Champ

manual version 5.1

OPERATIONAL TIPS - BEFORE YOU START

1) Before taking any measurements with the **CHAMP**™, first take the supplied CD-ROM from its antistatic bag. From the DOS text editor or suitable word processor, open and print out the following files. READ.ME and CHAMP.MAN. Read these files prior to reading the accompanying manual. These files will contain the most current information on the **CHAMP**.

2) Do not under any circumstances, turn the GPS switch located on the front case ON or OFF while the **CHAMP** is in use. The power surge required by the GPS module will cause the unit to reset. Any setup information entered prior to operating the GPS power switch on the **CHAMP** will be lost. If the unit is to be used in taking measurements requiring GPS information, put this switch in the 'ON' position and then turn the unit power on. The GPS switch has been included because the GPS receiver's power needs are the greatest in the unit as a whole. If you are taking measurements to determine building penetration, the GPS will most likely not be needed and therefore should not be turned on during this testing.

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

4) 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.

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

6) 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.

7) Be very careful to be familiar with and follow the instructions for exiting the **CHAMP** 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 **CHAMP** to record the selection made, and therefore must preceed turning off the unit.

8) It is recommended that you set the unit up to take the fewest number of measurements per reading period in order to reduce the final size of the data file. For example, approximately 1.7 Mbytes of data taken from the PCMCIA card will expand to over 7.0 Mbytes of file size once the information is converted to tab delimited ASCII. The ASCII format data can be saved as an Excel spread sheet for post measurement analysis by following the instructions in the Champ.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).

9) If the PC used to download the PCMCIA was running Windows, reenter Windows before downloading from a DOS screen. Use the system select to change COM PORT flow control to "Hardware." If the computer used to download the PCMCIA card boots up in Windows (3.1 or 95), do the following BEFORE attempting to download the Champ PCMCIA card:
1) Enter WINDOWS®
2) Select the MAIN menu (win 95 "Mycomputer")
3) Select CONTROL PANEL, when in, select PORTS (win 95 system/device manager)
4) Set COM 1 or COM 2 (depending on which is to be used) FLOW CONTROL to "HARDWARE" or "OFF". The nor mal setting for this option is "XON-XOFF". Flow Control MUST be set to the "HARDWARE" or "OFF" option for download to work reliably.
5) Enter MS-DOS® and use Champ.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

CHAMP 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. **CHAMP** 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

- **CHAMP** 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 **CHAMP** 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

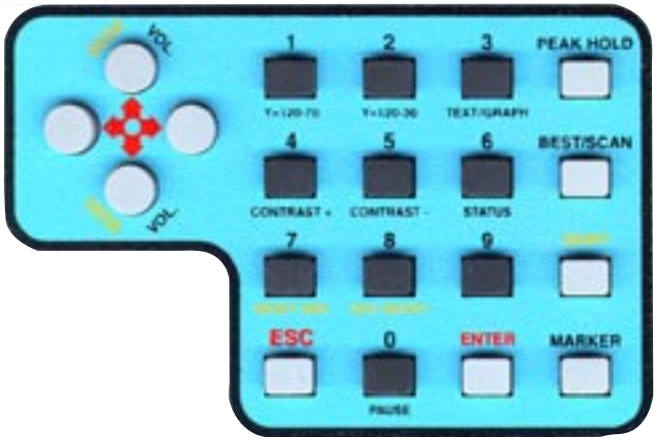
- Internal differential GPS 8 channel receiver uses an active antenna, which can magnetically attach to the roof of a vehicle

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 or	Enter frequency (or channel #) for position marked by cursor (CO, ADJ, 20 CHAN) 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 >100dbm
SHIFT + BEST/SCAN	Seek next lower freq >100dbm
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 **CHAMP** 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.

Champ 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 down load PCMCIA card, collect measurements with laptop or PC (RF Dump mode on), print er 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

6 ON/OFF power switch

7 IF Filter change

Charging/Fast Charging

FAST CHARGING LED (yellow) - When lit, indicates **CHAMP** is connected to supplied fast charge power supply. For best results, charge with **CHAMP** turned OFF. 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 Champ's internal batteries are fully charged, the charge light will go off.

LOW BATT LED (red) - When lit, indicates battery is low and the **CHAMP** 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 **CHAMP** 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 **CHAMP**'s internal batteries need charging. As soon as the LOW BATT light comes on, you should stop making measurements and plug the Champ into the appropriate charging jack.

Trickle Charge: Charges the **CHAMP**'s internal batteries overnight (approx. 8 hours).If the FAST CHARGING light is off and the **CHAMP** 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 **CHAMP**'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.

CAUTION: The GPS switch at the upper right of the panel should only be switched ON or OFF when the unit's main power is off. Never turn the GPS switch ON or OFF while the Champ is running.

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

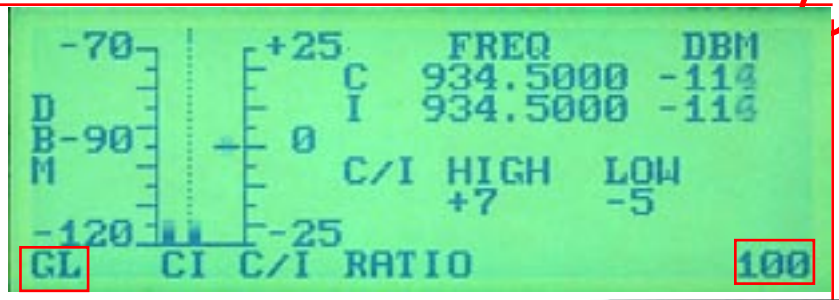
MAIN MENU

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 **CHAMP** you have purchased. This manual covers all **CHAMP** models (except for EAMPS) so some menus may not apply to your own custom Fox.

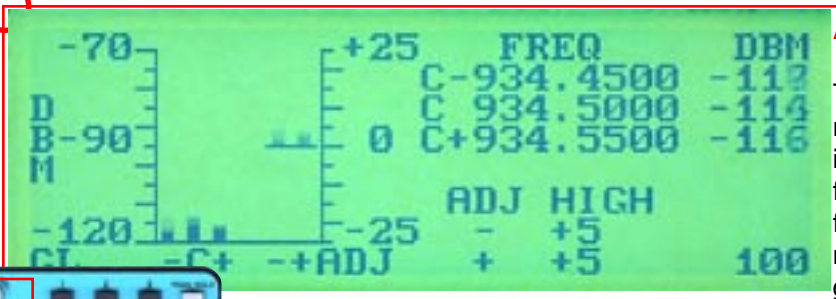
The current GPS status is displayed in the lower lefthand comer of the display. If GL appears, it means the GPS is locked to at least 3 satellites and LAT/LON is valid. If "DL" appears, it means the GPS is DIFFERENTIAL locked to at least 3 satellites and LAT/LON is valid. If "??" is displayed, it means 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.

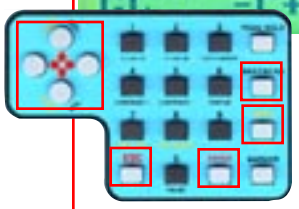
C/I RATIO

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

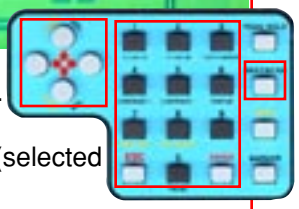
The adjacent channel measurement is used to measure any frequency and the two frequencies immediately adjacent to it. To select the center frequency, press ENTER and enter the center frequency. This measurement displays the dBm readings of all three frequencies in both bar graph and digital formats. 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

CHAMP 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.)

Each AD sample of RSSI takes the CHAMP 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).

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

NOTE: The **CHAMP** 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.

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

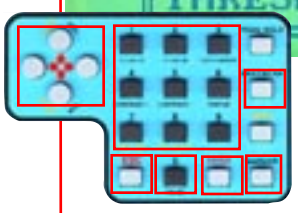
This feature is only available for the following measurements:

20 CHAN, VAR SWEEP, 1 MHZ SWEEP

1 CHANNEL MEASUREMENT

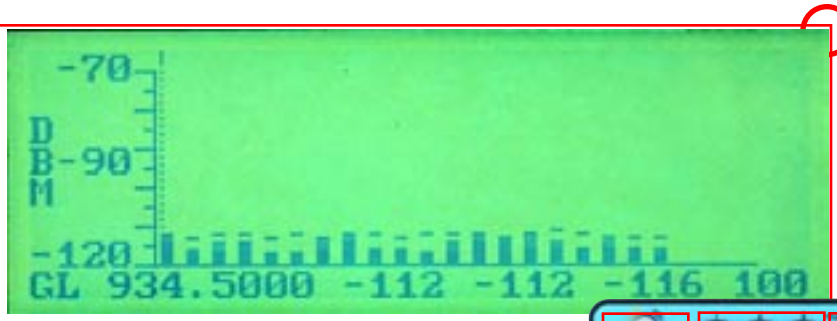
This measurement is used to monitor one frequency on the display in “oscilloscope” fashion. Before the measurement begins, select the number of samples taken for each reading. Use the right or left arrow key to place the check mark next to the desired number of samples (64, 128, 256, 512, or 4096) per 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 **CHAMP**’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.

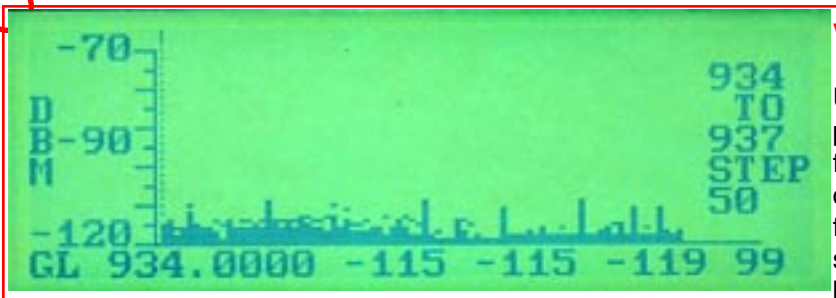
When using the bar graph screen, all 20 selected frequencies are displayed along the X axis in the order that they were entered. In addition, the frequency ‘marked’ by the vertical dotted line cursor is displayed in text below the X axis. This cursor can be moved by either left or right arrow keys. Data 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

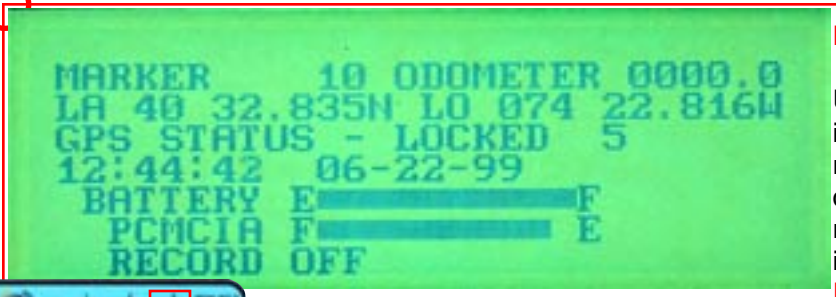
Use this measurement to display a selected portion of the frequency band. Enter the start frequency of the sweep, the end is automatically calculated based on the frequency step. The frequency step can be adjusted during the measurement using the UP and DOWN ARROW keys. The current sweep start, end and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

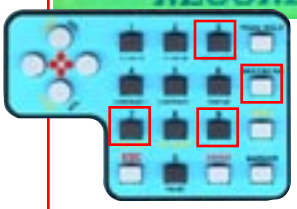
1 MHZ STEP MEASUREMENT (optional)

This measurement sweeps 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), and increasing by the step frequency towards the right side of 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 cursor position and change 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 **CHAMP**. 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 **CHAMP** comes standard with a 8 Megabyte SRAM memory card. To view data collected on the **CHAMP** 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 **CHAMP**. 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 **CHAMP** in the field, record some test data on the PCMCIA card. Then verify download using the PC that will be used later for downloading field data.

