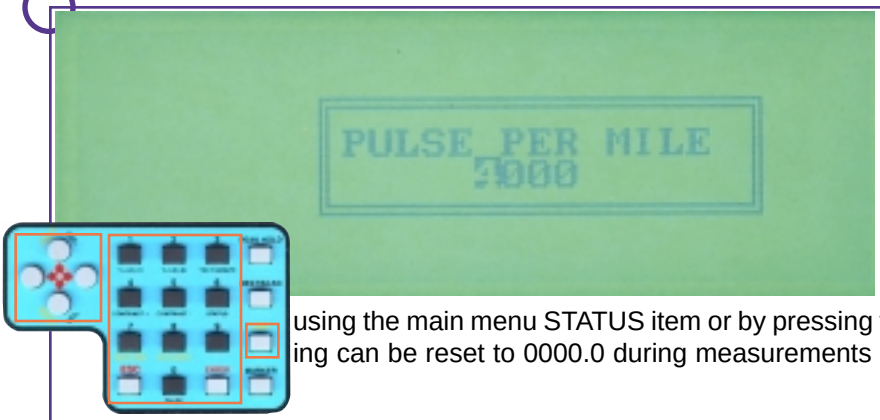


SET MARKER NUMBER

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

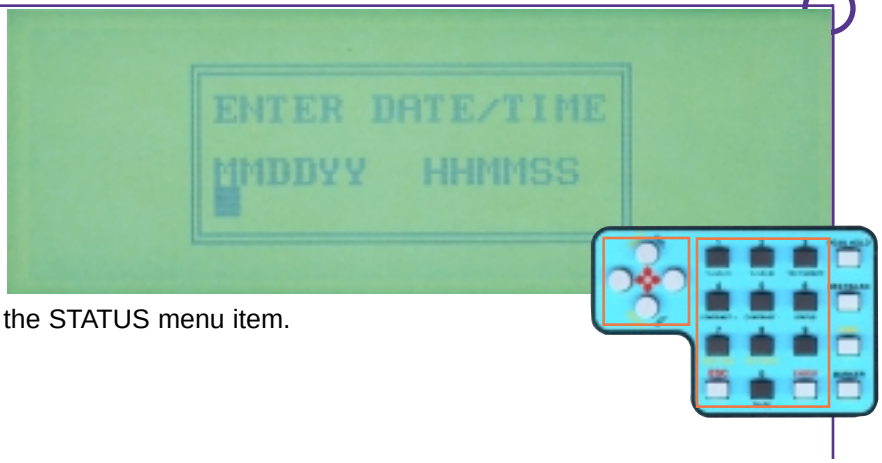
The measurement X-Y coordinates are saved (both RF DUMP and PCMCIA) in place of the original user marker/odometer readings. A flag is set in the RF DUMP header and ATA RECT1 to indicate to the PC software which marker type has been selected by the operator. Use the numeric keys and bottom command keys 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.



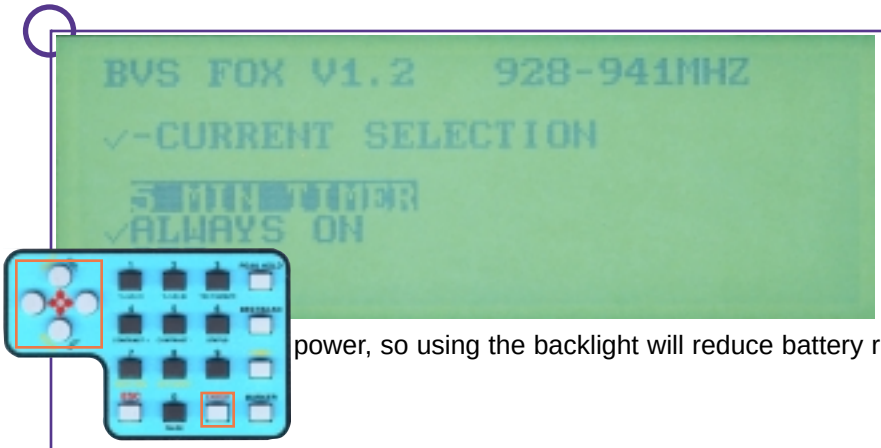
PP MILE ODOMETER SETTING

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.

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.

BVS Fox Data Logger
Software Operations Manual
(including FLEX)

Introduction

The Fox Data Logger (FoxDL) application software is the PC interface that enables a user of the Fox Signal Strength Meter to collect and display valuable Fox scan data. The main screen of the application can be seen in Figure 1.

FoxDL 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. FoxDL can also download the data stored in the PC Card. This data can then be converted and filtered by BVS's Chameleon CW application for input into most of the popular post-processing packages such as MapInfo and MSI Planet. A newer feature allows the FoxDL to upload channel tables for use with the 20-channel measurement on the Fox.

The following sections of this document outline the various features of the Fox Data Logger.

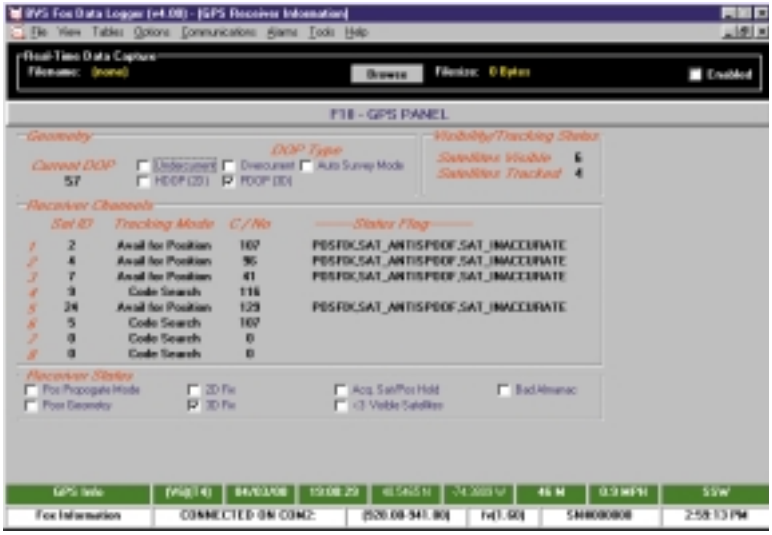


FIGURE 1 – FoxDL Main Screen

Starting the Application

To begin using FoxDL, 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 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 FoxDL application by clicking on the icon provided.

When the application starts, a prompt appears for entering the correct serial port. FoxDL will automatically find the correct port if the option is left as AUTOMATIC. After the port has been selected, a message will show up in the Fox information status bar stating that a connection has been made. The appropriate screen will be displaying data from the unit.

The following sections explain all of the features of FoxDL.

Main Screen

The main screen contains the main menu, data capture bar, 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 FoxDL. The real-time viewing area can be toggled with the GPS satellite screen by pressing the button located in the data capture bar.

Data Capture Window

The data capture bar is located directly underneath the main menu. This bar contains information on the data capture filename and whether or not data capturing is enabled. If the enabled checkbox is checked, any real-time data will be captured to the corresponding filename. The data capture bar also contains a button that allows toggling from the real-time viewing area to the GPS satellite screen.

