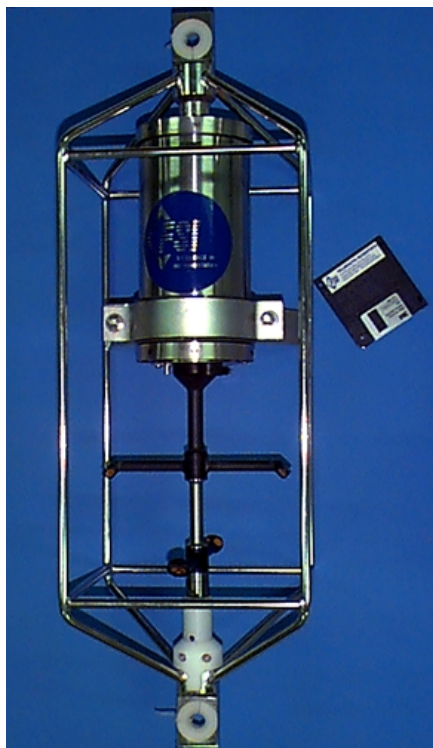

3-D ACOUSTIC CURRENT METER MANUAL



VERSION 7.0
FIRMWARE VERSION 3.6
P/N A800-010

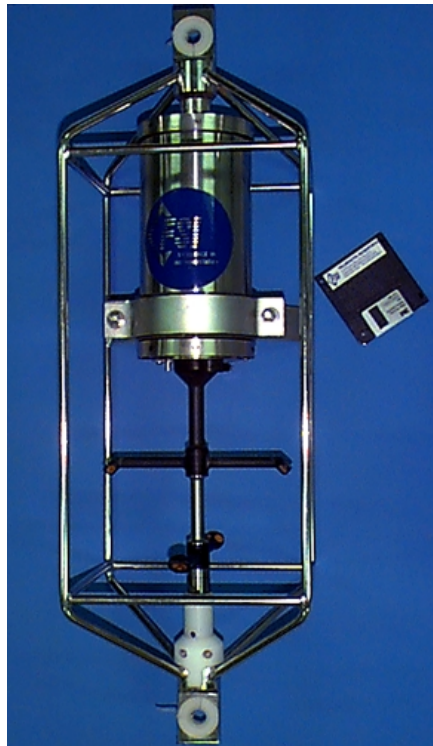
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1140 Route 28A PO Box 315
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FALMOUTH SCIENTIFIC, INC.
3-D ACOUSTIC CURRENT METER

3D-ACM

VERSION 7.0
FIRMWARE VERSION 3.6
P/N A800-010

Operating Instructions



This manual covers the operational aspects of the FSI Three Dimensional Acoustic Current Meter (3D-ACM). FSI continuously strives to meet the full expectations of our customers and we welcome comments on the structure, content and the ability of this manual to answer your questions regarding our product. If you have any suggestions or comments please contact us. This document is provided with the understanding that future versions of this instrument may have additional commands and the function of the commands shown in this document may vary from the present operation.

NOTE: THE FSI 3D-ACM IS RATED FOR A MAXIMUM OPERATIONAL DEPTH OF 7000 METERS. THE COASTAL 3D-ACM IS RATED FOR MAXIMUM OPERATIONAL DEPTH OF 1000 METERS. ACTUAL OPERATIONAL DEPTH IS DEPENDENT UPON THE FULL SCALE RANGE OF THE PRESSURE TRANSDUCER USED IN ANY OF THE OPTIONS USED IN-CONJUNCTION WITH THE 3D-ACM. CONSULT THE MANUFACTURED CONFIGURATION SECTION OF THE MANUAL FOR COMPLETE DETAILS ON THE MAXIMUM OPERATIONAL DEPTH TO WHICH THIS INSTRUMENT IS DESIGNED FOR USE. DO NOT EXCEED 125% OF FULL SCALE DURING USE OR CALIBRATION OR PERMANENT DAMAGE WILL OCCUR TO THE UNIT. AS WITH ALL HIGH PRESSURE INSTRUMENTATION OBSERVE CAUTION WHILE USING OR AFTER EXPOSURE TO HIGH PRESSURES.

3D-ACM FIRMWARE

The below list indicates the revisions of 3D-ACM firmware. The factory recommends that the latest firmware be installed prior to any major deployment of the instrument. Up-Dated Chip sets can be obtained from the factory for a nominal charge of \$100 each set. Note: Versions listed as “un-released” are pending final verification and quality testing and may only be available under “special” circumstances. Note in some instances the manual may not reflect changes in operation of the instrument which are listed below. If the change is listed below, the “manual” has not yet incorporated these changes. FSI@Falmouth.COM

VERSION	STATUS	DESCRIPTION
2.60	RELEASE D	Corrected Vector Mathematics by S. Anderson. 1st fully verified down finger operation.
2.65	RELEASE D	Memory Reset Delay Modification to allow for Hardware De-Glitch rewind of memory.
2.70	RELEASE D	Addition of VPATH Parameter Selection. Commands Selects all 4 velocity paths for data output as instantaneous.
2.72	RELEASE D	Corrected Address Mode Operations To Comply with FSI Standards
2.74	RELEASE D	Addition of Warning Messages related to the Compass, Tilt, an Memory Function Status to remind customer of the need to set these functions “ON” if they have be set “off”. Issue during ***D, ***R, and ***I Command implementation.
2.75	RELEASE D	Corrected Set Continuous Mode
2.76	RELEASE D	Housekeeping
2.78	RELEASE D	Correct Check Sum Message Output
2.79	RELEASE D	Housekeeping
3.0	PENDING	Corrected Mathematics for Velocity Fingers in UP position for double negation of Ty due to test fixture “standard” operation.
3.1	PENDING	Change Vector Averaging Interval to allow for Data Memory Write prior to end of Vector Average Interval. This stops walking time Vector average intervals if the user sets for continuous interval mode. (Old firmware delayed 1.0 second after completing old interval before starting new.

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SECTION 1.0SECTION 1.0:

GENERAL INSTRUMENT DISCUSSIONGENERAL INSTRUMENT DISCUSSION:

Your 3D-ACM is designed to optimize your ability to collect high precision current velocity data in three dimensions. The 3D-ACM also offers the ability to interface optional sensors such as Conductivity, Pressure and Depth and to log data from these sensors in conjunction with the velocity information. The basic instrument measures velocity along four acoustic paths, three orthogonal magnetic vectors and two orthogonal gravity vectors (tilt) from which it calculates velocity relative to the earth. The velocity interface uses a single transmitter and receiver which are multiplex to the eight acoustic transducers mounted on the sensor head. Using the acoustic transmission of sound from one transducer to another, the 3D-ACM can calculate water flow along each of the four acoustic paths. The computation is based on the acoustic phase shift of the sound which occurs due to the advance of sound traveling in the same direction as the water flow and the corresponding retardation of sound traveling against the water flow.

The compass uses a fixed (no-gimbals) three axis magnetometer along with the two axis tilt sensor to determine the instrument orientation relative to the earth's magnetic and gravity vectors.

The user can select any "vector averaging interval" for the determination of the "vector averaged velocity." Vector Averaging Intervals from 15 seconds to 60 minutes can be selected. A wide variety of additional parameters can also be selected for output or data storage. The velocity interface and magnetometer interface are digitized using a high speed 12 bit converter. The Command/Data Serial Port is accessed from the RS-C or RS-485 port located on the CPU card. A second internal UART supports options such as the High Accuracy CTD (HACTD) option.

Instrument configuration, averaging intervals, channels enabled, time functions are all configured using commands given to the instrument via the Command/Control port. A computer using any terminal emulation program can be used to interact with the instrument, see the command section for specific commands and responses.

UNPACKING AND INITIAL CHECK OUTUNPACKING AND INITIAL CHECK OUT:

Your 3D-ACM is provided in a high quality moisture proof plastic packing crate. This shipping container should be maintain to protect your instrument from damage during transportation. The shipping container should be carefully inspected for shipment damage. Any suspected damage should be reported immediately to your forwarding agent.

Note: Most all forwarding agents and insurance carries have time limits for the notification of concealed damage. Instruments should be fully inspected and functionally tested within 48 hours of receipt.

BATTERIESBATTERIES

Depending on the type of batteries purchased in conjunction with your instrument they have been packed in one of the two following manners:

ALKALINEALKALINE

Alkaline batteries are packed inside the instrument (spares or additionally purchased batteries may be shipped separately). They **will not be plugged in**. This is to prevent accidental discharge which could result in battery case failure damaging the instrument.

LITHIUMLITHIUM

Lithium batteries will be packed separately from the 3D-ACM. See battery installation section for details to install your batteries in your 3D-ACM.

Attention: Air craft shipment of Lithium Batteries without proper paper work and identification is a violation of the law. In NO instance should instruments be returned to FSI with Lithium or Alkaline Batteries installed.

TEST CABLE & INTERFACE TEST CABLE & INTERFACES

Your 3D-ACM will be packed with a 1 Meter test cable. The test cable connects directly to the SUB CONN Micro Series connector mounted on the bottom end cap of the instrument. The Test Cable is provided with a DB-25 connector for direct plug in to your RS-232 port. If your unit has been provided with RS-485, the FSI RS-485 to RS-232C converter box will need to be used (Deck Unit P/N FSI-DU-STD, consult the factory). This box allows direct interconnection from your RS-485 instrument to the RS-232C port of your terminal or computer.

Note: the converter box uses internal timers set by jumpers to allow communication at a specific Baud Rate. Consult the label inside the Converter Box for jumper configuration if you change the Baud Rate of the 3D-ACM.

The converter box must be powered by either the supplied universal AC input power module or by externally supplied 8 - 35 VDC power via the rear Red and Black Jacks. The 3D-ACM can also be powered from the front panel jacks of the data converter.

Note: 3D-ACM's delivered after 1 August 1997 will be provided with a 5 pin connector. Pin 5 of the connector provided the "kick-start" function. All test cables provided with the 5 pin connector will have pin 5 connected to ground to enable the "kick-start" upon connection of the cable. Consult the both the "Connector Specification" and "Kick Start" Section's of this manual for complete instructions.

EXTERNAL POWER EXTERNAL POWER

The provided Test Cable has two "banana jacks" to which power can be provided to operate the 3D-ACM. The Red Jack indicates the "Positive Voltage" lead, the Green Jack represents the "Negative Voltage" lead. These can be tied to any DC power source of 7 - 35 VDC with @ 10 mA supply current. (Note, if the HA-CTD or other options are in use the user will be required to provide higher current.

PERFORMANCE VERIFICATION PERFORMANCE VERIFICATION

This test requires that the user have a general working knowledge of the 3D-ACM and its command structure, operations modes, and data outputs prior to completion.

Once a general understanding of the command structure has been achieved, the user can verify correct 3D-ACM operation using a small tank large enough to hold the velocity sensor fully submerged (note, do not try to reset zeros in tanks less than 1.0 meter square). The unit can then be tested for zero (or near zero in small tanks) flow. To test velocity, have the unit output Vx, Vy, and Vz setting AVGI=00:00. Then, entering the RUN mode the instantaneous values for velocity should be read. The tilt and compass functions can also be checked by setting VEL=OFF in the OPEN MODE, and setting Tx, Ty and DIR enabled for output. The 3D-ACM can be rotated and tilted while in the RUN MODE and data is being output. The user can find the position where the DIR reads 0 or 360 degrees, three 90 degree rotations can then be used when testing the cardinal points. Likewise, the user can tilt the unit in one direction where only Tx responds and then back at an equal angle, repeating for the Ty axis. When upright the tilts should read zero.

Pointer: Note if the 3D-ACM will not respond to user commands, the user should send several "S" as the instrument may have been left in the Set Continuous Mode On Power, (SCOP). In this mode the only command the 3D-ACM will respond to is the Stop Command,(S). Note, the Stop Command is case sensitive and must be sent as a capital. The user can then send a <CR> or <LF> and the 3D-ACM will then respond with "RUN MODE" or a Data Frame.

COMMUNICATIONCOMMUNICATION

COMMUNICATION PROTOCOLSCOMMUNICATION PROTOCOL'S

The 3D-ACM can be provided with either RS-485 or RS-232 data interface. Consult your serial number tag which identifies which hardware protocol your instrument is configured. Use of the RS-232 port requires that your computer supplies true RS-232 data levels. Some older laptop computers do not support negative output voltages from the RS-232 port and these devices may not work with the RS-232 port supplied 3D-ACM.

CONNECTORCONNECTOR

CONNECTOR MANUFACTURER

**MacArtney Inc.
40 Western Way
P.O. Box 68
Duxbury, MA 02331 USA
617-934-0719
617-934-0699 FAX**

CONNECTOR SPECIFICATIONS

FOR INSTRUMENTS MANUFACTURED PRIOR TO 1 AUGUST 1997

TYPE	MFG. PART NUMBER	FSI PART NUMBER
PIGTAIL	MCBH4F	2106-MCBH4F
BULKHEAD	MCIL4M	2106-MCIL4M
DUMMY PLUG	MCDC4M	2106-MCDC4M
TEST CABLE	N/A	B240-291

NOTE: Consult the table below or the SUB CONN manual for color code of the wires in the connecting pigtail. Pigtails and custom cables are available directly from FSI.

PIGTAIL COLOR CODES/FUNCTIONS

PIN	COLOR	RS-232	RS-485
1	WHITE	GROUND	GROUND
2	BLACK	RXD	RS-485A
3	GREEN	+ POWER	+POWER
4	RED	TXD	RS-485B

TEST CABLE PIN OUT TEST CABLE PIN OUT

CONNECTOR	PIN	RS-232	RS-485
DB-25	2	RXD	RS-485A
DB-25	3	TXD	RS-485B
DB-25	7	DATA GROUND	DATA GROUND
BANANA RED	N/A	+ POWER	+POWER
BANANA BLACK	N/A	GROUND	GROUND

FOR INSTRUMENTS MANUFACTURED AFTER TO 1 AUGUST 1997

TYPE	MFG. PART NUMBER	FSI PART NUMBER
PIGTAIL	MCBH5F	2106-MCBH5F
BULKHEAD	MCIL5M	2106-MCIL5M
DUMMY PLUG	MCDC5M	2106-MCDC5M
TEST CABLE	N/A	B240-314

NOTE: Consult the table below or the SUB CONN manual for color code of the wires in the connecting pigtail. Pigtails and custom cables are available directly from FSI.

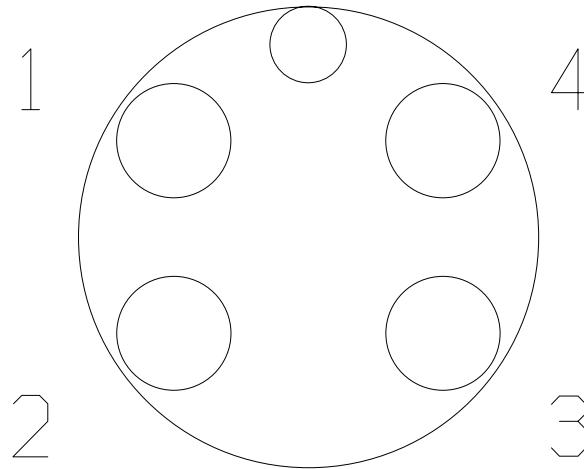
PIGTAIL COLOR CODES/FUNCTIONS

PIN	COLOR	RS-232	RS-485
1	WHITE	GROUND	GROUND
2	BLACK	RXD	RS-485A
3	GREEN	+ POWER	+POWER
4	RED	TXD	RS-485B
5		KICK START	KICK START

TEST CABLE PIN OUT TEST CABLE PIN OUT

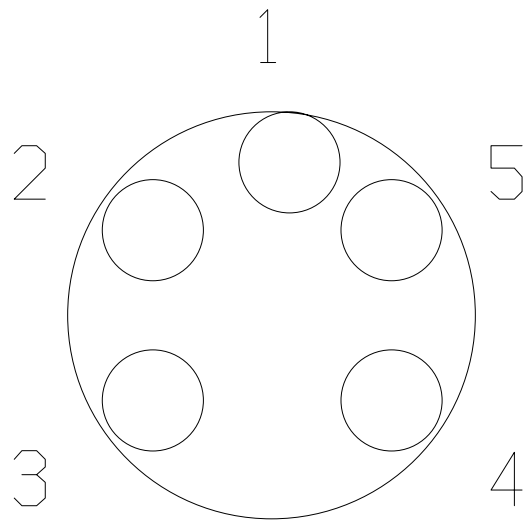
CONNECTOR	PIN	RS-232	RS-485
DB-25	2	RXD	RS-485A
DB-25	3	TXD	RS-485B
DB-25	7	DATA GROUND	DATA GROUND
BANANA RED	N/A	+ POWER	+POWER
BANANA BLACK	N/A	GROUND	GROUND
KICK START	N/A	GROUND	GROUND

BULKHEAD CONNECTOR DETAIL
FACE VIEW SUB CONN 4 PIN FEMALE



F A C E V I E W
F E M A L E

BULKHEAD CONNECTOR DETAIL
FACE VIEW SUB CONN 5 PIN FEMALE



F A C E V I E W
F E M A L E

ON-LINE	COMMAND	HELP/MANUAL	ON-LINE	COMMAND
HELP/MANUAL				

The 3D-ACM has complete on-line help. The user can immediately access the command list along with a brief description for each command listed for the current operational mode. This on-line help can be accessed by issuing a "?<CR>" to the 3D-ACM.

MODES OF OPERATION

The 3D-ACM operates in one of five modes; RUN mode, INTERVAL mode, DELAYED mode, CAL mode, or OPEN mode. These operational states are depicted in the "state" diagram below. The 3D-ACM user must fully understand the relevance of each of these operational modes to become a proficient user of the instrument. The 3D-ACM has a high level user interface which allows the user to easily move from one mode to another. While in any operational mode, the command "?<CR>" will send the user the available serial commands for the current mode with a brief description of each command.

SEE STATE DIAGRAM PAGE 84

RUN MODE

RUN, INTERVAL, and DELAYED modes are the normal data collection operating mode. The 3D-ACM always powers up in the RUN mode (if calibration parameters are incorrect or missing the unit will use default operational and calibration parameters and continue to power up in the RUN mode). RUN MODE is entered from OPEN Mode using the ***R command. The unit upon receipt of the command will instantly start the collection of current velocity and direction information based on the current OPEN Mode settings. Data can be retrieved by the entry of either a <CR> or <LF> ASCII characters. Note if the vector averaging interval AVGI is non zero, then vector averaged data will only become valid at the end of one vector averaging interval.

INTERVAL RUN MODEINTERVAL RUN MODE

Note, INTERVAL RUN MODE can also be called ON/OFF or DUTY CYCLE MODE. In INTERVAL MODE the instrument will sample for the "on time" during each "interval time". See the TIME section of this manual for complete definition and set up of these times.

Interval mode is a sub mode of RUN mode. Interval mode is entered upon from OPEN mode using the ***I command. If the 3D-ACM does not have a valid Interval Times set while in OPEN mode a error will be reported to the user, and the instrument will operate in RUN mode. Upon entering the INTERVAL mode, the user will be told the current start and end times.

DELAYED RUN MODEDELAYED RUN MODE

DELAYED mode is a sub mode of RUN Mode. DELAYED mode is entered upon from OPEN Mode using the ***D command. If the 3D-ACM does not have a valid Delay Time set while in OPEN mode, an error will be reported to the user, and the instrument will commence operation in RUN MODE or INTERVAL mode if valid INTERVAL mode times have been entered. Upon entering the DELAYED mode, the user will be told the time and date the instrument will commence data sampling.

Note, if a valid Interval Time (both a Interval Time and corresponding On Time) have been set while in open mode, the unit at the delay Start Time & Date will commence Interval Mode Operations.

OPEN MODEOPEN MODE

OPEN mode is used to update calibration and other operational parameters. While the instrument is in the OPEN mode all data collections functions are stopped. In this mode the user can access all instrument configurations such as times, calibration constants, data logging, memory, and parameter output/stored selections. All data request in the OPEN mode will be responded to with a "OPEN MODE" response.

CAL MODECAL MODE

The calibration mode is used by the factory to calibrate the instrument and is typically not used by the customer unless the user needs the data for diagnostic requirements.

The CAL mode provides functions used during calibration. While the instrument is operating in the calibration mode, data processing is stopped and raw data counts are output to the user allowing calibration coefficients to be determined. This mode is usually used only by the factory or for user diagnostic purposes. The CAL mode has two sub operating modes, Read All Velocity (RALLV) and Read All Compass (RALLC). These two sub modes are used to determine which set of raw data counts are sent to the user. See the Parameter section of the manual for complete details of raw data outputs while operating either of the CAL Mode, sub modes: RALLV and RALLC.

UP/DOWN SENSOR ORIENTATION

The 3D-ACM is fully implemented for either sensors “UP” or sensors “DOWN” operation. This allows the instrument to be placed on the mooring with the velocity sensors pointing UP or with the velocity sensors pointing “DOWN”. The instrument detects which orientation it is in “**AT POWER UP**” and utilizes the correct set of calibration constants for tilt and the correct algorithms for the determination of east, north, and up velocity vectors. The user must be aware of the “HOW”, “WHEN”, and “WARNINGS” associated with the instrument determining its basic orientation and the effect this will have on collected data. Each of these is detailed below:

“HOW UP/DOWN SENSOR ORIENTATION IS DETERMINED”

The 3D-ACM has a magnetic switch which tells the unit when it is up or down +/-45 degrees. When the instrument is tilted within +/-45 degrees of the horizontal, the result is “UNKNOWN” . This switch is read each time the instrument goes into “RUN” mode. Due to the limited amount of internal RAM in the CPU, the 3D-ACM reads the position switch, decides UP/DOWN orientation and “loads” into the main processor either the UP or DOWN tilt calibration constants. The unit also multiplies VY, VZ, HX and HZ by -1 to attain the correct rotation of the velocity vectors.

“WHEN UP/DOWN SENSOR ORIENTATION IS DETERMINED”

The 3D-ACM checks the magnetic position switch whenever it is going to read the calibration constants from EEPROM. This is done when the unit is first powered, or when it transitions from “OPEN” to “RUN” modes. The unit will report the UP/DOWN condition with either the “RUNNING FINGERS UP” or “RUNNING FINGERS DOWN” message. If in INTERVAL mode then at the start of each Interval, the position is checked. As the typical current meter deployment is INTERVAL MODE, the unit can be running on deck (horizontal) and is deployed at the start of the first INTERVAL where it will be in the correct position as deployed and use the proper information.

“WARNINGS UP/DOWN SENSOR ORIENTATION IS DETERMINED”

If you are to deploy the unit in RUN MODE, you should start the instrument place in “OPEN MODE” configure as required and then HOLD THE UNIT in the position to be deployed and issue the “***R” RUN MODE command. Make sure the unit responds with the correct position information, either the “RUNNING FINGERS UP” or RUNNING FINGERS DOWN” message. If you are using Interval Mode “***I”, you can ignore this information as at the start of the first Interval Time when the unit is deployed, the data will be correct.

DATA PARAMETERS DATA PARAMETERS

SELECTING PARAMETERSSELECTING PARAMETERS

Any of the data parameters can be selected for incorporation into both the stored data record and the logged data record while in the OPEN mode. The user needs to only type the name of the parameter followed by an equals sign and either "ON" or "OFF". For example, to turn "ON" Average Velocity North-AVN the user would enter:

AVN=ON<CR>

To read which parameters are ON the user can issue the Read Data Message command "RDM" and a list of parameters currently "ON" are listed. The position in the list indicates the location in the actual data scan. For example, while in the OPEN mode the RDM command could respond with:

AVE=ON, AVN=ON, AVU=ON, ATIME=ON, 19

Note, the 19 at the end of the RDM response is the number of bytes of data memory that each record will consume, consult the data capacity section of this manual for complete details.

DATA OUTPUT FORMATSDATA OUTPUT FORMATS

A data read issued by the user while the instrument is operating in run mode would then have a format, for example:

18.45, 4.67, 0.5, 12:23:10 10-JUL-1995<CR><LF>

Where AVE = 18.45, AVN = 4.67, AVU= 0.5 all in cm/sec and the ATIME is equal to the date and time listed at the end of the record. Data when read from data memory will also have the same order (consult data recovery sections of this manual).

INSTANTANEOUS VALUES INSTANTANEOUS VALUES

The 3D-ACM outputs a number of Instantaneous Data Products. Instantaneous data products are not "Vector Averaged".

Note, that if Vector averaging parameters are selected and a "Vector Averaged Interval" is set, then "Instantaneous Data Products" are reported ONLY at the completion of the Vector Average Interval.

The complete mathematical definition of each of calculated parameters can be found in the 3D-ACM Algorithm section of the service.