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

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

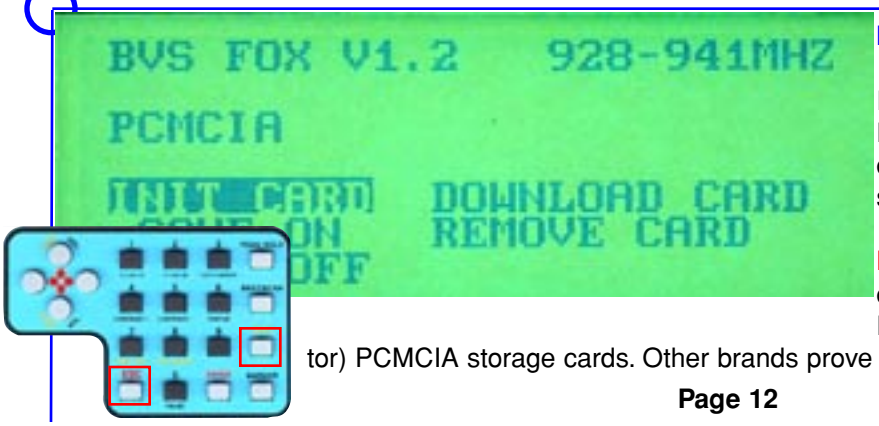
If the PCMCIA SAVE ON option is checked ON, the key sequence SHIFT+8 can be used during any measurement to toggle the PCMCIA save on and off. The status of PCMCIA save can be determined by looking at the lower right hand corner of the measurement display as follows:

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

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

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

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

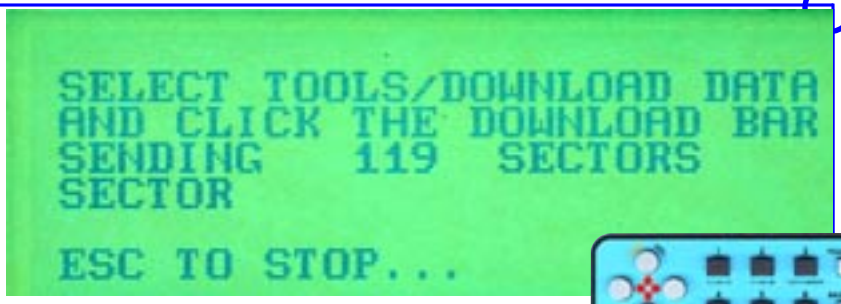


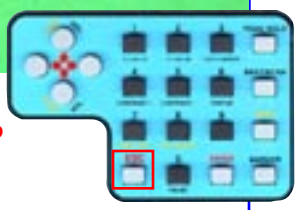
INITIALIZE PCMCIA CARD

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 **CHAMP** receiver.

DOWNLOAD DATA

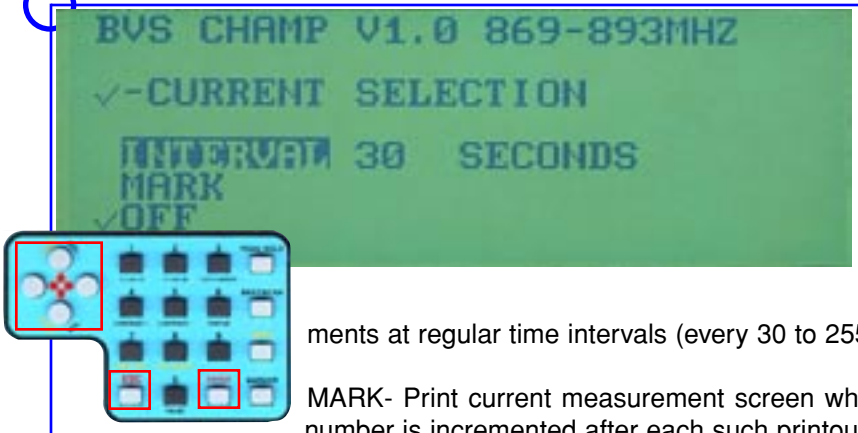




Use this menu option when you are ready to download your collected data from the **CHAMP** to your PC. If the PC used to download the PCMCIA was running Windows, reenter Windows before downloading from a DOS screen. Use the system select to change COM PORT flow control to “Hardware.” If the computer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



PRINTER

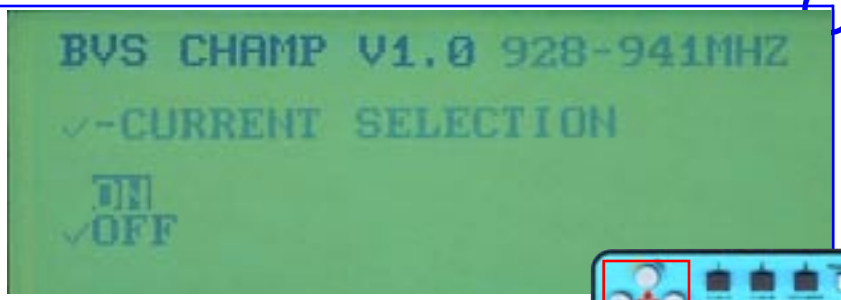
Move the check mark next to the desired option and press enter. The RF DUMP and PRINTER functions share a common serial port so when one is selected ‘ON’, the other is automatically shut ‘OFF’.

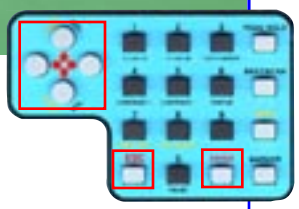
INTERVAL- Printing will occur during measurements at regular time intervals (every 30 to 255 seconds).

MARK- Print current measurement screen when the MARKER key is pressed. The MARKER number is incremented after each such printout.

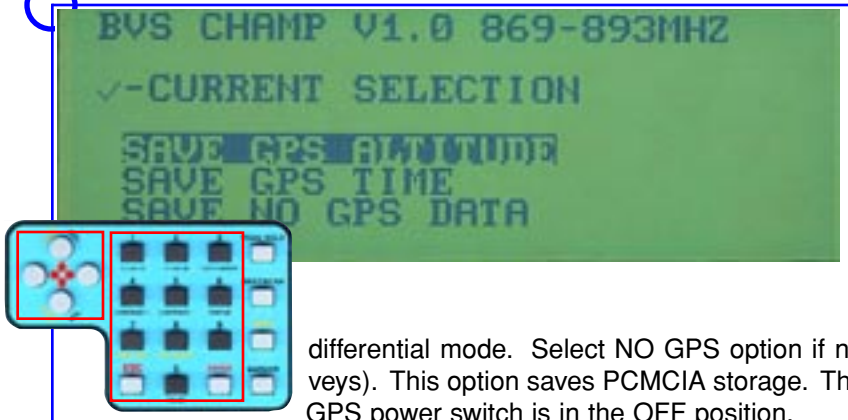
OFF- Set to OFF if not using printer. If RF DUMP option is used, printer is unavailable (forced ‘OFF’).

RF DUMP TO PC





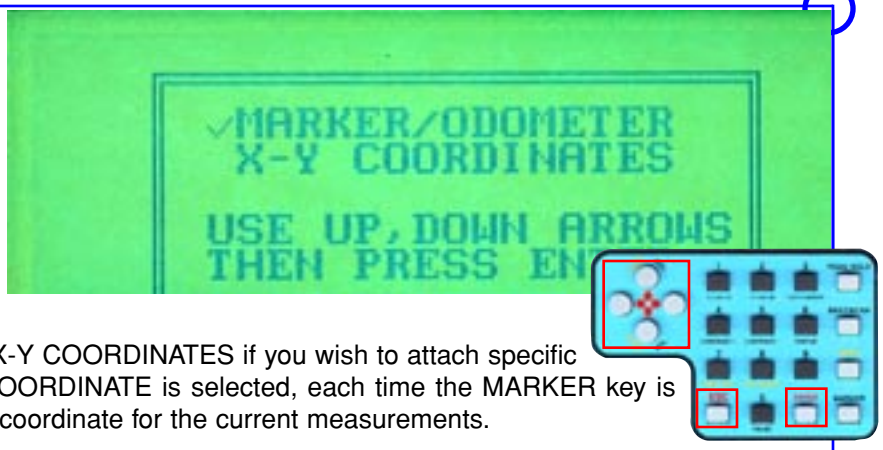
RF DUMP is used to save real time data on a PC compatible computer via the serial connection on the **CHAMP**. All of the data for current measurements is saved in a disk file using the “Champ.EXE” PC program. The RF dump mode can be used to provide a backup to the PCMCIA data or in situations where 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.



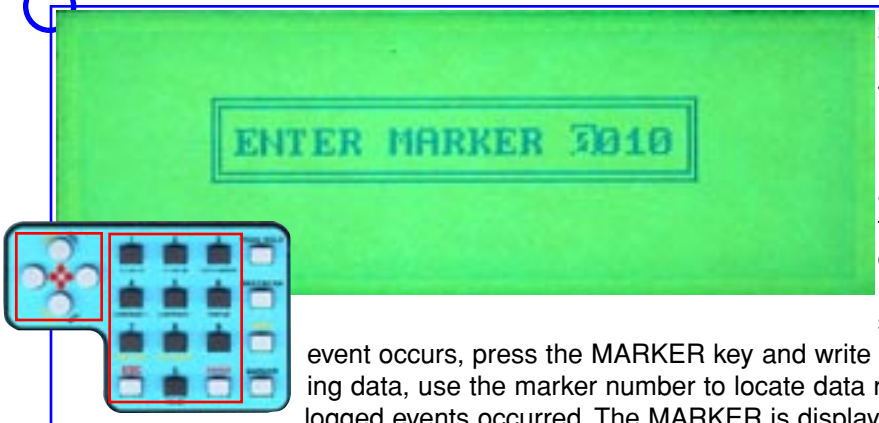
GPS

CHAMP allows additional GPS data to be saved on the PCMCIA card during measurements. ALTITUDE and GPS TIME can be selectively included along with Latitude and Longitude. Use the GPS sub-menu to select the GPS data required. Note that GPS ALTITUDE requires the GPS receiver to track 4 satellites and that ALTITUDE is subject to large errors when not in differential mode. Select NO GPS option if no GPS data is required (as in during building surveys). This option saves PCMCIA storage. This mode is automatically selected by **CHAMP** if the GPS power switch is in the OFF position.

MARKER TYPE



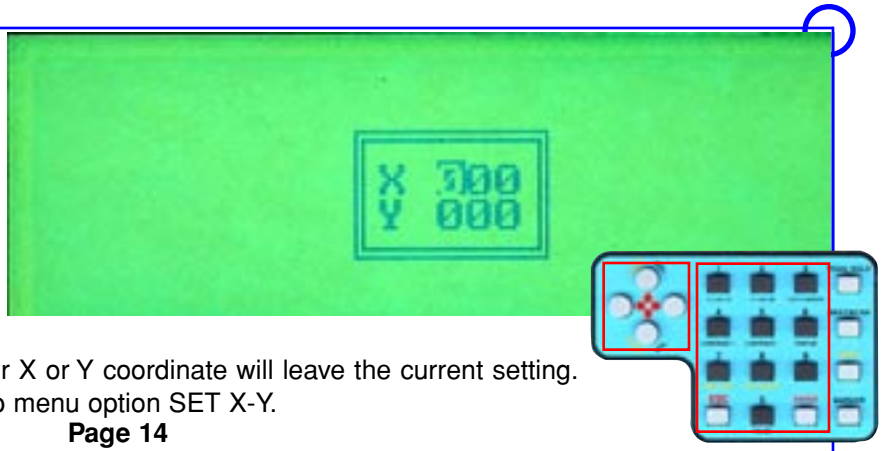
Use this selection under the SETUP MENU to determine the way in which you plan to log your events. When MARKER / ODOMETER is selected, a mark may be attached to a study based upon PP MILE settings. In this setting the MARKER key works as in prior versions during measurements and the odometer reading 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.