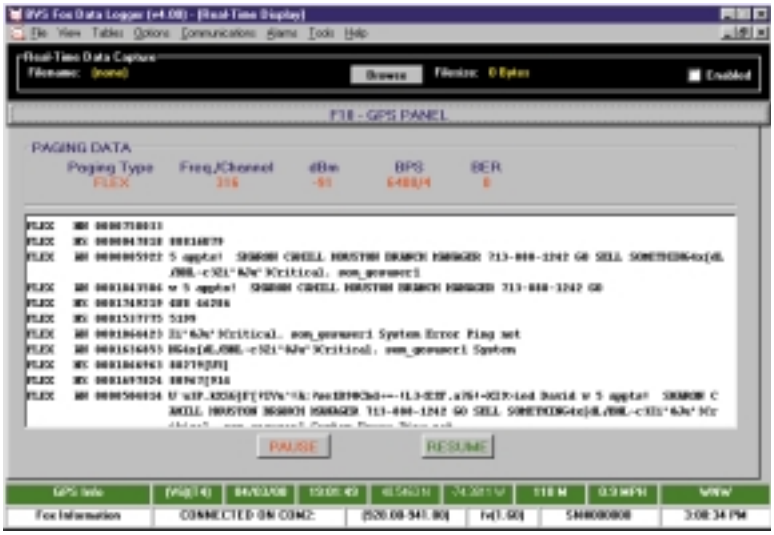


FIGURE 2 – Paging Screen

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 satellite statuses. The receiver can track up to 8 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.

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.

Frequency/Channel Option
The real-time displays may display frequencies or channels. To choose, select the appropriate option under the "Options" menu.

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 Options menu.

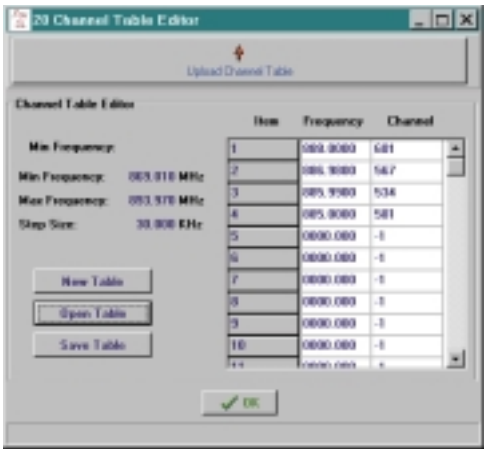


FIGURE 3 – Channel Table Screen

20 Channel Table
The user may configure a channel table for upload to the Fox. To choose, select the appropriate option under the "Options" menu. 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. The channel table screen can be seen in Figure 3.

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. Choose the CAPCODES to match and then upload or download accordingly using the options given. The CAPCODE screen is shown in Figure 4. The tables can be saved and retrieved to disk for later use as well.

FIGURE 4 – Paging CAPCODE Table Screen

Communication Ports

Under the Communications menu is an option called "Ports". This option pops up the same screen which shows up when the application is started. This screen can be used to change which serial port to attempt a connection with the Fox.

GPS Lock Alarm

Under the "Alarms" menu is an option to set a GPS Lock alarm. The item will be checked if the alarm is active. This alarm will be activated if real-time data is being received from the Fox and it is reporting that the GPS receiver does not have position/timing lock.

If the "Audible" alarm is selected, the application will sound a warning beep for as long as there is no GPS lock. If the "Visible" alarm is selected, a warning box will appear the instant that lock has been lost.

Download Tool

If it is undesirable to offload the data stored on the PC Card through a drive slot on the PC, there is an alternate method of retrieving the data.

Select "Download Data" from the Tools menu. An applet called "Fox Data Download Utility" will be launched after having closed the real-time connection with the Fox. This applet may also be selected from the directory where the FoxDL application is stored. It is named "Ringmaster.exe".

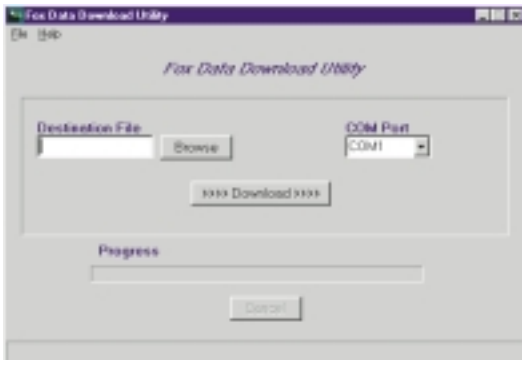


FIGURE 4 – FoxDL Download Screen

The main screen for this applet can be seen in Figure 4. Choose an output file. Then select the "Download Card" option from the menu on the Fox. When the Fox is ready to transmit, press the "Download" button. This data can now be converted using "Chameleon CW".

BVS Fox Download Utility (v5.00)
Application Software

PC Requirements

Operating System:	Windows 9x
RAM:	24 MB
HDD (free space):	5 MB
Processor:	Pentium-class
Access:	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.

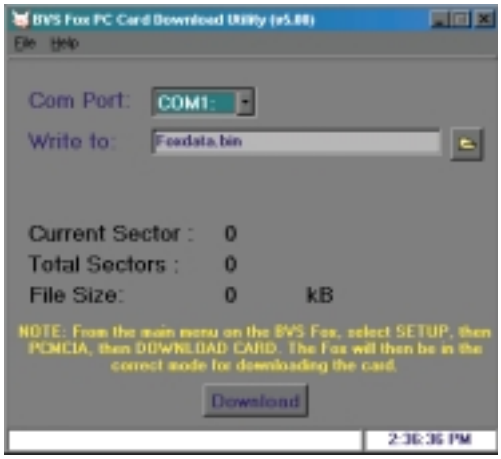


FIGURE 1 – BVS Fox Download Utility

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 main screen of the application can be seen in **Figure 1**.

The Chameleon was designed to greatly simplify the transfer of receiver data to many popular post-processing applications such as MapInfo's dB Planner®, MSI's Planet®, Safco's OPAS® and TEC Cellular's Wizard®. 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 Chameleon consists of two separate applications. The CDMA application (used for the Raven) converts data collected using BVS's lineup of CDMA receivers. The CW application converts data collected using BVS CW receivers. There are separate addendum that discuss the application-specific features for CDMA and CW.

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

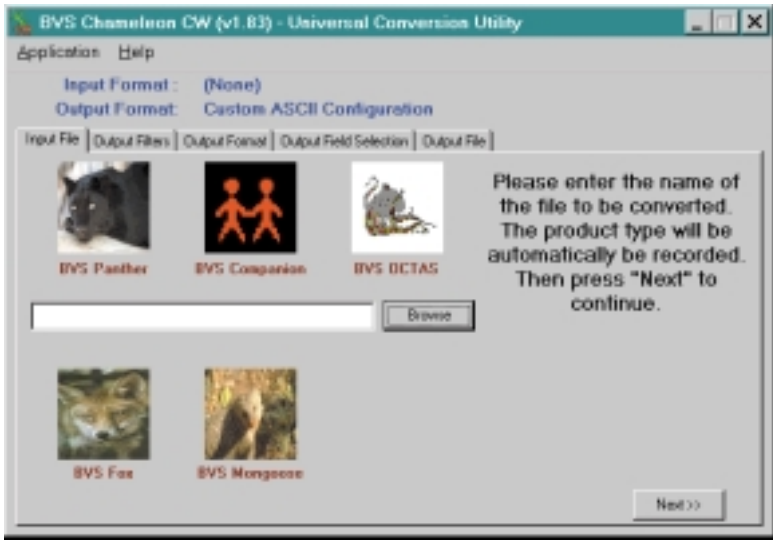


FIGURE 1 – Chameleon Main Screen

Installation

Installation of Chameleon is straightforward. Insert diskette #1 and run SETUP.EXE. 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 "Chameleon"). This folder will sit minimized on the task bar. For easy access to Chameleon, drag this icon from the folder onto the desktop.