INSTANTANEOUS VARIABLES

NAME	DESCRIPTION
STEMP	SEA TEMPERATURE CELSIUS
SV	VELOCITY OF SOUND IN WATER M/S
TX	INSTANTANEOUS TILT X DEGREES
TY	INSTANTANEOUS TILT Y DEGREES
HX	INSTANTANEOUS COMPASS X NORMALIZED
HY	INSTANTANEOUS COMPASS Y NORMALIZED
HZ	INSTANTANEOUS COMPASS Z NORMALIZED
VX	INSTANTANEOUS X VELOCITY
VY	INSTANTANEOUS Y VELOCITY
VZ	INSTANTANEOUS Z VELOCITY
VN	INSTANTANEOUS NORTH VELOCITY
VE	INSTANTANEOUS EAST VELOCITY
VU	INSTANTANEOUS UP VELOCITY
DIR	INSTANTANEOUS DIRECTION DEGREES 0-360*
CTD	HIGH ACCURACY CTD DATA
SPRES	LOCAL PRESSURE DBAR (Coastal 3D-ACM
BATT	MAIN BATTERY VOLTAGE
AUX1	USER DC VOLTAGE INPUT #1
AUX2	USER DC VOLTAGE INPUT #2

VECTOR AVERAGED VALUES VECTOR AVERAGED VALUES

The 3D-ACM is capable of vector averaging the North Velocity Component "AVN", East Velocity Component "AVE", Vertical (Up) Velocity Component "AVU", and Tilt "ATLT" (the angle of the instrument from the vertical reference). We also define ATIME as the completion time of the vector average which can be added to the data output and storage message.

VECTOR AVERAGED VARIABLES

NAME	DESCRIPTION
AVN	VECTOR AVERAGED NORTH VELOCITY CM/SEC
AVE	VECTOR AVERAGED EAST VELOCITY CM/SEC
AVU	VECTOR AVERAGED UP VELOCITY CM/SEC
ATLT	VECTOR AVERAGED INSTRUMENT TILT DEGREE
ATIME	DATA RECORD TIME

READ LAST DATA READ LAST DATA:

The 3D-ACM always stores the last data frame as defined by the "RDM" command in non-volatile RAM. This allows the user to power the instrument and read the last vector averaged data taken by the instrument. This command is used normally with data collection systems which are polling the 3D-ACM for data in a non synchronous manner. For instance, a host unit can power the 3D-ACM and read the last vector average data set stored and then power the instrument down without interrupting the vector averaging sequence. The last data is read in the **RUN MODE** using the "RLD" command. Consult the FSI inductive modem manual for specific instructions related to the RLD command and its use with FSI inductive modem systems.

RAW VALUES RAW VALUES (CALIBRATION MODE)

With the instrument operating in the "Calibration Mode", "raw data" is available for all sensors, velocity sensor, orientation sensor, internal pressure, temperature and auxiliary user DC input channels (SEE Section Operational Modes for the 3D-ACM Operational State Diagram which depicts the various 3D-ACM operating modes). The "raw" data types are used by the factory to calibrate the 3D-ACM. Within the calibration mode the instrument can report two distinct data

sets, the first is after the "Read All Velocity" command is given "RALLV". When in this mode and data is requested using either the <CR> or <LF> command the 3D-ACM reports the following block of information:

READ ALL VELOCITIESREAD ALL VELOCITIES

When first entering the CAL mode state, the instrument will be in the "Read All Velocity" state. The command RALLV can also be given. When in this sub mode and data is requested using either the <CR> or <LF> command, the 3D-ACM reports the following block of information:

```
2340, 2345, 3456, 1876, 3456, 2674, 2467, 3274 'Ph a-b & b-a
3456, 1876, 3456, 2674, 2467, 3274, 2340, 2345 'Ph c-d & d-c
2674, 2467, 3274, 3456, 1876, 3456, 2674, 2467 'Ph e-f & f-e
3274, 2340, 2345, 3456, 2674, 2467, 3274, 2340 'Ph g-h & h-g
34.56, 26.45, 17.6, 12.8 'Vel a-b, c-d, g-h, e-f
```

The first four lines of the block are the eight phase measurements made along each of the four velocity paths. The last line contains the calculated velocity for each of the four velocity paths, Va-b, Vc-d, Ve-f, and Vg-h. The velocities are calculated using a nominal speed of sound in sea water of 1500 m/s, and velocity scaling factor of 1.0.

READ ALL COMPASSREAD ALL COMPASS

In the second mode all of the raw data for parameters measured on the compass card are listed. This mode is entered using the "RALLC" command while in the "CAL MODE". The following block of information is then reported.

```
2204, 1734, 2334 ' Hcx, Hcy, Hcz
2069, 2078, 0 ' Tcx, Tcy, UpDn
3245, 3101, 2490 ' Stemp, Vbatt, Spress
3845, 2048, 2048, 2048 ' Zcal, Fscal, Aux1, Aux2
```

The block consist of four lines of raw digitizer counts. The first line contains the output of the three axis magnetometer. The second contains the two axis tilt sensor data and the Up/Down sensor. The third line contains data related to the internal Sea Temperature Measurement circuit and the internal Pressure Measurement Circuit (Coastal Version 3D-ACM) and the Battery voltage. The fourth contains the compass card calibration data "Zero Calibration" and "Full Scale Calibration" and two

Auxiliary DC channels.

The calibration mode is used by the factory to calibrate the instrument and is normally not used by the customer unless the user needs the data for diagnostic requirements.

TIMETIME

The 3D-ACM uses Real Time Clock to control the start of data collection and the vector averaging of data. The RTC clock in the 3D-ACM Time variables must be set correctly for the instrument to sample per your requirements. After setting all time variables they **MUST** be stored into the EEPROM, as time settings are constants, the same as calibration constants.

Note: TIME and DATE must be initialized prior to the use of any time control functions of the 3D-ACM. These are set by the factory to GMT +/- 5 minutes at the time of manufacture.

TIMETIME

The "TIME" command when entered in the Run Mode returns the present "instrument time". The format is 24 hour time. The "TIME" command when entered in the Open Mode is similar to the DOS Time command, an Enter Key given without new time retains the current time and a time entered with a return sets the RTC to the present time. Again, the format for time entry is 24 hour time.

DATEDATE

The "DATE" command when entered in the Run Mode returns the present "instrument date". The format is day, month, year. The "DATE" command when entered in the Open Mode is similar to the DOS Date command, an Enter Key given without new date retains the current date, a date entered with a return sets the RTC to the present date, again the format for date entry is day, month, year.

INTERVAL TIMEINTERVAL TIME

The 3D-ACM can be programmed to "awake", sample data for a given time, and then return to "sleep". These functions are controlled by the RTC. Two

commands control the length of these intervals. The first "Interval Time" (ITIME), is the length of the sampling period. The second "On Time" (OTIME), is the length of time the instrument is "on" collecting data. The "On Time" is contained within each "Interval Time". While the instrument is in the Open mode both "ITIME" and "OTIME" can be set. To enter interval mode operation (AFTER THE INTERVAL TIMES HAVE BEEN SET), the command "***I" is issued which stores all data in EEPROM, reads the RTC, calculates the "turn off time", calculates the "turn on time", and places the instrument in the run mode for a duration equal to the "OTIME". The instrument collects data (stores to memory, transmits, or awaits for valid "RUN" mode commands) until the end of the "OTIME" when it powers down (assuming "Kick-Start" has been released, see "Kick Start" section of manual).

Note, the "I" command stores all current operational set-ups and calibration factors into internal EEPROM.***

ON TIME ON TIME

The "ON TIME" (OTIME) is the time during each Interval Mode that the instrument will be "ON" and acquiring data. The "On Time" must be set less than the Interval time or the Interval time will be cleared. If the user enters an "On Time", which is longer than the "Interval Time", an error will be sent to the user and the current value of Interval Time will be cleared.

VECTOR AVERAGING INTERVAL VECTOR AVERAGING

The RTC in the 3D-ACM can be used to set a VECTOR AVERAGING period over which Velocity North, Velocity East, Velocity Up and Instrument Tilt are averaged. The vector average is a true average found by taking the sum of the data for each parameter and dividing it by the number of samples taken over the period by the number of samples. At the end of the vector average interval, the 3D-ACM writes the values to both memory and the output data buffers. Vector averaging is only available with the instrument operating in the "RUN" mode. The vector averaging interval is set via the "AVGI" command and can be set from 15 seconds to 59 minutes 59 seconds. Until the first vector average interval has been completed, the instrument will hold "zero" values in the output data record. (In other words, if data is requested for the 3D-ACM then the unit will respond with zero values for all vector averaged parameters until the end of the first vector averaging interval). If the AVGI is set and the unit is placed into the RUN MODE without enabling vector averaged parameters, they will not be output or stored. Only instantaneous parameters and output which are enabled

will be stored and, a warning message to the user will be issued.

Note: If AVGI is set such that it is not an integer number time segments of the set "OTIME" period and the 3D-ACM is operating in Interval Mode, it will store N+1 Vector Averages During each "OTIME". For example, if the user has set AVGI to 1 minute and has set "OTIME" to 5 minutes, then during each "ON" time the 3D-ACM will store 5 vector averaged records in memory, and each record will represent exactly 1 minute of current speed and direction data. If however the user set "AVGI" to 1 minute and set the "ON" time to 5 minutes and 30 seconds, the 3D-ACM will store 6 vector averaged records during each "ON" time. The first 5 records will represent 1.0 minute vector averages and the last record, record 6, will represent the last 30 seconds of "ON" time vector averages. It is therefore highly recommended that the "AVGI" time be set equal to "OTIME" or equal to an integer number of the "OTIME" setting.

Note: if the user wants to collect data at the sampling rate of the instrument, "burst mode", the vector average interval must be set to 00:00. This disables all vector averaging interval operation of the instrument. The unit will operate as prescribed by other intervals set. Interval time "ITIME", on time "OTIME, and delayed start time "DTIME" will be observed by the 3D-ACM as set prescribed by the user.

DELAYED START DELAYED START

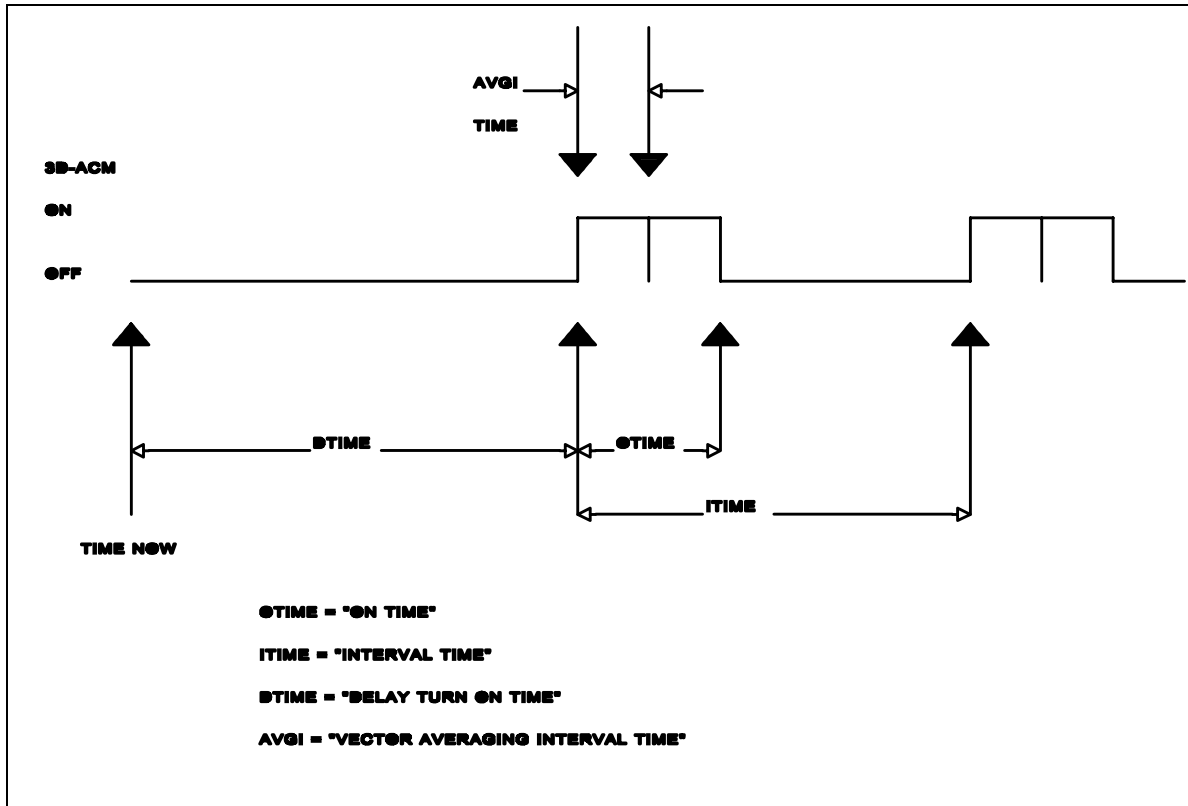
The RTC in the 3D-ACM can be used to set a delayed start time. This is performed using the "DTIME" and "***D" commands. While the instrument is in the OPEN mode the DTIME can be set. The DTIME command asks for both a Time and Date when you want the instrument to commence sampling. At the

end of "DTIME", sampling begins and is performed using the current conditions set in EEPROM including "Interval Mode", if they have been set. For example, if the DTIME was set for a time of 17:30:00, with a date of 02-13-1993, and an OTIME = 00:00:30 with corresponding ITIME = 00:60:00, then on the 13th of February 1993, the 3D-ACM would turn on at 17:30:00 for 30 seconds and sample data, one hour later the unit would again turn on and sample for 30 seconds. Alternately, if ITIME and OTIME are set to zero and the Delayed Mode is used then the instrument in the above example will power on at 17:30:00 on the 13th of February 1993 and run continuously. Again the Kick Start line must be released for the unit to enter into power downed states, see Kick Start.

Note, the "D" command stores all current operational set-ups and calibration factors into internal EEPROM.***

TIME INTERVALS

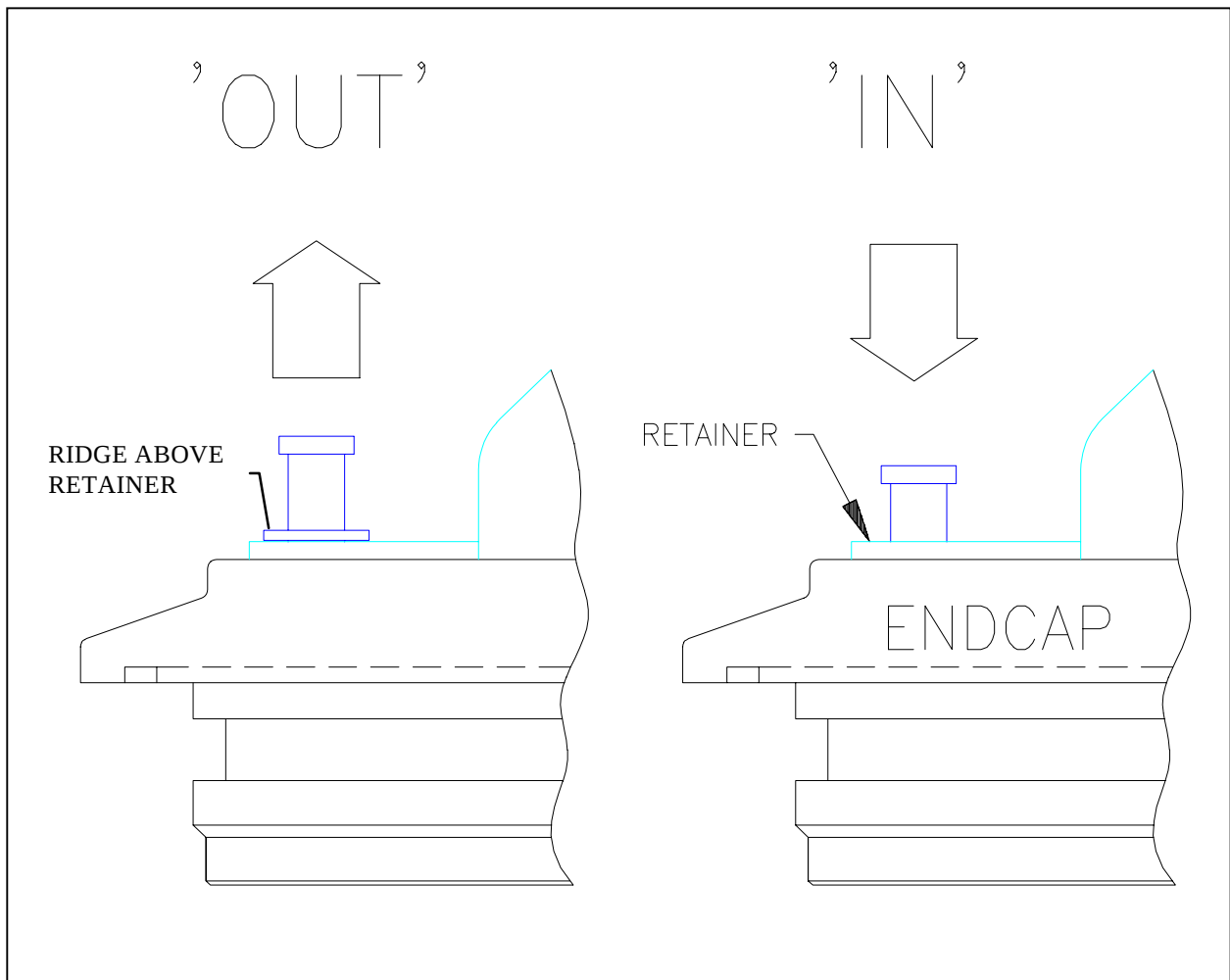
Timing intervals are depicted in the figure below. Note that in the Figure, the Vector Averaging Interval "AVGI" is set such that it is an integer number of the "ON TIME" (OTIME) setting.



KICK STARTKICK START

FOR INSTRUMENTS MANUFACTURED PRIOR TO 1 AUGUST 1997

The RTC allows for time control of power functions for the 3D-ACM. These power control functions can be overridden by the use of the Kick Start button mounted on the bottom end cap near the user input cable. This button essentially holds the power "ON" despite control function emanating from the RTC. This allows the user to turn the instrument "ON" after recovery and immediately start data down loading. When the "Kick Start" switch is in its "IN" position and is disabled, the instrument is operating under normal RTC functions; when the switch is in its "OUT" position it is enabled and the instrument turns "ON", begins sampling and awaiting user commands. Detailed in the Figure below is the kick start and the proper location of the "kick start" button in relation to the hold down "retainer" for the "OUT=ON" position and "IN=OFF" position of the button:



Note: If the internal main battery is dead the user may be required to apply external power to get the 3D-ACM operational, consult the power section of this manual for complete details.

Note: if the switch is left in the kick start position and either delayed operation or interval operation modes are used, the instrument will not be able to turn off, thereby depleting the battery. FSI recommends that after the unit is "kick started" using the switch, the user return the switch to the disabled position. The switch will also be returned to its disabled position when the instrument is subjected to external hydrostatic pressure.

FOR INSTRUMENTS MANUFACTURED AFTER 1 AUGUST 1997

The RTC allows for time control of power functions for the 3D-ACM. These power control functions can be overridden by the use of the Kick Start LOGIC LINE. The "Kick Start" Logic Control line is located on PIN 5 of the instrument communication connector. The "KICK START" line is held high by an internal pull up resistor and needs only to be connected to ground to "Kick Start" the instrument. Note, while the "Kick Start" line is held low, Interval and or Delayed Timing Intervals will not power the instrument down. The Kick Start Logic Line allows the user to turn the instrument "ON" after recovery and immediately start data down loading. The "Kick Start" pin with high impedance is in its "disabled" condition with the instrument operating under normal RTC functions; the logic pin in a low impedance state to ground is "enabled" and the instrument turns "ON" and starts sampling and awaiting user commands. The user supplied test download cable has the "kick Start" Pin 5 tied to ground.

MEMORYMEMORY

OVERVIEWOVERVIEW

The 3D-ACM stores data in a SRAM. The SRAM is organized as sequentially written, as opposed to random access. In essence the data memory is similar to a tape recorder. Data is organized in bytes, or RAM written in sequence. The position of the data pointer therefore, has one unique location and is called the Logging pointer, which can be read while in the open mode using the "Read

Logging Pointer", (RDPTR). The actual position of the memory pointer is kept in hardware, which counts each time the data logging memory is read or written. The hardware pointer can only be controlled by the 3D-ACM CPU. It can be reset to the zero position (rewind the tape) using the Reset Hardware Pointer command (RHPTR). A third command, "Reset Logging Memory" (RLPTR) which resets both the hardware and software pointers, is provided. Normal configuration for deployment would then use the RLPTR command, resting both pointers, setting logging using the Set Logging command (SLOG) and saving to EEPROM. Recovery requires the rewind of tape using the Reset Hardware Pointer command (RHPTR), reading the amount of stored data using Read Data Pointer command (RDPTR), setting the number of data sets to be read using the Define Length command (DLEN=XXX) command, and commencing download using the Data Dump command (DDMP), repeating the data dumps until all data has been read.

TYPE & SIZE

The 3D-ACM memory is sequentially stored bytes in SRAM. The standard configuration 1.0 M Byte sequential. The Coastal 3D-ACM is equipped with 0.5 M Byte. Data is stored using IEEE Standard 4 byte floating point, except for time and date which are stored using 7 bytes. Data can be transferred and store memory sequentially starting at the first record stored. Data transfer can occur using either ASCII standard format or Binary format for high speed transfer.

CAPACITY OF STORED DATA MEMORY

The standard 3D-ACM Memory Stack holds 1.0 Million, one byte records. Capacity is a function of the number of data channels stored. To determine the number of data bytes stored per sample, the Read Data Message command (RDM) used must be in OPEN mode to list data parameters stored. At the end of the message is the number of data bytes used per data record. For example for a 3D-ACM with the following parameters selected:

RDM<CR>

AVN = ON, AVE = ON, AVU = ON, ATLT = ON, ATIME=ON, 23

Then each data record will consist of:

AVN -> 4 bytes each
AVE -> 4 bytes each
AVU -> 4 bytes each
ATLT -> 4 bytes each
ATIME -> 7 bytes each

Total each record = 23 bytes

Total Number of records possible = $1.0E6/23 = 43,478$

The number listed at the end of the response, "23", is the number of bytes used in memory for each scan of 3D-ACM data logged to data memory as is detailed above.

If in addition, the user configured the instrument for 10, 1 minute vector averages per hour, the unit as configured would operate for 181 days at which point memory would be filled. This is calculated by dividing the number of bytes in memory, in this case 1.0 million, by the number of bytes per record. Taking the result and dividing by the number of records per day to determine the total deployment days.

In the following Table some data collection duration's are calculated for various RDM stored parameter configurations, assuming a single 10 minute average per hour data storage rate.

MEMORY CAPACITY IN DAYS

PARAMETERS	BYTES/RECORD	CAPACITY IN DAYS
4 PARMS + TIME	23	1810
8 PARMS + TIME	39	1068
16 PARMS	64	651

In the following Table some instrument deployment lengths are calculated for various RDM stored parameter configurations. The duration calculations assume two "ON" periods per hour and during each "ON" period two data records are written to memory (i.e. 4 records written to memory/hour).

MEMORY CAPACITY IN DAYS

PARAMETERS	BYTES/RECORD	CAPACITY IN DAYS
4 PARMS + TIME	23	160
8 PARMS + TIME	39	106
16 PARMS	64	65

DIRECT READING OPERATIONDIRECT READING OPERATION

The 3D-ACM can be configured for direct reading applications. Power during direction can be supplied from either the internal battery pack or from the user. All data can be read using either individual read commands (ASCII <CR> or <LF>) sent to the unit or the unit can be set to send data continuously using the "Set Continuous" (SC) command. The following sections outline the options available for direct reading operations.

Note: The 3D-ACM will only respond to the Stop command , "S", after the Set Continuous "SC" command has been issued. Remember that the 3D-ACM, when operating in a valid averaging mode, will only transmit data at the end of the averaging interval. For example, if the AVGI = 05:00, 5 minutes, then data will only be transmitted every 5 minutes while the SC command is active.

DATA OUTPUT FORMATDATA OUTPUT FORMAT

The 3D-ACM outputs data dependent on the enabled parameters. Data parameters available are listed in the below table named "3D-ACM OUTPUT DATA SELECTION TABLE". Data is output in physical units appropriate to the parameter enabled, i.e. Velocities in cm/sec, Angles in Degrees, Pressure in dBars, Temperatures in Celsius, Sound Velocity in Meters/Second, Battery Voltage in Volts. Data channels can be enabled or disabled using the "XXXX=ON" or the "XXXX=OFF" command while the instrument is in the open mode, where "XXXX" equals the parameter name such as "AVE" = Averaged Velocity East. An example of a data format is:

***O	'GOTO OPEN MODE
RDM<cr>	'COMMAND TO METER
VN = ON, VE = ON, VU = ON, 12<CR><LF>	'RESPONSE
***R	'PLACE METER IN RUN MODE
<cr>	'ASK FOR FRAME DATA
0.123, 0.456, 0. 789<CR><LF>	'3D-ACM RESPONSE

WHERE:

VN = **0.123** = NORTH VELOCITY CM/SEC
VE = **0.456** = EAST VELOCITY CM/SEC
VU = **0.789** = UP VELOCITY CM/SEC

The Data record length varies, dependent upon the number of parameters selected for output. To determine which parameters have been selected, the "RDM" command given in the open mode lists the currently enable parameters (Read Data Message). Data is output in the Run Mode in same order left to right as listed by the "RDM" command.

Note: If data is needed to be collected at the 3D-ACM actual digitizing data rate the unit must have the AVGI time set to 00:00. While in the open mode, set the data for continuous using the "SC" command and data will be reported at the fastest sampling rate. If ATIME = ON, then the time interval between each sample can be directly determined by the time gap as listed between each record.