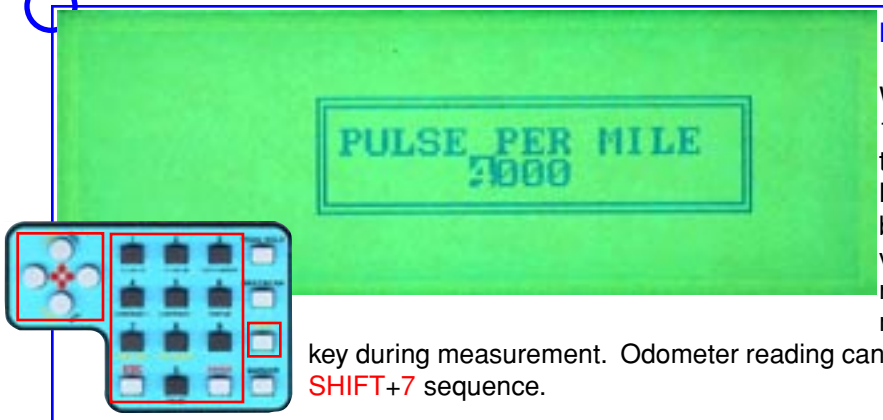
SET MARKER NUMBER

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 **CHAMP** 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 **CHAMP** 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.

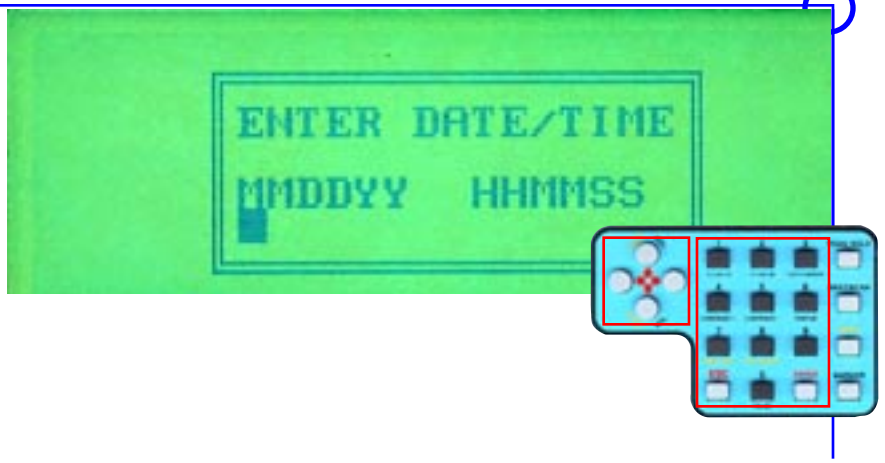


PP MILE ODOMETER SETTING

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 **CHAMP** 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.

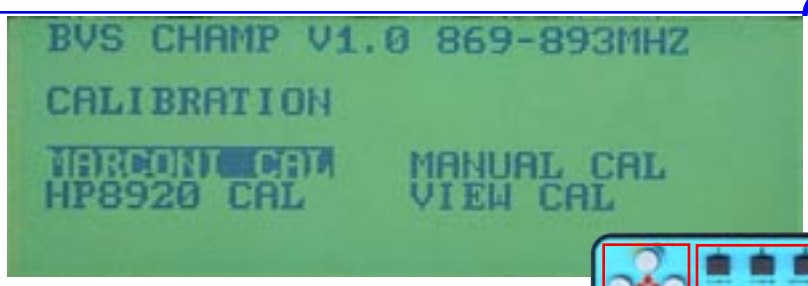


BACKLIGHT CONTROL

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.

CALIBRATION MODES



Note: A 3 dB pad is required at the input connector of the **CHAMP** for proper calibration. This pad negates any reactive properties of the signal generator or interconnecting coaxial cable. The internal software and A/D convertor inside the **CHAMP** compensates for this pad during the calibrate mode. Be sure to remove this pad after completing the calibration procedure. Calibration of the **CHAMP** by the end user is an uncommon procedure. BVS maintains all

CHAMP recalibration as standard factory procedure offering it free of charge to all CHAMP customers.

AUTO CALIBRATION

MARCONI OR HP AUTO CAL

MARCONI: 2995A with 2960 option (serial port)
HP: 8920 with serial port option

Connect the CHAMP to a TEST SET (HP or MARCONI) using a 3 dB pad as shown in diagram. Set the MARCONI or HP as follows:

Both the MARCONI and the HP must be 9600 baud, 8 bit data, 1 stop bit and no parity.

To set the MARCONI:
1) Press CRTS and wait for the menu screen.
2) Select FULL AUTO TEST
3) Select CHANGE FORMAT
4) Select PAGE 2
5) Select INTERFACE and:

Set BAUD RATE to 9600
Set LENGTH/PARITY IS to 8/NONE
Set STOP BITS IS to 1

To set the HP:
Press SHIFT CONFIG and select the following options:

PRINT TO:	SERIAL
PRINT:	CANCEL
SERIAL IN:	INST
IBASIC ECHO:	OFF
INST ECHO:	OFF
SERIAL BAUD:	9600
PARITY:	NONE
DATA LENGTH:	8 BITS
STOPLENGTH:	1 BIT
RCV PACE:	NONE
XMT PACE:	NONE

When the TEST SET is ready, select the appropriate menu item for the test being used (MARCONI or HP 8920) and press enter. The CHAMP will take over from this point, no further action is required until the calibration is complete (2-3 minutes). Use VIEW CAL menu item to verify results.

NOTE: be sure to escape the calibrate screen before shutting-off the power, to allow the CHAMP to save the calibrate values in NVRAM.

MANUAL CALIBRATION

To calibrate in the manual mode connect the CHAMP to the test set using a 3 dB pad.

dBm CALIBRATION

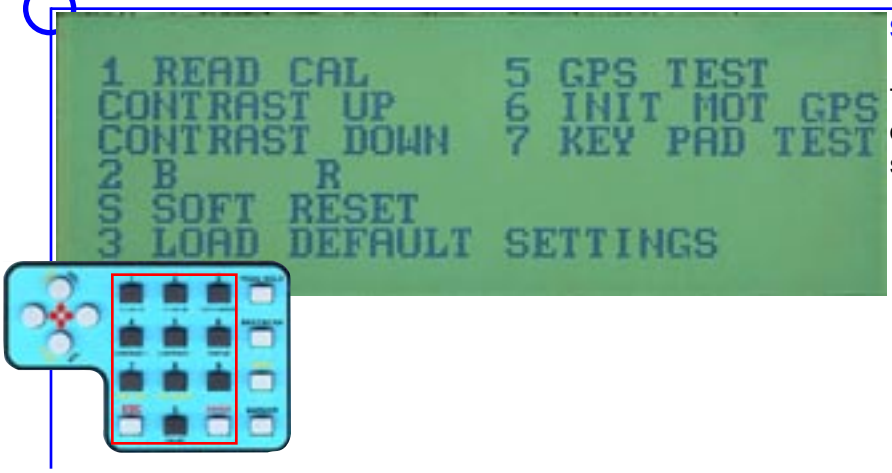
Set the test set to the frequency on the top line of the display at the level indicated (also on the top line). When A/D display is stable (not changing by more than 3 counts), press the up arrow key and set the next level indicated on the top line. The down arrow key can be used to repeat (go back) one step.

FREQUENCY CAL

When the dBm calibration is complete, the manual Cal screen will prompt for the frequency calibration settings. As in the dBm calibrate procedure, set TEST SET to the frequency and level indicated on the top line. Wait for the A/D reading to settle and press the up arrow to proceed to next.

VIEW CAL

After calibration (MANUAL or AUTO), use the VIEW CAL screen to verify the results. The resulting dB vs. percentage of a-to-d reading graph should be a continuous line (no breaks or discontinuities). It will not be exactly straight (the slope will change slightly in places), but this is normal.



SELF TEST

This menu option runs a series of rudimentary dignostics and calibrations on your **CHAMP** singal strength meter.

Pulses Per Mile (PPM) Settings

Note: Champ setup parameter, Pulses Per Mile (PPM), must be set to a minimum value of 10.

Tested:

Signal source: pulse generator (0-12v) pulses.

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

CHAMP PC SOFTWARE

IMPORTANT NOTE WHEN USING PCMCIA DOWNLOAD

a) Enter WINDOWS
b) Select the MAIN menu (win 95 “Mycomputer”)
c) Select CONTROL PANEL, when in, select PORTS (win 95 system\device manager)
d) Set COM 1 or COM 2 (depending on which is to be used) FLOW CONTROL to “HARDWARE” or “OFF”. The normal setting for this option is “XON-XOFF”. Flow Control MUST be set to the “HARDWARE” or “OFF” option for download to work reliably.
e) Enter DOS and use CHAMP.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 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.

DOWNLOAD DATA TO PC

1) Connect the cable supplied marked “DOWNLOAD” to the serial interface jack on the back of the champ.
2) Connect the DB-9 end of this cable to the PC serial port COM 1.
3) Place the disk supplied in the A: drive of the PC after turning on the PC and running MS-DOS (not Windows).
4) Make a directory for the champ software.
Type: MD CHAMP
5) Change to the directory just created.
Type: CD CHAMP
6) Copy the champ pc software to this directory.
Type: COPY A:CHAMP.EXE
7) Run the champ pc software.
Type: CHAMP
8) When prompted for ADTRON drive letter, press ENTER if not using or the drive letter of the ADTRON drive.
9) On the champ, select the CHAMP SETUP menu and press ENTER. Select PCMCIA and press ENTER. Select DOWNLOAD CARD and press ENTER.
10) On the PC, press ‘D’ (DOWNLOAD PCMCIA CARD).
11) Enter the name of the PC file that will receive the download data. EXAMPLE: Type rfdata.bin
12) The data from the champ will be saved in a pc disk file called “rfdata.bin”. The PC and CHAMP display will report when the download is complete.
13) NEVER re-init the PCMCIA card until the above step and the following step (VIEW) is complete.
14) VIEW the download data file “rfdata.bin”.

OVERVIEW

Use the supplied PC software (must be run from DOS, NOT Windows) to do the following:

1. Download data from the CHAMP PCMCIA card into a DOS disk file for further processing.
2. Collect REAL TIME measurement data using the PC serial port and save in a DOS disk file for further processing.
3. Use an ADTRON SOLIDSTATE DATA DRIVE Model SDD-R-PCC to transfer data from the CHAMP PCMCIA card to a PC disk file.
4. Convert data collected from the CHAMP into ASCII TAB delimited format for use with TEC CELLULAR WIZARD,EXCEL,MAP INFO or PLANET PC software.
5. Plot data collected vs. LAT-LON or vs. TIME (FAST FADE).