Starting the Application

Start Chameleon clicking on the icon created by the installation utility. When the application starts, a screen similar to **Figure 1** will be displayed. The tabbed notebook shows the five necessary steps to complete in preparation of data conversion. Chameleon has been designed to give the user a step-by-step type of interface in order to facilitate ease of conversion. This notebook is stepped through by using the NEXT and BACK buttons on the bottom of each page. The steps required to complete the conversion are explained in the following sections.

Main Menu
The main screen contains the main menu and the notebook. 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.

Input File
As shown in **Figure 1**, the first tab in the notebook is the "Input File" tab. Choose the data file that is to be converted. The Chameleon will automatically determine which product created the file. Chameleon will display the product on the top of the screen. If the data file is not recognized, the user will not be allowed to proceed to the next screen. Click on the NEXT button to get to the next step.

Output Filters
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.

The specific filters available for each application are discussed in greater detail in the application addendums. The page can be seen in **Figure 2**.

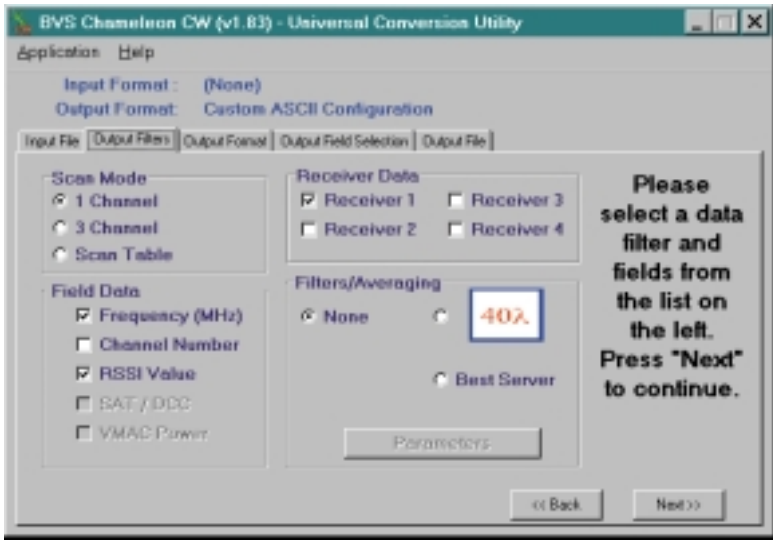


FIGURE 2 – Output Filter Page

Output Format
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 field selection screen in the appropriate order. If the format selected requires information that is not ASCII-delimited, no fields will show as selected in the field selection screen. 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 "Output Format" screen can be found in **Figure 3**.

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.

FIGURE 3 – Output Format Page

Output Field Selection

Figure 4 shows the "Output Field Selection" page. This page enables the selection of those 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 application has been chosen from the "Output Format" page, this page will already have fields displayed in the selected box. If the format chosen is a non-ASCII delimited custom format, the selection boxes will be inactive.

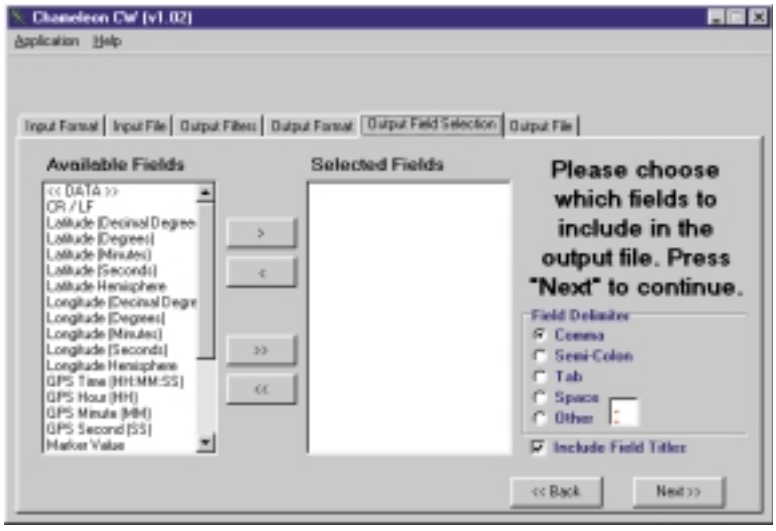


FIGURE 4 – Output Field Selection Page

Output File

The final page in the step-by-step process is the "Output File" page; see **Figure 5**. Here the name of the converted file is chosen. For some post-processing packages, a default filename will be displayed here. After the name has been chosen, 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.

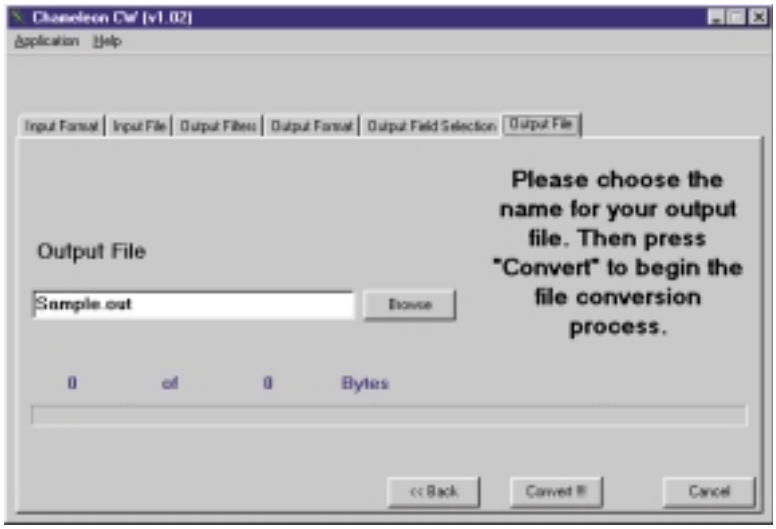


FIGURE 5 – Output File Page

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 (also above the display) is on. 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 times-lot). 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

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 GPSOK0x80                   /* 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;
```

PCMCIA Card Record Structures

```
/*      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)

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 command. 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=O)
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: Thning1I 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.

FLEX/POCSAG FOX - OVERVIEW

The FLEX/POCSAG FOX has all of the features as a standard FOX:

8 Meg ATA flash PCMCIA card for measurement storage.
38k baud serial port for logging measurement data to a PC.
8 channel GPS receiver for position tagging measurements.
All standard FOX RF measurements.

In addition, both FLEX and POCSAG paging data are demodulated and all data is saved for post processing (card and/or serial port). Both CAP CODES and paging messages are displayed in real time on the FOX display.

POCSAG measurement decodes 512,1200 and 2400 BPS messages. The FLEX measurement decodes 1600,3200 BPS 2 level and 3200,6400 BPS 4 level data.

Up to 30 POCSAG and 30 FLEX cap codes can be entered via the setup menu or the PC. Only paging messages that match these cap codes will be displayed if MATCHING measurement is selected.