3D-ACM OUTPUT DATA SELECTION TABLE

NAME	DESCRIPTION
AVN	VECTOR AVERAGED NORTH VELOCITY CM/SEC
AVE	VECTOR AVERAGED EAST VELOCITY CM/SEC
AVU	VECTOR AVERAGED UP VELOCITY CM/SEC
ATLT	VECTOR AVERAGED INSTRUMENT TILT DEGREE
ATIME	DATA RECORD TIME
STEMP	SEA TEMPERATURE CELSIUS
SV	VELOCITY OF SOUND IN WATER M/S
TX	INSTANTANEOUS TILT X DEGREES
TY	INSTANTANEOUS TILT Y DEGREES
HX	INSTANTANEOUS COMPASS X NORMALIZED
HY	INSTANTANEOUS COMPASS Y NORMALIZED
HZ	INSTANTANEOUS COMPASS Z NORMALIZED
VX	INSTANTANEOUS X VELOCITY
VY	INSTANTANEOUS Y VELOCITY
VZ	INSTANTANEOUS Z VELOCITY
VN	INSTANTANEOUS NORTH VELOCITY
VE	INSTANTANEOUS EAST VELOCITY
VU	INSTANTANEOUS UP VELOCITY
DIR	INSTANTANEOUS DIRECTION DEGREES 0-360*
CTD	HIGH ACCURACY CTD DATA
SPRES	LOCAL PRESSURE DBAR (Coastal 3D-ACM
BATT	MAIN BATTERY VOLTAGE
AUX1	USER DC VOLTAGE INPUT #1
AUX2	USER DC VOLTAGE INPUT #2

EXTERNAL POWEREXTERNAL POWER

The 3D-ACM should be powered from a constant voltage power supply. The power supplied to the instrument should maintain a minimum compliance voltage of 6 volts DC. The standard instrument consumes 10 milliamp of current operating, and 25 milliamp while in the "OPEN" or "CAL" modes. Optional sensors also add to power consumption. The High Accuracy Conductivity, Temperature and Depth (HACTD) consumes 65 milliamps of current.

The 3D-ACM is equipped with an internal voltage regulator which allows the user to input voltage up to 32 VDC.

NOTE: DO NOT INPUT VOLTAGES GREATER THAN 35 VDC OR DAMAGE TO THE 3D-ACM MAY OCCUR.

CONTINUOUS MODECONTINUOUS MODE

The 3D-ACM can be configured to send data continuously (without data request from the user). The continuous output data can be used in both the Run and Calibration modes. The user can set the 3D-ACM to output data continuously using the "Set Continuous" (SC) command. While the unit is in the Run mode the unit will transmit data each time new data is available. If the unit is set to Vector average (i.e. AVGI not equal to 0), the 3D-ACM will transmit data at the "end" of each vector average interval (the AVGI interval does not effect continuous data output while in calibration mode). To stop continuous data transfers the user can send the "Stop" (S) command.

Warning: The "Stop" (S) command is the only case sensitive command. The 3D-ACM must receive in upper case.

The 3D-ACM can also be set to send continuous data at power up. The Open Mode command "Set Continuous On Power-up", (SCOP) command allows the user to set the 3D-ACM to power up and start sending data immediately. This setting works with interval mode operations. The user must save the setting prior to powering down the instrument using the "***E" write to EEPROM. The data output can be stopped using the "Stop" (S) command, see the note above.

MULTIPLE INSTRUMENTS (ADDRESS MODE)MULTIPLE INSTRUMENTS (ADDRESS MODE)

The 3D-ACM is provided with built in address protocol. The protocol supports a subset of the IEEE-SAIL interface specification. Address mode operations allow the user to connect multiple instruments on common hardware minimizing cabling requirements. The address mode is usually used with the 3D-ACM configured for the RS-485 hardware protocol. The RS-485 allows up to 32 instruments to be connected to a single master using a half duplex two wire interface. Consult the command section for complete details for address mode operations, specifically the "SAOP" command and usage.

WARNING: PRIOR TO ENTRY INTO THE ADDRESS MODE OPERATION, THE USER SHOULD DETERMINE BOTH THE ADDRESS OF THE UNIT AND RECONFIRM THE PRESENT OPERATING BAUD RATE. THE ISSUE OF THIS COMMAND REQUIRES THE UNIT TO BE ADDRESSED IN ORDER TO ESTABLISH COMMUNICATION.

CABLES AND DATA TRANSMISSION

ELECTRICAL

The 3D-ACM can transmit data at baud rates up to 19,200 baud (1920 characters/second). The instrument is provided with a high quality, under water, wet mateable connector to assist in direct cable operation of the instrument. The length and type of cable will determine the quality of the your data transmission system. FSI engineers can provide electrical engineer support for design of a real time cable current measurement system with single or multiple instruments. The following table is typical operating distances and rates for the two standard hardware interfaces provided in the 3D-ACM. The data is only representative and may vary greatly dependent on actual conditions of your wiring system. FSI offers a line of long wire and acoustic communication systems fully compatible with the 3D-ACM.

CABLE DISTANCE VERSUS BAUD RATE BY PROTOCOL (estimated)

BAUD RATE	RS-232	RS-485
19,200	100 METERS	1000 METERS
9,600	300 METERS	3000 METERS
4,800	400 METERS	4000 METERS
1,200	500 METERS	5000 METERS
300	700 METERS	7000 METERS

MECHANICALMECHANICAL

Combined data strength cables longer than 100 meters or load carrying must be provided with an addition strength member of steel or kevlar. Information on the drag mooring point loading for the 3D-ACM can be found in the appendix. The mooring cabling designer should work to ensure that the instrument is held in a fixed position eliminating as much motion dynamics as is possible. Although the 3D-ACM has an optimized sampling design, excessive mooring dynamics may reduce final data quality. FSI has access to experts in the field for mooring design and fabrication and can supply complete mooring/instrument systems.

DEPLOYMENT SETUP WITH LOGGINGDEPLOYMENT SETUP WITH LOGGING

The FSI 3D-ACM can be prepared to collect data into internal memory by following the steps listed below. Complete details and commands for changing the operation of the 3D-ACM can be found in other sections of this manual.

WARNING: After data collection to memory is complete the user must not change enabled parameters prior to reading stored memory data. The 3D-ACM uses the user enabled list to decode serially stored data in memory.

DEPLOYMENTDEPLOYMENT:

- 1) See previous sections for powering up and communicating with the 3D-ACM.
- 2) Configure your computer using a terminal emulation program such as PROCOMM or MIRROR or PCTALK on your terminal for 9600 Baud, 8 Data Bits, 1 Stop Bit, No-Parity.
- 3) Press the "Enter" (Carriage Return) or a CRT "J" (Line Feed) and the 3D-ACM will respond with a data frame for all "Enabled Channels. The Data Frame will be in the Order listed by the Read Data Message "RDM". The data frame will be followed by a carriage return and a linefeed.
- 5) To place the unit in logging mode enter the following commands.

COMMAND	DESCRIPTION
***O	Place the unit in the "OPEN" mode
RDM	Read Data Message to confirm selected parameters, and reset as is required
TIME	Verify TIME is set
DATE	Verify DATE is set
ITIME	Verify Interval Time is Set (if Interval Mode is to be used)
OTIME	Verify On Time is Set (if Interval Mode is to be used)
AVGI	Verify Vector Average Interval (if Vector Averaged Parameters are to be used)
CLOG	Clear the logging function to allow the memory pointers (hardware & software) to be reset
RLPTR	Reset the Logging & Hardware Pointer's to "Zero"
ZMEM	Fills Memory with Zeros (Optional Takes a Couple of Minutes)
SLOG	Sets Logging "On"

***E Saves the current settings in EEPROM. If battery bounce or other power down occurs the unit will re-power and continue logging, as such it is highly recommend that the setting be saved in EEPROM.

***I Saves the current settings and the logging bit in the EEPROM. If battery bounce or other power down occurs the unit will re-power and continue logging. The instrument will commence "INTERVAL MODE" data logging.

OR

***D Saves the current settings and the logging bit in the EEPROM. If battery bounce or other power down occurs the unit will re-power and continue logging. The instrument will commence "DELAYED MODE" data logging. IF ITIME and OTIME are set will commence "INTERVAL MODE" sampling at the Date and TIME specified as DTIME

OR

***R Returns the unit to "RUN" mode commences Data Logging.

- 6) Remove the Data Communication Cable and **Install Dummy Plug**.
- 7) Ensure that the "KICK START" button is pushed in, and secured with the retaining clip.
- 8) Deploy Instrument.

DEPLOYMENT CAUTIONSDEPLOYMENT CAUTIONS

The flexibility of the 3D-ACM allows the user to specify a large number of data storage options. The user should become familiar with the command set and the effect each command has on instrument operation prior to deployment. The instrument should be fully inspected for damage prior to deployment, ensuring that all components of the mooring frame are secure and that the frame has proper zincs installed. The 3D-ACM is a precision measurement instrument, and although it does not rely on fragile mechanical sensors, care during deployment should be taken to ensure the instrument safety during deployment.

BATTERY POWERBATTERY POWER:

The 3D-ACM is powered from either a custom Alkaline, Lithium or a replaceable "C" size Alkaline cell pack which is mounted at the top end of the instrument

chassis. Battery life is dependent on the sampling regime the user implements. In the table below the power capacity for each type of battery pack is listed. These capacities are based on fully rated batteries operating at 0 Celsius. Please note the use of "fresh" dated batteries is strongly recommended. Only purchase your packs from a known source and carefully inspect battery manufacture dates. Old batteries can lose much of their rated capacity.

**3D-ACM BATTERY PACK CAPACITIES
3D-ACM BATTERY PACK "ON" TIMES**

INSTRUMENT	PACK TYPE	NOMINAL VOLTAGE	AMP-HOUR CAPACITY/ RUN TIME HOURS*
SCIENTIFIC	10 D CELL LITHIUM	7.0 VDC	70/7000
SCIENTIFIC	10 D CELL ALKALINE	3.0 VDC	50/1428
COASTAL	8 C CELL LITHIUM	7.0 VDC	28/2800
COASTAL	8 C CELL ALKALINE	3.0 VDC	16/460

*** NON-BATTERY DERATED RUN TIMES**

BATTERY POWER CONSUMPTIONBATTERY POWER CONSUMPTION:

The 3D-ACM uses on average 0.010 amps of current when operating from Lithium Packs and consumes 0.025 amps when operating from the alkaline packs. Battery life of the 3D-ACM can be extend by using Interval Mode operations where the instrument is only sampling only a portion of the time. See Interval Time and On Time sections of this manual for complete details.

Note: 3D-ACM battery consumption must be measured with the instrument operating in the "RUN" mode. Power consumption in the "OPEN" and "CAL" modes varies greatly from the "RUN" mode.

Note: 3D-ACM battery consumption in the "RUN" mode is increased if the unit is communicating. The 3D-ACM uses electrical components which are turned "ON" only when the user is actively communicating with the device. Disconnect and ensure that "SC" (Set Continuous) is disabled to ensure low power 3D-ACM operation.

3D-ACM CURRENT CONSUMPTION

PACK TYPE	NOMINAL VOLTAGE	3D-ACM CURRENT RUN MODE
LITHIUM PACK	7.0 VDC	0.010 AMPS
ALKALINE PACK	3.0 VDC	0.035 AMPS

Total "on" time for any of the packs can be found from the equation:

$$\text{ON Time (Hrs)} = \text{Capacity (AmpHrs)} / \text{Load Current (amps)}$$

SAMPLING EXTENSION BY POWER CYCLINGSAMPLING EXTENSION BY POWER CYCLING:

Battery life of the 3D-ACM can be extended by using a program for "On time" and "Interval Time" using the "OTIME" and "ITIME" commands respectively. The start time of the 3D-ACM can also be delayed using the "***D" exit to run with a preset date and time for 3D-ACM sampling to commence. The "***I" (Interval Time) can be used to directly extend battery life. In essence it is a direct relationship to the duty cycle of "off time" to "on time" which can be used to determine actual total sampling time for the 3D-ACM. The total run time can be found using the following formula (be careful to convert both "on time" and "off time" to the same units i.e. minutes):

$$\text{Total Run Time (hrs) } RT = \text{ITIME} / \text{OTIME} * PL$$

Where = ITIME = interval time

OTIME = on time

PL = Pack Life given above

For example, an 3D-ACM with Lithium Pack (7000 hrs) configured for an "OTIME" = 10 minutes each hour interval time "ITIME" would be capable of operating for:

$$RT = 60 / 10 * 7000 = 42,000 \text{ (hrs)}$$

$$RT = 1,750 \text{ (days)} = 4.7 \text{ (yrs)}$$

Note: Further battery derating may be required due to battery shelf life expectancy, consult your battery manufacturer for complete details on your particular battery's performance at low load currents.

EFFECTS ON BATTERY CONSUMPTION BY OPTIONSEFFECTS ON BATTERY CONSUMPTION BY OPTIONS:

User options are normally sampled at even a lower rate than vector averaged velocity data. The power consumption in amp-seconds is detailed for options in the following table. Option power consumption is used each time the option is sampled. In absence of special record blocks, it is normally each vector average interval. To determine the total consumption the following formula can be used which translates samples to amp-hrs of battery use:

$$\text{Consumption (amp-hrs)} = \text{OL} * \text{OT} * \text{Samples}$$

Where:

OL = Option Load Current (amps)

Samples = The total # of Samples per deployment

OT = On Time per sample (hrs)

3D-ACM OPTION CURRENT CONSUMPTION

OPTION	"ON" TIME / SAMPLE	OPTION LOAD CURRENT
HIGH ACCURACY CTD	.00138 HOURS	0.065 AMPS
FSI PRESSURE	.00138 HOURS	0.035 AMPS
FSI CONDUCTIVITY	.00138 HOURS	0.035 AMPS

For example: If the High Accuracy CTD option is installed and sampled each vector averaging in a current meter configured to take one vector average per hour then the total yearly battery consumption by the option would be:

$$\begin{aligned}\text{Samples / Year} &= 365 \text{ Day/Year} * 24 \text{ Hours/Day} * 1 \text{ Sample/Hours} \\ \text{Consumption (Amp-Hr)} &= \text{Samples/Year} * .00138 \text{ Hours/Sample} * 0.065 \text{ Amps} \\ &= 0.785 \text{ Amp-Hours}\end{aligned}$$

BATTERY EFFECTS ON COMPASSBATTERY EFFECTS ON COMPASS:

Many commercial batteries contain magnetic materials which may adversely effect the performance of the 3D-ACM compass. This is very true of alkaline batteries which contain mild steel casings. Net magnetic effects from batteries can be reduced by eliminating "DC" fields through the use of a degaussing coil. A degaussing coil is simply a large circular coil through which an AC current is passed which creates a relatively large alternating polarity magnetic field. The item to be degaussed is simply passed through the large AC field and slowly removed from its presence. These coils are commonly used by television repair shops to eliminate DC magnetic fields which may be affecting picture tube alignment. Several sources for these devices are available in the US including:

**Butler Tool & Design
641S. Newton Street
Gooland, IN 47948**

Remember the battery pack should be passed through the degaussing coil field and then slowly withdrawn prior to stoppage of the coil signal. In the figure below, the battery is shown being degaussed of residual DC magnetic fields using a commercial degaussing coil.



Battery pack effect on the compass can be tested by moving the battery pack around the 3D-ACM while the unit is in RUN mode and outputting DIR (Direction) (Note: the VEL=OFF should be set).

MEMORY BATTERY BACK-UPMEMORY BATTERY BACK-UP:

Located on the Memory card is a 12.0 mm Lithium (3.0 VDC) Memory Battery. Back-Up battery will support memory for period of 2 years in the event that the main supply discharges completely. Note, this requires the main battery to drop below 2.5 VDC. FSI recommends that the memory contents be extracted at the end of each deployment and that the main battery pack be replaced between deployments to prevent memory loss, or damage due to battery leakage.

RECOVERYRECOVERY

Upon recovery the 3D-ACM should be carefully inspected for damage during deployment.

ASCII DATA READ

Data from the 3D-ACM can be retrieved by following the easy steps listed below. Complete details and commands for changing the operation of the 3D-ACM can be found in the remaining sections of this manual.

- 1) Connect the supplied data cable to the four pin connector located on the bottom end of the 3D-ACM (The Command Port). Connect the 25 Pin "D" connector of the RS-485 converter to either serial; the port of your computer or to a terminal.
- 2) Configure your computer using a terminal emulation program such as PROCOMM or MIRROR or PCTALK on your terminal for 9600 Baud, 8 Data Bits, 1 Stop Bit, No-Parity.
- 3) Pull the "Kick Start" button. With the entry of either an "Enter" (Carriage Return) or a CRT "J" (Line Feed) the 3D-ACM will respond with a data frame for all "Enabled Channels". If no data returns, apply an external voltage source and re-try the "kick-start" button. The data frame will be followed by a carriage return and a linefeed.
- 4) To retrieve data from the instrument enter the following commands:

COMMAND	DESCRIPTION
***O	Place the unit in the "OPEN" mode
CLOG	Sets Logging "Off"
RDPTR	Read the Logging Data Pointer to determine how many data bytes have been stored.
RHPTR	Reset the Logging Hardware Pointer to "Zero"

Note: The 3D-ACM will lock memory from re-wind if the memory has been filled RDPTR = SMEM the RHPTR command will not reset the software pointer. The user in this situation is required to issue the RLPTTR command which rewinds both the memory pointer and the hardware pointer prior to the readout of stored data. If the user fails to issue the RLPTTR command zero data only will be returned from

logged memory.

DLEN=####	Set DLEN to the number of scans of data you want output after each "DDMP" command is issued. Note, the default is 128 scans. Set your computer to capture data to a file.
DDMP	Sends DLEN scans of memory. (Note: a DDMP read command can be discontinued in version F.t4 version firmware and later using the stop command (Capital "S").
DDMP	Repeat download until entire memory is read. Remove the Data Communication Cable & Disable Kick Start Switch, Vent and REMOVE Battery Pack.

BINARY DATA READ

Use the same procedure as above except use the "BDMP" command in place of the "DDMP" command. See the command detail for exact description of the binary data read and the conversion of binary data back to engineering units. This dump is normally reserved for program high speed data transfer from the instrument and requires knowledge of the conversion of the binary data to ASCII floating values.

BINARY DATA READ ALL

Use the same procedure as above except use the "BDALL" command in place of the DDMP command. This command reads all of data memory transferring it in its stored IEEE format binary form. In other words it ignores the DLEN setting and transmits the entire data memory in one continuous burst. This command yields the highest speed data transfer. See the command detail for exact description of the binary data read and the conversion of binary data back to engineering units. This dump is normally reserved for program high speed data transfer from the instrument and requires knowledge of the conversion of the binary data to ASCII floating values.

ADDITIONAL FEATURESADDITIONAL FEATURES

COMPASS DISABLECOMPASS DISABLE

The 3D-ACM COMPASS can be disabled by the "COMP=OFF" command (issued in OPEN mode). This command inputs a North pointing direction into all 3D-ACM calculations. This command can be used for tow tank testing or when the instrument is installed in a rigid "known" position relative to the earth's magnetic field. (Remember all operational change commands must be stored using the ***E command or the instrument will revert to the settings held in internal EEPROM at the next power-up). The 3D-ACM is set to a North direction when the compass is set to "off", i.e.. $H_x = 1.0$, $H_y = 0.0$, and $H_z = 0.0$.

TILT DISABLETILT DISABLE

The 3D-ACM TILT SENSOR can be disabled by the "TILT=OFF" command (issued in OPEN mode). This command inputs a VERTICAL ORIENTATION into all 3D-ACM calculations. This command can be used for tow tank testing or when the instrument is installed in a rigid "known" position relative to the earth's gravity field. (Remember all operational change commands must be stored using the ***E command or the instrument will revert to the settings held in internal EEPROM at the next power-up). The 3D-ACM is set to a Vertical direction when the tilt is set to "off", i.e.. $T_x = 0.0$, and $T_y = 0.0$.

VELOCITY DISABLE (TEST)VELOCITY DISABLE (TEST):

The 3D-ACM VELOCITY SENSOR can be disabled by the "VEL=OFF" command (issued in OPEN mode). This command inputs a fixed velocity into all 3D-ACM calculations. This command can be used for bench testing of the compass. (The VEL=OFF command can **NOT** be stored in EEPROM and **is reset to "ON"** if the instrument is powered down). The 3D-ACM is set to Velocities of $V_x = 10.0$, $V_y = 10.0$ and $V_z = 10.0$ when the Velocity Function is set to "off".

AUXILIARY DC INPUTSAUXILIARY DC INPUTS

The 3D-ACM provides the user with two each 0 - 5 VDC inputs for auxiliary sensors. These sensors can be connected via the compass card, consult the service manual for complete details for wiring these inputs. The user can also use a provide power control switch to turn "ON" and "OFF" external sensors. The switch allows for either use of the main 3D-ACM battery pack or a user supplied battery pack (jumper selectable). The two channels can be enabled in the data stream using the AUX1=ON and/or AUX2=ON commands while in the Open Mode.

AUXILIARY DC CONNECTIONSAUXILIARY DC CONNECTIONS

The two user DC channels can be connected to via J3 located on the compass interface card. This connector also provides a "switch" power control. The Switch can be configured to supply power for the 3D-ACM main supply battery or from a user supplied source. To supply power via the 3D-ACM battery pack the user must install J3 on the compass interface card. The User connector is configured as per the table below. The User can interface to the connector using a Molex Series 5 pin housing with corresponding crimp pins.

USER DC CHANNELS CONNECTOR COMPASS CARD J3

PIN	FUNCTIONAL DESCRIPTION
1	0-5 VDC USER INPUT #1 (AUX1)
2	0-5 VDC USER INPUT #2 (AUX2)
3	USER SWITCH POWER OUTPUT
4	USER SWITCH POWER INPUT
5	3D-ACM SYSTEM GROUND

AUXILIARY DC POWER SWITCHAUXILIARY DC POWER SWITCH

The user is provided a power switch. This switch can source from the 3D-ACM battery or from an externally supplied battery. Externally supplied batteries must be ground referenced to the 3D-ACM battery, pin 5 of J3, as listed above. The electronic switch is controlled by the 3D-ACM and is only enabled if AUX1 or AUX2 are turned on. The user can set a delay from the time at which the power switch is turned on to the point in time when the AUX1 and AUX2 channels are digitized. This delay is set using the "AUXD=n" command, where "n" is the number of .05 second periods that the 3D-ACM waits to digitize the auxiliary channels. For example, if AUXD = 10, then the delay is 0.5 seconds. See the detail command section of the manual for specifics related to the AUXD command and its usage.

CALIBRATION COEFFICIENTSCALIBRATION COEFFICIENTS

VELOCITYVELOCITY

The 3D-ACM has several constants which define the velocity reading of the instrument. The main constants are the path offsets for each acoustic path V_{a-b} , V_{c-d} , V_{g-h} , and V_{e-f} . The second main velocity term is the overall scaling constant for the sensor. This constant corrects for the net reduction in water flow along the acoustic path due to the intrusion of the crystal mounts. As the sensor head is constructed to have a high symmetry, the coefficient is the same for all four paths. Included in the velocity section constants are the polynomial coefficients for the end cap thermistor and, in the case of the Coastal 3D-ACM, the pressure transducer constants. The two fixed values used for the sound speed calculation are also listed under the velocity calibrations constants. These are normally set to 35 PSU for salinity and 0 dBar for pressure. The user should review the section on salinity and pressure effects on the sound speed equation for the effects these preset values have on actual field collected data. Complete mathematics for the derivation and application of velocity, temperature and pressure constants can be found in the service manual. The velocity calibration constants are therefore:

VELOCITY CONSTANTS

NAME	CONSTANT DESCRIPTION
ABOF	PATH AB OFFSET CM/SEC
CDOF	PATH CD OFFSET CM/SEC
EFOF	PATH EF OFFSET CM/SEC
GHOF	PATH GH OFFSET CM/SEC
VELXS	ALL PATH SCALE CONSTANT (NOM = 1.08)
STOFF	SEA TEMPERATURE OFFSET (C)
STSLP	SEA TEMPERATURE SLOPE (C/COUNTS)
ST2ND	SEA TEMP 2ND ORDER (C/COUNTS^2)
ST3RD	SEA TEMP 3RD ORDER (C/COUNTS^3)
SPOFF	SEA PRESSURE OFFSET (dBar)
SPLIN	SEA PRESSURE SLOPE (dBar/COUNTS)
SP2ND	SEA PRESSURE 2ND ORDER (dBar/COUNTS^2)
SAL	SOUND SPEED EQU. FIXED SALINITY VALUE
DBAR	SOUND SPEED FIXED PRESSURE VALUE

COMPASSCOMPASS

The 3D-ACM has several constants which define the compass function of the instrument. The compass utilizes a 3x3 Matrix solution to correct for sensor alignment errors of the three individual saturated flux core sensors. The main constants are the path offsets for each compass sensor. The remaining terms define the cross products of each axis. These eliminate the non-uniform alignment of the compass sensors along each sensitive axis. Complete mathematics for the derivation and application of compass constants can be found in the service manual. The compass calibration constants are therefore:

COMPASS CONSTANTS

NAME	CONSTANT DESCRIPTION
ZHX, ZHY, ZHZ	'COMP OFFSET VALUES Hx, Hy, Hz
T11,T12,T13	'Hx AXIS CORRECTION FACTORS
T21,T22,T23	'Hy AXIS CORRECTION FACTORS
T31,T32,T33	'Hz AXIS CORRECTION FACTORS

TILTTILT

The 3D-ACM has several constants which define the tilt function of the instrument. The main constants are primary Tx and Ty defining equations which determine the tilt in radian for a given reading from the DC digitizer counts. The tilt channel also has cross product terms as each axis may respond slightly as the instrument is tilted along the other tilt sensor axis. Then there are two complete sets, one for the sensor in the Up position, and a second for the sensor in the down position. Complete mathematics for the derivation and application of tilt constants can be found in the service manual. The tilt calibration constants are therefore:

TILT CONSTANTS

NAME	CONSTANT DESCRIPTION
ATU1, BTU1, CTU1, DTU1, ETU1, FTU1	'X UP TILT CONST
ATU2, BTU2, CTU2, DTU2, ETU2, FTU2	'Y UP TILT CONST
ATD1, BTD1, CTD1, DTD1, ETD1, FTD1	'X DOWN TILT
ATD2, BTD2, CTD2, DTD2, ETD2, FTD2	'Y DOWN TILT

SOUND VELOCITY EFFECTS

The 3D-ACM corrects for the speed of sound in water using temperature measured from the bottom end cap and user input values for salinity and depth. (NOTE: Data from optional sensors: pressure, conductivity, and High Accuracy Conductivity, Temperature and Depth package (HACTD) are not used by the 3D-ACM to calculate speed of sound in sea water, the user must apply these as post corrections for adjustment of measured velocities. The user can post correct for different sound velocity by multiplication of the velocity vector averages by a scaling constant).