SUPPLIED DISK CONTENTS

Root Directory files:

CHAMP EXE Execution file
CHAMP MAN Text manual - CHAMP operation

```
PC        MAN       Text manual - CHAMP PC software
READ      ME        Latest Info
1CH       BIN Example 1 chan data file
FADE      BIN Example fast fade data file
CHAMP     MOD Champ Model File
C_TO_F    TXT      Ascii chan to freq conversion table
SOURCE   <DIR>      Source code directory

Directory <SOURCE> files:

CHAMP     PRJ Borland Project file
CHAMP     H         header file
ADTRON    H         header file
COM       H         header file
ASCII     C         source 'c' file
CHAMPSER  C         source 'c' file
COM       C         source 'c' file
CHAMP     C         source 'c' file
MISC      C         source 'c' file
POCSAG    C         source 'c' file
PLOT      C         source 'c' file
EGAVGA    OBJ plot ega-vga driver
BINARY    TXT binary data formats
ASCII     TXT ascii data formats
```

Source files are supplied for users who may wish to modify the way the PC software displays or converts CHAMP data. To compile the pc software you must use BORLAND Version 3.00 (DOS ONLY VERSION) - not supplied.

INSTALLATION

NOTE: All example DOS commands given are typed as given and followed by pressing the Enter key.

1) Make a directory on the PC that will be used with the CHAMP. Example: md CHAMP

2) Copy all files from the supplied disk Root Directory into the directory just created. EXAMPLE (assumes supplied disk in in the 'A' floppy drive): copy a:*.* champ

3) To run the CHAMP PC SOFTWARE, change to the champ directory created, Example: cd champ

4) Run the CHAMP PC program, EXAMPLE: champ

NOTE: All files required by or created by the champ pc software will reside in the same directory as the champ pc software itself.

CHAMP PC SOFTWARE STARTUP SCREEN AND PROMPTS

After starting the CHAMP PC software, the following screen is displayed on the PC:

```
BVS CHAMP PCMCIA CARD and SERIAL PORT Interface Vx.xx
Copyright (c) 1997
Berkeley Varitronics Systems, Inc.,Metuchen, N.J. 08840 908-548-3737

For use with ADTRON SolidState Data Drive (tm) Model SDD-R-PCC
Enter ADTRON SolidState Data Drive (tm) drive letter
A-F or ENTER if not using the ADTRON drive:
```

If using the ADTRON DRIVE, type its drive letter. If not, just press ENTER. The program now prompts the following:

Use COM Port 1 or 2 For RF DUMP and PCMCIA DOWNLOAD
Press 1 for COM 1 or 2 for COM 2 ?

Press 1 if the CHAMP will be connected to the PC COM PORT 1 (the most common connection), press 2 if connected to PC COM PORT 2.

The MAIN MENU will now be displayed.

PC SOFTWARE MAIN MENU

BVS CHAMP PCMCIA CARD and SERIAL PORT Interface Vx.xx
MAIN MENU

Press:R to Collect Serial RF Dump data
D Download PCMCIA Card using the PC serial port

1 to display ADTRON PCMCIA data
2 display ADTRON PCMCIA data and save in disk file

3 display PCMCIA or RF Dump disk file data
P to plot PCMCIA or RF Dump disk file data

O to change POCSAG FC overrides, Turn ON-OFF
M to change POCSAG match Cap Code

4 to view or create CHAMP model file

Esc to quit ?

PC SOFTWARE MAIN MENU OPTIONS

To select a main menu option, type the letter or number of the option. Options 1 and 2 require the ADTRON drive. Options 3,P can be used with data file “1ch.bin” supplied.

OPTION

R- Enter RF DUMP (Serial interface) menu.
D- Download PCMCIA card data into DOS disk file.

note: option 1,2 appear only if using the ADTRON drive

1- Displays champ measurement data contained in the PCMCIA card (read by the ADTRON).
2- Same as option 1 and data is written to PC disk file.
Disk file name is supplied by user.

3- Display data contained in file previously saved using option ‘D’ or RF DUMP menu option ‘1’ and convert to ASCII.

P- Plot data contained in file previously saved using option ‘D’ or RF DUMP menu option ‘1’. The PC must be equipped with a VGA display.

O- Use to OVERRIDE the CHAMP POCSAG FC settings. If these settings are not correct, POCSAG messages will not be decoded properly on the PC screen.

M- Enter POCSAG Cap Code to match and pause display, enter 0 to turn matching OFF.

4- CHAMP MODEL MENU - create or view CHAMP model file that is used by the PC software for chan to frequency conversion.

ESC - Return to MS-DOS.

Option 3 and P require the name of a data file. For demonstration, enter the name “1ch.bin”, the BVS supplied example file.

MAIN MENU and RF DUMP ‘D’ OPTION

Use to copy the contents of the CHAMP PCMCIA card to a PC disk file using the PC serial port.

PCMCIA SERIAL DOWNLOAD PROCEDURE

Step #

1-Connect CHAMP to the PC COM port selected using the supplied cable marked ‘PCMCIA DOWNLOAD’.
2-Make sure PCMCIA card to download is in the CHAMP card socket and fully engaged.

Using the CHAMP keypad:

3-Enter the SETUP-PCMCIA MENU.
4-Select (highlight) the DOWNLOAD option.
5-Press CHAMP ENTER key. Champ LCD will show # of pages that will be sent (each page = 8192 characters)

Using the PC keyboard and “CHAMP” PC software:

6-Select MAIN MENU or RF DUMP MENU option ‘D’.
7-Enter name of PC disk file to save the data in when prompted.
8-Press PC ENTER (or RETURN) key.

Both the PC screen and CHAMP lcd will report download progress until the download the is complete.

IMPORTANT NOTE:
Before collecting data using the CHAMP 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. Some PC’s will not download properly. If this problem occurs, try booting the computer with MICROSOFT DOS v5.0 and try again. If using WINDOWS, run the CHAMP PC Software from a DOS WINDOW. Find some combination of computer/DOS that will download BEFORE taking the CHAMP into the field.

MAIN MENU ‘R’ OPTION

RF DUMP MENU DISPLAY

RF Dump and PCMCIA Download Menu

Press:1 to display COM 1 RF Dump data
D Download PCMCIA Card

Esc key to return

OPTION

1 - Real time results of current CHAMP measurement are displayed on PC. If a disk file name is supplied when prompted, the RF Dump data will be saved in this disk file.

D - Collect data saved on CHAMP PCMCIA card and save to PC disk file. User supplies file name. After data is ‘downloaded’ using this option, it can be displayed and printed using MAIN MENU option 3 or plotted using option P.
Option D is the same as the ‘D’ option in the main menu.

RF Dump OPTION 1

Use to view and save real time data from the CHAMP using the PC serial port.

RF DUMP OPTION 1 PROCEDURE

Step #

1-Connect CHAMP to the PC COM port selected using the supplied cable marked ‘PC SAVE’.

Using the CHAMP keypad:

2-Enter the SETUP-RF DUMP MENU.
3-Select (highlight) the ON option (put check mark next to ON).
4-Return to the CHAMP MAIN MENU.
5-Highlight the measurement to view and save to disk.

Using the PC keyboard and “CHAMP” PC software:

6-Select RF DUMP option ‘1’. Enter a file name when prompted
to save the data into.

Using the CHAMP keypad:

7-Start the measurement (press Enter). If all is connected correctly, data will appear on the PC Screen within 2 seconds (depending on the measurement selected - VAR SWEEP takes the longest if all 160 channels are being scanned).

MAIN MENU ‘1’ and ‘2’ OPTIONS

Use to view or view/save data from the CHAMP PCMCIA card using the ADTRON Card Reader. These options will only appear in the MAIN MENU if the ADTRON DRIVE is being used (a drive letter was supplied when the PC software was started).

MAIN MENU OPTION 1 PROCEDURE

Step #

1-Place the CHAMP PCMCIA card into the ADTRON Card Reader.
2-Select MAIN MENU OPTION 1.
3-Data is displayed on the PC Screen till the end of data.
PC Space BAR can be used to pause-unpause the display, ESC to return the MAIN MENU.

MAIN MENU OPTION 2 PROCEDURE

Note: This option is the same as the ‘D’ (serial download) option but is about twice as fast.

Step #

1-Place the CHAMP PCMCIA card into the ADTRON Card Reader.
2-Select MAIN MENU OPTION 2.
3-When Prompted “Save File Name:”, enter the name of the
PC disk file to save the PCMCIA card data into.

4-When Prompted “Display (Y or N)”, press ‘Y’ if you wish to view the data as it is saved to disk. Press ‘N’ to just display the save file disk status. The ‘N’ selection is faster then the ‘Y’ since no data is displayed.

When complete, you can return to the MAIN MENU and use OPTION '3' to convert-display the data or the 'P' OPTION to plot the data saved in the disk file.

MAIN MENU '3' OPTION

Use to view and convert to ASCII the contents of a CHAMP data file collected via the 'D' (PCMCIA Download option) or RF DUMP MENU option '1' (Real Time Serial Data).

MAIN MENU OPTION 3 PROCEDURE

Step #

1-Press '3' from the MAIN MENU, and enter the name of the file to view and convert to ASCII when prompted.

2-The following prompt will now appear:

WIZARD, MAPINFO-PLANET,EXCEL Tab delimited OUTPUT
Enter FILE NAME for disk file output
Press P for printer output
Or press ENTER for output to terminal only:

3-Enter the name of the ASCII output file. Use file extension '.XL' if the ASCII file will be imported into EXCEL, use '.TXT' otherwise. If an ASCII file is not required (just view data), just press ENTER.

4-If a file name for ASCII conversion was entered in step 3 above, the following prompt will appear:

Press W for TEC CELLULAR WIZARD format
M for Mapinfo-Planet format
E for EXCEL format ?

5-Press 'M' if the ASCII file will be used by MAP INFO or PLANET. Press 'E' if the ASCII file will be used by TEC CELLULAR WIZARD.

The conversion and display will now begin. To pause and un-pause the display, press the SPACE BAR. To stop the conversion-display, press the ESC key. The conversion-display will continue until the end of the data is reached.

MAIN MENU 'P' OPTION

Use to view the contents of a CHAMP data file collected via the 'D' (PCMCIA Download option) or RF DUMP MENU option '1' (Real Time Serial Data) in a graphic format. The PC must be equipped with VGA graphics (color recommended).

MAIN MENU OPTION P PROCEDURE

Step #

1Press 'P' from the MAIN MENU, and enter the name of the file to view when prompted.

The PC will display the following if the data file does not contain FAST FADE data:

Scanning RF Dump File xxxx.xxx Please Wait....

(if the data file was collected via RF DUMP option 1)

Scanning Download File xxxx.xxx Please Wait....

(if the data file was collected via ‘D’ option)

The entire file will be scanned to determine the dBm and LAT-LON limits. If the message:

Not enough GPS data to plot...

is displayed, there was not enough valid (or the GPS was off) GPS data to create a dBm vs. LAT-LON plot.

Otherwise, the dBm data will be displayed vs. LAT (y axis) and LON (x axis). If the measurement contains more than one channel, you will be prompted to select a frequency to plot.

After the data is displayed, press any key to return to the main menu.

MAIN MENU ‘O’ OPTION

This option is only used if the CHAMP is equipped with POCSAG decoding.

Use to change the POCSAG FC overrides, Turn ON-OFF Override

Press ‘O’ and the following screen is displayed:

FC codes only effect how POCSAG data words are interpreted. However, if the FC code message types are not correct, decoded messages are not displayed properly on either the PC screen or or the CHAMP display. Use this MENU to change the FC message types in case they were not set correctly on the CHAMP.

To set FC message types on the CHAMP, use DATA MENU function SELECT FC.