FLEX/POCSAG FOX - MAIN MENU

C/I RATIO	1 CHAN	SETUP
ADJ CHAN	20 CHAN	STATUS
PAGING	VAR SWEEP	REPLAY
	FAST FADE	

To start a POCSAG or FLEX measurement, highlight the PAGING option and press ENTER. The following screen will appear:

HIGHLIGHT WITH THE
<- -> ARROW KEYS
ENTER - TOGGLE ON-OFF
ESC - TO USE & CONTINUE

POCSAG FLEX MATCHING

Highlight the measurement required using the arrow keys (POCSAG, FLEX or both) and press enter. A check mark will appear next to the selected measurement. To view only messages that match entered CAP CODES, also select MATCHING.

When all required options have been selected, press ESC to start the measurement. If serial data or card storage of the measurement data is required, select these options using the SETUP menu prior to starting the paging measurement.

CAP CODES for the matching option are entered in the SETUP menu or with the PC software.

FLEX/POCSAG FOX - PAGING MEASUREMENT SCREEN
EXAMPLE WITH BOTH FLEX AND POCSAG BEING DECODED

LINE #:

1 FREQ DBM BPS % BER
2 933.0000 -80 6400/4 00

3 ADDRESS F#001 MARKER 0000
4 1234567890 Flex LONG CAP CODE
5 1234567 Flex SHORT CAP CODE
6 P 1234567 POCSAG CAP CODE GL
7 P 1234567 POCSAG CAP CODE 85

Line 1 - Measurement Text Header
Line 2 - FREQ - current frequency being measured
DBM - received signal strength
BPS - Speed of last frame or batch

6400/4 - Flex 6400 bps, 4 level modulation
3200/4 - Flex 3200 bps, 4 level modulation
3200/2 - Flex 3200 bps, 2 level modulation
1600/2 - Flex 1600 bps, 2 level modulation
512 - POCSAG 512 bps
1200 - POCSAG 1200 bps
2400 - POCSAG 2400 bps

% BER - precent of bits in error for the last frame or batch.

Line 3 - Indicates the CAP CODE column (ADDRESS), the flex frame number (blanked during POCSAG) and the current MARKER value. Use the marker to tag data being saved by pressing the MARKER key during measurement.

Lines 4-7 - Display of the latest capcodes and messages. A 'P' to the left of the address indicates that this was a POCSAG cap code and message.

Line 6 - At the rightmost end of this line is the GPS status. 'GL' indicates GPS is locked, '??' indicates the GPS is not locked or off.

Line 7 - At the rightmost end of this line is the precent of PCMCIA storage remaining (if PCMCIA SAVE is on).

NOTE: STATUS, PAUSE and SEEK keys have no effect during a FLEX/POCSAG measurement and X-Y marker is not avaiable.

To change frequency during the measurement, press ENTER and enter the new frequency when prompted.

Use the up and down arrow keys to adjust the audio volume.

Use the 4 and 5 keys to adjust the display contrast.

FLEX/POCSAG FOX - PAGING MEASUREMENT

FLEX

When the FLEX measurement is selected, ALL frames (SYNC + 11 BLOCKS) encountered, whatever the speed, are de-interleaved and BCH checked. The BER % is calculated by dividing the number of bits in error by the number of bits checked. The BPS and F# (Frame number) are displayed based on the information contained in the SYNC portion of the frame.

DATA DISPLAY - MATCHING ON

Any alpha-numeric, standard numeric and numbered numeric message from any phase (1, 2 or 4 if 1600, 3200 or 6400 bps) is displayed that match any one of the 30 cap codes in the FLEX CAP CODE table.

DATA DISPLAY - MATCHING OFF

All alpha-numeric, standard numeric and numbered numeric messages from each phase (1, 2 or 4 if 1600,

3200 or 6400 bps) are displayed.

DATA SAVED

All frame data plus signal strength, bits in error and SYNC information are saved on the pcmcia card, sent out the serial port or both.

POCSAG

When the POCSAG measurement is selected, ALL batches, whatever the speed, are BCH checked. The BER % is calculated by dividing the number of bits in error by the number of bits checked. The BPS is also displayed.

DATA DISPLAY - MATCHING ON

Any alpha-numeric or numeric message is displayed that match any one of the 30 cap codes in the POCSAG CAP CODE table.

DATA DISPLAY - MATCHING OFF

All alpha-numeric and numeric messages are displayed.

Note that the display of POCSAG messages depends on the correct setting of the "FC" bits.

DATA SAVED

All batches plus signal strength, bits in error and BPS information are saved on the pcmcia card, sent out the serial port or both.

For both FLEX and POCSAG measurements, if no paging data is detected, signal strength and GPS data are saved once per second.

FLEX/POCSAG FOX - SETUP MENU

```
PCMCIA              MARKET TYPE DATE/TIME
RFDUMP              SET MARK    BACKLIGHT
POCSAG              SET X-Y
FLEX          SET PP MILE
```

Use the POCSAG option to enter,view and clear the 30 entry POCSAG CAP CODE table. This menu also has the option used to determine how the FOX will interpret the "function bits" or function code "FC" when displaying POCSAG messages. The "FC's" must be set according to the system being monitored or the messages displayed by the FOX will not be correct.

Use the FLEX option to enter,view and clear the 30 entry FLEX CAP CODE table.

To use the POCSAG setup menu, select the 'POCSAG' setup option and press enter. To use the FLEX setup menu, select the 'FLEX' setup option and press enter.

POCSAG SETUP MENU

```
ENTER CAP CODES          SELECT FC
VIEW CAP CODES
ERASE CAP CODES
```

To select an option, highlight it and press enter.

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) asscociated 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:

FC	Message Type
00	Alpha-numeric
01	Numeric only
10	Numeric only
11	Alpha-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. The setting of the function codes DOES NOT EFFECT the data saved on PCMCIA card or RF DUMP file, it ONLY effects HOW the message data words are interpreted and displayed.

ENTER CAP CODES/VIEW CAP CODES

Enter the POCSAG pager addresses used when MATCHING is selected. Select table # (1-30) 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 entry. Press enter to skip a table location, press ESC to return to the POCSAG setup menu.

ERASE CAP CODES

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

The PC software can also be used to load the FOX POCSAG matching table.

FLEX SETUP MENU

ENTER CAP CODES
VIEW CAP CODES
ERASE CAP CODES

To select an option, highlight it and press enter.

ENTER CAP CODES/VIEW CAP CODES

Enter the FLEX pager addresses used when MATCHING is selected. Select table # (1-30) and press ENTER. The contents of that table location will be displayed, 0000000000 if empty. Enter the new address (LONG or SHORT) and press ENTER. The screen will automatically step to the next table entry. Press enter to skip a table location, press ESC to return to the FLEX setup menu.

ERASE CAP CODES

Use to clear out all pager addresses in the address table (all set to 0000000000).

The PC software can also be used to load the FOX FLEX matching table.

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

If you require technical assistance, or service to your FOX™ FLEX/POCSAG Receiver , please contact:

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E-mail: info@bvsystems.com

8:00am - 6:00pm Eastern Time

wireless products

BERKELEY VARITRONICS SYSTEMS

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)	

Berkeley Varitronics Systems, Liberty Corporate Park, 255 Liberty Street, Metuchen, NJ 08840
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NATIONAL CERTIFICATION LABORATORY
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(410) 461-5548

CENELEC EMI MEASUREMENT REPORT

for

Berkeley Varitronics Systems
255 Liberty Street
Metuchen, NJ 08840

The Fox Signal Strength Meter

September 1, 2000

TABLE OF CONTENTS

1.0 Purpose of Test

The purpose of this series of tests was to verify compliance of *The Fox* (EUT) with the limits and standards of IEC 1000-4-2,3, and 4 and EN55022.