The speed of sound is calculated on a scan by scan basis using the following formula:

$$C/100 = 1449 + 4.6T - .055T^2 + .0003T^3 + (1.39 - .012T) * (S - 35) + .017D$$

WHERE:

T = TEMPERATURE (FOUND FROM END CAP SENSOR)

S = SAL = SALINITY (ENTERED INTO 3D-ACM CONSTANTS)

D = DEPTH = DBAR (ENTERED INTO 3D-ACM CONSTANTS)

NOTE: The nominal settings for SAL = 35 PSU and dBar = 0. The velocity data can be post corrected for alternate salinities and/or deployment depths. For velocity errors of less than 1% uncertainties, the three inputs must be maintained at or below the following table:

Temperature +/- 1.0 C = +/- 1% velocity error

Pressure +/- 500 dBars = +/-1% velocity error

Salinity +/- 6 PSU = +/-1% velocity error

NOTE: The 3D-ACM using the HACTD option DOES NOT use the HACTD data to correct the speed of sound in water. The user must post process the HACTD data to obtain salinity and pressure/depth corrections for the 3D-ACM.

CORRECTIONS FOR SALINITYCORRECTIONS FOR SALINITY

The effects of salinity on sound velocity are less than 0.2% per one part per thousand salinity. If the salinity is then known to within +/- 6 PSU then the salinity induced velocity error is maintained below +/-1%. If the average salinity is different, or an inappropriate value was used, the salinity induced velocity error can be corrected by the use of the following equation:

$$\text{Velc} = \text{Vel} * (\text{SALA} - \text{SAL}) * -.17$$

Where:

Velc = Corrected 3D-ACM Velocity for Salinity

Vel = Measured 3D-ACM at SAL value in instrument

SALA = Actual Salinity Value

SAL = Instrument Stored Salinity value

CORRECTIONS FOR PRESSURECORRECTIONS FOR PRESSURE

The effects of pressure on sound velocity is less than 0.2% per 100 dBars of pressure. If the pressure is then known to within 500 dBar then the pressure induced velocity error is maintained better than 1%. If the average pressure is different, or an inappropriate value was used, the pressure induced velocity error can be corrected by the use of the following equation:

$$\text{Velc} = \text{Vel} * (\text{Pres} - \text{dBar}) * -.0020$$

Where:

Velc = Corrected 3D-ACM Velocity for Pressure

Vel = 3D-ACM at dBar value in instrument

Pres = Actual Pressure Value (in dBar)

dBar = Instrument Stored Pressure value

TOW TANK TESTINGTOW TANK TESTING:

The 3D-ACM is easily tow tank tested due to its direct ASCII readout, immunity from steel structures in the tank, and ability to measure accurately even in tanks with a cross sectional area as small as 1.0M by 1.0M. However, the user should avoid mistakes often made during tow tank evaluations. FSI has performed over 1000 tow tank calibration runs of both the original development instrument and production models of the 3D-ACM. Please consult the factory for advice in the planning and execution of your tow tank test to help eliminate problems you may encounter. Due to the unique design of the 3D-ACM, the use of acoustic phase shift does **not** require tow tank calibration prior to or after use as its "sensitivity" is a result of the physics on which the instrument is based. The instrument scale factor is dependent on the frequency of the acoustic pulse, the separation of the acoustic transducers, and the speed of sound in sea water.

DISABLE COMPASSDISABLE COMPASS

To assist in Tow Tank Calibration it is recommend that the compass be placed in the "OFF" using the "COMP=OFF" while in the OPEN mode. This will eliminate effects from local disturbances in the earth's magnetic field while the instrument moves along the tow tank.

INSTANTANEOUS DATAINSTANTANEOUS DATA

To assist in Tow Tank Calibration it is recommend that the user report (log) instantaneous data. Vector averages can always be calculated later. This eliminates the problems of short tank runs and the confusion of separating "up to velocity" and "down from velocity" components from the steady state velocity obtained while the carriage is at its steady state velocity. The user need only to select the parameters he wants reported, set "AVGI=00:00", and, then enter the RUN mode using the "***R". Know to collect the data, send the SC "Send Continuous" data command and configure the data collection computer to capture the data to a file. The user can then collect data using any terminal program operating the "capture" mode (consult the manual for your terminal emulation software).

PATH DATA COLLECTIONPATH DATA COLLECTION

Optionally the user can collect data for the individual velocity paths. This data can be collected (along with phase counts) while operating in the "CAL MODE". The user can also use the "SC" (Set Continuous Mode) and a Capture Routine with most terminal emulation software packages like PROCOMM, MIRROR, or PC TALK. The Path data can be reduced to Vx, Vy, and Vz data using the algorithms found in the appendix of this manual. The user must "measure the Temperature" of the Tow and calculate a scale factor correction for the "velocity calculated" as the individual path velocities are **not** corrected for the actual speed of sound. The 3D-ACM uses a fixed "calibration" term used to scale Path Velocities while operating in the "CAL" Mode. To scale the velocities the following formula can be used:

$$V_n = V_n * X/100$$

Where:

V_n = Reported Path Velocity

X = Velocity of Sound In Tow Tank Water*

*(See section for sound of velocity in water to calculate the velocity of sound in your tow tank water).

TOW TANK TECHNIQUETOW TANK TECHNIQUE

Good tow tank results start with the physical mounting of the instrument. The user must ensure that the unit is solidly mounted. Often the instrument is counter levered from the bottom of the carriage. This results in vibration (typically) along the direction of the flow being introduced to the unit. Make sure prior to first runs that the instrument will clear all facility structures. The carriage speed detector should integrate the velocity data in a manner similar to which data from the instrument will be processed.

Good Tow Tank techniques must be applied to get reasonable results. The best way to ruin a day of tow tank calibration is to try to obtain too many runs in too short a time frame. All tow tanks require "long" settling times after the instrument is pulled through the water. Once a settling time is established (which varies with the velocity of towing) the user can

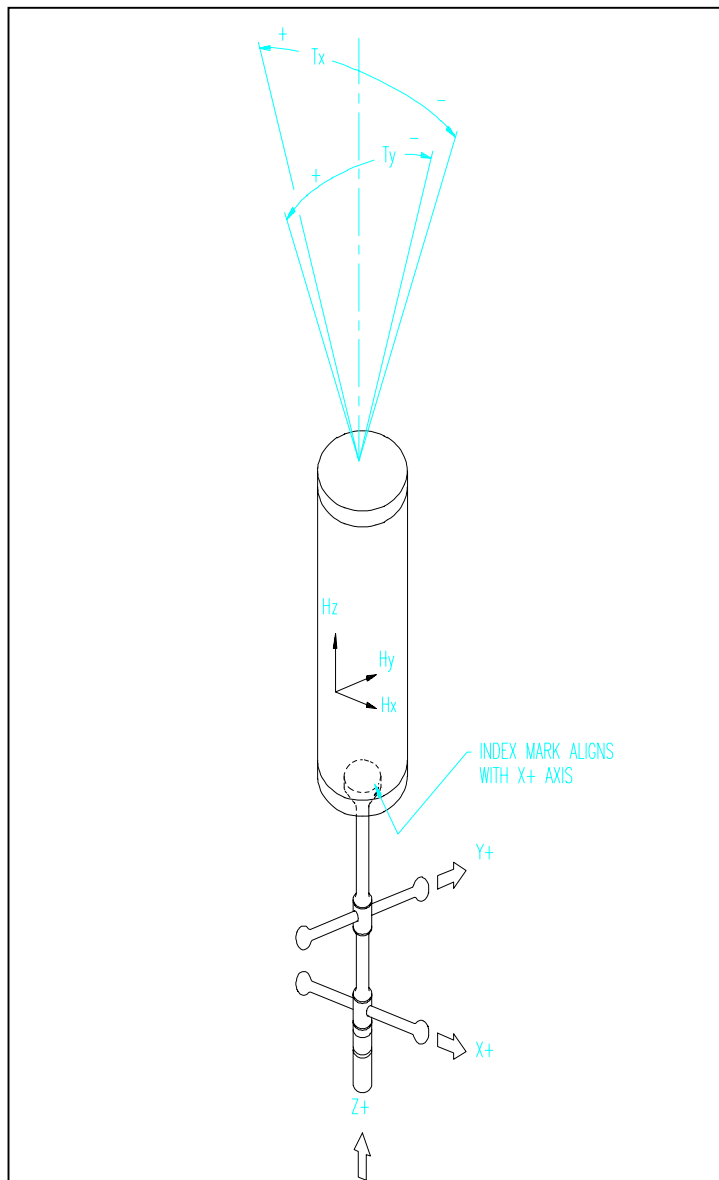
then determine the number of hours required to get test directions, tilts, etc. The most common mistake of tow tank calibration is hurrying to collect all of the data points. The user must remember that 1.0 cm/sec is a 10% error in a 10 cm/sec tow. The user must also be aware of thermal and other "corrupting" effects on the tow tank. These can occur during the day when the temperature is changing. Other "external " effects result in passive flows being established in the tank.

FLUME CALIBRATIONFLUME CALIBRATION

The ability to test cosine the cosine response is greatly enhanced by the use of a constant flow Flume. Flumes allow the user to rotate and tilt the 3D-ACM while operating in a constant velocity flow. Flumes however, are very difficult to use for an "absolute" calibration. The flow rate in a flume is proportional the flow "obstructions" found in the flume free path. The insertion of an instrument affects the flume and its average velocity and around the acoustic sensor. The user should take care while operating the flume to ensure that a secondary flow calibration device in use. The flume operator can also use vector averaging to ensure that the averaged values are correct. One possible problem while operating a flume is "bubble injection" due to pumps or small air leak on the "suction side" of the pump. Take extreme care to ensure that the water in the flume is fully degassed and that the water flow has no "visible" signs of aeration.

3D-ACM ORIENTATION DEFINITIONS

The orientation definitions for the 3D-ACM are as depicted in the following figure:



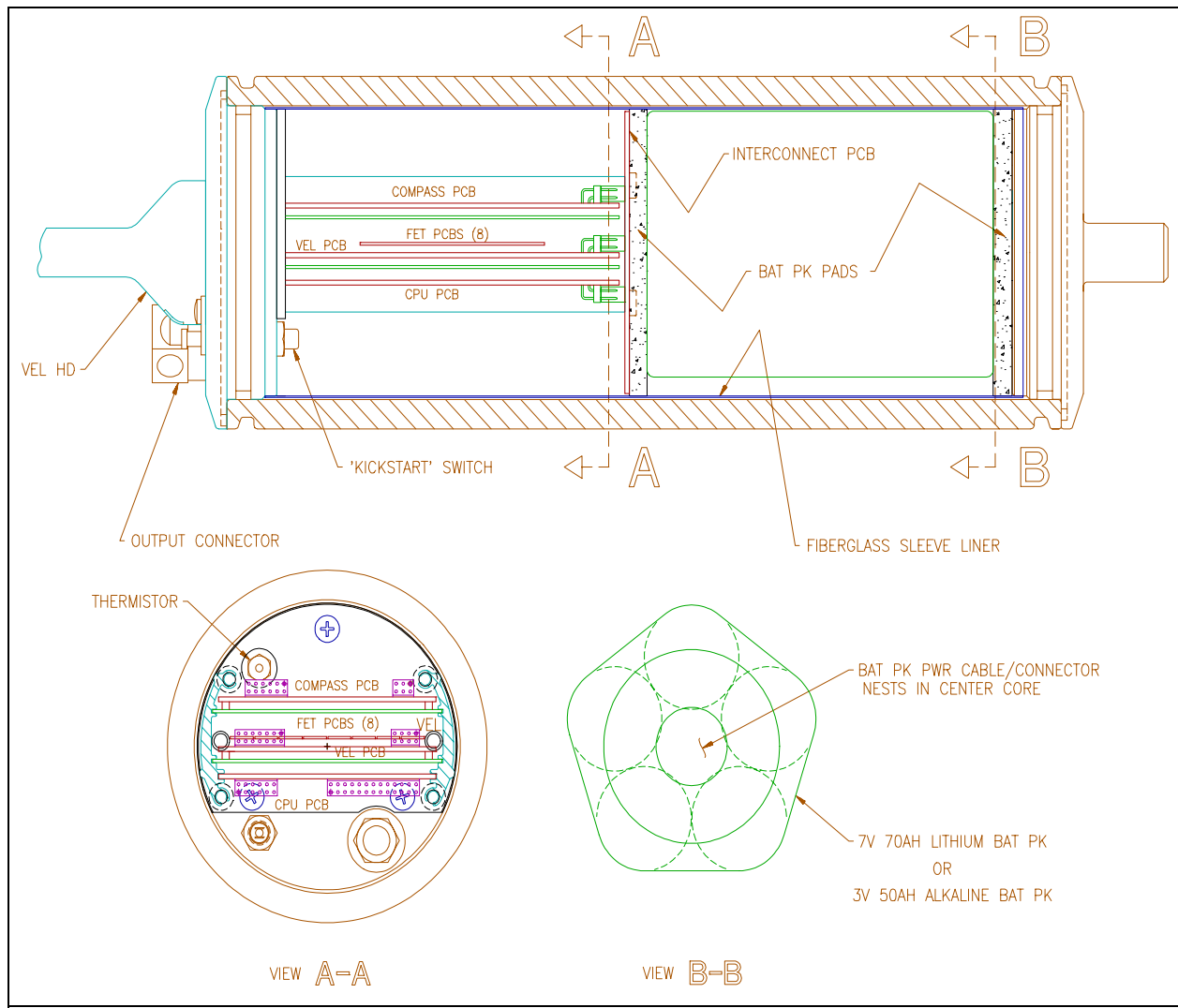
BATTERY INSTALLATIONBATTERY INSTALLATION

RTC AUXILIARY BATTERYRTC AUXILIARY BATTERY

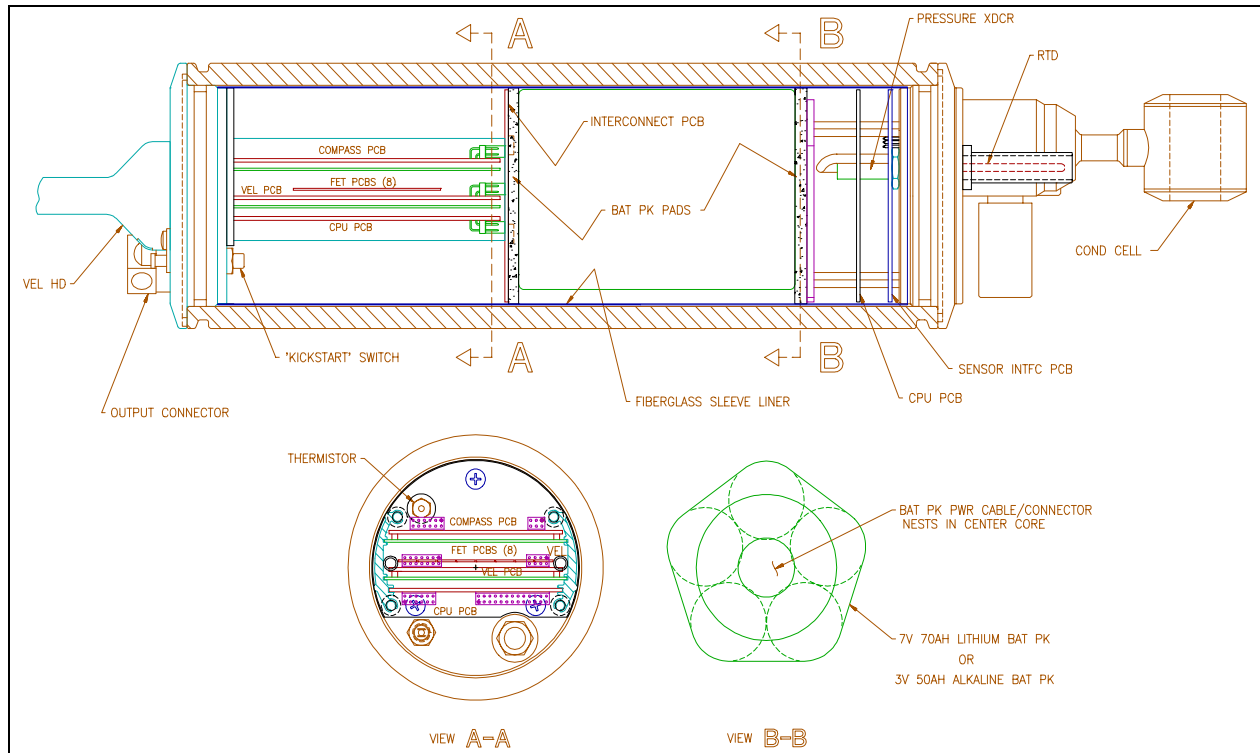
Located on the CPU card are two 12.0 mm Lithium (3.0 VDC) Auxiliary Batteries for use by the Real Time Clock. These can be obtained from FSI or from any local drugstore. (Note: In older versions of the instrument where only one battery is located in on the CPU card, the second battery was located in the RTC itself.) The RTC Auxiliary Battery must be in place and have sufficient charge for the RTC to perform all required functions. FSI recommends that the RTC auxiliary batteries be replaced after each deployment of the instrument.

MAIN BATTERY INSTALLATIONMAIN BATTERY INSTALLATION:

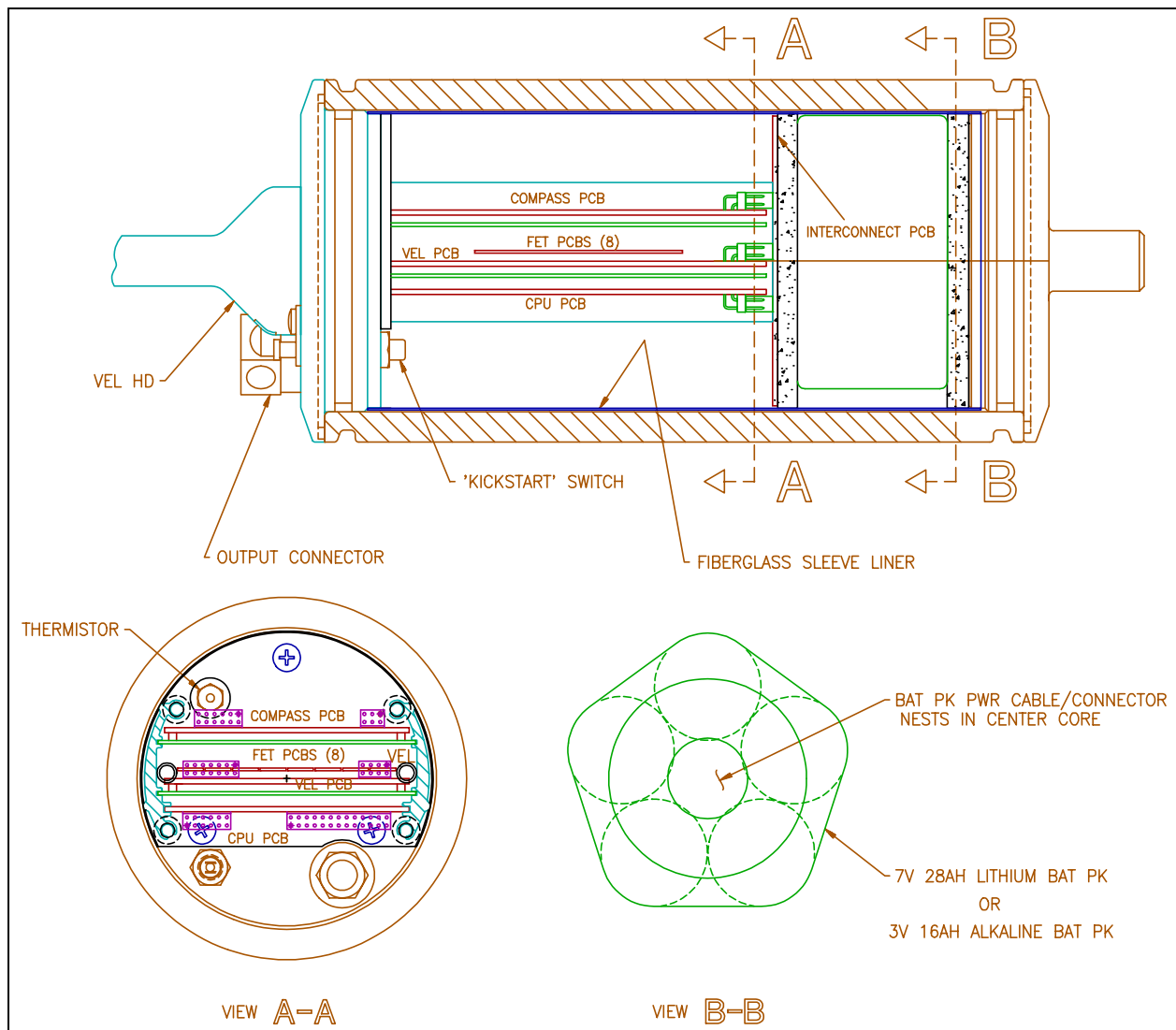
The 3D-ACM battery is installed through the top end cap of the instrument. Proper procedures for o-ring handling and electrostatic discharge should be maintained at all times. Remove the top V-Band/Hose ring clamp and remove the top end cap by pulling it out straight. The top foam piece should be removed and the battery installed with the connector to the battery held out to one side. The battery can then be plugged in and the wiring pushed back down the center hole in the pack. The top foam should be replaced and the top end cap replaced. Note, on units with the HA-CTD installed the same procedure is followed except that the HA-CTD is removed and the battery installed. Be sure to plug the cable that routes to the HA-CTD back in. Reference the following figures for detailed assembly schematic views.



INTERNAL SCHEMATIC VIEW 3D-ACM DEEP WITHOUT HA-CTD



INTERNAL SCHEMATIC VIEW 3D-ACM WITH HA-CTD



INTERNAL SCHEMATIC VIEW
COASTAL 3D-ACM

BATTERY TYPE IDENTIFICATION:*BATTERY TYPE IDENTIFICATION*

In the following figure the two types of 3D-ACM batteries can be seen. The Battery on the left contains 10 “D” size cells in two layers is for the Deep version 3D-ACM. The Battery on the right is for the Coastal 3D-ACM and contains 8 “C” size cells in a single layer. In both packs cells are tied in stacks of two batteries each and all stacks are tied in parallel. If Alkaline batteries are the pack outputs then voltage on Pin 4 of the connector is at a nominal voltage of 3.4 VDC. If the packs are Lithium then the cells voltage is output on Pin 5 of the connector with a nominal voltage of 7.8 VDC.



BATTERY TYPES:*BATTERY TYPES*

LEFT DEEP - RIGHT COASTAL

BATTERY CONNECTION:*BATTERY CONNECTION*

The 3D-ACM electronics should be mounted in the pressure housing with the lower band clamp installed prior to installation of the battery. In the figure below, the battery can be seen prepared by connection to the chassis battery input connector. Make sure that the wiring harness has not been pinched between the electronics end plate and the pressure housing by inspection. The battery and connector should be inspected for loose wires or abraded wires. The battery can be plugged into the instrument with the “kick-start” switch in either position.