POCSAG FC OVERRIDES

FC 00 -- Alpha-Numeric
FC 01 -- Tone Only
FC 10 -- Numeric Only
FC 11 -- Unused

OVERRIDE is - ON

Press: 0 to change FC 00 message type
1 to change FC 01 message type
2 to change FC 10 message type
3 to change FC 11 message type
T to toggle override ON-OFF
ESC to save and return

Press 0,1,2 or 3 to change the override for the FC message type. The new setting will then be displayed. When all of the settings are correct, press ESC. Press ‘T’ to toggle the override on-off. When OFF, the defaults are used:

Defaults (override OFF):

FC	Message Type
00	Alpha-numeric
01	Numeric only
10	Numeric only
11	Alpha-numeric

MAIN MENU ‘M’ OPTION

This option is only used if the CHAMP is equipped with POCSAG decoding.

Use this option to change the POCSAG match Cap Code. When viewing POCSAG data, the screen display will stop when a CAP CODE that matches the match CAP CODE is encountered. The display is resumed by pressing the SPACE BAR.

Press ‘M’ and the following prompt will appear:

Enter CAP CODE to match and pause display
Enter 0 to disable match ?

EXAMPLE: Enter 0 to disable match ? 123456

Screen will pause if CAP CODE ‘123456’ is encountered.

EXAMPLE: Enter 0 to disable match ? 0

Cap Code Matching is turned OFF.

MAIN MENU OPTION 4

Use to view or create a CHAMP MODEL INFORMATION FILE. This file is used by the PC software to convert between frequency and channel numbers. This menu should only be used by those upgrading older CHAMP PC software. All current CHAMP’s are supplied with a model file.

MODEL MENU

CHAMP MODEL MENU

Press: V to view model information
C to create model information file

Esc to return to MAIN MENU ?

MODEL MENU ‘V’ OPTION

View model information Display Example

Base Frequency..... 850.0000 MHz
Top Frequency...... 870.0000 MHz
Channel Step....... 12.5 KHz

Channel Numbering.. LINEAR
Firmware Version... 3.60

To return to the MODEL MENU, press any PC Key.

MODEL MENU ‘C’ OPTION

When prompted:
Enter Base Frequency in MHz ?

Enter base frequency in MHz. Example: 869.01

When prompted:

Enter Top Frequency in MHz ?

Enter top frequency in MHz. Example: 893.97

When prompted:
Enter Channel Step in KHz ?

Enter channel step in KHz. Example: 12.5

When prompted:

Press ‘A’ for EAMPS channel numbering
‘T’ for ETACS channel numbering
‘L’ for Standard LINEAR channel numbering ?

Press ‘A’ if the CHAMP is EAMPS model, press ‘T’ if ETACS model,
otherwise press ‘L’.

When prompted:
Enter Firmware Version (x.xx) ?

Enter the firmware version displayed on the CHAMP main menu.
Example: 3.60

After entering the CHAMP Firmware Version, the program will now also create the file ‘C_TO_F.TXT’ used by TEC CELLULAR WIZARD using the model information just supplied.

The PC screen will display:

Creating Chan # to Freq table file...Please Wait...

RF DUMP and PCMCIA DISPLAY OF POCSAG DATA

PC DISPLAY FORMAT EXAMPLE:

Line #

1 Type: POCSAG Data, #xxxx, Marker # xx, Mile xxxx.x 11:08:11 03-31-95
2 tGPS LOCKED #Sat 7 LA 40 33.027N LO 074 23.010W 16:05:47 xxxx.x Meters

3 MHz dbm BPS BER Count Stat #Bits Corrected
4 931.9375 -087 2400.0 0000 $1E

5 SYNC Word 7CD215D80 FC
6 Frame 1 word 1 1A48A080 00430632 00 0 00 Alpha
7 Frame 1 word 2 F415CF99 714-9 0 01 Numeric
8 Frame 2 word 1 CF5A6387 97-23 0 02 Numeric
9 Frame 2 word 2 9499E3ED 49 3 0 03 Alpha
10 Frame 3 word 1 21C5B052 00553322 02 0
11 Frame 3 word 2 8802015F 0 Match 404440
12 Frame 4 word 1 8565302A 0
13 Frame 4 word 2 511FB9C2 01329131 03 0
14 Frame 5 word 1 D16F4B82 Ev 0
15 Frame 5 word 2 D3CF2B76 ery 0
16 Frame 6 word 1 E2E5B955 thi 0
17 Frame 6 word 2 BE609069 ng 0
18 Frame 7 word 1 BD3E7157 reg 0
19 Frame 7 word 2 8D3938E5 ard 0
20 Frame 8 word 1 96EF9D88 ing 0
21 Frame 8 word 2 82CA5FB4 S 0

22 Alpha-Numeric message - Address: 01329131
23 Every thing regarding S

RF DUMP and PCMCIA DISPLAY OF POCSAG DATA

Line # 1 : Header
a. Record Type (POCSAG Data)
b. Record #
c. Current Marker #
d. Current Odometer
e. Time and Date

Line # 2 : a. #Sat 7 - number of satellites in view
b. (LA) Latitude, (LO) Longitude
b. 16:05:47 - gps time
c. xxxx.x Meters - if 4 satellite solution, gps altitude

Line # 3 : Header: BPS,BER Count, Stat
4 : BPS,BER Count, Stat

Stat:

Bit value:	Meaning
$80	Waiting for preamble
$40	Preamble search in progress
$20	Preamble measurement in progress
$10	Bit sync established
$08	Preamble preceded batch
$04	Searching for SYNC word
$02	Batch received
$01	Batch transfer (internal use)

#Bits Corrected Column: displays the the number of bits that were in error for that word (and the number corrected, if < 3).

Line # 5 : Sync word in hex. To the right (line 5-9) is the current FC settings (as set on the CHAMP or PC FC OVERRIDE). Below the FC's is the current MATCH cap code (entered using the M option in the main menu). When a cap code is encountered that matches the display is paused - press any key to continue.

Line # 6-21: Batch data in hex and decimal (address)

Example of an address word:

	hex	decimal	fc	#Bits Corrected
line #13	511FB9C2	01329131	03	0

hex: the corrected address word
decimal: the pager address in decimal
fc: the function code (0,1,2 or 3)
Bits Corrected: 0 in this case,meaning word was received without error

Example of a message word:

hex	decoded data	#Bits Corrected
line #14	D16F4B82 Ev	0

hex: the corrected message word

decoded data: Ev in this case, alpha-numeric since associated address FC was 03.

Decoded data can also contain numeric only data (line #7) when the associated FC is 00.

ASCII CONVERSION FORMATS

COMMON TO ALL ASCII FORMATS:

All fields are TAB delimited.

Measurement type 2-3 letter codes:

UK- unknown
COC- CO chan
ADJ- ADJ chan
1CH- 1 chan
20CH- 20 chan
VAR- var sweep
1MH- 1mhz sweep
POC- pocsag
FF- fast fade

Frequencies are saved in MHz.

For both EXCEL and MAPINFO-PLANET, latitude and longitude are converted to degrees as follows:

Latitude: positive if North, negative if South.
Longitude: positive if East, negative if West

GPS Status is saved with the following codes:

OK- Position is OK to use
OFF- GPS save is off or GPS power is off
W- Position is NOT OK to use (Warn)

ASCII file name extensions

If the ASCII data file is to be imported into EXCEL, use the file name extension .XL as this is the EXCEL default.

If the ASCII data file is to be imported into MAPINFO or PLANET, use the file name extension .TXT

Champ ASCII conversion format, 1 Chan measurement Marker, Odometer MODE

```
row #
|   time
|   |         date
|   |         |         record #
|   |         |         |   marker
|   |         |         |   | odometer
|   |         |         |   | |     measurement type
|   |         |         |   | |     |    gps status
|   |         |         |   | |     |    |  lat deg
|   |         |         |   | |     |    |  |
|   |         |         |   | |     |    |  |
|   |         |         |   | |     |    |  |         lon deg
|   |         |         |   | |     |    |  |         |
|   |         |         |   | |     |    |  |         |
|   |         |         |   | |     |    |  |         |       MHz
|   |         |         |   | |     |    |  |         |        |        dBm
|   |         |         |   | |     |    |  |         |        |         |
|   |         |         |   | |     |    |  |         |        |         |
146 13:20:07 06-14-96 147 1 38.0 1CH OK 40.5453 -74.3806 933.000 -080
|             |         |...
Tab           Tab       Tab...
```

ASCII conversion format, 1 Chan measurement
X, Y Marker MODE

```
row #
|   time
|   |         date
|   |         |         record #
|   |         |         |   X coordinate
|   |         |         |   |   Y coordinate
|   |         |         |   |   |  measurement type
|   |         |         |   |   |  |   gps status
|   |         |         |   |   |  |   |  lat deg
|   |         |         |   |   |  |   |  |
|   |         |         |   |   |  |   |  |
|   |         |         |   |   |  |   |  |            lon deg
|   |         |         |   |   |  |   |  |            |
|   |         |         |   |   |  |   |  |            |
|   |         |         |   |   |  |   |  |            |    MHz
|   |         |         |   |   |  |   |  |            |    |        dBm
|   |         |         |   |   |  |   |  |            |    |        |
|   |         |         |   |   |  |   |  |            |    |        |
146 13:20:07 06-14-96 147 100 20 1CH OK 40.5453 -74.3806 933.000   -080
   |        |         |...
   Tab      Tab       Tab...
```

ASCII conversion format, POCSAG measurement

Marker, Odometer mode

General - each batch is contained in 1 row with time, date, gps data, rf data and batch speed/ber, and batch data as follows:

```
row #
| time       date record #
| |             |     | marker
| |             |     | | odometer
| |             |     | | |     measurement Type
| |             |     | | |     |   GPS status
| |             |     | | |     |   |  lat deg
| |             |     | | |     |   |  |         lon deg
| |             |     | | |     |   |  |          |    freq (MHz)
| |             |     | | |     |   |  |          |       |          dBm
| |             |     | | |     |   |  |          |       |          | Speed (BPS)
| |             |     | | |     |   |  |          |       |          |   |
| |             |     | | |     |   |  |          |       |          |   |      BER
| |             |     | | |     |   |  |          |       |          |   |       |
| |             |     | | |     |   |  |          |       |          |   |       |
| |             |     | | |     |   |  |          |       |          |   |       |
1 09:11:05 06-17-96  2 8 00.0 POC OK 40.5453 -74.3806 933.0000    -080 1200.0 0000
|         |...
Tab       Tab...
```

Speed: Batch data rate in bits per second.
BER: # of bits in error for the following batch.

POCSAG ASCII Conversion Output - Continued

Each word of the batch (sync plus 8 frames of 2 words each) is saved following the BER as follows:

Example of cap code (address word):

```
 address word
 |         # of bits in error
 |         | FC (only valid for address words)
 |         | | frame #
 |         | | | word #
 |         | | | |
 |         | | | |
 |         | | | | cap code
 |         | | | | | message
 |         | | | | | |
 |         | | | | | |
 02097152 0 3 8 1 0
|         | | | | |
Tab       . . . . .
```

Example of data word:

```
 data word
 |           # of bits in error
 |           | FC (always 0 for data words)
 |           | | frame #
 |           | | | word #
 |           | | | | cap code associated with this data word
 |           | | | | |         message (ALPHA or NUMERIC)
 |           | | | | |         |
 |           | | | | |         |
 |           | | | | |         |
 |           | | | | |         |
 2501067869 0 0 8 2 02097152 TH
|           | | | | |         |
Tab         . . . . .         .
```

NOTE: a) For EXCEL compatibility, commas are replaced with underscore character (_) in messages.
b) If there is no message (see address word above), the cap code is set to zero, the message is set to a single space. This keeps the data column aligned in EXCEL.