2.0 Description of Test Sample

The EUT is a hand-held Signal Strength Meter used for measuring Signal Propagation, RF leakage, and RF shadows in the PCS, Cellular, GSM, ISM, ETACS, Paging, IVDS, WCS, and LMR bands. Other features include 240 X 64 graphic LCD panel, RS-232 interface, battery powered, auto calibration, GPS receiver, 20 alpha-numeric keypad, PCMCIA memory card, odometer input.

3.0 References

IEC 1000-4-2.....	Part 2: Electrostatic discharge requirements, Second edition, 1991-04
IEC 1000-4-3.....	Part 3: Radiated electromagnetic field requirements, 1984, 3rd Impression 1997
IEC 1000-4-4.....	Part 4: Electrical fast transient/ burst requirements, 1988, 3rd Impression 1998
EN55022	EMI emissions requirements, CISPR 22, 1998 version

4.0 List of Required Tests

The following tests were performed in accordance with Berkeley Varitronics Systems:

5.0 Test Site

Testing was performed at **National Certification Laboratory** in Ellicott City, MD. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch. FCC acceptance was granted on May 26, 1993.

6.0 Modifications to EUT

No modifications were made to the equipment under test, in order to comply with the standards in Section 4.0.

7.0 Modifications to Test Standard

No modifications were made to the test standards referenced in this report.

8.0 Test Configuration

The *Fox* was configured in accordance with the manufacturer's instructions and operated in a manner representive of the typical usage of the equipment. The equipment was tested with the following Host equipment:

1. 50 ohm omni antenna (RF input)
2. RS-232 Serial cable (RJ11)
3. Phono cable (odometer input)
4. Battery charger (DC input)

The EUT was set to Scan Mode during testing.

9.0 Results Summmary

The tests referenced on page 3 were performed in accordance with the applicable standards. The severity levels used for immunity testing were chosen according to the anticipated installation environment of the EUT.

The acceptable performance criteria is determined through agreement between manufacturer and end user or client. The acceptance is based on the actual severity levels chosen for normal installation of the EUT.

Based on the above explanations, we state that the EUT (**Berkeley Varitronics Systems** *The Fox Signal meter*) as supplied to **National Certification Laboratory**, complied with all requirements stated in this report.

Signature

Bijan Haghtalab

Printed

Operations Manager, NCL

Title

9.1 IEC 801-2 Electrostatic Discharge Requirements

Introduction

The requirements of this test call out Electrostatic Discharge (ESD) test levels and procedures. The intent of this test is to determine the effect of electrostatic discharge events on equipment operation. ESD is the result of potential build-up and the subsequent rapid discharge and equalization of that potential. The result of the discharge is a transient waveform that produces peak voltages up to tens of kilovolts, peak currents of a few amperes, and rise times on the order of a few nanoseconds (ns). This energetic discharge may produce malfunction and damage to sensitive electronic equipment.

This test requires an "air discharge" and "contact discharge" test to evaluate the immunity of electronic equipment to ESD.

The specification limit depends on the designated "severity level," which is determined by the intended area of installation of the device. The severity levels for both contact and air discharge ESD are located in the standard.

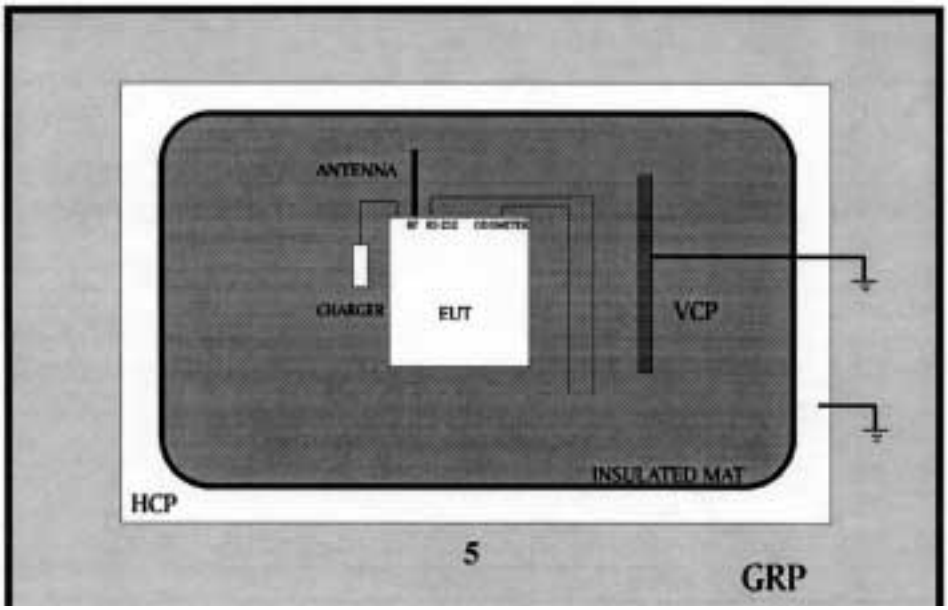
Configuration

The EUT is situated on a .5 mm thick non-conductive mat which was placed on a horizontal coupling plane (HCP). The HCP is composed of a sheet of copper metal, the size being 1.6 m X 0.8 m, mounted to a table top. The table stands 0.8 m in height and is centered on a metallic ground reference plane (GRP), measuring 2.2 X 2.2 m. The GRP is more than 0.25 mm thick as required by IEC 801-2, Section 7.1.

A vertical coupling plane (VCP) measuring 0.5 X 0.5 m, and comprised of copper sheet is placed 0.1 m from the EUT. The HCP and VCP are connected to the GRP via two series 470 K resistors. The GRP is safety grounded with the laboratory A.C. mains network.

FIGURE 1 - IEC 1000-4-2

TOP VIEW



Procedure

The EUT was set to Scan Mode during testing.

The ESD gun is repeatedly charged to the required voltage and air-discharged at all locations on the EUT that are accessible to human contact. The ESD gun was also discharged at least ten times on the HCP and at the center of the left vertical edge of the VCP. The test was repeated with the VCP facing the front, back, left side, and right side of the EUT. The functionality of the EUT was determined after each discharge.

Technique

Direct Discharge -

These discharges are made directly to the unit in the air and contact discharge modes. All tests are performed in the single discharge mode and with a negative and positive ESD pulse. On the preselected points at least ten discharges are applied with, approximately, a one second interval between discharges.

For repeatability, the ESD generator is held perpendicular to the surface of each discharge point.

The test voltage is set at a lower level than the predetermined severity level and increased until the EUT fails or until the predetermined test voltage is reached. If the EUT fails before the proper test voltage is reached then the voltage the unit failed at should be noted as the threshold.

Contact Discharge -

The tip of the discharge point should touch the EUT before the ESD discharge is made. If the surface of the EUT is painted and the coating is not declared by the manufacturer as an insulator, then the tip of the ESD generator should penetrate the coating before the discharge. If the coating is declared as an insulator by the manufacturer then the contact discharge is not applied to this surface.

Air Discharge -

The tip of the discharge point does make contact with the EUT and the discharge is made as the tip is held close to the EUT.