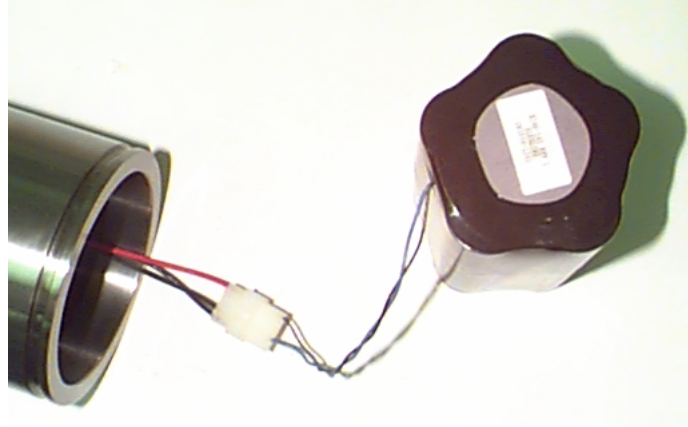
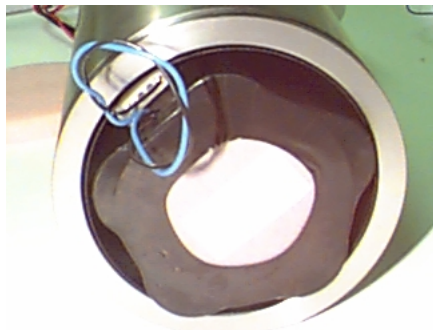


DIAGRAM BATTERY CONNECTION

BATTERY HOUSING INSTALLATION: BATTERY HOUSING INSTALLATION

In the below figure, the battery can be seen properly inserted in the pressure housing. Note the location of the cable and connector. The connector I was placed such that it is between the battery pack and the housing wall on the same side as the wires exit the battery pack. The pack is installed such that the label with date code can be read by removing the top end cap only. Note: a Foam insert has been installed below the battery and above the electronics chassis, see schematic diagrams above.



BATTERY INSTALLATION WITH CABLE PLACEMENT

FINAL STAGE BATTERY INSTALLATION:

In the figure below the battery installation is complete. The second foam insert has been installed and the top of the assembly is positioned such

that the top end cap or, for HA-CTD equipped instruments, the CTD can be installed without interference from the battery or its connector.



FINAL BATTERY POSITION

BAND CLAMP INSTALLATION/ISOLATION BAND CLAMP INSTALLATION/ISOLATION:

The 3D-ACM and Coastal 3D-ACM are supplied with 316 S.S. band clamps to hold the top and bottom end caps in place. As the main instrument housing is constructed from titanium, the band clamps **MUST** be electrically isolated from the housing. For this purpose two isolators have been provided. The isolators are formed from large diameter, heat shrink film such that it has the same contour as the inside of the band clamp, thereby easing installation. Install the isolators and then install the bands clamps such that the split in the band clamp "brackets" the split in the isolation sleeve. The band clamp can then be tightened using a "nut driver". **DO NOT OVER TIGHTEN** the band clamps. Then using a DVM, check the isolation from the clamp to the main pressure housing. It should be in excess of 10 M ohm. Install the two band clamp zincs which screw onto the protruding end of the band clamp threaded adjusters.



PICTURE DETAILING CORRECT ISOLATOR PLACEMENT PRIOR TO BAND CLAMP INSTALLATION



DETAIL SHOWING CORRECT INSTALLATION OF
BAND CLAMP OVER ISOLATOR



DETAIL SHOWING INCORRECT INSTALLATION OF BAND CLAMP
OVER ISOLATOR, NOTE CONTACT FROM CLAMP TO HOUSING



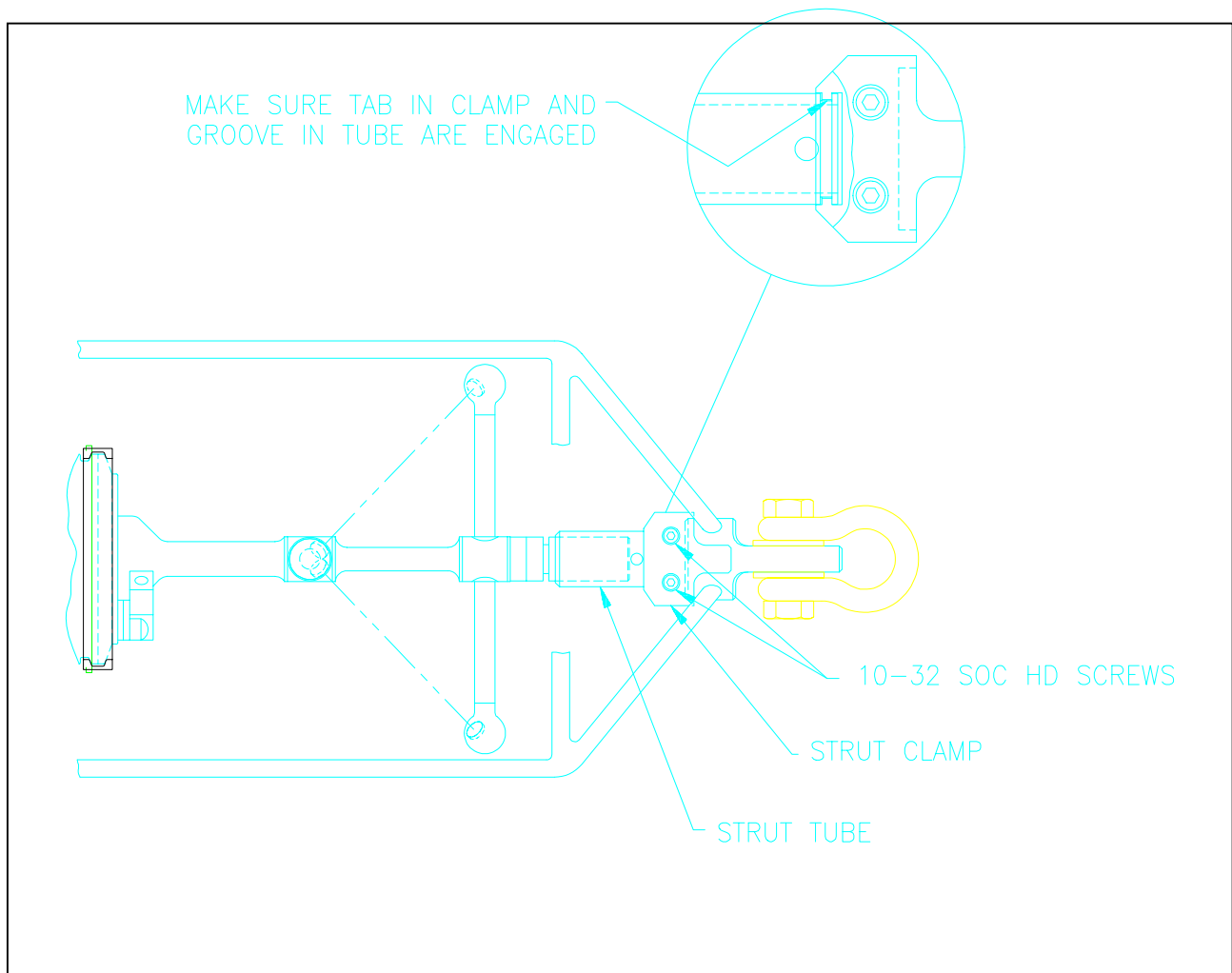
TESTING ISOLATION OF BAND CLAMP FROM HOUSING USING
DVM OR SIMILAR DEVICE

FRAME INSTALLATION/STING STRUMMING SUPPORTFRAME

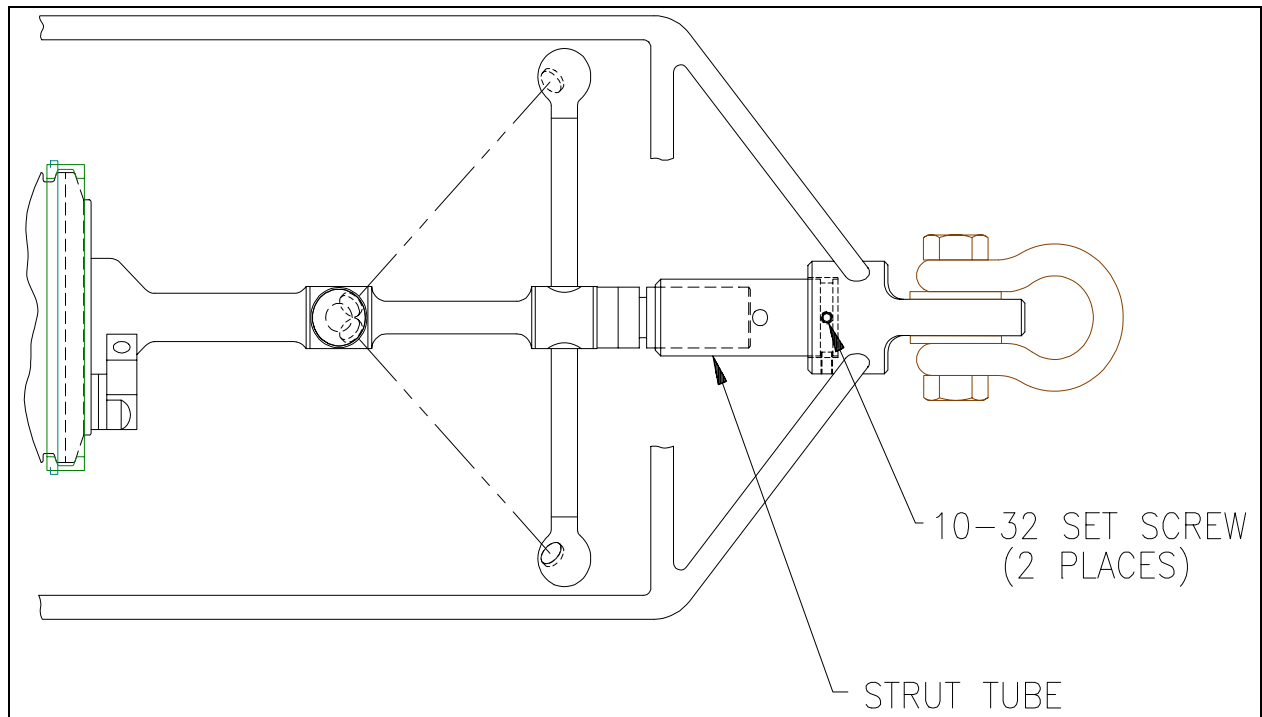
INSTALLATION/STING STRUMMING SUPPORT:

The 3D-ACM and Coastal 3D-ACM are supplied with 316 S.S. in-line mooring frames. These frames protect the instrument during deployment and retrieval and provide on deck protection for the sensor head. Each frame is provided with a sting support. The end sting support is required for use of the instrument in current flows where they are in excess of 150 cm/sec. In the situation where the current is in excess of 150 cm/sec and the flow is orthogonal to the lower finger pair, we have experienced strumming of the sensor head. This situation is completely eliminated by the addition of the Strut Clamp with integral Strut Tube.

The STRUT support is shown installed in detail in following figures. The support can be installed after the instrument is mounted into the mooring frame. Installation is achieved by first sliding the strut tube over the end of the Sting Diaphragm assembly. The strut clamp is then bolted in place such that A) the Groove is captured into the slot of the strut clamp (see detail), and B) the recess in the bottom of the strut clamp is in contact with the top of the lower pin of the mooring frame. The user may need to bend the sensor sting due to small misalignments in the welded mooring frames to install the strut support. This is acceptable and the reason the new sensors are built with a metal center support thus eliminating bending between the sensor finger pairs. Tighten the two socket head screws which will hold the assembly clamped to the lower pin on the guard frame. Ensure that both the frame zincs and band clamp zinc's are properly installed prior to deployment.



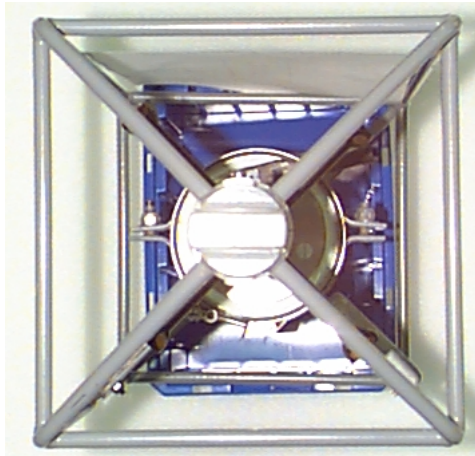
3D-ACM STING SUPPORT OLD STYLE INSTALLATION



3D-ACM STING SUPPORT NEW STYLE INSTALLATION

FRAME TO 3D-ACM ORIENTATION3D-ACM HA-CTD OPTION

The 3D-ACM has a definitive installation orientation in the mooring frame. We have found some confusion over the correct orientation of the instrument in the mooring frame. The instrument should be positioned such that the velocity fingers are “pointed at the 4 corner bars of the mooring frame”.. The correct position is detailed in the following figures. This position reduces the effects of the mooring frame on flow measured and as such offers the optimum cosine response for the unit when mounted in the mooring frame.



BOTTOM VIEW CORRECT FRAME TO INSTRUMENT POSITION



SIDE VIEW CORRECT FRAME TO INSTRUMENT ORIENTATION

3D-ACM HA-CTD OPTION:3D-ACM HA-CTD OPTION

Your 3D-ACM can be equipped with a High Accuracy CTD, (HA-CTD). This HA-CTD is a modified version of the popular FSI Micro-CTD. The instrument is reconfigured to mount in the larger 3D-ACM tube diameter. The HA-CTD is a complete stand alone instrument. The unit receives power via the #D-ACM and an external logic line from the 3D-ACM turns the unit "ON" and "OFF". Data is transmitted between the two instruments using a serial 9600 baud RS-485 data interface. The sampling sequence is commenced by the 3D-ACM at the start of each vector averaging period. The 3D-ACM enables the HA-CTD. The HA-CTD commences sampling the CTD sensors and at the completion, the HA-CTD transmits the sample to the 3D-ACM. Upon receipt of the data from the HA-CTD or after a 10 second time out, the HA-CTD is powered down. Consult the HA-CTD manual for specific details on its operation.

HA-CTD INTERCONNECTION:HA-CTD INTERCONNECTION

A single 5 pin cable connects the 3D-ACM to the HA-CTD. The Molex housing terminated cable connects from the 3D-ACM interconnect card directly to the HA-CTD CPU card. Note connections are pointed "away" from the direction of the cable routing to prevent accidental dislodging during battery installation.

HA-CTD COMMUNICATION TESTHA-CTD COMMUNICATION TEST

The user can easily test the 3D-ACM to HA-CTD data communication function using the "RCTD" command. The RCTD functions with the 3D-ACM, operating in the "OPEN MODE". Upon the receipt of the RCTD command, the 3D-ACM will commence a standard HA-CTD data collection process. The sequence is as listed below:

Example (Successful Test)

RCTD<CR>

Turning CTD on for 10 Seconds

02000,54000,00010<CR><LF>

'send test command

'3D-ACM Response

'Good Data Returned from HA-CTD

Example (Failed Test)

RCTD<CR>	'send test command
Turning CTD on for 10 Seconds	'3D-ACM Response
00000,00000,00000<CR><LF>	'No Data Returned from HA-CTD

If the HA-CTD test fails, check that the interconnecting cable is properly installed. If the interconnection is correct, then the Pass Through CTD, (PTCTD) command can be used to determine if the HA-CTD is operating in the correct mode (see Pass Through CTD Mode detailed below).

HA-CTD DATA LOGGING CONFIGURATIONHA-CTD DATA LOGGING CONFIGURATION

The HA-CTD data can be enabled for data logging or reporting by the 3D-ACM using the "CTD=ON" command issued to the instrument while in the OPEN MODE. The CTD can be disabled from data collection using the "CTD=OFF". Confirmation of the present data status for the HA-CTD can be found using either the "CTD" or "Read Data Message (RDM)" command. See the Command Detail section of this manual for complete command listings and response for the 3D-ACM.

3D-ACM PASS THROUGH MODE TO HA-CTD OPTION3D-ACM PASS THROUGH MODE TO HA-CTD OPTION

The 3D-ACM utilizes a secondary serial port to communicate with the HA-CTD. The 3D-ACM allows the user to by-pass the 3D-ACM and communicate directly with the HA-CTD. The command "Pass Through CTD (PTCTD)" enables the 3D-ACM (while in the open mode) to enter this mode.

Note: Prior to entering the PTCTD mode the user must change the 3D-ACM operating baud rate to 19.2K baud. Failure to do so will result in spurious results received from the HA-CTD as the 3D-ACM does not double buffer data while in the pass through mode. The HA-CTD communicates at 9600 Baud resulting in the 3D-ACM needing to be at the high Baud rate. See the "SBXX" command detail in command detail section of this manual for baud rate change functions.

Note: Once the PTCTD mode is entered the 3D-ACM will no longer respond to command input. The user must issue a CTRL-C to the 3D-ACM to terminate Pass Through Mode Operations.

As the HA-CTD is configured for Set Continuous On Power, (SCOP), the user should begin to see CTD data frames presented. The data is sent as Set Scaled Output, (SSOT) a such it will appear as counts in the range of 0 - 65536. If data is being displayed the user "must" send a Capital "S" to discontinue data transmission. If data is not being received the user can transmit a <CR> or <LF>, if data is received then the interface between the HA-CTD and the 3D-ACM is operating correctly, however, the HA-CTD is not in the correct mode of operation. Consult the HA-CTD manual for configuration of the HA-CTD in the SSOT and SCOP modes. Remember that these commands MUST be saved in the HA-CTD EEPROM using the "***E" command (Consult the HA-CTD Manual).

3D-ACM HA-CTD DATA CONVERSION:3D-ACM HA-CTD DATA CONVERSION

Data from the HA-CTD is provided in Scaled Units. Scaled data is used to reduce the amount of memory data space required to store the HA-CTD information. Data is scaled into and ASCII integer in the range of 0 - 65536. Data can be converted back to physical units using the below formulas:

For the data Frame:

452234,56234,20003

The first value 452234 represents conductivity counts "C"

The second value 56234 represents temperature counts "T"

The third 20003 represents pressure counts "P"

Where:

Conductivity (MMHO) = $C' / 1000 - 2.0$

Temperature (ITS-90) = $T' / 2000 - 5.0$

Pressure (dBARS) = $P' / PSCALE - 10$

Where:

Pscale = 300 using transducer F.S. < 500 dBAR

Pscale = 60 using transducer F.S. < 1500 dBAR

Pscale = 30 using transducer F.S. < 2500 dBAR

Pscale = 20 using transducer F.S. < 3500 dBAR

Pscale = 10 using transducer F.S. > 3500 dBAR

Consult your configuration or S/N tag to determine full scale range of transducer used in your HA-CTD Option.

SECTION 2.0SECTION 2.0

USER APPLICATION CONSIDERATIONSUSER APPLICATION CONSIDERATIONS

This section is provided to assist the user in avoiding set/deployment errors which might result in degradation of 3D-ACM data. All deployment configurations should be carefully reviewed by the end user to ensure that the 3D-ACM will collect the intended data. This section of the manual is provided only as a guide, the user should consult appropriate industry experts and references for further application information.

NEAR SURFACE INSTALLATIONNEAR SURFACE INSTALLATION:

FIXED PLATFORMFIXED PLATFORM:

Fixed platform measurements are often the easiest to configure. The fixed platform offers the user a stable base, eliminating movement of the instrument. However, the fixed platform deployment requires the user to take precautions. In fixed platform deployments the user must take precautions to ensure that the platform does not degrade data quality. The structure may result in two disturbances. The first due to steel or other "magnetic" construction components which degrade compass accuracy. The second may be the structure affecting the current flow being measured by the instrument. A good guide line is to keep structures a minimum distance of 20 times their cross sectional distance from the instrument. If possible the instrument should be oriented in a "know" position (normally with the +Vx Axis aligned with magnetic north-south) and the 3D-ACM placed in the "disabled compass" mode.

Often in fixed platform applications the instrument is used with direct readout. The instrument is thus cabled to the platform. The user should take adequate precautions to strain relief the cable to ensure that the strain is not translated to the bulkhead connector.

Sampling protocols on fixed platforms need not be specialized. The elimination of instrument motion allows for any averaging or instantaneous data collection intervals.

SHALLOW MOORING INSTALLATIONSHALLOW MOORING INSTALLATION:

Shallow moorings pose the most difficult deployment requirement for current meter measurement. Shallow water moorings with either surface or sub-surface floatation often are subjected to large dynamic motions in response to wave induced forces. The user must take particular care to reduce mooring induced motion to the 3D-ACM. High frequency mechanical motion can destroy the instrument's ability to collect environmental velocity data. The use of "spar" or other non-wave following buoy's is recommend if a surface expression is required. The user should work to keep the mooring as taut as possible, to prevent the instruments from "floating" down and "pulling" up with each surface wave passage. These actions may not be symmetrical, reducing the ability of vector averaging to determine the actual environmental flows. If possible longer vector averaging intervals should be used in these applications.

DEEP WATER MOORING INSTALLATIONDEEP WATER MOORING INSTALLATION:

The largest percentage of instrument loss is on deep water moorings. The design and development of mooring techniques has been well documented and several good references on the subject are available. The most common mistake of current meter users on deep water moorings is the deployment of an instrument with a low range pressure transducer which, as a result of mooring component failure, is allowed to drop to the bottom. The bottom depth subjects the transducer to a pressure in excess of its burst pressure, and results in subsequent failure due to instrument flooding.

SURFACE EXPRESSION MOORINGSURFACE EXPRESSION MOORING:

As in the shallow water mooring the user should take all actions required to minimize the surface induced motions to the mooring. The 3D-ACM has excellent vertical cosine response, however, the data can still be contaminated if the instrument is subjected to large vertical motions resulting in the sensor being dragged into flows where the pressure housing had formally resided prior to the motion. Again, as in the shallow

surface expression mooring, the user should select longer vector averaging intervals over which to collect data. Care should also be taken to maintain as vertical a mooring cable to reduce tilt related errors.

SUB-SURFACE FLOATATION MOORING INSTALLATION SUB-SURFACE FLOATATION MOORING INSTALLATION:

The sub-surface deep water mooring is a more ideal situation for the measurement of current. Sub-surface moorings provide a more stable support for the collection of current velocity data.

NEAR BOTTOM INSTALLATION NEAR BOTTOM INSTALLATION:

The 3D-ACM can be used very near the bottom. It is possible to build special tripods which allow the lower sensor finger pair to be positioned on or near the ocean floor. The user should take care not to damage the sensor sting, of the pressure compensation diaphragm assembly.

FIXED PLATFORM FIXED PLATFORM:

The fixed platform configuration allows the user to position the instrument as near to the bottom as possible. The user should take care to design the platform with all non-magnetic materials to prevent degradation of the 3D-ACM compass response. If this is not possible the user can disable the compass function. The user must secure the instrument in such a manner that it does not swing in the tripod or bottom mounted structure, swinging will degrade the quality of the data.

NEAR BOTTOM MOORING INSTALLATION NEAR BOTTOM MOORING INSTALLATION:

This one of the most difficult deployment situations. The user must allow for anchor and other holding devices, while trying to maintain the 3D-ACM in a fixed position on or near the bottom. Care should be taken to ensure that the 3D-ACM is clear of bottom end mooring structures which may disturb the flow around sensors. The acoustic signals used by the 3D-ACM will not interfere with commercial acoustic release devices and the proximity of the 3D-ACM to such a device will not result in degradation of the release performance.

SECTION 3.0SECTION 3.0

COMMANDS/DATA PORT COMMANDS COMMANDS/DATA PORT
COMMANDS

COMMAND SECTION NOMENCLATURECOMMAND SECTION
NOMENCLATURE

ALL OF THE FOLLOWING COMMAND ARE GIVEN TO THE INSTRUMENT VIA THE COMMAND PORT. DATA FROM THE INSTRUMENT IS ONLY TRANSMITTED OR STORED WHILE THE INSTRUMENT IS IN THE "RUN" OPERATIONAL MODE. A REQUEST FOR DATA WHILE THE INSTRUMENT IS OPERATING IN THE "OPEN MODE" WILL RESULT IN THE RESPONSE "OPEN MODE" FROM THE 3D-ACM.

Each Command that the 3D-ACM responds to has a "Description" on the following pages. The commands are listed in alphabetical order. Each of the "Descriptions" conform to the following format: The command appears at the top of the page. Below the command, **Usage** shows the exact syntax of the command. **Mode** indicates the operating mode the 3D-ACM must be in to respond to the command. **Description** outlines the command's effects. **Return** describes what, if anything the command returns. **See Also** references related commands. **Example** provides more information on the command, its use and implications.

COMMAND FORMAT NOTESCOMMAND FORMAT NOTES:

- A terminating character must be received before entry processing starts.
- Commands may be terminated with either a LINE FEED (0Ah) or CARRIAGE RETURN (0Dh) character. The second terminator is ignored.

Exception -> A 3D-ACM address used during address mode operations does not require a terminating character. See "SAOP" command detail.
- Responses from the 3D-ACM are terminated with both CARRIAGE

RETURN and LINE FEED characters.

- Space characters (20h) received by the 3D-ACM are ignored.
- All characters received after the first terminating character are ignored until processing the entry is completed.
- **Except** where noted, command characters may be either **UPPER** or **lower** case.

Exception -> A 3D-ACM address used during address mode operations must use upper case "A". Additionally, during "SC" Set Continuous data send operation, the 3D-ACM will only recognize an upper case "S" Stop command, see "SC" detail.

- For any invalid command, the 3D-ACM will respond with "BAD COMMAND" with the "bell" character and with or without an error message depicting the nature of the error. A command is invalid if it is not recognized or if it is incomplete or parts are incorrect. Also where noted, some commands are only valid when the 3D-ACM is in a specific mode and invalid in the other modes.
- The commands as detailed in this section relate only to the version of firmware as listed on the front of this manual. Your instrument may have more or less commands as they are listed herein. If you have any questions related to either the firmware your instrument is equipped with and/or lack of command response consult the factory.