SYNC and IDLE words

	Hex	Decimal
IDLE WORD	7A89C197H	2,055,848,343
SYNC WORD	7CD215D8H	2,094,142,936

Data words are greater than 80000000 Hex (2,147,483,648 decimal)
Cap Codes are less than the IDLE Word (0 - 2,097,151)

ASCII conversion format, 1 Chan measurement, MAPINFO-PLANET

```
Latitude
|
|       Longitude
|       |
|       |          dBm
|       |           |
40.5460 -74.3790 -080
        |       |
       Tab      Tab
```

For MAPINFO-PLANET output, POCSAG

```
Latitude
|
|         Longitude
|         |
|         |         dBm Speed  BER
|         |          |   |      |
40.5460 -74.3790 -080 1200.0 0000
        |         |    |    |
       Tab       Tab  Tab   Tab
```

ASCII FORMATS - EAMPS/ETACS CHAMPS

Ascii Measurement type codes:

UK- unknown
COV- CO chan voice
ADJ- ADJ chan
1CH- 1 chan
20CH- 20 chan
VAR- var sweep

AMPS-TACS measurements

SAB- Strongest A&B
COC- CO Control
GRP- Group
FOL- Follow
BER- BER
SYS- System

SAT/DCC has been added to the following measurement outputs when converting for EXCEL format:

a) CO Voice
b) ADJ Voice
c) 1 Chan
d) 20 Channel
e) Survey group
f) CO Control (DCC)
g) BER (DCC)
h) FOLLOW (DCC/SAT)
i) SYSTEM (DCC)

The dBm reading is followed by 1 character SAT/DCC code as follows:

```
dBm
|   SAT/DCC code
|    |
-080  1
      |
   Tab
```

SAT/DCC codes: ascii 0,1,2,3 or ?

0	5970 Hz	
1	6000 Hz	
2	6030 Hz	
3	unknown	(dBm below SAT detect threshold)
?	invalid	(control channel)

VMAC PWR code has been added to the FOLLOW measurement output when converting for EXCEL format.

The dBm reading is followed by 1 character SAT/DCC code and 1 character PWR code as follows:

```
dBm
|     SAT/DCC code
|      |    PWR code
|      |     |
080    1     0
       |     |
     Tab   Tab
```

VMAC PWR codes: ascii 0-7 or ?

Code	Attenuation (dBm)
0	0
1	-4
2	-8
3	-12
4	-16
5	-20
6	-24
7	-28
?	unknown

BER % data has been added to the BER measurement output when converting for EXCEL format.

The dBm reading is followed by 1 character DCC code and 3 character BER % as follows:

```
dBm
|    DCC code
|      |        % BER
|      |          |
080    1          0
     |        |
    Tab      Tab
```

% BER	meaning
0	0 words received with bit errors
25	25 % of words had bit errors
50	50 % of words had bit errors
75	75 % of words had bit errors
100	ALL words had errors

ASCII conversion format, PACS BER measurement

Marker, Odometer MODE

```
row #
|    time
|    |          date
|    |          |       record #
|    |          |       |    marker
|    |          |       |    | odometer
|    |          |       |    | |     measurement
|    |          |       |    | |     |    gps status
|    |          |       |    | |     |    |  lat deg
|    |          |       |    | |     |    |  |  |       lon deg
|    |          |       |    | |     |    |  |  |       |
|    |          |       |    | |     |    |  |  |       |
```

```
|    |         |       |    | |     |    |  |  |       |
|    |         |       |    | |     |    |  |  |       |
|    |         |       |    | |     |    |  |  |       |       MHz
|    |         |       |    | |     |    |  |  |       |       |         dBm   BER
|    |         |       |    | |     |    |  |  |       |       |          |    |
|    |         |       |    | |     |    |  |  |       |       |          |    |
1 13:20:07 06-14-96 147 1 38.0 BER OK 40.5453 -74.3806  1933.000    -080 00
  |        |...
Tab      Tab...


ASCII conversion format, PACS BER measurement

X, Y Marker MODE

row #
|   time
|   |         date
|   |         |       record #
|   |         |       |    X coordinate
|   |         |       |    |  Y coordinate
|   |         |       |    |  |  measurement
|   |         |       |    |  |  |  gps status
|   |         |       |    |  |  |  |  lat deg
|   |         |       |    |  |  |  |  |         lon deg
|   |         |       |    |  |  |  |  |          |        MHz
|   |         |       |    |  |  |  |  |          |        |         dBm BER
|   |         |       |    |  |  |  |  |          |        |          |   |
|   |         |       |    |  |  |  |  |          |        |          |   |
1 13:20:07 06-14-96 147 1  1 BER OK 40.5453 -74.3806  1933.000    -080 00
  |        |         |   |....
Tab      Tab        Tab Tab..

ASCII conversion format, BER, MAPINFO-PLANET Format

Latitude
|
|         Longitude
|         |
|         |         dBm BER
|         |          |  |
40.5460 -74.3790     -080 00
        |          |     |
       Tab        Tab   Tab


       ASCII conversion format, TEC CELLULAR WIZARD

       TEC CELLULAR WIZARD ASCII FORMAT:

       - All fields are COMMA delimited.
       - Frequencies are saved in MHz.
       - LAT-LON saved in deg,min,sec format

Sequence # (starts at 1 and is incremented by 1 on each successive line)
| Lat Deg
| |  Lat Min
| |  |  Lat Sec
| |  |  |     Lat Hemisphere(N,S)
| |  |  |     | Lon Deg
| |  |  |     | |  Lon Min
| |  |  |     | |  |  Lon Sec
| |  |  |     | |  |  |     Lon Hemisphere(E,W)
| |  |  |     | |  |  |     | Freq (MHz)
| |  |  |     | |  |  |     | |          dBm
| |  |  |     | |  |  |     | |          |   year
```

```
| |  |  |      | |  |  |      | |          |   |  mon
| |  |  |      | |  |  |      | |          |   |  |  day
| |  |  |      | |  |  |      | |          |   |  |  |  hour
| |  |  |      | |  |  |      | |          |   |  |  |  |  minute
| |  |  |      | |  |  |      | |          |   |  |  |  |  |  seconds
| |  |  |      | |  |  |      | |          |   |  |  |  |  |  |
| |  |  |      | |  |  |      | |          |   |  |  |  |  |  |
| |  |  |      | |  |  |      | |          |   |  |  |  |  |  |
1,45,23,13.23,N,76,33,12.45,W,851.0125,  -100,97,06,04,09,28,30.00
```

FILE ‘C_TO_F.TXT’ (supplied with CHAMP and created by the PC software MODEL MENU ‘C’ option) is the Ascii chan to freq conversion table used by WIZARD. This file contains the channel number and associated frequency for each channel used by the CHAMP. Each line in the file starts with the channel number followed by the frequency (in MHz) associated with that channel number. Each chan # and freq are seperated by a comma.

EXAMPLE ‘C_TO_F.TXT’

```
 Chan Frequency(MHz)
 ---- --------------
      0001,928.0000
      0002,928.0125
      0003,928.0250
      0004,928.0375
        .      .
        .      .
        .      .
```

CHAMP BINARY DATA FILE STRUCTURES

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

COMMON TO RF DUMP (serial) AND PCMCIA FILES

Champ type and measurement code:

Each file will contain an 8 bit code that identifies the type of measurement contained in the file. 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, PACS BER
8	fast fade

Bits 7-4 (high nibble) are reserved

RF DUMP (Serial) FILE STRUCTURE

RF Dump data is sent to the PC at 9600 baud, 8 data bits, no parity.

Each Rf dump data record from the Champ begins with a trigger character and data count as follows:

```
       0xAA          trigger byte
       0xllhh        data count (16 bit ll-low byte, hh-high byte)

       Data Record   RF Dump data record (header + rf data packets)

       0xllhh        Check Sum (2's comp sum of Data)
                     16 bit ll-low byte, hh-high byte
```

To receive RF Dump data:

1) wait for the trigger
2) get the 16 bit count, clear checksum summation

3) take in 'count' bytes, add the value of each byte received to the 16 bit summation.

4) get the 16 bit checksum

5) add received checksum to computed summation, if the result of this addition is zero, process the data, else skip (checksum error).

Each RF dump data record begins with a header that contains the type-measurement code, gps, markers, realtime and the number of RF measurements that follow:

```
struct pcs_head {

        byte pcscod;              measurement code
        byte pcsnavs;             navigation status
        byte gpslat[5];           BCD gps lat
        byte gpslon[5];           BCD gps lon
        byte gpsalt[3];           BCD gps altitude
        byte gpstim[3];           BCD gps time

        byte pcsmxy;              == 0 means user marker,odometer
                                  != 0 means x-y coordinates

        byte rsv_future[4];       reserved - future

        byte pcsndr;              number of RF data records
                                  following the header

        byte pcssec;              24 hour real time seconds
        byte pcsmin;              minutes
        byte pcshr;        hour
        byte pcsday;              day
        byte pcsmon;              month
        byte pcsyr;        year

        byte pcscf;        chan-freq display flag
                                  0 == freq, != 0 == chan

        word pcsmm;        mile marker or Y coordinate
        word pcsmrk;              user marker # or X coordinate
};


        pcsnavs - navigation status

        Bit               meaning

        7                 set - gps ok, clr - no lock
        6                 set - gps off
        5                 set - gps installed
        4-0               reserved - unused
```

BCD format of GPS data:

```
gps latitude degrees and decimal minutes

bcd format gpslat[x] x = 001 12 233 4
                         xxx xx.xxx Q

gps longitude degrees and decimal minutes

bcd format gpslon[x] x = 001 12 233 4
                         xxx xx.xxx Q

bcd format gpsalt[x] x = 001122
                         xxxx.x

bcd format gpstim[x] x = 001122
                         hhmmss

Where 'x' is the index into the particular array.

EXAMPLE:

gpstim[0]    BCD hours
gpstim[1]    BCD minutes
gpstim[2]    BCD seconds

gpslat[0]    lat deg hundred (always 0), tens
gpslat[1]    lat deg ones, tens digit of dec. minutes
gpslat[2]    lat ones digit, 1/10's digit dec. minutes
gpslat[3]    lat 1/00's, 1/1000's digit dec. minutes
gpslat[4]    Q - ascii 'N' - north, 'S' - south


Following the header is the RF measurement data. The result of each channel measured is sent
as follows:

struct       pcs_data {

             byte pcsdb;  current dBm
             byte pcshdb; highest dBm encountered since start
             byte pcsldb; lowest dBm encountered since start
             word pcsch;  16 bit chan #
};

dBm values range from 120 to 30 and are assumed to be negative (-120 to -30).

Contained in the header is the variable 'pcsndr'. This 8 bit value contains number of 'pcs_
data' RF measurement packets that follow the header.

After the Data Record has been read in (header and rf packets), the header variable 'pcsndr'
is used to determine how many RF data packets need to be displayed or converted.

The CHAMP PC software saves the RF DUMP data just as it was received from the CHAMP (trig,coun
t,data,cksum...) when it saves RF DUMP data to disk.


MISC RF DUMP HEADER VALUES


byte pcsmxy         - when 0, 'pcsmm' contains odometer reading
                    'pcsmrk' contains the user marker value

                    - when not 0, 'pcsmm' contains Y coordinate value
                    'pcsmrk' contains X coordinate value

word pcsmm          - current mile marker or Y coordinate
word pcsmrk         - current user marker # or X coordinate
```

```
byte pcscf;         - if 0, Champ is displaying frequency
                    - if not 0, Champ is displaying channel #
```

PCMCIA FILE FORMAT

PCMCIA disk files (saved via serial download or with the ADTRON card reader) are formatted as follows:

1) Card header record (32 bytes)
2) Card records containing measurement data

The 32 byte Card Header record is formatted as follows:

NOTE:word's in this struct are NOT in INTEL format (llhh), they are MOTOROLA format (hhll), therefore, their byte order must be reversed before using on a PC.

```
struct       tc_idrec {

             byte tcid[16];      id field
             word tcsiz;  card size in pages
             word tcnxtp; next free page
             word tcnxto; next free offset
             byte tcidrsv[8];    8 bytes - rom ver, base freq
             word tcibck; id block checksum
};
```

where:

16 char id string -
tcid = 0xc5,0x3a,0xa3,0x5c,0xc5,0x3a,0xa3,0x5c,
'B','V','S','C','H','A','M','P'

tcsiz = the number of 8192 byte pages contained on the card
(256 for the standard 2 Meg card).

tcnxtp = next free page (0-255)
tcnxto = offset into current free page (0 - 1fffH)
tcidrsv = ASCII rom version number (first 4 char) of CHAMP
          ASCII base frequency (MHz) of CHAMP
tcibck = 2's complement checksum of 'tc_idrec' data

PCMCIA serial download and ADTRON reader create a disk file the starts with the 'tc_idrec' and contain 'tcnxtp' * 8192 bytes, only the amount of data actually save on the card is saved.