Indirect Discharge -

This test is done to simulate discharges made by objects installed near the EUT and is done in the contact discharge mode only (see above). It is done to the HCP and VCP as determined earlier.

HCP -

At least 10 discharges should be made to the plane at several points around the EUT and at a distance of 0.1 m from the EUT.

VCP -

At least 10 discharges should be made to the center of one of the side edges of the plane. The VCP should be 0.5 m x 0.5 m and placed parallel to the EUT and perpendicular to, but isolated by 0.5 mm from, the HCP. The discharges should be made to the plane, with the plane 0.1 m from the EUT and at different positions on the four sides of the EUT so the EUT is completely illuminated.

If during any of the above tests the unit does not meet the previously specified function criteria, the EUT does not comply.

Test Equipment/Conditions

EQUIPMENT	SERIAL NUMBER
AH Associates ESD 254 - ESD Simulator	1030
CLIMATIC CONDITIONS	**MEASURED**
Temperature	15 C to 35 C
Humidity	30 % to 60 %
Atmospheric Pressure	68 kPa to 106 kPa

Results

The EUT was evaluated according to the following criteria.

Performance Criteria:

1. Normal performance within the spec. limits.
2. Temporary degradation or loss of function or performance which is self-recoverable.
3. Temporary degradation or loss of function or performance which requires system reset.
4. Degradation or loss of function which is not recoverable due to damage of equipment.

The EUT was subjected to Severity Level 3 as described below, which is appropriate for a Class 3 installation.

LEVEL	CONTACT DISCHARGE VOLTAGE	AIR DISCHARGE VOLTAGE
3	6 kV	8 kV

Discharge to Coupling Planes:

Performance of the EUT complied to performance criterion 1 while air discharges were applied to **Severity Level 3** to both the vertical and horizontal coupling planes a minimum of 10 times on each of four sides.

Discharge to EUT:

Performance of the EUT complied to performance criterion 1 while contact discharges were applied to all conductive surfaces on the exterior of the EUT to **Severity Level 3** a minimum of 10 times.

9.2 IEC 801-3 Radiated Electromagnetic Field

Introduction

The requirements of this test call out radiated susceptibility test levels and procedures. The intent of this test is to determine the effect of radiated RF energy on equipment operation. Radiated RF energy from other devices in the facility or from ambient RF energy (i.e. radio and TV broadcast stations) can cause equipment to malfunction.

The specification limit depends on the designated "severity level," which is determined by the intended area of installation of the device.

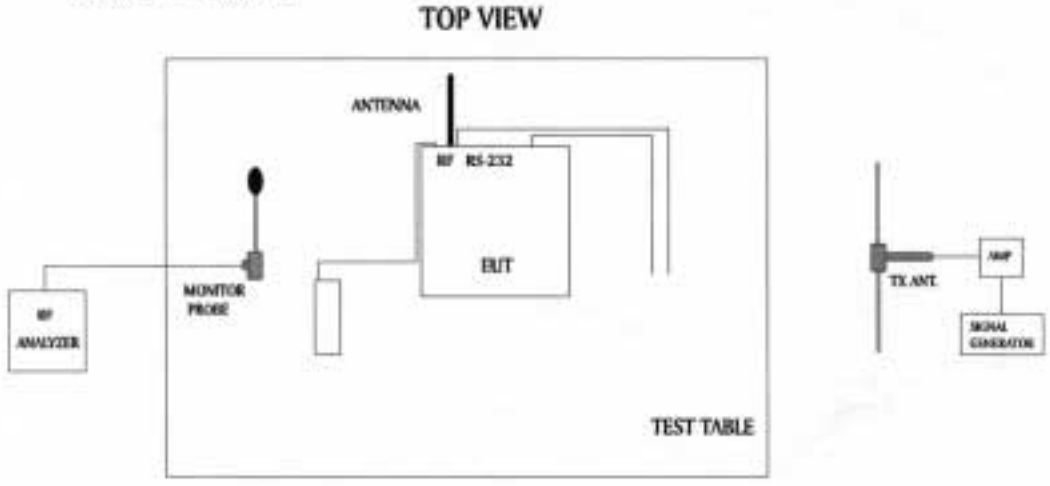
Configuration

This basic test setup applies to both types of equipment, floor standing and desktop. The equipment under test (EUT) is setup in a shielded room, so test personnel and equipment are protected from the radiated fields. If the EUT requires external interconnecting cables, they should be of the length specified by the manufacturer. If the manufacturer's specified length is greater than 3 m then the cabling should be reduced to a 3 m length by non-inductive bundling. The cables are also placed uniformly in the field.

A transmit antenna is placed 1 m from the EUT and at a height of 1 m. The antenna is then connected to the test equipment outside the shielded room via the room bulkhead. On the external end of the bulkhead a power amplifier is connected. A signal generator is then connected to the input of the power amplifier, so the necessary field can be produced. The field probe for measuring the radiated field is also placed inside the shielded room. The probe is placed as close to the EUT as possible without disturbing the radiated field. The probe is then connected, through a bulkhead, to a monitoring device outside the room.

The EUT and cables are placed on a 0.8 m high non-conductive table at a distance of 1m from the transmit antenna. The antenna height is adjusted between 1 and 2 m so that the center of the antenna aligns with the center of the EUT.

FIGURE 2 - IEC 1000-4-3



Procedure

The EUT was set to Scan Mode during testing.

The signal source is swept through the frequency range of 80 to 1000 MHz, at a rate no faster than .0015 decades/s as recommended in IEC 801-3, Section 7. During testing, the amplitude of the signal generator is adjusted to maintain at least the required field strength. At a minimum of three points per octave, the achieved field strengths were recorded.

Throughout the test, the EUT is closely monitored for signs of susceptibility. The testing is performed with the antennas oriented in both horizontal and vertical polarization. If during any of the above tests the unit does not meet the previously specified function criteria, the EUT does not comply.

Test Equipment

EQUIPMENT	SERIAL NUMBER
Boonton 102F Signal Generator	43628
EMCO Model 3110 Biconical Antenna	1235
EMCO Model 3146 Log Periodic Antenna	1222
Sahand IID RF Field Probe	
ENI Model 604L RF Amplifier	47569
Advantest Model R4131D Spectrum Analyzer	54378A

Results

The EUT was evaluated according to the following criteria.

Performance Criteria:

1. Normal performance within the spec. limits.
2. Temporary degradation or loss of function or performance which is self-recoverable.
3. Temporary degradation or loss of function or performance which requires system reset.
4. Degradation or loss of function which is not recoverable due to damage of equipment.

The EUT was subjected to **Severity Level 2** as described below, which is appropriate for a Class 2 installation:

LEVEL	TEST FIELD STRENGTH (V/m)
2	3

Final

Performance of the EUT complied to performance criterion 1 while subjected to Electromagnetic fields were generated to Severity Level 2 in both the vertical and horizontal polarizations of the antennae.