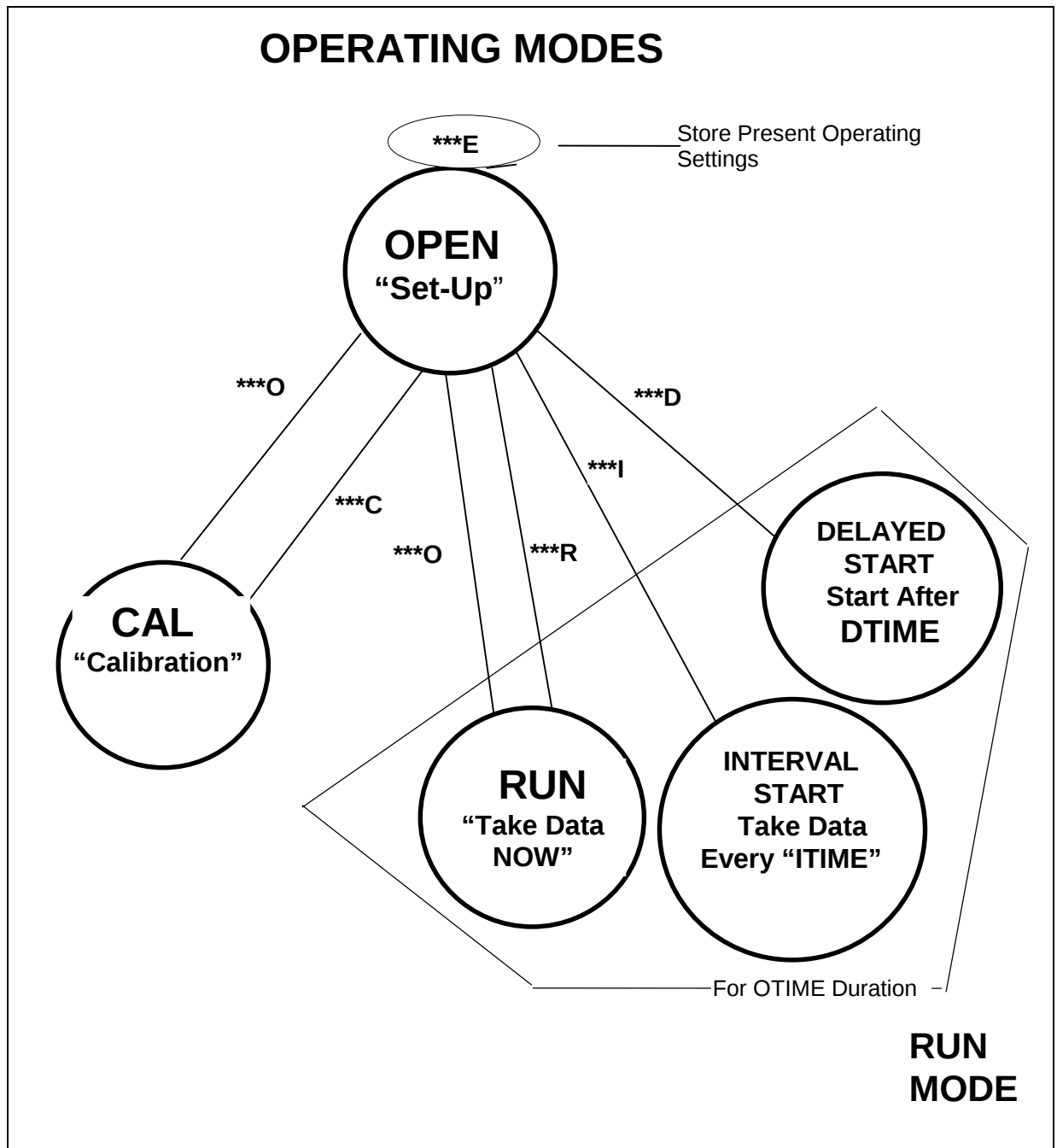
OPERATION MODES OPERATION MODES:

The 3D-ACM operates in one of five modes, these are, RUN mode, INTERVAL mode, DELAYED mode, CAL mode or OPEN mode. The CAL mode provides functions used during calibration. OPEN mode is used to update calibration and other operational parameters. RUN, INTERVAL, and DELAYED modes are the normal operating mode from which physical data and DC channel data is obtained from the device. The unit always powers up in the RUN mode (if calibration parameters are incorrect or missing the unit will power up in the OPEN mode). All data requested in the OPEN mode will be responded to with a "OPEN MODE" response.

In the Table on the following pages is listed all commands and the mode under which operate: (Note: some commands are listed under two or more Modes of operation). See detailed descriptions listed in the following sections of the manual for complete command operational usage and responses.

SEE STATE DIAGRAM NEXT PAGE

3D-ACM STATE DIAGRAM



3D-ACM COMMAND TABLE

MODE RUN	MODE OPEN	MODE CAL	DESCRIPTION
<CR>	<CR>	<CR>	READ CURRENT DATA/MODE
<LF>	<LF>	<LF>	READ CURRENT DATA/MODE
RLD			READ LAST VECTOR AVERAGED DATA
***C	***C	***C	GOTO CALIBRATION MODE
***O	***O	***O	GOTO OPEN MODE
***R	***R	***R	GOTO RUN MODE
***D	***D	***D	GOTO RUN W/ DELAY MODE
***I	***I	***I	GOTO RUN W/ INTERVAL MODE
	***E		WRITE CAL & OPERATION TO EEPROM
?	?	?	LIST COMMANDS (HELP MENU)
SC		SC	SEND CONTINUOUS DATA
C		S	STOP SENDING CONTINUOUS DATA
	DATE		READ/SET DATE
	TIME		READ/SET TIME
	DTIME		READ/SET DELAYED START TIME
	OTIME		READ/SET "ON" TIME
	ITIME		READ/SET INTERVAL TIME
	AVGI		READ/SET VECTOR AVERAGING INTERVAL
	SBxx		SET COMMAND PORT BAUD RATE xx xx - 19 = 19,200 xx - 96 = 9,600 xx - 12 = 1,200 xx - 30 = 300
	DLEN		READ DATA DUMP LENGTH IN SCANS <128>
	DLEN=		SET DATA DUMP LENGTH IN SCANS <128>
	DDMP		SEND DLEN SCANS OF LOGGED MEMORY, ASCII
	BDMP		SEND DLEN SCANS OF LOGGED MEMORY, BINARY
	BDALL		SEND ALL LOGGED MEMORY, BINARY
	ZMEM		ZERO ALL LOCATIONS IN LOGGING MEMORY
	CLOG		TURN DATA LOGGING ON
	SLOG		TURN DATA LOGGING OFF
	SMEM		READ MEMORY SIZE 0.5 M OR 1.0 M BYTE
	RLPTR		RESET HARDWARE & STORED LOGGING POINTER
	RHPTR		RESET HARDWARE LOGGING POINTER ONLY
	RDPTR		READ TOTAL DATA STORED POINTER
	TSTM		TEST DATA STORAGE MEMORY DESTROYS DATA

3D-ACM COMMAND TABLE

MODE RUN	MODE OPEN	MODE CAL	DESCRIPTION
	RCONF		READ LAST DATA COLLECTION CONFIGURATION
	ROP		READ CURRENT OPERATIONAL SETTINGS
	RLOG		READ CURRENT LOGGING STATUS
	RCTD		TEST HA-CTD TO 3D-ACM INTERFACE
	PTCTD		ENTER PASS THROUGH TO HA-CTD
	^C		END PASS THROUGH TO HA-CTD <CNTR>C
	RDM		READ DATA MESSAGE (ENABLED CHAN ONLY)
	SCOP		SET CONTINUOUS DATA SEND ON POWER-UP
	CCOP		CLEAR CONTINUOUS DATA SEND ON POWER-UP
	SAOP		SET ADDRESS OPERATION
	CAOP		CLEAR ADDRESS OPERATION
	RAOP		READ IF ADDRESS OPERATION SET
	ADR		READ ADDRESS
	ADR=n		WRITE ADDRESS (WHERE n = 0 - 7)
		RALLV	READ ALL VELOCITY (DE-FAULT ON "***C") PATH A-B & B-A 0, 90, 180, 270 DATA PATH C-D & D-C 0, 90, 180, 270 DATA PATH E-F & F-E 0, 90, 180, 270 DATA PATH G-H & H-G 0, 90, 180, 270 DATA PATH A-B, C-D, E-F, G-H VELOCITY
		RALLC	READ ALL COMPASS CARD DATA HX, HY, HZ COMPASS COUNTS TX, TY TILT COUNTS, UP/DOWN STEMP, BATTV, SPRES COUNTS ZCAL, FSCAL COUNTS, AUX1, AUX2
	DLY		DELAY CAL MODE ONLY, MILLISECONDS
	DLYV		DELAY VEL (FACTORY SETTING NOM =2)
	CLYC		DELAY COMP (FACTORY SETTING NOM =50)
	S/N		READ UNIT SERIAL NUMBER
	VER		READ FIRMWARE VERSION NUMBER
	RCAL		READ CALIBRATION CONSTANT TABLE (ALL)
	RCALC		READ CALIBRATION CONSTANT TABLE COMP.
	RCALT		READ CALIBRATION CONSTANT TABLE TILT
	RCALV		READ CALIBRATION CONSTANT TABLE VELOC.
	CDATE		READ CALIBRATION DATE
	CDATE=		SET CALIBRATION DATE

3D-ACM COMMAND TABLE

MODE RUN	MODE OPEN	MODE CAL	DESCRIPTION
	AT#1		READ CAL TERM AT1, TILT X (# = D FOR DOWN)
	BT#1		READ CAL TERM BT1, TILT X (# = U FOR UP)
	CT#1		READ CALIBRATION TERM CT1, TILT X
	DT#1		READ CALIBRATION TERM DT1, TILT X
	ET#1		READ CALIBRATION TERM ET1, TILT X
	FT#1		READ CALIBRATION TERM FT1, TILT X
	AT#2		READ CALIBRATION TERM AT2, TILT Y
	BT#2		READ CALIBRATION TERM BT2, TILT Y
	CT#2		READ CALIBRATION TERM CT2, TILT Y
	DT#2		READ CALIBRATION TERM DT2, TILT Y
	ET#2		READ CALIBRATION TERM ET2, TILT Y
	FT#2		READ CALIBRATION TERM FT2, TILT Y
	AT#1=		SET CAL TERM AT1, TILT X (# = D FOR DOWN)
	BT#1=		SET CAL TERM BT1, TILT X (# = U FOR UP)
	CT#1=		SET CALIBRATION TERM CT1, TILT X
	DT#1=		SET CALIBRATION TERM DT1, TILT X
	ET#1=		SET CALIBRATION TERM ET1, TILT X
	FT#1=		SET CALIBRATION TERM FT1, TILT X
	AT#2=		SET CALIBRATION TERM AT2, TILT Y
	BT#2=		SET CALIBRATION TERM BT2, TILT Y
	CT#2=		SET CALIBRATION TERM CT2, TILT Y
	DT#2=		SET CALIBRATION TERM DT2, TILT Y
	ET#2=		SET CALIBRATION TERM ET2, TILT Y
	FT#2=		SET CALIBRATION TERM FT2, TILT Y
	STOFF		READ CALIBRATION TERM STOFF, SEA TEMP
	STSLP		READ CALIBRATION TERM STSLP, SEA TEMP
	ST2ND		READ CALIBRATION TERM ST2ND, SEA TEMP
	ST3RD		READ CALIBRATION TERM ST3RD, SEA TEMP
	STOFF=		SET CALIBRATION TERM STOFF, SEA TEMP
	STSLP=		SET CALIBRATION TERM STSLP, SEA TEMP
	ST2ND=		SET CALIBRATION TERM ST2ND, SEA TEMP
	ST3RD=		SET CALIBRATION TERM ST3RD, SEA TEMP

3D-ACM COMMAND TABLE

MODE RUN	MODE OPEN	MODE CAL	DESCRIPTION
	POFF		READ CALIBRATION TERM POFF, SEA PRES
	PSLP		READ CALIBRATION TERM PSLP, SEA PRES
	P2ND		READ CALIBRATION TERM P2ND, SEA PRES
	SPTOF		READ CALIBRATION TERM SPTOF, SEA PRES
	SPTSL		READ CALIBRATION TERM SPTSL, SEA PRES
	POFF=		SET CALIBRATION TERM SPOFF, SEA PRES
	PSLP=		SET CALIBRATION TERM SPSLP, SEA PRES
	P2ND=		SET CALIBRATION TERM SP2ND, SEA PRES
	SPTOF=		SET CALIBRATION TERM SPTOF, SEA PRES
	SPTSL=		SET CALIBRATION TERM SPTSL, SEA PRES
	ZHX		READ CALIBRATION TERM ZHX, COMPASS X
	ZHY		READ CALIBRATION TERM ZHY, COMPASS Y
	ZHZ		READ CALIBRATION TERM ZHZ, COMPASS Z
	T11		READ CALIBRATION TERM T11, COMPASS X
	T12		READ CALIBRATION TERM T12, COMPASS X
	T13		READ CALIBRATION TERM T13, COMPASS X
	T21		READ CALIBRATION TERM T21, COMPASS Y
	T22		READ CALIBRATION TERM T22, COMPASS Y
	T23		READ CALIBRATION TERM T23, COMPASS Y
	T31		READ CALIBRATION TERM T31, COMPASS Z
	T32		READ CALIBRATION TERM T32, COMPASS Z
	T33		READ CALIBRATION TERM T33, COMPASS Z
	ZHX=		SET CALIBRATION TERM ZHX, COMPASS X
	ZHY=		SET CALIBRATION TERM ZHY, COMPASS Y
	ZHZ=		SET CALIBRATION TERM ZHZ, COMPASS Z
	T11=		SET CALIBRATION TERM T11, COMPASS X
	T12=		SET CALIBRATION TERM T12, COMPASS X
	T13=		SET CALIBRATION TERM T13, COMPASS X
	T21=		SET CALIBRATION TERM T21, COMPASS Y
	T22=		SET CALIBRATION TERM T22, COMPASS Y
	T23=		SET CALIBRATION TERM T23, COMPASS Y
	T31=		SET CALIBRATION TERM T31, COMPASS Z
	T32=		SET CALIBRATION TERM T32, COMPASS Z
	T33=		SET CALIBRATION TERM T33, COMPASS Z

3D-ACM COMMAND TABLE

MODE RUN	MODE OPEN	MODE CAL	DESCRIPTION
	ABOF		READ CAL OFFSET TERM ABOF, VEL PATH AB
	CDOF		READ CAL OFFSET TERM CDOF, VEL PATH CD
	EFOF		READ CAL OFFSET TERM EFOF, VEL PATH EF
	GHOFF		READ CAL OFFSET TERM GHOF, VEL PATH GH
	ABOF=		SET CAL OFFSET TERM ABOF, VEL PATH AB
	CDOF=		SET CAL OFFSET TERM CDOF, VEL PATH CD
	EFOF=		SET CAL OFFSET TERM EFOF, VEL PATH EF
	GHOFF=		SET CAL OFFSET TERM GHOF, VEL PATH GH
	ABSL		READ CAL SLOPE TERM ABOF, VEL PATH AB **
	CDSL		READ CAL SLOPE TERM CDOF, VEL PATH CD **
	EFSL		READ CAL SLOPE TERM EFOF, VEL PATH EF **
	GHSL		READ CAL SLOPE TERM GHOF, VEL PATH GH **
	ABSL=		SET CAL SLOPE TERM ABOF, VEL PATH AB **
	CDSL=		SET CAL SLOPE TERM CDOF, VEL PATH CD **
	EFSL=		SET CAL SLOPE TERM EFOF, VEL PATH EF **
	GHSL=		SET CAL SLOPE TERM GHOF, VEL PATH GH **
	VELXS		READ TERM VELXS VELOCITY (NOM 1.08)
	VELXS=		SET CALIBRATION TERM VELXS VELOCITY ***
	SAL		READ SALINITY FOR SV CALCULATION
	SAL=		SET SALINITY FOR SV CALCULATION
	DBAR		READ DEPTH FOR SV CALCULATION
	DBAR=		SET DEPTH FOR SV CALCULATION

** NOMINAL VALUE 1.00, CONSULT FACTORY FOR ALTERNATE SETTINGS & USAGE, NOT REPORTED IN EITHER RCAL OR RCALL V COMMANDS.

*** NOMINAL VALUE 1.08, CONSULT FACTORY FOR ALTERNATE SETTINGS & USAGE.

3D-ACM COMMAND OUTPUT DATA SELECTION TABLE

3D-ACM COMMAND OUTPUT DATA SELECTION TABLE

TO SELECT SET "= ON" WHILE IN OPEN MODE

TO REMOVE SET "= OFF" WHILE IN OPEN MODE

NAME	DESCRIPTION
AVN	VECTOR AVERAGED NORTH VELOCITY CM/SEC
AVE	VECTOR AVERAGED EAST VELOCITY CM/SEC
AVU	VECTOR AVERAGED UP VELOCITY CM/SEC
ATLT	VECTOR AVERAGED INSTRUMENT TILT DEGREE
ATIME	DATA RECORD TIME
STEMP	SEA TEMPERATURE CELSIUS
SV	VELOCITY OF SOUND IN WATER M/S
TX	INSTANTANEOUS TILT X DEGREES
TY	INSTANTANEOUS TILT Y DEGREES
HX	INSTANTANEOUS COMPASS X NORMALIZED
HY	INSTANTANEOUS COMPASS Y NORMALIZED
HZ	INSTANTANEOUS COMPASS Z NORMALIZED
VX	INSTANTANEOUS X VELOCITY
VY	INSTANTANEOUS Y VELOCITY
VZ	INSTANTANEOUS Z VELOCITY
VN	INSTANTANEOUS NORTH VELOCITY
VE	INSTANTANEOUS EAST VELOCITY
VU	INSTANTANEOUS UP VELOCITY
DIR	INSTANTANEOUS DIRECTION DEGREES 0-360*
CTD	HIGH ACCURACY CTD DATA
SPRES	LOCAL PRESSURE DBAR (Coastal 3D-ACM
BATT	MAIN BATTERY VOLTAGE
AUX1	USER DC VOLTAGE INPUT #1
AUX2	USER DC VOLTAGE INPUT #2

3D-ACM FUNCTION COMMANDS

3D-ACM COMMAND TABLE

TO SELECT SET "= ON" TO ENABLE FUNCTION WHILE IN OPEN MODE
TO REMOVE SET "= OFF" TO DISABLE FUNCTION WHILE IN OPEN MODE

MODE OPEN	"OFF" VALUES	DESCRIPTION
VEL	VE=VN=V U=10.0 CM/SEC	CONTROLS SAMPLING OF VELOCITY SECTION (NORMALLY FOR TEST PURPOSES ONLY) **
COMP	HX=1, HY=HZ=0	CONTROLS COMPASS FUNCTION. DIRECTION IS SET DUE NORTH WHEN DISABLED.
TILT	TX=TY=0	CONTROLS TILT FUNCTION. TILT IS SET VERTICAL WHEN DISABLED.

** Note: VEL Function is not stored in EEPROM. If the user disables the velocity function and power is cycled the function will re-enable.

COMMAND INSTRUCTIONS DETAILED

COMMAND INSTRUCTIONS DETAILED:

The following pages contain detailed descriptions for each command used by the 3D-ACM.

ADR

Usage: ADR

Mode: OPEN

Description:

This command reads the present value of address in volatile memory. Note: these values are held in volatile memory until the user issues the "***E" command at which time they are written into EEPROM (non-volatile memory). To ensure that current value is the one found in EEPROM (non-volatile memory) issue the "***Q" command which will read the EEPROM and return the unit to the RUN mode. Re-enter the OPEN mode using the "***O" command and re-read the address using the "ADR" command.

See Also: SAOP, CAOP, RAOP, ADR=

Returns: adr = 2 'where 2 equals ADR

Example: ADR<CR>
adr = 1 'Reads ADR which is equal to 1

ADR=

Usage: ADR=n 'Where n = integer 0 - 7

Mode: OPEN

Description:

This command writes the value of the address to the 3D-ACM. Note: these values are held in volatile memory until the user issues the "***E" command at which time they are written into EEPROM (non-volatile memory).

See Also: SAOP, CAOP, RAOP, ADR, ROP

Returns: No Return

Example

ADR=1 "Enters ADR as 1

AUXD

Usage: AUXD

Mode: OPEN

Description:

This command reads the delay in 50.0 milliseconds periods for the Auxiliary DC digitizer delay. This is the delay from when the "power switch is enabled and the DC Digitizer is sampled". The DLYA count must be multiplied by 0.05 seconds to determine the time selected. Consult your auxiliary sensor manual for recommended start time delays. The DC power switch is turned off at the completion of the digitization of the channel. Note, long delay times will adversely effect 3D-ACM sampling periods, consult the factory.

See Also: DLYV, DLYC

Returns: AUXD<CR>

AUXD=10<CR><LF> ' Auxiliary delay = $10 * .05 = 0.5$ seconds

AUXD=

Usage: AUXD=##.## Note, Maximum = 99.99

Mode: OPEN

Description:

This command writes the delay in 50.0 milliseconds periods for the Auxiliary DC digitizer delay. This is the delay from when the "power switch is enabled and the DC Digitizer is sampled". The DLYA count must be multiplied by 0.05 seconds to determine the time selected. Consult your auxiliary sensor manual for recommended start time delays. The DC power switch is turned off at the completion of the digitization of the channel. Note, long delay times will adversely effect 3D-ACM sampling periods, consult the factory.

See Also: DLYV, DLYC

Returns: As Specified

Example: AUXD=10.00<cr> 'Set DLYA equal to $10 * 0.05 = 0.5$ seconds

AVGI

Usage: AVGI

Mode: OPEN

Description:

This commands reads and allows the user to set the current VECTOR AVERAGING INTERVAL stored in the internal real time clock. The AVGI is the length of time during any ON TIME or during RUN MODE operation that the 3D-ACM will vector average over. This is a DOS like TIME command. The current INTERVAL is displayed and can be changed by the entry of a new time or left as is by pressing Enter ONLY. To enter a new time, follow the format displayed of mm:ss, minutes and seconds. Note the shortest AVGI interval is 15 seconds.

See Also: DATE, TIME, ITIME, DTIME

Returns: AVGI<CR>

Averaging Interval Time = 00:30' current INTERVAL is 30 Enter interval (mm:ss):

Example: AVGI<CR>

Averaging Interval Time = 00:30

Enter interval (mm:ss): 1:0

' change above to 1 minute

BDMP

WARNING: BDMP SHOULD ONLY BE USED BY PROGRAMS CABLE OF CONVERTING THE OUTPUT BINARY DATA STREAM BACK TO ASCII FLOATING POINT REPRESENTATIONS FOR THE DATA. CONSULT THE 3D-ACM PROGRAMMERS REFERENCE FOE SPECIFIC DETAILS RELATED TO TRANSLATION OF BINARY DATA. IMPROPER USE OF THE BINARY DUMP MAY RESULT IN LOSS OF STORED DATA.

Mode: OPEN

Description:

This command causes the 3D-ACM to dump the contents of memory to the command port. The memory will be transmitted in blocks of scans. The length of these blocks is determined by the "DLEN" command (note default is DLEN=128). Reading past the Software Memory Pointer location is allowed. The current position of the software memory pointer can be read using the "RDPTR" command. There is no flow control, data is in **IEEE STANDARD 4 BYTE BINARY FORM** (reference **PROGRAMMERS REFERENCE MANUAL** for the exact syntax).

See Also: RLPTR, RHPTR, RDPTR, DLEN, DDMP, BDALL, CLOG, SMEM

Returns: As Specified

Example: BDMP<cr>

BDALL

Usage: BDALL

WARNING: BDMP SHOULD ONLY BE USED BY PROGRAMS CAPABLE OF CONVERTING THE OUTPUT BINARY DATA STREAM BACK TO ASCII FLOATING POINT REPRESENTATIONS FOR THE DATA. CONSULT THE 3D-ACM PROGRAMMERS REFERENCE FOR SPECIFIC DETAILS RELATED TO TRANSLATION OF BINARY DATA. IMPROPER USE OF THE BINARY DUMP MAY RESULT IN LOSS OF STORED DATA.

Mode: OPEN

Description:

This command causes the 3D-ACM to dump the "**the entire**" contents of memory to the command port. There is no flow control, data is in **IEEE STANDARD 4 BYTE BINARY FORM** (reference **PROGRAMMERS REFERENCE MANUAL** for the exact syntax).

See Also: RLPTR, RHPTR, RDPTR, DLEN, DDMP, BDMP, CLOG, SMEM

Returns: As Specified

Example: BDALL<cr>

CAOP

Usage: CAOP

Mode: OPEN

Description:

This command clears the UNIT FROM address mode operations. The unit will revert to sending data upon return to the RUN mode with the entry of the SC, a <CR>, or a <LF>, without the issuance of an attention character and the units address. (Note: This command must be followed by the ***E command prior to turning the power off or the unit will power up and run as per the setting currently stored in EEPROM.)

See Also: SAOP, RAOP, ADR, ADR=, ROP

Returns: No Return

Carriage-Return or Linefeed

Usage: The single character Carriage-Return, character (13d) or (0Dh) or Ctrl M.
The single character Linefeed, character (10d) or (0Ah) or Ctrl J.

Mode: RUN, CAL or OPEN

Description:

Sending a carriage-return or Linefeed character alone, is a request for the 3D-ACM to send data. Data from the 3D-ACM is always as decimal numbers. The number of parameters sent and what each value represents is determined by the current operating mode.