PCMCIA measurement structure as saved on the card (and disk file).

Each measurement starts with a 'start record' that contains data that does not change (usually) during the measurement. This includes measurement type code, date, and channels being measured. If the user DOES change a channel being measured, a new start record is written at the point of change.

The start record is followed by measurement records. There are several types of measurement records, each containing a different set of data. This was done to minimize the amount of data saved to the card during measurement without having to use compression.

All RF measurement data records have a common structure:

Record Type code
Time
GPS data
marker data
# of RF records

RF data

What varies is the amount of GPS data that is saved, from none to the entire GPS data set (la,lo,time,alt).

When the user stops the measurement, a STOP record is written to the card, indicating when and where the measurement was stopped.

When a new measurement is started, a start record is written after the last stop record, thus the card can contain multiple measurements.

RECORD CODE	TYPE OF RECORD
0x00	end of data
0xA1	start measurement
0xB2	reserved
0xC3	gps la,lo & rssi
0xC4	no gps & rssi
0xC5	gps la,lo,alt & rssi
0xC6	gps la,lo,tim & rssi
0xC7	gps la,lo,tim,alt & rssi
0xD4	reserved
0xE5	end measurement

The procedure to read a card file is as follows:

1) read the 32 byte id (can be used to determine how much data is in the file, Champ rom version).

2) read Record Code byte

3) read and process the particular type of record that follows the Code byte

4) continue from step 2 until end of data (record type = 0)

PCMCIA RECORD TYPES

record code A1 - start measurement contains date and channel table

```
struct       tc_rec1 {

             byte tcr1day;       day
             byte tcr1mon;       month
             byte tcr1yr; year

             byte tcr1mt; rf measurement type

             byte tcr1mxy;       0 means user marker,odometer
                                 not = 0 means x-y coordinates

             byte tcr1rsv;       reserved - future

             byte tcr1nc; # of channels
};
```

tcr1mt - same as RF DUMP ‘pcscod’ - measurement code
tcr1mxy - same as RF DUMP ‘pcsmxy’ - 0 means user marker,odometer
- Not 0 means x-y coordinates

As with RF DUMP, tcr1mt is used to determine type of Champ measurement.

‘tcrimxy’ is used to determine how to interpret the marker data contained in the RF records.

‘tcr1nc’ - contains the # of channels being measured. Following this value are ‘tcr1nc’ words containing the value of the channel #’s being measured. The RF dBm values saved in the RF data records will be saved in the same sequence as the values in this table (1 to 1 correspondence).

PCMCIA RF DATA SAVE RECORDS

These records all start with the real time of measurement and the current marker values. Following the marker data is GPS data (save in the same format as RF DUMP). Use the Recode type code to determine which type of GPS data is saved.

Following the GPS data is a count ‘rXnms’ of dBm readings that follow. These values are saved in the same sequence as the channel table contained in the start record.

Record code C3 (rf + gps la,lo)

```
struct       tc_rec3 {

             byte tcr3rt[3];     real time (hh mm ss)
             word tcr3mm; mile marker or Y coordinate
             word tcr3um; user marker # or X coordinate

             byte tcr3ns; navigation status
             byte r3glat[5];     gps lat
             byte r3glon[5];     gps lon

             byte r3nms;         # of rssi measurements following
};
```

Record code C4 (just rf)

```
struct       tc_rec3_A {

             byte tcr3art[3];    real time (hh mm ss)
             word tcr3amm;       mile marker or Y coordinate
             word tcr3aum;       user marker # or X coordinate

             byte r3anms; # of rssi measurements following
};
```

Record code C5 (rf + gps la,lo,alt)

```
struct       tc_rec3_B {

             byte tcr3brt[3];    real time (hh mm ss)
             word tcr3bmm;       mile marker or Y coordinate
             word tcr3bum;       user marker # or X coordinate

             byte tcr3bns;       navigation status
             byte r3bglat[5];    gps lat
             byte r3bglon[5];    gps lon
             byte r3bgalt[3];    gps altitude

             byte r3bnms; # of rssi measurements following
};
```

Record code C6 (rf + gps la,lo,time)

```
struct       tc_rec3_C {
```

```
            byte tcr3crt[3];    real time (hh mm ss)
            word tcr3cmm;       mile marker or Y coordinate
            word tcr3cum;       user marker # or X coordinate

            byte tcr3cns;       navigation status
            byte r3cglat[5];    gps lat
            byte r3cglon[5];    gps lon
            byte r3cgtim[3];    gps time

            byte r3cnms; # of rssi measurements following
};


Record code C7 (rf + gps la,lo,altitude,time)

struct      tc_rec3_D {

            byte tcr3drt[3];    real time (hh mm ss)
            word tcr3dmm;mile marker or Y coordinate
            word tcr3dum;user marker # or X coordinate

            byte tcr3dns;       navigation status
            byte r3dglat[5];    gps lat
            byte r3dglon[5];    gps lon
            byte r3dgalt[3];    gps altitude
            byte r3dgtim[3];    gps time

            byte r3dnms; # of rssi measurements following
};



End of measurement record.

This record indicates that the user stopped the measurement and contains time and position.

Record code E5 (end measurement)

struct      tc_rec5 {

            byte tcr5rt[3];     real time (hh mm ss)
            word tcr5mm; mile marker or Y coordinate
            word tcr5um; user marker # or X coordinate

            byte tcr5ns; navigation status
            byte r5glat[5];     gps lat
            byte r5glon[5];     gps lon
};

The next Record type code following an End Record will either be start record (new measurement
started) or end of data record (0).
```

DPU-411 PRINTER SWITCH SETTINGS

DIPO I	SET	Function
SW1	OFF	Serial input selected
SW2	ON	Auto Line Feed ON
SW3	ON	40 column selected
SW4	ON	Regular Char Set selected
SW5	OFF	Normal zero char selected
SW6	OFF	USA char set selected
SW7	ON	USA char set selected
SW8	ON	USA char set selected
DIP0 2	SET	
SW1	ON	8 bit data selected
SW2	ON	No Parity
SW3	ON	Odd Parity (this switch ignored)
SW4	OFF	9600 baud selected
SW5	OFF	9600 baud selected
SW6	OFF	9600 baud selected

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
PCMCIA save on (2 Meg card)
RF dump on
RUN TIME: 3 hours
CONDITION 2 (best case):
GPS off
BACKLIGHT off

PCMCIA 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.

FAST CHARGING

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

CAUTION: If saving POCSAG data on PCMCIA card, turn RF DUMP to OFF. With BOTH PCMCIA SAVE ON and RF DUMP ON, some POCSAG batch's may be lost. To ensure correct operation, use either PCMCIA 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 CHAMP 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 Measurements

d. 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 xxxxxxxxxxxxxxxxxx
6 xxxxxxx xxxxxxxxxxxxxxxxxx
7 xxxxxxx xxxxxxxxxxxxxxxxxx GL
8 xxxxxxx xxxxxxxxxxxxxxxxxx 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 PCMCIA 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 PCMCIA card and sent via RF DUMP.

e. 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 PCMCIA 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 CHAMP and PC SCREEN WILL NOT BE CORRECT. If data was saved on the PC with the function codes improperly set on the CHAMP, 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 PCMCIA 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)

ONE CHAN THRESHOLD

1) During ONE CHAN measurement, the following feature has been added:

A PCMCIA save and audio MUTE-UNMUTE threshold has been added to the ONE CHAN measurement. This feature is used to control the amount of data saved on the PCMCIA card and to automatically turn off the audio when the signal is below the set threshold.

Only measurement dBm values greater than or equal to the threshold are saved on the PCMCIA 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.

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 regard-

less 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 CHAMPROM.

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 PCMCIA 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 PCMCIA 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.

CHAMP TroubleShooting

SYMPTOM - After CHAMP 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 CHAMP 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 CHAMP and charge the battery by plugging the supplied charger into the CHAMP 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 CHAMP back on.

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

CAUSE - The CHAMP has been moved more than 50 miles since the GPS was last locked. The greater the distance the CHAMP was moved, the longer it will take the GPS to re-aquire the satellite information it needs to get a “fix”. If the CHAMP 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 CHAMP 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 CHAMP main power switch is on. When using the GPS, turn on BEFORE turning on the main power switch.

PCMCIA DATA STORAGE - DO’s and DON’Ts

1) DON'T turn off the CHAMP while data is being recorded on the card. ALWAYS stop the measurement (by pressing ESC) BEFORE turning off the CHAMP.

2) DON'T re-init the card UNTIL the data has been downloaded and checked on the PC.

3) If recording POCSAG data, turn OFF the RF DUMP option. Data can be missed if both PCMCIA SAVE and RF DUMP are both on while measuring POCSAG. USE one option or the other but never both.

4) DO collect some test data on the PCMCIA card and download it to the PC BEFORE doing field surveys. This will assure that the important data will later download without trouble. Some PC's (laptops and notebooks) do not download correctly because of battery saver features. Find a combination of PC and DOS that will download BEFORE collecting data.

5) DO use the CHAMP RF DUMP feature to verify which PC COM port is associated with the DB9 male connector on the back of the PC (COM 1 or 2).

6) DON'T run the supplied CHAMP PC software in WINDOWS. ONLY run the supplied software in MS DOS.

7) DO use the cable marked "DOWNLOAD" to connect the CHAMP to the PC for download. A similar cable is supplied with the CHAMP marked "PC SAVE". This cable is used when only with the RF DUMP feature.

OTHER - To extend battery run time:
1) Turn off the GPS if not being used (such as during in building surveys).

2) Turn off the display backlight in well lit conditions.

3) Use the supplied cigarette lighter adapter when using the CHAMP in a vehicle.

SYMPTOM - The message **CARD BATTERY** is displayed by the Champ while trying to initialize the PCMCIA card.

CAUSE - The 2Mbyte SRAM PCMCIA cards from Centennial Technologies, Inc. that are supplied with the Champ do not have a removable coin cell battery. They are equipped with a built-in rechargable Ni-Cad cell which has little or no charge. The card should be left in the slot without turning off the Champ for at least an hour. This will charge the card allowing initialization.

SYMPTOM - The message **INSERT CARD** is displayed by the Champ while trying to initialize the PCMCIA card.

CAUSE - The 2Mbyte SRAM PCMCIA cards from Centennial Technologies, Inc. that are supplied with the Champ do not have a removable coin cell battery. They are equipped with a built-in rechargable Ni-Cad cell which has little or no charge. This message indicates a Champ with old firmware. In order to intialize this PCMCIA card, it must be chargerd externally. Use a PC or laptop PCMCIA card slot to do this for at least an hour before using this card in the Champ.