Tabular data follows:

Freq. MHz	Pol.	Limit V/m	Monitor V/m	Compliance
80	H	3	3.4	COMPLIES
80	V	3	3.2	COMPLIES
100	H	3	3.6	COMPLIES
100	V	3	3.5	COMPLIES
120	H	3	3.3	COMPLIES
120	V	3	4.1	COMPLIES
150	H	3	3.9	COMPLIES
150	V	3	4	COMPLIES
175	H	3	3.1	COMPLIES
175	V	3	3.2	COMPLIES
200	H	3	3.1	COMPLIES
200	V	3	3.6	COMPLIES
266	H	3	4.3	COMPLIES
266	V	3	4.1	COMPLIES
300	H	3	4.2	COMPLIES
300	V	3	4.2	COMPLIES
366	H	3	3.7	COMPLIES
366	V	3	3.7	COMPLIES
400	H	3	3.5	COMPLIES
400	V	3	3.1	COMPLIES
466	H	3	3.8	COMPLIES
466	V	3	3.5	COMPLIES
500	H	3	4.5	COMPLIES
500	V	3	4.6	COMPLIES
525	H	3	4.4	COMPLIES
525	V	3	4.1	COMPLIES
600	H	3	4.8	COMPLIES
600	V	3	4.9	COMPLIES
650	H	3	4.5	COMPLIES
650	V	3	4.3	COMPLIES
700	H	3	4.2	COMPLIES
700	V	3	4.1	COMPLIES
800	H	3	4.1	COMPLIES
800	V	3	4.7	COMPLIES
914	H	3	4.8	COMPLIES
914	V	3	4.9	COMPLIES
1000	H	3	4.5	COMPLIES
1000	V	3	4.4	COMPLIES

9.3 IEC 1000-4-4 Electrical Fast Transients Requirements

Introduction

The requirements of this test call out Electrical Fast Transient (EFT) test levels and procedures. The intent of this test is to determine the effect of EFT's on equipment operation. EFT's are the result of switching inductive loads or relay contact bounce. This energetic discharge may produce malfunction and damage to sensitive electronic equipment.

This test requires a "coupling/decoupling network" for AC/DC supply lines and "capacitive clamp" for signal or control lines.

The specification limit depends on the designated "severity level," which is determined by the intended area of installation of the device.

Configuration

The EUT is placed on a 0.8 m high non-conductive table and the table is placed on a metallic ground reference plane (GRP), measuring 2.2 X 2.2 m. The EFT/B generator and the coupling clamp are mounted to the GRP and bonded to the protective grounding system.

Power is supplied to the EUT through the EFT/B generator, and all I/O cables exceeding 2 m in length were placed in the coupling clamp, which is also connected to the EFT/B generator. The coupling clamp is terminated into a 50 ohm impedance.

The EFT/B generator is programmed to produce an output test signal with the following parameters:

PRF ..... 5 kHz for output < 2kV, 2.5 kHz for output > 2kV

Burst Duration ..... 15 ms

Burst Period ..... 300 ms

Test Time ..... 60 s

Procedure

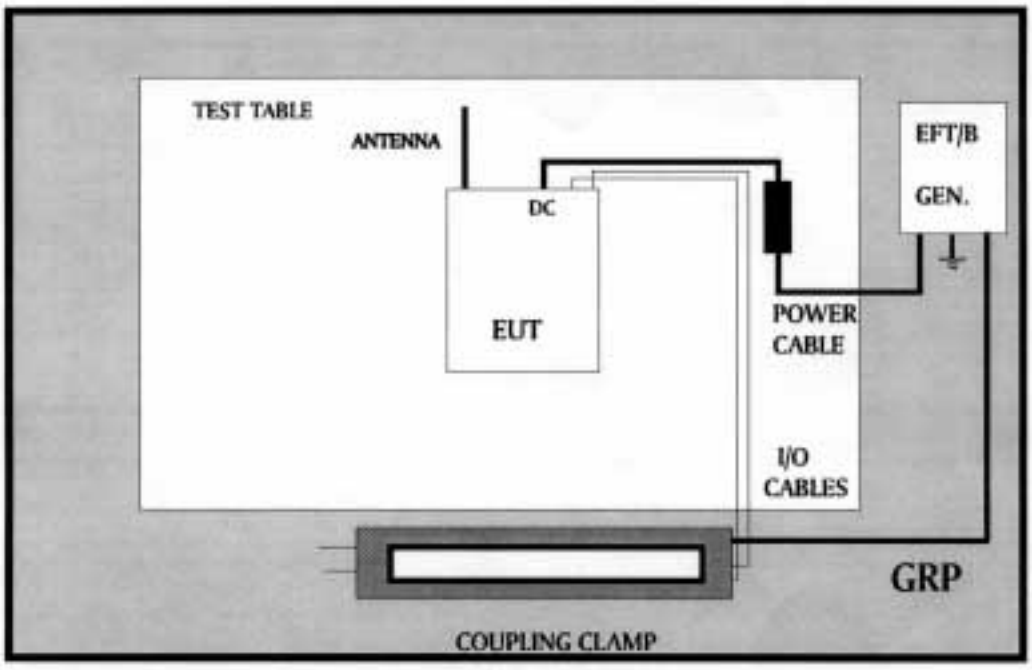
The EUT was set to Scan Mode during testing.

The EFT/B generator is operated to couple the transient bursts onto the EUT I/O lines and the A.C. power input line for a period not less than one minute. This test is performed with positive transients first, and subsequently with negative transients.

Throughout the test, the EUT is closely monitored for signs of susceptibility. If during any of the above tests the unit does not meet the previously specified function criteria, the EUT does not comply.

FIGURE 3 - IEC 1000-4-4

TOP VIEW



Test Equipment

EQUIPMENT	SERIAL NUMBER
Compliance Design EFT Generator	3150129
Compliance Design Coupling Clamp	161-34

Results

The EUT was evaluated according to the following criteria.

Performance Criteria:

1. Normal performance within the spec. limits.
2. Temporary degradation or loss of function or performance which is self-recoverable.
3. Temporary degradation or loss of function or performance which requires system reset.
4. Degradation or loss of function which is not recoverable due to damage of equipment.

The EUT was subjected to **Severity Level 2** as described below, which is appropriate for a Protective Environment installation:

LEVEL	TEST VOLTAGE on A.C.	TEST VOLTAGE on I/O
2	1 kV	0.5 kV

Final

Performance of the EUT complied to performance criterion 1 while subjected to Electrically Fast Transient Burst signals generated at Severity Level 2, on both the A.C. power line and the I/O data and control lines.

9.4 EN55022 EMI Radiated and Conducted Emissions

1.0 Introduction

Radio-Noise Emissions tests were performed according to the CISPR Pub. 22 1993, titled **"Measurement of Radio Interference Characteristics of Information Technology Equipment"**. The measuring equipment conforms to CISPR Pub. 16, Section 1, Specifications for Electromagnetic Noise and Field Strength Instrumentation.

Testing was performed at National Certification Laboratory in Ellicott City, MD. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch. FCC acceptance was granted on May 26, 1993.

1.1 Summary

The **Fox Signal Meter** complies with the limits for a Class B ITE device.

2.0 EMI Countermeasures

No modifications were made to the EUT, by the project engineer to assure compliance to Class B specifications:

3.0 Test Program

The EUT was set to Scan Mode during testing.

4.0 Test Configuration

The EUT and support equipment were setup on the test table in a manner which follows the general guidelines of CISPR 22 Section 8.1. The support equipment consisted of a 50 ohm whip antenna, phono cable, battery charger, and RS-232 cable as prescribed in Section 8.1. The EUT was centered on the table with it's rear flush with the rear of the table.

I/O cables were placed on top of the table and moved in position to maximize emission levels. Cables were more than 40 cm from the ground plane during radiated and conducted tests.