Returns:

In the RUN mode, will return numbers each representing the physical value for enabled channels. Note if any channel is shown off via the RDM command then it will not be transmitted in the RUN mode, see RDM command for complete details. The rate of new data availability is based on the acquisition averaging period specified. In RUN if the instrument has not completed the current acquisition cycle, it will return a "RUN MODE" response.

In the CAL mode, the raw counts will be transmitted. The exact format of the data is dependent upon if the 3D-ACM is operating in the RALLC or RALLV sub operational mode. If the instrument has not completed the current acquisition cycle, it will return a "CAL MODE" response.

In the OPEN mode a request for data will always return a "OPEN MODE" response.

See Also: SC, SCOP, CCOP, S, RLD

CCOP

Usage: CCOP

Mode: OPEN

Description:

This command clears the 3D-ACM from sending "continuous data on power up". (Note. This command must be followed by the ***E command prior to turning the power off or the unit will power up and run as per the setting currently stored in EEPROM.)

Returns: No Return

CLOG

Usage: CLOG

Mode: OPEN

Description:

This command clears the logging flag and turns logging off. Logging must be turned off in order to dump the memory to the PC. (Note: With the logging flag off you can go into run mode and NO memory logging will take place.)

See Also: SLOG, RDPTR, RHPTR, RLPTR, ZMEM, DDMP, DLEN

Returns: CLOG<cr>
Data Logging is CLEAR

COMP=ON/OFF

Usage: COMP = ON ' ENABLE NORMAL COMPASS DATA COLLECTION
COMP = OFF ' DISABLE COMPASS SET HX=1.0, HY=HZ=0.0, 0.0 DEGREES

Mode: OPEN

Description:

This commands allows the user to disable the COMPASS sensor of the instrument. This is normally used when the instrument will be used in a "known" orientation to the earth's magnetic field, or for testing purposes. Note, this switch is stored in EEPROM and will stay in the last setting after either an ***E, ***I, or ***D command has written it to EEPROM. The user must re-enable it and then store the flag in EEPROM for it to remain enabled. Note the user can determine if the compass function is enabled by entering the name not followed by the "equate" sign, the instrument will respond with "ON" or "OFF".

See Also: TILT, VEL

Returns: As Specified

Example: COMP=OFF<CR> ' sets COMP FUNCTION "OFF"

COMP<CR> ' request the status of COMPASS function
COMP=OFF ' 3D-ACM responds with COMPASS is "OFF"

DATE

Usage: DATE

Mode: OPEN

Description:

This command allows reading and setting the 3D-ACM's date. This command is DOS like. The current date is displayed and can be changed by the entry of a new date or left as is by pressing Enter ONLY. To enter a new date, follow the format displayed of mm-dd-yyyy. Note unlike the DOS date command, the "yyyy", year field, requires the full 4 year digits. Also, the date entered is checked for both a valid month and day of the month.

See Also: TIME, ITIME, OTIME, DTIME

Returns: As Specified

Example: DATE<CR>

Current date is Fri 04-20-1995

Enter new date (mm-dd-yyyy):<CR> 'Displays the date ONLY

DATE<CR>

Current date is Fri 04-20-1995

Enter new date (mm-dd-yyyy): 5-3-1995<CR> 'Changes the date to the 3rd of May.

DDMP

Usage: DDMP

Mode: OPEN

Description:

This command causes the 3D-ACM to dump the contents of memory to the command port. The memory will be transmitted in blocks of scans. The length of these blocks is determined by the "DLEN" command (note default is DLEN=128). Reading past the Software Memory Pointer location is allowed. The current position of the software memory pointer can be read using the "RDPTR" command. There is no hardware flow control, data is in ASCII form (reference **DATA OUTPUT FORMAT** Section for the exact syntax).

See Also: RLPTR, RHPTR, RDPTR, DLEN, BDMP, BDALL, CLOG, SMEM

Returns: As Specified

Example: DDMP<cr>

35.234, 7.456, 23.4678<CR><LF> 'FIRST SCAN OF THE BLOCK

.
.
.

33.756, 12.339, 18.287<CR><LF> 'LAST SCAN OF THE BLOCK

DLEN

Usage: DLEN

Mode: OPEN

Description:

This command reads the number of stored data records the 3D-ACM will send upon receipt of the "DDMP" command to the command port. To determine the total number of stored memory bytes to be read and transferred you can read the length of a data record using the "RDM" command. This lists the number of bytes per record at the end of the response and multiplies it times the current "DLEN".

See Also: RLPTR, RDPTR, CLOG, SLOG RHPTR, SMEM

Returns: DLEN
128<CR><LF>

Example: DLEN<cr>
128<CR><LF>

DLEN=

Usage: DLEN=####

Mode: OPEN

Description:

This command sets the number of stored data records the 3D-ACM will send upon receipt of the "DDMP" command to the command port. To determine the total number of stored memory bytes to be read and transferred you can read the length of a data record using the "RDM" command. This lists the number of bytes per record at the end of the response and multiplies it times the current "DLEN". The DLEN can be set to a maximum number of 9999 records of data, the default setting is 128.

See Also: RLPTR, RDPTR, CLOG, SLOG RHPTR, SMEM, DLEN

Returns: As Specified

Example: DLEN=1200<cr> 'Set DLEN equal to 1200 Records

DLYC

Usage: DLYC

Mode: OPEN

Description:

This command reads the delay in milliseconds for the compass electronics settling time. This time is factory set to 50.0. Consult the factory for changes in this time as it will effect instrument operation.

See Also: DLYV, DLYA

Returns: DLYC

DLYC=50.0<CR><LF>

DLYC=

Usage: DLYC=##.## Note, Maximum = 99.99

Mode: OPEN

Description:

This command writes the delay in milliseconds for the compass electronics settling time. This time is factory set to 50.0. Consult the factory for changes in this time as it will effect instrument operation.

See Also: DLYV, DLYA

Returns: As Specified

Example: DLYC=50.00<cr> 'Set DLYC equal to factory default 50 milli-second

DLYV

Usage

DLYV

Mode

OPEN

Description

This command reads the delay in milliseconds for the velocity electronics settling time. This time is factory set to 2.0. Consult the factory for changes in this time as it will effect instrument operation.

See Also

DLYC, DLYA

Returns

DLYV
DLYV=2.0<CR><LF>

DLYV=

Usage: DLYV=###.## Note, Maximum = 99.99

Mode: OPEN

Description:

This command writes the delay in milliseconds for the velocity electronics settling time. This time is factory set to 2.0. Consult the factory for changes in this time as it will effect instrument operation.

See Also: DLYC, DLYA

Returns: As Specified

Example: DLYV=2.0<cr> 'Set DLYV equal to factory default 2 milli-second

DTIME

Usage: DTIME

Mode: OPEN

Description:

This command reads and allows the user to set the current DELAYED START TIME stored in the internal real time clock. The DELAY START TIME is the Time and Date that the 3D-ACM will start its first INTERVAL TIME. Note, the DELAY TIME must be set later than the current Time and Date.

See Also: DATE, TIME, ITIME, OTIME

Returns: As Specified

ITIME

Usage: ITIME

Mode: OPEN

Description:

This command reads and allows the user to set the current INTERVAL time stored in the internal real time clock. The INTERVAL TIME is the length of time for each power up to power up. The instrument at the start of each INTERVAL TIME will remain on the length of time as specified by the OTIME COMMAND. Note the INTERVAL TIME must be set longer than the OTIME.

See Also: DATE, TIME, OTIME, DTIME

Returns: As Specified

MODE

Usage: MODE

Mode: RUN, CAL or OPEN

Description:

This status command reads from the 3D-ACM and its current operating mode.

Returns: For RUN mode:
RUN MODE

For Calibration mode:
CAL MODE

For OPEN mode:
OPEN MODE

Example: MODE<CR>
CAL MODE

nnnnn

Usage:

ATU1, BTU1, CTU1, DTU1, ETU1, FTU1	'X UP TILT CONST
ATU2, BTU2, CTU2, DTU2, ETU2, FTU2	'Y UP TILT CONST
ATD1, BTD1, CTD1, DTD1, ETD1, FTD1	'X DOWN TILT CONST
ATD2, BTD2, CTD2, DTD2, ETD2, FTD2	'Y DOWN TILT CONST
ZHX, ZHY, ZHZ	'COMP OFFSET VALS
T11, T21, T31	'X COMP MATRIX CAL CONST
T12, T22, T32	'Y COMP MATRIX CAL CONST
T13, T23, T33	'Z COMP MATRIX CAL CONST
STOFF, STSLP, ST2ND, ST3RD	'SEA TEMP CAL CONST
POFF, PSLP, P2ND, SPTOF, SPTSL	'SEA PRES CAL CONST
SAL	*MUST BE SET FOR CORRECT SV
DBAR	*MUST BE SET FOR CORRECT SV
ABOF, CDOF, EFOF, GHOF	'VEL PATH OFFSETS
ABSL, CDSL, EFSL, GHSL	'VEL PATH SLOPE
VELXS	'OVERALL VELOCITY SCALE FACTOR
S/N	'SERIAL NUMBER
CDATE	'CAL/MAN DATE
VER	'FIRMWARE VERSION

Mode: OPEN

Description:

These read commands read specific data from the 3D-ACM. The RCAL command reads all calibration factors out in a table form. Note these values are the values held in volatile memory until the user issues the "***E" command at which time they are written into EEPROM (non-volatile memory).

NOTE: SAL AND DBAR MUST BE SET FOR DEPLOYMENT AREA OR POST CORRECT TO ALLOW FOR CORRECT SOUND SPEED CALCULATION BY 3D-ACM, REFER TO SECTION ON THE EFFECTS OF SOUND VELOCITY IN SEA WATER AND ITS EFFECTS ON MEASURED VELOCITIES.

Returns: As Specified

Example:

NOTE: FOUR COMMANDS ALLOW THE USER TO LIST THE CALIBRATION CONSTANTS OUT ALTOGETHER IN GROUPS RELATED TO THE CHANNEL. THESE COMMANDS ARE "RCAL" WHICH READS OUT ALL CONSTANTS, "RCALV" WHICH READS OUT CONSTANTS RELATED TO THE VELOCITY CALIBRATION, "RCALC" WHICH READS CONSTANTS RELATED TO THE COMPASS FUNCTION, AND, "RCALT" WHICH READS CONSTANTS RELATED TO THE TILT FUNCTION.

nnnnn=

Usage

Floating point values:

ATU1=, BTU1=, CTU1=, DTU1=, ETU1=, FTU1= 'X UP TILT CONST
ATU2=, BTU2=, CTU2=, DTU2=, ETU2=, FTU2= 'Y UP TILT CONST
ATD1=, BTD1=, CTD1=, DTD1=, ETD1=, FTD1= 'X DOWN TILT CONST
ATD2=, BTD2=, CTD2=, DTD2=, ETD2=, FTD2= 'Y DOWN TILT CONST
T11=, T21=, T31= 'X COMP MATRIX CAL CONST
T12=, T22=, T32= 'Y COMP MATRIX CAL CONST
T13=, T23=, T33= 'Z COMP MATRIX CAL CONST
STOFF=, STSLP=, ST2ND=, ST3RD= 'SEA TEMP CAL CONST
POFF=, PSLP=, P2ND=, SPTOF=, SPTSL= 'SEA PRES CAL CONST
SAL= *MUST BE SET FOR CORRECT SV
DBAR= *MUST BE SET FOR CORRECT SV
ABOF=, CDOF=, EFOF=, GHOF= 'VEL PATH OFFSETS
ABSL=, CDSL=, EFSL=, GHSL= 'VEL PATH SLOPE
VELXS= 'OVERALL VELOCITY SCALE FACTOR
CDATE= 'CAL/MAN DATE

Integer Values:

ZHX=, ZHY=, ZHZ= 'COMP OFFSET CONST

Date Values:

CDATE= 'Use 03SEP94 format

Mode

OPEN

Description

These commands write calibration constant data to the 3D-ACM. Note: these values are held in volatile memory until the user issues the "***E" command at which time they are written into EEPROM (non-volatile memory). Floating point numbers can be entered as exponential. The user can not change the S/N or version numbers.

NOTE: SAL AND DBAR MUST BE SET FOR DEPLOYMENT AREA OR POST CORRECTED TO ALLOW FOR CORRECT SOUND SPEED CALCULATION BY 3D-ACM, REFER TO SECTION ON THE EFFECTS OF SOUND VELOCITY IN SEA WATER AND ITS EFFECTS ON MEASURED VELOCITIES.

Returns

No Return

Example

AT1=4.233456E-01 "Enters AT1 as 0.4233456

OTIME

Usage: OTIME

Mode: OPEN

Description:

This commands reads and allows the user to set the current ON TIME stored in the internal real time clock. The ON TIME is the length of time for each INTERVAL TIME that the 3D-ACM is powered and collecting data. The instrument at the start of each INTERVAL TIME will remain on for the duration of time specified by the OTIME COMMAND. Note the ON TIME must be set shorter than the INTERVAL TIME.

See Also: DATE, TIME, ITIME, DTIME

Returns: As Specified

PARAM=ON/OFF

Usage: NAME = ON ' ENABLE DATA PARAMETER FOR STORAGE OR TRANSMISSION
NAME = OF ' DISABLE DATA PARAMETER FOR STORAGE OR TRANSMISSION
WHERE NAME = VX = INSTANTANEOUS VELOCITY VX AXIS CM/SECOND
VY = INSTANTANEOUS VELOCITY VY AXIS CM/SECOND
VZ = INSTANTANEOUS VELOCITY VZ AXIS CM/SECOND
HX = INSTANTANEOUS HX COMPASS COMPONENT RADIAN'S
HY = INSTANTANEOUS HY COMPASS COMPONENT RADIAN'S
HZ = INSTANTANEOUS HZ COMPASS COMPONENT RADIAN'S
DIR = INSTANTANEOUS INSTRUMENT HEADING DEGREES
STEMP = SEA TEMPERATURE CELSIUS
SPRES = SEA PRESSURE DBARS (COASTAL 3D-ACM ONLY)
TX = TX TILT DEGREES
TY = TY TILT DEGREES
ATLT = VECTOR AVERAGED INSTRUMENT TILT DEGREES
BATT = BATTERY VOLTAGE
VN = INSTANTANEOUS VELOCITY NORTH CM/SECOND
VE = INSTANTANEOUS VELOCITY EAST CM/SECOND
VU = INSTANTANEOUS VELOCITY UP CM/SECOND
AVN = VECTOR AVERAGED VELOCITY NORTH CM/SECOND
AVE = VECTOR AVERAGED VELOCITY EAST CM/SECOND
AVU = VECTOR AVERAGED VELOCITY UP CM/SECOND
ATIME = TIME AT END OF THE VECTOR AVERAGE (STORED TIME)
CTD = HA-CTD DATA COLLECT AT START OF VECTOR AVERAGE
SV = VELOCITY OF SOUND IN SEA WATER CM/SEC
AUX1 = DC USER INPUT #1 0 - 5 VDC
AUX2 = DC USER INPUT #2 0 - 5 VDC

Mode: OPEN

Description

This commands allows the user to select the current parameters which are to be reported and logged in data storage memory. Note, instantaneous values are only recorded at the "end" of each vector averaging interval. Vector averages are only record if a valid vector averaging interval has been set. Consult the main section of the manual for complete details on stored parameter formats. Note the user can determine if an individual parameter is enabled by entering the name not followed by the "equate" sign, the instrument will respond with "ON" or "OFF",

see also RDM command.

See Also

ZMEM, AVGI, RDM

Example

VN=ON<CR> ' sets VN "ON" in stored data and output data

VN<CR> ' request the status of VN parameter

VN=ON ' 3D-ACM responds with parameter is "ON"

PTCTD

NOTE; THE 3D-ACM MUST BE CHANGED TO OPERATE AT 19.2 K BAUD FOR THIS COMMAND TO OPERATE CORRECTLY. THE 3D-ACM DOES NOT DOUBLE BUFFER DATA FROM THE HA-CTD AND AS SUCH MUST OPERATE AT A BAUD RATE HIGHER THAN THE HA-CTD (9600 BAUD).

NOTE: AS THIS COMMAND ALLOWS THE USER TO COMMUNICATE WITH THE HA-CTD FOR TEST PURPOSES ONLY THE NEED TO OPERATE THE 3D-ACM AT 19.2 K BAUD ONLY EFFECTS TEST AND OR CALIBRATION OF THE HA-CTD IN COMBINATION WITH THE 3D-ACM. CONSULT THE FACTORY IF YOU HAVE ANY QUESTIONS RELATED TO THIS COMMAND PRIOR TO ITS USE.

NOTE: THE HA-CTD WILL COMMENCE OPERATION IN THE "SCOP" AND "SSOT" MODE'S.. THE USER MUST ISSUE A CAPITOL "S" TO COMMENCE COMMUNICATION WITH THE HA-CTD. THE HA-CTD MUST BE RETURNED TO THE "SCOP" AND "SSOT" MODES FOR CORRECT OPERATION WITH THE 3D-ACM. CONSULT THE HA-CTD MANUAL.

Usage: PTCTD ' Set 3D-ACM to pass through mode.
 ^C ' Stop Pass Through Mode.

Mode: OPEN

Description

This allows the user to communicate directly with the HA-CTD for test purposes. This allows the user to change the HA-CTD while operating in conjunction with the 3D-ACM. Note the 3D-ACM will not respond to any other command until a control "C" has been issued following the entry into the pass through mode using the "PTCTD" command. To test the communicate of the HA-CTD with the 3D-ACM use the "RCTD command. The 3D-ACM must be set to communicate at 19.2K for this command to work correctly, see SBXX commands. Consult the HA-CTD manual for a complete set of command for this instrument. The command powers the HA-CTD and allows open bi-directional communication with the HA-CTD until a control "C" "^C" is received by the 3D-ACM from the user.

See Also: RCTD

RAOP

Usage: RAOP

Mode: OPEN

Description:

This command reads the 3D-ACM address mode operation. Note: if the unit is presently in the address mode operation, the units address preceded by the attention character must be transmitted to allow the unit to enter the "addressed unit open status".

See Also: SAOP, RAOP, ADR, ADR=

Returns: address mode set
address mode not set

Example: RAOP(LF/CR)
address mode set

RCAL

Usage: RCAL

Mode: OPEN

Description:

This command reads all calibration data from the 3D-ACM. Note these values are the values held in volatile memory until the user issues the "***E" command, at which time they are written into EEPROM (non-volatile memory). The user cannot change the S/N or version numbers.

Returns: As Specified

Example:

```
RCAL<CR>
S/N=1376
VER=2.0
CDATE=1SEP95
ABOF = -9.000000e-02
CDOF = -3.200000e-01
EFOF = -2.000000e-02
GHOF = 1.500000e-01
ABSL = 1.000000e+00
CDSL = 1.000000e+00
EFSL = 1.000000e+00
GHSL = 1.000000e+00
ATU1 = -3.469840e-01
BTU1 = 6.046510e-01
CTU1 = 2.298960e-01
DTU1 = -1.356910e-01
ETU1 = -9.796160e-02
FTU1 = -7.903270e-03
ATU2 = -4.946240e-01
BTU2 = 7.221100e-01
CTU2 = -5.876470e-02
DTU2 = 6.654320e-02
ETU2 = -4.946240e-01
FTU2 = -5.965730e-03
ATD1 = -3.469840e-01
BTD1 = 6.046510e-01
CTD1 = 2.298960e-01
DTD2 = 6.654320e-02
ETD2 = -4.946240e-01
FTD2 = -5.965730e-03
SAL = 3.500000e+01
DBAR = 0.000000e+00
STOFF = 3.958533e+01
STSLP = -1.740306e-02
ST2ND = 2.320446e-06
ST3RD = -3.642729e-10
POFF = 0.000000e+00
PSLP = 0.000000e+00
P2ND = 0.000000e+00
SPTOF = 0.000000e+00
SPTSL = 0.000000e+00
```

RCAL (Continued)

ST2ND = 2.320446e-06
ST3RD = -3.642729e-10
POFF = 0.000000e+00
PSLP = 0.000000e+00
P2ND = 0.000000e+00
SPTOF = 0.000000e+00
SPTSL = 0.000000e+00
VELXS = 1.000000e+00
ZHX = 2062
ZHY = 2056
ZHZ = 2031
T11 = -9.004544e-01
T21 = 2.077520e-03
T12 = 5.287817e-02
T22 = 9.763811e-01
T13 = -5.074692e-03
T23 = -1.220043e-02
T31 = 1.083571e-02
T32 = -6.910717e-03
T33 = 9.949460e-01

RCALC

Usage: RCALC

Mode: OPEN, CAL

Description: This command reads all calibration data for the "COMPASS" from the 3D-ACM. Note these values are the values held in volatile memory until the user issues the "***E" command at which time they are written into EEPROM (non-volatile memory). The user cannot change the S/N or version numbers.

Example

RCALC<CR>
S/N=1376
VER=2.0
CDATE=1SEP95
ZHX = 2062
ZHY = 2056
ZHZ = 2031
T11 = -9.004544e-01
T21 = 2.077520e-03
T12 = 5.287817e-02
T22 = 9.763811e-01
T13 = -5.074692e-03
T23 = -1.220043e-02
T31 = 1.083571e-02
T32 = -6.910717e-03
T33 = 9.949460e-01

RCALT

Usage: RCALT

Mode: OPEN, CAL

Description: This command reads all calibration data for the "TILT" from the 3D-ACM. Note these values are the values held in volatile memory until the user issues the "***E" command at which time they are written into EEPROM (non-volatile memory). The user cannot change the S/N or version numbers.

Returns: As Specified

Example

```
RCALT<CR>
S/N=1376
VER=2.0
CDATE=1SEP95
ATU1 = -3.469840e-01
BTU1 = 6.046510e-01
CTU1 = 2.298960e-01
DTU1 = -1.356910e-01
ETU1 = -9.796160e-02
FTU1 = -7.903270e-03
ATU2 = -4.946240e-01
BTU2 = 7.221100e-01
CTU2 = -5.876470e-02
DTU2 = 6.654320e-02
ETU2 = -4.946240e-01
FTU2 = -5.965730e-03
ATD1 = -3.469840e-01
BTD1 = 6.046510e-01
CTD1 = 2.298960e-01
DTD1 = -1.356910e-01
ETD1 = -9.796160e-02
FTD1 = -7.903270e-03
ATD2 = -4.946240e-01
BTD2 = 7.221100e-01
CTD2 = -5.876470e-02
DTD2 = 6.654320e-02
ETD2 = -4.946240e-01
FTD2 = -5.965730e-03
```

RCALV

Usage: RCALV

Mode: OPEN, CAL

Description: This command reads all calibration data for the "VELOCITY" and auxiliary sensors from the 3D-ACM. Note, the individual path length slopes are not transmitted. These slopes are nominally set to unity by the Factory, ABSL = CDSL = EFSL = GHSL = 1.0. Note these values are the values held in volatile memory until the user issues the "***E" command at which time they are written into EEPROM (non-volatile memory). The user cannot change the S/N or version numbers.

Returns: As Specified

Example:

```
RCALV<CR>
S/N=1376
VER=2.0
CDATE=1SEP95
ABOF = -9.000000e-02
CDOF = -3.200000e-01
EFOF = -2.000000e-02
GHOF = 1.500000e-01
SAL = 3.500000e+01
DBAR = 0.000000e+00
STOFF = 3.958533e+01
STSLP = -1.740306e-02
ST2ND = 2.320446e-06
ST3RD = -3.642729e-10
POFF = 0.000000e+00
PSLP = 0.000000e+00
P2ND = 0.000000e+00
SPTOF = 0.000000e+00
SPTSL = 0.000000e+00
VELXS = 1.000000e+00
```

RCONF

Usage: RCONF

Mode: OPEN

Description: This command reads all PRIOR operational data from the 3D-ACM. Note, these operational settings are from the last time the unit was set to start data collection. The RCONF data set is stored at the receipt of any start commands, i.e. commands that move the 3D-ACM from the OPEN MODE to the RUN MODE. These commands are the *****I**, *****D**, or *****R** commands. The RCONF is used to determine the mode the instrument was set to operate in at its last deployment, and is normally read upon recovery to ensure that a correct operational sequence was set during the last deployment.

Returns: As Specified

Example:

```
RCONF<CR>
***R          'started with the ***R command
AVN=ON, AVE=ON, AVU=ON, TIME=ON    'channels selected
Averaging Interval Time = 01:00    'vector average interval
ON time = 00:05:00                'On Time Interval
Interval time = 00:06:00          'Interval Time
Delayed Date = 01-01-2000         'Delayed Start
Delayed Start Time = 01:00:00     'Delayed Start
cont=OFF                          'Send Data On Power Up OFF
```

RCTD

Usage: RCTD

Mode: OPEN

Description: This command tests the HA-CTD interface with the 3D-ACM. The command powers the HA-CTD and awaits the first frame of data. Upon receipt of data the 3D-ACM powers down the HA-CTD and sends the received data to the user via the serial interface. If data is not received after 10 seconds the HA-CTD is powered down and three sets of zero data are sent to the user. Note: Control of HA-CTD data to stored memory or in RUN MODE output messages is via the "CTD=ON/OFF" command.