Champ Supplemental Material

CHAMP data file structures

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

Common to RF DUMP (serial) and PCMCIA files

Champ 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 Champ 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 Champ Type code. Use this code to determine the channel number to frequency conversion.

Code (hex)	Champ 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

ACCQPOINT DIFFERENTIAL GPS

For more information, contact:

ACCQPOINT Communications Corporation
2737 Campus Drive
Irvine, CA 92612-1602
800-995-3477

INITIAL ACCQPOINT RECEIVER SETUP

The ACCQPOINT receiver must be setup to work with the CHAMP. The receiver baud rate must be set to 4800 and the receiver set to send TYPE 1 messages. Once setup, the new settings will be retained by the ACCQPOINT receiver.

Use the ACCQPOINT RTCM Utility Program to set the receiver to the following:

Receiver Baud rate to 4800 (command !B4800!)
Receiver to Type 1 messages (command !R01!)

Refer to the ACCQPOINT manual, Appendix A.

CONNECTING CHAMP TO THE ACCQPOINT RECEIVER

Step 1) Connect the GPS antenna to the CHAMP, connect the FM antenna supplied by ACCQPOINT to the ACCQPOINT receiver.

Step 2) Turn on the CHAMP (GPS Power switch ON), then turn on the ACCQPOINT receiver.

Step 3) Use cable supplied with the CHAMP (CHAMP DIFF/SAVE 00-10220) to connect the CHAMP Serial Interface to the ACCQPOINT receiver as shown below (connect the end marked SERIAL INTERFACE to the CHAMP, connect the end marked DIFF GPS to the ACCQPOINT receiver. If data is to be collected using a PC, connect the PC serial port (COM1 or COM2) to the connector marked PC SAVE.

Step 4) Verify connections by doing the following:

a) Select CHAMP MAIN MENU 'STATUS' display. Wait for the display to indicate that the GPS is locked.

b) If the ACCUPOINT is receiving, the following LED's will indicate:

QUAL is not lit (if blinking constantly, indicates poor reception - check ACCQPOINT antenna). NOTE that the QUAL LED will blink after the ACCQPOINT receiver is turned on indicating that the receiver is searching for a signal. The QUAL LED goes out when a station is found.

DGPS is lit - indicates a correction signal is being received.

DATA blinks - indicates correction data is being sent to the CHAMP at 4800 baud.

c) Some time after the ACCQPOINT DATA led blinks, the CHAMP status display will indicated differential lock.

IS-136 CHAMP

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

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

3. IS-136 CHAMP 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 CHAMP units with DSP receiver (such as PACS and IS-136) is about one half the standard CHAMP 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 IS136 CHAMP

Highlight ‘BER’ on the CHAMP 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 CHAMP

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 CHAMP 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 CHAMP to be able to measure BER. There is no special requirement when using the CHAMP with base station signals (since they do contain a sync in each timeslot). The 28 bit sync words checked are as follows:

SYNC1	0A91DE4Ah
SYNC2	0A9D127Ah
SYNC3	0C7E3C0Ch
SYNC4	0342C3F3h
SYNC5	013E23D1h
SYNC6	0DC2EC1Dh

Freq range: 1930.05 - 1989.99
Channel step: 30KHz

Channel numbering:

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

ONCORE INTERNAL GPS RECEIVER

Refer to this text for: interface protocol descriptions

operational modes of your ONCORE receiver

additional customizing ca pabilities/operation

OVERVIEW

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

INTERFACE PROTOCOL

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

Available Interface Protocols

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

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

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

Motorola Binary Format

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

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

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

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

Checksum:

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

Message Terminator:

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

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

A binary message is considered to be received if:

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

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

(3) The checksum validates

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

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

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

Data Message Output Rates

OUTPUT MESSAGE TYPE	CONTINUOUS (m=1 255)	ONE TIME (m=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.

Glossary of Acronyms

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

GPS-MM Active Mobile (Magnetic Mount) GPS Antenna

General Description:

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

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

Specifications:

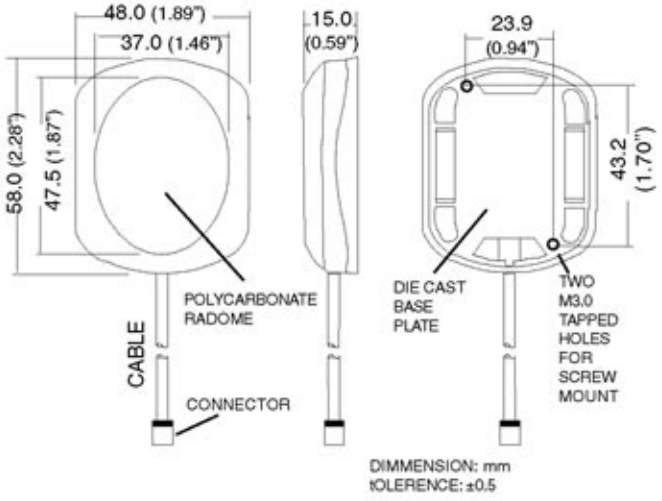
PHYSICAL	
Construction:	Dark gray Polycarbonate-radome at top, die-cast shell at bottom/ rubber gasket for water seal in between
Dimension:	58mm (L) x 48mm (W) x 14mm (H)
Weight:	65 grams (excluding cable & connector)
Standard Mounting:	Magnet mount with two magnets
ANTENNA ELEMENT	
Center Frequency: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

Specifications (Continued):

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

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

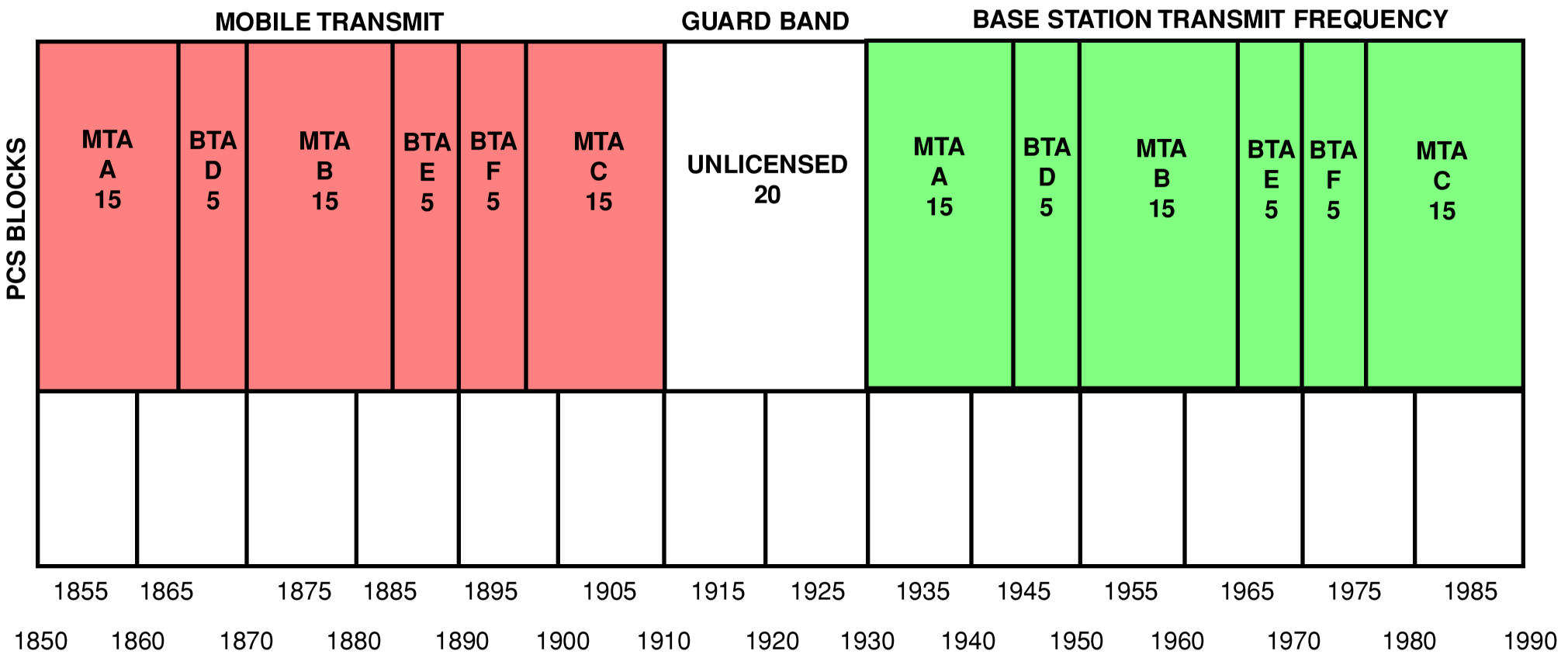
Dimensional Drawing:



Ordering Information:

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

PCS ALLOCATION TABLE



IMPORTANT SAFETY INSTRUCTIONS

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

1)Read and understand all instructions.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

INSTALLATION INSTRUCTIONS

1. Never install telephone wiring during a lightning storm.

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

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

4. Use caution when installing or modifying telephone lines.

INSTRUCTION FOR BATTERIES

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

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

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

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

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

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

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

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

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

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

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

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

The Champ

POWERFUL, PORTABLE SIGNAL STRENGTH METER

This compact (less than 5 lbs.) 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 footage during drive-around studies
- Weighs less than 5 pounds

The Champ is convenient for finding RF "shadows" in indoor wireless systems for drive-around studies to detect RF leakage and propagation coverage. The PCMCIA memory system stores data for post processing.

POST PROCESSING

Data from The Champ measurements are saved to a 2 Mbyte PCMCIA battery backed-up card and to an RS-232 serial port for direct storage to a PC (up to 38K baud, selectable). The PCMCIA card data can be down-loaded to a PC using supplied PC software. Serial output may be binary (compressed) for later conversion or in an ASCII comma delimited format.

The Champ data can be imported directly into third-party software including spread sheets, such as EXCEL or propagation analysis software such as TEC's WIZARD (shown below) or MLJ's Path Pro.

The Champ comes in a durable jacket that keeps the case clean, provides protection in any weather conditions. Convenient shoulder strap for easy carrying.

Available Frequencies:

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

Available from stock.

The Champ 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: http://www.bvsystems.com
E-mail: info@bvsystems.com

BERKELEY VARITRONICS SYSTEMS

The Champ 100 MHz to 2 GHz Receiver

SPECIFICATIONS

DISPLAY	64 X 240 pixel Graphic Backlighted Electro-luminescence LCD (Super Twist)	
TUNING RANGE	20-40 MHz tuning range of band	
BANDS SUPPORTED	ISM: 900-932 MHz PCS: 1850-1910 or 1930-1995 MHz LMR: 805-825 or 850-870 MHz Cellular: 824-848 or 868-896 MHz tunable in 30 kHz steps ETACS: 872-905 or 915-950 MHz Paging: 145-165 or 450-465 or 928-941 MHz IVDS: 218-219 MHz	
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 spillproof 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 ohm
Case:	Black vinyl foam lined carrying case with shoulder strap
Car Lighter Adapter:	12-16 VDC @ 200 mA
Charger:	Battery charger with fast charge circuit (< 2 hours full charge)
PC Software:	3-1/2" Diskette MS DOS - commented source code provided
GPS:	Internal 8 Channel Differential GPS Navigation with active antenna

OPTIONS

PCMCIA:	Mass (Non-Volatile) Storage RAM Cards (128 k to 2 MBytes)
Printer:	Seiko, Inc. DPU-411 or DPU-411 Type II, with cable
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
Phone 732-548-3737 • Fax 732-548-3404 • Internet: http://www.bvsystems.com • E-mail: info@bvsystems.com