5.0 Conducted Emissions Scheme

The EUT is placed on an 80 cm high 1 X 1.5 m non-conductive table. Power to the CPU is provided through a Solar Corporation 50 Ω/50 μH Line Impedance Stabilization Network bonded to a 2.2 X 2 meter horizontal ground plane, and a 2.2 X 2 meter vertical ground plane. The LISN has its AC input supplied from a filtered AC power source. A separate LISN provides AC power to the peripheral equipment. I/O cables are moved about to obtain maximum emissions.

The 50 Ω output of the LISN is connected to the input of the spectrum analyzer and emissions in the frequency range of 150 kHz to 30 MHz are searched. The detector function is set to quasi- peak and the resolution bandwidth is set at 9 kHz, with all post-detector filtering no less than 10 times the resolution bandwidth for final measurements. All emissions within 20 dB of the limit are recorded in the data tables.

6.0 Radiated Emissions Scheme

The EUT was initially scanned in the frequency range 0.3 to 10 GHz indoors, at a distance of 1 meter to determine its emissions profile. The EUT was then placed on an 80 cm high 1 X 1.5 meter non-conductive motorized turntable for radiated testing on the 10-meter open area test site. The emissions from the EUT are measured continuously at every azimuth by rotating the turntable. Dipole and log periodic broadband antennas are mounted on an antenna mast to determine the height of maximum emissions. The height of the antenna is varied between 1 and 4 meters. Cables are varied in position to produce maximum emissions. Both the horizontal and vertical field components are measured.

The output from the antenna is connected to the input of the spectrum analyzer. The detector function is set to quasi-peak. The resolution bandwidth of the spectrum analyzer system is set at 120 kHz, with all post-detector filtering no less than 10 times the resolution bandwidth. All emissions within 20 dB of the limit are recorded in the data tables.

To convert the spectrum analyzer reading into a quantified E-field level to allow comparison with the CISPR limits, it is necessary to account for various calibration factors. These factors include

cable loss (CL) and antenna factors (AF). The AF/CL in dB/m is algebraically added to the Spectrum Analyzer Voltage in dbμV to obtain the Radiated Electric Field in dBμV/m. This level is then compared with the CISPR limit.

Example:

Spectrum Analyzer Volt: VdBuV

Composite Factor: AF/CLdB/m

Electric Field: EdBμV/m = VdBμV + AF/CLdB/m

Linear Conversion: EuV/m = Antilog (EdBμV/m/20)

CISPR 22 CLASS B RADIATED DATA

CLIENT: Berkeley Varitronics
EUT: The Fox
CPU:

10-METER TEST

FREQ MHz	POL H/V	SPEC A dBuV	AF/CL dB/m	E-FIELD dBuV/m	E-FIELD uV/m	LIMIT uV/m	MRGN dB
41.82	V	10.0	17.0	27.0	22.4	32.0	-3.1
56.54	H	15.0	11.0	26.0	19.9	32.0	-4.1
65.13	H	19.0	8.0	27.0	22.4	32.0	-3.1
78.63	H	20.0	8.0	28.0	25.1	32.0	-2.1
121.61	H	19.0	14.0	33.0	44.7	70.0	-3.9
138.83	H	16.0	15.0	31.0	35.5	70.0	-5.9
156.02	V	09.0	16.0	25.0	17.8	70.0	-11.9
168.96	V	16.0	17.0	33.0	44.7	70.0	-3.9
175.67	H	16.0	18.0	34.0	50.1	70.0	-2.9

TEST ENGINEER

Bijan Haghtalab

CISPR 22 CLASS B CONDUCTED DATA

CLIENT: Berkeley Varitronics
EUT: The Fox
CPU:

LINE 1 - NEUTRAL

FREQ MHz	QUASI PEAK dBuV	AVERAGE dBuV	QP LIMIT dBuV	AVG LIMIT dBuV
0.156	46.8	45.3	64	54
0.421	36.7	35.1	62	52
1.824	40.1	39.6	59	49

LINE 2 - PHASE

FREQ MHz	QUASI PEAK dBuV	AVERAGE dBuV	QP LIMIT dBuV	AVG LIMIT dBuV
0.156	46.4	45.1	64	54
0.421	35.7	34.4	62	52
1.824	41.2	40.7	59	49

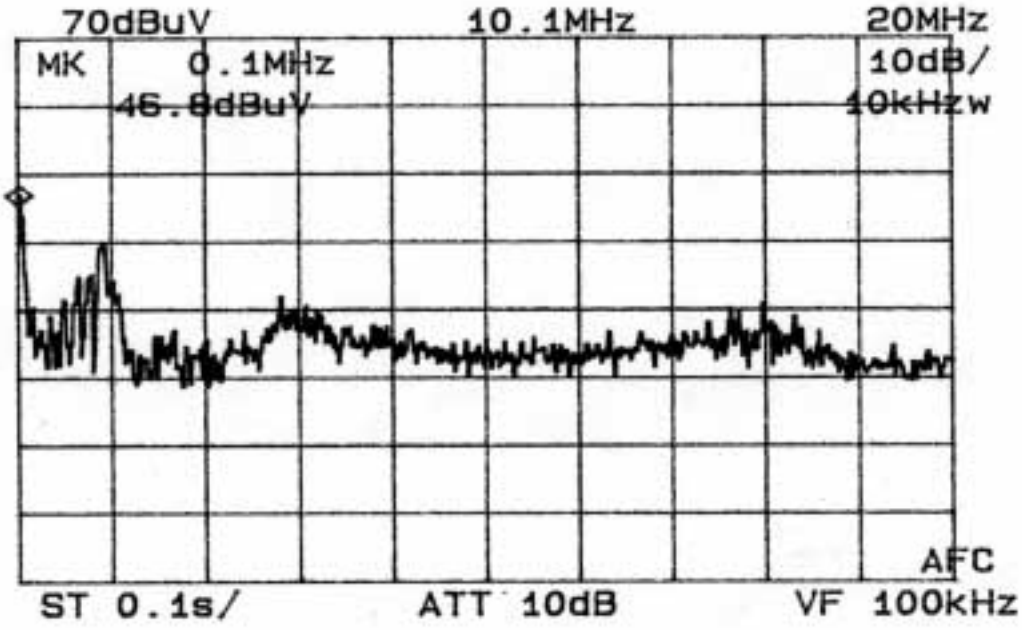


Table 1

Interface Cables Used

RS-232	1.8 meter RJ-11 bundled to 1 meter in length - unshielded
Phono Cable	1 meter coaxial cable
Power Cable	Unshielded 120 VAC power cord
All other I/O cables such as monitor, keyboard, mouse are permanently attached to the peripherals - presume shielded.	
Note: There are no ferrite beads attached to any I/O cables for this test.	

Table 2

Measurement Equipment Used

The following equipment is used to perform measurements:

EQUIPMENT	SERIAL NUMBER
Wavetek 2410A 1100 MHz Signal Generator	1362016
EMCO Model 3110 Biconical Antenna	1619
EMCO Model 3146 Log Periodic Antenna	1222
Solar 8012-50-R-24-BNC LISN	924867
Advantest Model R4131D Spectrum Analyzer	54378A
Solar 8012-50-R-24-BNC LISN	927230
4 Meter Antenna Mast	None
Motorized Turntable	None
RG-233U 50 ohm coax Cable	None