See Also: CTD, RLM

Returns: Turning CTD on for 10 Seconds
02000,54000,00010<CR><LF>

Example (Successful Test)

```
RCTD<CR>          'send test command
Turning CTD on for 10 Seconds    '3D-ACM Response
02000,54000,00010<CR><LF>      'Good Data Returned from HA-CTD
```

Example (Failed Test)

```
RCTD<CR>          'send test command
Turning CTD on for 10 Seconds    '3D-ACM Response
00000,00000,00000<CR><LF>      'No Data Returned from HA-CTD
```

RLD

Usage: RLD

Mode: RUN

Description: Sending a RLD command reads the last vector average stored to logging memory. The command only returns data after at least one vector averaging interval is complete. The data is stored in non-volatile RAM as such it can be accessed at any time. The command is provided for use with the FSI Inductive Coupled Modem to allow for data reads synchronously from 3D-ACM ON TIME intervals. The command always returns the last record stored up to the time at which the next vector average is completed. Data is transmitted as described by the "RDM" command. Note: "SLOG" set logging must be set at least one vector averaging interval past prior to first data availability using the "RLD" command.

Returns:

See Also: <CR>, <LF>

Example: RLD<CR> "Carriage Return
34.5067, 34.4567, 2.098,

RDM

Usage: RDM

Mode: OPEN

Description: This command reads all enabled data channels in the order that the data will be listed on the command port in response to a request for data while the 3D-ACM is in the RUN MODE. Note the list contains data parameters which may not be stored in data logging memory, consult the RDM command for a list of stored data types and the order in which they are communicated via the "DDMP" Command. The list of enabled parameters is followed by a count which is equal to the number of bytes written into to logging memory for each data record.

See Also: RDM

Returns: As Specified

Example

RDM
AVE=ON, AVN=ON, AVU=ON, ATIME=ON, VX=ON, VY=ON, VY=ON, COUNT

RDPTR

Usage: RDPTR

Mode: OPEN

Description: This command reads software memory pointer current location (the location of the next byte to be written to logged memory). Normally used upon retrieval of the instrument to determine total data storage. To determine the number of scans divide the output of the RDPTR command minus 1, by the number of bytes in a scan listed at the end of the RDM command.

See Also: RLPTR, RHPTR, DDMP, DLEN, SMEM, SLOG, CLOG

Returns: ##### where number of bytes of data stored

Example: RLPTR<cr>
45678

RHPTR

Usage: RHPTR

Mode: OPEN

Description: This command resets ONLY the hardware memory pointer and NOT the software memory pointer to zero. Normally used to start a read of data stored in memory. Data is read then using the DDMP command and is completed when RDPTR/DLEN scans of data have been read from memory.

See Also: RDPTR, RHPTR, DDMP, DLEN, SMEM, SLOG, CLOG

Returns: 'Hardware Logging Pointer Reset'

Example: RHPTR<cr>
Hardware Logging Pointer Reset

RLPTR

Usage: RLPTR

Mode: OPEN

Description: This command resets BOTH the hardware memory pointer and the software memory pointer (total data stored) to zero. Normally used to configure the instrument for deployment. It must be issued when the 3D-ACM is first powered on for logging to work properly.

See Also: RDPTR, RHPTR, DDMP, DLEN, SMEM, SLOG, CLOG

Returns: 'Logging Pointer Reset'

Example: RLPTR<cr>
Logging Pointer Reset
Memory Hardware Pointer Reset

ROP

Usage: ROP

Mode: OPEN

Description: This command reads all operational data from the 3D-ACM. Note these operational settings are the values held in volatile memory until the user issues the "***E" command at which time they are written into EEPROM (non-volatile memory).

Returns: As Specified

Example: ROP<CR>
cont clr "continuous on power-up cleared; see SCOP
adre clr "address mode operations cleared; see SAOP
slog "data logging set; see SLOG

SAOP

Usage: SAOP

WARNING: PRIOR TO ENTRY INTO THE ADDRESS MODE OPERATION THE USER SHOULD DETERMINE BOTH THE ADDRESS OF THE UNIT AND RECONFIRM THE PRESENT OPERATING BAUD RATE. THE ISSUE OF THIS COMMAND REQUIRES THE UNIT TO BE ADDRESSED IN ORDER TO ESTABLISH COMMUNICATION.

Mode: OPEN

Description: This command sets the 3D-ACM to enter address mode operations. The unit will initially enter the "open communication mode" when the command is transmitted until an attention "#" character is received, at which point the unit will only re-enter the "open communication mode" when its valid address has been received. The 3D-ACM will remain in the "closed communication" mode until it is "re-opened" by the receipt of its address. (Note: This command must be followed by the ***E command prior to turning the power off or the unit will power up and run as per the setting currently stored in EEPROM.) The unit will send data at the baud rate set by the current value found in EEPROM.

An 3D-ACM is placed in the "open communication" mode (ready to receive commands by the receipt of its address) while operating in "Addressed Operations". The 3D-ACM address is the attention character followed by "A" and the current ADR value:

For example:

#A2 "Where ADR=2"

Upon receipt of the correct address the 3D-ACM will respond with the current enabled channels.

NOTE: A 3D-ACM's address command is NOT followed by a <CR> or a <LF>. The 3D-ACM will respond with 1 scan of data (within 200 milliseconds) after receipt its address. The unit will not transmit the next value until it has completed the next measurement cycle.

To exit address mode operations enter the "open communication" mode by sending its address, enter the OPEN mode using the "***O" command. Give the unit the "CAOP" clear address operations command. Verify that address mode operations has been cleared by either the "RAOP" or the "ROP" command. If you want the unit to continue to operate from power up without addressing, send the "***E" command to store the present operation in EEPROM prior to turning the unit off.

See Also: CAOP, RAOP, ADR, ADR=

Return: Example

#A2+34.0000, 26.3345, 23.4454<CR><LF>

SBXX

Usage: SB19 'set baud to 19.2K baud

SB96 'set baud to 9.6K baud

SB12 'set baud to 1200 baud

SB30 'set baud to 300 baud

Mode: OPEN

Description: This command sets the 3D-ACM's data transfer rate to 19200 baud. The unit changes to this rate upon the receipt of the command. All further communication must then be performed at 19200 baud. Note: this rate is not written into EEPROM until the ***E command is issued to the 3D-ACM. The unit will power up at the last baud rate specified and then saved by the combination of SB19 and ***E. (Note: Unless otherwise specified all units are shipped at 9600 baud). FSI recommends that the unit be used in the 9600 or 19200 baud mode whenever possible by the host device.

Returns: No Return

Example: SB19 "unit now communicates at 19200 baud

***E "stores current baud rate in EEPROM

SC

Usage: SC

S Note "S" is the only command the 3D-ACM will respond to after the "SC" command has been issued or the unit is set in "SCIOP". This is a case sensitive command.!!

Mode: RUN or CAL

Description: The SC command sets the 3D-ACM into the continuous data mode. When continuous data is selected, new data is automatically transmitted as soon as it is available without any user request. The rate of new data availability depends upon the integration interval selected. Note the SC command is ignored in the OPEN mode.

The S command is used to stop the continuous data mode. **NOTE:** This is a special command. When the 3D-ACM is in the continuous mode, the S command is the **ONLY** command the 3D-ACM will recognize. This **MUST** be an **UPPER** case S and no terminator character is required.

Returns: Data, as it is acquired, enables channels if in the RUN mode. If in the CAL mode, the data type selected and compass RALLC or velocity RALLV data is sent.

See Also: SCOP, CCOP

SCOP

Usage: SCOP

Mode: OPEN

Description: This command sets the 3D-ACM to send continuous data on power up. (Note. This command must be followed by the ***E command prior to turning the power off or the unit will power up and run as per the setting currently stored in EEPROM.) The unit will send data at the baud rate and frequency as set by the current value found in EEPROM.

Returns: No Return

SLOG

Usage: SLOG

Mode: OPEN

Description: This command sets logging on and start recording data to memory.

See Also: RDPTR, RHPTR, RLPTR, CLOG

Returns: 'Data logging is SET'

Example

SLOG<cr>
Data Logging is SET

SMEM

Usage: SMEM

Mode: OPEN

Description: This command returns the size of logging memory in bytes. Normally set to 524,287 for a Coastal 3D-ACM and 1,048,575 for a Standard 3D-ACM. Note, the Coastal may have a full 1.0 M Byte Memory installed.

See Also: RDPTR, RHPTR, RLPTR, CLOG, SLOG

Returns: '1048575'
or
'524287'

Example: SMEM<cr>
1048575<CR><LF>

Note: To reset use the "SMEM=" command which is not separately listed. Consult the configuration of your 3D-ACM prior to resetting stored data memory size, or consult the factory.

TILT=ON/OFF

Usage: TILT = ON ' ENABLE NORMAL TILT DATA COLLECTION
TILT = OFF ' DISABLE TILT FUNCTION SET TX=TY=0.0 DEGREES

Mode: OPEN

Description: This command allows the user to disable the TILT sensor of the instrument. This is normally used when the instrument will be used in a "known" vertical position or for testing. Note, this switch is stored in EEPROM and will stay in the last setting after either an ***E, ***I, or ***D command has written it to EEPROM. The user must re-enable it and then store the flag in EEPROM for it to remain enabled. Note, the user can determine if the tilt function is enabled by entering the name not followed by the "equate" sign and the instrument will respond with "ON" or "OFF".

See Also: COMP, VEL

Returns: As Specified

Example: TILT=OFF<CR> ' sets TILT FUNCTION "OFF"
TILT<CR> ' request the status of TILT function
TILT=OFF ' 3D-ACM responds with TILT is "OFF"

TIME

Usage: TIME

Mode: OPEN

Description: This command reads and allows the user to set the current time stored in the internal real time clock. Note, check the Delay Time set as it may be eliminated if a new TIME is entered that is after the current setting of the Delay Start Time

See Also: DATE, OTIME, ITIME, DTIME

Returns: As Specified

TSTM

Usage: TSTM

Mode: OPEN

Description: This command tests BOTH the on CPU RAM and Logged Data Ram. Note Logged data RAM is tested to the number of bytes as indicated by the SMEM command. This test should be run whenever a problem with logged data is suspected.

See Also: RDPTR, RHPTR, DDMP, DLEN, SMEM, SLOG, CLOG

Returns: As Specified

VEL=ON/OFF

Usage: VEL = ON ' ENABLE NORMAL VELOCITY DATA COLLECTION
VEL = OFF ' DISABLE VELOCITY FUNCTION SET VX=VY=VZ=10.0 CM/SEC

Mode: OPEN

Description: This command allows the user to disable the velocity sensor of the instrument. This is normally used to test compass and tilt functions when the velocity sensor is not placed in water. Note, this switch is **not** stored in EEPROM and will return to the enabled position if the unit is turned off or after the first interval mode data collection. Note the user can determine if the velocity function is enabled by entering the name not followed by the "equate" sign, and the instrument will respond with "ON" or "OFF", see also RDM command.

See Also: TILT, COMP

Returns: As Specified

Example: VEL=OFF<CR> ' sets VELOCITY FUNCTION "OFF"
VEL<CR> ' request the status of VELOCITY function
VEL=OFF ' 3D-ACM responds with VELOCITY is "OFF"

ZMEM

Usage: ZMEM

Mode: OPEN

Description: This command causes the 3,D-ACM to write zero to all memory locations. This can take some time, about 4.0 minutes on average. Both memory pointers hardware and software, are reset at the completion of the command.

See Also: RLPTR, RHPTR, RDPTR, SLOG, CLOG, DLEN, DDMP

Returns: As Specified

Example: ZMEM<cr>

***C

Usage: ***C

Mode: OPEN

Description: This command enters the unit into the CAL mode. This mode allows the user to read raw data for either the velocity interface or the compass interface. The data response is fixed for either mode.

Returns: No Return

***D

Usage: ***D

Mode: OPEN

Description: This command sets the unit into the DELAYED run mode. It will power down and wait until the clock reaches the preset DTIME, then power up and commence sampling based upon the current stored parameters in EEPROM. If the unit has valid OTIME and ITIME settings the unit will commence INTERVAL time operations. It will only enter the delayed mode if valid calibration factors are found for the unit. The unit will issue timing statements and commence sampling. Data will not be sent unless requested. The unit will sample for the preset OTIME. The unit will then turn off and recommence sampling at the end of the ITIME.

Returns: As Specified

***E

Usage: ***E

Mode: OPEN

Description: This command is valid in either CAL mode or the OPEN mode. Upon entry of the command all calibration constants and operational settings are written to EEPROM (saved). This is the only command which will update EEPROM data and must be used when data is to be saved. Note: You will overwrite any stored data so ensure your calibration constants are correct using the RCAL command prior to issuing this command.

Returns: <CR>

*****I**

Usage: ***I

Mode: OPEN

Description: This command sets the unit into the INTERVAL mode. It will only enter the interval mode if valid calibration factors are found for the unit. The unit will issue timing statements and commence sampling. Data will not be sent unless requested. The unit will sample for the preset OTIME. The unit will then turn off and recommence sampling at the end of the ITIME.

Returns: As Specified

*****O**

Usage: ***O

Mode: RUN or CAL

Description: This command enters the unit to the OPEN mode. Data collection is stopped. From the OPEN mode operational settings and calibration constants can be read and edited. The unit will return a statement of "OPEN MODE" if data is requested by either a CR or LF (the SC command is invalid in this mode).

Returns: No Return

*****R**

Usage: ***R

Mode: OPEN

Description: This command sets the unit into the RUN mode. It will only enter the run mode if valid calibration factors are found for the unit.

Returns: No Return

***Q

Usage: ***Q

Mode: OPEN

Description: This command reads the EEPROM and begins operation based on the parameters found there. If the SCOP (send continuous on power up) has been set in EEPROM the unit will begin to send data on receipt of this command. If the SAOP (address operation enabled) has been set in EEPROM, the unit will enter the un-addressed state and await for the appropriate address to be received (see address mode operations). Note: if calibration constants have been modified and the ***E command has NOT been issued, this command will overwrite these edited values with the data contained within the EEPROM.

Note: if the Baud Rate of operation has been changed via the "Sbxx" command, and the new rate has not been stored to EEPROM via the use of the "***E" command, and the "***Q" command is issued, the unit will revert to baud rate operation at the rate stored in EEPROM.

Returns: No Return

?

Usage: ?<CR>

Mode: CAL, RUN, or OPEN

Description: This command sends the current Mode Help Menu.

Returns:

When in RUN MODE:

Falmouth Scientific, Inc. Current Meter Ver F.t3 RUN Mode Help List:

Carriage-Return or Linefeed, get 1 scan of data. See OPEN Mode 'RDM' Command.

? -> This Help Menu.

***O -> OPEN Command Mode. Allow altering calibration & operational settings.

RLD -> Read-the-Last-Data stored at the end of the last ON Interval.

SC -> Set for Continuous data output for RUN and CALIBRATION Modes.

S -> Stop Continuous data. This is the ONLY command recognized when Continuous output is active. MUST BE AN UPPER CASE 'S'.

When in OPEN MODE:

1 -> General Operation

2 -> Advanced Operation

3 -> Calibration Data

4 -> Data Output Control

5 -> Logging Data to Memory

ANY Other Key to QUIT

1

Falmouth Scientific, Inc. Current Meter Ver F.t3 General Operation Help List:

Carriage-Return or Linefeed, get 1 scan of data, any mode.

? -> This Help Menu.

***O -> Goto OPEN {this} mode. Allow altering calibration & operational settings

***C -> Goto Calibration mode. Select & Read raw Sensor & Reference data.

***R -> Goto Immediate RUN mode. Acquire & Calculate Velocity data.

***E -> Write current Calibration & Operation values to EEPROM.

NOTE: Calibration and Operational settings MUST be written to EEPROM using the '***E' command to remain in effect at Power-UP.

TIME -> Read and/or Set Instrument Internal Time.

DATE -> Read and/or Set Instrument Internal Date.

SC -> Set for Continuous data output for RUN and CALIBRATION Modes.

S -> Stop Continuous data. This is the ONLY command recognized when Continuous output is active. MUST BE AN UPPER CASE 'S'.

2

Falmouth Scientific, Inc. Current Meter Ver F.t3 Advanced Operation Help List:

ITIME-> Read and/or Set or Clear Interval Operation Time.

Maximum Allowed Interval is 24 Hours, Minimum is 20 Seconds.

To Clear Interval Operations, Enter an Interval of 0.

OTIME-> Read or Set or Clear Interval ON Time. Minimum ON Time is 10 Sec.

DTIME-> Read and/or Set Delayed Start Date & Time. Minimum Delay is 1 Minute.

***I -> Start Interval Run Operation. ITIME & OTIME MUST be Present.

***D -> Start Delayed Start Operation. If ITIME and OTIME are Present

Then Interval Run Operating will Occur When the Start Time is Reached. If ITIME or OTIME NOT set then Normal Run will Occur.

ROP -> Read the current Operation settings: If Continuous Output on Power-Up, if Scaled Output is active, if Operating in Addressed Mode, if Data Logging to Memory is Active.

SCOP -> Set Continuous Output ON Power-UP. CANNOT set if Address Mode is Active.

CCOP -> Clear Continuous Output ON Power-UP.

SAOP -> Set Addressed Operation. CANNOT set if Continuous-ON-Power-UP is Active.

CAOP -> Clear Addressed Operation.

ADR{=n} -> Read and/or Set the Current Instrument Address to 'n' {0 - 7}.

Used if Addressed Operation is Active.

RCONF-> Read 'How-You-got-to-Run' Status.

SB{30}{12}{96}{19} -> Set Communication Baud Rate Immediately to 300, 1200, 9600 or 19200.

3

Falmouth Scientific, Inc. Current Meter Ver F.t3 Calibration Factors,
Read & Write Help List:

RCAL -> Read ALL Calibration Factors.

All calibration factors are read individually or written using the term references shown by the 'RCAL' commands. Except 'S/N' and 'VER' which are factory ONLY settings. Values are assigned by adding a '=' and the new value.

RCALV-> Read Velocity Calibration Factors separately.

RCALC-> Read Compass Calibration Factors separately.

RCALT-> Read Tilt Calibration Factors separately.

DLYV{=nnn} -> Read / Set Velocity Mux delay in milliseconds (Default = 5).

DLYC{=nnn} -> Read/Set Compass & External Sensor Mux dly in mSec (Default=50).

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Falmouth Scientific, Inc. Current Meter Ver F.t3 Data Output Control Help List:
The Following Parameters can be turned ON/OFF for both Logging and Display.

The Status of an Individual Parameter can be read by Entering it's command Alone. The Status can be changed by adding an '=' and ON or OFF.

AVE{=ON/OFF} -> Read / Set Averaged East Velocity.

AVN{=ON/OFF} -> Read / Set Averaged North Velocity.

AVU{=ON/OFF} -> Averaged Up. ATLT{=ON/OFF}-> Averaged Tilt.

ATIME{=ON/OFF} -> Time and Date. CTD{=ON/OFF} -> CTD Data.

DIR{=ON/OFF} Calculated Heading (0 - 360). BATT{=ON/OFF}-> Battery Voltage.

VX{=ON/OFF} -> Velocity X-Axis. VY{=ON/OFF} -> Velocity Y-Axis.

VZ{=ON/OFF} -> Velocity Z-Axis.

TX{=ON/OFF} -> Tilt X-Axis. TY{=ON/OFF} -> Tilt Y-Axis.

HX{=ON/OFF} -> Calculated X-heading. HY{=ON/OFF} -> Calc'd Y-heading.

HZ{=ON/OFF} -> Calculated Z-heading.

VN{=ON/OFF} -> Calc'd Immediate Vel North. VE{=ON/OFF} -> Calc'd Vel East.

VU{=ON/OFF} -> Calc'd Immediate Vel Up/Down.

STEMP{=ON/OFF}-> Calc's Sea Temperature. SPRESS{=ON/OFF}-> Calc's Pressure.

SV{=ON/OFF} -> Calc'd Sound Velocity.

TILT{=ON/OFF} -> Control Calculation of Tilt Parameters.

COMP{=ON/OFF} -> Control Calculation of Compass Parameters.

VEL{=ON/OFF} -> For test ONLY, Velocity Calculations can be Turned OFF
and Vx, Vy and Vz are forced to a value 10.0.

AUX1{=ON/OFF}-> Control of AUX DC Channel 1.

AUX2{=ON/OFF}-> Control of AUX DC Channel 2.

5

Falmouth Scientific, Inc. Current Meter Ver F.t3 Logging Data Control Help List:

RLOP -> Read Logging Operational Status.

CLOG -> Turn Data Logging OFF. Logging MUST be OFF for Pointer, Zero, Offload
or Test Commands to Operate.

SLOG -> Turn Data Logging ON. Use this Prior Starting Run for Deployment.

DLEN{=nnnnn}-> Read or Set Count of Scans per Memory request, {128 Default}.

DDMP -> Dump Logging Memory. NOTE: The Logging pointer is NOT Automatically
Reset to 0 by This Command.

RLPTR-> Reset Logged and Hardware Pointers. Use this Command in Preparation
for Deployment.

RHPTR-> Reset Hardware Pointer. Use this Command before Dumping Logged Data.

RDPTR-> Read the Logged Memory Pointer. How much Logging Memory has been Used.

ZMEM -> Zero Logging Memory. It is good to do this prior to Deployment

SMEM{=nnnnnnn} -> Read / Set Log Memory Size. {Default = 1048576 bytes}.

TSTM -> Test Internal 4K Memory & Logging Memory based on 'SMEM' size.

RCTD -> A Test to Determine if an Associated CTD is Working.

When in CAL MODE:

Falmouth Scientific, Inc. Current Meter Ver F.t3 CALIBRATION Mode Help List:

Carriage-Return or Linefeed, get 1 scan of data. See Descriptions Below.

? -> This Help Menu.

***C -> Goto Calibration {This} Mode. Collect and Display raw data.

***O -> Goto OPEN mode. Allow altering calibration & operational settings.

RALLV-> Set to Read All Velocities. The default Mode when Entering Cal Mode.

Data Returned in RALLV Mode is shown below, PATH and PHASE.

AB 0, AB 90, AB 180, AB 270, BA 0, BA 90, BA 180, BA 270
CD 0, CD 90, CD 180, CD 270, DC 0, DC 90, DC 180, DC 270
EF 0, EF 90, EF 180, EF 270, FE 0, FE 90, FE 180, FE 270
GH 0, GH 90, GH 180, GH 270, HG 0, HG 90, HG 180, HG 270
Velocity AB, Velocity CD, Velocity EF, Velocity GH

RALLC-> Set to Read All Compass.

Data Returned in RALLC Mode is shown below.

HX counts, HY counts, HZ counts
TX counts, TY counts, 1=UP or 0=DOWN
Sea Temp counts, Battery Voltage counts, Sea Pressure counts
Full Scale counts, Zero Scale counts

DLY -> Read / Set Calibration mode Muxing Delay (mSec) Default = 0, No delay.

SC -> Set for Continuous data output for RUN and CALIBRATION Modes.

S -> Stop Continuous data. This is the ONLY command recognized when
Continuous output is active. MUST BE AN UPPER CASE 'S'.

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ERROR MESSAGES

For any invalid command, the 3D-ACM will respond with "BAD CMD" with the "bell" character. Some error messages are followed by a short description to assist depicting the nature of the error. A command is invalid if it is not recognized or if it is incomplete or parts are incorrect. Also where noted, some commands are only valid when the 3D-ACM is in a specific mode and invalid in the other modes.

SECTION 4.0SECTION 4.0

3D-ACM SPECIFICATIONS3D-ACM SPECIFICATIONS:

PARAMETER	TYPE	RANGE	ACCURACY	RESOLUTION
VELOCITY	ACOUSTIC (PHASE SHIFT)	0-300 CM/SEC	+/-1.0% OR 5% OF READ.	0.1 CM/SEC
DIRECTION	3 AXIS FIXED FLUXGATE	0-360 DEG.	+/-2.0 * +/-3.0**	0.1 DEG.
TILT	2 AXIS ELECTROLYTIC	0-25 DEG.	+/-0.2 DEG.	0.01 DEG.
TEMPERATURE	THERMISTOR	-2 - 35 C	+/-0.05 C	0.005 C
PRESSURE	STRAIN	USER SPECIFIED	+/- 0.5% F.S.	0.1 dBAR

POWER SOURCE	VOLTAGE RANGE	LOAD CURRENT	LOAD POWER
EXTERNAL	8 - 35 VDC	12 mA	0.096 - 0.420 mW
ALKALINE	2.0 - 3.63 VDC	35 mA	0.070 - 0.127 mW
LITHIUM	5.50 - 7.50 VDC	.010 mA	0.055 - 0.075 mW

SAMPLING	RATE SAMPLE/SEC	RATE SEC/SAMPLE	RESOLUTION
STANDARD	2.0	0.5	12 BITS
HIGH SPEED *	4.0	0.25	12 BITS

* FACTORY OPTION

**REAL-TIME CLOCK: TYPE CRYSTAL CONTROLLED 32.768 Khz
STABILITY +/- 12 PPM/YEAR (6.3 MIN/YEAR)
PROGRAMMABLE ALARM/SLEEP FUNCTIONS
EXTERNAL USER SWITCH DISABLE**

+ Compass direction error RMS all directions with the unit vertical, magnetic dip angle no greater than 60 degrees, ++ Compass direction error RMS all directions with the instrument operation at a maximum tilt angle +20 degrees. ## Tilt is maximum equal to $T_{max} < 20 \sim = (T_x^2 + T_y^2)^{1/2}$, * Optional Physical Sensor Package, *** Standard Unit Consumption measured from the Lithium 7.0 VDC

MANUAL REVISION HISTORY

REV	CHANGES
7.1	Change Memory Battery Back-Up life to 2 years from 6 months.